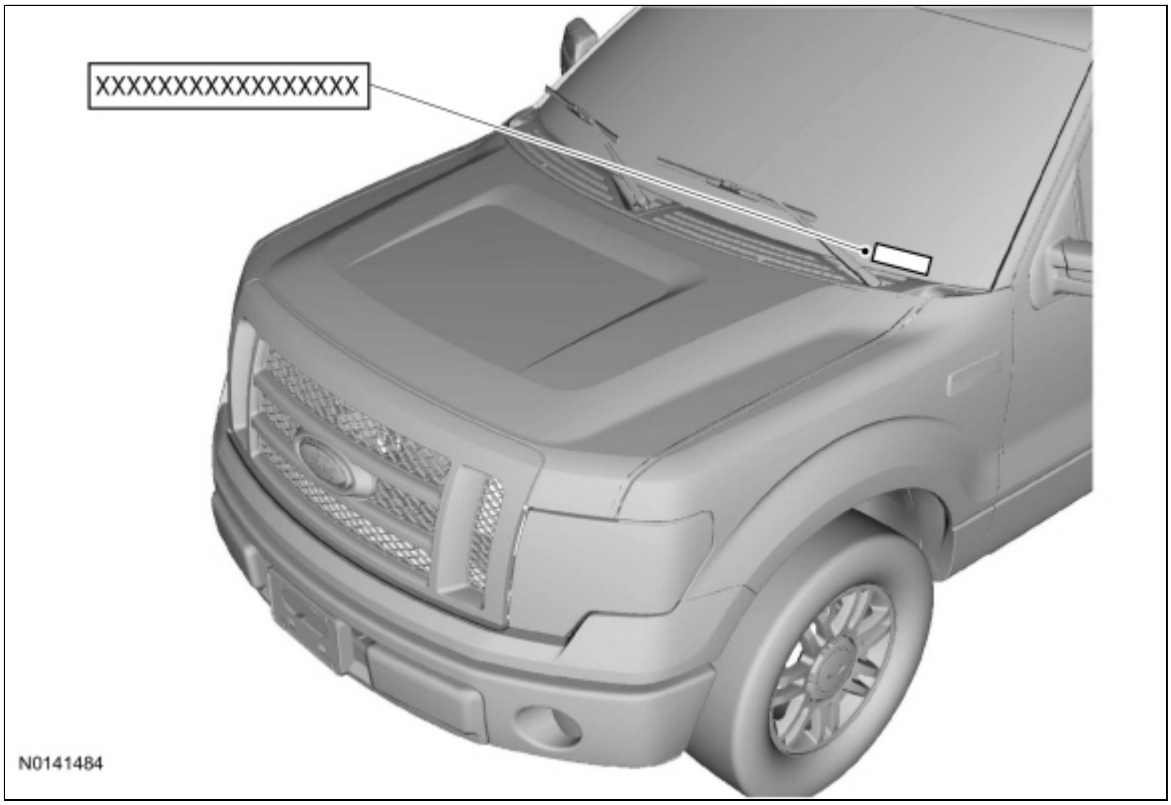
Identification Codes

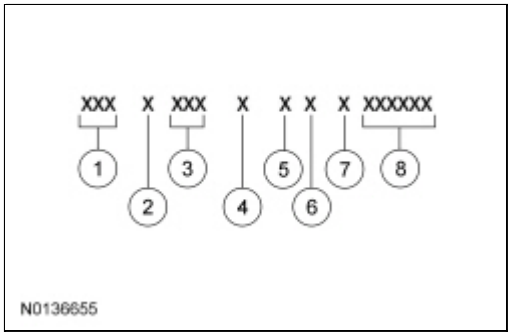
Vehicle Identification Number (VIN)

Vehicle Identification Number (VIN) Tag Locator



The Vehicle Identification Number (VIN) is a 17-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted on the instrument panel, top upper left of the dash. The VIN is also found on the Vehicle Certification (VC) label.

If the VIN plate requires replacement, authorized dealers must contact their respective regional office.



Item	Description
1	World Manufacturer Identifier (WMI)
2	Brake type and Gross Vehicle Weight Rating (GVWR)
3	Vehicle line and body type
4	Engine type
5	Check digit
6	Model year
7	Assembly plant
8	Production sequence number

World Manufacturer Identifier (WMI)

The first 3 VIN positions are the World Manufacturer Identifier (WMI).

- 1FT - Ford Motor Company, USA, truck (completed vehicle)
- 5LT - Lincoln, USA, truck (Mexico only)

Brake Type and Gross Vehicle Weight Rating (GVWR)

The fourth VIN position is the vehicle brake type and Gross Vehicle Weight Rating (GVWR) code, all vehicles use hydraulic brakes. This code may also identify the vehicle safety restraint system.

- E - 6,001-7,000 pound GVWR , active safety belts (all positions), driver and front passenger air bags, side inflatable restraint (first and second row)
- F - 7,001-8,000 pound GVWR , active safety belt (all positions), driver and front passenger air bags, side inflatable restraint (first and second row)
- M - 6,001-7,000 pound GVWR , active safety belts (all positions), driver and front passenger air bags, side inflatable restraint (first row)
- N - 7,001-8,000 pound GVWR , active safety belts (all positions), driver and front passenger air bags, side inflatable restraint (first row)
- P - 8,001-8,500 pound GVWR , active safety belts (all positions), driver and front passenger air bags, side inflatable restraint (first row)
- V - 8,001-8,500 pound GVWR , active safety belts (all positions), driver and front passenger air bags, side inflatable restraint (first and second row)

Line and Body Type

VIN positions 5 through 7 indicate the vehicle line and body type.

- F1C - Ford F-150, Rear Wheel Drive (RWD), regular cab, 5.5 ft, 6.5 ft or 8 ft styleside
- F1E - Ford F-150, Four-Wheel Drive (4WD), regular cab, 5.5 ft, 6.5 ft or 8 ft styleside
- J1G - Lincoln Mark LT, RWD , Crew Cab, styleside (Mexico only)
- J1J - Lincoln Mark LT, 4WD , Crew Cab, styleside (Mexico only)
- W1C - Ford F-150, RWD , Crew Cab, 5.5 ft or 6.5 ft styleside
- W1E - Ford F-150, 4WD , Crew Cab, 5.5 ft or 6.5 ft styleside
- W1R - Ford F-150, 4WD , Crew Cab, styleside, SVT
- X1C - Ford F-150, RWD , SuperCab, 5.5 ft, 6.5 ft or 8 ft styleside
- X1E - Ford F-150, 4WD , SuperCab, 5.5 ft, 6.5 ft or 8 ft styleside

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- X1R - Ford F-150, 4WD , SuperCab, styleside, SVT

Engine Type

The eighth VIN position is the engine type (displacement and number of cylinders).

- F - 5.0L, 4-valve, Dual Overhead Camshaft (DOHC), V8, electronic fuel injection, Flex-fuel
- M - 3.7L, 4-valve, V6, port fuel injection, Flex-fuel
- T - 3.5L, DOHC , V6, gas
- 6 - 6.2L, 2-valve, V8, electronic fuel injection

Additional engine information can be obtained from the engine tag. Refer to Section 303-01A , Section 303-01B , Section 303-01C or Section 303-01D .

Check Digit

The ninth VIN position is a government-assigned, computer-generated check digit.

Model Year

The tenth VIN position is the model year code.

- E - 2014

Assembly Plant

The eleventh VIN position is the assembly plant code.

- F - Dearborn (Dearborn, Michigan, USA)
- K - Kansas City (Claycomo, Missouri, USA)

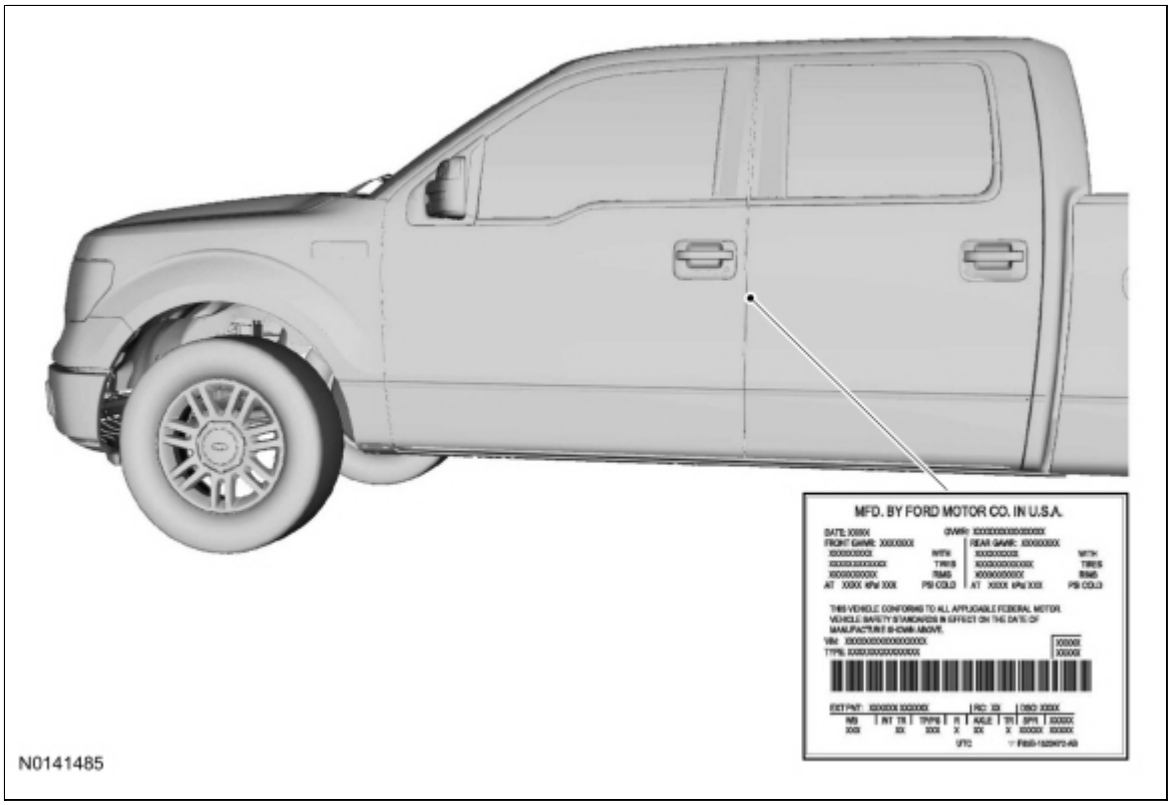
Build Sequence

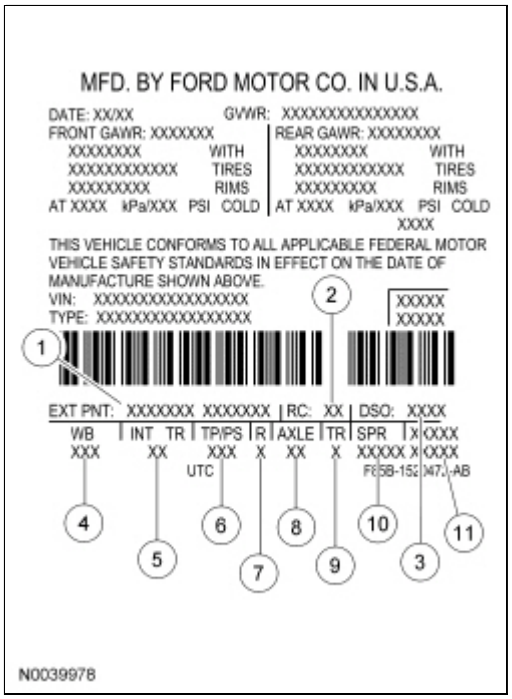
VIN positions 12 through 17 are an alphanumeric code for the vehicle build sequence. This is also the vehicle serial and warranty number. The serial number can also be found on the engine block, transmission and frame.

- A00001-F99999 - Ford
- J00001-L99999 - Lincoln

Vehicle Certification (VC) Codes

Vehicle Certification (VC) Label Locator





Item	Description
1	Exterior paint code
2	Region code
3	District Special Order (DSO)
4	Wheelbase code

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5	Interior trim code
6	Tape/paint stripe code
7	Radio code
8	Axle code
9	Transmission code
10	Spring code
11	Powertrain calibration information

The Vehicle Certification (VC) label contains information on the manufacturer name, the month and year of manufacture, the certification statement and the Vehicle Identification Number (VIN). This label also includes Gross Vehicle Weight Rating (GVWR) information.

If a vehicle requires replacement of the VC label and is 4 years old or less, an authorized dealer must submit the VIN to their respective regional office. The regional office will submit a web form to the assembly plant for the replacement label. Once the label has been printed, a representative from the regional office will deliver the label to the dealer and witness installation on the vehicle. If a vehicle is more than 4 years old and requires a replacement label, the dealer must submit a request to the Department of Motor Vehicles.

Exterior Paint

Exterior paint codes may be listed as a 2-part code. The first set of characters identify the primary body color. The second set of characters (if applicable) identify the vehicle accent or 2-tone body color. All colors are base coat/clear coat.

Primary Exterior Color Codes

- Blank - No paint
- D7 - Sunset
- E4 - Vermilion Red
- J1 - Kodiak Brown #2
- LQ - Pale Adobe Metallic
- N1 - Blue Jeans Metallic
- PQ - Race Red
- RR - Ruby Red (tri-coat)
- UG - White Platinum (tri-coat)
- UH - Tuxedo Black Metallic
- UJ - Sterling Gray Metallic
- UX - Ingot Silver Metallic
- VA - Terrain
- W6 - Green Gem #2
- YZ - Oxford White

Exterior Accent Color Codes

- LQ - Pale Adobe Metallic
- UX - Ingot Silver Metallic

Wheelbase

- 126 - 3,200 mm (126 in)
- 133 - 3,378 mm (133 in)
- 145 - 3,683 mm (145 in)
- 157 - 3,988 mm (157 in)

- 163 - 4,140 mm (163 in)

Interior Trim

Interior trim codes are listed as a 2-part code. The first character identifies the interior trim type. The second character identifies the interior trim color.

Interior Trim Type

- 3 - Brick Red accent SVT mini-perforated leather, F-150 SVT
- 4 - Blue accent SVT mini-perforated leather, F-150 SVT
- 5 - Milled pebble leather, captains chairs, F-150 FX
- 6 - Sport leather, F-150 FX
- 7 - Mini perforated leather, 40/console/40 split bench seat, F-150 SVT
- 9 - Leather, 40/console/40 split bench seat, F-150 Platinum
- A - Structure vinyl, 40/20/40 split bench seat, F-150
- C - Lucas cloth, 40/20/40 split bench seat, F-150
- D - Speck cloth, 40/20/40 split bench seat, F-150
- E - Milled pebble leather, 40/20/40 split bench seat, F-150
- G - Luxury leather, 40/console/40 split bench seat, F-150
- H - Milled pebble perforated leather, captains chairs, F-150
- K - Leather, captains chairs, F-150 King Ranch
- M - Premium Lucas cloth, 40/20/40 individual seats, F-150
- P - Micro perforated leather #1 captains chairs, F-150 Platinum
- R - Carbonite cloth, sport bucket seats, F-150
- S - STX Sport cloth bucket seats, F-150
- T - Micro perforated leather #2, captains chairs, F-150 Limited
- U - Lucas cloth, captains chairs, F-150
- V - Leather, 40/20/40 bucket seats, Mark LT

Interior Trim Color

- A - Adobe
- B - Charcoal Black
- S - Steel Gray

Tape/Paint Stripe

Tape and paint stripe codes do not apply.

Radio Type

- A - Amplitude Modulation/Frequency Modulation (AM/FM) stereo with clock – less human machine interface
- B - AM/FM stereo, Compact Disc (CD) player with clock – human machine interface 1
- C - AM/FM stereo, CD player, SYNC® - human machine interface 2
- D - AM/FM stereo, CD player, Liquid Crystal Display (LCD), SYNC® - human machine interface 3
- E - AM/FM stereo, CD player, LCD and SYNC®
- F - AM/FM stereo, CD player, LCD , SYNC®, dual-zone Electronic Automatic Temperature Control (EATC) – human machine interface 5
- G - Sony AM/FM stereo, CD player, SYNC®, human machine interface 6

Axle Type

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The following lists the available axle ratios:

- 15 - 3.15 non-limited slip
- 19 - 3.55 non-limited slip
- 26 - 3.73 non-limited slip
- 27 - 3.31 non-limited slip
- B6 - 3.73 limited slip
- H9 - 3.55 limited slip
- L3 - 3.31 electronic locking differential
- L4 - 4.10 electronic locking differential
- L5 - 3.15 electronic locking differential
- L6 - 3.73 electronic locking differential
- L9 - 3.55 electronic locking differential

Transmission Type

- 6 - 6-speed automatic, 6R80

Additional transmission information is available on the transmission tag. Refer to Section 307-01 .

Spring Code

Spring codes are listed as a 2-part code. The first 2 characters listed identify the front springs. The second 2 characters listed identify the rear springs.

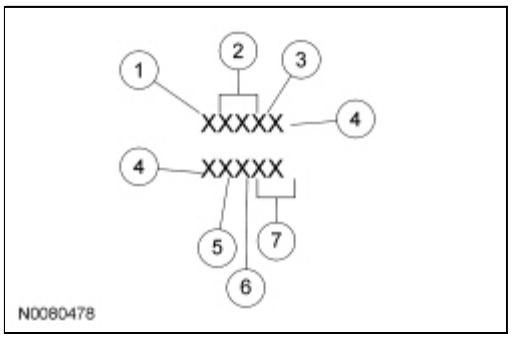
- Front spring base part number - 5310
- Rear spring base part number - 5560

Powertrain Calibration Information



NOTE: Powertrain calibration information is limited to a maximum of 5 characters per line on the VC label. Because of this, calibration identification consisting of more than 5 characters will wrap to the second line on the VC label.

Powertrain calibration information is printed in the lower right corner of the VC label. Only base calibration information is printed. Revision levels will not appear, however, they can be obtained through a scan tool using the most current software revision.



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Vehicle code
3	Transmission code
4	Unique calibration (designates different hardware to similar vehicles), example: tires or drive ratios
5	Fleet code (describes fleet to which the vehicle belongs), example: 6 - Evaporative Emission (EVAP)
6	Certification region (lead region where multiple regions are included in one calibration), example: A - U.S. federal
7	Revision level (will advance as revisions occur), not printed on label

Model Year

- 1 - 2001
- 2 - 2002
- 3 - 2003
- 4 - 2004
- 5 - 2005
- 6 - 2006
- 7 - 2007
- 8 - 2008
- 9 - 2009
- A - 2010
- B - 2011
- C - 2012
- D - 2013
- E - 2014

Vehicle Line

- F6 - F-150
- F6 - Mark LT (Mexico only)

Transmission

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- 1 - Automatic transmission

Unique Calibration

The Emissions/Corporate Average Fuel Economy/CO2 Compliance Department is responsible for assigning these calibration numbers. Unique calibration identifications are assigned to cover similar vehicles to differentiate tires, drive configurations, final drive ratios and other calibration-significant factors.

These 2 characters are chosen by the analyst to provide identifiable information unique to each calibration. For example, using the number 2 to denote a 2-valve engine versus using the number 4 to denote a 4-valve engine, offers an easily identifiable difference.

Fleet Code

- 1 - Heavy duty gas engine/Dyno
- 2 - Fast - Automobile Manufacturers' Association, US
- 3 - Alternative durability protocol, US
- 4 - Not assigned
- 5 - Not assigned
- 6 - Evaporative Emission (EVAP)
- 7 - Mileage accumulation, aging endurance durability
- 8 - On-Board Diagnostic (OBD)
- 9 - Not assigned

Certification Region

- 5 - US 50 states
- A - US federal, including altitude, may include Canada and/or Mexico
- B - US California, includes US green states
- C - Canada
- D - China
- E - European Community (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom)
- F - Extended European Community (E plus Croatia, Czech Republic, Estonia, Hungary, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Switzerland, Yugoslavia)
- G - Gulf Cooperative Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates)
- H - Hong Kong
- J - Japan
- K - Korea
- L - Malaysia
- M - Mexico
- N - New Zealand
- P - Australia
- Q - South America (Brazil)
- S - Singapore
- T - Taiwan
- V - Vietnam
- X - Rest Of World (ROW)
- Y - Military
- Z - Israel

Revision Level (not printed on label)

- 91-99 - Hardware calibration levels

- 01-04 - Preliminary levels
- 00 - Job 1 production (initial calibration)
- 05-09 - Pre-job 1 revisions to calibrations
- 10-89 - Post-job 1 revisions to calibrations
- 0B - Durability test level
- BD - OBD intermediate level (pre-05)

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Jacking and Lifting

WARNING: Never get underneath a vehicle that is supported only by a jack. The jack could unintentionally lower. Always support vehicle with floor stands. Failure to follow these instructions may result in serious personal injury.

WARNING: Turn off (disable) the power running boards (if equipped) before jacking, lifting or placing any object under the vehicle. Never place your hand between the power running board and the vehicle. Extended power running boards will retract when doors are closed. Failure to follow these instructions may result in serious personal injury.

WARNING: Only raise the vehicle when positioned on a hard, level surface. Attempting to raise the vehicle on an uneven or soft surface may result in vehicle slipping or falling from the jack or jackstand. Failure to follow this instruction may result in serious personal injury.

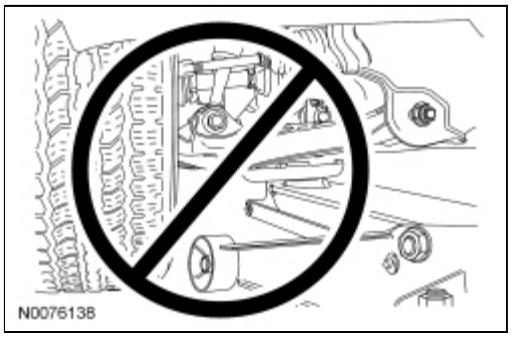
WARNING: Vehicle may have multiple drive wheels. Do not use engine to power the driveline unless all drive wheels are elevated off the ground. Drive wheels in contact with ground could cause unexpected vehicle movement. Failure to follow this instruction may result in serious personal injury.

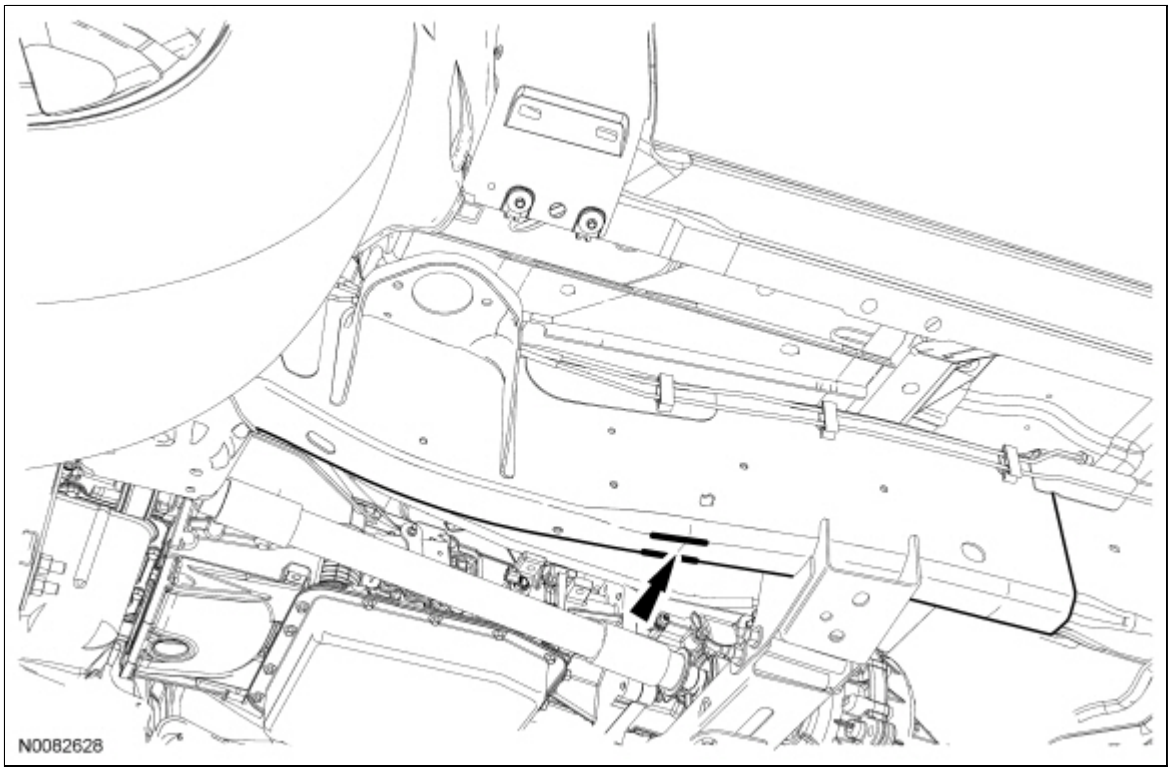
WARNING: When jacking or lifting the vehicle, block all wheels remaining on the ground. Set the parking brake if the rear wheels will remain on the ground. These actions help prevent unintended vehicle movement. Failure to follow these instructions may result in serious personal injury.

WARNING: Position the hoist lift arms as shown in the illustration. Incorrect positioning could result in vehicle slipping or falling from the hoist. Failure to follow this instruction may result in serious personal injury.

Jacking Points — Front

NOTICE: **Do not use the control arm as a jacking point. Damage to the vehicle may occur.**

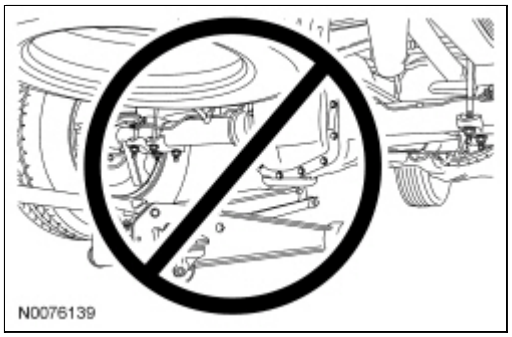




The jacking point is a flat portion on the frame, located behind the front tire and wheel and right below the arrow marked on the frame.

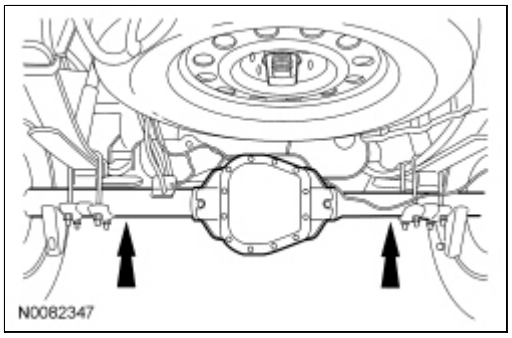
Jacking Points — Rear

NOTICE: **Do not use the differential housing as a lift point. Leaks or damage to the rear axle cover and adjoining differential housing surface may occur if a floor jack or any lifting device is allowed to contact the cover at any point where the cover joins the housing.**

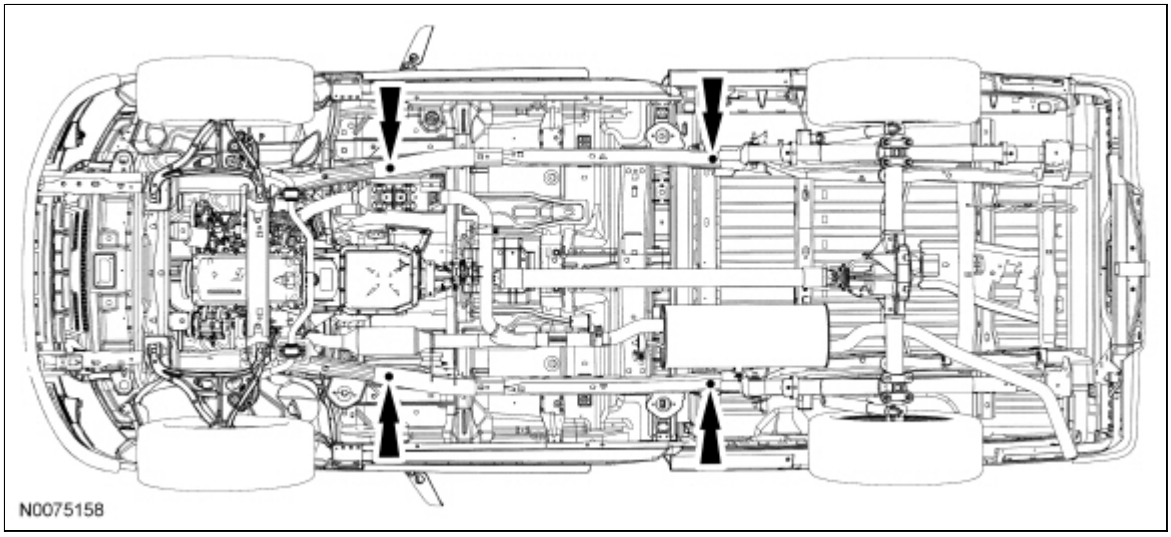


The rear jacking points are located on the rear axle.

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Frame Lifting Points



Noise, Vibration and Harshness (NVH)

Noise is any undesirable sound, usually unpleasant in nature. Vibration is any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down. Harshness is a ride quality issue where the vehicle's response to the road transmits sharply to the customer. Harshness normally describes a firmer than usual response from the suspension system. NVH is a term used to describe these conditions, which result in varying degrees of dissatisfaction. Although a certain level of NVH caused by road and environmental conditions is normal, this section is designed to aid in the diagnosis, testing and repair of NVH symptoms.

Acceptable NVH

All internal combustion engines and drivelines produce some noise and vibration; operating in a real world environment adds noise that is not subject to control. Vibration isolators, mufflers and dampers reduce these to acceptable levels. A driver who is unfamiliar with a vehicle can think that some sounds are abnormal when actually the sounds are normal for the vehicle type. As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH symptoms and their diagnosis. For example, if the vehicle has automatic overdrive, it is important to test drive the vehicle both in and out of overdrive mode.

Glossary of Terms

Amplitude

The quantity or amount of energy produced by a vibrating component (G-force). An extreme vibration has a high amplitude. A mild vibration has a low amplitude. See Intensity.

Boom

Low frequency or low pitched noise often accompanied by a vibration. Also refer to Drumming.

Buffet/Buffeting

Strong noise fluctuations caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

A low-pitched sound like that from a bee. Often a metallic or hard plastic humming sound. Also describes a high-frequency vibration. Vibration feels similar to an electric razor.

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

A short-duration, high-pitched noise associated with a slipping drive belt.

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Chuckle

A repetitious, low-pitched sound. A loud chuckle is usually described as a knock.

Click

A sharp, brief, non-resonant sound, similar to actuating a ball point pen.

Clonk

A hydraulic knocking sound. Sound occurs with air pockets in a hydraulic system. Also described as hammering.

Clunk/Driveline Clunk

A heavy or dull, short-duration, low-frequency sound. Occurs mostly on a vehicle that is accelerating or decelerating abruptly. Also described as a thunk.

Conductor

The components that carry (transmit) a vibration frequency from the originator to the reactor.

Cycles Per Second

Cycles per second. Same as hertz (Hz).

Cracks

A mid-frequency sound, related to squeak. Sound varies with temperature conditions.

Creak

A metallic squeak.

Cycle

The process of a vibrating component going through a complete range of motion and returning to the starting point.

Decibel (dB)

A unit of measurement, referring to sound pressure level, abbreviated dB.

Drone

A low-frequency, steady sound, like a freezer compressor. Also described as a moan.

Drumming

A cycling, low-frequency, rhythmic noise often accompanied by a sensation of pressure on the ear drums. Also described as a low rumble, boom or rolling thunder.

Flutter

Mid to high intermittent sound due to air flow. Similar to a flag flapping in the wind.

Frequency

The rate at which a cycle occurs within a given time.

G-force

The additional load or weight produced in an object during acceleration. When measuring the level or amplitude of a vibration without sound, the unit G is added to associate the force of the vibration to gravity. This is similar to measuring the weight of an object, which is also a function of gravity.

Gravelly Feel

A grinding or growl in a component, similar to the feel experienced when driving on gravel.

Grind

An abrasive sound, similar to using a grinding wheel, or rubbing sand paper against wood.

Hertz (Hz)

A unit of measure used to describe noise and vibration concerns expressed in cycles per second.

Hiss

Steady, high-frequency noise. Vacuum leak sound.

Hoot

A steady, low-frequency tone, sounds like blowing over a long neck bottle.

Howl

A mid-range frequency noise between drumming and whine. Also described as a hum.

Hum

Mid-frequency steady sound, like a small fan motor. Also described as a howl.

Intensity

The physical quality of sound that relates to the strength of the vibration (measured in decibels). The higher the sound's amplitude, the higher the intensity and vice versa. See Amplitude.

Knock

A heavy, loud, repetitious sound, like a knock on the door.

Moan

A constant, low-frequency tone. Also described as a hum.

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Ping

A short-duration, high-frequency sound, which has a slight echo.

Pitch

The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

Pumping Feel

A slow, pulsing movement.

Rattle

A random and momentary or short-duration noise.

Reactor

The component, or part, that receives a vibration from an originator and conductor and reacts to the vibration by moving.

Roughness

A medium-frequency vibration. A slightly higher frequency than a shake. This type of vibration is usually related to drivetrain components.

Rustling

Intermittent sound of varying frequency, sounds similar to shuffling through leaves.

Shake

A low-frequency vibration, usually with visible component movement. Usually relates to tires, wheels, brake drums or brake discs if it is vehicle speed sensitive, or engine if it is engine speed sensitive. Also referred to as a shimmy or wobble.

Shimmy

An abnormal vibration or wobbling, felt as a side-to-side motion of the steering wheel in the driveshaft rotation. Also described as waddle.

Shudder

A low-frequency vibration that is felt through the steering wheel or seat during light brake application.

Slap

A resonance from flat surfaces, such as safety belt webbing or door trim panels.

Squeak

A high-pitched transient sound, similar to rubbing fingers against a clean window.

Squeal

A long-duration, high-pitched noise.

Tap

A light, rhythmic or intermittent hammering sound, similar to tapping a pencil on a table edge.

Thump

A dull beat caused by 2 items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

A light moaning noise heard during light vehicle acceleration, usually between 40-100 km/h (25-65 mph).

Transient

A noise or vibration that is momentary, a short duration.

Vibration

Any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down.

Whine

A constant, high-pitched noise. Also described as a screech.

Whistle

High-pitched noise with a very narrow frequency band. Examples of whistle noises are a turbocharger or air flow around an antenna.

Wind Noise

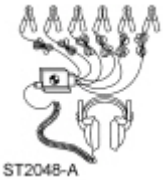
Any noise caused by air movement in, out or around the vehicle.

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Noise, Vibration and Harshness (NVH)

Special Tool(s)

 ST2311-A	Electronic Vibration Analyzer (EVA) 100-F027 (014-00344) or equivalent
 ST2312-A	EngineEAR 107-R2100 or equivalent
 ST2048-A	EngineEAR/ChassisEAR 107-R2102 or equivalent
 ST3025-A	Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) 257-00018 or equivalent
 ST3108-A	Squeak and Rattle Repair Kit 164-R4900
 ST2314-A	Ultrasonic Leak Detector 134-R0135 or equivalent

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

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- system knowledge, including comparison with a known good system.
- system history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of possible sources.
- using a systematic diagnostic method that divides the system into related areas.

The diagnosis and correction of NVH symptoms requires:

- a road or system test to determine the exact nature of the symptom.
- an analysis of the possible causes.
- testing to verify the cause.
- repairing any symptoms found.
- a road test or system test to make sure the cause has been corrected or brought back to within an acceptable range.

Diagnostic Procedure Overview

Qualifying the symptom by the particular sensation present can help narrow down the cause. Always use the "symptom" to "system" to "component" to "cause" diagnosis technique. This diagnostic method divides the problem into related areas to correct the customer concern.

- Verify the "symptom".
- Determine which "system(s)" can cause the "symptom" using the diagnostic tools described in this section.
- After determining the possible "system(s)", refer to the appropriate section in this manual to identify the worn or damaged "components".
- After identifying the "components", identify the "cause" of the failure.

Tools and Techniques

The diagnostic tools allow for a systematic collection of information that is necessary to accurately diagnose and repair NVH problems. Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration/noise to emanate from another receiving component (reactor), due to contact with other components (transfer path). For the best results, carry out the test as follows:

a. Test drive the vehicle with the vibration sensor inside the vehicle.
b. Place the sensor in the vehicle according to feel.
    - If the condition is felt through the steering wheel, the source is most likely in the front of the vehicle.
    - A vibration that is felt in the seat or floor only will most likely be found in the driveline, drive axle or rear wheels and tires.
c. Record the readings. Also note when the condition begins, when it reaches maximum intensity and if it tends to diminish above/below a certain speed.
    - If a vibration symptom is vehicle speed related, the tire and wheel rpm/frequency and driveshaft frequency should be calculated.
    - If a vibration symptom is engine speed related, the engine, engine accessory and engine firing frequencies should be calculated.
    - Frequencies with an amplitude reading of 0.06 Gs or less are barely perceptible NVH levels.

No corrective action is necessary.

d. Place the vibration sensor on or near the suspect area outside the vehicle.
e. Continue the road test, driving the vehicle at the speed the symptom occurs and take another reading.
f. Compare the readings.
    - A match in frequency indicates the problem component or area.
    - An unmatched test could indicate the symptom is caused by the engine, torque converter or engine accessory. Use the diagnostic tools in the rpm mode and check if symptom is rpm related.

The following diagnostic tools and techniques can be used separately or in conjunction with each other to aid in the diagnosis of NVH symptoms. They are listed in order of preference for ease in their use for locating these symptoms.

NVH Analyzer (Vetronix)

The Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) and the MTS 4100 NVH analyzers are tools to aid in the identification and isolation of a noise, vibration or harshness symptom in a vehicle. They measure noise and vibration data and compare it with data obtained from the vehicle's PCM as well as vehicle variants that were entered by the user such as pulley size, axle ratio and tire size in order to provide possible sources. The Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) and the MTS 4100 have the following characteristics:

- Interface with the vehicle's computer system
- Support and store vibration data input from 1 or 2 accelerometers
- Support and store noise data input from 2 microphones
- Provide a photo-tachometer for operation of the driveshaft balancing function
- Provide a strobe output capable of driving a standard timing light
- Contain a real-time clock circuit that provides time and date information which is used for tagging test data
- Have the capability to print to an external printer and interface with a PC
- Can be powered from a variety of power sources: cigarette lighter, AC power or the internal battery pack

The Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) and the MTS 4100 NVH analyzers have 4 main operating modes. The first is for vibration diagnosis. This mode measures data from 1 or 2 accelerometers simultaneously while obtaining data from the vehicle. Then it carries out a frequency analysis on the accelerometer information and compares the vibration frequencies with the frequencies associated with various rotating components within the vehicle. The data can be presented in 4 different display modes: principle component, bar chart, frequency spectrum or waterfall. All display mode formats contain the same common elements, such as amplitude.

The second is for noise diagnosis. This mode measures noise from 1 or 2 microphones simultaneously. All noise measurements are in decibels (dBs). All frequency bands used for noise measurements are the same as for the vibration measurements, up to 1,000 Hz.

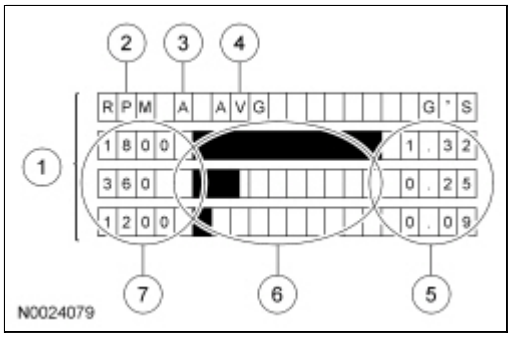
The third is driveshaft balancing. Driveshaft balancing is done using 1 or 2 accelerometers and a photo-tachometer. The accelerometers measure the vibration at both ends of the driveshaft, while the photo-tachometer measures the rotation speed and position reference. Refer to Section 205-00.

The fourth is the strobe. A strobe or standard timing light can be connected to an analyzer, to provide a means for measuring rotation speed. The strobe function is used for isolating the source of a vibration.

Electronic Vibration Analyzer (EVA)

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The Electronic Vibration Analyzer (EVA) is a hand-held electronic scan tool which will assist in locating the source of unacceptable vibrations. The vibration sensor can be remotely mounted anywhere in the vehicle for testing purposes. The unit displays the 3 most common vibration frequencies and their corresponding amplitudes simultaneously. A bar graph provides a visual reference of the relative signal strength (amplitude) of each vibration being displayed and its relative G-force. The keypad is arranged to make the EVA simple to program and use. Some of the functions include the ability to average readings as well as record, play back and freeze readings. The EVA has a strobe balancing function that can be used to detect imbalance on rotating components such as a driveshaft or engine accessories.



Item	Description
1	Electronic Vibration Analyzer (EVA) screen
2	Frequency mode displayed in rpm or Hz
3	Active sensor input (A or B)
4	Current active mode
5	G-force indicators or the strongest frequencies in descending strength of each vibration
6	Strength of each vibration
7	Frequency in rpm/Hz of each vibration

Record the readings taken with the diagnostic tool.

- Frequencies should be read in the "average" mode.
- Frequencies have a range of plus or minus 2 Hz. A reading of 10 Hz can be displayed as an 8 Hz through 12 Hz.

Vibrate Software®

Vibrate Software® (Rotunda tool number 215-00003) is a diagnostic aid which will assist in pinpointing the source of unacceptable vibrations. The engine's crankshaft is the point of reference for vibration diagnosis. Every rotating component will have an angular velocity that is faster, slower or the same as the engine's crankshaft. Vibrate Software® calculates the angular velocity of each component and graphically represents these velocities on a computer screen and on a printed vibration worksheet. The following steps outline how Vibrate Software® helps diagnose a vibration symptom:

- Enter the vehicle information. Vibrate will do all the calculations and display a graph showing tire, driveshaft and engine vibrations.
- Print a Vibration Worksheet graph. The printed graph is to be used during the road test.
- Road test the vehicle at the speed where the vibration is most noticeable. Record the vibration frequency rpm and the engine rpm on the worksheet graph. The point on the graph where the vibration frequency rpm reading and the engine rpm reading intersect indicates the specific component group causing the symptom.

    - A frequency measurement tool capable of measuring vibration frequency and engine rpm will be needed.
- Provides graphics of diagnostic procedures to aid in testing components.

Reed Tachometer

The Reed tachometer is a hand-held vibration sensor which will assist in locating the source of unacceptable vibrations. The vibration sensor can be placed anywhere in the vehicle for testing purposes. The Reed tachometer contains several reeds that are tuned to vibrate or resonate at different frequencies ranging from 10 to 80 Hz or 600 to 4,800 rpm. Though the Reed tachometer is able to measure multiple frequencies, it does not measure amplitude.

Sirometer

The Sirometer measures frequency in hertz and rpm. To use the Sirometer, place it on any vibrating component and slowly scroll the wire out by turning the knob. As the length of wire changes, so does its natural frequency. Find the length of wire that vibrates with the highest amplitude. This frequency will match that of the vibrating component. Read the frequency for that length of wire.

Combination EngineEAR/ChassisEAR

An electronic listening device used to quickly identify noise and the location under the chassis while the vehicle is being road tested. The ChassisEARs can identify the noise and location of damaged/worn wheel bearings, CV joints, brakes, springs, axle bearings or driveshaft carrier bearings.

EngineEAR Basic Unit

An electronic listening device used to detect even the faintest noises. The EngineEARs can detect the noise of damaged/worn bearings in generators, coolant pumps, A/C compressors and power steering pumps. They are also used to identify noisy lifters, exhaust manifold leaks, chipped gear teeth and for detecting wind noise. The EngineEAR has a sensing tip, amplifier and headphones. The directional sensing tip is used to listen to the various components. Point the sensing tip at the suspect component and adjust the volume with the amplifier. Placing the tip in direct contact with a component will reveal structure-borne noise and vibrations, generated by or passing through, the component. Various volume levels can reveal different sounds.

Mechanic's Stethoscope

A mechanic's stethoscope is an inexpensive tool for locating noises in engines and other moving parts. It can be used to help diagnose piston slap, worn gears, faulty valves, coolant pump failure, damaged gaskets, defective bearings and body squeaks.

Squeak and Rattle Repair Kit

The Squeak and Rattle Repair Kit (Rotunda tool number 164-R4900) contains lubricants and self-adhesive materials that can be used to eliminate interior and exterior squeaks and rattles. The kit consists of the following materials:

- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

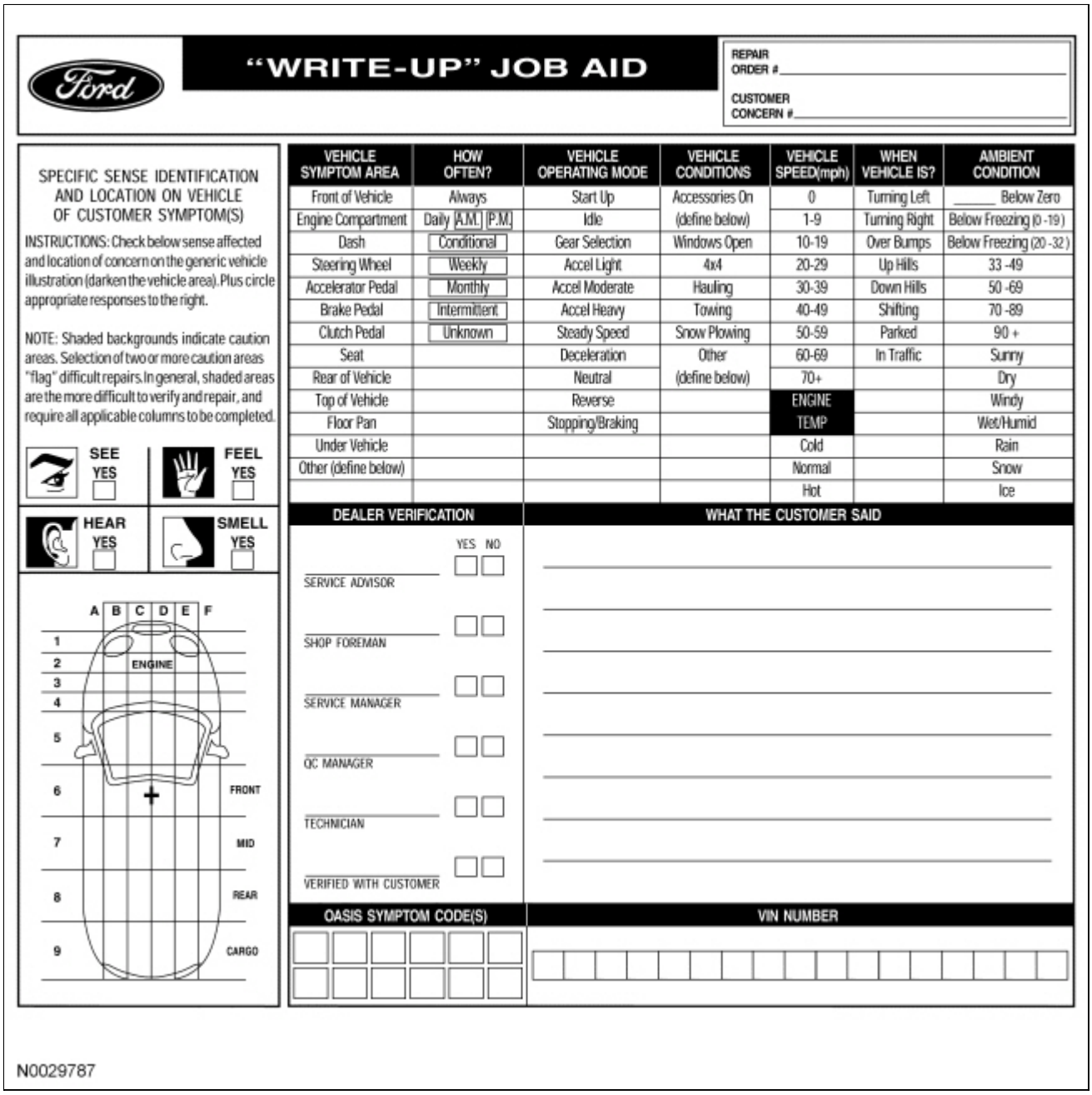
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Ultrasonic Leak Detector

The Ultrasonic Leak Detector is used to detect wind noises caused by leaks and gaps in areas where there is weatherstripping or other sealing material. It is also used to identify A/C leaks, vacuum leaks and evaporative emission noises. The Ultrasonic Leak Detector includes a multi-directional transmitter (operating in the ultrasonic range) and a hand-held detector. The transmitter is placed inside the vehicle. On the outside of the vehicle, the hand-held detector is used to sweep the area of the suspected leak. As the source of the leak is approached, a beeping sound is produced which increases in both speed and frequency.

Write-Up Job Aid

To assist the service advisor and the technician, a Write-Up Job Aid used during the interview process is included with this material. The Write-Up Job Aid serves as a place to record all important symptom information.



"WRITE-UP" JOB AID

REPAIR ORDER #

CUSTOMER CONCERN #

SPECIFIC SENSE IDENTIFICATION AND LOCATION ON VEHICLE OF CUSTOMER SYMPTOM(S)

INSTRUCTIONS: Check below sense affected and location of concern on the generic vehicle illustration (darken the vehicle area). Plus circle appropriate responses to the right.

NOTE: Shaded backgrounds indicate caution areas. Selection of two or more caution areas "flag" difficult repairs. In general, shaded areas are the more difficult to verify and repair, and require all applicable columns to be completed.

SEE YES ☐ FEEL YES ☐

HEAR YES ☐ SMELL YES ☐

A B C D E F
1 2 3 4 5 6 7 8 9
ENGINE FRONT MID REAR CARGO

VEHICLE SYMPTOM AREA	HOW OFTEN?	VEHICLE OPERATING MODE	VEHICLE CONDITIONS	VEHICLE SPEED(mph)	WHEN VEHICLE IS?	AMBIENT CONDITION
Front of Vehicle	Always	Start Up	Accessories On	0	Turning Left	_____ Below Zero
Engine Compartment	Daily A.M. P.M.	Idle	(define below)	1-9	Turning Right	Below Freezing (0 -19)
Dash	Conditional	Gear Selection	Windows Open	10-19	Over Bumps	Below Freezing (20 -32)
Steering Wheel	Weekly	Accel Light	4x4	20-29	Up Hills	33 -49
Accelerator Pedal	Monthly	Accel Moderate	Hauling	30-39	Down Hills	50 -69
Brake Pedal	Intermittent	Accel Heavy	Towing	40-49	Shifting	70 -89
Clutch Pedal	Unknown	Steady Speed	Snow Plowing	50-59	Parked	90 +
Seat		Deceleration	Other	60-69	In Traffic	Sunny
Rear of Vehicle		Neutral	(define below)	70+		Dry
Top of Vehicle		Reverse		ENGINE		Windy
Floor Pan		Stopping/Braking		TEMP		Wet/Humid
Under Vehicle				Cold		Rain
Other (define below)				Normal		Snow
				Hot		Ice

DEALER VERIFICATION

	YES	NO
SERVICE ADVISOR	☐	☐
SHOP FOREMAN	☐	☐
SERVICE MANAGER	☐	☐
QC MANAGER	☐	☐
TECHNICIAN	☐	☐
VERIFIED WITH CUSTOMER	☐	☐

WHAT THE CUSTOMER SAID

OASIS SYMPTOM CODE(S)

VIN NUMBER

N0029787

1: Customer Interview

The diagnostic process starts with the customer interview. The service advisor must obtain as much information as possible about the symptom and take a test drive with the customer. There are many ways a customer will describe NVH symptoms and this will help minimize confusion arising from descriptive language differences. It is important that the symptom is correctly interpreted and the customer descriptions are recorded. During the interview, complete the write-up job aid and ask the following questions:

- When was it first noticed?
- Did it appear suddenly or gradually?
- Did any abnormal occurrence coincide with or precede its appearance?

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Use the information gained from the customer to accurately begin the diagnostic process.

2: Pre-Drive Check

It is important to do a pre-drive check before road testing the vehicle. A pre-drive check verifies that the vehicle is relatively safe to drive and eliminates any obvious faults on the vehicle.

The pre-drive check consists of a brief visual inspection. During this brief inspection, take note of anything that will compromise safety during the road test and make those repairs/adjustments before taking the vehicle on the road.

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the write-up job aid. It is important to know the specific symptom the customer has with the vehicle.
- Do not be misled by the reported location of the noise/vibration. The cause can actually be some distance away.
- Conduct the road test on a quiet street where it is safe to duplicate the vibration/noise. The ideal testing route is an open, low-traffic area where it is possible to operate the vehicle at the speed in which the condition occurs.
- While observing that they are not related to the symptom, eliminate the following:
    - If possible, lower the radio antenna in order to minimize turbulence.
    - Identify anything that could potentially make noise or be a source of wind noise.
    - Inspect the vehicle for add-on items that create vibration/noise.
    - Turn off the radio and the heating and cooling system blower.
- The engine speed is an important factor in arriving at a final conclusion. Therefore, connect a diagnostic tool, Vetronix, or an accurate tachometer to the engine, even if the vehicle has a tachometer. This will make sure of an exact engine speed reading.

4: Verify the Customer Concern

Verify the customer concern by carrying out a road test, an engine run-up test or both.

The decision to carry out a road test, an engine run-up test or both depends on the type of NVH symptom. A road test may be necessary if the symptom relates to the suspension system or is sensitive to torque. A Drive Engine Run-Up (DERU) or a Neutral Engine Run-Up (NERU) test identifies noises and vibrations relating to engine and drivetrain rpm. Remember, a condition will not always be identifiable by carrying out these tests, however, they will eliminate many possibilities if carried out correctly.

5: Road Test

NOTE: It may be necessary to have the customer ride along or drive the vehicle to point out the symptom. During the road test, take into consideration the customer's driving habits and the driving conditions. The customer's concern just may be an acceptable operating condition for that vehicle.

The following is a brief overview of each test in the order in which it appears. A review of this information helps to quickly identify the most appropriate process necessary to make a successful diagnosis. After reviewing this information, select and carry out the appropriate test(s), proceeding to the next step of this process.

- The Slow Acceleration Test is normally the first test to carry out when identifying an NVH symptom, especially when a road test with the customer is not possible.
- The Heavy Acceleration Test helps to determine if the symptom is torque-related.
- The Neutral Coast Down Speed Test helps to determine if the symptom is vehicle speed-related.
- The Downshift Speed Test helps to determine if the symptom is engine speed-related.
- The Steering Input Test helps to determine how the wheel bearings and other suspension components contribute to a vehicle speed-related symptom.
- The Brake Test helps to identify vibrations or noise that are brake related.
- The Road Test Over Bumps helps isolate a noise that occurs when driving over a rough or bumpy surface.
- The Engine Run-Up Tests consist of the Neutral Engine Run-Up (NERU) Test and the Drive Engine Run-Up (DERU) Load Test. These tests help to determine if the symptom is engine speed-related.
- The Neutral Engine Run-Up (NERU) Test is used as a follow-up test to the Downshift Speed Test when the symptom occurs at idle.
- The Drive Engine Run-Up (DERU) Load Test helps to identify vibration/noise sensitive to engine load or torque. It also helps to reproduce engine speed-related symptoms that cannot be duplicated when carrying out the Neutral Engine Run-Up (NERU) Test or the Neutral Coast Down Test.
- The Engine Accessory Test helps to locate faulty belts and accessories that cause engine speed-related symptoms.
- The Vehicle Cold Soak Procedure helps to identify symptoms occurring during initial start-up and when an extended time lapse occurs between vehicle usage.

Slow Acceleration Test

To carry out this test, proceed as follows:

- Slowly accelerate to the speed where the reported symptom occurs. Note the vehicle speed, the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify from what part of the vehicle the symptom is coming.
- Attempt to identify the source of the symptom.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Heavy Acceleration Test

To carry out this test, proceed as follows:

- Accelerate hard from 0-64 km/h (0-40 mph).
- Decelerate in a lower gear.
- The symptom is torque-related if duplicated while carrying out this test.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

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Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

- Drive at a higher rate of speed than where the symptom occurred when carrying out the Slow Acceleration Test.
- Place the transmission in NEUTRAL and coast down past the speed where the symptom occurs.
- The symptom is vehicle speed-related if duplicated while carrying out this test. This eliminates the engine and the torque converter as sources.
- If the symptom was not duplicated while carrying out this test, carry out the Downshift Speed Test to verify if the symptom is engine speed related.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Downshift Speed Test

To carry out this test, proceed as follows:

- Shift into a lower gear than the gear used when carrying out the Slow Acceleration Test.
- Drive at the engine rpm where the symptom occurs.
- The symptom is engine speed related if duplicated while carrying out this test. This eliminates the tires, wheels, brakes and the suspension components as sources.
- If necessary, repeat this test using other gears and NEUTRAL to verify the results.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Steering Input Test

To carry out this test, proceed as follows:

- Drive at the speed where the symptom occurs, while making sweeping turns in both directions.
- If the symptom goes away or gets worse, the wheel bearings, hubs, U-joints (contained in the axles of Four-Wheel Drive (4WD) applications), and tire tread wear are all possible sources.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Brake Test

To carry out this test, proceed as follows:

- With the brake released, accelerate the vehicle. While coasting (brake pedal released) to a stop in NEUTRAL, note any abnormal rate of deceleration. Abnormal deceleration could indicate a parking

brake or service brake that is not fully releasing.

- Warm the brakes by slowing the vehicle a few times from 80-32 km/h (50-20 mph) using light braking applications.
- Accelerate to 89-97 km/h (55-60 mph). Moderately apply the brakes and slow the vehicle to a stop.
- A brake vibration can be felt in the steering wheel, seat or brake pedal. A brake noise can be heard upon brake application and should diminish when the brake is released. For vehicles with separate park brake shoes, noise or vibration from the parking brake system will not be affected by applying the hydraulic brakes. On these systems, the parking brake system requires inspection if a parking brake concern is suspected.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate brake section(s) for further diagnosis and repair. If the source has not been identified, continue with the road test.

Road Test Over Bumps

To carry out this test, proceed as follows:

- Drive the vehicle over a bump or rough surface one wheel at a time to determine if the noise is coming from the front or the back and the left or the right side of the vehicle.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Neutral Engine Run-Up (NERU) Test

To carry out this test, proceed as follows:

- Install a tachometer.
- Increase the engine rpm up from an idle to approximately 4,000 rpm while in PARK on Front Wheel Drive (FWD) vehicles with automatic transmissions, or NEUTRAL for all other vehicles. Note the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify what part of the vehicle the symptom is coming from.
- Attempt to identify the source of the symptom.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

WARNING: Block all wheels, set the parking brake and firmly apply the service brake to reduce the risk of vehicle movement during this procedure. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not carry out the Engine Load Test for more than 5 seconds or damage to the transmission or transaxle may result.**

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- Block the front and rear wheels.
- Apply the parking brake and the service brake.
- Install a tachometer.
- Shift the transmission into DRIVE, and increase and decrease the engine rpm between an idle to approximately 2,000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.
- Repeat the test in REVERSE.
- If the vibration/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the symptom is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Engine Accessory Test

To carry out this test, proceed as follows:

 **WARNING: Block all wheels, set the parking brake and firmly apply the service brake to reduce the risk of vehicle movement during this procedure. Failure to follow these instructions may result in serious personal injury.**

NOTICE: **Limit engine running time to one minute or less with belts removed or serious engine damage will result.**

NOTE: Use a frequency measurement tool to pinpoint accessory vibrations. A listening device, such as an EngineEAR, will also help to identify noises from specific accessories.

- Remove the accessory drive belt(s).
- Increase the engine rpm to where the symptom occurs.
- If the vibration/noise is duplicated when carrying out this test, the belt(s) and accessories are not sources.
- If the vibration/noise was not duplicated when carrying out this test, install the accessory belt(s), one at a time, to locate the source.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to 3 minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the symptom temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.
- Turn the key on, but do not start the engine. Listen for the fuel pump, ABS and air suspension system

noises.

- Start the engine.
- Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Classify NVH Symptom

For NVH concerns, it is necessary to classify the customer's concern into one of the 3 categories: noise, vibration or harshness. The reason for this is that a customer concern may consist of a combination of symptoms involving noise and vibration, or vibration and harshness. In cases where there are combination symptoms, determine which diagnostic path to follow: noise, vibration or harshness. For example, if a customer has a concern involving a noise and a vibration, and it is determined that it is vehicle speed-related, follow the vibration diagnostic path.

Noise Symptoms

Once a symptom is classified as a noise, the particular conditions under which the noise occurs need to be identified. These conditions are identified and verified during the road test. For example, a noise may only occur while turning. The next step is to determine which systems on the vehicle are related to that condition. In this case, the steering system and wheel/tire system may be suspect. After identifying possible systems, a preliminary inspection of these systems should be done. If the source of noise is still unidentified, use a listening device (such as the ChassisEAR) to pinpoint the source. Once the source has been identified, determine if this source is related to the suspected system previously identified. If it is related, then complete the repair to resolve the customer concern. If it is unrelated, then it is possible that the source of the noise is a reactor to a noise being transmitted through a transfer path. If this is the case, repairing the reactor will not resolve the customer concern. The transfer path must be identified and a determination made if the noise is normal, but accentuated by the transfer path (conductor), or if the originator is the fault causing excessive noise to transfer to another component through a conductor. There is a relationship between systems identified as related to conditions and the noise transfer path. In some cases, the condition under which the noise occurs has nothing to do with the identified source. This relationship is important in the diagnosis of noise concerns. It is the first clue that the identified source of noise might be a reactor and that further investigation is needed to diagnose a possible noise transfer path concern. Based on the results from the road test, make a determination of which action in the symptom chart to take first.

Vibration Symptoms

Most vibrations consist of movements back and forth or up and down that repeat. Every time the vibrating component goes through its complete range of motion and returns to the starting point is called a cycle. The rate at which these cycles occur within a given time is called the frequency. Frequency is measured in cycles per second or Hertz (Hz). One cycle per second equals one Hz. Once the frequency of a vibration is known, calculations can be done to determine the system that is the source of the concern.

Order of Vibration

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The order of a vibration refers to how often the vibration is present in one revolution of the component. For example, a vibration that is present once each revolution of a component would be a first order vibration. A vibration present twice each revolution of the component would be a second order vibration. Vibration orders do not have to be whole numbers, they can have decimal values such as 1.5 order vibration or 3.08 order vibration.

The concept of order of vibration is important to remember when the measured frequency of a vibration does not seem to match the frequency calculations of any of the likely systems or components. As the order increases, the frequency of the vibration will also increase by a multiple of that number.

For example, vibration may be present where the frequency is measured at 14 Hz. After doing the necessary calculations it is determined the first order tire and wheel frequency is 7 Hz and the first order driveshaft frequency is 22 Hz. Based on this information it can be determined the vibration is most likely a second order tire and wheel vibration: 7 Hz (first order tire and wheel frequency) multiplied by 2 (second order) equals 14 Hz (second order tire and wheel frequency).

Relationship of Vibration Frequency to Order of Vibration

After carrying out the road test as described in this section, the vibration was determined to be either vehicle-speed related or engine-speed related. That determination will identify the vibration frequency calculations that should be done.

Vibration Type	Calculate
Vehicle-speed related	Tire-speed vibration frequency Driveshaft-speed vibration frequency
Engine-speed related	Engine vibration frequency Engine accessory vibration frequency Engine firing vibration frequency

In calculating and using frequency readings, it is important to remember the direct relationship between Hz and rpm. One Hz is equal to 60 rpm. This is easy to remember; think of Hz as cycles per second. There are 60 seconds in a minute, therefore multiply Hz reading by 60 to get rpm. Conversely, divide rpm by 60 to get Hz.

Use the Frequency and RPM Calculations Worksheet to calculate system/component frequencies. The worksheet provides the necessary steps to determine each system/component group frequency.

Frequency Calculations

Calculating Tire and Wheel Frequency

For a vibration concern, use the vehicle speed to determine tire/wheel frequency and rpm. Calculate tire and

wheel rpm and frequency by carrying out the following:

- Measure the diameter of the tire.
- Record the speed at which the vibration occurs.
- Obtain the corresponding tire and wheel rpm and frequency from the Tire Speed and Frequency Chart.
- If the vehicle speed is not listed, calculate the tire and wheel frequency as follows:
    - Divide the vehicle speed at which the vibration occurs by 16 km/h (10 mph). Multiply that number by the 16 km/h (10 mph) tire rpm listed for that tire diameter in the chart. Then divide that number by 60.
    - For example, if calculating the frequency based on vehicle speed in km/h for a 64 km/h vibration with 835 mm tires, divide 64 km/h by 16 km/h = 4. Multiply 4 by 105 rpm = 420. Divide 420 by 60 seconds = 7 Hz at 64 km/h.
    - If calculating the frequency based on vehicle speed in mph for a 40 mph vibration with 33 inch tires, divide 40 mph by 10 mph = 4. Multiply 4 by 105 rpm = 420. Divide 420 by 60 seconds = 7 Hz at 40 mph.
    - The calculated frequency of 7 Hz is the first order tire and wheel vibration; the second order tire and wheel vibration would be twice this number at 14 Hz; the third order tire and wheel vibration would be 21 Hz; and so on.

Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz
mm (in)	@ 16 km/h (10 mph)	@ 80 km/h (50 mph)	@ 97 km/h (60 mph)	@ 113 km/h (70 mph)
483 (19)	182	910/15	1,092/18	1,274/21
508 (20)	173	865/14	1,038/17	1,211/20
533 (21)	165	825/14	990/16	1,155/19
560 (22)	158	790/13	948/16	1,106/18
585 (23)	151	755/13	906/15	1,057/18
610 (24)	145	725/12	870/14	1,015/17
635 (25)	139	695/12	834/14	973/16
660 (26)	134	670/11	804/13	938/16
685 (27)	129	645/11	774/13	903/15
710 (28)	124	620/10	744/12	868/14
735 (29)	119	595/10	714/12	833/14
760 (30)	115	575/10	690/11	805/13
785 (31)	111	555/9	666/11	777/13
810 (32)	108	540/9	648/11	756/13
835 (33)	105	525/9	630/10	735/12
864 (34)	102	510/8	612/10	714/12

Calculating Driveshaft Frequency

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Knowing the tire and wheel frequency allows for easy calculation of driveshaft frequency. The driveshaft drives the tires through the rear axle. Therefore, to determine driveshaft frequency, multiply tire and wheel frequency by the ratio of the rear axle. Calculate driveshaft frequency by performing the following steps:

- Obtain the axle ratio of the vehicle. Suppose the vehicle has a vibration problem at 64 km/h (40 mph) and a rear axle ratio of 2.93:1.
- Multiply the tire and wheel frequency of 7 Hz (calculated previously) with the rear axle ratio of 2.93:1. This results in a driveshaft frequency of 21 Hz at a vehicle speed of 64 km/h (40 mph).

The calculated frequency of 21 Hz is the first order driveshaft frequency; the second order frequency of the driveshaft is twice this number, or 42 Hz; and so on.

Calculating Engine Frequency

Use the engine rpm where the vibration symptom occurs to determine engine frequency. Calculate engine frequency by dividing the engine rpm by 60 (the number of seconds in a minute). For example, if the corresponding engine rpm of a vibration concern on a vehicle is 2,400 rpm, the resulting engine frequency is 40 Hz. Therefore, a 40 Hz vibration is a first order engine vibration. For purposes of vibration diagnosis, the engine also includes the torque converter and exhaust system.

Calculating Engine Accessory Frequency

Belt-driven engine accessories often produce vibrations at different frequencies than the engine itself. This is because the drive ratio created by the different size pulleys causes them to rotate at different speeds. Determining engine accessory frequency is comparable to calculating driveshaft frequency.

Calculate engine accessory frequency by performing the following steps:

- Determine the size ratio factor between the accessory pulley and the crankshaft pulley. For example, if the diameter of the crankshaft pulley is 6 inches and the accessory pulley diameter is 2 inches, the accessory pulley rotates 3 times for every crankshaft rotation (6 divided by 2).
- Multiply the engine rpm where the vibration condition occurs by the number of times the accessory pulley is rotating per crankshaft revolution. For example, if the engine rpm is 2,400 rpm, the accessory is rotating at 7,200 rpm (2,400 rpm multiplied by 3).
- Divide the accessory rpm by 60 (the number of seconds in a minute). In this example, the engine accessory frequency is 120 Hz (7,200 divided by 60).

Calculating Engine Firing Frequency

Engine firing frequency is a term used to describe the pulses an engine creates from the firing of the cylinders. Engine firing frequency depends on how many cylinders an engine has. The number of times an engine fires a cylinder with each crankshaft revolution is equal to one-half the number of cylinders. A 4-cylinder engine fires 2 cylinders with each crankshaft revolution. Two revolutions of the crankshaft fire all 4 cylinders. A 6-cylinder engine fires 3 cylinders with each crankshaft revolution. An 8-cylinder engine fires 4 cylinders for each crankshaft revolution.

Calculate engine firing frequency by performing the following steps:

- Multiply the engine rpm where the vibration symptom occurs by the number of cylinders fired with

each crankshaft revolution. For example, a vehicle with a 6-cylinder engine experiences a vibration concern at 2,400 rpm. The engine is firing the cylinders at 7,200 times per minute (3 multiplied by 2,400).

- Divide this number by 60 (the number of seconds in a minute) to obtain the engine firing frequency. In this example, the engine firing frequency is 120 Hz (7,200 divided by 60) at 2,400 rpm.

Frequency and RPM Calculations Worksheet

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FREQUENCY AND RPM CALCULATIONS

TIRE AND WHEEL

Vibration occurs at _____ mph (km/h)

Tire diameter _____

Tire speed RPM and frequency from chart	_____ RPM	_____ Hz

DRIVESHAFT

Tire/wheel frequency _____ x axle ratio =	_____ Hz
Tire/wheel RPM _____ x axle ratio =	_____ RPM

ENGINE FREQUENCIES AND ASSOCIATED RPMS

Engine RPM divided by 60 equals 1st order frequency	_____ Hz
1st order RPM x 2 = 2nd order RPM (normal for 4 cylinder engines) Cylinders fired per engine revolutions	_____ RPM
1st order Hz x 2 = 2nd order Hz (normal for 4 cylinder engines)	_____ Hz

1st order RPM x 3 = 3rd order RPM (normal for 6 cylinder engines)

1st order Hz x 3 = 3rd order Hz (normal for 6 cylinder engines)
x 4 = 4th order vibrations (normal for 8 cylinder engines)
x 5 = 5th order, x 6 = 6th order, etc.

Order of vibration x engine RPM equals cylinders fired per minute	_____ RPM
Order of vibration (2nd, 3rd, 4th etc.) x 1st order Hz equals	_____ Hz

ENGINE ACCESSORY FREQUENCIES AND RPMS

Crankshaft pulley diameter _____ divided by accessory pulley diameter _____ = _____ pulley size ratio

Engine speed _____ RPM x pulley ratio = accessory _____ RPM

Accessory pulley _____ RPM divided by 60 = _____ Hz

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Harshness is customer perception which gives the impression of no isolation from the tire/wheel and suspension system. Harshness may be caused by road conditions, temperature changes, component damage and/or incorrect customer modifications on original components/specifications. Customers usually experience harshness when the vehicle is driving over bumps or potholes and in cold weather conditions. Harshness can also be experienced with excessive tire pressure, sporty tires, heavy-duty springs and shocks, or other vehicle modifications. Some aftermarket tires, even with the correct size, may change vehicle behavior and produce customer concerns. The first step in diagnosing a harshness concern is to determine if the concern was experienced only in certain specific operating conditions, such as large potholes or extremely cold weather. In these cases, harshness should be considered normal. A known good vehicle can be driven under the same conditions and the rides can be compared to determine whether the concern is normal or vehicle specific. The second step is to check tire pressure and make sure it was set within vehicle specifications. The third step is to inspect for aftermarket or modified components and determine if they are the cause of the harshness complaint. If the harshness concern persists after the above steps, it is possible that some components are damaged. Based on the results from the road test, make a determination of which action in the symptom chart to take first.

NVH Symptom Chart Categories

A good diagnostic process is a logical sequence of steps that lead to the identification of a causal system. Use the symptom and possible system categories as follows:

- Identify the operating condition that the vehicle is exhibiting.
- Match the operating condition to the symptom.
- Verify the symptom.
- Calculate the frequency and order of the symptom.
- Identify which category or system(s) could cause the symptom.
- Refer to the section indicated to identify and diagnose the symptom or confirm that the system is not the source of the condition.

Use the diagnostic instructions in this section along with the necessary listed tools to identify the vibration order and to isolate the symptom and the possible systems associated with that symptom. Then based on the results from the road test, make a determination of which action in the symptom chart to take first. Since it is possible any one of multiple systems may be the cause of the symptom, it may be necessary to use a process of elimination type diagnostic approach to pinpoint the concern. Refer to the section(s) indicated to identify and isolate the cause or rule that system out as being the causal system for the symptom.

Vehicle-Speed Related Vibrations

NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

When a vehicle-speed related vibration is present, both tire-speed related vibration and driveshaft-speed related vibration calculations should be carried out.

Symptom Chart — Tire-Speed Related Vibrations

Symptom Chart — Tire-Speed Related Vibrations

Condition	Possible Sources	Action

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• First order tire vibration	• Tire or wheel • Wheel bearings • Drive axle • Halfshaft • Brake rotor or drum	• REFER to Section 204-04 . • REFER to Section 204-00 . • REFER to Section 205-00 . • REFER to Section 205-00 . • REFER to Section 206-00 .
• Second order tire vibration	• Tire or wheel	• REFER to Section 204-04 .
• Third order tire vibration	• Tire or wheel • Drive axle • Driveshaft • Halfshaft	• REFER to Section 204-04 . • REFER to Section 205-00 . • REFER to Section 205-00 . • REFER to Section 205-00 .

Symptom Chart — Driveshaft-Speed Related Vibrations

Symptom Chart — Driveshaft-Speed Related Vibrations

NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

Condition	Possible Sources	Action
• First order driveshaft vibration	• Driveshaft • Rear drive axle/differential	• REFER to Section 205-00 . • REFER to Section 205-00 .
• Second order driveshaft vibration	• U-joint • Output shaft bushing in transmission/transaxle	• REFER to Section 205-00 . • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
• Third order driveshaft vibration	• Rear drive axle/differential	• REFER to Section 205-00 .

Symptom Chart — Engine-Speed Related Vibrations

Symptom Chart — Engine-Speed Related Vibrations

NOTE: When an engine-speed related vibration is present, engine, engine accessory and engine firing calculations should be carried out.

NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

NOTE: Some engine-speed related vibrations are normal though they should not be felt in the passenger compartment.

Condition	Possible Sources	Action
• 0.5 order engine vibration	• Engine	• REFER to Section 303-00 .
• First through sixth order engine vibration	• Engine	• REFER to Section 303-00 .
	• Transmission/transaxle	• Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
	• Engine mounts	• REFER to Section 303-00 .
	• Transmission/transaxle mounts	• Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
	• Exhaust system	• REFER to Section 309-00 .
• Belt driven accessory speed vibration	• Engine pulley	• REFER to Section 303-00 .
	• Coolant pump	• REFER to Section 303-00 .
	• Generator	• REFER to Section 414-00 .
	• A/C compressor	• REFER to Section 412-00 .
	• Power steering pump	• REFER to Section 211-00B .
	• Vacuum pump	• REFER to Section 303-00 .
	• Accessory drive belt	• REFER to Section 303-00 .

Symptom Chart — Noise, Air Leaks or Water Leaks

Symptom Chart — Noise, Air Leaks or Water Leaks

Condition	Possible Sources	Action
• Wind noise, air or water leaks	• Body	• REFER to the Symptom Chart in Section 501-00 .

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	• Roof opening panel	• REFER to the Symptom Chart in Section 501-00 .
• Belt driven accessory noise/squeal or chirping	• Accessory drive belt • Pulleys	• REFER to Section 303-05 .
• Front end noise while driving vehicle	• Front suspension	• REFER to Section 204-00 .
	• Drive axle or differential	• REFER to Section 205-00 .
	• Brake system	• REFER to Section 206-00 .
	• Steering linkage or gear	• REFER to Section 211-00A for Electronic Power Assist Steering (EPAS) or Section 211-00B for Hydraulic Power Assist Steering (HPAS).
	• Transmission/transaxle	• Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
	• Engine	• REFER to Section 303-00 .
	• Exhaust system	• REFER to Section 309-00 .
	• Body	• REFER to the Symptom Chart in Section 501-00 .
• Rear end noise while driving vehicle	• Rear suspension	• REFER to Section 204-00 .
	• Drive axle or differential	• REFER to Section 205-00 .
	• Brake system	• REFER to Section 206-00 .
	• Transmission/transaxle	• Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
	• Exhaust system	• REFER to Section 309-00 .
	• Body	• REFER to the Symptom Chart in Section 501-00 .
• Noise with vehicle stopped	• Engine	• REFER to Section 303-00 .
	• Transmission/transaxle	• Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
	• Exhaust system	• REFER to Section 309-00 .

	• Power steering pump • Generator • A/C compressor • Body	• REFER to Section 211-00B . • REFER to Section 414-00 . • REFER to Section 412-00 . • REFER to the Symptom Chart in Section 501-00 .

Symptom Chart — Harshness

Symptom Chart — Harshness

Condition	Possible Sources	Action
• Harsh vehicle ride	• Front suspension • Rear suspension	• REFER to Section 204-00 . • REFER to Section 204-00 .

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Material

Item	Specification	Fill Capacity
Motorcraft® Wheel and Tire Cleaner ZC-37-A	—	—

Alignment Specifications

Item	LH	RH	Total/Split
Rear Wheel Drive (RWD)			
Camber	-0.2° ± 0.75°	-0.4° ± 0.75°	0.2° ± 0.75°
Caster	3.9° ± 1.0°	4.3° ± 1.0°	-0.4° ± 0.75°
Total toe (front)	—	—	0.20° ± 0.20°
Thrust angle (rear)	—	—	0.0° ± 0.50°
Four-Wheel Drive (4WD) (all except SVT Raptor)			
Camber	-0.2° ± 0.75°	-0.4° ± 0.75°	0.2° ± 0.75°
Caster	3.8° ± 1.0°	4.2° ± 1.0°	-0.4° ± 0.75°
Total toe (front)	—	—	0.20° ± 0.20°
Thrust angle (rear)	—	—	0.0° ± 0.50°
Four-Wheel Drive (4WD) (SVT Raptor)			
Camber	-0.45° ± 0.75°	-0.45° ± 0.75°	0.2° ± 0.75°
Caster	3.7° ± 1.0°	4.1° ± 1.0°	0.0° ± 0.75°
Total toe (front)	—	—	0.20° ± 0.20°
Thrust angle (rear)	—	—	0.0° ± 0.50°

General Specifications

Item	Specification
Ball Joint Deflection, All Vehicles	
Lower	0-0.8 mm (0-0.032 in)
Upper	0-0.2 mm (0-0.008 in)
Ride Height — Four-Wheel Drive (4WD) Crew Cab	
145-in wheelbase, 3.5L GTDI	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	163 mm (6.417 in)

	± 12 mm (0.472 in)
145-in wheelbase, 3.5L GTDI (Max Trailer Tow)	
Front	116 mm (4.488 in) ± 12 mm (0.472 in)
Rear	164 mm (6.456 in) ± 12 mm (0.472 in)
145-in wheelbase, 5.0L	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	163 mm (6.417 in) ± 12 mm (0.472 in)
145-in wheelbase, 6.2L (Max Trailer Tow)	
Front	107 mm (4.212 in) ± 12 mm (0.472 in)
Rear	149 mm (5.866 in) ± 12 mm (0.472 in)
145-in wheelbase, 6.2L (Harley/Lariat Ltd)	
Front	107 mm (4.212 in) ± 12 mm (0.472 in)
Rear	146 mm (5.748 in) ± 12 mm (0.472 in)
157-in wheelbase, 3.5L GTDI	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	162 mm (6.377 in) ± 12 mm (0.472 in)
157-in wheelbase, 3.5L GTDI (Max Trailer Tow)	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	164 mm (6.456 in) ± 12 mm (0.472 in)
157-in wheelbase, 5.0L	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)

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Rear	160 mm (6.299 in) ± 12 mm (0.472 in)
Ride Height — 4WD Heavy Duty	
Regular cab, 145-in wheelbase, 3.5L GTDI	
Front	110 mm (4.330 in) ± 12 mm (0.472 in)
Rear	198 mm (7.795 in) ± 12 mm (0.472 in)
Regular cab, 145-in wheelbase, 5.0L	
Front	109 mm (4.291 in) ± 12 mm (0.472 in)
Rear	197 mm (7.755 in) ± 12 mm (0.472 in)
SuperCab, 163-in wheelbase, 3.5L GTDI	
Front	115 mm (4.527 in) ± 12 mm (0.472 in)
Rear	182 mm (7.165 in) ± 12 mm (0.472 in)
SuperCab, 163-in wheelbase, 5.0L	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	181 mm (7.125 in) ± 12 mm (0.472 in)
Ride Height — 4WD Regular Cab	
126-in wheelbase, 3.7L	
Front	111 mm (4.370 in) ± 12 mm (0.472 in)
Rear	174 mm (6.850 in) ± 12 mm (0.472 in)
126-in wheelbase, 5.0L	
Front	112 mm (4.409 in) ± 12 mm (0.472 in)
Rear	172 mm (6.771 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.5L 2 GTDI	
Front	111 mm (4.370 in)

Rear	± 12 mm (0.472 in) 185 mm (7.283 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.7L	
Front	111 mm (4.370 in) ± 12 mm (0.472 in)
Rear	190 mm (7.480 in) ± 12 mm (0.472 in)
145-in wheelbase, 5.0L	
Front	112 mm (4.409 in) ± 12 mm (0.472 in)
Rear	185 mm (7.283 in) ± 12 mm (0.472 in)
Ride Height — 4WD SuperCab	
145-in wheelbase, 3.5L GTDI	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	171 mm (6.732 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.5L GTDI (Max Trailer Tow)	
Front	112 mm (4.409 in) ± 12 mm (0.472 in)
Rear	172 mm (6.771 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.7L	
Front	112 mm (4.409 in) ± 12 mm (0.472 in)
Rear	175 mm (6.889 in) ± 12 mm (0.472 in)
133-in wheelbase, 5.0L	
Front	111 mm (4.370 in) ± 12 mm (0.472 in)
Rear	169 mm (6.653 in) ± 12 mm (0.472 in)

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Ride Height — Rear Wheel Drive (RWD) Crew Cab	
145-in wheelbase, 3.5L GTDI	
Front	108 mm (4.251 in) ± 12 mm (0.472 in)
Rear	162 mm (6.377 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.5L GTDI (Max Trailer Tow)	
Front	108 mm (4.251 in) ± 12 mm (0.472 in)
Rear	163 mm (6.417 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.7L	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	167 mm (6.574 in) ± 12 mm (0.472 in)
145-in wheelbase, 5.0L	
Front	109 mm (4.291 in) ± 12 mm (0.472 in)
Rear	163 mm (6.417 in) ± 12 mm (0.472 in)
145-in wheelbase, 6.2L (Max Trailer Tow)	
Front	103 mm (4.055 in) ± 12 mm (0.472 in)
Rear	148 mm (5.826 in) ± 12 mm (0.472 in)
145-in wheelbase, 6.2L (Harley/Lariat Ltd)	
Front	102 mm (4.015 in) ± 12 mm (0.472 in)
Rear	145 mm (5.708 in) ± 12 mm (0.472 in)
157-in wheelbase, 3.5L GTDI	
Front	109 mm (4.291 in) ± 12 mm (0.472 in)
Rear	164 mm (6.456 in)

	± 12 mm (0.472 in)
157-in wheelbase, 3.5L GTDI (Max Trailer Tow)	
Front	108 mm (4.251 in) ± 12 mm (0.472 in)
Rear	165 mm (6.496 in) ± 12 mm (0.472 in)
157-in wheelbase, 5.0L	
Front	109 mm (4.291 in) ± 12 mm (0.472 in)
Rear	162 mm (6.377 in) ± 12 mm (0.472 in)
Ride Height — RWD Heavy Duty	
Regular cab, 145-in wheelbase, 3.5L GTDI	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	195 mm (7.677 in) ± 12 mm (0.472 in)
Regular cab, 145-in wheelbase, 5.0L	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	193 mm (7.598 in) ± 12 mm (0.472 in)
SuperCab, 163-in wheelbase, 3.5L GTDI	
Front	118 mm (4.645 in) ± 12 mm (0.472 in)
Rear	182 mm (7.165 in) ± 12 mm (0.472 in)
SuperCab, 163-in wheelbase, 5.0L	
Front	116 mm (4.566 in) ± 12 mm (0.472 in)
Rear	179 mm (7.047 in) ± 12 mm (0.472 in)
Ride Height — RWD Regular Cab	
126-in wheelbase, 3.7L	
Front	106 mm (4.173 in)

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Rear	± 12 mm (0.472 in) 170 mm (6.692 in) ± 12 mm (0.472 in)
126-in wheelbase, 5.0L	
Front	115 mm (4.527 in) ± 12 mm (0.472 in)
Rear	170 mm (6.692 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.5L GTDI	
Front	112 mm (4.409 in) ± 12 mm (0.472 in)
Rear	186 mm (7.322 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.7L	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	186 mm (7.322 in) ± 12 mm (0.472 in)
145-in wheelbase, 5.0L	
Front	107 mm (4.212 in) ± 12 mm (0.472 in)
Rear	182 mm (7.165 in) ± 12 mm (0.472 in)
Ride Height — RWD SuperCab	
145-in wheelbase, 3.5L GTDI	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	169 mm (6.653 in) ± 12 mm (0.472 in)
145-in wheelbase, 3.5L GTDI (Max Trailer Tow)	
Front	113 mm (4.448 in) ± 12 mm (0.472 in)
Rear	169 mm (6.653 in) ± 12 mm (0.472 in)

145-in wheelbase, 3.7L	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	174 mm (6.850 in) ± 12 mm (0.472 in)
145-in wheelbase, 5.0L	
Front	114 mm (4.488 in) ± 12 mm (0.472 in)
Rear	169 mm (6.653 in) ± 12 mm (0.472 in)
Ride Height — 4WD (SVT Raptor)	
Regular Cab, 5.4L	
Front	129 mm (5.078 in) ± 12 mm (0.472 in)
Rear	242 mm (9.527 in) ± 12 mm (0.472 in)
SuperCab, 6.2L	
Front	130 mm (5.1188 in) ± 12 mm (0.472 in)
Rear	242 mm (9.527 in) ± 12 mm (0.472 in)
Crew Cab, 6.2L	
Front	127 mm (4.999 in) ± 12 mm (0.472 in)
Rear	242 mm (9.527 in) ± 12 mm (0.472 in)
Tire Inflation	
Tires	See safety certification sticker located on driver door jamb
Vehicle Lean (side-to-side height differences), All Vehicles	
Front — maximum	7 mm (0.28 in)
Rear — maximum	8 mm (0.32 in)

Torque Specifications

Description	Nm	lb-ft

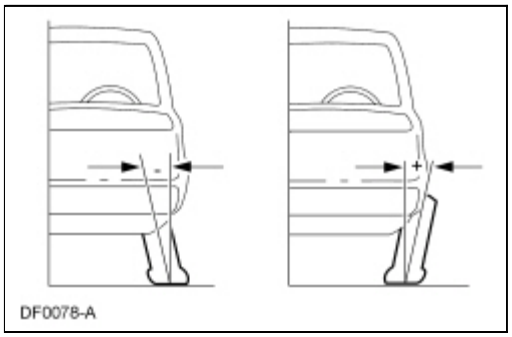
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Front Suspension		
Cam bolts	350	258
Stabilizer bar bracket nuts	55	41
Stabilizer bar link lower nuts	80	59
Tie-rod jam nuts	103	76

Wheel Alignment Angles

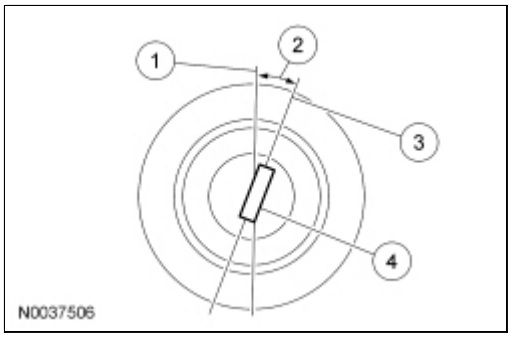
Camber

Negative and Positive Camber



Camber is the vertical tilt of the wheel when viewed from the front. Camber can be positive or negative and has a direct effect on tire wear.

Caster



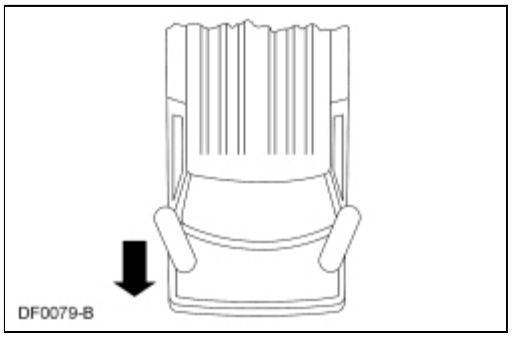
Item	Description
1	True vertical
2	Positive caster
3	Ball joint centerline
4	Pivot centerline

Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. The caster setting is not related to tire wear.

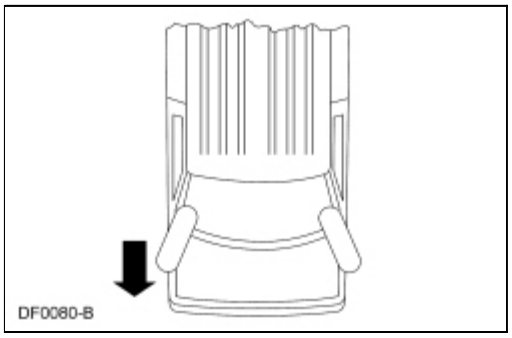
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Toe

Positive Toe (Toe In)

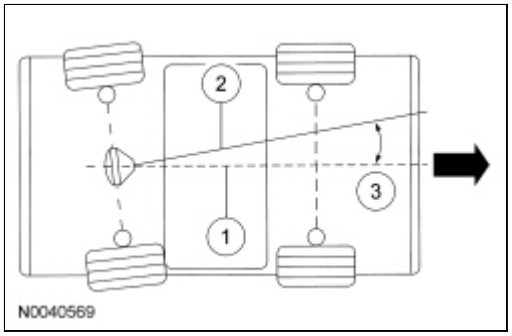


Negative Toe (Toe Out)



The vehicle toe setting affects tire wear and directional stability.

Incorrect Thrust Angle (Dogtracking)



Item	Description
1	Vertical centerline
2	Axle centerline
3	Thrust angle

Incorrect thrust angle (dogtracking) is the condition in which the rear axle is not square to the chassis. Heavily crowned roads can give the illusion of dogtracking.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph) and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel. For wheel and tire diagnosis, refer to Section 204-04 .

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to described the poor return of the steering wheel to center after a turn or the steering correction is completed.

Drift/Pull

Pull is a tugging sensation, felt by the hands on the steering wheel, that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (for example: wind, road crown).

Poor Groove Feel

Poor groove feel is characterized by little or no buildup of turning effort felt in the steering wheel as the wheel is rocked slowly left and right within very small turns around center or straight-ahead (under 20 degrees of steering wheel turn). Efforts may be said to be "flat on center".

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- Under 20 degrees of turn, most of the turning effort that builds up comes from the mesh of gear teeth in the steering gear. In this range, the steering wheel is not yet turned enough to feel the effort from the self-aligning forces at the road wheel or tire patch.
- In the diagnosis of a roadability problem, it is important to understand the difference between wander and poor groove feel.

Suspension System

Inspection and Verification

1. Road test.
   - Verify the customer concern by carrying out a road test on a smooth road. If any vibrations are apparent, refer to Section 100-04 .

2. Inspect tires.
   - Check the tire pressure with all normal loads in the vehicle and the tires cold. Refer to the Vehicle Certification (VC) label.
   - Verify that all tires are sized to specification. Refer to the VC label.
   - Inspect the tires for incorrect wear and damage. Install new tires as necessary.

3. Inspect chassis and underbody.

4. Inspect for aftermarket equipment.
   - Check for aftermarket changes to the steering, suspension, wheel and tire components (such as competition, heavy duty, etc.). The specifications shown in this manual do not apply to vehicles equipped with aftermarket equipment.

Visual Inspection Chart

Mechanical
• Front wheel bearing(s) • Loose or damaged front or rear suspension components • Loose, damaged or missing suspension fastener(s) • Incorrect spring usage • Damaged or sagging spring(s) • Damaged or leaking shock absorber(s) • Worn or damaged suspension bushing(s) • Loose, worn or damaged steering system components • Damaged axle components

5. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.

6. If the fault is not visually evident, GO to Symptom Chart - Suspension System or GO to Symptom Chart - NVH .

Symptom Chart — Suspension System

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Symptom Chart — Suspension System

Condition	Possible Sources	Action
• Incorrect thrust angle (dogtracking)	• Rear suspension components	• INSPECT the rear suspension system. CHECK the rear alignment for the correct thrust angle. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-02 .
• Vehicle drifts/pulls	• Unevenly loaded or overloaded vehicle • Tires/tire pressure • Alignment is not within specification • Brake drag • Steering components	• GO to Pinpoint Test A .
• Front bottoming or riding low	• Worn, damaged or incorrect springs	• MEASURE the ride height. REFER to Ride Height Measurement in this section. INSTALL new springs as necessary. Refer to the appropriate section in Group 204 for the procedure.
	• Worn front shock absorbers	• INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group 204 for the procedure.
• Abnormal/incorrect tire wear	• Incorrect tire pressure (rapid center rib or inner and outer edge wear)	• ADJUST the tire pressure. REFER to the Vehicle Certification (VC) label. REFER to Section 204-04 Diagnosis and Testing for further tire wear diagnosis.
	• Incorrect tire rotation intervals	• REFER to Section 100-03 .
	• High-speed cornering • Excessive front or rear toe (inner or outer edge wear) • Excessive negative or positive camber (inner or outer edge wear)	• REFER to Section 204-04 Diagnosis and Testing for further tire wear diagnosis.
	• Front or rear suspension components	• INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. Refer to the appropriate section in Group 204 for the procedure.

• Sticky steering, poor returnability	• Binding ball joints • Steering components • Caster out of specification	• REFER to the Ball Joint Inspection Component Test in this section. • INSPECT the steering system. INSTALL new components as necessary. REFER to Section 211-02 . • CHECK the wheel alignment. REFER to Camber and Caster Adjustment in this section. ADJUST as necessary.
• Steering wheel off-center	• Unequal front toe setting (side-to-side) • Steering components	• CHECK the wheel alignment. REFER to Toe Adjustment — Front in this section. ADJUST as necessary. • INSPECT the steering system. INSTALL new components as necessary. For vehicles equipped with Electronic Power Assist Steering (EPAS), refer to Section 211-00A . For vehicles equipped with Hydraulic Power Assist Steering (HPAS), refer to Section 211-00B .
• Sway or roll	• Overloaded, unevenly or incorrectly loaded vehicle • Loose wheel nut (s) • Shock absorber (s) • Loose stabilizer bracket-to-frame bolts • Worn stabilizer bar bushings or links • Damaged or broken stabilizer bar • Damaged spring (s)	• NOTIFY the customer of incorrect vehicle loading. • TIGHTEN the wheel nut(s) to specification. REFER to Section 204-04 . • INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group 204 for the procedure. • TIGHTEN the bolts to specification. Refer to the appropriate section in Group 204 for the procedure. • INSTALL new stabilizer bar bushings or links as necessary. Refer to the appropriate section in Group 204 for the procedure. • INSTALL a new stabilizer bar as necessary. Refer to the appropriate section in Group 204 for the procedure. • INSTALL new springs as necessary. Refer to the appropriate section in Group 204 for the procedure.
• Vehicle leans to one side	• Unevenly loaded or overloaded vehicle • Front or rear	• NOTIFY the customer of incorrect vehicle loading. • MEASURE the ride height. REFER

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	suspension components	to Ride Height Measurement in this section. If the ride height is not within specification, INSPECT the front and rear suspension systems. INSTALL new suspension components as necessary. Refer to the appropriate section in Group 204 for the procedure.
• Wander	• Overloaded, unevenly or incorrectly loaded vehicle	• NOTIFY the customer of incorrect vehicle loading.
	• Ball joint(s)	• INSPECT the ball joints. REFER to the Ball Joint Inspection Component Test in this section.
	• Loose, worn or damaged front wheel bearing(s)	• INSPECT the wheel bearings. INSTALL new wheel bearings as necessary.
	• Loose, worn or damaged suspension component(s)	• INSTALL new suspension component(s) as necessary. Refer to the appropriate section in Group 204 for the procedure.
	• Loose suspension fasteners	• INSPECT the suspension fasteners. TIGHTEN to specification. Refer to the appropriate section in Group 204 for the procedure.
	• Steering components	• INSPECT the steering system. INSTALL new components as necessary. For vehicles equipped with Electronic Power Assist Steering (EPAS), refer to Section 211-00A . For vehicles equipped with Hydraulic Power Assist Steering (HPAS), refer to Section 211-00B .
	• Wheel alignment (excessive total front toe out)	• ADJUST as necessary. REFER to Toe Adjustment — Front in this section.

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Squeak or grunt — noise	• Front stabilizer	• Under these conditions, the

from the front or rear suspension, occurs more in cold ambient temperature with or without the presence of moisture. More noticeable over rough roads or when turning	bar insulators • Leaf spring bushings	noise is acceptable.
• Clunk — noise from the front suspension, occurs in and out of turns	• Loose front suspension	• INSPECT for loose nuts or bolts. TIGHTEN to specification. Refer to the appropriate section in Group 204 for the procedure.
• Clunk — noise from the rear suspension, occurs when shifting from REVERSE to DRIVE	• Loose rear suspension components	• INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to Section 204-02 .
• Click or pop — noise from the front suspension. More noticeable over rough roads or over bumps	• Worn or damaged ball joint(s)	• CARRY OUT a ball joint inspection. INSTALL new ball joint(s) or control arm(s) as necessary. REFER to Section 204-00 .
• Front suspension noise — a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads	• Front suspension components • Loose or damaged shock absorber(s) or shock absorber bushing(s) • Damaged spring or spring mount(s) • Damaged or worn control/radius arm bushing(s) • Worn or damaged stabilizer bar bushings or link (s)	• INSPECT the front suspension. INSTALL new components as necessary. Refer to the appropriate section in Group 204 for the procedure.
• Rear suspension noise — a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads	• Loose or damaged rear shock absorber (s) or shock absorber bushing(s) • Rear leaf spring tip isolator or bushing • Damaged leaf spring or leaf spring mount(s) • Worn or	• INSPECT the rear suspension. INSTALL new components as necessary. REFER to Section 204-02 .

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	damaged stabilizer bar bushing(s) or link(s) • Rear leaf spring or bushing contaminated with dirt, sand or mud	• **NOTE:** To avoid the re-occurrence of noise, make sure that all contamination and moisture trapped between the individual leaf spring components have been completely removed. • **NOTE:** Do not apply any lubricant or grease to the leaf springs as this will attract dirt and moisture. PRESSURE WASH the leaf springs between the individual spring leafs and the gaps between the spring bushings, mounting brackets and shackles to remove any trapped debris. USE compressed (shop) air to remove any remaining debris and to completely dry between all of the individual spring components.
• Shudder — occurs during acceleration from a slow speed or stop	• Incorrect ride height causing incorrect driveline angle	• REFER to Section 205-00 for driveline angle diagnosis.
• Shimmy	• Loose wheel nut (s) • Loose front suspension fastener(s) • Loose front wheel bearing (s) • Shock absorber (s)	• TIGHTEN the nut(s) to specification. REFER to Section 204-04 . • TIGHTEN the fastener(s) to specification. Refer to the appropriate section in Group 204 for the procedure. • INSPECT the front wheel bearing(s). INSTALL new bearing(s) as necessary. Refer to the appropriate section in Group 204 for the procedure. • INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group 204 for the procedure.
• Shimmy — most noticeable on coast/deceleration. Also hard steering condition	• Excessive positive caster	• CHECK the wheel alignment. REFER to Camber and Caster Adjustment in this section. ADJUST as necessary.

• Rough/harsh ride	• Incorrect tire pressure • Shock absorber (s) • Spring(s) • Loose, worn or damaged suspension component(s)	• ADJUST the tire pressure. REFER to the VC label. • INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group 204 for the procedure. • MEASURE the ride height. REFER to Ride Height Measurement in this section. INSTALL new springs as necessary. Refer to the appropriate section in Group 204 for the procedure. • INSTALL new suspension component(s) as necessary. Refer to the appropriate section in Group 204 for the procedure.

Pinpoint Tests

Pinpoint Test A: Vehicle Drifts/Pulls

This pinpoint test is intended to diagnose the following:

- Unevenly loaded vehicle
- Tire pressure
- Tire forces
- Brake drag
- Incorrect vehicle alignment
- Steering system

PINPOINT TEST A: VEHICLE DRIFTS/PULLS

Test Step	Result / Action to Take
A1 CHECK FOR UNEVENLY LOADED VEHICLE	
• Visually check the vehicle for an uneven loading condition. • **Is the vehicle unevenly loaded?**	**Yes** ADVISE the customer of uneven loading condition. **No** GO to A2.
A2 CHECK THE TIRE PRESSURES AND TIRE CONDITIONS	
• Check the tire pressures. Refer to the Vehicle Certification (VC) label located on the driver door jamb. Check the tires for	**Yes** GO to A3.

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uneven/abnormal wear. Refer to Diagnosis and Testing — Wheels and Tires in Section 204-04 . • **Are the tire pressures and tire conditions OK?**	**No** ADJUST the tire pressures to the specified pressure or INSTALL new tires as necessary.
A3 ISOLATE TIRE DRIFT/PULL CONDITION • Cross the front wheel and tire assemblies from left-to-right. Refer to Section 204-04 . • **Does the vehicle drift/pull?**	**Yes** If the vehicle drifts/pulls in the opposite direction, tire forces are causing the drift/pull. ROTATE the wheel and tire assemblies front-to-rear. REFER to Section 204-04 . If the vehicle drifts/pulls in the same direction, GO to A4 . **No** Tire forces were causing the drift/pull and the concern has been corrected.
A4 CHECK FOR BRAKE DRAG • Spin all 4 wheel and tire assemblies by hand and check for brake drag. • **Do the wheels spin freely?**	**Yes** GO to A5 . **No** REFER to Section 206-00 to diagnose brake drag condition.
A5 CHECK THE WHEEL ALIGNMENT • Using alignment equipment and the manufacturer's instructions, check the wheel alignment. • **Is the wheel alignment out of specification?**	**Yes** ADJUST the alignment as necessary. REFER to General Procedures in this section. **No** REFER to Section 211-00A or Section 211-00B to diagnose steering system drift/pull/wander condition.

Component Tests

Ball Joint Inspection

1. Prior to inspecting the ball joints for wear, inspect the wheel bearings. Refer to Section 100-04 .

2. **NOTE:** In order to obtain accurate measurements, the suspension must be in full rebound with the weight of the vehicle supported by the frame.

   Raise and support the vehicle by the frame to allow the wheels to hang in the rebound position.

3. Inspect the ball joint and ball joint boot for damage.
   - If the ball joint or ball joint boot is damaged, install a new ball joint as necessary. Refer to Section 204-01A for Rear Wheel Drive (RWD) vehicles and Section 204-01B for Four-Wheel Drive (4WD) vehicles.

NOTE: Carry out Steps 4 through 6 to inspect the lower ball joint. Carry out Steps 7 through 9 to inspect the

upper ball joint.

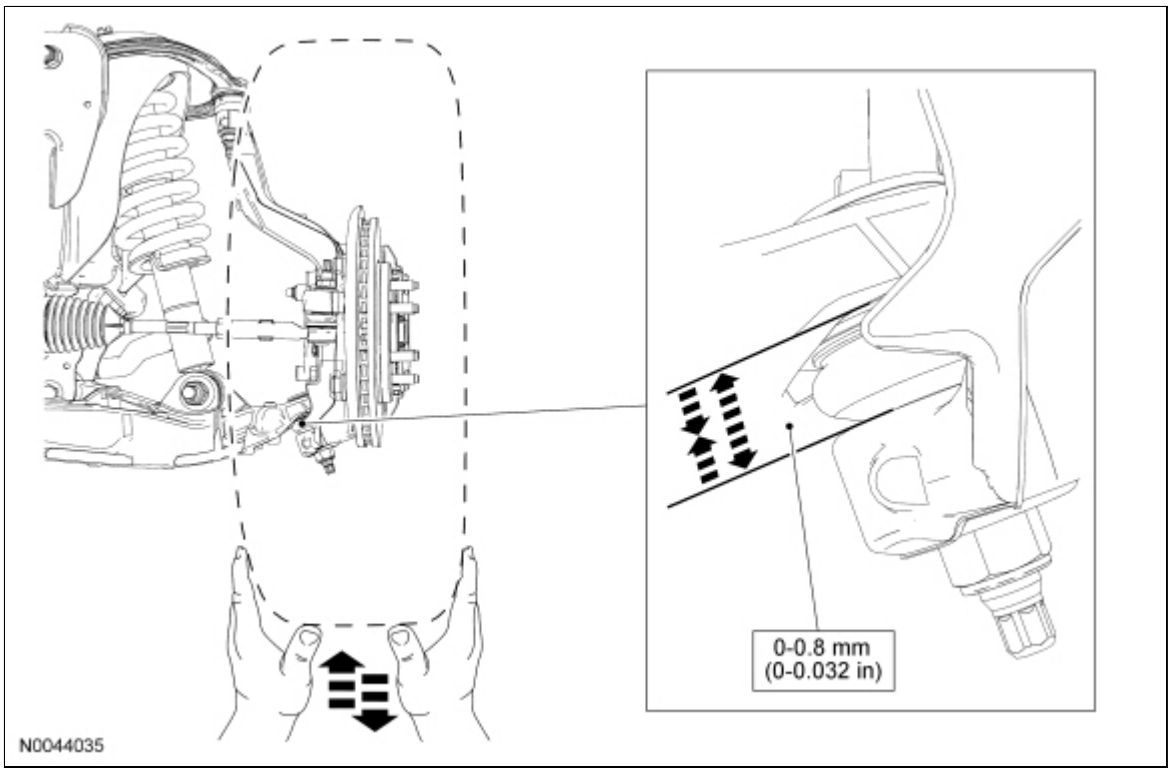
4. ***NOTICE:*** **Do not use any tools or equipment to move the wheel and tire assembly or suspension components while checking for relative movement. Suspension damage can occur. The use of tools or equipment will also create relative movement that may not exist when using hand force. Relative movement must be measured using hand force only.**

   NOTE: The weight of the wheel and tire assembly must be overcome to obtain an accurate measurement on the dial indicator.

   Inspect the ball joint for relative movement by alternately pulling downward and pushing upward on the wheel and tire assembly by hand. Note any relative vertical movement between the wheel knuckle and lower arm at the lower ball joint.
   - If relative movement is not felt or seen, the ball joint is OK. Do not install a new ball joint.
   - If relative movement is found, continue with Step 5.

5. **NOTE:** In order to obtain an accurate measurement, the dial indicator should be aligned as close as possible with the vertical axis (center line) of the ball joint.

   To measure ball joint deflection, attach a suitable dial indicator with a flexible arm between the lower control arm and the wheel knuckle or ball joint stud.



6. Measure the ball joint deflection while an assistant pushes up and pulls down on the wheel and tire assembly, by hand.
   - If the deflection exceeds the specification, a new ball joint must be installed. Refer to Section 204-01A for RWD vehicles and Section 204-01B for 4WD vehicles.
   - If the deflection meets or is below the specification, continue with the procedure.

7. ***NOTICE:*** **Do not use any tools or equipment to move the wheel and tire assembly or suspension components while checking for relative movement. Suspension damage can**

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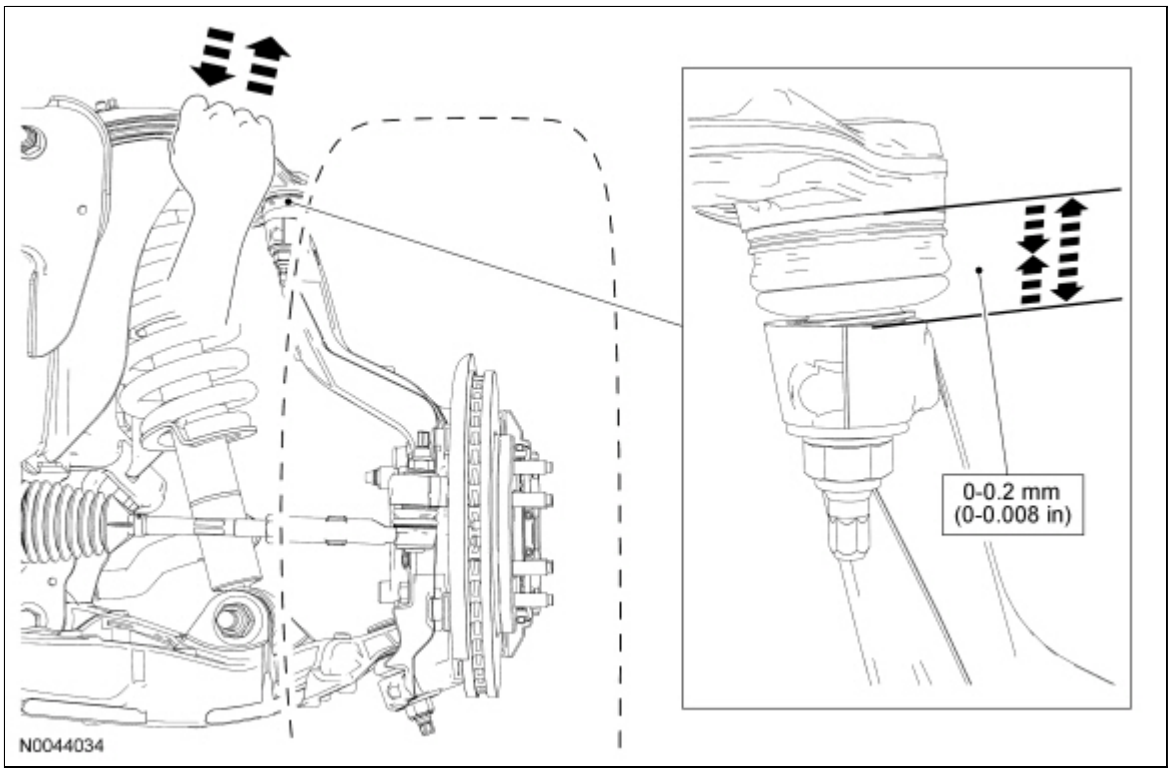
occur. The use of tools or equipment will also create relative movement that may not exist when using hand force. Relative movement must be measured using hand force only.

Inspect the ball joint for relative movement by alternately pulling downward and pushing upward on the upper control arm by hand. Note any relative vertical movement between the wheel knuckle and upper arm at the upper ball joint.

- If relative movement is not felt or seen, the ball joint is OK. Do not install a new ball joint.
- If relative movement is found, continue with Step 8.

8. **NOTE:** In order to obtain an accurate measurement, the dial indicator should be aligned as close as possible with the vertical axis of the ball joint.

   To measure ball joint deflection, attach a suitable dial indicator with a flexible arm between the upper control arm and the wheel knuckle or ball joint stud.



9. Measure the ball joint deflection while an assistant pushes up and then pulls down on the upper control arm, by hand.
   - If the deflection exceeds the specification, a new ball joint must be installed. Refer to Section 204-01A for RWD vehicles and Section 204-01B for 4WD vehicles.
   - If the deflection meets or is below the specification, no further action is required.

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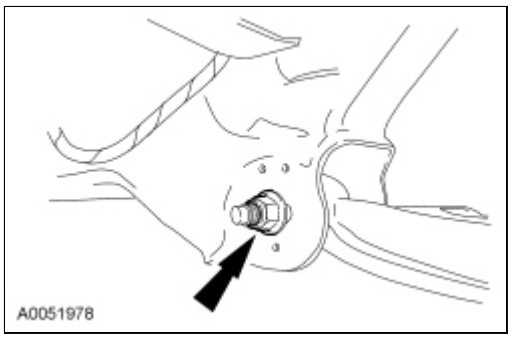
Camber and Caster Adjustment

NOTICE: **Do not remove the stabilizer bar brackets until the stabilizer links have been disconnected or damage to the stabilizer bar links may occur.**

NOTE: To allow for adjustment of the lower arm in the frame slots, the lower arm bolts and nuts must be removed and discarded. They are replaced with cam bolt kit 3C333. The vehicle should be supported by the frame to ease movement of the lower arm in the slot.

1. Using alignment equipment and the manufacturers instructions, measure the front caster and camber.
   - Refer to Alignment Specifications in the Specifications portion of this section for optimal alignment settings.
   - If the caster and camber values are not within specification, go to the next step.

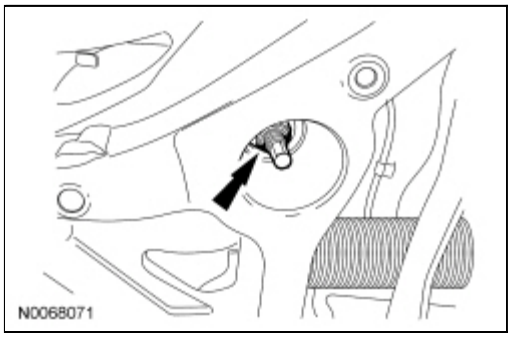
2. Remove and discard the lower arm front and rear nuts and bolts.



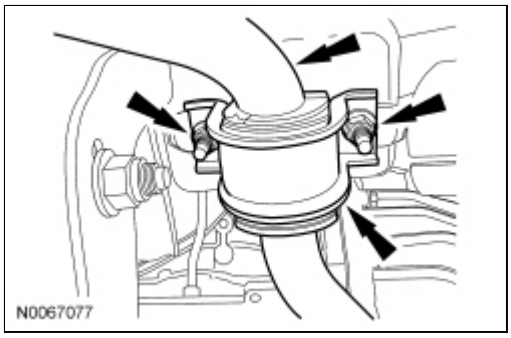
3. ***NOTICE:*** **Do not hold the stabilizer link boot with any tool as damage to the boot will occur.**

   NOTE: Use the hex-holding feature to prevent the stud from turning while removing the nuts.

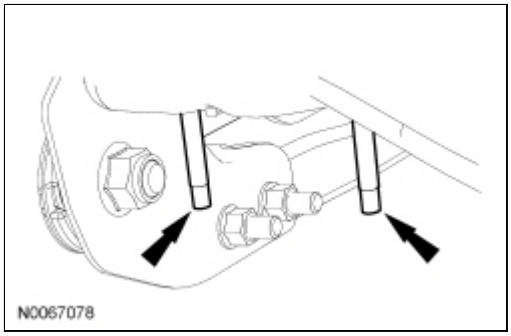
   Remove and discard the stabilizer bar link lower nuts.



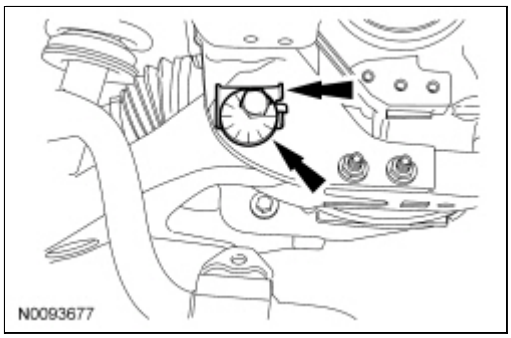
4. Remove the 4 stabilizer bar bracket nuts, 2 stabilizer bar brackets and position the stabilizer bar aside.
   - Discard the nuts.



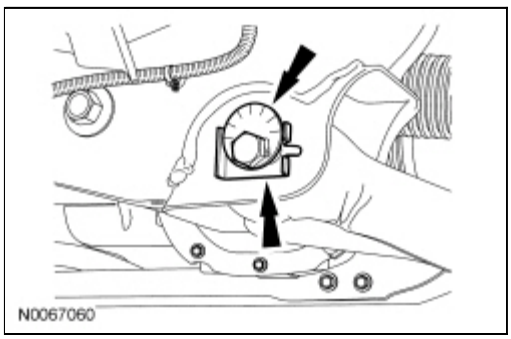
5. Remove the stabilizer bar bracket bolts and plate assembly.



6. Install the front cam bolt kit and loosely install the nut.



7. Install the rear cam bolt kit and loosely install the nut.

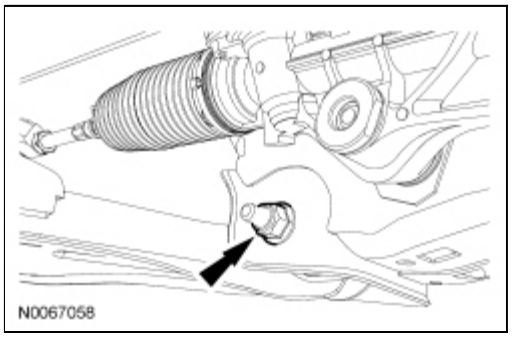


8. To adjust the caster and camber, refer to the following chart.
    - Adjustments that require moving the front and the rear of the lower arm should be made equally.

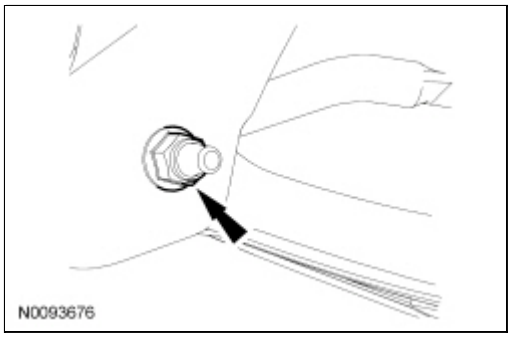
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Adjustment	Front of Lower Arm	Rear of Lower Arm
Increase caster	In	Out
Decrease caster	Out	In
Increase camber	In	In
Decrease camber	Out	Out
Increase caster and camber simultaneously	In	—
Decrease caster and camber simultaneously	Out	—

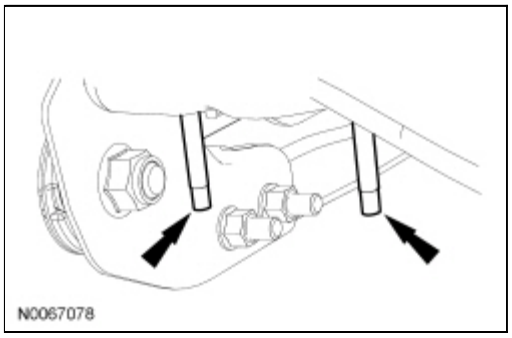
9. With the weight of the vehicle resting on the wheel and tire assemblies, hold the front cam bolt and tighten the nut to 350 Nm (258 lb-ft).



10. With the weight of the vehicle resting on the wheel and tire assemblies, hold the rear cam bolt and tighten the nut to 350 Nm (258 lb-ft).

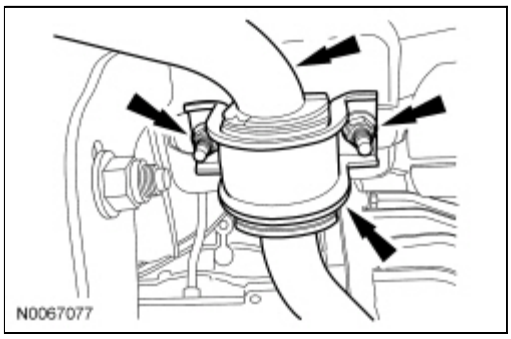


11. Install the 2 stabilizer bar bracket bolts and plate assembly.



12. Position the stabilizer bar, install the 2 stabilizer bar brackets and the 4 new stabilizer bar bracket nuts.

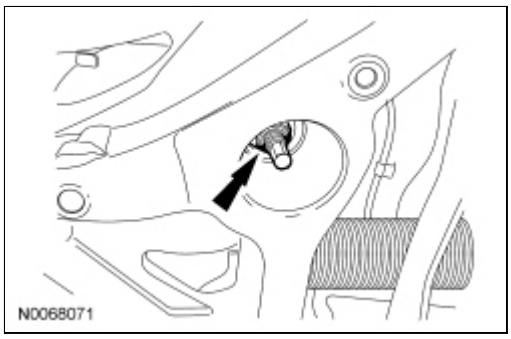
- Tighten the nuts to 55 Nm (41 lb-ft).



13. ***NOTICE:*** **Do not hold the stabilizer link boot with any tool as damage to the boot will occur.**

    NOTE: Use the hex-holding feature to prevent the stud from turning while installing the nuts.

    Install the 2 new stabilizer bar link lower nuts.
    - Tighten the nuts to 80 Nm (59 lb-ft).

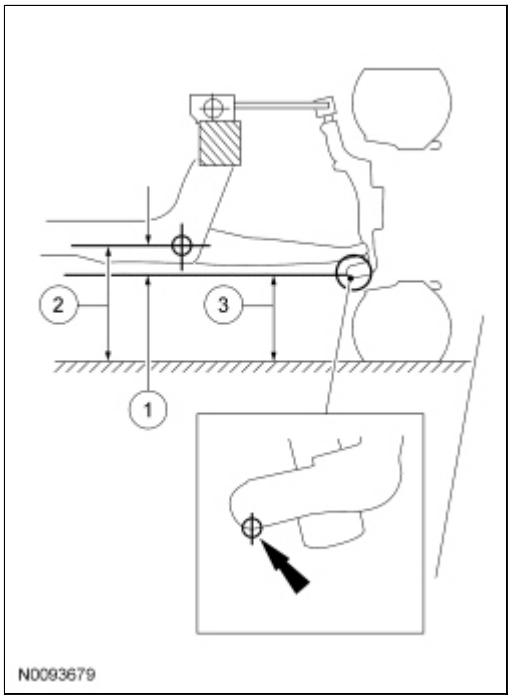


14. Check and, if necessary, adjust the front toe. For additional information, refer to Toe Adjustment — Front in this section.

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Ride Height Measurement

Front Ride Height Measurement

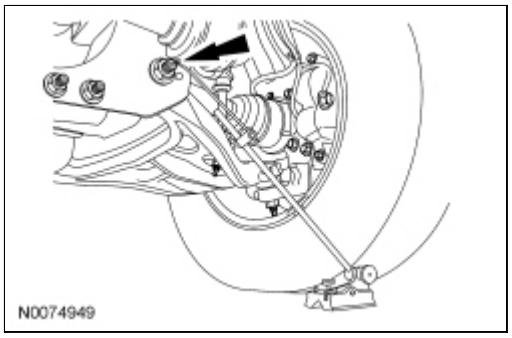


Item	Description
1	Ride height = 2 - 3
2	Measurement 2
3	Measurement 3

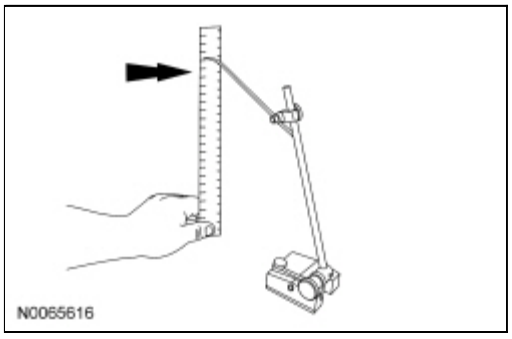
NOTE: Make sure that the vehicle is positioned on a flat, level surface and the tires are inflated to the correct pressure. Vehicle should have at least one-half tank of fuel.

1. Position a suitable surface gauge (such as Starrett 57D Surface Gauge) on a flat, level surface and adjust the gauge arm until the scriber point is located in the center of the rearward lower arm bolt.
    - Lock the surface gauge in this position.

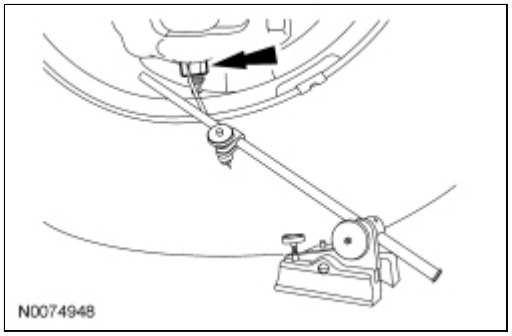
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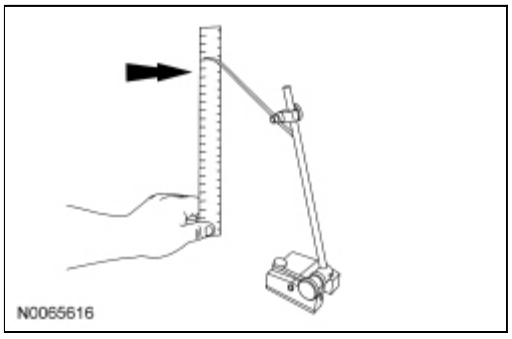
2. With the surface gauge positioned on a flat, level surface, record the measurement of the surface gauge position (measurement 2).



3. Position the surface gauge on the same flat, level surface as used in Step 1 and adjust the gauge arm until the scriber point is located at the lowest point on the wheel knuckle.
    - Lock the surface gauge in this position.

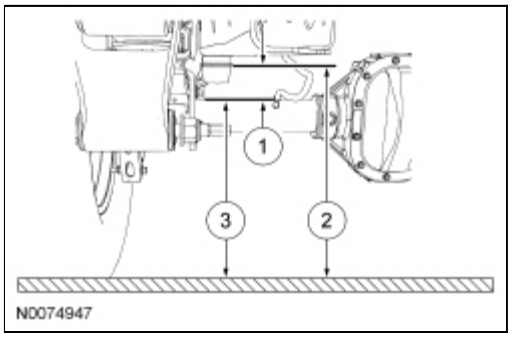


4. With the surface gauge positioned on a flat, level surface, record the measurement of the surface gauge position (measurement 3).



5. Subtract measurement 3 from measurement 2 to obtain the front ride height.
    - Refer to Specifications in this section.

Rear Ride Height Measurement (All Except SVT Raptor)

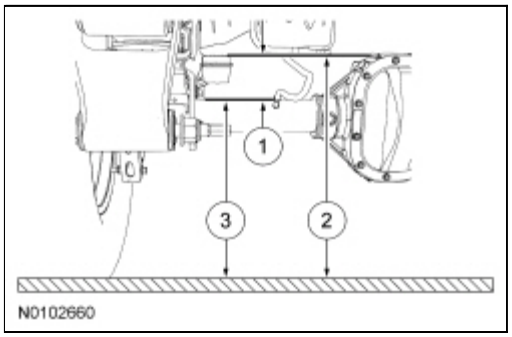


Item	Description
1	Ride height
2	Rear axle jounce stop
3	Top of the rear axle tube

NOTE: Make sure that the vehicle is positioned on a flat, level surface and the tires are inflated to the correct pressure. Vehicle should have at lease one-half tank of fuel.

1. Measure the distance between the rear axle jounce stop (Item 2) and the top of the rear axle tube (Item 3) to obtain the rear ride height (Item 1).

Rear Ride Height Measurement (SVT Raptor)



Item	Description
1	Ride height
2	Rear frame rail
3	Top of the rear axle tube

NOTE: Make sure that the vehicle is positioned on a flat, level surface and the tires are inflated to the

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correct pressure. Vehicle should have at lease one-half tank of fuel.

1. Measure the distance between the rear frame rail (Item 2) and the top of the rear axle tube (Item 3) to obtain the rear ride height (Item 1).

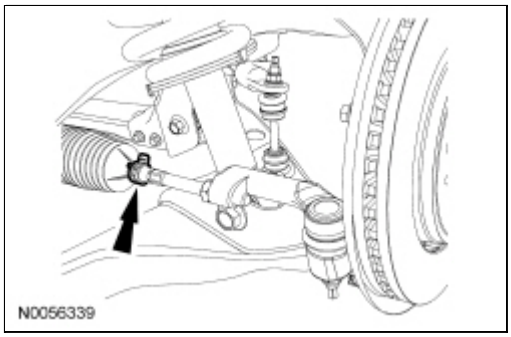
Toe Adjustment — Front

1. Using alignment equipment and the manufacturer's instructions, measure the front toe.
   - Refer to Alignment Specifications in the Specifications portion of this section for optimal alignment settings.
   - If the front toe values are not within specification, go to the next step.

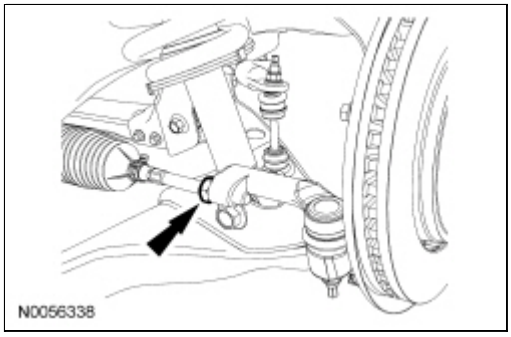
2. Start the engine and center the steering wheel.

3. Turn the engine off and, using a suitable steering wheel holding device, lock the steering wheel in the straight-ahead position.

4. Remove the steering gear bellows clamp(s).



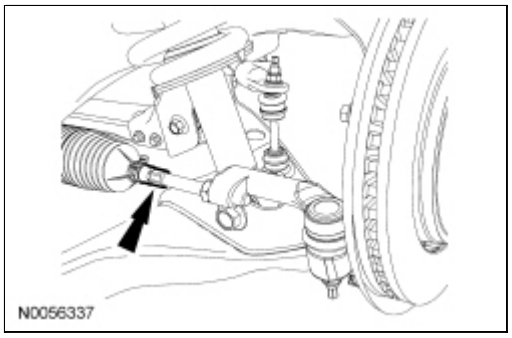
5. Loosen the tie-rod end jam nut(s).



6. **NOTE:** Do not allow the steering gear bellows to twist while rotating the tie rod.

   Rotate the tie rod(s) to achieve the desired toe setting.

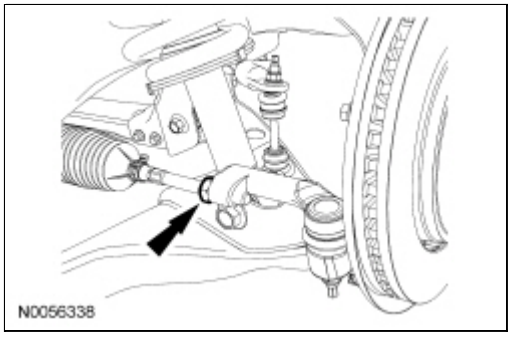
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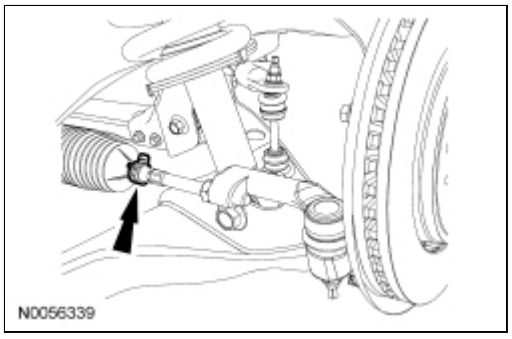
7. ***NOTICE:*** **Make sure to hold the tie-rod end stationary while tightening the jam nut or damage to the boot may occur.**

   NOTE: Make sure that the toe settings are not disturbed while tightening the jam nuts.

   Tighten the tie-rod end jam nut(s) to 103 Nm (76 lb-ft).



8. Install the steering gear bellows clamp(s).



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Torque Specifications

Description	Nm	lb-ft	lb-in
Brake disc shield bolts	17	—	150
Brake hose bracket bolt	12	—	106
Lower arm forward and rearward nuts	350	258	—
Lower ball joint nut	175	129	—
Shock absorber lower nuts	90	66	—
Shock absorber upper mount nuts	63	46	—
Shock rod nut	55	41	—
Stabilizer bar bracket nuts	55	41	—
Stabilizer bar link nuts	70	52	—
Tie-rod end nut	115	85	—
Upper arm-to-frame nuts	150	111	—
Upper ball joint nut	115	85	—
Wheel bearing and wheel hub bolts	175	129	—
Wheel speed sensor bolt	18	—	159
Wheel speed sensor harness bracket bolt	12	—	106

Front Suspension

The Rear Wheel Drive (RWD) front suspension consists of the following components:

- Lower ball joints
- Lower control arms
- Shock absorber and coil spring assemblies
- Stabilizer bar and links
- Upper control arms
- Wheel bearings and wheel hubs
- Wheel knuckles
- Wheel studs

The vehicle is equipped with a front coil spring suspension. This independent-type suspension utilizes a stabilizer bar to aid in vehicle stability. The wheel hub and wheel bearing are sealed units and are serviced as assemblies. The lower ball joints can be serviced independently from the lower arms.

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Front Suspension

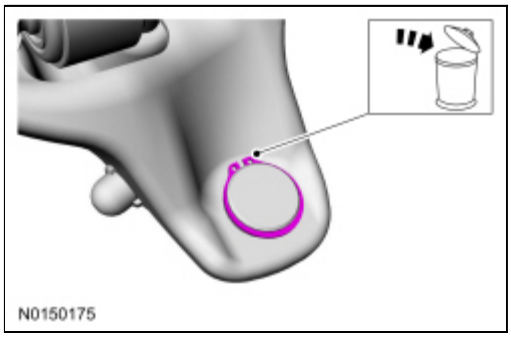
Refer to Section 204-00 .

Ball Joint — Lower

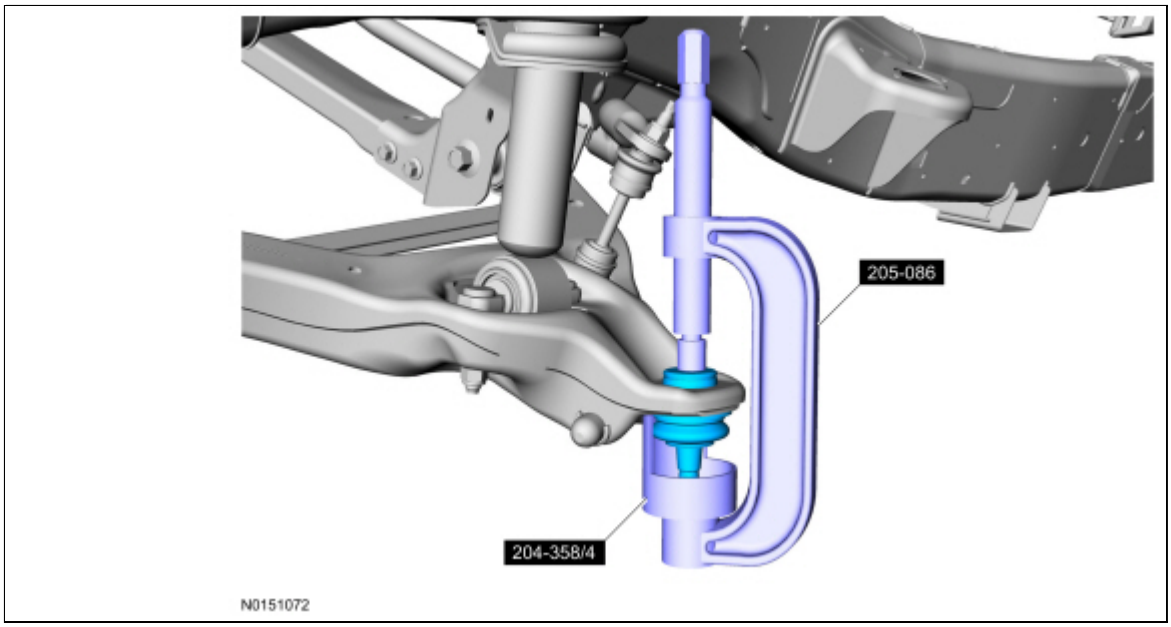
Special Tool(s)

 ST2929-A	Installer/Remover, Ball Joint 204-358
 ST1172-A	Installer/Remover, C-Frame and Screw 205-086

Removal

1. Remove the wheel knuckle. Refer to Wheel Knuckle .
2.  N0150175
3. Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/4.

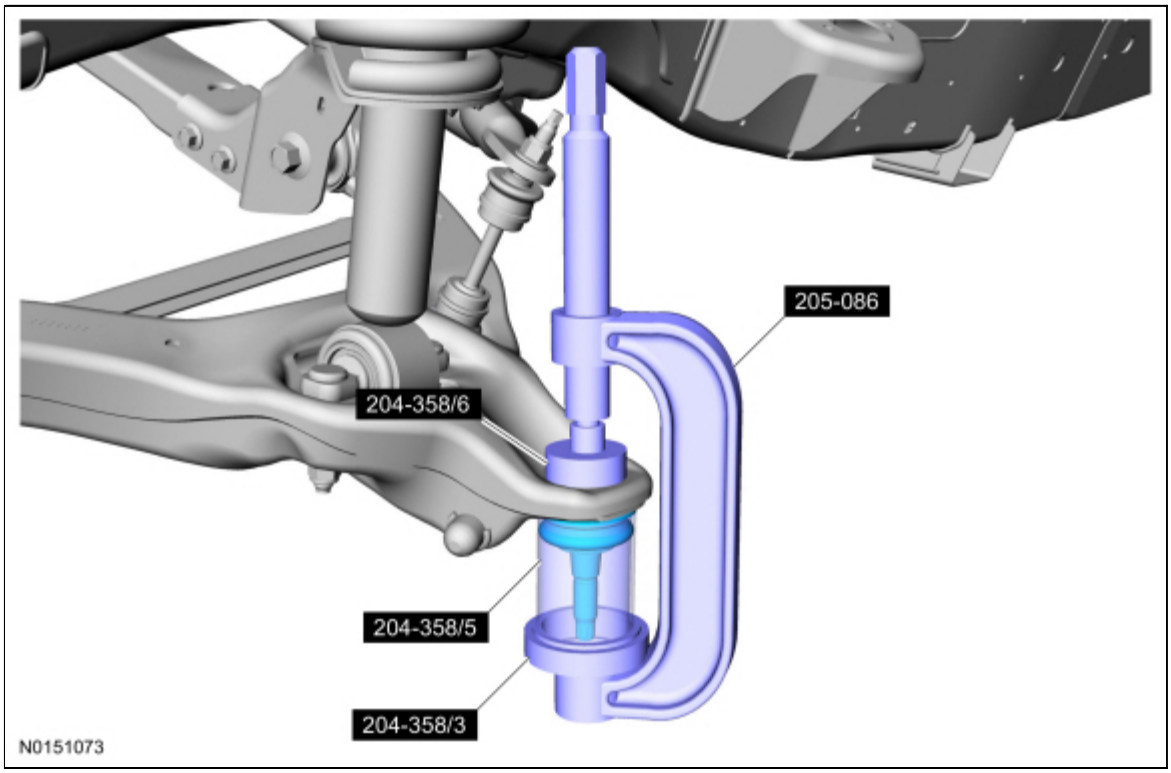
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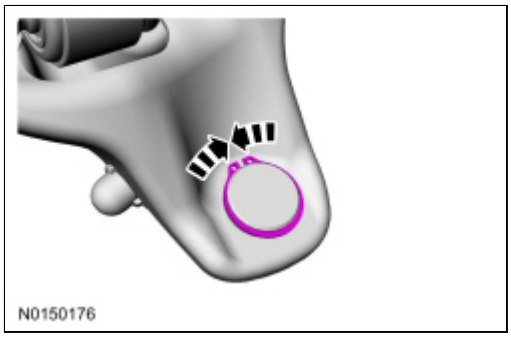
Installation

1. ***NOTICE:*** **Do not damage the lower ball joint boot when installing the C-Frame and Screw Installer/Remover and Ball Joint Installer/Remover or premature failure of the ball joint may occur.**

   Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/3. Remover, Ball Joint 204-358/5. Remover, Ball Joint 204-358/6.



2. **NOTE:** Make sure the ball joint snap ring is fully seated.



3. Install the wheel knuckle. Refer to Wheel Knuckle .

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Lower Arm

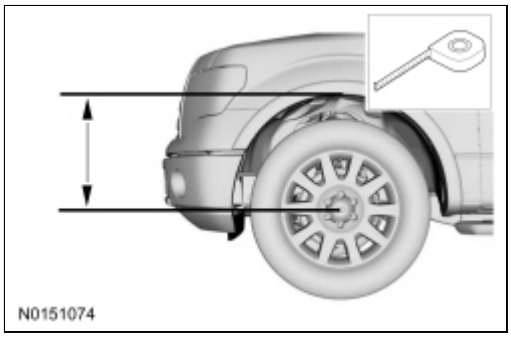
Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

Removal

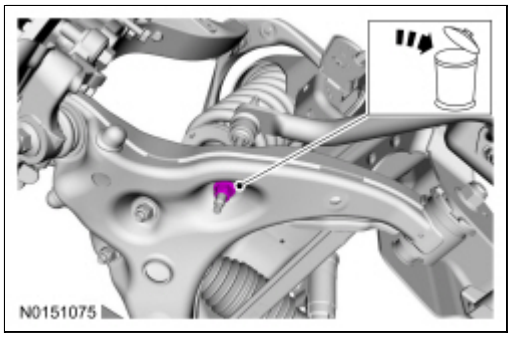
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).

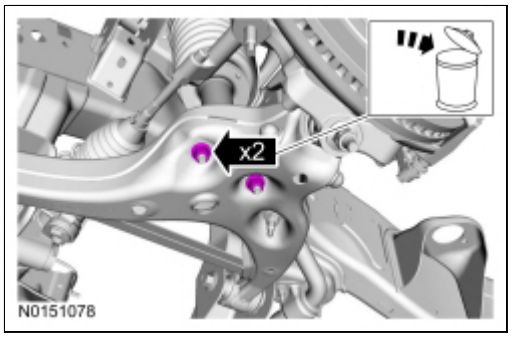


2. Remove the wheel and tire. Refer to Section 204-04 .

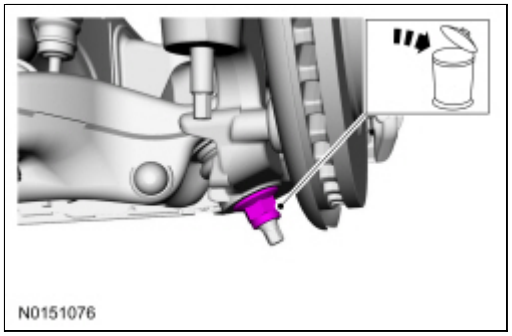
3. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



4.



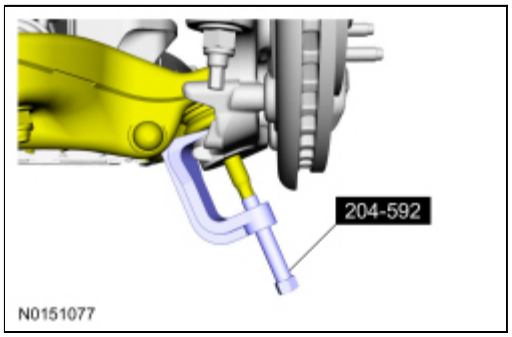
5.



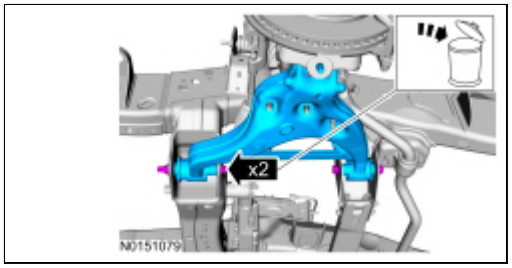
6. ***NOTICE:*** **Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.**

   NOTICE: **Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.**

   Special Tool(s): Separator, Ball Joint 204-592.



7.

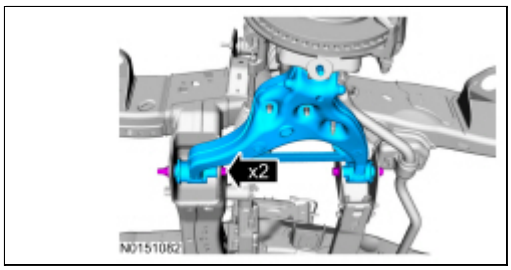


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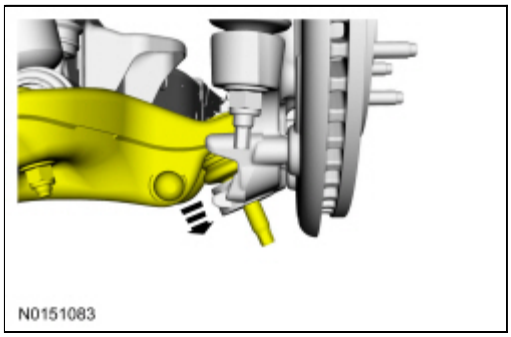
Installation

1. ***NOTICE:*** **Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.**

   Finger tight at this stage.

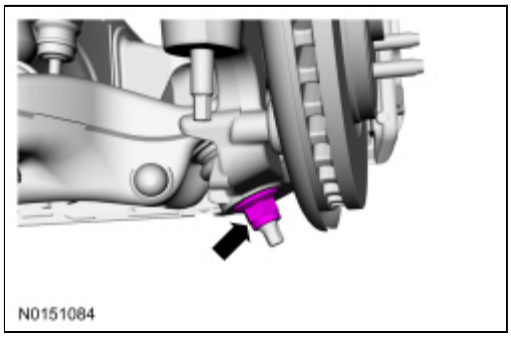


2.



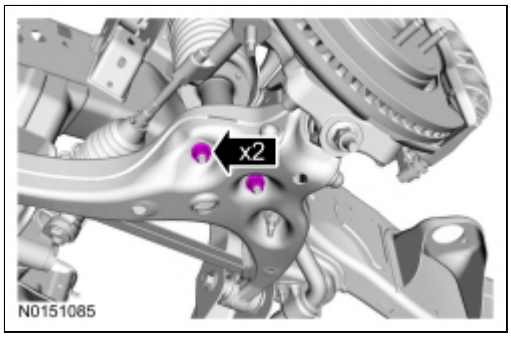
3.

   - Tighten to 175 Nm (129 lb-ft).



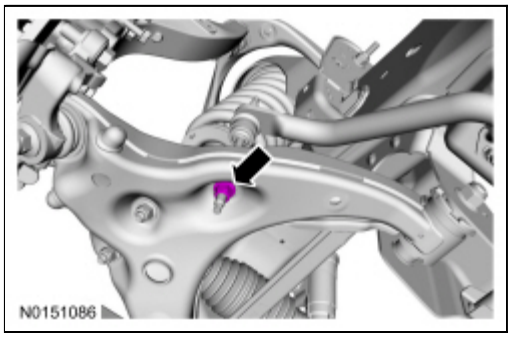
4.

   - Tighten to 90 Nm (66 lb-ft).

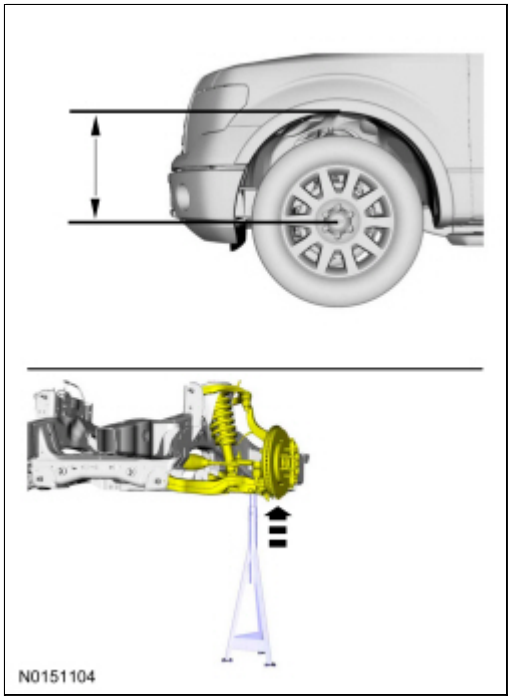


5. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

    - Tighten to 70 Nm (52 lb-ft).



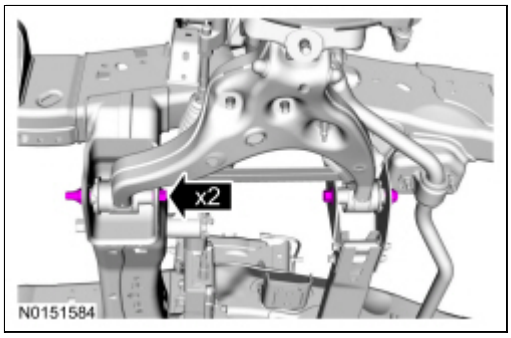
6. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



7.

    - Tighten to 350 Nm (258 lb-ft).

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8. Install the wheel and tire. Refer to Section 204-04 .
9. Check and, if necessary, align the front end. Refer to Section 204-00 .

Shock Absorber and Spring Assembly

Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

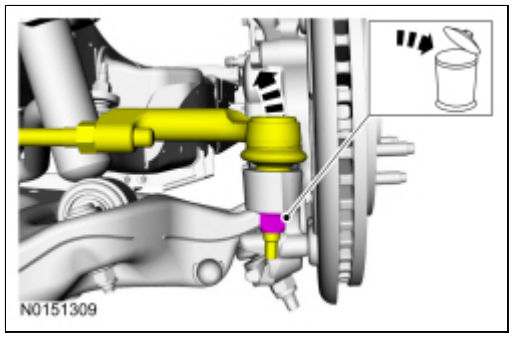
Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

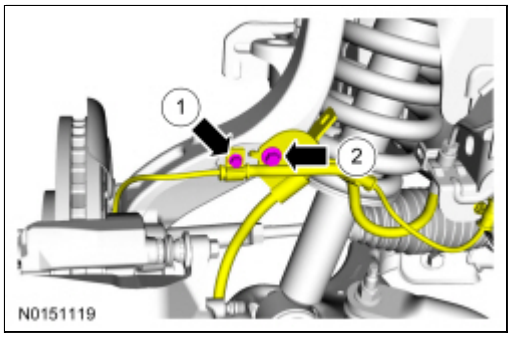
1. Remove the wheel and tire. Refer to Section 204-04 .
2. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

   NOTICE: **Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.**

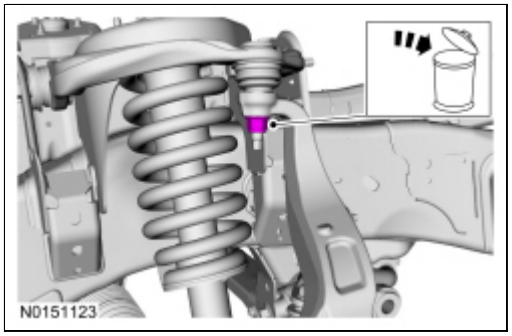
   General Equipment: Tie-rod Separator.

   
   N0151309
3.

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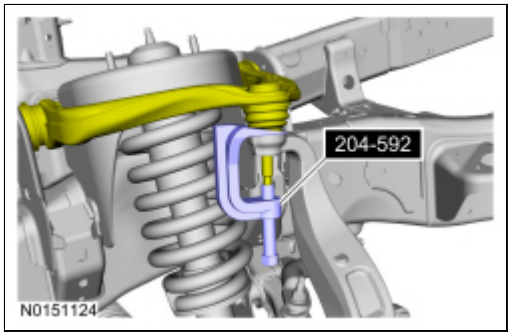


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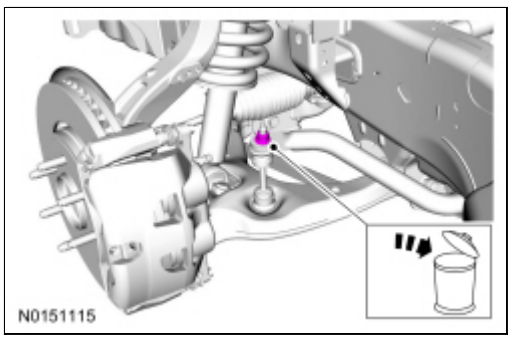


5. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

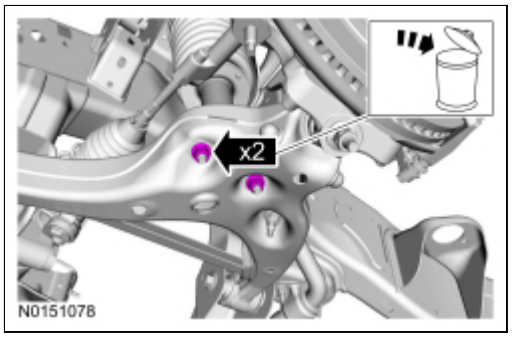
   Special Tool(s): Separator, Ball Joint 204-592.



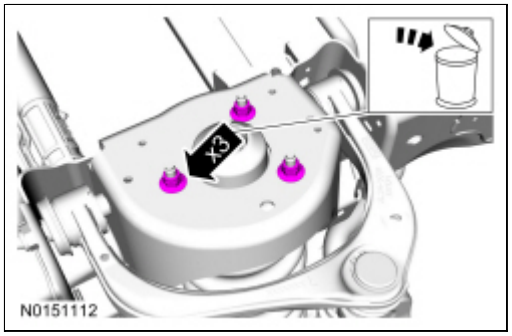
6. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



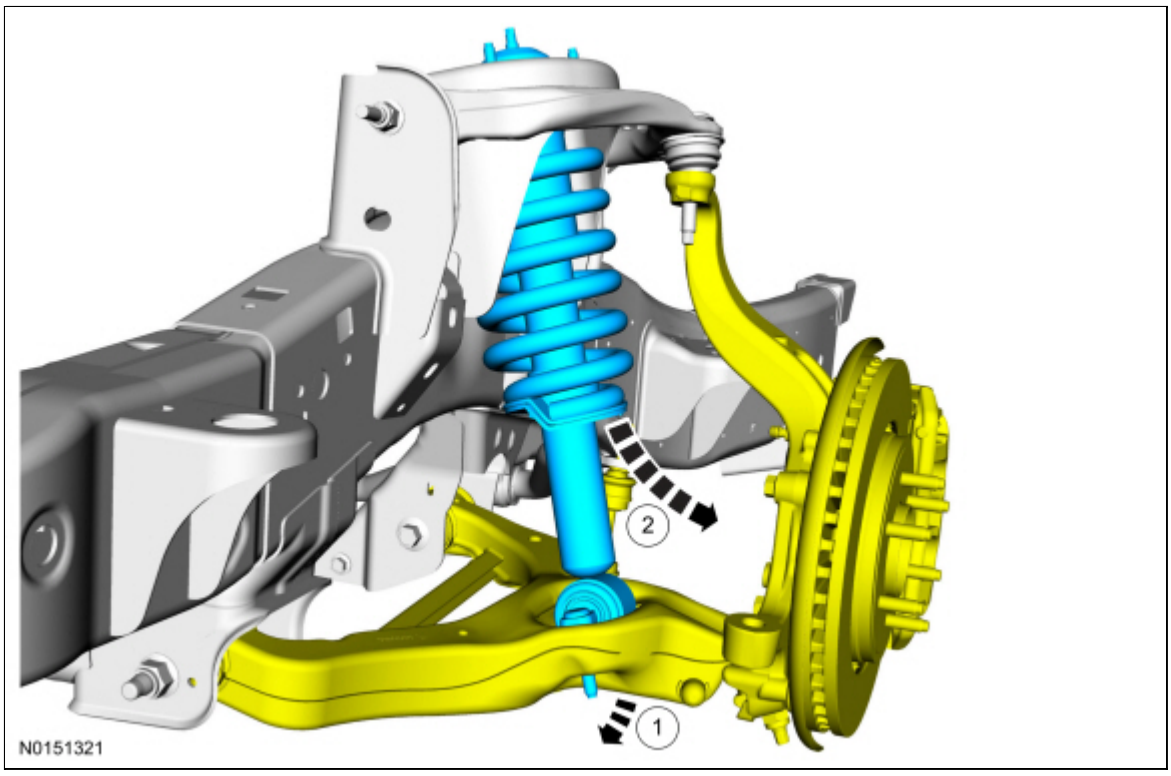
7.



8.



9.

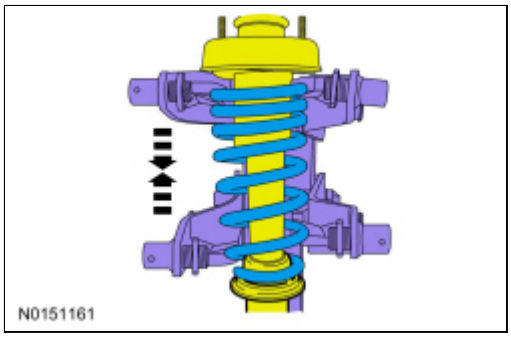


10. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

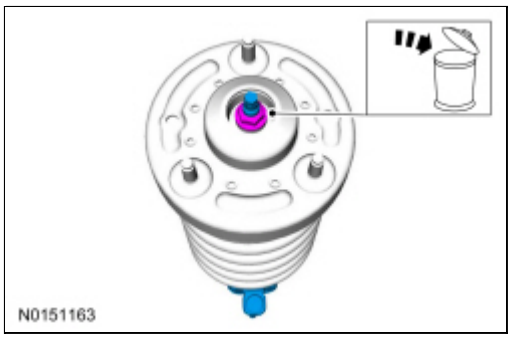
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NOTE: For reference during assembly, index the upper mount, spring and shock absorber.

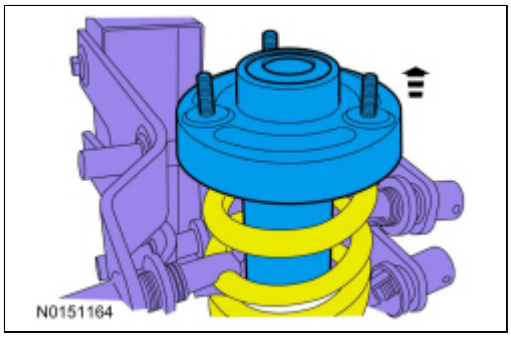
Compress the spring until the tension is released from the shock absorber.
General Equipment: Spring Compressor.



11. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

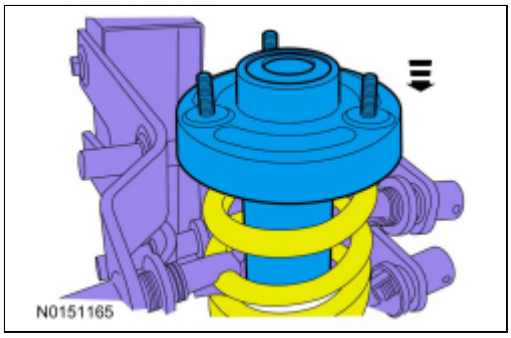


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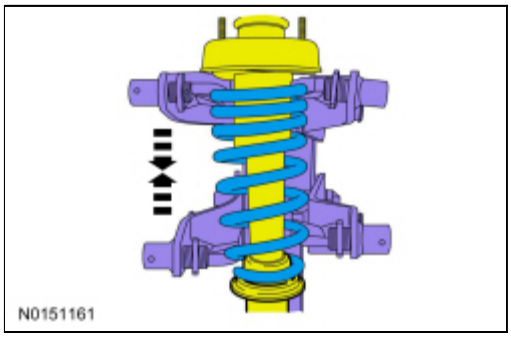
Installation

1.



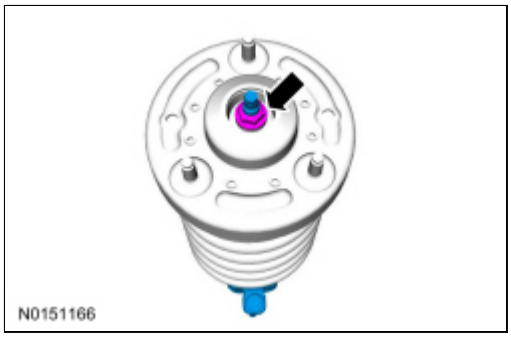
2. **NOTE:** Align the index marks made during disassembly.

   Compress the spring until the tension is released from the shock absorber.
   General Equipment: Spring Compressor.



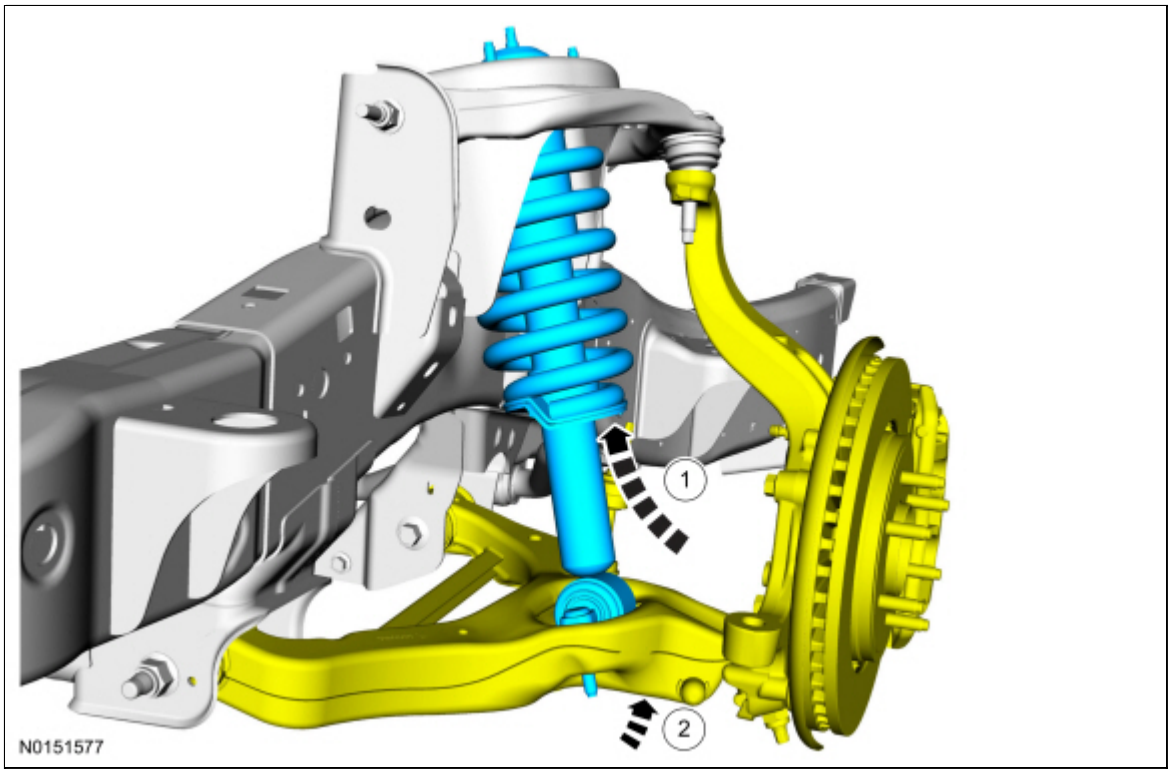
3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

   While holding the shock rod, install the new shock absorber and the shock rod nut.
   - Tighten to 55 Nm (41 lb-ft).



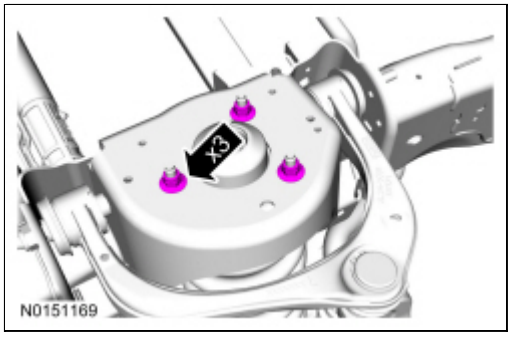
4.

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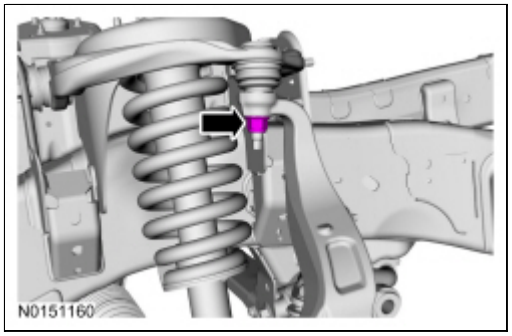
5.

- Tighten to 63 Nm (46 lb-ft).



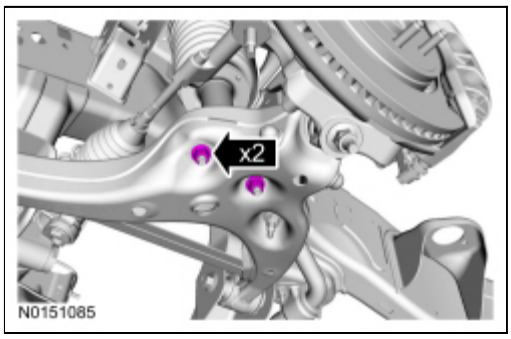
6.

- Tighten to 115 Nm (85 lb-ft).



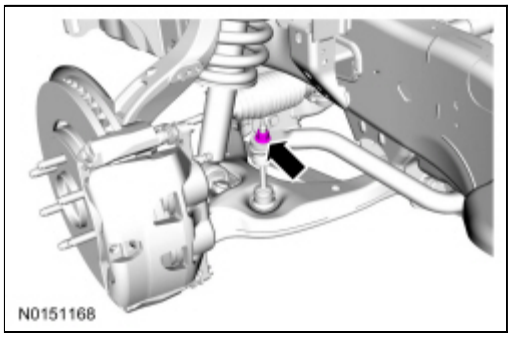
7.

- Tighten to 90 Nm (66 lb-ft).



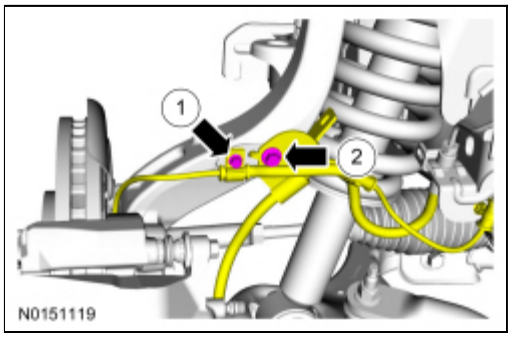
8. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

    - Tighten to 70 Nm (52 lb-ft).



9.

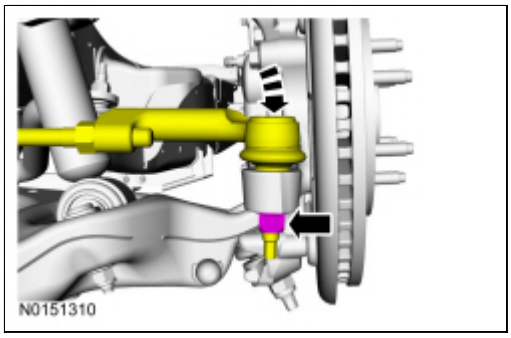
    - Tighten to 12 Nm (106 lb-in).



10.

    - Tighten to 115 Nm (85 lb-ft).

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11. Install the wheel and tire. Refer to Section 204-04 .

Stabilizer Bar and Link

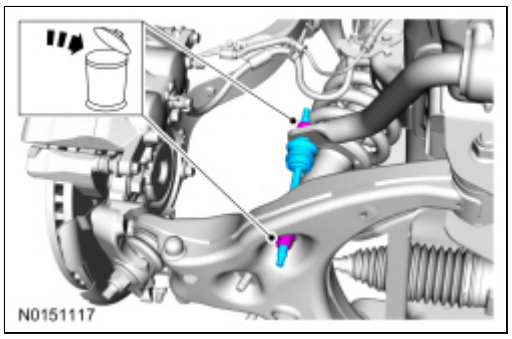
Removal and Installation

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

2. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

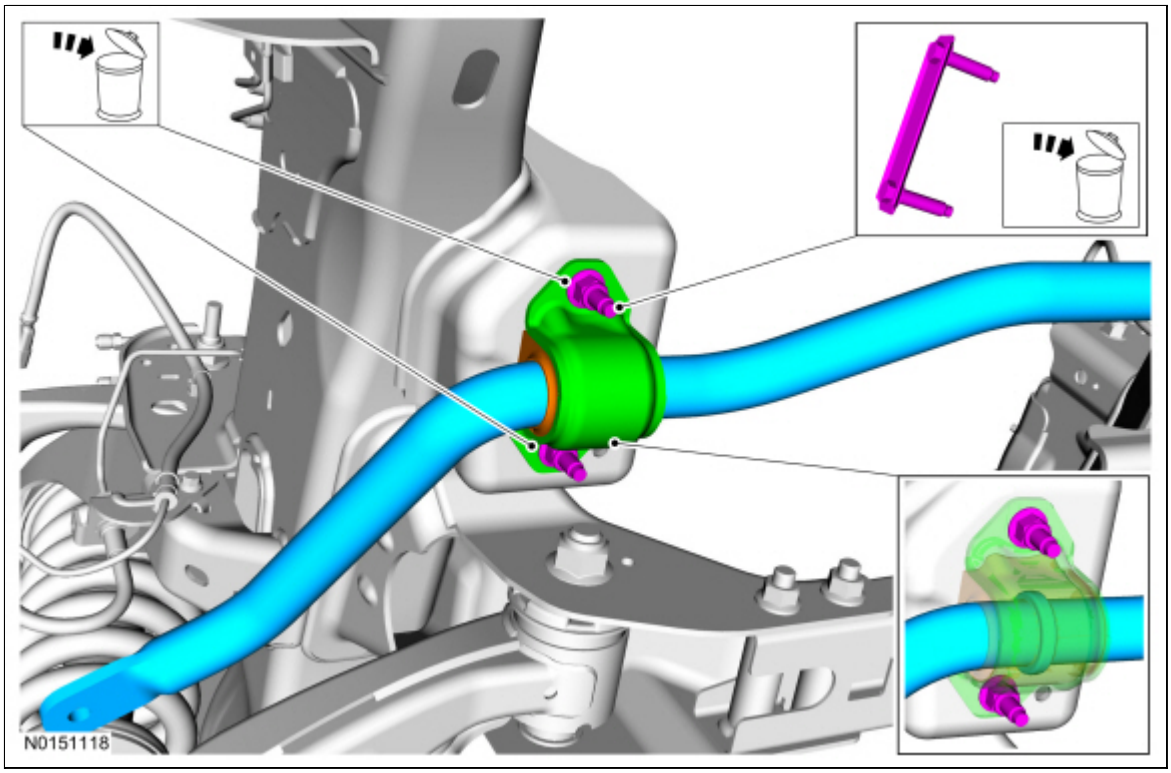
   On both sides.
   - To install, tighten to 70 Nm (52 lb-ft).



3. ***NOTICE:*** **The raised ring on the stabilizer bar must be encapsulated inside the inner groove of the stabilizer bar bushing on the driver side of the vehicle for proper installation.**

   On both sides.
   - To install, tighten to 63 Nm (46 lb-ft).

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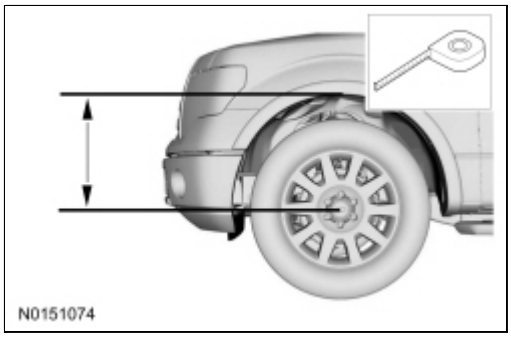
4. Inspect and, if necessary, install new stabilizer bar bushings.
5. To install, reverse the removal procedure.

Upper Arm

Removal

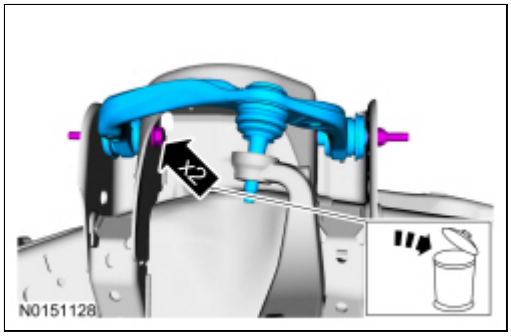
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



2. Remove the shock absorber and spring assembly. Refer to Shock Absorber and Spring Assembly .

3.

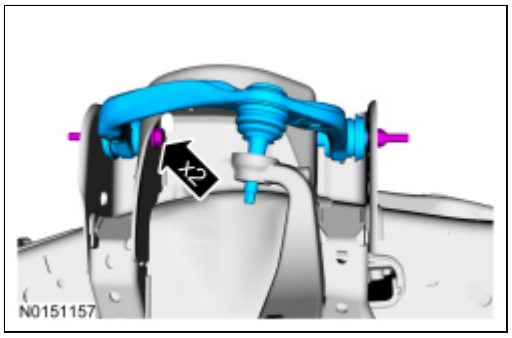


Installation

1. ***NOTICE:*** **Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.**

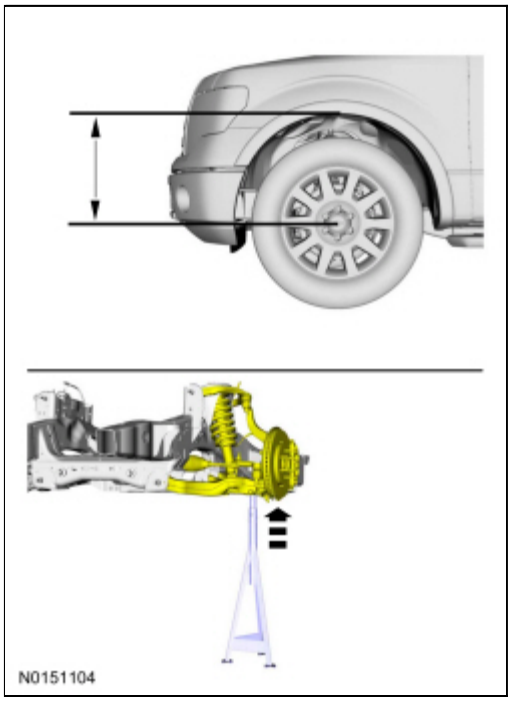
   Finger tight at this stage.

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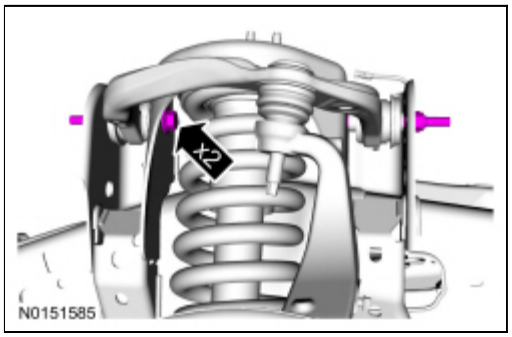


2. Install the shock absorber and spring assembly. Refer to Shock Absorber and Spring Assembly .

3. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



4.
   - Tighten to 150 Nm (111 lb-ft).



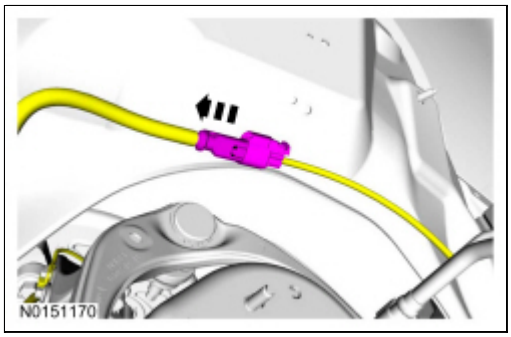
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Wheel Bearing and Wheel Hub

Removal and Installation

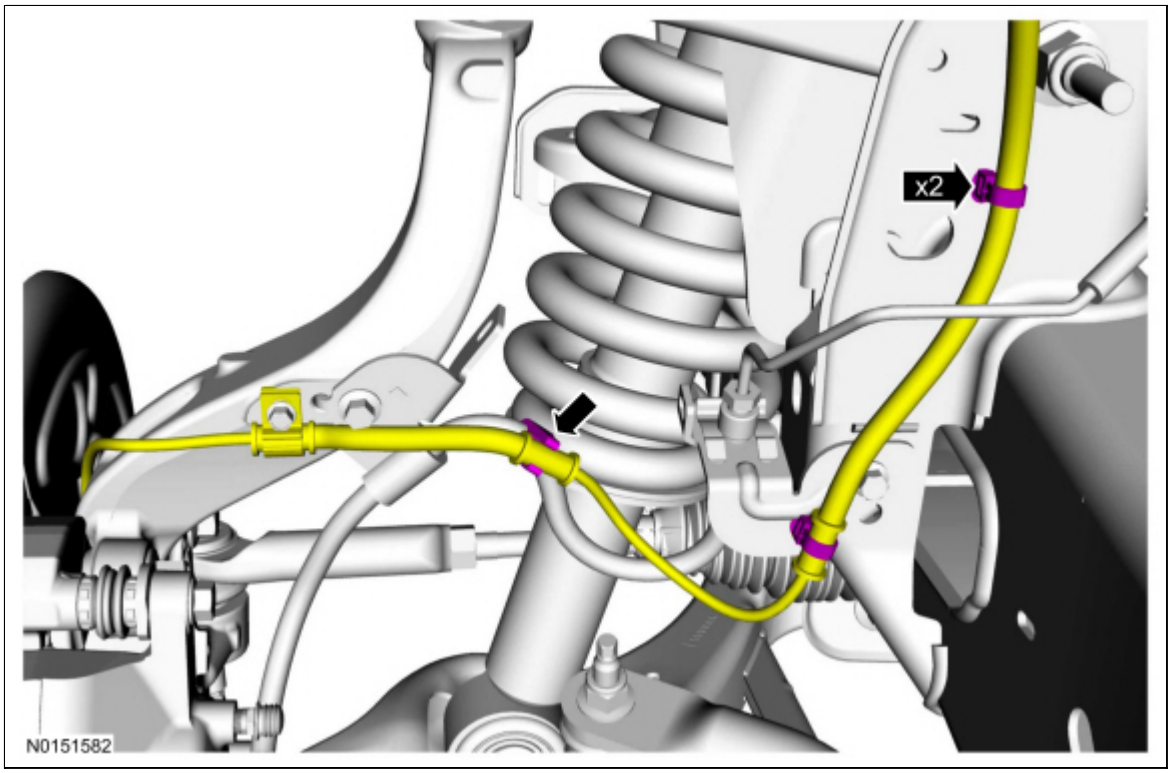
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



2. Remove the wheel and tire. Refer to Section 204-04 .

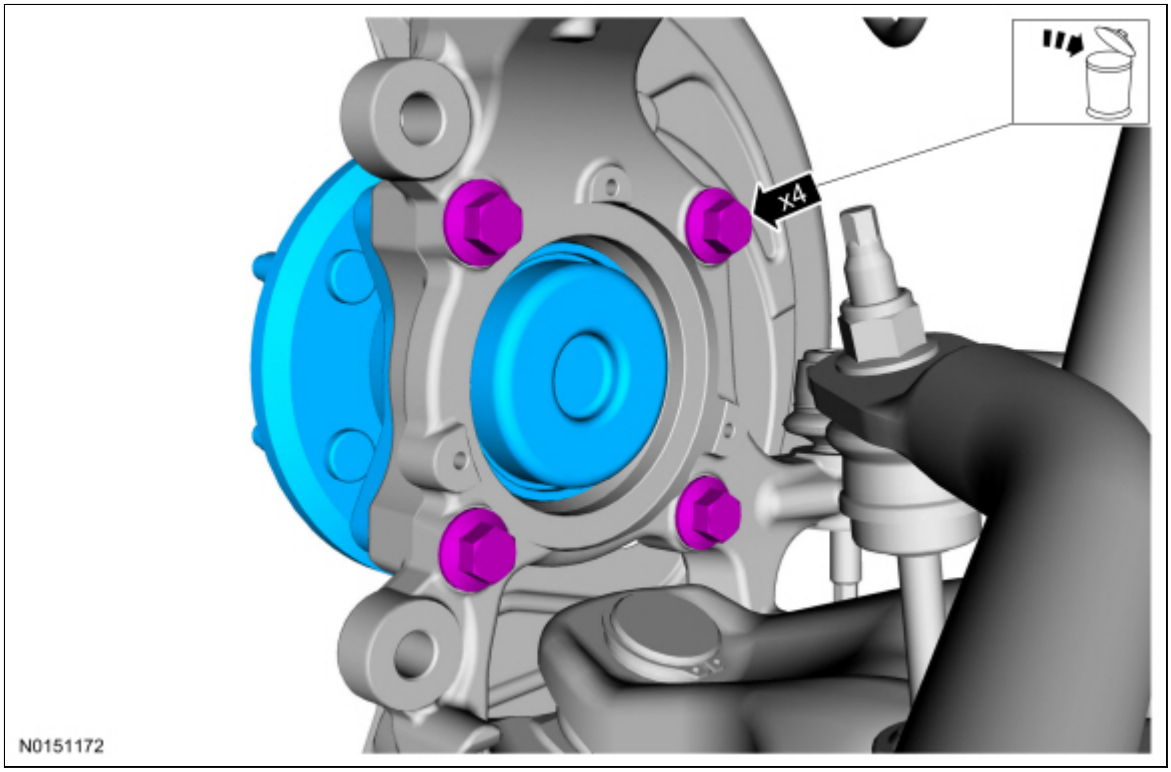
3.
   - To install, tighten to 12 Nm (106 lb-in).



4. Remove the brake disc. Refer to Section 206-03 .

5.

- To install, tighten to 175 Nm (129 lb-ft).



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6. To install, reverse the removal procedure.

Wheel Knuckle

Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

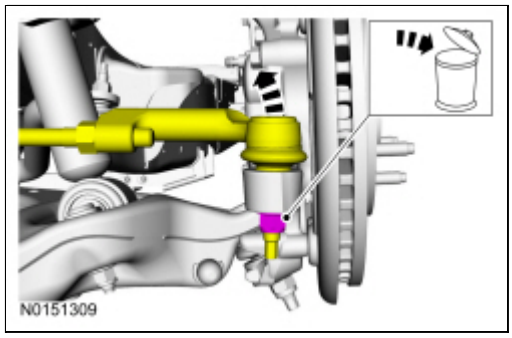
Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

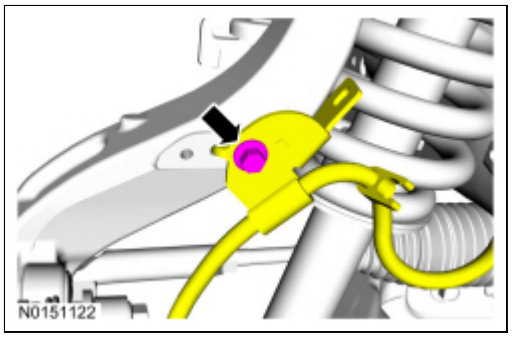
1. Remove the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .
2. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

   NOTICE: **Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.**

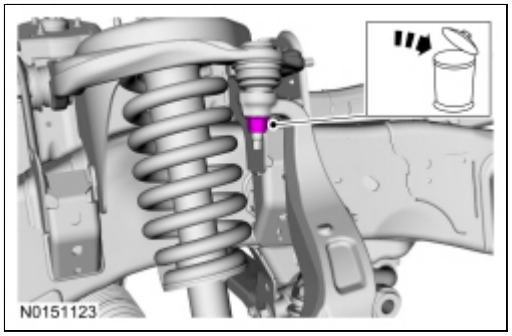
   General Equipment: Tie-rod Separator.

   
   N0151309
3.

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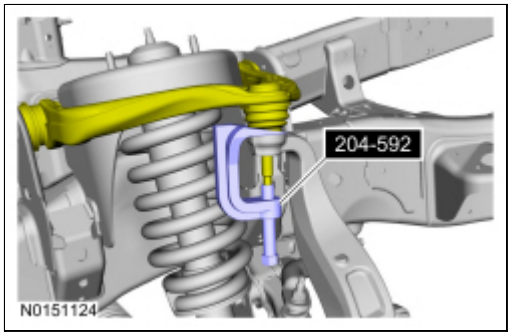


4.

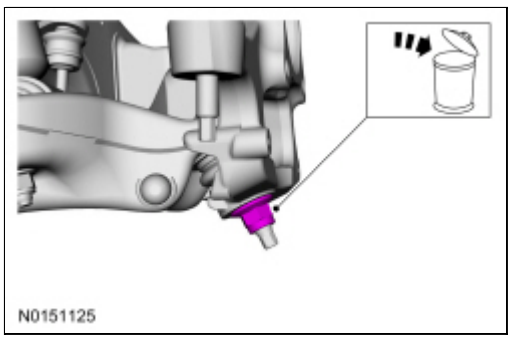


5. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

   Special Tool(s): Separator, Ball Joint 204-592.



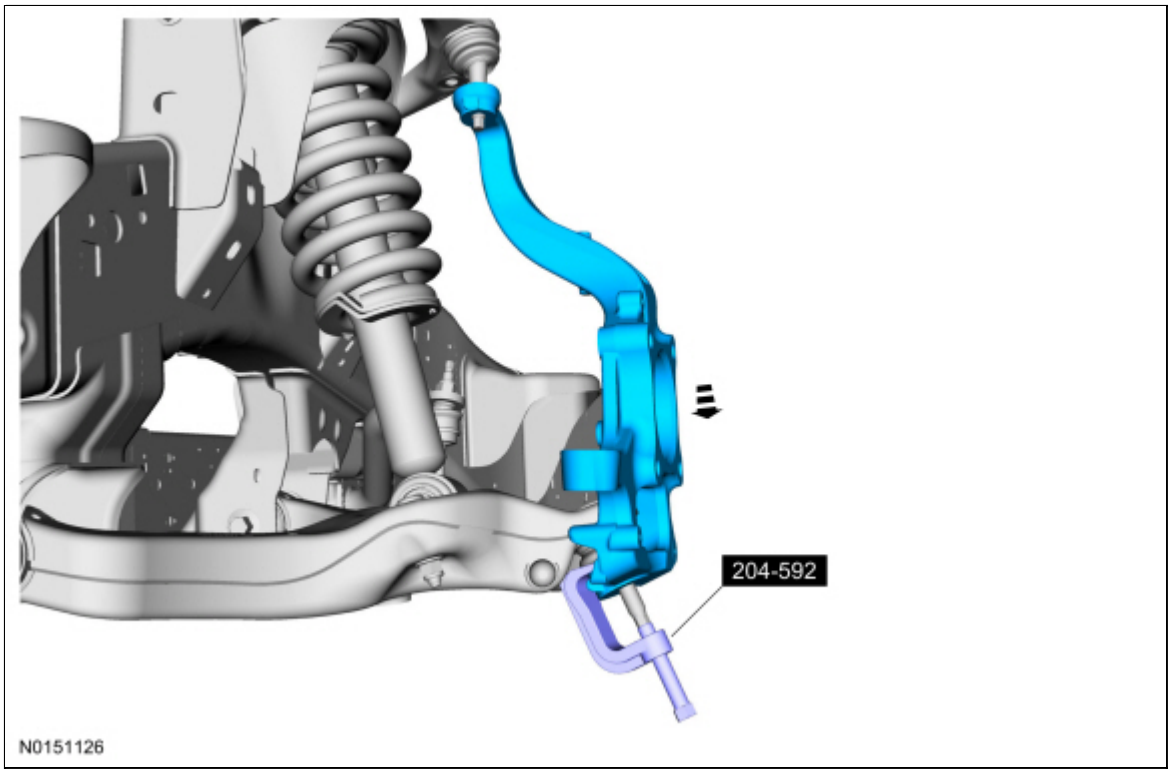
6.



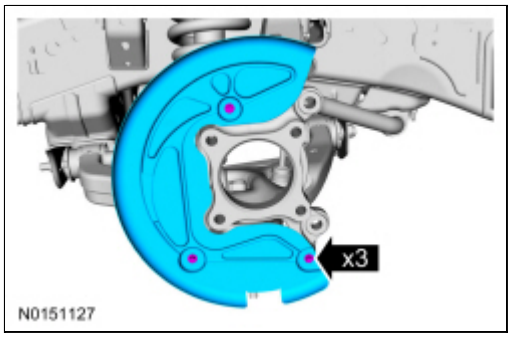
7. ***NOTICE:*** **Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.**

NOTICE: **Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.**

Special Tool(s): Separator, Ball Joint 204-592.



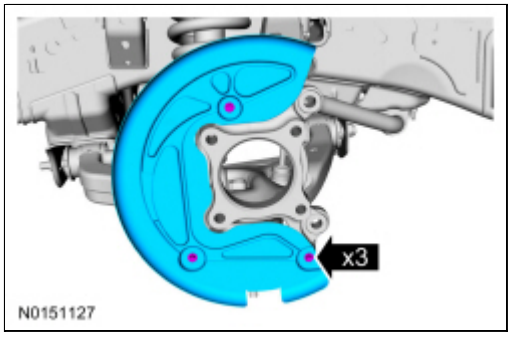
8. If necessary.



Installation

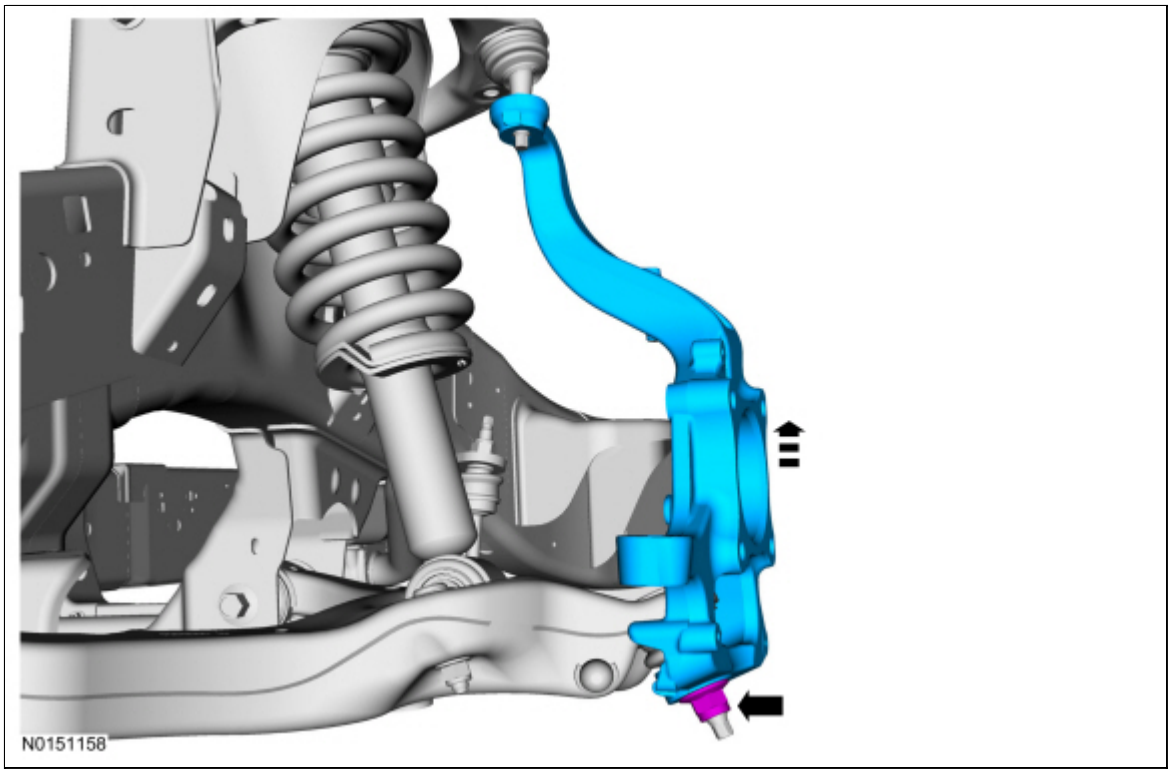
1. If necessary.
    - Tighten to 17 Nm (150 lb-in).

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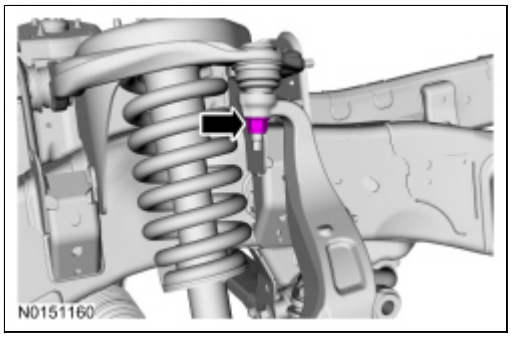
2.

- Tighten to 175 Nm (129 lb-ft).



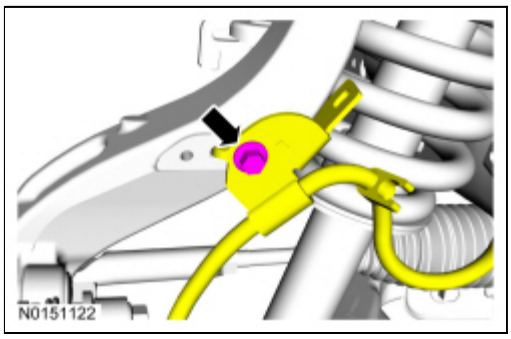
3.

- Tighten to 115 Nm (85 lb-ft).

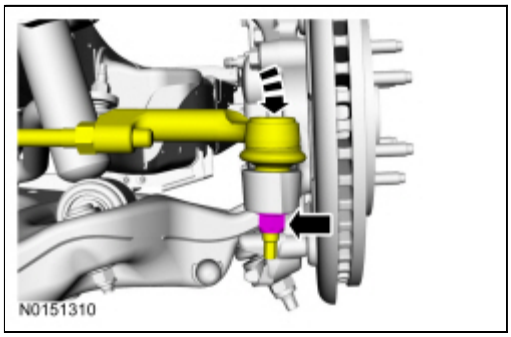


4.

- Tighten to 12 Nm (106 lb-in).



5.
   - Tighten to 115 Nm (85 lb-ft).



6. Install the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

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Wheel Studs

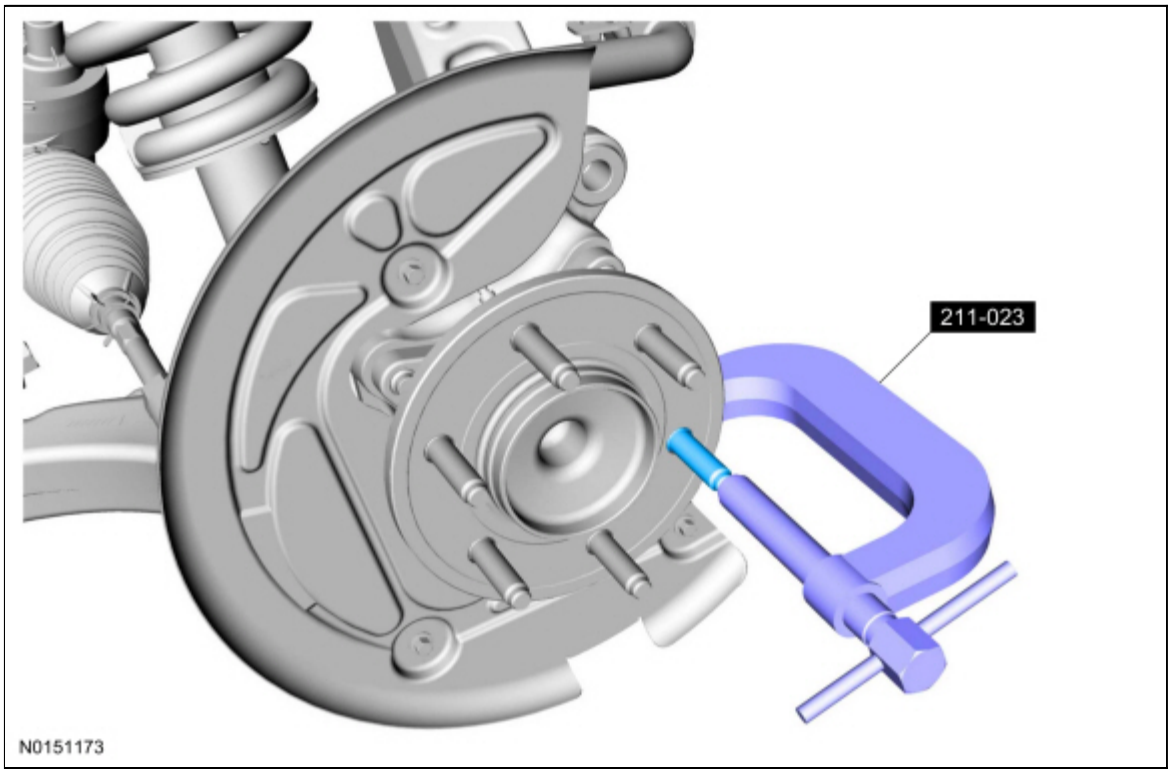
Special Tool(s)

 ST1494-A	Installer/Remover, C-Frame and Screw 211-023 (T74P-3044-A1)

Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

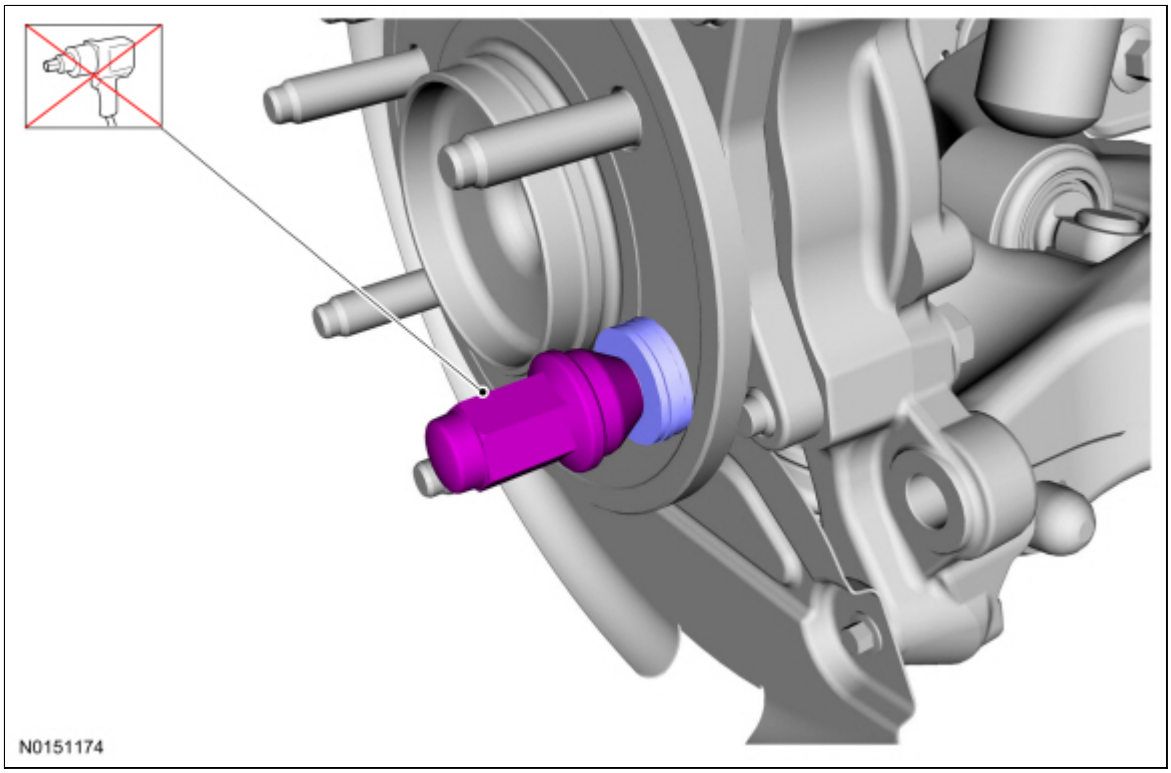
1. Remove the brake disc. Refer to Section 206-03 .
2. Special Tool(s): Installer/Remover, C-Frame and Screw 211-023.



Installation

1. **NOTE:** Make sure to use washers that have an ID that is larger than the OD of the wheel stud serrations. Use enough washers (approximately 3 to 4) to allow the wheel stud to fully seat against the hub flange.

    - Tighten the wheel nut until the wheel stud is seated against the hub flange.
    - Discard the wheel nut.



2. Install the brake disc. Refer to Section 206-03 .

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Material

Item	Specification	Fill Capacity
Motorcraft® Metal Brake Parts Cleaner (US) / Motorcraft® Brake Parts Cleaner (Canada) PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake disc shield bolts	17	—	150
Brake hose bracket bolt	12	—	106
Halfshaft nut	40	30	—
Integrated Wheel End (IWE) bolts	12	—	106
Lower arm forward and rearward nuts	350	258	—
Lower ball joint nut	175	129	—
Shock absorber lower nut (SVT Raptor)	550	406	—
Shock absorber lower nuts	90	66	—
Shock absorber upper mount nuts	63	46	—
Shock rod nut	55	41	—
Skid plate bolts	48	35	—
Stabilizer bar bracket nuts	55	41	—
Stabilizer bar link nuts	70	52	—
Stabilizer bar link nuts (SVT Raptor)	80	59	—
Tie-rod end nut	115	85	—
Upper arm-to-frame nuts	150	111	—
Upper ball joint nut	115	85	—
Wheel bearing and wheel hub bolts	175	129	—
Wheel speed sensor bolt	18	—	159
Wheel speed sensor harness bracket bolt	12	—	106

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Front Suspension

The Four-Wheel Drive (4WD) front suspension consists of the following components:

- Ball joints
- Coil springs
- Lower control arms
- Shock absorbers
- Stabilizer bar and links
- Upper control arms
- Wheel bearing and wheel hubs
- Wheel knuckles
- Wheel studs

The vehicle is equipped with a front coil spring suspension. This independent-type front suspension utilizes a stabilizer bar to aid in vehicle stability. The wheel hub and wheel bearing are sealed units and are serviced as an assembly. The lower ball joints can be serviced independently from the lower arm.

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Front Suspension

Refer to Section 204-00 .

Shock Absorber and Spring Assembly — SVT Raptor

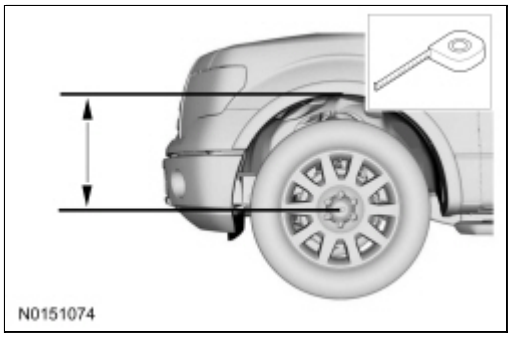
Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

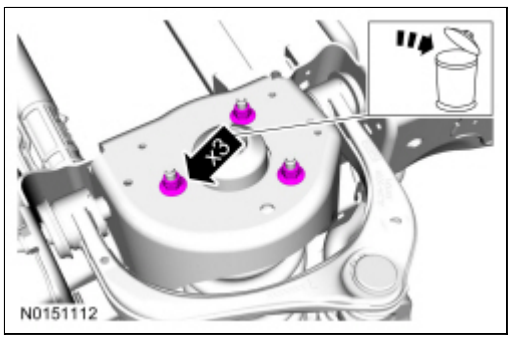
Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).

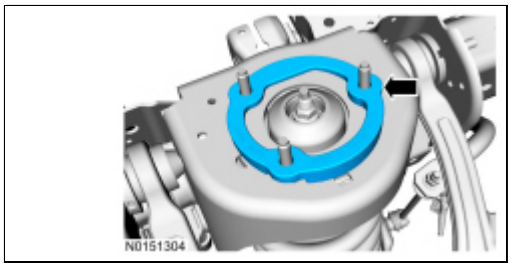


2.



3.

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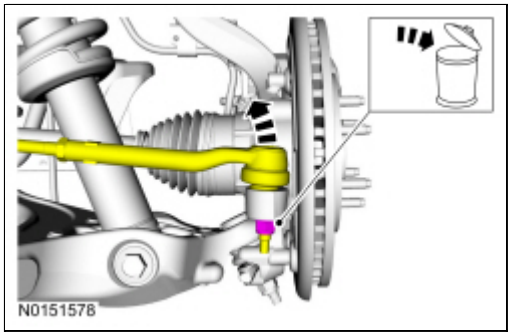


4. Remove the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

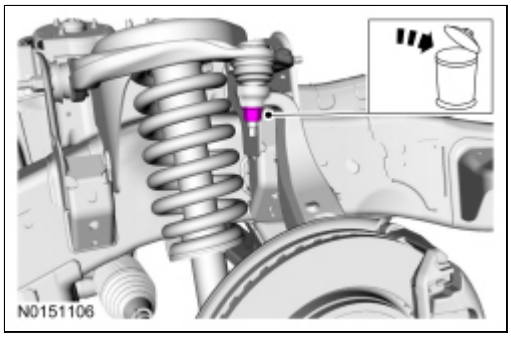
5. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

   NOTICE: **Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.**

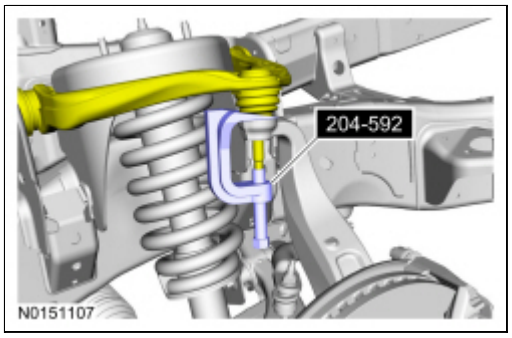
   General Equipment: Tie-rod Separator.



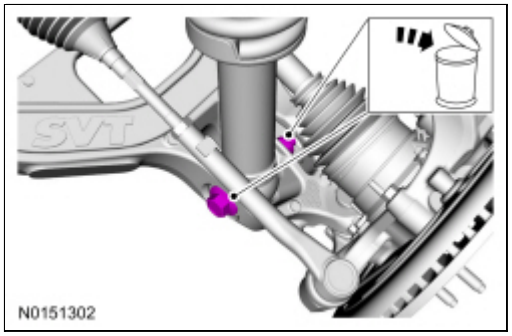
6.



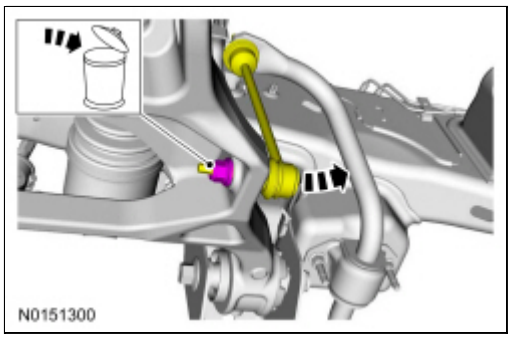
7. Special Tool(s): Separator, Ball Joint 204-592.



8.

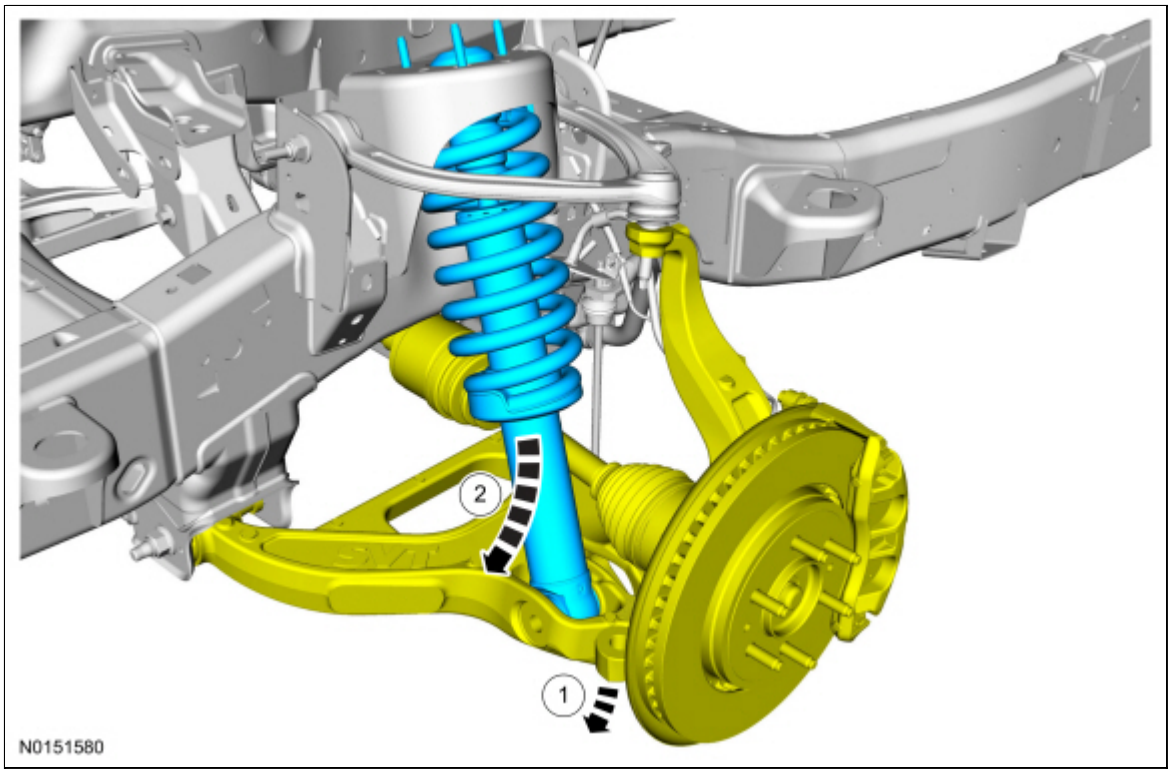


9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

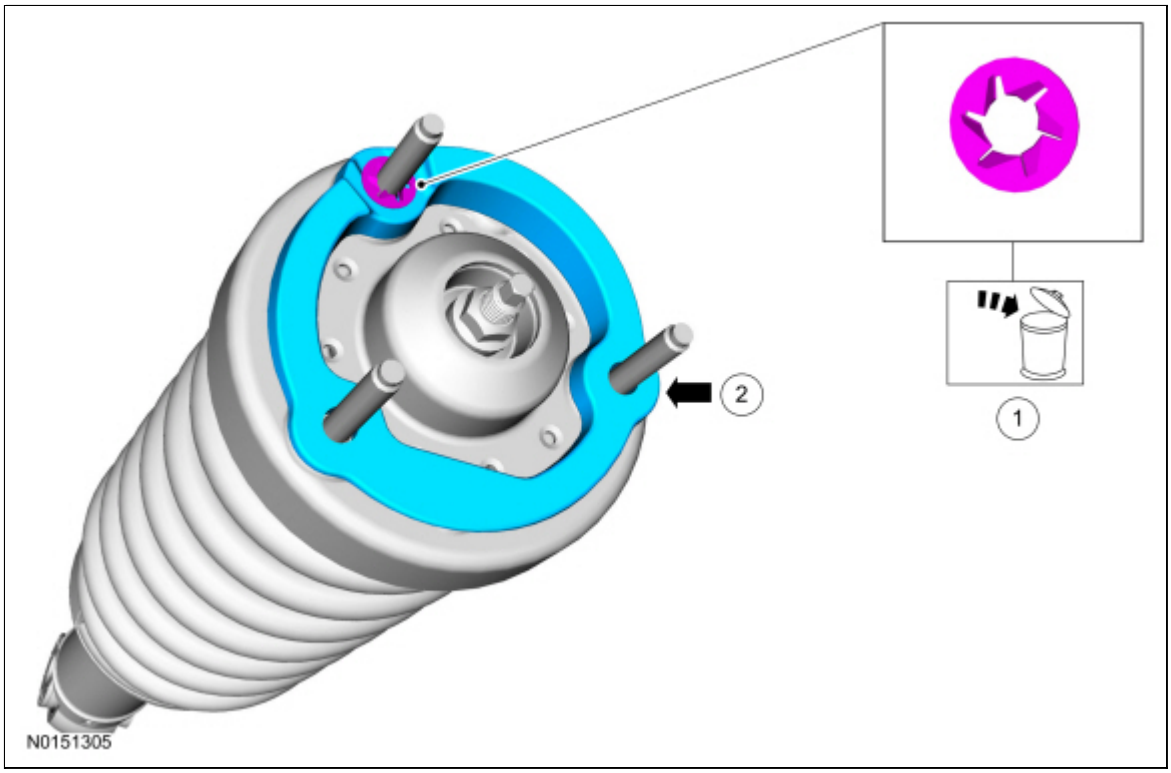


10. **NOTE:** SVT Raptor similar.

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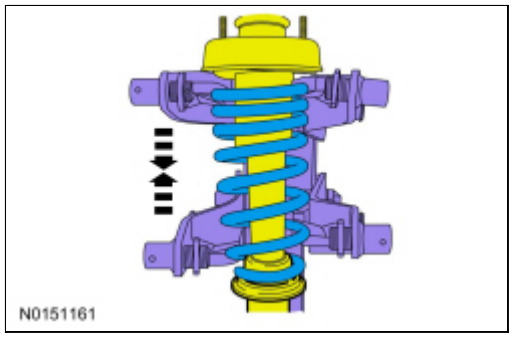
11.



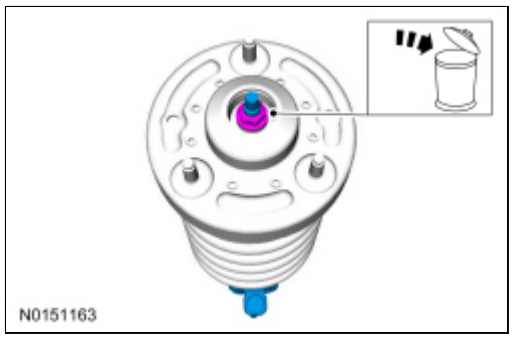
12. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

NOTE: For reference during assembly, index the upper mount, spring and shock absorber.

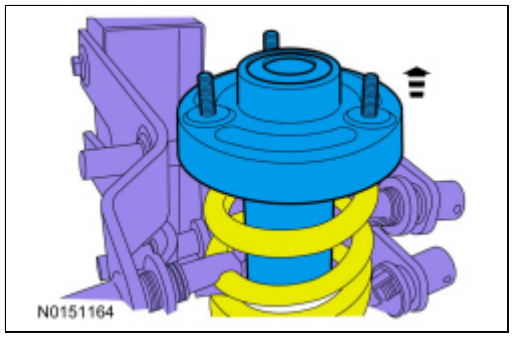
Compress the spring until the tension is released from the shock absorber.
General Equipment: Spring Compressor.



13. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.



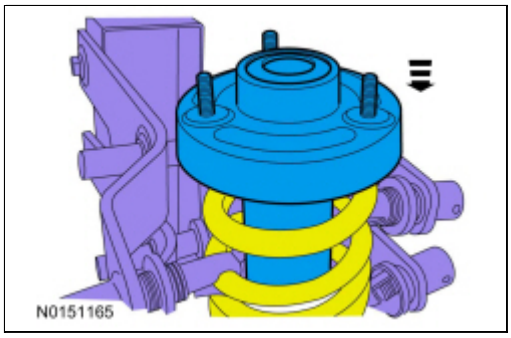
14.



Installation

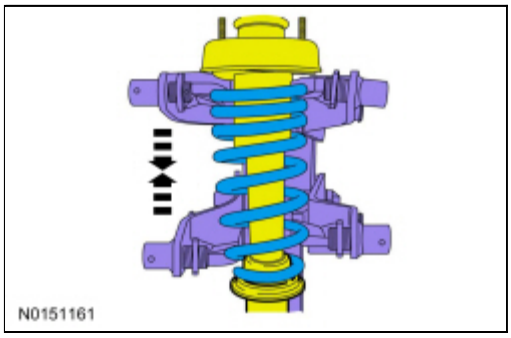
1.

repair4less



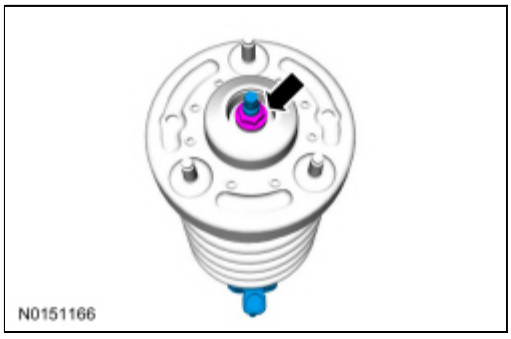
2. **NOTE:** Align the index marks made during disassembly.

   Compress the spring until the tension is released from the shock absorber.
   General Equipment: Spring Compressor.

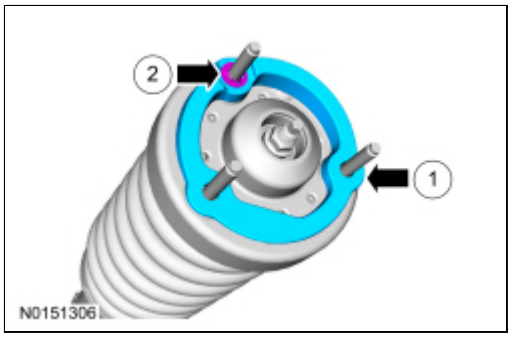


3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

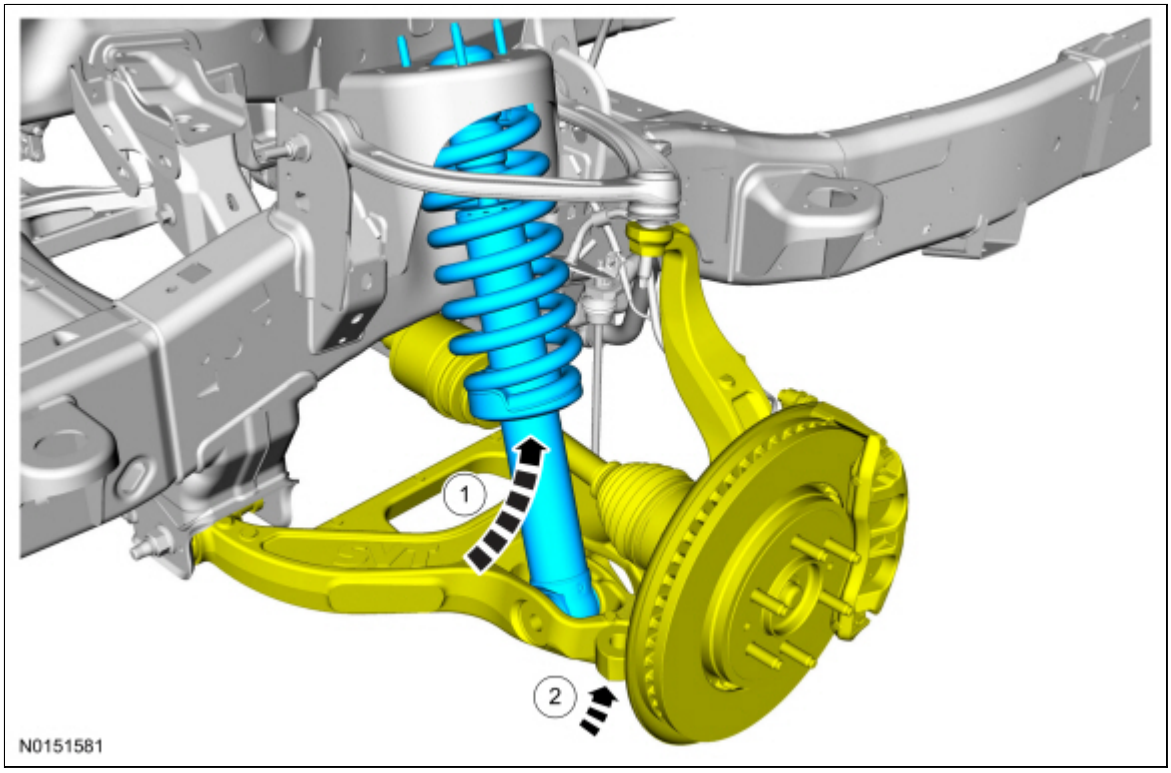
   - Tighten to 55 Nm (41 lb-ft).



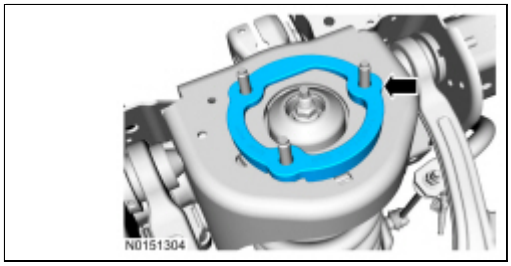
4.



5. **NOTE:** SVT Raptor similar



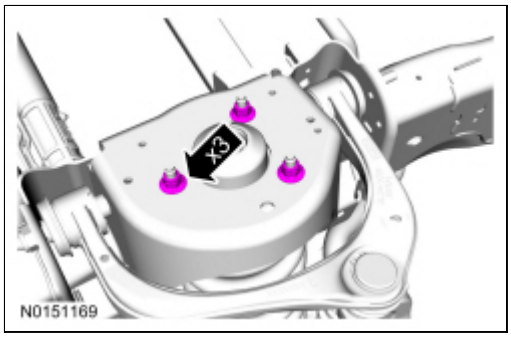
6.



7.

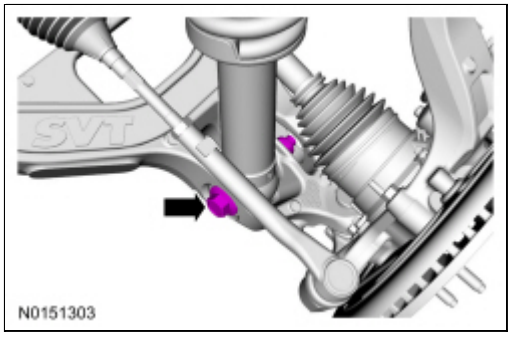
- Tighten to 40 Nm (30 lb-ft).

repair4less



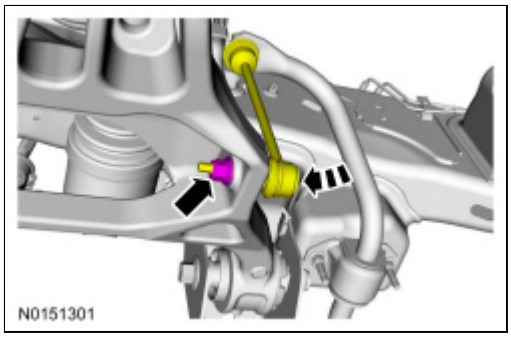
8. ***NOTICE:*** **SVT Raptor: Do not tighten the lower shock nut until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies or incorrect clamp load and bushing damage may occur.**

   Finger tight at this stage.



9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

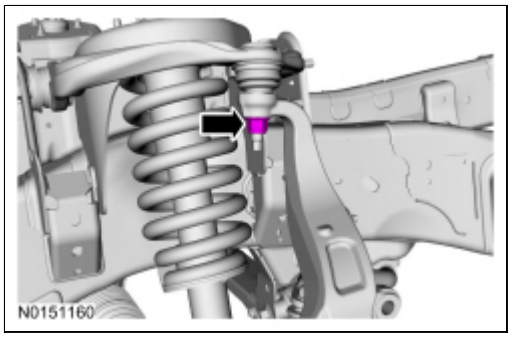
   - Tighten to 80 Nm (59 lb-ft).



10. Install the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

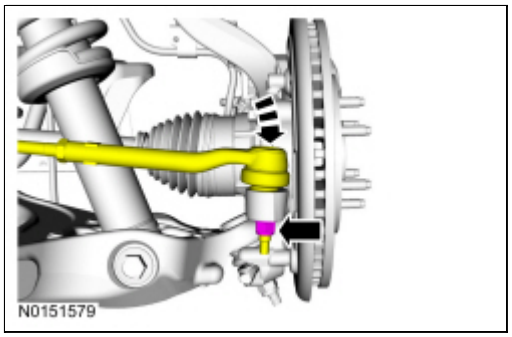
11.

    - Tighten to 115 Nm (85 lb-ft).

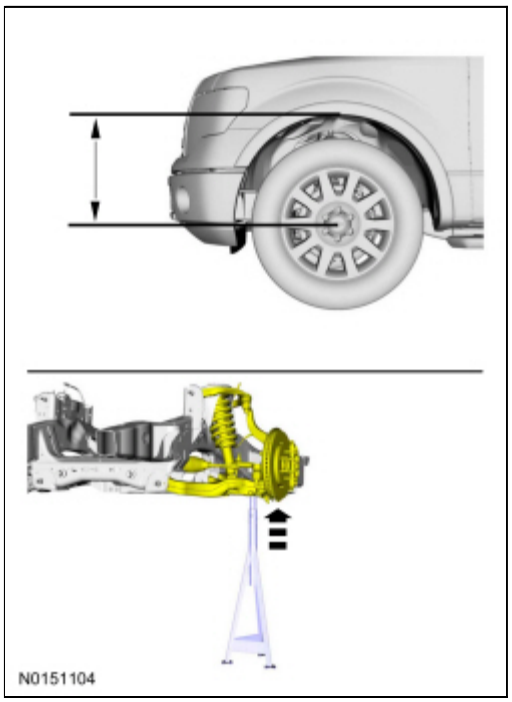


12.

- Tighten to 115 Nm (85 lb-ft).



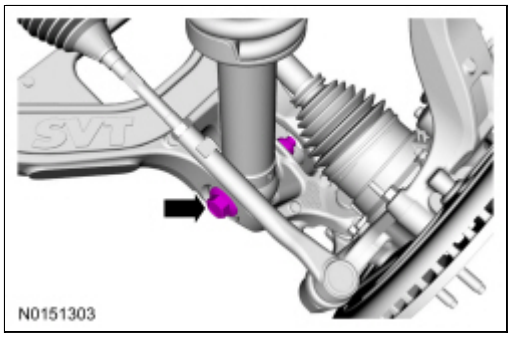
13. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



14.

- Tighten to 550 Nm (406 lb-ft).

repair4less


SVT
N0151303

Ball Joint — Lower

Special Tool(s)

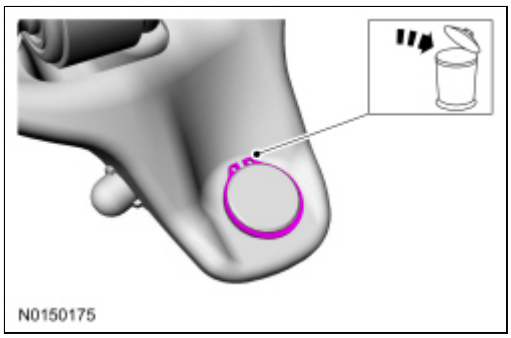
 ST2929-A	Installer/Remover, Ball Joint 204-358
 ST1172-A	Installer/Remover, C-Frame and Screw 205-086

Material

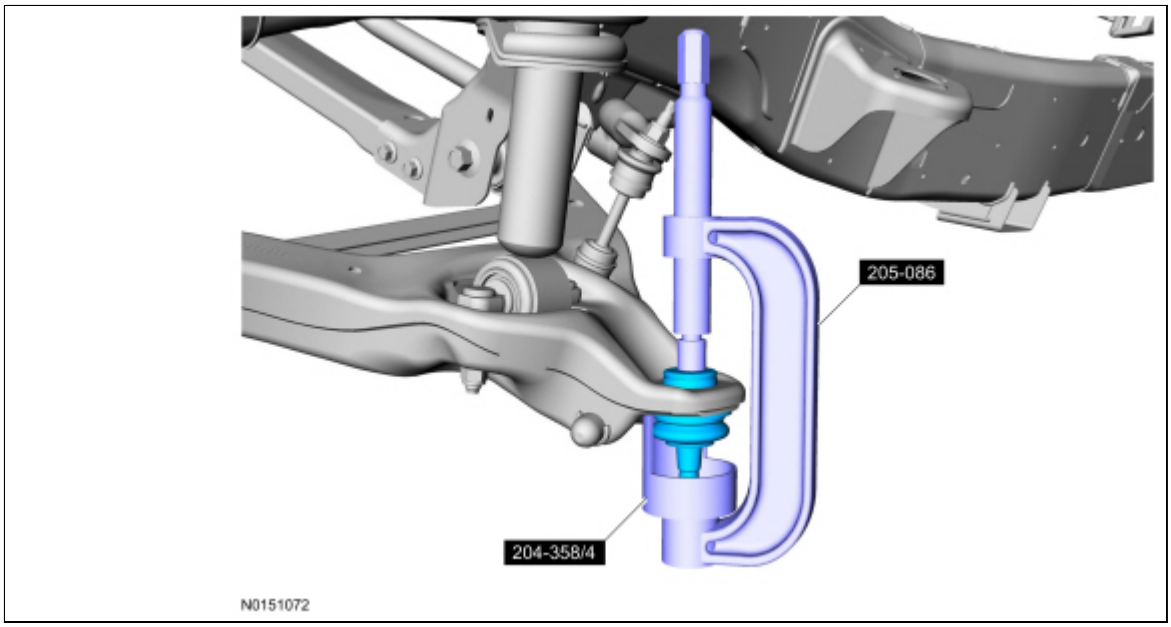
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—

Removal

All vehicles

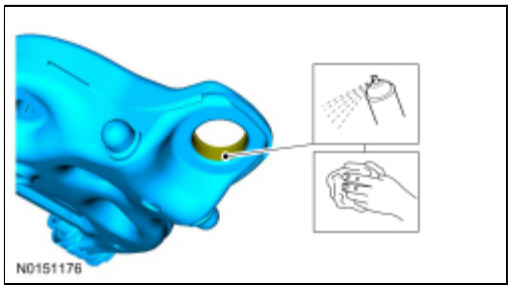
1. Remove the wheel knuckle. Refer to Wheel Knuckle .
2. 
N0150175
3. Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/4.

repair4less

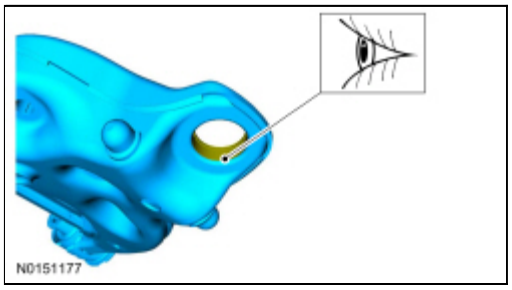


SVT Raptor

4. Materials: Motorcraft® Metal Surface Prep ZC-31-A.



5. ***NOTICE:*** **If there is evidence of cracks or damage, a new lower arm must be installed.**



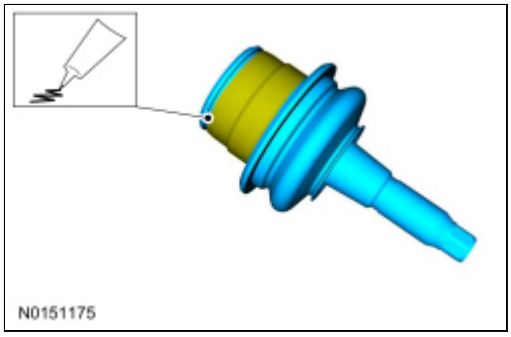
Installation

SVT Raptor

1. ***NOTICE:*** **Use care to prevent adhesive from contacting the ball joint boot or damage to the boot may occur, causing premature ball joint failure.**

   NOTE: To allow the adhesive to fully cure, the vehicle must not be driven on the road for at least one hour after the installation of a new ball joint.

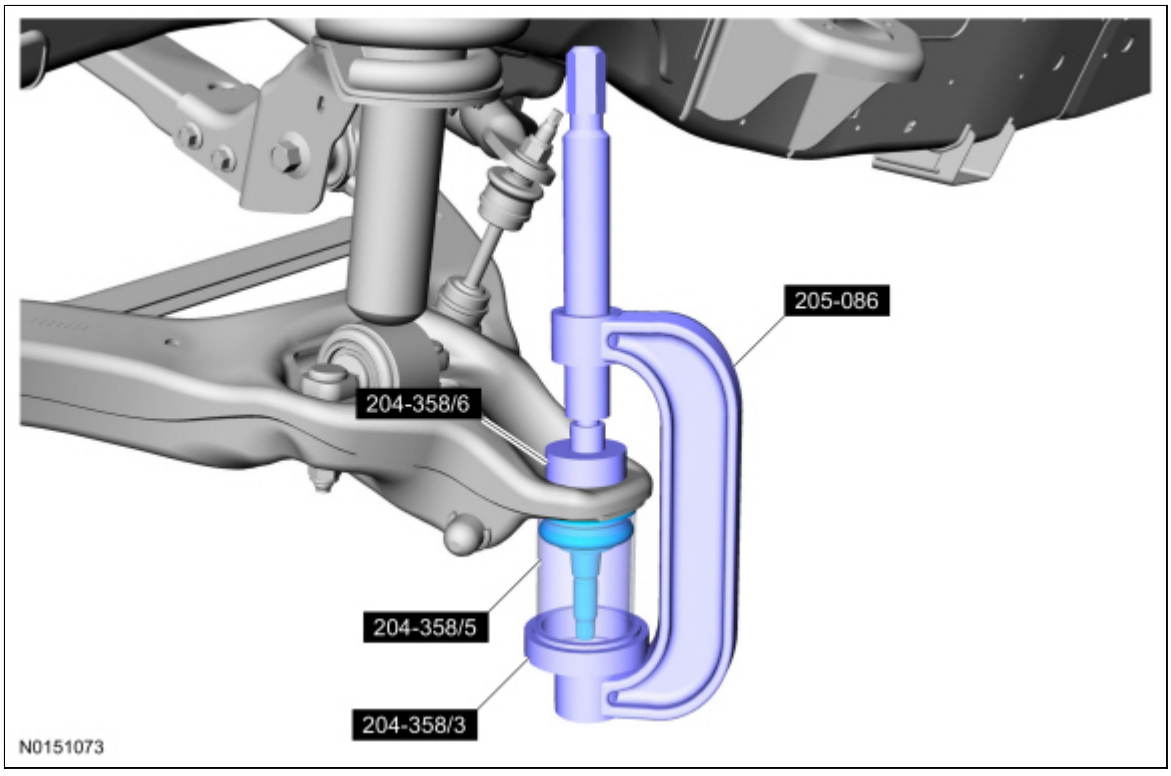
Materials: Adhesive (supplied with kit).



All vehicles

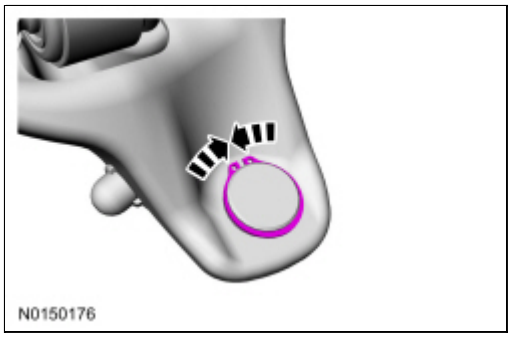
2. ***NOTICE:*** **Do not damage the lower ball joint boot when installing the C-Frame and Screw Installer/Remover and Ball Joint Installer/Remover or premature failure of the ball joint may occur.**

   Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/3. Remover, Ball Joint 204-358/5. Remover, Ball Joint 204-358/6.



3. **NOTE:** Make sure the ball joint snap ring is fully seated.

repair4less



SVT Raptor

4. Using a clean shop towel and the specified surface cleaner, wipe any excess adhesive from the ball joint and lower arm.

All vehicles

5. Install the wheel knuckle. Refer to Wheel Knuckle .

Lower Arm

Special Tool(s)

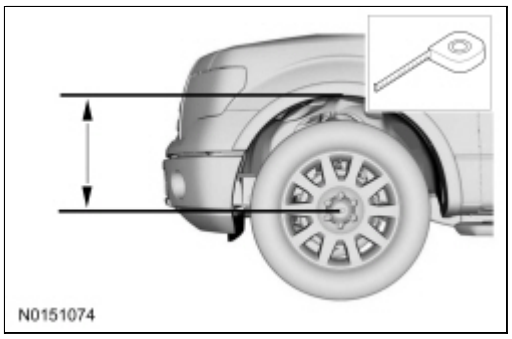
 ST2945-A	Separator, Ball Joint 204-592

Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

All vehicles

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).

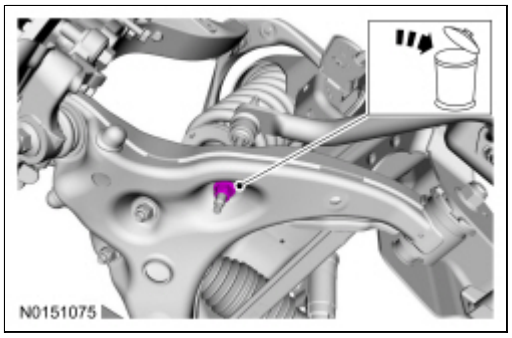


2. Remove the wheel and tire. Refer to Section 204-04 .

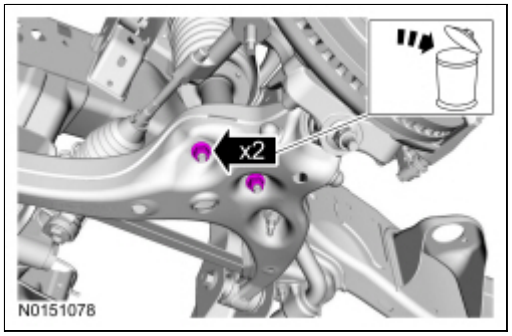
All except SVT Raptor

3. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

repair4less

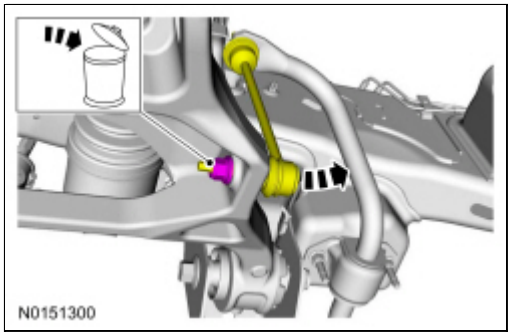


4.

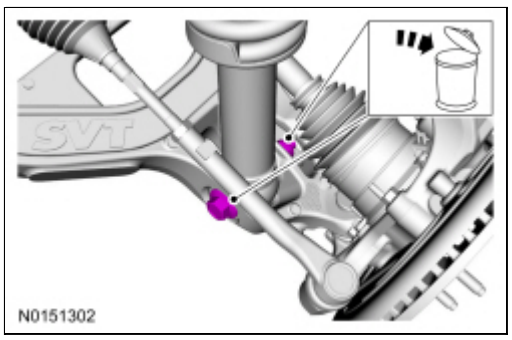


SVT Raptor

5. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

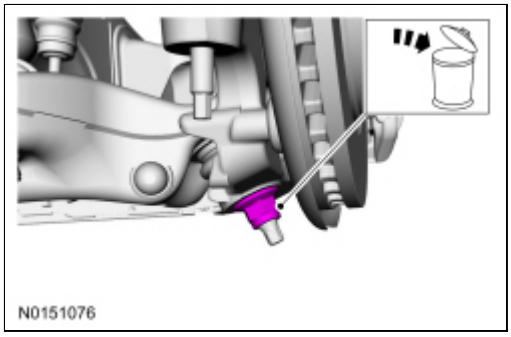


6.



All vehicles

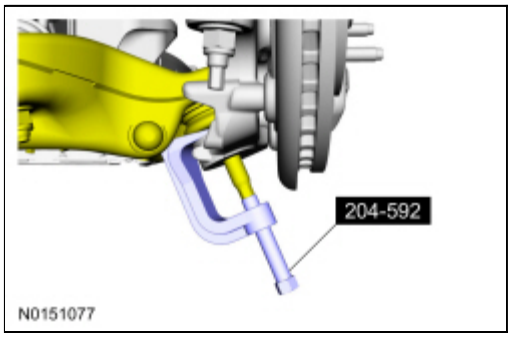
7.



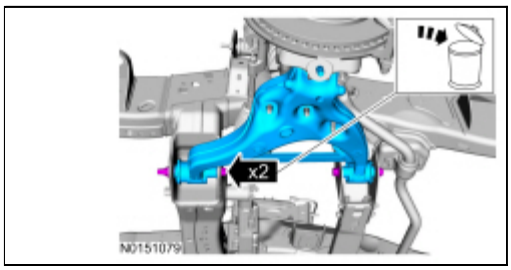
8. ***NOTICE:*** **Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.**

   NOTICE: **Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.**

   Special Tool(s): Separator, Ball Joint 204-592.



9.



Installation

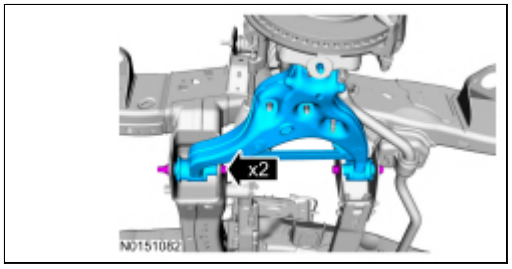
All vehicles

NOTICE: **SVT Raptor: Do not tighten the shock absorber lower nut, lower arm forward nut or lower arm rearward nut until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies.**

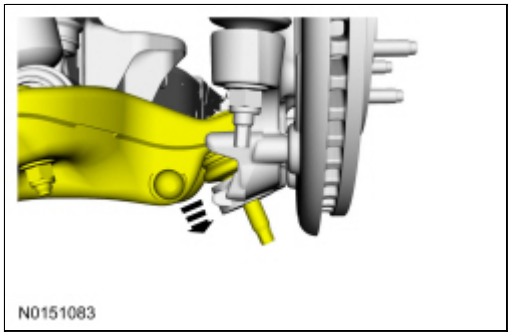
1. ***NOTICE:*** **Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.**

repair4less

Finger tight at this stage.

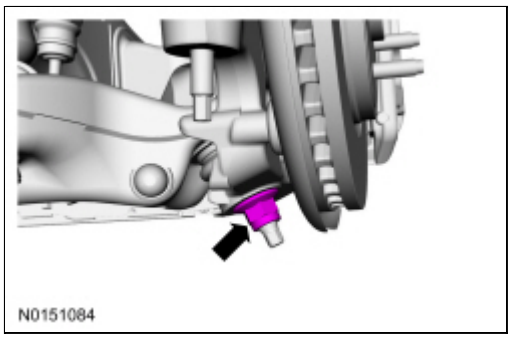


2.



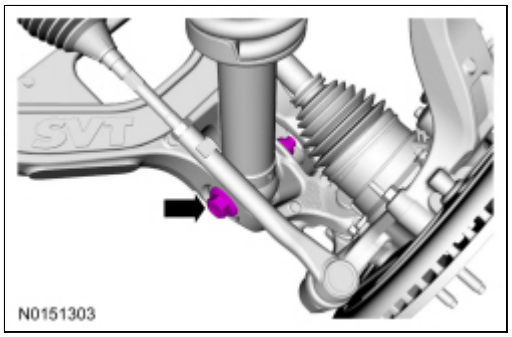
3.

- Tighten to 175 Nm (129 lb-ft).



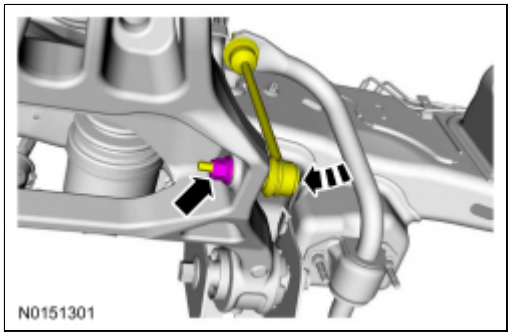
SVT Raptor

4. Finger tight at this stage.



5. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

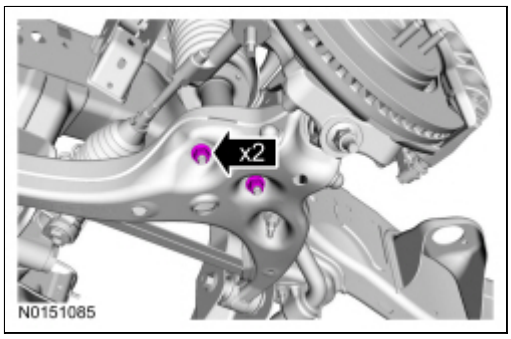
    - Tighten to 80 Nm (59 lb-ft).



All except SVT Raptor

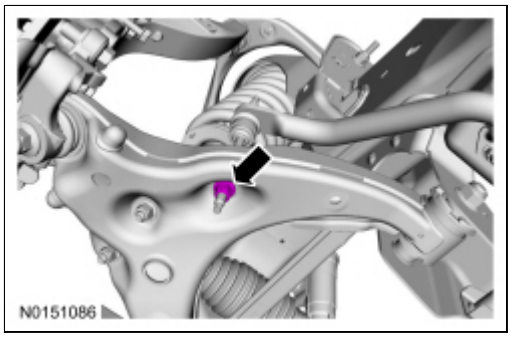
6.

    - Tighten to 90 Nm (66 lb-ft).



7. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

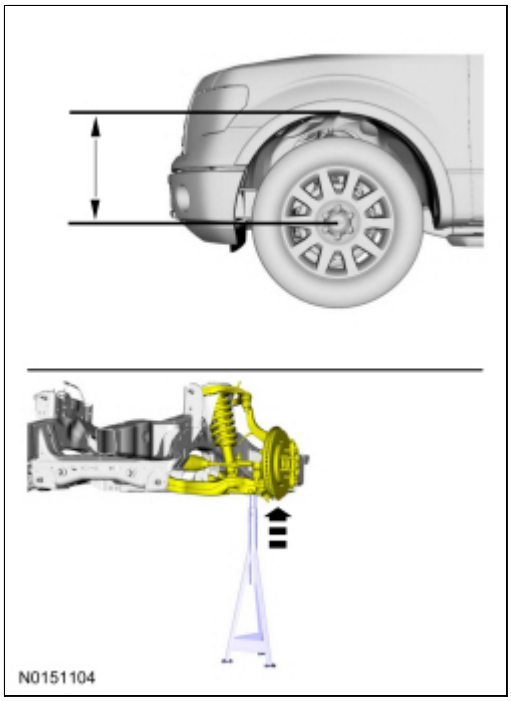
    - Tighten to 70 Nm (52 lb-ft).



All vehicles

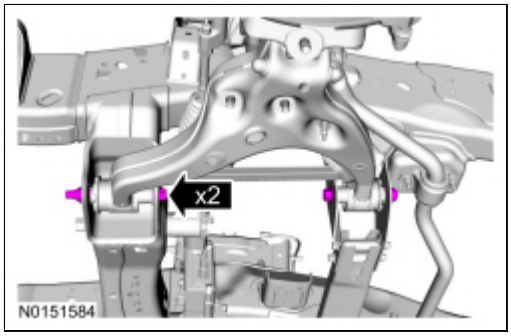
8. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).

repair4less



9.

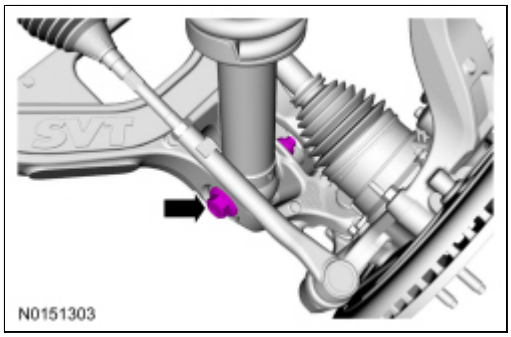
- Tighten to 350 Nm (258 lb-ft).



SVT Raptor

10.

- Tighten to 550 Nm (406 lb-ft).



All vehicles

11. Install the wheel and tire. Refer to Section 204-04 .

12. Check and, if necessary, align the front end. Refer to Section 204-00 .

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repair4less

Shock Absorber and Spring Assembly — SVT Raptor

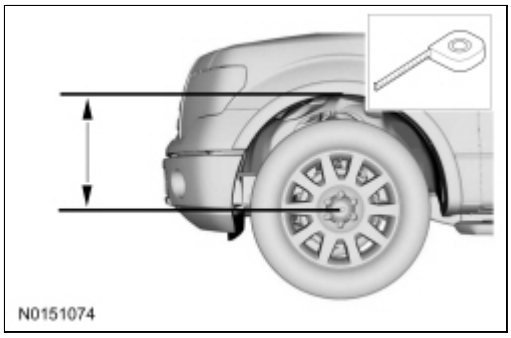
Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

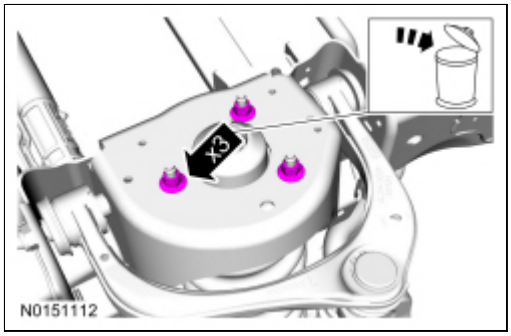
Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

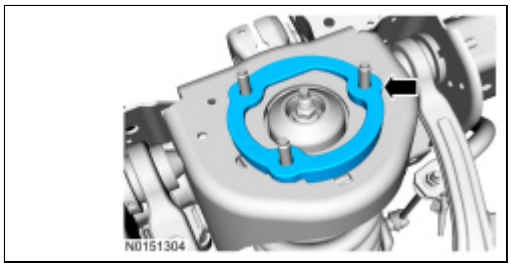
1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



2.



3.

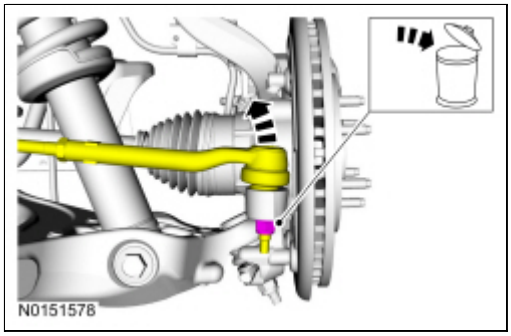


4. Remove the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

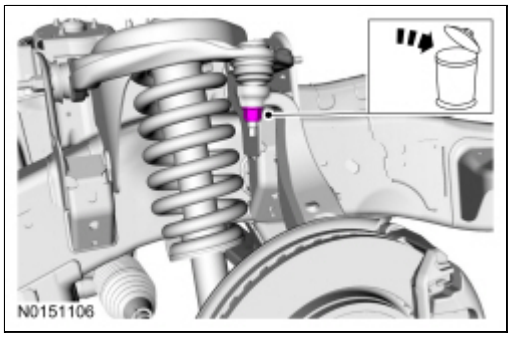
5. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

   NOTICE: **Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.**

   General Equipment: Tie-rod Separator.

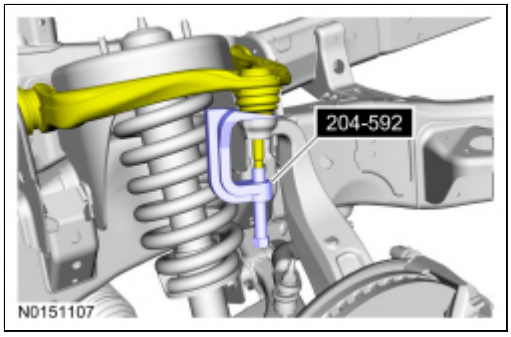


6.

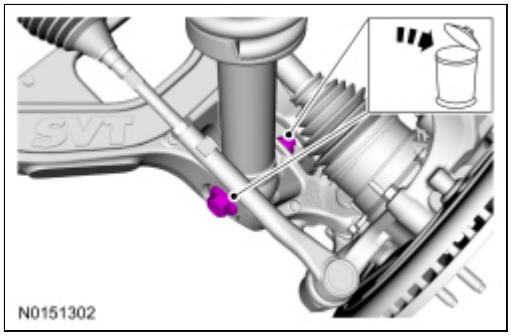


7. Special Tool(s): Separator, Ball Joint 204-592.

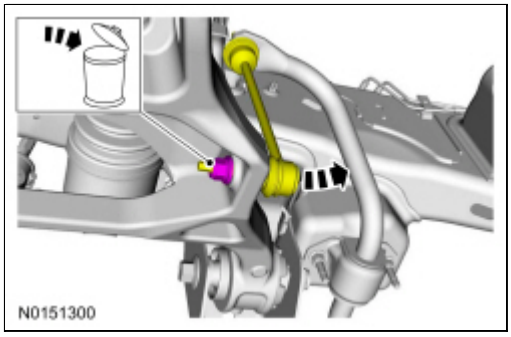
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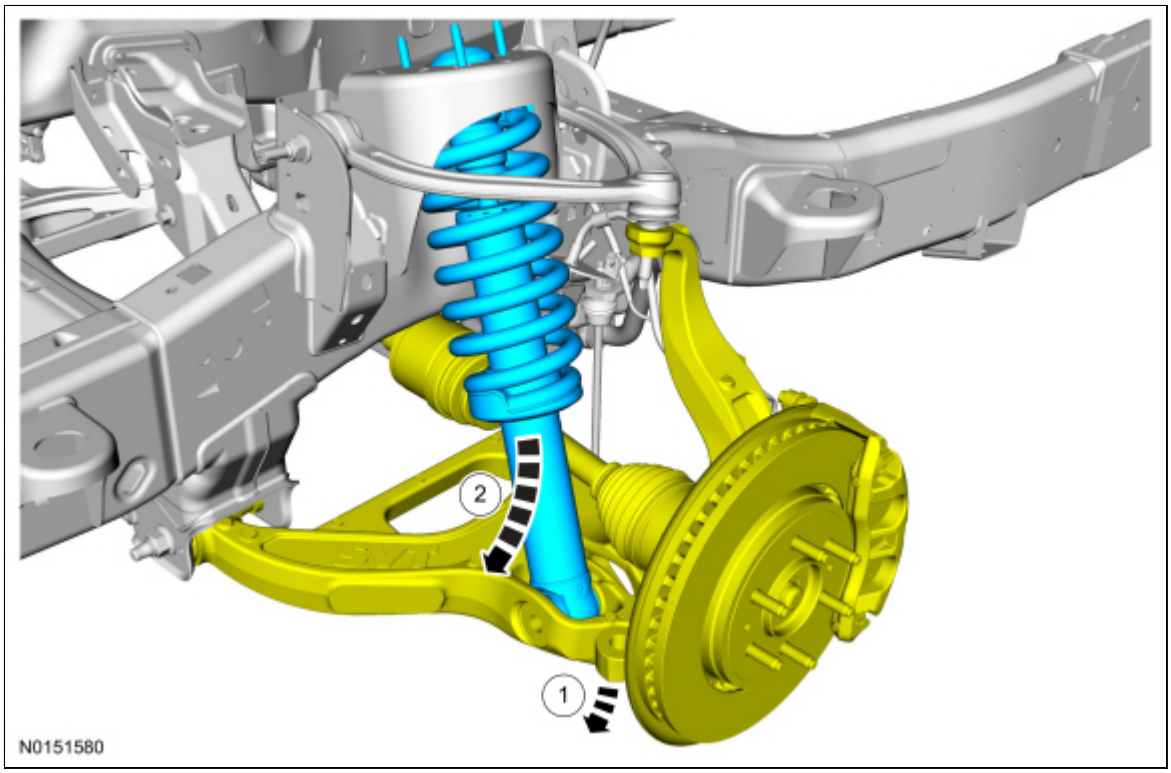
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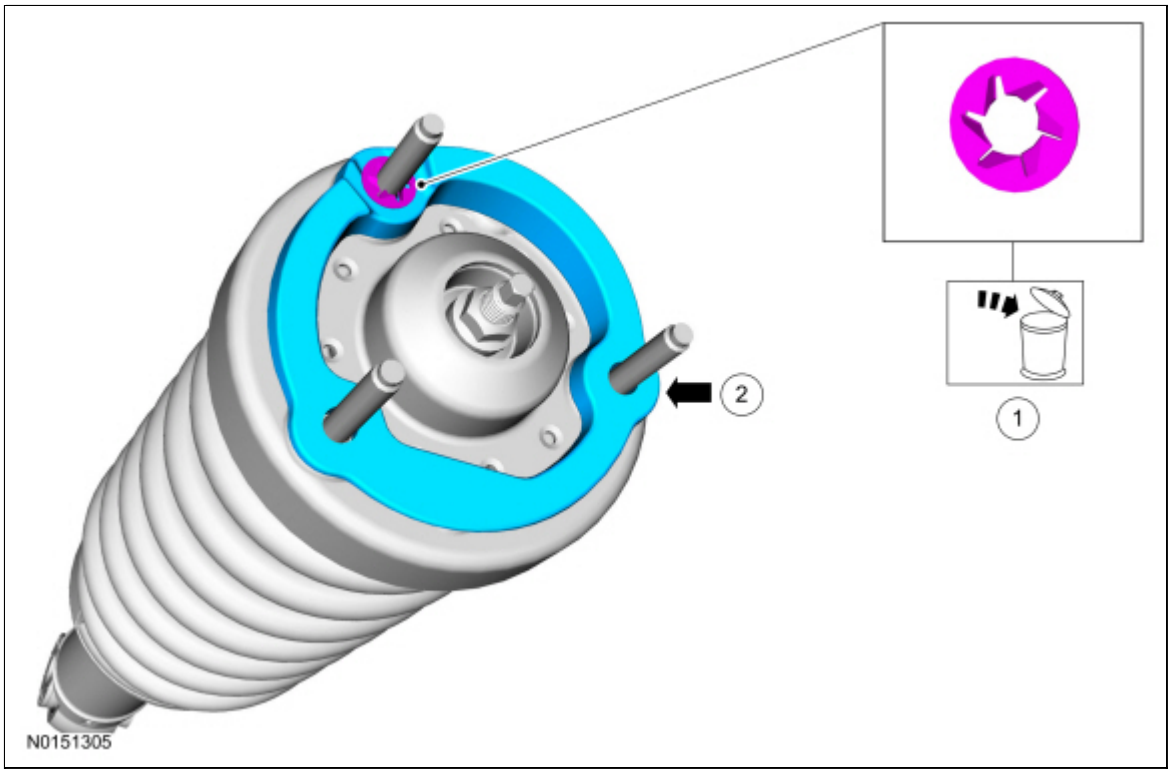
9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



10. **NOTE:** SVT Raptor similar.



11.

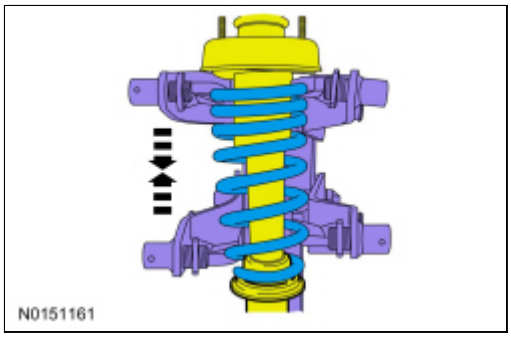


12. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

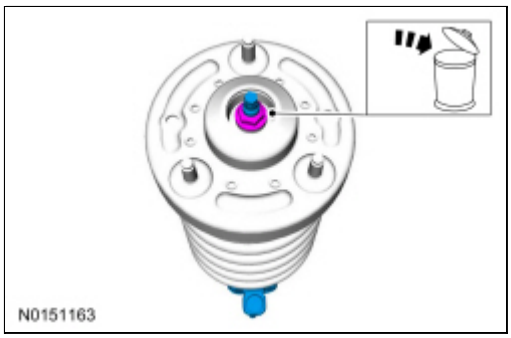
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NOTE: For reference during assembly, index the upper mount, spring and shock absorber.

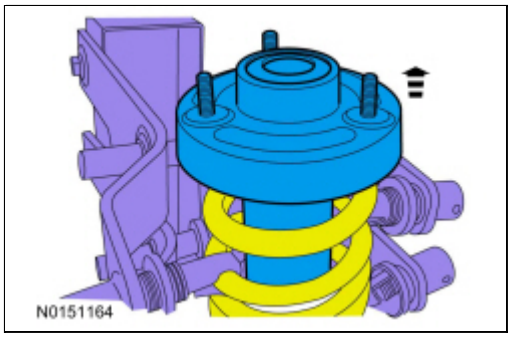
Compress the spring until the tension is released from the shock absorber.
General Equipment: Spring Compressor.



13. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

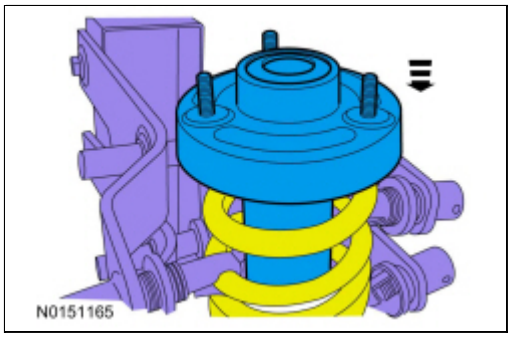


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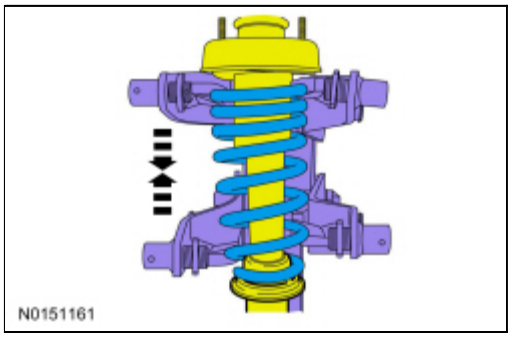
Installation

1.



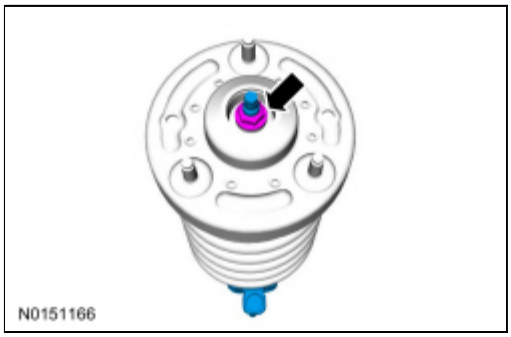
2. **NOTE:** Align the index marks made during disassembly.

   Compress the spring until the tension is released from the shock absorber.
   General Equipment: Spring Compressor.



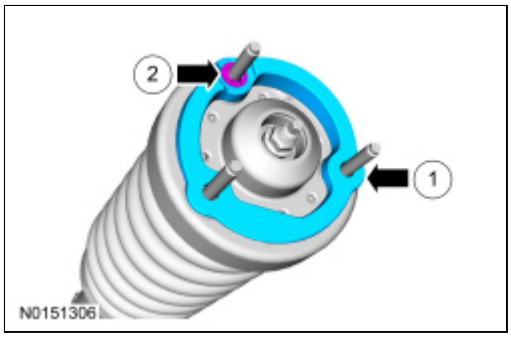
3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

   - Tighten to 55 Nm (41 lb-ft).

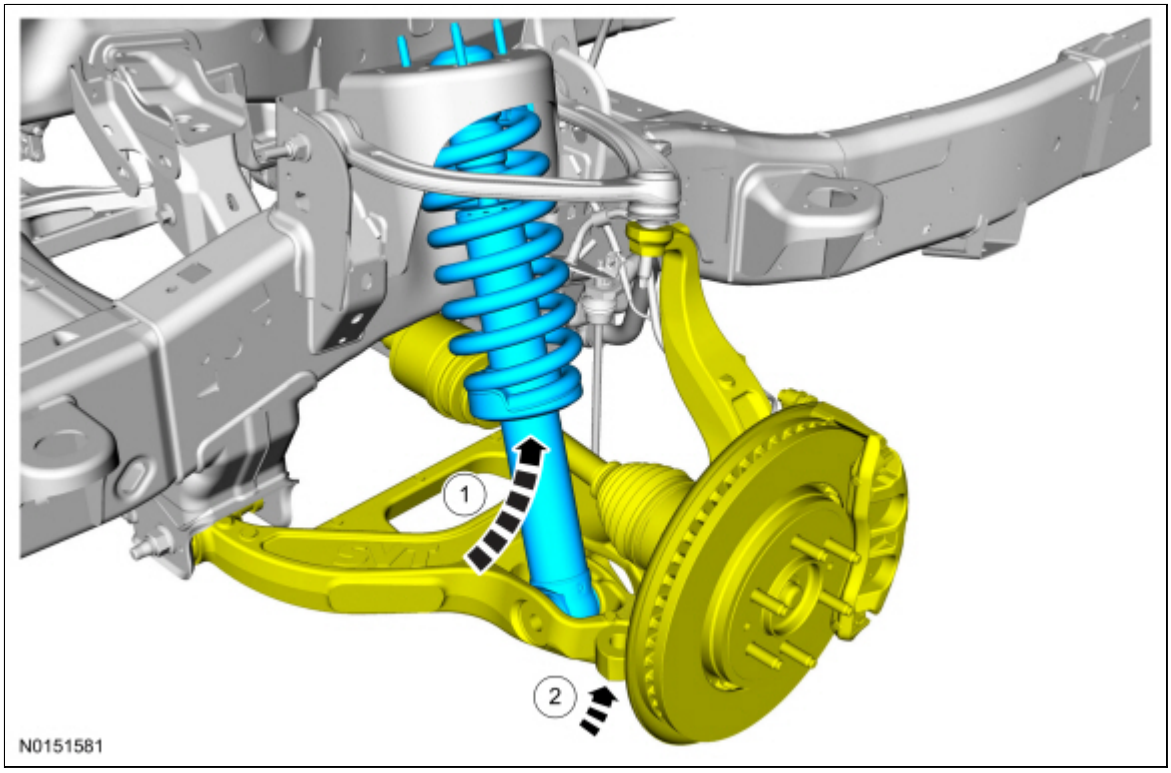


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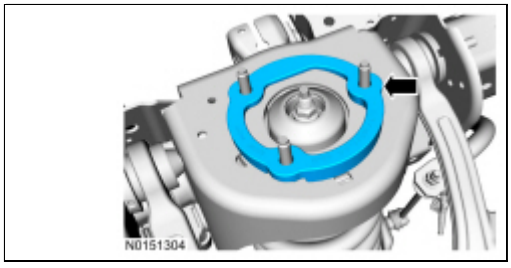
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5. **NOTE:** SVT Raptor similar

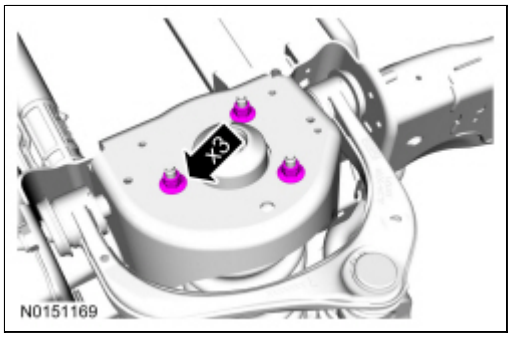


6.



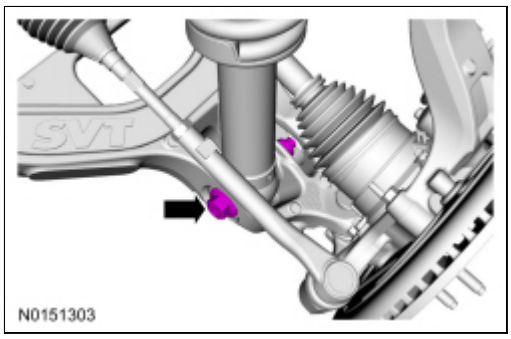
7.

- Tighten to 40 Nm (30 lb-ft).



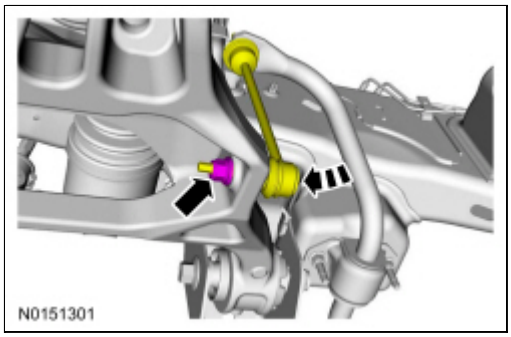
8. ***NOTICE:*** **SVT Raptor: Do not tighten the lower shock nut until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies or incorrect clamp load and bushing damage may occur.**

   Finger tight at this stage.



9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

   - Tighten to 80 Nm (59 lb-ft).

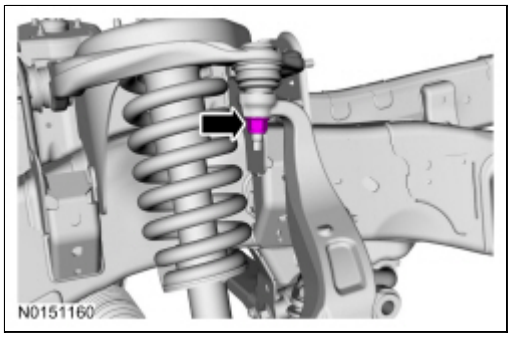


10. Install the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

11.

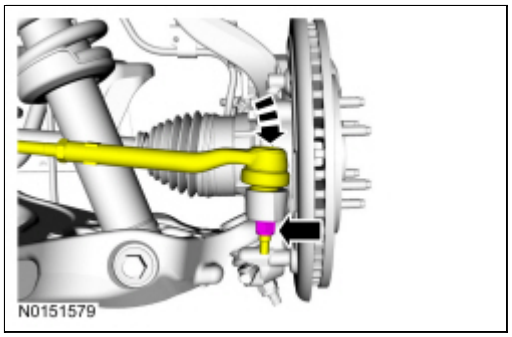
    - Tighten to 115 Nm (85 lb-ft).

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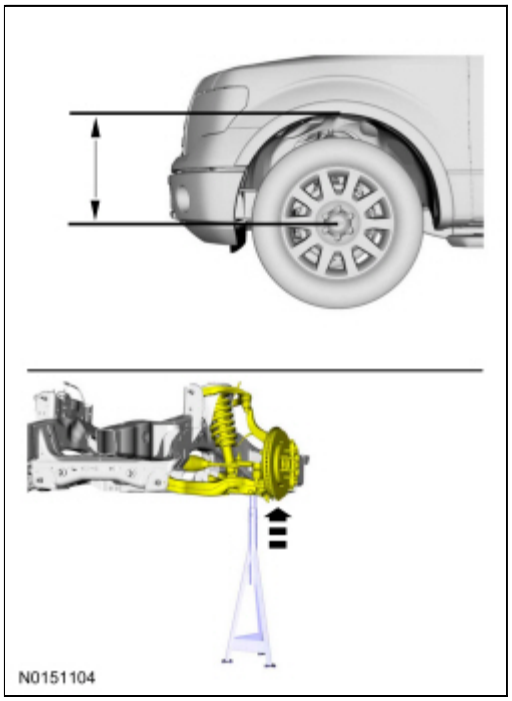


12.

- Tighten to 115 Nm (85 lb-ft).

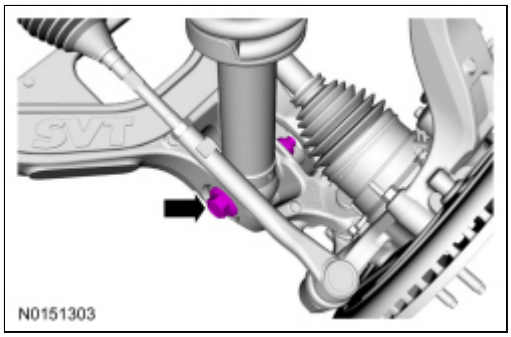


13. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



14.

- Tighten to 550 Nm (406 lb-ft).



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Shock Absorber and Spring Assembly

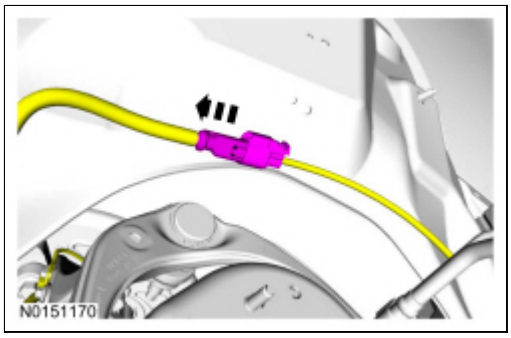
Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

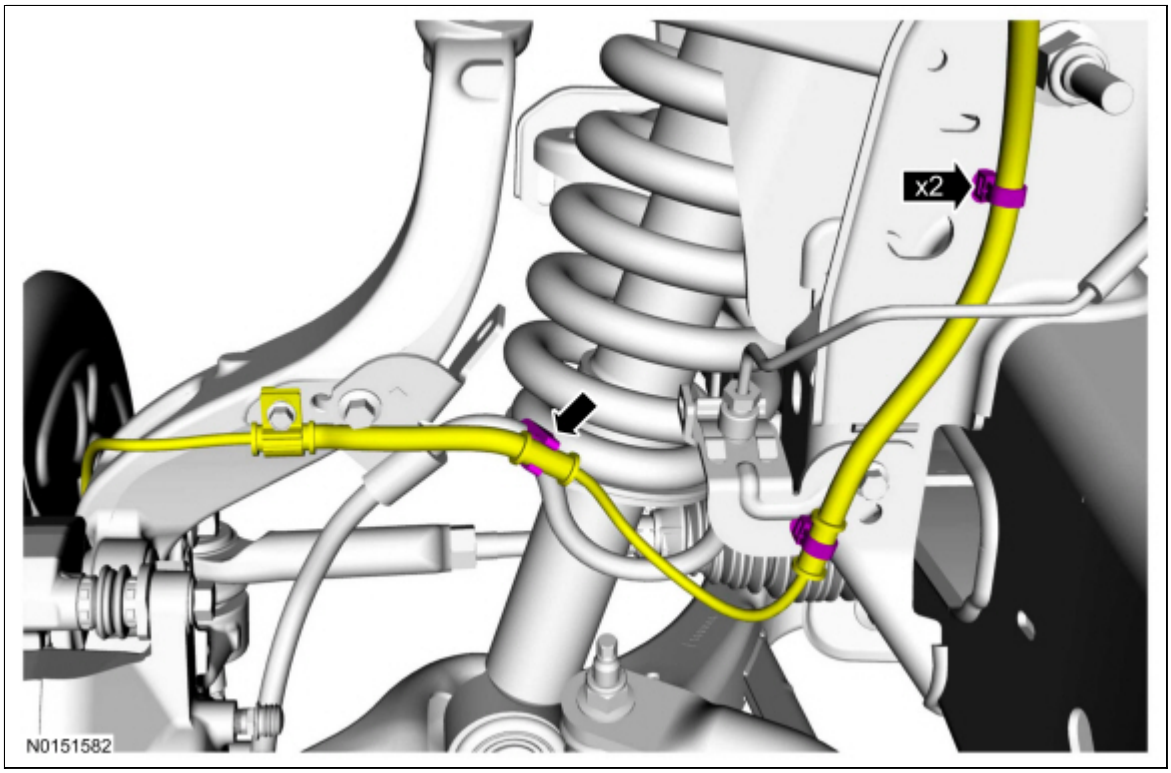
Removal

NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

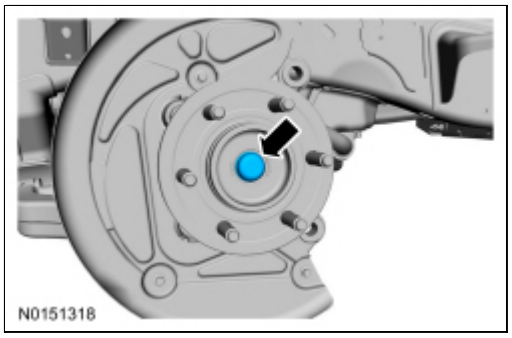
1. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



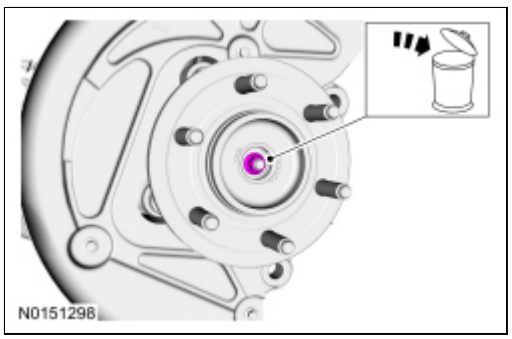
2. Remove the brake disc. Refer to Section 206-03 .
3.



4.



5.

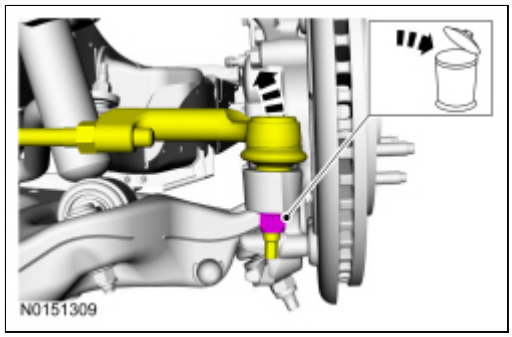


6. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

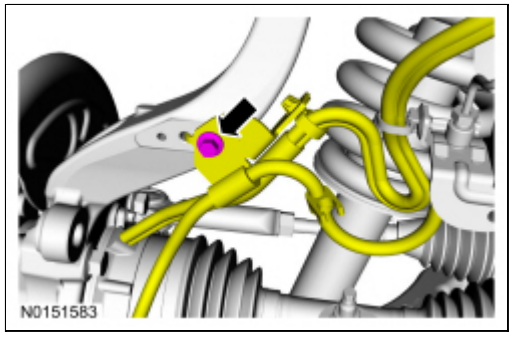
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NOTICE: **Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.**

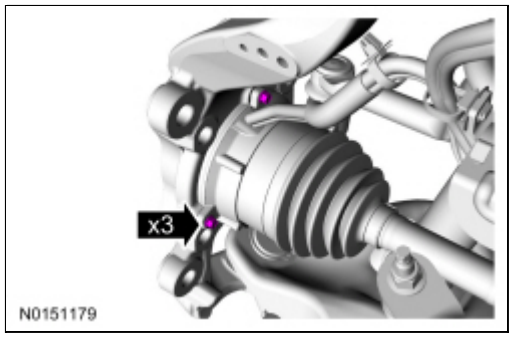
General Equipment: Tie-rod Separator.



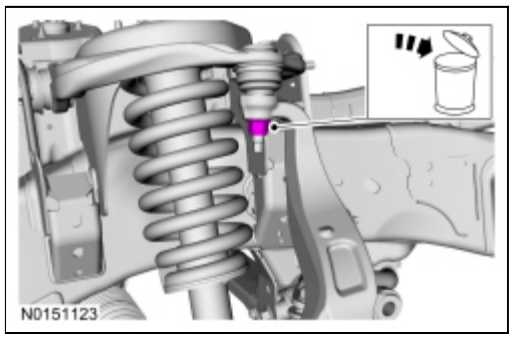
7.



8.

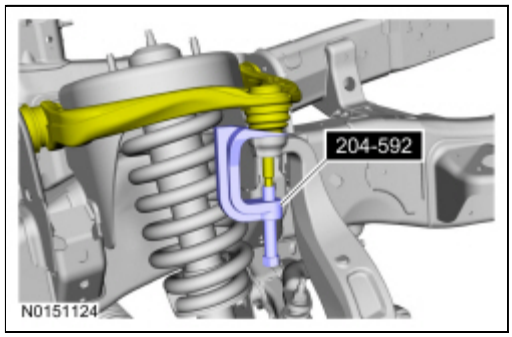


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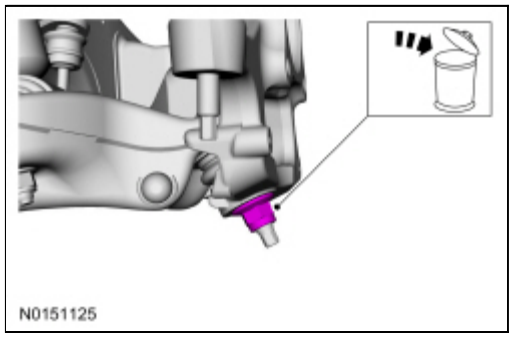


10. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

    Special Tool(s): Separator, Ball Joint 204-592.



11.

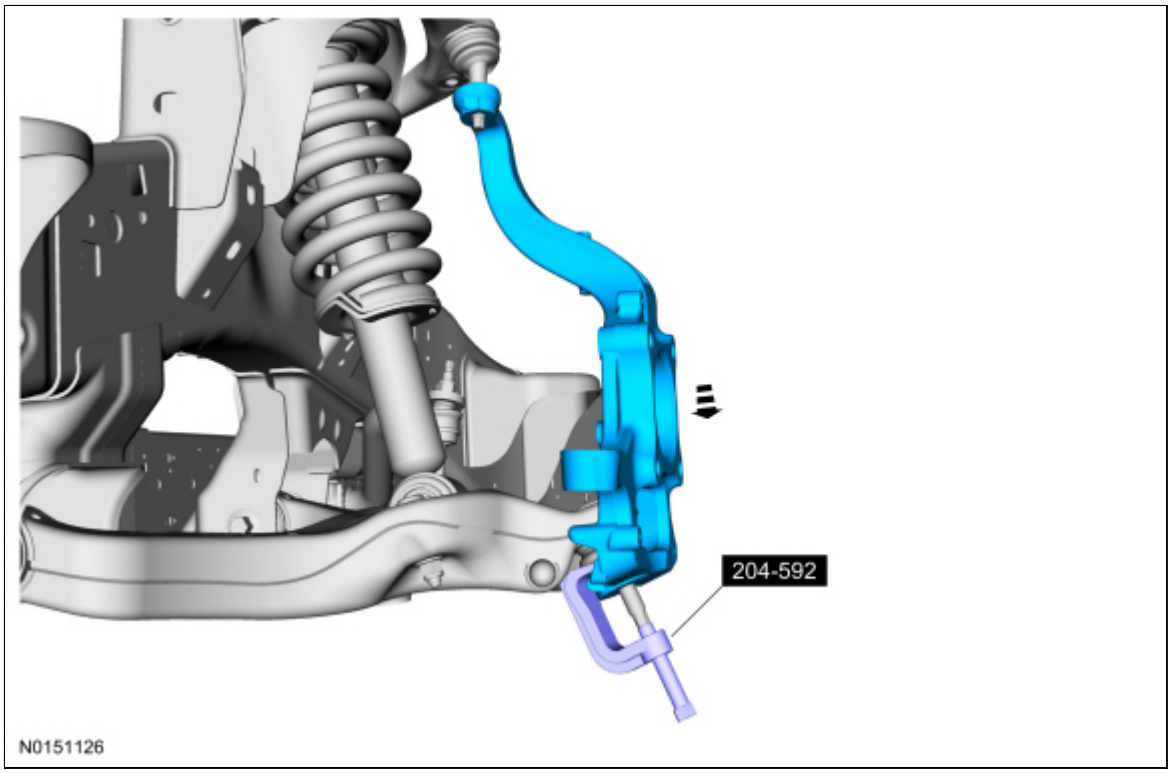


12. ***NOTICE:*** **Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.**

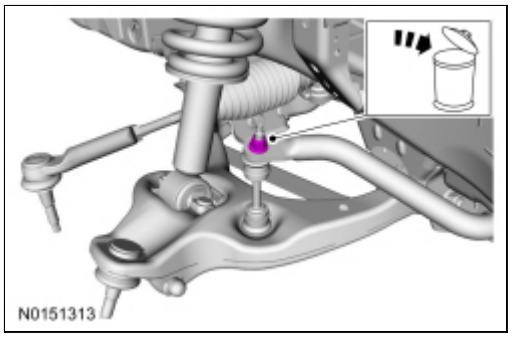
    NOTICE: **Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.**

    Special Tool(s): Separator, Ball Joint 204-592.

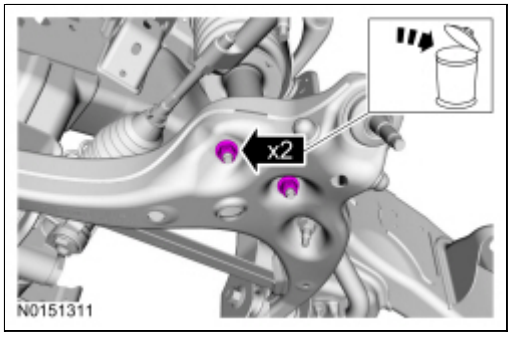
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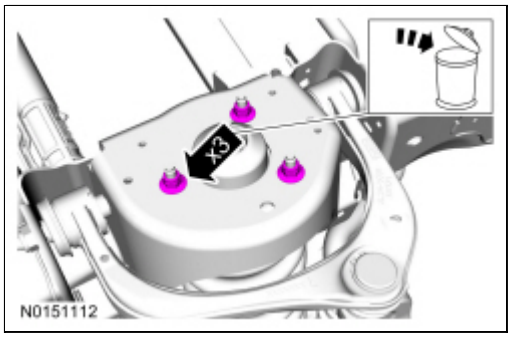
13. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



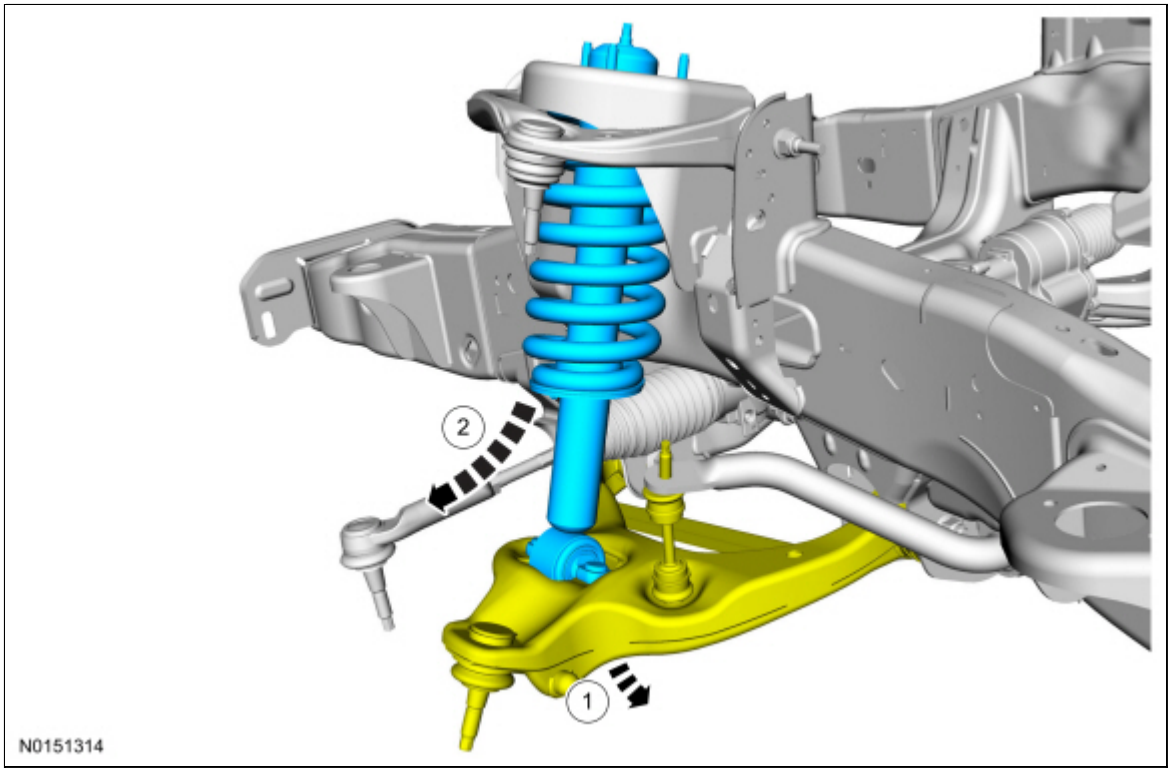
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15.



16.

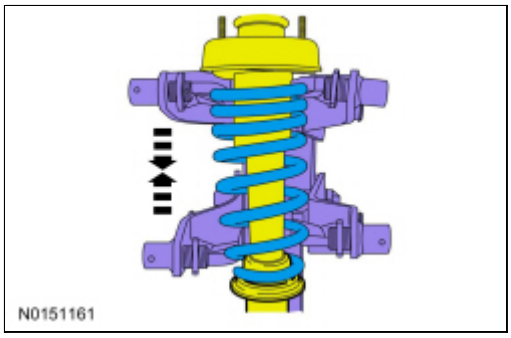


17. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

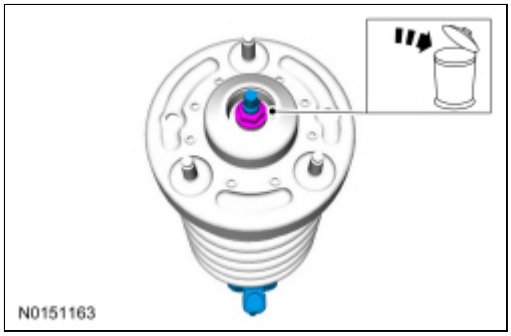
NOTE: For reference during assembly, index the upper mount, spring and shock absorber.

Compress the spring until the tension is released from the shock absorber.
General Equipment: Spring Compressor.

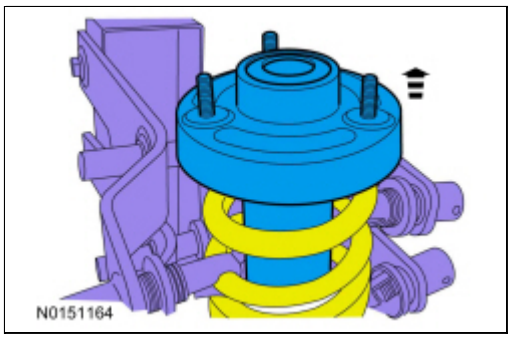
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18. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

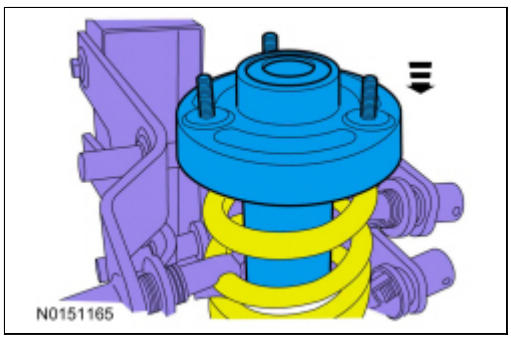


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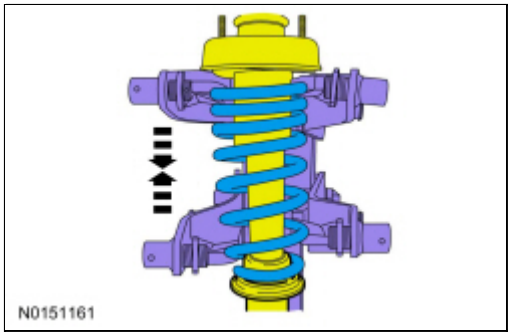
Installation

1.



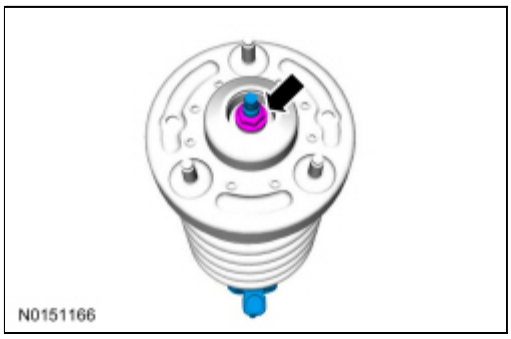
2. **NOTE:** Align the index marks made during disassembly.

Compress the spring until the tension is released from the shock absorber.
General Equipment: Spring Compressor.



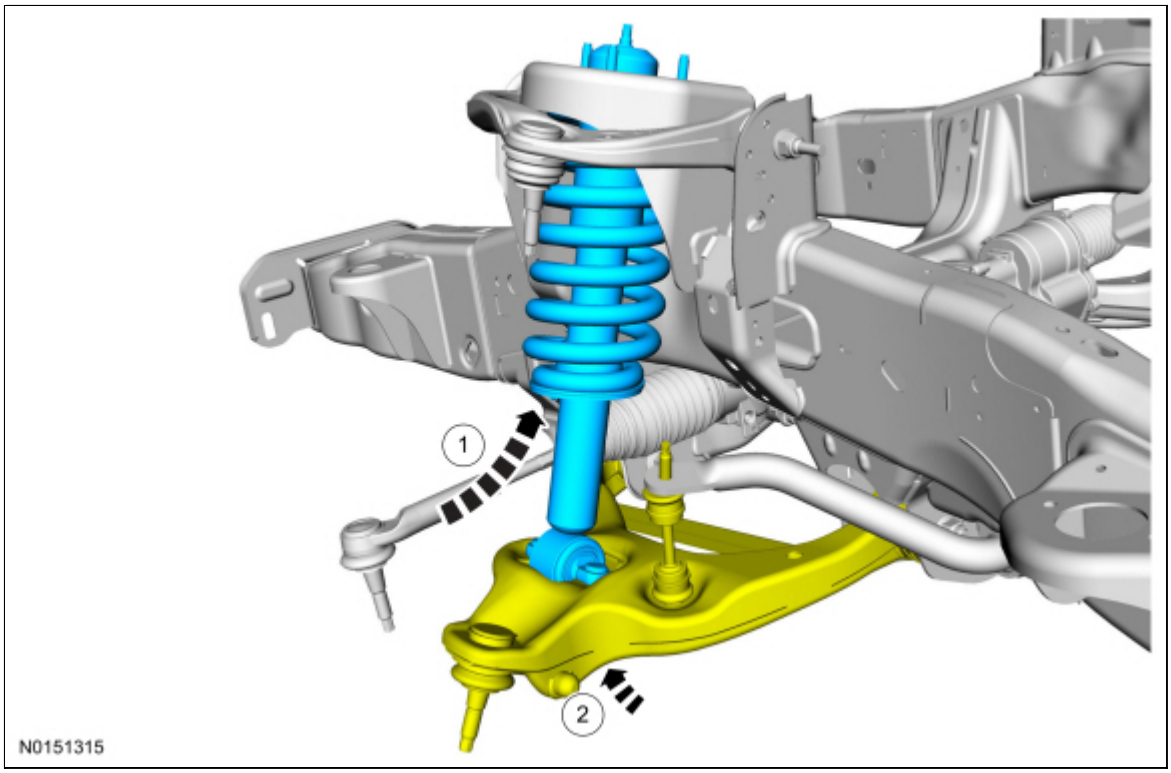
3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

    - Tighten to 55 Nm (41 lb-ft).



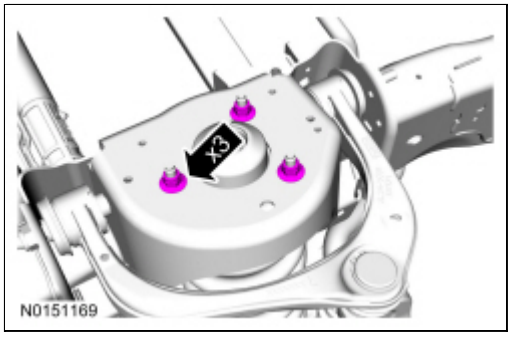
4.

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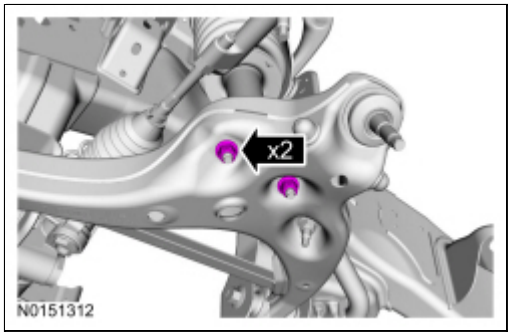
5.

- Tighten to 63 Nm (46 lb-ft).



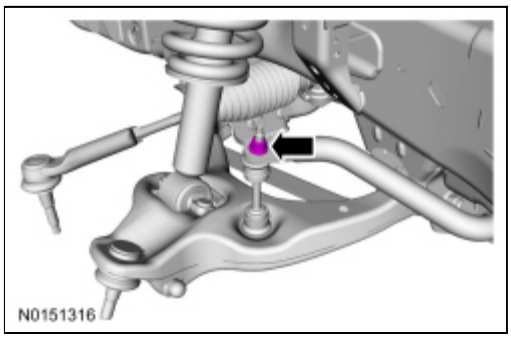
6.

- Tighten to 90 Nm (66 lb-ft).



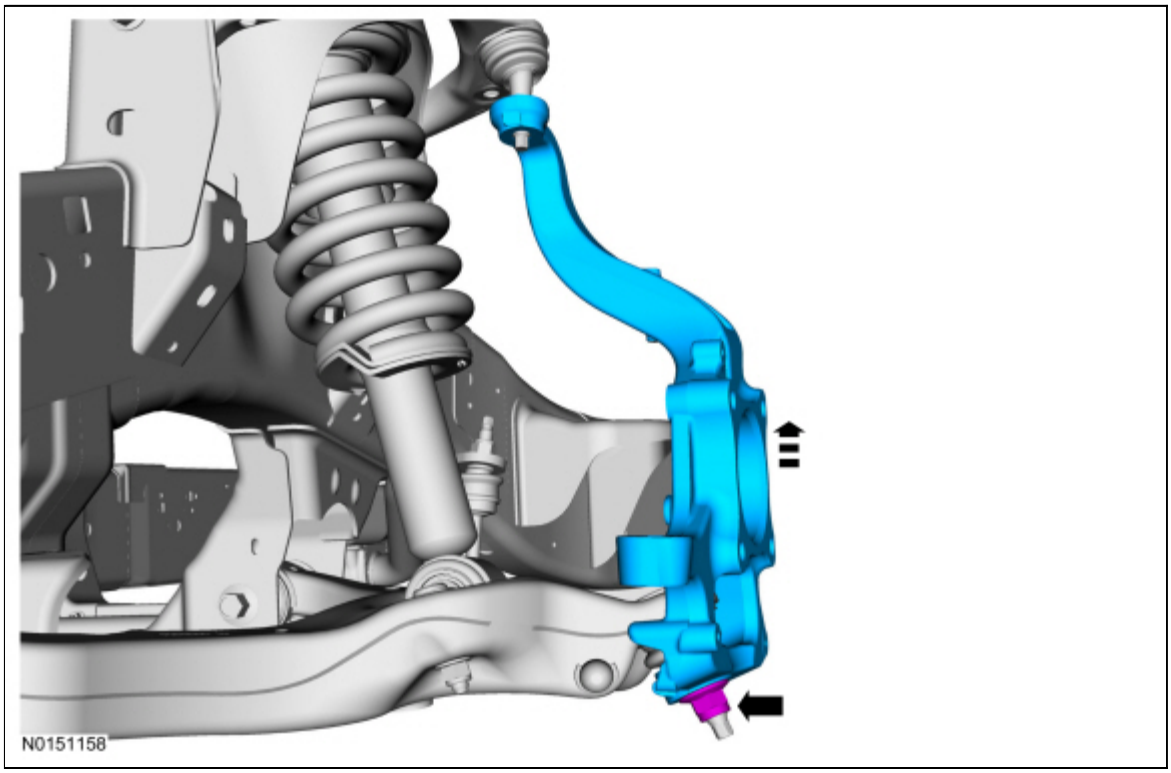
7. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

- Tighten to 70 Nm (52 lb-ft).



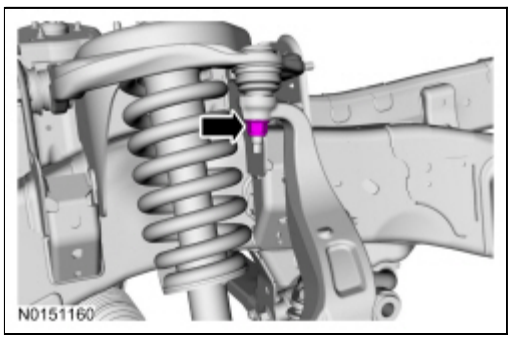
8.

- Tighten to 175 Nm (129 lb-ft).



9.

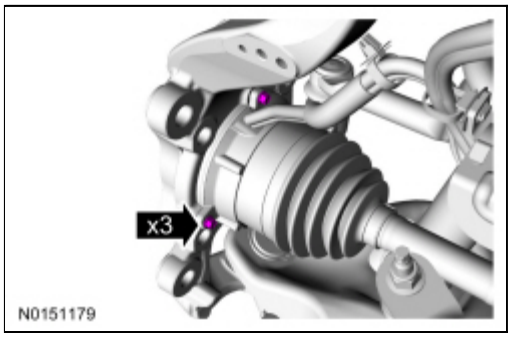
- Tighten to 115 Nm (85 lb-ft).



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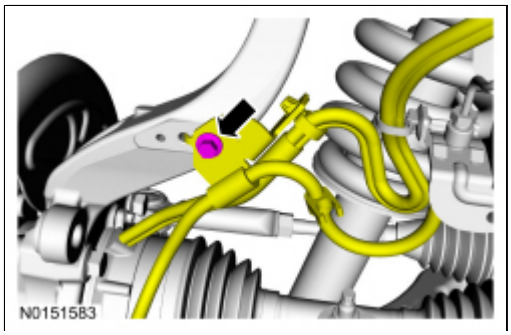
10.

- Tighten to 12 Nm (106 lb-in).



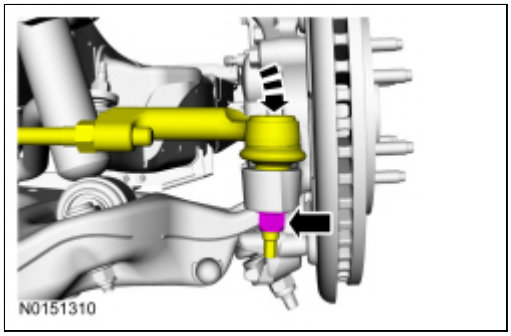
11.

- Tighten to 12 Nm (106 lb-in).



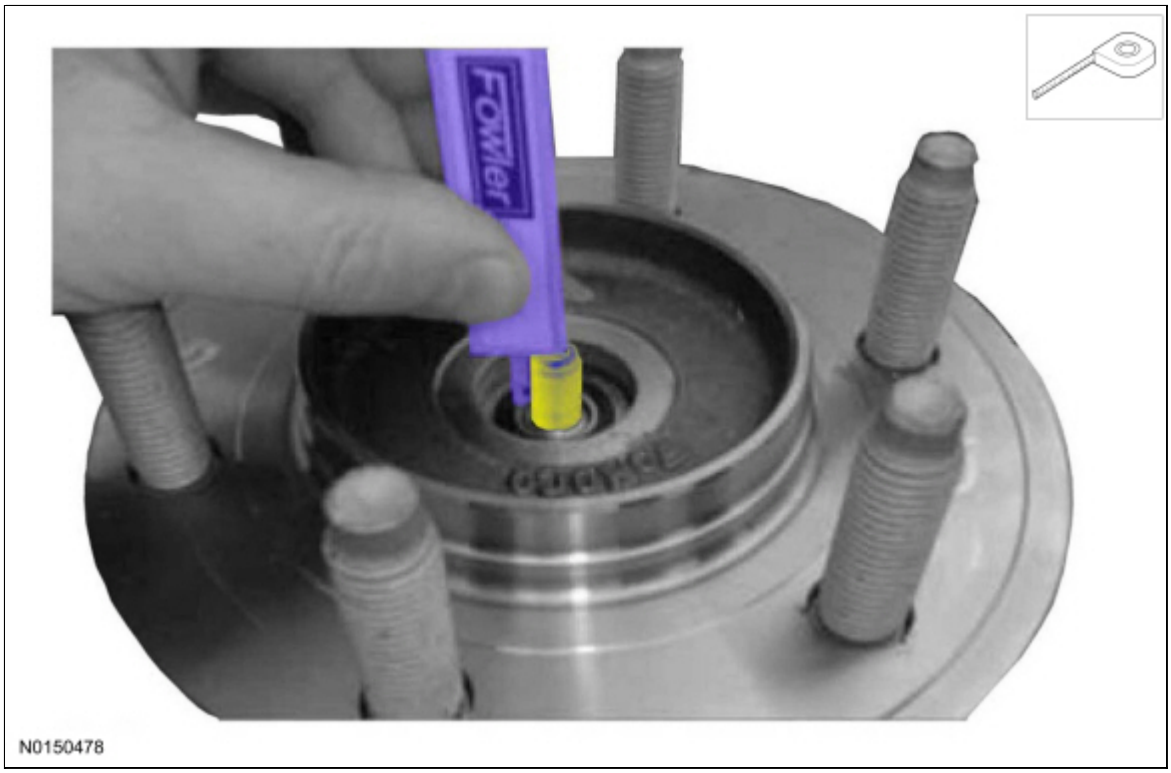
12.

- Tighten to 115 Nm (85 lb-ft).



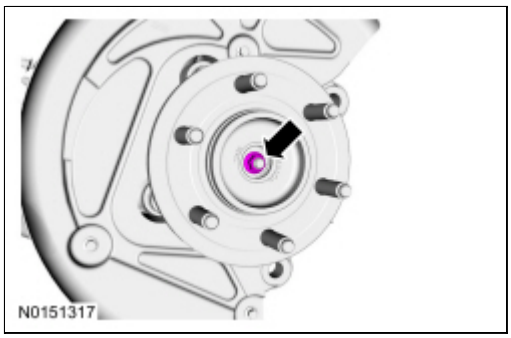
13. ***NOTICE:*** **Measure the depth of the Constant Velocity (CV) shaft threaded end to the inner bearing race (shown in illustration). The minimum depth is 15.5 mm (0.61 in). If the depth is less than 15.5 mm (0.61 in) rotate the CV shaft to clear a binding condition between the Integrated Wheel End (IWE) and CV splines. Installing the axle nut and tightening without the proper depth of protrusion will result in damage to the IWE .**

    Measure the CV shaft threaded end to the inner bearing race.

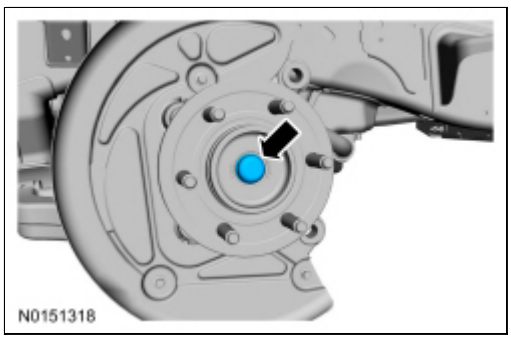


14. ***NOTICE:*** **Verify the spline engagement by checking for spline lash before installing the axle nut or component damage may occur.**

    - Tighten to 40 Nm (30 lb-ft).

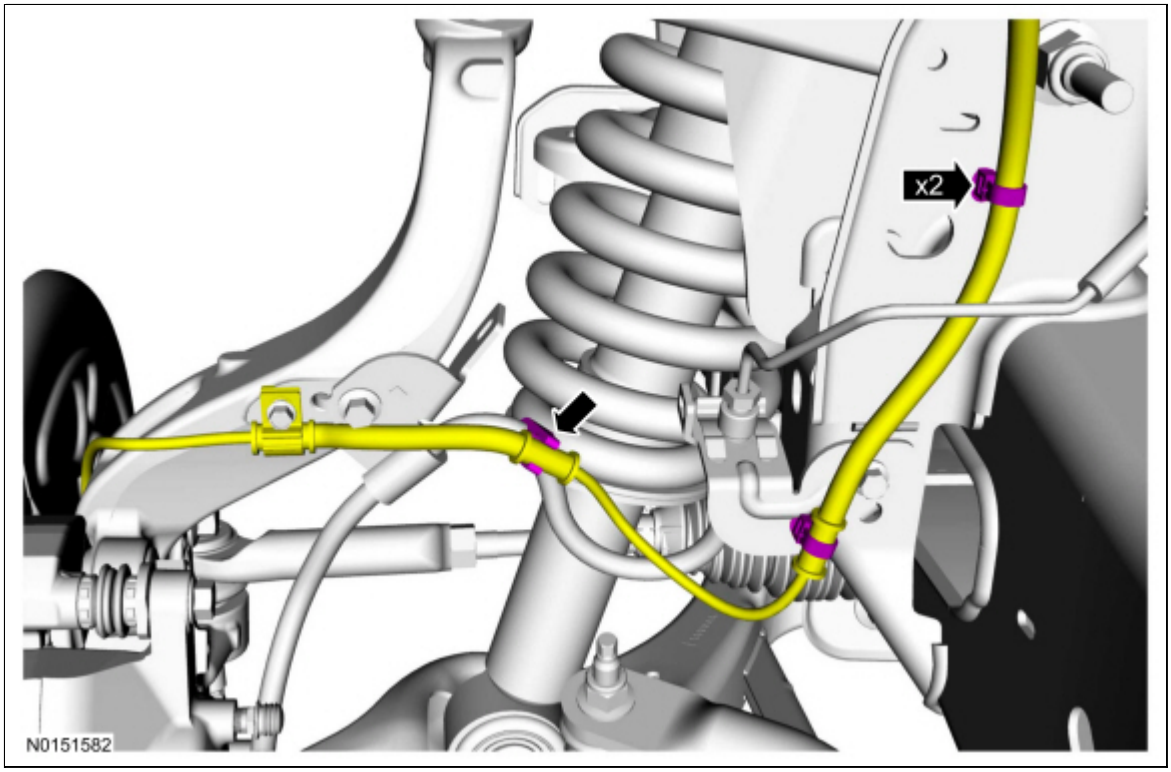


15.



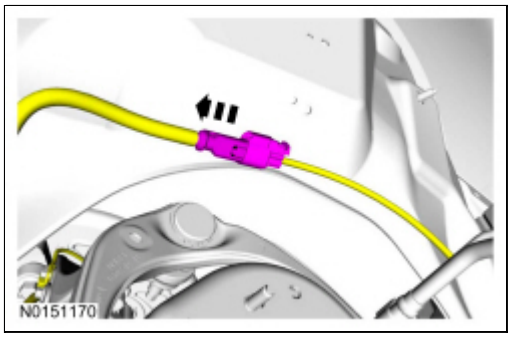
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16.



17. Install the brake disc. Refer to Section 206-03 .

18. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



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Stabilizer Bar and Link

Removal and Installation

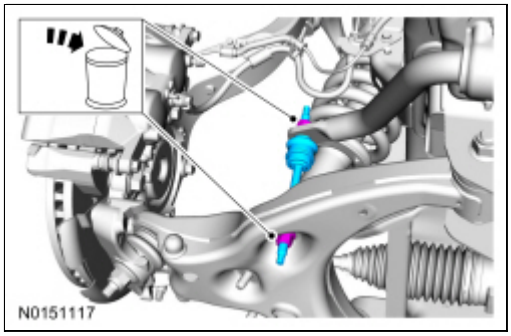
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

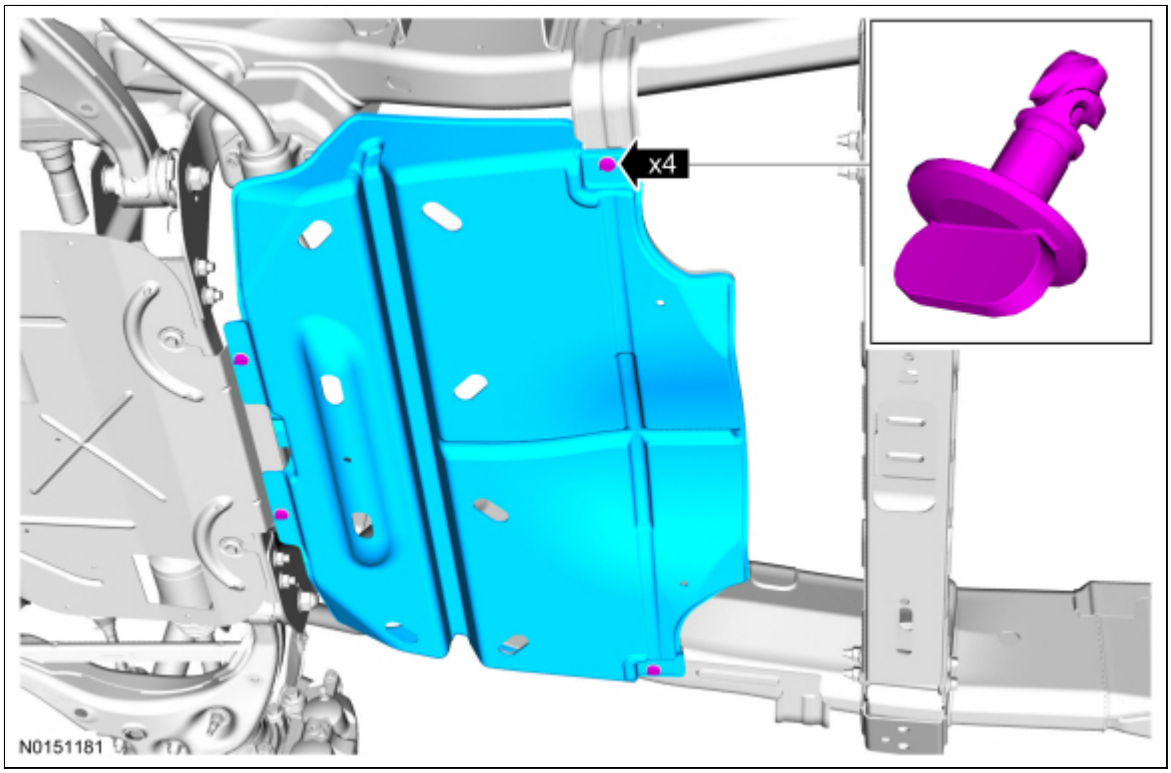
2. **NOTE:** SVT Raptor similar.

   NOTE: Use the hex-holding feature to prevent the stud from turning while removing the nut(s).

   On both sides.
   - To install, tighten to 70 Nm (52 lb-ft).
   - (SVT Raptor) To install, tighten to 80 Nm (59 lb-ft).

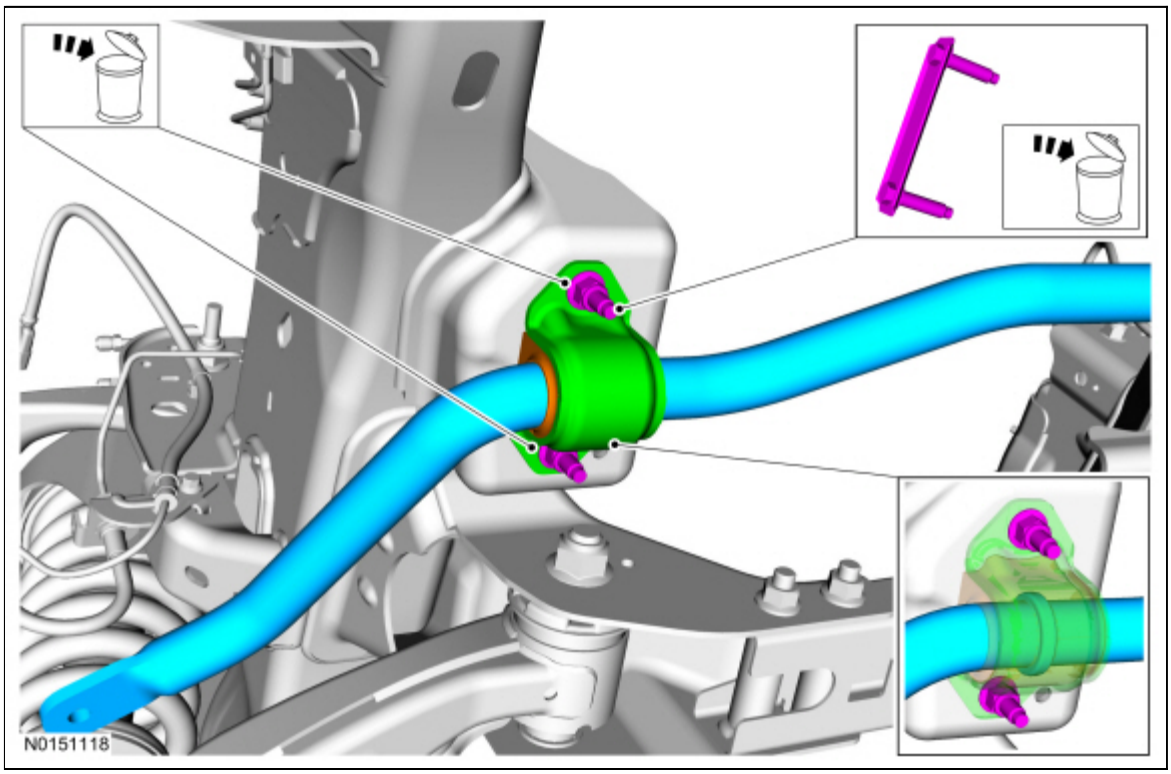


3. If equipped.



4. ***NOTICE:*** **The raised ring on the stabilizer bar must be encapsulated inside the inner groove of the stabilizer bar bushing on the driver side of the vehicle for proper installation.**

   On both sides.
   - To install, tighten to 63 Nm (46 lb-ft).



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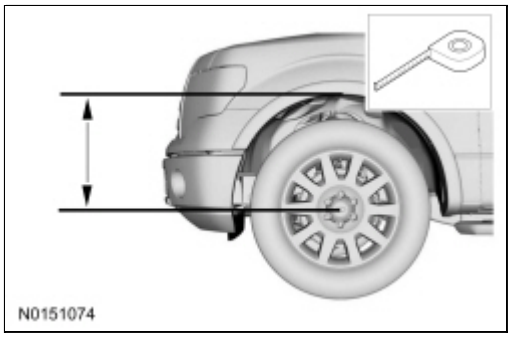
5. Inspect and, if necessary, install new stabilizer bar bushings.
6. To install, reverse the removal procedure.

Upper Arm

Removal

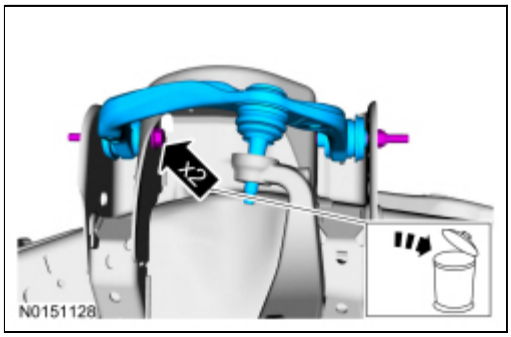
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



2. Remove the shock absorber and spring assembly. Refer to Shock Absorber and Spring Assembly or Shock Absorber and Spring Assembly — SVT Raptor .

3.

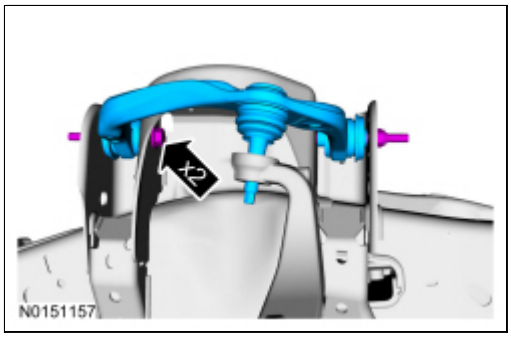


Installation

1. ***NOTICE:*** **Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.**

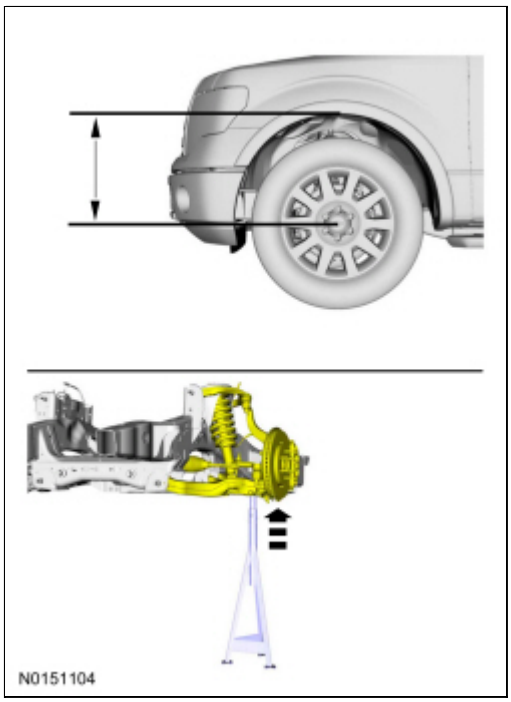
   Finger tight at this stage.

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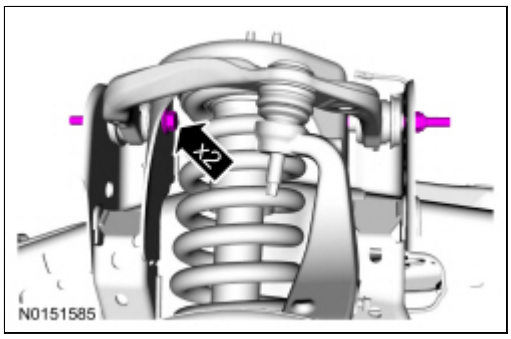


2. Install the shock absorber and spring assembly. Refer to Shock Absorber and Spring Assembly or Shock Absorber and Spring Assembly — SVT Raptor .

3. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



4.
   - Tighten to 150 Nm (111 lb-ft).



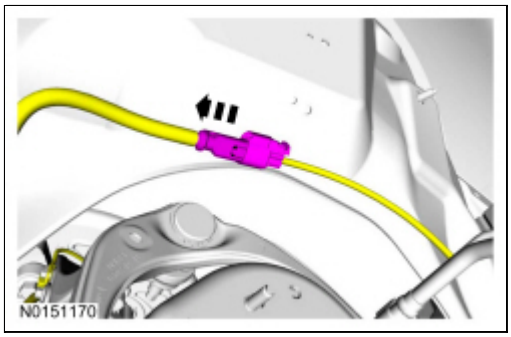
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Wheel Bearing and Wheel Hub

Removal and Installation

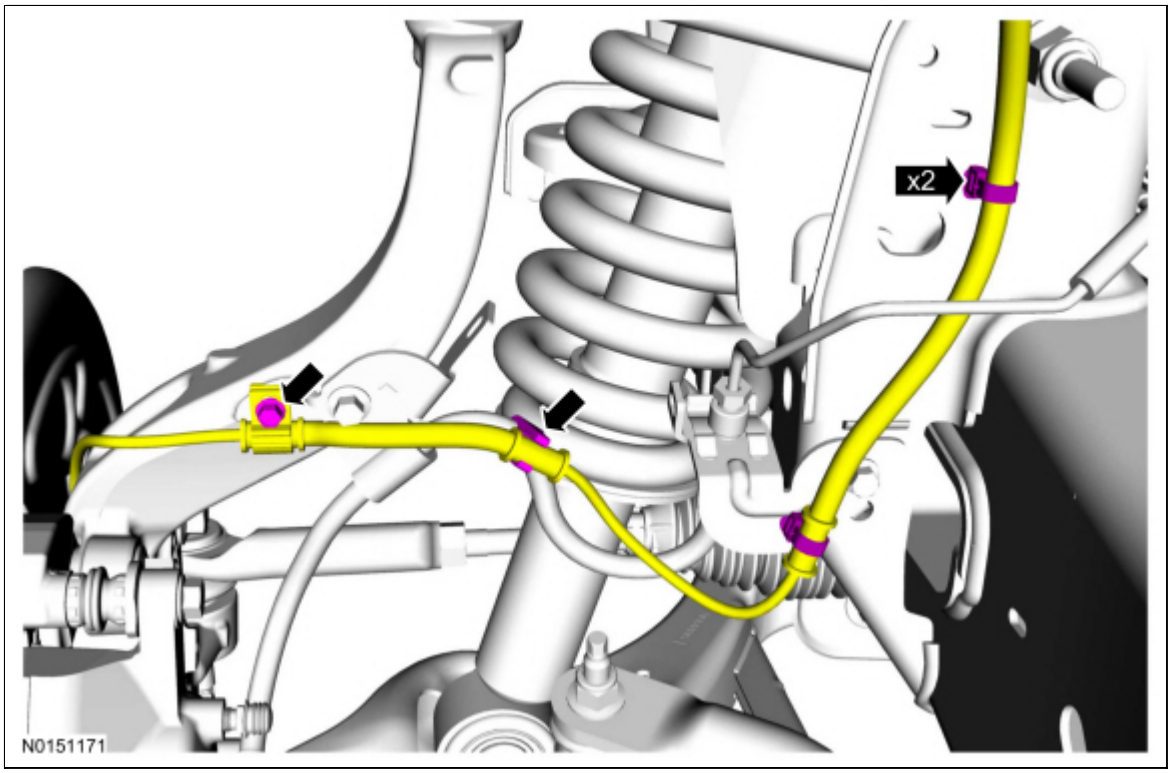
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



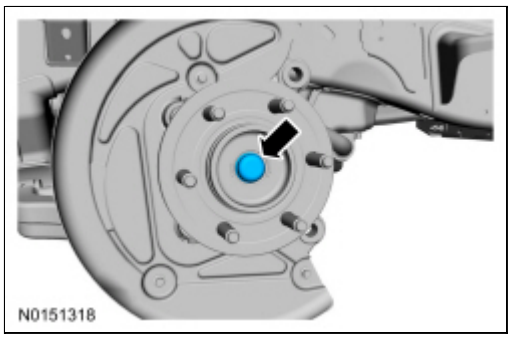
2. Remove the wheel and tire. Refer to Section 204-04 .

3.

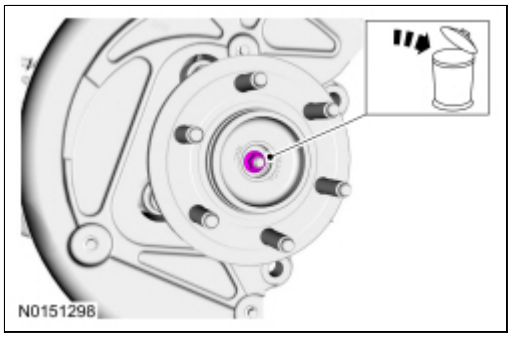


4. Remove the brake disc. Refer to Section 206-03 .

5.

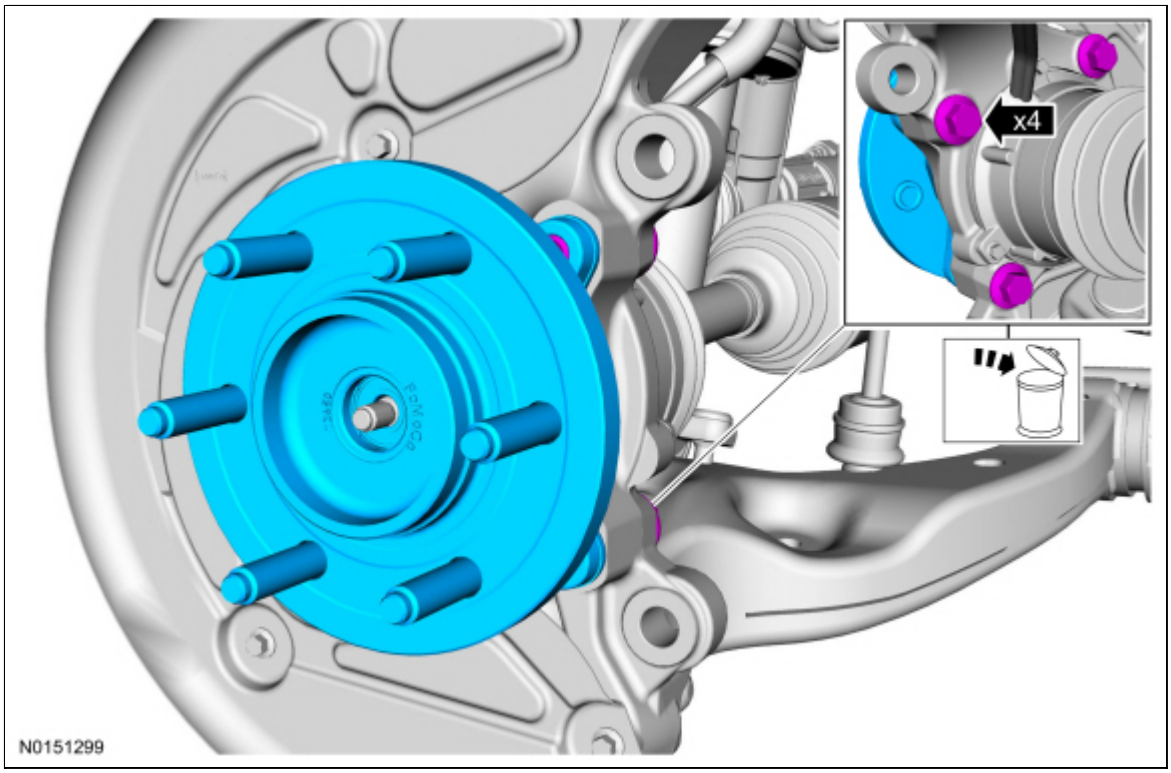


6.



7.

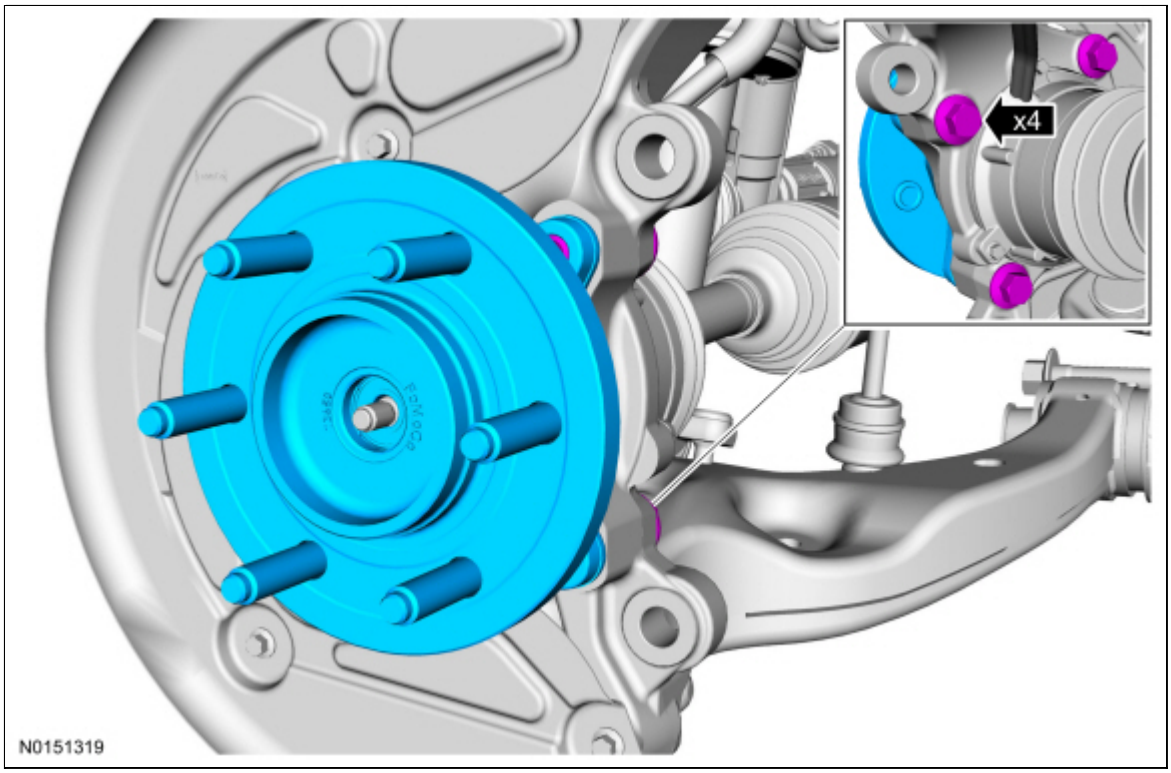
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Installation

1. ***NOTICE:*** **If the original wheel bearing and wheel hub is being installed, install a new wheel hub O-ring seal or damage to the wheel bearing may occur.**

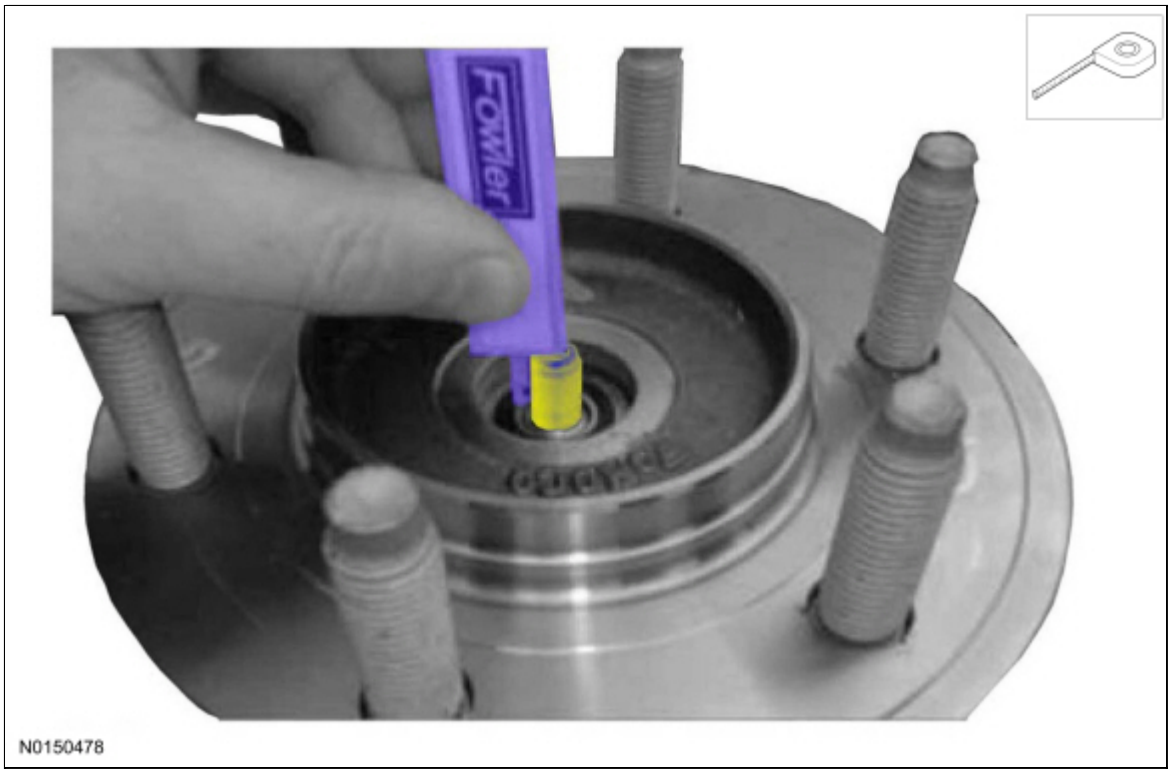
    - Tighten to 175 Nm (129 lb-ft).



2. ***NOTICE:*** **Measure the depth of the Constant Velocity (CV) shaft threaded end to the inner bearing race (shown in illustration). The minimum depth is 15.5 mm (0.61 in). If the depth is less than 15.5 mm (0.61 in) rotate the CV shaft to clear a binding condition between the Integrated Wheel End (IWE) and CV splines. Installing the axle nut and tightening without the proper depth of protrusion will result in damage to the IWE .**

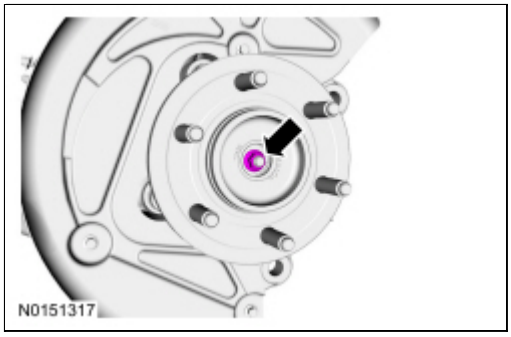
   Measure the CV shaft threaded end to the inner bearing race.

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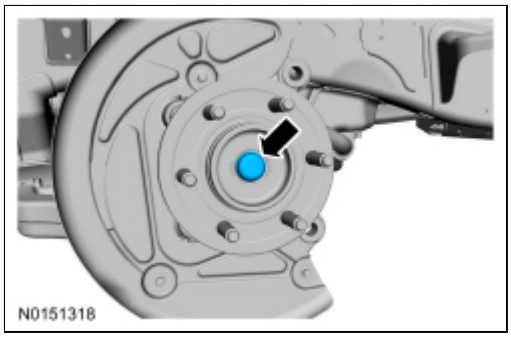


3. ***NOTICE:*** **Verify the spline engagement by checking for spline lash before installing the axle nut or component damage may occur.**

    - Tighten to 40 Nm (30 lb-ft).

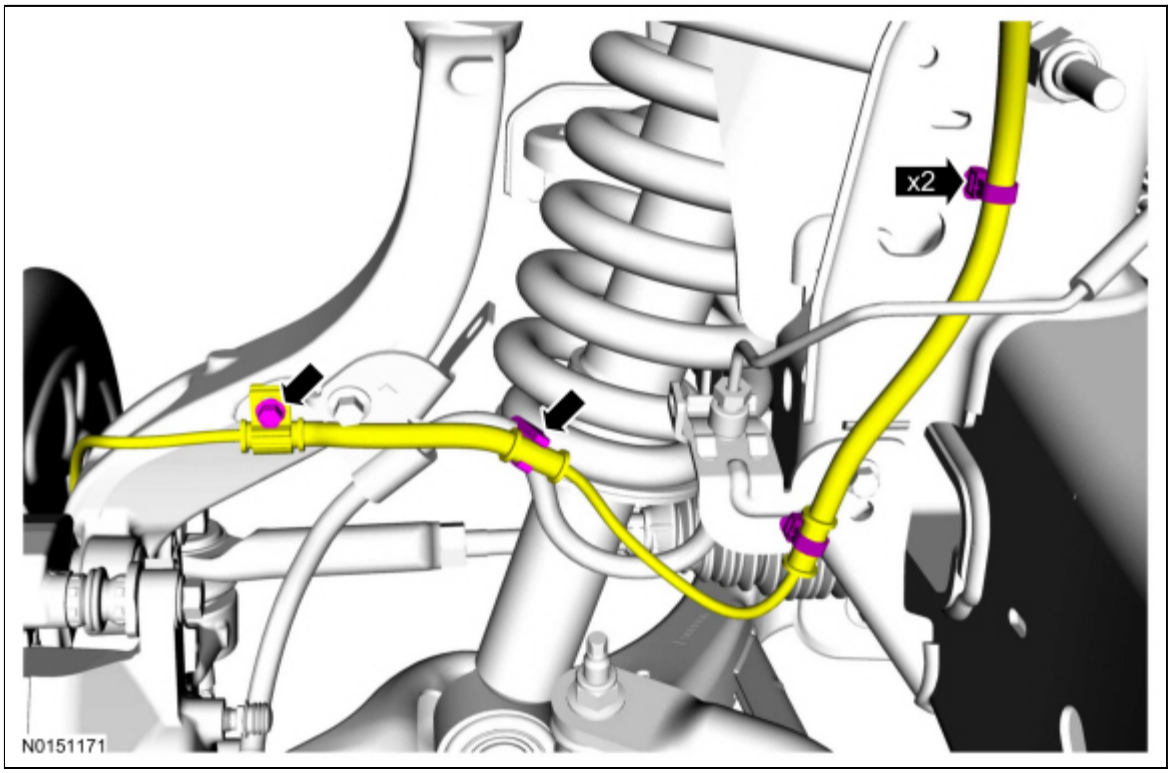


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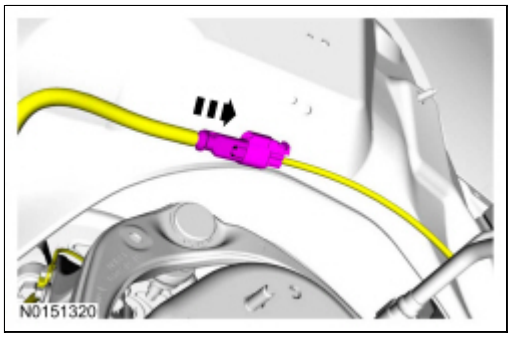
5. Install the brake disc. Refer to Section 206-03 .

6.
   - Tighten to 12 Nm (106 lb-in).



7. Install the wheel and tire. Refer to Section 204-04 .

8. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



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Wheel Knuckle

Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592

Removal

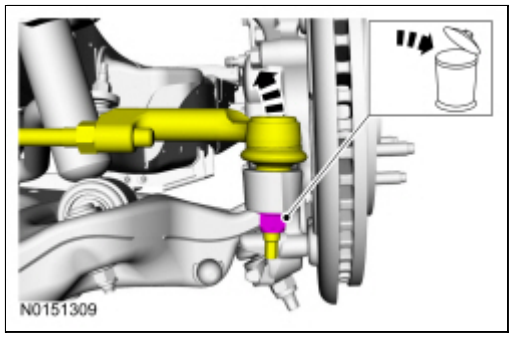
NOTICE: **Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.**

1. Remove the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

2. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

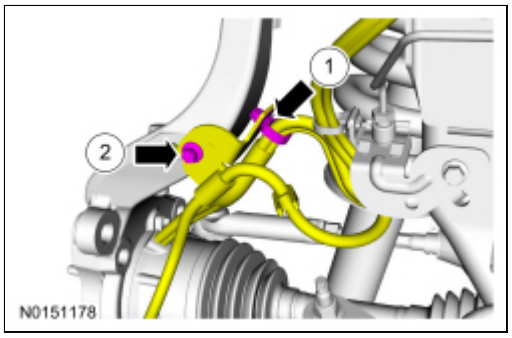
   NOTICE: **Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.**

   General Equipment: Tie-rod Separator.

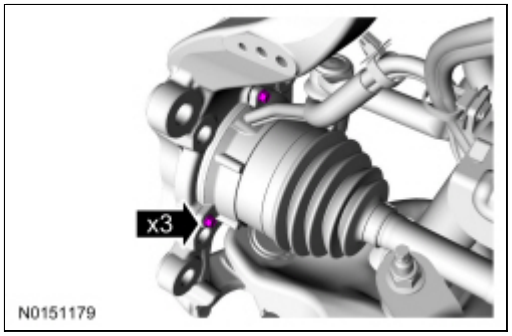
   
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3.

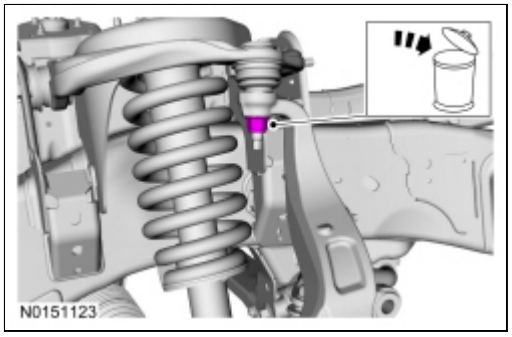
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4.

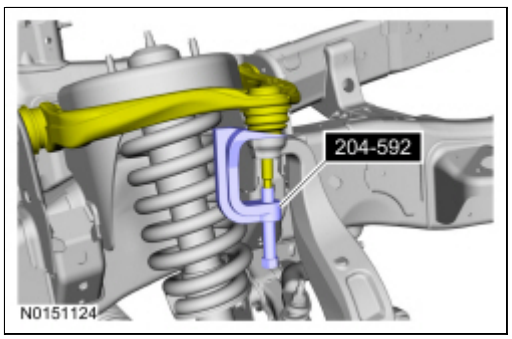


5.

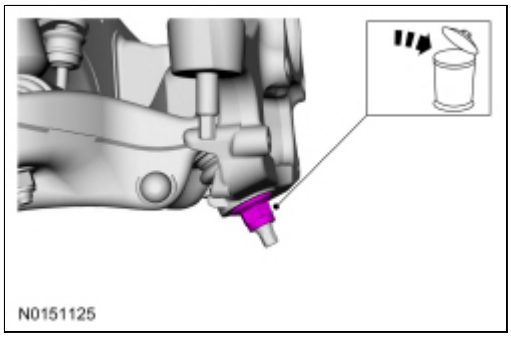


6. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

   Special Tool(s): Separator, Ball Joint 204-592.



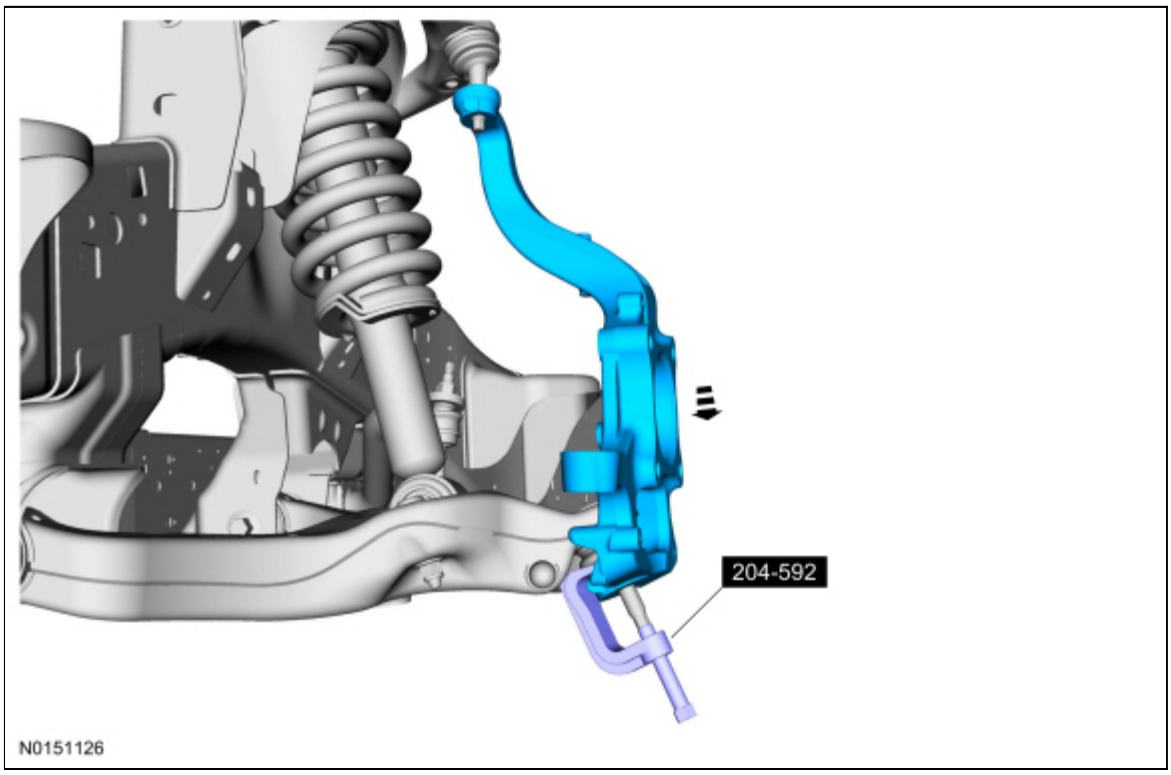
7.



8. ***NOTICE:*** **Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.**

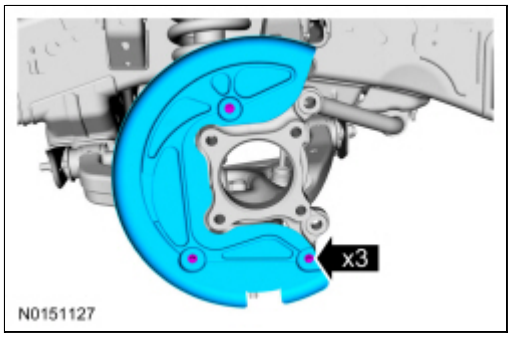
   NOTICE: **Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.**

   Special Tool(s): Separator, Ball Joint 204-592.



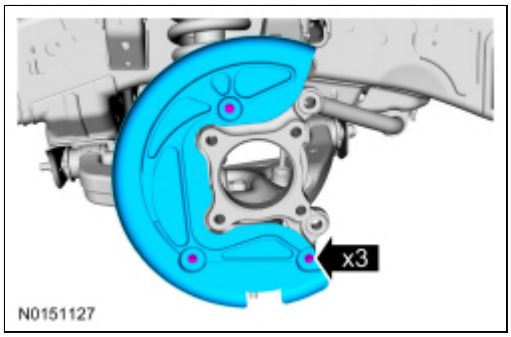
9. If necessary.

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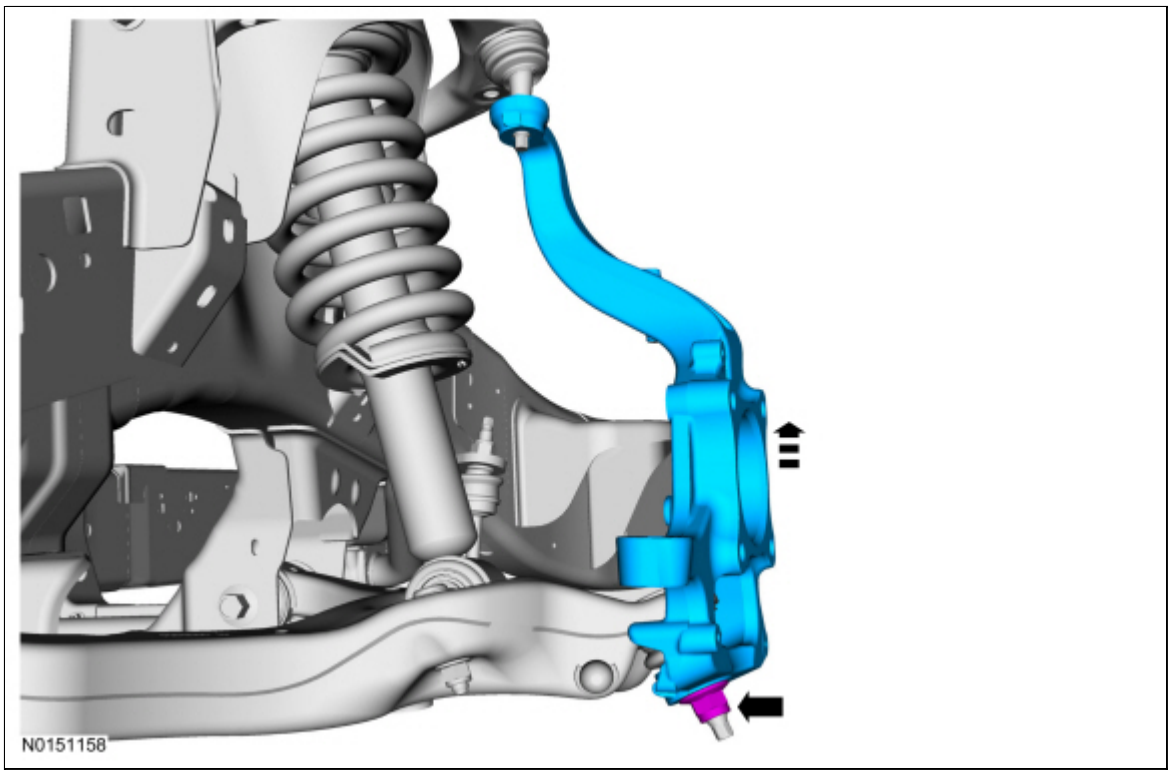


Installation

1. If necessary.
    - Tighten to 17 Nm (150 lb-in).

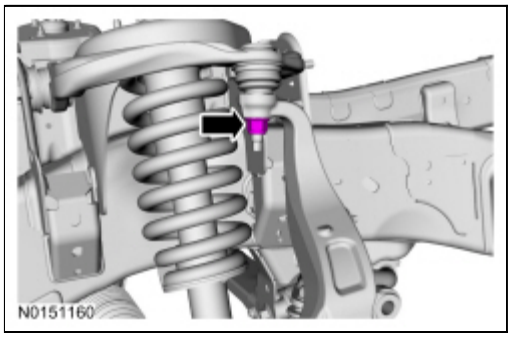


2.
    - Tighten to 175 Nm (129 lb-ft).



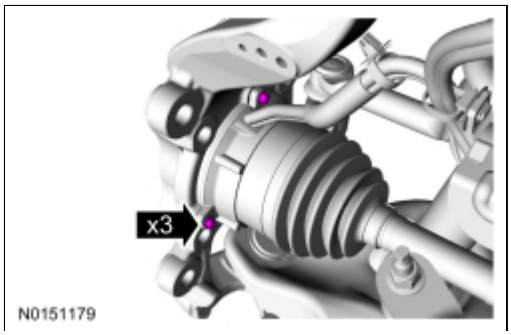
3.

- Tighten to 115 Nm (85 lb-ft).



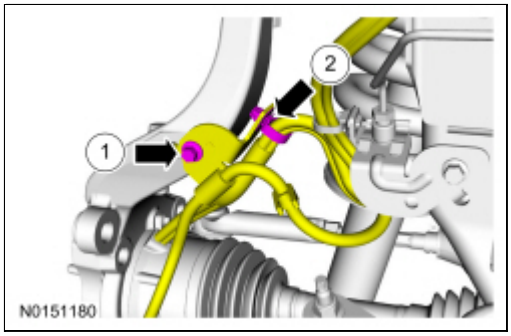
4.

- Tighten to 12 Nm (106 lb-in).



5.

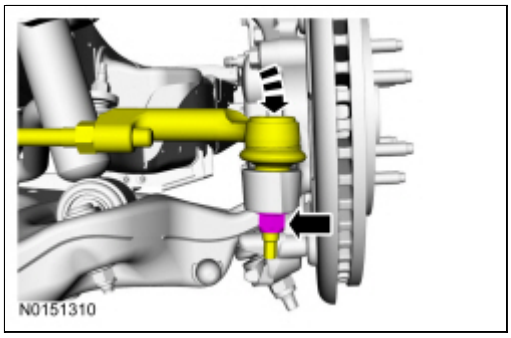
- Tighten to 12 Nm (106 lb-in).



6.

- Tighten to 115 Nm (85 lb-ft).

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7. Install the wheel bearing and wheel hub. Refer to Wheel Bearing and Wheel Hub .

Wheel Studs

For additional information, refer to Section 204-01A .

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Torque Specifications

Description	Nm	lb-ft	lb-in
Shock absorber nuts	90	66	—
Shock absorber shield bolts (SVT Raptor)	4	—	35
Spring shackle-to-frame nut	185	136	—
Spring-to-frame nut	350	258	—
Spring-to-shackle nut	185	136	—
Spring U-bolt nuts [a]	—	—	—
Jounce bumper-to-frame bolt	35	26	—

[a] Refer to the procedure in this section

Rear Suspension

Refer to Section 204-00 .

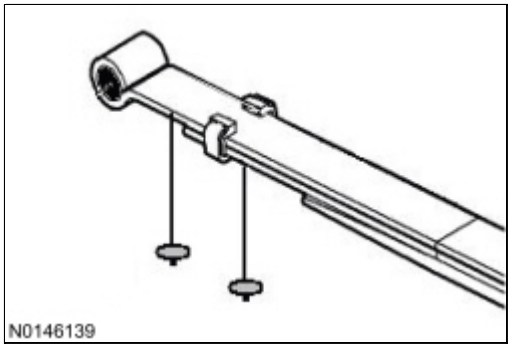
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Leaf Spring Tip Isolator

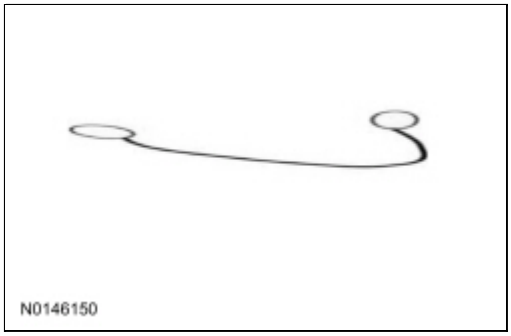
1. Position and lift the vehicle on a hoist to unload the leaf spring assembly. Refer to Section 100-02 .

2. **NOTE:** It is very important to use a non-metallic wedge or corrosion protection can be compromised.

   Use a non-metallic wedge (such as a rubber door stop or rubber coated pry bar) near the leaf tip insulator and wedge the leaf spring apart.



3. Using a locally obtained pvc cable saw, cut the top of the leaf tip insert off and remove the insert.



4. Thoroughly rinse the leaf tip insert area with brake clean and a clean shop rag to remove debris from the leaf tip insert seating area.

5. If required trim service tip insert post to aid installation between the leaves.

6. Once dry, install the new leaf spring tip insert and remove the non-metallic wedge.

7. Repeat steps 2-6 for remaining leaf tip inserts.

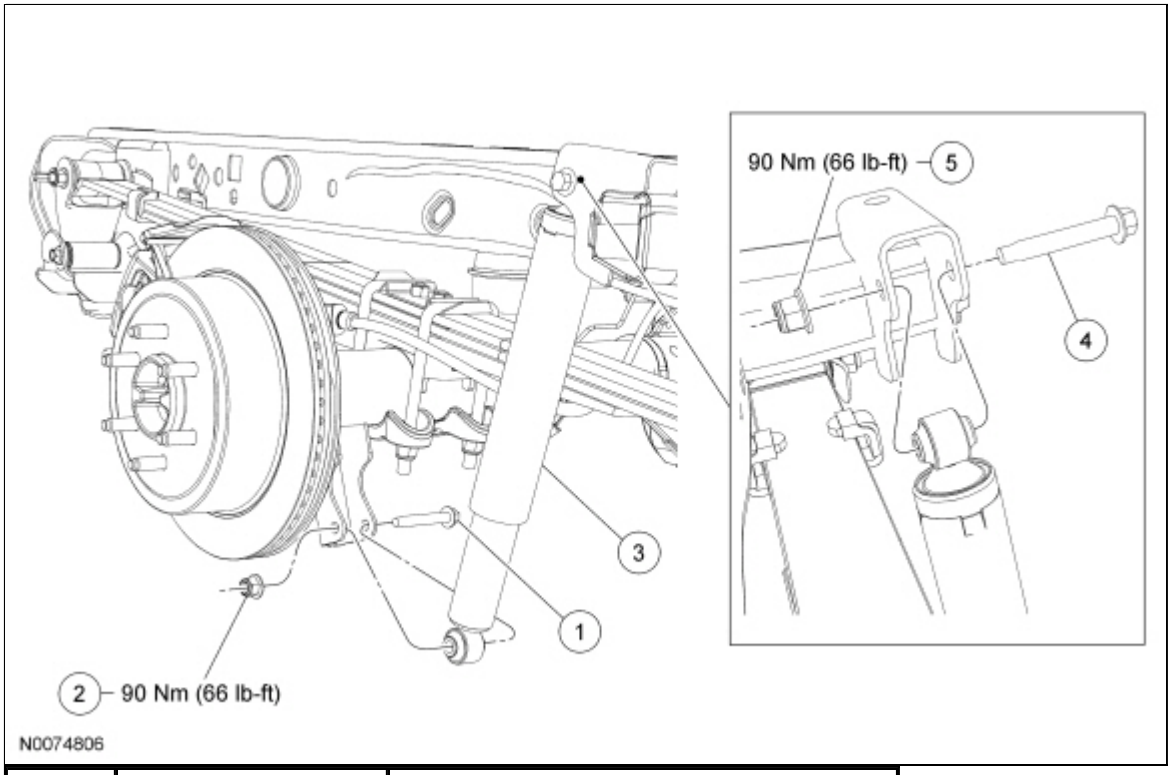
8. Lower the vehicle and wash the leaf spring assembly to remove any remaining dirt or debris using a power washer or direct stream of water.

9. Using shop air, dry the leaf spring assembly thoroughly.

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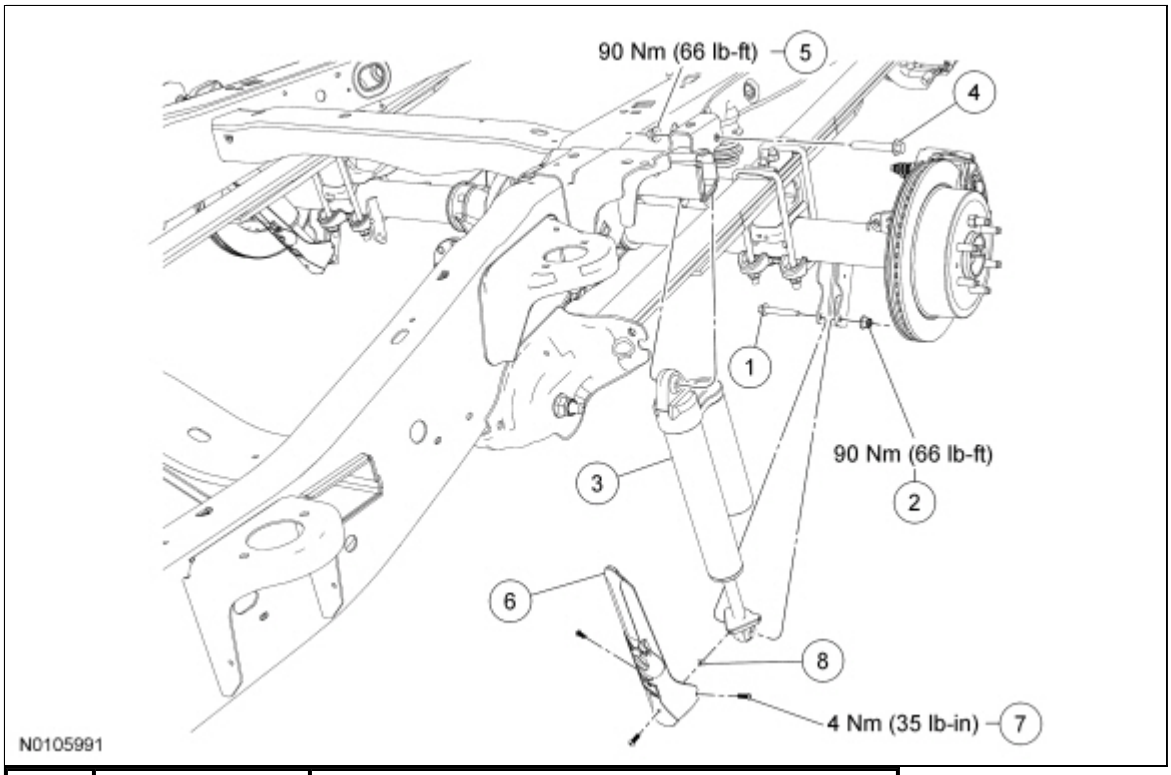
Shock Absorber

All Except SVT Raptor



Item	Part Number	Description
1	W506545	Shock absorber lower bolt
2	W520214	Shock absorber lower nut
3	18125	Shock absorber
4	W506545	Shock absorber upper bolt
5	W520214	Shock absorber upper nut

SVT Raptor



Item	Part Number	Description
1	W506545	Shock absorber lower bolt
2	W520214	Shock absorber lower nut
3	18080	Shock absorber
4	W506545	Shock absorber upper bolt
5	W520214	Shock absorber upper nut
6	18159	Shock absorber shield
7	18A149-B	Shock absorber shield bolt (3 required)
8	18A149-C	Shock absorber shield washer

WARNING: Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.

WARNING: Keep all body parts clear of shock absorbers or strut rods. Shock absorbers or struts can extend unassisted. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.**

All Vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

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02 .

2. Using a suitable jack, support the axle.

SVT Raptor

3. **NOTE:** Chase the threads in the shock prior to installing the screws. This is needed to prevent potential breaking the screws or reaching torque prior to full run-down.

   Remove the shock absorber shield.
   - Remove and discard the three shield bolts and remove the shield.
   - To install, tighten the three new bolts to 4 Nm (25 lb-in).

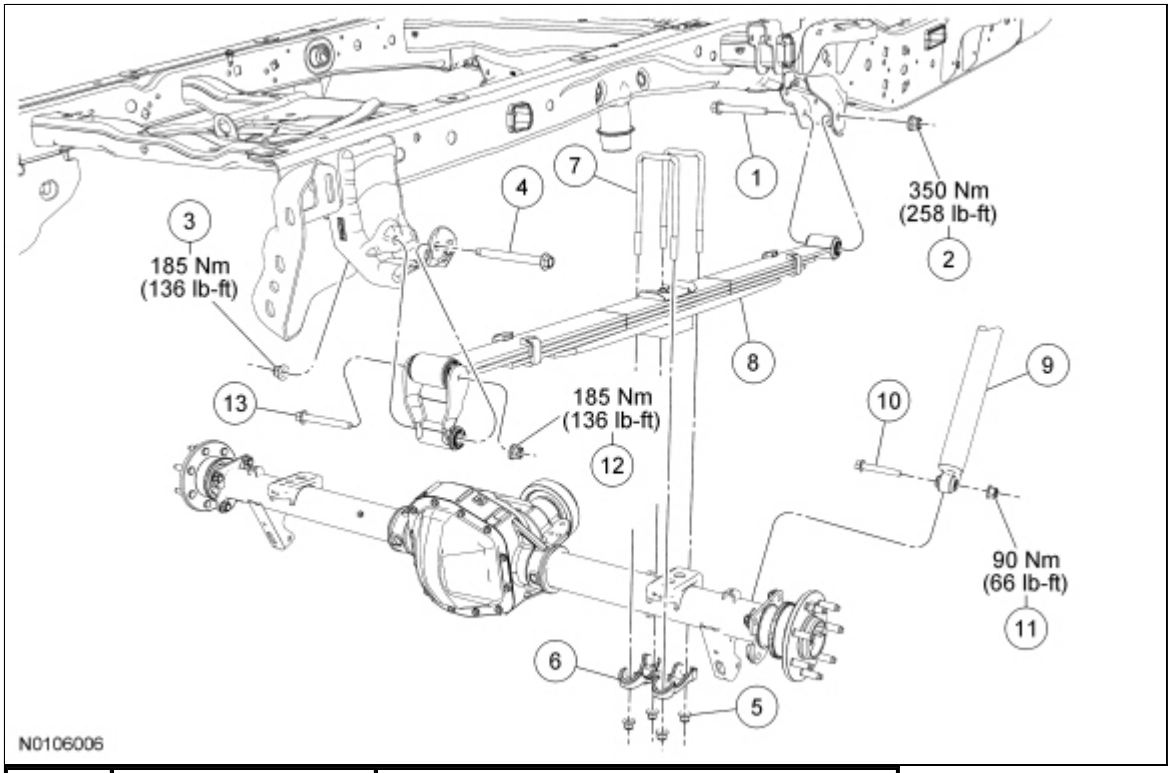
All Vehicles

4. Remove and discard the shock absorber upper nut and bolt.
   - To install, tighten the new nut to 90 Nm (66 lb-ft).

5. Remove the shock absorber lower nut, lower bolt and the shock absorber.
   - Discard the nut and bolt.
   - To install, tighten the new nut to 90 Nm (66 lb-ft).

6. To install, reverse the removal procedure.

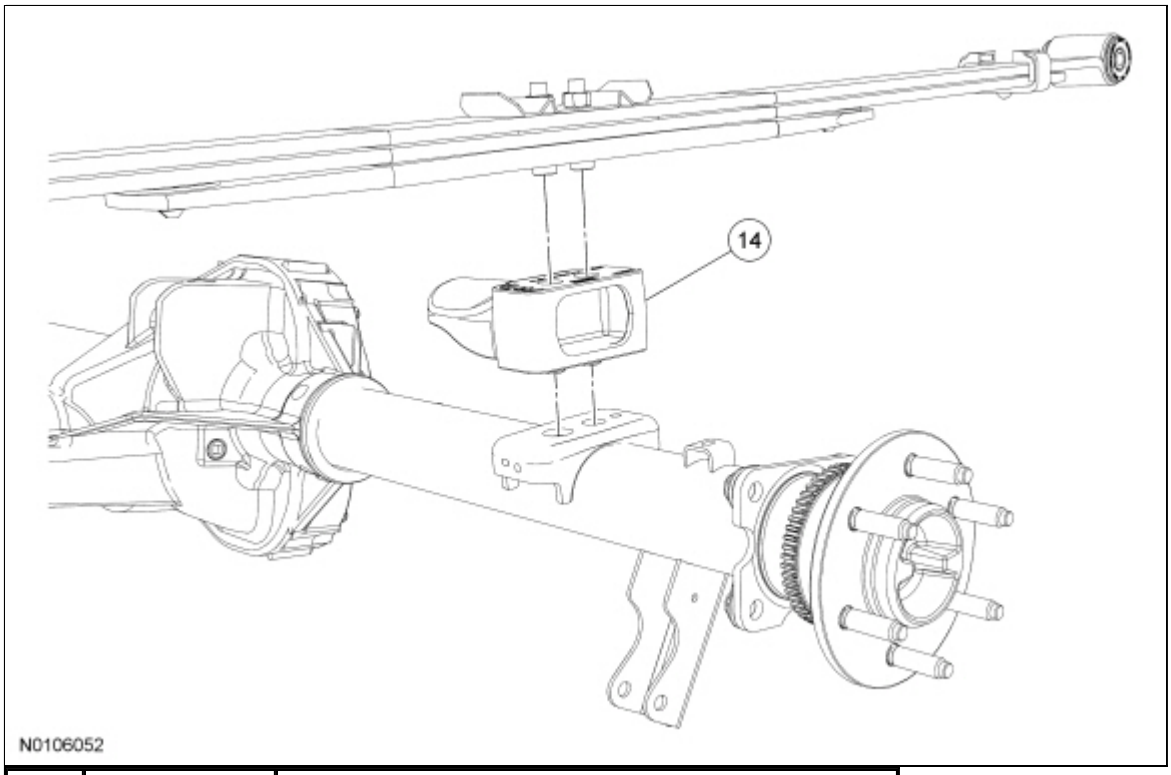
Spring



Item	Part Number	Description
1	W709627	Spring-to-frame bolt
2	W714297	Spring-to-frame nut
3	W705518	Spring shackle-to-frame nut
4	W715654	Spring shackle-to-frame bolt
5	W520215	U-bolt nut (4 required)
6	5798	U-bolt plate
7	5705	U-bolt (2 required)
8	5560	Spring
9	18125	Shock absorber
10	W506545	Shock absorber lower bolt
11	W520214	Shock absorber lower nut
12	W705518	Spring-to-shackle nut
13	W715654	Spring-to-shackle bolt

NOTE: SVT Raptor shown, others similar.

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Item	Part Number	Description
14	5A799	Spring spacer — Four-Wheel Drive (4WD) only

Removal

WARNING: Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.

WARNING: Keep all body parts clear of shock absorbers or strut rods. Shock absorbers or struts can extend unassisted. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.**

All vehicles

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. Using a suitable jack, support the axle.
3. Remove the shock absorber lower nut and bolt.
   - Discard the nut and bolt.
4. Remove the 4 U-bolt nuts, the U-bolt plate and the 2 U-bolts.

- Discard the nuts and the U-bolts.

5. For the LH spring, lower the fuel tank to gain access to the spring shackle-to-frame bolt. For additional information, refer to Section 310-01 .

6. For the RH spring, remove the muffler to gain access to the spring-to-frame bolt. For additional information, refer to Section 309-00 .

7. Remove and discard the spring-to-frame nut and bolt.

8. Remove and discard the spring shackle-to-frame nut and bolt.

9. **NOTE:** Only lower the axle enough to gain access to remove the spring.

   Lower the jack and remove the spring and shackle assembly.

10. If necessary, remove the spring-to-shackle nut, bolt and spring shackle.
    - Discard the nut and bolt.

Four-Wheel Drive (4WD) vehicles

11. Remove the Four-Wheel Drive (4WD) spring spacer.

Installation

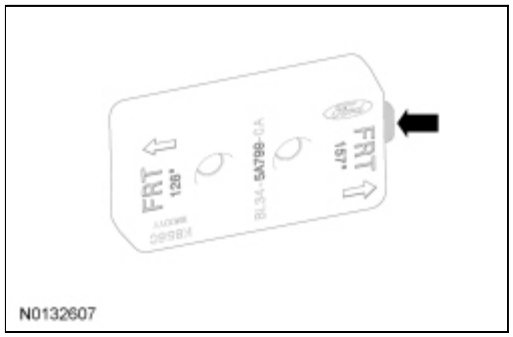
4WD vehicles

NOTE: The SVT Raptor spring spacer must be positioned with the jounce bumper pad inboard and the arrow facing the front of the vehicle.

All other vehicles, the arrow on the spring spacer must face toward the front of the vehicle according to the wheelbase application. Use specifications on spring spacer.

1. **NOTE:** The protrusion on the spring spacer should face toward the front of the vehicle on 157 inch wheelbase applications and face toward the rear on 126 inch wheelbase applications.

   Position the spring spacer and make sure that it is correctly seated between the axle and spring with the arrow pointed to the front of the vehicle according to the wheelbase application.



All vehicles

2. If necessary, install a new shackle-to-spring bolt and nut.

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- Tighten until snug.

3. Position the spring and install a new spring shackle-to-frame bolt and nut.
   - Tighten until snug.

4. Position the U-bolt plate and install the new U-bolts and nuts.
   - Tighten until snug.

5. Install a new spring-to-frame bolt and nut.
   - Tighten until snug.

6. Install a new shock absorber lower bolt and nut.
   - Tighten until snug.

7. Install the wheel and tire. For additional information, refer to Section 204-04 .

8. Lower the vehicle until the weight of the vehicle is resting on the wheels and tires (curb height).

9. Tighten the spring shackle-to-frame nut to 185 Nm (136 lb-ft).

10. Tighten the spring-to-frame nut to 350 Nm (258 lb-ft).

11. If necessary, tighten the spring-to-shackle nut to 185 Nm (136 lb-ft).

12. For the LH spring, raise the fuel tank. For additional information, refer to Section 310-01 .

13. For the RH spring, install the muffler. For additional information, refer to Section 309-00 .

14. Tighten the U-bolt nuts in 4 stages.
    - Stage 1: Tighten in a cross pattern to 35 Nm (26 lb-ft).
    - Stage 2: Tighten in a cross pattern to 70 Nm (52 lb-ft).
    - Stage 3: Tighten in a cross pattern to 100 Nm (74 lb-ft).
    - Stage 4: Tighten in a cross pattern to 133 Nm (98 lb-ft).

15. Tighten the shock absorber lower nut to 90 Nm (66 lb-ft).

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Material

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	—	—
Motorcraft® Wheel and Tire Cleaner ZC-37-A	—	—

General Specifications

Item	Specification
Tire Inflation	
Tires	See Safety Certification Label on driver door jamb
Wheel Weights	
Wheel weight type	Use a wheel weight manufacturer's rim gauge to determine the correct wheel weight application

Torque Specifications

Description	Nm	lb-in
Valve stem-to-Tire Pressure Monitoring System (TPMS) sensor screw	1.5	13
Wheel nuts [a]	—	—

[a] Refer to the procedure in this section.

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Wheels And Tires

Safety Precautions

WARNING: Vehicle may have multiple drive wheels. Do not use engine to power the driveline unless all drive wheels are elevated off the ground. Drive wheels in contact with ground could cause unexpected vehicle movement. Failure to follow this instruction may result in serious personal injury.

WARNING: Always match the tire size to the wheel size during assembly. Incorrect matching can result in tire bead damage or tire separation from the wheel. Failure to follow this instruction may result in serious personal injury to technician or vehicle occupant(s).

WARNING: Before servicing any tire, ask the customer if anyone injected a tire sealant into the tire. Tire sealants may be flammable and can burn or explode if exposed to an ignition source. Failure to follow this instruction may result in serious personal injury.

WARNING: Replacement wheels must be equivalent to the original equipment wheels in:

- **load carrying capacity.**
- **diameter, width and offset.**
- **pilot hole and bolt circle.**

Combined load carrying capacity of replacement wheels for a given axle, must be equal to or greater than that axle's gross axle weight rating (GAWR) identified on the vehicle's Safety Compliance Certification label. All other specifications should be evaluated by measurement of both the original wheel and the replacement wheel. If specifications are not equivalent, the safety and handling of the vehicle may be degraded, which may result in serious injury to the vehicle occupant(s).

WARNING: Wear eye and ear protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

WARNING: Keep eyes away from valve stem when deflating tires. Reduce air pressure in tire as much as possible by pushing in valve core plunger prior to removing the core. Escaping air can carry particles that can injure the eyes. Failure to follow these instructions may result in serious personal injury.

WARNING: Only use replacement tires that are the same size, load index, speed rating and type (such as P-metric versus LT-metric or all-season versus all-terrain) as those originally provided by Ford. The recommended tire and wheel size may be found on either the Safety Compliance Certification Label or the Tire Label, which is located on the B-pillar or edge of the driver's door. If the information is not found on these labels, consult a Ford dealer. Use of any tire or wheel not recommended by Ford can affect the safety and performance of the vehicle, which could result in an

increased risk of loss of vehicle control, vehicle rollover, personal injury and death. Additionally, the use of non-recommended tires and wheels could cause steering, suspension, axle or transfer case/power transfer unit failure.

NOTICE: **Do not clean aluminum wheels with steel wool, abrasive-type cleaners or strong detergents. Damage to the wheel finish may occur. Use Wheel and Tire Cleaner ZC-37-A or -B or equivalent.**

Factory-installed tires and wheels are designed to operate satisfactorily with loads up to and including full-rated load capacity when inflated to recommended inflation pressures.

Correct tire pressure and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration and unnecessary sharp braking increase tire wear.

To equalize tire wear, the tires should be rotated at recommended intervals.

Tire Pressure Monitoring System (TPMS)

The Tire Pressure Monitoring System (TPMS) includes:

- the Body Control Module (BCM), located behind the passenger side kick panel.
- the Tire Pressure Monitor (TPM) module, located behind the instrument panel on the RH side near the glove box.
- four valve stem mounted tire pressure sensors.
- an Instrument Panel Cluster (IPC) warning indicator.
- message center warnings.

Tire Pressure Monitor (TPM) Module

The TPM module is a radio receiver that collects the tire pressure data from the TPMS tire pressure sensors. The TPM module passes the tire pressure data to the BCM , where the BCM applies a predetermined pass/fail criteria.

The BCM compares the information of each tire pressure message against a pressure limit. If the BCM determines that the tire pressure has fallen below the minimum pressure, the BCM communicates this to the IPC on the vehicle communication network.

Tire Pressure Monitoring System (TPMS) Pressure Sensor

The BCM uses tire pressure sensors to monitor the tire pressure in the 4 road tires. The sensors transmit radio frequency signals to the BCM approximately once every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph).

The tire pressure sensors are battery operated and mounted to the valve stem.

Instrument Panel Cluster (IPC) and Message Center

The IPC illuminates the TPMS warning indicator when it receives a TPMS warning indicator on request from

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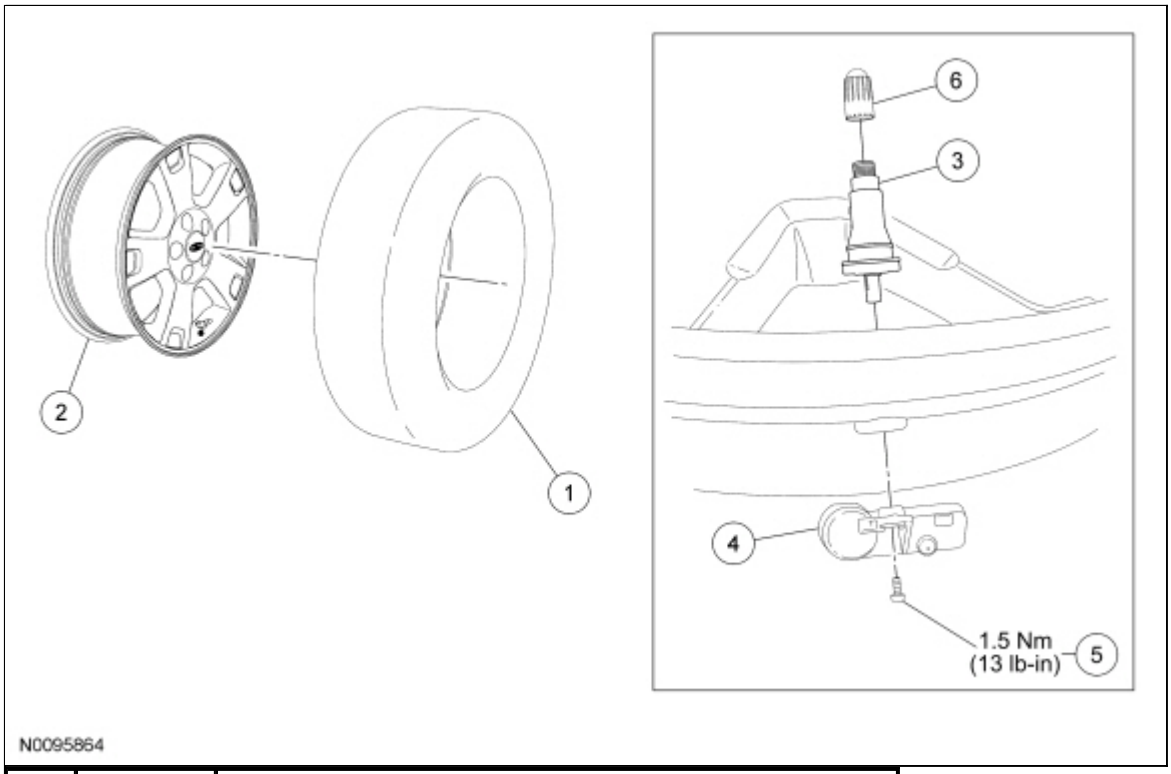
the BCM and displays the appropriate message(s) in the message center.

For additional information on the IPC and message center, refer to Section 413-01 .

Wheel and Tire

Special Tool(s)

 ST2869-A	Digital Tire Pressure Gauge 204-354



Item	Part Number	Description
1	1508	Tire
2	1007	Wheel
3	1700	Valve stem and screw (also part of 1A189)
4	1A189	Tire Pressure Monitoring System (TPMS) sensor (a new sensor assembly includes W714266 screw and 1700 valve stem and cap)
5	—	Valve stem-to- TPMS sensor screw (part of 1700)
6	1A163	Valve stem cap (also part of 1A189)

Disassembly

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WARNING: The tire pressure monitoring system (TPMS) sensor battery may release hazardous chemicals if exposed to extreme mechanical damage. If these chemicals contact the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If any part of the battery is swallowed, contact a physician immediately. When disposing of TPMS sensors, follow the correct procedures for hazardous material disposal. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Failure to follow the instructions below may result in damage to the Tire Pressure Monitoring System (TPMS) sensor.**

NOTICE: **The Tire Pressure Monitoring System (TPMS) sensor is mounted to the valve stem. Removal of the valve stem requires dismounting the tire from the wheel and removal of the TPMS sensor.**

NOTE: Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

1. Remove the wheel and tire. For additional information, refer to Wheel and Tire in this section.

2. ***NOTICE:*** **The valve stem is connected to the Tire Pressure Monitoring System (TPMS) sensor. Do not pull the valve stem from the wheel, or damage to the sensor will occur.**

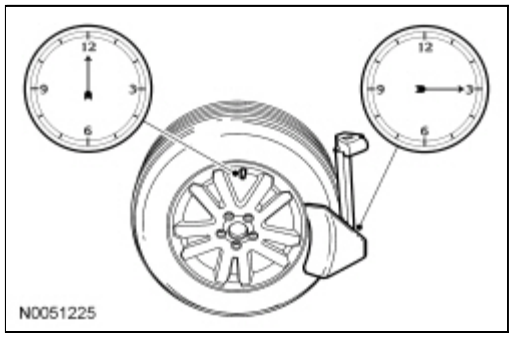
   Remove the valve stem core and fully deflate all air from the tire.
   - If a new Tire Pressure Monitoring System (TPMS) sensor is being installed, remove and discard the valve stem-to-sensor screw and the sensor.

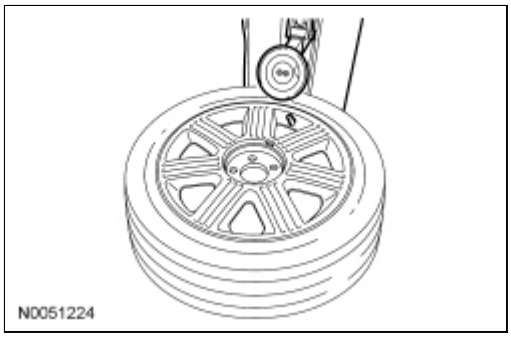
NOTICE: **Do not allow the tire beads to move beyond the wheel mid-plane (middle of the wheel) when separating the beads from the wheels, damage to the Tire Pressure Monitoring System (TPMS) sensor may occur.**

3. ***NOTICE:*** **Tire and valve stem position is critical to prevent damage to the Tire Pressure Monitoring System (TPMS) sensor when using a paddle-type bead separator.**

   NOTE: Some machines may have a nylon roller bead separator at the 12 o'clock position instead of the paddle-type bead separator at the 3 o'clock position.

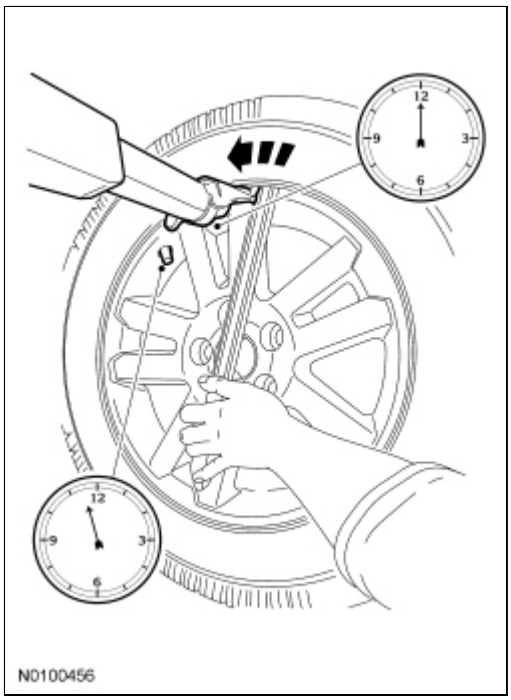
   Position the wheel and tire assembly on a suitable tire machine and separate both beads of the tire from the wheel.
   - For a paddle-type tire machine, position the valve stem at the 12 o'clock or 6 o'clock position and the paddle at the 3 o'clock position.
   - For a roller-type tire machine, align the valve stem with the roller at any position.





4. **NOTE:** Index-mark the valve stem and wheel weight positions on the tire.

   Place the wheel and tire assembly on the turntable of the tire machine with the valve stem at the 11:30 position and the machine arm at the 12 o'clock position and dismount the outer bead from the wheel.

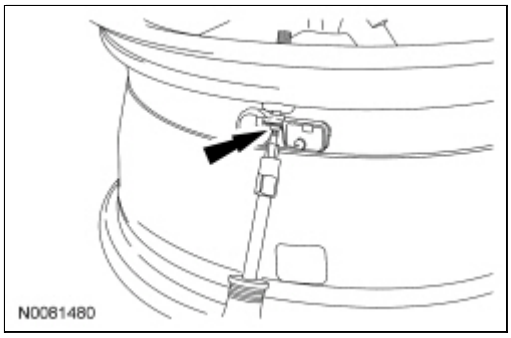


5. Reset the wheel and tire assembly on the turntable of the tire machine with the valve stem at the 11:30 position and the machine arm at the 12 o'clock position and dismount the inner bead from the wheel.

6. **NOTE:** A new valve stem must be installed whenever a new tire or wheel is installed.

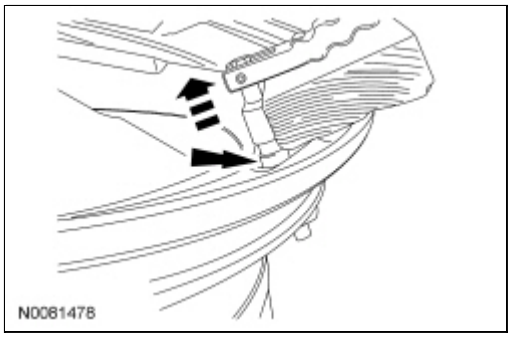
   Remove the TPMS sensor in the following sequence.
   1. Using a T10 Torx, remove the valve stem-to- TPMS sensor screw.
   2. Carefully and firmly, pull the sensor straight down and separate it from the valve stem.

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7. ***NOTICE:*** **Use care not to damage the wheel surface when removing the valve stem.**

   Using a suitable valve stem puller and a wood block, remove the valve stem from the wheel.



8. **NOTE:** When installing a new wheel, always install a new valve stem and sensor screw. Reuse the TPMS sensor from the previous wheel if possible. The TPMS will not have to be trained if the sensor is reused.

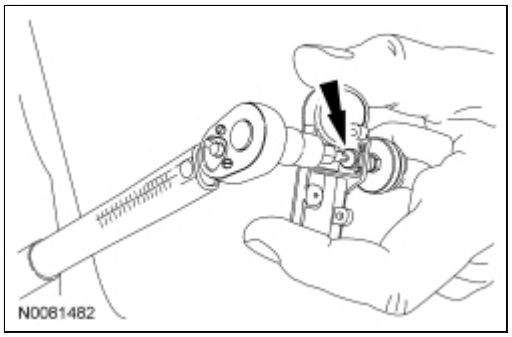
   If the TPMS sensor is being reused, inspect the TPMS sensor for damage and install a new sensor as necessary.

Assembly

NOTICE: **Damage to the Tire Pressure Monitoring System (TPMS) sensor may result if the tire mounting is not carried out as instructed.**

1. ***NOTICE:*** **To prevent Tire Pressure Monitoring System (TPMS) sensor and valve stem damage, the valve stem must be installed onto the TPMS sensor and then installed into the wheel as an assembly.**

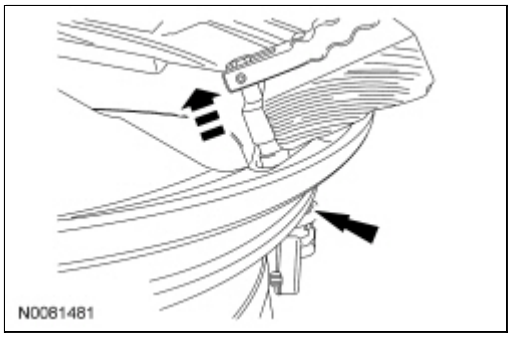
   Install a new valve stem onto the TPMS sensor.
   - Tighten the new valve stem-to- TPMS sensor screw to 1.5 Nm (13 lb-in).



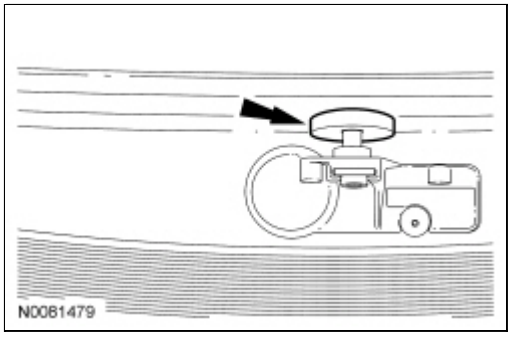
2. ***NOTICE:*** **It is important to pull the valve stem and Tire Pressure Monitoring System (TPMS) sensor assembly through the wheel rim hole in a direction parallel to the valve stem hole axis. If the assembly is pulled through at an angle, damage to the valve stem and sensor assembly may occur.**

   NOTICE: **Use care not to damage the wheel surface when installing the valve stem and Tire Pressure Monitoring System (TPMS) sensor assembly.**

   Lubricate the valve stem with soapy water and install the valve stem and TPMS sensor assembly into the wheel using a block of wood and a suitable valve stem installer.



3. Make sure the valve stem rubber is fully seated against the wheel.



4. **NOTE:** Lubricate the tire beads using a suitable fast-drying, corrosion-inhibiting tire bead lubricant.

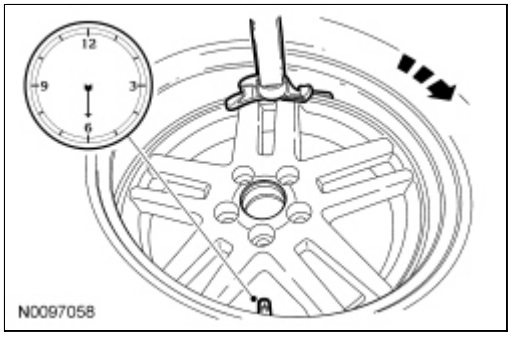
   NOTE: Do not mount the tire at this time.

   Position the wheel on the turntable of the tire machine, then lubricate and position the bottom bead of the tire on the wheel.

5. Position the wheel to align the valve stem with the machine arm, at the 6 o'clock position, and mount

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the bottom bead of the tire.



6. Reposition the wheel to align the valve stem with the machine arm at the 6 o'clock position, and mount the top bead of the tire.

7. **NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to make sure that accurate values are obtained.

   Inflate the tire to the pressure specified on the Vehicle Certification (VC) label located on the driver door or door pillar.
   - Proceed to Step 8 if the tire beads do not seat at the specified inflation pressure.

8. **WARNING: If there is a need to exceed the maximum pressure indicated on the sidewall of the tire in order to seat the beads, follow all steps listed below. Failure to follow these steps may result in serious personal injury.**

   The following steps should only be carried out if the tire beads cannot be seated by inflating the tire up to the maximum inflation pressure listed on the tire sidewall.
   1. Relubricate the tire bead and wheel bead seat area.
   2. Install a remote valve and pressure gauge.
   3. Wear eye and ear protection and stand at a minimum of 3.65 m (12 ft) away from the wheel and tire assembly.
   4. Inflate the tire using the remote valve and tire gauge until the beads have seated or until the pressure gauge is 138 kPa (20 psi) more than maximum inflation pressure on tire sidewall. If beads have not seated, deflate the tire and proceed to the next step.
   5. Place the wheel and tire assembly in an OSHA-approved tire safety cage.
   6. Inflate the tire using the remote valve and pressure gauge until the beads have seated or until the pressure gauge is 276 kPa (40 psi) more than maximum inflation pressure on the tire sidewall. **Do not exceed 276 kPa (40 psi) above the maximum pressure on tire sidewall. Install a new tire if the beads do not seat at this pressure.**

9. Install the wheel and tire. For additional information, refer to Wheel and Tire in this section.

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Tire Pressure Monitoring System (TPMS) Sensor

Disassembly

1. **NOTE:** The Tire Pressure Monitoring System (TPMS) sensor cannot be removed without disassembly of the wheel and tire.

   Disassemble the wheel and tire. For additional information, refer to Wheel and Tire in this section.

Tire Pressure Monitoring System (TPMS)

Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363
 ST2869-A	Digital Tire Pressure Gauge 204-354
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

WARNING: The tire pressure monitoring system (TPMS) sensor battery may release hazardous chemicals if exposed to extreme mechanical damage. If these chemicals contact the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If any part of the battery is swallowed, contact a physician immediately. When disposing of TPMS sensors, follow the correct procedures for hazardous material disposal. Failure to follow these instructions may result in serious personal injury.

The Tire Pressure Monitor (TPM) module monitors the tire pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit signals via radio frequency to the TPM module. The TPM module is a radio receiver that collects the tire pressure data from the tire pressure sensors. The TPMS sensor radio transmissions are sent once approximately every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The data is then sent to the Body Control Module (BCM) where a predetermined pass/fail criteria is applied. The BCM compares each TPMS sensor transmission against a low-pressure limit. If it has been determined that the tire pressure has fallen below this limit, the BCM communicates this on the vehicle communication bus to the Instrument Panel Cluster (IPC). The IPC then illuminates the TPMS warning indicator and displays the appropriate message(s) in the message center.

Ambient Temperature Change and Tire Pressure

Tire pressures fluctuate with temperature changes. For this reason, tire pressure must be set to specification

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when tires are at outdoor ambient temperatures. If the vehicle is allowed to warm up to shop temperatures, and the outside temperature is less than shop temperature, the tire inflation pressure must be adjusted accordingly.

If the tires are inflated to specification at shop temperatures, and the vehicle is moved outdoors when the outdoor ambient temperature is significantly lower, the tire pressure may drop enough to be detected by the TPMS and activate the TPMS warning indicator.

As the ambient temperature decreases by 6°C (10°F), tire pressure decreases 7 kPa (1 psi). Adjust the tire pressure by 7 kPa (1 psi) for each 6°C (10°F) ambient temperature drop as necessary to keep the tire at the specified Vehicle Certification (VC) label pressure. Refer to the following tables to adjust the tire pressure indoors for colder outside temperatures.

Table 1. Use Table to Adjust Tire Pressure Inside Garage for Colder Outside Temperature[1]

** Do Not Inflate Tire Higher than Maximum Pressure Stamped on Tire Sidewall. **

Table is based on a Garage Temperature of 70˚F. Max Pressure Adjustment is 7 psi.																		
	← Tire Placard Pressure (PSI) →																	
Outside Temperature (˚F)	30	32	34	35	38	40	41	42	45	50	55	60	65	70	75	80	85	90
70	30	32	34	35	38	40	41	42	45	50	55	60	65	70	75	80	85	90
60	31	33	35	36	39	41	42	43	46	51	56	61	67	72	77	82	87	92
50	32	34	36	37	40	42	43	44	47	53	58	63	68	73	79	84	89	94
40	33	35	37	38	41	43	44	45	49	54	59	64	70	75	80	86	91	96
30	34	36	38	39	42	44	46	47	50	55	61	66	72	77	82	87	92	97
20	35	37	39	40	43	46	47	48	51	57	62	67	72	77	82	87	92	97
10	36	38	40	41	45	47	48	49	52	57	62	67	72	77	82	87	92	97
0	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97
-10	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97
-20	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97
-30	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97
-40	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97

Table 2. Use Table to Adjust Tire Pressure Inside Garage for Colder Outside Temperature (Metric Units)[1]

** Do Not Inflate Tire Higher than Maximum Pressure Stamped on Tire Sidewall. **

Table is based on a Garage Temperature of 21˚C. Max Pressure Adjustment is 50 kPa.																		
	← Tire Placard Pressure (kPa) →																	
Outside Temperature (˚C)	205	220	235	240	260	275	285	290	310	345	380	415	450	485	515	550	585	620
21	205	220	235	240	260	275	285	290	310	345	380	415	450	485	515	550	585	620
16	215	230	240	250	270	285	290	295	315	350	385	420	460	495	530	565	600	635
10	220	235	250	255	275	290	295	305	325	365	400	435	470	505	545	580	615	650
4	230	240	255	260	285	295	305	310	340	370	405	440	485	515	550	595	625	660
-1	235	250	260	270	290	305	315	325	345	380	420	455	495	530	565	600	635	670
-7	240	255	270	275	295	315	325	330	350	395	425	460	495	530	565	600	635	670
-12	250	260	275	285	310	325	330	340	360	395	425	460	495	530	565	600	635	670
-18	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670
-23	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670
-29	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670
-34	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670
-40	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670

[1]When Outside (Ambient) Temperature is greater than 21˚C (70˚F), Inflate tires to placard pressure.
[1]Use the table to adjust tire pressure for P-metric and LT tires only.
[1]Do NOT use table for Commercial Truck Tires (i.e. 19.5 inch tires for F450 & F550). See F-Super Duty Service Manual for tire inflation procedure.

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Tire Pressure Monitoring System (TPMS) Warning Indicator and Message Center Messages

The TPMS warning indicator and vehicle message center sometimes display faults that cannot be resolved by the customer. Treat these messages as TPMS faults that must be serviced.

Tire Pressure Monitoring System (TPMS) Warning Indicator Illuminates Continuously

NOTE: When directed to train or re-train any TPMS sensors, use **only** the sensor training procedure outlined in Tire Pressure Monitoring System (TPMS) Sensor Training . Do not use the TPMS reset procedure outlined in the Owner's Literature as this procedure **will not** program new sensors to the module.

The TPMS warning indicator remains on continuously and the message center displays LOW TIRE PRESSURE when any of the tire pressures are low. When this condition exists, adjust the tire pressure to the recommended cold pressure indicated on the VC label.

NOTE: The TPMS sensors do not transmit when the vehicle is stationary. If the vehicle has been stationary for more than 30 minutes, it is necessary to wake up the sensors so that they transmit the latest tire pressure information to the TPM module.

If the vehicle has been stationary for more than 30 minutes, carry out the Tire Pressure Monitoring System (TPMS) Sensor Activation procedure in this section.

TPMS Warning Indicator Flashes

The TPMS warning indicator flashes for 70 seconds, then remains ON continuously when the ignition switch is turned to the ON position and 1 or more of the following conditions exists:

- Tire Pressure Sensor Fault — The message center displays TIRE PRESSURE SENSOR FAULT when a TPMS sensor is malfunctioning. GO to Symptom Chart .
- No communication with the BCM . The TPMS indicator is illuminated when the IPC has not received any signals from the BCM for more than 5 seconds. The message center displays TIRE PRESSURE MONITOR FAULT. GO to Symptom Chart .
- Tire Pressure Monitor Fault — The message center displays TIRE PRESSURE MONITOR FAULT when the TPMS is malfunctioning or communication with the IPC has been lost. GO to Symptom Chart .

The TP_STAT PID can be used to determine why the TPMS warning indicator is flashing.

Tire Pressure Monitoring System (TPMS) PID Definitions and Intermittent Troubleshooting

TPMS Status PID

The TPM monitors the TPMS status. The current status can be viewed by accessing the TPMS status PID : TPMS_STAT using the scan tool. This helps identify the current system status and may aid in diagnosing the system. The PID has 4 valid states:

1. TPMS_STAT = SENSOR FAULT.
    - If the module has not received the tire pressure status from 1 to 3 TPMS sensors for 20 minutes when the vehicle speed is above 32 km/h (20 mph), the PID displays SENSOR FAULT.

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2. TPMS_STAT = SYSTEM FAULT.
    - If the module has not received the tire pressure status from all 4 TPMS sensors for 20 minutes and the vehicle speed is above 32 km/h (20 mph), the PID displays SYSTEM FAULT.

3. TPMS_STAT = LOW.
    - If the module has detected that at least 1 TPMS sensor is reporting low tire pressure, the PID displays LOW.

4. TPMS_STAT = SYSTEM ACTIVE.
    - If the TPMS is functioning normally, the PID displays SYSTEM ACTIVE.

TPMS Last Warning Event PID Definitions

The TPMS uses the TPMS last warning event PIDs to store detailed information about the last 5 times the TPMS warning indicator was activated. These PIDs can be used to acquire more information about a particular TPMS event, but must be used carefully.

EVT1_AGE_IGN through EVT5_AGE_IGN

The number of key cycles since the TPMS indicator was activated. This PID cycles from zero to 255. Default is $00, this can be used to determine how long ago a TPMS event occurred and the time (in key cycles) between events.

EVT1_TR_LOC through EVT5_TR_LOC

This is the last programmed location for the sensor identifier causing each TPMS event. Due to tire rotation, the sensor may no longer be at the original location. It is suggested that all the PIDs be recorded, the system retrained, and then the sensor identifier PIDs be used to pinpoint the actual location of each sensor.

EVT1_PRESS through EVT5_PRESS

This is the tire pressure associated with each TPMS warning indicator event. This can be used along with the function code to clearly identify the TPMS events that were strictly due to low pressure. It can also be used to determine when a sensor is transmitting inaccurate tire pressure.

EVT1_SNSR_ST through EVT5_SNSR_ST

Describes the warning status of each TPMS event by using the information received from the TPMS status (TPMS_STAT) PID . If there is a communication issue, the status could be Normal.

- Unknown
- Normal (normal operation)
- Low (low pressure event)
- Fault (sensor fault or system fault)

EVT1_SNSR_ID through EVT5_SNSR_ID

This is the identifier of the sensor involved in each TPMS event. EVT1 is the most recent event that triggered the TPMS warning indicator. Default is $ 00 00 00 00.

Wheel Rotation and Sensor Training Techniques

Moving a Problem Sensor/Wheel to a Different Position

If a sensor in a certain location has caused several events, yet the sensor trains and seems to operate normally, moving that particular wheel to a different location on the vehicle is a good way to isolate the issue to a certain sensor/wheel location. Rotate the wheels and road test the vehicle. This can be done in an attempt to replicate the issue. This determines if the issue followed the sensor or remained in the original sensor location.

Training Sensors in a Different Order

This is a technique to get past a left front sensor that may not be responding to determine if the remaining sensors train to the module. This can help save time determining if other sensors are having issues or if the module is experiencing training difficulties with a certain location.

Training Known Good Sensors From Another Vehicle

Training known good sensors from another vehicle cannot differentiate between a faulted module and Radio Frequency Interference (RFI), as some noise source could be preventing the TPM module from receiving the tire pressure status from the original sensors as well as the known good sensors. This technique can be used to differentiate between a sensor and module issue. If the TPM module cannot train any of the sensors on the same vehicle, and likewise cannot train known good sensors from another vehicle, then the issue is with the TPM module or RFI and not with the original sensors. The original sensors should not be replaced.

Items That Cause RFI

Non-OEM Equipment

The following equipment has been found to sometimes cause RFI :

- Video equipment has been found to cause RFI especially when the video and power supply lines are near the TPMS .
- Car alarms (even those installed by dealerships) have been found to create enough RFI to cause the TPMS to malfunction or lose considerable range. These car alarms can sometimes be difficult to locate, as they are usually hidden somewhere out of the way for reduced accessibility.
- Many different in-vehicle cell phone chargers have been found to cause considerable RFI . The vehicles with the power point closest to the TPM module are the most affected. It must be noted that most cell phone chargers do not produce high levels of RFI all the time. This depends on the state of charge of the cell phone battery. The phone must be almost completely discharged in some cases.
- Power supplies and DC/AC inverters typically create a lot of RFI . Most consumer grade equipment has very little filtering or shielding.

OEM Modules

In some cases, the RFI may actually be caused by a module or ground on the vehicle. Depending on the severity of the issue, a dirty ground, improperly built ground shield or module can disable the system. Modules that have microcontrollers using clock circuits to create the timing pulses for the microprocessor may radiate RFI .

Using Customer's Electronics to Pinpoint the Radio Frequency Interference (RFI) Source

This can be a way to determine the cause of an issue well before the sensors and module are replaced with little or no affect on the system performance. Since this takes more up-front work, it relies on working with the customer to determine what equipment was being used at the time of the event.

Options for Eliminating Intermittent TPMS Conditions Caused by RFI

- If an OEM component or customer device is causing an RFI issue, replace the device.

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- If a phone charger is causing an RFI issue, the customer should consult their cell phone provider to acquire a different phone charger.
- If a device such as a dealer-installed alarm is causing an RFI issue, move the device to another location on the vehicle. In the case of a portable device, move the power cord to another power point location.

In summary, if the RFI source is present and cannot be moved or replaced, the intermittent issue remains. The TPMS system must accept RFI and the unwanted system operation it can cause.

Inspection and Verification

1. Verify the customer concern. Keep the following items in mind when diagnosing any TPMS related issue:
    - The tire pressure sensors are not designed to be used with aftermarket wheels. The use of run-flat tires (tires with steel body cord plies in the tire sidewall) that are not originally equipped, may block the TPMS signal and are not recommended.
    - Non-OEM modifications made to the vehicle may result in false TPMS warnings.
    - Swapping wheels on vehicles with the same TPMS sensors sets a fault if the sensors are not trained. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
    - The tire pressure calibrations in the TPM for the system cannot be changed to use lower tire pressures than those listed on the Vehicle Certification (VC) label.
    - Certain non-OEM electronic equipment may cause RFI and false TPMS warnings. To aid in diagnosis, obtain information from the owner regarding any equipment that has been added or was in use at the time the TPMS fault occurred.
    - It may be necessary to disconnect any electronic add-on equipment to verify its impact on TPMS operation. For intermittent cases, it may be necessary to ask the customer to provide portable electronic equipment to verify its impact on the system.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Low tire pressure • Spare tire installed as a road wheel • Sensors not trained after a tire rotation • Tire Pressure Monitoring System (TPMS) sensor damaged or missing • Incorrect TPMS sensor installed • TPMS sensor installed incorrectly • Non-OEM wheels installed (aftermarket rims) • Non-OEM equipped run-flat tires or rigid sidewall tires (19.5" steel carcass heavy-duty tires) installed • Other non-OEM modifications (roll cages, service barriers, part racks, ladder racks)	• Body Control Module (BCM) fuse 26 (5A) • Wiring, terminals or connectors • TPM missing or damaged • Aftermarket electronic accessories (in-car chargers or supplies, DC/AC inverters, video screens, car alarms)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To the Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the CMDTCs and carry out the self-test diagnostics for the BCM and the TPM module.

9. If the DTCs retrieved are related to the concern, go to the BCM DTC Chart or the TPM Module DTC Chart. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1182:00	Tire Pressure Monitoring System (TPMS): No Sub Type Information	GO to Pinpoint Test F.
B1182:55	Tire Pressure Monitoring System (TPMS): Not Configured	This DTC is only present when a new BCM is installed, the BCM is flashed or is reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
B124D:02	Tire Pressure Sensor: General Signal Failure	**NOTE:** If the vehicle has been stationary for more than 30 minutes, the sensors go into sleep mode to conserve battery power. It may be necessary to wake them up so they transmit the latest tire pressure information to the TPM module. ACTIVATE the TPMS sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section.

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		REPEAT the self-test. If DTC B124D:02 is retrieved again, GO to Pinpoint Test F .
B1251:00	Tire Pressure Sensor Low Battery: No Sub Type Information	GO to Pinpoint Test H .
B1254:51	Right Rear (Outside on Dual Wheel) Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new BCM is installed, the BCM is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
B1255:51	Left Rear (Outside on Dual Wheel) Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new BCM is installed, the BCM is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
C1A56:51	Left Front Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new BCM is installed, the BCM is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
C1A58:51	Right Front Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new BCM is installed, the BCM is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
All other DTCs	—	REFER to Section 419-10 .

Tire Pressure Monitor (TPM) Module DTC Chart

DTC	Description	Action
B1D55:01	Antenna #2: General Electrical Failure	REFER to Section 303-06 .
U0140:87	Lost Communication with Body Control Module: Missing Message	GO to Pinpoint Test I .
U0422:68	Invalid Data Received from Body Control Module (BCM): Event Information	RETRIEVE and REPAIR all non-network DTCs in the BCM . REFER to Section 419-10 .

Symptom Chart

Symptom Chart

NOTE: For vehicles with different front and rear tire pressures, the tire pressures must be adjusted and the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors results in a false low tire pressure event, causing the Tire Pressure Monitoring System (TPMS) indicator to illuminate.

For vehicles with the same tire pressure for front and rear tires, training the sensors is not necessary after a tire rotation.

Failure of a TPMS component may not cause the message center to display a fault message or store a DTC. The Symptom Chart is a starting point to begin diagnosis of these concerns.

Condition	Possible Sources	Action
• The Tire Pressure Monitoring System (TPMS) warning indicator is on continuously and the message center displays LOW TIRE PRESSURE	• Spare tire currently in use • Tire pressure not set to specifications listed on the Vehicle Certification (VC) label • TPMS sensors not trained following tire rotation • TPMS sensor(s)	• GO to Pinpoint Test D .
• The Body Control Module (BCM) cannot enter sensor training mode when using the TPMS sensor training procedure	• Stoplamp switch concern • Ignition switch concern • BCM	• GO to Pinpoint Test E .
• The TPMS warning indicator illuminates with DTCs present	• Not all TPMS sensors are installed • TPMS sensors not trained • TPMS sensor(s) • Intermittent TPMS operation due to Radio Frequency Interference (RFI) • TPM module wiring • TPM module • BCM wiring • BCM	• GO to Pinpoint Test F .
• The TPMS warning indicator illuminates with no DTCs present	• Communication network concern • Instrument Panel Cluster (IPC)	• REFER to Section 413-01 to diagnose the TPMS warning indicator is always on.
• One or more TPMS sensors do not train and DTCs are present	• TPMS sensor(s) • Vehicle communication issue • Intermittent TPMS operation due to RFI • TPM module wiring • TPM module • BCM wiring • BCM	• FOLLOW the diagnostics for the DTC(s) retrieved. REFER to DTC Charts in this section.
• One or more TPMS sensors do not train and no DTCs are present	• TPMS sensor(s) • Radio Frequency Interference (RFI)	• GO to Pinpoint Test G .

Pinpoint Tests

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Pinpoint Test D: The Tire Pressure Monitoring System (TPMS) Warning Indicator Is ON Continuously and The Message Center Displays LOW TIRE PRESSURE

Normal Operation

The Tire Pressure Monitor (TPM) module monitors the air pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit data via radio frequency signals to the TPM module. The TPM module is a radio receiver that collects the air pressure data from the Tire Pressure Monitoring System (TPMS) tire pressure sensors. The data is then sent to the Body Control Module (BCM) where a predetermined pass/fail criteria is applied. The TPMS sensor radio transmissions are sent approximately once every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The BCM compares each TPMS sensor transmission against a low-pressure limit. If it has been determined that the tire pressure has fallen below this limit, the BCM communicates this on the vehicle communication bus to the Instrument Panel Cluster (IPC). The IPC then illuminates the TPMS warning indicator and displays the appropriate message(s) in the message center .

This symptom can also be caused by a spare tire currently being used in place of a road tire. Make sure that the spare tire is not currently in use. On vehicles with different front and rear tire pressures, if the sensors are not trained following a tire rotation, this symptom may result. Advise the customer that on vehicles with different front and rear tire pressures, the sensors must be trained as directed in the Owner's Literature.

This pinpoint test is intended to diagnose the following:

- Spare tire currently in use
- Tire pressure not set to specifications listed on the Vehicle Certification (VC) label
- TPMS sensors not trained following tire rotation
- TPMS sensor(s)

PINPOINT TEST D: THE TPMS WARNING INDICATOR IS ON CONTINUOUSLY AND THE MESSAGE CENTER DISPLAYS LOW TIRE PRESSURE

NOTE: Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

NOTE: If a warranty case is opened for an actual TPMS fault, document and include the actual tire pressure data in all warranty communications.

Test Step	Result / Action to Take
D1 CHECK FOR LOW TIRE PRESSURE • Using the Digital Tire Pressure Gauge, measure and record the air pressure in all 4 tires. • Adjust the pressure for those found to be below the specification listed on the VC label. • Activate each sensor at least twice with the training tool or customer activation tool to make sure the TPM module gets the latest air pressure data. Refer to Tire Pressure Monitoring System (TPMS) Sensor Activation or drive the vehicle for at least 2 minutes above 32 km/h (20 mph) to clear the low pressure warning. Do not train the sensors at this time. • **Has the TPMS warning indicator gone out?**	**Yes** The system is operating correctly at this time. The concern was caused by low tire pressure. **No** GO to D2.
D2 CHECK FOR SPARE TIRE IN USE **NOTE:** The spare tire is not programmable even if it is	**Yes** REPAIR and REMOUNT the

equipped with a TPMS sensor. If a damaged road wheel is located in the cargo area, the sensor may still be recognized by the TPMS as low. Make sure the spare tire is not currently in use. To restore TPMS functionality, repair the damaged road wheel and re-mount it to the vehicle. • Check spare tire location. • **Is the spare tire in use?**	wheel to the vehicle. REFER to Wheel and Tire in this section. ADJUST tire pressures to the required pressure as defined on the VC label located in the driver door jam. **No** GO to D3.
D3 CHECK IF THE TIRES WERE ROTATED WITHOUT TPMS SENSOR TRAINING	

NOTE: If the TPMS sensors at the front of the vehicle are still trained in the rear positions but inflated to the front air pressures, the TPMS warning indicator illuminates continuously.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: DataLogger — BCM.
• Monitor and record the following BCM PIDs:
  ▪ Left Front Tire Pressure (TPM_PRES_LF)
  ▪ Right Front Tire Pressure (TPM_PRES_RF)
  ▪ Left Rear Tire Pressure (TPM_PRES_LRO)
  ▪ Right Rear Tire Pressure (TPM_PRES_RRO)
• **Do the rear PIDs show front air pressures and the front PIDs show rear air pressures?**
	Yes
	The tires have been rotated without training the sensors. TRAIN the sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
	
	No
	GO to D4.

D4 CHECK FOR STUCK TPMS SENSOR	

• Monitor and record the following BCM PIDs:
  ▪ Left Front Tire Pressure (TPM_PRES_LF)
  ▪ Right Front Tire Pressure (TPM_PRES_RF)
  ▪ Left Rear Tire Pressure (TPM_PRES_LRO)
  ▪ Right Rear Tire Pressure (TPM_PRES_RRO)
• Using the Digital Tire Pressure Gauge, measure the actual tire pressures.
• Compare the air pressure PIDs with the actual air pressures.
• **Do the compared tire pressure values match within ± 5 psi?**
	Yes
	REFER to Section 413-01 to diagnose the TPMS warning indicator is always on.
	
	No
	INSTALL a new TPMS sensor (s) for the sensor(s) in question. REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section.

Pinpoint Test E: The Body Control Module (BCM) Cannot Enter Sensor Training Mode When Using the Tire Pressure Monitoring System (TPMS) Sensor Training Procedure

Normal Operation

For the Body Control Module (BCM) to enter Tire Pressure Monitoring System (TPMS) sensor training mode, the BCM must receive valid inputs from the stoplamp switch (off) and ignition switch (run), and it must receive valid vehicle speed sensor input (0 km/h [0 mph]). Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section for the complete sensor training procedure.

This pinpoint test is intended to diagnose the following:

- Stoplamp switch concern
- Ignition switch concern
- BCM

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PINPOINT TEST E: THE BCM CANNOT ENTER SENSOR TRAINING MODE WHEN USING THE TPM SENSOR TRAINING PROCEDURE

Test Step	Result / Action to Take
E1 CHECK THE STOPLAMP OPERATION • Ignition ON. • Press and release the brake pedal while monitoring the stoplamps. • **Do the stoplamps operate properly?**	**Yes** GO to E2. **No** REFER to Section 417-01 to continue diagnosis of the stoplamp switch.
E2 CHECK THE IGNITION SWITCH INPUT • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Monitor the BCM ignition switch PID (IGN_SW_STATE) with the ignition in the RUN position. • **Does the PID indicate the correct ignition switch position?**	**Yes** GO to E3. **No** REFER to Section 211-05 to continue diagnosis of the ignition switch.
E3 CHECK FOR VEHICLE SPEED-RELATED DTCs IN THE BCM • Carry out the BCM self-test. • **Are any vehicle speed-related DTCs present?**	**Yes** REFER to the BCM DTC Chart in Section 419-10. **No** GO to E4.

E4 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check the connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure that they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: The Tire Pressure Monitoring System (TPMS) Warning Indicator Illuminates With DTCs Present

Normal Operation

If there is a fault with 1, 2 or 3 of the Tire Pressure Monitoring System (TPMS) sensors, DTC B124D:02 sets. The TPMS warning indicator flashes for 70 seconds and then remains on continuously when the ignition switch is turned to the ON position and the message center displays TIRE PRESSURE SENSOR FAULT.

If the TPM module does not get a response from all 4 of the TPMS sensors and transfers that information to

the BCM , DTC B1182:00 sets and the message center displays TIRE PRESSURE MONITOR FAULT.

It should be noted that TPMS sensor communication to the TPM module can be interrupted by radio frequency noise, which can cause intermittent issues that are not vehicle concerns. Radio frequency noise is generated by electrical motors and appliance operation, cellular telephones, remote transmitters, power inverters and portable entertainment equipment. Anytime the TPMS sensor training procedure is performed successfully, the warning indicator is extinguished and the vehicle must be driven for 18-20 minutes before the TPM module sets a fault.

- DTC B1182:00 (Tire Pressure Monitoring System (TPMS): No Sub Type Information) — set by the BCM when **all 4** of the tire pressure sensors are faulted, not responding or not heard by the TPM module.
- DTC B124D:02 (Tire Pressure Sensor: General Signal Failure) — set by the BCM when 1, 2 or 3 of the tire pressure sensors are faulted, not responding or not heard by the TPM module.
- TPMS_STAT PID = SENSOR FAULT — when the BCM does not receive the tire pressure status for 1 to 3 TPMS sensors from the TPM module for 20 minutes with vehicle speed above 32 km/h (20 mph).
- TP_STAT PID = SYSTEM FAULT when the BCM does not receive a signal transmission from **all 4** TPMS sensors from the TPM module for 20 minutes with vehicle speed above 32 km/h (20 mph).

This pinpoint test is intended to diagnose the following:

- Not all TPMS sensors are installed
- TPMS sensors not trained
- TPMS sensor(s)
- TPM module wiring
- TPM module
- BCM wiring
- BCM

PINPOINT TEST F: THE TPMS WARNING INDICATOR ILLUMINATES WITH DTCs PRESENT

NOTE: If a warranty case is opened for an actual TPMS fault, document and include the actual tire pressure data in all warranty communications.

NOTE: If the vehicle has been stationary for more than 30 minutes, the sensors go into a "sleep mode" to conserve battery power. It is necessary to wake them up so that they transmit the latest tire pressure information to the TPM module.

Test Step	Result / Action to Take
F1 VERIFY TPM MODULE COMMUNICATION	
• Ignition ON. • Using a scan tool, carry out the Network Test. • **Does the TPM module pass the Network Test?**	**Yes** GO to F2 . **No** REFER to Section 418-00 to diagnose the TPM module does not respond to the scan tool.
F2 CHECK THE SENSOR IDENTIFIER PIDs AND SYSTEM STATUS PID	
• Enter the following diagnostic mode on the scan tool: DataLogger —	**Yes** GO to F3 .

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BCM . • Read and record the following PIDs : ▪ Left Front Tire Transmitter Identifier (TPM_S_ID_LF) ▪ Right Front Tire Transmitter Identifier (TPM_S_ID_RF) ▪ Left Rear Tire Transmitter Identifier (TPM_S_ID_LRO) ▪ Right Rear Tire Transmitter Identifier (TPM_S_ID_RRO) • Monitor the TPMS system status (TPMS_STAT) PID . • **Does the TPMS_STAT PID display SENSOR FAULT?**	**No** If the TPMS_STAT PID displays SYSTEM FAULT, GO to F4 .
F3 CARRY OUT THE SENSOR TRAINING PROCEDURE (SENSOR FAULT)	
• Train all 4 tire pressure sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did all of the tire pressure sensors transmit correctly and did the horn sound when each TPMS sensor transmitted to the TPM module?**	**Yes** Using the scan tool, LOCATE the updated TPMS sensor identifiers trained to the BCM module. COMPARE these values to those recorded prior to the TPMS sensor training procedure. Disregarding sensor position, any sensor identifiers that do not match those retrieved from the module were changed, but not retrained. The sensors are now trained to the vehicle, diagnosis is complete. DOCUMENT all TPMS sensor identifiers on the applicable warranty claim. TEST the system for normal operation. **No** **Before installing a new sensor(s)** : If a sensor does not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensor again. If the sensor still fails to train, ATTEMPT to train the sensor with the vehicle doors open. If the sensor(s) fails to train a second time, INSTALL a new TPMS sensor (s) for the sensor(s) in question. REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section.
F4 CARRY OUT THE SENSOR TRAINING PROCEDURE (SYSTEM FAULT)	
• Train all 4 tire pressure sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did all of the tire pressure sensors transmit correctly and did the horn sound when each TPMS sensor transmitted to the TPM module?**	**Yes** Using the scan tool, LOCATE the updated TPMS sensor identifiers trained to the BCM module. COMPARE these values to those recorded prior to the Tire Pressure Monitoring System (TPMS) Sensor Training procedure. Disregarding sensor position, any sensor identifiers that do not match those retrieved from the module were changed, but not retrained. The sensors are now trained to the vehicle, diagnosis is complete. DOCUMENT all TPMS sensor identifiers on the applicable warranty claim. TEST the system for normal operation.

	No **Before installing a TPM module** : If sensors do not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensors again. If the sensors still fail to train, ATTEMPT to train the sensors with the vehicle doors open. If the sensors still fail to train, INSTALL a new TPM module. REFER to Tire Pressure Monitor (TPM) Module in this section. TEST the system for normal operation. If the concern is still present, GO to F5.
F5 CHECK FOR CORRECT BCM OPERATION • Disconnect all the BCM electrical connectors. • Check the connectors for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the BCM connectors and make sure that they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** **NOTE:** The TPMS sensors may not be present. DISMOUNT the tire. REFER to Wheel and Tire in this section. VERIFY the TPMS sensors are present and mounted to the wheels. If missing, INSTALL new TPMS sensors. If the TPMS sensors are present, INSTALL a new BCM. REFER to Section 419-10. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test G: One Or More TPMS Sensors Do Not Train And No DTCs Are Present

NOTE: If the vehicle has been stationary for more than 30 minutes, the sensors go into a sleep mode to conserve battery power. It becomes necessary to wake them up so they transmit the latest tire pressure information to the TPM module. For additional information, refer to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section.

Normal Operation

The TPM module monitors the tire pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit signals via radio frequency to the Tire Pressure Monitor (TPM) module. The TPM module is a radio receiver that collects the tire pressure data from the tire pressure sensors. The TPMS sensor radio transmissions are sent approximately once every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The BCM learns the position on the vehicle of each TPMS sensor through the training process. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section for the complete sensor training procedure.

This pinpoint test is intended to diagnose the following:

- TPMS sensors
- Radio Frequency Interference (RFI)

PINPOINT TEST G: ONE OR MORE TPMS SENSORS DO NOT TRAIN AND NO DTCs ARE PRESENT

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Test Step	Result / Action to Take
G1 ATTEMPT TO TRAIN THE TPMS SENSORS **NOTE:** Banded TPMS sensors are not compatible with the valve mounted TPMS sensor system. **NOTE:** The BCM has a 2-minute time limit between sensor responses. If the BCM does not recognize any 1 of the 4 tire pressure sensors during this time limit, the horn sounds twice, the message center displays TIRE NOT TRAINED REPEAT, and the entire procedure must be repeated. • Train all 4 TPMS sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Do all of the TPMS sensors train?**	**Yes** The system is operating correctly at this time. The concern may have been caused by RFI . **No** If one or more TPMS sensors trained, GO to G2 . If none of the TPMS sensors trained, GO to Pinpoint Test E .
G2 CHECK FOR RADIO FREQUENCY INTERFERENCE • Ignition ON. • Move the vehicle to rotate the wheels at least one-fourth turn. • Train all 4 TPMS sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did the TPMS sensor(s) train?**	**Yes** The system is operating correctly at this time. The concern may have been caused by RFI . **No** ATTEMPT to train the TPMS sensor(s) with the doors open. If the TPMS sensor(s) still do not train INSTALL a new TPMS sensor(s) for the sensor(s) in question. REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section. TEST the system for normal operation.

Pinpoint Test H: DTC B1251:00

Normal Operation

- DTC B1251:00 (Tire Pressure Sensor Low Battery: No Sub Type Information) — This DTC sets in continuous memory in the Body Control Module (BCM) when there is a fault in the Tire Pressure Monitoring System (TPMS), such as a damaged or missing TPMS sensor(s), or when attempting to train a TPMS sensor(s) with a low battery. The TPMS warning indicator flashes for 70 seconds then illuminates continuously when the ignition switch is turned to the ON position. The message center also displays TIRE PRESSURE SENSOR FAULT.

This pinpoint test is intended to diagnose the following:

- TPMS sensor(s)

PINPOINT TEST H: DTC B1251:00

Test Step	Result / Action to Take
H1 TRAIN THE TPMS SENSORS TO DETERMINE THE INOPERATIVE SENSOR	

• Train all 4 TPMS sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did all of the TPMS sensors transmit correctly when each TPMS sensor transmitted to the TPM module?**	**Yes** CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** If the TPMS sensors fail to train, REFER to **Wheel Rotation And Sensor Training Techniques** in this section. If the TPMS sensor(s) fails to train a second time, INSTALL a new TPMS sensor(s) for the sensor(s) in question. REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section.

Pinpoint Test I: DTC U0140:87

Normal Operation

- DTC U0140:87 (Lost Communication With Body Control Module: Missing Message) — This DTC is set by the Tire Pressure Monitor (TPM) module in continuous memory if data messages received from the BCM are missing.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- TPM module
- BCM

PINPOINT TEST I: DTC U0140:87

Test Step	Result / Action to Take
I1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to I2. **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
I2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Using a scan tool, carry out the Network Test. • **Do both the BCM and the TPM module pass the Network Test?**	**Yes** GO to I3. **No** If either module does not pass the Network Test, REFER to Section 418-00 to diagnose the BCM does not respond to the scan tool or the TPM module does not respond to the scan tool.
I3 CHECK THE TPM MODULE	

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CMDTCs	
• Using a scan tool, carry out the TPM module self-test. • Using a scan tool, clear the TPM module DTCs. • Ignition OFF. • Wait 10 seconds. • Ignition ON. • Using a scan tool, carry out the TPM module self-test. • **Is DTC U0140:87 retrieved again?**	**Yes** GO to I4 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
I4 CHECK FOR DTCs IN THE BCM	
• Using a scan tool, carry out the BCM self-test. • **Is DTC U3003:16 or U3003:17 present?**	**Yes** TPM module DTC U0140:87 may have been set due to a voltage issue in the BCM . REFER to the BCM DTC Chart in Section 419-10 . **No** GO to I5 .
I5 CHECK FOR DTC U0140, U0140:00, OR U0140:87 SET IN OTHER MODULES	
• Clear the CMDTCs from all modules. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Using a scan tool, retrieve the CMDTCs from all modules. • **Is DTC U0140, U0140:00, or U0140:87 set in more than one module?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . CLEAR all continuous DTCs. REPEAT the self-test. **No** INSTALL a new TPM module. REFER to Tire Pressure Monitor (TPM) Module in this section. TEST the system for normal operation.

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Wheels And Tires

Special Tool(s)

 ST2869-A	Digital Tire Pressure Gauge 204-354
 ST3058-A	Hunter Road Force® Wheel Balancer GSP9700 Series

Inspection and Verification

WARNING: Vehicle may have multiple drive wheels. Do not use engine to power the driveline unless all drive wheels are elevated off the ground. Drive wheels in contact with ground could cause unexpected vehicle movement. Failure to follow this instruction may result in serious personal injury.

Verify the customer concern by carrying out a road test on a smooth road. If any vibrations are apparent, GO to Symptom Chart - NVH .

To maximize tire performance, inspect for signs of incorrect inflation and uneven wear, which may indicate a need for balancing, rotation or front suspension alignment.

Correct tire pressure and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration and unnecessary sharp braking increase tire wear.

Replacement tires must follow the recommended:

- tire sizes.
- speed rating.
- load range.
- tire construction type.

The use of any other tire/wheel size, load range or type can seriously affect:

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.

- tire clearance between the body and chassis.
- wheel bearing life.
- braking performance.

New wheels need to be installed when the vehicle wheels:

- are bent.
- are cracked.
- are dented.
- are heavily corroded.
- are leaking.
- have elongated wheel hub bolt holes.
- have excessive lateral or radial runout.

Use only the tire sizes recommended on the tire label located on the driver door or door pillar attached to the vehicle. Larger or smaller tires can damage the vehicle, affect durability and require changing the speedometer calibration. Make sure wheel size and offsets match those recommended for the tire in use.

1. Inspect the tires for signs of uneven wear. Refer to the following descriptions to identify the type of wear and for the appropriate repair action to be carried out.

2. Check the tires for:
    - cuts.
    - stone bruises.
    - abrasions.
    - blisters.
    - embedded objects.

3. Check the valve stems for:
    - cracks.
    - cuts.

Install a new valve stem when damage is found or any time a new tire is installed.

4. Tread wear indicators are molded into the bottom of the tread grooves. Install a new tire when the indicator bands become less than 2/32 inch.

Tire Wear

Tire wear is commonly defined as a loss of tread depth. Tire tread wear occurs due to friction with the contact surface (road/pavement). The tread should wear down uniformly all the way around the circumference of the tire and all the way across the tread face. When this does not occur, the tire may have abnormal/incorrect wear.

Normal Tire Wear

Normal tire wear is identified as even wear around and across the tread. Because there are many factors (driving style, road surfaces, type of vehicle, type of tire) that can affect tire wear, there is no absolute mileage expectation for a normal wear condition. A tire is considered worn-out when the tread has worn to the level of the tread wear indicators.

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Abnormal/Incorrect Tire Wear

Abnormal/incorrect tire wear is identified as tire wear that is not even around or across the tread, creating performance-related issues.

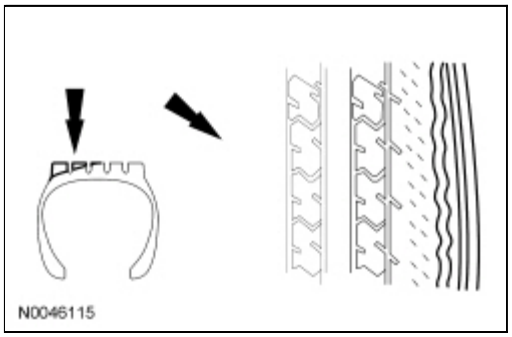
Abnormal/incorrect tire wear can be caused by numerous factors, some of which include driving style (aggressive, passive), climate (hot, cold), road conditions, vehicle loading and maintenance (correct tire pressure, rotation intervals and balance). It is important to determine the root cause of wear on a vehicle before carrying out repair. Tires exhibiting abnormal/incorrect tire wear may still be serviceable provided that the minimum tread depth is greater than 2/32 inch and the tire is not causing a vehicle performance (noise/vibration) concern.

Some abnormal/incorrect wear patterns look the same all the way around the tread of the tire, other wear patterns are not consistent and can occur in various spots on the tread area. The underlying causes of the 6 wear categories are different. Refer to the following descriptions to identify the type of wear and the appropriate repair action to be carried out.

Inner Edge/Shoulder Wear

Inner edge (or shoulder) wear occurs on the inside edge of the tire and is usually caused by excessive toe out and/or excessive negative camber. If the tread depth of the outer shoulder is at least 50% greater than the tread depth of the inner shoulder, the tire is experiencing inner edge/shoulder wear. Visually inspect the tires to determine whether the tires have this type of wear. In some instances, the tread depth of each rib may need to be measured and compared it to that of the shoulder.

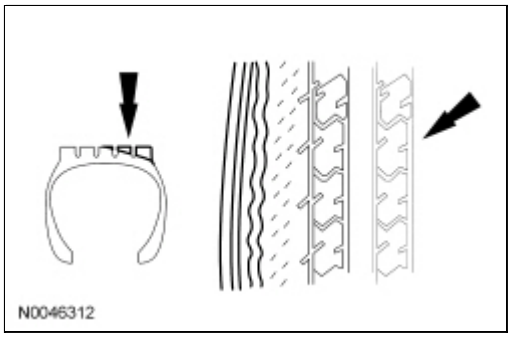
NOTE: RF tire shown, others similar.



Outer Edge/Shoulder Wear

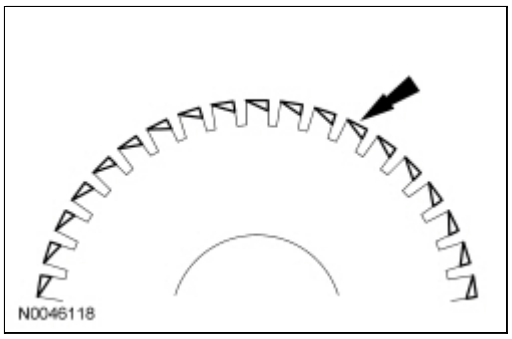
Outer edge (or shoulder) wear occurs on the outside edge of the tire and is usually caused by excessive toe in and/or excessive positive camber. If the tread depth of the inner shoulder is at least 50% greater than the tread depth of the outer shoulder, the tire is experiencing outer edge/shoulder wear. Visually inspect the tires to determine whether the tires have this type of wear. In some instances, the tread depth of each rib may need to be measured and compared to that of the shoulder.

NOTE: RF tire shown, others similar.



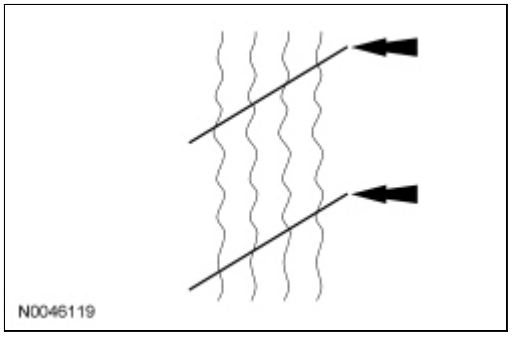
Heel/Toe Wear

Heel/toe wear (also known as feathering) occurs along the outside or inside edge/shoulder of the tire. Visually inspect the tires in both the inside and outside shoulder ribs to determine whether the tires have this type of wear. In some instances, the difference in tread depth of leading versus trailing edge of each lug in the inside and outside shoulder rib may need to be measured.



Diagonal Wear

Diagonal wear occurs diagonally across the tread area and around the circumference of the tire. To determine whether tires have this type of wear, visually inspect the tires to determine if the wear pattern runs diagonally across the tread and around the circumference of the tire. In some instances, the difference in tread depth along the diagonal wear pattern may need to be measured.



Symptom Chart — Tire Wear

Symptom Chart — Tire Wear

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NOTE: For suspension system and additional alignment diagnosis, refer to Section 204-00 .

Condition	Possible Sources	Action
• Inner edge/shoulder wear	• Excessive toe out and/or negative camber	• GO to Pinpoint Test A .
	• Incorrect wheel and tire assembly rotation intervals	• GO to Pinpoint Test A .
	• High-speed cornering	• GO to Pinpoint Test A .
• Outer edge/shoulder wear	• Excessive toe in and/or positive camber	• GO to Pinpoint Test B .
	• Incorrect wheel and tire assembly rotation intervals	• GO to Pinpoint Test B .
	• High-speed cornering	• GO to Pinpoint Test B .
• Heel/toe wear	• Excessive toe in/out • Incorrect wheel and tire assembly rotation intervals	• ROTATE the wheel and tire assemblies. REFER to Wheel and Tire Rotation in this section. CHECK the alignment, ADJUST as necessary.
• Diagonal wear	• Excessive toe in/out	• GO to Pinpoint Test C .
	• Incorrect tire rotation intervals	• GO to Pinpoint Test C .
	• Loose, worn or damaged suspension components	• REFER to Section 204-00 .

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Wobble or shimmy	• Bent wheel	• INSTALL a new wheel as necessary.
	• Damaged tire	• INSTALL a new tire as necessary.
	• Loose wheel nuts	• TIGHTEN to specification.

• High-speed shake	• Tires/wheels	• REFER to Wheel and Tire Runout Component Tests in this section.
• Vehicle vibration	• Tires/wheels	• REFER to Wheel and Tire Runout Component Tests in this section.

Pinpoint Tests

For a description of the various tire wear patterns, refer to Inspection and Verification.

For vehicles with different front and rear tire pressures (such as E-Series and certain F-Series), adjust the tire pressures and train he tire pressure sensors following a tire rotation. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. Failure to train the sensors results in a false low tire pressure event, causing the Tire Pressure Monitoring System (TPMS) indicator to illuminate.

For vehicles with the same tire pressure for front and rear tires, tire rotation does not affect the system.

Pinpoint Test A: Inner Edge/Shoulder Wear

This pinpoint test is intended to diagnose the following:

- Excessive toe out and/or negative camber
- Incorrect wheel and tire assembly rotation intervals
- High-speed cornering

PINPOINT TEST A: INNER EDGE/SHOULDER WEAR

Test Step	Result / Action to Take
A1 MEASURE THE TREAD DEPTH	
• Using a tread depth gauge or similar tool, measure the inside edge/shoulder tread depth. • **Is the tread depth greater than 2/32 inch?**	**Yes** ROTATE the wheel and tire assemblies. REFER to Wheel and Tire Rotation in this section. CHECK and ADJUST the toe to nominal +0.15 degrees (toe in). CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 . **No** INSTALL a new tire(s). CHECK and ADJUST the toe to nominal. CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 .

Pinpoint Test B: Outer Edge/Shoulder Wear

This pinpoint test is intended to diagnose the following:

- Excessive toe in and/or positive camber
- Incorrect wheel and tire assembly rotation intervals
- High-speed cornering

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PINPOINT TEST B: OUTER EDGE/SHOULDER WEAR

Test Step	Result / Action to Take
B1 MEASURE THE TREAD DEPTH • Using a tread depth gauge or similar tool, measure the outside edge/shoulder tread depth. • **Is the tread depth greater than 2/32 inch?**	**Yes** ROTATE the wheel and tire assemblies. REFER to Wheel and Tire Rotation in this section. CHECK and ADJUST the toe to nominal -0.15 degrees (toe out). CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 . **No** INSTALL a new tire(s). CHECK and ADJUST the toe to nominal. CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 .

Pinpoint Test C: Diagonal Wear

This pinpoint test is intended to diagnose the following:

- Incorrect tire rotation intervals
- Excessive toe in/out
- Loose, worn or damaged suspension components

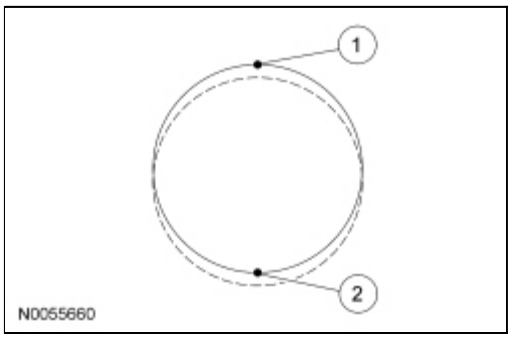
PINPOINT TEST C: DIAGONAL WEAR

Test Step	Result / Action to Take
C1 MEASURE THE TREAD DEPTH • Using a tread depth gauge or similar tool, measure the tread depth of the wear pattern. • **Is the tread depth greater than 2/32 inch?**	**Yes** If no performance concerns (noise/vibration) are present, the tire can remain in service. CHECK the air pressure in the tires, ADJUST as necessary. ROTATE the wheel and tire assemblies. REFER to Wheel and Tire Rotation in this section. INSPECT for loose, worn or damaged suspension components. INSTALL new components as necessary. CHECK the alignment and ADJUST as necessary. REFER to Section 204-00 . **No** INSTALL a new tire(s). CHECK the air pressure in the tires, ADJUST as necessary. ROTATE the wheel and tire assemblies. REFER to Wheel and Tire Rotation in this section. INSPECT for loose, worn or damaged suspension components. INSTALL new components as necessary. CHECK the alignment and ADJUST as necessary. REFER to Section 204-00 .

Component Tests

Radial Runout

Radial runout is the egg-shaped deviation from a perfect circle and is measured perpendicular to the circumference. On a wheel and tire assembly, this means measuring the center tire tread rib. The center rib is indicative of the condition of the tire as a whole. Total runout is the difference between the maximum-to-minimum gauge reading. The high spot is the location of maximum runout.



Item	Description
1	High spot
2	Low spot

Loaded Runout Measurement (Hunter Road Force® 9700 Series Wheel Balancer)

NOTE: Diagnosis of tire/wheel vibration should not be performed on tires with less than 320 km (200 mi). Some initial tire/wheel vibration issues (such as flat spotting) correct themselves after the tires have been in service for 320 km (200 mi).

This procedure is intended to assist with the diagnosis of wheel and tire assembly runout and/or force variation issues.

The Hunter Road Force® 9700 Series Wheel Balancer measures the wheel and tire assembly's loaded runout and the tire's radial spring rate. The balancer then converts the runout into pounds of force (termed as Road Force®). Measuring loaded runout (Road Force®) is more effective than measuring unloaded runout using a dial indicator.

1. Using a tire crayon, record the vehicle position on the inner sidewall of all 4 tires.

2. Remove the wheel and tire assemblies. For additional information, refer to Wheel and Tire in this section.

3. **NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

   Make sure the tire pressures are set to the correct pressure as indicated on the Vehicle Certification (VC) label.

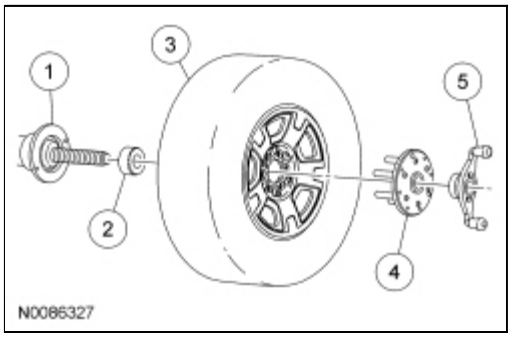
4. ***NOTICE:*** **Make sure the correct wheel balancer adapters are used when mounting the assembly to the wheel balancer or damage to the wheel may occur.**

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NOTE: Make sure the wheel and tire assembly is clean and free of foreign material prior to installation on the balancer.

NOTE: The wheel balancer inflation station must be turned OFF for tires with inflation pressures of 414 kPa (60 psi) or above.

Mount the wheel and tire assembly on a suitable wheel balancer using the correct wheel balancer adapters as shown. Refer to the list of recommended wheel balancer adapters on the PTS website.



Item	Description
1	Wheel balancer
2	Cone
3	Wheel and tire assembly
4	Finger plate
5	Balancer wing nut

5. Measure the Road Force®.
    - Temporarily mark the high spot and the Road Force® value on the sidewall of the tire. If the wheel and tire assembly Road Force® value is not within specification, carry out the Match Mounting procedure to optimize the wheel and tire assembly.
    - If the wheel and tire assembly Road Force® value is within specification, permanently mark the high spot and the Road Force® value on the inward sidewall of the tire for reference during future wheel and tire service. Balance the assembly and install the wheel and tire on the vehicle using the Wheel-to-Hub Optimization procedure.

Vehicle	Maximum allowable Road Force® value
F-150 with P-metric tires	11 kg (25 lb)
F-150 with LT-metric tires	16 kg (35 lb)

Runout Measurement (Dial Indicator)

NOTE: Diagnosis of tire/wheel vibration should not be performed on tires with less than 320 km (200 mi). Some initial tire/wheel vibration issues (such as flat spotting) correct themselves after the tires have been in service for 320 km (200 mi).

NOTE: Loaded runout measurements are the preferred method for verifying tire serviceability. While a dial indicator can be used to optimize the position of the tire on the wheel, the unloaded runout measurement cannot accurately determine if the tire should be removed from service.

Use the following procedures if normal diagnostics leads to a potential runout issue.

Some vehicles may exhibit a wheel and tire vibration caused by excessive runout. Radial runout measurements can be taken using a dial indicator and should be measured with the wheel and tire assembly mounted on a suitable wheel balancer. Make sure the dial indicator is mounted securely to eliminate gauge movement when measuring runout.

1. **NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

   Make sure the tire pressures are set to the correct pressure as indicated on the VC label.

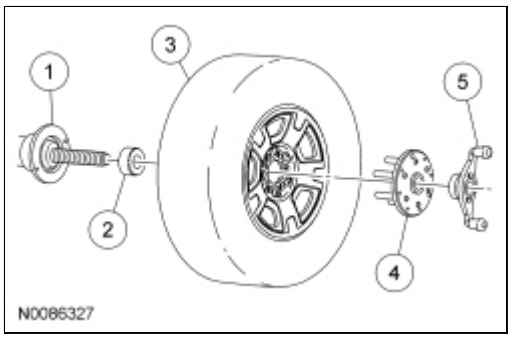
2. Using a tire crayon, record the vehicle position on the inner sidewall of all 4 tires.

3. Remove the wheel and tire assemblies. Refer to Wheel and Tire in this section.

4. ***NOTICE:*** **Make sure the correct wheel balancer adapters are used when mounting the assembly to the wheel balancer or damage to the wheel may occur.**

   NOTE: Make sure the wheel and tire assembly is clean and free of foreign material prior to installation on the balancer.

   Mount the wheel and tire assembly on a suitable wheel balancer using the correct wheel balancer adapters as shown. Refer to the list of recommended wheel balancer adapters on the PTS website.



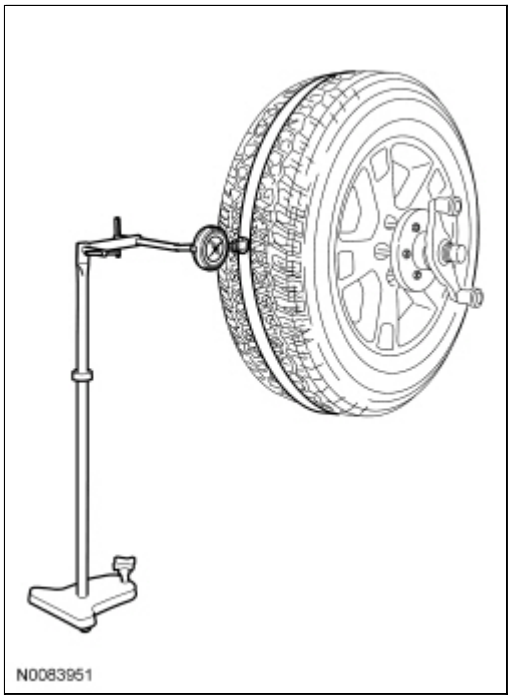
Item	Description
1	Wheel balancer
2	Cone
3	Wheel and tire assembly
4	Finger plate
5	Balancer wing nut

5. **NOTE:** Apply masking tape on the center tread rib to allow for a smoother measuring surface. Some fluctuation of the gauge reading is expected. Observe the overall sweep of the gauge from the highest to the lowest spot on the tire.

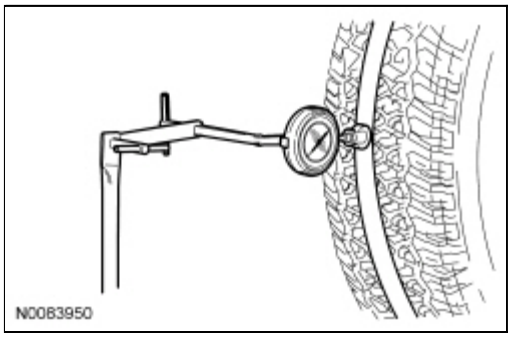
   Position the dial indicator and stand with the dial indicator on the center tread rib.

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- Rotate the wheel and tire assembly (or wheel) to locate the low spot.
- Adjust the runout gauge to read 0.
- Rotate the wheel and tire assembly one complete revolution to make sure the low spot has been found and the dial indicator returns to 0.



6. While slowly and constantly rotating the wheel and tire assembly (or wheel), measure the radial runout.
    - Note the variance (runout) from 0 on the dial of the gauge.
    - If the runout reading of a wheel and tire assembly is greater than 1.14 mm (0.045 in), locate and temporarily mark the high spot and runout reading on the sidewall of the tire and carry out the Match Mounting procedure to optimize the wheel and tire assembly.
    - If the runout reading of a wheel and tire assembly is 1.14 mm (0.045 in) or less, permanently mark the high spot and the runout reading on the inner sidewall of the tire for reference during future wheel and tire service. Balance the assembly and install the wheel and tire on the vehicle using the Wheel-to-Hub Optimization procedure.

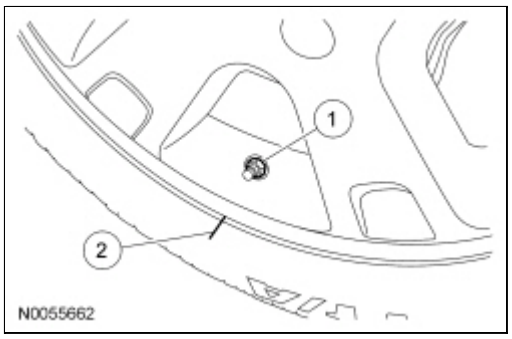


Match Mounting

NOTE: Road Force® values in illustrations are shown in pounds.

Match mounting is a technique used to reduce radial runout or Road Force® on wheel and tire assemblies. Excessive runout is a source of ride quality complaints and match mounting can be used to minimize the runout. Match mounting can be accomplished by changing the position of the tire on the wheel.

1. Position the wheel and tire assembly on a tire machine and put a reference mark on the tire sidewall at the valve stem position.



Item	Description
1	Valve stem
2	Reference mark

2. ***NOTICE:*** **For tires equipped with a Tire Pressure Monitoring System (TPMS), the sensor may be damaged by incorrect tire mounting or dismounting. Dismount the tire from the wheel as instructed in the Disassembly and Assembly procedure. Failure to follow these instructions may result in component damage.**

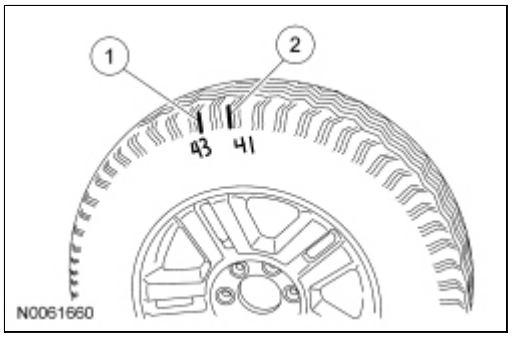
   NOTE: Always make sure that the final high spot and measurement values are permanently marked on the inner sidewall of the tire for reference during future wheel and tire service.

   Using a suitable tire machine, separate the tire beads from the wheel.
   - Lubricate the tire beads using a suitable fast drying, corrosion inhibiting tire bead lubricant.
   - Position the tire 180 degrees (halfway around) on the rim so the valve stem reference mark is opposite the valve stem.

3. Reinflate the wheel and tire assembly to the specified air pressure and measure the assembly again using the dial indicator or Hunter Road Force® 9700 Series Wheel Balancer. Mark the second high spot on the tire.
   - If the runout or Road Force® is reduced to within specifications, the concern has been resolved. Balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.

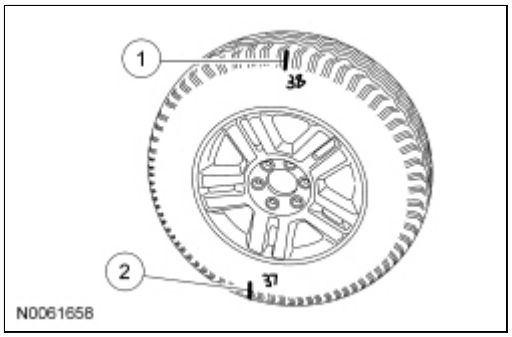
4. If the second runout or Road Force® measurement is still not within specification and both high spots are close to each other (within 101.6 mm [4 in]), the root cause is probably the tire (the high spot followed the tire).
   - To be sure the tire is causing the high runout, it is necessary to have 2 runout or Road Force® measurements that are not within specification and the high spots must be in approximately the same location on the tire's sidewall. If the tire is the cause, install a new tire, balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.
   - If the second high spot is not within 101.6 mm (4 in) of the first high spot, proceed to the next step.

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Item	Description
1	First high spot on the tire
2	Second high spot on the tire

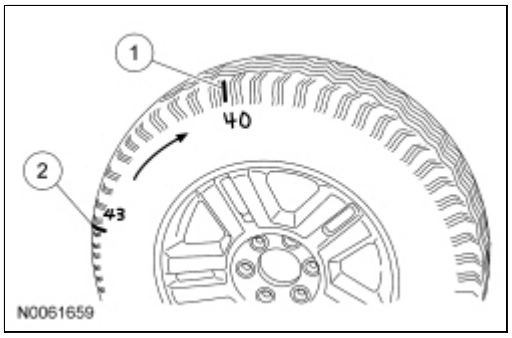
5. If the second high spot is still above specification and within 101.6 mm (4 in) of being opposite the first high spot on the wheel, the root cause is probably the wheel (the high spot followed the wheel). Dismount the tire from the wheel, mount the wheel on a balancer and check the wheel runout. If the wheel runout exceeds 1.14 mm (0.045 in), install a new wheel, balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.



Item	Description
1	First high spot on the tire
2	Second high spot on the tire

6. **NOTE:** If the second high spot did not follow the wheel or the tire and the runout is still not within specification, improvements may be made by rotating the tire 90 degrees (one-fourth turn).

   Draw an arrow on the tire sidewall from the second high spot towards the first high spot (in the shortest direction).
   - Separate the tire beads from the wheel and rotate the tire 90 degrees (one-fourth turn) in the direction of the arrow.

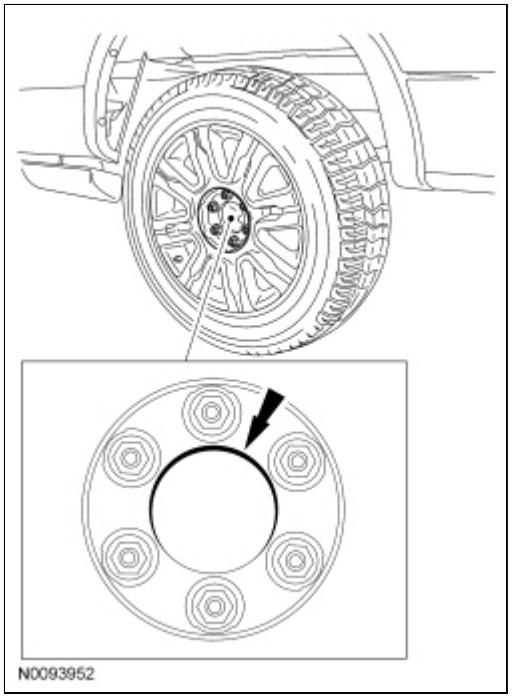


Item	Description
1	First high spot on the tire
2	Second high spot on the tire

Wheel-to-Hub Optimization

Wheel-to-hub optimization is important. Use the clearance between the wheel and hub to offset or neutralize the Road Force® or runout of the wheel and tire assembly. For every 0.001 inch of wheel-to-hub clearance, the Road Force® can be affected between 1 and 3 pounds depending on the tire stiffness.

NOTE: The example below illustrates how the clearance between the wheel and the hub can be used to offset the high spot of radial runout or Road Force®. Following the procedure will make sure of the best optimization.



1. Position the wheel and tire assembly on the vehicle so the high spot location is at the 6 o'clock position and install the wheel nuts by hand until snug.

2. **NOTE:** Do not allow the full weight of the vehicle to rest on the tires while tightening the wheel nuts.

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Lower the vehicle until the tires make contact with the ground, slightly loading the suspension. Tighten the wheel nuts as described in this section.

Tire Pressure Monitoring System (TPMS) Sensor Activation

Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363, or Customer Activation Tool, Tire Pressure Monitor

NOTE: The tire pressure sensors will go into a "sleep mode" when a vehicle is stationary to conserve battery power. The sensors do not transmit information while in sleep mode. It will be necessary to wake them up so they will transmit the latest tire pressure information.

1. Turn the ignition switch to the ON position.

2. Position the Tire Pressure Monitor Activation Tool against the LF tire sidewall at the tire valve stem.

3. **NOTE:** The Tire Pressure Monitor Activation Tool will provide feedback in the form of a flashing green light and a beep sound for each successful response from a tire pressure sensor. This feedback may not always be present, do not rely on it as a confirmation that the module heard a particular sensor.

   NOTE: If a sensor does not respond to the Tire Pressure Monitor Activation Tool, move the vehicle to rotate the wheels at least one-fourth of a turn and attempt to activate the same sensor again. If the sensor still does not respond, attempt to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, attempt to train the sensor with the vehicle doors open.

   Press the test button on the Tire Pressure Monitor Activation Tool to activate the sensor. Activate the sensor at least 2 times.

4. Repeat Steps 2 and 3 for the remaining tires.

5. If the Tire Pressure Monitoring System (TPMS) indicator remains illuminated after adjusting and activating each sensor, refer to the Symptom Chart in Diagnosis and Testing in this section.

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Tire Pressure Monitoring System (TPMS) Sensor Training

Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: If the vehicle has been stationary for more than 30 minutes, the sensors will go into a "sleep mode" to conserve battery power. It will be necessary to wake them up so they will transmit the latest tire pressure information to the BCM . For additional information, refer to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section.

NOTE: The Tire Pressure Monitoring System (TPMS) Training procedure must be done on a single vehicle, in an area without radio frequency noise and at least 1 m (3 ft) away from other vehicles equipped with a Tire Pressure Monitoring System (TPMS).

Radio frequency noise is generated by electrical motors and appliance operation, cellular telephones, remote transmitters, power inverters and portable entertainment equipment.

NOTE: If a sensor does not respond to the Tire Pressure Monitor Activation Tool, move the vehicle to rotate the wheels at least one-fourth of a turn and attempt to activate the same sensor again. If the sensor still does not respond, attempt to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, attempt to train the sensor with the vehicle doors open.

NOTE: The BCM has a 2-minute time limit between sensor responses. If the BCM does not recognize any 1 of the 4 tire pressure sensors during this time limit, the horn will sound twice and the message center (if equipped) will display TIRE NOT TRAINED REPEAT and the entire procedure must be repeated.

NOTE: For vehicles with different front and rear tire pressures (such as the E-Series and certain F-Series), the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will cause the TPMS indicator to illuminate. For vehicles with the same tire pressure for front and rear tires, tire rotation will not affect the system.

NOTE: Refer to Description and Operation, Push Button Start System Ignition Modules in Section 211-05 to review the procedures for achieving the various ignition states on vehicles with this feature.

1. **NOTE:** An animated version of this procedure is available on-line.

   Turn the ignition switch to the OFF position, then press and release the brake pedal.

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2. Cycle the ignition switch from the OFF position to the RUN position 3 times, ending in the RUN position.

3. Press and release the brake pedal.

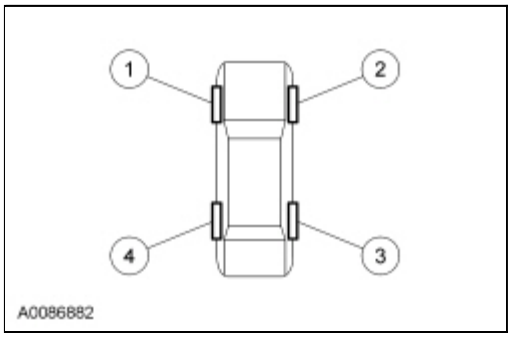
4. Turn the ignition switch to the OFF position.

5. Turn the ignition switch from the OFF position to the RUN position 3 times, ending in the RUN position.
   - The horn will sound once and the TPMS indicator will flash if the training mode has been entered successfully. If equipped, the message center will display TRAIN LF TIRE.

6. **NOTE:** It may take up to 6 seconds to activate a tire pressure sensor. During this time, the Tire Pressure Monitor Activation Tool must remain in place at the valve stem.

   Place the Tire Pressure Monitor Activation Tool on the LF tire sidewall at the valve stem. Press and release the test button on the Tire Pressure Monitor Activation Tool. The horn will sound briefly to indicate that the tire pressure sensor has been recognized by the BCM .

7. Within 2 minutes of the horn sounding, place the Tire Pressure Monitor Activation Tool on the RF tire sidewall at the valve stem and press and release the test button to train the RF tire pressure sensor.



8. **NOTE:** Do not wait more than 2 minutes between training each sensor or the BCM will time out and the entire procedure must be repeated.

   Repeat Step 7 for the RR and LR tires.
   The procedure is completed after the last tire has been trained. When the training procedure is complete, the message center (if equipped) will display TIRE TRAINING COMPLETE.
   For vehicles not equipped with a message center, successful completion of the training procedure will be verified by turning the ignition switch to the OFF position without the horn sounding. If the horn sounds twice when the switch is turned to the OFF position, the training procedure was not successful.

9. Using the scan tool, locate the updated TPMS sensor identifiers trained to the BCM and document them on the applicable warranty claim.

10. **NOTE:** This step is required to clear DTC C2780, cause the BCM to exit the manufacturing mode and to make sure there are no other concerns with a newly programmed BCM .

    If the sensors are being trained due to the installation of a new BCM , clear any DTCs and carry out the BCM On-Demand Self Test.

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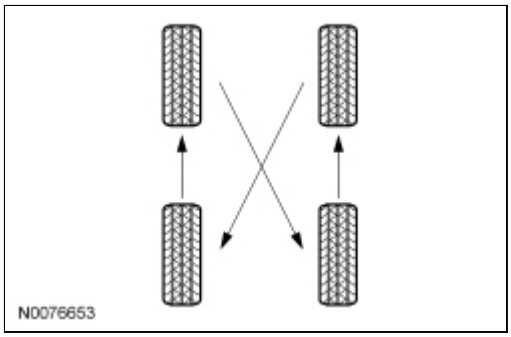
Wheel and Tire Rotation

NOTE: This procedure is intended for vehicles equipped with Tire Pressure Monitoring System (TPMS) and different front and rear tire pressures.

1. Remove the wheel and tire assemblies. For additional information, refer to Wheel and Tire in this section.

2. **NOTE:** The front tires are shown at the top of the illustration.

   Rotate the wheel and tire assemblies as shown.
   - Cross the front tires and move them to the rear of the vehicle.
   - Move the rear tires (without crossing) to the front of the vehicle.



3. Install the wheel and tire assemblies. For additional information, refer to Wheel and Tire in this section.

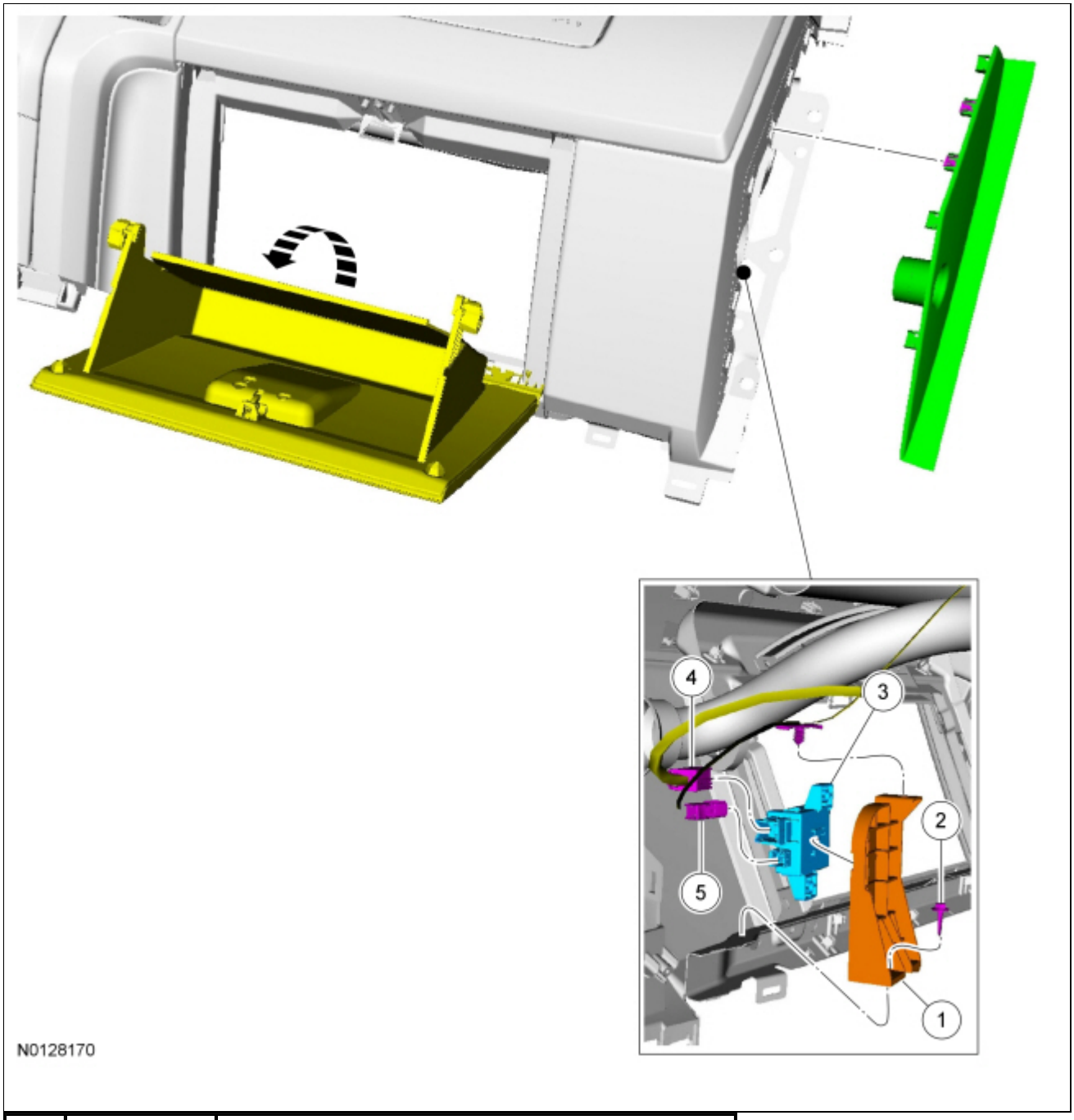
4. Adjust the tire pressures. For additional information, refer to the Vehicle Certification (VC) label located on the driver door jamb.

5. **NOTE:** The tire pressures must be adjusted and the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will result in a false low tire pressure event, which will cause the TPMS indicator to illuminate.

   Train the TPMS sensors. For additional information, refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.

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Tire Pressure Monitor (TPM) Module



Item	Part Number	Description
1	19A435	TPMS module mounting bracket
2	W707628	TPMS screw (1 required)
3	15K602	Tire Pressure Monitoring System (TPMS) module

4	—	TPMS module electrical connector (part of 14401)
5	—	External antenna coax connector

Removal

NOTICE: **Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

1. Remove the RH instrument panel side finish panel.
2. Open the glove compartment door and while pushing in on the glove compartment tab, position the glove compartment downwards.
3. Remove the screw from the TPMS module mounting bracket.
4. Disconnect the TPMS module electrical connector and the external antenna connector.
5. Separate the TPMS module from the TPMS module mounting bracket.

Installation

1. To install, reverse the removal procedure.

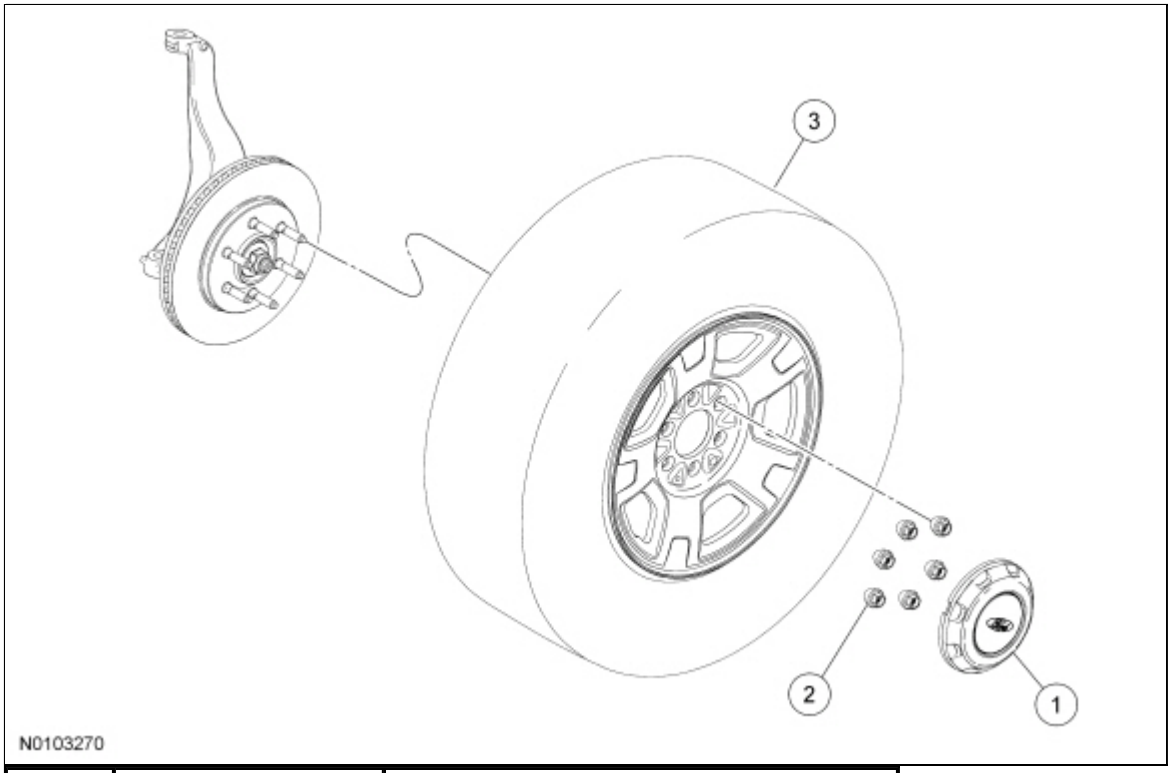
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Wheel and Tire

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	—

NOTE: Typical 6 lug wheel shown, 7 lug similar.



Item	Part Number	Description
1	1130	Center cap (if equipped)
2	1012	Wheel nut (6 or 7 required)
3	—	Wheel and tire assembly

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. ***NOTICE:*** **Do not use heat to loosen a seized wheel nut or damage to the wheel and wheel bearing can occur.**

Remove the 6 or 7 wheel nuts.

3. Remove the wheel and tire assembly.

Installation

1.  **WARNING: When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surface of the wheel and the mounting surface of the wheel hub, brake drum or brake disc. Make sure that any fasteners that attach the rotor to the hub are secured so they do not interfere with the mounting surfaces of the wheel. Failure to follow these instructions when installing wheels may result in the wheel nuts loosening and the wheel coming off while the vehicle is in motion, which could result in loss of control, leading to serious injury or death to vehicle occupant(s).**

   NOTICE: **Make sure to apply a thin coat of anti-seize lubrication only to the interface between the wheel pilot bore and the hub pilot. Do not allow the anti-seize to make contact with the wheel-to-brake disc/drum mounting surface, wheel studs, wheel nuts, brake pads or brake disc friction surfaces or damage to components may occur.**

   Clean the wheel mounting surfaces and apply a thin coat of anti-seize to the wheel hub pilot surface (wheel only).

2. Install the wheel and tire assembly.

3.  **WARNING: Retighten wheel nuts within 160 km (100 mi) after a wheel is reinstalled. Wheels can loosen after initial tightening. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   NOTICE: **Failure to tighten the wheel nuts in a star/cross pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

   NOTE: The wheel nut torque specification is for clean, dry wheel stud and wheel nut threads.

   Install the 6 or 7 wheel nuts by hand.
   - Tighten the wheel nuts in a star/cross pattern.
   - Tighten to 204 Nm (150 lb-ft).

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Material

Item	Specification	Fill Capacity
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

General Specifications

Item	Specification
Drive pinion flange runout	0.25 mm (0.010 in)
Maximum allowable driveshaft runout	0.50 mm (0.020 in)
Minimum Traction-Lok breakaway torque	27 Nm (20 lb-ft)
U-joint operating angle	0.5°-3.0°

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Driveline System

The driveline consists of the following:

- Front drive axle
- Rear drive axle
- Front axle halfshafts
- Front driveshaft
- Rear driveshaft
- Center support bearings
- CV joints
- U-joints and flanges
- Flex couplers

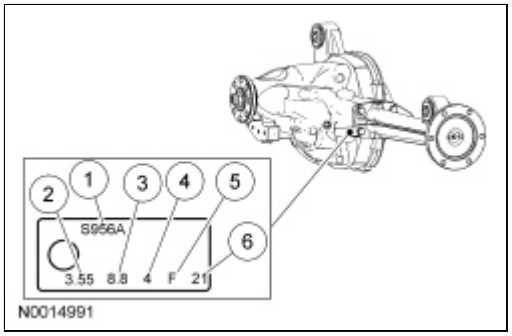
The source of the drivetrain power is generated by the engine and delivered to the transmission. The driveline transfers the engine torque through the driveshaft to the axle. The rear driveshaft is connected to the output shaft of the transmission or transfer case and to the rear axle. The front driveshaft is connected to the transfer case and to the front axle. Slip yokes are used to allow for any changes to the length of the driveshaft. Changes in length are self-adjusted up in the driveshaft slip mechanism. The engine torque enters the axle through the drive pinion, which rotates the ring gear. The ring gear is mounted to the differential case, which contains the gears that transmit power to the rear axle shafts or front halfshafts. These shafts and halfshafts rotate the drive wheels. The Electronic Locking Differential (ELD) rear axle assembly, except for the differential case and its internal components, is identical to the conventional rear axle. The ELD employs an electronically operated magnetic coil to engage the unit. The Traction-Lok rear axle assembly, except for the differential case and its internal components, is identical to the conventional rear axle. The Traction-Lok employs 2 multi-disc differential clutch packs to control differential action. The mounting distance of the differential side gear is controlled by plates on each side, friction and steel. Also included is a steel selective shim to control the position of the differential side gear, and a spring which provides initial preload to the clutch pack. The steel clutch plates are splined to the axle shafts. The friction plates are contained in the case by matching slots, thus providing continuous engagement of the differential clutch packs. The Torsen® front differential case houses the parallel axis planetary helical side gears to which the axle shafts are splined. The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage.

Vehicle Certification (VC) Label Example



The Vehicle Certification (VC) label is located in the driver door jamb. The first 2 digits of the axle code indicate the rear axle and the third digit refers to the front axle, if equipped. For information on the VC label, refer to Section 100-01 .

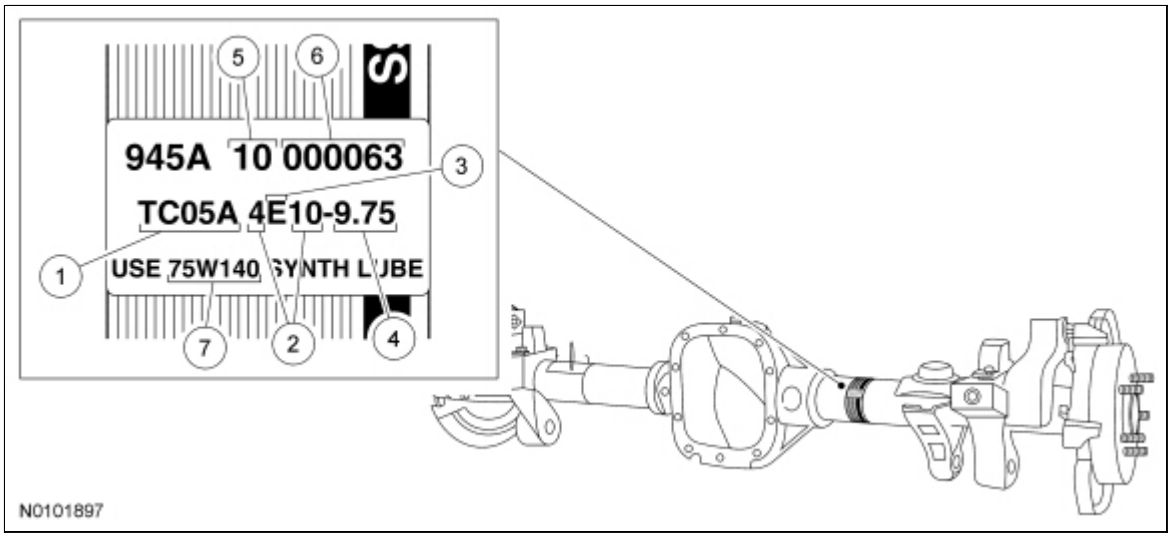
Front Axle Identification Tag



Item	Description
1	Plant code
2	Axle ratio
3	Ring gear diameter (inch)
4	Build year
5	Build month
6	Build day

Rear Axle Identification Tag

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Item	Description
1	Plant code
2	Axle ratio
3	Differential type C= Open/conventional L= Limited slip E= Electronic Locking Differential (ELD)
4	Ring gear diameter (inch)
5	Build year
6	Axle serial number
7	Lubricant type

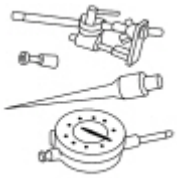
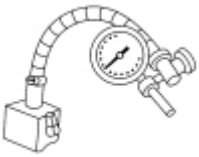
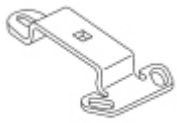
NOTE: The axle identification tag is the official service identifier. Do not damage the tag.

The axle identification tag identifies a particular axle design, a specific ratio, and if it is a conventional or limited slip type. In addition, the plant code will not change as long as that particular axle assembly never undergoes an external design change. If, however, an internal design change takes place during the production life of the axle and that internal change affects the interchangeability of the components, a dash and numerical suffix is added to the plant code. This means that, as an assembly, both axles are interchangeable; however, internally they are different. Therefore, each requires different internal components at the time of repair.

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Driveline System

Special Tool(s)

 ST1268-A	Clamp Plate, Driveshaft 205-320 (T92L-4851-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent
 ST1863-A	Gauge, Differential (Traction-Lok) 205-385 (T97T-4205-B)
 ST1267-A	Runout Gauge, Drive Pinion Flange 205-319 (T92L-4851-B)

Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5

Principles of Operation

The driveline system enables the power generated by the engine and transferred through the transmission and, if applicable, transfer case, to place the vehicle in motion. Rotational torque received from the transmission or transfer case is delivered to the front and rear drive axles by way of the driveshafts. The U-

joints or CV joints at the ends of the shafts allow the shafts to rotate smoothly in an allowable angle plane. The rotational torque is introduced into the axle drive pinion which drives the differential ring gear. The ring gear is bolted to the differential case flange on the differential. The differential divides the torque between the right and left halfshaft while permitting the halfshafts to turn at different speeds when required, such as when cornering.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• U-joints • CV joints • Center bearings • Driveshaft tubes • Mounting brackets • Flanges • Housing and cover damage • Differential bearings • Differential gear sets • Pinion bearings

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart - Driveline or GO to Symptom Chart - NVH .

Symptom Chart — Driveline

Symptom Chart — Driveline

Condition	Possible Sources	Action
• Traction-Lok does not work in snow, mud or on ice	• Differential	• CARRY OUT the Traction-Lok Differential Operation Check in this section. REPAIR as necessary. REFER to Section 205-02A or Section 205-02B .
• Torsen® differential does not work in snow, mud or on ice	• Differential	• CARRY OUT the Torsen Differential Operation Check in this section. REPAIR as necessary. REFER to Section 205-03 .
• Lubricant leaking	• Vent	• CLEAN the axle housing vent.

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from the pinion seal, axle shaft oil seals or support arm to the housing	• Damage in the seal contact area or dust slinger on the pinion flange dust shield	• INSTALL a new pinion flange and the pinion seal if damage is found.
• The vehicle does not shift between the different modes correctly	• Mode switch • Wiring/relays • Shift motor • Transfer case • Generic Electronic Module (GEM) or 4x4 control module	• REFER to Section 308-07A .
• Front axle will not engage	• Switches • Wiring • GEM or 4x4 control module • Shift motor • Integrated Wheel End (IWE)	• REFER to Section 308-07A .
• Front axle will not disengage	• Switches • Wiring • GEM or 4x4 control module • Shift motor • IWE	• REFER to Section 308-07A .
• Electronic Locking Differential (ELD) does not engage in snow, mud or on ice	• Mode switch • Differential • Transfer Case Control Module (TCCM) • Wiring	• REFER to Section 308-07A .
• Differential side gears/pinion gears are scored	• Insufficient lubrication • Incorrect or contaminated lubricant type	• INSTALL new gears. FILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 . • INSTALL new gears. CLEAN and REFILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Axle overheating	• Lubricant level too low • Incorrect or contaminated lubrication type • Bearing preload adjusted too tight	• CHECK the lubricant level. FILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 . • INSPECT the axle for damage. REPAIR as necessary. CLEAN and REFILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 . • CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. ADJUST the preload as

		necessary.
	• Excessive gear wear	• INSPECT all the axle gears for wear or damaged. INSTALL new components as necessary.
	• Incorrect ring gear backlash	• INSPECT the ring gear for scoring. INSPECT the ring and pinion wear pattern. ADJUST the ring gear backlash as necessary.
• Broken gear teeth on the ring gear or pinion	• Overloading the vehicle	• INSTALL a new ring and pinion. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Halfshaft broken	• Overloading the vehicle • Misaligned axle halfshaft	• INSTALL a new axle halfshaft. REFER to Section 205-04 . • INSPECT the axle for damage. CHECK axle halfshaft alignment. INSTALL a new axle halfshaft. REFER to Section 205-04 .

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Axle howling or whine — front or rear axle	• Axle lubricant low	• CHECK the lubricant level. FILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Axle housing damage	• INSPECT the axle housing for damage. REPAIR or INSTALL a new axle as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Damaged or worn wheel hub bearings	• CHECK for abnormal wheel hub bearing play or roughness. REFER to Section 204-01A , Section 204-01B or Section 204-02 .

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	• Damaged or worn differential ring and pinion	• INSPECT and INSTALL a new differential ring and pinion as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Damaged or worn differential side or pinion bearings	• INSPECT and INSTALL new differential side or pinion bearings as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Driveline clunk — loud clunk when shifting from REVERSE to DRIVE	• Incorrect axle lubricant level	• CHECK the lubricant level. FILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Excessive backlash in the axle	• CHECK the axle backlash. REPAIR as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Damaged or worn pinion bearings	• REPAIR or INSTALL new pinion bearings as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Damaged or worn U-joints	• INSPECT the U-joints for wear or damage. INSTALL new U-joints or driveshaft as necessary. REFER to Section 205-01 .
	• Loose or missing fasteners	• CHECK all driveline fasteners for proper torque. REFER to Section 205-01 , Section 205-02A , Section 205-02B or Section 205-03 .
• Driveline clunk — occurs as the vehicle starts to move forward following a stop	• Worn driveshaft CV joint or U-joints with excessive play	• INSPECT the CV joint and U-joints for a worn condition. INSTALL a new driveshaft or U-joints as necessary. REFER to Section 205-01 .
	• Loose axle mount	• CHECK the axle for loose bolts. TIGHTEN to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Loose or missing fasteners	• CHECK all driveline fasteners for proper

		torque. REFER to Section 205-01 , Section 205-02A , Section 205-02B or Section 205-03 .
• Driveline clunk — occurs during acceleration or from cruise to coast/deceleration	• Damaged or worn CV joint • Loose or missing fasteners	• INSPECT the CV joint and boot. INSTALL a new CV joint as necessary. REFER to Section 205-04 . • CHECK all driveline fasteners for proper torque. REFER to Section 205-01 , Section 205-02A , Section 205-02B or Section 205-03 .
• Clicking, popping or grinding — occurs while the vehicle is turning	• Inadequate or contaminated lubrication in the CV joints • Another component contacting the halfshaft	• CHECK the CV boots and joints for wear or damage. INSTALL new components as necessary. REFER to Section 205-04 . • CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary.
• High pitched chattering — noise from the axle when the vehicle is turning	• Incorrect or contaminated lubricant • Damaged or worn differential (differential side gears and pinion gears)	• CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). CLEAN and REFILL the axle to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 . • REPAIR or INSTALL new differential side gears or pinion gears as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Buzz — buzzing noise is the same at cruise or coast/deceleration	• Incorrect driveline angles	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Driveline Angle Measurement in this section.
• Rumble or boom — noise occurs at coast/deceleration, usually driveshaft speed-related and noticeable over a wide range of speeds	• Driveshaft is out-of-balance • U-joints are binding or seized	• CHECK the driveshaft for damage, missing balance weights or undercoating. REFER to Driveshaft Runout and Balancing in this section. • ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints or driveshaft as

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		necessary. REFER to Section 205-01 .
	• Misalignment of yellow dot on driveshaft-to-yellow dot on pinion flange plus or minus 1 bolt hole	• REINSTALL driveshaft with yellow dots aligned plus or minus 1 bolt hole. REFER to Section 205-01 .
	• Worn or damaged driveshaft center bearing support	• CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
• Grunting — normally associated with a shudder experienced during acceleration from a complete stop	• Driveshaft CV joint binding	• CLEAN the CV joint and INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
	• Loose axle mount bolts or suspension fasteners	• INSPECT the rear suspension and axle. TIGHTEN the fasteners to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Howl — can occur at various speeds and driving conditions. Affected by acceleration and deceleration	• Incorrect ring and pinion contact, incorrect bearing preload or gear damage	• INSPECT and REPAIR as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Chuckle — heard at coast/deceleration. Also described as a knock	• Incorrect ring and pinion contact or damaged teeth on the coast side of the ring and pinion	• INSPECT and REPAIR as necessary. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Knock — noise occurs at various speeds. Not affected by acceleration or deceleration	• Gear tooth damage to the drive side of the ring and pinion	• INSTALL a new ring and pinion. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Scraping noise — a continuous low pitched noise starting at low speeds	• Worn or damaged pinion bearings	• INSPECT and REPAIR or INSTALL new pinion bearings. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Driveline shudder — occurs during acceleration from a slow speed or stop (vehicle unloaded)	• Drive axle assembly mispositioned	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary. REFER to Section 205-02A , Section 205-02B or

		Section 205-03 .
	• Loose axle bolts	• CHECK the axle for loose bolts. TIGHTEN the bolts to specification. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
	• Loose or missing fasteners	• CHECK all driveline fasteners for proper torque. REFER to Section 205-01 , Section 205-02A , Section 205-02B or Section 205-03 .
	• Driveline angles out of specification	• MEASURE and ADJUST the driveline angles as necessary. REFER to Driveline Angle Measurement , Driveline Angle Adjustment .
	• U-joints binding or seized	• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints or driveshaft as necessary. REFER to Section 205-01 .
	• Binding or damaged driveshaft CV joint	• INSPECT the driveshaft CV joint and coupling shaft for wear or damage. INSTALL a new driveshaft as necessary. REPAIR as necessary. REFER to Section 205-01 .
	• Transfer case	• REFER to Section 308-07A .
• Driveline shudder — occurs during acceleration from a slow speed or stop (vehicle loaded)	• Driveline angle out of specification due to loaded condition	• MEASURE and ADJUST the driveline angles as necessary. REFER to Driveline Angle Measurement , Driveline Angle Adjustment .
• Take-off shudder — with 1-piece driveshaft (loaded or unloaded)	• Driveline angle out of specification	• MEASURE and ADJUST the driveline angles as necessary. REFER to Driveline Angle Measurement , Driveline Angle Adjustment . • If concern is still present lower axle pinion using 1 degree shim with thick end forward. REFER to, Driveline Angle Adjustment .
• Take-off shudder — with 1-piece driveshaft (loaded or	• Driveline angle out of	• Lower axle pinion replacing 1 degree shim

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unloaded) after driveline angle adjustment using 1 degree shim	specification	with a 2 degree shim with thick end forward. REFER to, Driveline Angle Adjustment .
• Driveline vibration or moan — occurs on deceleration (coast down) above 45 mph with 1-piece driveshaft (loaded or unloaded)	• Driveline angle out of specification	• MEASURE and ADJUST the driveline angles as necessary. REFER to Driveline Angle Measurement , Driveline Angle Adjustment . • If concern is still present raise axle pinion using 1 degree shim with thick end rearward. REFER to, Driveline Angle Adjustment .
• Driveline vibration or moan — occurs on deceleration (coast down) above 45 mph with 1-piece driveshaft (loaded or unloaded) after driveline angle adjustment using 1 degree shim	• Driveline angle out of specification	• Raise axle pinion replacing 1 degree shim with a 2 degree shim with thick end rearward. REFER to, Driveline Angle Adjustment .
• Shudder on acceleration from 10-25 mph under medium to heavy throttle — with 2-piece driveshaft (loaded or unloaded)	• Driveline angle out of specification	• MEASURE and ADJUST the driveline angles as necessary. REFER to Driveline Angle Measurement , Driveline Angle Adjustment . • If concern is still present lower axle pinion using 1 degree shim with thick end forward. REFER to, Driveline Angle Adjustment .
• Shudder on acceleration from 10-25 mph under medium to heavy throttle — with 2-piece driveshaft (loaded or unloaded) after driveline angle adjustment using 1 degree shim	• Driveline angle out of specification	• Lower axle pinion replacing 1 degree shim with a 2 degree shim with thick end forward. REFER to, Driveline Angle Adjustment .
• Driveline vibration or moan — occurs on deceleration above 45 mph with 2-piece driveshaft (loaded or unloaded), after driveline angle adjustment using 1 degree shim is installed with the thick end forward	• Driveline angle out of specification	• Lower the center bearing. Driveline Angle Adjustment .
• Driveline vibration or moan — occurs on deceleration above 45 mph with 2-piece driveshaft (loaded or unloaded)	• Driveline angle out of specification	• MEASURE and ADJUST the driveline angles as necessary. REFER to Driveline Angle Measurement , Driveline

		Angle Adjustment . • If concern is still present raise axle pinion using 1 degree shim with thick end rearward. REFER to, Driveline Angle Adjustment .
• Driveline vibration or moan — occurs on deceleration above 45 mph with 2-piece driveshaft (unloaded), after driveline angle adjustment using 1 degree shim is installed with the thick end rearward	• Driveline angle out of specification	• Raise axle pinion replacing 1 degree shim with a 2 degree shim with thick end rearward. REFER to, Driveline Angle Adjustment .
• Shudder on acceleration from 10-25 mph under medium to heavy throttle — after driveline angle adjustment using 1 degree shim is installed with the thick end rearward — with 2-piece driveshaft (unloaded)	• Driveline angle out of specification	• Lower the center bearing. Driveline Angle Adjustment .
• Driveline vibration — occurs at cruising speeds	• Worn U-joints	• CHECK for wear or incorrect seating. INSTALL new U-joints or driveshaft as necessary. REFER to Section 205-01 .
	• Misalignment of yellow dot on driveshaft-to-yellow dot on pinion flange plus or minus 1 bolt hole	• REINSTALL driveshaft with yellow dots aligned plus or minus 1 bolt hole. REFER to Section 205-01 .
	• Worn or damaged driveshaft center bearing support	• CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
	• Loose driveshaft-to-axle pinion or transmission flange bolts	• INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to Section 205-01 .
	• Excessive axle pinion flange runout	• CARRY OUT a runout check. REPAIR as necessary. REFER to Component Test in this section.
	• Driveshaft is out-of-balance	• CHECK the driveshaft for damage, missing balance

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		weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to Driveshaft Runout and Balancing in this section.
	• Binding or damaged driveshaft CV joint	• INSPECT the driveshaft CV joint for wear or damage. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
	• Excessive driveshaft runout	• CARRY OUT a runout check. REFER to Driveshaft Runout and Balancing in this section.
	• Driveline angles out of specification	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Driveline Angle Measurement in this section.
	• Incorrectly seated CV joint in the wheel hub	• CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary. REFER to Section 205-04 .
	• Damage or missing driveshaft slip yoke damper (163 in wheelbase and 133 in wheelbase 4.6L 4x2 do not get dampers)	• INSTALL a new driveshaft as necessary. REFER to Section 205-01 .

Analysis of Leakage

Clean the leaking area enough to identify the exact source.

A plugged axle housing vent can cause excessive pinion seal lip wear due to internal pressure buildup.

Verify the lubricant level is at least 3-5 mm (1/8-3/16 in) below the bottom of the fill hole.

Axle Vent

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. If the vent cannot be cleared, install a new vent.

Drive Pinion Seal

Leaks at the drive pinion seal originate from the following causes:

- Damaged seal
- Worn seal journal surface

Any damage to the seal bore (dings, dents, gouges or other imperfections) distorts the seal casing and allows leakage past the outer edge of the drive pinion seal.

The drive pinion seal can be torn, cut or gouged if it is not installed correctly. The spring that holds the drive pinion seal against the pinion flange may be knocked out and allow fluid to pass the lip.

Metal chips trapped at the sealing lip can cause oil leaks. These can cause a wear groove on the drive pinion flange and result in pinion seal wear.

When a seal leak occurs, install a new drive pinion seal and check the vent to make sure it is clean and free of foreign material.

A new drive pinion flange must be installed if any of these conditions exist.

Drive Pinion Nut

NOTICE: **Install the drive pinion nut to the correct torque specifications or damage to the differential components may occur.**

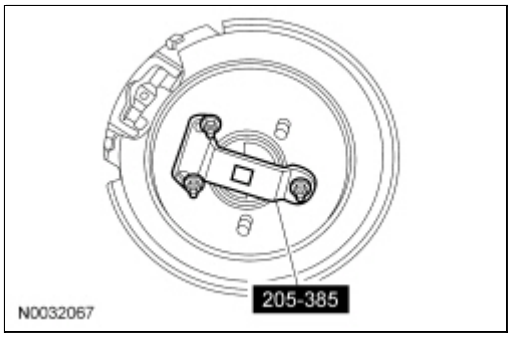
On some high-mileage vehicles, oil may leak through the threads of the drive pinion nut. This condition can be corrected by installing a new nut and applying threadlock and sealer on the threads and nut face.

Component Tests

Traction-Lok Differential Operation Check

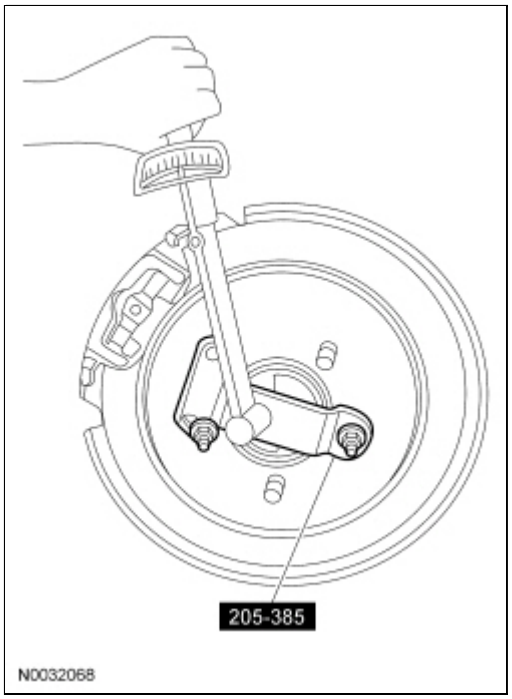
A Traction-Lok differential can be checked for correct operation without removing it from the rear axle housing.

Raise and remove only one rear wheel. Install the Differential Gauge (Traction-Lok) on the wheel bolts.



Use a torque wrench with the capacity of at least 271 Nm (200 lb-ft) to rotate the axle shaft. Make sure that the transmission is in NEUTRAL, and that one rear wheel is on the floor while the other rear wheel is raised off the floor. The breakaway torque required to start rotation must be at least 27 Nm (20 lb-ft). The initial breakaway torque may be higher than the continuous turning torque.

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The axle shaft must turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential case for incorrect assembly.

Traction-Lok Differential Check Road Test

1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct performance of a Traction-Lok rear axle assembly.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Traction-Lok feature of the differential. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.
4. If, with unequal traction, both wheels slip, the limited slip rear axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Traction-Lok has transferred as much torque as possible to the non-slipping wheel.

Torsen® Differential Check Road Test

1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct performance of a Torsen® front axle assembly.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Torsen® feature of the differential. Release the brake

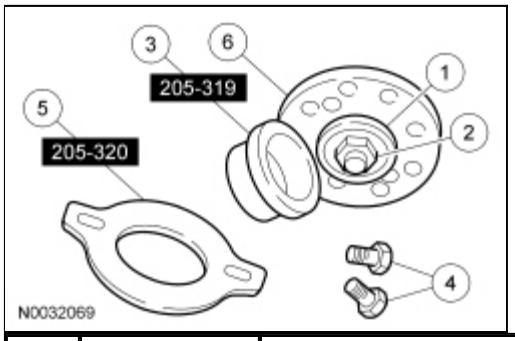
when traction is established. Use light throttle on starting to provide maximum traction.

4. If, with unequal traction, both wheels slip, the limited slip front axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Torsen® has transferred as much torque as possible to the non-slipping wheel.

Pinion Flange Runout Check — Circular

NOTICE: **Pinion bearing preload must be reset if the pinion nut has been loosened or removed for pinion flange reindexing or replacement or damage to the component may occur.**

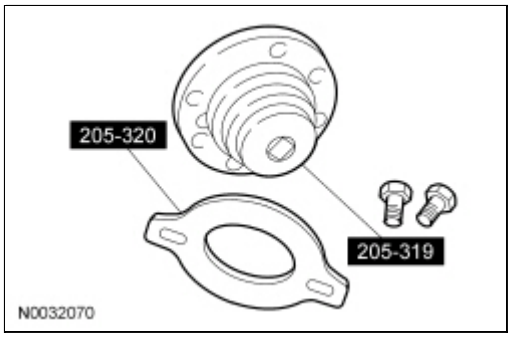
1. Raise the vehicle on a twin-post hoist that supports the rear axle.
2. Remove the driveshaft. Refer to Section 205-01 .
3. Check the pinion flange for damage.
4. Position the Driveshaft Clamp Plate and Drive Pinion Flange Runout Gauge on the pinion flange.



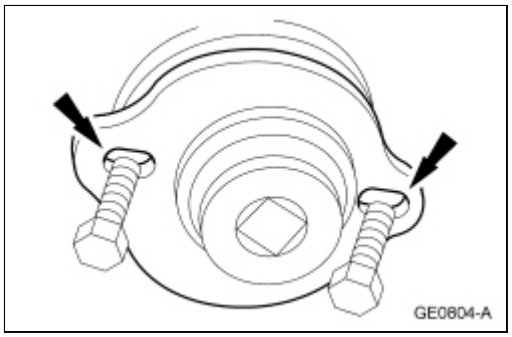
Item	Part Number	Description
1	—	Pilot (part of 205-319) (T92L-4851-B)
2	354845	Pinion nut
3	205-319	Gauge, Drive Pinion Flange Runout (T92L-4851-B)
4	—	Bolts (2 required) (part of 205-320) (T92L-4851-C)
5	205-320	Plate, Driveshaft Clamp (T92L-4851-C)
6	4851	Pinion flange

5. Position the Driveshaft Clamp Plate and Drive Pinion Flange Runout Gauge onto the pinion flange.

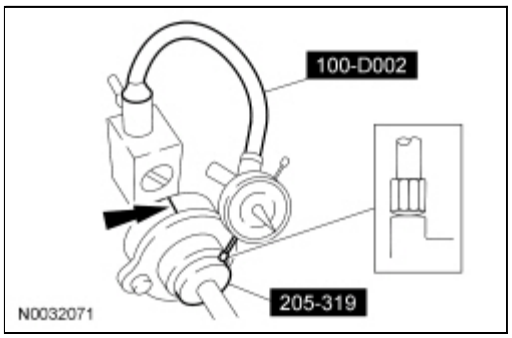
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6. Align the holes on the clamp plate with the holes in the pinion flange and install the bolts. Snug the bolts evenly.

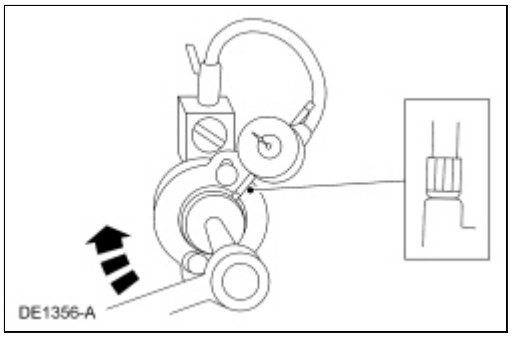


7. Position the Dial Indicator Gauge with Holding Fixture as shown. Turn the Dial Indicator Gauge, and locate and mark the high spot on the pinion flange with yellow paint.



If the flange runout exceeds 0.25 mm (0.010 in), remove the pinion flange, reindex the flange one-half turn on the pinion, and reinstall it. Refer to Section 205-02A , Section 205-02B or Section 205-03 for the flange removal and installation procedures.

8. Check the runout again. If necessary, rotate the flange until an acceptable runout is obtained. If the flange runout is still more than 0.25 mm (0.010 in), install a new pinion flange.



9. If excessive runout is still evident after replacement of the pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.

10. Install the driveshaft. Refer to Section 205-01 .

Tooth Contact Pattern Check — Gearset

1. To check the gear tooth contact, paint the gear teeth with a suitable marking compound. A mixture that is too wet will run and smear; a mixture that is too dry cannot be pressed out from between the teeth.

2. Use a box wrench on the ring gear bolts as a lever to rotate the ring gear several complete revolutions in both directions or until a clear tooth contact pattern is obtained.

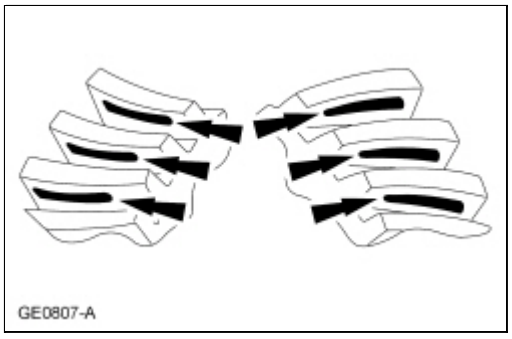
3. Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Incorrect adjustment can be corrected by readjusting the ring gear or the pinion.

Contact Pattern Location

In general, desirable ring gear tooth patterns must have the following characteristics:

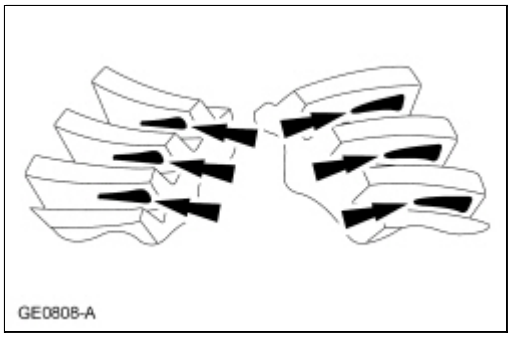
- Drive pattern on the drive side ring gear well centered on the tooth.
- Coast pattern on the coast side ring gear well centered on the tooth.
- Clearance between the pattern and the top of the tooth.
- No hard lines where the pressure is high.

Acceptable ring gear tooth patterns for all axles.

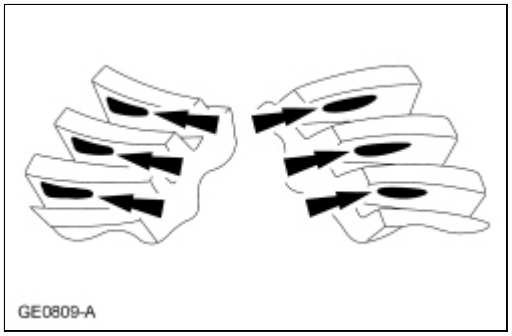


Correct backlash with a thinner pinion position shim required.

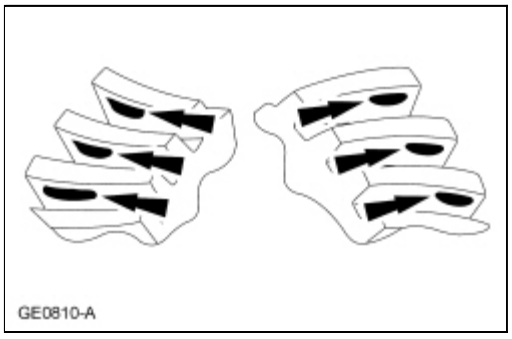
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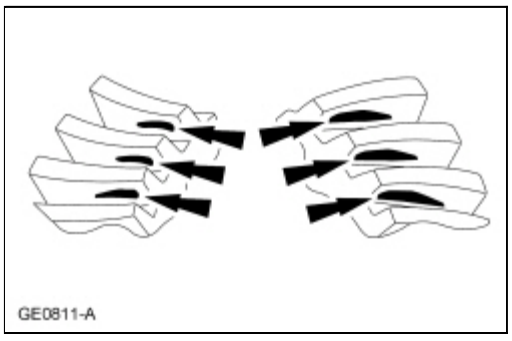
Correct backlash with a thicker pinion position shim required.



Correct pinion position shim that requires a decrease in backlash.



Correct pinion position shim that requires an increase in backlash.



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Driveline Angle Adjustment

NOTE: Some vehicles may exhibit a drive-away shudder or vibration under moderate to heavy acceleration from a stop, especially when heavily loaded or when towing a trailer. It is important to confirm how the vehicle is driven the majority of the time (loaded or unloaded), as adjusting the driveline angle in one condition (loaded or unloaded) may result in a shudder or vibration with the vehicle in the opposite condition (loaded or unloaded).

NOTE: Verify suspension is not modified from the original configuration. Aftermarket leveling kits and rear leaf spring shackle kits change ride height, which affects pinion angle and other critical driveline related operating angles. Vehicle must be at Original Equipment Manufacturer (OEM) specifications before accurate evaluation and diagnosis can be performed.

NOTE: The driveline angle must be measured with the vehicle in the same condition as the concern (loaded or unloaded) to determine the amount of adjustment necessary to correct the condition.

1. Measure the driveline angle. For additional information, refer to Driveline Angle Measurement in this section.
    - If the driveline does not have an optimum 3.5 degree operating range, proceed to the following adjustment steps using the parts listed in the table below.

Part Number	Part Name
5A313	1 degree pinion angle shim
5A313	2 degree pinion angle shim
00812	Upper u-bolt center plate bolt (4 required)
5705	U-bolt (4 required)
W520215	U-bolt nut (8 required)
W713078	Center bearing support bolt
W713649	Center bearing support nut
4A209	Center bearing support shim
506545	Shock absorber lower bolt
W520214	Shock absorber lower nut

NOTE: The driveline angle on these vehicles can be changed by adding 1 degree or 2 degree pinion angle shims.

2. Remove and discard the shock absorber lower nut and bolt.

3. **NOTE:** To change the pinion angle.

   Using a suitable jack to support the rear axle, remove and discard the 8 u-bolt nuts and the 4 u-bolts. For additional information, refer to Section 204-02 .

4. **NOTE:** Replace one bolt at time.

   Replace the upper u-bolt center plate bolts. For additional information, refer to Section 204-02 .

- Install the new bolts and tighten to 102 Nm (75 lb-ft).

5. **NOTE:** Never use more then 1 shim on a side at a time.

   Install desired shim on the axle spring seat, or on top of the 4x4 spacer block.
   - Lower the axle pinion using the thick edge of the shim forward, to decrease pinion angle.
   - Raise the axle pinion using the thick edge of the shim rearward, to increase pinion angle.

6. Install 4 new u-bolts and 8 new u-bolt nuts. With the suspension at curb height, tighten the new u-bolt nuts evenly in a cross-type pattern in 4 stages. For additional information, refer to Section 204-02 .
   - Stage 1: Tighten in a cross pattern to 35 Nm (26 lb-ft).
   - Stage 2: Tighten in a cross pattern to 70 Nm (52 lb-ft).
   - Stage 3: Tighten in a cross pattern to 100 Nm (74 lb-ft).
   - Stage 4: Tighten in a cross pattern to 133 Nm (98 lb-ft).

7. Install a new shock absorber lower nut and bolt. For additional information, refer to Section 204-02 .
   - Tighten the new nut and bolt to 90 Nm (66 lb-ft).

8. **NOTE:** If adjusting axle pinion angle to reduce/eliminate driveline vibration or moan causes an issue with shudder on acceleration, then the pinion angle must be adjusted to optimize the balance between perceived vibration/moan and perceived shudder.

   NOTE: Shims can be used to lower the center bearing support and minimize this condition. Up to 3 shims may be installed. The center bearing support bolts must be replaced using the part listed in the table or new grade 10.9 bolts. The bolts should be long enough to extend at least 3 threads past the nuts.

   Measure the driveline angle again. For additional information, refer to Driveline Angle Measurement in this section.
   - If necessary, remove and discard the 2 center bearing support bolts and install shims in 1/4 inch increments to lower the center bearing support.
   - Install 2 new bolts and tighten to 48 Nm (35 lb-ft).

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Driveline Angle Measurement

Special Tool(s)

 ST1622-A	Anglemaster II Driveline Inclinometer/Protractor 164-R2402 or equivalent

NOTE: This procedure does not apply to CV joints, flex couplers or double cardan joints that are used in some driveshafts. This check is for single-cross and roller-style joints found in the driveshafts.

NOTE: Prior to checking driveline angularity, inspect the U-joints for correct operation.

NOTE: An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to Section 100-04 .

NOTE: Driveline angularity is the angular relationship between the engine crankshaft, the driveshaft and the rear axle pinion. Factors determining driveline angularity include ride height, rear spring and engine mounts.

All vehicles

1. Carry out the following preliminary setup steps:
   - Inspect the U-joints for correct operation.
   - Park the vehicle on a level surface such as a drive-on hoist, or back onto a front end alignment rack.
   - Verify the curb position ride height is within specifications with the vehicle unloaded and all of the tires are inflated to their normal operating pressures.
   - Calibrate the Anglemaster II Driveline Inclinometer/Protractor by placing it on a clean, flat level section of the frame rail and press the ALT-ZERO button.

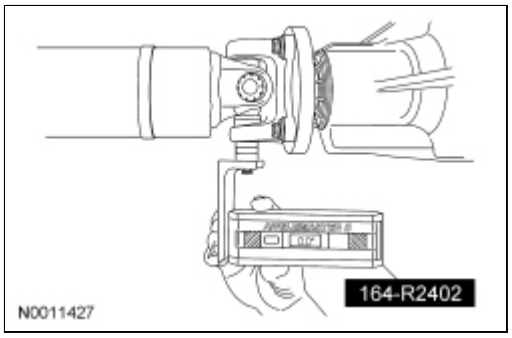
Vehicles with flat-flanged, split-pin or slip-flanged U-joints

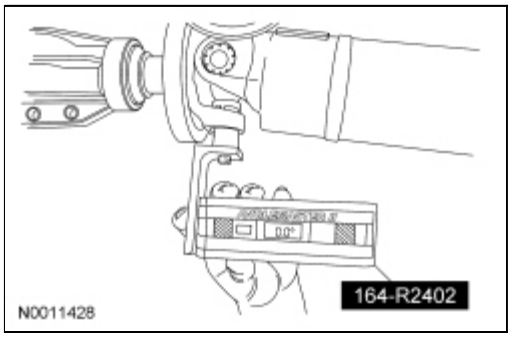
2. **NOTE:** If equipped, remove the snap ring to allow access to the base of the U-joint cup. Make sure the Anglemaster II Driveline Inclinometer/Protractor is seated against the U-joint cup.

   NOTE: Rotate the driveshaft until the flange U-joint cup is parallel with the floor. This will simplify taking measurements.

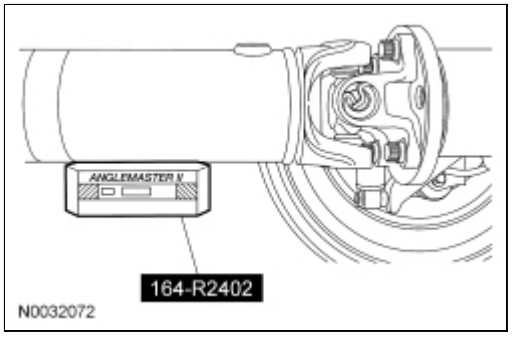
   To check the U-joint operating angle, install the Anglemaster II Driveline Inclinometer/Protractor. Check and record the flange angle as angle A.

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3. Using the Anglemaster II Driveline Inclinometer/Protractor, measure the slope of the connecting component. Record the measurement of the component angle as angle B.

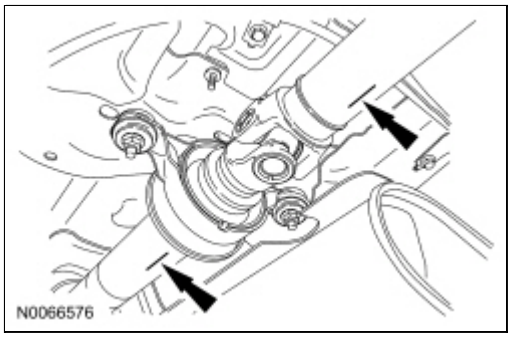


Multiple piece driveshafts

4. **NOTE:** Repeat this step for each center support bearing on the driveshaft.

   NOTE: It is not necessary to remove the U-joint snap ring, if equipped, for these measurements.

   Using the Anglemaster II Driveline Inclinometer/Protractor, measure the slope of the components in front and behind the center support bearing U-joint in the area indicated. Record the front component as angle A and the rear component as angle B.



All vehicles

5. **NOTE:** When 2 connected components slope in the same direction, subtract the smallest number from the larger number to find the U-joint operating angle. When 2 connected components slope in the opposite direction, add the measurements to find the U-joint operating angle.

   Calculate the difference in the slope of the components to determine the U-joint operating angle.
   - The U-joint operating angle is the angle formed by 2 yokes connected by a cross and bearing kit. Ideally, the operating angles on each connection of the driveshaft must:
     - be equal or within one degree of each other.
     - have a 3 degree maximum operating angle.
     - have at least one-half of one degree continuous operating angle.

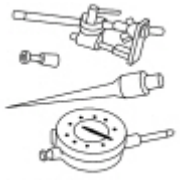
6. If the angle is not within specifications, repair or adjust to obtain the correct angle. Inspect the engine mounts, transmission mounts, center support bearing mounting, rear suspension, rear axle, rear axle mounting or the frame for wear or damage.

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Driveshaft Runout and Balancing

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST3025-A	Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) 257-00018 or equivalent

Driveshaft Inspection

NOTE: Driveline vibration exhibits a higher frequency and lower amplitude than high-speed shake. Driveline vibration is directly related to the speed of the vehicle and is noticed at various speeds. Driveline vibration can be perceived as a tremor in the floorpan or heard as a rumble, hum or boom.

NOTE: Refer to Specifications in this section for all runout specifications.

1. **NOTE:** Do not make any adjustments before carrying out a road test. Do not change the tire pressure or the vehicle load.

   Carry out a visual inspection of the vehicle. Operate the vehicle and verify the condition by reproducing it during the road test.
   - The concern should be directly related to vehicle road speed, not affected by acceleration or deceleration or could not be reduced by coasting in NEUTRAL.

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
   - The driveshaft should be kept at an angle equal to or close to the curb-weighted position. Use a twin-post hoist or a frame hoist with jackstands.

3. Inspect the driveshaft for damage, undercoating or incorrectly seated U-joints. Rotate the driveshaft slowly by hand and feel for binding or end play in the U-joint trunnions. Remove the driveshaft. For additional information, refer to Section 205-01 . Inspect the slip yoke splines for any galling, dirt, rust or incorrect lubrication. Clean the driveshaft or install new U-joints as necessary. Install a new driveshaft if damaged. After any corrections or new components are installed, recheck for the vibration at the road test speed.
   - If the vibration is gone, test drive the vehicle.
   - If the vibration persists or the driveshaft passes visual inspection, measure the driveshaft runout.

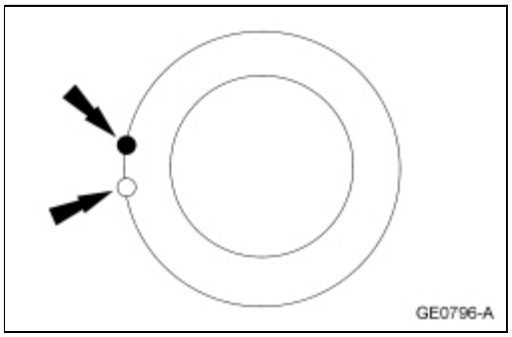
Driveshaft Runout

1. Install the Dial Indicator Gauge with Holding Fixture. Rotate the driveshaft by turning the axle and measure the runout at the front, the center and the rear of the driveshaft.
    - If the runout exceeds 1 mm (0.040 in) at the front or center, install a new driveshaft.
    - If the front and center is within 1 mm (0.040 in), but the rear runout is not, index-mark the rear runout high point and proceed to Step 2.
    - If the runout is within 1 mm (0.040 in) at all points, recheck for vibration at road test speed. If the vibration persists, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.

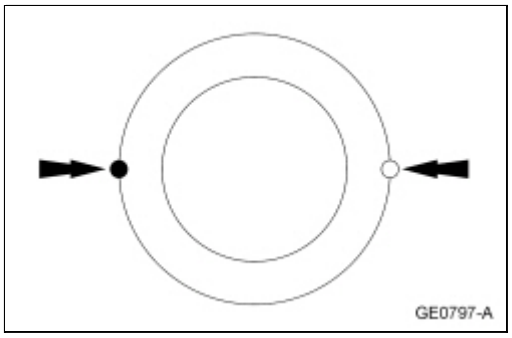
2. **NOTE:** Circular pinion flanges can be turned in 90 degree or one-fourth increments. Half-round pinion flanges are limited to 2 positions.

   Index-mark the driveshaft to the pinion flange. Disconnect the driveshaft and rotate it 180 degrees. Reconnect the driveshaft. Recheck the runout at the rear of the driveshaft.
    - If the runout is still over specification, mark the high point and proceed to Step 3.
    - If the runout is within specification, check for the vibration at the road test speed. If the vibration is still present, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.

3. Excessive driveshaft runout can originate in the driveshaft itself or from the pinion flange. To find the source, compare the 2 high points previously determined.
    - If the index marks are close together, within 25 mm (1 in), the driveshaft is eccentric. Install a new driveshaft.
    - If the marks are on opposite sides of the driveshaft, 180 degrees apart, the slip yoke or pinion flange is responsible. Check the pinion flange runout. If the pinion flange runout exceeds specifications, a bent pinion is indicated.
    - If the pinion flange and pinion runouts are within specifications, road test and check for the vibration at the road test speed. If the vibration persists, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.



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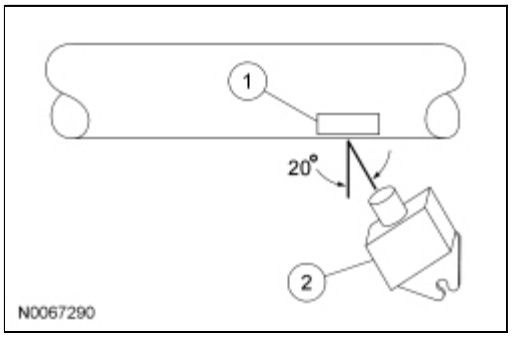
Driveshaft Balancing — Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix)

All vehicles

1. Install the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) to the vehicle.

2. Working under the vehicle, install an accelerometer. The accelerometer can be attached and mounted near either the transmission or differential end of the driveshaft.

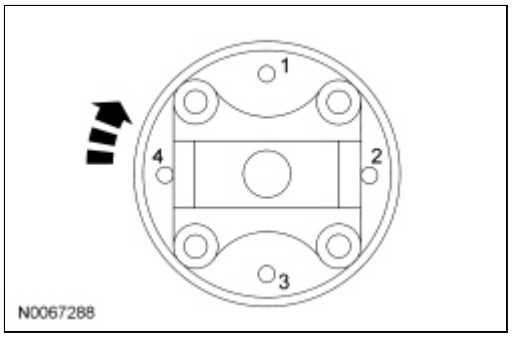
3. Clean an area of the driveshaft and install the reflective tape, then install the photo-tachometer sensor. The sensor should be placed at approximately a 20-degree angle from perpendicular to the surface of the reflective tape. Make sure the sensor does not get moved during the balance procedure.
    1. Reflective tape.
    2. Photo-tachometer sensor.



4. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a driveshaft balance test with the driveshaft unmodified.

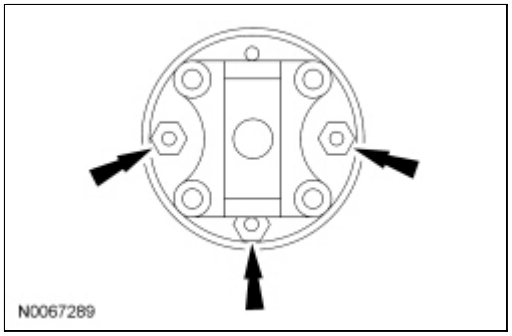
Vehicles with tapped pinion flanges

5. Label the tapped holes in the pinion flange numerically, starting at the top hole as 1. Mark the remaining holes 2, 3 and 4. Label in the direction of rotation.



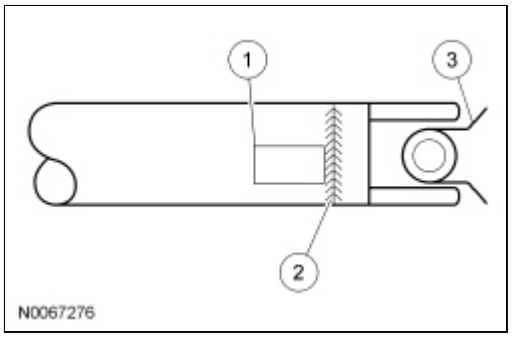
6. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a second test with the 12 mm (0.47 in) test weight set screw in the No. 1 hole, previously marked on the pinion flange.

7. Remove the test weight, then install the weight combination directed by the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix).



Vehicles without tapped pinion flanges

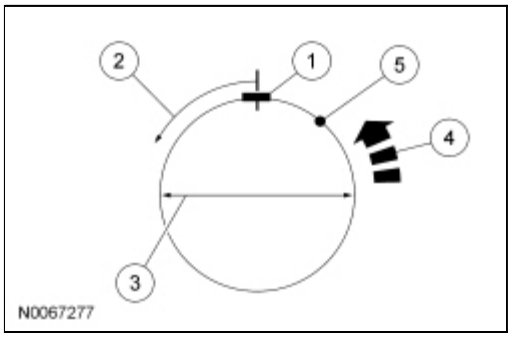
8. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a second test with a test weight. Using a metal band, secure the test weight to the end of the driveshaft. The weight should be placed at the end of the driveshaft tube, as close to the tube-to-yoke weld seam as possible. Mark the location of the test weight on the driveshaft, as shown in the figure below.
    1. Test weight.
    2. Tube-to-yoke weld seam.
    3. Driveshaft pinion flange.
    - Select the test weight based on driveshaft size. Larger driveshafts use 10 g (0.353 oz). Smaller driveshafts use 5 g (0.176 oz).



9. Remove the test weight, then install the recommended weight at the position directed by the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix). Using a metal band and epoxy, secure the test weight to the driveshaft, as shown in the figure below.

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1. Test weight.
2. Measure in this direction.
3. Driveshaft diameter.
4. Directional rotation.
5. Balance weight relative to test weight centerline.
   - The results are displayed with respect to the location to where the test weight was placed.



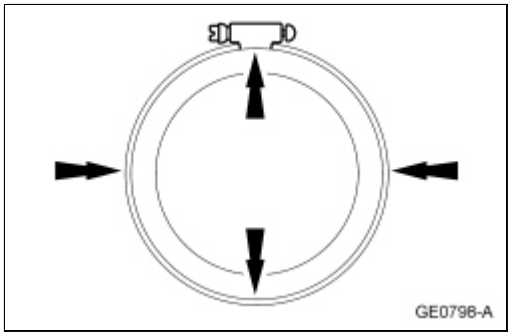
All vehicles

10. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a third test to verify the repair.

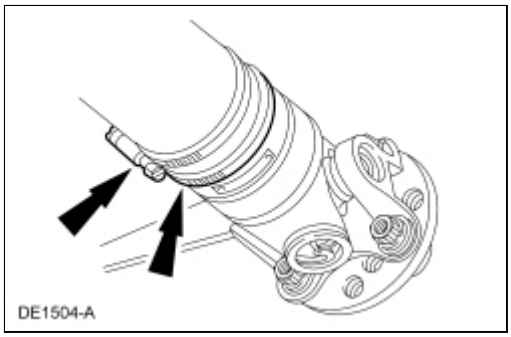
Driveshaft Balancing — Hose Clamp Method

1. Install 1 or 2 hose clamps on the driveshaft, near the rear. Position of the hose clamp head(s) can be determined through trial and error.

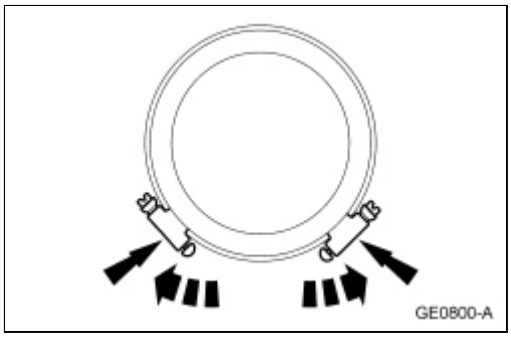
2. Mark the rear of the driveshaft into 4 approximately equal sectors and number the marks 1 through 4. Install a hose clamp on the driveshaft with its head at position No. 1, as shown in the figure below. Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If 2 adjacent positions show equal improvement, position the clamp head between them.



3. If the vibration persists, add a second clamp at the same position and recheck for vibration.



4. If no improvement is noted, rotate the clamps in opposite directions, equal distances from the best position determined in Step 2. Separate the clamp heads about 13 mm (1/2 in) and recheck for vibration at the road speed.



5. Repeat the process with increasing separation until the best combination is found or the vibration is reduced to an acceptable level.

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Material

Item	Specification	Fill Capacity
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

Torque Specifications

Description	Nm	lb-ft
Rear driveshaft center bearing bolts	48	35
Rear driveshaft flange bolts	103	76
Front driveshaft flange-to-pinion flange bolts	55	41
Front driveshaft flange-to-transfer case flange bolts	55	41
Skid plate bolts (SVT Raptor vehicles)	48	35
Stabilizer bar bracket nuts	55	41

Driveshaft

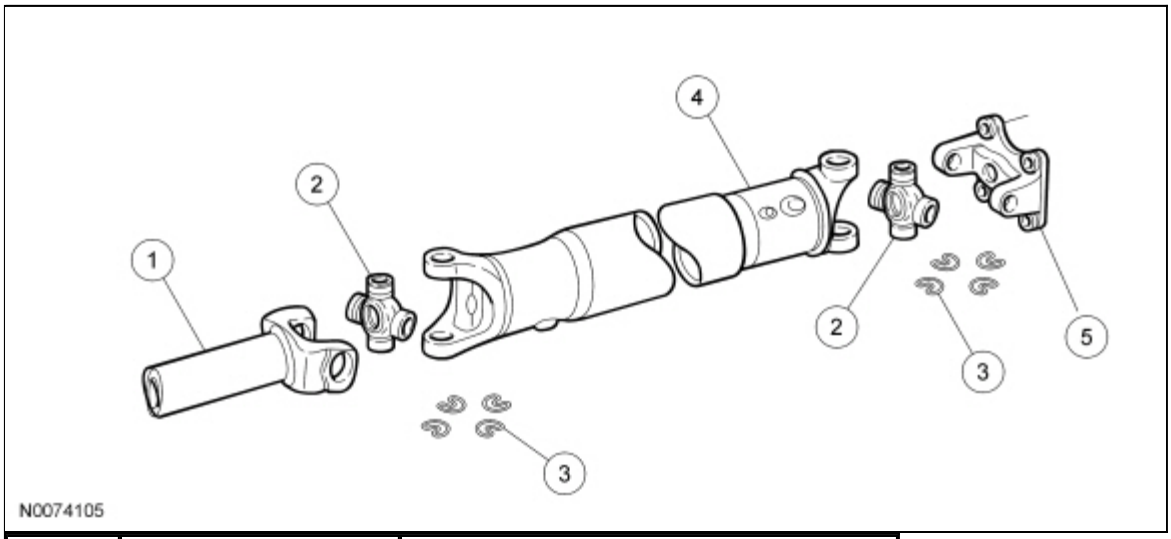
Refer to Section 205-00 .

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Driveshaft Universal Joint — Snap Ring Type

Special Tool(s)

 ST1172-A	Installer/Remover, C-Frame and Screw 205-086 (T74P-4635-C)



Item	Part Number	Description
1	4841	Driveshaft slip yoke
2	4635	U-joint assembly
3	—	Snap rings (part of 4635)
4	4602	Driveshaft assembly
5	4782	Driveshaft flange

Disassembly

1. Remove the driveshaft. Refer to Driveshaft — Front , Driveshaft — Rear, One-Piece or Driveshaft — Rear, Two-Piece in this section.

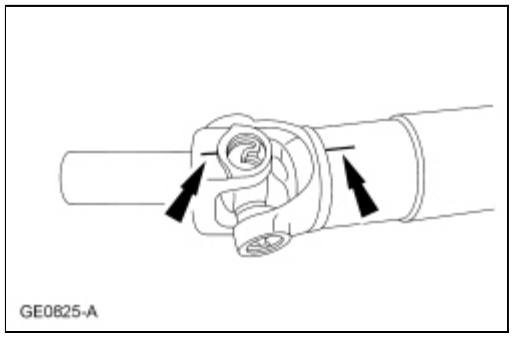
2. ***NOTICE:*** **Do not, under any circumstance, clamp the driveshaft assembly in the jaws of a vise or similar holding fixture. Denting or localized fracturing may result, causing driveshaft failure during vehicle operation.**

   Place the driveshaft on a suitable workbench. Do not damage the tube.

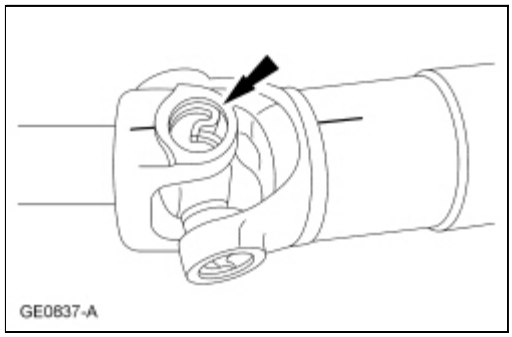
3. **NOTE:** If the components are not marked and therefore installed incorrectly, driveshaft imbalance can

occur.

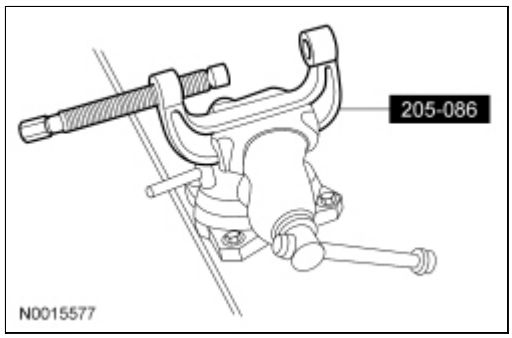
Index-mark the driveshaft components.



4. Remove and discard all 4 of the snap rings.



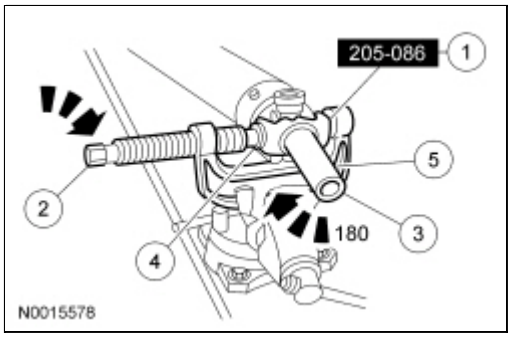
5. Place the C-Frame and Screw Remover/Installer in a vise.



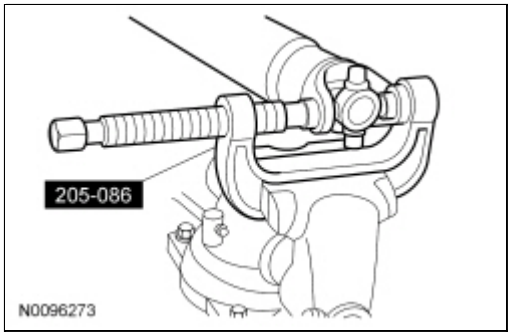
6. **NOTE:** If necessary, use a pair of pliers to remove a bearing cup that fails to press out all the way.

   Remove the bearing cups and the driveshaft slip yoke.
   1. Position the driveshaft slip yoke in the C-Frame and Screw Remover/Installer.
   2. Press out a bearing cup.
   3. Rotate the driveshaft slip yoke 180 degrees.
   4. Press on the U-joint spider to remove the remaining bearing cup.
   5. Remove the driveshaft slip yoke.

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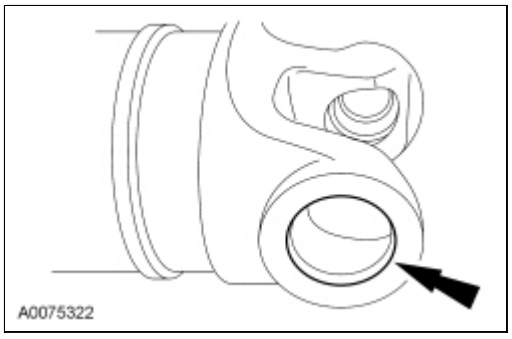


7. Repeat steps to remove the remaining bearing cups and the U-joint spider from the driveshaft yoke.



8. **NOTE:** Inspect the bearing cup bores and retaining ring grooves. Remove any rust or other surface irregularities.

   Inspect the bearing cup bores of the driveshaft slip yoke and driveshaft yoke. Make sure that the bearing cup bores are clean and smooth.



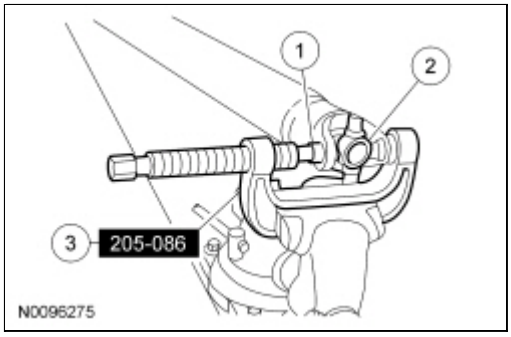
Assembly

1. **NOTE:** Install the U-Joint Kits as complete assemblies only. Do not mix components from other U-Joint Kits.

   NOTE: Lubricate the driveshaft slip yoke and driveshaft yoke bearing cup bores with grease from part kit # KT9L3P-M1C111-AA before installing the bearing cups.

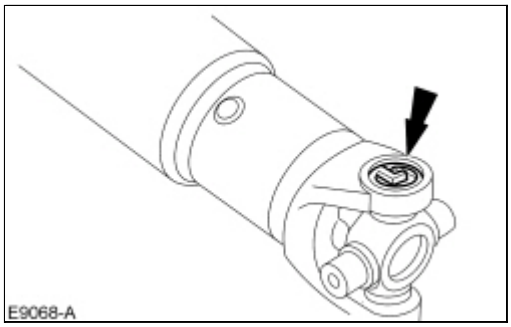
   Install a new U-joint spider and bearing cup.
   1. Start a new bearing cup in the driveshaft yoke.
      - Check the needle bearings for correct positioning.
   2. Position the new U-joint spider in the driveshaft yoke.
   3. Press the bearing cup to just below the snap ring groove using the C-Frame and Screw

Remover/Installer.



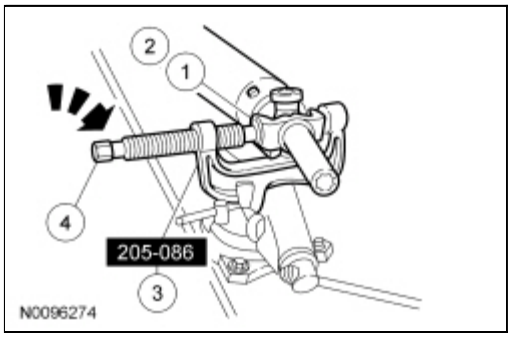
2. **NOTE:** Never mix yellow and black snap rings on opposing sides.

   Remove the shaft from the C-Frame and Screw Remover/Installer and install a new yellow snap ring.



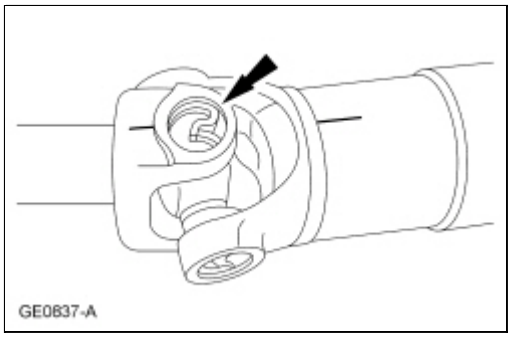
3. Repeat steps to install the new bearing cup and snap ring on the opposite side of the driveshaft yoke.
   - If the yellow snap ring will not seat in the snap ring groove, install the black snap rings.

4. Install the driveshaft slip yoke and new bearing cup.
   1. Align the index marks made during disassembly and install the driveshaft slip yoke on the U-joint spider.
   2. Start a new bearing cup in the driveshaft slip yoke.
      - Check the needle bearings for correct positioning.
   3. Position the assembly in the C-Frame and Screw Remover/Installer.
   4. Press the bearing cup to just below the snap ring groove using the C-Frame and Screw Remover/Installer.



5. Remove the driveshaft from the C-Frame and Screw Remover/Installer and install a new yellow snap ring.

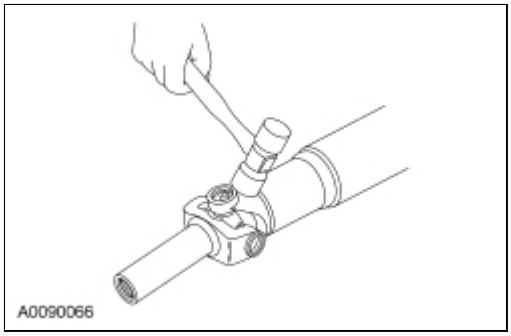
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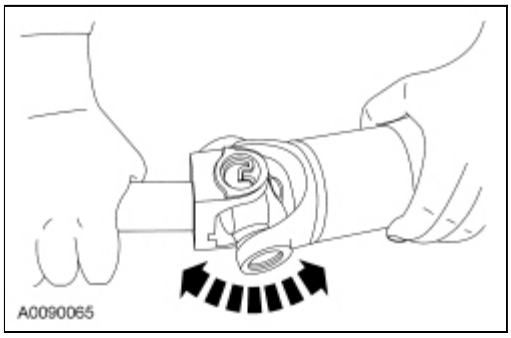
6. **NOTE:** Never mix yellow and black snap rings on opposing sides.

   Repeat steps to install the new bearing cup and snap ring on the opposite side of the driveshaft slip yoke.
   - If the yellow snap ring will not seat in the snap ring groove, install the black snap rings.

7. A sharp rap on the driveshaft yoke with a brass or plastic hammer will seat the bearing cups.



8. Rotate the driveshaft yoke to make sure the U-joints are free to rotate easily, without binding, before installing the driveshaft.



9. Install the driveshaft. Refer to Driveshaft — Front , Driveshaft — Rear, One-Piece or Driveshaft — Rear, Two-Piece in this section.

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Driveshaft

NOTE: All driveshafts are balanced. If undercoating the vehicle, protect the driveshaft and U-joints to prevent overspray of any undercoating material.

Vehicles have the following types of driveshafts:

- Front driveshaft with CV joints at the front and rear ends of the driveshaft. The only serviceable part of the front driveshaft is the mounting hardware. The front driveshaft can be balanced by methods described in the General Driveline section. Refer to Section 205-00 .
- One-piece rear driveshafts with a rear U-joint flange and a slip yoke
- Two-piece rear driveshafts with a front flanged U-joint or slip yoke, center bearing with a slip joint and a flanged U-joint at the rear

Driveshafts are used to transfer movement from the transmission or transfer case to the front or rear axle. The driveshaft is composed of the U-joints, CV joints, connecting shafts and the attaching yokes. Some vehicles are equipped with a center support bearing. The center support bearing is prelubricated and sealed for the life of the bearing.

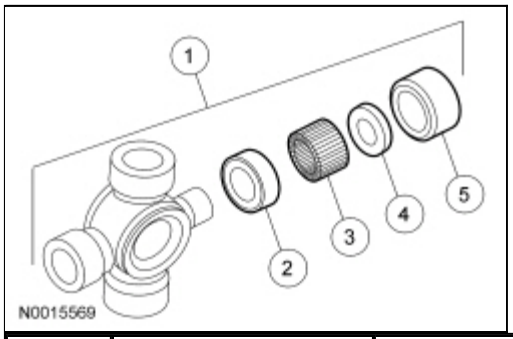
Driveshafts differ in length, diameter and type of yoke to accommodate various wheelbase and powertrain combinations.

Universal Joints

U-joints have the following features:

- Lubed-for-life design and require no lubrication
- Equipped with nylon thrust washers (located at each base of the bearing cup) which control end play, position the needle bearing and improve grease movement
- Held in place by snap rings

The U-joints allow the speeding up and slowing down of the driveshafts as the angularity of the driveshaft changes.



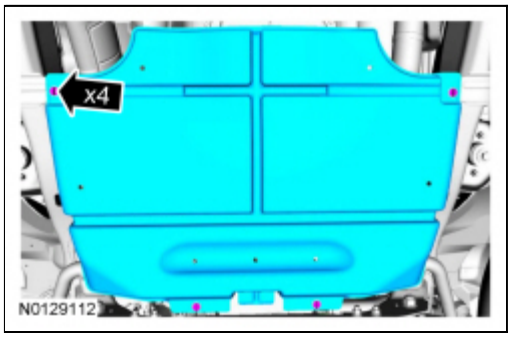
Item	Part Number	Description
1	4635	U-joint
2	—	Grease seal (part of 4635)
3	—	Needle rollers (part of 4635)
4	—	Thrust washer (part of 4635)
5	—	Bearing cup (part of 4635)

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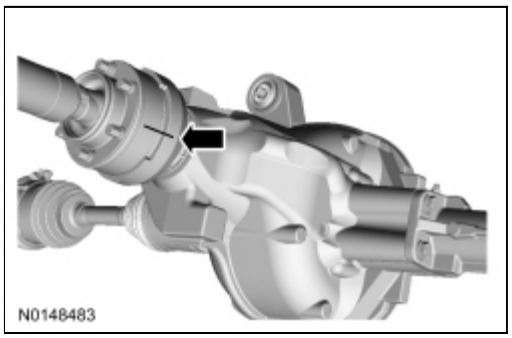
Driveshaft — Front

Removal

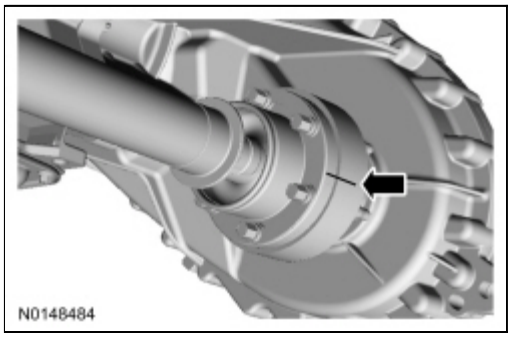
1. With the vehicle in NEUTRAL, position the vehicle on a hoist. Refer to Section 100-02 .
2. If equipped.



3.



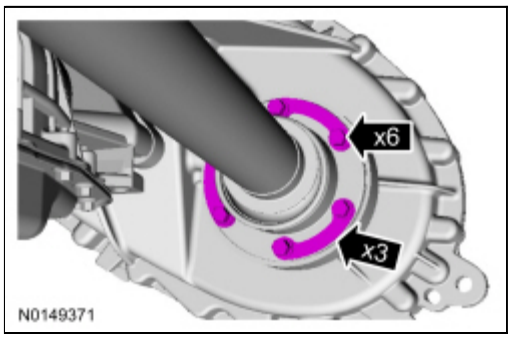
4.



5. **NOTE:** If new bolts are not available, the old bolts and washers can be reused if they are not damaged. When reusing old bolts, the threads need to be cleaned and loctite has to be used on the threads of each bolt.

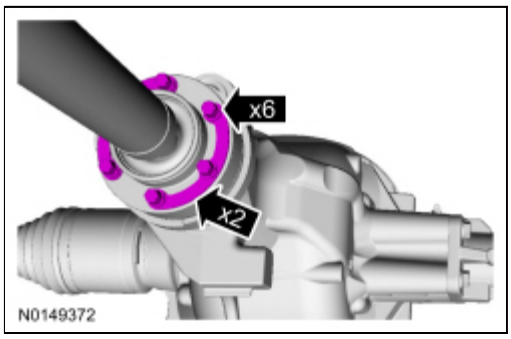
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- To install, tighten to 55 Nm (41 lb-ft).



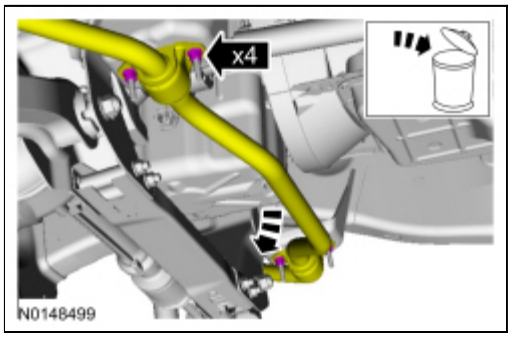
6. **NOTE:** If new bolts are not available, the old bolts and washers can be reused if they are not damaged. When reusing old bolts, the threads need to be cleaned and loctite has to be used on the threads of each bolt.

    - To install, tighten to 55 Nm (41 lb-ft).

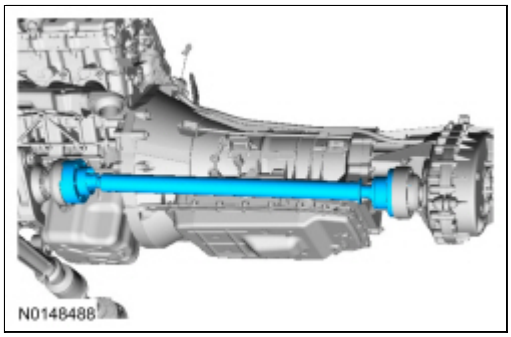


7.

    - To install, tighten to 55 Nm (41 lb-ft).



8.



Installation

1. To install, reverse the removal procedure.

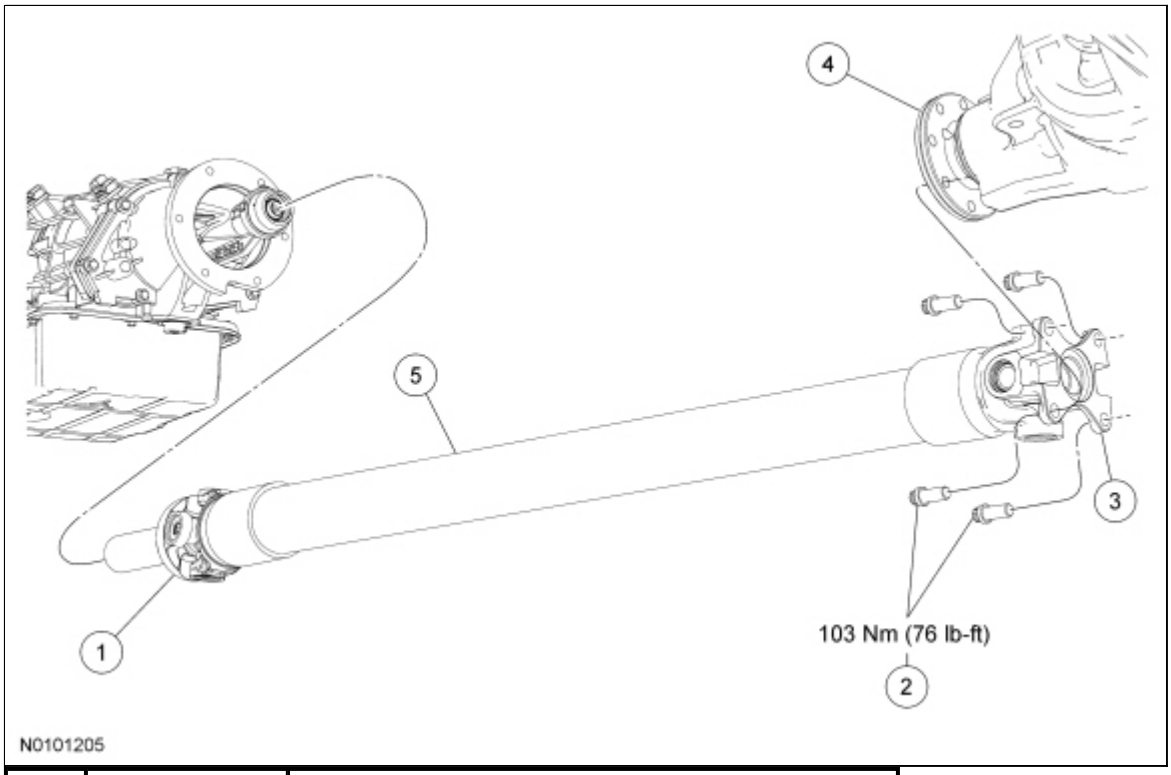
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Driveshaft — Rear, One-Piece

Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5



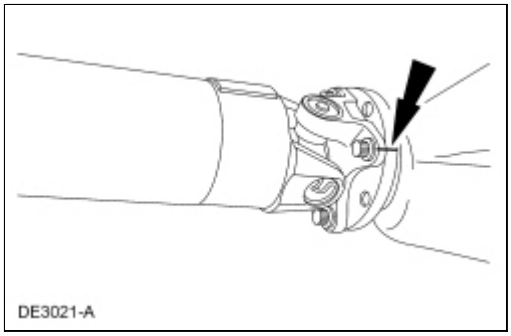
Item	Part Number	Description
1	4841	Driveshaft slip yoke
2	N800594	Driveshaft flange-to-pinion bolts (4 required)
3	4782	Rear driveshaft flange
4	4851	Pinion flange
5	4602	Driveshaft assembly

Removal and Installation

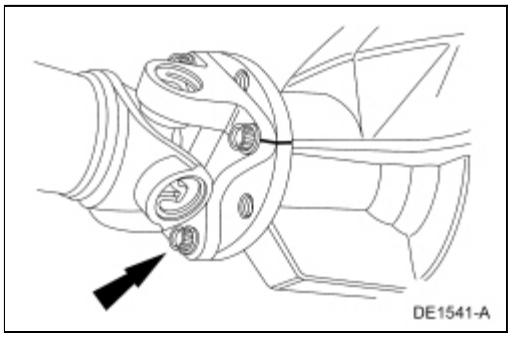
NOTE: For automatic transmissions, when installing a new driveshaft, match the yellow dots on the driveshaft to the yellow dots on the pinion flange and the output shaft to maintain balance during installation.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Index-mark the driveshaft flange to the pinion flange and the driveshaft flange to the transmission flange to maintain alignment during installation.

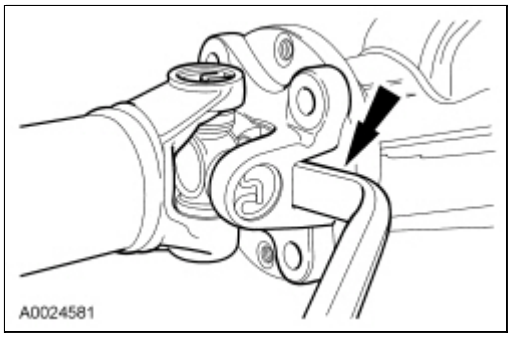


3. Remove and discard the 4 driveshaft flange bolts.
    - To install, tighten the 4 new bolts to 103 Nm (76 lb-ft).



4. ***NOTICE:*** **The driveshaft flange fits tightly on the flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the flange pilot. Pry only in the area shown with a suitable tool to disconnect the driveshaft flange from the flange pilot or damage to the driveshaft flange can occur.**

    Using a suitable tool as shown, disconnect the driveshaft flange from the flange pilot and remove the driveshaft.



5. ***NOTICE:*** **The driveshaft flange fits tightly on the pinion flange pilots. To make sure that the driveshaft flanges seat squarely on the pinion flange pilots, tighten the driveshaft flange bolts evenly in a cross pattern or damage to the flanges can occur.**

    NOTE: If new bolts are not available, coat the threads of the original driveshaft flange bolts with threadlock and sealer.

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NOTE: Align the index marks made during removal.

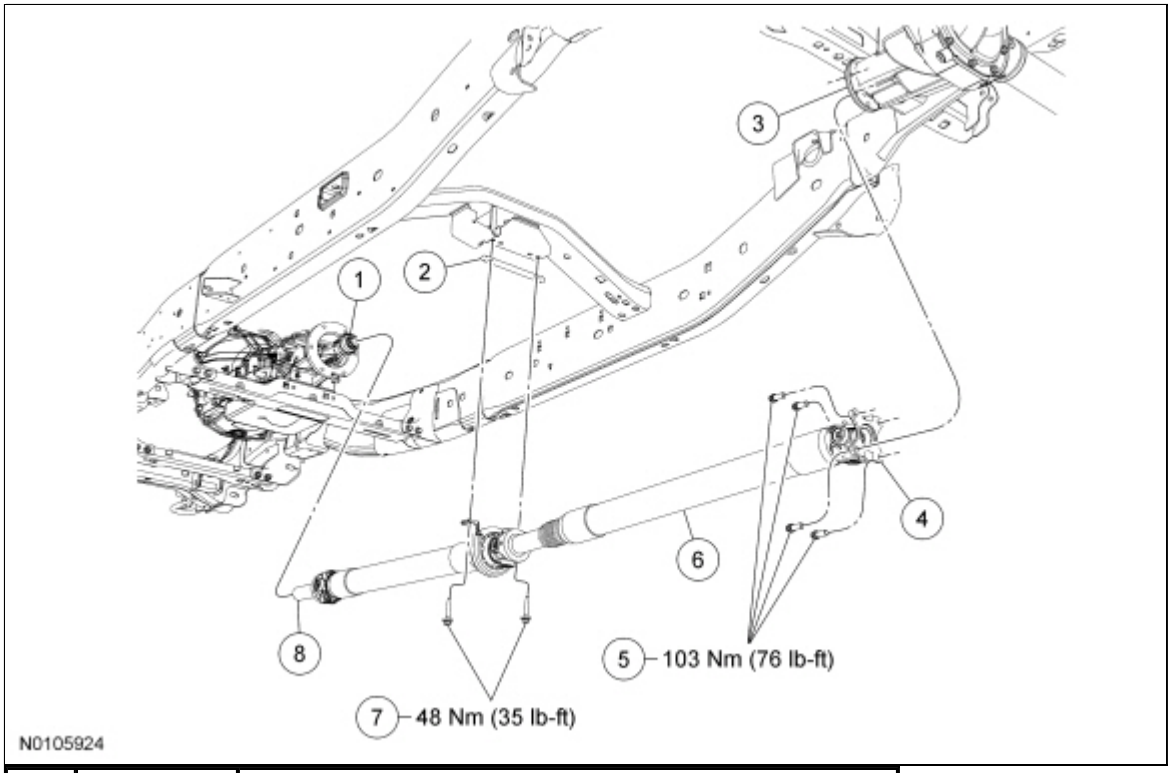
To install, reverse the removal procedure.

Driveshaft — Rear, Two-Piece

Material

Item	Specification
Motorcraft® Threadlock and Sealer TA-25	WSK-M2G351-A5

NOTE: Front slip yoke shown, front fixed flange similar.



Item	Part Number	Description
1	7A309	Transmission extension housing
2	4A209	Center bearing shim (if equipped)
3	4858	Pinion flange
4	4782	Driveshaft flange
5	N800594	Driveshaft flange-to-pinion bolts (4 required) (front fixed flange [8 required])
6	4R602	Driveshaft assembly
7	W713078	Driveshaft center bearing bolts (2 required)
8	4841	Driveshaft slip yoke

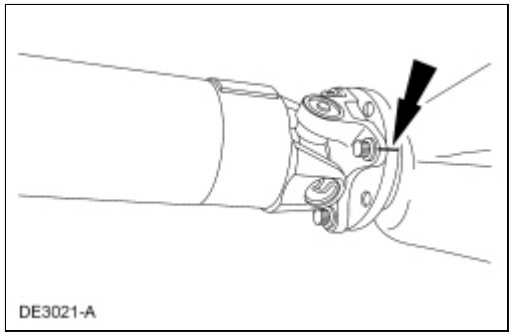
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Removal and Installation

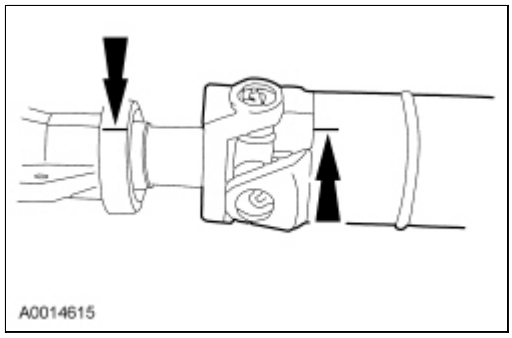
NOTE: For automatic transmissions, when installing a new driveshaft, match the yellow dots on the driveshaft to the yellow dots on the pinion flange and the output shaft to maintain balance during installation.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

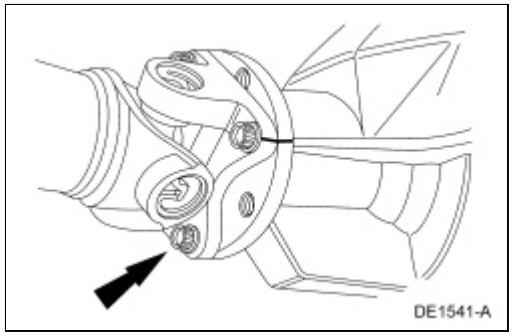
2. Index-mark the driveshaft flange to the pinion flange to maintain alignment during installation.



3. Index-mark the driveshaft to the extension housing to maintain alignment during installation.

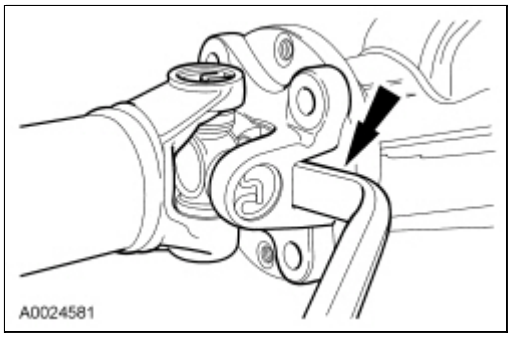


4. Remove and discard the 4 driveshaft flange bolts.
   - To install, tighten the 4 new bolts to 103 Nm (76 lb-ft).



5. ***NOTICE:*** **The driveshaft flange fits tightly on the flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the flange pilot. Pry only in the area shown with a suitable tool, to disconnect the driveshaft flange from the flange pilot or damage to the driveshaft flange can occur.**

   Using a suitable tool as shown, disconnect the driveshaft flange from the flange pilot.



6. Remove the driveshaft in the following sequence.
    1. Remove the 2 driveshaft center bearing bolts.
    2. Lower the driveshaft and slide the driveshaft slip yoke rearward off of the output shaft.
        - To install, tighten to 48 Nm (35 lb-ft).

7. Plug the extension housing to prevent fluid loss.

8. ***NOTICE:*** **The driveshaft flange fits tightly on the pinion flange pilots. To make sure that the driveshaft flanges seat squarely on the pinion flange pilots, tighten the driveshaft flange bolts evenly in a cross pattern or damage to the driveshaft flange can occur.**

    NOTE: If new bolts are not available, coat the threads of the original driveshaft flange bolts with threadlock and sealer.

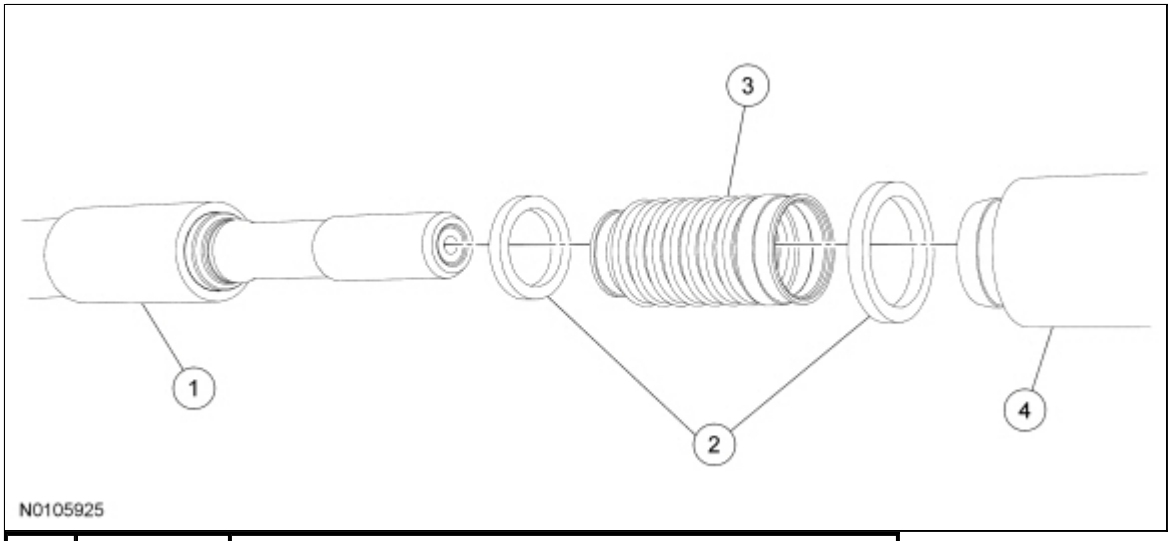
    NOTE: Align the index marks made during removal.

    NOTE: Clean any residual lubricant from the component.

    To install, reverse the removal procedure.

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Driveshaft Slip Yoke Boot

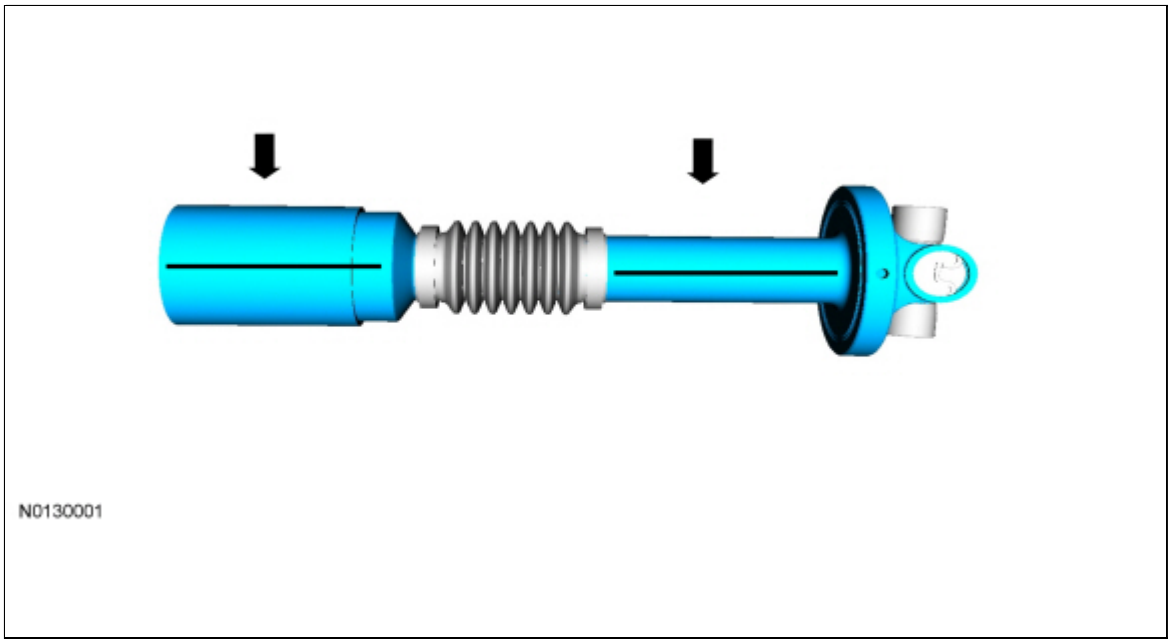


Item	Part Number	Description
1	4R602	Driveshaft assembly
2	3B478	Driveshaft slip-yoke boot clamps (2 required)(large clamp also part of kit M1C111)
3	4421	Driveshaft slip-yoke boot
4	4A335	Slip yoke

Removal

1. ***NOTICE:*** **The driveshaft and slip yoke have to be reassembled in the same phase as it was before disassembly. If the driveshaft and slip yoke isn't assembled in the same phase, a vibration can result.**

   Mark a straight line down the slip yoke and driveshaft, to help align for reassembly.



2. Remove the driveshaft. Refer to Driveshaft — Front or Driveshaft — Rear, Two-Piece in this section.

3. ***NOTICE:*** **Do not, under any circumstance, clamp the driveshaft in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.**

   Place the driveshaft on a suitable workbench. Do not damage the tubes.

4. Remove the driveshaft slip yoke from the driveshaft in the following sequence.
   1. Remove and discard the front driveshaft slip-yoke boot clamp.
   2. Remove the driveshaft slip yoke from the driveshaft.

5. Remove the slip-yoke boot from the driveshaft.
   - Inspect the boot for damage. Replace the boot as necessary.

6. Inspect the lubricant on the driveshaft splines and in the driveshaft slip yoke for contamination. If contaminated, inspect the driveshaft splines and the driveshaft slip yoke for wear. Install new components as necessary.

Installation

1. Using a clean, dry lint free shop towel, thoroughly clean old grease from slip yoke splines.

2. Position the new small driveshaft slip-yoke boot clamp on the driveshaft stub shaft.

3. Slide the small opening end of the slip-yoke boot on the driveshaft stub shaft, as far as it will travel.

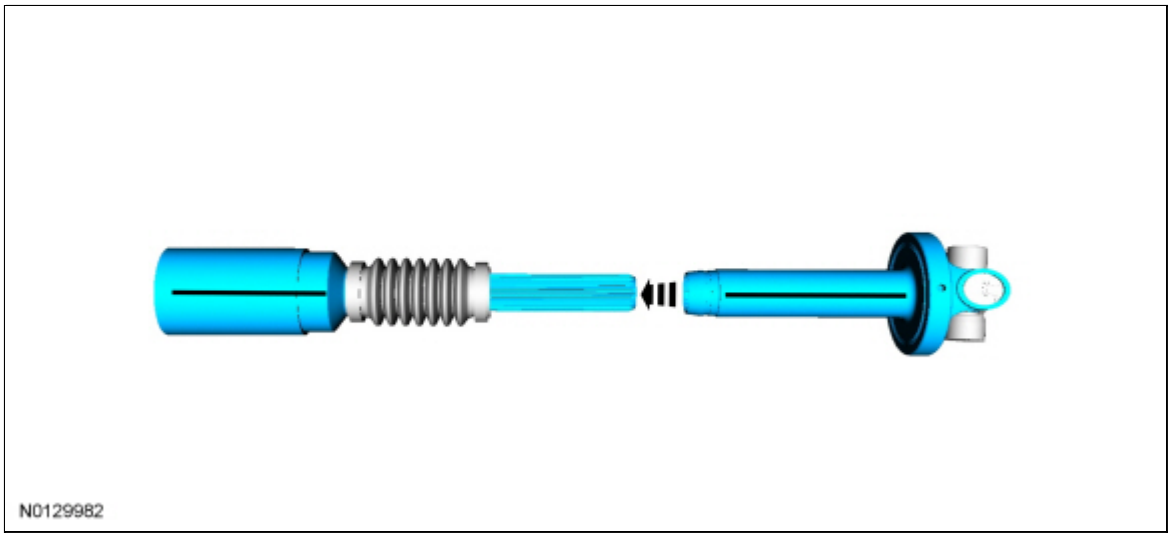
4. Using boot clamp pliers, crimp the driveshaft slip-yoke boot clamp.

5. ***NOTICE:*** **The driveshaft and slip yoke have to be reassembled in the same phase as before disassembly. If the driveshaft and slip yoke aren't assembled in the same phase, a vibration can result.**

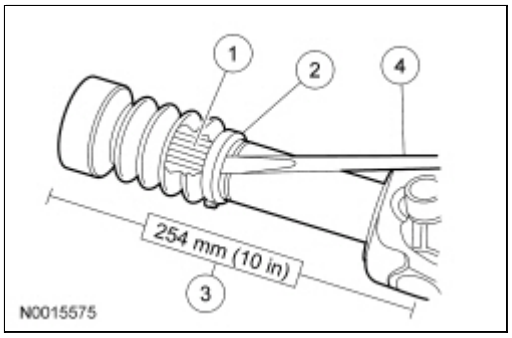
   Install the driveshaft slip-yoke on the driveshaft.

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1. Lubricate the driveshaft splines with long-life grease supplied in part # KT9L3P-M1C111-AA.
2. Pull the slip-yoke boot toward the driveshaft.
3. Position the new large slip-yoke boot clamp supplied in part # KT9L3P-M1C111-AA.
4. Align the marks from disassembly, and install the driveshaft slip yoke on the driveshaft.



6. Set the driveshaft assembled length to specification.
    1. Remove any excess grease from the slip-yoke boot and driveshaft slip-yoke surfaces.
    2. Position the slip-yoke boot in the slip-yoke boot groove.
    3. Set the driveshaft assembled length to specification.
        - Measure from the stub shaft weld to the U-joint centerline.
    4. Bleed the air from the slip-yoke boot.



7. Using boot clamp pliers, crimp the large driveshaft slip-yoke boot clamp.

8. Install the driveshaft. Refer to Driveshaft — Front or Driveshaft — Rear, Two-Piece in this section.

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Material

Item	Specification	Fill Capacity
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A	—
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5	2.84L (6.0 pt) (to the bottom of the filler hole)
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

General Specifications

Item	Specification
Available drive pinion bearing adjustment shim in steps of 0.25 mm (0.010 in)	0.254-0.965 mm (0.010-0.038 in)
Backlash between ring gear teeth and pinion teeth	0.203-0.304 mm (0.008-0.012 in)
Differential case maximum runout	0.076 mm (0.003 in)
Pinion bearing rotational preload	1.5-3.0 Nm (13-26 lb-in)
Ring gear maximum variation between teeth backlash	0.102 mm (0.004 in)
Maximum axle shaft flange runout	0.279 mm (0.011 in)

Rear Axle Backlash Shim Adjustment Table

Backlash Change Required		Thickness Change Required	
mm	in	mm	in

0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

Torque Specifications

Description	Nm	lb-ft	lb-in
Axle vent	18	—	159
Brake hose bracket bolts	30	22	—
Brake tube/parking brake cable bracket bolt	25	18	—
RH parking brake cable bracket bolt	30	22	—
Differential bearing cap bolt	112	83	—
Differential housing cover bolts	45	33	—
Differential pinion shaft lock bolt	30	22	—
Differential ring gear bolts [a]	—	—	—
Filler plug	52	38	—
Handle Adapter	2.2	—	20
Lower shock absorber nuts	90	66	—
Tool 205-135 nut	7	—	62
U-bolt nut [a]	—	—	—
Wheel speed sensor bolts	15	—	133

[a] Refer to the procedure in this section.

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Rear Drive Axle and Differential

The rear axle assembly consists of the following:

- Integral-type housing hypoid gear design (center of the pinion set below the centerline of the ring gear)
- Hypoid differential ring gear and pinion consists of an 8.8-inch ring gear and an overhung drive pinion that is supported by 2 opposed tapered roller bearings
- Axle housing assembly that consists of a cast center section with 2 steel tube assemblies and a stamped differential housing cover
- Differential pinion shaft is retained by a threaded differential pinion shaft lock bolt attached to the differential case
- Differential case is mounted in the rear axle housing between 2 opposing differential bearings that are retained in the rear axle housing by 2 removable bearing caps

The rear drive axle receives rotational torque from the driveshaft. The direction of the rotation determines movement of the vehicle. The rotation enters the rear drive axle through the drive pinion flange, turning the drive pinion and rotating the ring gear. The ring gear is bolted to the differential case. The differential case houses the pinion shaft upon which the differential pinion gears ride. The pinion gears are in mesh with the differential side gears to which the axle shafts are splined. It is the unique arrangement of the differential that allows the axle shafts to be driven at different speed when needed, such as when driving around corners. A Traction-Lok differential is also available that introduces a series of clutch plates and discs behind the differential side gears to deliver as much torque as possible to each axle shaft when the traction at the rear wheels is not equal. The Traction-Lok differential requires a friction modifier that must be installed with the axle lubricant for the plates and discs to be functional.

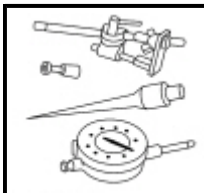
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Rear Drive Axle and Differential

Refer to Section 205-00 .

Ring Gear Backlash Adjustment

Special Tool(s)

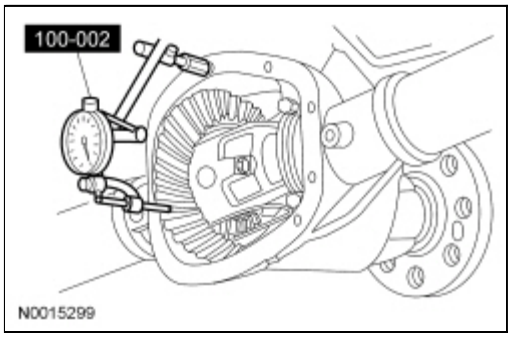
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1485-A	Installer, Differential Shim 205-220 (T85L-4067-AH)

Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—

1. Remove the differential housing cover. For additional information, refer to Differential Housing Cover in this section.

2. Install the Dial Indicator Gauge with Holding Fixture and measure the ring gear backlash.
   - If a zero backlash condition occurs or the backlash is not within specification, proceed to Step 3.
   - If the backlash is within specification, proceed to Step 14.

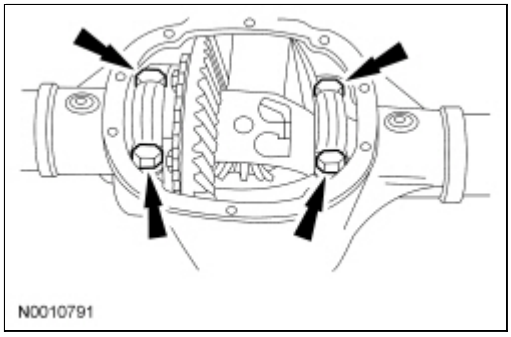


3. Remove the axle shafts. For additional information, refer to Axle Shaft in this section.

4. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

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Remove the 4 bearing cap bolts and 2 caps.



5. If a zero backlash condition has occurred, add 0.50 mm (0.020 in) to the RH side shim and subtract 0.50 mm (0.020 in) from the LH side shim to allow a backlash indication. Install the 2 bearing caps and 4 bolts.
    - Tighten to 112 Nm (83 lb-ft).
    - Go back to Step 2.

6. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

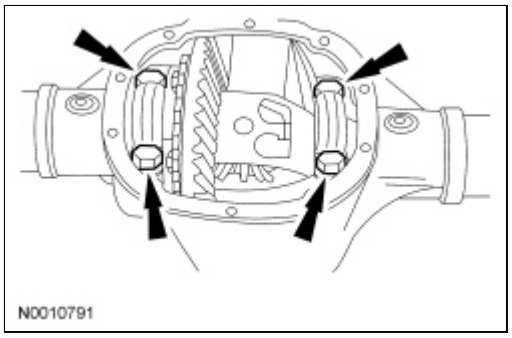
Differential Shim Size Chart 4067

Stripes and Color Code	Dimension A	
	mm	Inch

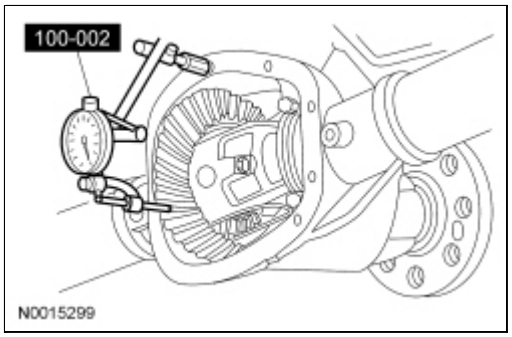
2 — C-COAL	7.7978-7.8105	0.3070-0.3075
1 — C-COAL	7.7470-7.7597	0.3050-0.3055
5 — BLU	7.6962-7.7089	0.3030-0.3035
4 — BLU	7.6454-7.6581	0.3010-0.3015
3 — BLU	7.5946-7.6073	0.2990-0.2995
2 — BLU	7.5458-7.5565	0.2970-0.2975
5 — PINK	7.4422-7.4549	0.2930-0.2935
4 — PINK	7.3914-7.4041	0.2910-0.2915
3 — PINK	7.3406-7.3533	0.2890-0.2895
2 — PINK	7.2898-7.3025	0.2870-0.2875
1 — PINK	7.2390-7.2517	0.2850-0.2855
5 — GRN	7.1882-7.2009	0.2830-0.2835
4 — GRN	7.1374-7.1501	0.2810-0.2815
3 — GRN	7.0866-7.0993	0.2790-0.2795
2 — GRN	7.0358-7.0485	0.2770-0.2775
1 — GRN	6.9850-7.0485	0.2750-0.2755
5 — WH	6.9342-6.9469	0.2730-0.2735
4 — WH	6.8834-6.8961	0.2710-0.2715
3 — WH	6.8326-6.8453	0.2690-0.2695
2 — WH	6.7818-6.7945	0.2670-0.2675
1 — WH	6.7310-6.7437	0.2650-0.2655
5 — YEL	6.6802-6.6929	0.2630-0.2635
4 — YEL	6.6294-6.6421	0.2610-0.2615
3 — YEL	6.5786-6.5913	0.2590-0.2595
2 — YEL	6.5278-6.5405	0.2570-0.2575
1 — YEL	6.4770-6.4897	0.2550-0.2555
5 — ORNG	6.4262-6.4389	0.2530-0.2535
4 — ORNG	6.3754-6.3881	0.2510-0.2515
3 — ORNG	6.3246-6.3373	0.2490-0.2495
2 — ORNG	6.2738-6.2865	0.2470-0.2475
1 — ORNG	6.2223-6.2357	0.2450-0.2455
2 — RED	6.1722-6.1849	0.2430-0.2435
1 — RED	6.1214-6.1341	0.2410-0.2415

7. Install the 2 bearing caps and 4 bolts.
    - Tighten to 112 Nm (83 lb-ft).

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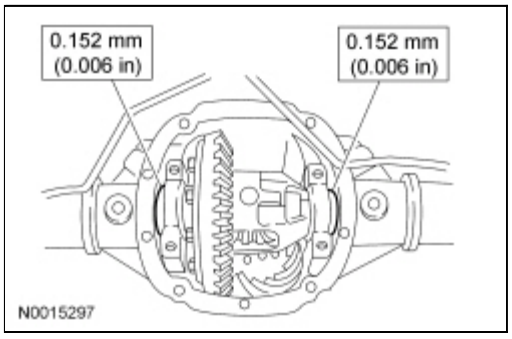


8. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.
    - If backlash is now within specification, proceed to Step 9.
    - If backlash is not within specification, go back to Step 4.

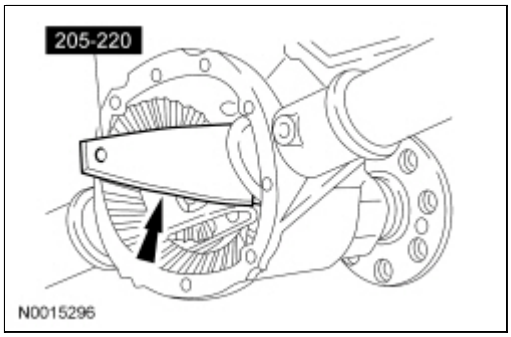


9. Remove the 4 bearing cap bolts and 2 bearing caps.

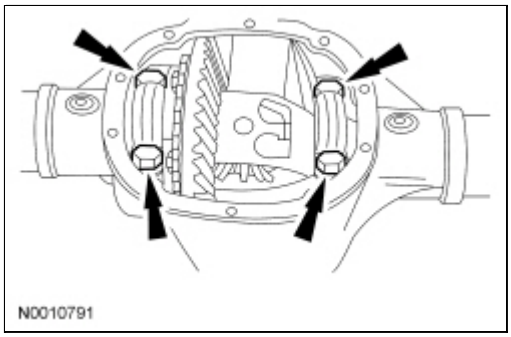
10. To establish differential bearing preload, increase both LH and RH differential bearing shim size by the thickness shown.



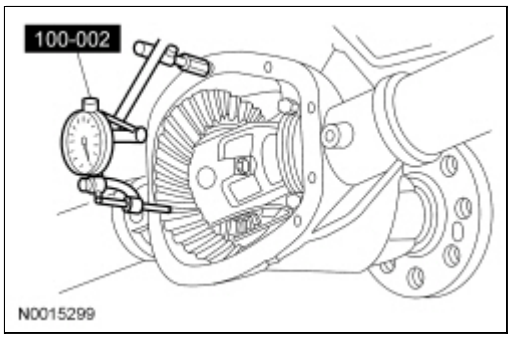
11. Using the Differential Shim Installer, fully seat the differential bearing shims. Make sure the assembly rotates freely.



12. Install the 2 bearing caps and 4 bolts.
    - Tighten to 112 Nm (83 lb-ft).



13. Using the Dial Indicator Gauge with Holding Fixture, do a final check of the ring gear backlash.



14. Apply marking compound and rotate the differential assembly 5 complete revolutions.

15. Verify an acceptable pattern check. For additional information, refer to Tooth Contact Pattern Check in Section 205-00 .

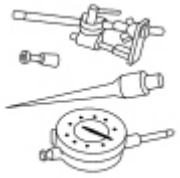
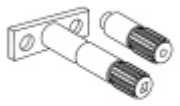
16. Install the axle shafts. For additional information, refer to Axle Shaft in this section.

17. Install the differential housing cover. For additional information, refer to Differential Housing Cover in this section.

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Differential Case and Ring Gear — Conventional

Special Tool(s)

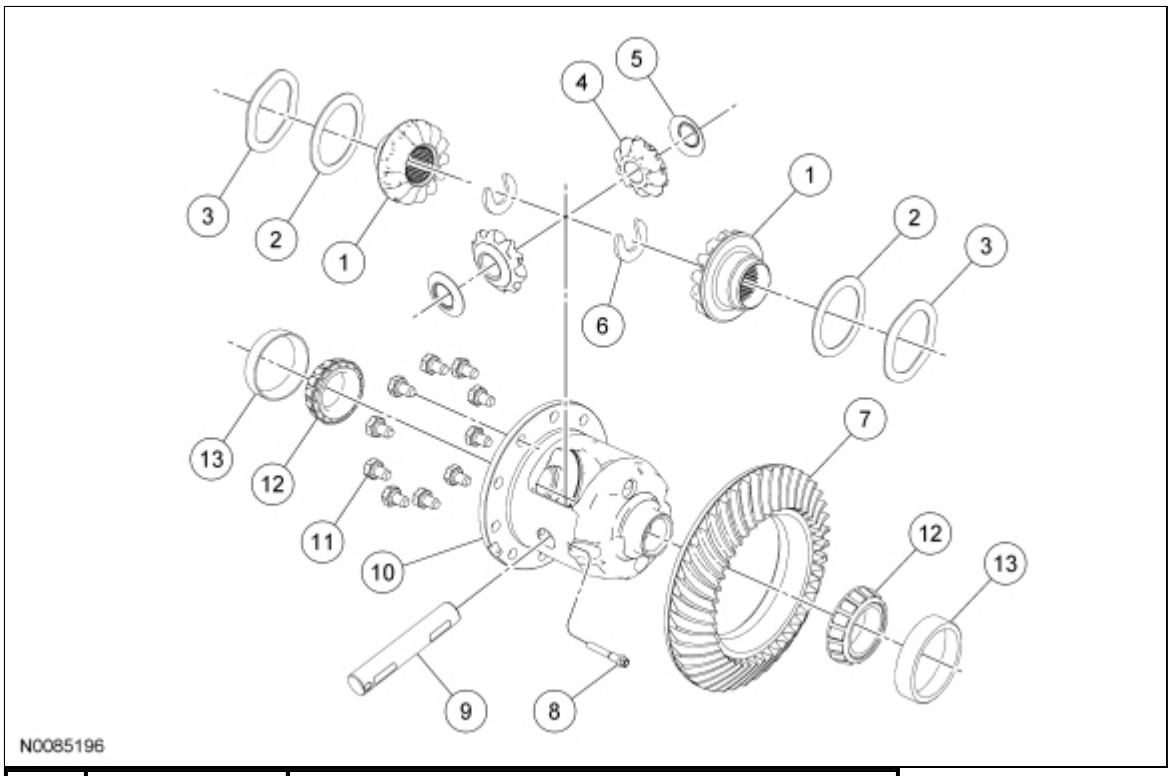
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1265-A	Gauge, Differential Clutch 205-022 (T66L-4204-A)
 ST1749-A	Gauge, Differential (Traction Lock) 205-386 (T97T-4205-D)
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1220-A	Remover, Differential Bearing 205-116 (T77F-4220-B1)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent

Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant	WSL-M2C192-A and GL-5

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XY-75W140-QL (US); CXY-75W140-1L (Canada)	
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5



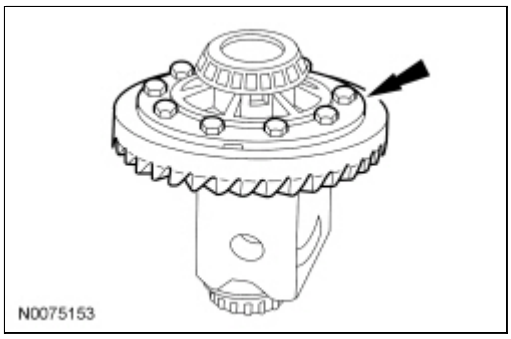
Item	Part Number	Description
1	4236	Differential side gears
2	4228	Differential side gear thrust washers
3	—	Differential side gear wave washers
4	4215	Differential pinion gear (2 required)
5	4230	Differential pinion thrust washer (2 required)
6	4N237	Axle shaft U-washer (2 required)
7	4209	Differential ring gear
8	4241	Differential pinion shaft lock bolt
9	4211	Differential pinion shaft
10	4204	Differential case
11	4216	Differential ring gear bolt (10 required)
12	4221	Differential bearings
13	4222	Differential bearing cups

Initial disassembly

NOTE: If the differential ring gear backlash between teeth is greater than specification, remove the ring gear to check the differential case flange runout. Do not disassemble the differential carrier assembly.

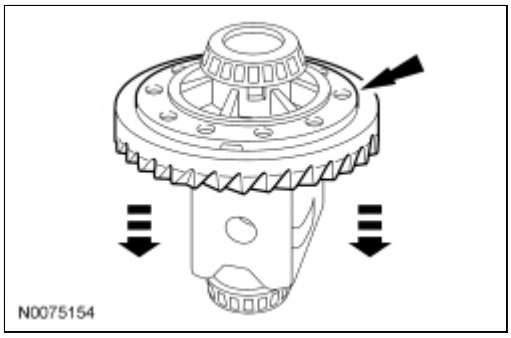
1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to Differential Carrier in this section.

2. Remove and discard the 10 differential ring gear bolts.

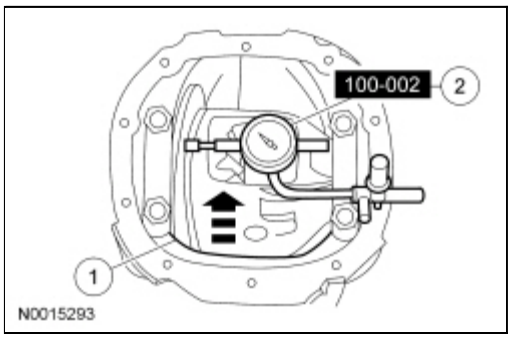


3. ***NOTICE:*** **Care should be taken not to damage the differential ring gear bolt hole threads.**

   Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.



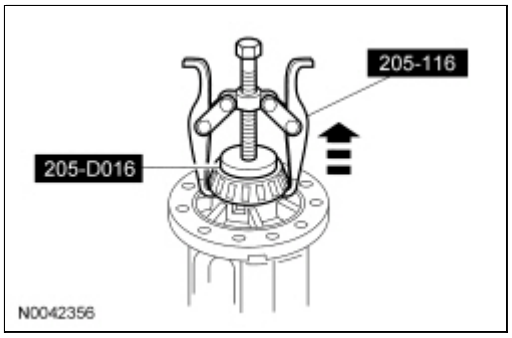
4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
   1. Install the bearing caps and differential shims.
      - Rotate the differential assembly to verify the bearings have seated.
   2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.



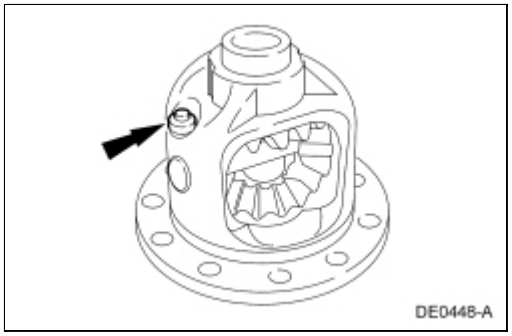
Final disassembly

5. Using the Differential Bearing Remover and Step Plate, remove the differential bearings.

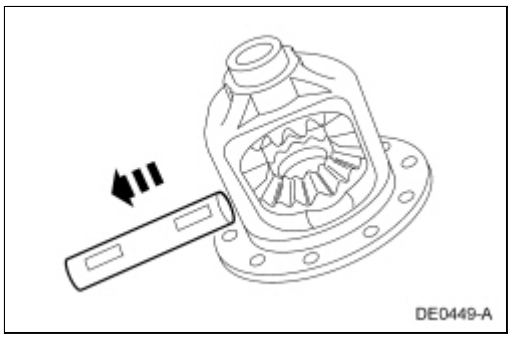
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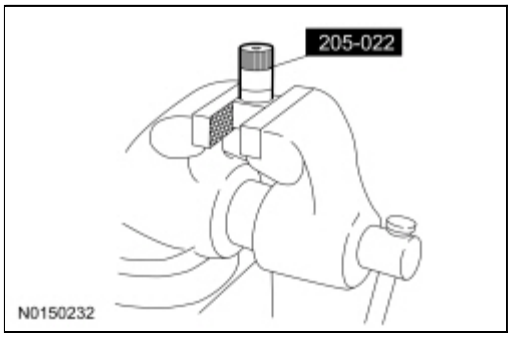
6. Remove the differential pinion shaft lock bolt.



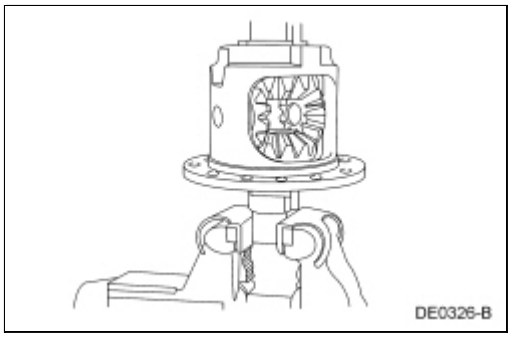
7. Remove the differential pinion shaft.



8. Install the Differential Gauge in a suitable vise.

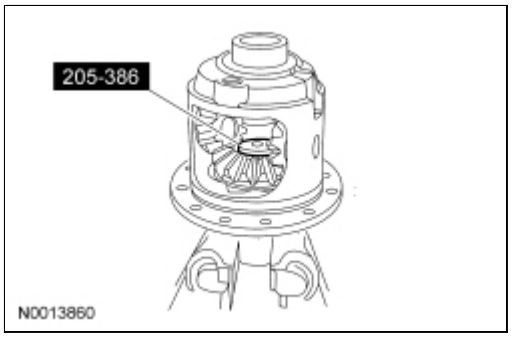


9. Install the differential case on the Differential Gauge.

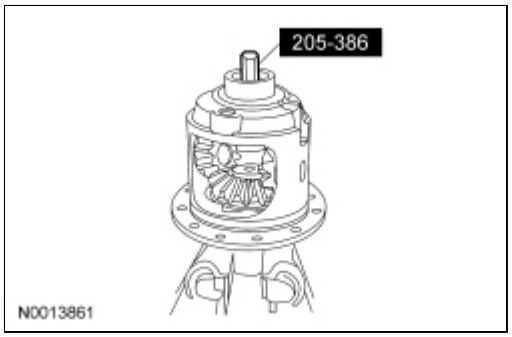


10. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge.

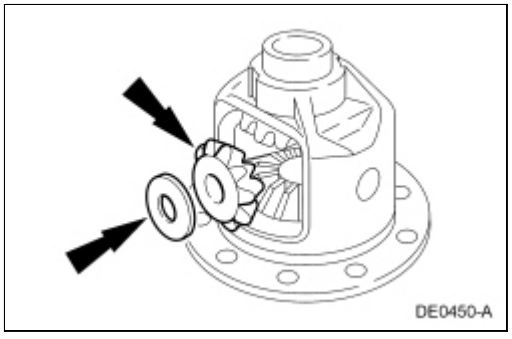
    Install the Differential Gauge step plate in the bottom differential side gear.



11. Install the Differential Gauge nut in the upper differential side gear. Hold the nut in position while installing the Differential Gauge hex screw. Tighten the hex-head screw until contact is made with the Step Plate.

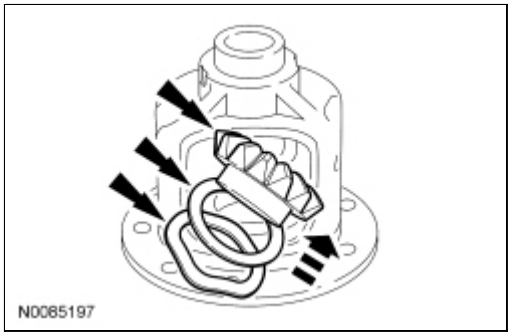


12. Rotate and remove the differential pinion gears and differential pinion gear thrust washers.



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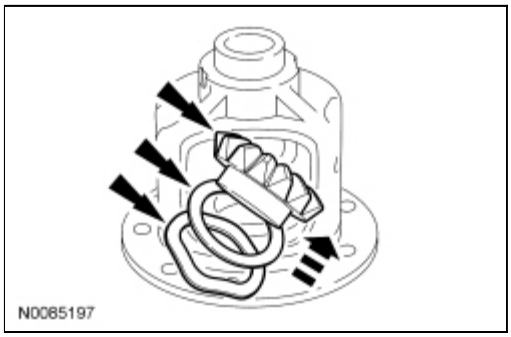
13. Remove the differential side gears, the differential side gear washers and the differential side gear wave washers.



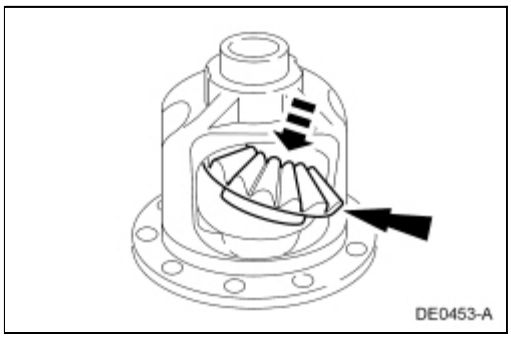
Assembly

1. **NOTE:** Lubricate the differential side gear thrust washers, wave washers and the side gear journals with axle lubricant.

   Position the differential side gear thrust washers and wave washers on the differential side gears.



2. Install the differential side gears.

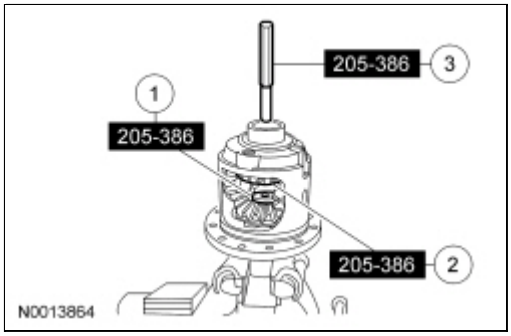


3. **NOTE:** Apply a small amount of grease to the Step Plate bore.

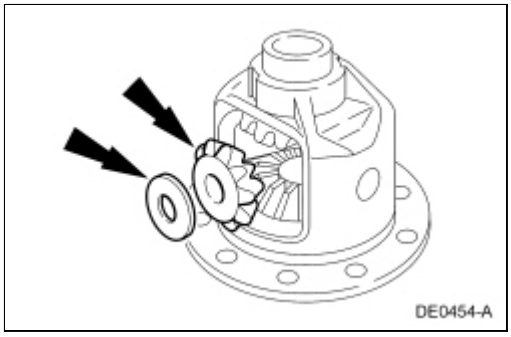
   NOTE: If necessary, insert the Differential Gauge dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

   Assembly the Differential Gauge to the differential case.
   1. Position the Differential Gauge step plate in the bottom differential side gear.
   2. Position the Differential Gauge hex screw plate in the top differential side gear and hold it in place.

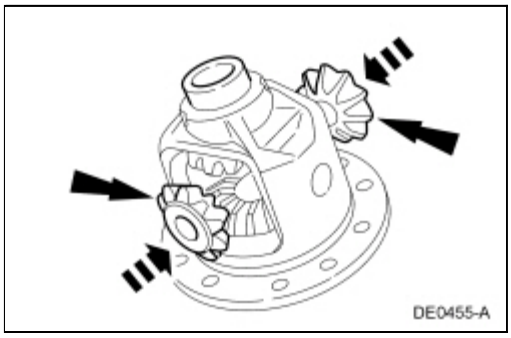
3. Install the Differential Gauge hex screw and tighten it 2 turns after it contacts the bottom Step Plate.



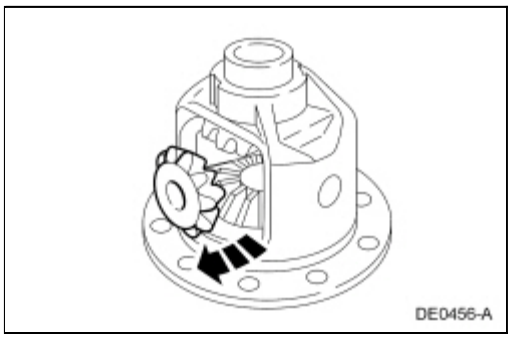
4. Use axle lubricant to lubricate the differential pinion gear thrust washers and the differential pinion gears.



5. Install the differential pinion gears and differential pinion gear thrust washers opposite the differential side gears.

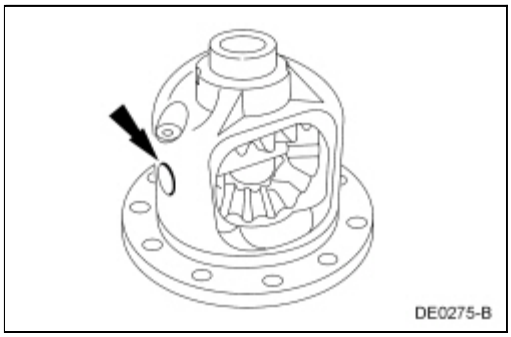


6. Rotate the differential pinion gears to align with the differential pinion shaft bore.



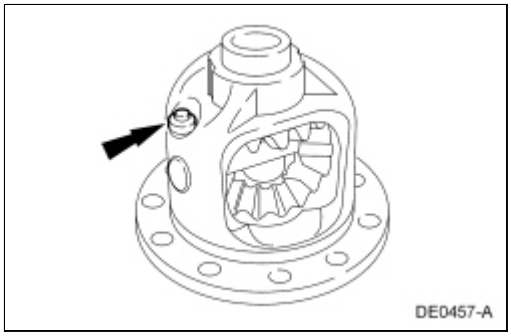
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7. Install the differential pinion shaft.
    - Align the hole in the differential pinion shaft with the hole in the differential case.

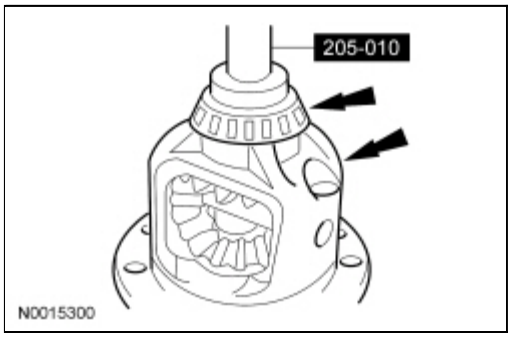


8. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with threadlock and sealer prior to installation.

    Install a new differential pinion shaft lock bolt and tighten finger-tight.



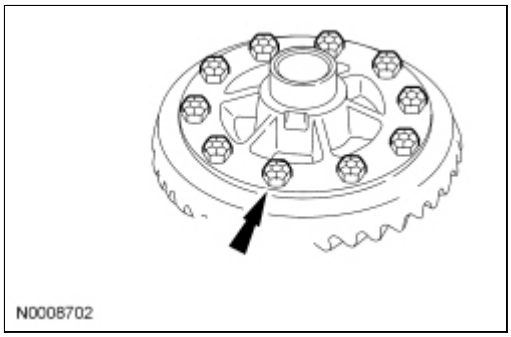
9. Using the Differential Side Bearing Installer, install the new differential bearings on the differential case.



10. Position the differential ring gear on the differential case. Align the bolt holes by starting 2 bolts through the holes in the differential case and into the differential ring gear.

11. Using a shop press, press the ring gear on the differential case.

12. Install the 10 new differential ring gear bolts. Tighten in 2 stages.
    - Stage 1: Tighten to 60 Nm (44 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.

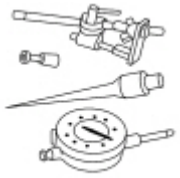
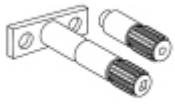


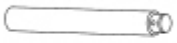
13. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

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Differential Case and Ring Gear — Traction-Lok

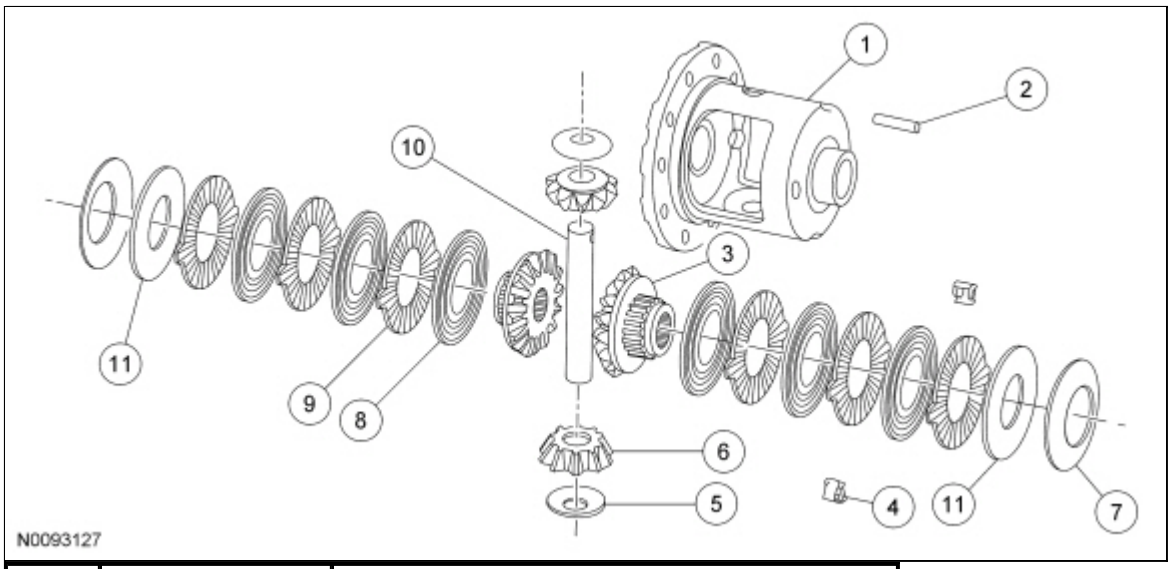
Special Tool(s)

 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1374-A	Gauge, Differential Clutch 205-135 (T80P-4946-A)
 ST1265-A	Gauge, Differential Clutch 205-022 (T66L-4204-A)
 ST1372-A	Gauge, Differential Clutch (Mandrel for 205-135 [T80P-4946-A]) 205-270 (T87T-4946A)
 ST1749-A	Gauge, Differential (Traction-Lock) 205-386 (T97T-4205-D)
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Remover, Differential Bearing 205-116 (T77F-4220-B1)

 ST1220-A	
 ST1858-A	Rotator, Differential 205-378 (T97T-4205-C)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent

Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5



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Item	Part Number	Description
1	4204	Differential case
2	4241	Differential pinion shaft lock bolt
3	4236	Differential side gear
4	—	Retainer clip (part of 4880)
5	4230	Differential pinion thrust washer
6	4215	Differential pinion gear
7	—	Plate preload spacer (part of 4880)
8	—	Clutch disc (part of 4880)
9	—	Clutch plate (part of 4880)
10	4211	Differential pinion shaft
11	—	Selective shim (part of 4880)

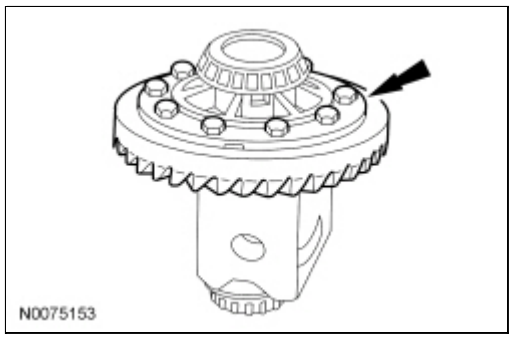
Initial disassembly

NOTE: If the Diagnostic Chart directed the servicing of the Traction-Lok clutch packs, it is not necessary to remove the differential carrier assembly from the axle housing. Proceed to Step 7.

NOTE: If the differential ring gear backlash between teeth is greater than specification, remove the ring gear to check the differential case flange runout. Do not disassemble the differential carrier assembly.

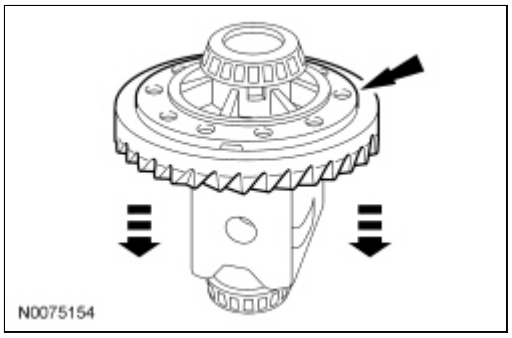
1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to Differential Carrier in this section.

2. Remove and discard the 10 differential ring gear bolts.

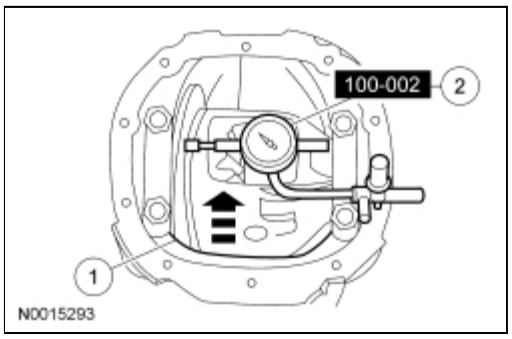


3. ***NOTICE:*** **Care should be taken not to damage the differential ring gear bolt hole threads.**

   Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.

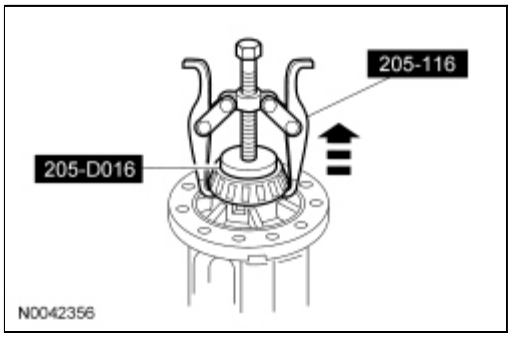


4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
    1. Install the bearing caps and differential shims.
        - Rotate the differential assembly to verify the bearings have seated.
    2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.



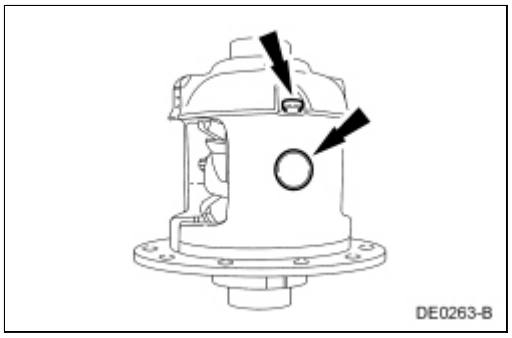
Final disassembly

5. Using the Differential Bearing Remover and Step Plate, remove the differential bearings.

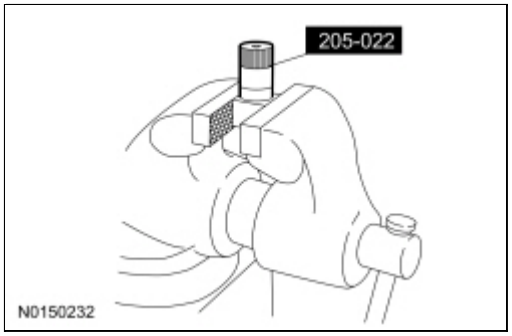


6. Remove the differential pinion shaft lock bolt and remove the differential pinion shaft.

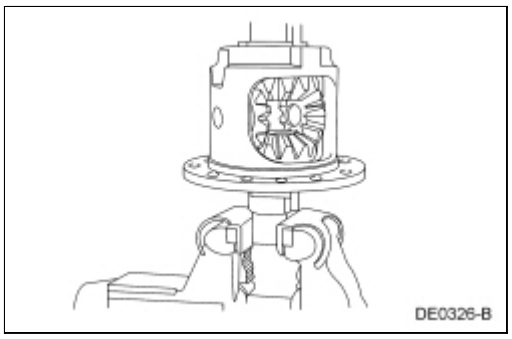
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7. Install the Differential Gauge in a suitable vise.

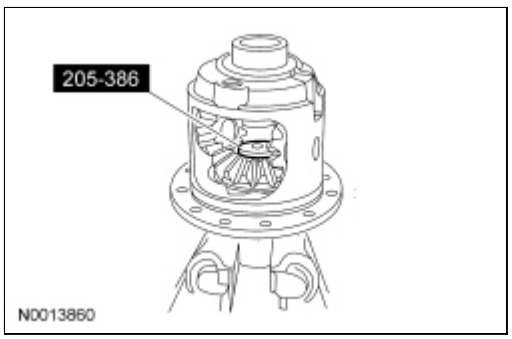


8. Install the differential case on the Differential Gauge.

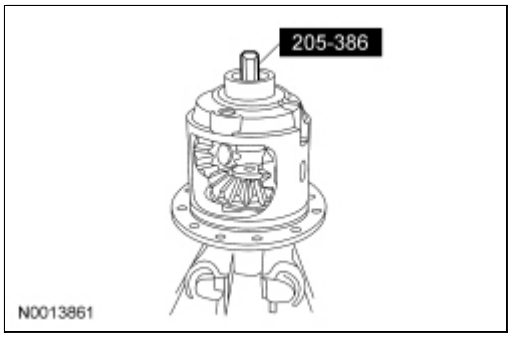


9. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge.

   Install the Differential Gauge step plate in the bottom differential side gear.

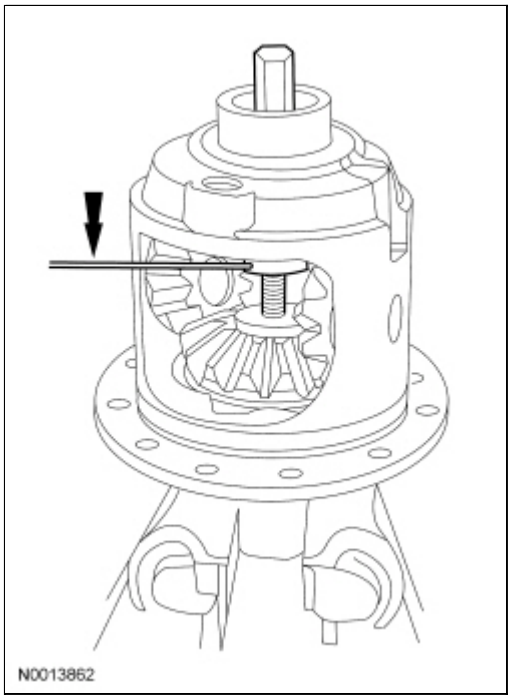


10. Install the nut in the upper differential side gear. Hold the nut in position while installing the hex screw. Tighten the hex-head screw until contact is made with the Differential Gauge step plate.



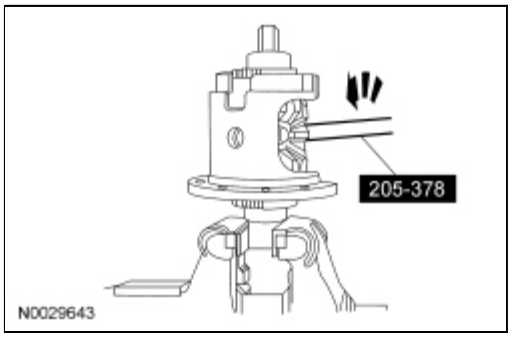
11. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

    Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gears away from the differential pinion gears.



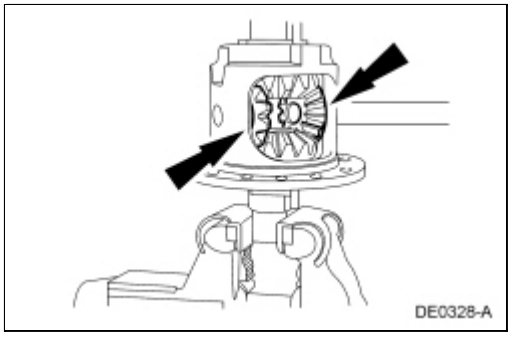
12. **NOTE:** Differential pinion gear thrust washers cannot be removed independently of the differential pinion gears.

    Insert the Differential Rotator in the pinion shaft bore, and turn the differential case to "walk" the differential pinion gears and differential case windows.

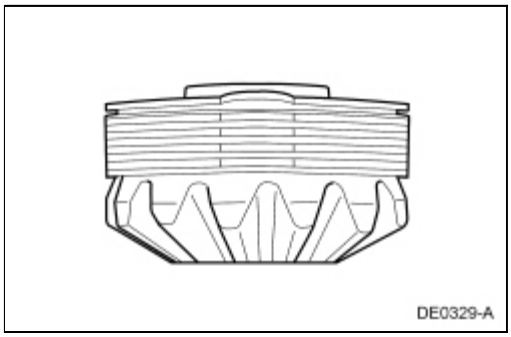


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13. Remove the differential pinion gears and differential pinion gear thrust washers.



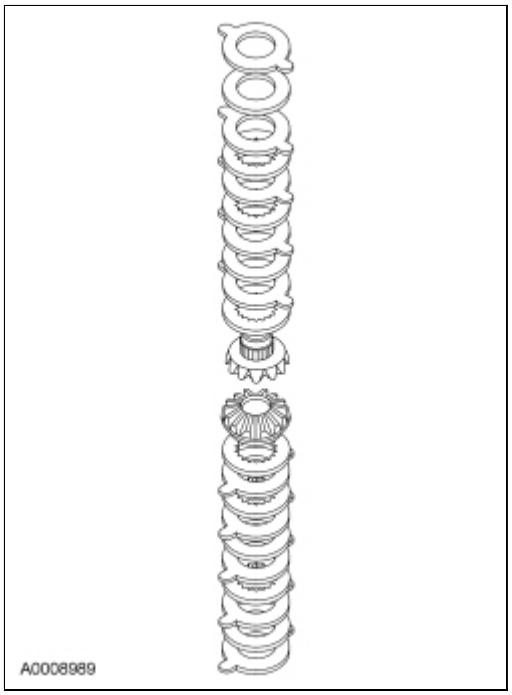
14. Remove the differential side gears and differential clutch packs with the selective shim and Belleville spring, tag them RH and LH.



15. ***NOTICE:*** **Do not use acids or solvents when cleaning the differential clutch pack or damage to the components can result. Wipe components with a clean, lint-free cloth only.**

    NOTE: When separating the clutch plates and clutch disc, note the sequence in which they are disassembled. They must be reassembled in the same sequence.

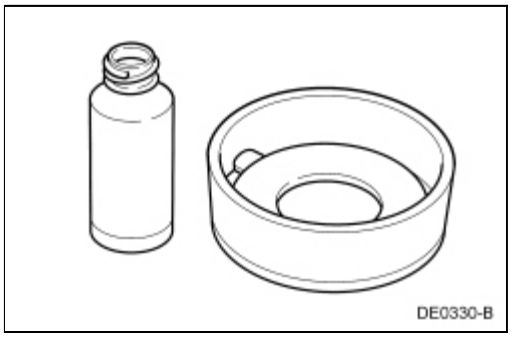
    Separate the differential clutch disc and clutch plates for cleaning and inspection.



Assembly

1. **NOTE:** Use 118 ml (4 oz) of the specified friction modifier in the axle.

   Pre-lubricate each steel clutch plate and soak all friction plates with friction modifier for at least 15 minutes.

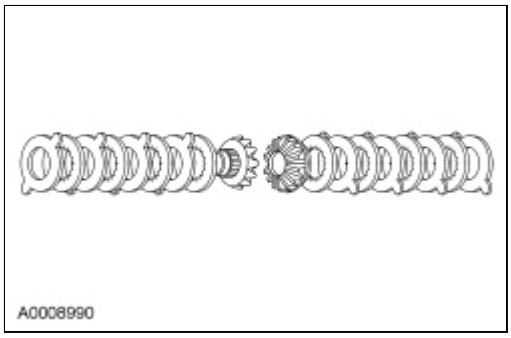


2. **NOTE:** Do not mix the differential clutch packs or selective shims from one side with the other.

   NOTE: The Belleville spring is a dished plate.

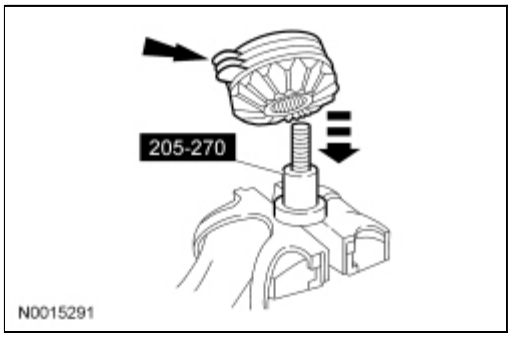
   Assemble the differential clutch packs (without the selective shims and Belleville spring) on the respective differential side gears.

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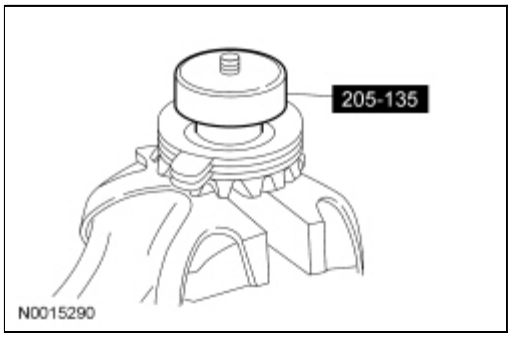


3. **NOTE:** Make sure the correct mandrel is used with the Differential Clutch Gauge.

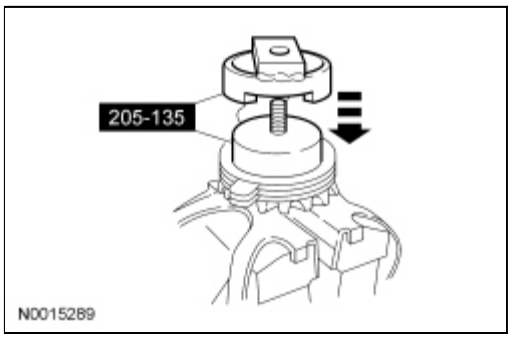
   Place the base portion of the Differential Clutch Gauge in a vise. Install the differential clutch pack and differential side gear (without the selective shim or Belleville spring) on the gauge.



4. Position the Differential Clutch Gauge hand-tight on top of the differential clutch pack.

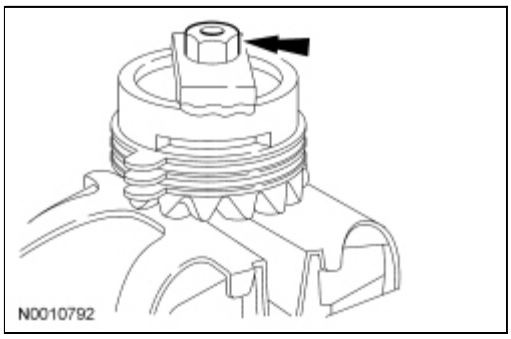


5. Install the Differential Clutch Gauge over the disc and differential clutch pack.



6. Install the nut of the gauge over the top and base stud.

- Tighten to 7 Nm (62 lb-in).

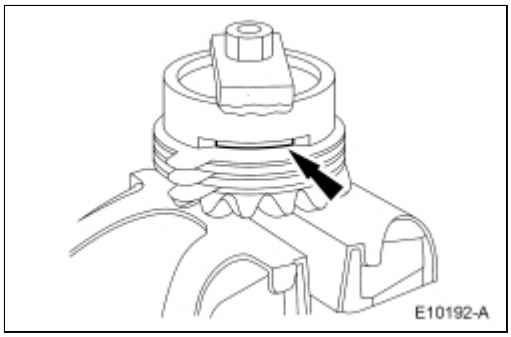


7. **NOTE:** Selective shims shown are available as part of the Clutch Pack Replacement Kit.

   Use the feeler gauge and select the thickest blade that will enter between the tool and the differential clutch pack. Refer to the chart to determine which shim to use.

   Selective Shims

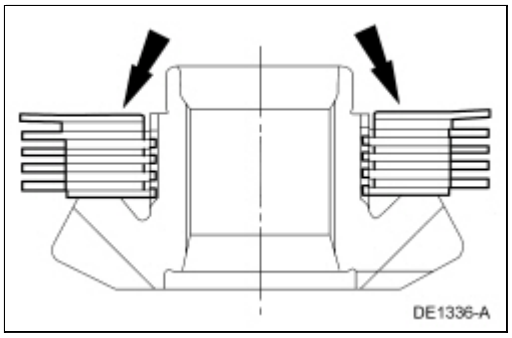
Feeler Gauge	Part Number	Description
0.096-0.104	E0AZ-4A324-G	0.025 in
0.105-0.109	E0AZ-4A324-H	0.030 in
0.110-0.114	E0AZ-4A324-C	0.035 in
0.115-0.190	E0AZ-4A324-D	0.040 in
0.120-0.125	E0AZ-4A324-F	0.045 in



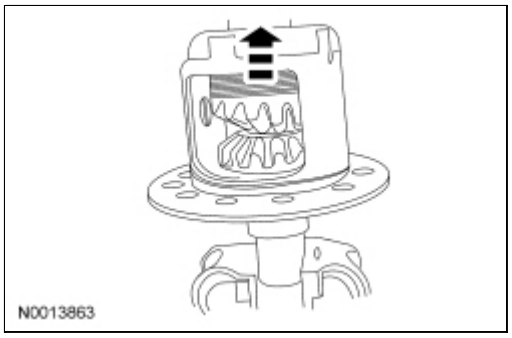
8. Remove the Differential Clutch Gauge from the clutch pack and differential side gear assembly.

9. Place the selective shim and Belleville spring on the differential clutch pack.
   - The dished or concave side of the Belleville spring must face up against the thrust face of the differential case.

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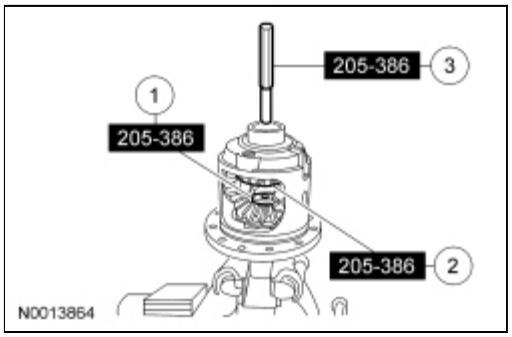
10. Install the differential side gears with the differential clutch packs, selective shims and Belleville spring into the differential case.
    - Hold the differential side gear assembly in place to prevent it from falling out of the differential case.



11. **NOTE:** Apply a small amount of grease to the step plate bore.

    NOTE: If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

    Assemble the Differential Gauge to the differential case.
    1. Position the Differential Gauge step plate in the bottom differential side gear.
    2. Position the Differential Gauge in the top differential side gear and hold it in place.
    3. Install the Differential Gauge and tighten it 2 turns after it contacts the bottom step plate.

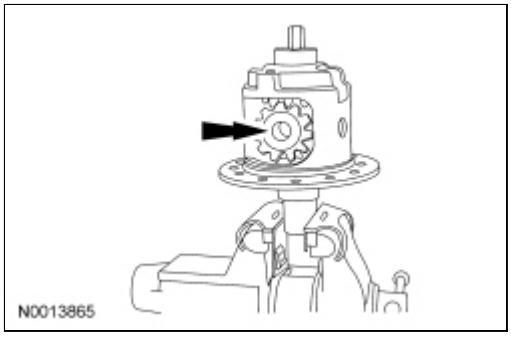


12. **NOTE:** Lubricate both sides of the differential pinion gear thrust washers with axle lubricant.

    NOTE: Make sure the differential pinion gears are 180 degrees apart so they will align correctly with the pinion shaft bore.

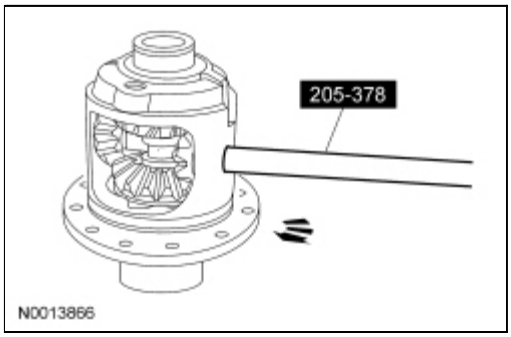
    Position the differential pinion gears and differential pinion gear thrust washers in the window of the

differential case so they mesh with the differential side gear teeth.



13. **NOTE:** It will probably be necessary to loosen or tighten the forcing screw to allow the differential pinion gears and differential side gears to rotate.

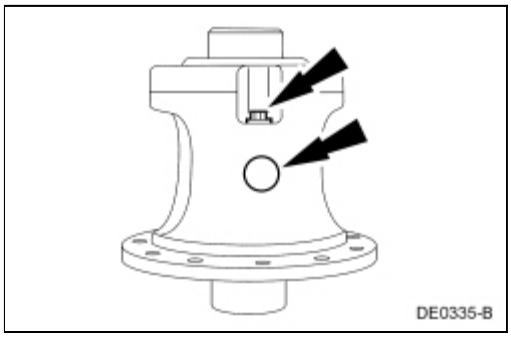
    Inspect the Differential Rotator into the pinion shaft bore, and turn the differential case. This will cause the differential pinion gears to engage the differential side gear and "walk" into the differential case. Rotate the differential case until the pinion shaft mating holes are lined up exactly with the holes in the differential pinion gears.



14. Remove the special tools.

15. **NOTE:** If a new differential pinion shaft lock bolt is unavailable, coat the threads of the original differential pinion shaft lock bolt with threadlock prior to installation.

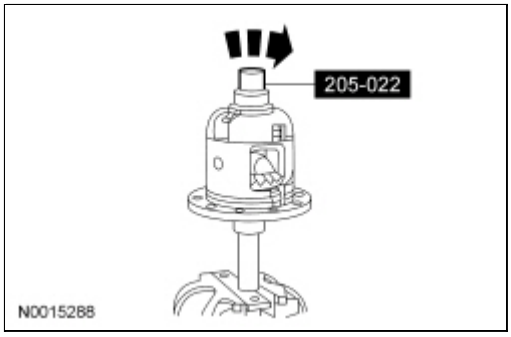
    Install the differential pinion shaft, then a new differential pinion shaft lock bolt finger-tight.



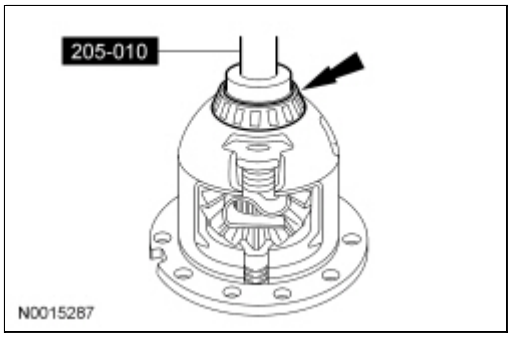
16. Check the torque required to rotate one differential side gear.
    - Mount the differential assembly and Differential Clutch Gauge in a vise.
    - The initial minimum break-away torque, if original clutch plates are used, must be within specification. The minimum rotating torque required to keep the differential side gear turning

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with new clutch plates may vary.

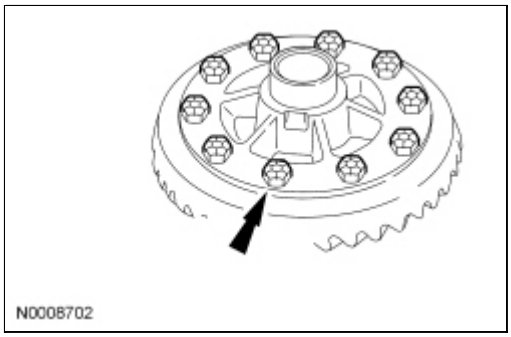


17. Using the Differential Side Bearing Installer, install the 2 differential bearings on the differential case.



18. Position the differential ring gear and the differential case. Align the bolt holes by hand-starting 2 new bolts through the holes in the differential case and into the differential ring gear.

19. Hand-start the 8 remaining new differential ring gear bolts. Tighten the 10 bolts in 2 stages.
    - Stage 1: Tighten to 60 Nm (44 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



20. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

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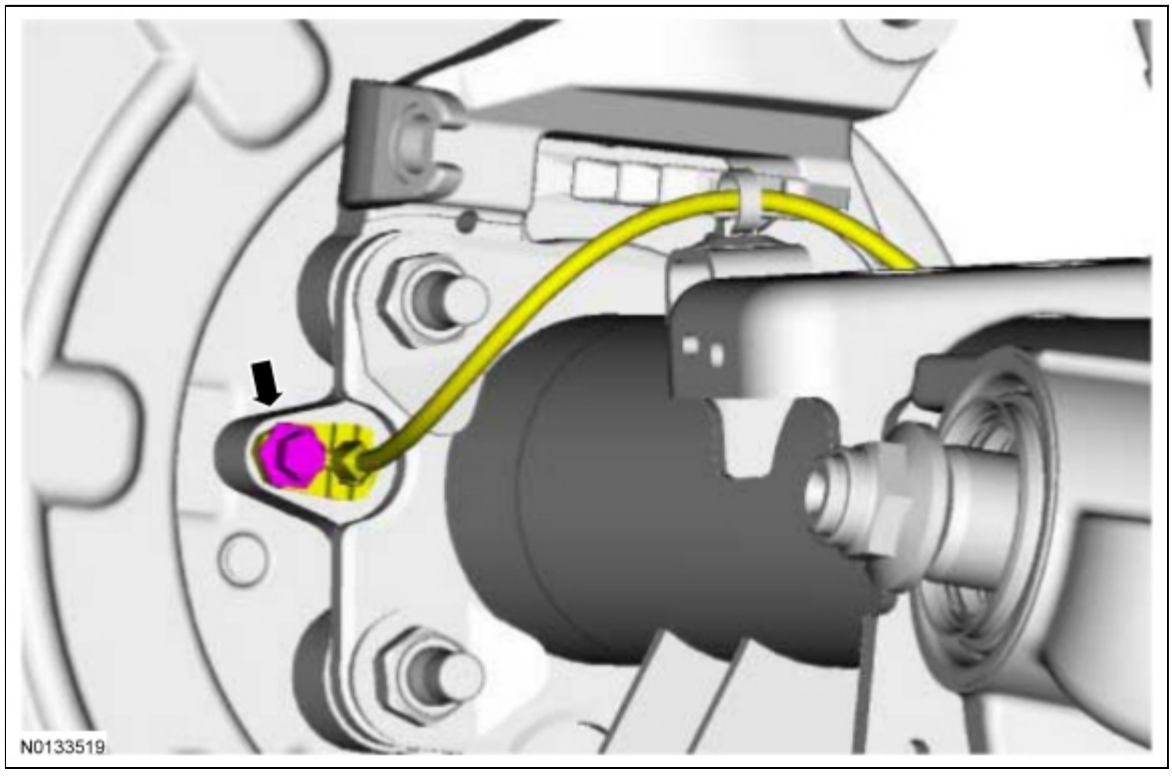
Axle Shaft

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

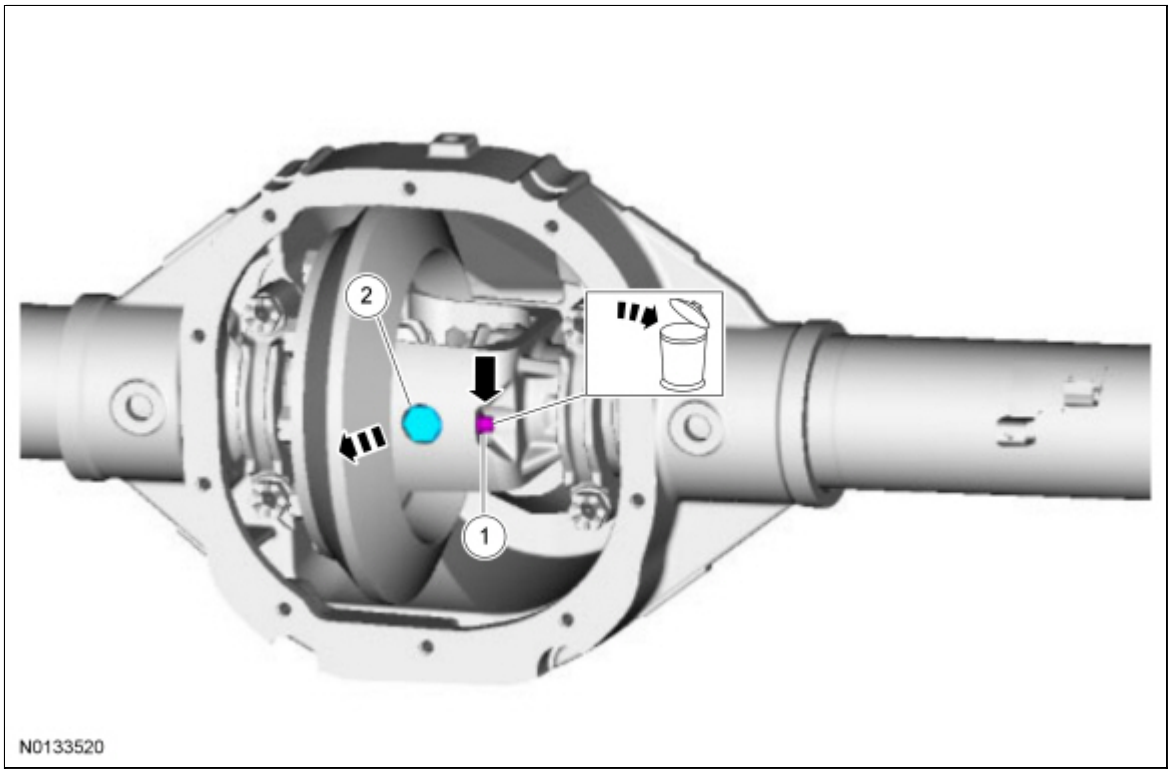
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the rear wheel and tire. For additional information, refer to Section 204-04 .
3. Remove the rear brake disc. For additional information, refer to Section 206-04 .
4.
   - To install, tighten to 15 Nm (133 lb-in).



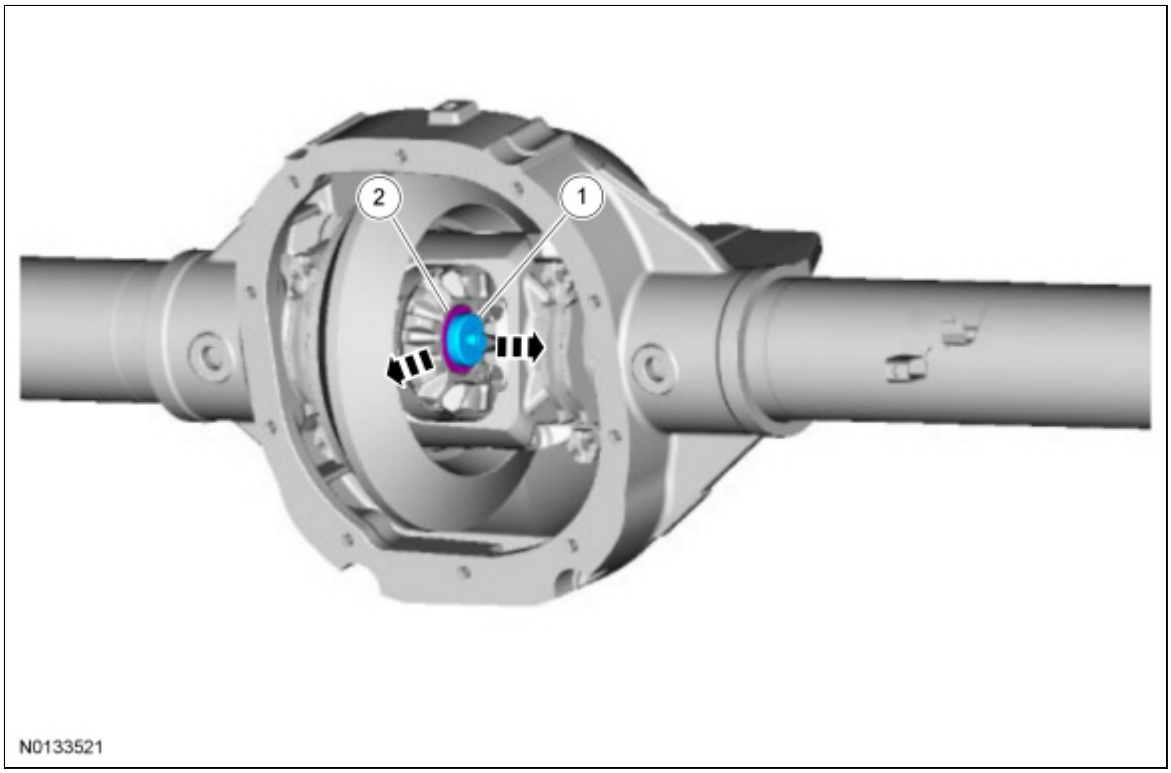
5. Remove the differential housing cover and drain the lubricant. For additional information, refer to Differential Housing Cover in this section.

6. Discard the specified component. Follow local disposal regulations.
    - To install, tighten to 30 Nm (22 lb-ft).

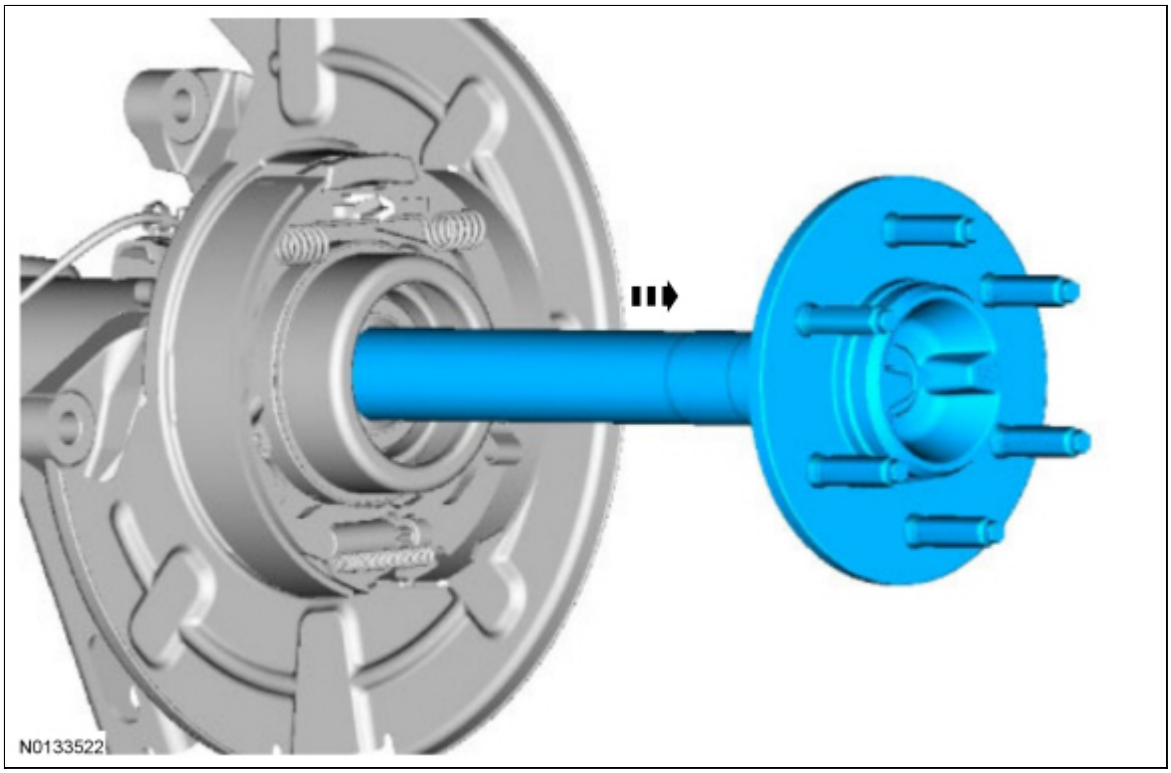


7.

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8.

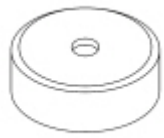
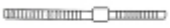
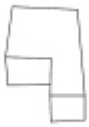
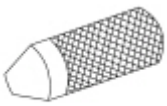
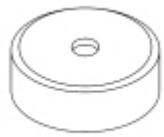


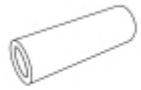
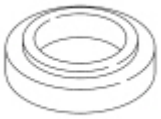
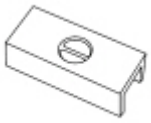
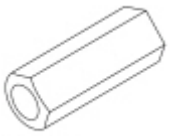
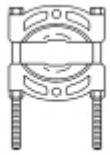
9. To install, reverse the removal procedure.
    - Inspect and lubricate the lip of the wheel bearing oil seal with grease.

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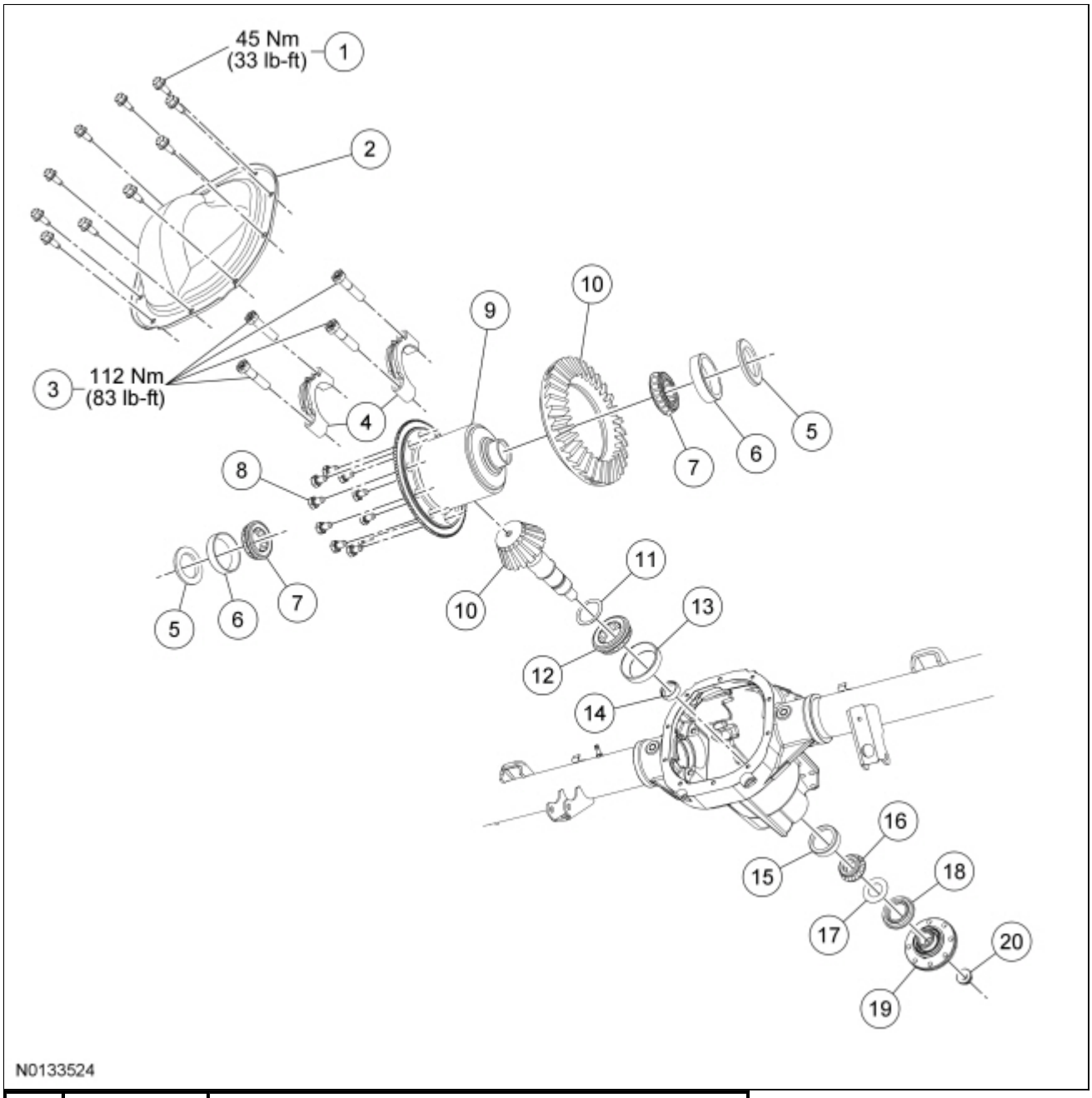
Differential Bearings

Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D79L-4221-A1) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1743-A	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for 205-S127 205-130 (T79P-4020-A19)

 ST1434-A	
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1367-A	Installer, Shaft Bearing Cone 308-169 (T88T-7025-B)
 ST1254-A	Plate, Bearing Oil Seal 205-090 (T75L-1165-B)
 ST1744-A	Protector, Drive Pinion Thread 205-460 or equivalent
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A) or equivalent
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent

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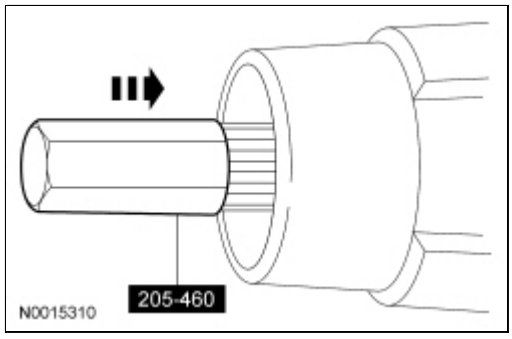


Item	Part Number	Description
1	4346	Differential housing cover bolt (10 required)
2	4033	Differential housing cover
3	46108	Differential bearing cap bolts (part of 4010) (4 required)
4	—	Differential bearing caps (part of 4010) (2 required)
5	4067	Differential bearing shims (2 required)
6	4222	Differential bearing cups (2 required)
7	4221	Differential bearings (2 required)
8	4216	Ring gear bolt (10 required)

9	4204	Differential assembly
10	4209	Ring gear
10	4209	Drive pinion
11	4663	Pinion bearing alignment shim
12	—	Inner pinion bearing cup (part of 4625)
13	4625	Inner pinion bearing
14	4662	Collapsible spacer (part of 4320)
15	—	Outer pinion bearing cup (part of 4621)
16	4621	Outer pinion bearing
17	4670	Oil slinger
18	4676	Drive pinion oil seal
19	4851	Drive pinion flange
20	4C121	Drive pinion nut (part of 4320)

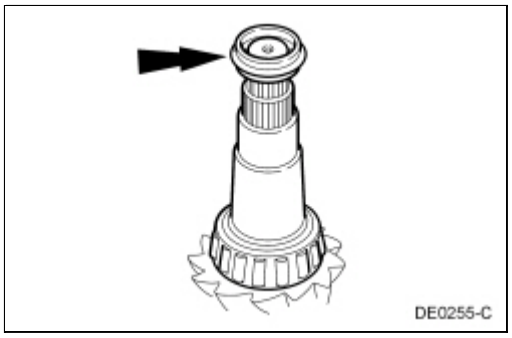
Removal

1. Remove the drive pinion seal. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.
2. Remove the differential carrier. For additional information, refer to Differential Carrier in this section.
3. Remove the axle drive pinion shaft oil slinger.
4. Using the Drive Pinion Thread Protector and a soft-faced hammer, drive the pinion assembly out of the outer pinion bearing and remove it through the rear of the differential housing.

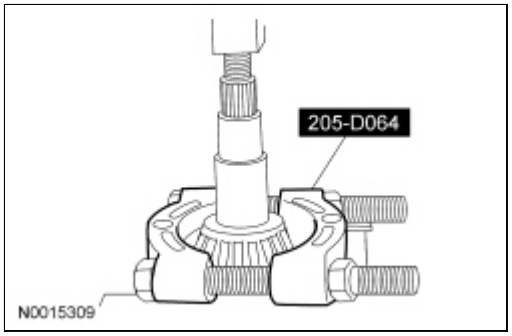


5. Remove the outer pinion bearing.
6. Remove the drive pinion collapsible spacer and discard it.

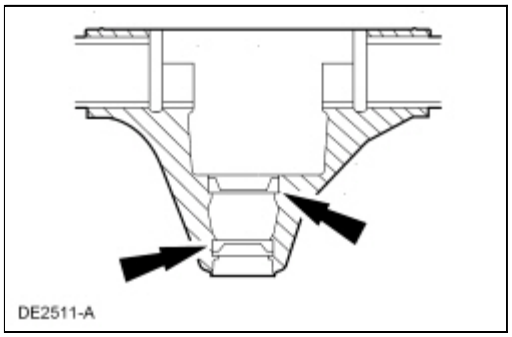
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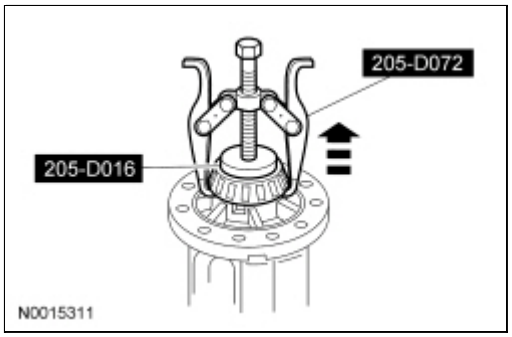
7. Using the Bearing Puller and a suitable press, remove the inner pinion bearing.



8. Using a brass drift, remove the pinion bearing cups by tapping alternately on opposite sides of the bearing cups.



9. Using the 2 Jaw Puller and Step Plate, remove the 2 differential bearings.

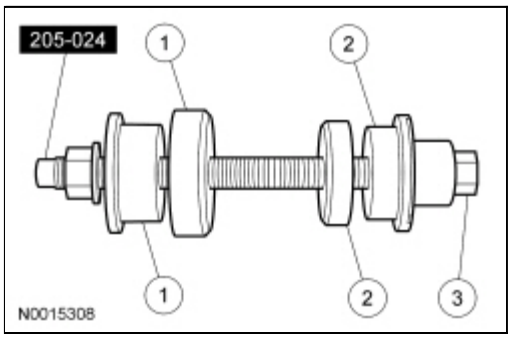


Installation

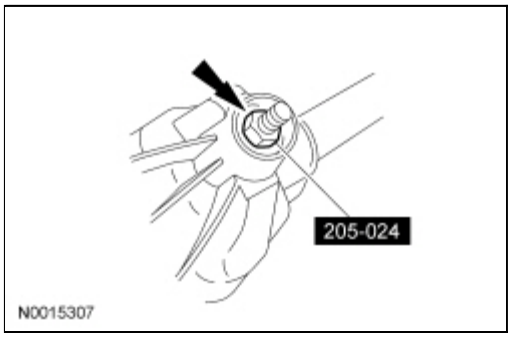
1. Position the Drive Pinion Bearing Cup Installer and the inner and outer bearing cups in their

respective bores.

1. After placing the inner and outer bearing cups in their respective bores, place the Drive Pinion Bearing Cup Installer on the inner bearing cup.
2. Place the Drive Pinion Bearing Cup Installer on the outer bearing cup.
3. Install the Drive Pinion Bearing Cup Installer.

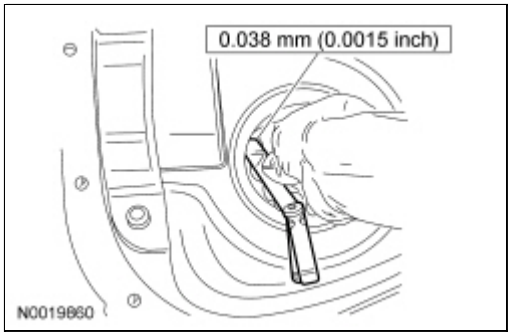


2. Tighten the Drive Pinion Bearing Cup Installer to seat the pinion bearing cups in their bores.



3. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

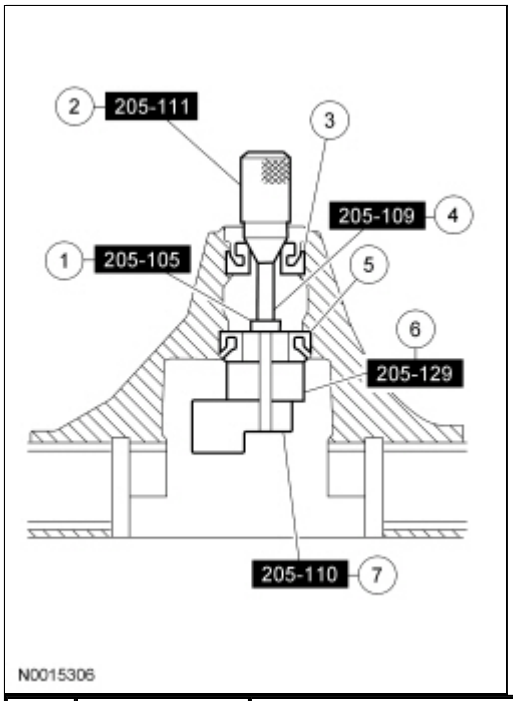
   Make sure the differential pinion bearing cups are correctly seated.



4. **NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

   Assemble and position the Adapters.

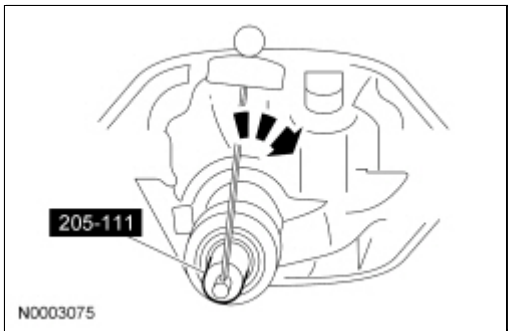
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Item	Part Number	Description
1	205-105	Adapter for 205-S127 (1.612 in OD) (T76P-4020-A3)
2	205-111	Adapter for 205-S127 (T76P-4020-A11)
3	4621	Drive pinion bearing (outer)
4	205-109	Adapter for 205-S127 (T76P-4020-A9)
5	4630	Drive pinion bearing (inner)
6	205-129	Adapter for 105-S127 (1.1884 in thick) (T79P-4020-A18)
7	205-110	Adapter for 205-S127 (1.7 in thick) (T76P-4020-A10)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

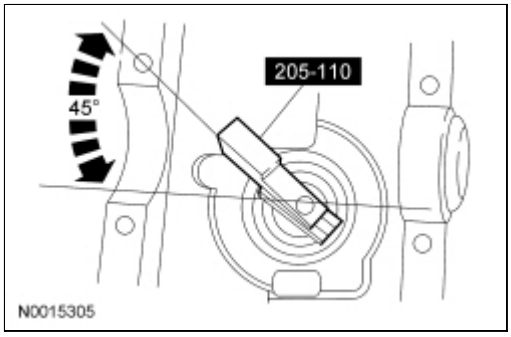
   Tighten the Adapter.
   - Tighten to 2.2 Nm (20 lb-in) rotational torque.



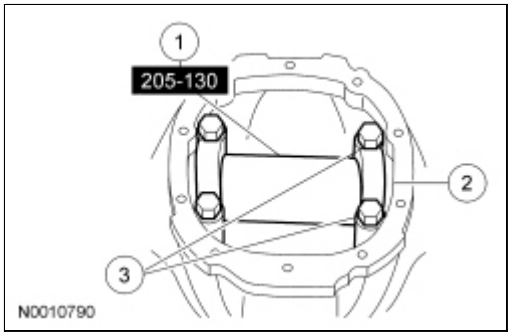
6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

   Rotate the Adapter several half turns to make sure of correct seating of the drive pinion bearings and

position the Adapter.



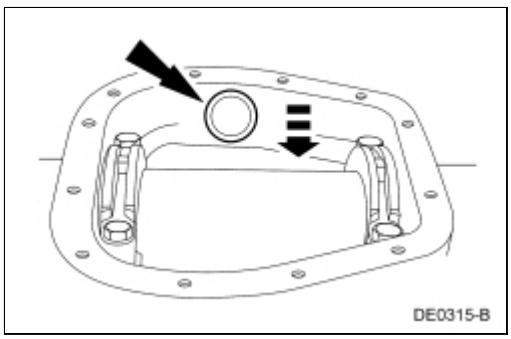
7. Install the Adapter.
    1. Position the gauge tube.
    2. Install the 2 differential bearing caps.
    3. Install the 4 differential bearing cap bolts.
        - Tighten to 112 Nm (83 lb-ft).



8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

    NOTE: A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between Adapter and gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in final assembly of integral axle assemblies.

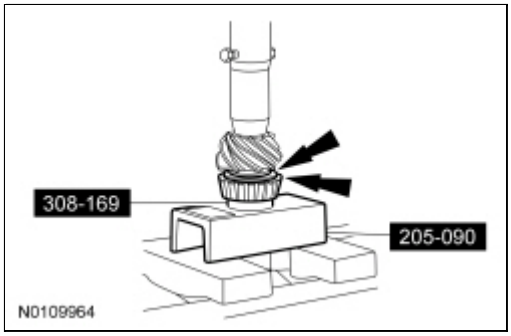
    Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.
    - After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the Adapters.



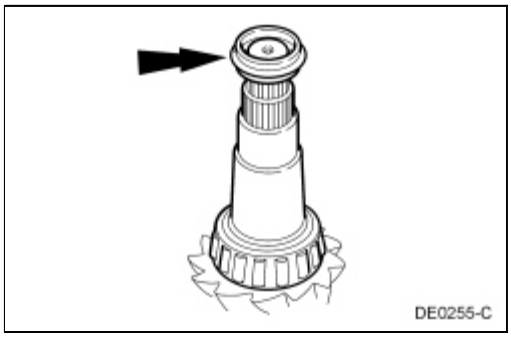
9. Using the Shaft Bearing Cone Installer and Bearing Oil Seal Plate and a shop press, drive the inner

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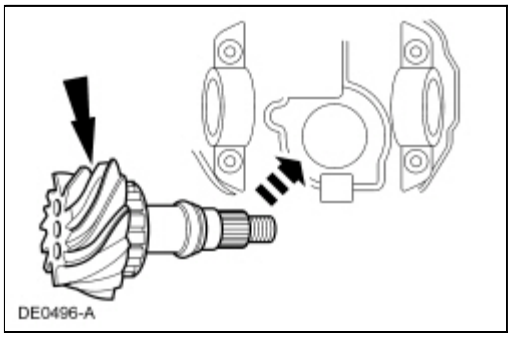
drive pinion bearing and drive pinion bearing adjustment shim until they are firmly seated on the pinion shaft.



10. Install a new drive pinion collapsible spacer on the pinion shaft against the pinion shaft shoulder.



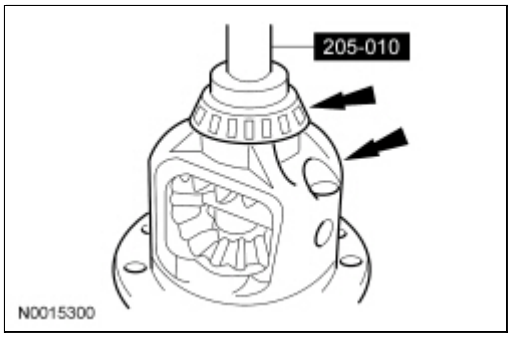
11. Install the drive pinion assembly into the axle housing.



12. Install the outer drive pinion bearing and the drive pinion shaft oil slinger.

13. Install the drive pinion seal and flange. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

14. Using the Differential Side Bearing Installer, install the 2 new differential bearings.



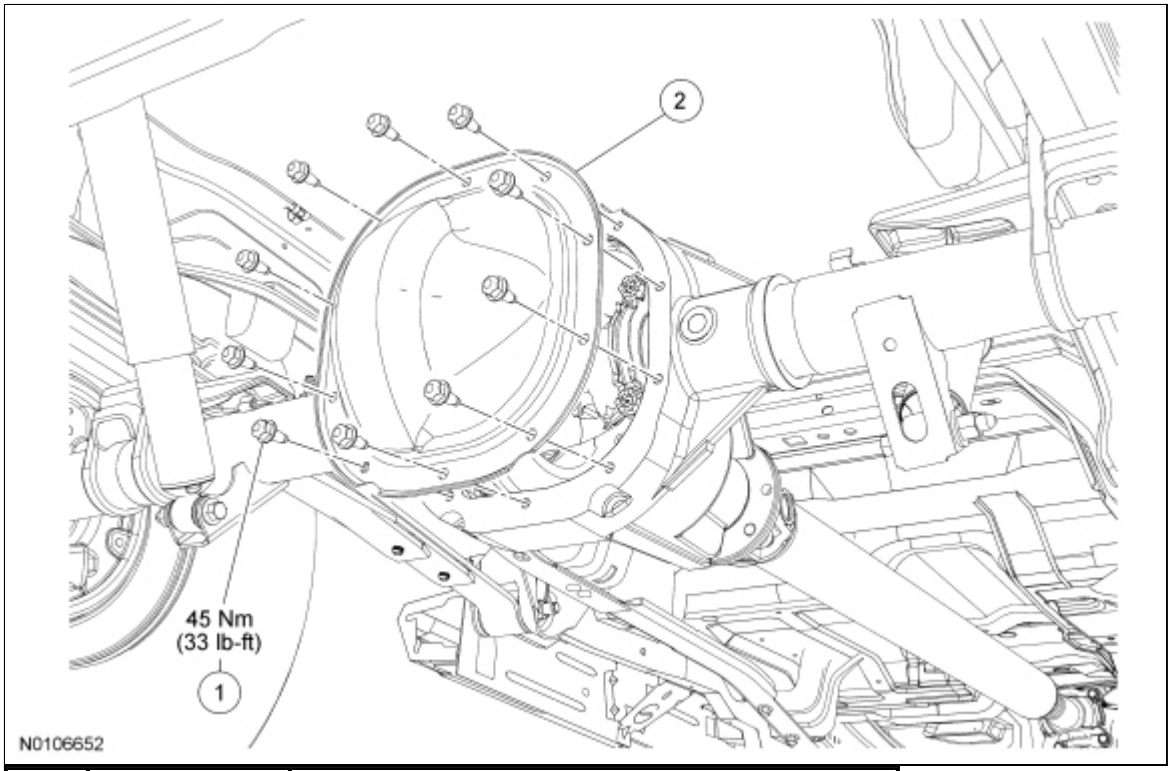
15. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

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Differential Housing Cover

Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

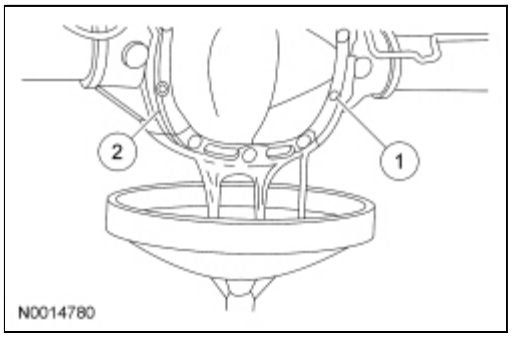


Item	Part Number	Description
1	4346	Differential housing cover bolt (10 required)
2	4033	Differential housing cover

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the differential housing cover.
    1. Remove the 10 differential housing cover bolts and drain the lubricant from the axle housing.
    2. Remove the differential housing cover.

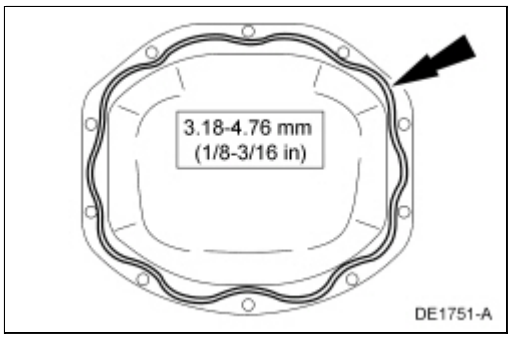


Installation

1. **NOTE:** The machined surfaces on the differential housing and the differential housing cover must be clean and free of oil before applying the silicone sealant. Cover the inside of the rear axle prior to cleaning the machined surface to prevent contamination.

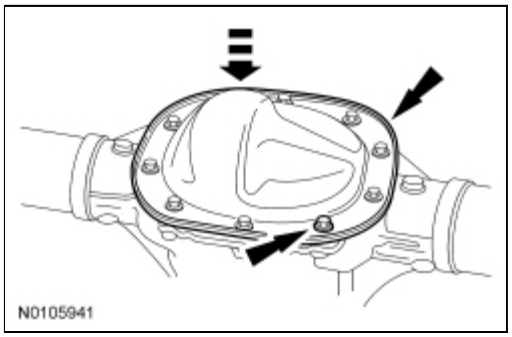
   Clean the gasket mating surfaces.

2. Apply a new continuous bead of sealant to the differential housing cover.



3. **NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone sealant, or new sealant must be applied. If possible, allow one hour before filling the axle housing with axle lubricant to make sure the silicone sealant has correctly cured.

   Install the differential housing cover and the 10 differential housing cover bolts.
   - Tighten to 45 Nm (33 lb-ft).



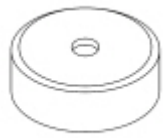
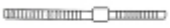
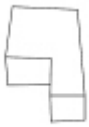
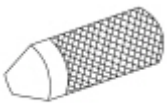
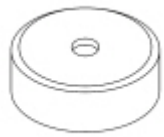
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4. **NOTE:** When filling a Traction-Lok axle with new lubricant, first fill the axle with 118 ml (4 oz) of friction modifier.

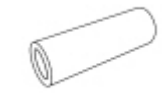
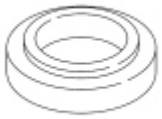
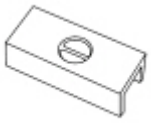
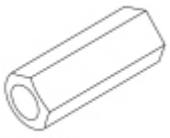
   Remove the filler plug, fill the axle with 2.8L (6.0 pt) of axle lubricant and install the filler plug.
   - Tighten to 52 Nm (38 lb-ft).

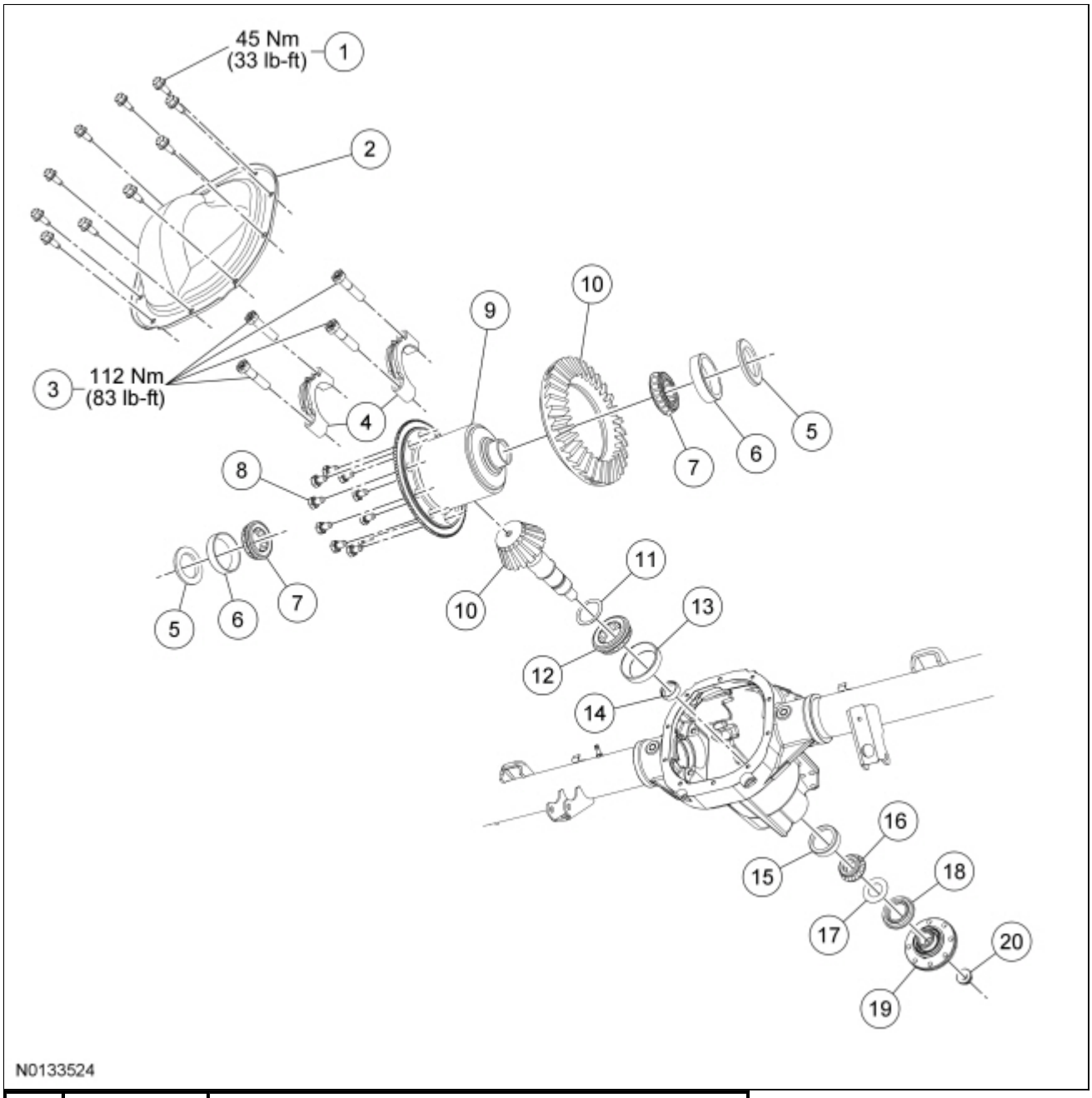
Differential Ring And Pinion

Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D79L-4221-A1) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1743-A	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for 205-S127 205-130 (T79P-4020-A19)

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 ST1434-A	
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1367-A	Installer, Shaft Bearing Cone 308-169 (T88T-7025-B)
 ST1254-A	Plate, Bearing Oil Seal 205–090 (T75L-1165–B)
 ST1744-A	Protector, Drive Pinion Thread 205-460 or equivalent
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent



Item	Part Number	Description
1	4346	Differential housing cover bolt (10 required)
2	4033	Differential housing cover
3	46108	Differential bearing cap bolts (part of 4010) (4 required)
4	—	Differential bearing caps (part of 4010) (2 required)
5	4067	Differential bearing shims (2 required)
6	4222	Differential bearing cups (2 required)
7	4221	Differential bearings (2 required)
8	4216	Ring gear bolt (10 required)

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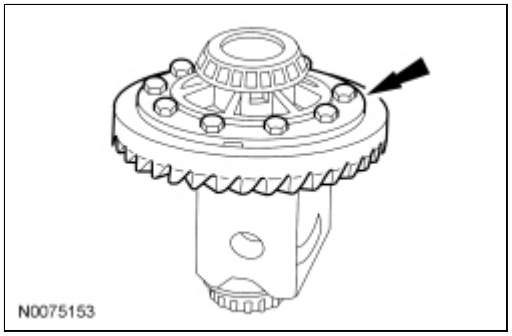
9	4204	Differential assembly
10	4209	Ring gear
10	4209	Drive pinion
11	4663	Pinion bearing alignment shim
12	—	Inner pinion bearing cup (part of 4625)
13	4625	Inner pinion bearing
14	4662	Collapsible spacer (part of 4320)
15	—	Outer pinion bearing cup (part of 4621)
16	4621	Outer pinion bearing
17	4670	Oil slinger
18	4676	Drive pinion oil seal
19	4851	Drive pinion flange
20	4C121	Drive pinion nut (part of 4320)

Removal

1. Remove the drive pinion flange seal. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

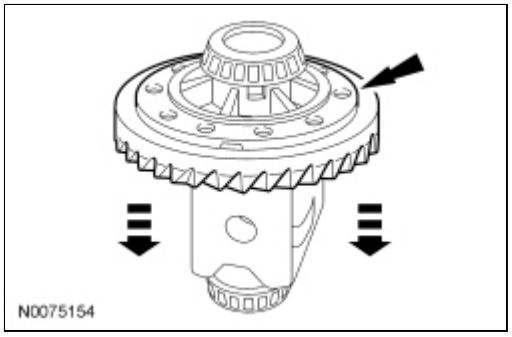
2. Remove the differential carrier assembly. For additional information, refer to Differential Carrier in this section.

3. Remove and discard the 10 differential ring gear bolts.

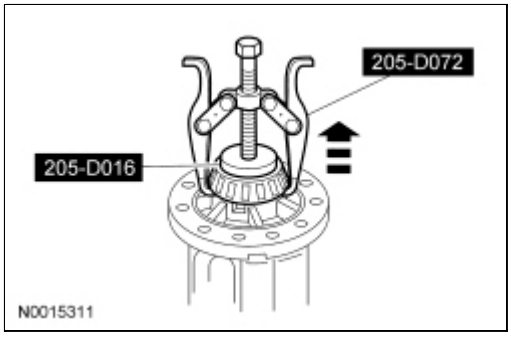


4. **NOTE:** Care should be taken not to damage the differential ring gear bolt hole threads.

   Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.

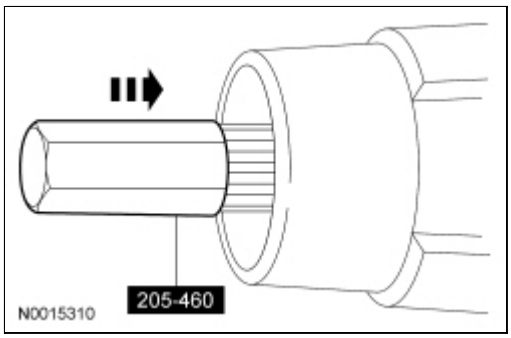


5. Using the 2 Jaw Puller and Step Plate, remove the differential bearings.

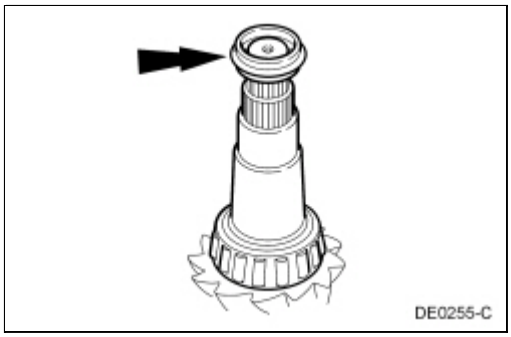


6. Remove the drive pinion shaft oil slinger and the outer drive pinion bearing.

7. Install the Drive Pinion Thread Protector. Using a soft-faced hammer, drive the pinion assembly out of the axle housing.

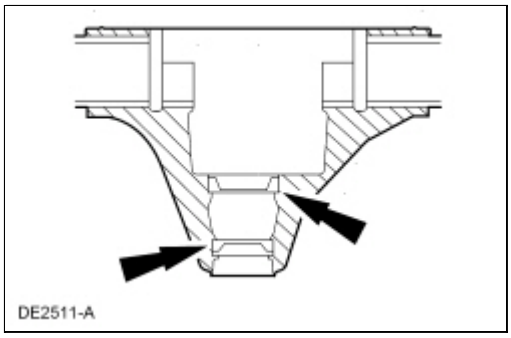


8. Remove and discard the drive pinion collapsible spacer.



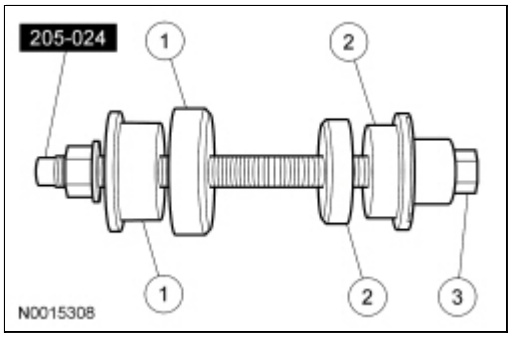
9. Using a brass drift, remove the drive pinion bearing cups by tapping alternately on opposite sides of the drive pinion bearing cups.

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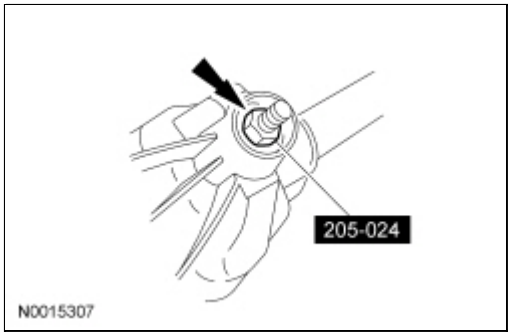


Installation

1. Position the Drive Pinion Bearing Cup Installer and the inner and outer drive pinion bearing cups in their respective bores.
    1. After placing the inner and outer drive pinion bearing cups in their bores, place the Drive Pinion Bearing Cup Installer (inner) on the inner drive pinion bearing cup.
    2. Place the Drive Pinion Bearing Cup Installer (outer) on the outer drive pinion bearing cup.
    3. Install the Drive Pinion Bearing Cup Installer.

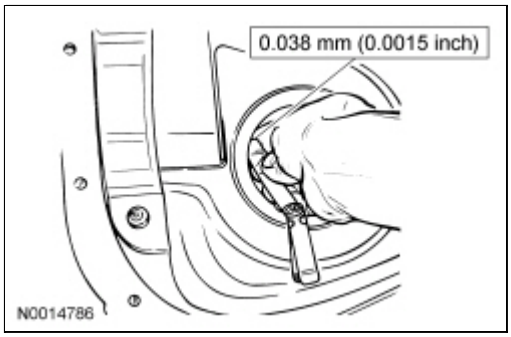


2. Tighten the Drive Pinion Bearing Cup Installer to seat the drive pinion bearing cups into their bores.



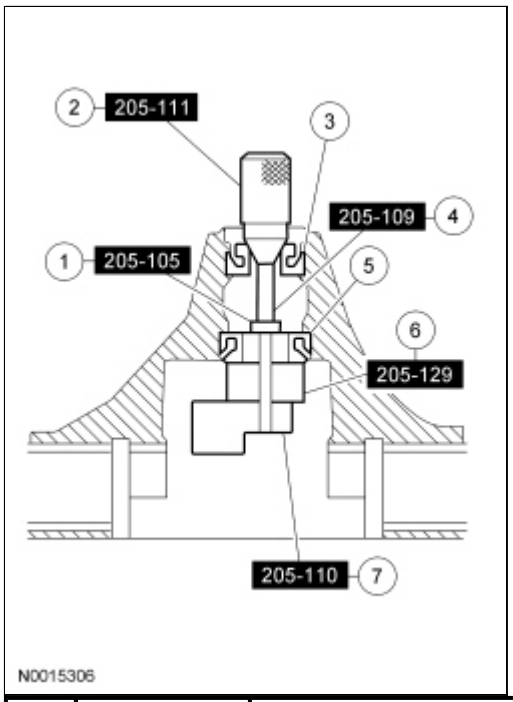
3. **NOTE:** If a feeler gauge can be inserted between a drive pinion bearing cup and the bottom of its bore at any point around the drive pinion bearing cup, the drive pinion bearing cup is not correctly seated.

   Make sure the drive pinion bearing cups are correctly seated in their bores.



4. **NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

   Assemble and position the Adapters.



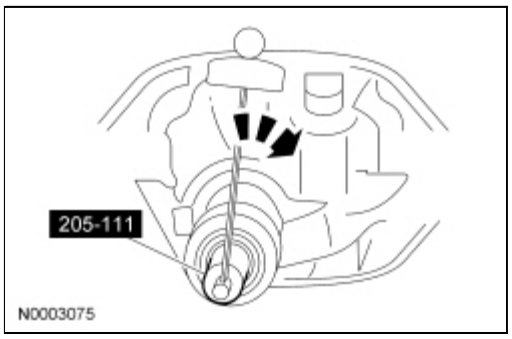
Item	Part Number	Description
1	205-105	Adapter for 205-S127 (1.612 in OD) (T76P-4020-A3)
2	205-111	Adapter for 205-S127 (T76P-4020-A11)
3	4621	Drive pinion bearing (outer)
4	205-109	Adapter for 205-S127 (T76P-4020-A9)
5	4630	Drive pinion bearing (inner)
6	205-129	Adapter for 105-S127 (1.1884 in thick) (T79P-4020-A18)
7	205-110	Adapter for 205-S127 (1.7 in thick) (T76P-4020-A10)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

   Tighten the Adapter.

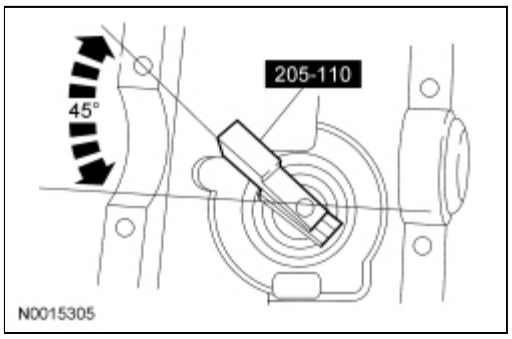
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- Tighten to 2.2 Nm (20 lb-in) rotational torque.

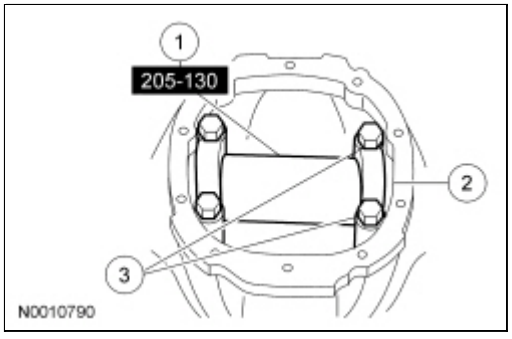


6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

   Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings and position the Adapter.



7. Install the Adapter.
   1. Position the Adapter.
   2. Install the 2 differential bearing caps.
   3. Install the 4 differential bearing cap bolts.
      - Tighten to 112 Nm (83 lb-ft).



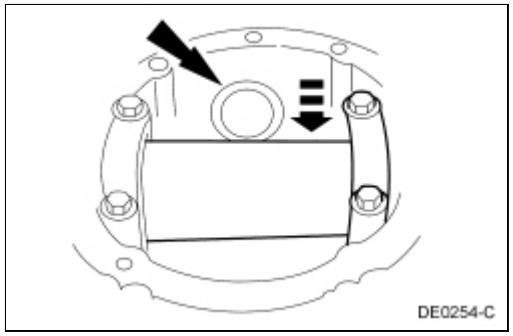
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

   NOTE: A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the Adapter and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in final assembly of integral axle assemblies.

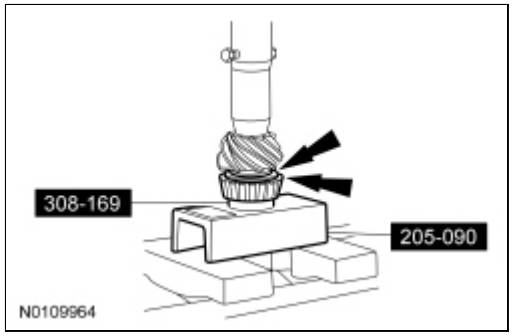
   Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim

selection.

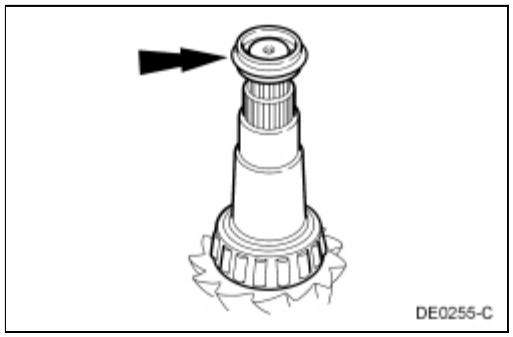
- After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the special tools.



9. Using the Shaft Bearing Cone Installer and Bearing Oil Seal Plate and a shop press, drive the inner drive pinion bearing and the selected drive pinion bearing adjustment shim until they are firmly seated on the pinion shaft.

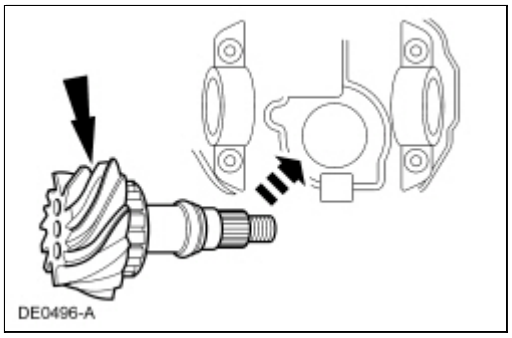


10. Install a new drive pinion collapsible spacer on the pinion shaft against the pinion shaft shoulder.

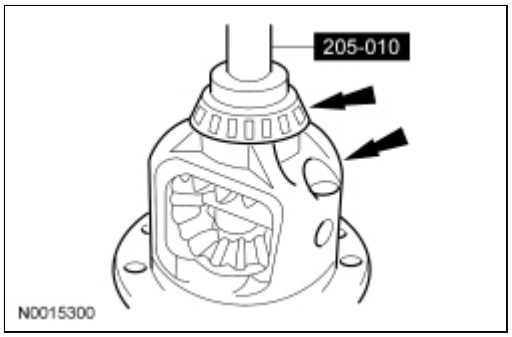


11. Install the drive pinion assembly into the axle housing.

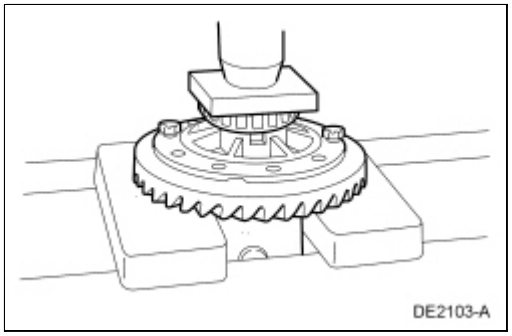
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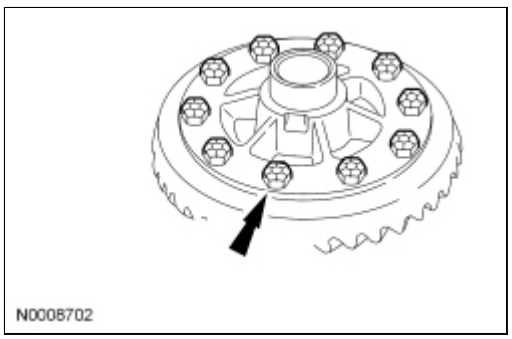
12. Install the outer drive pinion bearing and the drive pinion shaft oil slinger.
13. Using the Differential Side Bearing Installer, install the 2 new differential bearings.



14. Using 2 ring gear bolts as a guide, press the ring gear on the differential assembly.



15. Install the 10 new differential ring gear bolts. Tighten in 2 stages.
    - Stage 1: Tighten to 60 Nm (44 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



16. Install the drive pinion seal and flange. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

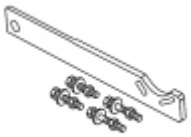
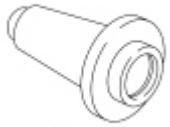
17. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

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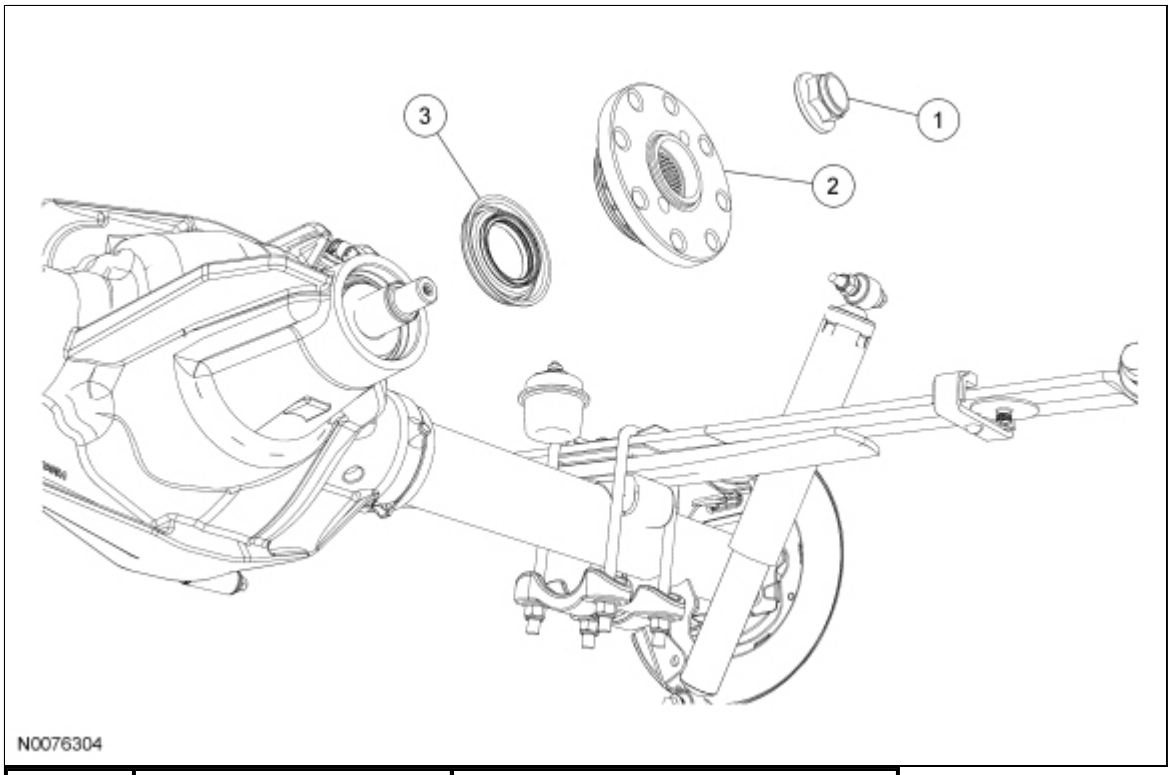
Drive Pinion Flange and Drive Pinion Seal

Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



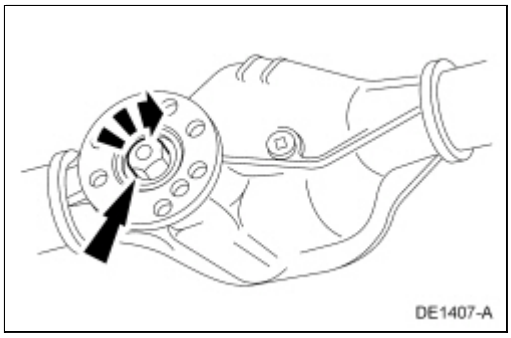
Item	Part Number	Description
1	389546	Drive pinion nut
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal

Removal

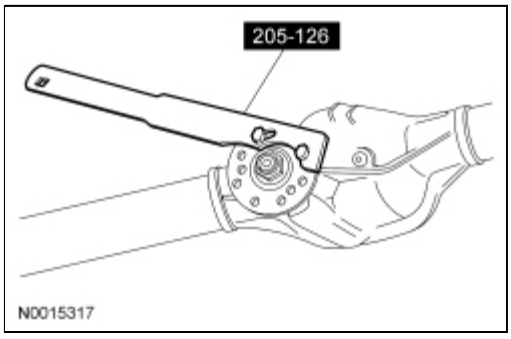
NOTICE: **The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the brake disc. For additional information, refer to Section 206-04 .
3. Remove the driveshaft. For additional information, refer to Section 205-01 .
4. Using a Nm (lb-in) torque wrench on the pinion nut, record the torque required to maintain rotation of the pinion gear through several revolutions.

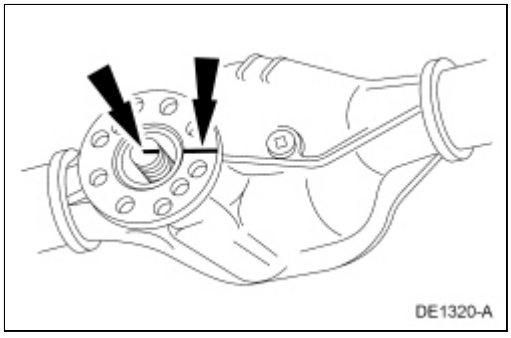
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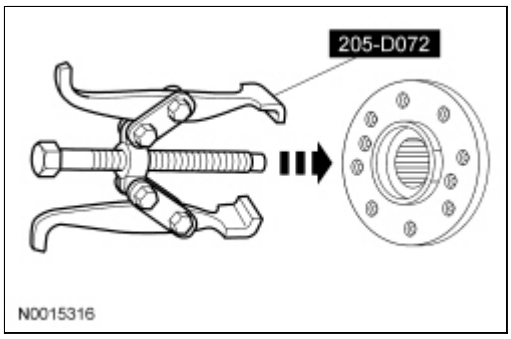
5. Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, remove and discard the pinion nut.



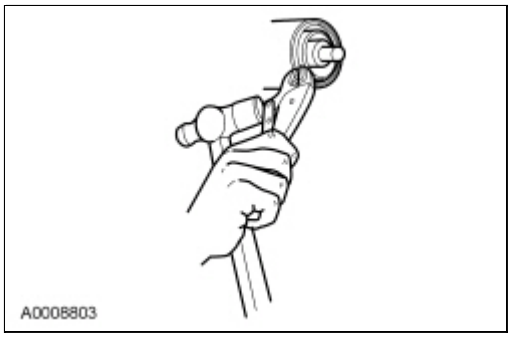
6. Index-mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.



7. Using the 2 Jaw Puller, remove the pinion flange.



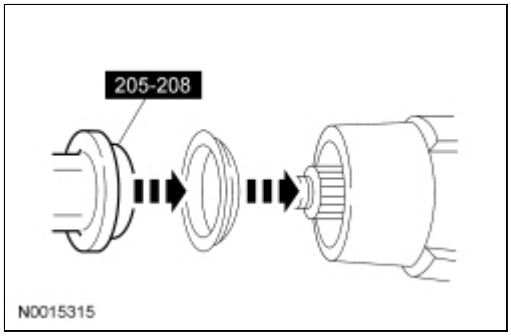
8. Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer until the drive pinion seal is removed.



Installation

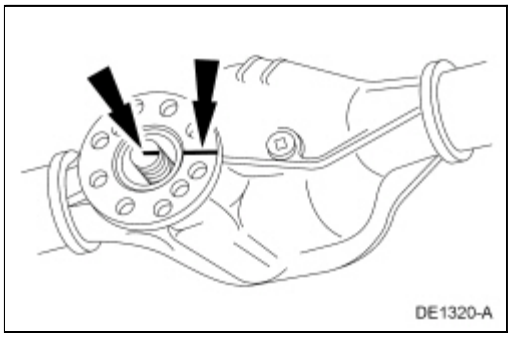
1. Lubricate the new drive pinion seal with grease.
2. **NOTE:** If the new drive pinion seal becomes misaligned during installation, remove the drive pinion seal and install a new drive pinion seal.

   Using the Drive Pinion Oil Seal Installer, install a new drive pinion seal.



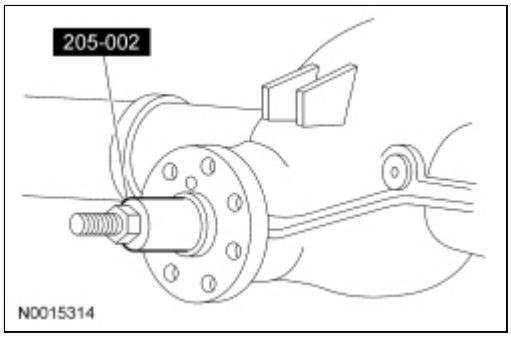
3. Lubricate the pinion flange splines with axle lubricant.
4. **NOTE:** Disregard the scribe marks if a new pinion flange is being installed.

   Align the pinion flange with the drive pinion shaft.



5. Using the Drive Pinion Flange Installer, install the pinion flange.

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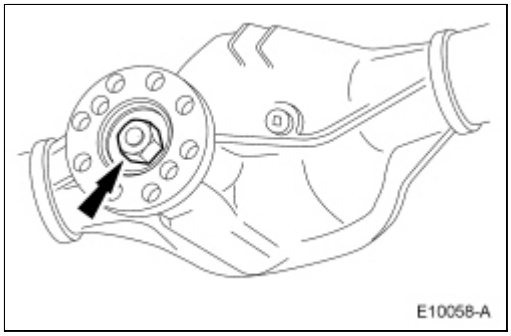


6. ***NOTICE:*** **Install a new pinion nut with the same color as the original if not replacing the collapsible spacer. If a new collapsible spacer is installed, install the nut in the kit or damage to the component may occur.**

   Position the new pinion nut.

   8.8-In Drive Pinion Nut

Part Number	Color Description	Application
389546-S100	Orange	Axles built before 7/16/07
4320	Purple	Axles built after 7/16/07
4C121	Purple	Kit with spacer for all 223.52 mm (8.8 in) axles



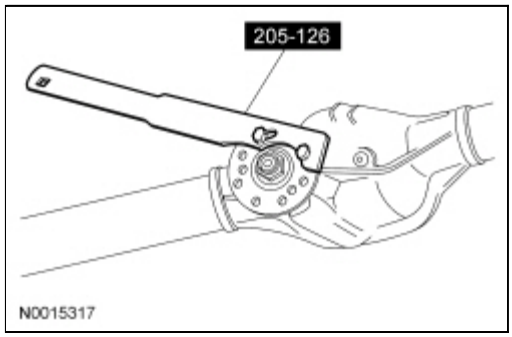
7. ***NOTICE:*** **Under no circumstances is the pinion nut to be backed off to reduce drive pinion bearing preload. If reduced drive pinion bearing preload is required, a new drive pinion collapsible spacer and pinion nut must be installed or damage to the component may occur.**

   NOTICE: **The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.**

   NOTE: Remove the Drive Pinion Flange Holding Fixture while taking drive pinion bearing preload readings with the Nm (lb-in) torque wrench.

   Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, tighten the pinion nut.
   - Rotate the drive pinion occasionally to make sure the drive pinion bearings are seating correctly.
   - Install a Nm (lb-in) torque wrench on the pinion nut.
   - Rotating the drive pinion through several revolutions, take frequent drive pinion bearing preload readings until the original recorded drive pinion bearing preload reading is obtained.

- If the original recorded drive pinion bearing preload is lower than specifications, tighten to the appropriate specifications for used drive pinion bearings. If the drive pinion bearing preload is higher than specification, tighten the pinion nut to the original reading as recorded. For additional information, refer to Specifications in this section.



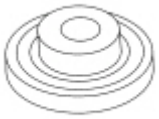
8. Install the driveshaft. For additional information, refer to Section 205-01 .
9. Install the brake disc. For additional information, refer to Section 206-04 .

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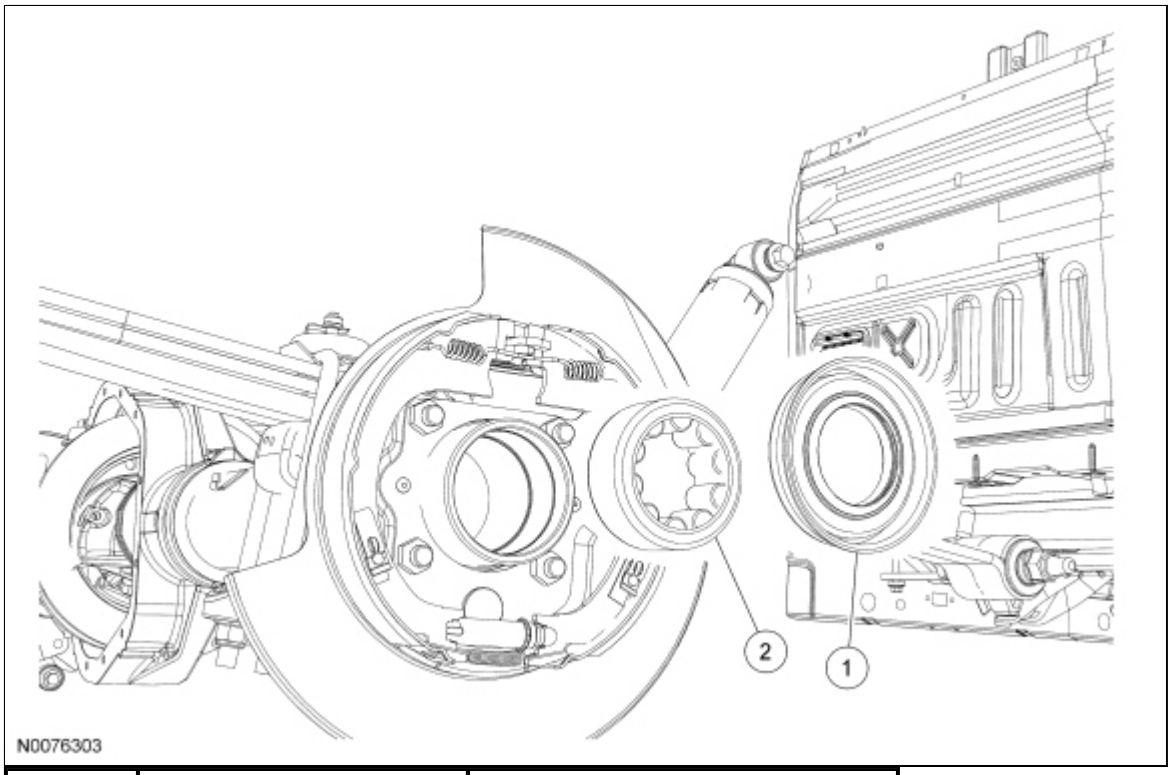
Rear Wheel Bearing and Axle Shaft Seal

Special Tool(s)

 ST1326-A	Adapter For 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1322-A	Installer, Axle Bearing 205-194 (T83T-1225-B)
 ST1736-A	Installer, Axle Oil Seal 205-381 (T97T-1177-A)
 ST1283-A	Remover, Axle Bearing 205-193 (T83T-1225-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



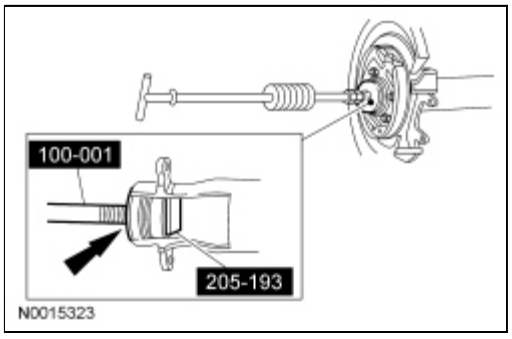
Item	Part Number	Description
1	1177	Axle shaft oil seal
2	1225	Axle shaft bearing

Removal

1. Remove the axle shaft. For additional information, refer to Axle Shaft in this section.
2. **NOTE:** If the axle shaft oil seal is leaking, the axle housing vent may be plugged with foreign material.

   NOTE: Use care to avoid damaging the axle shaft oil seal bore.

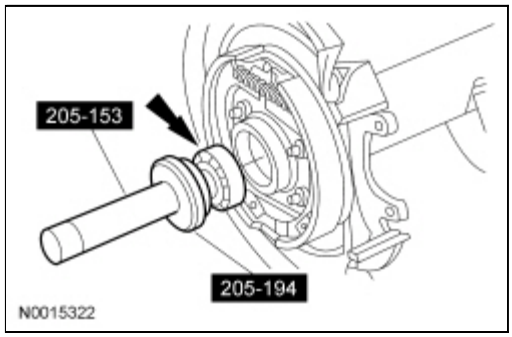
   Using a suitable seal remover, remove and discard the axle shaft oil seal.
3. Inspect the rear wheel bearing and axle shaft for wear or damage.
4. If necessary, using the Axle Bearing Remover and Slide Hammer, remove the rear wheel bearing.



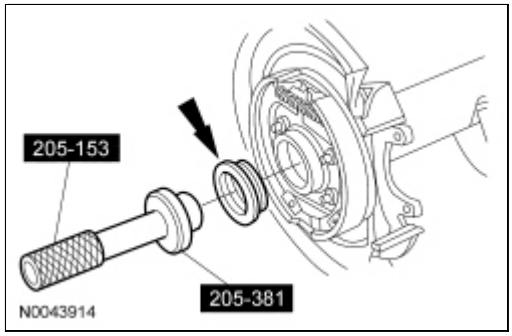
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Installation

1. If removed, lubricate the new rear wheel bearing with axle lubricant.
2. If removed, use the Axle Bearing Installer and Handle to install the rear wheel bearing.



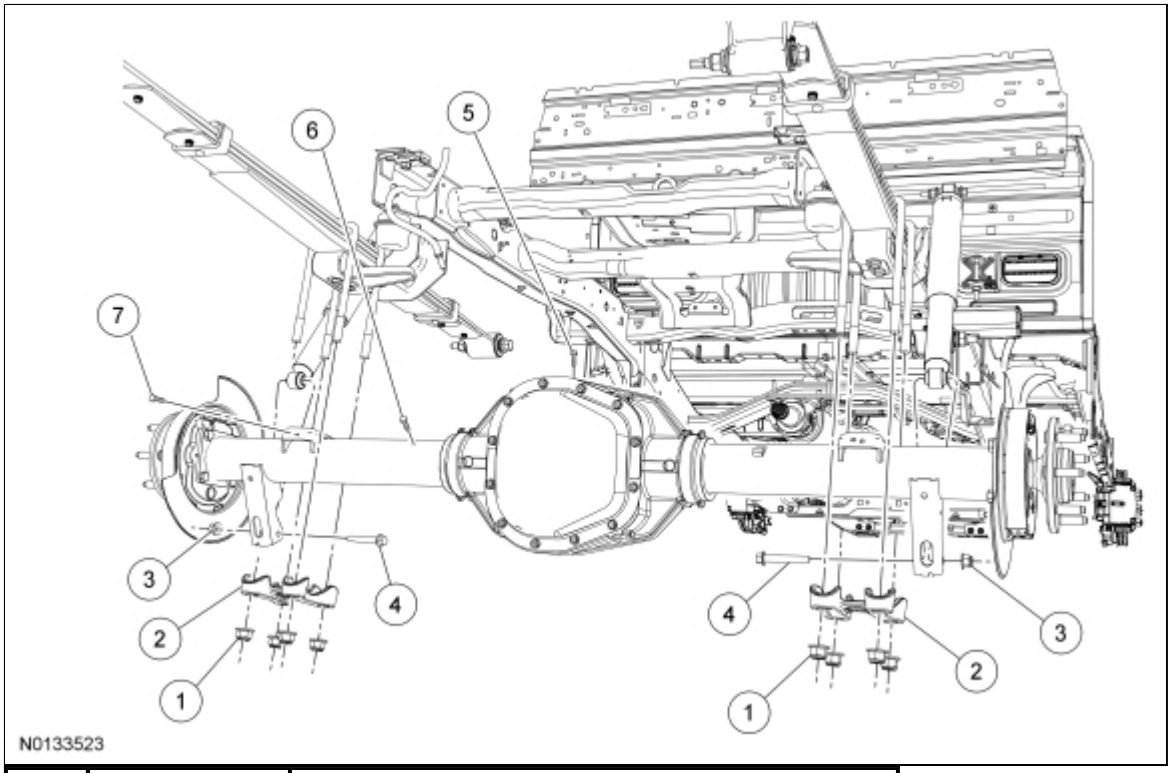
3. Lubricate the lip of the new axle shaft oil seal with grease.
4. Using the Axle Oil Seal Installer and Handle, install the new axle shaft oil seal.



5. Install the axle shaft. For additional information, refer to Axle Shaft in this section.

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Axle Assembly



Item	Part Number	Description
1	W705518	U-bolt nuts (8 required)
2	5798	U-bolt plates (2 required)
3	W520214	Lower shock absorber nuts (2 required)
4	W506545	Lower shock absorber bolts (2 required)
5	57632	Brake tube/parking brake cable bracket bolt
6	4022	Axle vent
7	W712215	Brake hose bracket bolt

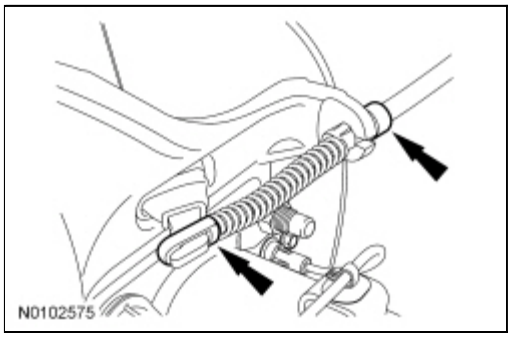
Removal and Installation

NOTICE: **Suspension fasteners are critical components because they affect performance of vital components and systems and their failure can result in major service expense. Install new components with the same component number or an equivalent component if installation is necessary. Do not use an installation component of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these components.**

1. Remove the driveshaft. For additional information, refer to Section 205-01 .
2. Remove the axle shafts. For additional information, refer to Axle Shaft in this section.

3. Release the parking brake cable tension. For additional information, refer to Section 206-05 .

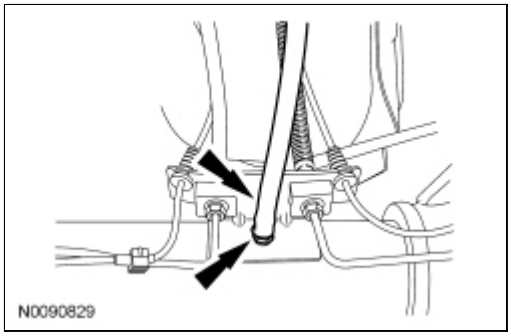
4. Disconnect the parking brake cables.



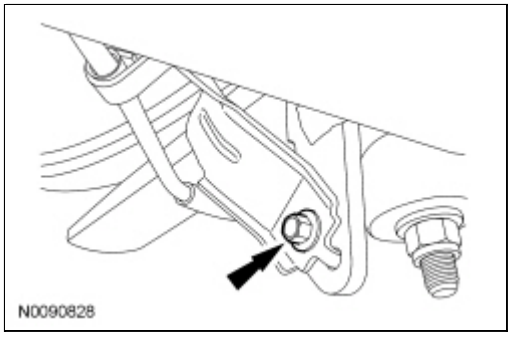
5. Disconnect the wheel speed sensor harness retainers from the axle.

NOTE: If the vent hose is disconnected from the vehicle body, a new retainer must be installed.

6. Disconnect the vent hose and remove the axle vent.
    - To install, tighten to 18 Nm (159 lb-in).

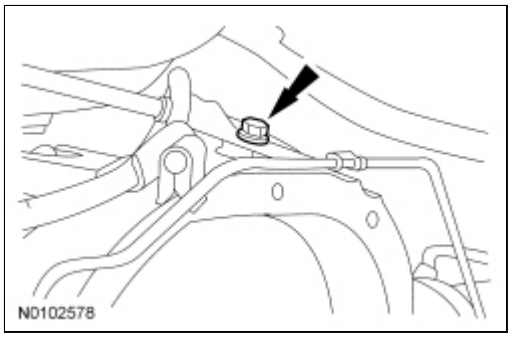


7. Remove the RH parking brake cable bracket bolt.
    - To install, tighten to 30 Nm (22 lb-ft).

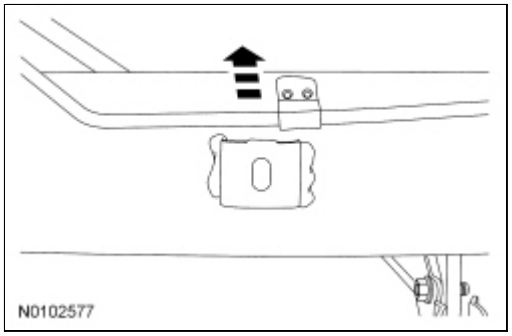


8. Remove the brake tube/parking brake cable bracket bolt.
    - To install, tighten to 25 Nm (18 lb-ft).

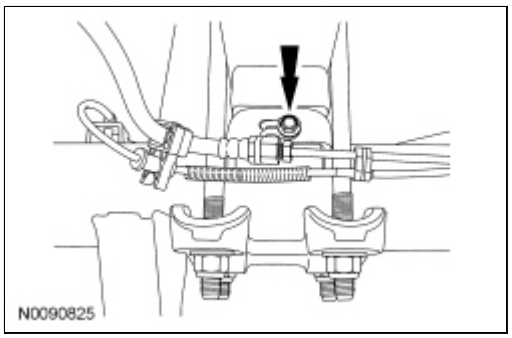
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9. Disconnect the brake tube from the brake tube retaining clip.



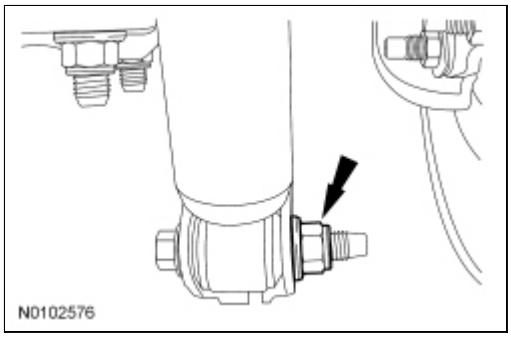
10. Remove the 2 brake hose bracket bolts.
    - To install, tighten to 30 Nm (22 lb-ft).



11. Support the axle with a suitable transmission jack.

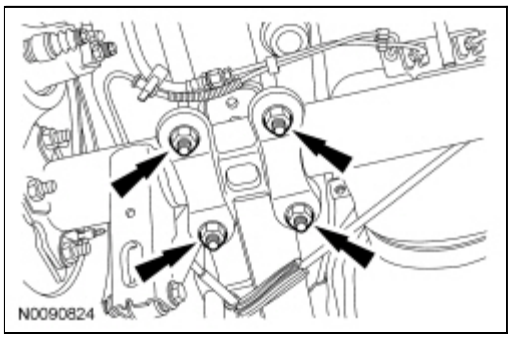
12. **WARNING: Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.**

    Remove and discard the 2 lower shock absorber nuts and 2 bolts.
    - To install, tighten the new nuts to 90 Nm (66 lb-ft).



13. ***NOTICE:*** **Final tightening of the U-bolt nuts must be done with the suspension at curb height or incorrect clamp load may occur.**

    Remove and discard the 8 U-bolt nuts and the 4 U-bolts.
    - To install, with the suspension at curb height, tighten the new nuts evenly in a cross-type pattern in 4 stages.
        - Stage 1: Tighten to 35 Nm (26 lb-ft).
        - Stage 2: Tighten to 70 Nm (52 lb-ft).
        - Stage 3: Tighten to 100 Nm (74 lb-ft).
        - Stage 4: Tighten to 133Nm (98 lb-ft).



14. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

    Lower and remove the axle assembly.

15. To install the original assembly, reverse the removal procedure.

16. Check the rear axle fluid level after installation.

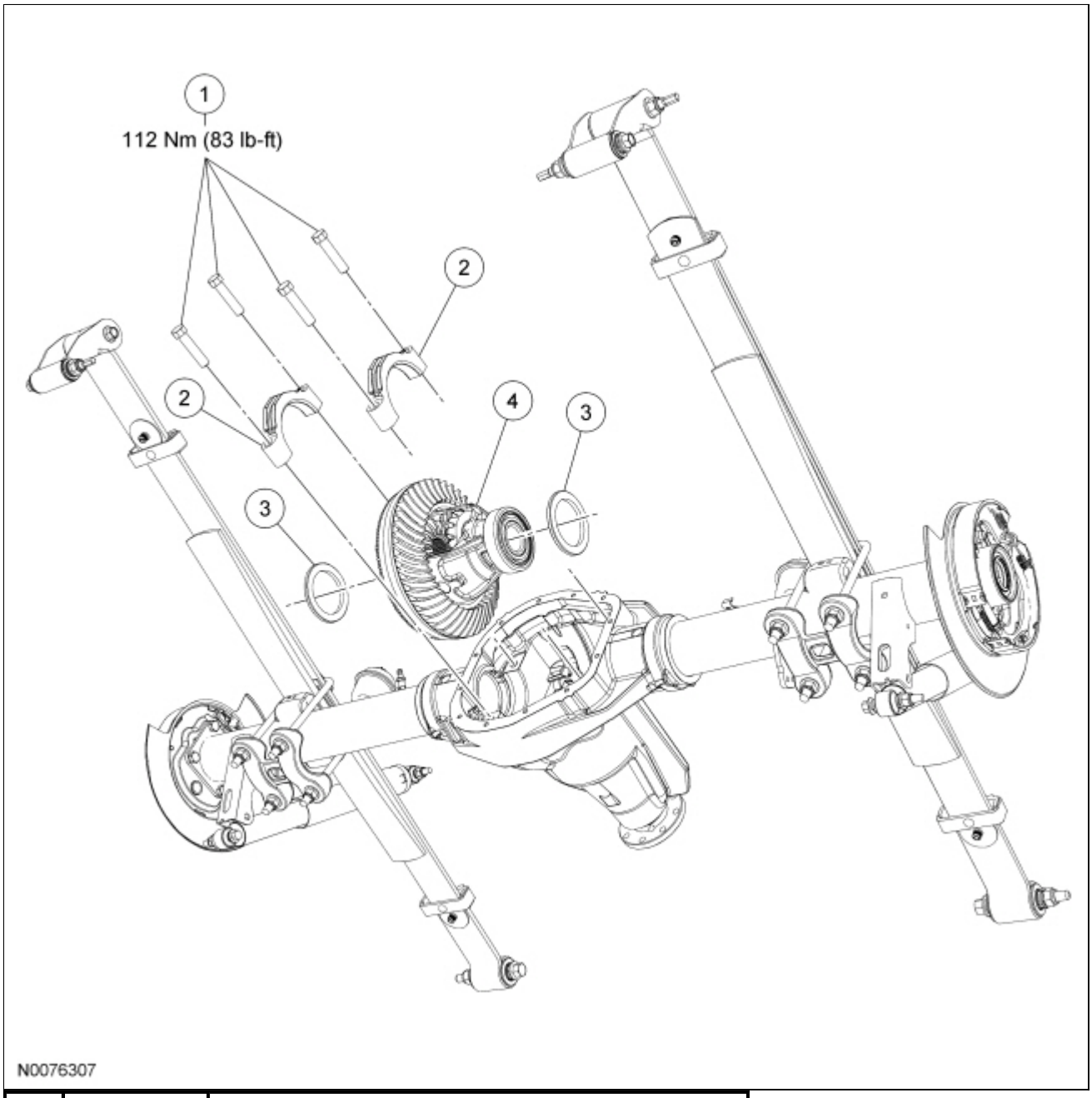
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Differential Carrier

Special Tool(s)

 ST1485-A	Shim Driver 205-220 (T85L-4067-AH)

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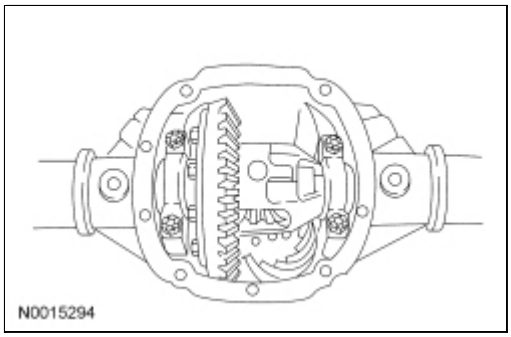
Item	Part Number	Description
1	—	Differential bearing cap bolts (part of 4010) (4 required)
2	—	Differential bearing caps (part of 4010) (2 required)
3	4067	Differential carrier bearing shims (2 required)
4	4204	Differential assembly

Removal

1. Remove the axle shafts. For additional information, refer to Axle Shaft in this section.

2. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

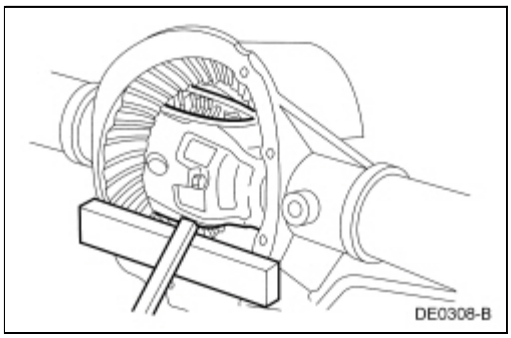
   Remove the 4 differential bearing cap bolts and the 2 differential bearing caps.



3. ***NOTICE:*** **Place a wood block between the pry bar and the axle housing to protect the machined surface from damage.**

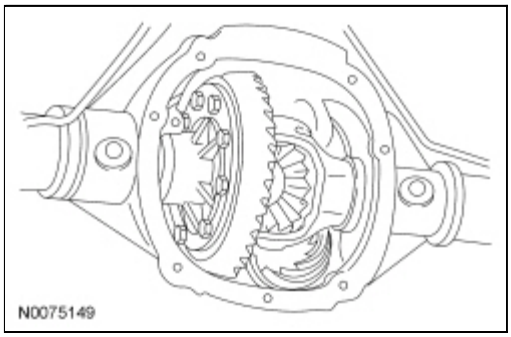
   NOTE: Index-mark the position of the differential bearing shims. The differential bearing shims must be installed in their original locations and positions.

   Using pry bars and wood blocks, remove the differential carrier assembly from the axle housing.



Installation

1. Position the differential assembly in the axle housing.

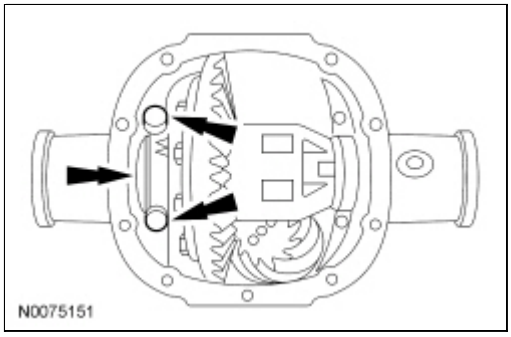


2. Install the originally removed differential bearing shim on the LH side.

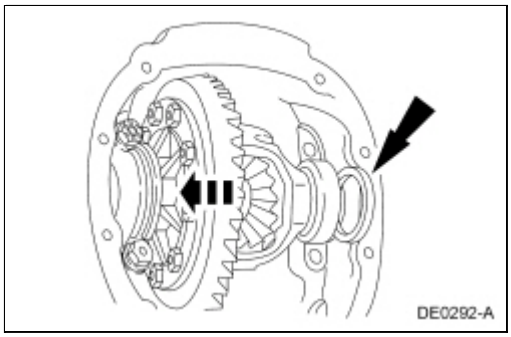
3. **NOTE:** Apply pressure toward the LH side to make sure the LH differential bearing cap is seated.

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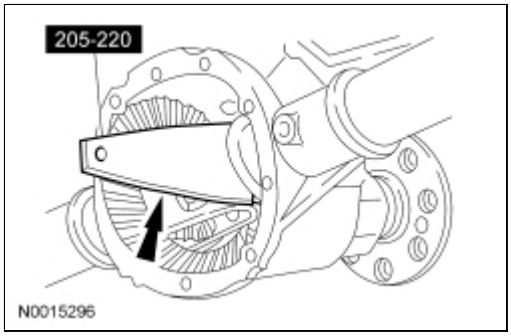
Install the LH differential bearing cap and loosely install the 2 differential bearing cap bolts.



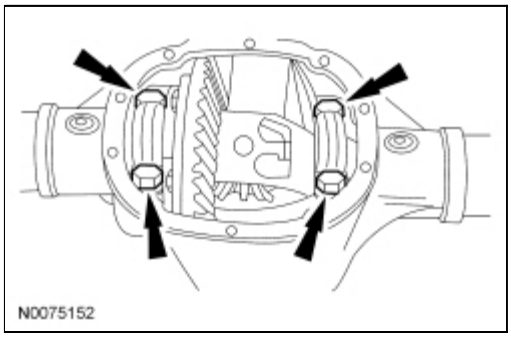
4. Install the original differential bearing shim on the RH side.



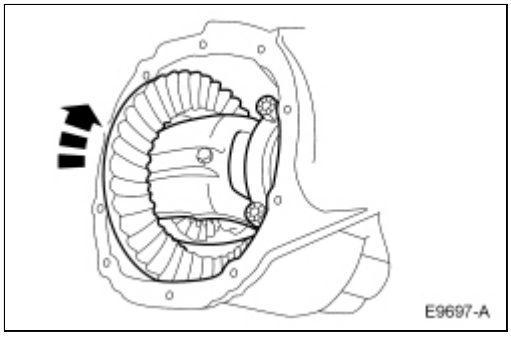
5. Using the Shim Driver, fully seat the differential bearing shims.



6. Install the RH side differential bearing cap and tighten the 4 LH side and RH side differential bearing cap bolts.
    - Tighten to 112 Nm (83 lb-ft).



7. Rotate the differential assembly to make sure it rotates freely.



8. Adjust the ring and pinion backlash. For additional information, refer to Ring Gear Backlash Adjustment in this section.

9. Install the axle shafts. For additional information, refer to Axle Shaft in this section.

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Material

Item	Specification	Fill Capacity
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A	118 ml (4 oz) to be installed before axle lubricant — Not to be used with Electronic Locking Differentials (ELD)
Maximum Strength Retaining Compound Loctite® 638™	—	—
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5	2.84L (6.0 pt) — ELD only 2.60L (5.5 pt) — Non Traction-Lok equipped 2.48L (5.25 pt) — Traction-Lok equipped
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

Rear Axle Backlash Shim Adjustment Table

Backlash Change Required		Thickness Change Required	
mm	In	mm	In
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006

0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

General Specifications

Item	Specification
Available drive pinion shims in steps of 0.25 mm (0.010 in)	0.254 mm (0.010 in) — 0.965 mm (0.038 in)
Electronic Locking Differential (ELD) side gear backlash	0.100-1.000 mm (0.004-0.040 in)
Maximum differential case flange ring gear runout	0.076 mm (0.003 in)
Maximum variation between ring gear teeth	0.102 mm (0.004 in)
Pinion bearing preload	1.8-3.3 Nm (16-29 lb-in)
Ring gear backlash	0.203-0.304 mm (0.008-0.012 in)
Maximum axle shaft flange runout	0.279 mm (0.011 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Axle vent	18	—	159
Brake hose bracket bolts	30	22	—
Brake tube/parking brake cable bracket bolt	25	18	—
RH parking brake cable bracket bolt	30	22	—
Differential bearing cap bolts	105	77	—
Differential housing cover bolts	45	33	—
Differential pinion shaft lock bolt	30	22	—
Differential ring gear bolts [a]	—	—	—
Driveshaft flange bolts	103	76	—
Electronic Locking Differential (ELD) coil screws	5	—	44
ELD electrical connector bolt	7	—	62

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Fill plug	30	22	—
Handle Adapter	2.2	—	20
Lower shock absorber nuts	90	66	—
Tool 205-135 nut	7	—	62
U-bolt nut [a]	—	—	—
Wheel speed sensor bolts	15	—	133

[a] Refer to the procedure in this section.

Rear Drive Axle and Differential

The rear axle assembly consists of the following:

- Integral-type housing hypoid gear design (center of the pinion set below the centerline of the ring gear)
- Hypoid differential ring gear and pinion consisting of a 9.75-inch ring gear and an overhung drive pinion that is supported by 2 opposed tapered roller bearings
- Pinion bearing preload that is maintained by a drive pinion collapsible spacer on the differential pinion shaft and adjusted by the pinion nut
- Cast center section with 2 steel tube assemblies and a stamped differential housing cover
- Differential housing cover using silicone sealant as a gasket
- Differential pinion shaft that is retained by a threaded differential pinion shaft lock bolt attached to the differential case
- Differential case that is mounted in the rear axle housing between 2 opposing differential bearings that are retained in the rear axle housing by 2 removable bearing caps
- Differential bearing preload and ring gear backlash which are adjusted by differential bearing shims that are located between the differential bearing cups and the rear axle housing

The rear drive axle receives rotational torque from the driveshaft. The direction of the rotation determines movement of the vehicle. The rotation enters the rear drive axle through the drive pinion flange, turning the drive pinion and rotating the ring gear. The ring gear is bolted to the differential case. The differential case houses the pinion shaft upon which the differential pinion gears ride. The pinion gears are in mesh with the differential side gears to which the axle shafts are splined. It is the unique arrangement of the differential that allows the axle shafts to be driven at different speed when needed, such as when driving around corners. A Traction-Lok differential is available that introduces a series of clutch plates and discs behind the differential side gears to deliver as much torque as possible to each axle shaft when the traction at the rear wheels is not equal. The Traction-Lok differential requires a friction modifier that must be installed with the axle lubricant for the plates and discs to be functional. An Electronic Locking Differential (ELD) is also available which electronically locks the differential side gears to the differential case which will allow maximum torque to both rear wheels. The operator controls the differential with a dash mounted switch.

The ELD system consists of the following components:

- ELD coil, located at the rear differential
- Rear differential
- Mode Select Switch (MSS) (unique for ELD equipped vehicles), located on instrument panel

The ELD system, which is optional on Electronic Shift-On-The-Fly (ESOF) equipped vehicles, allows the operator to lock the rear differential side gears when in 4H or 4L mode. ELD operation is requested by pulling out on the MSS when in 4H or 4L mode.

The operator can switch between 4H mode without ELD or 4H mode with ELD at speeds up to 30 km/h (19 mph). In 4H, the ELD will disengage at speeds above 40 km/h (25 mph) and will automatically reengage at speeds below 30 km/h (19 mph).

To engage or disengage the ELD while in 4L range, the vehicle speed must be less than 90 km/h (56 mph).

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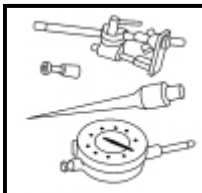
Rear Drive Axle and Differential

Refer to Section 205-00 .

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Ring Gear Backlash Adjustment

Special Tool(s)

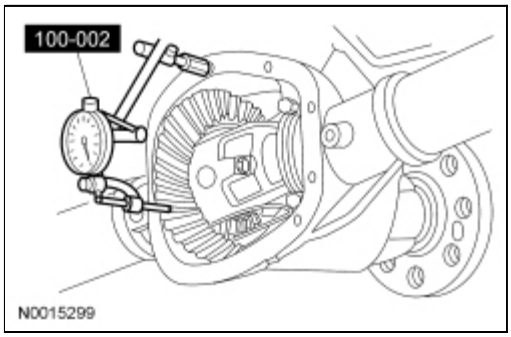
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1485-A	Installer, Differential Shim 205-220 (T85L-4067-AH)

Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—

1. Remove the differential housing cover. For additional information, refer to Differential Housing Cover in this section.

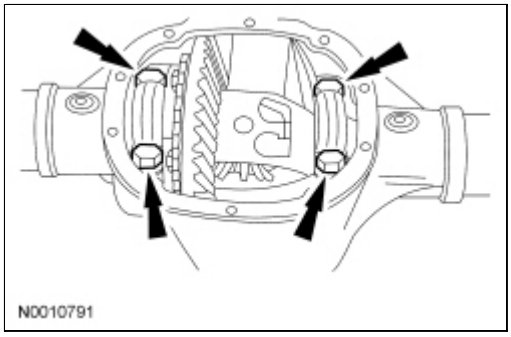
2. Install the Dial Indicator Gauge with Holding Fixture and measure the ring gear backlash.
   - If a zero backlash condition occurs or the backlash is not within specification, proceed to Step 3.
   - If the backlash is within specification, proceed to Step 14.



3. Remove the axle shafts. For additional information, refer to Axle Shaft in this section.

4. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

Remove the 4 bearing cap bolts and 2 caps.



5. If a zero backlash condition had occurred, add 0.50 mm (0.020 in) to the RH side shim and subtract 0.50 mm (0.020 in) from the LH side shim to allow a backlash indication. Install the 2 bearing caps and 4 bolts.
    - Tighten to 105 Nm (77 lb-ft).
    - Go back to Step 2.

6. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

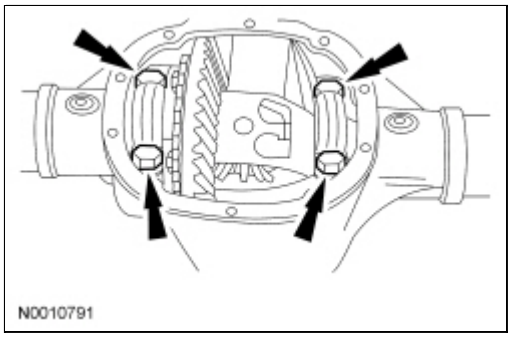
Differential Shim Size Chart 4067

Stripes and Color Code	Dimension A	
	mm	Inch

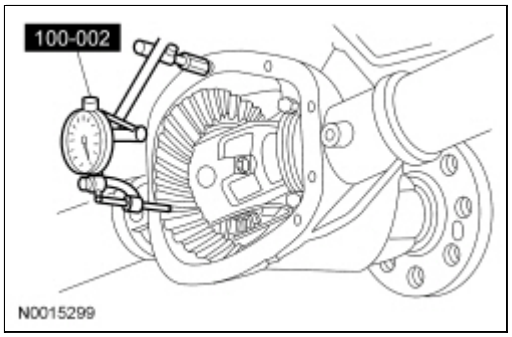
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2 — C-COAL	7.7978-7.8105	0.3070-0.3075
1 — C-COAL	7.7470-7.7597	0.3050-0.3055
5 — BLU	7.6962-7.7089	0.3030-0.3035
4 — BLU	7.6454-7.6581	0.3010-0.3015
3 — BLU	7.5946-7.6073	0.2990-0.2995
2 — BLU	7.5458-7.5565	0.2970-0.2975
5 — PINK	7.4422-7.4549	0.2930-0.2935
4 — PINK	7.3914-7.4041	0.2910-0.2915
3 — PINK	7.3406-7.3533	0.2890-0.2895
2 — PINK	7.2898-7.3025	0.2870-0.2875
1 — PINK	7.2390-7.2517	0.2850-0.2855
5 — GRN	7.1882-7.2009	0.2830-0.2835
4 — GRN	7.1374-7.1501	0.2810-0.2815
3 — GRN	7.0866-7.0993	0.2790-0.2795
2 — GRN	7.0358-7.0485	0.2770-0.2775
1 — GRN	6.9850-7.0485	0.2750-0.2755
5 — WH	6.9342-6.9469	0.2730-0.2735
4 — WH	6.8834-6.8961	0.2710-0.2715
3 — WH	6.8326-6.8453	0.2690-0.2695
2 — WH	6.7818-6.7945	0.2670-0.2675
1 — WH	6.7310-6.7437	0.2650-0.2655
5 — YEL	6.6802-6.6929	0.2630-0.2635
4 — YEL	6.6294-6.6421	0.2610-0.2615
3 — YEL	6.5786-6.5913	0.2590-0.2595
2 — YEL	6.5278-6.5405	0.2570-0.2575
1 — YEL	6.4770-6.4897	0.2550-0.2555
5 — ORNG	6.4262-6.4389	0.2530-0.2535
4 — ORNG	6.3754-6.3881	0.2510-0.2515
3 — ORNG	6.3246-6.3373	0.2490-0.2495
2 — ORNG	6.2738-6.2865	0.2470-0.2475
1 — ORNG	6.2223-6.2357	0.2450-0.2455
2 — RED	6.1722-6.1849	0.2430-0.2435
1 — RED	6.1214-6.1341	0.2410-0.2415

7. Install the 2 bearing caps and 4 bolts.
    - Tighten to 105 Nm (77 lb-ft).

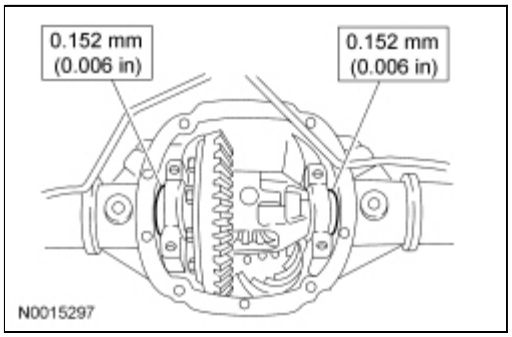


8. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.
    - If backlash is now within specification, proceed to Step 9.
    - If backlash is not within specification, go back to Step 4.



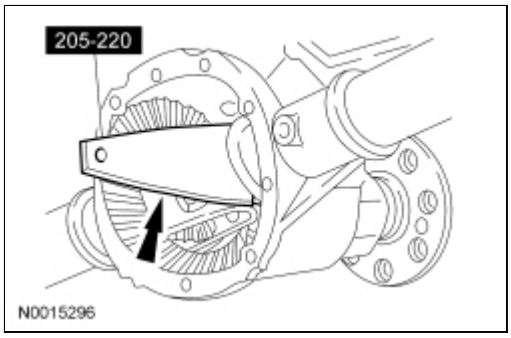
9. Remove the 4 bearing cap bolts and 2 bearing caps.

10. To establish differential bearing preload, increase both LH and RH differential bearing shim size by the thickness shown.

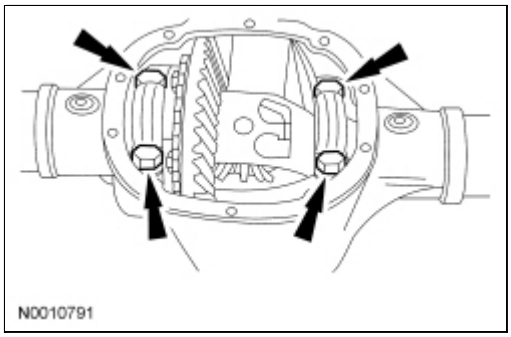


11. Using the Differential Shim Installer, fully seat the differential bearing shims. Make sure the assembly rotates freely.

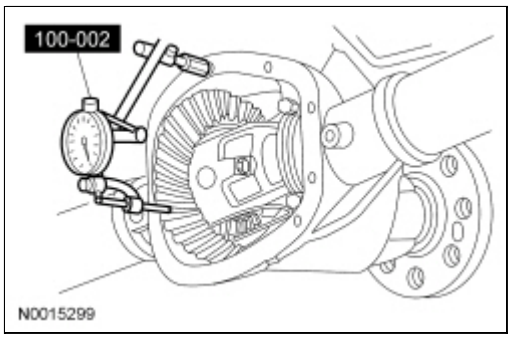
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12. Install the 2 bearing caps and 4 bolts.
    - Tighten to 105 Nm (77 lb-ft).



13. Using the Dial Indicator Gauge with Holding Fixture, do a final check of the ring gear backlash.



14. Apply marking compound and rotate the differential assembly 5 complete revolutions.

15. Verify an acceptable pattern check. For additional information, refer to Tooth Contact Pattern Check in Section 205-00 .

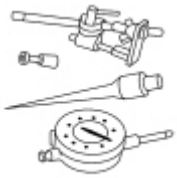
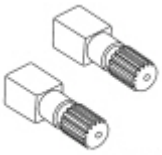
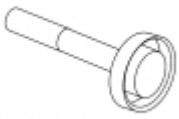
16. Install the axle shafts. For additional information, refer to Axle Shaft in this section.

17. Install the differential housing cover. For additional information, refer to Differential Housing Cover in this section.

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Differential Case and Ring Gear — Conventional

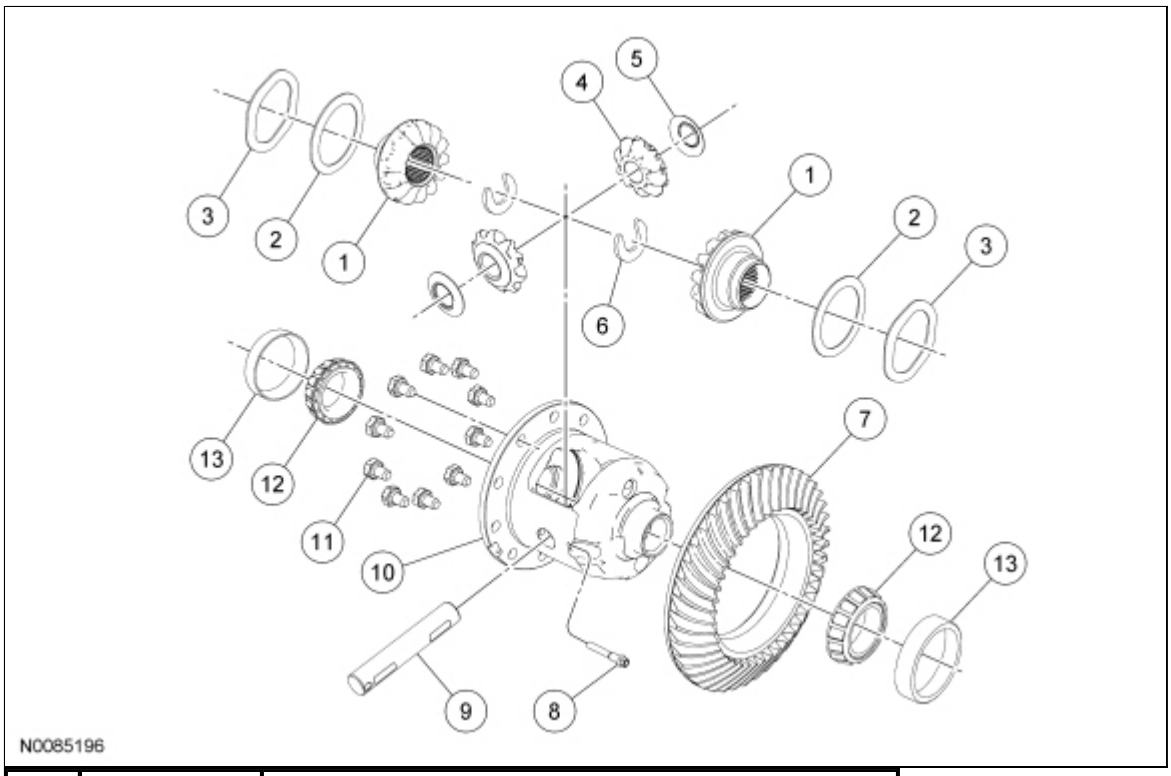
Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1857-A	Gauge, Differential (Traction-Lock) 205-384 (T97T-4205-A)
 ST1749-A	Gauge, Differential (Traction-Lock) 205-386 (T97T-4205-D)
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1543-A	Step Plate 205-D061 (D80L-630-8) or equivalent

Material

Item	Specification
Maximum Strength Retaining Compound	—

Loctite® 638™	
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5



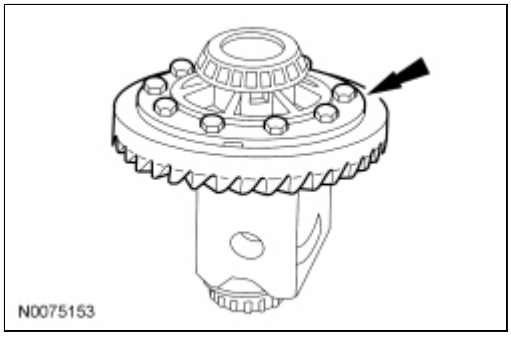
Item	Part Number	Description
1	—	Differential side gears (part of 4215)
2	4228	Differential side gear thrust washers
3	4214	Differential side gear wave washers
4	4215	Differential pinion gear
5	4230	Differential pinion thrust washer (also part of 4215)
6	4N237	Axle shaft U-washer
7	4209	Differential ring gear
8	4241	Differential pinion shaft lock bolt (also part of 4215)
9	4211	Differential pinion shaft
10	4204	Differential case
11	4216	Differential ring gear bolts (12 required)
12	4220	Differential bearings
13	—	Differential bearing cups (part of 4220)

Disassembly

1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to Differential Carrier in this section.

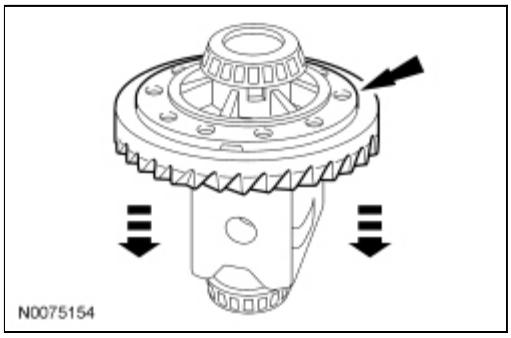
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2. Remove and discard the 12 differential ring gear bolts.

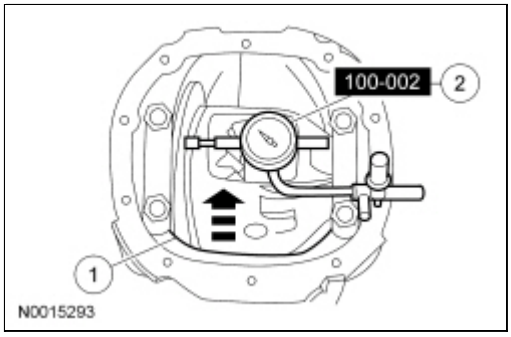


3. ***NOTICE:*** **Care should be taken not to damage the differential ring gear bolt hole threads.**

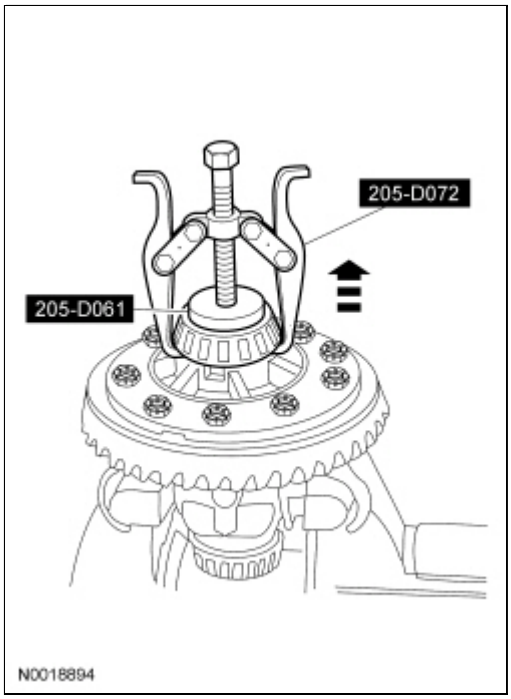
   Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.



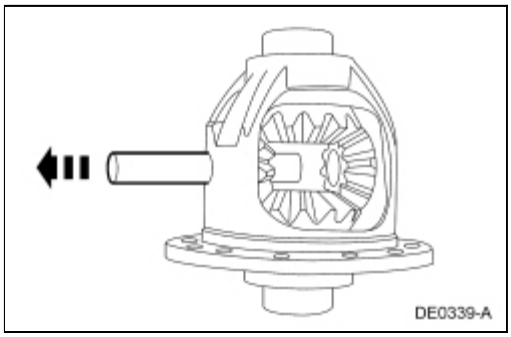
4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
   1. Install the bearing caps and differential shims.
      - Rotate the differential assembly to verify the bearings have seated.
   2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.



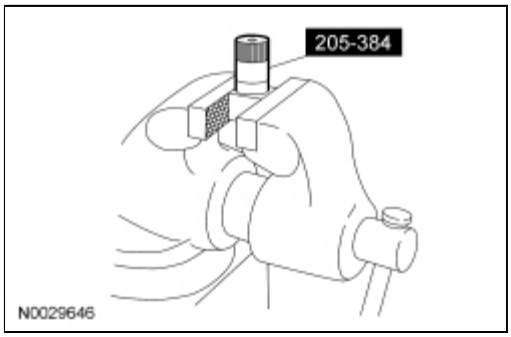
5. If necessary, remove the differential bearings with the 2 Jaw Puller and Step Plate.



6. Remove the differential pinion shaft lock bolt and the differential pinion shaft.

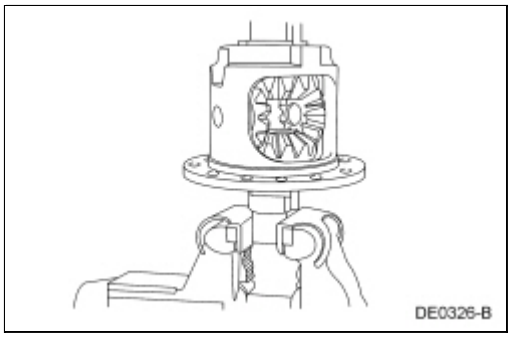


7. Install the Differential Gauge in a suitable vise.



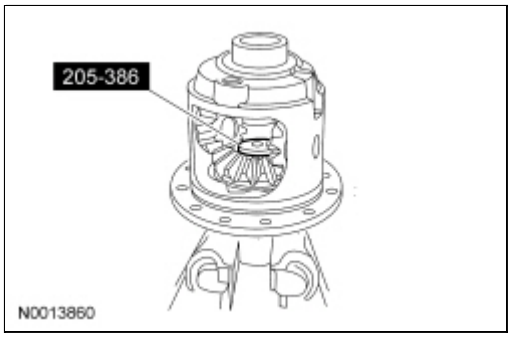
8. Install the differential case on the Differential Gauge.

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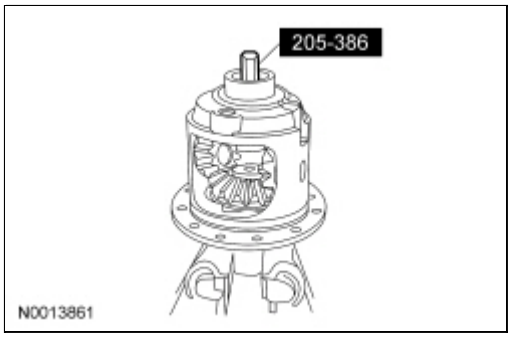


9. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge step plate.

   Install the Differential Gauge step plate in the bottom differential side gear.

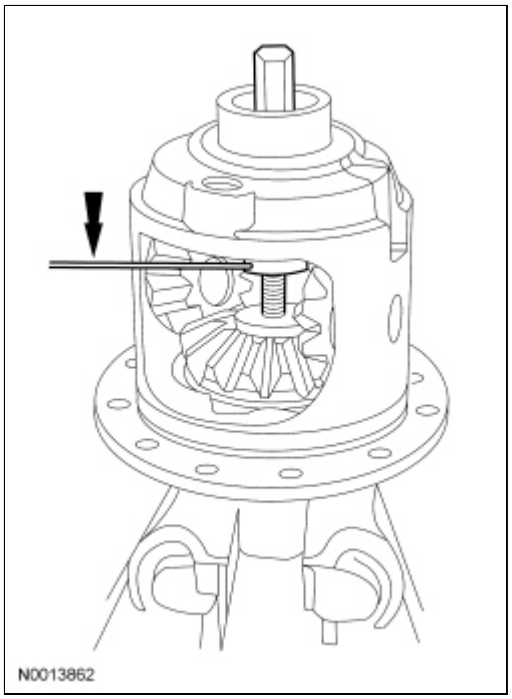


10. Install the Differential Gauge nut in the upper differential side gear. Hold the nut in position while installing the Differential Gauge hex screw. Tighten the hex-head screw until contact is made with the Step Plate.

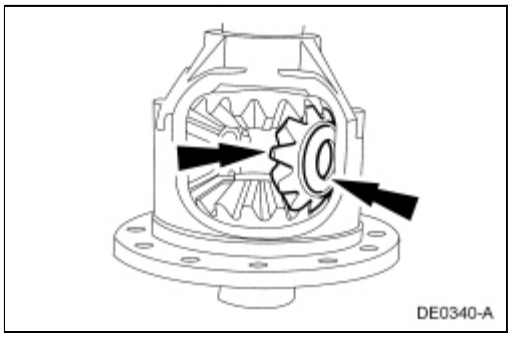


11. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

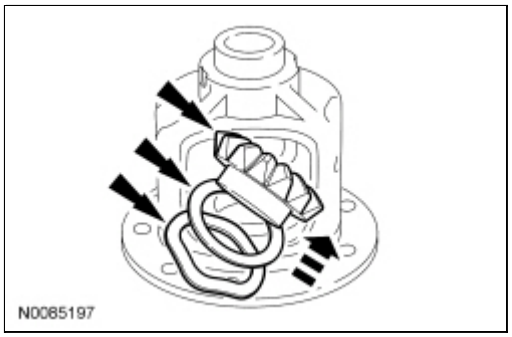
    Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gears away from the differential pinion gears.



12. Rotate and remove the differential pinion gears and differential pinion gear thrust washers.



13. Remove the differential side gears, the differential side gear thrust washers and the differential side gear wave washers.



Assembly

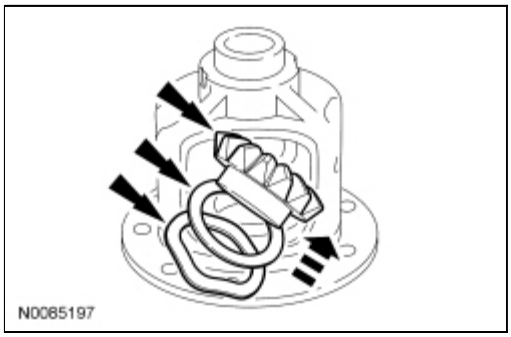
All vehicles

1. **NOTE:** Lubricate the differential side gear thrust washers, wave washers and the side gear journals

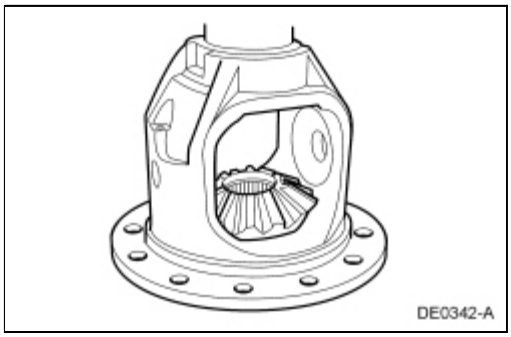
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with axle lubricant.

Position the differential side gear thrust washers and wave washers on the differential side gears.



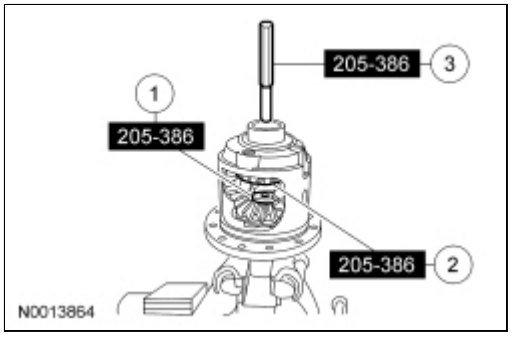
2. Position the differential side gears.



3. **NOTE:** Apply a small amount of grease to the step plate bore.

   NOTE: If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

   Assemble the Differential Gauge to the differential case.
   1. Position the Differential Gauge step plate in the bottom differential side gear.
   2. Position the Differential Gauge hex screw plate in the top differential side gear and hold it in place.
   3. Install the Differential Gauge hex screw and tighten it 2 turns after it contacts the bottom step plate.

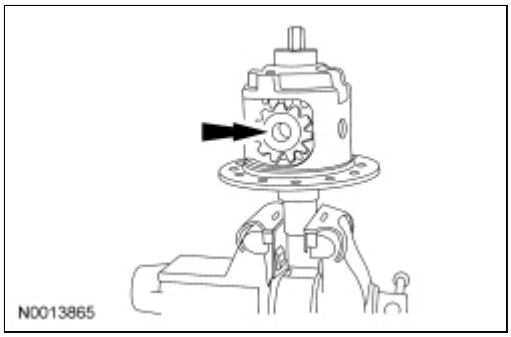


4. **NOTE:** Lubricate both sides of the differential pinion gear thrust washers with axle lubricant.

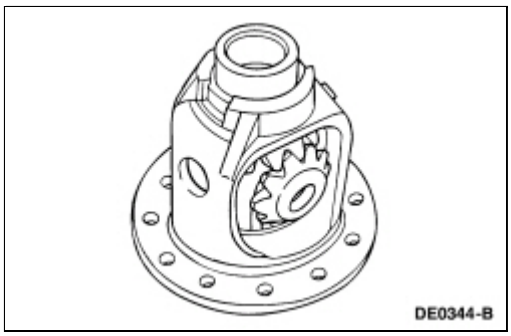
   NOTE: Make sure the differential pinion gears are 180 degrees apart so they will align correctly with

the pinion shaft bore.

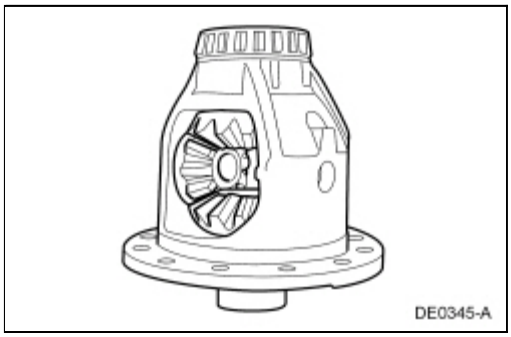
Position the differential pinion gears and differential pinion gear thrust washers in the window of the differential case so they mesh with the differential side gear teeth.



5. Engage the differential pinion gears opposite the differential side gears.



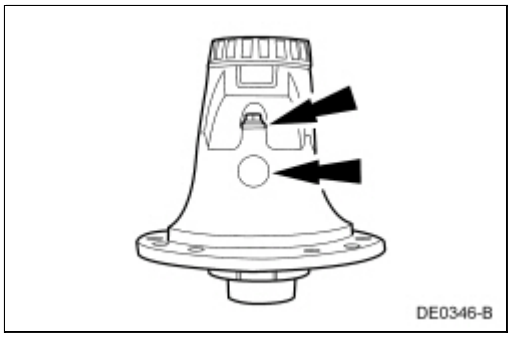
6. Rotate the differential pinion gears to align the differential pinion shaft bore.



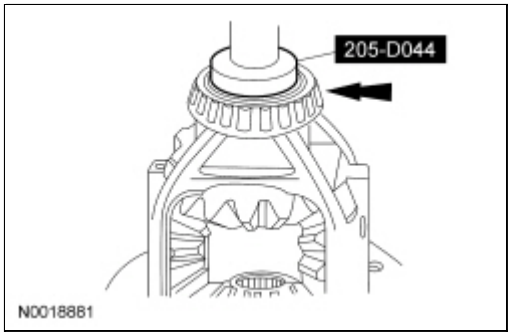
7. Remove the Differential Gauges after verifying the differential pinion shaft bore alignment.

8. Insert the differential pinion shaft, and install a new differential pinion shaft lock bolt finger-tight.

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9. If removed, use the Differential Carrier Bearing Installer to install the differential bearings.

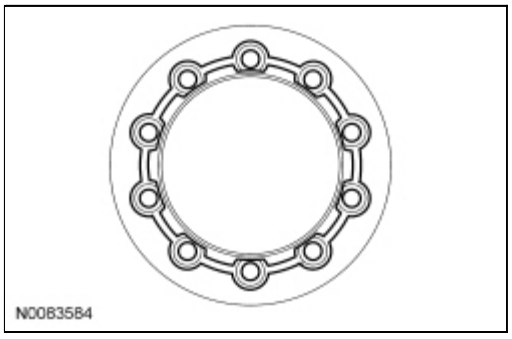


Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets

10. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

    Clean all traces of the old retaining compound material from the differential flange.
    - Use solvent and Scotch-Brite® pads to remove.

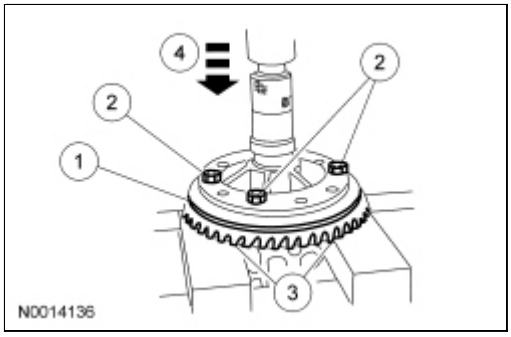
11. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.



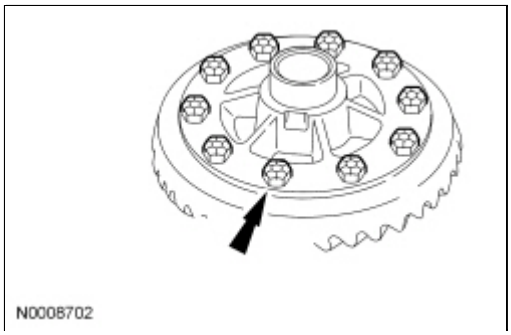
All vehicles

12. Install the ring gear.
    1. Place the ring gear on the differential assembly.
    2. Hand-start 3 new ring gear bolts to align the holes in the ring gear and the differential case.
    3. Using a suitable press, position the ring gear.

4. Press the ring gear into place.



13. Hand-start the remaining 9 new differential ring gear bolts. Tighten the 12 bolts in 2 stages.
    - Stage 1: Tighten to 60 Nm (44 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.

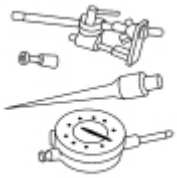
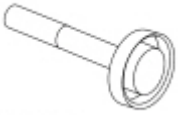
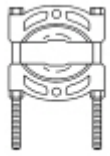


14. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

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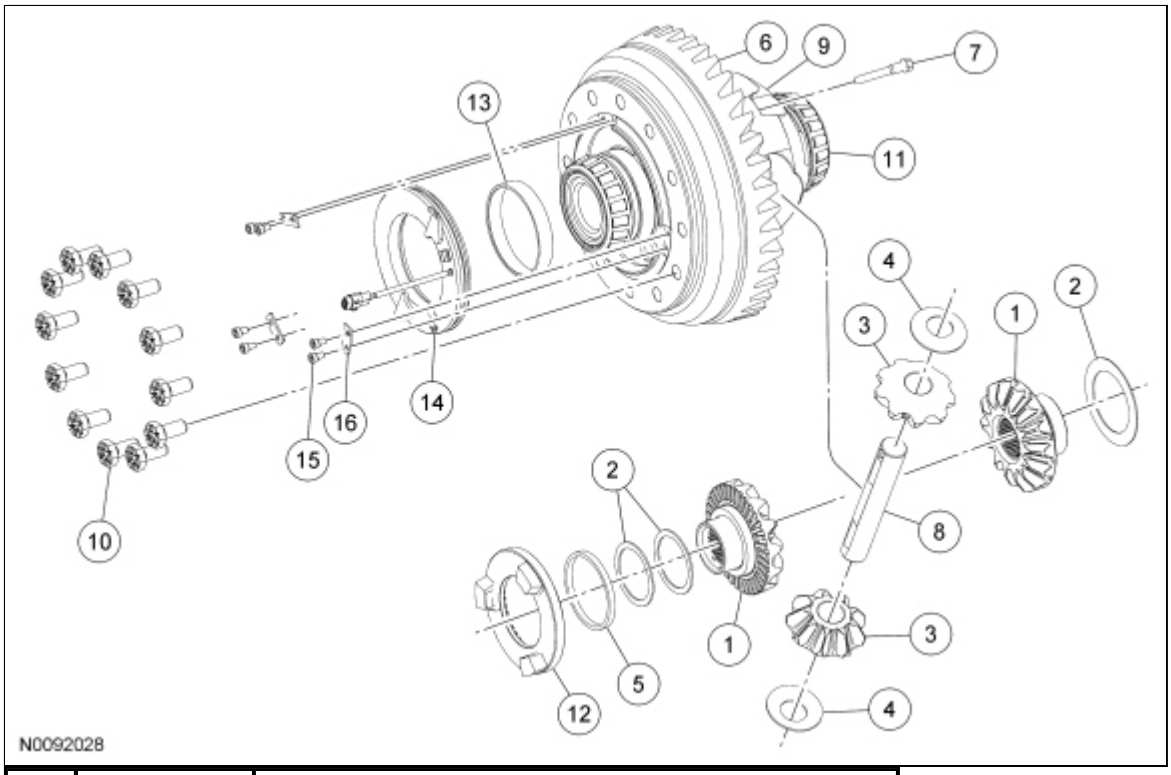
Differential Case and Ring Gear — Electronic Locking Differential (ELD)

Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1543-A	Step Plate 205-D061 (D80L-630-8) or equivalent

Material

Item	Specification
Maximum Strength Retaining Compound Loctite® 638™	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5

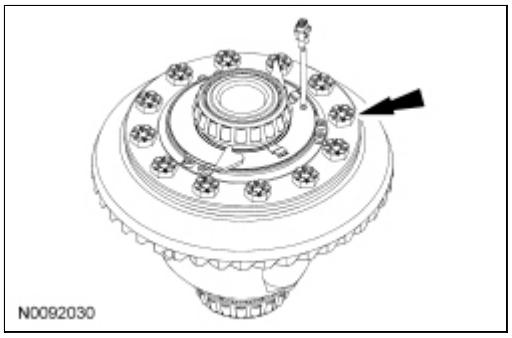


Item	Part Number	Description
1	—	Differential side gears (part of kit 4215)
2	—	Differential side gear thrust washers (part of kit 4215)
3	—	Differential pinion gears (part of kit 4215)
4	—	Differential pinion thrust washers (part of kit 4215)
5	—	Differential pinion spring (part of kit 4215)
6	4209	Differential ring gear
7	4241	Differential pinion shaft lock bolt
8	4211	Differential pinion shaft
9	4204	Differential case
10	4216	Differential ring gear bolt (12 required)
11	4220	Differential bearing
12	—	Cam-ring (part of kit 4880)
13	—	Plunger (part of kit 4880)
14	—	Coil (part of kit 4880)
15	—	Coil bolt (part of kit 4880) (6 required)
16	—	Stopper (part of kit 4880) (3 required)

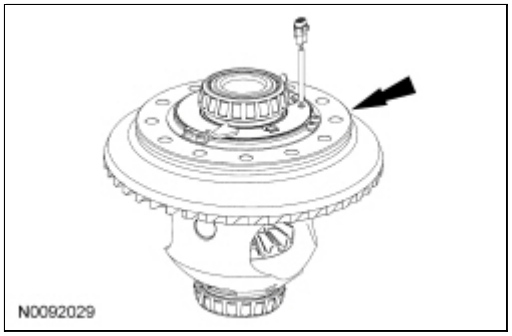
Disassembly

1. Remove the differential carrier. For additional information, refer to Differential Carrier in this section.
2. Remove and discard the 12 differential ring gear bolts.

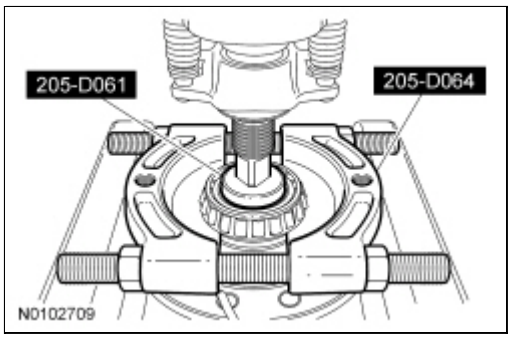
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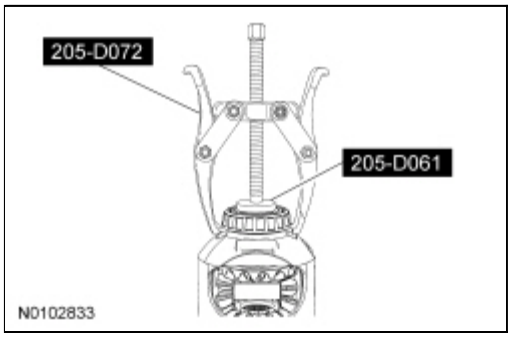
3. Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.



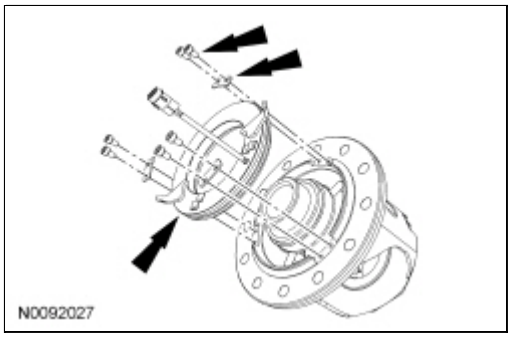
4. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.



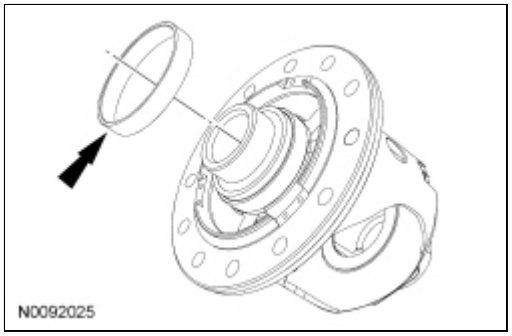
5. Using the 2 Jaw Puller and Step Plate, remove the RH differential bearing.



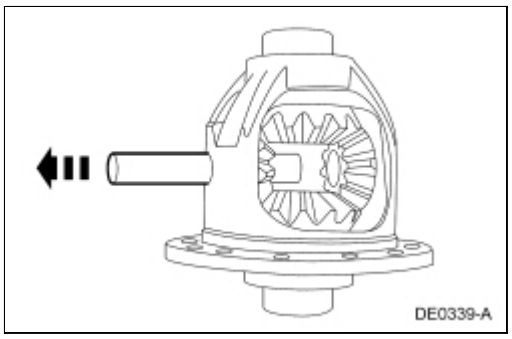
6. Remove and discard the 6 screws and 3 stoppers that hold the Electronic Locking Differential (ELD) coil in place and remove the coil.



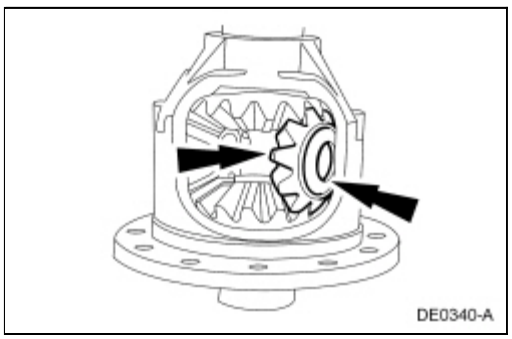
7. Remove the plunger assembly.



8. Remove the differential pinion shaft lock bolt and the differential pinion shaft.

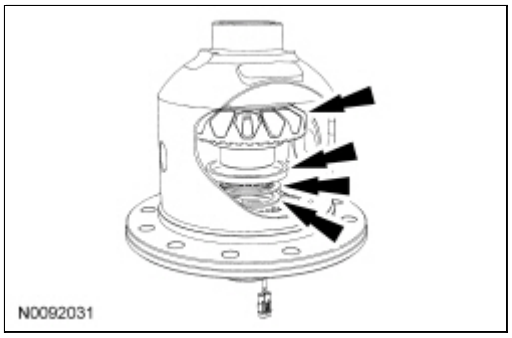


9. Rotate and remove the differential pinion gears and differential pinion gear thrust washers.

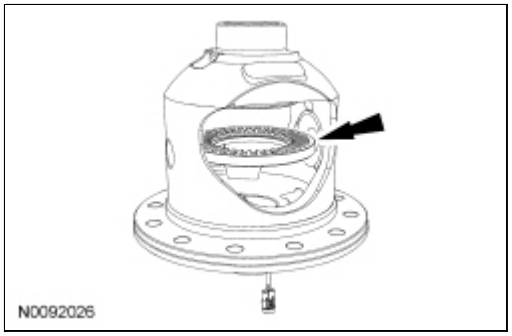


10. Remove the differential side gears, the differential side gear thrust washers and spring.

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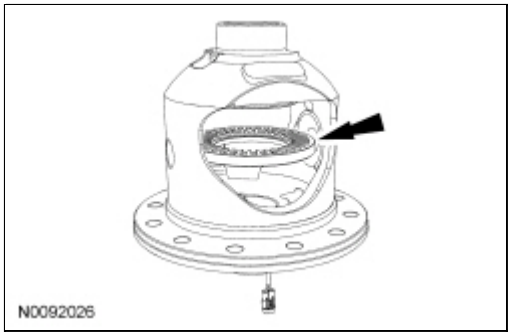
11. Remove the cam-ring.



Assembly

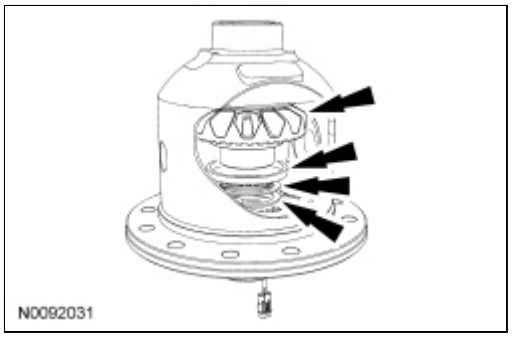
All vehicles

1. Install the cam-ring.



2. **NOTE:** Start by using the thickest thrust washers. If the gears do not assemble using the thickest thrust washers, back down in thickness until the gears will assemble.

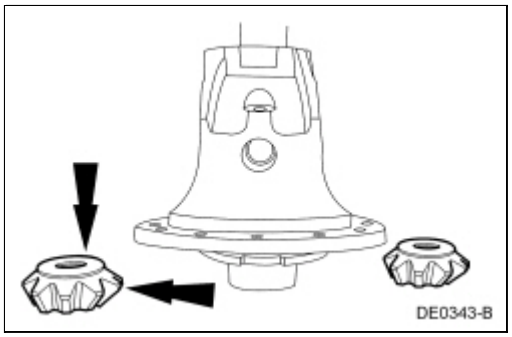
   Position the 2 LH differential side gear thrust washers and spring on the lower differential side gear and install the gear.
   - Lubricate the differential side gear thrust washers and the differential side gear journals with axle lubricant.



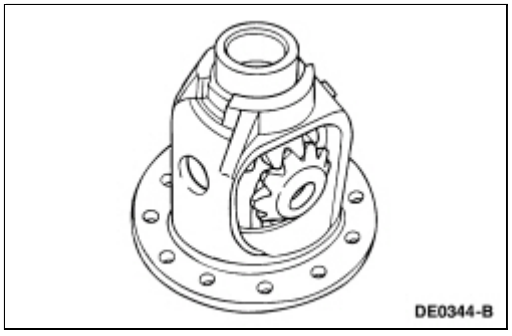
3. **NOTE:** Start by using the thickest thrust washer. If the gears do not assemble using the thickest thrust washers, back down in thickness until the gears will assemble.

   Position the differential side gear thickest thrust washer on the RH differential side gear and install the gear.
   - Lubricate the differential side gear thrust washers and the differential side gear journals with axle lubricant.

4. Assemble the differential pinion gear thrust washers and the differential pinion gears.
   - Lubricate the washers and gears with rear axle lubricant.

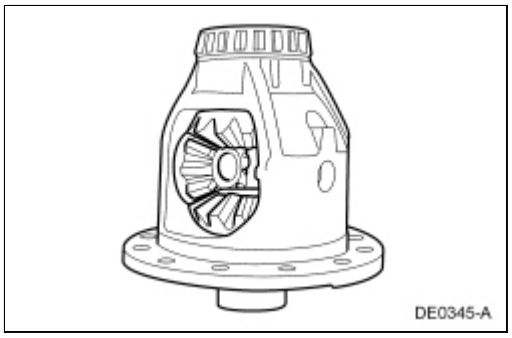


5. Engage the differential pinion gears opposite the differential side gears.

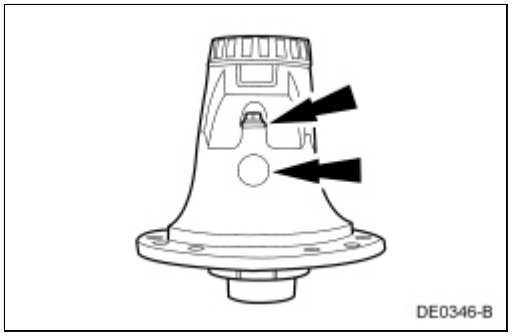


6. Rotate the differential pinion gears to align the differential pinion shaft bore.

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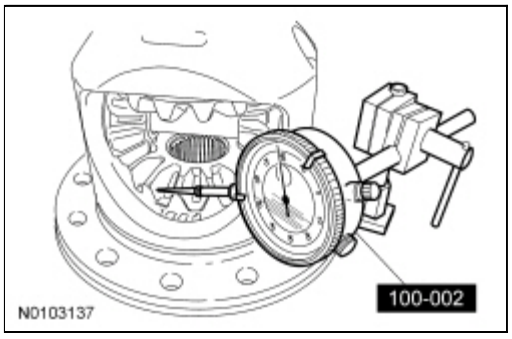


7. Insert the differential pinion shaft, and install a new differential pinion shaft lock bolt finger-tight.



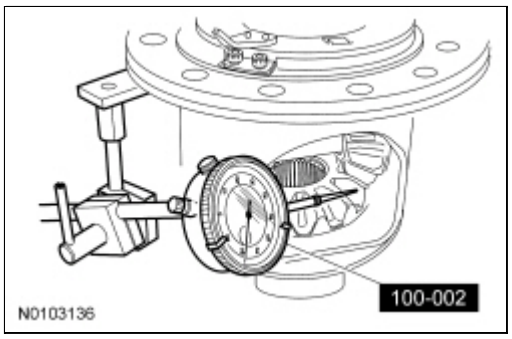
8. Install the Dial Indicator Gauge With Holding Fixture.
    - While pulling up on the RH differential gear, measure the backlash of the LH differential gear.
    - Backlash should be 0.001-1.000 mm (0.004-0.040 in).
    - If backlash is incorrect, install a thicker LH thrust washer to reduce backlash, or a thinner washer to increase backlash.

Part Number	Thickness (mm)	Thickness (in)	Quantity
Part of kit 4880	1.4	0.05	2
Part of kit 4880	1.6	0.06	2
Part of kit 4880	1.8	0.07	2



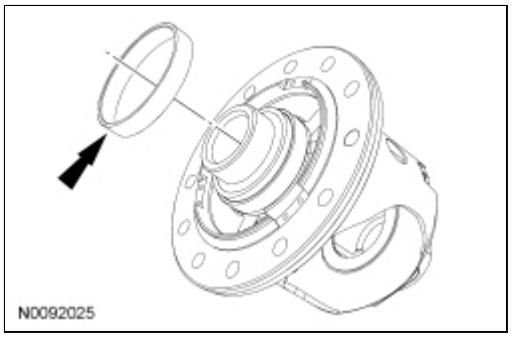
9. Turn the differential over and reposition the Dial Indicator Gauge With Holding Fixture.
    - While pulling up on the LH differential gear, measure the backlash of the RH differential gear.
    - Backlash should be 0.001-1.000 mm (0.004-0.040 in).
    - If backlash is incorrect, install a thicker RH thrust washer to reduce backlash, or a thinner washer to increase backlash.

Part Number	Thickness (mm)	Thickness (in)	Quantity
Part of kit 4880	1.1	0.04	1
Part of kit 4880	1.3	0.05	1
Part of kit 4880	1.5	0.06	1

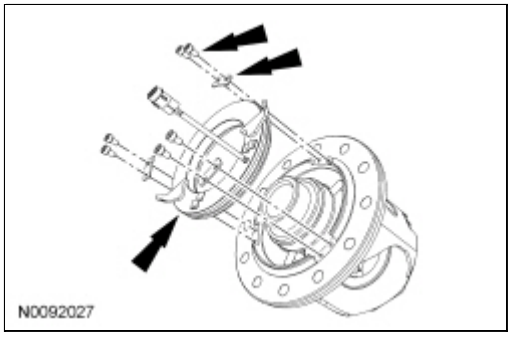


10. Tighten the differential pinion shaft lock bolt to 30 Nm (22 lb-ft).

11. Install the plunger assembly.

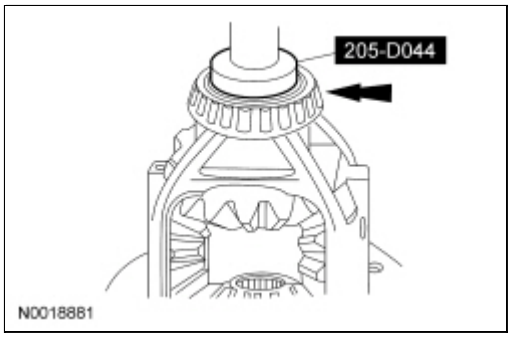


12. Install the ELD coil, 3 new stoppers and 6 new screws that hold the coil in place.
    - Tighten to 5 Nm (44 lb-in).



13. Use the Differential Carrier Bearing Installer to install the 2 differential bearings.

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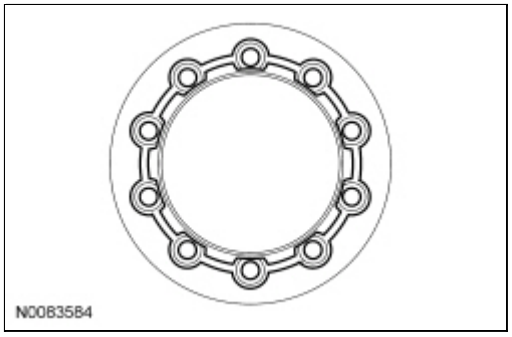


Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets

14. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

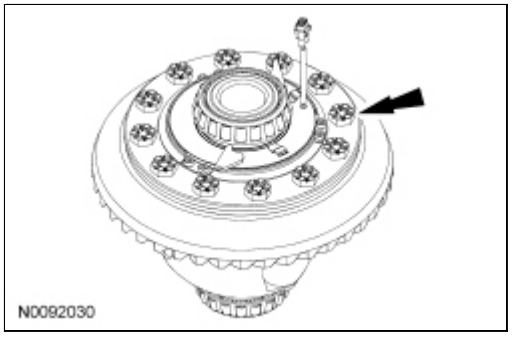
    Clean all traces of the old retaining compound material from the differential flange.
    - Use solvent and Scotch-Brite® pads to remove.

15. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.



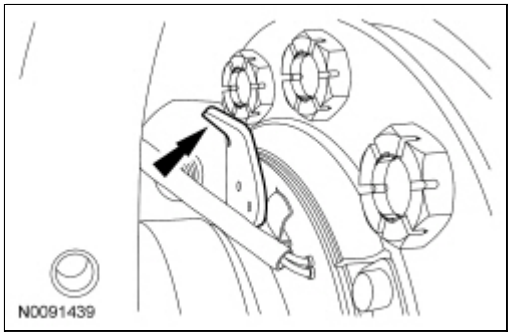
All vehicles

16. Install the ring gear and the 12 new differential ring gear bolts. Tighten in 2 stages.
    - Stage 1: Tighten to 60 Nm (44 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



17. **NOTE:** Install the differential with the tabs on the ELD coil up against the differential bearing cap mounting surface.

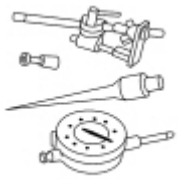
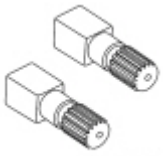
Install the differential carrier in the axle housing. For additional information, refer to Differential Carrier in this section.

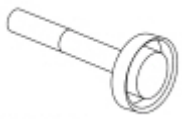
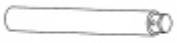


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Differential Case and Ring Gear — Traction-Lok

Special Tool(s)

 ST1374-A	15-101 Gauge, Differential Clutch (Excluding Mandrel) 205-135 (T80P-4946-A)
 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1857-A	Gauge, Differential (Traction-Lock) 205-384 (T97T-4205-A)
 ST1749-A	Gauge, Differential (Traction Lock) 205-386 (T97T-4205-D)
 ST1372-A	Gauge, Differential (Traction-Lock) (Mandrel for 205-135 [T80P-4946-A]) 205-389 (T97T-4946-A)
	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent

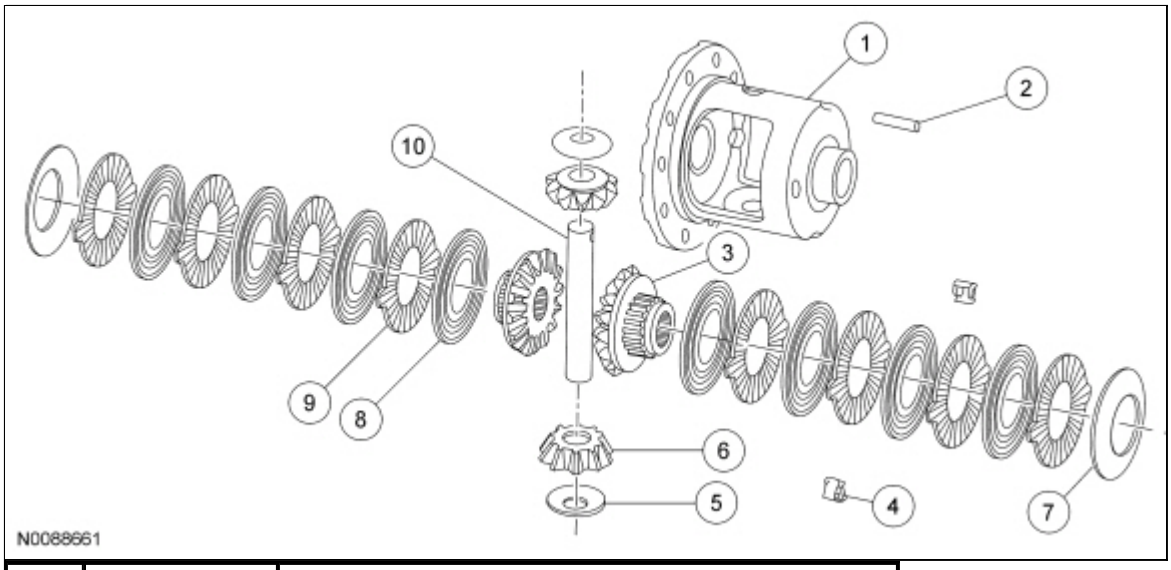
 ST2473-A	
 ST1858-A	Rotator, Differential 205-378 (T97T-4205-C)
 ST1543-A	Step Plate 205-D061 (D80L-630-8) or equivalent

Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Maximum Strength Retaining Compound Loctite® 638™	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

Traction-Lok Differential Assembly

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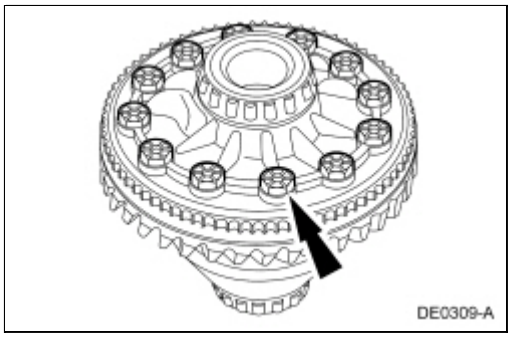


Item	Part Number	Description
1	4204	Differential case
2	4241	Differential pinion shaft lock bolt (part of 4215)
3	—	Differential side gear (part of 4215)
4	—	Retainer clip (part of 4947)
5	4230	Differential pinion thrust washer (part of 4215)
6	—	Differential pinion gear (part of 4215)
7	—	Plate preload spacer (part of 4947)
8	—	Clutch disc (part of 4947)
9	—	Clutch plate (part of 4947)
10	4211	Differential pinion shaft

Disassembly

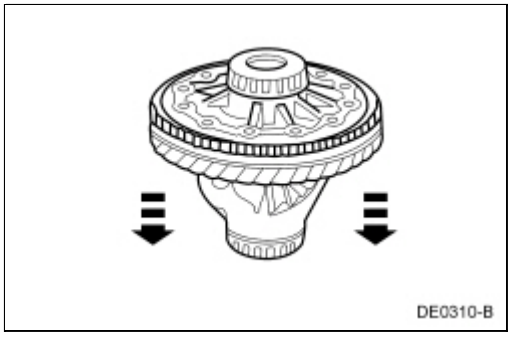
1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to Differential Carrier in this section.

2. Remove and discard the 12 differential ring gear bolts.

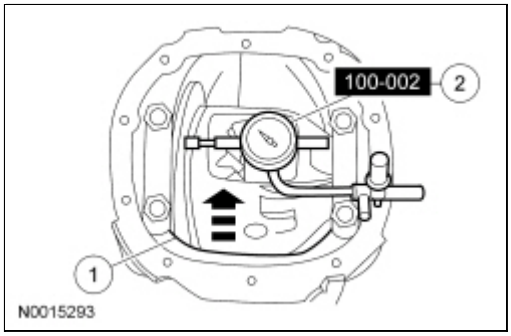


3. ***NOTICE:*** **Care should be taken not to damage the differential ring gear bolt hole threads.**

Insert a punch in the differential ring gear bolt holes. Drive off the differential ring gear.



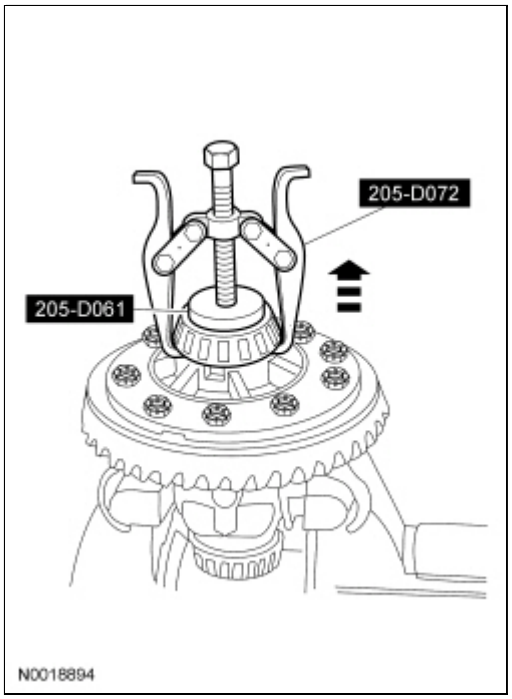
4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
    1. Install the bearing caps and differential shims.
        - Rotate the differential assembly to verify the bearings have seated.
    2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.



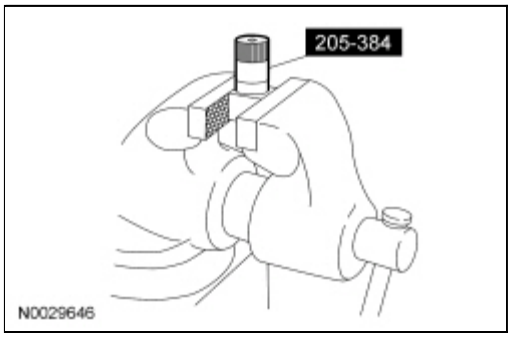
5. **NOTE:** The differential bearings need not be removed to overhaul the Ford limited slip differential.

    If necessary, use the 2 Jaw Puller and Step Plate to remove the differential bearings.

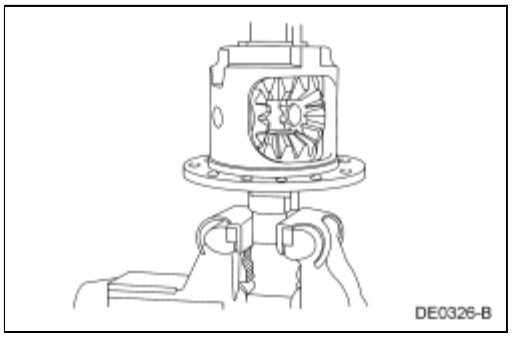
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6. Install the Differential Gauge in a suitable vise.

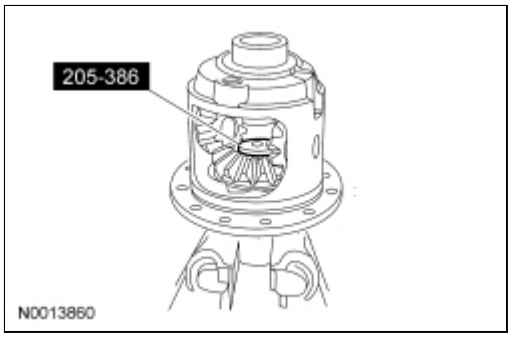


7. Install the differential case on the Differential Gauge.

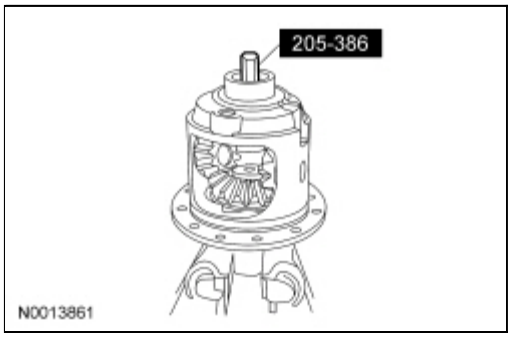


8. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge.

   Install the Differential Gauge in the bottom differential side gear.

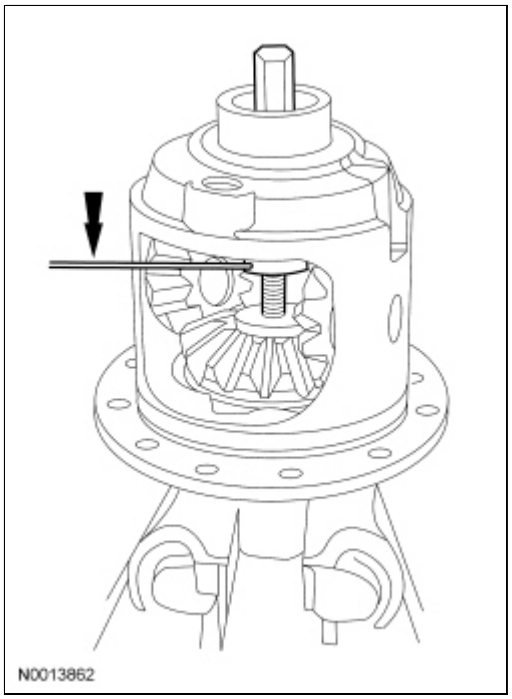


9. Install the nut in the upper differential side gear. Hold the nut in position while installing the hex screw. Tighten the hex-head screw until contact is made with the Step Plate.



10. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

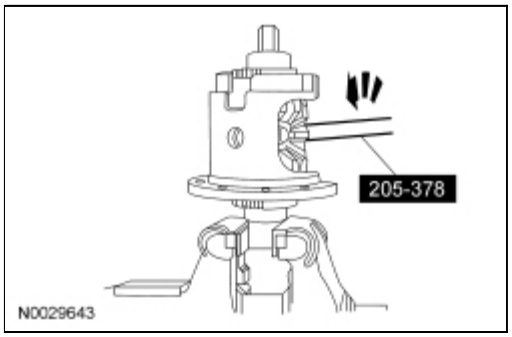
    Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gears away from the differential pinion gears.



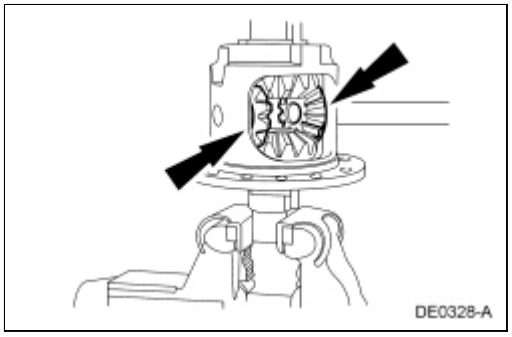
11. **NOTE:** Differential pinion gear thrust washers cannot be removed independently of the differential pinion gears.

repair4less

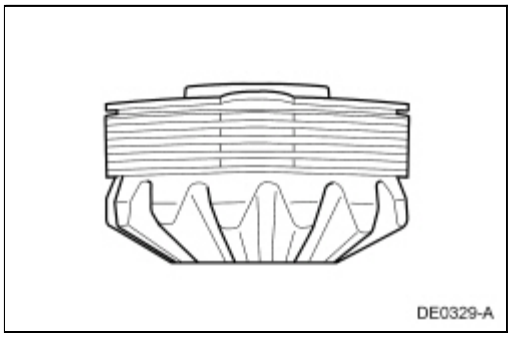
Insert the Differential Rotator in the pinion shaft bore, and turn the differential case to "walk" the differential pinion gears and differential pinion gear thrust washers out to the differential case windows.



12. Remove the differential pinion gears and differential pinion gear thrust washers.



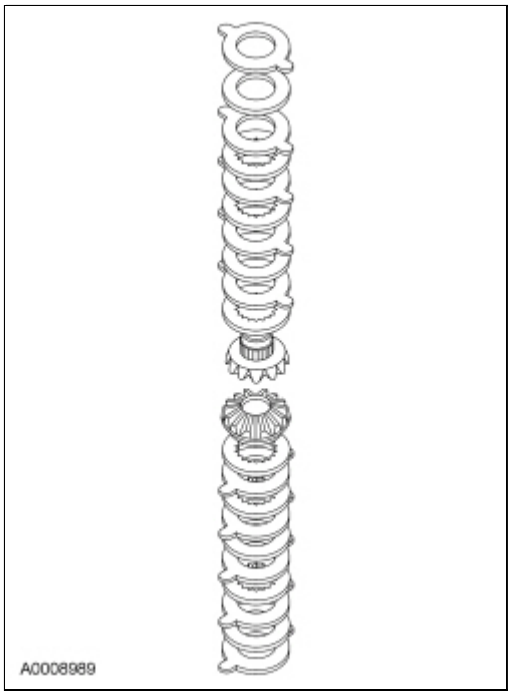
13. Remove the differential side gears and differential clutch packs with the selective shim and Belleville spring, tag them RH and LH.



14. **NOTE:** When separating the clutch plates and clutch discs, note the sequence in which they are disassembled. They must be reassembled in the same sequence.

    NOTE: Do not use acids or solvents when cleaning the differential clutch pack. Wipe components with a clean, lint-free cloth only.

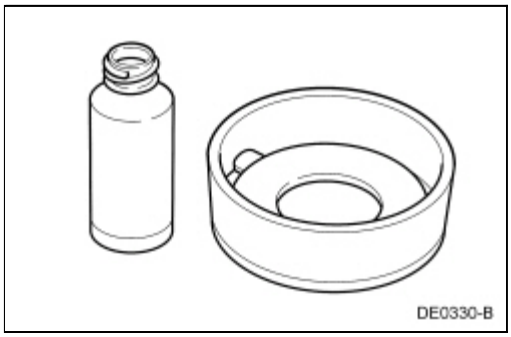
    Separate the differential clutch discs and clutch plates for cleaning and inspection.



Assembly

All vehicles

1. Lubricate each steel clutch plate and soak all friction plates with friction modifier for at least 15 minutes.

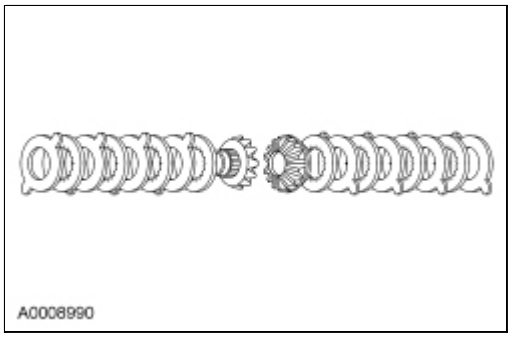


2. **NOTE:** Do not mix the differential clutch packs or selective shims from one side with the other.

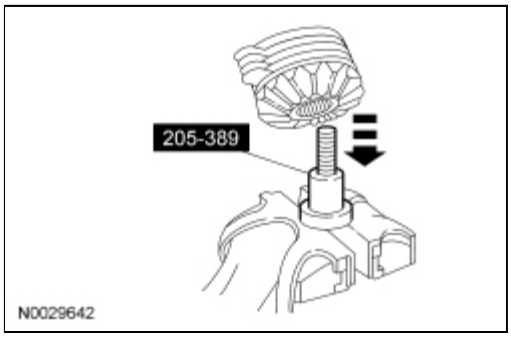
   NOTE: The Belleville spring is a dished plate.

   Assemble the differential clutch packs (without the selective shims and Belleville springs) on their respective differential side gears.

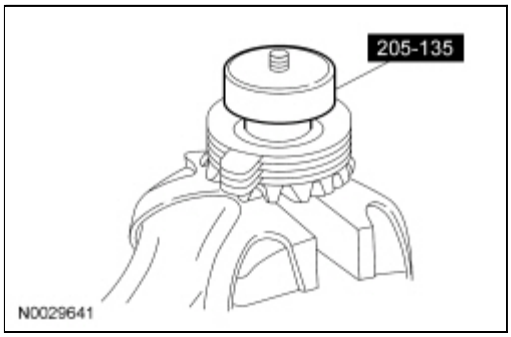
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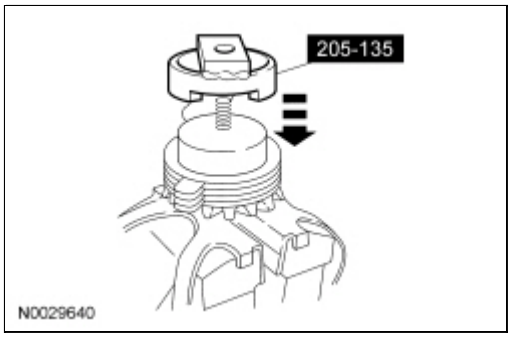
3. Clamp the bolt head of the Differential Gauge in a vise. Install the differential clutch pack and the differential side gear (without the selective shim or the Belleville spring) on the Differential Gauge.



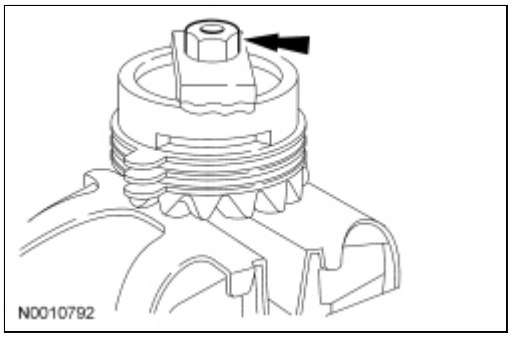
4. Position the Differential Clutch Gauge on top of the differential clutch pack.



5. Install the Differential Gauge over the disc and differential clutch pack.

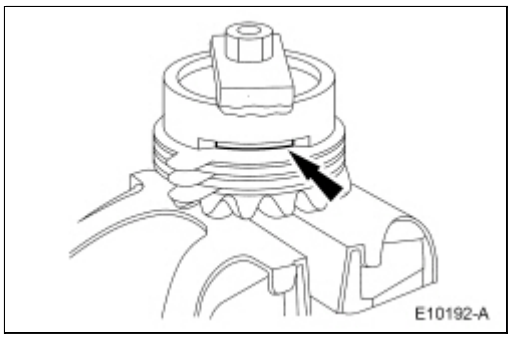


6. Install the nut over the top and base stud.
    - Tighten to 7 Nm (62 lb-in).

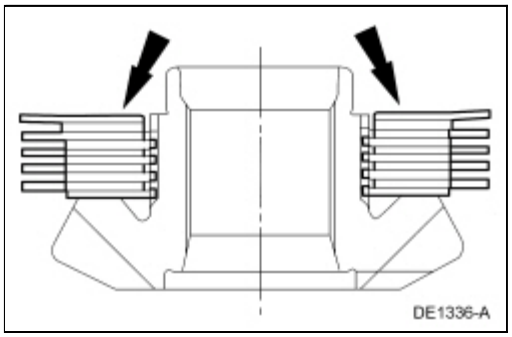


7. **NOTE:** Selective shims shown are available as part of the Clutch Pack Replacement Kit.

   Use the feeler gauge and select the thickest blade that will enter between the tool and the differential clutch pack. Subtract 0.0075" from the reading, Then select the closest thinner thickness selective shim, that will be the new selective shim that should be used.

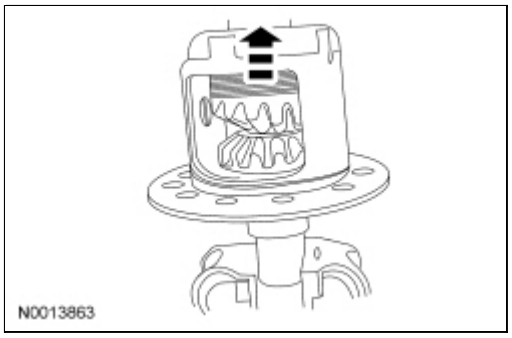


8. Place the selective shim and Belleville spring on the differential clutch pack.
   - The dished or concave side of the Belleville spring must face up against the thrust face of the differential case.



9. Install the differential side gears with the differential clutch packs, selective shims and Belleville spring into the differential case.
   - Hold the differential side gear assembly in place to prevent it from falling out of the differential case.

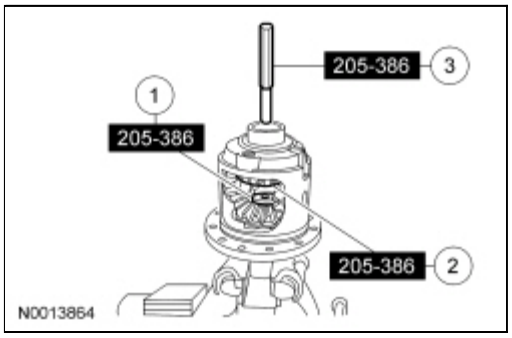
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10. **NOTE:** Apply a small amount of grease to the step plate bore.

    NOTE: If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

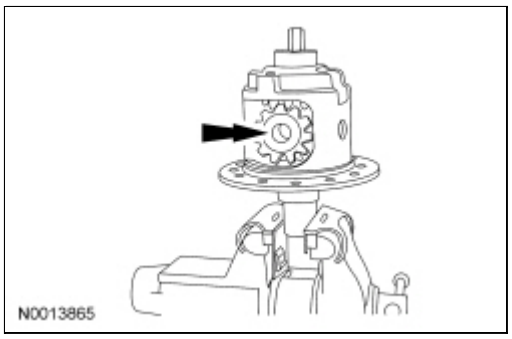
    Assemble the Differential Gauge to the differential case.
    1. Position the Differential Gauge in the bottom differential side gear.
    2. Position the Differential Gauge in the top differential side gear and hold it in place.
    3. Install the Differential Gauge and tighten it 2 turns after it contacts the bottom step plate.



11. **NOTE:** Lubricate both sides of the differential pinion gear thrust washers with axle lubricant.

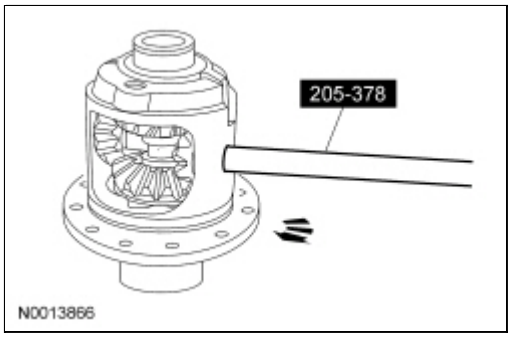
    NOTE: Make sure the differential pinion gears are 180 degrees apart so they will align correctly with the pinion shaft bore.

    Position the differential pinion gears and differential pinion gear thrust washers in the window of the differential case so they mesh with the differential side gear teeth.



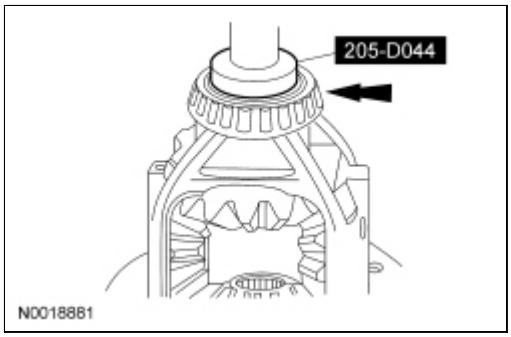
12. **NOTE:** It will probably be necessary to loosen or tighten the forcing screw to allow the differential pinion gears and differential side gears to rotate.

Insert the Differential Rotator into the pinion shaft bore, and turn the differential case. This will cause the differential pinion gears to engage the differential side gears and "walk" into the differential case. Rotate the differential case until the pinion shaft mating holes are lined up exactly with the holes in the differential pinion gears.

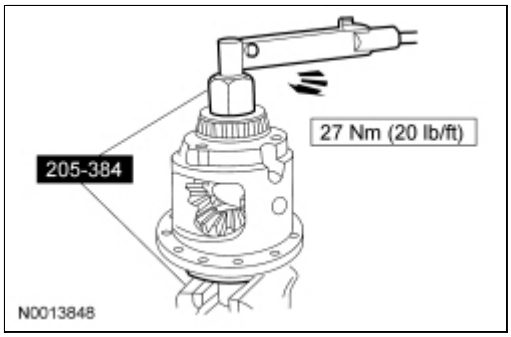


13. Remove the Differential Gauge.

14. Install the 2 new differential bearings using the Differential Carrier Bearing Installer.



15. Check the torque required to rotate one differential side gear.
    - Install the Differential Gauge with the 1/2-inch drive hole as shown.
    - The initial break-away torque, if original clutch plates are used, must be at least the minimum specification. The rotating torque required to keep the differential side gear turning with new clutch plates may vary.



Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets

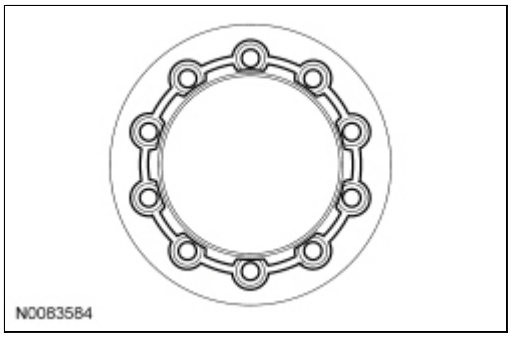
16. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

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Clean all traces of the old retaining compound material from the differential flange.

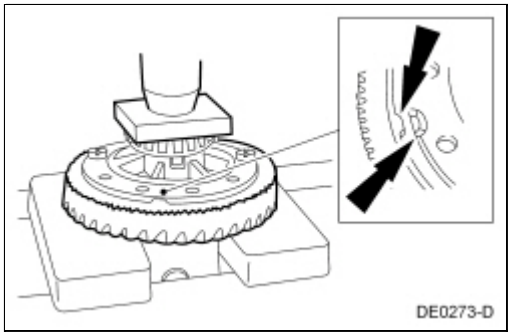
- Use solvent and Scotch-Brite® pads to remove.

17. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.

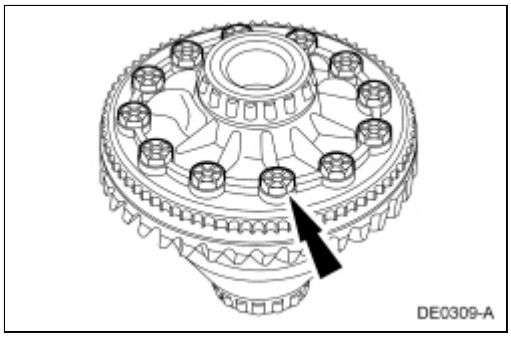


All vehicles

18. Using a suitable press, install the differential ring gear.



19. Install the new 12 differential ring gear bolts.
    - Tighten to 150 Nm (111 lb-ft).



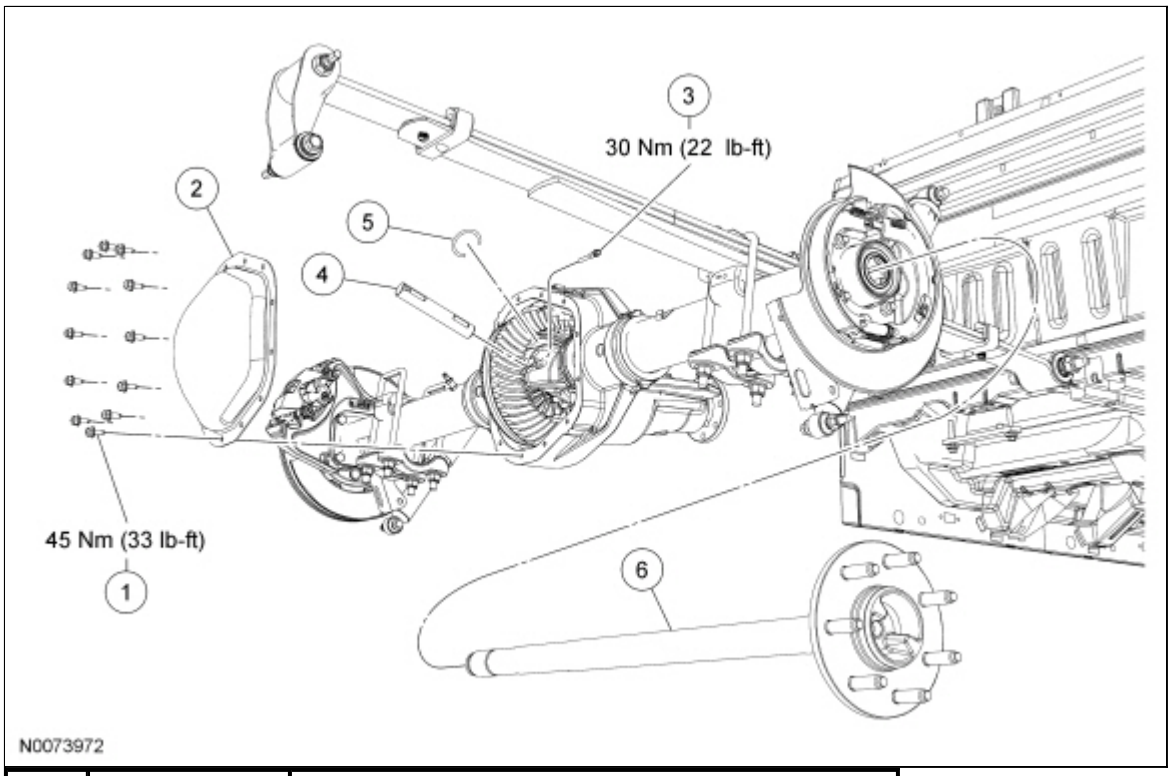
20. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

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Axle Shaft

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5



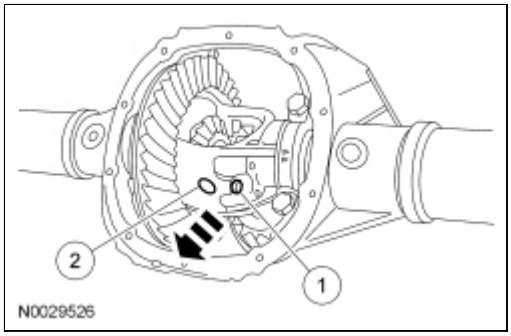
Item	Part Number	Description
1	4346	Differential housing cover bolt (12 required)
2	4033	Differential housing cover
3	4241	Differential pinion shaft locking bolt
4	4211	Differential pinion shaft
5	4N237	Axle shaft C-washer
6	4234	Axle shaft

Removal

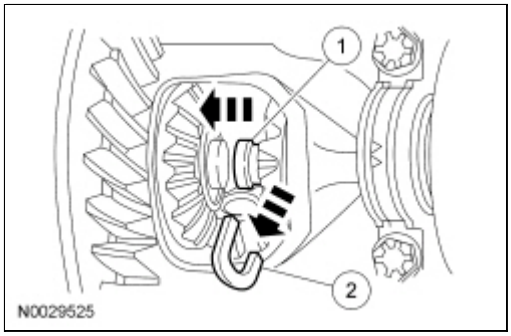
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

02 .

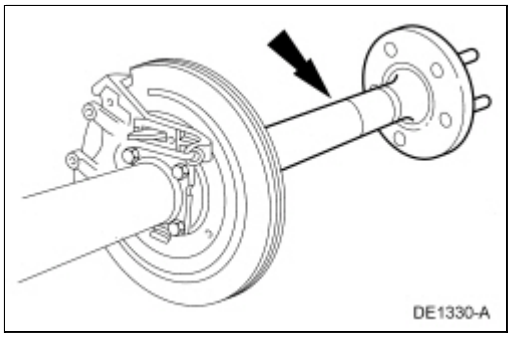
2. Remove the differential housing cover. For additional information, refer to Differential Housing Cover .
3. Remove the rear brake disc. For additional information, refer to Section 206-04 .
4. Remove the bolt and position aside the wheel speed sensor.
5. Remove the differential pinion shaft.
    1. Remove and discard the differential pinion shaft lock bolt.
    2. Remove the differential pinion shaft.



6. Remove the U-washer.
    1. Push in on the axle shaft.
    2. Remove the U-washer.



7. Remove the axle shaft.

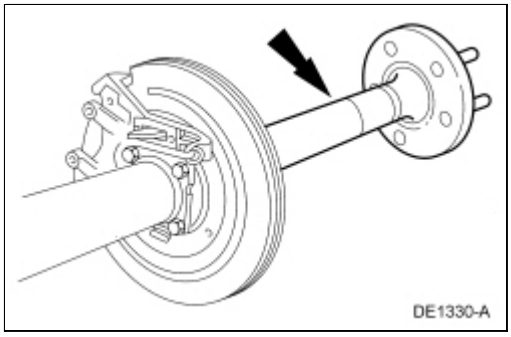


Installation

1. Lubricate the lip of the axle shaft oil seal with grease.

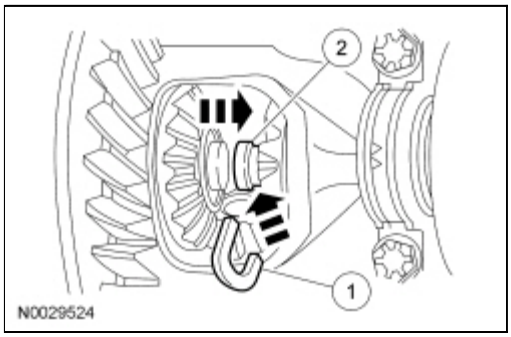
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2. Install the axle shaft.



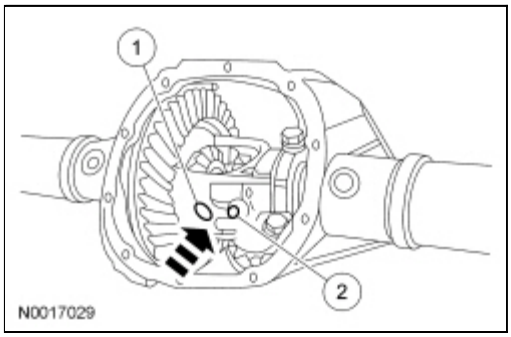
3. **NOTE:** Do not damage the rubber O-rings in the U-washer grooves.

   Install the U-washer.
   1. Position the U-washer on the button end of the axle shaft.
   2. Pull the axle shaft outward.



4. **NOTE:** If a new differential pinion shaft lock bolt is unavailable coat the threads of the original differential pinion shaft lock bolt with threadlock prior to installation.

   Install the differential pinion shaft.
   1. Align the hole in the differential pinion shaft with the differential case lock bolt hole.
   2. Install a new differential pinion shaft lock bolt.
      - Tighten to 30 Nm (22 lb-ft).



5. Install the wheel speed sensor and the bolt.
   - Tighten to 15 Nm (133 lb-in).

6. Install the rear brake disc. For additional information, refer to Section 206-04 .

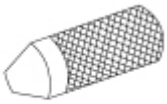
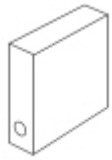
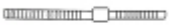
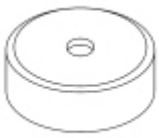
7. Install the differential housing cover. For additional information, refer to Differential Housing Cover .

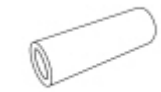
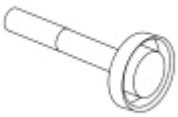
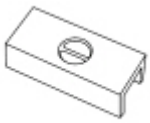
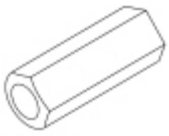
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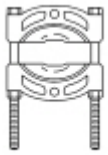
Differential Bearings

Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST2468-A	Adapter for 205-S156 205-159 (T80T-4020-F42)
 ST1429-A	Adapter for 205-S156 205-160 (T80T-4020-F43)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-226 (T85T-4020-AH1)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-383 (T97T-4020-B)
	Gauge Tube, Drive Pinion 205-377 (T97T-4020-A)

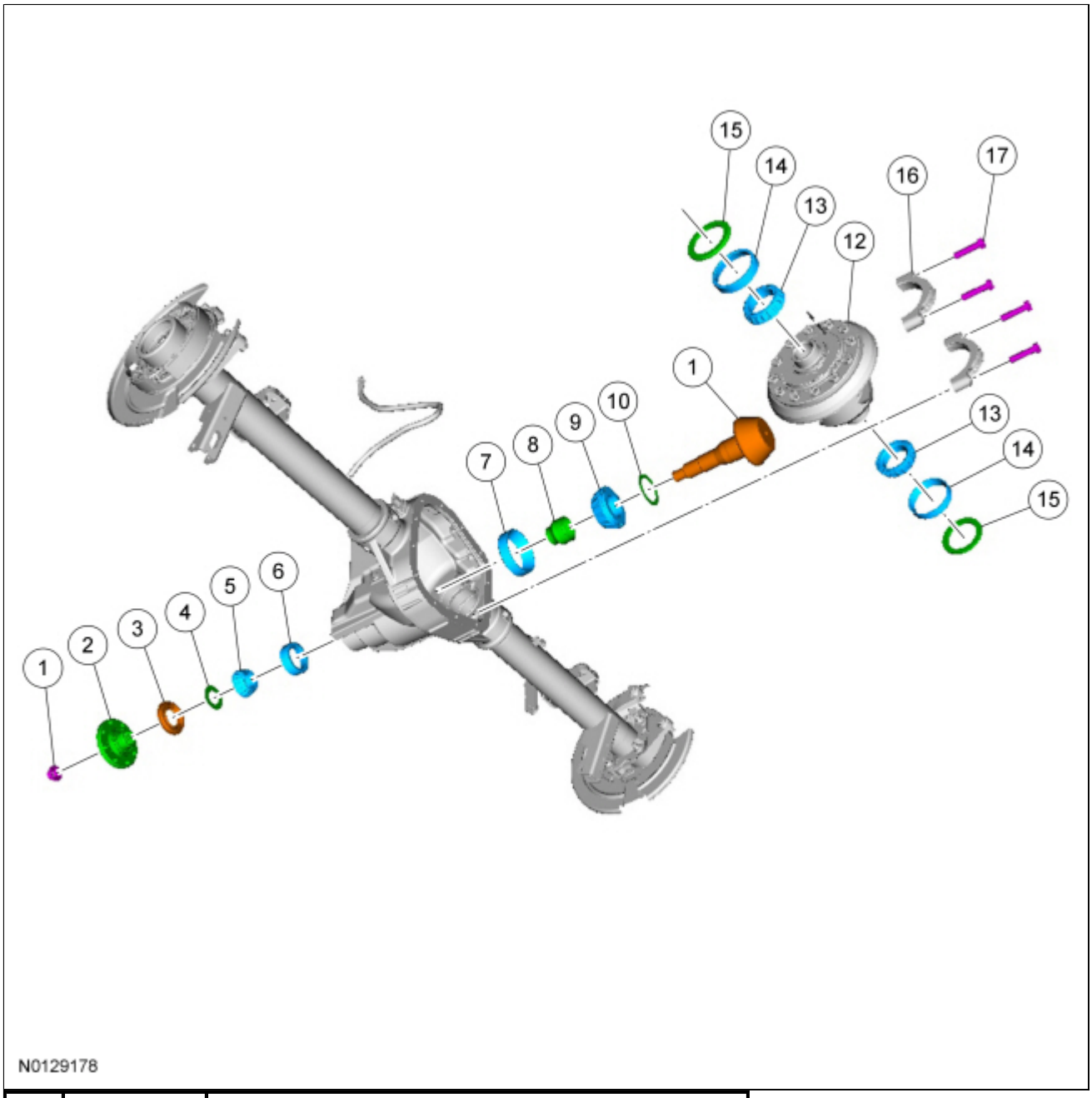
 ST1434-A	
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1367-A	Installer, Drive Pinion Bearing Cone 205-488
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST2368-A	Installer, Input Shaft Bearing Cup 308-391
 ST1741-A	Installer, Rear Axle Pinion Bearing Cup 205-852
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1744-A	Protector, Drive Pinion Thread 205-229 (T85T-4209-AH)
	Puller, Bearing 205-D064 (D84L-1123-A)

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 ST1368-A	
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

Material

Item	Specification
Motorcraft® Premium Long-Life Grease XG-1-C (US); CXG-1-C (Canada)	ESA-M1C75-B



Item	Part Number	Description
1	389546	Drive pinion nut
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal
4	4670	Pinion oil slinger
5	4621	Outer pinion bearing
6	—	Outer pinion bearing cup (part of 4621)
7	—	Inner pinion bearing cup (part of 4630)
8	4662	Collapsible spacer

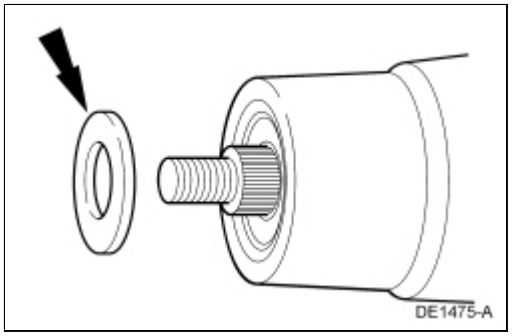
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9	4630	Inner pinion bearing
10	4663	Pinion bearing adjustment shim
11	4209	Drive pinion
12	4204	Differential assembly
13	4220	Differential carrier bearings (2 required)
14	—	Differential carrier bearing cups (Part of 4220) (2 required)
15	4067	Differential carrier bearing shims (2 required)
16	—	Differential bearing cap (part of 4010) (2 required)
17	—	Differential bearing cap bolts (part of 4010) (4 required)

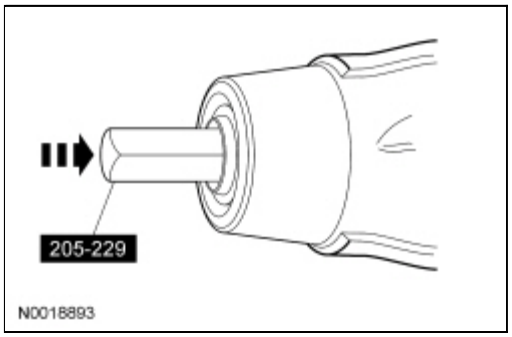
Removal

All vehicles

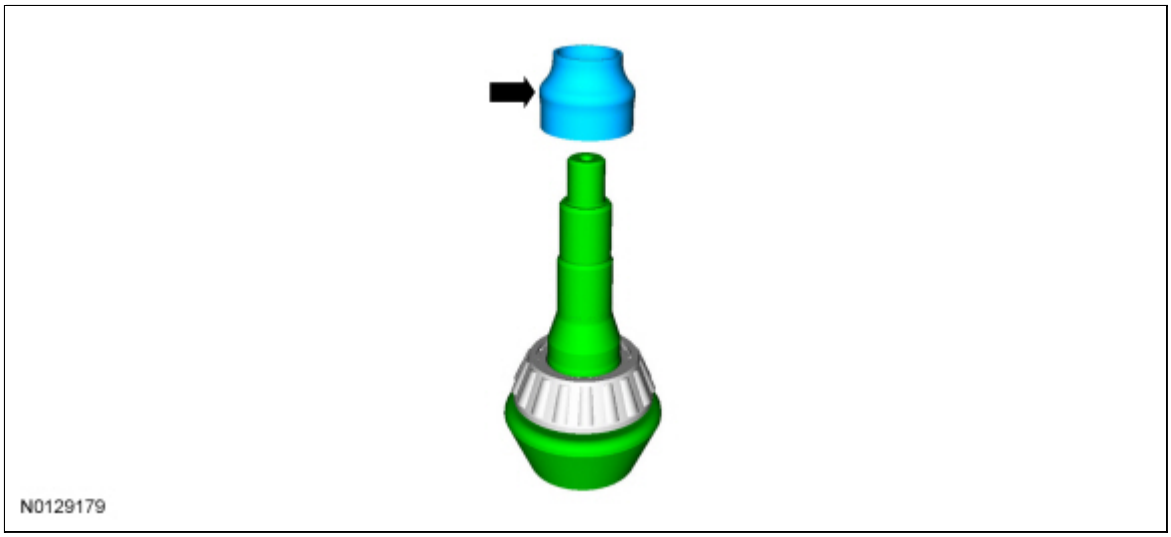
1. Remove the drive pinion seal. Refer to Drive Pinion Flange and Drive Pinion Seal in this section.
2. Remove the differential carrier assembly. Refer to Differential Carrier in this section.
3. Remove the drive pinion shaft oil slinger.



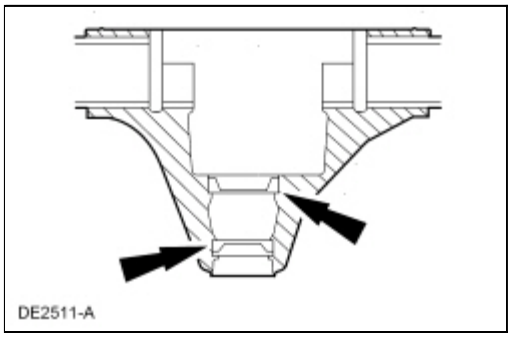
4. Install the Drive Pinion Thread Protector, then use a soft-faced hammer to drive the pinion gear out of the outer drive pinion bearing and remove the pinion gear.



5. Remove and discard the drive pinion collapsible spacer.

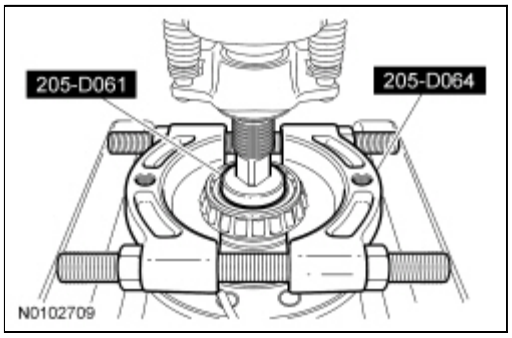


6. Using a brass drift, remove the 2 drive pinion bearing cups by tapping alternately on opposite sides of the 2 drive pinion bearing cups.



Electronic Locking Differential (ELD) equipped vehicles

7. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.

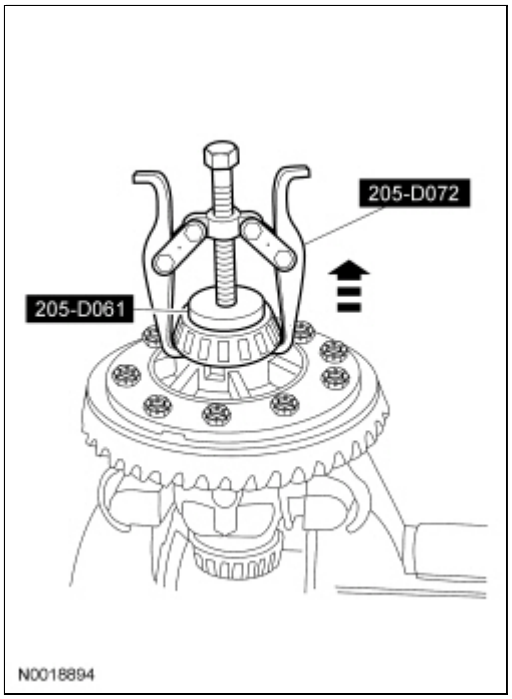


8. Using the 2 Jaw Puller and Step Plate, remove the RH differential bearing.

Non- ELD equipped vehicles

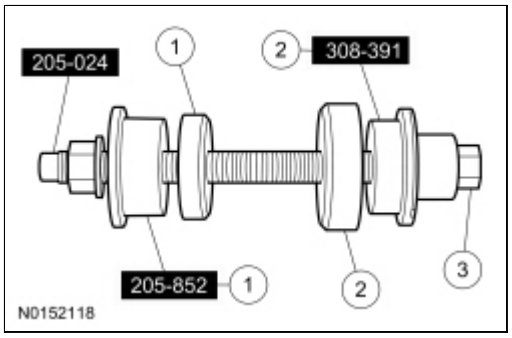
9. Remove the 2 differential bearings with the 2 Jaw Puller and Step Plate.

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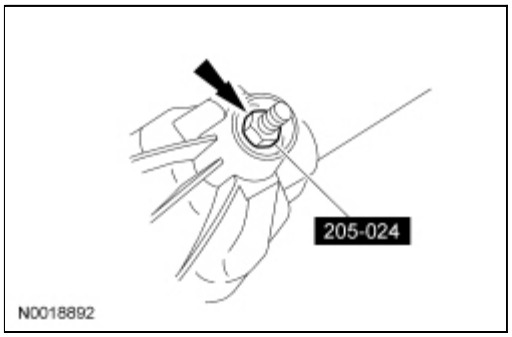


Installation

1. Position the Drive Pinion Bearing Cup Installer and the inner and outer drive pinion bearing cups in their respective bores.
    1. Place the Rear Axle Pinion Bearing Cup Installer on the outer drive pinion bearing cup.
    2. Place the Rear Axle Pinion Bearing Cup Installer on the inner drive pinion bearing cup.
    3. Install the Drive Pinion Bearing Cup Installer.

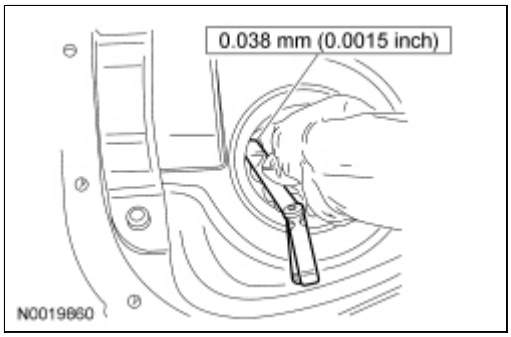


2. Tighten the Drive Pinion Bearing Cup Installer to fully seat the 2 differential drive pinion bearing cups.



3. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

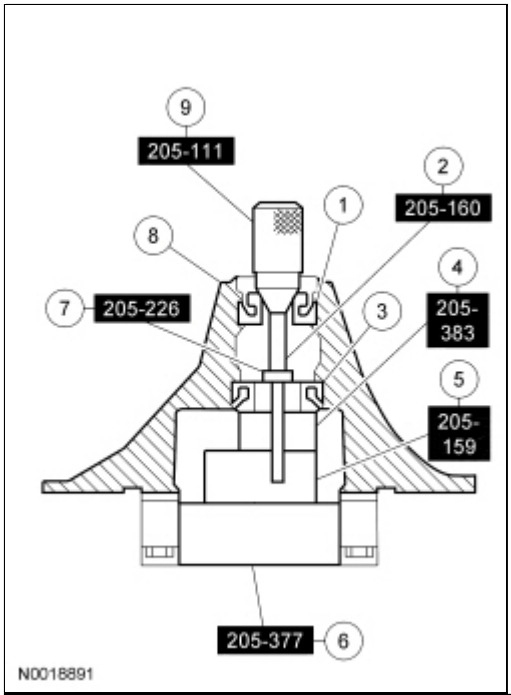
   Make sure the differential pinion bearing cups are correctly seated.



4. ***NOTICE:*** **Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.**

   NOTE: Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

   Install the new drive pinion bearings and Adapters as shown.



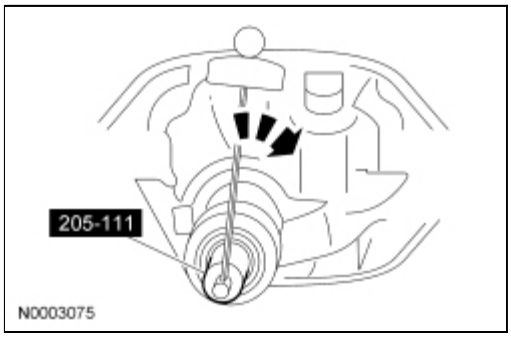
Item	Part Number	Description
1	4621	Outer pinion bearing
2	205-160	Adapter for 205-S127
3	4630	Inner pinion bearing
4	205-383	Depth Gauge/Aligner, Drive Pinion
5	205-159	Adapter for 205-S127

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6	205-377	Drive Pinion Gauge Tube
7	205-226	Depth Gauge/Aligner, Drive Pinion
8	4010	Rear axle housing outer (front) pinion bearing
9	205-111	Adapter for 205-S127

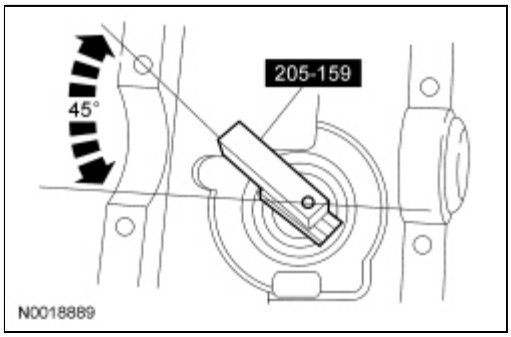
5. **NOTE:** This step duplicates final drive pinion bearing preload.

   Tighten the Adapter.
   - Tighten to 2.2 Nm (20 lb-in).

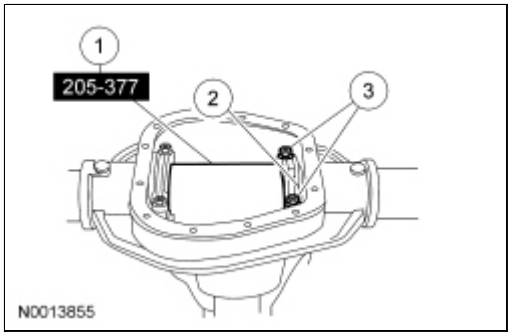


6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

   Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings.



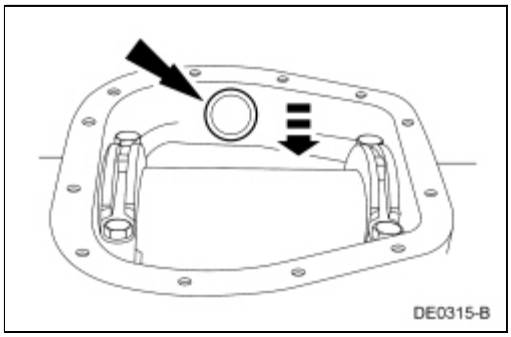
7. Install the Drive Pinion Gauge Tube.
   1. Position the Drive Pinion Gauge Tube.
   2. Install the 2 differential bearing caps.
   3. Install the 4 differential bearing cap bolts.
      - Tighten to 105 Nm (77 lb-ft).



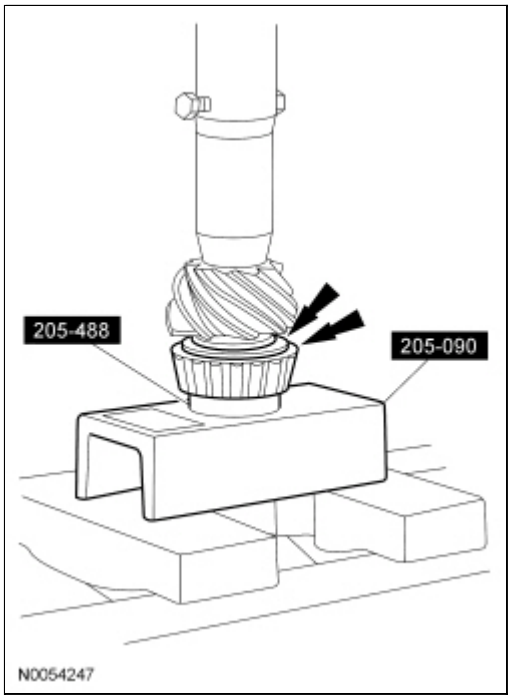
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

   NOTE: A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in the final assembly of integral axle assemblies.

   Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.
   - After the correct drive pinion bearing adjustment shim thickness has been determined, remove the Adapters.

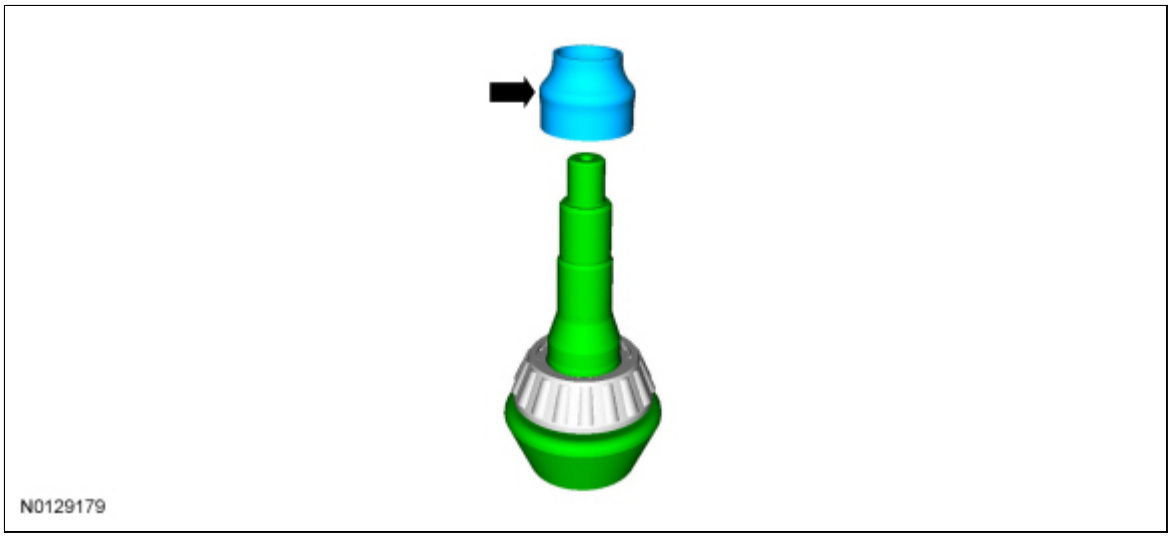


9. Using the Bearing/Oil Seal Plate and Drive Pinion Bearing Cone Installer, press the drive pinion bearing and selected drive pinion bearing adjustment shim until they are firmly seated on the pinion gear.

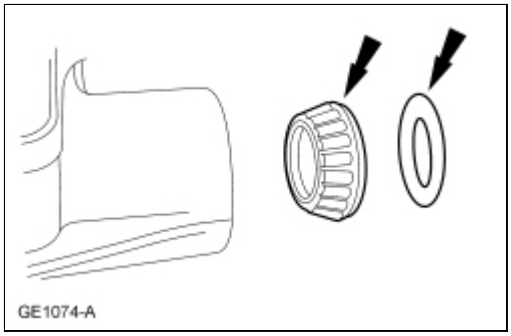


10. Place a new drive pinion collapsible spacer on the pinion gear against the pinion gear shoulder.

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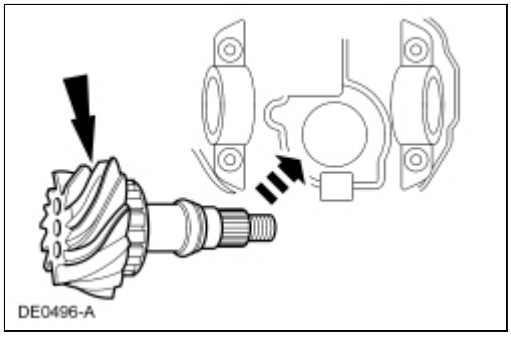


11. Install the outer drive pinion bearing and drive pinion shaft oil slinger.

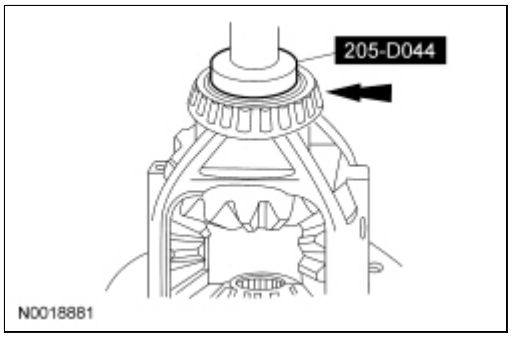


12. Lubricate the pinion flange splines with grease.

13. Install the pinion gear in the pinion gear bore from inside the axle housing.



14. Using the Differential Carrier Bearing Installer, press the LH and RH differential bearing on the differential assembly.



15. Install the differential carrier. Refer to Differential Carrier in this section.

16. Install the drive pinion seal and flange. Refer to Drive Pinion Flange and Drive Pinion Seal in this section.

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Differential Housing Cover

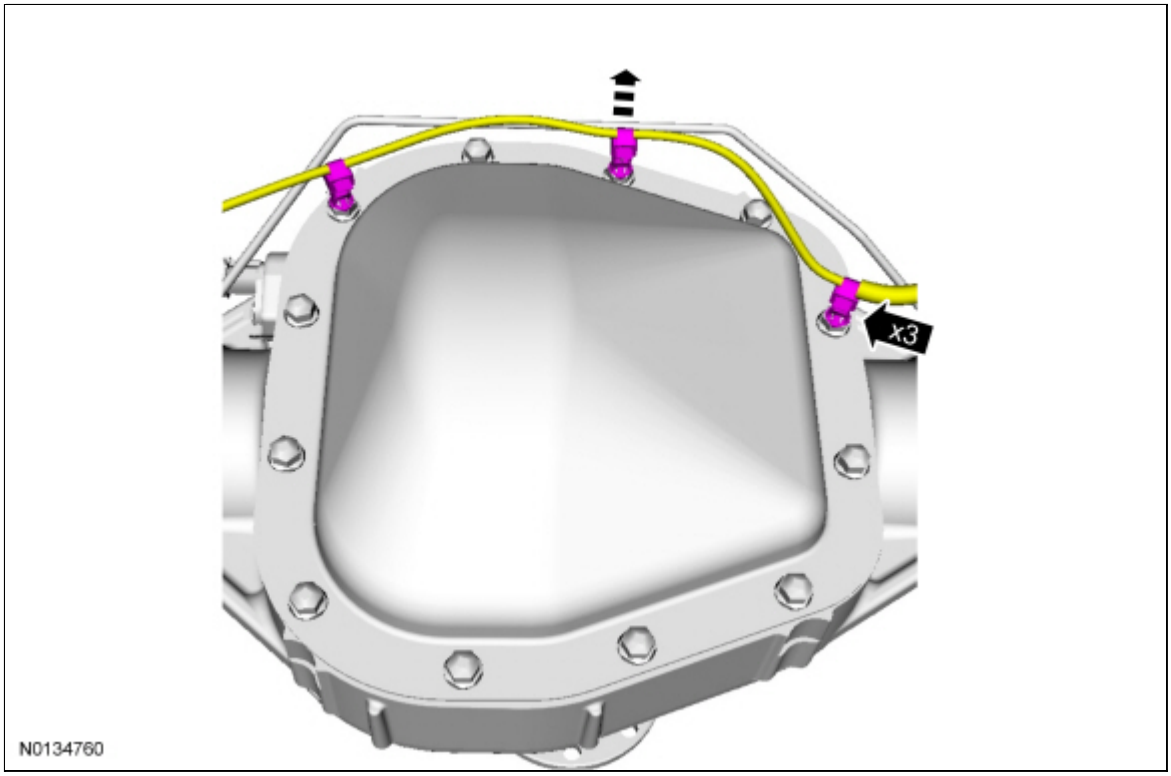
Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal and Installation

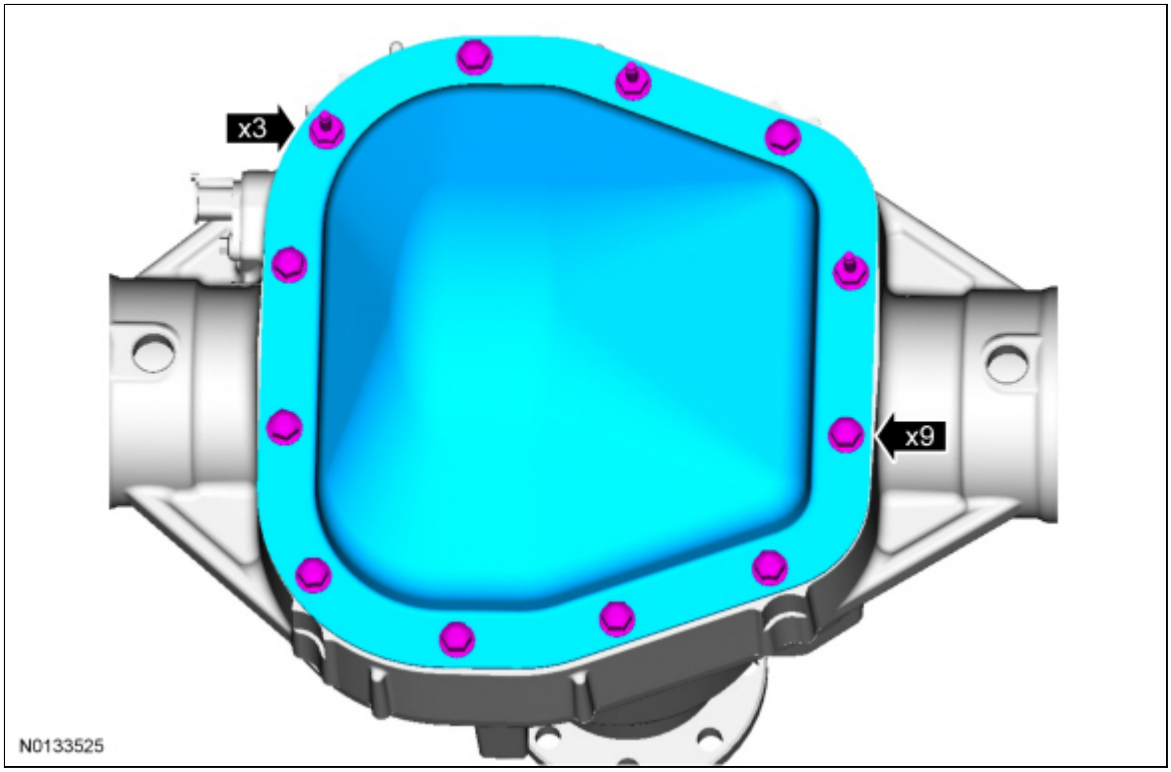
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Separate the 3 brake tube fasteners from the differential housing cover stud bolts.



3. Remove the differential housing cover.
    1. Remove the 9 differential housing cover bolts and the 3 differential housing cover stud bolts, and drain the lubricant from the axle housing.

2. Remove the differential housing cover.

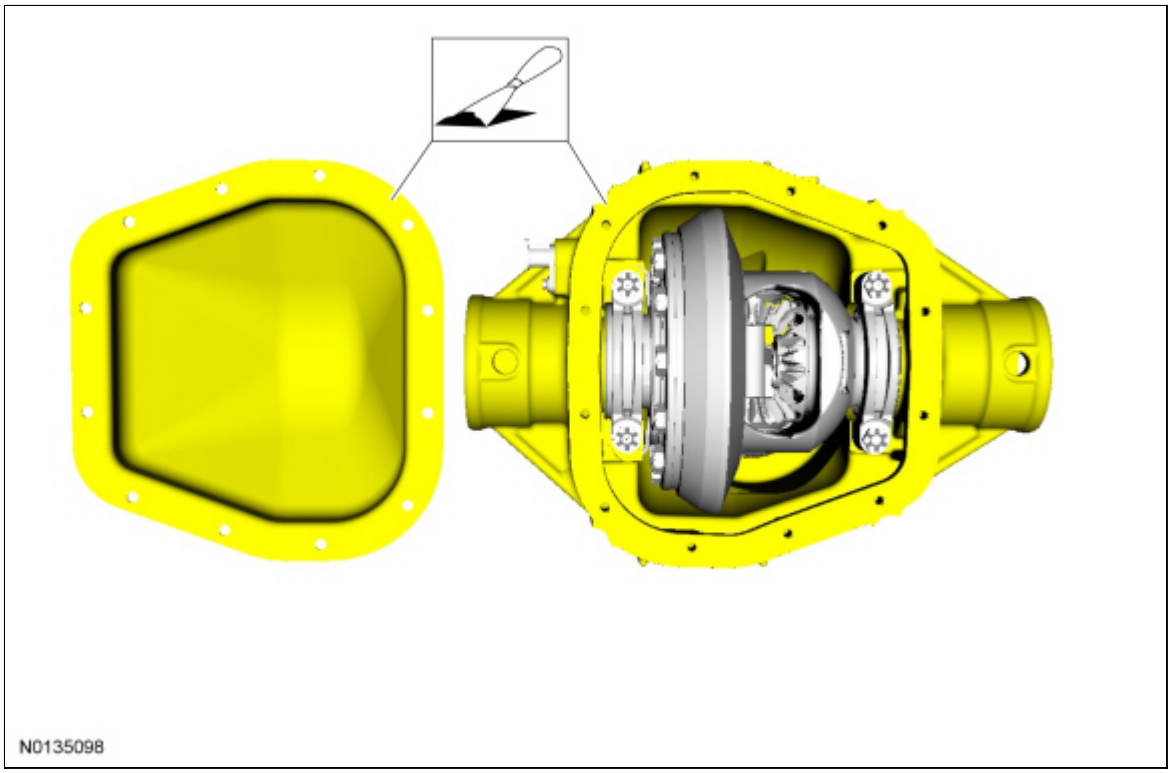


Installation

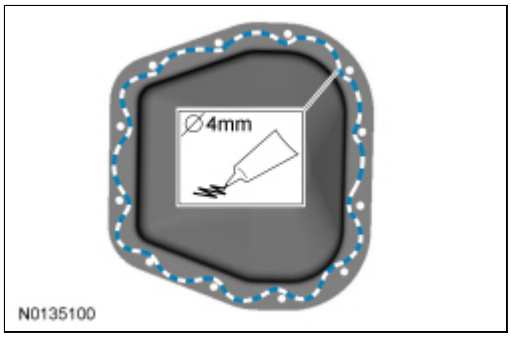
1. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

   Clean the gasket mating surface of the axle and the differential housing cover.

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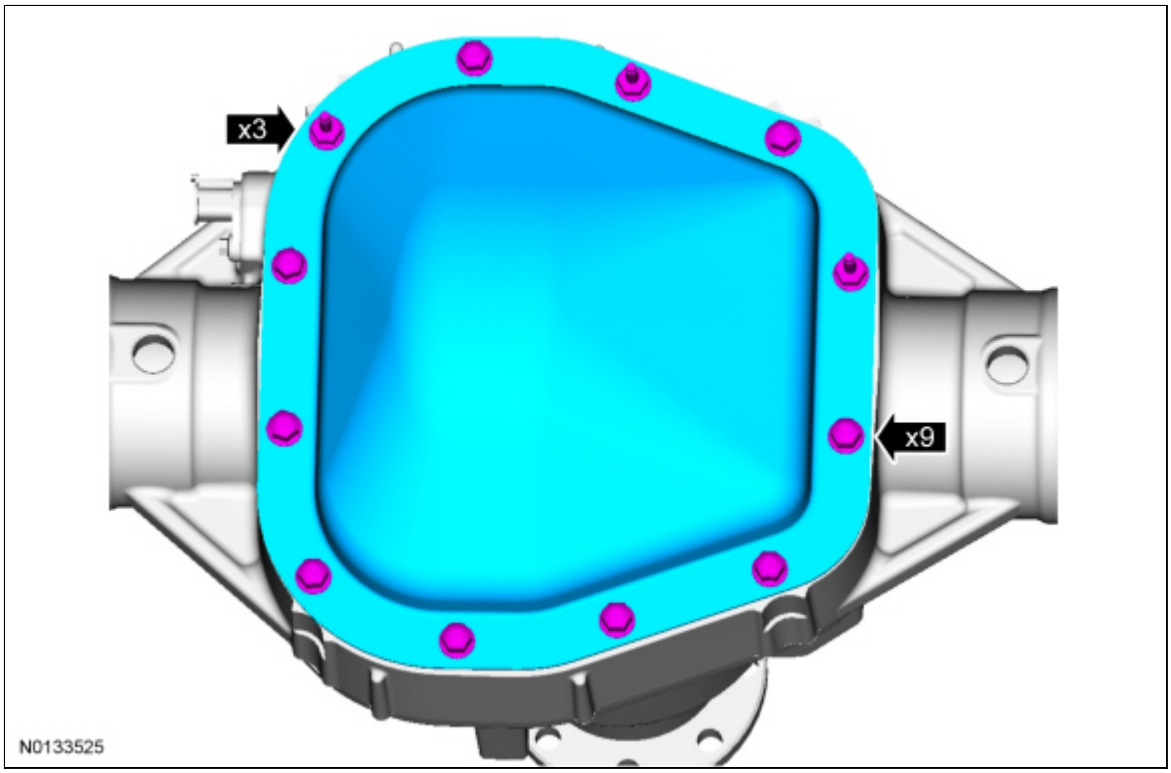


2. Apply a new, continuous bead of sealant to the differential housing cover as shown.

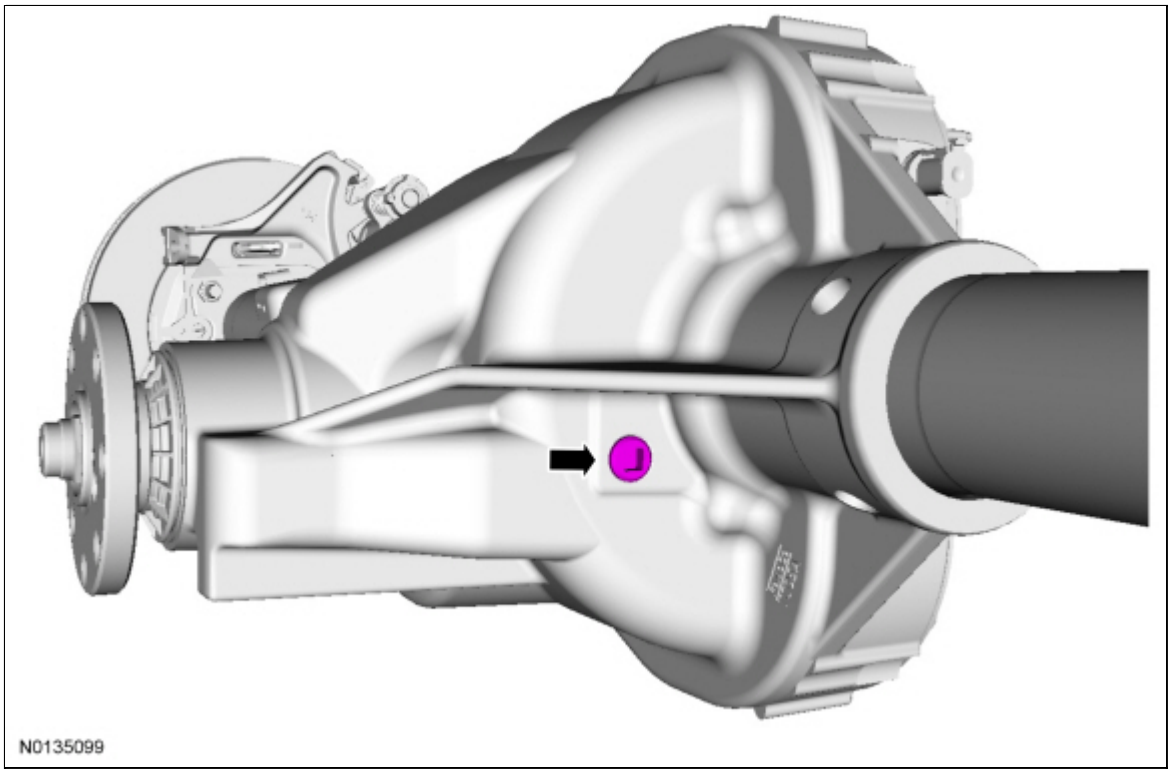


3. **NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

   Install the differential housing cover and the 9 differential housing cover bolts and the 3 differential housing cover stud bolts.
   - Tighten to 45 Nm (33 lb-ft).



4. Remove the fill plug.



5. **NOTE:** If equipped with Traction-Lok axles, first fill the axle with 118 ml (4 oz) of friction modifier. No friction modifier is used on Electronic Locking Differential (ELD) axles.

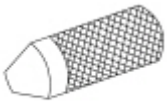
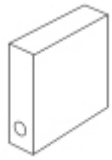
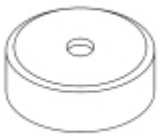
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Fill the axle with the specified amount of axle lubricant and install the fill plug.

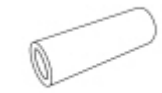
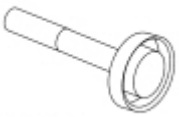
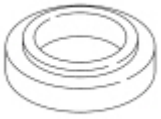
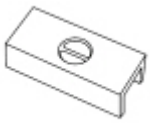
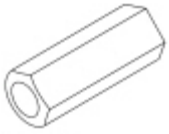
- Tighten to 30 Nm (22 lb-ft).

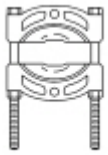
Differential Ring And Pinion

Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST2468-A	Adapter for 205-S156 205-159 (T80T-4020-F42)
 ST1429-A	Adapter for 205-S156 205-160 (T80T-4020-F43)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-937 (TKIT-2009C-F)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-383 (T97T-4020-B)
	Gauge Tube, Drive Pinion 205-377 (T97T-4020-A)

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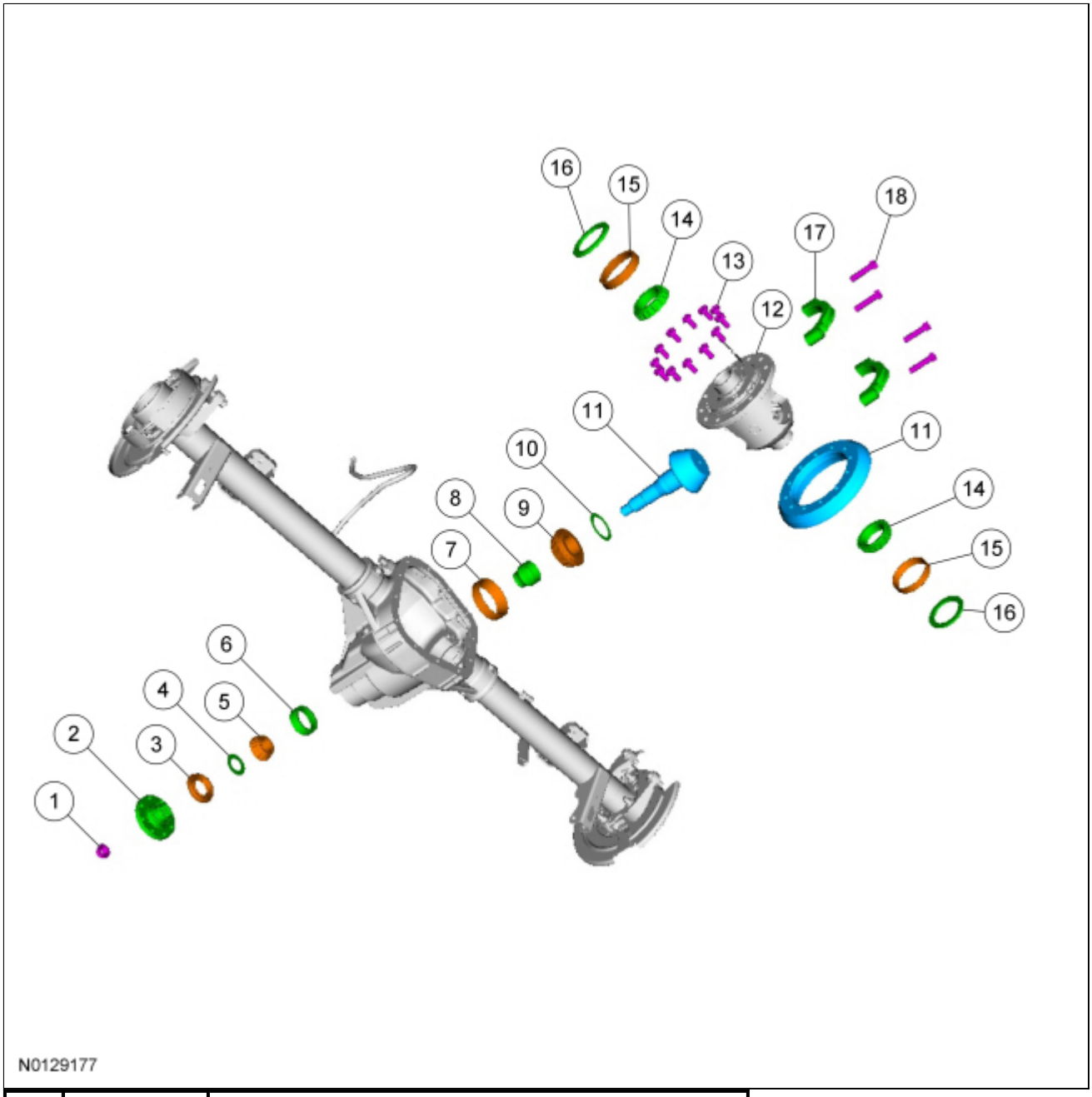
 ST1434-A	
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1367-A	Installer, Drive Pinion Bearing Cone 205-488
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST2368-A	Installer, Input Shaft Bearing Cup 308-391
 ST1741-A	Installer, Rear Axle Pinion Bearing Cup 205-852
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1744-A	Protector, Drive Pinion Thread 205-229 (T85T-4209-AH)
	Puller, Bearing 205-D064 (D84L-1123-A)

 ST1368-A	
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

Material

Item	Specification
Maximum Strength Retaining Compound Loctite® 638™	—
Motorcraft® Premium Long-Life Grease XG-1-C (US); CXG-1-C (Canada)	ESA-M1C75-B

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N0129177

Item	Part Number	Description
1	4C121	Drive pinion nut (part of 4320)
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal
4	4670	Pinion oil slinger
5	4621	Outer pinion bearing
6	—	Outer pinion bearing cup (part of 4621)
7	—	Inner pinion bearing cup (part of 4630)
8	4662	Collapsible spacer (part of 4320)

9	4630	Inner pinion bearing
10	4663	Pinion bearing adjustment shim
11	4209	Drive pinion and ring gear
12	4204	Differential assembly
13	4216	Differential ring gear bolt (12 required)
14	4220	Differential carrier bearings (2 required)
15	—	Differential carrier bearing cups (part of 4220)
16	4067	Differential carrier bearing shims (2 required)
17	—	Differential bearing cap (part of 4010) (2 required)
18	46108	Differential bearing cap bolts (part of 4010) (4 required)

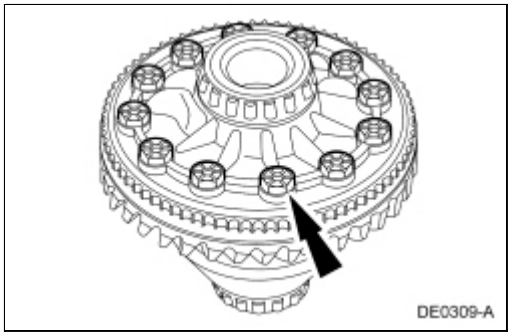
Removal

All vehicles

1. Remove the drive pinion flange seal. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

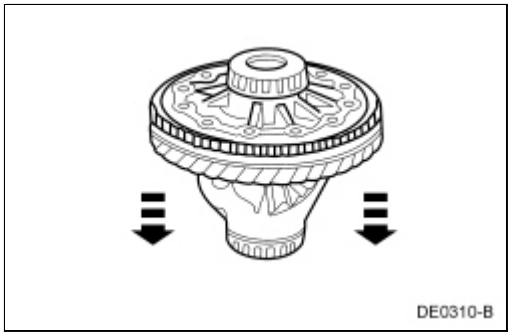
2. Remove the differential carrier assembly. For additional information, refer to Differential Carrier in this section.

3. Remove and discard the 12 ring gear bolts.



4. **NOTE:** Do not damage the ring gear bolt hole threads.

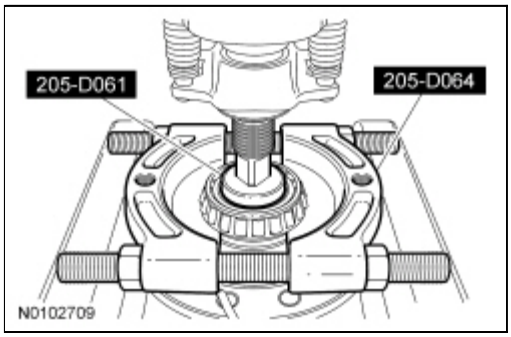
   Insert a punch in the ring gear bolt holes and drive the differential ring gear off.



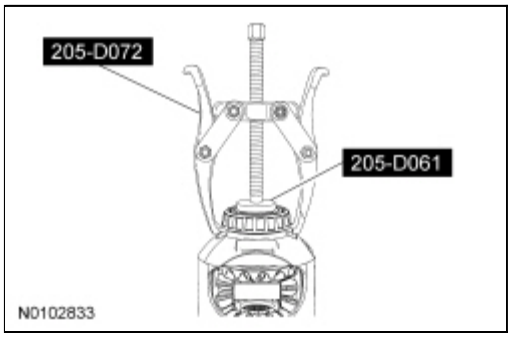
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Electronic Locking Differential (ELD) equipped vehicles

5. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.

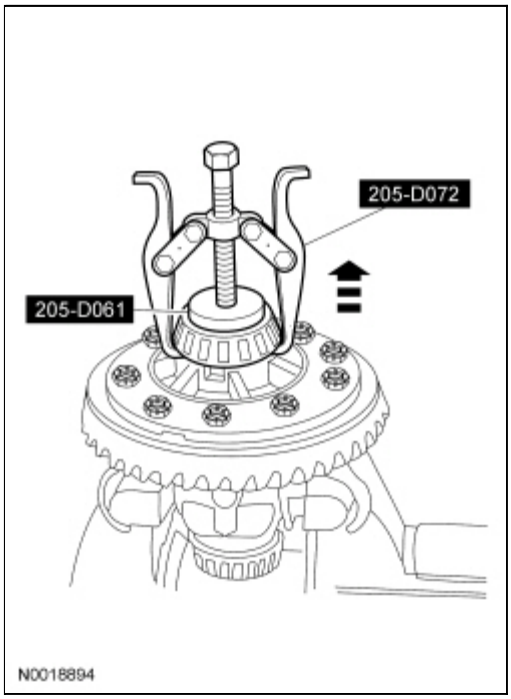


6. Using the 2 Jaw Puller and Step Plate, remove the RH differential bearing.



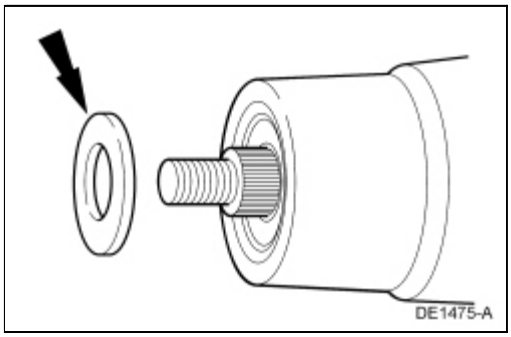
Non- ELD equipped vehicles

7. Remove the 2 differential bearings with the 2 Jaw Puller and Step Plate.

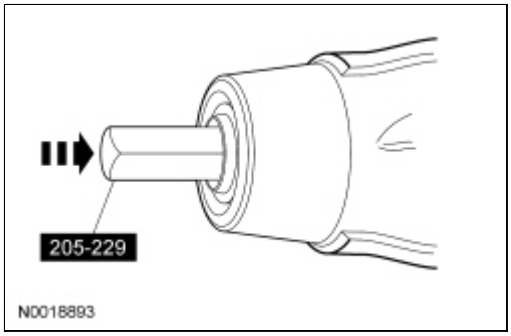


All Vehicles

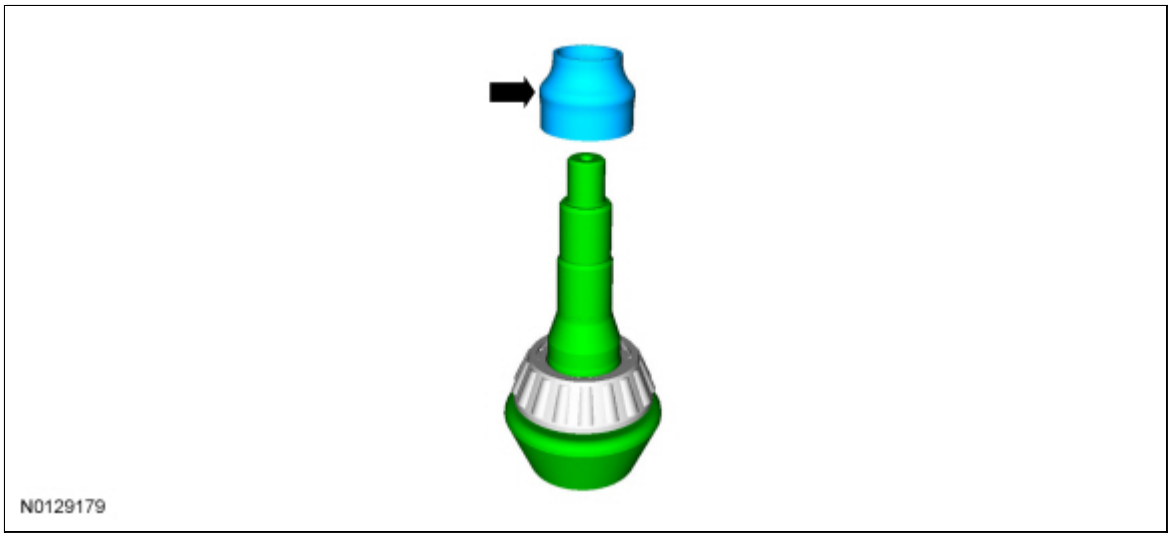
8. Remove the drive pinion shaft oil slinger.



9. Install the Drive Pinion Thread Protector, then use a soft-faced hammer to drive the pinion gear out of the outer drive pinion bearing and remove the pinion gear.

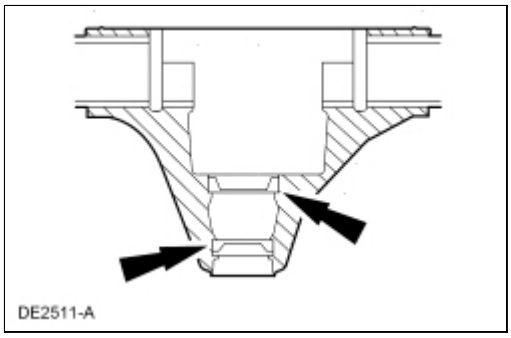


10. Remove and discard the drive pinion collapsible spacer.



11. Using a brass drift, remove the 2 drive pinion bearing cups by tapping alternately on opposite sides of the 2 drive pinion bearing cups.

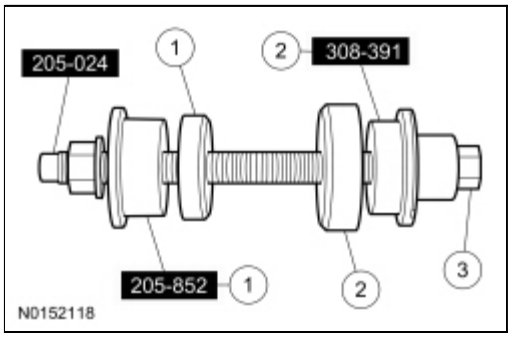
repair4less



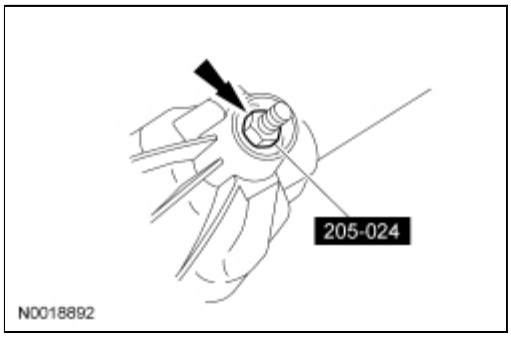
Installation

All vehicles

1. Position the Drive Pinion Bearing Cup Installer and the inner and outer drive pinion bearing cups in their respective bores.
    1. Place the Rear Axle Pinion Bearing Cup Installer on the outer drive pinion bearing cup.
    2. Place the Rear Axle Pinion Bearing Cup Installer on the inner drive pinion bearing cup.
    3. Install the Drive Pinion Bearing Cup Installer.

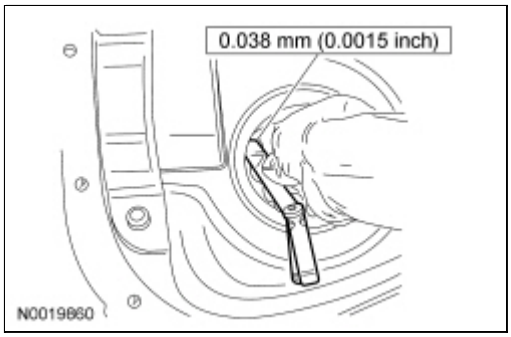


2. Tighten the Drive Pinion Bearing Cup Installer to fully seat the 2 differential drive pinion bearing cups.



3. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

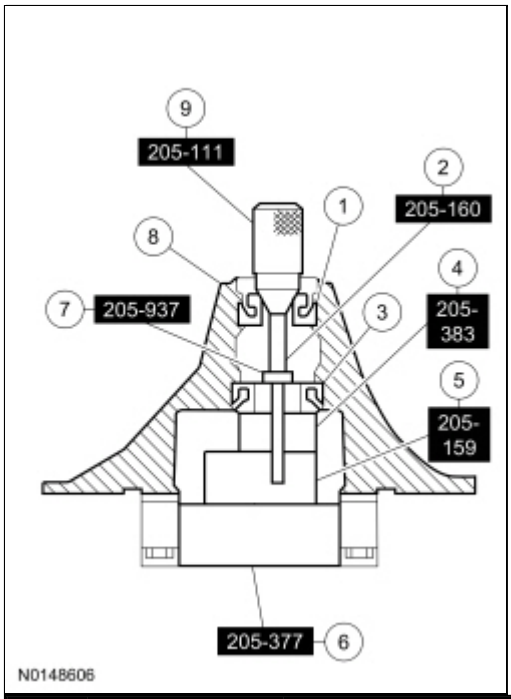
   Make sure the differential pinion bearing cups are correctly seated.



4. ***NOTICE:*** **Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.**

   NOTE: Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

   Install the new drive pinion bearings and Adapters as shown.

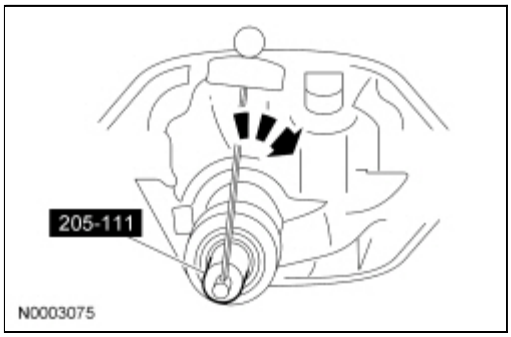


Item	Part Number	Description
1	4621	Outer pinion bearing
2	205-160	Adapter for 205-S127
3	4630	Inner pinion bearing
4	205-383	Depth Gauge/Aligner, Drive Pinion
5	205-159	Adapter for 205-S127
6	205-377	Drive Pinion Gauge Tube
7	205-937	Depth Gauge/Aligner, Drive Pinion
8	4010	Rear axle housing outer (front) pinion bearing

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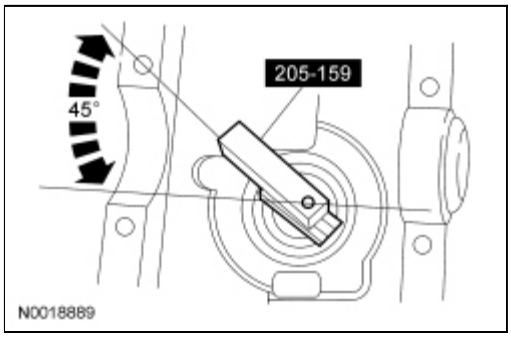
9	205-111	Adapter for 205-S127

5. Tighten the Adapter to the specified rotational torque.
    - Tighten to 2.2 Nm (20 lb-in).

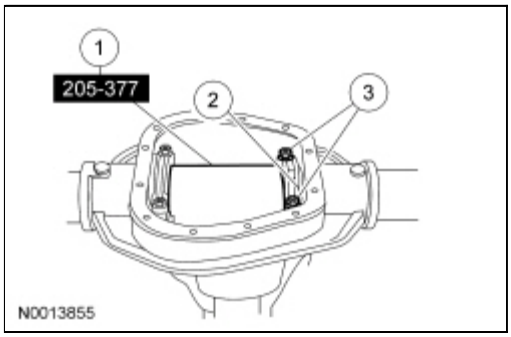


6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

   Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings.



7. Install the Drive Pinion Gauge Tube.
    1. Position the Drive Pinion Gauge Tube.
    2. Install the 2 differential bearing caps.
    3. Install the 4 differential bearing cap bolts.
        - Tighten to 105 Nm (77 lb-ft).



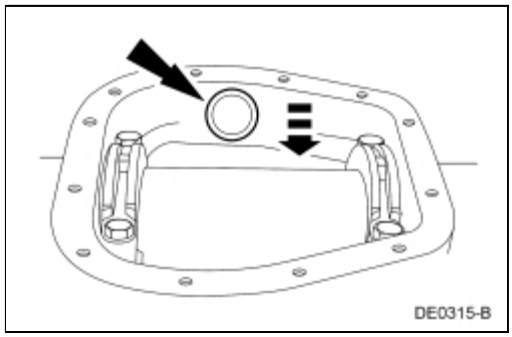
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

   NOTE: A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required,

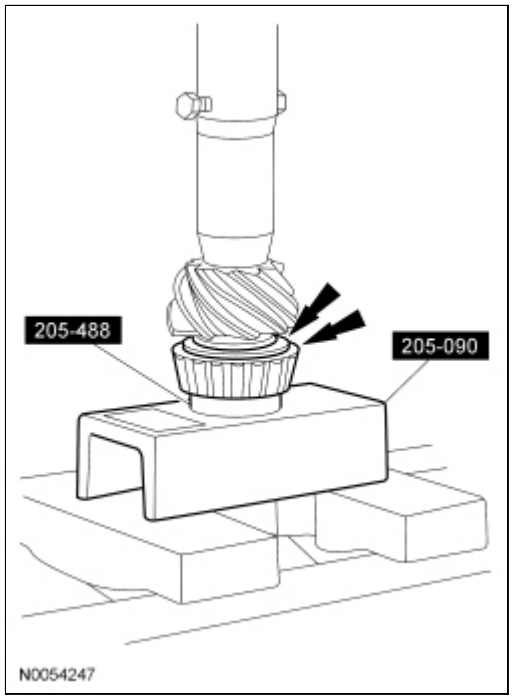
which results in a deep tooth contact in the final assembly of integral axle assemblies.

Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

- After the correct drive pinion bearing adjustment shim thickness has been determined, remove the Adapters.

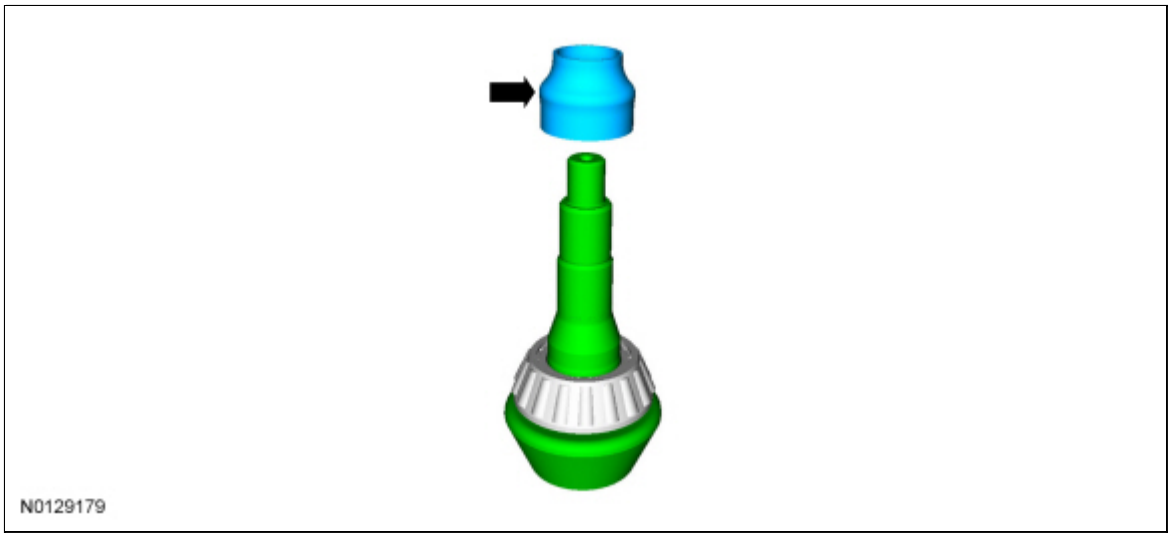


9. Using the Bearing/Oil Seal Plate and Drive Pinion Bearing Cone Installer, press the drive pinion bearing and selected drive pinion bearing adjustment shim until they are firmly seated on the pinion gear.

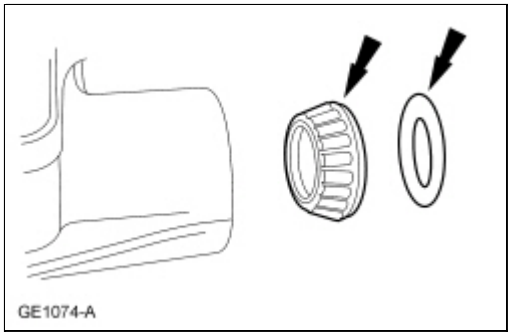


10. Place a new drive pinion collapsible spacer on the pinion gear against the pinion gear shoulder.

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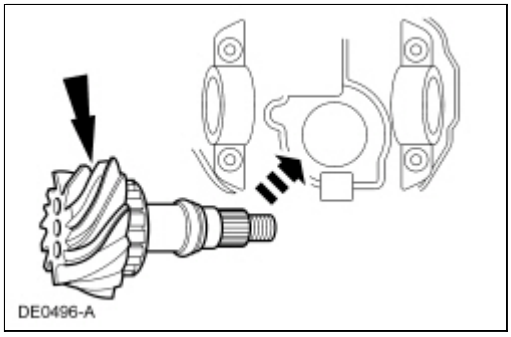


11. Install the outer drive pinion bearing and drive pinion shaft oil slinger.



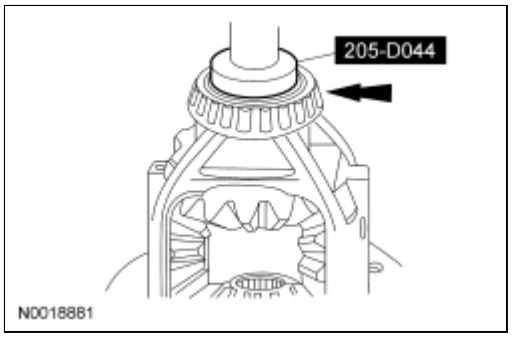
12. Lubricate the pinion flange splines with grease.

13. Install the pinion gear in the pinion gear bore from inside the axle housing.



14. Install the drive pinion seal and flange. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

15. Using the Differential Carrier Bearing Installer, press the LH and RH differential bearing on the differential assembly.

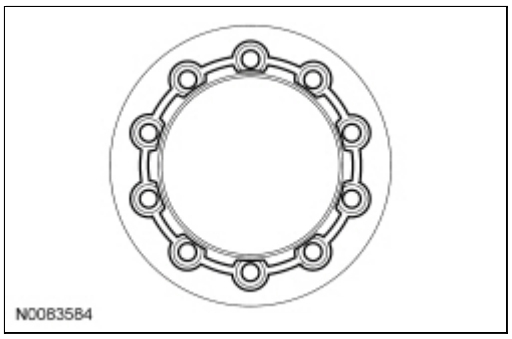


Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets

16. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

    Clean all traces of the old retaining compound material from the differential flange.
    - Use solvent and Scotch-Brite® pads to remove.

17. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.

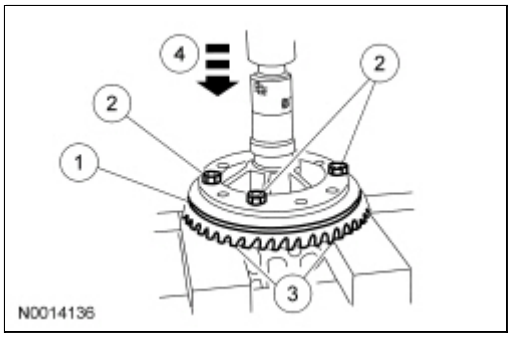


All vehicles

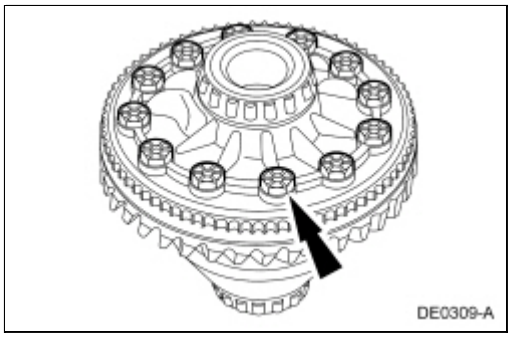
18. **NOTE:** If removed, press the speed sensor ring on with the differential ring gear.

    Install the differential ring gear.
    1. Place the differential ring gear on the differential assembly.
    2. Hand-start 3 new ring gear bolts to align the holes in the differential ring gear and the differential assembly.
    3. Place the differential assembly and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.
    4. Press the differential ring gear into place.

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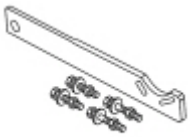
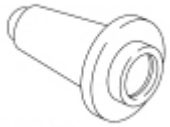
19. Install the remaining 9 new differential ring gear bolts.
    - Tighten to 150 Nm (111 lb-ft).



20. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

Drive Pinion Flange and Drive Pinion Seal

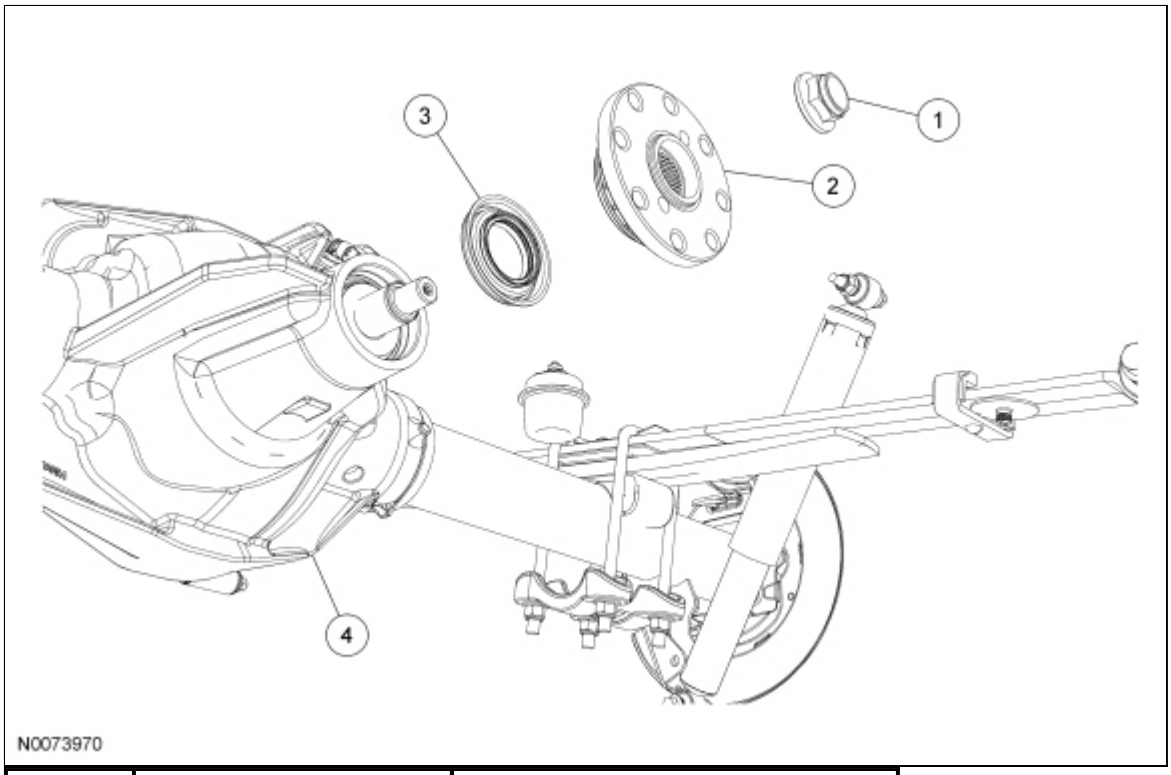
Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
	Installer, Drive Pinion Flange 205-233 (T85T-4851-AH)
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Motorcraft® Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B

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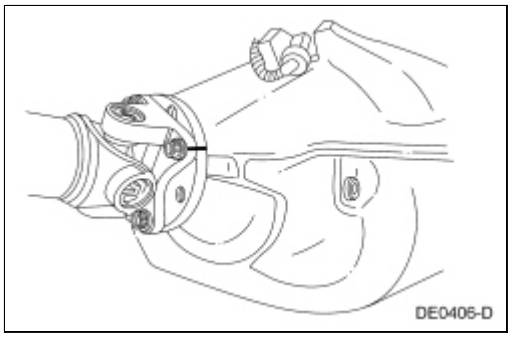


Item	Part Number	Description
1	4320	Drive pinion nut
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal
4	4010	Differential housing

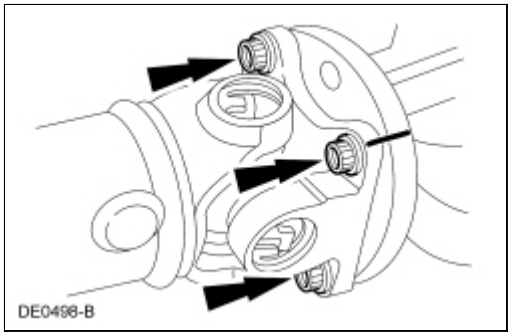
Removal

NOTICE: **The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the brake disc. For additional information, refer to Section 206-04 .
3. Index-mark the driveshaft flange and pinion flange for correct alignment during installation.

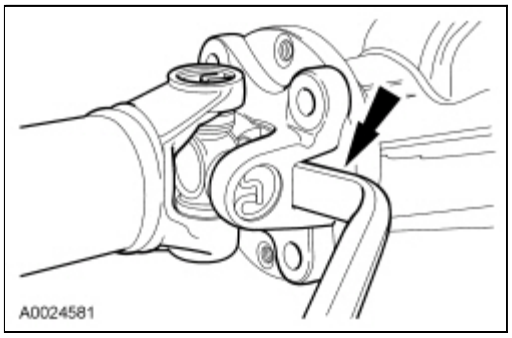


4. Remove the 4 driveshaft flange bolts.



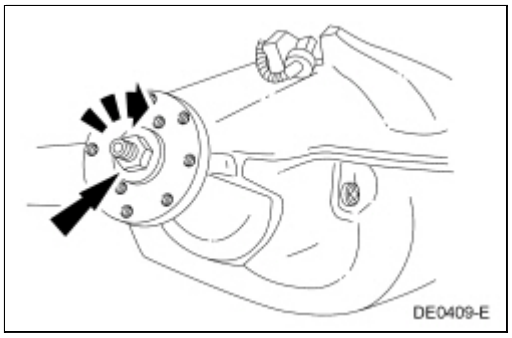
5. **NOTE:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft centering socket yoke from the pinion flange. Pry only in the area shown with a suitable tool to disconnect the driveshaft centering socket yoke from the pinion flange.

   Using a suitable tool as shown, disconnect the driveshaft centering socket yoke from the pinion flange.
   - Using mechanic's wire, position the driveshaft aside.

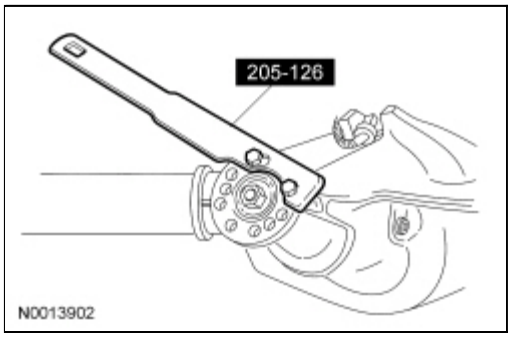


6. Using a Nm (lb-in) torque wrench on the pinion nut, record the torque required to maintain rotation of the pinion gear through several revolutions.

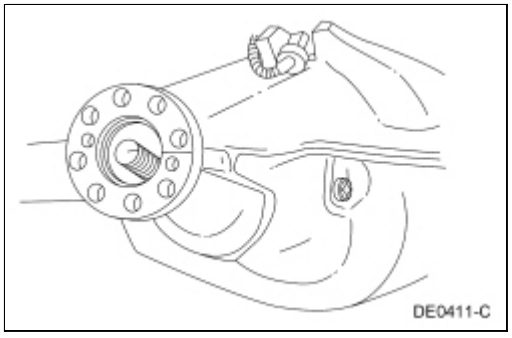
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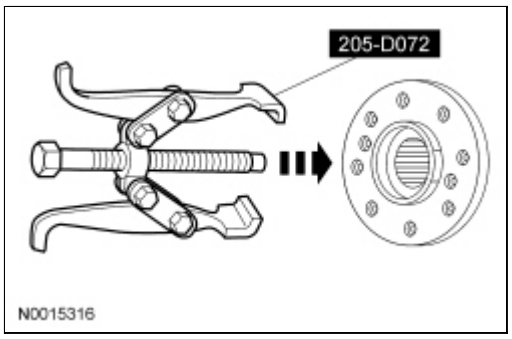
7. Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, remove and discard the pinion nut.



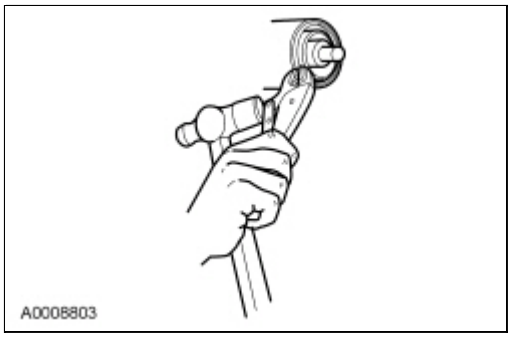
8. Index-mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.



9. Using the 2 Jaw Puller, remove the pinion flange.

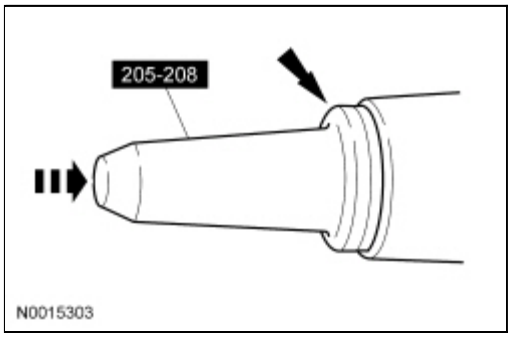


10. Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer until the drive pinion seal is removed.



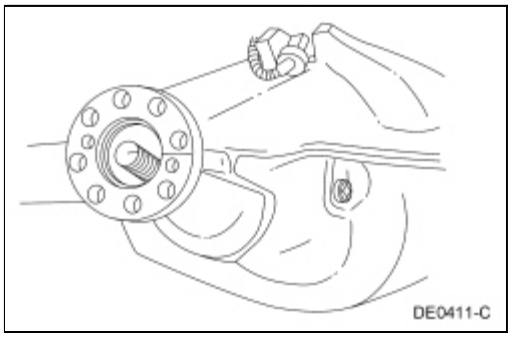
Installation

1. Lubricate the new drive pinion seal with grease.
2. Using the Drive Pinion Oil Seal Installer, install a new drive pinion seal.



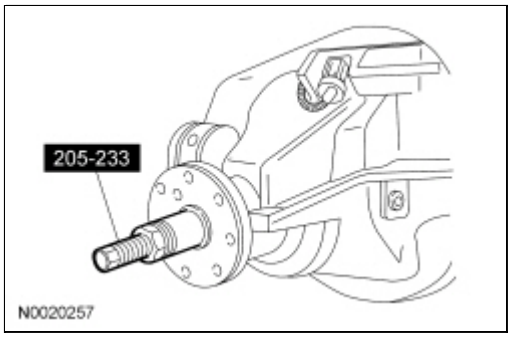
3. Lubricate the pinion flange splines with axle lubricant.
4. **NOTE:** Disregard the scribe marks if a new pinion flange is being installed.

   Align the pinion flange with the drive pinion shaft.



5. Using the Drive Pinion Flange Installer, install the pinion flange.

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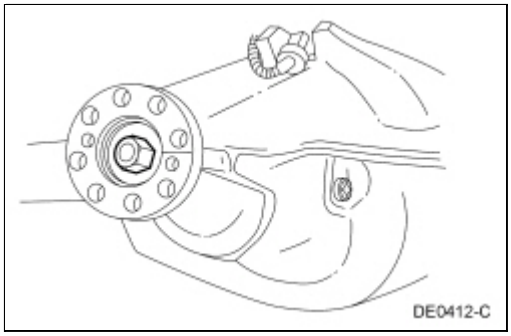


6. ***NOTICE:*** **Install a new pinion nut with the same color as the original if not replacing the collapsible spacer. If a new collapsible spacer is installed, install the nut in the kit, as indicated in the chart below, or damage to the component may occur.**

   Position the new pinion nut.

   9.75 Inch Drive Pinion Nut

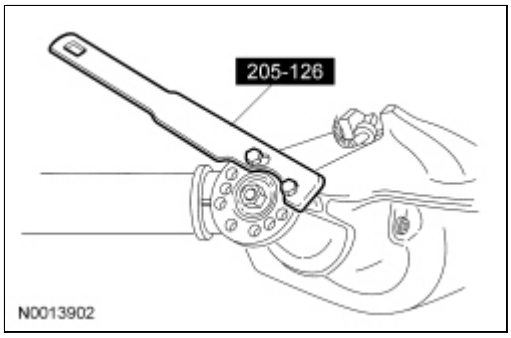
Part Number	Color Description	Application
19G405	Green	Axles built before 7/16/07
4320	White	Axles built after 7/16/07
4C121	White	Kit with spacer for all 9.75-in axles



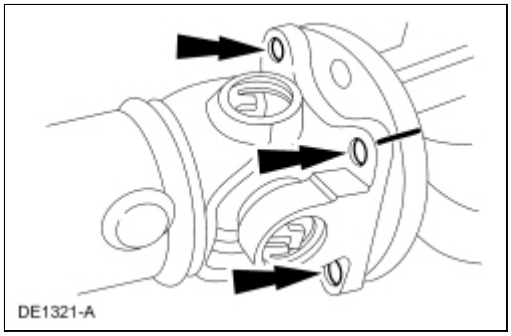
7. ***NOTICE:*** **Under no circumstances is the pinion nut to be backed off to reduce drive pinion bearing preload. If reduced drive pinion bearing preload is required, a new drive pinion collapsible spacer and pinion nut must be installed or damage to the component may occur.**

   NOTE: Remove the Drive Pinion Flange Holding Fixture while taking drive pinion bearing preload readings with the Nm (lb-in) torque wrench.

   Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, tighten the pinion nut.
   - Rotate the drive pinion occasionally to make sure the drive pinion bearings are seating correctly.
   - Install a Nm (lb-in) torque wrench on the pinion nut.
   - Rotating the drive pinion through several revolutions, take frequent drive pinion bearing preload readings until the original recorded drive pinion bearing preload reading is obtained.
   - If the original recorded drive pinion bearing preload is lower than specification, tighten to the appropriate specification for used drive pinion bearings. If the drive pinion bearing preload is higher than specification, tighten the pinion nut to the original reading as recorded. For additional information, refer to the Specification portion of this section.



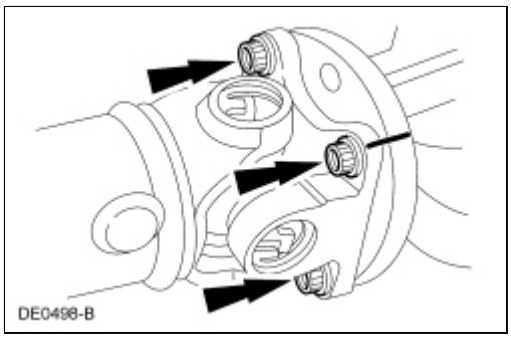
8. Position the driveshaft and align the index mark on the pinion flange.



9. **NOTE:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the driveshaft centering socket yoke seats squarely on the pinion flange, tighten the driveshaft flange bolts evenly in a cross pattern.

   NOTE: If new bolts are not available, coat the threads of the original driveshaft flange bolts with threadlock and sealer.

   Install the 4 new driveshaft flange bolts.
   - Tighten to 103 Nm (76 lb-ft).

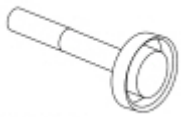
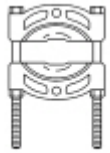


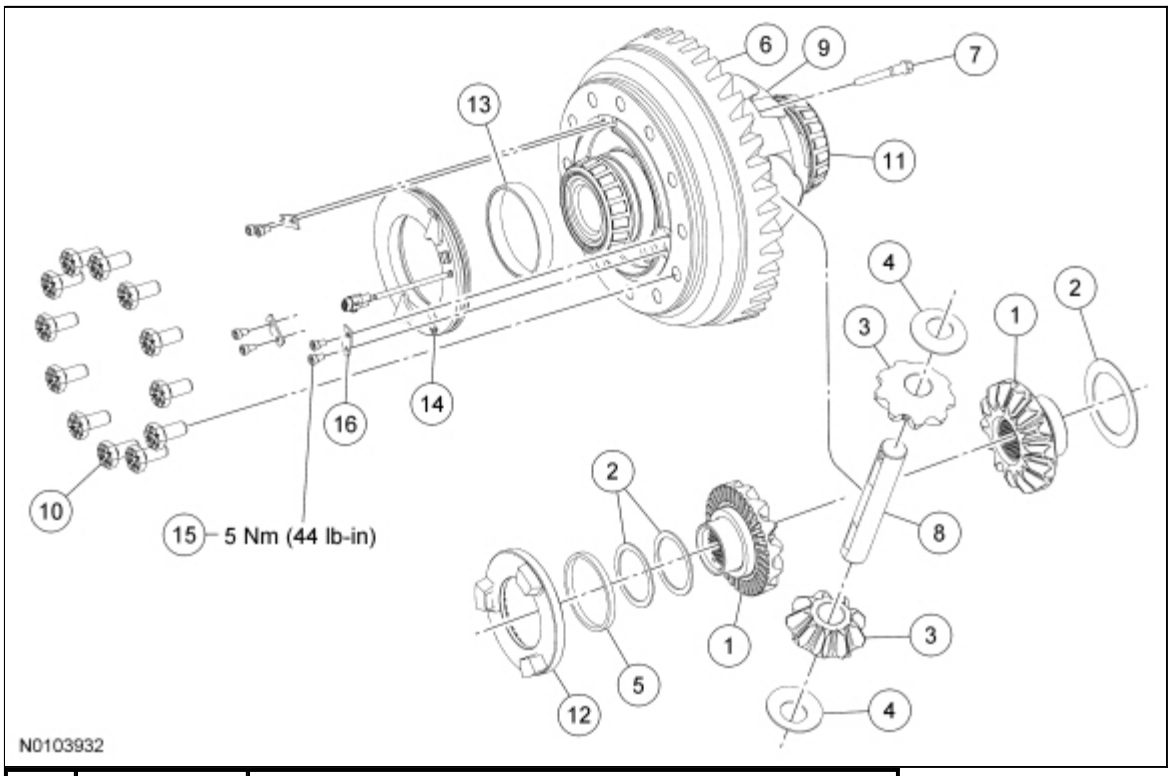
10. Install the rear brake disc. For additional information, refer to Section 206-04 .

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Electronic Locking Differential (ELD) Field Coil

Special Tool(s)

 ST2473-A	Installer, Differential Carrier Bearing 205-D044 9D81T-4221-A) or equivalent
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent



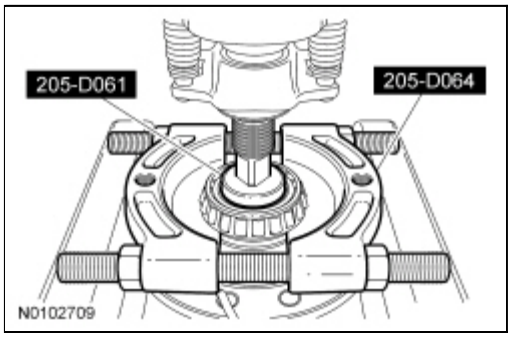
	Part	

repair4less

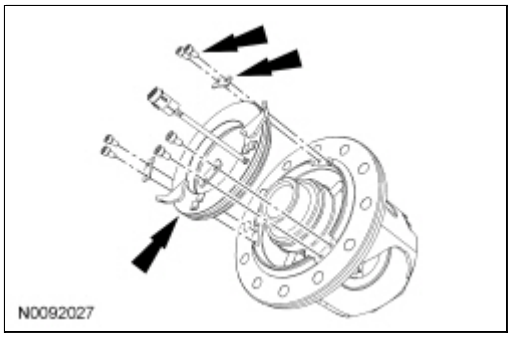
Item	Number	Description
1	—	Differential side gears (part of kit 4880)
2	—	Differential side gear thrust washers (part of kit 4880)
3	—	Differential pinion gears (part of kit 4880)
4	—	Differential pinion thrust washers (part of kit 4880)
5	—	Differential pinion spring (part of kit 4880)
6	4209	Differential ring gear
7	—	Differential pinion shaft lock bolt (part of kit 4880)
8	4211	Differential pinion shaft
9	4204	Differential case
10	4216	Differential ring gear bolt (12 required)
11	4221	Differential bearing
12	—	Cam-ring (part of kit 4880)
13	—	Plunger (part of kit 4880)
14	—	Electronic Locking Differential (ELD) coil (part of kit 4880)
15	—	ELD coil screw (part of kit 4880) (6 required)
16	—	Stopper (part of kit 4880) (3 required)

Removal

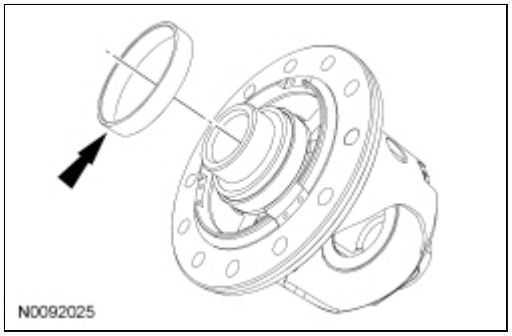
1. Remove the differential carrier. For additional information, refer to Differential Carrier in this section.
2. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.



3. Remove and discard the 6 screws and 3 stoppers that hold the Electronic Locking Differential (ELD) coil in place and remove the coil.

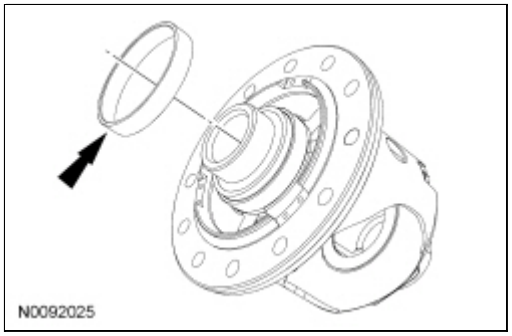


4. Remove and discard the plunger assembly.

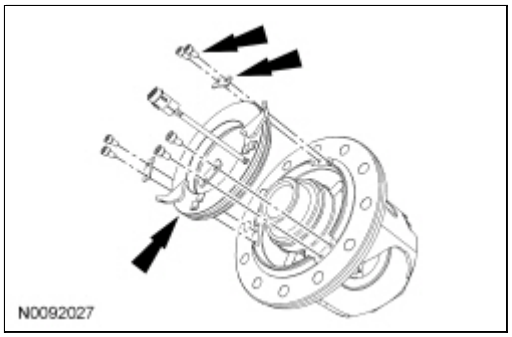


Installation

1. Install a new plunger assembly.

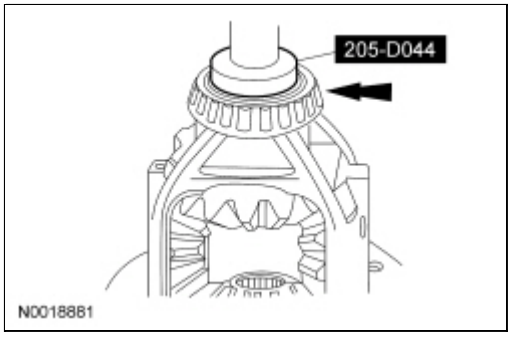


2. Install the new ELD coil, 3 stoppers and 6 screws that hold the coil in place.
    - Tighten to 5 Nm (44 lb-in).



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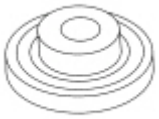
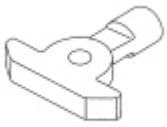
3. Use the Differential Carrier Bearing Installer to install the LH differential bearing.



4. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

Rear Wheel Bearing and Axle Shaft Seal

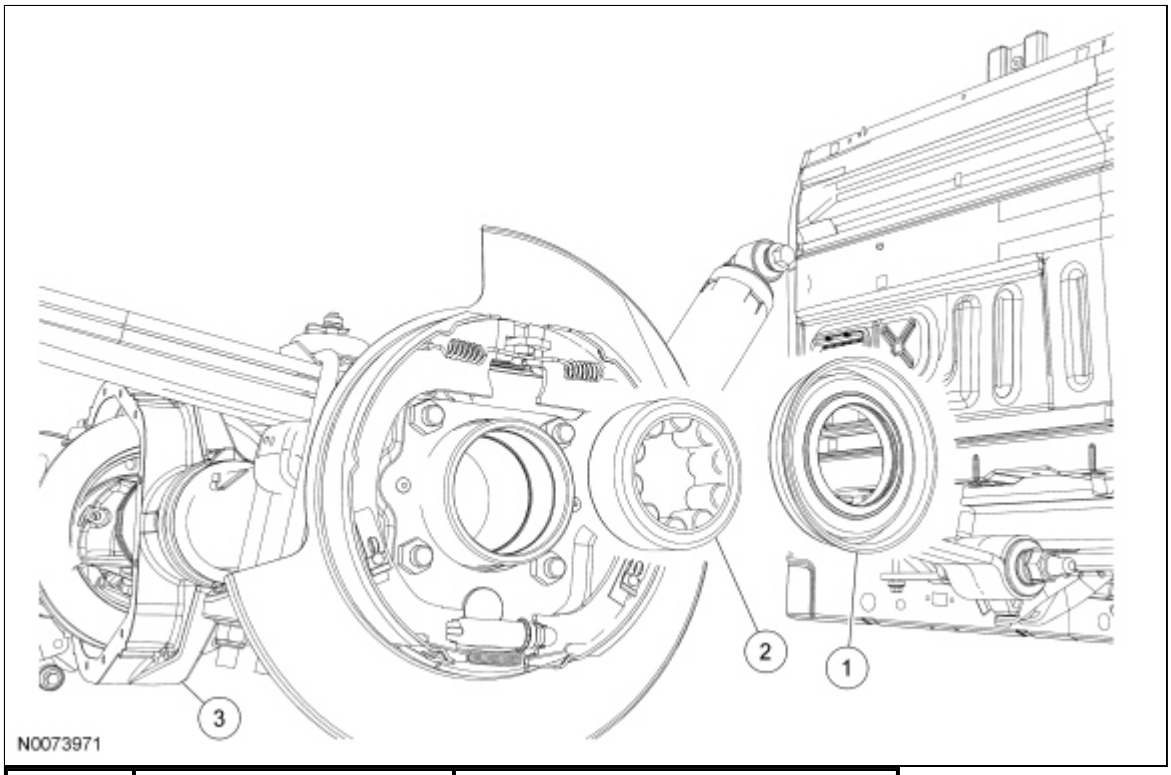
Special Tool(s)

 ST1326-A	Adapter For 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1322-A	Installer, Axle Bearing 205-382 (T97T-1225-A)
 ST1736-A	Installer, Axle Oil Seal 205-381 (T97T-1177-A)
 ST2035-A	Remover, Axle Bearing 205-224 (T85T-1225-AH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B

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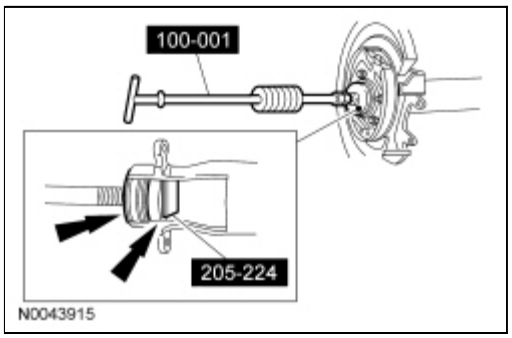


Item	Part Number	Description
1	1177	Axle shaft oil seal
2	1225	Axle shaft bearing
3	4010	Differential housing

Removal

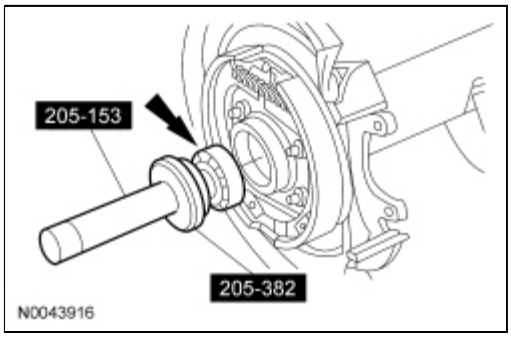
1. Remove the axle shaft. For additional information, refer to Axle Shaft in this section.
2. **NOTE:** If only a new axle shaft oil seal needs to be installed, use care to avoid damaging the axle shaft oil seal bore.

   Using a suitable seal remover, remove and discard the axle shaft oil seal.
3. Inspect the rear wheel bearing and axle shaft for wear or damage.
4. Using the Axle Bearing Remover and Slide Hammer, remove the rear wheel bearing.

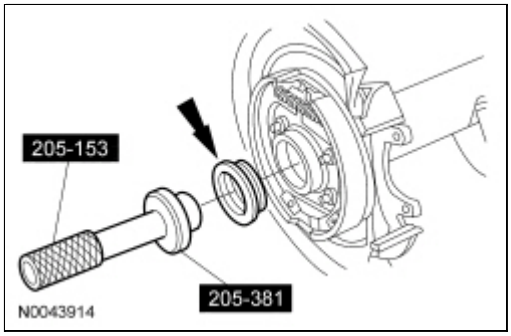


Installation

1. Lubricate the new rear wheel bearing with axle lubricant.
2. Using the Axle Bearing Installer and Handle, install the rear wheel bearing.



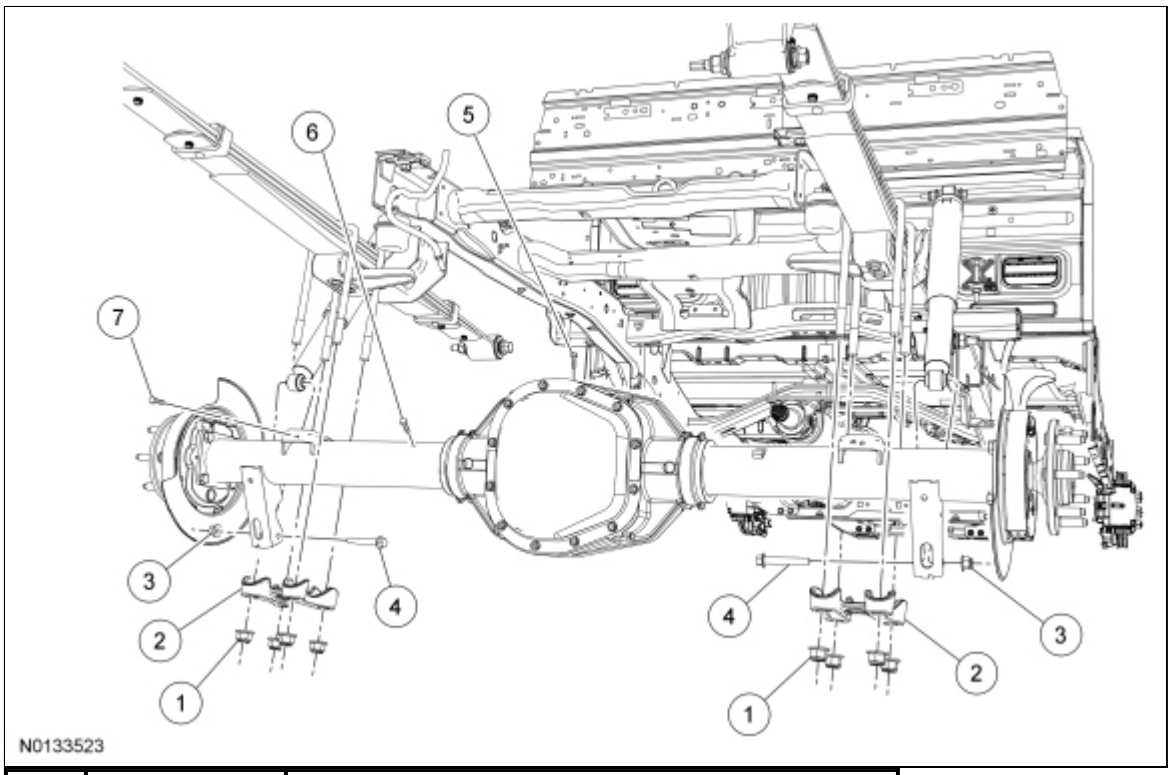
3. Lubricate the lip of the new axle shaft oil seal with grease.
4. Using the Axle Oil Seal Installer and Handle, install the new axle shaft oil seal.



5. Install the axle shaft. For additional information, refer to Axle Shaft in this section.

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Axle Assembly



Item	Part Number	Description
1	W705518	U-bolt nuts (8 required)
2	5798	U-bolt plates (2 required)
3	W520214	Lower shock absorber nuts (2 required)
4	W506545	Lower shock absorber bolts (2 required)
5	57632	Brake tube/ parking brake cable bracket bolt
6	4022	Axle vent
7	W712215	Brake hose bracket bolt (2 required)

Removal and Installation

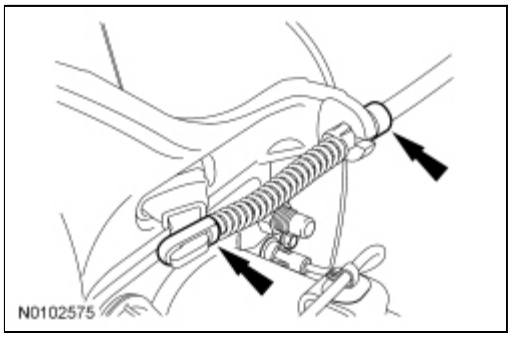
All vehicles

NOTICE: **Suspension fasteners are critical components because they affect performance of vital components and systems and their failure can result in major service expense. Install new components with the same component number or an equivalent component if installation is necessary. Do not use an installation component of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these components.**

1. Remove the driveshaft. For additional information, refer to Section 205-01 .

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2. Remove the axle shafts. For additional information, refer to Axle Shaft in this section.
3. Release the parking brake cable tension. For additional information, refer to Section 206-05 .
4. Disconnect the parking brake cables.



5. Disconnect the wheel speed sensor harness retainers from the axle.

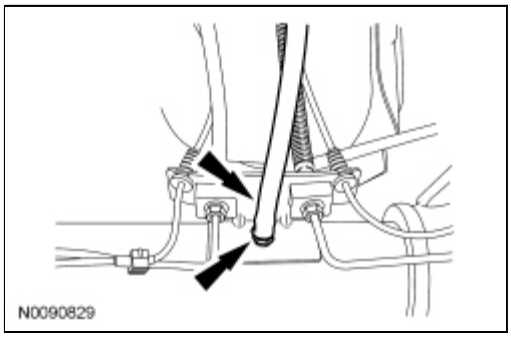
Vehicles with Electronic Locking Differential (ELD)

6. Disconnect the ELD electrical connector.

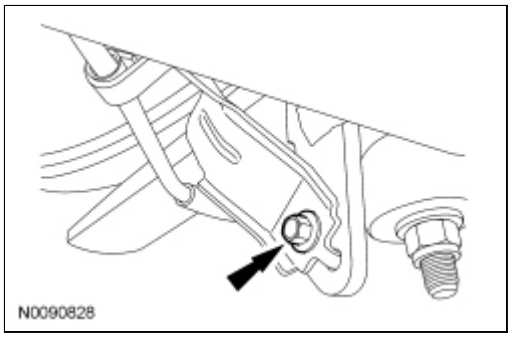
All vehicles

7. **NOTE:** If the vent hose is disconnected from the vehicle body, a new retainer must be installed.

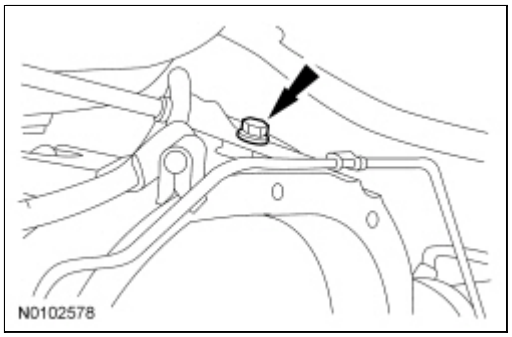
   Disconnect the vent hose and remove the axle vent.
   - To install, tighten to 18 Nm (159 lb-in).



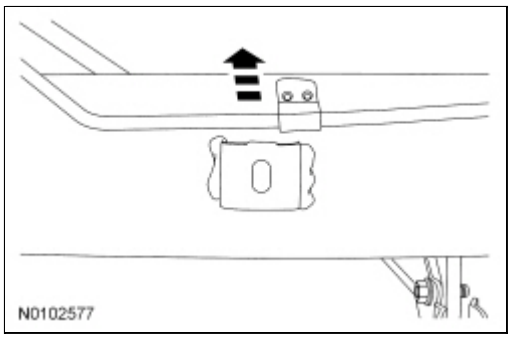
8. Remove the RH parking brake cable bracket bolt.
   - To install, tighten to 30 Nm (22 lb-ft).



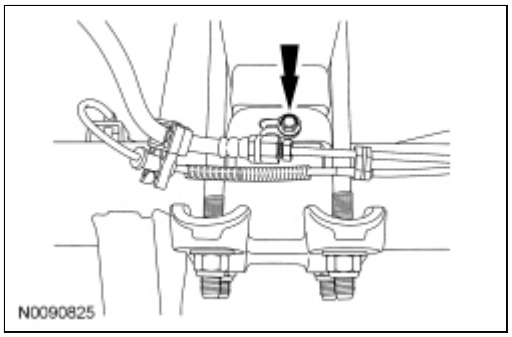
9. Remove the brake tube/parking brake cable bracket bolt.
    - To install, tighten to 25 Nm (18 lb-ft).



10. Disconnect the brake tube from the brake tube retaining clip.



11. Remove the 2 brake hose bracket bolts.
    - To install, tighten to 30 Nm (22 lb-ft).

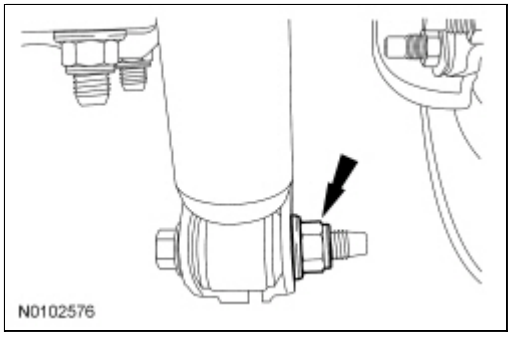


12. Support the axle with a suitable transmission jack.

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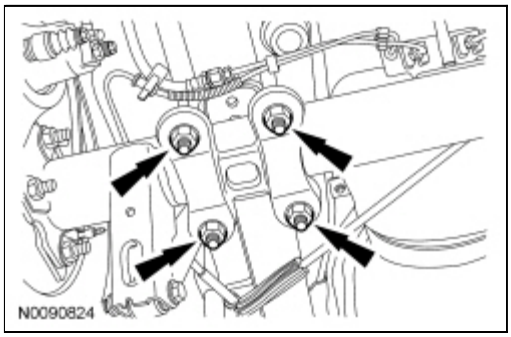
13. **WARNING: Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.**

    Remove and discard the 2 lower shock absorber nuts and 2 bolts.
    - To install, tighten the new nuts to 90 Nm (66 lb-ft).



14. ***NOTICE:*** **Final tightening of the U-bolt nuts must be done with the suspension at curb height or incorrect clamp load may occur.**

    Remove and discard the 8 U-bolt nuts and the 4 U-bolts.
    - To install, with the suspension at curb height, tighten the new nuts evenly in a cross-type pattern in 4 stages.
        - Stage 1: Tighten to 35 Nm (26 lb-ft).
        - Stage 2: Tighten to 70 Nm (52 lb-ft).
        - Stage 3: Tighten to 100 Nm (74 lb-ft).
        - Stage 4: Tighten to 133 Nm (98 lb-ft).



15. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

    Lower and remove the axle assembly.

16. To install the original assembly, reverse the removal procedure.

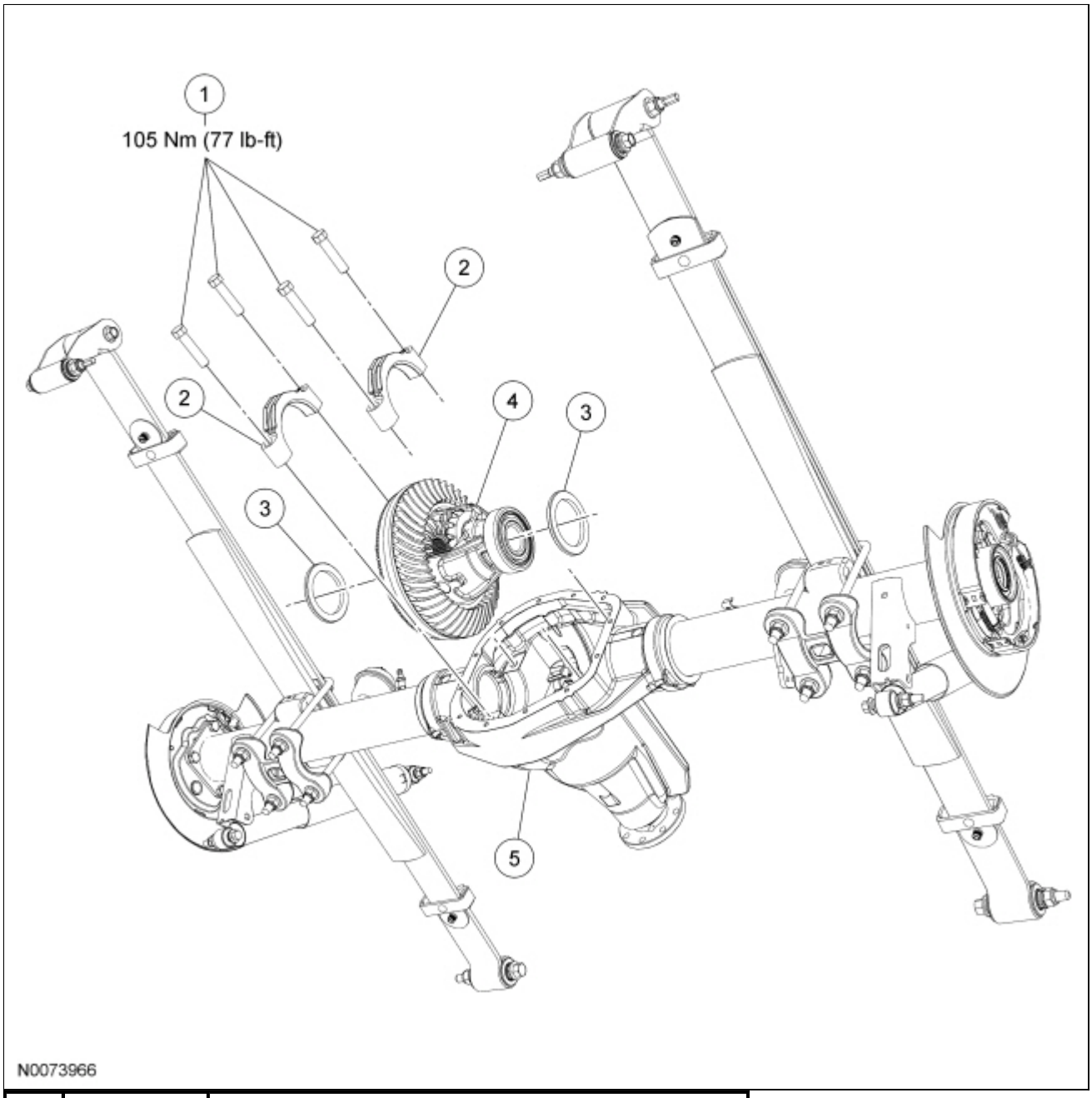
17. Check the rear axle fluid level after installation.

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Differential Carrier

Special Tool(s)

 ST1485-A	Shim Driver 205-228 (T85T-4067-AH)



Item	Part Number	Description
1	—	Differential bearing cap bolts (part of 4010) (4 required)
2	—	Differential bearing caps (part of 4010) (2 required)
3	4067	Differential carrier bearing shims (2 required)
4	4204	Differential assembly
5	4010	Differential housing

Removal

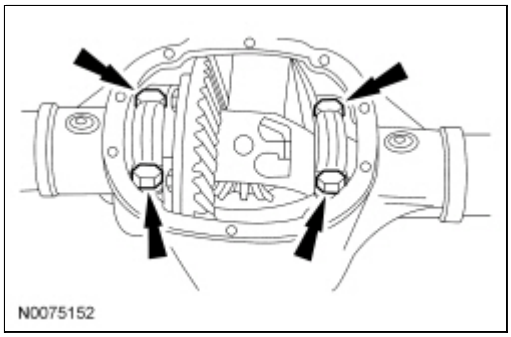
All vehicles

repair4less

1. Remove the axle shafts. For additional information, refer to Axle Shaft in this section.

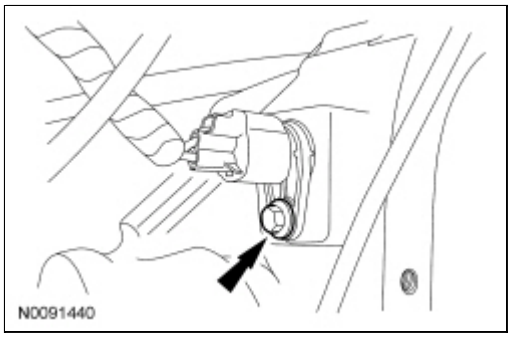
2. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

   Remove the 4 differential bearing cap bolts and the 2 differential bearing caps.

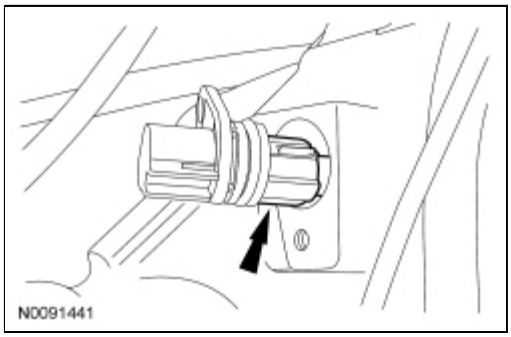


Electronic Locking Differential (ELD) equipped vehicles

3. Disconnect the Electronic Locking Differential (ELD) electrical connector and remove the bolt that holds the connector adapter to the housing.



4. Pull the connector adapter out and disconnect the ELD coil electrical connector from the connector adapter. Discard the adapter.



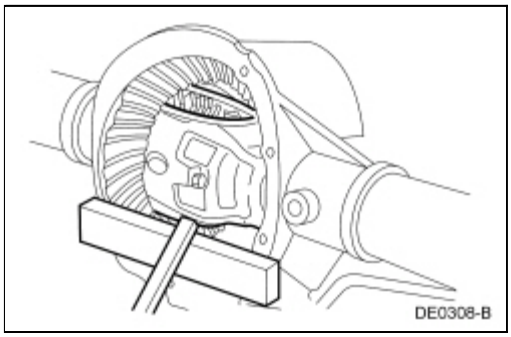
All vehicles

5. ***NOTICE:*** **Place a wood block between the pry bar and the axle housing to protect the machined surface from damage.**

   NOTE: Index-mark the position of the differential bearing shims. The differential bearing shims must

be installed in their original locations and positions.

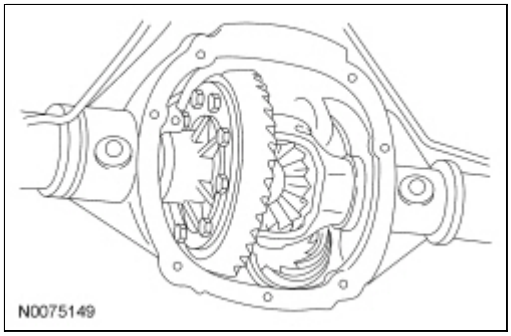
Using pry bars and wood blocks, remove the differential carrier assembly from the axle housing.



Installation

All vehicles

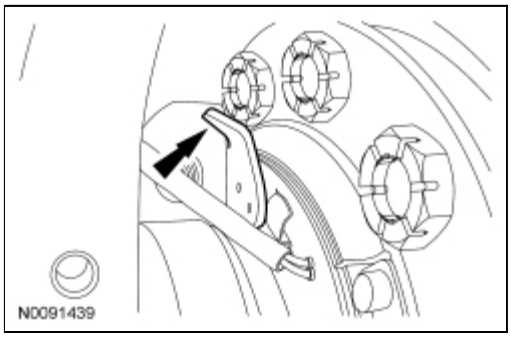
1. Position the differential assembly in the axle housing.



2. Install the original differential bearing shim on the LH side.

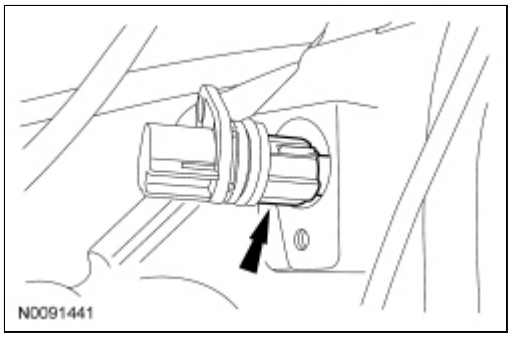
ELD equipped vehicles

3. Install the differential with the tabs on the ELD coil up against the differential bearing cap mounting surface.

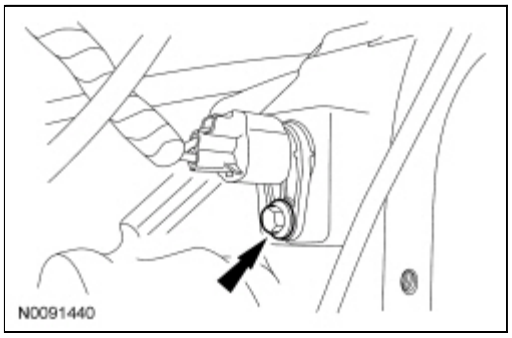


4. Push the ELD coil electrical connector through the differential case and connect the connector to the new adapter.

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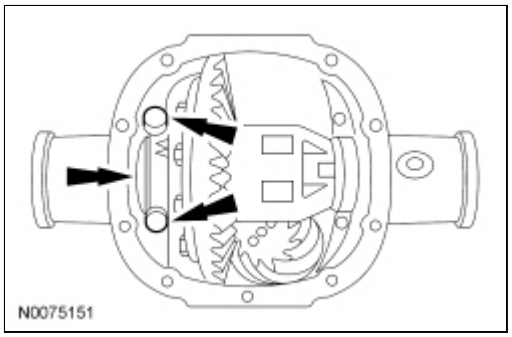
5. Seat the connector adapter into the differential housing and install the bolt. Connect the electrical connector.
    - Tighten to 7 Nm (62 lb-in).



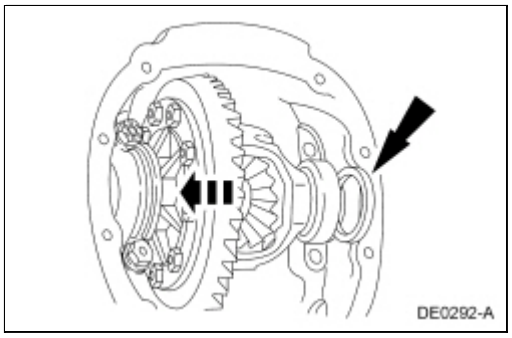
All vehicles

6. **NOTE:** Apply pressure toward the LH side to make sure the LH differential bearing cap is seated.

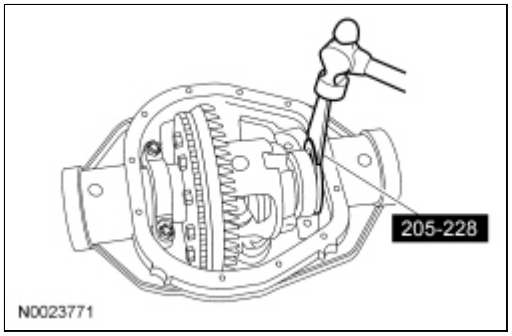
   Install the LH differential bearing cap and loosely install the 2 differential bearing cap bolts.



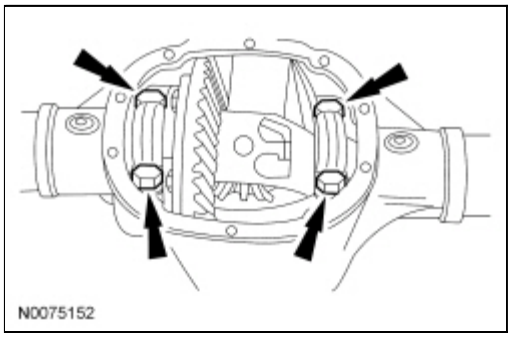
7. Install the original differential bearing shim on the RH side.



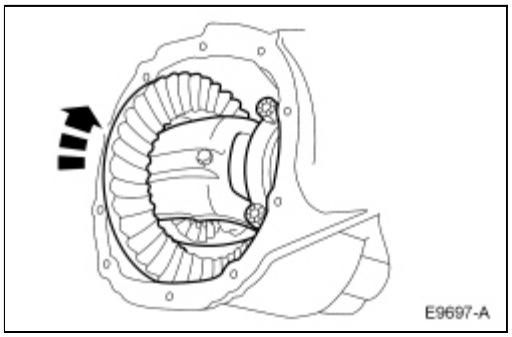
8. Using the Shim Driver, fully seat the differential bearing shims.



9. Install the RH side differential bearing cap and tighten the 2 LH side and 2 RH side differential bearing cap bolts.
   - Tighten to 105 Nm (77 lb-ft).



10. Rotate the differential assembly to make sure it rotates freely.



11. Adjust the ring and pinion backlash. For additional information, refer to Ring Gear Backlash Adjustment in this section.

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12. Install the axle shafts. For additional information, refer to Axle Shaft in this section.

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A	1.66L (3.5 pt)
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A	4.0 oz
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

General Specifications

Item	Specification
Backlash Specifications	
Ring gear backlash	0.204-0.305 mm (0.008-0.012 in)
Ring gear maximum backlash between teeth	0.101mm (0.004 in)
Clearance Specifications	
Differential case maximum runout	0.076 mm (0.003 in)
Housing spreader adapter thread engagement	12.5 mm (0.500 in)
Maximum differential housing spread	0.762 mm (0.030 in)
Lubricant Fill Level Checks	
Front axle	
Lubricant level	9.56 mm (0.38 in) below bottom of differential housing fill hole
Rotational Torque Ranges	
Pinion bearing torque preload	1.8-3.3 Nm (16-29 lb-in)

Torque Specifications

Description	Nm	lb-ft
Axle housing tube bolts	73	54
Axle housing tube bushing bolt	175	129

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Crossmember bolts and nuts	90	66
Differential bearing cap bolts	105	77
Differential housing cover bolts	32	24
Differential pinion shaft lock bolt	30	22
Fill plug	25	18
Front axle housing bushing bolt	175	129
Rear axle housing bushing bolt	175	129
Ring gear bolts [a]	—	—
Lower steering column shaft-to-steering gear bolt	30	22

[a] Refer to the procedure in this section.

Front Drive Axle and Differential

The front drive axle consists of:

- a cast-aluminum center section, a removable cast-aluminum axle housing tube and a differential housing cover. Both the axle housing tube and the differential housing cover use silicone sealant as a gasket.
- a hypoid-design gearset of an 8.8-inch ring gear and a pinion gear. Two opposed tapered roller bearings support the drive pinion in the axle housing.
- a drive pinion collapsible spacer, located on the pinion shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
- differential bearing shims, located between the differential bearing cups and the axle housing, adjust the differential bearing preload and the ring gear backlash.
- a differential case, a 1-piece design with 2 openings to allow for assembly of the internal components and lubricant flow. Two opposed tapered roller bearings (differential bearings) support the differential case in the axle housing. Removable differential bearing caps retain the differential assembly in the axle housing.
- inside the differential case, the differential pinion shaft supports 2 differential pinion gears. The pinion gear speed is synchronized by a differential clutch spring. The pinion gears engage the differential side gears, to which the left axle shaft and the right axle shaft are splined. The differential pinion shaft bolt retains the differential pinion shaft in the differential case.
- The bar code tag located on the differential cover contains the axle information.

The front drive axle receives input from the transfer case by way of the front driveshaft. Rotational torque is transferred through the drive pinion to the ring gear, which in turn drives the differential case. Inside the differential case are the pinion gears which rotate on the stationary pinion shaft and the side gears which are splined to the axle shafts. The differential assembly is a gear arrangement that allows the drive wheels to be driven at different speeds and divides the input torque of the pinion gear between the axle halfshafts. The front axle transmits torque only and carries no vehicle load. CV joints located at each end of the halfshafts allow the axle to remain stationary in relationship to front wheels, yet articulate at the knuckle. These CV joints permit the wheels to be driven and turned at the same time. Lack of lubrication is among the most common causes of CV joint concerns. It is essential that all CV boots and clamps be inspected for damage or signs of leakage. Refer to Section 205-04 .

The Torsen® front differential case houses the parallel axis planetary helical side gears to which the axle halfshafts are splined. It is the unique arrangement of the differential that allows the continuous, uninterrupted torque output and allows the axle halfshafts to be driven at different speed when needed, such as when driving around corners. There are no clutch plates or discs in this axle design. The Torsen® differential requires 4.0 oz of friction modifier to be added with the axle lubricant. The axle shafts are retained in this differential with the circlips.

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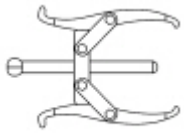
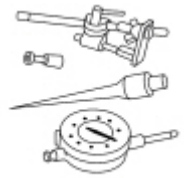
Front Drive Axle

Refer to Section 205-00 .

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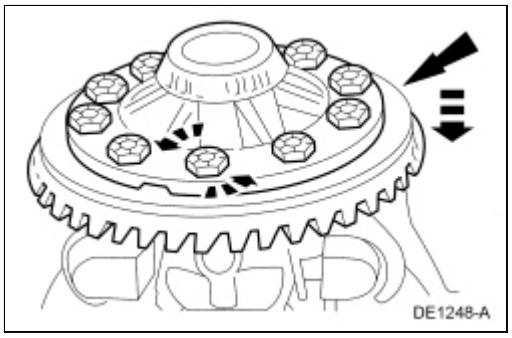
Differential Case Runout Check

Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E)
 ST2043-A	Step Plate 205-D061 (D83T-4205-C2)

1. Remove the differential carrier. For additional information, refer to Differential Carrier in this section.
2. **NOTE:** Use a drift punch to separate the ring gear from the differential case.

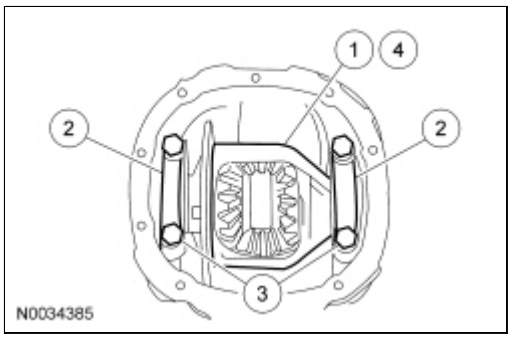
   Remove and discard the 10 bolts. Remove the ring gear.



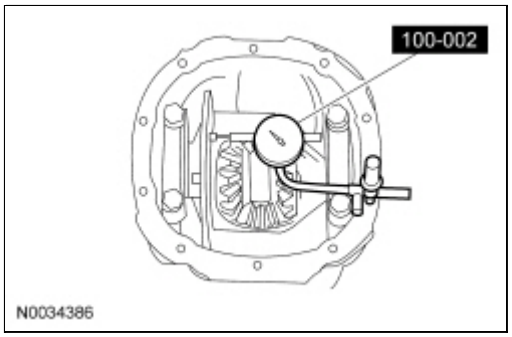
3. **NOTE:** Visually inspect the differential bearing cups and cones for discoloration indicating bearing overheating or failure.

   NOTE: It may be necessary to use the Differential Carrier Spreader to carry out this step.

   Install the differential case with the bearing cups and all the shims in the housing.
   1. Position the differential case with the bearing cups and shims in their original location.
   2. Install the 2 bearing caps.
   3. Install the 4 bolts.
      - Tighten to 105 Nm (77 lb-ft).
   4. Rotate the differential case to make sure the bearings have seated correctly.



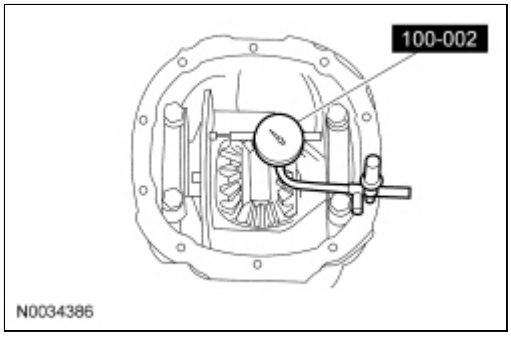
4. Install the Dial Indicator Gauge with Holding Fixture.



5. Rotate the differential case and check the differential case runout using the Dial Indicator Gauge with Holding Fixture.
   - If the runout does not exceed the specification, install a new ring gear and pinion.
   - If runout exceeds the specification, the ring gear is true and the condition is due to differential case/differential bearing damage.
     - Inspect the differential bearings and the differential case. Always install new differential bearings when installing a new differential case, or if a bearing condition is

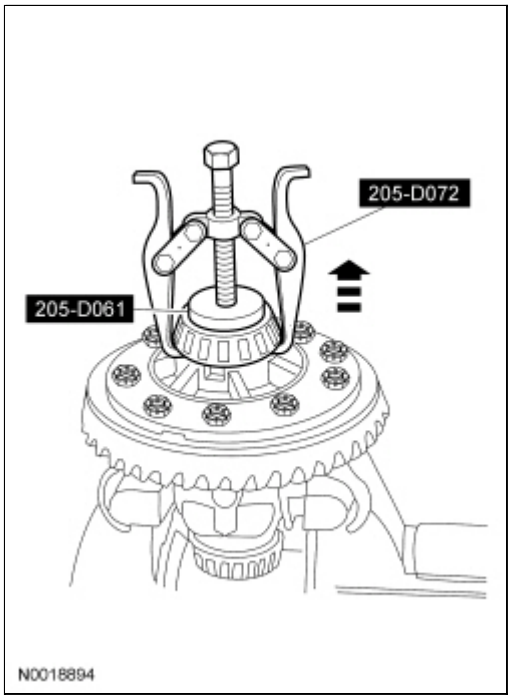
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questionable.



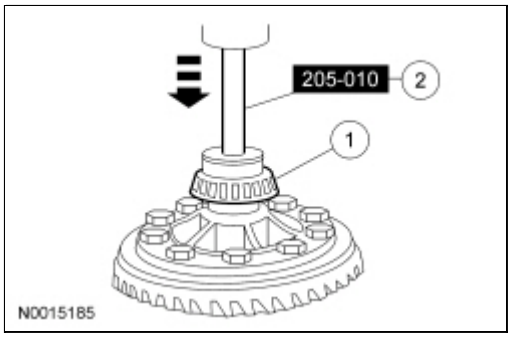
6. Remove the bearing caps and the differential case with the bearing cups and shims from the housing.

7. If necessary, using the 2 Jaw Puller and Step Plate, remove the differential bearings.



8. ***NOTICE:*** **Press against the differential bearing inner cone only or damage to the component may occur.**

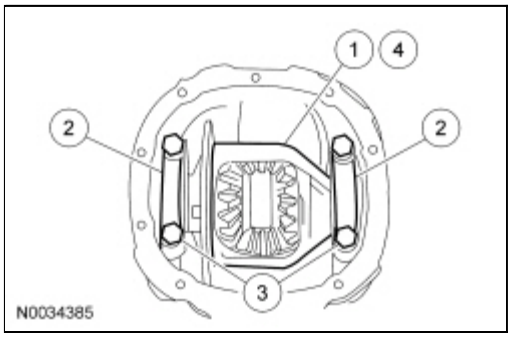
   Install the new differential bearings.
   1. Position the appropriate differential bearing (RH or LH).
   2. Using a suitable press and the Differential Side Bearing Installer, install the differential bearing.
      - Repeat the steps for the other differential bearing.



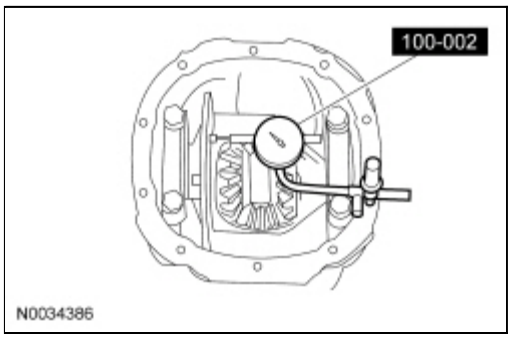
9. **NOTE:** It may be necessary to use the Differential Carrier Spreader to carry out this step.

   NOTE: Recheck the flange runout.

   Install the differential case with the bearing cups and the shims in the housing.
   1. Position the differential case with the bearing cups and shims in their original locations.
   2. Install the 2 bearing caps.
   3. Install the 4 bolts.
      - Tighten to 105 Nm (77 lb-ft).
   4. Rotate the differential case to make sure the bearings have seated correctly.



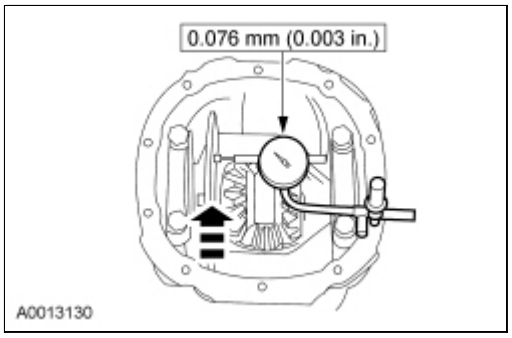
10. Install the Dial Indicator Gauge with Holding Fixture.



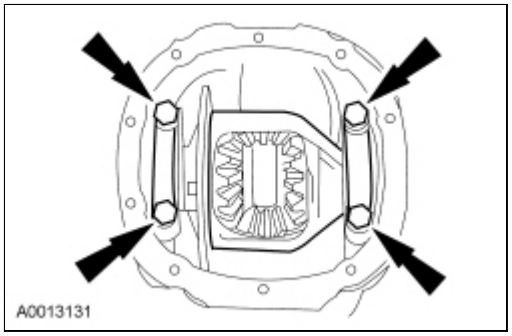
11. **NOTE:** If the runout is still excessive, install a new differential case.

    Using the Dial Indicator Gauge with Holding Fixture, check the runout with the new differential bearings. If the runout does not exceed the specification, use the new differential bearings for assembly.

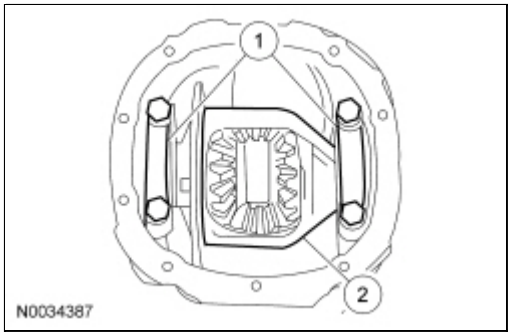
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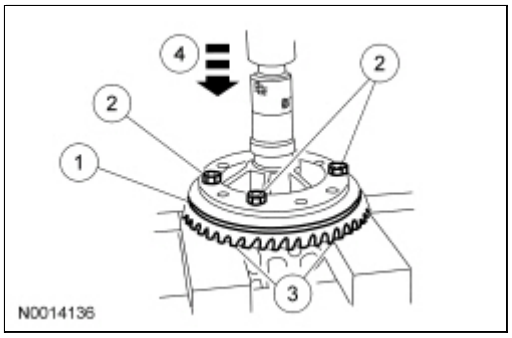
12. Remove the 4 bolts.



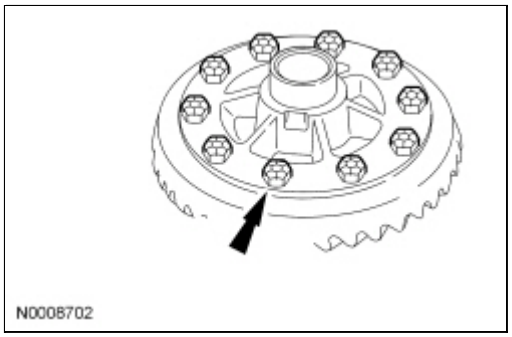
13. Remove the differential case with the bearing cups and the shims from the housing.
    1. Remove the 2 bearing caps.
    2. Remove the differential case with the bearing cups and the shims from the housing.



14. Install the differential ring gear.
    1. Place the differential ring gear on the differential assembly.
    2. Hand-start 3 new ring gear bolts to align the holes in the differential ring gear and the differential assembly.
    3. Place the differential carrier and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.
    4. Press the differential ring gear into place.



15. Install the 10 new ring gear bolts.
    - Tighten to 128 Nm (95 lb-ft).



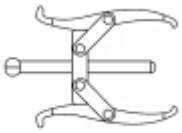
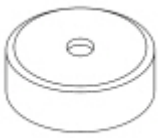
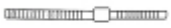
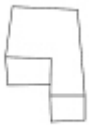
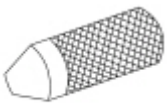
16. Install the differential carrier. For additional information, refer to Differential Carrier in this section.

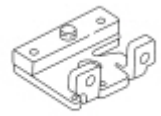
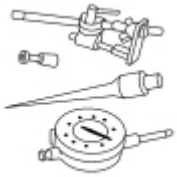
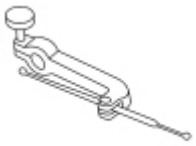
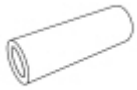
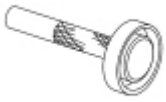
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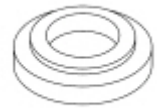
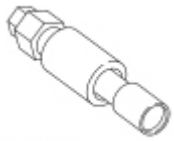
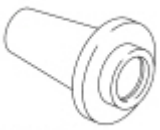
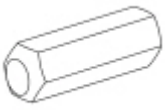
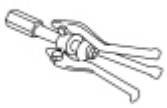
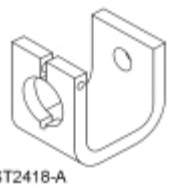
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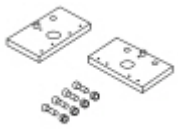
Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 **ST1433-B**	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)

 ST1150-B	
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1357-A	Installer, Differential Carrier Bearings 205-D044 (D81T-4221-A) or equivalent
 **ST1437-A**	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cone

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 ST1484-A	205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
	Slide Hammer 100-001 (T50T-100-A)

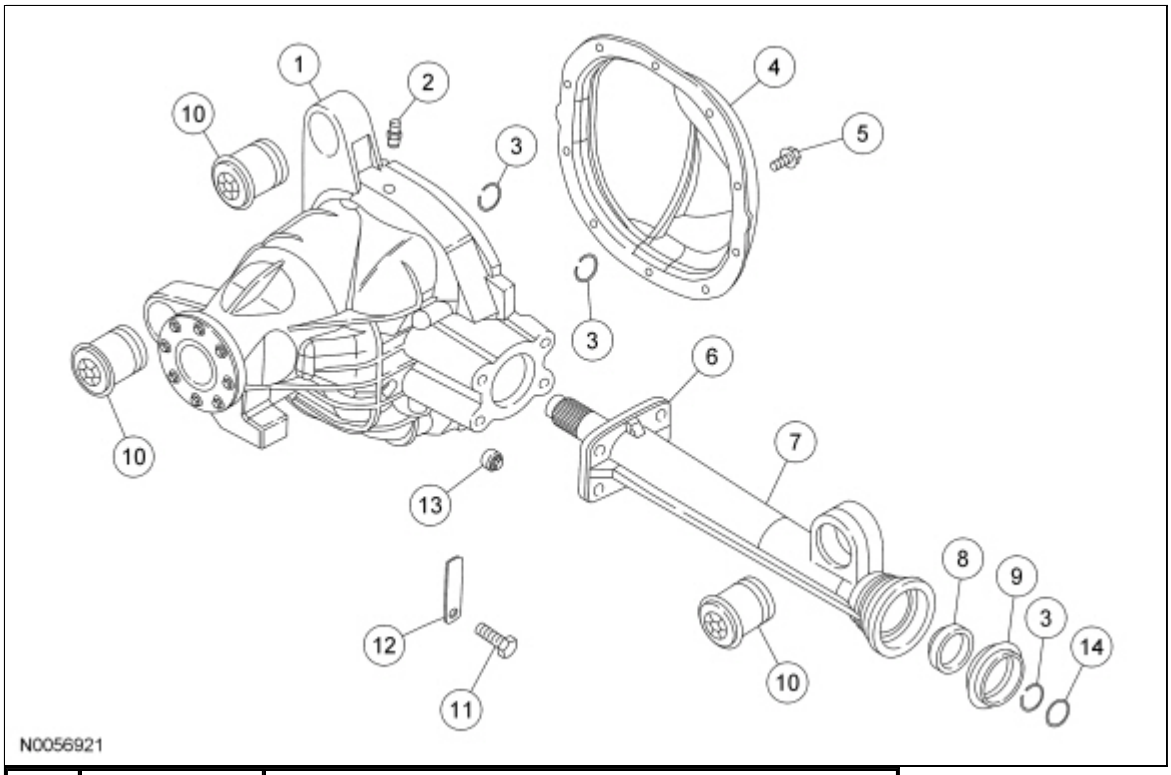
 ST1185-A	
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E) or equivalent
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)
 ST2043-A	Step Plate 205-D061 (D83T-4205-C2)

Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Front Axle Assembly — Disassembled View

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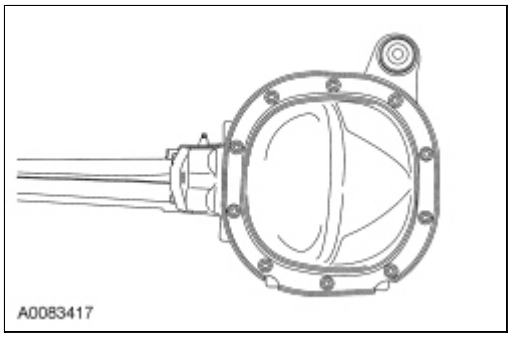


Item	Part Number	Description
1	3C202	Differential carrier assembly
2	4338	Axle housing vent
3	4B422	Circlips
4	3N136	Differential housing cover
5	390919	Differential housing cover bolt (10 required)
6	3A380	Intermediate shaft
7	3B210	Axle housing tube
8	4B413	Axle shaft bearing assembly (outer)
9	4B416	Axle shaft dust seal
10	5638	Front axle support mounting bushings (3 required)
11	N808703	Axle housing tube bolt (4 required)
12	4121	Axle identification tag
13	373098	Fill plug
14	4369	O-ring

Disassembly

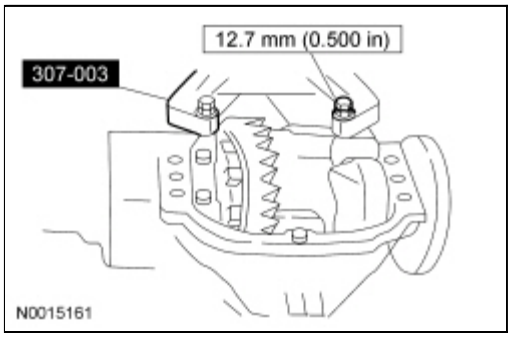
1. Remove the axle assembly. For additional information, refer to Axle Assembly in this section.

2. Remove the 10 bolts and the differential housing cover.
   - Drain the fluid.
   - Remove the bolts.
   - Remove the differential housing cover.

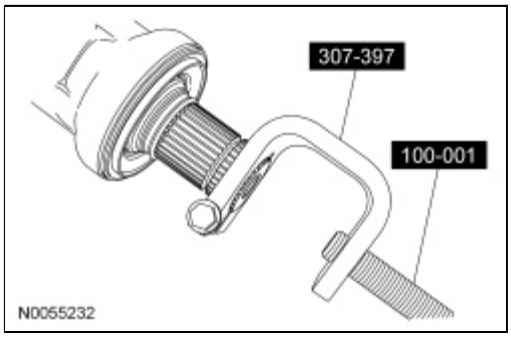


3. ***NOTICE:*** **The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

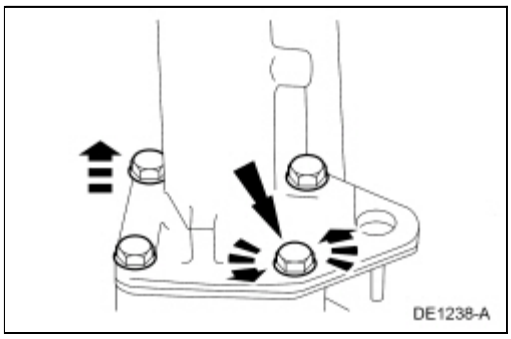
   Install the Transmission Holding Fixture.



4. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.



5. Remove the 4 bolts and the axle housing tube.

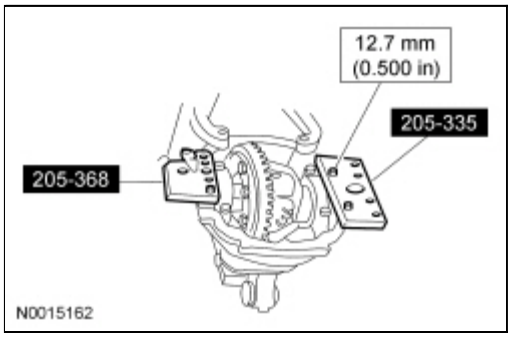


6. ***NOTICE:*** **The housing spreader adapter bolts must have the minimum specified thread**

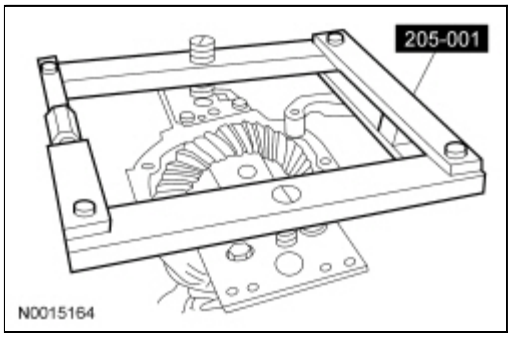
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engagement in the carrier or damage to the component may occur.

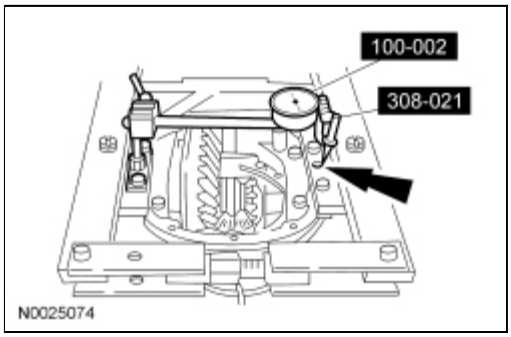
Install the Differential Housing Spreader Plate and Adapter for Differential Housing Spreader.



7. Position the Differential Carrier Spreader on the spreader adapters.



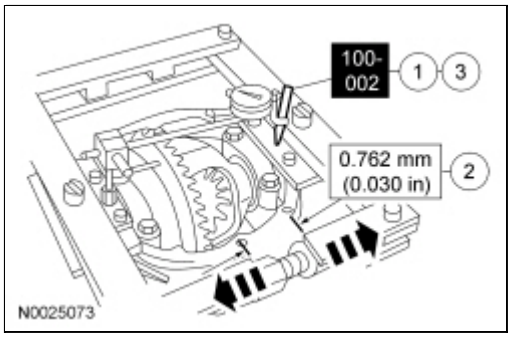
8. Install the Dial Indicator Gauge with Holding Fixture and Clutch Holding Gauge.
    - Position the adapter tip in the spreader adapter hole.



9. ***NOTICE:*** **Overspreading may damage the axle housing.**

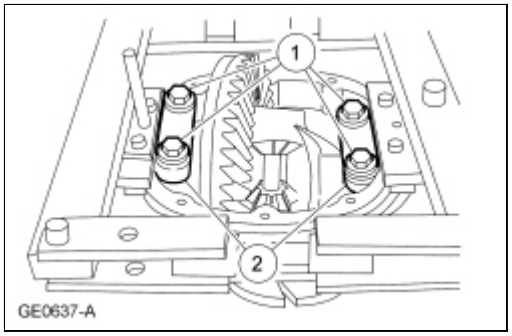
Spread the axle housing to the specification.

1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the housing spreader screw to spread the axle housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture.



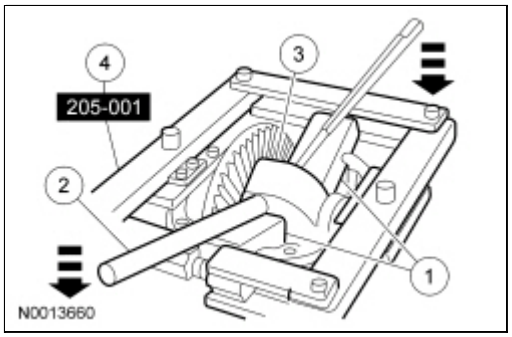
10. **NOTE:** Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original place and position.

    Mark and remove the 2 differential bearing caps.
    1. Remove the bolts.
    2. Remove the differential bearing caps.



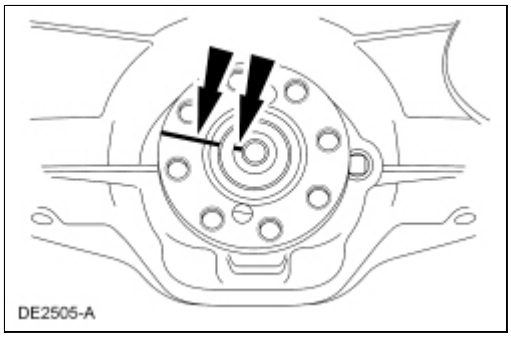
11. ***NOTICE:*** **Use wood blocks to avoid axle housing damage.**

    Remove the differential assembly from the axle housing.
    1. Position the wood blocks.
    2. Position and push down on the 2 pry bars.
    3. Remove the differential assembly.
    4. Remove the Differential Carrier Spreader.

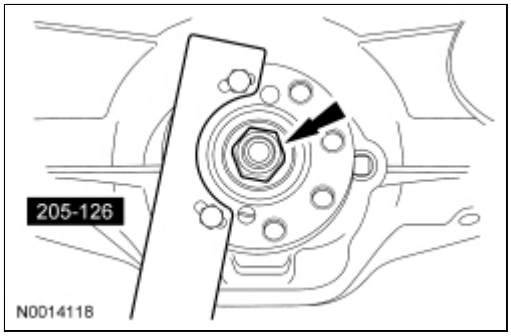


12. Index-mark the axle U-joint flange to the pinion stem.

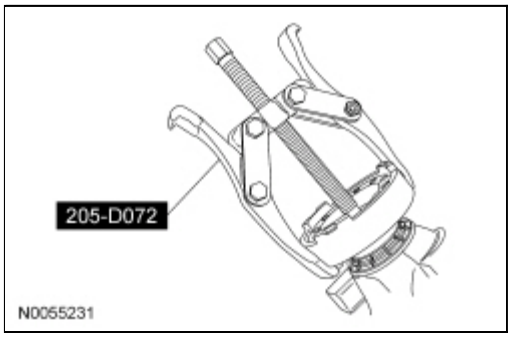
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13. Install the Drive Pinion Flange Holding Fixture and loosen, but do not remove, the pinion nut.

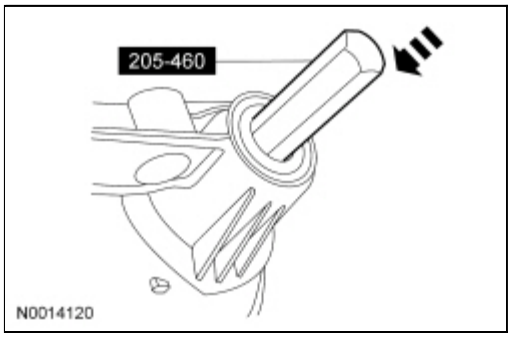


14. With the pinion nut still engaged by a few threads, use the 2 Jaw Puller to separate the axle U-joint flange from the pinion gear.

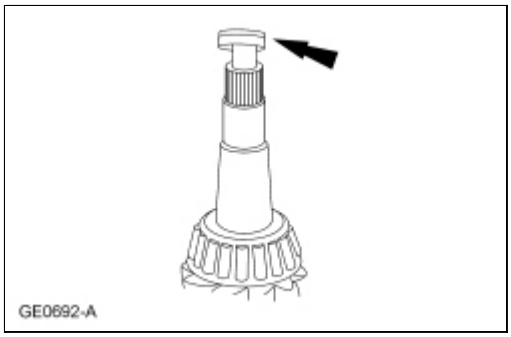


15. Remove the nut and the flange.

16. Using the Drive Pinion Thread Protector and a soft hammer, remove the pinion gear.

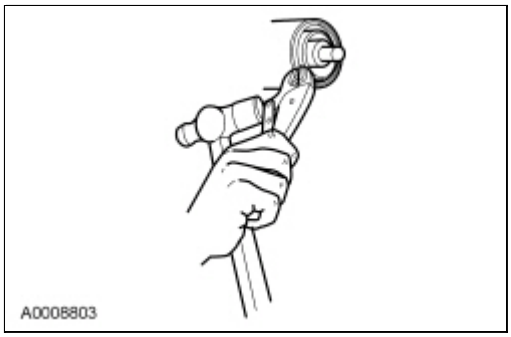


17. Discard the drive pinion collapsible spacer.



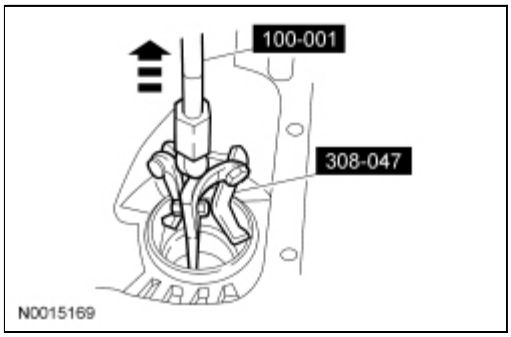
18. ***NOTICE:*** **Do not damage the carrier housing while removing the pinion seal.**

    Remove the pinion seal and slinger.
    - Pry up on the seal flange. Install gripping pliers, and strike with a hammer to remove the seal.



19. Remove the outer pinion bearing.

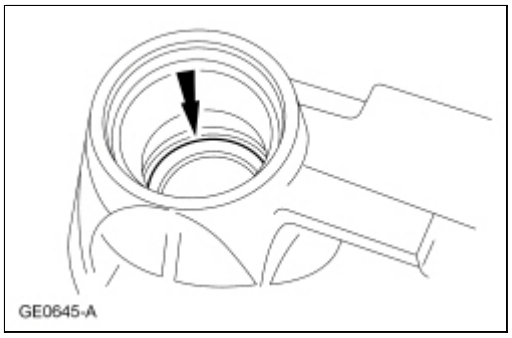
20. Using the Bearing Cup Remover and Slide Hammer, remove the inner pinion bearing cup.



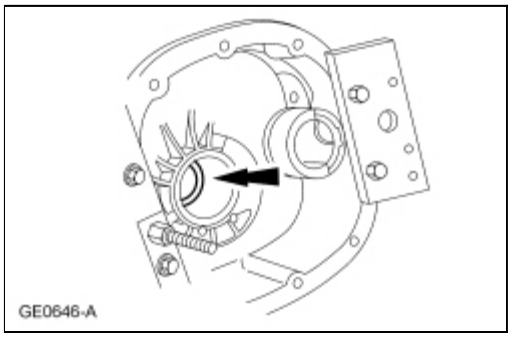
21. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

    If necessary, remove the pinion bearing oil baffle.

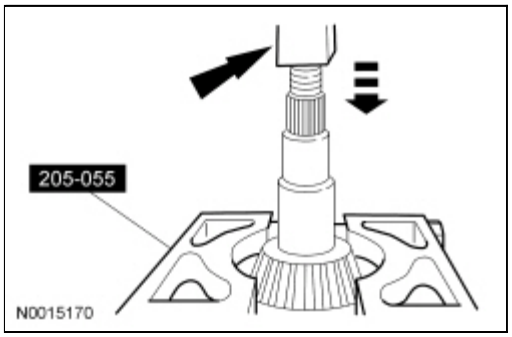
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22. Remove the outer pinion bearing cup by tapping alternately on each side to prevent the cup from cocking.

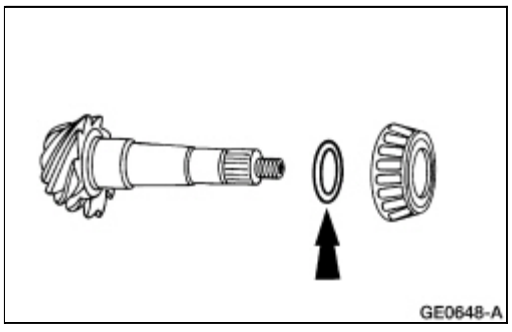


23. Using the Bearing Remover and a suitable press, remove the pinion bearing.



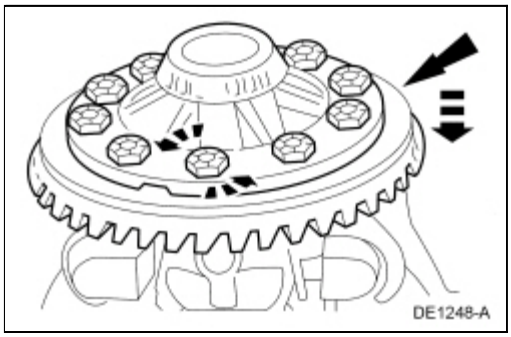
24. **NOTE:** A drive pinion bearing adjustment shim sits under the pinion bearing. Use a micrometer to measure the shim thickness. Record the measurement for comparison to the shim gauge reading taken prior to installing the pinion bearing.

    Remove and measure the drive pinion bearing adjustment shim.

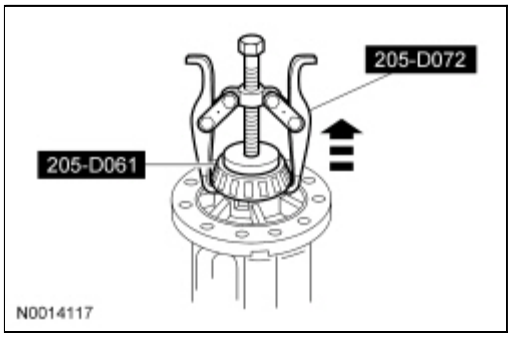


25. **NOTE:** Use a drift punch to separate the ring gear from the differential case.

    Remove and discard the 10 bolts and remove the ring gear.



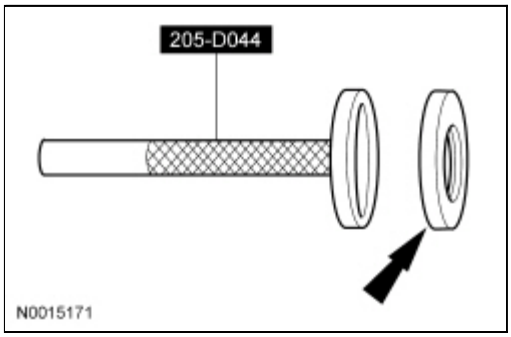
26. Using the 2 Jaw Puller and Step Plate, remove the differential bearings.



Assembly

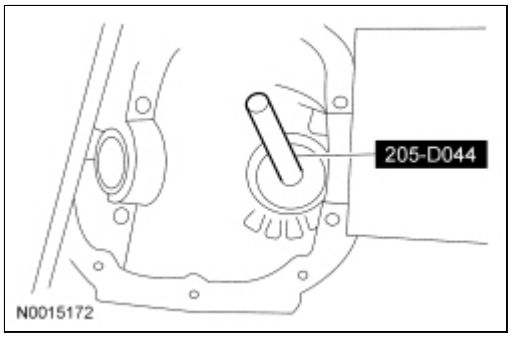
1. ***NOTICE:*** **Do not omit the pinion bearing oil baffle; bearing failure may result.**

    If removed, position the baffle on the Drive Carrier Bearings Installer.



2. Using the Drive Carrier Bearings Installer, install the baffle.

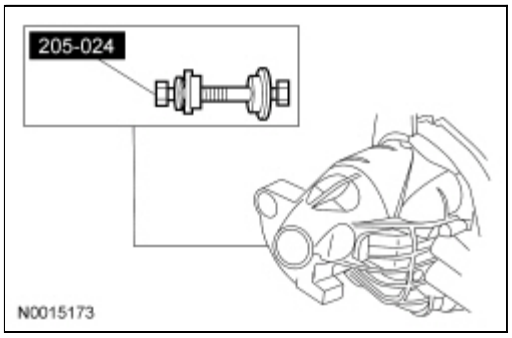
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3. **NOTE:** Always install new pinion bearings when installing new pinion bearing cups.

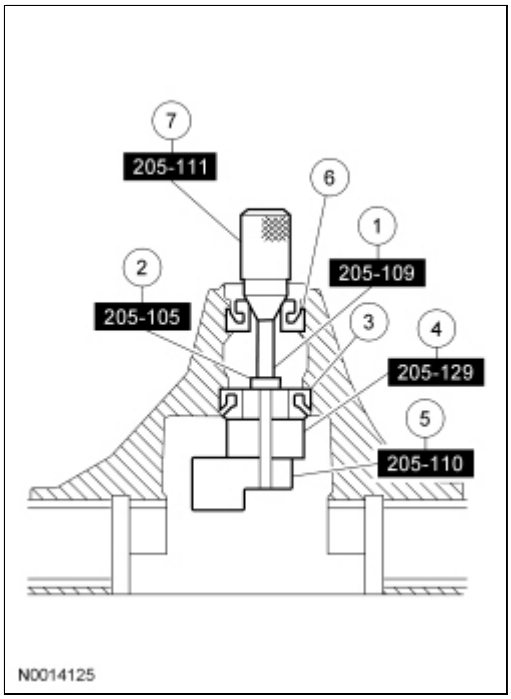
   Lightly oil the new pinion bearing cups and pinion bearings with front axle lubricant.

4. Using the Drive Pinion Bearing Cup Installer, install the bearing cups.



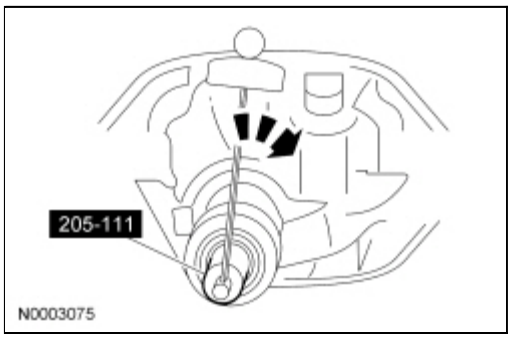
5. **NOTE:** The pinion bearings assembled in this procedure step must be used at final assembly.

   Assemble and position the Adapters and the pinion bearings in the carrier housing.
   1. Position the screw adapter.
   2. Position the aligning adapter.
   3. Position the pinion bearing.
   4. Position the gauge disc adapter.
   5. Position the gauge block adapter.
   6. Position the pinion bearing.
   7. Thread on the handle adapter.



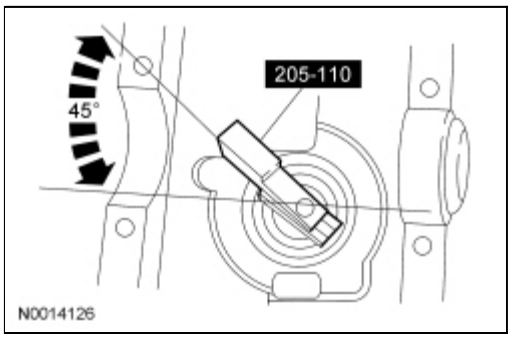
6. **NOTE:** This step duplicates final pinion bearing preload.

   Tighten the Adapter to simulate bearing preload.
   - Tighten to 2.2 Nm (20 lb-in).



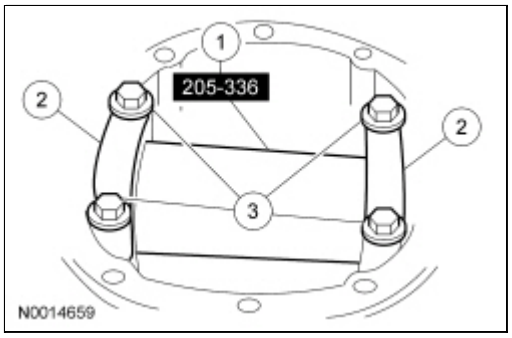
7. **NOTE:** Offset the gauge block adapter to obtain an accurate reading.

   Rotate the gauge block Adapter several half-turns to make sure the pinion bearings seat correctly and position the gauge block adapter.



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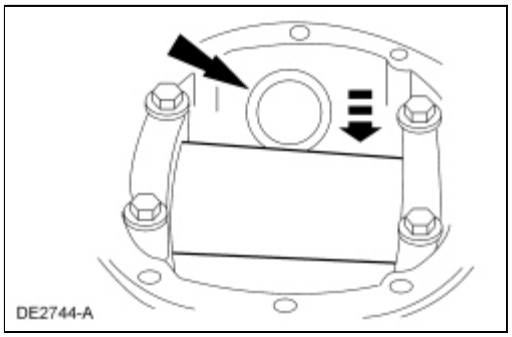
8. Install the Drive Pinion Gauge Tube.
    1. Position the Drive Pinion Gauge Tube.
    2. Install the 2 differential bearing caps.
    3. Install the 4 bolts.
        - Tighten to 105 Nm (77 lb-ft).



9. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims.

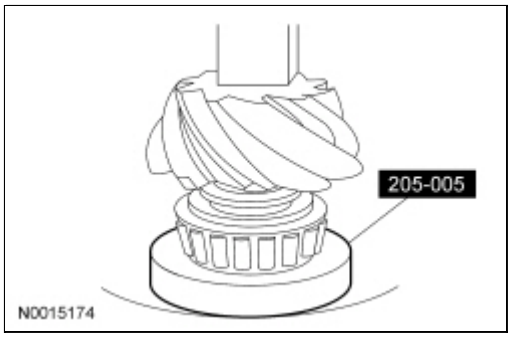
    NOTE: Do not attempt to force the shim between the gauge block adapter and the gauge tube adapter. A slight drag indicates correct shim selection.

    Use a drive pinion bearing adjustment shim as a gauge for shim selection.
    - Check the adjustment shim thickness between the gauge block adapter and the gauge tube adapter.
    - After determining the correct shim thickness, remove the Drive Pinion Gauge Tube.

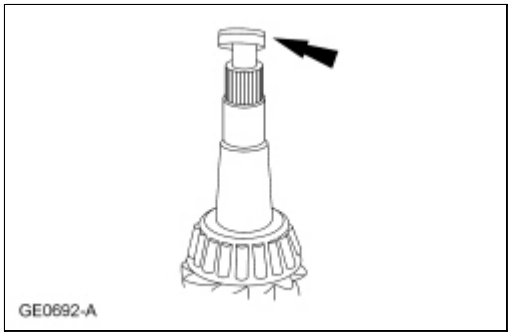


10. **NOTE:** The same pinion bearings from the previous steps must be used.

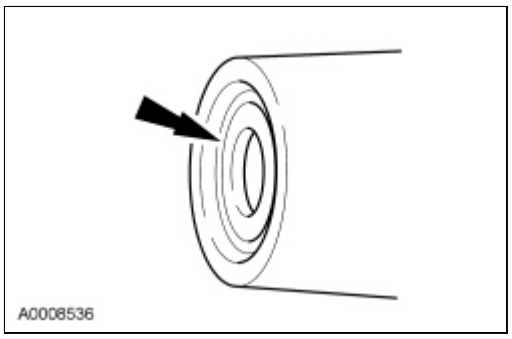
    Install the pinion bearing.
    - Place the drive pinion bearing adjustment shim on the pinion gear.
    - Using a suitable press and the Drive Pinion Bearing Cone Installer, press the pinion bearing until it is firmly seated on the pinion gear.



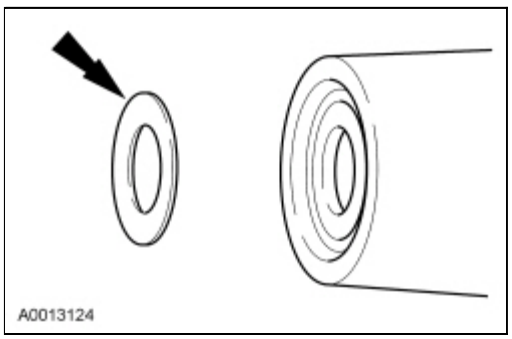
11. Place a new drive pinion collapsible spacer on the pinion stem.



12. Install the outer pinion bearing.



13. Install the slinger.

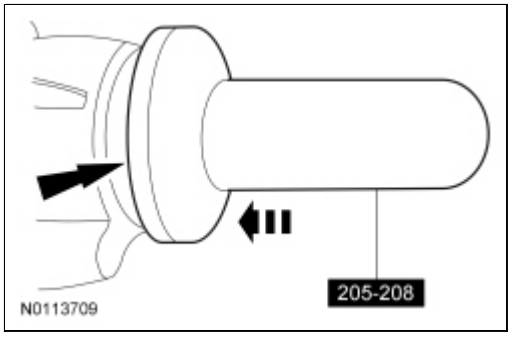


14. **NOTE:** Coat the lips of the pinion seal with front axle lubricant.

    Place the pinion seal on the Drive Pinion Oil Seal Installer.

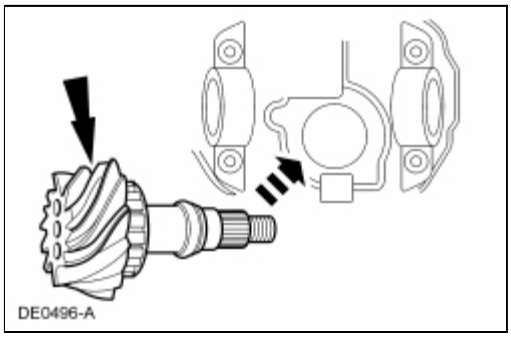
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15. Place the Drive Pinion Oil Seal Installer and seal in the pinion seal bore and drive the seal into place.



16. Lightly lubricate the pinion gear splines with front axle lubricant.

17. Position the drive pinion in the housing.

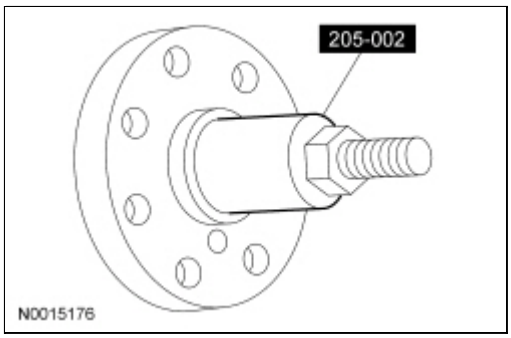


18. ***NOTICE:*** **Never install the drive pinion U-joint flange with a hammer or power tools.**

    NOTE: Disregard the scribe marks if installing a new flange.

    Align the index marks and position the U-joint flange on the drive pinion.

19. Using the Drive Pinion Flange Installer, install the drive pinion U-joint flange.



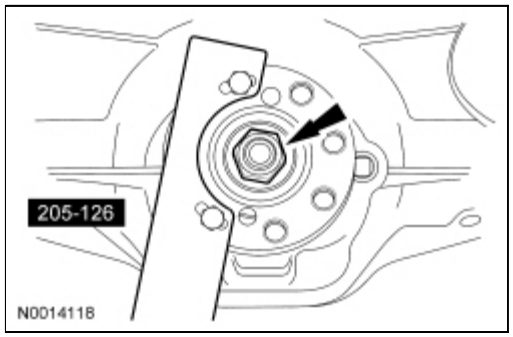
20. Apply a small amount of lubricant to the washer side of the new pinion nut, and install the nut.

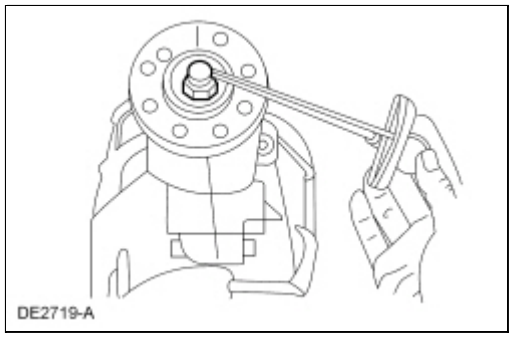
21. ***NOTICE:*** **Do not loosen the pinion nut to reduce preload under any circumstance. If it is necessary to reduce preload, install a new drive pinion collapsible spacer and pinion nut or damage to the component may occur.**

    Install the Drive Pinion Flange Holding Fixture and tighten the pinion nut. Refer to the torque

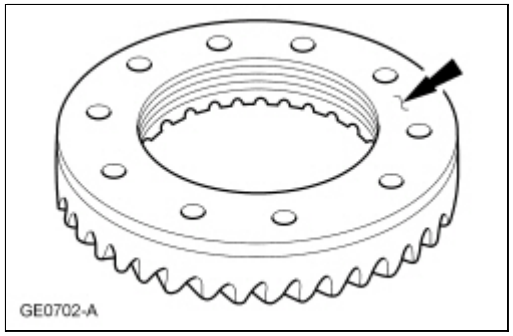
specifications in the Specifications portion of this section.

- Rotate the pinion gear occasionally to make sure the pinion bearings are seating correctly. Take frequent pinion bearing torque preload readings by rotating the pinion gear with a Nm (lb-in) torque wrench.



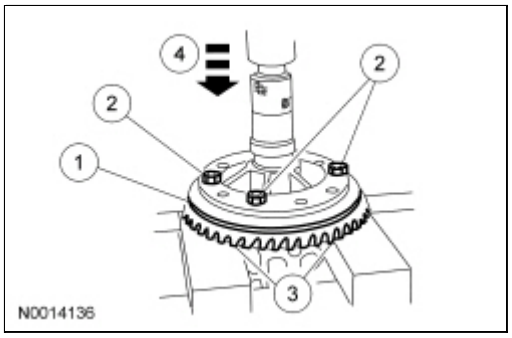


22. Use a fine flat file to remove any burrs or nicks from the ring gear mounting surface.

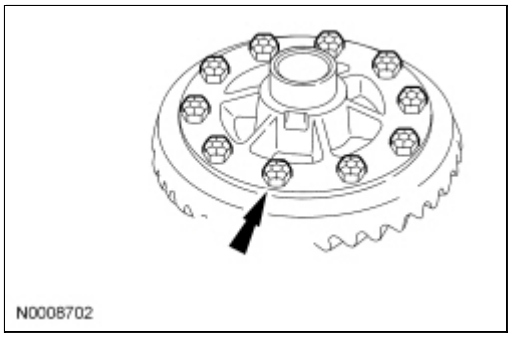


23. Install the differential ring gear.
    1. Place the differential ring gear on the differential assembly.
    2. Hand-start 3 ring gear bolts to align the holes in the differential ring gear and the differential assembly.
    3. Place the differential carrier and differential ring gear onto the press bed blocks with the differential gear teeth facing downward.
    4. Press the differential ring gear into place.

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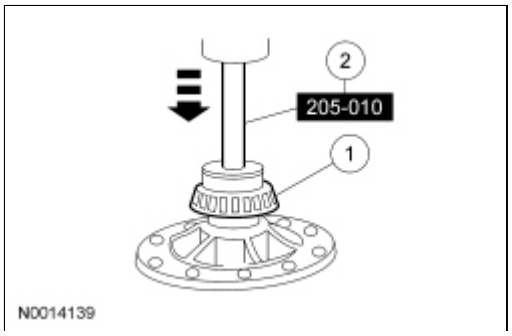


24. Install the remaining new bolts.
    - Tighten to 128 Nm (95 lb-ft).

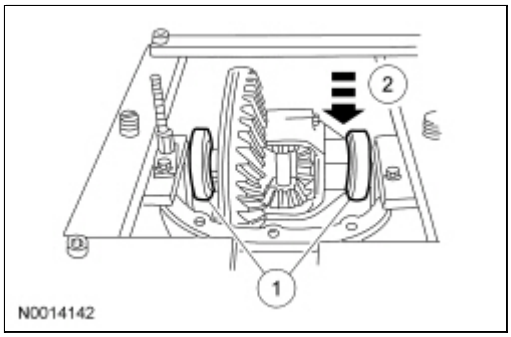


25. **NOTE:** Press against the bearing inner core only.

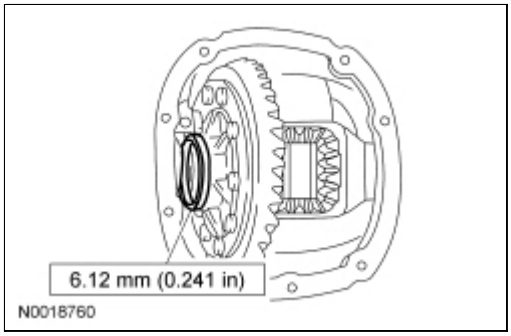
    Using a suitable press and the Differential Side Bearing Installer, install the differential bearings.
    1. Position the appropriate differential bearing (RH or LH).
    2. Using a suitable press and the Differential Side Bearing Installer, install the differential bearing.
       - Repeat the procedure for the other differential bearing.



26. Install the differential carrier.
    1. Position the differential bearing cups on the differential bearings.
    2. Lower the differential carrier in place.

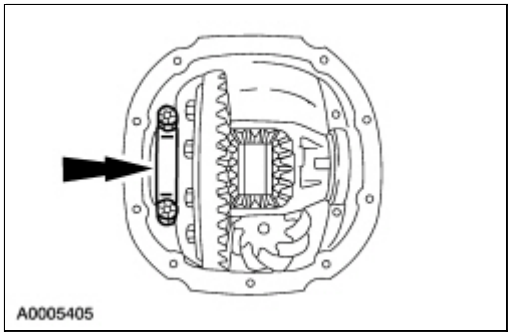


27. Install a differential bearing shim of the thickness shown on the LH side of the differential bearing.

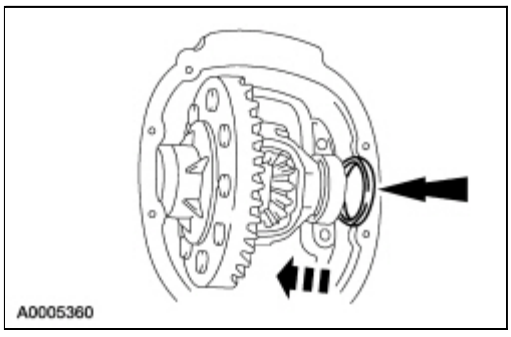


28. **NOTE:** Apply pressure to the left side to make sure the left bearing cup is seated.

    Install the left bearing cap and loosely install the 2 bearing cap bolts.



29. Install progressively thicker differential bearing shims on the right side until the thickest differential bearing shim can be inserted by hand.



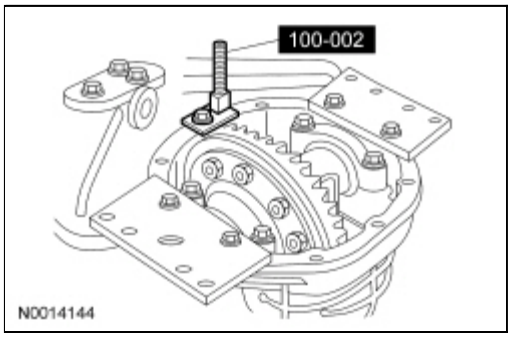
30. Install the right bearing cap and 2 bolts.

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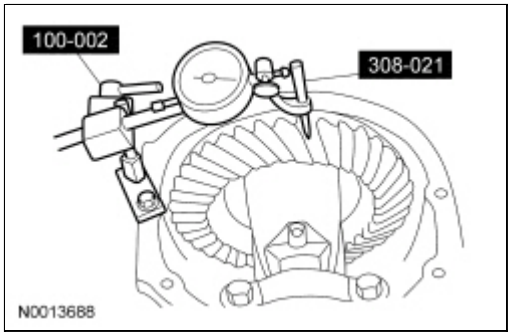
31. Tighten the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).

32. Rotate the differential carrier to make sure it turns freely.

33. Install the Dial Indicator Gauge with Holding Fixture.

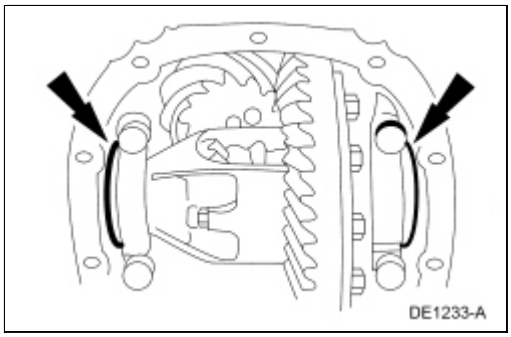


34. Using the Dial Indicator Gauge with Holding Fixture and the Clutch Housing Gauge, measure the ring gear backlash at 4 places to obtain a consistent reading.

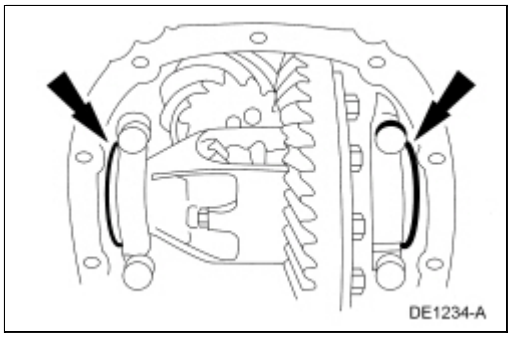


35. **NOTE:** If the backlash is not within the specifications, correct it by increasing the thickness of one differential bearing shim and decreasing the thickness on the other differential bearing shim by the same amount.

    To increase the backlash, install a thicker differential bearing shim and a thinner differential bearing shim as shown.



36. To decrease the backlash, install a thicker differential bearing shim and a thinner differential bearing shim as shown.



37. Select the appropriate shim by the thickness or the stripe color.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

Differential Shim Size Chart

Stripes/Color	mm	Inch
2 — C-COAL	7.7978-7.8105	0.3070-0.3075
1 — C-COAL 5 — BLU	7.7470-7.7597	0.3050-0.3055

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4 — BLU	7.6962-7.7089	0.3030-0.3035
3 — BLU	7.6454-7.6581	0.3010-0.3015
2 — BLU		
1 — BLU	7.5946-7.6073	0.2990-0.2995
5 — PINK	7.5458-7.5565	0.2970-0.2975
4 — PINK		
3 — PINK	7.4930-7.5050	0.2950-0.2955
2 — PINK	7.4422-7.4549	0.2930-0.2935
1 — PINK		
5 — GRN	7.3914-7.4041	0.2910-0.2915
4 — GRN	7.3406-7.3533	0.2890-0.2895
3 — GRN		
2 — GRN	7.2898-7.3025	0.2870-0.2875
1 — GRN	7.2390-7.2517	0.2850-0.2855
5 — WH		
4 — WH	7.1882-7.2009	0.2830-0.2835
3 — WH	7.1374-7.1501	0.2810-0.2815
2 — WH		
1 — WH	7.0866-7.0993	0.2790-0.2795
5 — YEL	7.0358-7.0485	0.2770-0.2775
4 — YEL		
3 — YEL	6.9850-6.9977	0.2750-0.2755
2 — YEL	6.9342-6.9469	0.2730-0.2735
1 — YEL		
5 — ORNG	6.8834-6.8961	0.2710-0.2715
4 — ORNG	6.8326-6.8453	0.2690-0.2695
3 — ORNG		
2 — ORNG	6.7818-6.7945	0.2670-0.2675
1 — ORNG	6.7310-6.7437	0.2650-0.2655
2 — RED		

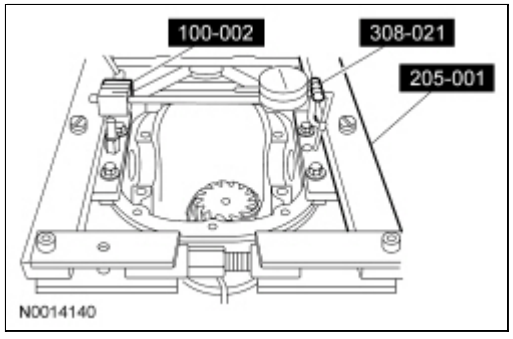
1 — RED	6.6802-6.6929	0.2630-0.2635
	6.6294-6.6421	0.2610-0.2615
	6.5786-6.5913	0.2590-0.2595
	6.5278-6.5405	0.2570-0.2575
	6.4770-6.4897	0.2550-0.2555
	6.4262-6.4389	0.2530-0.2535
	6.3754-6.3881	0.2510-0.2515
	6.3246-6.3373	0.2490-0.2495
	6.2738-6.2865	0.2470-0.2475
	6.2223-6.2357	0.2450-0.2455
	6.1722-6.1849	0.2430-0.2335
	6.1214-6.1341	0.2410-0.2415

38. Remove the 4 differential bearing cap bolts.
    - Remove the differential carrier.

39. Measure the thickness of the selected right and left bearing shims.

40. To establish differential bearing preload, increase both the left and right differential bearing shim thickness by 0.203 mm (0.008 in).

41. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.

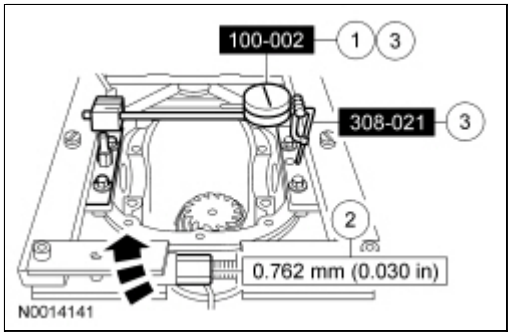


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42. ***NOTICE:*** **Overspreading may damage the differential housing.**

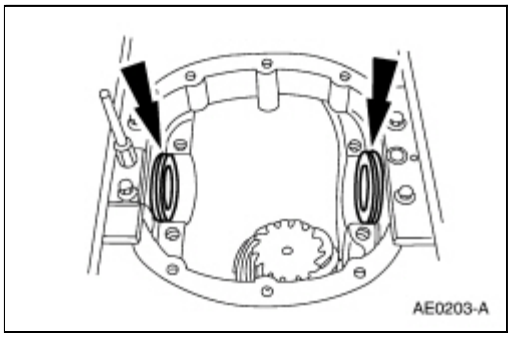
    NOTE: Tighten and loosen the differential carrier spreader adapters to normalize the housing adapters prior to taking the final Dial Indicator reading.

    Spread the differential housing to the specification.
    1. Adjust the Dial Indicator Gauge to zero.
    2. Tighten the screw until spreading the differential housing to the specifications.
    3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.

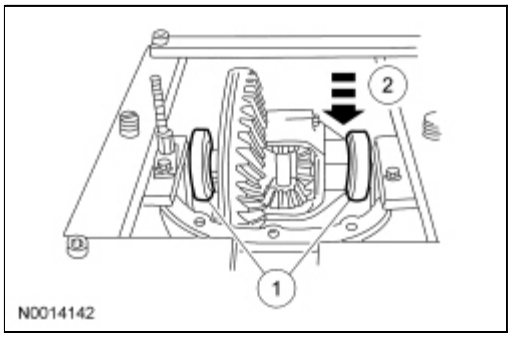


43. ***NOTICE:*** **To avoid galling the case, insert the shims with a light coating of grease before installing the differential carrier.**

    Place the differential bearing shims in the differential housing.

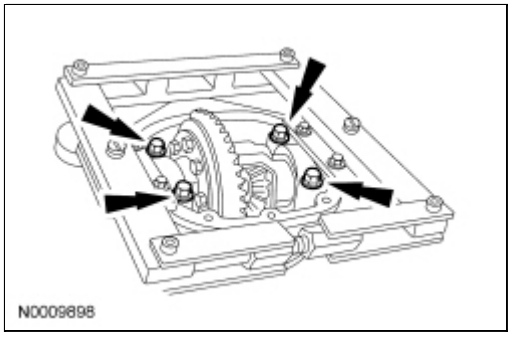


44. Install the differential carrier.
    1. Position the 2 differential bearing cups on the differential bearings.
    2. Lower the differential carrier in place between the differential bearing shims.

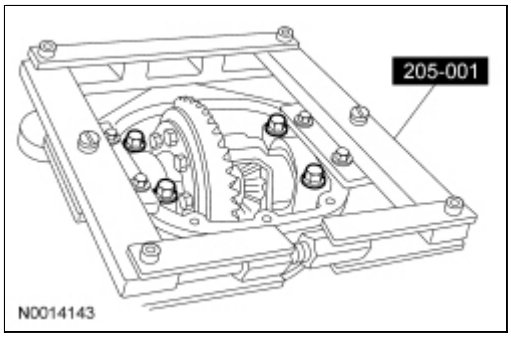


45. **NOTE:** Hand-tighten the differential bearing cap bolts prior to releasing the Differential Carrier Spreader.

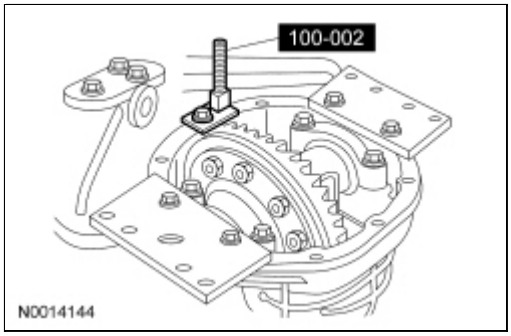
Install the 2 differential bearing caps and 4 bolts in their original location.



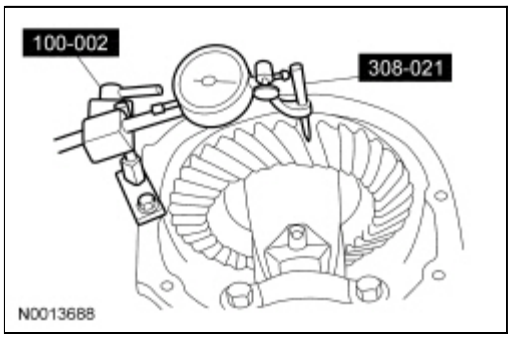
46. Loosen and remove the Differential Carrier Spreader.



47. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



48. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, recheck the ring gear backlash.

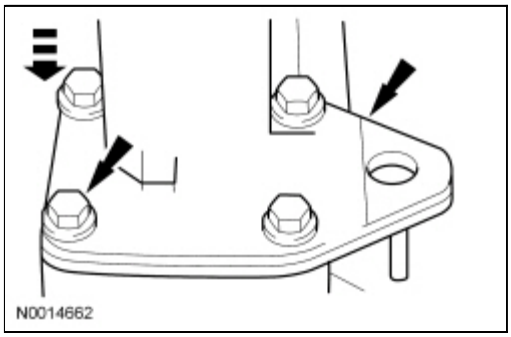


49. Apply marking compound and rotate the differential assembly 5 complete revolutions.

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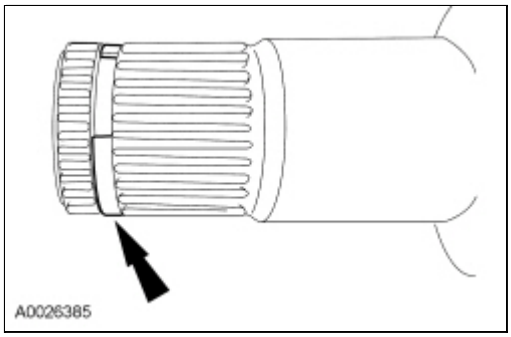
50. Verify an acceptable pattern check. For additional information, refer to Diagnosis and Testing in this section.

51. Assemble the axle housing tube.
    - Align the bolt holes and position the axle tube.
    - Position the axle identification tag.
    - Install the 4 bolts.
        - Tighten to 73 Nm (54 lb-ft).



52. Install a new stub shaft seal. For additional information, refer to Stub Shaft Pilot Bearing and Seal in this section.

53. Install a new circlip on the intermediate shaft end.



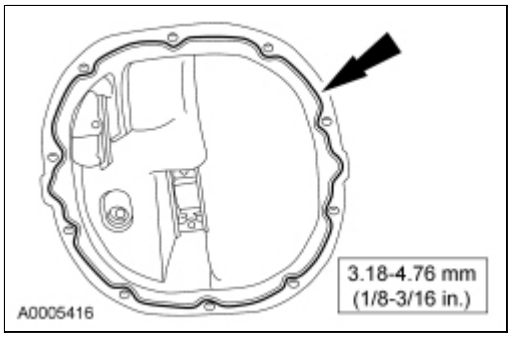
54. Insert the intermediate shaft and engage the circlip with the side gears.

55. Remove the axle assembly from the Holding Fixture and place it on the bench.

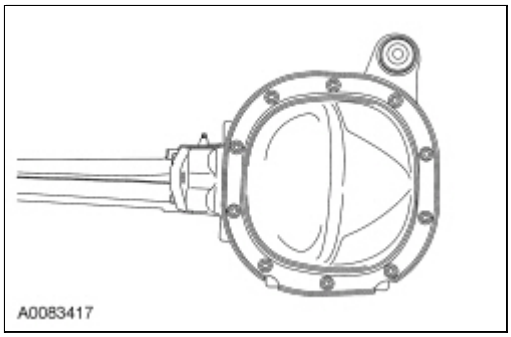
56. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

    NOTE: The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

    Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.
    - Use silicone gasket and sealant.



57. Install the differential housing cover and the 10 cover bolts.
    - Tighten to 32 Nm (24 lb-ft).



58. Install the axle assembly. For additional information, refer to Axle Assembly in this section.

59. Remove the fill plug and fill the axle assembly with the specified type and amount of lubricant.
    - Tighten the fill plug to 25 Nm (18 lb-ft).

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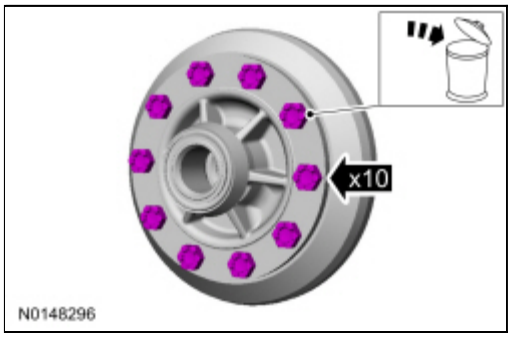
Differential Case

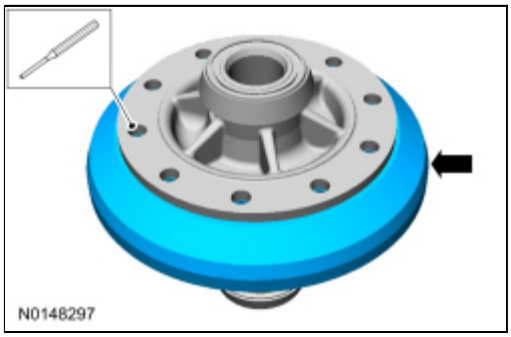
Material

Item	Specification
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Threadlock and Sealer TA-25	WSK-M2G351-A5

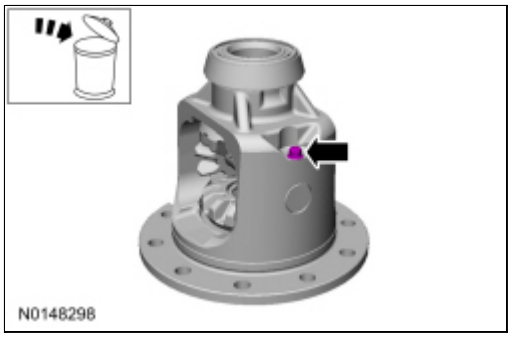
Disassembly

NOTE: The Torsen® differential should be replaced as a unit only. Do not attempt to rebuild.

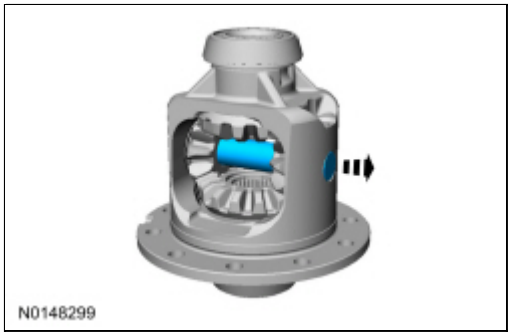
1. Remove the differential carrier. Refer to Differential Carrier .
2. 

3. 

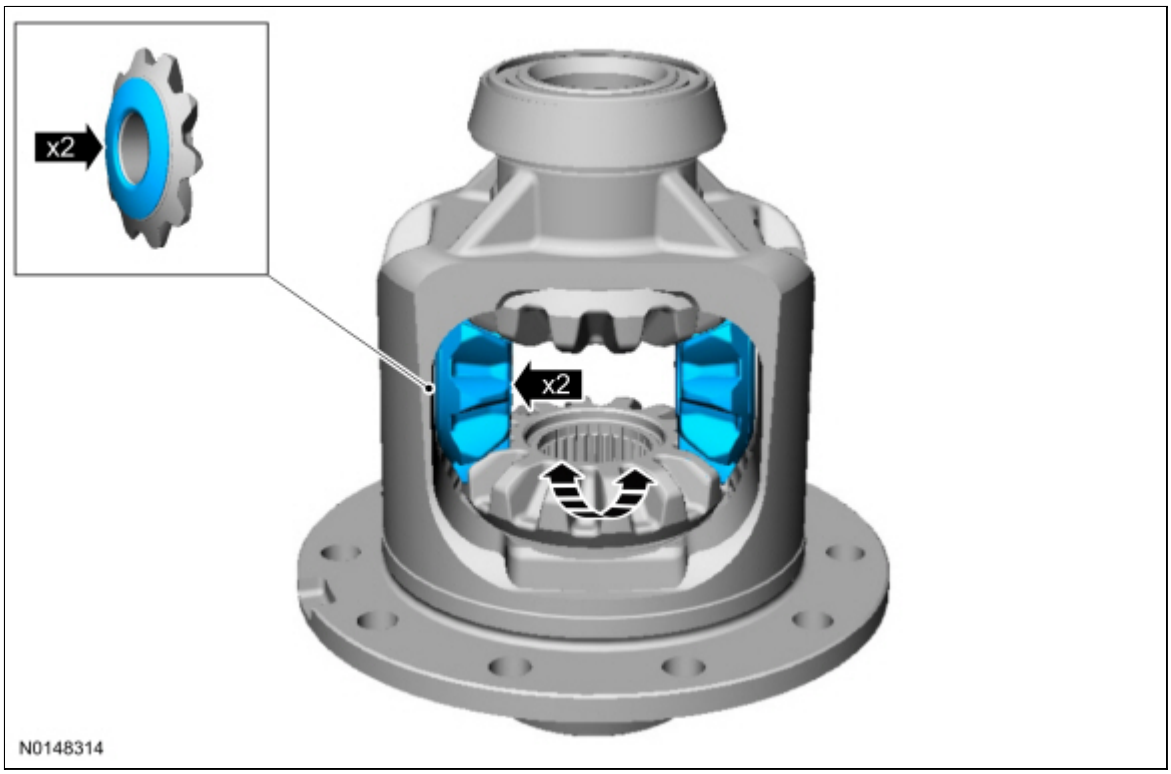
4.



5.

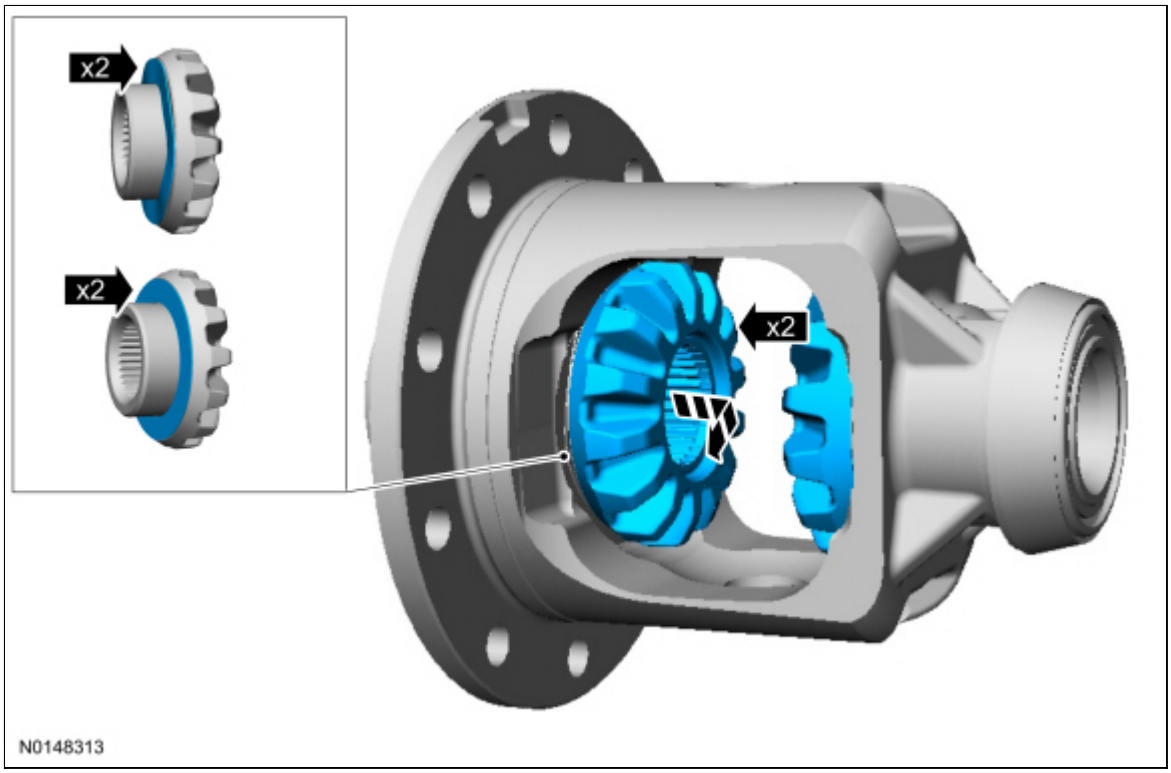


6.

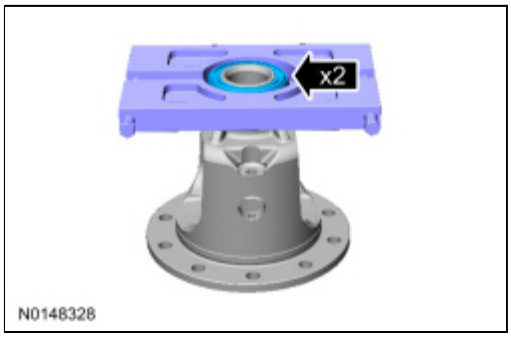


7.

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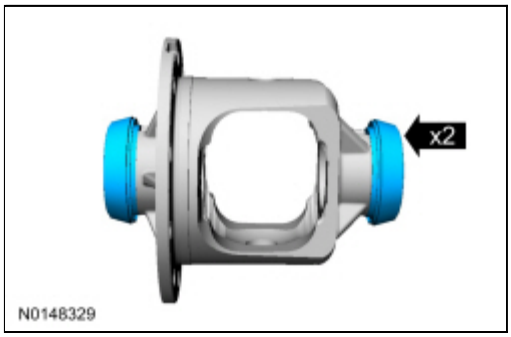


8. General Equipment: Hydraulic Press
   General Equipment: Bearing Puller

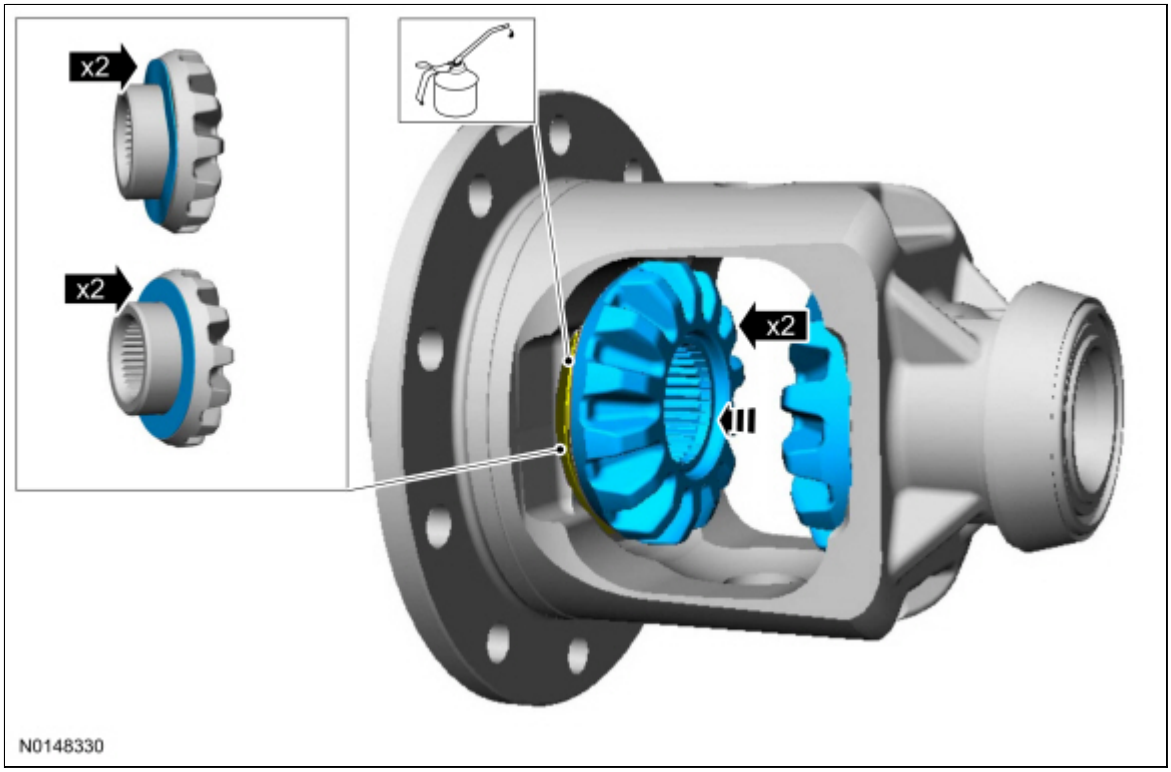


Assembly

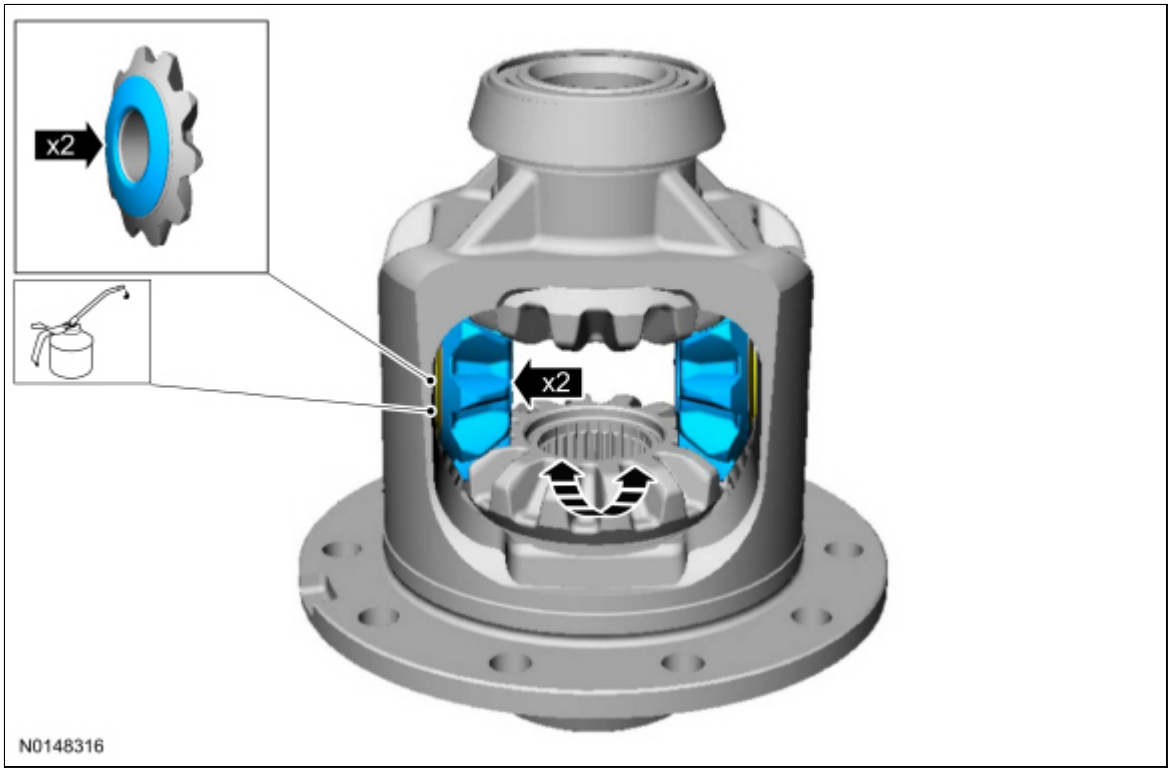
1. General Equipment: Hydraulic Press



2.

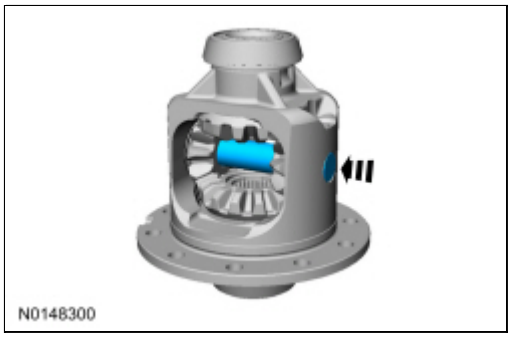


3.



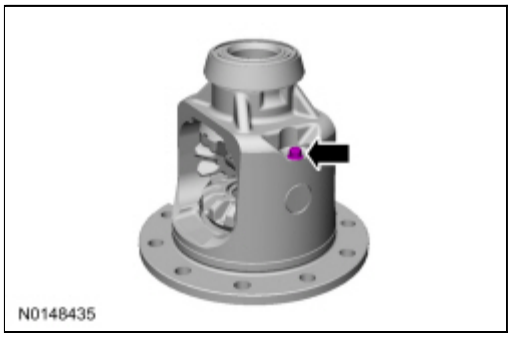
4.

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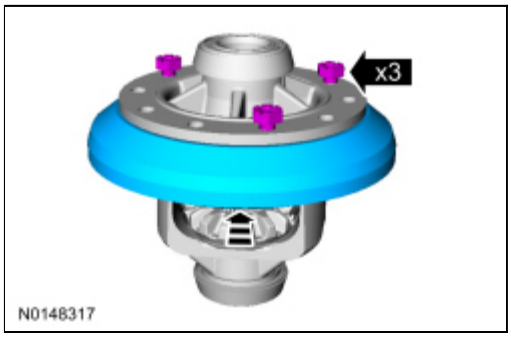
5. **NOTE:** If a new pinion shaft bolt is unavailable, coat the threads with sealer.

    - Tighten to 30 Nm (22 lb-ft).



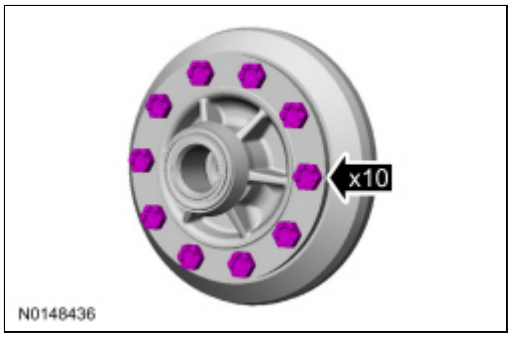
6. **NOTE:** Loosely install 3 bolts to align the ring gear and carrier bolt holes.

    General Equipment: Hydraulic press



7.

    - Tighten to 128 Nm (95 lb-ft).

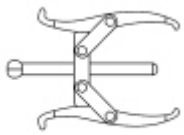
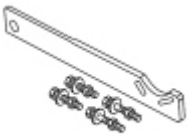


8. Install the differential carrier. Refer to Differential Carrier .

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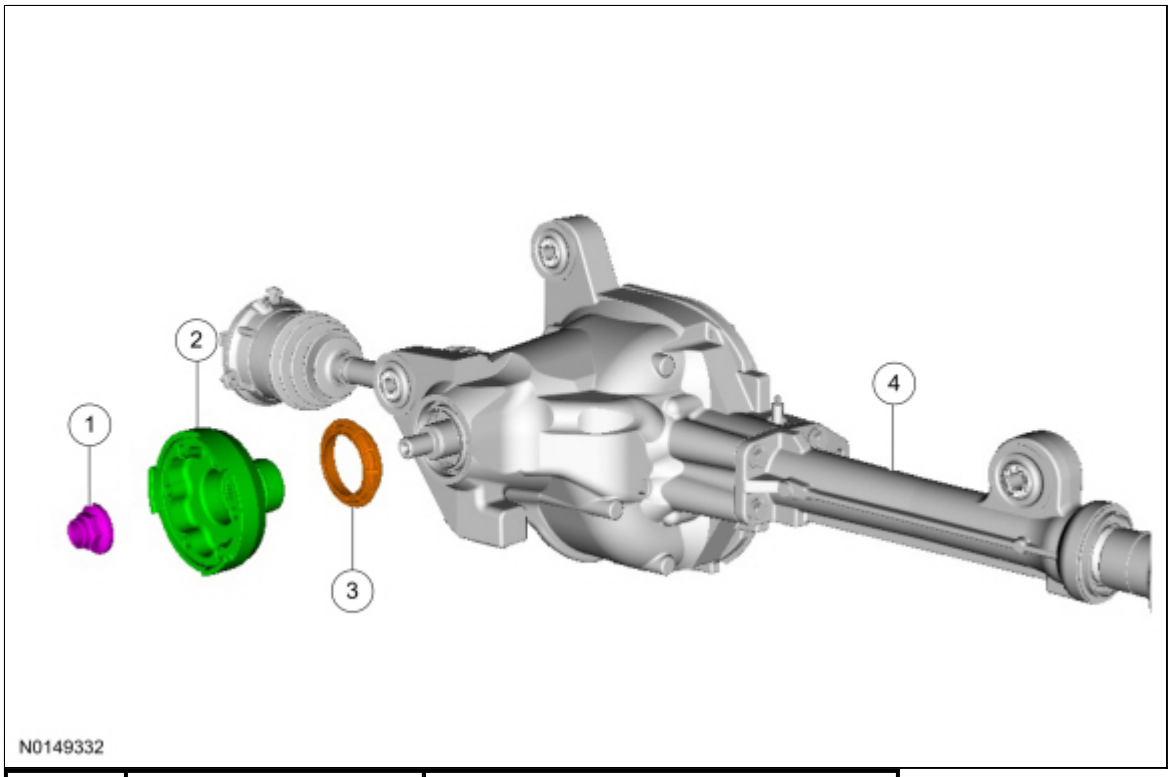
Drive Pinion Flange and Seal

Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)

Material

Item	Specification
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A



Item	Part Number	Description
1	389546	Pinion nut and washer
2	4858	Pinion flange
3	3N134	Drive pinion oil seal
4	3C202	Axle housing

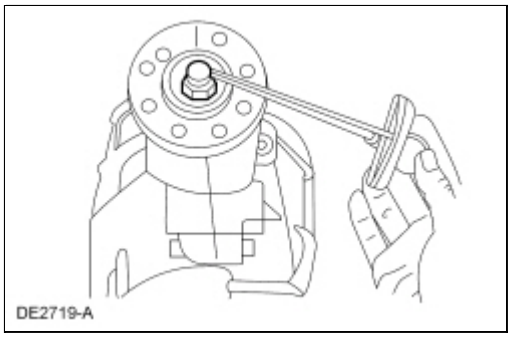
Removal

NOTICE: **The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation as the original. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.**

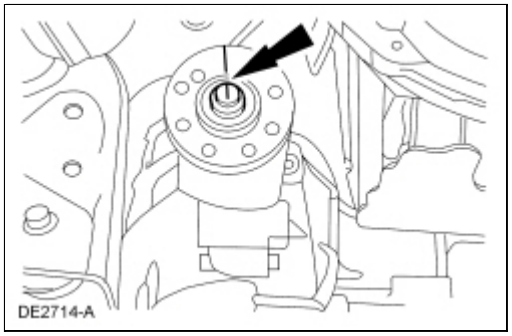
NOTICE: **This operation disturbs the pinion bearing preload. Carefully reset the pinion bearing preload during assembly.**

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. Remove the front brake pads. Refer to Section 206-03 .
3. Remove the front driveshaft. Refer to Section 205-01 .
4. Measure and record the pinion bearing preload.
   - Using a Nm (lb-in) torque wrench, rotate the pinion gear. Measure the torque required to maintain pinion gear rotation.

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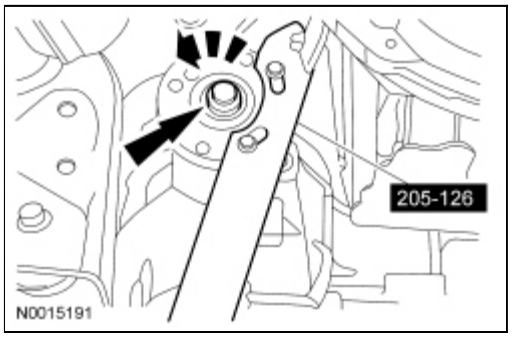


5. Index-mark the pinion flange and the drive pinion gear.

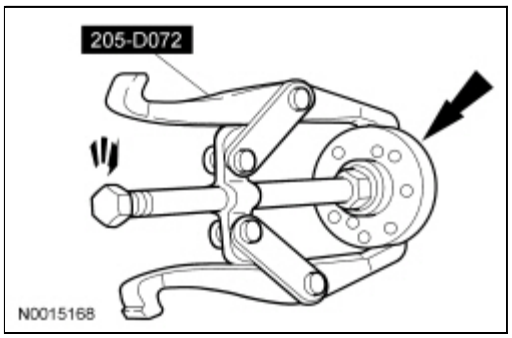


6. ***NOTICE:*** **Install a new pinion nut with the same color as the original if not replacing the collapsible spacer. If a new collapsible spacer is installed, install the nut in the kit or damage to the component may occur.**

   Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, remove and discard the pinion nut and washer.



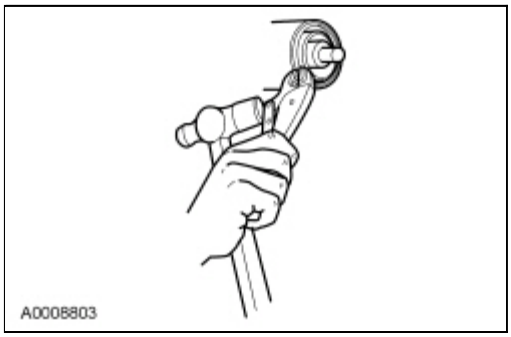
7. Using the 2 Jaw Puller, remove the pinion flange.



8. Inspect the pinion flange for burrs and damage. Inspect the end of the pinion flange that contacts the pinion bearing cone, pinion nut counterbore and drive pinion seal surface for nicks. Discard the pinion flange if damaged.

9. ***NOTICE:*** **Do not damage the axle housing.**

   Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer to remove the drive pinion seal.



10. Verify the splines on the drive pinion gear are free of burrs. If burrs are evident, remove them with a fine crocus cloth.

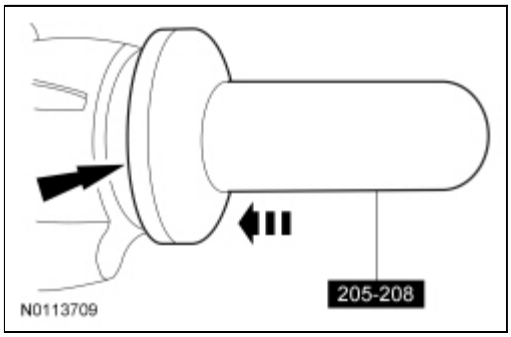
11. Clean the drive pinion seal bore.

Installation

1. **NOTE:** Lubricate the drive pinion seal lips with axle lubricant.

   NOTE: Drive pinion seal must be fully seated all the way around or drive pinion seal damage will occur.

   Using the Drive Pinion Oil Seal Installer, install the drive pinion seal.

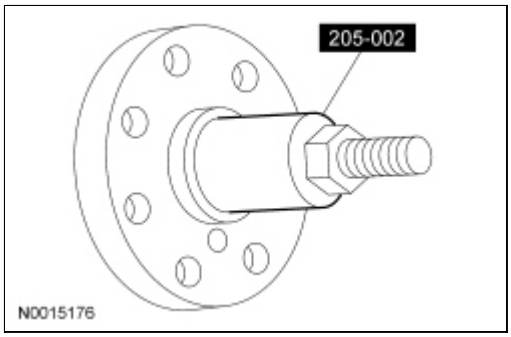


2. ***NOTICE:*** **Never use a hammer or install the pinion flange with power tools.**

   NOTE: Lubricate the pinion flange splines with axle lubricant.

   Align the index marks made during removal and, using the Drive Pinion Flange Installer, install the pinion flange.

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3. ***NOTICE:*** **The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation as the original. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.**

   Select the correct pinion nut for installation.

   8.8 In. Drive Pinion Nut

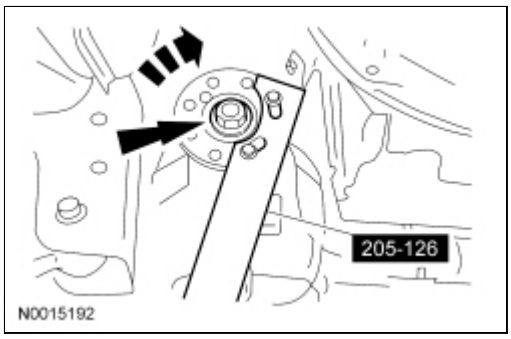
Part Number	Color Description	Part Description
389546-S100	Orange	Pinion nut
4320	Purple	Pinion nut
4C121	Purple	Kit with spacer for all 223.52 mm (8.8 in) axles

4. ***NOTICE:*** **Install a new pinion nut with the same color as the original if not replacing the collapsible spacer or damage to the component may occur.**

   Install the new washer and pinion nut. Only hand-tighten the pinion nut at this time.

5. ***NOTICE:*** **Do not loosen the pinion nut to reduce drive pinion bearing preload. Install a new drive pinion collapsible spacer and pinion nut if drive pinion bearing preload reduction is necessary. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.**

   Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, tighten the pinion nut to set the drive pinion bearing preload.
   - Tighten the pinion nut, rotating the pinion occasionally to make sure the drive pinion bearings are seating correctly. Take frequent drive pinion bearing preload readings by rotating the drive pinion gear with a Nm (lb-in) torque wrench. The final reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during removal.



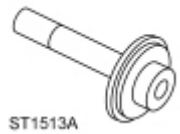
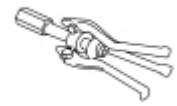
6. Install the front driveshaft. Refer to Section 205-01 .

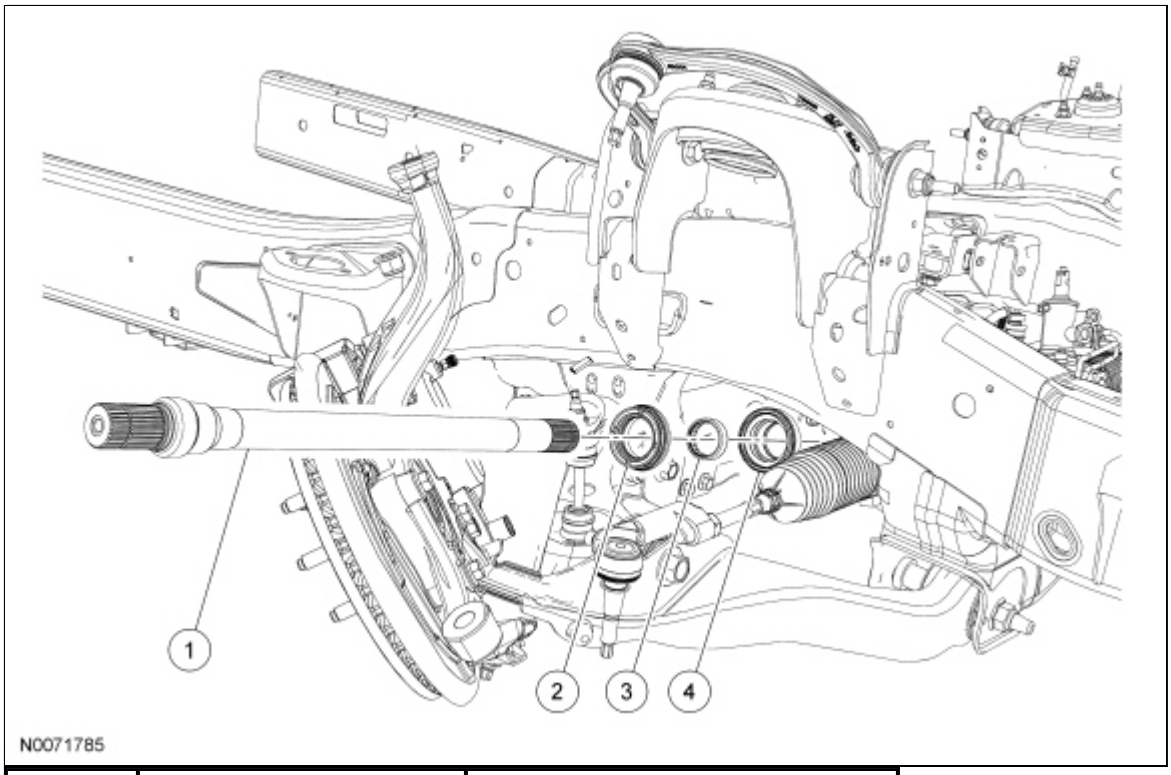
7. Install the disc brake pads. Refer to Section 206-03 .

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Stub Shaft Pilot Bearing and Seal

Special Tool(s)

 ST1326-A	Handle 205-D055 (D81L-4000-A)
 ST1513A	Installer, Axle Shaft Oil Seal 205-123 (T78P-1177-A)
 ST2369-A	Installer, Wheel Speed Sensor Ring 206-034 (T88P-20202-B)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

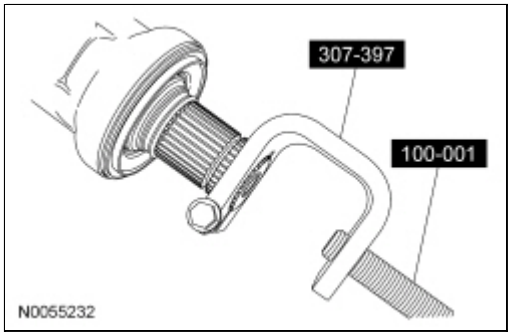


Item	Part Number	Description
1	3A380	Intermediate shaft
2	3B112	Stub shaft seal
3	4B413	Stub shaft bearing
4	3B210	Axle housing tube

Removal

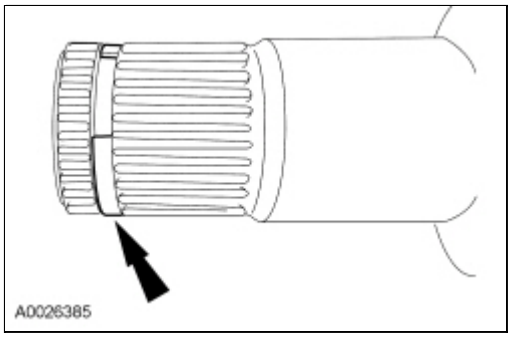
NOTE: Install a new stub shaft seal whenever a halfshaft is removed.

1. Remove the halfshafts. For additional information, refer to Section 205-03 .
2. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.

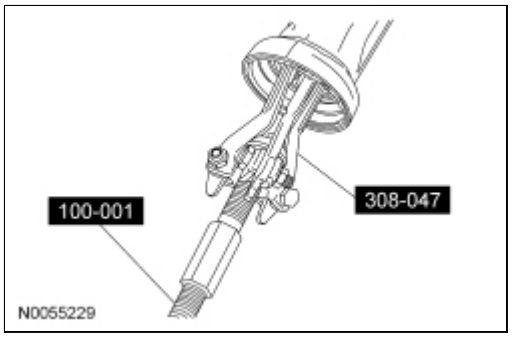


3. Remove and discard the intermediate shaft circlip.

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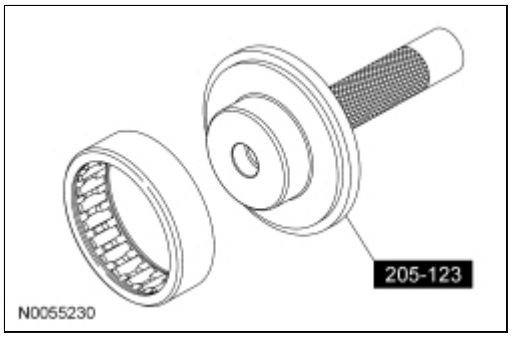


4. Using a suitable seal remover, remove and discard the stub shaft pilot bearing oil seal.
5. Using the Bearing Cup Remover and Slide Hammer, remove and discard the stub shaft pilot bearing.

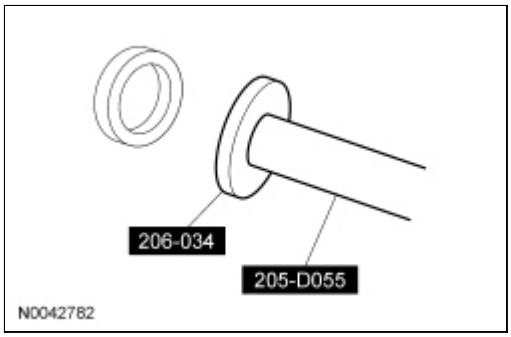


Installation

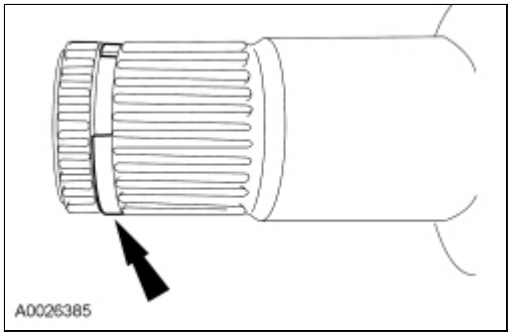
1. Position the stub shaft pilot bearing in the axle tube or differential housing bore and using the Axle Shaft Oil Seal Installer, install the bearing.



2. Carefully align the stub shaft pilot bearing oil seal with the housing bore and install the stub shaft bearing oil seal flush in the housing using the Wheel Speed Sensor Ring Installer and Handle.



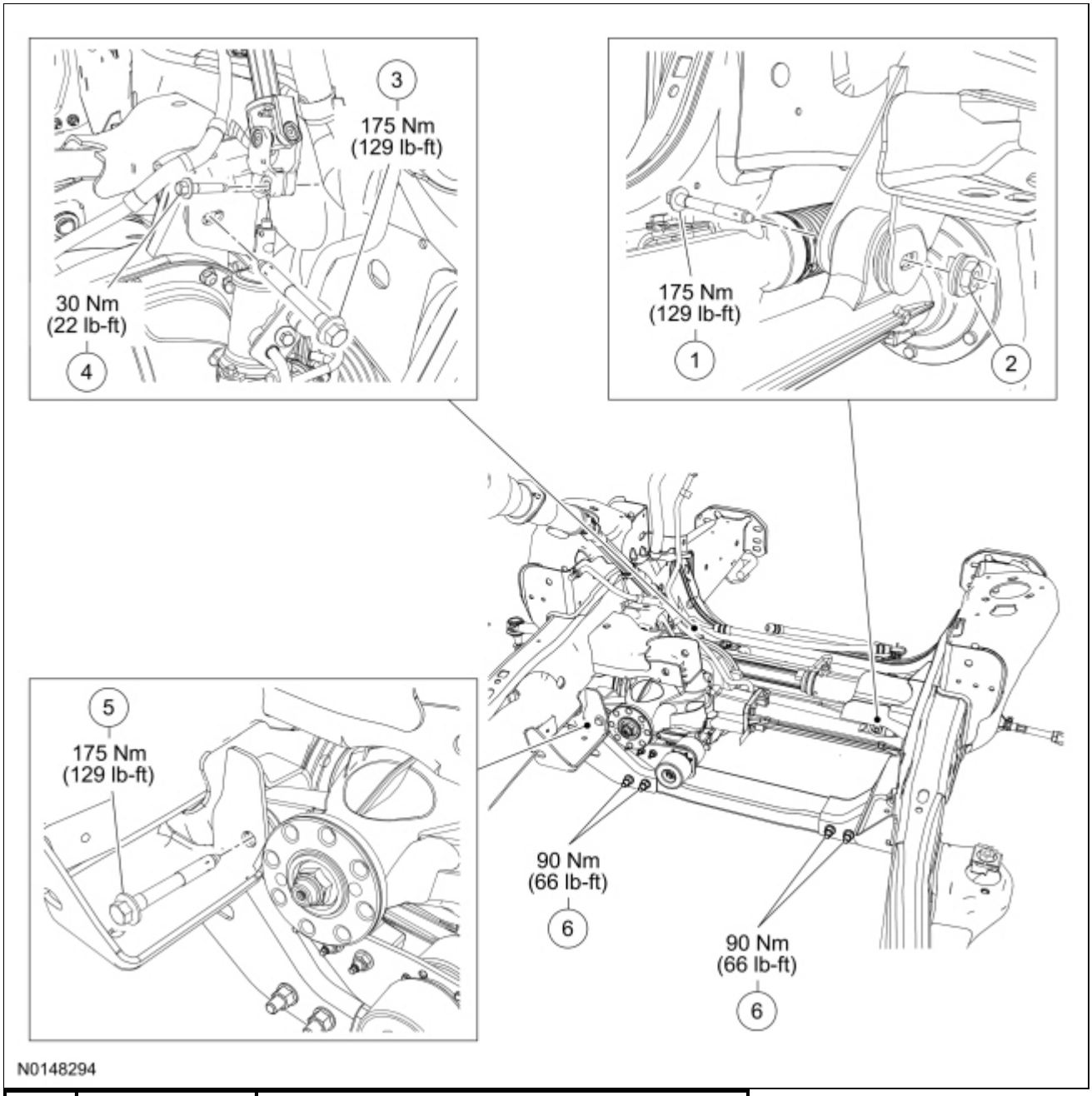
3. Install a new circlip on the intermediate shaft end.



4. Insert the intermediate shaft and engage the circlip with the differential side gear.
5. Install the halfshafts. For additional information, refer to Section 205-04 .

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Axle Assembly



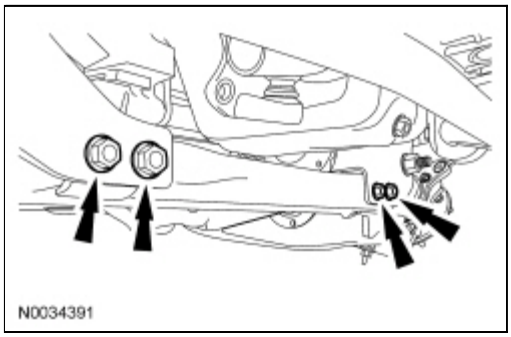
N0148294

Item	Part Number	Description
1	W712724	Axle tube bushing bolt
2	W712723	Axle tube bushing flagnut
3	W712724	Rear axle housing bushing bolt
4	N808684	Steering column coupler bolt

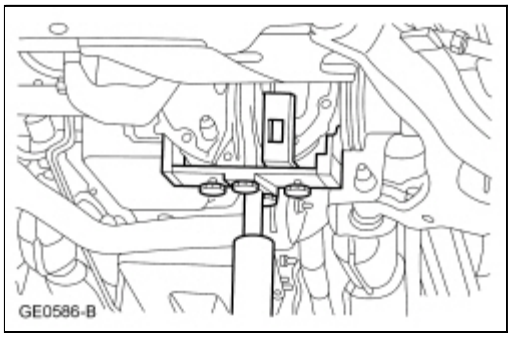
5	W712743	Front axle housing bushing support bolt
6	636893	Crossmember nuts (4 required)

Removal and Installation

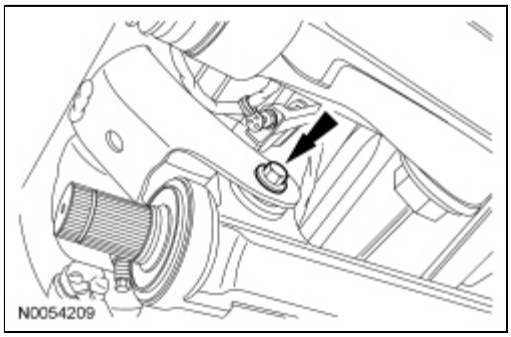
1. Remove the front driveshaft. Refer to Section 205-01 .
2. Remove the halfshafts. Refer to Section 205-04 .
3. Remove the 4 crossmember nuts and bolts and the crossmember.
   - To install, tighten to 90 Nm (66 lb-ft).



4. Use a high-lift jack to support the axle assembly.

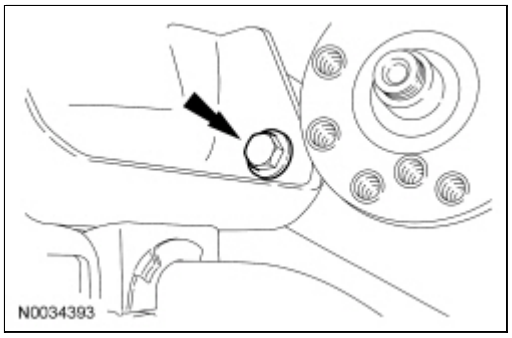


5. Remove the axle tube bushing bolt and flagnut.
   - To install, tighten to 175 Nm (129 lb-ft).



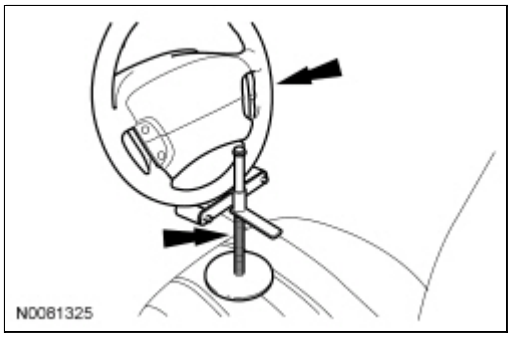
6. Remove the front axle housing bushing bolt.
   - To install, tighten to 175 Nm (129 lb-ft).

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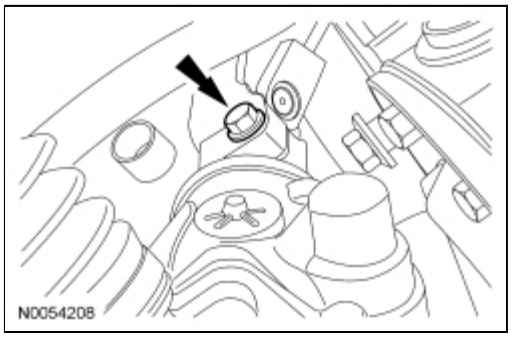
7. **NOTE:** Use a steering wheel holding device (such as a Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.

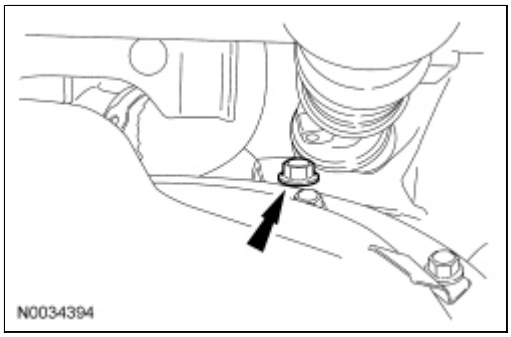


8. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. Refer to Section 501-20B .**

   Remove and discard the steering column shaft-to-steering gear bolt and disconnect the shaft from the steering gear.
   - To install, tighten the new bolt to 30 Nm (22 lb-ft).



9. Remove the rear axle housing bushing bolt.
   - To install, tighten to 175 Nm (129 lb-ft).



10. Carefully lower the front drive axle assembly.
11. Disconnect the vent hose from the axle vent barbed fitting.
12. **NOTE:** Make sure the axle vent hose is connected.

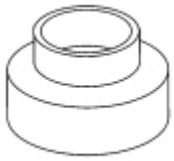
    To install, reverse the removal procedure.

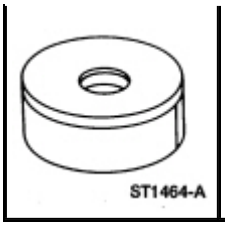
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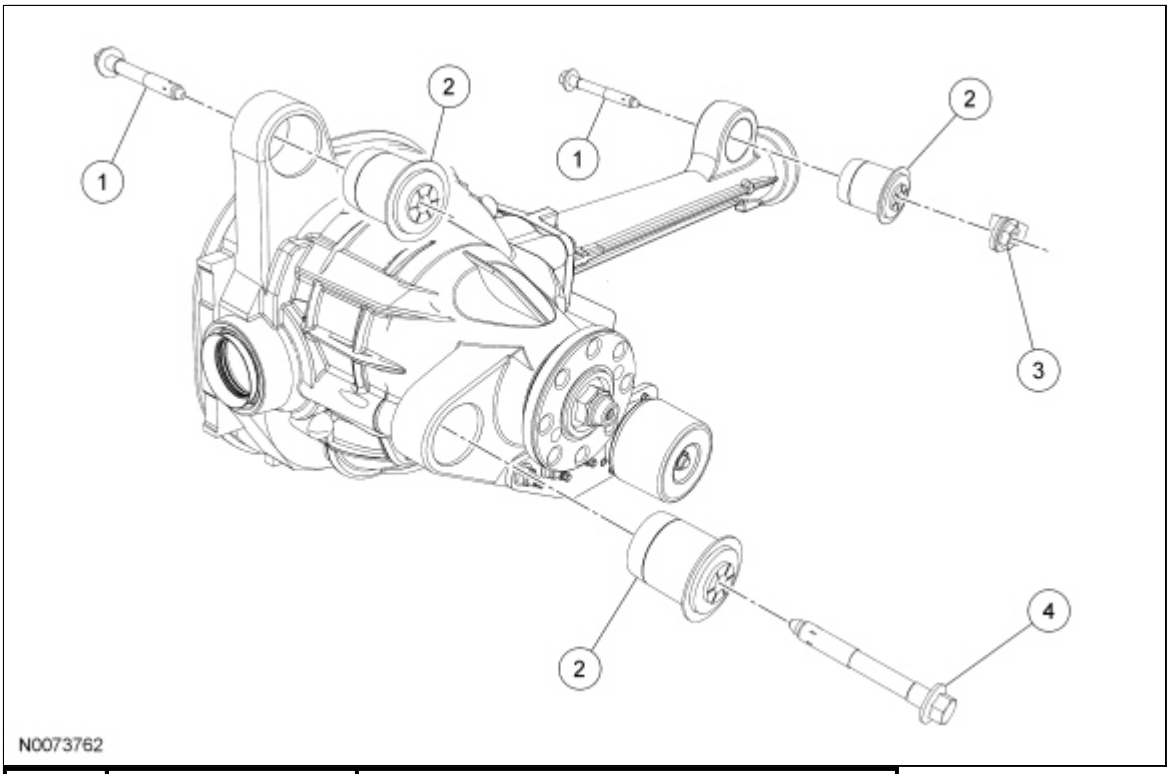
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Axle Carrier Bushing

Special Tool(s)

 ST1162-A	Installer, Front Axle Mounting Bushing Drawbolt 205-374 (T96T-5638-H)
 ST2586-A	Installer, Front Differential Mounting Bushing 204-187 (T95T-5638-AH)
 ST2265-A	Installer, Wheel Hub Dust Seal 205-289 (T89P-1249-A)
 ST1159-A	Remover, Front Axle Mounting Bushing Cup 205-371 (T96T-5638-E)
 ST1155-A	Remover, Front Axle Mounting Bushing 205-376 (T96T-5638-K)
 ST2587-A	Remover, Front Differential Housing Bushing 204-186 (T95T-5638-AH)
	Remover/Installer, Front Differential Housing Bushing 205-527/1





Item	Part Number	Description
1	W712724	Axle bushing bolts (2 required)
2	5638	Axle bushings (3 required)
3	W712723	Axle bushing flagnut
4	W712743	Axle bushing bolt

Removal

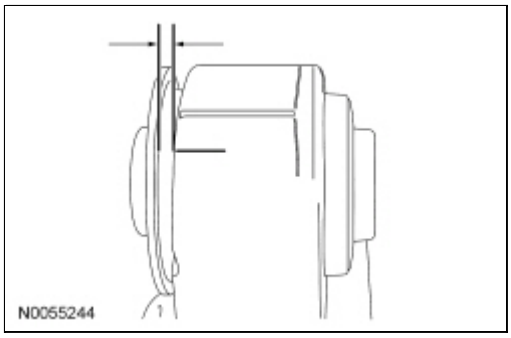
All bushings

1. **NOTE:** It is not necessary to remove the axle assembly from the jack.

   Remove the axle assembly. For additional information, refer to Axle Assembly in this section.

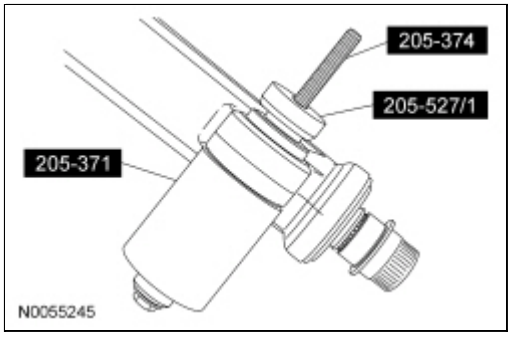
2. Measure and record the width of the gap between the bushing front lip and the housing. Mark the housing at the point where the measurement was taken.

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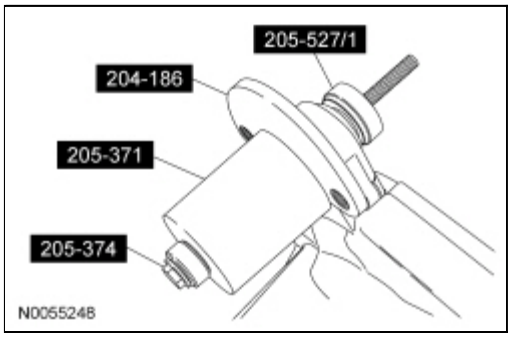
Axle tube bushing

3. Position the Front Axle Mounting Bushing Cup Remover, Front Differential Housing Bushing Remover/Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Turn in the drawbar to remove the bushing.



Rear housing bushing

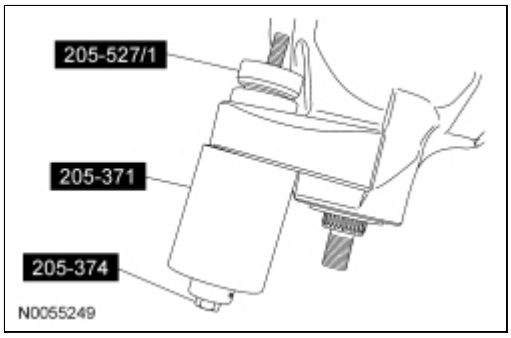
4. Position the Front Differential Housing Bushing Remover, Front Axle Mounting Bushing Cup Remover, Front Differential Housing Bushing Remover/Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Turn in the drawbar to remove the bushing.



Front housing bushing

5. Remove the pinion flange. For additional information, refer to Drive Pinion Flange and Seal in this section.

6. Position the Front Axle Mounting Bushing Cup Remover, Front Differential Housing Bushing Remover/Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Turn in the drawbar to remove the bushing.



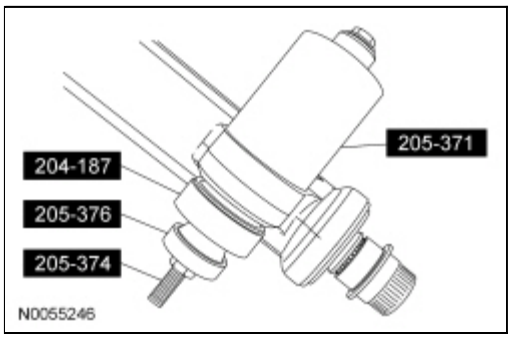
All bushings

7. Inspect the bushing bores for wear or damage.

Installation

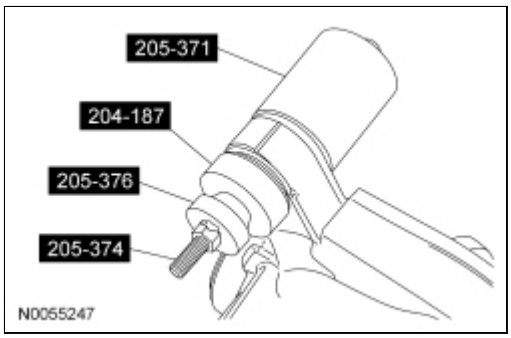
Axle tube bushing

1. Position the bushing and the Front Axle Mounting Bushing Remover, Front Differential Mounting Bushing Installer, Front Axle Mounting Bushing Cup Remover and Front Axle Mounting Bushing Drawbolt Installer as shown. Draw the bushing into the bushing bore to the same depth and point measured before removal.



Rear housing bushing

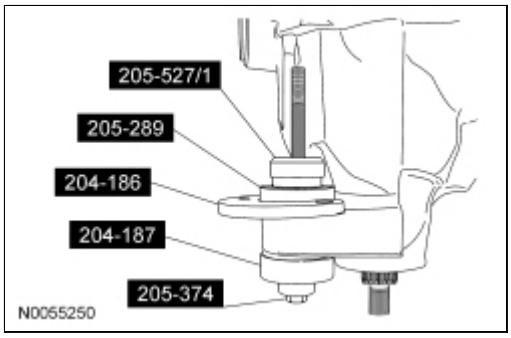
2. Position the bushing and the Front Axle Mounting Bushing Remover, Front Differential Mounting Bushing Installer, Front Axle Mounting Bushing Cup Remover and Front Axle Mounting Bushing Drawbolt Installer as shown. Draw the bushing into the bushing bore to the same depth and point measured before removal.



Front housing bushing

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3. Position the bushing and the Front Differential Housing Bushing Remover/Installer, Wheel Hub Dust Seal Installer, Front Differential Housing Bushing Remover, Front Differential Mounting Bushing Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Draw the bushing into the bushing bore to the same depth and point measured before removal.



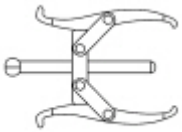
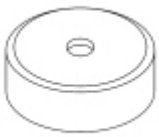
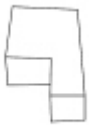
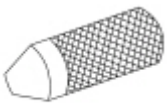
4. Install the U-joint flange. For additional information, refer to Drive Pinion Flange and Seal in this section.

All bushings

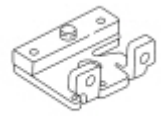
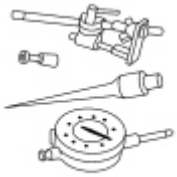
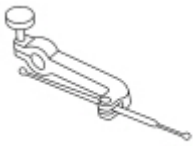
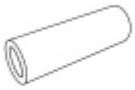
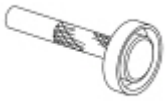
5. Install the axle assembly. For additional information, refer to Axle Assembly in this section.

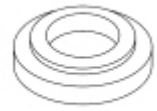
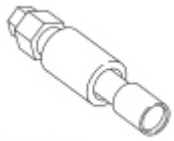
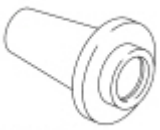
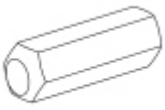
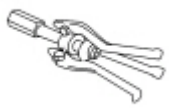
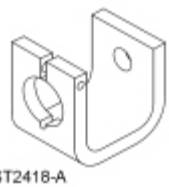
Differential Bearings

Special Tool(s)

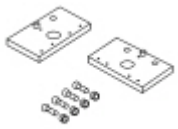
 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 **ST1433-B**	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)

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 ST1150-B	
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1357-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 **ST1437-A**	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cone

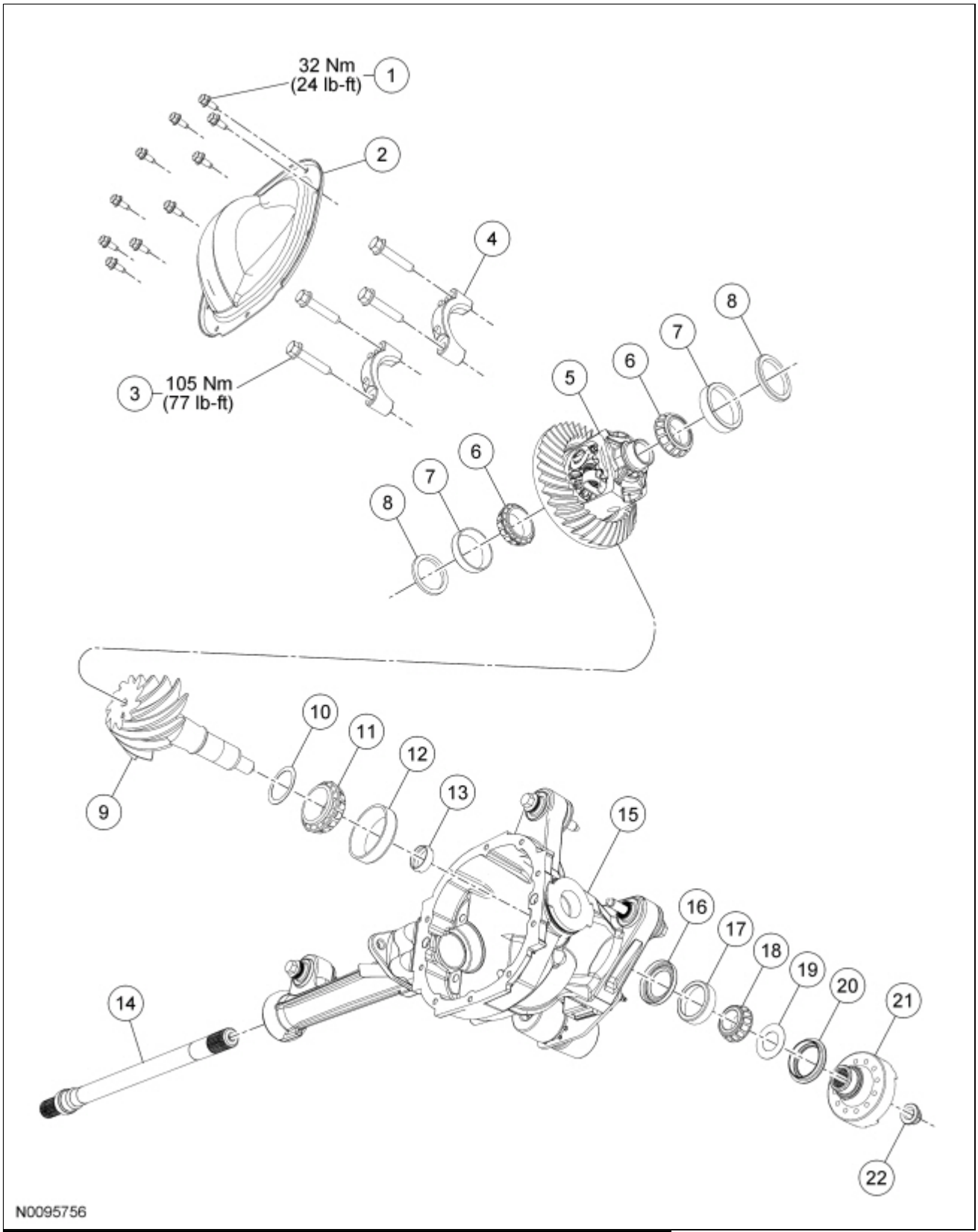
 ST1484-A	205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
	Slide Hammer 100-001 (T50T-100-A)

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 ST1185-A	
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E)
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)

Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4



Item	Part Number	Description
1	390919	Differential housing cover bolt (10 required)

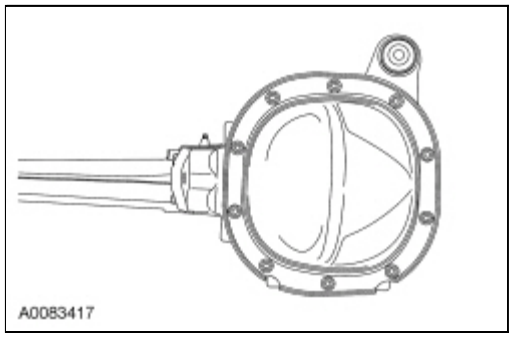
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2	3N136	Differential housing cover
3	—	Differential bearing cap bolt (part of 3A412) (4 required)
4	—	Differential bearing cap (part of 3A412) (2 required)
5	3C202	Differential assembly
6	4221	Differential bearings (2 required)
7	4221	Differential bearing cups (2 required)
8	4A451	Differential bearing shims (2 required)
9	—	Pinion gear (part of 4209)
10	4663	Drive pinion bearing adjustment shim
11	4628	Inner drive pinion bearing cup
12	4630	Inner drive pinion bearing
13	4662	Drive pinion collapsible spacer
14	3A380	Intermediate axle shaft
15	3A412	Differential housing
16	4631	Drive pinion oil baffle
17	4616	Drive pinion outer bearing cup
18	4621	Drive pinion outer bearing
19	386989	Drive pinion oil slinger
20	3N134	Drive pinion oil seal
21	4858	Drive pinion flange
22	389546	Drive pinion nut and washer

Removal

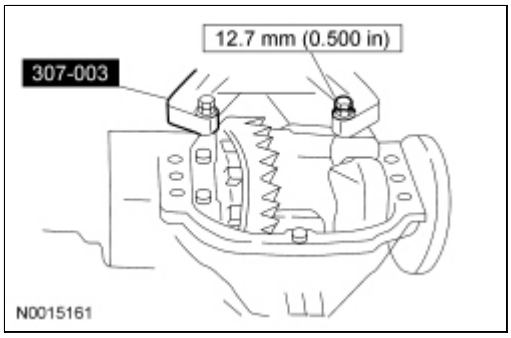
1. Remove the axle assembly. For additional information, refer to Axle Assembly in this section.

2. Remove the 10 bolts and the differential housing cover.
   - Drain the fluid.

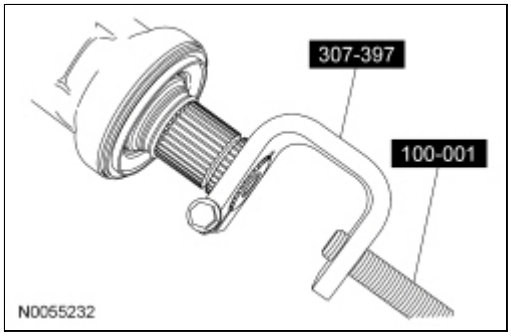


3. ***NOTICE:*** **The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

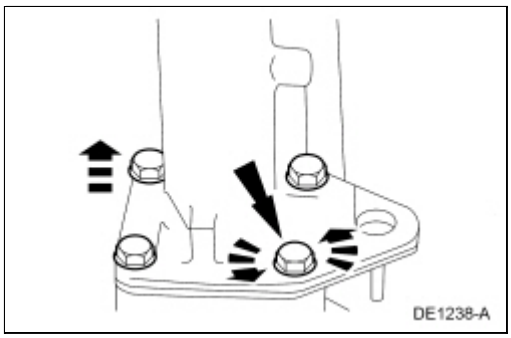
   Install the Transmission Holding Fixture.



4. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.

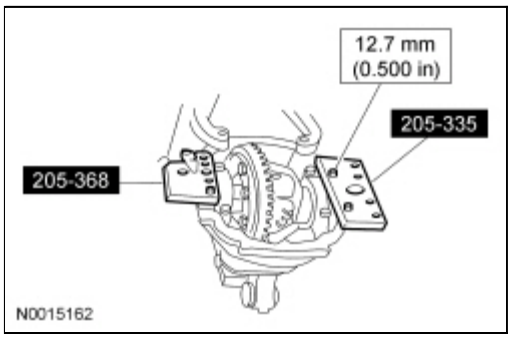


5. Remove the 4 bolts and the axle housing tube.



6. ***NOTICE:*** **The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

   Install the Differential Housing Spreader Plate and Adapter for Differential Housing Spreader.

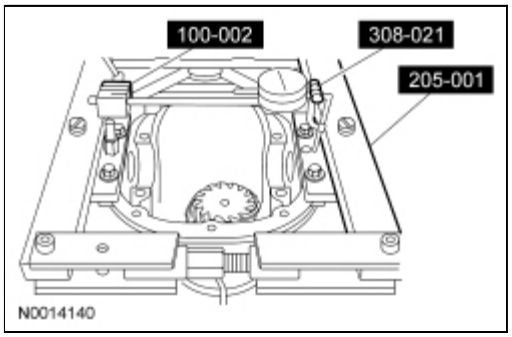


7. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier

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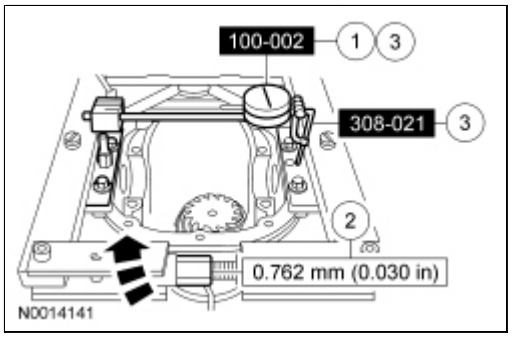
Spreader.

- Position the adapter tip in the spreader adapter hole.



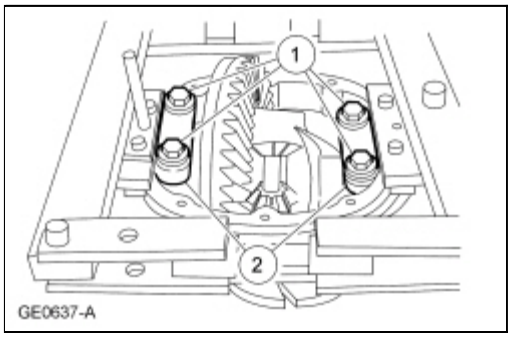
8. ***NOTICE:*** **Overspreading may damage the axle housing.**

   Spread the axle housing to the specification.
   1. Adjust the Dial Indicator Gauge to zero.
   2. Tighten the housing spreader screw to spread the axle housing to the specification.
   3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



9. ***NOTICE:*** **Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original location and position or damage to the component may occur.**

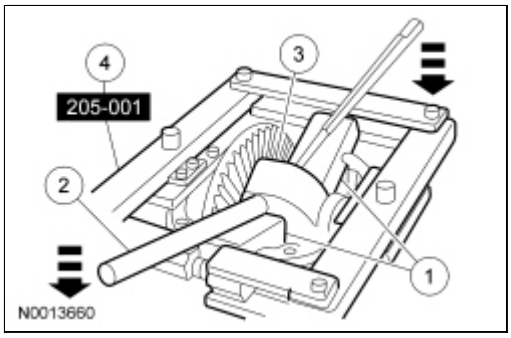
   Mark and remove the 2 differential bearing caps.
   1. Remove the 4 bolts.
   2. Remove the 2 differential bearing caps.



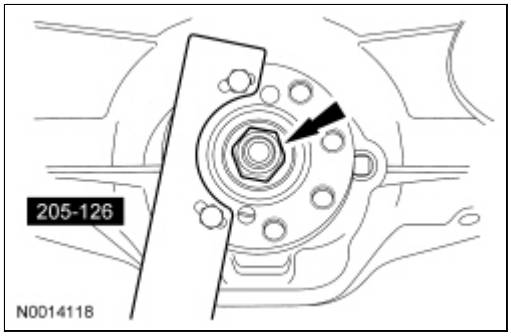
10. **NOTE:** Use wood blocks to avoid axle housing damage.

    Remove the differential assembly from the axle housing.

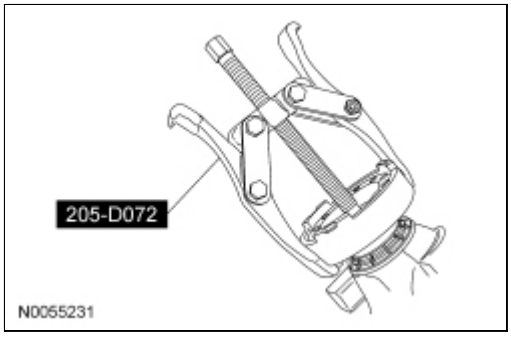
1. Position the wood blocks.
2. Position and push down on the 2 pry bars.
3. Remove the differential assembly.
4. Remove the Differential Carrier Spreader.



11. Install the Drive Pinion Flange Holding Fixture and loosen, but do not remove, the pinion nut.



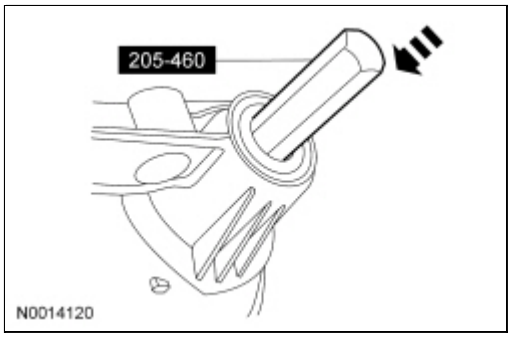
12. With the pinion nut still engaged by a few threads, use the 2 Jaw Puller to separate the axle U-joint flange from the pinion gear.



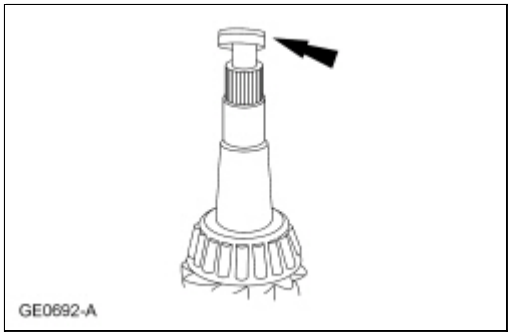
13. Remove the nut and the flange.

14. Using the Drive Pinion Thread Protector and a soft hammer, remove the pinion gear.

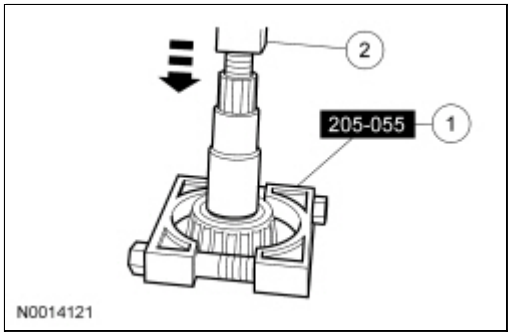
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15. Remove and discard the drive pinion collapsible spacer.

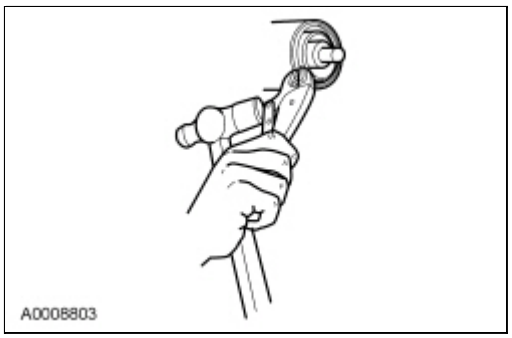


16. Using the Bearing Remover and a press, remove the drive pinion inner bearing.
    1. Position the Bearing Remover under the drive pinion inner bearing.
    2. Using a press, remove the inner drive pinion bearing and shim.



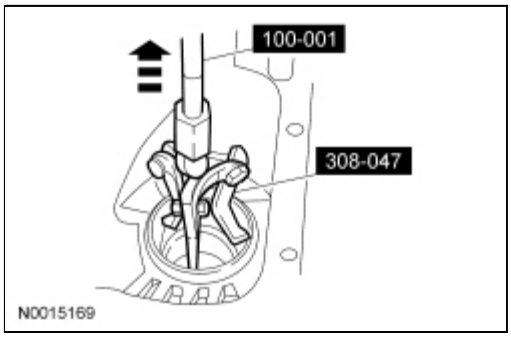
17. **NOTE:** Do not damage the carrier housing while removing the pinion seal.

    Remove the pinion seal and slinger.
    - Pry up on the seal flange. Install gripping pliers and strike with a hammer to remove the seal.



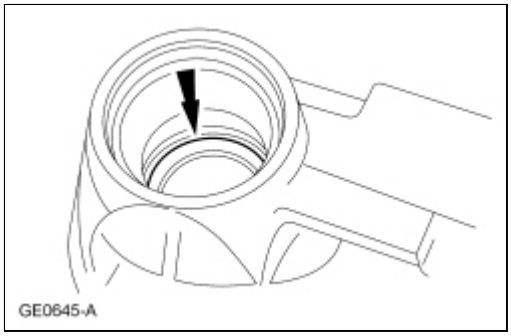
18. Remove the outer pinion bearing.

19. Using the Bearing Cup Remover and Slide Hammer, remove the inner drive pinion bearing cup.

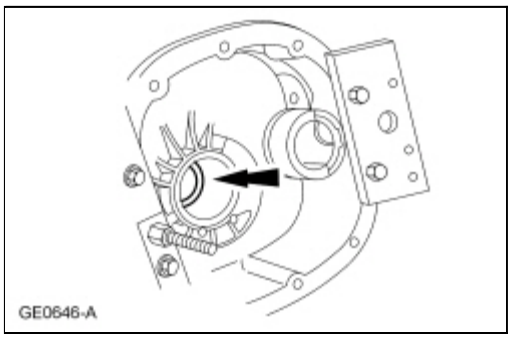


20. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

    If necessary, remove the pinion bearing oil baffle.



21. Remove the outer drive pinion bearing cup by tapping alternately on each side to prevent the drive pinion bearing cup from becoming misaligned.

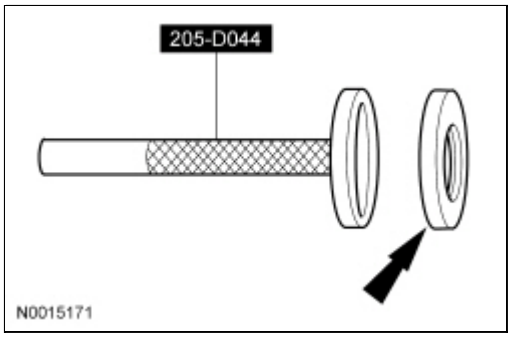


Installation

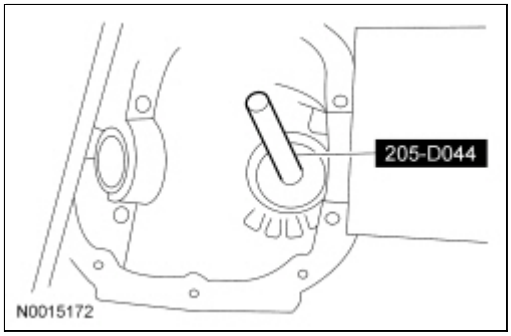
1. ***NOTICE:*** **Do not omit the drive pinion bearing oil baffle or drive pinion bearing failure may result.**

   If removed, position the drive pinion bearing oil baffle on the Differential Carrier Bearing Installer.

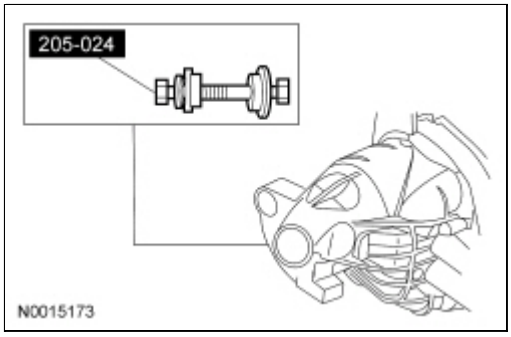
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2. Using the Differential Carrier Bearing Installer, install the drive pinion bearing oil baffle.



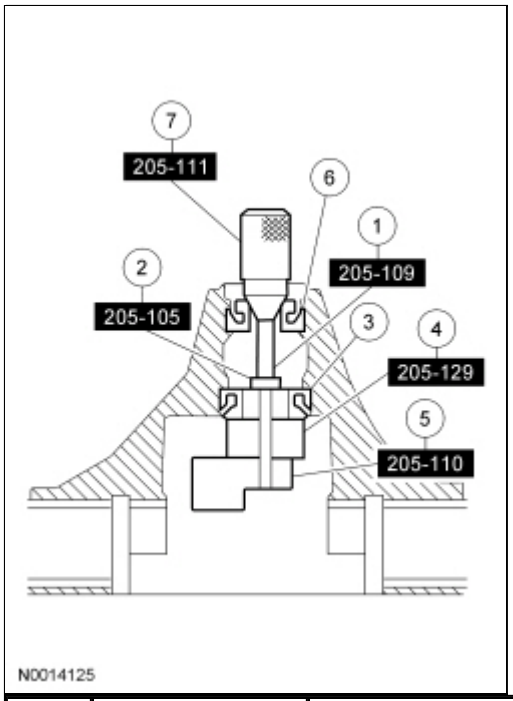
3. Using the Drive Pinion Bearing Cup Installer, install the drive pinion bearing cups.



4. ***NOTICE:*** **Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.**

   NOTE: Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

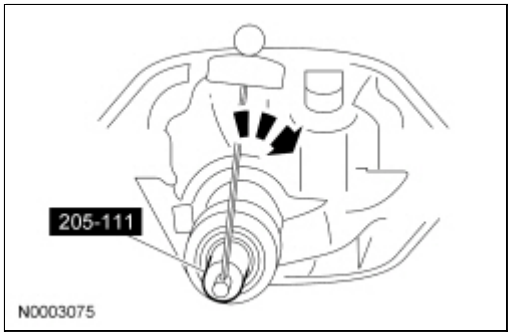
   Assemble and position the Adapters.



Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-105	Adapter for 205-S127 (T76P-4020-A3)
3	4630	Drive pinion bearing (inner)
4	205-129	Adapter for 105-S127 (T79P-4020-A18)
5	205-110	Adapter for 205-S127 (T76P-4020-A10)
6	4621	Drive pinion bearing (outer)
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

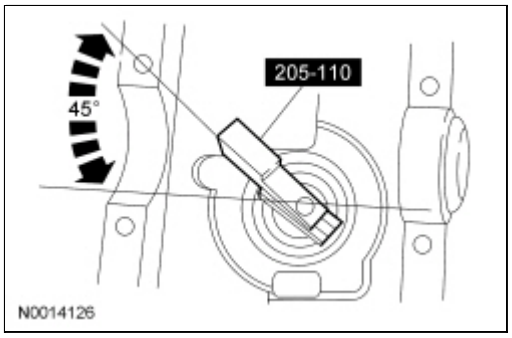
   Tighten the Adapter.
   - Tighten to 2.2 Nm (20 lb-in).



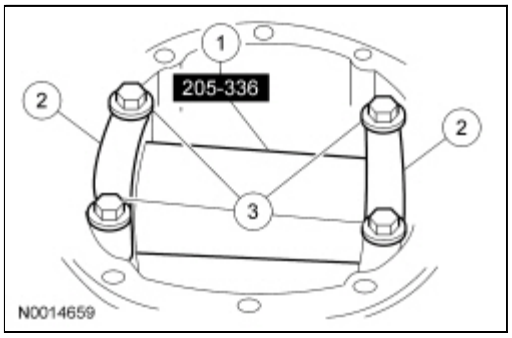
6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

   Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings and position the Adapter.

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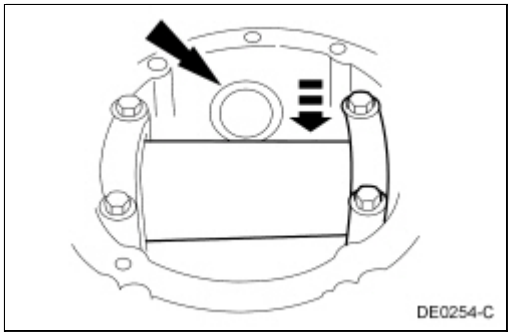
7. Install the Drive Pinion Gauge Tube.
    1. Position the Drive Pinion Gauge Tube.
    2. Install the 2 differential bearing caps.
    3. Install the 4 differential bearing cap bolts.
        - Tighten to 105 Nm (77 lb-ft).



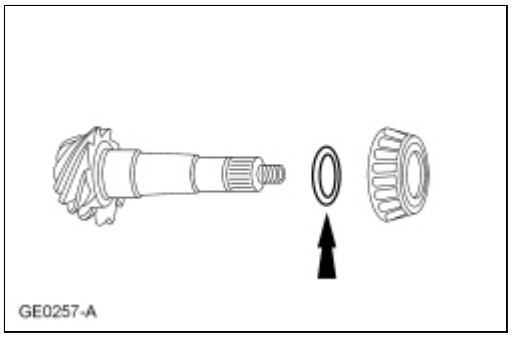
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

    NOTE: A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in final assembly of integral axle assemblies.

    Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.
    - After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the Adapters.

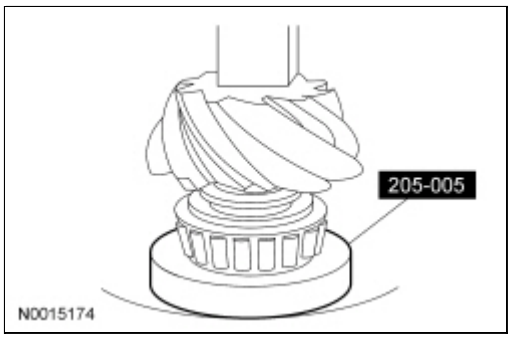


9. Position the drive pinion bearing adjustment shim and the inner pinion bearing on the drive pinion gear stem.

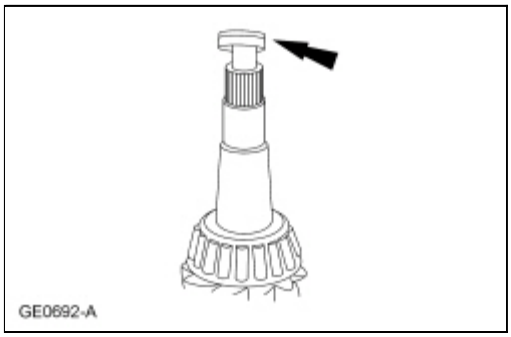


10. **NOTE:** The same drive pinion bearing from the previous steps must be used.

    Install the inner drive pinion bearing.
    - Place the drive pinion bearing adjustment shim on the drive pinion gear.
    - Using a suitable press and the Drive Pinion Bearing Cone Installer, press the inner drive pinion bearing until it is firmly seated on the pinion gear.

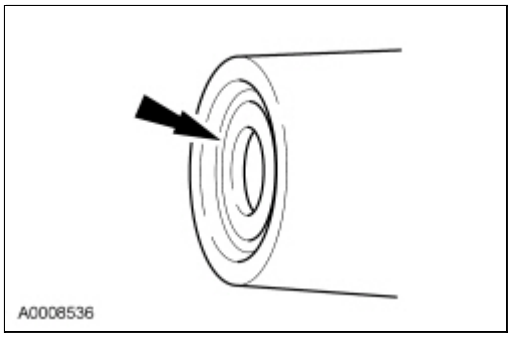


11. Place a new drive pinion collapsible spacer on the drive pinion gear.

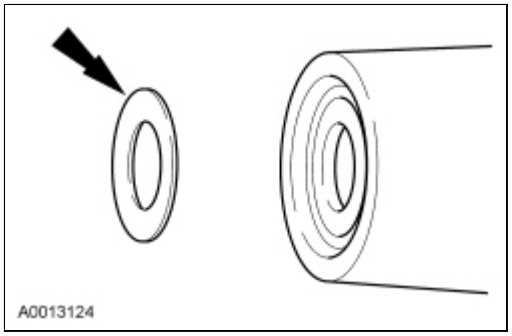


12. Install the outer drive pinion bearing.

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13. Install the drive pinion oil slinger.

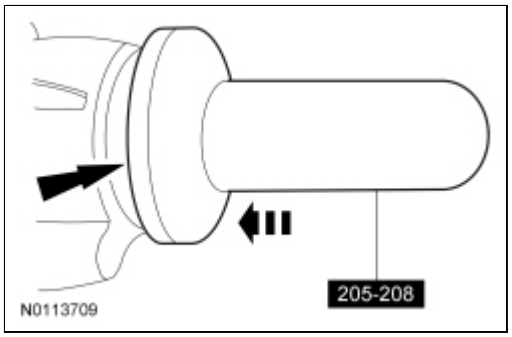


14. **NOTE:** Coat the drive pinion seal lips with long-life grease.

    Install the drive pinion seal on the Drive Pinion Oil Seal Installer.

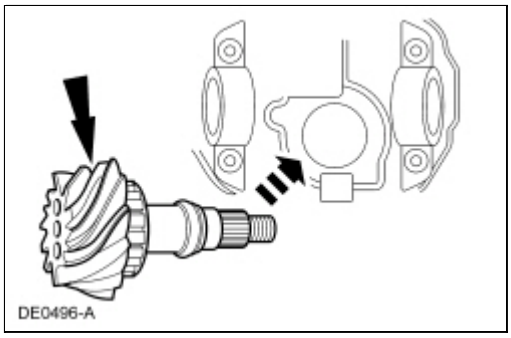
15. **NOTE:** If the drive pinion seal becomes misaligned during installation, remove it and install a new drive pinion seal.

    Using the Drive Pinion Oil Seal Installer, install the drive pinion seal.



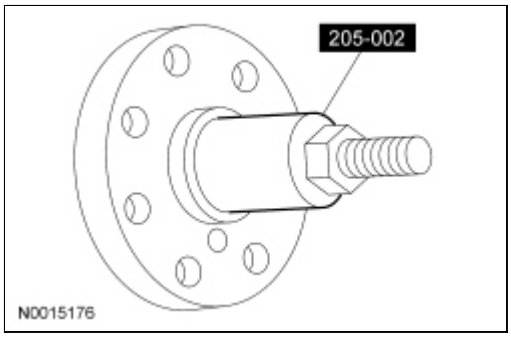
16. Lightly lubricate the drive pinion gear splines with rear axle lubricant.

17. Position the drive pinion gear in the axle housing.



18. Position the pinion flange.

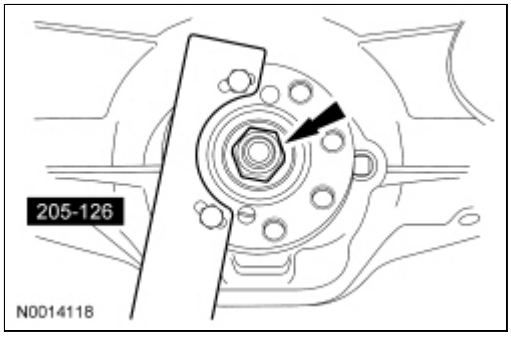
19. Using the Drive Pinion Flange Installer, install the pinion flange.



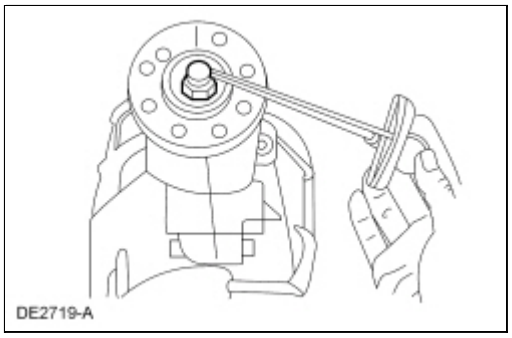
20. Apply a small amount of axle lubricant to the washer side of the new pinion nut and install the new pinion nut.

21. ***NOTICE:*** **Do not loosen the pinion nut to reduce drive pinion bearing preload under any circumstance. If it is necessary to reduce drive pinion bearing preload, install a new drive pinion collapsible spacer and pinion nut or damage to the component may occur.**

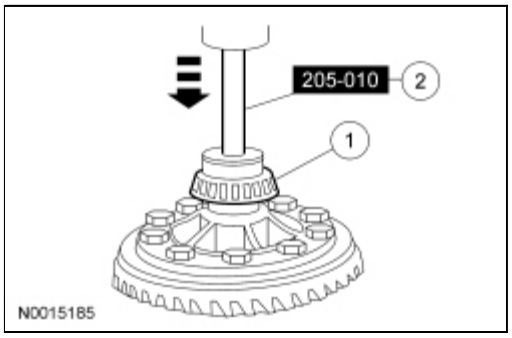
    Install the Drive Pinion Flange Holding Fixture and tighten the pinion nut. Refer to the torque specifications in the Specifications portion of this section.
    - Rotate the drive pinion gear occasionally to make sure the drive pinion bearings are seating correctly. Take frequent drive pinion bearing preload readings by rotating the drive pinion gear with a Nm (lb-in) torque wrench.



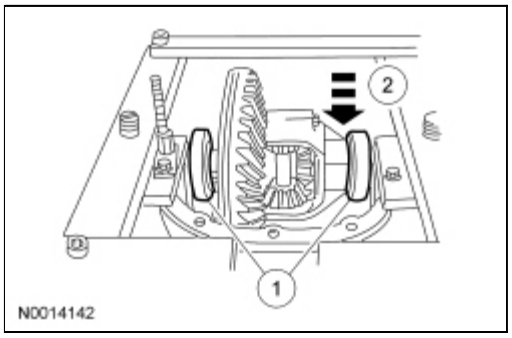
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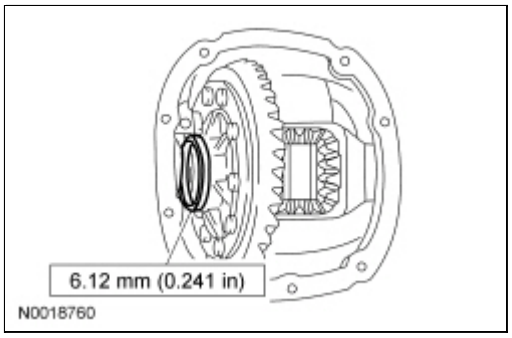
22. Press the left and right differential bearing on the differential case.
    1. Position the differential bearing.
    2. Using the Differential Side Bearing Installer, press the differential bearing on the differential case.
       - Repeat for the other side.



23. Install the differential carrier.
    1. Position the 2 differential bearing cups on the differential bearings.
    2. Lower the differential carrier in place.

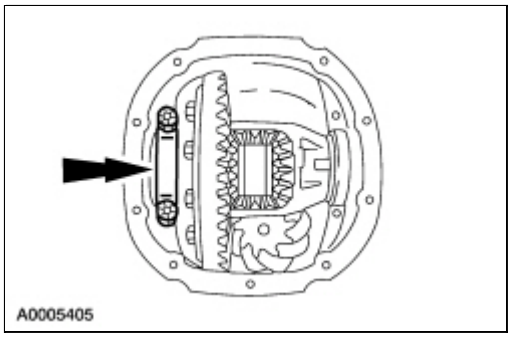


24. Install a differential bearing shim of the thickness shown on the LH side of the differential bearing.



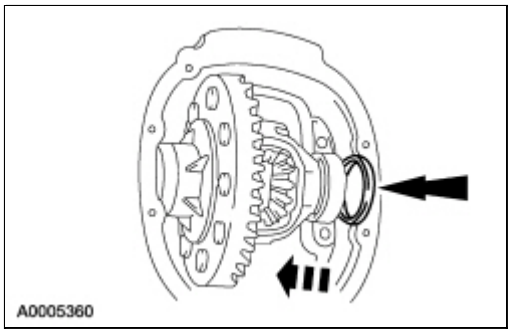
25. **NOTE:** Apply pressure toward the left side to make sure the left bearing cap is seated.

    Install the left bearing cap and loosely install the 2 bearing cap bolts.



26. **NOTE:** Apply pressure toward the left side to make sure the left bearing cap is seated.

    Install progressively thicker differential bearing shims on the right side until the thickest differential bearing shim can be inserted by hand.



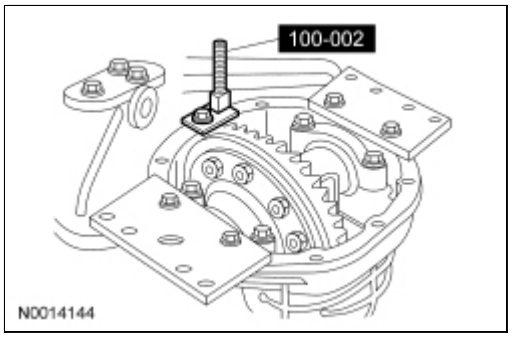
27. Install the right bearing cap and 2 bolts.

28. Tighten the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).

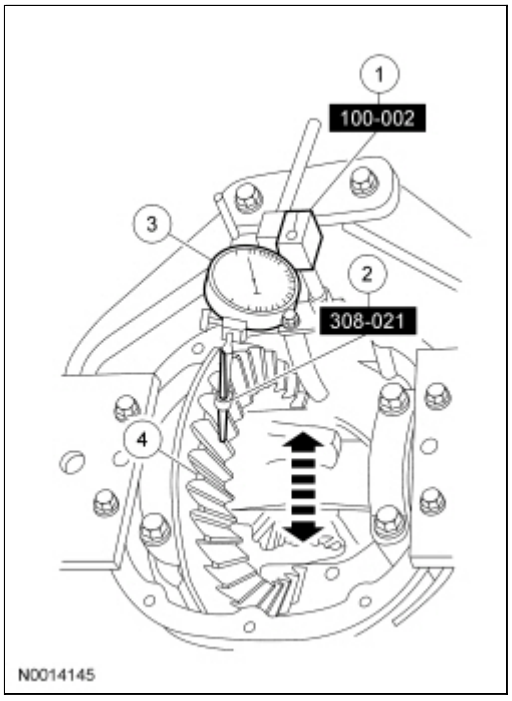
29. Rotate the differential carrier to make sure it turns freely.

30. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.

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31. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, measure the differential ring gear backlash at 4 equally spaced points.
    1. Attach the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.
    2. Position the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge tip centrally on a drive tooth.
    3. Zero the Dial Indicator.
    4. Turn the differential ring gear without turning the drive pinion gear. Record the indicator reading. The allowable backlash is 0.203 mm (0.008 in) to 0.305 mm (0.012 in) and must not vary more than 0.101 mm (0.004 in) between points measured.
        - To correct for a high or low backlash, proceed as follows.



32. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004

0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

Differential Shim Size Chart — 4067

Numbers of Stripes and Color Code	Dimension A	
	mm	Inch
2 — C-COAL	7.7978- 7.8105	0.3070- 0.3075
1 — C-COAL	7.7470- 7.7597	0.3050- 0.3055
5 — BLU	7.6962- 7.7089	0.3030- 0.3035
4 — BLU	7.6454- 7.6581	0.3010- 0.3015
3 — BLU	7.5946- 7.6073	0.2990- 0.2995
2 — BLU	7.5458- 7.5565	0.2970- 0.2975
1 — BLU	7.493- 7.505	0.2950- 0.2955
5 — PINK	7.4422- 7.4549	0.2930- 0.2935
4 — PINK	7.3914- 7.4041	0.2910- 0.2915
3 — PINK	7.3406- 7.3533	0.2890- 0.2895
2 — PINK	7.2898- 7.3025	0.2870- 0.2875
1 — PINK	7.2390- 7.2517	0.2850- 0.2855
5 — GRN	7.1882- 7.2009	0.2830- 0.2835
4 — GRN	7.1374- 7.1501	0.2810- 0.2815
3 — GRN	7.0866- 7.0993	0.2790- 0.2795
2 — GRN	7.0358- 7.0485	0.2770- 0.2775
1 — GRN	6.9850- 7.0485	0.2750- 0.2755
5 — WH	6.9342- 6.9469	0.2730- 0.2735
4 — WH	6.8834- 6.8961	0.2710- 0.2715
3 — WH	6.8326- 6.8453	0.2690- 0.2695
2 — WH	6.7818- 6.7945	0.2670- 0.2675
1 — WH	6.7310- 6.7437	0.2650- 0.2655

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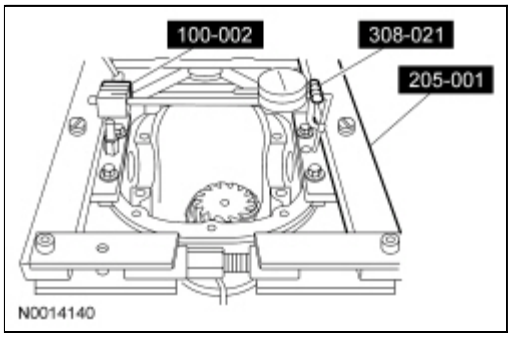
5 — YEL	6.6802- 6.6929	0.2630- 0.2635
4 — YEL	6.6294- 6.6421	0.2610- 0.2615
3 — YEL	6.5786- 6.5913	0.2590- 0.2595
2 — YEL	6.5278- 6.5405	0.2570- 0.2575
1 — YEL	6.4770- 6.4897	0.2550- 0.2555
5 — ORNG	6.4262- 6.4389	0.2530- 0.2535
4 — ORNG	6.3754- 6.3881	0.2510- 0.2515
3 — ORNG	6.3246- 6.3373	0.2490- 0.2495
2 — ORNG	6.2738- 6.2865	0.2470- 0.2475
1 — ORNG	6.2223- 6.2357	0.2450- 0.2455
2 — RED	6.1722- 6.1849	0.2430- 0.2435
1 — RED	6.1214- 6.1341	0.2410- 0.2415

33. Remove the 4 differential bearing cap bolts.
    - Remove the differential carrier.

34. Measure the thickness of the selected right and left bearing shims.

35. To establish differential bearing preload, increase both the left and right differential bearing shim thickness by 0.203 mm (0.008 in).

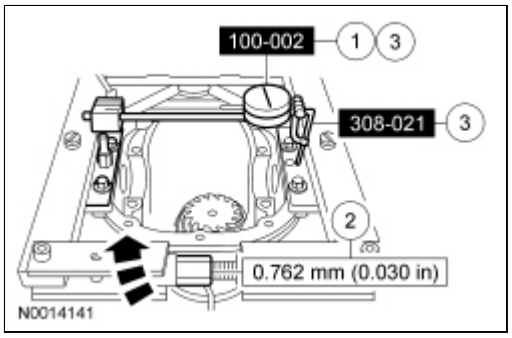
36. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.



37. ***NOTICE:*** **Overspreading may damage the differential housing.**

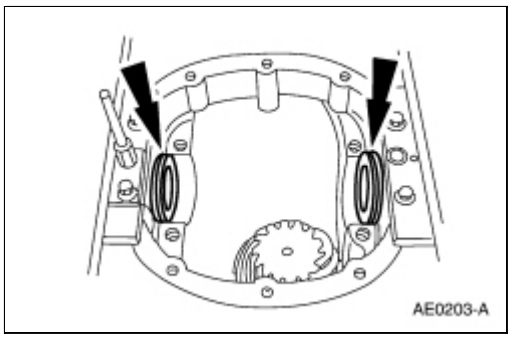
    NOTE: Tighten and loosen the differential carrier spreader screw to normalize the housing spreader adapters prior to taking the final Dial Indicator reading.

    Spread the differential housing to the specification.
    1. Adjust the Dial Indicator Gauge to zero.
    2. Tighten the screw until spreading the differential housing to the specification.
    3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.

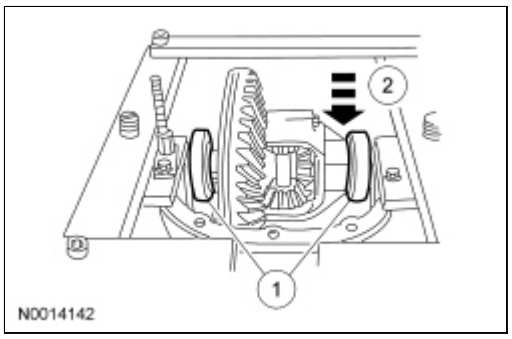


38. ***NOTICE:*** **To avoid galling the case, insert shims with a light coating of grease before installing the differential assembly. If not carried out in this order, the aluminum housing can be damaged.**

    Place the differential bearing shims in the differential housing.



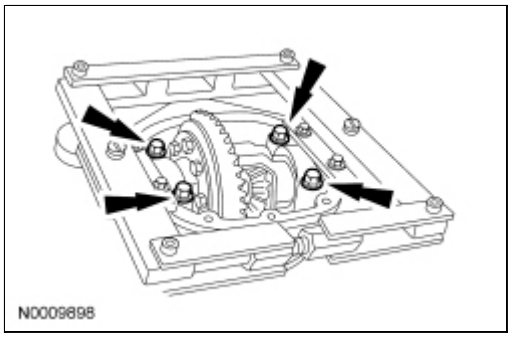
39. Install the differential carrier.
    1. Position the differential bearing cups on the differential bearings.
    2. Lower the differential carrier in place between the differential bearing shims.



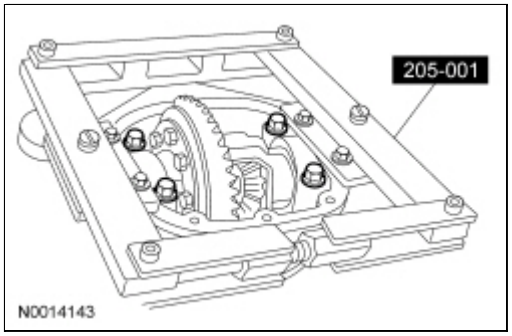
40. **NOTE:** Hand-tighten the differential bearing cap bolts prior to releasing the Differential Carrier Spreader.

    Install the 2 differential bearing caps and the 4 differential bearing cap bolts in their original locations and positions.

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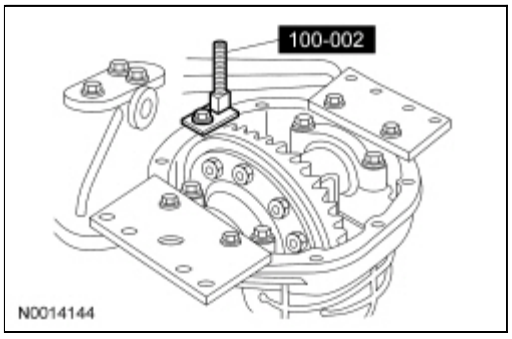
41. Loosen and remove the Differential Carrier Spreader.



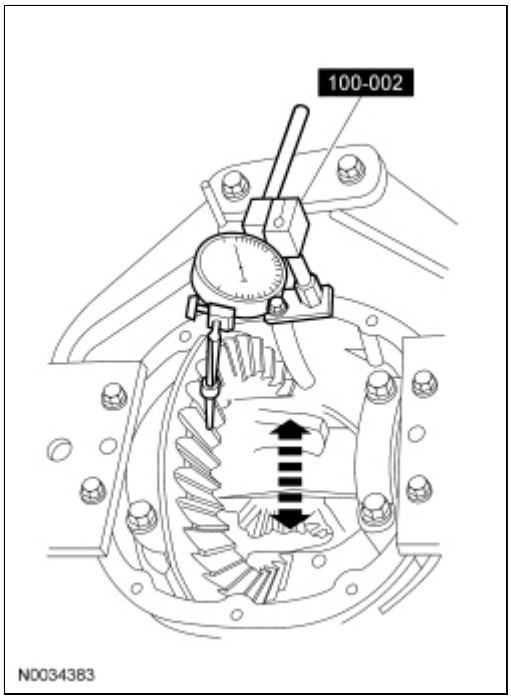
42. Tighten the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).

43. Rotate the differential carrier to make sure it turns freely.

44. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



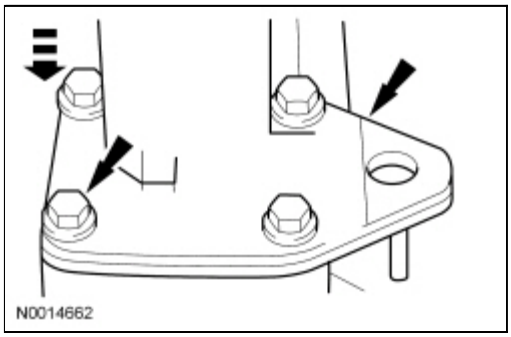
45. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.



46. Apply marking compound and rotate the differential assembly 5 complete revolutions.

47. Verify an acceptable pattern check. For additional information, refer to Diagnosis and Testing in this section.

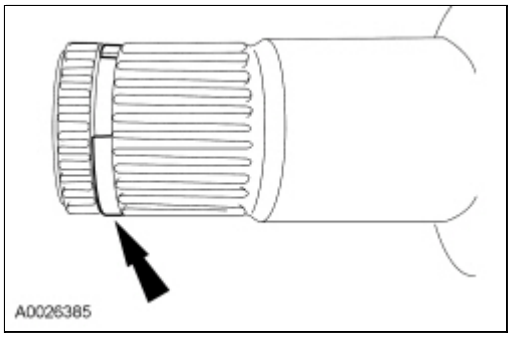
48. Install the axle housing tube and the 4 bolts.
    - Tighten to 73 Nm (54 lb-ft).



49. Install a new stub shaft seal. For additional information, refer to Stub Shaft Pilot Bearing and Seal in this section.

50. Install a new circlip on the intermediate shaft end.

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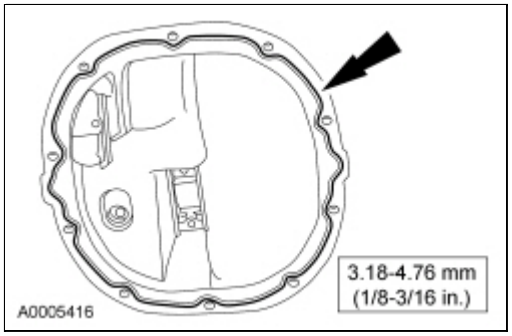
51. Insert the intermediate shaft and engage the circlip with the differential side gear.

52. Remove the axle assembly from the Transmission Holding Fixture and place it on the bench.

53. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

    NOTE: The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

    Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.
    - Use silicone gasket and sealant.



54. Install the differential housing cover and the 10 bolts.
    - Tighten to 32 Nm (24 lb-ft).

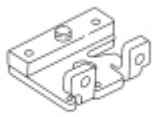
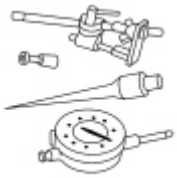
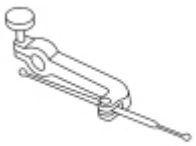
55. Install the axle assembly. For additional information, refer to Axle Assembly in this section.

56. Remove the fill plug and fill the axle assembly with the specified type and amount of axle lubricant.
    - Tighten the fill plug to 25 Nm (18 lb-ft).

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Differential Carrier

Special Tool(s)

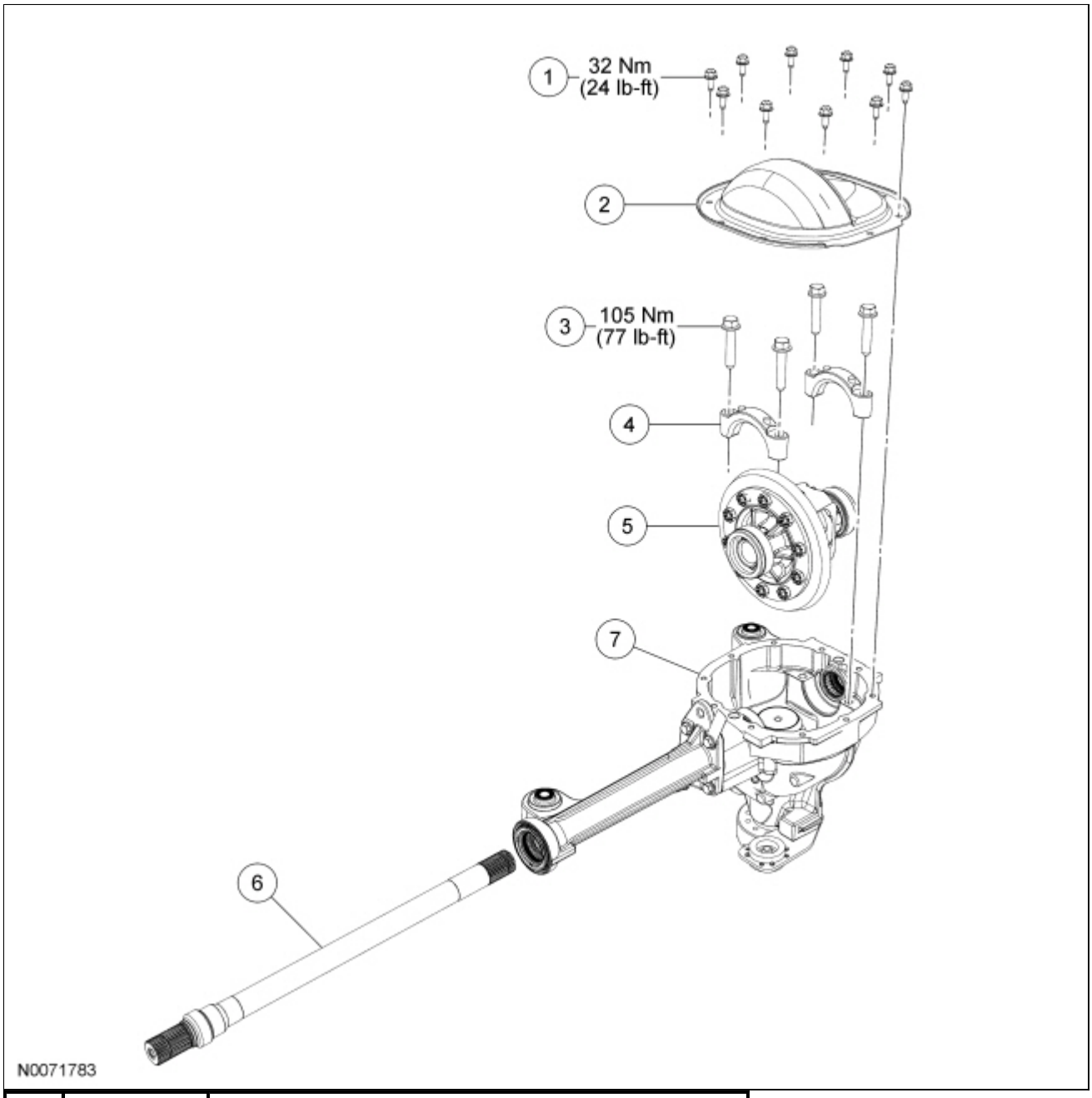
 ST1150-B	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST2891-A	Remover, Transmission Fluid Pump 307-397
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
	Spreader, Differential Carrier 205-001 (TOOL-4000-E)

 ST1259-A	
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)

Material

Item	Specification
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

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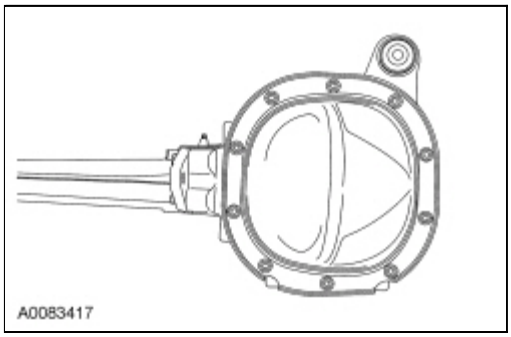


Item	Part Number	Description
1	390919	Differential housing cover bolt (10 required)
2	3N136	Differential housing cover
3	—	Differential bearing cap bolt (part of 3A412) (4 required)
4	—	Differential bearing cap (part of 3A412) (2 required)
5	3C202	Differential assembly
6	3A380	Intermediate axle shaft
7	3A412	Differential housing

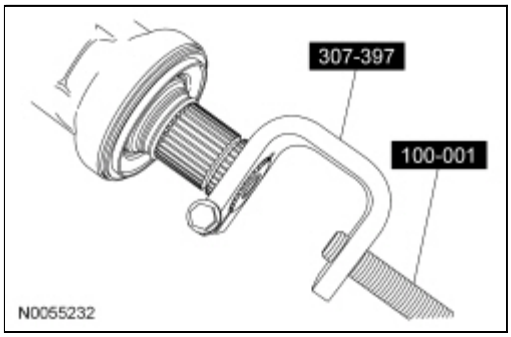
Removal

1. Remove the axle assembly. For additional information, refer to Axle Assembly in this section.

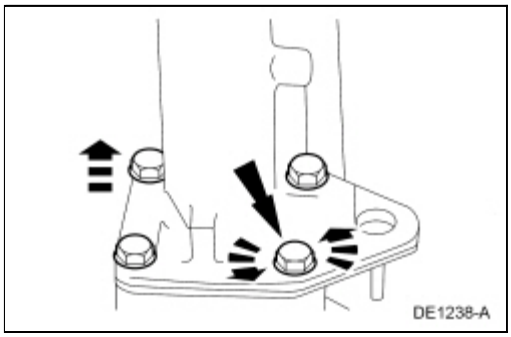
2. Remove the 10 bolts and the differential housing cover.
   - Drain the fluid.



3. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.



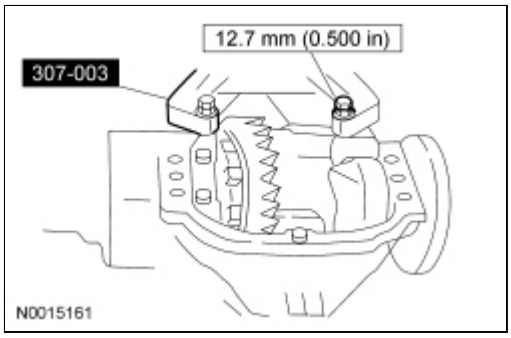
4. Remove the 4 bolts and the axle housing tube.



5. ***NOTICE:*** **The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

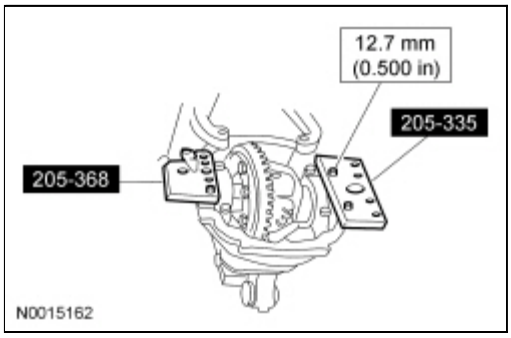
   Install the Transmission Holding Fixture.

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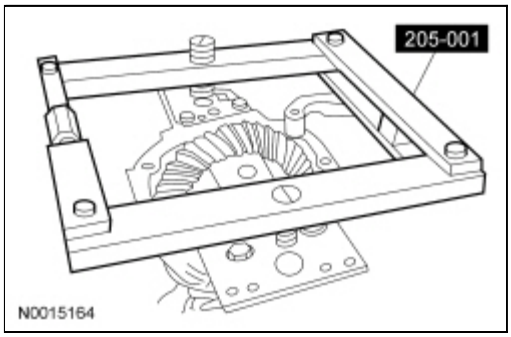


6. ***NOTICE:*** **The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

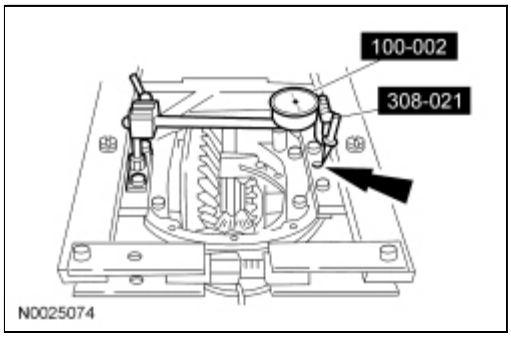
   Install the Differential Housing Spreader Plate and Adapter for Differential Housing Spreader.



7. Position the Differential Carrier Spreader on the spreader adapters.

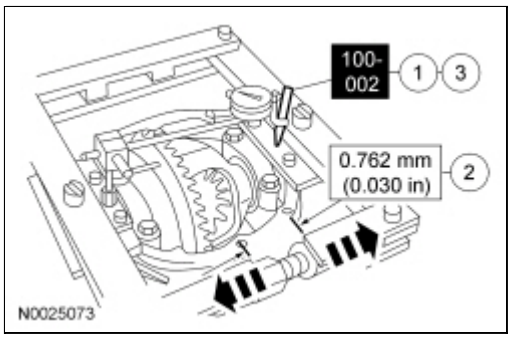


8. Install the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.
   - Position the adapter tip in the spreader adapter hole.



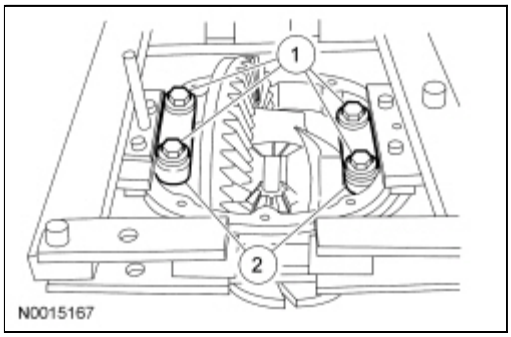
9. ***NOTICE:*** **Overspreading may damage the component.**

   Spread the axle housing to the specification.
   1. Adjust the Dial Indicator Gauge to zero.
   2. Tighten the housing spreader screw to spread the axle housing to the specification.
   3. Remove the Dial Indicator Gauge with Holding Fixture.



10. ***NOTICE:*** **Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the differential bearing caps in their original positions or damage to the component may occur.**

    Mark and remove the 2 differential bearing caps.
    1. Remove the 4 differential bearing cap bolts.
    2. Remove the 2 differential bearing caps.

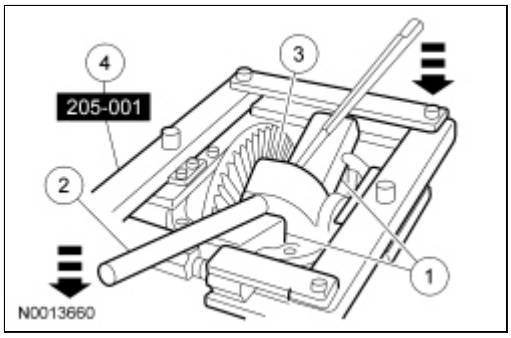


11. **NOTE:** Use wood blocks to avoid axle housing damage.

    NOTE: Index-mark the position of the differential bearing shims. The differential bearing shims must be installed in their original locations and positions.

    Remove the differential carrier from the axle housing.
    1. Position the wood blocks.
    2. Position and push down on the 2 pry bars.
    3. Remove the differential carrier.
    4. Remove the Differential Carrier Spreader.

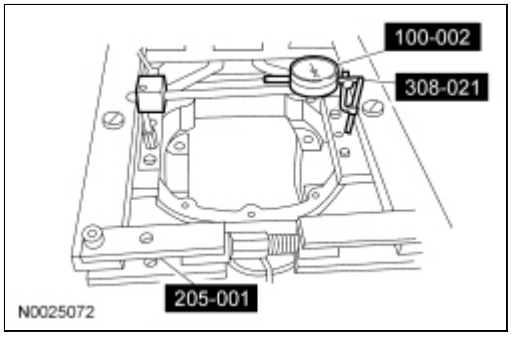
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Installation

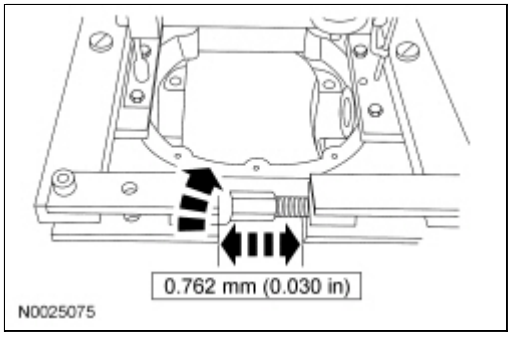
1. **NOTE:** Make sure the Dial Indicator needle is in the spreader adapter hole.

   Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.



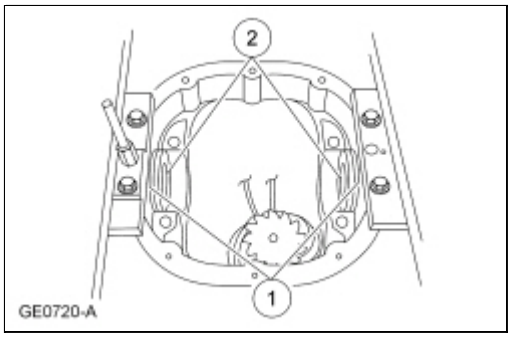
2. ***NOTICE:*** **Overspreading may damage the component.**

   Spread the axle housing to the specification.
   - Remove the Dial Indicator.



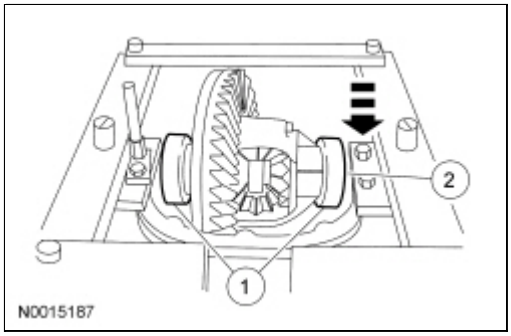
3. ***NOTICE:*** **Never attempt to drive the differential bearing shim in place. Permanent damage to the machined axle housing surfaces may occur.**

   Position the differential bearing shims.
   1. Apply a light coating of grease to one side of the differential bearing shims to help hold them in place.
   2. Position the differential bearing shims.

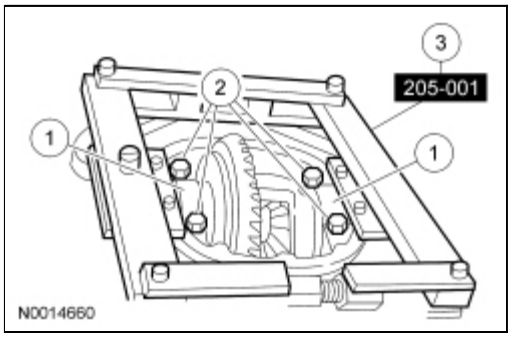


4. **NOTE:** Push the differential carrier downward to fully seat the differential bearing cups in the axle housing.

   Position the differential carrier.
   1. Position the differential bearing cups on the differential bearings.
   2. Lower the differential assembly in place between the differential bearing shims.

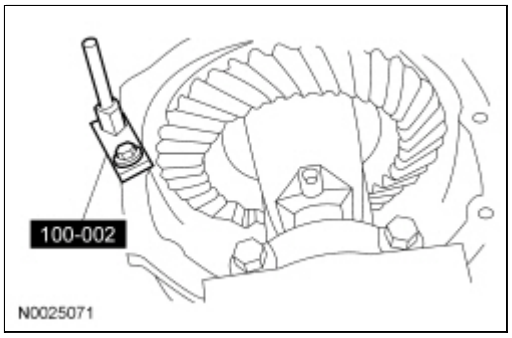


5. Install the differential bearing caps in their original positions and tighten with the housing still spread.
   1. Position the 2 differential bearing caps.
   2. Install the 4 differential bearing cap bolts.
      - Tighten to 105 Nm (77 lb-ft).
   3. Remove the Differential Carrier Spreader.

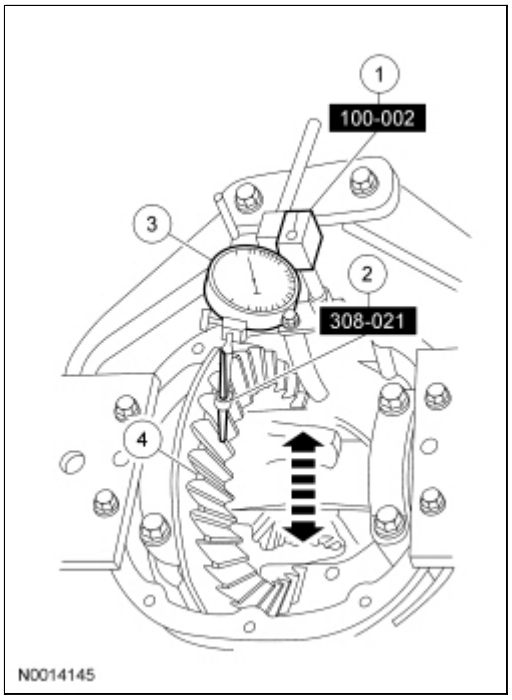


6. Install the Dial Indicator Gauge with Holding Fixture.

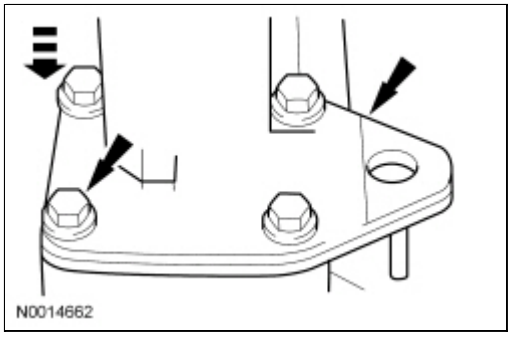
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7. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, measure the differential ring gear backlash at 4 equally spaced points.
    1. Attach the Dial Indicator Gauge with Holding Fixture.
    2. Position the Clutch Housing Gauge tip centrally on a drive tooth.
    3. Zero the Dial Indicator.
    4. Turn the differential ring gear without turning the drive pinion gear.

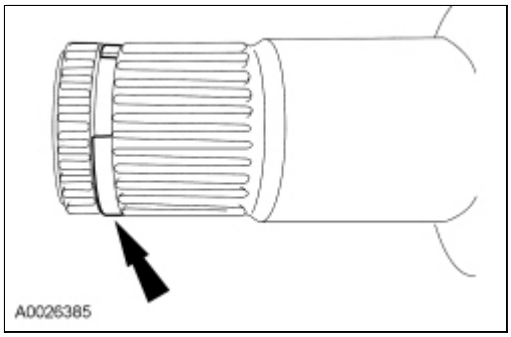


8. Install the axle housing tube and the 4 bolts.
    - Tighten to 73 Nm (54 lb-ft).



9. Install a new stub shaft seal. For additional information, refer to Stub Shaft Pilot Bearing and Seal in this section.

10. Install a new circlip on the intermediate shaft end.



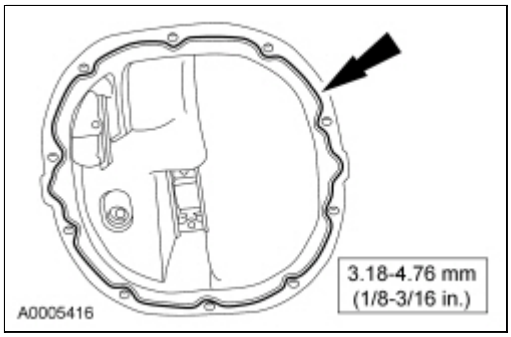
11. Insert the intermediate shaft and engage the circlip with the differential side gear.

12. Remove the axle assembly from the Transmission Holding Fixture and place it on the bench.

13. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

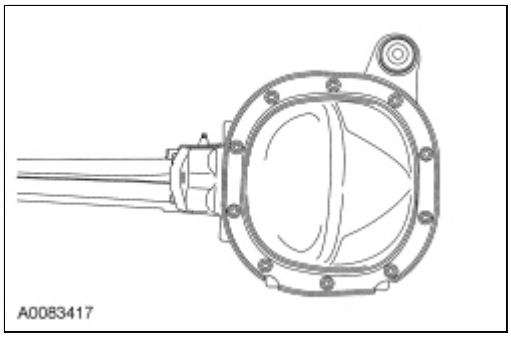
    NOTE: The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

    Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.
    - Use silicone gasket and sealant.



14. Install the differential housing cover and the 10 differential housing cover bolts.
    - Tighten to 32 Nm (24 lb-ft).

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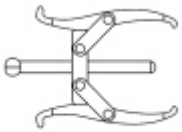
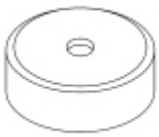
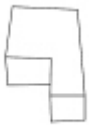
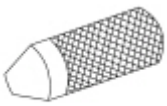


15. Install the axle assembly. For additional information, refer to Axle Assembly in this section.

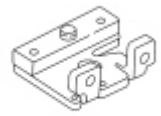
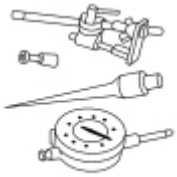
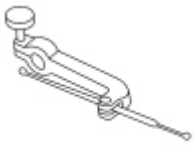
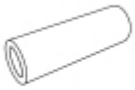
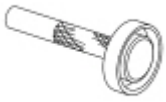
16. Remove the fill plug and fill the axle assembly with the specified type and amount of axle lubricant.
    - Tighten the fill plug to 25 Nm (18 lb-ft).

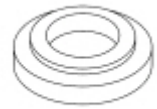
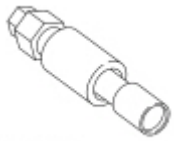
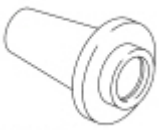
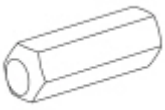
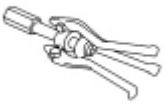
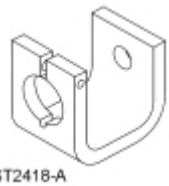
Differential Ring And Pinion

Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 **ST1433-B**	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)

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 ST1150-B	
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1357-A	Installer, Differential Carrier Bearings 205-D044 (D81T-4221-A) or equivalent
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cone

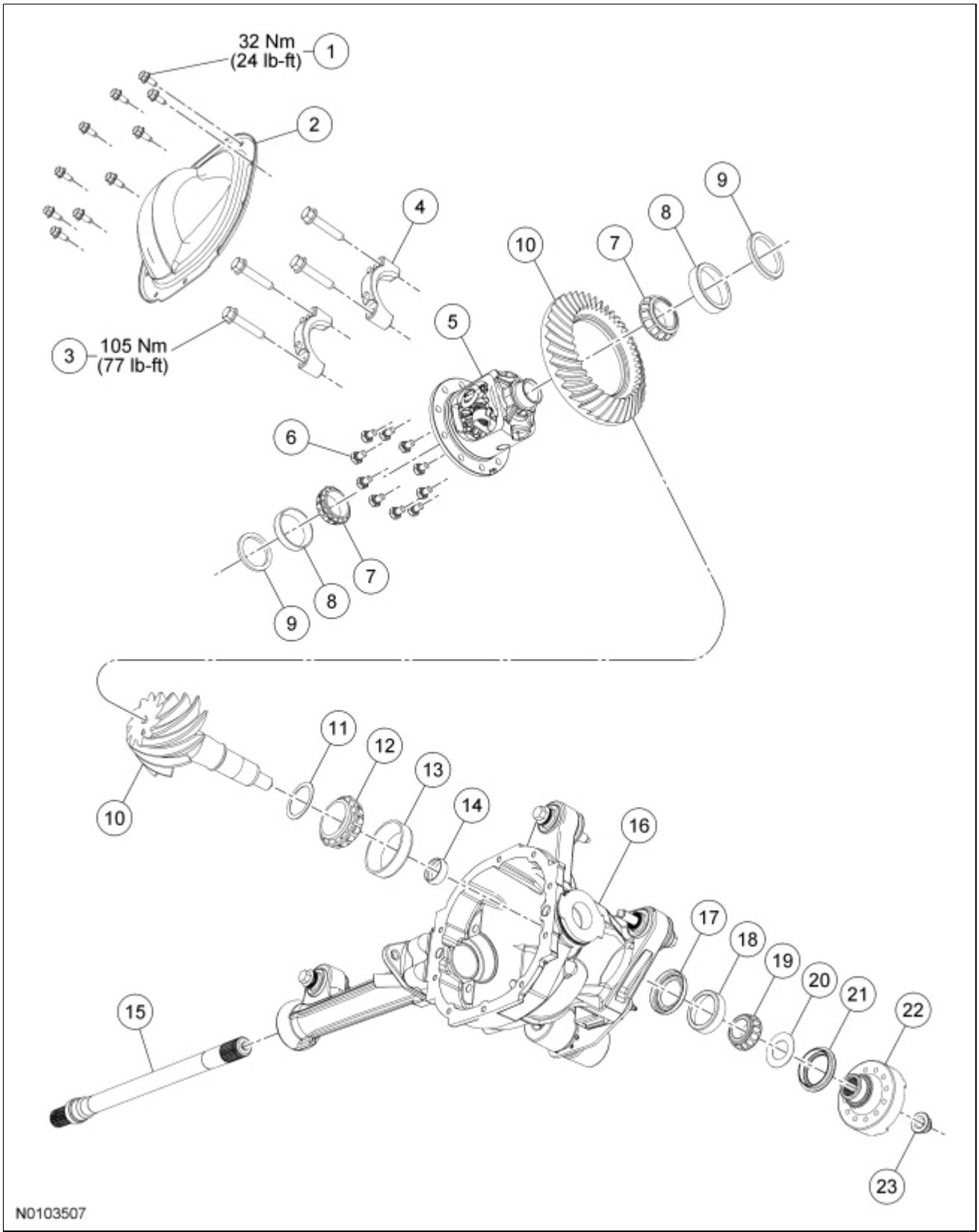
 ST1484-A	205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
	Spreader, Differential Carrier 205-001 (TOOL-4000-E)

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 ST1259-A	
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)
 ST2043-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4



Item	Part Number	Description
1	390919	Differential housing cover bolt (10 required)

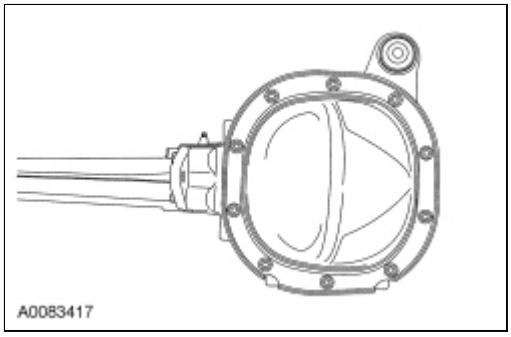
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2	3N136	Differential housing cover
3	—	Differential bearing cap bolt (part of 3A412) (4 required)
4	—	Differential bearing cap (part of 3A412) (2 required)
5	3C202	Differential assembly
6	388056	Ring gear bolt (10 required)
7	4221	Differential bearings (2 required)
8	4221	Differential bearing cups (2 required)
9	4A451	Differential bearing shims (2 required)
10	—	Ring gear (part of 4209)
10	—	Pinion gear (part of 4209)
11	4663	Drive pinion bearing adjustment shim
12	4628	Inner drive pinion bearing cup
13	4630	Inner drive pinion bearing
14	4662	Drive pinion collapsible spacer
15	3A380	Intermediate axle shaft
16	3A412	Differential housing
17	4631	Drive pinion oil baffle
18	4616	Drive pinion outer bearing cup
19	4621	Drive pinion outer bearing
20	386989	Drive pinion oil slinger
21	3N134	Drive pinion oil seal
22	4858	Drive pinion flange
23	389546	Drive pinion nut and washer

Removal

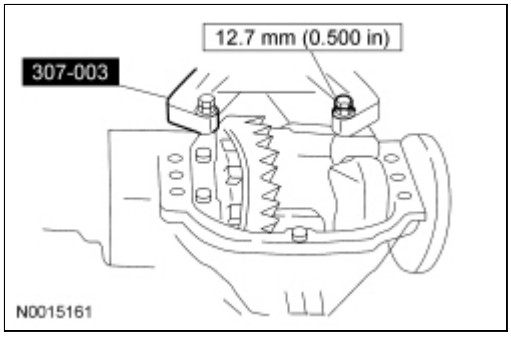
1. Remove the axle assembly. For additional information, refer to Axle Assembly in this section.

2. Remove the 10 bolts and the differential housing cover.
   - Drain the fluid.

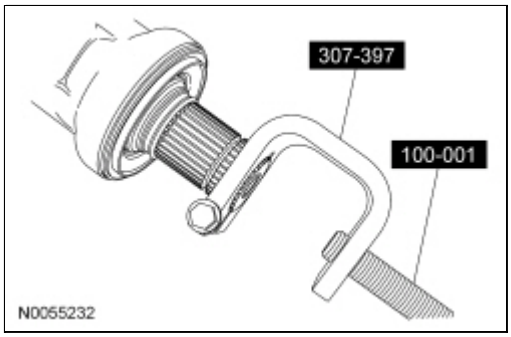


3. ***NOTICE:*** **The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

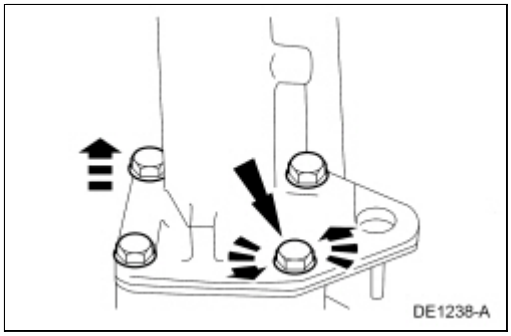
Install the Transmission Holding Fixture.



4. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.

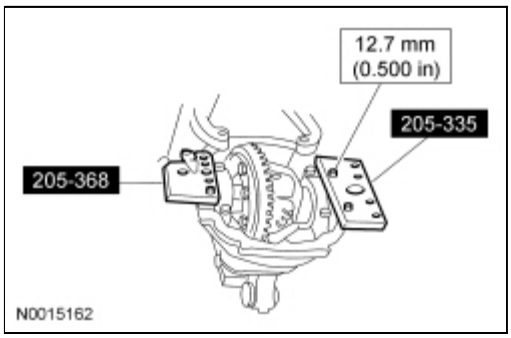


5. Remove the 4 bolts and the axle housing tube.



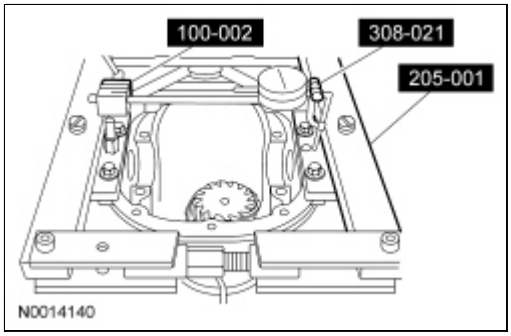
6. ***NOTICE:*** **The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.**

   Install the Adapter for Differential Housing Spreader and Differential Housing Spreader Plate.



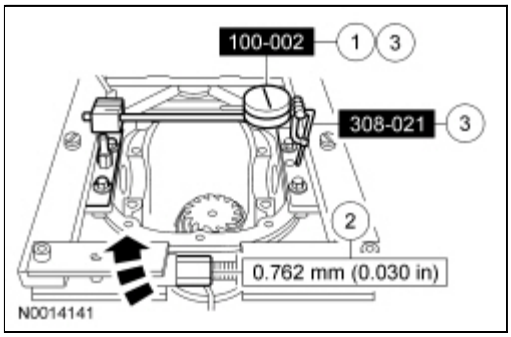
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7. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.
    - Position the adapter tip in the spreader adapter hole.



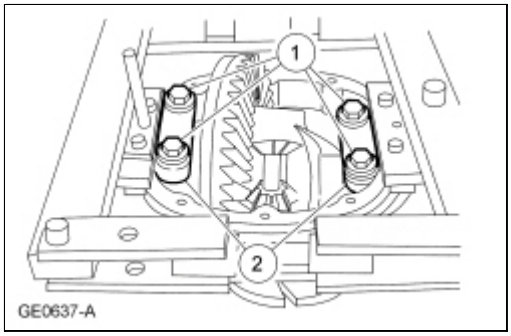
8. ***NOTICE:*** **Overspreading may damage the axle housing.**

    Spread the axle housing to the specification.
    1. Adjust the Dial Indicator Gauge to zero.
    2. Tighten the housing spreader screw to spread the axle housing to the specification.
    3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



9. ***NOTICE:*** **Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original location and position or damage to the component may occur.**

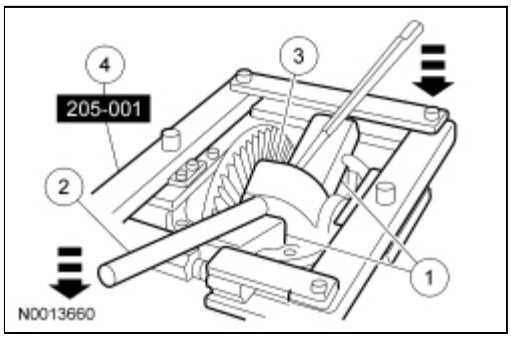
    Mark and remove the 2 differential bearing caps.
    1. Remove the 4 bolts.
    2. Remove the 2 differential bearing caps.



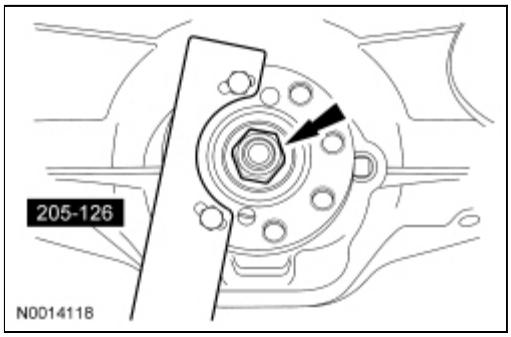
10. ***NOTICE:*** **Use wood blocks to avoid axle housing damage.**

Remove the differential assembly from the axle housing.

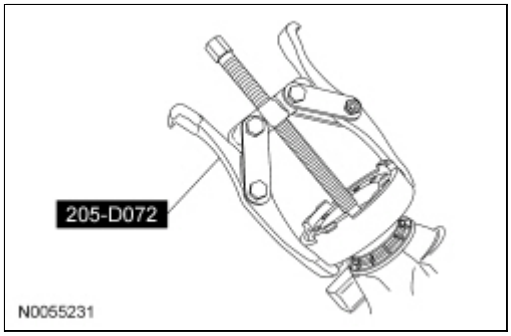
1. Position the wood blocks.
2. Position and push down on the 2 pry bars.
3. Remove the differential assembly.
4. Remove the Differential Carrier/Spreader.



11. Install the Drive Pinion Flange Holding Fixture and loosen, but do not remove, the pinion nut.



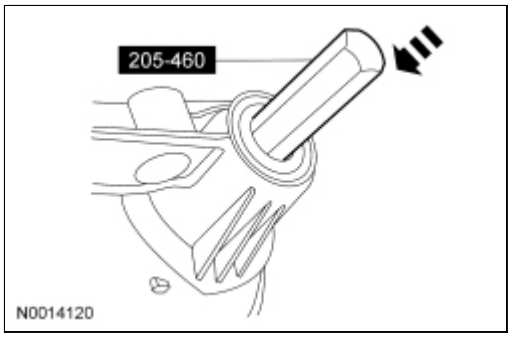
12. With the pinion nut still engaged by a few threads, use the 2 Jaw Puller to separate the axle U-joint flange from the pinion gear.



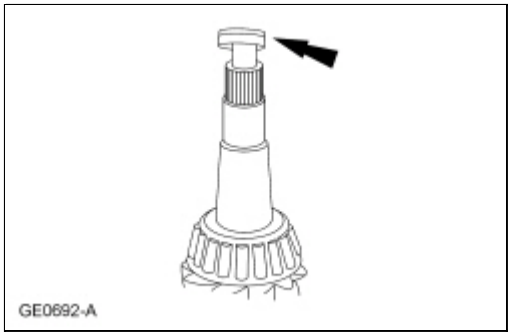
13. Remove the nut and the flange.

14. Using the Drive Pinion Thread Protector and a soft hammer, remove the pinion gear.

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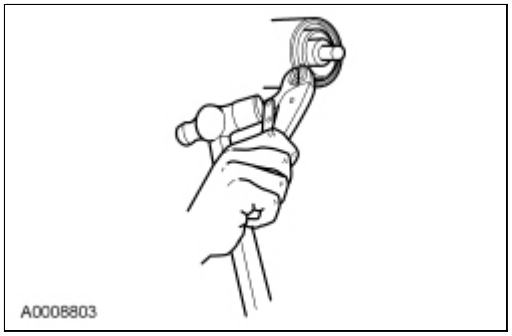


15. Discard the drive pinion collapsible spacer.



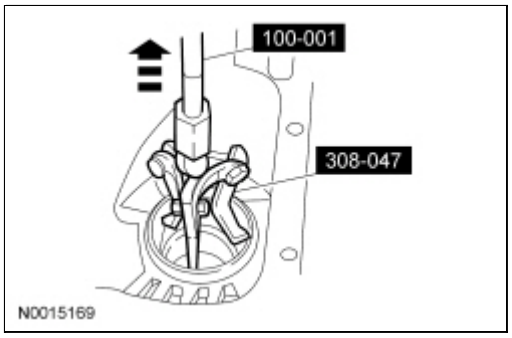
16. ***NOTICE:*** **Do not damage the carrier housing while removing the pinion seal.**

    Remove the pinion seal and slinger.
    - Pry up on the seal flange. Install gripping pliers and strike with a hammer to remove the seal.



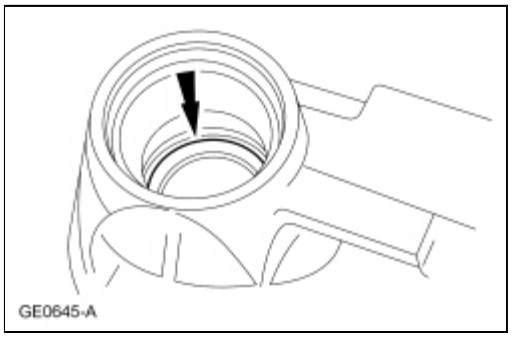
17. Remove the outer pinion bearing.

18. Using the Bearing Cup Remover and Slide Hammer, remove the inner pinion bearing cup.

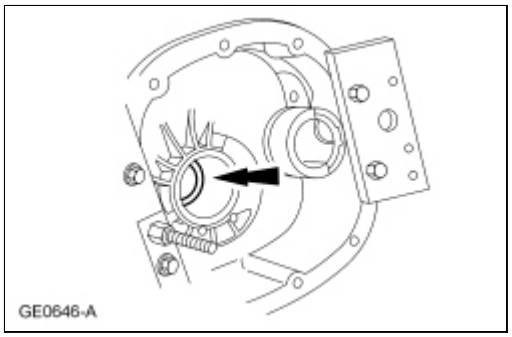


19. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

    If necessary, remove the pinion bearing oil baffle.



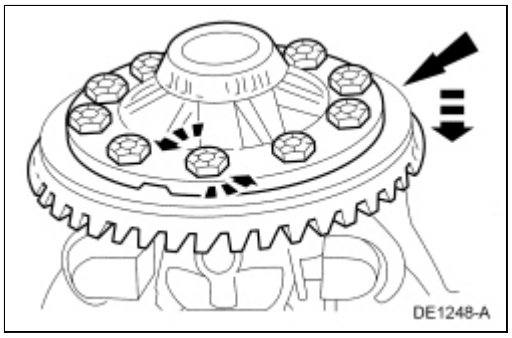
20. Remove the outer pinion bearing cup by tapping alternately on each side to prevent the cup from cocking.



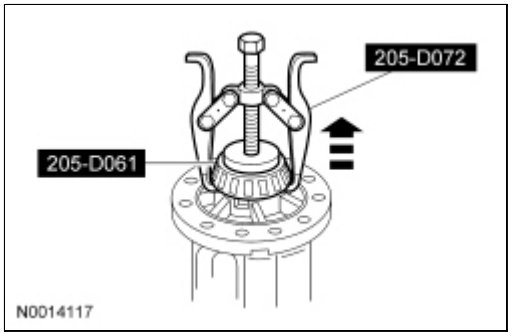
21. **NOTE:** Use a drift punch to separate the differential ring gear from the differential case.

    Remove and discard the 10 differential ring gear bolts and remove the differential ring gear.

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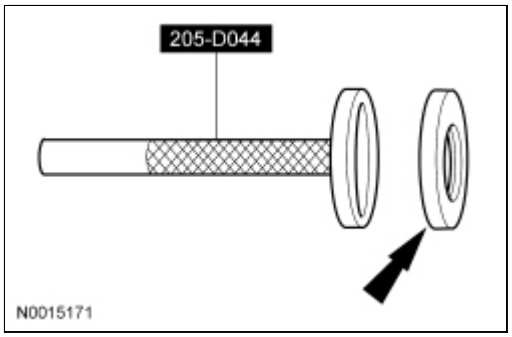
22. Using the 2 Jaw Puller and Step Plate, remove the 2 differential bearings.



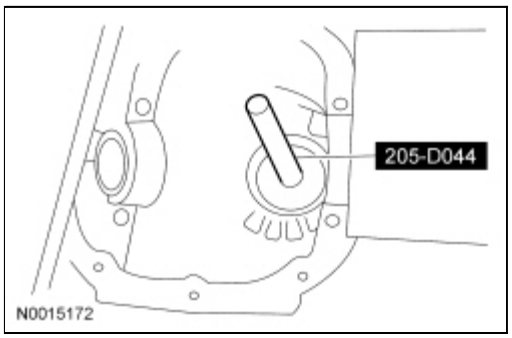
Installation

1. ***NOTICE:*** **Do not omit the drive pinion bearing oil baffle or damage to the component may occur.**

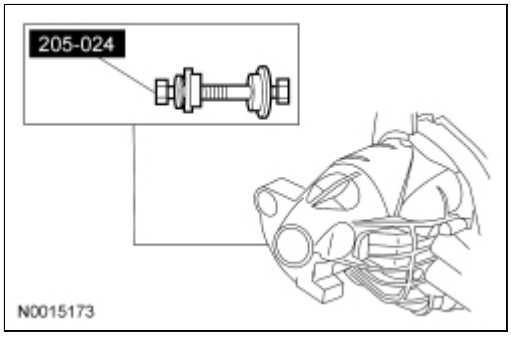
   If removed, position the drive pinion bearing oil baffle on the Differential Carrier Bearings Installer.



2. Using the Differential Carrier Bearings Installer, install the drive pinion bearing oil baffle.



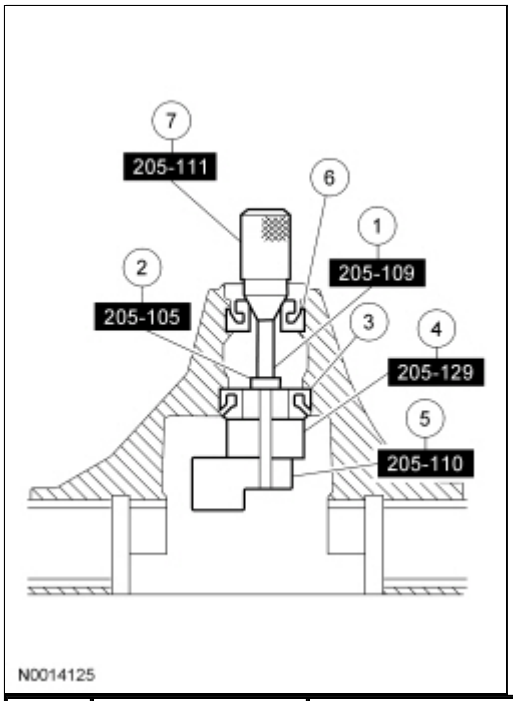
3. Using the Drive Pinion Bearing Cup Installer, install the drive pinion bearing cups.



4. ***NOTICE:*** **Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.**

   NOTE: Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

   Assemble and position the Adapters.

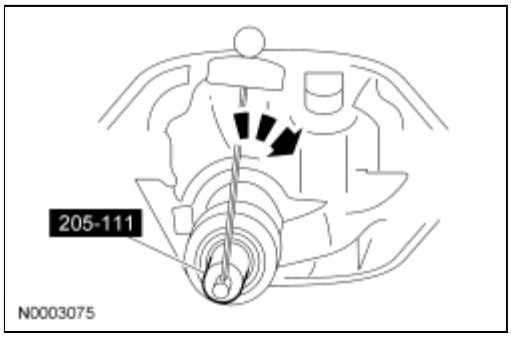


Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-105	Adapter for 205-S127 (T76P-4020-A3)
3	4630	Drive pinion bearing (inner)
4	205-129	Adapter for 105-S127 (T79P-4020-A18)
5	205-110	Adapter for 205-S127 (T76P-4020-A10)
6	4621	Drive pinion bearing (outer)
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

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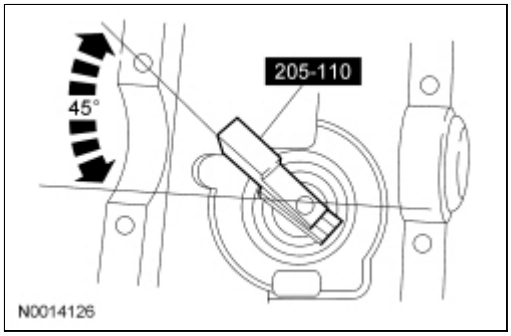
5. **NOTE:** This step duplicates final drive pinion bearing preload.

   Tighten the Adapter.
   - Tighten to 2.2 Nm (20 lb-in).

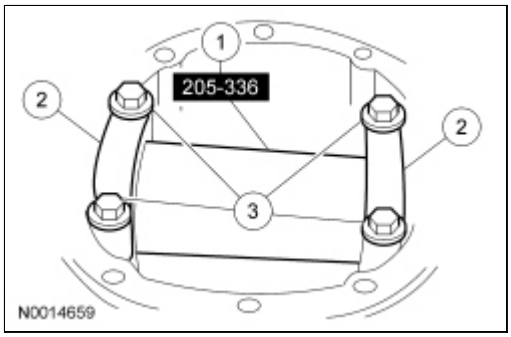


6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

   Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings and position the Adapter.



7. Install the Drive Pinion Gauge Tube.
   1. Position the Drive Pinion Gauge Tube.
   2. Install the 2 differential bearing caps.
   3. Install the 4 differential bearing cap bolts.
      - Tighten to 105 Nm (77 lb-ft).



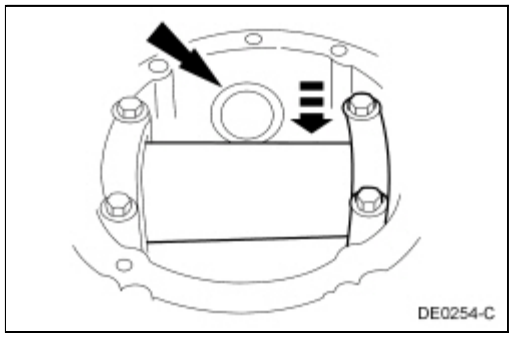
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

   NOTE: A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required,

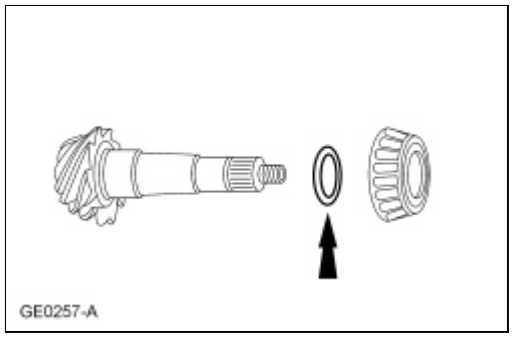
which results in a deep tooth contact in final assembly of integral axle assemblies.

Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

- After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the special tools.



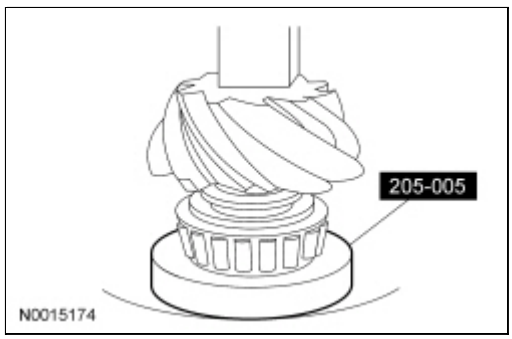
9. Position the drive pinion bearing adjustment shim and the inner pinion bearing on the new drive pinion gear stem.



10. **NOTE:** The same drive pinion bearings from the previous steps must be used.

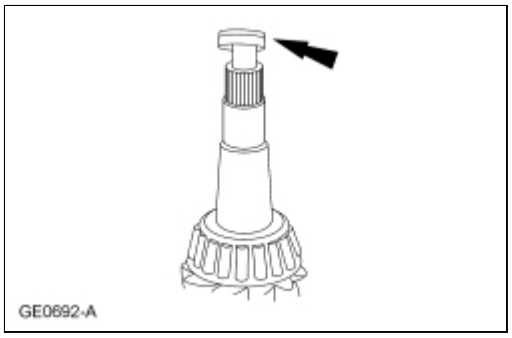
    Install the inner drive pinion bearing.

    - Place the drive pinion bearing adjustment shim on the drive pinion gear.
    - Using a suitable press and the Drive Pinion Bearing Cone Installer, press the inner drive pinion bearing until it is firmly seated on the pinion gear.

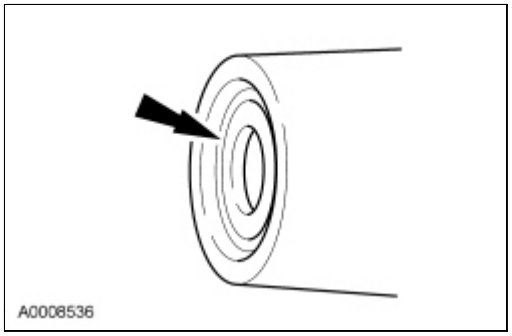


11. Place a new drive pinion collapsible spacer on the drive pinion gear.

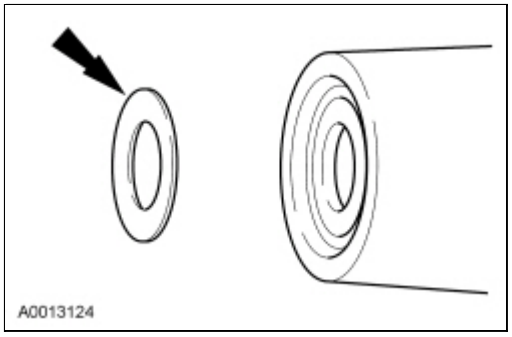
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12. Install the outer drive pinion bearing.



13. Install the drive pinion oil slinger.

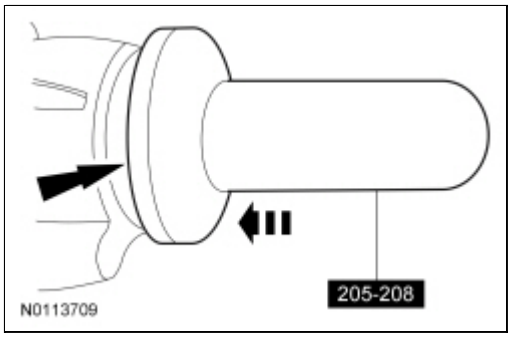


14. **NOTE:** Coat the drive pinion seal lips with long-life grease.

    Install the drive pinion seal on the Drive Pinion Oil Seal Installer.

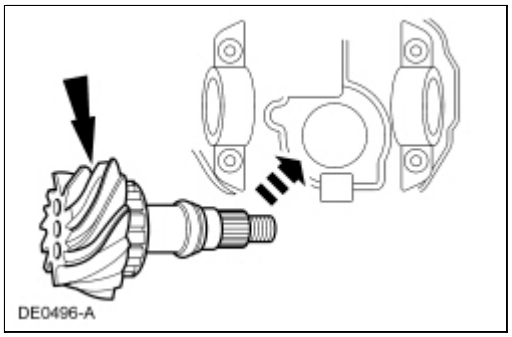
15. **NOTE:** If the drive pinion seal becomes misaligned during installation, remove it and install a new drive pinion seal.

    Using the Drive Pinion Oil Seal Installer, install the drive pinion seal.

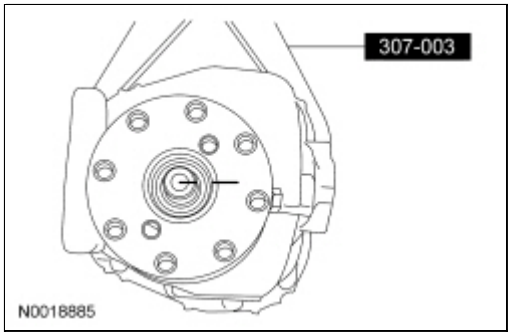


16. Lightly lubricate the drive pinion gear splines with axle lubricant.

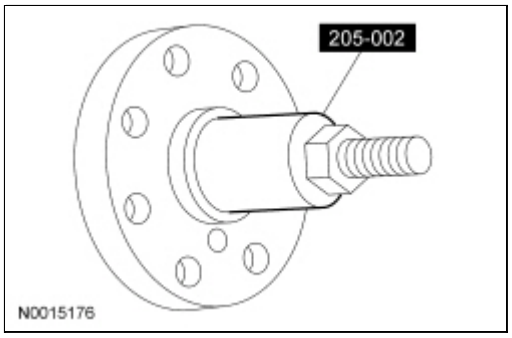
17. Position the drive pinion gear in the axle housing.



18. Position the pinion flange onto the pinion shaft while mounted on the Transmission Holding Fixture.



19. Using the Drive Pinion Flange Installer, install the pinion flange.

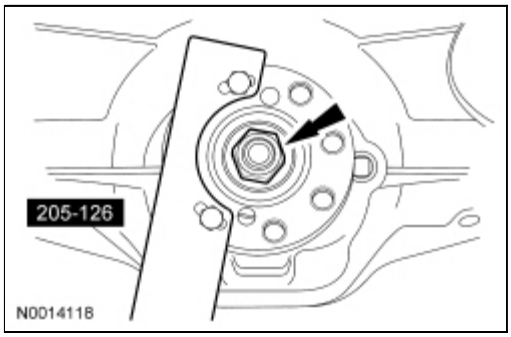


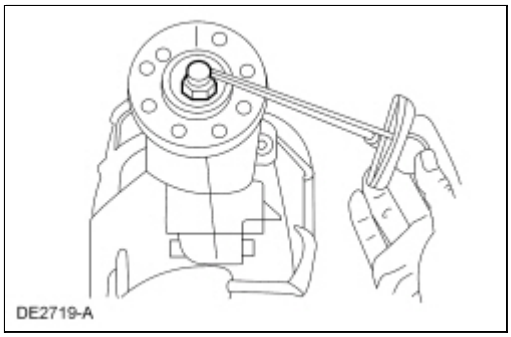
20. Apply a small amount of axle lubricant to the washer side of the new pinion nut and install the new pinion nut.

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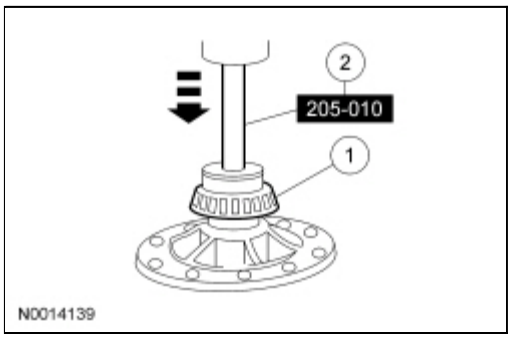
21. ***NOTICE:*** **Do not loosen the pinion nut to reduce drive pinion bearing preload under any circumstance. If it is necessary to reduce drive pinion bearing preload, install a new drive pinion collapsible spacer and pinion nut or damage to the component may occur.**

    Install the Drive Pinion Flange Holding Fixture and tighten the pinion nut. For additional information, refer to the torque specifications in the Specifications portion of this section.
    - Rotate the drive pinion gear occasionally to make sure the drive pinion bearings are seating correctly. Take frequent drive pinion bearing preload readings by rotating the drive pinion gear with a Nm (lb-in) torque wrench.



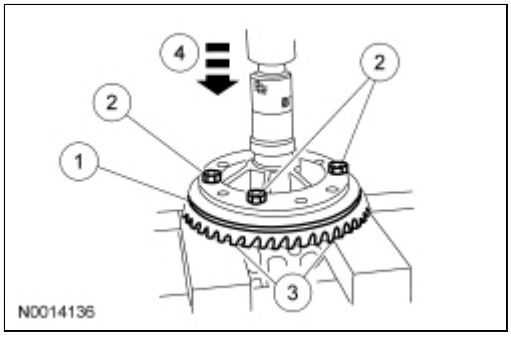


22. Press the left and right differential bearing on the differential carrier.
    1. Position the differential bearing.
    2. Using the Differential Side Bearing Installer, press the differential bearing on the differential carrier.
       - Repeat for the other side.

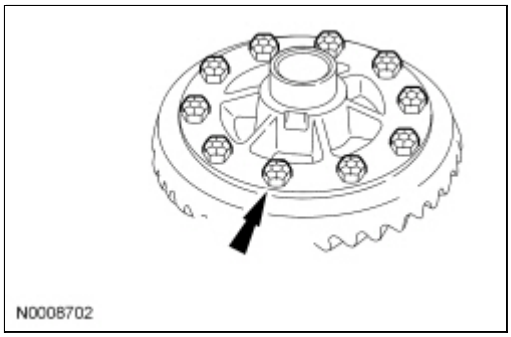


23. Install the differential ring gear.
    1. Place the differential ring gear on the differential assembly.
    2. Hand-start 3 new ring gear bolts to align the holes in the differential ring gear and the differential assembly.
    3. Place the differential carrier and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.

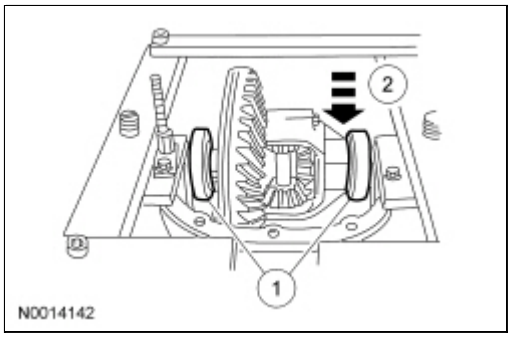
4. Press the differential ring gear into place.



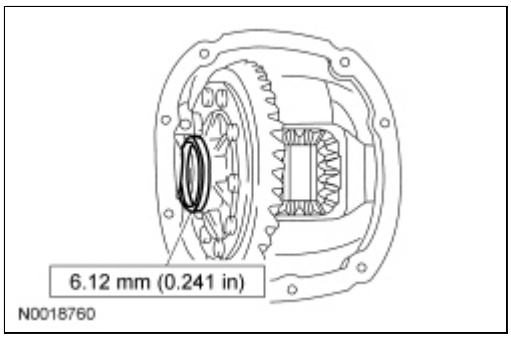
24. Install the 10 new ring gear bolts.
    - Tighten to 128 Nm (95 lb-ft).



25. Install the differential carrier.
    1. Position the differential bearing cups on the differential bearings.
    2. Lower the differential carrier in place.



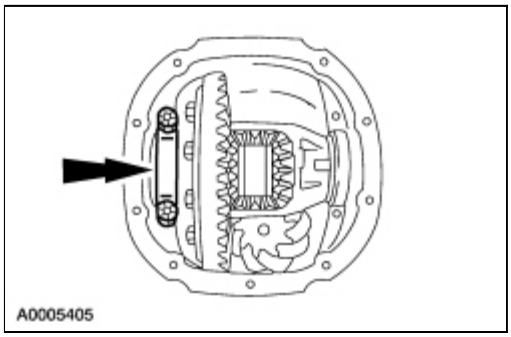
26. Install a differential bearing shim of the thickness shown on the LH side of the differential bearing.



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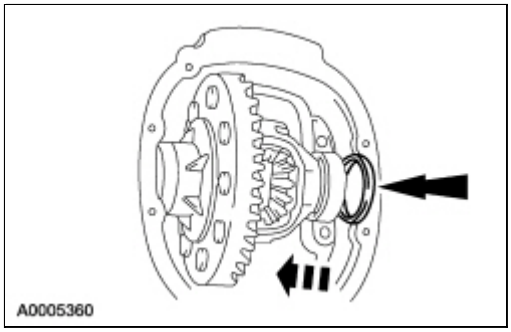
27. **NOTE:** Apply pressure toward the left side to make sure the left bearing cup is seated.

    Install the left bearing cap and loosely install the 2 bearing cap bolts.



28. **NOTE:** Apply pressure toward the left side to make sure the left bearing cap is seated.

    Install progressively thicker differential bearing shims on the right side until the thickest differential bearing shim can be inserted by hand.

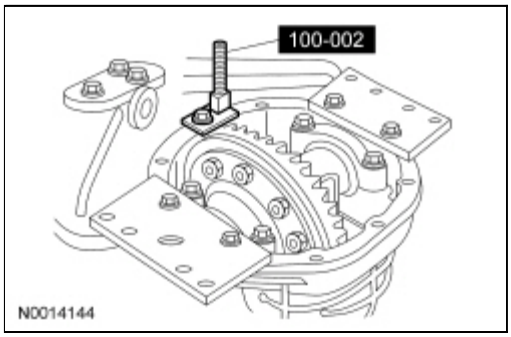


29. Install the right bearing cap and 2 bolts.

30. Tighten the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).

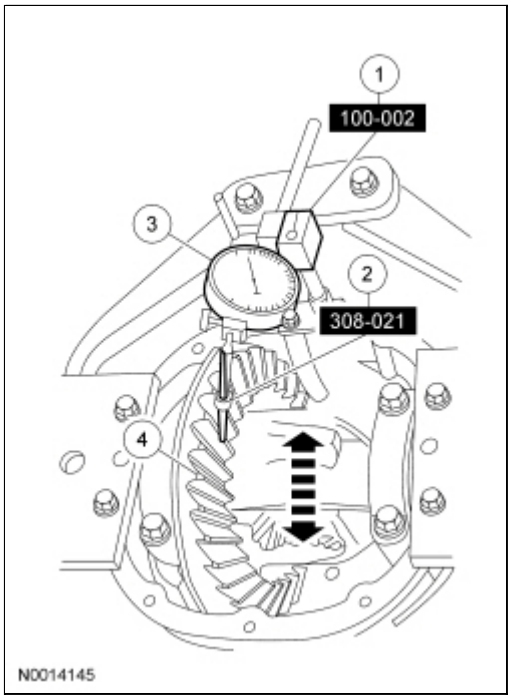
31. Rotate the differential carrier to make sure it turns freely.

32. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



33. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, measure the differential ring gear backlash at 4 equally spaced points.
    1. Attach the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.

2. Position the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge tip centrally on a drive tooth.
3. Zero the Dial Indicator.
4. Turn the differential ring gear without turning the drive pinion gear. Record the indicator reading. The allowable backlash is 0.203 mm (0.008 in) to 0.305 mm (0.012 in) and must not vary more than 0.101 mm (0.004 in) between points measured. A backlash variation of more than 0.101 mm (0.004 in) between points checked indicates gear/case runout.
    - To correct for a high or low backlash, proceed as follows.



34. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016

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0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

Differential Shim Size Chart — 4067

	Dimension A	
Numbers of Stripes and Color Code	**mm**	**Inch**
2 — C-COAL	7.7978- 7.8105	0.3070- 0.3075
1 — C-COAL	7.7470- 7.7597	0.3050- 0.3055
5 — BLU	7.6962- 7.7089	0.3030- 0.3035
4 — BLU	7.6454- 7.6581	0.3010- 0.3015
3 — BLU	7.5946- 7.6073	0.2990- 0.2995
2 — BLU	7.5458- 7.5565	0.2970- 0.2975
1 — BLU	7.493- 7.505	0.2950- 0.2955
5 — PINK	7.4422- 7.4549	0.2930- 0.2935
4 — PINK	7.3914- 7.4041	0.2910- 0.2915
3 — PINK	7.3406- 7.3533	0.2890- 0.2895
2 — PINK	7.2898- 7.3025	0.2870- 0.2875
1 — PINK	7.2390- 7.2517	0.2850- 0.2855
5 — GRN	7.1882- 7.2009	0.2830- 0.2835
4 — GRN	7.1374- 7.1501	0.2810- 0.2815
3 — GRN	7.0866- 7.0993	0.2790- 0.2795
2 — GRN	7.0358- 7.0485	0.2770- 0.2775
1 — GRN	6.9850- 7.0485	0.2750- 0.2755
5 — WH	6.9342- 6.9469	0.2730- 0.2735
4 — WH	6.8834- 6.8961	0.2710- 0.2715
3 — WH	6.8326- 6.8453	0.2690- 0.2695
2 — WH	6.7818- 6.7945	0.2670- 0.2675
1 — WH	6.7310- 6.7437	0.2650- 0.2655
5 — YEL	6.6802- 6.6929	0.2630- 0.2635
4 — YEL	6.6294- 6.6421	0.2610- 0.2615
3 — YEL	6.5786- 6.5913	0.2590- 0.2595
2 — YEL	6.5278- 6.5405	0.2570- 0.2575
1 — YEL	6.4770- 6.4897	0.2550- 0.2555
5 — ORNG	6.4262- 6.4389	0.2530- 0.2535
4 — ORNG	6.3754- 6.3881	0.2510- 0.2515
3 — ORNG	6.3246- 6.3373	0.2490- 0.2495
2 — ORNG	6.2738- 6.2865	0.2470- 0.2475

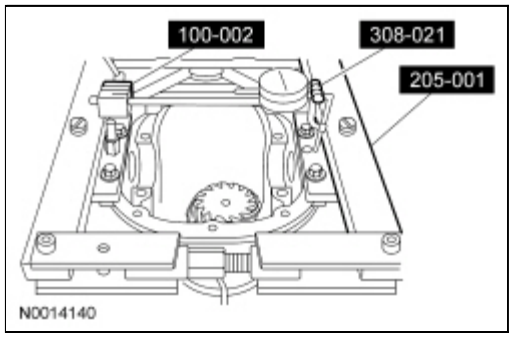
1 — ORNG	6.2223- 6.2357	0.2450- 0.2455
2 — RED	6.1722- 6.1849	0.2430- 0.2435
1 — RED	6.1214- 6.1341	0.2410- 0.2415

35. Remove the 4 differential bearing cap bolts.
    - Remove the differential carrier.

36. Measure the thickness of the selected right and left bearing shims.

37. To establish differential bearing preload, increase both the left and right differential bearing shim thickness by 0.203 mm (0.008 in).

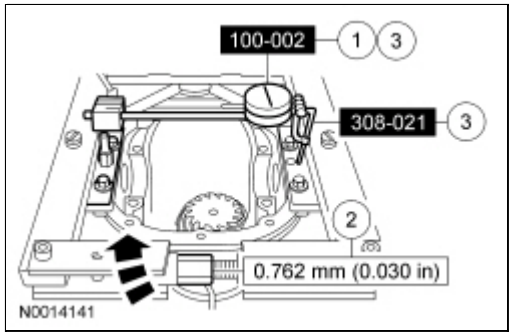
38. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.



39. ***NOTICE:*** **Overspreading may damage the differential housing.**

    NOTE: Tighten and loosen the differential carrier spreader screw to normalize the housing spreader adapters prior to taking the final Dial Indicator reading.

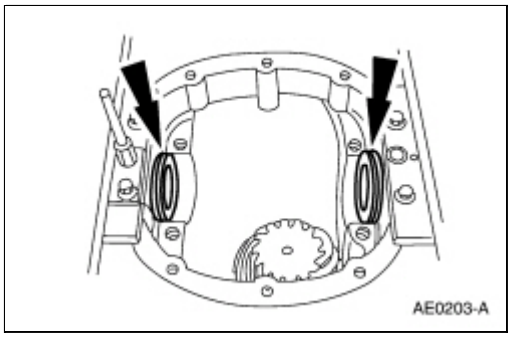
    Spread the differential housing to the specification.
    1. Adjust the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge to zero.
    2. Tighten the screw until spreading the differential housing to the specification.
    3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



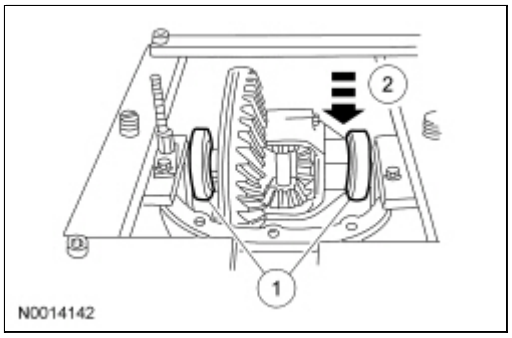
40. ***NOTICE:*** **To avoid galling the case, insert shims with a light coating of grease before installing the differential assembly. If not carried out in this order, the aluminum housing may be damaged.**

    Place the differential bearing shims in the differential housing.

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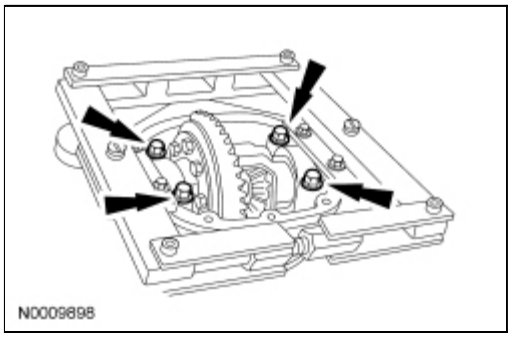


41. Install the differential carrier.
    1. Position the differential bearing cups on the differential bearings.
    2. Lower the differential carrier in place between the differential bearing shims.

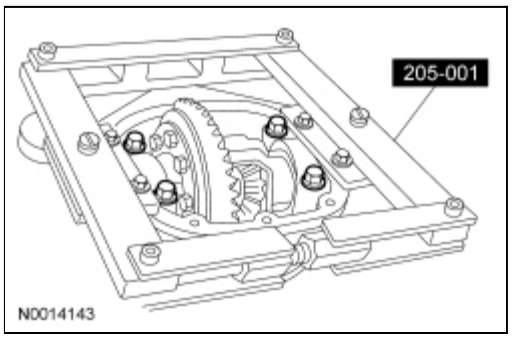


42. **NOTE:** Hand-tighten the differential bearing cap bolts prior to releasing the carrier spreader.

    Install the 2 differential bearing caps and the 4 differential bearing cap bolts in their original locations and positions.



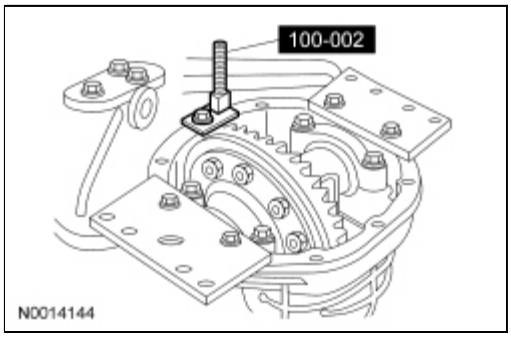
43. Loosen and remove the Differential Carrier Spreader.



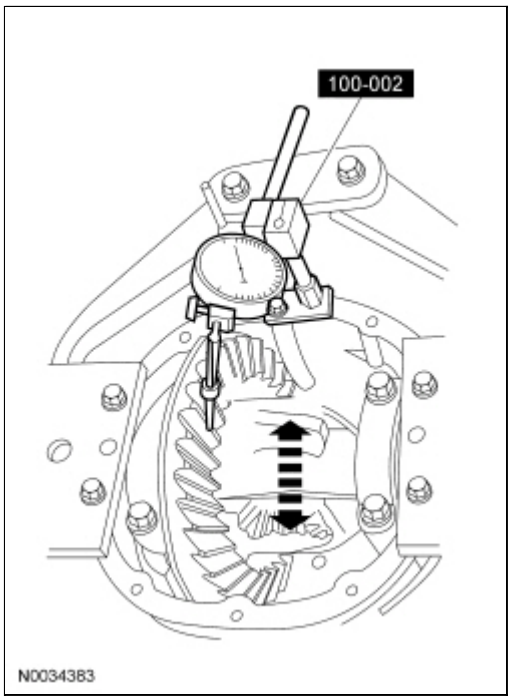
44. Tighten the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).

45. Rotate the differential carrier to make sure it turns freely.

46. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



47. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.

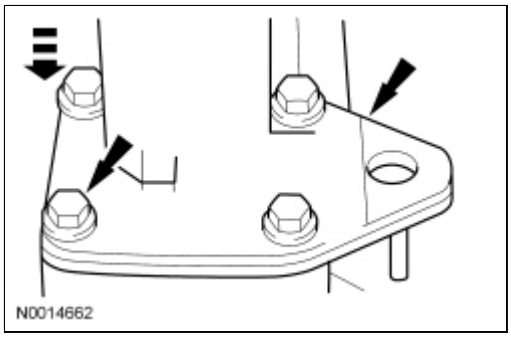


48. Apply marking compound and rotate the differential assembly 5 complete revolutions.

49. Verify an acceptable pattern check. For additional information, refer to Diagnosis and Testing in this section.

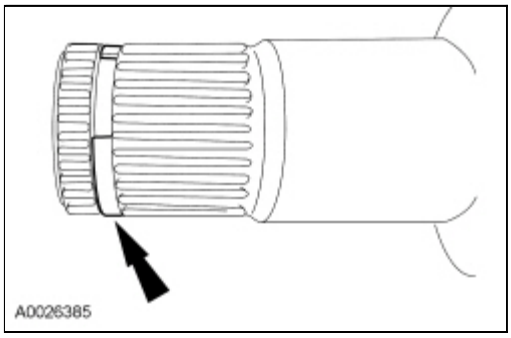
50. Install the 4 bolts and the axle housing tube.
    - Tighten to 73 Nm (54 lb-ft).

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51. Install a new stub shaft seal. For additional information, refer to Stub Shaft Pilot Bearing and Seal in this section.

52. Install a new circlip on the intermediate shaft end.



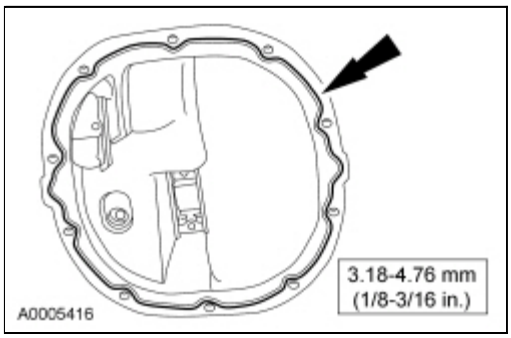
53. Insert the intermediate shaft and engage the circlip with the differential side gear.

54. Remove the axle assembly from the Transmission Holding Fixture and place it on the bench.

55. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

    NOTE: The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

    Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.
    - Use silicone gasket and sealant.



56. Install the differential housing cover and 10 bolts.

- Tighten to 32 Nm (24 lb-ft).

57. Install the axle assembly. For additional information, refer to Axle Assembly in this section.

58. Remove the fill plug and fill the axle assembly with the specified amount and type of axle lubricant.
    - Tighten the fill plug to 25 Nm (18 lb-ft).

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Material

Item	Specification	Fill Capacity
Constant Velocity Joint Grease (High Temperature) XG-5	WSS-M1C258-A1	—

General Specifications

Item	Specification
Left halfshaft assembled length	406.45 mm (16.00 in)
Right halfshaft assembled length	411.85 mm (16.21 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake flexible hose bracket bolt	30	22	—
Integrated Wheel End (IWE) bolts	12	—	106
Tie-rod end nut	115	85	—
Upper ball joint nut	150	111	—
Wheel hub nut	40	30	—
Wheel speed sensor harness bracket bolt	12	—	106

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Front Drive Halfshafts

The front drive halfshafts consist of the following:

- Inner CV joints
- Outer CV joints
- Interconnecting shafts
- Convoluted CV joint boots
- CV joint boot clamps
- Special CV high-temperature grease
- Tripod joint housings
- Ball and cage housings
- A circlip stopper that holds the cross-groove inboard race assembly (inboard CV joint) together
- A circlip that retains the splined inboard CV joint to the differential side gear

The front drive halfshafts link the front axle to the front wheel hubs. The CV joints allow the halfshafts to rotate smoothly through the required changes in angles between the stationary axle and the varying angles of the front wheels including jounce and rebound plus changes while turning. The CV joints are either tri-lobed style or the caged ball type depending on inboard or outboard. New halfshaft components are available as kits containing grease, boots and clamps.

Halfshaft Handling

Handle all halfshaft components carefully during removal and installation and during various component disassembly and assembly procedures.

- Never pick up or hold the halfshaft only by the inboard or outboard CV joint.
- Do not overangle the CV joints.
- Damage will occur to an assembled inboard CV joint if it is overplunged outward from the joint housing.
- Never use a hammer to remove or install the halfshafts from the hub.
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft.
- Do not allow the boots to contact sharp edges or hot exhaust components.
- Handle the halfshaft only by the interconnecting shaft to avoid pull-apart and potential damage to the CV joints.
- Excessive pulling force on the interconnecting shaft between joints of the halfshaft will result in internal joint damage. Axial loads used in assisting removal must be applied through the inboard joint housing only.
- Do not drop assembled halfshafts. The impact will cut the boots from the inside without evidence of external damage.
- Do not remove the outer CV joint by pulling on the interconnecting shaft.
- Inspect all machined surfaces and splines for damage.

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Front Drive Halfshafts

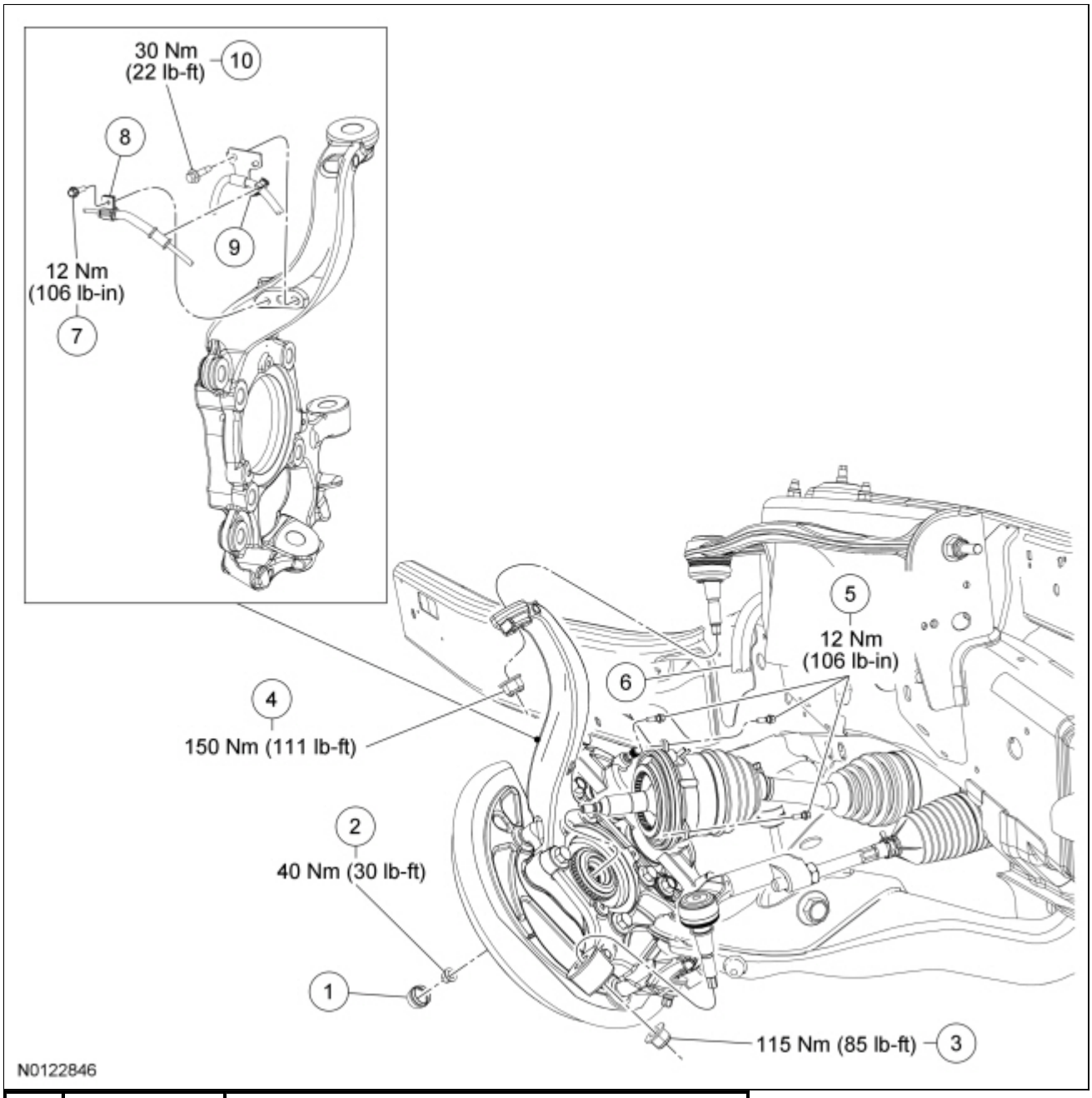
Refer to Section 205-00 .

Halfshaft

Special Tool(s)

 ST2934-A	Halfshaft Remover 205-832
 ST1185-A	Slide Hammer 100-001 T50T-100-A

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Item	Part Number	Description
1	1131	Dust cap
2	N802827-S100	Wheel hub nut
3	W520215	Tie-rod end nut
4	W520215	Upper ball joint nut
5	W505211	Integrated Wheel End (IWE) bolts (3 required)
6	—	Vacuum vent and apply tube
7	—	Wheel speed sensor harness bracket bolt
8	—	Wheel speed sensor harness bracket (part of 2C204)

9	—	Brake flexible hose retainer (part of 2078)
10	W611633	Brake flexible hose bracket bolt

Removal and Installation

NOTICE: **Whenever a halfshaft is removed, install a new circlip and stub shaft pilot bearing seal or damage to the component may occur.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the dust cap.

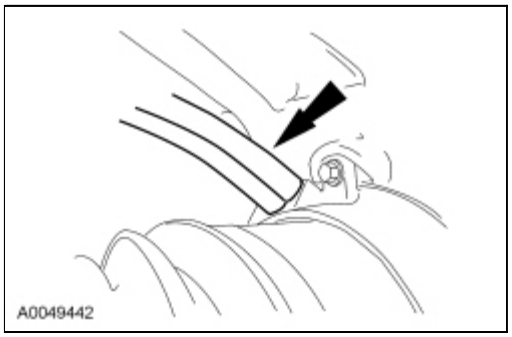
3. Remove and discard the wheel hub nut.
   - To install, tighten the new wheel hub nut to 40 Nm (30 lb-ft).

4. Remove the wheel speed sensor harness bracket bolt and position the wheel speed sensor harness aside.
   - To install, tighten to 12 Nm (106 lb-in).

5. Detach the brake flexible hose retainer from the wheel speed sensor harness.

6. Remove the brake flexible hose bracket bolt and disconnect the brake flexible hose bracket from the wheel knuckle.
   - To install, tighten to 30 Nm (22 lb-ft).

7. Remove the vacuum vent and apply tube at the vacuum vent and apply tube port of the Integrated Wheel End (IWE) disconnect.



8. Remove the 3 IWE bolts.
   - To install, tighten to 12 Nm (106 lb-in).

9. Remove and discard the tie-rod end nut.
   - Disconnect the tie-rod end from the wheel knuckle.
   - To install, tighten the new tie-rod end nut to 115 Nm (85 lb-ft).

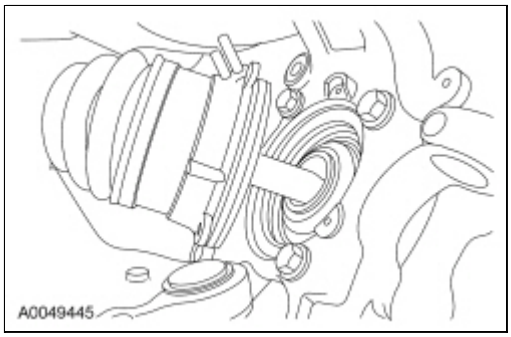
10. Remove and discard the upper ball joint nut.
    - Disconnect the upper ball joint from the wheel knuckle.
    - To install, tighten the new upper ball joint nut to 150 Nm (111 lb-ft).

11. **NOTE:** Do not damage the hub seal.

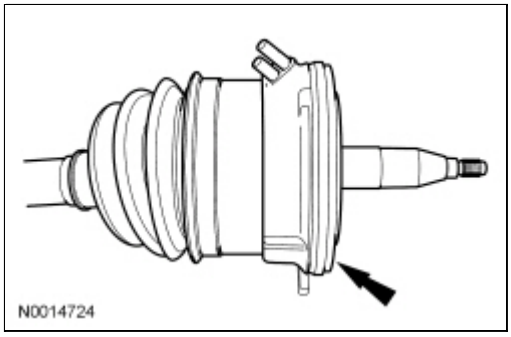
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NOTE: Allow the steering knuckle to swing outboard while keeping the CV shaft pushed inboard.

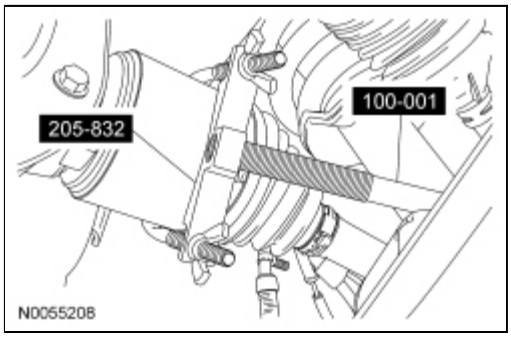
Once clearance is available, remove the CV shaft joint outboard end and IWE disconnect from the steering knuckle hub bearing.



12. Remove the IWE disconnect from the outboard CV joint housing.



13. Using the Halfshaft Remover and Slide Hammer, remove the halfshaft from the differential and the intermediate shaft.



14. Remove and discard the circlip and the stub shaft seal. For additional information, refer to Section 205-03 .

15. ***NOTICE:*** **Verify the spline engagement by checking for spline lash before installing the halfshaft nut or component damage may occur.**

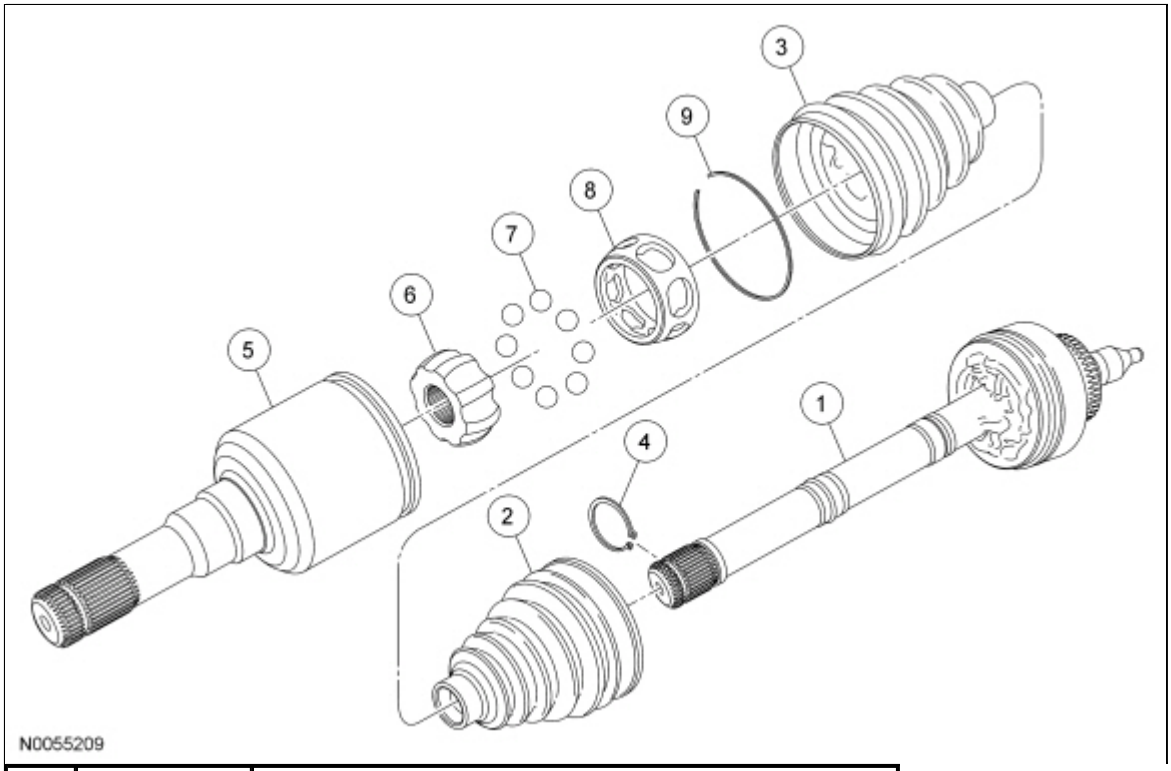
    To install, reverse the removal procedure.

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Halfshaft

Material

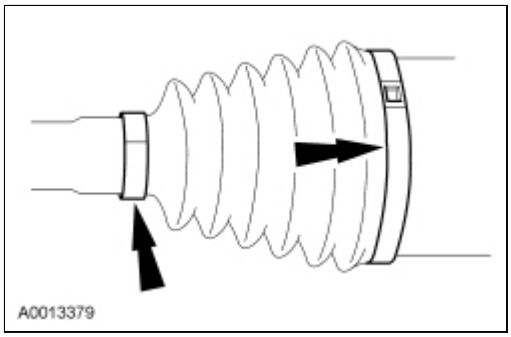
Item	Specification
Constant Velocity Joint Grease (High Temperature) XG-5	WSS-M1C258-A1



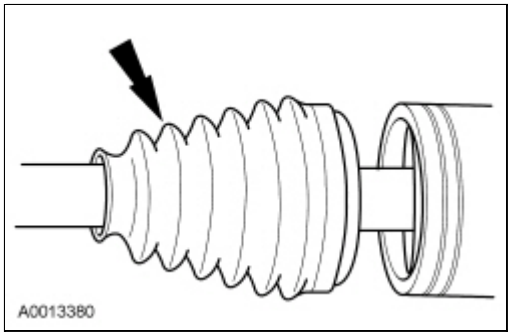
Item	Part Number	Description
1	3B436B	Outboard CV joint and interconnecting shaft assembly
2	3A331A	Outboard CV boot
3	3A331B	Inboard CV boot
4	4B422	Snap ring
5	3B414	Inboard CV joint housing
6	—	Inner race (part of 3B436 RH/ 3B437 LH)
7	—	Ball (8 required) (part of 3B436 RH/ 3B437 LH)
8	—	Ball cage (part of 3B436 RH/ 3B437 LH)
9	3B426	Retaining ring (part of 3B436 RH/ 3B437 LH)

Disassembly

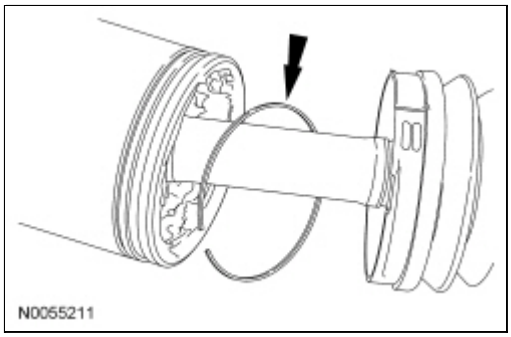
1. Remove the halfshaft from the vehicle. For additional information, refer to Halfshaft in the Removal and Installation portion of this section.
2. Remove the 2 boot clamps.



3. Separate the boot from the inboard CV joint housing.

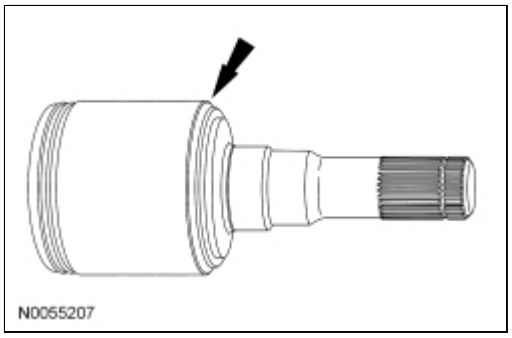


4. Remove the retaining ring.

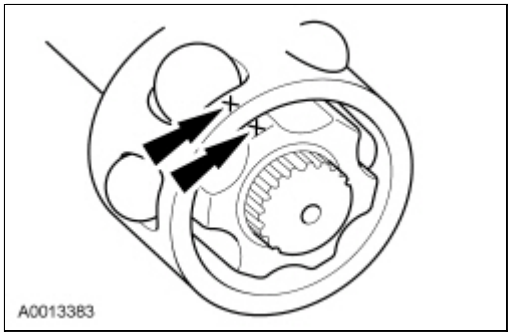


5. Remove the inboard CV joint housing.

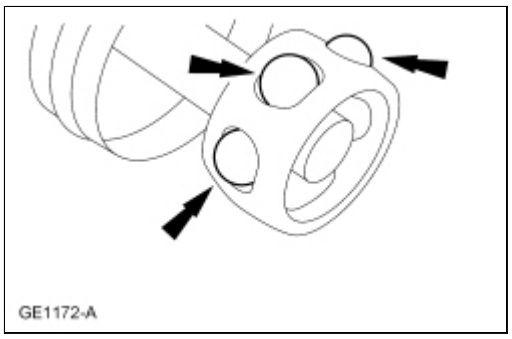
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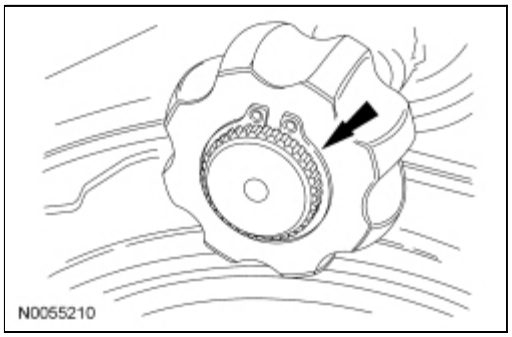
6. Index-mark the inner race and ball cage.



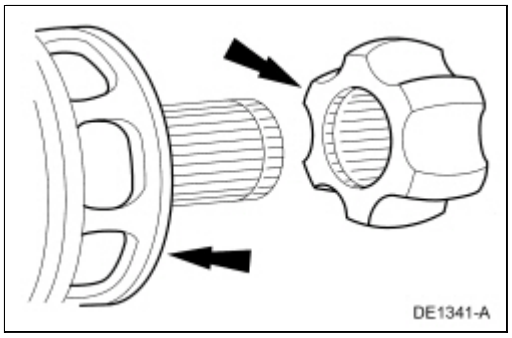
7. Remove the 6 balls.



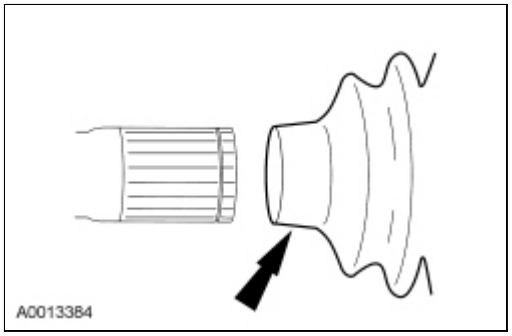
8. Remove the snap ring.



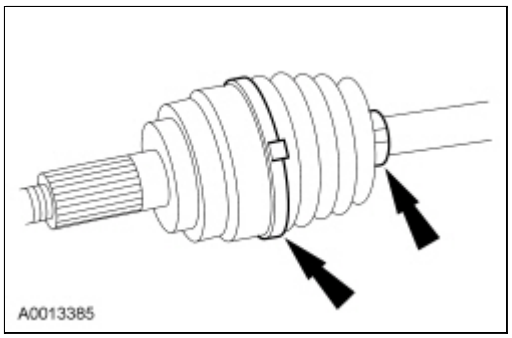
9. Remove the inner race and the ball cage.



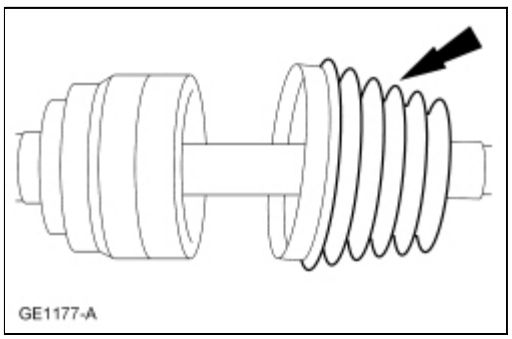
10. Remove the inboard boot.



11. Remove the 2 boot clamps.



12. Remove the outboard boot.



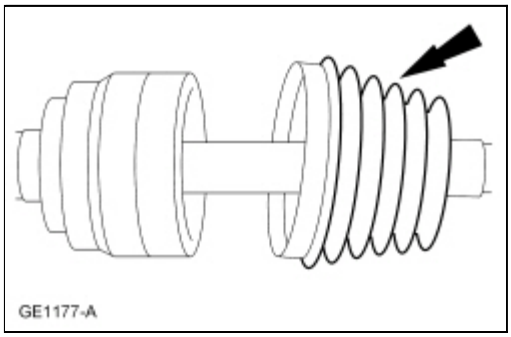
13. **NOTE:** If the grease is contaminated, clean and inspect the joint for wear. Install a new outboard CV joint and interconnecting shaft assembly if worn/damaged.

    Check the CV joint grease for contamination.

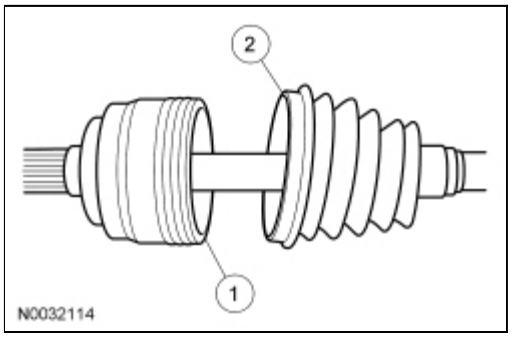
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Assembly

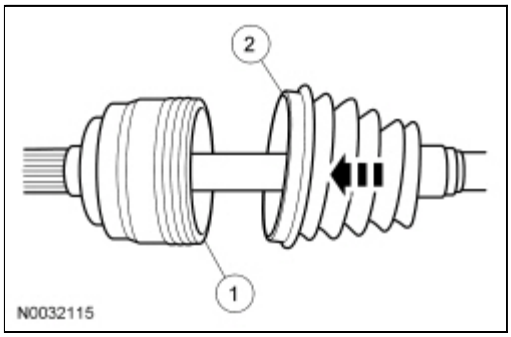
1. Position the outboard boot on the shaft.



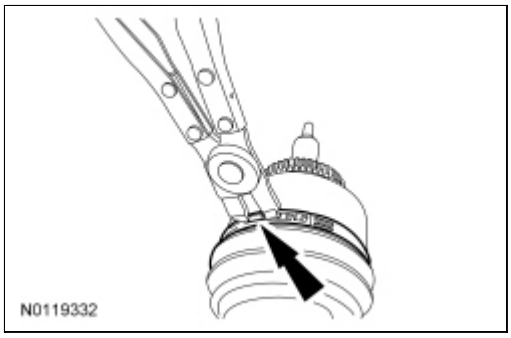
2. Pack the outboard CV joint with 165 g (5.82 oz) of grease.
    1. Use CV joint grease or equivalent provided in the boot kit.
    2. Spread any remaining grease from the kit evenly inside the boot.



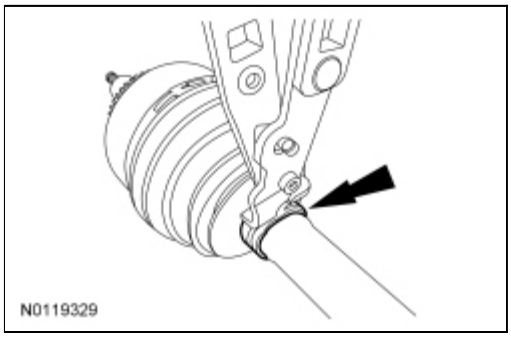
3. Install the outboard boot.
    1. Clean the boot mounting surface.
    2. Seat the boot in the joint boot groove.



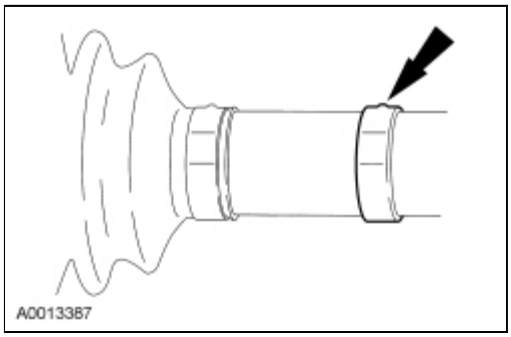
4. Using a suitable boot clamp installer (such as Snap-On® stock #YA3050 or equivalent) install the large boot clamp.



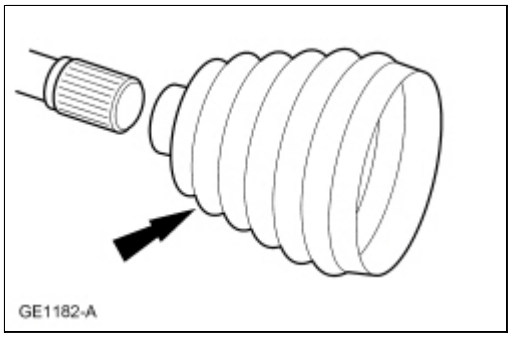
5. Using a suitable boot clamp installer (such as Snap-On® stock #YA3080 or equivalent) install the small boot clamp.



6. Position the boot clamp on the shaft.

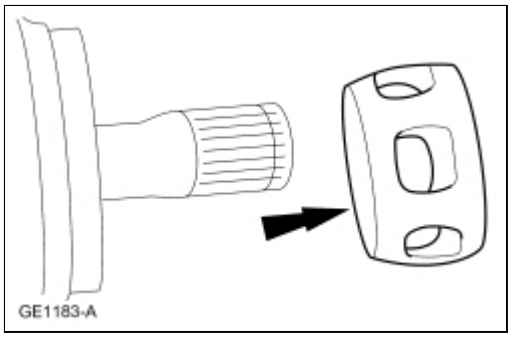


7. Position the inboard boot on the shaft.



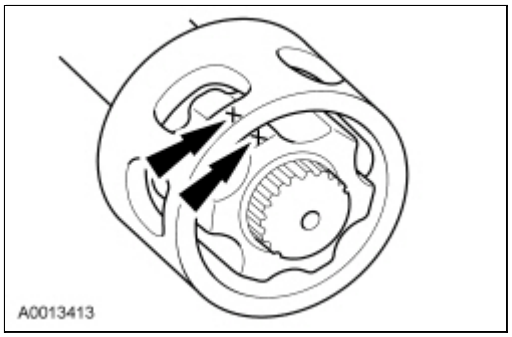
8. Position the ball cage on the shaft with the tapered end facing the boot.

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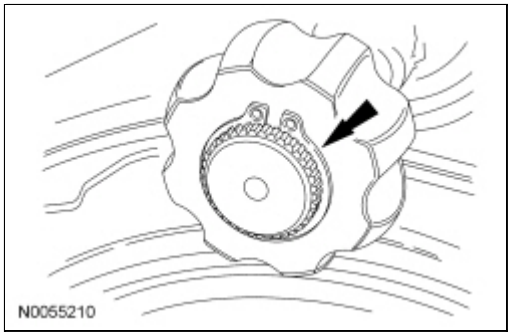


9. **NOTE:** Align the index marks.

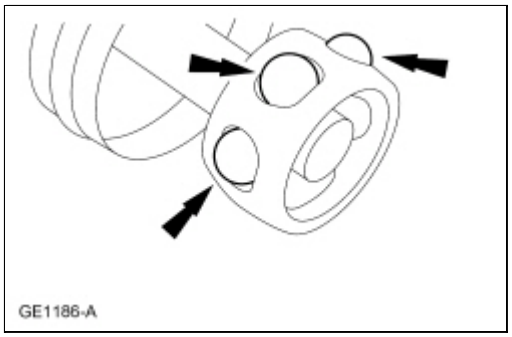
   Position the inner race on the shaft with the counterbored end facing the boot.



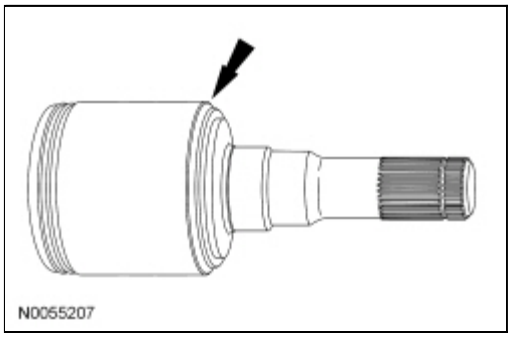
10. Install the snap ring.



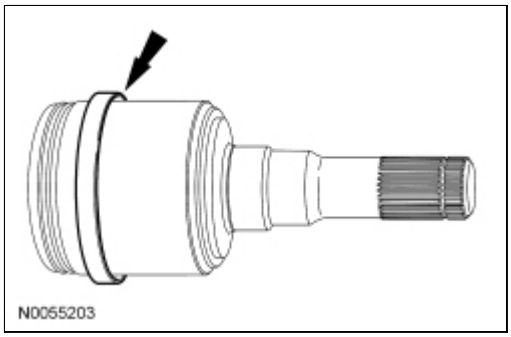
11. Lubricate and position the 6 balls.
    - Use CV joint grease or equivalent provided in the boot kit.



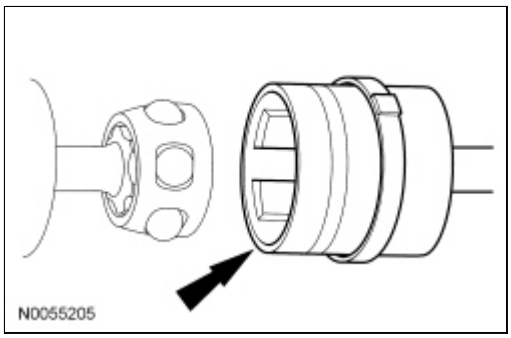
12. Fill the inboard CV joint housing with 235 g (8.29 oz) of grease.
    - Use CV joint grease or equivalent provided in the boot kit.



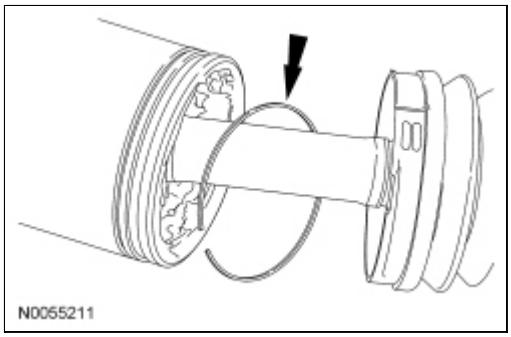
13. Position the boot clamp on the inboard CV joint housing.



14. Position the inboard CV joint housing on the ball and race assembly.

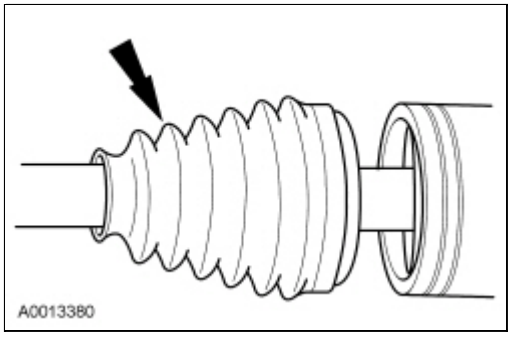


15. Install the retaining ring.

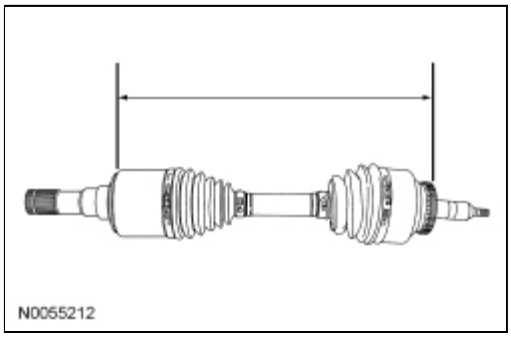


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16. Remove any excess grease from the mating surface. Seat the boot in the joint boot groove.

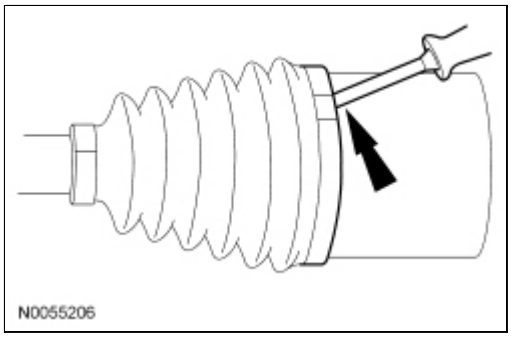


17. Set the halfshaft assembled length to specification. For additional information, refer to Specifications in this section.

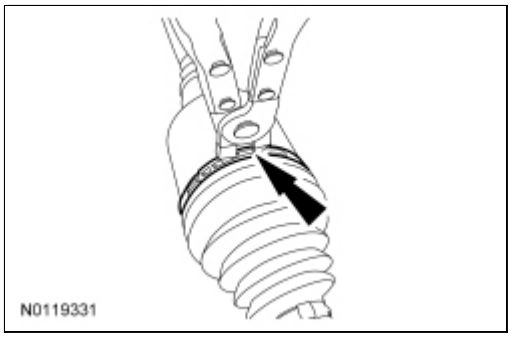


18. ***NOTICE:*** **Use care when inserting the screwdriver or damage to the boot may occur.**

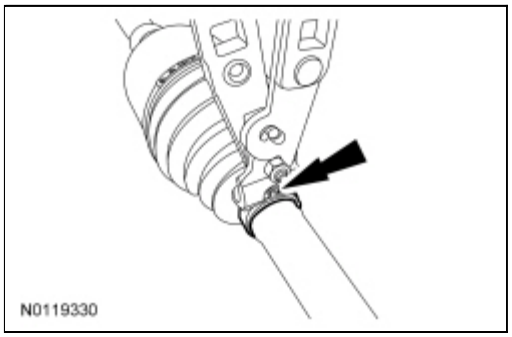
    Insert a dull screwdriver blade under the boot to release the pressure.



19. Using a suitable boot clamp installer (such as Snap-On® stock #YA3050 or equivalent) install the large boot clamp.

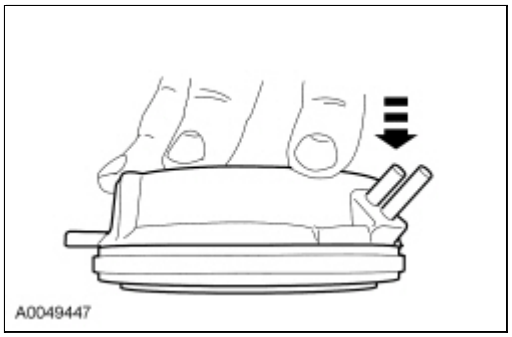


20. Using a suitable boot clamp installer (such as Snap-On® stock #YA3080 or equivalent) install the small boot clamp.

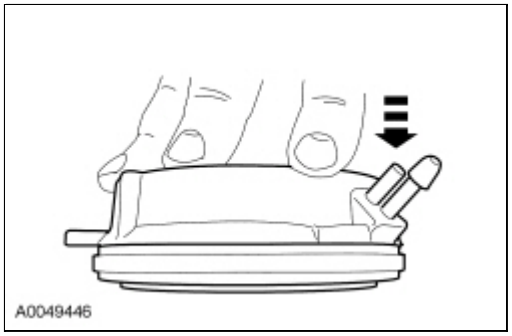


21. **NOTE:** Maintain a clean work surface.

    Compress the Integrated Wheel End (IWE) disconnect on the bench to collapse the vacuum chamber.



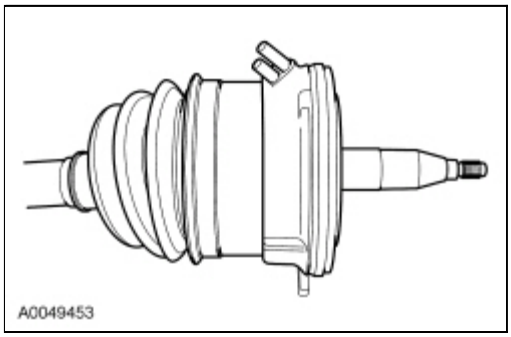
22. While the IWE disconnect is collapsed, install a vacuum cap on the vacuum port.



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23. ***NOTICE:*** **Do not install the Integrated Wheel End (IWE) end disconnect in the knuckle. It must be installed on the outer Constant Velocity (CV) joint housing or damage to the component may occur.**

    Install the IWE disconnect on the outer CV joint housing.



24. ***NOTICE:*** **Verify the spline engagement by checking for spline lash before installing the halfshaft nut or damage to the component may occur.**

    Install the halfshaft in the vehicle. For additional information, refer to Halfshaft in the Removal and Installation portion of this section.

Material

Item	Specification	Fill Capacity
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	1,420 ml (3.0 pt)
Motorcraft® Metal Brake Parts Cleaner (US) / Motorcraft® Brake Parts Cleaner (Canada) PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

General Specifications

Item	Specification
Brake Disc	
Front brake disc minimum thickness	32 mm (1.259 in)
Rear brake disc minimum thickness	23.0 mm (0.906 in)
Brake Pads	
Maximum brake pad taper wear (in any direction)	3.0 mm (0.118 in)
Minimum brake pad thickness	3.0 mm (0.118 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake caliper bleed screw	10	—	89
Master cylinder primary brake tube fittings	28	21	—
Master cylinder secondary brake tube fitting	20	—	177

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Brake System

The brake system consists of the following components:

- Front and rear disc brakes
- Cable/drum-in-hat actuated parking brake
- Brake master cylinder and fluid reservoir
- Vacuum-assisted power brake booster
- Four-wheel ABS
- Red brake warning indicator

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is pushed through the double-walled steel tubes and flexible hoses to the front and rear disc brake calipers. The brake fluid enters the disc brake calipers, forcing the caliper pistons and brake pads outward against the brake disc friction surface, slowing or stopping rotation. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear disc brake caliper pistons and brake pads to the unapplied position.

For information on the following:

- Front disc brakes, refer to Section 206-03 .
- Rear disc brakes, refer to Section 206-04 .
- Parking brake actuation, refer to Section 206-05 .
- Hydraulic brake actuation, refer to Section 206-06 .
- Vacuum-assisted power brake booster, refer to Section 206-07 .
- ABS, refer to Section 206-09 .

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Component Tests

Brake Booster

1. Disconnect the brake booster vacuum sensor/check valve from the brake booster and connect a suitable vacuum/pressure tester to the booster side of the vacuum sensor/check valve.

2. Apply the parking brake, start the engine and place the transmission in NEUTRAL.
   - Allow the engine to reach normal operating temperature.

3. **NOTE:** Subtract approximately 3.38 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 ft) of elevation above sea level.

   Verify that vacuum is available at the vacuum sensor/check valve with engine running at normal idle speed.
   - The vacuum gauge should read between 51-74 kPa (15-22 in-Hg).
   - If specified vacuum is available, stop the engine, connect the vacuum sensor/check valve and continue with Step 5.
   - If specified vacuum is not available, continue with Step 4.

4. Disconnect the vacuum sensor/check valve from the vacuum hose and verify that the specified vacuum is available at the hose with the engine at idle speed and the transmission in NEUTRAL.
   - If specified vacuum is available, stop the engine, install a new vacuum sensor/check valve and continue with Step 5.
   - If specified vacuum is not available, stop the engine, connect the vacuum hose to the vacuum sensor/check valve and refer to Section 303-00 to diagnose the no/low vacuum condition.
   - On vehicles equipped with a brake vacuum pump, if specified vacuum is not available, inspect the vacuum hose and install new as necessary. If vacuum hose is OK, install a new brake vacuum pump. Refer to Section 206-07 .

5. Apply the brake pedal several times to exhaust all vacuum from the system.

6. Apply the brake pedal and hold it in the applied position. Start the engine and verify that the brake pedal moves downward after the engine starts.
   - If the brake pedal moves, the brake booster is operating correctly.
   - If the brake pedal does not move, install a new brake booster. Refer to Section 206-07 .

7. Operate the engine a minimum of 20 seconds at idle. Stop the engine and let the vehicle stand for 10 minutes, then apply the brake pedal. The brake pedal feel should be the same as that noted with the engine operating.
   - If the brake pedal feels hard (no power assist), install a new brake booster vacuum sensor/check valve and retest.
   - If condition still exists, install a new brake booster. Refer to Section 206-07 .
   - If the brake pedal feels the same as noted with the engine operating, the vacuum sensor/check valve is functioning properly.

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Brake Master Cylinder — Bypass Condition

1. Inspect the master cylinder. Refer to Brake System Inspection in this section.

2. Disconnect the brake tubes from the master cylinder.

3. Plug the outlet ports of the master cylinder.

4. **NOTE:** Make sure that the outlet port plugs do not show signs of leakage.

   Lightly apply the brakes and hold for 10 seconds. Release the brakes and then reapply with heavy force. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and a new brake master cylinder must be installed.
   - If brake pedal height is maintained, reinstall brake tubes and tighten to specifications. Refer to Specifications in this section. After installation, bleed the brake system. Refer to Brake System Bleeding in this section.

Brake Master Cylinder — Compensator Port

1. Inspect the master cylinder. Refer to Brake System Inspection in this section.

2. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

3. Apply and release the brakes.

4. With the brakes released, attempt to rotate each wheel and check for any brake drag.
   - If an excessive amount of brake drag exists at multiple wheels, continue to Step 5.
   - If an excessive amount of brake drag exists at only one wheel, it indicates a possible seized brake caliper, brake wheel cylinder or parking brake component. Repair or install new components as necessary.

5. Check the brake stoplamp switch and the brake pedal free play to verify that the brake pedal is not partially applied.

6. Loosen the brake master cylinder nuts and position the brake master cylinder away from the brake booster.

7. With the brakes released, attempt to rotate each wheel and check for any brake drag.
   - If the brake drag is no longer present, install a new brake booster. Refer to Section 206-07 .
   - If the brake drag is still present, install a new master cylinder. Refer to Section 206-06 .

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Inspection And Verification

Material

Item	Specification
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Blistering or swelling of rubber brake components can indicate contamination of the brake fluid by a petroleum-based substance. The entire hydraulic brake system must be flushed with clean, specified brake fluid and contaminated rubber components must be replaced to prevent recontamination.**

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

The first indication that something may be wrong in the brake system is a change in the feeling through the brake pedal. The brake warning indicator in the Instrument Cluster (IC) and the brake fluid level in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel is locked and the vehicle must be moved, open a bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. If multiple wheels are locked, check the brake pedal free play to verify brake pedal is not partially applied. These operations may release the brakes, but will not correct the concern. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

1. Verify the customer concern.
   - For parking brake concerns, refer to Section 206-05 .
   - For ABS concerns, refer to Section 206-09 .
   - For adjustable pedal concerns, refer to Section 206-06 .
   - For all other concerns, continue with the next step.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Brake fluid level and condition • Brake master cylinder • Brake master cylinder reservoir • Brake booster • Brake booster check valve • Brake booster vacuum hose • Brake hoses and tubes • Brake caliper, guide pins and anchor plate • Brake disc • Brake pads • Brake pedal, bracket and booster linkage • Aftermarket modifications	• Parking brake switch • Brake fluid level switch • Wiring, terminals or connectors

3. Visually inspect the suspension system and tires for obvious signs of wear or damage.
    - For suspension system concerns, refer to Section 204-00 .
    - For tire concerns, refer to Section 204-04 .

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

5. If the cause is not visually evident, GO to Symptom Chart - Brake System or GO to Symptom Chart - NVH in this section.

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Pinpoint Tests

Pinpoint Test A: Vibration When the Brakes are Applied

Normal Operation

During moderate to heavy braking, noise from the Hydraulic Control Unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS. Pedal pulsation or steering wheel nibble when the brakes are applied (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component.

PINPOINT TEST A: VIBRATION WHEN THE BRAKES ARE APPLIED

Test Step	Result / Action to Take
A1 ROAD TEST THE VEHICLE — LIGHT BRAKING	
• Road test the vehicle. Warm the brakes by slowing the vehicle from 80 to 32 km/h (50 to 20 mph) using light brake force. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using light pedal force. • **Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?**	**Yes** GO to A4. **No** GO to A2.
A2 ROAD TEST THE VEHICLE — MODERATE TO HEAVY BRAKING	
• Road test the vehicle. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force. • **Is there a vibration/shudder?**	**Yes** GO to A3. **No** The concern is not present at this time.
A3 CHECK ABS OPERATION	
• **NOTE:** During moderate to heavy braking, noise from the HCU and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct operation of the ABS. Pedal pulsation or steering wheel nibble with the frequency proportional to vehicle speed indicates a concern with a brake or suspension component. • Road test the vehicle and apply the brakes on a dry, firm surface, then apply the brakes on a wet, snowy or loose surface (such as gravel). • **Is the vibration/shudder only present on a wet, snowy or loose surface?**	**Yes** This is a normal operating condition of the ABS. **No** GO to A5.
A4 ISOLATE BRAKE VIBRATION	
• **NOTE:** This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed	**Yes** GO to A7.

to the next test step. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. • Apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89-97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test. • **Is there a vibration/shudder?**	**No** GO to A5.
A5 CHECK THE FRONT SUSPENSION	
• Check the front suspension. Refer to Section 204-00. • **Are all the suspension components in satisfactory condition?**	**Yes** GO to A6. **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A6 CHECK THE FRONT BRAKE DISCS	
• Inspect the front brake discs. Refer to Brake System Inspection in this section. • Road test the vehicle. • **Is the vibration/shudder present?**	**Yes** GO to A7. **No** The concern has been repaired.
A7 CHECK THE REAR SUSPENSION	
• Check the rear suspension. Refer to Section 204-00. • **Are all the suspension components in satisfactory condition?**	**Yes** INSPECT the rear brake discs. REFER to Brake System Inspection in this section. **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.

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Principles of Operation

Brake System

Applying the brake pedal uses lever action to push a rod into the brake booster, which through the use of vacuum, boosts the force of the rod and then transmits this force to the primary piston in the master cylinder. This produces hydraulic pressure in the master cylinder. This pressure builds in the master cylinder and brake tubes as the brake pedal is applied further. The pressure between the primary and secondary piston forces the secondary piston to compress, building pressure in its circuit. The hydraulic pressure is transmitted by brake fluid through the brake tubes to the ABS Hydraulic Control Unit (HCU), which then distributes that pressure to the individual brake calipers. The brake calipers use hydraulic pressure to apply the pads. The application of the brake pads will cause the rotation of the wheels to slow or stop, depending on how much brake pressure is applied. The parking brakes carry out the same function except that they are mechanically actuated by a cable that connects only to the rear brakes.

Brake Master Cylinder Compensator Ports

The purpose of the compensator ports in the brake master cylinder is to supply additional brake fluid from the master cylinder reservoir when needed by the brake system due to brake lining wear and allow brake fluid to return to the master cylinder reservoir when the brakes are released. The returning brake fluid creates a slight turbulence in the master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged. Clogged compensator ports may cause the brakes to hang up or not fully release.

Red Brake Warning Indicator

The red brake warning indicator alerts the driver to certain conditions that exist in the brake system. The Instrument Cluster (IC) performs a bulb check when the ignition key is turned to the RUN position. The conditions that cause the indicator to illuminate are low brake fluid level, the parking brake is applied or there is a fault in the ABS (if the yellow ABS warning indicator is also illuminated). To diagnose red brake warning indicator concerns, refer to Section 413-01.

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Symptom Chart

Symptom Chart — Brake System

Symptom Chart — Brake System

Condition	Possible Sources	Action
• The red brake warning indicator and the yellow ABS warning indicator are illuminated	• DTCs in the ABS module	• REFER to Section 206-09 to diagnose the ABS.
• The red brake warning indicator is always/never on	• Brake fluid level switch • Parking brake switch • Wiring, terminals or connectors • Instrument Cluster (IC) • Smart Junction Box (SJB) • Vacuum sensor • Electronic Brake Distribution (EBD)	• REFER to Section 413-01 to diagnose the red brake warning indicator.
• Vehicle pulls or drifts during braking	• Tires • Brake calipers and/or guide pins • Brake flexible hose • Brake pads • Brake discs • Suspension component(s) and/or wheel alignment	• REFER to Section 204-04 to diagnose tire concerns. • INSPECT the brake system components. REFER to Brake System Inspection in this section. • REFER to Section 204-00 to diagnose suspension system.
• Brake pedal goes down fast or eases down slowly	• Brake fluid leaks and/or air in the system • Brake master cylinder • Hydraulic Control Unit (HCU)	• INSPECT the system for leaks. REPAIR as necessary. BLEED the system. REFER to Brake System Bleeding in this section. • CARRY OUT the Brake Master Cylinder — Bypass Condition Component Test in this section. • REFER to Section 206-09 to diagnose the HCU .
• Brakes lock up	• Brake pads	• INSPECT the brake system

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under light brake pedal force	• Brake flexible hose • Brake disc • Brake calipers and/or guide pins	components. REFER to Brake System Inspection in this section.
	• ABS	• REFER to Section 206-09 to diagnose the ABS.
• Excessive brake pedal travel (low/spongy pedal)	• Brake fluid leaks and/or air in the system	• INSPECT the system for leaks. REPAIR as necessary. BLEED the system. REFER to Brake System Bleeding in this section.
	• Brake master cylinder	• CARRY OUT the Brake Master Cylinder — Bypass Condition Component Test in this section.
	• Brake calipers and/or guide pins	• INSPECT the brake calipers and guide pins. REFER to Brake System Inspection in this section.
	• Brake flexible hose	• INSPECT the brake flexible hoses during brake application. REFER to Brake System Inspection in this section.
	• HCU	• REFER to Section 206-09 to diagnose the HCU.
• Erratic brake pedal travel	• Brake pedal	• INSPECT the brake pedal for binding, obstructions and correct connection to booster rod. REPAIR as necessary. CHECK the brake pedal fasteners for correct torque. REFER to Specifications in Section 206-06.
	• ABS	• REFER to Section 206-09 to diagnose the ABS.
• Brakes drag	• Stoplamp switch	• VERIFY correct installation of the stoplamp switch. REFER to Section 417-01.
	• Parking brake component	• REFER to Section 206-05 to diagnose the parking brake system.
	• Brake caliper and/or guide pins	• INSPECT the brake caliper and guide pins. REFER to Brake System Inspection in this section.
	• Brake booster/Master cylinder	• CARRY OUT the Brake Master Cylinder — Compensator Port Component Test in this section.
	• HCU	• REFER to Section 206-09 to diagnose the HCU.
• Excessive brake pedal effort	• Insufficient engine vacuum for brake booster operation • Brake booster manifold vacuum hose • Brake booster	• CARRY OUT the Brake Booster Component Test in this section. • If any DTCs are retrieved for the brake vacuum pump, resolve them first before attempting any base brake repairs.

	• Brake booster vacuum sensor/check valve • Brake vacuum pump • Brake pads	• INSPECT the brake pads. REFER to Brake System Inspection in this section.

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Vibration when the brakes are applied	• Brake disc(s) • Suspension components	• GO to Pinpoint Test A .
• Brake vibration/shudder — occurs when the brake pedal is released	• Brake drag	• GO to Symptom Chart - Brake System .
• Rear brake noise — occurs when the brake pedal is unapplied	• Parking brake component	• INSPECT the parking brake components. REFER to Section 206-05 .
• Rattling noise	• Caliper guide pins or guide pin bolts • Missing or damaged anti-rattle clips or springs • Loose brake disc shield	• CHECK the caliper guide pins and guide pin bolts. REFER to Brake System Inspection in this section. • CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. • TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Squealing noise — occurs on first (morning) brake application	• Brake pads	• Acceptable condition. Caused by humidity and low brake pad temperature.
• Squealing noise — a	• Brake pads	• INSPECT the brake pads.

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continuous squeal		REFER to Brake System Inspection in this section.
• Squealing noise — an intermittent squeal	• Brake pads	• Acceptable condition. Caused by cold, heat, water, mud or snow.
• Groaning noise — occurs at low speeds with brake lightly applied (creeping)	• Brake pads	• Acceptable condition.
• Grinding/moaning noise — continuous	• Brake pads • Brake disc	• INSPECT the brake pads, brake discs and attaching hardware. VERIFY brake components are within specifications. REFER to Brake System Inspection in this section.

Brake Disc Machining

NOTE: Do not use a bench lathe to machine the brake discs. Use an on-vehicle brake lathe only. Read the entire operating manual and/or view the video shipped with the lathe before installing, operating or repairing the lathe.

NOTE: An on-vehicle brake lathe with an automatic runout adjustment feature is preferred. However, if the lathe is not self adjusting, the lathe oscillation must be adjusted using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in). If the runout adjustment (automatic or manual) is carried out correctly prior to machining, then the final brake disc runout will be within specification and a runout measurement is not necessary after machining.

NOTE: Lateral runout and disc thickness variation measurements are not required because correct adjustment of the on-vehicle brake lathe will make sure that these dimensions are within specification.

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. ***NOTICE:*** **Do not allow the caliper to hang from the brake hose or damage to the hose may occur.**

   Remove the bolts and position the brake caliper or brake caliper and anchor plate assembly aside, as required.
   - Support the brake caliper using mechanic's wire.

3. Install the hub adapter using:
   - four wheel nuts on a 4-stud wheel hub.
   - five wheel nuts on a 5-stud wheel hub.
   - six wheel nuts on a 6-stud wheel hub.
   - four wheel nuts on a 7- or 8-stud wheel hub.
   - five wheel nuts on a 10-stud wheel hub.

4. Install the cutting lathe.

5. If the lathe is not self adjusting, adjust the lathe oscillation using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in).

6. Center the cutting head, adjust the cutting bits and install the chip deflector/silencer.

7. **NOTE:** The depth of the cut should be between 0.10 and 0.40 mm (0.004 and 0.015 in). Lighter cuts will cause the bit to heat up and wear faster. Heavier cuts will cause poor brake disc surface finish.

   Machine the brake disc.

8. Remove the lathe and the silencer.

9. Remove the wheel nuts and hub adapter.

10. Remove the metal shavings.

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11. Measure the brake disc thickness.
    - If the measurement is below the minimum specification, install a new brake disc. For additional information, refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

12. **NOTE:** It is not required to install new brake pads if friction material is within specifications. For additional information, refer to Specifications in this section.

    Position the brake caliper or brake caliper and anchor plate assembly.
    - Install the bolts.
    - For fastener torque specifications, refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

13. Install the wheel and tire. For additional information, refer to Section 204-04 .

Brake System Bleeding

General Equipment

Brake/Clutch System Pressure Bleeder/Filler
Fluid Container and Hose

Pressure

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

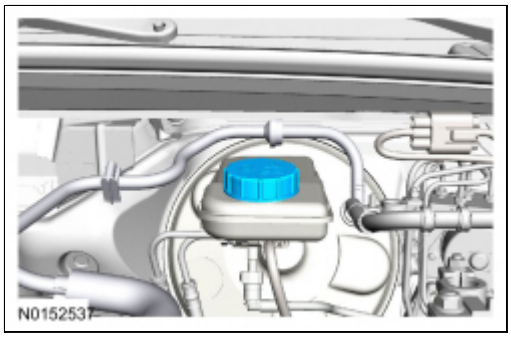
***NOTICE:* Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: Pressure bleeding the brake system is preferred to manual bleeding.

NOTE: The HCU bleeding procedure must be carried out if a new HCU has been installed.

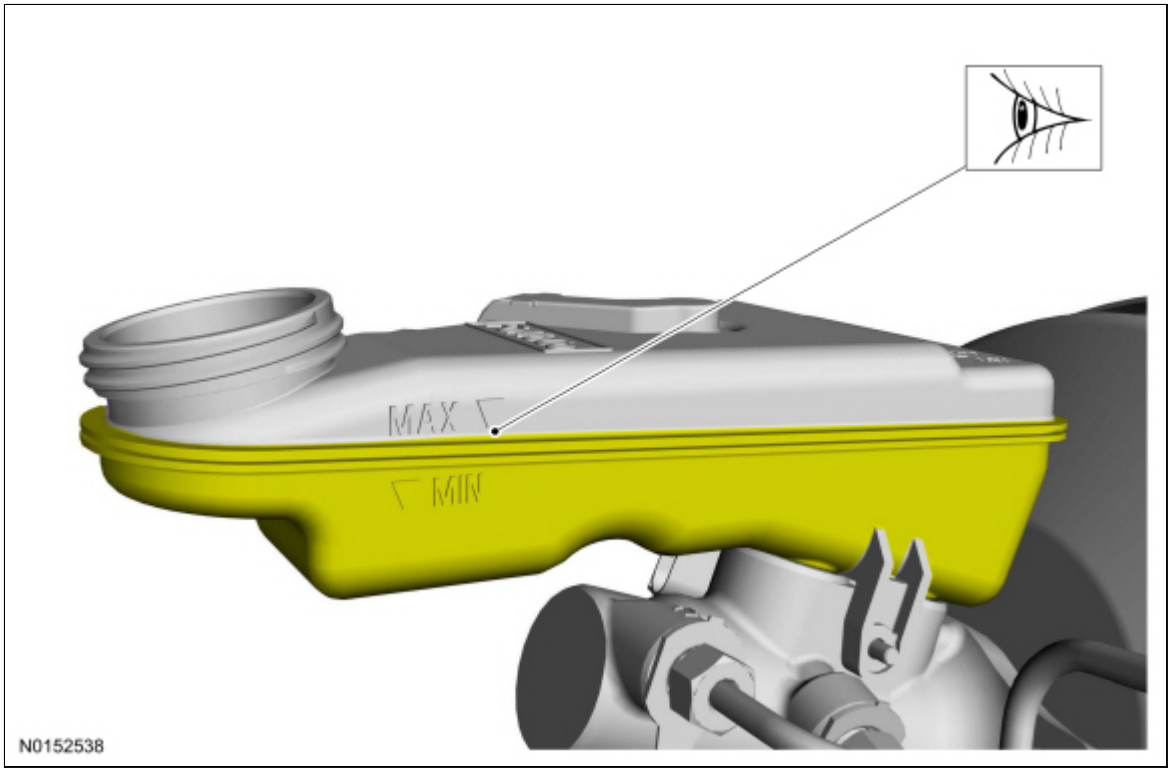
All Vehicles

1. **NOTE:** Make sure the area around the master cylinder cap is clean and free of foriegn material.



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2. Fill the reservoir with clean, specified brake fluid. Refer to Specifications in this section.



3. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

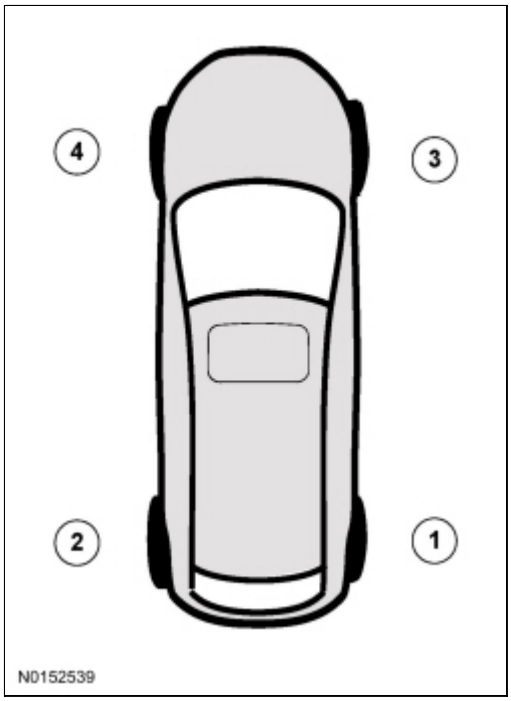
   Install the bleeder adapter to the brake master cylinder reservoir and attach the bleeder tank hose to the fitting on the adapter.

4. **NOTE:** Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation. Refer to Specifications in this section.

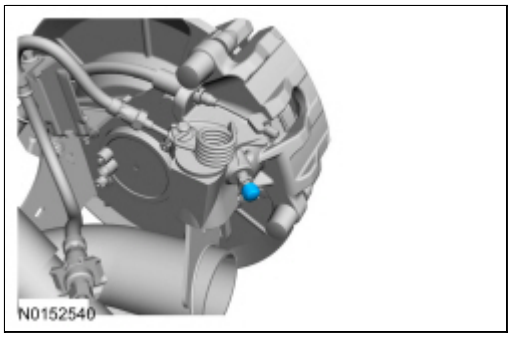
   Open the valve on the bleeder tank.
   - Apply 207-345 kPa (30-50 psi) to the brake system.

5. With the vehicle in NEUTRAL, position it on a hoist. Section 100-02 .

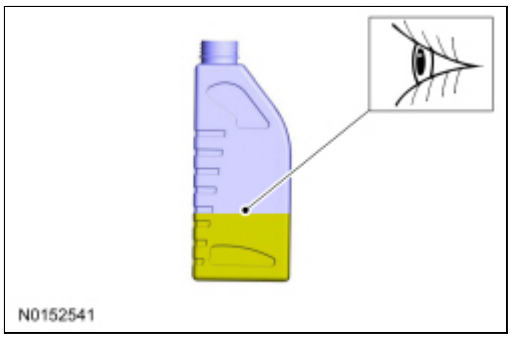
6. Bleeding steps must be followed in the order indicated in the graphic.



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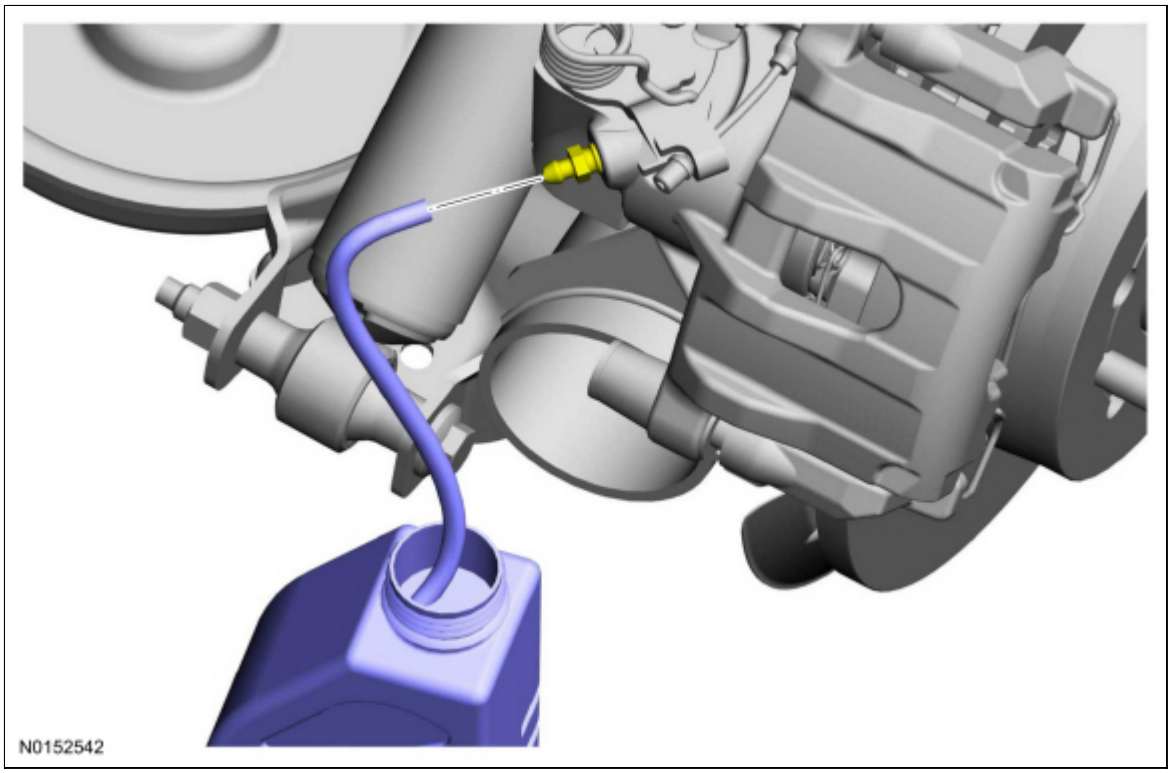


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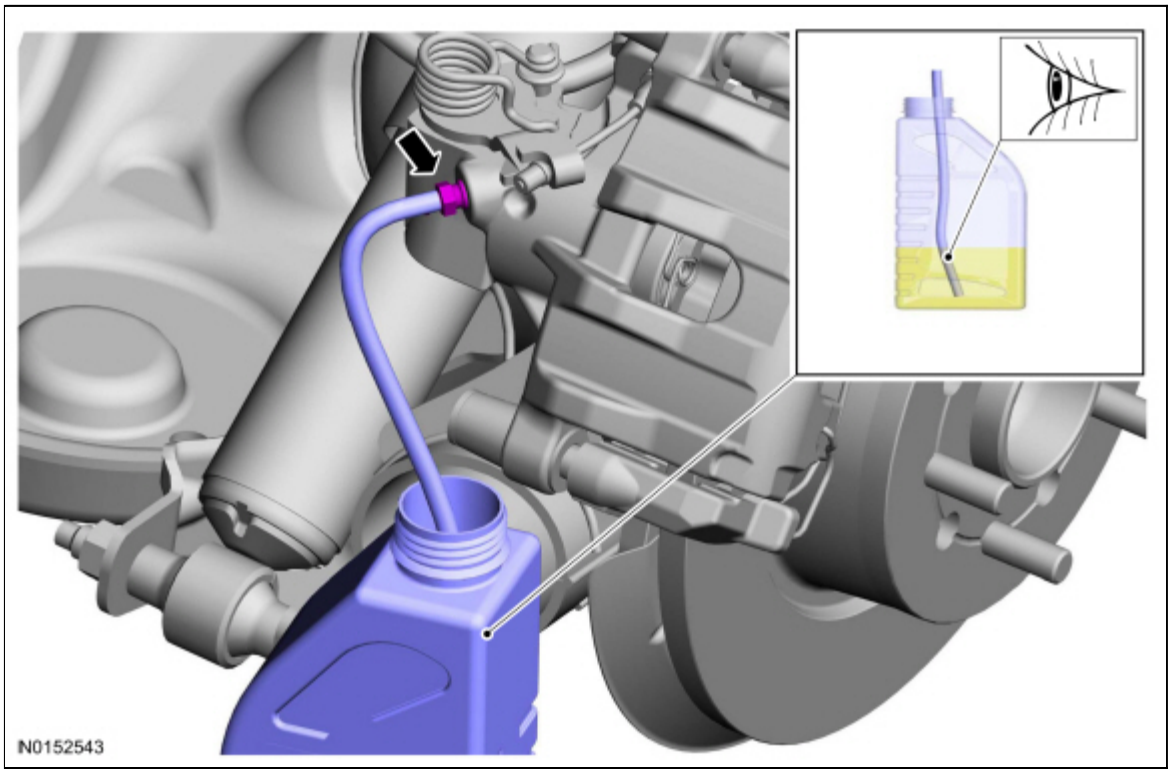


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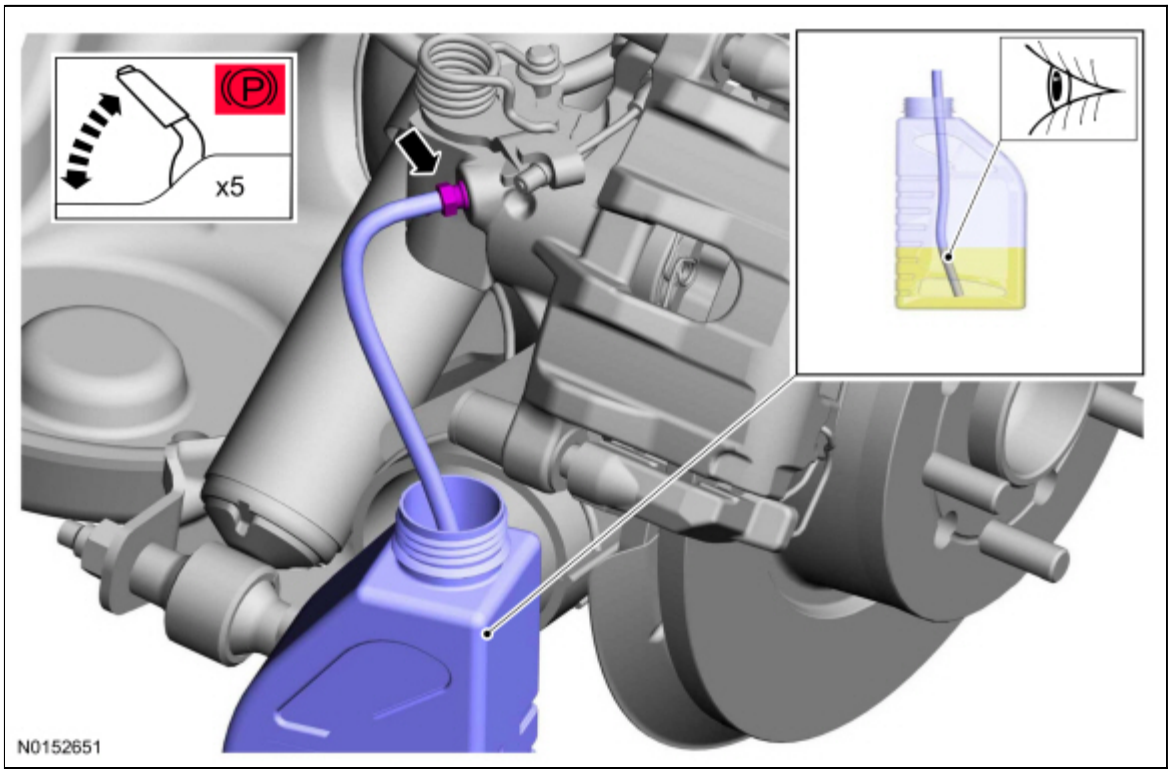
10. Loosen the bleeder screw 180° and leave open until clear bubble free brake fluid flows and then tighten the bleeder screw.



Vehicles with rear integral parking brake calipers

11. **NOTE:** Due to the complexity of the fluid path within the rear integral parking brake calipers, it is necessary to press and release the parking brake during the bleed procedure.

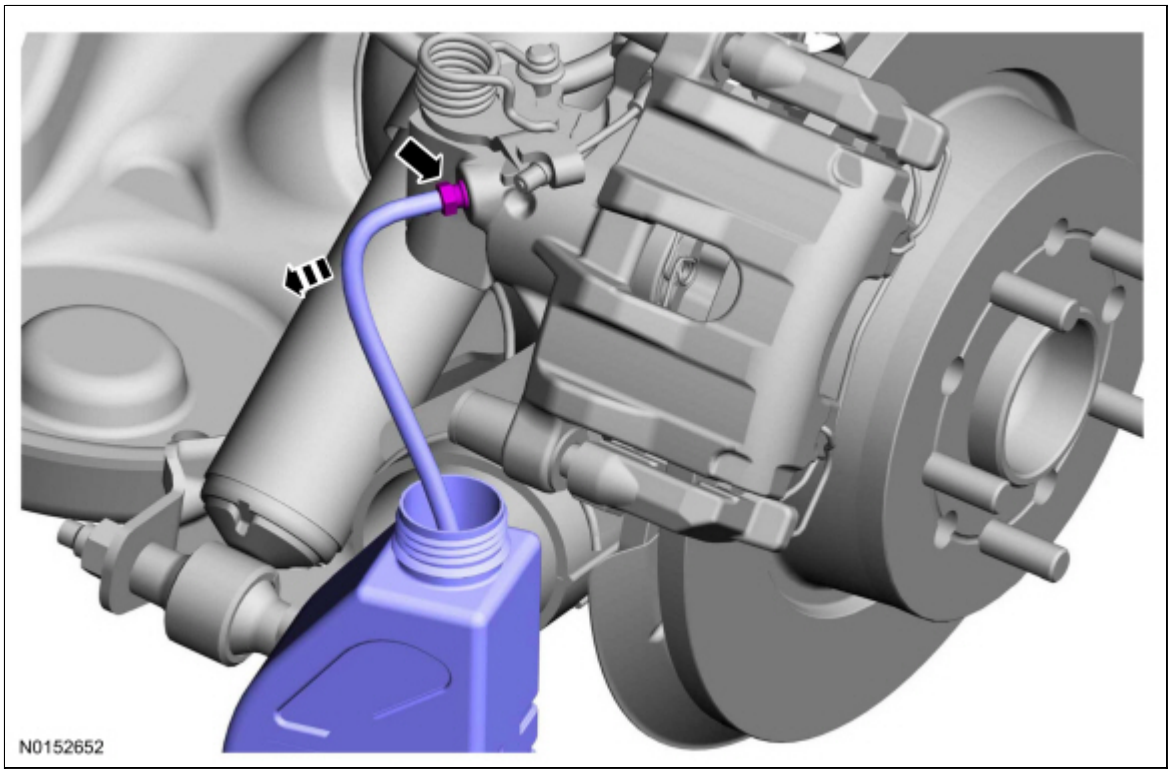
    Apply and release the parking brake 5 times. Loosen the rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the rear bleeder screw.
    - Repeat until clear, bubble-free fluid comes out.



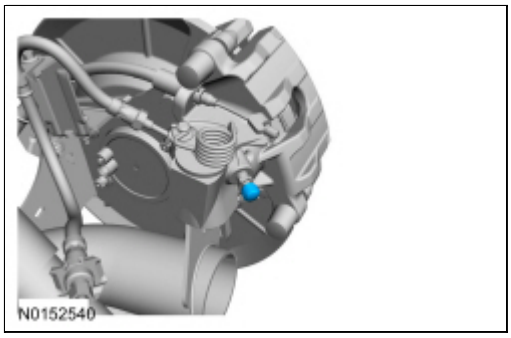
All vehicles

12. Tighten the bleeder screw to specification. Refer to Specifications in this section.
    - Remove the fluid container and hose.

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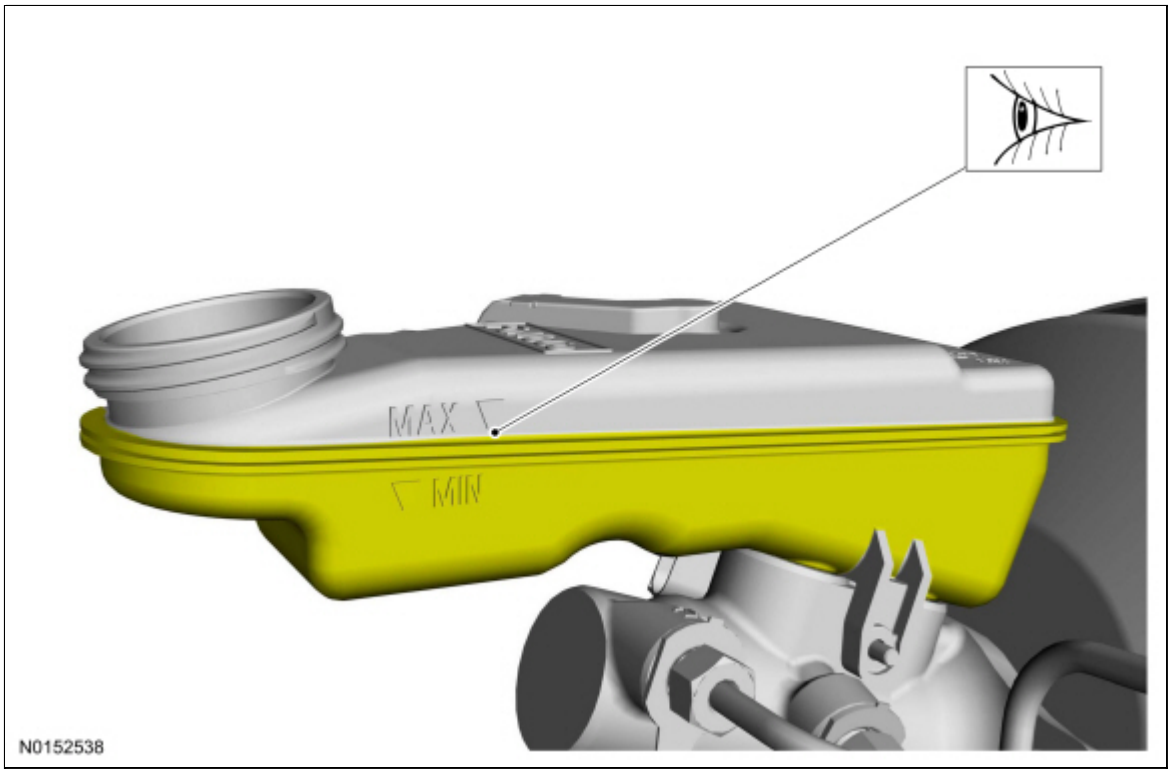
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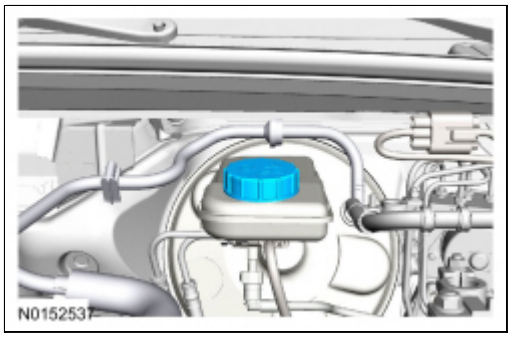
14. Repeat steps 7-13 at the remaining wheel ends.

15. Close the bleeder tank valve and release the pressure. Remove the tank hose from the adapter and remove the adapter.

16. Fill the reservoir with clean, specified brake fluid. Refer to Specifications in this section.



17.



Hydraulic Control Unit (HCU) Bleeding

NOTE: The HCU bleeding procedure must be carried out if a new HCU has been installed.

NOTE: Pressure bleeding the brake system is preferred to manual bleeding.

1. Follow the pressure bleeding or manual bleeding procedure steps to bleed the system.
2. Connect the diagnostic scan tool and follow the ABS Service Bleed instructions.
3. Repeat the pressure bleeding or manual bleeding procedure steps to bleed the system.

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Brake System Inspection

Material

Item	Specification
Motorcraft® Metal Brake Parts Cleaner (US) / Motorcraft® Brake Parts Cleaner (Canada) PM-4-A or PM-4-B (US); CPM-4 (Canada)	—
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Brake Pads

NOTE: It is not required to install new brake pads when the brake discs are machined.

1. Inspect the brake pad friction material for contamination.
   - If the friction material shows evidence of contamination, install new brake pads. For additional information, refer to Section 206-03 for front brake pads or Section 206-04 for rear brake pads.

2. Inspect and measure the thickness of the brake pad friction material. For additional information, refer to Specifications in this section.
   - Minor surface cracks do not require pad replacement, however, if there are missing chunks or cracks in the lining through to the backing plate, install new brake pads. For additional information, refer to Section 206-03 for front brake pads or Section 206-04 for rear brake pads.
   - If the thickness of the friction material is less than the specified thickness, install new brake pads. For additional information, refer to Section 206-03 for front brake pads or Section 206-04 for rear brake pads.
   - If the friction material shows taper wear that is not within specifications, install new brake pads and verify the caliper guide pins are functioning correctly. For additional information, refer to Brake Caliper Guide Pins inspection.

Brake Discs

NOTICE: **Using an impact tool without a torque socket will lead to unevenly tightened wheel nuts. This causes brake disc on-vehicle lateral runout and brake roughness.**

1. Inspect the brake discs and measure the brake disc thickness. Record the measurement. Refer to Specifications in this section.
   - If the brake disc is cracked or otherwise damaged, install a new brake disc. For additional information, refer to Section 206-03 for front brakes or Section 206-04 for rear brakes.
   - If the measurement is below the minimum thickness specification, install a new brake disc. For additional information, refer to Section 206-03 for front brakes or Section 206-04 for rear brakes.

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- If the diagnosis has revealed vibration in the steering wheel, seat or pedal while braking that varies with vehicle speed, machine the brake disc. Heavily scored brake discs, similar to that caused by pads worn down to the backing plate, should also be machined. In order to machine, discs must be above the minimum thickness specification. For additional information, refer to Specifications and Brake Disc Machining in this section.

Brake Calipers

1. Inspect the brake calipers for leaks, damage to seals and piston corrosion or binding.
    - If the brake caliper is leaking or otherwise damaged, install a new brake caliper. For additional information, refer to Section 206-03 for front brake calipers or Section 206-04 for rear brake calipers.

Brake Caliper Guide Pins

1. The guide pins should slide with a reasonable amount of hand force. If the brake pads show taper wear or the guide pins are difficult to move, carry out the following steps.
    - Disassemble the brake caliper guide pins and inspect the guide pins and guide pin bores for wear, damage and corrosion. If the bore is worn or damaged, replace the damaged component.
    - Use a wire brush, rolled-up sandpaper or emery cloth to remove all corrosion and foreign material from the caliper guide pin bores. Clean any remaining foreign material from the bores with brake parts cleaner and compressed air.
    - Assemble the caliper seals, boots and guide pins. Use an ample amount of the specified grease to lubricate the bores and guide pins.
    - Inspect the brake pads. For additional information, refer to Brake Pads inspection in this section.

Brake Flexible Hoses and Tubes

NOTICE: **Never use copper tubing. It is subject to fatigue, cracking and corrosion, which may result in brake tube failure.**

NOTE: Double-wall steel tubing is used throughout the brake hydraulic system. All brake tube fittings must be correctly double flared to provide strong, leakproof connections. When bending tubing to fit the underbody or rear axle contours, be careful not to kink or crack the tube.

1. Inspect brake tubes for corrosion, cracks, leaks or any other signs of damage.
    - If a section of the brake tube is damaged, the entire section must be installed with a new tube of the same type, size, shape and length.
    - When installing the hydraulic brake tubing, hoses or connectors, tighten all connections to specifications. After installation, bleed the brake system. For additional information, refer to Brake System Bleeding in this section.

2. Inspect the brake flexible hoses for cracks, leaks and swelling during brake application or any other signs of damage.
    - Install a new brake flexible hose if the hose shows signs of softening, cracking or other damage. For additional information, refer to Section 206-03 for the front brake flexible hose or Section 206-04 for the rear brake flexible hose.

Brake Master Cylinder

NOTE: During normal operation of the brake master cylinder, the returning brake fluid creates a slight turbulence in the master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged. Clogged compensator ports may cause the brakes to hang up or not fully release. The net fluid level (such as after brake application and release) will remain unchanged. Fluid level will decrease with pad wear.

NOTE: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

1. Inspect the brake master cylinder for fluid leaks.
    - Install a new master cylinder or brake fluid reservoir if signs of excessive leaking are present. For additional information, refer to Section 206-06 .
    - To check for correct brake master cylinder operation, refer to Component Tests in this section.

Brake Booster

1. Inspect the brake booster for excessive corrosion or damage. Inspect the vacuum hoses for leaks and kinks.
    - Install a new brake booster if signs of excessive corrosion or damage is found. For additional information, refer to Section 206-07 .
    - Repair or replace vacuum hoses as necessary.
    - To check for correct brake booster operation, refer to Component Tests in this section.

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Component Bleeding

General Equipment

Master Cylinder Bleeding Set

Master Cylinder

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

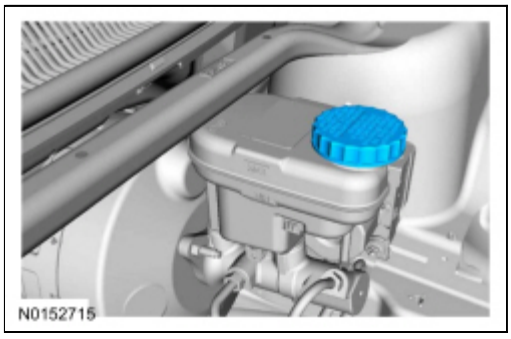
WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

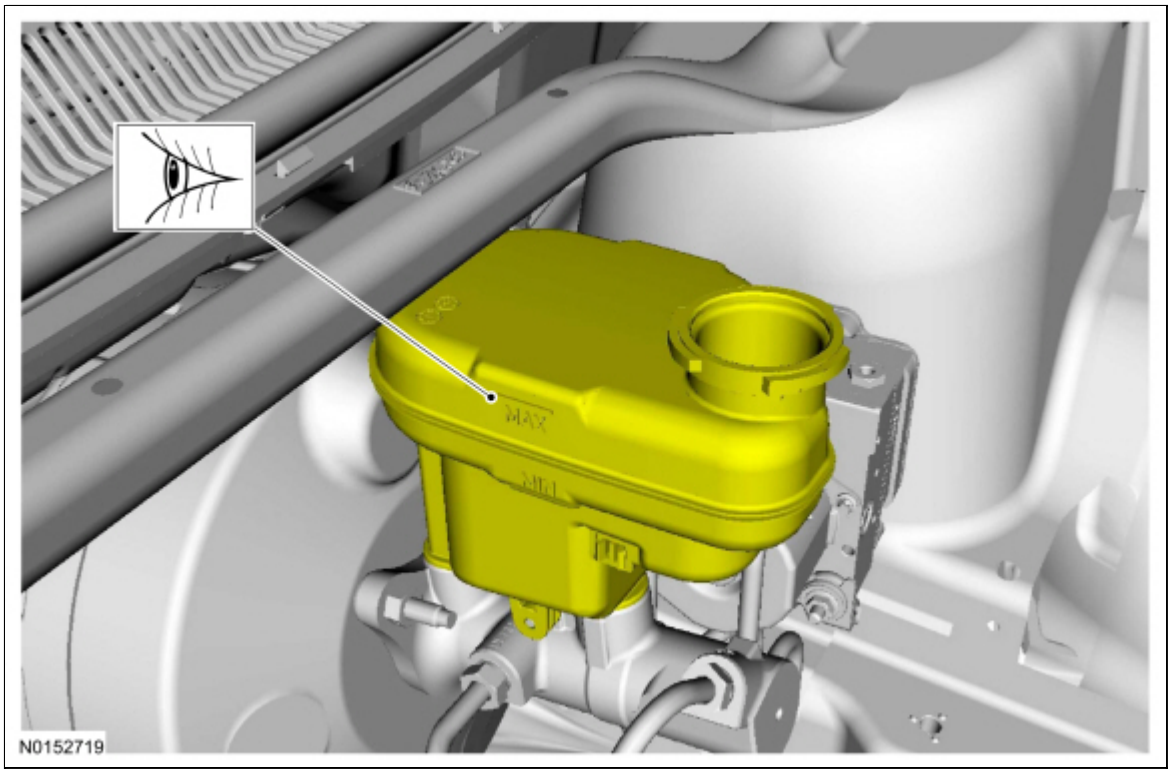
***NOTICE:* Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: When a new brake master cylinder has been installed, it should be primed to prevent air from entering the system.

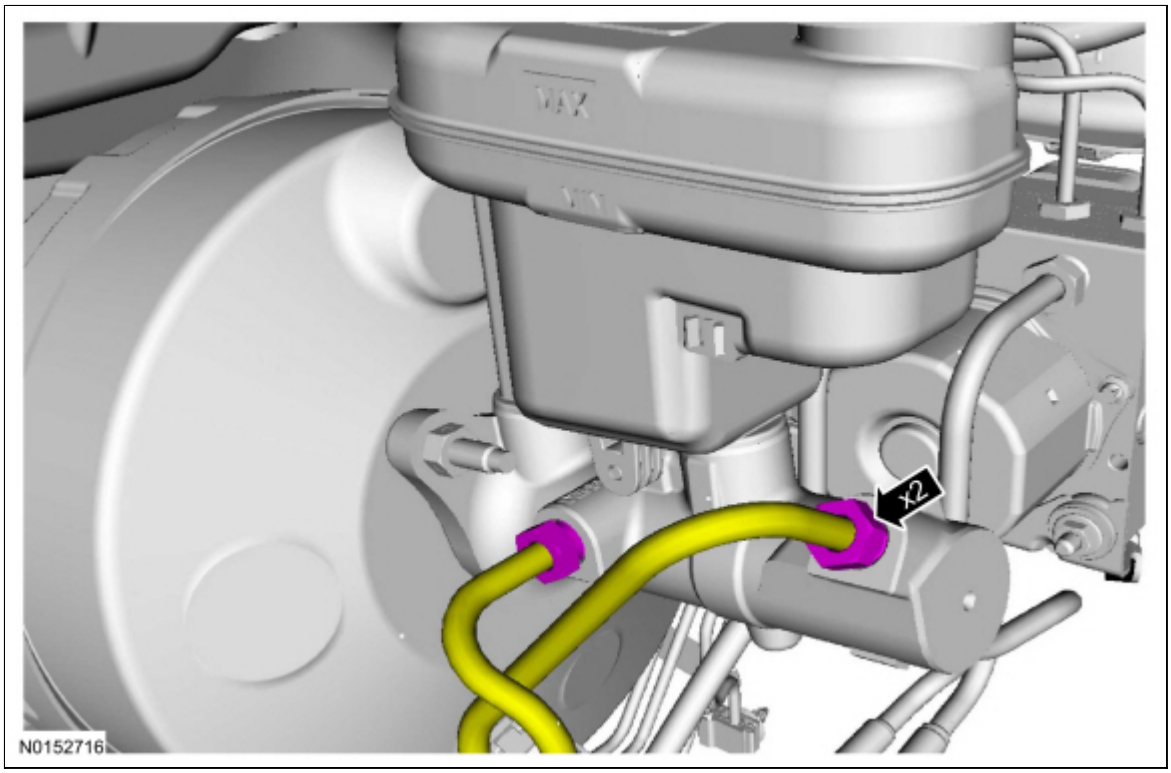
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2. Refer to Specifications in this section.

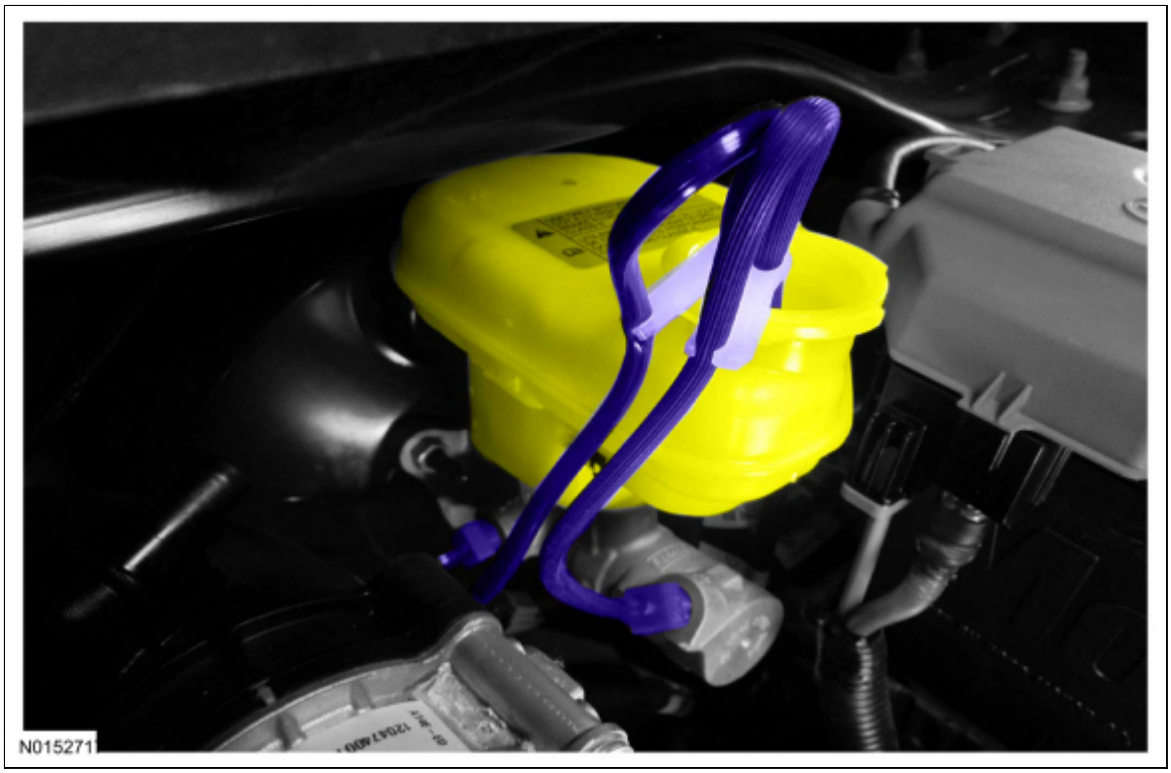


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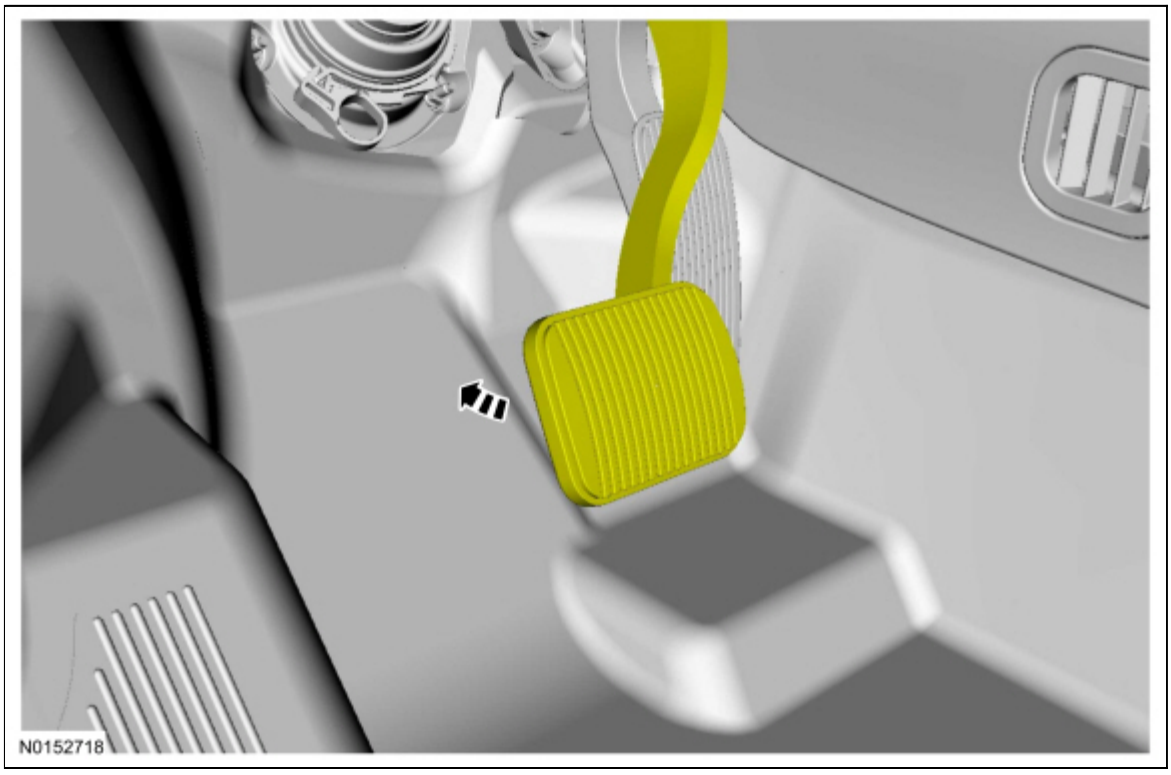


4. Use the General Equipment: Master Cylinder Bleeding Set

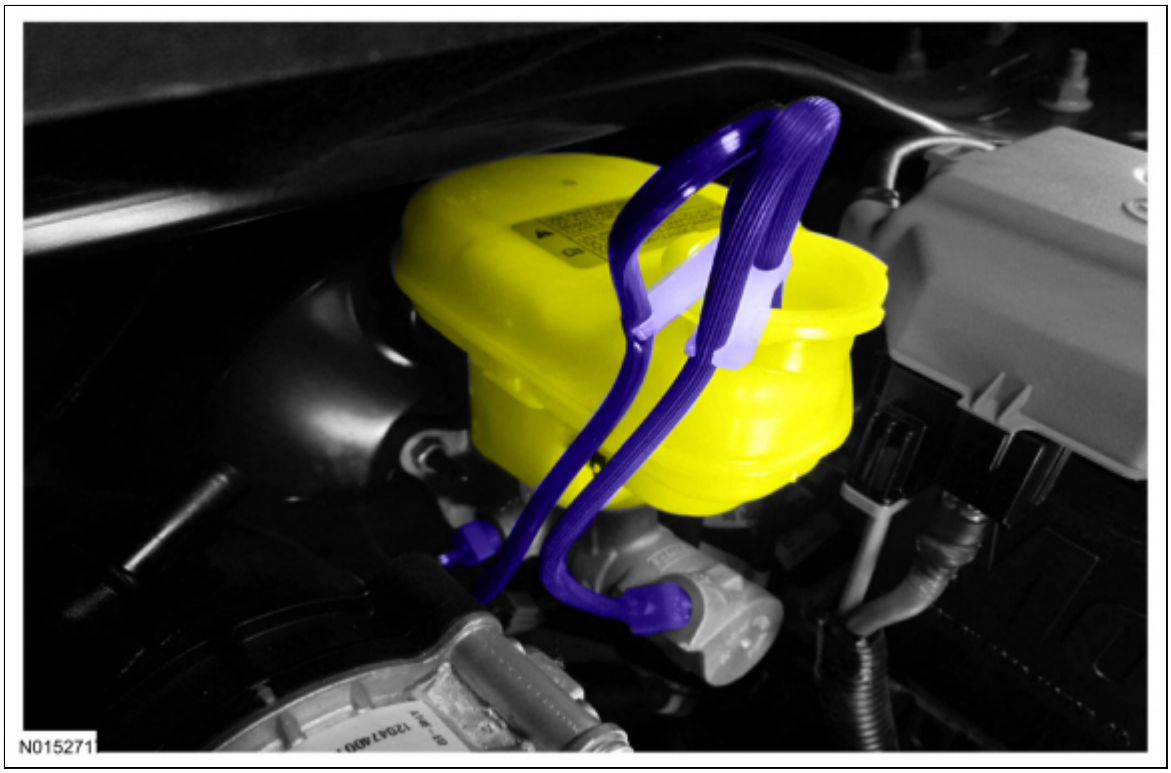
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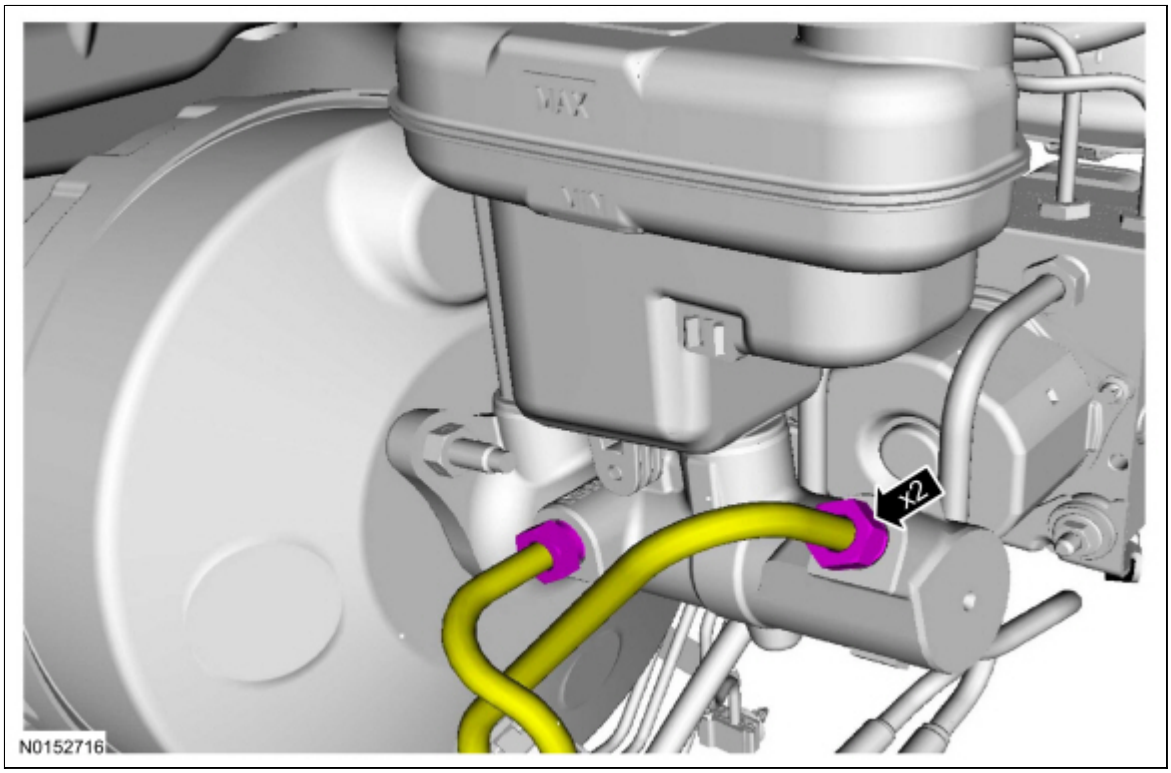
5. Have an assistant pump the brake pedal slowly until clear bubble free fluid flows from the brake tubes.



6. Remove the General Equipment: Master Cylinder Bleeding Set

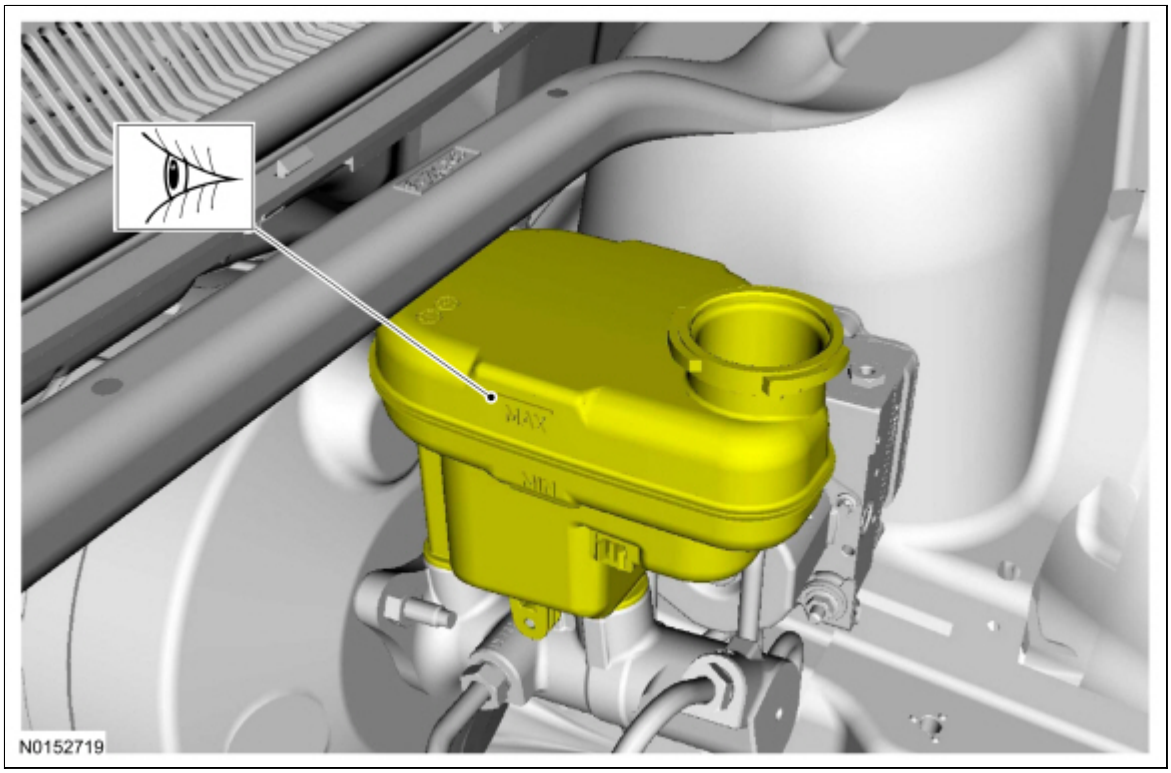


7. Refer to Specifications in this section.



8. Refer to Specifications in this section.

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9. Presssure bleed the brake system. Refer to Brake System Bleeding .

Brake Caliper, Wheel Cylinder, Brake Hose or Brake Tube

1. **NOTE:** Pressure bleeding the brake system is required anytime a hydraulic brake system component has been disconnected.

   Pressure bleed the brake system. Refer to Brake System Bleeding .

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Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	1,420 ml (3 pt)
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—

General Specifications

Item	Specification
Brake Disc	
Brake disc minimum thickness	32 mm (1.259 in)
Brake Pads	
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake caliper anchor plate bolts	250	184	—
Brake caliper flow bolt	35	26	—
Brake caliper guide pin bolts	37	27	—
Brake disc shield bolts	18	—	159
Brake flexible hose bracket-to-wheel knuckle bolt	30	22	—
Brake tube fitting	17	—	150

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Front Disc Brake

The front brake disc system consists of the following components:

- Brake pads
- Brake caliper anchor plate
- Brake caliper
- Brake disc
- Brake disc shield
- Brake flexible hose

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing of wheel rotation and the vehicle.

Front Disc Brake

Refer to Section 206-00 .

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Brake Caliper Anchor Plate

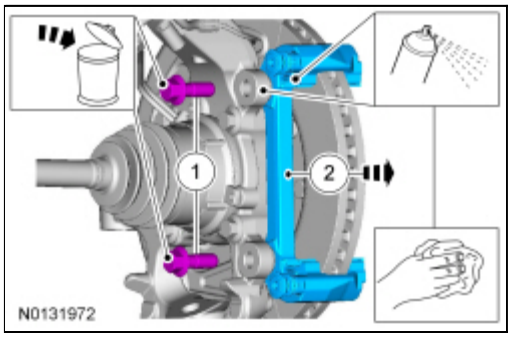
Material

Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

Removal

1. Remove the brake pads. For additional information, refer to Brake Pads in this section.

2. Discard the specified component. Follow local disposal regulations.
   Apply the specified chemical with a spray can
   Clean the specified component with the specified material
   - To install, tighten the new bolts to 250 Nm (184 lb-ft).



Installation

1. To install, reverse the removal procedure.

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Brake Caliper

Removal

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

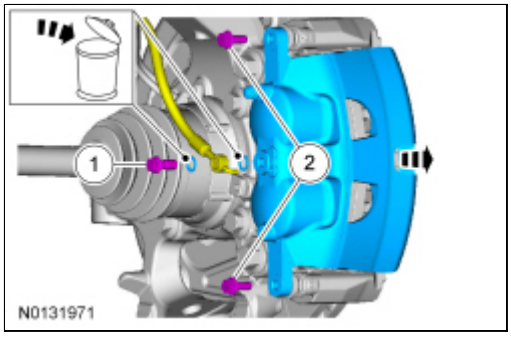
NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: Removal steps in this procedure may contain installation details.

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. Discard the specified component. Follow local disposal regulations.
    1. **NOTE:** Use 2 new copper washers.

       To install, tighten to 35 Nm (26 lb-ft).
    2. **NOTE:** Tighten the lower brake caliper guide pin bolt first.

       To install, tighten to 37 Nm (27 lb-ft).



Installation

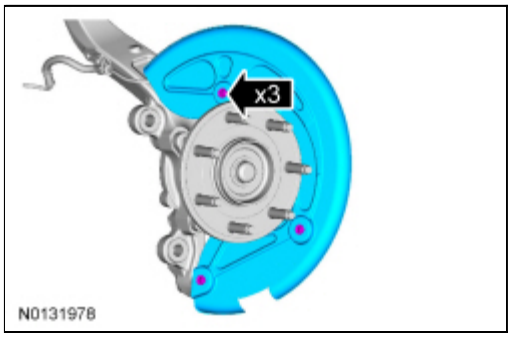
1. To install, reverse the removal procedure.
2. Bleed the brake caliper. For additional information, refer to Component Bleeding in Section 206-00 .

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Brake Disc Shield

Removal

1. Remove the brake disc. For additional information, refer to Brake Disc in this section.
2.
   - To install, tighten to 18 Nm (159 lb-in).



Installation

1. To install, reverse the removal procedure.

Brake Disc

Material

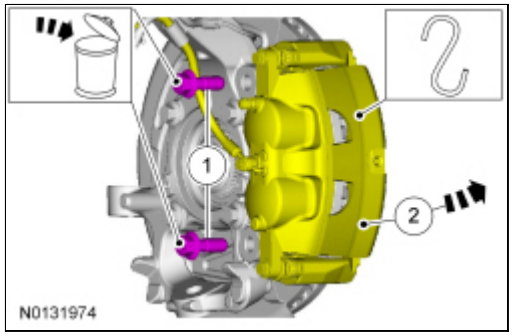
Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

Removal

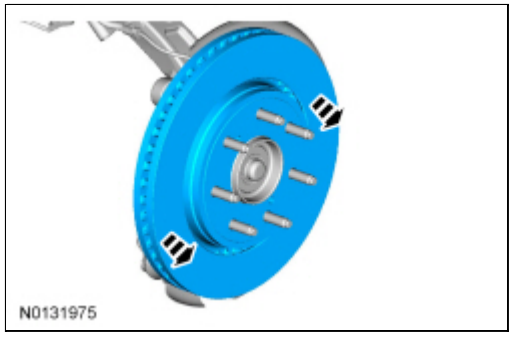
1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. ***NOTICE:*** **Do not allow the caliper and anchor plate assembly to hang from the brake hose or damage to the hose can occur.**

   Discard the specified component. Follow local disposal regulations.
   Relocate and support the component.
   - To install, tighten the 2 new bolts to 250 Nm (184 lb-ft).



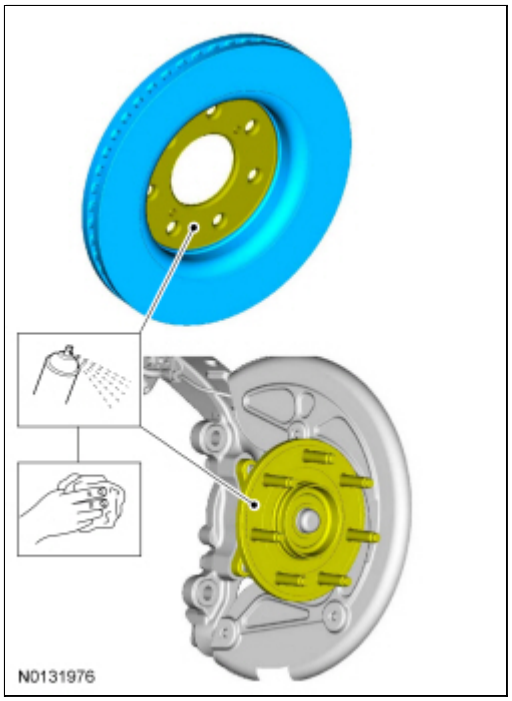
3.



Installation

1. Apply the specified chemical with a spray can.
   Clean the specified component with the specified material.

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2. To install, reverse the removal procedure.

Brake Flexible Hose

Removal

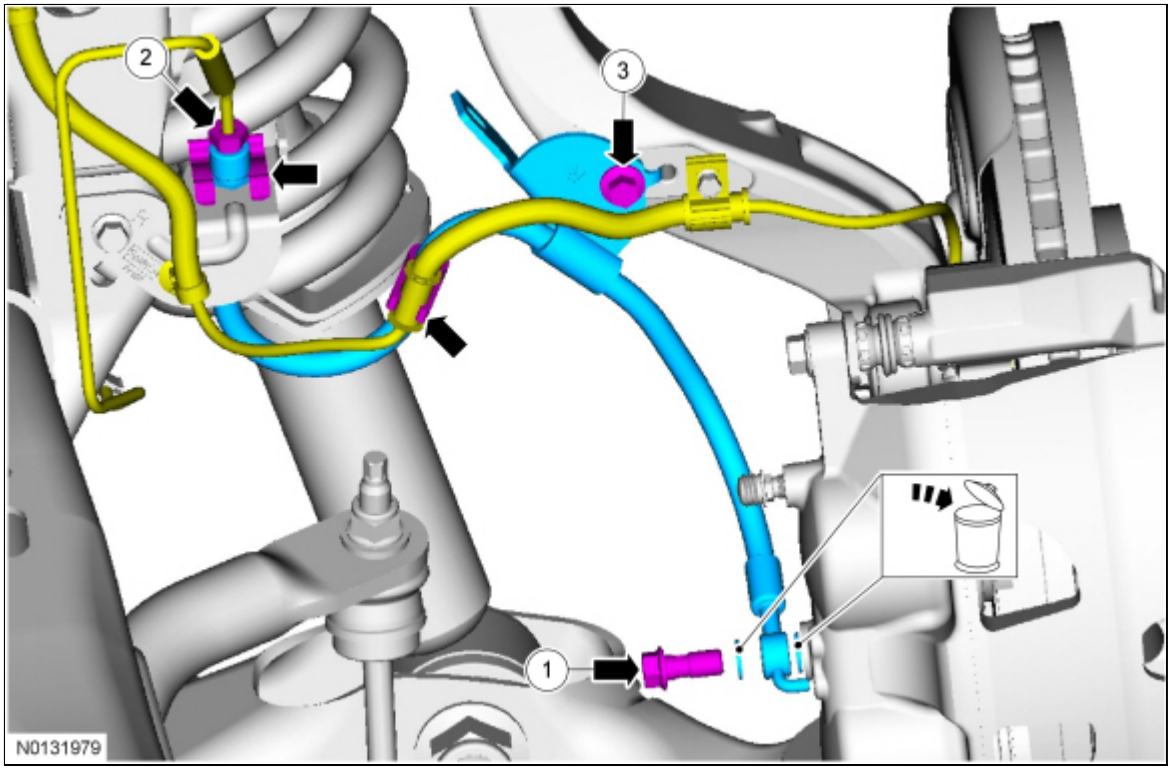
WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Discard the specified component. Follow local disposal regulations.
    1. **NOTE:** Use new copper washers.

       To install, tighten to 35 Nm (26 lb-ft).
    2. To install, tighten to 17 Nm (150 lb-in).
    3. To install, tighten to 30 Nm (22 lb-ft).



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Installation

1. To install, reverse the removal procedure.
    - Bleed the brake caliper. For additional information, refer to Component Bleeding in Section 206-00 .

Brake Pads

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

Removal

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

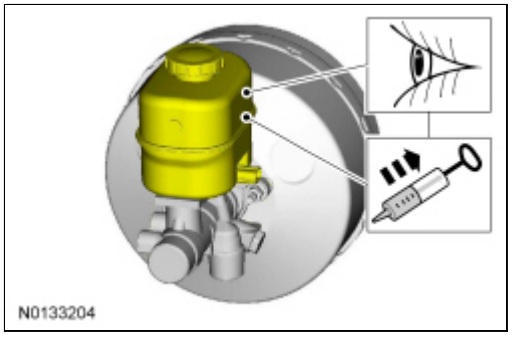
WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

***NOTICE:* Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: Removal steps in this procedure may contain installation details.

1. Visual check. Extract the fluid with a syringe.
   If necessary, remove fluid until the brake master cylinder reservoir is half full.

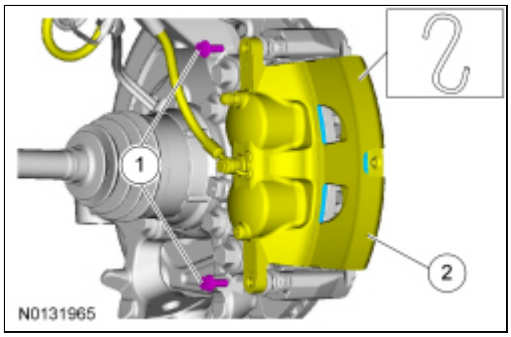


2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

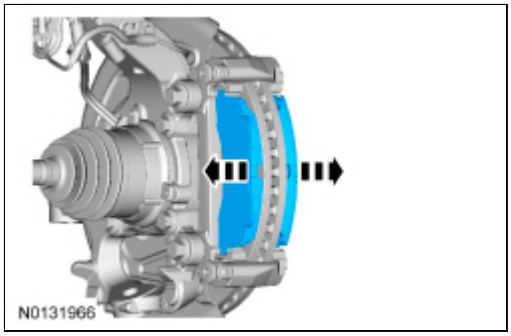
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3. ***NOTICE:*** **Do not allow the caliper to hang from the brake hose or damage to the hose can occur.**

   Relocate and support the component.
   - To install, tighten to 37 Nm (27 lb-ft).

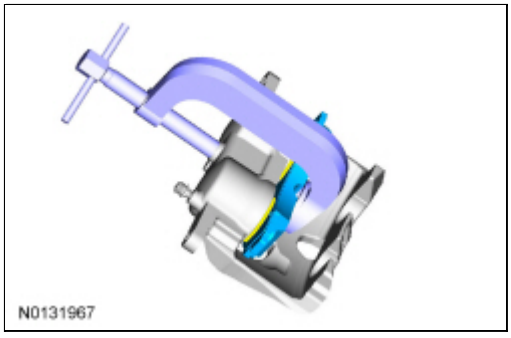


4.



5. **NOTE:** Protect the piston and boots when pushing the caliper piston into the caliper piston bores or damage to the piston or boots may occur.

   If installing new brake pads, Use a C-clamp and a worn brake pad to compress the disc brake caliper pistons into the brake caliper bore.



Installation

NOTE: If installing new brake pads, make sure to install all new hardware and specified lubricant supplied with the brake pad kit. Refer to the brake pad instruction sheet when applying lubricant.

1. To install, reverse the removal procedure.
   1. Fill the master cylinder with clean, specified brake fluid.

2. Apply brakes several times to verify correct brake operation.

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Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	1,420 ml (3.0 pt)
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—

General Specifications

Item	Specification
Brake Disc	
Brake disc minimum thickness	23.0 mm (0.906 in)
Brake Pads	
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Axle vent valve	18	—	159
Brake caliper bleeder screw	10	—	89
Brake caliper flow bolt	35	26	—
Brake caliper guide pin bolts	33	24	—
Brake caliper support bracket bolts	150	111	—
Brake flexible hose bracket-to-axle bolt	30	22	—
Brake flexible hose bracket-to-frame bolt	17	—	150
Brake tube fitting	17	—	150

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Rear Disc Brake

The rear disc brake system consists of the following components:

- Brake caliper
- Brake caliper support bracket
- Brake disc
- Brake pads
- Inner brake flexible hose
- Outer brake flexible hose

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing or stopping of wheel rotation and the vehicle.

Rear Disc Brake

Refer to Section 206-00 .

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Brake Caliper

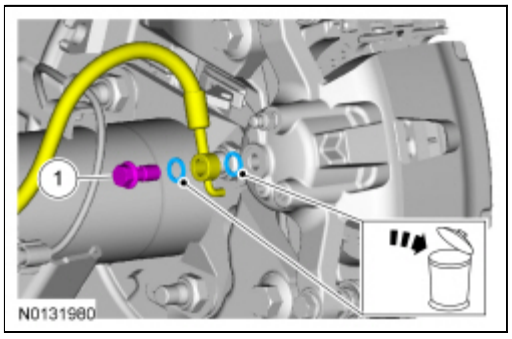
Removal

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

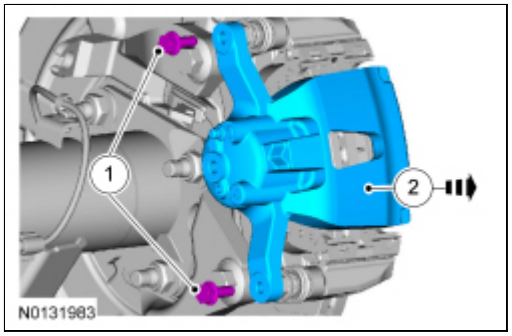
WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. Discard the specified component. Follow local disposal regulations.



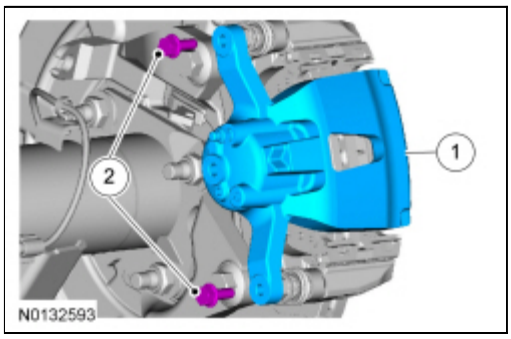
3.



Installation

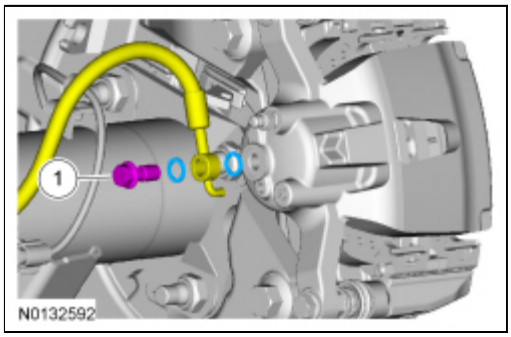
1.

- Tighten to 33 Nm (24 lb-ft).



2. **NOTE:** Use 2 new copper washers.

   - Tighten to 35 Nm (26 lb-ft).



3. Bleed the brake caliper. For additional information, refer to Component Bleeding in Section 206-00 .
4. Install the wheel and tire. For additional information, refer to Section 204-04 .

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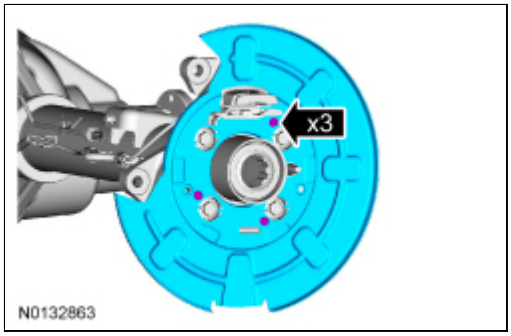
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Brake Disc Shield

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Remove the rear axle. For additional information, refer to Section 205-02A or Section 205-02B .
2. Remove the parking brake shoes. For additional information, refer to Section 206-05 .
3. To install, tighten to 14 Nm (124 lb-in).



Installation

1. To install, reverse the removal procedure.

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Brake Disc

Material

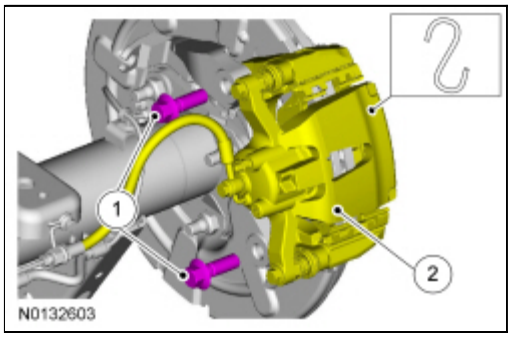
Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

Removal

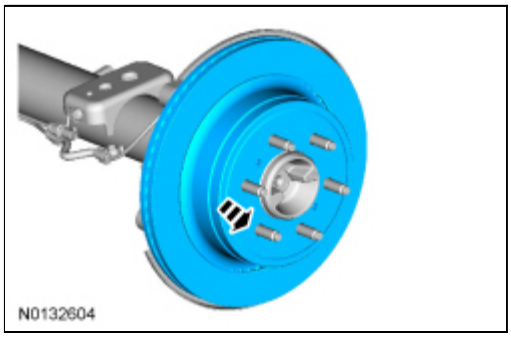
NOTE: Removal steps in this procedure may contain installation details.

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. ***NOTICE:*** **Do not allow the caliper assembly to hang from the brake hose or damage to the hose can occur.**

   Relocate and support the component.
   - To install, tighten to 150 Nm (111 lb-ft).



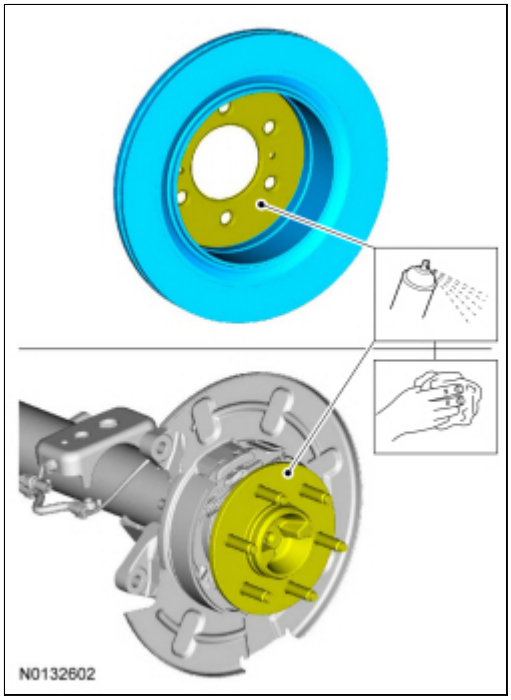
3.



Installation

1. Apply the specified chemical with a spray can. Clean the specified component with the specified

material.



2. To install, reverse the removal procedure.
    - Apply brakes several times to verify correct brake operation.

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Brake Flexible Hose — Inner

Removal

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

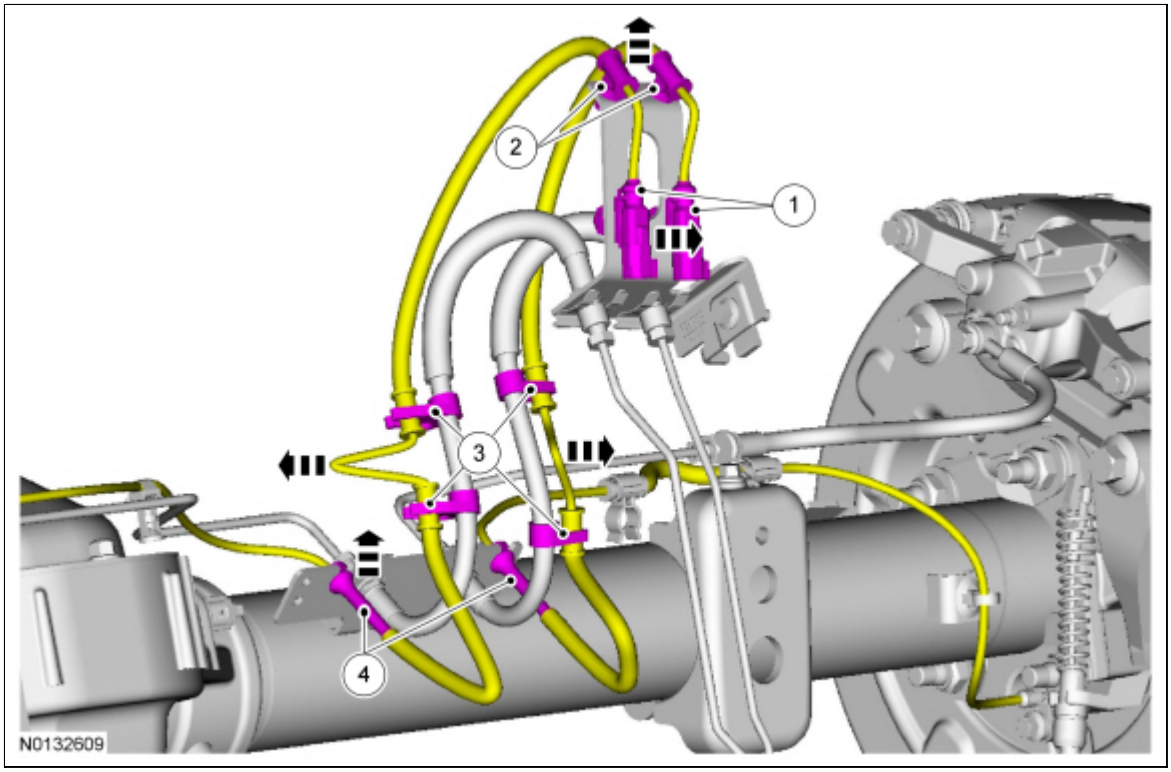
WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: Removal steps in this procedure may contain installation details.

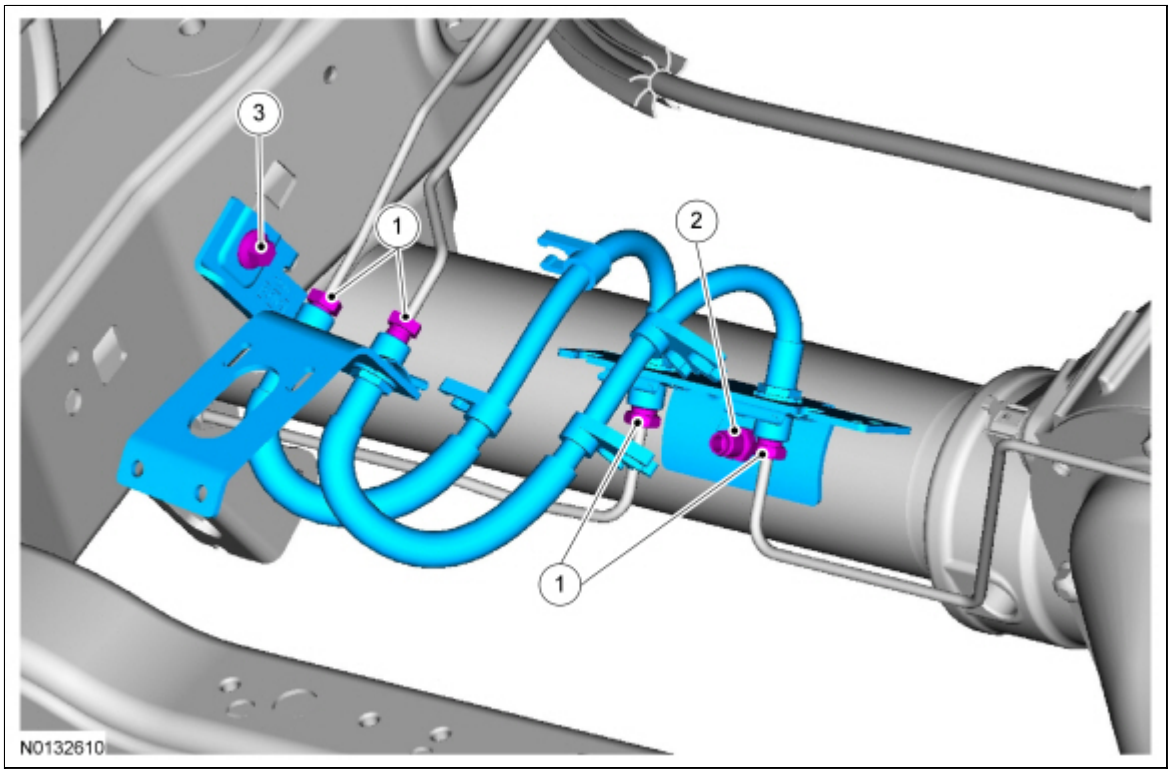
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2.



3.

1. To install, tighten to 17 Nm (150 lb-in).
2. To install, tighten to 18 Nm (159 lb-in).
3. To install, tighten to 17 Nm (150 lb-in).



Installation

1. To install, reverse the removal procedure.
2. Bleed the brake calipers. For additional information, refer to Component Bleeding in Section 206-00 .

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Brake Flexible Hose — Outer

Removal

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: Removal steps in this procedure may contain installation details.

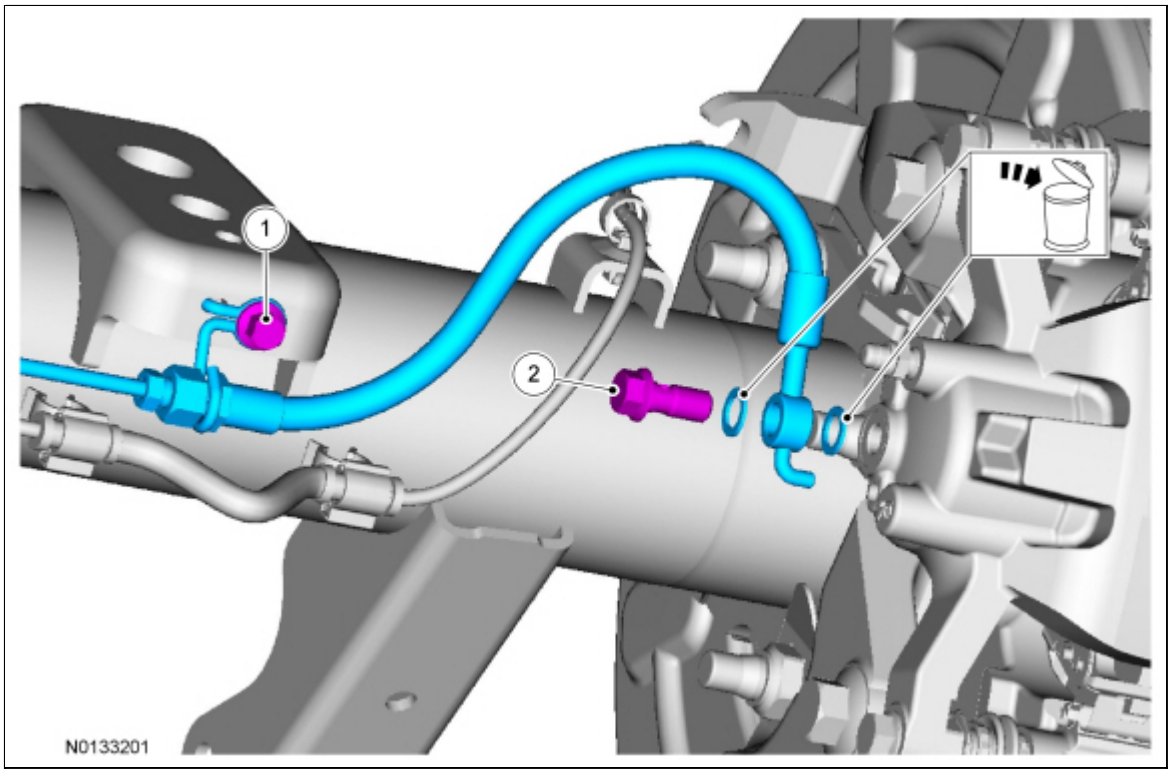
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** RH shown LH similar.

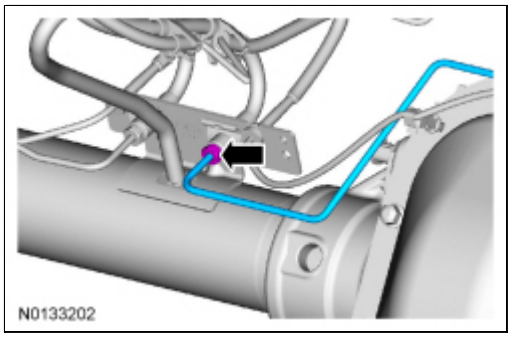
   Discard the specified component. Follow local disposal regulations.
   1. To install, tighten to 30 Nm (22 lb-ft).
   2. **NOTE:** Use new copper washers.

      To install, tighten to 35 Nm (26 lb-ft).

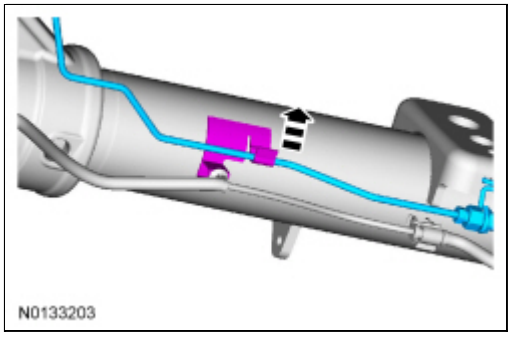
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3. To install, tighten to 17 Nm (150 lb-in).



4.



Installation

1. To install, reverse the removal procedure.

2. Bleed the brake caliper. For additional information, refer to Component Bleeding in Section 206-00 .

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Brake Pads

Material

Item	Specification
Molykote® M77 8U7Z-19A506-A	—

Removal

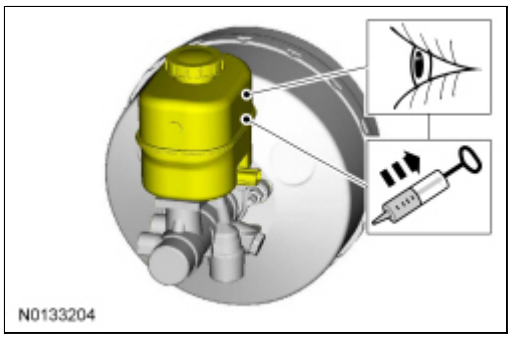
WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

***NOTICE:* Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

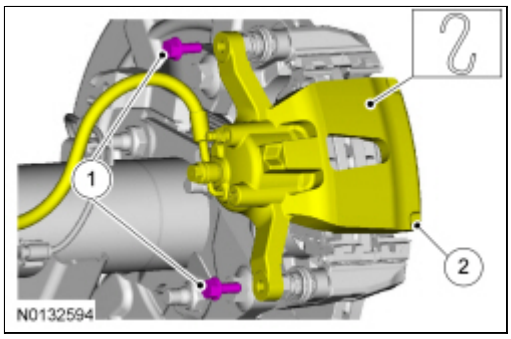
1. Visual check. Extract the fluid with a syringe.
   If necessary, remove fluid until the brake master cylinder reservoir is half full.



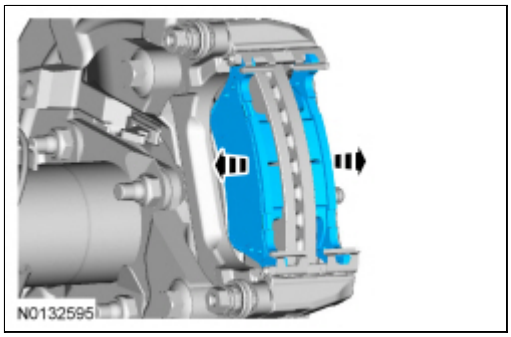
2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

3. ***NOTICE:* Do not allow the caliper to hang from the brake hose or damage to the hose can occur.**

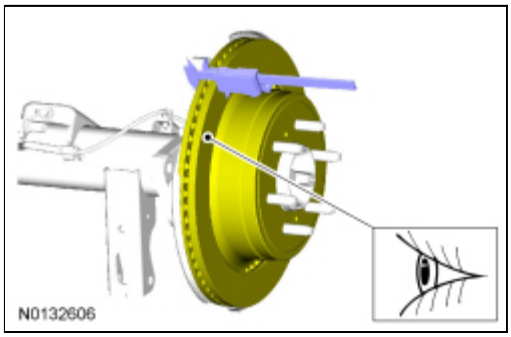
Relocate and support the component.



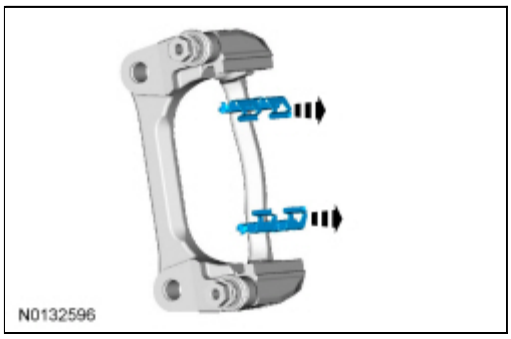
4.



5. Visual check.
Measure the brake disc thickness and install a new brake disc if it is not within specification.



6.

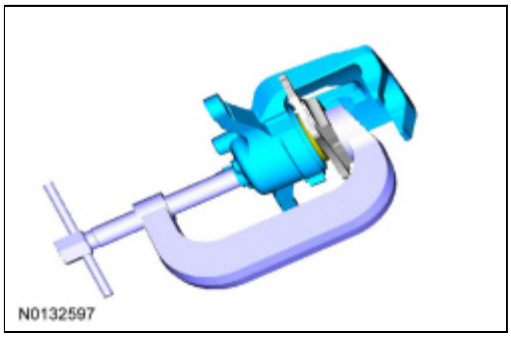


Installation

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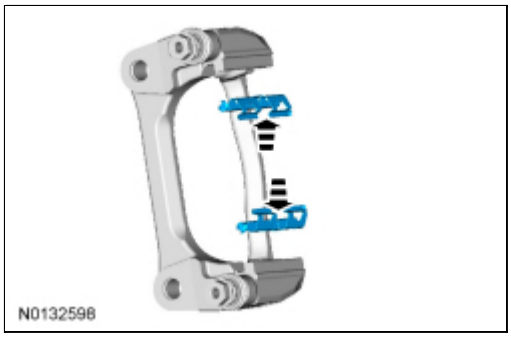
NOTE: If installing new brake pads, make sure to install all new hardware and specified lubricant supplied with the brake pad kit. Refer to the brake pad instruction sheet when applying lubricant.

1. ***NOTICE:*** **Protect the caliper pistons and boots when pushing the caliper piston into the caliper piston bores or damage to components may occur.**

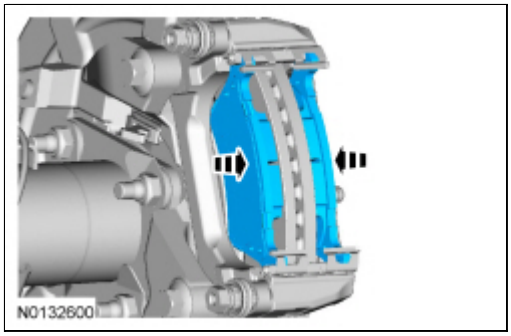


2. ***NOTICE:*** **Do not allow grease, oil, brake fluid or other contaminants to contact the pad lining material or damage to components may occur. Do not install contaminated pads.**

   NOTE: Install all new hardware supplied with the pad kit.

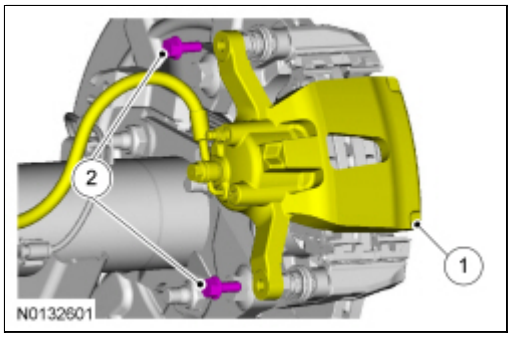


3.



4.

   - Tighten to 33 Nm (24 lb-ft).



5. Fill the master cylinder with clean specified brake fluid.
    - Apply brakes several times to verify correct brake operation.

6. Install the wheel and tire. For additional information, refer to Section 204-04 .
    - Apply brakes several times to verify correct brake operation.

---

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Material

Item	Specification	Fill Capacity
Molykote® M77 8U7Z-19A506-A	—	—

General Specifications

Item	Specification
Parking brake shoe clearance	0.59 mm (0.023 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Parking brake cable bracket bolt (RH)	30	22	—
Parking brake control bolts	20	—	177

Parking Brake

The parking brake and actuation system consists of the following components:

- Parking brake cables
- Parking brake control
- Parking brake shoes
- Red brake warning indicator

The parking brake system is a foot-operated/cable-actuated system that applies a drum-in-hat assembly within each rear brake disc. A red brake warning indicator is located in the instrument cluster and will illuminate when the system is actuated to alert the driver that the parking brakes are applied.

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Parking Brake

Principles of Operation

Parking Brake System

The parking brake system is an independent, cable-actuated system controlled by an foot-operated parking brake control that is self adjusting. The parking brake control applies tension to the front parking brake cable and conduit. The front parking brake cable is coupled to the LH rear parking brake cable and conduit which is coupled to the RH rear parking brake cable. The parking brake cable and conduits actuate the parking brake levers, engaging the parking brake shoes with the parking brake drum-in-hat assembly. The system is returned to the released position by pulling the parking brake control release handle. Springs in the parking brake system apply the necessary force to return the system to the unapplied position. The parking brake warning indicator is located in the instrument cluster. It illuminates to signal the driver that the parking brake is applied or to signal a low brake fluid condition. The warning indicator system is diagnosed in Section 413-01.

Inspection and Verification

NOTE: Prior to carrying out any diagnosis, make sure the red brake warning indicator is functional. Refer to Section 413-01.

The first indication that something may be wrong in the brake system is a change in the feeling through the parking brake control. The parking brake not holding on an incline or dragging after being released are also indicators of system concerns.

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control fully released. Check for any damaged cables and install new components as necessary. Check the rear brake adjustment or carry out the brake system diagnosis.

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Parking brake cable(s) • Parking brake control • Parking brake control release handle • Parking brake shoes and hardware

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The red brake warning indicator is always/never on	• Brake fluid level switch • Parking brake switch • Wiring, terminals or connectors • Instrument cluster • Smart Junction Box (SJB) • Vacuum sensor	• REFER to Diagnosis and Testing in Section 413-01 .
• The parking brake does not apply	• Parking brake cable(s) • Parking brake control • Parking brake shoes and hardware	• GO to Pinpoint Test A .
• The parking brake does not release and/or parking brake shoes drag	• Parking brake cable(s) • Parking brake control • Parking brake shoes and hardware	• GO to Pinpoint Test B .

Pinpoint Tests

Pinpoint Test A: The Parking Brake Does Not Apply

Normal Operation

When the parking brake control is pressed, tension is applied to the front parking brake cable. This tension pulls on the RH rear parking brake cable, which is attached to the RH rear parking brake shoe actuator and applies the RH rear brake shoes. At the same time, the tension in the RH rear cable causes the RH rear conduit to attempt to straighten out. This straightening effect causes the RH rear conduit to pull on the LH rear parking brake cable, which is attached to the LH rear parking brake shoe actuator and applies the LH rear brake shoes.

This pinpoint test is intended to diagnose the following:

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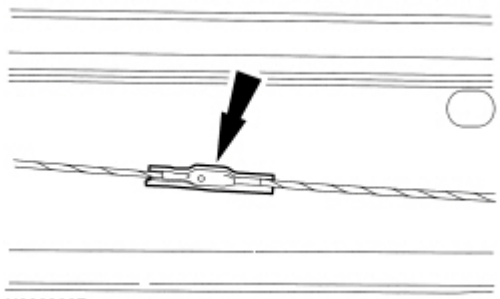
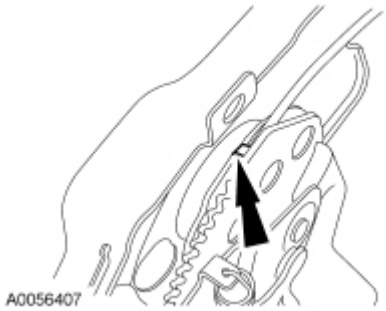
- Parking brake cable(s)
- Parking brake control
- Parking brake shoes and hardware

PINPOINT TEST A: THE PARKING BRAKE DOES NOT APPLY

Test Step	Result / Action to Take
A1 CHECK THE PARKING BRAKE CONTROL	
• Press the parking brake control pedal. • **Does the parking brake control pedal move?**	**Yes** GO to A2 . **No** GO to A5 .
A2 CHECK FOR BROKEN CABLES	

• Have an assistant press and release the parking brake pedal to help isolate disconnected cables or cables that do not move.
• Inspect the following items for damage and correct connections.
  ▪ Front cable and conduit
  ▪ LH rear cable and conduit
  ▪ RH rear cable and conduit
  ▪ Rear cable brackets
• **Are the cables in good condition?**
	Yes
	GO to A3 .
	
	No
	CONNECT the cable(s) or INSTALL new parking brake component(s) as necessary. TEST the system for normal operation.

A3 CHECK THE PARKING BRAKE SHOES, ACTUATOR LEVERS AND HARDWARE	
• Remove the rear brake disc, refer to Section 206-04 . Inspect the parking brake shoes, actuator levers and hardware. • **Are the parking brake shoes, actuator levers and hardware in good condition?**	**Yes** GO to A4 . **No** INSTALL new components as necessary. REFER to Parking Brake Shoes in this section. TEST the system for normal operation.
A4 CHECK THE PARKING BRAKE SHOE ADJUSTMENT	
• Check the parking brake shoe adjustment. Refer to Parking Brake Shoe Adjustment in this section. • **Are the parking brake shoes adjusted to specification?**	**Yes** INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation. **No** ADJUST the rear parking brake shoes. REFER to Parking Brake Shoe Adjustment in this section.
A5 ISOLATE THE PARKING BRAKE CONTROL AND FRONT PARKING BRAKE CABLE	
• Disconnect the front parking brake cable from the RH rear parking brake cable at the cable union.	**Yes** GO to A6 . **No**

 N0002007 • Press the parking brake control pedal. • **Does the parking brake control pedal move?**	GO to A7 .
A6 ISOLATE THE REAR PARKING BRAKE CABLES	
• Disconnect the LH cable from the RH conduit equalizer. • Disconnect the rear parking brake cables from the parking brake actuating levers. • While holding the cable conduit, attempt to slide the cable inside the conduit. • **Does the cable slide freely inside the conduit?**	**Yes** INSPECT the parking brake shoes, hardware and backing plate. INSTALL new components as necessary. REFER to Parking Brake Shoes in this section. TEST the system for normal operation. **No** INSTALL new rear brake cable(s). REFER to Parking Brake Cable — Rear, LH or Parking Brake Cable — Rear, RH in this section. TEST the system for normal operation.
A7 ISOLATE THE FRONT PARKING BRAKE CABLE	
• **NOTE:** The parking brake control take-up spool tab may need to be bent aside to allow the cable to be removed. • Disconnect the front parking brake cable and conduit from the parking brake control.  A0056407 • While holding the cable conduit, attempt to slide the cable inside the conduit. • **Does the cable slide freely inside the conduit?**	**Yes** INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation. **No** INSTALL a new front parking brake cable. REFER to Parking Brake Cable — Front in this section. TEST the system for normal operation.

Pinpoint Test B: The Parking Brake Does Not Release and/or Parking Brake Shoes Drag

Normal Operation

When the parking brake release handle is pulled, the ratchet mechanism and return spring in the parking

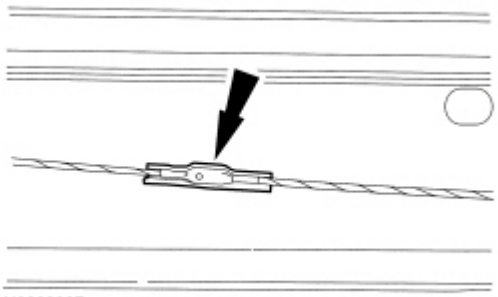
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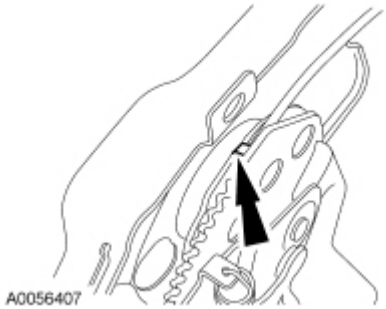
brake control release the tension on the parking brake cables and conduits. The cable conduits, cable springs and parking brake shoe springs provide the force necessary to return the parking brake system to the released position.

This pinpoint test is intended to diagnose the following:

- Parking brake cable(s)
- Parking brake control
- Parking brake control release handle
- Parking brake shoe actuators
- Parking brake shoes and hardware

PINPOINT TEST B: THE PARKING BRAKE DOES NOT RELEASE AND/OR PARKING BRAKE SHOES DRAG

Test Step	Result / Action to Take
B1 CHECK THE PARKING BRAKE CONTROL RELEASE HANDLE AND CABLE	
• Verify that the release handle and cable are connected to the parking brake control. • **Are the release handle and cable connected?**	**Yes** GO to B2. **No** CONNECT the handle and cable. TEST the system for normal operation.
B2 CHECK THE REAR PARKING BRAKE CABLES	
• Disconnect the LH cable from the RH conduit equalizer. • Disconnect the front parking brake cable from the RH rear parking brake cable at the cable union.  N0002007 • Disconnect the rear parking brake cables from the parking brake actuating levers. • While holding the rear cable conduit, attempt to slide the rear cable inside the conduit. • **Does the cable slide freely inside the conduit?**	**Yes** GO to B3. **No** INSTALL new rear brake cable(s). REFER to Parking Brake Cable — Rear, LH or Parking Brake Cable — Rear, RH in this section. TEST the system for normal operation.
B3 CHECK THE REAR PARKING BRAKE SHOES AND HARDWARE	
• Remove the rear brake disc. Refer to Section 206-04. • Inspect the parking brake shoes, hardware and backing plate. • **Are the shoes, hardware and backing plate in good condition?**	**Yes** GO to B4. **No** INSTALL new components as

	necessary. REFER to Parking Brake Shoes in this section. TEST the system for normal operation.
B4 ISOLATE THE FRONT PARKING BRAKE CABLE • **NOTE:** The parking brake control take-up spool tab may need to be bent aside to allow the cable to be removed. • Disconnect the front parking brake cable and conduit from the parking brake control.  A0056407 • While holding the cable conduit, attempt to slide the cable inside the conduit. • **Does the cable slide freely inside the conduit?**	**Yes** INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation. **No** INSTALL a new front cable. TEST the system for normal operation.

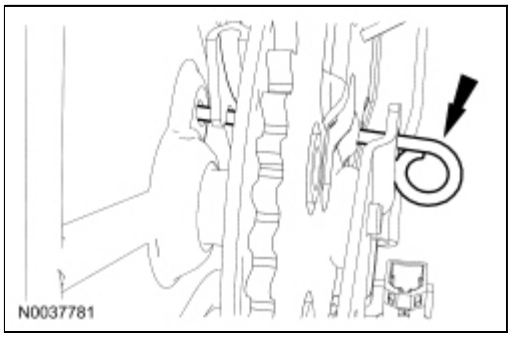
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Parking Brake Cable Tension Release

1. Release the parking brake.

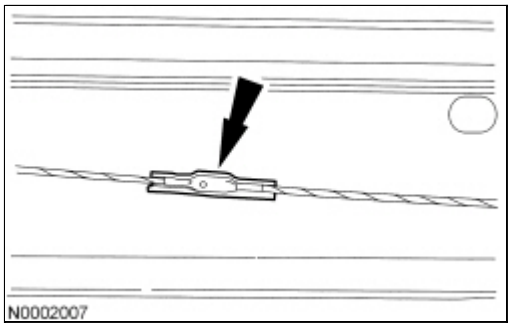
2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. With an assistant, release the parking brake cable tension by pulling down on the intermediate cable at the cable-to-cable union until the parking brake control sector rotates to its stop and a 4 mm (0.15 in) x 150 mm (5.9 in) retainer pin can be inserted.



4. Disconnect the cable at the cable-to-cable union.

5. To reload the tension on the parking brake cable, follow the release procedure in reverse.
   - Inspect the parking brake system for correct operation.



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Parking Brake Shoe Adjustment

Special Tool(s)

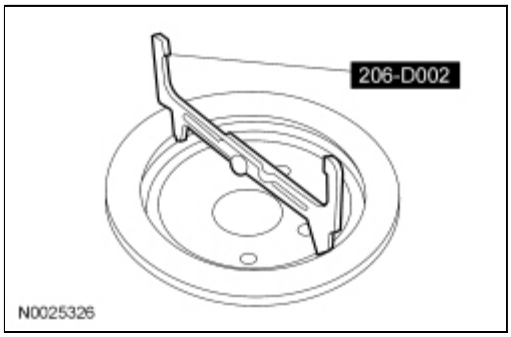
 ST1468-A	Brake Adjusting Gauge 206-D002 (D81L-1103-A) or equivalent

1. **NOTE:** Make sure the parking brake is fully released.

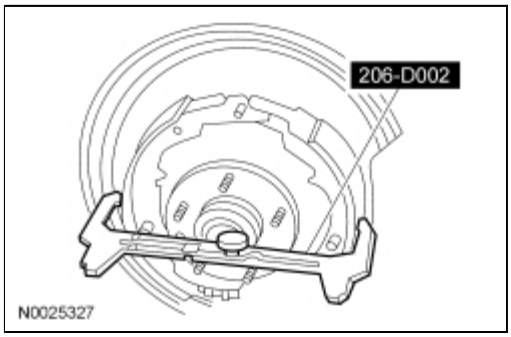
   Using the release handle, release the parking brake control.

2. Remove the rear brake disc. For additional information, refer to Section 206-04 .

3. Using the Brake Adjusting Gauge, measure the ID of the drum portion of the rear brake disc and set the locking screw.
   - Record the measurement.



4. Place the Brake Adjusting Gauge over the widest diameter of the parking brake shoes.



5. Adjust the parking brake shoe clearance to 0.59 mm (0.023 in) less than the ID of the drum portion of the rear brake disc.
   - Rotate the parking brake shoe adjuster to achieve the correct parking brake shoe-to-brake disc

clearance.

6. Install the rear brake disc. For additional information, refer to Section 206-04 .
7. Test the parking brake for normal operation.

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Parking Brake Cable — Front

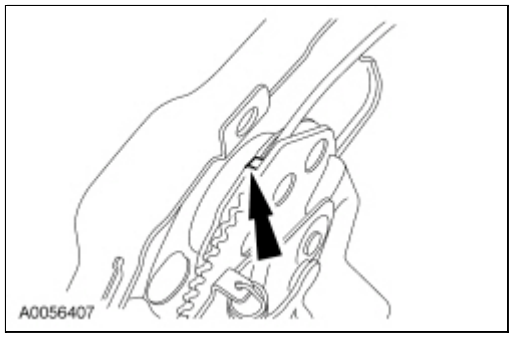
Removal and Installation

1. Release the tension on the parking brake cable. For additional information, refer to Parking Brake Cable Tension Release in this section.

2. Remove the LH cowl side trim panel. For additional information, refer to Section 501-05 .

3. **NOTE:** The parking brake control take-up spool tab may need to be bent aside to allow the cable to be removed.

   Disconnect the front parking brake cables from the parking brake control.

4. Release the front parking brake cable conduit from the parking brake control.

5. Detach the cable conduit grommet and remove the cable.

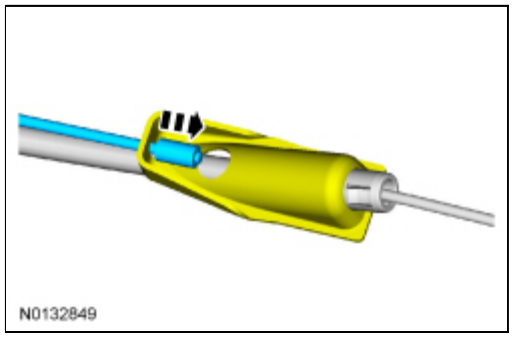
6. To install, reverse the removal procedure.
   - Inspect the parking brake system for correct operation.

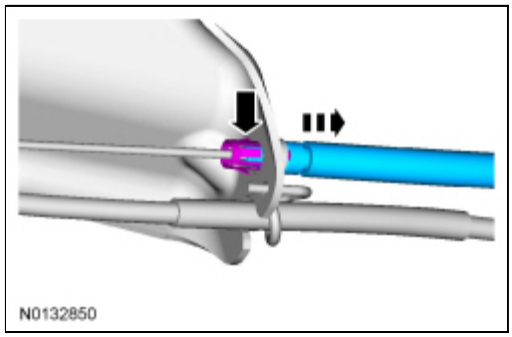
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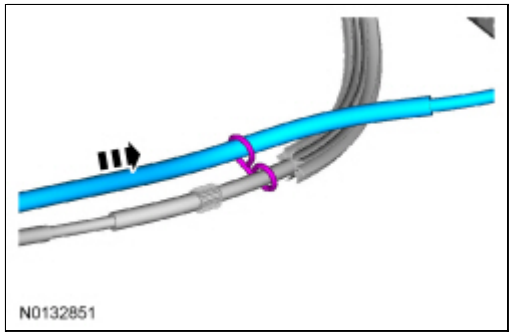
Parking Brake Cable — Rear, LH

Removal

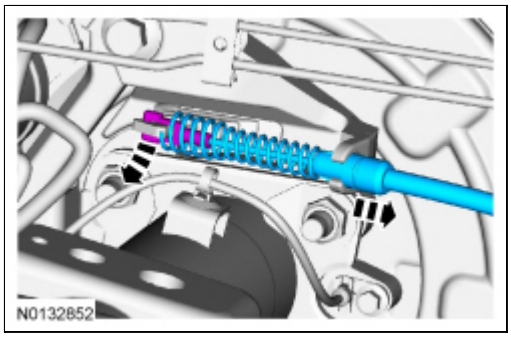
NOTE: Removal steps in this procedure may contain installation details.

1. Release the parking brake cable tension. For additional information, refer to Parking Brake Cable Tension Release in this section.
2. 

3. 

4. 

5.



Installation

1. To install, reverse the removal procedure.
    - Inspect the parking brake system for correct operation.

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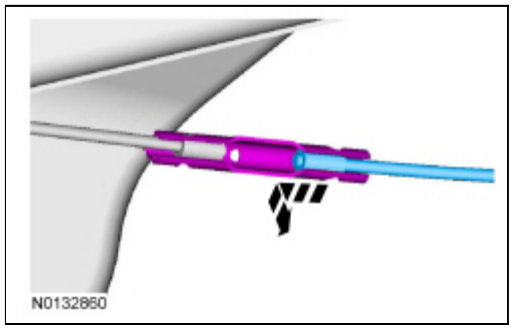
Parking Brake Cable — Rear, RH

Removal

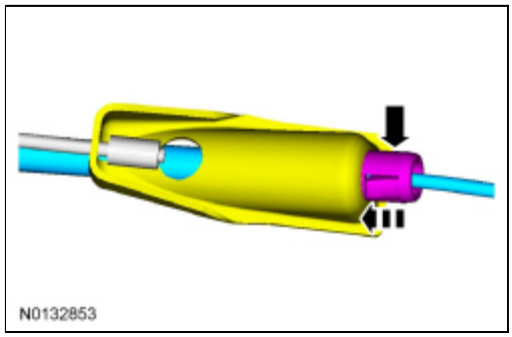
NOTE: Removal steps in this procedure may contain installation details.

1. Release the parking brake cable tension. For additional information, refer to Parking Brake Cable Tension Release in this section.

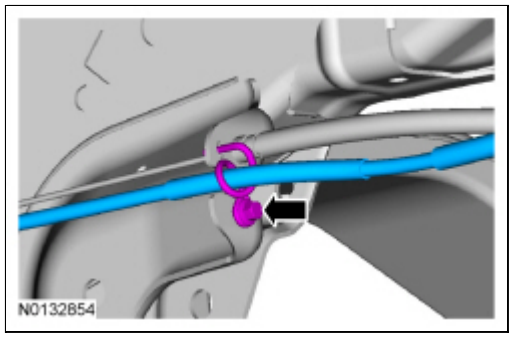
2.



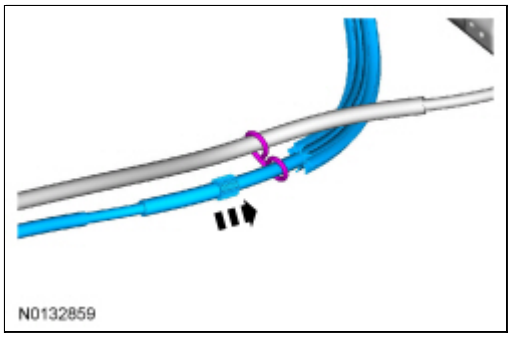
3.



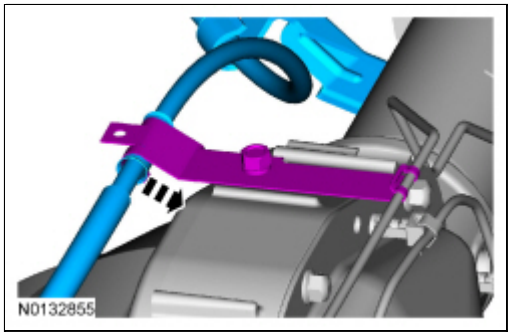
4. To install, tighten to 15 Nm (133 lb-in).



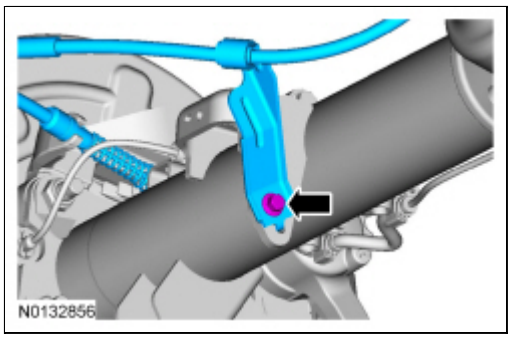
5.



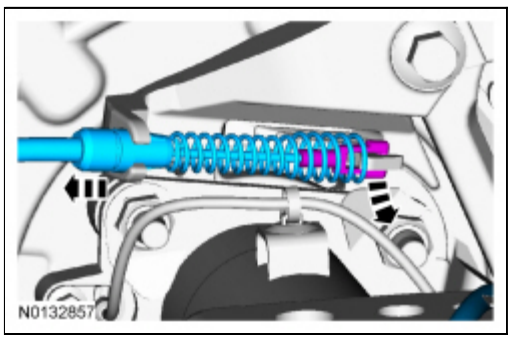
6.



7. To install, tighten to 30 Nm (22 lb-ft).



8.



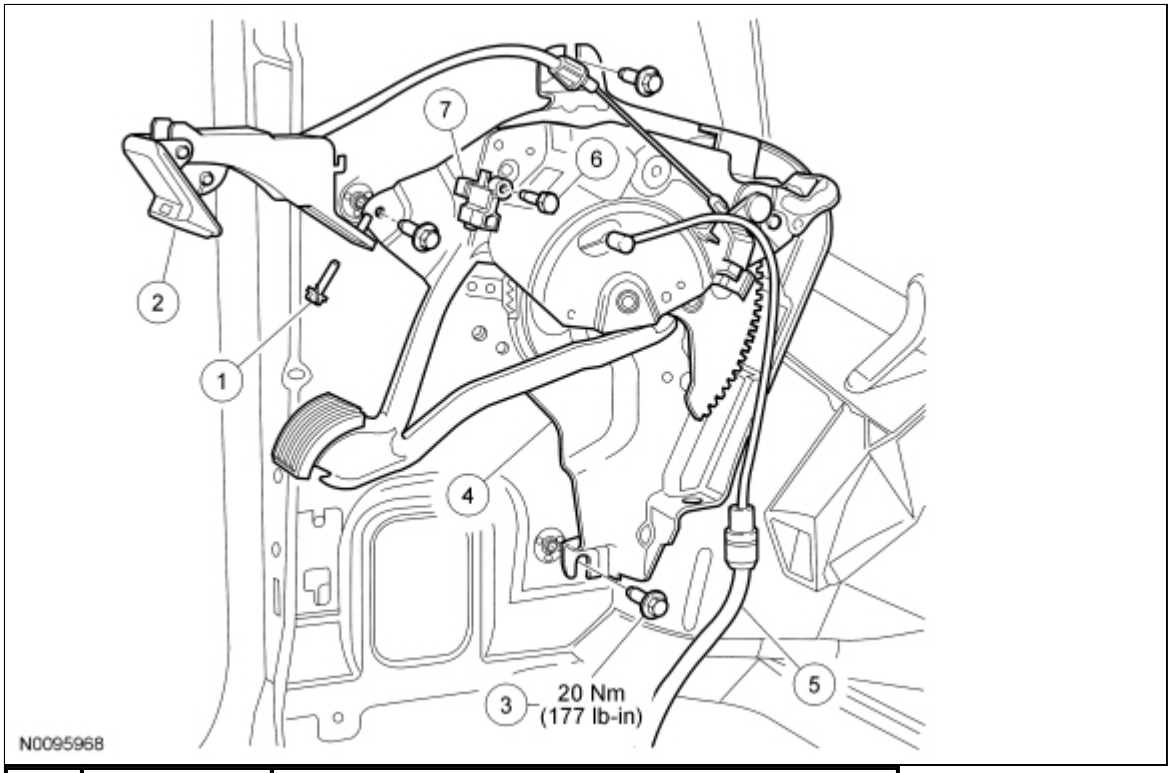
Installation

1. To install, reverse the removal procedure.

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- Inspect the parking brake system for correct operation.

Parking Brake Control



Item	Part Number	Description
1	W707628	Parking brake release handle bolt
2	2783	Parking brake release handle
3	W704522	Parking brake control assembly bolt (3 required)
4	2780	Parking brake control
5	2853	Front parking brake cable
6	N807729	Parking brake warning indicator switch screw
7	15A851	Parking brake warning indicator switch

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Remove the LH cowl side trim panel. For additional information, refer to Section 501-05 .
2. Release the tension on the parking brake cable. For additional information, refer to Parking Brake Cable Tension Release in this section.
3. Remove the parking brake release handle bolt and pull the handle assembly down to prevent breaking off the locator tabs.

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4. Disconnect the parking brake release handle cable from the parking brake control.

5. Disconnect the parking brake switch electrical connector.

6. Remove the 3 bolts from the parking brake control.
    - To install, tighten to 20 Nm (177 lb-in).

7. Position the cable conduit grommet up through the floor.
    - Release the cable from the parking brake control.

8. Remove the parking brake control from the vehicle.

Installation

1. To install, reverse the removal procedure.
    - Inspect the parking brake system for correct operation.

Parking Brake Shoes

Material

Item	Specification
Molykote® M77 8U7Z-19A506-A	—

Removal

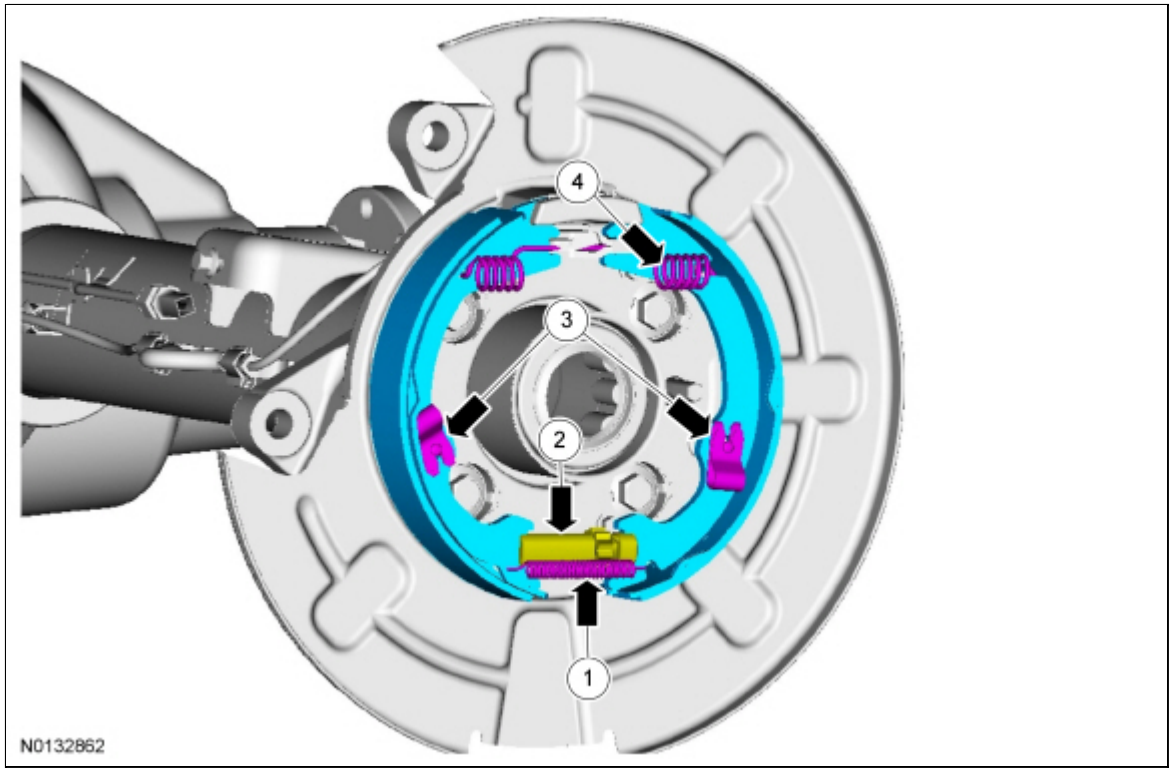
NOTE: Removal steps in this procedure may contain installation details.

NOTE: One parking brake shoe kit contains the linings required for both the LH and RH side.

1. Release the parking brake cable tension. For additional information, refer to Parking Brake Cable Tension Release in this section.

2. Remove the rear brake disc. For additional information, refer to Section 206-04 .

3.



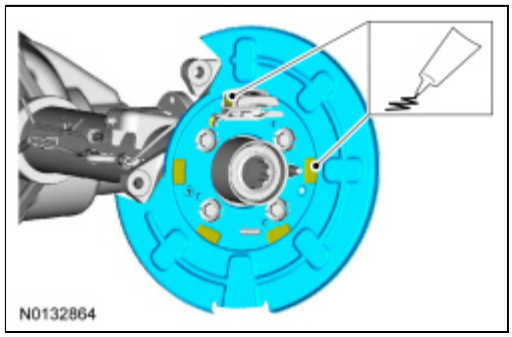
Installation

1. **NOTE:** Using specified grease, lubricate the parking brake shoes where the shoe contacts the

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actuator lever and the support bracket.

Apply the substance from the specified tube.



2. **NOTE:** Completely retract the parking brake adjusting screw before installation.

   To install, reverse the removal procedure.

3. Adjust the parking brake shoe. For additional information, refer to Parking Brake Shoe Adjustment in this section.

4. Reload the tension on the parking brake cable. For additional information, refer to Parking Brake Cable Tension Release in this section.

Parking Brake Warning Indicator Switch

Removal and Installation

1. Disconnect the parking brake warning indicator switch electrical connector.
2. Remove the parking brake warning indicator switch screw and the switch.
3. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	740 ml (1.56 pt)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake booster-to-pedal bracket nuts [a]	—	—	—
Brake master cylinder nuts	25	18	—
Brake pedal bracket bolts	25	18	—
Brake pedal control switch screw	3	—	27
Coolant expansion tank/lower Air Cleaner (ACL) housing assembly bolts	15	—	133
Hood switch and bracket nut	6	—	53
Primary brake tube fitting	28	21	—
Secondary brake tube fitting	20	—	177

[a] Refer to the procedure in this section.

Hydraulic Brake Actuation

Hydraulic Brakes

The hydraulic brake actuation system consists of the following components:

- Brake master cylinder and fluid reservoir
- Brake tubes and hoses
- Brake pedal and bracket
- Hydraulic Control Unit (HCU) (part of ABS)

Adjustable Pedals

Adjustable pedals are available as an optional feature on this vehicle. Two systems are available, with or without memory and consist of the following components:

- Adjustable brake pedal and bracket
- Adjustable accelerator pedal with motor and attached cable
- Adjustable pedal switch
- Steering Column Control Module (SCCM)
- Memory SET switch (with memory feature only)
- Driver Seat Module (DSM) (with memory feature only)
- Body Control Module (BCM) (with memory feature only)
- Remote Keyless Entry (RKE) (with memory feature only)

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Diagnostic Trouble Code (DTC) Charts

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1368:11	Adjustable Pedal Position Feedback Sensor: Circuit Short To Ground	GO to Pinpoint Test C .
B1368:12	Adjustable Pedal Position Feedback Sensor: Circuit Short To Battery	GO to Pinpoint Test C .
B1369:09	Pedal Adjustment Switch: Component Failure	INSTALL a new brake pedal control switch. REFER to Brake Pedal Control Switch in this section. CLEAR the DTCs. REPEAT the self-test. If DTC B1369:09 returns, INSTALL a new Steering Column Control Module (SCCM). REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B137D:18	Pedal Adjustment Motor: Circuit Current Below Threshold	GO to Pinpoint Test A .
B137D:19	Pedal Adjustment Motor: Circuit Current Above Threshold	GO to Pinpoint Test A .
B137D:71	Pedal Adjustment Motor: Actuator Stuck	GO to Pinpoint Test A .
B1D36:09	Turn Indicator Switch: Component Failure	REFER to Section 417-01 .
All other SCCM DTCs	—	REFER to Section 211-05 .

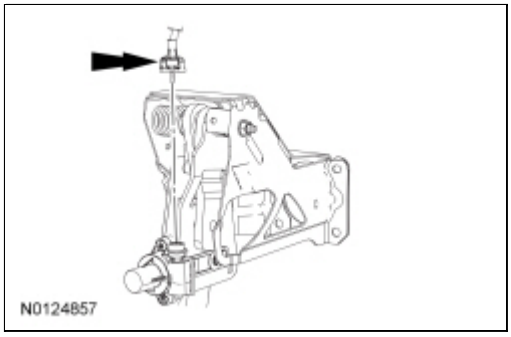
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Adjustable Pedal Indexing

NOTICE: **The adjustable pedal system must be indexed whenever the brake pedal assembly or accelerator pedal assembly is installed or damage to the components may result.**

1. **NOTE:** Make sure the electrical connector is connected to the adjustable pedal motor.

   Disconnect the accelerator pedal-to-brake pedal cable from the adjustable brake pedal gear set.



2. Operate the accelerator pedal to the full rearward position.
3. Connect the adjustable pedal motor drive cable to the adjustable brake pedal drive.
4. Operate the adjustable pedals to the full forward position.
5. Disconnect the adjustable pedal motor drive cable from the adjustable brake pedal assembly.
6. Operate the adjustable accelerator pedal to the full forward position.
7. Connect the adjustable pedal motor drive cable to the adjustable brake pedal drive.
8. Check that the brake and accelerator pedals can be fully adjusted forward and rearward.

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Inspection And Verification

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Adjustable Pedals

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart — Without Memory Feature

Mechanical	Electrical
● Adjustable accelerator pedal and motor with cable attached ● Adjustable brake pedal and bracket ● Foreign objects or material	● Wiring, terminals or connectors ● Body Control Module (BCM) fuse(s): ■ 23 (15A) ■ 24 (15A) ● Steering Column Control Module (SCCM) ● Brake pedal control switch

Visual Inspection Chart — With Memory Feature

Mechanical	Electrical
● Adjustable accelerate pedal and motor with cable attached ● Adjustable brake pedal and bracket ● Foreign objects or material	● BCM fuse(s): ■ 23 (15A) ■ 24 (15A) ● Memory SET switch ● Remote Keyless Entry (RKE) transmitter ● SCCM ● Wiring, terminals or connectors ● Brake pedal control switch

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

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4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, proceed with module self-test diagnostics.

8. Carry out the self-test diagnostics for the SCCM, BCM and Driver Seat Module (DSM).

9. If the DTCs retrieved are related to the concern, go to SCCM DTC Chart. For all other SCCM DTCs, refer to Section 211-05. For DSM DTCs, refer to Section 501-10. For BCM and all other DTCs, refer to Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

Pinpoint Tests

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT 27000 or equivalent 250-350 mA incandescent bulb test lamp SGT 27000
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Pinpoint Tests

Pinpoint Test A: The Adjustable Pedals Are Inoperative/Does Not Operate Correctly — Using the Brake Pedal Control Switch

Refer to Wiring Diagrams Cell 127 , Adjustable Pedals for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) receives fused battery voltage from Body Control Module (BCM) fuses 23 (15A) and 24 (15A).

When the brake pedal control switch is pressed, the SCCM sends current to the adjustable pedals motor along one circuit and the current returns to the SCCM along another circuit, which is grounded through the SCCM to move the pedals in the desired direction.

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- DTC B137D:18 (Pedal Adjustment Motor: Circuit Current Below Threshold) — This DTC sets if the SCCM senses current flow to the adjustable pedals motor below a preset limit while the brake pedal control switch is pressed, or if there is an open or high resistance in the adjustable pedals motor circuits when the ignition is ON.
- DTC B137D:19 (Pedal Adjustment Motor: Circuit Current Above Threshold) — This DTC sets if the SCCM senses current flow to the adjustable pedals motor above a preset limit while the brake pedal control switch is pressed, or if there is a short to ground in the adjustable pedals motor circuits when the ignition is ON.
- DTC B137D:71 (Pedal Adjustment Motor: Actuator Stuck) — This DTC sets if the SCCM senses current flow to the adjustable pedals motor within a specific range but above a preset limit while the brake pedal control switch is pressed when the ignition is ON.

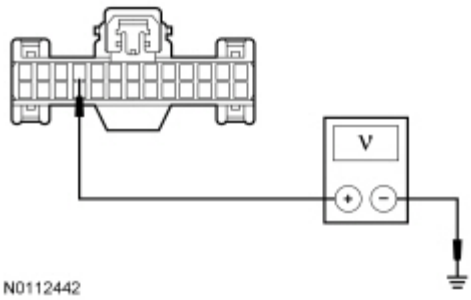
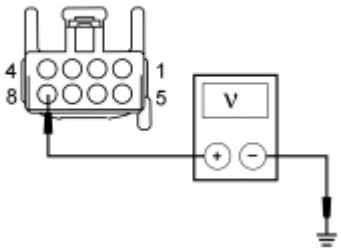
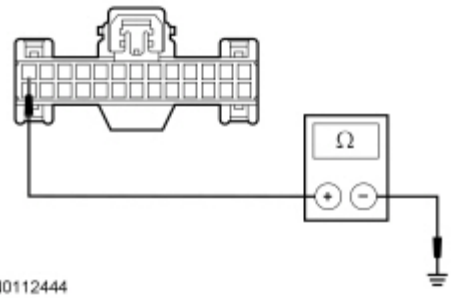
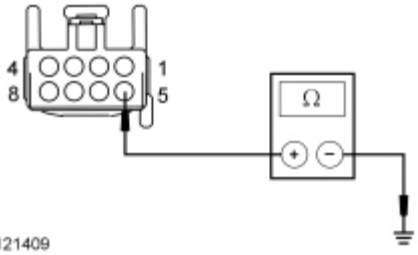
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Foreign objects or material
- Brake pedal control switch
- Adjustable accelerator pedal and motor with attached cable
- Adjustable brake pedal and bracket
- SCCM

PINPOINT TEST A: THE ADJUSTABLE PEDALS ARE INOPERATIVE/DOES NOT OPERATE CORRECTLY — USING THE BRAKE PEDAL CONTROL SWITCH

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
A1 CHECK THE ADJUSTABLE PEDALS MOTOR AND CABLE INSTALLATION	
• Check the adjustable pedals motor and cable for correct installation. • **Is the motor and cable correctly installed?**	**Yes** GO to A2 . **No** CORRECT the adjustable pedals motor installation. REFER to Section 310-02 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A2 INSPECT FOR FOREIGN MATERIAL	
• Inspect the adjustable brake pedal and accelerator assemblies for foreign material causing a binding condition. • **Are the pedal assemblies free from foreign material?**	**Yes** GO to A3 . **No** REMOVE the foreign material. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A3 CHECK FOR VOLTAGE AT THE SCCM	
• Disconnect: SCCM C2414A and C2414B.	**Yes**

• Measure the voltage between SCCM C2414A-10, circuit SBP23 (WH/RD), harness side and ground.  N0112442 • Measure the voltage between SCCM C2414B-8, circuit SBP24 (VT/RD), harness side and ground.  N0121410 • **Is the voltage greater than 10 volts?**	GO to A4 . **No** VERIFY BCM fuses 23 (15A) and 24 (15A) are OK. If OK, REPAIR the affected circuit (s). If not OK, REFER to the Wiring Diagrams manual to identify the cause for the circuit(s) short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A4 CHECK THE SCCM GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between SCCM C2414A-13, circuit GD133 (BK), harness side and ground.  N0112444 • Measure the resistance between SCCM C2414B-5, circuit GD138 (BK/WH), harness side and ground.  N0121409	**Yes** GO to A5 . **No** REPAIR the affected circuit (s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

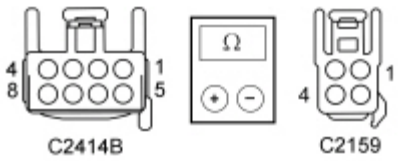
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- **Are the resistances less than 5 ohms?**

A5 CHECK THE ADJUSTABLE PEDALS MOTOR CIRCUITS FOR AN OPEN

- Disconnect: Adjustable Pedals Motor C2159 (vehicles with memory) or C2003 (vehicles without memory).
- Vehicles with memory, measure the resistance between SCCM C2414B, harness side and adjustable pedals motor C2159, harness side as follows:

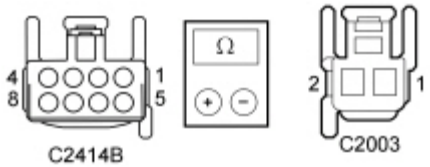
SCCM	Circuit	Adjustable Pedals Motor
C2414B-4	CPP01 (WH/OG)	C2159-2
C2414B-7	CPP02 (BN)	C2159-1



N0121359

- Vehicles without memory, measure the resistance between SCCM C2414B, harness side and adjustable pedal motor C2003, harness side as follows:

SCCM	Circuit	Adjustable Pedals Motor
C2414B-4	CPP01 (WH/OG)	C2003-2
C2414B-7	CPP02 (BN)	C2003-1



N0121408

- **Are the resistances less than 5 ohms?**

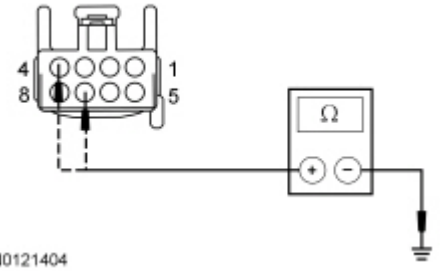
Yes
GO to A6.

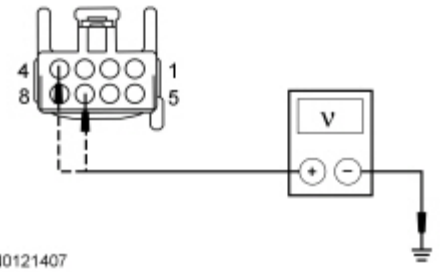
No
REPAIR the affected circuit (s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

A6 CHECK THE ADJUSTABLE PEDALS MOTOR CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between ground and:
  - SCCM C2414B-4, circuit CPP01 (WH/OG), harness side.
  - SCCM C2414B-7, circuit CPP02 (BN), harness side.

Yes
GO to A7.

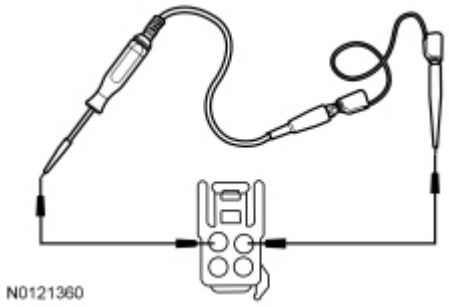
 • **Are the resistances greater than 10,000 ohms?**	**No** REPAIR the affected circuit (s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A7 CHECK THE ADJUSTABLE PEDALS MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition ON.
• Measure the voltage between ground and:
  ▪ SCCM C2414B-4, circuit CPP01 (WH/OG), harness side.
  ▪ SCCM C2414B-7, circuit CPP02 (BN), harness side.

• **Is any voltage present?**
	Yes
	REPAIR the affected circuit (s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	GO to A8.

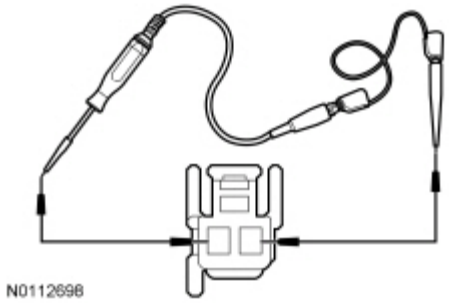
A8 CHECK FOR SCCM OUTPUT	

• Ignition OFF.
• Connect: SCCM C2414A and C2414B.
• ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.**
• **NOTE:** When the adjustable pedals electrical connector is disconnected, the SCCM only supplies voltage to the adjustable pedals motor in 1 second intervals due to the open on the Hall-effect sensor circuits.
• Vehicles with memory, connect the test light as follows:
  ▪ Connect one lead on the test light to C2159-1, circuit CPP02 (BN), harness side.
  ▪ Connect the other lead on the test light to C2159-2, circuit CPP01 (WH/OG), harness side.
	Yes
	GO to A9.
	
	No
	GO to A10.

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- Vehicles without memory, connect the test light as follows:
  - Connect one lead on the test light to C2003-1, circuit CPP02 (BN), harness side.
  - Connect the other lead on the test light to C2003-2, circuit CPP01 (WH/OG), harness side.



- Press the brake pedal control switch in the forward and rearward positions and verify the test light illuminates.
- **Does the test light illuminate when the brake pedal control switch is pressed in each direction?**

A9 CHECK THE ADJUSTABLE BRAKE PEDALS CABLE OPERATION	
• Connect: Adjustable Pedals Motor C2159 (vehicles with memory feature) or C2003 (vehicles without memory feature). • Disconnect the adjustable brake pedals cable from the adjustable brake pedal and bracket. • Operate the brake pedal control switch and observe the cable in the conduit. • **Does the adjustable brake pedals cable turn in the conduit?**	**Yes** INSTALL a new brake pedal assembly. REFER to Brake Pedal and Bracket in this section. CLEAR the DTCs. REPEAT the self test. TEST the system for normal operation. **No** INSTALL a new adjustable accelerator pedal and motor with attached cable. REFER to Accelerator Pedal — Adjustable, Exploded View in Section 310-02 . CLEAR the DTCs. REPEAT the self test. TEST the system for normal operation.
A10 CHECK THE SCCM ADJUSTABLE PEDALS ACTIVE COMMANDS	
• Select PARK.	**Yes**

• Connect: Adjustable Pedals Motor C2159 (vehicles with memory feature) or C2003 (vehicles without memory feature). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — SCCM . • **NOTE:** Toggling the active command ON causes the pedal to move in the commanded direction for 2 seconds and then the pedal stops. • Toggle the pedals forward (PEDAL_IN) active command ON. • Toggle the PEDAL_IN active command OFF. • Toggle the pedals rearward (PEDAL_OUT) active command ON. • Toggle the PEDAL_OUT active command OFF. • **Do the adjustable pedals respond correctly to the corresponding active commands?**	INSTALL a new brake pedal control switch. REFER to Brake Pedal Control Switch in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A11 .
A11 CHECK THE SCCM FOR CORRECT OPERATION	

• Disconnect: SCCM C2414A and C2414B.
• Check SCCM C2414A and SCCM C2414B for:
  ▪ corrosion.
  ▪ pushed-out pins.
  ▪ spread terminals.
• Connect: SCCM C2414A and C2414B.
• Connect: Adjustable Pedals Motor C2159 (vehicles with memory feature) or C2003 (vehicles without memory feature).
• Make sure the connectors seat correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: The Adjustable Pedals Are Inoperative/Does Not Operate Correctly — Using the Memory SET Switch or the Remote Keyless Entry (RKE) Transmitter

Refer to Wiring Diagrams Cell 127 , Adjustable Pedals for schematic and connector information.

Normal Operation

When the desired memory position is selected using the memory SET switch or the Remote Keyless Entry (RKE) transmitter, the Driver Seat Module (DSM) communicates the desired pedals position in a message on the Medium Speed Controller Area Network (MS-CAN) bus to the Body Control Module (BCM). The BCM acts as a gateway module, relaying the message to the Steering Column Control Module (SCCM) over the High Speed Controller Area Network (HS-CAN) bus. The SCCM then sends current in one direction to the adjustable pedals motor to move the pedals forward and in another direction (reversed polarity) to move the pedals rearward.

The SCCM uses a Hall-effect sensor that is integral to the pedals motor to identify the current pedal position. The SCCM sends a reference voltage along one circuit, through the sensor and back to the SCCM along the signal return circuit.

If the vehicle is equipped with the memory feature but the SCCM is incorrectly configured, memory recall may not function correctly when the memory SET switch or the RKE transmitter is used to adjust the pedal position.

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This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Foreign objects or material
- Adjustable accelerator pedal and motor with attached cable
- Adjustable brake pedal and bracket
- RKE transmitter
- DSM
- SCCM
- Incorrect SCCM configuration
- BCM

PINPOINT TEST B: THE ADJUSTABLE PEDALS ARE INOPERATIVE/DOES NOT OPERATE CORRECTLY — USING THE MEMORY SET SWITCH BUTTONS OR THE RKE TRANSMITTER

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
B1 CHECK THE ADJUSTABLE PEDALS OPERATION WITH THE BRAKE PEDAL CONTROL SWITCH	
• Press the brake pedal control switch in each direction for more than one second and observe the pedals. • **Do the pedals operate for more than one second in the direction selected using the switch?**	**Yes** GO to B2. **No** If the pedals do not move using the brake pedal control switch, GO to Pinpoint Test A. If the pedals only move in one second intervals regardless of button operation, GO to Pinpoint Test C.
B2 CHECK THE MEMORY SYSTEM OPERATION	

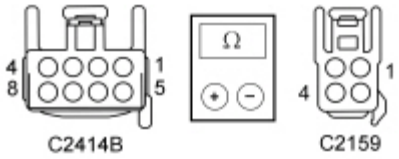
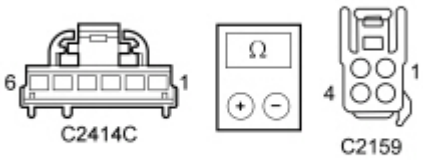
• Set a memory position for the driver seat, exterior mirrors and adjustable pedals to memory SET switch button 1. Refer to Memory Position Programming in Section 501-10.
• Select PARK.
• Press the memory SET switch button 1 and observe the following items:
  ▪ Driver seat
  ▪ Exterior mirrors
  ▪ Adjustable pedals
• **Do all 3 items move when the button is pressed?**
	Yes
	GO to B3.
	
	No
	If all 3 items do not move, REFER to Diagnosis and Testing in Section 501-10 to diagnose the memory SET switch.
	
	If **only** the adjustable pedals do not move, GO to B4.
	
	If **only** the driver seat does not move, REFER to Diagnosis and Testing in Section 501-10.
	
	If **only** the exterior mirrors do not move, REFER to Diagnosis and Testing in Section 501-09.

B3 CHECK THE RKE TRANSMITTER OPERATION	

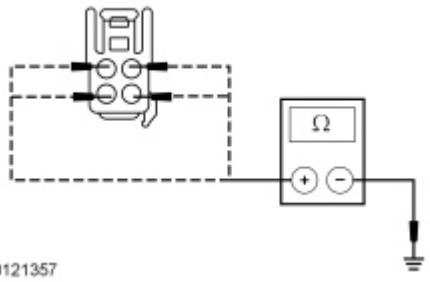
• Set a memory position in the RKE transmitter for the driver seat, exterior mirrors and adjustable pedals. Refer to Remote Memory Activation in Section 501-14 .
• Select PARK.
• Press the unlock button on the RKE transmitter and observe the following items:
  ▪ Driver seat
  ▪ Exterior mirrors
  ▪ Adjustable pedals
• **Do all 3 items move when the button is pressed?**
	Yes
	GO to B4 .
	
	No
	If all 3 items do not move, REFER to Diagnosis and Testing in Section 501-14 to diagnose the RKE transmitter.
	
	If **only** the adjustable pedals do not move, GO to B4 .
	
	If **only** the driver seat does not move, REFER to Diagnosis and Testing in Section 501-10 .
	
	If **only** the exterior mirrors do not move, REFER to Diagnosis and Testing in Section 501-09 .

B4 CHECK THE ADJUSTABLE PEDALS MOTOR AND CABLE INSTALLATION	
• Check the adjustable pedals motor and cable for correct installation. • **Are the motor and cable correctly installed?**	**Yes** GO to B5 . **No** CORRECT the adjustable pedals motor installation. REFER to Section 310-02 . TEST the system for normal operation.
B5 INSPECT FOR FOREIGN OBJECTS OR MATERIAL	
• Inspect the adjustable brake pedal and accelerator assemblies for foreign material causing a binding condition. • **Are the pedal assemblies free from foreign material?**	**Yes** GO to B6 . **No** REMOVE the foreign material. TEST the system for normal operation.
B6 CHECK FOR DSM OR BCM DTCs	
• Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: Self-Test — DSM . • Enter the following diagnostic mode on the scan tool: Self-Test — BCM . • Record any DTCs retrieved from the DSM or the BCM . • **Was DTC U0140 retrieved from the DSM or was DTC U0212:87 retrieved from the BCM ?**	**Yes** If DTC U0140 is retrieved from the DSM , REFER to Section 501-10 to diagnose the lost communication concern. If DTC U0212:87 is retrieved from the BCM , REFER to Section 419-10 to diagnose the lost communication concern. **No** GO to B7 .
B7 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Adjustable Pedals Motor C2159. • Disconnect: SCCM C2414B. • Measure the resistance between SCCM C2414B,	**Yes** GO to B8 . **No**

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harness side and adjustable pedals motor C2159, harness side as follows: **SCCM** / **Circuit** / **Adjustable Pedals Motor** C2414B-4 / CPP01 (WH/OG) / C2159-2 C2414B-7 / CPP02 (BN) / C2159-1  N0121359 • Disconnect: SCCM C2414C. • Measure the resistance between SCCM C2414C, harness side and adjustable pedals motor C2159, harness side as follows **SCCM** / **Circuit** / **Adjustable Pedals Motor** C2414C-3 / RPP06 (GN) / C2159-3 C2414C-6 / LPP06 (YE/BU) / C2159-4  N0121358 • **Are the resistances less than 5 ohms?**	REPAIR the affected circuit(s). TEST the system for normal operation.
B8 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between ground and: ▪ adjustable pedals motor C2159-1, circuit CPP02	**Yes** GO to B9 .

(BN), harness side.
- adjustable pedals motor C2159-2, circuit CPP01 (WH/OG), harness side.
- adjustable pedals motor C2159-4, circuit LPP06 (YE/BU), harness side.
- adjustable pedals motor C2159-3, circuit RPP06 (GN), harness side.



N0121357

- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the affected circuit(s). TEST the system for normal operation.

B9 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TOGETHER

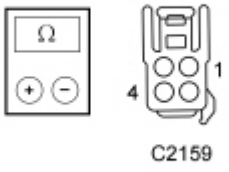
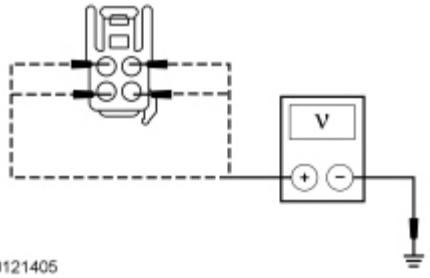
- Measure the resistance between adjustable pedals motor C2159, harness side as follows:

Adjustable Pedals Motor	Circuit	Adjustable Pedals Motor	Circuit
C2159-4	LPP06 (YE/BU)	C2159-2	CPP01 (WH/OG)
C2159-4	LPP06 (YE/BU)	C2159-3	RPP06 (GN)
C2159-4	LPP06 (YE/BU)	C2159-1	CPP02 (BN)
C2159-2	CPP01 (WH/OG)	C2159-3	RPP06 (GN)
C2159-2	CPP01 (WH/OG)	C2159-1	CPP02 (BN)
C2159-3	RPP06 (GN)	C2159-1	CPP02 (BN)

Yes
GO to B10 .

No
REPAIR the affected circuit(s). TEST the system for normal operation.

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 N0121355 • **Are the resistance greater than 10,000 ohms?**	
B10 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and: ▪ adjustable pedals motor C2159-2, circuit CPP01 (WH/OG), harness side. ▪ adjustable pedals motor C2159-4, circuit LPP06 (YE/BU), harness side. ▪ adjustable pedals motor C2159-3, circuit RPP06 (GN), harness side. ▪ adjustable pedals motor C2159-1, circuit CPP02 (BN), harness side.  N0121405 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** CONFIGURE the SCCM using As-Built data. TEST the system for normal operation. If the adjustable pedals do not operate correctly, INSTALL a new adjustable pedals motor and bracket assembly. REFER to Accelerator Pedal — Adjustable, Exploded View in Section 310-02 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test C: The Adjustable Pedals Only Move in 1 Second Intervals

Refer to Wiring Diagrams Cell 127 , Adjustable Pedals for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) uses a Hall-effect sensor integral to the motor to identify the current pedal position. The SCCM sends a reference voltage along the sensor feed circuit, through the Hall-effect sensor and back to the SCCM along the signal return circuit.

When the following DTCs are set, the adjustable pedals enters a "jog mode". When the pedals are in jog mode, the memory system recall does not function from either the Remote Keyless Entry (RKE) transmitter or memory SET switch. When the pedals are activated using the brake pedal control switch, the motor moves the pedals for one second regardless of the length of time the button is pressed.

If the vehicle is not equipped with memory and the SCCM is incorrectly configured, the SCCM expects to receive pedal position information when the vehicle is not equipped to provide it. If this happens, the adjustable pedals enters a "jog mode" similar to if a fault were present in the adjustable pedals position sensor circuits.

- DTC B1368:11 (Adjustable Pedal Position Feedback Sensor: Circuit Short to Ground) — This DTC sets if the SCCM detects a short to ground on the Hall-effect sensor feed and/or return circuits when the ignition is ON.
- DTC B1368:12 (Adjustable Pedal Position Feedback Sensor: Circuit Short to Battery) — This DTC sets if the SCCM detects a short to voltage on the Hall-effect sensor feed and/or return circuits when the ignition is ON.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Adjustable accelerator pedal and motor with attached cable
- SCCM
- Incorrect SCCM configuration

PINPOINT TEST C: THE ADJUSTABLE PEDALS ONLY MOVE IN 1 SECOND INTERVALS

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.**

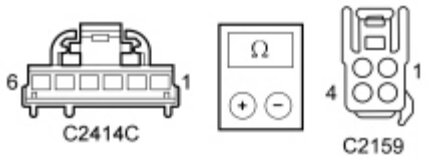
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE SCCM DTCs</td><td rowspan="2">Yes
GO to C2.

No
If no DTCs were retrieved, CONFIGURE the SCCM using As-Built data. REPEAT the self-test. TEST the system for normal operation. If DTCs B1369:09, B137D:18, 19, or 71 were retrieved, REFER to DTC Charts in this section. For all other SCCM DTCs, REFER to the SCCM DTC Chart in Section 211-05. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</td></tr>
<tr><td>• Review the SCCM DTCs retrieved during Inspection and Verification.
• Were DTCs B1368:11 or B1368:12 retrieved?</td></tr>
<tr><td>C2 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR AN OPEN</td><td rowspan="2">Yes
GO to C3.

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Adjustable Pedals Motor C2159.
• Disconnect: SCCM C2414C.
• Measure the resistance between SCCM C2414C, harness side and adjustable pedals motor C2159, harness side as follows:
<table>
<tr><th>SCCM</th><th>Circuit</th><th>Adjustable Pedals Motor</th></tr>
<tr><td>C2414C-</td><td>RPP06 (GN)</td><td>C2159-3</td></tr>
</table>
</td></tr>
</table>

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3		
C2414C-6	LPP06 (YE/BU)	C2159-4

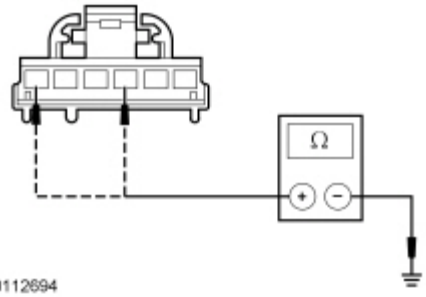


N0121358

- **Are the resistances less than 5 ohms?**

C3 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between ground and:
  - SCCM C2414C-6, circuit LPP06 (YE/BU), harness side.
  - SCCM C2414C-3, circuit RPP06 (GN), harness side.



N0112694

- **Are the resistances greater than 10,000 ohms?**

Yes
GO to C4.

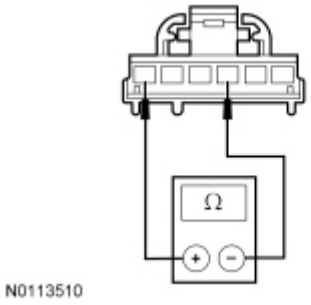
No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

C4 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between SCCM C2414C-3, circuit RPP06 (GN), harness side and SCCM C2414C-6, circuit LPP06 (YE/BU), harness side.

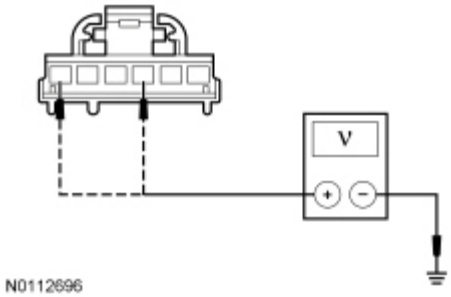
Yes
GO to C5.

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.



- **Is the resistance greater than 10,000 ohms?**

C5 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition ON.
• Measure the voltage between ground and:
  ▪ SCCM C2414C-6, circuit LPP06 (YE/BU), harness side.
  ▪ SCCM C2414C-3, circuit RPP06 (GN), harness side.
 	

 	
• **Is any voltage present?**
	Yes
	REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	INSTALL a new adjustable accelerator pedal and motor with attached cable. REFER to Accelerator Pedal — Adjustable, Exploded View in Section 310-02 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If DTC B1368:11 or B1368:12 return, INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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Principles of Operation

Hydraulic Brakes

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is forced through the double-walled steel tubes and flexible hoses to the Hydraulic Control Unit (HCU). The brake fluid is then distributed to the front and rear brake calipers. The fluid enters the caliper, forcing the caliper pistons and brake pads outward against the brake disc friction surface, slowing or stopping rotation of the brake disc. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear brake caliper pistons and brake pads to the unapplied position.

To diagnose hydraulic brake concerns, refer to Section 206-00 .

For information on the HCU , refer to Section 206-09 .

Adjustable Pedals Without Memory Feature

The adjustable pedals without memory are controlled by the brake pedal control switch and the Steering Column Control Module (SCCM). The adjustable pedals motor is attached to the accelerator pedal bracket and controls the accelerator pedals directly. It operates forward and rearward, depending on which direction the switch is pressed. The adjustable brake pedals is connected to the motor by a cable that rotates inside a sleeve. This allows both the brake and accelerator pedals to move together as an assembly. When the brake pedal control switch is pressed, voltage is applied from the SCCM to the adjustable pedals motor. The end of the motor that is attached to the accelerator pedal bracket rotates the pinion of a worm gear set and causes the accelerator pedal to move. At the same time, the other end of the motor rotates the cable inside the sleeve which causes the brake pedal adjuster to move through the use of a worm gear set. The pedals can be adjusted with the ignition switch in the OFF, ACC or RUN position, regardless of gear selector position.

The SCCM monitors the adjustable pedals motor and circuits for faults. If a fault is detected, the SCCM is capable of setting DTCs.

Adjustable Pedals With Memory Feature

The adjustable pedals with memory are controlled by the SCCM , Body Control Module (BCM) and Driver Seat Module (DSM). The pedals can be adjusted in 3 different ways:

- Using the brake pedal control switch.
- Using the memory SET switch.
- Using the Remote Keyless Entry (RKE) transmitter.

The SCCM monitors the position of the pedals using a Hall-effect sensor that is integral to the adjustable pedals motor. When a memory position is recalled through either the memory SET switch or the RKE transmitter, the SCCM monitors the Hall-effect sensor and stops sending voltage to the motor once the

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commanded memory position is reached. If the SCCM receives a pedals position input during a memory position recall function, the module stops the memory recall and responds to the new pedals position input.

When the RKE transmitter is activated, a message is sent over the Medium Speed Controller Area Network (MS-CAN) to the DSM . When the memory SET switch is pressed, the DSM senses continuity to ground on the switch circuit. When the DSM receives either the MS-CAN message or the ground input through the switch circuit, it sends a message over the MS-CAN to the BCM . The BCM acts as a gateway module, relaying the MS-CAN message that was received from the DSM to the SCCM over the High Speed Controller Area Network (HS-CAN). The SCCM then sends voltage over the appropriate circuit to the adjustable pedals motor to adjust the pedals.

The SCCM continuously monitors the adjustable pedals motor and circuits for faults. If a fault is detected, the SCCM is capable of setting DTCs.

The DSM also controls the driver seat and the exterior mirrors.

For information on setting and recalling a memory pedal position, refer to Memory Position Programming in Section 501-10 .

Symptom Charts

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Steering Column Control Module (SCCM)	• Fuse • Wiring, terminals or connectors • SCCM	• REFER to Section 418-00 .
• Adjustable pedals are inoperative/does not operate correctly — using the brake pedal control switch	• Foreign objects or material • Fuse • Wiring, terminals or connectors • Brake pedal control switch • Adjustable accelerator pedal and motor with attached cable • Adjustable brake pedal and bracket • SCCM	• GO to Pinpoint Test A .
• Adjustable pedals are inoperative/does not operate correctly — using the memory SET switch buttons	• Foreign objects or material • Fuse • Wiring, terminals or connectors • Memory SET switch • Adjustable accelerator pedal and motor with attached cable • Adjustable brake pedal and bracket • Incorrect SCCM configuration • Driver Seat Module (DSM) • SCCM • Body Control Module (BCM)	• GO to Pinpoint Test B .
• Adjustable pedals are inoperative/does not operate correctly — using the Remote Keyless Entry (RKE) transmitter	• Foreign objects or material • Wiring, terminals or connectors • Adjustable accelerator pedal and motor with attached cable • Adjustable brake pedal and bracket • RKE transmitter • DSM	• GO to Pinpoint Test B .

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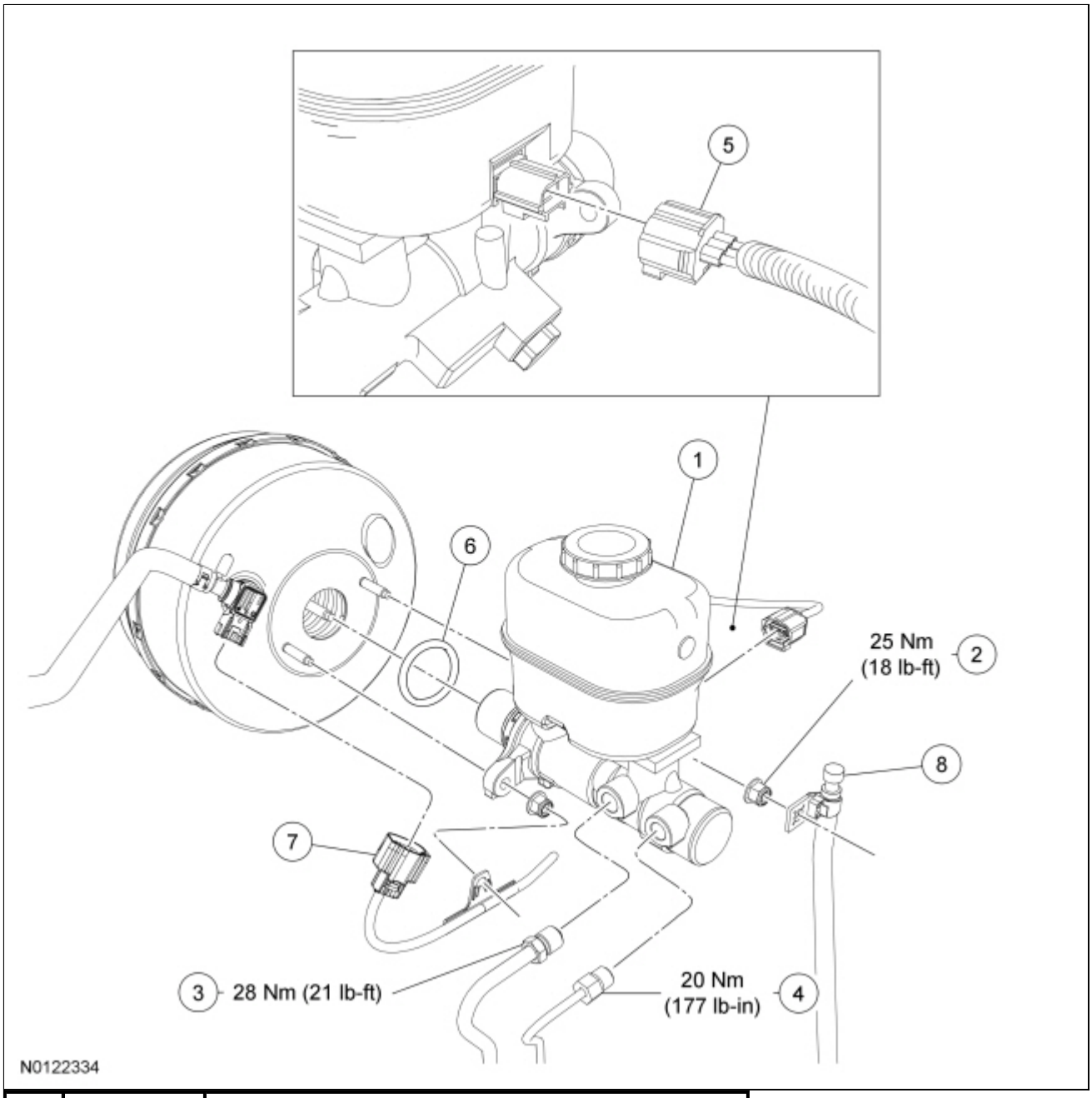
	• SCCM • BCM	
• The adjustable pedals only move in 1 second intervals	• Wiring, terminals or connectors • Adjustable accelerator pedal and motor with attached cable • Incorrect SCCM configuration • SCCM	• GO to Pinpoint Test C .

Brake Master Cylinder

Material

Item	Specification
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

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Item	Part Number	Description
1	2140	Brake master cylinder and reservoir assembly
2	W520212	Brake master cylinder nut (2 required)
3	—	Primary brake tube fitting (part of 2A040)
4	—	Secondary brake tube fitting (part of 2B253)
5	—	Brake fluid level switch electrical connector (part of 12A581)
6	2152	Brake master cylinder-to-booster seal
7	—	Vacuum sensor electrical connector (part of 12A581)
8	3B476	Front axle vent hose

Removal and Installation

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

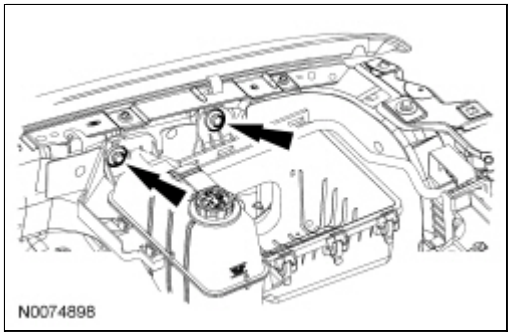
NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Relieve the vacuum in the brake booster by pressing and releasing the brake pedal a minimum of 5 times with the engine not running.

2. Remove the Air Cleaner (ACL) element. For additional information, refer to Air Cleaner Element in Section 303-12 .

3. Remove the nut and position the hood switch and bracket aside.
   - To install, tighten nut to 6 Nm (53 lb-in).

4. Remove the 2 bolts and position the coolant expansion tank/lower ACL housing assembly aside.
   - To install, tighten bolts to 15 Nm (133 lb-in).



5. Disconnect the brake fluid level switch.

6. If equipped, position the vacuum sensor wiring harness and front axle vent hose aside.

7. Loosen the brake tube fittings and disconnect the brake tubes.
   - Plug the master cylinder ports.
   - To install, tighten primary brake tube fitting to 28 Nm (21 lb-ft).
   - To install, tighten secondary brake tube fitting to 20 Nm (177 lb-in).

8. ***NOTICE:*** **When the master cylinder is removed, the piston will be exposed. Do not damage the piston or piston surface or a fluid leak may occur.**

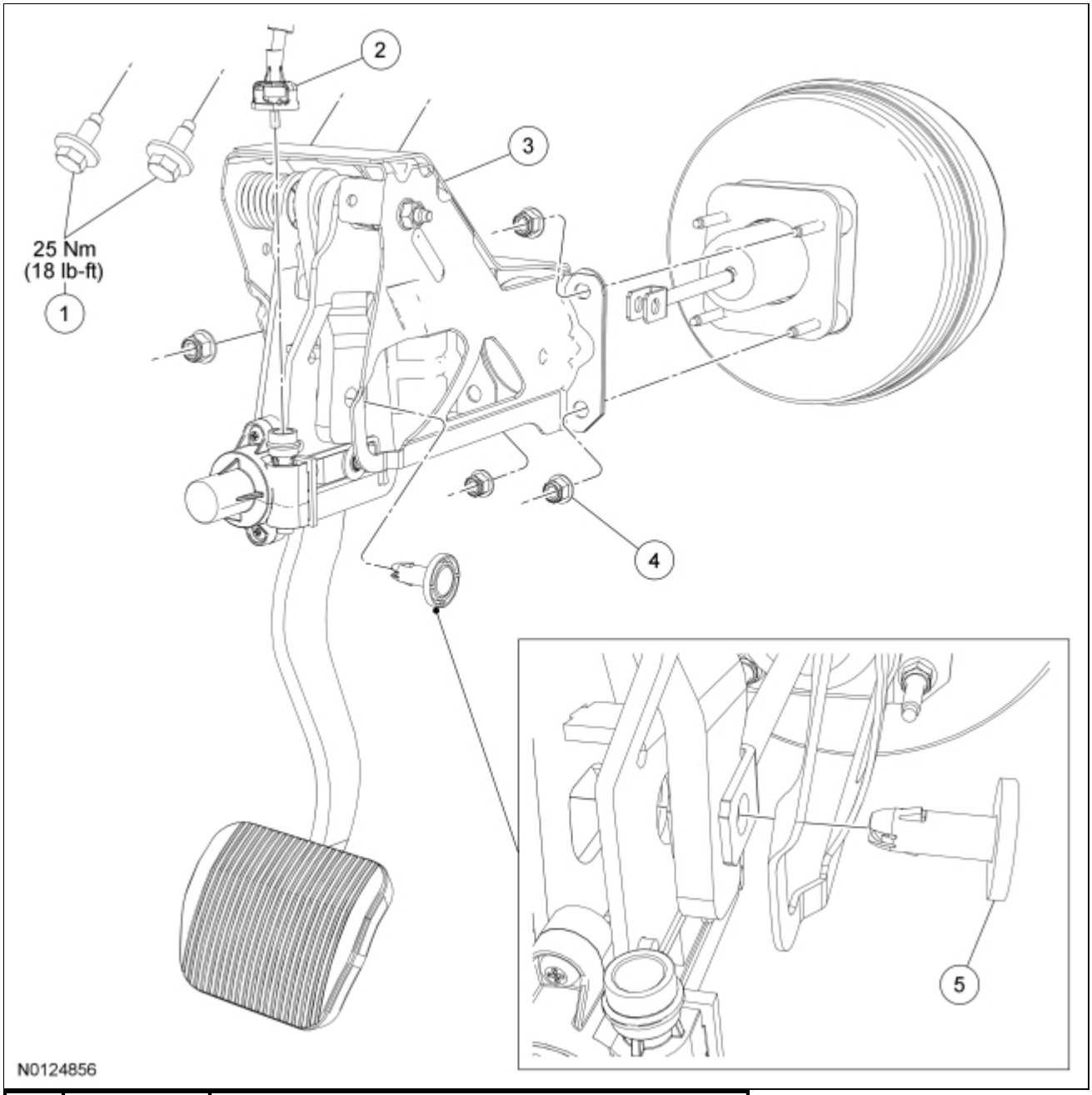
   Remove the 2 brake master cylinder nuts and the brake master cylinder.
   - To install, tighten to 25 Nm (18 lb-ft).

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9. To install, reverse the removal procedure.
    - If a new brake master cylinder has been installed, bleed the master cylinder. Refer to Component Bleeding in Section 206-00 .
    - If the brake master cylinder was removed to access other components, bleed the brake system. Refer to Brake System Bleeding in Section 206-00 .

Brake Pedal and Bracket

NOTE: Adjustable brake pedal and bracket shown, fixed brake pedal and bracket similar.



Item	Part Number	Description
1	W702368	Brake pedal bracket bolts
2	—	Accelerator pedal-to-brake pedal cable (part of 9F836)

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3	2450	Brake pedal and bracket
4	W520212	Brake booster-to-pedal bracket nut (4 required)
5	2L523	Brake pedal pin

Removal and Installation

Vehicles equipped with adjustable pedals

1. ***NOTICE:*** **The brake pedal and the accelerator pedal must be in the same position when installing a new cable or a new pedal. The pedals must be all the way forward or all the way rearward or damage to components may occur.**

   Move the pedals to the full forward (away from the driver) position.

2. Disconnect the accelerator pedal-to-brake pedal cable from the adjustable brake pedal gear set.

All vehicles

3. ***NOTICE:*** **Do not service the brake pedal without first removing the stoplamp switch. Remove this switch with the brake pedal in the at-rest position. Attempting to remove the switch when the plunger is extended (during pedal apply) results in damage to the switch.**

   Remove the stoplamp switch. For additional information, refer to Section 417-01.

4. **NOTE:** Use an 11 mm, 12-point socket or wrench to compress the 2 tabs on the brake pedal arm pin.

   Remove and discard the brake pedal pin, then disconnect the brake booster push rod from the brake pedal arm.

5. Remove the bulkhead sound insulator.

6. Remove the 4 brake booster-to-pedal bracket nuts.
   - To install, tighten to 25 Nm (18 lb-ft) following a clockwise pattern starting with the upper left nut.

7. Remove the 2 brake pedal bracket bolts and remove the brake pedal and bracket.
   - To install, tighten to 25 Nm (18 lb-ft).

8. ***NOTICE:*** **Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. Install this switch with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the pedal in any other position results in incorrect adjustment and damages the switch.**

   To install, reverse the removal procedure.

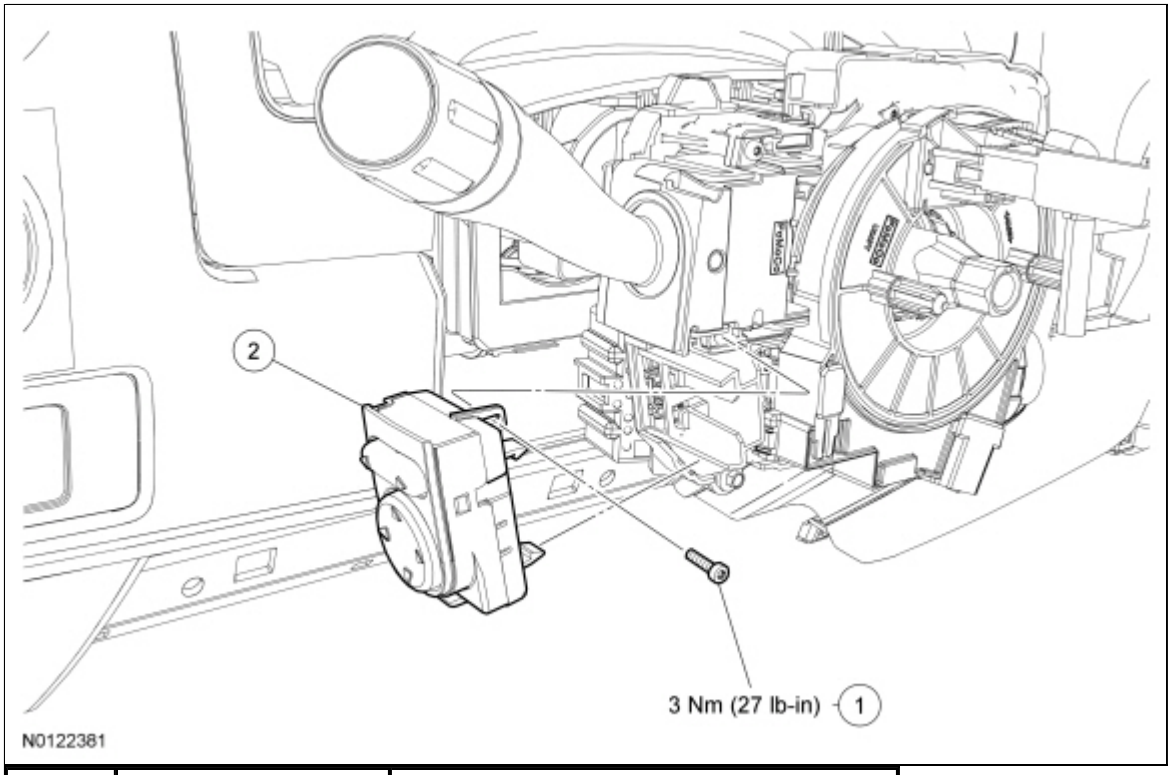
Vehicles equipped with adjustable pedals

9. Index the pedal assemblies. For additional information, refer to Adjustable Pedal Indexing in this section.

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Brake Pedal Control Switch

NOTE: Steering wheel removed for clarity.



Item	Part Number	Description
1	W715057	Screw
2	9G604	Brake pedal control switch

Removal and Installation

NOTE: Turn the steering wheel 90 degrees to the left to access the brake pedal control switch screws.

1. Remove the steering column shrouds. For additional information, refer to Section 211-04 .
2. Remove the screw.
   - To install, tighten to 3 Nm (27 lb-in).
3. Using a suitable tool (such as a pocket screwdriver), carefully disengage the control switch locking tabs one at a time, then remove the switch.
4. To install, reverse the removal procedure.

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Torque Specifications

Description	Nm	lb-ft	lb-in
Brake booster nuts [a]	—	—	—
Brake master cylinder nuts	25	18	—
Brake vacuum pump bolts [a]	—	—	—
Coolant expansion tank/lower Air Cleaner (ACL) housing assembly bolts	15	—	133

[a] Refer to the procedure in this section.

Brake Booster

The power brake actuation system consists of the following components:

- Brake booster
- Brake booster check valve
- Brake booster vacuum sensor
- Brake booster vacuum supply hose
- Brake booster vacuum pump (3.5L GTDI engine only)

The brake booster uses vacuum from the intake manifold (3.7L and 5.0L) or an engine mounted vacuum pump (3.5L GTDI) to create a partial vacuum inside the vacuum booster on both sides of the diaphragm. When the brake pedal is pressed, the booster rod opens a valve, allowing air to enter the booster on one side of the diaphragm while sealing off the opposite side. This increases pressure on that side of the diaphragm so that it helps push the rod, which in turn pushes the piston in the master cylinder. As the brake pedal is released, the valve seals off the outside air supply while opening the vacuum valve. This restores vacuum to both sides of the diaphragm, allowing everything to return to its original position. The ABS module uses the signals produced by the vacuum sensor to verify the vacuum is maintained in the brake booster.

Brake Booster Vacuum Pump

Vehicles equipped with a 3.5L GTDI engine are also equipped with an engine mounted/cam-driven brake booster vacuum pump. The brake vacuum pump is located on the backside of the RH cylinder head. Refer to Brake Vacuum Pump .

- For vacuum sensor and vacuum pump diagnosis, refer to Section 206-09 .

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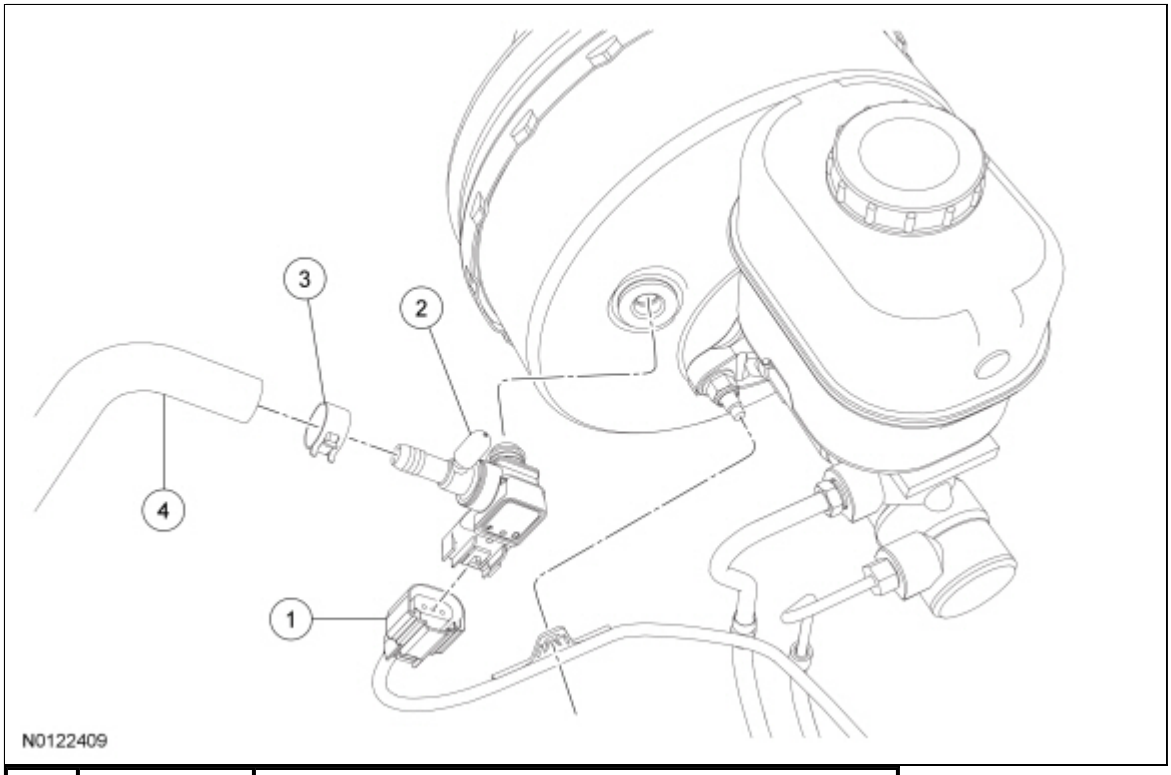
Power Brake System

Refer to Section 206-00 .

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Brake Booster Vacuum Sensor

NOTE: Rear Wheel Drive (RWD) shown, Four-Wheel Drive (4WD) similar.



Item	Part Number	Description
1	—	Vacuum sensor electrical connector (part of 12A581)
2	2365	Brake booster vacuum sensor
3	—	Hose clamp (part of 9C490)
4	—	Vacuum supply hose (part of 9C490)

1. Relieve the vacuum in the brake booster by pressing and releasing the brake pedal a minimum of 5 times with the engine not running.

2. Disconnect the vacuum supply hose from the brake booster vacuum sensor.

3. If equipped, disconnect the Four-Wheel Drive (4WD) vacuum reservoir supply hose from the brake booster vacuum sensor.

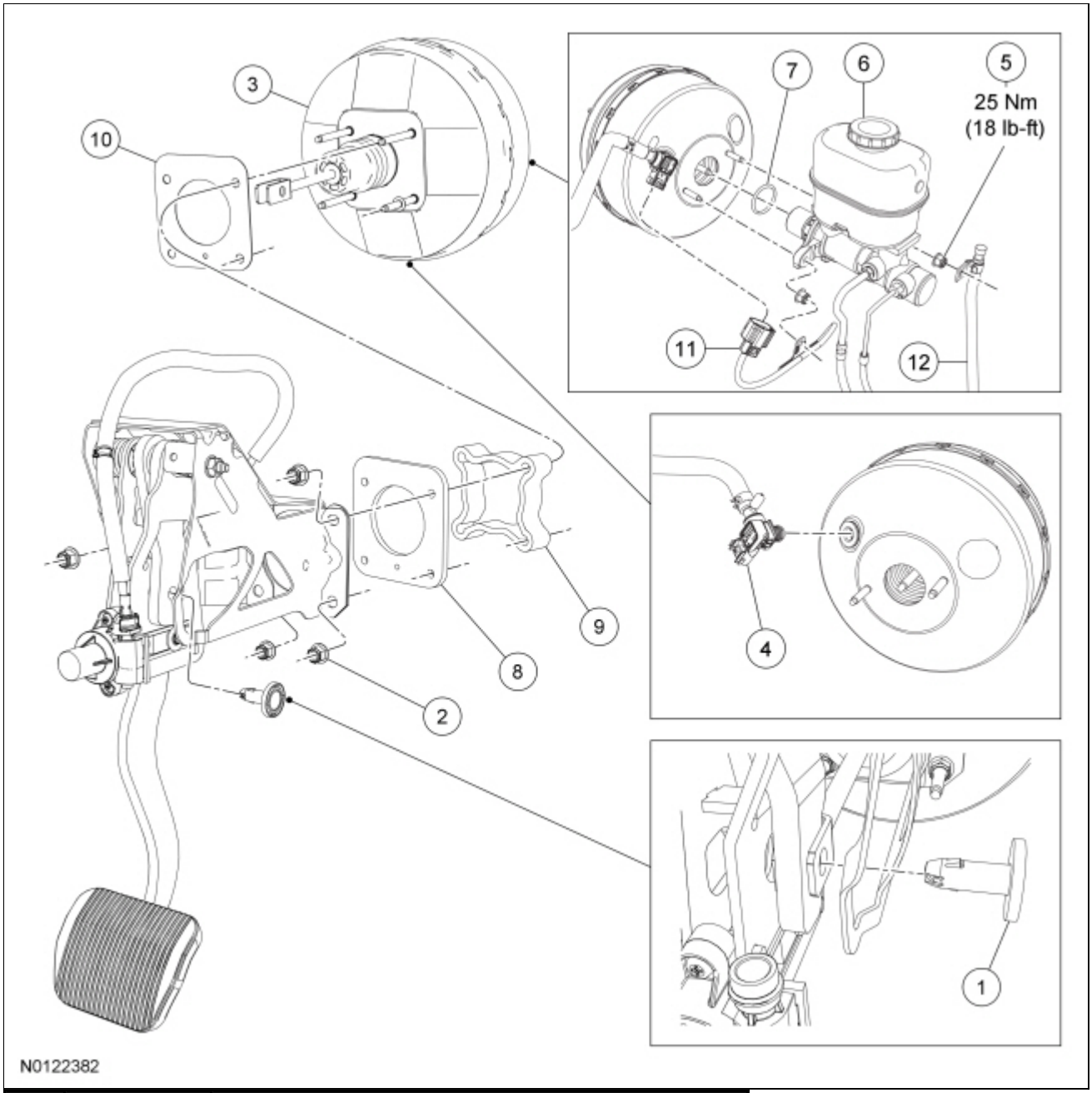
4. Disconnect the vacuum sensor electrical connector and remove the vacuum sensor.

5. **NOTE:** To allow proper drainage of any moisture, the vacuum sensor must be installed in the same position and orientation as removed.

   To install, reverse the removal procedure.

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Brake Booster



Item	Part Number	Description
1	2L523	Brake pedal pin
2	W520212	Brake booster nut (4 required)
3	2005	Brake booster
4	2365A	Vacuum sensor assembly

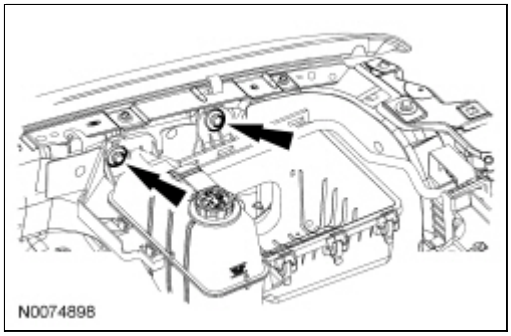
5	W520212	Brake master cylinder nut (2 required)
6	2140	Brake master cylinder assembly
7	2152	Brake master cylinder-to-booster seal
8	—	Gasket (part of 2B022)
9	—	Spacer
10	—	Gasket (part of 2B022)
11	—	Vacuum sensor electrical connector (part of 12A581)
12	3B476	Front axle vent hose

Removal and Installation

1. Relieve the vacuum in the brake booster by pressing and releasing the brake pedal a minimum of 5 times with the engine not running.

2. Remove the Air Cleaner (ACL) element. For additional information, refer to Air Cleaner Element in Section 303-12 .

3. Remove the 2 bolts and position the coolant expansion tank/lower ACL housing assembly aside.
   - To install, tighten bolts to 15 Nm (133 lb-in).



4. Disconnect the brake fluid level switch.

5. If equipped, position the vacuum sensor wiring harness and front axle vent hose aside.

6. ***NOTICE:*** **When the master cylinder is removed, the piston will be exposed. Do not damage the piston or piston surface or a fluid leak may occur.**

   Remove the 2 brake master cylinder nuts and position the master cylinder aside.
   - Support the master cylinder with mechanic's wire.
   - To install, tighten the nuts to 25 Nm (18 lb-ft).

7. **NOTE:** To allow proper drainage of any moisture, the vacuum sensor must be installed in the same position and orientation as removed.

   Disconnect the vacuum sensor assembly from the brake booster.

8. ***NOTICE:*** **Do not service the brake pedal or brake booster without first removing the stoplamp switch. This switch must be removed with the brake pedal in the at-rest position. The switch plunger must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.**

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Remove the stoplamp switch. For additional information, refer to Section 417-01 .

9. **NOTE:** The booster push rod clevis-locking pin is a one-time use only part. Any time the booster push rod clevis-locking pin is removed, a new booster push rod clevis-locking pin should be used.

   NOTE: Remove the clevis-locking pin by squeezing the locking tabs and pulling outward on the opposite end.

   Remove and discard the booster push rod clevis-locking pin.

10. Remove the 4 brake booster nuts and remove the brake booster.
    - To access the nuts, fold back the sound insulation.
    - To install, tighten the nuts to 25 Nm (18 lb-ft) following a clockwise pattern starting with the upper left nut.

11. ***NOTICE:*** **Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. This switch must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the brake pedal in any other position will result in incorrect adjustment and may damage the switch.**

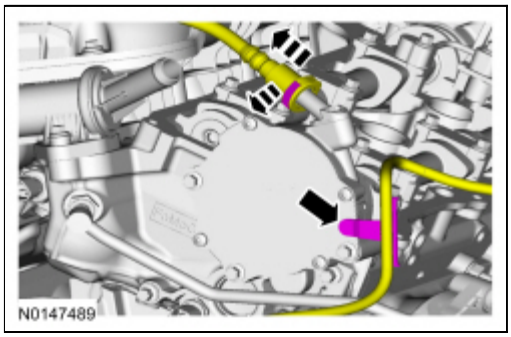
    To install, reverse the removal procedure.

Brake Vacuum Pump

Material

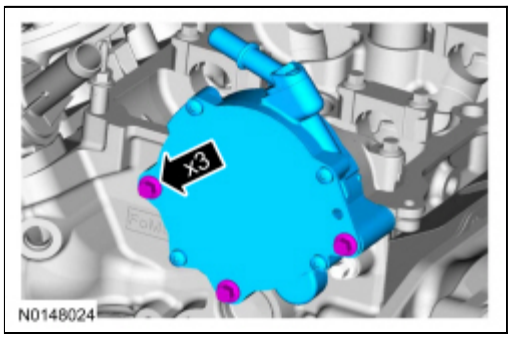
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—

Removal

1. Remove the RH front fender inner splash shield. Refer to Section 501-02 .
2. 

3. ***NOTICE:*** **Do not use excessive force when removing the vacuum pump or the vacuum pump oil tube may be dilodged from the pump causing internal oil seal damage to the pump. If the oil tube becomes dislodged from the pump, a new vacuum pump must be installed.**

   NOTE: The upper/inboard vacuum pump bolt will remain in the vacuum pump housing when removing the vacuum pump.

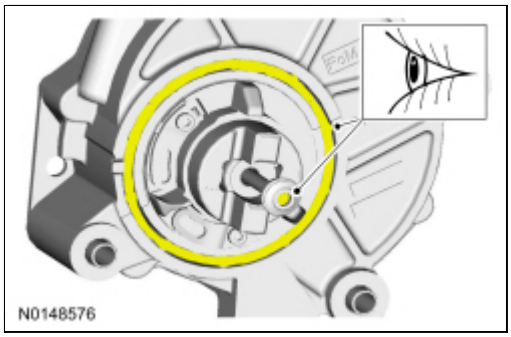
Installation

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1.

2. ***NOTICE:*** **Make sure the oil tube filter screen is free of contaminants prior to the installation of the pump or damage to components may occur.**

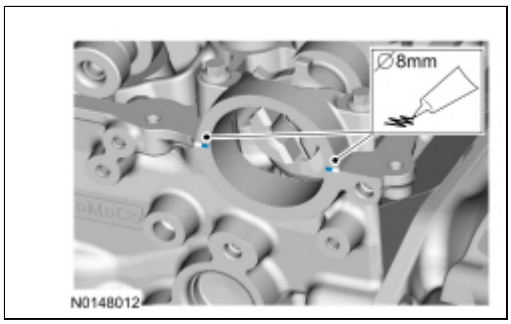
   Visual check. Install a new gasket as necessary.



3. ***NOTICE:*** **If the brake vacuum pump is not secured within 10 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Failure to follow this procedure can cause future oil leakage.**

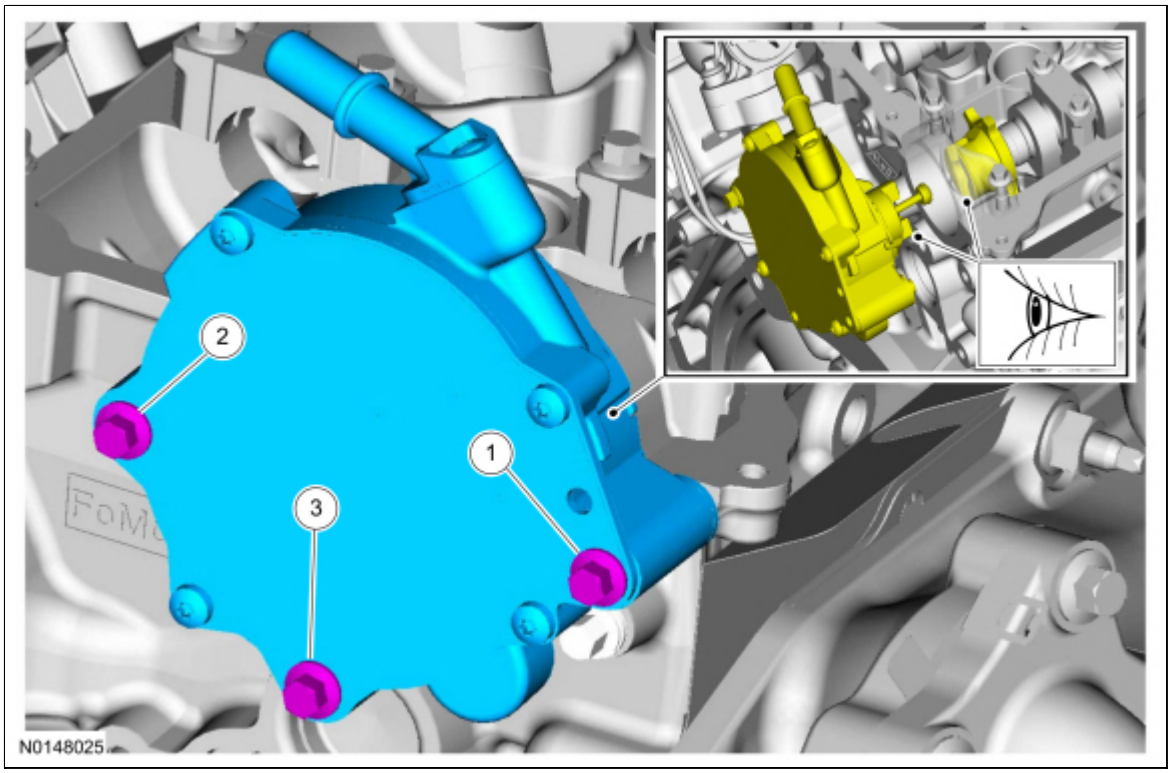
   NOTE: Make sure the mating surfaces are clean and free of foreign material.

   Apply a bead of the specified diameter from the specified tube.

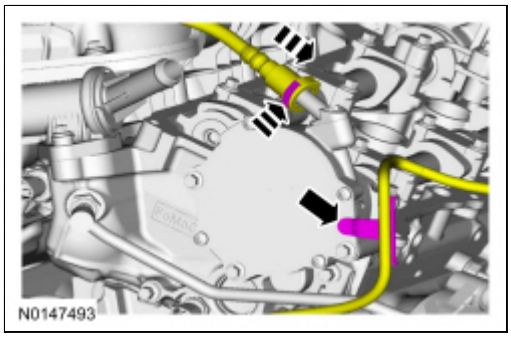


4. **NOTE:** Manually align the brake vacuum pump drive key with the camshaft slot before installation.

   Visual check.
   - Stage 1: Tighten in the sequence shown to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



5.



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Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	740 ml (1.56 pt)

Torque Specifications

Description	Nm	lb-ft	lb-in
ABS module screws	3	—	27
Brake tube-to-Hydraulic Control Unit (HCU) fittings	20	—	177
Front wheel speed sensor bolt	17	—	150
Front wheel speed sensor harness bolt	12	—	106
HCU -to-bracket nuts	8	—	71
HCU bracket bolts	20	—	177
Master cylinder primary brake tube-to- HCU fitting	28	21	—
Master cylinder secondary brake tube-to- HCU fitting	20	—	177
Rear wheel speed sensor bolt	15	—	133

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Anti-Lock Brake System (ABS) and Stability Control

AdvanceTrac® With RSC®

The AdvanceTrac® system is made up of the following systems:

- Anti-lock braking
- Traction control
- ESC

The RSC® system is an optional feature that works in conjunction with AdvanceTrac® to aid in maintaining vehicle stability. AdvanceTrac® with RSC® system consists of the following components:

- ABS module — attached to the Hydraulic Control Unit (HCU), but can be serviced separately from the HCU .
- Front wheel speed sensors — one sensor is located in each front wheel knuckle. The sensors are serviced separately from the knuckle.
- Front wheel speed sensor encoders — one encoder strip is located in each wheel bearing and wheel hub assembly and is serviced with the wheel bearing.
- HCU — contains several valves (inlet, outlet, isolation and dump) and a hydraulic pump motor. It is mounted behind the radiator, below the air cleaner assembly. The HCU is replaced as a unit, including the ABS module.
- Rear wheel speed sensors — one sensor is located in each end of the rear axle housing. The sensors are serviced separately.
- Rear wheel speed sensor tone rings — one tone ring is located on each axle shaft.
- Stability control sensors — located inside the Restraints Control Module (RCM) and consist of the following sensors: yaw rate, roll rate, lateral and longitudinal accelerometers. The sensors are integral to the RCM and cannot be serviced separately.
- Steering wheel rotation sensor (6.2L) — located on the end of the steering column near the intermediate shaft. The sensor is serviced separately from the steering column but the sensor ring is replaced with the column. For all other applications, the steering wheel rotation sensor is part of the EPAS .
- Stability/traction control switch — located in the instrument panel finish panel and is serviced separately from the finish panel.
- Hill Descent Control™ switch — located in the auxiliary switch panel and is serviced separately.
- Brake vacuum pump (3.5L) — a mechanical pump located on the back of the RH cylinder head and driven by the RH exhaust cam shaft.

Electronic Brake Distribution (EBD)

The ABS module and HCU incorporate a strategy called EBD . The EBD strategy uses the HCU as an electronic proportioning valve to create a balanced braking condition between the front and rear wheels and minimizes the chance of rear wheel lockup during hard braking.

A slight bump sensation may be felt in the brake pedal when EBD is active.

Anti-Lock Braking

The conventional ABS aids in the prevention of wheel lock-up during braking events allowing the driver to maintain steering control and stop in the shortest distance possible under most conditions. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper (s).

When the ABS activates, both of the following can occur:

- A rumble or grinding sound may be heard
- If the driver's foot is on the brake pedal, a vibration may be felt in the brake pedal

Supplemental Braking Assist

In addition to preventing wheel lock up during braking events, the ABS module also provides supplemental hydraulic brake assist through the use of the hydraulic pump motor and the HCU . This is done in the event of a severe vacuum loss at the brake booster.

AdvanceTrac® System

Traction Control System

The traction control system aids in the prevention of excessive wheel spin allowing the vehicle to maintain traction during acceleration. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque.

Electronic Stability Control (ESC) System

The ESC system constantly monitors the vehicle's direction of travel relative to the driver's intended course, except when the vehicle is traveling in reverse, and aids in keeping the vehicle traveling along that course. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque.

When the AdvanceTrac® system activates, any of the following can occur:

- A rumble or grinding sound may be heard, much like ABS
- If the driver's foot is on the brake pedal, a vibration may be felt in the brake pedal, much like ABS
- A small deceleration or a reduction in the acceleration of the vehicle
- The stability/traction control indicator (sliding car icon) flashes

Roll Stability Control (RSC®) System

The RSC® system constantly monitors vehicle roll motion, except when the vehicle is traveling in reverse, and aids in keeping the vehicle stable during sudden or abrupt maneuvers. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque. The combination of reduced engine torque and modulated brake fluid pressure

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aids in reducing the cornering forces and, therefore, the total roll momentum acting on the vehicle.

When the RSC® system activates, the vehicle produces the same noticeable symptoms as it does when the AdvanceTrac® system activates.

Trailer Sway Control

Trailer sway control is a unique function in the AdvanceTrac® with RSC® system that recognizes and aids in reducing trailer sway. The trailer sway control function continually monitors the steering wheel rotation and yaw rate sensors to identify specific, increasing yaw oscillations that occur during a trailer sway event. If the trailer sway event exceeds programmed parameters, the ABS module and the HCU modulate brake fluid pressure to specific brake caliper(s) and the PCM modulates engine torque until the trailer sway is reduced below the programmed parameters.

For vehicles equipped with an optional TBC module, the trailer sway control system utilizes the module to apply the trailer brakes to quickly reduce trailer sway.

When the trailer sway control function activates, the vehicle produces the same noticeable symptoms as it does when the AdvanceTrac® system activates. In addition, the message center displays TRAILER SWAY, REDUCE SPEED and, if the vehicle is equipped with a TBC module, the module shows output to the trailer brakes.

The trailer sway control function only activates when the vehicle speed exceeds 64 km/h (40 mph). The system can be disabled during any key cycle. Refer to the Owner's Literature for information on disabling the system. The system is re-enabled when the ignition is turned to the OFF position and back to the RUN position.

MyKey® Interaction

Through the MyKey® feature, the traction control function of the AdvanceTrac® system can be configured to be always on or to allow the driver to select the traction control function on or off.

When the traction control function is configured to be always on and a MyKey® restricted key is in use, the IPC will ignore any requests made by the driver to disable the traction control function and will not send any traction control disable messages to the ABS module. Refer to the Owner's Literature for additional information on the MyKey® feature and settings.

Hill Start Assist

The hill start assist system is designed to assist the driver during hill-starts. Using the ABS, the hill start assist system holds the vehicle on an incline for a short time, allowing the driver to release the brake pedal and press the accelerator pedal without needing to use the parking brake.

Hill Descent Control™

Hill Descent Control™ maintains vehicle speed on a downhill grade, operating at speeds between 3 km/h (2 mph) and 32 km/h (20 mph). If the vehicle is on flat or uphill terrain, the system goes into standby mode,

remaining activated up to 64 km/h (40 mph). At speeds greater than 64 km/h (40 mph), the Hill Descent Control™ system is deactivated. When Hill Descent Control™ is active, a rumble or grinding sound may be heard and/or felt.

Traction Control Switch

The stability/traction control switch can be used by the driver to disable and enable the traction control, ESC and RSC® functions. Refer to the Owner's Literature for instructions on disabling and enabling the traction control, ESC and RSC® functions.

The conventional ABS cannot be disabled using the stability/traction control switch.

Stability/Traction Control Indicators

The IPC message center is a reconfigurable telltale which is capable of displaying a variety of different messages and indicators such as the stability/traction control indicator (sliding car icon), stability/traction control disabled indicator (sliding car OFF icon), the 4WD mode/range or door open messages. For information about the IPC , refer to Section 413-01 .

There are 2 separate stability/traction control indicators, the sliding car icon and the sliding car OFF icon. Both icons are located in the IPC message center. The sliding car icon is used to alert the driver that a stability/traction event is taking place (flashes twice per second) and to alert the driver of potential concerns in the AdvanceTrac® system (illuminates continuously). The sliding car OFF icon is used to alert the driver that the traction control portion of the AdvanceTrac® system has been disabled by the driver. This icon only illuminates continuously and does not flash.

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Anti-Lock Brake System (ABS) and Stability Control

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3030-A	Rotunda Active Wheel Speed Sensor Tester 105-R0110
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operations

Anti-Lock Braking

The ABS module continuously monitors brake pedal input, lateral vehicle motion and the rotational speed of each wheel. The PCM sends the brake pedal switch information to the ABS module over the HS-CAN while the RCM sends lateral acceleration sensor information to the ABS module over a private HS-CAN . Wheel speed information is retrieved by the ABS module using 4 active wheel speed sensors. When the ABS module detects an impending wheel lock during a braking event, the ABS module modulates brake pressure to the appropriate brake caliper(s) by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. Once the affected wheel(s) return to the desired speed, the ABS module returns the solenoid valves in the HCU to their normal position.

The ABS module has 2 self-test options, one is carried out after the ignition is turned to the RUN position and the other is carried out after an ABS stop or after an AdvanceTrac® system activation. When the ignition is turned to the RUN position, the ABS module carries out a preliminary electrical check of the wheel speed

sensors and their circuits by sending voltage through the sensor and checking for the voltage to return. When the vehicle is traveling at speeds above 21 km/h (13 mph) and the brake pedal is not being pressed, the HCU pump motor is commanded on for approximately 0.5 second to check pump motor operation. Also, during all phases of operation while the vehicle is in motion, the ABS module checks for correct operation of the wheel speed sensors by comparing wheel speed input to other sensor input. Depending on the nature of the malfunction detected, the ABS module deactivates the anti-lock control system and sends a message over the HS-CAN to the IPC . When the IPC receives this message, it illuminates the yellow ABS warning indicator and the stability/traction control indicator (sliding car icon).

Electronic Brake Distribution (EBD)

On initial application of the brake pedal, full pressure is applied to the rear brakes. The ABS module then uses wheel speed input to calculate an estimated rate of deceleration. Once vehicle deceleration exceeds a predetermined threshold, the ABS module commands the HCU to close the appropriate isolation valves to hold the rear brake pressure constant while allowing the front brake pressure to build. This creates a balanced braking condition between the front and rear wheels and minimizes the chance of rear wheel lockup during hard braking. As the vehicle decelerates, the valves are opened to increase the rear brake pressure in proportion to the front brake pressure.

If ABS is disabled due to DTCs being present in the ABS module, EBD continues to function unless the DTCs are for wheel speed sensors or the HCU . When EBD is disabled, the red brake warning light, the ABS warning indicator and the stability/traction control indicator (sliding car icon) illuminate.

Supplemental Braking Assist

The ABS module uses the HCU and hydraulic pump motor to aid in bringing the vehicle to a safe, controlled stop in the event of severe vacuum loss at the brake booster. The ABS module continually monitors the vacuum in the brake booster through the use of a vacuum sensor. When the vacuum sensor indicates vacuum is below a predetermined level, a DTC is set in the ABS module. If this occurs during a braking event or if the driver attempts to stop the vehicle with a low vacuum condition in the brake booster, the ABS module activates the hydraulic pump motor in the HCU to assist with vehicle braking.

Traction Control Function

The ABS module continuously monitors and compares the rotational speed of the drive wheels in relation to the non-driven wheels. When the drive wheels begin to spin faster than the non-driven wheels, the ABS module commands the HCU to modulate brake pressure to the appropriate brake caliper. This is accomplished by opening and closing the appropriate solenoid valves inside of the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN that a traction control event is taking place. When the IPC receives this message, it flashes the stability/traction control indicator (sliding car icon). If the event is severe enough, the ABS module sends a message to the PCM over the HS-CAN to assist with traction control. When the PCM receives this message, it adjusts engine timing and decreases fuel injector pulses. Once the affected wheel returns to normal speed, the ABS module returns the solenoid valves in the HCU to their normal position, deactivates the hydraulic pump motor and sends another message over the HS-CAN indicating that the traction event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC turns off the sliding car icon.

Once vehicle speed reaches or exceeds 144 km/h (89 mph), traction control is accomplished only through PCM intervention.

Certain DTCs in the ABS module disable the traction control system. Depending on the DTCs present, the

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red brake warning light, the yellow ABS warning indicator and the sliding car icon illuminate.

Electronic Stability Control (ESC) and Roll Stability Control (RSC®) Functions

The ESC and RSC® functions are controlled by the ABS module and use the same wheel speed sensors and tone rings used for anti-lock braking. The ESC and RSC® functions also use input from the steering wheel rotation sensor, the stability control sensors (yaw rate, roll rate, longitudinal and lateral accelerometers) which are internal to the RCM and information from other modules sent over the HS-CAN to help maintain vehicle stability.

The ABS module uses the various sensors to continuously monitor vehicle roll motion and direction of travel relative to the driver's intended course. If the ABS module determines from all these inputs that the vehicle is unable to travel in the intended direction or that a condition exists for a potential rollover event, it modulates brake pressure to the appropriate brake caliper(s) by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN that a stability event is taking place. When the IPC receives this message, it flashes the stability/traction control indicator (sliding car icon). During a stability event, conditions may require the involvement of the PCM to limit engine torque like it does for traction control. Once the stability condition has been corrected, the ABS module sends another message over the HS-CAN indicating that the event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC turns off the sliding car icon.

Certain DTCs being present in the ABS module may disable the ESC and RSC® functions. Depending on the DTCs present, the yellow ABS warning indicator and/or the sliding car icon are illuminated.

Trailer Sway Control Function

Trailer sway control is a unique function of the RSC® system that uses information from the steering wheel rotation sensor and the yaw information from the RCM to determine if a trailer sway event is taking place. Trailer sway is the undesirable yaw force a trailer can apply to the towing vehicle. If the ABS module determines that a trailer sway event is taking place, it takes action similar to the action taken for an ESC and an RSC® event. At the same time, the ABS module sends a message over the HS-CAN that a trailer sway event is taking place. When the IPC receives this message, it flashes the stability traction control indicator (sliding car icon) and displays TRAILER SWAY REDUCE SPEED in the message center. If necessary, the PCM reduces engine torque as it does for ESC and RSC® . Once the trailer sway has been corrected, the ABS module sends another message over the HS-CAN indicating that the event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC turns off the stability traction control indicator (sliding car icon).

If the vehicle is also equipped with a TBC system, the TBC module receives the trailer sway message from the ABS module and takes appropriate action to assist in reducing the trailer sway. Refer to Section 206-10 for information on the TBC system.

Trailer sway control only activates with vehicle speed greater than 64 km/h (40 mph). Any malfunction that disables the RSC® function also disables the trailer sway control function. Trailer sway control can also be disabled through the message center. Refer to the Owner's Literature for the disabling/enabling procedure. Regardless of the chosen state (enabled or disabled), trailer sway control is re-enabled at each ignition key cycle.

Hill Start Assist

The hill start assist system engages automatically when the following conditions are met:

- The driver applies the vehicle brake and the vehicle is at a complete stop.
- Road inclination of approximately 4 degrees or more is detected (as indicated by the stability control sensor information).
- The vehicle transmission information indicates that the driver selects the correct gear, indicating the intention to drive up the hill.
- The parking brake is not engaged.

Once all the above criteria have been met and the driver releases the brake pedal, hill start assist utilizes the valves in the Hydraulic Control Unit (HCU) to hold the car stationary for up to 2 seconds giving the driver time to accelerate the vehicle. As the vehicle accelerates hill start assist gradually releases the brake pressure to make sure that the vehicle is neither rolling back nor driving off until there is sufficient driving torque to accelerate the vehicle forward. Hill start assist also functions if the vehicle is facing downhill if the reverse gear is selected.

Hill Descent Control™ and Hill Descent Control™ Switch

Hill Descent Control™ uses the pump motor and HCU to provide vehicle speed control while descending a downhill grade, information from the RCM to determine whether or not the vehicle is on a downhill grade and wheel speed sensor information to determine vehicle speed. When the Hill Descent Control™ switch is pressed, a ground signal is sent to the IPC indicating that the driver has activated the system. The IPC then sends a message to the ABS module along the HS-CAN requesting system activation. The ABS module uses the input from the RCM and wheel speed sensors to determine the mode of operation (active, stand-by or deactivated). During a hill descent, while the Hill Descent Control™ system is activated, the driver sets vehicle speed through the use of the accelerator and brake pedals. Once the desired speed has been set, the system maintains that speed until one of the following occur:

- The vehicle is no longer on a downhill grade.
- The driver presses the switch again.
- Vehicle speed exceeds 64 km/h (40 mph).
- The system is disabled for cooling.

During periods of sustained use, the Hill Descent Control™ system automatically deactivates in order to cool the brake system. When this occurs, the system notifies the driver with a message in the message center and by sounding a warning chime. At this time the driver needs to provide brake and/or throttle control to maintain the desired descent speed. The system remains disabled until it has sufficiently cooled. The length of time needed for cooling varies depending on operating conditions.

Stability/Traction Control Switch

Unlike conventional ABS, the individual functions of AdvanceTrac® with RSC® can be deactivated by the driver through the stability/traction control switch. The switch is hard-wired to the IPC and when pressed, sends a ground signal to the IPC .

If the stability/traction control switch is pressed and held for more than 30 seconds, a DTC sets in the ABS module.

Once disabled, the system remains in that state until the driver presses the switch again, the ignition is cycled or the vehicle speed reaches or exceeds 56 km/h (35 mph). Once the vehicle speed reaches or exceeds 56 km/h (35 mph), RSC® and ESC are reactivated. Once the vehicle speed drops below 48 km/h

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(30 mph), traction control returns to the state the driver had originally selected, either on or off.

The functions cannot be disabled when a MyKey® restricted key is in use with the AdvanceTrac® always-on feature configured to on. If an attempt is made to disable the ESC system while a MyKey® restricted key is in use, ADVTRAC ON MY KEY SETTING displays in the IPC message center. For information about MyKey®, refer to Section 419-01B .

Stability/Traction Control Indicators

Both the stability/traction control indicator (sliding car icon) and the stability/traction control disabled indicator (sliding car OFF icon) alert the driver of stability/traction control system status.

When certain stability control system DTC(s) are present, the ABS module sends a message to the IPC over the HS-CAN . Depending on the nature of the DTC(s), the IPC responds by either solidly illuminating 1 or both icons or by flashing the icon(s) once every 2 seconds.

When a stability/traction control event is taking place, the ABS module sends a message to the IPC over the HS-CAN to flash the sliding car icon twice per second.

When the driver disables the stability/traction control system by using the traction control switch, the IPC receives a ground signal from the switch and then sends a message over the HS-CAN indicating that the driver has requested the system be deactivated and illuminates the sliding car OFF icon.

Stability Control Sensors

The stability control sensors provide information to the ABS module for the operation of the ESC function, RSC® function (if equipped), hill start assist system and the Hill Descent Control™ system (if equipped). The stability control sensors are housed in the RCM and are serviced with the module. The sensors used for stability control include the yaw rate sensor, the lateral accelerometer, the longitudinal accelerometer and (if equipped with RSC®) the roll rate sensor. Sensor information is sent to the ABS module over a private HS-CAN .

Steering Wheel Sensor Information

For the 6.2L engine, the steering wheel rotation sensor uses an optical sensor and a slotted wheel to measure the rate of rotation (angle) of the steering wheel. The steering wheel rotation sensor uses the HS-CAN to transmit information to the ABS module about steering wheel turning direction (left or right) and how far the steering wheel is being turned. The steering wheel rotation sensor does not indicate the absolute position of the steering wheel relative to straight-ahead. The ABS module learns this position by comparing the steering wheel position with other signals and storing the position it has learned. The module confirms this position and modifies it as necessary during every new driving cycle.

For all other applications, the steering wheel rotation sensor is part of the EPAS system and is located inside the PSCM . The sensor is serviced with the PSCM . The PSCM uses the HS-CAN to transmit information to the ABS module about steering wheel turning direction (left or right) and how far it is being turned. The PSCM does not indicate the absolute position of the steering wheel relative to straight-ahead. The ABS module learns this position by comparing the steering wheel position with other signals and storing the position it has learned. The ABS module confirms this position and modifies it as necessary during every new driving cycle.

ABS Module Configuration

Module configuration is a scan tool process which configures specific vehicle settings in a new module. If installing a new ABS module and/or a new HCU , the ABS module must be configured. To configure the ABS module, refer to PMI in Section 418-01 .

Inspection and Verification

1. Verify the customer concern.

2. Verify the stoplamps operate correctly by applying and releasing the brake pedal. If the stoplamps do not operate correctly, refer to Section 417-01 . If the stoplamps operate correctly, proceed to the next step.

3. Verify that the PRNDL operates correctly on the IPC . If the PRNDL does not operate correctly, refer to Section 413-01 . If the PRNDL operates correctly, proceed to the next step.

4. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Wheel speed sensor ring
• HCU
• Tire pressure
• Mismatched wheels or tires on vehicle
• Base brake system
• Brake booster vacuum hose
• Steering components, suspension components and tire size
	• BJB fuses:
	  ▪ 36 (30A)
	  ▪ 47 (60A)
	  ▪ 54 (5A)
	• ABS module
	• Wheel speed sensors
	• Stoplamp switch
	• Stability/traction control switch
	• Hill Descent Control™ switch (if equipped)
	• Brake fluid level switch
	• Wiring, terminals or connectors
	• Brake booster vacuum sensor

5. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

6. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the DLC .

7. **NOTE:** The VCM LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

8. If the scan tool does not communicate with the vehicle:

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- verify the ignition is ON.
- verify the scan tool operation with a known good vehicle.
- refer to Section 418-00 The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

9. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record CMDTCs .

10. Clear the continuous DTCs and carry out the self-test diagnostics for the ABS module.

11. If the DTCs retrieved are related to the concern, go to ABS Module DTC Chart. For all other DTCs, refer to the Master DTC Chart in Section 419-10 .

12. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

ABS Module DTC Chart

NOTE: Always retrieve the continuous DTCs after running the self-test.

DTC	Description	Action
B1342	ECU is Defective	***NOTICE:*** **Do not power the Electronic Control Unit (ECU) while it is removed from the HCU . Failure to do so could damage the ECU or cause the ECU to set unrelated DTCs.** **NOTE:** If other DTCs are present, repair them before installing a new component. CLEAR the DTCs. REPEAT the self-test. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. REPEAT the self-test.
B1596	Service Continuous Codes	**NOTE:** This DTC does not indicate a malfunction of the ABS. If other DTCs are present, REPAIR them before addressing this DTC. Some DTCs cannot be detected by the ABS module until the ignition is cycled from ON to OFF and back to ON again. When DTCs are cleared using the scan tool, the ignition needs to be cycled in order to clear this DTC and have the ABS module check for other DTCs. DIAGNOSE all other DTCs. CLEAR the DTCs. CYCLE the ignition. RETRIEVE the DTCs. GO to the ABS Module DTC Chart.
B1676	Battery Pack Voltage Out of Range	GO to Pinpoint Test A .
B2477	Module Configuration Failure	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01 . CLEAR the DTCs. REPEAT the self-test.
B2900	VIN Mismatch	GO to Pinpoint Test B .

C109D	Low Vacuum Condition Detected	GO to Pinpoint Test I .
C109E	Vacuum Sensor Circuit Fault	GO to Pinpoint Test I .
C109F	Vacuum Sensor Signal Fault	GO to Pinpoint Test I .
C1145	Wheel Speed Sensor RF Input Circuit Failure	GO to Pinpoint Test D .
C1155	Wheel Speed Sensor LF Input Circuit Failure	GO to Pinpoint Test D .
C1165	Wheel Speed Sensor RR Input Circuit Failure	GO to Pinpoint Test D .
C1175	Wheel Speed Sensor LR Input Circuit Failure	GO to Pinpoint Test D .
C116A	ABS Pressure Transducer / Brake Switch Mismatch	GO to Pinpoint Test G .
C1222	Wheel Speed Mismatch	GO to Pinpoint Test E .
C1266	ABS Valve Power Relay Circuit Failure	GO to Pinpoint Test F .
C1278	Steering Wheel Angle 1 and 2 Signal Faulted	This DTC sets when the steering wheel angle sensor data received over the HS-CAN is out of range and does not agree with other supporting sensor data. For the 6.2L engine, REFER to Section 211-05 to diagnose any SCCM DTCs. For all others, REFER to Section 211-05 to diagnose any SCCM DTCs. If no SCCM DTCs are present, REFER to Section 211-00A to diagnose any PSCM DTCs.
C1280	Yaw Rate Sensor Signal Fault	This DTC indicates a concern with the yaw rate sensor which is integral to the Restraints Control Module (RCM). REFER to Section 501-20B to diagnose all the RCM DTCs. If no RCM DTCs are present, GO to Pinpoint Test P .
C1282	Lateral Accelerometer Signal Fault	This DTC indicates a concern with the lateral accelerometer which is integral to the RCM . REFER to Section 501-20B to diagnose all the RCM DTCs. If no RCM DTCs are present, GO to Pinpoint Test P .
C1288	Pressure Transducer Main/Primary Input Circuit Failure	CLEAR the DTCs. REPEAT the self-test. RETRIEVE the DTCs. If DTC C1288 is retrieved, INSTALL a new Hydraulic Control Unit (HCU). REFER to Hydraulic Control Unit (HCU) . CLEAR the DTCs. REPEAT the self-test.
C1296	Wheel Speed LF Signal Fault	GO to Pinpoint Test E .
C1297	Wheel Speed RF Signal Fault	GO to Pinpoint Test E .
C1298	Wheel Speed RR Signal Fault	GO to Pinpoint Test E .
C1299	Wheel Speed LR Signal Fault	GO to Pinpoint Test E .

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C1300	ABS Pump Motor Circuit Failure	GO to Pinpoint Test C .
C1440	Pressure Transducer Main/Primary Signal Faulted	GO to Pinpoint Test G .
C1516	Roll Rate Sensor Signal Fault	This DTC indicates a concern with the roll rate sensor which is integral to the RCM . REFER to Section 501-20B to diagnose all the RCM DTCs. If no RCM DTCs are present, GO to Pinpoint Test P .
C1963	Stability Control Inhibit Warning	GO to Pinpoint Test P .
C1975	IVD Plausibility Failure	GO to Pinpoint Test P .
C2770	Longitudinal Acceleration Sensor Plausibility Failure	This DTC indicates a concern with the longitudinal accelerometer which is integral to the RCM . REFER to Section 501-20B to diagnose all the RCM DTCs. If no RCM DTCs are present, GO to Pinpoint Test P .
C2775	TC/AYC ON/OFF Switch Stuck Failure	GO to Pinpoint Test R .
C2809	Hill Descent Control Switch Stuck	GO to Pinpoint Test J .
U0073	Control Module Communication Bus A Off	REFER to Section 418-00 to diagnose the High Speed Controller Area Network (HS-CAN).
U0100	Loss of Communication with ECM/PCM	GO to Pinpoint Test K .
U0114	Lost Communication With Four-Wheel Drive Clutch Control Module	GO to Pinpoint Test L .
U0131	Lost Communication With Power Steering Control Module (VAPS)	GO to Pinpoint Test M . For the 6.2L engine, GO to Pinpoint Test N .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test O .
U0151	Lost Communication With Restraints Control Module	GO to Pinpoint Test P .
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	GO to Pinpoint Test Q .
U0401	Invalid Data Received From ECM/PCM	This DTC sets when the ABS module receives invalid network data from the PCM. RETRIEVE and REPAIR all non-network DTCs in the PCM. REFER to Section 303-14 .
U0414	Invalid Data Received from Four-Wheel Drive Clutch Control Module	This DTC sets when the ABS module receives invalid network data from the Transfer Case Control Module (TCCM). RETRIEVE and REPAIR all non-network DTCs in the TCCM . REFER to Section 308-07A .
U0423	Invalid Data Received From Instrument Panel Control Module	This DTC sets when the ABS module receives invalid network data from the Instrument Panel Cluster (IPC). RETRIEVE and REPAIR all non-network DTCs in the IPC . REFER to Section 413-01 .

U0428	Invalid Data Received from Steering Angle Sensor Module	This DTC sets when the ABS module receives invalid steering angle network data. For vehicles equipped with Hydraulic Power Assist Steering (HPAS), this data is sent from the Steering Column Control Module (SCCM). RETRIEVE and REPAIR all non-network DTCs in the SCCM. REFER to Section 211-05. For vehicles equipped with Electronic Power Assist Steering (EPAS), this data is sent from the Power Steering Control Module (PSCM). RETRIEVE and REPAIR all non-network DTCs in the PSCM. REFER to Section 211-00B.
U0452	Invalid Data Received From Restraints Control Module	This DTC sets when the ABS module receives invalid network data from the RCM. RETRIEVE and REPAIR all non-network DTCs in the RCM. REFER to Section 501-20B. If no RCM DTCs are present, GO to Pinpoint Test P.
U2050	No Application Present	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01. CLEAR the DTCs. REPEAT the self test.
U2051	One or More Calibration Files Missing /Corrupt	CLEAR the DTC. CARRY OUT the ABS module self-test. If DTC U2051 returns, RECONFIGURE the ABS module using as-built data. REFER to PMI Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available in Section 418-01. CLEAR the DTC and REPEAT the self-test. If DTC U2051 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. REPEAT the self-test.
U2152	SCP (J1850) Invalid Data from GEM	This DTC sets when the ABS module receives invalid network data from the Body Control Module (BCM). RETRIEVE and REPAIR all non-network DTCs in the BCM. REFER to Section 419-10.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the ABS module	• Fuse • Wiring, terminals or connectors • ABS module	• REFER to Section 418-00.
• The yellow ABS warning indicator is never on	• Wiring, terminals or connectors • Instrument Panel Cluster (IPC)	• REFER to Section 413-01.
• The stability/traction control indicator (sliding car icon) is never on	• Stability/traction control system • ABS module • IPC	• REFER to Section 413-01.
• Only the red brake warning indicator is always/never on	• Wiring, terminals or connectors • Parking brake switch • Brake fluid level switch	• REFER to Section 413-01.

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	• Body Control Module (BCM) • IPC	
• The yellow ABS warning indicator is always on	• DTCs in the ABS module • ABS module • IPC	• RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart. • If there are no DTCs present in the ABS module, REFER to Section 413-01 .
• The sliding car icon is always on	• DTCs in the ABS module • Stability/traction control system • IPC	• RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart. • If there are no DTCs present in the ABS module, REFER to Section 413-01 .
• All 3 indicators (red brake warning light, yellow ABS warning indicator and the sliding car icon) are always on	• DTCs in the ABS module • Wiring, terminals or connectors • Parking brake switch • Brake fluid level switch • Stability/traction control system • BCM • ABS module • IPC	• RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart. • If there are no DTCs present in the ABS module, REFER to Section 413-01 .
• Spongy brake pedal with no warning indicator	• Air in the brake hydraulic system • Damaged or incorrectly installed brake components	• BLEED the brake system and the Hydraulic Control Unit (HCU). REFER to Brake System Bleeding in Section 206-00 . • INSPECT the brake pedal, brake booster and master cylinder for correct installation. REFER to Section 206-06 for the brake pedal and master cylinder or Section 206-07 for the brake booster. CORRECT the installation or INSTALL new as necessary. TEST the system for normal operation.
• Poor vehicle tracking during anti-lock function	• Air in the hydraulic brake system • Low tire pressure • HCU • Base brake system concern	• GO to Pinpoint Test S . • REFER to Section 206-00 .
• The stability/traction	• Wiring, terminals or	• GO to Pinpoint Test R .

control system is inoperative	connectors • Stability/traction control switch • ABS module • IPC	
• The stability/traction control system cannot be disabled	• If a MyKey® restricted key is in use with the AdvanceTrac® always on feature configured to on, the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system • Wiring, terminals or connectors • Stability/traction control switch • IPC	• GO to Pinpoint Test R .
• The Hill Descent Control™ system (if equipped) is inoperative	• ABS module DTCs present • Hill Descent Control™ switch • Wiring, terminals or connectors	• CARRY OUT a ABS module self-test. • GO to Pinpoint Test J .

Pinpoint Tests

Pinpoint Test A: DTC B1676

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The voltage required for correct ABS operation is between 10 and 17 volts. Voltage outside of this range causes the ABS module to set DTC B1676.

- DTC B1676 (Battery Pack Voltage Out of Range) — this DTC sets in every ignition cycle if, with the ignition in the RUN position and vehicle speed greater than 6 km/h (4 mph), the battery voltage is less than 10 volts or more than 17 volts. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

This pinpoint test is intended to diagnose the following:

- Fuse
- Battery condition
- Wiring, terminals or connectors
- ABS module

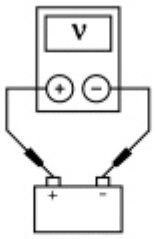
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PINPOINT TEST A: DTC B1676

NOTE: DTC B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

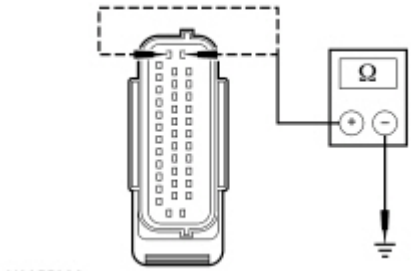
Test Step	Result / Action to Take
A1 RETRIEVE ALL CMDTC IN ALL MODULES • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • **Is DTC B1317, B1318 or B1676 present in one or more modules AND P0563, P0620, P0625, P0626 or P065B present in the PCM?**	**Yes** REFER to Section 414-00 for diagnosis of the battery and charging system. **No** GO to A2 .
A2 CHECK BATTERY CONDITION • Ignition OFF. • Carry out the Battery — Condition Test. Refer to Section 414-01 . • **Does the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to A3 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR all CMDTCs . TEST the system for normal operation.
A3 CHECK CHARGING SYSTEM VOLTAGE **NOTE:** Do not allow the engine speed to increase above 2,000 rpm while carrying out this step or the generator can self excite and result in default charging system output voltage. If engine speed goes above 2,000 rpm, shut the vehicle off and restart the engine before carrying out this step. • Start the engine. • Measure the voltage of the battery with and without a load on the charging system as follows: ▪ Turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage. ▪ Turn the headlights on and the HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage.	**Yes** GO to A4 . **No** REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.



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- **Are the voltages between 13 and 15.2 volts?**

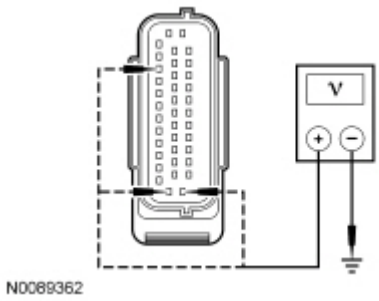
A4 CHECK THE ABS MODULE GROUND CIRCUITS FOR AN OPEN	

• Disconnect: Battery Negative Cable .
• Ignition OFF.
• Disconnect: ABS Module C135 .
• Measure the resistance between ground and:
  ▪ ABS module C135-13, circuit GD121 (BK/YE), harness side.
  ▪ ABS module C135-38, circuit GD121 (BK/YE), harness side.

 	
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• **Are the resistances less than 0.5 ohm?**
	Yes
	GO to A5 .
	
	No
	REPAIR the affected circuit(s). CLEAR all CMDTCs . REPEAT the self-test.

A5 CHECK FOR VOLTAGE AT THE ABS MODULE	

• Connect: Battery Negative Cable .
• Ignition ON.
• Measure the voltage between ground and:
  ▪ ABS module C135-1, circuit SBB47 (WH/RD), harness side.
  ▪ ABS module C135-25, circuit SBB36 (GN/RD), harness side.
  ▪ ABS module C135-35, circuit CBB54 (VT/OG), harness side.
	Yes
	GO to A6 .
	
	No
	VERIFY that Battery Junction Box (BJB) fuses 36 (30A), 47 (60A), and 54 (5A) are OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test.

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 N0089362 • **Are the voltages greater than 10 volts?**	
A6 CHECK FOR CORRECT ABS MODULE OPERATION	

• Disconnect: ABS Module C135 .
• Check the connector for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: ABS Module C135 .
• Make sure the connector seats correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test B: DTC B2900

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

When the ignition is turned to the RUN position, the ABS module and the Body Control Module (BCM) share Vehicle Identification Number (VIN) information over the High Speed Controller Area Network (HS-CAN).

- DTC B2900 (VIN Mismatch) — this DTC sets in the ignition cycle if the VIN information stored in the ABS module does not match the information transmitted by the BCM . DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

This pinpoint test is intended to diagnose the following:

- Module configuration (ABS and BCM)
- ABS module

PINPOINT TEST B: DTC B2900

Test Step	Result / Action to Take
B1 VERIFY BCM VIN	
• Connect the scan tool.	**Yes**

• Ignition ON. • Using the scan tool, carry out the network test. • Enter the following diagnostic mode on the scan tool: Log Viewer . • Compare the VIN in log viewer to the VIN plate. • **Does VIN in log viewer match the VIN plate?**	GO to B2 . **No** RECONFIGURE the BCM . FOLLOW the instructions on the scan tool. CLEAR the DTCs. CYCLE the ignition key. REPEAT the self-test.
B2 VERIFY ABS MODULE PART NUMBER	
• Retrieve and record the ABS module part number from log viewer and verify that the vehicle has the correct ABS module installed. • **Is the correct ABS module installed in the vehicle?**	**Yes** CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available in Section 418-01 . CLEAR the DTC. CYCLE the ignition key. REPEAT the self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. CYCLE the ignition key. TEST the system for normal operation.

Pinpoint Test C: DTC C1300

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The operating voltage required to run the hydraulic pump motor is between 10 and 17 volts. Fused battery voltage for the hydraulic pump motor is supplied to the ABS module from the Battery Junction Box (BJB). The hydraulic pump motor is internal to the Hydraulic Control Unit (HCU). If a new hydraulic pump motor is needed, a new HCU must be installed.

- DTC C1300 (ABS Pump Motor Circuit Failure) — this DTC sets every ignition cycle or in on-demand memory if there are circuit failures such as a short to ground, open, high circuit resistance, damaged motor, blown fuse. The module also checks the motor after every actuation. When the pump is shut off, the ABS module measures the output voltage of the motor. If the voltage drops too quickly, there may be a locked motor. DTC C1300 sets if this fault is detected 3 times. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

This pinpoint test is intended to diagnose the following:

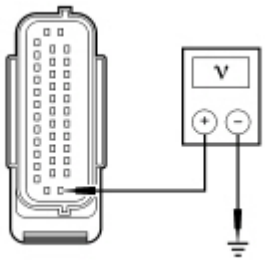
- Fuse
- Wiring, terminals or connectors
- HCU
- ABS module

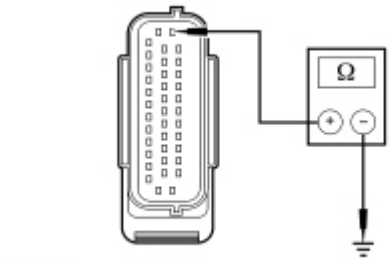
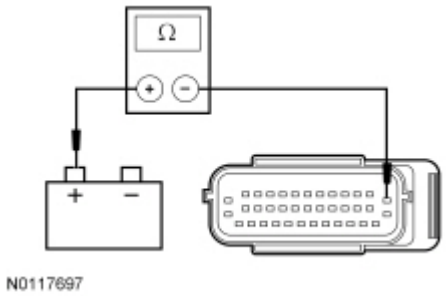
PINPOINT TEST C: DTC C1300

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct**

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probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
C1 CHECK THE ABS PUMP MOTOR	
• Ignition ON. • **Is the ABS pump motor running all the time?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation. **No** GO to C2 .
C2 CHECK THE ABS MODULE PUMP MOTOR (PMP_MOTOR) OUTPUT COMMAND	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • Toggle the PMP_MOTOR output command ON. • **Does the ABS pump motor run for approximately 3 seconds?**	**Yes** TOGGLE the PMP_MOTOR output command OFF. CLEAR the DTCs. CHECK the yellow ABS warning indicator while driving the vehicle (the brakes must not be applied) above 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, RETRIEVE the DTCs. If DTC C1300 is retrieved again, GO to C5 . If the yellow ABS warning indicator does not illuminate, the system is OK. **No** TOGGLE the PMP_MOTOR output command OFF. GO to C3 .
C3 CHECK FOR VOLTAGE TO THE ABS MODULE	
• Ignition OFF. • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between ABS module C135-1, circuit SBB47 (WH/RD), harness side and ground.  N0058091 • **Is the voltage greater than 10 volts?**	**Yes** GO to C4 . **No** VERIFY BJB fuse 47 (60A) is OK. If OK, REPAIR open in circuit SBB47 (WH/RD). If not OK, REPAIR the short circuit in circuit SBB47 (WH/RD). CLEAR the DTCs. REPEAT the self-test.
C4 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN OR EXCESSIVE RESISTANCE	

• Ignition OFF. • Disconnect: Battery Negative Cable . • Measure the resistance between ABS module C135-13, circuit GD121 (BK/YE), harness side and ground.  N0055398 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to C5 . **No** REPAIR circuit GD121 (BK/YE). CLEAR the DTCs. REPEAT the self-test.
C5 CHECK THE ABS MODULE POWER CIRCUIT FOR CONTINUITY	
• Measure the resistance between the ABS module C135-1, circuit SBB47 (WH-RD), harness side and battery positive.  N0117697 • **Is the resistance less than 0.5 ohms?**	**Yes** GO to C6 . **No** REPAIR the open circuit SBB47 (WH/RD). CLEAR the DTCs. REPEAT the self-test.
C6 CHECK FOR CORRECT ABS MODULE OPERATION	

• Disconnect: ABS Module C135 .
• Check the connector for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: ABS Module C135 .
• Connect: Battery Negative Cable .
• Make sure the connector seats correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: DTCs C1145, C1155, C1165 and C1175

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

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Active wheel speed sensors generate a square wave current signal that is sent to the ABS module. The wheel speed sensor circuitry connects to the ABS module through 2 wires and a connector at each wheel speed sensor. When the ignition switch is turned to the RUN position, the ABS module carries out a self-test by sending a reference voltage through the wheel speed sensors and their circuitry to determine if they are functional. The front wheel bearings contain a magnetic strip that replaces the tone ring. It functions the same but is not visible for inspection.

Battery voltage and ground are supplied to the active wheel speed sensors from the ABS module.

DTC Description	Fault Trigger Condition
• C1145 — Speed Wheel Sensor RF Input Circuit Failure • C1155 — Speed Wheel Sensor LF Input Circuit Failure • C1165 — Speed Wheel Sensor RR Input Circuit Failure • C1175 — Speed Wheel Sensor LR Input Circuit Failure	These DTCs set in continuous memory if the ABS module detects an open, short to ground or voltage or a damaged wheel speed sensor input circuit, the appropriate DTC sets when the vehicle speed exceeds 6 km/h (4 mph). DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected. DTCs C1165 and C1175 also set on-demand.

This pinpoint test is intended to diagnose the following:

- Wheel speed sensors
- Wheel bearing magnetic strips, rear tone rings
- Wiring, terminals or connectors
- ABS module

PINPOINT TEST D: DTCs C1145, C1155, C1165 AND C1175

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: If the ignition is turned to the ON position when a wheel speed sensor is disconnected, the ABS module disables the output to that sensor. Make sure all test connections are made at the wheel speed sensor connector before turning the ignition to the ON position.

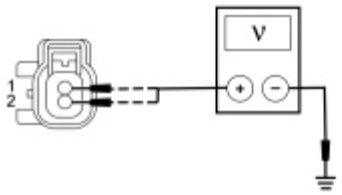
Test Step	Result / Action to Take
D1 CHECK FOR FAULT REPEATABILITY	
• Connect the scan tool. • Ignition ON.	**Yes** If the Rotunda Active Wheel Speed Sensor Tester is available, GO to D2 . If

• Enter the following diagnostic mode on the scan tool: Clear the Continuous DTCs . • Drive the vehicle at least 16 km/h (10 mph). • Retrieve the Continuous Memory Diagnostic Trouble Codes (CMDTCs). • **Is DTC C1145, C1155, C1165 or C1175 retrieved?**	the Rotunda Active Wheel Speed Sensor Tester is not available, GO to D4 . **No** INSPECT the wheel speed sensors and wheel speed sensor wiring. REPAIR or INSTALL new as necessary. If any other DTCs are retrieved, GO to the ABS Module DTC Chart.
D2 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor . • Connect the Rotunda Active Wheel Speed Sensor Tester to the wheel speed sensor connectors. • Select the correct system polarity on the tester and turn the tester power switch to the ON position. • Ignition ON. • **Is the module output LED illuminated?**	**Yes** GO to D3 . **No** GO to D6 .
D3 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Raise the suspect wheel until it can spin freely. Refer to Section 100-02 . • While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin the suspect wheel. • **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. **No** If the current overload level LED is not illuminated and the sensor output LEDs do not illuminate or if the current overload level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test. If the current overload level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test. If the outputs LEDs still do not flash when spinning the wheel, INSTALL a new wheel bearing magnetic strip or tone ring (rear). REFER to Section 204-01A , Section 204-01B or Wheel Speed Sensor Ring — Rear in this section.
D4 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
NOTE: Check both circuits for each DTC. • Ignition OFF.	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

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- Disconnect: ABS Module C135 .
- Disconnect: Suspect Wheel Speed Sensor .
- Ignition ON.
- Measure the voltage between the suspect wheel speed sensor connector, harness side and ground as follows:

Wheel Speed Sensor	Circuit
C150-1 (LF)	VCA03 (VT/WH)
C150-2 (LF)	RCA17 (YE)
C160-1 (RF)	VCA05 (GY/VT)
C160-2 (RF)	RCA19 (VT)
C426-1 (RR)	VCA06 (WH/OG)
C426-2 (RR)	RCA20 (BN)
C440-1 (LR)	VCA04 (BU/OG)
C440-2 (LR)	RCA18 (BN/GN)



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- **Is any voltage present?**

No
GO to D5 .

D5 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND

NOTE: Check both circuits for each DTC.

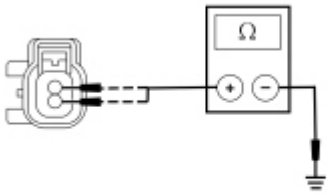
- Ignition OFF.
- Measure the resistance between the wheel speed sensor connector, harness side and ground as follows:

Wheel Speed Sensor	Circuit
C150-1 (LF)	VCA03 (VT/WH)
C150-2 (LF)	RCA17 (YE)
C160-1 (RF)	VCA05 (GY/VT)
C160-2 (RF)	RCA19 (VT)
C426-1 (RR)	VCA06 (WH/OG)
C426-2 (RR)	RCA20 (BN)
C440-1 (LR)	VCA04 (BU/OG)

Yes
GO to D6 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

C440-2 (LR)	RCA18 (BN/GN)



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- **Are the resistances greater than 10,000 ohms?**

D6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

NOTE: Check both circuits for each DTC.

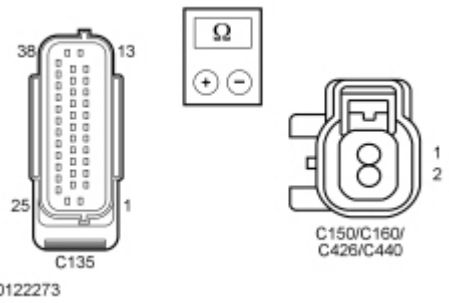
- Ignition OFF.
- Disconnect: ABS Module C135 .
- Disconnect: Suspect Wheel Speed Sensor .
- Measure the resistance between the ABS module connector, harness side and the suspect wheel speed sensor connector, harness side as follows:

ABS Module	Circuit	Wheel Speed Sensor
C135-21	VCA03 (VT/WH)	C150-1 (LF)
C135-34	RCA17 (YE)	C150-2 (LF)
C135-18	VCA05 (GY/VT)	C160-1 (RF)
C135-6	RCA19 (VT)	C160-2 (RF)
C135-19	VCA06 (WH/OG)	C426-1 (RR)
C135-31	RCA20 (BN)	C426-2 (RR)
C135-33	VCA04 (BU/OG)	C440-1 (LR)
C135-20	RCA18 (BN/GN)	C440-2 (LR)

Yes
GO to D7 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the ABS self-test.

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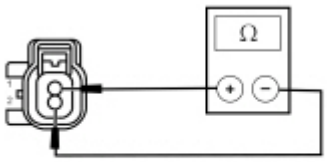


- **Are the resistances less than 5 ohms?**

D7 CHECK SHORTED WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between the suspect wheel speed sensor connector, harness side as follows:

ABS Module	Circuit	Wheel Speed Sensor
C135-21	VCA03 (VT/WH)	C150-1 (LF)
C135-34	RCA17 (YE)	C150-2 (LF)
C135-18	VCA05 (GY/VT)	C160-1 (RF)
C135-6	RCA19 (VT)	C160-2 (RF)
C135-19	VCA06 (WH/OG)	C426-1 (RR)
C135-31	RCA20 (BN)	C426-2 (RR)
C135-33	VCA04 (BU/OG)	C440-1 (LR)
C135-20	RCA18 (BN/GN)	C440-2 (LR)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to D8 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

D8 CHECK THE ABS MODULE OUTPUT

NOTE: Make sure all test connections are made at the wheel speed sensor before the ignition key is turned to the ON position.

Yes
INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this

NOTE: Use a meter with a min/max feature and/or recording capabilities to obtain accurate measurements. The ABS module disables the voltage output immediately if the wheel speed sensor is not present. • Ignition OFF. • Connect: ABS Module C135 . • Connect the meter to the suspect wheel speed sensor electrical connector pins, harness side. • Set the meter to measure DC voltage. • Set the meter range to greater than 15 volts. • Enable the min/max or recording feature. • Ignition ON. • Check the maximum recorded voltage on the meter. • **Is the maximum recorded voltage greater than 10 volts?**	section. CLEAR the DTCs. REPEAT the self-test. **No** GO to D9 .
D9 CHECK FOR CORRECT ABS MODULE OPERATION	

• Disconnect: ABS Module C135 .
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: ABS Module C135 .
• Make sure the connector seats correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: DTCs C1222, C1296, C1297, C1298 and C1299

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The wheel speed sensor and tone ring generate a square wave current signal to the ABS module that is proportional to the wheel speed. The ABS module compares the wheel speed inputs from all the wheel speed sensors to determine an impending wheel lockup. Incorrect tire size or tire pressure can set these DTCs as well. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

DTC Description	Fault Trigger Condition
• C1222 — Speed Wheel Mismatch	This DTC sets in the ignition cycle when the vehicle speed exceeds 20 km/h (12 mph) or the ABS module detects a difference between wheel speed sensor signals. This DTC can also be set by damaged tone rings, mismatched wheel and/or tire sizes or driving the vehicle on one or more deflated tires.
• C1296 — Wheel Speed LF Signal Fault • C1297 —	These DTCs set in the ignition cycle when the vehicle speed exceeds 20 km/h (12 mph). The appropriate DTC sets if the ABS module does not receive a signal from the wheel speed sensor. These DTCs can also be set by an excessive wheel speed sensor-to-tone ring air gap or a damaged tone ring, mismatched wheel

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Wheel Speed RF Signal Fault • C1298 — Wheel Speed RR Signal Fault • C1299 — Wheel Speed LR Signal Fault	and/or tire sizes or driving the vehicle on one or more deflated tires.

This pinpoint test is intended to diagnose the following:

- ABS module
- Wheel speed sensor magnetic strip/tone ring
- Wheel speed sensor

PINPOINT TEST E: DTCs C1222, C1296, C1297, C1298 AND C1299

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: If the ignition is turned to ON when one or more wheel speed sensors are disconnected, the ABS module disables the output to that sensor. Make sure all test connectors are made at the sensor before turning the ignition to ON.

Test Step	Result / Action to Take
E1 CHECK THE ABS MODULE DTCs	
• Review the ABS module DTCs retrieved and recorded during Inspection and Verification. • **Is DTC C1145, C1155, C1165 or C1175 also present?**	**Yes** GO to Pinpoint Test D . **No** GO to E2 .
E2 MONITOR THE WHEEL SPEED SENSOR PIDs	

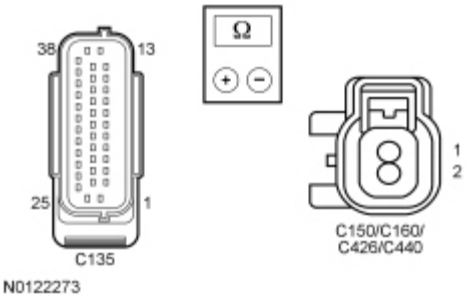
• Connect the scan tool.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module .
• While driving the vehicle at the speed at which the concern occurred, monitor the following PIDs:
  ▪ Left Front Wheel Speed Sensor (LF_WSPD)
  ▪ Right Front Wheel Speed Sensor (RF_WSPD)
  ▪ Left Rear Wheel Speed Sensor (LR_WSPD)
  ▪ Right Rear Wheel Speed Sensor (RR_WSPD)
• **Are the wheel speed sensor PIDs consistent with the vehicle speed and each other?**
	Yes
	CLEAR the DTCs. DRIVE the vehicle. REPEAT the self-test. RETRIEVE and RECORD any ABS module DTCs.
	
	If DTC C1296, C1297, C1298 or C1299 returns, GO to E11 .
	
	If DTC C1222 is present, GO to E10 .
	
	For all other ABS module DTCs, GO to the ABS Module DTC Chart.
	
	If no DTCs return, INSPECT the ABS module and wheel speed sensor connectors for corrosion, pushed-out pins, or damaged pins and REPAIR if necessary. If all connectors are OK, GO to E7 .

	No If the Rotunda Active Wheel Speed Sensor Tester is available, GO to E3 . If the Rotunda Active Wheel Speed Sensor Tester is not available, GO to E5 .
E3 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor . • Connect the Rotunda Active Wheel Speed Sensor Tester to the wheel speed sensor connectors. • Select the correct system polarity on the Rotunda Active Wheel Speed Sensor Tester and turn the power switch to the ON position. • Ignition ON. • **Is the module output LED illuminated?**	**Yes** GO to E4 . **No** GO to E6 .
E4 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Raise the suspect wheel until it can spin freely. Refer to Section 100-02 . • While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin the suspect wheel. • **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**	**Yes** INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, the concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. **No** If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test. If the current level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL new if necessary. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test.
E5 CHECK THE ABS MODULE OUTPUT	
NOTE: Make sure all test connections are made at the wheel speed sensor before the ignition is turned to the ON position.	**Yes** GO to E7 . **No**

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NOTE: Use a meter with a min/max feature and/or recording capabilities to obtain accurate measurements. The ABS module disables the voltage output immediately if the wheel speed sensor is not present. • Ignition OFF. • Connect the meter to the suspect wheel speed sensor electrical connector pins, harness side. • Enable the min/max or recording feature. • Ignition ON. • Check the maximum recorded voltage on the meter. • **Is the maximum recorded voltage greater than 10 volts?**	GO to E6 .
E6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN **NOTE:** Check both circuits for each DTC. • Ignition OFF. • Disconnect: ABS Module C135 . • Disconnect: Suspect Wheel Speed Sensor . • Measure the resistance between the ABS module connector, harness side and the suspect wheel speed sensor connector, harness side as follows:	**Yes** GO to E11 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

ABS Module	Circuit	Wheel Speed Sensor
C135-21	VCA03 (VT/WH)	C150-1 (LF)
C135-34	RCA17 (YE)	C150-2 (LF)
C135-18	VCA05 (GY/VT)	C160-1 (RF)
C135-6	RCA19 (VT)	C160-2 (RF)
C135-19	VCA06 (WH/OG)	C426-1 (RR)
C135-31	RCA20 (BN)	C426-2 (RR)
C135-33	VCA04 (BU/OG)	C440-1 (LR)
C135-20	RCA18 (BN/GN)	C440-2 (LR)



• **Are the resistances less than 5 ohms?**	
E7 CHECK THE WHEEL SPEED SENSOR AND MOUNTING	**Yes** GO to E9. **No** TIGHTEN the wheel speed sensor to specification. REFER to Specifications in this section. CLEAR the DTCs. GO to E8.
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02. • **NOTE:** Use a good light source and carefully examine the wheel speed sensor wire. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component. • Inspect the wheel speed sensor for looseness. • **Is the wheel speed sensor and mounting OK?**	
E8 RECHECK THE WHEEL SPEED SENSOR PIDs	**Yes** The vehicle is OK. The concern may have been caused by a loose wheel speed sensor. **No** GO to E9.

• While driving the vehicle at a constant speed, monitor the following PIDs:
  ▪ Left Front Wheel Speed (LF_WSPD)
  ▪ Right Front Wheel Speed (RF_WSPD)
  ▪ Left Rear Wheel Speed (LR_WSPD)
  ▪ Right Rear Wheel Speed (RR_WSPD)
• **Are all the wheel speed sensor PID values similar?**	

E9 CHECK THE WHEEL SPEED SENSOR(S) FOR DAMAGE	**Yes** For DTC C1296 or C1297, INSTALL a new wheel hub and bearing (wheel speed sensor tone rings are part of the wheel hub and bearing assembly). REFER to Section 204-01A or Section 204-01B. For DTC C1298 or C1299, INSTALL a new wheel speed sensor tone ring. REFER to Wheel Speed Sensor Ring — Rear in this section. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTC. REPEAT the self-test.
• Ignition OFF. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02. • Remove the wheel speed sensor. Refer to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. • **NOTE:** Use a good light source and carefully examine the wheel speed sensor wire. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component. • Inspect the wheel speed sensor and attached wire harness for general damage. • **Is the wheel speed sensor and harness OK?**	
E10 CHECK THE ABS MODULE CONFIGURATION	**Yes** GO to E11. **No** The system is operating correctly at this time. The concern may have been caused by an incorrectly configured ABS module.
• Verify that the tires are the correct size for the vehicle and inflated to the specified pressures as indicated on the Vehicle Certification (VC) label. • Carry out the ABS module configuration. Verify that the vehicle data matches the vehicle options. Refer to Programmable Module Installation (PMI) in Section 418-01. • Clear the DTCs. Carry out the ABS module on-demand self-test. • **Is DTC C1222 still present?**	
E11 CHECK FOR CORRECT ABS MODULE OPERATION	

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• Ignition OFF.
• Disconnect: ABS Module C135 .
• Check ABS module connector for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: ABS Module C135 .
• Make sure the connector seats correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSPECT the wheel speed sensor tone rings for damage. INSTALL new components as necessary. If the tone rings are OK, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: DTC C1266

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The operating voltage required for ABS module isolation valve operation is between 10 and 17 volts.

Fused battery voltage is supplied to the ABS module for the valves by the Battery Junction Box (BJB).

- DTC C1266 (ABS Valve Power Relay Circuit Failure) — this DTC sets in the ignition cycle if the ABS module detects an open or a short to ground on the valve power feed circuit. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

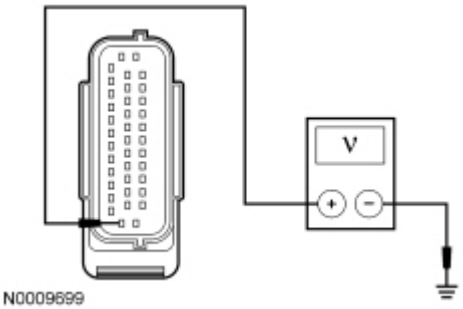
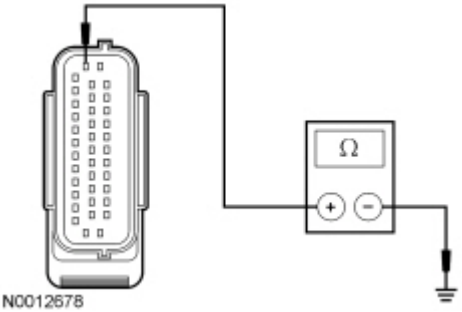
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- ABS module

PINPOINT TEST F: DTC C1266

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK FOR VOLTAGE TO THE ABS MODULE	
• Ignition OFF. • Disconnect: ABS Module C135 . • Measure the voltage between ABS module C135-25, circuit SBB36 (GN/RD), harness side and ground.	**Yes** GO to F2 . **No** VERIFY that Battery Junction Box (BJB) fuse 36 (30A) is OK. If OK, REPAIR circuit SBB36 (GN/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short.

 N0009699 • **Is the voltage greater than 10 volts?**	CLEAR the DTCs. REPEAT the self-test.
F2 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between ABS module C135-38, circuit GD121 (BK/YE), harness side and ground.  N0012678 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to F3 . **No** REPAIR circuit GD121 (BK/YE). CLEAR the DTCs. REPEAT the self-test.
F3 CHECK FOR CORRECT ABS MODULE OPERATION	

• Disconnect: ABS Module C135 .
• Check ABS module connector for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: ABS Module C135 .
• **Is the concern still present?**
	Yes
	INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test G: DTCs C116A, C1440

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The pressure transducer is integral to the Hydraulic Control Unit (HCU). The pressure transducer sends a signal to the ABS module that varies in relation to the amount of pressure applied to the brake pedal. The more pressure that is applied, the greater the signal sent to the ABS module. If a new pressure transducer is needed, then a new HCU must be installed.

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When the brake pedal is pressed, the stoplamp switch closes and a voltage is sent to the PCM. The PCM then sends a message over the High Speed Controller Area Network (HS-CAN) to the ABS module indicating that the brake pedal has been pressed. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

- DTC C116A (ABS Pressure Transducer / Brake Switch Mismatch) — this DTC sets in every ignition cycle if, during normal operation, the stoplamp switch message does not match the HCU transducer, both signals have to agree about whether the brakes are being applied or not.
- DTC C1440 (Pressure Transducer Main/Primary Signal Faulted) — this DTC sets in every ignition cycle if the signal that the pressure transducer sends to the ABS module does not agree with the stoplamp switch position.

This pinpoint test is intended to diagnose the following:

- HCU
- ABS module

PINPOINT TEST G: DTCs C116A, C1440

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 MONITOR THE ABS MODULE BRAKE ON/OFF (BOO_ABS) PID	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • Press and release the brake pedal while monitoring the BOO_ABS PID. • **Does the PID display ON with the brake pedal applied and OFF with the brake pedal released?**	**Yes** GO to G3 . **No** GO to G2 .
G2 MONITOR THE PCM BRAKE ON/OFF (BOO1) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — PCM . • Press and release the brake pedal while monitoring the BOO1 PID. • **Does the PID display ON with the brake pedal applied and OFF with the brake pedal released?**	**Yes** REFER to Section 418-00 to continue diagnosis of the HS-CAN . **No** REFER to Section 417-01 to continue diagnosis of the stoplamp switch fault.
G3 MONITOR THE INITIAL (BRAKE PEDAL NOT APPLIED) BRAKE PRESSURE USING THE ABS MODULE BRAKE PRESSURE (BRAKPRES) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • With the brake pedal **not** applied, record the pressure displayed by the BRAKPRES PID. • **Is the initial brake pressure less than 275 kPa (40 psi) with the brake pedal not applied?**	**Yes** GO to G4 . **No** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section.

G4 MONITOR THE BRAKPRES PID WHILE APPLYING THE BRAKE PEDAL	
• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • Firmly press and release the brake pedal while monitoring the BRAKPRES PID. • **Does the PID increase with firm pressure on the brake pedal and then decrease with the brake pedal released?**	**Yes** The system is operating correctly at this time. TEST the system for normal operation. **No** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section.

Pinpoint Test I: DTCs C109D, C109E and C109F

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module uses the vacuum sensor to determine if hydraulic pump intervention is necessary due to a severe loss of vacuum in the booster. The ABS module sends a 5-volt reference voltage to the sensor and the sensor compares the pressure in the booster to the ambient air pressure in the engine compartment and sends a varying voltage back to the ABS module based on the difference between the pressures. Normally, the pressure in the booster is much lower than ambient air pressure. As the pressure in the booster gets higher (closer to matching ambient air pressure), the lower the voltage sent back to the ABS module becomes.

- DTC C109D (Low Vacuum Condition Detected) — this DTC sets in continuous memory and every ignition cycle when the vacuum in the brake booster goes below a predetermined threshold and does not necessarily indicate a concern with the vacuum sensor, the related wiring or the ABS module. This DTC indicates a vacuum concern in the brake booster, engine and any related vacuum hoses/tubes. High altitude locations with low ambient air temperatures can cause a low vacuum condition to exist in the booster until the engine compartment warms up.
- DTC C109E (Vacuum Sensor Circuit Fault) — this DTC sets in continuous memory and every ignition cycle if during normal operation or the ABS module on-demand self-test, the ABS module detects an open circuit, a short to voltage or a short to ground on the vacuum sensor circuits or a failure of the vacuum sensor.
- DTC C109F (Vacuum Sensor Signal Fault) — this DTC sets in continuous memory and every ignition cycle if the vacuum sensor ambient air pressure inlet ports, or the vacuum sensor ports become restricted or clogged.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Vacuum sensor
- ABS module

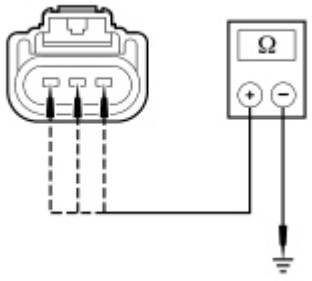
PINPOINT TEST I: DTCs C109D, C109E AND C109F

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

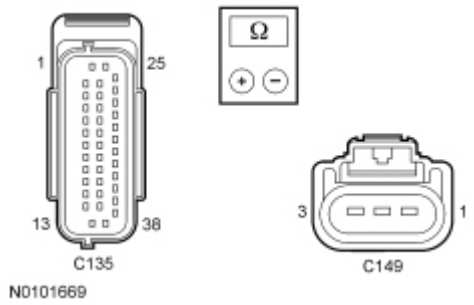
Test Step	Result / Action to Take

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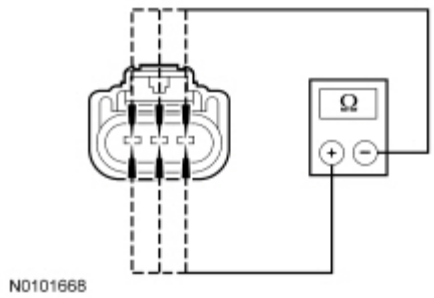
I1 CHECK THE ABS MODULE DTCs • Review the DTCs recorded during Inspection and Verification. • **Was DTC C109D the only recorded DTC?**	**Yes** GO to I2 . **No** If DTC C109E and/or C109F was retrieved, GO to I6 . For all other DTCs, REFER to the ABS Module DTC Chart in this section.
I2 CHECK DTC RETURNABILITY • Using the scan tool, clear the ABS module DTCs. • Ignition OFF. • Disconnect the scan tool. • Start the engine. • **NOTE:** It may take up to 3 minutes for DTC C109D to set. • Allow the vehicle to idle for a minimum of 4 minutes. Apply and release the brake pedal for a minimum of 3 times per minute with normal pedal force for up to 3 minutes • Ignition OFF. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is DTC C109D the only vacuum sensor DTC present?**	**Yes** GO to I3 . **No** If DTC C109E and/or C109F was retrieved, GO to I6 . For all other DTCs, REFER to the ABS Module DTC Chart in this section. If no DTC is set, the system is operating correctly as this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTC. REPEAT the self-test.
I3 CHECK THE ENGINE VACUUM • Carry out the Intake Manifold Vacuum Test, refer to Diagnosis and Testing in Section 303-00 . • Record the vacuum reading. • **Does the vacuum gauge indicate normal vacuum?**	**Yes** GO to I4 . **No** FOLLOW the diagnostic procedure in Section 303-00 .
I4 CHECK THE BRAKE BOOSTER • Carry out the Brake Booster Component Test. Refer to Section 206-00 . • **Do the brake booster and check valve pass the component test?**	**Yes** GO to I5 . **No** REPAIR or INSTALL new as necessary. CLEAR the DTC. REPEAT the self-test.
I5 CHECK THE BRAKE BOOSTER VACUUM LEVEL (BBVACLVL) PID • Connect the scan tool. • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • Compare the recorded vacuum reading the brake booster vacuum level PID. • **Does the PID match the recorded vacuum reading of ±3.386 kPa (1 in-Hg)?**	**Yes** REPAIR any vacuum leaks at the vacuum system. For 4x4 vehicles, REPAIR any vacuum leaks from the vacuum hub lock system. REPEAT the ABS module self-test.

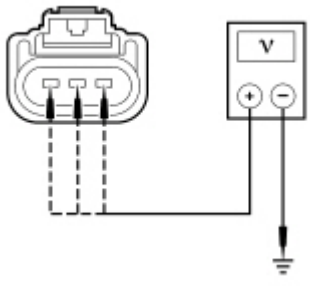
	No INSTALL a new brake booster vacuum sensor. REFER to Section 206-07 . CLEAR the DTCs. TEST the system for normal operation.
I6 CHECK THE BRAKE BOOSTER VACUUM SENSOR • Inspect the vacuum sensor ambient air pressure inlet ports. • **Are both ports free of contamination, debris and/or foreign material?**	**Yes** GO to I7 . **No** REPAIR or INSTALL a new vacuum sensor as necessary. REFER to Section 206-07 . CLEAR the DTCs. REPEAT the self-test.
I7 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TO GROUND • Disconnect: ABS Module C135 . • Disconnect: Brake Booster Vacuum Sensor C149 . • Measure the resistance between ground and: ▪ brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side. ▪ brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side. ▪ brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.  N0101670 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I8 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
I8 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR AN OPEN • Measure the resistance between the ABS module C135, harness side and the brake booster vacuum sensor C149, harness side as follows: **ABS Module** | **Circuit** | **Vacuum Sensor** C135-10 | VCA22 (GN/BN) | C149-1 C135-28 | GD120 (BK/GN) | C149-2 C135-2 | CCA22 (GY/YE) | C149-3	**Yes** GO to I9 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

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- **Are the resistances less than 5 ohms?**

I9 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between: ▪ brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side and brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side. ▪ brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side and brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side. ▪ brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side, and brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I10 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
I10 CHECK THE ACTIVE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and: ▪ brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side. ▪ brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side. ▪ brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to I11 .

 N0101667 • **Is any voltage present?**	

I11 CHECK THE BRAKE BOOSTER VACUUM SENSOR CONNECTOR
• Ignition OFF.
• Check brake booster vacuum sensor connector for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: Brake Booster Vacuum Sensor C149 .
• Make sure the connector seats correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new vacuum sensor. REFER to Section 206-07 . CLEAR the DTCs. REPEAT the self-test.
	
	If DTC C109E or C109F return, GO to I12 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

I12 CHECK THE ABS MODULE CONNECTORS
• Ignition OFF.
• Disconnect: ABS Module C135 .
• Check ABS module connector for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: ABS Module C135 .
• Make sure the connector seats correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test J: The Hill Descent Control System Is Inoperative

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

Hill Descent Control™ can be activated by momentarily pressing the Hill Descent Control™ switch at speeds from 3 km/h (2 mph) and 16 km/h (10 mph), but the system stays in control up to 32 km/h (20 mph). At speeds between 32 km/h (20 mph) and 64 km/h (40 mph), Hill Descent Control™ does not set or maintain speeds. Hill Descent Control™ automatically disables itself above 64 km/h (40 mph).

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When the Hill Descent Control™ switch is pressed, a circuit inside of the switch is closed, ground is provided to the Instrument Panel Cluster (IPC) disabling or enabling the Hill Descent Control™.

DTC C2809 can be set by manually pressing and holding the Hill Descent Control™ switch for more than 30 seconds.

- DTC C2809 (Hill Descent Control Switch Stuck) — this DTC sets if the ABS module receives the HILL_DESC_SW message from the High Speed Controller Area Network (HS-CAN) for greater than 30 seconds.

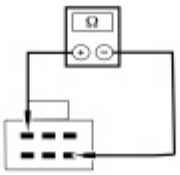
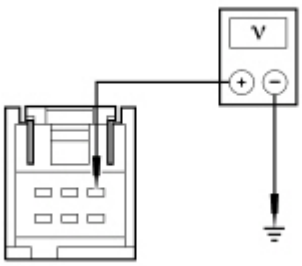
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Hill Descent Control™ switch
- ABS module

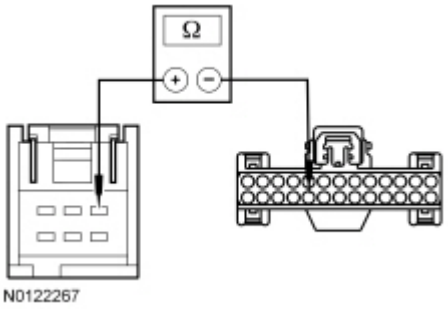
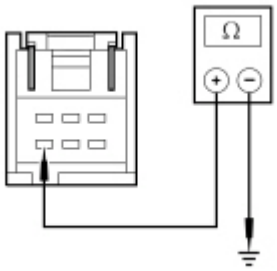
PINPOINT TEST J: THE HILL DESCENT CONTROL SYSTEM IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
J1 CHECK FOR DTCs • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs. • **Are any ABS module, IPC or communication DTCs present?**	**Yes** For ABS module DTC C2809, GO to J2. For all other ABS module DTCs, REFER to the ABS Module DTC Chart. For IPC DTCs, REFER to the Section 413-01. **No** System is operating correctly at this time.
J2 VISUALLY INSPECT THE HILL DESCENT CONTROL™ SWITCH • Inspect the Hill Descent Control™ switch for damage. • Verify that the Hill Descent Control™ switch does not stick. • **Is the Hill Descent Control™ switch damaged or sticking?**	**Yes** INSTALL a new Hill Descent Control™ switch by removing the auxiliary switch assembly. REFER to the exploded view in Section 501-12. PRESS the tab on each side of the switch to remove it from the bezel. After replacing the switch, CLEAR the DTCs and REPEAT the self-test. TEST the system for normal operation. **No** GO to J3.
J3 ISOLATE THE HILL DESCENT CONTROL™ SWITCH	

• Ignition OFF. • Disconnect: Hill Descent Control™ Switch C3394 . • Measure the resistance between Hill Descent Control™ switch pins 1 and 6, component side, while pressing and releasing the switch.  N0122269 • **Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?**	**Yes** If DTC C2809 was recorded, GO to J4 . For all other conditions, GO to J5 . **No** INSTALL a new Hill Descent Control™ switch by removing the auxiliary switch assembly. REFER to the exploded view in Section 501-12 . PRESS the tab on each side of the switch to remove it from the bezel. After replacing the switch, CLEAR the DTCs and REPEAT the self-test. TEST the system for normal operation.
J4 CHECK THE HILL DESCENT CONTROL™ SWITCH SIGNAL CIRCUIT FOR A SHORT TO VOLTAGE • Disconnect: IPC C220 . • Ignition ON. • Measure the voltage between Hill Descent Control™ switch C3394-1, circuit CET59 (GY/VT), harness side and ground.  N0101067 • **Is any voltage present?**	**Yes** REPAIR circuit CET59 (GY/VT). CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST for normal operation.
J5 CHECK THE HILL DESCENT CONTROL™ SWITCH SIGNAL CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: IPC C220 . • Measure the resistance between Hill Descent Control™ switch C3394-1, circuit CET59 (GY/VT), harness side and IPC C220-22, circuit CET59 (GY/VT), harness side.	**Yes** GO to J6 . **No** REPAIR circuit CET59 (GY/VT). TEST the system for normal operation.

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 N0122267 • **Is the resistance less than 5 ohms?**	
J6 CHECK THE HILL DESCENT CONTROL™ SWITCH GROUND CIRCUIT	**Yes** GO to J7 . **No** REPAIR the open in circuit GD138 (BK/WH). CLEAR the DTCs. REPEAT the self-test.
• Ignition ON. • Measure the resistance between Hill Descent Control™ switch C3394-6, circuit GD138 (BK/WH), harness side and ground.  N0122268 • **Is the resistance less than 5 ohms?**	
J7 CHECK FOR CORRECT IPC OPERATION	**Yes** INSTALL a new IPC . REFER to Section 413-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
• Check IPC connector: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test K: DTC U0100

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

- DTC U0100 (Lost Communication With ECM/PCM) — this DTC sets in continuous memory if the brake pedal position switch, and traction control messages that should be received from the ECM/PCM are missing for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- PCM

- ABS module

PINPOINT TEST K: DTC U0100

Test Step	Result / Action to Take
K1 VERIFY THE SCAN TOOL COMMUNICATES WITH THE PCM	
• Connect the scan tool. • Check that a vehicle session can be established using the scan tool. • **Can a vehicle session be established?**	**Yes** GO to K2 . **No** REFER to Section 418-00 to diagnose no communication with the PCM.
K2 CHECK THE ABS MODULE CONTINUOUS MEMORY DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Clear the DTCs. • Wait 10 seconds. • Repeat the ABS module self-test. • **Is DTC U0100 retrieved again?**	**Yes** GO to K3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
K3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded DTCs from the PCM Key ON Engine OFF (KOEO) self-test. • **Is DTC P0562 or P0563 recorded?**	**Yes** For PCM DTCs, REFER to Section 303-14 . **No** GO to K4 .
K4 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS module self-test. • **Is DTC B1676 recorded?**	**Yes** GO to Pinpoint Test A . **No** GO to K5 .
K5 CHECK FOR DTC U0100 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0100:00 or U0100 set in more than 1 module?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

Pinpoint Test L: DTC U0114

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Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

- DTC U0114 (Lost Communication with Transfer Case Control Module (TCCM)) — this DTC sets in continuous memory if the Four-Wheel Drive (4WD) message that should be received from the Transfer Case Control Module (TCCM) is missing for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- TCCM
- ABS module

PINPOINT TEST L: DTC U0114

Test Step	Result / Action to Take
L1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to L2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
L2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out a Network Test. • **Does the TCCM pass the network test?**	**Yes** GO to L3 . **No** REFER to Section 418-00 .
L3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND TCCM SELF-TESTS	
• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Enter the following diagnostic mode on the scan tool: Self Test — TCCM . • **Is DTC B1676 (or P0562:00) or DTC P0563:00 recorded?**	**Yes** For ABS module DTC B1676, GO to Pinpoint Test A . For TCCM DTCs, REFER to Section 308-07A . **No** GO to L4 .
L4 RECHECK THE ABS MODULE DTCs	
• Clear the DTCs. • Ignition OFF. • Wait 10 seconds. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is DTC U0114 still present?**	**Yes** GO to L5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
L5 CHECK FOR DTC U0114 SET IN OTHER MODULES	

• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • **Is DTC U0114 set in more than 1 module?**	**Yes** INSTALL a new TCCM . REFER to Section 308-07A . CLEAR the DTCs. REPEAT the ABS module self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

Pinpoint Test M: DTC U0131

Normal Operation

- DTC U0131 (Lost Communication With Power Steering Control Module (VAPS) — this DTC sets in continuous memory and on-demand if the steering sensor message that should be received from the Power Steering Control Module (PSCM) is missing for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- PSCM
- ABS module

PINPOINT TEST M: DTC U0131

Test Step	Result / Action to Take
M1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to M2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
M2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out a Network Test. • **Does the PSCM pass the network test?**	**Yes** GO to M3 . **No** REFER to Section 418-00 .
M3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND PSCM SELF-TESTS	
• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Enter the following diagnostic mode on the scan tool: Self Test — PSCM . • **Is DTC B1676 (or U3003:16) or DTC U3003:17 recorded?**	**Yes** For ABS module DTC B1676, GO to Pinpoint Test A . For PSCM DTCs, REFER to Section 211-00B . **No** GO to M4 .
M4 RECHECK THE ABS MODULE DTCs	

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• Clear the DTCs. • Ignition OFF. • Wait 10 seconds. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is DTC U0131 still present?**	**Yes** GO to M5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
M5 CHECK FOR DTC U0131 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • **Is DTC U0131 set in more than 1 module?**	**Yes** INSTALL a new PSCM . REFER to Section 211-00B . CLEAR the DTCs. REPEAT the ABS module self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

Pinpoint Test N: DTC U0131

Normal Operation

- **NOTE:** Vehicles with a 6.2L engine are equipped with a Steering Column Control Module (SCCM).

DTC U0131 (Lost Communication With Power Steering Control Module (VAPS) — this DTC sets in continuous memory and on-demand if the steering sensor message that should be received from the SCCM is missing for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- SCCM .
- ABS module

PINPOINT TEST N: DTC U0131

Test Step	Result / Action to Take
N1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to N2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
N2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out a Network Test. • **Does the SCCM pass the network test?**	**Yes** GO to N3 . **No**

	REFER to Section 418-00 .
N3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND SCCM SELF-TESTS	
• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Enter the following diagnostic mode on the scan tool: Self Test — SCCM . • **Is DTC B1676 (or B11D9:16) or DTC B11D9:17 recorded?**	**Yes** For ABS module DTC B1676, GO to Pinpoint Test A . For SCCM DTCs, REFER to Section 211-05 . **No** GO to N4 .
N4 RECHECK THE ABS MODULE DTCs	
• Clear the DTCs. • Ignition OFF. • Wait 10 seconds. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is DTC U0131 still present?**	**Yes** GO to N5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
N5 CHECK FOR DTC U0131 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • **Is DTC U0131 set in more than 1 module?**	**Yes** INSTALL a new SCCM . REFER to Section 211-00A . CLEAR the DTCs. REPEAT the ABS module self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

Pinpoint Test O: DTCs U0140

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

- DTC U0140 (Lost Communication With Body Control Module (GEM)) — this DTC sets in the ABS module if it cannot transmit to or receive messages from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN) for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- ABS module
- BCM

PINPOINT TEST O: DTC U0140

Test Step	Result / Action to Take
O1 VERIFY THE CUSTOMER CONCERN	

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• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to O2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
O2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Using a scan tool, carry out a Network Test. • **Does the BCM pass the network test?**	**Yes** GO to O3 . **No** REFER to Section 418-00 .
O3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND BCM SELF-TESTS	
• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Enter the following diagnostic mode on the scan tool: Self Test — BCM . • **Is DTC B1676 (or U3003:16) or DTC U3003:17 recorded?**	**Yes** For ABS module DTC B1676, GO to Pinpoint Test A . For BCM DTCs, REFER to Section 419-10 . **No** GO to O4 .
O4 CHECK FOR DTC U0140 OR U0140:00 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • **Is DTC U0140 or U0140:00 set in more than 1 module?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. CLEAR the DTCs. REPEAT the ABS module self-test **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

Pinpoint Test P: DTCs C1280, C1282, C1516, C1963, C1975, C2770, U0151 and U0452

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module uses information received from several sensors (wheel speed sensors, steering wheel rotation sensor, stability/traction control system sensors, etc.) to determine if vehicle stability, traction or roll warrants ESC or RSC® interaction. If an event is going to occur, the ABS module adjusts the brake torque at specific wheels and the PCM reduces engine torque to make the vehicle more stable. Once the ABS module has determined that the stability event has been corrected, it returns the brake and engine torque to normal and continues to monitor the vehicle. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected. The Restraints Control Module (RCM) measures the yaw rate and vehicle acceleration, then sends the signal through a secondary, dedicated Controller Area Network (CAN) to the ABS module. The ABS module uses this information for AdvanceTrac® and RSC® system operation. The ABS module also compares this information to information it receives from other sensors (brake pedal input, steering wheel) to determine how valid the information is and to determine if an instability event is about to occur.

The RCM and the ABS module communicate along circuits VCA23 (BU/WH) and VCA24 (GN/OG). An open circuit or a short to power or ground on any one of these circuits causes the ABS module to set a DTC. Also, if the RCM is not mounted in the correct position, with the electrical connector facing the driver-side of the vehicle, the ABS module also sets DTCs.

DTC Description	Fault Trigger Condition
• C1280 — Yaw Rate Sensor Signal Fault • C1282 — Lateral Accelerometer Signal Fault • C1516 — Roll Rate Sensor Signal Fault • C2770 — Longitudinal Acceleration Sensor Signal Fault	If the ABS module receives a message from the RCM that is out of the normal operating range or one that does not agree with other sensor information, the appropriate signal fault DTC sets.
• C1963 — Stability Control Inhibit Warning • C1975 — IVD Plausibility Failure [a]	If conditions or DTCs exist that prevent the AdvanceTrac® and RSC® systems from operating, DTCs C1963 and/or C1975 sets. This DTC is usually set due to the steering wheel rotation sensor or the RCM being damaged or installed incorrectly. If DTCs are present from the RCM or PSCM , diagnose these DTCs first.
• U0151 — Lost Communication with Restraints Control Module (RCM) • U0452 — Invalid Data Received from RCM	The RCM uses a dedicated communication bus to send information to the ABS module. If, during normal operation, the ABS module does not receive any information from the RCM for more than 250 milliseconds, DTC U0151 or U0452 sets. U0151 monitors both the HS-CAN and the dedicated CAN circuits. If the ABS module does not receive the RCM serial number, over the HS-CAN , DTC U0151 sets. It also sets if the sensor data is not received over the dedicated CAN from the RCM . These DTCs can also be caused by another module software update. CLEAR all module DTCs and carry out another self-test to recheck the system.

[a] Interactive Vehicle Dynamics

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- RCM
- ABS module

PINPOINT TEST P: DTCs C1280, C1282, C1516, C1963, C1975, C2770, U0151 and U0452

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these

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assemblies, which increases the risk of serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

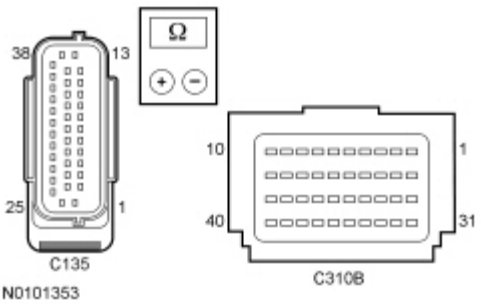
NOTE: Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
P1 CHECK FOR A HS-CAN COMMUNICATION CONCERN WITH THE RCM OR PSCM	
• Connect the scan tool. • Ignition ON. • **NOTE:** The Network Test does not test the dedicated CAN communications between the ABS module and RCM . • Using a scan tool, carry out a Network Test. • **Does the RCM and PSCM pass the Network Test?**	**Yes** GO to P2 . **No** REFER to Section 418-00 to diagnose the High Speed Controller Area Network (HS-CAN) bus.
P2 CHECK FOR RCM AND PSCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test — RCM . • Enter the following diagnostic mode on the scan tool: Self Test — PSCM . • **Are any RCM or PSCM DTCs retrieved on-demand self-test?**	**Yes** For RCM DTCs, REFER to Section 501-20B . For PSCM DTCs, REFER to Section 211-00A . **No** If only one of the following ABS module DTCs C1280, C1282, C1516, C2770 was retrieved, GO to P3 . If more than one ABS module DTC C1280, C1282, C1516, C2770 was retrieved, GO to P7 . For DTCs U0151 and U0452, GO to P7 . For all other DTCs, GO to P3 .
P3 CHECK THE ABS MODULE YAW RATE (YAW_RATE_2) PID	
• Enter the following diagnostic mode on the scan tool: Data Logger — ABS Module . • **NOTE:** The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the YAW_RATE_2 PID. • **Is the YAW_RATE_2 PID value between -3.5 and 3.5?**	**Yes** GO to P4 . **No** GO to P12 .

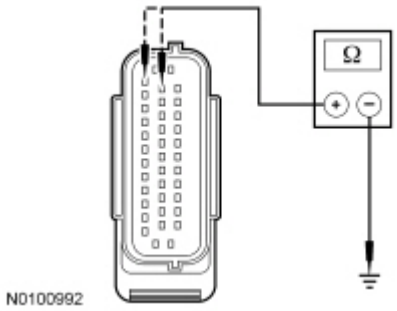
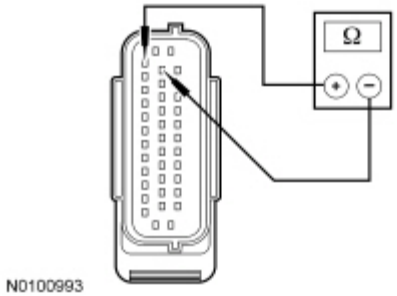
P4 CHECK THE ABS MODULE LATERAL ACCELERATION (LAT_ACCL_2) PID	
• **NOTE:** The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the LAT_ACCL_2 PID. • **Is the LAT_ACCL_2 PID value between -0.125g and 0.125g?**	**Yes** GO to P5 . **No** GO to P12 .
P5 CHECK THE ABS MODULE LONGITUDINAL ACCELERATION (LONG_ACCL) PID	
• **NOTE:** The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the LONG_ACCL PID. • **Is the LONG_ACCL PID value between -0.15g and 0.15g?**	**Yes** GO to P6 . **No** GO to P12 .
P6 CHECK THE ABS MODULE ROLL RATE (ROLLRAT) PID	
NOTE: The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the ROLLRAT PID. • **Is the ROLLRAT PID value between -3.5 and 3.5?**	**Yes** GO to P7 . **No** GO to P12 .
P7 CHECK THE DEDICATED CAN CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Disconnect: ABS Module C135 . • Disconnect: RCM C310A and C310B . • Measure the resistance between the ABS module C135, harness side and the RCM C310B, harness side as indicated in the following chart:	**Yes** GO to P8 . **No** REPAIR the affected circuit(s). REPOWER the SRS . REFER to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . CLEAR all CMDTCs. PERFORM a road test. REPEAT the self-test.

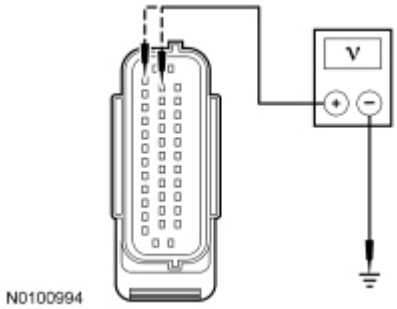
ABS Module	Circuit	RCM
C135-37	VCA23 (BU/WH)	C310B-20
C135-24	VCA24 (GN/OG)	C310B-19



- **Are the resistances less than 5 ohms?**

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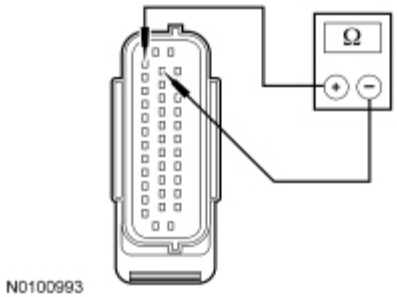
P8 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between ground and: ▪ ABS module C135-24, circuit VCA24 (GN/OG), harness side. ▪ ABS module C135-37, circuit VCA23 (BU/WH), harness side.  N0100992 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P9. **No** REPAIR the affected circuit(s). REPOWER the SRS. REFER to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B. CLEAR all CMDTCs. PERFORM a road test. REPEAT the self test.
P9 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between ABS module C135-24, circuit VCA24 (GN/OG), harness side and ABS module C135-37, circuit VCA23 (BU/WH), harness side.  N0100993 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P10. **No** REPAIR the affected circuit(s). REPOWER the SRS. REFER to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B. CLEAR all CMDTCs. PERFORM a road test. REPEAT the self test.
P10 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO VOLTAGE	
• Repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B. • Ignition ON. • Measure the voltage between ground and: ▪ ABS module C135-24, circuit VCA24 (GN/OG), harness side. ▪ ABS module C135-37, circuit VCA23 (BU/WH), harness side.	**Yes** REPAIR the affected circuit(s). CLEAR all CMDTCs. PERFORM a road test. REPEAT the self test. **No** GO to P11.



- **Is any voltage present?**

P11 CHECK RCM TERMINATING RESISTOR	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B .
• Prior to reconnecting any previously disconnected SRS component:
  ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to RCM in Section 501-20B .
  ▪ repair any concerns found.
 	
Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
 	
• Connect: RCM C310A and C310B .
• Measure the resistance between ABS module C135-37, circuit VCA23 (BU/WH), harness side and C135-24, circuit VCA24 (GN/OG), harness side.
	Yes
	GO to P12 .
	
	No
	INSTALL a new RCM . REFER to Section 501-20B . CLEAR all CMDTCs . PERFORM a road test. REPEAT the self test. If the concern is still present, GO to P14 . If other DTCs are present, REFER to the appropriate DTC chart.



- **Is the resistance between 108 and 132 ohms?**

P12 CHECK THE RCM INSTALLATION AND MOUNTING SURFACE	
• Ignition OFF. • If not previously directed to do so, depower the Supplemental Restraint System (SRS). Refer to	**Yes** GO to P13 .

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Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Inspect the Restraints Control Module (RCM) installation and make sure that the fasteners are fully seated and tightened correctly. Refer to RCM in Section 501-20B . • Inspect the mounting surface for damage, corrosion or foreign material. • **Is the RCM installed correctly and is the mounting surface clean and free from damage?**	**No** REPAIR or INSTALL new as necessary. REPOWER the SRS . REFER to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . CLEAR all CMDTCs . PERFORM a road test. REPEAT the self test.
P13 CHECK FOR AN INTERMITTENT FAULT	

• Disconnect: RCM C310A and C310B .
• Disconnect: ABS module C135 .
  ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ repair any concerns found.
 	
Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
 	
• Connect: All Previously Disconnected Component (s)/Connector(s) .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B .
• Perform a road test.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .
• **Is the concern still present?**
	Yes
	INSTALL a new RCM . REFER to Section 501-20B . CLEAR all CMDTCs . PERFORM a road test. REPEAT the self test. If the concern is still present, GO to P14 . If other DTCs are present, REFER to the appropriate DTC chart.
	
	No
	The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.**

P14 CHECK THE ABS MODULE FOR CORRECT OPERATION	

• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B .
• Prior to reconnecting any previously disconnected SRS component:
  ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to RCM in Section 501-20B .
  ▪ inspect ABS module C135 for dirt, corrosion, water intrusion, pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ repair any concerns found.
	Yes
	INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component (s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Perform a road test. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is the concern still present?**	

Pinpoint Test Q: DTC U0155

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IC) Control Module) — this DTC sets in continuous memory and on-demand if the traction control switch information, or other sensor messages from the IPC are not received for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- IPC
- ABS module

PINPOINT TEST Q: DTC U0155

Test Step	Result / Action to Take
Q1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to Q2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
Q2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out a Network Test. • **Does the IPC pass the network test?**	**Yes** GO to Q3 . **No** REFER to Section 418-00 .
Q3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND IPC SELF-TESTS	

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• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Enter the following diagnostic mode on the scan tool: Self Test — IPC . • **Is ABS module DTC B1676 or IPC DTC U3003:16 or DTC U3003:17 received?**	**Yes** For ABS module DTC B1676, GO to Pinpoint Test A . For IPC DTCs, REFER to Section 413-01 . **No** GO to Q4 .
Q4 RECHECK THE ABS MODULE DTCs	
• Clear the DTCs. • Ignition OFF. • Wait 10 seconds. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is DTC U0155 still present?**	**Yes** GO to Q5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
Q5 CHECK FOR DTC U0155 OR U0155:00 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • **Is DTC U0155:00 set in more than 1 module?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR the DTCs. REPEAT the ABS module self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

Pinpoint Test R: The Stability/Traction Control System is Inoperative or Cannot be Disabled

Refer to Wiring Diagrams Cell 42 , Instrument Cluster for schematic and connector information.

Normal Operation

The stability/traction control switch is a normally open switch. When the switch is pressed, the Instrument Panel Cluster (IPC) senses ground through the switch and sends a message to the ABS module along the High Speed Controller Area Network (HS-CAN) to disable the stability/traction control system. The IPC also illuminates the traction control message center indicator.

NOTE: If a MyKey® restricted key is in use with the AdvanceTrac® always on feature configured to on, the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system .

- DTC C2775 (TC/AYC ON/OFF Switch Stuck Failure) — this DTC sets during the key cycle if the IPC senses a short to ground on stability/traction control switch circuit, if the stability/traction control switch is pressed for longer than 30 seconds, or if the stability/traction control switch is pressed during the on-demand self-test.

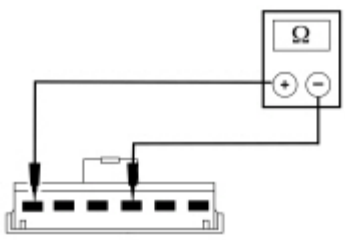
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- MyKey® restricted key in use
- Stability/traction control switch

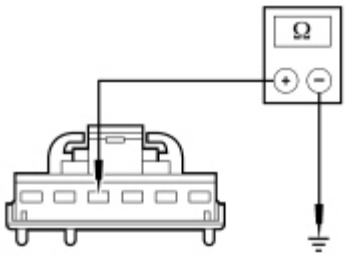
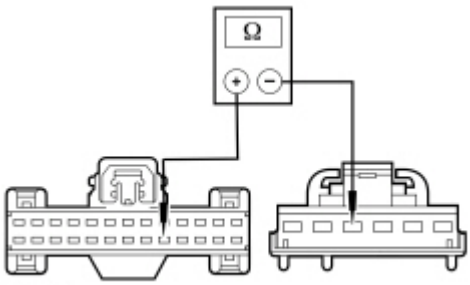
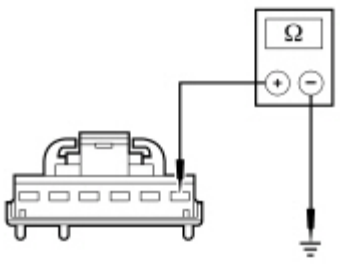
- IPC

PINPOINT TEST R: THE STABILITY/TRACTION CONTROL SYSTEM IS INOPERATIVE OR CANNOT BE DISABLED

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
R1 VERIFY THAT THE KEY IN USE IS NOT MYKEY® RESTRICTED	
• Ignition ON. • Attempt to disable the Electronic Stability Control (ESC) system by pressing the stability/traction control switch. • **Is ADVTRAC ON MyKey® SETTING displayed in the message center?**	**Yes** INFORM the customer that the key in use is MyKey® restricted. If necessary, REFER to the Owner's Literature for information regarding the programming of MyKey® features. **No** GO to R2 .
R2 CHECK FOR ABS MODULE DTCs	
• Attempt to disable the ESC system by pressing the stability/traction control switch. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • **Is DTC U0073, U0155 or U0423 present?**	**Yes** For DTC U0073, REFER to Section 418-00 to diagnose the HS-CAN . For DTC U0155, GO to Pinpoint Test Q . For DTC U0423, CARRY OUT a self-test of the IPC . REFER to Section 413-01 to diagnose the IPC concern. **No** GO to R3 .
R3 ISOLATE THE STABILITY/TRACTION CONTROL SWITCH	
• Ignition OFF. • Disconnect: Stability/Traction Control Switch C2355 . • Measure the resistance between stability/traction control switch pins 1 and 4, component side, while pressing and releasing the switch.  N0122274 • **Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?**	**Yes** GO to R4 . **No** INSTALL a new stability/traction control switch. REFER to Stability/Traction Control Switch in this section. TEST the system for normal operation.

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R4 CHECK THE SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: Battery Negative Cable . • Disconnect: IPC C220 . • Measure the resistance between stability/traction control switch C2355-4, circuit CCA15 (YE/GY), harness side and ground.  N0089363 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R5 . **No** REPAIR circuit CCA15 (YE/GY). TEST the system for normal operation.
R5 CHECK THE SWITCH INPUT CIRCUIT FOR AN OPEN	
• Measure the resistance between stability/traction control switch C2355-4, circuit CCA15 (YE/GY), harness side and IPC C220-18, circuit CCA15 (YE/GY), harness side.  N0120950 • **Is the resistance less than 5 ohms?**	**Yes** GO to R6 . **No** REPAIR circuit CCA15 (YE/GY). TEST the system for normal operation.
R6 CHECK THE SWITCH GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between stability/traction control switch C2355-1, circuit GD133 (BK), harness side and ground.  N0106102 • **Is the resistance less than 5 ohms?**	**Yes** GO to R7 . **No** REPAIR circuit GD133 (BK). TEST the system for normal operation.

R7 CHECK FOR CORRECT IPC OPERATION	

• Check IPC C220 for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC. REFER to Section 413-01. CLEAR the DTCs. REPEAT the self-test.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test S: Poor Vehicle Tracking During Anti-Lock Function

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module uses input from several different sensors (wheel speed sensors, Brake Pedal Position (BPP) switch, sensor cluster, etc.) to determine if an ABS event is necessary. If an ABS event is necessary, the ABS module commands the hydraulic pump motor on and the Hydraulic Control Unit (HCU) to actuate the appropriate solenoids. During an ABS event, the front and rear end of the vehicle should track true to the direction of travel along the vehicle centerline unless driver input dictates otherwise. Other items that could cause uneven braking during an ABS event are; an internal issue with the HCU, an issue with the base brake system (caliper, brake pads, etc.) or worn out suspension components.

The operating voltage required for ABS module, hydraulic pump and isolation valve operation is between 10 and 17 volts.

This pinpoint test is intended to diagnose the following:

- Air in hydraulic brake system
- Low tire pressure
- Base brake system
- HCU

PINPOINT TEST S: POOR VEHICLE TRACKING DURING ANTI-LOCK FUNCTION

Test Step	Result / Action to Take
S1 VERIFY VEHICLE TRACKING DURING NON-ABS BRAKING	
• **NOTE:** Before road testing the vehicle, check the tire pressure and confirm tire pressures are set to the pressure indicated on the VC label. • Test drive the vehicle and verify vehicle tracking during normal braking. • **Does the vehicle track correctly during normal braking?**	**Yes** GO to S2. **No** The condition can be caused by a base brake concern or vehicle alignment. REFER to Section 206-00 to verify the base brake system and REFER to Section 204-00 to verify suspension components.

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S2 BLEED THE BRAKE SYSTEM • Bleed the HCU . Refer to Section 206-00 . • Test drive the vehicle and verify vehicle tracking during an ABS stop. • **Does the vehicle track correctly during an ABS stop?**	**Yes** The brake system is operating correctly. The concern may have been caused by air in the hydraulic system or a sticky valve. **No** GO to S3 .
S3 CHECK THE ABS INLET VALVE (CLOSED POSITION) • Connect the scan tool. • Ignition ON. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Rotate all the wheels to make sure they rotate freely (the transmission must be in NEUTRAL). • Apply moderate brake pedal effort. • Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • Toggle the left front inlet valve (LF_INLET) active command ON and at the same time, have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** TOGGLE the LF_INLET active command OFF. INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** TOGGLE the LF_INLET active command OFF. GO to S4 .
S4 CHECK THE ABS INLET VALVE (OPEN POSITION) • Apply moderate brake pedal effort. • Have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** GO to S5 .
S5 CHECK THE ABS OUTPUT VALVE (OPEN POSITION) • Apply moderate brake pedal effort. • Toggle the left front outlet valve (LF_OUTLET) and the LF_INLET active commands ON and, at the same time, have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** TOGGLE all active commands OFF. INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** TOGGLE all active commands OFF. GO to S6 .
S6 CHECK THE ABS INLET AND OUTLET VALVE (CLOSED POSITION) • Apply moderate brake pedal effort. • Have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** REPEAT this procedure (GO to S3) for the RF, LR and RR wheels using the appropriate active

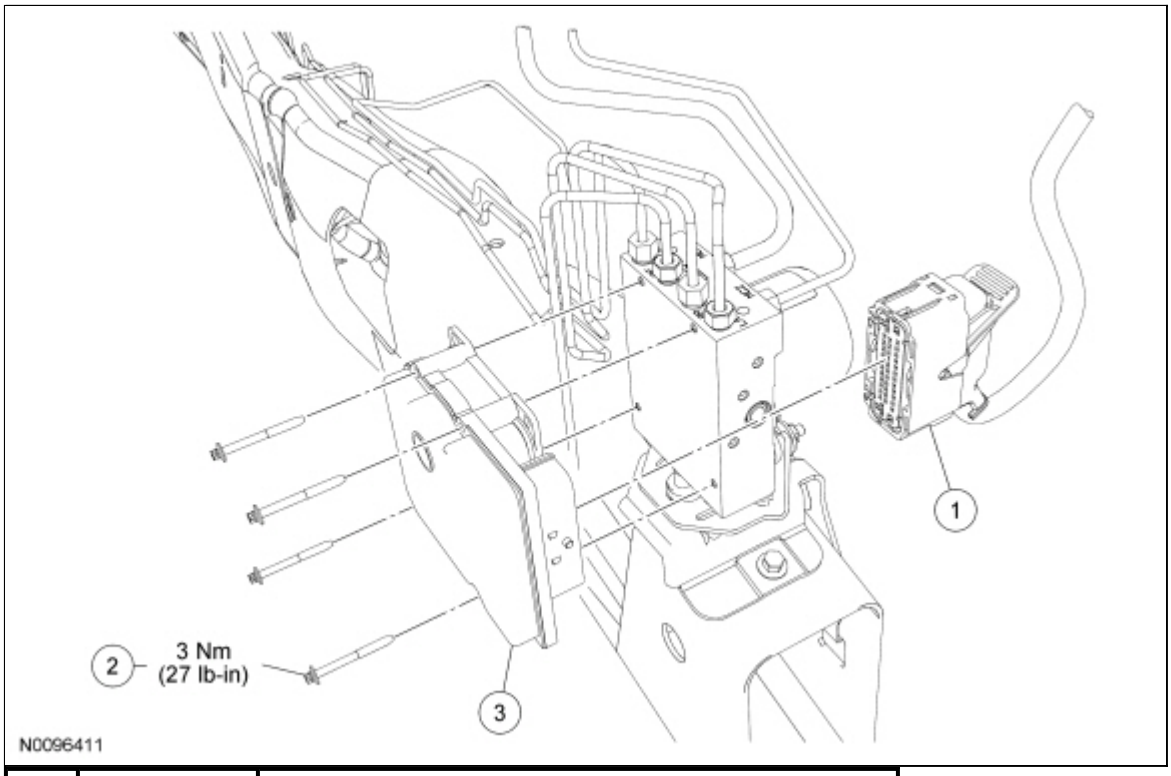
	commands. If no failure occurs, the system is operating normally.

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Anti-Lock Brake System (ABS) Module

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	—	ABS module electrical connector (part of 12A581)
2	2M101	ABS module screw (also part of 2C219) (4 required)
3	2C219	ABS module

Removal and Installation

NOTICE: **Do not connect the wiring connector to the ABS module while it is separated from the HCU , doing so sets DTCs that cannot be cleared.**

NOTICE: **Electronic modules are sensitive to electrical charges. The ABS module can be damaged if exposed to these charges.**

NOTICE: **Do not swap ABS modules between vehicles. Brake fluid pressure sensor calibration varies depending on vehicle configuration. Swapping ABS modules between vehicles with different calibrations causes a DTC to set in the ABS module that cannot be cleared.**

1. If a new ABS module is being installed, connect the scan tool and upload the module configuration information from the ABS module. For additional information on configuration, refer to Programmable Module Installation (PMI) in Section 418-01 .

2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

3. Disconnect the ABS module electrical connector.

4. ***NOTICE:*** **Pull the ABS module straight back until the coil packs and motor connector clear the Hydraulic Control Unit (HCU) or damage to the ABS module may result.**

   Remove the 4 ABS module screws and the ABS module.
   - To install, tighten to 3 Nm (27 lb-in).

5. To install, reverse the removal procedure.
   - When installing a new ABS module, it must be configured (using vehicle as-built data or module configuration information retrieved earlier in this procedure). For additional information on configuration, refer to PMI in Section 418-01 .

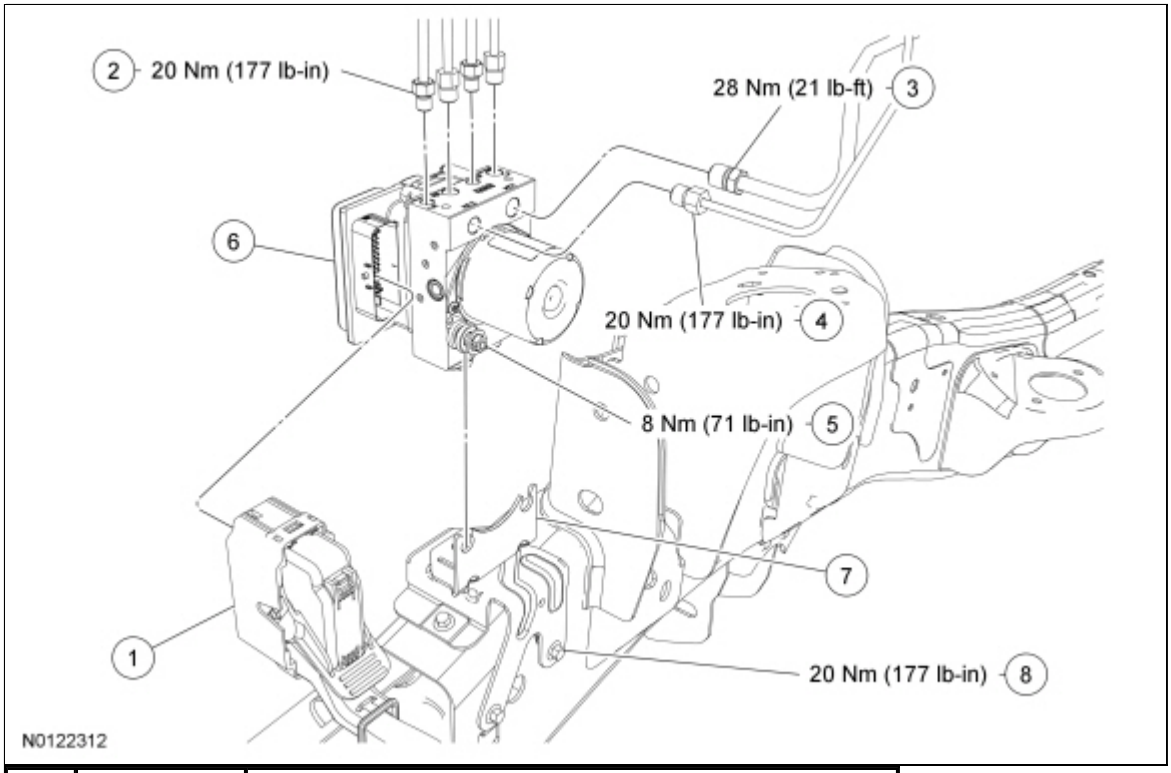
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Hydraulic Control Unit (HCU)

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	—	ABS module electrical connector (part of 12A581)
2	—	Brake tube-to-Hydraulic Control Unit (HCU) fitting (4 required)
3	2A040	Master cylinder primary brake tube-to- HCU fitting
4	2B253	Master cylinder secondary brake tube-to- HCU fitting
5	—	HCU -to-bracket nut (part of kit 2C229) (2 required)
6	2C215	HCU (also part of 2C405)
7	2C304	HCU bracket (also part of 2C405)
8	W506424	HCU bracket bolts (3 required)

Removal and Installation

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTICE: **Electronic modules are sensitive to electrical charges. The ABS module can be damaged if exposed to these charges.**

NOTICE: **Do not allow brake fluid or other contaminates to drip onto the ABS module or into the electrical connector. Contamination may cause a permanent failure to occur.**

NOTE: The Hydraulic Control Unit (HCU) bracket does not have to be removed in order to complete this procedure.

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

2. **NOTE:** The brake tubes must be installed in the same location as removed.

   Remove the 4 brake tube-to- HCU fittings.
   - To install, tighten to 20 Nm (177 lb-in).

3. Disconnect the master cylinder primary and secondary brake tube-to- HCU fittings.
   - To install, tighten the master cylinder primary brake tube-to- HCU fitting to 28 Nm (21 lb-ft).
   - To install, tighten the master cylinder secondary tube brake tube-to- HCU fitting to 20 Nm (177 lb-in).

4. Loosen the 2 HCU -to-bracket nuts and remove the HCU .
   - To install, tighten to 8 Nm (71 lb-in).

5. To install, reverse the removal procedure.
   - Bleed the brake system. For additional information, refer to Section 206-00 .

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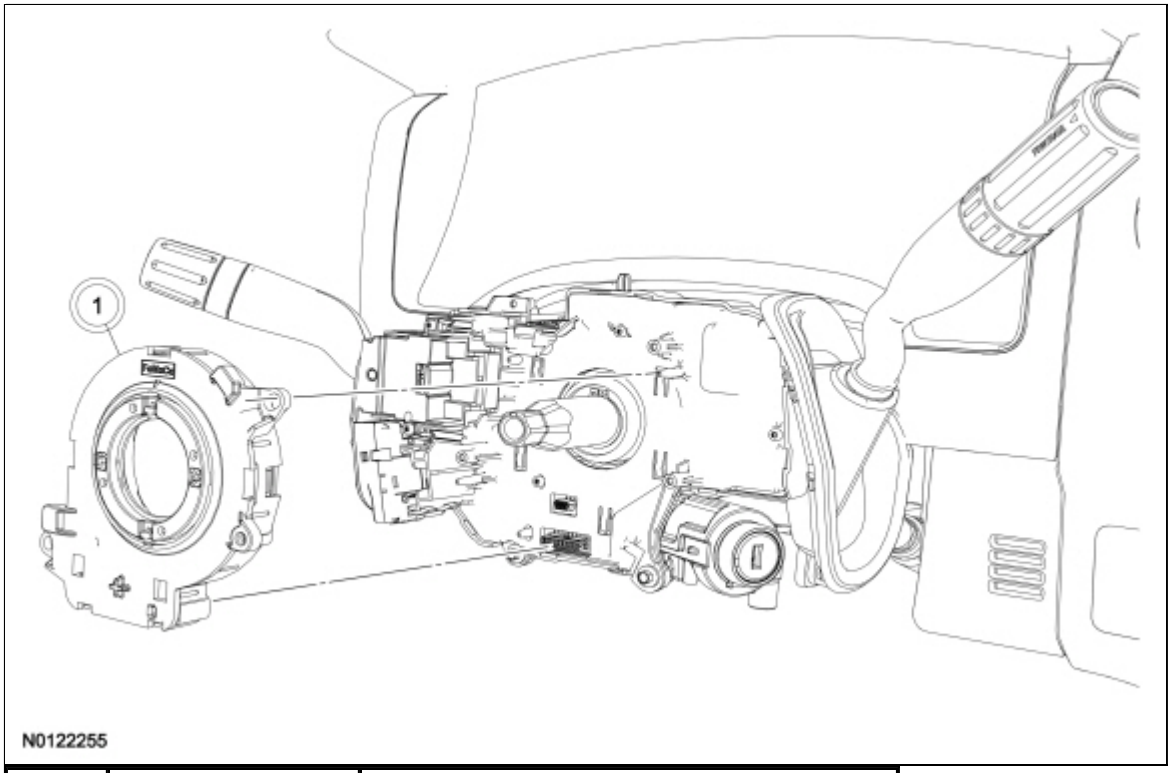
Stability/Traction Control Switch

Removal and Installation

1. Refer to Passenger Air Bag Deactivation (PAD) Indicator in Section 501-20B .

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Steering Wheel Rotation Sensor



Item	Part Number	Description
1	3F818	Steering wheel rotation sensor

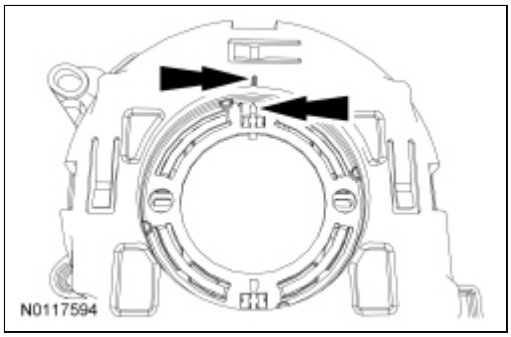
Removal

NOTE: Only available on the 6.2L engine. For all other applications, the sensor is part of the Electronic Power Assist Steering (EPAS) and is not serviced seperatley.

1. Remove the clockspring. For additional information, refer to Section 501-20B .
2. Remove the steering wheel rotation sensor.

Installation

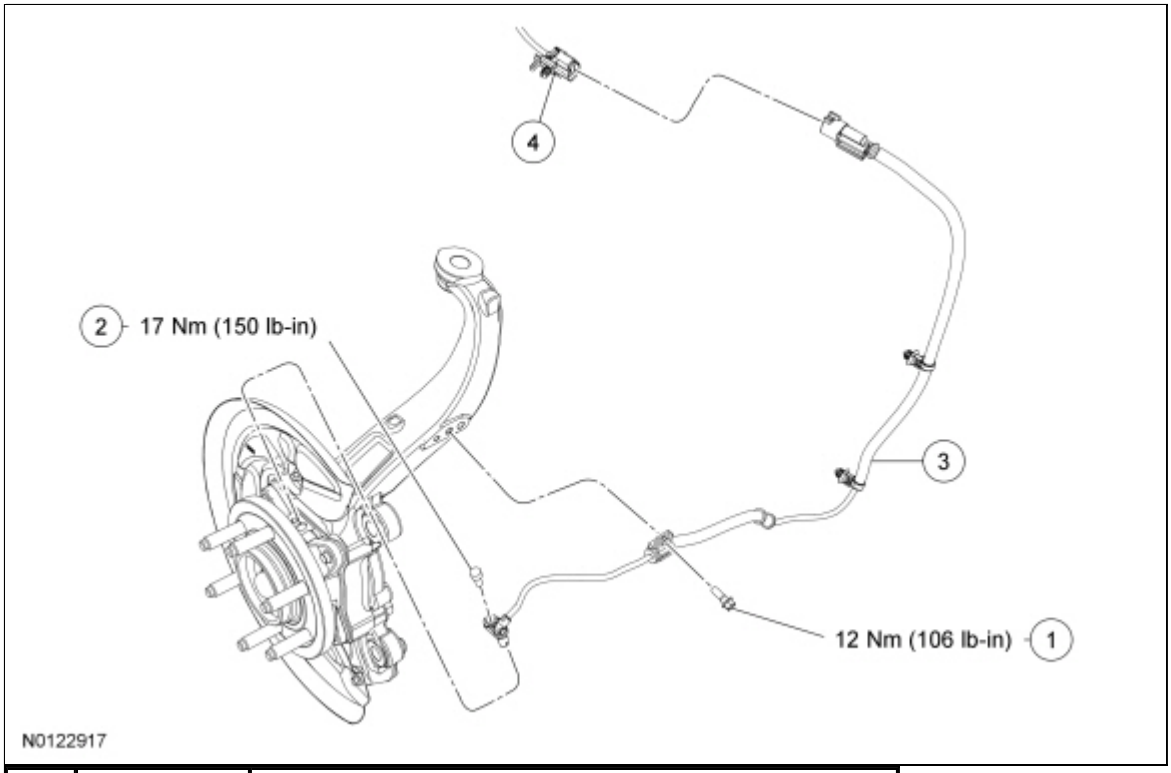
1. Align the arrow on the inner ring of the sensor to the notch on the sensor body.



2. Position the sensor on the Steering Column Control Module (SCCM).
3. Install the clockspring. For additional information, refer to Section 501-20B .

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Wheel Speed Sensor — Front



Item	Part Number	Description
1	W710279	Wheel speed sensor harness bolt
2	—	Wheel speed sensor bolt (part of 2C204)
3	2C204	Wheel speed sensor
4	—	Wheel speed sensor electrical connector (part of 14250)

Removal and Installation

1. Remove the brake disc. For additional information, refer to Section 206-03 .

2. **NOTE:** The wheel speed sensor harness electrical connector is located in the engine compartment secured to the fender apron.

   Disconnect the wheel speed sensor electrical connector.

3. Detach the 2 wheel speed sensor harness pushpin retainers.

4. Detach the wheel speed sensor harness retainer from the brake hose.

5. Remove the wheel speed sensor harness bolt.

- To install, tighten to 12 Nm (106 lb-in).

6. Remove the wheel speed sensor bolt and the wheel speed sensor.
    - To install, tighten to 17 Nm (150 lb-in).

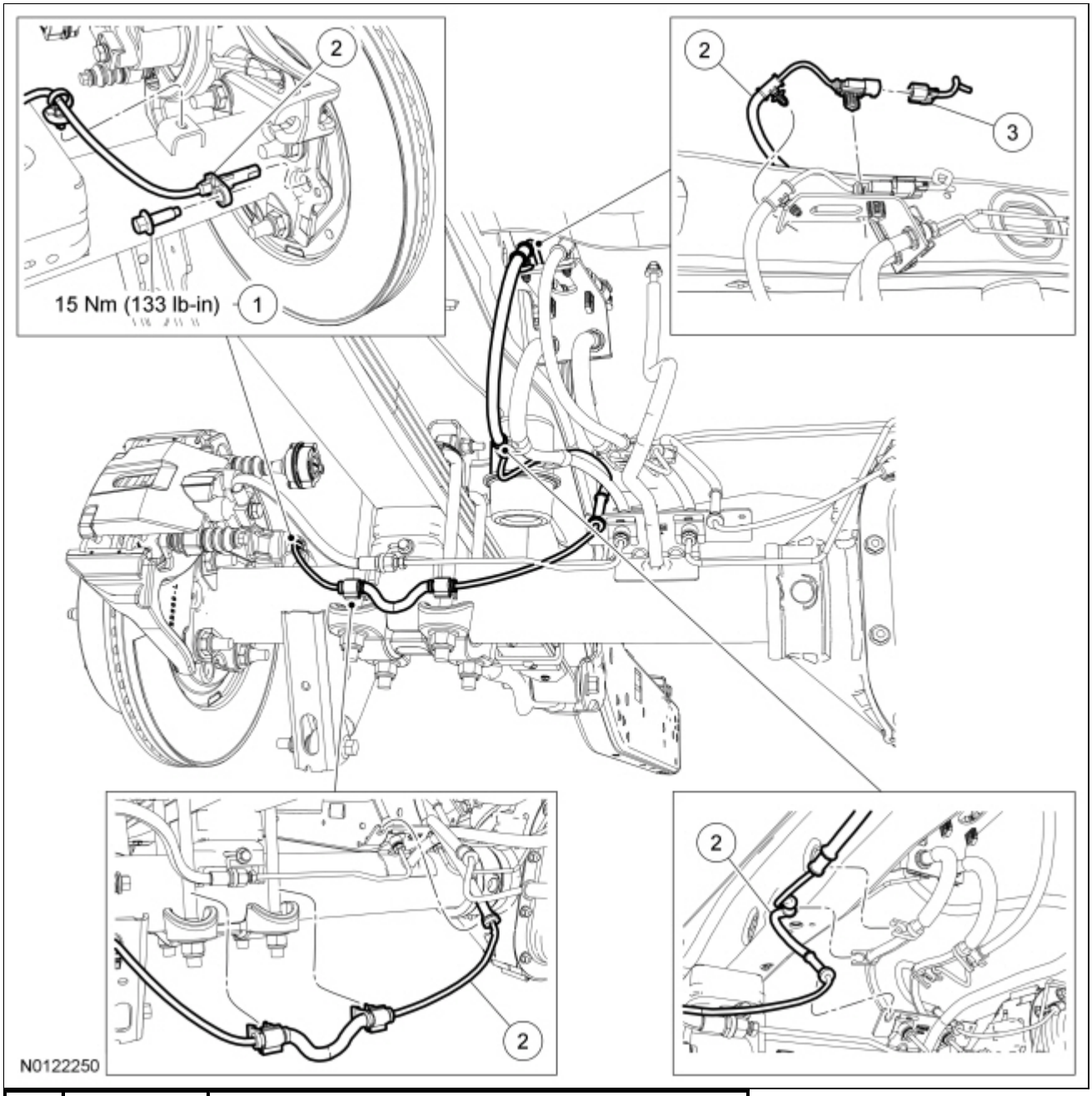
7. To install, reverse the removal procedure.

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Wheel Speed Sensor — Rear

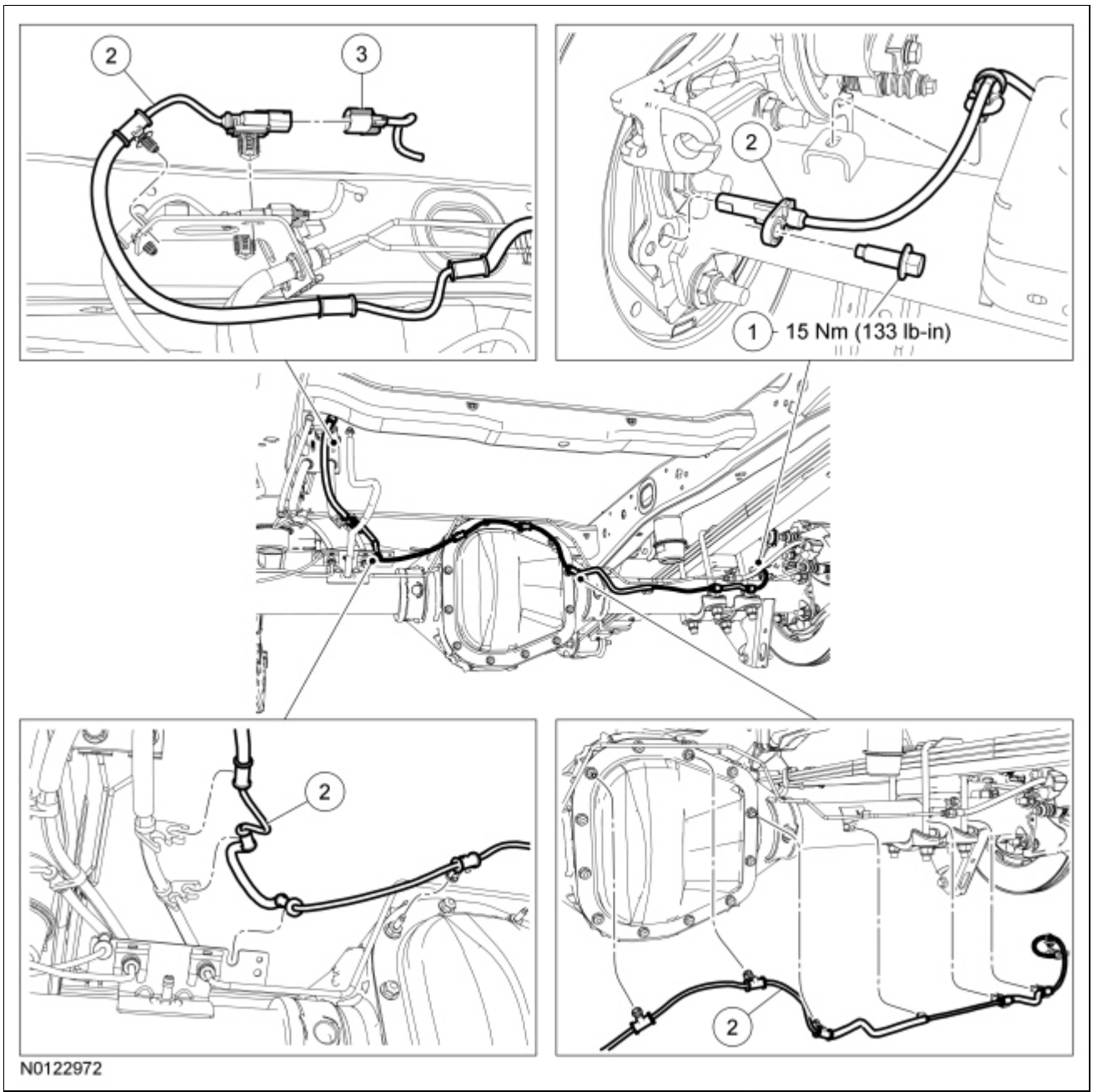
Left Rear Wheel Speed Sensor



Item	Part Number	Description
1	W500223	Wheel speed sensor bolt
2	2C190	Wheel speed sensor

3	—	Wheel speed sensor electrical connector (part of 14405)

Right Rear Wheel Speed Sensor



Item	Part Number	Description
1	W500223	Wheel speed sensor bolt
2	2C190	Wheel speed sensor
3	—	Wheel speed sensor electrical connector (part of 14405)

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Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the wheel speed sensor electrical connector.

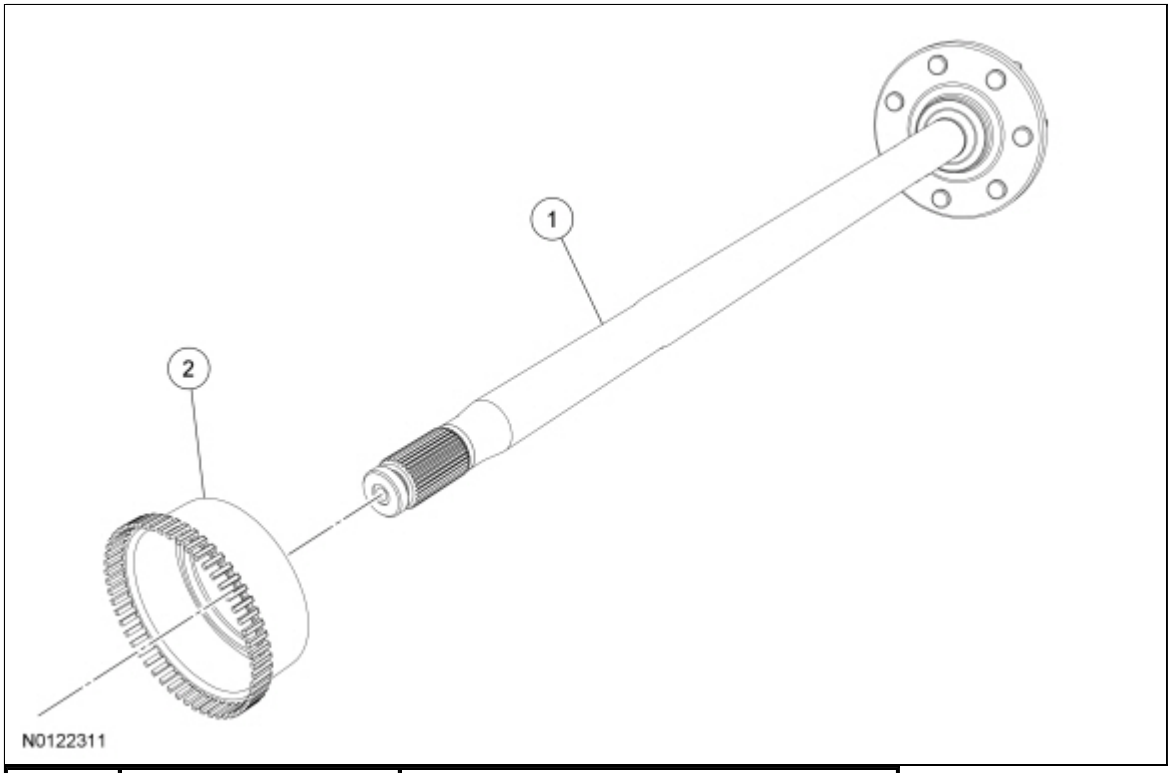
3. Detach the wheel speed sensor harness retainers and pushpin retainers.

4. Remove the wheel speed sensor bolt and the wheel speed sensor.
    - To install, tighten to 15 Nm (133 lb-in).

5. To install, reverse the removal procedure.

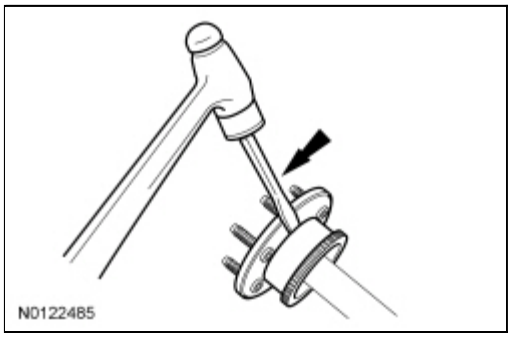
Wheel Speed Sensor Ring — Rear

Removal



Item	Part Number	Description
1	4234	Axle shaft
2	2C189	Wheel speed sensor ring

1. Remove the rear axle shaft. For additional information, refer to Section 205-02A or Section 205-02B .
2. Using a suitable driver, remove the wheel speed sensor ring from the axle shaft and discard the ring.

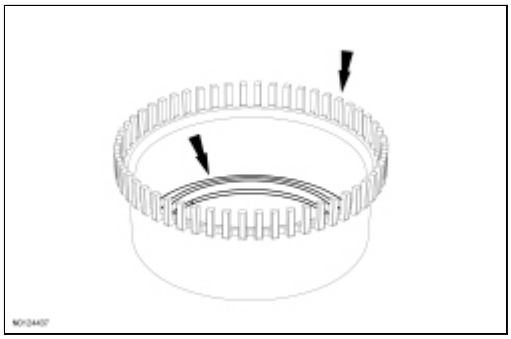


Installation

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1. ***NOTICE:*** **Do not apply any amount of force to the tooth area of the wheel speed sensor ring during installation, the sensor teeth are fragile and can be easily damaged. Apply force only to the inner lip area of the wheel speed sensor ring.**

   Using suitable adapters, press the wheel speed sensor ring onto the rear axle shaft.



2. Install the rear axle shaft. For additional information, refer to Section 205-02A or Section 205-02B .

Auxiliary Brake System — Trailer Brake Control (TBC) Module

Trailer Brake Control System

The trailer brake control system consists of the following components:

- Trailer Brake Control (TBC) module, which is mounted in the center of the instrument panel just below the climate controls
- Trailer tow connector
- Instrument Panel Cluster (IPC)

The TBC module has the following driver inputs and outputs:

- Manual slider switch (input)
- Gain buttons (input)
- Gain setting display (output)
- Trailer connectivity icon (output)
- Output bar graph display (output)

The manual slider switch on the TBC module activates the trailer brakes independently from the vehicle brakes. The manual slider is used in conjunction with the gain buttons to adjust and set the trailer brakes. When the manual lever is activated with a trailer connected to the vehicle, the trailer stoplamps and the vehicle stoplamps illuminate. Activating the manual lever without a trailer connected to the vehicle still illuminates the vehicle stoplamps.

The gain buttons set the TBC system for specific towing conditions such as trailer load, vehicle load, road conditions and weather. The gain is normally set to provide maximum trailer braking while maintaining trailer stability. For information on setting the trailer brake gain, refer to the Owner's Literature.

The gain setting and output bar graph displays provide the driver with TBC system information. Trailer connectivity is provided through the trailer connector icon or message center depending on which IPC the vehicle is equipped with, the gain setting display provides the driver with the current gain setting and the output bar graph shows the amount of power going to the trailer brakes relative to brake pedal or manual lever input (only if a trailer is connected to the vehicle).

TBC System Message Center Messages and Displays

The IPC message center displays the gain setting and relative braking power during a braking event. The message center also indicates trailer connectivity and trailer wiring faults. The following message center messages pertain to the TBC system:

- **NO TRAILER** — This message is displayed whenever the ignition is cycled from OFF to RUN without a trailer connected to the 7-pin trailer connector.
- **TRAILER CONNECTED** — This message is displayed when a correct trailer connection at the 7-pin trailer connector has been made during a given ignition cycle.
- **OUTPUT** — When the vehicle brake pedal is applied, or when the manual control is activated, bar indicators illuminate in the message center to indicate the amount of power going to the trailer brakes

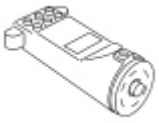
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relative to the brake pedal or manual control input. One bar indicates the least amount of output with 6 bars indicating maximum output.

- **TRAILER DISCONNECTED** — This message is displayed and accompanied by a single chime when a correct trailer connection was made and then a disconnection has been sensed during a given ignition cycle. This message is also displayed if any of the following occur:
  - the 7-pin trailer connector becomes disconnected while driving
  - an intermittent open circuit occurs in the vehicle wiring from the TBC module to the 7-pin trailer connector or the trailer wiring
  - during manual activation using the manual control lever without a trailer connected (accompanied by a single chime)
- **TRAILER BRAKE MODULE FAULT** — This message is displayed and a DTC is stored when a fault is detected by the TBC module.
- **WIRING FAULT ON TRAILER** — This message is displayed when the trailer brake output circuit is shorted to ground or shorted to voltage. A DTC sets in the TBC module indicating which circuit fault was observed. It is important to determine if a trailer was connected when this message was displayed. If this message is only observed with a trailer connected, the concern is related to the trailer wiring and not the vehicle. If this message is observed without a trailer connected, the concern is with the vehicle wiring from the TBC module to the 7-pin trailer connector.
- **TBC FAULT** — This message is displayed if the Instrument Panel Cluster (IPC) is receiving communications from the TBC module, but has not been configured for a trailer brake system. If the message center displays TBC FAULT and there are no DTCs stored in the TBC module, follow the steps in Programmable Parameters to verify and/or modify the TBC module programmable parameter in the IPC .

Auxiliary Brake System — Trailer Brake Control (TBC) Module

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2954-A	7-Way Trailer Emulator TEK-6562A or equivalent

Principles of Operation

NOTE: A trailer brake emulator tool is available to verify that the Trailer Brake Control (TBC) module and vehicle wiring are functioning correctly. The trailer emulator requires the trailer tow connector ground and 12 volt trailer tow charge circuit to be connected in order to check the electric brake circuit. Battery Junction Box (BJB) fuse 21 (30A) and the Trailer Tow/Battery Charge Relay must be installed for battery voltage to be supplied to the trailer tow connector. The fuse and relay are supplied as loose-shipped items with the vehicle and may not have been installed during Pre-Delivery Inspection (PDI).

The Trailer Brake Control (TBC) module is an integrated electronic control device designed to provide variable braking power to the electric-actuated drum brakes on a towed trailer (1 to 4 axles only). The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available.

The TBC module receives information from the stoplamp switch and the PCM. The brake pressure transducer is internal to the ABS module.

The stoplamp switch is mounted on the brake pedal bracket and switches on or off depending on the brake

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pedal position. The TBC module receives the stoplamp switch and the brake torque information over the High Speed Controller Area Network (HS-CAN) from the PCM.

The TBC module receives information through the HS-CAN . These inputs are from the PCM, the Instrument Panel Cluster (IPC) and the ABS module. The Body Control Module (BCM) also sends ignition state, park lamp status and illumination dimming level data to the TBC module. The information sent from the TBC module is passed to the IPC and is displayed on the message center.

To adjust the gain setting up or down, the TBC module faceplate provides the driver with control buttons which determine the maximum power output. The TBC module faceplate also provides a manual control lever to manually apply the trailer brakes, independent of the vehicle brakes, to calibrate the gain setting to the specific trailer loading and road conditions. When the manual control lever is activated with a trailer connected to the vehicle, the trailer stoplamps and the vehicle stoplamps (except the center high mount stoplamp) illuminate. If a trailer is not connected and the manual control lever is activated, the vehicle still illuminates the vehicle stoplamps (except the center high mount stoplamp).

Trailer Brake Control (TBC) Module Wake Up

NOTE: These conditions require that a trailer **not** be connected to the trailer tow connector.

The following conditions describe the normal operation of the TBC module at start up.

When the ignition key is in the RUN position and the manual lever is set all the way to the left with a gain of 10, the message center should display TRAILER DISCONNECTED. At the same time, with the vehicle stationary, battery voltage should be present at pin 3 of the trailer tow connector.

When not braking the TBC module sends a voltage pulse every 4 seconds to pin 3 of the trailer tow connector to determine whether a trailer is connected to the trailer tow connector.

Instrument Panel Cluster (IPC) Configuration For Trailer Brake Control (TBC) Functionality

The same IPC is used for vehicles with and without the TBC option. TBC functionality is enabled or disabled using the scan tool. If the vehicle is equipped with a TBC module, but the IPC was not configured for TBC , the TBC module shuts down, no TBC information is displayed in the message center and DTC U2202 sets in the TBC module.

If the IPC is configured for TBC , but the vehicle is not equipped with a TBC module, TRAILER BRAKE MODULE FAULT is displayed in the message center. This symptom could occur if a replacement IPC was installed, but not configured correctly. For information on the TBC programmable parameter, refer to Programmable Parameters below.

Programmable Parameters

The message center displays TBC FAULT if it is receiving communications from the TBC module, but has not been configured for a trailer brake system. If the message center displays TBC FAULT and there are no DTCs stored in the TBC module, follow these steps to verify and/or modify the TBC module programmable parameter in the Instrument Panel Cluster (IPC).

1. Identify the vehicle using the normal Integrated Diagnostic System (IDS) process.

2. Select Programming and press the check box.

3. Select Module Programming and press the check box.

4. Select Programmable Parameters and press the check box.

5. Select Personality and press the check box.

6. Follow the on-screen directions.

7. **NOTE:** The scan tool displays either EQUIPPED or NOT EQUIPPED to the left of TBC - IPC .

   Highlight TBC - IPC .

8. If the IPC needs to be configured for a trailer brake system, choose EQUIPPED and press the check box.

9. Clear DTCs from the TBC module, then carry out a self-test on the TBC module. Refer to the Trailer Brake Control (TBC) Module DTC Chart for any DTCs retrieved.

Inspection and Verification

NOTE: Carry out all pinpoint tests **without** a trailer connected to the vehicle.

NOTE: A trailer brake emulator tool is available to verify that the TBC module and vehicle wiring are functioning correctly. The trailer emulator requires the trailer tow connector ground and 12 volt trailer tow charge circuit to be connected in order to check the electric brake circuit.

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Base brake system ● Trailer	● Battery Junction Box (BJB) fuse 17 (30A) ● Body Control Module (BCM) fuse 37 (10A) ● Wiring, terminals or connectors ● Trailer Brake Control (TBC) module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.

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- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the CMDTCs and carry out the self-test diagnostics for the TBC module.

9. If the DTCs retrieved are related to the concern, go to the Trailer Brake Control (TBC) Module DTC Chart. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Chart

Trailer Brake Control (TBC) Module DTC Chart

DTC	Description	Action
B1317	Battery Voltage High	GO to Pinpoint Test D .
B1318	Battery Voltage Low	GO to Pinpoint Test E .
B1342	ECU is Faulted	INSPECT for a stuck or damaged manual sliding lever and gain control buttons. REPAIR or CLEAR any obstructions or foreign material. REPAIR all other DTCs before repairing B1342. CLEAR the DTCs. TEST the system for normal operation. **NOTE:** It takes 2 minutes for the Trailer Brake Control (TBC) module to set this DTC due to a stuck manual sliding lever or a stuck gain control button. If the DTC returns, INSTALL a new Trailer Brake Control (TBC) module. REFER to Trailer Brake Control (TBC) Module in this section.
B1863	TBC Ground Open Circuit	GO to Pinpoint Test F .
C2806	Trailer Brakes Wiring Circuit Short to Vbatt	GO to Pinpoint Test A .
C2807	Trailer Brakes Wiring Circuit Short to Ground	GO to Pinpoint Test A .
U0100	Lost Communication With ECM /PCM "B"	GO to Pinpoint Test G .

U0121	Lost Communication With Anti-Lock Brake System (ABS) Control Module	GO to Pinpoint Test H .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test I .
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	GO to Pinpoint Test J .
U0415	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module	This DTC indicates that the TBC module has received the brake pressure information sent from the ABS module, but that information does not agree with other sensor inputs. REFER to Section 206-09 to diagnose the ABS module.
U2202	Invalid Configuration Data Received	The Instrument Panel Cluster (IPC) is not configured for trailer brakes. REFER to Programmable Parameters in this section. CLEAR the DTCs. REPEAT the self-test.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Trailer Brake Control (TBC) module	• Fuse(s) • Wiring, terminals or connectors • TBC module	• REFER to Section 418-00 .
• The trailer brakes are inoperative	• Fuse(s) • Wiring, terminals or connectors • Trailer tow connector • TBC module • Customer trailer	• GO to Pinpoint Test B .
• The trailer brakes are always engaged	• Wiring, terminals or connectors • TBC module • Customer trailer	• GO to Pinpoint Test C .
• The message center intermittently displays TRAILER DISCONNECTED or WIRING FAULT ON TRAILER while towing a trailer	• Wiring, terminals or connectors • Customer trailer	• GO to Pinpoint Test A .
• The message center displays TBC FAULT	• DTCs present	• RETRIEVE and RECORD the DTCs. REFER to the Trailer Brake Control (TBC)

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		Module DTC Chart.
• The message center displays TRAILER BRAKE MODULE FAULT when the vehicle is not equipped with a TBC module	• Incorrect IPC configuration	• CONFIGURE the IPC. REFER to Programmable Parameters in this section.
• The message center displays WIRING FAULT ON TRAILER	• Wiring, terminals or connectors • TBC module • Customer trailer	• GO to Pinpoint Test A.

Pinpoint Tests

Pinpoint Test A: The Message Center Displays WIRING FAULT ON TRAILER

NOTE: Carry out all pinpoint tests **without** a trailer connected to the vehicle.

Refer to Wiring Diagrams Cell 95, Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available. The Trailer Brake Control (TBC) module varies the PWM signal based on various inputs such as the brake torque message, the manual slider switch and the gain buttons. With the vehicle stationary and the manual slider switch fully to the left with a gain of 10, there should be more than 10-12 volts supplied to pin 3 of the 7-pin trailer tow connector. When the trailer is connected to the vehicle the Instrument Panel Cluster (IPC) should show the TRAILER CONNECTED message. If the WIRING FAULT ON TRAILER is only message displayed when the trailer is connected, the fault is with the trailer wiring.

Every 4 seconds (when not braking) the TBC module sends a voltage pulse to pin 3 of the 7-pin trailer tow connector to determine whether or not a trailer is connected.

- DTC C2806 (Trailer Brakes Wiring Circuit Short to Vbatt) — this DTC sets in continuous memory when the TBC module detects that the battery voltage is greater than 9 volts while not braking. The TBC module shuts off the trailer brake output and then shuts down.
- DTC C2807 (Trailer Brakes Wiring Circuit Short to Ground) — this DTC sets in continuous memory or on-demand when the TBC module detects that the battery voltage drops by more than 20 percent during a braking event or the trailer brakes are drawing more than 28 amps. The TBC module shuts off the trailer brake output and then shuts down.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TBC module
- Customer trailer

PINPOINT TEST A: THE MESSAGE CENTER DISPLAYS WIRING FAULT ON TRAILER

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

NOTE: Make sure the trailer brakes are electric-magnet actuated drum type brakes before proceeding with this pinpoint test.

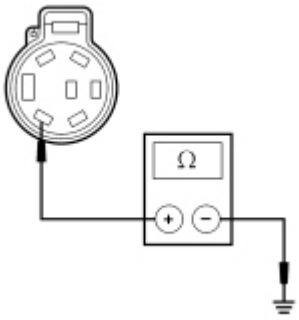
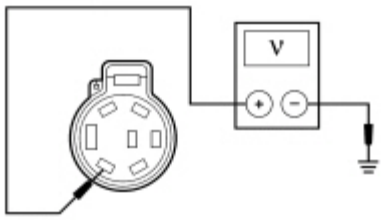
Test Step	Result / Action to Take

A1 VERIFY TBC MODULE DTCs
• Verify a trailer is **not** connected to the trailer tow connector.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: TBC Module Self-Test .
• Clear the DTCs.
• Test drive the vehicle in the following manner:
  ▪ maintain a speed greater than 5 km/h (3 mph)
  ▪ turn the headlights ON
  ▪ lightly apply the brakes for more than 5 seconds
  ▪ activate the left and right turn signals
• Ignition OFF.
• Ignition ON.
• Wait at least 10 seconds for all modules to wake up and prove out.
• Enter the following diagnostic mode on the scan tool: TBC Module Self-Test .
• **Is DTC C2806 or C2807 present?**
	Yes
	GO to A2 .
	
	No
	For all other TBC module DTCs, GO to the TBC Module DTC Chart. If no DTCs return, the system is operating correctly at this time. INSPECT the 7-pin trailer tow connector for water intrusion, corrosion, pushed-out pins and spread terminals. REPAIR or INSTALL new as necessary. If the 7-pin trailer tow connector is OK, SEND the trailer to an authorized camper/trailer repair facility.

A2 CHECK THE TRAILER TOW CONNECTOR
• Ignition OFF.
• Disconnect: Trailer Tow C439A .
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: TBC Module Self-Test .
• Clear the DTCs.
• Test drive the vehicle in the following manner:
  ▪ maintain a speed greater than 5 km/h (3 mph)
  ▪ turn the headlights ON
  ▪ lightly apply the brakes for more than 5 seconds
  ▪ activate the left and right turn signals
• Ignition OFF.
• Ignition ON.
• Wait at least 10 seconds for all modules to wake up and prove out.
• Enter the following diagnostic mode on the scan tool: TBC Module Self-Test .
• **Is DTC C2806 or C2807 present?**
	Yes
	For DTC C2806, GO to A4 . For DTC C2807, GO to A3 .
	
	No
	INSTALL a new 7-pin trailer tow connector. CLEAR any DTCs present. TEST the system for normal operation.

A3 CHECK THE TBC MODULE PWM OUTPUT CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Connect: Trailer Tow C439A . • Disconnect: TBC Module C2142 . • Measure the resistance between C439A-3, circuit	**Yes** GO to A5 . **No**

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CAT19 (BU), harness side and ground.  N0009553 • **Is the resistance greater than 10,000 ohms?**	REPAIR circuit CAT19 (BU) for a short to ground. TEST the system for normal operation.
A4 CHECK THE TBC MODULE PWM OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Connect: Trailer Tow C439A . • Disconnect: TBC Module C2142 . • Ignition ON. • Measure the voltage between C439A-3, circuit CAT19, (BU), harness side and ground while operating the following lamps in turn: ▪ Parking lamps ▪ Stop lamps ▪ Reversing lamps  A0025430 • **Is any voltage present?**	**Yes** REPAIR circuit CAT19 (BU) for a short to power. TEST the system for normal operation. **No** GO to A5 .
A5 CHECK FOR CORRECT TBC MODULE OPERATION • Ignition OFF. • Inspect the TBC module connector. • Repair: ▪ corrosion (install a new connector or terminal - clean module pins) ▪ damaged or bent pins - install new terminals or pins ▪ pushed-out pins - install new pins as necessary ▪ spread terminals - install new terminals as necessary • Connect the TBC module connector and make sure that it seats correctly. • Test drive the vehicle in the following manner: ▪ maintain a speed greater than 5 km/h (3	**Yes** INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

mph) ■ turn the headlights ON ■ lightly apply the brakes for more than 5 seconds ■ activate the left and right turn signals • Ignition OFF. • Ignition ON. • Wait at least 10 seconds for all modules to wake up and prove out. • Enter the following diagnostic mode on the scan tool: TBC Module Self-Test . • **Is DTC C2806 or C2807 present?**	

Pinpoint Test B: The Trailer Brakes are Inoperative

NOTE: Carry out all pinpoint tests **without** a trailer connected to the vehicle.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available. The Trailer Brake Control (TBC) module varies the PWM signal based on various inputs such as the brake torque message, the manual slider switch and the gain buttons. With the vehicle stationary and the manual slider switch fully to the left with a gain of 10, there should be more than 10-12 volts supplied to the trailer tow connector.

The TBC module receives stoplamp switch information from the PCM and information from the ABS module over the High Speed Controller Area Network (HS-CAN). If there is a problem in the ABS module that is preventing this information from being sent to the TBC module, the TBC module enters a limited operating mode. The TBC module receives fused battery voltage from Battery Junction Box (BJB) fuse 17 (30A) and fused ignition voltage from Body Control Module (BCM) fuse 37 (10A).

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Trailer tow connector
- TBC module
- Customer trailer

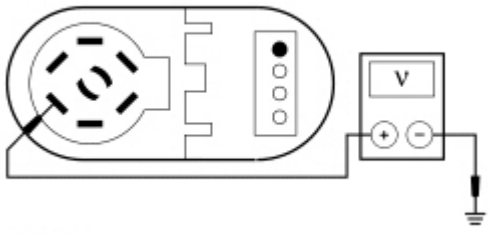
PINPOINT TEST B: THE TRAILER BRAKES ARE INOPERATIVE

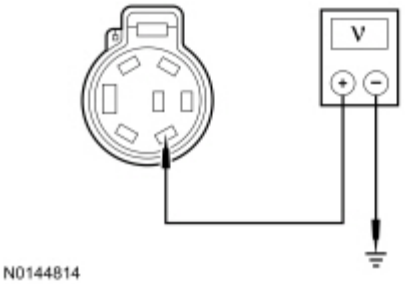
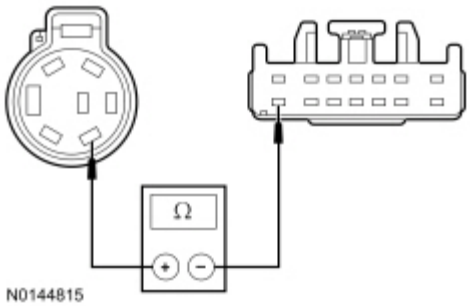
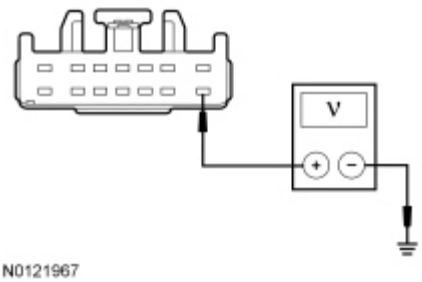
NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

NOTE: Make sure the trailer brakes are electric-magnet actuated drum-type brakes before proceeding with this pinpoint test.

Test Step	Result / Action to Take
B1 CHECK FOR ANY PCM DTCs	

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• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) . • Retrieve and record any PCM DTCs. • **Are any PCM DTCs retrieved?**	**Yes** REFER to Section 303-14 . **No** GO to B2 .
B2 CHECK FOR ANY ABS MODULE DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module . • Retrieve and record any ABS module DTCs. • **Are any ABS module DTCs retrieved?**	**Yes** REFER to Section 206-09 . **No** GO to B3 .
B3 CHECK FOR SCAN TOOL COMMUNICATION WITH THE TBC MODULE	
• Using a scan tool, carry out the network test. • **Did the TBC module pass the network test?**	**Yes** GO to B4 . **No** REFER to Section 418-00 .
B4 CHECK FOR TBC MODULE DTCs	
• Review the DTCs retrieved and recorded during TBC module self-test. • **Are any TBC module DTCs present?**	**Yes** REFER to the Trailer Brake Control (TBC) Module DTC Chart. **No** GO to B5 .
B5 CHECK THE TBC MODULE FOR MAXIMUM OUTPUT	
NOTE: Battery voltage must be greater than 10 volts. • Ignition ON. • Set a gain of 10 in the TBC module. • **NOTE:** If the manual slider switch is held to the full left position for more than 5 to 20 minutes, the TBC module automatically shuts down. • Have an assistant press the manual slider switch fully to the left with a gain of 10 on the TBC module. • Measure the voltage between trailer tow 7-pin trailer tow connector electric brake supply pin, component side and ground.  N0084023 • **Is the voltage greater than 10-12 volts?**	**Yes** The TBC module is operating correctly. SEND the trailer to an authorized camper/trailer repair center for an overload condition. **No** GO to B6 .
B6 CHECK THE TRAILER TOW CONNECTOR FOR AN OPEN	

• Ignition OFF. • Disconnect: Trailer Tow Connector C439A . • Ignition ON. • Have an assistant press the manual slider switch fully to the left with a gain of 10 on the TBC module. • Measure the voltage between the trailer tow connector C439A-3, circuit CAT19 (BU), harness side and ground.  N0144814 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new trailer tow connector. CLEAR the DTCs. TEST the system for normal operation. **No** GO to B7 .
B7 CHECK THE TBC MODULE PWM OUTPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the trailer tow connector C439A-3, circuit CAT19 (BU), harness side and TBC module C2142-14, circuit CAT19 (BU), harness side.  N0144815 • **Is the resistance less than 5 ohms?**	**Yes** GO to B8 . **No** REPAIR the circuit. TEST the system for normal operation.
B8 CHECK THE BATTERY VOLTAGE TO THE TBC MODULE	
• Ignition OFF. • Measure the voltage between TBC module C2142-8, circuit SBB17 (RD), harness side and ground.  N0121967 • **Is the voltage greater than 10 volts?**	**Yes** GO to B9 . **No** VERIFY the BJB fuse 17 (30A) is OK. If OK, REPAIR circuit SBB17 (RD) for an open. TEST the system for normal operation.

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B9 CHECK FOR CORRECT TBC MODULE OPERATION	

• Disconnect the TBC module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the TBC module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Trailer Brakes are Always Engaged

NOTE: Carry out all pinpoint tests **without** a trailer connected to the vehicle.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available. With the vehicle stationary and the manual slider switch fully to the left with a gain of 10, there should be more than 10-12 volts supplied to pin 3 of the 7-pin trailer tow connector. The Trailer Brake Control (TBC) module also receives information from the brake pressure switch (also called the speed control deactivation switch) and the stoplamp switch from the PCM over the High Speed Controller Area Network (HS-CAN).

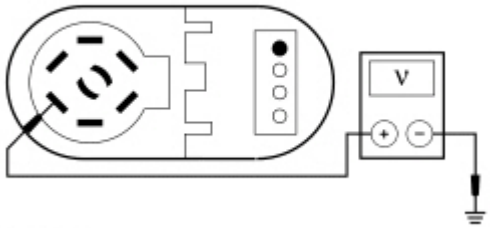
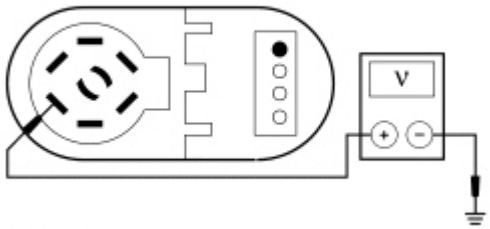
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TBC module
- Customer trailer

PINPOINT TEST C: THE TRAILER BRAKES ARE ALWAYS ENGAGED

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
C1 CHECK FOR ANY PCM DTCs	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) . • Retrieve and record any PCM DTCs. • **Are any PCM DTCs retrieved?**	**Yes** REFER to Section 303-14 . **No** GO to C2 .
C2 CHECK FOR ANY TBC MODULE DTCs	

• Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • Retrieve and record any TBC module DTCs. • **Are any TBC module DTCs retrieved?**	**Yes** REFER to DTC Charts in this section. **No** GO to C3 .
C3 OBSERVE THE VEHICLE STOPLAMP OPERATION • Monitor the vehicle stoplamps while pressing and releasing the brake pedal. • **Do the vehicle stoplamps operate correctly?**	**Yes** GO to C4 . **No** REFER to Section 417-01 to diagnose the stoplamp switch.
C4 CHECK THE TBC MODULE OUTPUT **NOTE:** Every 4 seconds a voltage pulse is applied as a trailer connectivity test. • Ignition ON. • Make sure the brake pedal is not pressed and the manual slider switch is not being applied. • Measure the voltage between 7-pin trailer tow connector electric brake supply pin, component side and ground.  N0084023 • **Is the voltage approximately 0.3-0.4 volt?**	**Yes** The TBC module and vehicle wiring are operating correctly. SEND the trailer to an authorized camper/trailer repair center. **No** GO to C5 .
C5 CHECK THE TBC MODULE PWM OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: TBC Module C2142 . • Ignition ON. • Measure the voltage between 7-pin trailer tow connector electric brake supply pin, component side and ground.  N0084023 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to C6 .

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C6 CHECK FOR CORRECT TBC MODULE OPERATION	

• Disconnect the TBC module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the TBC module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test D: DTC B1317

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Normal Operation

- DTC B1317 (Battery Voltage High) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module when the TBC module detects that battery voltage has risen above 16 volts on the voltage supply circuit while not braking.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- TBC module

PINPOINT TEST D: DTC B1317

NOTE: DTC B1317 may be stored in the module memory due to previous battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
D1 CHECK FOR DTC B1317, B1676, P0563 (PCM) OR U3003:17 SET IN OTHER MODULES	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Retrieve the continuous memory DTCs from all modules. • **Is DTC B1317, B1676, P0563 (PCM) or U3003:17 set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to D2 .
D2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring	**Yes** REFER to Section 414-00 to diagnose an overcharging condition.

the battery voltage. • **Does the battery voltage rise to 16 volts or higher?**	**No** GO to D3 .
D3 RECHECK FOR DTC B1317	
• Turn the engine off. • Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • Clear the continuous memory DTCs. • Carry out the TBC module self-test. • **Is DTC B1317 present?**	**Yes** INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module module in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test E: DTC B1318

Refer to Wiring Diagrams Cell 13 , Power Distribution/SJB for schematic and connector information.

Normal Operation

- DTC B1318 (Battery Voltage Low) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module when the TBC module detects that battery voltage has dropped below 9 volts on the voltage supply circuit while not braking.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Charging system concern
- TBC module

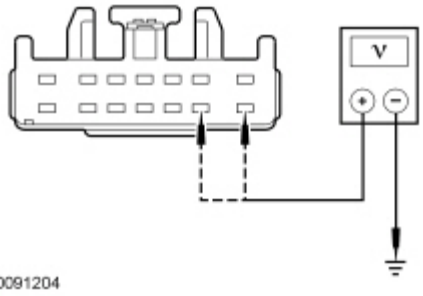
PINPOINT TEST E: DTC B1318

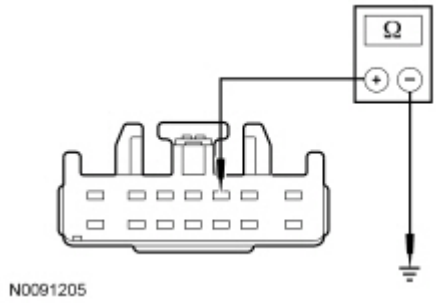
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
E1 RECHECK THE TBC MODULE DTCs	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • Clear the DTCs. Repeat the TBC module self-test. • **Is DTC B1318 still present?**	**Yes** GO to E2 . **No** The system is operating normally at this time. The DTC may have been set due to a previous low battery voltage condition.
E2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	

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• Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) . • **Is DTC P0620, P0622, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-01 . **No** GO to E3 .
E3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to E4 . **No** REFER to Section 414-00 .
E4 CHECK THE TBC MODULE VOLTAGE (MODULE_VOLT) PID	
• Ignition ON. • Measure and record the voltage at the battery. • Enter the following diagnostic mode on the scan tool: DataLogger — TBC Module . • Monitor the TBC MODULE_VOLT PID. • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to E7 . **No** GO to E5 .
E5 CHECK THE TBC MODULE VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: TBC Module C2142 . • Ignition ON. • Measure the voltage between the TBC module C2142-8, circuit SBB17 (RD), harness side and ground; and between the TBC module C2142-9, circuit CBP37 (WH), harness side and ground.  N0091204 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to E6 . **No** REPAIR the circuit. TEST the system for normal operation.
E6 CHECK THE TBC MODULE GROUND CIRCUIT FOR HIGH RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the TBC module C2142-3, circuit GD138 (BK/WH), harness side and ground.	**Yes** GO to E7 . **No** REPAIR the circuit. CLEAR the DTC. REPEAT the self-test.

 • **Is the resistance less than 5 ohms?**	
E7 CHECK FOR CORRECT TBC MODULE OPERATION	

• Disconnect the TBC module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the TBC module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: DTC B1863

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The Trailer Brake Control (TBC) module receives battery voltage from Battery Junction Box (BJB) fuse 17 (30A) and ignition voltage from Body Control Module (BCM) fuse 37 (10A).

- DTC B1863 (TBC Ground Open Circuit) — this DTC sets in continuous memory or on-demand when the TBC module detects an open circuit in the wiring, a connector condition causes an open in the ground circuit or if an internal failure of the TBC module causes an open in the ground circuit. The TBC module also disables trailer braking and sends a TRAILER BRAKE MODULE FAULT message to the message center. A trailer must be connected for this DTC to set.

This pinpoint test is intended to diagnose the following:

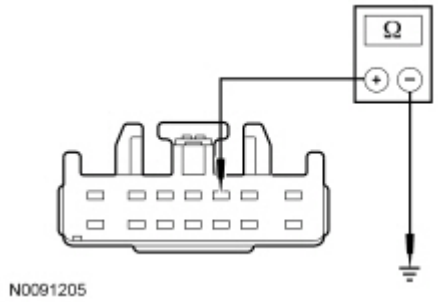
- Wiring, terminals or connectors
- TBC module

PINPOINT TEST F: DTC B1863

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

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NOTE: A trailer must be connected to the 7-pin trailer connector for DTC B1863 to set during the on-demand self-test.

Test Step	Result / Action to Take
F1 CHECK THE TBC MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: TBC Module C2142 . • Measure the resistance between TBC module C2142-3, circuit GD138 (BK/WH), harness side and ground.  N0091205 • **Is the resistance less than 5 ohms?**	**Yes** GO to F2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
F2 CHECK FOR CORRECT TBC MODULE OPERATION	

• Disconnect the TBC module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
  ▪ broken harness wire
  ▪ broken connector
• Connect the TBC module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test G: DTC U0100

Normal Operation

- DTC U0100 (Lost Communication With ECM/PCM "B") — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages received (vehicle speed) from the PCM are missing for more than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- PCM
- TBC module

PINPOINT TEST G: DTC U0100

Test Step	Result / Action to Take
G1 VERIFY THE SCAN TOOL CAN COMMUNICATE WITH THE PCM	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Verify that a vehicle session can be established with a scan tool. • **Can a vehicle session be established?**	**Yes** GO to G2 . **No** REFER to Section 418-00 to diagnose no communication with the PCM.
G2 CHECK THE TBC MODULE CONTINUOUS MEMORY DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • Clear the DTCs. Repeat the TBC module self-test. Record all TBC module DTCs. • **Is DTC U0100 retrieved again?**	**Yes** GO to G3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
G3 RETRIEVE THE RECORDED DTCs FROM THE TBC MODULE SELF-TEST	
• Check for recorded TBC module DTCs from the previous self-test. • **Is DTC B1317 or DTC B1318 recorded?**	**Yes** For DTC B1317, GO to Pinpoint Test D . For DTC B1318, GO to Pinpoint Test E . **No** GO to G4 .
G4 RETRIEVE THE RECORDED DTCs FROM THE PCM SELF-TEST	
• Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) . • **Is DTC P0562 or DTC P0563 recorded?**	**Yes** REFER to Section 303-14 . **No** GO to G5 .
G5 CHECK FOR DTC U0100:00 SET IN OTHER MODULES	

• Using a scan tool, retrieve the continuous memory DTCs from the following modules:
  ▪ Accessory Protocol Interface Module (APIM) (if equipped)
  ▪ BCM
  ▪ Instrument Panel Cluster (IPC)
  ▪ Occupant Classification System Module (OCSM)
  ▪ Power Steering Control Module (PSCM) (if equipped)
  ▪ Restraints Control Module (RCM)
  ▪ Transfer Case Control Module (TCCM) (if equipped)
• **Is DTC U0100:00 set in any of these modules?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 .
	
	No
	INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.

Pinpoint Test H: DTC U0121

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Normal Operation

- DTC U0121 (Lost Communication With Anti-Lock Brake System (ABS) Control Module) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages such as brake torque information are not received from the ABS module. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- ABS module
- TBC module

PINPOINT TEST H: DTC U0121

Test Step	Result / Action to Take
H1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to H2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
H2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out the network test. • **Does the ABS module pass the network test?**	**Yes** GO to H3 . **No** REFER to Section 418-00 to diagnose the ABS module does not respond to the scan tool.
H3 RETRIEVE ANY DTCs FROM THE TBC MODULE	
• Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • **Is DTC U3003:16 (or B1318) or DTC U3003:17 (or B1317) recorded?**	**Yes** For DTC B1317, GO to Pinpoint Test D . For DTC B1318, GO to Pinpoint Test E . For the ABS module, REFER to Section 206-09 . **No** GO to H4 .
H4 CHECK FOR DTC U0121:00 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Wait at least 5 seconds to allow the TBC module to sleep (power down). • Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Using a scan tool, retrieve the continuous memory DTCs from the following modules:	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the ABS module self-test. **No** INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.

▪ Body Control Module (BCM) ▪ Instrument Panel Cluster (IPC) ▪ Power Steering Control Module (PSCM) (if equipped) ▪ Transfer Case Control Module (TCCM) (if equipped) • **Is DTC U0121:00 set in any of these modules?**	

Pinpoint Test I: DTC U0140

Normal Operation

- DTC U0140 (Lost Communication With Body Control Module (GEM)) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages such as ignition state, park lamp status and illumination dimming level data are not received from the Body Control Module (BCM). For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- BCM
- TBC module

PINPOINT TEST I: DTC U0140

Test Step	Result / Action to Take
I1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to I2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
I2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out the network test. • **Does the BCM module pass the network test?**	**Yes** GO to I3 . **No** REFER to Section 418-00 .
I3 RETRIEVE ANY DTCs FROM THE TBC MODULE	
• Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • **Is DTC B1317 or DTC B1318 recorded?**	**Yes** For DTC B1317, GO to Pinpoint Test D . For DTC B1318, GO to Pinpoint Test E . **No** GO to I4 .
I4 RETRIEVE ANY DTCs FROM THE BCM	

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• Enter the following diagnostic mode on the scan tool: Self Test — BCM . • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to Section 419-10 . **No** GO to I5 .
I5 RECHECK THE TBC MODULE DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the TBC module self-test. • **Is DTC U0140 still present?**	**Yes** GO to I6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
I6 CHECK FOR DTC U0140 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Wait at least 5 seconds to allow the TBC module to sleep (power down). • Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Using a scan tool, retrieve the continuous memory DTCs from all modules. • **Is DTC U0140 set in more than one module?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . REPEAT the BCM self-test. **No** INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.

Pinpoint Test J: DTC U0155

Normal Operation

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IC) Control Module) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages received from the Instrument Panel Cluster (IPC) are missing. The IPC sends a TRAILER BRAKE CONFIG message to the TBC module. For a complete list of all network messages, refer to Section 413-01 .

This pinpoint test is intended to diagnose the following:

- IPC
- TBC module

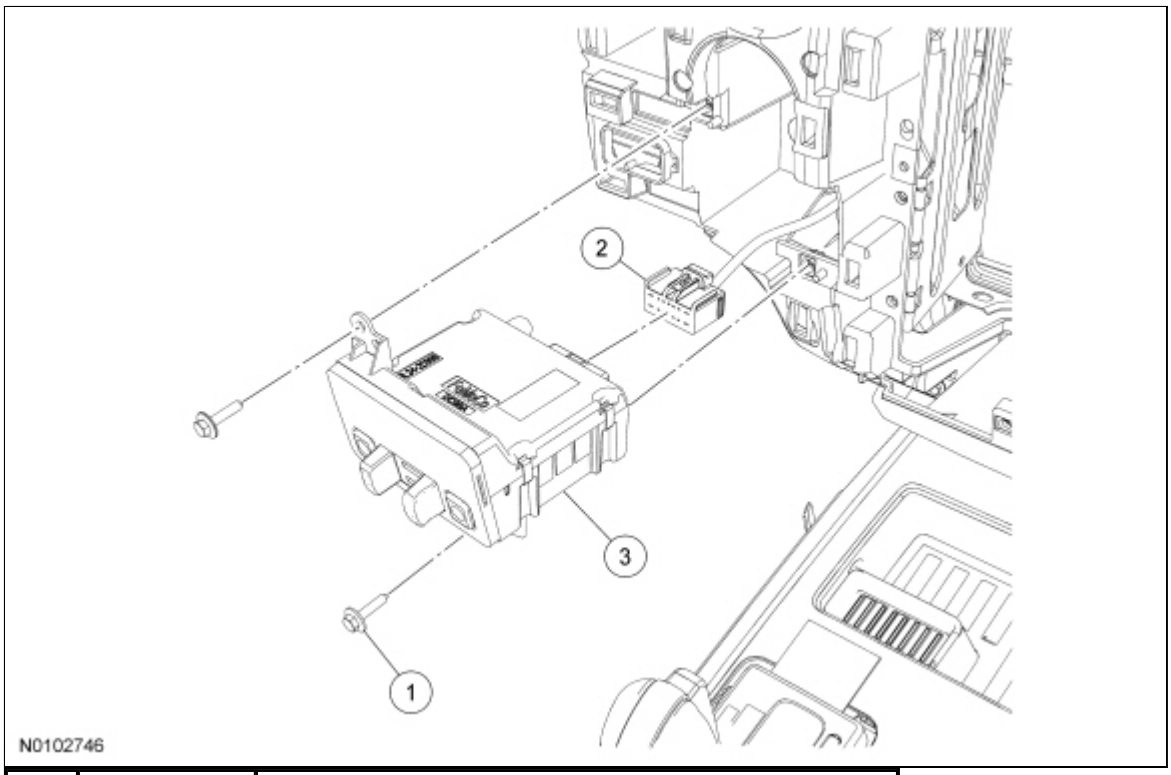
PINPOINT TEST J: DTC U0155

Test Step	Result / Action to Take
J1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Verify that there is an observable symptom present. • **Is an observable symptom**	**Yes** GO to J2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an

present?	intermittent fault condition.
J2 CHECK THE COMMUNICATION NETWORK	
• Using a scan tool, carry out the network test. • **Does the IPC pass the network test?**	**Yes** GO to J3 . **No** REFER to Section 418-00 .
J3 RETRIEVE THE RECORDED DTCs FROM THE TBC MODULE AND IPC SELF-TESTS	
• Enter the following diagnostic mode on the scan tool: Self Test — TBC Module . • Record the TBC module DTCs. • Enter the following diagnostic mode on the scan tool: Self Test — IPC . • **Is DTC U3003:16 (or B1318) or DTC U3003:17 (or B1317) recorded?**	**Yes** For TBC module DTC B1317, GO to Pinpoint Test D . For TBC module DTC B1318, GO to Pinpoint Test E . For IPC DTCs, REFER to Section 413-01 . **No** GO to J4 .
J4 CHECK FOR DTC U0155 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Wait at least 5 seconds to allow the TBC module to sleep (power down). • Ignition ON. • Allow at least 10 seconds for all modules to wake up and prove out. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0155:00 or DTC U0155 set in more than one module?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR the DTCs. REPEAT the IPC self-test. **No** INSTALL a new TBC module. REFER to Trailer Brake Control (TBC) Module in this section. TEST the system for normal operation.

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Trailer Brake Control (TBC) Module



Item	Part Number	Description
1	W707628	Trailer Brake Control (TBC) module bolt (2 required)
2	—	TBC module electrical connector (part of 14401)
3	2C006	TBC module

Removal and Installation

NOTE: The trailer brake system is normally installed at the assembly plant, however, the system can be installed at the dealership but only if the vehicle is equipped with the trailer tow option. This option can be confirmed by verifying the presence of both the 4-pin and the 7-pin connectors at the rear of the vehicle as well as a receiver hitch. If the vehicle is not equipped with these 3 items, then it is not equipped with trailer tow and cannot have the factory Trailer Brake Control (TBC) system installed.

On those vehicles equipped with the trailer tow option, the electrical connector for the TBC module is attached to the 14401 harness behind the steering column opening trim panel. If the system is installed at the dealership, the TBC module will be installed in place of the coin bin/storage tray and the Instrument Panel Cluster (IPC) must be configured to communicate with the TBC module. Refer to the Wiring Diagrams manual, Cell 95 Trailer/Camper Adapter and Cell 151 Component Location Views for connector and wiring information. Refer to Programmable Parameters in the Diagnosis and Testing portion of this section for information on IPC configuration.

1. Remove the LH center instrument panel trim panel. For additional information, refer to Center Instrument Panel Trim Panel in Section 501-12 .

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2. Remove the 2 TBC module bolts.

3. Remove the TBC module.
    - Disconnect the electrical connector.

4. To install, reverse the removal procedure.

Steering System

Electronic Power Assist Steering (EPAS) System

The Electronic Power Assist Steering (EPAS) system consists of the following components:

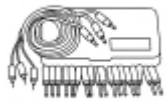
- Power Steering Control Module (PSCM) — the PSCM controls the functions of the EPAS system and communicates with other modules that are on the High Speed Controller Area Network (HS-CAN). The PSCM is attached to the EPAS gear assembly and is not available separately for service.
- Motor — the EPAS gear uses a 12-volt reversible motor to control the steering effort. The motor is connected to the steering rack by a toothed belt and a pulley/bearing assembly. The motor is used by the PSCM to move the rack inside the gear housing. Motor position is used to determine steering wheel angle/position instead of using a separate sensor. The motor is attached to the RH side of the EPAS gear assembly and is not available separately for service.
- EPAS gear assembly — the vehicle has two EPAS steering gear options available, one with a 20:1 steering ratio and one with a 17:1 steering ratio. The steering gear installed to the vehicle is dependant on the wheelbase and trailer tow capacity.
- Steering shaft torque sensor — the steering shaft torque sensor is used by the PSCM to determine how much force is being used to turn the steering wheel. The sensor sends out 2 signals, one for left and one for right. When the steering wheel is turned to the left, the left signal increases while the right signal decreases, likewise when the steering wheel is turned to the right, the right signal increases while the left signal decreases. This allows the PSCM to determine if the driver intends to go left or right in order to spin the motor in the appropriate direction. The sensor is mounted inside the EPAS gear assembly and is not available separately for service.
- Inner tie rod — one inner tie rod is located at each end of the EPAS gear assembly and is available separately for service, refer to Section 211-02 .
- Outer tie rod — one outer tie rod is located at each end of the EPAS gear assembly and is available separately for service, refer to Section 211-02 .
- EPAS gear bellows boot — one bellows boot is located on each side of the EPAS gear assembly. Each boot is held in place with 2 boot clamps. The boots and clamps are available for service, refer to Section 211-02 .
- EPAS gear isolators — there are two rubber isolators (one at each attaching point) on the EPAS gear assembly. These isolators aid in reducing NVH concerns and are not available separately for service.

The EPAS system utilizes a rack-and-pinion type steering gear. Power assist is provided by a motor that is connected to the steering rack by a belt and a pulley and bearing assembly. The steering gear and motor/module are serviced as an assembly. A new steering gear includes inner tie rods, however, the inner and outer tie rods can also be serviced separately. For information on tie-rod end service, refer to Section 211-02 .

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Steering System

Special Tool(s)

 ST1138-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Electronic Power Assist Steering (EPAS) System

The Electronic Power Assist Steering (EPAS) system provides power steering assist to the driver by replacing the conventional hydraulic valve system with an electric motor coupled to the steering rack by a toothed belt. The motor is controlled by the Power Steering Control Module (PSCM) that senses steering effort/use through an internally mounted steering shaft torque sensor. Steering assist is provided in proportion to the steering input effort and vehicle speed.

The EPAS system requires a 12-volt, hot at all times feed for system operation. The PSCM is activated when power is applied to the hard-wired ignition/run input. After activation, the PSCM monitors the High Speed Controller Area Network (HS-CAN) bus to determine if the vehicle is operating in a manner capable of supporting the EPAS system.

Once this is determined, vehicle speed sent by the PCM over the HS-CAN bus, steering shaft speed and direction sent by the steering shaft torque sensor and steering wheel angle/position determined by the motor position all provide the necessary information for the PSCM to determine the amount or level of assist provided by the EPAS system.

Assist is primarily based off of vehicle speed. As vehicle speed increases, the amount of assist provided by

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the system is decreased to improve and enhance road feel at the steering wheel. As vehicle speed decreases, the amount of assist provided by the system is increased to ease vehicle maneuvering. If the vehicle speed is missing or out of range, the PSCM defaults to a safe level of assist for all driving conditions. If the vehicle speed returns to the correct in-range values, the PSCM adjusts the level of assist accordingly. Steering wheel/shaft speed, torque and direction information allows the PSCM to determine how much assist is needed to turn the wheels right and left.

The PSCM continually monitors and adjusts steering efforts based on the torque sensor inputs to enhance the feel of the steering. Compensation is made to reduce the effect of pull or drift that may be experienced when driving on roads with a high degree of camber. Active nibble control is also employed by the PSCM to reduce the vibrating movement felt at the steering wheel that can be caused by driving on rough surfaces or out of balance wheels.

The PSCM is self-monitoring and has the capability of setting and storing DTCs. Depending on the DTC set, the control module enters into a "safe mode" of manual steering. In addition, the PSCM may send a request to the Instrument Panel Cluster (IPC) module over the HS-CAN bus to display a message in the message center to alert the driver of a potential EPAS concern.

Interactive Diagnostics

For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Material

Item	Specification	Fill Capacity
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	—	—
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV	—

General Specifications

Item	Specification
Steering Gear — SVT Raptor Crew Cab and Base F150 Without Max Trailer Tow	
Ratio	17:1
Turns of steering wheel lock to lock (linkage disconnected)	3.26
Steering Gear — SVT Raptor Super Cab and Base F150 With Max Trailer Tow	
Ratio	20:1
Turns of steering wheel lock to lock (linkage disconnected)	3.74
Power Steering Pump	
Flow	3.0 gpm ± 0.2 @ 145 psi and 1,500 rpm
Minimum capacity	1.6 gpm @ 725 psi and 500 rpm
Relief pressure	1,400-1,520 psi
Power Steering Purge Vacuum	
Minimum vacuum	67-84 kPa (20-25 in-Hg)

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Steering System

The power steering system consists of the following components:

- Power steering pump
- Power steering fluid reservoir
- Steering gear
- Power steering lines
- Steering column
- Steering column shaft
- Power steering cooler (if equipped)

The power steering system transfers driver inputs at the steering wheel to the front wheels of the vehicle. The steering column, hydraulic system and linkages that transfer these driver inputs make up the steering system. Gearing and hydraulic assist are used to significantly reduce steering efforts.

For information on the power steering fluid reservoir, power steering pump, power steering lines and steering gear, refer to Section 211-02 .

For information on the steering wheel, steering column and steering column shaft, refer to Section 211-04 .

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Steering System

Special Tool(s)

 ST1300-A	100W/12 Volt DC UV Lamp 164-R0751
 ST1396-A	Dial Thermometer 0-220°F 023-R0007 or equivalent
 ST2670-A	Evacuation Cap, Power Steering 211-265 or equivalent
 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	—
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Principles of Operation

Power Steering

The power steering system uses a vane-type pump to move the fluid from the reservoir to the steering gear and through the rest of the steering hydraulic system. The power steering pump is mounted to the engine and driven by the engine accessory drive belt. Power steering fluid flows into the pump from the reservoir. The power steering fluid is trapped between the pump vanes and moved to the high pressure side of the pump creating a flow of fluid. The restriction of this flow by the steering gear creates the pressure that provides the steering assist. A combined pressure relief/flow valve is built into the pump to control the maximum pressure and flow provided to the steering system. This action prevents damage to the system and provides the correct level of assist during all engine speeds. While under pressure, the power steering fluid flows through the high pressure power steering line to the steering gear. The fluid exits the gear and flows through the return line, cooler and finally to the reservoir. The reservoir slows the fluid, allows air to escape and filters the fluid before returning it to the pump.

Inspection and Verification

NOTICE: **Do not adjust the steering gear pinion preload or steering gear wear and/or damage to the steering gear may occur.**

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage or leaks.

Visual Inspection Chart

Mechanical
• Fluid level • Tire pressure • Tires • Drive belt • Drive belt tensioner • Steering column alignment • Tie-rod ends • Suspension components • Steering column shaft U-joints • Intermediate shaft bolts • Power steering reservoir baffle • Power steering reservoir screen • Power steering pressure lines, fittings or O-rings • Power steering return hoses and clamps • Steering gear • Power steering pump • Power steering fluid cooler (if equipped)

3. Inspect the power steering fluid for the following conditions:
   - Aeration or foam: Purge the power steering system. Refer to Power Steering System Purging in this section.
   - Overheating or contamination: Flush the power steering system. Refer to Power Steering

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System Flushing in this section.

4. **NOTE:** It may be necessary to add power steering fluid to achieve the correct level.

   Check the fluid level and clean the power steering components.
   With the ignition OFF:
   - check the power steering fluid level and add fluid as necessary.
   - wipe off any visible signs of fluid or residue build up.
   - ***NOTICE:*** **Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump may occur.**

     Start the engine and turn the steering wheel from stop-to-stop several times.

5. Visually inspect the power steering hydraulic line/hose connections for damage or leaks.

- If a leak is detected at a threaded fitting or clamp plate joint, tighten to specification. If the leak is still evident, visually inspect the O-rings or Teflon® seals. Install new O-rings or Teflon® seals as necessary. Refer to Section 211-02 .
- If a leak is detected at a constant tension spring clamp, verify that the hose is not damaged and fully installed on the hose fitting. Make sure that the constant tension spring clamp is positioned 2 mm (0.078 in) from the end of the hose. If the leak remains, install a new constant tension spring clamp.
- If a leak is detected at a screw clamp joint, verify that the hose is not damaged and fully installed on the hose fitting and the clamp is positioned 2 mm (0.078 in) from the end of the hose before tightening the screw clamp. If the leak remains, install a new screw clamp. Refer to Section 211-02 .

6. Visually inspect the power steering components for leaks.

- If a leak is detected in the power steering pressure line or return hose, install a new hose. Refer to Section 211-02 .
- If a leak is detected in the steering gear turn tubes, repair or install new turn tubes. Refer to Section 211-02 .
- If a leak is detected in the power steering pump, install a new power steering pump. Refer to Section 211-02 .
- **NOTE:** On vehicles with rack-and-pinion steering gear, it may be necessary to remove the bellows boot clamp from the steering gear bellows boot to inspect for internal steering gear leaks.

  If a leak is detected in the steering gear, repair or install a new steering gear. Refer to Section 211-02 .
- If a leak is detected in the power steering reservoir, install a new reservoir. Refer to Section 211-02 .

7. For information on power steering leak detection, refer to Component Tests in this section.

8. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding.

9. If the cause is not visually evident, verify the symptom and GO to Symptom Chart - Steering System or GO to Symptom Chart - NVH .

Steering System Symptom Definitions

NOTICE: **Do not adjust the steering gear pinion preload or steering gear wear and/or damage to the steering gear may occur.**

Drift/Pull

Pull is described as a tugging sensation felt by the hands on the steering wheel that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with the hands off the steering wheel.

- A vehicle-related drift/pull on a flat road can cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull can be induced by conditions external to the vehicle, such as wind or road camber.

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel free play is considered normal.

Lack of Assist or Inconsistent Assist

Lack of assist or inconsistent assist is experienced when the steering wheel effort is higher than normal. Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and poor returnability/sticky steering.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving or during high-effort parking maneuvers.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or steering correction is completed.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.

Symptom Chart — Steering System

Symptom Chart — Steering System

NOTICE: **Do not adjust the steering gear pinion preload or steering gear wear and/or damage to the steering gear may occur.**

Condition	Possible Sources	Action
• Steering has lack of assist or inconsistent assist	• Contaminated power steering fluid • Steering gear • Power steering pump • Restricted power steering lines/hoses	• GO to Pinpoint Test A .
• Excessive steering	• Steering gear	• GO to Pinpoint Test B .

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wheel play	• Steering column shaft/coupling • Steering linkage	
• Steering system drift/pull/wander	• Steering column shaft/U-joints • Steering gear • Steering gear mounts	• GO to Pinpoint Test C .
• Poor returnability/sticky steering	• Binding steering column shaft/coupling U-joints	• INSTALL a new steering column shaft. REFER to Section 211-04 .
	• Suspension components	• To continue the suspension diagnosis, REFER to Section 204-00 .
	• Binding steering column bearing(s)	• INSTALL a new steering column. REFER to Section 211-04 .
	• Binding dash boot seal	• INSTALL a new dash boot seal. REFER to Section 211-04 .
	• Steering gear turn tube banjo bolts/dampers	• INSTALL new banjo bolt/dampers. REFER to Steering Gear Turn Tubes Removal and Installation in Section 211-02 .
	• Steering gear	• The steering gear cannot be adjusted. INSTALL a new steering gear as necessary. REFER to Section 211-02 .

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Steering system cold start noise	• Blockage in the power steering fluid reservoir filter screen or return ports caused by power steering fluid contamination	• **NOTE:** Some noise during an extremely cold start (-12.2°C [-10°F]) is normal and should improve as the steering system warms up (usually within 60 seconds). • **NOTE:** It may be necessary to remove the power steering fluid reservoir to flush contamination trapped in the reservoir

		filter/screen or to remove blockage in the return ports. CHECK the power steering fluid reservoir filter/screen or return ports for contaminants or blockage. FLUSH the power steering system as necessary. REFER to Power Steering System Flushing in this section.
	• Air in the steering hydraulic system (aerated fluid)	• CHECK for leaks in the system. REFER to Power Steering Leak Test Component Test. PURGE the air from the system. REFER to Power Steering System Purging in this section.
• Steering grunt or shudder — occurs when turning into or out of a turn at low speeds (temperature sensitive)	• Air in the steering hydraulic system (aerated fluid)	• CHECK for leaks in the system. REFER to Power Steering Leak Test Component Test. PURGE the air from the system. REFER to Power Steering System Purging in this section.
	• Steering gear or power steering hoses	• GO to Steering Gear Grunt/Shudder Component Test in this section.
• Steering system clonk — hydraulic knocking sound	• Air in the steering hydraulic system (aerated fluid)	• **NOTE:** Some amount of clonk noise is considered acceptable. If in doubt of the acceptability, compare to another vehicle. CHECK for leaks in the system. REFER to Power Steering Leak Test Component Test. PURGE the air from the system. REFER to Power Steering System Purging in this section.
• Power steering pump moan — loud humming noise occurs when the steering wheel is rotated to the stop position. Produces a 120-600 Hz frequency that changes with rpm	• Low fluid and/or air in the steering hydraulic system (aerated fluid)	• CHECK for leaks in the system. REFER to Power Steering Leak Test Component Test. PURGE the air from the system. REFER to Power Steering System Purging in this section. If a pump moan still exists, INSTALL a new power steering pump. REFER to Section 211-02.
	• Blockage in the power steering fluid reservoir filter/screen or return ports caused by power steering fluid contamination	• **NOTE:** It may be necessary to remove the power steering fluid reservoir to flush contamination trapped in the reservoir filter/screen or to remove blockage in the return ports. CHECK the power steering fluid

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		reservoir filter/screen or return ports for contaminants or blockage. FLUSH the power steering system as necessary. REFER to Power Steering System Flushing in this section.
	• Power steering line/hose grounded to chassis	• INSPECT the power steering lines/hoses. REPAIR as necessary.
	• Power steering pump brackets loose or misaligned	• CHECK bolts, brackets and bracket alignment. TIGHTEN bolts to specification. REPAIR or INSTALL new brackets as necessary. REFER to Section 211-02 .
	• Steering gear isolators	• INSPECT the isolators for wear or damage. REPAIR as necessary.
• Steering gear clunk — occurs only while cornering over a bump (can be temperature sensitive)	• Steering gear	• INSPECT the steering gear for loose mounting bolts. TIGHTEN to specification as necessary. REFER to Section 211-02 .
• Feedback (rattle, chuckle or knocking noise in the steering gear) — roughness is felt in the steering wheel when the vehicle is driven over rough surfaces	• Steering column shaft/coupling joints damaged or worn	• INSTALL a new steering column shaft. REFER to Section 211-04 .
	• Loose, damaged or worn tie-rod ends	• INSPECT and INSTALL new tie-rod ends as necessary. GO to Steering Linkage Component Test in this section.
	• Steering gear insulators or mounting bolts loose or damaged	• TIGHTEN the bolts to specification or INSTALL new bolts as necessary. REFER to Section 211-02 .
	• Steering column shaft/coupling bolts are loose	• TIGHTEN the bolts to specification. REFER to Section 211-04 .
	• Steering column damaged or worn	• REPAIR or INSTALL a new steering column as necessary. REFER to Section 211-04 .
• Power steering hiss or whistle	• Steering column shaft/coupling-to-steering gear is binding or misaligned	• REPAIR or INSTALL a new steering column shaft as necessary. REFER to Section 211-04 .
	• Grounded or loose steering column boot at the dash	• REPAIR as necessary.

	panel • Damaged or worn steering gear input shaft and valve • Restricted power steering lines/hoses	 • REPAIR or INSTALL a new steering gear as necessary. REFER to Section 211-02 . • GO to Pinpoint Test A .
• Steering column rattle	• Loose bolts or attaching brackets • Loose, worn or insufficiently lubricated column bearings • Steering shaft insulators damaged or worn • Steering column shaft/coupling compressed or extended	• TIGHTEN the bolts to specification. • LUBRICATE bearings or INSTALL new steering column bearings or steering column as necessary. REFER to Section 211-04 . • INSTALL new insulators. REFER to Section 211-04 . • INSPECT the rubber spider coupling for damage. INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
• Steering gear squeak	• Incorrect power steering fluid in system • Steering gear rotary seal • Stone shield (if equipped)	• If incorrect power steering fluid is suspected, FLUSH the power steering system. REFER to Power Steering System Flushing in this section. If noise persists after system flush, INSTALL a new steering gear. REFER to Section 211-02 . • **NOTE:** Use the chassis ears to verify that the steering gear is the source of the noise. It may be necessary to replicate the customer operating conditions (fluid temperature, turning rate of steering wheel) to get the squeak to reoccur. INSTALL a new steering gear as necessary. REFER to Section 211-02 . • MAKE SURE that the stone shield is correctly installed and that it is not making contact with the steering shaft. REPOSITION stone shield or INSTALL a new stone shield as necessary.
• Steering column squeak, cracks or grinds	• Loose or misaligned steering column shrouds • Steering wheel rubbing against	• TIGHTEN or ALIGN the steering column shrouds. • REPOSITION the steering column shrouds.

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	steering column shrouds	
• Steering column ticking or creaking noise	• Steering column lower bearing	• VERIFY that the noise is coming from the lower bearing and INSTALL a new bearing as necessary. REFER to Disassembly and Assembly — Steering Column in Section 211-04 .
• Power steering pump noisy	• Blockage in the power steering fluid reservoir filter/screen or return ports caused by power steering fluid contamination	• **NOTE:** It may be necessary to remove the power steering fluid reservoir to flush contamination trapped in the reservoir filter/screen or to remove blockage in the return ports. CHECK the power steering fluid reservoir filter/screen or return ports for contaminants or blockage. FLUSH the power steering system as necessary. REFER to Power Steering System Flushing in this section.
	• Power steering pump	• INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
• Power steering pump noise (steering wheel turned fully to stop/lock)	• Power steering fluid flow into the bypass valve of the pump valve housing, with fluid temperature below 54°C (130°F)	• Acceptable condition.
• Power steering pump whine noise	• Aerated fluid	• CHECK for a leak in the system. REFER to Power Steering Fluid Leak Test Component Test. PURGE the air from the system. REFER to Power Steering System Purging in this section.
	• Blockage in the power steering fluid reservoir filter/screen or return ports caused by power steering fluid contamination	• **NOTE:** It may be necessary to remove the power steering fluid reservoir to flush contamination trapped in the reservoir filter/screen or to remove blockage in the return ports. CHECK the power steering fluid reservoir filter/screen or return ports for contaminants or blockage. FLUSH the power steering system as necessary. REFER to Power Steering System Flushing in this section.
	• Damaged power steering pump	• INSTALL a new power steering pump as necessary. REFER to

		Section 211-02 .
• High speed shake or shimmy — occurs at high speeds	• Worn or damaged steering linkage components	• GO to Steering Linkage Component Test in this section.

Pinpoint Tests

Pinpoint Test A: Steering Has a Lack of Assist or Inconsistent Assist

NOTE: Hard steering or lack of assist is experienced when the steering wheel effort is higher than normal. Hard steering can remain constant through the full turn, occur near the end of a turn or differ right to left.

This pinpoint test is intended to diagnose the following:

- Power steering fluid contamination
- Steering gear
- Power steering pump
- Power steering hoses

PINPOINT TEST A: STEERING HAS A LACK OF ASSIST OR INCONSISTENT ASSIST — RWD VEHICLES

Test Step	Result / Action to Take
A1 CHECK FOR POWER STEERING FLUID CONTAMINATION	
• Check the power steering fluid for contamination. • **Is the power steering fluid free of any contamination?**	**Yes** GO to A2 . **No** FLUSH the power steering system. REFER to Power Steering System Flushing in this section. TEST the system for normal operation. If the assist concern is still present, GO to A2 .
A2 CHECK THE STEERING ASSIST WITH THE ENGINE SPEED RAISED	
• ***NOTICE:*** **Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump may occur.** • Set the engine speed to 2,100 rpm and turn the steering wheel fully to the left and right. • **Is steering assist fully restored to normal with the engine speed raised?**	**Yes** INSTALL a new power steering pump. REFER to Section 211-02 . **No** GO to A3 .
A3 CHECK FOR A CHANGE IN ASSIST ON LEFT AND RIGHT TURNS	
• With the engine running at idle, turn the steering	**Yes**

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wheel fully to the left and to the right. • **Does the steering assist change when turning from right to left?**	INSTALL a new power steering gear. REFER to Section 211-02 . **No** GO to A4 .
A4 CHECK THE STEERING LINES AND HOSES FOR RESTRICTIONS	
• Inspect the steering lines and hoses for damage, kinks or restrictions. • **Are the steering lines and hoses free from any damage, kinks and/or restrictions?**	**Yes** GO to A5 . **No** INSTALL new lines and/or hoses as necessary. TEST the system for normal operation.
A5 MONITOR THE ENGINE SPEED CHANGES	
***NOTICE:* Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump may occur.** **NOTE:** Make sure that the vehicle is on a flat dry surface, all accessories are in the OFF position and that the steering system is at normal operating temperature. • Connect the scan tool. • Start the engine. • With the engine running at idle, raise the power steering fluid temperature to 74°-80°C (165°-176°F) by rotating the steering wheel fully to the left and to the right several time. • Enter the following diagnostic mode on the scan tool: DataLogger — PCM. • Monitor the Engine Revolutions Per Minute (RPM) PID while turning the steering wheel quickly to the left stop position and then to the right stop position. • Note the engine rpm during the turns. • **Does the engine speed change (even temporarily) by more than 30 rpm when turning the steering wheel?**	**Yes** INSTALL a new power steering gear. REFER to Section 211-02 . **No** INSTALL a new power steering pump. REFER to Section 211-02 .

Pinpoint Test B: Excessive Steering Wheel Play

This pinpoint test is intended to diagnose the following:

- Steering linkage
- Steering column shaft
- Steering gear

PINPOINT TEST B: EXCESSIVE STEERING WHEEL PLAY

Test Step	Result / Action to Take
B1 CHECK THE STEERING LINKAGE	

• Carry out the Steering Linkage Component Test in this section. • **Is the steering linkage OK?**	**Yes** GO to B2 . **No** INSTALL new steering linkage components as necessary. REFER to Section 211-02 .
B2 CHECK THE STEERING COLUMN SHAFT	
• Inspect the steering column shaft U-joints and fasteners for looseness. • **Are the U-joints and fasteners OK?**	**Yes** INSTALL a new steering gear as necessary. REFER to Section 211-02 . **No** TIGHTEN the steering column shaft fasteners or INSTALL a new steering column shaft. REFER to Section 211-04 .

Pinpoint Test C: Steering System Drift/Pull/Wander

This pinpoint test is intended to diagnose the following:

- Steering column shaft
- Steering gear
- Steering gear mounts
- Steering column shaft U-joints

PINPOINT TEST C: STEERING SYSTEM DRIFT/PULL/WANDER

Test Step	Result / Action to Take
C1 CHECK THE STEERING COLUMN SHAFT	
• **NOTE:** Be sure to keep the clockspring centered when disconnecting the intermediate shaft. Refer to Section 501-20B . • Check the steering column and shaft for grounding. • Disconnect the steering column shaft at the steering column. • Inspect the steering column shaft U-joints for looseness or wear. • **Are the steering column shaft U-joints OK?**	**Yes** GO to C2 . **No** INSTALL new steering column shaft as necessary. REFER to Section 211-04 .
C2 CHECK THE STEERING GEAR MOUNTING	
• Check the steering gear mounts for looseness or wear. • **Are the steering gear mounts OK?**	**Yes** GO to C3 . **No** INSTALL a new steering gear as necessary. REFER to Section 211-02 .
C3 CHECK THE STEERING GEAR	
• Carry out the Steering Gear Valve Component Test in this section. • **Is the steering gear valve OK?**	**Yes** REFER to Section 204-00 to diagnose suspension system drift/pull/wander.

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	No INSTALL a new steering gear as necessary. REFER to Section 211-02 .

Component Tests

Power Steering Fluid Leak Test

NOTE: This test should only be carried out if a leak in the system has not been detected during a thorough visual inspection. Refer to Inspection and Verification.

1. Remove the power steering pump reservoir cap and check the power steering fluid level. If necessary, add the specified power steering fluid.

2. Tightly install the Power Steering Evacuation Cap onto the reservoir and connect the Vacuum Pump Kit to the Evacuation Cap.

3. Using the Vacuum Pump Kit, apply 68-85 kPa (20-25 in-Hg) of vacuum to the power steering system.

4. Observe the vacuum gauge for 30 seconds. If the vacuum gauge reading drops more than 3 kPa (0.88 in-Hg), a leak is present.

5. Remove the Vacuum Pump Kit.

6. Start the engine and insert the Dial Thermometer into the Evacuation Cap.

7. ***NOTICE:*** **Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump may occur.**

   With the engine at idle, raise the power steering fluid temperature to 74-80°C (165-176°F) by rotating the steering wheel fully to the left and right several times.

8. Stop the engine and visually inspect the system for leaks.
   - If a leak is evident, repair as necessary.
   - If a leak is not evident, add the specified UV fluorescent tracer dye to the power steering fluid. Use 14.78 ml (1/2 oz) of dye solution for every 1.89L (2 qt) of power steering fluid.

9. Start the engine.

10. ***NOTICE:*** **Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump may occur.**

    With the engine at idle, raise the power steering fluid temperature to 74-80°C (165-176°F) by rotating the steering wheel fully to the left and right several times.

11. Stop the engine and inspect the system for traces of UV dye using the 100W/12 Volt DC UV Lamp. Repair as necessary.

Steering Gear Valve Test

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
   - Raise the vehicle until the front wheels are off the ground.

2. **NOTE:** Do not hold the steering wheel while carrying out this step.

   Start the engine.
   - If the steering wheel rotates in either direction (with no hand input), install a new steering gear. Refer to Section 211-02 .

Steering Gear Grunt/Shudder Test

1. Place a Dial Thermometer in the power steering fluid reservoir.

2. With the engine cold, start the engine and set engine idle speed to 1,200 rpm.

3. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

   Rotate the steering wheel to the RH stop, then turn the steering wheel 90 degrees back from that position. Slowly turn the steering wheel back and forth approximately one-twelfth of a full turn.

4. Turn the steering wheel another 90 degrees. Slowly turn the steering wheel back and forth approximately one-twelfth of a full turn.

5. Repeat the test with the power steering fluid at different temperatures until the temperature reaches 74-80°C (165-176°F).

6. If a light grunt is heard or a low (50-200 Hz) shudder is present, this is a normal steering system condition.

7. If a loud grunt is heard, or a strong shudder is felt, purge the power steering system. Refer to Power Steering System Purging in this section. If a loud grunt or strong shudder still exists, check the power steering lines/hoses for restrictions or damage and repair as necessary. Refer to Section 211-02 . If the lines/hoses are OK, install a new steering gear. Refer to Section 211-02 .

Steering Linkage Test

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

2. Using hand force only, check the inner and outer tie rods for vertical and lateral movement in the tie-rod ball studs/sockets.
   - If there is any lateral or vertical movement in the tie-rod ball studs/sockets (inner or outer), a new tie-rod must be installed. Refer to the appropriate section in Group 211 for the procedure.

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Power Steering System Filling

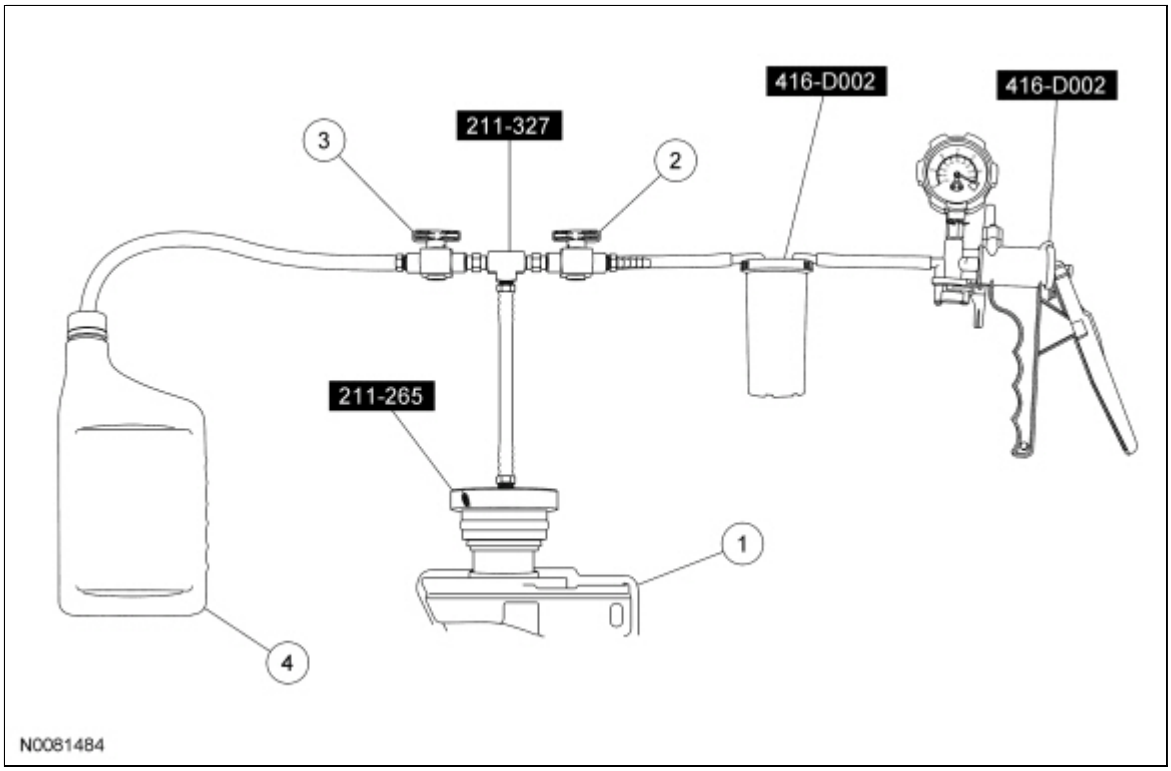
Special Tool(s)

 ST2670-A	Evacuation Cap, Power Steering 211-265
 ST2826-A	Fill Adapter Manifold, Power Steering 211-327
 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

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Item	Description
1	Power steering fluid reservoir
2	Control valve (vacuum side)
3	Control valve (fluid container side)
4	Fluid container

1. ***NOTICE:*** **If the air is not purged from the power steering system correctly, premature power steering pump failure may result. The condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.**

   Remove the power steering fluid reservoir cap.

2. Install the Power Steering Evacuation Cap, Power Steering Fill Adapter Manifold and Vacuum Pump Kit as shown in the illustration.

3. **NOTE:** The Power Steering Fill Adapter Manifold control valves are in the OPEN position when the points of the handles face the center of the Power Steering Fill Adapter Manifold.

   Close the Power Steering Fill Adapter Manifold control valve (fluid side).

4. Open the Power Steering Fill Adapter Manifold control valve (vacuum side).

5. Using the Vacuum Pump Kit, apply 68-85 kPa (20-25 in-Hg) of vacuum to the power steering system.

6. Observe the Vacuum Pump Kit gauge for 30 seconds.

7. If the Vacuum Pump Kit gauge reading drops more than 3 kPa (0.88 in-Hg), correct any leaks in the power steering system or the Power Steering Evacuation Cap, Power Steering Fill Adapter Manifold

and Vacuum Pump Kit before proceeding.

8. **NOTE:** The Vacuum Pump Kit gauge reading will drop slightly during this step.

   Slowly open the Power Steering Fill Adapter Manifold control valve (fluid side) until power steering fluid completely fills the hose and then close the control valve.

9. Using the Vacuum Pump Kit, apply 68-85 kPa (20-25 in-Hg) of vacuum to the power steering system.

10. Close the Power Steering Fill Adapter Manifold control valve (vacuum side).

11. Slowly open the Power Steering Fill Adapter Manifold control valve (fluid side).

12. Once power steering fluid enters the fluid reservoir and reaches the minimum fluid level indicator line on the reservoir, close the Power Steering Fill Adapter Manifold control valve (fluid side).

13. Remove the Power Steering Evacuation Cap, Power Steering Fill Adapter Manifold and Vacuum Pump Kit.

14. Install the reservoir cap.

15. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

    NOTE: There will be a slight drop in the power steering fluid level in the reservoir when the engine is started.

    Start the engine and turn the steering wheel from stop-to-stop.

16. Turn the ignition switch to the OFF position.

17. **NOTE:** Do not overfill the reservoir.

    Remove the reservoir cap and fill the reservoir with the specified fluid.

18. Install the reservoir cap.

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Power Steering System Flushing

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

NOTICE: **Do not mix fluid types. Any mixture or any unapproved fluid may lead to seal deterioration and leaks. A leak may ultimately cause loss of fluid, which may result in a loss of power steering assist.**

1. Remove the power steering fluid reservoir cap.
2. Using a suitable suction device, remove the power steering fluid from the reservoir.
3. Release the clamp and disconnect the return hose from the reservoir.
   - Remove the clamp from the hose and allow the remaining fluid to drain out of the reservoir.
4. Plug the power steering fluid reservoir inlet port.
5. Attach an extension hose to the return hose.
6. **NOTE:** Do not reuse the power steering fluid that has been flushed from the power steering system.

   Place the open end of the extension hose into a suitable container.
7. If equipped with Hydro-Boost®, apply the brake pedal 4 times.
8. **NOTE:** Do not overfill the reservoir.

   Fill the reservoir as needed with the specified fluid.
9. ***NOTICE:*** **Do not allow the power steering pump to run completely dry of power steering fluid. Damage to the power steering pump may occur.**

   Start the engine while simultaneously turning the steering wheel to lock and then immediately turn the ignition switch to the OFF position.
10. **NOTE:** Avoid turning the steering wheel without the engine running as this may cause air to be pulled into the steering gear.

    NOTE: Do not overfill the reservoir.

    Fill the reservoir as needed with the specified fluid.

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11. Repeat Steps 8 and 9, turning the steering wheel in the opposite direction each time, until the fluid exiting the power steering fluid return hose is clean and clear of foreign material.

12. Remove the extension hose from the return hose.

13. Remove the plug from the fluid reservoir inlet port.

14. Install the clamp and connect the power steering return hose to the reservoir.

15. **NOTE:** It is necessary to correctly fill the power steering system to remove any trapped air and completely fill the power steering system components.

    If, after correctly filling the power steering system, there is power steering noise accompanied by evidence of aerated fluid and there are no fluid leaks, it may be necessary to purge the power steering system. For additional information, refer to Power Steering System Purging in this section.

    Fill the power steering system. For additional information, refer to Power Steering System Filling in this section.

Power Steering System Purging

Special Tool(s)

 ST2670-A	Evacuation Cap, Power Steering 211-265
 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

NOTICE: **If the air is not purged from the power steering system correctly, premature power steering pump failure may result. The condition may occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.**

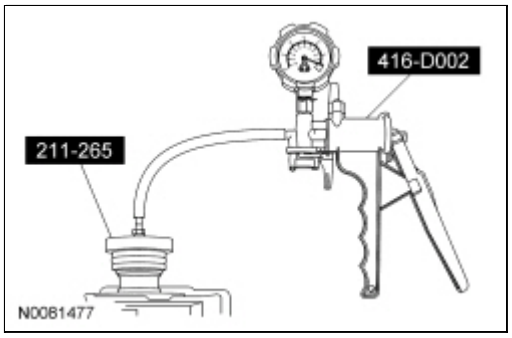
1. **NOTE:** A whine heard from the power steering pump can be caused by air in the system. The power steering purge procedure must be carried out prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.

   Remove the power steering reservoir cap. Check the fluid.

2. Raise the front wheels off the floor. Refer to the appropriate section in Group 100 for the procedure.

3. Tightly insert the Power Steering Evacuation Cap into the reservoir and connect the Vacuum Pump Kit.

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4. Start the engine.

5. Using the Vacuum Pump Kit, apply vacuum and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).
    - If the Vacuum Pump Kit does not maintain vacuum, check the power steering system for leaks before proceeding. For additional information, refer to Power Steering Fluid Leak Test in this section.

6. If equipped with Hydro-Boost®, apply the brake pedal 4 times.

7. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

    Cycle the steering wheel fully from stop-to-stop 10 times.

8. Stop the engine.

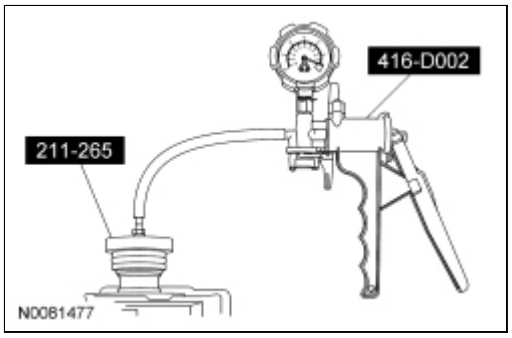
9. Release the vacuum and remove the Vacuum Pump Kit and the Power Steering Evacuation Cap.

10. **NOTE:** Do not overfill the reservoir.

    Fill the reservoir as needed with the specified fluid.

11. Start the engine.

12. Install the Power Steering Evacuation Cap and the Vacuum Pump Kit. Apply and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).



13. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

    Cycle the steering wheel fully from stop-to-stop 10 times.

14. Stop the engine, release the vacuum and remove the Vacuum Pump Kit and the Power Steering Evacuation Cap.

15. **NOTE:** Do not overfill the reservoir.

    Fill the reservoir as needed with the specified fluid and install the reservoir cap.

16. Visually inspect the power steering system for leaks.

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Material

Item	Specification	Fill Capacity
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Inner tie rod	120	89	—
Outer tie-rod end jam nut	103	76	—
Outer tie-rod end nut	115	85	—
Power steering fluid reservoir stud bolt	8	—	71
Pressure line bracket-to-crossmember bolt	7	—	62
Pressure line clamp plate-to-pump bolt	25	18	—
Power steering pump bolts	25	18	—
Skid plate bolts (all except SVT Raptor)	25	18	—
Skid plate bolts (SVT Raptor)	48	35	—
Steering column shaft-to-steering gear bolt	30	22	—
Steering gear-to-crossmember bolts	440	325	—
Steering gear turn tube dampers	30	—	22
Steering gear turn tube fittings	20	—	177
Steering line clamp plate-to-steering gear bolt	23	17	—

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Power Steering

Hydraulic Power Assist Steering (HPAS)

The hydraulic power steering system consists of the following components:

- Power steering pump
- Power steering fluid reservoir
- Power steering pressure and return lines/hoses
- Power steering fluid cooler
- Steering gear
- Inner tie rod
- Outer tie rod

The power steering system uses a vane-type pump to move the fluid from the reservoir to the steering gear and through the rest of the steering hydraulic system. The power steering pump is mounted to the engine and driven by the engine accessory drive belt. Power steering fluid flows into the pump from the reservoir. The power steering fluid is then trapped between the pump vanes and moved to the high-pressure side of the pump creating a flow of fluid. The restriction of this flow by the steering gear creates the pressure that provides the steering assist. A combined pressure relief/flow valve is built into the pump to control the maximum pressure and flow provided to the steering system. This action prevents damage to the system and provides the correct level of assist during all engine speeds. While under pressure, the power steering fluid flows through the high-pressure power steering line to the steering gear. The fluid exits the gear and flows through the return line, cooler and finally to the reservoir. The reservoir slows the fluid, allows air to escape and filters the fluid before returning it to the pump.

Electronic Power Assist Steering (EPAS)

The Electronic Power Assist Steering (EPAS) consists of the following components:

- Steering gear
- Outer tie rod
- Inner tie rod

The EPAS system utilizes a rack-and-pinion type steering gear. Power assist is provided by a motor that is connected to the steering rack by a belt and a pulley and bearing assembly. The steering gear and motor/module are serviced as an assembly. A new steering gear includes inner tie rods, however, the inner and outer tie rods can also be serviced separately.

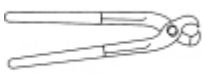
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Power Steering

For vehicles equipped with Electronic Power Assist Steering (EPAS), refer to Section 211-00A . For vehicles equipped with Hydraulic Power Assist Steering (HPAS), refer to Section 211-00B .

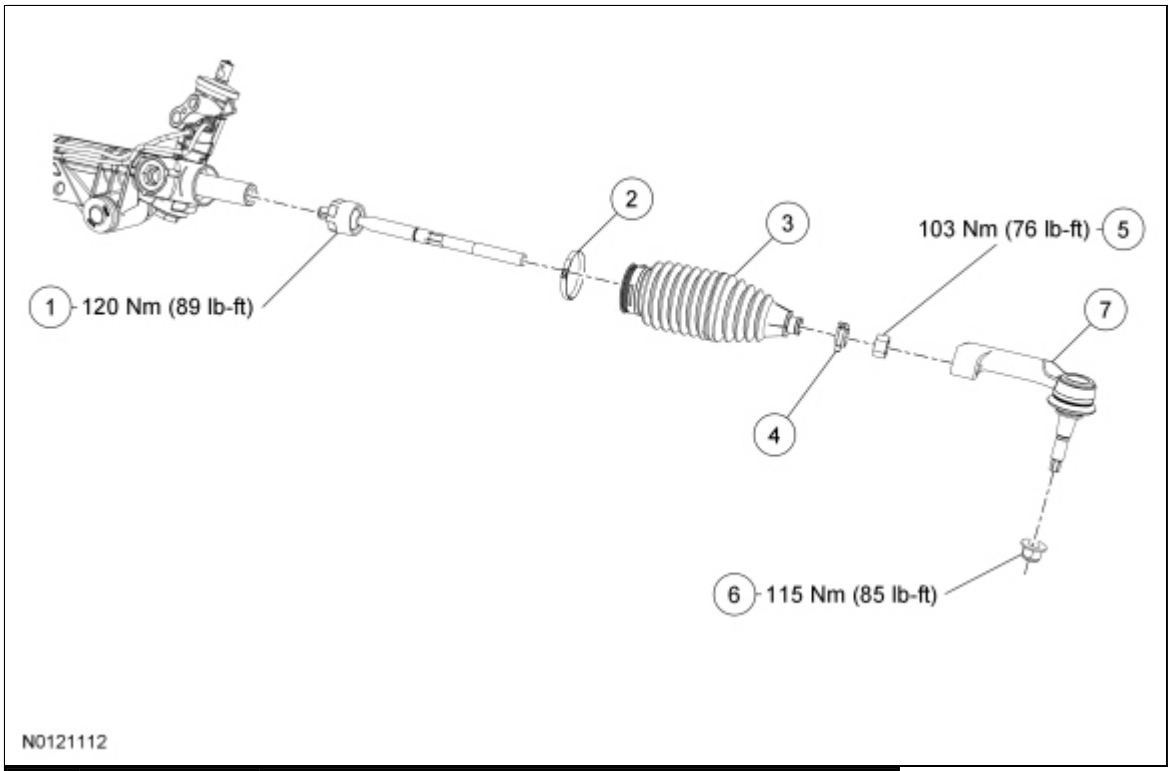
Inner Tie Rod

Special Tool(s)

 ST1525-A	Boot Clamp Pliers 205-D067 (D87P-1098-A) or equivalent
 ST2945-A	Separator, Ball Joint Tool 204-592

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



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Item	Part Number	Description
1	3280	Inner tie rod
2	—	Inner bellows boot clamp (part of 3332 service kit)
3	—	Steering gear bellows boot (part of 3332 service kit)
4	—	Outer bellows boot clamp (part of 3332 service kit)
5	W712367	Tie-rod jam nut
6	W520215	Outer tie-rod end nut
7	3A130	Outer tie-rod end

Removal

NOTICE: **The steering gear boots and clamps are designed to produce an airtight seal and protect the internal components of the steering gear. If the seal is not airtight, the vacuum generated during turning will draw water and foreign material into the gear, causing damage. Zip ties do not provide an airtight seal and must not be used.**

NOTICE: **When servicing inner tie rods, a new bellows boot and clamps must be installed or a leak may occur causing steering gear damage.**

NOTICE: **The inner tie-rod ball joint grease is not compatible with water. Water trapped in the grease will damage the joint.**

1. ***NOTICE:*** **For vehicles equipped with Electronic Power Assist Steering (EPAS), disconnect the negative battery cable anytime the steering linkage is being serviced or damage to the steering gear internal power relay may occur resulting in steering gear replacement.**

   If equipped with Electronic Power Assist Steering (EPAS), disconnect the battery ground cable. For additional information, refer to Section 414-01 .

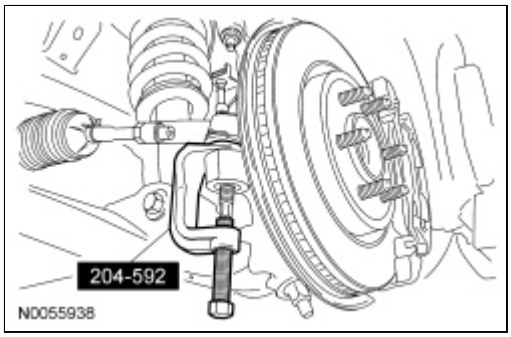
2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. Loosen the tie-rod jam nut.

4. Remove and discard the outer tie-rod end nut.

5. ***NOTICE:*** **Use care when installing the Ball Joint Tool Separator or damage to the tie-rod end boot may occur.**

   Using the Ball Joint Tool Separator, separate the outer tie-rod end from the wheel knuckle.



6. **NOTE:** Note the number of times the outer tie-rod ends turn for reference during assembly.

   Remove the outer tie-rod end.

7. Remove the tie-rod jam nut from the inner tie rod.

8. **NOTE:** New bellows boot clamps must be installed.

   Remove and discard the inner and outer bellows boot clamps.

9. Remove and discard the steering gear bellows boot.

10. **NOTE:** Place the steering gear at the center position. Use an appropriate-sized crowfoot wrench on the flat of the rack gear to resist rotation and to prevent damage during removal and installation of the inner tie rod.

    NOTE: If repairing the RH side, it will be necessary to pull back the LH inner tie-rod boot to hold the steering gear.

    NOTE: An assistant may be needed for removal of the RH inner tie rod.

    While holding the steering gear rack, use an appropriate-sized crowfoot wrench to remove the inner tie rod.

11. Thoroughly clean and inspect all the parts to be reused. Install new parts as necessary.

Installation

1. ***NOTICE:*** **Place the steering gear at the center position. Use an appropriate-sized crowfoot wrench on the flat of the rack gear to resist rotation and to prevent damage during the installation of the inner tie rod.**

   NOTE: An assistant may be needed for installation of the RH inner tie rod.

   Using an appropriate-sized crowfoot wrench, install the inner tie rod.
   - Tighten to 120 Nm (89 lb-ft).

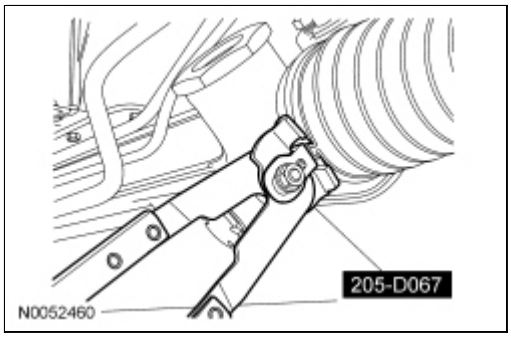
2. **NOTE:** Apply the specified grease to the bellows boot groove on the inner tie rod.

   NOTE: Make sure the steering gear bellows boot is positioned correctly over the steering gear housing bead and the groove in the inner tie rod.

   Install the new steering gear bellows boot.

3. Using the Boot Clamp Pliers, install a new inner bellows boot clamp.

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4. **NOTE:** Make sure the end of the steering gear bellows is positioned between the 2 grooves on the inner tie rod or an internal leak can result.

   Install a new outer bellows boot clamp.

5. Thread the tie-rod jam nut onto the inner tie rod.

6. **NOTE:** Install the outer tie-rod end the same number of turns as recorded during the removal.

   Install the outer tie-rod end.

7. ***NOTICE:*** **Make sure that the tie-rod end boots are seated correctly on the tie-rod ends or failure may occur.**

   Connect the outer tie-rod end to the wheel knuckle and install a new tie-rod end nut.
   - Tighten the new nut to 115 Nm (85 lb-ft).

8. Tighten the tie-rod jam nut.
   - Tighten to 103 Nm (76 lb-ft).

9. Check and if necessary, adjust the front toe. For additional information, refer to Section 204-00 .

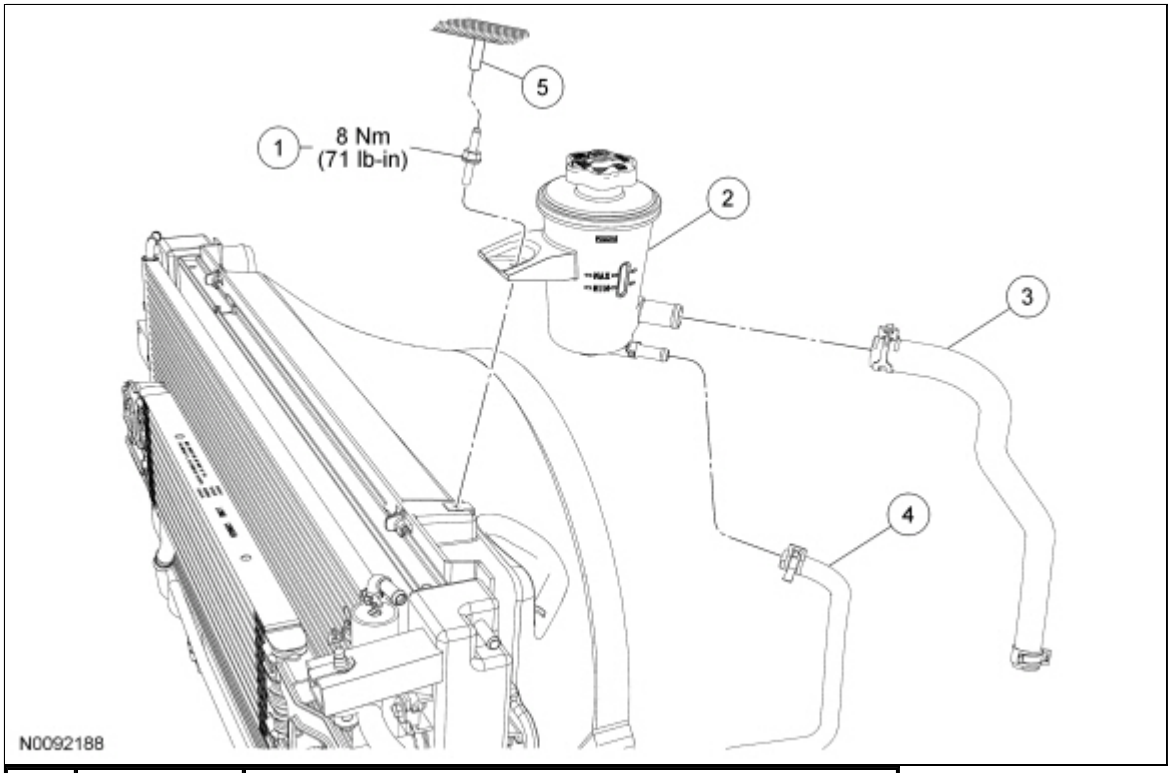
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Power Steering Fluid Cooler

Removal and Installation

1. The power steering fluid cooler is integral to the A/C condenser core. For additional information, refer to Section 412-01 .

Power Steering Fluid Reservoir



Item	Part Number	Description
1	W710897	Power steering fluid reservoir stud bolt
2	3E764	Power steering fluid reservoir
3	3691	Power steering fluid reservoir-to-pump supply hose
4	3A713	Power steering fluid cooler-to-power steering fluid reservoir hose
5	—	Wiring harness retainer (part of 14A067)

Removal and Installation

1. ***NOTICE:*** **While repairing the power steering system, care should be taken to prevent the entry of foreign materials or failure of the power steering components may result.**

   Using a suitable suction device, remove the power steering fluid from the fluid reservoir.

2. Detach the wiring harness retainer from the power steering fluid reservoir stud bolt and position the wiring harness aside.

3. Release the clamp and disconnect the power steering fluid reservoir-to-pump supply hose.

4. Release the clamp and disconnect the power steering fluid cooler-to-power steering fluid reservoir

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hose.

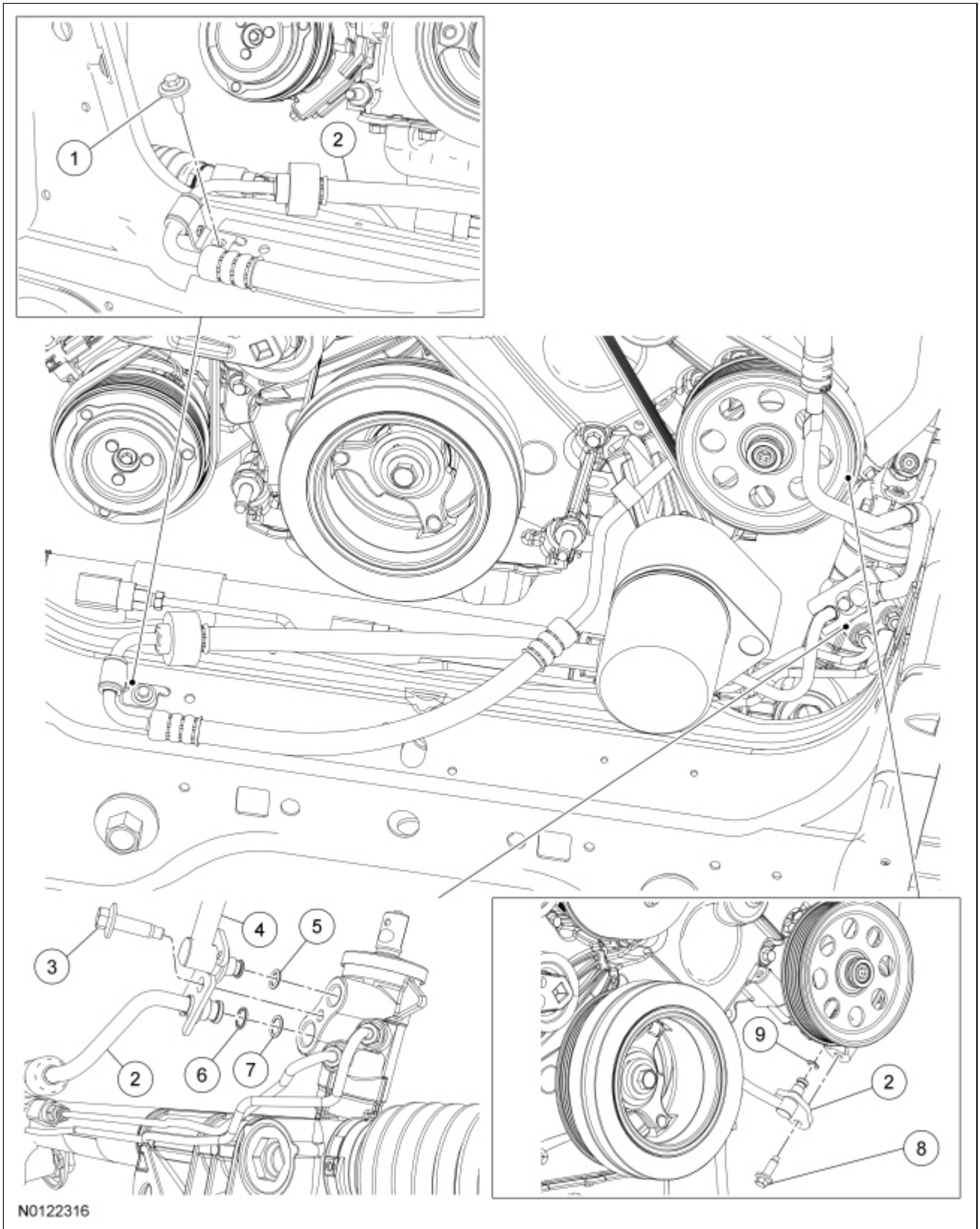
5. Remove the power steering fluid reservoir stud bolt and the power steering fluid reservoir.
    - To install, tighten to 8 Nm (71 lb-in).

6. To install, reverse the removal procedure.

7. Fill the power steering system. For additional information, refer to Section 211-00B .

Power Steering Pump to Steering Gear Pressure Line

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Item	Part Number	Description
1	W706681	Pressure line bracket-to-crossmember bolt
2	3A719	Pressure line

3	W712679	Steering line clamp plate-to-steering gear bolt
4	3A713C	Return line
5	3F886	Return line O-ring seal (also part of 3A713C)
6	3B602	Back-up O-ring seal
7	3F886	Pressure line-to-gear O-ring seal (also part of 3A719)
8	W714824	Pressure line clamp plate-to-pump bolt
9	3F887	Pressure line-to-pump O-ring seal

Removal and Installation

NOTICE: **While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Detach the wiring harness retainer from the pressure line.

3. Remove the pressure line clamp plate-to-pump bolt and disconnect the pressure line from the pump.
   - To install, tighten to 25 Nm (18 lb-ft).

4. Remove the pressure line bracket-to-crossmember bolt.
   - To install, tighten to 7 Nm (62 lb-in).

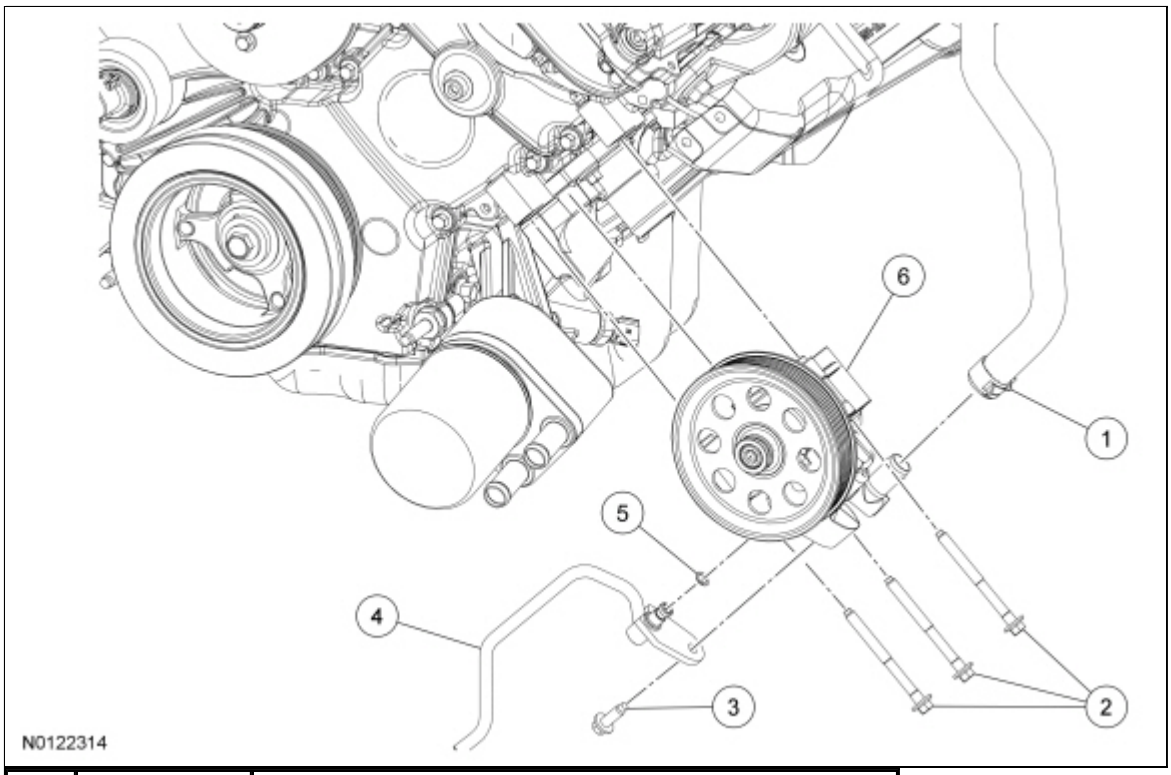
5. Remove the steering line clamp plate-to-steering gear bolt, disconnect the lines from the steering gear and remove the pressure line.
   - To install, tighten the steering line clamp plate-to-steering gear bolt to 23 Nm (17 lb-ft).

6. To install, reverse the removal procedure.

7. Fill the power steering system. For additional information, refer to Section 211-00B .

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Power Steering Pump



Item	Part Number	Description
1	3691	Power steering pump supply hose
2	W715068	Power steering pump bolt (3 required)
3	W714824	Pressure line clamp plate-to-pump bolt
4	3A719	Pressure line
5	3F887	Pressure line-to-pump O-ring seal (also part of 3A719)
6	3A674	Power steering pump and pulley assembly

Removal and Installation

NOTICE: **While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Using a suitable suction device, remove the power steering fluid from the fluid reservoir.
3. Release the clamp and disconnect the supply hose.

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4. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the power steering pump pulley.

5. Remove and discard the pressure line clamp plate-to-pump bolt.
    - Disconnect the pressure line from the pump.
    - To install, tighten to 25 Nm (18 lb-ft).

6. Remove the 3 power steering pump bolts and the power steering pump.
    - To install, tighten to 25 Nm (18 lb-ft).

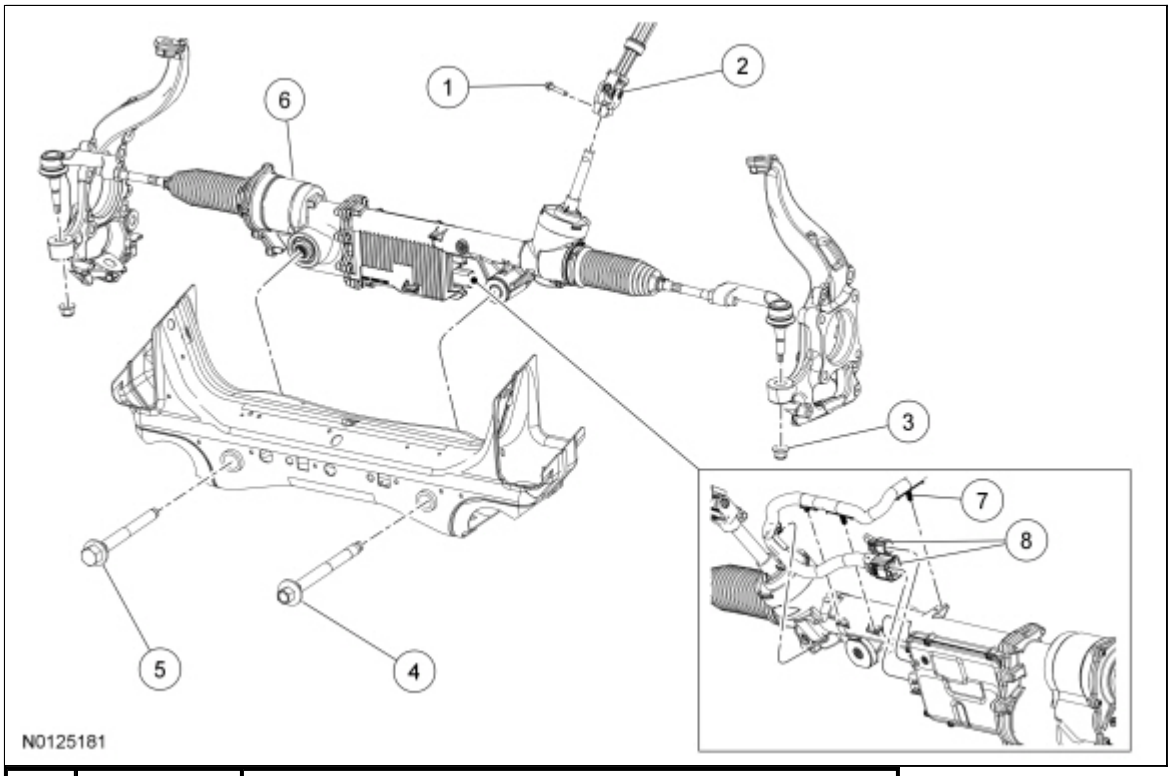
7. To install, reverse the removal procedure.

8. Fill the power steering system. For additional information, refer to Section 211-00B .

Steering Gear — Electronic Power Assist Steering (EPAS)

Special Tool(s)

 ST2945-A	Separator, Ball Joint Tool 204-592



Item	Part Number	Description
1	N808684	Steering column shaft-to-steering gear bolt
2	3C662	Steering column shaft
3	W520215	Outer tie-rod end nut (2 required)
4	W713954	Steering gear-to-crossmember bolt
5	W715436	Steering gear-to-crossmember bolt
6	3504	Steering gear
7	—	Steering gear wiring harness retainers (4 required) (part of 3F720)
8	—	Steering gear electrical connectors (2 required) (part

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		of 3F720)

1. If installing a new steering gear, connect the scan tool and upload the module configuration information from the Power Steering Control Module (PSCM). For additional information, refer to Section 418-01 .

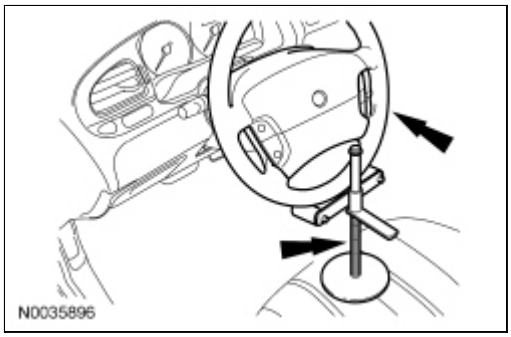
2. ***NOTICE:*** **Disconnect the negative battery cable anytime the steering gear is being serviced or damage to the steering gear internal power relay may occur resulting in steering gear replacement.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

4. ***NOTICE:*** **Do not allow the steering column shaft to rotate while disconnected from the gear or damage to the clockspring may occur. If there is evidence that the steering column shaft has rotated, remove and recenter the clockspring. For additional information, refer to Section 501-20B .**

   Use a suitable holding device to hold the steering wheel in the straight-ahead position.



5. Remove the front wheels and tires. For additional information, refer to Section 204-04 .

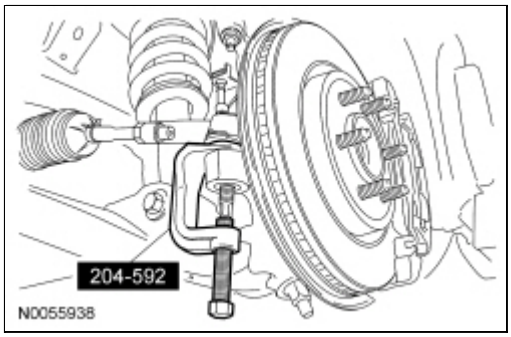
6. Disconnect the 2 steering gear electrical connectors, the 4 wiring harness retainers and position the wiring harness aside.

7. If equipped, remove the skid plate bolts and the skid plate.
   - To install, tighten to 25 Nm (18 lb-ft).

8. Remove and discard the outer tie-rod end nuts.
   - To install, tighten to 115 Nm (85 lb-ft).

9. ***NOTICE:*** **Use care when installing the Ball Joint Tool Separator or damage to the tie-rod end boot may occur.**

   Using the Ball Joint Tool Separator, disconnect the tie-rod ends from the wheel knuckles.



10. ***NOTICE:*** **Do not allow the steering column shaft to rotate while disconnected from the gear or damage to the clockspring may occur. If there is evidence that the steering column shaft has rotated, remove and recenter the clockspring. For additional information, refer to Section 501-20B .**

    Remove and discard the steering column shaft-to-steering gear bolt and disconnect the steering column shaft from the steering gear.
    - To install, tighten to 30 Nm (22 lb-ft).

11. Remove and discard the 2 steering gear-to-crossmember bolts and remove the steering gear.
    - To install, tighten to 440 Nm (325 lb-ft).

12. ***NOTICE:*** **Make sure the tie-rod end boots are seated correctly on the tie-rod ends or tie-rod end failure may occur.**

    To install, reverse the removal procedure.

13. When installing a new steering gear, it must be configured (using vehicle as-built data or module configuration information retrieved earlier in this procedure). For additional information on configuration, refer to Programmable Module Installation (PMI) in Section 418-01 .

14. Check and, if necessary, adjust the front toe. For additional information, refer to Section 204-00 .

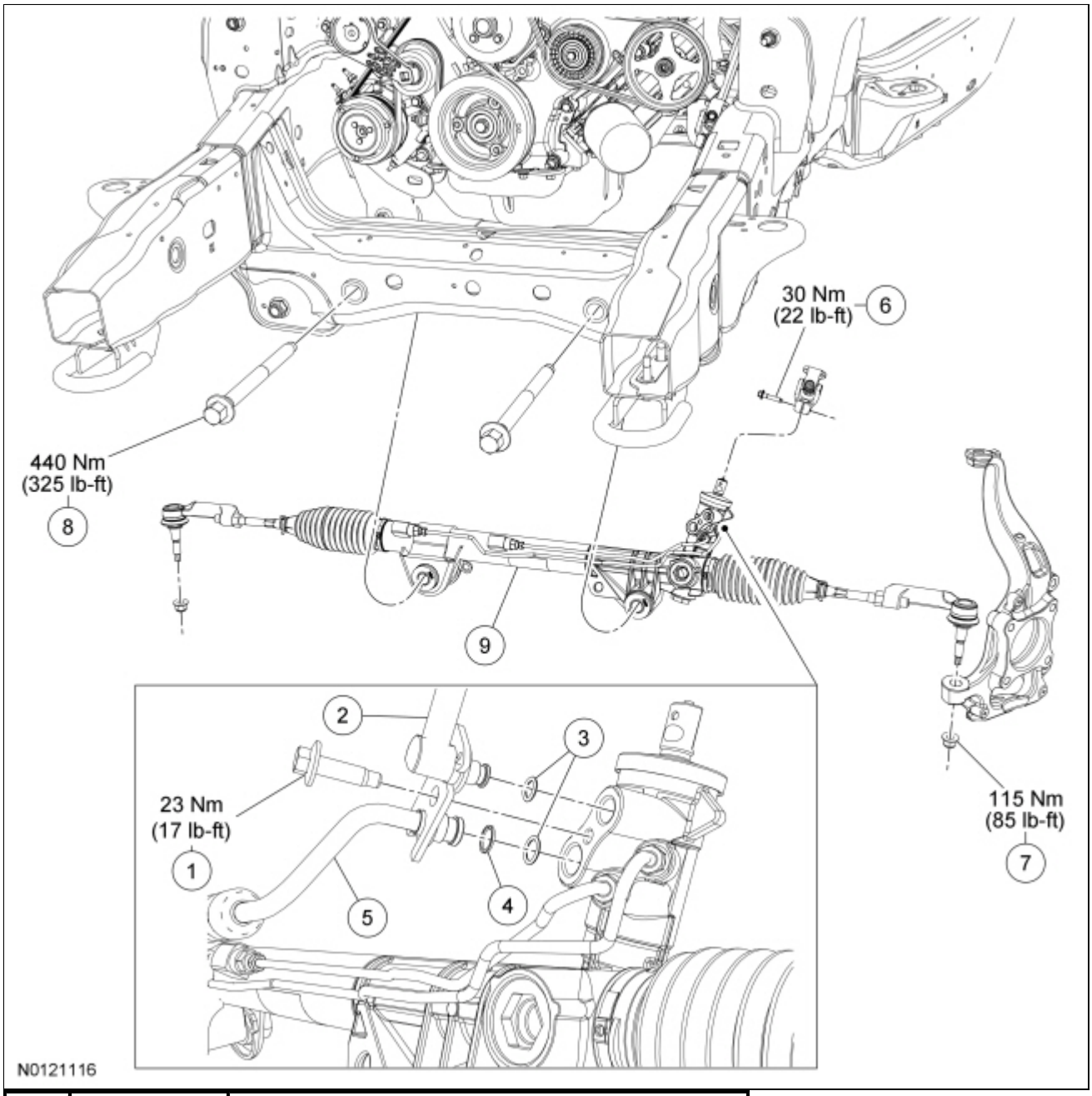
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Steering Gear — Hydraulic Power Assist Steering (HPAS)

Special Tool(s)

 ST2945-A	Separator, Ball Joint Tool 204-592

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Item	Part Number	Description
1	W712679	Steering line clamp plate-to-steering gear bolt
2	3A713C	Return line
3	3F886	O-ring seals (2 required)
4	3B602	Back-up O-ring seal
5	3A719	Pressure line
6	N808684	Steering column shaft-to-steering gear bolt
7	W520215	Outer tie-rod end nut (2 required)
8	W713954	Steering gear-to-crossmember bolt (2 required)
9	3504	Steering gear

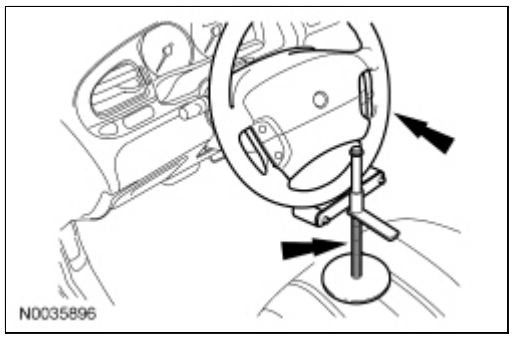
Removal and Installation

NOTICE: **While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. ***NOTICE:*** **Do not allow the steering column shaft to rotate while disconnected from the gear or damage to the clockspring may occur. If there is evidence that the steering column shaft has rotated, remove and recenter the clockspring. For additional information, refer to Section 501-20B .**

   Use a suitable holding device and hold the steering wheel in the straight-ahead position.



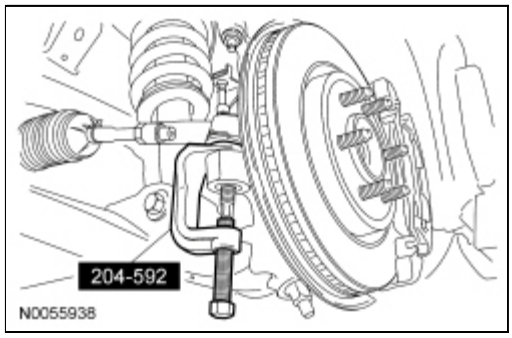
3. Remove the front wheels and tires. For additional information, refer to Section 204-04 .

4. If equipped, remove the skid plate bolts and the skid plate.
   - To install (all except SVT Raptor), tighten to 25 Nm (18 lb-ft).
   - To install (SVT Raptor), tighten to 48 Nm (35 lb-ft).

5. Remove and discard the outer tie-rod end nuts.
   - To install, tighten to 115 Nm (85 lb-ft).

6. ***NOTICE:*** **Use care when installing the Ball Joint Tool Separator or damage to the tie-rod end boot may occur.**

   Using the Ball Joint Tool Separator, disconnect the tie-rod ends from the wheel knuckles.



7. ***NOTICE:*** **Do not allow the steering column shaft to rotate while disconnected from the gear or damage to the clockspring may occur. If there is evidence that the steering column shaft has rotated, remove and recenter the clockspring. For additional information, refer to Section 501-**

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20B .

Remove and discard the steering column shaft-to-steering gear bolt and disconnect the steering column shaft from the steering gear.

- To install, tighten to 30 Nm (22 lb-ft).

8. ***NOTICE:*** **Install new O-ring seals any time the lines are disconnected from the steering gear or a fluid leak may occur.**

   Remove the steering line clamp plate-to-steering gear bolt, and disconnect the power steering lines.
   - Discard the O-ring seals.
   - To install, tighten the steering line clamp plate-to-steering gear bolt to 23 Nm (17 lb-ft).

9. Remove and discard the 2 steering gear-to-crossmember bolts and remove the steering gear.
   - To install, tighten to 440 Nm (325 lb-ft).

10. ***NOTICE:*** **Make sure the tie-rod end boots are seated correctly on the tie-rod ends or tie-rod end failure may occur.**

    To install, reverse the removal procedure.

11. Fill the power steering system. For additional information, refer to Section 211-00B .

12. Check and, if necessary, adjust the front toe. For additional information, refer to Section 204-00 .

Steering Gear to Fluid Cooler Return Hose — From Gear

Removal

NOTICE: **While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

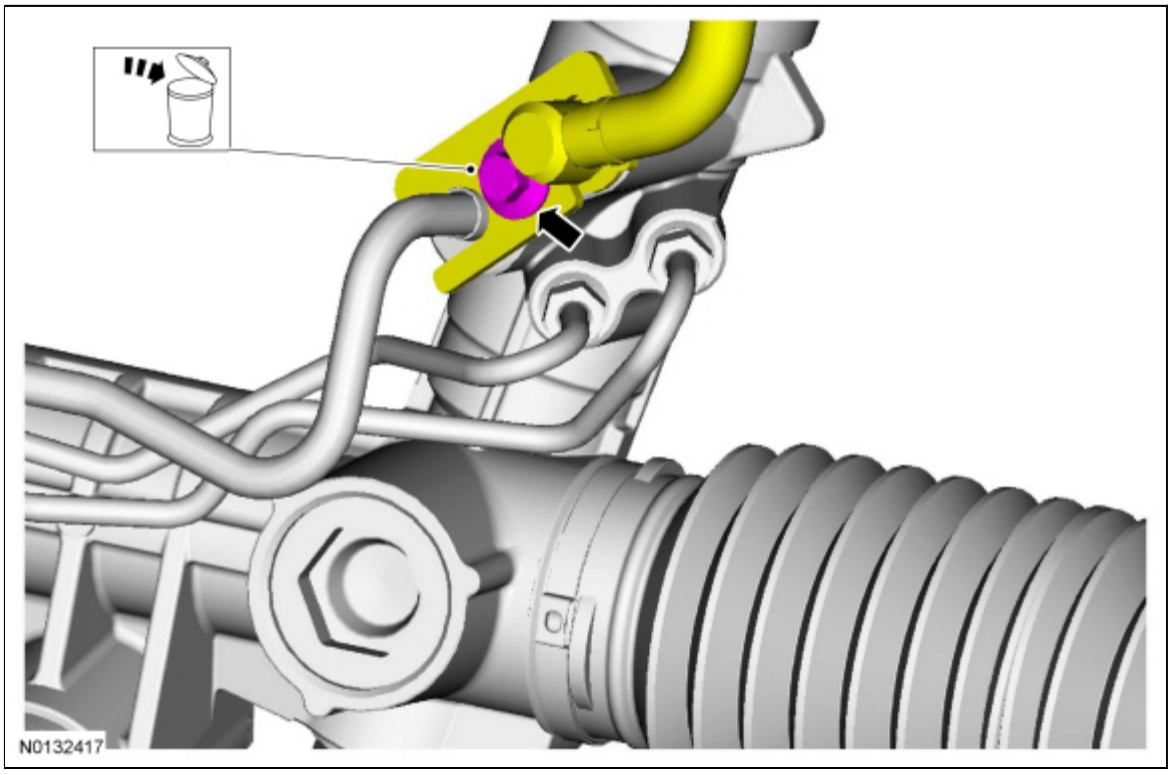
NOTE: Service the return hose from the gear with the return hose to the cooler.

NOTE: Removal steps in this procedure may include installation details.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

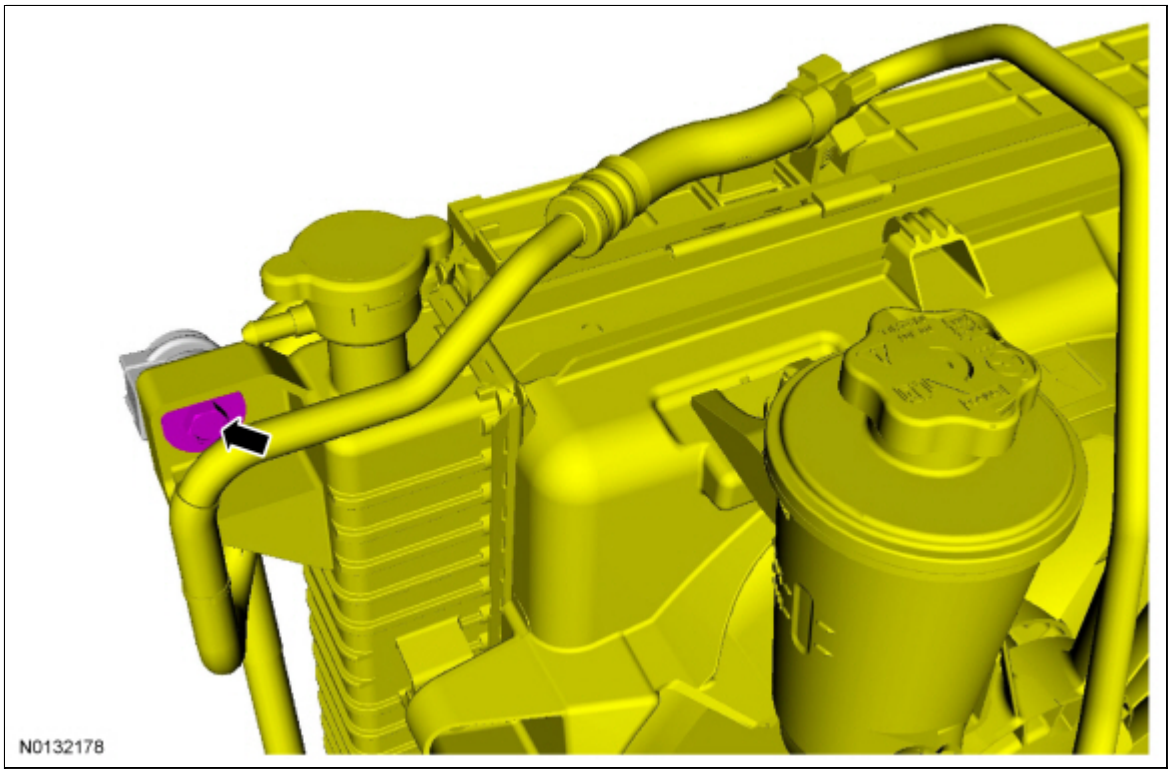
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

3. Discard the specified component. Follow local disposal regulations.
   - To install, tighten to 23 Nm (17 lb-ft).

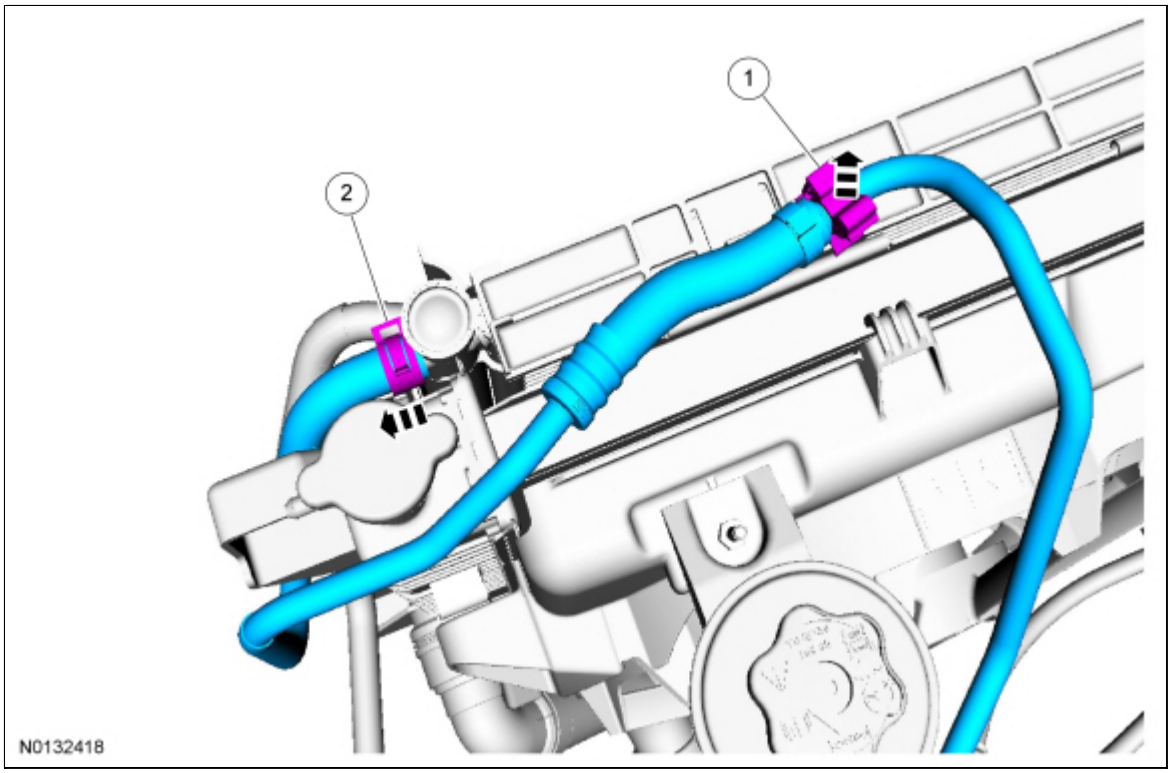


4. On both sides.
   - To install, tighten to 15 Nm (133 lb-in).

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5.



Installation

1. To install, reverse the removal procedure.

2. Fill the power steering system. For additional information, refer to Section 211-00B .

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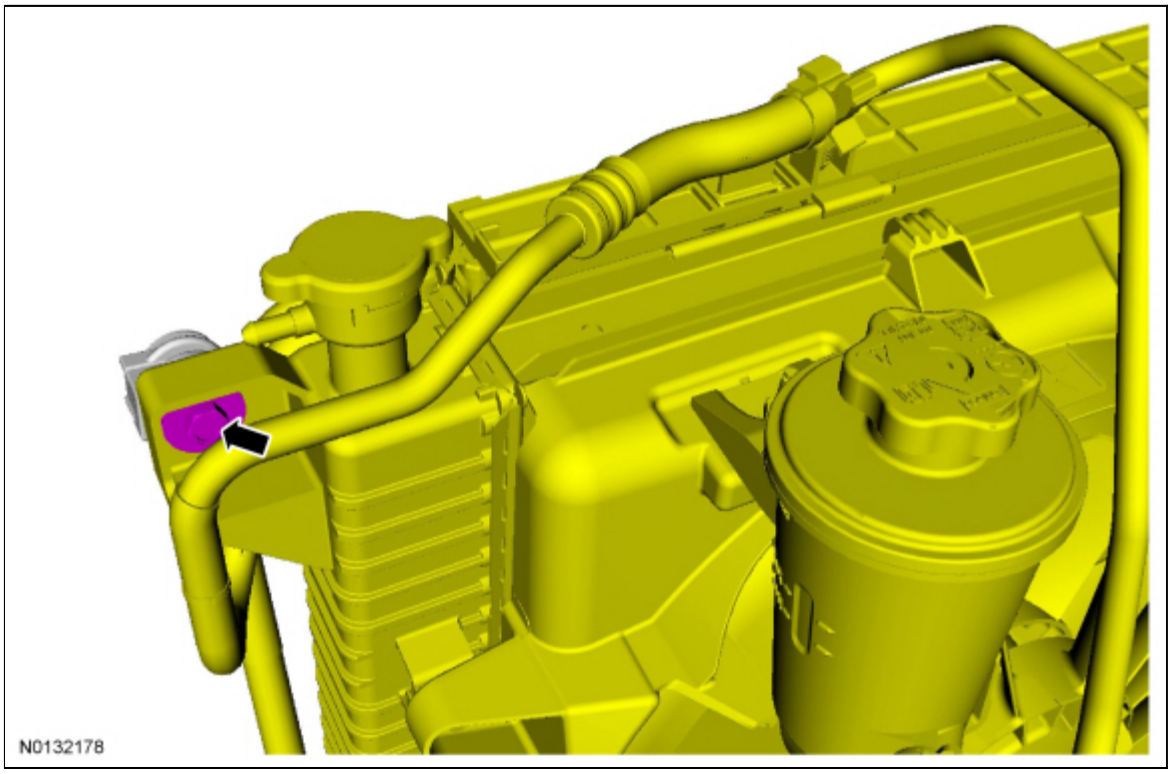
Steering Gear to Fluid Cooler Return Hose — To Cooler

Removal

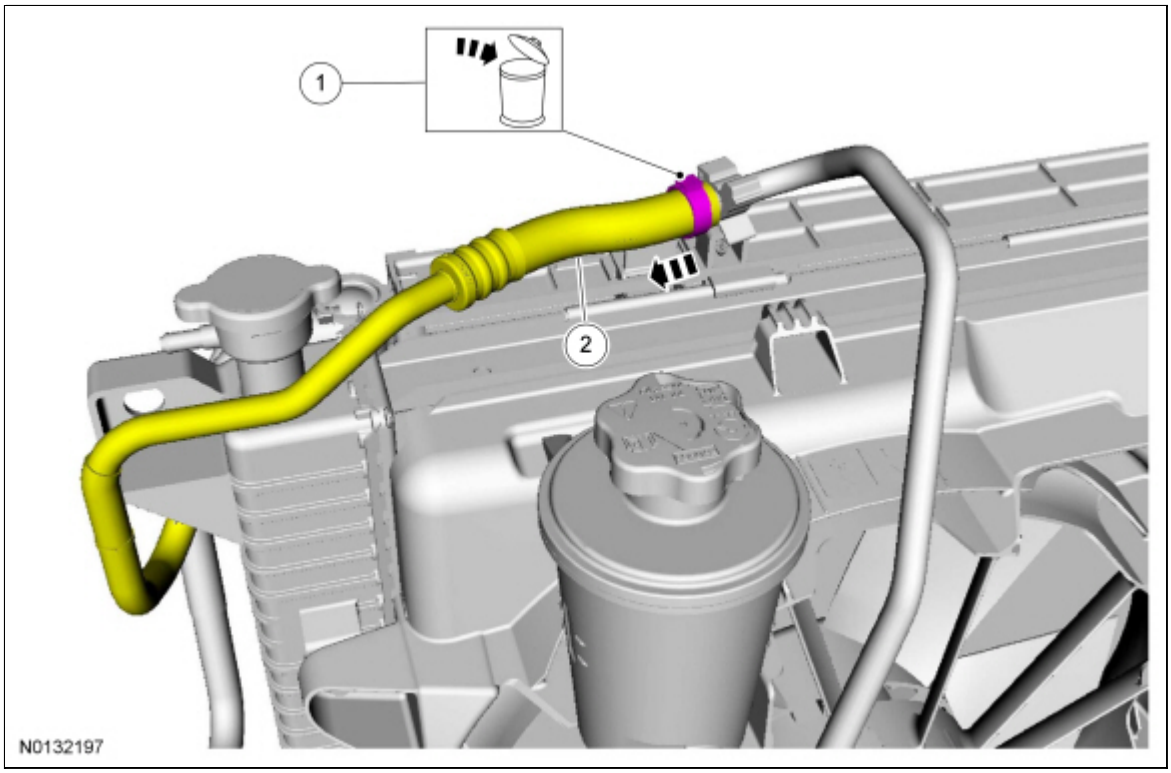
NOTICE: **While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

NOTE: Removal steps in this procedure may include installation details.

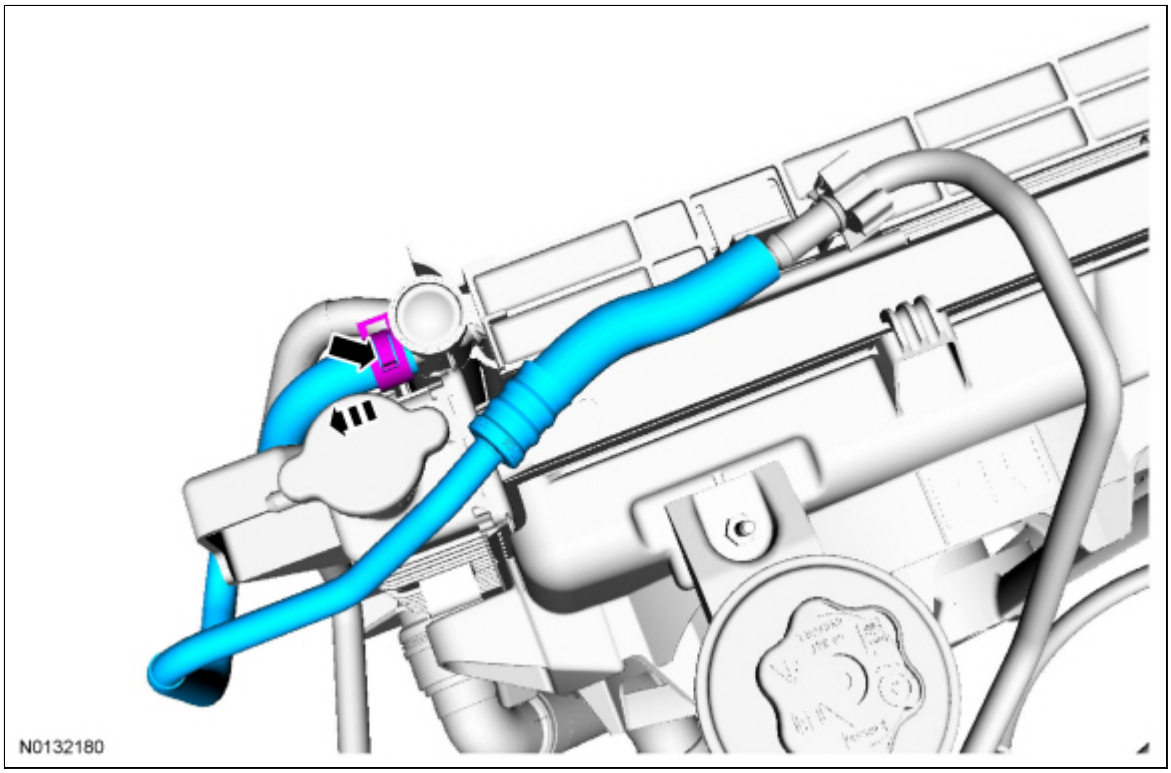
1. On both sides.
    - To install, tighten to 15 Nm (133 lb-in).



2. Discard the specified component. Follow local disposal regulations.



3.



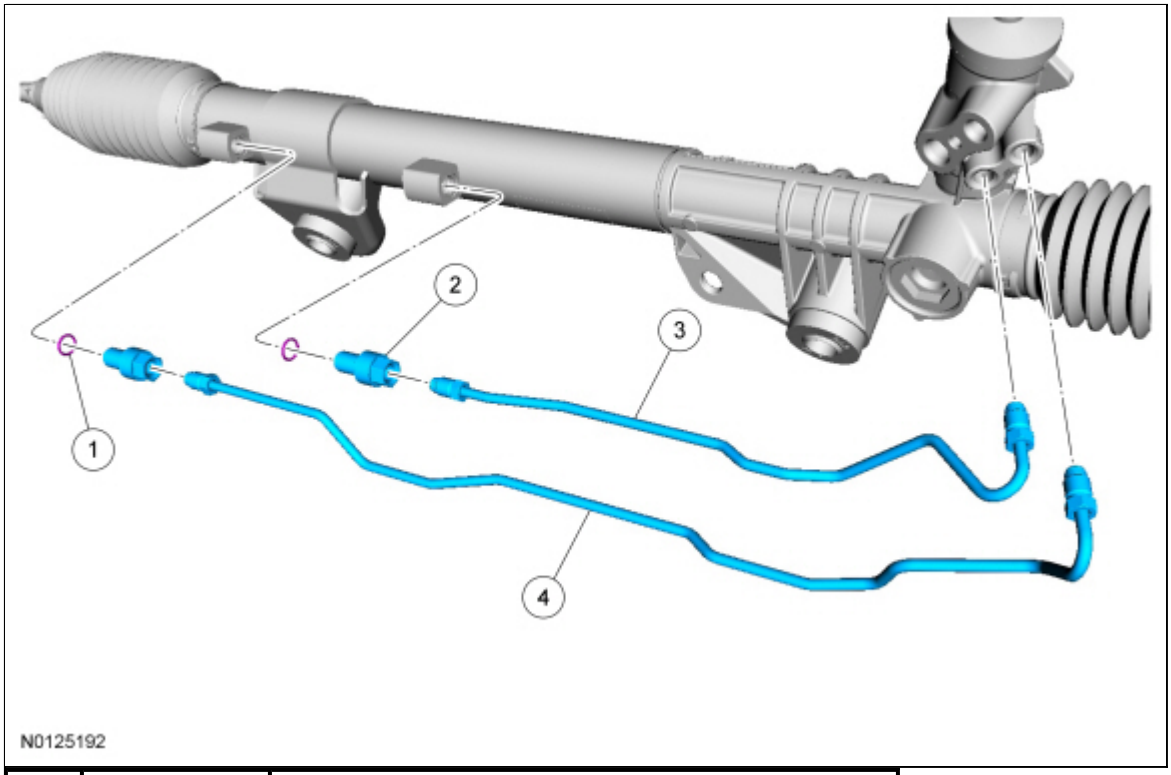
Installation

1. To install, reverse the removal procedure.

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2. Fill the power steering system. For additional information, refer to Section 211-00B .

Steering Gear Turn Tubes



Item	Part Number	Description
1	00815	Steering gear turn tube damper seal (2 required)
2	3E651	Steering gear turn tube damper (2 required)
3	3A717	Steering gear (right) turn tube
4	3A714	Steering gear (left) turn tube

Removal and Installation

NOTICE: **While repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, remove the skid plate bolts and the skid plate.
   - To install (all except SVT Raptor), tighten to 25 Nm (18 lb-ft).
   - To install (SVT Raptor), tighten to 48 Nm (35 lb-ft).

3. Disconnect the 4 steering gear turn tube fittings and remove the 2 turn tubes.
   - To install, tighten the fittings to 20 Nm (177 lb-in).

4. If necessary, remove the steering gear turn tube dampers.

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- Inspect the O-ring seals and replace as necessary.
- To install, tighten to 30 Nm (22 lb-ft).

5. To install, reverse the removal procedure.

6. Fill the power steering system. For additional information, refer to Section 211-00B .

Material

Item	Specification	Fill Capacity
Instant Gel Adhesive TA-19	WSK-M2G402-A4	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Lower steering column shaft-to-steering gear bolt	30	22	—
Lower steering column shaft-to-upper steering column shaft bolt	48	35	—
Steering column bolts	28	21	—
Steering column motor screws	6	—	53
Steering column motor trunnion nut bracket screws	7	—	62
Steering column nuts	30	22	—
Steering column shaft dash seal bolts	12	—	106
Steering column shroud screws	2	—	18
Steering wheel bolt	48	35	—
Upper steering column shaft-to-steering column bolt	28	21	—

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Steering Column

The steering column consists of the following:

- Steering wheel
- Steering column
- Upper and lower steering column shafts
- Steering Column Control Module (SCCM)
- Steering column control switch — located on the LH side of the SCCM just below the multifunction switch and can be serviced separately from the module. The steering column control switch and the brake pedal control switch are located in the same position. On vehicles equipped with both features, the 2 switches are combined into a single switch assembly. For additional information, refer to Section 206-06 .
- Steering column tilt motor (if equipped) — located on the steering column and can be serviced separately from the column. For additional information, refer to Steering Column Motor — Tilt in this section.
- Steering column telescopic motor (if equipped) — located on the steering column and can be serviced separately from the column. For additional information, refer to Steering Column Motor — Telescopic in this section.

The steering column is the mechanical linkage between the steering wheel and the steering gear. The steering wheel is mounted to a shaft, which passes through the center of the steering column. The shaft is centered by bearings within the steering column. The steering column shaft then connects the steering column to the steering gear. The upper and lower steering column shaft connections utilize U-joint type couplings.

Manual Tilt/Telescope Steering Column (if equipped)

The manual tilt/telescope function of the steering column is controlled by a mechanical lever on the left side of the steering column to lock and unlock the steering column. When the lever is pulled down, the steering column can be adjusted up or down and in or out to the desired position(s). While holding the steering wheel in the desired position, pulling the lever up to the original position locks the steering column.

Power Adjustable Tilt/Telescope Steering Column (if equipped)

The power tilt and telescope function of the steering column is controlled by the steering column control switch, the memory SET switch or the Remote Keyless Entry (RKE) transmitter. The steering column control switch is a 4-position, normally open, momentary contact switch located on the steering column below the multifunction switch. The steering column control switch moves the adjustable steering column in 4 directions:

- Forward/In (away from the driver)
- Rearward/Out (toward the driver)
- Up
- Down

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Steering Column

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT 27000 or equivalent 250-300 mA incandescent bulb test lamp
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Power Adjustable Tilt/Telescope Steering Column

The power adjustable tilt/telescope steering column is controlled by the steering column control switch and 2 electric motors that are powered by the Steering Column Control Module (SCCM). The steering column control switch is a 4-position, momentary-contact switch. When the steering column control switch is moved to any of the 4 positions, it sends a signal to the SCCM to tilt the steering column up or down or telescope the steering column forward or rearward.

The SCCM continuously monitors the steering column tilt and telescoping motors and circuits for faults. If a fault is detected, the SCCM is capable of setting DTCs.

Tilt/Telescoping Motor Sensors

The SCCM receives digital signals from Hall-effect type rotation sensors that are integral to the tilt and telescoping motors. The SCCM uses these signals to calculate the location of the steering column in relation to the full forward/rearward and full up/down positions. The SCCM also uses these signals to store and recall memory positions, carry out the easy entry/exit operations and to make sure the tilt and telescoping motors do not stall against the steering column end of travel in the forward/rearward or up/down directions. Both the tilt and telescopic motors can be serviced separately from the steering column.

Jog Mode

If the SCCM loses the signal from either of the motor sensors, the affected steering column motor operates in jog mode. Jog mode allows limited operation of the affected steering column motor using only the steering column control switch. When the steering column control switch is operated in jog mode, the steering column moves in the desired direction for one second, then stops. The steering column control switch must be released, then pressed again in order to move the steering column for an additional second. Jog mode is an indication that there is a tilt or telescoping motor sensor fault. If the adjustable steering column is operating in jog mode, a DTC can set in the SCCM .

Memory Position Programming and Recall

The SCCM monitors steering column position using Hall-effect sensors that are integral to the tilt and telescoping motors. When a memory position is recalled through either the memory SET switch or the Remote Keyless Entry (RKE) transmitter, the SCCM monitors the Hall-effect sensors and stops sending voltage to the steering column motors once the commanded memory position is reached. If the SCCM receives a steering column switch input during a memory position recall function, the module stops the memory recall and responds to the new steering column switch position input.

When the RKE transmitter is activated, a message is sent over the Medium Speed Controller Area Network (MS-CAN) to the Driver Seat Module (DSM). When the memory SET switch is pressed, the DSM senses continuity to ground on the switch circuit. When the DSM receives either the MS-CAN message or the ground input through the switch circuit, it sends a message over the MS-CAN to the Body Control Module (BCM). The BCM acts as a gateway module, relaying the MS-CAN message that was received from the DSM to the SCCM over the High Speed Controller Area Network (HS-CAN). The SCCM then sends voltage over the appropriate circuit to the steering column tilt or telescoping motor to adjust the steering column position.

For information on setting and recalling a memory position, refer to the Owner's Literature or Memory Position Programming in Section 501-10 .

Easy Entry/Exit

The easy entry/exit function moves the steering column to the full inward and upward position when the selector lever is in the PARK position and the ignition switch indicates the ignition key has been removed from the ignition lock cylinder. The SCCM receives an ignition status message over the High Speed Controller Area Network (HS-CAN). When the ignition status message indicates the ignition key has been removed from the lock cylinder, the SCCM commands the steering column to the full upward/forward position. The SCCM cancels this operation if a valid input is received from the steering column control switch or memory position switch.

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The SCCM records the current steering column position before powering the steering column for an easy exit operation. This recorded position returns the steering column to this position on the next easy entry operation. During easy entry operation, the steering column is returned to the position previous to the easy exit operation.

The easy entry/exit feature can be activated or deactivated using the message center. Refer to driver controls in the Owner's Literature for additional instructions for using the message center.

Power Tilt Steering Column Hard Stop/Soft Stop

A hard stop occurs when the power column physically reaches the end of travel and cannot go any further. A soft stop occurs when the power column stops before physically reaching the end of travel. The hard stop is set by steering column design and cannot be changed or adjusted. The soft stop is set by the SCCM . To prevent unnecessary stress on the power column and motors, the SCCM sets 4 soft stop positions, one for tilt up, one for tilt down, one for telescope out and one for telescope in. The SCCM uses a preset distance from the hard stop to determine where the soft stop occurs.

The soft stops must be relearned by the SCCM whenever a new steering column or SCCM is installed.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. Visually inspect for obstructions preventing column movement.

Visual Inspection Chart

Mechanical	Electrical
• Steering column control switch • Adjustable steering column tilt motor • Adjustable steering column telescope motor • Steering column assembly	• Wiring, terminals or connectors • Steering Column Control Module (SCCM)

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
6. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .

- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, proceed with module self-test diagnostics.

9. Carry out the self-test diagnostics for the SCCM .

10. If the DTCs retrieved are related to the concern, go to Steering Column Control Module (SCCM) DTC Chart. For all other SCCM DTCs, refer to the Master DTC Chart in Section 211-05 .

11. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Chart

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1298:09	Steering Column Adjust Up Switch: Component Failure	INSTALL a new steering column control switch. REFER to Brake Pedal Control Switch in Section 206-06 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test. If DTC B1298:09 returns, INSTALL a new Steering Column Control Module (SCCM). REFER to Section 211-05 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test.
B1299:09	Steering Column Adjust Down Switch: Component Failure	INSTALL a new steering column control switch. REFER to Brake Pedal Control Switch in Section 206-06 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test. If DTC B1299:09 returns, INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test.
B12A1:09	Steering Column Adjust Out Switch: Component Failure	INSTALL a new steering column control switch. REFER to Brake Pedal Control Switch in Section 206-06 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test.

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		If DTC B12A1:09 returns, INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test.
B12A2:09	Steering Column Adjust In Switch: Component Failure	INSTALL a new steering column control switch. REFER to Brake Pedal Control Switch in Section 206-06 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test. If DTC B12A2:09 returns, INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test.
B1375:18	Steering Column Tilt Motor: Circuit Current Below Threshold	GO to Pinpoint Test A .
B1375:19	Steering Column Tilt Motor: Circuit Current Above Threshold	GO to Pinpoint Test A .
B1375:71	Steering Column Tilt Motor: Actuator Stuck	GO to Pinpoint Test A .
B137E:18	Steering Column Telescope Motor: Current Below Threshold	GO to Pinpoint Test A .
B137E:19	Steering Column Telescope Motor: Current Above Threshold	GO to Pinpoint Test A .
B137E:71	Steering Column Telescope Motor: Actuator Stuck	GO to Pinpoint Test A .
B1C33:11	Steering Column Tilt Feedback Signal: Circuit Short To Ground	GO to Pinpoint Test C .
B1C33:12	Steering Column Tilt Feedback Signal: Circuit Short To Battery	GO to Pinpoint Test C .
B1C35:11	Steering Column Telescope Feedback Signal: Circuit Short To Ground	GO to Pinpoint Test C .
B1C35:12	Steering Column Telescope Feedback Signal: Circuit Short To Battery	GO to Pinpoint Test C .
—	All Other SCCM DTCs	REFER to Section 211-05 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Steering Column	• Fuse • Wiring, terminals or	• REFER to Section 418-00 to diagnose the no

Control Module (SCCM)	connectors • SCCM	communication condition.
• The adjustable steering column is inoperative in one or more directions — using the steering column control switch	• Fuse • Wiring, terminals or connectors • Steering column control switch • Adjustable steering column tilt motor • Adjustable steering column telescopic motor • SCCM	• GO to Pinpoint Test A .
• The adjustable steering column is inoperative in one or more directions — using the memory SET switch buttons	• Wiring, terminals or connectors • Memory SET switch • Driver Seat Module (DSM) • SCCM • Body Control Module (BCM)	• GO to Pinpoint Test B .
• The adjustable steering column is inoperative in one or more directions — using an Remote Keyless Entry (RKE) transmitter	• Wiring, terminals or connectors • RKE transmitter • DSM • SCCM • BCM	• GO to Pinpoint Test B .
• The adjustable steering column is inoperative in one or more directions — using the easy entry/exit feature	• Entry/exit feature is disabled in the message center • Wiring, terminals or connectors • SCCM	• GO to Pinpoint Test B .
• The adjustable steering column operates in one second intervals when using the steering column control switch (jog mode)	• Wiring, terminals or connectors • Adjustable steering column tilt motor • Adjustable steering column telescopic motor • SCCM	• GO to Pinpoint Test C .
• Looseness felt in the steering wheel or tilt mechanism	• Loose tilt motor fastener(s) • Loose steering column assembly fastener(s) • Wore internal steering column component(s) or loose internal fastener/fasteners • Steering column tilt housing fastener(s)	• TIGHTEN fasteners. For additional information, refer to Steering Column Motor — Tilt or Steering Column Motor — Telescopic . • INSTALL a new steering column. For additional information, REFER to Steering Column in this section.

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Pinpoint Tests

Pinpoint Test A: The Adjustable Steering Column is Inoperative in One or More Directions — Using the Steering Column Control Switch

Refer to Wiring Diagrams Cell 128 , Adjustable Steering Column for schematic and connector information.

Normal Operation

When the steering column control switch is activated, the Steering Column Control Module (SCCM) supplies voltage and ground to the applicable steering column tilt or telescoping motor to move the steering column to the desired position.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Steering column control switch
- Adjustable steering column tilt motor
- Adjustable steering column telescopic motor
- SCCM

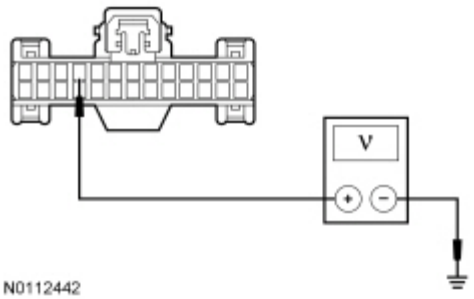
DTC Description	Fault Trigger Conditions
• B1375:18 — Steering Column Tilt Motor: Circuit Current Below Threshold	This DTC sets when the SCCM senses current flow to the adjustable steering column tilt motor is below a preset limit while the steering column control switch is activated. This may be caused by an open or high resistance in the adjustable steering column tilt motor circuits.
• B1375:19 — Steering Column Tilt Motor: Circuit Current Above Threshold	This DTC sets when the SCCM senses current flow to the adjustable steering column tilt motor is above a preset limit while the steering column control switch is activated. This may be caused by a short to ground in the adjustable steering column tilt motor circuits.
• B1375:71 — Steering Column Tilt Motor: Actuator Stuck	This DTC sets when the SCCM senses current flow to the adjustable steering column tilt motor is within a specific range but above a preset limit during self test.
• B137E:18 — Steering Column Telescope Motor: Current Below Threshold	This DTC sets when the SCCM senses current flow to the adjustable steering column telescope motor is below a preset limit while the steering column control switch is activated. This may be caused by an open or high resistance in the adjustable steering column telescope motor circuits.
• B137E:19 — Steering Column Telescope Motor: Current Above Threshold	This DTC sets when the SCCM senses current flow to the adjustable steering column telescope motor is above a preset limit while the steering column control switch is activated. This may be caused by a short to ground in the adjustable steering column telescope motor circuits.
• B137E:71 — Steering Column Telescope Motor: Actuator Stuck	This DTC sets when the SCCM senses current flow to the adjustable steering column telescope motor is within a specific range but above a preset limit during on-demand self test.

PINPOINT TEST A: THE ADJUSTABLE STEERING COLUMN IS INOPERATIVE IN ONE OR MORE

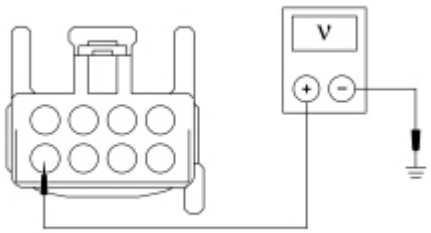
DIRECTIONS — USING THE STEERING COLUMN CONTROL SWITCH

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

NOTE: If the adjustable steering column only operates in one second intervals when activating the steering column control switch, GO to Pinpoint Test C .

Test Step	Result / Action to Take
A1 CHECK THE OPERATION OF THE ADJUSTABLE COLUMN USING THE STEERING COLUMN CONTROL SWITCH	
• Operate the adjustable steering column in all directions using the steering column control switch. • **Does the steering column operate correctly in at least one direction using the steering column control switch?**	**Yes** GO to A4 . **No** If the steering column does not move in any direction at all using the steering column switch, GO to A2 . If the steering column moves in only one second intervals (jog mode) in one or more directions using the steering column switch, GO to Pinpoint Test C .
A2 CHECK FOR VOLTAGE AT THE SCCM	
• Ignition OFF. • Disconnect: SCCM C2414A. • Disconnect: SCCM C2414B. • Measure the voltage between SCCM C2414A-10, circuit SBP23 (WH/RD), harness side and ground.  N0112442 • Measure the voltage between SCCM C2414B-8, circuit SBP24 (VT/RD), harness side and ground.	**Yes** GO to A3 . **No** VERIFY BCM fuses 23 (15A) and 24 (15A) are OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the cause for the circuit short. TEST the system for normal operation.

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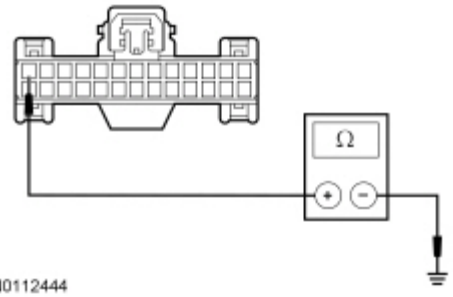


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- **Are the voltages greater than 10 volts?**

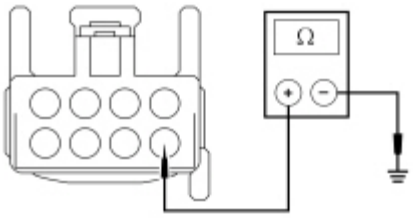
A3 CHECK THE SCCM GROUND CIRCUITS FOR AN OPEN

- Measure the resistance between SCCM C2414A-13, circuit GD133 (BK), harness side and ground.



N0112444

- Measure the resistance between SCCM C2414B-5, circuit GD138 (BK/WH), harness side and ground.



N0119446

- **Are the resistances less than 5 ohms?**

Yes
GO to A4.

No
REPAIR the affected circuit(s). TEST the system for normal operation.

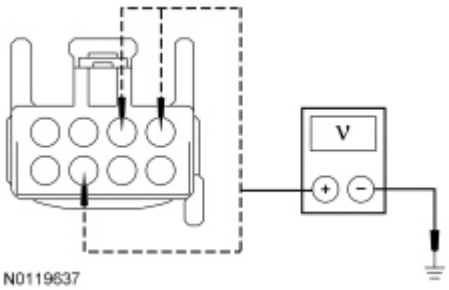
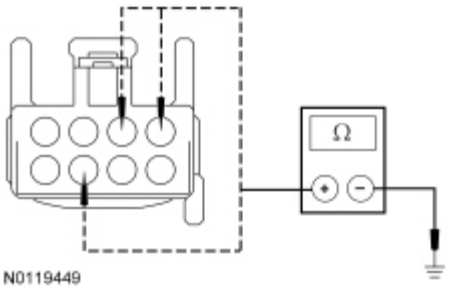
A4 CHECK THE SCCM STEERING COLUMN ADJUST SWITCH (STRCOL_ADJ) PID

- Connect: SCCM C2414A (if previously disconnected).
- Connect: SCCM C2414B (if previously disconnected).
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: DataLogger — SCCM.
- Monitor the STRCOL_ADJ PID while moving the steering column control switch in all directions.
- **Do the PID values agree with the steering column control switch positions?**

Yes
GO to A5.

No
INSTALL a new steering column control switch. REFER to Brake Pedal Control Switch in Section 206-06.

CLEAR the DTCs. VERIFY correct system operation. REPEAT the self-test

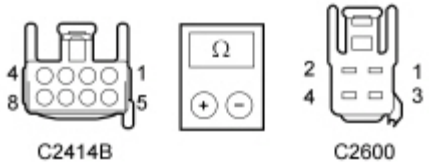
	If the concern is still present, INSTALL a new Steering Column Control Module (SCCM). REFER to Section 211-05. TEST the system for normal operation.
A5 CHECK THE ADJUSTABLE STEERING COLUMN MOTOR CIRCUITS FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: SCCM C2414B. • Disconnect: SCCM C2414C. • Ignition ON. • Measure the voltage between ground and: ▪ SCCM C2414B-1, circuit CPP22 (GY/BN), harness side. ▪ SCCM C2414B-2, circuit CPP04 (GY), harness side. ▪ SCCM C2414B-7, circuit CPP02 (BN), harness side.  N0119637 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). TEST the system for normal operation. **No** GO to A6.
A6 CHECK THE ADJUSTABLE STEERING COLUMN MOTOR CIRCUITS FOR A SHORT TO GROUND • Ignition OFF. • Measure the resistance between ground and: ▪ SCCM C2414B-1, circuit CPP22 (GY/BN), harness side. ▪ SCCM C2414B-2, circuit CPP04 (GY), harness side. ▪ SCCM C2414B-7, circuit CPP02 (BN), harness side.  N0119449 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to A7. **No** REPAIR the affected circuit(s). TEST the system for normal operation.
A7 CHECK THE ADJUSTABLE STEERING COLUMN MOTOR CIRCUITS FOR AN OPEN • Disconnect: Adjustable Steering Column Tilt Motor C2600 or	**Yes**

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Adjustable Steering Column Telescope Motor C2601.

- For an inoperative adjustable steering column tilt motor, measure the resistance between SCCM C2414B and adjustable steering column tilt motor C2600 using the following chart:

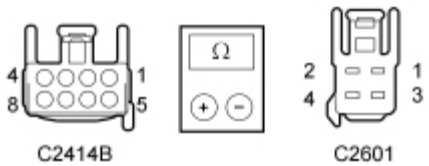
SCCM	Circuit	Adjustable Steering Column Tilt Motor
C2414B-7	CPP02 (BN)	C2600-2
C2414B-2	CPP04 (GY)	C2600-1



N0122534

- For an inoperative adjustable steering column telescope motor, measure the resistance between SCCM C2414B and adjustable steering column telescope motor C2601 using the following chart:

SCCM	Circuit	Adjustable Steering Column Telescope Motor
C2414B-7	CPP02 (BN)	C2601-2
C2414B-1	CPP22 (GY/BN)	C2601-1



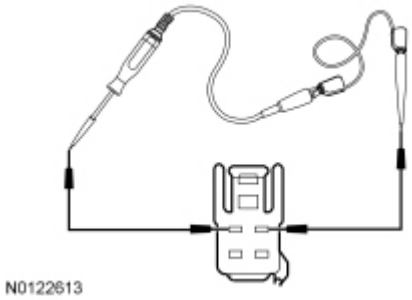
N0122581

- **Are the resistances less than 5 ohms?**

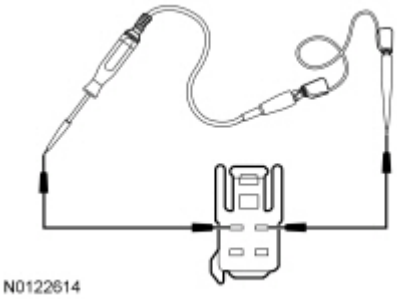
For a tilt motor that is inoperative/does not operate correctly, GO to A8 . For a telescope motor that is inoperative/does not operate correctly, GO to A9 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

A8 CHECK THE SCCM OUTPUT TO THE ADJUSTABLE STEERING COLUMN TILT MOTOR

• Ignition OFF. • Connect: SCCM C2414B. • Connect: SCCM C2414C. • ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Connect a 12-volt incandescent test light between adjustable steering column tilt motor C2600-1, circuit CPP02 (BN), harness side and C2600-2, circuit CPP04 (GY), harness side.  N0122613 • Ignition ON. • **NOTE:** Because the steering column motor (Hall-effect sensor) is disconnected, the SCCM only activates the output for approximately 1 second each time the steering column control switch is activated (jog mode). • Activate the steering column control switch in both the UP and DOWN positions (release the switch briefly between each switch activation) while observing the test light. • **Does the test light momentarily illuminate when the steering column control switch is activated in both UP and DOWN positions?**	**Yes** INSTALL a new adjustable steering column tilt motor. REFER to Steering Column Motor — Tilt in this section. CLEAR the DTCs. TEST the system for normal operation. REPEAT the self test. **No** GO to A10 .
A9 CHECK THE SCCM OUTPUT TO THE ADJUSTABLE STEERING COLUMN TELESCOPE MOTOR	
• Ignition OFF. • Connect: SCCM C2414B. • Connect: SCCM C2414C. • ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Connect a 12-volt incandescent test light between adjustable steering column telescope motor C2601-2, circuit CPP02 (BN), harness side and C2601-1, circuit CPP22 (GY/BN), harness side.	**Yes** INSTALL a new adjustable steering column telescopic motor. REFER to Steering Column Motor — Telescopic in this section. CLEAR the DTCs. TEST the system for normal operation. REPEAT the self test. **No** GO to A10 .

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 N0122614 • Ignition ON. • **NOTE:** Because the steering column motor (Hall-effect sensor) is disconnected, the SCCM only activates the output for approximately 1 second each time the steering column control switch is activated (jog mode). • Activate the steering column control switch in both the FORWARD and REARWARD positions (release the switch briefly between each switch activation) while observing the test light. • **Does the test light momentarily illuminate when the steering column control switch is activated in both FORWARD and REARWARD positions?**	

A10 CHECK THE SCCM CONNECTORS
• Check the SCCM electrical connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: Reconnect all previously disconnected electrical connectors.
• Make sure the connectors are seated correctly then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM.
	REFER to Section 211-05.
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: The Adjustable Steering Column is Inoperative in One or More Directions — Using the Memory SET Switch Buttons/Using an RKE Transmitter/Using the Easy Entry/Exit Feature

Refer to Wiring Diagrams Cell 128, Adjustable Steering Column for schematic and connector information.

Normal Operation

When the desired memory position is selected using the memory SET switch or an Remote Keyless Entry (RKE) transmitter, the Driver Seat Module (DSM) communicates the desired steering column position in a message on the Medium Speed Controller Area Network (MS-CAN) to the Body Control Module (BCM). The BCM acts as a gateway module, relaying the message to the Steering Column Control Module (SCCM) over the High Speed Controller Area Network (HS-CAN). The SCCM monitors the position of the adjustable steering column using Hall-effect type rotation sensors that are integral to the tilt and telescoping motors. The sensors provide a digital signal used by the SCCM to calculate the position of the steering column in relation to the full forward/rearward and full up/down positions. The SCCM uses these signals to store and recall memory positions, carry out easy entry/exit operations and to make sure the tilt and telescope motors do not stall against the steering column end of travel. If a tilt or telescope motor sensor DTC sets, the SCCM

does not recall a programmed memory position or automatically position the steering column during the easy entry/exit operation. If a DTC sets for either sensor, the affected adjustable steering column motor operates in jog mode. Jog mode allows limited operation of the affected steering column motor using only the steering column control switch. When the steering column control switch is operated in jog mode, the steering column moves in the desired direction for one second, then stops. The steering column control switch must be released, then pressed again in order to move the steering column for an additional second.

This pinpoint test is intended to diagnose the following:

- Entry/exit feature is disabled in the message center
- Wiring, terminals or connectors
- Memory SET switch
- RKE transmitter
- DSM
- BCM
- SCCM

PINPOINT TEST B: THE ADJUSTABLE STEERING COLUMN IS INOPERATIVE IN ONE OR MORE DIRECTIONS — USING THE MEMORY SET SWITCH BUTTONS/USING AN RKE TRANSMITTER/USING THE EASY ENTRY/EXIT FEATURE

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
B1 CHECK THE OPERATION OF THE ADJUSTABLE COLUMN USING THE STEERING COLUMN CONTROL SWITCH	
• Operate the adjustable steering column in all directions using the steering column control switch. • **Does the steering column move for more than one second in each direction using the steering column control switch?**	**Yes** If the adjustable steering column is inoperative using the easy entry/exit feature, GO to B2. If the adjustable steering column is inoperative using the memory SET switch, GO to B3. If the adjustable steering column is inoperative using an RKE transmitter, GO to B4. **No** If the steering column does not move in any direction at all using the steering column switch, GO to Pinpoint Test A. If the steering column moves in only one second intervals (jog mode) in one or more directions using the steering column switch, GO to Pinpoint Test C.
B2 VERIFY THE EASY ENTRY/EXIT FEATURE IS ENABLED	
• Verify the easy entry/exit feature is enabled using the message center. Refer to the Owner's Literature for additional instructions for using the message center. • **Does the message center indicate that the easy entry/exit feature is enabled?**	**Yes** GO to B5. **No** TOGGLE the easy entry/exit feature on using the message center controls. TEST the system for normal operation.
B3 CHECK THE OPERATION OF THE	

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MEMORY SEATS, MEMORY MIRRORS AND STEERING COLUMN USING THE MEMORY SET SWITCH	
• Check the operation of the seats, memory mirrors and steering column using the memory SET switch. Refer to the Owner's Literature for additional instructions for programming a memory position. • **Do the seats and mirrors operate properly using the memory SET switch?**	**Yes** If only the adjustable steering column is inoperative using the memory SET switch, GO to B5 . **No** If the seats and mirrors are also inoperative using the memory SET switch, REFER to Section 501-10 .
B4 CHECK THE OPERATION OF THE MEMORY SEATS, MIRRORS AND STEERING COLUMN USING AN RKE TRANSMITTER	
• Check the operation of the seats, mirrors and steering column using an RKE transmitter. Refer to the Owner's Literature for additional instructions for programming a memory position to an RKE transmitter. • **Do the seats and mirrors operate correctly using an RKE transmitter?**	**Yes** If only the adjustable steering column is inoperative using an RKE transmitter, GO to B5 . **No** If the seats and mirrors are also inoperative using an RKE transmitter, REFER to Section 501-10 .
B5 CHECK FOR DSM , BCM AND SCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — DSM . • Enter the following diagnostic mode on the scan tool: Self Test — BCM . • Enter the following diagnostic mode on the scan tool: Self-Test — SCCM . • Record all DTCs retrieved from the DSM , BCM and SCCM . • **Are any symptom or communication related DTCs present?**	**Yes** To diagnose the DSM DTCs, REFER to Section 501-10 . To diagnose the BCM DTCs, REFER to Section 419-10 . To diagnose the SCCM DTCs, REFER to Section 211-05 . **No** INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.

Pinpoint Test C: The Adjustable Steering Column Operates in One Second Intervals When Using the Steering Column Control Switch (Jog Mode)

Refer to Wiring Diagrams Cell 128 , Adjustable Steering Column for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors the position of the adjustable steering column using of Hall-effect type rotation sensors that are integral to the tilt and telescoping motors. Both the adjustable steering column tilt motor and telescope motor can be serviced separately from the steering column.

The SCCM sends a reference voltage along the sensor feed circuit through the Hall-effect sensor and back to the SCCM through a shared signal return circuit. The sensors provide a digital signal used by the SCCM to calculate the position of the steering column in relation to the full forward/rearward and full up/down positions. The SCCM uses this signal to store and recall memory positions, to carry out the easy entry/exit operations and to make sure the adjustable steering column tilt and telescope motors do not stall against the steering column end of travel.

If an adjustable steering column tilt or telescope motor sensor DTC sets (or if either of the sensor circuits

become open), the SCCM does not recall a programmed memory position or automatically position the steering column during the easy entry/exit operations. The affected steering column motor operates in jog mode. Jog mode allows limited operation of the affected steering column motor using only the steering column control switch. When the steering column control switch is operated in jog mode, the steering column moves in the desired direction for one second, then stops regardless of the length of time the switch is actually activated. The steering column control switch must be released, then activated again in order to move the steering column for an additional second.

DTC Description	Fault Trigger Conditions
• B1C33:11 — Steering Column Tilt Feedback Signal: Circuit Short To Ground	This DTC sets when the SCCM senses the adjustable steering column tilt motor feedback sensor signal is below 1.5 volts. This may be caused by a short to ground in the sensor signal circuit.
• B1C33:12 — Steering Column Tilt Feedback Signal: Circuit Short To Battery	This DTC sets when the SCCM senses the adjustable steering column tilt motor feedback sensor signal is above 7 volts. This may be caused by a short to voltage in the sensor signal circuit.
• B1C35:11 — Steering Column Telescope Feedback Signal: Circuit Short To Ground	This DTC sets when the SCCM senses the adjustable steering column telescope motor feedback sensor signal is below 1.5 volts. This may be caused by a short to ground in the sensor signal circuit.
• B1C35:12 — Steering Column Telescope Feedback Signal: Circuit Short To Battery	This DTC sets when the SCCM senses the adjustable steering column telescope motor feedback sensor signal is above 7 volts. This may be caused by a short to voltage in the sensor signal circuit.

This pinpoint test is intended to diagnose the following:

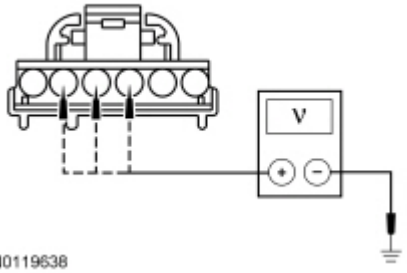
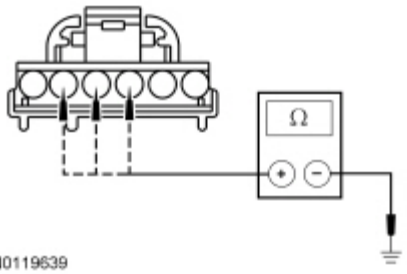
- Wiring, terminals or connectors
- Adjustable steering column tilt motor
- Adjustable steering column telescopic motor
- SCCM

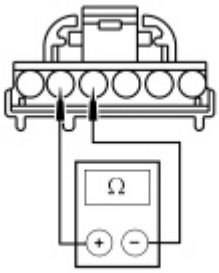
PINPOINT TEST C: THE ADJUSTABLE STEERING COLUMN OPERATES IN ONE SECOND INTERVALS WHEN USING THE STEERING COLUMN CONTROL SWITCH (JOG MODE)

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

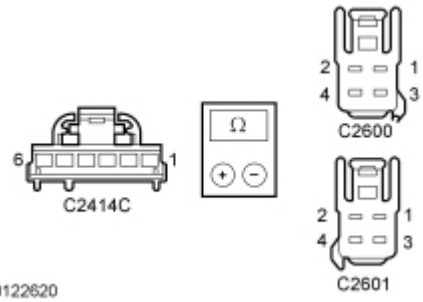
Test Step	Result / Action to Take
C1 CHECK THE TILT/TELESCOPE SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SCCM C2414C. • Disconnect: Adjustable Steering Column Tilt Motor C2600. • Disconnect: Adjustable Steering Column Telescope Motor C2601. • Ignition ON. • Measure the voltage between ground and: ▪ SCCM C2414C-3, circuit RPP06 (GN),	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to C2 .

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harness side. ■ SCCM C2414C-4, circuit VPP08 (WH), harness side. ■ SCCM C2414C-5, circuit VPP17 (VT/BN), harness side.  N0119638 • **Is any voltage present?**	
C2 CHECK THE TILT/TELESCOPE SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and: ■ SCCM C2414C-3, circuit RPP06 (GN), harness side. ■ SCCM C2414C-4, circuit VPP08 (WH), harness side. ■ SCCM C2414C-5, circuit VPP17 (VT/BN), harness side.  N0119639 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C3 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C3 CHECK THE TILT/TELESCOPE SENSOR CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between SCCM C2414C-4, circuit VPP08 (WH), harness side and SCCM C2414C-5, circuit VPP17 (VT/BN), harness side.	**Yes** GO to C4 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.



- **Is the resistance greater than 10,000 ohms?**

C4 CHECK THE TILT/TELESCOPE SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between SCCM C2414C, harness side and adjustable steering column tilt motor C2600; and between SCCM C2414C, harness side and adjustable steering column telescope motor C2601, harness side using the following chart: **SCCM** / **Circuit** / **Adjustable Steering Column Tilt/Telescope Motor** C2414C-3 / RPP06 (GN) / C2600-3 C2414C-3 / RPP06 (GN) / C2601-3 C2414C-4 / VPP08 (WH) / C2600-4 C2414C-5 / VPP17 (VT/BN) / C2601-4  • **Are the resistances less than 5 ohms?**	**Yes** GO to C5 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C5 CHECK THE SCCM CONNECTOR	
• Check SCCM connector C2414C for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect: SCCM C2414C. • Connect: Adjustable Steering Column Tilt	**Yes** If the adjustable steering column does not operate correctly when the steering column control switch is in the UP/DOWN (tilt) position (s), INSTALL a new adjustable steering column tilt motor. REFER to Steering Column

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Motor C2600. • Connect: Adjustable Steering Column Telescope Motor C2601. • Ignition ON. • Make sure the connectors are seated correctly then operate the system and verify the concern is still present. • **Is the concern still present?**	Motor — Tilt in this section. CLEAR the DTCs. REPEAT the self-test. If the concern is still present, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation. If the adjustable steering column does not operate correctly when the steering column control switch is in the FORWARD/REARWARD (telescope) position (s), INSTALL a new adjustable steering column telescopic motor. REFER to Steering Column Motor — Telescopic in this section. CLEAR the DTCs. REPEAT the self-test. If the concern is still present, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Steering Wheel Wrap Bonding

Material

Item	Specification
Instant Gel Adhesive TA-19	WSK-M2G402-A4

1. **NOTE:** If re-adhering leather to the front side of the steering wheel only, it will not be necessary to remove the steering wheel. Steering wheel removal is necessary only when repairing loose leather on the backside of the steering wheel.

   If necessary remove the steering wheel. For additional information, refer to Steering Wheel in this section.

2. Position the loose leather out of the way.

3. Apply the specificed adhesive evenly over the wheel spoke.

4. Position the loose leather back into the original position.

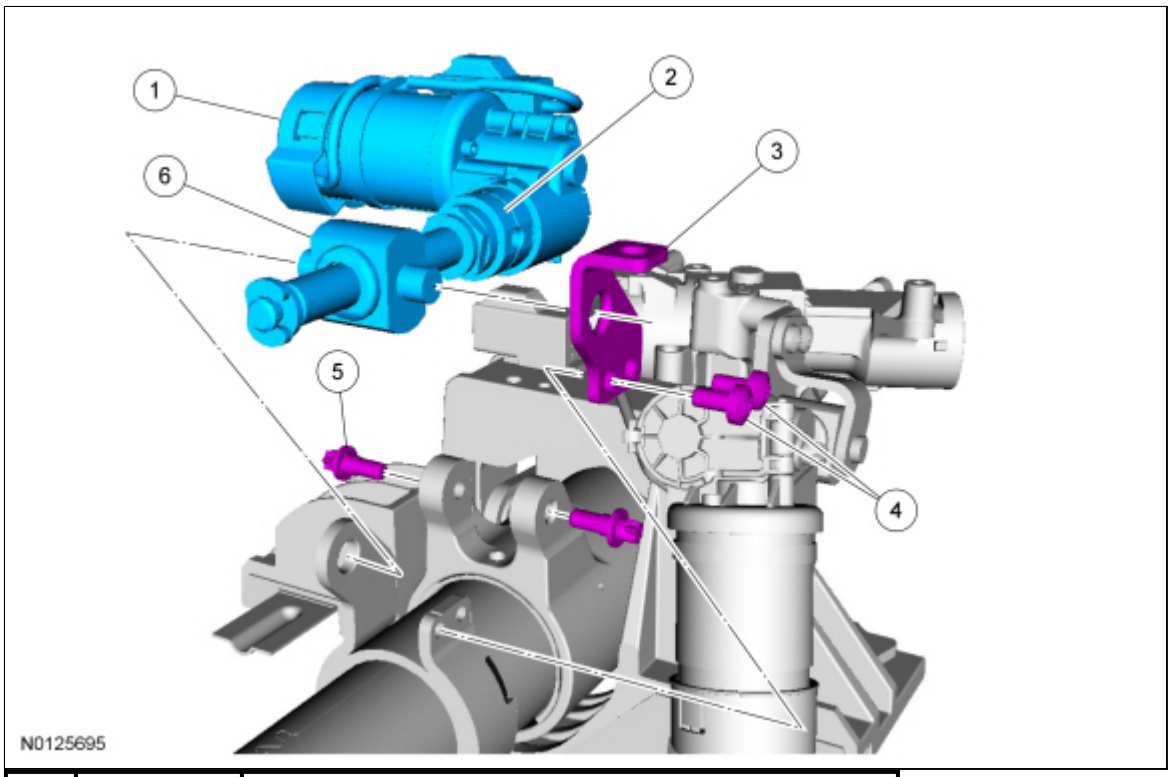
5. **NOTE:** The adhesive should be completely set after 5 minutes. Do not pull on the repair area.

   Smooth the leather and tuck in for neat appearance.
   - Apply pressure (for at least 30 seconds) until the leather is bonded to the wheel spoke.

6. If removed, Install the steering wheel. For additional information, refer to Steering Wheel in this section.

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Steering Column Motor — Telescopic

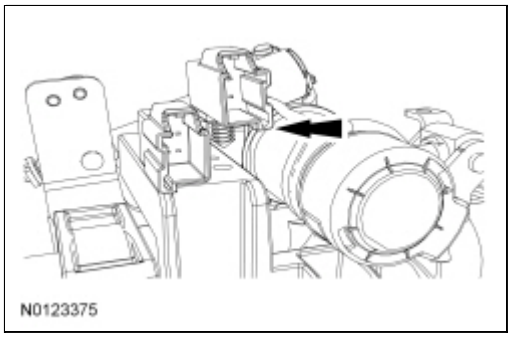


Item	Part Number	Description
1	3F797	Steering column motor (telescopic)
2	—	Leadscrew housing (part of 3F797)
3	—	Trunion nut capture bracket (part of 3C529)
4	—	Trunion nut capture bracket screws (2 required) (part of 3C529)
5	—	Steering column motor screws (2 required) (part of 3C529)
6	—	Trunion nut (part of 3F797)

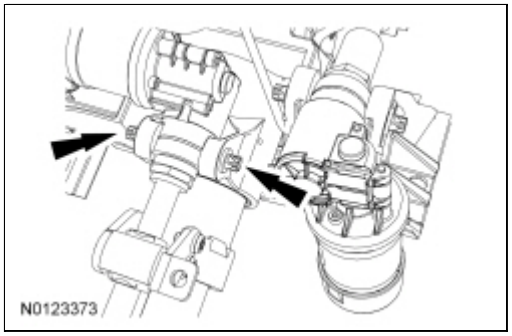
Removal

1. Remove the steering column. For additional information, refer to Steering Column in this section.
2. Place the steering column upside down on a workbench.
3. Detach the electrical connector pin-type retainer from the steering column.

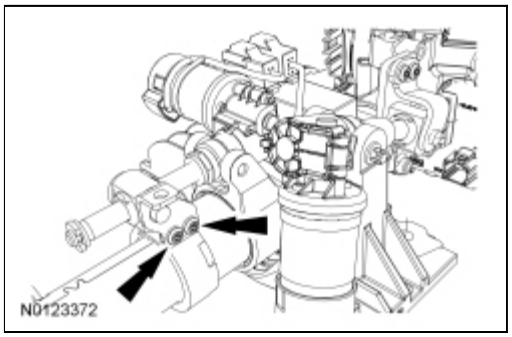
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4. Remove the 2 steering column motor screws.



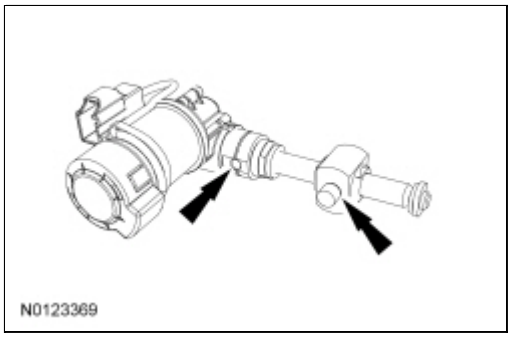
5. Remove the 2 steering column motor trunnion nut capture bracket screws and the trunnion nut capture bracket.



6. Remove the steering column motor.

Installation

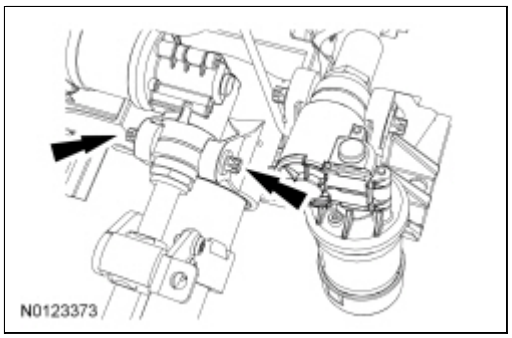
1. Apply grease (supplied with the motor) to the trunnion nut axles and the steering column motor leadscrew housing holes.



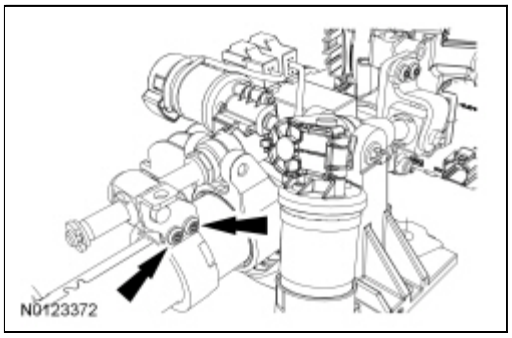
2. **NOTE:** Install the trunnion nut with the axle O-ring facing inward towards the column.

   NOTE: If necessary, make small alignment adjustments by pivoting the tilt bracket.

   Rotate the pinion nut until the correct length is achieved to align the leadscrew housing with the threaded holes in the support arm.
   - Loosely install the 2 steering column motor screws.



3. Position the trunnion nut capture bracket and loosely install the 2 steering column motor trunnion nut capture bracket screws.

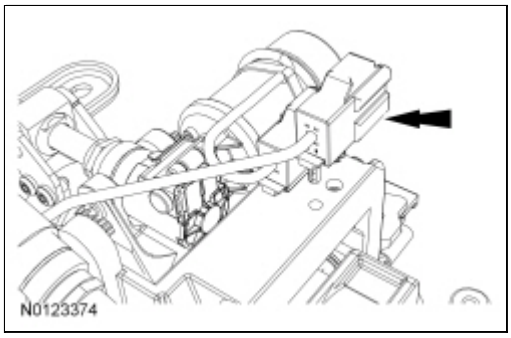


4. Tighten the 2 steering column motor screws to 6 Nm (53 lb-in).

5. Tighten the 2 steering column motor trunnion nut capture bracket screws to 7 Nm (62 lb-in).

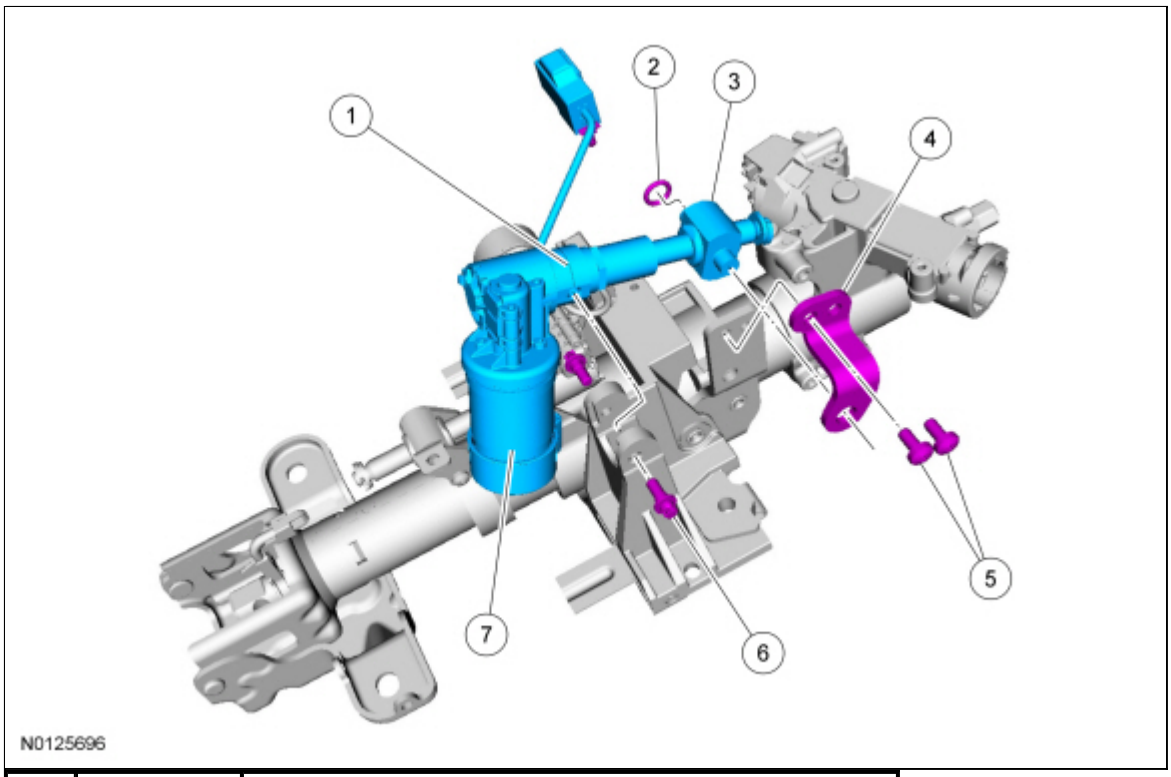
6. Attach the electrical connector pin-type retainer to the steering column.

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7. Install the steering column. For additional information, refer to Steering Column in this section.

Steering Column Motor — Tilt

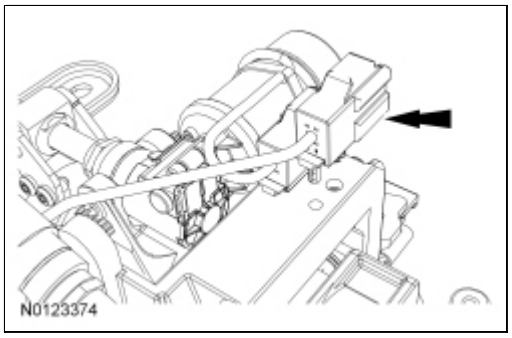


Item	Part Number	Description
1	—	Leadscrew housing (part of 3F797)
2	—	O-ring (part of 3F797)
3	—	Trunion nut (part of 3F797)
4	—	Trunion nut capture bracket (part of 3C529)
5	—	Trunion nut capture bracket screws (2 required) (part of 3C529)
6	—	Steering column motor screws (2 required) (part of 3C529)
7	3F797	Steering column motor (tilt)

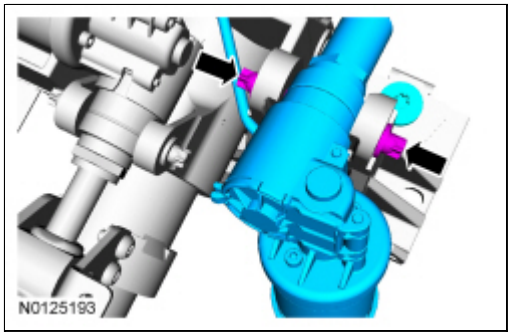
Removal

1. Remove the steering column. For additional information, refer to Steering Column in this section.
2. Place the steering column upside down on a workbench.
3. Detach the electrical connector pin-type retainer from the steering column.

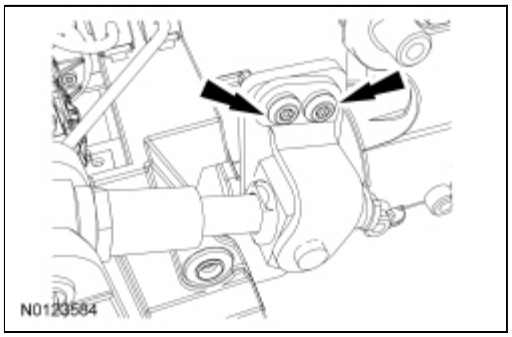
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4. Remove the 2 steering column motor screws.



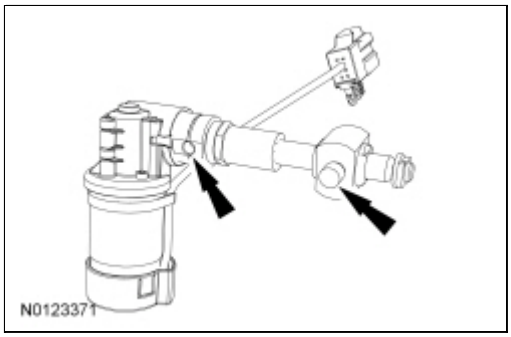
5. Remove the 2 steering column motor trunnion nut capture bracket screws and the trunnion nut capture bracket.



6. Remove the steering column motor.

Installation

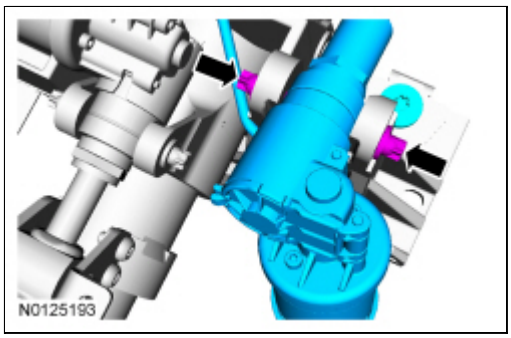
1. Apply grease (supplied with the motor) to the trunnion nut axles and the steering column motor leadscrew housing holes.



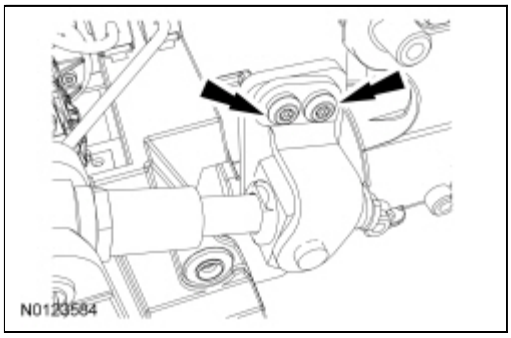
2. **NOTE:** Install the trunnion nut with the axle O-ring facing inward towards the column.

   NOTE: If necessary, make small alignment adjustments by pivoting the tilt bracket.

   Rotate the pinion nut until the correct length is achieved to align the leadscrew housing with the threaded holes in the support arm.
   - Loosely install the 2 steering column motor screws.



3. Position the trunnion nut capture bracket and loosely install the 2 steering column motor trunnion nut capture bracket screws.

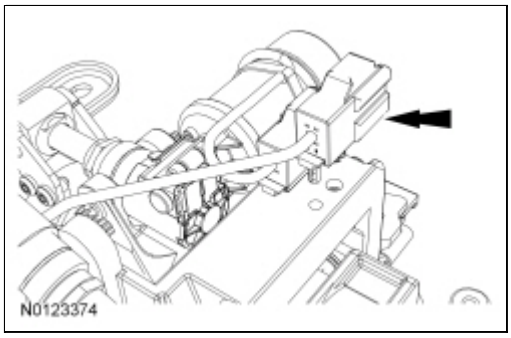


4. Tighten the 2 steering column motor screws to 6 Nm (53 lb-in).

5. Tighten the 2 steering column motor trunnion nut capture bracket screws to 7 Nm (62 lb-in).

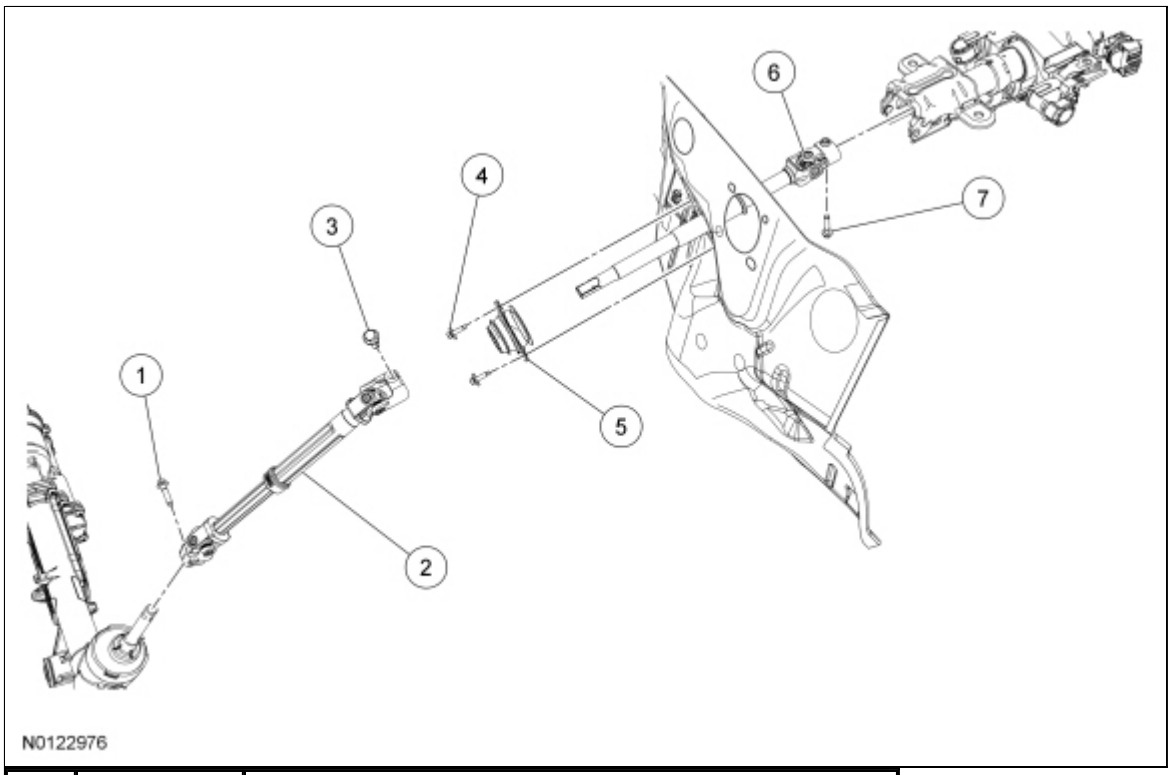
6. Attach the electrical connector pin-type retainer to the steering column.

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7. Install the steering column. For additional information, refer to Steering Column in this section.

Steering Column Shaft



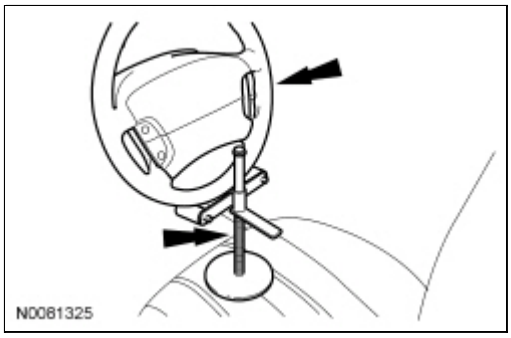
Item	Part Number	Description
1	N808684	Lower steering column shaft-to-steering gear bolt
2	3B676	Lower steering column shaft
3	W710570	Lower steering column shaft-to-upper steering column shaft bolt
4	W705132	Steering column shaft dash seal bolt (2 required)
5	3D677	Steering column shaft dash seal
6	3E751	Upper steering column shaft
7	W714409	Upper steering column shaft-to-steering column bolt

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Using a suitable holding device, hold the steering wheel in the straight-ahead position.

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3. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the steering column shaft has rotated, remove and recenter the clockspring. For additional information, refer to Section 501-20B .**

   Remove and discard the upper steering column shaft-to-steering column bolt and disconnect the upper steering column shaft from the steering column.
   - To install, tighten the new bolt to 28 Nm (21 lb-ft).

4. Remove and discard the lower steering column shaft-to-upper steering column shaft bolt and disconnect the lower steering column shaft from the upper steering column shaft.
   - To install, tighten the new bolt to 48 Nm (35 lb-ft).

5. Remove the 2 steering column shaft dash seal bolts, the steering column shaft dash seal and the upper steering column shaft.
   - To install, tighten to 12 Nm (106 lb-in).

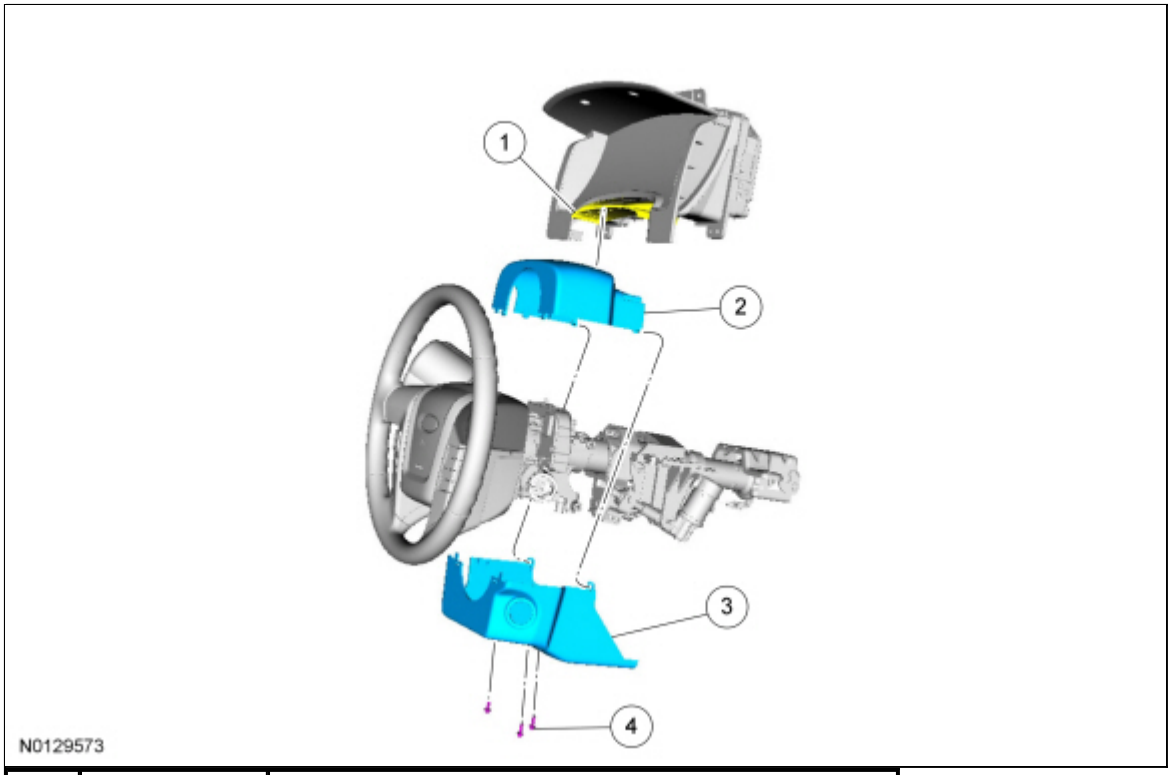
6. Remove and discard the lower steering column shaft-to-steering gear bolt and disconnect the lower steering column shaft from the steering gear.
   - To install, tighten the new bolt to 30 Nm (22 lb-ft).

7. **WARNING: Do not reuse steering column shaft bolts. This may result in fastener failure and steering column shaft detachment or loss of steering control. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   To install, reverse the removal procedure.

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Steering Column Shroud — Floor Shift



Item	Part Number	Description
1	—	Instrument cluster trim (part of 15044D70)
2	3530A	Upper steering column shroud
3	3530B	Lower steering column shroud
4	W710485	Lower steering column shroud screw (3 required)

Removal and Installation

1. Remove the 3 screws and the steering column opening trim panel.

2. Separate the instrument cluster trim from the upper steering column shroud.

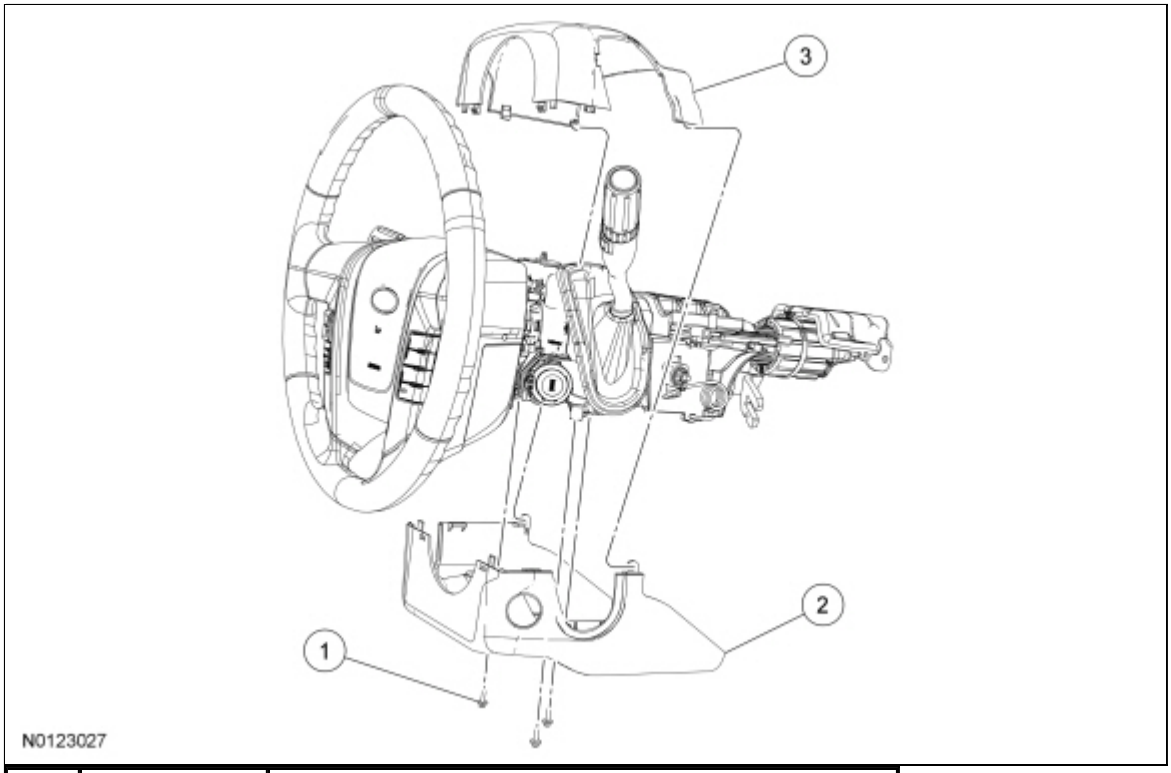
3. Pull upward on the rearward portion of the upper steering column shroud to separate the clips from the lower steering column shroud.
   - Roll the upper steering column shroud upward on the hinge point and then pull straight rearward to remove the upper shroud.

4. Remove the 3 screws and the lower steering column shroud.
   - To install, tighten to 2 Nm (18 lb-in).

5. To install, reverse the removal procedure.

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Steering Column Shroud



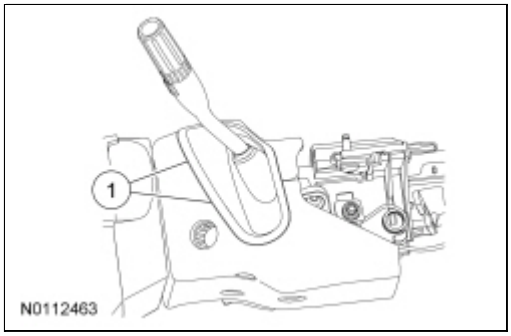
Item	Part Number	Description
1	W710485	Lower steering column shroud screw (3 required)
2	3530B	Lower steering column shroud
3	3530A	Upper steering column shroud

Removal

1. Remove the 3 screws and the steering column opening trim panel.
2. Place transmission selector lever in PARK.
3. Position the steering column in the full downward and rearward position.
4. Apply the parking brake.
5. With the ignition key in the ON position and the brake pedal pressed, shift the transmission selector lever into DRIVE.
6. ***NOTICE:*** **Use care when detaching the transmission selector lever boot clips from steering column shrouds or damage to the selector lever boot may occur causing replacement of the shift lever assembly. The transmission selector lever boot is not serviceable separately.**

   Position the selector lever boot aside.

1. Push forward on the selector lever boot at the area indicated and separate the boot from the upper and lower steering column shrouds.



7. Pull upward on the rearward portion of the upper steering column shroud to separate the clips from the lower steering column shroud.
    - Roll the upper steering column shroud upward on the hinge point and then pull straight rearward to remove the upper shroud.

8. Shift the shift lever to PARK and remove the ignition key.

9. Remove the 3 screws and the lower steering column shroud.

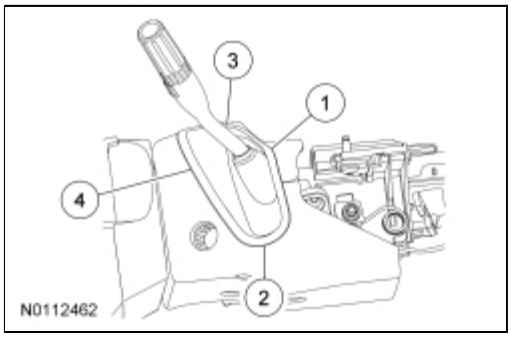
Installation

1. Position the lower steering column shroud and install the 3 screws.
    - Tighten to 2 Nm (18 lb-in).

2. Position the upper steering column shroud onto the lower steering column shroud and secure the front clips.

3. ***NOTICE:*** **Use care and follow the installation sequence when installing the selector lever boot to the steering column shrouds or damage to the boot may occur causing replacement of the selector lever assembly. The selector lever boot is not serviceable separately.**

    Install the selector lever boot in the sequence shown.
    1. Slide the front of the selector lever boot into position.
    2. Slide the bottom of the selector lever boot into position.
    3. Slide the top of the selector lever boot into position and push down.
    4. Push down on the back of the selector lever boot until selector lever boot is fully seated.



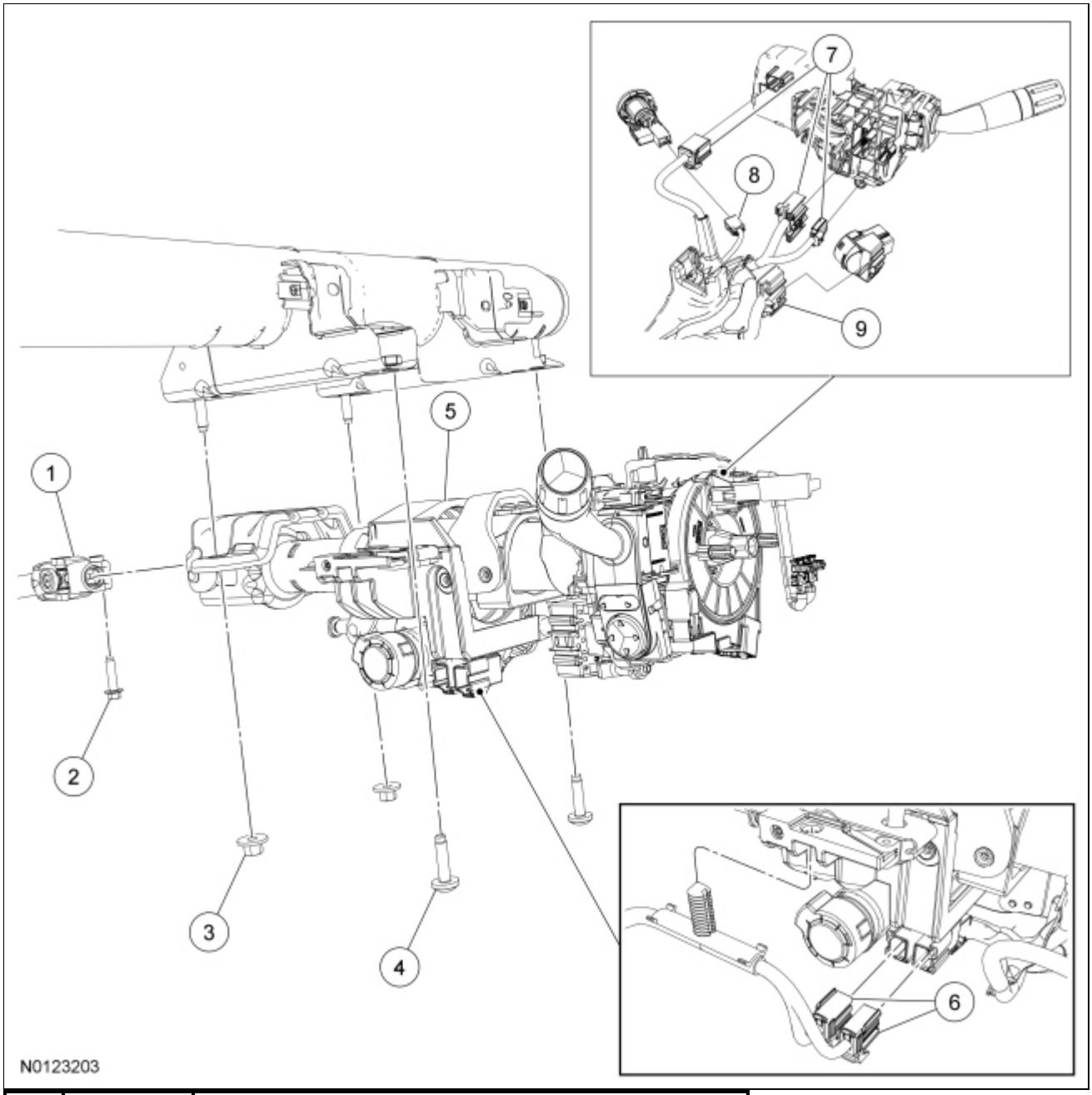
4. Place transmission selector lever in PARK.

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5. Release the parking brake.
6. Position the steering column opening trim panel and install the 3 screws.

Steering Column

Power Column

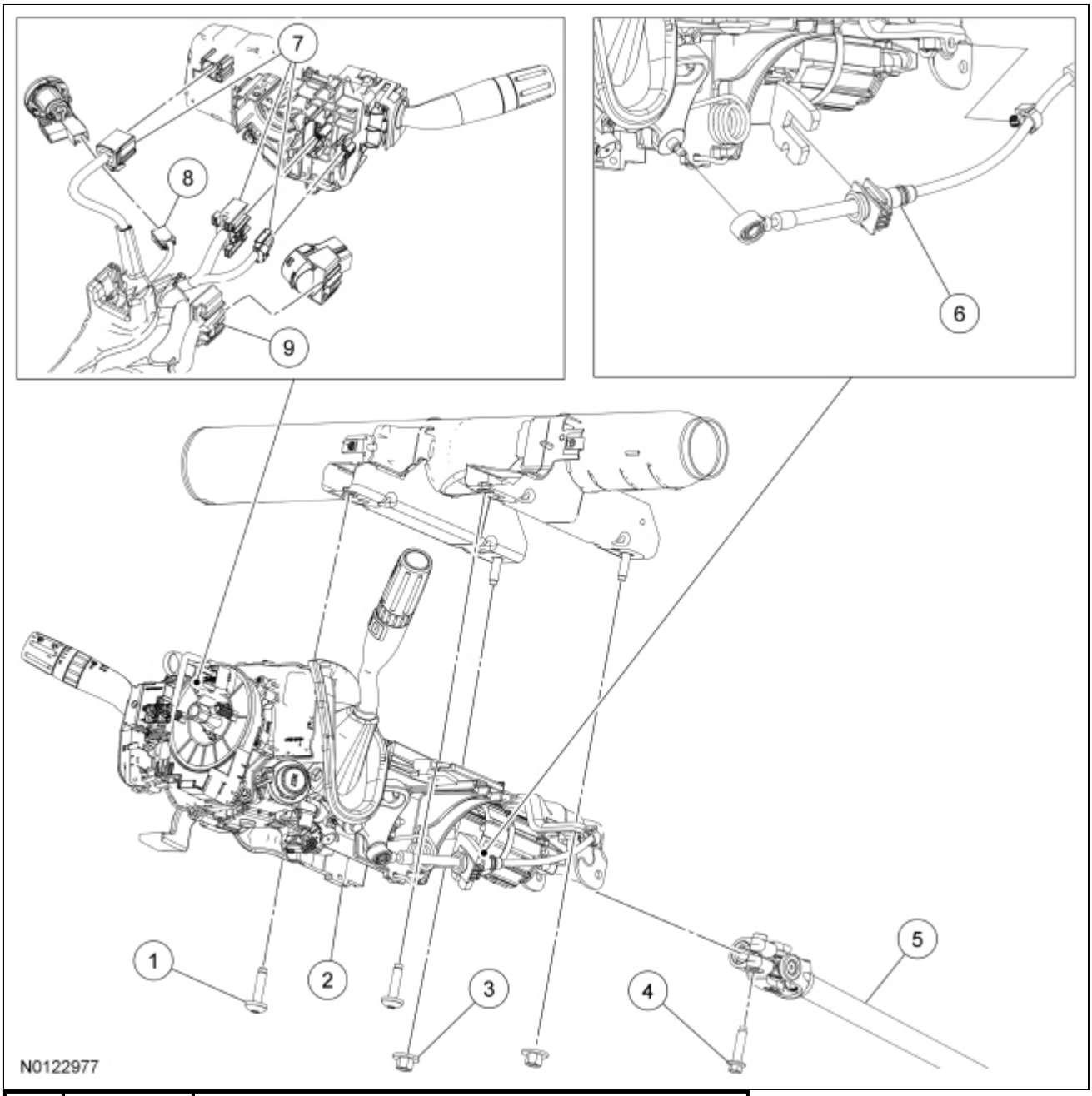


Item	Part Number	Description
1	3E751	Upper steering column shaft
2	N808684	Upper steering column shaft-to-steering column bolt

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3	N806423	Steering column nut (2 required)
4	W715057	Steering column bolt (2 required)
5	3C529	Steering column
6	—	Steering column motor electrical connectors (2 required) (part of 14401)
7	—	Steering Column Control Module (SCCM) electrical connectors (3 required) (part of 14401)
8	—	Passive Anti-Theft System (PATS) electrical connector (part of 14401)
9	—	Ignition switch electrical connector (part of 14401)

Manual Column



Item	Part Number	Description
1	W715057	Steering column bolt (2 required)
2	3C529	Steering column
3	N806423	Steering column nut (2 required)
4	W714409	Upper steering column shaft-to-steering column bolt
5	3E751	Upper steering column shaft
6	7E395	Selector lever cable (column shift only)
7	—	Steering Column Control Module (SCCM) electrical connectors (3 required) (part of 14401)
8	—	Passive Anti-Theft System (PATS) electrical connector

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		(part of 14401)
9	—	Ignition switch electrical connector (part of 14401)

Removal and Installation

All vehicles

1. Remove the steering column shrouds. For additional information, refer to Steering Column Shroud — Floor Shift in this section.

2. Remove the steering wheel. For additional information, refer to Steering Wheel in this section.

3. Disconnect the following electrical connectors.
   - Clockspring
   - Passive Anti-Theft System (PATS) transceiver
   - Ignition switch
   - Steering Column Control Module (SCCM) (3 required)
   - Key release interlock actuator (if equipped)

Vehicles with power column

4. Disconnect the 2 steering column motor electrical connectors.

Vehicles with column shift

5. Detach the shift lever cable from the steering column and the bracket.

6. Disconnect the overdrive cancel switch and the Brake Shift Interlock Actuator (BSIA) electrical connectors.

All vehicles

7. Detach the wiring harness retainers from the steering column and position the wiring harness aside.

8. **WARNING: Do not reuse steering column shaft bolts. This may result in fastener failure and steering column shaft detachment or loss of steering control. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   Remove and discard the upper steering column shaft-to-steering column bolt and detach the upper steering column shaft from the steering column.
   - To install, tighten the new bolt to 28 Nm (21 lb-ft).

9. Remove the 2 steering column nuts, the 2 steering column bolts and the steering column.
   - To install, tighten the new steering column nuts to 30 Nm (22 lb-ft).
   - To install, tighten the new steering column bolts to 28 Nm (21 lb-ft).

10. ***NOTICE:*** **Make sure the steering column support is flush with the instrument panel and the tilt lever (if equipped) is in the locked position before tightening the nuts and bolts or damage to the steering column may occur.**

    NOTICE: **Make sure the electrical wiring harness is routed correctly and secured to the steering column or damage to the wires and/or connectors may occur.**

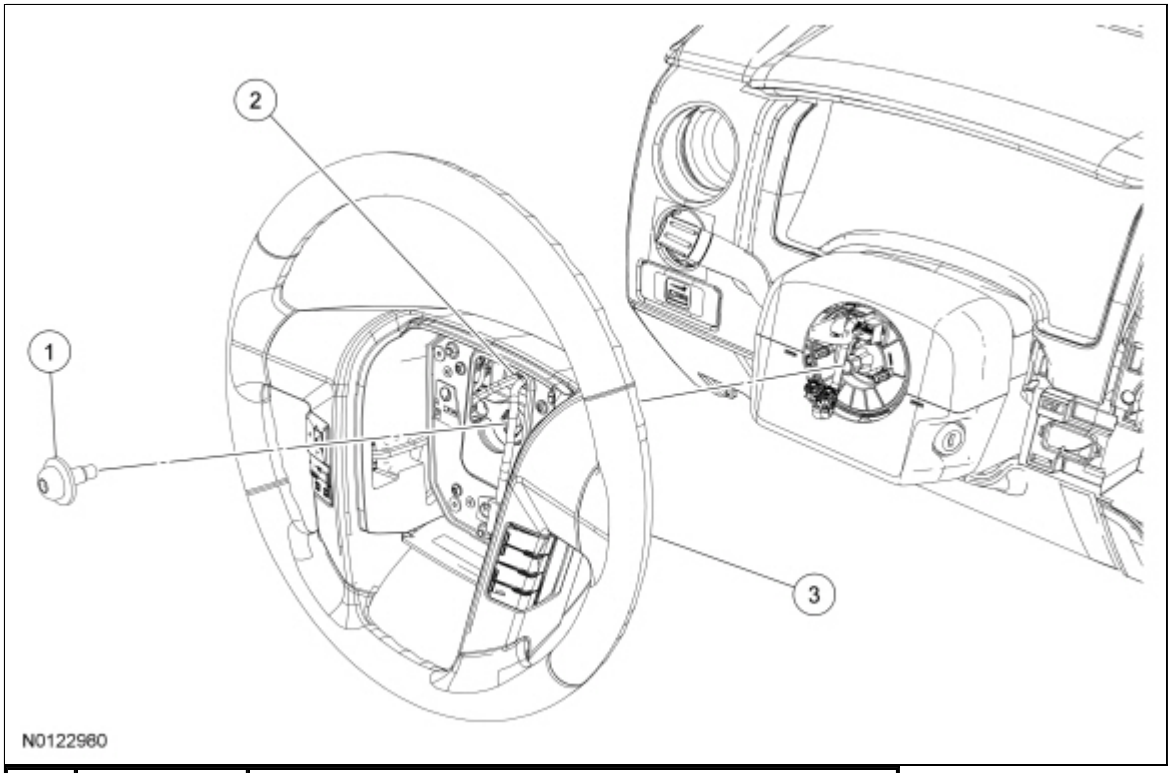
To install, reverse the removal procedure.

Vehicles with power column

11. If a new power steering column has been installed, use the steering column control switch and set the soft stops as follows.
    1. Move the column rearward until it reaches the end of travel and hold the switch for 2 seconds after the column has reached the end of travel.
    2. Move the column in the same direction until it reaches the end of travel again and hold the switch for 2 seconds after the motor has reached the end of travel. This clears any unintended soft stops.
    3. Move the column forward until it reaches the end of travel and hold the switch for 2 seconds after the motor has reached the end of travel.
    4. Move the column in the same direction until it reaches the end of travel and hold the switch for 2 seconds after the motor has reached the end of travel. This clears any unintended soft stops.
    5. Repeat the sequence moving the column up and down.

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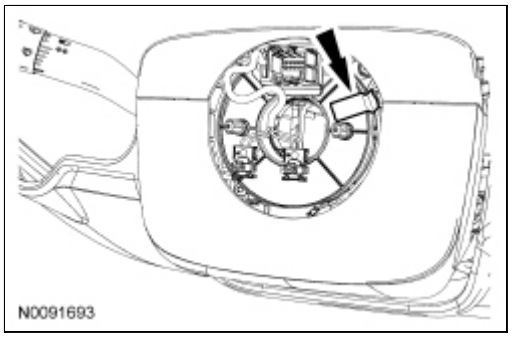
Steering Wheel



Item	Part Number	Description
1	W709344	Steering wheel bolt
2	—	Steering wheel switches electrical connector (part of 3600)
3	3600	Steering wheel

Removal and Installation

1. Remove the driver air bag module. For additional information, refer to Section 501-20B .
2. Turn the steering wheel to the straight-ahead position.
3. Remove and discard the steering wheel bolt.
   - To install, tighten the new bolt to 48 Nm (35 lb-ft).
4. Disconnect the steering wheel switches electrical connector from the clockspring.
5. Remove the steering wheel while routing the wires from the clockspring through the steering wheel.
6. Tape the clockspring center rotor to the outer housing to prevent it from rotating.



7. To install, reverse the removal procedure.

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Torque Specifications

Description	Nm	lb-in
Multifunction switch screws	2	18
Steering Column Control Module (SCCM) screws	2	18

Steering Column Switches

The steering column switches consist of the following components:

- Steering Column Control Module (SCCM)
- Ignition switch
- Hazard flasher switch
- Multifunction switch
- Brake pedal control switch (if equipped)
- Steering column control switch (if equipped)
- Steering wheel switches (if equipped)
- Steering wheel rotation sensor (if equipped)

Steering Column Control Module (SCCM)

The SCCM acts as a central hub for the steering column switches and circuits. The hazard flasher switch, multifunction switch, brake pedal control switch and steering column control switch are mounted directly to the SCCM and can be serviced separately from the SCCM .

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Steering Column Switches

Special Tool(s)

 ST3104-A	Backprobe Pins POM 6411 or equivalent
 ST2574-A	Flex Probe Kit NU105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Ignition Switch

When the ignition lock cylinder is turned using the key, a mechanical connection positions the ignition switch to the desired position. The available ignition switch positions are:

- OFF
- ACC
- RUN
- START

When placed in any position other than OFF, the ignition switch provides fused battery voltage inputs to the Body Control Module (BCM). When placed in the START position, the ignition switch also provides fused battery voltage input to the PCM. The ignition switch contains a key-in-ignition input that allows the BCM to

detect when the key has been inserted in the ignition to initiate the module wake up cycle. This information is also used by the BCM for the brake shift interlock system. For information on the brake shift interlock system, refer to Section 307-05 .

Key Removal Inhibit Solenoid

The key removal inhibit solenoid (also known as the key release interlock actuator) is an electronically controlled solenoid that prevents the ignition lock cylinder from being turned to the OFF position unless the gear selector lever is in the PARK position. The key removal inhibit solenoid is part of the ignition switch.

Steering Column Control Module (SCCM)

The Steering Column Control Module (SCCM) controls various systems and/or features:

- Wiper and washer system, refer to Section 501-16 .
- Exterior lighting, refer to Section 417-01 .
- Interior lighting, refer to Section 417-02 .
- Steering wheel audio controls (if equipped), refer to Refer to the appropriate section in Group 415 for the procedure..
- Steering wheel message center controls (if equipped), refer to Section 413-01 .
- Cruise control, refer to Section 419-03 .
- Adjustable pedals, refer to Section 206-06 .
- Steering column control, refer to Section 211-04 .

The SCCM also provides a pass-through circuit path for various components and/or features:

- Steering wheel switch illumination
- Driver air bag module
- Horn

The multifunction switch, brake pedal control switch (if equipped), hazard flasher switch, steering column control switch (if equipped), and LH/RH steering wheel switches (if equipped) provide inputs to the SCCM . Based on inputs from the various switches, the SCCM communicates over the High Speed Controller Area Network (HS-CAN) or the Local Interconnect Network (LIN) to control the supporting features.

Clockspring

The clockspring is mounted on the front of the SCCM and provides a continuous electrical connection between the driver air bag and the Restraints Control Module (RCM) when the steering wheel is turned. For information on the clockspring and other components of the Supplemental Restraint System (SRS), refer to Section 501-20B .

Steering Wheel Rotation Sensor

The steering wheel rotation sensor is mounted on the front of the SCCM behind the clockspring and provides steering wheel position information to the SCCM . This information is broadcast over the HS-CAN .

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Multifunction Switch

The multifunction switch is mounted directly to the SCCM and controls the low/high-beam headlamps, flash-to-pass, turn signals, windshield wiper and washer and front camera washer (if equipped), by transferring the driver inputs to the SCCM. The high-beam headlamps, flash-to-pass and turn signals are communicated from the SCCM over the HS-CAN. The windshield wiper and front camera washer signals (if equipped) are communicated from the SCCM to the wiper motor internal module over the LIN. When the BCM receives the correct signal from the SCCM, the BCM activates the required component.

Brake Pedal Control Switch

The brake pedal control switch is mounted directly to the SCCM and controls the forward and rearward movement of the accelerator and brake pedals. The brake pedal control switch functions when the ignition switch is in the OFF, ACC or RUN positions. When the brake pedal control switch is pressed voltage is connected through the SCCM to the adjustable pedals motor.

Hazard Flasher Switch

The hazard flasher switch is mounted directly to the SCCM and operates when the ignition switch is in any position or when the key is removed. One press of the switch supplies a ground signal through the SCCM to the BCM. When the ground signal is sensed by the BCM it turns the directional indicators ON. A second press of the button releases the ground connection and turns the directional indicators OFF.

Steering Wheel Switches

The steering wheel switches are mounted directly to the steering wheel and wired to the SCCM. Depending on what features the vehicle is equipped with, the SCCM sends messages via the HS-CAN to the PCM (cruise control), Instrument Panel Cluster (IPC) (message center) and BCM (entertainment system). The SCCM entertainment system messages are received by the BCM via HS-CAN and gatewayed over the Medium Speed Controller Area Network (MS-CAN) where the messages are received by the applicable entertainment system module(s).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Multifunction switch • Ignition switch	• Battery Junction Box (BJB) fuse(s): ▪ 31 (15A)

• Key efforts • Steering column shrouds	▪ 42 (5A) • Body Control Module (BCM) fuse(s): ▪ 23 (15A) ▪ 24 (15A) ▪ 28 (15A) ▪ 42 (5A) • Instrument Panel Cluster (IPC) • Steering Column Control Module (SCCM) • Passive Anti-Theft System (PATS) module • Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
     - GO to Pinpoint Test A in this section to diagnose no power in all ignition switch positions or GO to Pinpoint Test C to diagnose no power in RUN position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record continuous memory DTCs.

8. Carry out the self-test diagnostics for the BCM and the SCCM.

9. If the DTCs retrieved are related to the concern, refer to the Body Control Module (BCM) DTC Chart, or the Steering Column Control Module (SCCM) DTC Chart. For all other DTCs, refer to Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action

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B1142:29	Ignition Status 1: Signal Invalid	GO to Pinpoint Test E .
B1310:12	Run/Start Control: Circuit Short to Battery	GO to Pinpoint Test F .
B1310:14	Run/Start Control: Circuit Short to Ground or Open	GO to Pinpoint Test C .
U300A:01	Ignition Switch: General Electrical Failure	GO to Pinpoint Test A .
All other DTCs	—	REFER to the Master DTC Chart in Section 419-10 .

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1007:09	High-Beam Headlamp Switch: Component Failure	REFER to Section 417-01 .
B1008:09	Wiper Mode Switch: Component Failure	REFER to Section 501-16 .
B1051:09	Front Washer Switch: Component Failure	REFER to Section 501-16 .
B10A6:09	Main Light Switch: Component Failure	REFER to Section 417-01 .
B10AD:02	Rain Sensor: General Signal Failure	REFER to Section 501-16 .
B10AD:08	Rain Sensor: Bus Signal / Message Failure	REFER to Section 501-16 .
B10AD:49	Rain Sensor: Internal Electronic Failure	REFER to Section 501-16 .
B10AD:55	Rain Sensor: Not Configured	CARRY OUT Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available (using As-Built Data) on the SCCM . REFER to Section 418-01 . RETRIEVE SCCM DTCs. If B10AD:55 returns, INSTALL a new SCCM . REFER to Steering Column Control Module (SCCM) in this section.
B1124:09	Lamp Fade Control: Component Failure	REFER to Section 417-01 .
B1131:02	Wiper Motor Module: General Signal Failure	REFER to Section 501-16 .
B1131:08	Wiper Motor Module: Bus Signal / Message Failure	REFER to Section 501-16 .
B11D9:16	Vehicle Battery: Circuit Voltage Below Threshold	GO to Pinpoint Test J .
B11D9:17	Vehicle Battery: Circuit Voltage Above Threshold	GO to Pinpoint Test K .

B1298:09	Steering Column Adjust Up Switch: Component Failure	REFER to Section 211-04 .
B1299:09	Steering Column Adjust Down Switch: Component Failure	REFER to Section 211-04 .
B12A1:09	Steering Column Adjust Out Switch: Component Failure	REFER to Section 211-04 .
B12A2:09	Steering Column Adjust In Switch: Component Failure	REFER to Section 211-04 .
B12F7:09	Single Wipe Switch: Component Failure	REFER to Section 501-16 .
B1368:11	Adjustable Pedal Position Feedback Sensor: Circuit Short to Ground	REFER to Section 206-06 .
B1368:12	Adjustable Pedal Position Feedback Sensor: Circuit Short to Battery	REFER to Section 206-06 .
B1369:09	Pedal Adjustment Switch: Component Failure	REFER to Section 206-06 .
B1375:18	Steering Column Tilt Motor: Circuit Current Below Threshold	REFER to Section 211-04 .
B1375:19	Steering Column Tilt Motor: Circuit Current Above Threshold	REFER to Section 211-04 .
B1375:71	Steering Column Tilt Motor: Actuator Stuck	REFER to Section 211-04 .
B137D:18	Pedal Adjustment Motor: Circuit Current Below Threshold	REFER to Section 206-06 .
B137D:19	Pedal Adjustment Motor: Circuit Current Above Threshold	REFER to Section 206-06 .
B137D:71	Pedal Adjustment Motor: Actuator Stuck	REFER to Section 206-06 .
B137E:18	Steering Column Telescope Motor: Circuit Current Below Threshold	REFER to Section 211-04 .
B137E:19	Steering Column Telescope Motor: Circuit Current Above Threshold	REFER to Section 211-04 .
B137E:71	Steering Column	REFER to Section 211-04 .

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	Telescope Motor: Actuator Stuck	
B137F:09	Steering Wheel Left Switch Pack: Component Failure	REFER to Section 419-03 .
B137F:11	Steering Wheel Left Switch Pack: Circuit Short To Ground	REFER to Section 419-03 .
B137F:17	Steering Wheel Left Switch Pack: Circuit Voltage Above Threshold	REFER to Section 419-03 .
B1380:09	Steering Wheel Right Switch Pack: Component Failure	REFER to Refer to the appropriate section in Group 415 for the procedure..
B1380:11	Steering Wheel Right Switch Pack: Circuit Short to Ground	REFER to Refer to the appropriate section in Group 415 for the procedure..
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	REFER to Refer to the appropriate section in Group 415 for the procedure..
B1C33:11	Steering Column Tilt Feedback Signal: Circuit Short To Ground	REFER to Section 211-04 .
B1C33:12	Steering Column Tilt Feedback Signal: Circuit Short To Battery	REFER to Section 211-04 .
B1C35:11	Steering Column Telescope Feedback Signal: Circuit Short To Ground	REFER to Section 211-04 .
B1C35:12	Steering Column Telescope Feedback Signal: Circuit Short To Battery	REFER to Section 211-04 .
B1D36:09	Turn Indicator Switch: Component Failure	REFER to Section 417-01 .
C0051:09	Steering Wheel Position Sensor: Component Failure	INSTALL a new steering wheel rotation sensor. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the self-test.
C0051:16	Steering Wheel Position Sensor: Circuit Voltage Below Threshold	GO to Pinpoint Test I .
C0051:17	Steering Wheel Position Sensor: Circuit Voltage Above Threshold	GO to Pinpoint Test I .
U1000:00	Solid State Driver Protection Active-Driver	REPAIR all other SCCM DTCs before addressing this concern. CLEAR the DTCs and REPEAT the self test.

	Disabled: No Sub Type Information	
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CARRY OUT Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available (using As-Built Data) on the SCCM . REFER to Section 418-01 . RETRIEVE SCCM DTCs. If U2100:00 returns, INSTALL a new SCCM . REFER to Steering Column Control Module (SCCM) in this section.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	This DTC sets if the steering wheel switches do not match the switch function configuration data in the SCCM . CHECK the part numbers in Ford Catalog Advantage™ or equivalent and CONFIRM the correct SCCM and steering wheel control switches are installed to the vehicle.
U3000:49	Control Module: Internal Electronic Failure	INSTALL a new SCCM . REFER to Steering Column Control Module (SCCM) in this section. CLEAR the DTCs. REPEAT the self-test.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Body Control Module (BCM)	• Wiring, terminals or connectors • BCM	• REFER to Section 418-00 .
• No power in all ignition switch positions	• Fuse • Wiring, terminals or connectors • Ignition switch • BCM	• GO to Pinpoint Test A .
• No power in ACC	• Fuse • Wiring, terminals or connectors • Accessory delay relay • BCM	• GO to Pinpoint Test B .
• No power in RUN	• Fuse • Wiring, terminals or connectors • Run/start relay • Ignition switch • BCM	• GO to Pinpoint Test C .
• No power in START	• Wiring, terminals or connectors • Ignition switch	• GO to Pinpoint Test D .
• The ignition key cannot be returned to the OFF position	• Wiring, terminals or connectors • Ignition lock cylinder • Key removal	• GO to Pinpoint Test G .

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	• inhibit solenoid (part of the ignition switch) • Park range switch (part of the selector lever)	
• The ignition key can be turned to the OFF position when the selector lever is not in PARK	• Wiring, terminals or connectors • Key release interlock actuator (part of the ignition switch) • Park range switch (part of the selector lever)	• GO to Pinpoint Test H .
• The ignition key is hard to turn	• Ignition key • Ignition lock cylinder • Ignition switch rod • Ignition switch	• REFER to Ignition Switch — Mechanical Component Test in this section.
• The multifunction switch does not operate correctly	• Multifunction switch	• CARRY OUT the SCCM self-test. REFER to the Steering Column Control Module (SCCM) DTC Chart to diagnose any DTCs present. If no DTCs are present, INSTALL a new multifunction switch. REFER to Steering Column Multifunction Switch in this section.
• The wiper/washer switch does not operate correctly	• Wiper/washer switch	• REFER to Section 501-16 .

Pinpoint Tests

Pinpoint Test A: No Power in All Ignition Switch Positions

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Normal Operation

The ignition switch receives fused battery voltage from the Body Control Module (BCM) permanent voltage bus through fuse 28 (15A). In the ACC or ON position, voltage is sent to the BCM . In the START position, voltage is sent to both the BCM and PCM.

When the ignition switch is cycled to the OFF/LOCK position from any other position, the BCM begins a monitoring cycle. The monitoring cycle checks that the voltage supplied to the BCM from the ignition switch through the RUN/ACC, RUN/START and START circuits is delivered correctly for each ignition switch position.

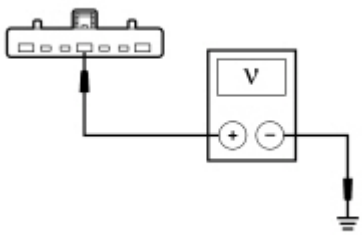
- DTC U300A:01 (Ignition Switch: General Electric Failure) — the BCM continuously monitors the ignition switch position. This DTC sets if the voltage inputs to the BCM do not match the pre-defined configurations for each ignition switch position.

This pinpoint test is intended to diagnose the following:

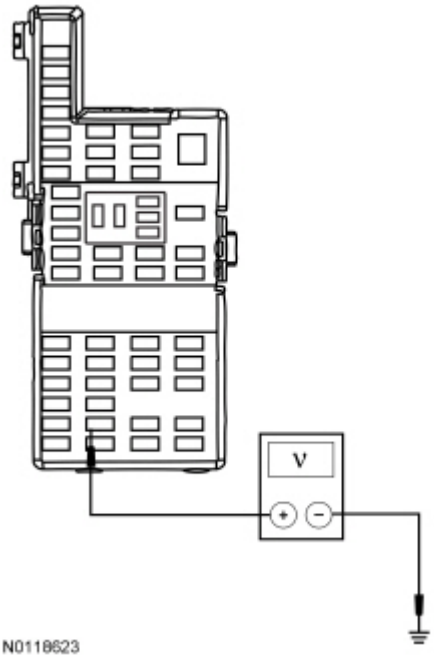
- Fuse
- Wiring, terminals or connectors
- Ignition switch

PINPOINT TEST A: NO POWER IN ALL IGNITION SWITCH POSITIONS

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
A1 CHECK THE IGNITION SWITCH • Ignition OFF. • Disconnect: Ignition Switch C250 . • Carry out the Ignition Switch Component Test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the ignition switch OK?**	**Yes** GO to A2 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
A2 CHECK FOR VOLTAGE TO THE IGNITION SWITCH • Measure the voltage between ignition switch C250-4, circuit SBP28 (GN/RD), harness side and ground.  A0089808 • **Is the voltage greater than 10 volts?**	**Yes** GO to A5 . **No** VERIFY BCM fuse 28 (15A) is OK. If OK, GO to A3 . If not OK, REFER to the Wiring Diagrams manual to identify the possible cause of the circuit short. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
A3 CHECK FOR VOLTAGE TO BCM • Measure the voltage between BCM fuse 28 (15A), circuit SBP28 (GN/RD), and ground.	**Yes** GO to A4 **No** VERIFY fusible links A and B are OK. If OK, REPAIR circuit SDC04 (RD or GY). If not OK, REFER to the Wiring Diagrams manual to identify the possible cause of the circuit short. CLEAR the DTC.

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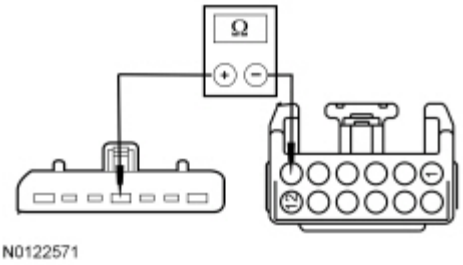


- **Is the voltage greater than 10 volts?**

REPEAT the self-test. TEST the system for normal operation.

A4 CHECK FOR AN OPEN BETWEEN THE BCM AND IGNITION SWITCH

- Disconnect: BCM C2280A .
- Measure the resistance between BCM C2280A-6 and ignition switch C250-4, circuit SBP28 (GN/RD), harness side.



- **Is the resistance less than 5 ohms?**

Yes
GO to A6 .

No
REPAIR circuit SBP28 (GN/RD) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

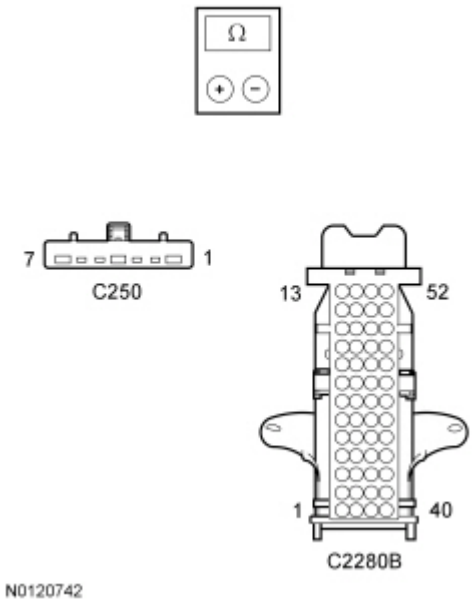
A5 CHECK THE IGNITION SWITCH OUTPUT CIRCUITS FOR AN OPEN

- Disconnect: BCM C2280B .
- Measure the resistance between ignition switch C250, harness side and BCM C2280B, harness side as follows:

Ignition Switch	Circuit	BCM
C250-6	CDC33 (VT/GN)	C2280B-35
C250-1	CDC34 (WH/OG)	C2280B-29
C250-7	CDC35 (BU/WH)	C2280B-47

Yes
GO to A6 .

No
REPAIR the affected circuit(s). CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.



- **Are the resistances less than 5 ohms?**

A6 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all BCM connectors.
• Check the connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all BCM connectors and make sure they are seated correctly.
• Connect: Ignition Switch C250 .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: No Power in ACC

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Normal Operation

When in ACC mode, the Body Control Module (BCM) provides ground for the coil (control) side of the run/acc relay located in the BCM . The run/acc relay is serviced with the BCM . The BCM also provides a ground circuit for the coil side of the accessory delay relay located in the BCM . The accessory delay relay can be serviced separately from the BCM .

This pinpoint test is intended to diagnose the following:

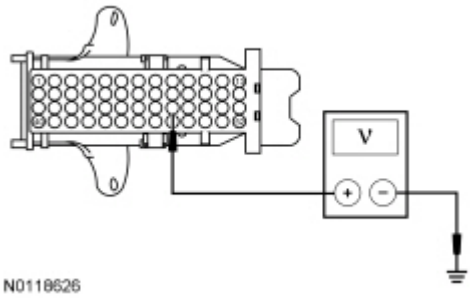
- Fuse
- Wiring, terminals or connectors

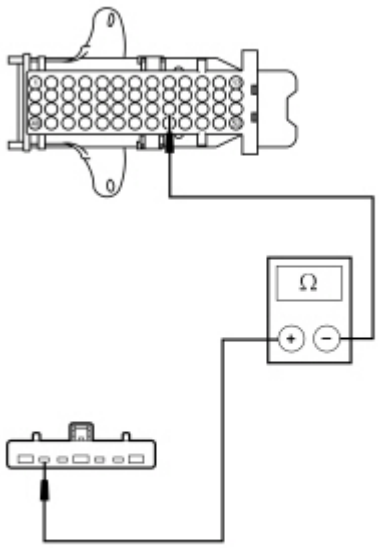
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- Accessory delay relay
- BCM

PINPOINT TEST B: NO POWER IN ACC

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
B1 CHECK FOR ACC VOLTAGE AT THE BCM	
• Disconnect: BCM C2280B . • Ignition In ACC. • Measure the voltage between BCM C2280B-35, circuit CDC33 (VT/GN), harness side and ground.  N0118626 • **Is the voltage greater than 10 volts?**	**Yes** GO to B3 . **No** GO to B2 .
B2 CHECK THE IGNITION ACC CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Ignition Switch C250 . • Measure the resistance between BCM C2280B-35, circuit CDC33 (VT/GN), harness side and ignition switch C250-6, circuit CDC33 (VT/GN), harness side.	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** REPAIR circuit CDC33 (VT/GN). TEST the system for normal operation.

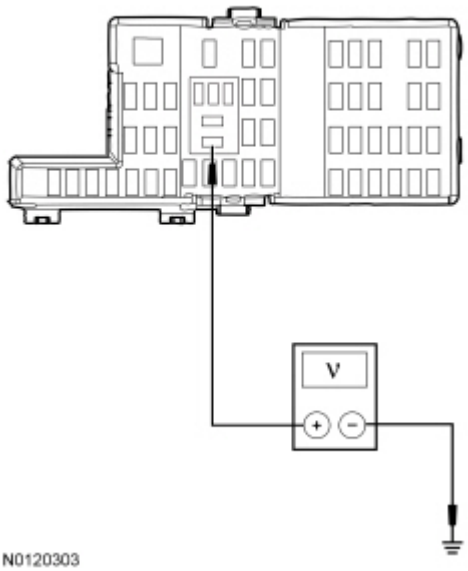


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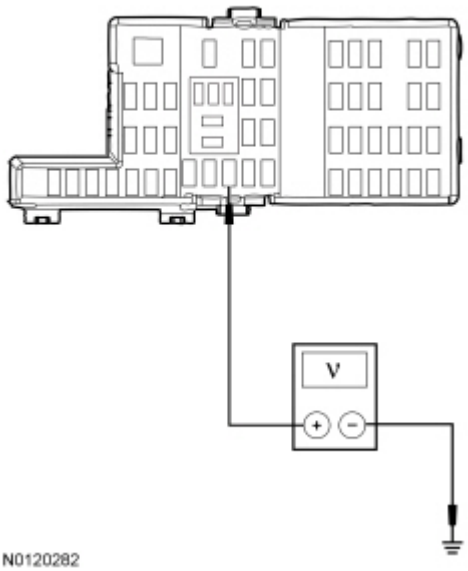
- **Is the resistance less than 5 ohms?**

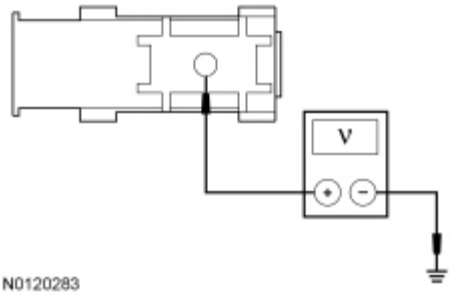
B3 CHECK THE ACCESSORY DELAY RELAY	
• Ignition OFF. • Disconnect: Accessory Delay Relay . • Carry out the appropriate relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Does the relay pass the test?**	**Yes** GO to B4 . **No** INSTALL a new accessory delay relay. TEST the system for normal operation.
B4 CHECK FOR POWER TO THE ACCESSORY DELAY RELAY	
• Measure the voltage between accessory delay relay cavity 3 and ground.	**Yes** GO to B5 . **No** GO to B6 .

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- **Is the voltage greater than 10 volts?**

B5 CHECK FOR POWER TO THE RUN/ACC RELAY	
• Disconnect: BCM Fuse 10 (10A) . • Measure the voltage between BCM fuse 10 (10A), input side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to B7 . **No** GO to B6 .
B6 CHECK THE BCM BATTERY FEED CIRCUIT FOR AN OPEN	
• Disconnect: BCM C2280G .	**Yes**

• Measure the voltage between BCM C2280G-1, circuit SDC04 (RD or GY), harness side and ground.  • **Is the voltage greater than 10 volts?**	GO to B7. **No** VERIFY fusible links A and B are OK. If OK, REPAIR circuit SDC04 (RD or GY). If not OK, REFER to the Wiring Diagrams manual to identify the possible cause of the circuit short. TEST the system for normal operation.
B7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all BCM connectors.
• Check the connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all BCM connectors and make sure they are seated correctly.
• Connect: BCM Fuse 10 (10A) (if previously disconnected) .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test C: No Power in RUN

Refer to Wiring Diagrams Cell 13, Power Distribution/BCM for schematic and connector information.

Normal Operation

When the ignition switch is turned to the RUN position, a voltage signal is sent to the Body Control Module (BCM). The BCM then activates the run/start relay and the run/acc relay, which distribute fused voltage to various components. The run/acc relay is serviced as part of the BCM.

- DTC B1310:14 (Run/Start Control: Circuit Short to Ground or Open) — the BCM continuously monitors the control side of the run/start relay. This DTC sets if the BCM detects an open or a short to ground on the control circuit. The BCM uses a Field-Effect Transistor (FET) to control the run/start relay. When this DTC sets, the control side of the run/start relay is disabled via the FET. Once the condition that caused the DTC to set is repaired, the BCM must pass a self-test in order for the DTC to clear and the system to resume normal operation.

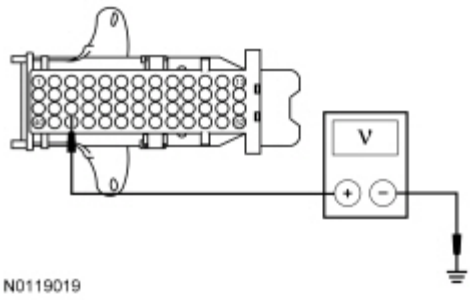
This pinpoint test is intended to diagnose the following:

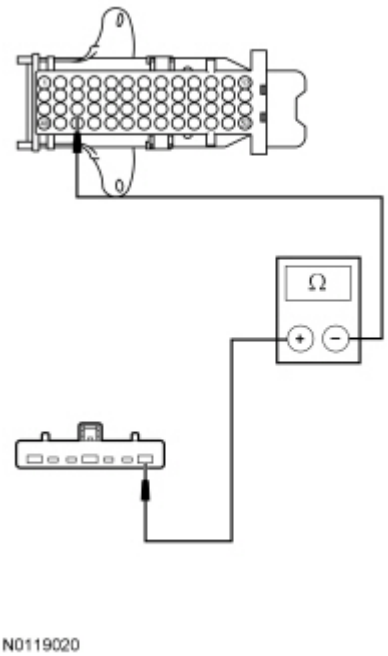
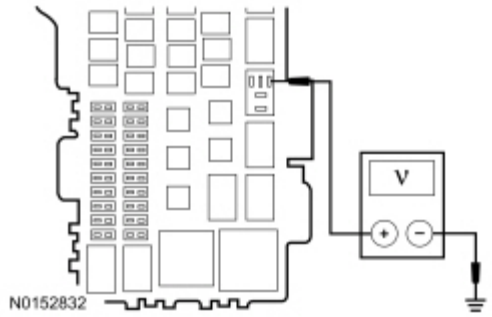
- Fuse
- Wiring, terminals or connectors
- Ignition switch
- Run/start relay
- BCM

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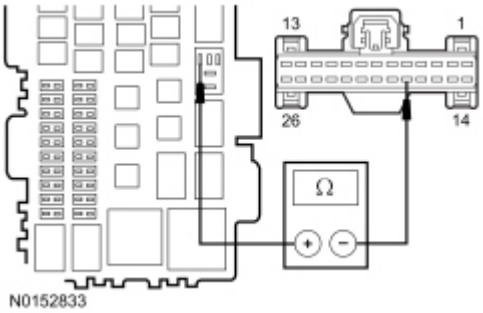
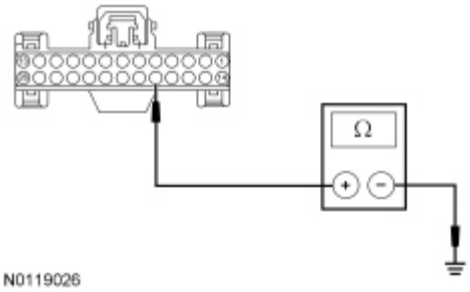
PINPOINT TEST C: NO POWER IN RUN

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
C1 REVIEW THE BCM DTCs • Review the BCM DTCs retrieved during inspection and verification. • **Is DTC B1310:14 present?**	**Yes** GO to C6 . **No** For all other BCM DTCs, GO to the Body Control Module (BCM) DTC Chart. If no DTCs are present, GO to C2 .
C2 CHECK FOR RUN VOLTAGE AT THE BCM • Ignition OFF. • Disconnect: BCM C2280B . • Ignition ON. • Measure the voltage between BCM C2280B-29, circuit CDC34 (WH/OG), harness side and ground.  N0119019 • **Is the voltage greater than 10 volts?**	**Yes** GO to C4 . **No** GO to C3 .
C3 CHECK THE IGNITION RUN CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Ignition Switch C250 . • Measure the resistance between BCM C2280B-29, circuit CDC34 (WH/OG), harness side and ignition switch C250-1, circuit CDC34 (WH/OG), harness side.	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR open circuit CDC34 (WH/OG). TEST the system for normal operation.

 N0119020 • **Is the resistance less than 5 ohms?**	
C4 CHECK THE RUN/START RELAY • Ignition OFF. • Disconnect: Run/Start Relay . • Carry out the appropriate relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the relay OK?**	**Yes** GO to C5 . **No** INSTALL a new run/start relay. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C5 CHECK THE VOLTAGE TO THE RUN/START RELAY COIL • Measure the voltage between run/start relay cavity 1, circuit SBB31 (WH/RD) and ground.  N0152832 • **Is the voltage greater than 10 volts?**	**Yes** GO to C6 . **No** VERIFY BJB fuse 31 (15A) is OK. If OK, REPAIR circuit SBB31 (WH/RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible cause of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C6 CHECK THE RUN/START RELAY CONTROL CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Run/Start Relay (if not previously disconnected) .	**Yes** GO to C7 .

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• Disconnect: BCM C2280F . • Measure the resistance between run/start relay cavity 2, circuit CDC55 (BN/VT) and BCM C2280F-18, circuit CDC55 (BN/VT), harness side.  • **Is the resistance less than 5 ohms?**	**No** REPAIR circuit CDC55 (BN/VT) for an open. CARRY OUT a self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.
C7 CHECK THE RUN/START RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	**Yes** GO to C8 . **No** REPAIR circuit CDC55 (BN/VT) for short to ground. CARRY OUT a self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.
• Measure the resistance between BCM C2280F-18, circuit CDC55 (BN/VT), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	
C8 CHECK FOR CORRECT BCM OPERATION	**Yes** INSTALL a new BCM . REFER to Section 419-10 . REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Check BCM C2280B and C2280F for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: BCM C2280B .
• Connect: BCM C2280F .
• Connect: Run/Start Relay .
• Make sure the connectors are seated correctly, then carry out a BCM self-test.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**	

Pinpoint Test D: No Power in START

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Normal Operation

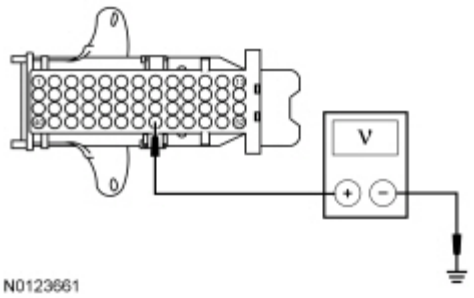
When the ignition switch is turned to the START position, a voltage signal is sent to the Body Control Module (BCM) and the PCM. The BCM sends out a voltage signal to various modules to indicate a start event and the PCM checks various inputs and bus messages in an effort to start the vehicle.

This pinpoint test is intended to diagnose the following:

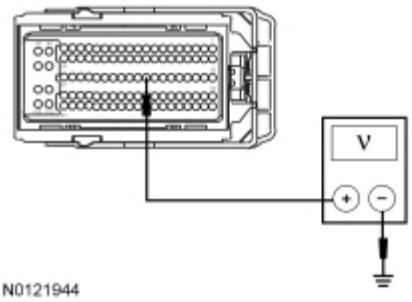
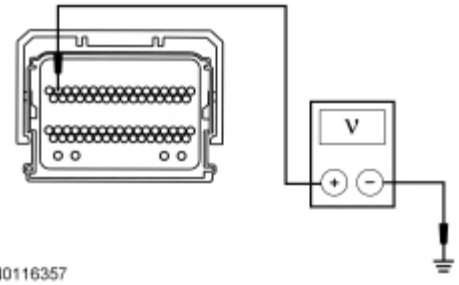
- Wiring, terminals or connectors
- Ignition switch

PINPOINT TEST D: NO POWER IN START

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
D1 CHECK THE IGNITION SWITCH	
• Ignition OFF. • Disconnect: Ignition Switch C250 . • Carry out the Ignition Switch Component Test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the ignition switch OK?**	**Yes** REINSTALL the ignition switch and CONNECT the ignition switch connector removed during the component test. GO to D2 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
D2 CHECK THE START CIRCUIT TO THE BCM FOR VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280B . • Measure the voltage between BCM C2280B-47, circuit CDC35 (BU/WH), harness side and ground, while holding the key in the START position.  • **Is the voltage greater than 10 volts?**	**Yes** GO to D3 . **No** REPAIR circuit CDC35 (BU/WH) for an open. TEST the system for normal operation.
D3 CHECK THE START CIRCUIT TO THE PCM FOR VOLTAGE	
• Ignition OFF. • Disconnect: PCM C1551B (3.5L), C175B (3.7L) or C1381B (5.0L/6.2L) . • For 3.5L, measure the voltage between PCM C1551B-47, circuit	**Yes** REFER to Section 303-06 to diagnose the starting system. TEST the system for normal

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CDC35 (BU/WH), harness side and ground, while holding the key in the START position.  N0121944 • For 3.7L, 5.0L and 6.2L, measure the voltage between PCM C175B-16 or C1381B-16, circuit CDC35 (BU/WH), harness side and ground, while holding the key in the START position.  N0116357 • **Is the voltage greater than 10 volts?**	operation. **No** REPAIR circuit CDC35 (BU/WH) for an open. TEST the system for normal operation.

Pinpoint Test E: DTC B1142:29

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Normal Operation

Battery voltage is sent to the ignition switch from the Battery Junction Box (BJB) fuse 28 (15A). When placed in ACC, RUN or START, the ignition switch sends fused battery voltage along 1 of 3 circuits to the Body Control Module (BCM). Microprocessors in the BCM continuously monitor the ignition switch state.

- DTC B1142:29 (Ignition Status 1: Signal Invalid) — this DTC sets when the BCM does not receive a valid ignition state signal during the BCM self-test.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Ignition switch
- BCM

PINPOINT TEST E: DTC B1142:29

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
E1 CHECK THE IGNITION SWITCH STATE (IGN_SW_STATE) PID • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — BCM . • Monitor the IGN_SW_STATE PID while turning the ignition switch through all 4 positions (OFF, ACC, RUN and START). • **Does the PID match each ignition switch position?**	**Yes** GO to E5 . **No** GO to E2 .
E2 CHECK THE ACC CIRCUIT FOR AN OPEN OR SHORT TO VOLTAGE • Ignition In ACC. • Monitor the IGN_SW_STATE PID with the ignition switch in the ACC position. • **Does the PID display "Acc"?**	**Yes** GO to E3 . **No** If the PID displays "Off" or "Unknown", REPAIR circuit CDC33 (VT/GN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If the PID displays "Run" or "Start", REPAIR circuit CDC34 (WH/OG) (RUN) or CDC35 (BU/WH) (START) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E3 CHECK THE RUN CIRCUIT FOR AN OPEN OR SHORT TO VOLTAGE • Ignition ON. • Monitor the IGN_SW_STATE PID with the ignition switch in the RUN position. • **Does the PID display "Run"?**	**Yes** GO to E4 . **No** If the PID displays "Off" or "Unknown", REPAIR circuit CDC34 (WH/OG) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If the PID displays "Acc" or "Start", REPAIR circuit CDC33 (VT/GN) (ACC) or CDC35 (BU/WH) (START) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E4 CHECK THE START CIRCUIT FOR AN OPEN OR SHORT TO VOLTAGE • Monitor the IGN_SW_STATE PID with the ignition switch in the START position. • **Does the PID display "Start"?**	**Yes** GO to E5 . **No** If the PID displays "Off" or "Unknown", REPAIR circuit CDC35 (BU/WH) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If the PID displays "Acc" or "Run", REPAIR circuit CDC33 (VT/GN) (ACC) or CDC34 (WH/OG) (RUN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E5 CHECK FOR CORRECT BCM	

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OPERATION	

• Disconnect: All BCM Connectors .
• Check BCM connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: All BCM Connectors .
• Make sure the connectors are seated correctly, then carry out a BCM self-test.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . REPEAT the self-test. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test F: DTC B1310:12

Refer to Wiring Diagrams Cell 13 , Power Distribution/SJB for schematic and connector information.

Normal Operation

When the ignition is placed in RUN mode, the Body Control Module (BCM) module provides a ground for the coil (control) side of the run/start relay located in the Battery Junction Box (BJB). The BCM monitors the run/start relay control circuit and sets the applicable DTC if the circuit is open, shorted to ground or shorted to voltage.

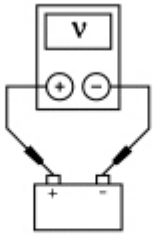
- DTC B1310:12 (Run/Start Control: Circuit Short to Battery) — this DTC sets if the BCM detects a short to battery in the run/start relay control circuit during a BCM self-test or during normal operation.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Run/start relay
- BCM

PINPOINT TEST F: DTC B1310:12

Test Step	Result / Action to Take
F1 CHECK THE RUN/START RELAY	
• Disconnect: Run/Start Relay . • Carry out the appropriate relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the relay OK?**	**Yes** GO to F2 . **No** INSTALL a new run/start relay. CARRY OUT a self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.

F2 CHECK THE RUN/START RELAY CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure and record battery voltage.  AJ0210-A • ***NOTICE:*** **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults** • Measure the voltage by backprobing between BCM C2280F-18, circuit CDC55 (BN/VT), harness side and ground. • **Is the voltage equal to the recorded battery voltage?**	**Yes** REPAIR circuit CDC55 (BN/VT) for a short to voltage. CARRY OUT a self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation. **No** GO to F3 .
F3 CHECK FOR CORRECT BCM OPERATION	

• Disconnect: All BCM Connectors .
• Check the connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: All BCM Connectors .
• Connect: Run/Start Relay .
• Make sure the connectors are seated correctly, then carry out a BCM self-test.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . CARRY OUT a self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CARRY OUT a self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.

Pinpoint Test G: The Ignition Key Cannot Be Returned to the OFF/LOCK Position

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Refer to Wiring Diagrams Cell 37 , Shift Interlock for schematic and connector information.

Normal Operation

The key removal inhibit solenoid (part of the ignition switch) receives battery voltage from the Body Control Module (BCM) fuse 28 (15A). When the selector lever is moved out of the PARK position, the park range switch (part of the selector lever) closes, providing a ground circuit to the key removal inhibit solenoid. The key removal inhibit solenoid activates and prevents the ignition lock cylinder from being turned to the OFF position and the key from being removed.

This pinpoint test is intended to diagnose the following:

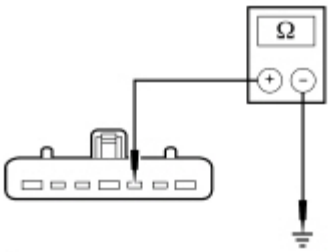
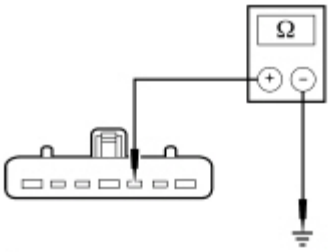
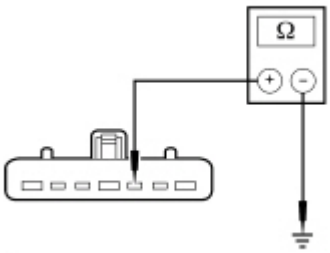
- Wiring, terminals or connectors
- Key removal inhibit solenoid (part of the ignition switch)
- Ignition lock cylinder
- Brake shift interlock solenoid
- Park range switch (part of the selector lever)

PINPOINT TEST G: THE IGNITION KEY CANNOT BE RETURNED TO THE OFF/LOCK POSITION

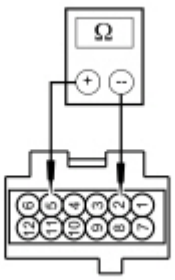
NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
G1 CHECK FOR AN ENERGIZED KEY REMOVAL INHIBIT SOLENOID	
• Remove BCM fuse 28 (15A). • Attempt to turn the ignition lock cylinder to the RUN position and then back to the OFF/LOCK position and remove the key. • **Can the ignition lock cylinder be turned to the OFF/LOCK position and the key removed?**	**Yes** GO to G3 . **No** GO to G2 .
G2 CHECK THE IGNITION SWITCH FOR MECHANICAL DAMAGE	
• Remove the ignition switch. Refer to Ignition Switch in this section. • Attempt to turn the ignition lock cylinder to the OFF/LOCK position and remove the ignition key. • **Does the ignition lock cylinder turn to the OFF/LOCK position and the key removed?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** INSTALL a new ignition lock cylinder. REFER to Section 501-14 . TEST the system for normal operation.
G3 CHECK THE KEY REMOVAL INHIBIT SOLENOID CIRCUIT FOR A SHORT TO GROUND	
• Select PARK. • Disconnect: Ignition Switch C250 .	**Yes** INSTALL a new ignition switch.

• Measure the resistance between ignition switch C250-3, circuit CDC41 (WH/BN), harness side and ground.  N0065439 • **Is the resistance greater than 10,000 ohms?**	REFER to Ignition Switch in this section. TEST the system for normal operation. **No** Vehicles with column shift, GO to G4 . Vehicles with floor shift, GO to G5 .
G4 ISOLATE THE BRAKE SHIFT INTERLOCK SOLENOID	
• Disconnect: Brake Shift Interlock Solenoid C2008 . • Measure the resistance between ignition switch C250-3, circuit CDC41 (WH/BN), harness side and ground.  N0065439 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new brake shift interlock solenoid. REFER to Section 307-05 . TEST the system for normal operation. **No** REPAIR circuit CDC41 (WH/BN) for a short to ground. TEST the system for normal operation.
G5 ISOLATE THE SHORT TO GROUND IN THE KEY REMOVAL INHIBIT SOLENOID CIRCUIT	
• Disconnect: Floor Shifter C3245 . • Measure the resistance between ignition switch C250-3, circuit CDC41 (WH/BN), harness side and ground.  N0065439 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G6 . **No** REPAIR circuit CDC41 (WH/BN) for a short to ground. TEST the system for normal operation.
G6 CHECK THE PARK DETECT SWITCH	
• Measure the resistance between the selector lever C3245-2, component side and selector lever C3245-5, component side with and without the selector lever in the PARK range and the selector lever button released.	**Yes** CHECK the selector lever cable adjustment. REFER to Section 307-05 . INSPECT the selector lever, selector lever knob, and selector

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 N0151254 • **Is the resistance greater than 10,000 ohms with the selector lever in PARK and less than 5 ohms with the selector lever in REVERSE, NEUTRAL and DRIVE?**	lever cable for damage. INSTALL new components as necessary. REFER to Section 307-05 . TEST the system for normal operation. **No** INSTALL a new selector lever. REFER to Section 307-05 . TEST the system for normal operation.

Pinpoint Test H: The Ignition Key Can Be Turned to the OFF/LOCK Position When the Selector Lever is Not In PARK

Refer to Wiring Diagrams Cell 37 , Shift Interlock for schematic and connector information.

Normal Operation

The key removal inhibit solenoid (part of the ignition switch) receives battery voltage from Body Control Module (BCM) fuse 28 (15A). When the selector lever is moved out of the PARK position, the park range switch (part of the selector lever) closes, providing a ground circuit to the key removal inhibit solenoid. The key removal inhibit solenoid activates and prevents the ignition lock cylinder from being turned to the OFF/LOCK position and the key from being removed.

This pinpoint test is intended to diagnose the following:

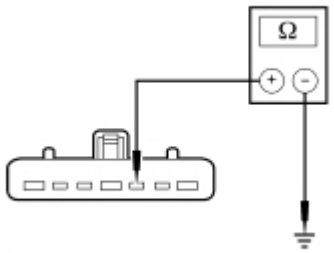
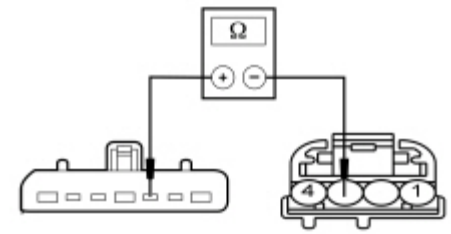
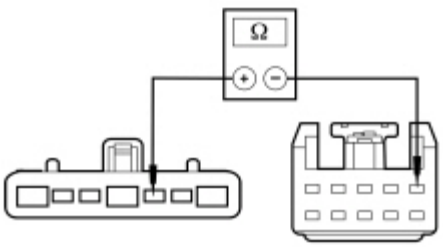
- Wiring, terminals or connectors
- Key release interlock actuator (part of the ignition switch)
- Park range switch (part of the selector lever)

PINPOINT TEST H: THE IGNITION KEY CAN BE TURNED TO THE OFF/LOCK POSITION WHEN THE SELECTOR LEVER IS NOT IN PARK

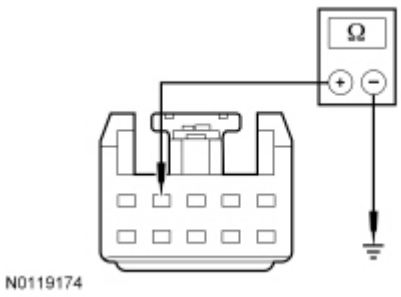
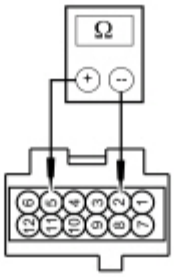
NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
H1 CHECK THE KEY INHIBIT SOLENOID CIRCUIT FOR GROUND	
• Disconnect: Ignition Switch C250 . • Select DRIVE. • Measure the resistance between ignition switch C250-3, circuit CDC41 (WH/BN), harness side and ground.	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.

 N0065439 • **Is the resistance less than 5 ohms?**	**No** Vehicles with column shift, GO to H2 . Vehicles with floor shift, GO to H3 .
H2 CHECK THE KEY INHIBIT SOLENOID CIRCUIT FOR AN OPEN (COLUMN SHIFT)	
• Disconnect: Brake Shift Interlock Solenoid C2008 . • Measure the resistance between ignition switch C250-3, circuit CDC41 (WH/BN), harness side and brake shift interlock solenoid C2008-3, circuit CDC41 (WH/BN), harness side.  N0122615 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new brake shift interlock solenoid. REFER to Section 307-05 . TEST the system for normal operation. **No** REPAIR circuit CDC41 (WH/BN) for an open. TEST the system for normal operation.
H3 CHECK THE KEY INHIBIT SOLENOID CIRCUIT FOR AN OPEN (FLOOR SHIFT)	
• Disconnect: Floor Shifter C3245 . • Measure the resistance between ignition switch C250-3, circuit CDC41 (WH/BN), harness side and floor shifter C3245-1, circuit CDC41 (WH/BN), harness side.  N0122061 • **Is the resistance less than 5 ohms?**	**Yes** GO to H4 . **No** REPAIR circuit CDC41 (WH/BN) for an open. TEST the system for normal operation.
H4 CHECK THE FLOOR SHIFTER GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between floor shifter C3245-5, circuit GD138 (BK/WH), harness side and ground.	**Yes** GO to H5 .

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 N0119174 • **Is the resistance less than 5 ohms?**	**No** REPAIR circuit GD138 (BK/WH) for an open. TEST the system for normal operation.
H5 CHECK THE PARK DETECT SWITCH	
• Measure the resistance between the selector lever C3245-2, component side and selector lever C3245-5, component side with and without the selector lever in the PARK range and the selector lever button released.  N0151254 • **Is the resistance greater than 10,000 ohms with the selector lever in PARK and less than 5 ohms with the selector lever in REVERSE, NEUTRAL and DRIVE?**	**Yes** CHECK the selector lever cable adjustment. REFER to Section 307-05 . INSPECT the selector lever, selector lever knob, and selector lever cable for damage. INSTALL new components as necessary. REFER to Section 307-05 . TEST the system for normal operation. **No** INSTALL a new selector lever. REFER to Section 307-05 . TEST the system for normal operation.

Pinpoint Test I: DTCs C0051:16 And C0051:17

Normal Operation

The Steering Column Control Module (SCCM) continuously monitors the voltage supplied to the steering wheel rotation sensor (also known as the steering wheel position sensor). If voltage outside of defined limits is detected by the SCCM , the applicable DTC sets.

- DTC C0051:16 (Steering Wheel Position Sensor: Circuit Voltage Below Threshold) — If the SCCM detects voltage to the steering wheel rotation sensor below 10 volts this DTC sets.
- DTC C0051:17 (Steering Wheel Position Sensor: Circuit Voltage Above Threshold) — If the SCCM detects voltage to the steering wheel rotation sensor above 15.5 volts this DTC sets.

This pinpoint test is intended to diagnose the following:

- Steering wheel rotation sensor

PINPOINT TEST I: DTCs C0051:16 AND C0051:17

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals.**

Do not use standard multi-meter probes.

Test Step	Result / Action to Take
I1 CHECK THE SCCM DTCs • Review the SCCM DTCs retrieved and recorded during Inspection and Verification. • **Is DTC B119D:16 and/or B119D:17 present?**	**Yes** DIAGNOSE DTCs B119D:16 and B119D:17 before diagnosing DTCs C0051:16 or C0051:17. For DTC B119D:16, GO to Pinpoint Test J. For DTC B119D:17, GO to Pinpoint Test K. **No** GO to I2.
I2 CHECK THE STEERING WHEEL ANGLE SENSOR STATUS (SW_ANG_SENS) PID • Enter the following diagnostic mode on the scan tool: DataLogger — SCCM. • Monitor the SW_ANG_SENS PID. • **Does the PID display CORRECT?**	**Yes** The condition that caused the DTC to set is not present at this time. CLEAR the DTCs. DRIVE the vehicle for more than 1 minute at a speed greater than 32 km/h (20 mph) and make at least one left turn and one right turn. REPEAT the self-test. If the DTC(s) does not return, RETURN the vehicle to the customer. If the DTC(s) return, GO to I3. **No** If the PID displays FAULT, INSTALL a new steering wheel rotation sensor. REFER to Section 206-09. REPEAT the self-test. TEST the system for normal operation. If the PID displays PSCM NOT INITIALIZED, GO to I3.

I3 CHECK FOR CORRECT SCCM OPERATION
• Ignition OFF.
• Disconnect: All SCCM Connectors .
• Check the SCCM connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: All SCCM Connectors .
• Make sure the SCCM connectors are seated correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM. REFER to Steering Column Control Module (SCCM) in this section. CLEAR the DTCs. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test J: DTC B119D:16

Refer to Wiring Diagrams Cell 13, Power Distribution/SJB for schematic and connector information.

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Normal Operation

The Steering Column Control Module (SCCM) continuously monitors input voltage for correct operation. If voltage outside of defined limits is detected by the SCCM , the applicable DTC sets.

- DTC B119D:16 (Vehicle Battery: Circuit Below Threshold) — This DTC sets in continuous memory if the SCCM detects battery voltage below 8 volts on the battery voltage supply circuit.

This pinpoint test is intended to diagnose the following:

- Fuses
- Wiring, terminals or connectors
- Charging system
- Vehicle battery
- SCCM

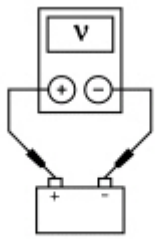
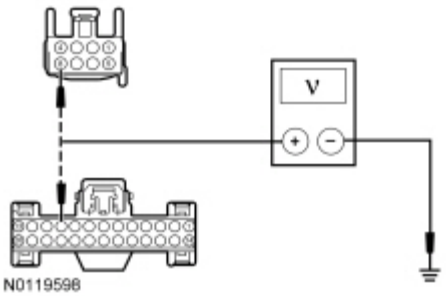
NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

NOTE: DTC B119D:16 can set if the vehicle battery has been discharged. The vehicle battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

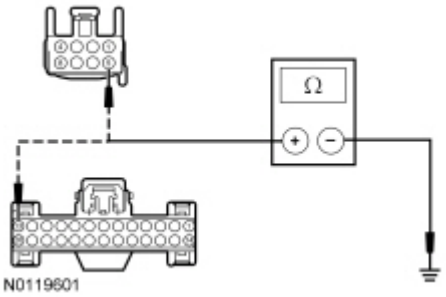
PINPOINT TEST J: DTC B119D:16

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
J1 VERIFY THE SCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — SCCM . • Clear the DTCs and repeat the self-test. • **Is DTC B119D:16 still present?**	**Yes** GO to J2 . **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: Self Test — PCM . • Retrieve and record all continuous memory DTCs from the PCM. • **Are any charging system DTCs present in the PCM?**	**Yes** REFER to Section 414-00 to diagnose the charging system DTCs. **No** GO to J3 .
J3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Ignition OFF.	**Yes**

• Refer to Section 414-01 and carry out pinpoint test A: Battery Condition Test. • **Is the battery OK and fully charged?**	GO to J4 . **No** REFER to Section 414-00 to diagnose the charging system.
J4 CHECK THE SCCM VOLTAGE SUPPLY	
• Measure and record battery voltage.  AJ0210-A • Disconnect: SCCM C2414A . • Disconnect: SCCM C2414B . • Measure the voltage between ground and: ▪ SCCM C2414A-10, SBP23 (WH/RD), harness side. ▪ SCCM C2414B-8, SBP24 (VT/RD), harness side.  N0119598 • **Are the voltages within 0.2 volt of the recorded battery voltage?**	**Yes** GO to J5 . **No** VERIFY BCM fuses 23 (15A) and 24 (15A) are OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J5 CHECK THE SCCM GROUND CIRCUIT	
• Disconnect the battery negative cable. Refer to Section 414-01 . • Measure the resistance between ground and: ▪ SCCM C2414A-13, GD133 (BK), harness side. ▪ SCCM C2414B-5, GD138 (BK/WH), harness side.	**Yes** CONNECT the battery negative cable. GO to J6 . **No** REPAIR the affected circuit(s). CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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 • **Are the resistances less than 5 ohms?**	
J6 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect: All SCCM Connectors .
• Check the SCCM connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: All SCCM Connectors .
• Make sure the SCCM connectors are seated correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Steering Column Control Module (SCCM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test K: DTC B119D:17

Refer to Wiring Diagrams Cell 13 , Power Distribution/SJB for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) continuously monitors input voltage for correct operation. If voltage outside of defined limits is detected by the SCCM , the applicable DTC sets.

- DTC B119D:17 (Vehicle Battery: Circuit Above Threshold) — This DTC sets in continuous memory if the SCCM detects battery voltage above 19 volts on the battery voltage supply circuit.

This pinpoint test is intended to diagnose the following:

- Charging system
- SCCM

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

NOTE: DTC B119D:17 can set if the vehicle has been recently jump started or the vehicle battery has been recently charged.

PINPOINT TEST K: DTC B119D:17

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals.**

Do not use standard multi-meter probes.

Test Step	Result / Action to Take
K1 CHECK FOR HIGH BATTERY VOLTAGE AND/OR CHARGING SYSTEM DTC IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs . • Retrieve and recorded all CMDTCs from all modules. • **Are any high battery voltage and/or charging system DTCs present in other modules?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to K2 .
K2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 16.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to K3 .
K3 RECHECK FOR SCCM DTC B119D:17	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — SCCM . • Clear the continuous memory DTCs and repeat the self-test. • **Is DTC B119D:17 present in the SCCM ?**	**Yes** GO to K4 . **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
K4 CHECK FOR CORRECT SCCM OPERATION	

• Ignition OFF.
• Disconnect: All SCCM Connectors .
• Check the SCCM connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: All SCCM Connectors .
• Make sure the SCCM connectors are seated correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Steering Column Control Module (SCCM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Component Tests

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Ignition Switch — Mechanical

The following conditions can cause difficulty in operating the ignition switch and lock cylinder:

- Burrs on the lock cylinder key
- Insufficient lube on the lock cylinder
- Binding lock cylinder
- Burrs or foreign material around the rack and pinion actuator in the lock cylinder housing
- Insufficient lube on the actuator (Do not apply lubricant to the inside of the ignition switch.)
- Binding ignition switch

If the steering wheel lock is engaged with the wheels loaded against a curb, high effort is necessary to turn the key from lock. Turn the steering wheel to either side of the lock to unload the system.

Carry out the following test to determine if the ignition switch and lock cylinder are operating correctly.

1. Inspect the ignition key for any burrs, damage or incorrect cut. Replace the ignition key as necessary.

2. **NOTE:** The steering wheel may be locked full left or full right. If the steering wheel is locked, it is necessary to apply turning effort to the steering wheel in the direction of the lock while turning the key.

   Turn the key to the ACC position and then the RUN position.
   - If the ignition key turns to the ACC and RUN position, continue with Step 3.
   - If the ignition key does not turn to the ACC and RUN position, continue with Step 4.

3. **NOTE:** The ignition switch and lock cylinder should return from the START position back to the RUN position without assistance.

   Turn the ignition key to the START position and release the key.
   - If the ignition switch and lock cylinder return from the START position back to the RUN position without assistance, the ignition switch is operating correctly at this time.
   - If the ignition switch and lock cylinder do not return from the START position back to the RUN position without assistance, continue with Step 4.

4. Remove the ignition lock cylinder. Refer to Section 501-14 .

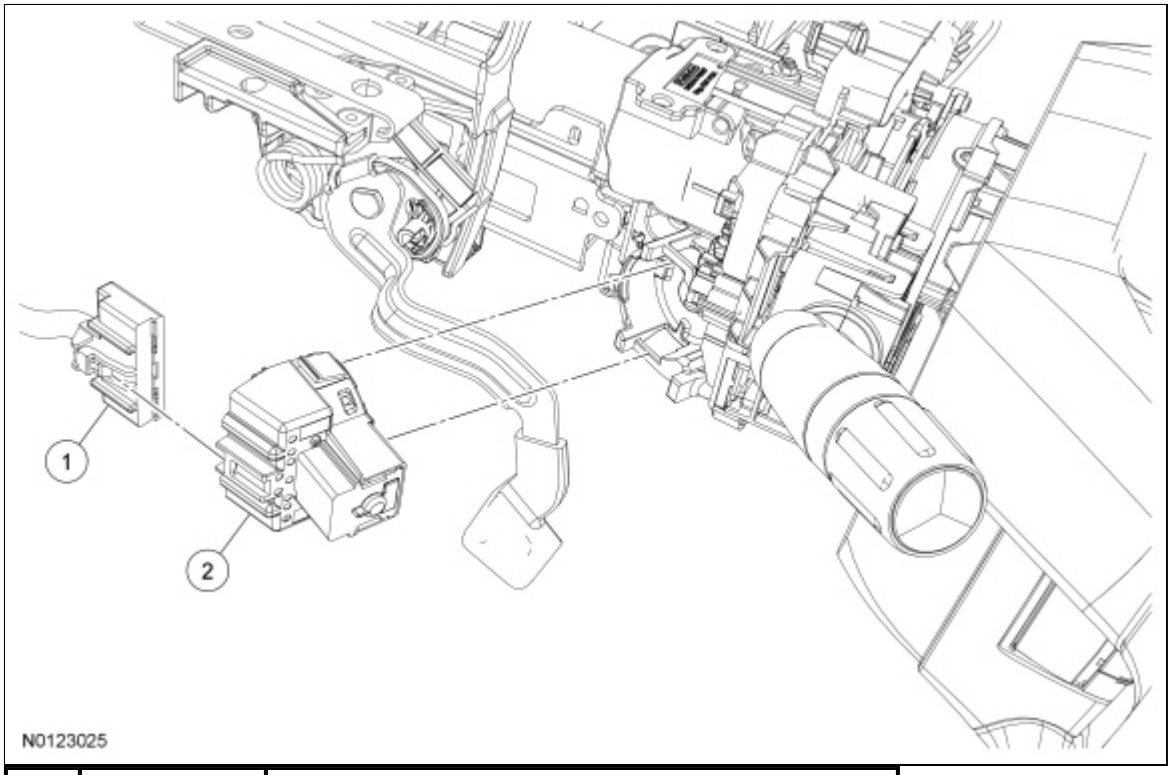
5. Rotate the ignition lock cylinder through all of the switch positions.
   - If the lock cylinder operates correctly, continue with Step 6.
   - If the lock cylinder does not operate correctly, install a new ignition lock cylinder. Refer to Section 501-14 .

6. Check for binding or sticking ignition switch actuating rod, burrs around the rack-and-pinion actuator in the ignition lock cylinder housing or insufficient lubrication.
   - If there is sufficient lubrication and there are no burrs, binding or sticking conditions, install a new ignition switch. Refer to Ignition Switch in this section.
   - If there is insufficient lubrication, burrs, binding or sticking conditions, repair or lubricate as necessary.

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Ignition Switch

NOTE: Manual column shown, power column similar.



Item	Part Number	Description
1	—	Ignition switch electrical connector (part of 14401)
2	11572	Ignition switch

Removal and Installation

Manual and Power Columns

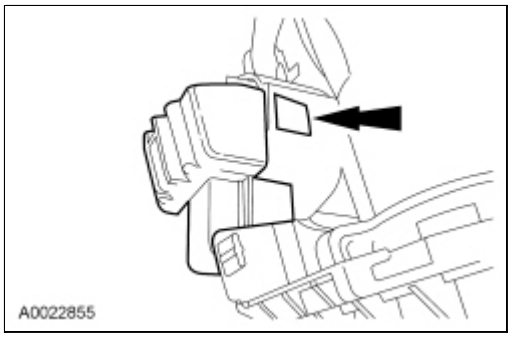
1. Remove the steering column shrouds. For additional information, refer to Section 211-04 .
2. Disconnect the ignition switch electrical connector.

Manual Columns

3. Place the steering column tilt lever in the unlocked position.

Manual and Power Columns

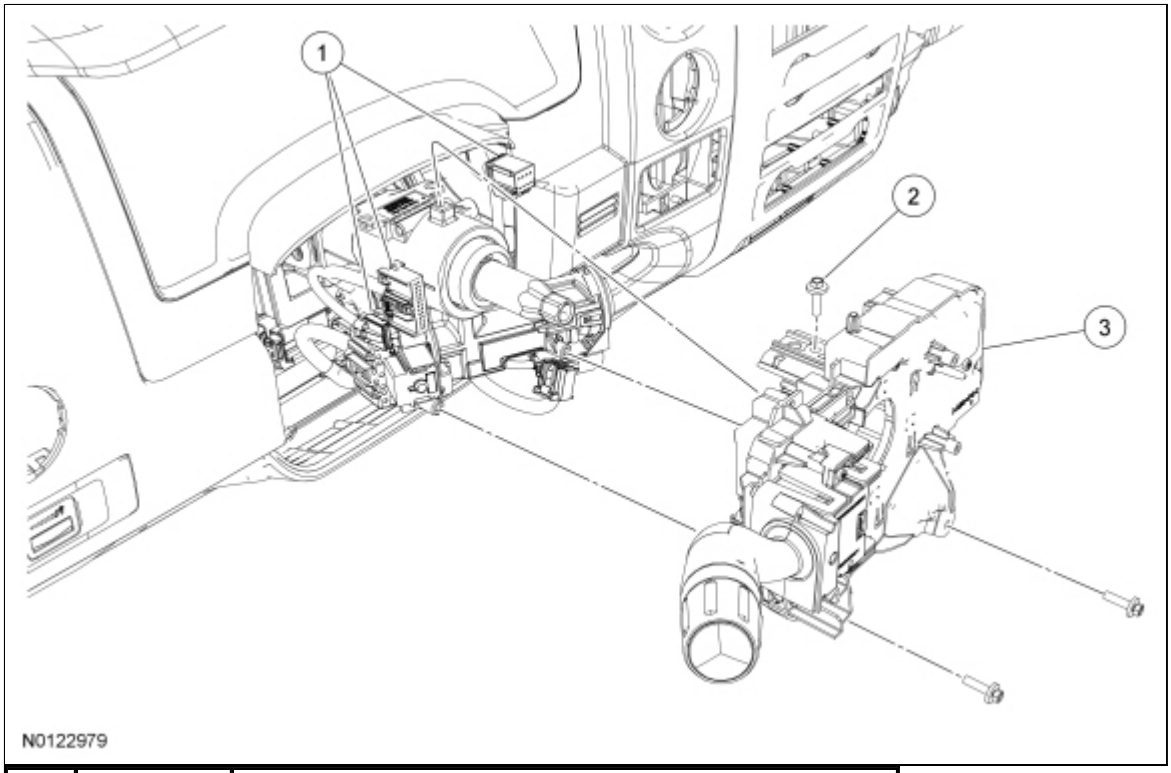
4. Press the 2 locking tabs and remove the ignition switch.



5. To install, reverse the removal procedure.

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Steering Column Control Module (SCCM)



Item	Part Number	Description
1	—	Steering Column Control Module (SCCM) electrical connectors (3 required) (part of 14401)
2	W715057	SCCM bolts (3 required)
3	3F791	SCCM

Removal and Installation

1. Remove the steering wheel rotation sensor. For additional information, refer to Section 206-09 .
2. Disconnect the 3 Steering Column Control Module (SCCM) electrical connectors.
3. Remove the 3 screws and the SCCM .
   - To install, tighten to 2 Nm (18 lb-in).
4. To install, reverse the removal procedure.

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Steering Column Control Switch

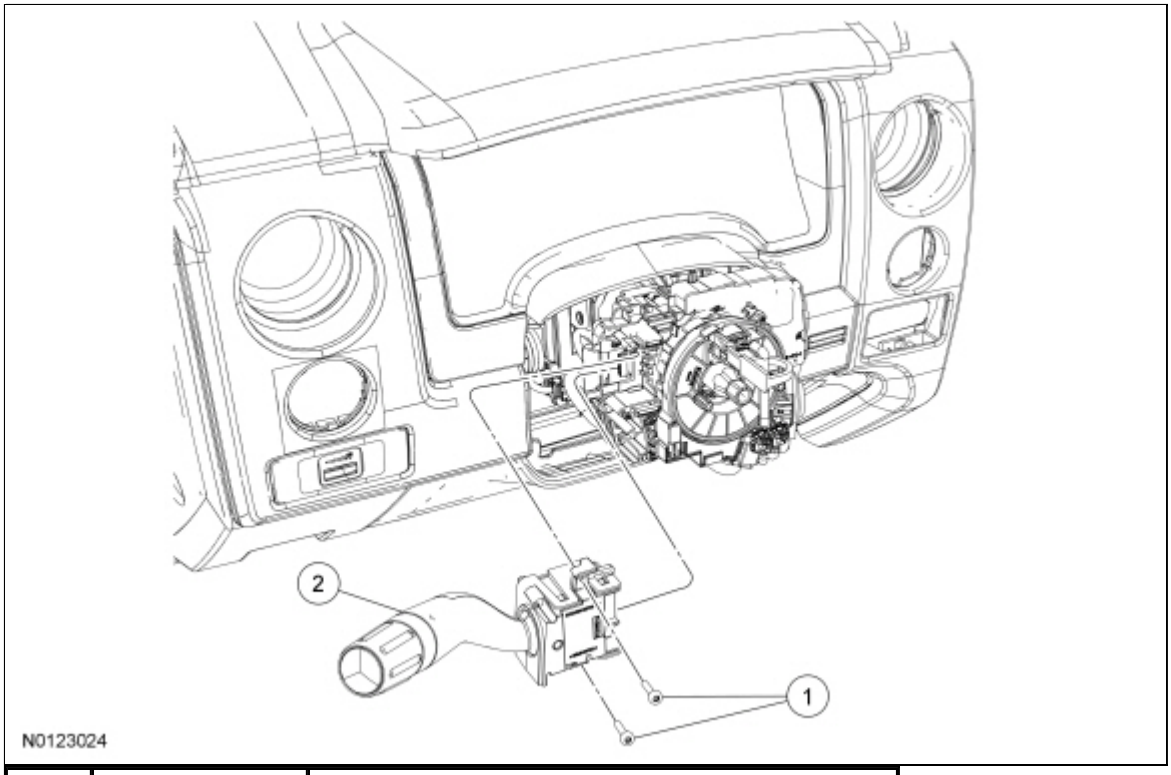
Removal and Installation

1. **NOTE:** The steering column control switch and the brake pedal control switch are serviced as an assembly.

   For additional information, refer to Brake Pedal Control Switch in Section 206-06 .

Steering Column Multifunction Switch

NOTE: Steering wheel removed for clarity.



Item	Part Number	Description
1	W705132	Multifunction switch screws (2 required)
2	13K359	Multifunction switch

Removal and Installation

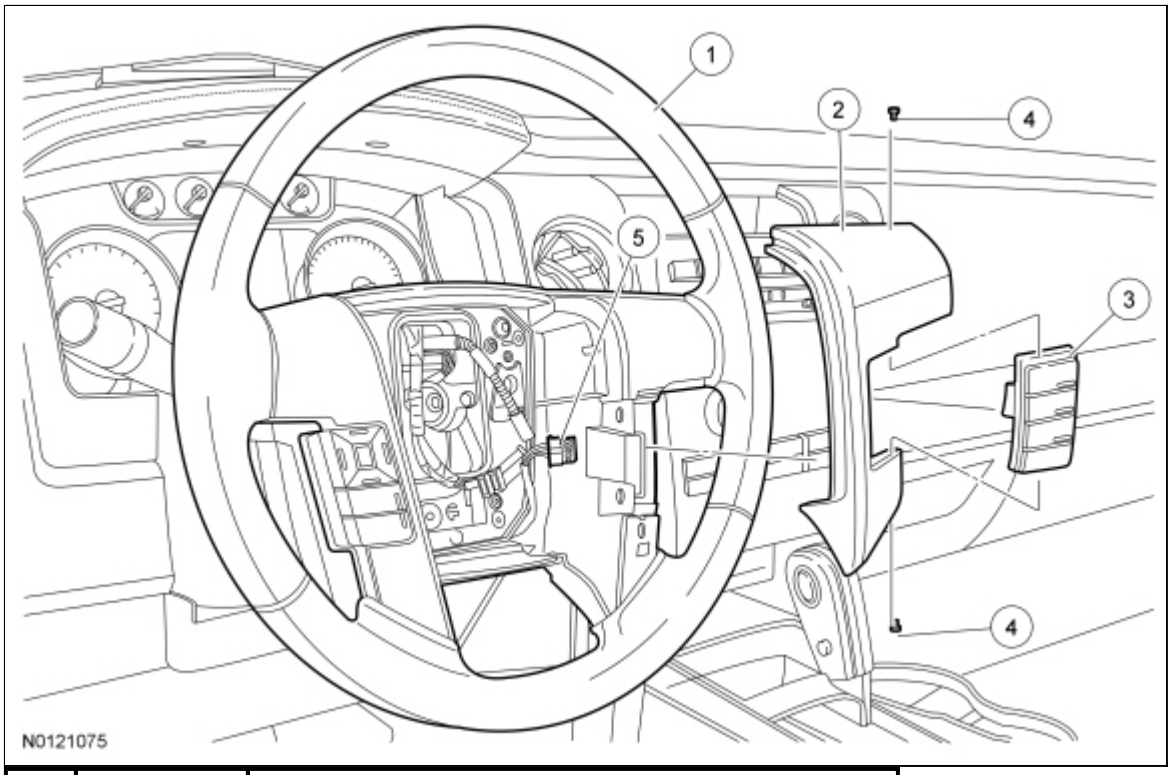
1. Remove the steering column shrouds. For additional information, refer to Section 211-04 .
2. If equipped, remove the steering column control switch. For additional information, refer to Steering Column Control Switch in this section.
3. Turn the steering wheel 90 degrees to the left and remove the 2 screws and the multifunction switch.
   - To install, tighten to 2 Nm (18 lb-in).
4. To install, reverse the removal procedure.

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Steering Wheel Switch

High Series

NOTE: RH shown, LH similar

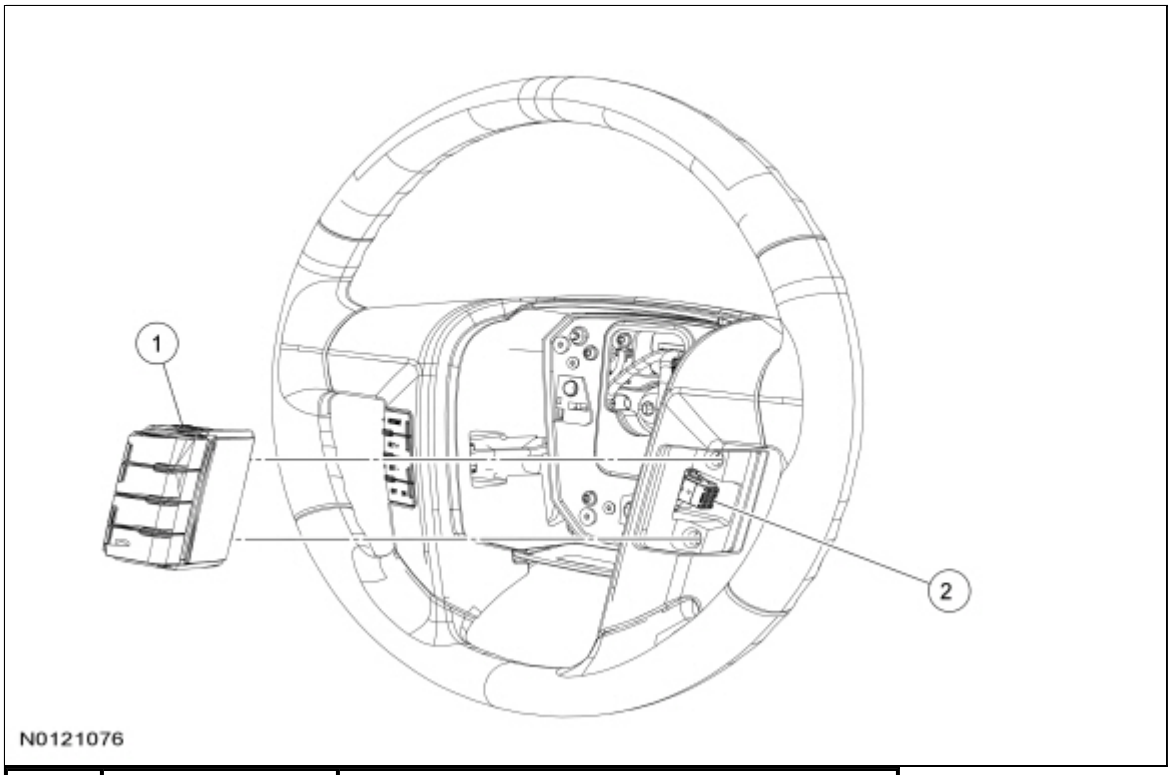


Item	Part Number	Description
1	3600	Steering wheel
2	—	Steering wheel control switch bezel (part of 3600)
3	9C888	RH steering wheel switch
4	—	Steering wheel switch screw (2 required) (part of 3600)
5	—	Steering wheel controls electrical connector (part of 3600)

Low Series

NOTE: RH shown, LH similar

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Item	Part Number	Description
1	9C888	RH steering wheel switch
2	—	Electrical connector (part of 3600)

Removal and Installation

High and Low Series

1. Remove the driver air bag module. For additional information, refer to Section 501-20B .

Low Series

2. Using a suitable flat-bladed tool, detach the steering wheel switch from the steering wheel.
    - Disconnect the electrical connector and remove the switch.

High Series

3. Remove the steering wheel switch bezel.
    - Disconnect the steering wheel switch electrical connector.

4. Remove the 2 screws and the steering wheel switch.

High and Low Series

5. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Dye-Lite® Gasoline Engine Oil Leak Detection Dye 164-R3700 (Rotunda)	—	—
High Temperature Retaining Compound Loctite® 620™/Permatex® 62050, or equivalent; obtain locally	WSK-M2G349-A9	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	—
Threadlock 262 TA-26	WSK-M2G351-A6	—

Engine

NOTICE: **When repairing engines, all parts must be contamination free. If contamination/foreign material is present when repairing an engine, premature engine failure may occur.**

NOTE: Specifications show the expected minimum or maximum condition. Refer to the appropriate section in Group 303 for the procedure.

NOTE: If a component fails to meet the specifications, it is necessary to refinish it or install a new component. Wear limits are provided as an aid to determine if the component can be refinished. A new component must be installed when any component fails to meet specifications and cannot be refinished.

NOTE: This section contains information, steps and procedures that may not be specific to this engine.

This section covers general procedures and diagnosis and testing of the engine system, except for exhaust emission control devices, which are covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

The engine incorporates the following features: Refer to the appropriate section in Group 303 for the procedure.

- Crankcase ventilation or breather system
- Exhaust emission control system
- Evaporative Emission (EVAP) control system

Some engines incorporate a fail-safe cooling system. Refer to the appropriate section in Group 303 for the procedure.

The engine, fuel system, ignition system, emissions system and exhaust system all affect exhaust emission levels and must be maintained according to the maintenance schedule. Refer to the scheduled Maintenance Guide.

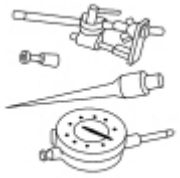
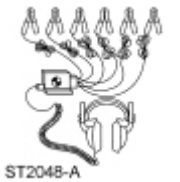
Correct engine identification is required to order parts. Refer to the appropriate section in Group 303 for the procedure.

For complete vehicle and engine identification codes, refer to Section 100-01 .

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Engine

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2312-A	EngineEAR 107-R2103 or equivalent
 ST2048-A	EngineEAR/ChassisEAR 107-R2102 or equivalent
 ST1296-A	Oil Pressure Gauge 303-088 (T73L-6600-A)
 ST1297-A	Vacuum/Pressure Tester 164-R0253 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Dye-Lite® Gasoline Engine Oil Leak Detection Dye	—

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164-R3700 (Rotunda)	
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

There are 2 diagnostic paths that can be followed depending on the type of engine concern. Carry out Inspection and Verification — Engine Performance or Inspection and Verification — Engine NVH.

Inspection and Verification — Engine Performance

1. Verify the customer concern by operating the engine to duplicate the condition.

2. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

   Visual Inspection Chart

Mechanical
• Engine coolant leaks • Engine oil leaks • Fuel leaks • Damaged or severely worn parts • Loose mounting bolts, studs and nuts

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the CMDTCs and carry out the self-test diagnostics for the PCM.

9. If the DTCs retrieved are related to the concern, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Engine Performance .

Inspection and Verification — Engine NVH

1. Engine NVH symptoms should be identified using the diagnostic tools and techniques that are available. For a list of these techniques, tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 .

2. Verify the customer concern by operating the engine to duplicate the condition.

3. Inspect the engine for installation of an aftermarket oil filter. Review oil and filter maintenance history to make sure that the vehicle has not gone beyond the standard Ford recommended oil change interval.

4. Check the engine oil level and check the oil for contamination. Low engine oil level or contaminated oil are common causes of engine noise. If the oil is contaminated, the source of the contamination must be identified and repaired as necessary.

5. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

   Visual Inspection Chart

Mechanical
• Loose mounting bolts, studs and nuts • Damaged or leaking powertrain mounts • Damaged or disconnected vacuum hoses • Damaged or disconnected air intake components • Obstruction of cooling fan • Obstruction of Front End Accessory Drive (FEAD)

6. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.

7. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

8. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

9. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

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10. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record CMDTCs .

11. Clear the CMDTCs and carry out the self-test diagnostics for the PCM.

12. If the DTCs retrieved are related to the concern, refer to Section 419-10 .

13. If no DTCs related to the concern are retrieved, continue the inspection and verification if a noise concern is related to the engine. For vibration concerns and noise concerns such as powertrain mounts, air intake system and starter GO to Symptom Chart - Engine NVH .

In some cases, a noise may be a normal characteristic of that engine type. In other cases the noise may require further investigation. Comparing the noise to a similar year/model vehicle equipped with the same engine will aid in determining if the noise is normal or abnormal.

Once a customer concern has been identified as an abnormal engine noise, it is critical to determine the location of the specific noise. Use the EngineEAR/ChassisEAR or stethoscope (the noise will always be louder closer to the noise source) to isolate the location of the noise to one of the following areas.

- Upper end of engine
- Lower end of engine
- Front of engine
- Rear of engine

Upper end engine noise

Common sources of upper end engine noise (ticking, knocking or rattle) include the fuel injectors, camshaft phaser sprocket(s), camshaft(s) and valve train. Upper end engine noise can be determined using the EngineEAR/ChassisEAR or stethoscope on the valve cover bolts. If the noise is loudest from the valve cover bolts, then the noise is upper end. The EngineEAR/ChassisEAR or stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder. Removal of the valve covers will be required to pinpoint the source of the noise.

- Fuel Injector Noise
    - A common source of an engine ticking noise can be related to the fuel injector(s). This is normal engine noise that can be verified by listening to another vehicle. If the injector noise is excessive or irregular, use the EngineEAR/ChassisEAR or stethoscope to isolate the noise to a specific fuel injector.
- Valve Train
    - Lash adjusters/valve tappets can make an engine ticking or tapping noise noticeable at any engine rpm or temperature and is audible through the wheel well or an open hood. However, with the hood down, lash adjuster/valve tappet noise can be heard as a light tapping noise through the wheel well and is considered normal. The EngineEAR/ChassisEAR or stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder, some disassembly of the engine may be required to inspect for damage or wear.

Lower end engine noise

A common source of lower end engine noise (ticking or knocking) include the crankshaft, connecting rod(s) and bearings. Lower end noises can be determined by using the oil pan or cylinder block lug bosses. If the noise is loudest from these areas then the noise is lower end. If an engine noise is isolated to the lower end, some disassembly of the engine may be required to inspect for damage or wear.

Front of engine noise

A common source of noise from the front of the engine (squeal, chirp, whine or hoot) is the Front End Accessory Drive (FEAD) components. To isolate FEAD noise, carry out the Engine Accessory Test, refer to Section 100-04 .

Some other noises from the front of the engine (ticking, tapping or rattle) may be internal to the engine. Use the EngineEAR/ChassisEAR or stethoscope on the engine front cover to determine if the noise is internal to the engine. Removal of the engine front cover may be necessary to inspect internal engine components.

Rear of engine noise

A common source of noise from the rear of the engine (knocking) is the flywheel/flexplate. Inspection of the flywheel/flexplate will be necessary.

14. After the noise is localized, note the characteristics of the noise, including type of noise, frequency and conditions when the noise occurs and GO to Symptom Chart - Engine NVH .

Symptom Chart — Engine Performance

Symptom Chart — Engine Performance

Condition	Possible Sources	Action
• Difficult starting	• Inoperative or damaged ignition system • Air or vacuum leak • Inoperative or damaged fuel system • Inoperative or damaged starting system	• INSPECT the starting system for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged charging system/battery	• REFER to Section 414-00 .
	• Low oil pressure	• CARRY OUT the oil pressure test.
	• Burnt valve	• INSPECT the valve(s) and valve seat (s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn piston	• INSPECT the piston(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn piston rings	• INSPECT the piston ring(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn cylinder	• INSPECT the cylinder block for

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		damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged head gasket	• INSPECT the cylinder head gasket(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged cooling system	• INSPECT the cooling system for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Poor idling	• Vacuum leaks • Malfunctioning or damaged ignition system • Malfunctioning or damaged fuel system	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool.
	• Damaged hydraulic lash adjuster — 5.0L (4V) engine only	• INSPECT the hydraulic lash adjuster (s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged rocker arm and/or shaft — 6.2L (2V) engine only	• INSPECT the rocker arm ahsft assemblies for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Incorrect valve-to-seat contact	• INSPECT the valve(s) and cylinder head(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged head gasket	• INSPECT the cylinder head gasket(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Low oil pressure	• CARRY OUT the oil pressure test.
	• Worn or damaged engine support bracket(s)	• INSPECT the engine support bracket (s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn or damaged engine support insulator(s)	• INSPECT the engine support insulator(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn or damaged transmission	• INSPECT the transmission insulator and retainer for damage. INSTALL

	insulator and retainer	new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Abnormal combustion	• Inoperative or damaged fuel system • Air or vacuum leaks • EGR system fault • Inoperative or damaged cooling system (if equipped, fail-safe cooling invoked) • Inoperative or damaged ignition system	• INSPECT each system for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged air intake system	• INSPECT the air intake system for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged hydraulic lash adjuster(s) — 5.0L (4V) engine only	• INSPECT the hydraulic lash adjuster (s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged rocker arm(s) — 6.2L (2V) engine only	• INSPECT the rocker arm(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Burnt or sticking valve	• INSPECT the valve(s) and valve seat (s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Weak or broken valve spring	• INSPECT the valve spring(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Carbon accumulation in combustion chamber	• ELIMINATE carbon buildup.
• Excessive oil consumption	• Leaking oil	• REPAIR oil leakage.
	• Malfunctioning PCV system	• INSPECT the PCV system for damage. Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Worn valve stem seal	• INSPECT the valve(s) and valve stem seal(s) for damage. INSTALL new

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		components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn valve stem or valve guide	• INSPECT the valve(s) and cylinder head(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Sticking piston rings	• INSPECT the piston(s) and cylinder block for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn piston ring groove	• INSPECT the piston(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn piston or cylinder	• INSPECT the piston(s) and cylinder block for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Insufficient power	• Inoperative or damaged ignition system • Air intake system blockage • Lubrication system blockage • Inoperative or damaged fuel system	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Oil level too high	• DRAIN oil to correct level.
	• Incorrect engine oil	• INSTALL correct specification engine oil.
	• Low oil pressure	• CARRY OUT the oil pressure test.
	• Excessive accessory drive belt loading	• INSPECT the accessory drive system for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Inoperative or damaged cooling system (if equipped, fail-safe cooling invoked)	• INSPECT the cooling system for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged or plugged exhaust system	• INSPECT the exhaust system for flow and damage. INSTALL new components as necessary. REFER to Section 309-00 .
	• Incorrect tire size	• REFER to Section 204-00 .
	• Dragging brakes	• REFER to Section 206-00 .

	• Slipping transmission	• Refer to the appropriate section in Group 307 for the procedure.
	• Incorrect valve clearance — 3.5L GTDI and 3.7L engines only	• ADJUST valve clearance. Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation after the repair.
	• Worn or damaged valve tappet — 3.5L GTDI and 3.7L engines only	• INSTALL a new valve tappet. TEST the system for normal operation after the repair.
	• Malfunctioning hydraulic lash adjuster — 5.0L (2V) engine only	• INSPECT the hydraulic lash adjuster for wear or damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged rocker arm and/or shaft — 6.2L (2V) engine only	• INSPECT the rocker arm ahsft assemblies for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Compression leakage at valve seat	• INSPECT the valve, valve seat and cylinder head for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Seized valve stem	• INSPECT the valve for wear or damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged valve guide • Compression leakage at valve seat • Seized valve stem	• INSTALL a new cylinder head assembly. TEST the system for normal operation after the repair.
	• Weak or broken valve spring	• INSPECT the valve spring. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn or damaged camshaft	• INSPECT the camshaft for wear or damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Damaged head gasket(s)	• INSPECT the cylinder head gasket(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Cracked or distorted cylinder head(s)	• INSPECT the cylinder head(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

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	• Damaged, worn or sticking piston ring (s) • Worn or damaged piston	• INSPECT the piston ring(s) for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. • INSPECT the piston for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Oil in coolant	• Leaking head gasket • Leaking oil cooler • Leaking oil filter adapter • Damaged cylinder head • Damaged cylinder block	• INSTALL a new head gasket. Refer to the appropriate section in Group 303 for the procedure. • INSPECT the oil filter adapter and seal for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. • INSPECT the oil filter adapter and gasket for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. • INSPECT the engine components for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. • INSPECT the engine components for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Oil in coolant	• Leaking head gasket • Damaged cylinder block • Damaged cylinder head	• INSPECT the engine components. INSTALL new engine components as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
• Coolant in oil	• Leaking head gasket • Leaking oil cooler (if equipped) • Leaking oil filter adapter • Damaged cylinder head • Damaged cylinder block	• INSPECT the engine components for damage. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

Symptom Chart — Engine NVH

Symptom Chart — Engine NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible that any one of multiple systems may be the cause of the symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Drone type noise	• Powertrain mount(s)	• CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure in this section.
• Drumming noise — occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent	• Engine vibration excites the body resonances inducing interior noise	• CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure in this section.
• Engine drumming noise — accompanied by vibration	• Powertrain mount(s)	• CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure in this section.
• Rattle — occurs at idle or at light acceleration from a stop	• Powertrain mount(s)	• CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure.
• Whine/moan type noise — pitch increases or changes with vehicle speed	• Powertrain mount(s)	• CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure.
• Clunk — occurs when shifting from PARK or between REVERSE and DRIVE	• Powertrain mounts • Idle speed is too high	• CHECK the powertrain/drivetrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure. • CHECK for the correct idle speed.

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• Accessory drive bearing hoot — occurs at idle or high idle in cold temperatures of approximately +4°C (+40°F) or colder at the first start of the day	• Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and the bearing race	• CARRY OUT the engine cold soak procedure. REFER to Section 100-04 . • PLACE the EngineEAR probe directly on the idler/tensioner center post or bolt to verify which bearing is making the noise. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Accessory drive belt noise, squeal or chirping	• Defective/worn or incorrect accessory drive belt • Misaligned pulley(s) • Pulley runout • Damaged or worn accessory drive component or idler • Fluid contamination of the accessory drive belt or pulleys • Damaged or worn accessory drive belt tensioner • Damaged pulley grooves	• CARRY OUT the Engine Accessory Test. REFER to Section 100-04 . INSPECT components and INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Clunking noise	• Coolant pump has excessive end play or imbalance	• CHECK the coolant pump for excessive end play. INSPECT the coolant pump for imbalance with the drive belt off. INSTALL a new coolant pump as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Whine or moaning noise	• Air intake system	• CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary.Refer to the appropriate section in Group 303 for the procedure.
• Whistling noise — normally accompanied with poor idle condition	• Air intake system	• CHECK the air intake ducts, Air Cleaner (ACL), Throttle Body (TB) and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary.Refer to the appropriate section in Group 303 for the procedure.
• Hissing noise — occurs during idle or high idle that is apparent with the hood open	• Vacuum leak noise • Vehicles with a	• USE the EngineEAR to locate the source. SCAN the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component. • Acceptable condition. Some

	plastic intake manifold	plastic manifolds exhibit this noise, which is the effect of the plastic manifold.
• Grinding noise — occurs during engine cranking	• Incorrect starter motor mounting	• INSPECT the starter motor for correct mounting. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Starter motor	• CHECK the starter motor. INSTALL a new starter motor as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Incorrect starter motor drive engagement	• INSPECT the starter motor drive for wear or damage. INSTALL a new starter motor as necessary. Refer to the appropriate section in Group 303 for the procedure. • INSPECT the flywheel/flexplate for wear or damage. INSTALL a new flywheel/flexplate as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine noise, front of engine — knocking noise from lower front of engine	• Damaged or separated crankshaft pulley/damper	• CHECK for obvious signs of damage or wobble during operation. INSTALL new as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine noise, front of engine — ticking, tapping or rattling noise from the front of the engine	• Timing drive components	• REMOVE the accessory drive belt. Refer to the appropriate section in Group 303 for the procedure. • USE the EngineEAR to isolate the noise to the engine front cover. • REMOVE the engine front cover and INSPECT the timing drive components. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine noise, upper end — ticking noise near the fuel rail and intake manifold	• Fuel rail clip	• CHECK for loose or damaged fuel rail clip(s). REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Fuel injector	• USE the EngineEAR to isolate the noisy injector(s). INSTALL new injector(s) as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine noise, upper	• Valve train noise	• CARRY OUT the Valve Train

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end — ticking, knocking or rattle noise that occurs during idle or high idle during the first cold start of the day and may disappear as the engine warms	(bled down lifter/lash adjuster/valve tappet)	Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine noise, upper end — occurs mostly with a warm engine at light/medium acceleration	• Worn or damaged spark plugs	• REMOVE the spark plugs. INSPECT and INSTALL new as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Carbon accumulation in combustion chamber	• INSPECT the cylinder using a Bore scope. ELIMINATE carbon buildup.
• Engine noise, upper end — rattling noise from the valve train. Worse when the engine is cold	• Low oil level	• CHECK the oil level. FILL as necessary.
	• Worn valve train components	• CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Worn valve guides	• CARRY OUT the Valve Guide Inner Diameter procedure in this section.
	• Excessive runout of the valve seats on the valve face	• CARRY OUT the Valve Seat Inspection procedure in this section.
• Engine noise, upper end — pinging noise	• Gasoline octane too low	• VERIFY with customer the type of gasoline used. CORRECT as necessary.
	• Knock Sensor (KS) operation	• CHECK the KS . INSTALL a new KS as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Incorrect spark timing	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• High operating temperature	• INSPECT the cooling system for leaks. CHECK the coolant level. REFILL as necessary. CHECK the coolant for the correct mix ratio. DRAIN and REFILL as needed. VERIFY the engine operating temperature is within specifications. REPAIR as

		necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Spark plug	• CHECK the spark plugs. REPAIR or INSTALL new spark plugs as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Catalytic converter	• Acceptable noise.
• Engine noise, upper end — knocking or ticking noise, occurs mostly with a warm engine at idle	• Low oil level	• CHECK the oil level. FILL as necessary.
	• Thin or diluted oil	• INSPECT the oil for contamination. If the oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter.
	• Damaged or incorrect oil filter	• INSPECT the oil filter. INSTALL a new oil filter as necessary.
	• Low oil pressure	• CARRY OUT the oil pressure test.
• Engine noise, lower end — ticking or knocking noise near the oil filter adapter	• Oil pump	• USE the EngineEAR to verify the oil pump as the source of the noise at low rpm. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine noise, lower end — light knocking noise, also described as piston slap. Noise is most noticeable when the engine is cold with light to medium acceleration. The noise disappears as the engine warms	• Excessive clearance between the piston and the cylinder wall	• CARRY OUT the Piston To Cylinder Bore Clearance procedure in this section.
• Engine noise, lower end — light double knock or sharp rap sound. Occurs mostly with a warm engine at idle or low speeds in drive. Increases in relation to engine load. Associated with a poor lubrication history	• Excessive clearance between the piston and the piston pin	• CARRY OUT the Piston Pin Bore Diameter procedure and the Piston Pin Diameter procedure in this section.
	• Excessive	• CARRY OUT the Connecting

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	clearance between the piston pin and the connecting rod bore	Rod Bushing Diameter procedure and the Piston Pin Diameter procedure in this section.
• Engine noise, lower end — light knocking noise. The noise is most noticeable when the engine is warm. The noise tends to decrease when the vehicle is coasting or in NEUTRAL	• Excessive clearance between the connecting rod bearings and the crankshaft	• CARRY OUT the Connecting Rod Bearing Journal-to-Bearing Clearance procedure in this section.
• Engine noise, lower end — deep knocking noise. The noise is most noticeable when the engine is warm, at lower rpm and under a light load and then at float	• Worn or damaged crankshaft main bearings	• CARRY OUT the Crankshaft Main Bearing Journal-to-Bearing Clearance procedure in this section.
• Engine noise, rear of engine — knocking noise at rear of engine	• Damaged flywheel/flexplate	• CARRY OUT the Flexplate Inspection procedure in this section.
• Engine vibration — vibration felt at all times	• Excessive crankshaft pulley runout • Damaged or worn accessory component	• CARRY OUT the Engine Accessory Test. INSTALL a new crankshaft pulley as necessary. Refer to the appropriate section in Group 303 for the procedure. • CARRY OUT the Engine Accessory Test. REPAIR or INSTALL a new component as necessary.
• Engine vibration — at idle, a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan	• Cylinder misfire • Engine or torque converter out of balance	• Using the scan tool, CARRY OUT the cylinder power balance and the relative compression test. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. • VERIFY the torque converter to crankshaft pilot clearance is correct. REPAIR as necessary. RE-INDEX the torque converter on the flexplate by 120 degrees for a 3-bolt converter or 180 degrees for a 4-bolt converter. Refer to the appropriate section in Group 307 for the procedure.
• Engine vibration — is felt with increases	• Powertrain mount(s)	• CHECK the powertrain mounts for damage. INSTALL new

and decreases in engine rpm		mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure.
	• Engine or transmission contacting the chassis	• INSPECT the powertrain/drivetrain for correct clearances. REPAIR as necessary.
• Engine vibration — increases intensity as the engine rpm is increased	• Engine out-of-balance	• CARRY OUT the Neutral Engine Run-Up (NERU) Test. REFER to Section 100-04 . ROTATE the torque converter, 120 degrees for 3-bolt or 180 degrees for 4-bolt. INSPECT the torque converter pilot outer diameter to crankshaft pilot inner diameter. REPAIR as necessary. Refer to the appropriate section in Group 307 for the procedure.
• Engine vibration — mostly at coast/neutral coast. Condition improves with vehicle acceleration	• Combustion instability	• CHECK the ignition system. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure.
• Engine vibration or shudder — occurs with light to medium acceleration above 56 km/h (35 mph)	• Worn or damaged spark plugs	• INSPECT the spark plugs for cracks, high resistance or broken insulators. INSTALL a new spark plug(s) as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Plugged fuel injector	• INSTALL a new fuel injector as necessary. Refer to the appropriate section in Group 303 for the procedure.
	• Contaminated fuel	• INSPECT the fuel for contamination. DRAIN the fuel system and refill.

Pinpoint Tests

Pinpoint Test A: Low Oil Pressure

Normal Operation

Oil is drawn into the oil pump through the oil pump screen and pickup tube in the sump of the oil pan. Oil is

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pumped through the oil filter and then enters the main gallery where it is distributed to the crankshaft main journals, piston oil coolers and to both cylinder heads. From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston ring assembly. The cylinder heads are fed from a drilling into the supply passage feeding the main gallery. Main gallery pressure is sent through Variable Camshaft Timing (VCT) circuit and reduced as it enters the cylinder head galleries through fixed serviceable orifices, located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feed the camshaft journals, rocker arm shafts or hydraulic lash adjusters and the primary and/or secondary timing chain tensioners. The camshaft lobe, roller followers, rocker arms and valve tappets are lubricated by splash created through valve train operation.

This pinpoint test is intended to diagnose the following:

- Excessive crankshaft end play
- Excessive main bearing clearance
- Excessive connecting rod bearing clearance
- Excessive camshaft bearing cap clearance
- Loose oil galley plugs
- Loose timing chain tensioner bolts
- Oil pump screen and pickup tube
- Restricted oil flow passages
- Worn or damaged oil pump
- Damaged piston oil coolers

PINPOINT TEST A: LOW OIL PRESSURE

Test Step	Result / Action to Take
A1 CHECK THE CRANKSHAFT END PLAY	
• Check the crankshaft end play. Refer to Crankshaft End Play in this section. • **Is the crankshaft end play within specification?**	**Yes** GO to A2. **No** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure.
A2 VERIFY THE CAMSHAFT BEARING CAPS ARE NOT DAMAGED AND TIGHT	
• Check that the camshaft bearing caps are not damaged and the bolts are properly tightened. Refer to the Specification chart in the appropriate engine section. • **Are the camshaft bearing caps loose or damaged?**	**Yes** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. **No** GO to A3.
A3 CHECK CAMSHAFT JOURNAL-TO-BEARING CLEARANCE	
• Check the camshaft journal-to-bearing clearance. Refer to the Specification chart in the appropriate engine section. • **Is camshaft journal-to-bearing clearance within specification?**	**Yes** GO to A4. **No** REPAIR as necessary. Refer to the

	appropriate section in Group 303 for the procedure.
A4 CHECK FOR RESTRICTED OIL FLOW	
• Verify the oil supply and return passages are not plugged and clean of debris. Refer to the oil flow chart in the appropriate engine section. • **Is oil flow restricted?**	**Yes** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. **No** GO to A5 .
A5 CHECK THE TIMING CHAIN TENSIONERS FOR DAMAGE AND VERIFY THE BOLTS ARE TIGHT	
• Check that the timing chain tensioners are not damaged or the bolts are loose. Refer to the Specification chart in the appropriate engine section. • **Are the timing chain tensioners damaged or bolts loose?**	**Yes** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. **No** GO to A6 .
A6 CHECK THE OIL PUMP PICKUP TUBE AND SCREEN FOR DAMAGE	
• Check that the oil pump pickup tube and screen is not plugged, cracked or that the bolts are loose. Refer to the Specification chart in the appropriate engine section. • **Is the oil pump screen and pickup tube damaged or loose?**	**Yes** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. **No** GO to A7 .
A7 CHECK THE OIL PUMP FOR DAMAGE	
• Verify the oil pump is not damaged. • **Is oil pump damaged?**	**Yes** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. **No** GO to A8 .
A8 CHECK CRANKSHAFT MAIN BEARING JOURNAL-TO-BEARING CLEARANCE	
• Check the crankshaft main bearing journal-to-bearing clearance. Refer to the Specification chart in the appropriate engine section. • **Is crankshaft main bearing journal-to-bearing clearance within specification?**	**Yes** GO to A9 . **No** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure.
A9 CHECK CONNECTING ROD BEARING JOURNAL-TO-BEARING CLEARANCE	
• Check the connecting rod bearing journal-to-bearing clearance. Refer to the Specification chart in the appropriate engine section. • **Is connecting rod bearing journal-to-bearing clearance within specification?**	**Yes** The concern may have been caused by debris or an incorrect assembly. REPEAT the oil pressure test. **No**

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	REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure.

Component Tests

The following component tests are used to diagnose engine concerns.

Engine Oil Leaks

NOTICE: **If an overnight drive is done, the fan air or road air blast may cause erroneous readings.**

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean the cylinder block, cylinder heads, valve covers, oil pan and flywheel with a suitable solvent to remove all traces of oil.

Engine Oil Leaks — Fluorescent Oil Additive Method

Use the 12 Volt Master UV Diagnostic Inspection Kit to carry out the following procedure for oil leak diagnosis.

1. Add 29.6 ml (1 oz) of gasoline engine oil dye to a minimum of 0.47L (1/2 qt) and a maximum of 0.95L (1 qt) engine oil and fill through the engine oil fill. If the oil is not premixed, the gasoline engine oil dye will not have enough time to reach the crankcase, oil galleries and seal surfaces during this particular 15 minute test. The gasoline engine oil dye must be mixed with oil and added through the oil fill. Check the level on the oil level indicator to determine what amount of oil to premix. If it is in the middle of the crosshatch area or below the full mark, use 0.95L (1 qt). If it is at the full mark, use 0.47L (1/2 qt).

2. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Diagnostic Inspection Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.

3. At the end of test, make sure the oil level is within the upper and lower oil indicator marks. Remove oil as necessary if it registers above the full mark.

Leakage Points — Underhood

Examine the following areas for oil leakage:

- Valve cover gaskets
- Cylinder head gaskets
- Oil cooler, if equipped
- Oil filter adapter
- Engine front cover
- Oil filter adapter and filter body
- Oil level indicator tube connection
- Engine Oil Pressure (EOP) sensor

- Oil passage end plugs

Leakage Points — Under Engine, With Vehicle on Hoist

Examine the following areas for oil leakage:

- Oil pan gaskets
- Oil pan sealer
- Engine front cover gasket
- Crankshaft front seal
- Crankshaft rear oil seal
- Oil filter adapter and filter body
- Oil cooler, if equipped
- Oil passage end plugs

Leakage Points — With Transmission and Flywheel Removed

Examine the following areas for oil leakage:

- Crankshaft rear seal
- Crankshaft rear seal retainer
- Flexplate mounting bolt holes (with flexplate installed)
- Oil passage end plugs

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when using the Gasoline Engine Oil Dye method.

Compression Test — Compression Gauge Check

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position, then remove all the spark plugs.

2. Set the throttle plates in the wide-open position.

3. Install a compression gauge in the No. 1 cylinder.

4. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of 5 compression strokes and record the highest reading. Note the approximate number of compression strokes required to obtain the highest reading.

5. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

Compression Test — Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is at least 75% of the highest reading. Refer to the Compression Pressure Limit Chart.

Compression Test — 3.5L Gasoline Turbocharged Direct Injection (GTDI) Engine Only

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Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1,131 kPa (164 psi)	848 kPa (123 psi)	1,338 kPa (194 psi)	1,000 kPa (145 psi)	1,544 kPa (224 psi)	1,158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1,145 kPa (166 psi)	855 kPa (124 psi)	1,351 kPa (196 psi)	1,014 kPa (147 psi)	1,558 kPa (226 psi)	1,165 kPa (169 psi)
952 kPa (138 psi)	717 kPa (104 psi)	1,158 kPa (168 psi)	869 kPa (126 psi)	1,365 kPa (198 psi)	1,020 kPa (148 psi)	1,572 kPa (228 psi)	1,179 kPa (171 psi)
965 kPa (140 psi)	724 kPa (105 psi)	1,172 kPa (170 psi)	876 kPa (127 psi)	1,379 kPa (200 psi)	1,034 kPa (150 psi)	1,586 kPa (230 psi)	1,186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1,186 kPa (172 psi)	889 kPa (129 psi)	1,303 kPa (189 psi)	1,041 kPa (151 psi)	1,600 kPa (232 psi)	1,200 kPa (174 psi)
933 kPa (135 psi)	745 kPa (108 psi)	1,200 kPa (174 psi)	903 kPa (131 psi)	1,407 kPa (204 psi)	1,055 kPa (153 psi)	1,055 kPa (153 psi)	1,207 kPa (175 psi)
1,007 kPa (146 psi)	758 kPa (110 psi)	1,214 kPa (176 psi)	910 kPa (132 psi)	1,420 kPa (206 psi)	1,062 kPa (154 psi)	1,627 kPa (236 psi)	1,220 kPa (177 psi)
1,020 kPa (148 psi)	765 kPa (111 psi)	1,227 kPa (178 psi)	917 kPa (133 psi)	1,434 kPa (208 psi)	1,075 kPa (156 psi)	1,641 kPa (238 psi)	1,227 kPa (178 psi)
1,034 kPa (150 psi)	779 kPa (113 psi)	1,241 kPa (180 psi)	931 kPa (135 psi)	1,448 kPa (210 psi)	1,083 kPa (157 psi)	1,655 kPa (240 psi)	1,241 kPa (180 psi)
1,048 kPa (152 psi)	786 kPa (114 psi)	1,255 kPa (182 psi)	936 kPa (136 psi)	1,462 kPa (212 psi)	1,089 kPa (158 psi)	1,669 kPa (242 psi)	1,248 kPa (181 psi)
1,062 kPa (154 psi)	793 kPa (115 psi)	1,269 kPa (184 psi)	952 kPa (138 psi)	1,476 kPa (214 psi)	1,103 kPa (160 psi)	1,682 kPa (244 psi)	1,262 kPa (183 psi)
1,076 kPa (156 psi)	807 kPa (117 psi)	1,282 kPa (186 psi)	965 kPa (140 psi)	1,489 kPa (216 psi)	1,117 kPa (162 psi)	1,696 kPa (246 psi)	1,269 kPa (184 psi)
1,089 kPa (158 psi)	814 kPa (118 psi)	1,296 kPa (188 psi)	972 kPa (141 psi)	1,503 kPa (218 psi)	1,124 kPa (163 psi)	1,710 kPa (248 psi)	1,202 kPa (174 psi)
1,103 kPa (160 psi)	827 kPa (120 psi)	1,310 kPa (190 psi)	979 kPa (142 psi)	1,517 kPa (220 psi)	1,138 kPa (165 psi)	1,724 kPa (250 psi)	1,289 kPa (187 psi)
1,110 kPa (161 psi)	834 kPa (121 psi)	1,324 kPa (192 psi)	993 kPa (144 psi)	1,631 kPa (237 psi)	1,145 kPa (166 psi)	—	—

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Compression Pressure Limit Chart — 3.7L, 5.0L (4V) and 6.2L (2V) Engines

Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1,131 kPa (164 psi)	848 kPa (123 psi)	1,338 kPa (194 psi)	1,000 kPa (145 psi)	1,544 kPa (224 psi)	1,158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1,145 kPa (166 psi)	855 kPa (124 psi)	1,351 kPa (196 psi)	1,014 kPa (147 psi)	1,558 kPa (226 psi)	1,165 kPa (169 psi)
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965 kPa (140 psi)	724 kPa (105 psi)	1,172 kPa (170 psi)	876 kPa (127 psi)	1,379 kPa (200 psi)	1,034 kPa (150 psi)	1,586 kPa (230 psi)	1,186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1,186 kPa (172 psi)	889 kPa (129 psi)	1,303 kPa (189 psi)	1,041 kPa (151 psi)	1,600 kPa (232 psi)	1,200 kPa (174 psi)
933 kPa (135 psi)	745 kPa (108 psi)	1,200 kPa (174 psi)	903 kPa (131 psi)	1,407 kPa (204 psi)	1,055 kPa (153 psi)	1,055 kPa (153 psi)	1,207 kPa (175 psi)
1,007 kPa (146 psi)	758 kPa (110 psi)	1,214 kPa (176 psi)	910 kPa (132 psi)	1,420 kPa (206 psi)	1,062 kPa (154 psi)	1,627 kPa (236 psi)	1,220 kPa (177 psi)
1,020 kPa (148 psi)	765 kPa (111 psi)	1,227 kPa (178 psi)	917 kPa (133 psi)	1,434 kPa (208 psi)	1,075 kPa (156 psi)	1,641 kPa (238 psi)	1,227 kPa (178 psi)
1,034 kPa (150 psi)	779 kPa (113 psi)	1,241 kPa (180 psi)	931 kPa (135 psi)	1,448 kPa (210 psi)	1,083 kPa (157 psi)	1,655 kPa (240 psi)	1,241 kPa (180 psi)
1,048 kPa (152 psi)	786 kPa (114 psi)	1,255 kPa (182 psi)	936 kPa (136 psi)	1,462 kPa (212 psi)	1,089 kPa (158 psi)	1,669 kPa (242 psi)	1,248 kPa (181 psi)
1,062 kPa (154 psi)	793 kPa (115 psi)	1,269 kPa (184 psi)	952 kPa (138 psi)	1,476 kPa (214 psi)	1,103 kPa (160 psi)	1,682 kPa (244 psi)	1,262 kPa (183 psi)
1,076 kPa (156 psi)	807 kPa (117 psi)	1,282 kPa (186 psi)	965 kPa (140 psi)	1,489 kPa (216 psi)	1,117 kPa (162 psi)	1,696 kPa (246 psi)	1,269 kPa (184 psi)
1,089 kPa (158 psi)	814 kPa (118 psi)	1,296 kPa (188 psi)	972 kPa (141 psi)	1,503 kPa (218 psi)	1,124 kPa (163 psi)	1,710 kPa (248 psi)	1,202 kPa (174 psi)
1,103 kPa (160 psi)	827 kPa (120 psi)	1,310 kPa (190 psi)	979 kPa (142 psi)	1,517 kPa (220 psi)	1,138 kPa (165 psi)	1,724 kPa (250 psi)	1,289 kPa (187 psi)
1,110 kPa (161 psi)	834 kPa (121 psi)	1,324 kPa (192 psi)	993 kPa (144 psi)	1,631 kPa (237 psi)	1,145 kPa (166 psi)	—	—

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If one or more cylinders reads low, squirt approximately one tablespoon of engine oil on top of the pistons in the low-reading cylinders. Repeat the compression pressure check on these cylinders.

Compression Test — Interpreting Compression Readings

1. If compression improves considerably, piston rings are faulty.

2. If compression does not improve, valves are sticking or seating incorrectly.

3. If 2 adjacent cylinders indicate low compression pressures and squirting oil on each piston does not increase compression, the head gasket may be leaking between cylinders. Engine oil or coolant in cylinders could result from this condition.
   Use the Compression Pressure Limit Chart when checking cylinder compression so that the lowest

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reading is within 75% of the highest reading.

Cylinder Leakage Detection

When a cylinder produces a low reading, use of a cylinder leakage tester will be helpful in pinpointing the exact cause.

The leakage tester is inserted in the spark plug hole, the piston is brought up to Top Dead Center (TDC) on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, the leakage tester gauge will read the percentage of leakage. Leakage exceeding 20% is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve will be heard in the Throttle Body (TB). A leak at the exhaust valve can be heard at the tail pipe. Leakage past the piston rings will be audible at the PCV connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator.

Excessive Engine Oil Consumption

Nearly all engines consume oil, which is essential for normal lubrication of the cylinder bore walls and pistons and rings. Determining the level of oil consumption may require testing by recording how much oil is being added over a given set of miles.

Customer driving habits greatly influence oil consumption. Mileage accumulated during towing or heavy loading generates extra heat. Frequent short trips, stop-and-go type traffic or extensive idling, prevent the engine from reaching normal operating temperature. This prevents component clearances from reaching specified operating ranges.

The following diagnostic procedure may be utilized to determine internal oil consumption. Make sure that the concern is related to internal oil consumption, and not external leakage, which also consumes oil. Verify there are no leaks before carrying out the test. Once verified, the rate of internal oil consumption can be tested.

A new engine may require extra oil in the early stages of operation. Internal piston-to-bore clearances and sealing characteristics improve as the engine breaks in. Engines are designed for close tolerances and do not require break-in oils or additives. Use the oil specified in the Owner's Literature. Ambient temperatures may determine the oil viscosity specification. Verify that the correct oil is being used for the vehicle in the geographic region in which it is driven.

Basic Pre-checks

1. For persistent complaints of oil consumption, interview the customer to determine the oil consumption characteristics. If possible, determine the brand and grade of oil currently in the oil pan. Look at the oil filter or oil-change station tags to determine if Ford-recommended maintenance schedules have been followed. Make sure that the oil has been changed at the specified mileage intervals. If vehicle mileage is past the first recommended drain interval, the OEM production filter should have been changed.

2. Ask how the most current mileage was accumulated. That is, determine whether the vehicle was

driven under the following conditions:

- Extended idling or curbside engine operation
- Stop-and-go traffic or taxi operation
- Towing a trailer or vehicle loaded heavily
- Frequent short trips (engine not up to normal operating temperature)
- Excessive throttling or high engine-rpm driving

3. Verify that there are no external leaks. If necessary, review the diagnostic procedure under Engine Oil Leaks in the Diagnosis and Testing portion of this section.

4. Inspect the crankcase ventilation system for:
   - disconnected hoses at the valve cover or TB .
   - loose or missing valve cover fill cap.
   - missing or incorrectly seated engine oil level indicator.
   - incorrect or dirty PCV valve.
   - a PCV valve grommet unseated in the valve cover (if so equipped).

5. Inspect for signs of sludge. Sludge affects PCV performance and can plug or restrict cylinder head drainback wells. It can also increase oil pressure by restricting passages and reducing the drainback capability of piston oil control rings.

6. Inspect the air filter for dirt, sludge or damage. A hole in the filter element will allow unfiltered air to bypass into the air induction system. This can cause premature internal wear (engine dusting), allowing oil to escape past rings, pistons, valves and guides.

7. If the engine is hot or was recently shut down, wait at least 5 minutes to allow the oil to drain back. Ask the customer if this requirement has been followed. Adding oil without this wait period can cause an overfill condition, leading to excessive oil consumption and foaming which may cause engine damage.

8. Make sure the oil level indicator (dipstick) is correctly and fully seated in the indicator tube. Remove the oil level indicator and record the oil level.

Detailed Pre-checks

1. Check the thermostat opening temperature to make sure that the cooling system is operating at the specified temperature. If it is low, internal engine parts are not running at specified internal operating clearances.

2. Verify the spark plugs are not oil saturated. Oil leaking into one or more cylinders will appear as an oil soaked condition on the plug. If a plug is saturated, a compression check may be necessary at the conclusion of the oil consumption test.

Oil Consumption Test

Once all of the previous conditions are met, carry out an oil consumption test.

1. Drain the engine oil and remove the oil filter. Install a new manufacturer-specified oil filter. Make sure the vehicle is positioned on a level surface. Refill the oil pan to a level **1 liter (1 quart) less** than the specified fill level, using manufacturer-specified oil.

2. Run the engine for 3 minutes (if hot) or 10 minutes (if cold). Allow for a minimum 5-minute drainback period and then record the oil level shown on the oil level indicator. Place a mark on the backside of the oil level indicator noting the oil level location.

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3. Add the final 1 L (1 qt) to complete the normal oil fill. Restart the engine and allow it to idle for 2 minutes. Shut the engine down.

4. After a 5-minute drainback period, record the location of the oil level again. Mark the oil level indicator with the new oil level location. (Note: Both marks should be very close to the MIN-MAX upper and lower limits or the upper and lower holes on the oil level indicator. These marks will exactly measure the engine's use of oil, with a one quart differential between the new marks.) Demonstrate to the customer that the factory-calibrated marks on the oil level indicator are where the oil should fall after an oil change with the specified fill amount. Explain however, that this may vary slightly between MIN-MAX or the upper and lower holes on the oil level indicator.

5. Record the vehicle mileage.

6. Advise the customer that oil level indicator readings must be taken every 320 km (200 mi) or weekly, using the revised marks as drawn. Remind the customer that the engine needs a minimum 5-minute drainback for an accurate reading and that the oil level indicator must be firmly seated in the tube prior to taking the reading.

7. When the subsequent indicator readings demonstrate a full quart (liter) has been used, record the vehicle mileage. The mileage driven between the 2 readings should not be less than 4,800 km (3,000 miles). The drive cycle the vehicle has been operated under must be considered when making this calculation. It may be necessary to have the customer bring the vehicle in for a periodic oil level indicator reading to closely monitor oil usage.

Post Checks, Evaluation and Corrective Action

1. If test results indicate excessive oil consumption, carry out a cylinder compression test. The cylinder compression test should be carried out with a fully charged battery and all spark plugs removed. See the Compression Test Chart in this section for pressure range limits.

2. Compression should be consistent across all cylinders. Refer to the Compression Testing portion of this section. If compression tested within the specifications found in this section, the excessive oil consumption may be due to wear on the valve guides, valves or valve seals.

3. A cylinder leak detection test can be carried out using a cylinder leakage tester. This can help identify valves, piston rings, or worn valve guides/valve stems, inoperative valve stem seals or other related areas as the source of oil consumption.

NOTE: An oil-soaked appearance on the porcelain tips of the spark plugs also indicates excessive oil use. A typical engine with normal oil consumption will exhibit a light tan to brown appearance. See Spark Plug Analysis in this section for details. A single or adjoining, multiple cylinder leak can be traced by viewing the tips.

4. If an internal engine part is isolated as the root cause, determine if the repair will exceed cost limits and proceed with a repair strategy as required.

5. Once corrective action to engine is complete and verifying that all pre-check items were eliminated in the original diagnosis, repeat the Oil Consumption Test as described above and verify consumption results.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 ft) of elevation above sea level.

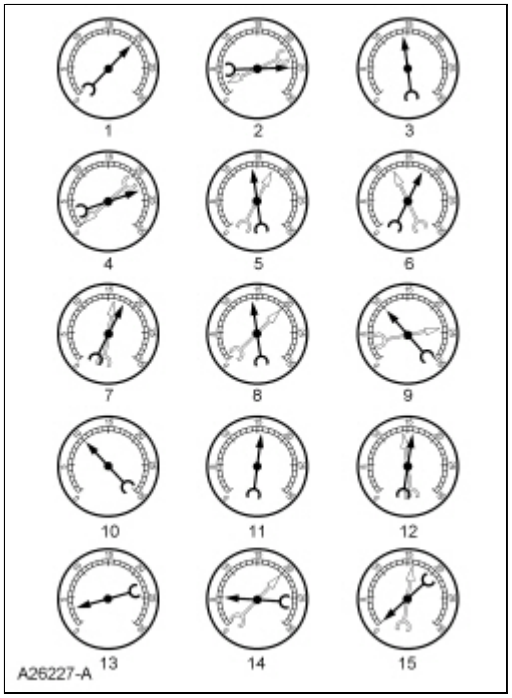
The reading should be steady. If necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

Intake Manifold Vacuum Test — Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



1. NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

2. NORMAL READING DURING RAPID ACCELERATION AND DECELERATION: When the engine is rapidly accelerated (dotted needle), the needle will drop to a low reading (not to zero). When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: The needle will register as low as 51 kPa (15 in-Hg), but will be relatively steady. Some oscillation is normal.

4. WORN RINGS OR DILUTED OIL: When the engine is accelerated (dotted needle), the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).

5. STICKING VALVES: When the needle (dotted) remains steady at a normal vacuum, but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.

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6. BURNED OR WARPED VALVES: A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient hydraulic lash adjuster or hydraulic lash adjuster clearance will also cause this reaction.

7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating.

8. WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.

9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady, but somewhat low, reading.

12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13. INTAKE LEAK: A low, steady reading can be caused by an intake manifold or throttle body gasket leak.

14. BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head-to-cylinder block surface.

15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler, kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

16. When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory unit such as the power brake booster, the unit will not function correctly. Always fix vacuum leaks.

Oil Pressure Test

NOTICE: **Inspect the engine for installation of an aftermarket oil filter. Review oil and filter maintenance history to make sure that the vehicle has not gone beyond the standard Ford recommended oil change intervals. Check the engine oil level and check the oil for contamination. If the oil is contaminated, engine damage can occur. The source of the contamination must be identified and repaired as necessary.**

1. Disconnect and remove the Engine Oil Pressure (EOP) switch from the engine. Refer to the appropriate section in Group 303 for the procedure.

2. Connect the Oil Pressure Gauge to the oil pressure port.

3. Run the engine until normal operating temperature is reached.

4. With the engine at idle record the gauge reading.

5. The oil pressure should be within specifications; refer to the specifications in the appropriate engine section.

6. If the pressure is not within specification, GO to Pinpoint Test A .

Valve Train Analysis — 3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L

The following component tests are used to diagnose valve train concerns.

Valve Train Analysis — Engine Off, Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis — Camshafts and Valve Tappets

- Check for broken or damaged parts.
- Check for loose mounting bolts on camshaft caps.
- Check for worn or damaged valve tappets.

Valve Train Analysis — Valve Springs, Valve Tappets Removed

- Check for broken or damaged parts.

Valve Train Analysis — Valve Spring Retainer and Valve Spring Retainer Keys, Valve Tappets Removed

- Check for correct seating of the valve spring retainer key on the valve stem and in valve spring retainer.
- Check for correct seating on the valve stem.

Valve Train Analysis — Valves and Cylinder Head, Valve Tappets Removed

- Check for plugged oil drain-back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged valve stem seals or guide-mounted valve stem seal.
- Check for missing or worn valve spring seats.

Valve Train Analysis — Camshaft Lobe Lift

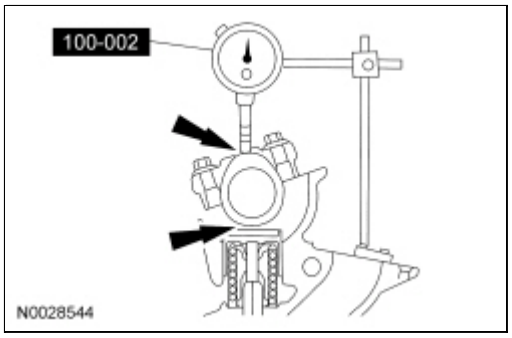
Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the spark plugs. Refer to Section 303-07A for 3.5L GTDI , or Section 303-07B for 3.7L.

2. Install the Dial Indicator Gauge with Holding Fixture so the rounded tip of the dial indicator is on top of the camshaft lobe and on the same plane as the valve tappet.

3. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.

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4. Zero the dial indicator. Continue to rotate the crankshaft until the high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).

5. To check the accuracy of the original dial indicator reading, continue to rotate crankshaft until the base circle is reached. The dial indicator reading should be zero. If zero reading is not obtained, repeat Steps 1 through 6.

6. If the lift on any lobe is below specified service limits, install a new camshaft and camshaft valve tappets.

7. Install the spark plugs. Refer to Section 303-07B .

Valve Train Analysis — 5.0L (4V)

The following component tests are used to diagnose valve train concerns.

Valve Train Analysis — Engine Off — Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis — Engine Off, Camshaft Roller Followers and Hydraulic Lash Adjusters, Overhead Camshaft

- Check for plugged oil feed in the camshaft roller followers, hydraulic lash adjusters or cylinder heads.

Valve Train Analysis — Engine Off, Camshaft — Engines

- Check for broken or damaged parts.

Valve Train Analysis — Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis — Engine Off, Valve Spring Retainer and Valve Spring Retainer Keys

- Check for correct seating of the valve spring retainer key on the valve stem and in valve spring retainer.
- Check for correct seating on the valve stem.

Valve Train Analysis — Engine Off, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check for damaged hydraulic lash adjuster.
- Check installed valve spring height.
- Check for missing or worn valve spring seats.

Static checks (engine off) are to be made on the engine prior to the dynamic procedure.

Valve Train Analysis — Engine Running, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for missing or damaged valve stem seals or guide mounted valve stem seals.

If insufficient oiling is suspected, check oil passages for blockage, then accelerate the engine to 1,200 rpm with the transmission in NEUTRAL and the engine at normal operating temperature. Oil should spurt from the rocker arm oil holes such that valve tips and camshaft roller followers are well oiled. With the valve covers off, some oil splash may overshoot camshaft roller followers.

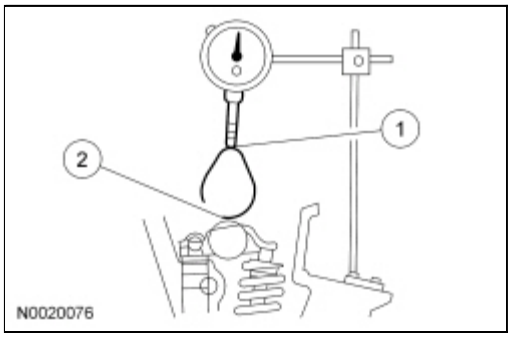
Valve Train Analysis — Camshaft Lobe Lift

Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the spark plugs. Refer to Section 303-07C for 5.0L (4V) engines.

2. Install the Dial Indicator Gauge with Holding Fixture so the rounded tip of indicator is on top of the camshaft lobe.

3. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.



4. Zero the Dial Indicator Gauge. Continue to rotate the crankshaft until the (1) high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).

5. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the (2) base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat the measurement.

6. If the lift on any lobe is below specified service limits, install a new camshaft and camshaft roller followers.

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7. Install the spark plugs. Refer to Section 303-07C for 5.0L (4V) engines.

Valve Train Analysis — 6.2L (2V)

The following component tests are used to diagnose valve train concerns.

Valve Train Analysis — Engine Off — Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis — Engine Off, Rocker Arm and Overhead Camshaft

- Check for loose mounting bolts on rocker arm shafts and camshaft carriers.
- Check for plugged oil feed in the rocker arm shafts and cylinder heads.

Valve Train Analysis — Engine Off, Camshaft

- Check for broken or damaged parts.

Valve Train Analysis — Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis — Engine Off, Valve Spring Retainer and Valve Spring Retainer Keys

- Check for correct seating of the valve spring retainer key on the valve stem and in valve spring retainer.
- Check for correct seating on the valve stem.

Valve Train Analysis — Engine Off, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check installed valve spring height.
- Check for missing or worn valve spring seats.
- Check for plugged oil metering orifice in cylinder head oil reservoir (if equipped).

Static checks (engine off) are to be made on the engine prior to the dynamic procedure.

Valve Train Analysis — Engine Running, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for missing or damaged valve stem seals or guide mounted valve stem seals.
- Check for a plugged oil metering orifice in the cylinder head oil reservoir.

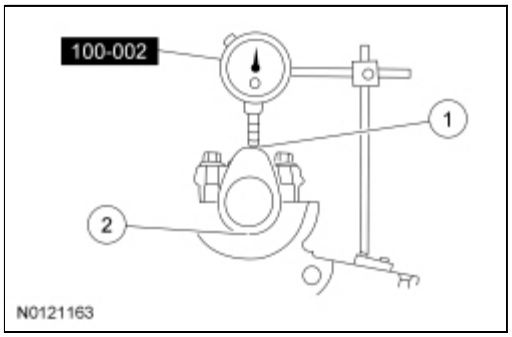
If insufficient oiling is suspected, check oil passages for blockage, then accelerate the engine to 1,200 rpm with the transmission in NEUTRAL and the engine at normal operating temperature. Oil should spurt from the rocker arm oil holes such that valve tips and camshaft roller followers are well oiled. With the valve

covers off, some oil splash may overshoot camshaft roller followers.

Valve Train Analysis — Camshaft Lobe Lift

Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the spark plugs. Refer to Section 303-07D .
2. Install the Dial Indicator Gauge with Holding Fixture so the rounded tip of indicator is on top of the camshaft lobe.
3. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.

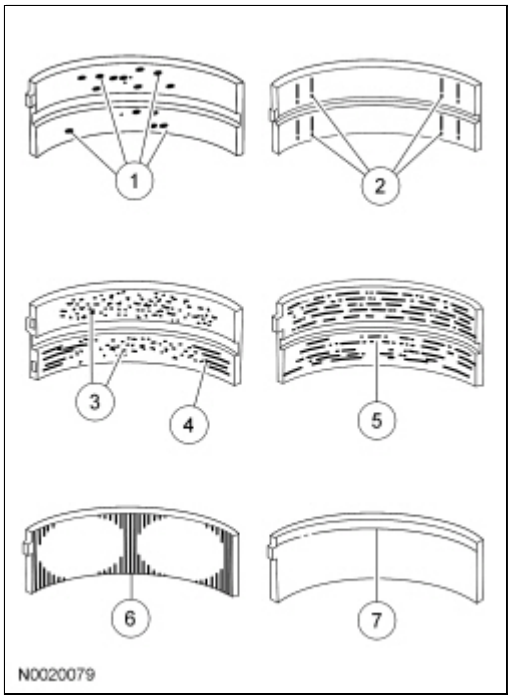


4. Zero the Dial Indicator Gauge. Continue to rotate the crankshaft until the (1) high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).
5. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the (2) base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat the measurement.
6. If the lift on any lobe is below specified service limits, install a new camshaft and camshaft roller followers.
7. Install the spark plugs. Refer to Section 303-07D .

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Bearing Inspection

1. Inspect bearings for the following defects:
    1. Cratering — fatigue failure
    2. Spot polishing — incorrect seating
    3. Imbedded dirty engine oil
    4. Scratching — dirty engine oil
    5. Base exposed — poor lubrication
    6. Both edges worn — journal damaged
    7. One edge worn — journal tapered or bearing not seated

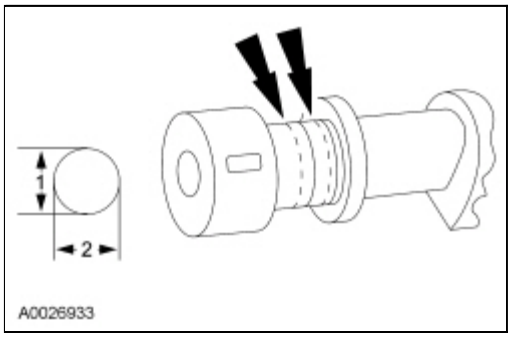


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Camshaft Bearing Journal Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

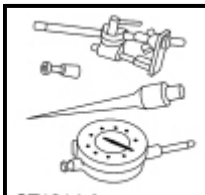
1. Measure each camshaft journal diameter in 2 directions.



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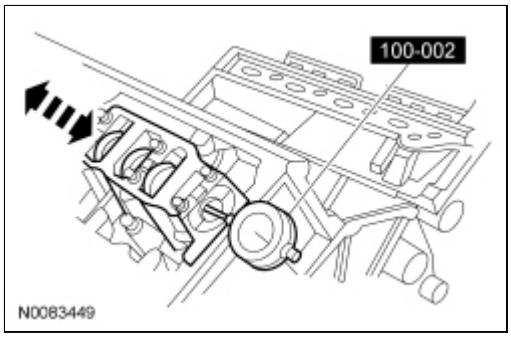
Camshaft End Play — OHC Engines

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Using the Dial Indicator Gauge with Holding Fixture, measure the camshaft end play.
2. Position the camshaft to the rear of the cylinder head.
3. Zero the Dial Indicator Gauge.
4. Move the camshaft to the front of the cylinder head. Note and record the camshaft end play.
    - If camshaft end play exceeds specifications, install a new camshaft and recheck end play.
    - If camshaft end play exceeds specification after camshaft installation, install a new cylinder head.



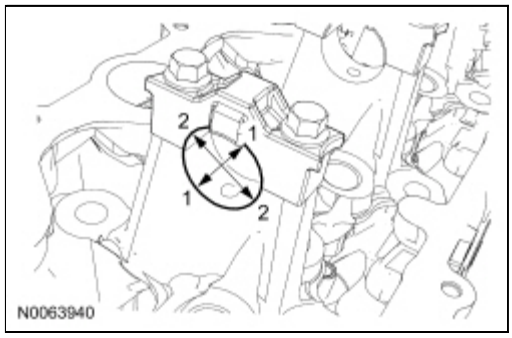
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Camshaft Journal to Bearing Clearance — OHC Engines

NOTE: Refer to the appropriate Section 303-01 for the specification.

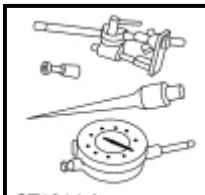
1. **NOTE:** The camshaft journals must meet specifications before checking camshaft journal clearance.

   Measure each camshaft bearing in 2 directions.
   - Subtract the camshaft journal diameter from the camshaft bearing diameter.



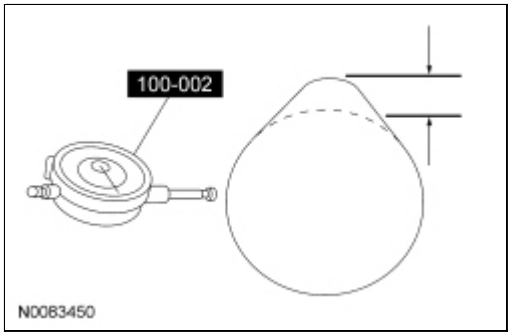
Camshaft Lobe Lift

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

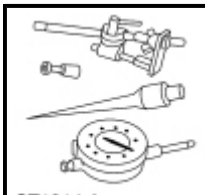
1. Use the Dial Indicator Gauge with Holding Fixture to measure camshaft intake/exhaust lobe lift.
   - Rotate the camshaft and subtract the lowest Dial Indicator Gauge reading from the highest Dial Indicator Gauge reading to figure the camshaft lobe lift.



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Camshaft Runout

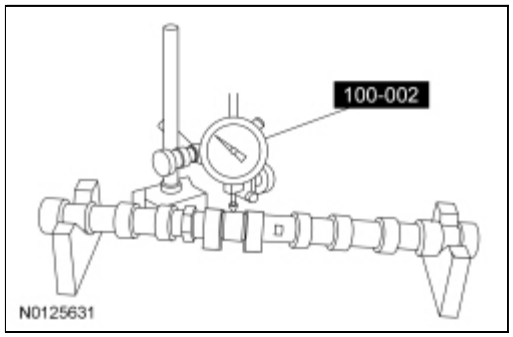
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Camshaft journals must be within specifications before checking runout.

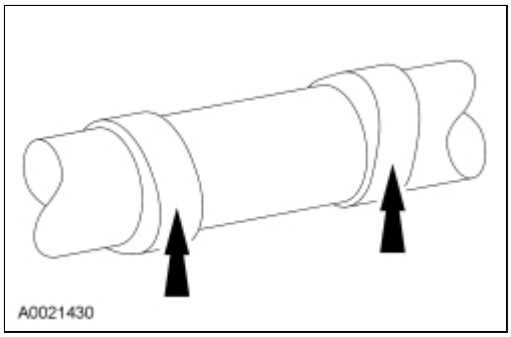
   Using the Dial Indicator Gauge with Holding Fixture, measure the camshaft runout.
   - Camshaft must be supported on the first and last camshaft bearing journal.
   - Rotate the camshaft and subtract the lowest Dial Indicator Gauge reading from the highest Dial Indicator Gauge reading.



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Camshaft Surface Inspection

1. Inspect camshaft lobes for pitting or damage in the contact area. Minor pitting is acceptable outside the contact area.

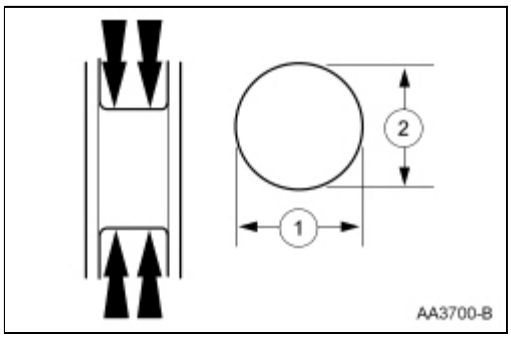


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Connecting Rod Bearing Journal Taper and Out-of-Round

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the crankshaft connecting rod journal diameters in 2 directions perpendicular to one another at each end of the connecting rod journal. The difference in the measurements from one end to the other is the taper. Verify measurement is within the wear limit.



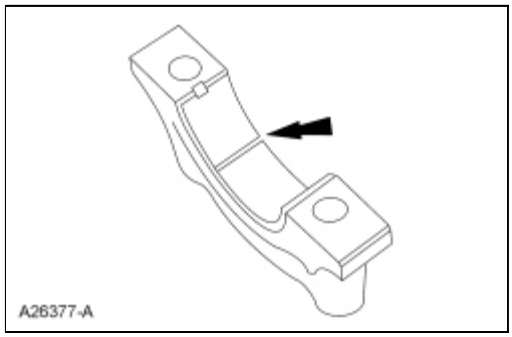
Connecting Rod Bearing Journal-to-Bearing Clearance

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: The crankshaft connecting rod journals must be within specifications to check the connecting rod bearing journal clearance.

1. Remove the connecting rod bearing cap.

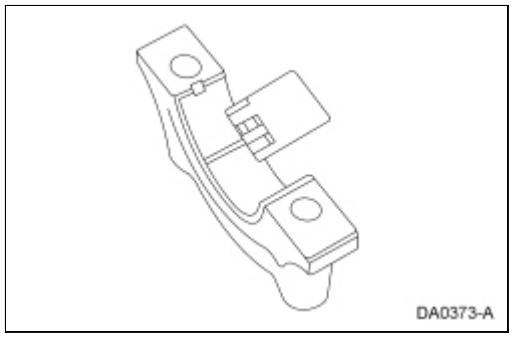
2. Position a piece of Plastigage across the bearing surface.



3. **NOTE:** Do not turn the crankshaft during this step.

   Install and tighten to specifications, then remove the connecting rod bearing cap.

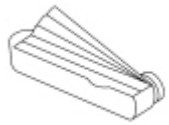
4. Measure the Plastigage to get the connecting rod bearing journal clearance. The Plastigage should be smooth and flat. A changing width indicates a tapered or damaged connecting rod or connecting rod bearing.



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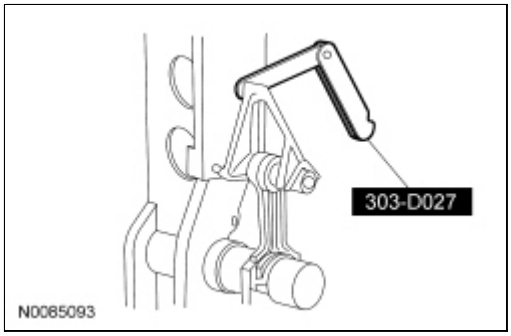
Connecting Rod Bend

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Using the Feeler Gauge Set, measure the connecting rod bend on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the bend measurement is within specification.

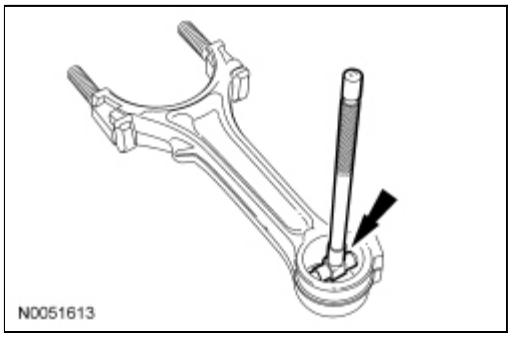


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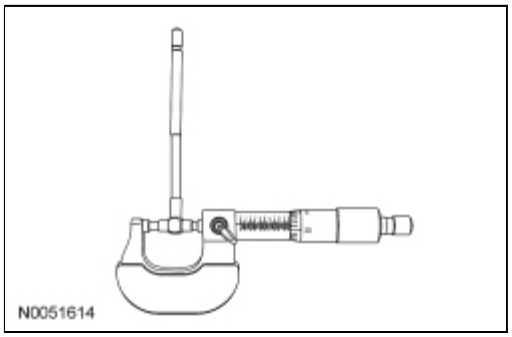
Connecting Rod Bushing Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Use a telescoping gauge to determine the ID of the connecting rod bushing, if equipped.



2. Measure the telescoping gauge with a micrometer. Verify the diameter is within specification.



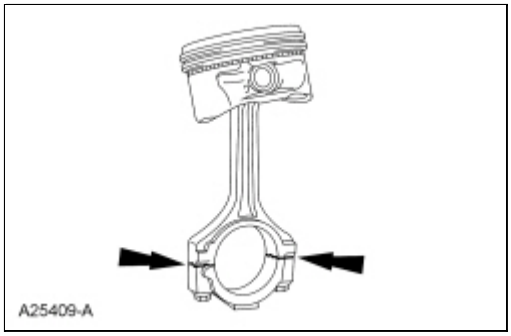
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Connecting Rod Cleaning

NOTICE: **Do not use a caustic cleaning solution or damage to connecting rods can occur.**

1. **NOTE:** The connecting rod large end is a matched set. The connecting rod cap must be installed on the original connecting rod in the original position. Do not reverse the cap. Parts are not interchangeable.

   Mark and separate the parts and clean with solvent. Clean the oil passages.

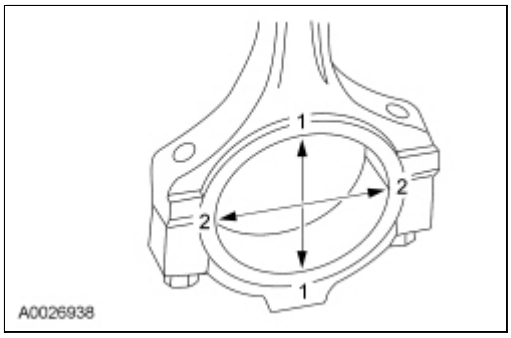


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Connecting Rod Large End Bore

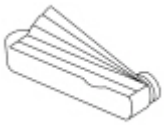
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Tighten the bolts to specification, then measure the bore in 2 directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.



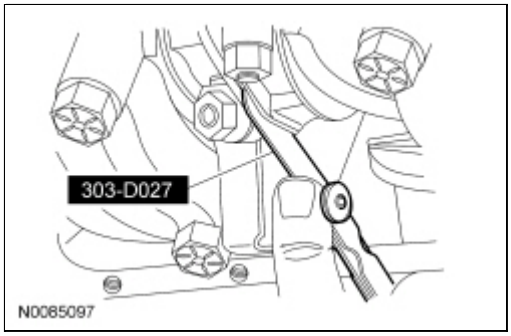
Connecting Rod to Crankshaft Side Clearance

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

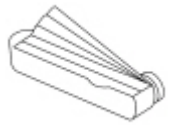
1. Using the Feeler Gauge Set, measure the clearance between the connecting rod and the crankshaft. Verify the measurement is within specification.



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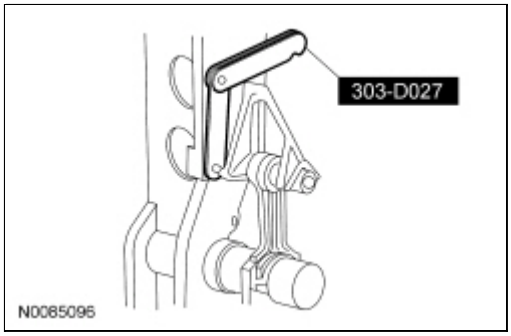
Connecting Rod Twist

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Using the Feeler Gauge Set, measure the connecting rod twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the measurement is within specification.



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Core Plug Replacement

Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
High Temperature Retaining Compound Loctite® 620™/Permatex® 62050, or equivalent; obtain locally	WSK-M2G349-A9
Threadlock 262 TA-26	WSK-M2G351-A6

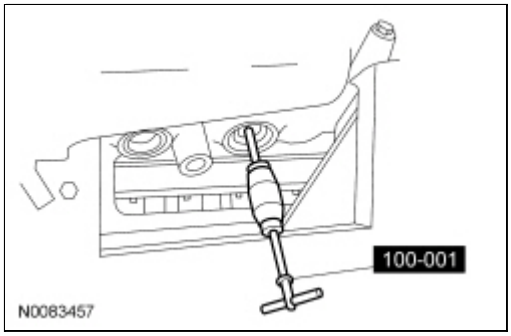
NOTICE: **It is necessary to use High Temperature Retaining Compound Loctite® 620™/Permatex® 62050 or equivalent on all 3 valve modular engine cylinder head cup plugs. If not used, the cylinder head cup plugs could leak or seep, causing serious engine damage.**

NOTE: Use threadlock 262 on all other applications.

All core plugs

1. **NOTE:** Cylinder block core plug shown, cylinder head core plug similar.

   Use the Slide Hammer and a freeze plug remover to remove the core plug.



2. **NOTE:** Oversize plugs are identified by the OS stamped in the flat located on the cup side of the plug.

   Inspect the core plug bore for any damage that would interfere with the correct sealing of the plug. If the core plug bore is damaged, bore for the next oversize plug.

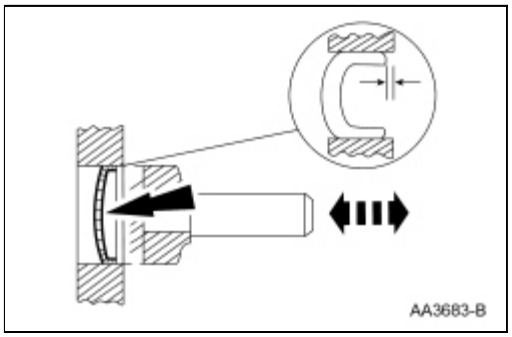
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Cup-type

3. ***NOTICE:*** **Use care during this procedure so as not to disturb or distort the cup sealing surface.**

   NOTE: When installed, the flanged edge must be below the chamfered edge of the bore to effectively seal the bore.

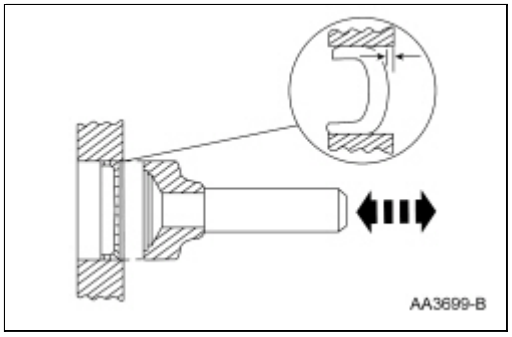
   Coat the cup-type core plug and bore lightly with sealant and install the core plug using a freeze plug installer.



Expansion-type

4. ***NOTICE:*** **Do not contact the crown when installing an expansion-type core plug. This could expand the plug before seating and result in leakage.**

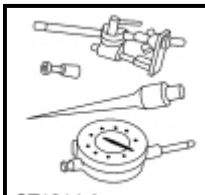
   Coat the expansion-type core plug and bore lightly with sealant and install the core plug using a freeze plug installer.



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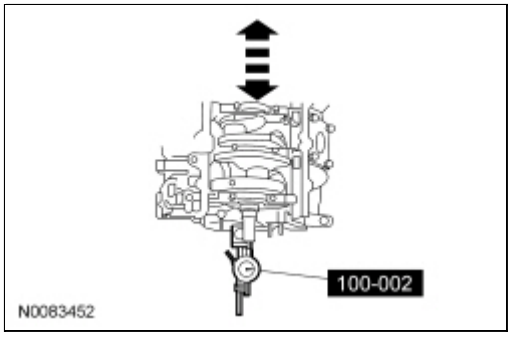
Crankshaft End Play

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Install the Dial Indicator Gauge with Holding Fixture.
2. Position the crankshaft to the rear of the cylinder block.
3. Zero the Dial Indicator Gauge.
4. Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.

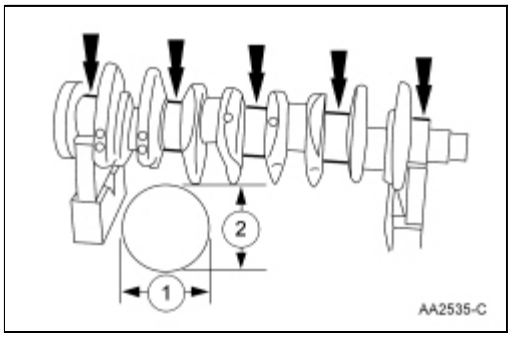


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Crankshaft Main Bearing Journal Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

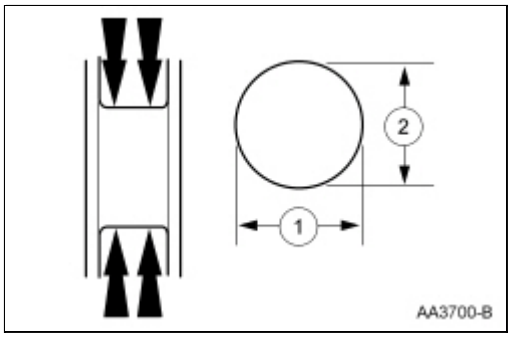
1. Measure each of the crankshaft main bearing journal diameters in at least 2 directions.



Crankshaft Main Bearing Journal Taper and Out-of-Round

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure each of the crankshaft main bearing journal diameters in at least 2 directions at each end of the main bearing journal.



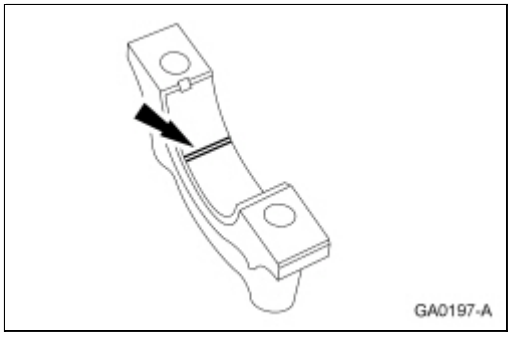
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Crankshaft Main Bearing Journal-to-Bearing Clearance

NOTE: Refer to the appropriate Section 303-01 for the specification.

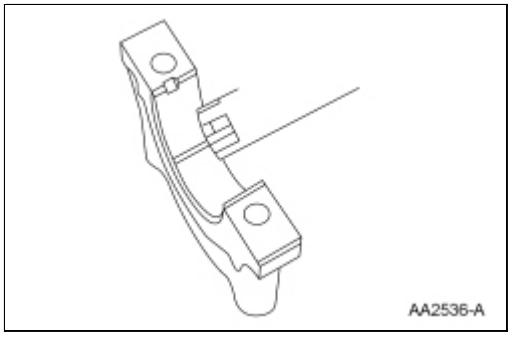
NOTE: Crankshaft main bearing journals must be within specifications before checking journal clearance.

1. Remove the crankshaft main bearing caps and crankshaft main bearing.
2. Lay a piece of Plastigage across the face of each crankshaft main bearing surface.



3. **NOTE:** Do not turn the crankshaft while carrying out this procedure.

   Install and remove the crankshaft main bearing cap.
4. Verify the crankshaft journal clearance.



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Cylinder Bore Cleaning

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

1. ***NOTICE:*** **If these procedures are not followed, rusting of the cylinder bores may occur.**

   Clean the cylinder bores with soap or detergent and water.

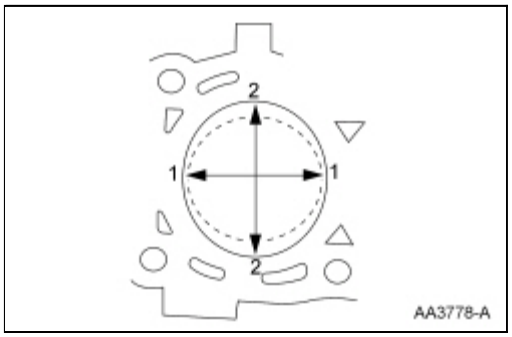
2. Thoroughly rinse with clean water and wipe dry with a clean, lint-free cloth.

3. Use a clean, lint-free cloth and lubricate the cylinder bores.
   - Use clean engine oil meeting Ford specification.

Cylinder Bore Out-of-Round

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the cylinder bore in 2 directions. The difference is the out-of-round.

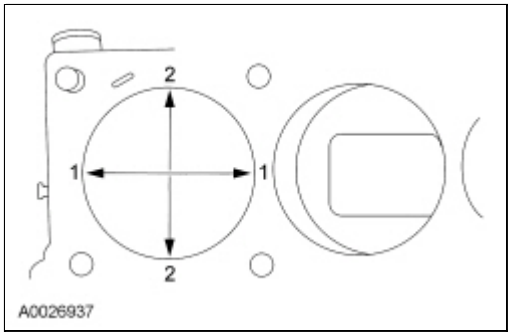


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Cylinder Bore Taper

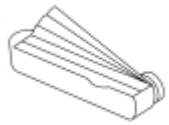
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the cylinder bore at the top, middle and bottom of piston ring travel in 2 directions as indicated. Verify the cylinder bore is within the wear limit. The difference indicates the cylinder bore taper. If the cylinder bore taper does not meet specification, bore the cylinder to the next oversize limit.



Cylinder Head Distortion

Special Tool(s)

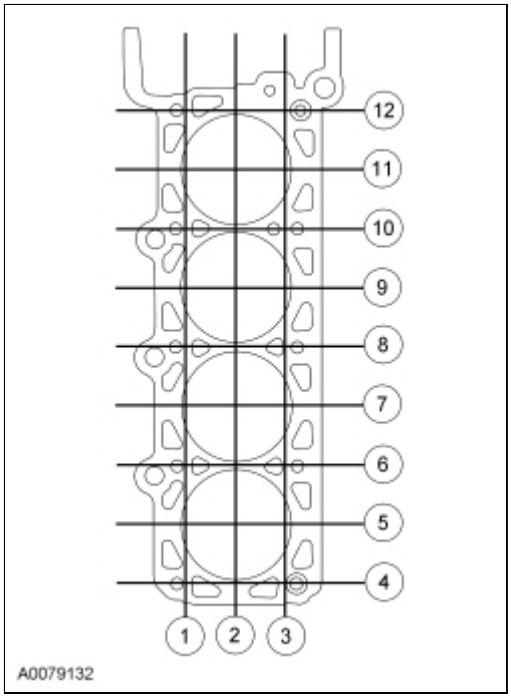
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, silicone sealant, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

   NOTE: Use a Straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot of length, such as Snap-On® GA438A or equivalent. For example, if the Straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

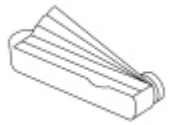
   Using a Straightedge and a Feeler Gauge Set, inspect the cylinder head for flatness in the sequence shown.



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Exhaust Manifold Cleaning and Inspection

Special Tool(s)

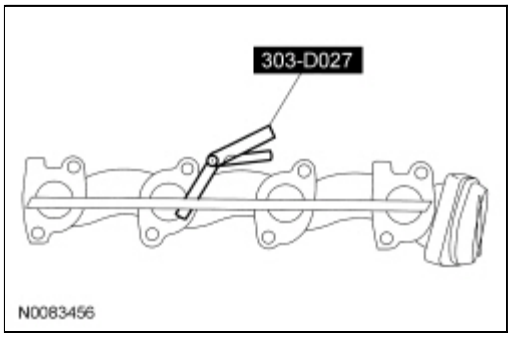
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

1. Clean the exhaust manifold using a suitable solvent. Use a plastic scraping tool to clean the gasket sealing surfaces.

2. **NOTE:** New exhaust manifold gaskets, studs, nuts and/or bolts must be installed when an exhaust manifold is serviced.

   NOTE: Use a Straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot of length, such as Snap-On® GA438A or equivalent. For example, if the Straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

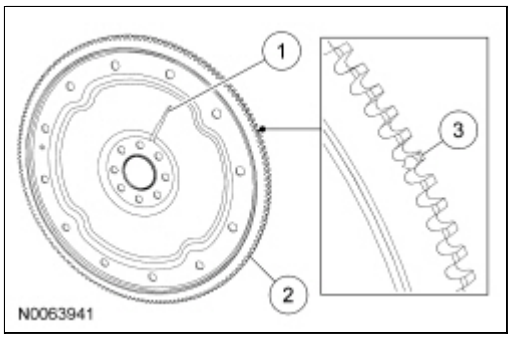
   Using the Straightedge and a Feeler Gauge Set, check the exhaust manifold sealing surface for warpage. If the warpage is greater than 0.76 mm (0.0299 in), install a new exhaust manifold.



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Flexplate Inspection

1. Inspect the flexplate for:
    1. any cracks.
    2. worn ring gear teeth.
    3. chipped or cracked ring gear teeth.

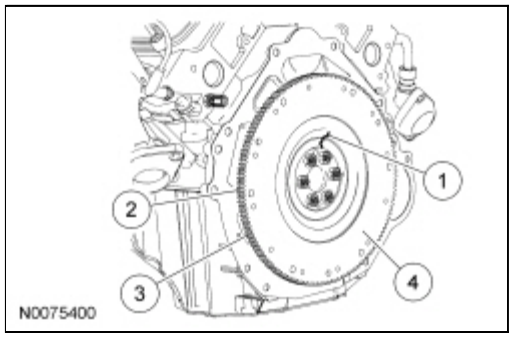


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Flywheel Inspection

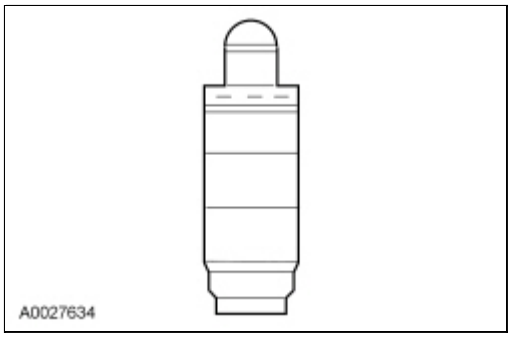
1. **NOTE:** The flywheel cannot be resurfaced, it must be replaced.

   Inspect the flywheel for:
   1. any cracks.
   2. worn ring gear teeth.
   3. chipped or cracked ring gear teeth.
   4. scratches, nicks and discoloration.



Hydraulic Lash Adjuster Inspection

1. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage.

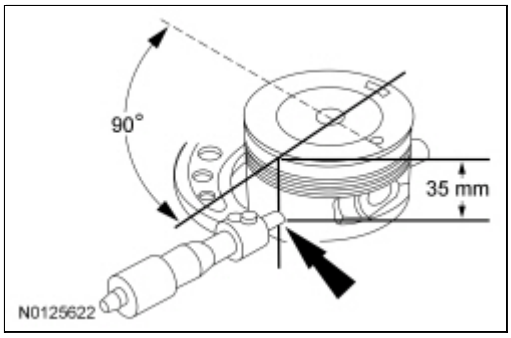


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Piston Diameter

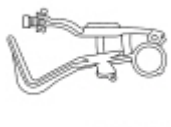
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the piston diameter 90 degrees from the piston pin and 35 mm (1.38 in) down from the top of the piston at the uncoated skirt area point indicated.



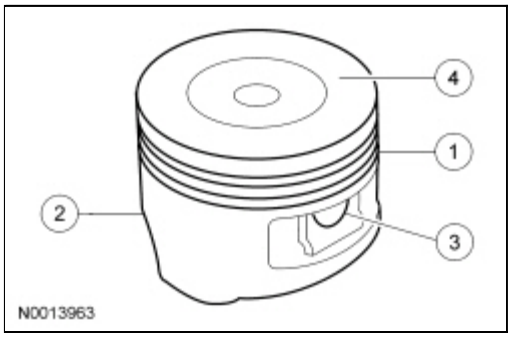
Piston Inspection

Special Tool(s)

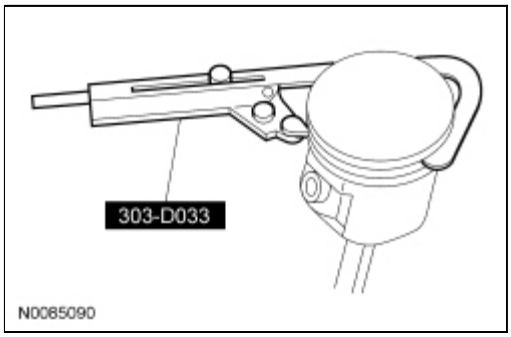
 ST1279-A	Scraper, Piston Ring Groove 303-D033 (D81L-6002-D) or equivalent

NOTICE: **Do not use a caustic cleaning solution or a wire brush to clean the pistons or damage can occur.**

1. Clean and inspect the (1) ring lands, (2) skirts, (3) pin bosses and the (4) tops of the pistons. If wear marks, scores or glazing is found on the piston skirt, check for a bent or twisted connecting rod.



2. Use the Piston Ring Groove Scraper to clean the piston ring grooves.
   - Make sure the oil ring holes are clean.



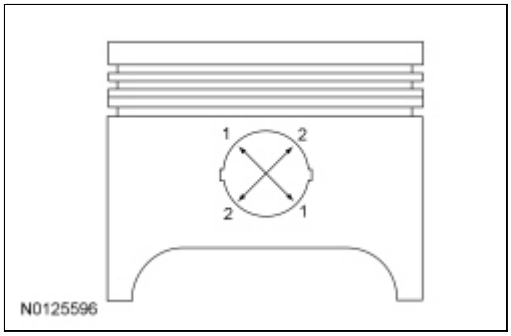
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Piston Pin Bore Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Piston and piston pins are a matched set and should not be interchanged.

   Measure the piston pin bore diameter in 2 directions on each side. Verify the diameter is within specification.

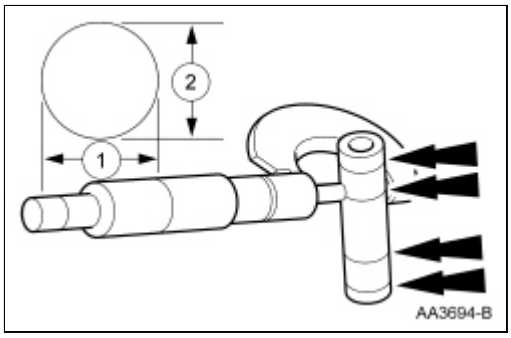


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Piston Pin Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the piston pin diameter in 2 directions at the points shown. Verify the diameter is within specification.



Piston Ring End Gap

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

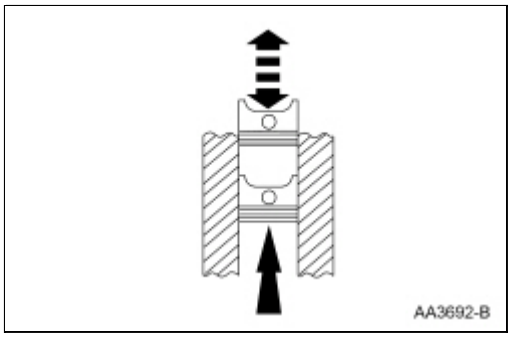
NOTICE: **Use care when fitting piston rings to avoid possible damage to the piston ring or the cylinder bore.**

NOTE: Piston rings should not be transferred from one piston to another.

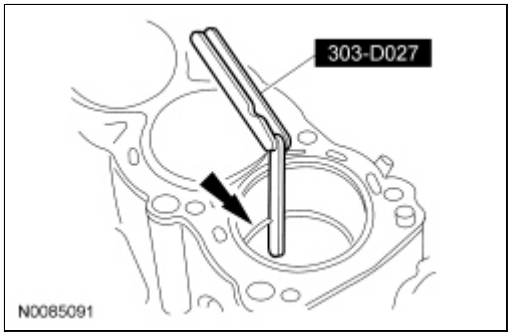
NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: The cylinder bore must be within specification for taper and out-of-round.

1. Use a piston without rings to push a piston ring in a cylinder to the bottom of ring travel.



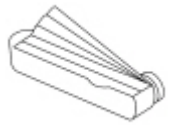
2. Use the Feeler Gauge Set to measure the top piston ring end gap and the second piston ring end gap.



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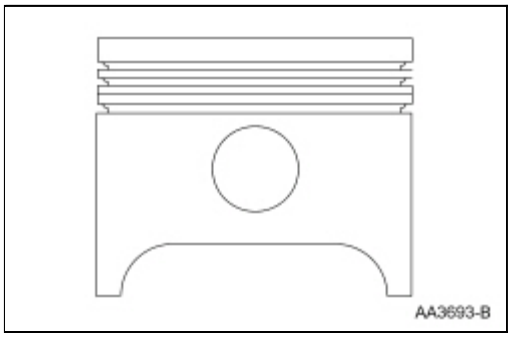
Piston Ring-to-Groove Clearance

Special Tool(s)

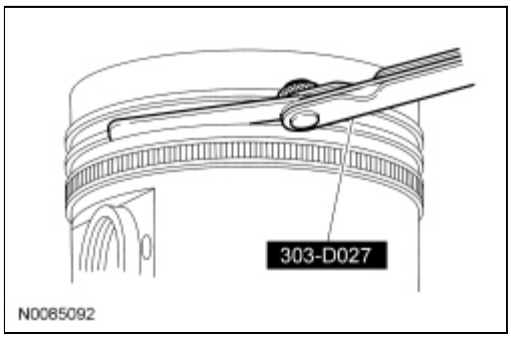
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Inspect the piston for ring land damage or accelerated wear.



2. Using the Feeler Gauge Set, measure the piston ring-to-groove clearance.



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Piston Selection

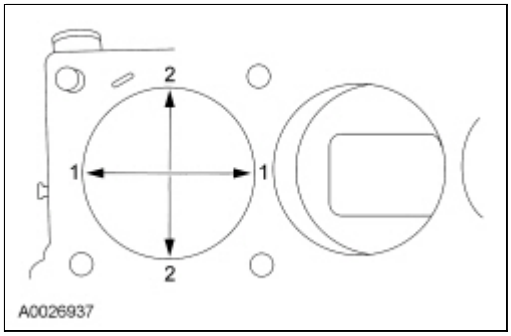
3.5L, 3.7L and 5.0L (4V) Engines

1. Engines are equipped with a single grade size piston.

6.2L (2V) Engines

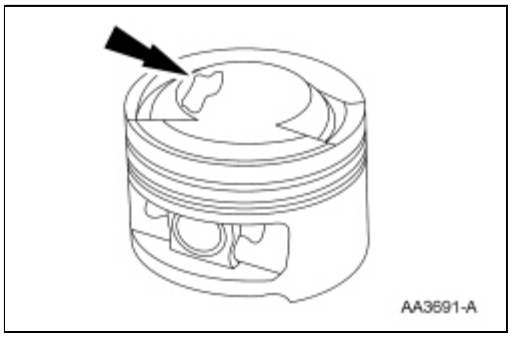
NOTE: The cylinder bore must be within the specifications for taper and out-of-round before fitting a piston.

2. Select a piston size based on the cylinder bore.



3. **NOTE:** For precision fit, new pistons are divided into 3 categories within each size range based on their relative position within the range. A paint spot or specific size grade on a new piston indicates the position within the size range.

   Choose the piston with the correct paint color or specific size grade.
   - Refer to the appropriate section in Group 303 for the procedure.



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Piston To Cylinder Bore Clearance

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance.

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Powertrain/Drivetrain Mount Neutralizing

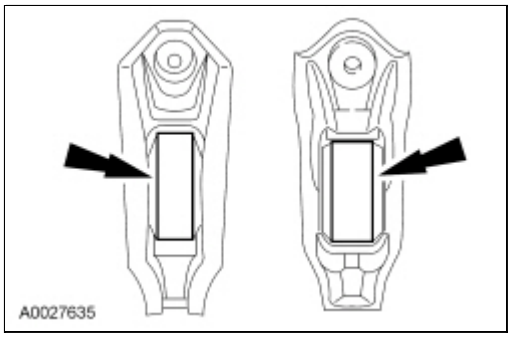
NOTE: Refer to the appropriate section and procedure for special instructions on loosening and tightening mount fasteners.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Loosen, but do not remove, the powertrain/drivetrain mount fasteners.
3. Lower the vehicle.
4. ***NOTICE:*** **Do not twist or strain the powertrain/drivetrain mounts or damage to the mounts may occur.**

   Start the vehicle and move it in forward 0.6-1.2 m (2-4 ft). Then move the vehicle in reverse the same distance.
5. Raise and support the vehicle.
6. Tighten the powertrain/drivetrain mount fasteners.
7. Lower the vehicle.
8. Test the system for normal operation.

Roller Follower Inspection

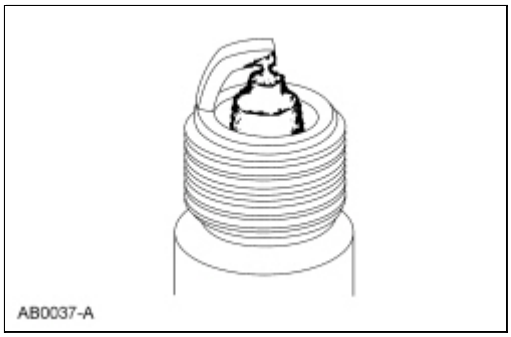
1. Inspect the roller follower for flat spots or scoring. If any damage is found, inspect the camshaft lobes and hydraulic lash adjuster for damage.



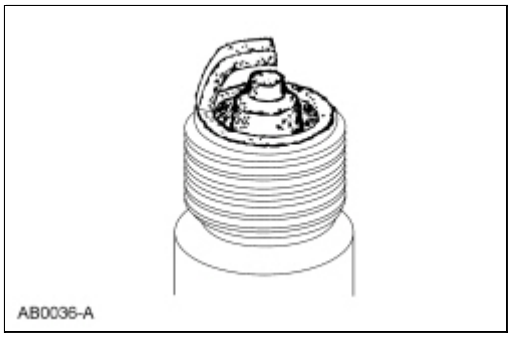
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Spark Plug Inspection

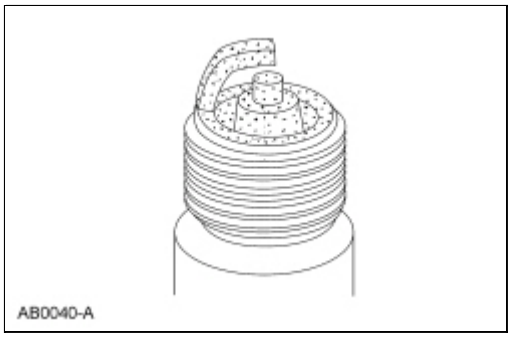
1. Inspect the spark plug for a bridged gap.
    - Check for deposit build-up closing the gap between the electrodes. Deposits are caused by oil or carbon fouling.
    - Install a new spark plug.



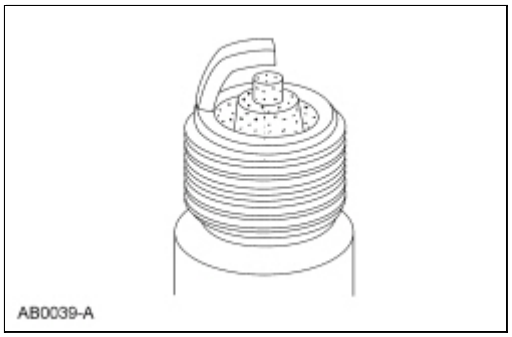
2. Check for oil fouling.
    - Check for wet, black deposits on the insulator shell bore electrodes, caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
    - Correct the oil leak concern.
    - Install a new spark plug.



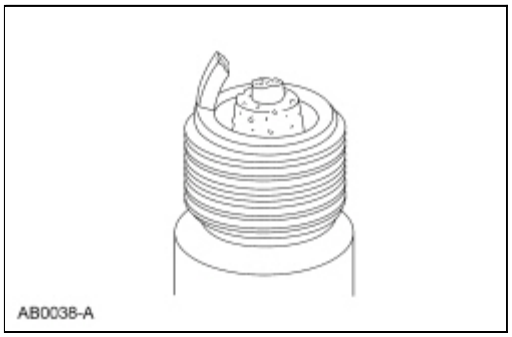
3. Inspect for carbon fouling. Look for black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes, caused by a spark plug with an incorrect heat range, dirty air cleaner, too rich a fuel mixture or excessive idling.
    - Install new spark plugs.



4. Inspect for normal burning.
    - Check for light tan or gray deposits on the firing tip.

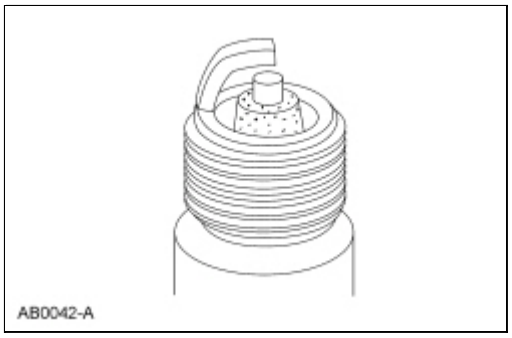


5. Inspect for pre-ignition, identified by melted electrodes and a possibly damaged insulator. Metallic deposits on the insulator indicate engine damage. This may be caused by incorrect ignition timing, wrong type of fuel or the unauthorized installation of a heli-coil insert in place of the spark plug threads.
    - Install a new spark plug.

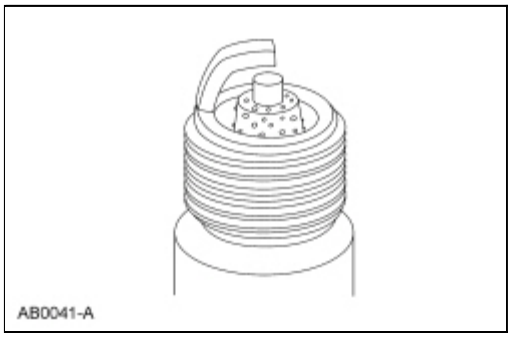


6. Inspect for overheating, identified by white or light gray spots and a bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.
    - Install a new spark plug.

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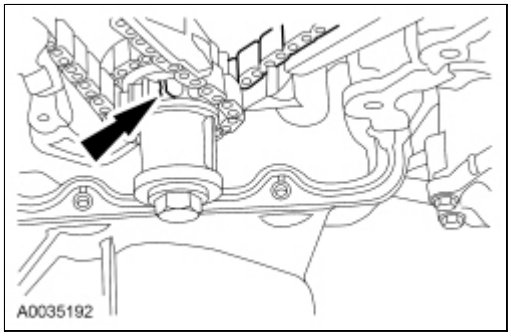


7. Inspect for fused deposits, identified by melted or spotty deposits resembling bubbles or blisters. These are caused by sudden acceleration.
    - Install new spark plugs.



Sprockets

1. Inspect the sprockets for cracks and worn or chipped teeth.



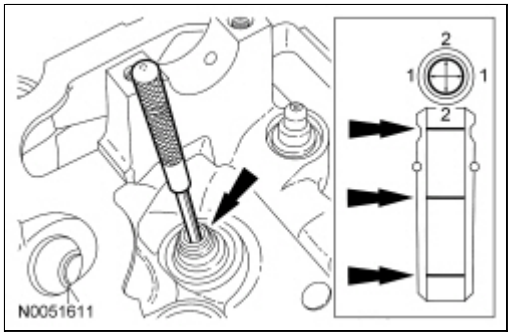
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Valve Guide Inner Diameter

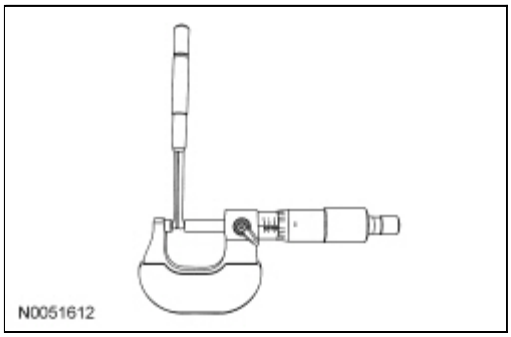
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Valve guides tend to wear in an hourglass pattern. The ball gauge can be inserted into the combustion chamber side of the valve guide, if necessary.

   Use a ball gauge to determine the inside diameter of the valve guides in 2 directions at the top, middle and bottom of the valve guide.



2. Measure the ball gauge with a micrometer.

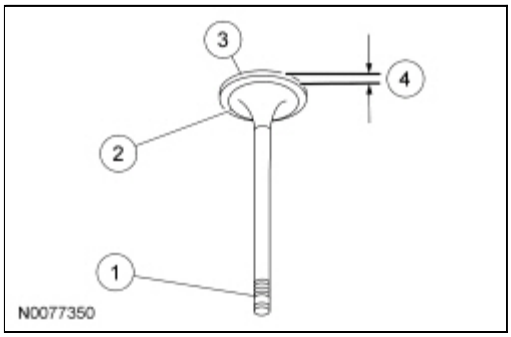


3. If the valve guide is not within specifications, install a new cylinder head assembly.

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Valve Inspection

1. Inspect the following valve areas:
    1. The end of the stem for grooves or scoring.
    2. The valve face and the edge for pits, grooves or scores.
    3. The valve head for signs of burning, erosion, warpage and cracking.
    4. The valve margin for wear.



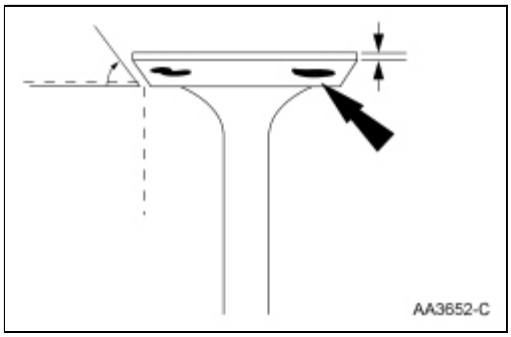
Valve Seat Inspection

Valve and Seat Refacing Measurements

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: After grinding valves or valve seats, check valve clearance.

1. Check the valve head and seat.
    - Check valve angles.
    - Check margin width.
    - Be sure margin width is within specification.



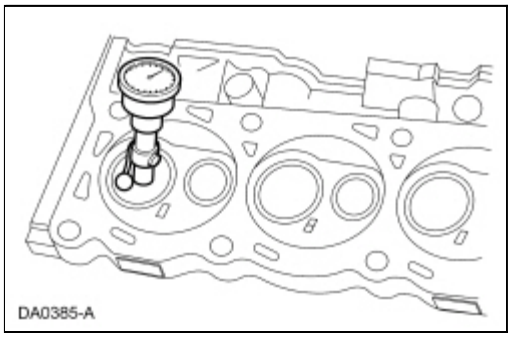
2. Inspect for abnormalities on the valve face and seat. Install a new cylinder head assembly if abnormalities are found.

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Valve Seat Runout

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Use a valve seat runout gauge to check valve seat runout.

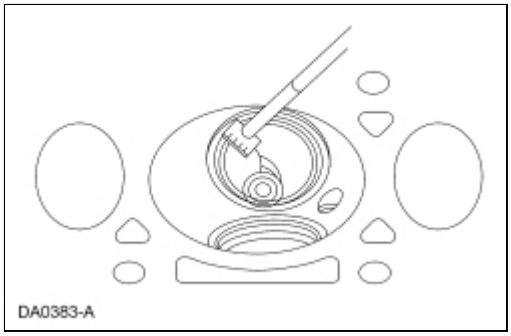


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Valve Seat Width

NOTE: Refer to the appropriate Section 303-01 for the specification.

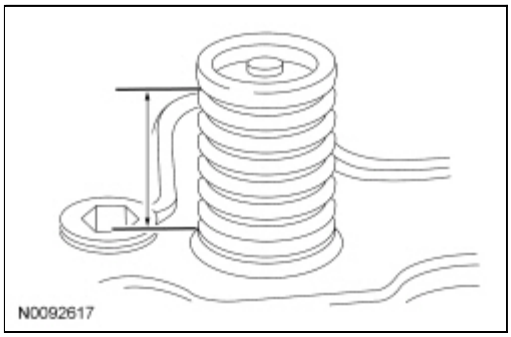
1. Measure the valve seat width. If necessary, grind the valve seat to specification.
    - Measure the intake valve seat width.
    - Measure the exhaust valve seat width.
    - Recheck the valve spring installed length after the seats have been ground, and shim the valve springs as necessary to achieve the correct installed spring length.
    - Depending on the engine, check the valve lash. Refer to General Procedures in Section 303-01.



Valve Spring Installed Length

NOTE: Refer to the appropriate Section 303-01 for the specification.

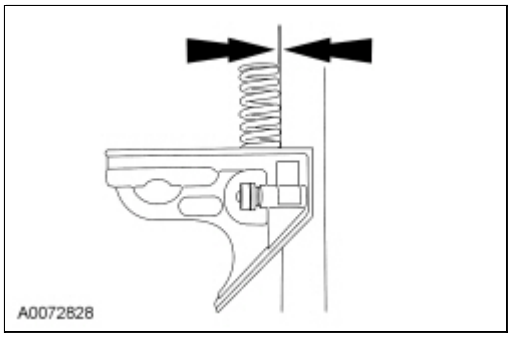
1. Measure the installed length of each valve spring.



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Valve Spring Squareness

1. Measure the out-of-square on each valve spring.
    - Turn the valve spring and observe the space between the top of the valve spring and the square.



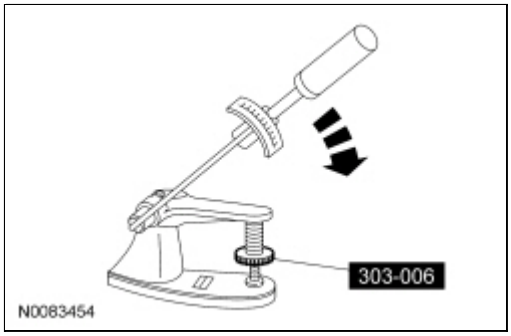
Valve Spring Strength

Special Tool(s)

 ST1278-A	Pressure Gauge, Valve/Clutch Spring 303-006 (TOOL-6513-DD) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Use the Valve/Clutch Spring Pressure Gauge to check the valve spring for correct strength at the specified valve spring length.

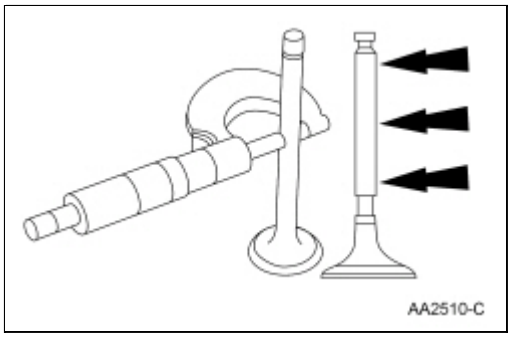


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Valve Stem Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

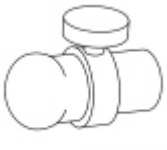
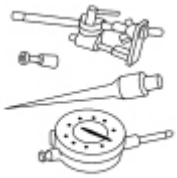
1. Measure the diameter of each intake and exhaust valve stem at the points shown. Verify the diameter is within specification.



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Valve Stem to Valve Guide Clearance

Special Tool(s)

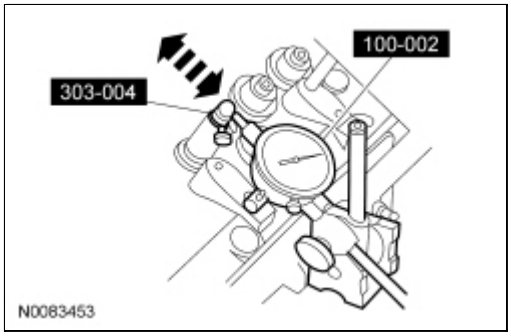
 ST1251-A	Clearance Gauge, Valve Guide 303-004 (TOOL-6505-E) or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: The valve stem diameter must be within specifications before checking valve stem-to-valve guide clearance.

1. **NOTE:** If necessary, use a magnetic base.

   Install a Valve Guide Clearance Gauge on the valve stem and install a Dial Indicator Gauge with Holding Fixture. Lower the valve until the clearance gauge contacts the upper surface of the valve guide.

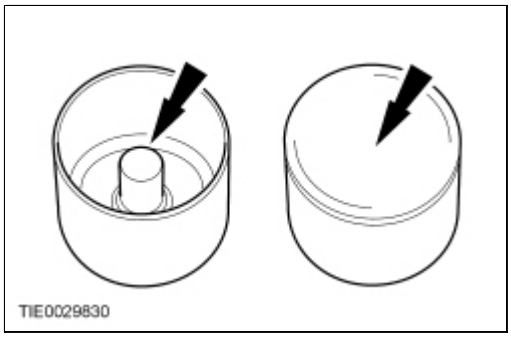
2. Move the Valve Guide Clearance Gauge toward the Dial Indicator Gauge with Holding Fixture and zero the Dial Indicator Gauge. Move the Valve Guide Clearance Gauge away from the Dial Indicator Gauge with Holding Fixture and note the reading. The reading will be DOUBLE the valve stem-to-valve guide clearance.

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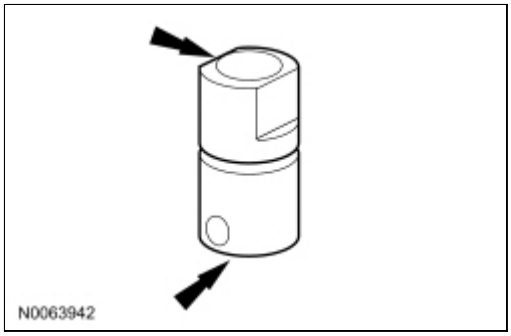
Valve Tappet Inspection

OHC engines

1. Inspect the valve tappet for damage, especially in the indicated areas. If any damage is evident, inspect the camshaft lobes and valves for damage. Replace components as necessary.



Push rod engines



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Material

Item	Specification	Fill Capacity
Motorcraft® Gasket Maker TA-16	WSK-M2G348-A5	—
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A	5.6L (6.0 qts.) includes oil filter change
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	—
Motorcraft® Silicone Gasket Remover ZC-30	—	—
Motorcraft® Thread Sealant with PTFE TA-24	WSK-M2G350-A2	—
Motorcraft® Threadlock 262 TA-26	WSK-M2G351-A6	—

General Specifications

Item	Specification
Engine	
Displacement	3.5L Gasoline Turbocharged Direct Injection (GTDI) (214 CID)
No. cylinders	6
Bore/stroke	92.5/86.7 mm (3.641/3.413 in)
Fire order	1-4-2-5-3-6
Spark plug	12405
Spark plug gap	0.889 mm (0.035 in)
Oil pressure	Minimum 30 psi @ 1,500 rpm with engine at normal operating temperature

Compression ratio	10.0:1
Engine weight (without accessory drive components)	189.01 kg (416.7 lb)
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	Flat within 0.08 mm (0.003 in) length end to end; area 150 mm (5.9 in) x 150 mm (5.9 in) (or full width) should be less than 0.05 mm (0.002 in)
Combustion chamber volume	55.84 cc (3.41 CI)
Valve tappet clearance — intake	0.15-0.25 mm (0.006-0.01 in)
Valve tappet clearance — exhaust	0.360-0.460 mm (0.0142-0.0181 in) Engine must be at room temperature before measuring
Valve guide bore inner diameter	5.519-5.549 mm (0.217-0.218 in)
Valve stem diameter — intake	5.479-5.497 mm (0.2157-0.2164 in)
Valve stem diameter — exhaust	5.466-5.484 mm (0.2151-0.2159 in)
Valve stem-to-guide clearance — intake	0.022-0.070 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance — exhaust	0.035-0.083 mm (0.0013-0.032 in)
Valve head diameter — intake	36.82-37.18 mm (1.44-1.46 in)
Valve head diameter — exhaust	30.82-31.18 mm (1.21-1.22 in)
Valve face runout	0.05 mm (0.0001 in)
Valve face angle	45.75-45.25 degrees
Valve seat width — intake	1.3-1.6 mm (0.051-0.063 in)
Valve seat width — exhaust	1.7-2.0 mm (0.067-0.079 in)
Valve seat runout	0.04 mm (0.0001 in) MAX
Valve seat angle	44.5-45.5 degrees
Valve spring free length (approx.)	55.16 mm (2.17 in)
Valve spring compression pressure (N @ spec. length)	465 N @ 28.0 mm (105 lb @ 1.10 in)
Valve spring installed height	37.0 mm (1.45 in)
Valve spring installed height pressure (N @ spec. length)	265 N @ 37.0 mm (60 lb @ 1.45 in)
Valve spring installed pressure — service limit	10% force loss @ specified height
Camshaft	
Theoretical valve lift @ 0 lash	9.49 mm (0.373 in)
Lobe lift — intake	9.49 mm (0.373 in)
Lobe lift — exhaust	9.49 mm (0.373 in)
Allowable lobe lift loss	0.062 mm (0.0024 in)
Camshaft journal bore inside diameter — 1st journal	39.0375-39.0625 mm (1.537-1.538 in)
Camshaft journal bore inside diameter — intermediate journals	25.9875-26.0125 mm (1.023-1.024 in)

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Camshaft bearing outside diameter — 1st journal	38.990-39.010 mm (1.535-1.536 in)
Camshaft bearing outside diameter — intermediate journals	25.937-25.963 mm (1.021-1.022 in)
Camshaft journal-to-bearing clearance, 1st journal — service limit	0.0725 mm (0.0029 in) MAX
Camshaft journal-to-bearing clearance, intermediate journals — service limit	0.0755 mm (0.0029 in) MAX
Runout	0.040 mm (0.0015 in) MAX
End play — standard	0.032-0.170 mm (0.0012-0.0066 in)
End play — service limit	0.190 mm (0.00748 in) MAX
Cylinder Block	
block main bore roundness	0.008 mm (0.003 in)
Cylinder bore diameter — grade 1	92.500-92.520 mm (3.641-3.642 in)
Cylinder bore roundness	0.013 mm (0.0005 in)
Cylinder bore taper	0.010 mm (0.0004 in) per 25.4 mm (1.000 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.8503-2.8513 in)
Head gasket surface flatness	Flat within 0.150 mm (0.005 in) overall 0.050 mm (0.001 in) per 150 mm (5.905 in) x 150 mm (5.905 in); 0.025 mm (0.0009 in) per 25 mm (0.984 in) x 25 mm (0.984 in)
Crankshaft	
Main bearing journal diameter	67.5 mm (2.657 in)
Main bearing journal maximum taper	0.004 mm (0.00015 in)
Main bearing journal maximum out-of-round	0.006 mm (0.00023 in)
Main bearing journal-to-cylinder block clearance	0.026-0.041 mm (0.0010-0.0016 in)
Connecting rod journal diameter	55.983-56.003 mm (2.204-2.205 in)
Connecting rod journal maximum taper	0.004 mm (0.00015 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.00023 in)
Crankshaft maximum end play	0.101-0.291 mm (0.0039-0.0114 in)
Piston and Connecting Rod	
Piston diameter — single grade	92.476-92.490 mm (3.6407-3.6413 in)
Piston-to-cylinder bore clearance	0.010 to 0.044 mm (0.0003-0.0017 in)
Piston ring end gap — compression (top, gauge diameter)	0.17-0.27 mm (0.0067-0.0106 in)
Piston ring end gap — compression (bottom, gauge diameter)	0.30-0.55 mm (0.0118-0.0216 in)
Piston ring end gap — oil ring (steel rail, gauge diameter)	0.15-0.45 mm (0.0059-0.0177 in)
Piston ring groove width — compression (top)	1.230-1.25 mm (0.0484-0.0492 in)

Piston ring groove width — compression (bottom)	1.530-1.55 mm (0.0602-0.0610 in)
Piston ring groove width — oil ring	2.53-2.55 mm (0.0996-0.1003 in)
Piston ring width — upper compression ring	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width — lower compression ring	1.47-1.49 mm (0.0578-0.0586 in)
Piston ring-to-groove clearance (upper and lower compression rings)	0.040-0.080 mm (0.0.0014-0.0031 in)
Piston pin bore diameter	23.004-23.008 mm (0.9056-0.9058 in)
Piston pin diameter	22.997-23.000 mm (0.9053-0.9055 in)
Piston pin length	2.343 in (59.512 mm)
Piston pin-to-piston fit	0.004-0.011 mm (0.00015-0.00043 in)
Piston-to-connecting rod clearance	3.3 mm (0.13 in)
Connecting rod-to-pin clearance — standard	0.007-0.022 mm (0.0002-0.0009 in)
Connecting rod pin bore diameter	23.007-23.019 mm (0.905-0.906 in)
Connecting rod length (center-to-center)	152.68 mm (6.01 in)
Connecting rod maximum allowed bend	0.038 mm (0.0014 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing bore diameter — grade 1	59.866-59.872 mm (2.3569-2.3571 in)
Connecting rod bearing bore diameter — grade 2	59.873-59.879 mm (2.3572-2.3574 in)
Connecting rod bearing bore diameter — grade 3	59.880-59.886 mm (2.3574-2.3577 in)
Connecting rod bearing-to-crankshaft clearance	0.020-0.054 mm (0.0007-0.0021 in)
Connecting rod side clearance (assembled to crank) — standard	0.175-0.425 mm (0.0068-0.0167 in)
Connecting rod side clearance (assembled to crank) — service limit	0.175-0.425 mm (0.0068-0.0167 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolt	25	18	—
A/C compressor stud	9	—	80
A/C tube nut	15	—	133
Accessory drive belt tensioner bolts	25	18	—
Axle shaft housing carrier bushing bolt	115	85	—
Bellhousing-to-engine bolts and stud bolts	48	35	—
Bellhousing-to-oil pan bolts	48	35	—
Block coolant drain plug — RH [a]	—	—	—
Block coolant drain plug — LH [b]	—	—	—

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Block oil gallery plug — LH [c]	48	35	—
Block oil gallery plug — rear [c]	85	63	—
Block oil gallery plug — RH [c]	32	24	—
Charge Air Cooler (CAC) tube bracket nuts	6	—	53
CAC tube clamps	5	—	44
CAC -to-Throttle Body (TB) pipe clamp	5	—	44
Camshaft bearing cap assembly bolts [d]	—	—	—
Camshaft bearing cap bolts [d]	—	—	—
Camshaft Position (CMP) sensor bolts (LH cylinder head)	10	—	89
CMP sensor bolts (RH valve cover)	7	—	62
CMP sensor heat shield bolt	10	—	89
CMP sensor heat shield nut	10	—	89
Catalytic converter-to-exhaust manifold nuts	45	35	—
Catalytic converter-to-intermediate pipe bolts [d]	—	—	—
Connecting rod cap bolts [d]	—	—	—
Coolant pump bolts [d]	—	—	—
Coolant pump pulley bolts	24	18	—
Crankshaft rear seal retainer plate bolts [d]	—	—	—
Crankshaft pulley bolt [d]	—	—	—
Crankshaft Position (CKP) sensor bolt	10	—	89
CKP sensor heat shield bolt	10	—	89
CKP sensor heat shield nut	10	—	89
Crossmember brace nuts and bolts	90	66	—
Cylinder head bolts [d]	—	—	—
Cylinder head M6 bolt	10	—	89
Cylinder Head Temperature (CHT) sensor	11	—	97
Engine appearance cover bracket bolts	10	—	89
Engine coolant crossover assembly bolt [d]	—	—	—
Engine front cover bolts [d]	—	—	—
Engine support insulator bolts	175	129	—
Engine support insulator bracket bolts - LH side	63	46	—
Engine support insulator bracket bolts - RH side, standard payload package	63	46	—
Engine support insulator bracket bolts - RH side, heavy duty payload package	77	53	—
Engine support insulator nuts	175	129	—
Engine support insulator studs	30	22	—
Engine support insulator through bolts	350	258	—
Engine oil filter [e]	—	—	—
Engine-to-bellhousing bolt	45	35	—

Engine Oil Pressure (EOP) switch [d]	—	—	—
Evaporative Emission (EVAP) canister purge valve bolt	10	—	89
Exhaust manifold nuts [d]	—	—	—
Exhaust manifold studs	12	—	106
Flexplate bolts [d]	—	—	—
Fuel injection pump mounting plate bolt [d]	—	—	—
Fuel rail bolts [d]	—	—	—
Generator B+ terminal nut	17	—	150
Generator nut and bolt	48	35	—
Generator stud	8	—	71
Ground strap bolt	10	—	89
Ground stud bolt [d]	—	—	—
Hood bolts	12	—	106
High pressure fuel tube bracket bolt [d]	—	—	—
High pressure fuel tube bracket nut	8	—	71
High pressure fuel tube flare nut [d]	—	—	—
Ignition coil-on-plug bolts [d]	—	—	—
Intake manifold bolts [d]	—	—	—
Knock Sensor (KS) bolts	20	—	177
Lower front axle carrier mounting bushing bolt	115	85	—
Main bearing bolts [d]	—	—	—
Main bearing side bolts [d]	—	—	—
Main bearing cap support brace bolts [d]	—	—	—
Oil cooler insert bolt	58	43	—
Oil filter adapter bolts [d]	—	—	—
Oil pan bolts [d]	—	—	—
Oil pan drain plug	27	20	—
Oil pump bolts	10	—	89
Oil pump screen and pickup tube bolts	10	—	89
Piston oil cool valves	4	—	35
Primary timing chain tensioner bolts	10	—	89
Skid plate bolts	48	35	—
Radio ignition interference capacitor bolt	10	—	89
Spark plugs	15	—	133
Thermostat housing bolts [d]	—	—	—
Timing chain gear bolts [d]	—	—	—
Timing chain guide bolts	10	—	89

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Timing chain guide pin [f]	—	—	—
Timing chain tensioner arm guide pin [f]	—	—	—
Torque converter nuts	44	32	—
Transmission cooler tube bracket bolt	12	—	106
Transmission cooler tube bracket nut	12	—	106
Transmission crossmember nuts	103	75	—
Turbocharger intake tube clamp	5	—	44
Turbocharger bracket-to-engine bolts	10	—	89
Turbocharger oil return tube assembly bolts [g]	—	—	—
Turbocharger-to-mounting bracket bolt	28	—	21
Turbocharger-to-exhaust manifold bolts	32	24	—
Vacuum pump bolts [d]	—	—	—
Wiring harness retainer stud bolt	10	—	89
Valve cover bolts and stud bolts [d]	—	—	—
Valve train oil tube bolts [d]	—	—	—
Variable Camshaft Timing (VCT) bolts [d]	—	—	—
VCT oil control solenoid bolts [d]	—	—	—
Wiring harness retainer stud bolt	10	—	89

[a] Tighten to 20 Nm (177 lb-in) plus an additional 180 degrees.
[b] Tighten to 10 Nm (89 lb-in) plus an additional 720 degrees
[c] Discard original plug and O-ring seal. Install a new plug and O-ring seal to specified torque, no sealer or lubricant required.
[d] Refer to the procedure in this section.
[e] Tighten to 5 Nm (44 lb-in) plus an additional 180 degrees.
[f] 20 Nm (177 lb-in) plus an additional 60 degrees
[g] Refer to the assembly procedure in this section.

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Engine

The 3.5L Gasoline Turbocharged Direct Injection (GTDI) (4V) is a V-6 engine with the following features:

- Dual overhead camshafts
- Four valves per cylinder
- GTDI
- A composite intake manifold
- Aluminum cylinder heads
- An aluminum, 60-degree V-cylinder block
- Twin independent Variable Camshaft Timing (VCT) system
- The electronic ignition system with 6 ignition coils

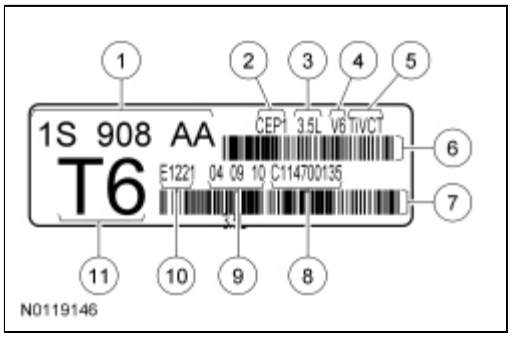
Engine Identification

For quick identification, refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.

Engine Code Information Label

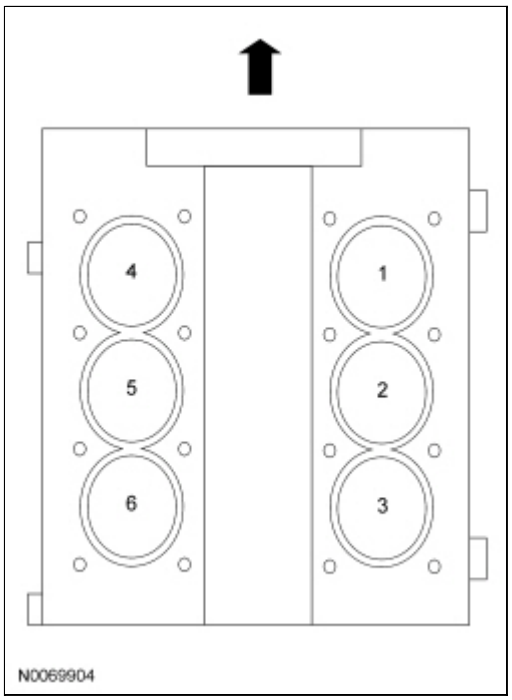
The engine code information label, located on the front side of the valve cover, contains the following:



Item	Description
1	Engine part number
2	Engine plant (Cleveland)
3	Engine displacement
4	Engine configuration
5	Twin independent Variable Camshaft Timing (VCT)
6	Bar code

7	Bar code
8	Running number
9	Engine build date (DDMMYY)
10	Plant shift line
11	Derivative code

Engine Cylinder Identification



Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The GTDI is Pulse Width Modulated (PWM).

Fuel is metered directly into each combustion chamber. Fuel injectors pulse to follow engine firing order, in accordance with engine demand.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

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Valve Train

The valve train uses Direct Acting Mechanical Buckets (DAMB). The camshaft lobes are positioned directly above mechanical buckets which are positioned on top of the valves.

Twin Independent Variable Camshaft Timing (VCT) System

The twin independent VCT system allows variable control of intake valve closing which optimizes combustion at full load providing improved power and low speed torque (broadening the torque curve) which enables variable valve overlap which provides better fuel economy and emissions and provides optimized cold start operation with improved exhaust emissions.

PCV System

All engines are equipped with a closed-type PCV system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rod bearings, piston cooling jets, turbochargers, timing chain tensioners and VCT solenoids. The flow of oil to the valve tappets and valve train is controlled by a restricting orifice located in the cylinder head, front camshaft cap.

Oil Pump

The lubrication system is designed to provide optimum oil flow to critical components of the engine through its entire operating range.

The heart of the system is a positive displacement internal gear oil pump.

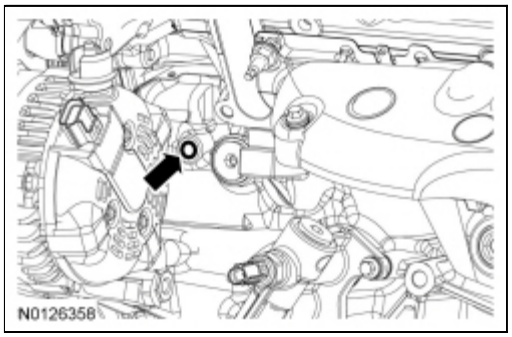
Generically, this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to make sure of correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high-viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

- Radiator
- Belt driven coolant pump
- Electric fan assembly(s)
- Degas bottle (aids in maintaining the correct volume of engine coolant)
- Coolant thermostat
- Coolant hoses



The channel cover plate is located under the engine front cover mounted to the cylinder block. It contains a timing chain idler and press-in-place gaskets separating engine coolant and engine oil. A weep hole is provided on the front left side of the engine behind the generator. If oil or coolant is leaking from the weep hole, then a gasket has failed and must be replaced.

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Engine

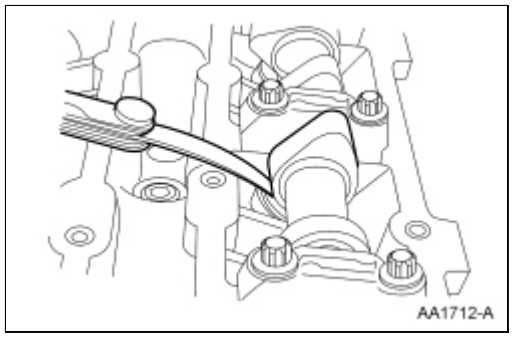
For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Valve Clearance Check

1. Remove the valve covers. For additional information, refer to Valve Cover — LH and Valve Cover — RH in this section.

2. **NOTE:** Engine must be at room temperature before measuring. The valve clearance must be measured with the camshaft at base circle. The engine will have to be rotated with the crankshaft pulley bolt to bring each valve to base circle.

   Use a feeler gauge to measure the clearance of each valve and record its location. A midrange clearance is the most desirable:
   - Intake: 0.15-0.25 mm (0.006-0.01 in)
   - Exhaust: 0.360-0.460 mm (0.0142-0.0181 in)



3. **NOTE:** The number on the valve tappet reflects the thickness of the valve tappet. For example, a tappet with the number 3.310 has the thickness of 3.31 mm (0.13 in).

   If any of the valve clearances are out of specification, select new tappets using this formula: tappet thickness = measured clearance + the base tappet thickness - most desirable thickness.
   Select the tappets and mark the installation location.

4. If required, install the new selected valve tappets in the marked locations. For additional information, refer to Valve Tappets in this section.

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Engine

Special Tool(s)

 ST3101-A	Bar, Engine Spreader 303-1454
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073) or equivalent
 ST3265-A	Lift Eye, Right Front 303-1566
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A) or equivalent

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

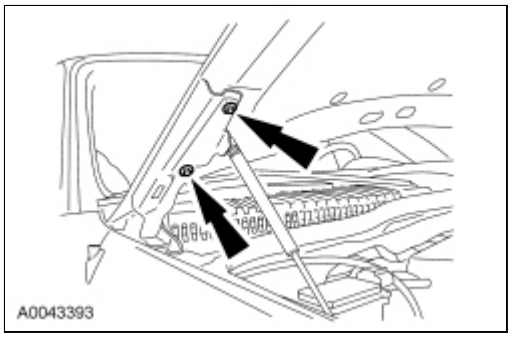
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02 .

2. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

   NOTE: RH shown, LH similar.

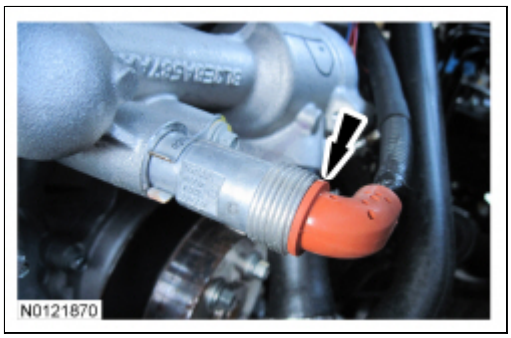
   Remove the 4 bolts (2 shown) and the hood.



3. Release the fuel system pressure. For additional information, refer to Section 310-00 .

4. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

5. If equipped, disconnect the block heater electrical connector at the thermostat housing.
   - Detach the block heater wiring harness retainer from the LH valve cover stud bolt and position aside.

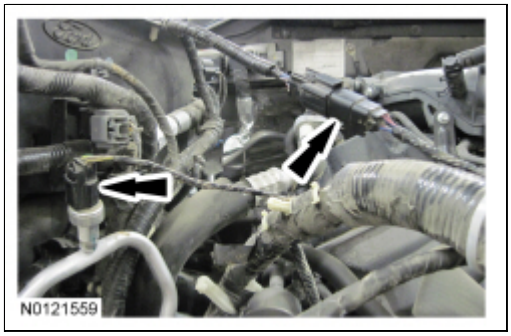


6. Remove the cooling module. For additional information, refer Section 303-03 .

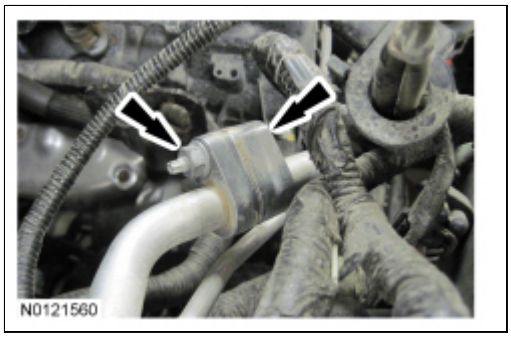
7. Remove the LH and RH turbocharger intake tubes. For additional information, refer to 3.5L Gasoline Turbocharged Direct Injection (GTDI) Charge Air Cooler (CAC) and Tubes Exploded View in Section 303-12 .

8. Remove the 2 Charge Air Cooler (CAC) inlet tubes and the CAC outlet tube. For additional information, refer to 3.5L Gasoline Turbocharged Direct Injection (GTDI) Charge Air Cooler (CAC) and Tubes Exploded View in Section 303-12 .

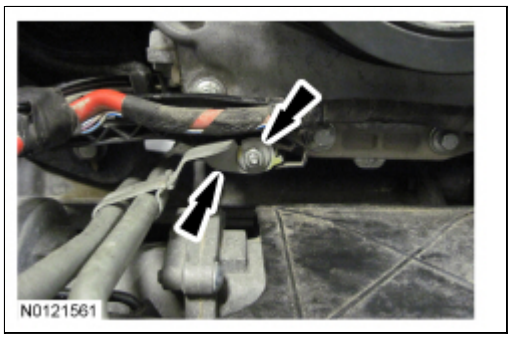
9. Disconnect the Battery Junction Box (BJB) wiring harness and the A/C pressure transducer electrical connectors.



10. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal and gasket seal.



11. Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.

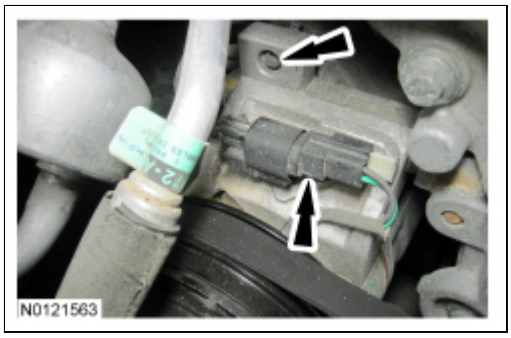


12. Detach the generator wiring harness from the engine front cover.



13. Disconnect the A/C compressor electrical connector.
    - Detach the A/C compressor wiring harness from the A/C compressor.

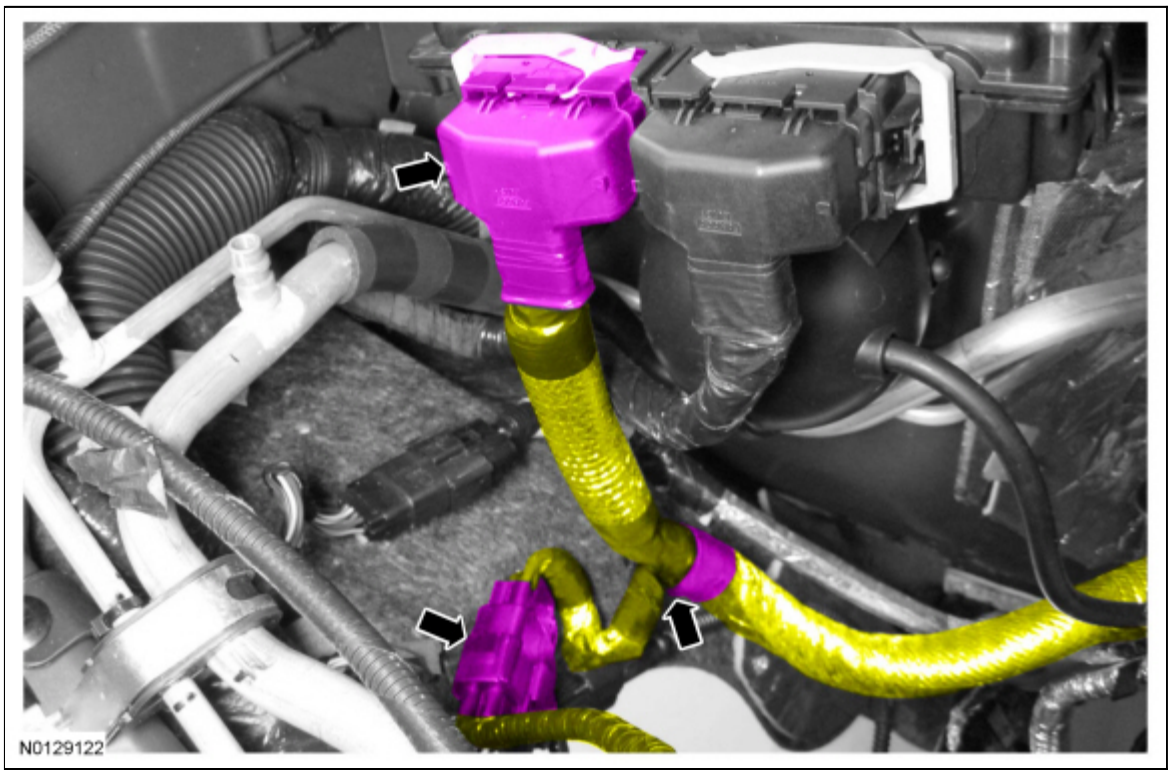
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14. Remove the generator. For additional information, refer to Section 414-00 .

15. Remove the A/C compressor belt. For additional information, refer to Section 303-05 .

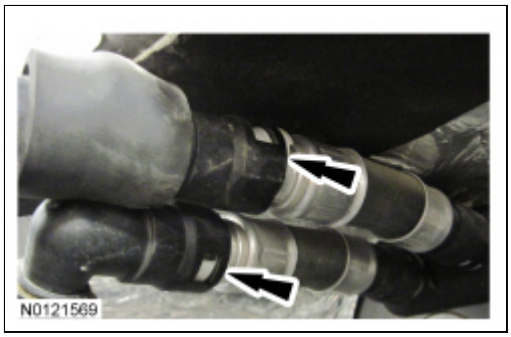
16. Disconnect the PCM electrical connector and the engine wire harness electrical connector.
    - Detach the wiring harness retainers from the fender splash shield.



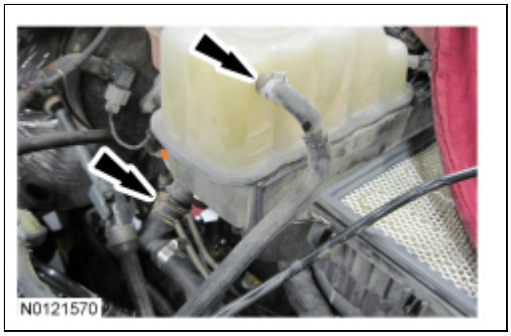
17. Remove the fuel injection pump. For additional information, refer to Section 303-04A .

18. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.

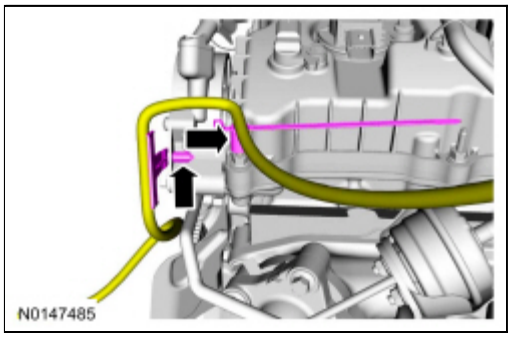
19. Disconnect the 2 heater hose couplings at the RH rear of the engine.



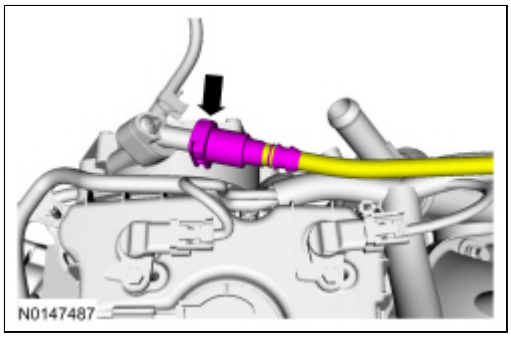
20. Disconnect the 2 coolant hoses from the degas bottle.



21. Detach the wiring harness retainers from the rear of the RH valve cover stud bolt and the rear of the vacuum pump.

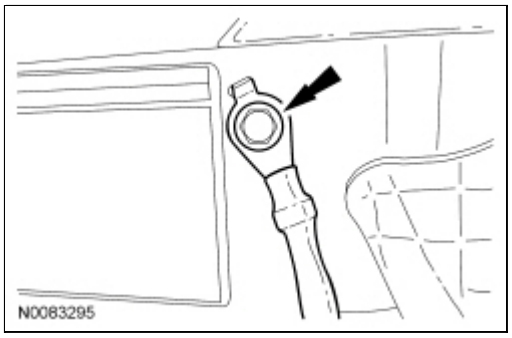


22. Disconnect the vacuum pump tube and position aside.



23. Remove the bolt and the ground strap from the cowl.

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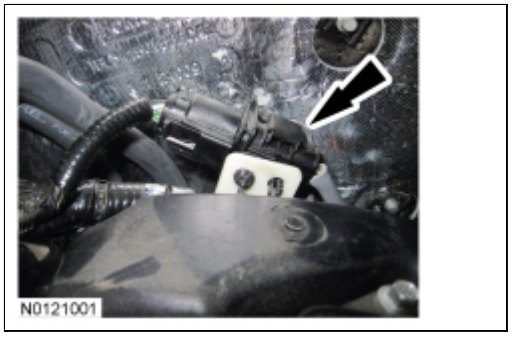


24. Remove the cowl panel grille. For additional information, refer to Section 501-02 .

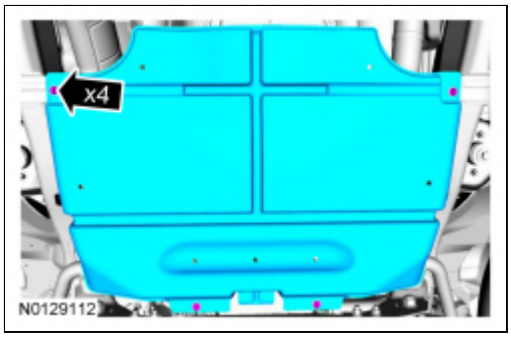
25. Remove the 6 screws and release the 2 cowl panel clips and remove the cowl panel.



26. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector from the engine wiring harness at the rear of the LH cylinder head.
    - Disconnect the HO2S electrical connector from the wiring harness retainer.

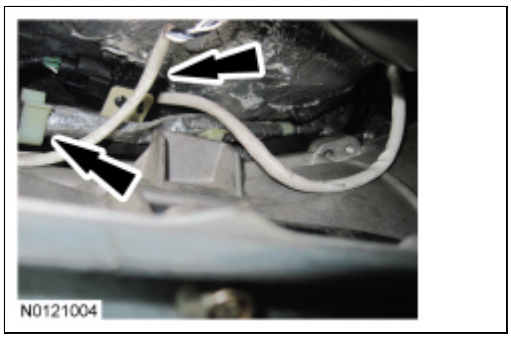


27. Release the 4 fasteners and the splash shield.



28. **NOTE:** Only one wire harness retainer and one electrical connector shown, others similar.

    Disconnect the 2 HO2S electrical connectors.
    - Disconnect the 2 HO2S electrical connector retainers.
    - If equipped, disconnect the 5 transmission wire harness retainers from the transfer case wire harness.



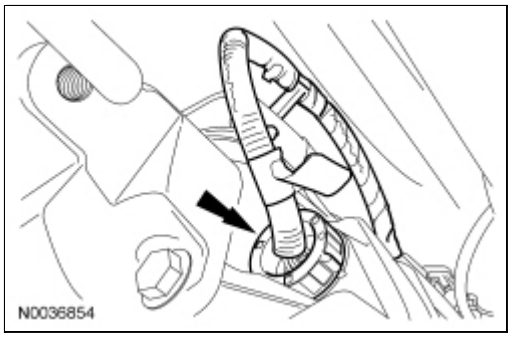
29. Disconnect the HO2S electrical connector at the LH rear of the transmission.
    - Disconnect the electrical connector retainer from the bracket at the rear of the transmission.



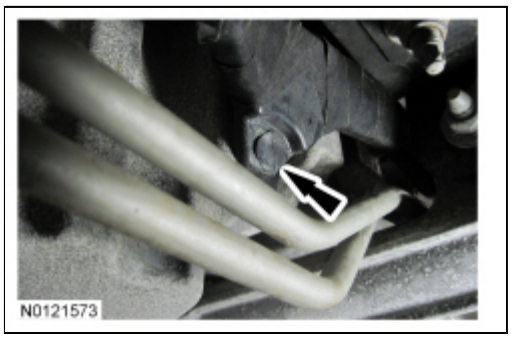
30. ***NOTICE:*** **Do not pull on the wire harness to disconnect the connector or damage to the connector will occur.**

    Disconnect the transmission vehicle harness connector by twisting the outer shell and pulling back on the connector.

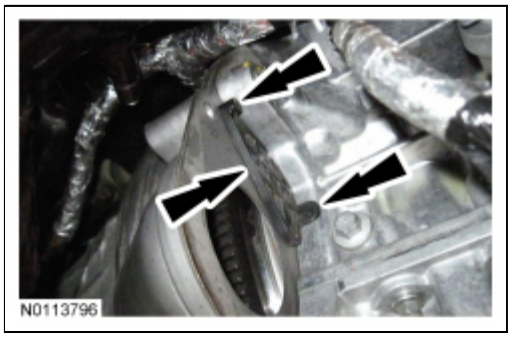
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31. Remove the 4 bolts and the skid plate.
32. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .
33. Remove the starter motor. For additional information, refer to Section 303-06 .
34. Detach the starter motor wiring harness retainer from the oil pan.

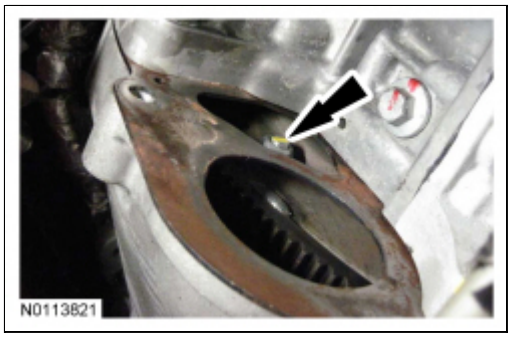


35. Remove the 2 pin-type retainers and the access cover.

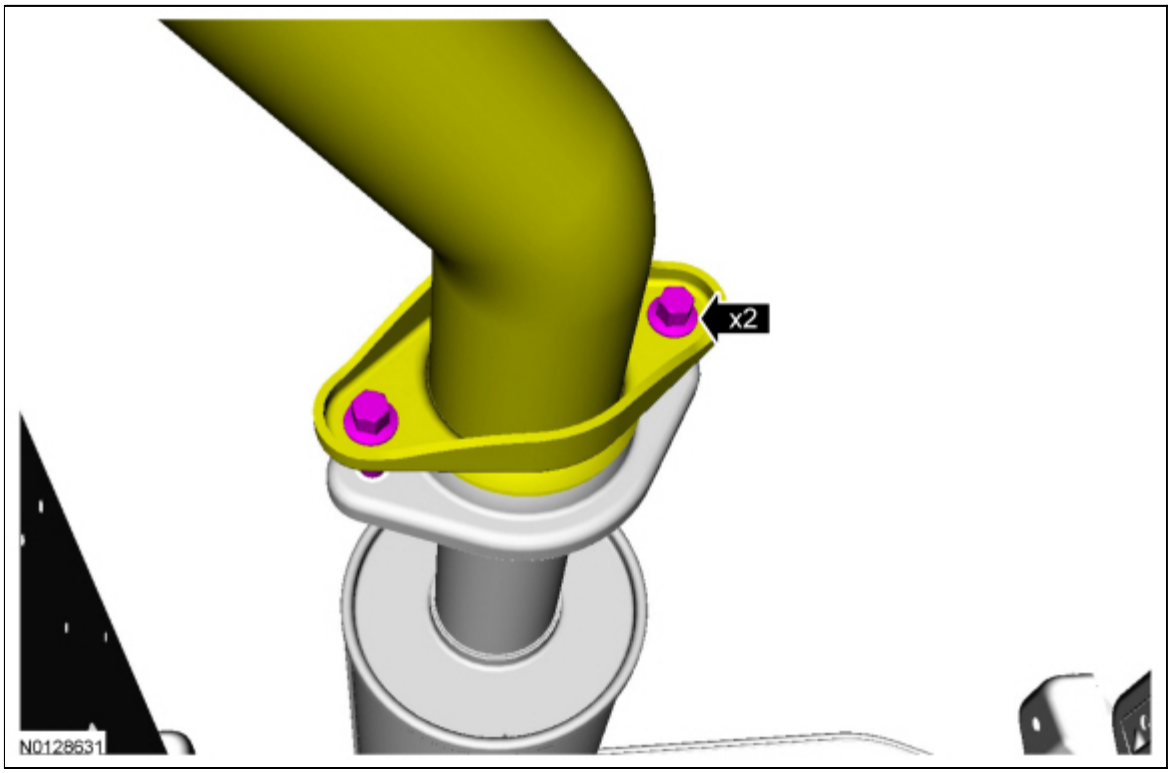


36. **NOTE:** Index-mark the end of one torque converter stud and the flexplate for installation.

    Remove the 4 torque converter nuts.

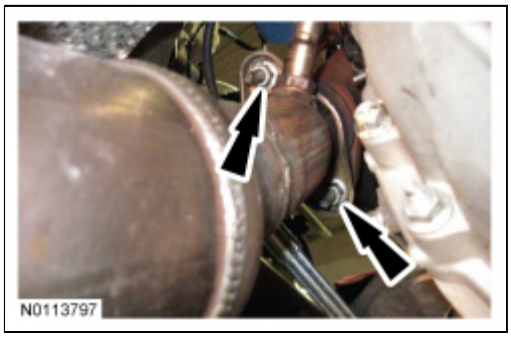


37. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the bolts.



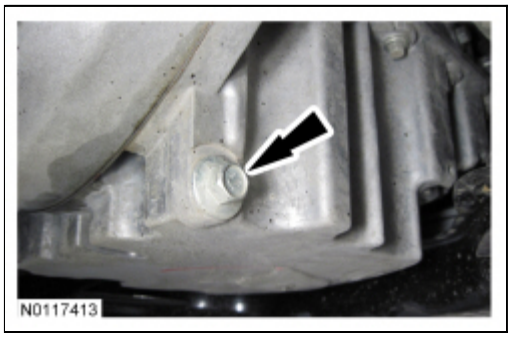
38. **NOTE:** LH shown, RH similar.

    Remove and discard the 2 LH and RH catalytic converter-to-exhaust manifold nuts.



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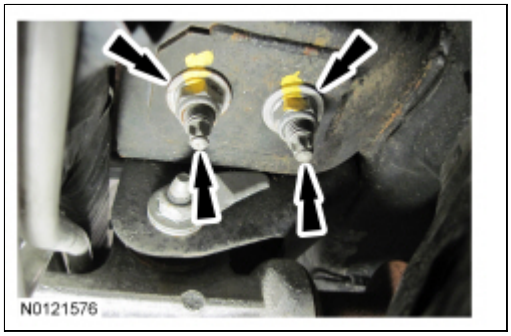
39. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).



40. Remove and discard the engine oil filter.

41. ***NOTICE:*** **Only use hand tools when removing the engine support insulator nuts and studs or damage to the engine support insulator can occur.**

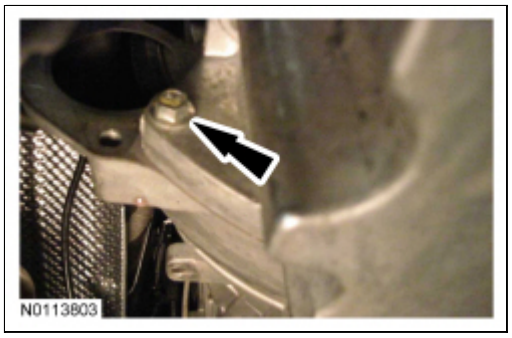
    Remove and discard the 2 RH engine support insulator nuts and the 2 studs.



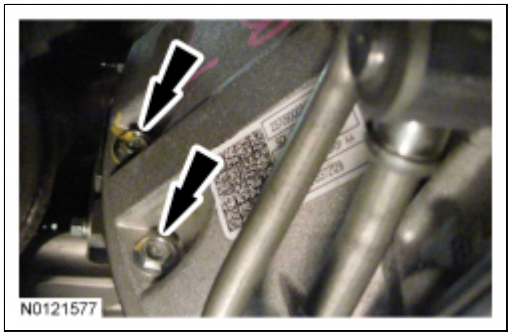
42. Remove the engine-to-bellhousing bolt.



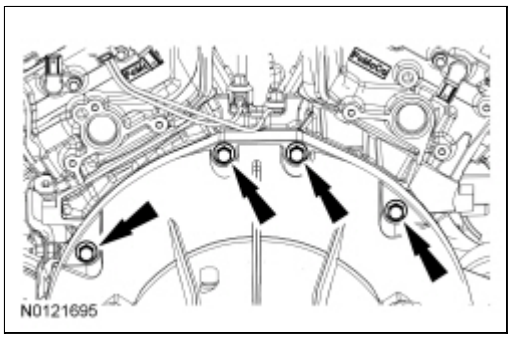
43. Remove the oil pan-to-bellhousing bolt.



44. Remove the 2 LH bellhousing-to-engine bolts.

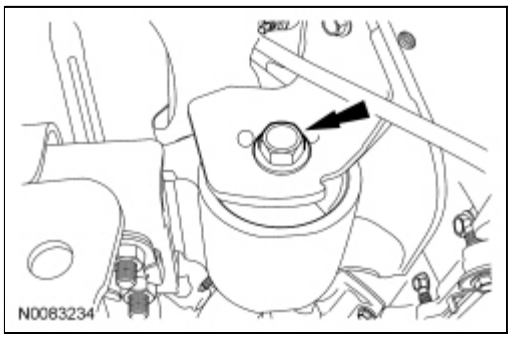


45. Remove the 4 upper bellhousing-to-engine bolts.



46. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove and discard the LH engine mount through bolt.



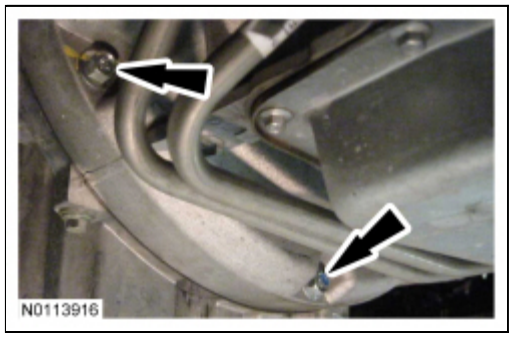
47. ***NOTICE:*** **Do not support the transmission by the fluid pan, failure to follow this instruction**

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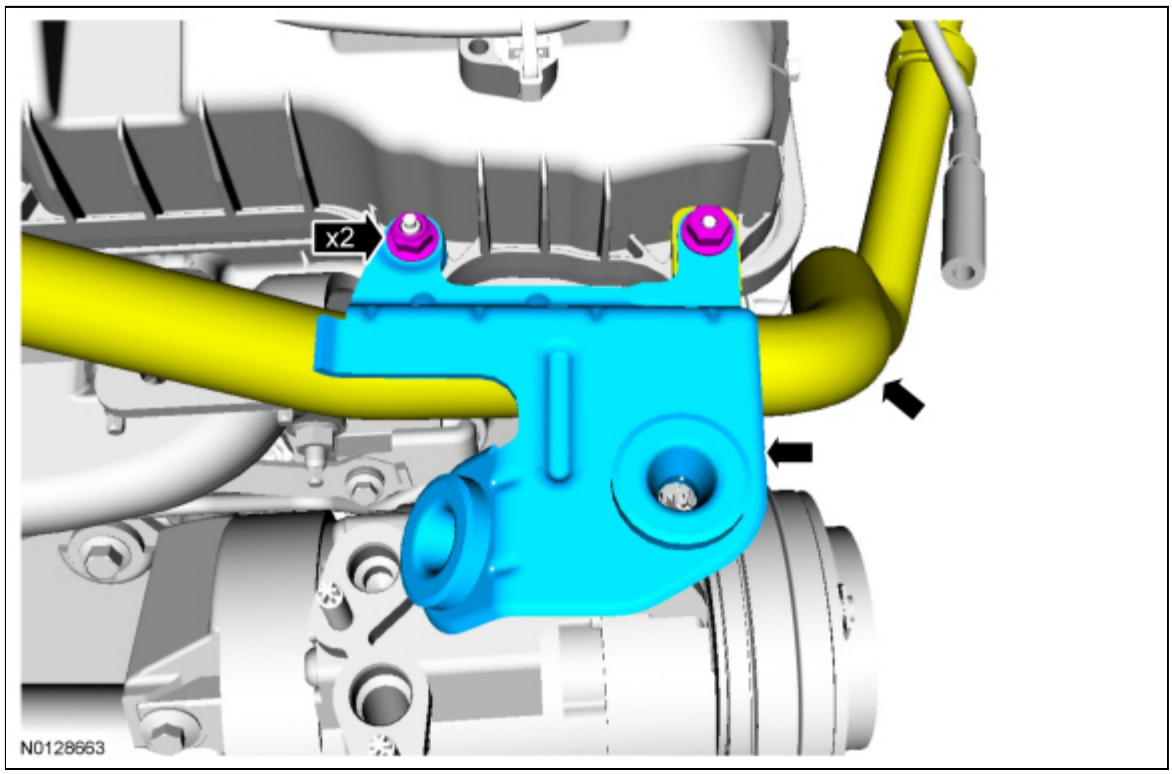
may result in serious damage to the transmission.

Support the bellhousing of the transmission with a suitable floor jack and a block of wood.

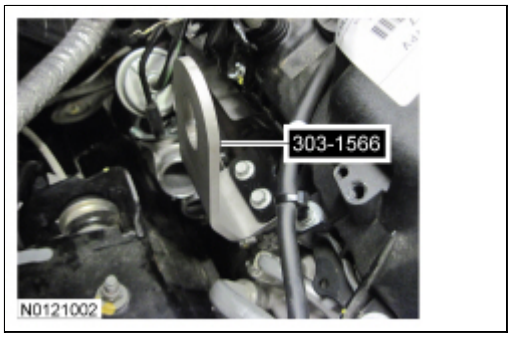
48. Remove the 2 LH bellhousing-to-oil pan bolts.



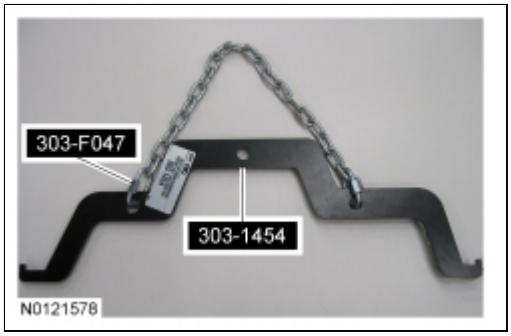
49. Remove the 2 nuts and the CAC tube bracket.
    - Disconnect the coolant hose from the valve cover stud.



50. Install the Right Front Lift Eye.



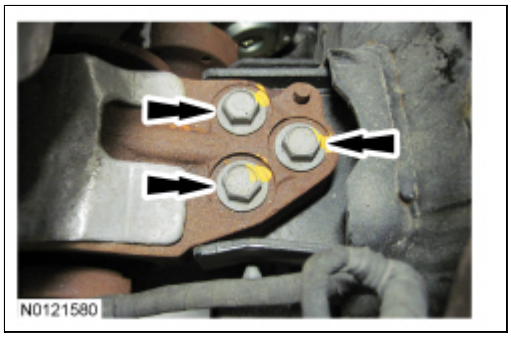
51. Using part of the Engine Lifting Bracket and a chain, assemble the Engine Spreader Bar as shown.



52. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.**

    NOTE: After removing the bolts leave the LH engine support insulator in place.

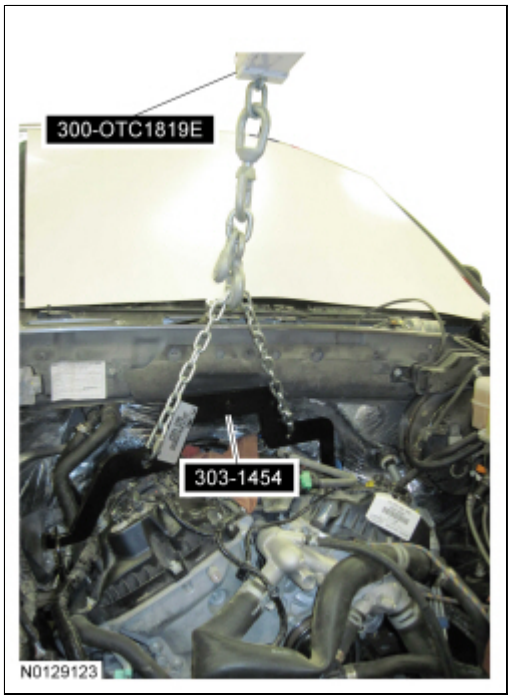
    Remove and discard the 3 bolts for the LH engine support insulator.



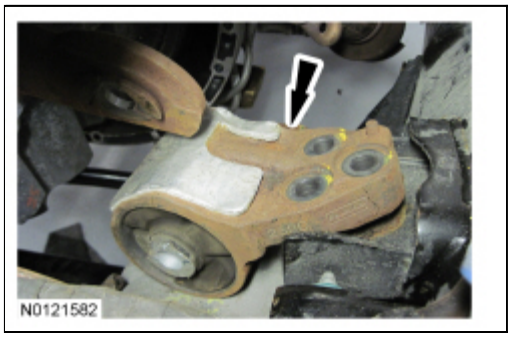
53. **NOTE:** The use of a ratchet strap may be needed to level the engine.

    Using the Floor Crane and Engine Spreader Bar assembly, lift the engine.

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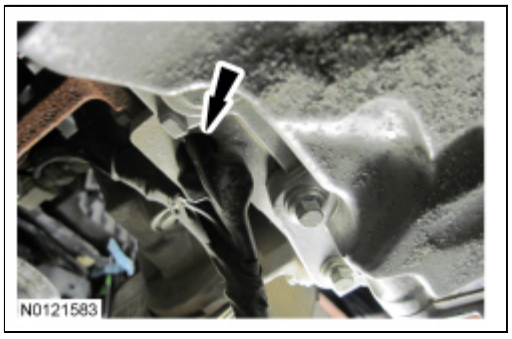


54. Remove the LH engine support insulator.

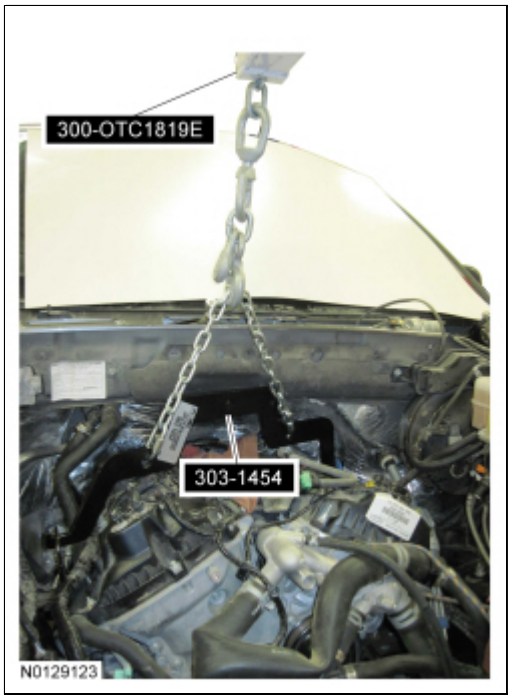


55. **NOTE:** The transmission wiring harness is part of the engine wiring harness.

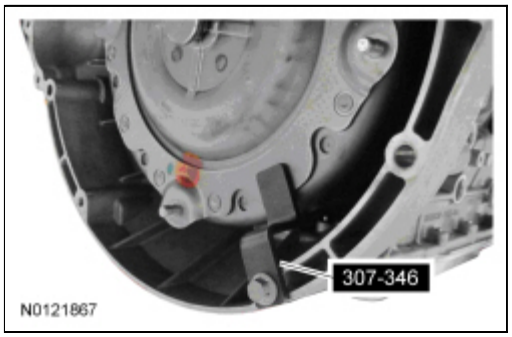
    Detach the generator wiring harness retainer from the lower LH side of the engine block.
    - Position the transmission wiring harness on top of the engine for removal.



56. Using the Floor Crane and Engine Spreader Bar assembly, remove the engine.



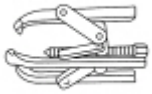
57. Install the Torque Converter Retainer.



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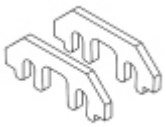
Engine

Special Tool(s)

 ST3101-A	Bar, Engine Spreader 303-1454
 ST1184-A	3 Jaw Puller 303-D121
 ST3096-A	Brush, Fuel Injector 310-205
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST3234-A	Hold Down, Secondary Chain 303-1530
	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

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 ST2212-A	
 ST2240-A	Installer, Spindle Bearing 205-150 (T80T-4000-S)
 ST3265-A	Lift Eye, Right Front 303-1566
 ST3095-A	Remover, Fuel Injector 310-206
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)
	Tool, Camshaft Holding 303-1248

 ST2979-A	

Material

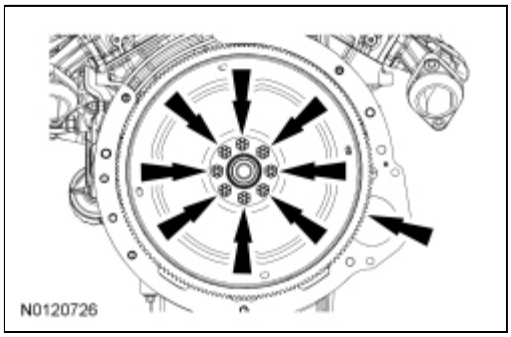
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

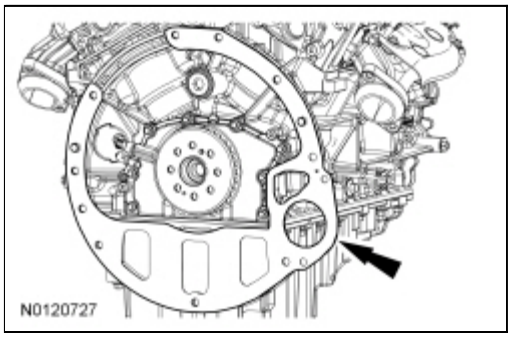
NOTE: For additional information, refer to the exploded view under the Assembly procedure in this section.

All engines

1. Remove the 8 bolts and the flexplate.

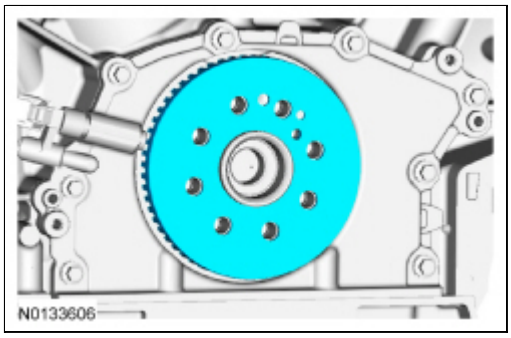


2. Remove the spacer plate.



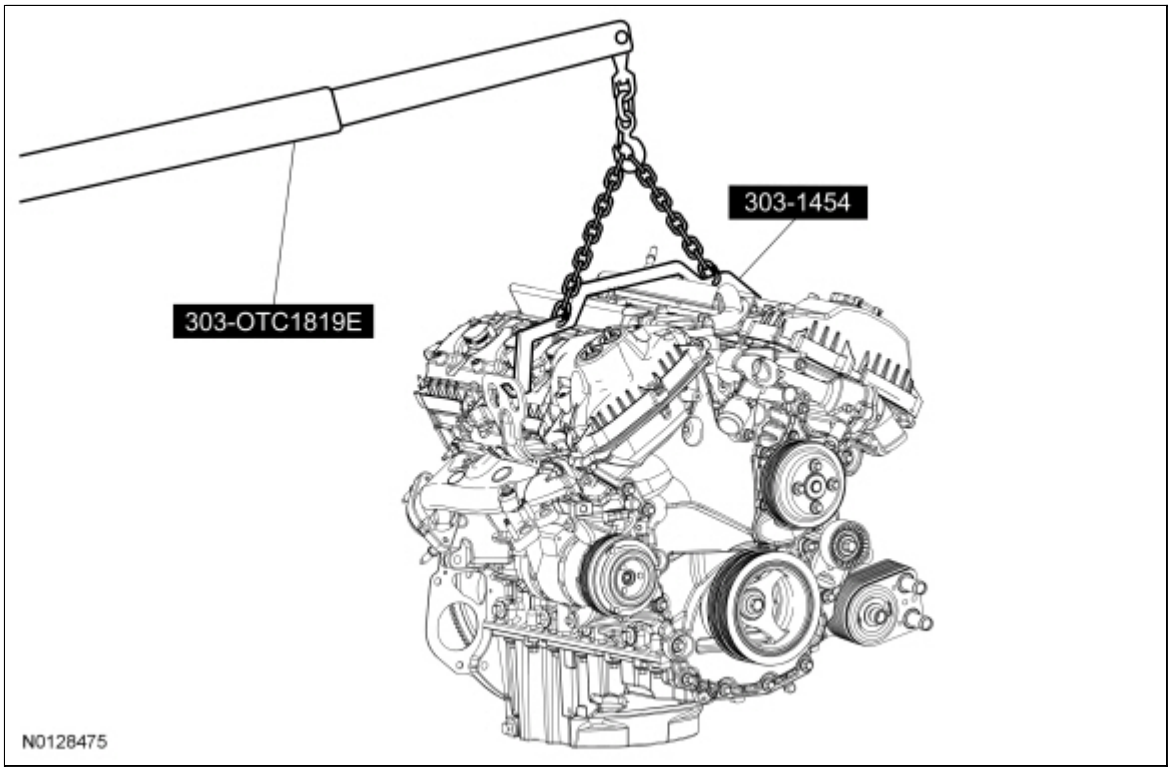
3. Remove the crankshaft sensor ring.

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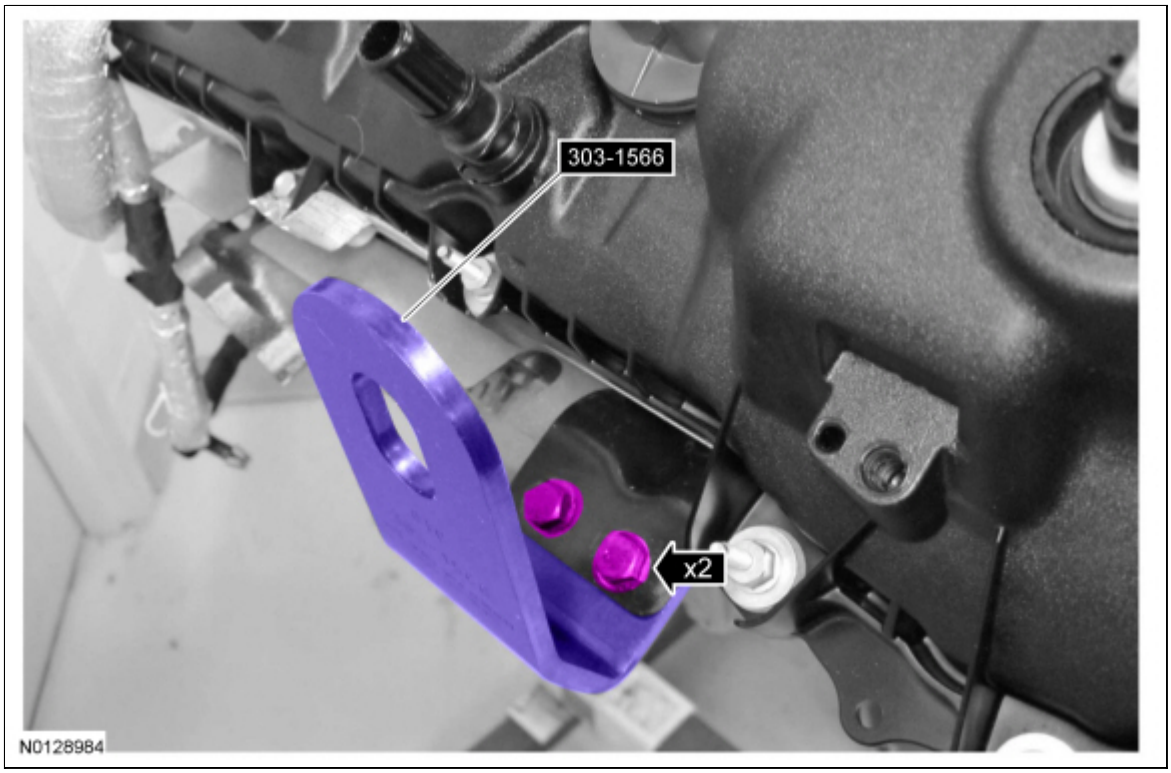


4. **NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

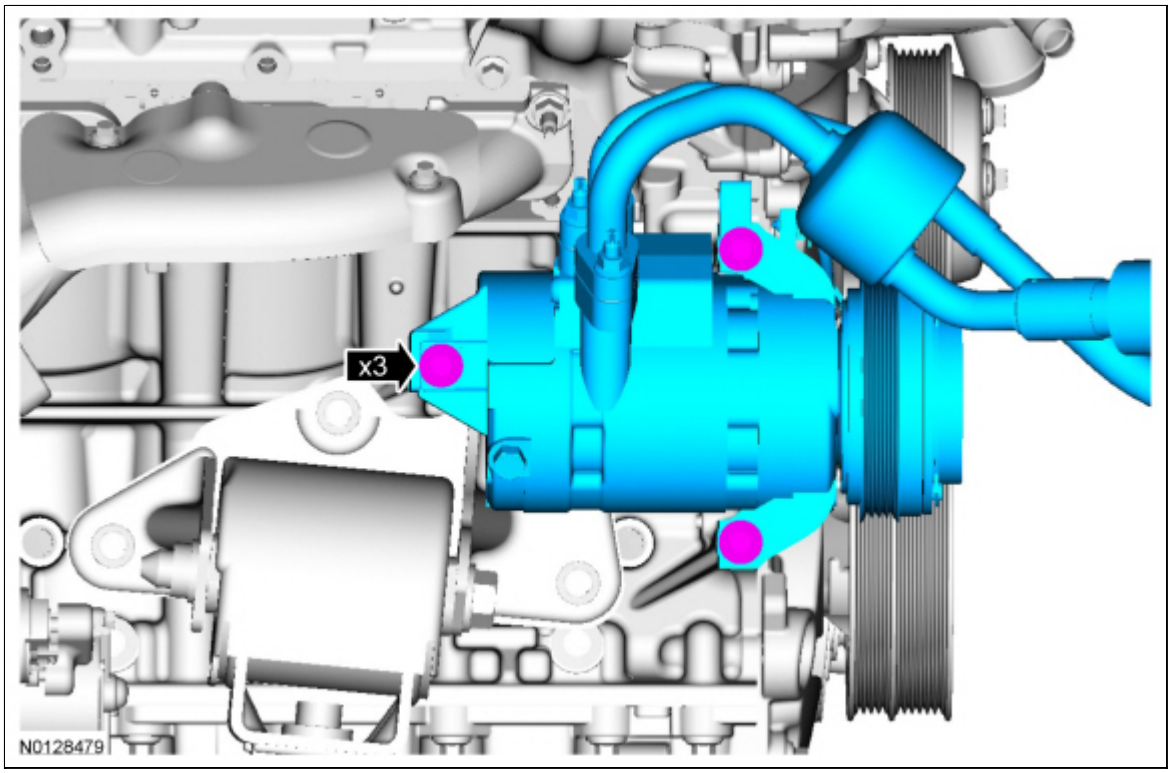
   Using the Floor Crane and Engine Spreader Bar, mount the engine on a suitable engine stand.



5. Remove the 2 bolts and the Right Front Lift Eye.

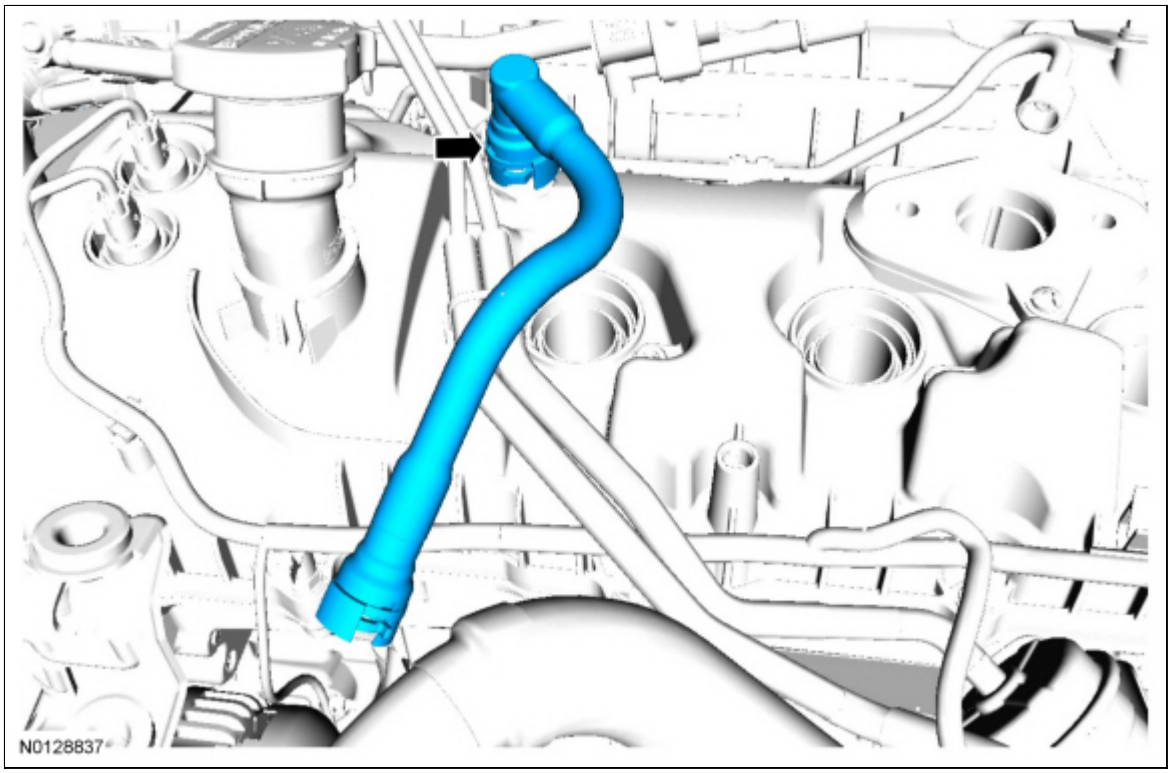


6. Remove the A/C compressor and the 3 bolts.

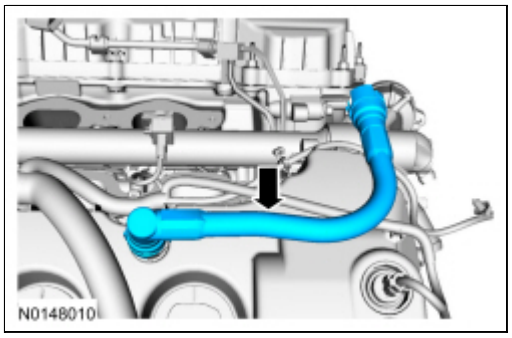


7. Remove the LH crankcase vent tube. For additional information, refer to Section 310-00 .

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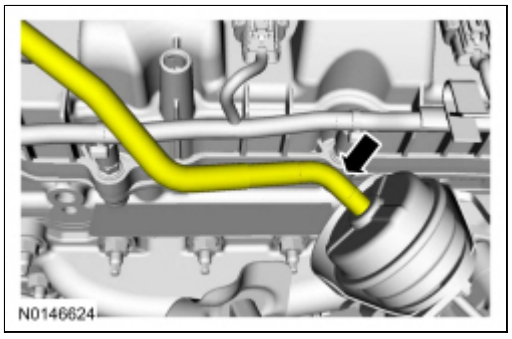


8. Remove the RH PCV tube. Refer to Section 310-00 .



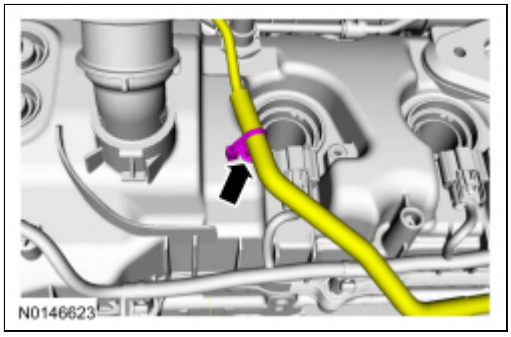
9. **NOTE:** LH shown, RH similar.

   Disconnect the 2 wastegate hoses at the turbochargers.

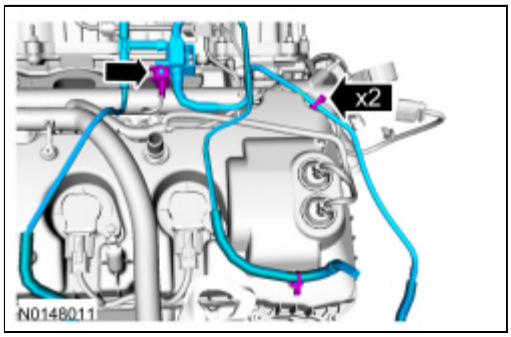


10. **NOTE:** LH shown, RH similar.

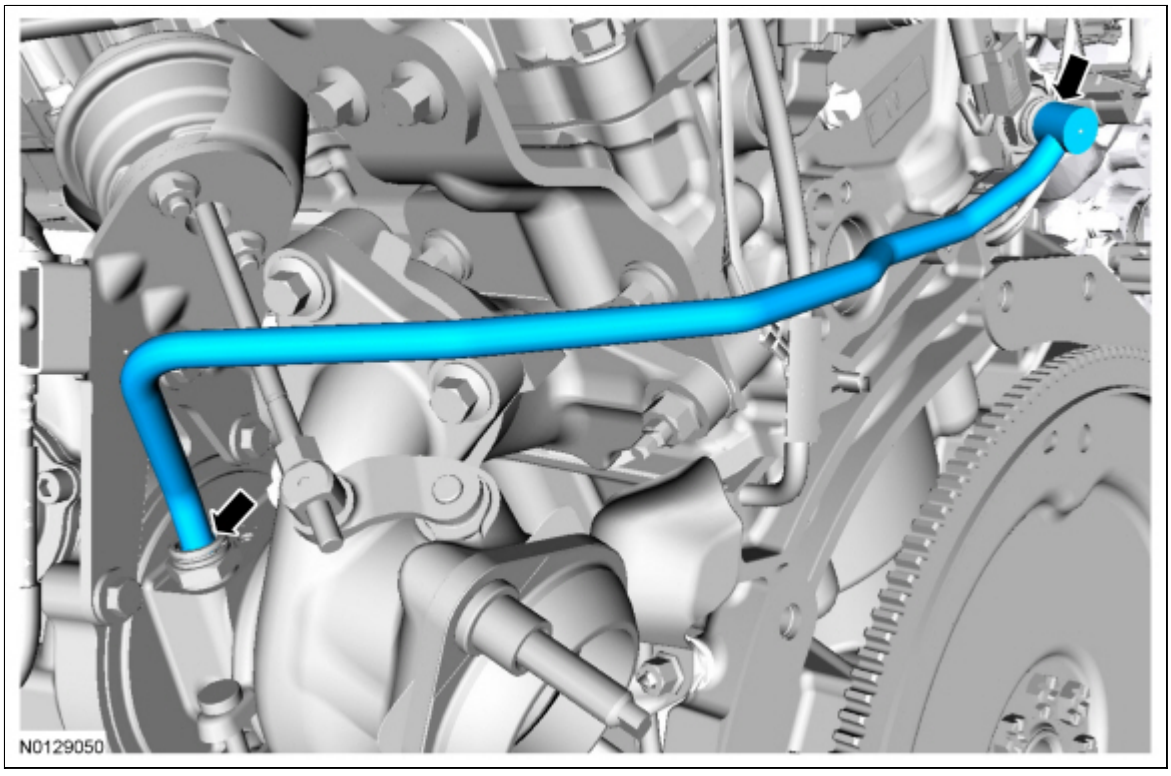
Remove the 2 tie straps for the wastegate hose assembly.



11. Disconnect the turbocharger pressure regulator electrical connector. Remove the 2 tie straps and the wastegate hose assembly.

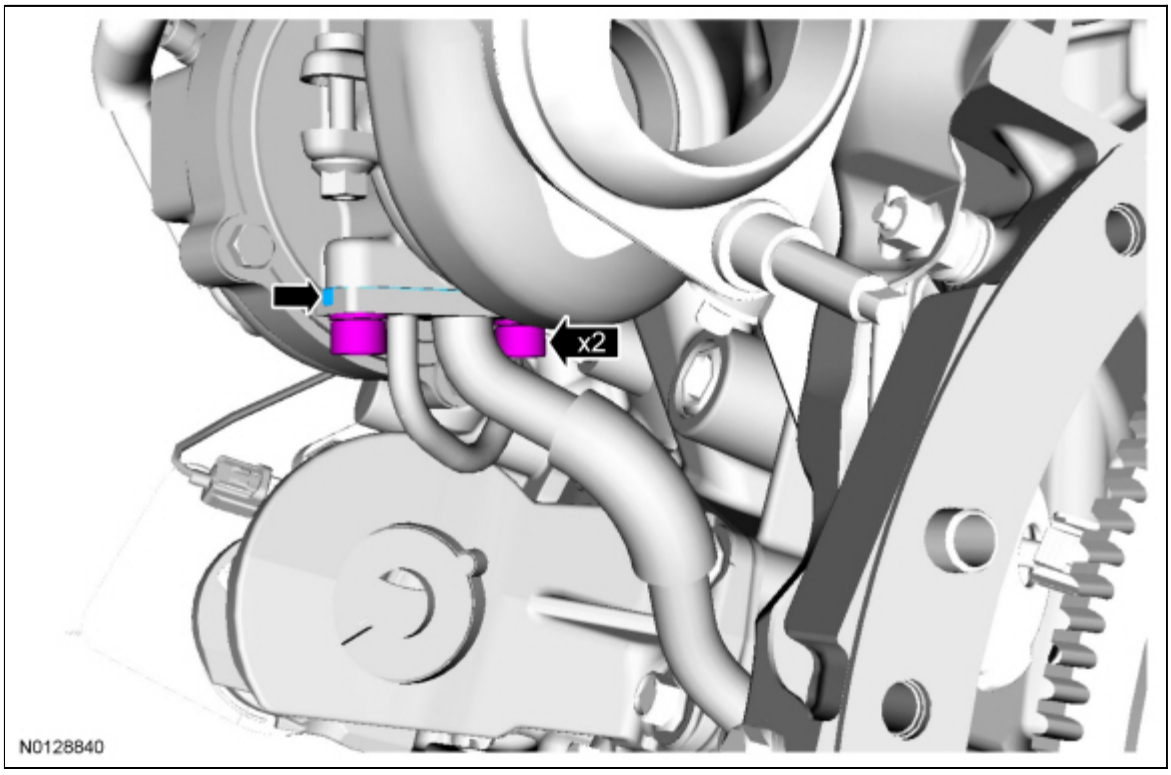


12. Using a commercially available quick disconnect tool, remove the LH turbocharger coolant supply tube.

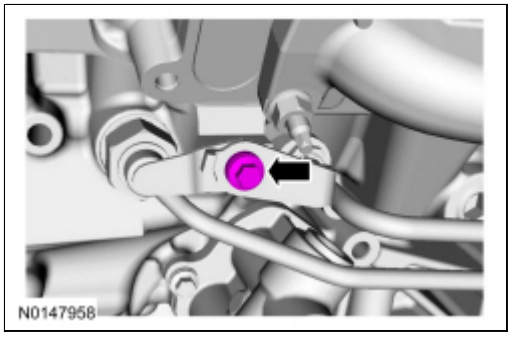


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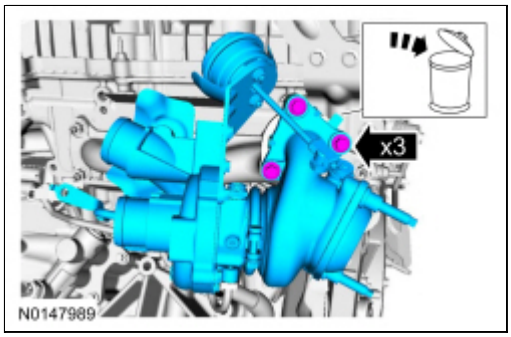
13. Remove the 2 bolts at the LH turbocharger oil return tube.
    - Remove and discard the turbocharger return tube gasket.



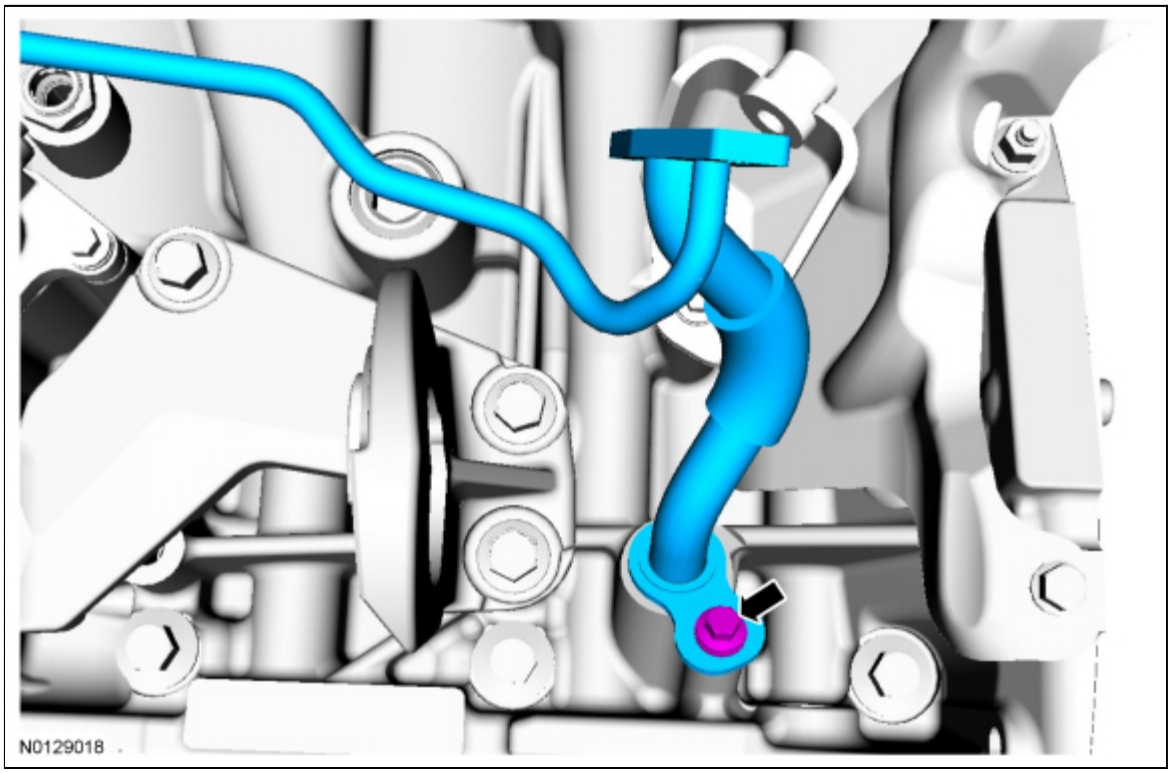
14. Remove the bolt for the LH turbocharger coolant and oil tubes.



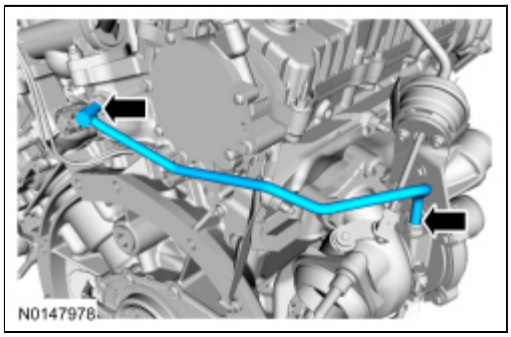
15. Remove the 3 bolts and the LH turbocharger.
    - Discard the turbocharger exhaust manifold gasket.



16. Remove the bolt and the LH oil turbocharger oil return tube.
    - Remove and discard the O-ring seal.

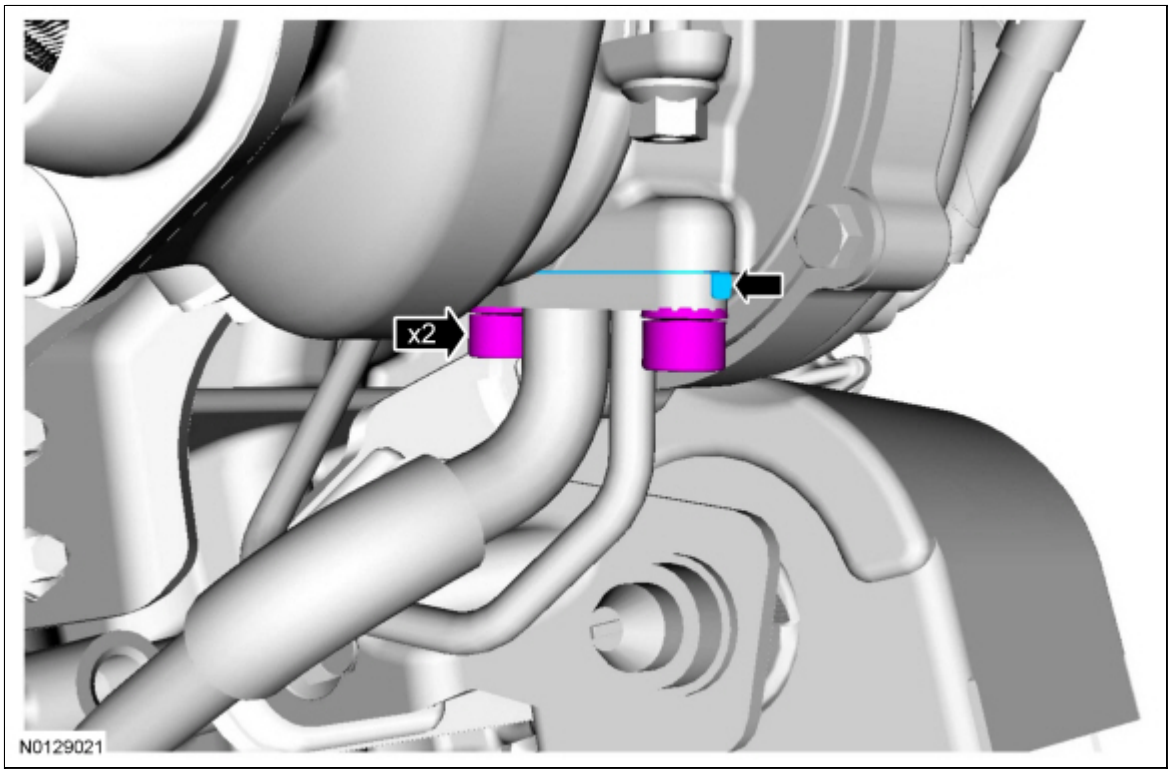


17. Using a commercially available quick disconnect tool, remove the RH turbocharger coolant supply tube.

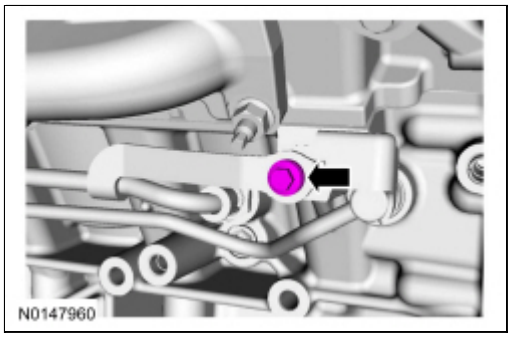


18. Remove the 2 bolts at the RH turbocharger oil return tube.
    - Remove and discard the turbocharger oil return tube gasket.

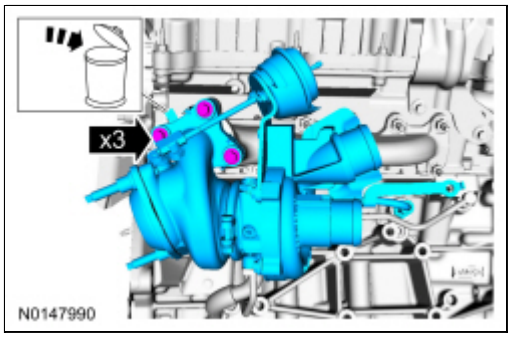
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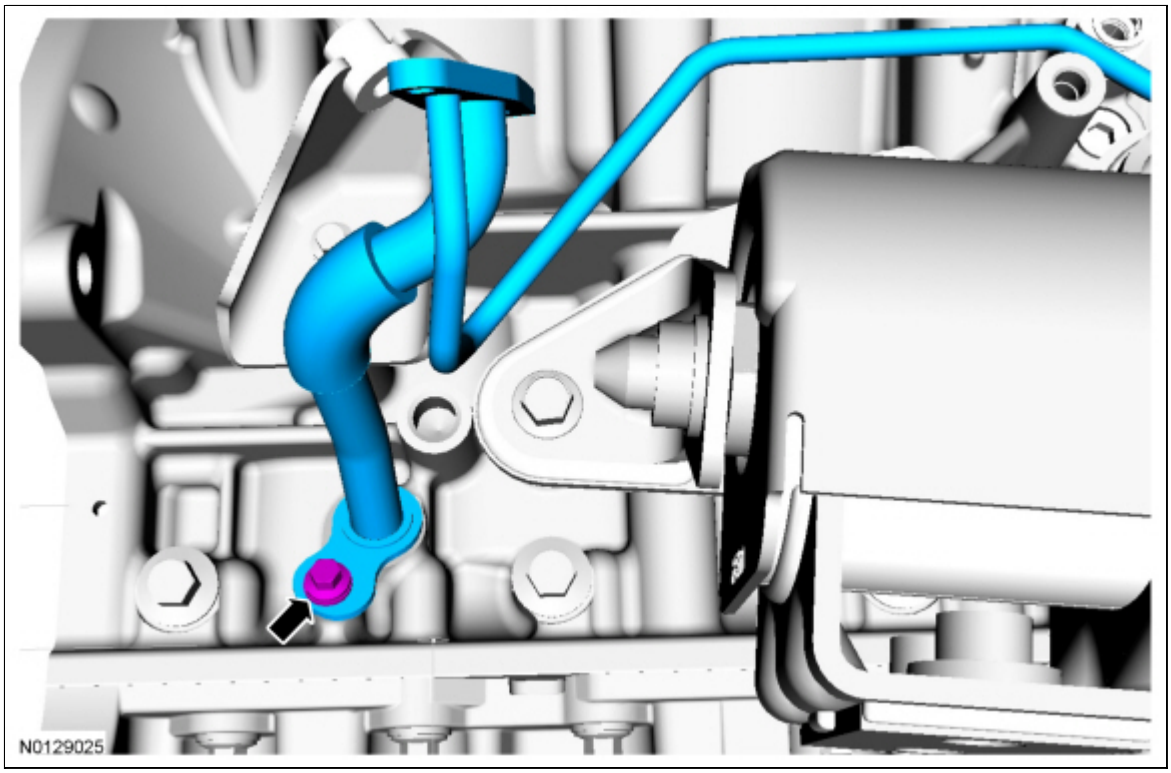
19. Remove the bolt for the RH turbocharger coolant and oil tubes.



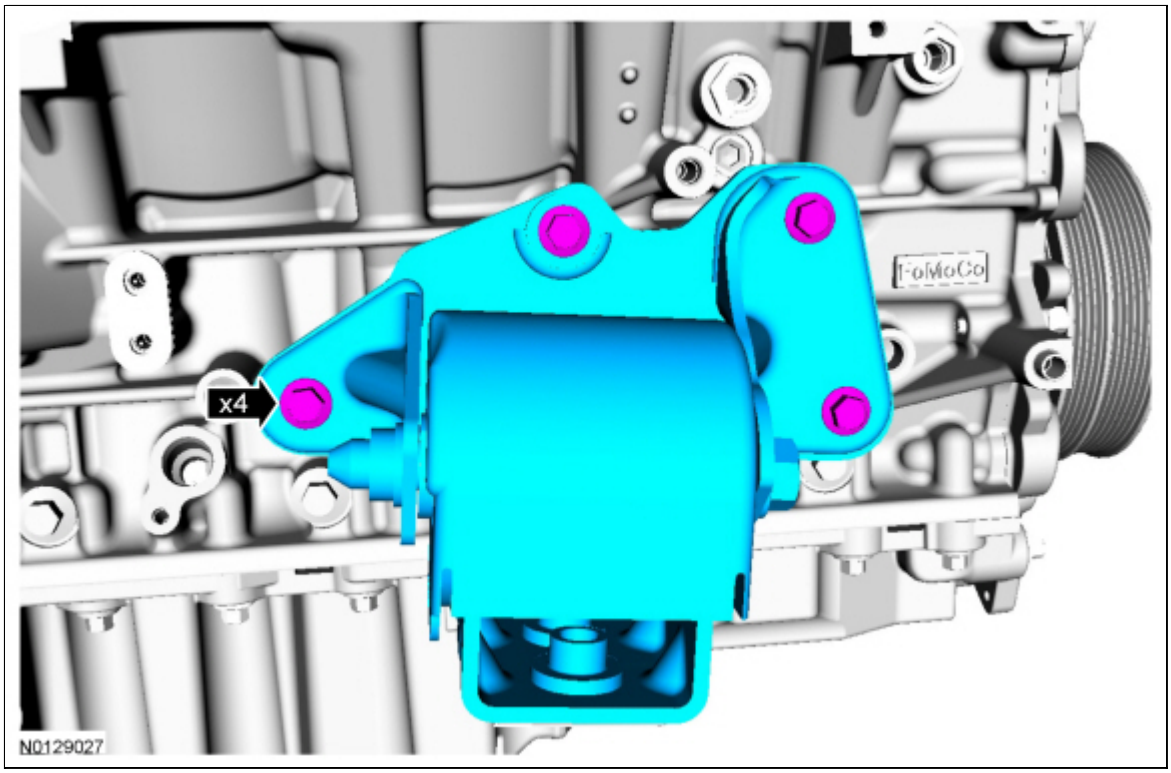
20. Remove the 3 bolts and the RH turbocharger.
    - Discard the turbocharger exhaust manifold gasket.



21. Remove the bolt and the RH turbocharger oil return tube.
    - Remove and discard the O-ring seal.

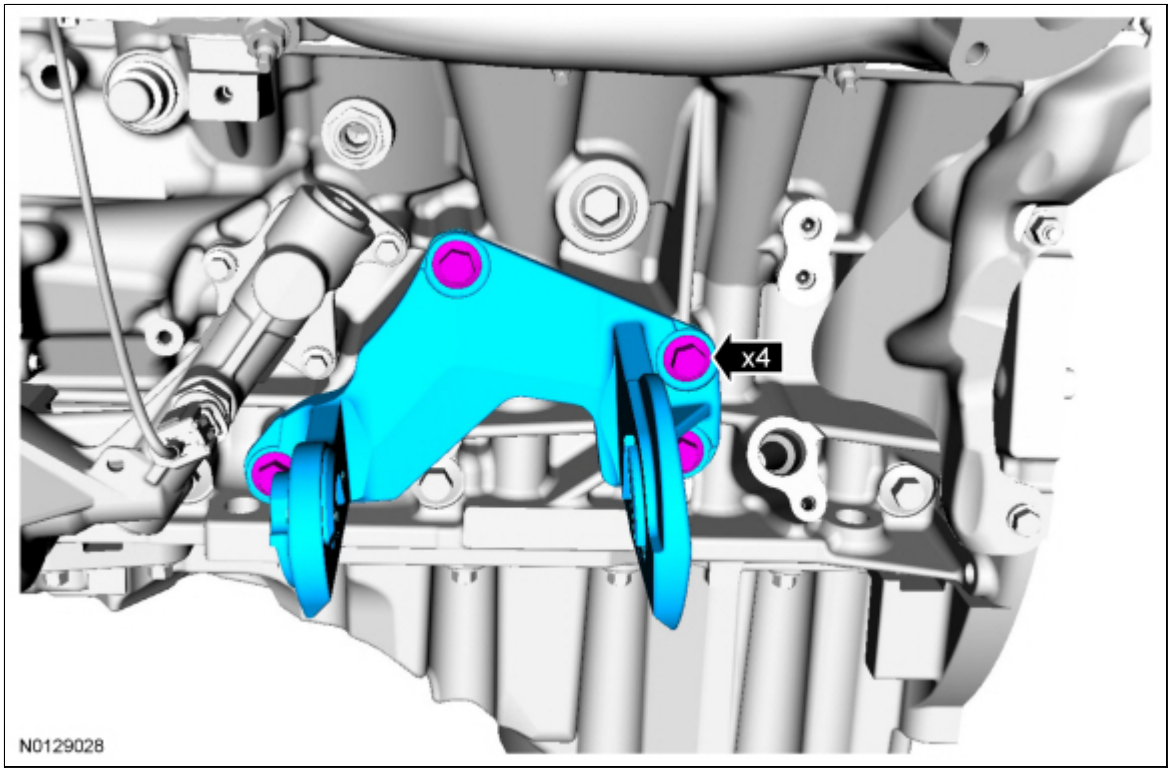


22. Remove the 4 bolts and the RH engine support insulator.
    - Discard the bolts.



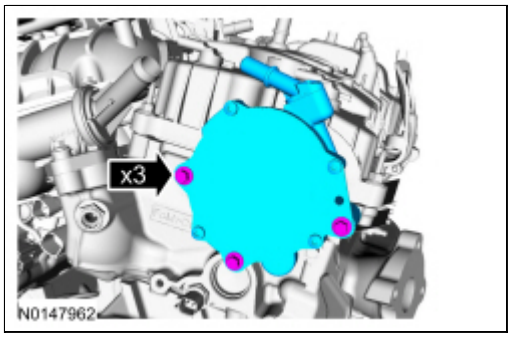
23. Remove the 4 bolts and the LH engine support insulator-to-cylinder block bracket.
    - Discard the bolts.

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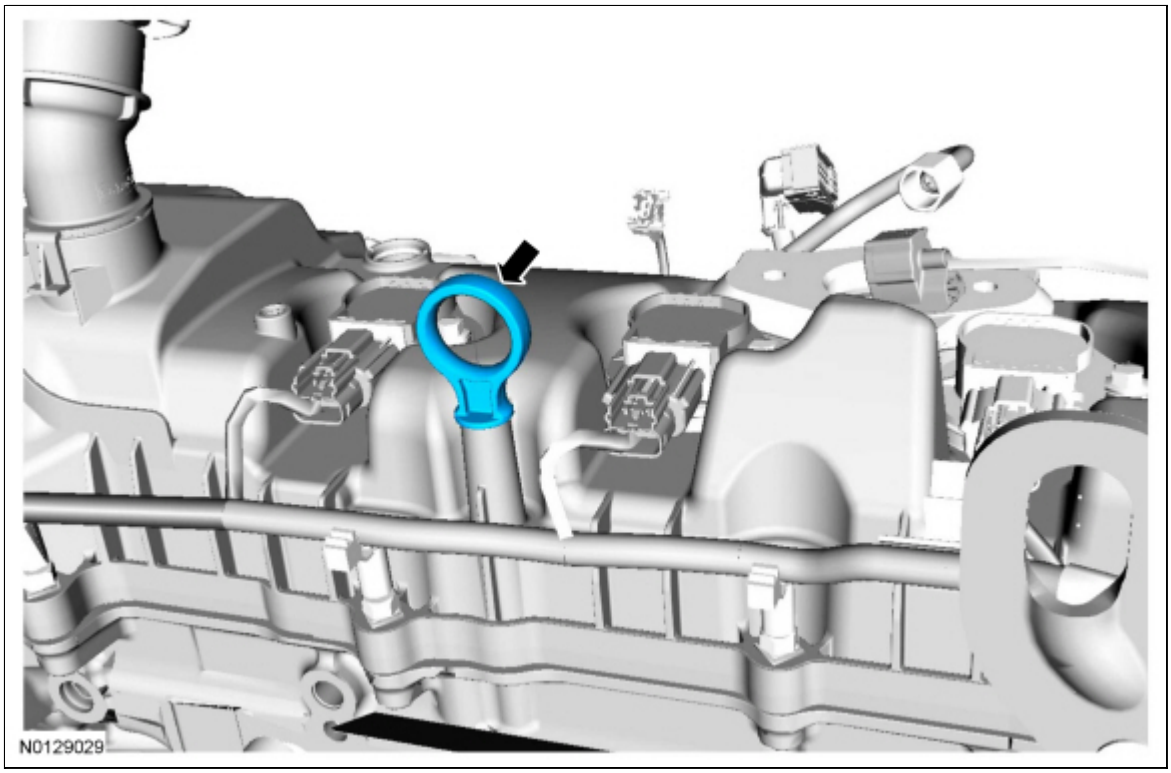


24. ***NOTICE:*** **Do not use excessive force when removing the vacuum pump or the vacuum pump oil tube may be dislodged from the vacuum pump causing internal oil seal damage to the pump. If the oil tube becomes dislodged from the pump, a new vacuum pump must be installed.**

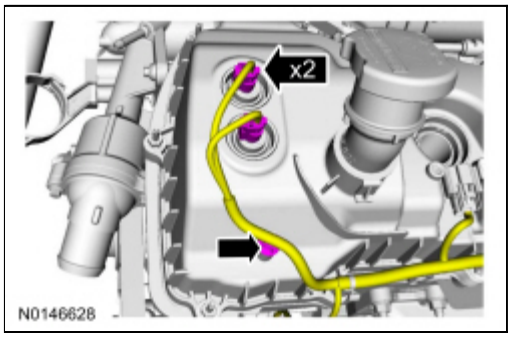
    Remove the 3 bolts and the vacuum pump.



25. Remove the engine oil level indicator.

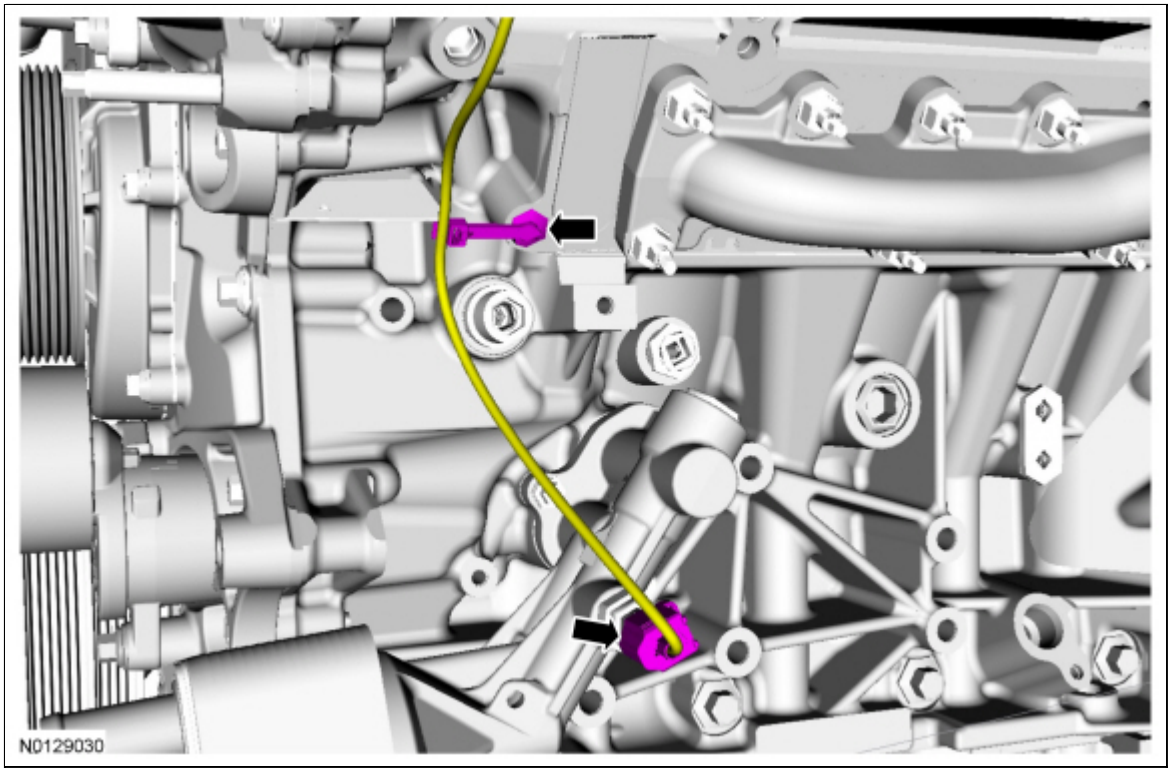


26. Disconnect the 2 LH Variable Camshaft Timing (VCT) solenoid electrical connectors. Remove the tie strap.

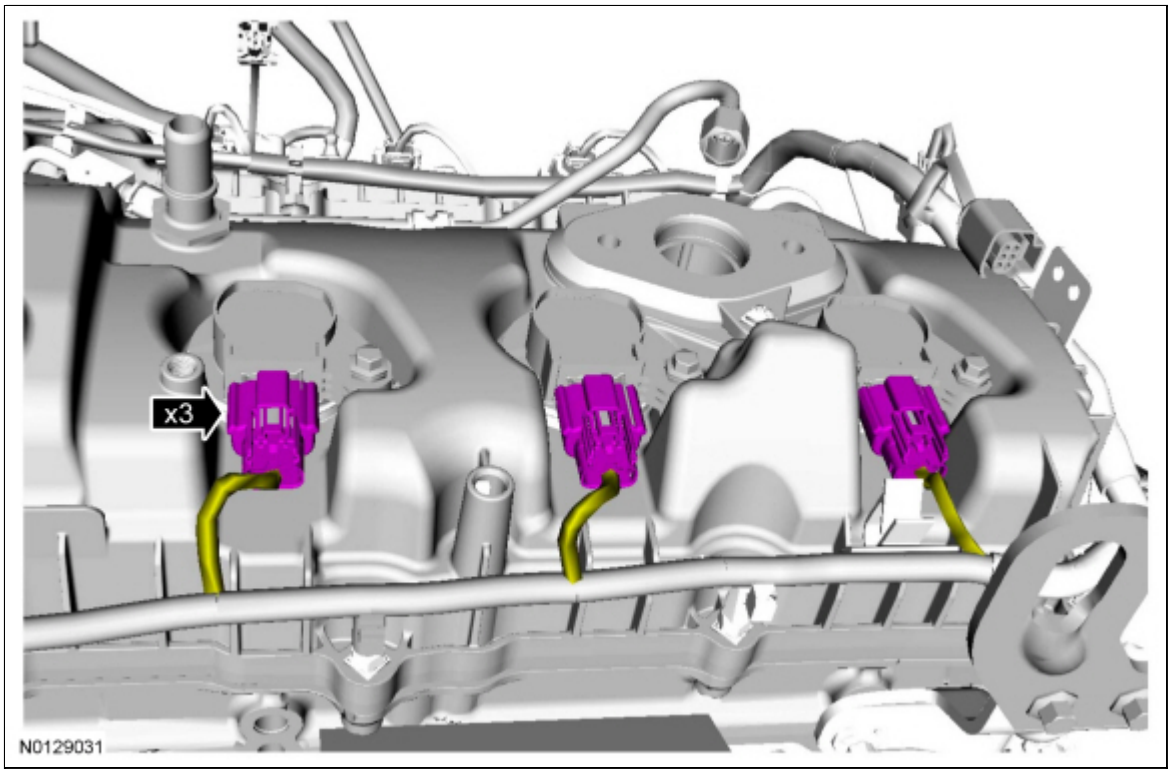


27. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.
    - Detach the EOP switch wiring harness retainer from the cylinder head.

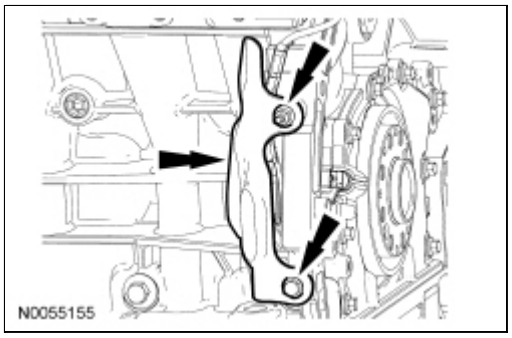
repair4less



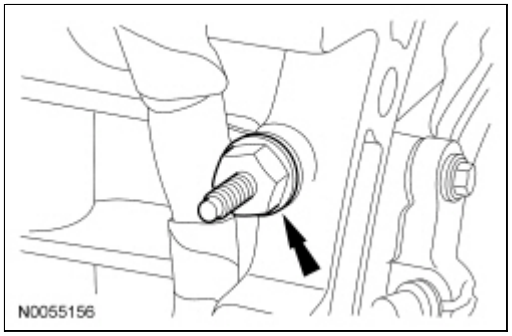
28. Disconnect the 3 LH ignition coil-on-plug electrical connectors.



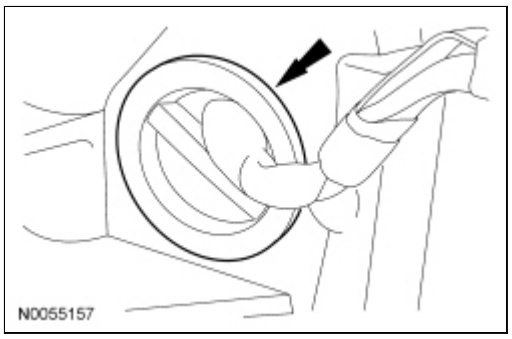
29. Remove the nut, the bolt and the CKP heat shield.



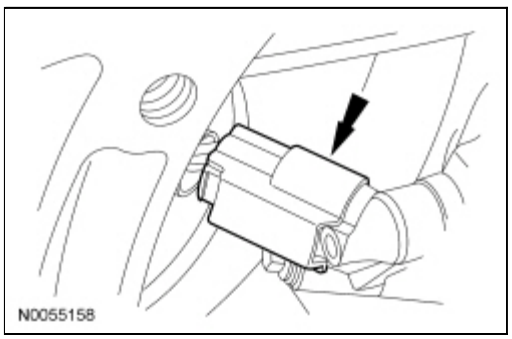
30. Remove the wiring harness retainer stud bolt.



31. Remove the wiring harness grommet.



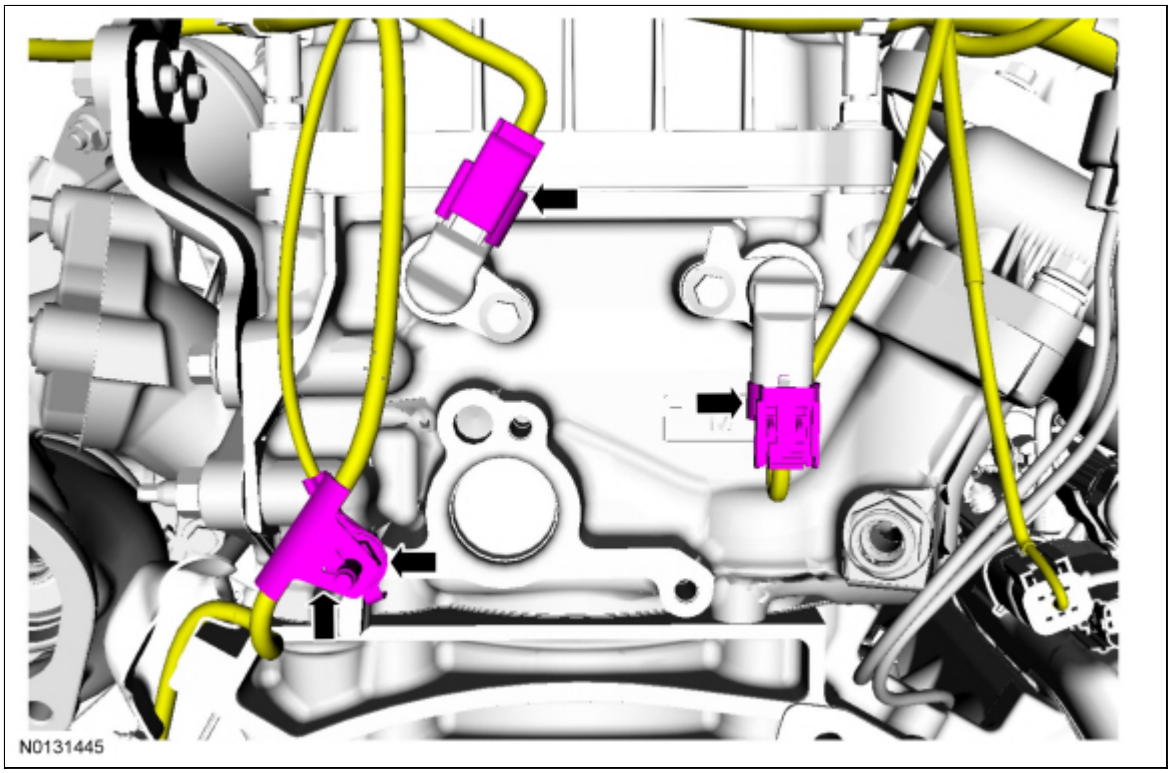
32. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



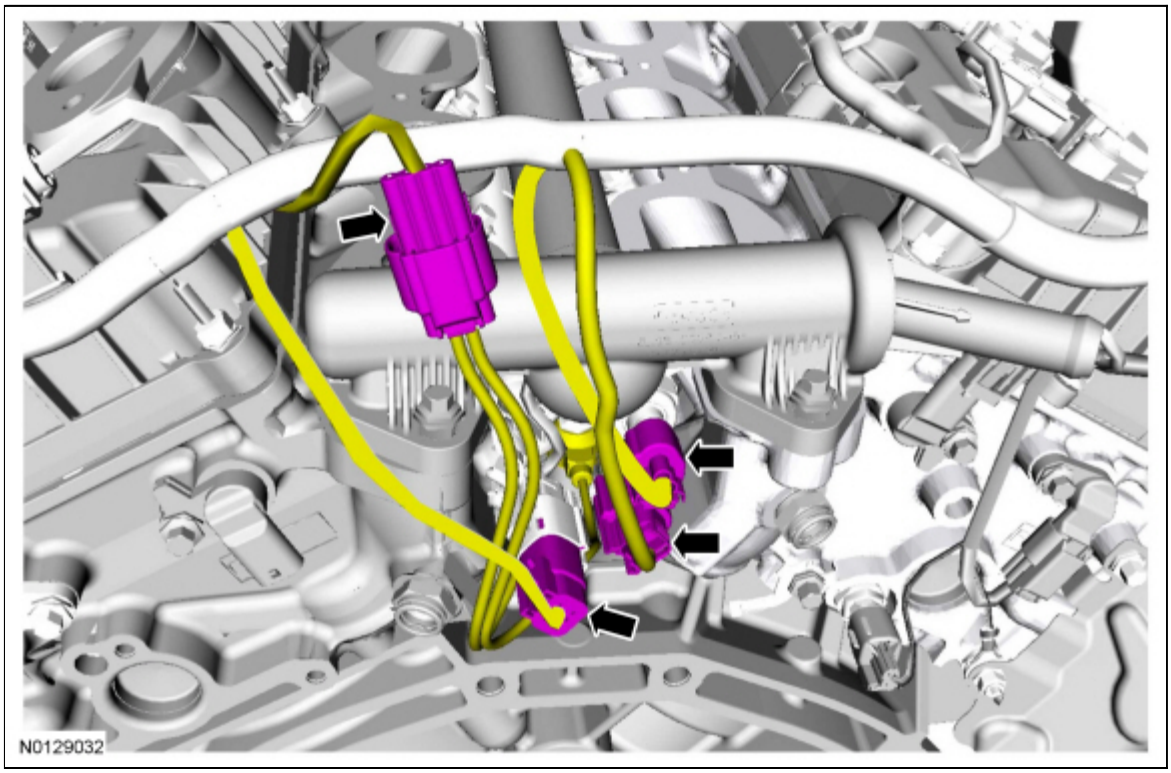
33. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

34. Disconnect the 2 LH Camshaft Position (CMP) sensor electrical connectors. Disconnect the CKP wire retainer. Remove the ground stud bolt.

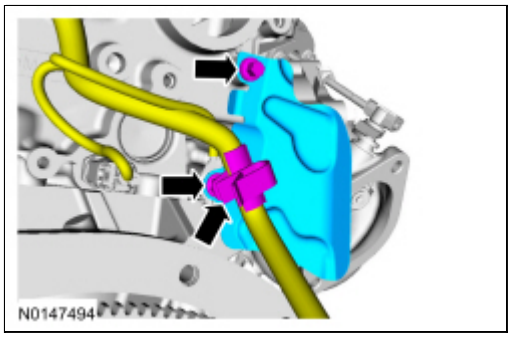
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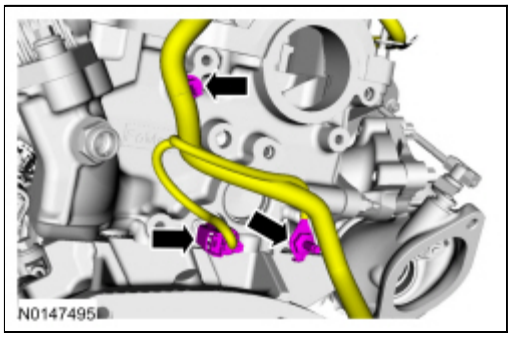
35. Disconnect the Knock Sensor (KS) sensor electrical connector. Disconnect the 2 fuel charge harness and the Fuel Rail Pressure (FRP) electrical connectors.



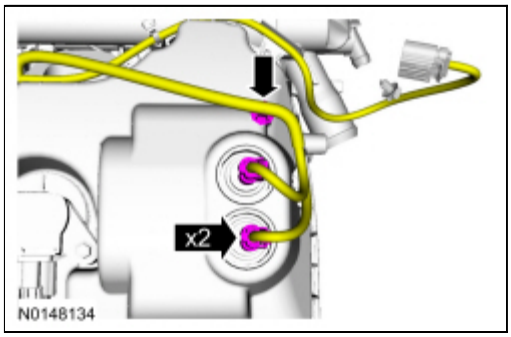
36. Disconnect the wire retainer. Remove the bolt, nut and the CMP heat shield.



37. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector. Remove the ground stud bolt and the tie strap.

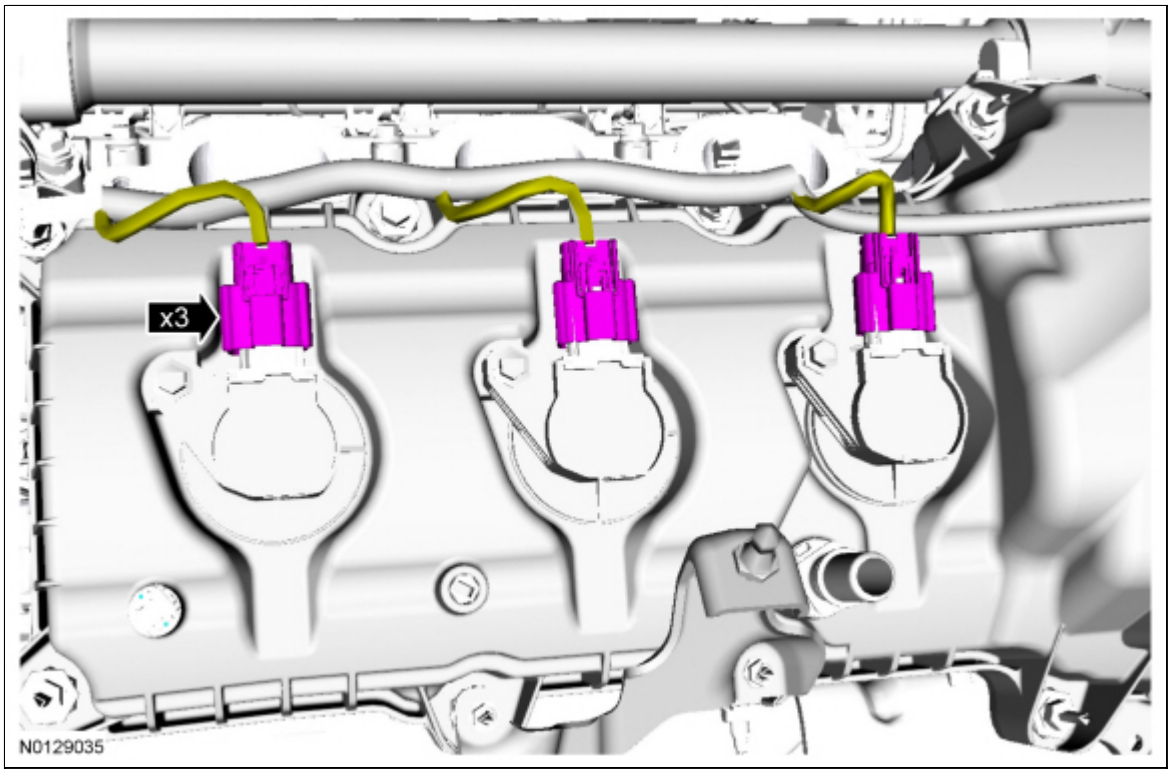


38. Disconnect the 2 RH VCT solenoid electrical connectors. Remove the tie strap.

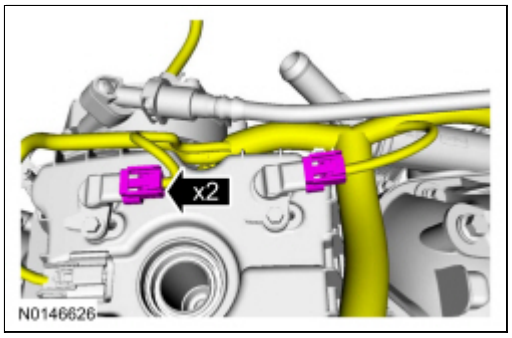


39. Disconnect the 3 RH ignition coil-on-plug electrical connectors.

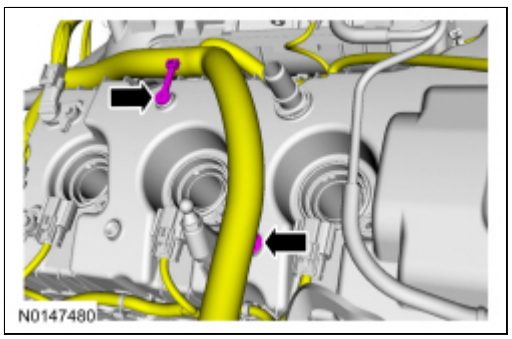
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40. Disconnect the 2 RH CMP electrical connectors.

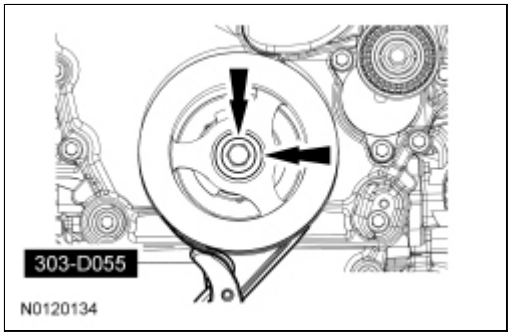


41. Disconnect the wire harness retainer and remove the tie strap.

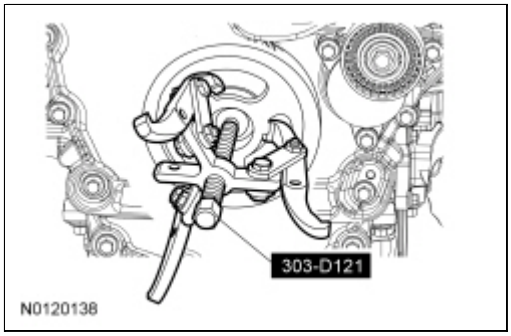


42. Detach all of the wiring harness retainers from the RH valve cover and stud bolts. Remove the engine wire harness.

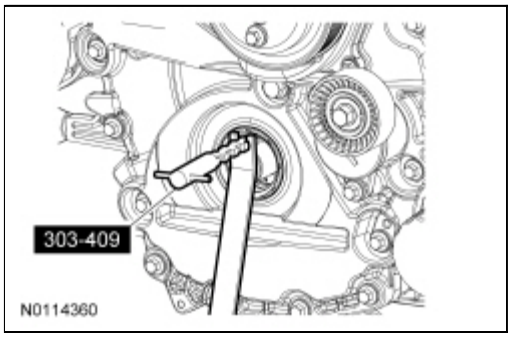
43. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Inspect the crankshaft pulley sealing surface for nicks or scratches that may effect the crankshaft front seal lip, replace the crankshaft pulley if necessary.
    - Discard the bolt.



44. Using the 3 Jaw Puller, remove the crankshaft pulley.

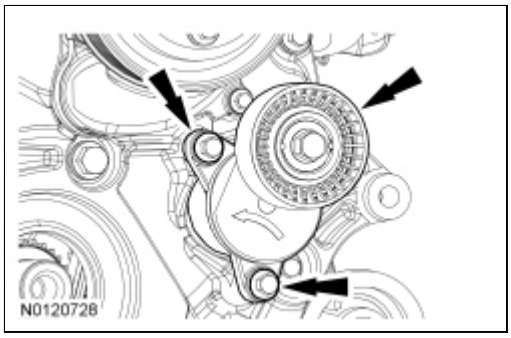


45. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

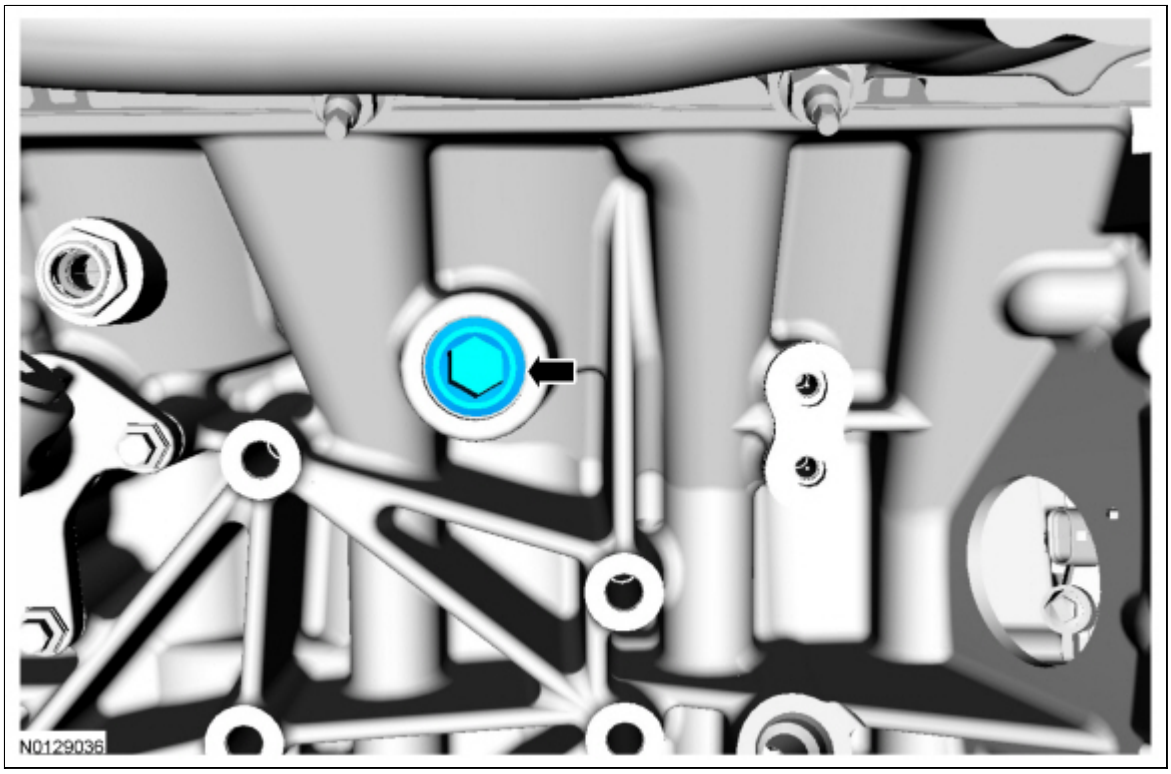


46. Remove the 2 bolts and the accessory drive belt tensioner.

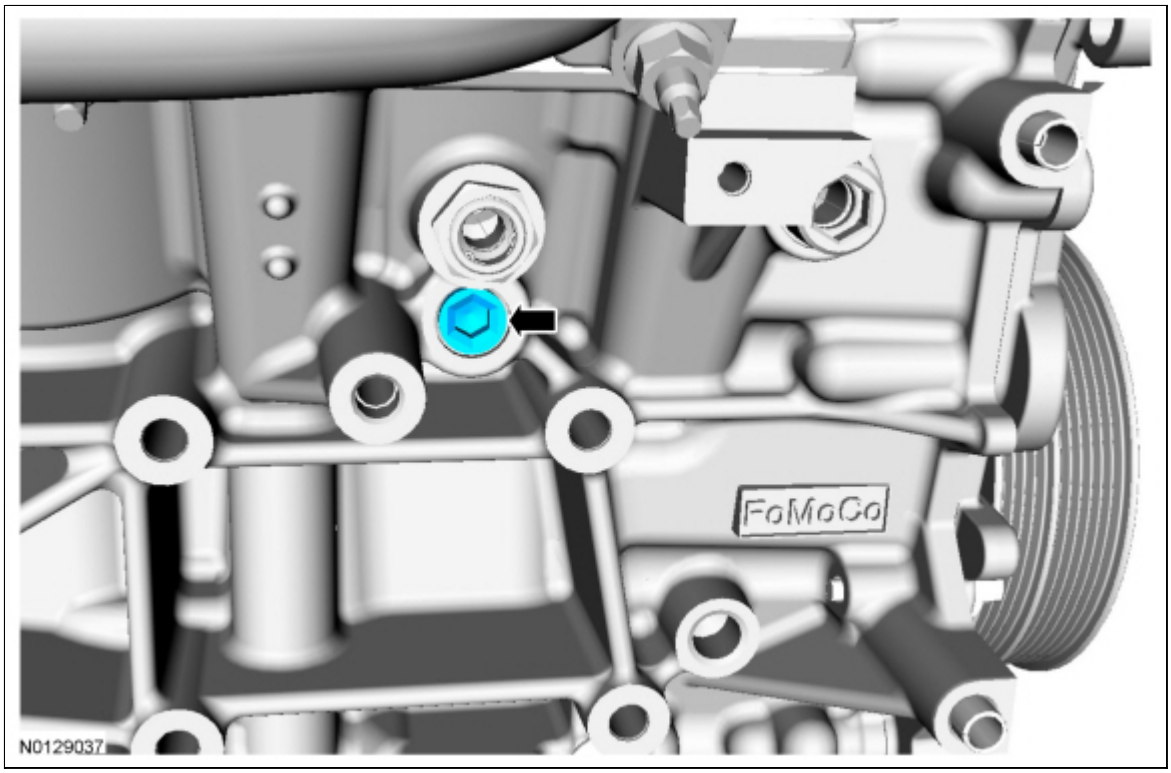
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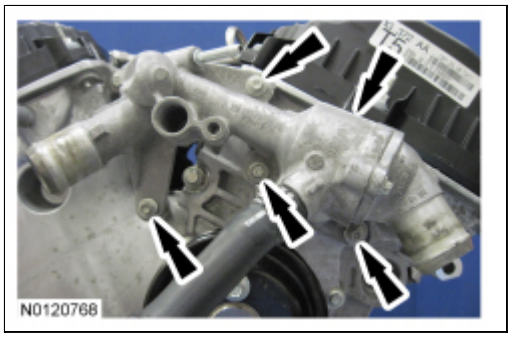
47. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.



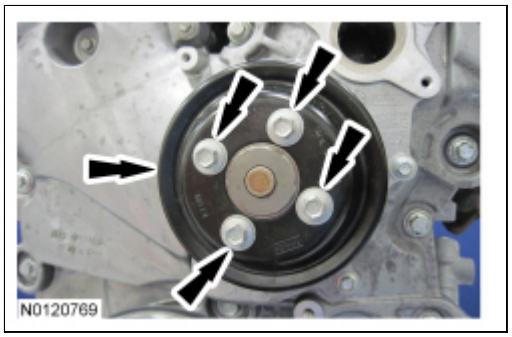
48. Remove the RH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.



49. Remove the 4 bolts and the thermostat housing.
    - Discard the thermostat housing and coolant inlet tube O-ring seals.

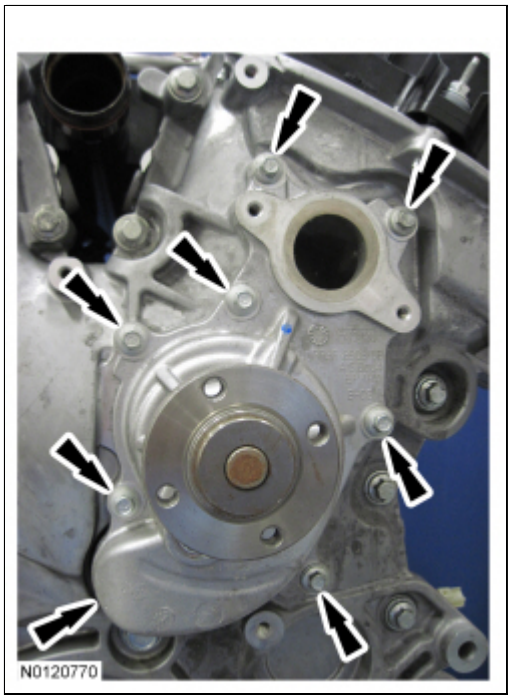


50. Remove the 4 bolts and the coolant pump pulley.

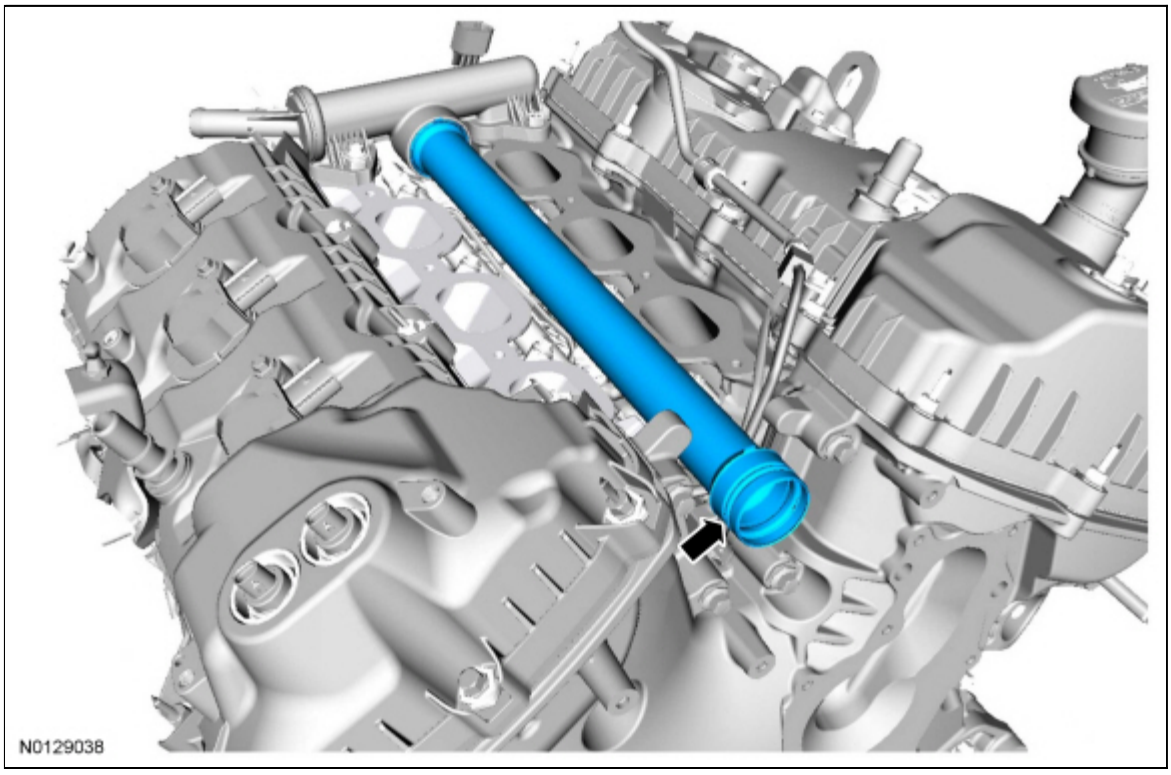


51. Remove the 7 bolts and the coolant pump.
    - Discard the coolant pump gasket and coolant pump O-ring seal.

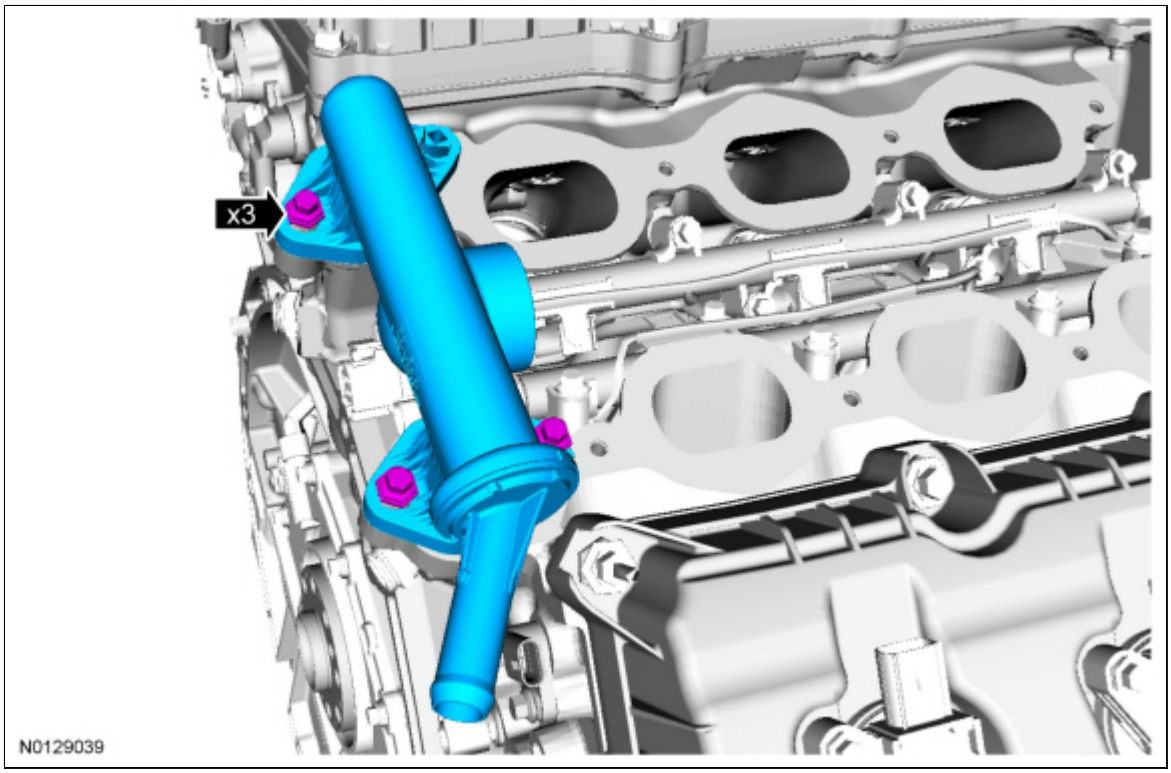
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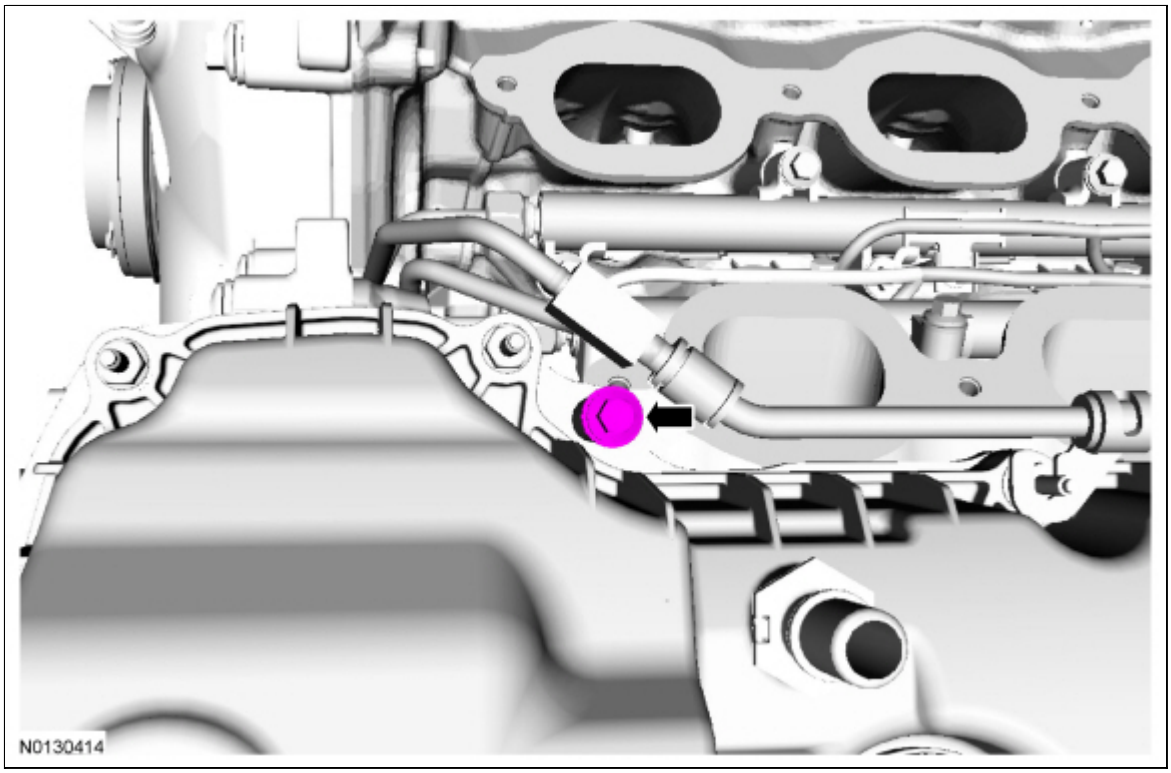
52. Remove the coolant inlet pipe.
    - Remove and discard the coolant inlet pipe O-ring seals.



53. Remove the 3 bolts and the coolant crossover manifold assembly.
    - Remove and discard the 2 gaskets.

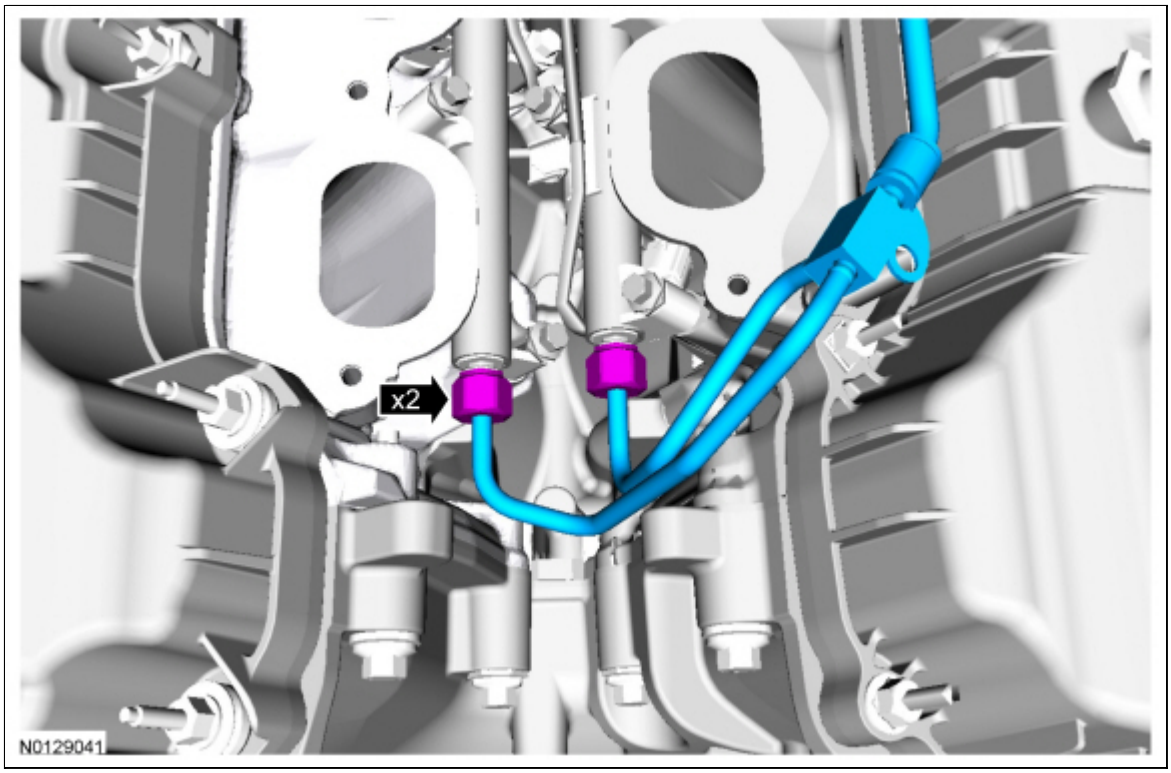


54. Remove the bolt for the high-pressure fuel tube.



55. Loosen the 2 flare nuts, remove and discard the high-pressure fuel tube assembly.

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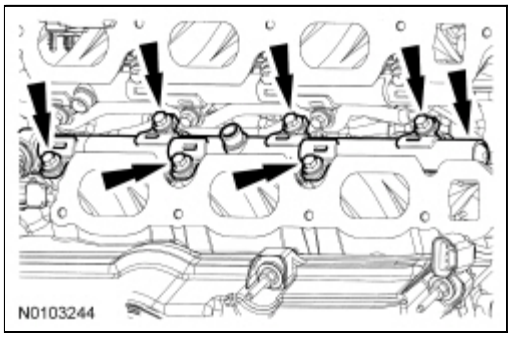


56. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors**

NOTE: When removing the fuel rails, the fuel injectors may remain in the fuel rails but normally remain lodged in the cylinder heads and require the use of a Fuel Injector Remover to extract.

Remove the 6 bolts and the LH fuel rail.

- Discard the bolts.

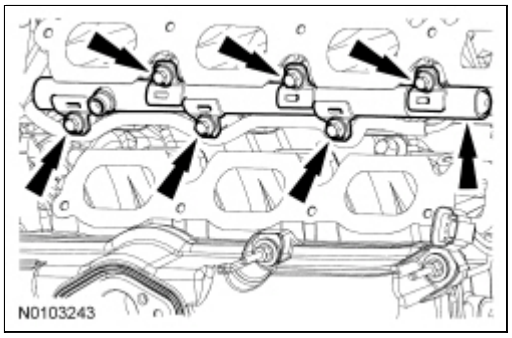


57. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors**

NOTE: When removing the fuel rails, the fuel injectors may remain in the fuel rails but normally remain lodged in the cylinder heads and require the use of a Fuel Injector Remover to extract.

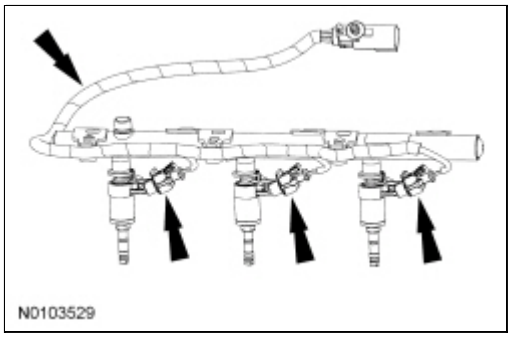
Remove the 6 bolts and the RH fuel rail.

- Discard the bolts.



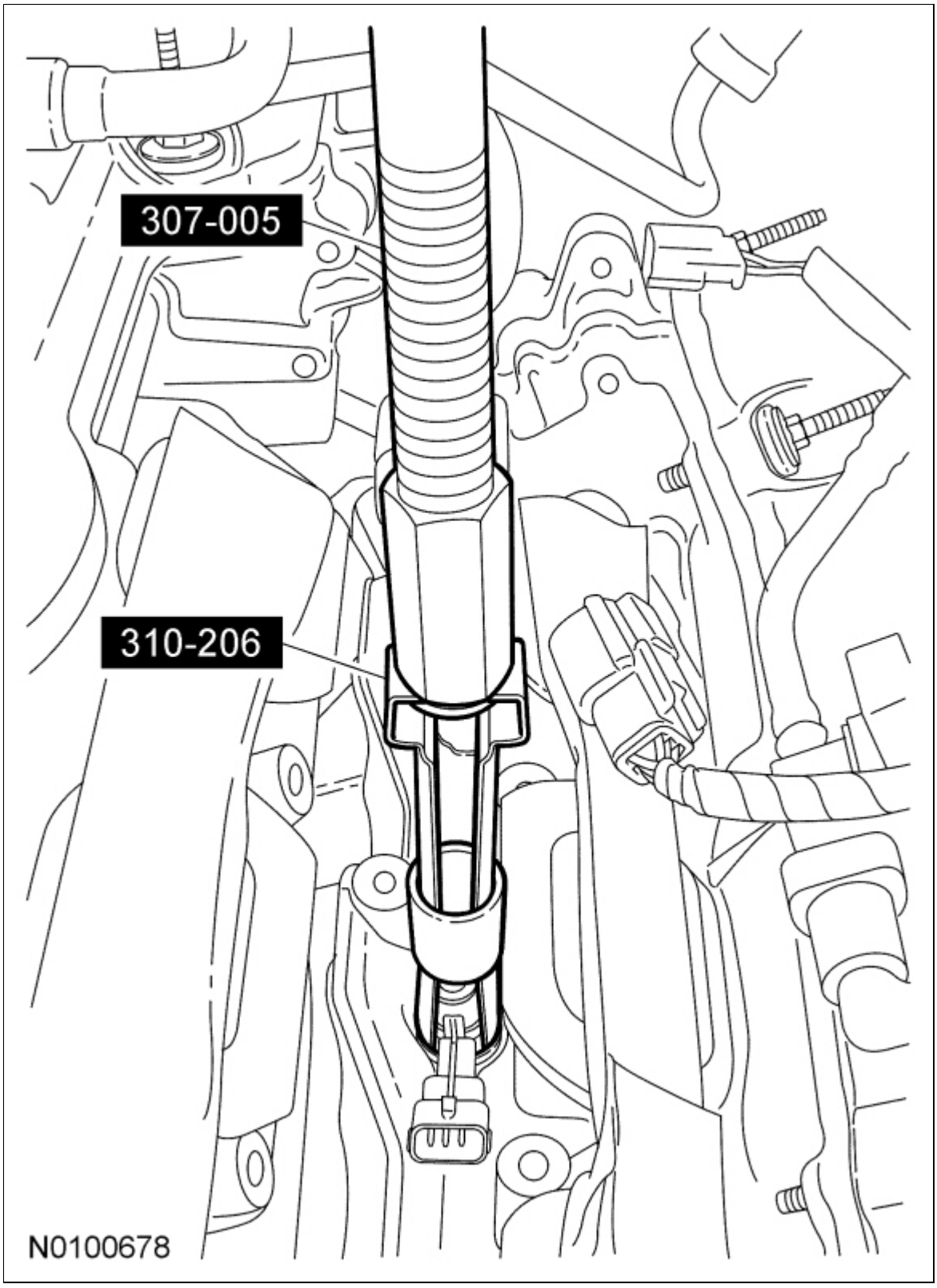
58. **NOTE:** RH shown, LH similar.

    Disconnect the 6 fuel injector electrical connectors and remove the 2 fuel injector wire harness.

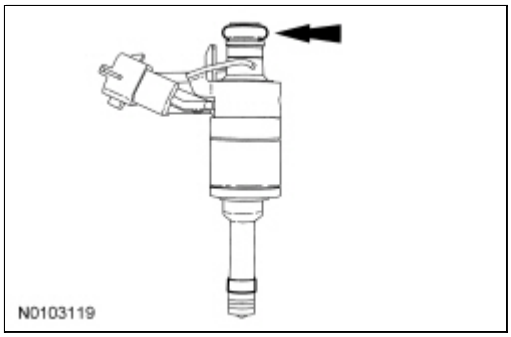


59. Using the Slide Hammer and the Fuel Injector Remover, remove any fuel injectors remaining in the cylinder head.

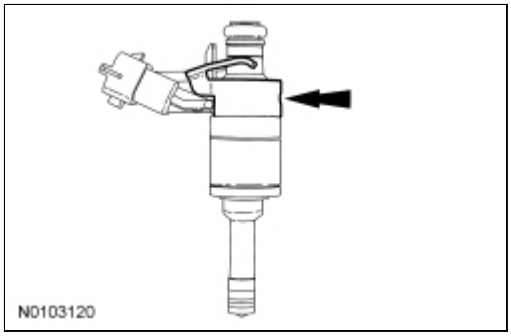
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60. Remove and discard the 6 upper fuel injector O-rings.



61. Remove and discard the 6 fuel injector clips.



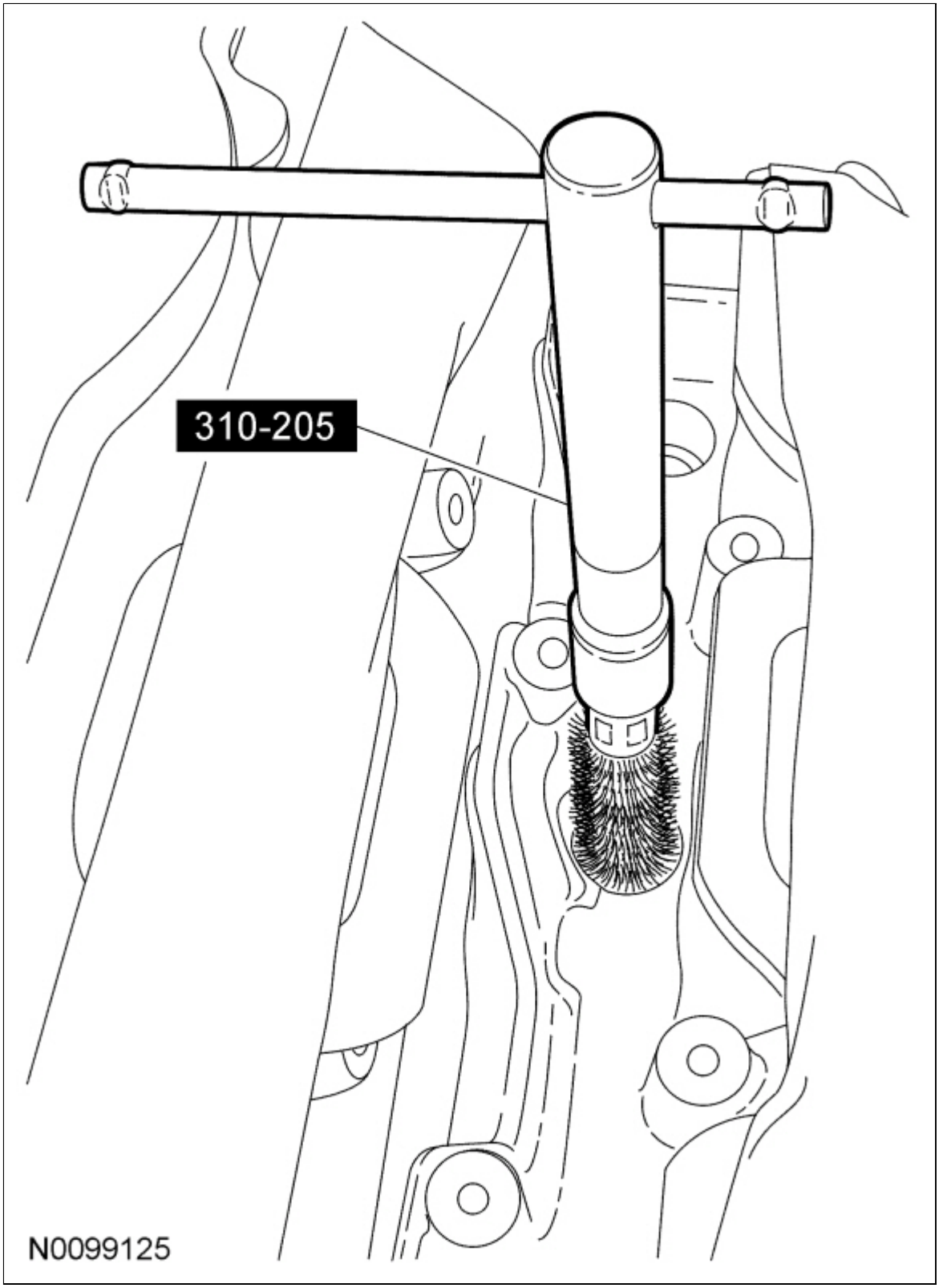
62. **NOTE:** Make sure to thoroughly clean any residual fuel or foreign material from the cylinder head, block and general surrounding area of the fuel rails and fuel injectors.

    NOTE: Do not use compressed air to clean the tip of the fuel injector.

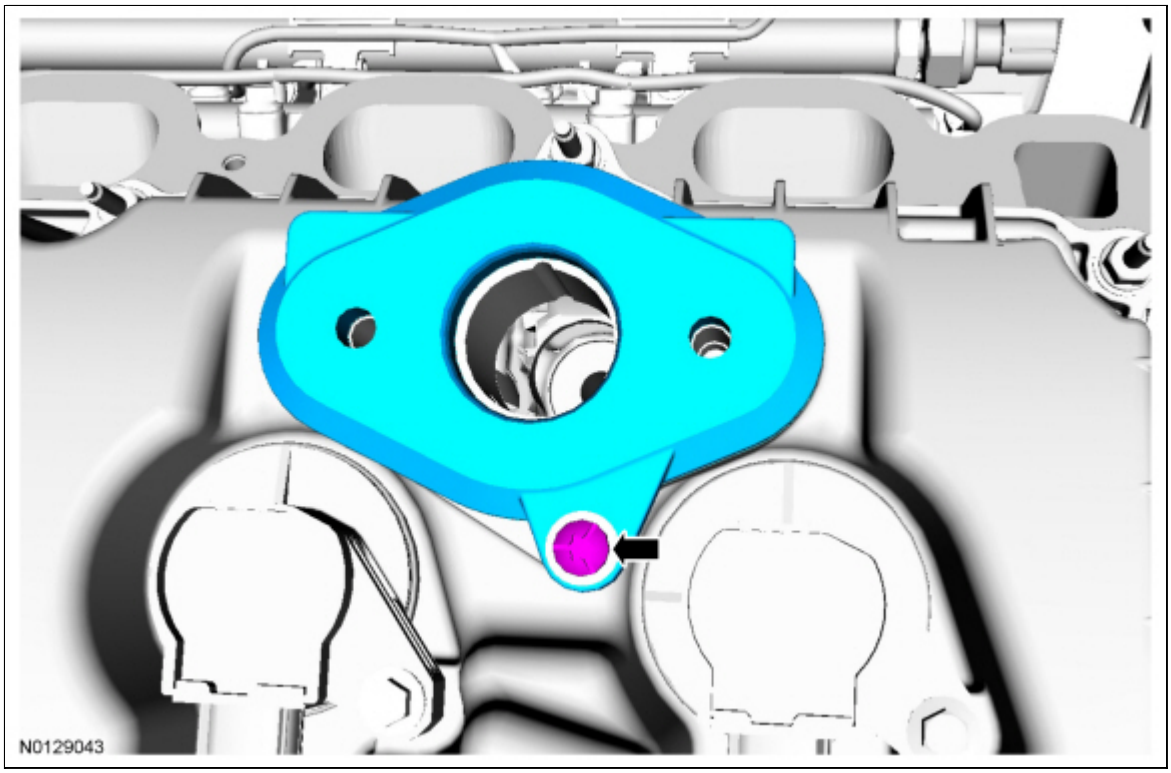
    NOTE: Do not use the brush to clean the tip of the fuel injector.

    Using the Fuel Injector Brush, clean the 6 fuel injector bores in the cylinder heads.

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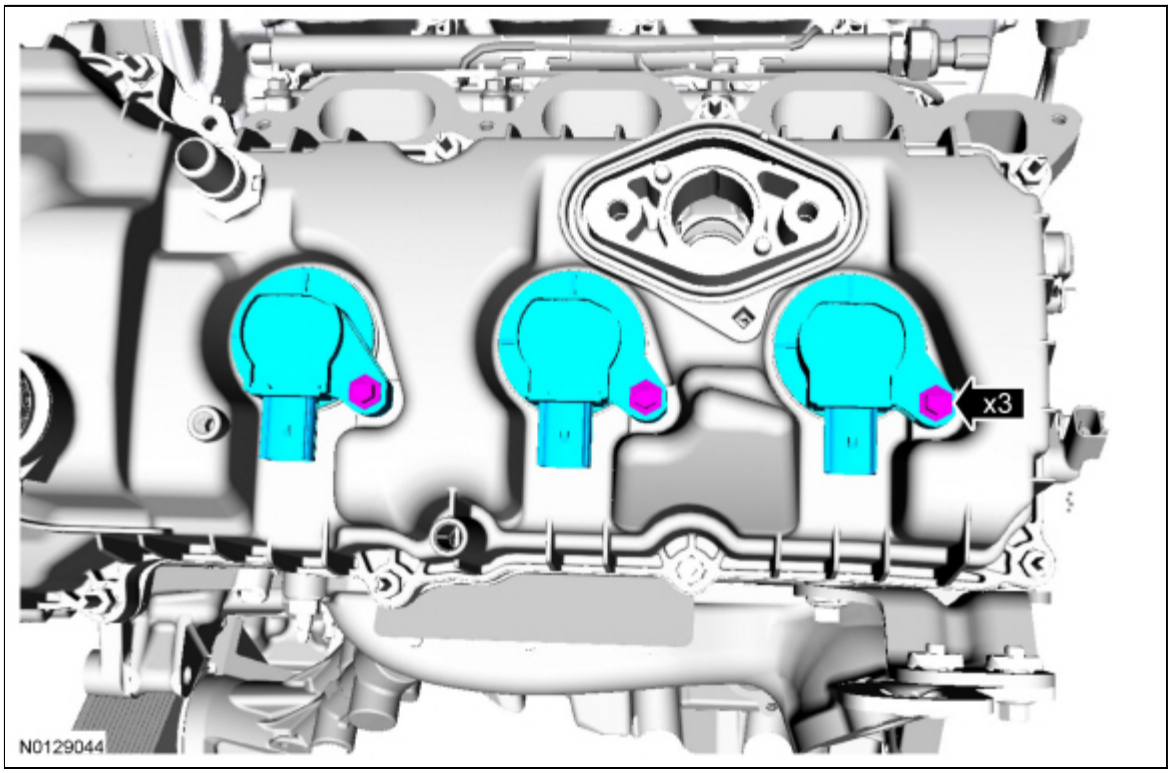


63. Remove the bolt and the fuel injection pump mounting plate.
    - Remove and discard the gaskets.



64. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

    Remove the 3 bolts and the 3 LH ignition coil-on-plugs.



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65. ***NOTICE:*** **Only use hand tools when removing the spark plugs, or damage may occur to the cylinder head or spark plug.**

    NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

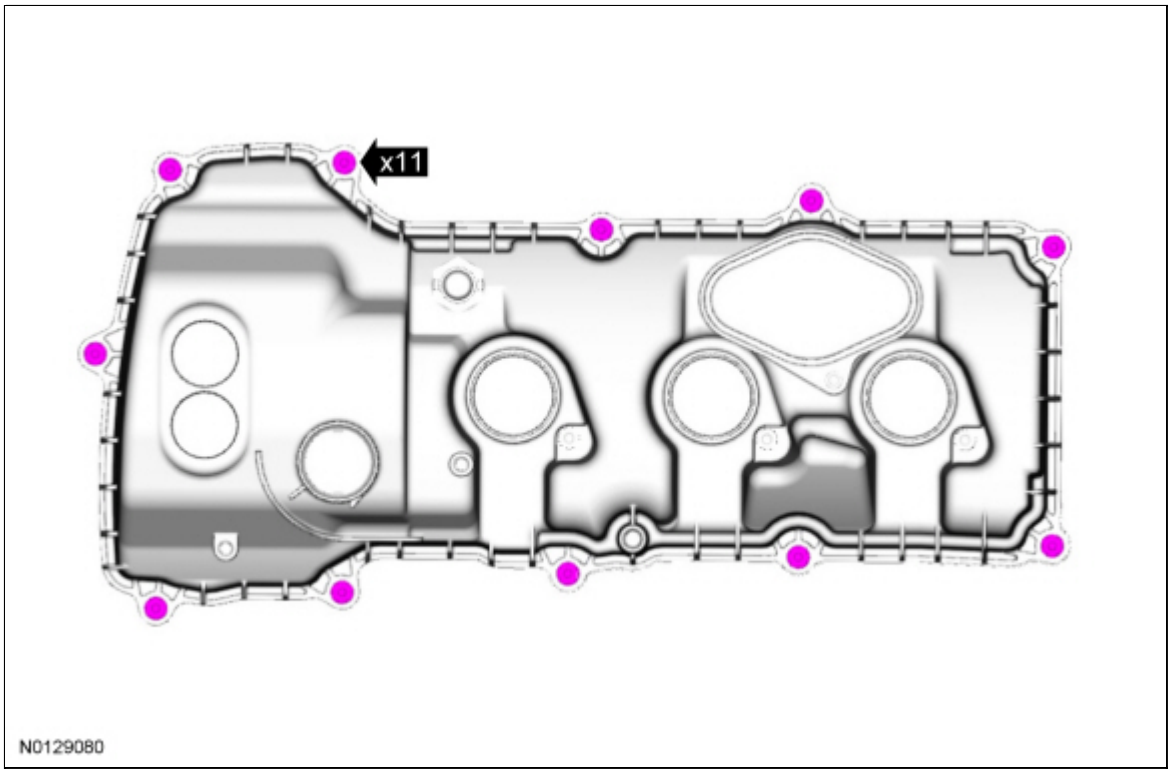
    Remove the 3 LH spark plugs.

66. ***NOTICE:*** **While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.**

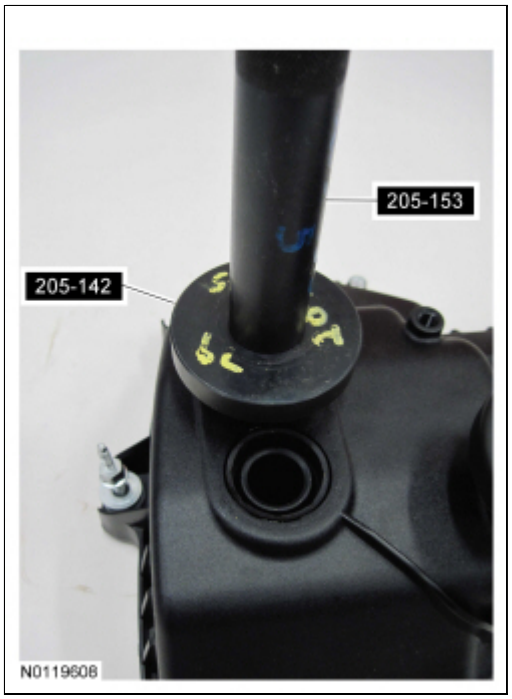
    NOTICE: **If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.**

    NOTE: The plastic electrical connector on the VCT oil control solenoid will rotate approximately 12 degrees inside the steel housing, which is normal.

    Loosen the 11 stud bolts and remove the LH valve cover.
    - Discard the gasket.



67. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



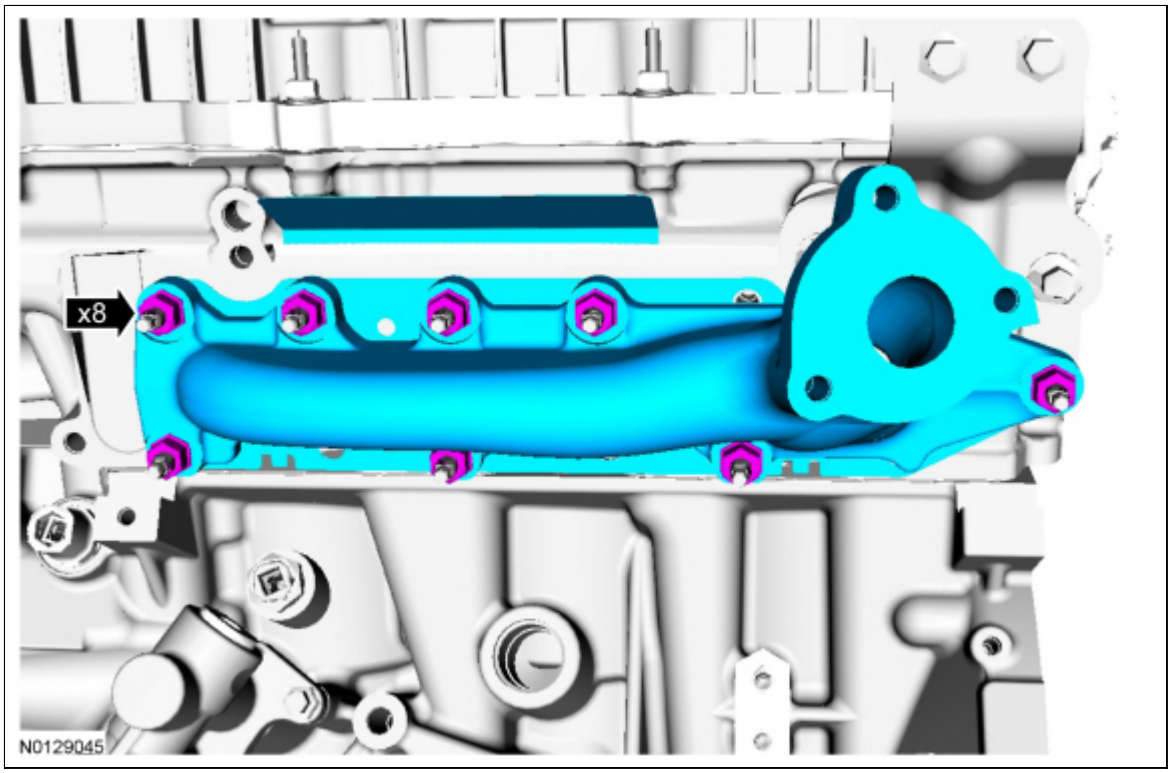
68. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



69. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

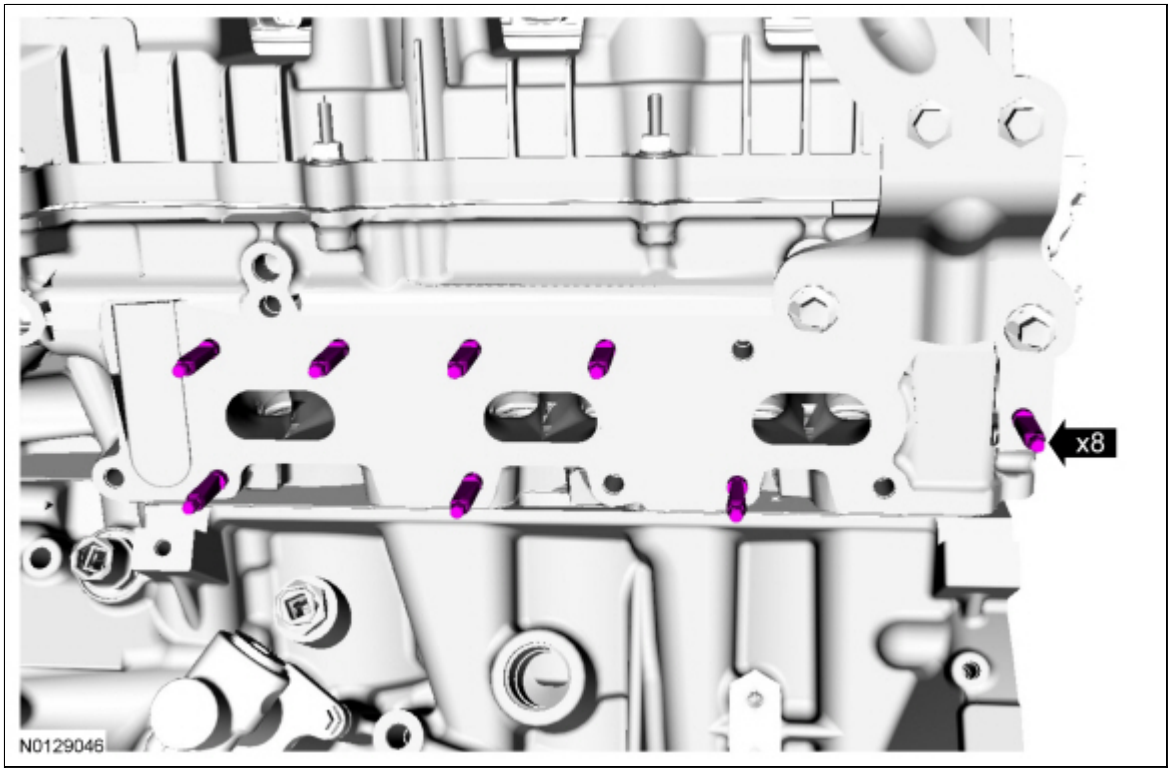
70. Remove the 8 nuts and the LH exhaust manifold.
    - Discard the nuts and exhaust manifold gasket.

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71. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

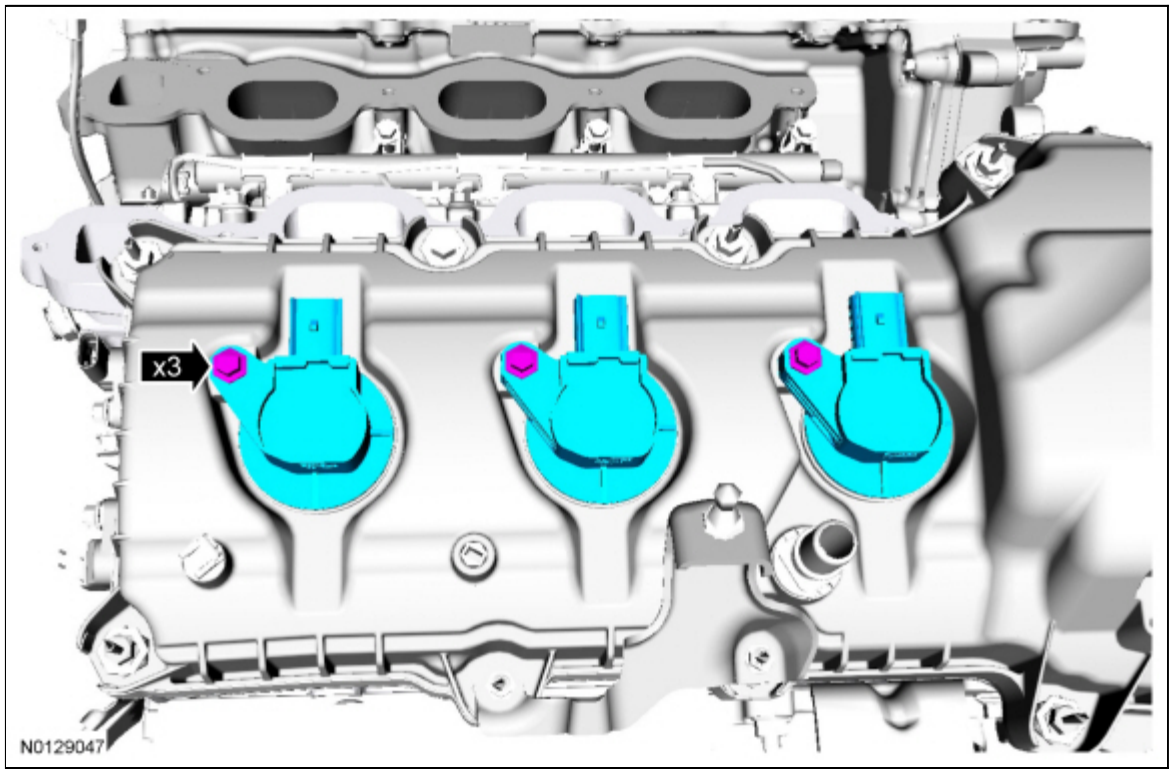
72. Remove and discard the 8 LH exhaust manifold studs.



73. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease

removal.

Remove the 3 bolts and the 3 RH ignition coil-on-plugs.

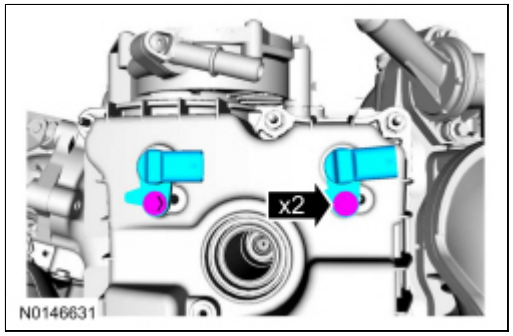


74. ***NOTICE:*** **Only use hand tools when removing the spark plugs, or damage may occur to the cylinder head or spark plug.**

    NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

    Remove the 3 RH spark plugs.

75. Remove the 2 bolts and the CMP sensors.



76. ***NOTICE:*** **While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.**

    NOTICE: **If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT**

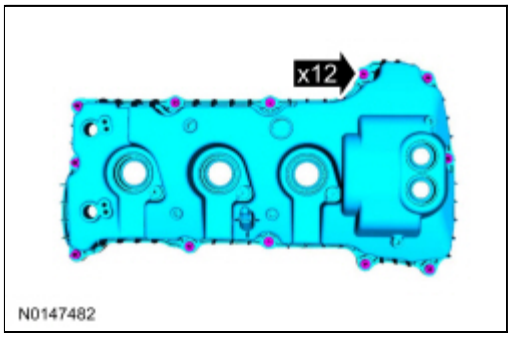
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oil control solenoid may occur.

NOTE: The plastic electrical connector on the VCT oil control solenoid will rotate approximately 12 degrees inside the steel housing, which is normal.

Loosen the 12 stud bolts and remove the RH valve cover.

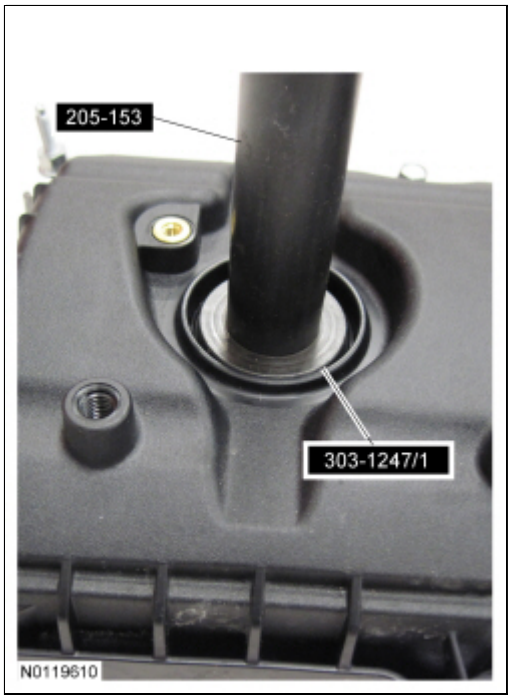
- Discard the gasket.



77. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).

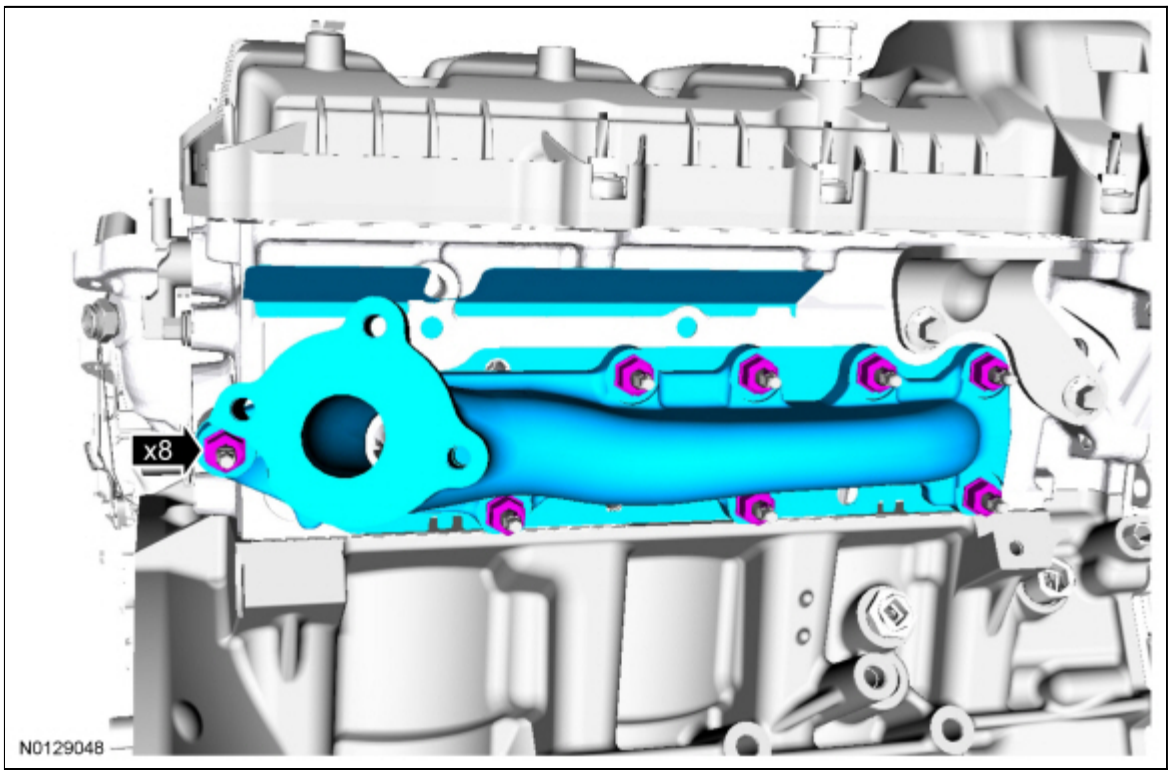


78. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



79. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

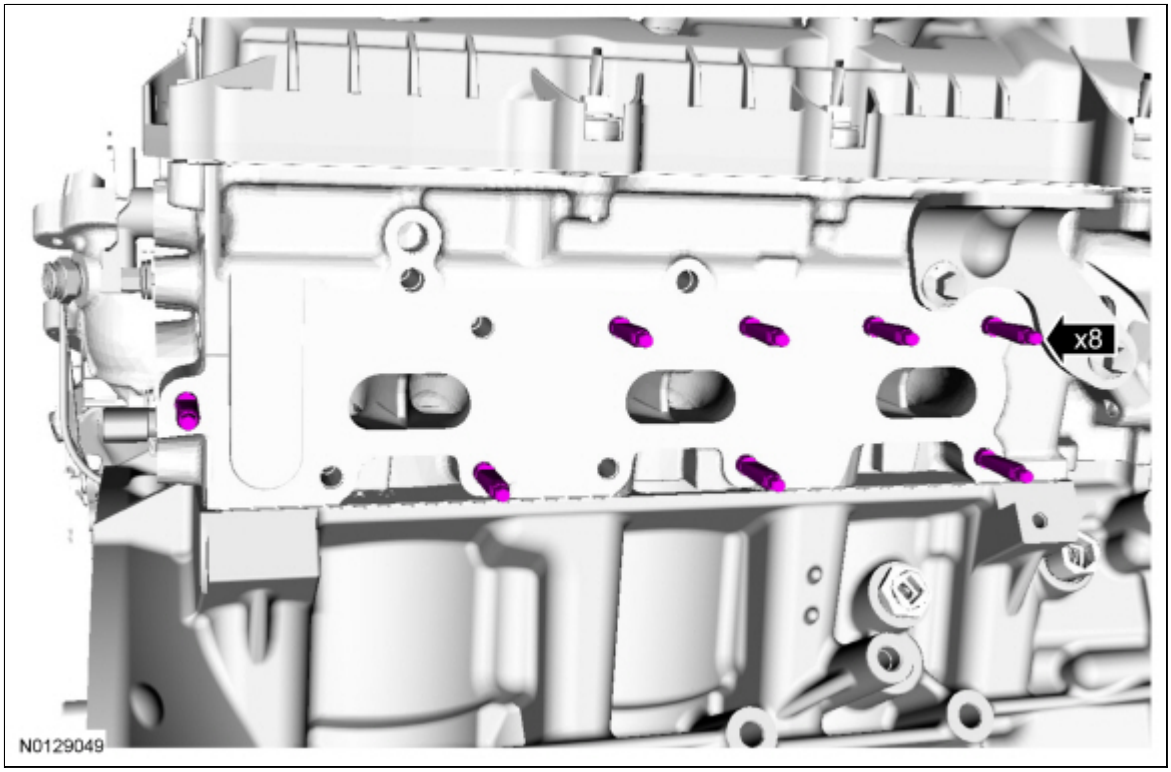
80. Remove the 8 nuts and the RH exhaust manifold.
    - Discard the nuts and exhaust manifold gasket.



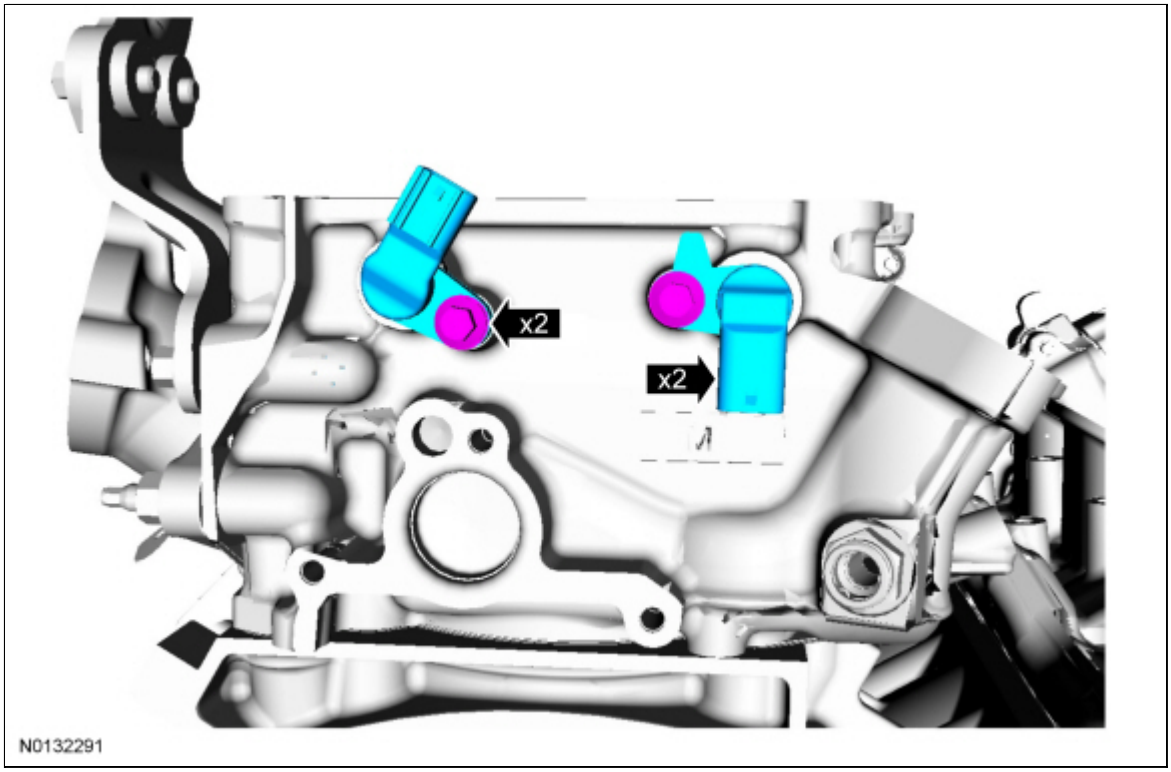
81. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

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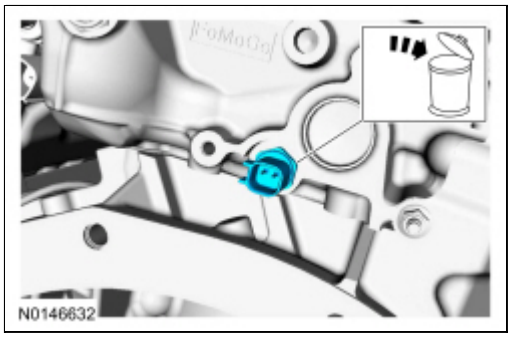
82. Remove and discard the 8 RH exhaust manifold studs.



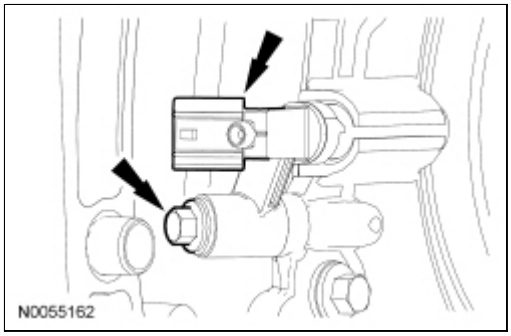
83. Remove the 2 bolts and the LH CMP sensors.



84. Remove and discard the CHT sensor



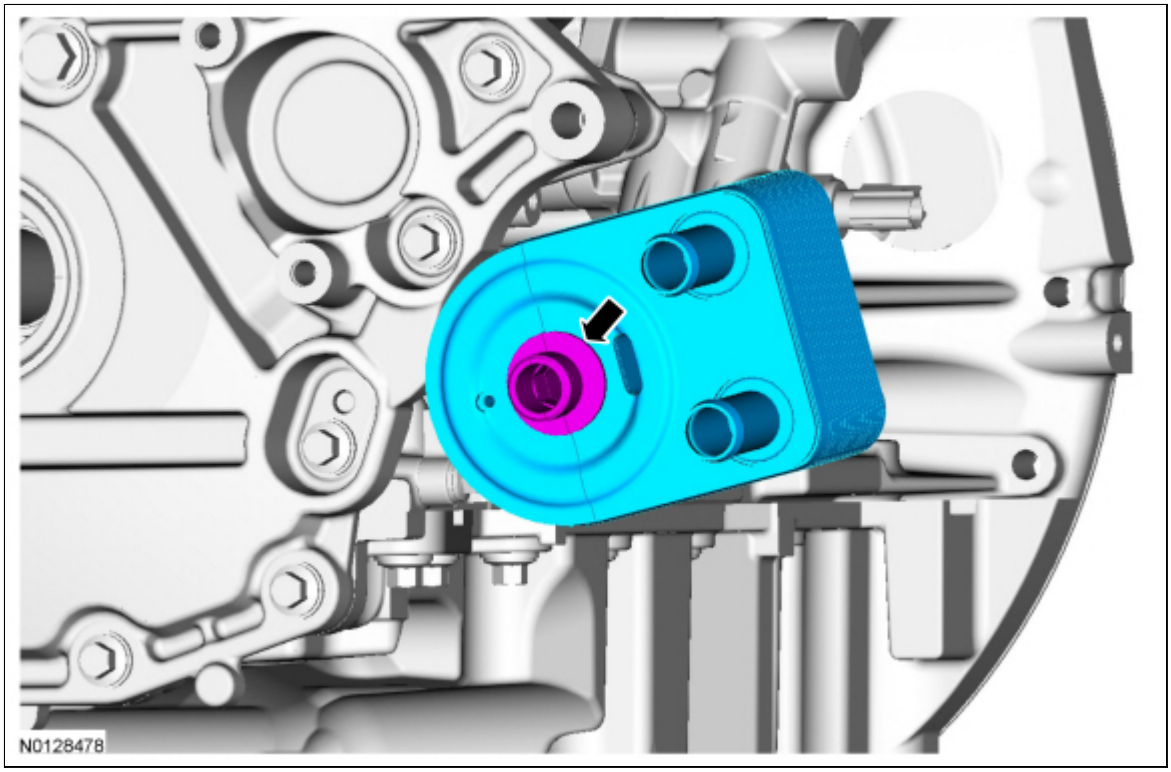
85. Remove the bolt and the CKP sensor.



86. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

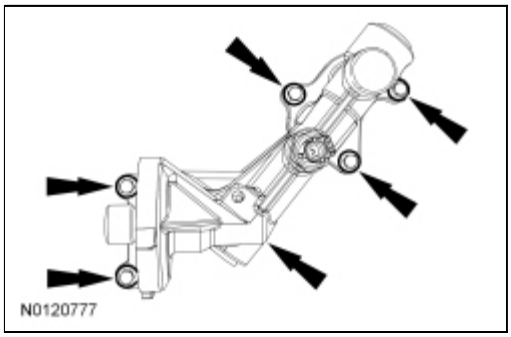
Remove the threaded shaft and the oil cooler.

- Discard the oil cooler.

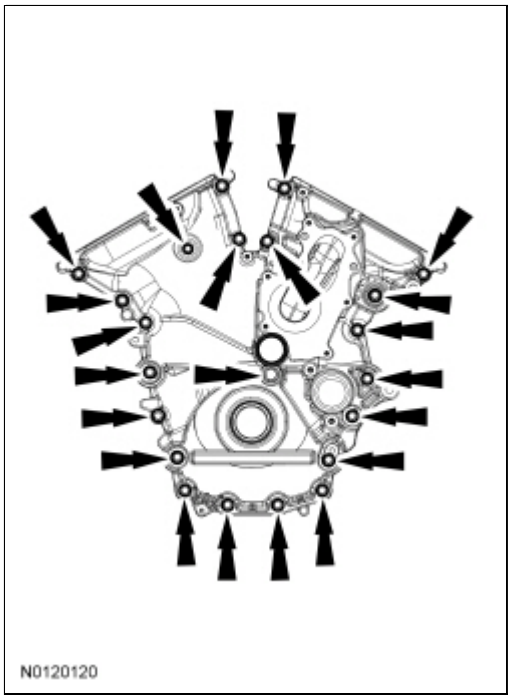


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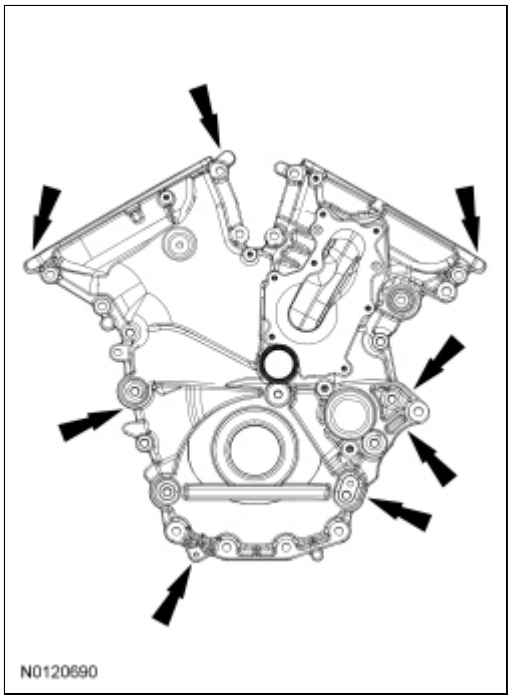
87. Remove the 5 bolts and the oil filter adapter.
    - Discard the gasket.



88. Remove the 22 engine front cover bolts.



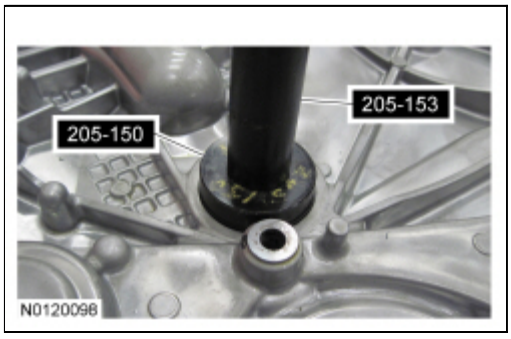
89. Using a suitable pry tool, locate the 7 pry pads shown and pry the engine front cover loose and remove.



90. **NOTE:** Inspect and replace the front cover radial seal as necessary.

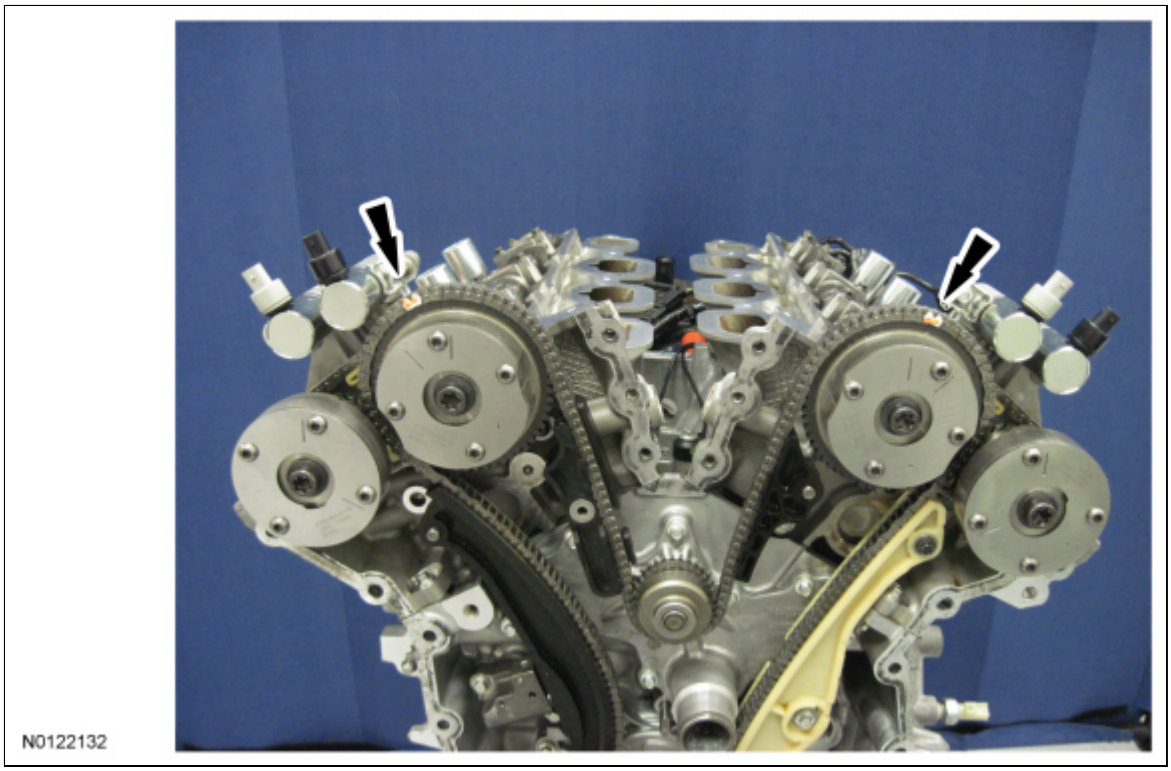
    NOTE: Use Spindle Bearing Installer 205-150 to remove the seal.

    Using the Spindle Bearing Installer and Handle, remove the front cover radial seal from the rear side of the front cover.

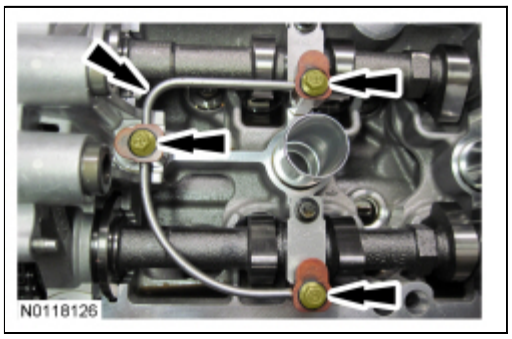


91. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown.

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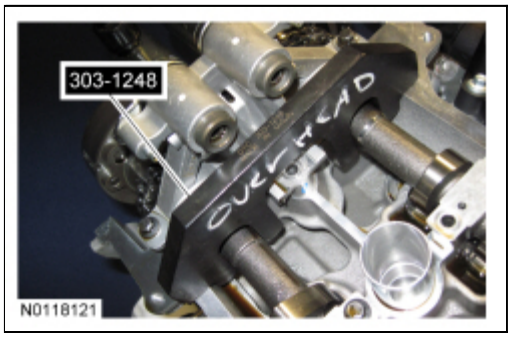


92. Remove the 3 bolts and the LH valve train oil tube.

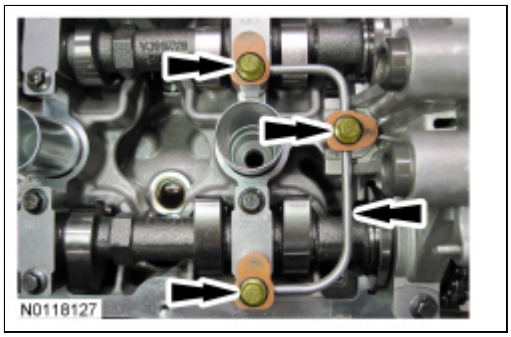


93. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

    Install the Camshaft Holding Tool onto the flats of the LH camshafts.

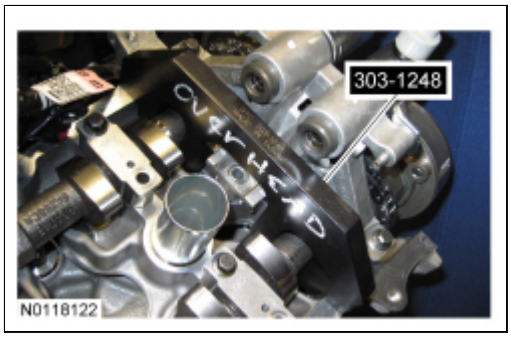


94. Remove the 3 bolts and the RH valve train oil tube.



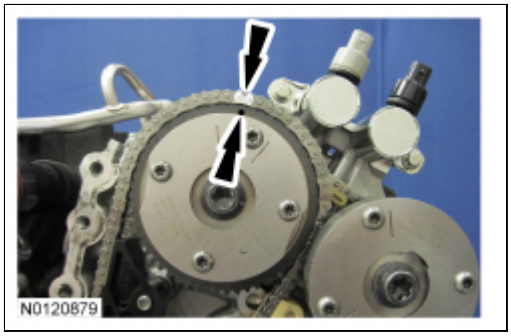
95. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the RH camshafts.

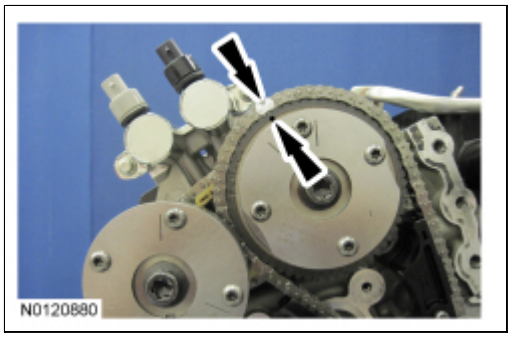


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

96. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.



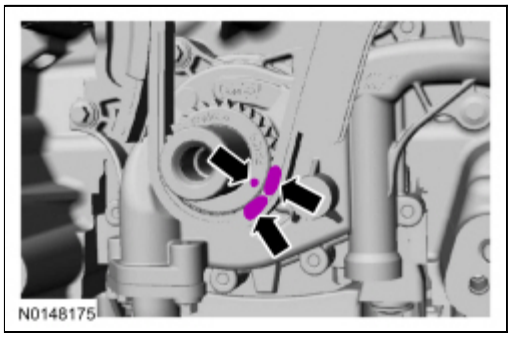
97. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.



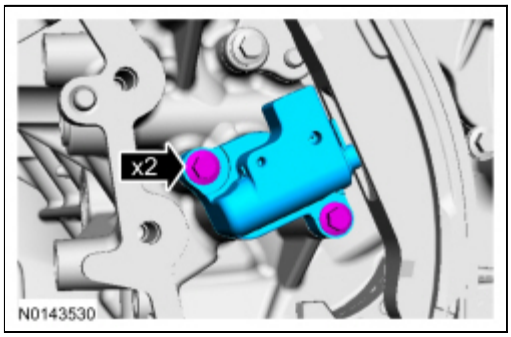
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98. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

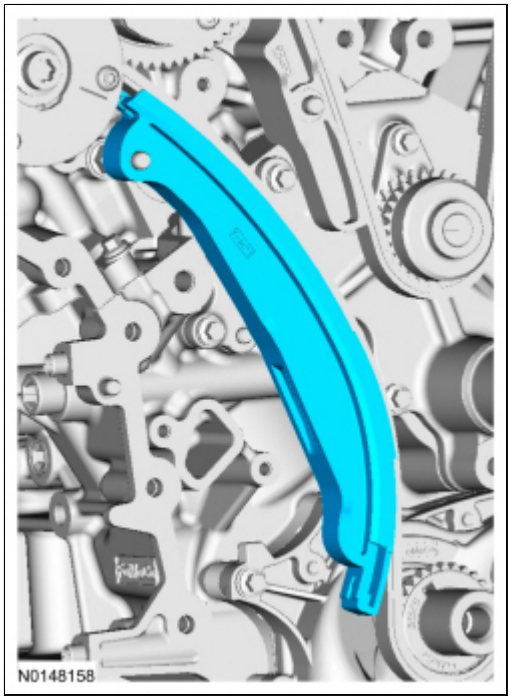
    Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



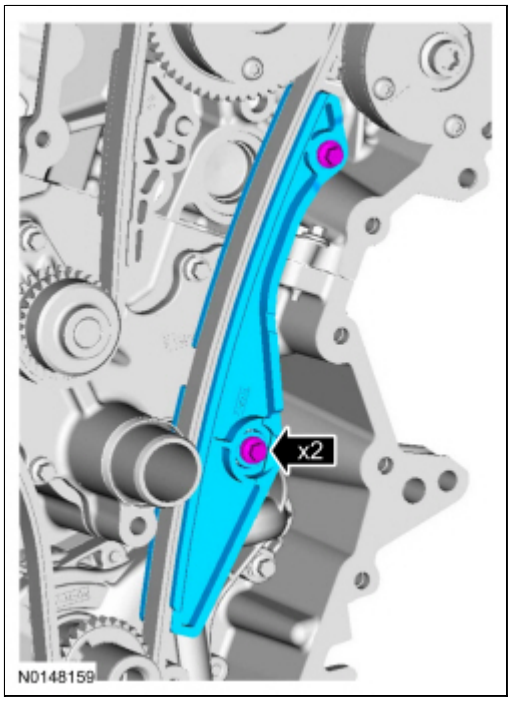
99. Remove the 2 bolts and the primary timing chain tensioner.



100. Remove the primary timing chain tensioner arm.



101. Remove the 2 bolts and the lower LH primary timing chain guide.

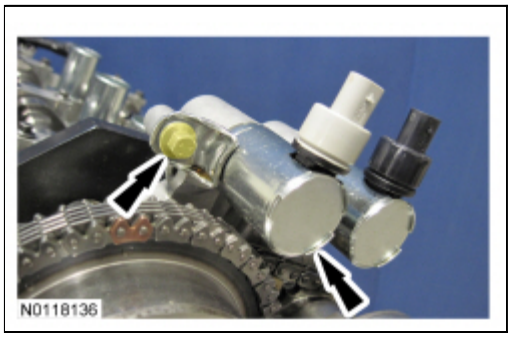


102. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Remove the bolt and the LH intake VCT oil control solenoid.



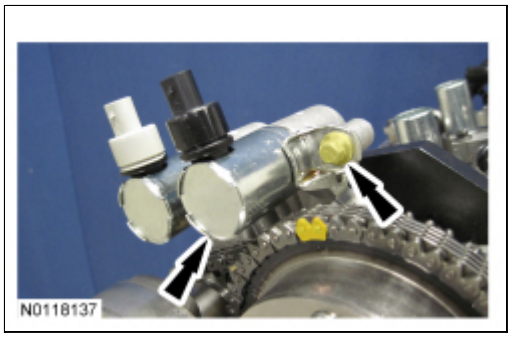
103. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

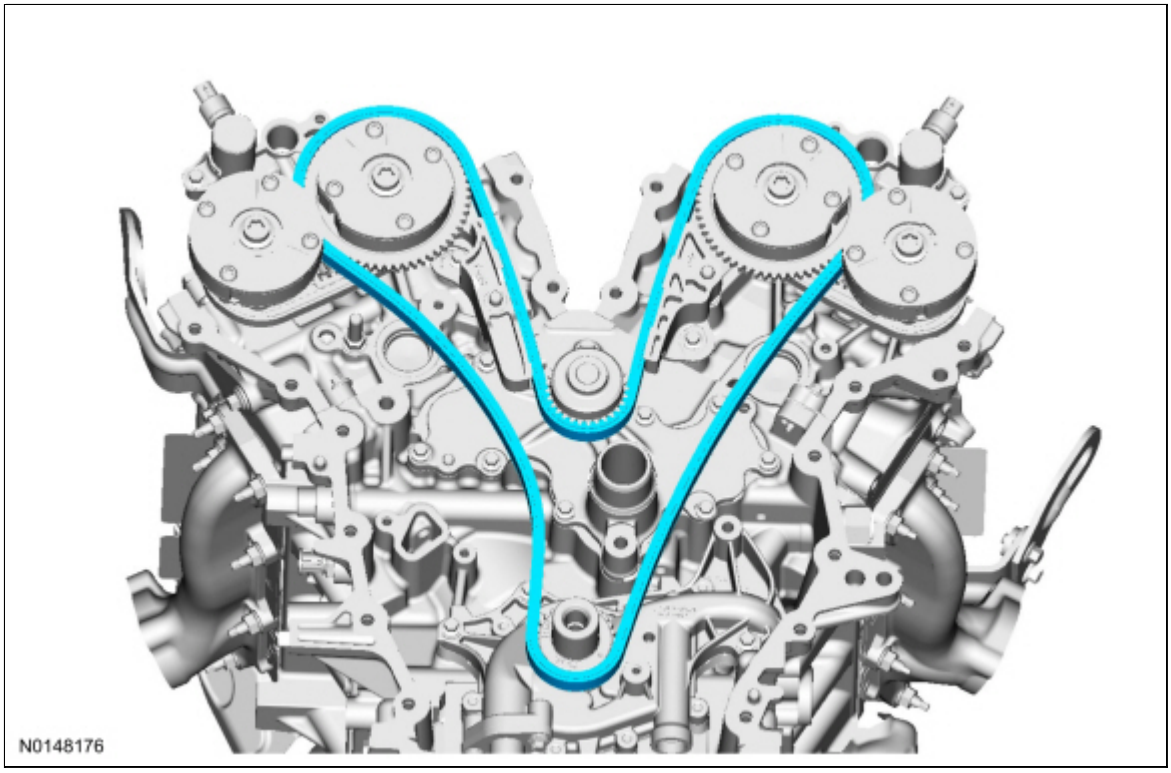
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Remove the bolt and the RH intake VCT oil control solenoid.

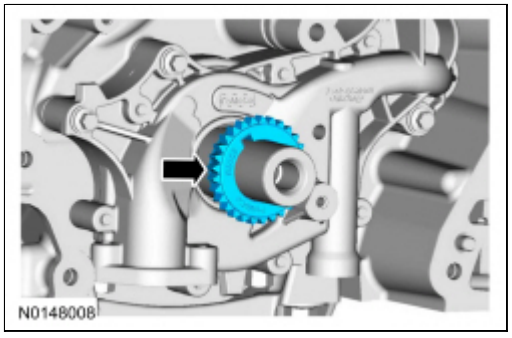
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104. Remove the primary timing chain.

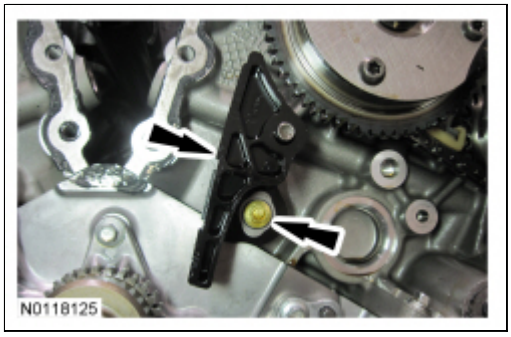


105. Remove the crankshaft timing chain sprocket.



106. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.**

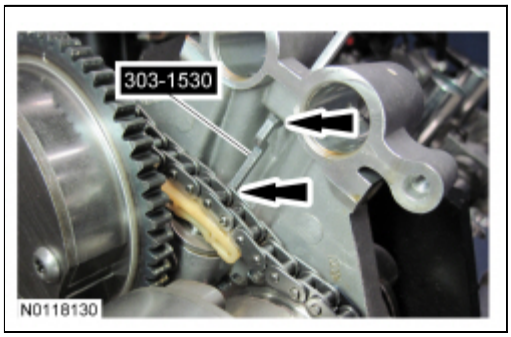
Remove the bolt and the upper LH primary timing chain guide.



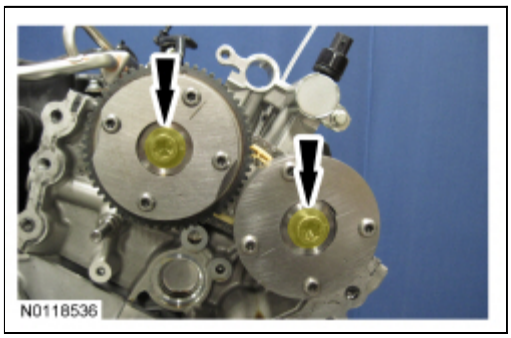
107. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

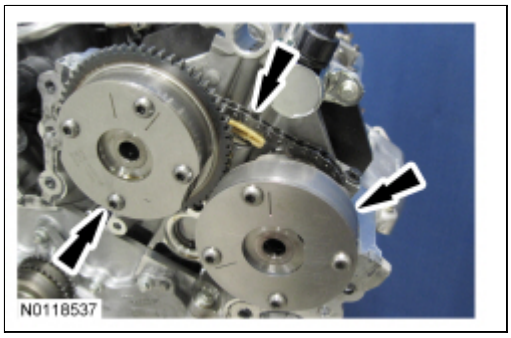


108. Remove and discard the 2 LH VCT assembly bolts.



109. Remove the 2 LH VCT assemblies and secondary timing chain.

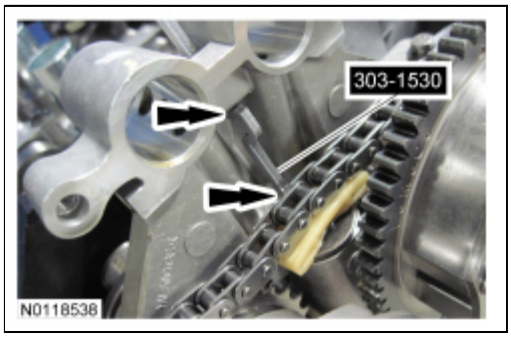
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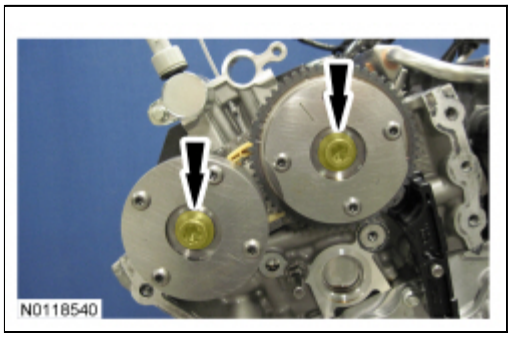
110. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

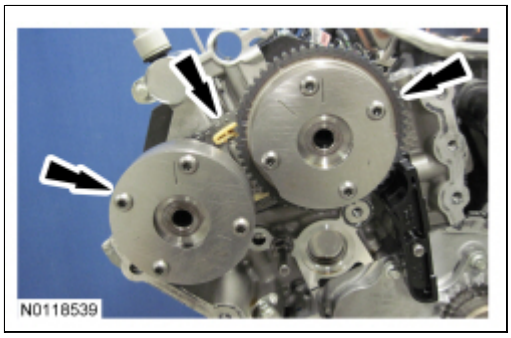
Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



111. Remove and discard the 2 RH VCT assembly bolts.

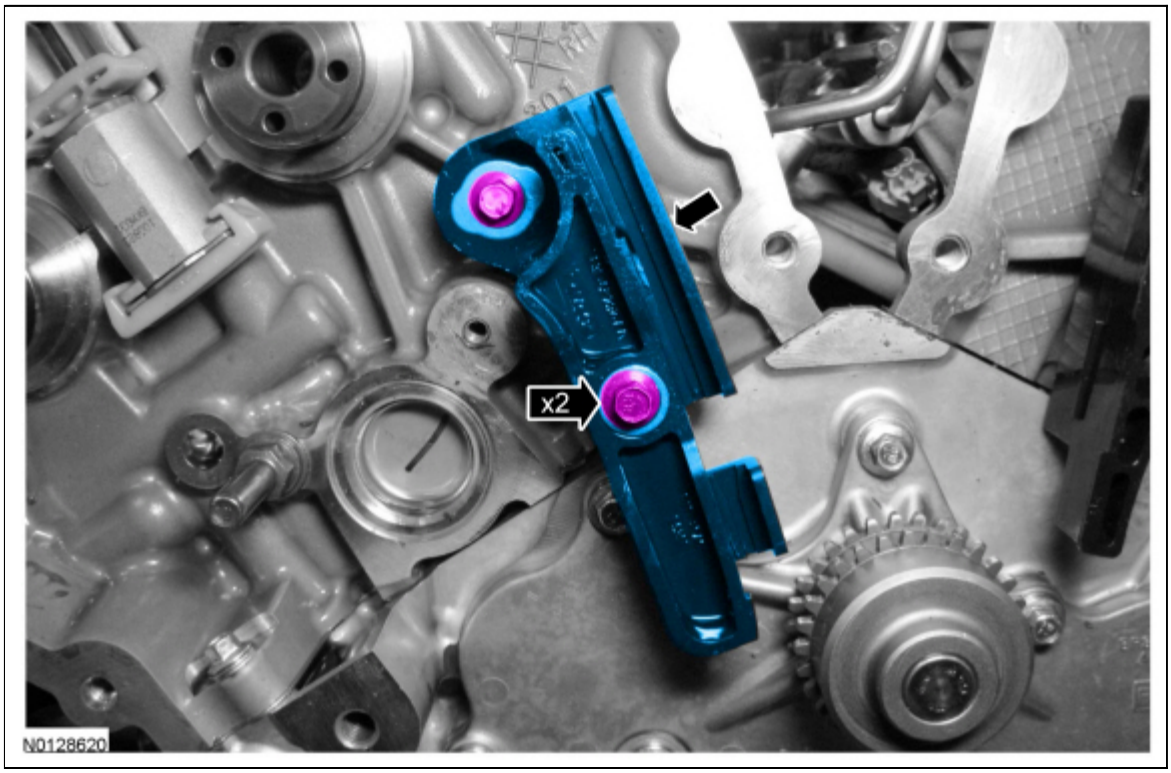


112. Remove the 2 RH VCT assemblies and secondary timing chain.

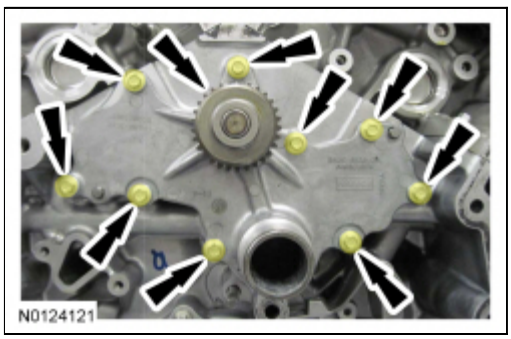


113. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.**

Remove the 2 bolts and the RH primary timing chain guide.



114. Remove the 9 bolts and the timing chain gear.
    - Discard the gasket.



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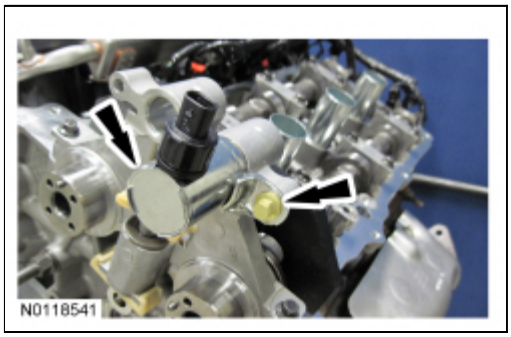
Engines with secondary timing chain tensioner removed

NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed, or damage to the engine may occur.**

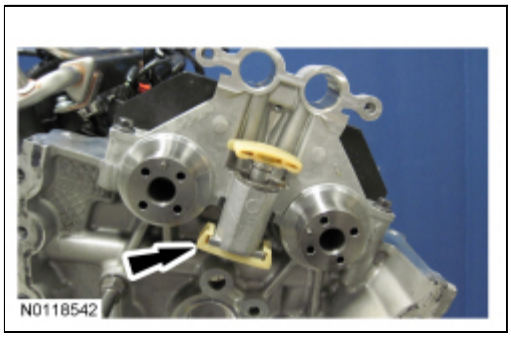
115. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

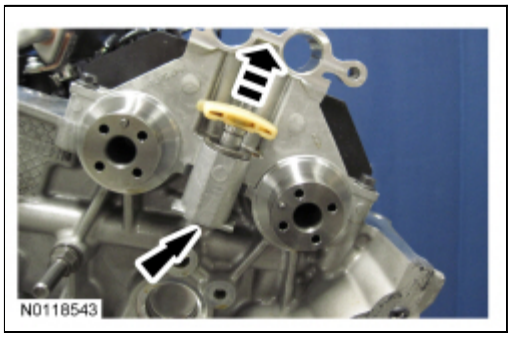
    Remove the LH exhaust VCT oil control solenoid.



116. Remove the LH secondary timing chain tensioner shoe.



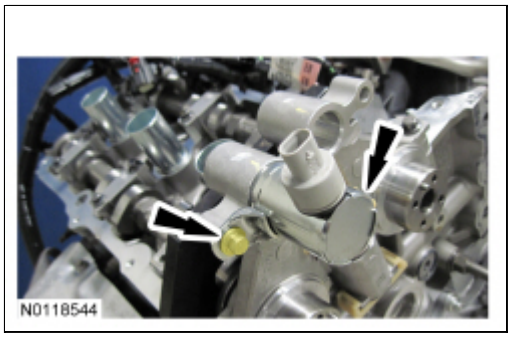
117. Remove the LH secondary timing chain tensioner by pushing up from the bottom and remove.



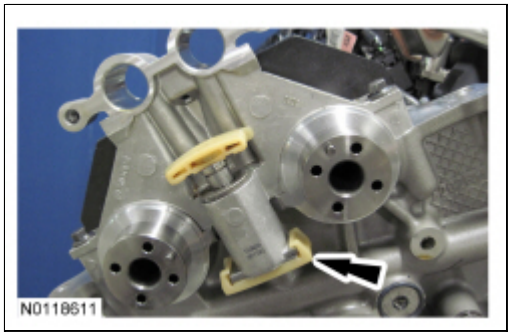
118. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

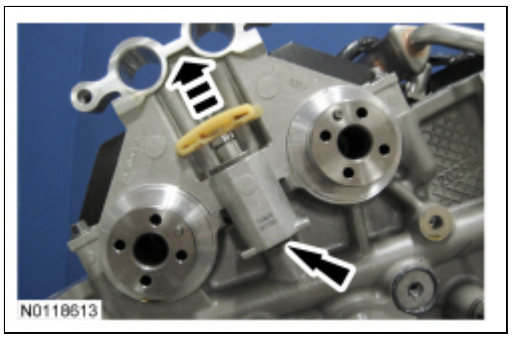
    Remove the RH exhaust VCT oil control solenoid.



119. Remove the RH secondary timing chain tensioner shoe.



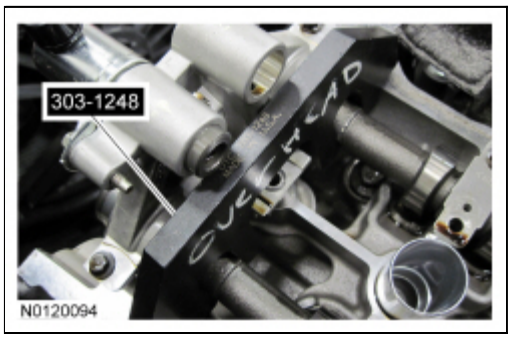
120. Remove the RH secondary timing chain tensioner by pushing up from the bottom and remove.



All engines

121. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the LH camshafts approximately 3 degrees to a neutral position.

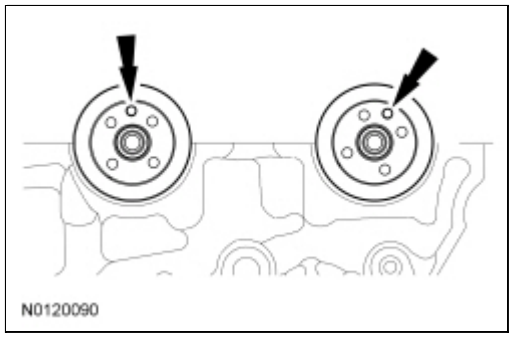
Remove the Camshaft Holding Tool from the LH camshafts.



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122. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

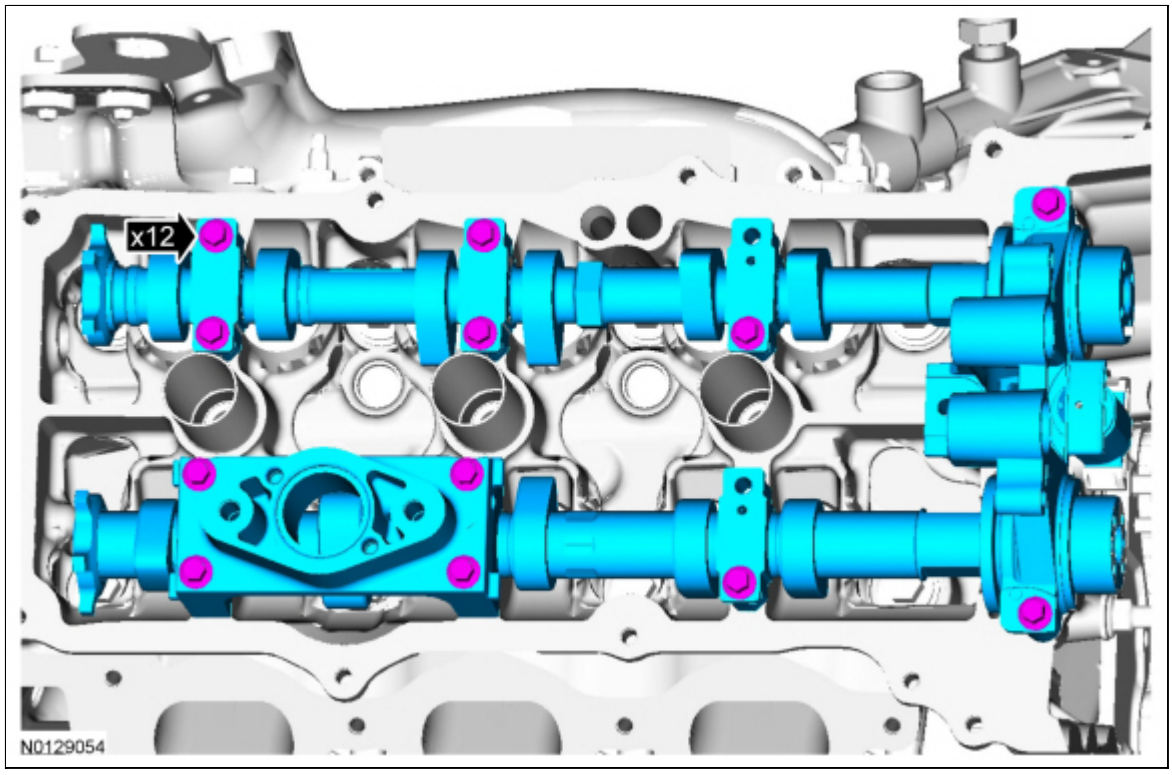
Verify the LH camshafts are in the neutral position.



123. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

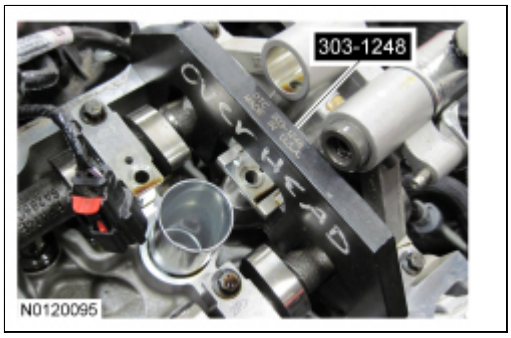
NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

Remove the 12 bolts, 6 camshaft caps, mega cap and the LH camshafts.



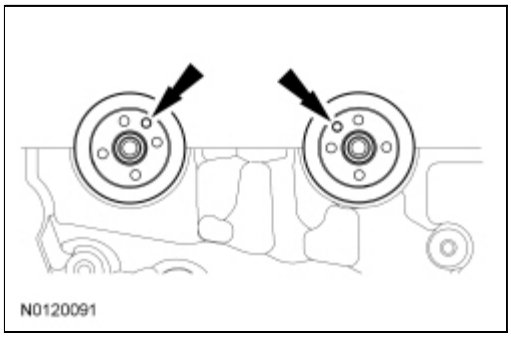
124. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the RH camshafts approximately 3 degrees to a neutral position.

Remove the Camshaft Holding Tool from the RH camshafts.

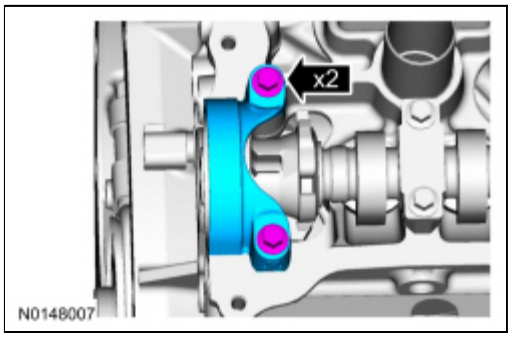


125. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

Rotate the RH camshafts counterclockwise to the neutral position.



126. Remove the 2 bolts and the camshaft bearing cap assembly.

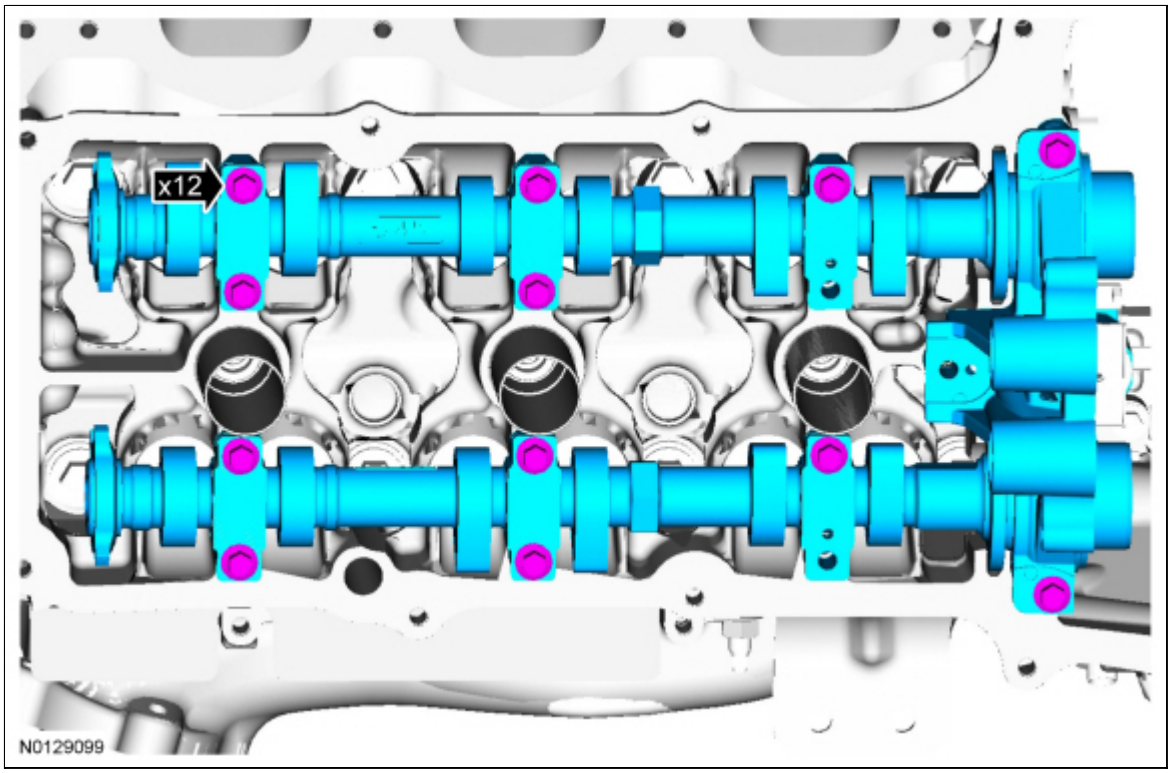


127. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

Remove the 12 bolts, 6 camshaft caps, mega cap and the RH camshafts.

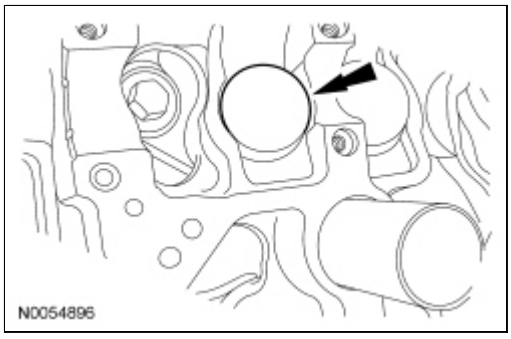
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128. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

NOTE: LH shown, RH similar.

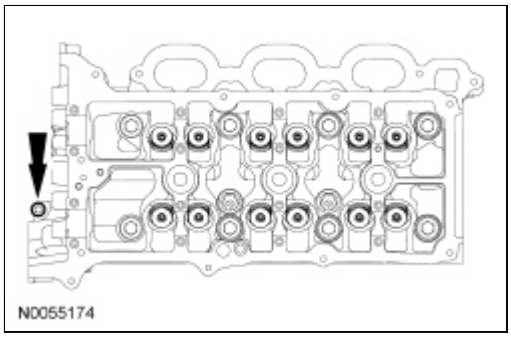
Remove the valve tappets from the cylinder heads.



129. Inspect the valve tappets. For additional information, refer to Section 303-00 .

130. **NOTE:** LH shown, RH similar.

Remove and discard the M6 bolt from each cylinder head.



131. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

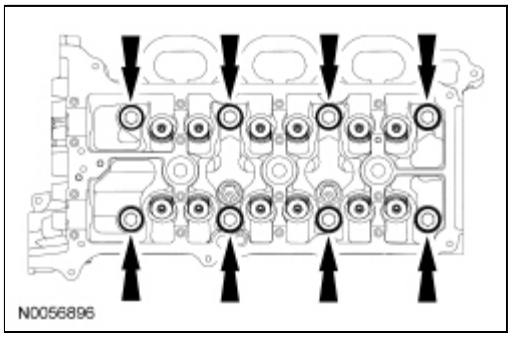
NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTE: LH shown, RH similar.

Remove and discard the 8 bolts from each cylinder head.

- Remove the cylinder heads.
- Discard the cylinder head gaskets.



132. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone

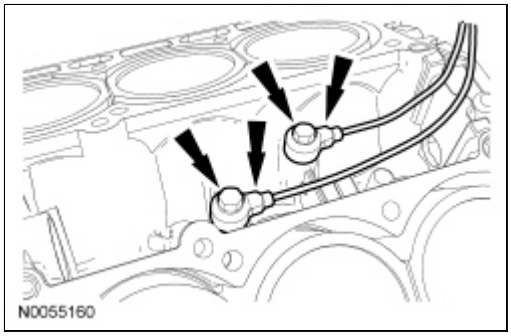
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gasket remover may be required if residual traces of silicone or gasket material remain.

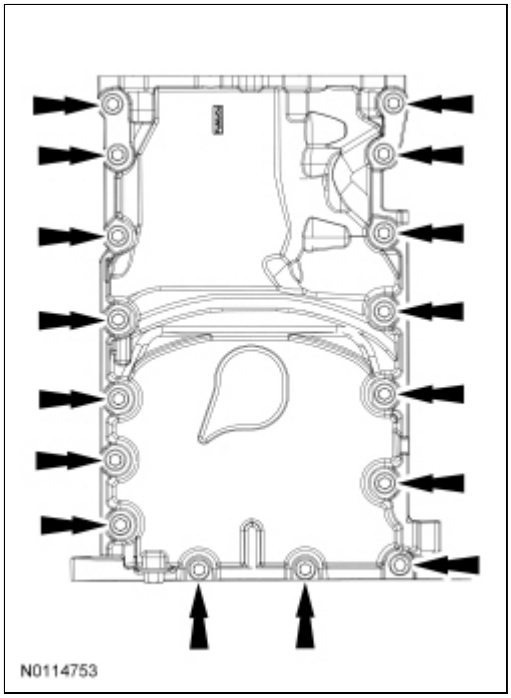
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

133. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

134. Remove the 2 bolts and the KS .

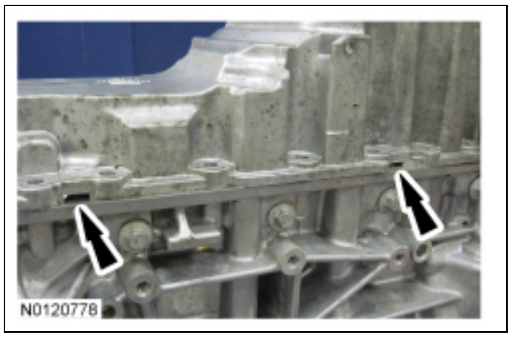


135. Remove the 16 oil pan bolts.

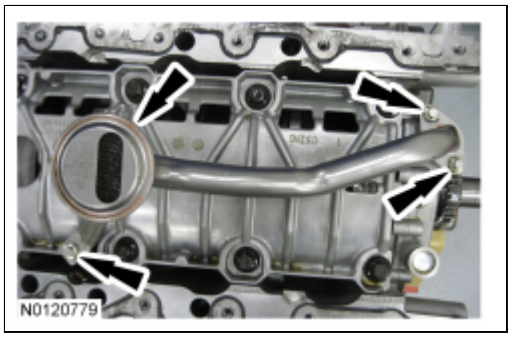


136. **NOTE:** RH shown, LH similar.

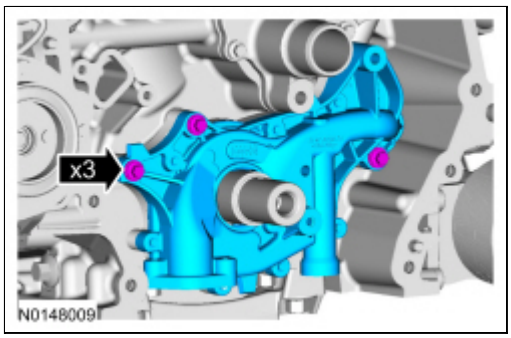
Using a suitable pry tool, locate the 2 pry pads at the LH and RH side of the oil pan and pry the oil pan loose and remove.



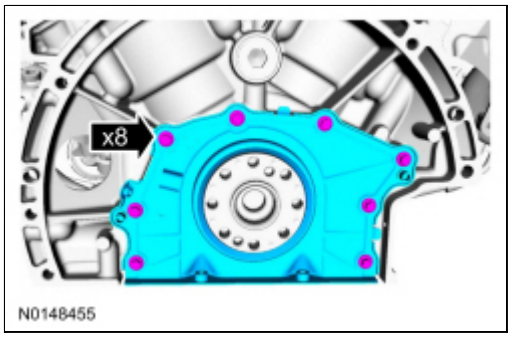
137. Remove the 3 bolts and the oil pump screen and the pickup tube.
    - Discard the O-ring seal.



138. Remove the 3 bolts and the oil pump.



139. Remove the 8 bolts and the crankshaft rear seal retainer plate.
    - Discard the plate and seal assembly.



140. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or

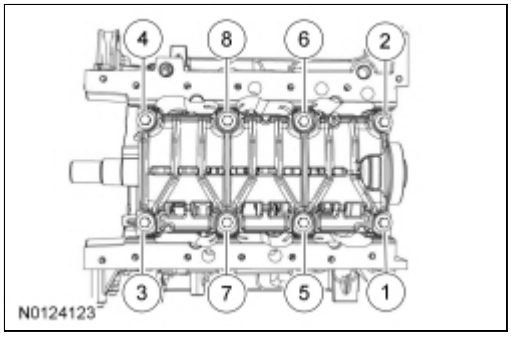
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carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

141. **NOTE:** The main bearing cap support brace bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

Remove the bolts in the sequence shown.

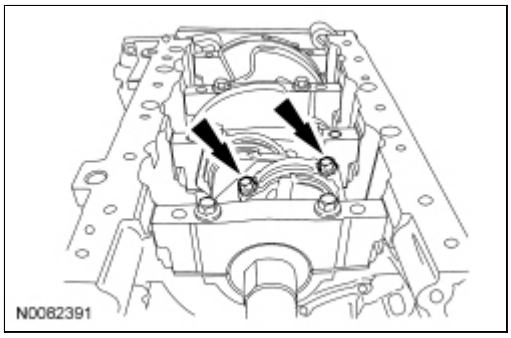
- Remove the main bearing cap support brace.
- Discard the bolts.



142. **NOTE:** The connecting rod cap bolts are a tighten-to-yield design. The original connecting rod cap bolts will be used when measuring the connecting rod large end bore during assembly. The connecting rod cap bolts will be discarded after measurement.

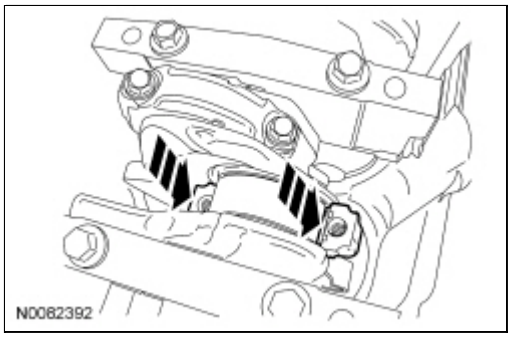
NOTE: Clearly mark the position and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.

Remove the connecting rod cap bolts and cap.



143. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

Remove the piston/rod assembly from the engine block.



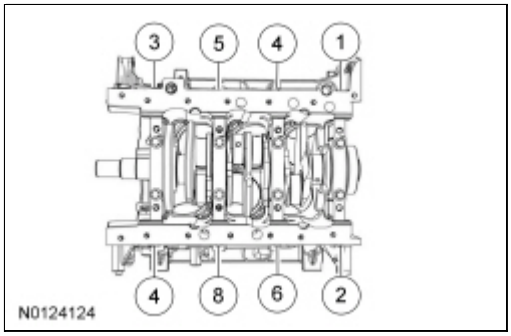
144. Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.

145. **NOTE:** The 8 main bearing cap side bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTE: Clearly mark the position and orientation of the main bearing caps for reassembly.

Remove the 8 main bearing cap side bolts in the sequence shown.

- Discard the bolts.

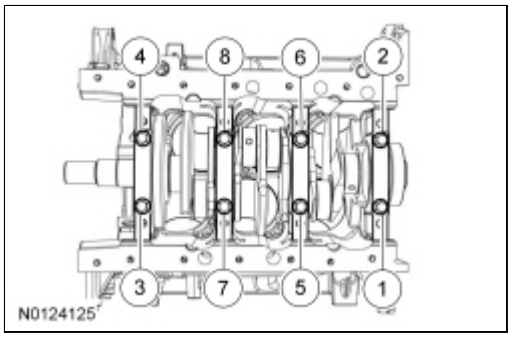


146. **NOTE:** The 8 main bearing cap bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTE: Clearly mark the position and orientation of the main bearing caps for reassembly.

Remove the 8 main bearing cap bolts in the sequence shown.

- Discard the bolts.

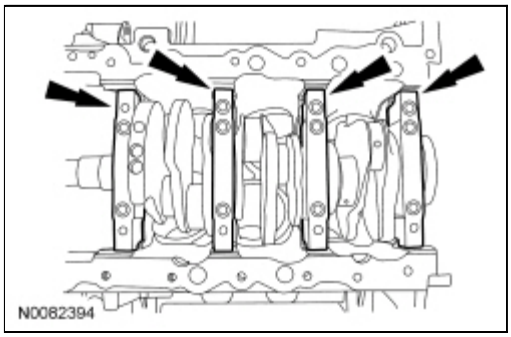


147. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

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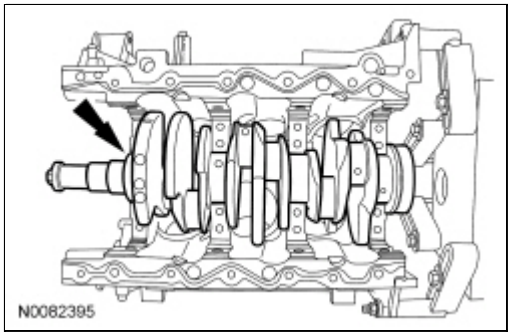
NOTE: Note the position of the thrust washer on the outside of the No. 4 rear main bearing cap.

Remove the 4 main bearing caps.



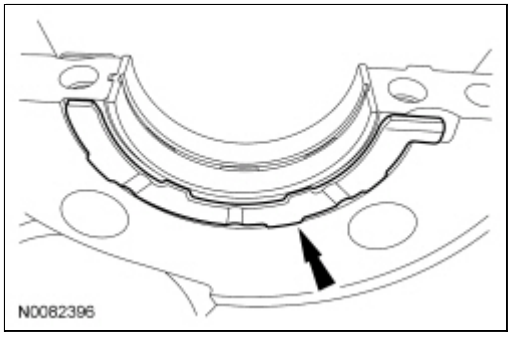
148. **NOTE:** Note the position of the 2 thrust washers on the inside and outside of the rear main bearing bulkhead.

Remove the crankshaft.



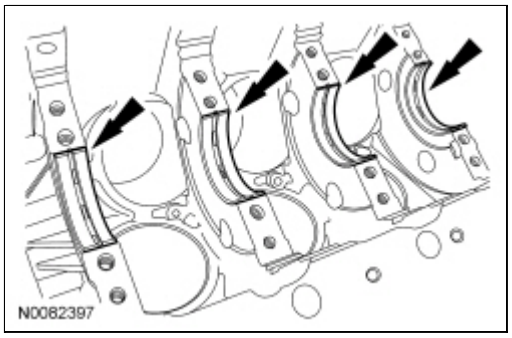
149. **NOTE:** Inside shown, outside similar.

Remove the 2 crankshaft thrust bearings from the rear main bearing bulkhead.

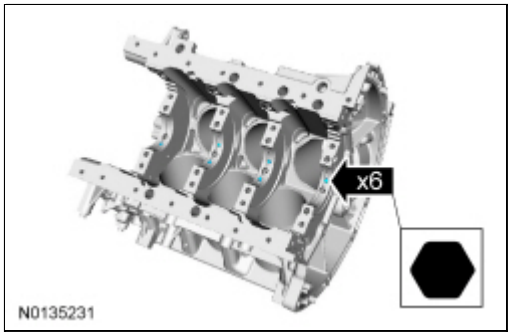


150. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the 4 crankshaft main bearings from the cylinder block.

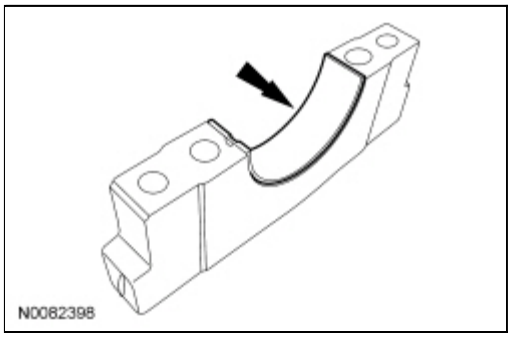


151. Using a hexagonal screwdriver, remove the 6 piston oil cool valves.



152. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the 4 crankshaft main bearings from the main bearing caps.



153. Inspect the cylinder block, bearing cap support brace, pistons and connecting rods. For additional information, refer to Section 303-00 .

154. ***NOTICE:*** **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.

1. Remove any large deposits of silicone or gasket material.
2. Apply silicone gasket remover and allow to set for several minutes.
3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to

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bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

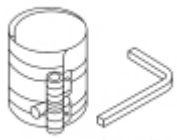
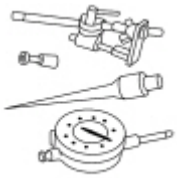
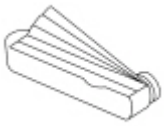
155. ***NOTICE:*** **Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover and oil pan. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover and oil pan. These tools cause scratches and gouges that make leak paths.**

Clean the engine front cover and oil pan using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

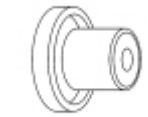
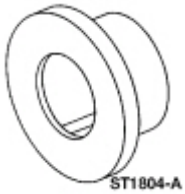
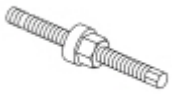
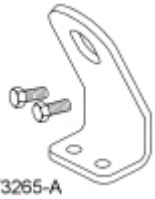
- Thoroughly wash the engine front cover and oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

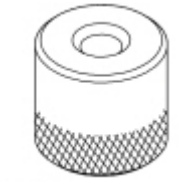
Engine

Special Tool(s)

 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST3101-A	Bar, Engine Spreader 303-1454
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST3234-A	Hold Down, Secondary Chain 303-1530
	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

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 ST2212-A	
 ST1804-A	Installer, Spindle Bearing 205-149 (T80T-4000-R)
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
 ST3265-A	Lift Eye, Right Front 303-1566
	Seal Installer, Fuel Injector 310-207

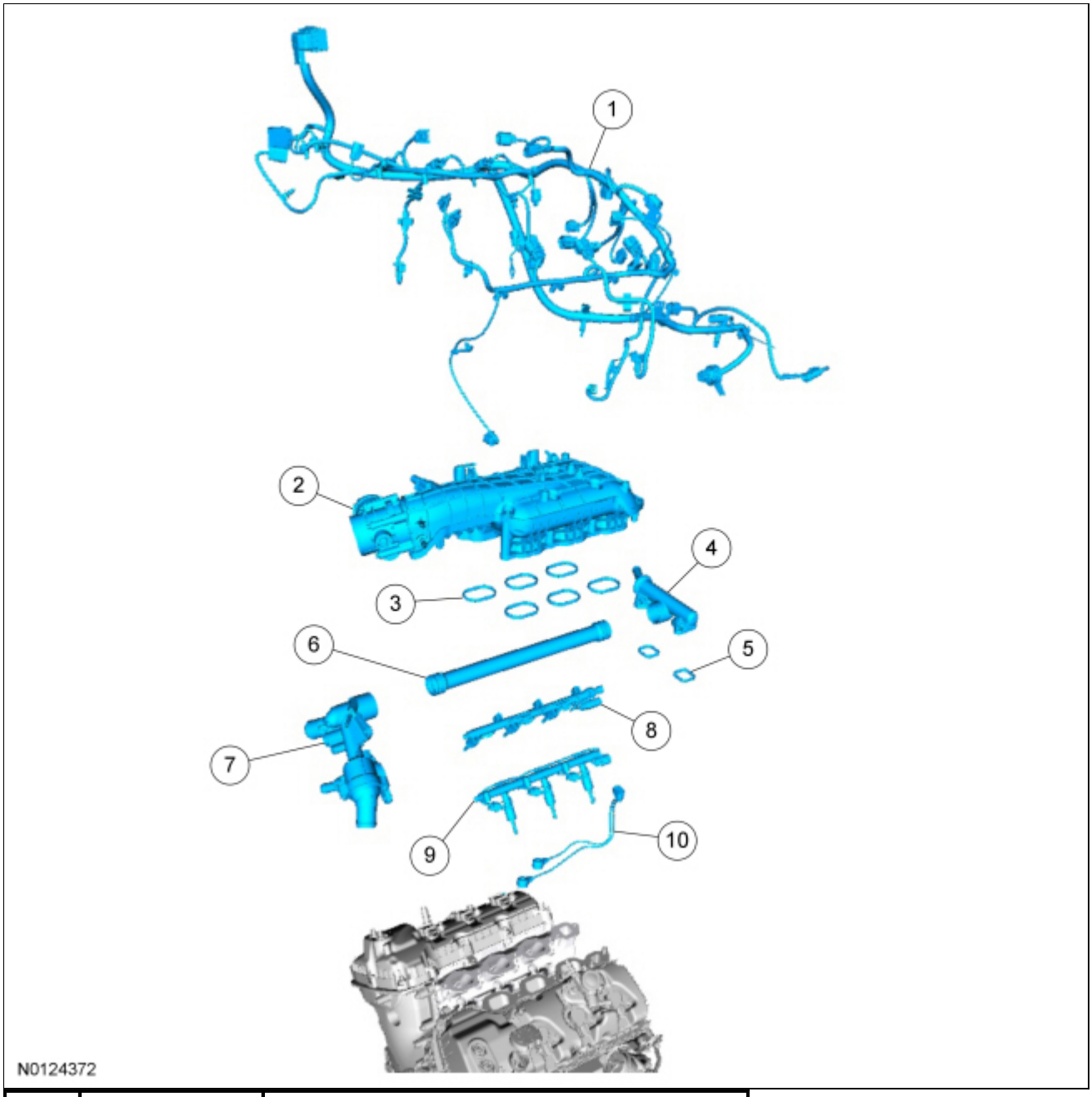
 ST3097-A	
 ST3266-A	Sizer, Teflon® Seal 303-1567
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

Item	Specification
Motorcraft® Gasket Maker TA-16	WSK-M2G348-A5
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D
Motorcraft® Thread Sealant with PTFE TA-24	WSK-M2G350-A2

Engine Upper

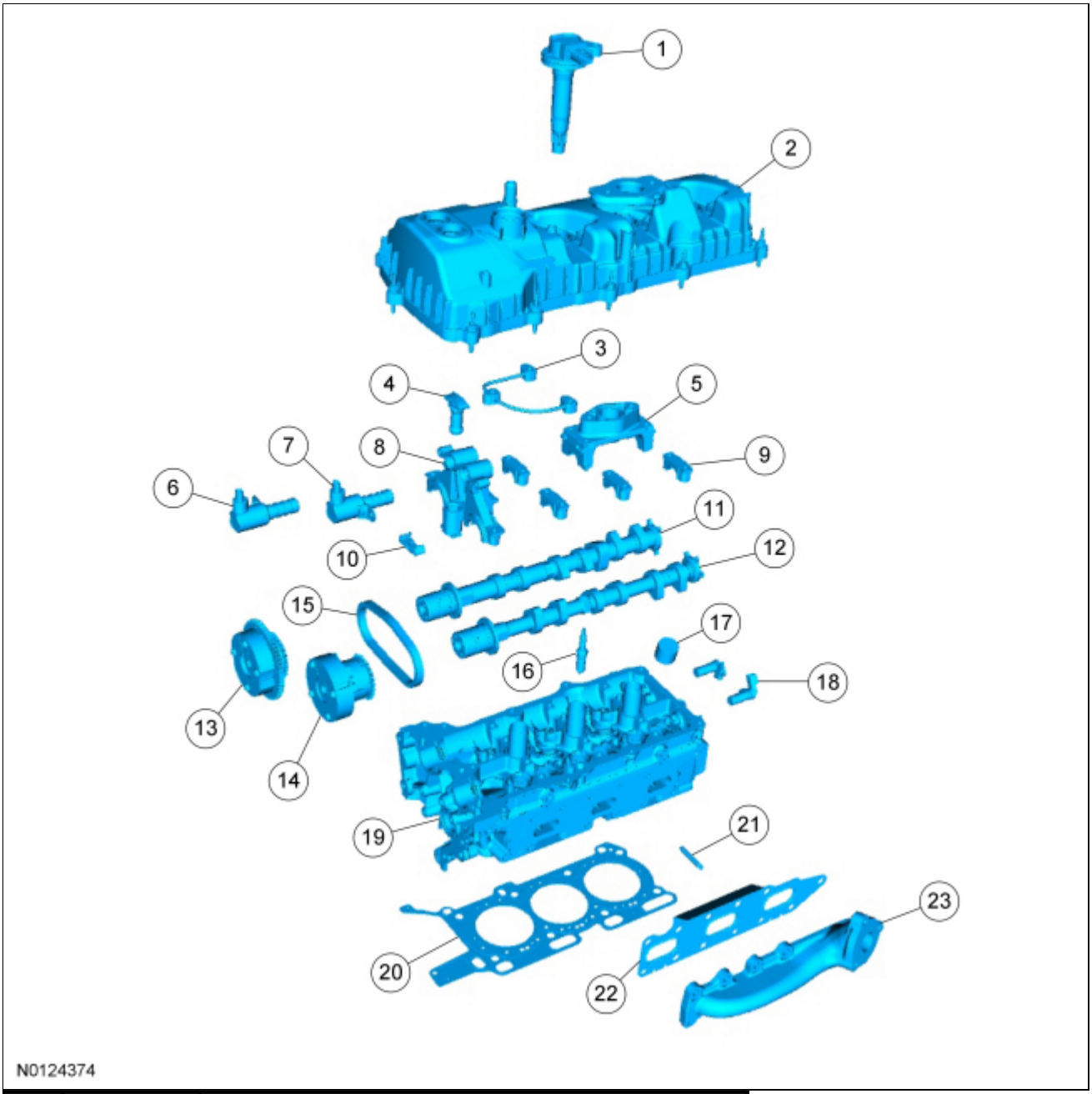
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Item	Part Number	Description
1	12A581	Engine control harness
2	9424	Intake manifold
3	9439	Intake manifold gasket
4	8C368	Coolant crossover
5	—	Coolant crossover gasket (2 required)
6	8A505	Thermostat housing inlet tube
7	8592	Thermostat housing
8	9D280	RH Fuel rail
9	9D280	LH Fuel rail

10	12A699	Knock Sensor (KS)

Engine Upper — LH Cylinder Head

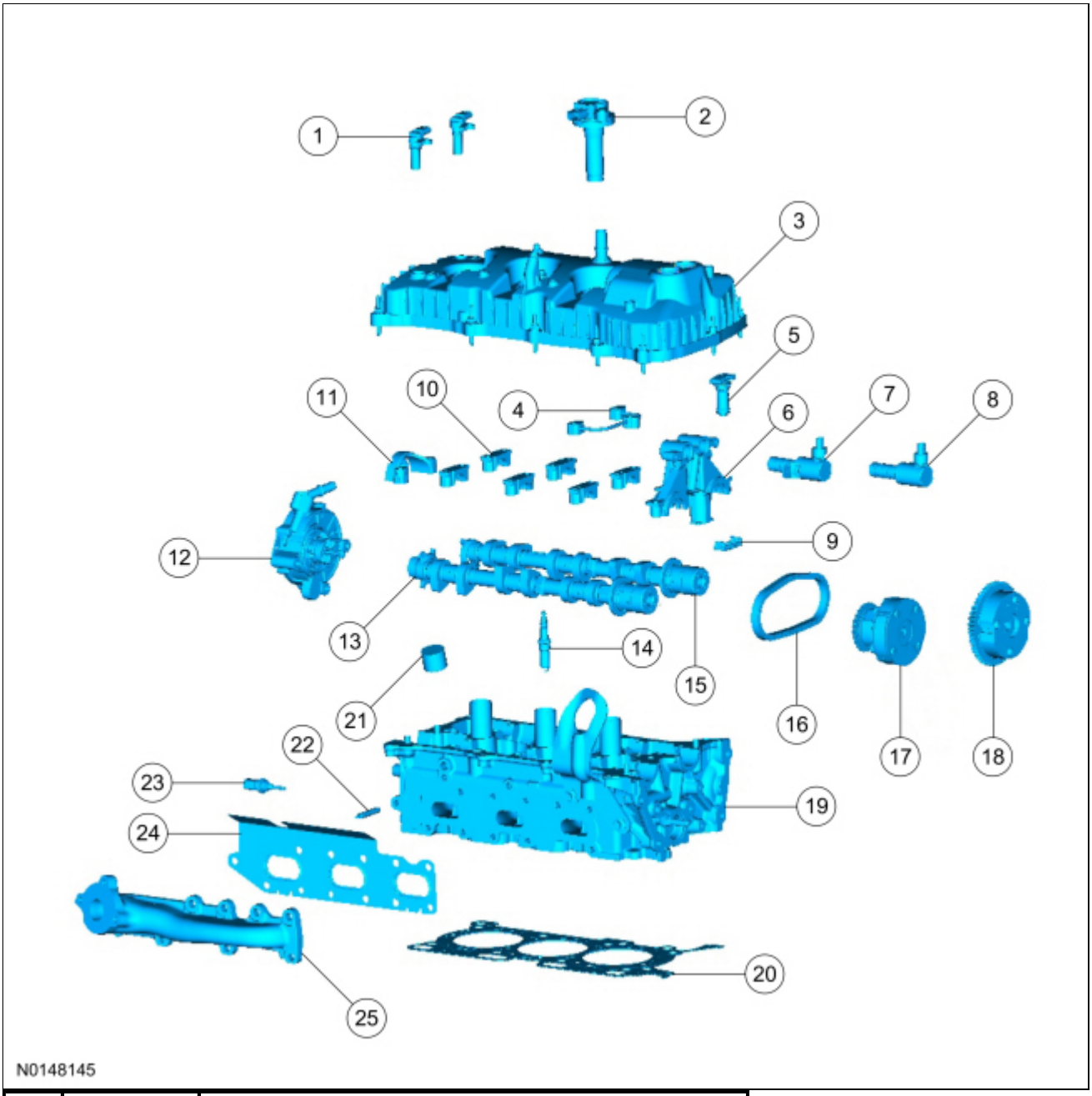


Item	Part Number	Description
1	12029	Ignition coil-on-plug (3 required)
2	6582	LH valve cover
3	6K602	Valve train oil feed tube

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4	6K254	LH secondary timing chain tensioner
5	6A258	LH camshaft cap
6	6M280	Intake camshaft Variable Camshaft Timing (VCT) oil control solenoid
7	6M280	Exhaust camshaft VCT oil control solenoid
8	6B280	Camshaft mega cap
9	6A258	LH camshaft cap (4 required)
10	6K297	LH secondary tensioner shoe
11	6250	LH intake camshaft
12	6250	LH exhaust camshaft
13	6256	Intake camshaft VCT assembly
14	6C525	Exhaust camshaft VCT assembly
15	6268	LH secondary timing chain
16	12405	Spark plug (3 required)
17	6500	Valve tappet (16 required)
18	6B288	LH cylinder head Camshaft Position (CMP) sensor (2 required)
19	6049	LH cylinder head
20	6051	LH cylinder head gasket
21	W712244	LH exhaust manifold stud (8 required)
22	9448	LH exhaust manifold gasket
23	9431	LH exhaust manifold

Engine Upper — RH Cylinder Head

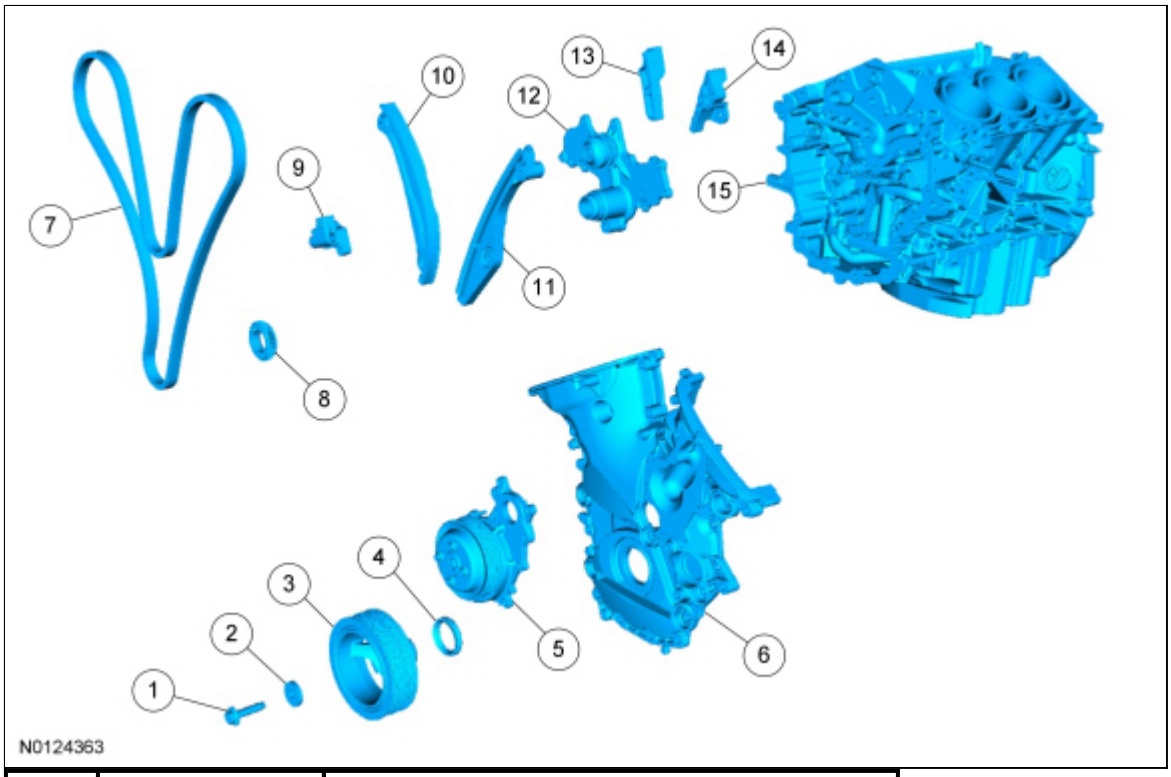


Item	Part Number	Description
1	6B288	RH cylinder head Camshaft Position (CMP) sensor (2 required)
2	12029	Ignition coil-on-plug (3 required)
3	6582	RH valve cover
4	6K602	Valve train oil feed tube
5	6K254	RH secondary timing chain tensioner
6	6B280	Camshaft mega cap
7	6M280	Exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid

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8	6M280	Intake camshaft VCT oil control solenoid
9	6K297	RH secondary tensioner shoe
10	6A258	RH camshaft cap (6 required)
11	6B284	RH rear camshaft bearing cap assembly
12	2A251	Vacuum pump
13	6250	RH exhaust camshaft
14	12405	Spark plug (3 required)
15	6250	RH intake camshaft
16	6268	RH secondary timing chain
17	6C525	Exhaust camshaft VCT assembly
18	6256	Intake camshaft VCT assembly
19	6049	RH cylinder head
20	6051	RH cylinder head gasket
21	6500	Valve tappet (16 required)
22	W712244	RH exhaust manifold stud (8 required)
23	6G004	Cylinder Head Temperature (CHT) sensor
24	9448	RH exhaust manifold gasket
25	9430	RH exhaust manifold

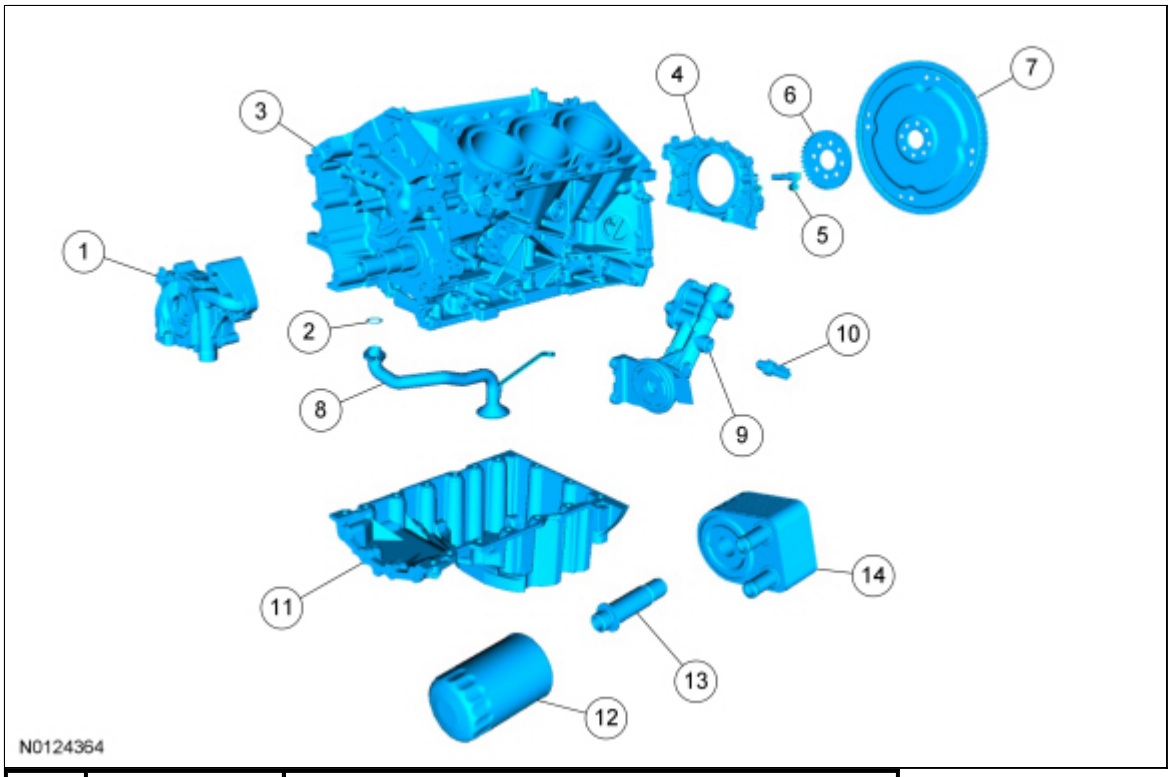
Engine Front



Item	Part Number	Description
1	6A340	Crankshaft pulley bolt
2	6378	Crankshaft pulley washer
3	6312	Crankshaft pulley
4	6700	Crankshaft front seal
5	8501	Coolant pump
6	6019	Engine front cover
7	6268	Timing chain
8	6306	Crankshaft timing sprocket
9	6K254	Primary timing chain tensioner
10	6K255	Primary timing chain tensioner arm
11	6B274	LH lower primary timing chain guide
12	8501	Timing chain gear
13	6M256	RH primary timing chain guide
14	6K297	LH upper primary timing chain guide
15	6010	Cylinder block

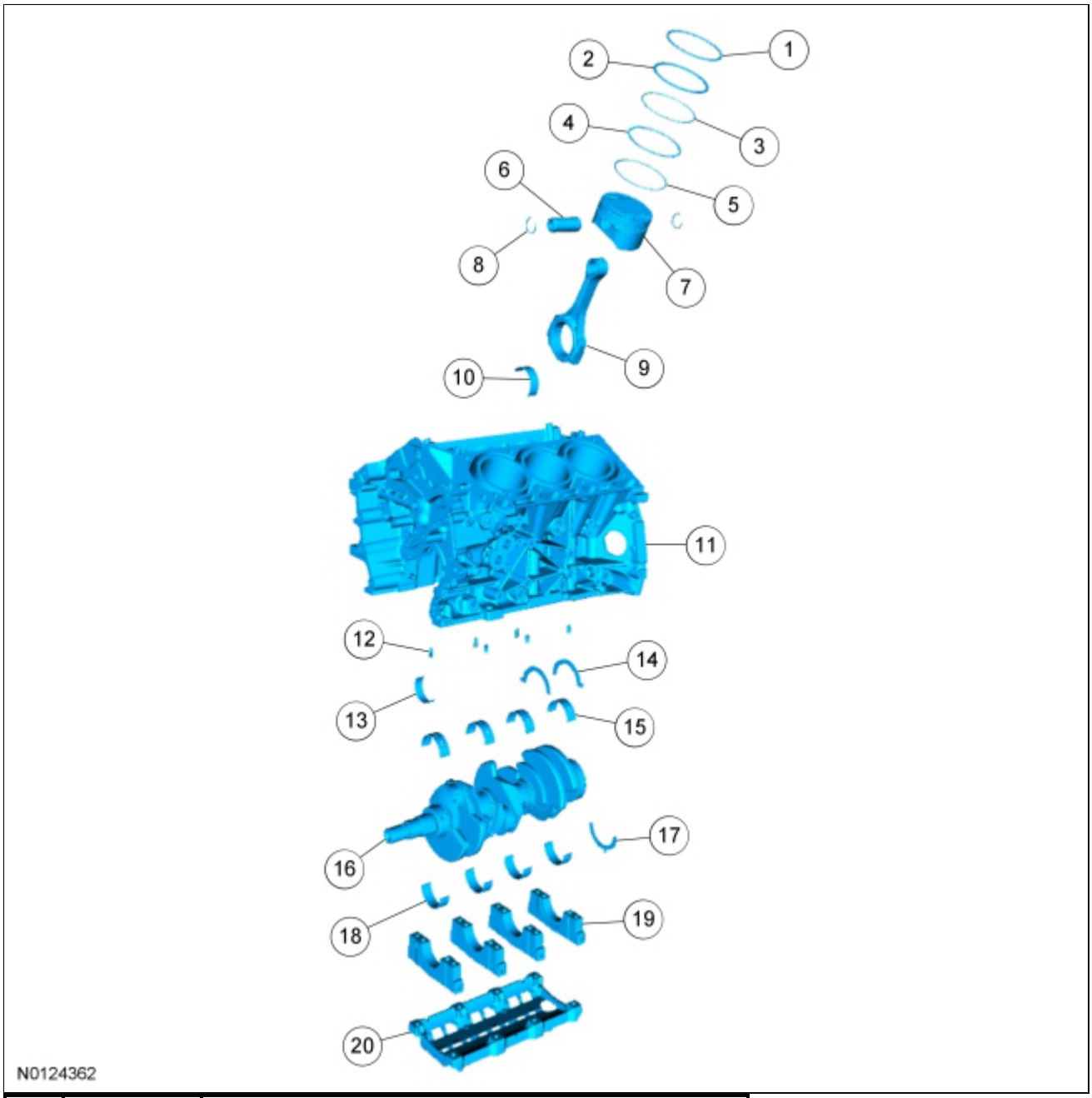
Lower Engine Block (View 1)

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Item	Part Number	Description
1	6600	Oil pump
2	6625	Oil pump screen and pickup tube O-ring seal
3	6010	Cylinder block
4	6K301	Crankshaft rear seal retainer plate
5	6C315	Crankshaft Position (CKP) sensor
6	12A227	Crankshaft sensor ring
7	6375	Flexplate
8	6622	Oil pump screen and pickup tube
9	6881	Oil filter adapter
10	9278	Engine Oil Pressure (EOP) switch
11	6675	Oil pan
12	6731	Engine oil filter
13	6L626	Oil cooler insert bolt
14	6A642	Oil cooler

Lower Engine Block (View 2)



Item	Part Number	Description
1	—	Piston compression upper ring (part of 6148) (6 required)
2	—	Piston compression lower ring (part of 6148) (6 required)
3	—	Piston oil control upper segment ring (part of 6148) (6 required)
4	—	Piston oil control spacer (part of 6148) (6 required)
5	—	Piston oil control lower segment ring (part of 6148) (6 required)
6	6140	Piston pin (6 required)

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7	6110	Piston (6 required)
8	6135	Piston pin retainer (12 required)
9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6010	Cylinder block
12	6K868	Piston oil cool valve (6 required)
13	6211	Connecting rod lower bearing (6 required)
14	6A341	Crankshaft upper thrust washer (2 required)
15	6D309	Cylinder block crankshaft main bearing (4 required)
16	6303	Crankshaft
17	6K302	Crankshaft lower thrust washer
18	6D309	Lower crankshaft main bearing (4 required)
19	6325	Lower crankshaft main bearing cap (4 required)
20	6C364	Main bearing cap support brace

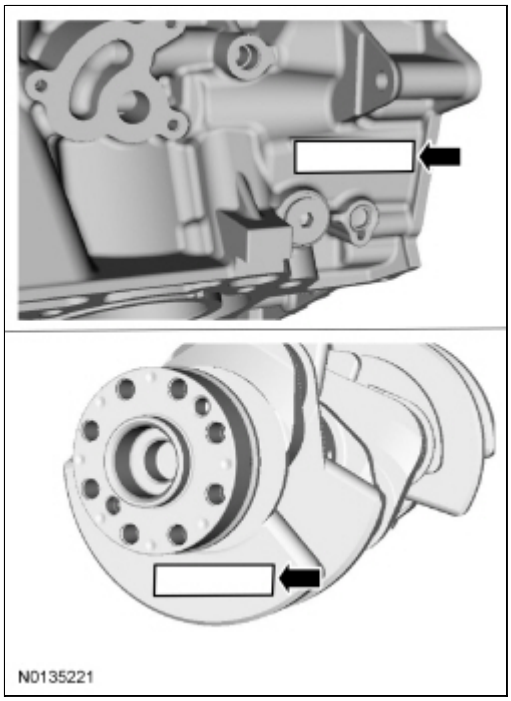
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to Section 303-00 .

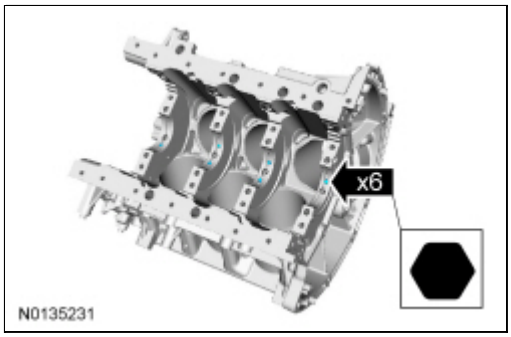
All engines

1. **NOTE:** This procedure is for selecting bearings using a new crankshaft.

   Select the crankshaft main bearings for each crankshaft journal.
   - Read the code on the crankshaft flange.
   - Read the code on the cylinder block face.
     - The first letter after the first asterisk makes up the code for main No. 1 and the next letter for main No. 2. The first letter after the second asterisk makes up the code for main No. 3 and the last letter for main No. 4.



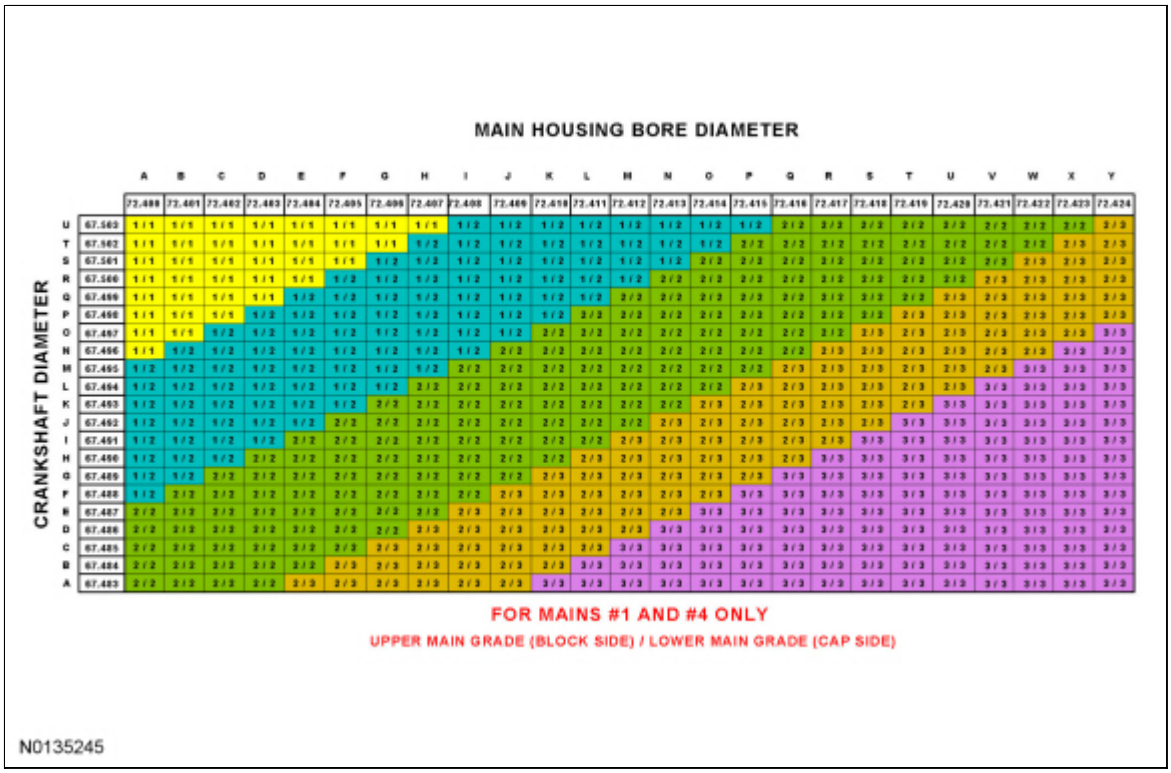
2. Using a hexagonal screwdriver, install the 6 piston oil cool valves.
    - Tighten to 4 Nm (35 lb-in).



3. **NOTE:** This chart is for selecting main bearings 1 and 4 only, the remaining bearings will be selected using a different chart in the next step.

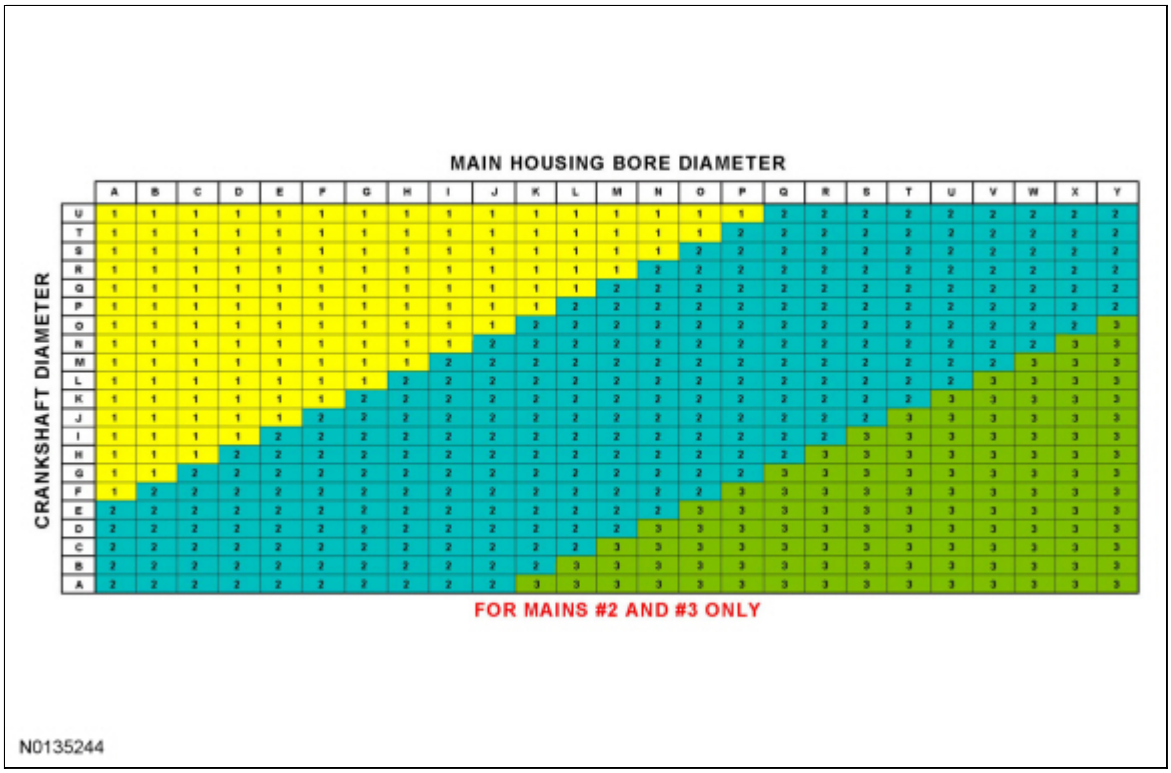
   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 1 and 4.
    - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
    - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade(s) for the No. 1 crankshaft main bearing.
    - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is a "1" for the upper bearing and a "2" for the lower bearing.
    - Repeat the above steps using the fourth letter of the block and crankshaft codes to select the No. 4 bearing.

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4. **NOTE:** This chart is for selecting main bearings 2 and 3 only.

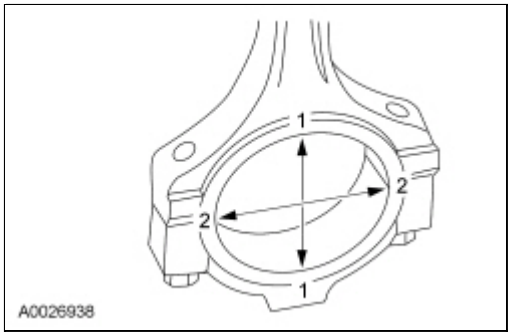
   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 2 and 3.
   - Read the second letter of the engine block main bearing code and the second letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade for the No. 2 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is "1".
   - Repeat the above steps using the third letter of the block and crankshaft codes to select the No. 3.



5. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

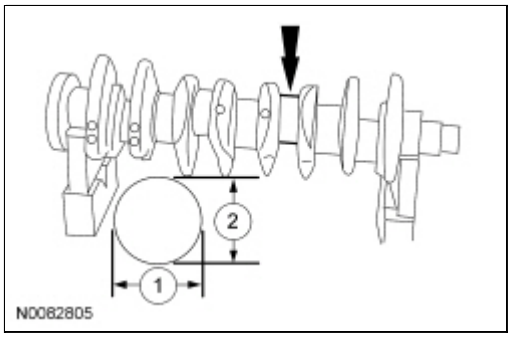
   Using the original connecting rod cap bolts, install the connecting rod caps and bolts.
   - Tighten the bolts in 3 stages.
   - Stage 1: Tighten to 23 Nm (17 lb-ft).
   - Stage 2: Tighten to 43 Nm (32 lb-ft).
   - Stage 3: Tighten an additional 90 degrees.

6. Measure the connecting rod large end bore in 2 directions. For additional information, refer to Specifications in this section.
   - Remove the bolts and the rod cap.
     - Discard the connecting rod cap bolts.



7. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions. For additional information, refer to Specifications in this section.

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8. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

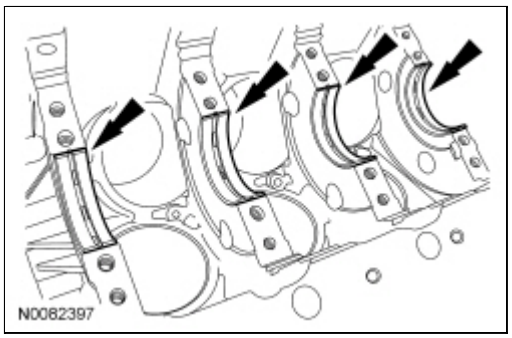
		CONNECTING ROD LARGE END BORE (59.XXX)																				
		1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
		.866	.867	.868	.869	.870	.871	.872	.873	.874	.875	.876	.877	.878	.879	.880	.881	.882	.883	.884	.885	.886
CRANK JOURNAL	56.003	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.002	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.001	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.000	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.999	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.996	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.994	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.993	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.992	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.991	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.990	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.989	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.988	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.987	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.986	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.985	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.984	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.983	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3

		MINIMUM	MAXIMUM	NOMINAL
WALL GRADES	1	1.918 mm	1.924 mm	1.921 mm
	2	1.921 mm	1.927 mm	1.924 mm
	3	1.925 mm	1.931 mm	1.928 mm

N0082806

9. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

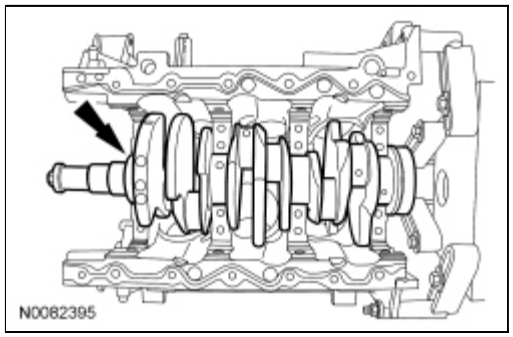
   Lubricate the upper crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the cylinder block.



10. **NOTE:** Do not install the upper thrust bearings until the crankshaft is installed.

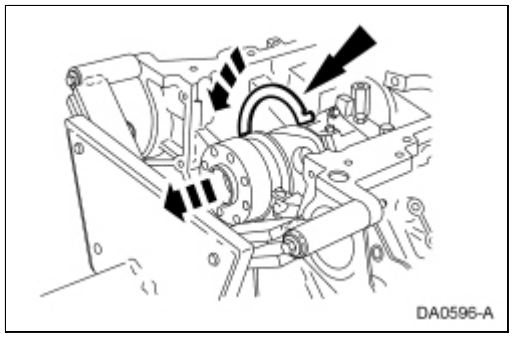
    NOTE: Lubricate the thrust surfaces of the crankshaft with clean engine oil.

    Install the crankshaft onto the upper main bearings.



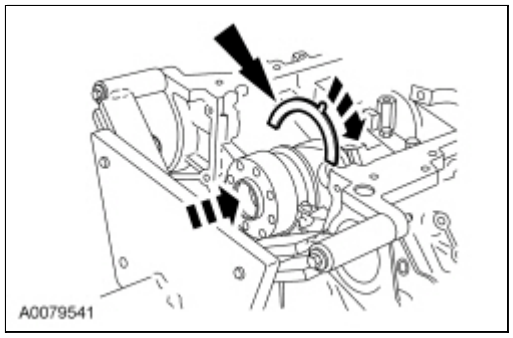
11. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 4 rear bulkhead.



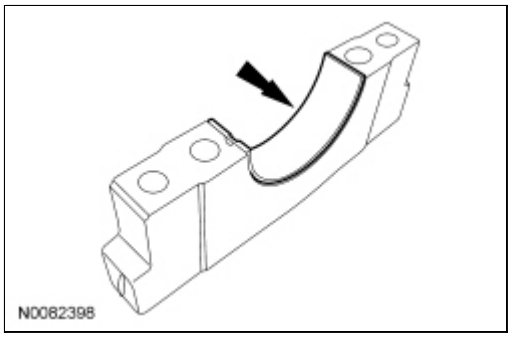
12. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 4 rear bulkhead.

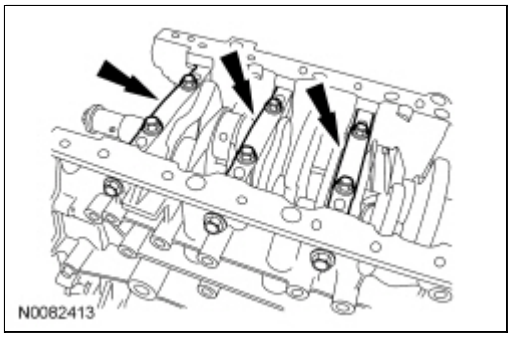


13. Lubricate the crankshaft lower main bearings with clean engine oil and install them into the main bearing caps. Visually check seating and squareness of the bearings to make sure of proper seating in caps.

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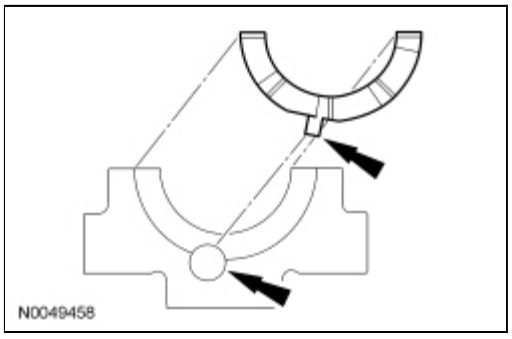
14. Position the No. 1, No. 2 and No. 3 main bearing caps on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the new bolts until the main bearing caps are seated.



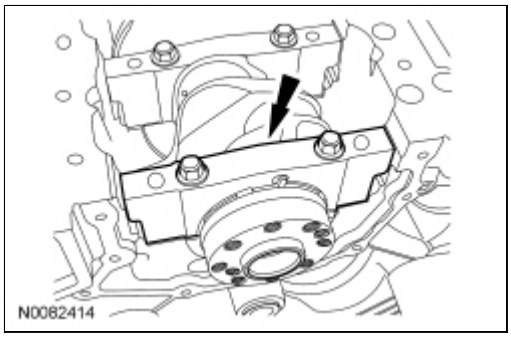
15. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    NOTE: To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

    Install the lower crankshaft thrust washer to the back side of the No. 4 rear main bearing cap, with the tab aligned with the cutout in the main bearing cap.



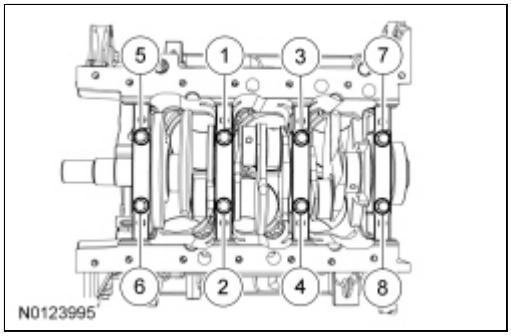
16. Position main bearing cap No. 4 on the cylinder block and keeping the cap as square as possible, alternately draw the cap down evenly using the new bolts until the main bearing cap is seated.



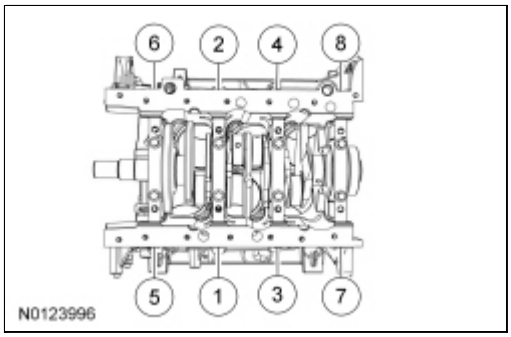
17. Loosen the No. 4 main bearing cap bolts.

18. **NOTE:** While tightening the main bearing vertical bolts, push the crankshaft forward and the No. 4 main bearing cap rearward to seat the crankshaft thrust washers.

    Tighten the main bearing bolts in 2 stages in the sequence shown.
    - Stage 1: Tighten fasteners 1 through 8 to 33 Nm (24 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.

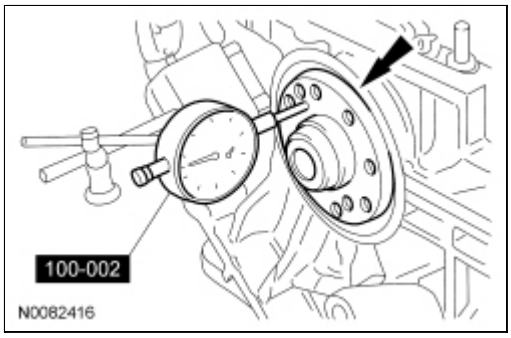


19. Install the new 8 main bearing cap side bolts. Tighten in 2 stages in the sequence shown.
    - Stage 1: Tighten fasteners 1 through 8 to 45 Nm (33 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.



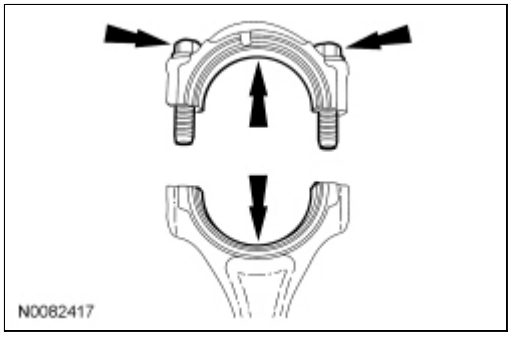
20. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.

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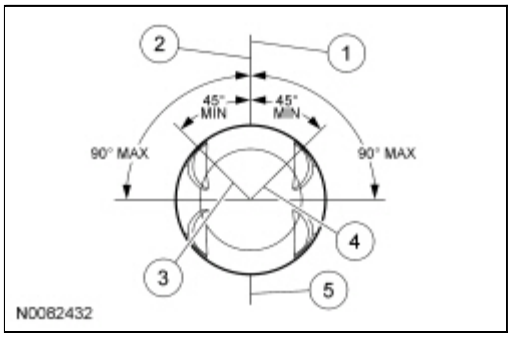


21. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    Prepare the connecting rod and cap.
    - Insert the new bolts in the rod cap.
    - Insert the upper and lower rod bearings into the rod and cap.



22. Before installing the pistons into the cylinder block, verify proper ring gap location.
    1. Center line of the piston parallel to the wrist pin bore
    2. Upper compression ring gap location
    3. Upper oil control segment ring gap location
    4. Lower oil control segment ring gap location
    5. Expander ring and lower compression ring gap location



23. ***NOTICE:*** **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

    NOTE: The next 3 steps are for all 6 connecting rods, rod caps and pistons. Only 1 connecting rod, rod cap and piston is shown.

    NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with

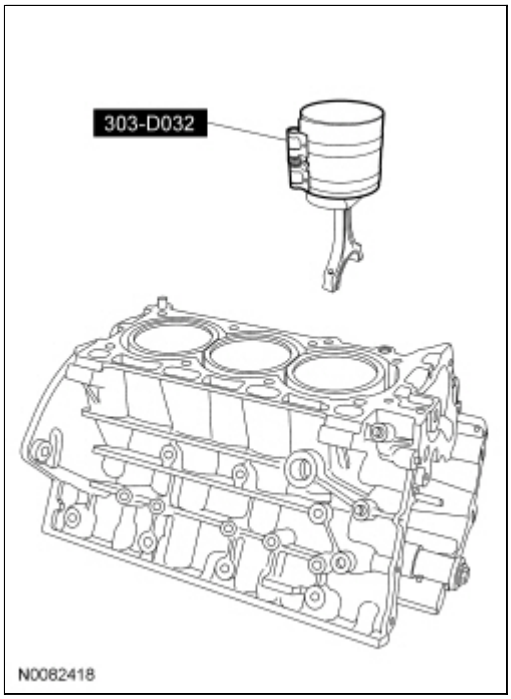
clean engine oil.

NOTE: Make sure the piston rings are positioned to specifications for installation. For additional information, refer to Disassembly and Assembly of Subassemblies - Piston in this section.

NOTE: If the piston and/or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

NOTE: If the piston and connecting rod are to be reinstalled, they must be installed in the same orientation as disassembled.

Using the Piston Ring Compressor, install the piston and connecting rod assemblies.



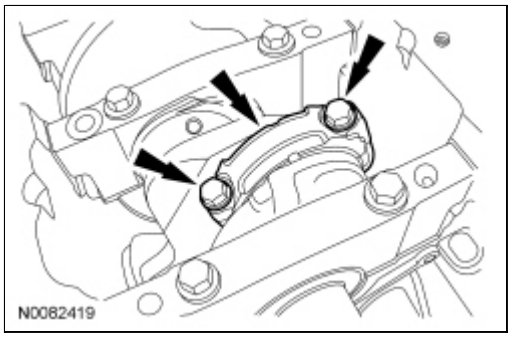
24. Seat the connecting rod on the crankshaft journal.

25. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    NOTE: After installation of each piston, connecting rod, rod cap and bolts, rotate the crankshaft to verify smooth operation.

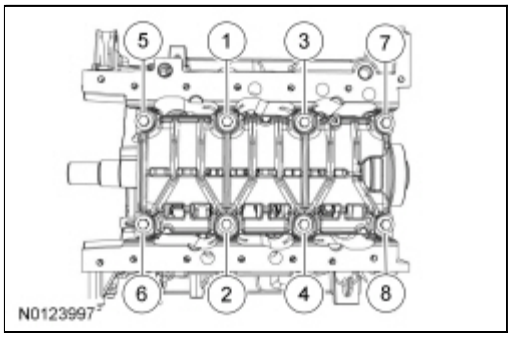
    Install the connecting rod cap and bolts. Tighten the bolts in 3 stages.
    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.

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26. Repeat the previous 3 steps until all 6 piston, connecting rod and connecting rod cap assemblies are installed.

27. Install the main bearing cap support brace and the new bolts. Tighten in 2 stages in the sequence shown.
    - Stage 1: Tighten fasteners to 24 Nm (18 lb-ft).
    - Stage 2: Tighten fasteners an additional 180 degrees.

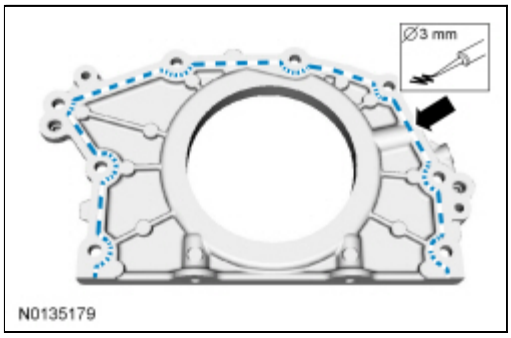


28. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

    NOTE: The stamped steel crankshaft rear seal retainer plate comes with the crankshaft rear seal.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.

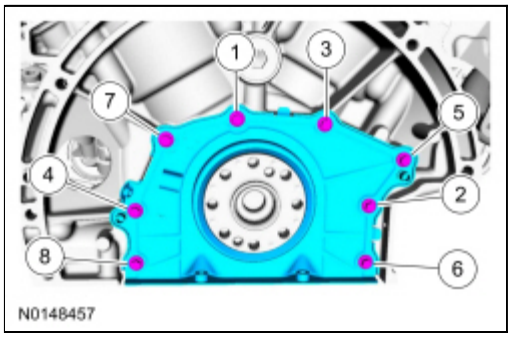


29. **NOTE:** Lubricate the crankshaft rear seal and the crankshaft with clean engine oil prior to installation.

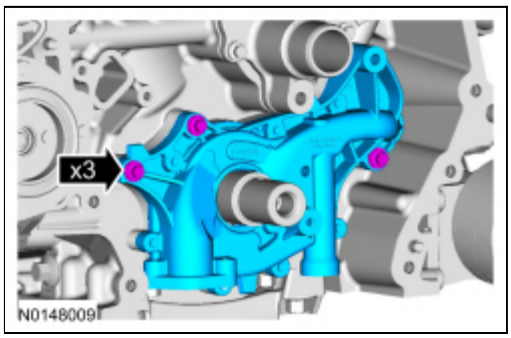
NOTE: Use the handles during installation to avoid touching the sealant.

Install the 8 crankshaft rear seal retainer plate bolts. Tighten in the sequence shown.

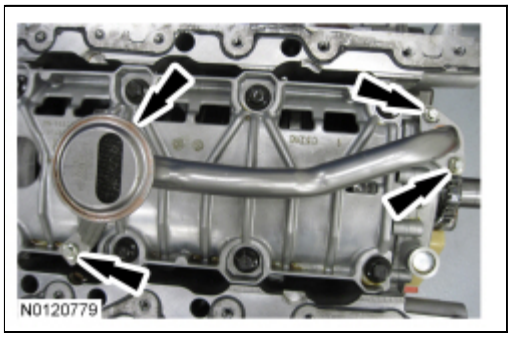
- Tighten to 10 Nm (89 lb-in).



30. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



31. Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

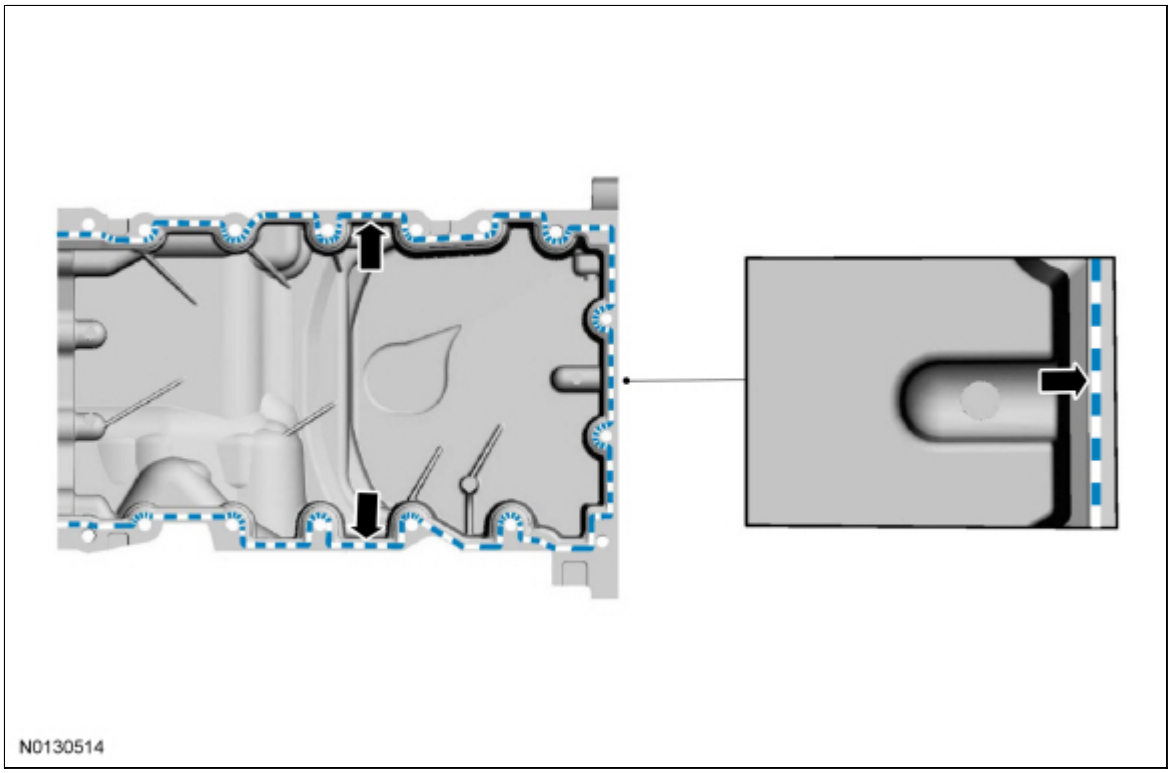


32. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

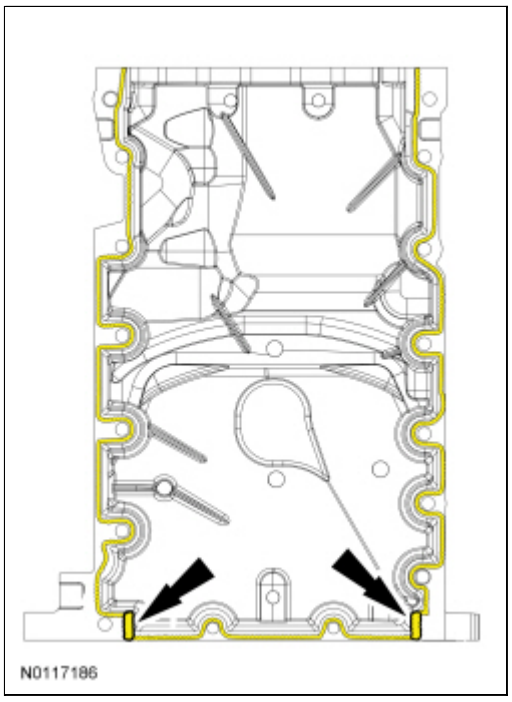
    NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the oil pan to the sealing surface of the oil pan-to-engine block mating surface.

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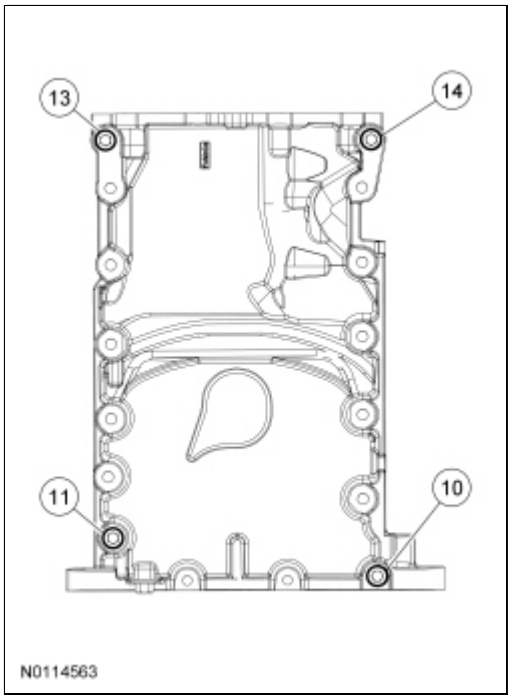


33. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.

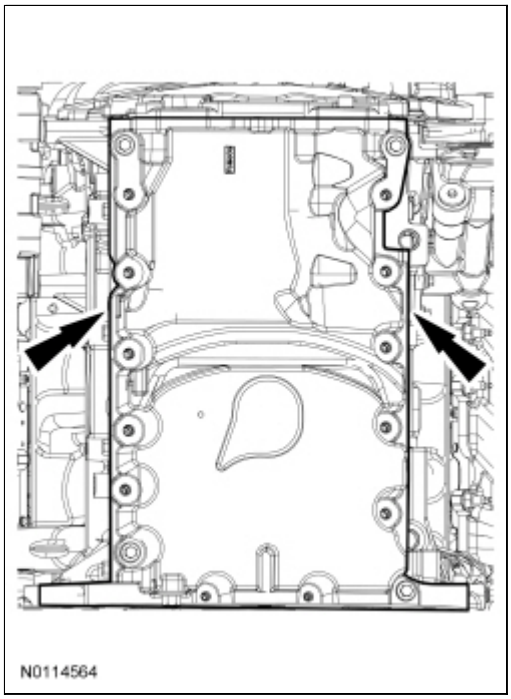


34. **NOTE:** The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.

    Install the oil pan and bolts 10, 11, 13 and 14 finger tight.

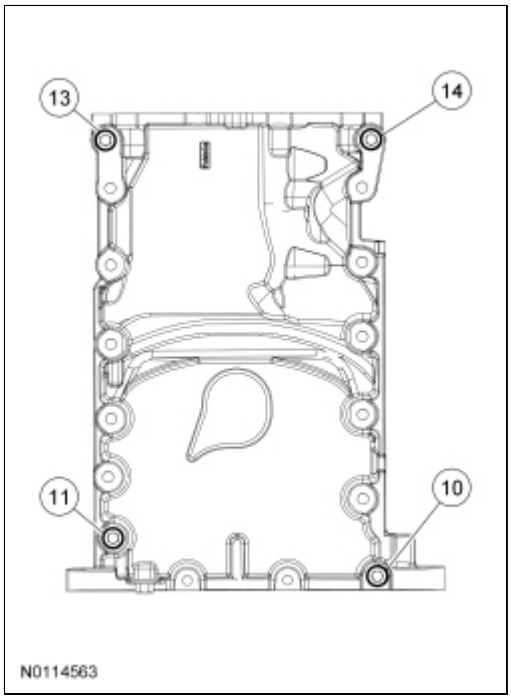


35. Laterally align the oil pan to the block. Make sure the oil pan is flush with the block at these 2 points.

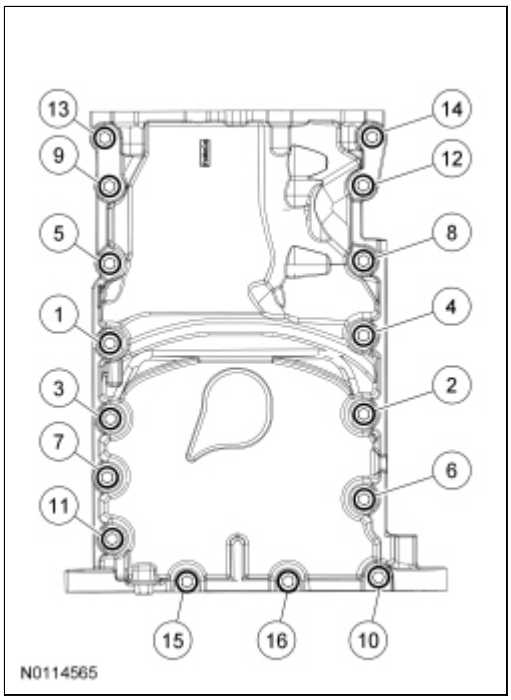


36. Tighten bolts 10, 11, 13 and 14 in the sequence shown.
    - Tighten to 3 Nm (27 lb-in).

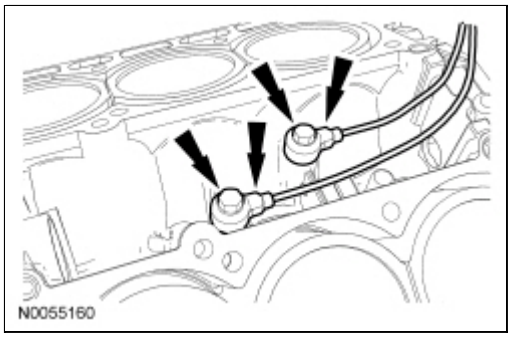
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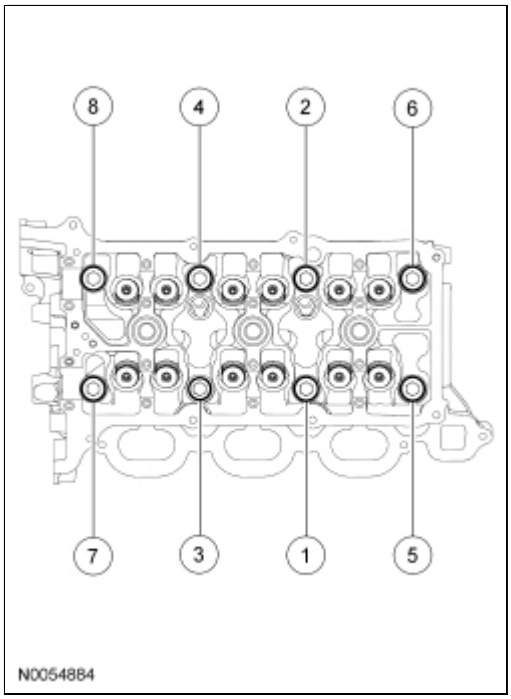
37. Install the remaining oil pan bolts and tighten in the sequence shown.
    - Tighten bolts 1-9 and 11-14 to 20 Nm (177 lb-in), then rotate an additional 45 degrees.
    - Tighten bolts 15 and 16 to 10 Nm (89 lb-in), then rotate an additional 45 degrees.
    - Tighten bolt 10 to 20 Nm (177 lb-in), then rotate an additional 90 degrees.



38. Install the Knock Sensor (KS) and the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).

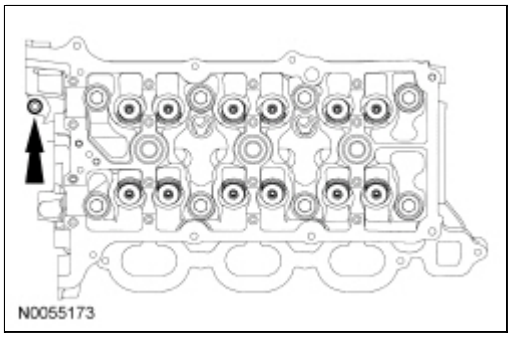


39. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in 5 stages in the sequence shown.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.

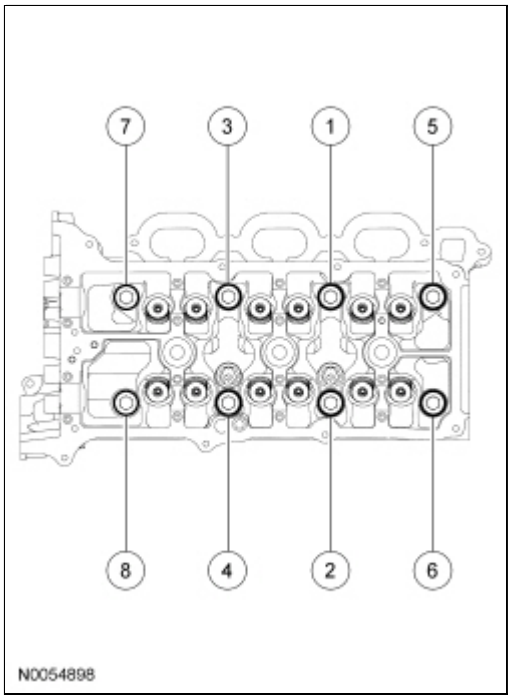


40. Install the new M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

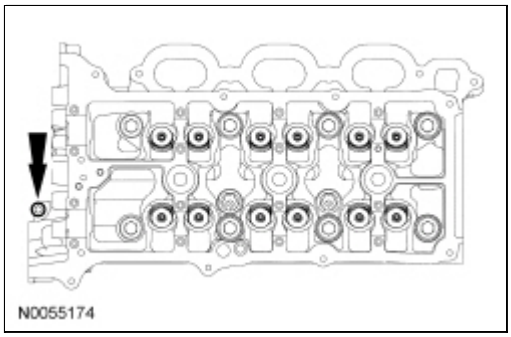
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41. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in 5 stages in the sequence shown.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.



42. Install the new M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

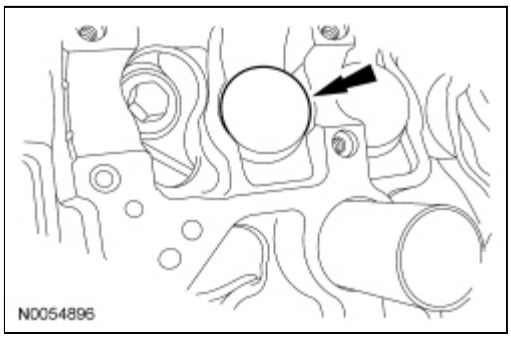


43. **NOTE:** The valve tappets must be installed in their original positions.

    NOTE: Coat the valve tappets with clean engine oil prior to installation.

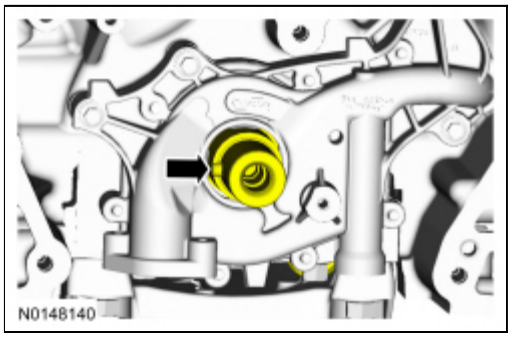
    NOTE: LH shown, RH similar.

    Install the valve tappets.



44. ***NOTICE:*** **The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

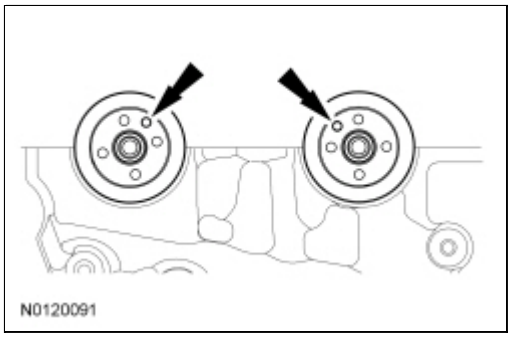
    Position the crankshaft dowel pin in the 9 o'clock position.



45. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

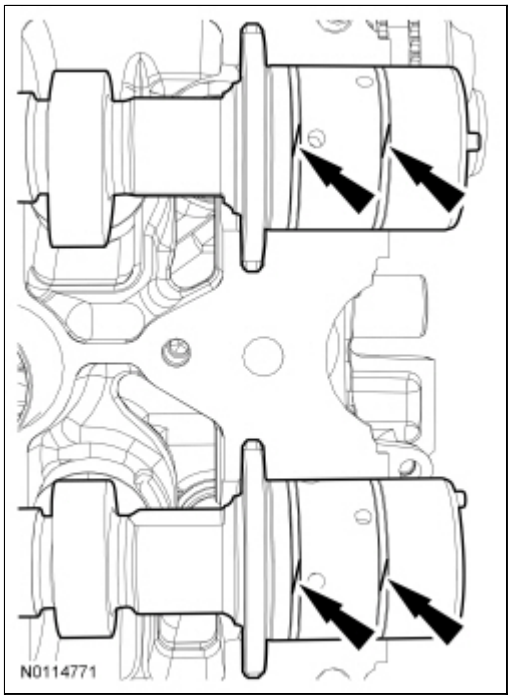
    Position the camshafts onto the RH cylinder head in the neutral position as shown.

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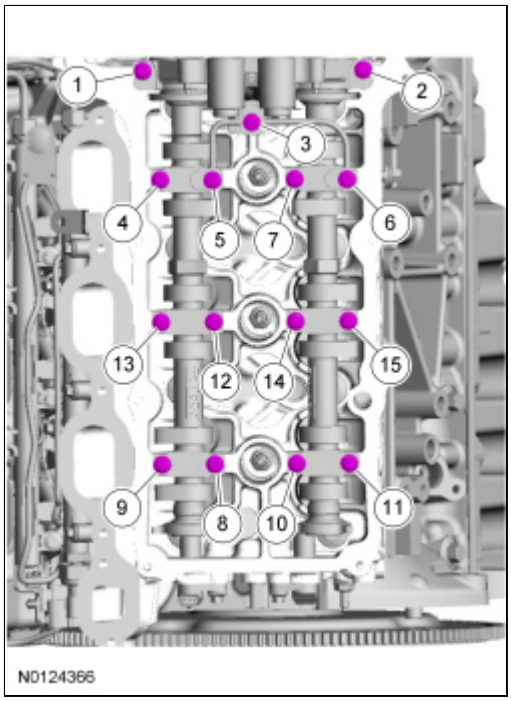
46. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

    Position the 4 camshaft seals gaps as shown.

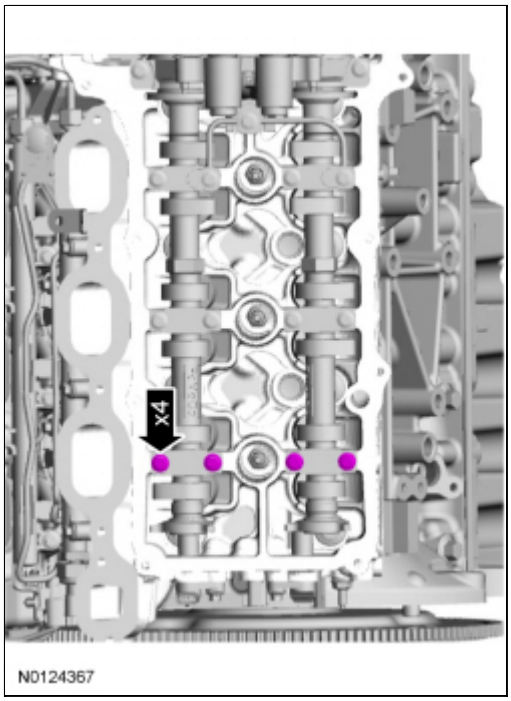


47. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
    - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.

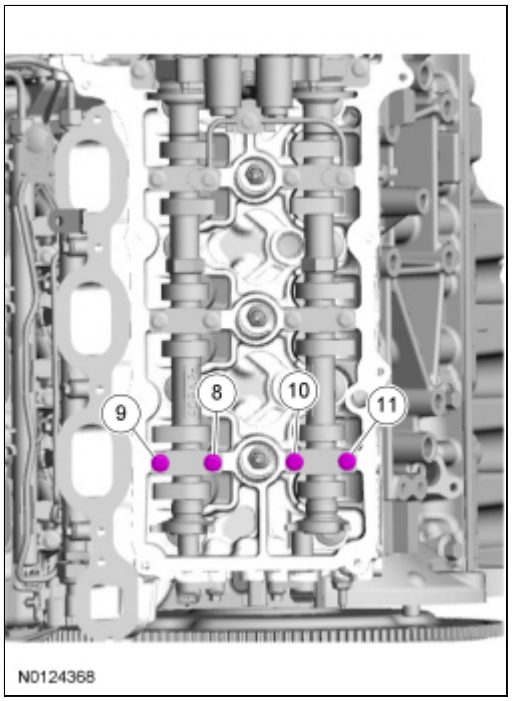


48. Loosen the 4 camshaft caps bolts.



49. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then an additional 45 degrees.

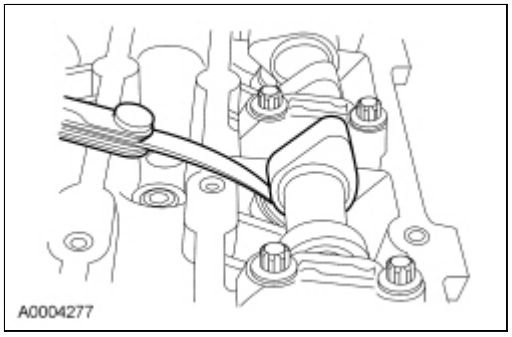
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50. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

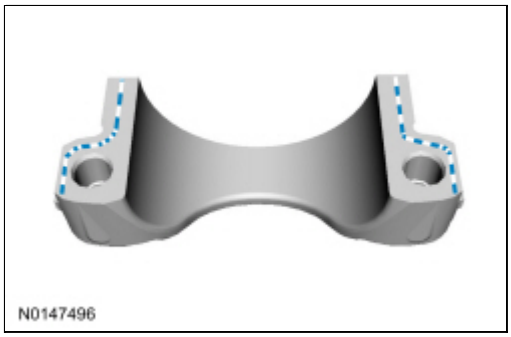
    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet (s) of the correct size. For additional information, refer to Valve Clearance Check in this section.

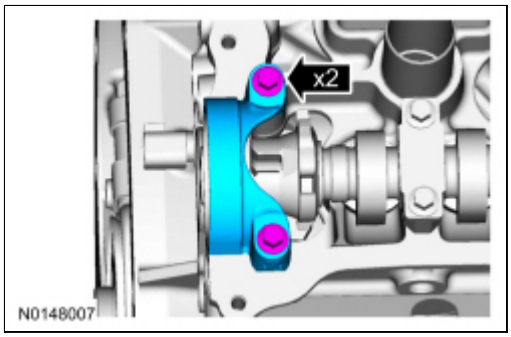


51. **NOTE:** The camshaft bearing cap assembly must be secured within 10 minutes of the Gasket Maker application. If the camshaft bearing cap assembly is not secured within 10 minutes, the sealant must be removed and the sealing area cleaned with Motorcraft® Metal Surface Prep.

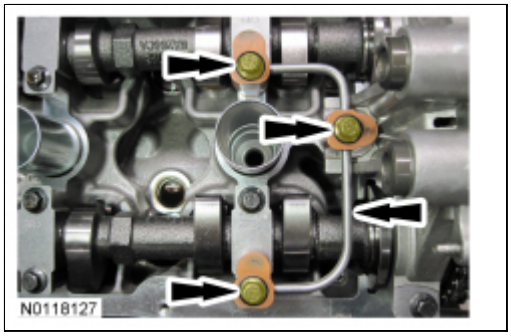
    Apply a 3 mm (0.118 in) bead of sealant to the camshaft bearing cap assembly.



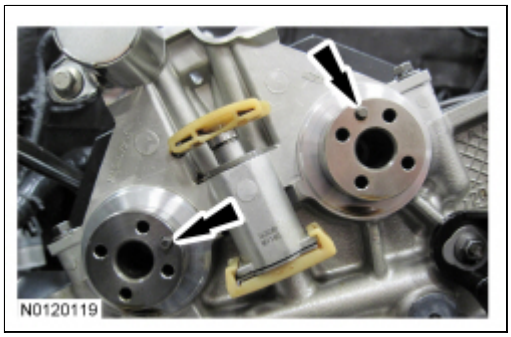
52. Install the camshaft bearing cap assembly and the 2 bolts.
    - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Remove the excess gasket maker.



53. Remove the 3 bolts and the RH valve train oil tube.



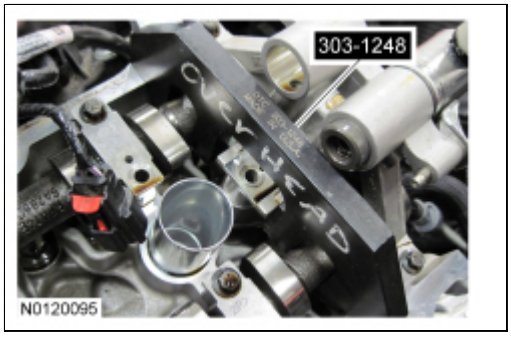
54. Rotate the RH camshafts to the Top Dead Center (TDC) position as shown.



55. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

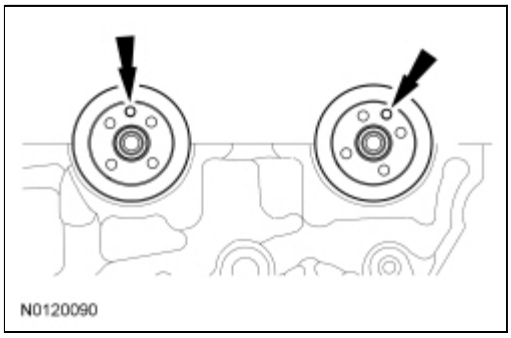
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Install the Camshaft Holding Tool onto the flats of the RH camshafts.



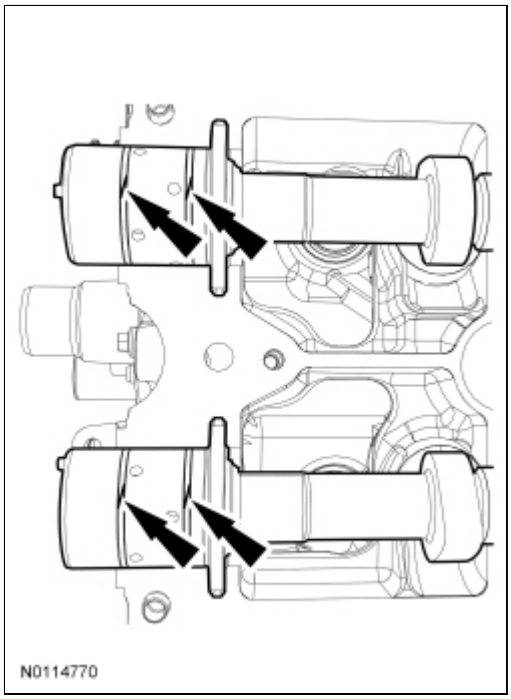
56. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

    Position the camshafts onto the LH cylinder head in the neutral position as shown.



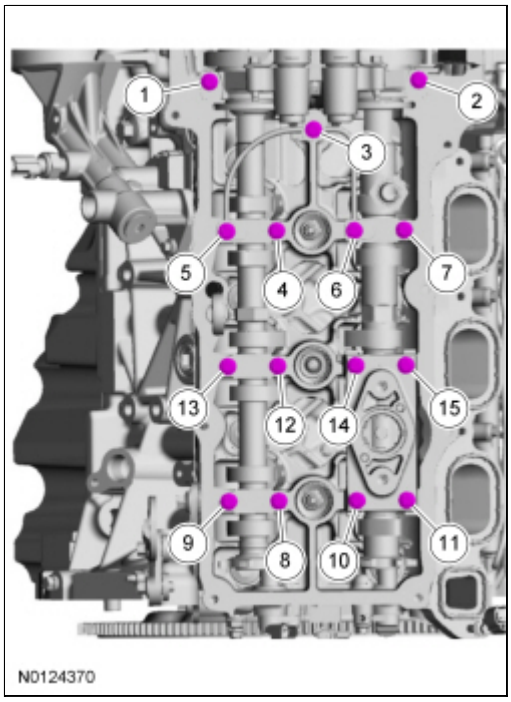
57. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

    Position the 4 camshaft seals gaps as shown.

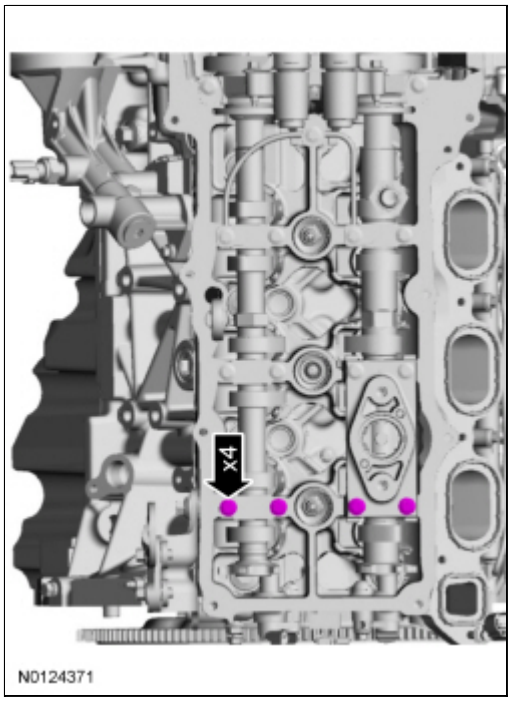


58. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
    - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.

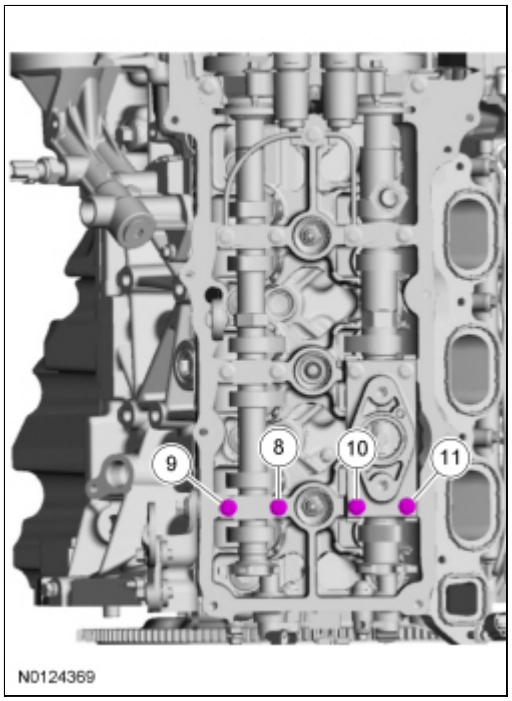


59. Loosen the 4 camshaft caps bolts.



60. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then an additional 45 degrees.

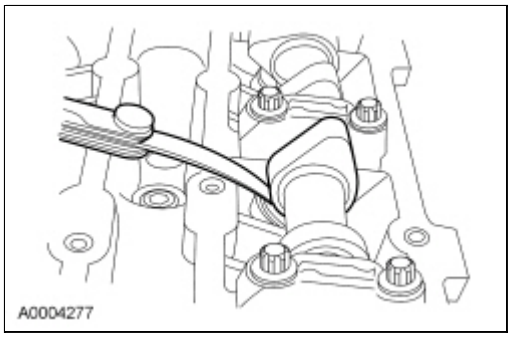
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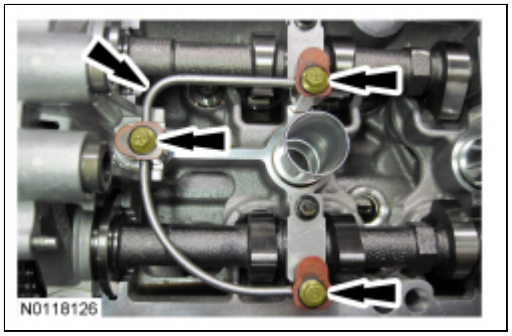
61. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

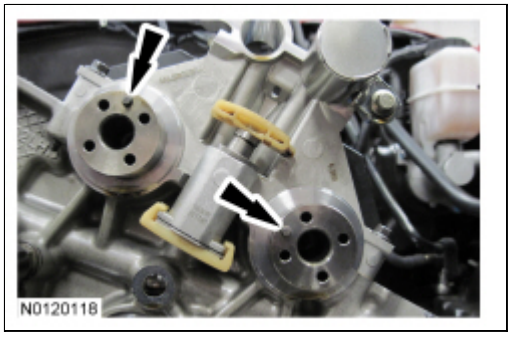
    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet (s) of the correct size. For additional information, refer to Valve Clearance Check in this section.



62. Remove the 3 bolts and the LH valve train oil tube.

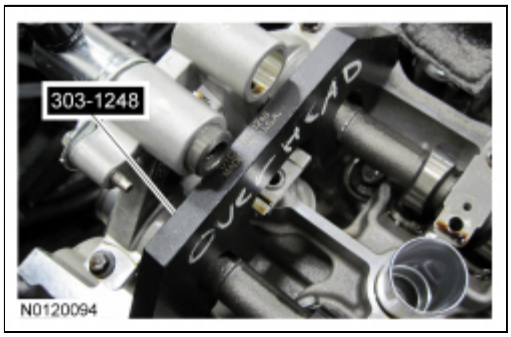


63. Rotate the LH camshafts to the TDC position as shown.

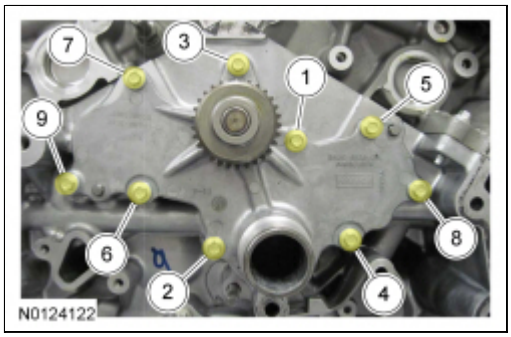


64. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the LH camshafts.

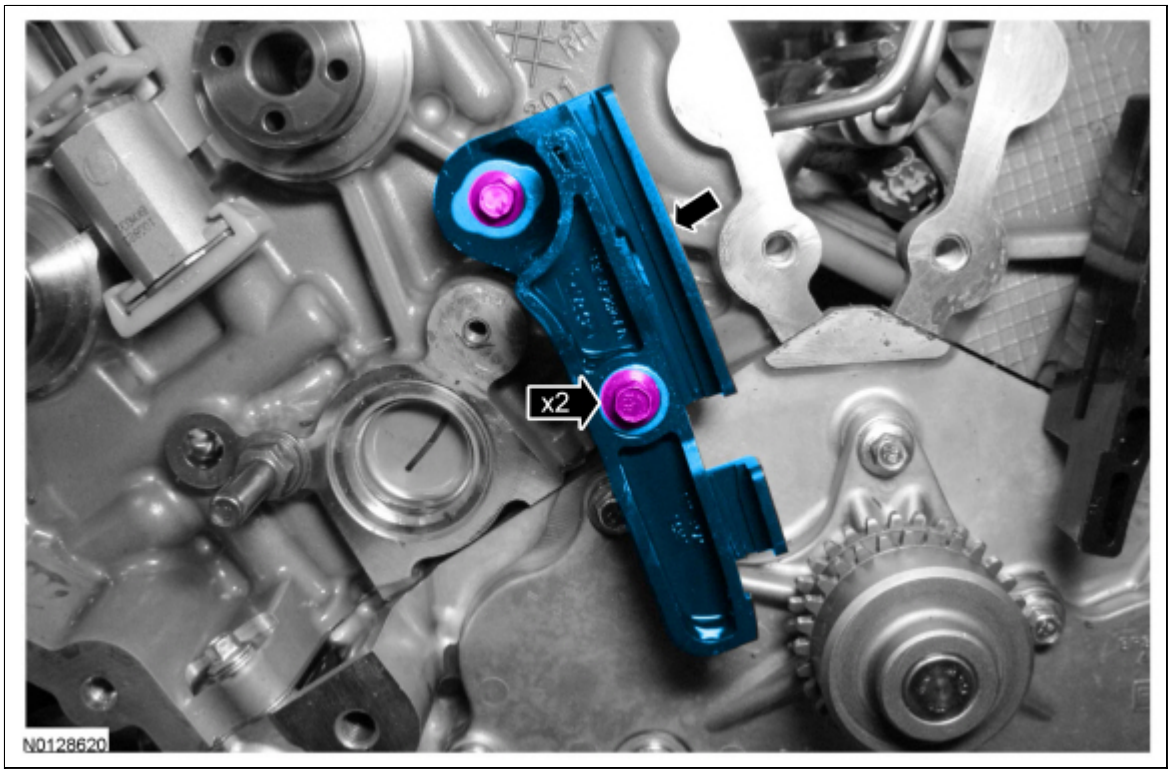


65. Using a new gasket, install the timing chain gear and the 9 bolts. Tighten in 2 stages in the sequence shown.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



66. Install the RH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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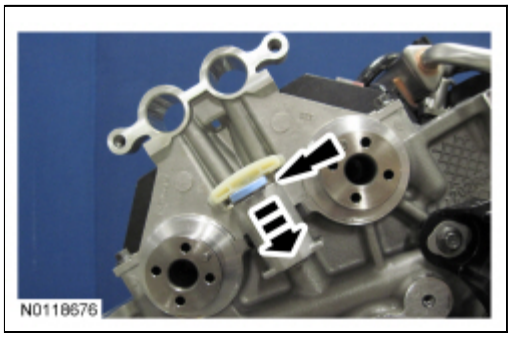
Engines with secondary timing chain tensioner removed

NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed or damage to the engine may occur.**

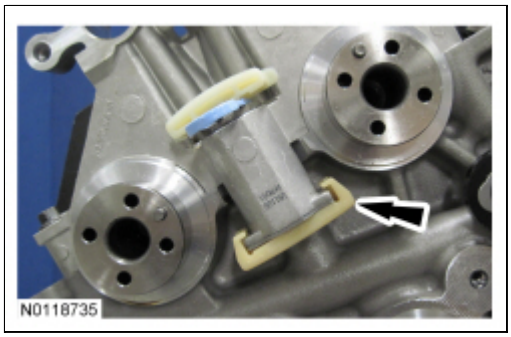
67. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

    NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

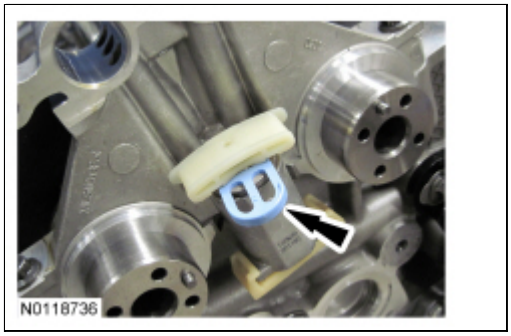
    Install the RH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



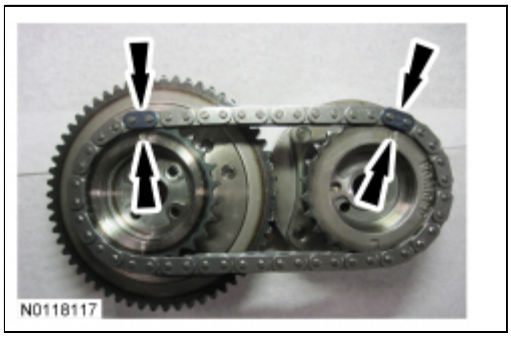
68. Install the RH secondary timing chain tensioner shoe.



69. Remove and discard the RH secondary timing chain tensioner shipping clip.



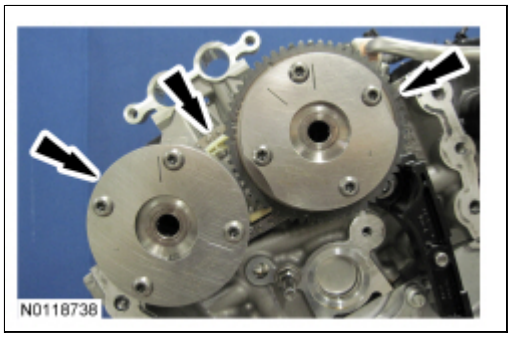
70. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.



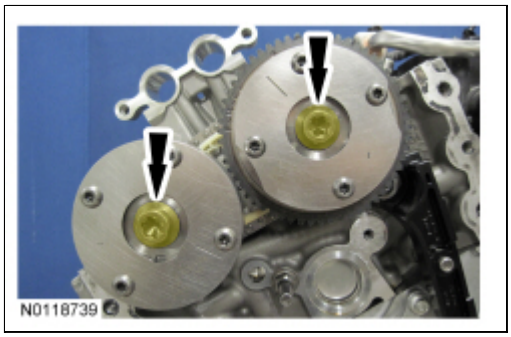
71. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

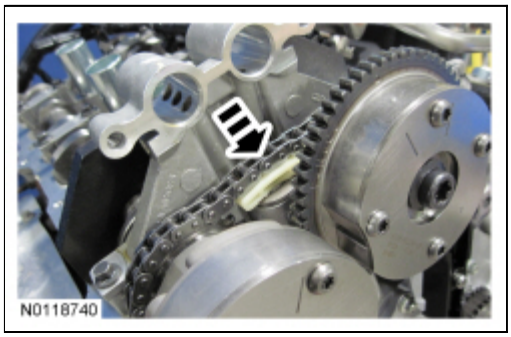
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72. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



73. Activate the RH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.

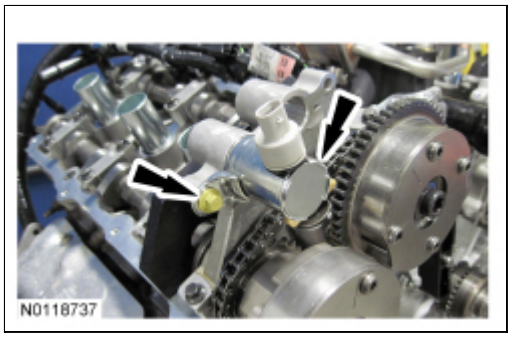


74. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

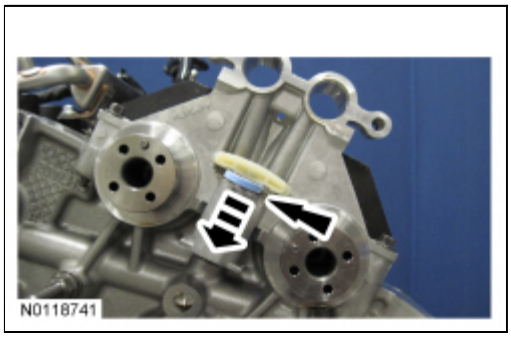
    Install the RH exhaust VCT oil control solenoid.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



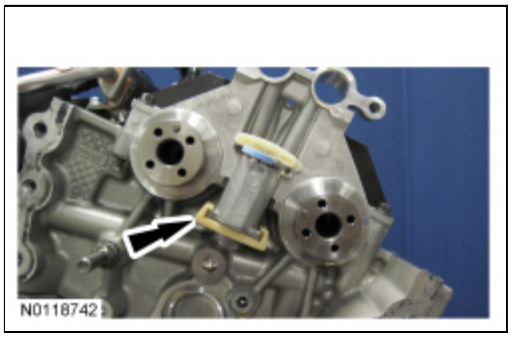
75. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

    NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

    Install the LH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.

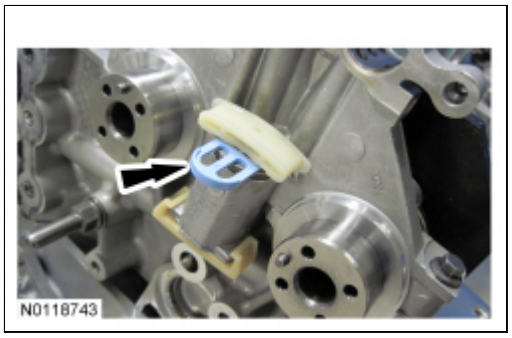


76. Install the LH secondary timing chain tensioner shoe.

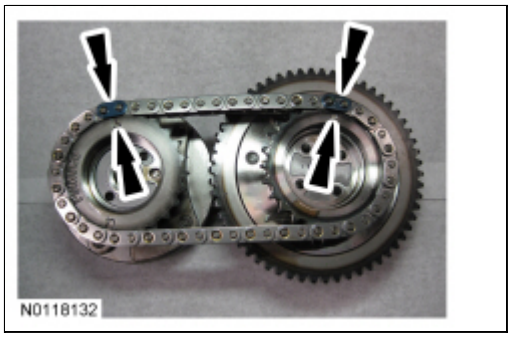


77. Remove and discard the LH secondary timing chain tensioner shipping clip.

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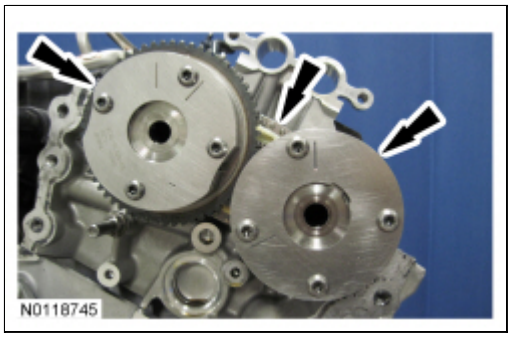


78. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

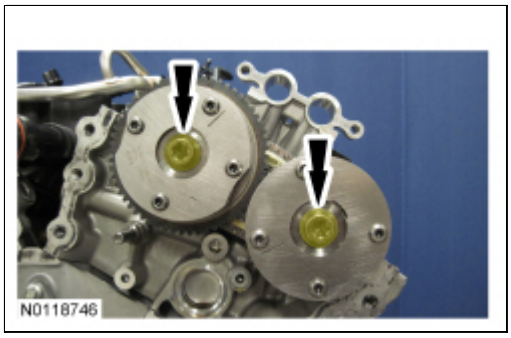


79. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

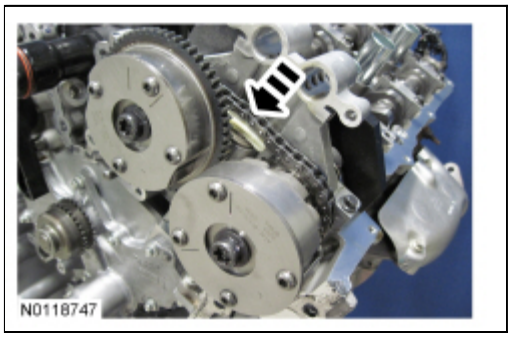
    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



80. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



81. Activate the LH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



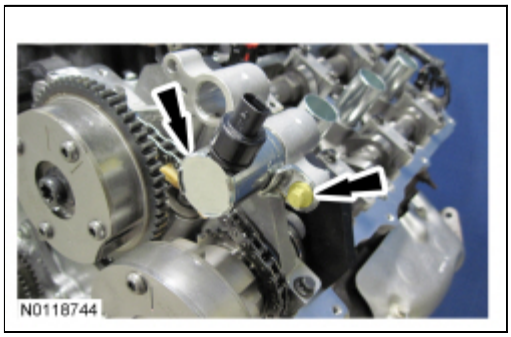
82. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH exhaust VCT oil control solenoid.

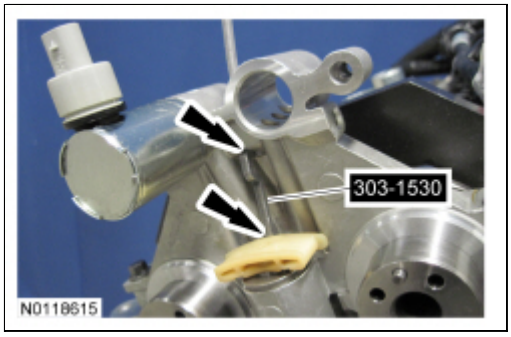
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



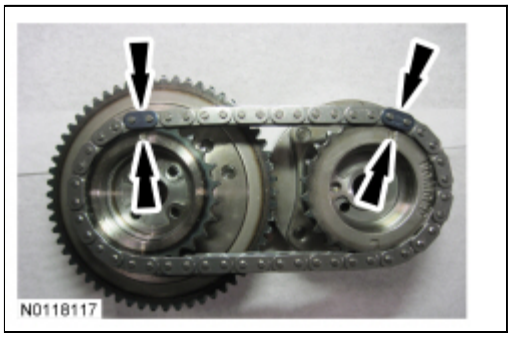
Engines with secondary timing chain tensioner not removed

83. Compress the RH secondary chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

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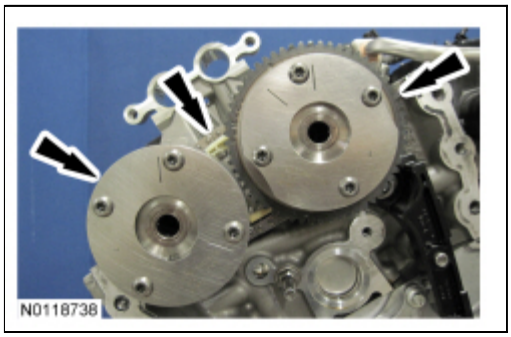


84. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

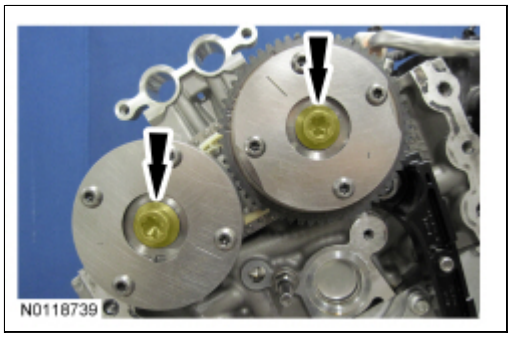


85. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

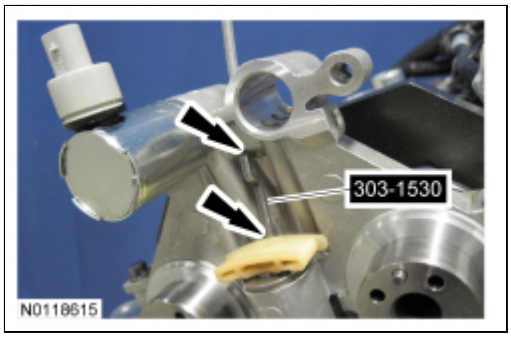
    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



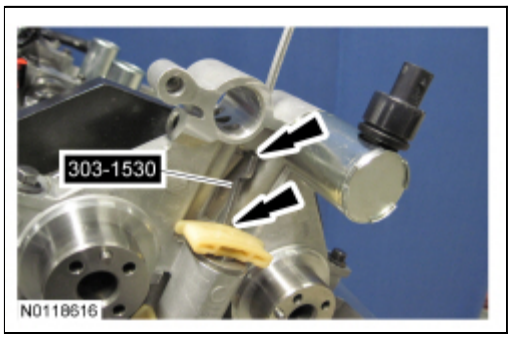
86. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



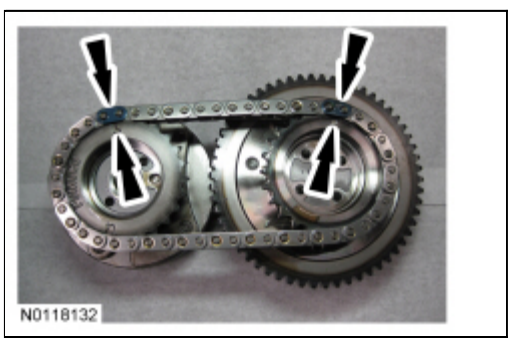
87. Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.



88. Compress the LH secondary chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.



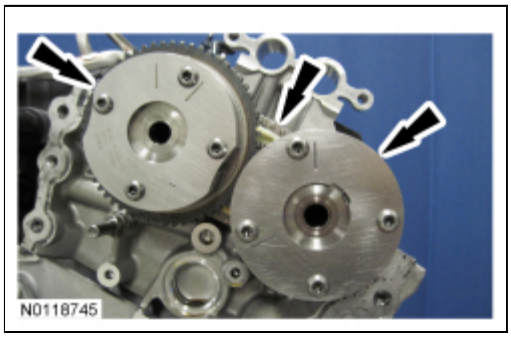
89. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.



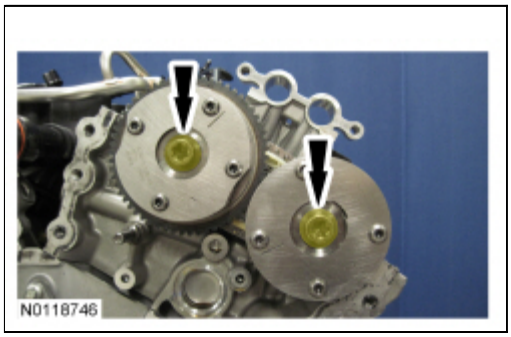
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90. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

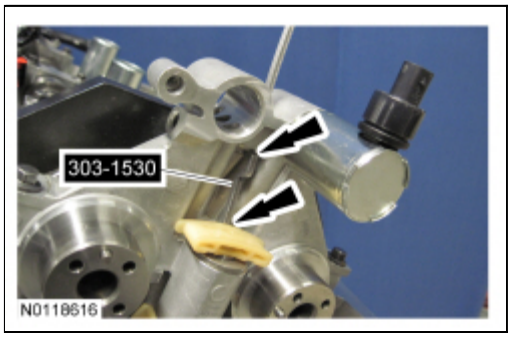
    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



91. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

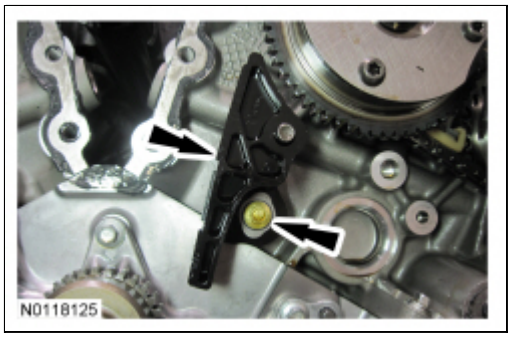


92. Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

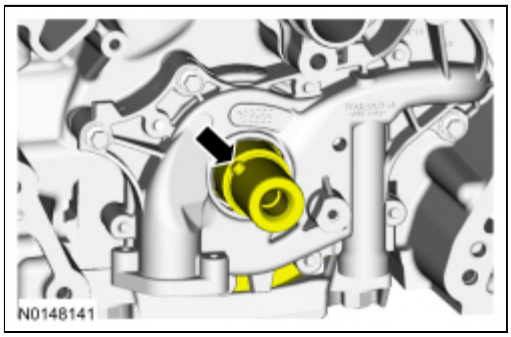


All engines

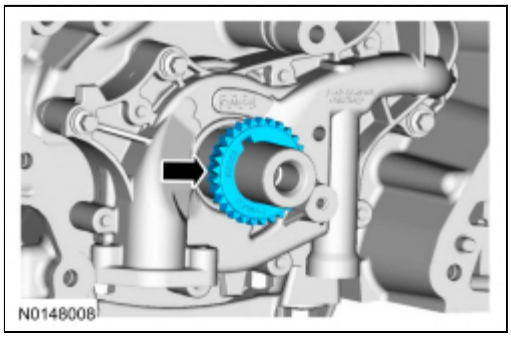
93. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).



94. Rotate the crankshaft 60 degrees to the Top Dead Center (TDC) position (crankshaft dowel at 11 o'clock).



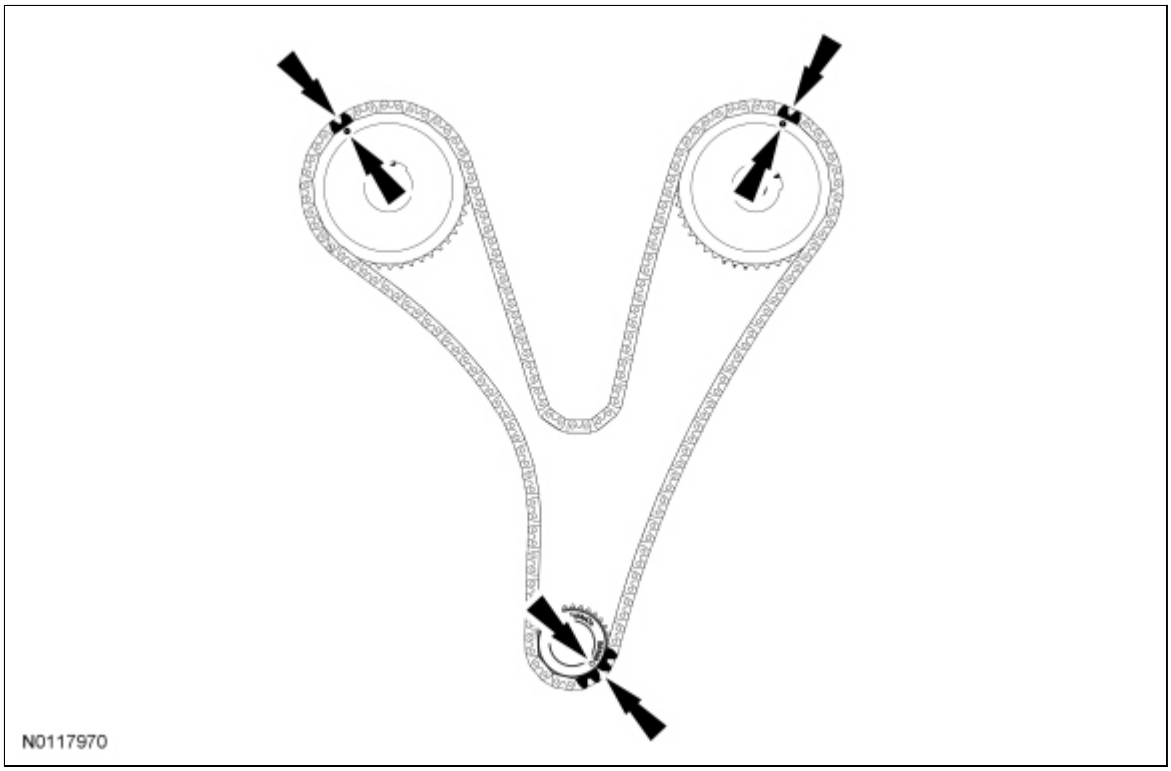
95. Install the crankshaft timing chain sprocket with timing dot mark out.



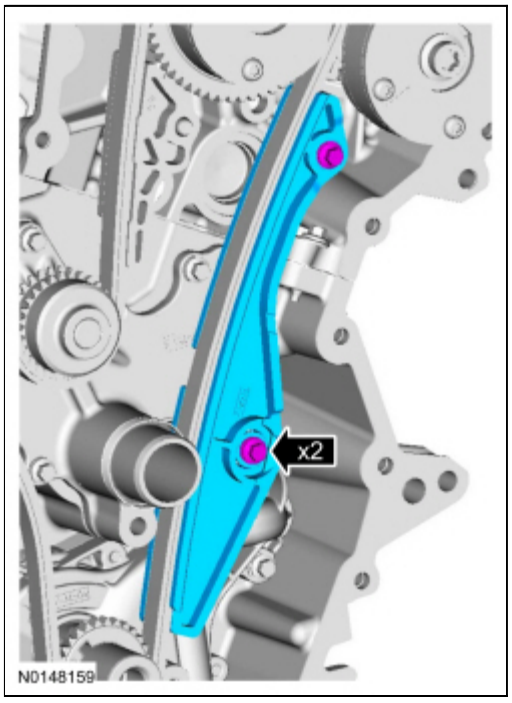
96. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

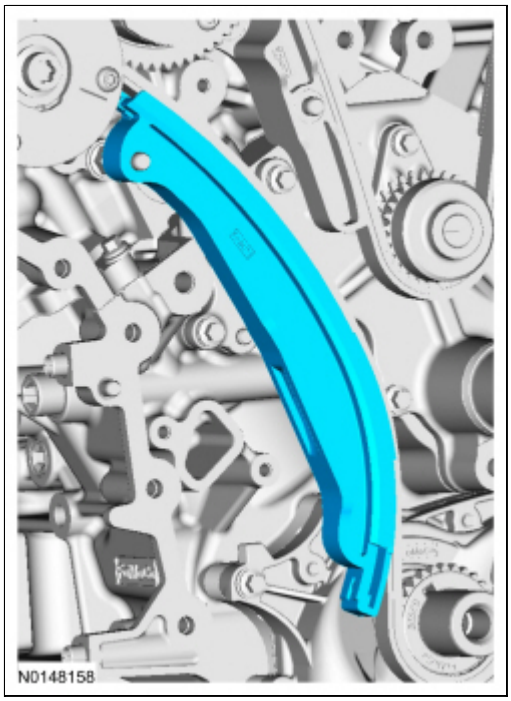
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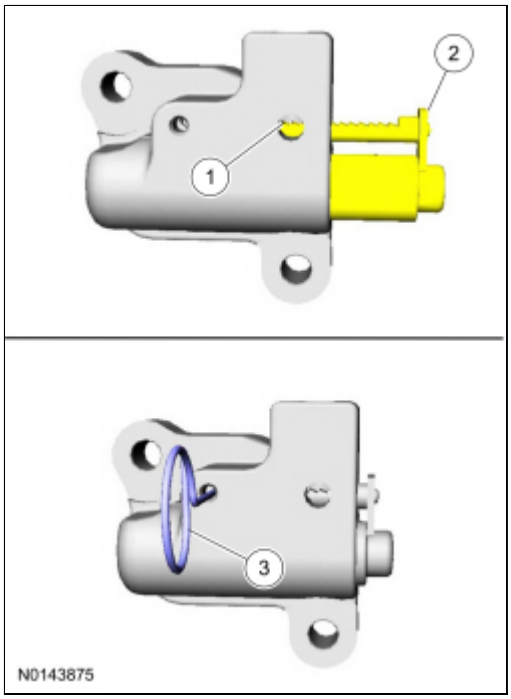
97. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



98. Install the primary timing chain tensioner arm.



99. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.

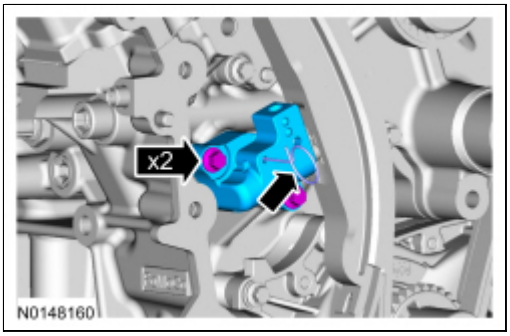


100. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

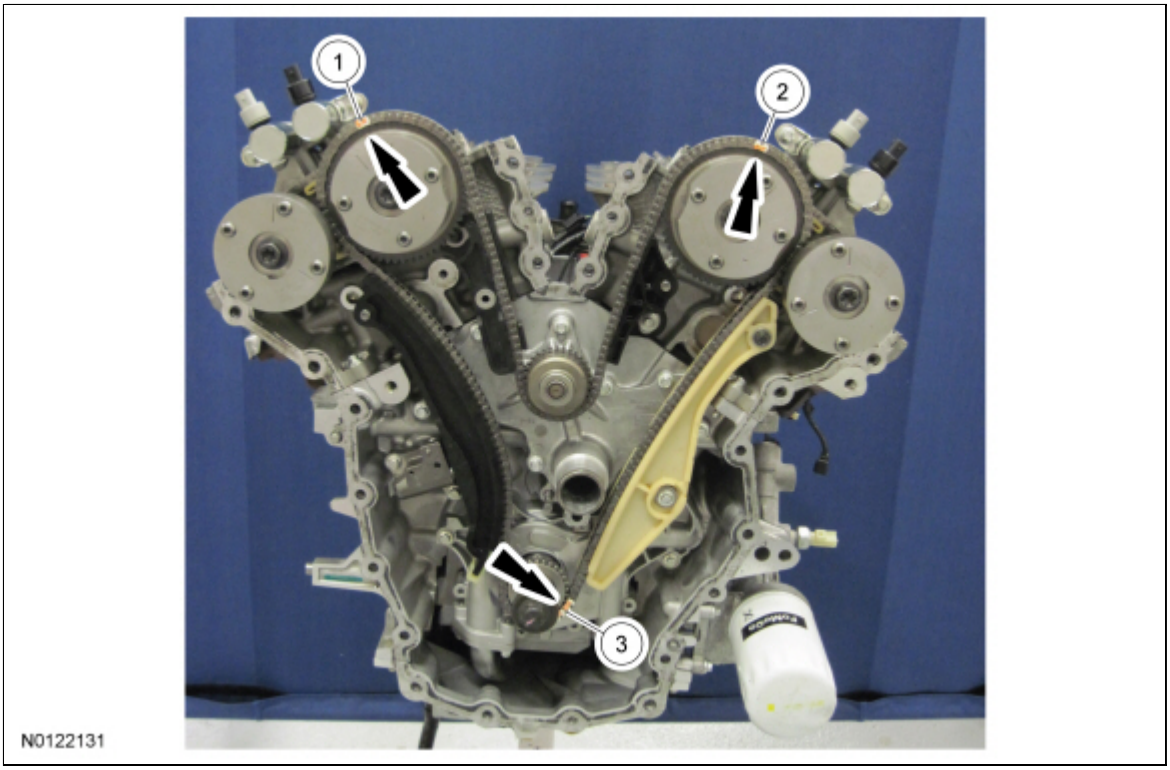
     Install the primary timing chain tensioner and the 2 bolts.

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- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



101. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



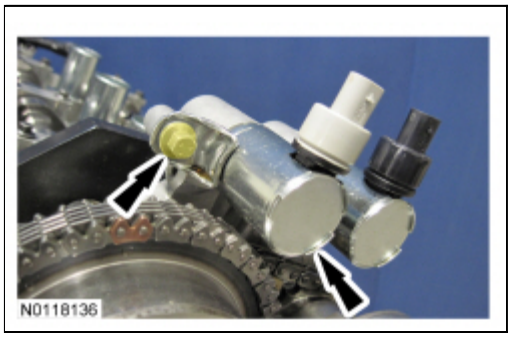
102. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



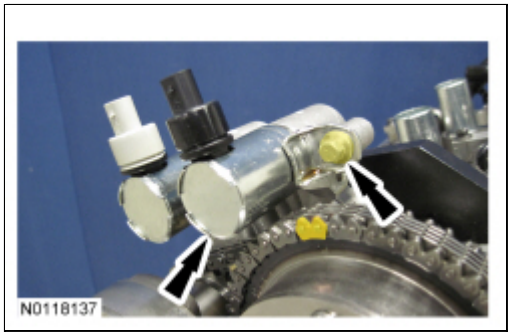
103. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

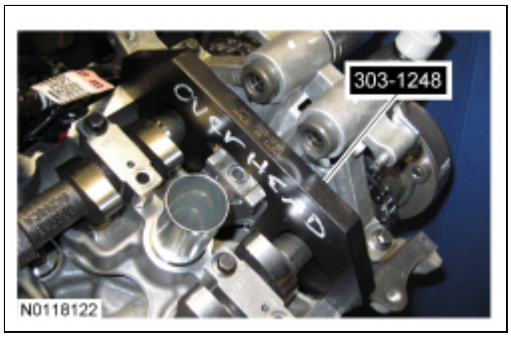
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



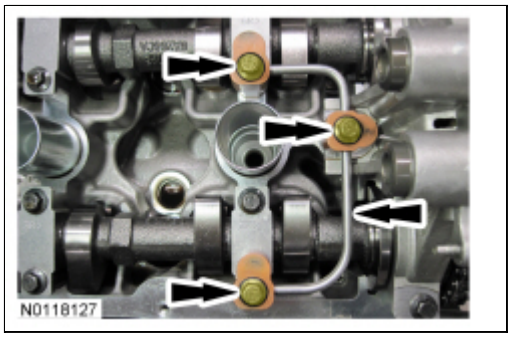
104. Remove the RH Camshaft Holding Tool.



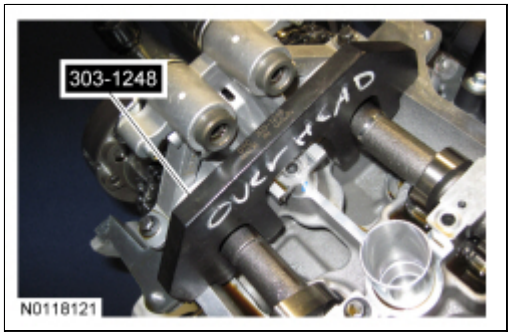
105. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.

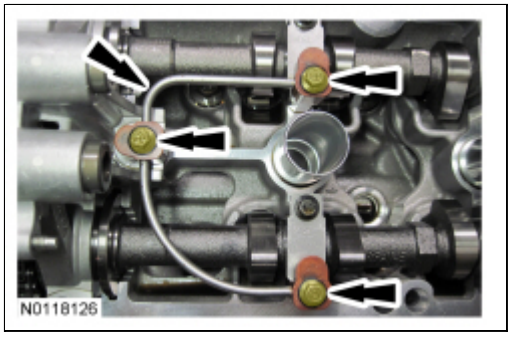
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106. Remove the LH Camshaft Holding Tool.

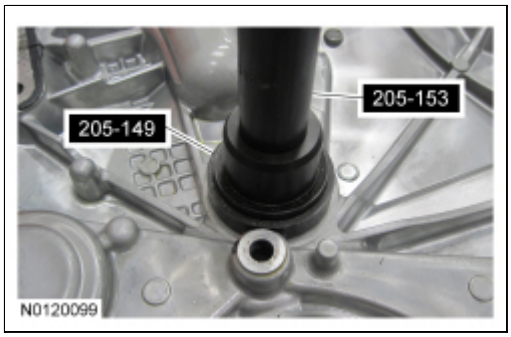


107. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



108. **NOTE:** Use Spindle Bearing Installer 205-149 to install the seal.

    Using the Spindle Bearing Installer, install the front cover radial seal from the rear side of the front cover.



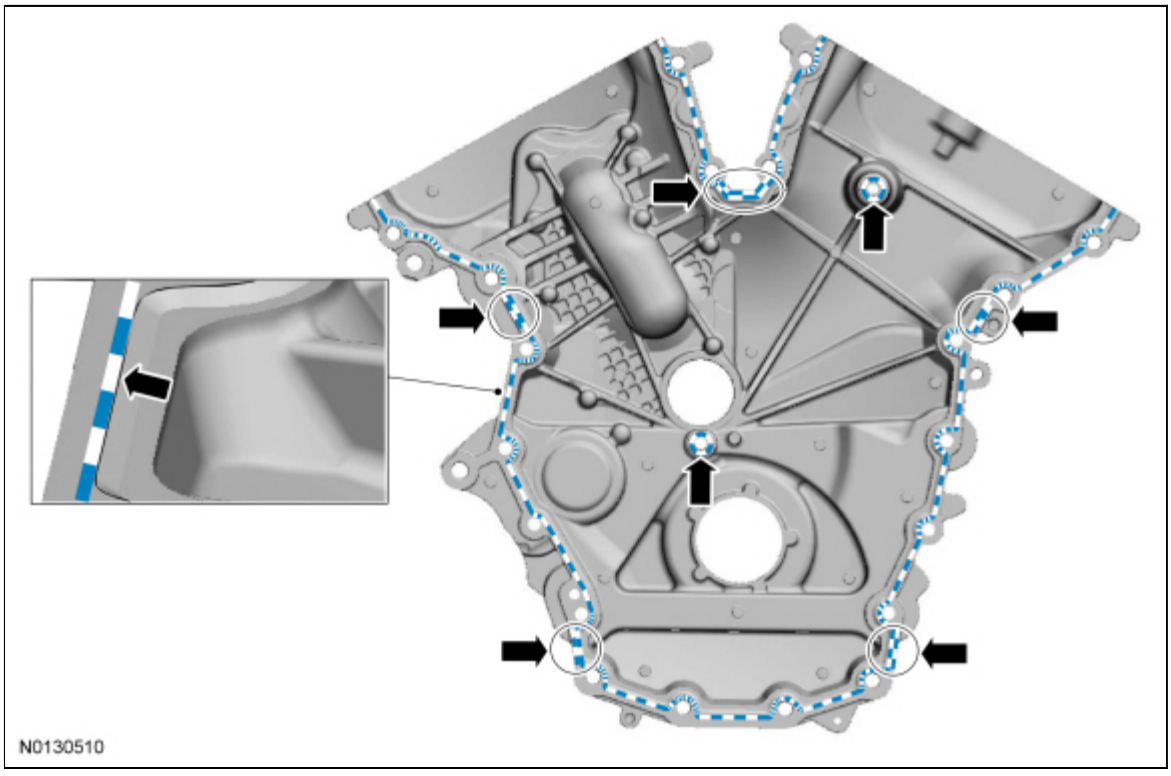
109. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

NOTICE: **Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this procedure can cause engine oil leakage.**

NOTE: The engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 must be installed within 10 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the engine front cover to the engine front cover sealing surfaces including the 2 engine front cover bolt bosses.

- Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.

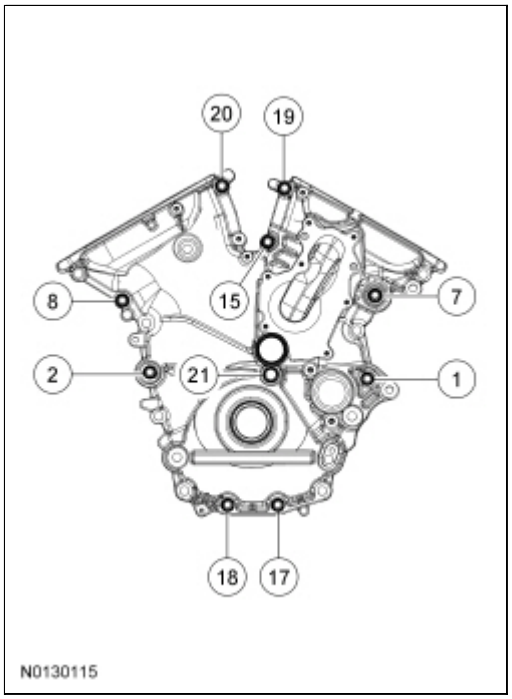


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110. **NOTE:** Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

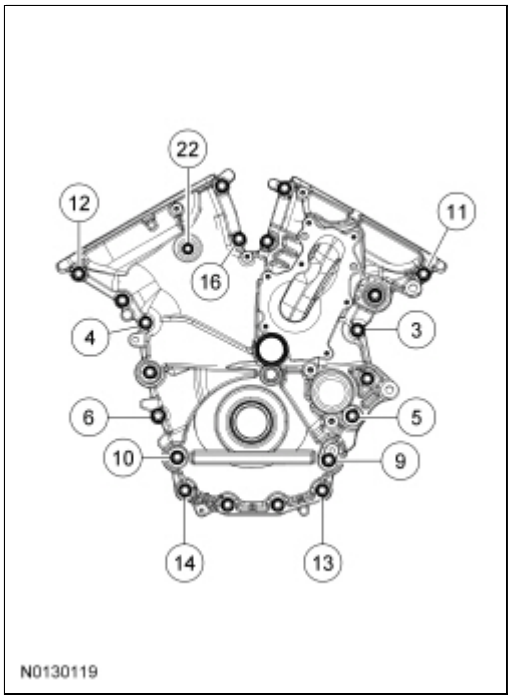
Install the engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 and tighten in the sequence shown in 3 stages:

- Stage 1: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 in sequence to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19 and 20 in sequence to 20 Nm (177 lb-in) then an additional 45 degrees.
- Stage 3: Tighten bolt 21 to 20 Nm (177 lb-in) then an additional 90 degrees.

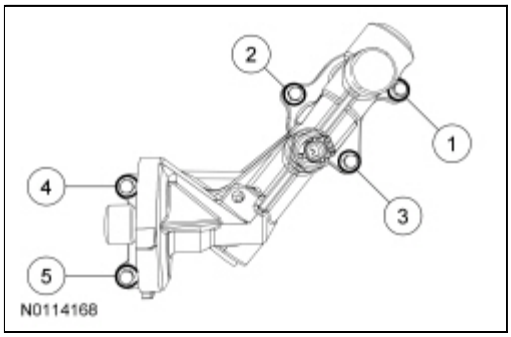


111. Install the remaining 12 engine front cover bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16, 22 and tighten in the sequence shown in 3 stages:

- Stage 1: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, and 16 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, and 16 to 20 Nm (177 lb-in) then an additional 45 degrees.
- Stage 3: Tighten bolt 22 to 10 Nm (89 lb-in) then an additional 45 degrees.



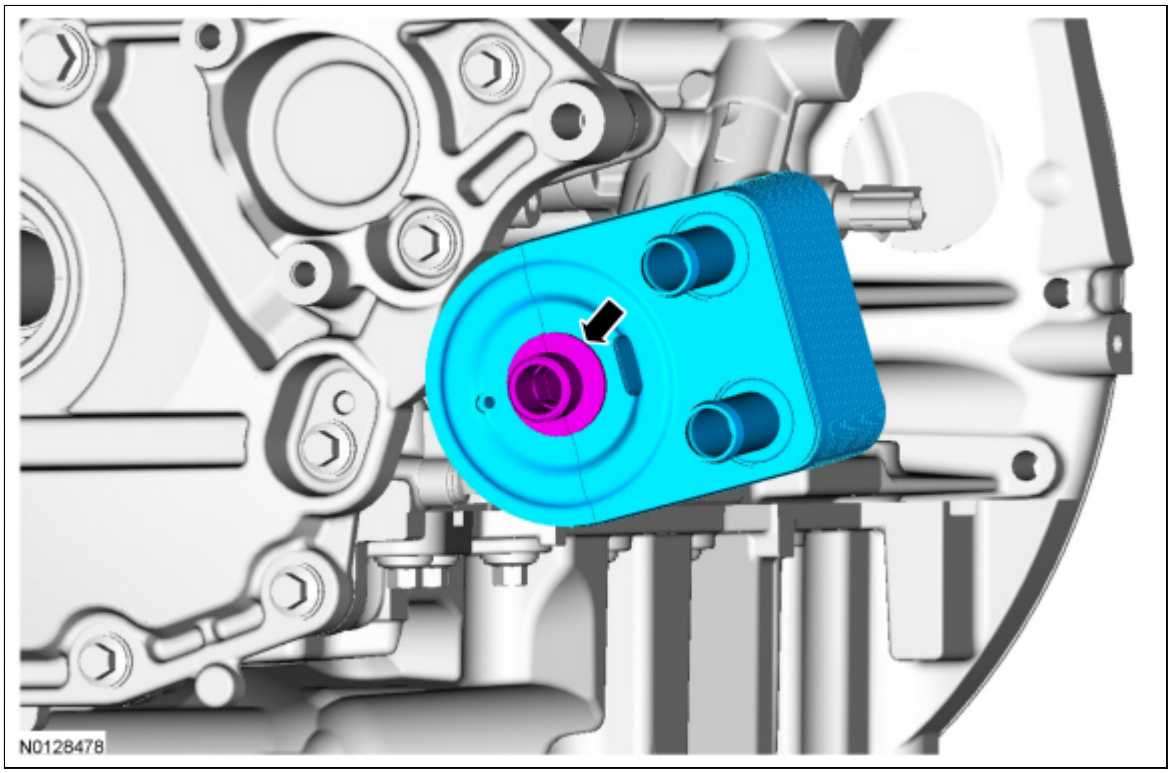
112. Using a new gasket, install the oil filter adapter and the 5 bolts and tighten in sequence shown.
    - Tighten to 10 Nm (89 lb-in) then an additional 45 degrees.



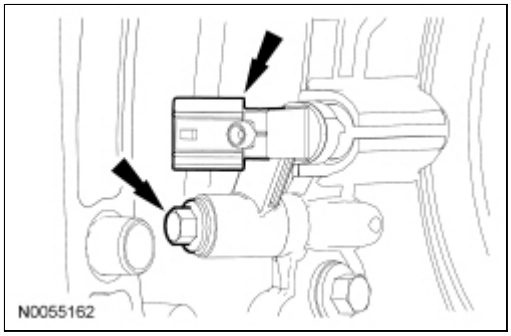
113. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

    Install the new oil cooler and the oil cooler insert bolt.
    - Tighten to 58 Nm (43 lb-ft).

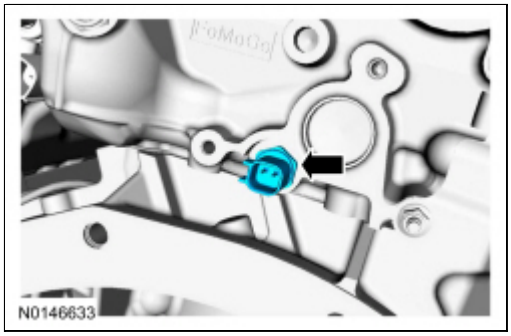
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114. Install the Crankshaft Position (CKP) sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).



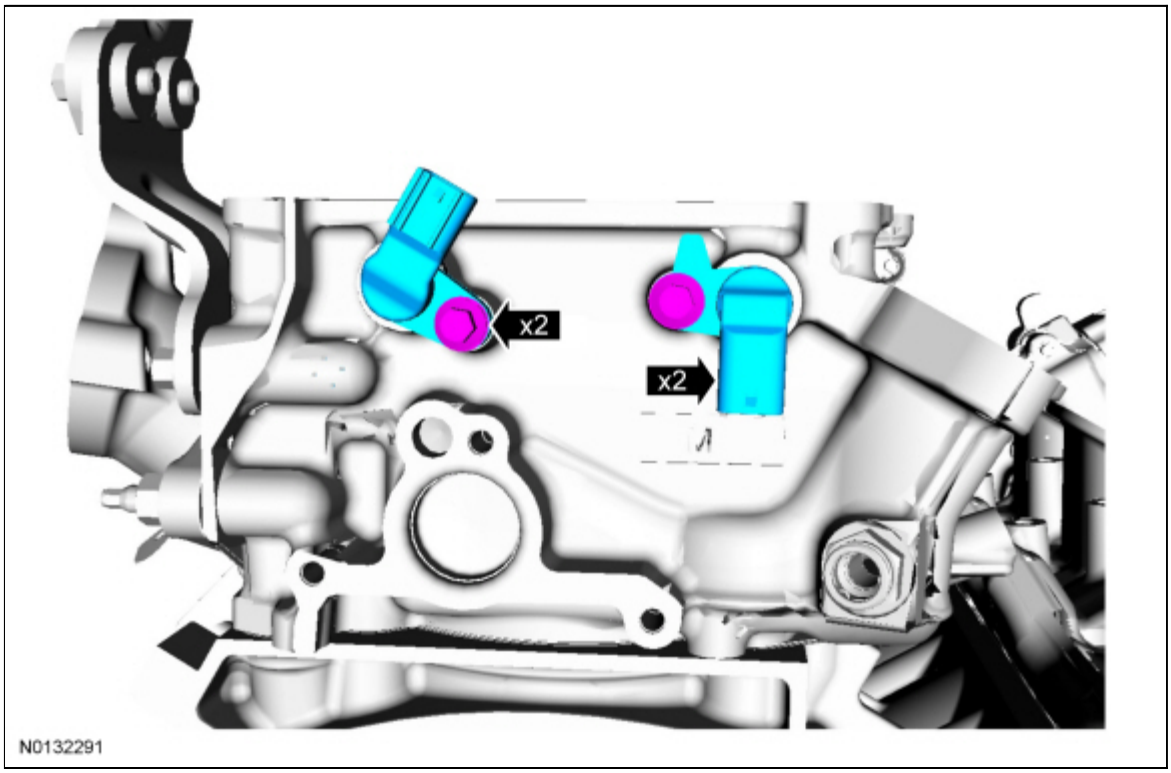
115. Install the new the Cylinder Head Temperature (CHT) sensor.
    - Tighten to 11 Nm (97 lb-in).



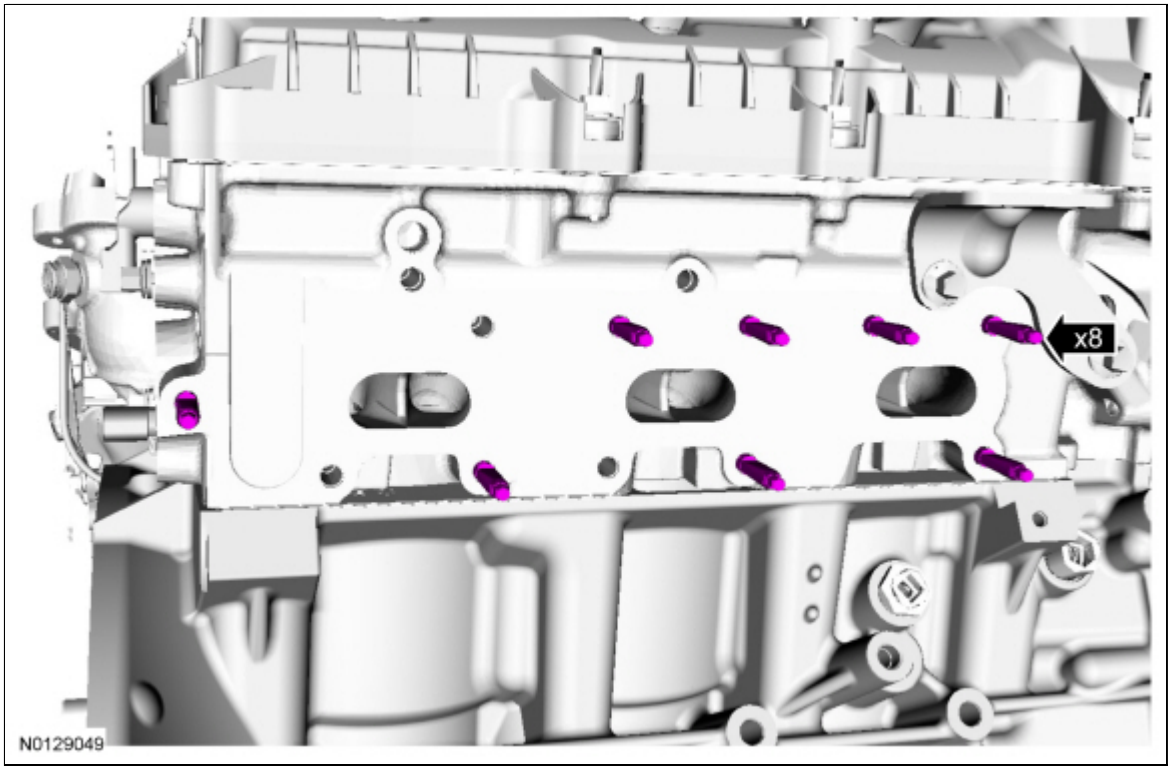
116. **NOTE:** Lubricate the 2 CMP sensor O-ring seals with clean engine oil.

Install the 2 LH CMP sensors and the bolts.

- Tighten to 10 Nm (89 lb-in).



117. Install the 8 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

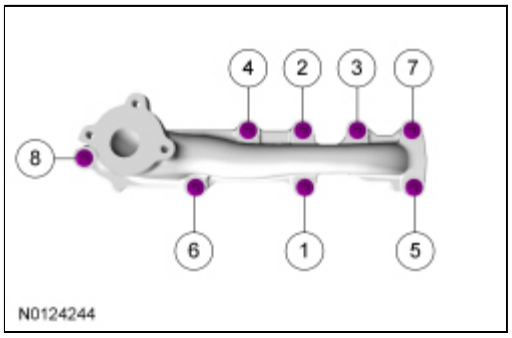


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118. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

Using a new gasket, install the RH exhaust manifold and the 8 new nuts. Tighten in 2 stages in the sequence shown.

- Stage 1: Tighten to 19 Nm (168 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).



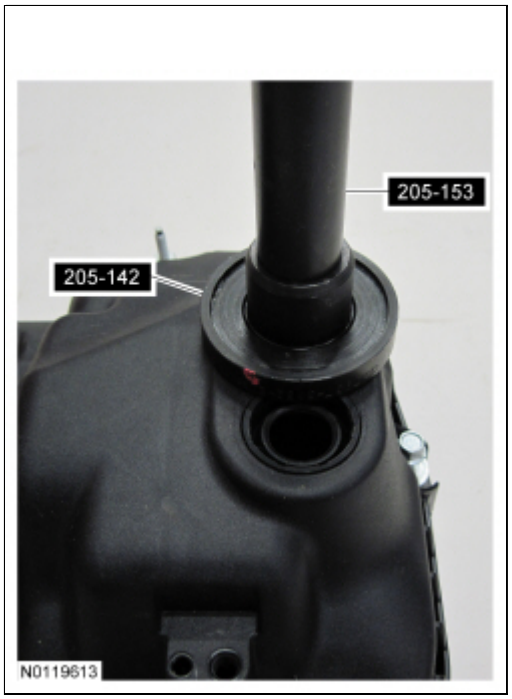
119. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



120. **NOTE:** Installation of new seals is only required if damaged seals were removed.

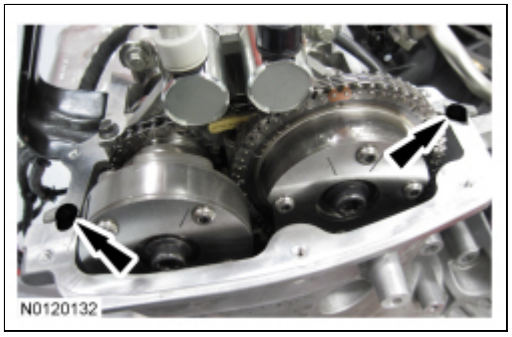
Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



121. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

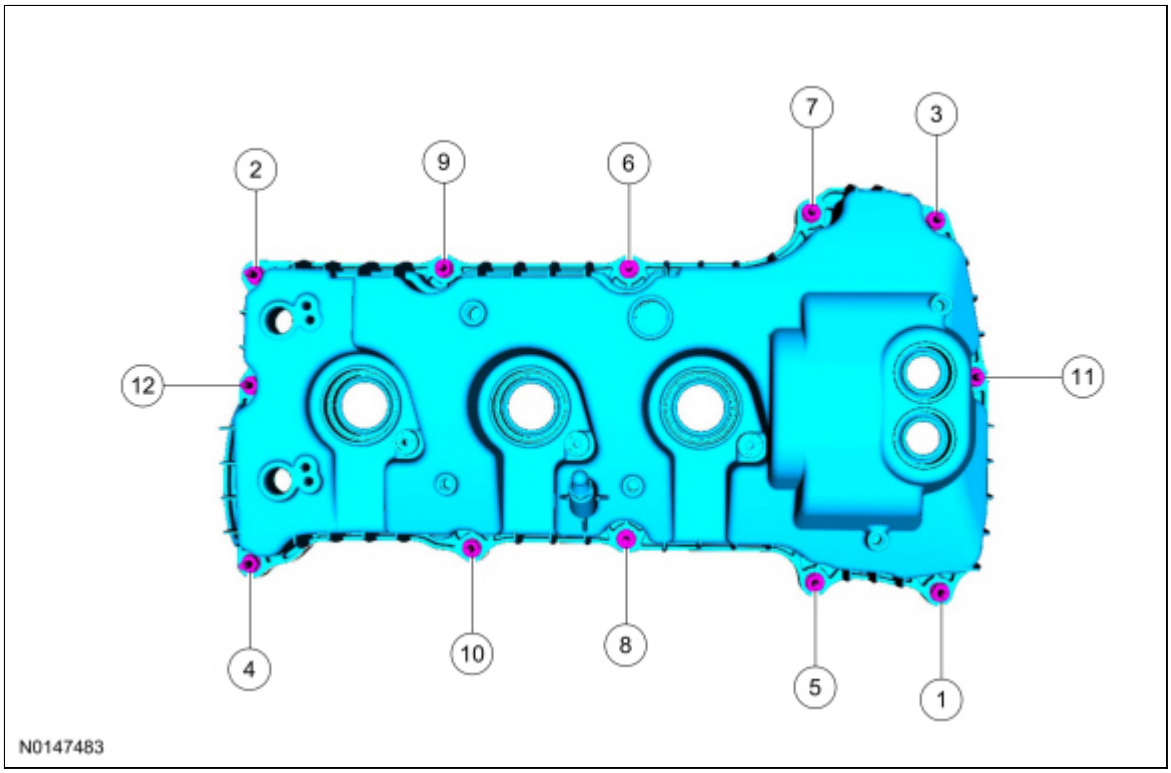
NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.

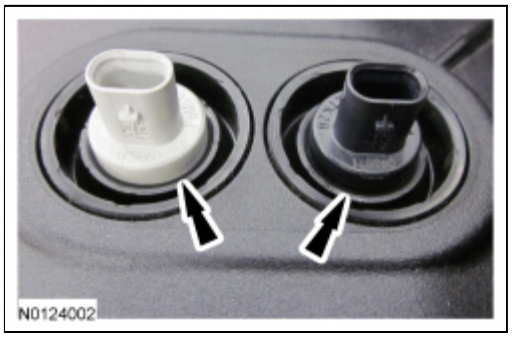


122. Using a new gasket, install the RH valve cover and tighten the 12 stud bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).

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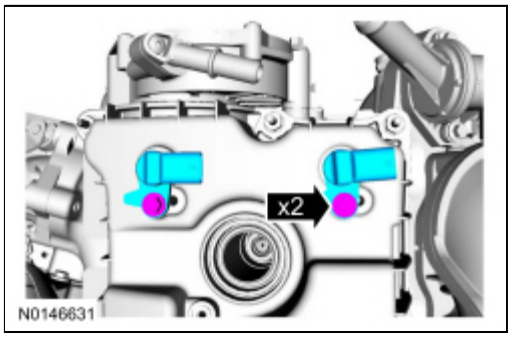
123. Ensure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.



124. **NOTE:** Lubricate the 2 CMP sensor O-ring seals with clean engine oil.

Install the 2 RH CMP sensors and the bolts.

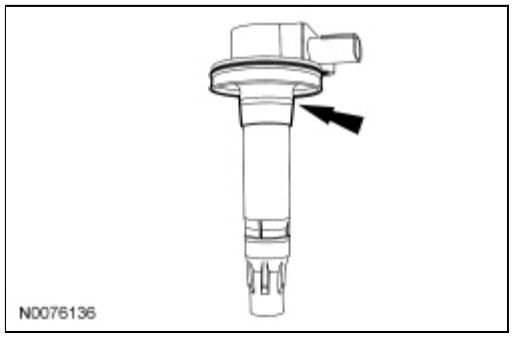
- Tighten to 7 Nm (62 lb-in).



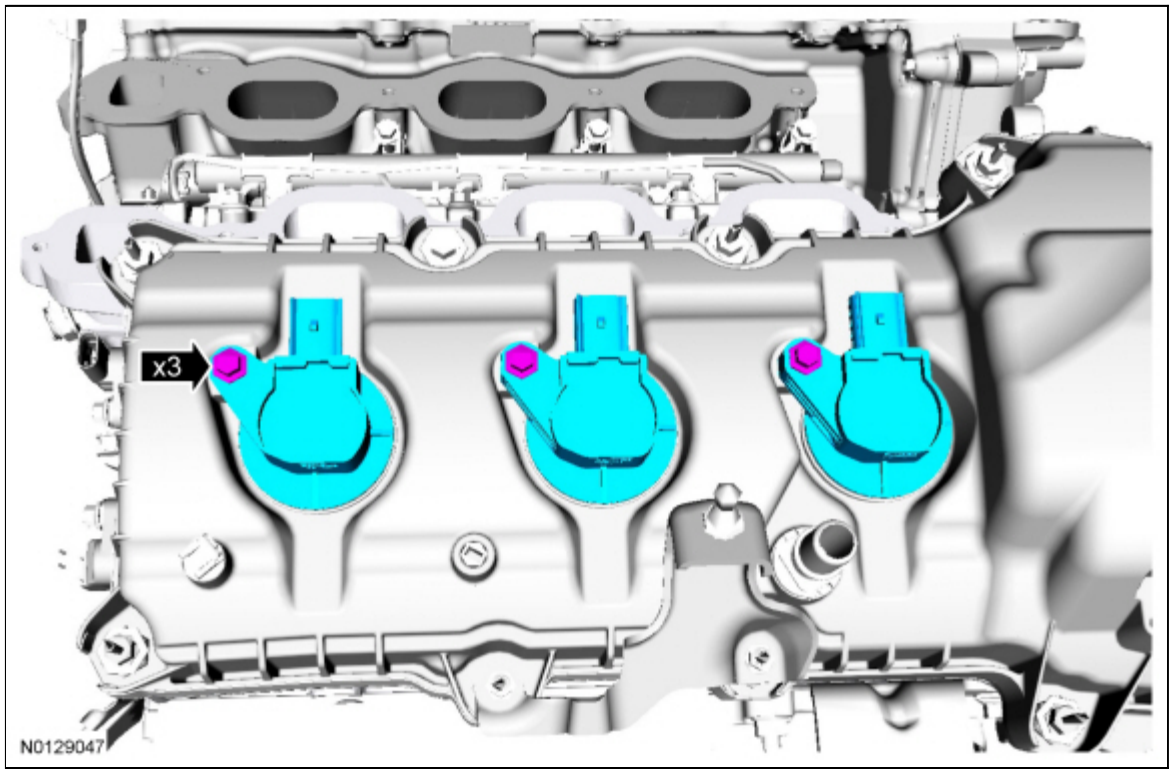
125. ***NOTICE:*** **Only use hand tools when installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

Install the 3 RH spark plugs.
- Tighten to 15 Nm (133 lb-in).

126. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
- To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.

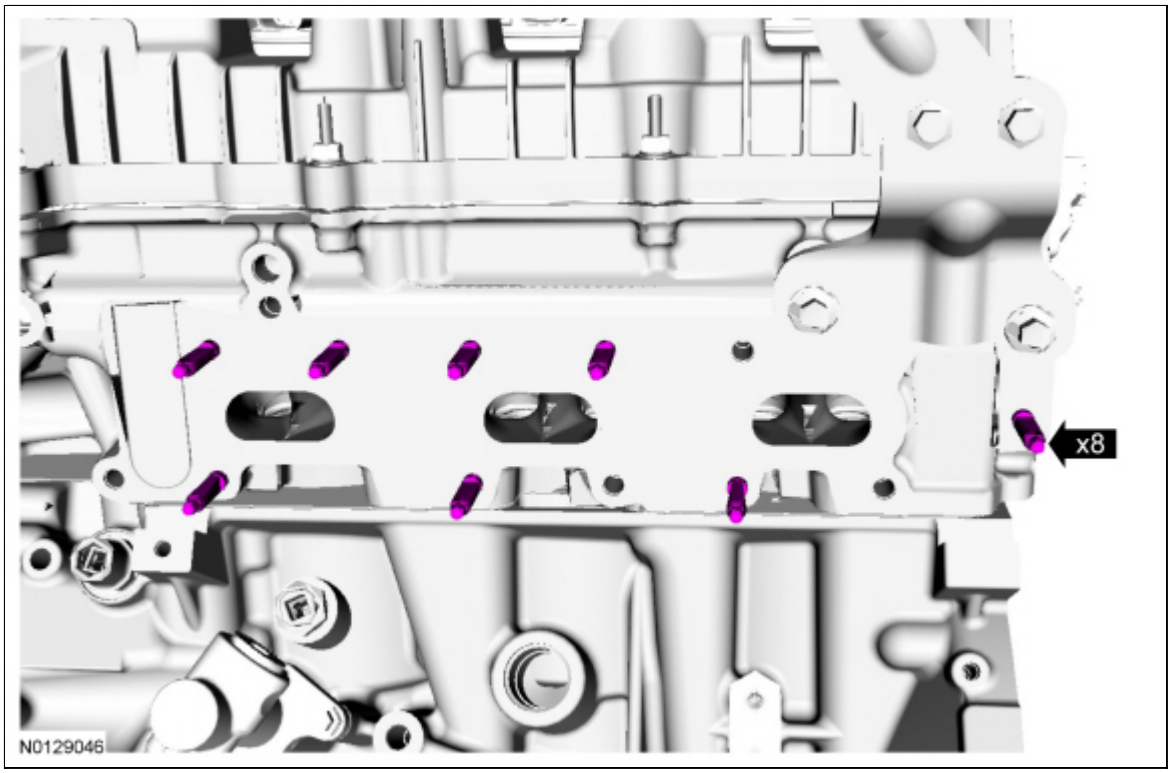


127. Install the 3 RH ignition coil-on-plug assemblies and the 3 bolts.
- Tighten to 7 Nm (62 lb-in) then an additional 45 degrees.



128. Install the 8 new LH exhaust manifold studs.
- Tighten to 12 Nm (106 lb-in).

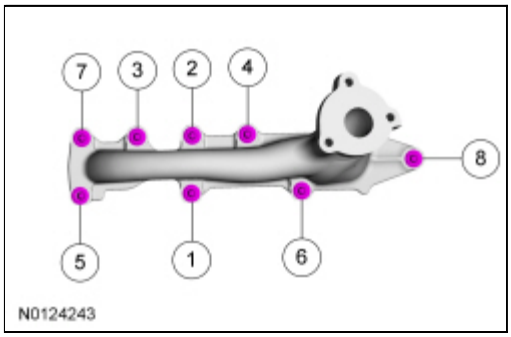
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129. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

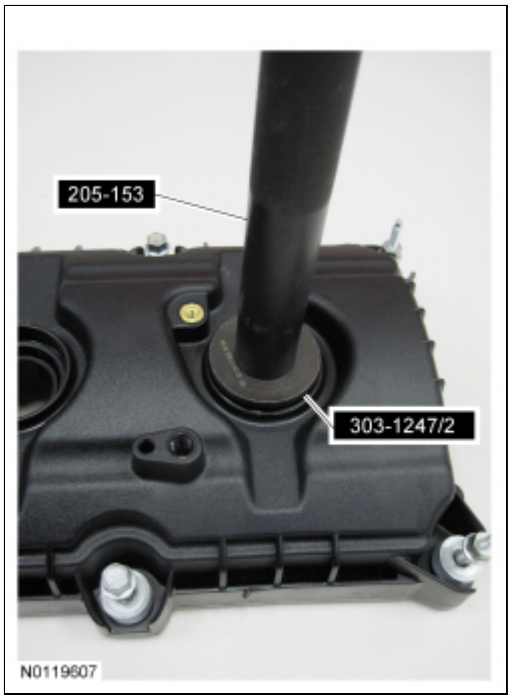
Using a new gasket, install the LH exhaust manifold and 8 new nuts. Tighten in 2 stages in the sequence shown.

- Stage 1: Tighten to 19 Nm (168 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).



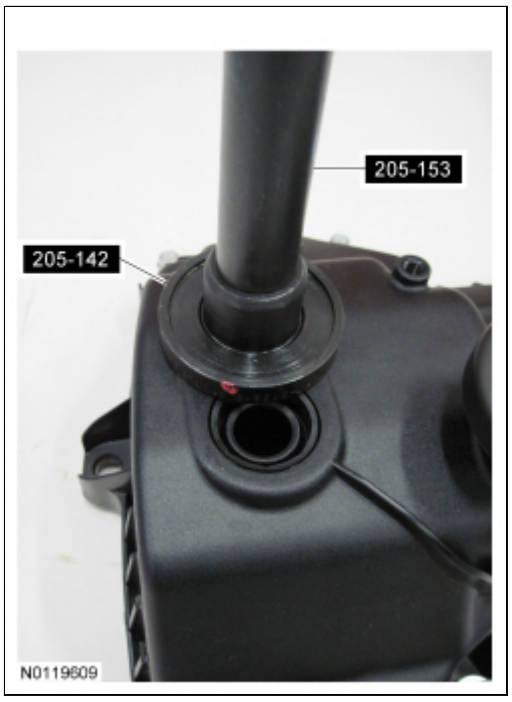
130. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



131. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).

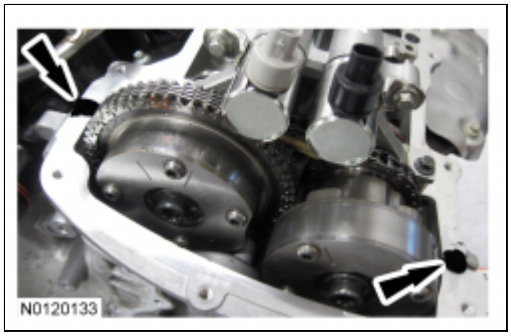


132. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

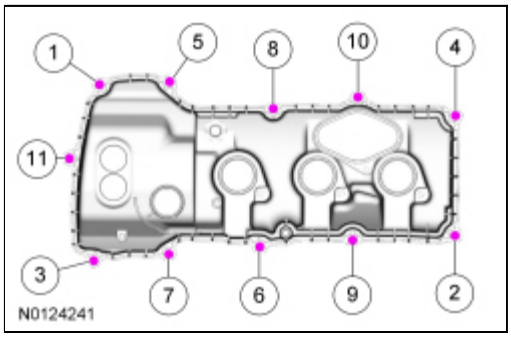
NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

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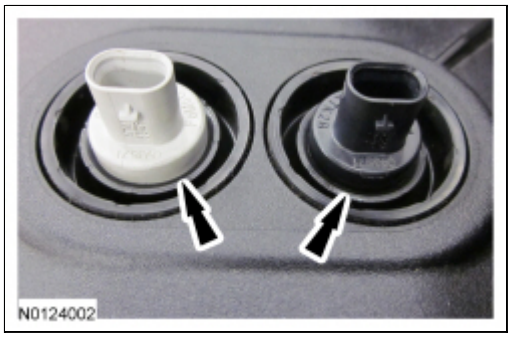
Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.



133. Using a new gasket, install the LH valve cover and tighten the 11 stud bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).



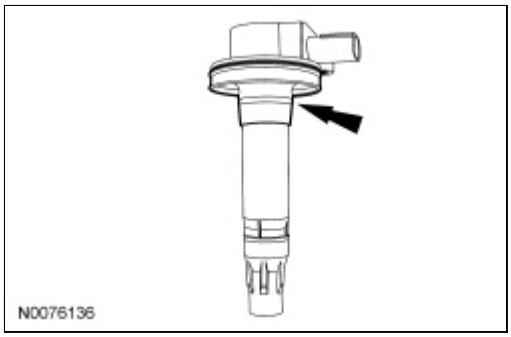
134. Ensure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.



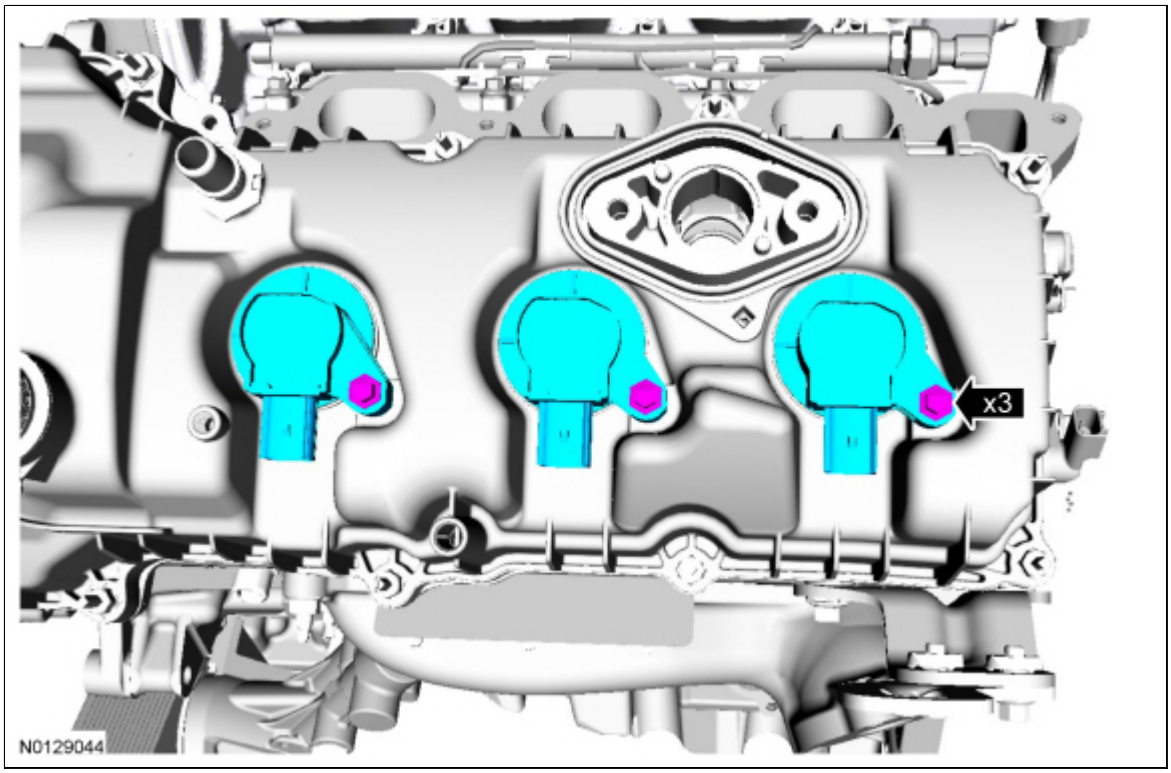
135. ***NOTICE:*** **Only use hand tools when installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

    Install the 3 LH spark plugs.
    - Tighten to 15 Nm (133 lb-in).

136. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
    - To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.

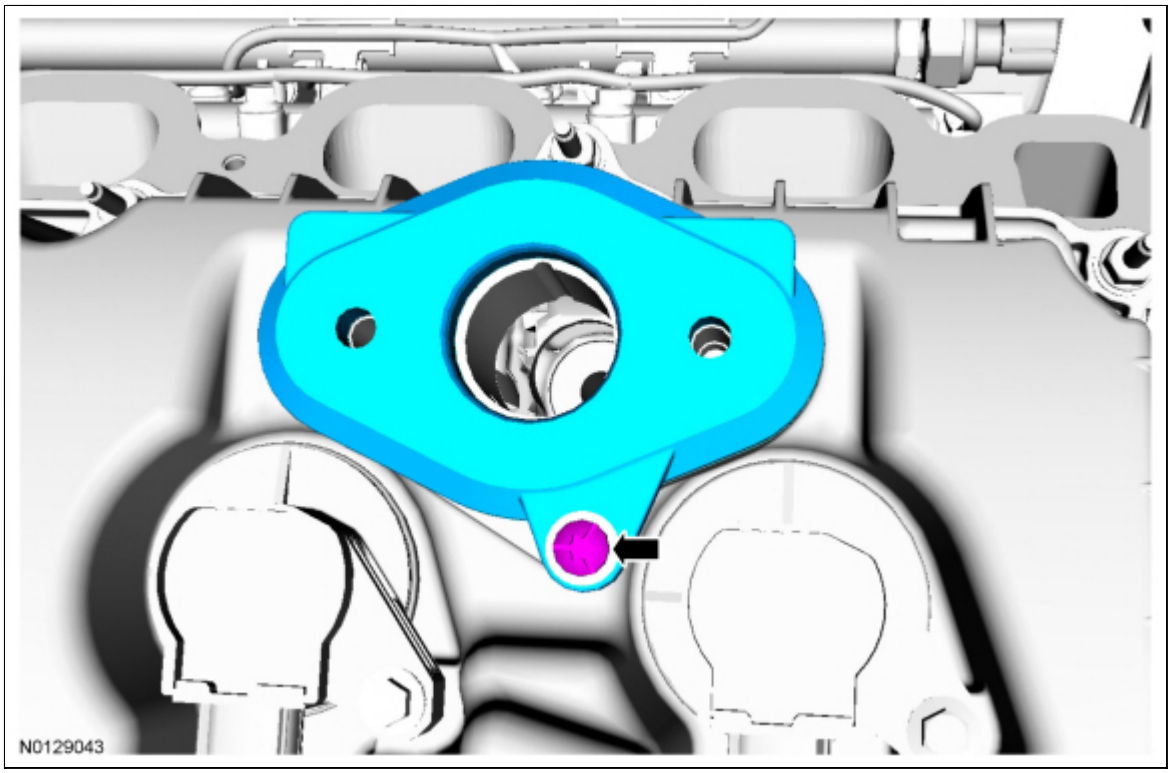


137. Install the 3 LH ignition coil-on-plug assemblies and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in) then an additional 45 degrees.



138. Using new gaskets, install the fuel injection pump mounting plate and bolt.
    - Tighten finger-tight.

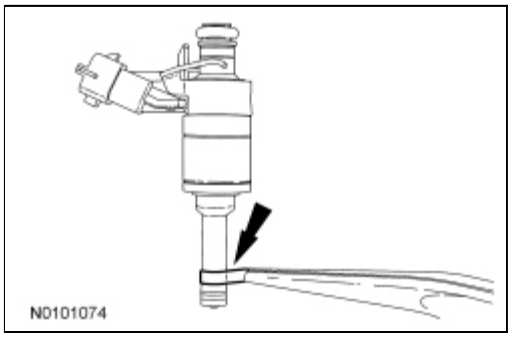
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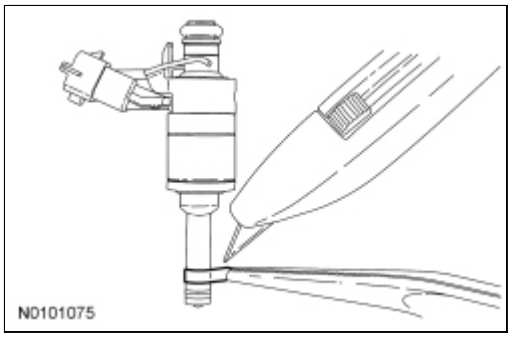
139. ***NOTICE:*** **Do not attempt to cut the lower Teflon® seal without pulling it away from the fuel injector or damage to the fuel injector may occur.**

NOTE: Be very careful when removing the lower Teflon® seals, not to scratch, nick or gouge the fuel injectors.

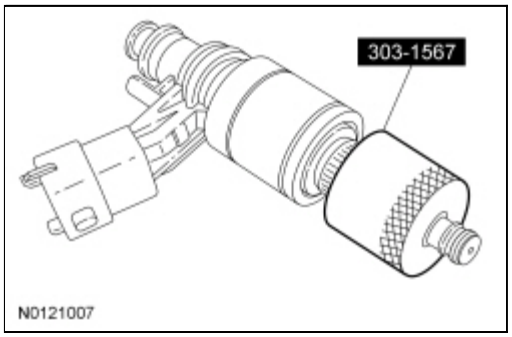
Pull the Teflon® seal away from the fuel injector with narrow tip pliers.



140. Carefully cut and discard the lower fuel injector Teflon® seals.

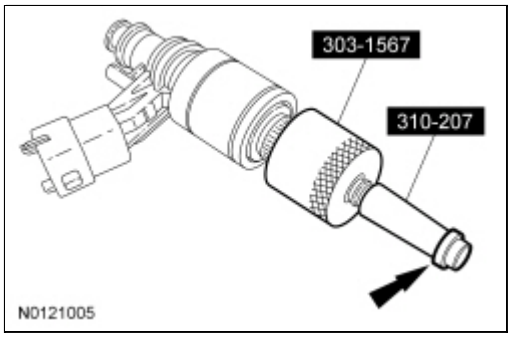


141. Place the Teflon® Seal Sizer, knurled side out, over the fuel injector tip until the fuel injector seal recess is exposed.



142. **NOTE:** Do not lubricate the new lower Teflon® fuel injector seals.

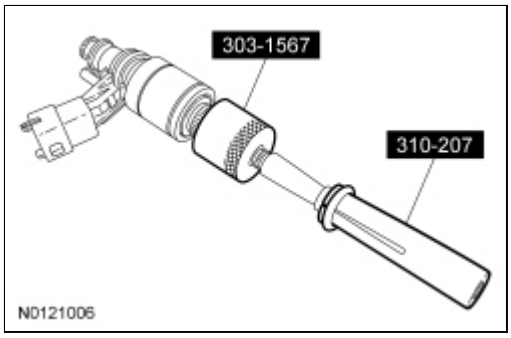
Install the new lower Teflon® seals on the narrow end of the Arbor (part of the Fuel Injector Seal Installer), then install the Arbor on the fuel injector tip.



143. ***NOTICE:*** **Once the Teflon® seal is installed on the Arbor, it should immediately be installed onto the fuel injector to avoid excessive expansion of the seal.**

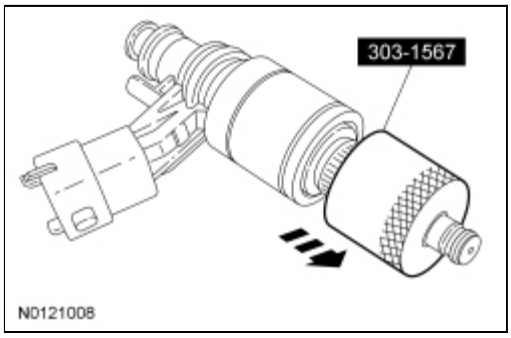
Using the Pusher Tool (part of the Fuel Injector Seal Installer), slide the Teflon® seals off of the Arbor and into the groove on the fuel injector.

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144. **NOTE:** Make sure the Teflon® seal is fully seated in the groove on the fuel injector before sizing the seal.

    Slide the Teflon® Seal Sizer off the end of the fuel injector to size the seal.

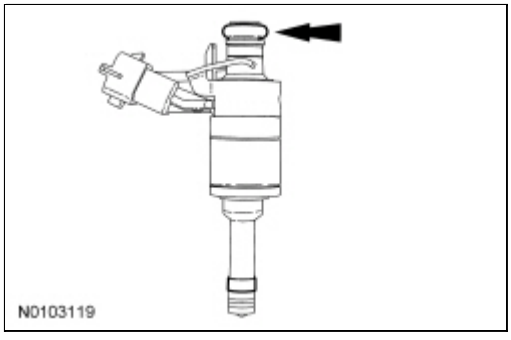


145. ***NOTICE:*** **Use fuel injector O-ring seals that are made of special fuel-resistant material. The use of ordinary O-ring seals may cause the fuel system to leak. Do not reuse the O-rings.**

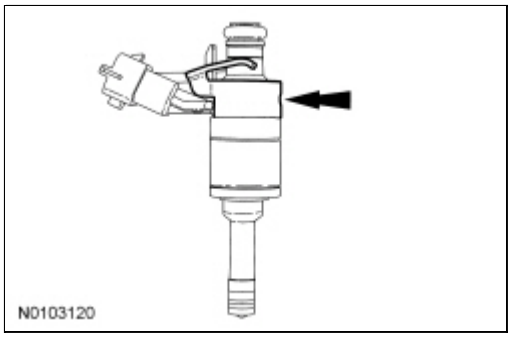
    NOTE: Apply clean engine oil to the 6 new upper fuel injector O-ring seals.

    NOTE: Inspect the fuel injector support disk and replace if necessary.

    Install the 6 new upper fuel injector O-ring seals.



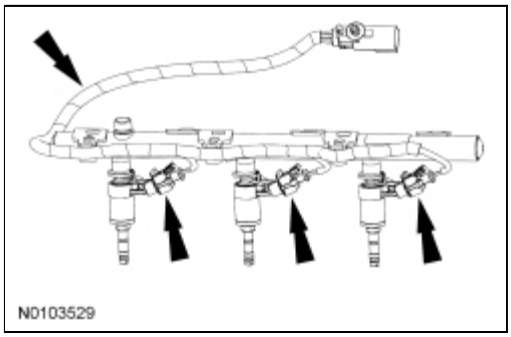
146. Install the 6 new fuel injector clips.



147. **NOTE:** RH shown, LH similar.

NOTE: The anti rotation device on the fuel injector has to slip into the groove of the fuel rail cup.

Install the 6 fuel injectors into the fuel rails and connect the fuel injector electrical connector.

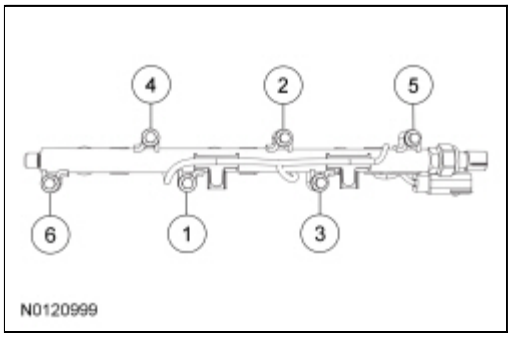


148. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

NOTE: Tighten the bolts using a method that draws the fuel rail evenly to the cylinder head, preventing a rocking motion.

Install the RH fuel rail assembly and the 6 new bolts. Tighten in 3 stages in the sequence shown.

- Stage 1: Push down on the fuel rail face above the fuel injectors.
- Stage 2: Tighten to 10 Nm (89 lb-in).
- Stage 3: Tighten an additional 45 degrees.



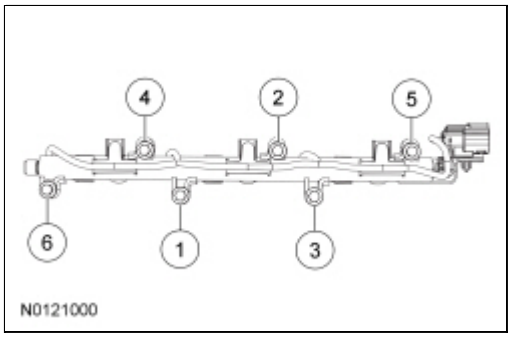
149. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

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NOTE: Tighten the bolts using a method that draws the fuel rail evenly to the cylinder head, preventing a rocking motion.

Install the LH fuel rail assembly and the 6 new bolts. Tighten in 3 stages in the sequence shown.

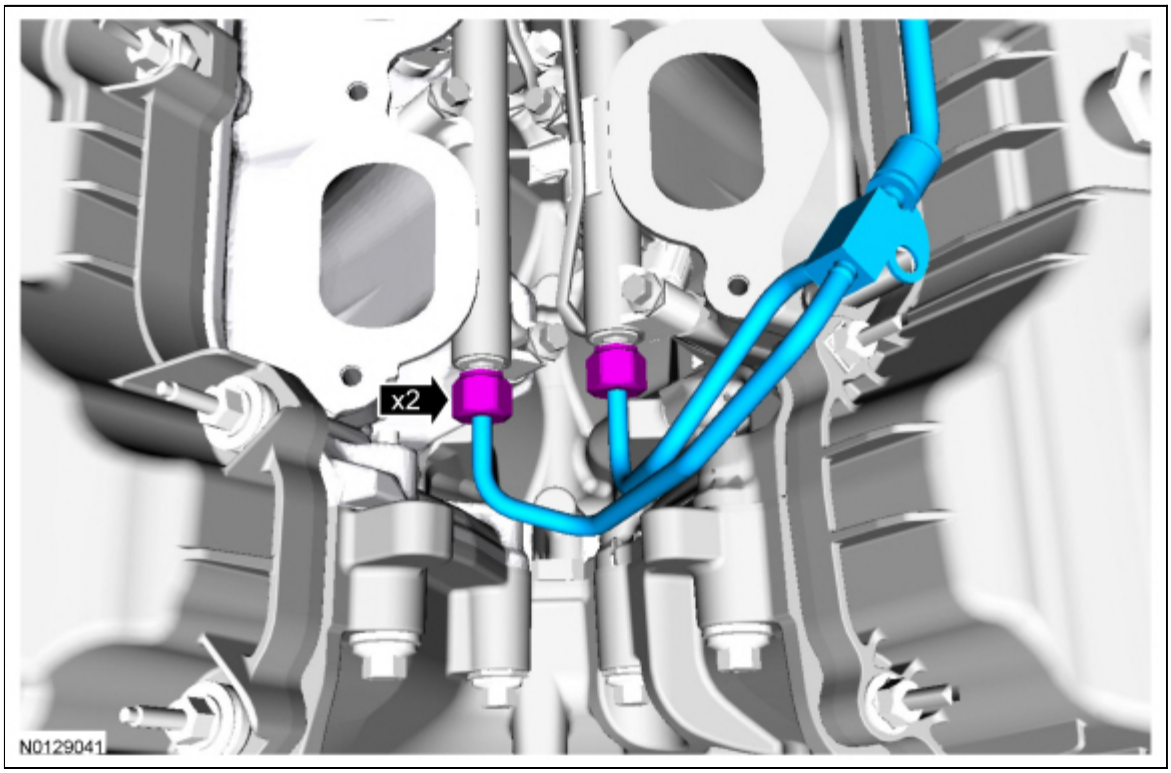
- Stage 1: Push down on the fuel rail face above the fuel injectors.
- Stage 2: Tighten to 10 Nm (89 lb-in).
- Stage 3: Tighten an additional 45 degrees.



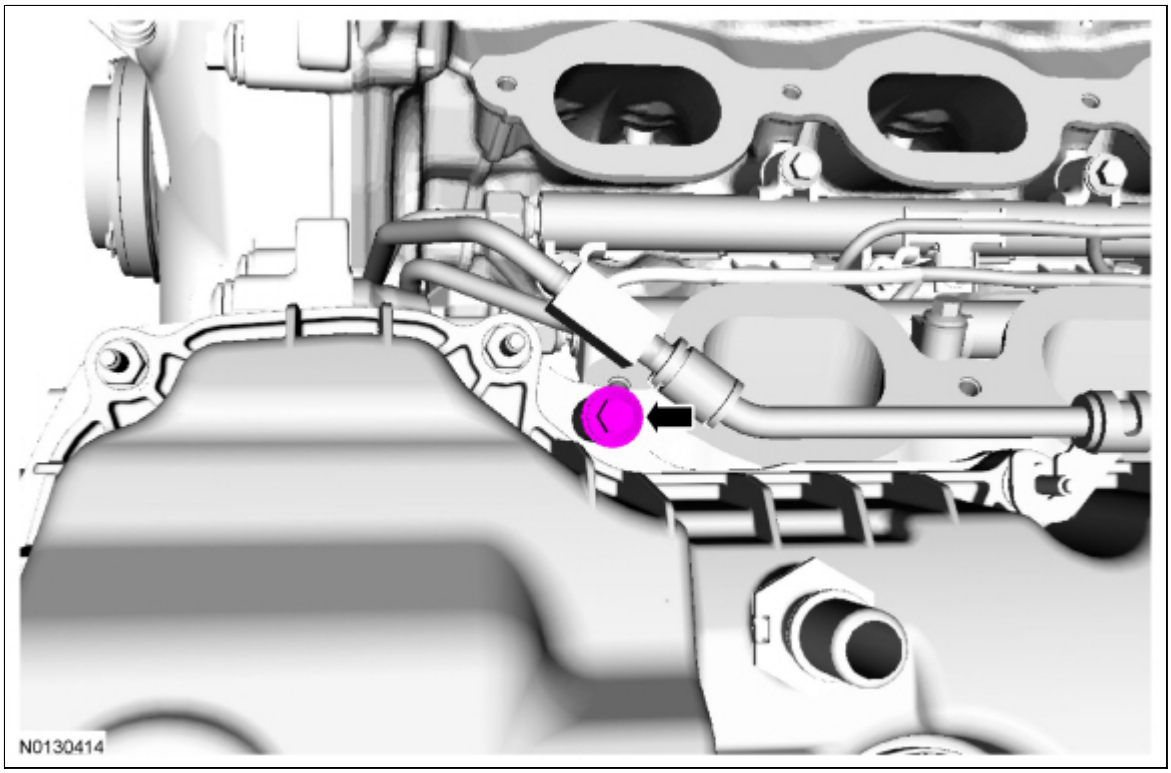
150. **NOTE:** Apply clean engine oil to the threads of the 2 high-pressure fuel tube flare nuts.

Position the new high-pressure fuel tube and hand start the flare nuts in 2 stages.

- Stage 1: Hand tighten the high-pressure fuel tube-to-RH fuel rail flare nut.
- Stage 2: Hand tighten the high-pressure fuel tube-to-LH fuel rail flare nut.

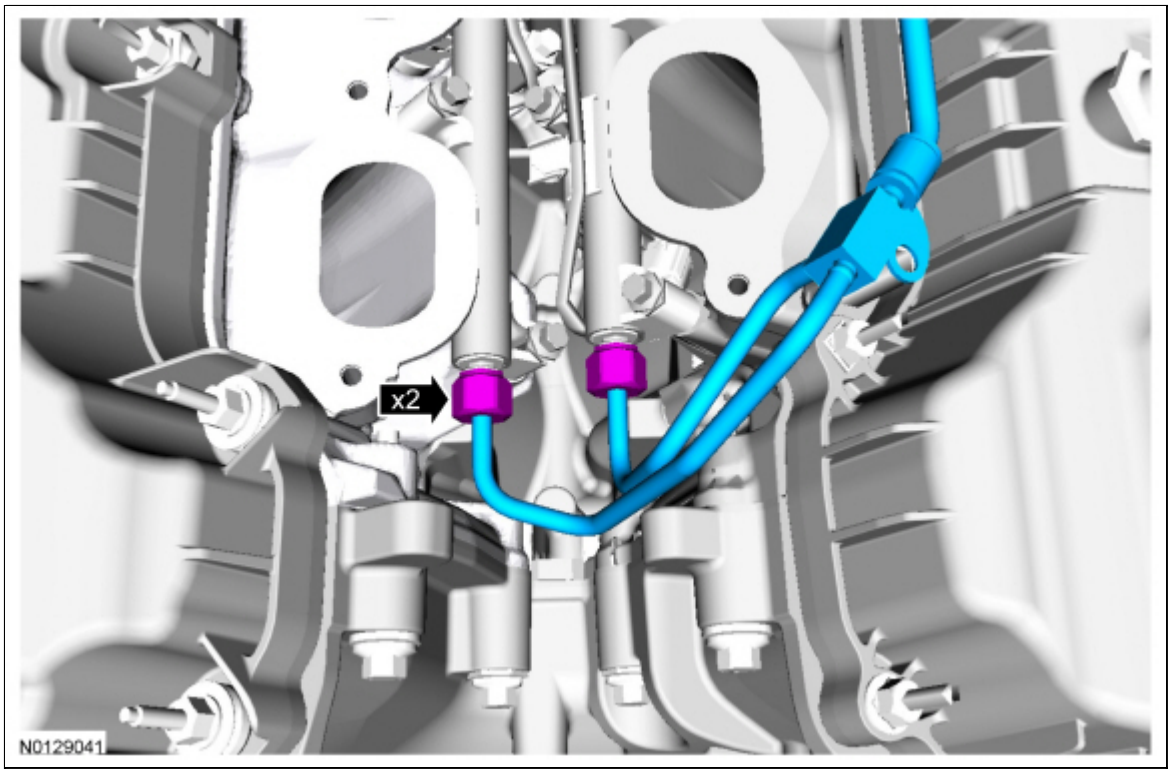


151. Loosely install the bolt for the high-pressure fuel tube.

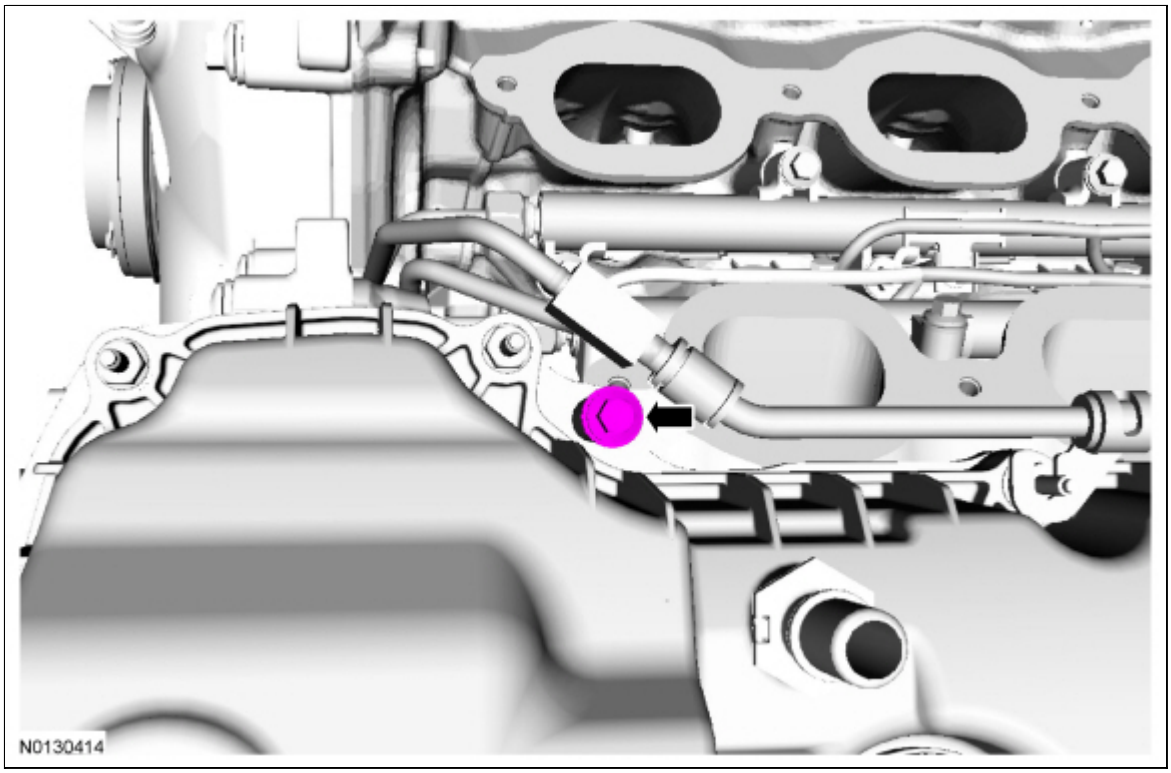


152. Connect the high-pressure fuel tube to the fuel rails. Tighten in 6 stages.
    - Stage 1: Tighten the high-pressure fuel tube-to-RH fuel rail flare nut to 15 Nm (133 lb-in).
    - Stage 2: Tighten an additional 30 degrees.
    - Stage 3: Tighten to 32 Nm (24 lb-ft).
    - Stage 4: Tighten the high-pressure fuel tube-to-LH fuel rail flare nut to 15 Nm (133 lb-in).
    - Stage 5: Tighten an additional 30 degrees.
    - Stage 6: Tighten to 32 Nm (24 lb-ft).

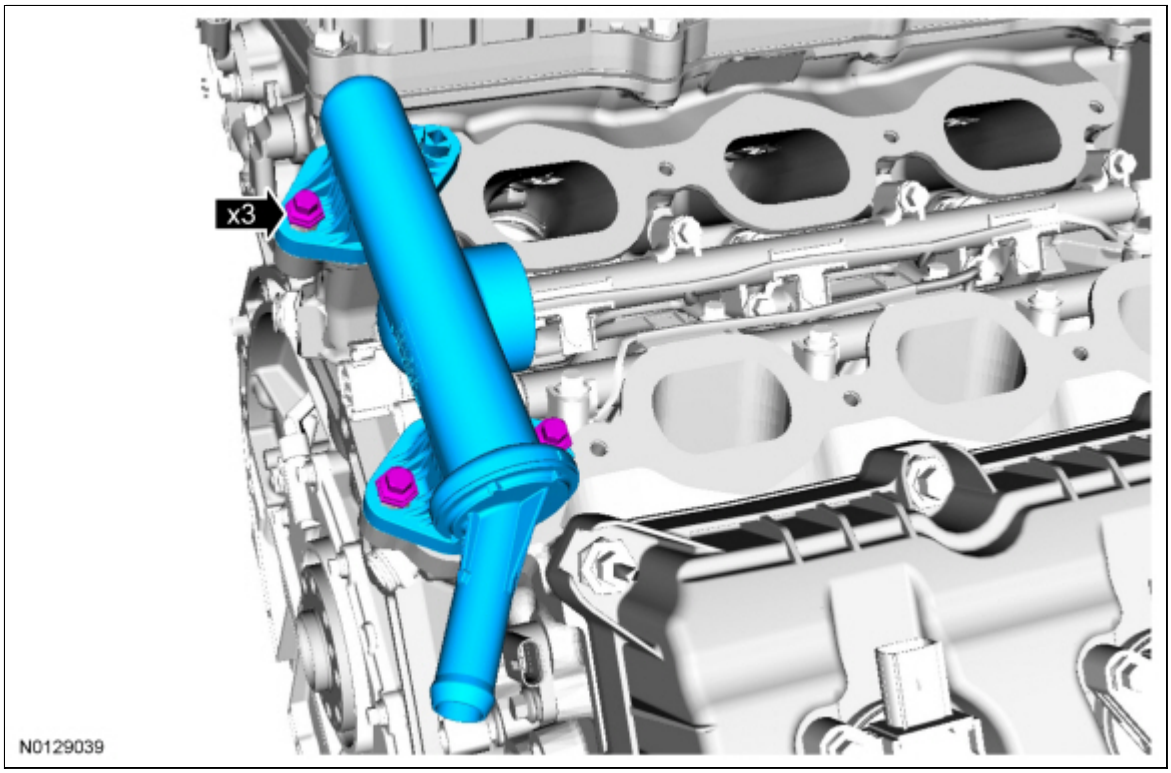
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153. Tighten the bolt for the high-pressure fuel tube.
    - Tighten the bolt to 10 Nm (89 lb-in) then an additional 45 degrees.

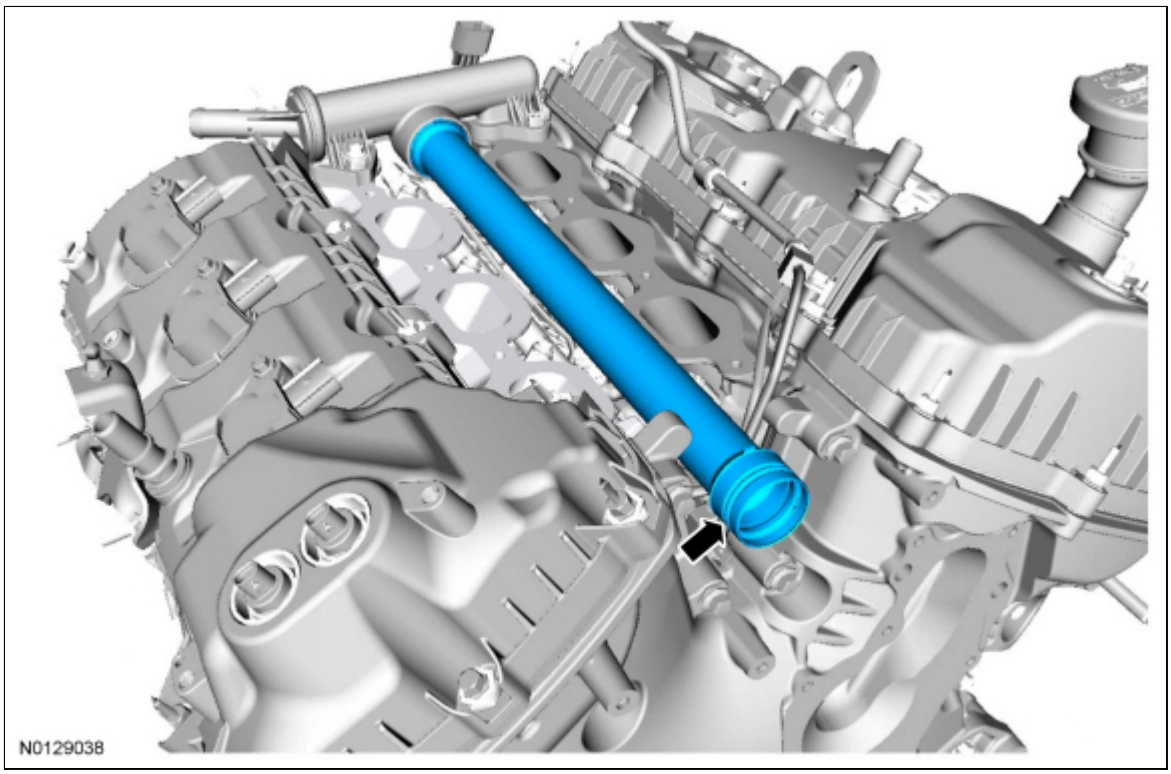


154. Using new gaskets, install the coolant crossover manifold assembly and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) then an additional 45 degrees.



155. **NOTE:** Lubricate the O-ring seal with clean engine coolant.

Using new O-ring seals, install the coolant inlet pipe.

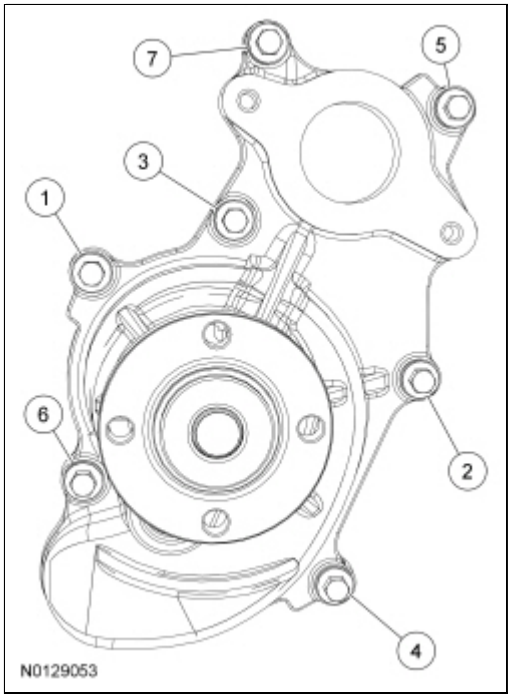


156. **NOTE:** Lubricate the O-ring seal with clean engine coolant.

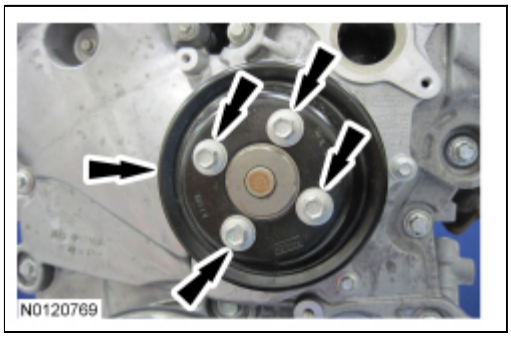
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Using new coolant pump gasket and coolant pump O-ring seal, install the coolant pump and the 7 bolts and tighten in 2 stages in the sequence shown.

- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.



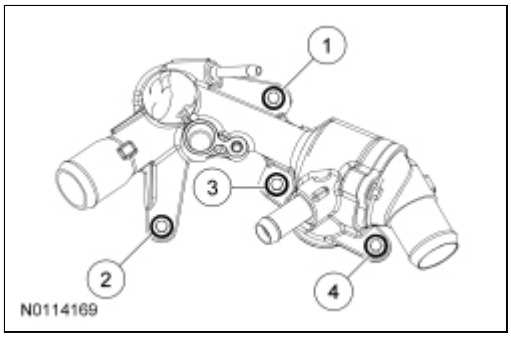
157. Install the coolant pump pulley and the 4 bolts.
    - Tighten to 24 Nm (18 lb-ft).



158. **NOTE:** Lubricate the coolant inlet tube O-ring seal with clean engine coolant.

Install the thermostat housing and the 4 bolts and tighten in 2 stages in the sequence shown.

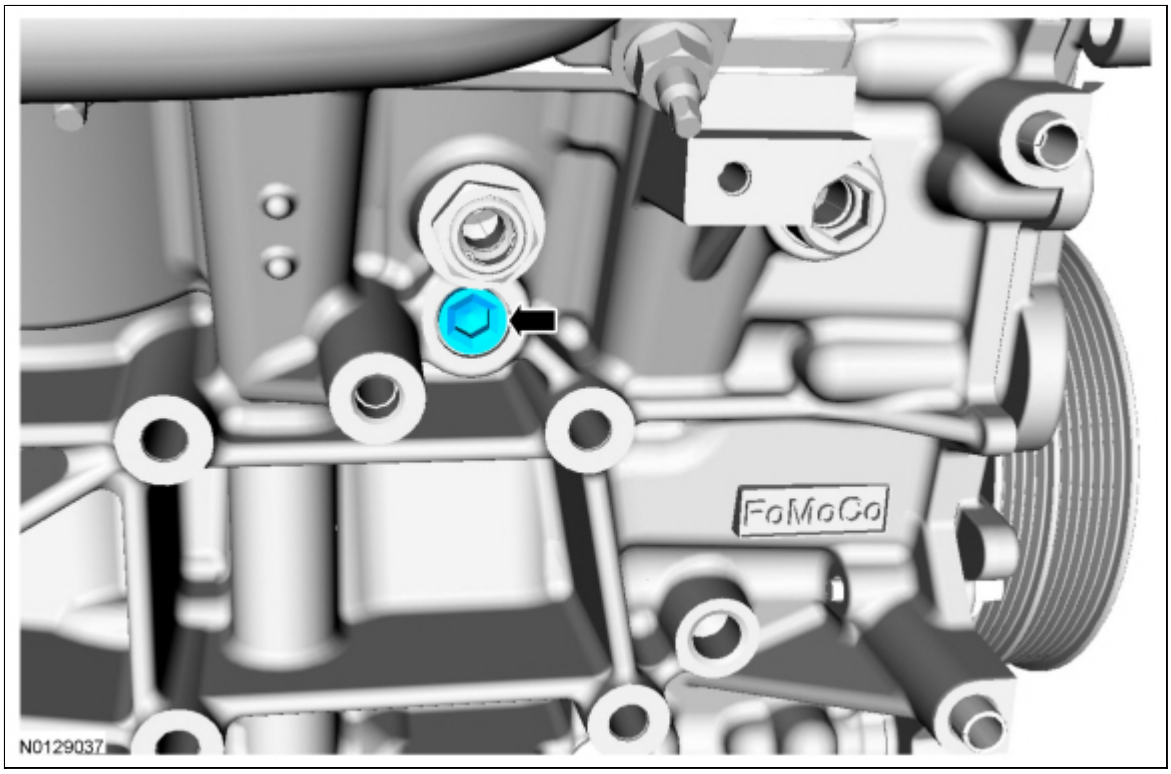
- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



159. **NOTE:** Apply thread sealant with PTFE to the threads prior to installing the cylinder block drain plug.

Install the RH cylinder block drain plug.

- Tighten to 20 Nm (177 lb-in) then an additional 180 degrees.

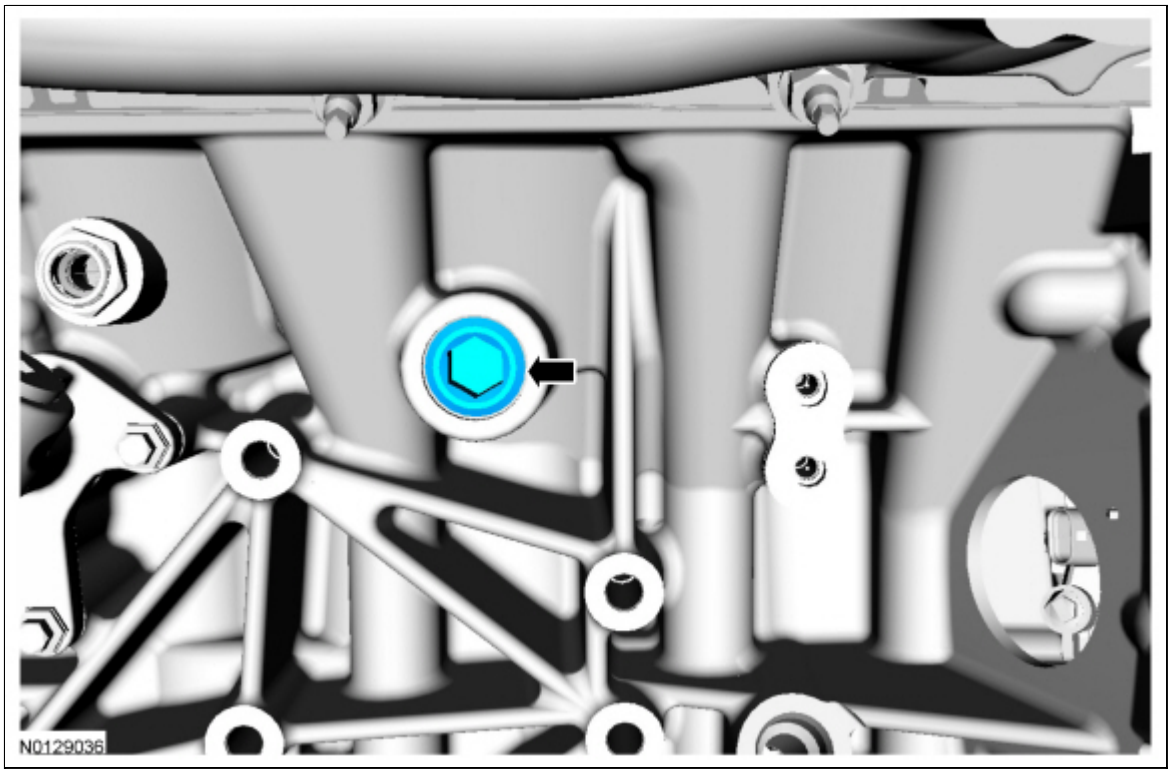


160. **NOTE:** Apply thread sealant with PTFE to the threads prior to installing the cylinder block drain plug.

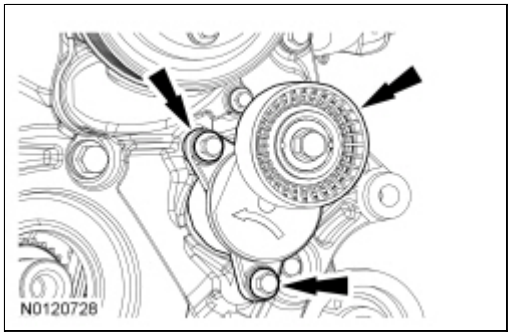
Install the LH cylinder block drain plug.

- Tighten the cylinder block drain plug to 10 Nm (89 lb-in) then an additional 720 degrees.

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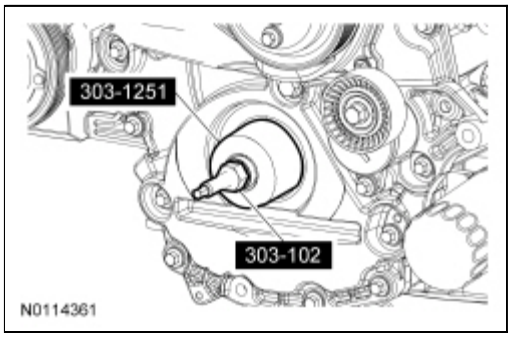


161. Install the accessory drive belt tensioner and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).



162. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

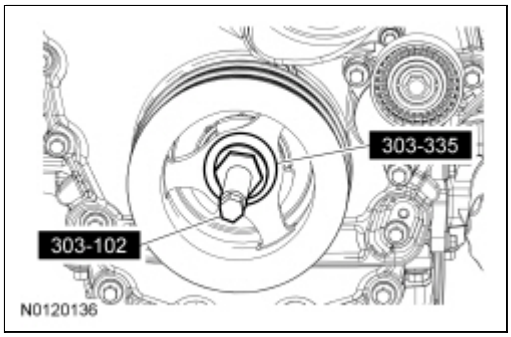
Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.



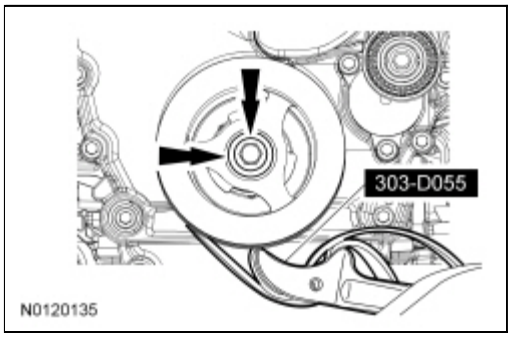
163. Lubricate the crankshaft front seal inner lip with clean engine oil.

164. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Replacer, install the crankshaft pulley.

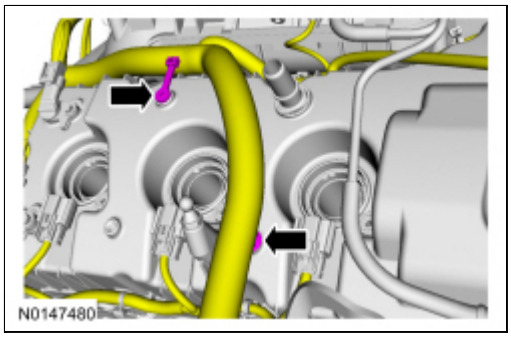


165. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
- Stage 1: Tighten to 120 Nm (89 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.



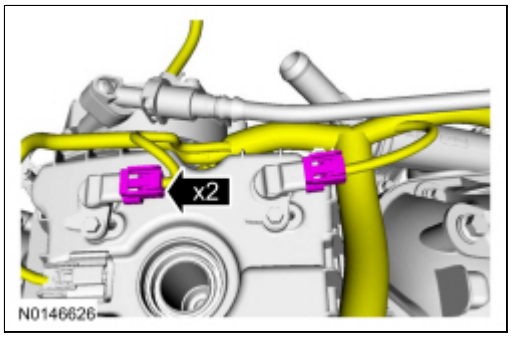
166. Position the engine wire harness on the engine. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.

167. Connect the wire harness retainer and install the tie strap.

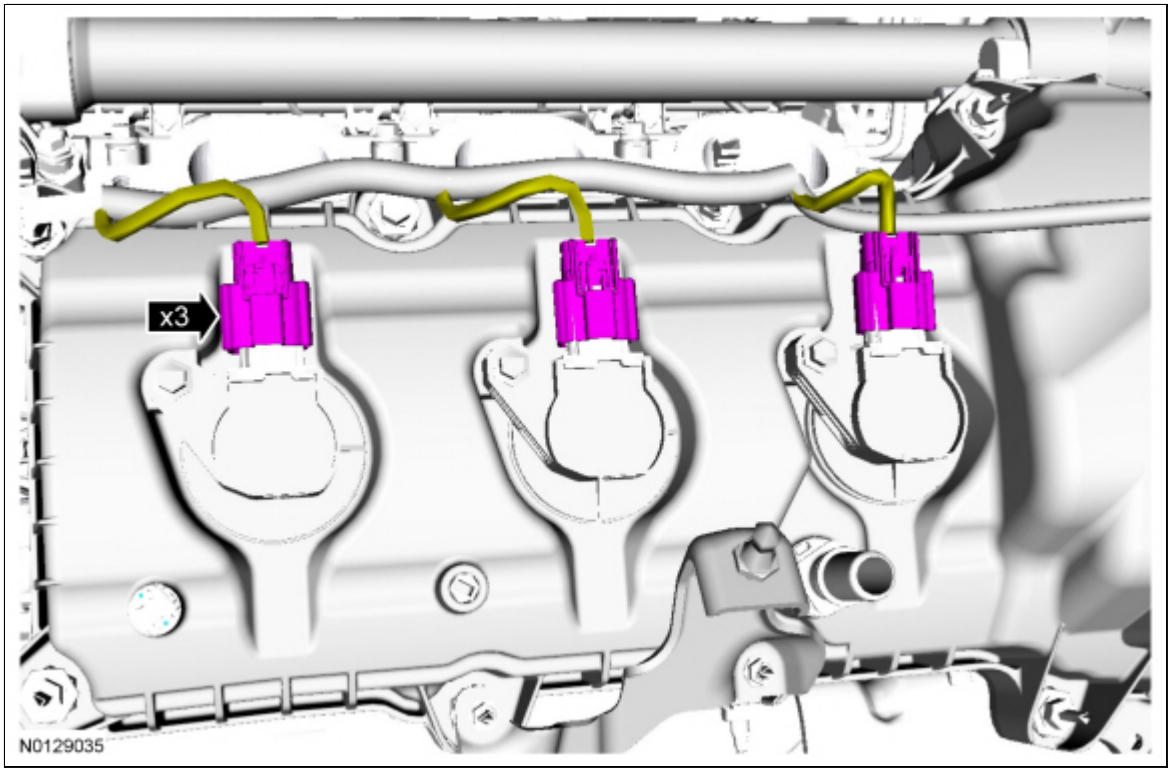


168. Connect the 2 RH CMP electrical connectors.

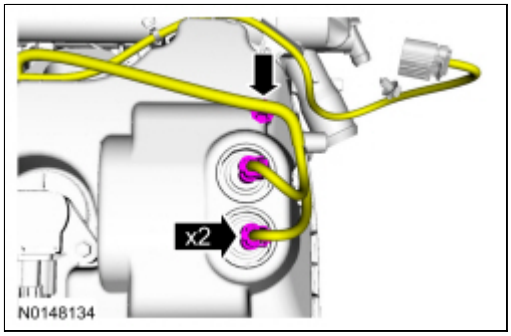
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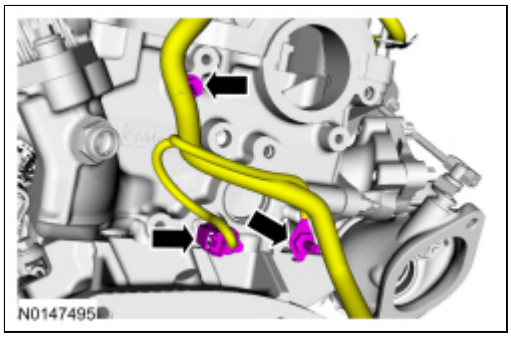
169. Connect the 3 RH ignition coil-on-plug electrical connectors.



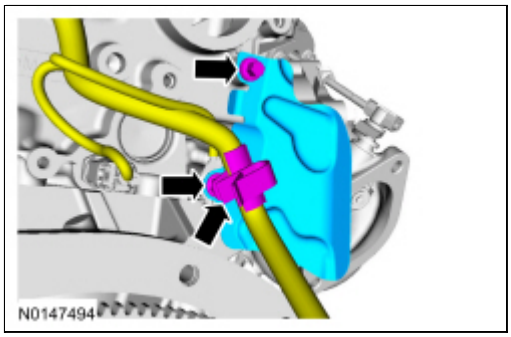
170. Connect the 2 RH VCT solenoid electrical connectors. Install the tie strap.



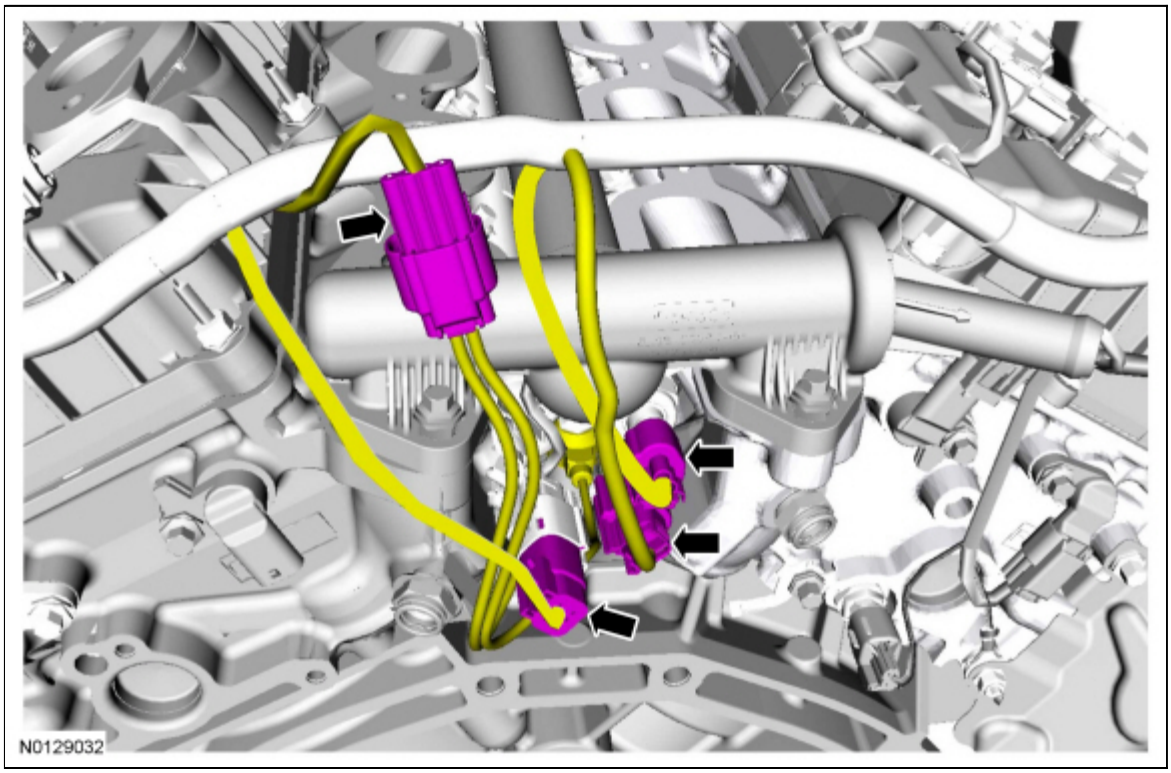
171. Connect the CHT sensor electrical connector. Install the ground stud bolt and the tie strap.
    - Tighten to 10 Nm (89 lb-in) then an additional 45 degrees.



172. Install the CMP heat shield, bolt and the nut. Connect the wire retainer.
    - Tighten the bolt to 10 Nm (89 lb-in).
    - Tighten the nut to 10 Nm (89 lb-in).

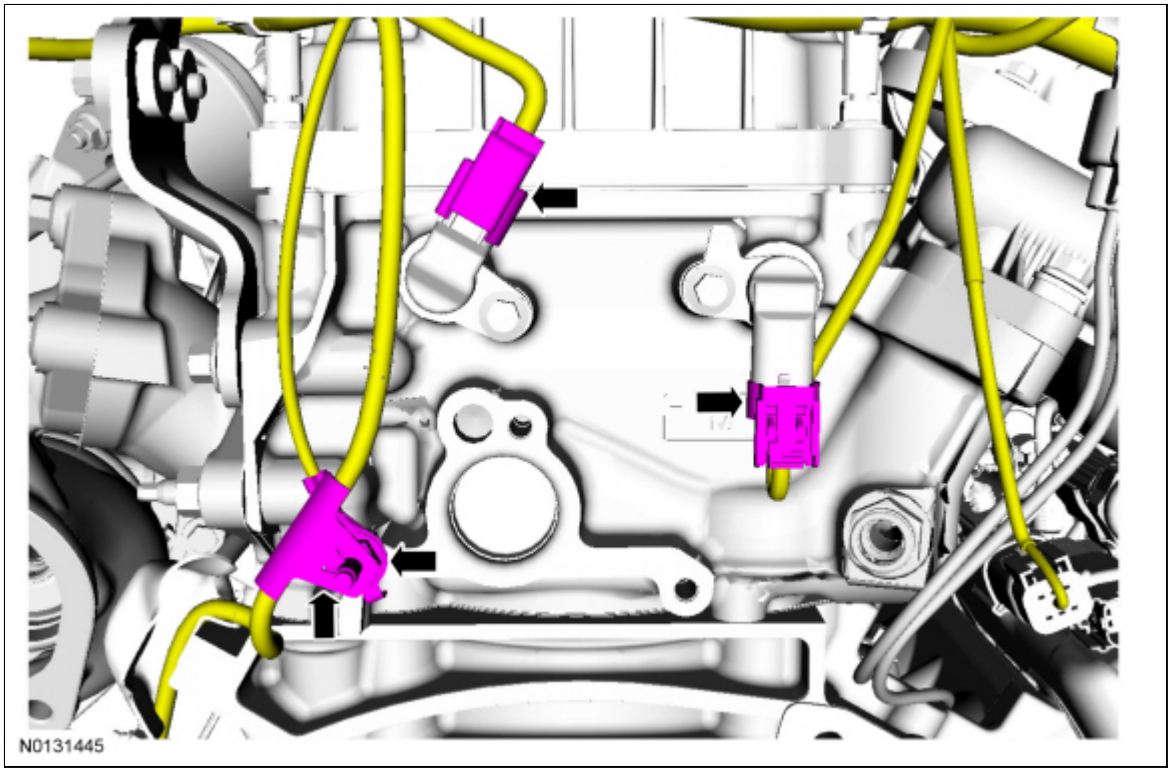


173. Connect the 2 fuel charge harness and the Fuel Rail Pressure (FRP) electrical connectors. Connect the KS sensor electrical connector.



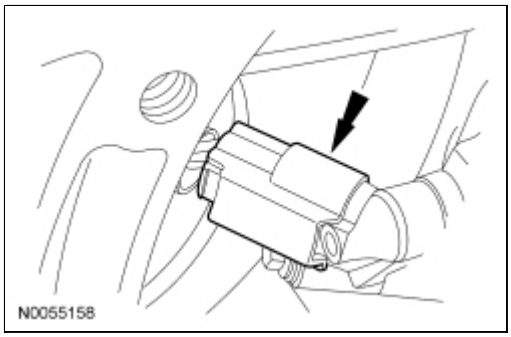
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174. Connect the 2 LH CMP sensor electrical connectors. Install the ground stud bolt. Install the CKP wire retainer.
    - Tighten to 10 Nm (89 lb-in) then an additional 45 degrees.

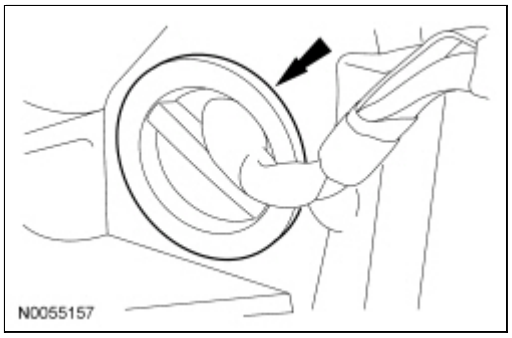


175. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.

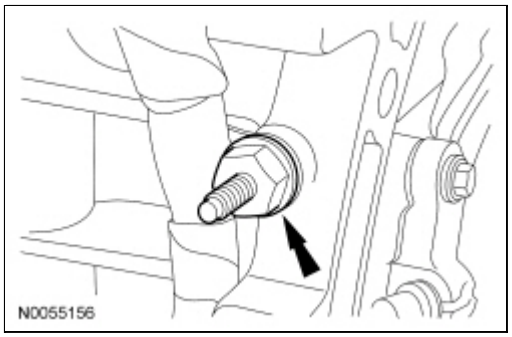
176. Connect the CKP sensor electrical connector.



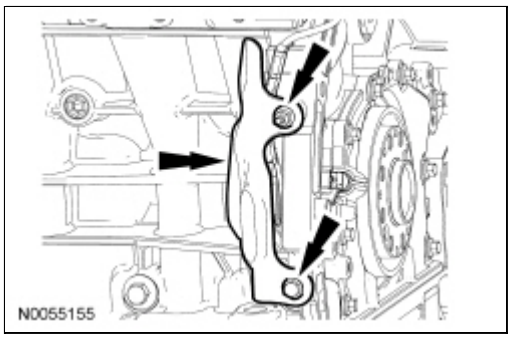
177. Install the wiring harness grommet.



178. Install the wiring harness retainer stud bolt.
    - Tighten to 10 Nm (89 lb-in).

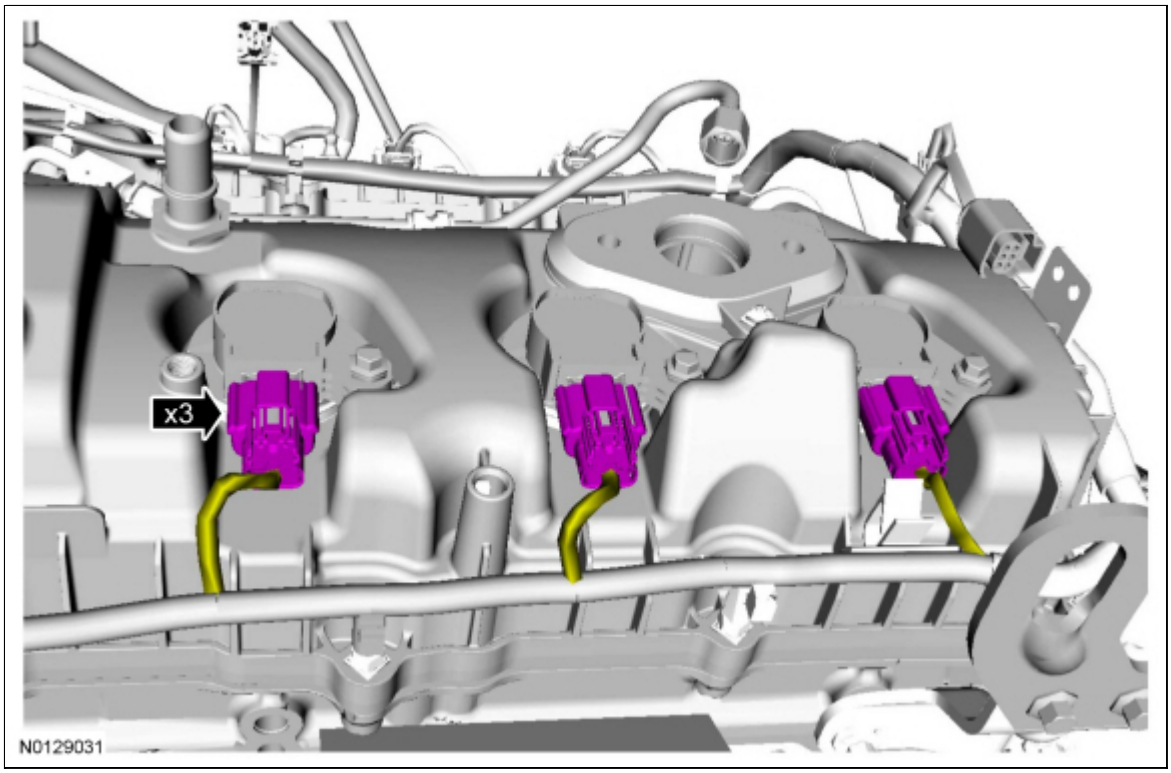


179. Install the CKP heat shield, the nut and the bolt.
    - Tighten to 10 Nm (89 lb-in).

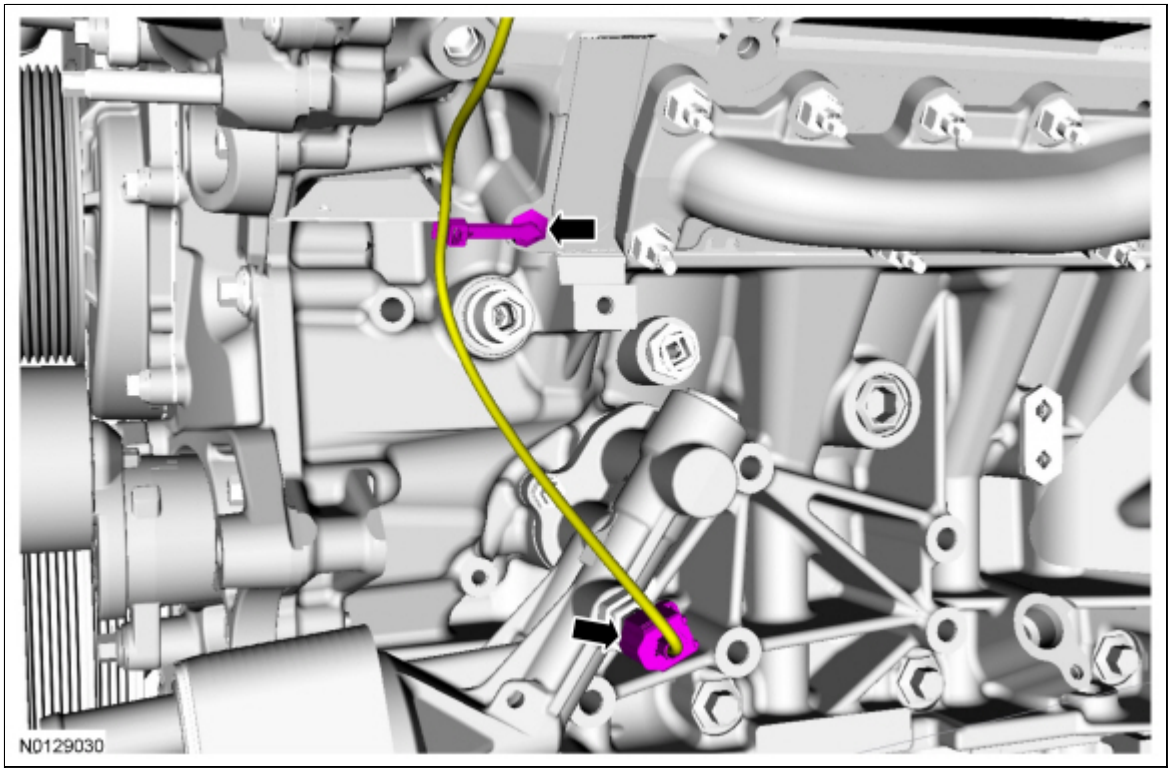


180. Connect the 3 LH ignition coil-on-plug electrical connectors.

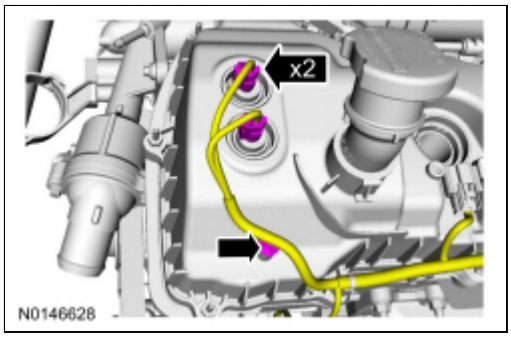
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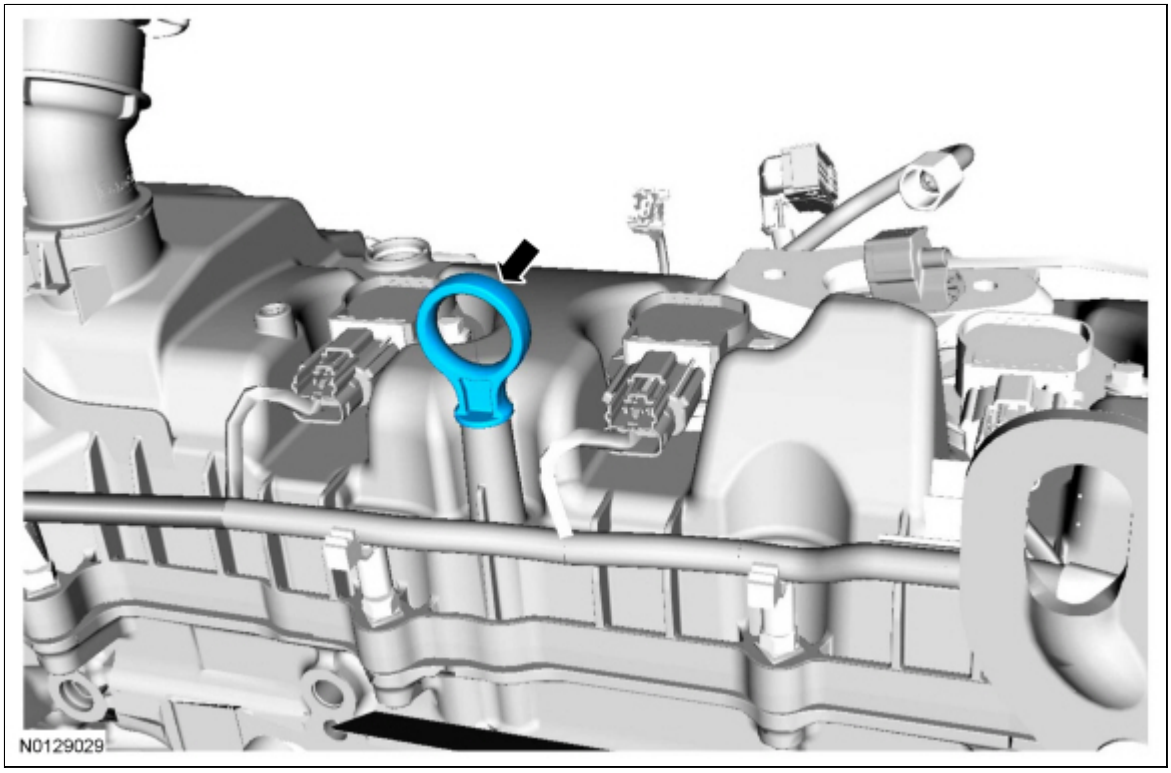
181. Connect the Engine Oil Pressure (EOP) switch electrical connector.
    - Attach the EOP switch wiring harness retainer to the cylinder head.



182. Connect the 2 LH VCT solenoid electrical connectors. Install the tie strap.

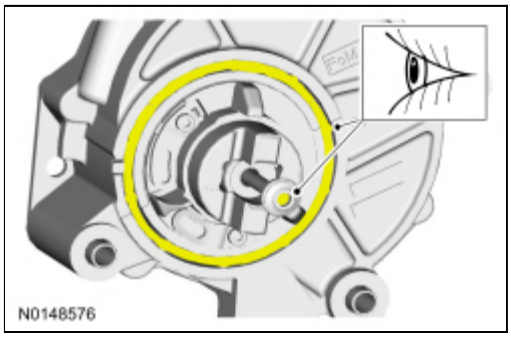


183. Install the engine oil level indicator.



184. ***NOTICE:*** **Make sure the oil tube filter screen is free of contaminants prior to the installation of the vacuum pump or damage to components may occur.**

Visual check. Install a new gasket if necessary.

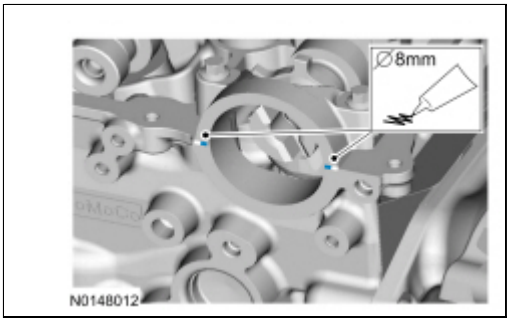


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185. ***NOTICE:*** **If the brake vacuum pump is not secured within 10 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Failure to follow this procedure can cause future oil leakage.**

NOTE: Make sure the mating surfaces are clean and free of foreign material.

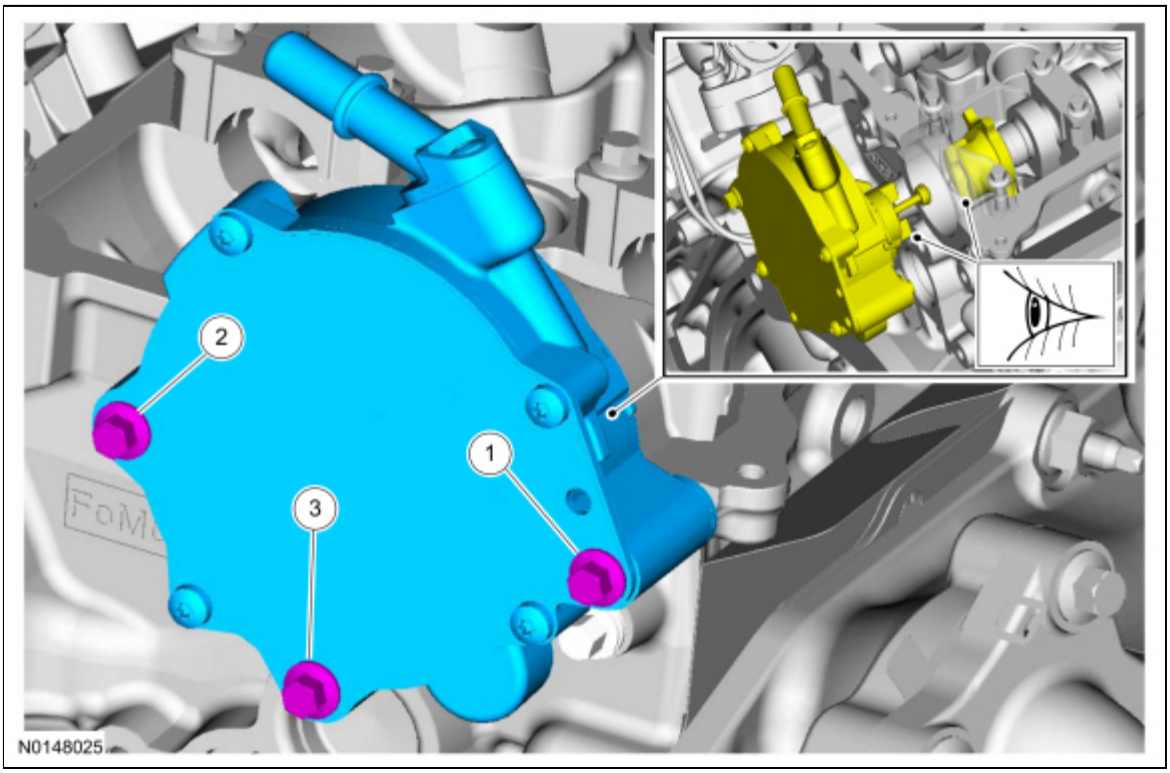
Apply a bead of the specified diameter from the specified tube.



186. **NOTE:** Manually align the brake vacuum pump drive key with the camshaft slot before installation.

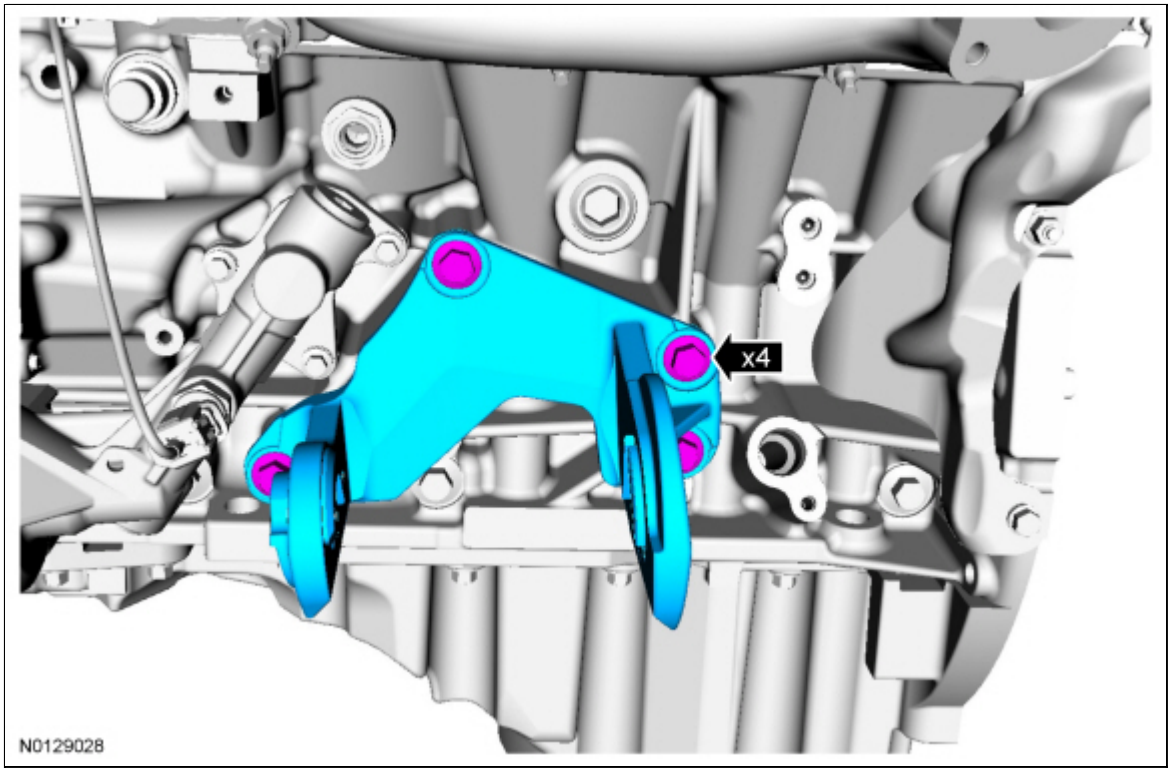
Visual check.

- Tighten in the sequence shown to 10 Nm (89 lb-in) then an additional 45 degrees.

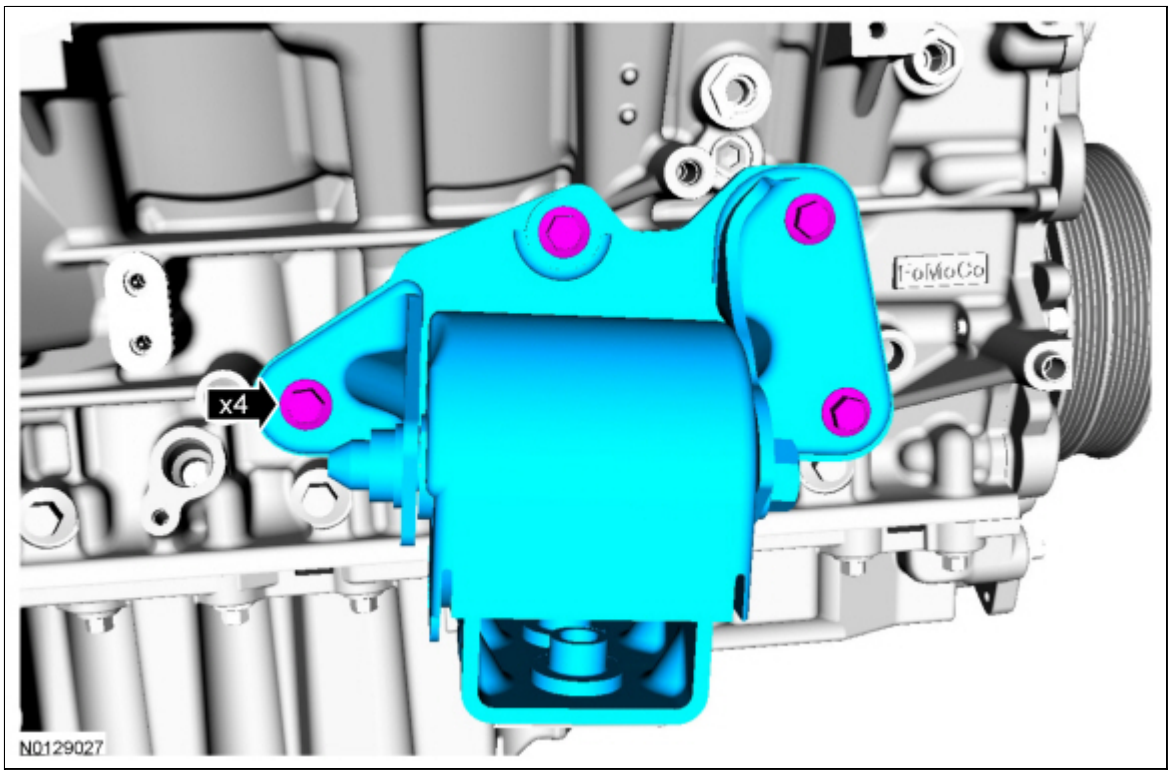


187. Install the LH engine support insulator-to-cylinder block bracket and the 4 new bolts.

- Tighten to 63 Nm (46 lb-ft).



188. Install the RH engine support insulator and the 4 new bolts.
    - For standard payload package, tighten to 63 Nm (46 lb-ft).
    - For heavy duty payload package, tighten to 77 Nm (57 lb-ft).



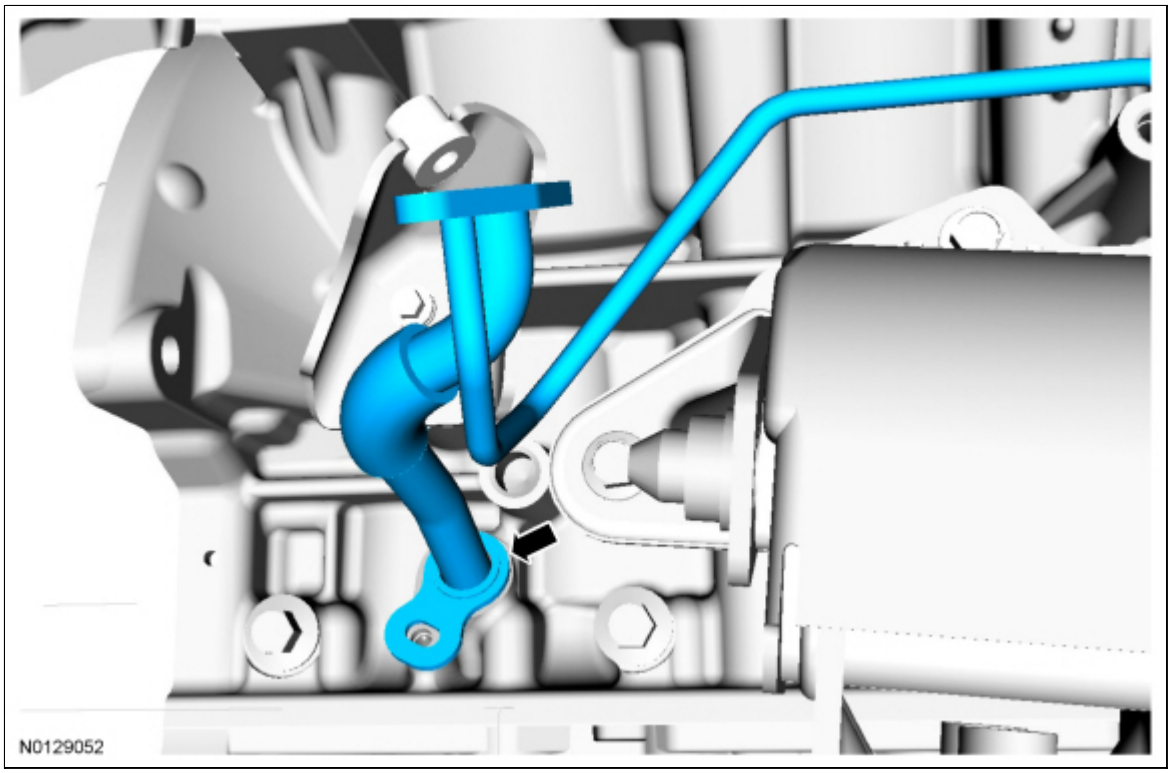
189. **NOTE:** Lubricate the cylinder block bore with clean engine oil.

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NOTE: Apply clean engine oil to the O-ring seal.

NOTE: Make sure the turbocharger oil supply tube in positioned in the cylinder block during the installation of the turbocharger oil return tube.

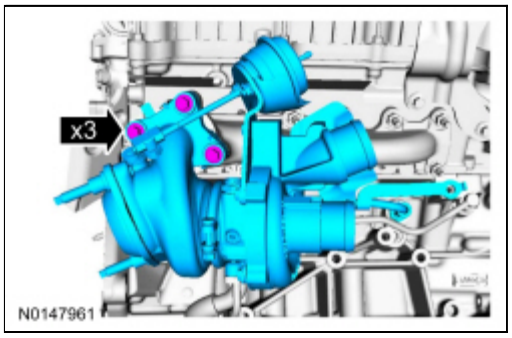
Using a new O-ring seal, install the RH turbocharger oil return tube.



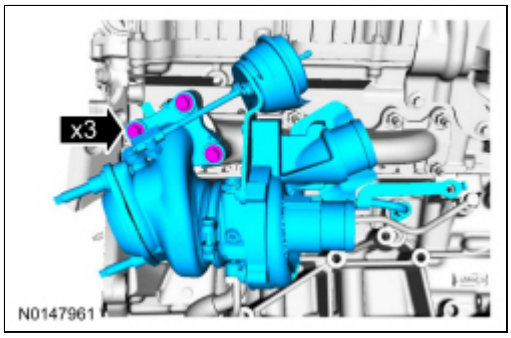
190. **NOTE:** Install the RH turbocharger coolant return tube in the turbocharger prior to installation.

Using a new turbocharger exhaust manifold gasket, install the RH turbocharger and the 3 bolts.

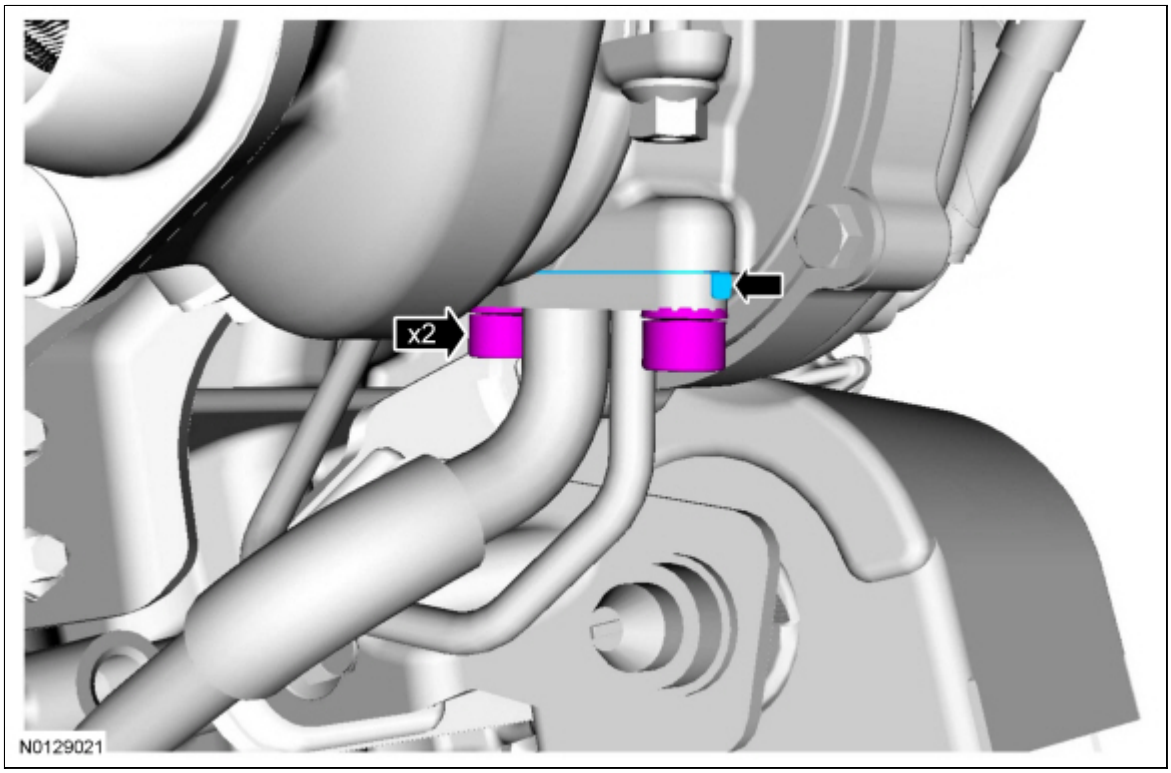
- Tighten finger-tight.



191. Tighten the RH turbocharger mounting bolts.
    - Tighten to 32 Nm (24 lb-ft).

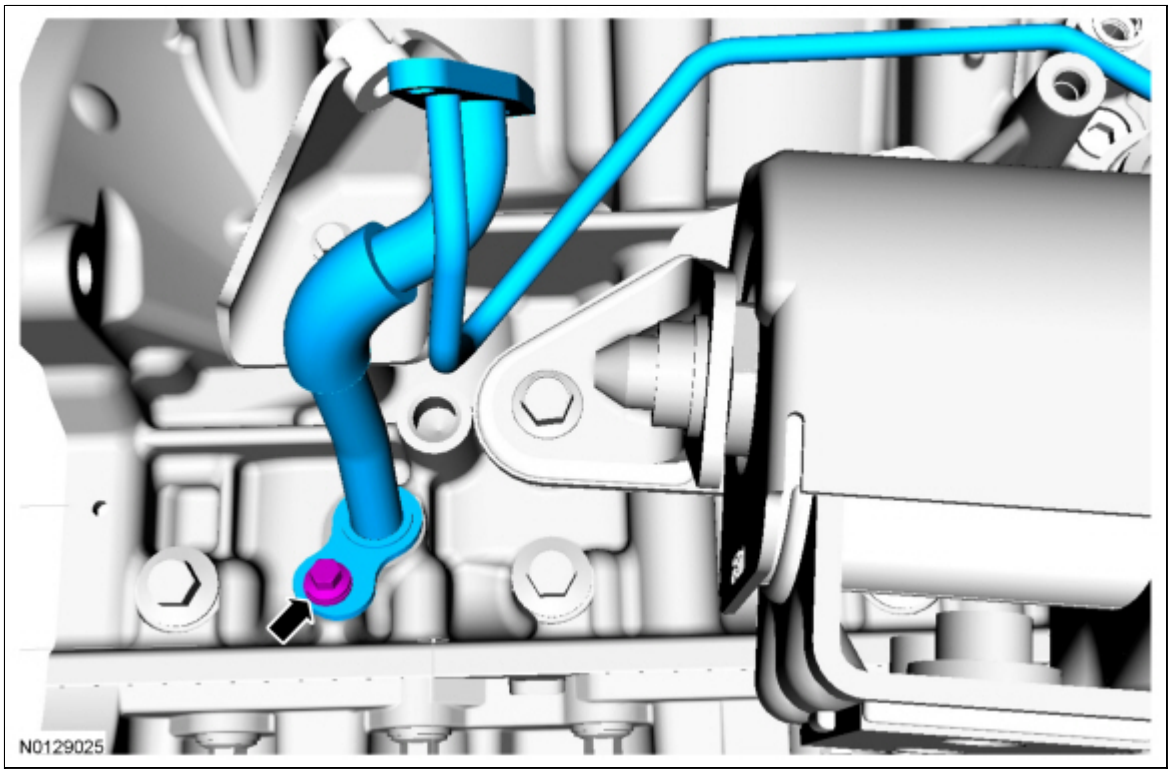


192. Using a new turbocharger oil return tube gasket, install the 2 bolts at the turbocharger. Tighten in the following stages.
    - Stage 1: Install the bolt for the oil pressure tube side halfway.
    - Stage 2: Install the bolt for the oil drain tube side and tighten to 10 Nm (89 lb-in).
    - Stage 3: Tighten the bolt for the oil drain tube side an additional 30 degrees.
    - Stage 4: Tighten the bolt for the oil pressure tube side to 10 Nm (89 lb-in).
    - Stage 5: Tighten the bolt for the oil pressure tube side an additional 30 degrees.

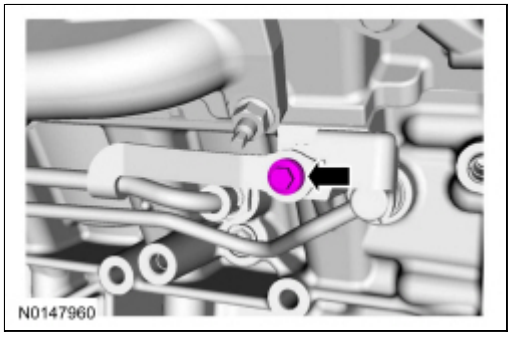


193. Install the RH turbocharger oil return tube bolt at the cylinder block. Tighten in the following stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.

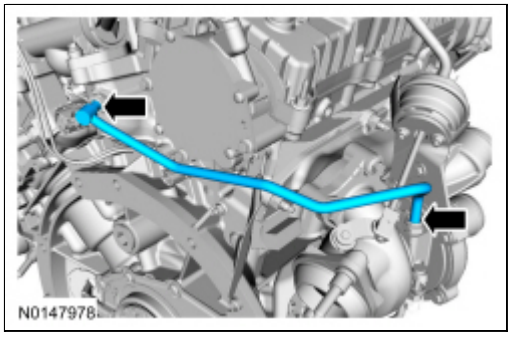
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194. Install the bolt for the RH turbocharger coolant and oil tubes. Tighten in the following stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.



195. Install the RH turbocharger coolant supply tube.

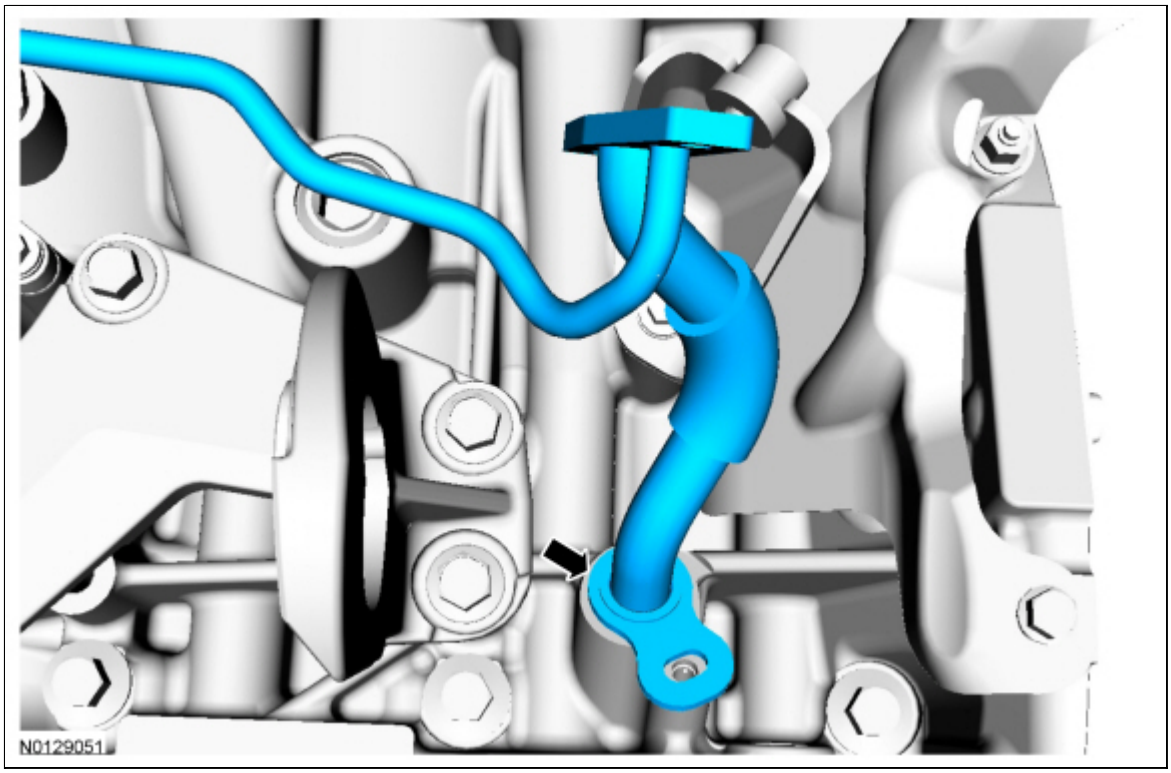


196. **NOTE:** Lubricate the cylinder block bore with clean engine oil.

NOTE: Apply clean engine oil to the O-ring seal.

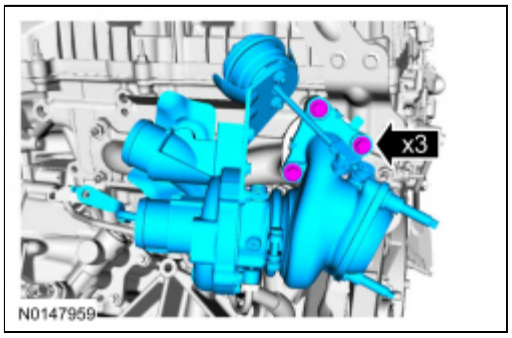
NOTE: Make sure the turbocharger oil supply tube in positioned in the cylinder block during the installation of the turbocharger oil return tube.

Using a new O-ring seal, install the LH turbocharger oil return tube.



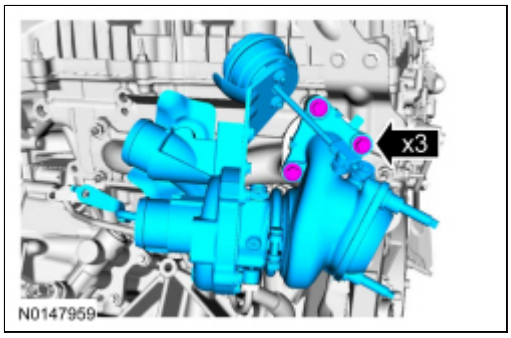
197. **NOTE:** Install the LH turbocharger coolant return tube in the turbocharger prior to installation.

Using a new turbocharger exhaust manifold gasket, install the LH turbocharger and the 3 bolts.
- Tighten finger-tight.

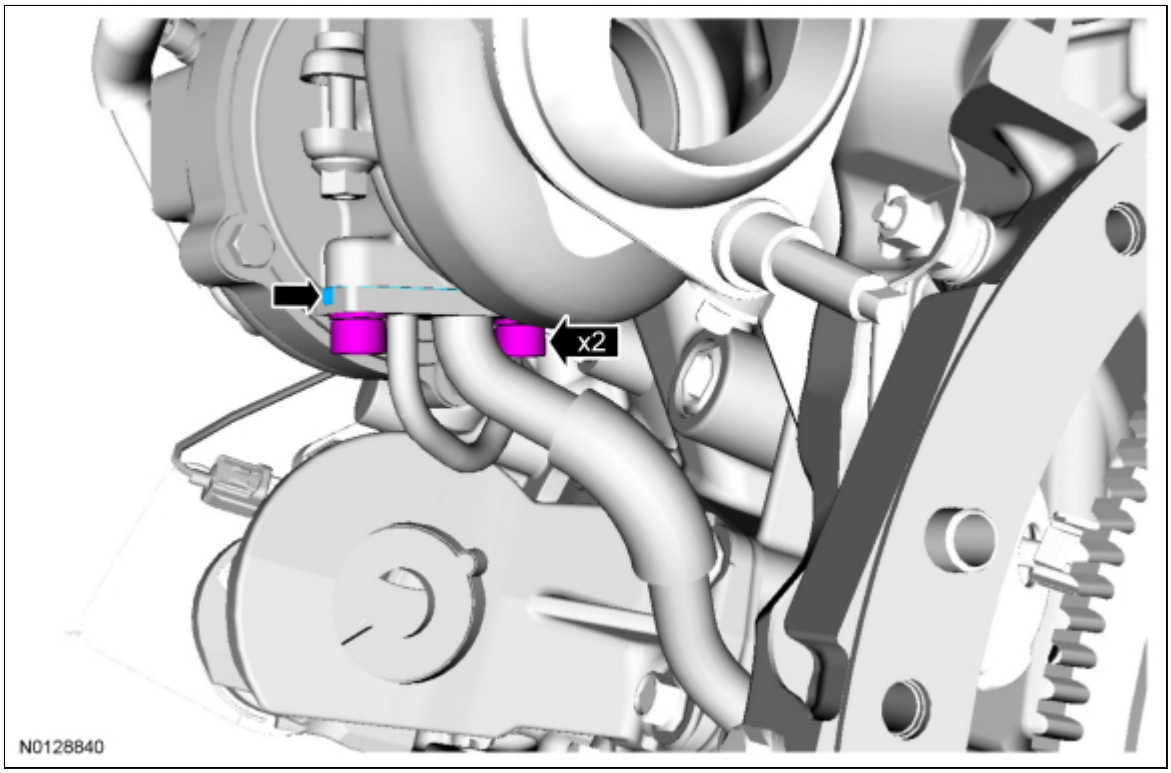


198. Tighten the LH turbocharger mounting bolts.
- Tighten to 32 Nm (24 lb-ft).

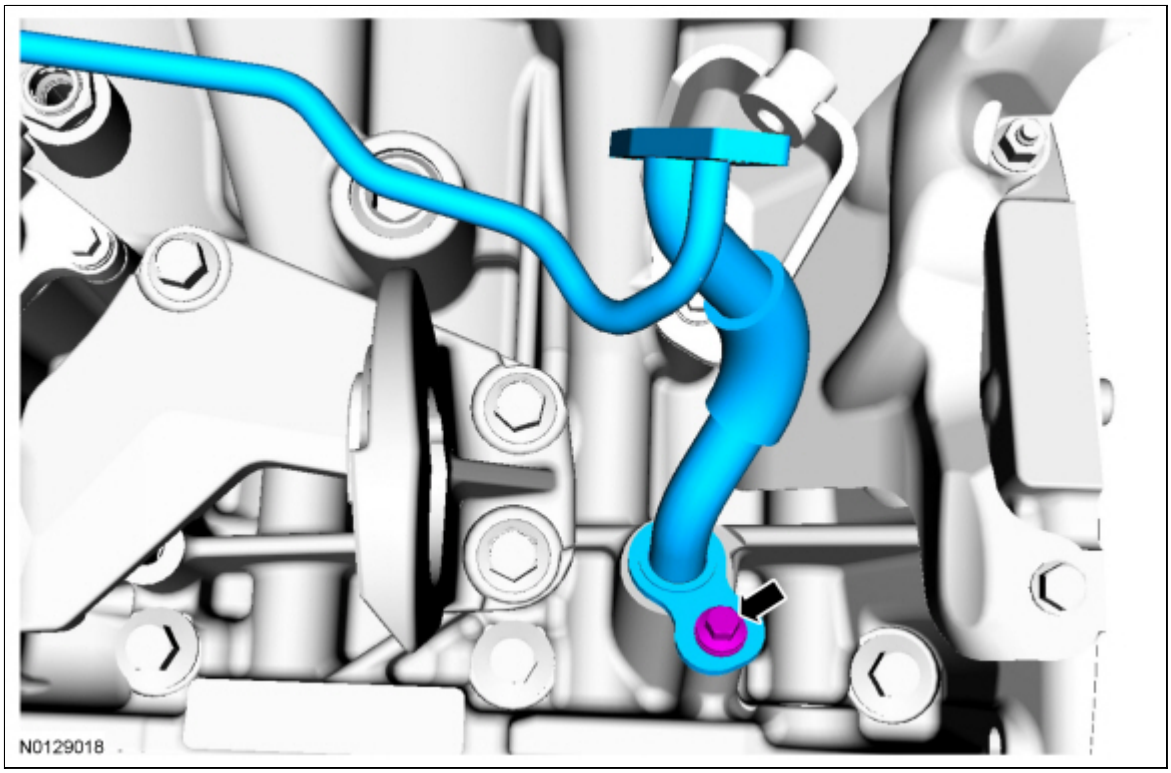
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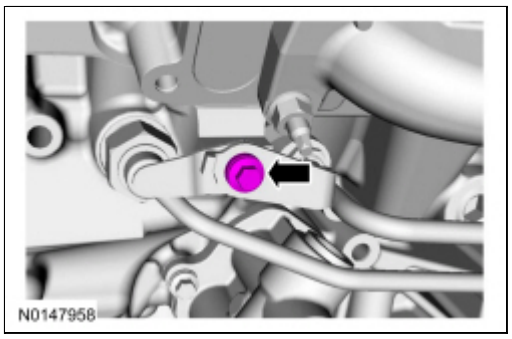
199. Using a new turbocharger oil return tube gasket, install the 2 bolts at the turbocharger. Tighten in the following stages.
    - Stage 1: Install the bolt for the oil pressure tube side halfway.
    - Stage 2: Install the bolt for the oil drain tube side and tighten to 10 Nm (89 lb-in).
    - Stage 3: Tighten the bolt for the oil drain tube side an additional 30 degrees.
    - Stage 4: Tighten the bolt for the oil pressure tube side to 10 Nm (89 lb-in).
    - Stage 5: Tighten the bolt for the oil pressure tube side an additional 30 degrees.



200. Install the LH turbocharger oil return tube bolt at the cylinder block. Tighten in the following stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.

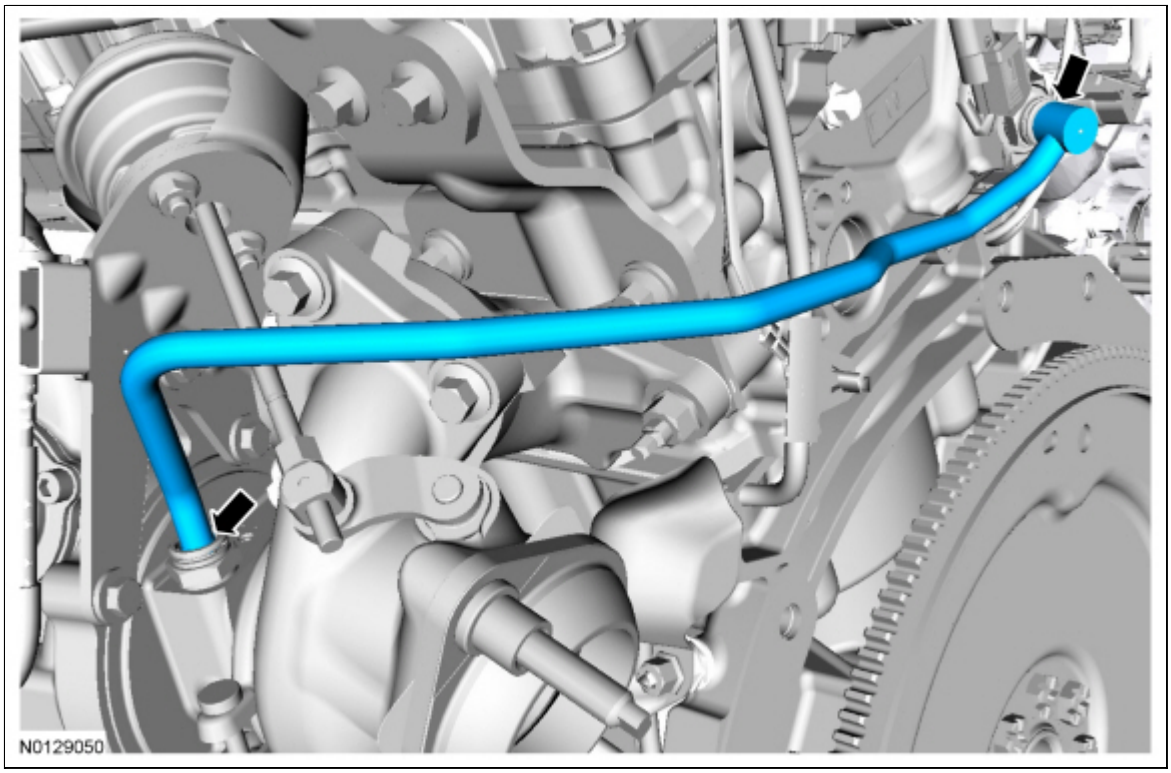


201. Remove the bolt for the LH turbocharger coolant and oil tubes. Tighten in the following stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.

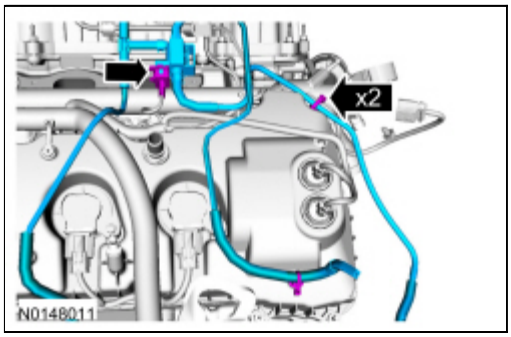


202. Install the LH turbocharger coolant supply tube.

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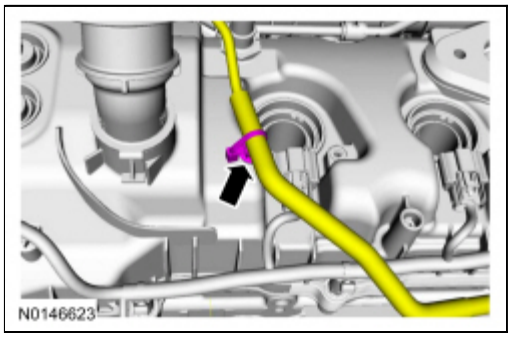


203. Install the wastegate hose assembly and 2 tie straps. Connect the turbocharger pressure regulator electrical connector.



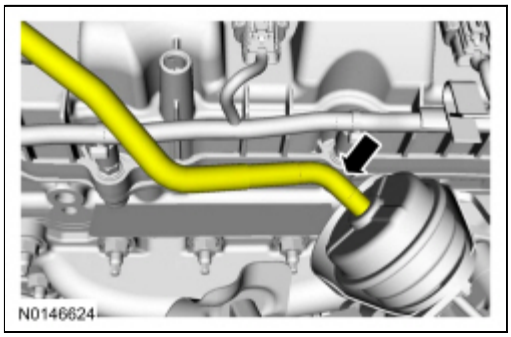
204. **NOTE:** LH shown, RH similar.

Position the wastegate hoses and install the 2 tie straps.

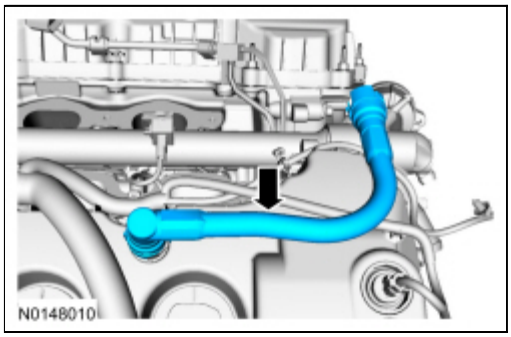


205. **NOTE:** LH shown, RH similar.

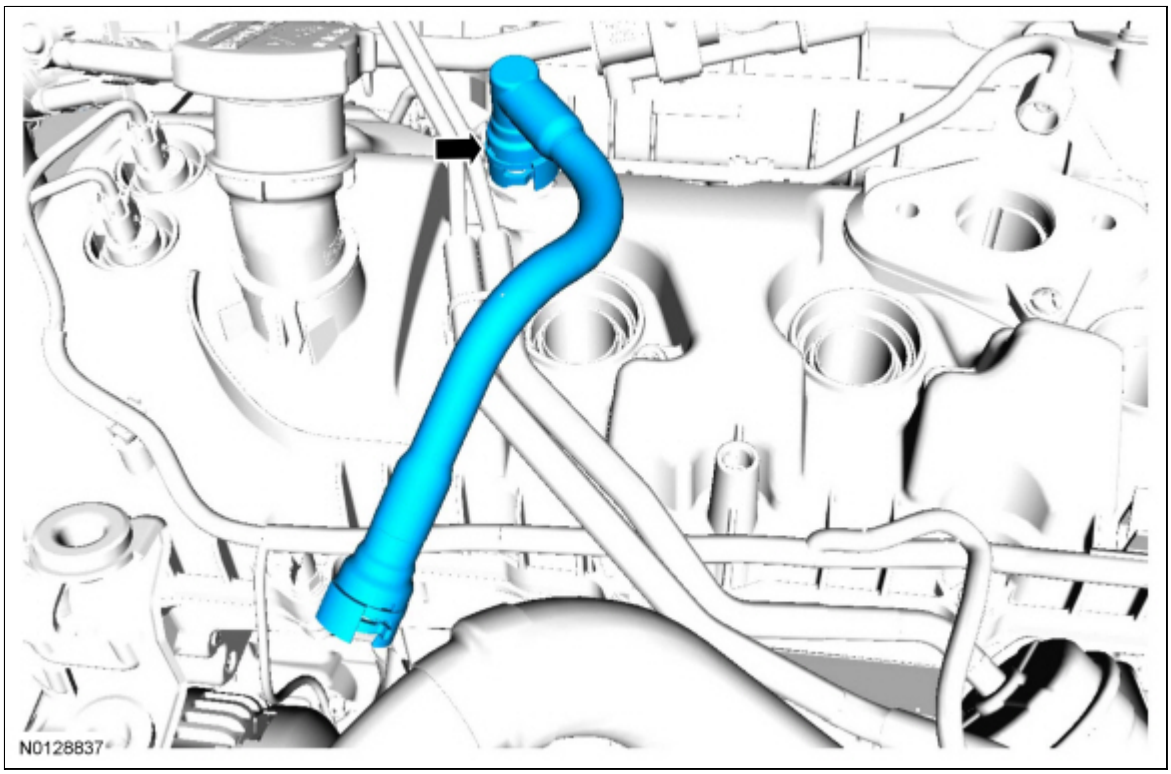
Connect the 2 wastegate hoses at the turbochargers.



206. Install the RH PCV tube. For additional information, refer to Section 310-00 .

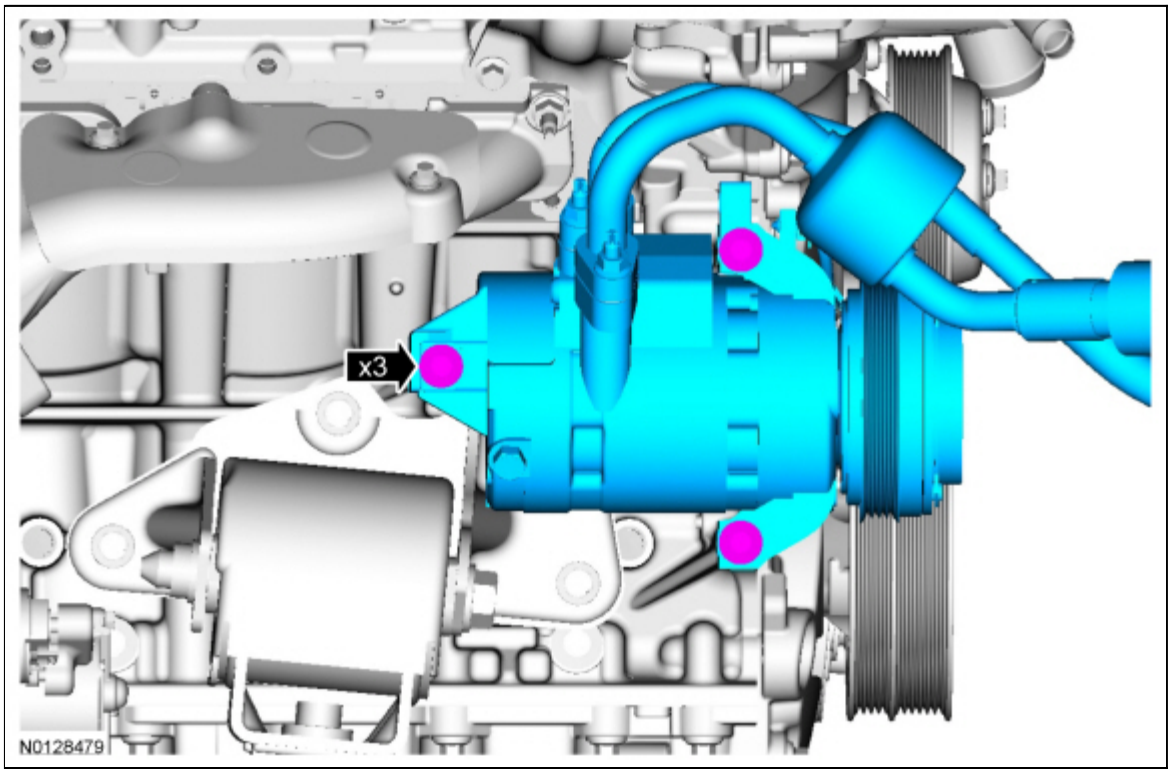


207. Install the LH crankcase vent tube. For additional information, refer to Section 310-00 .

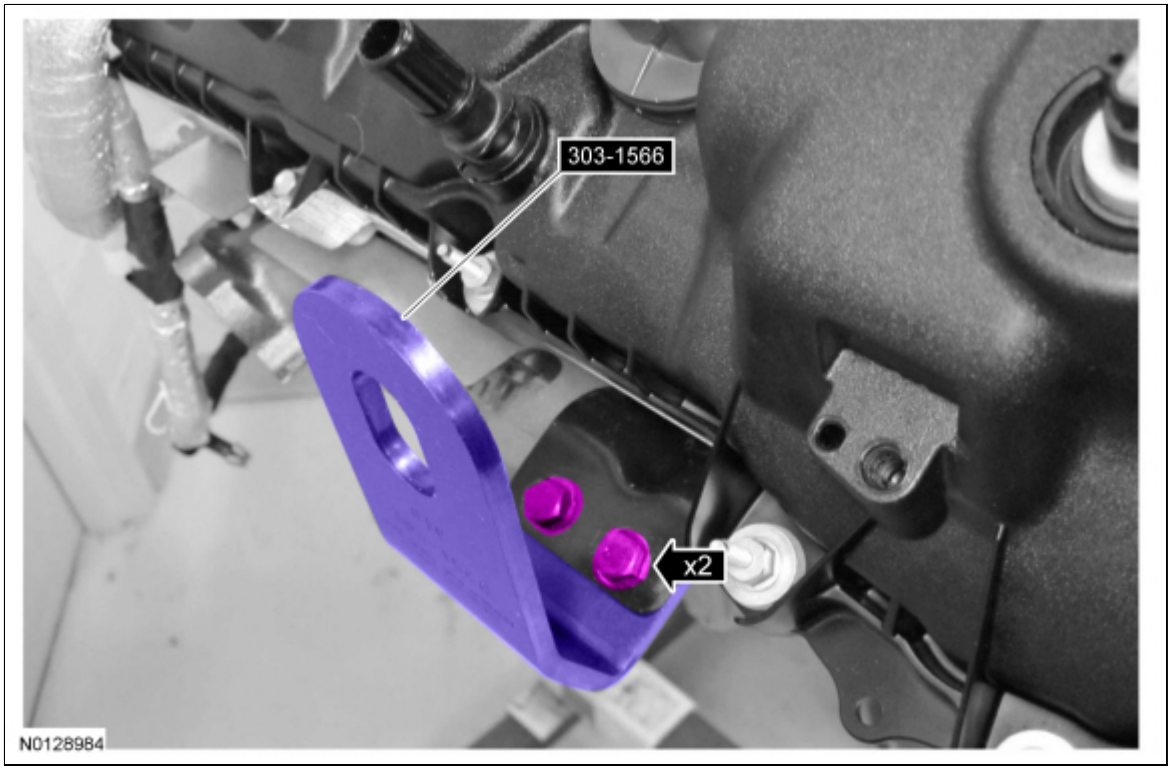


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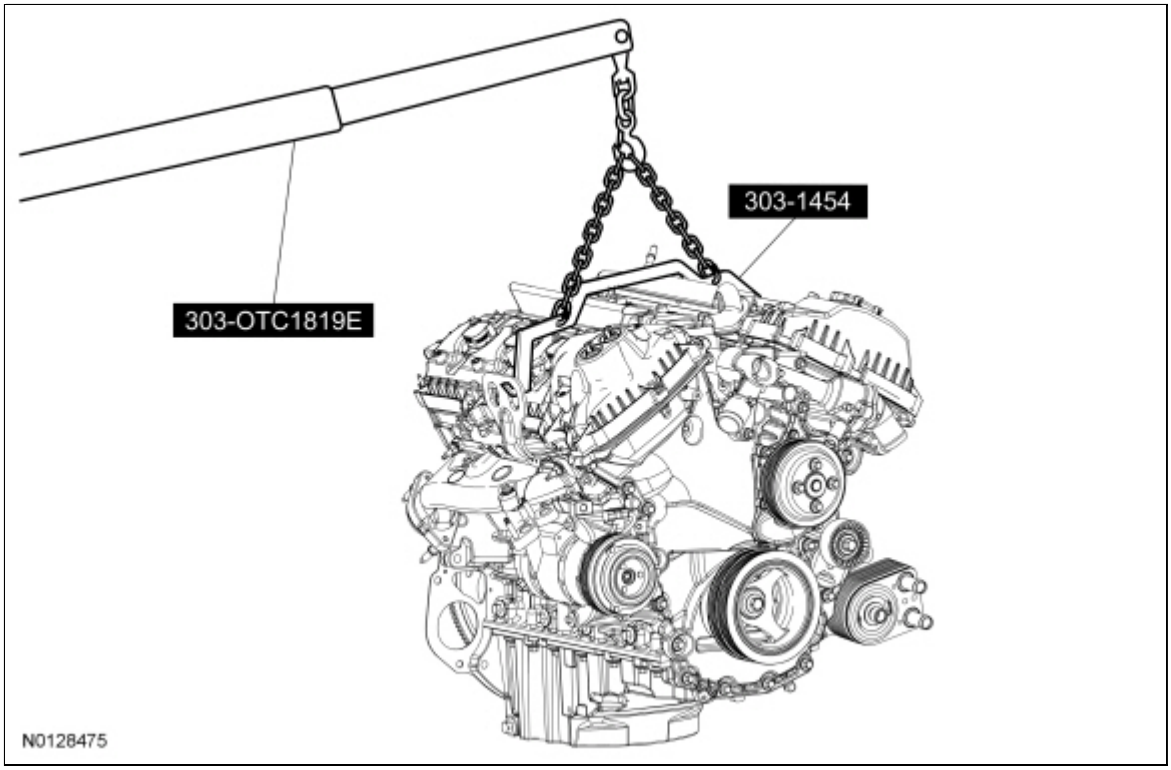
208. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



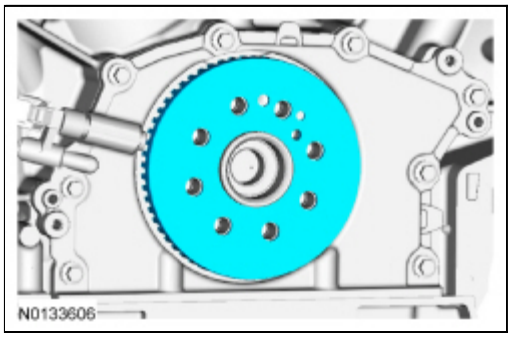
209. Install the Right Front Lifting Eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).



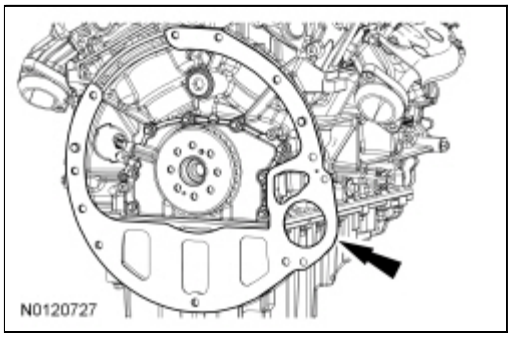
210. Using the Floor Crane and Engine Spreader Bar, remove the engine from the stand.



211. Install the crankshaft sensor ring.



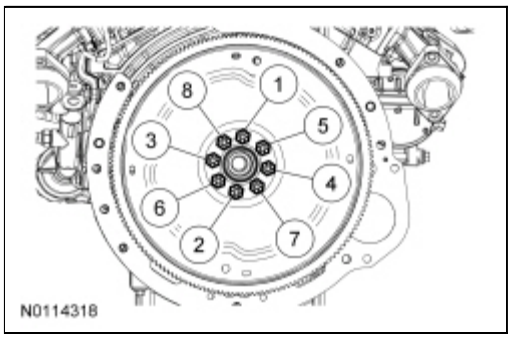
212. Install the spacer plate.



213. Install the flexplate and the 8 bolts and tighten is sequence shown.

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- Tighten to 80 Nm (59 lb-ft).



Engine

Special Tool(s)

 ST3101-A	Bar, Engine Spreader 303-1454
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073) or equivalent
 ST3265-A	Lift Eye, Right Front 303-1566
 ST1341-A	2,200# Floor Crane, Floor Crane 300-OTC1819E or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

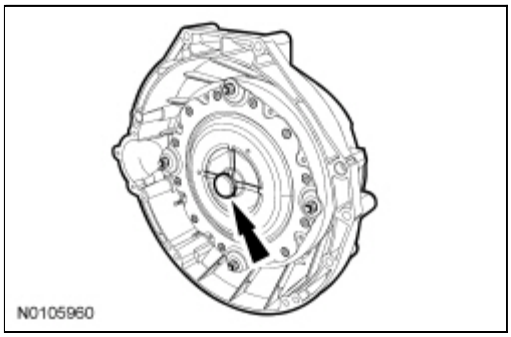
Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B

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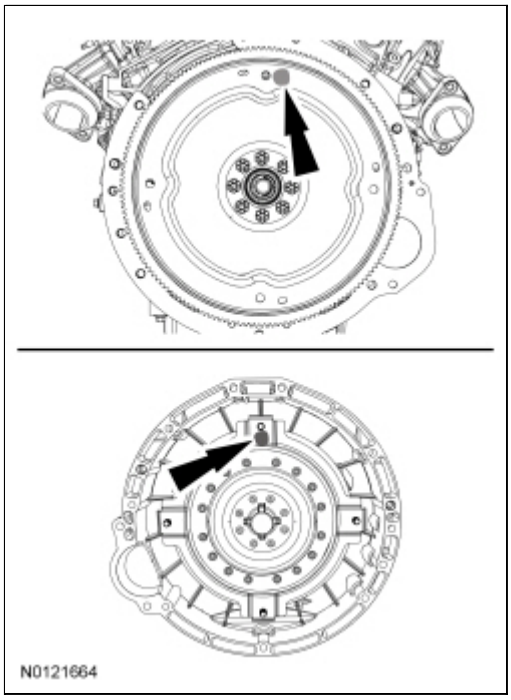
WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. ***NOTICE:*** **Prior to installation of the engine, the torque converter pilot hub must be lubricated with multi-purpose grease or damage to the torque converter or the engine crankshaft can occur**

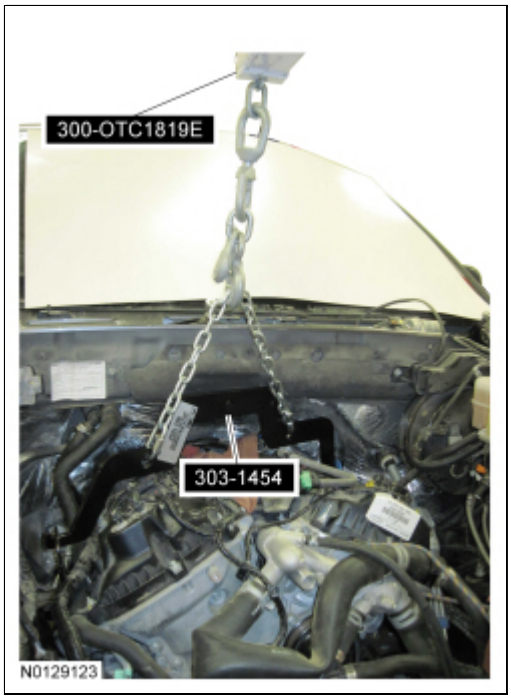
   Lubricate the torque converter pilot hub with multi-purpose grease.



2. Align the torque converter stud and flexplate hole near the paint marks at the 12 o'clock position.

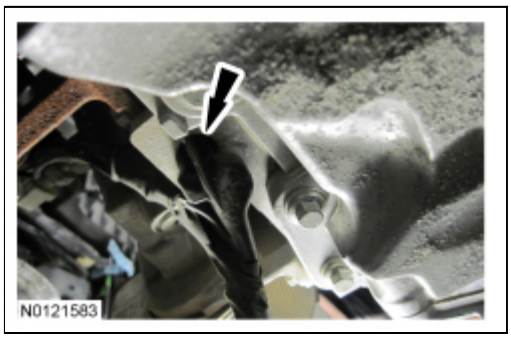


3. Using the Floor Crane and Engine Spreader Bar, position the engine in the engine compartment.



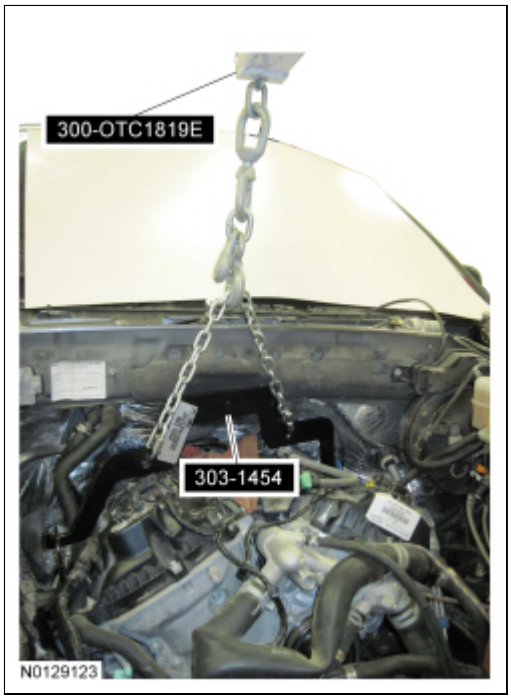
4. **NOTE:** The transmission wiring harness is part of the engine wiring harness.

   Attach the generator wiring harness retainer to the lower LH side of the engine block.
   - Position the transmission wiring harness along the side of the transmission for installation.

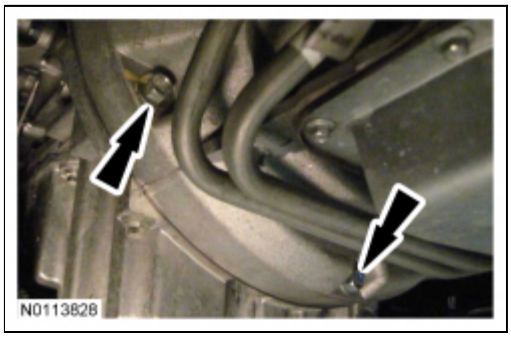


5. Using the Floor Crane and Engine Spreader Bar, position the engine to the transmission.

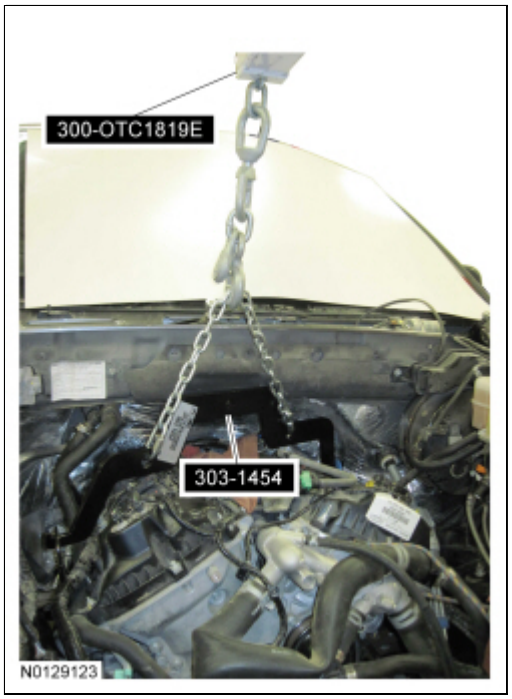
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6. Align the engine to the transmission and install the 2 LH bellhousing-to-oil pan bolts.
    - Tighten to 48 Nm (35 lb-ft).



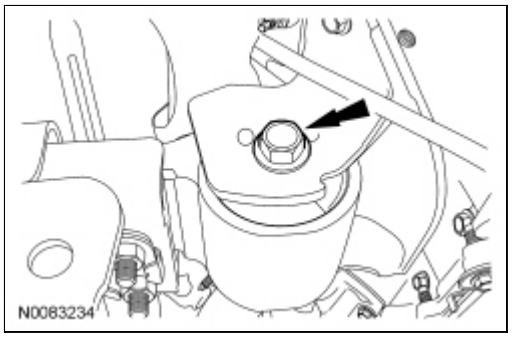
7. Using the Floor Crane and Engine Spreader Bar, raise the engine for clearance for the LH engine support insulator.



8. ***NOTICE:*** **Only use hand tools when loosening or tightening the LH engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.**

   NOTE: Clean the LH and RH engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

   Install the LH engine support insulator and the new through bolt.
   - Do not torque at this time.

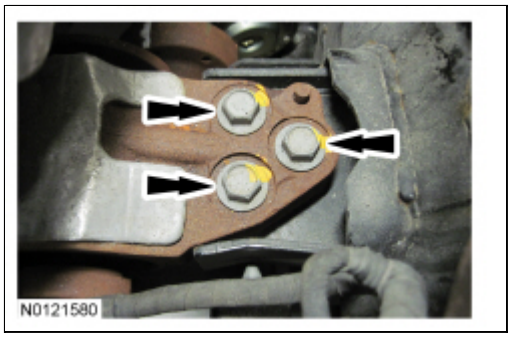


9. Lower the engine.

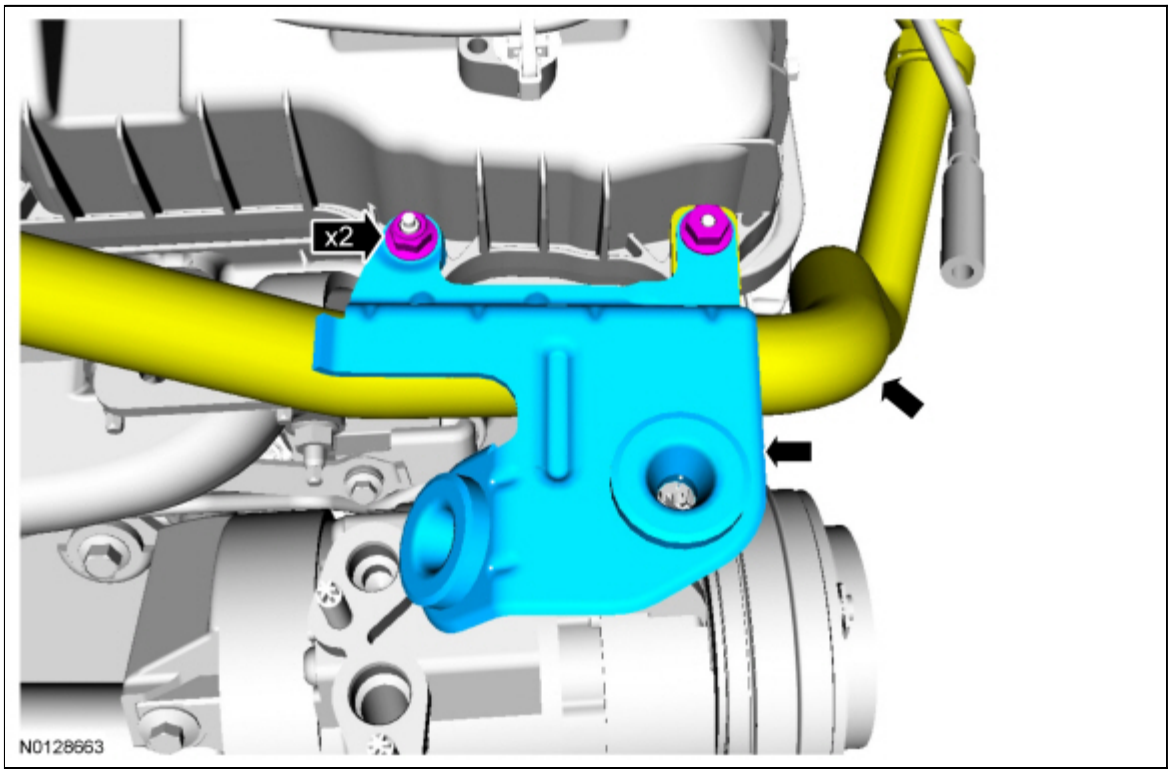
10. ***NOTICE:*** **Use only hand tools when removing or installing the engine support insulator-to-frame bolts or the damge to the engine support insulator-to-frame nut plate can occur.**

    Install the 3 new LH engine support insulator bolts.
    - Tighten to 175 Nm (129 lb-ft).

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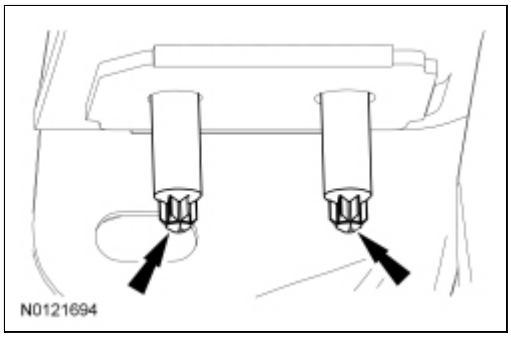


11. Position back the coolant hose to the valve cover stud. Install the Charge Air Cooler (CAC) bracket and 2 nuts.
    - Tighten to 6 Nm (53 lb-in).



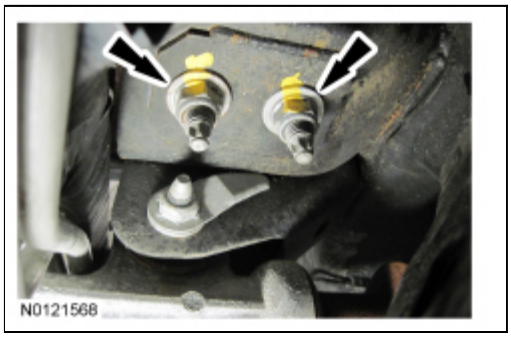
12. ***NOTICE:*** **Use only hand tools when installing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

    Install the 2 new RH engine support insulator studs.
    - Tighten to 30 Nm (22 lb-ft).



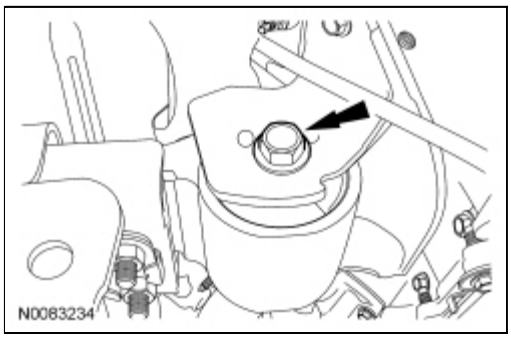
13. ***NOTICE:*** **Use only hand tools when installing the RH engine support insulator nuts or damage to the engine support insulator can occur.**

    Install the 2 new RH engine support insulator nuts.
    - Tighten to 175 Nm (129 lb-ft).



14. ***NOTICE:*** **Only use hand tools when loosening or tightening the LH engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Tighten the LH engine mount through bolt.
    - Tighten to 350 Nm (258 lb-ft).

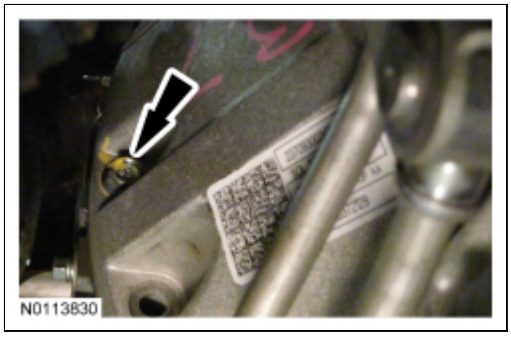


15. **NOTE:** Do not lubricate the engine oil filter gasket.

    Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

16. Install the LH bellhousing-to-engine bolt.
    - Tighten the bolt, it will be torqued at a later step.

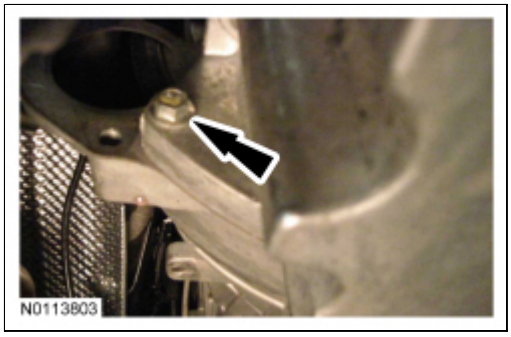
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17. Install the engine-to-bellhousing bolt.
    - Tighten the bolt, it will be torqued at a later step.



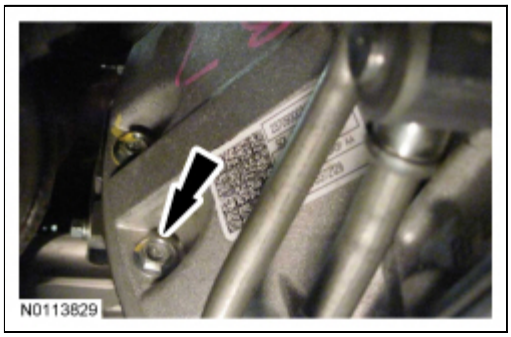
18. Install the oil pan-to-bellhousing bolt.
    - Tighten to 48 Nm (35 lb-ft).



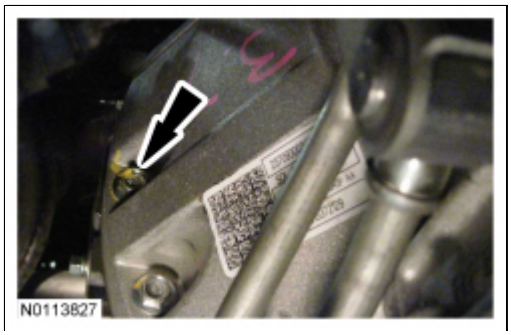
19. Tighten the engine-to-bellhousing bolt.
    - Tighten to 48 Nm (35 lb-ft).



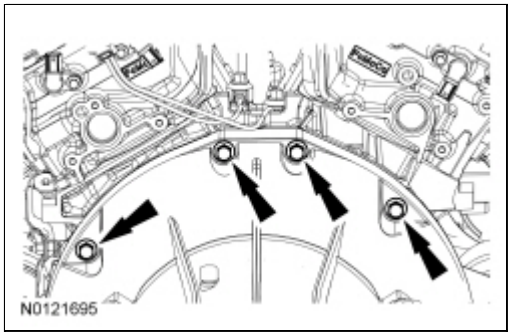
20. Install the LH bellhousing-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



21. Tighten the LH bellhousing-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



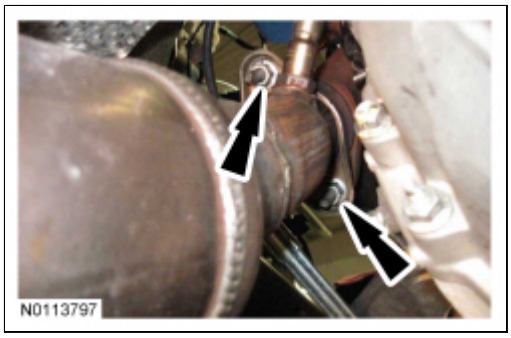
22. Install the 4 upper bellhousing-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).



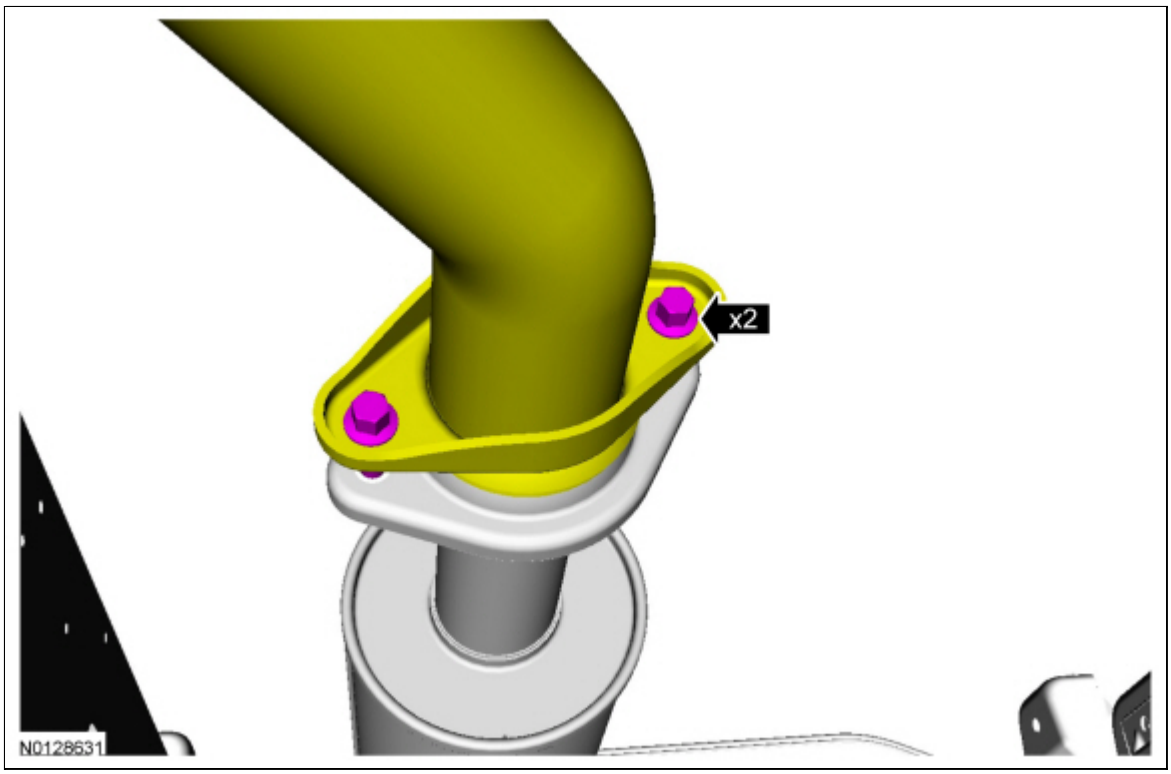
23. **NOTE:** LH shown, RH similar.

    Install the new 2 LH and RH catalytic converter-to-exhaust manifold nuts.
    - Tighten to 45 Nm (35 lb-ft).

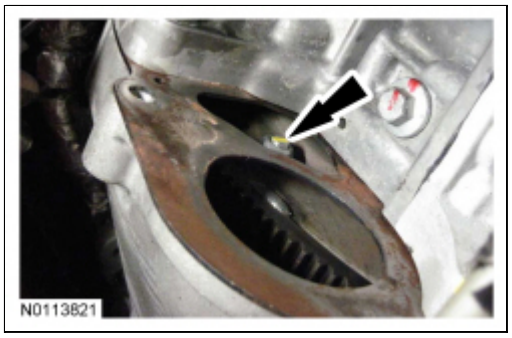
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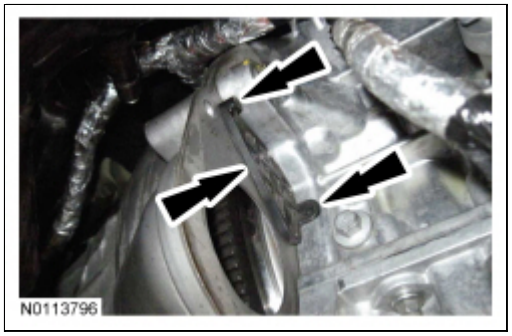
24. Position the exhaust Y-pipe dual catalytic converter-to-intermediate pipe and install the 2 bolts.
    - Tighten the inner exhaust Y-pipe catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    - Tighten the outer exhaust Y-pipe catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



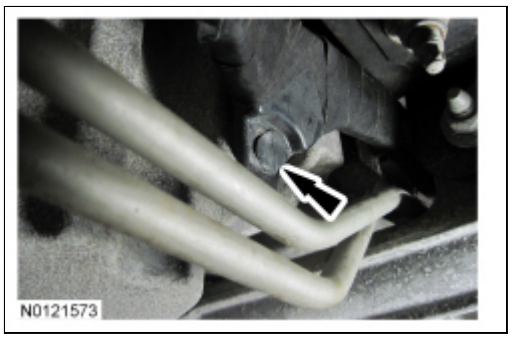
25. Install the 4 torque converter nuts.
    - Tighten to 44 Nm (32 lb-ft).



26. Install the access cover and the 2 pin-type retainers.



27. Attach the starter motor wiring harness retainer to the oil pan.



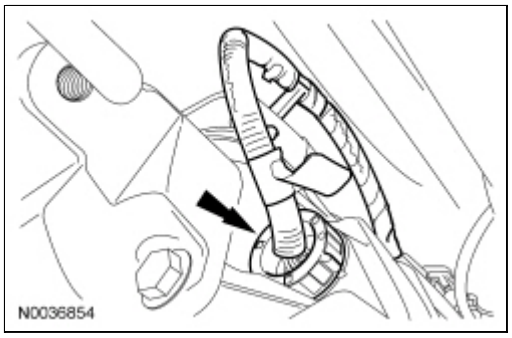
28. Install the starter motor. For additional information, refer to Section 303-06 .

29. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .

30. Install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).

31. Connect the transmission vehicle harness connector by pushing the connector into the transmission and twisting the outer shell.

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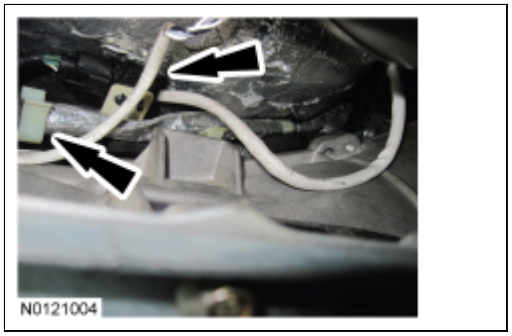


32. Connect the electrical connector retainer to the bracket at the rear of the transmission.
    - Connect the Heated Oxygen Sensor (HO2S) electrical connector.

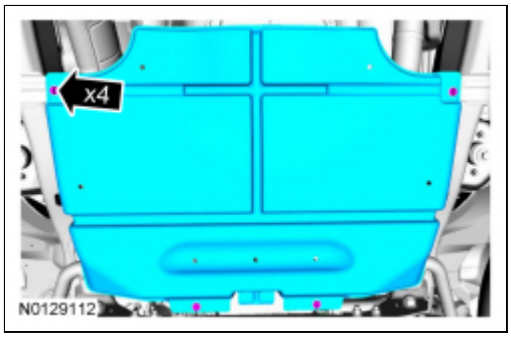


33. **NOTE:** Only one wire harness retainer and one electrical connector shown, others similar.

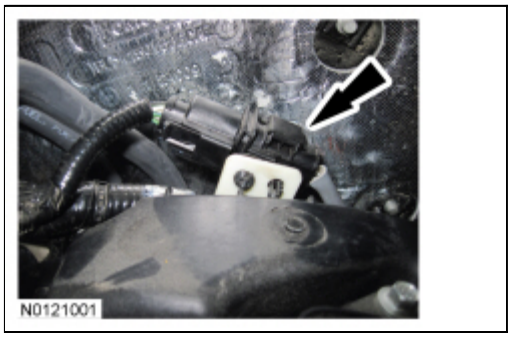
    If equipped, connect the 5 transmission wire harness retainers to the transfer case wire harness.
    - Connect the 2 HO2S electrical connector retainers.
    - Connect the 2 HO2S electrical connectors.



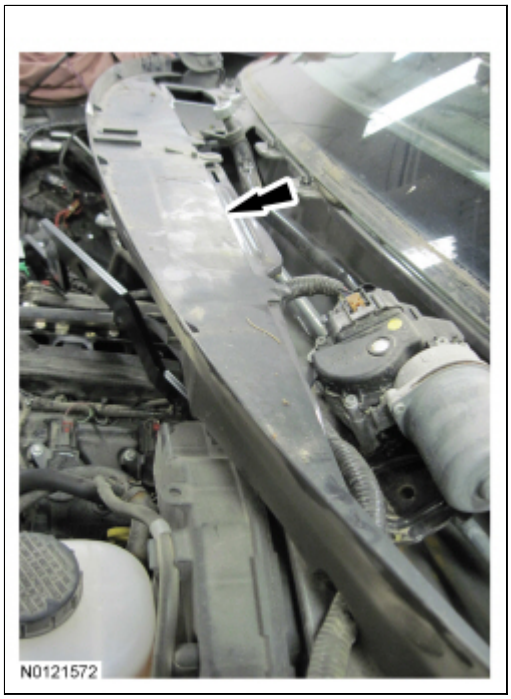
34. Install the splash shield and the 4 retainers.



35. Connect the HO2S electrical connector to the wiring harness retainer.
    - Connect the HO2S electrical connector to the engine wiring harness at the rear of the LH cylinder head.



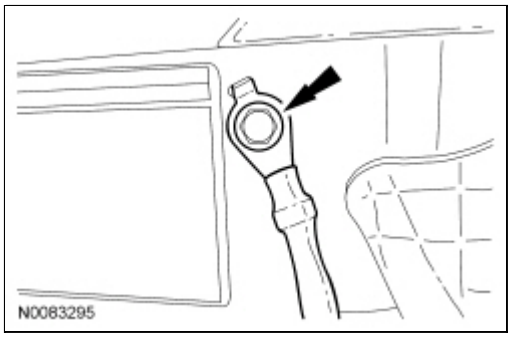
36. Install the cowl panel and attach the 2 clips and install the 6 screws.



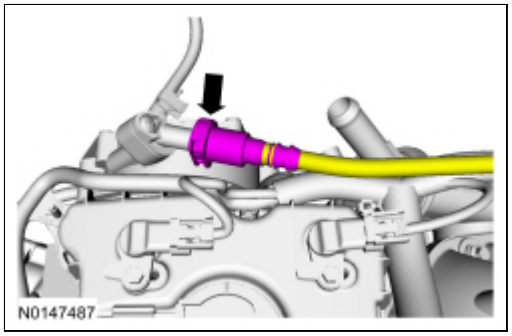
37. Install the cowl panel grille. For additional information, refer to Section 501-02 .

38. Install the ground strap and bolt to the cowl.
    - Tighten to 10 Nm (89 lb-in).

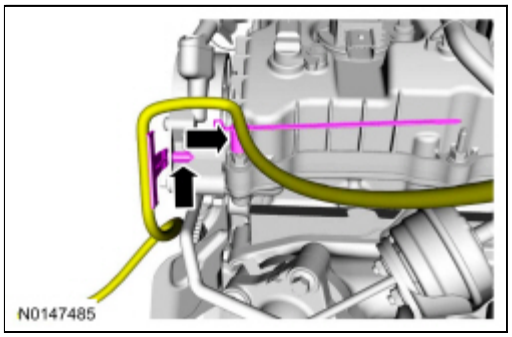
repair4less



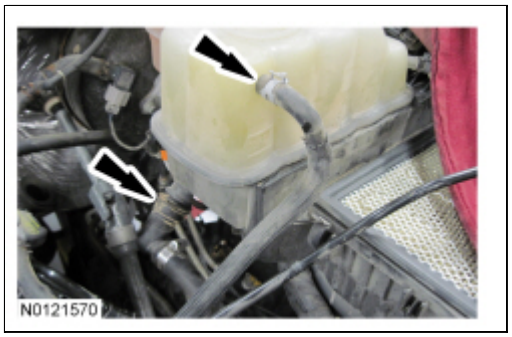
39. Connect the vacuum pump tube.



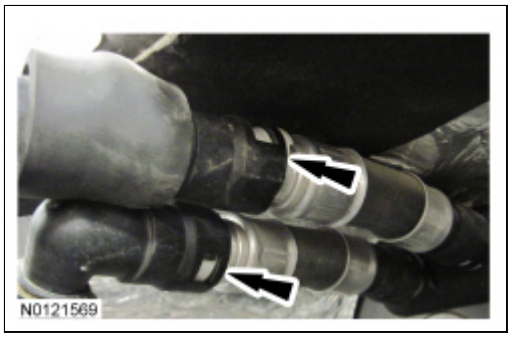
40. Attach the wiring harness retainers to the rear of the RH valve cover stud bolt and the rear of the vacuum pump.



41. Connect the 2 coolant hoses to the degas bottle.



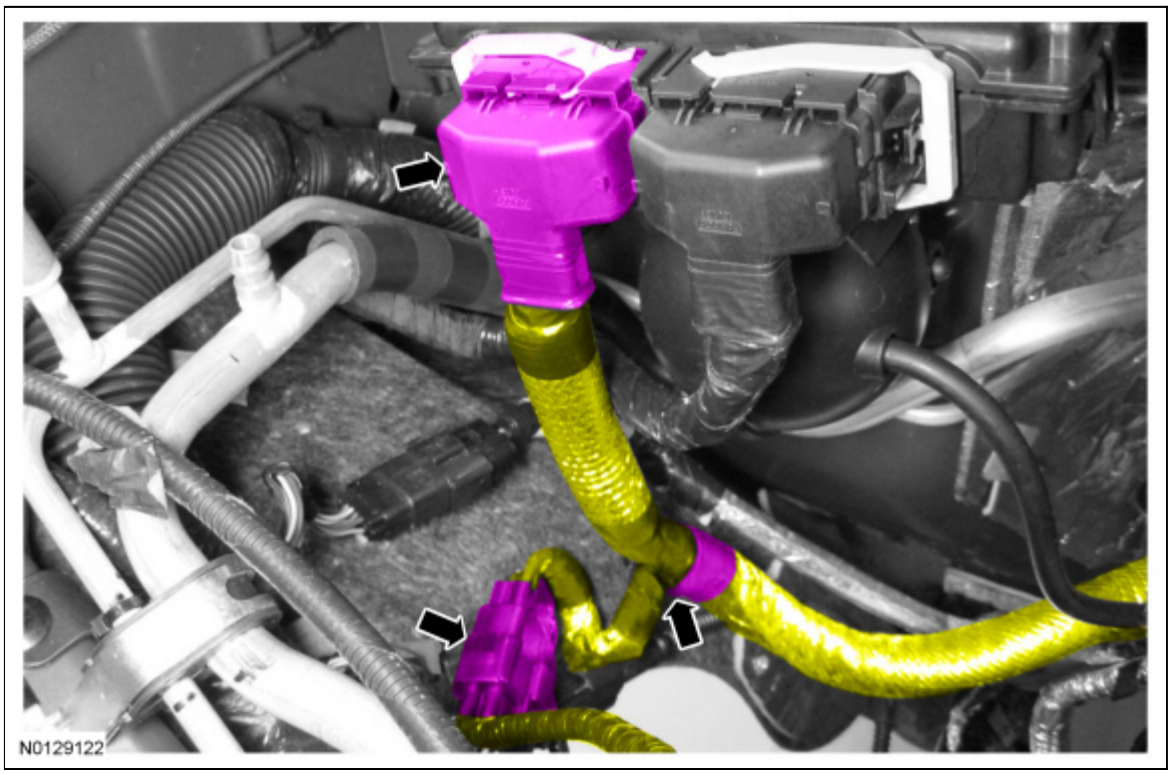
42. Connect the 2 heater hose couplings at the RH rear of the engine.



43. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

44. Install the fuel injection pump. For additional information, refer to Section 303-04A .

45. Connect the PCM electrical connector and the engine harness electrical connector.
    - Attach the wiring harness retainers to the fender splash shield.

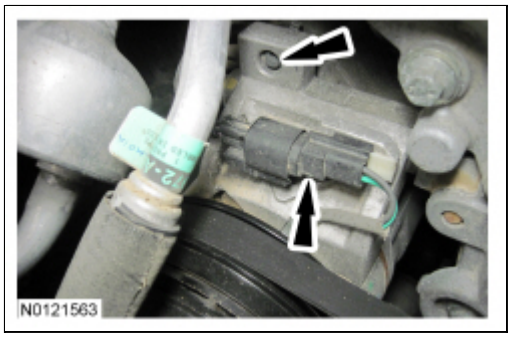


46. Install the A/C compressor belt. For additional information, refer to Section 303-05 .

47. Install the generator. For additional information, refer to Section 414-00 .

48. Connect the A/C compressor electrical connector.
    - Attach the A/C compressor wiring harness to the A/C compressor.

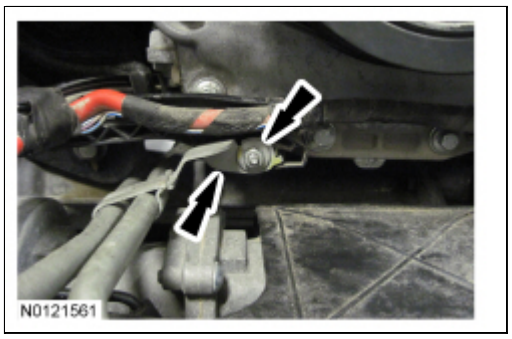
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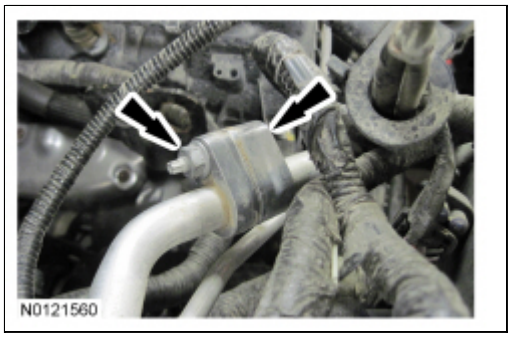
49. Attach the generator wiring harness to the engine front cover.



50. Install the transmission cooler line bracket and nut to the engine front cover stud bolt.
    - Tighten to 12 Nm (106 lb-in).

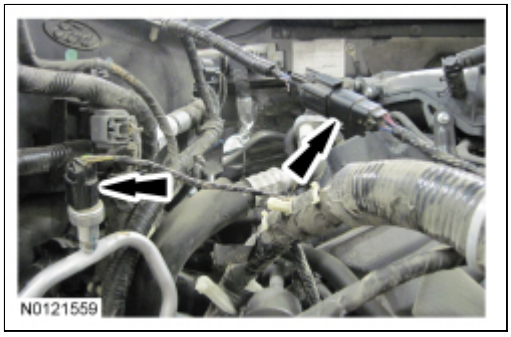


51. Using a new O-ring seal and gasket seal, install the A/C tube and the nut.
    - Tighten to 15 Nm (133 lb-in).



52. Connect the Battery Junction Box (BJB) wiring harness and the A/C pressure transducer electrical

connectors.



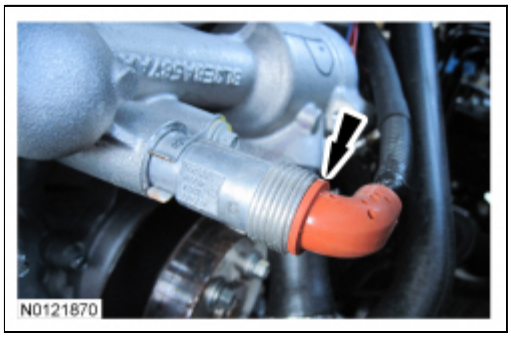
53. Fill the engine with clean engine oil.

54. Install the 2 Charge Air Cooler (CAC) inlet tubes and the CAC outlet tube. For additional information, refer to 3.5L Gasoline Turbocharged Direct Injection (GTDI) Charge Air Cooler (CAC) and Tubes Exploded View in Section 303-12 .

55. Install the LH and RH turbocharger intake tubes. For additional information, refer to 3.5L Gasoline Turbocharged Direct Injection (GTDI) Charge Air Cooler (CAC) and Tubes Exploded View in Section 303-12 .

56. Install the cooling module. For additional information, refer Section 303-03 .

57. If equipped, connect the block heater electrical connector at the thermostat housing.
    - Attach the block heater wiring harness retainer to the LH valve cover stud bolt.



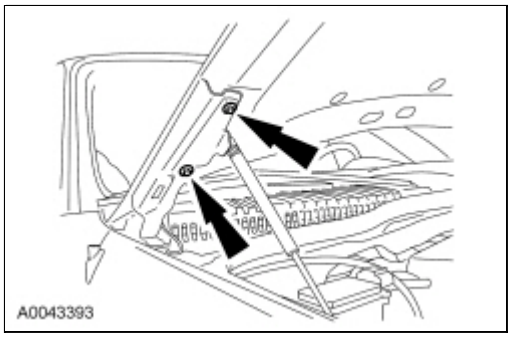
58. Connect the battery ground cable. For additional information, refer to Section 414-01 .

59. **NOTE:** Align the index marks made during hood removal.

    NOTE: RH shown, LH similar.

    Position the hood and install the 4 bolts.
    - Tighten to 12 Nm (106 lb-in).

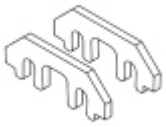
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60. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Camshaft — LH

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

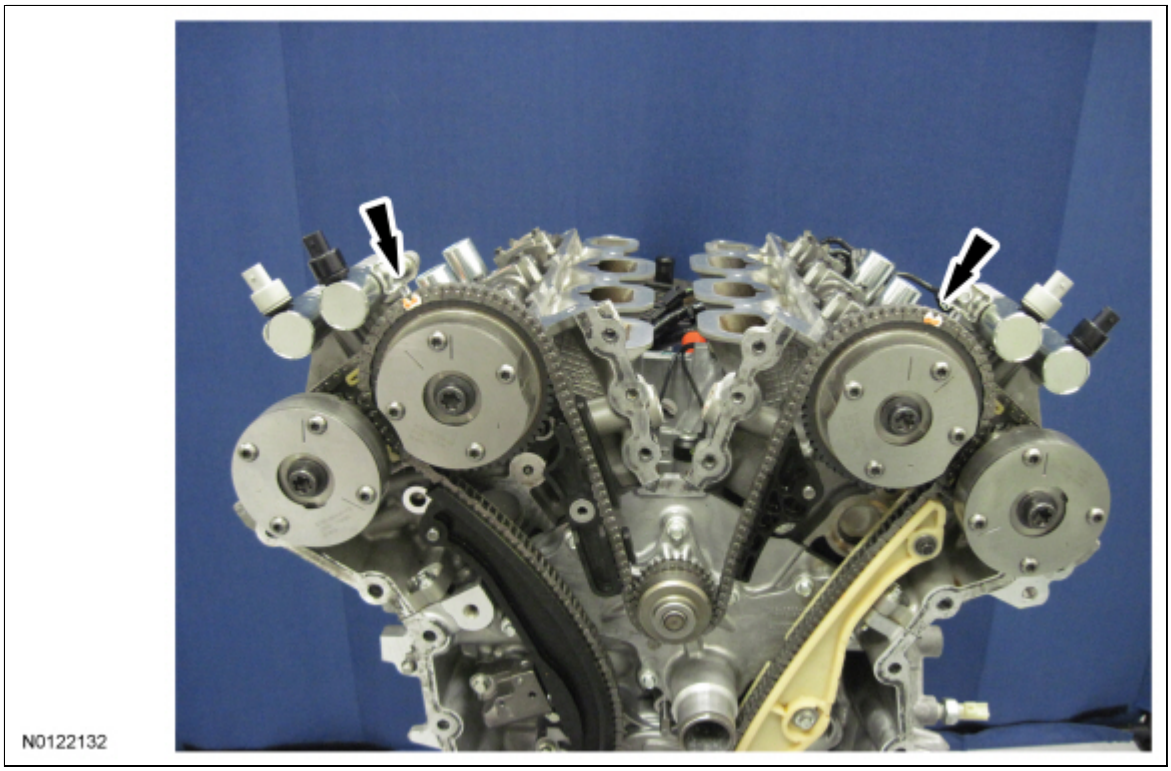
Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

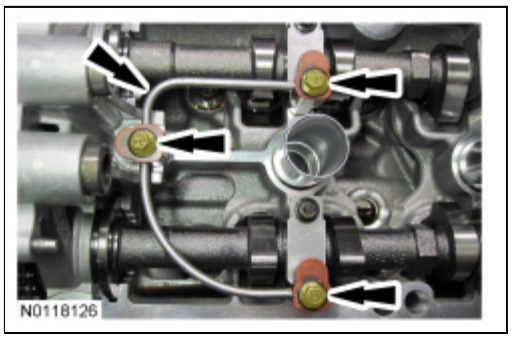
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown.

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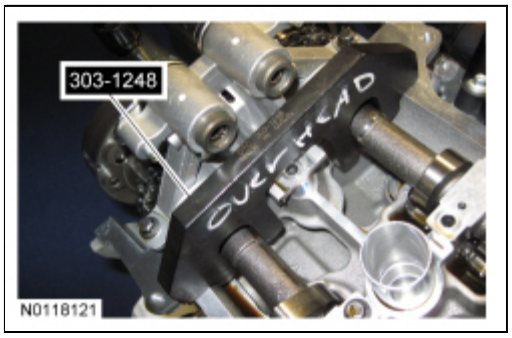


3. Remove the 3 bolts and the LH valve train oil tube.

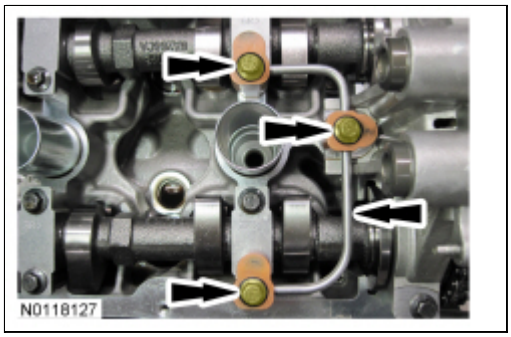


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

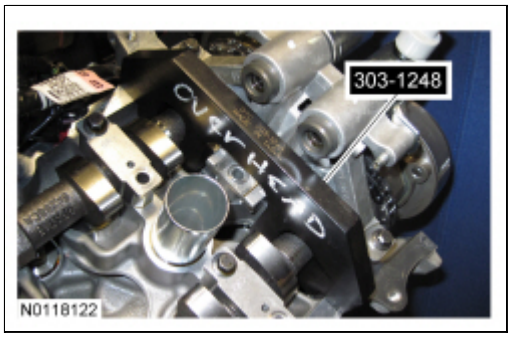


5. Remove the 3 bolts and the RH valve train oil tube.



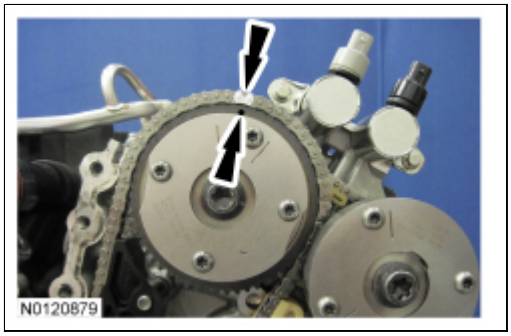
6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

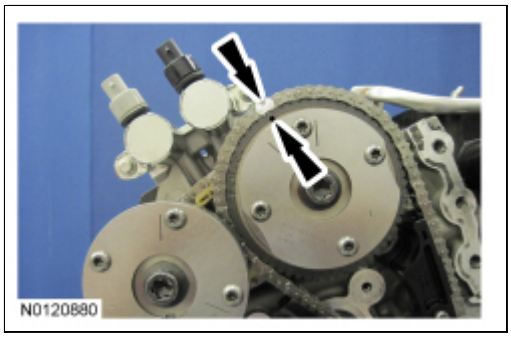


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.



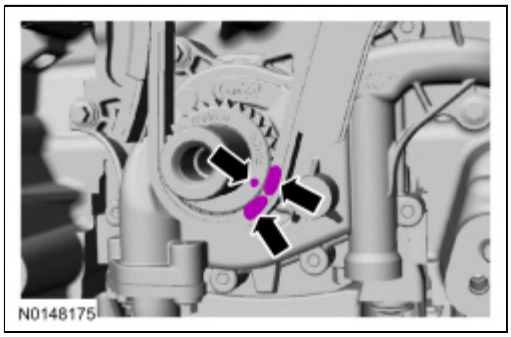
8. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.



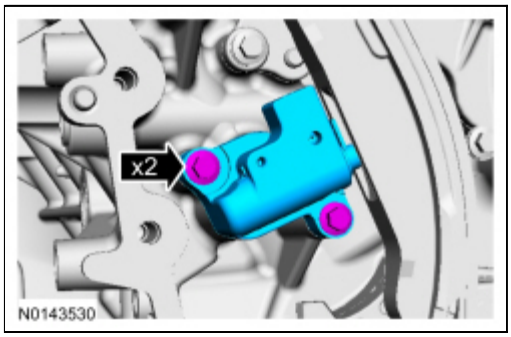
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9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

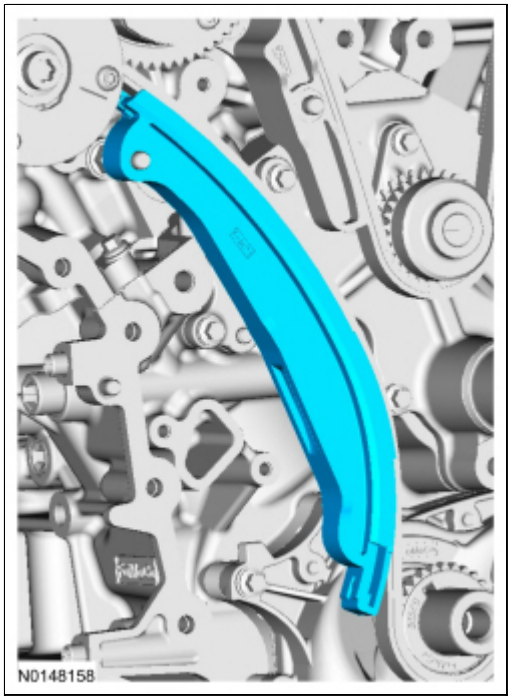
   Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



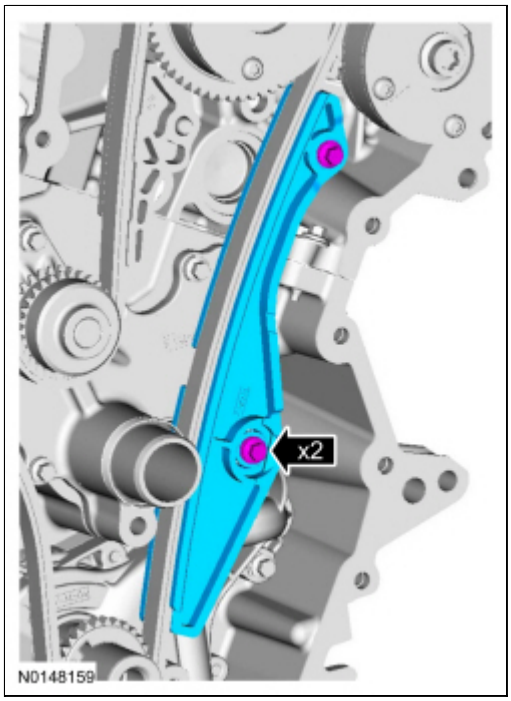
10. Remove the 2 bolts and the primary timing chain tensioner.



11. Remove the primary timing chain tensioner arm.



12. Remove the 2 bolts and the lower LH primary timing chain guide.

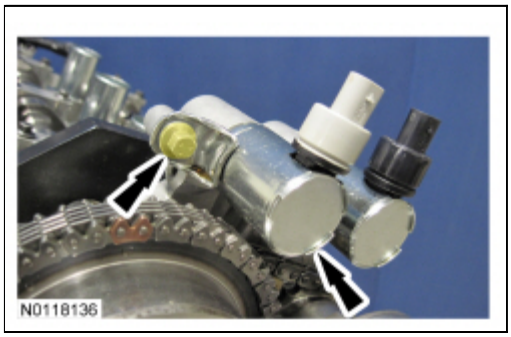


13. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.



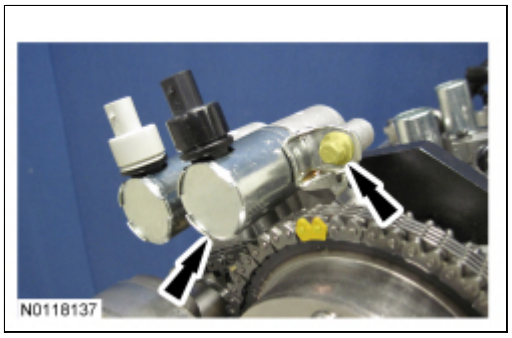
14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

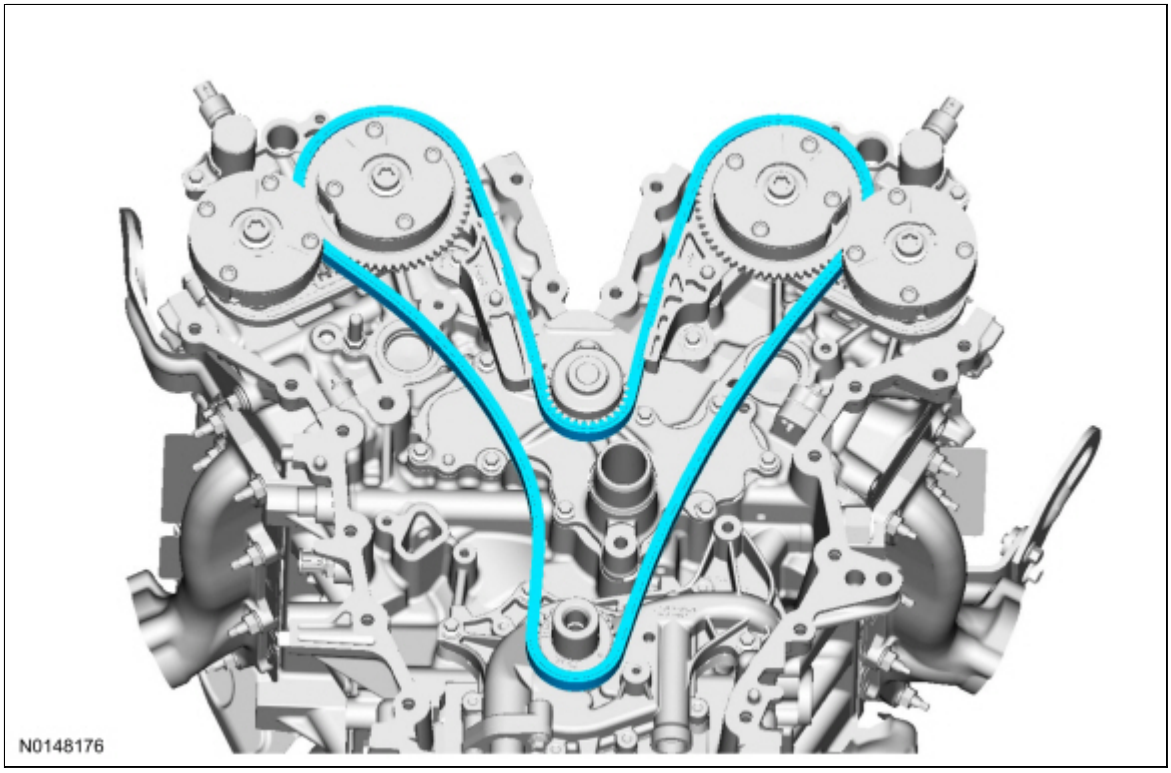
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.

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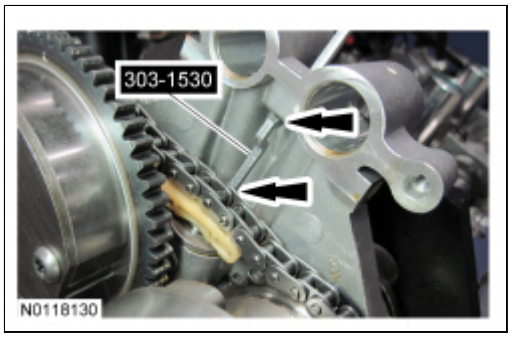
15. Remove the primary timing chain.



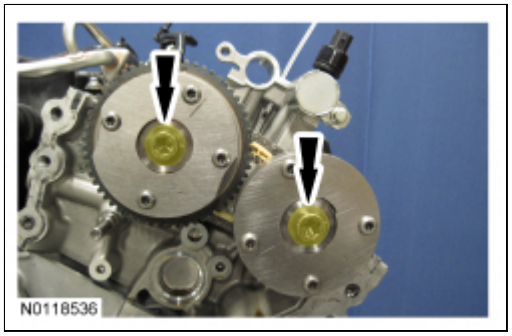
16. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

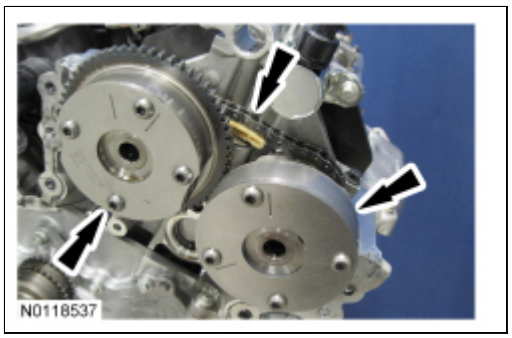
    Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



17. Remove and discard the 2 LH VCT assembly bolts.

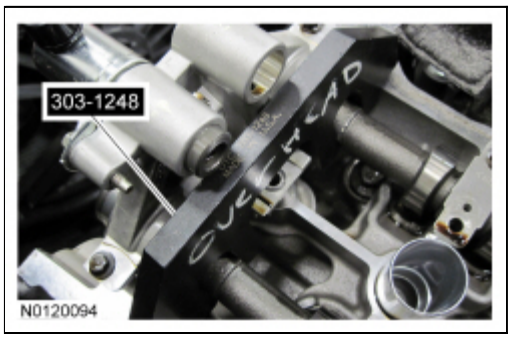


18. Remove the 2 LH VCT assemblies and secondary timing chain.



19. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the LH camshafts approximately 3 degrees to a neutral position.

    Remove the Camshaft Holding Tool from the LH camshafts.



20. Remove the 12 camshaft cap bolts, the 6 camshaft caps, and the mega cap.

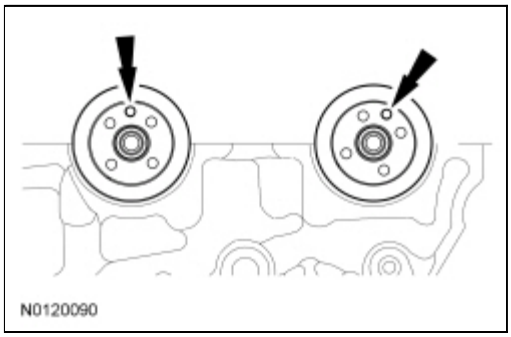
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- Remove the LH camshafts.

Installation

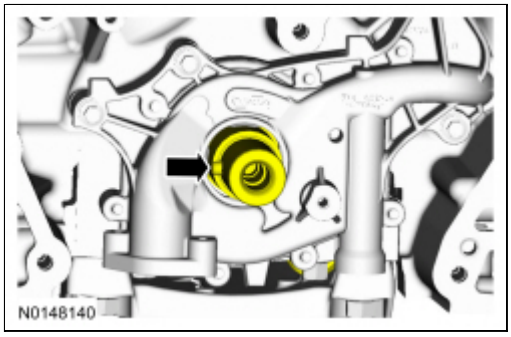
1. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

   Position the camshafts onto the LH cylinder head in the neutral position as shown.



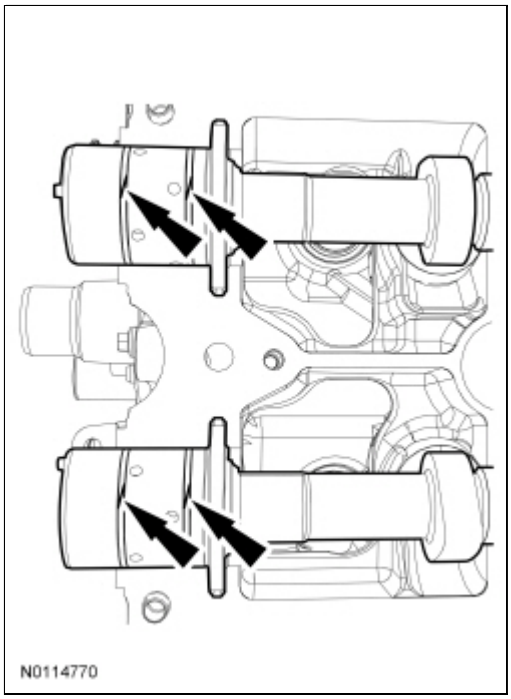
2. ***NOTICE:*** **The crankshaft must remain in the free wheeling position (crankshaft dowel pin at 9 o'clock) until the camshafts are installed and the valve clearance is checked/ adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

   Rotate the crankshaft couterclockwise until the crankshaft dowel pin is in the 9 o'clock position.



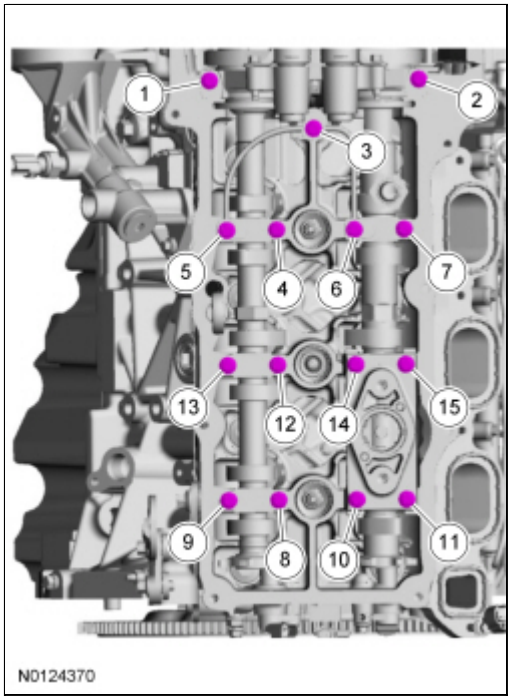
3. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

   Position the 4 camshaft seals gaps as shown.



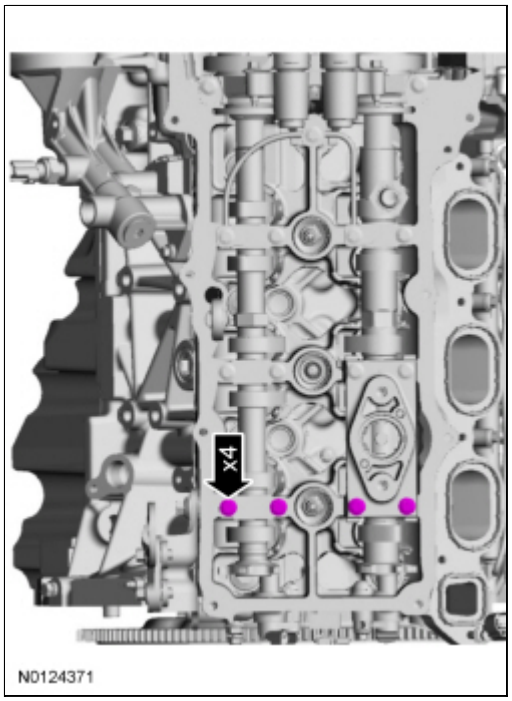
4. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

   Install the 5 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
   - Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

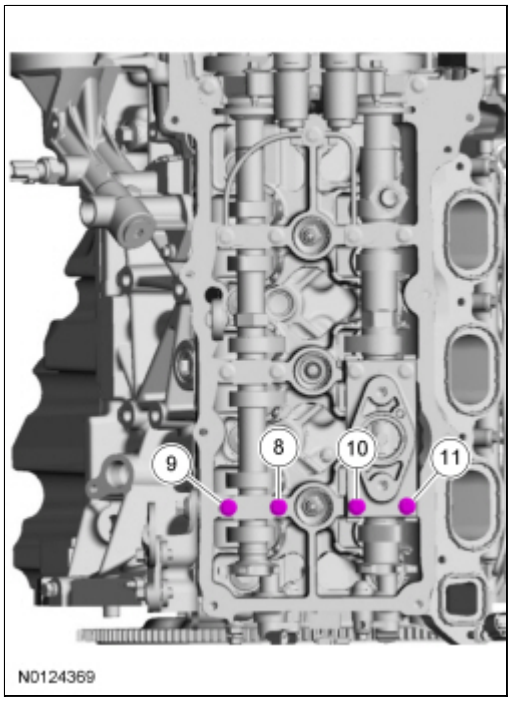


5. Loosen the 4 camshaft caps bolts.

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6. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.

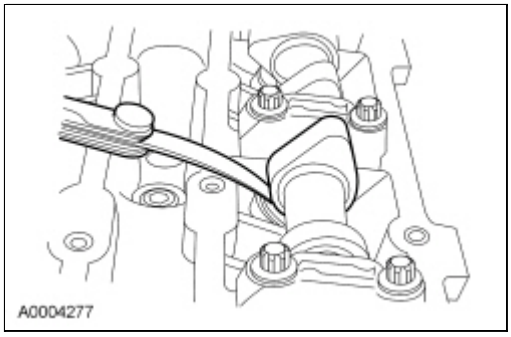


7. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

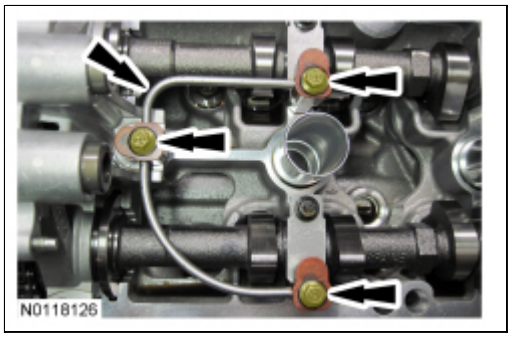
    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet

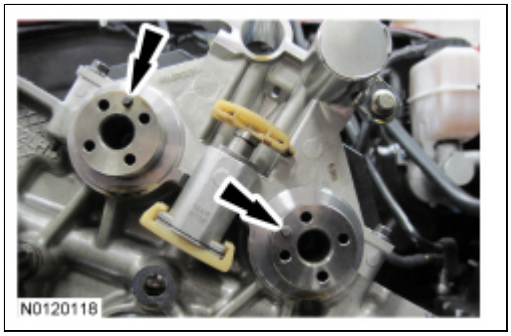
(s) of the correct size. For additional information, refer to Valve Clearance Check in this section.



8. Remove the 3 bolts and the LH valve train oil tube.

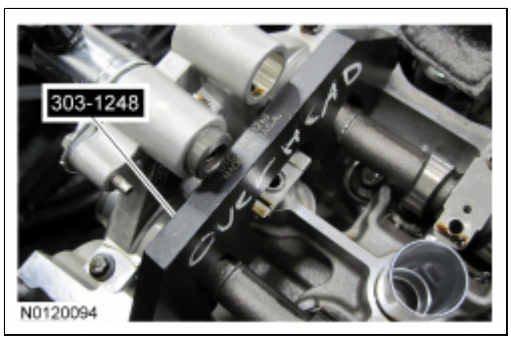


9. Rotate the LH camshafts to the TDC position as shown.



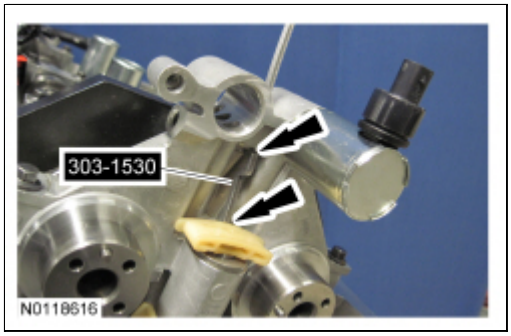
10. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the LH camshafts.

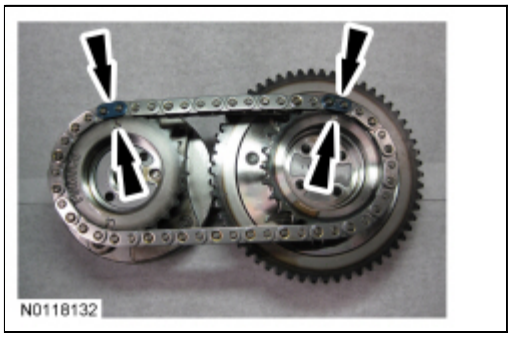


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11. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

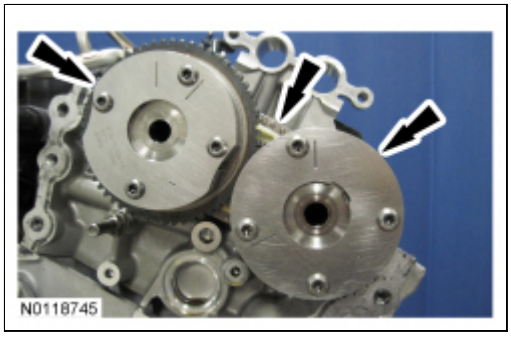


12. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

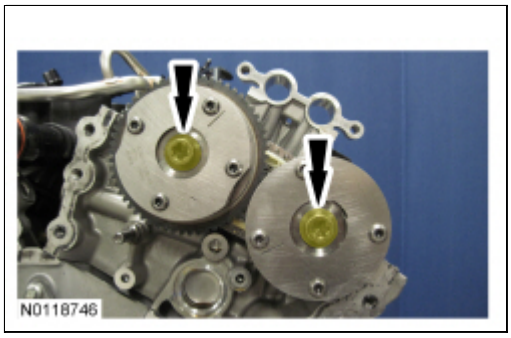


13. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

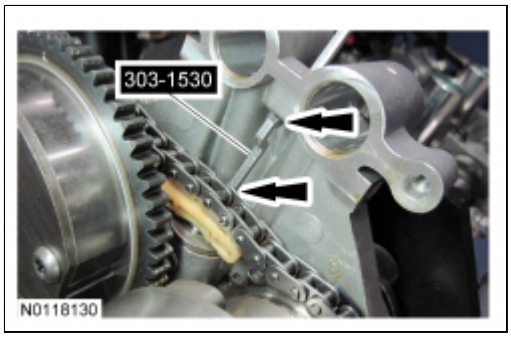


14. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

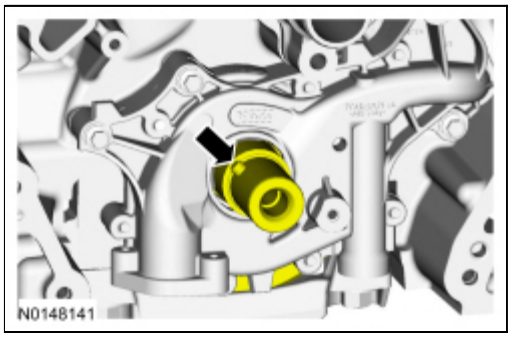


15. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.



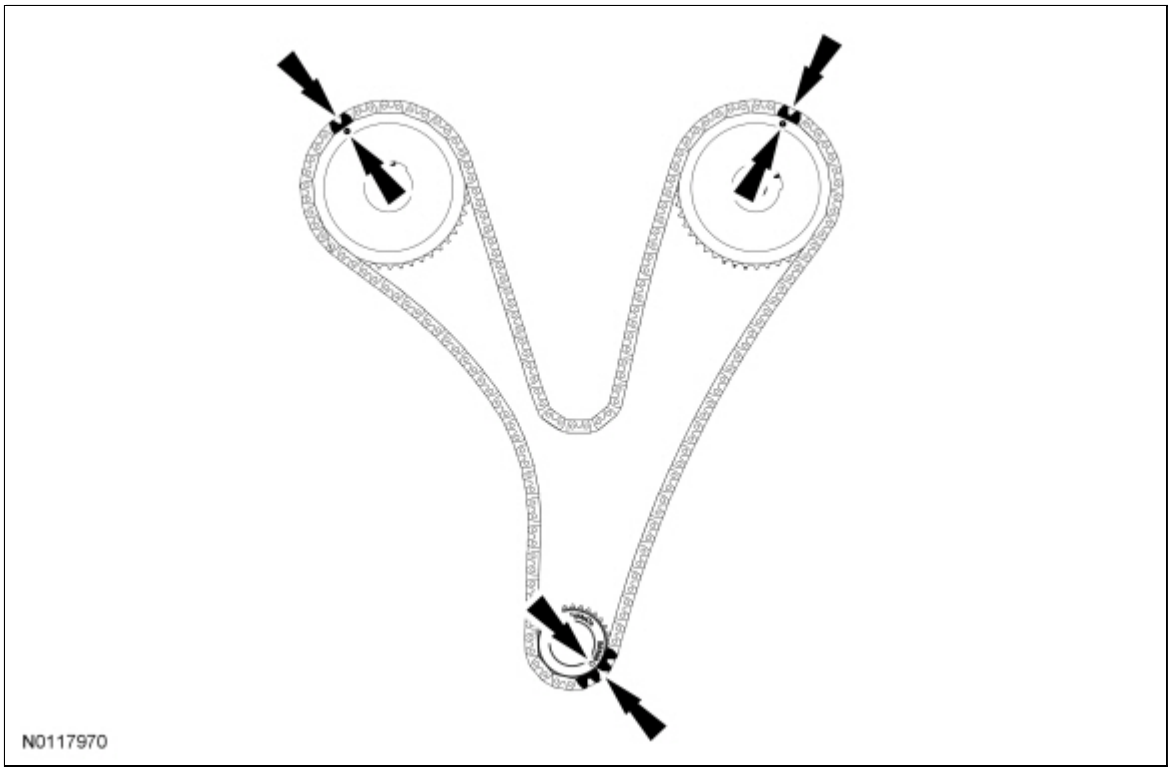
16. Rotate the crankshaft clockwise 60 degrees to TDC position (crankshaft dowel pin at the 11 o'clock position).



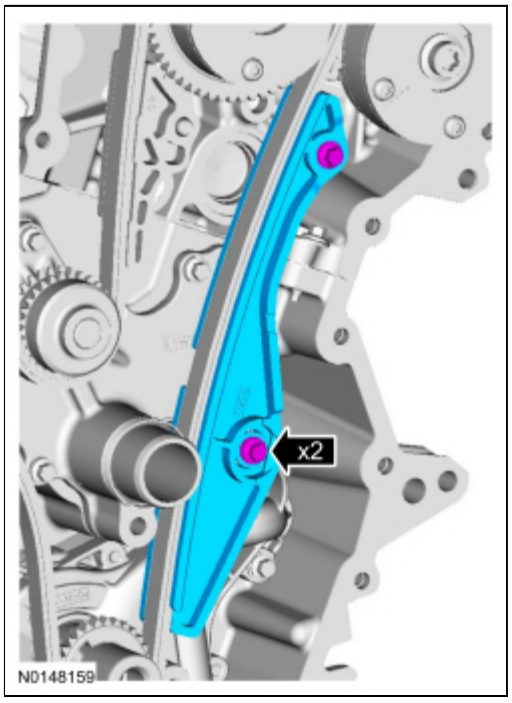
17. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

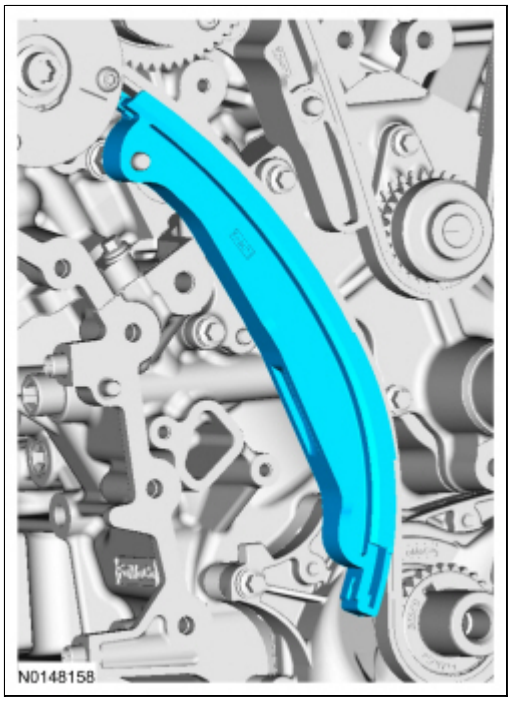
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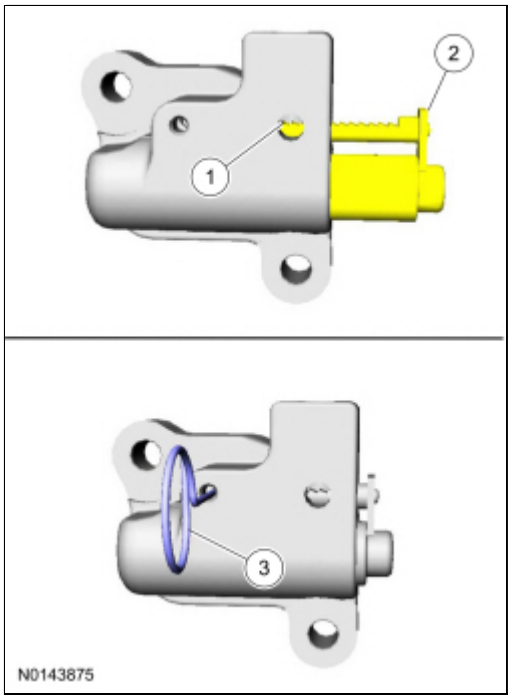
18. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



19. Install the primary timing chain tensioner arm.



20. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and Install a suitable lockpin.

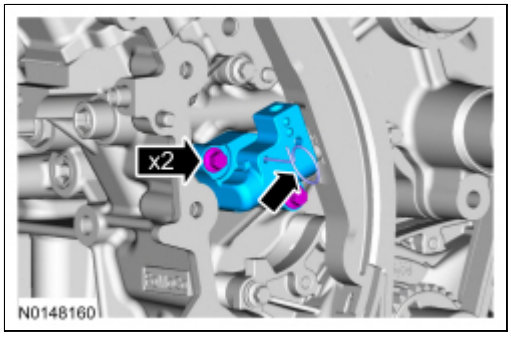


21. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

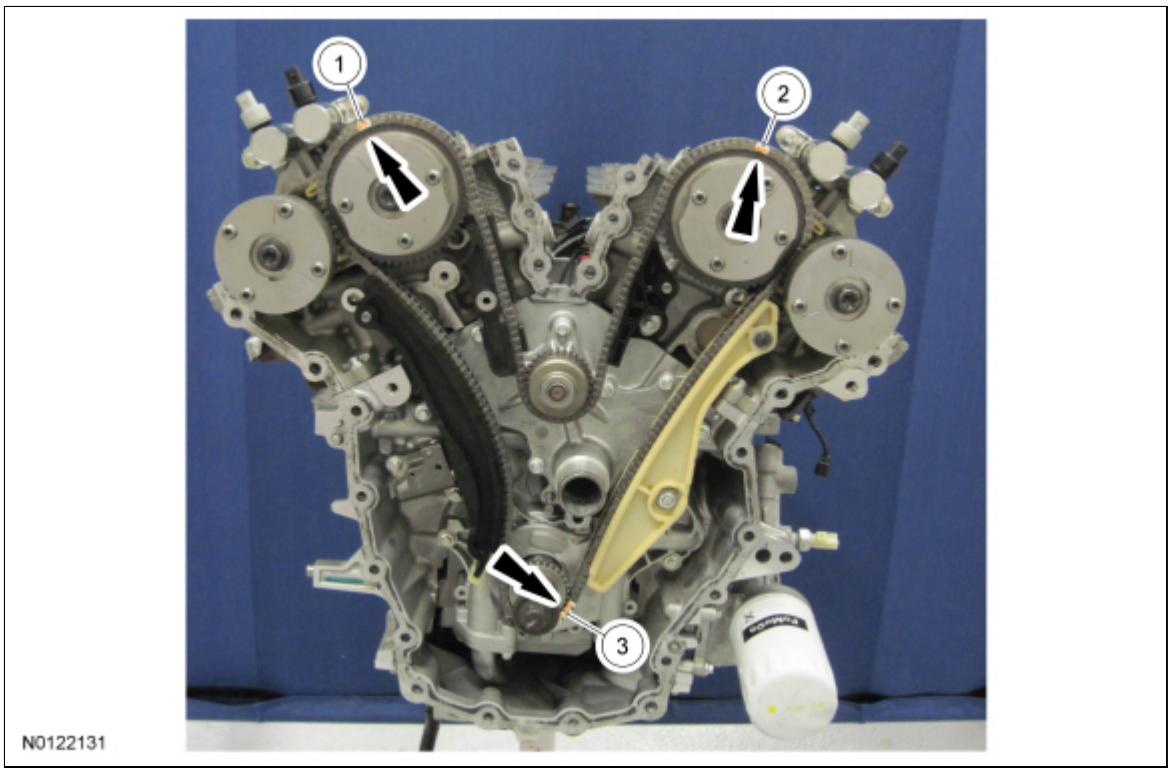
    Install the primary timing chain tensioner and the 2 bolts.

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- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



22. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



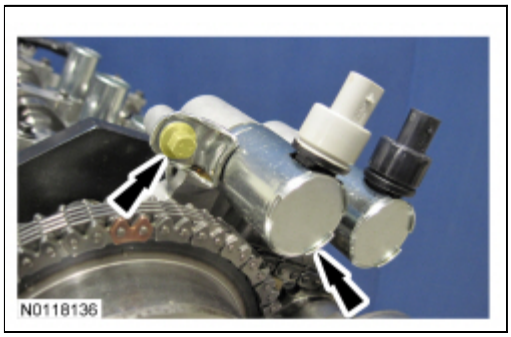
23. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



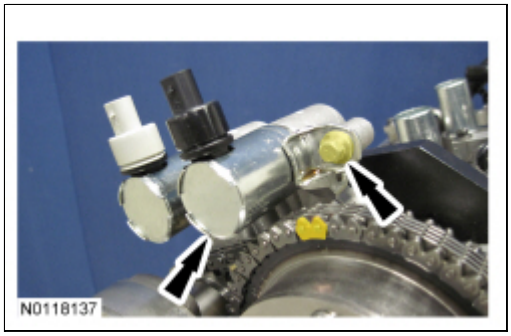
24. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

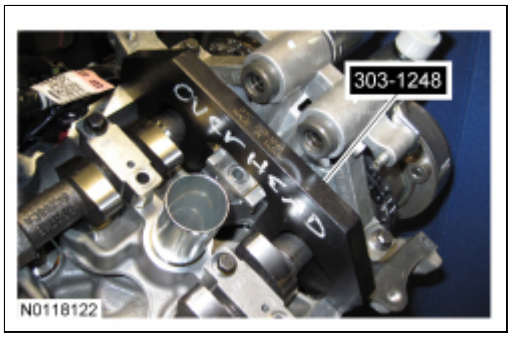
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

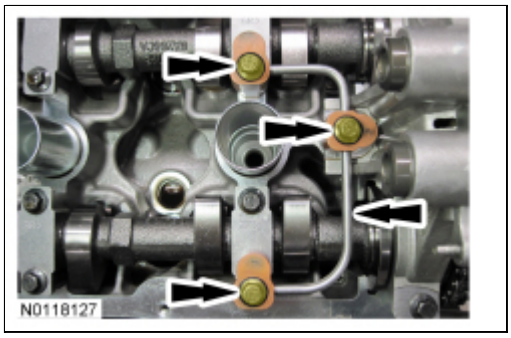


25. Remove the RH Camshaft Holding Tool.

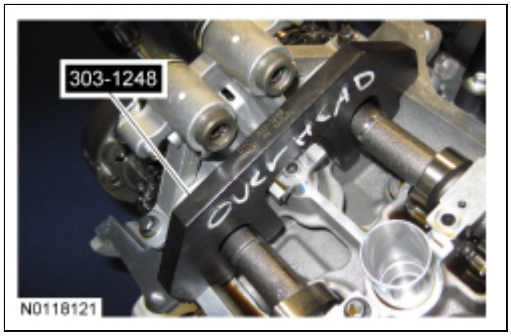


26. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

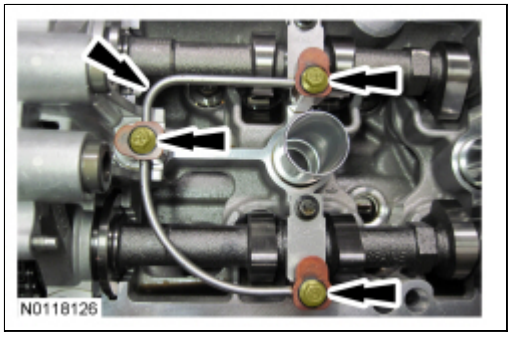
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27. Remove the LH Camshaft Holding Tool.



28. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

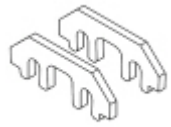


29. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

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Camshaft — RH

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248

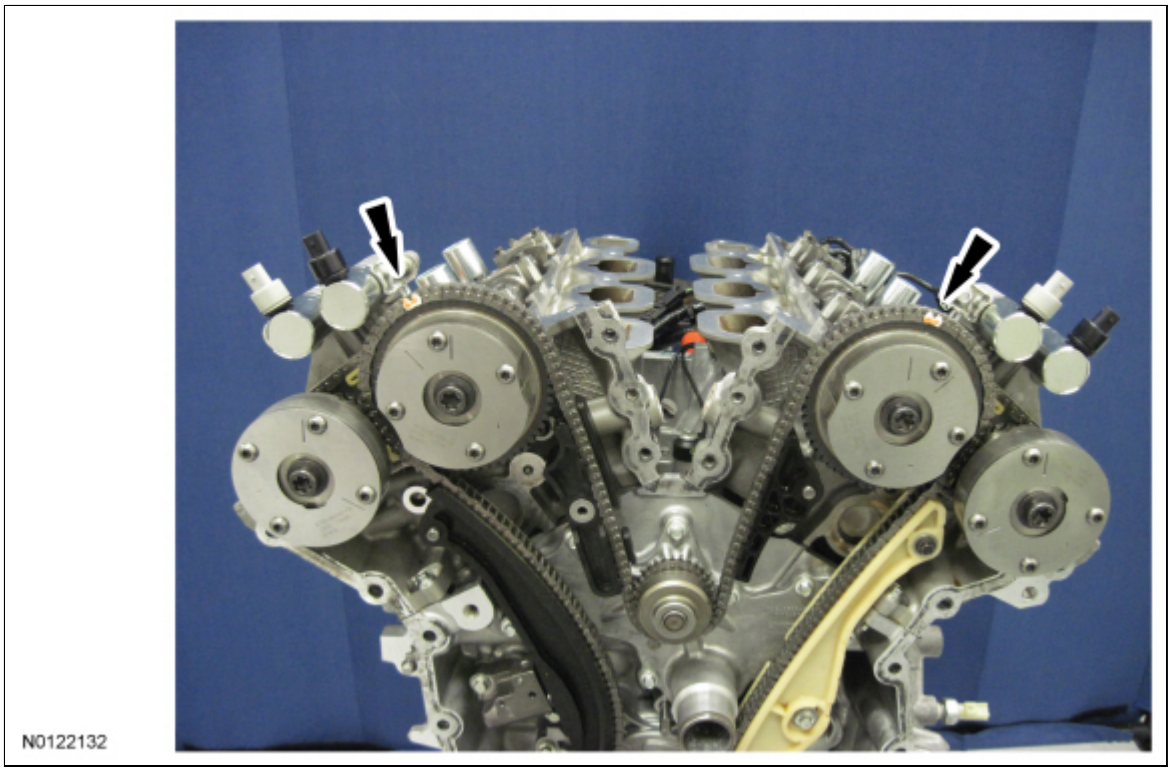
Material

Item	Specification
Motorcraft® Gasket Maker TA-16	WSK-M2G348-A5
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

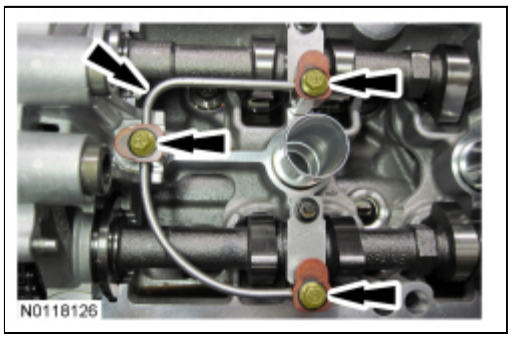
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Remove the vacuum pump. Refer to Section 206-07 .
3. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown.

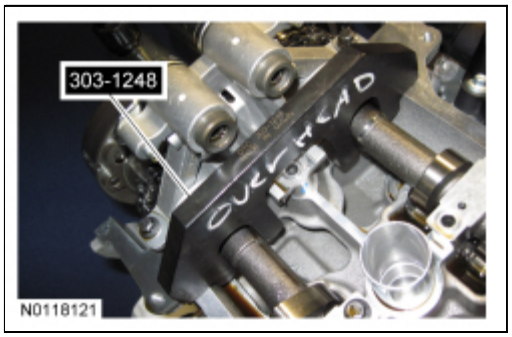


4. Remove the 3 bolts and the LH valve train oil tube.



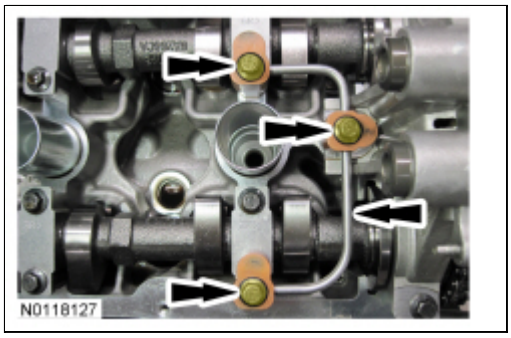
5. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.



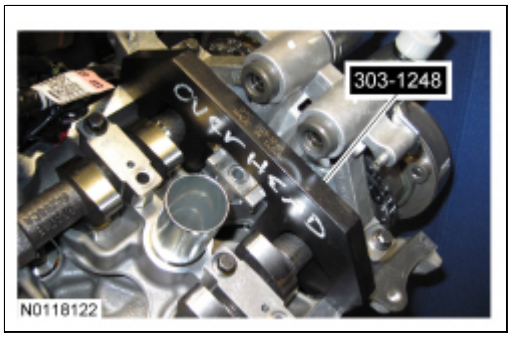
6. Remove the 3 bolts and the RH valve train oil tube.

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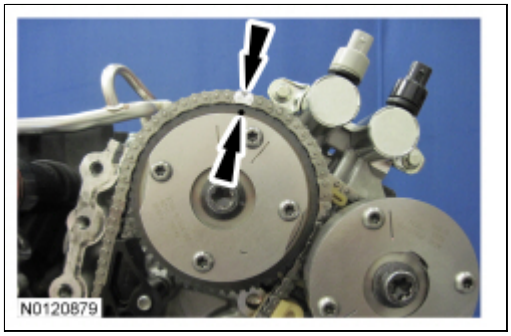
7. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

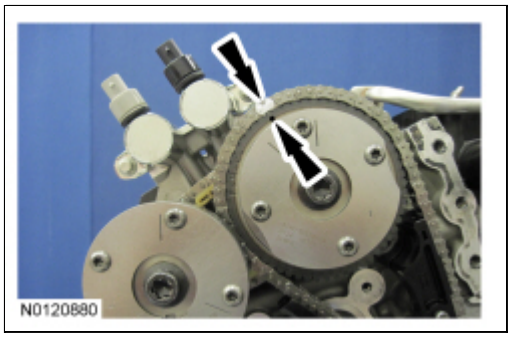


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

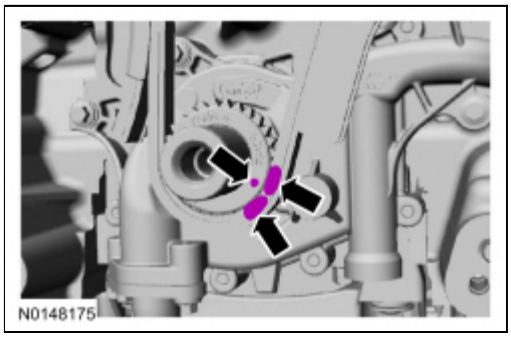


9. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

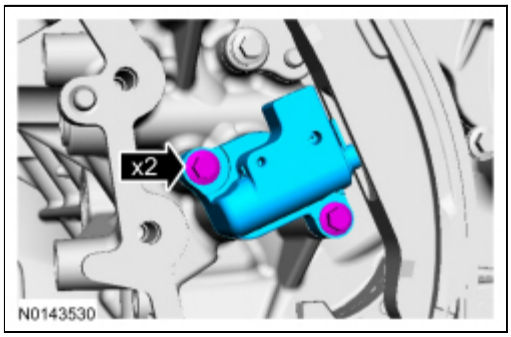


10. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

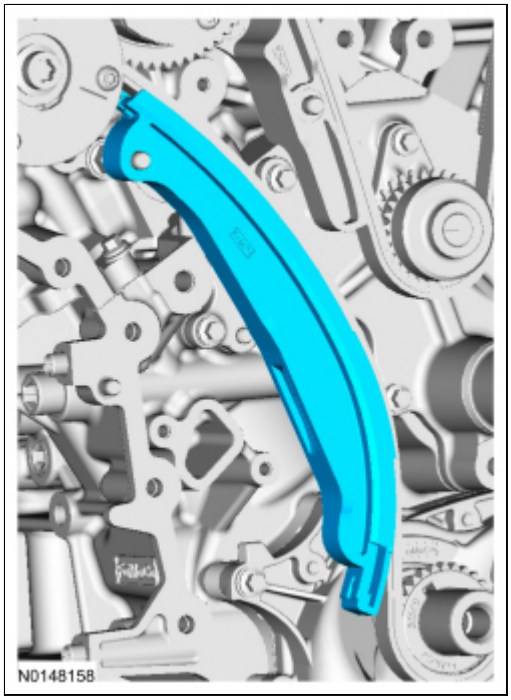
    Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



11. Remove the 2 bolts and the primary timing chain tensioner.

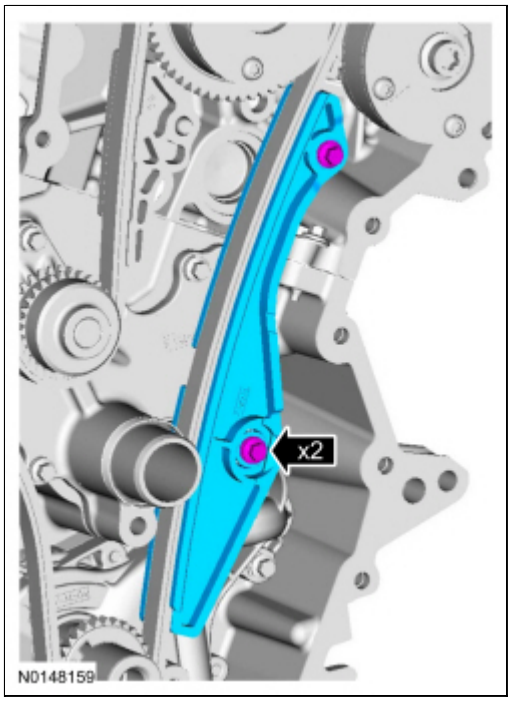


12. Remove the primary timing chain tensioner arm.



13. Remove the 2 bolts and the lower LH primary timing chain guide.

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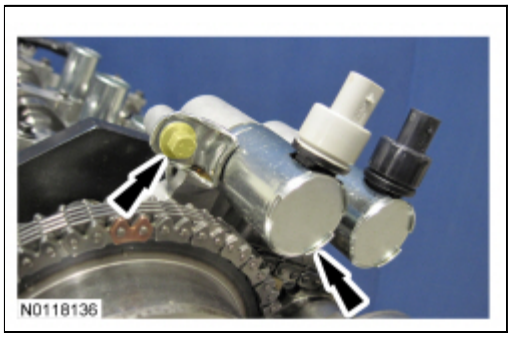


14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.

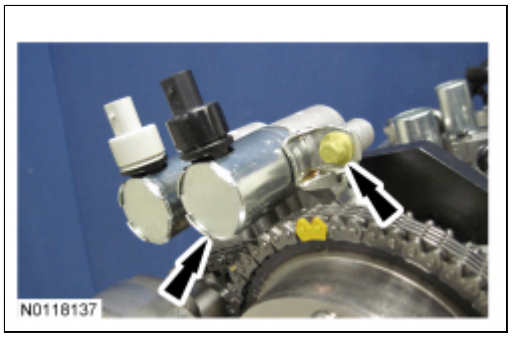


15. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

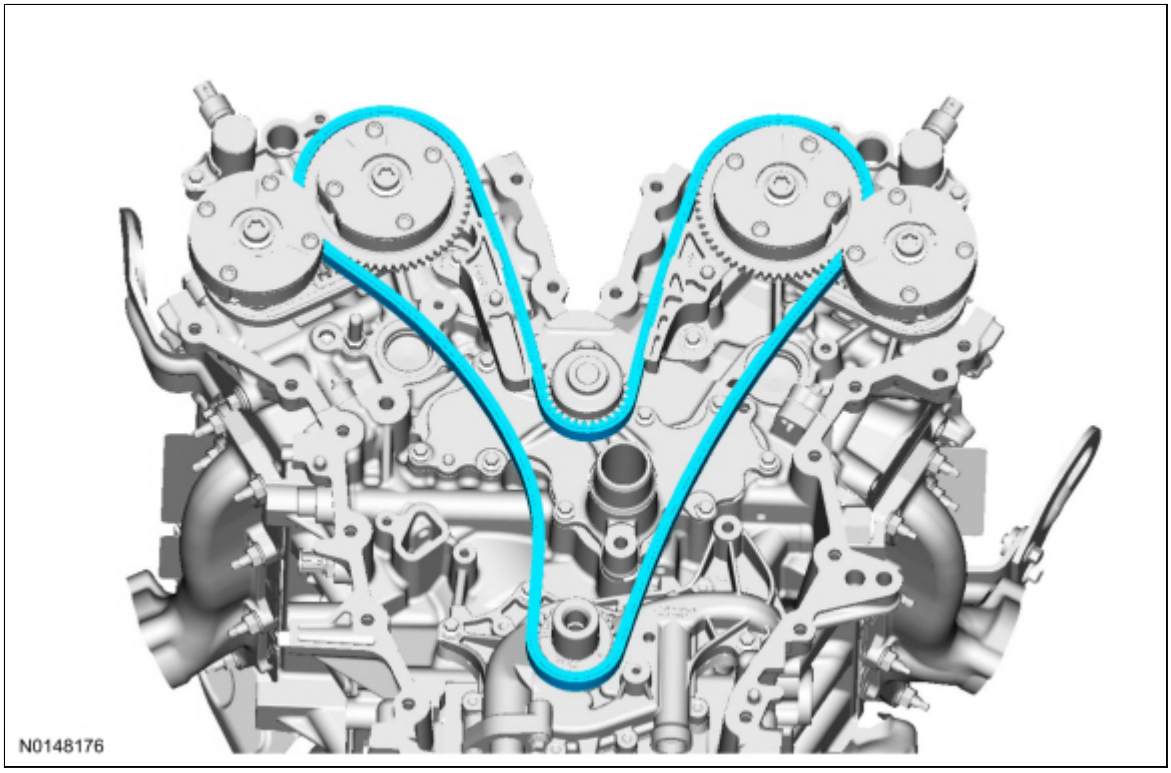
    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.



16. Remove the primary timing chain.

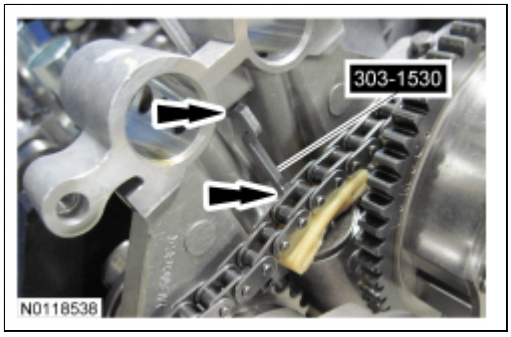


17. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

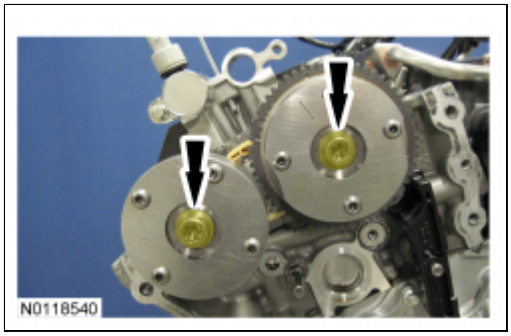
    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

    Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

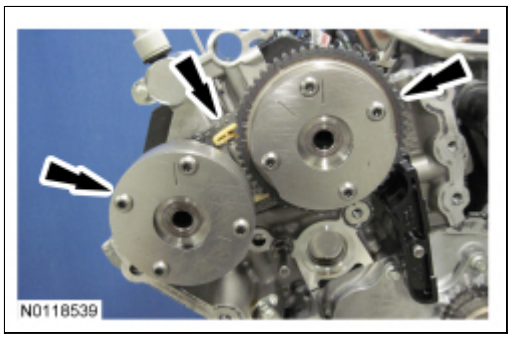
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18. Remove and discard the 2 RH VCT assembly bolts.

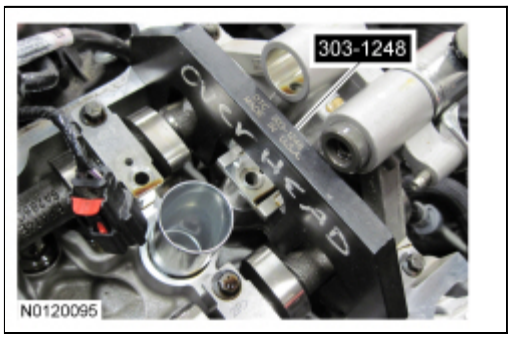


19. Remove the 2 RH VCT assemblies and secondary timing chain.

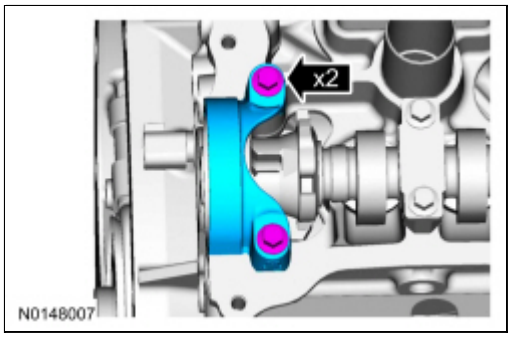


20. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the RH camshafts approximately 3 degrees to a neutral position.

    Remove the Camshaft Holding Tool from the RH camshafts.



21. Remove the 2 bolts and the camshaft bearing cap assembly.

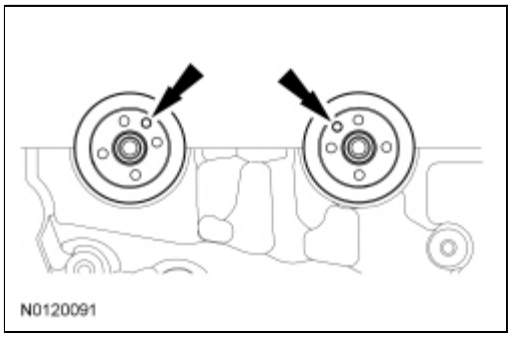


22. Remove the 12 camshaft cap bolts, the 6 camshaft caps, and the mega cap.
    - Remove the RH camshafts.

Installation

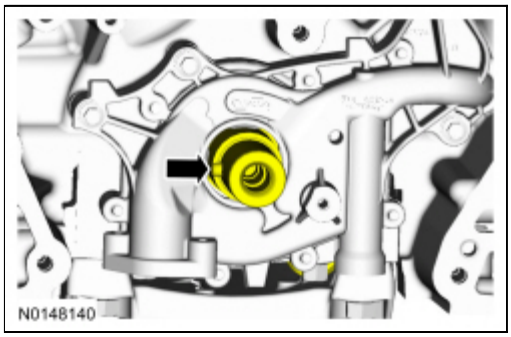
1. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

   Position the camshafts onto the RH cylinder head in the neutral position as shown.



2. ***NOTICE:*** **The crankshaft must remain in the free wheeling position (crankshaft dowel pin at 9 o'clock) until the camshafts are installed and the valve clearance is checked/ adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

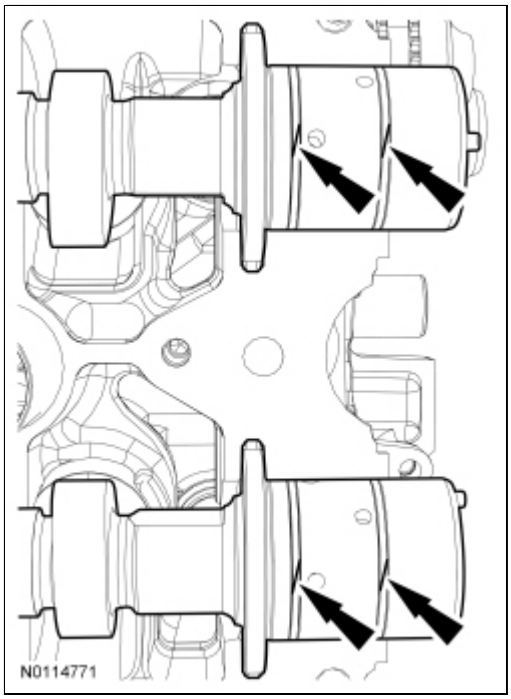
   Rotate the crankshaft couterclockwise until the crankshaft dowel pin is in the 9 o'clock position.



3. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

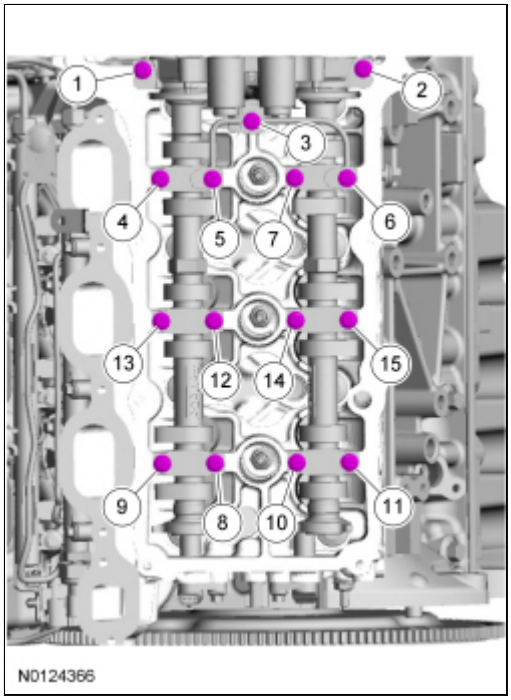
   Position the 4 camshaft seals gaps as shown.

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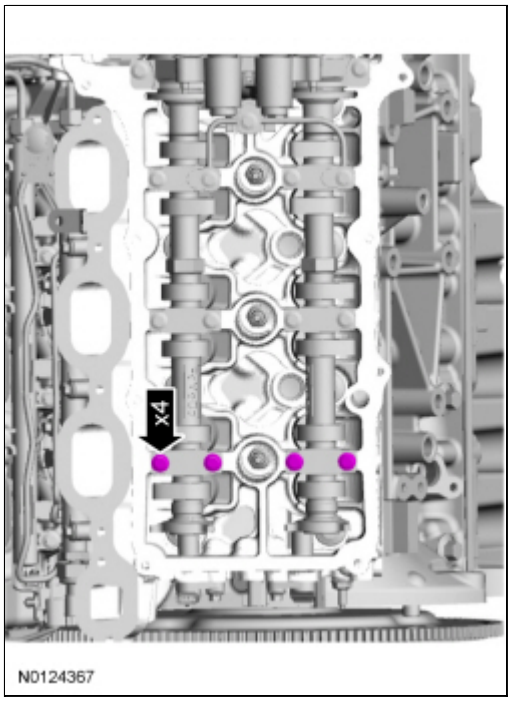


4. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

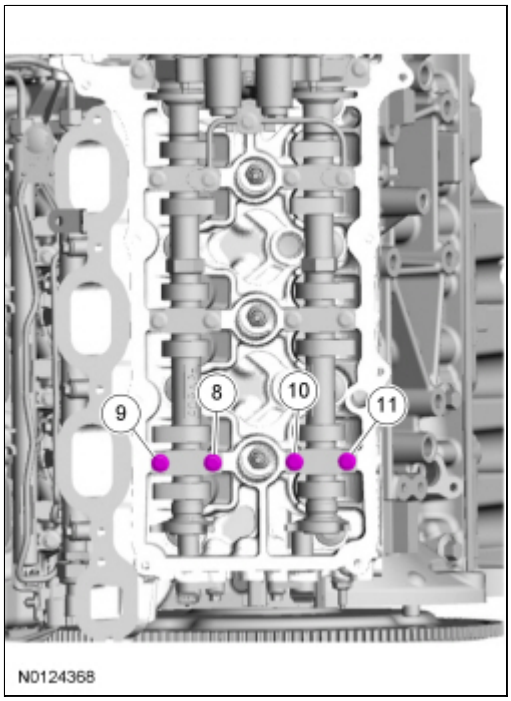
   Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
   - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.



5. Loosen the 4 camshaft caps bolts.



6. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then an additional 45 degrees.



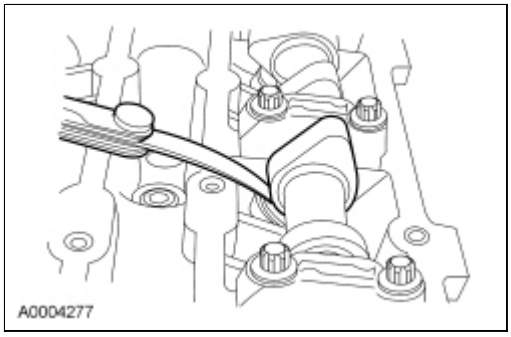
7. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet

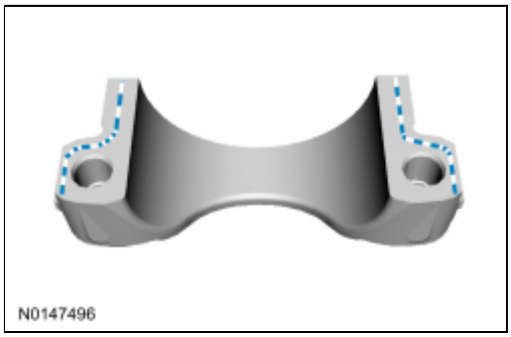
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(s) of the correct size. For additional information, refer to Valve Clearance Check in this section.

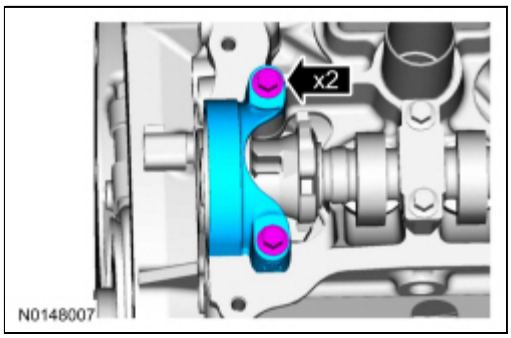


8. **NOTE:** The camshaft bearing cap assembly must be secured within 10 minutes of the Gasket Maker application. If the camshaft bearing cap assembly is not secured within 10 minutes, the sealant must be removed and the sealing area cleaned with Motorcraft® Metal Surface Prep.

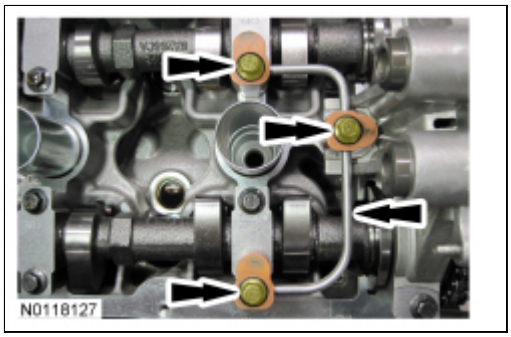
   Apply a 3 mm (0.118 in) bead of sealant to the camshaft bearing cap assembly.



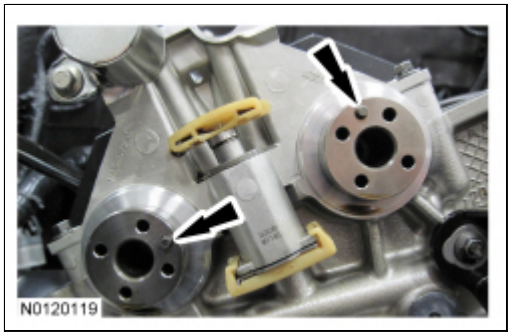
9. Install the camshaft bearing cap assembly and the 2 bolts.
   - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Remove the excess gasket maker.



10. Remove the 3 bolts and the RH valve train oil tube.

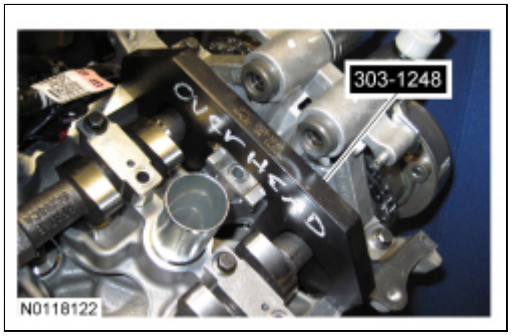


11. Rotate the RH camshafts to the TDC position as shown.

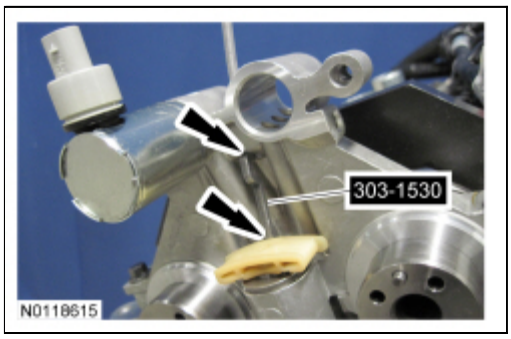


12. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the RH camshafts.



13. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

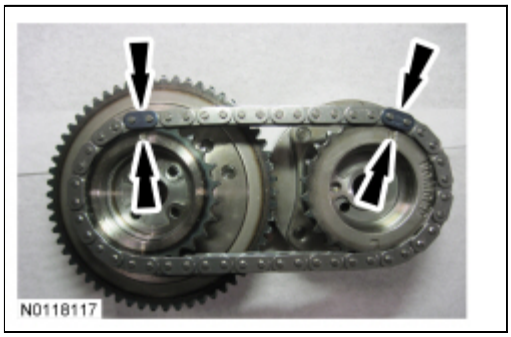


14. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing

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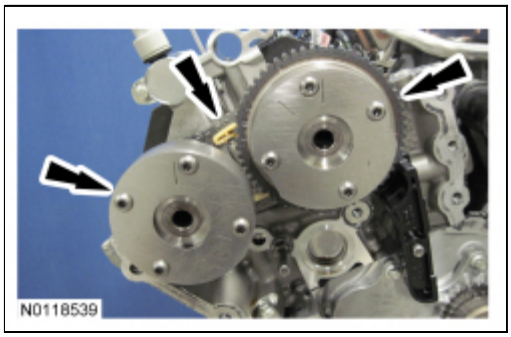
chain.

- Align the colored links with the timing marks.

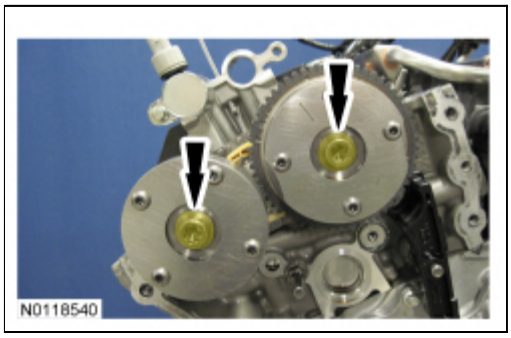


15. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

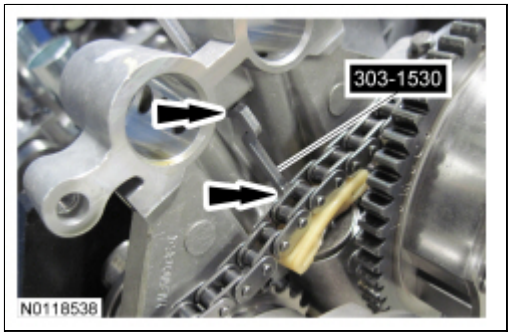


16. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

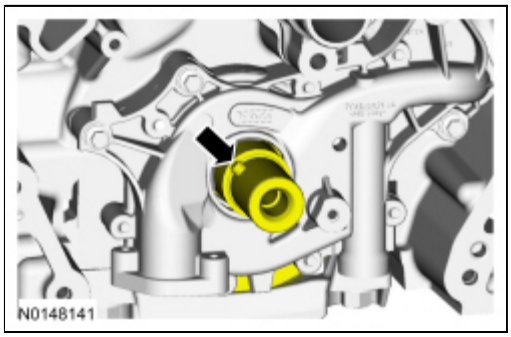


17. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

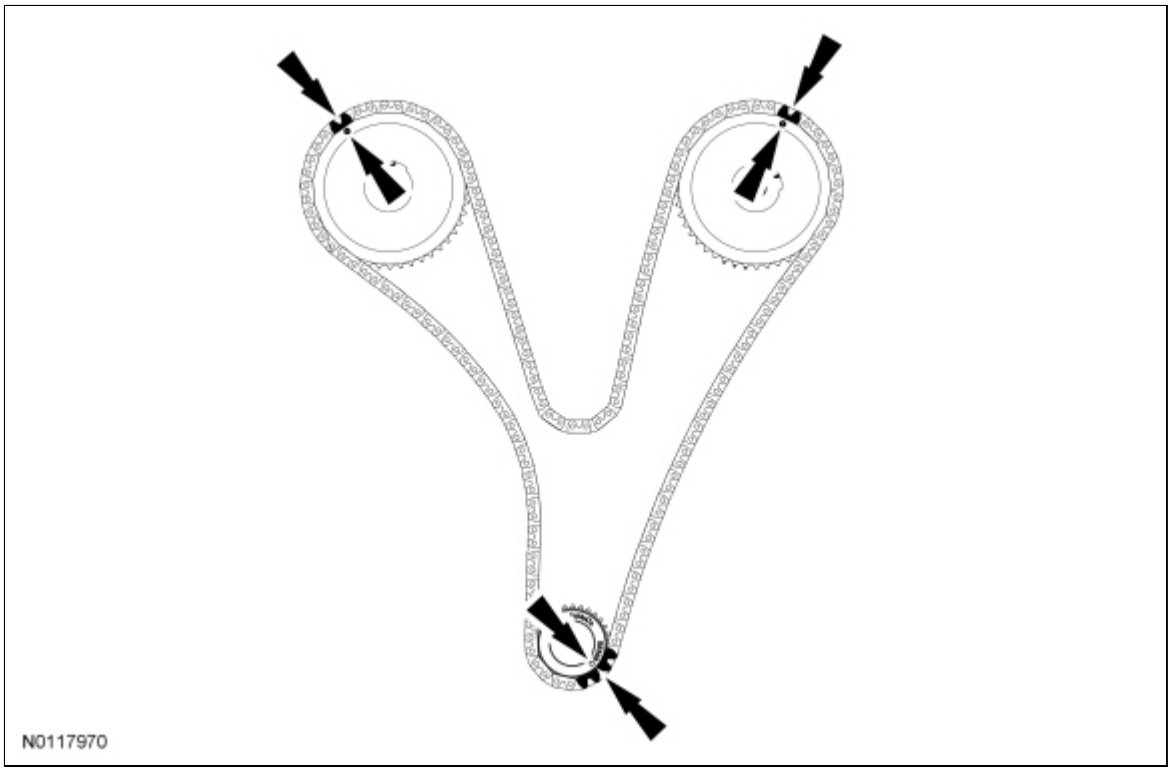


18. Rotate the crankshaft clockwise 60 degrees to TDC position (crankshaft dowel pin at the 11 o'clock position).



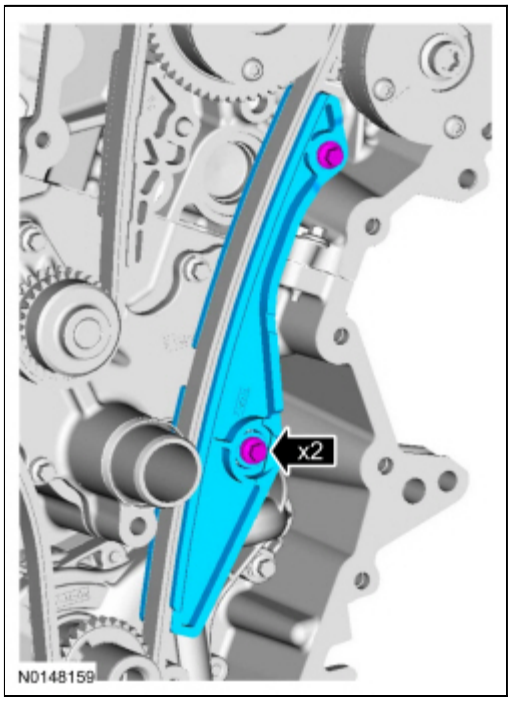
19. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

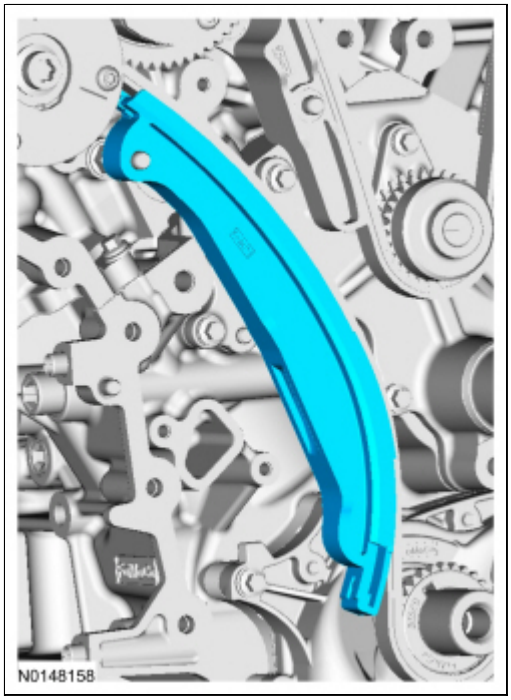


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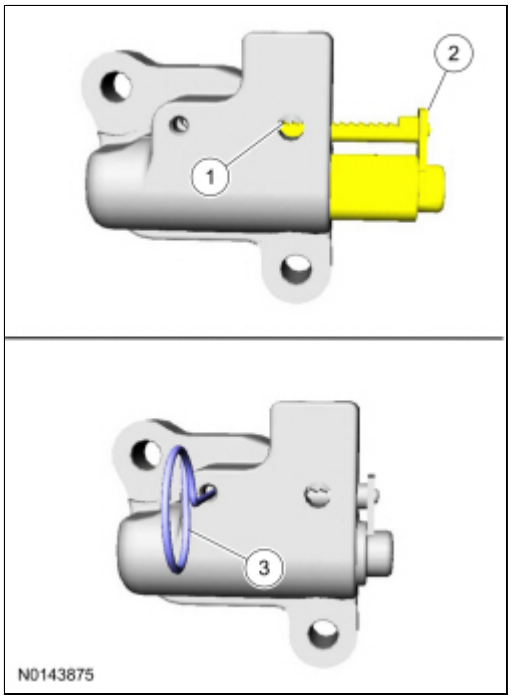
20. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



21. Install the primary timing chain tensioner arm.

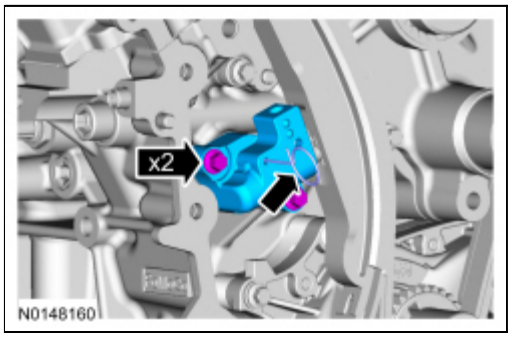


22. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.



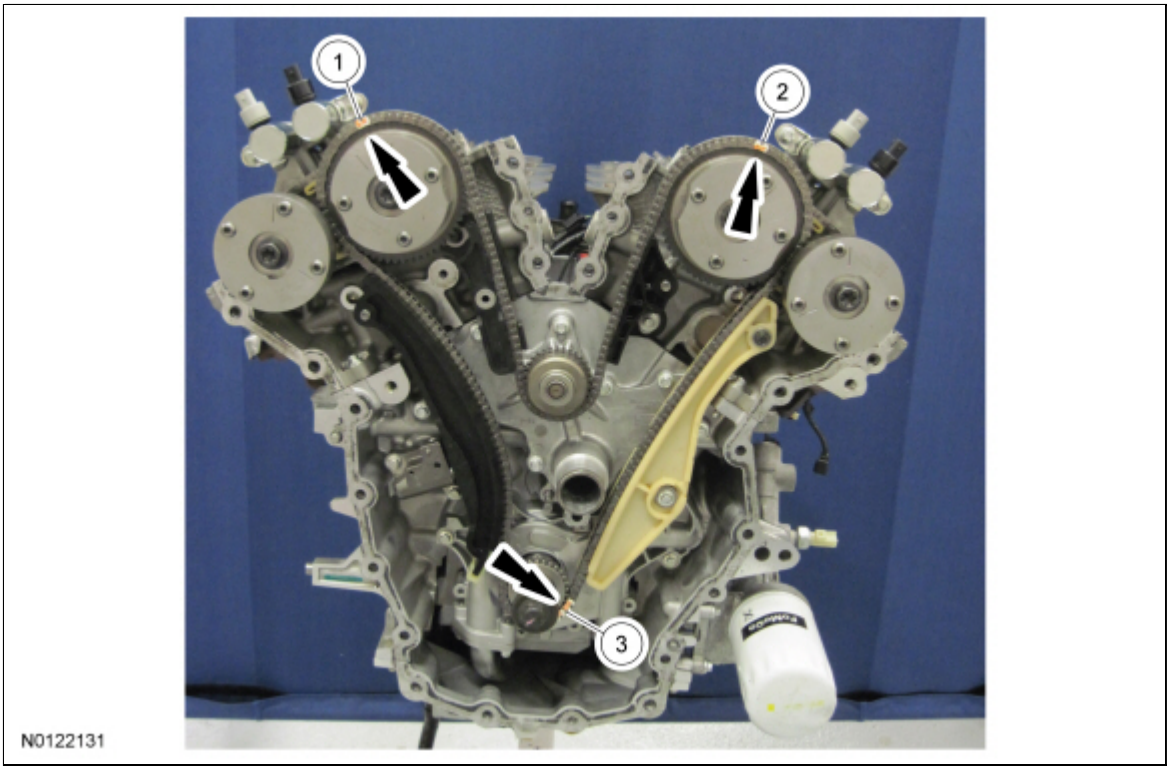
23. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

    Install the primary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.



24. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).

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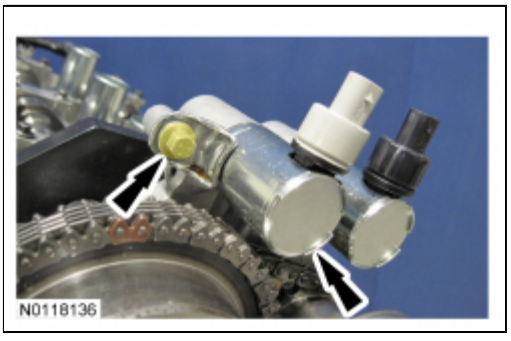
25. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



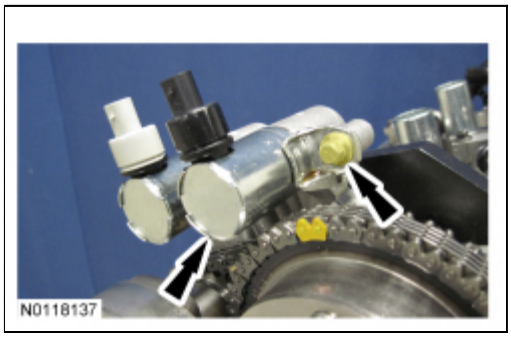
26. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

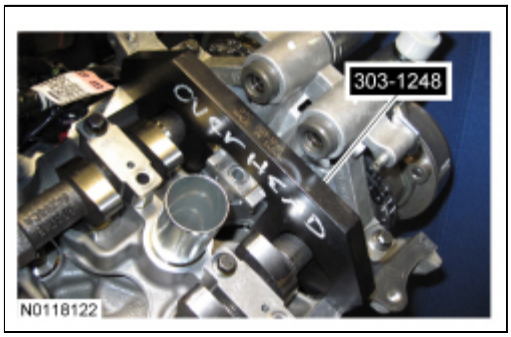
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

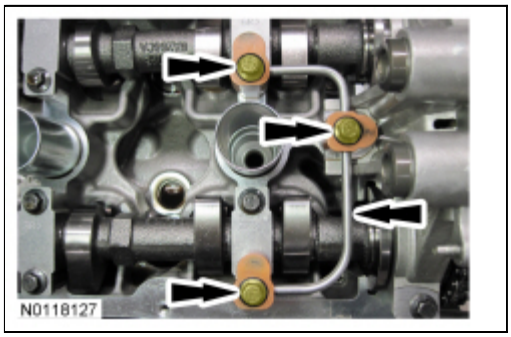
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



27. Remove the RH Camshaft Holding Tool.

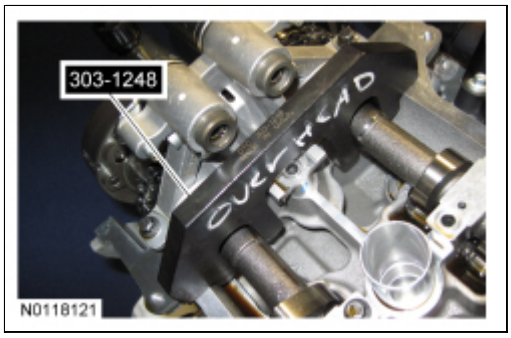


28. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

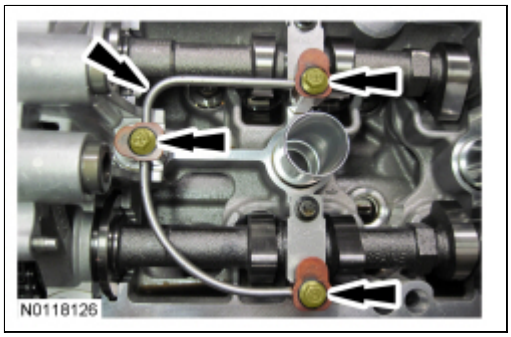


29. Remove the LH Camshaft Holding Tool.

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30. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

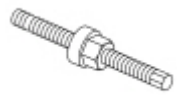


31. Install the vacuum pump. Refer to Section 206-07 .

32. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Crankshaft Front Seal

Special Tool(s)

 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)

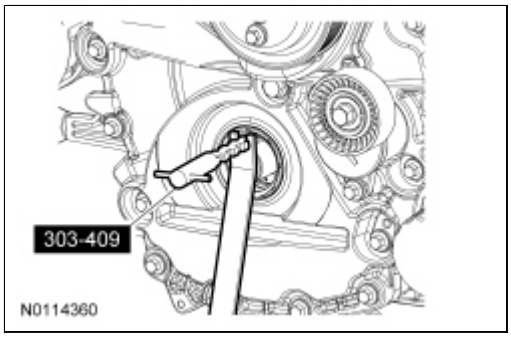
Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
3. Using the Oil Seal Remover, remove and discard the crankshaft front seal.
    - Clean all sealing surfaces with metal surface prep.

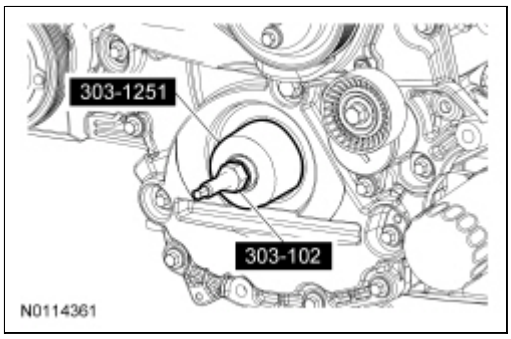
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Installation

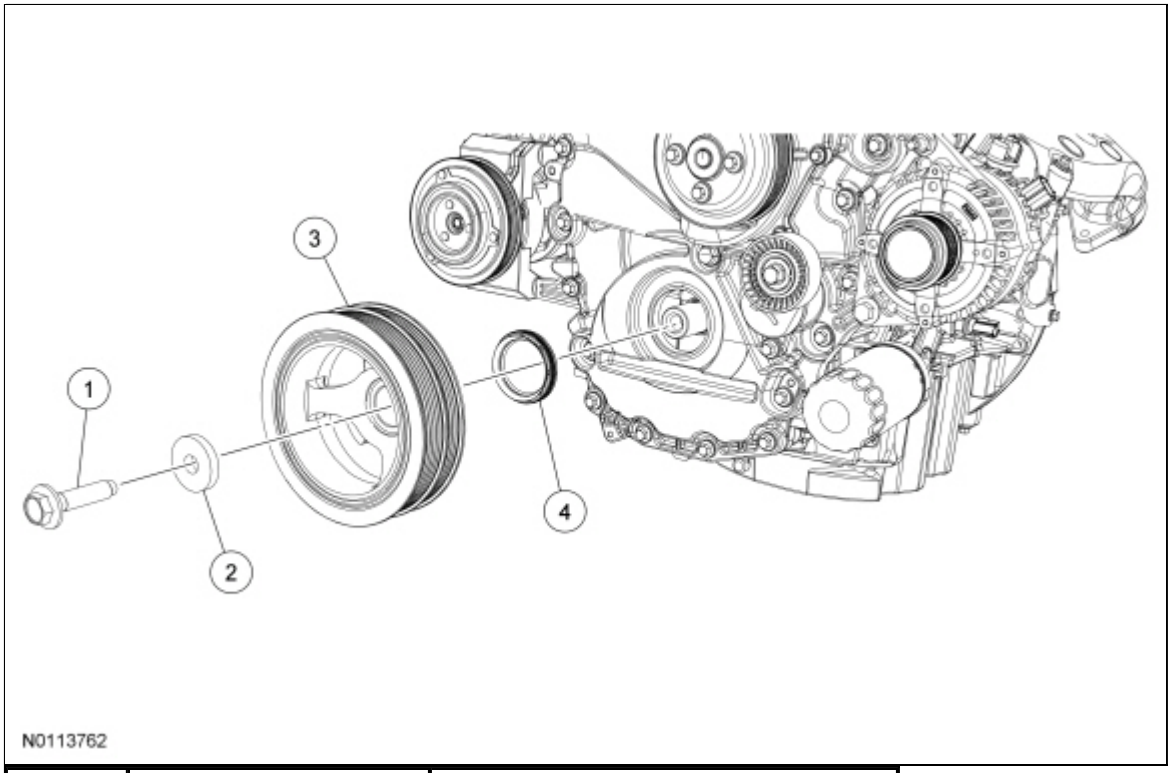
1. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

   Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Crankshaft Pulley and Crankshaft Front Seal — Exploded View



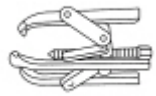
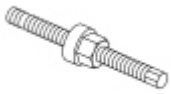
Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Washer
3	6312	Crankshaft pulley
4	6700	Crankshaft front seal

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Crankshaft Pulley

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST1287-A	Replacer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

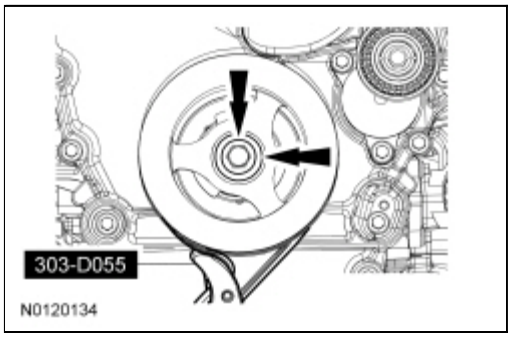
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1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

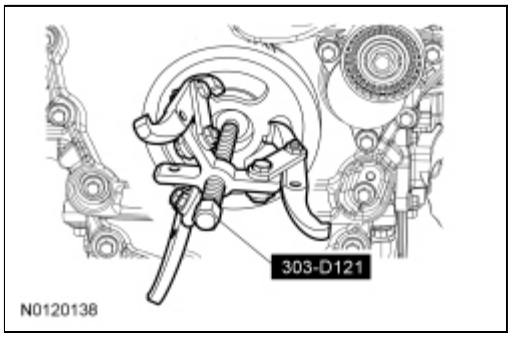
2. Remove the Air Cleaner (ACL) outlet pipe and the RH & LH ACL pipe-to-turbocharger pipes. Remove the LH turbocharger-to-Charge Air Cooler (CAC) tube and the CAC -to-Throttle Body (TB) pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .

3. Remove the accessory drive belt and the A/C belt. For additional information, refer to Section 303-05 .

4. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
   - Discard the bolt.



5. Using the 3 Jaw Puller, remove the crankshaft pulley.

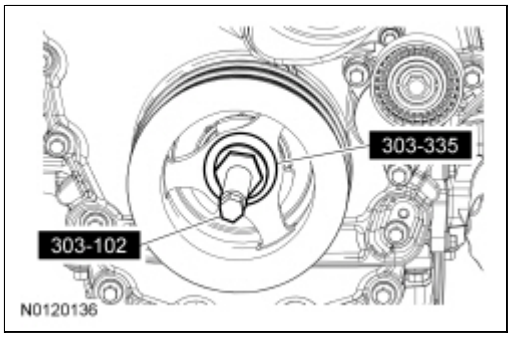


Installation

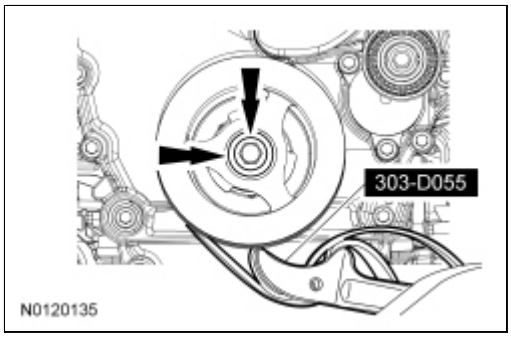
1. Lubricate the crankshaft front seal inner lip with clean engine oil.

2. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

   Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Replacer, install the crankshaft pulley.



3. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
   - Stage 1: Tighten to 120 Nm (89 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 50 Nm (37 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.



4. Install the accessory drive belt and the A/C belt. For additional information, refer to Section 303-05 .

5. Install the CAC -to- TB pipe and the LH turbocharger-to- CAC tube. Install the RH & LH ACL pipe-to-turbocharger pipes and the ACL outlet pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

6. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Crankshaft Rear Seal with Retainer Plate

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Silicone Gasket Remover ZC-30	—

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTICE: **The engine is equipped with a cast aluminum (early build) or stamped steel (late build) crankshaft rear seal retainer plate. If the engine is equipped with a stamped steel retainer plate, the seal and plate must be removed as an assembly and discarded.**

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

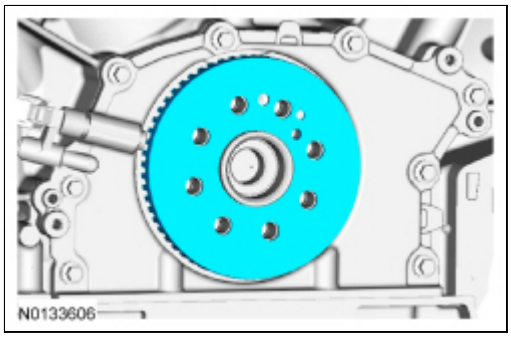
2. Remove the flexplate. Refer to Flexplate in this section.

3. **NOTE:** The engine can be equipped with a cast aluminum (early build) or stamped steel (late build) crankshaft rear seal retainer plate.

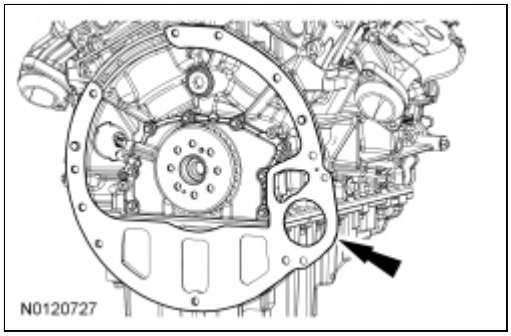
   NOTE: Cast aluminum crankshaft rear seal retainer plate shown, stamped steel crankshaft rear seal retainer plate similar.

   Remove the crankshaft sensor ring.

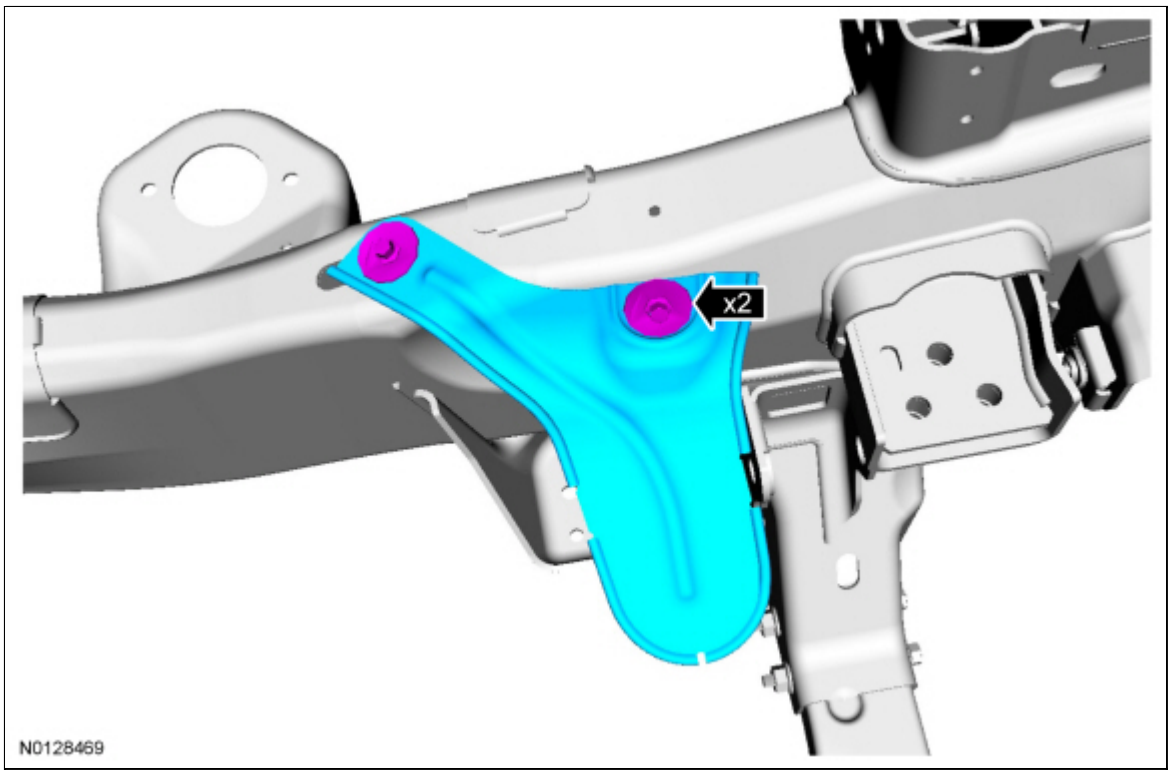
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4. Remove the engine-to-transmission spacer plate.

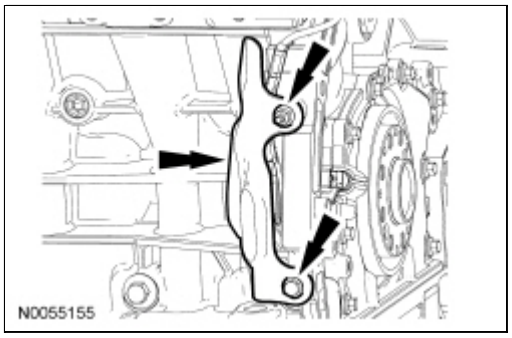


5. If equipped, remove the 2 bolts and the exhaust system heat shield.

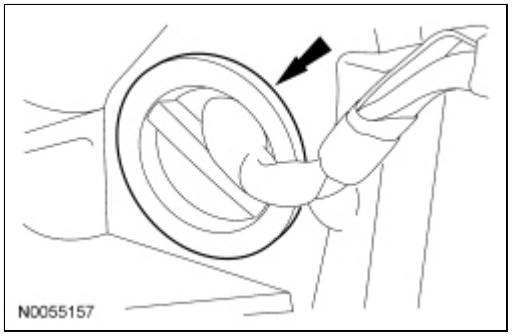


6. **NOTE:** The Crankshaft Position (CKP) heat shield is only positioned aside.

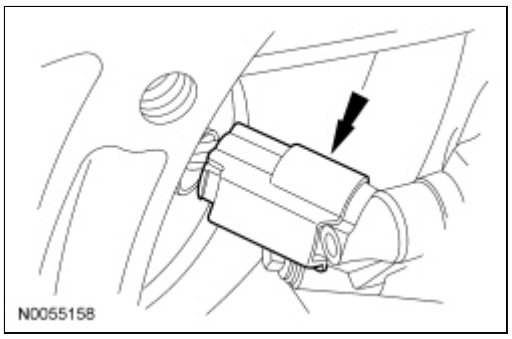
   Remove the nut and the bolt. Position the Crankshaft Position (CKP) heat shield aside.



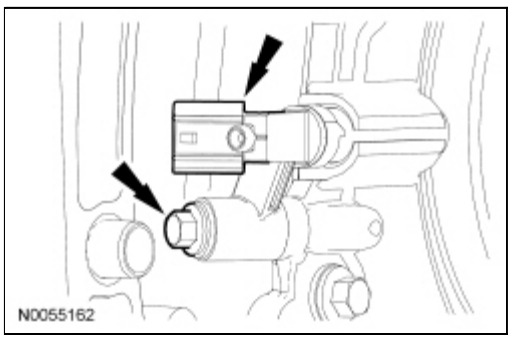
7. Remove the wiring harness grommet.



8. Disconnect the CKP sensor electrical connector.

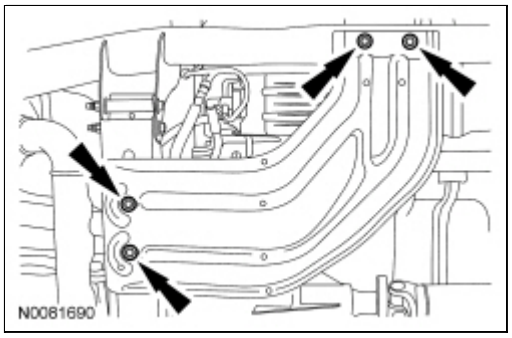


9. Remove the bolt and the CKP sensor.

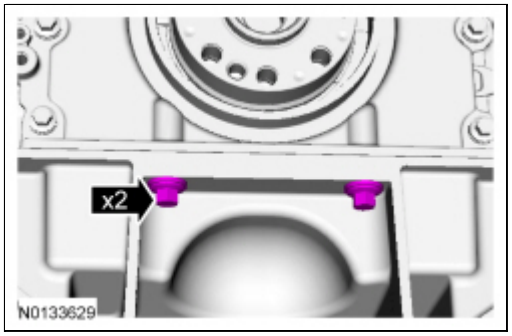


10. If equipped, remove the 4 bolts and the skid plate.

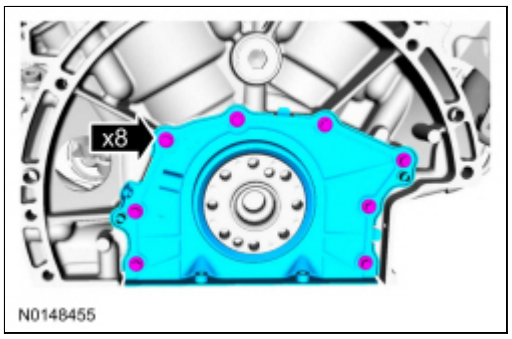
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11. Remove the 2 oil pan-to-crankshaft rear seal retainer plate bolts.



12. Remove the 8 bolts and the crankshaft rear seal retainer plate.
    - Discard the crankshaft rear seal retainer plate.



13. ***NOTICE:*** **Place clean, lint free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gaskets surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

    NOTICE: **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

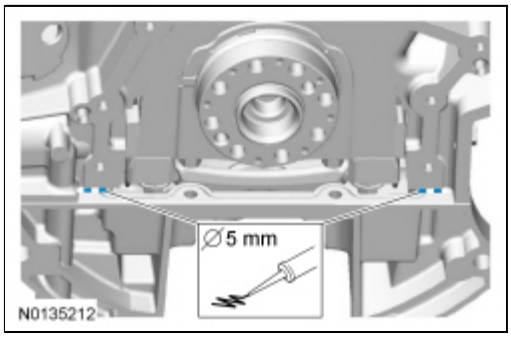
    Clean the sealing surfaces of the cylinder block and oil pan flange in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

1. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

   Apply a 5 mm (0.196 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 cylinder block/oil pan joints.

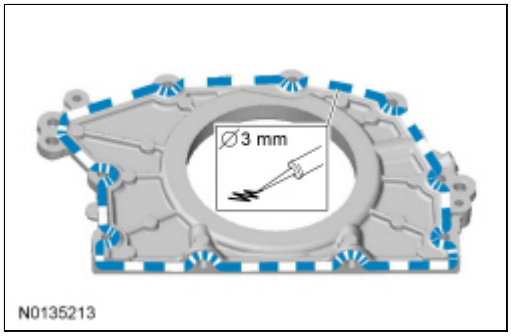


2. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

   NOTE: The stamped steel crankshaft rear seal retainer plate comes with the crankshaft rear seal.

   Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.

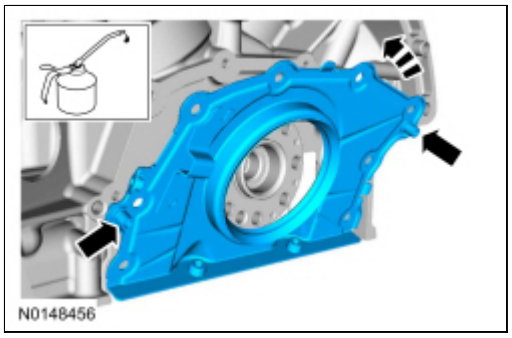


3. **NOTE:** Use the 2 handles during installation to avoid touching the sealant.

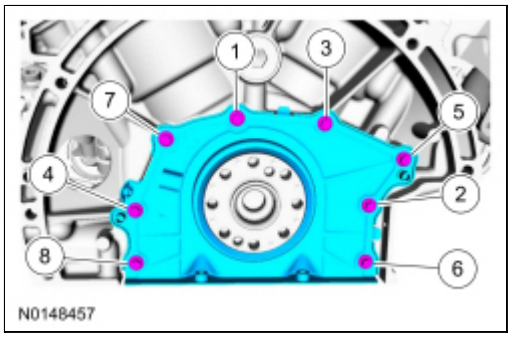
   NOTE: Lubricate the crankshaft rear seal with clean engine oil.

   Install the crankshaft rear seal retainer at an angle above the oil pan flange to avoid scraping off the sealer. Tilt the seal retainer up and onto the rear of the cylinder block.

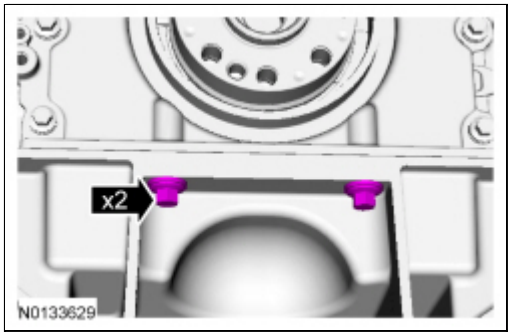
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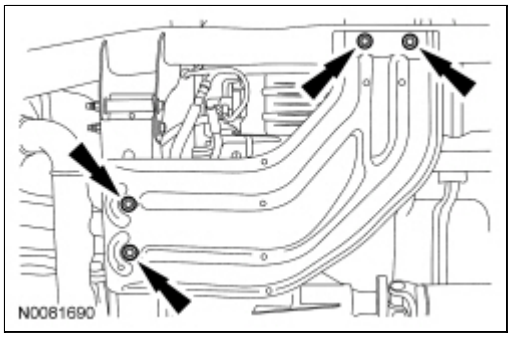
4. Install the 8 crankshaft rear seal retainer plate bolts. Tighten in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).



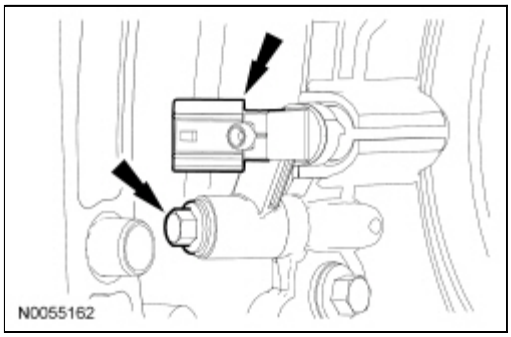
5. Install the 2 oil pan-to-crankshaft rear seal retainer plate bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.



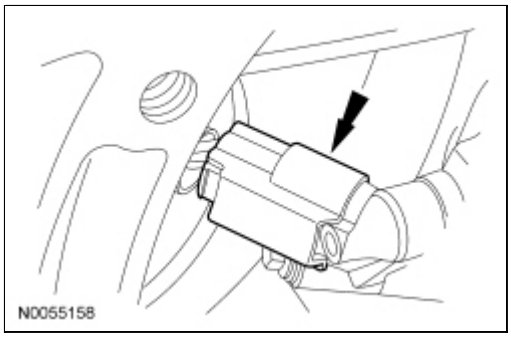
6. If equipped, install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).



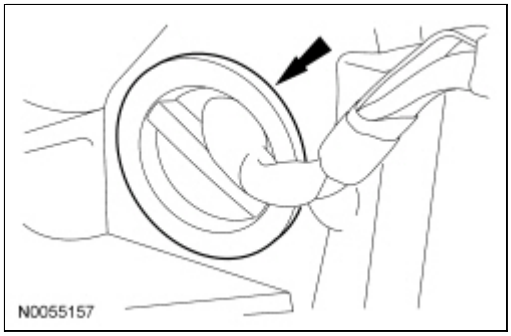
7. Install the CKP sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



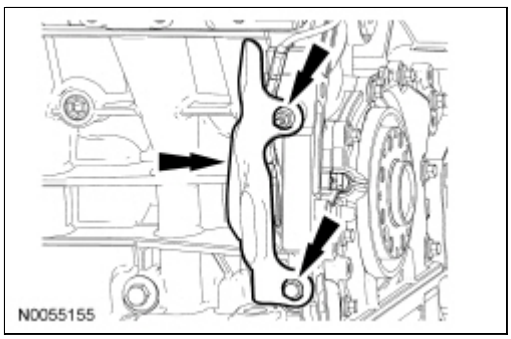
8. Connect the CKP sensor electrical connector.



9. Install the wiring harness grommet.

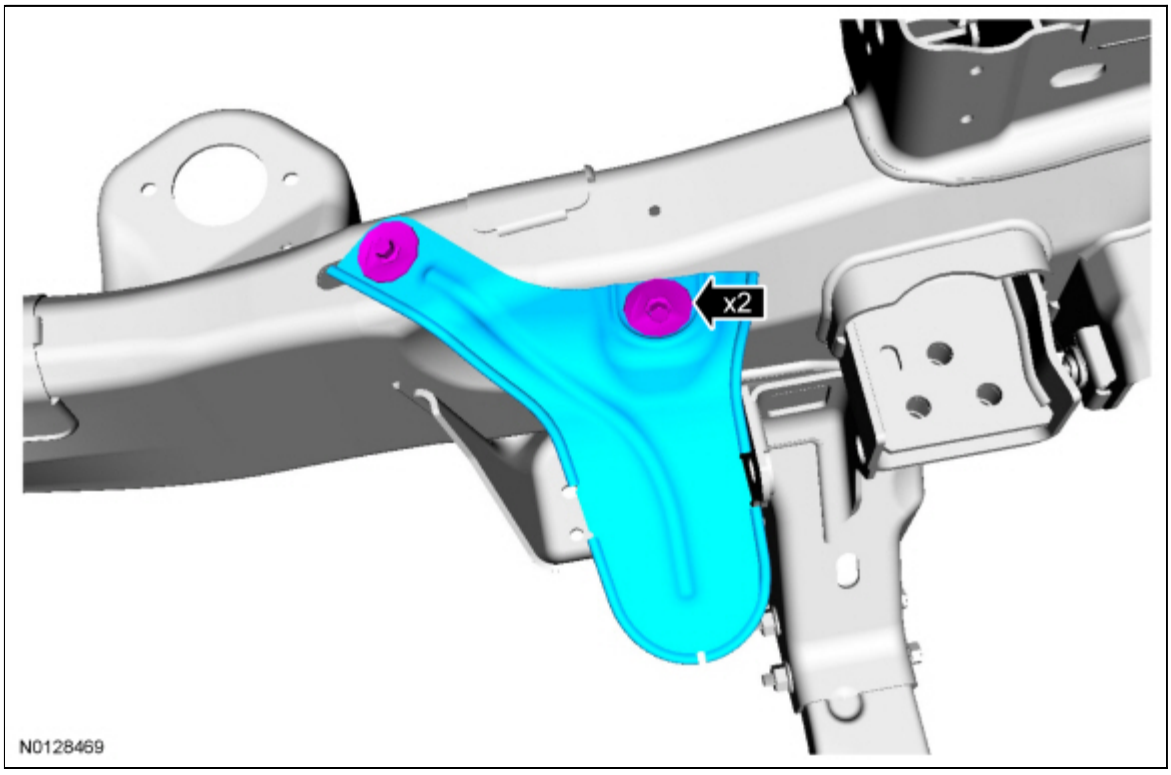


10. Position back the CKP heat shield. Install the nut and bolt.
    - Tighten to 10 Nm (89 lb-in).

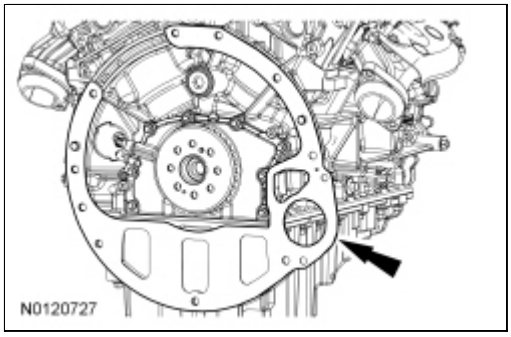


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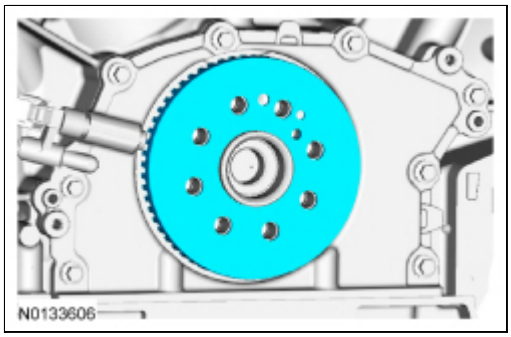
11. If equipped, install the exhaust system heat shield and the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).



12. Install the engine-to-transmission spacer plate.



13. Install the crankshaft sensor ring.



14. Install the flexplate. Refer to Flexplate in this section.

15. After completing the repairs, use the scan tool to preform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

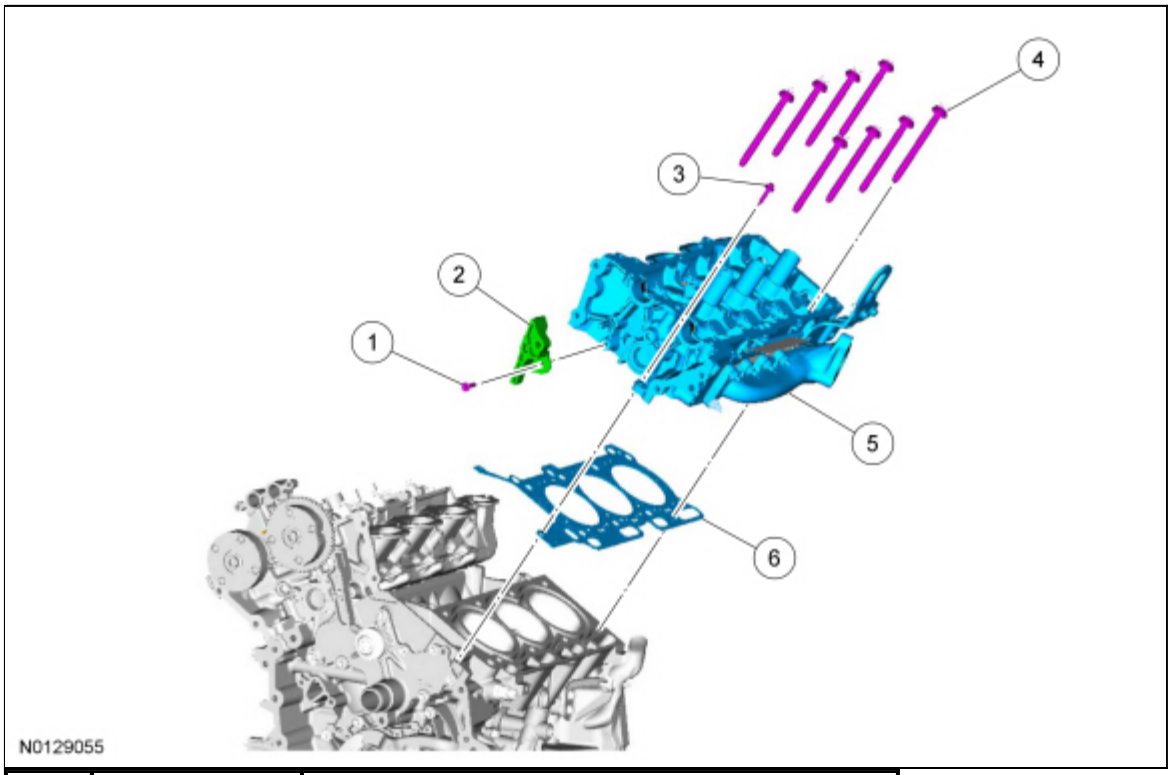
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repair4less

Cylinder Head — LH

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Silicone Gasket Remover ZC-30	—



Item	Part Number	Description
1	W709818	LH upper primary timing chain guide bolt
2	6K297	LH upper primary timing chain guide
3	W710702	Cylinder head M6 bolt
4	6065	Cylinder head bolt (8 required)

5	6049	Cylinder head
6	6051	Cylinder head gasket

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

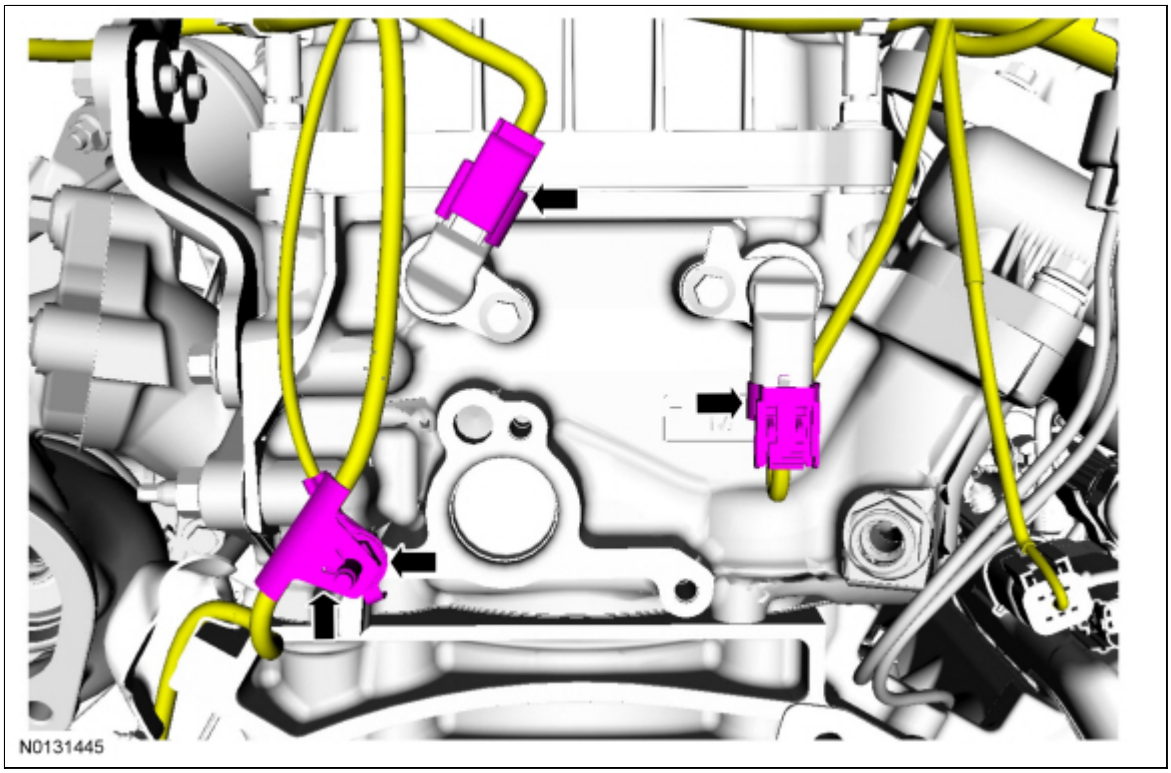
***NOTICE:* During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

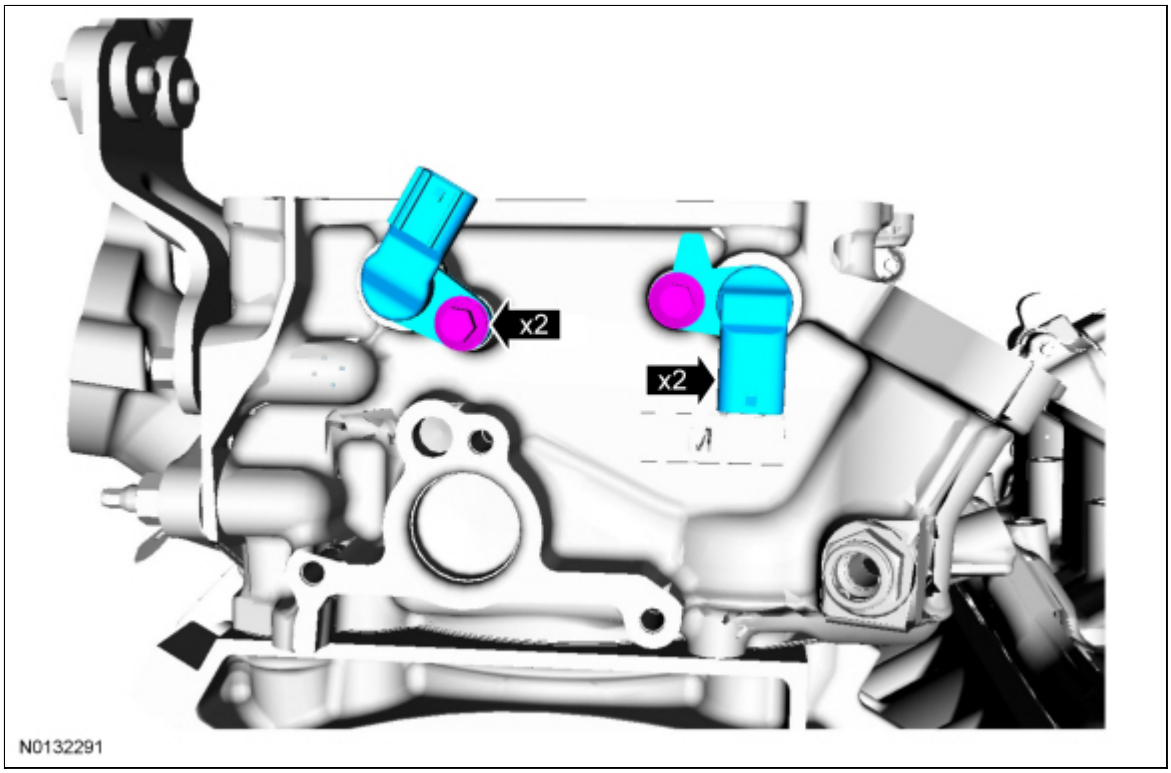
1. Release the fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the LH turbocharger. For additional information, refer to Section 303-04E .
3. Remove the LH camshafts. For additional information, refer to Camshaft — LH in this section.
4. Remove the fuel rail. For additional information, refer to Section 303-04A .
5. ***NOTICE:* Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.**

   Remove the bolt and the LH upper primary timing chain guide.
6. Disconnect the 2 LH Camshaft Position (CMP) sensor electrical connectors. Position back the Crankshaft Position (CKP) wire retainer. Remove the ground stud bolt.

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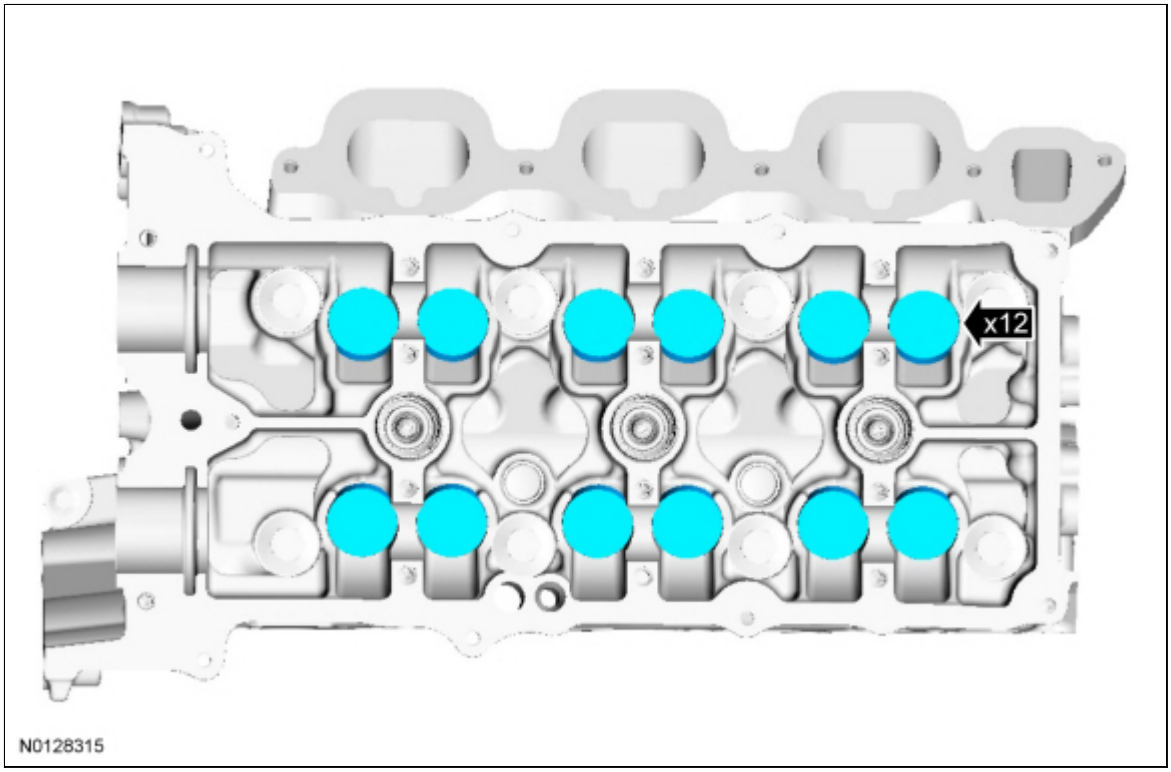


7. Remove the 2 bolts and the 2 LH CMP sensors.

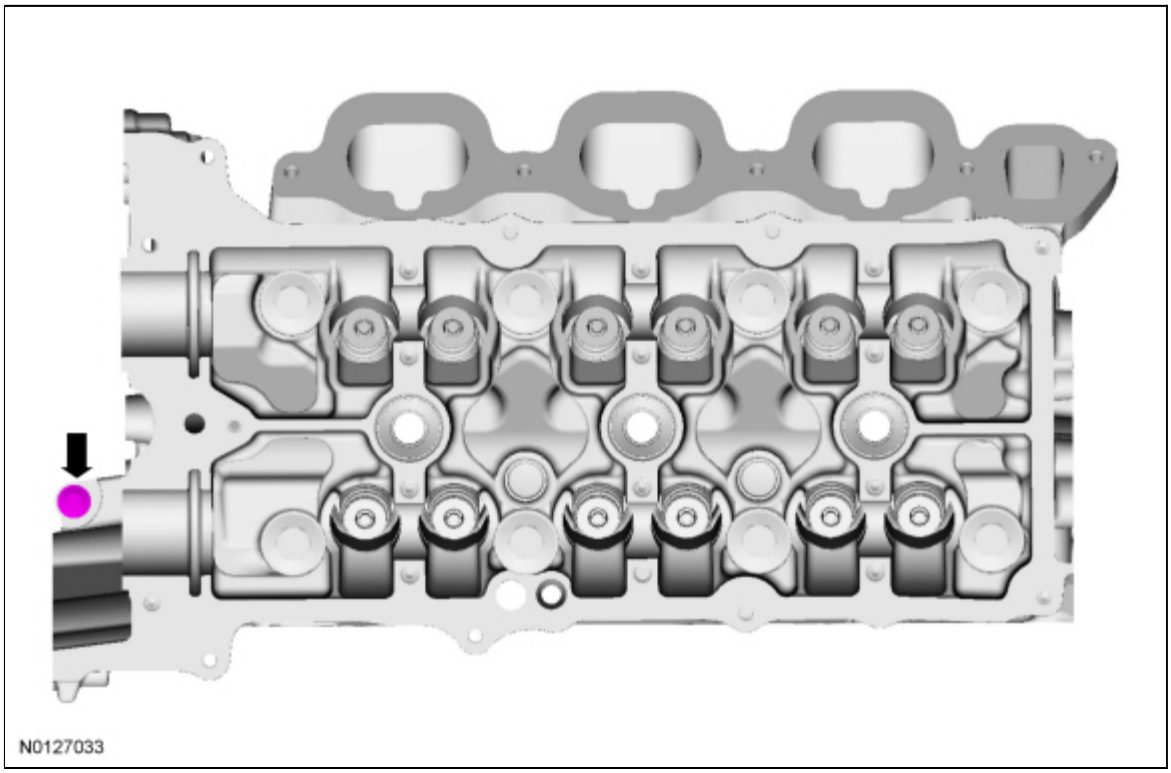


8. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original positions.

Remove the valve tappets form the cylinder head.



9. Inspect the valve tappets. For additional information, refer to Section 303-00 .
10. Remove and discard the M6 bolt.



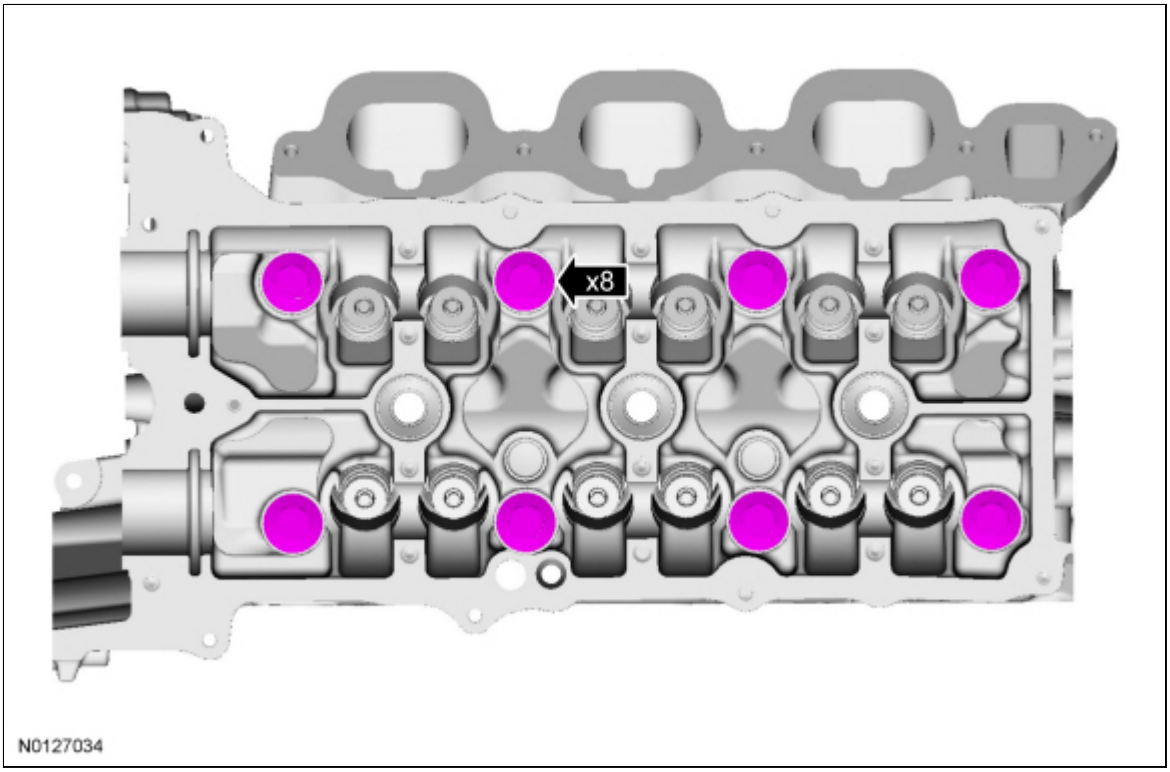
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11. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure**

    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove and discard the 8 bolts from the cylinder head.
    - Remove the cylinder head.
    - Discard the cylinder head gasket.



12. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone

gasket remover may be required if residual traces of silicone or gasket material remain.

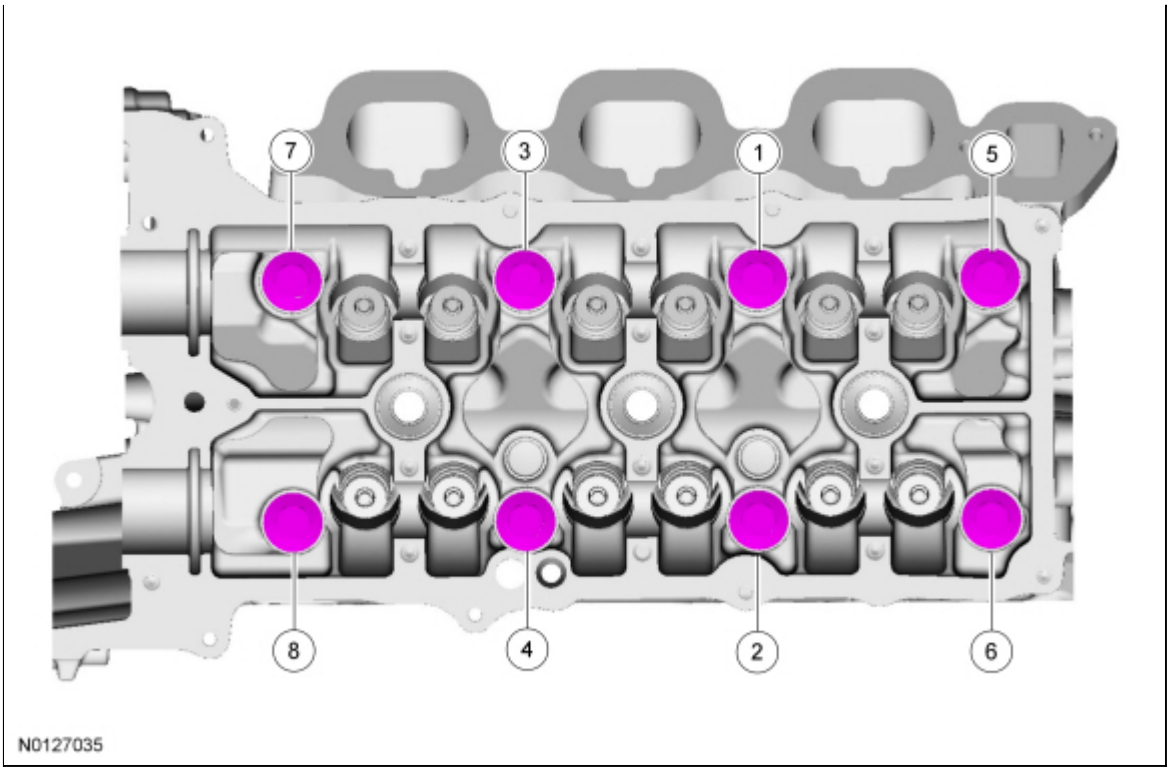
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal

13. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Installation

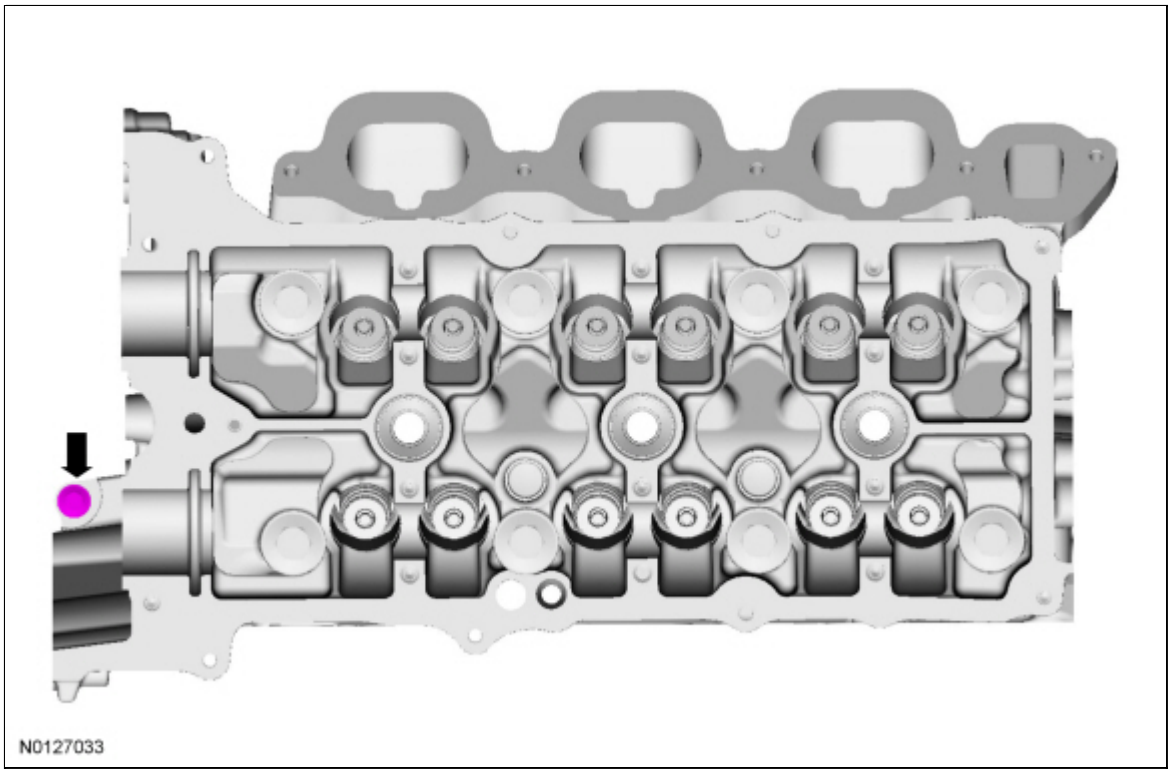
1. **NOTE:** If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

   Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 35 Nm (26 lb-ft).
   - Stage 3: Tighten 90 degrees.
   - Stage 4: Tighten 90 degrees
   - Stage 5: Tighten 45 degrees.



2. Install the new M6 bolt.
   - Tighten to 10 Nm (89 lb-in).

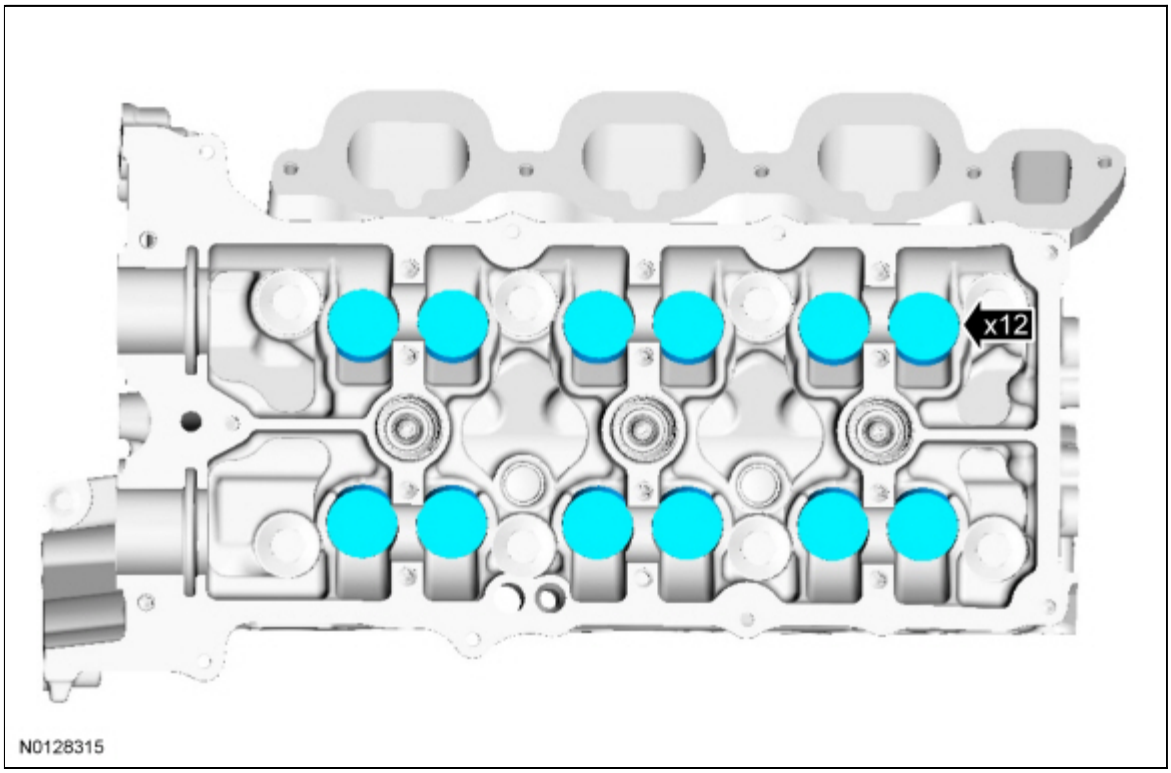
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3. **NOTE:** The valve tappets must be installed in their original positions.

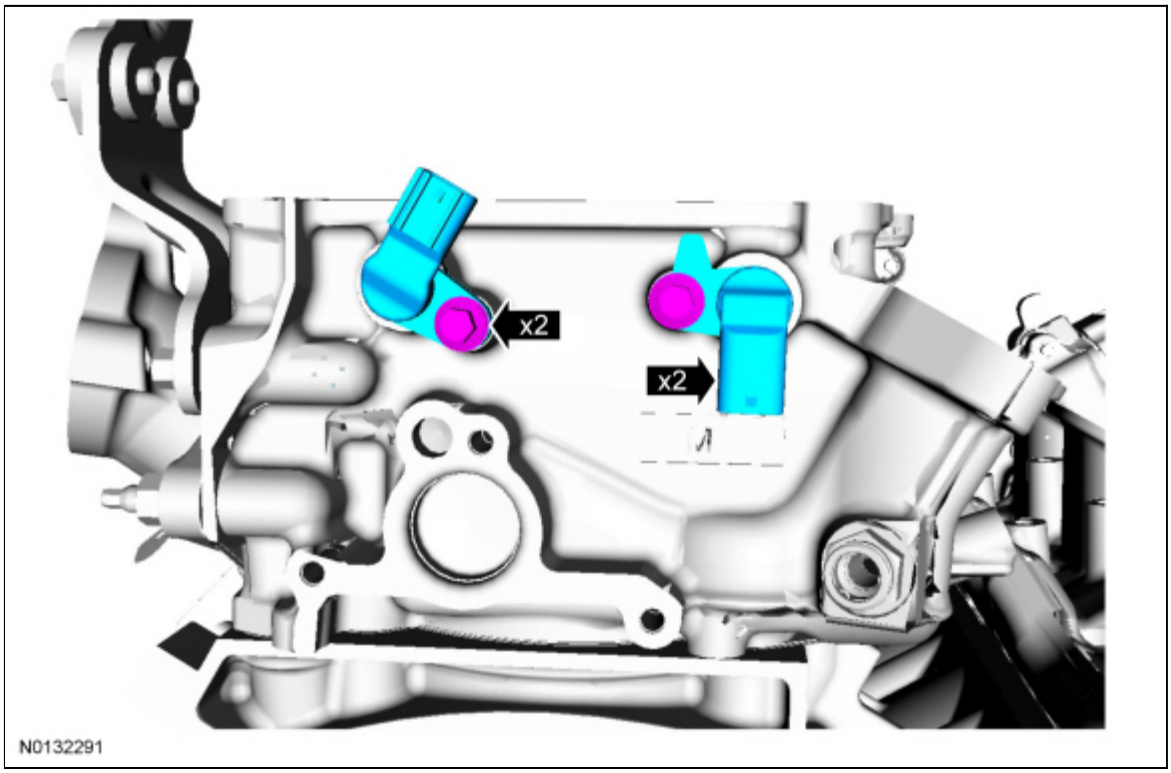
   NOTE: Coat the valve tappets with clean engine oil prior to installation.

   Install the valve tappets.



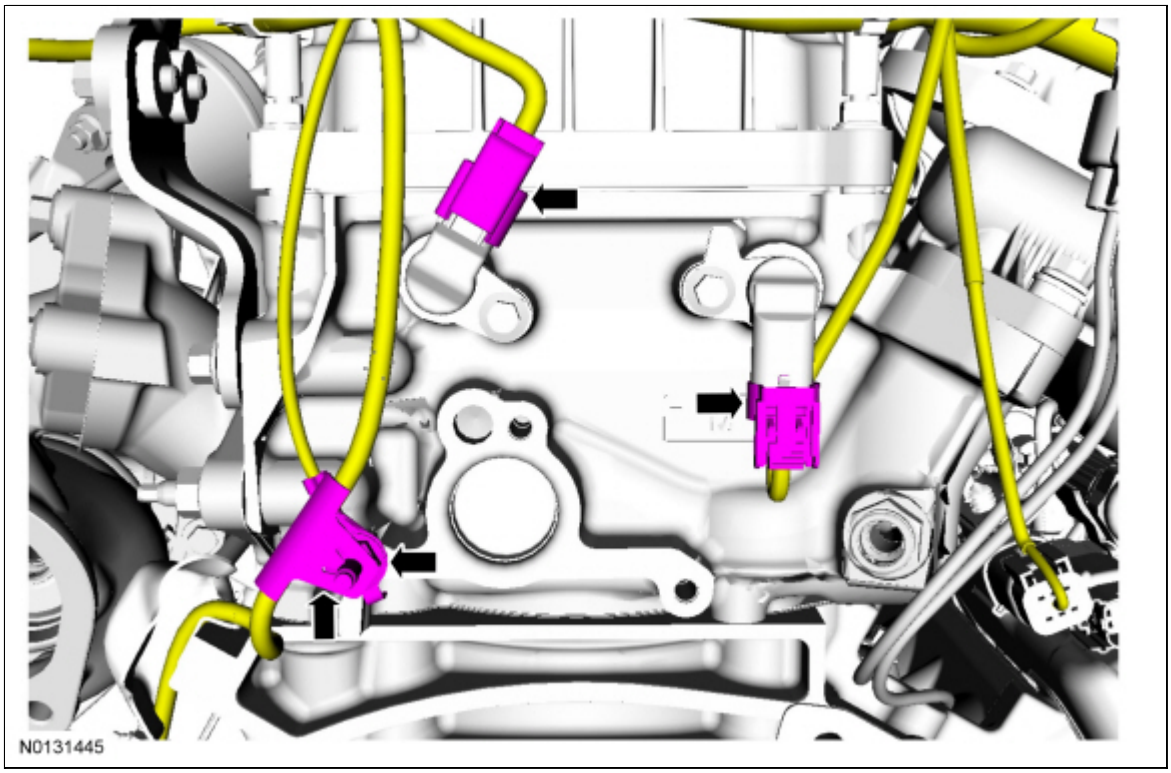
4. **NOTE:** Lubricate the 2 CMP sensor O-ring seals with clean engine oil.

   Install the 2 LH CMP sensors and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



5. Install the ground stud bolt. Position back the CKP wire retainer. Connect the 2 LH CMP sensor electrical connectors.
   - Tighten to 10 Nm (89 lb-in) then an additional 45 degrees.

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6. Install the LH upper primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

7. Install the fuel rail. For additional information, refer to Section 303-04A .

8. Install the LH camshafts. For additional information, refer to Camshaft — LH in this section.

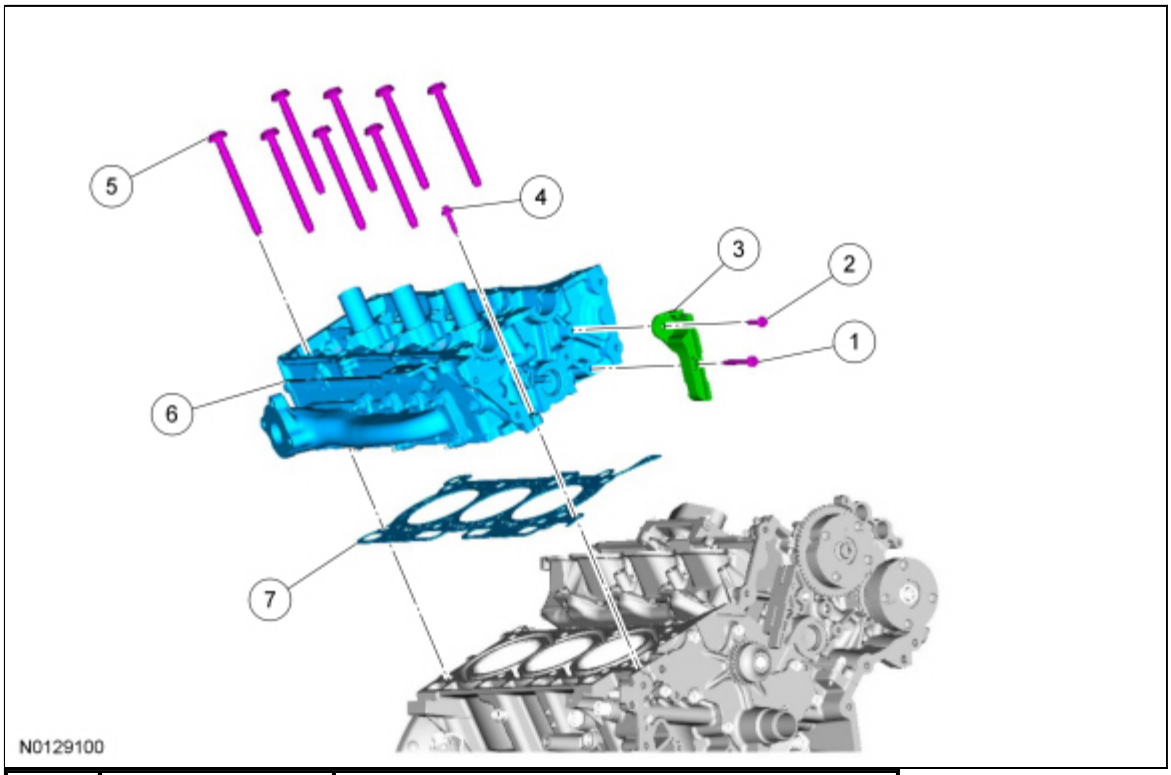
9. Install the LH turbocharger. For additional information, refer to Section 303-04E .

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Cylinder Head — RH

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Silicone Gasket Remover ZC-30	—



Item	Part Number	Description
1	W715145	RH primary timing chain guide bolt
2	W715118	RH primary timing chain guide bolt
3	6K297	RH primary timing chain guide
4	W710702	Cylinder head M6 bolt

5	6065	Cylinder head bolt (8 required)
6	6049	Cylinder head
7	6051	Cylinder head gasket

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

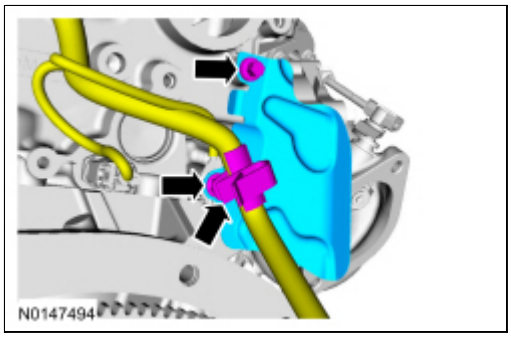
***NOTICE:* During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

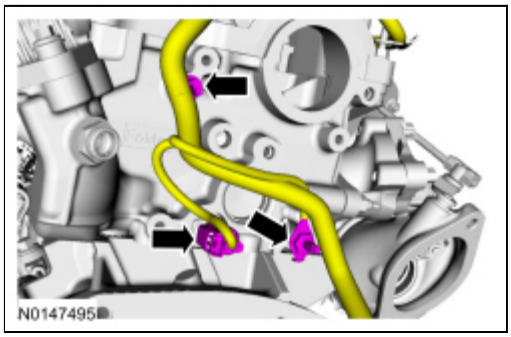
1. Release the fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the RH turbocharger. For additional information, refer to Section 303-04E .
3. Remove the RH camshafts. For additional information, refer to Camshaft — RH in this section.
4. Remove the fuel rail. For additional information, refer to Section 303-04A .
5. ***NOTICE:* Do not use power tools to remove the bolts or damage to the RH primary timing chain guide may occur.**

   Remove the 2 bolts and the RH upper primary timing chain guide.
6. Disconnect the wire retainer. Remove the nut, bolt and the CMP heat shield.

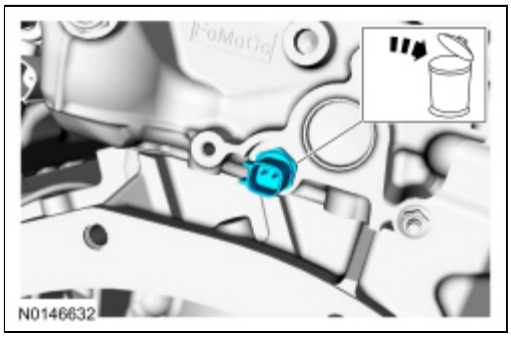
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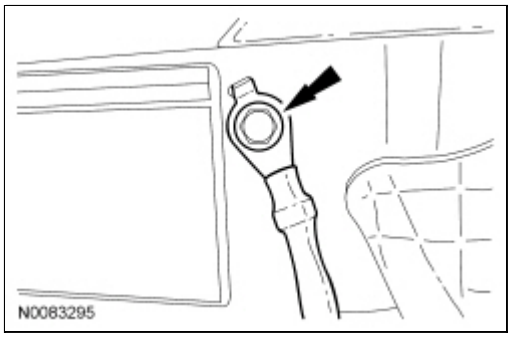
7. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector. Remove the ground stud bolt and the tie strap.



8. Remove and discard CHT sensor.

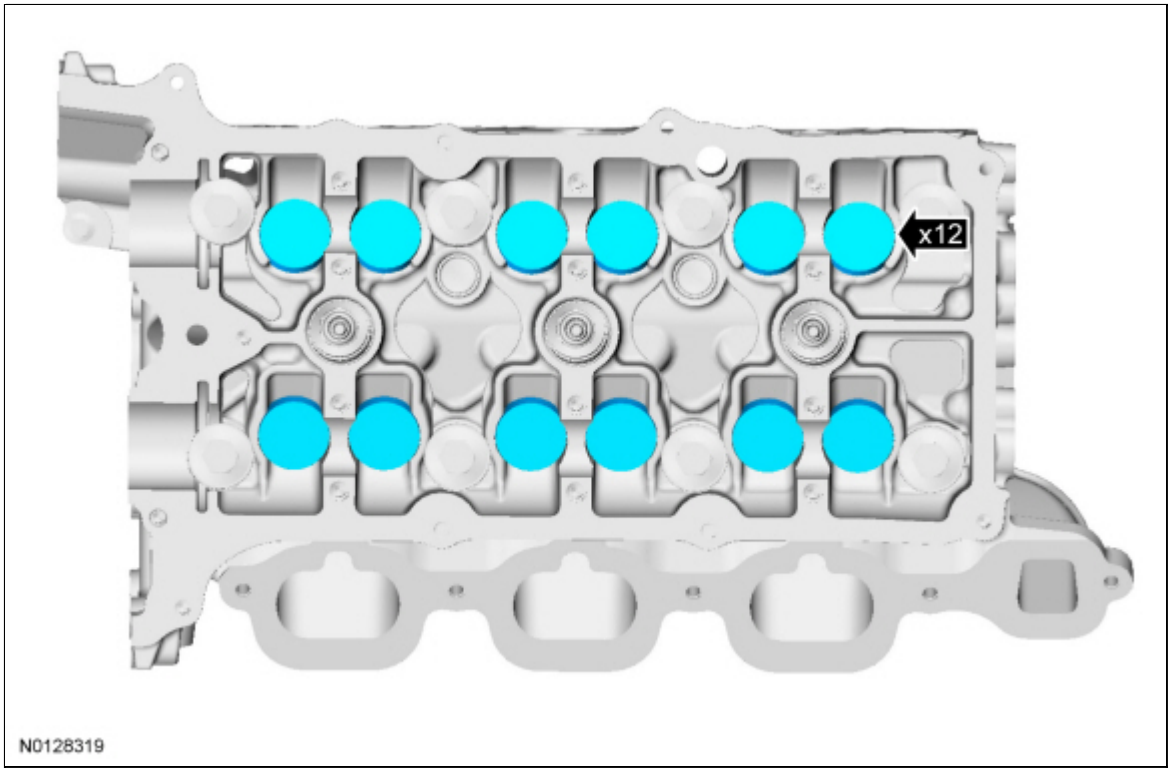


9. Remove the bolt and position aside the ground strap.



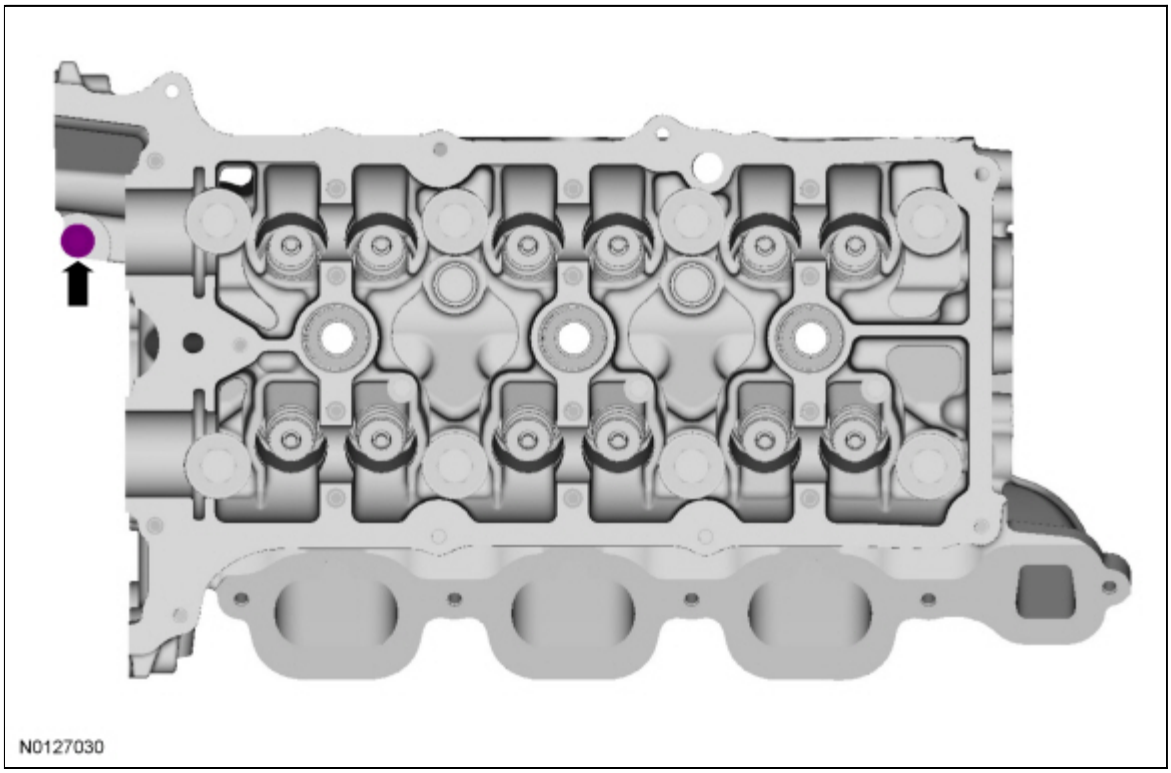
10. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original positions.

Remove the valve tappets form the cylinder head.



11. Inspect the valve tappets. For additional information, refer to Section 303-00 .

12. Remove and discard the M6 bolt.



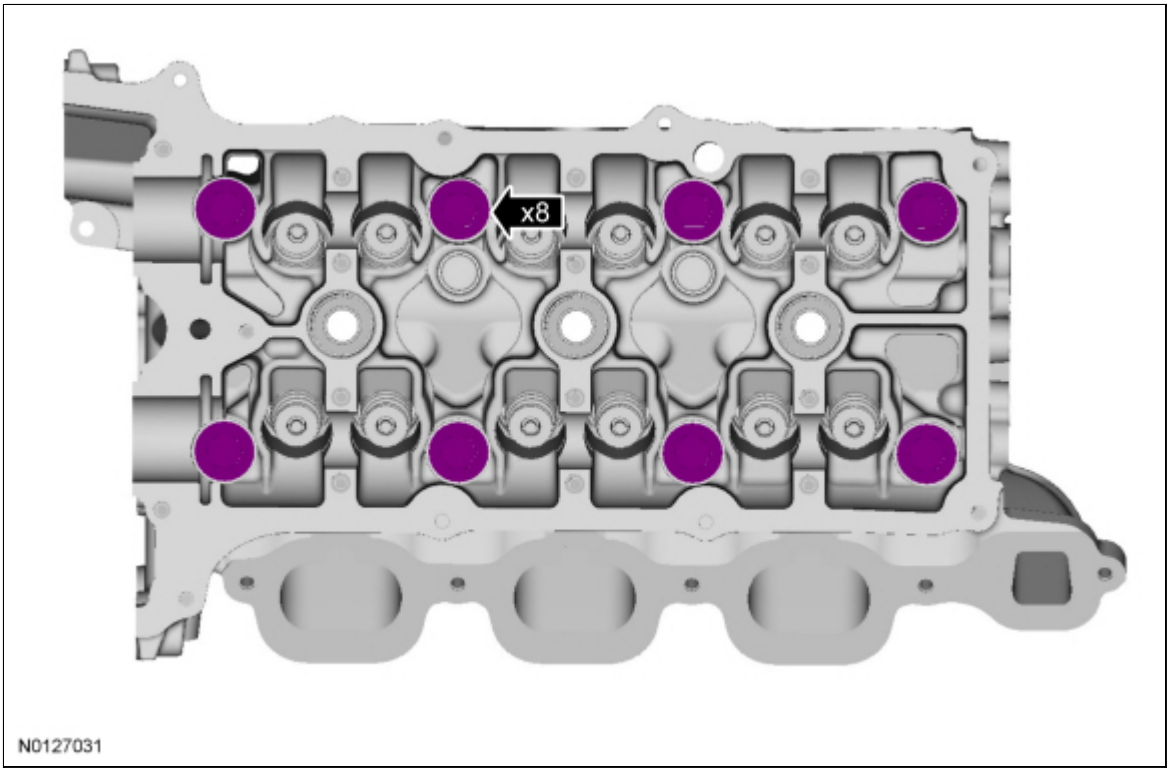
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13. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure**

    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove and discard the 8 bolts from the cylinder head.
    - Remove the cylinder head.
    - Discard the cylinder head gasket.



14. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone

gasket remover may be required if residual traces of silicone or gasket material remain.

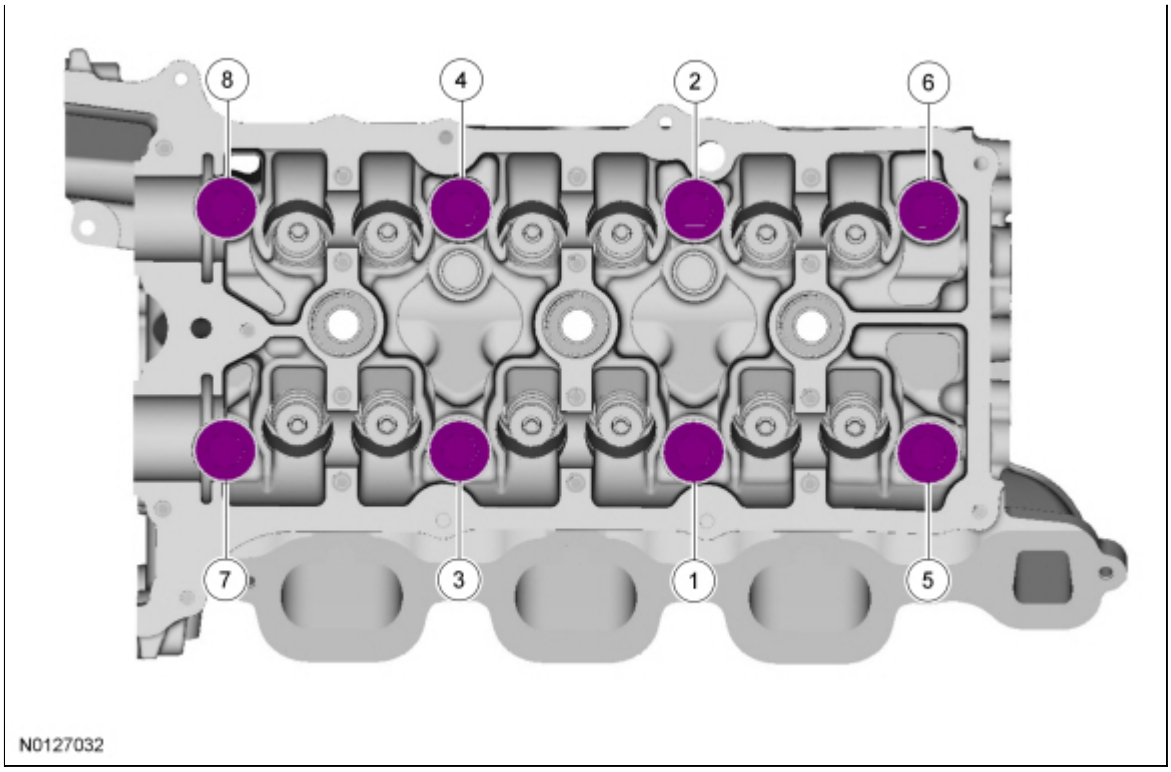
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal

15. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Installation

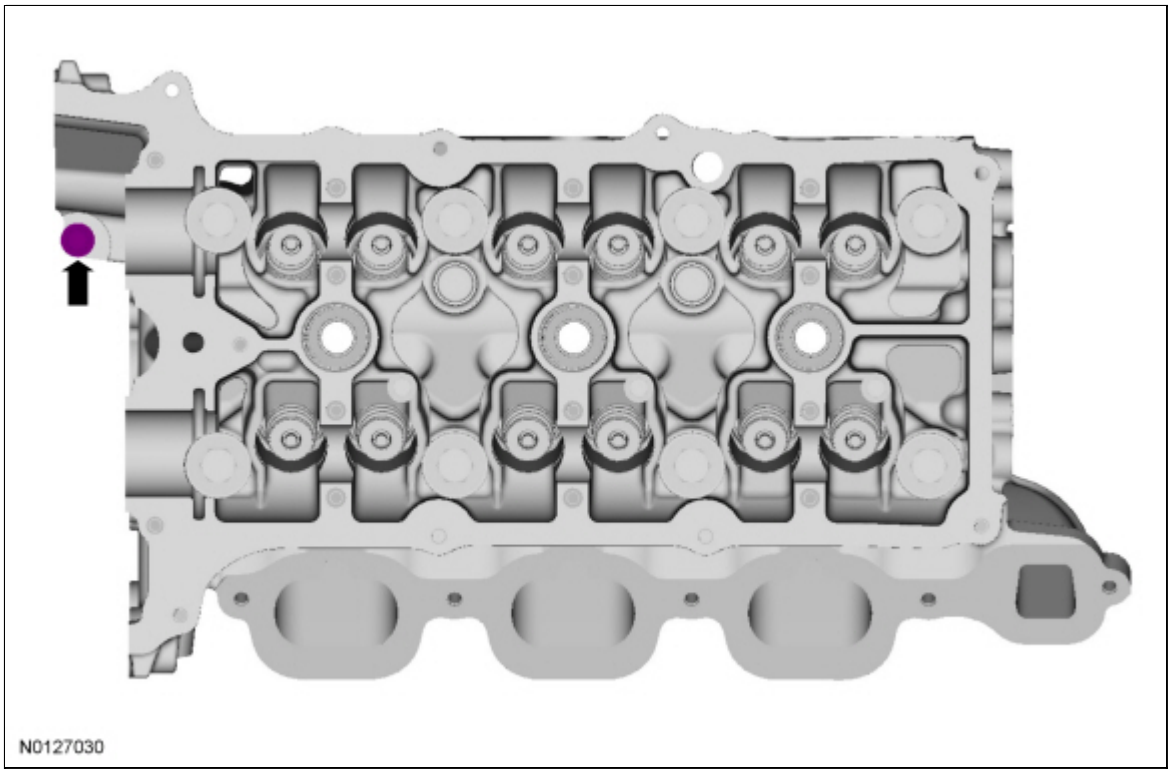
1. **NOTE:** If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

   Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 35 Nm (26 lb-ft).
   - Stage 3: Tighten 90 degrees.
   - Stage 4: Tighten 90 degrees
   - Stage 5: Tighten 45 degrees.



2. Install the new M6 bolt.
   - Tighten to 10 Nm (89 lb-in).

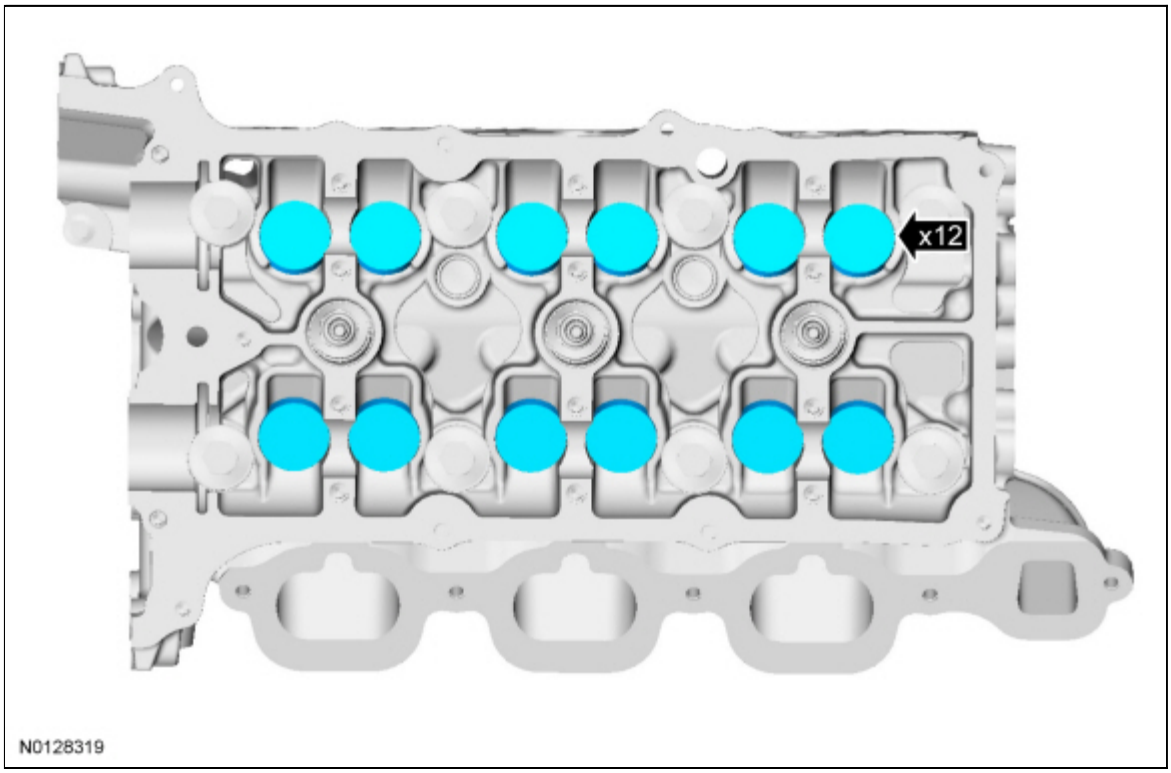
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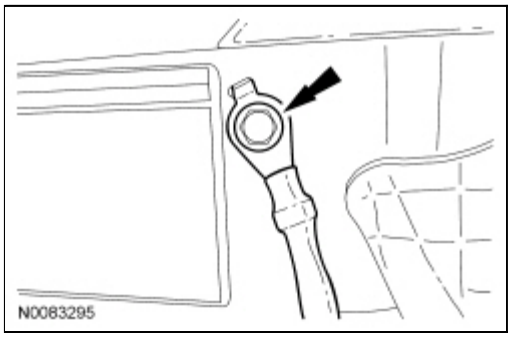
3. **NOTE:** The valve tappets must be installed in their original positions.

   NOTE: Coat the valve tappets with clean engine oil prior to installation.

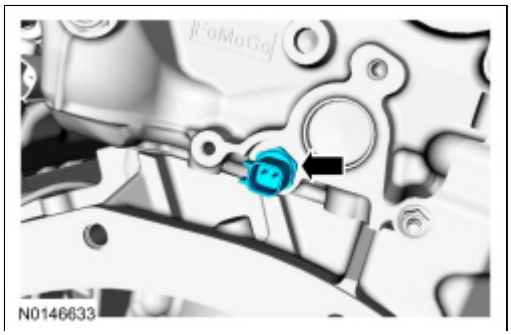
   Install the valve tappets.



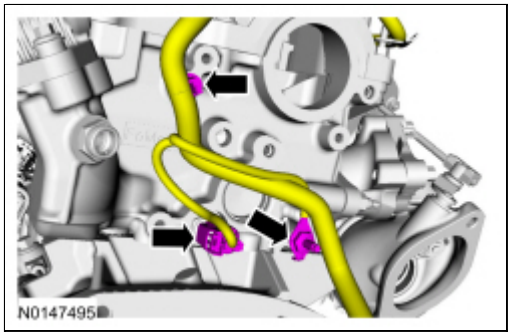
4. Position back the ground strap and install the bolt.
    - Tighten to 10 Nm (89 lb-in).



5. Install a new CHT sensor.
    - Tighten to 11 Nm (97 lb-in).

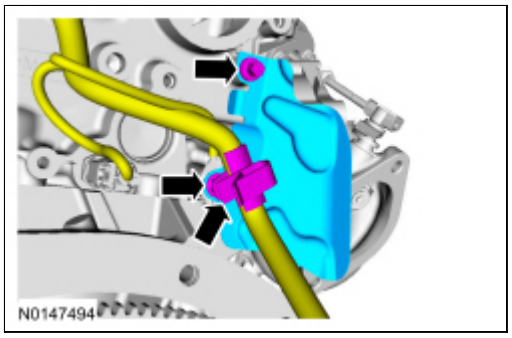


6. Install the ground stud bolt and the tie strap. Connect the CHT sensor electrical connector.
    - Tighten to 10 Nm (89 lb-in) then an additional 45 degrees.



7. Install the CMP heat shield, nut and the bolt. Connect the wire retainer.
    - Tighten the bolt to 10 Nm (89 lb-in).
    - Tighten the nut to 10 Nm (89 lb-in).

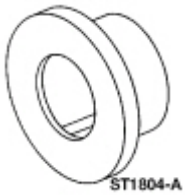
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8. Install the RH upper primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
9. Install the fuel rail. For additional information, refer to Section 303-04A .
10. Install the RH camshafts. For additional information, refer to Camshaft — RH in this section.
11. Install the RH turbocharger. For additional information, refer to Section 303-04E .

Engine Front Cover

Special Tool(s)

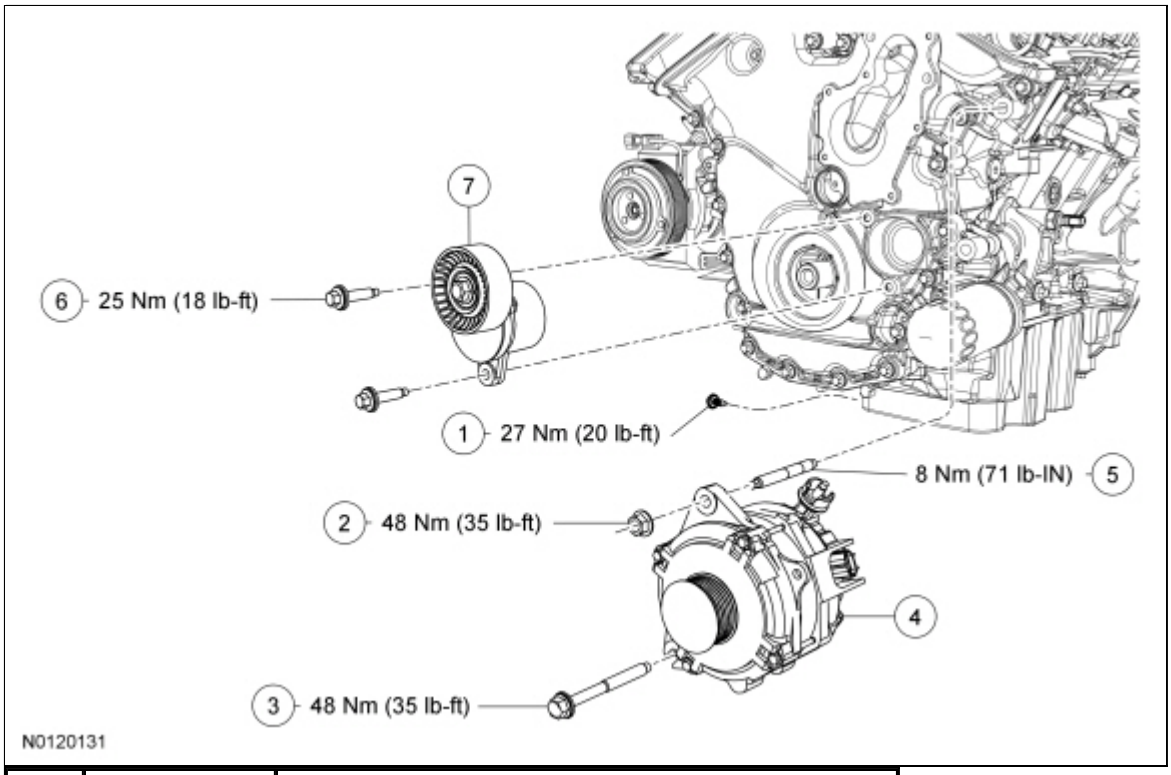
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1804-A	Installer, Spindle Bearing 205-149 (T80T-4000-R)
 ST2240-A	Installer, Spindle Bearing 205-150 (T80T-4000-S)

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Silicone Gasket Remover ZC-30	—

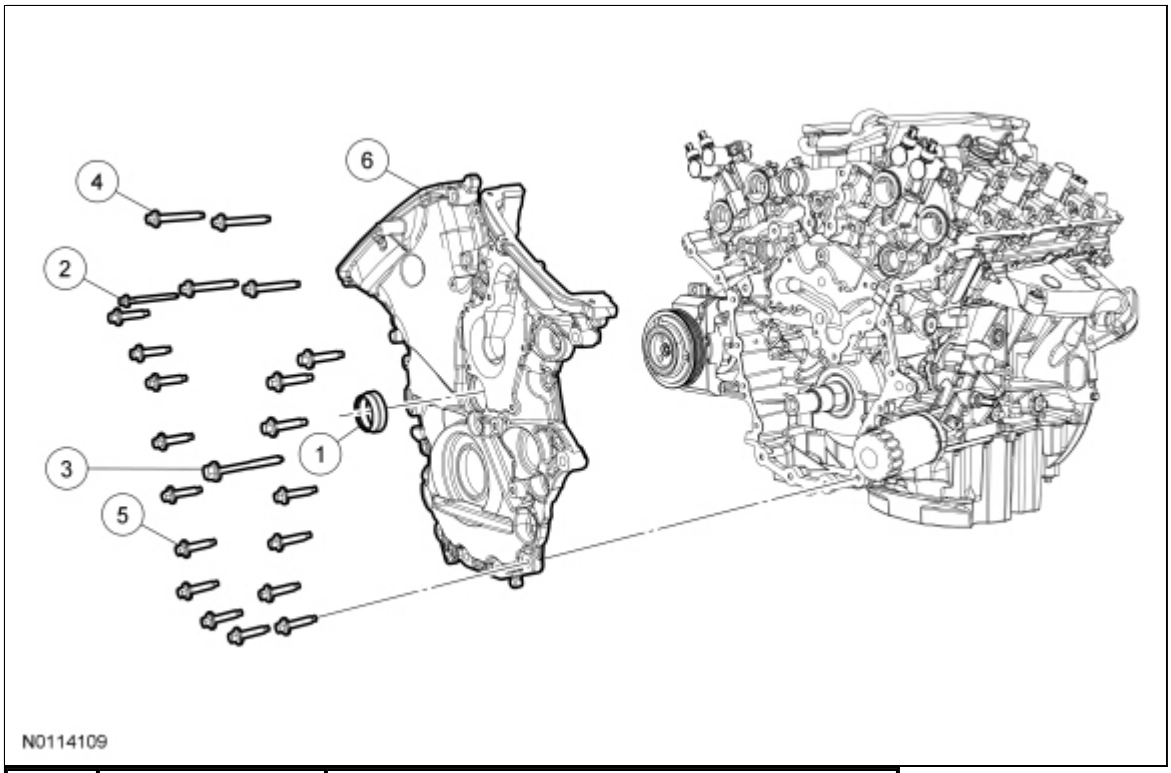
NOTE: Engine Front Cover (View 1 of 2)

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Item	Part Number	Description
1	6730	Oil pan drain plug.
2	W520414	Generator nut
3	W714577	Generator bolt
4	10346	Generator
5	W714329	Generator stud
6	W713261	Accessory drive belt tensioner bolt (2 required)
7	6B209	Accessory drive belt tensioner

NOTE: Engine Front Cover (View 2 of 2)



Item	Part Number	Description
1	6020	Front cover radial seal
2	W503285	Engine front cover bolt
3	W714662	Engine front cover bolt
4	W503301	Engine front cover bolt (4 required)
5	W503297	Engine front cover bolt (16 required)
6	6019	Engine front cover

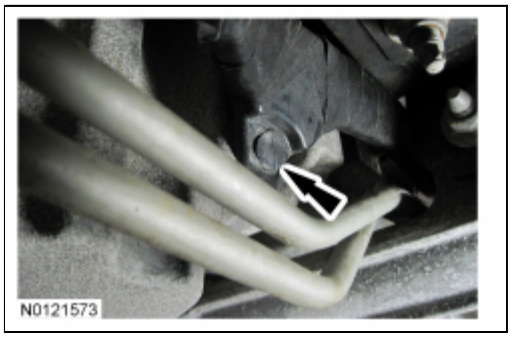
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

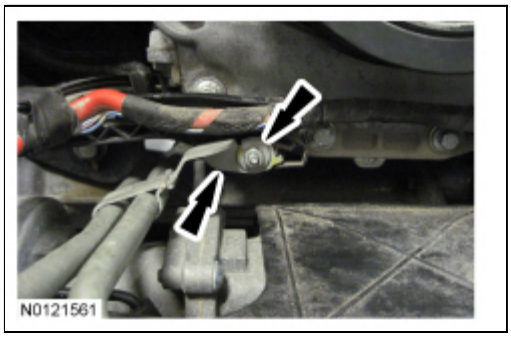
1. Release the fuel pressure. Refer to Section 310-00 .
2. Remove the Charge Air Cooler (CAC)-to-Throttle Body (TB) pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L in Section 303-12 .
3. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
4. Remove the LH and RH valve covers. For additional information, refer to Valve Cover — LH and Valve Cover — RH in this section.
5. Remove the drain plug and drain the engine oil.
   - Install the drain plug and tighten to 27 Nm (20 lb-ft).
6. Remove the coolant pump. For additional information, refer to Section 303-03 .

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7. Remove the bolt and position the generator aside.
8. Remove the generator stud.
9. Remove the 2 bolts and the accessory drive belt tensioner.
10. Remove the crankshaft front seal. For additional information, refer to Crankshaft Front Seal in this section.
11. Remove the pushpin retainer from the oil pan.



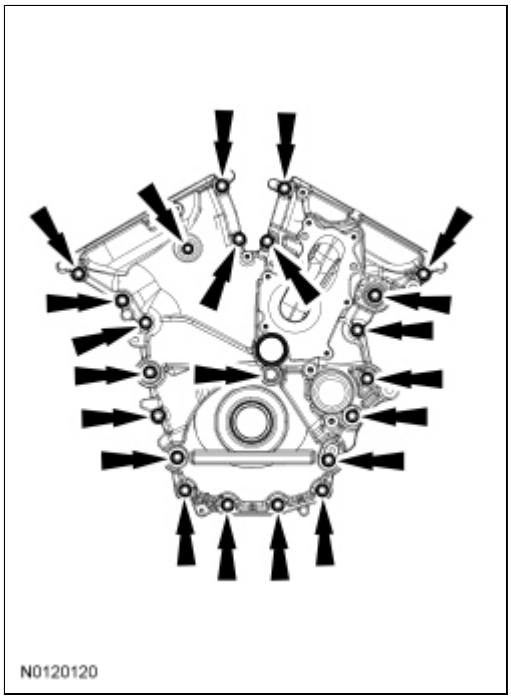
12. Remove the nut and the transmission cooler tube bracket from the engine front cover stud bolt.



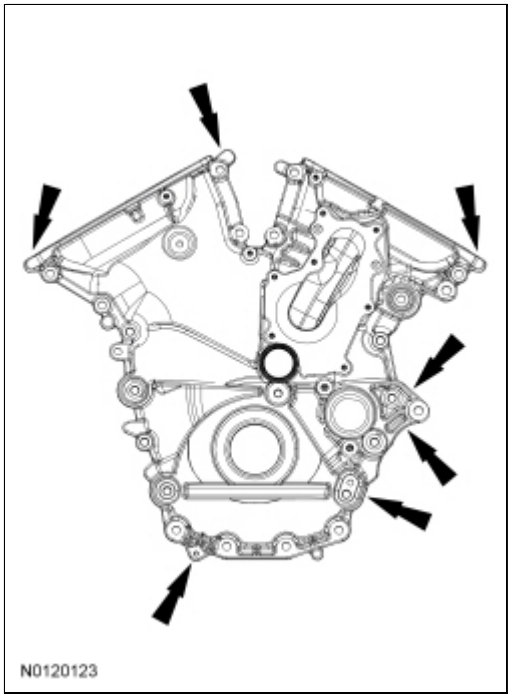
13. Disconnect the generator wiring harness from the engine front cover and the stud bolt.



14. Remove the 22 engine front cover bolts.



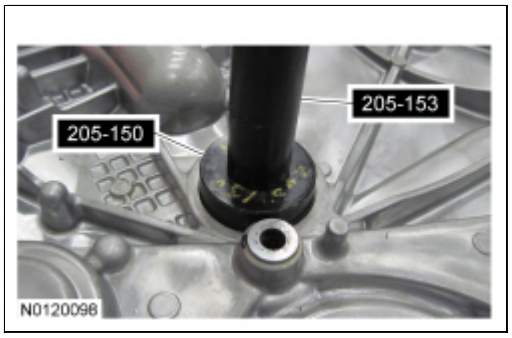
15. Using a suitable pry tool, locate the 7 pry pads shown and pry the engine front cover loose and remove.



16. **NOTE:** Inspect and replace the front cover radial seal as necessary.

    Using the Spindle Bearing Installer and Handle, remove the front cover radial seal from the rear side of the front cover.

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Installation

1. ***NOTICE:*** **Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean. These tools cause scratches and gouges that make leak paths.**

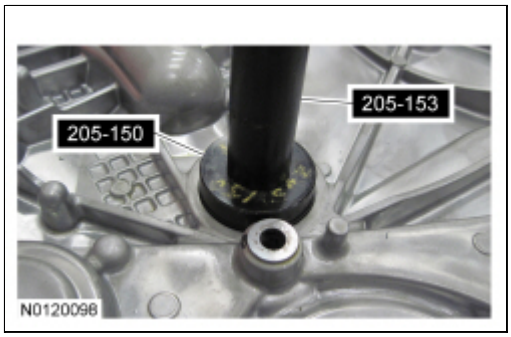
   Clean the engine front cover using 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.
   - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

2. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan may cause engine failure.**

   NOTICE: **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. These tools cause contamination that can cause premature engine failure. Remove all traces of sealant, including any sealant from the inner surface of the cylinder block and cylinder head.**

   Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.
   1. Remove any large deposits of silicone or gasket material.
   2. Apply silicone gasket remover and allow to sit for several minutes.
   3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
   4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
   5. Make sure the 2 locating pins are seated correctly in the cylinder block.

3. Using the Spindle Bearing Installer, install a new front cover radial seal from the rear side of the front cover.



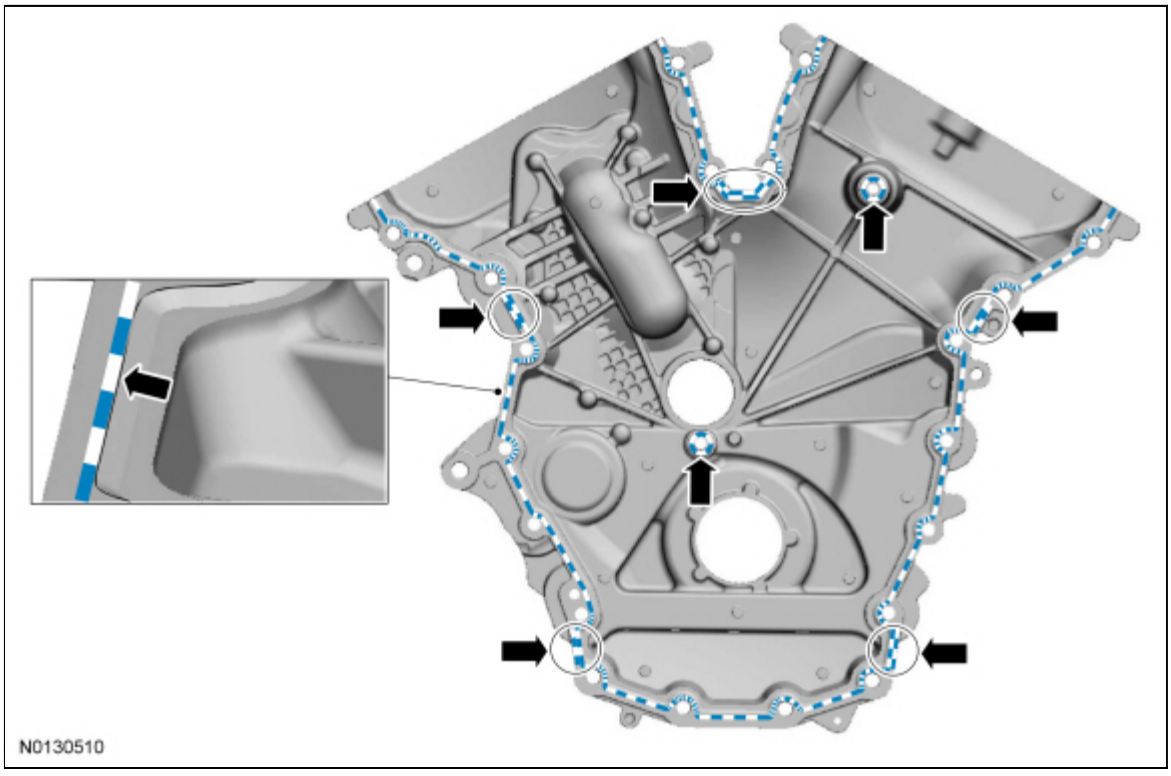
4. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTICE: **Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this procedure can cause engine oil leakage.**

   NOTE: The engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 must be installed within 10 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the engine front cover to the engine front cover sealing surfaces including the 2 engine front cover bolt bosses.

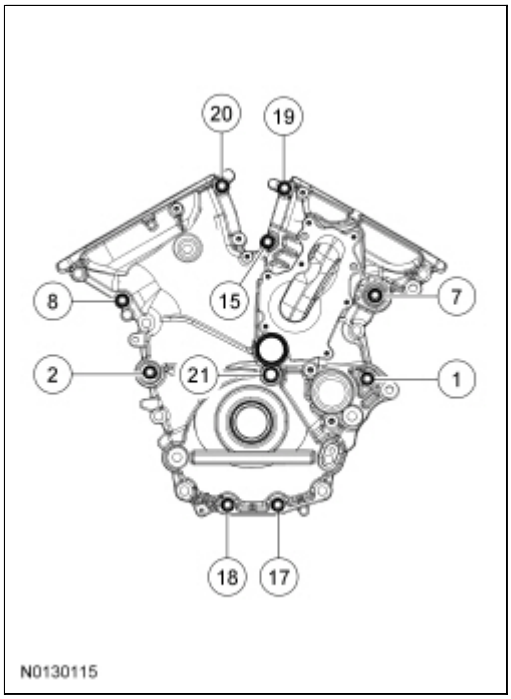
   - Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.



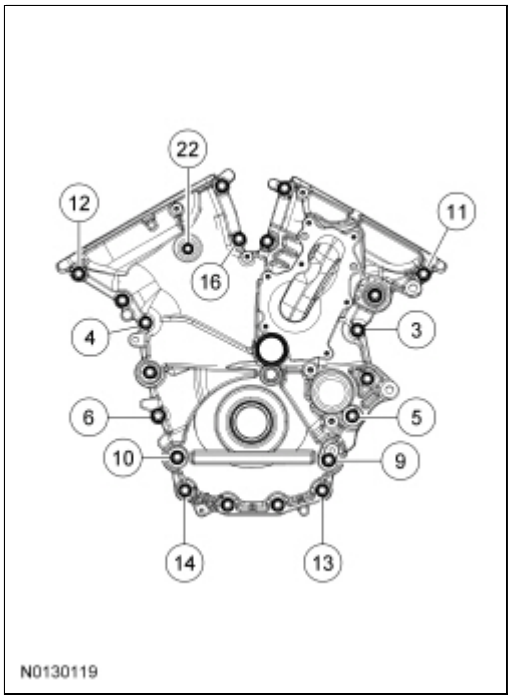
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5. **NOTE:** Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

   Install the engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 and tighten in the sequence shown in 3 stages:
   - Stage 1: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 in sequence to 10 Nm (89 lb-in).
   - Stage 2: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19 and 20 in sequence to 20 Nm (177 lb-in) then an additional 45 degrees.
   - Stage 3: Tighten bolt 21 to 20 Nm (177 lb-in) then an additional 90 degrees.



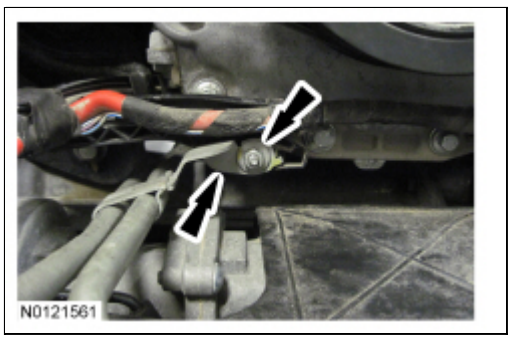
6. Install the remaining 12 engine front cover bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16, 22 and tighten in the sequence shown in 3 stages:
   - Stage 1: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, and 16 to 10 Nm (89 lb-in).
   - Stage 2: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, and 16 to 20 Nm (177 lb-in) then an additional 45 degrees.
   - Stage 3: Tighten bolt 22 to 10 Nm (89 lb-in) then an additional 45 degrees.



7. Position the generator wiring harness on the stud bolt and clip the engine harness on the engine front cover.

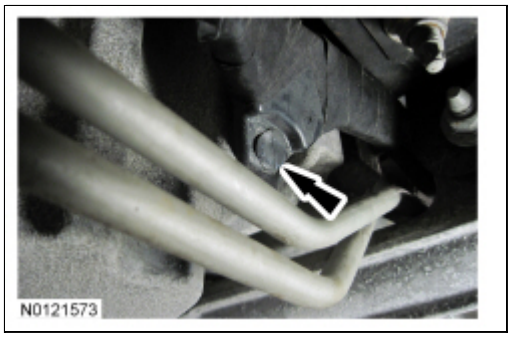


8. Install the transmission cooler tube bracket and the nut on the engine front cover stud bolt.
    - Tighten to 12 Nm (106 lb-in).



9. Install the pushpin retainer into the oil pan.

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10. Install the crankshaft front seal. For additional information, refer to Crankshaft Front Seal in this section.

11. Install the accessory drive belt tensioner and 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

12. Install the generator stud.
    - Tighten to 8 Nm (71 lb-in).

13. Position back the generator and install the bolt.
    - Tighten to 48 Nm (35 lb-ft).

14. Install the coolant pump. For additional information, refer to Section 303-03 .

15. Install the LH and RH valve covers. For additional information, refer to Valve Cover — LH and Valve Cover — RH in this section.

16. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

17. Install the CAC -to- TB pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L in Section 303-12 .

18. Connect the battery ground cable. For additional information, refer to Section 414-01 .

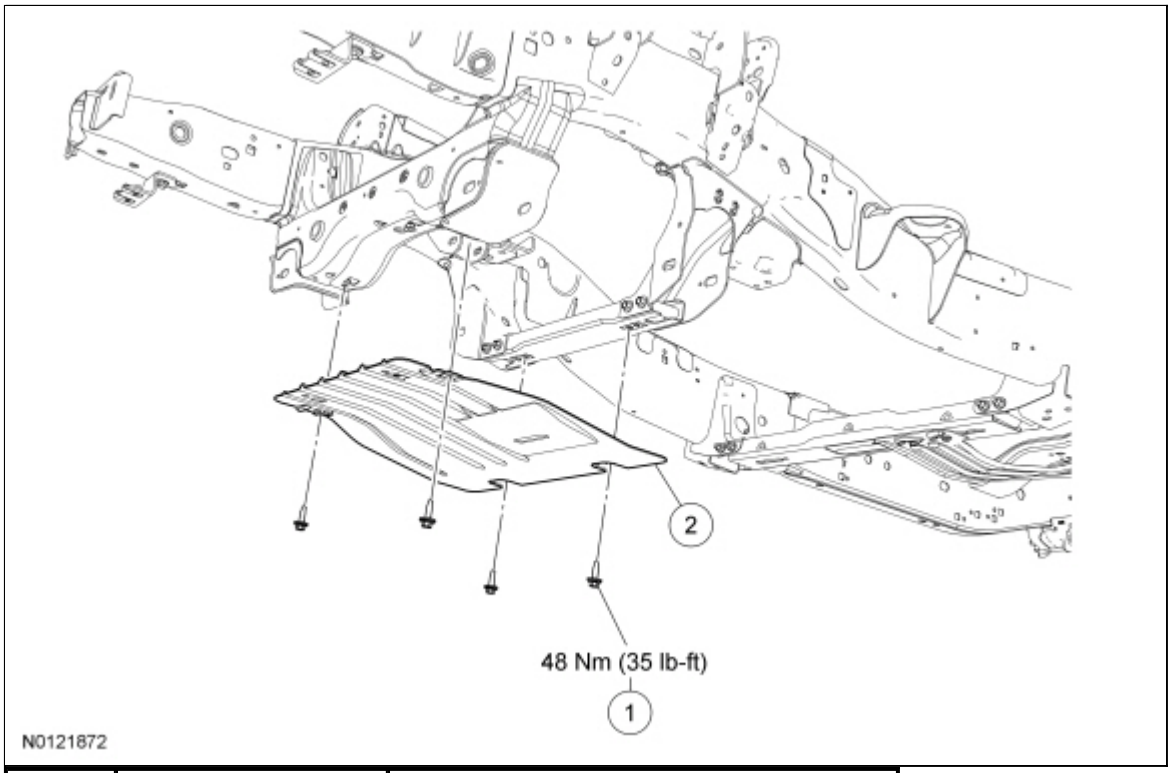
19. Fill the engine with clean engine oil.

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Engine Lubrication Components — Exploded View

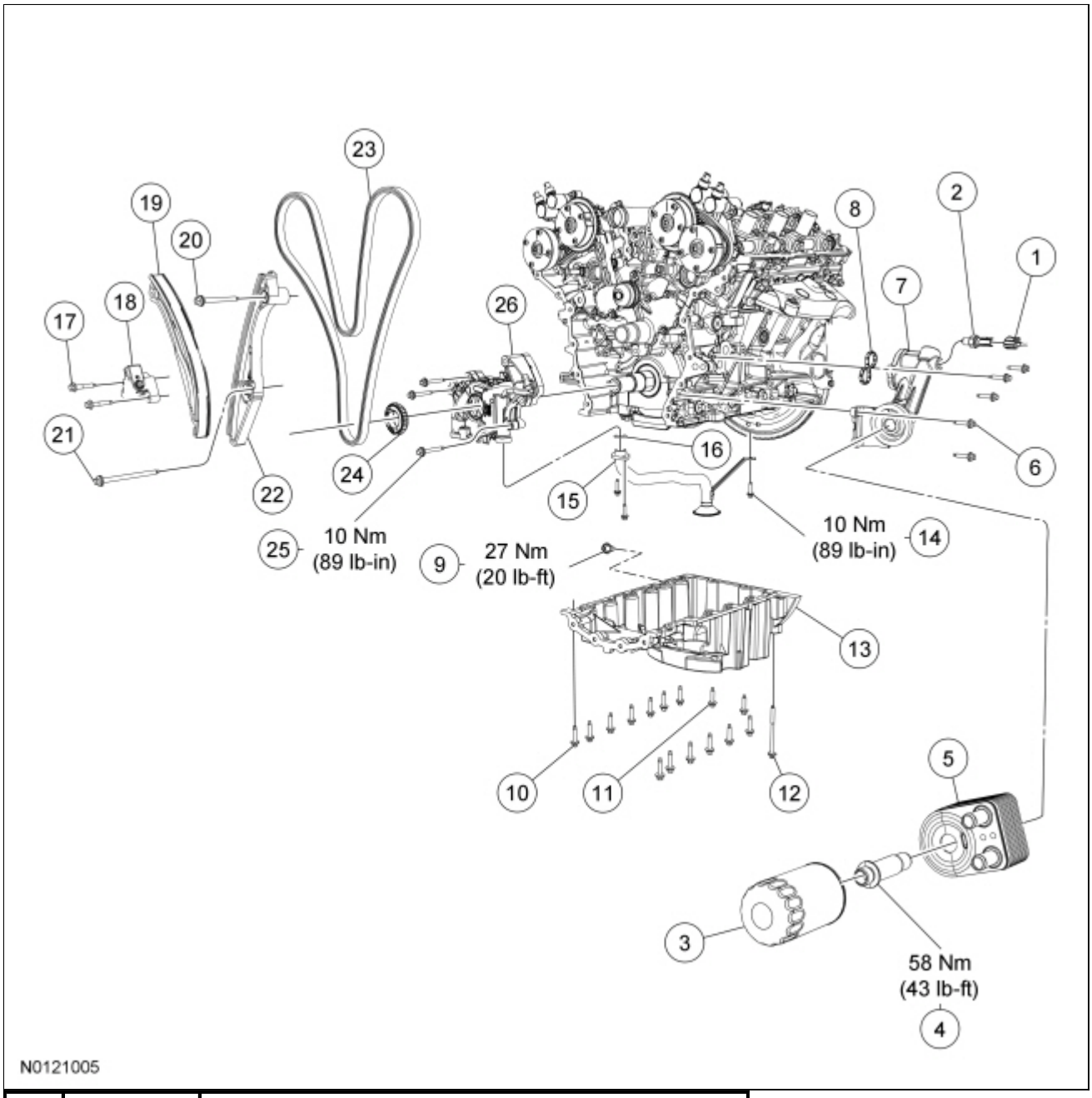
Skid Plate

NOTE: For vehicles equipped with skid plate.



Item	Part Number	Description
1	W706894	Skid plate bolt (4 required)
2	5D032	Skid plate

Engine Lubrication Components



Item	Part Number	Description
1	—	Engine Oil Pressure (EOP) switch electrical connector (part of 14A411)
2	9278	EOP switch
3	6731	Engine oil filter
4	6L626	Oil cooler insert bolt
5	6A642	Oil cooler
6	W503278	Oil filter adapter bolt (5 required)
7	6881	Oil filter adapter
8	6840	Oil filter adapter gasket

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9	6730	Oil pan drain plug
10	W712943	Oil pan bolt (13 required)
11	W503279	Oil pan bolt (2 required)
12	W708221	Oil pan bolt
13	6675	Oil pan
14	W503278	Oil pump screen and pickup tube bolt (3 required)
15	6622	Oil pump screen and pickup tube
16	6625	Oil pump screen and pickup tube O-ring seal
17	W500300	Primary timing chain tensioner bolt (2 required)
18	6L266	Primary timing chain tensioner
19	6K255	RH primary timing chain tensioner arm
20	W503284	LH primary timing chain guide bolt
21	W714094	LH primary timing chain guide bolt
22	6B274	LH primary timing chain guide
23	6268	Primary timing chain
24	6306	Crankshaft timing sprocket
25	W503282	Oil pump bolt (3 required)
26	6600	Oil pump

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

Engine Oil Pressure (EOP) Switch

Material

Item	Specification
Motorcraft® Thread Sealant with PTFE TA-24	WSK-M2G350-A2

Removal and Installation

1. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

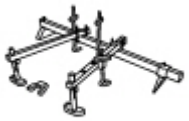
2. Remove the EOP switch.
   - To install, tighten to 14 Nm (124 lb-in) then an additional 180 degrees.

3. To install, reverse the removal procedure.
   - Apply thread sealant with PTFE to the EOP switch threads prior to installation.

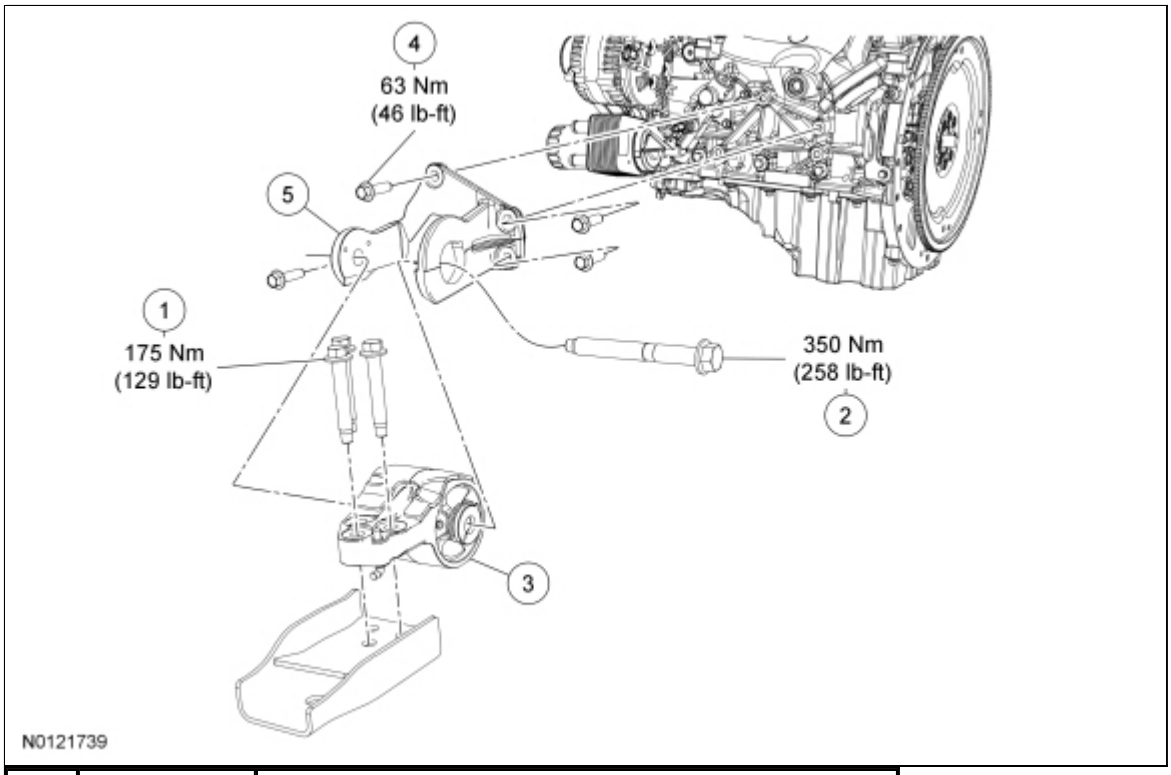
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Engine Support Insulators

Special Tool(s)

 ST3101-A	Bar, Engine Spreader 303-1454
 ST3265-A	Lift Eye, Right Front 303-1566
 ST2176-A	Support Bar, Engine 303-F070

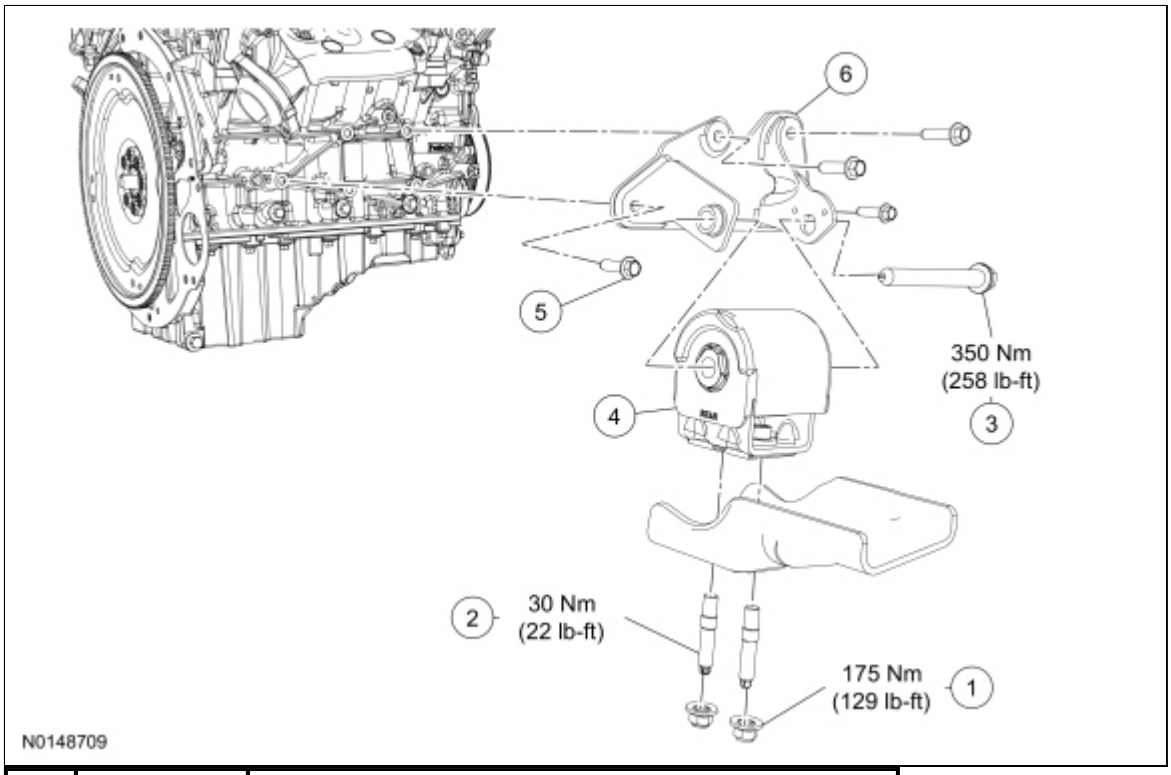
Engine Support Insulator — LH



Item	Part Number	Description
1	W713244	LH engine support insulator bolt (3 required)
2	W715211	LH engine support insulator through bolt
3	6038	LH engine support insulator
4	W714735	LH engine support insulator bracket bolt (3 required)
5	6038	LH engine support insulator bracket

Engine Support Insulator — RH

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Item	Part Number	Description
1	W707251	RH engine support insulator nut (2 required)
2	—	RH engine support insulator stud (part of 6038) (2 required)
3	—	RH engine support insulator through bolt (part of 6038)
4	6038	RH engine support insulator
5	W714735	RH engine support insulator bracket bolt (4 required)
6	—	RH engine support insulator bracket (part of 6038)

Removal

NOTICE: **Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.**

NOTE: Discard all engine support insulator fasteners and install new fasteners.

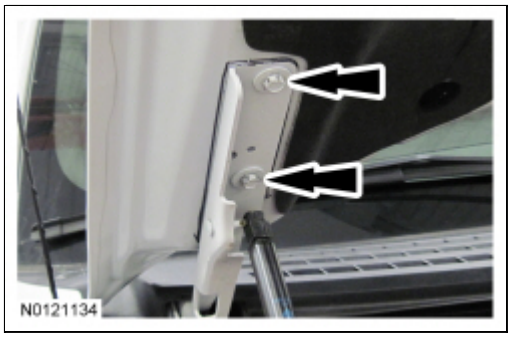
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

   NOTE: RH shown, LH similar.

   Remove the 4 bolts (2 shown) and the hood.



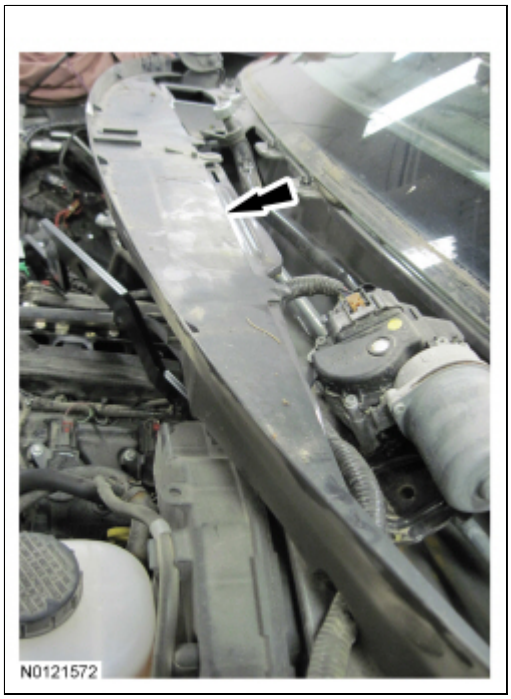
3. Remove the Air Cleaner (ACL) outlet pipe, ACL pipe-to-turbocharger pipes, turbocharger bypass hoses and the turbocharger-to- Charge Air Cooler (CAC) pipes. For additional information, refer to Intake Air System Components — Exploded View, 3.5L in Section 303-12 .

4. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.

5. Remove the high-pressure fuel pump. For addition information, refer to Section 303-04A .

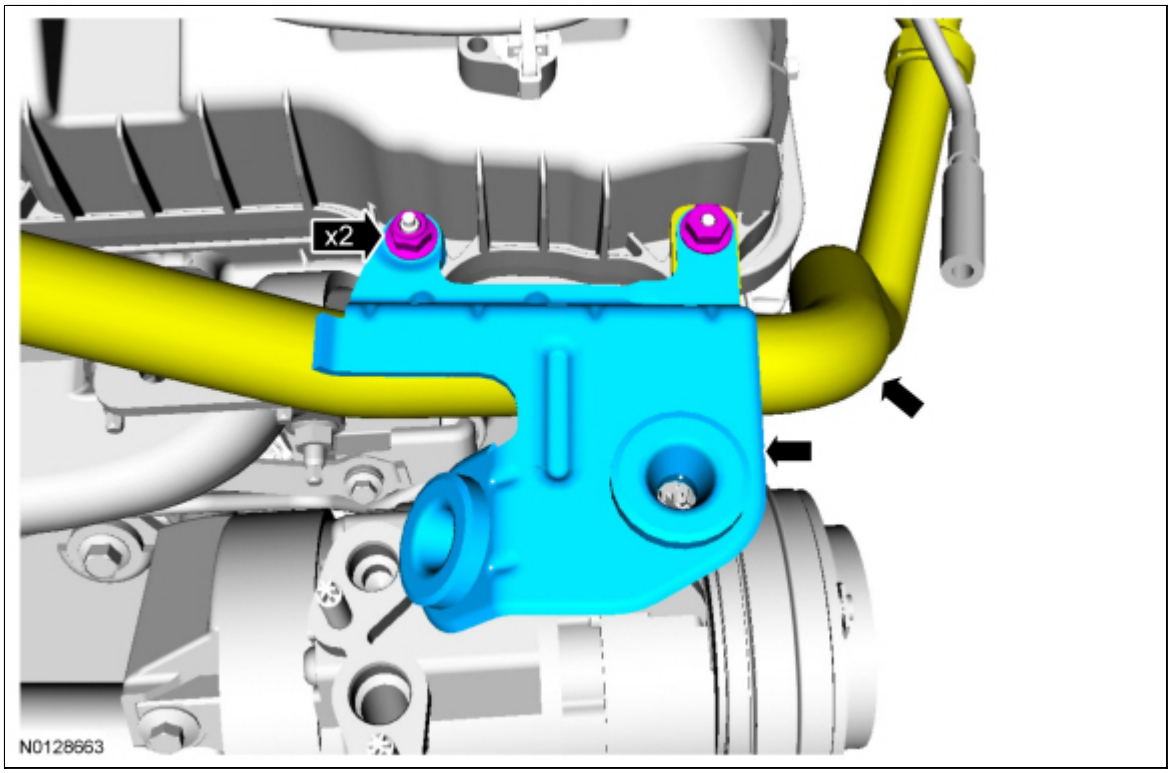
6. Remove the cowl panel grille. For additional information, refer to Section 501-02 .

7. Remove the 6 screws and release the 2 cowl panel clips and remove the cowl panel.

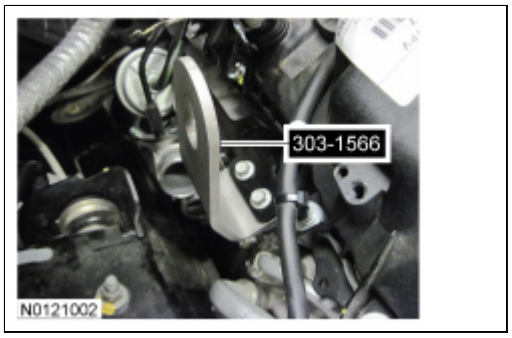


8. Remove the 2 nuts and the Charge Air Cooler (CAC) tube bracket.
    - Disconnect the coolant hose from the valve cover stud.

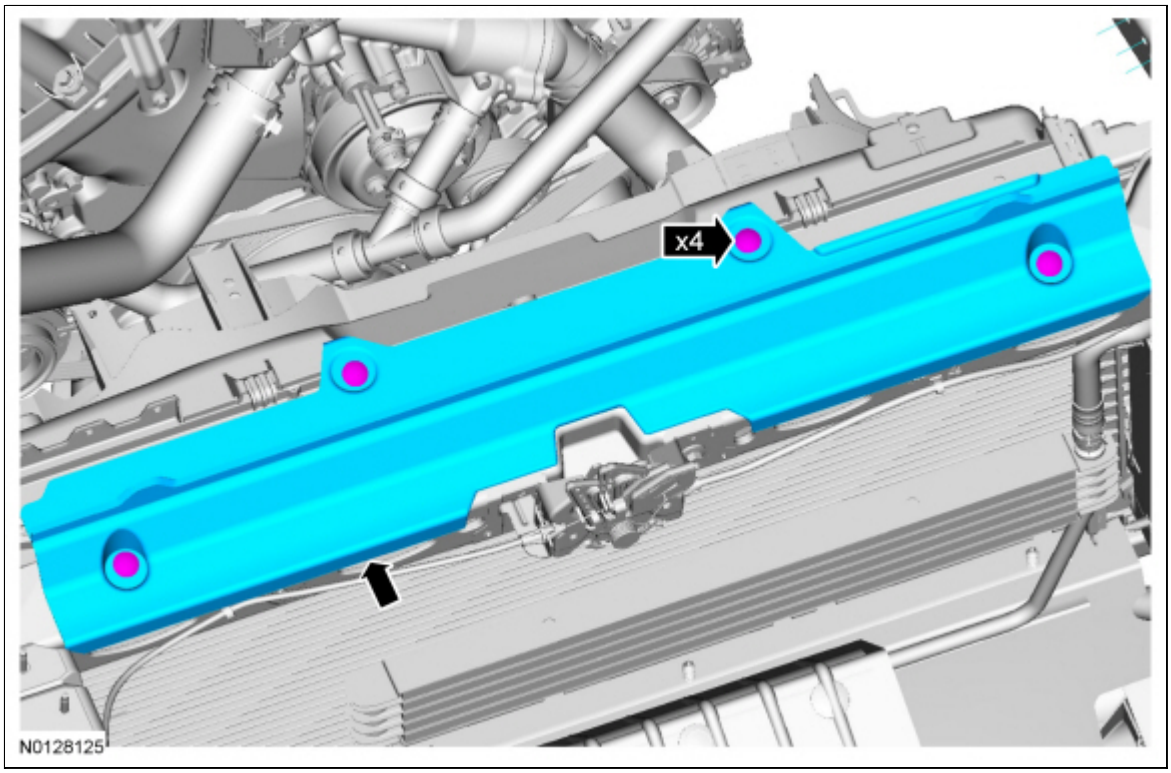
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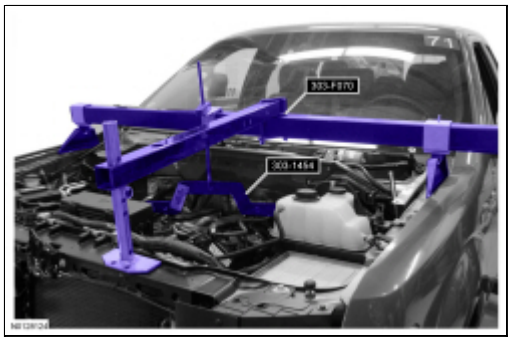
9. Install the Right Front Lift Eye and 2 bolts.



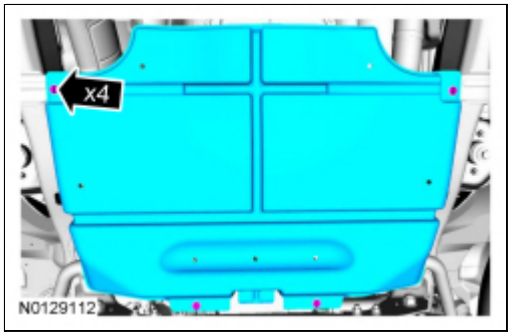
10. Remove the 4 pushpins and the upper radiator air deflector.



11. Install the Engine Support Bar.



12. Release the 4 fasteners and remove the splash shield.



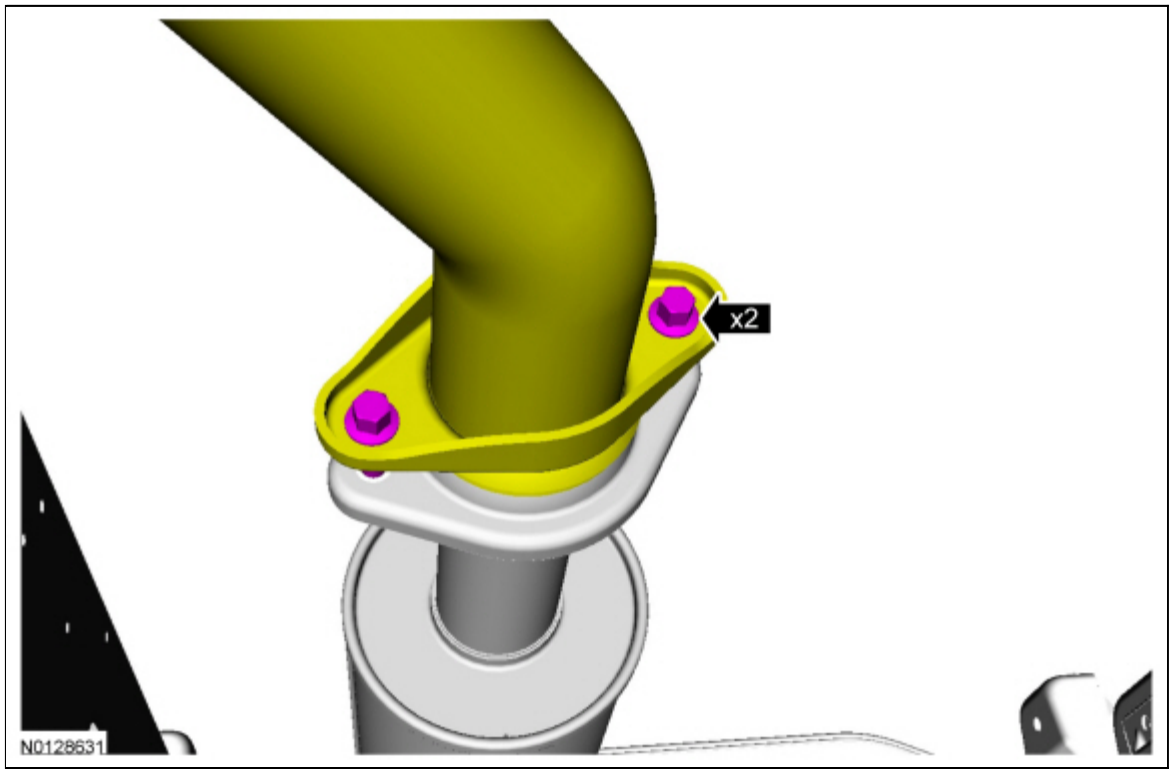
13. Remove the 4 bolts and the skid plate.

14. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .

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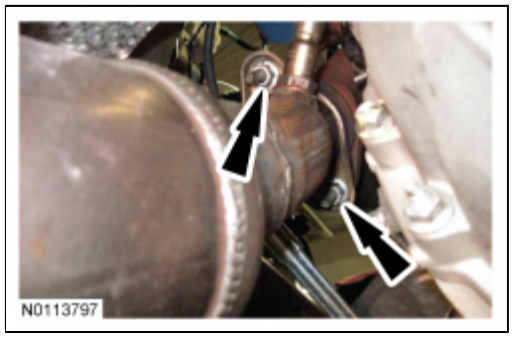
15. ***NOTICE:*** **Support the exhaust intermediate pipe prior to removing the bolts or damage to the flex pipe may occur.**

    Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.



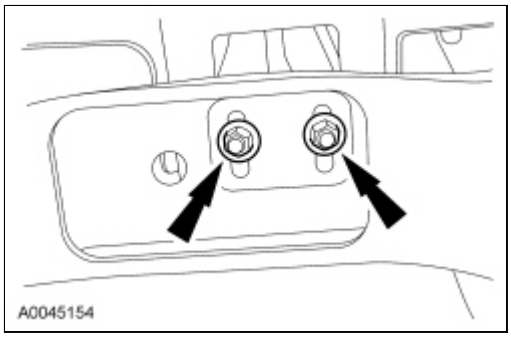
16. **NOTE:** LH shown, RH similar.

    Remove and discard the 2 LH and the 2 RH catalytic converter-to-turbocharger nuts.



17. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

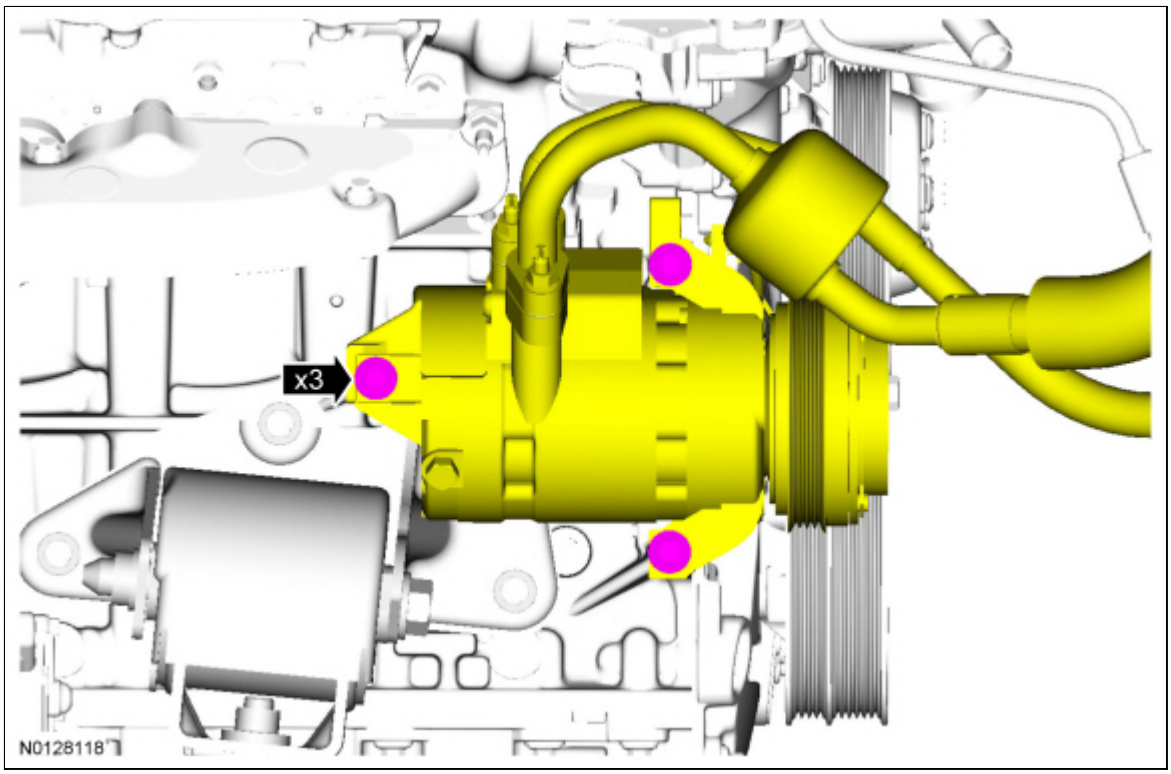
    Loosen the 2 transmission mount-to-crossmember nuts.



RH engine support insulator

18. Remove the Air Conditioning (A/C) compressor belt . For additional information, refer to Section 303-05 .

19. Remove the 3 bolts and position the A/C compressor aside.



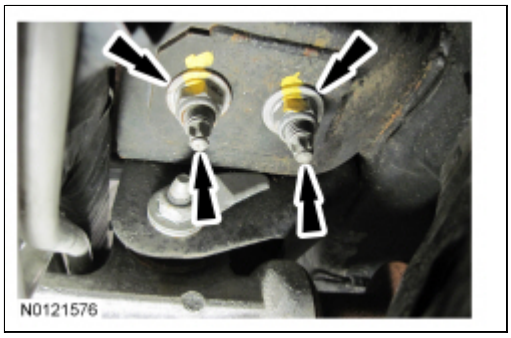
20. Remove the starter. For additional information, refer to Section 303-06 .

21. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove and discard the RH and LH engine support insulator through bolts.

22. Remove and discard the 2 RH engine support insulator nuts and the 2 studs.

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23. Raise the engine approximately 30 mm (1.18 in).

24. Remove the 4 bolts and the RH engine support insulator-to-cylinder block bracket.
    - Discard the bolts.

25. Remove the RH engine support insulator.

LH engine support insulator

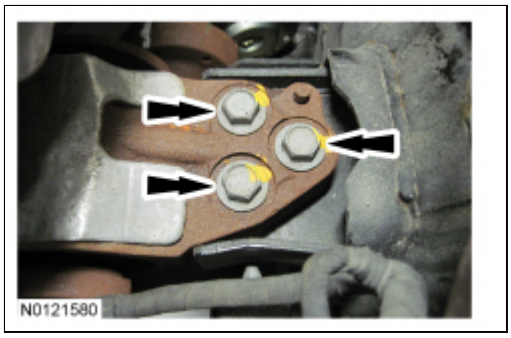
26. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove and discard the LH and RH engine support insulator through bolts.

27. Raise the engine approximately 30 mm (1.18 in).

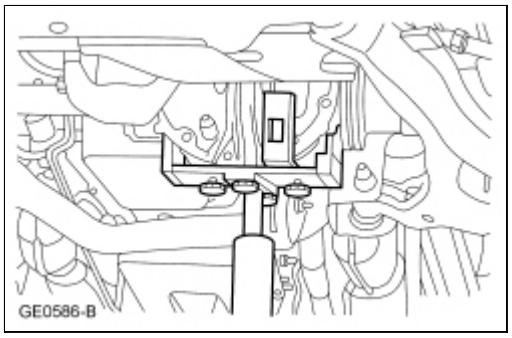
28. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.**

    Remove and discard the 3 LH engine support insulator-to-frame bolts.

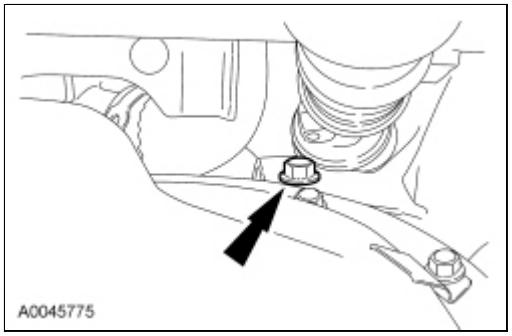


Four-Wheel Drive (4WD) — LH engine support insulator

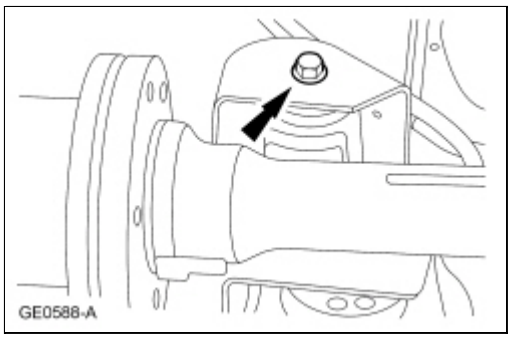
29. Position a suitable hydraulic jack under the front axle. Securely strap the axle to the jack.



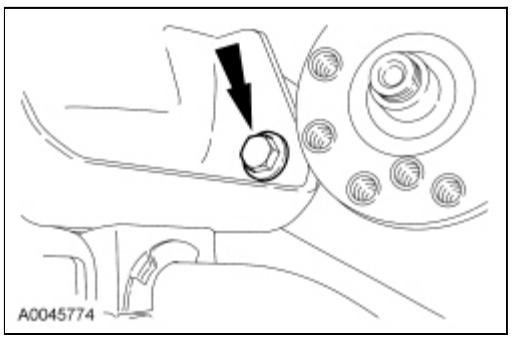
30. Remove the upper front axle carrier mounting bushing bolt.



31. Remove the axle shaft housing carrier bushing bolt.



32. Remove the lower front axle carrier mounting bushing bolt.

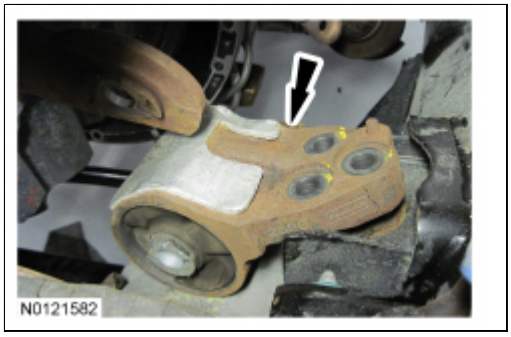


33. Lower the front axle to allow clearance to the LH engine support insulator.

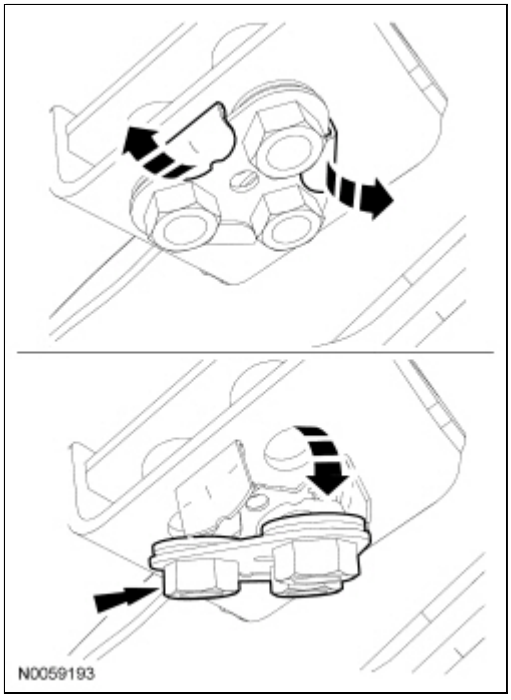
LH engine support insulator

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34. Remove the LH engine support insulator.



35. Inspect the engine support insulator-to-frame nut plate for thread damage. If the nut plate is damaged, bend 2 tabs back and remove the nut plate. Replace the nut plate with service part number 56190 and bend the 2 tabs back to the original position.

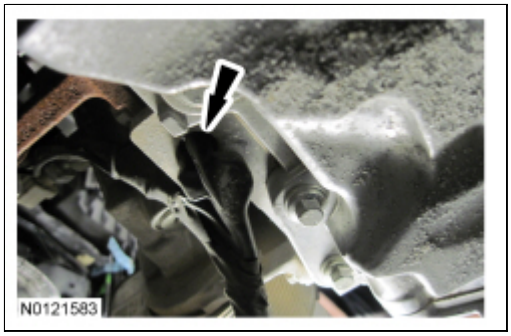


NOTE: If necessary, the following 3 steps are to remove the LH engine support insulator-to-cylinder block bracket.

36. Detach the generator wiring harness from the engine front cover.
    - Detach the generator wiring harness retainer from the oil filter adapter.



37. Detach the generator wiring harness retainer from the lower LH side of the engine block.



38. Remove the 4 bolts and the LH engine support insulator-to-cylinder block bracket.
    - Discard the bolts.

Installation

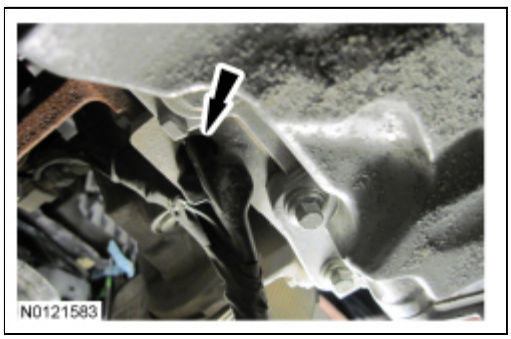
LH engine support insulator

1. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

NOTE: If removed, the following 3 steps are to install the LH engine support insulator-to-cylinder block bracket.

2. Install the LH engine support insulator-to-cylinder block bracket and install the 4 new bolts.
    - Tighten to 63 Nm (46 lb-ft).

3. Attach the generator wiring harness retainer to the lower LH side of the engine block.

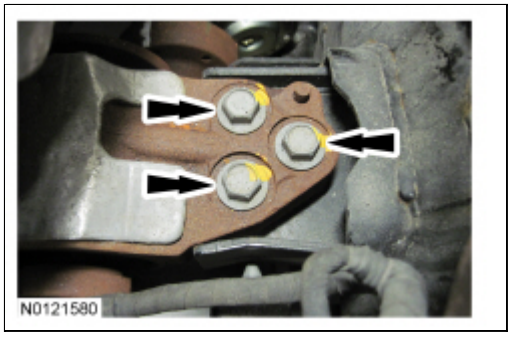


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4. Attach the generator wiring harness to the engine front cover.
    - Attach the generator wiring harness retainer to the oil filter adapter.

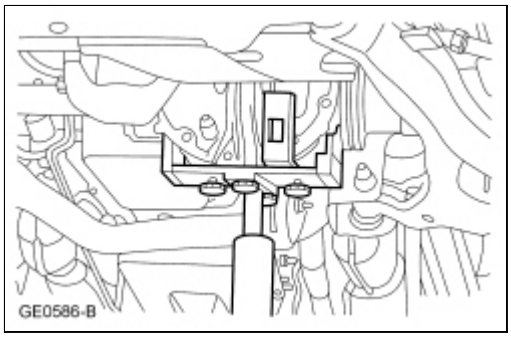


5. Position the LH engine support insulator and hand start the 3 new engine support insulator-to-frame bolts.
    - Do not torque at this time.

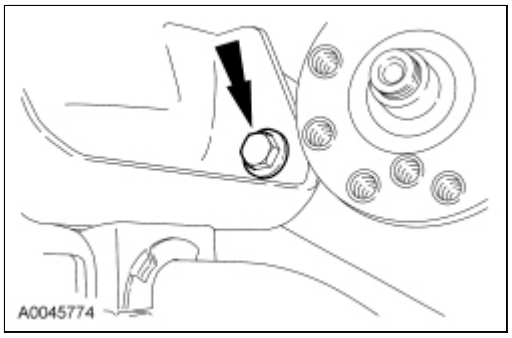


4WD — LH engine support insulator

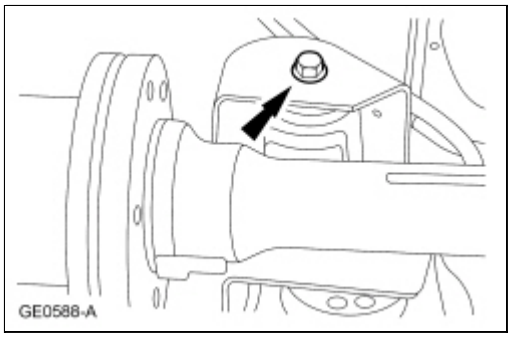
6. Raise the front axle carrier into position.



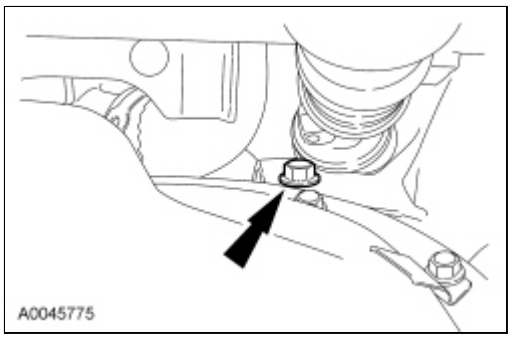
7. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



8. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



9. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

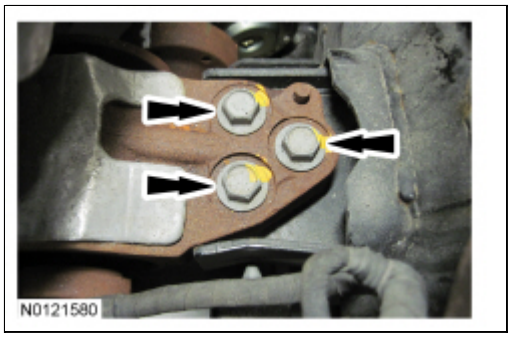


LH engine support insulator

10. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.**

    Tighten the 3 LH engine support insulator-to-frame bolts to 175 Nm (129 lb-ft).

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11. Lower the engine to the installed position.

12. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Install the new RH and LH engine support insulator through bolts.
    - Tighten to 350 Nm (258 lb-ft).

RH engine support insulator

13. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

14. Position the RH engine support insulator into the vehicle

15. Position the RH engine support insulator-to-cylinder block bracket and install the 4 new bolts.
    - For standard payload package, tighten to 63 Nm (46 lb-ft).
    - For heavy duty payload package, tighten to 77 Nm (57 lb-ft).

16. ***NOTICE:*** **Only use hand tools when installing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

    Install the 2 new RH engine support insulator studs.
    - Tighten to 30 Nm (22 lb-ft).

17. ***NOTICE:*** **Only use hand tools when installing the RH engine support insulator nuts or damage to the engine support insulator can occur.**

    Install the 2 new RH engine support insulator nuts.
    - Tighten to 175 Nm (129 lb-ft).

18. Lower the engine to the installed position.

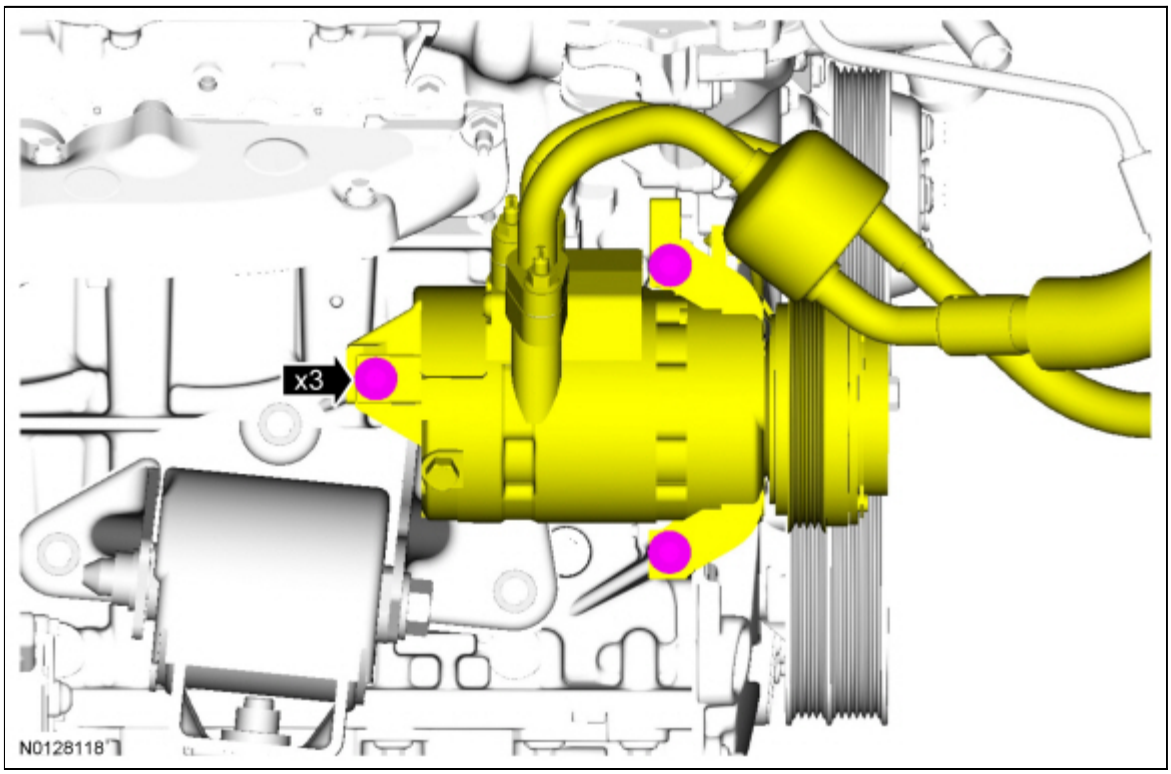
19. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Install the new RH and LH engine support insulator through bolts.
    - Tighten to 350 Nm (258 lb-ft).

20. Install the starter. For additional information, refer to Section 303-06 .

21. Position the A/C compressor and install the 3 bolts.

- Tighten to 25 Nm (18 lb-ft).

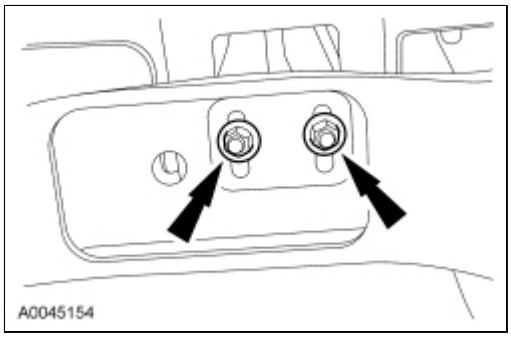


22. Install the A/C compressor belt. For additional information, refer to Section 303-05 .

All vehicles

23. ***NOTICE:*** **Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

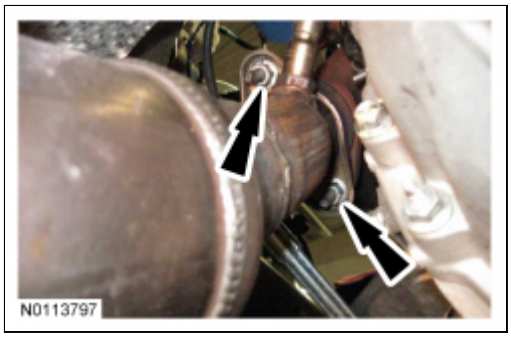
    Tighten the 2 transmission mount-to-crossmember nuts.
    - Tighten to 103 Nm (76 lb-ft).



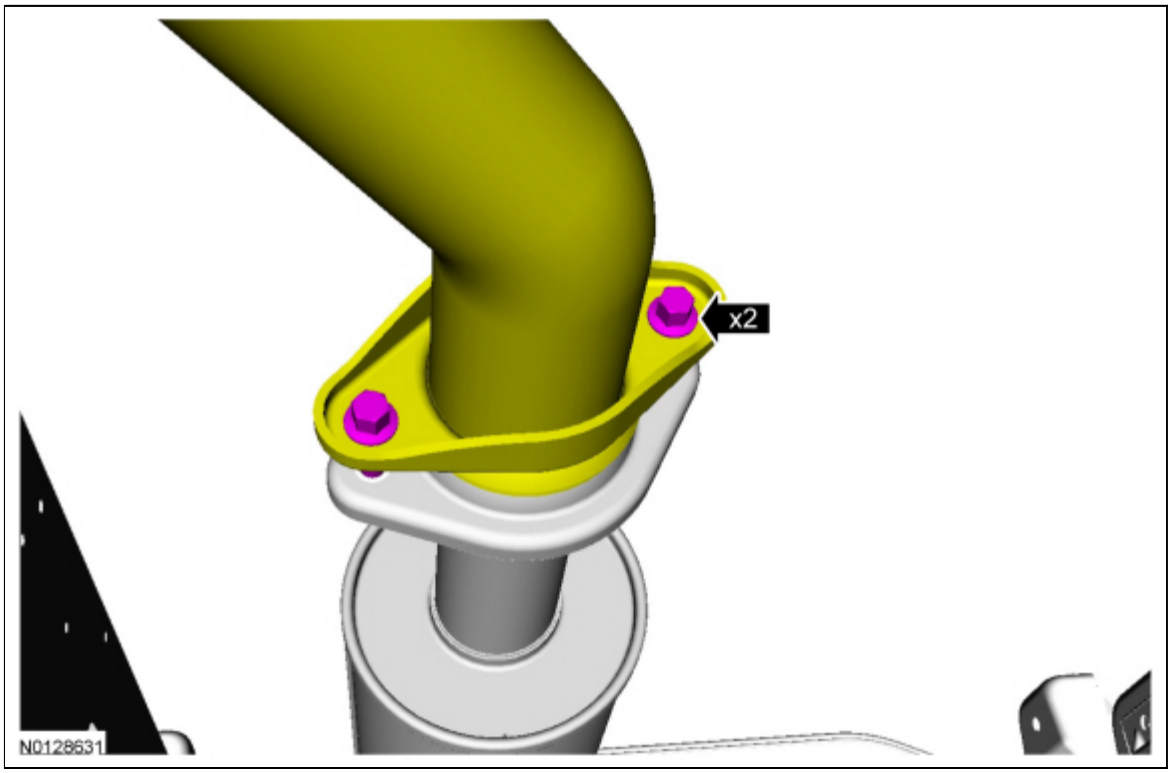
24. **NOTE:** LH shown, RH similar.

    Install the 2 new LH and the 2 new RH catalytic converter-to-turbocharger nuts.
    - Tighten to 45 Nm (35 lb-ft).

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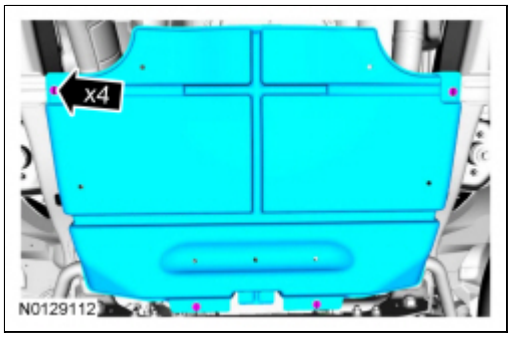
25. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



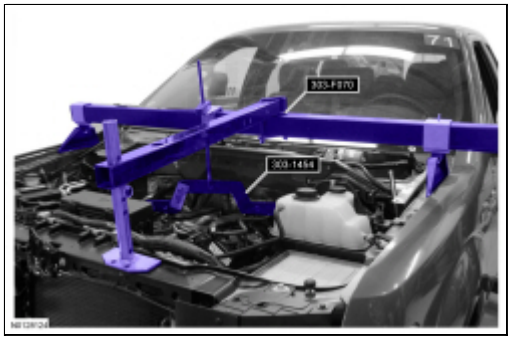
26. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .

27. Install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).

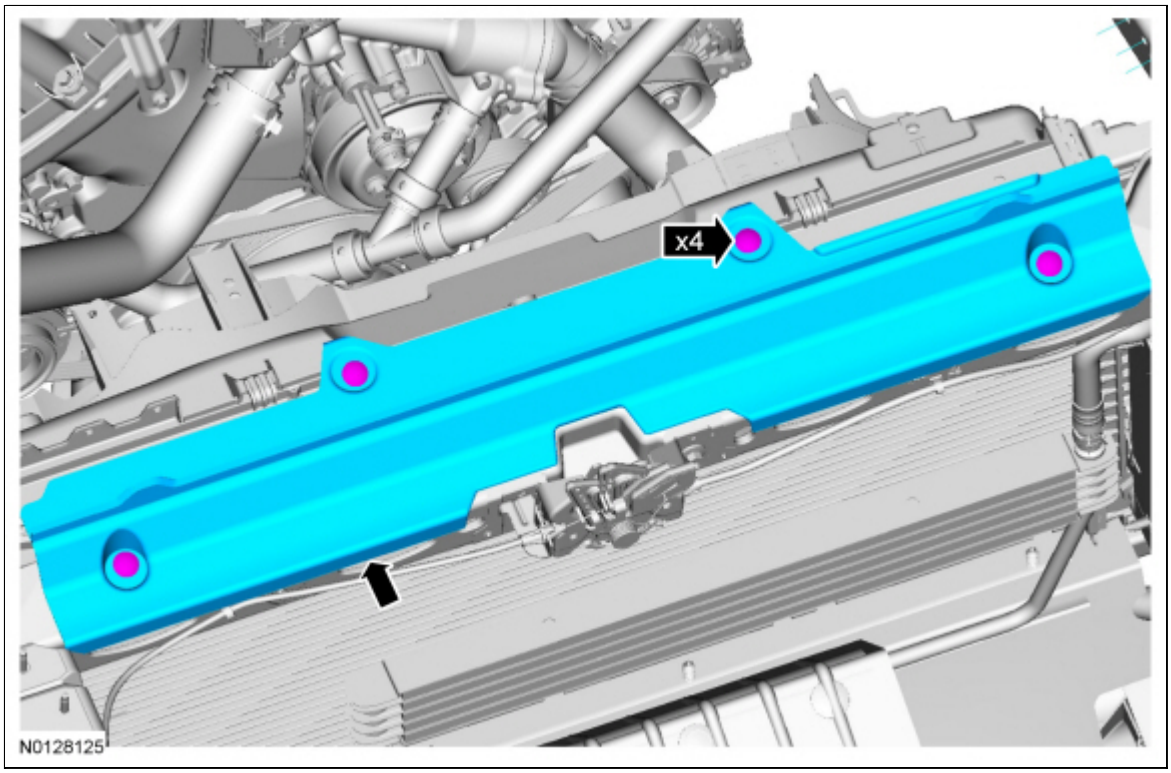
28. Install the splash shield and the 4 retainers.



29. Remove the Engine Support Bar.

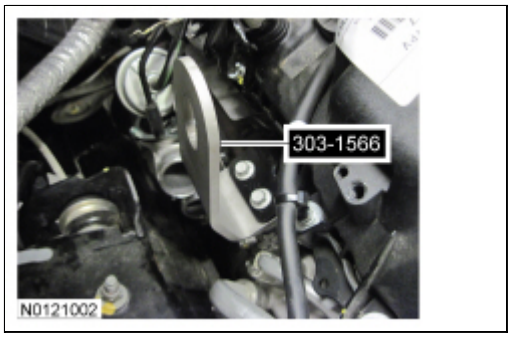


30. Install the upper radiator air deflector and the 4 pushpins.

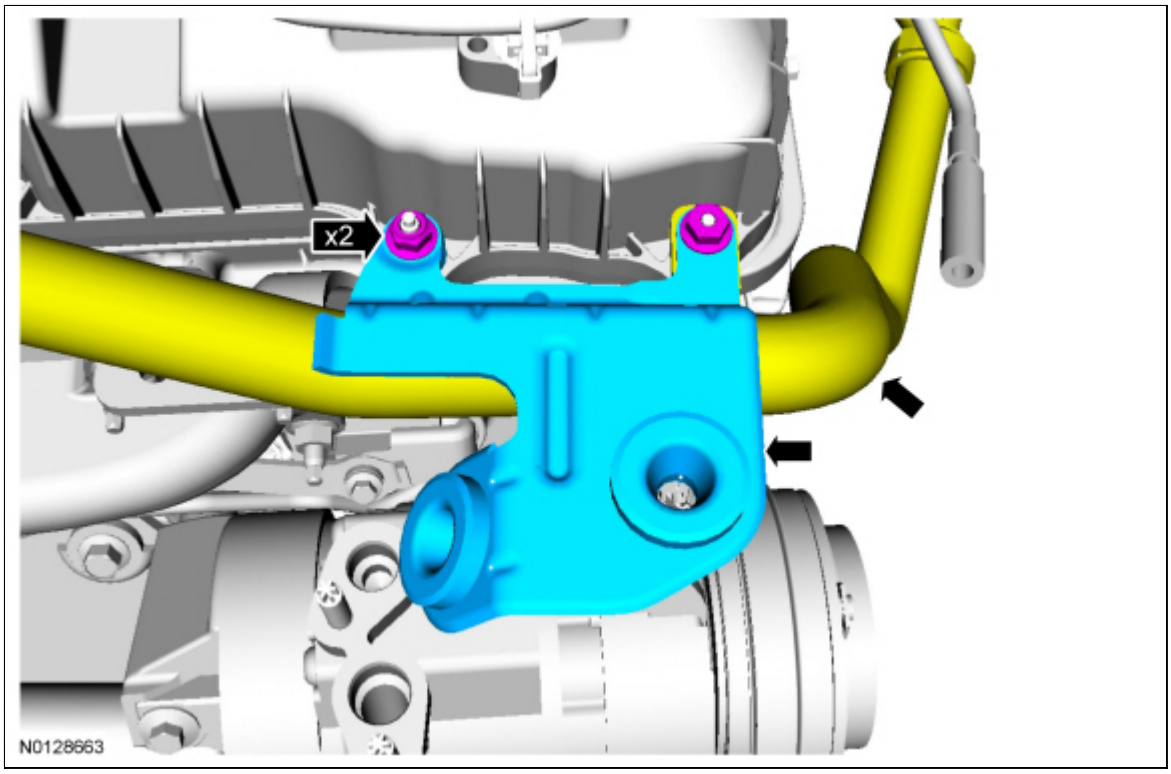


31. Remove the 2 bolts and the Right Front Lift Eye.

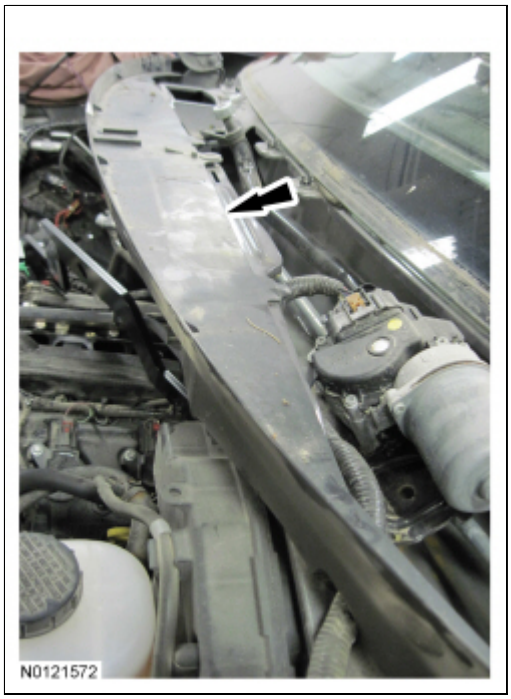
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32. Position back the coolant hose to the valve cover stud. Install the CAC tube bracket and the 2 nuts.
    - Tighten to 6 Nm (53 lb-in).



33. Install the cowl panel and attach the 2 clips and install the 6 screws.



34. Install the cowl panel grille. For additional information, refer to Section 501-02 .

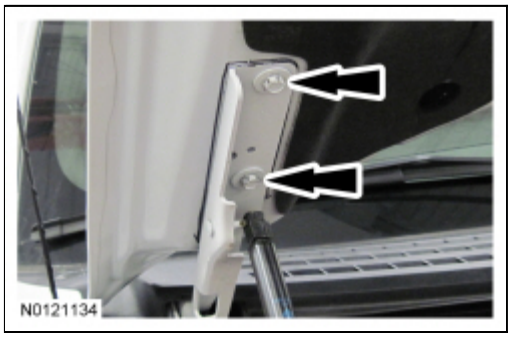
35. Install the high-pressure fuel pump. For addition information, refer to Section 303-04A .

36. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

37. Install the Air Cleaner (ACL) outlet pipe, ACL pipe-to-turbocharger pipes, turbocharger bypass hoses and the turbocharger-to- Charge Air Cooler (CAC) pipes. For additional information, refer to Intake Air System Components — Exploded View, 3.5L in Section 303-12 .

38. **NOTE:** RH shown, LH similar.

    Position the hood and install the 4 bolts.
    - Tighten to 12 Nm (106 lb-in).



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Flexplate

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

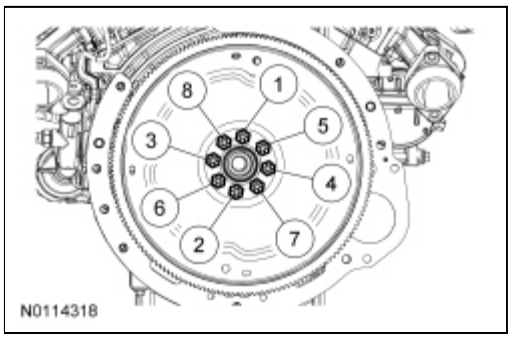
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the automatic transmission. For additional information, refer to Section 307-01 .
3. Remove the 8 bolts and the flexplate.

Installation

1. **NOTE:** One of the 8 flexplate holes are offset so the flexplate can only be installed in one position.

   Install the flexplate and the 8 bolts and tighten in sequence shown.
   - Tighten to 80 Nm (59 lb-ft).



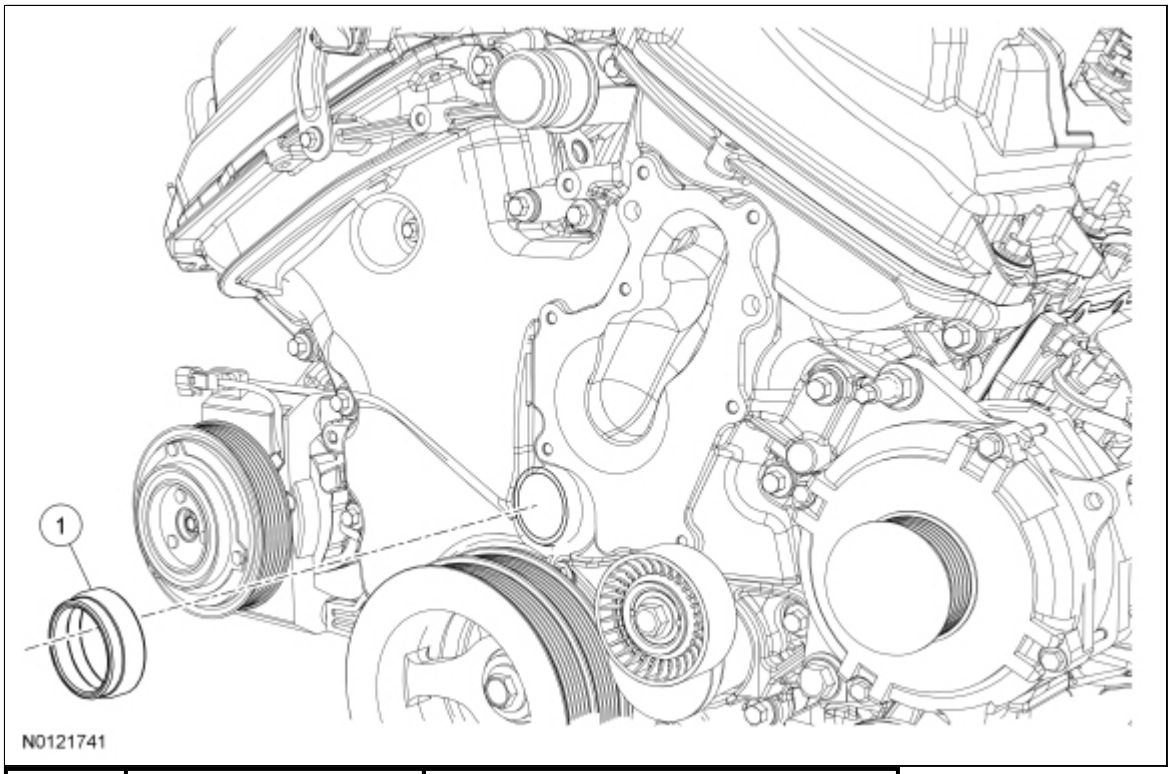
2. Install the automatic transmission. For additional information, refer to Section 307-01 .
3. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Front Cover Radial Seal

Special Tool(s)

 ST3232-A	Remover/Installer, Water Tube Seal 303-1528



Item	Part Number	Description
1	6020	Front cover radial seal

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the accessory drive and A/C compressor belt. For additional information, refer to Section 303-05 .
2. Remove the coolant pump. For additional information, refer to Section 303-03 .

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3. Using the Water Tube Seal Remover, remove the front cover radial seal.
    - Reset the Water Tube Seal Remover center bolt to its retracted position.
    - Screw the Water Tube Seal Remover onto the front cover radial seal until it bottoms out.
    - Using a brass hammer, give the Water Tube Seal Remover a slight tap inward to break front cover radial seal lose.
    - Turn the Water Tube Seal Remover center bolt clockwise and remove the front cover radial seal.



4. Clean the engine front cover radial seal area.

Installation

1. Using the Water Tube Seal Installer, install the front cover radial seal.
    - Position the front cover radial seal on the Water Tube Seal Installer.
    - Position the Water Tube Seal Installer into the engine front cover.
    - Using a brass hammer, tap the Water Tube Seal Installer until the front cover radial seal bottoms out.



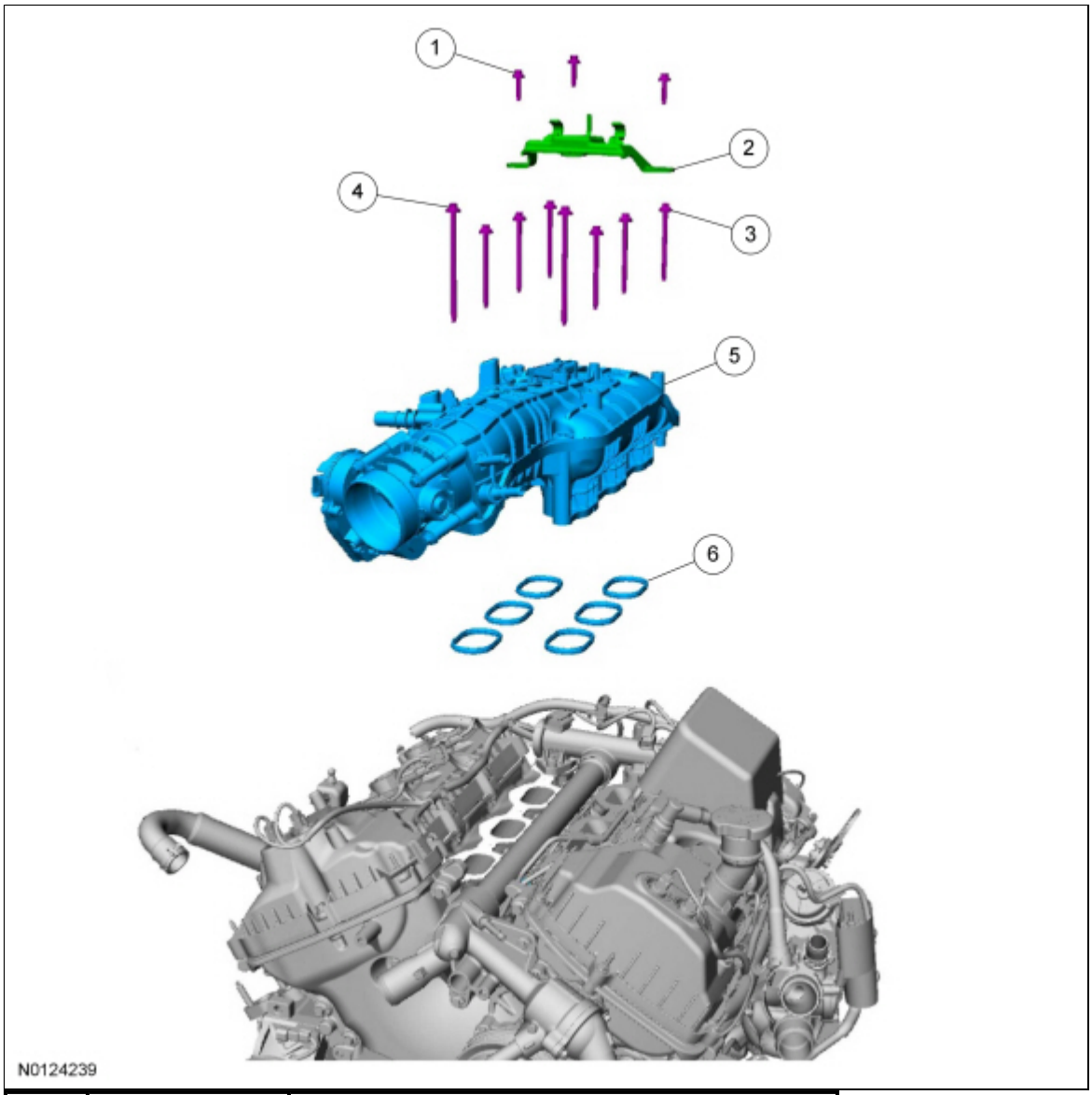
2. Inspect the front cover radial seal for proper installation or damage.
3. Install the coolant pump. For additional information, refer to Section 303-03 .
4. Install the accessory drive and A/C compressor belt. For additional information, refer to Section 303-05 .

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Intake Manifold

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	W503277	Engine cover bracket bolts (3 required)
2	—	Engine cover bracket (part of 6A949)
3	W714988	Intake manifold bolt (6 required)
4	W715096	Intake manifold bolt (2 required)

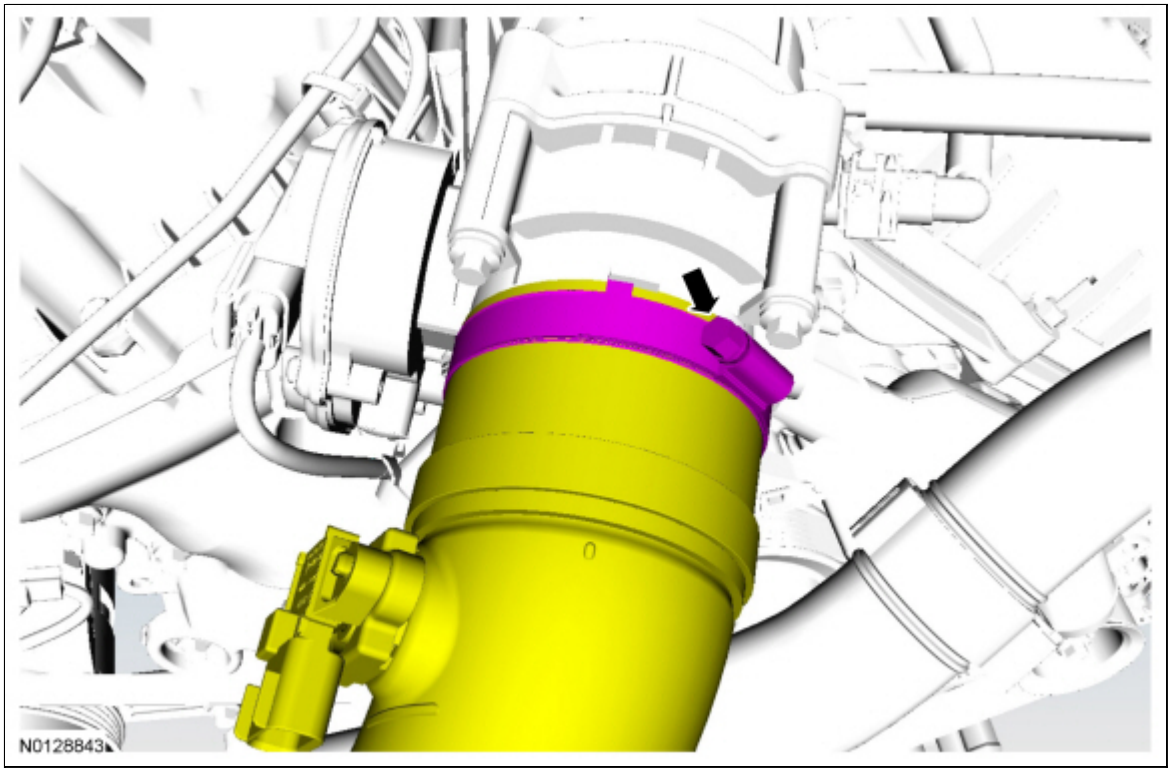
5	9424	Intake manifold
6	9439	Intake manifold gasket

Removal

1. Remove the engine appearance cover.

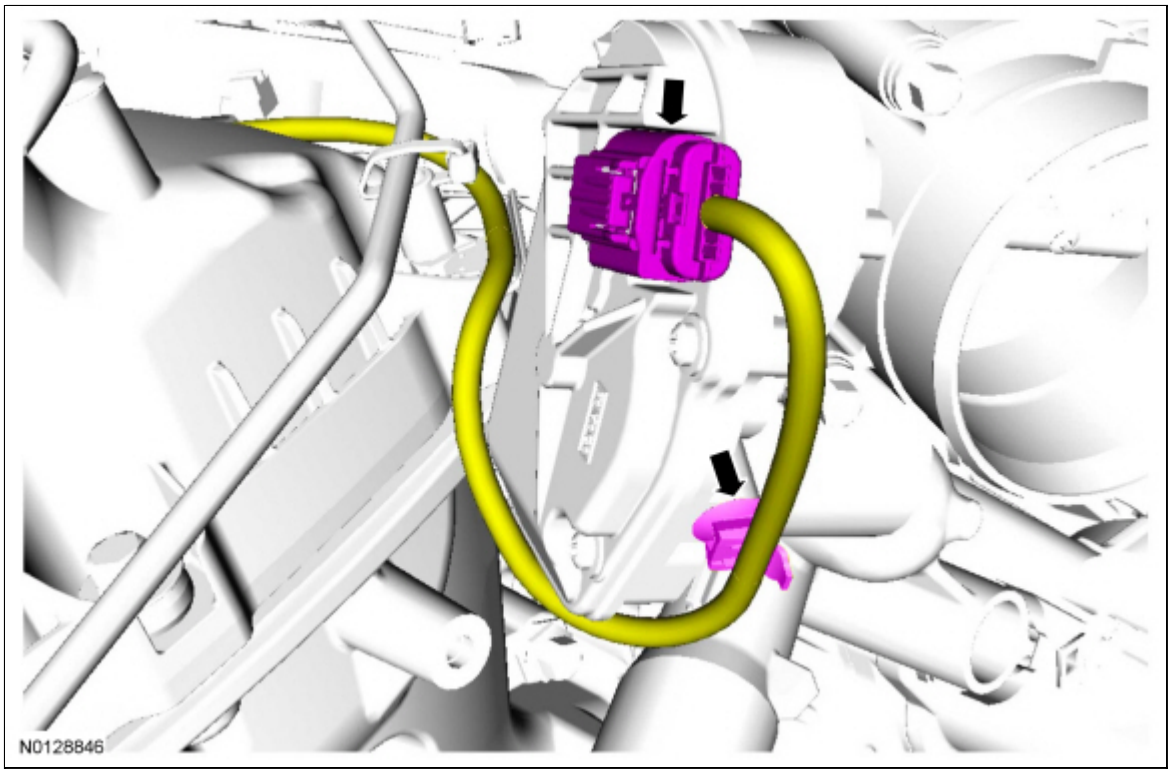
2. Remove the Air Cleaner (ACL) outlet pipe and the RH ACL pipe-to-turbocharger pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L in Section 303-12 .

3. Loosen the clamp and disconnect the Charge Air Cooler (CAC)-to-Throttle Body (TB) pipe.

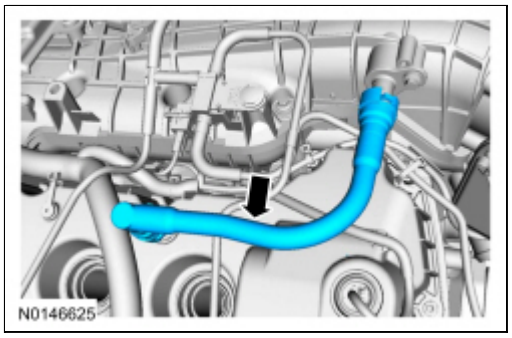


4. Disconnect the TB electrical connector.
   - Detach the TB electrical connector wiring harness retainer from the TB .

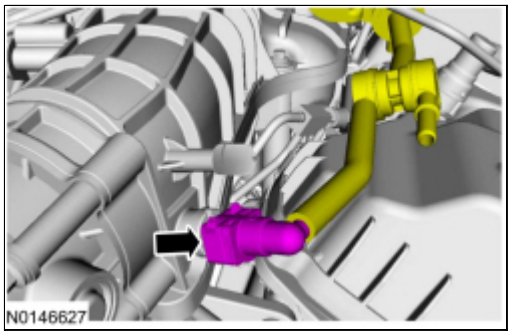
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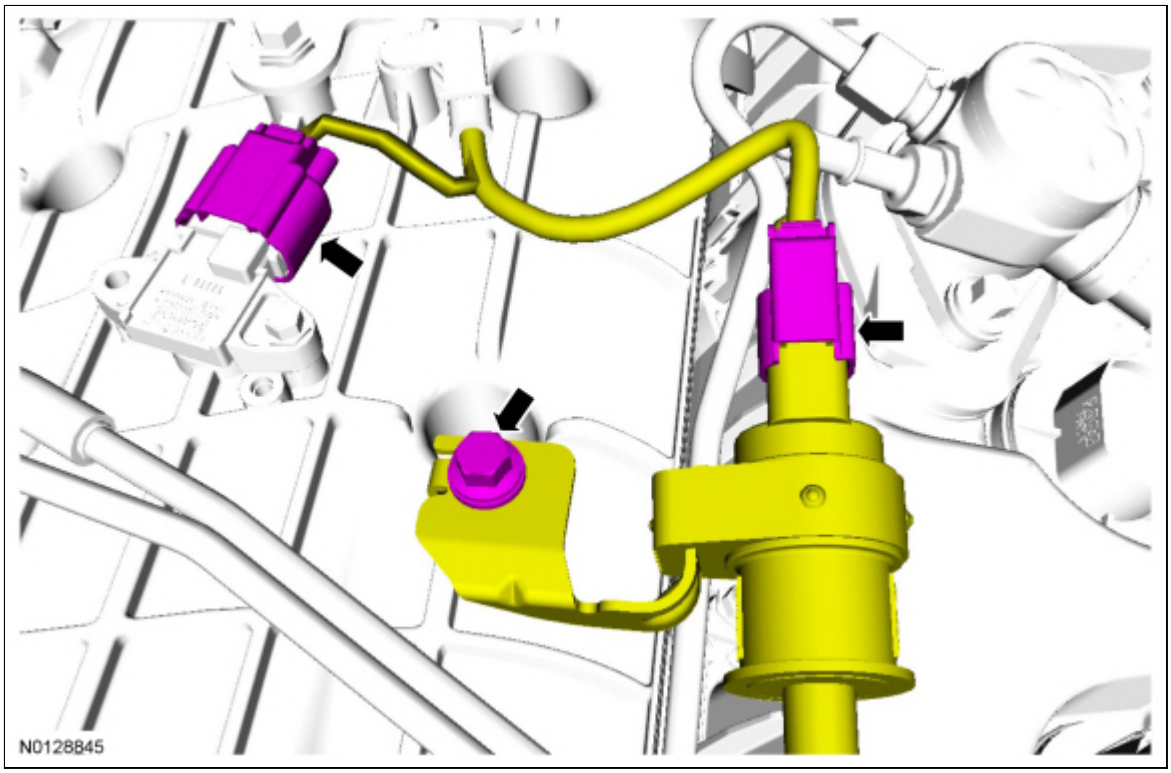
5. Remove the PCV tube. Refer to Section 310-00 .



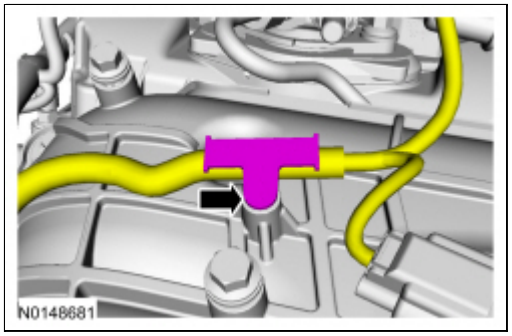
6. Disconnect the Evaporative Emission (EVAP) hose from the intake manifold. Refer to Section 310-00 .



7. Disconnect the Manifold Absolute Pressure (MAP) sensor and the EVAP canister purge valve electrical connectors. Remove the bolt for the EVAP canister purge valve and position aside.

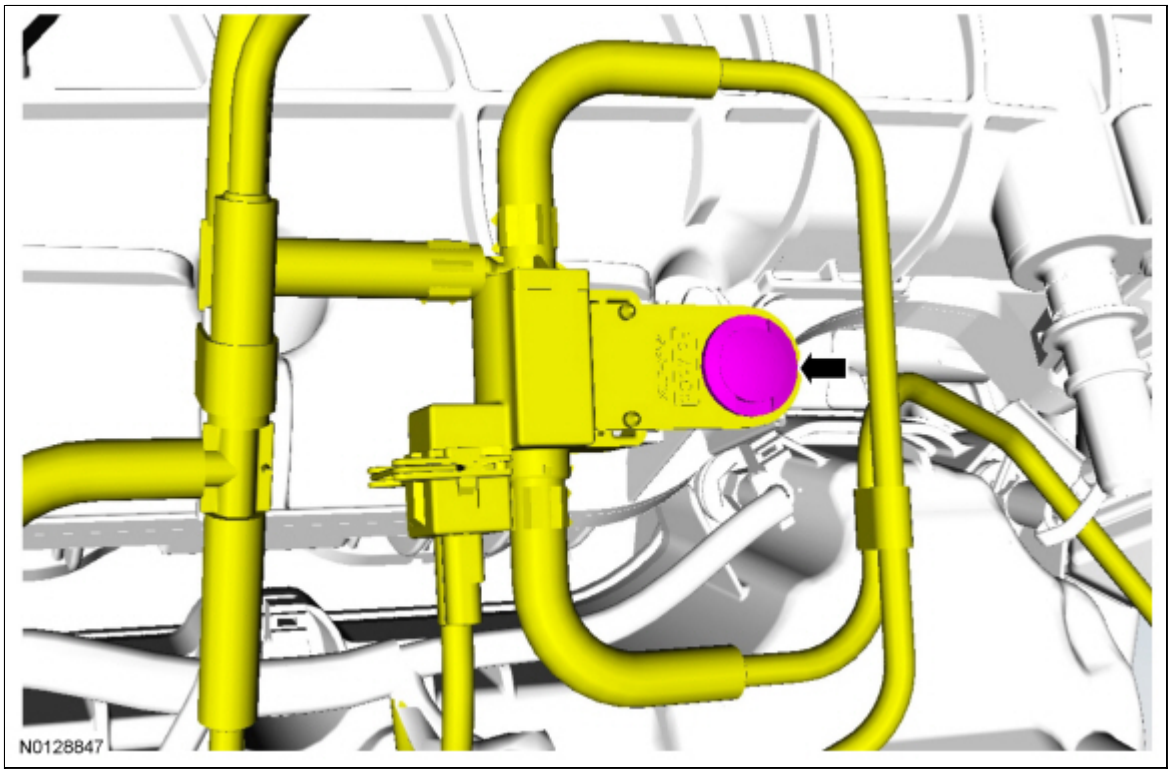


8. Remove the 3 bolts and the engine appearance cover bracket.
9. Disconnect the wire retainer from the intake manifold.



10. Remove the push pin and position the turbocharger vacuum regulator aside.

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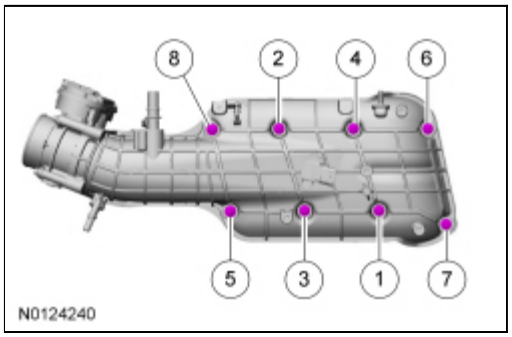


11. Loosen the 8 bolts and remove the intake manifold.
    - Remove and discard the gaskets.
    - Clean and inspect all of the sealing surfaces of the cylinder heads and the intake manifold.

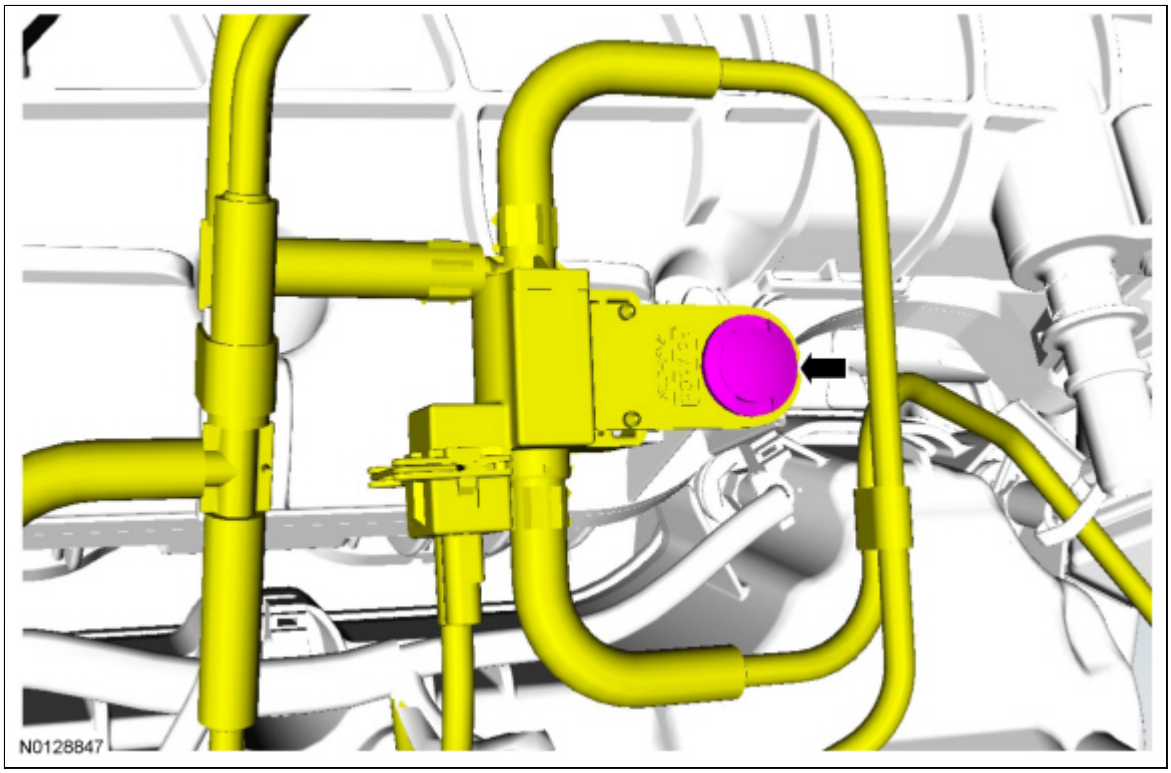
Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

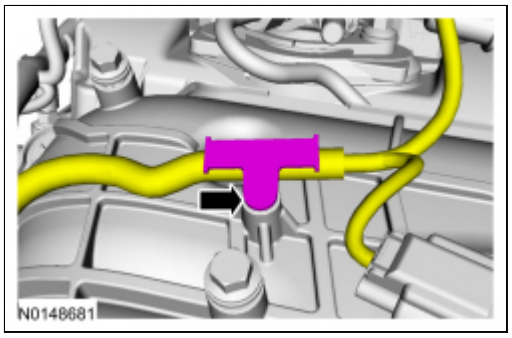
   Using new gaskets, install the intake manifold and tighten the 8 bolts in the sequence shown.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



2. Position back turbocharger vacuum regulator and install the push pin.



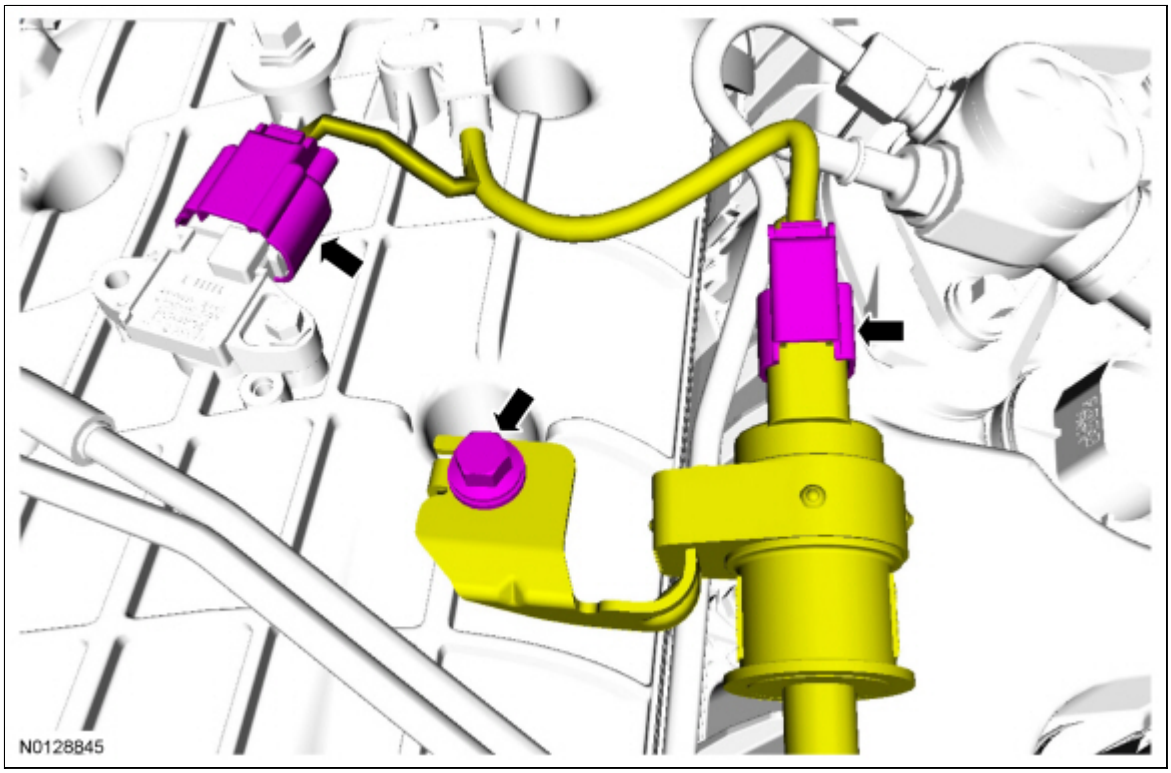
3. Connect the wire retainer to the intake manifold.



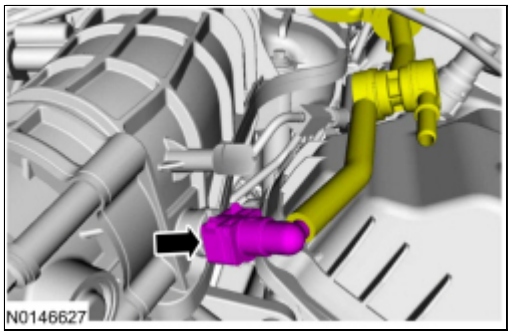
4. Install the engine appearance cover bracket and 3 bolts.
   - Tighten to 10 Nm (89 lb-in).

5. Position back the EVAP canister purge valve and install the bolt. Connect the MAP sensor and the EVAP canister purge valve electrical connectors.
   - Tighten to 10 Nm (89 lb-in).

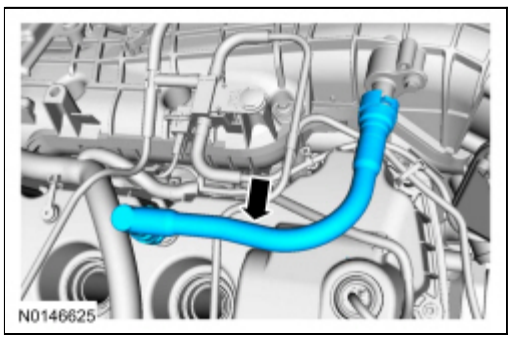
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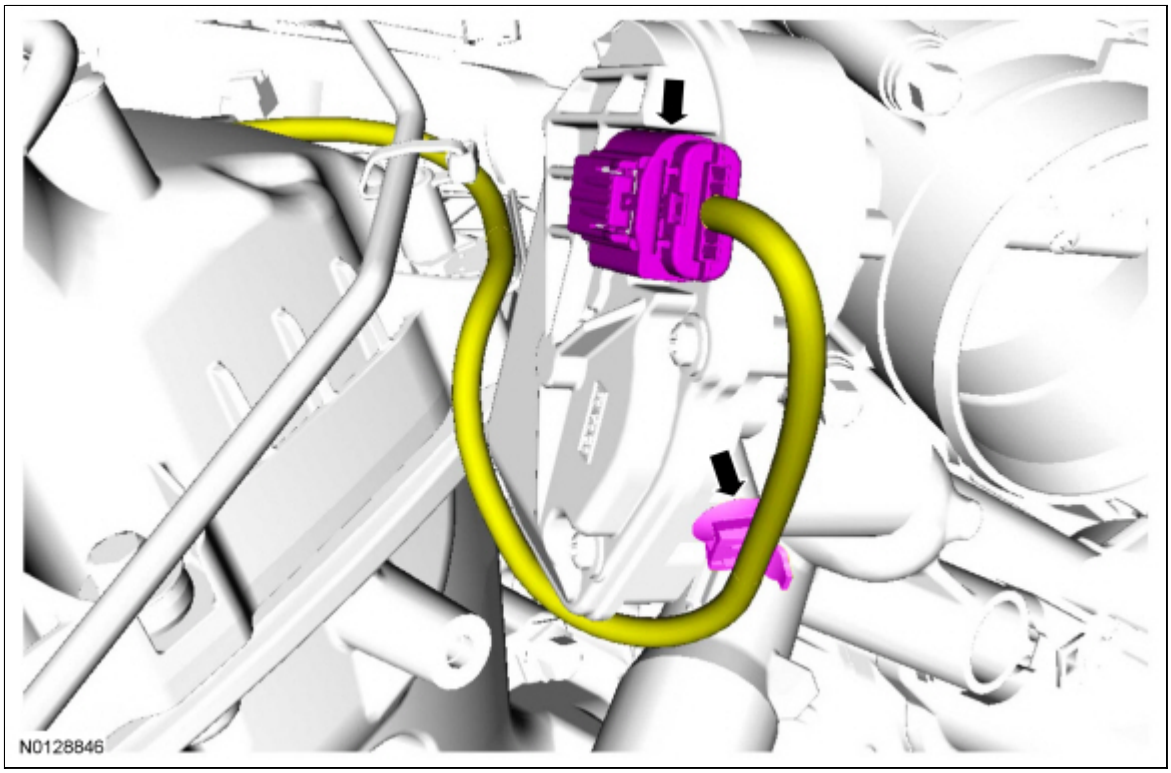
6. Connect the EVAP hose to the intake manifold. Refer to Section 310-00 .



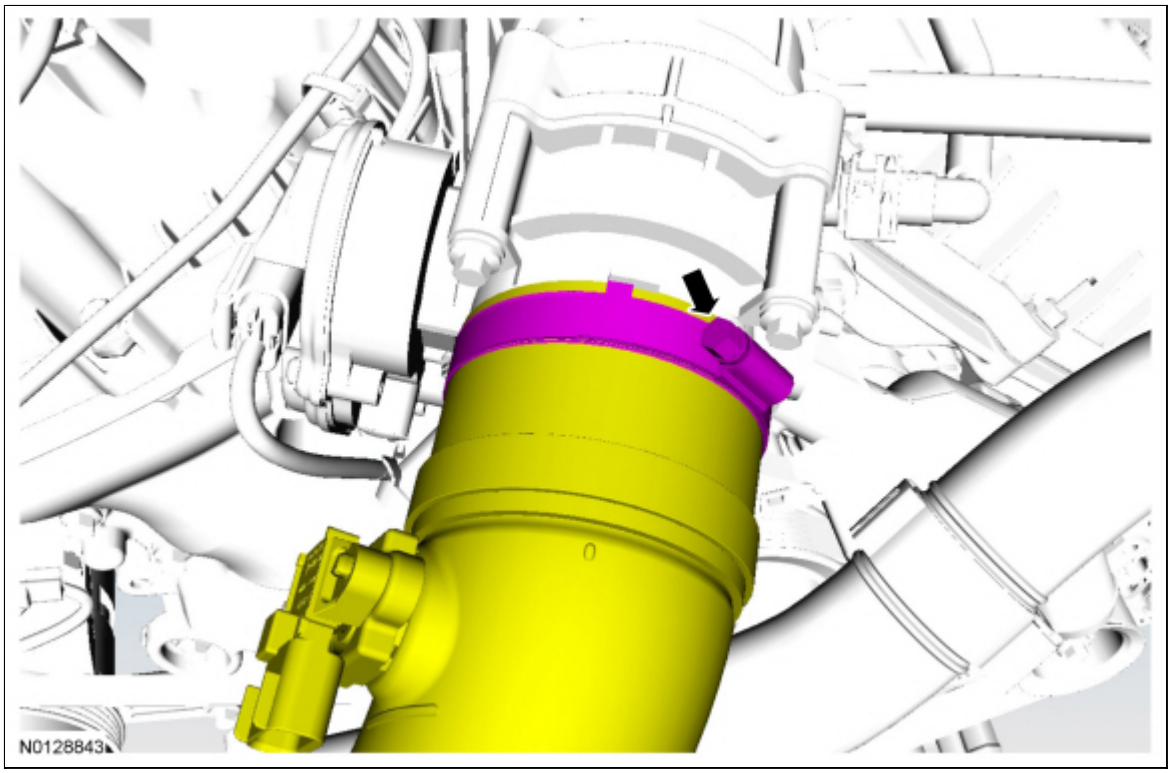
7. Install the PCV tube. Refer to Section 310-00 .



8. Connect the TB electrical connector.
    - Attach the TB electrical connector wiring harness pin-type retainer to the TB .



9. Connect the CAC -to- TB pipe and tighten the clamp.
    - Tighten to 5 Nm (44 lb-in).



10. Install the RH ACL pipe-to-turbocharger pipe and the ACL outlet pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L in Section 303-12 .

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11. Install the engine appearance cover.

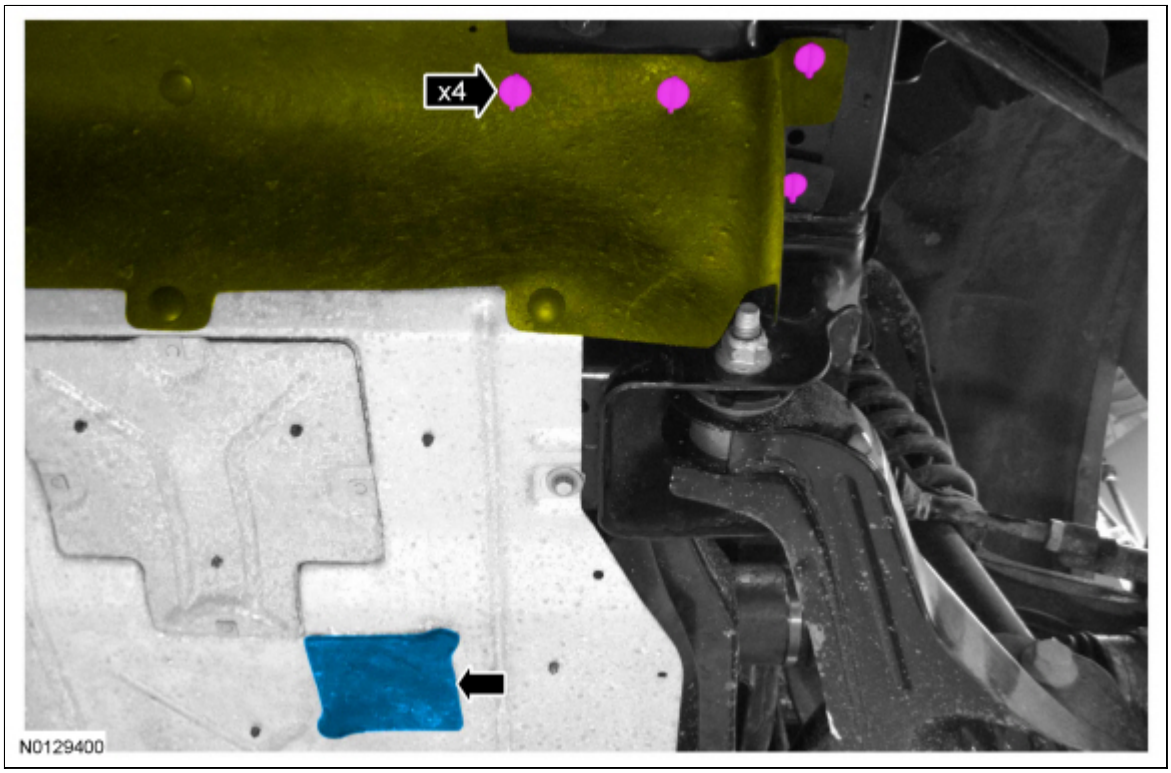
Oil Cooler

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) outlet pipe and the LH ACL -to-turbocharger pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .

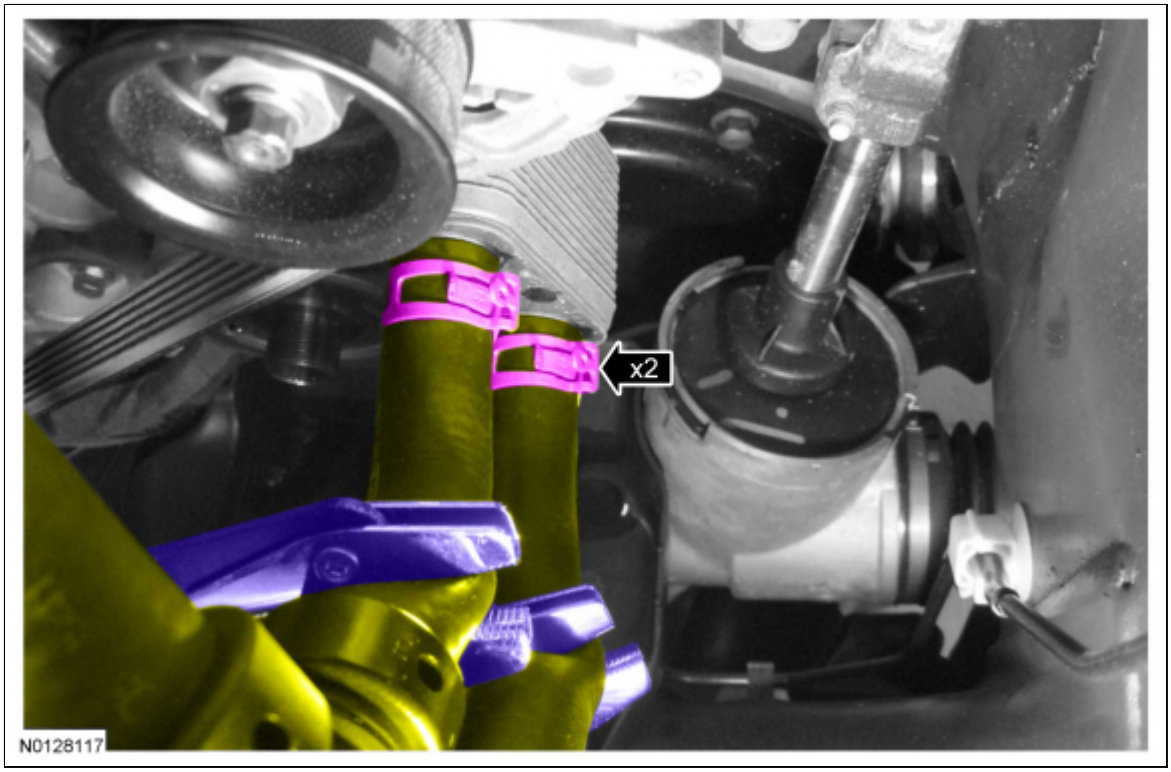
3. If equipped, rotate the 4 retainers and position the air deflector down. Rotate the skid plate cover counterclockwise and remove.



4. Remove and discard the engine oil filter.

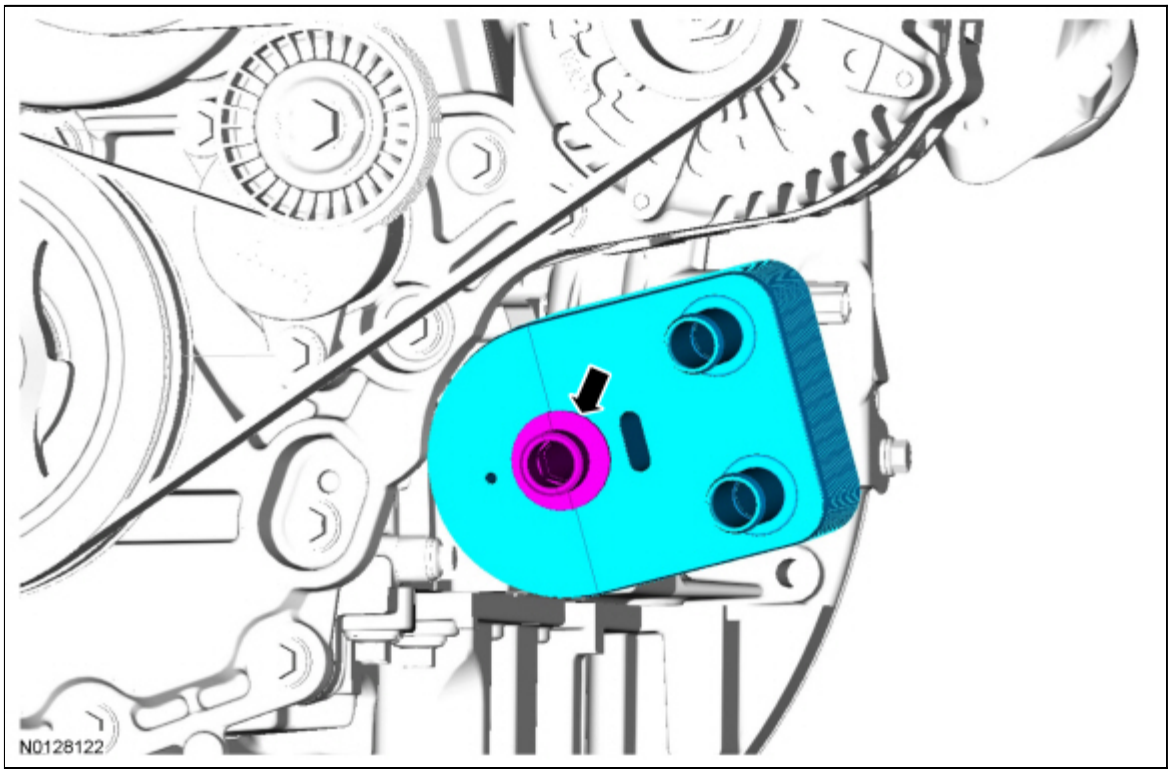
5. Using hose clamp pliers, clamp the 2 oil cooler coolant hoses.
   - Disconnect the 2 coolant hoses from the oil cooler.

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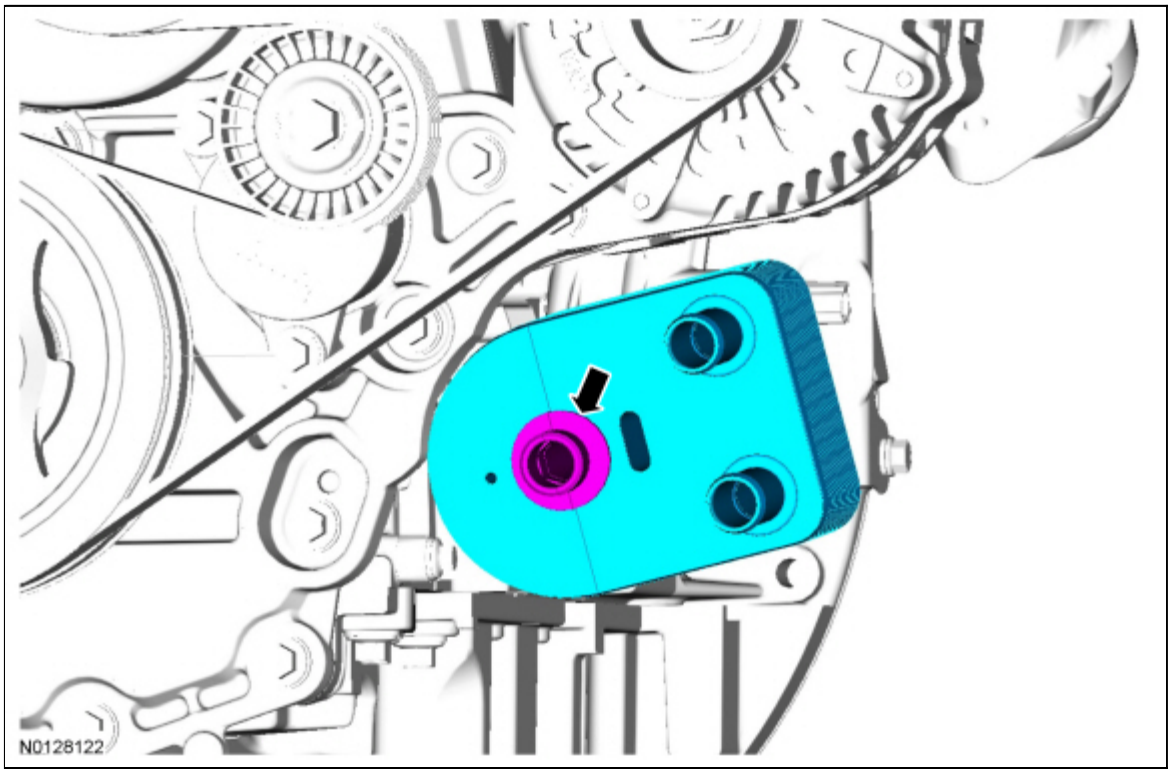
6. ***NOTICE:*** **If metal or foreign material is present in the oil cooler, mechanical concerns exist. To diagnose the mechanical concerns, refer to Section 303-00 .**

   Remove the oil cooler insert bolt and the oil cooler.
   - Inspect the oil cooler gasket, replace if necessary.



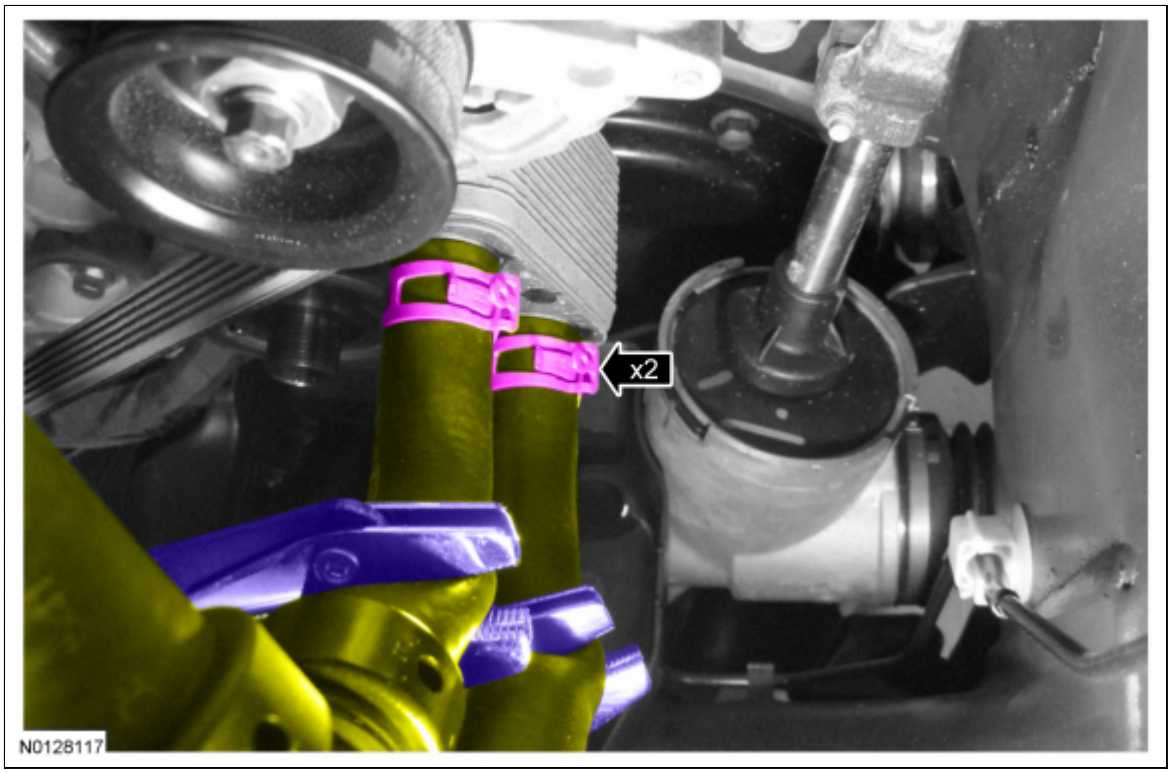
Installation

1. Align the oil cooler to the oil filter adapter and install the oil cooler insert bolt.
    - Tighten to 58 Nm (43 lb-ft).



2. Connect the oil cooler coolant hoses.
    - Remove the hose clamp pliers.

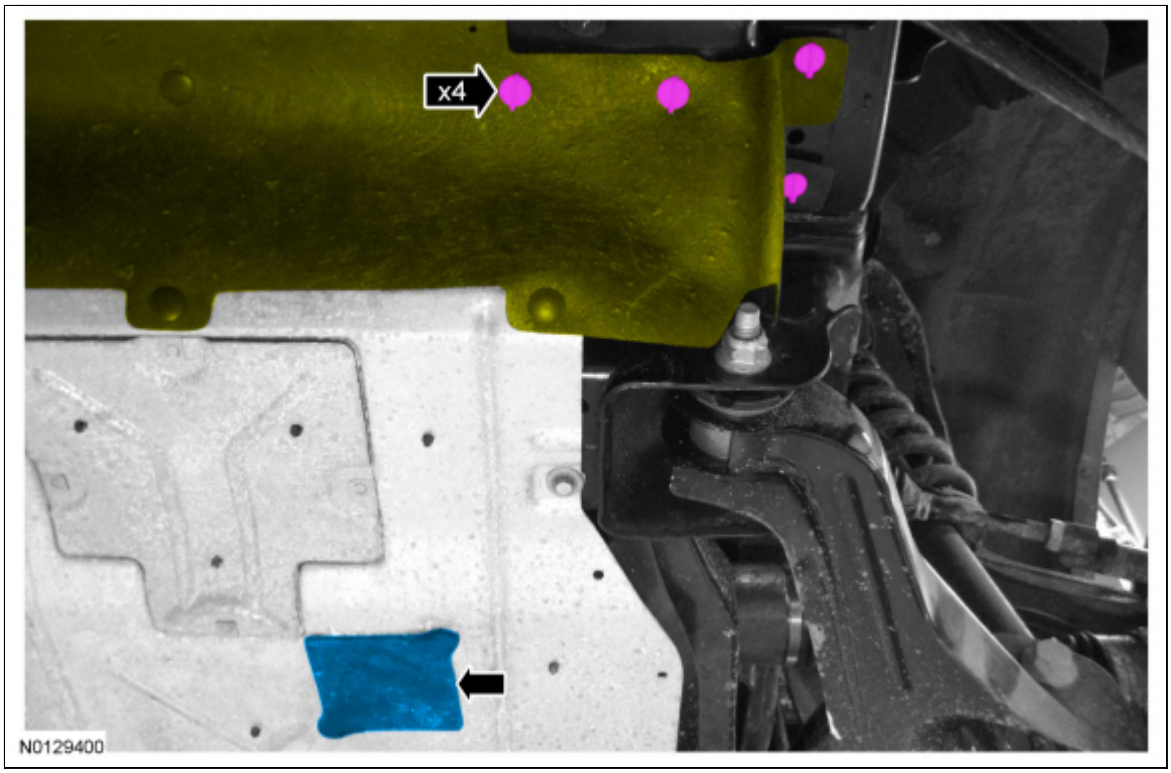
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3. **NOTE:** Do not lubricate the engine oil filter gasket.

   Install a new engine oil filter.
   - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

4. If equipped, position the air deflector and fasten the 4 retainers. Install the skid plate cover.



5. Install the ACL outlet pipe and the LH ACL -to-turbocharger pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

6. Inspect and adjust the coolant level in the degas bottle.

7. Inspect and adjust the engine oil level.

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Oil Filter Adapter

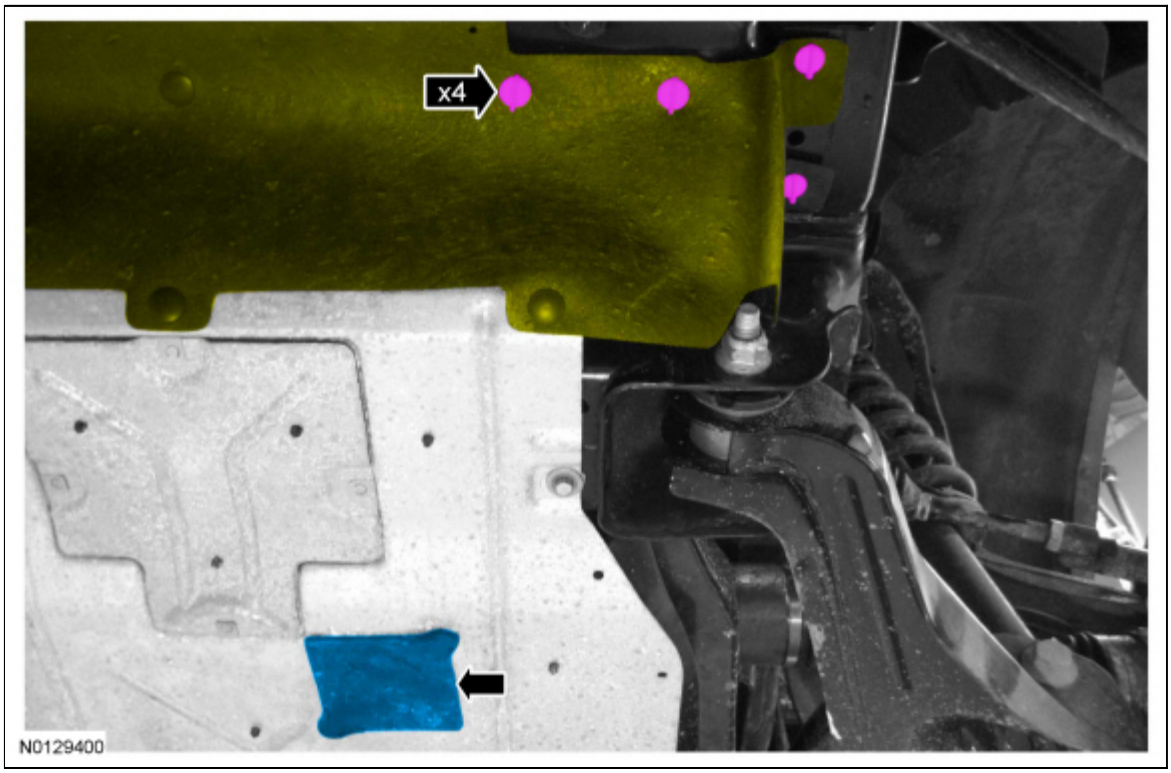
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the Air Cleaner (ACL) outlet pipe and the LH ACL -to-turbocharger pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .

4. If equipped, rotate the 4 retainers and position the air deflector down. Rotate the skid plate cover counterclockwise and remove.

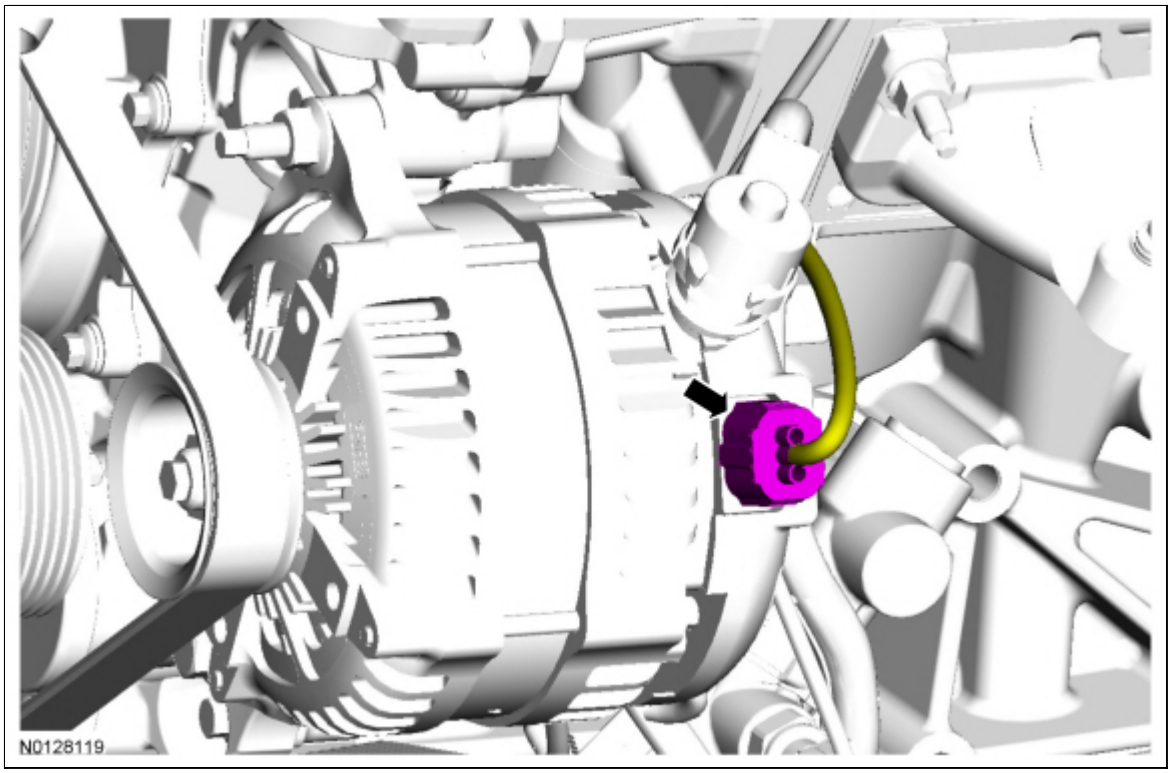


5. Remove and discard the engine oil filter.

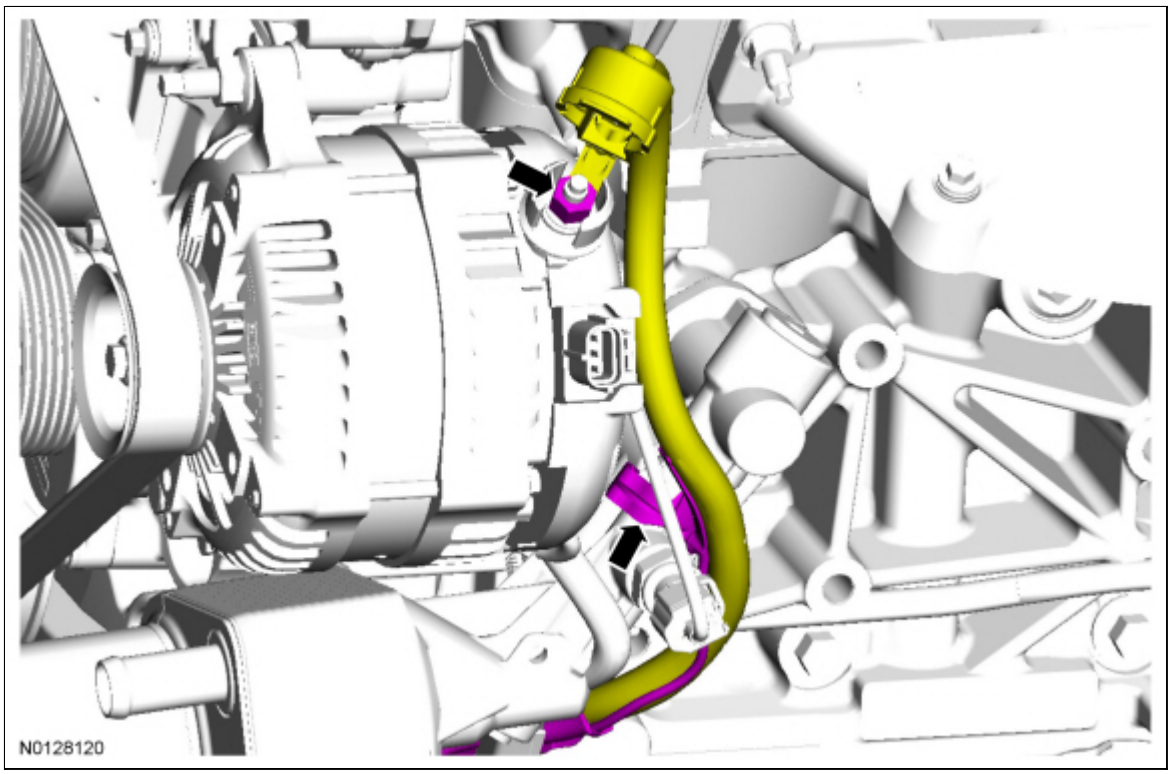
6. ***NOTICE:*** **If metal or foreign material is present in the oil cooler, mechanical concerns exist. To diagnose the mechanical concerns, refer to Section 303-00 .**

   Remove the oil cooler insert bolt and position the oil cooler aside.
   - Inspect the oil cooler gasket, replace if necessary.

7. Disconnect the generator electrical connector.



8. Position the generator B+ protective boot aside, remove the B+ nut and position the B+ terminal aside.
    - Detach the generator wiring harness retainer from the oil filter adapter and position the generator wiring harness aside.



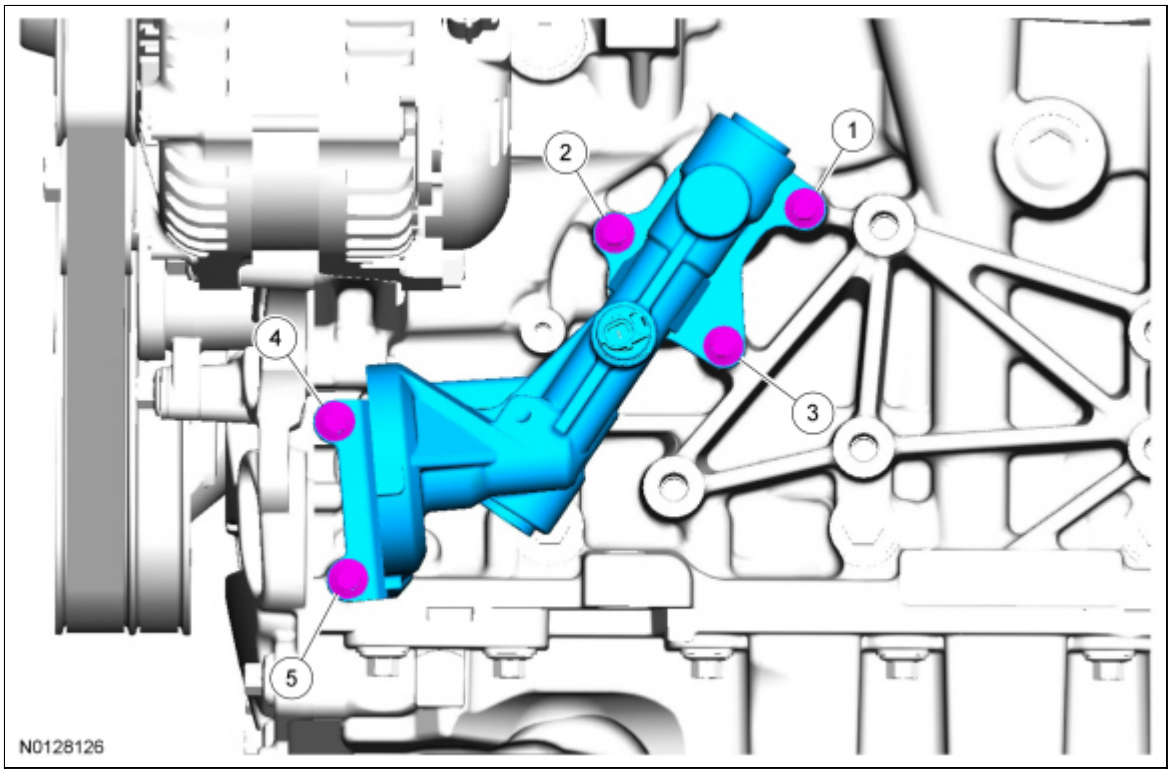
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9. Disconnect the Engine Oil Pressure (EOP) electrical connector.

10. Remove the 5 bolts and the oil filter adapter.
    - Discard the gasket.
    - Clean and inspect all sealing surfaces.

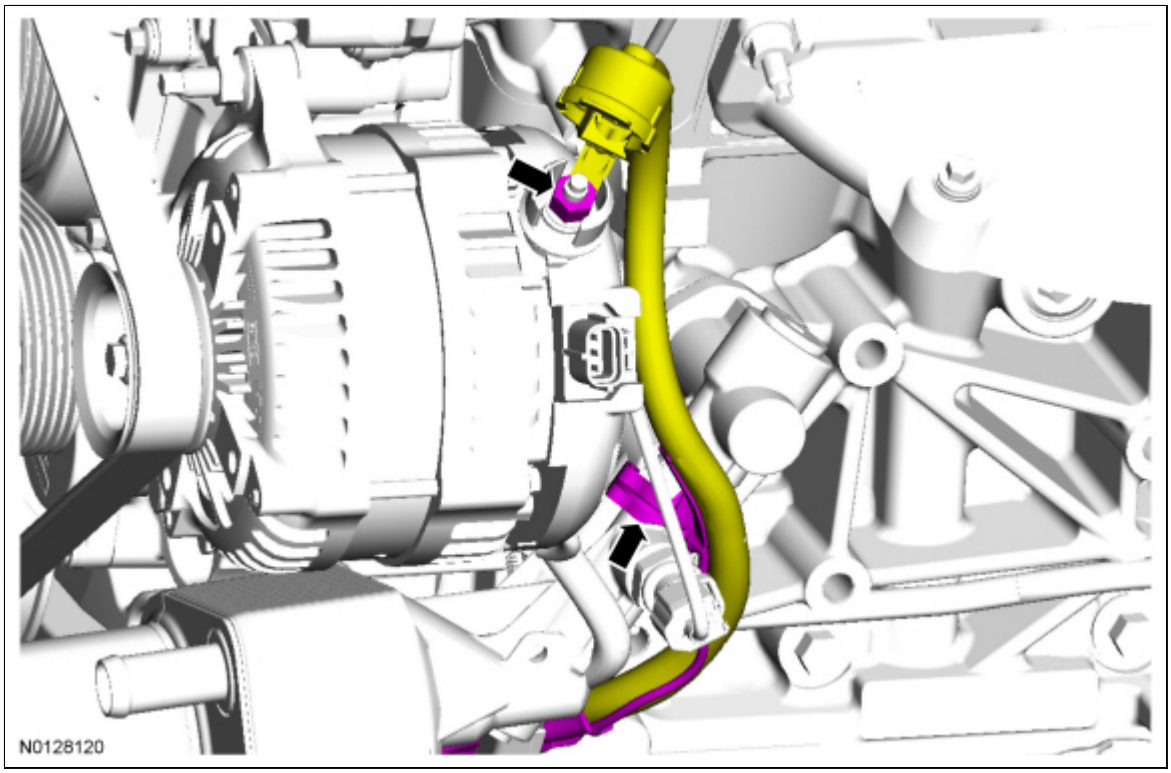
Installation

1. Using a new gasket, install the oil filter adapter and the 5 bolts. Tighten in sequence shown.
    - Tighten to 10 Nm (89 lb-in) and then an additional 45 degrees.

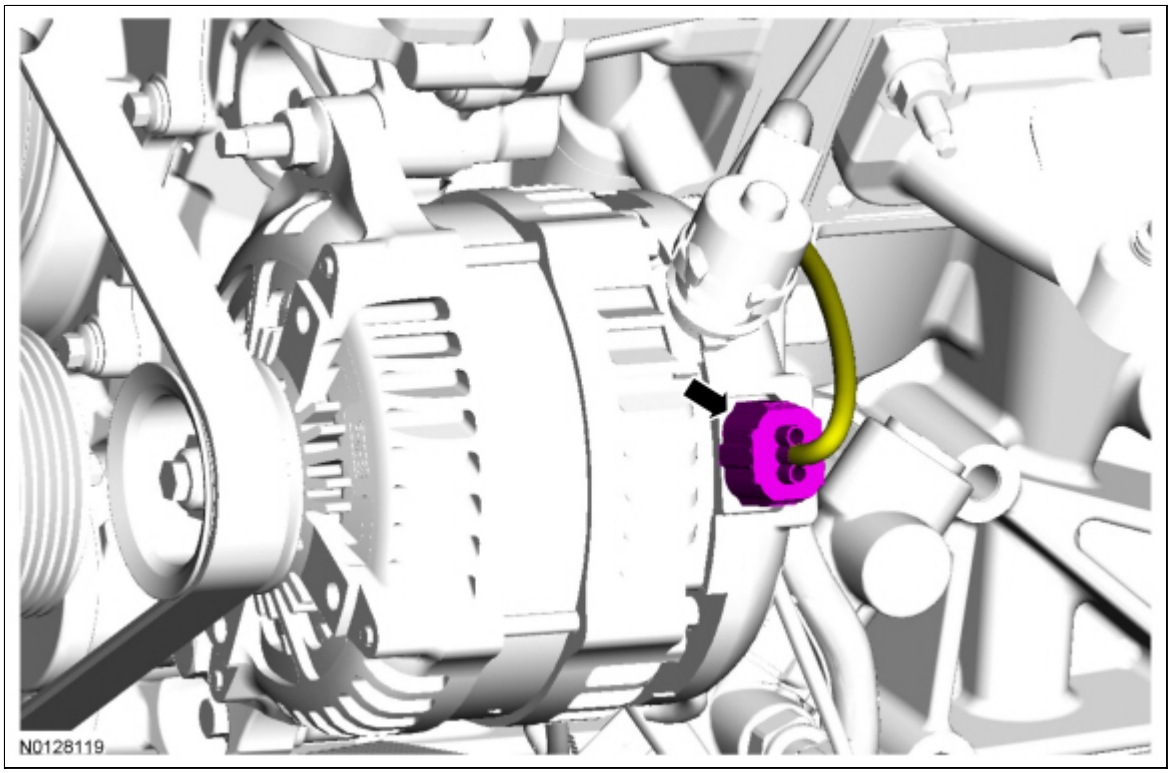


2. Connect the EOP electrical connector.

3. Position back the generator wiring harness and B+ terminal and install the nut.
    - Tighten to 17 Nm (150 lb-in).
    - Position back the generator B+ protective boot.
    - Attach the generator wiring harness retainer to the oil filter adapter.



4. Connect the generator electrical connector.



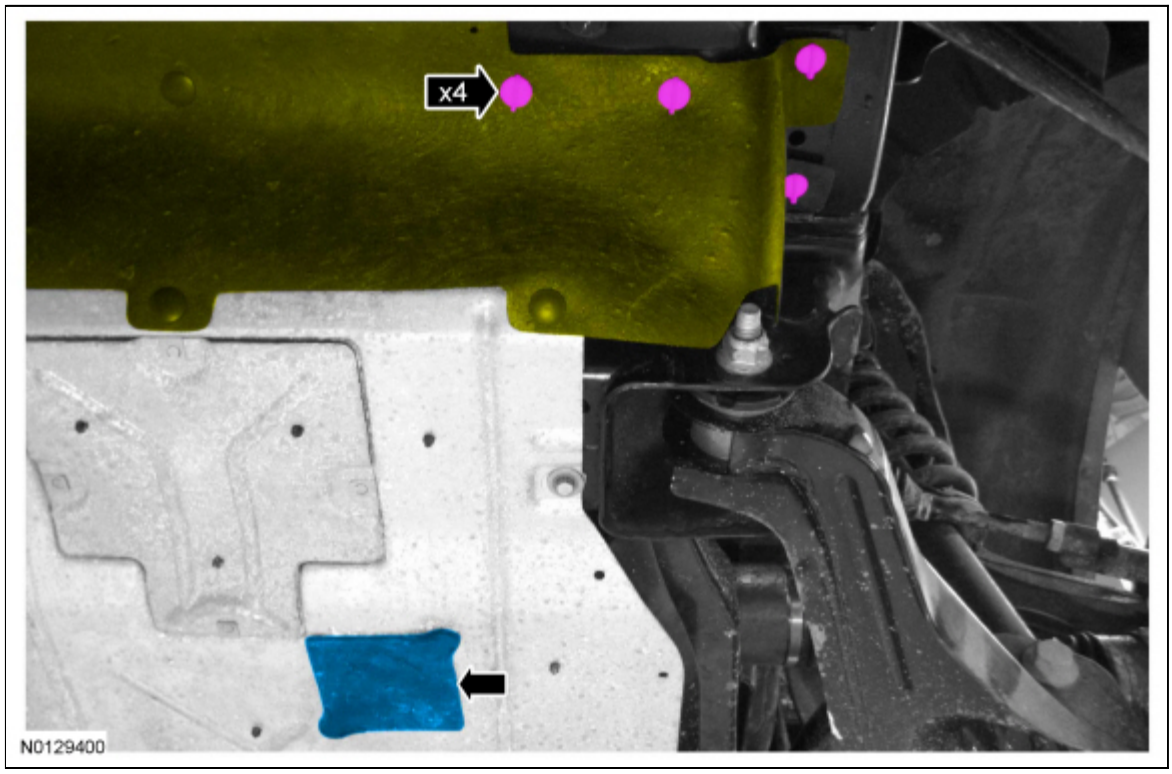
5. Position back the oil cooler and install the oil cooler insert bolt.
    - Tighten to 58 Nm (43 lb-ft).

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6. **NOTE:** Do not lubricate the engine oil filter gasket.

   Install the engine oil filter.
   - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

7. If equipped, position the air deflector and fasten the 4 retainers. Install the skid plate cover.



8. Install the ACL outlet pipe and the LH ACL -to-turbocharger pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

10. Inspect and adjust the engine oil level.

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Oil Pan

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Silicone Gasket Remover ZC-30	—

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All vehicles

1. **NOTE:** This step does not apply if the front engine cover is removed.

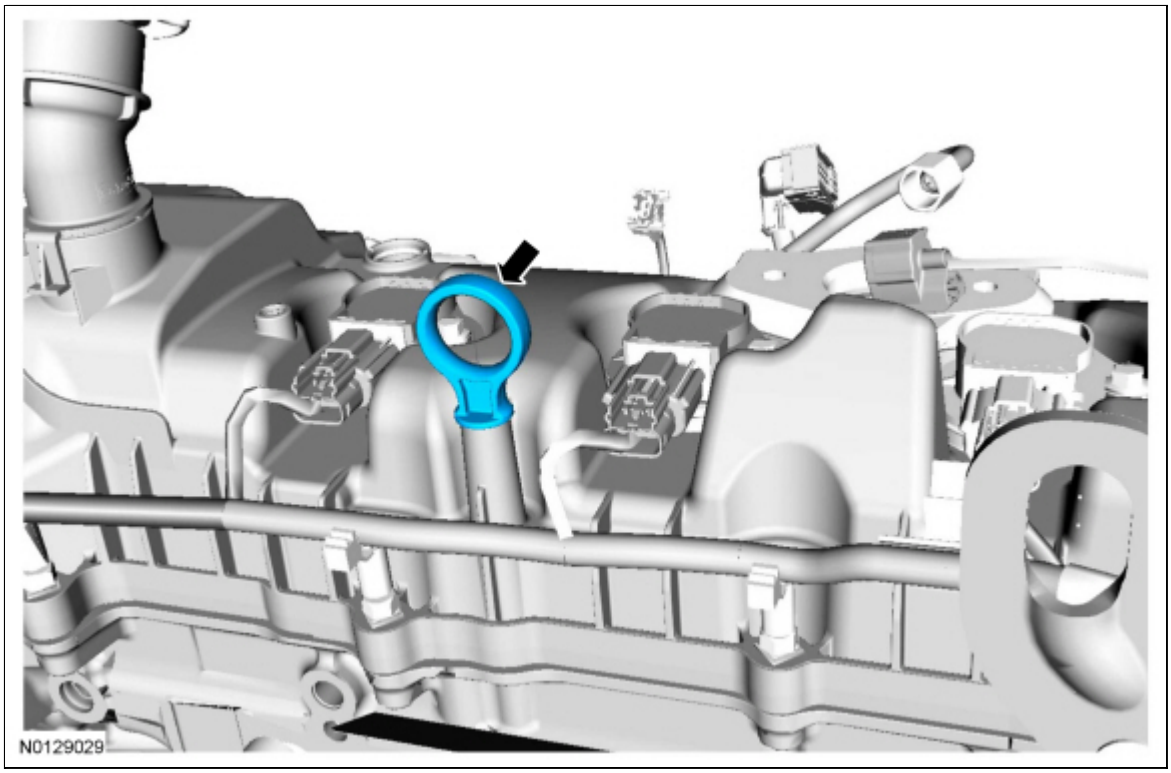
   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** This step does not apply if the front engine cover is removed.

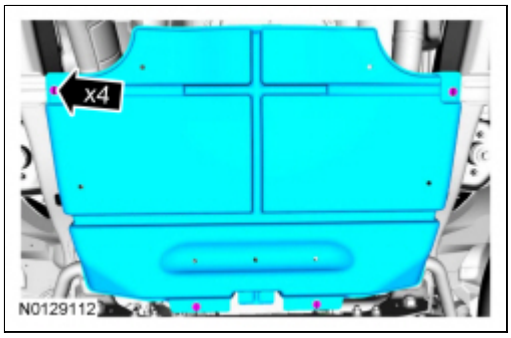
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** This step does not apply if the front engine cover is removed.

   Remove the oil level indicator.



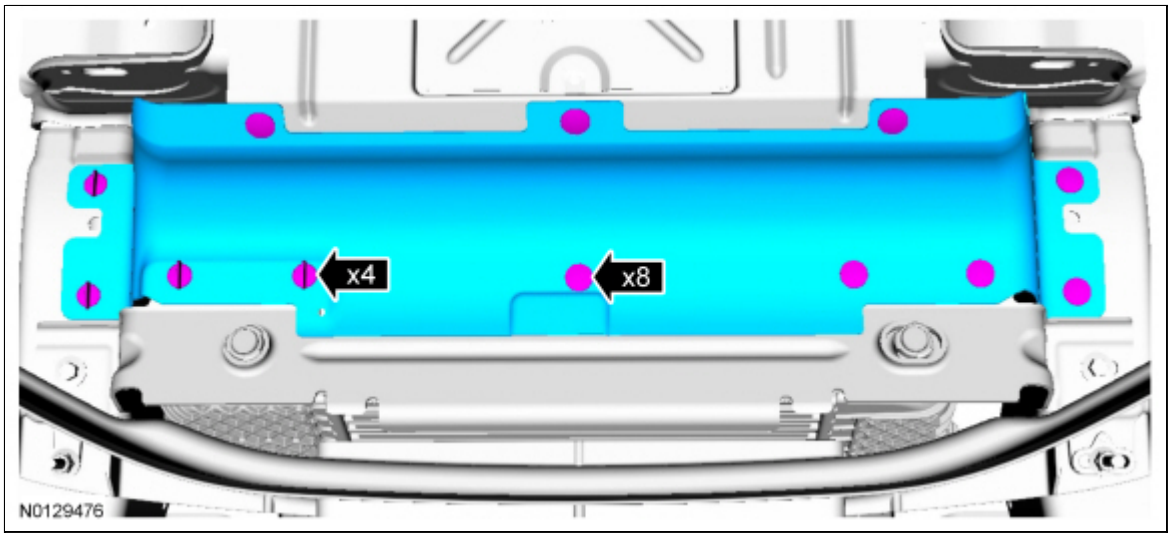
4. Release the 4 fasteners and remove the splash shield.



5. **NOTE:** This step does not apply if the front engine cover is removed.

   If equipped, turn the 4 quarter-turn retainers, detach the 8 pushpins and remove the lower air deflector.

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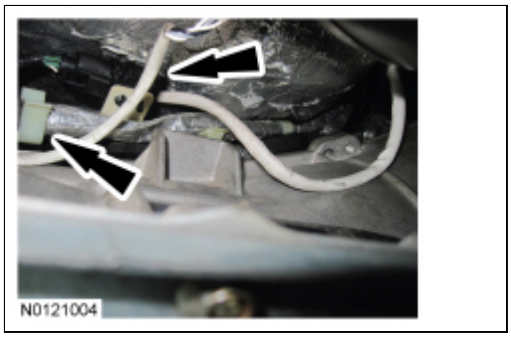
6. If equipped, Remove the 4 bolts and the skid plate.

7. Remove the front air dam. For additional information, refer to the Front End Body Panels — Exploded View in Section 501-02 .

8. **NOTE:** This step does not apply if the front engine cover is removed.

   NOTE: Only one wire harness retainer and one electrical connector shown, others similar.

   Disconnect the 2 HO2S electrical connectors.
   - Disconnect the 2 HO2S electrical connector retainers.
   - If equipped, disconnect the 5 transmission wire harness retainers from the transfer case wire harness.



9. **NOTE:** This step does not apply if the front engine cover is removed.

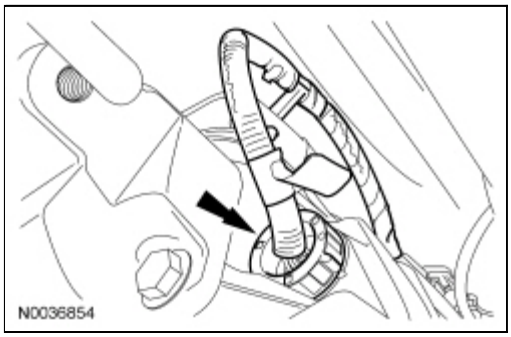
   Disconnect the HO2S electrical connector at the LH rear of the transmission.
   - Disconnect the electrical connector retainer from the bracket at the rear of the transmission.



10. ***NOTICE:*** **Do not pull on the wire harness to disconnect the connector or damage to the connector will occur.**

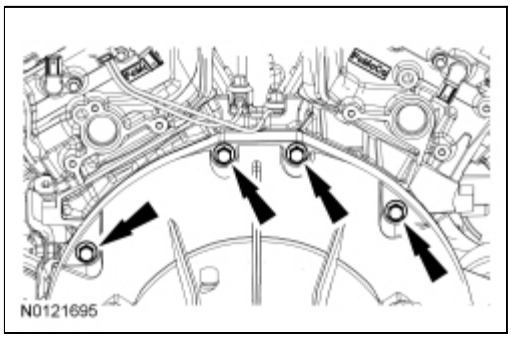
    NOTE: This step does not apply if the front engine cover is removed.

    Disconnect the transmission vehicle harness connector by twisting the outer shell and pulling back on the connector.



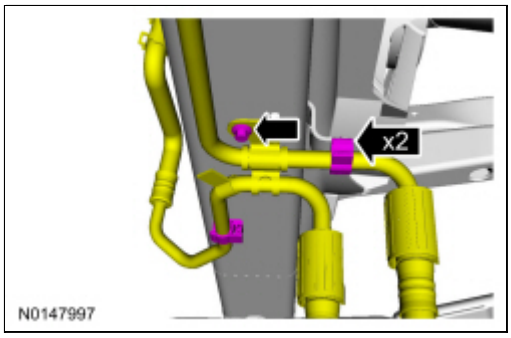
11. **NOTE:** This step does not apply if the front engine cover is removed.

    Loosen the 4 upper bellhousing-to-engine bolts 5 mm (0.19 in).



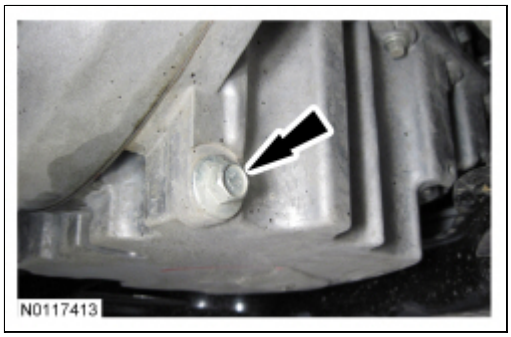
12. Remove the bolt and disconnect the 2 retainers for the transmission cooler tubes.

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13. **NOTE:** This step does not apply if the front engine cover is removed.

    Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

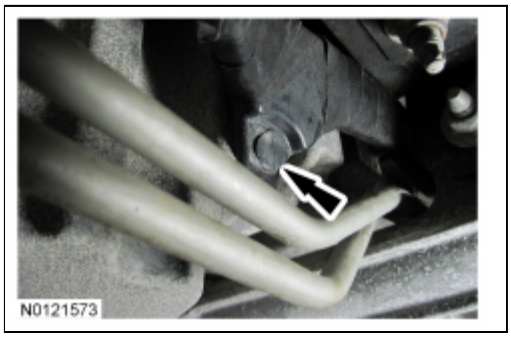


14. Remove and discard the engine oil filter.

15. Remove the starter motor. For additional information, refer to Section 303-06 .

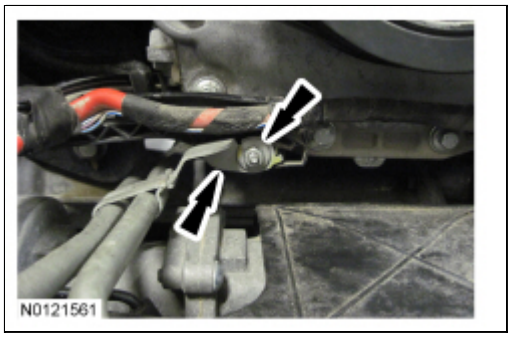
16. **NOTE:** This step does not apply if the front engine cover is removed.

    Detach the starter motor wiring harness retainer from the oil pan.



17. **NOTE:** This step does not apply if the front engine cover is removed.

    Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.

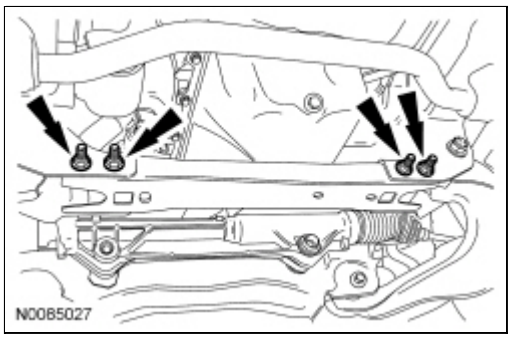


18. **NOTE:** This step does not apply if the front engine cover is removed.

    Detach the generator wiring harness from the engine front cover.

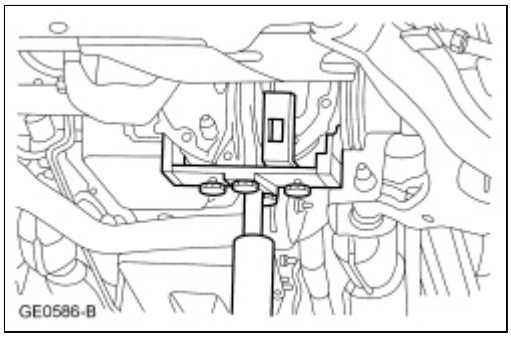


19. Remove the 4 nuts and bolts and the crossmember.



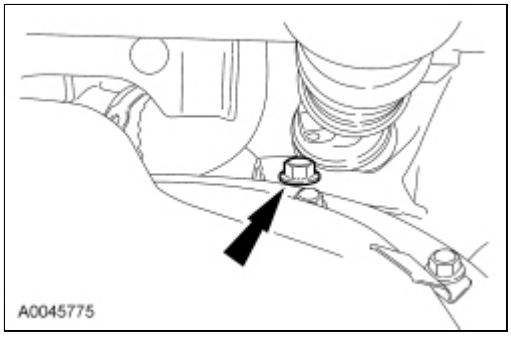
Four Wheel Drive (4X4) vehicles

20. Position a suitable hydraulic jack under the front axle. Securely strap the axle to the jack.

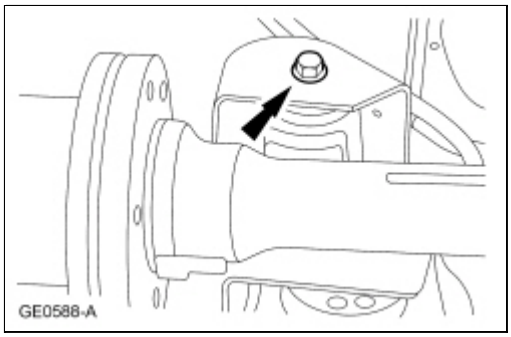


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21. Remove the upper front axle carrier mounting bushing bolt.

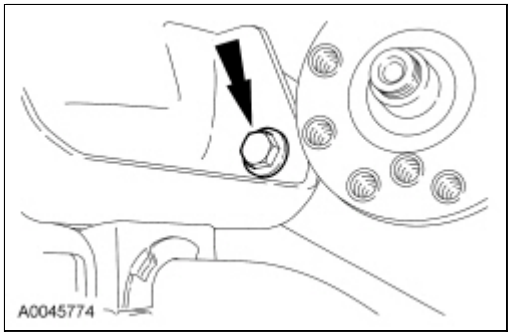


22. Remove the axle shaft housing carrier bushing bolt.



23. **NOTE:** Front driveshaft removed for clarity only.

    Remove the lower front axle carrier mounting bushing bolt.



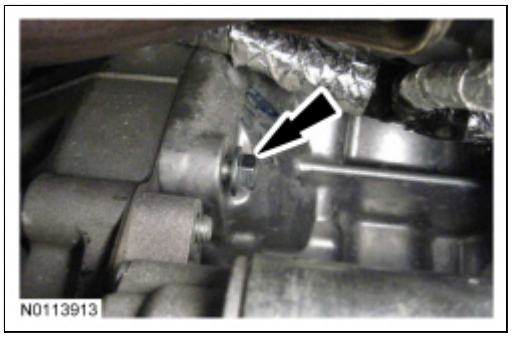
24. ***NOTICE:*** **Use care when lowering the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

    Lower the axle to allow clearance for the oil pan to be removed.

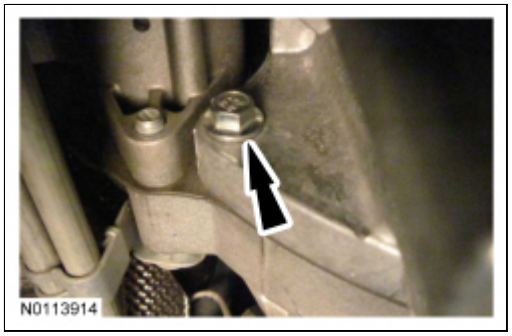
All vehicles

25. **NOTE:** This step does not apply if the front engine cover is removed.

    Loosen the engine-to-bellhousing bolt above the starter motor 5 mm (0.19 in).

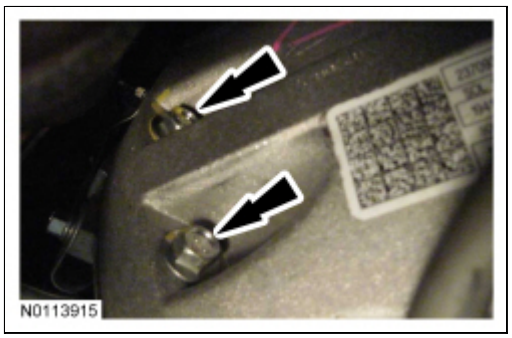


26. Remove the oil pan-to-bellhousing bolt from below the starter motor.

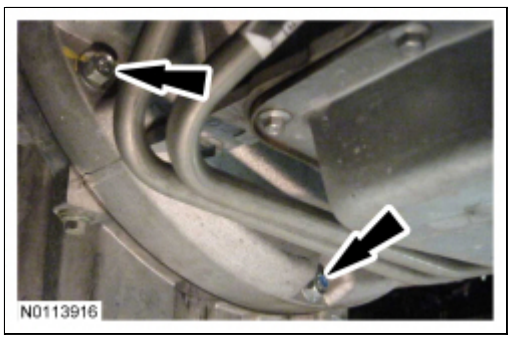


27. **NOTE:** This step does not apply if the front engine cover is removed.

    Loosen the 2 LH bellhousing-to-engine bolts 5 mm (0.19 in).



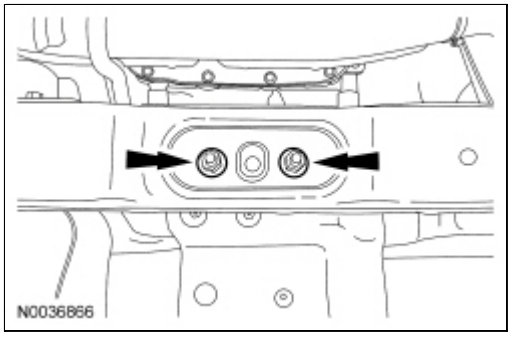
28. Remove the 2 LH bellhousing-to-oil pan bolts.



29. **NOTE:** This step does not apply if the front engine cover is removed.

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Loosen the 2 transmission crossmember nuts.

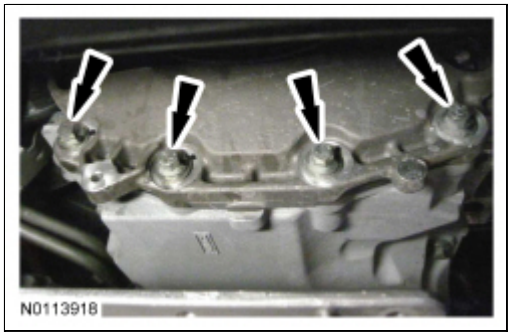


30. **NOTE:** This step does not apply if the front engine cover is removed.

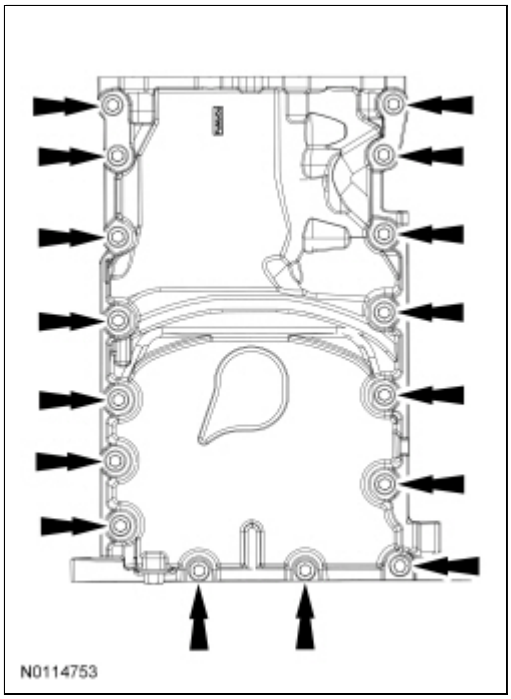
    Slide the transmission rearward 5 mm (0.19 in).

31. **NOTE:** This step does not apply if the front engine cover is removed.

    Remove the 4 lower engine front cover bolts.

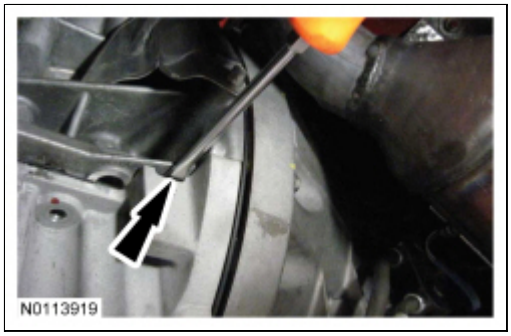


32. Remove the 16 oil pan bolts.



33. **NOTE:** LH rear shown, RH front similar.

    Using a suitable pry tool, locate the 2 pry pads at the LH and RH sides of the oil pan and pry the oil pan loose and remove.



34. **NOTE:** The generator wiring harness retainer is being removed for clearance to install the oil pan.

    Detach the generator wiring harness retainer from the engine block.



35. ***NOTICE:*** **Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the oil**

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pan. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean. These tools cause scratches and gouges that make leak paths.

Clean the engine oil pan using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

- Thoroughly wash the oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

36. ***NOTICE:*** **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the cylinder block and engine front cover sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

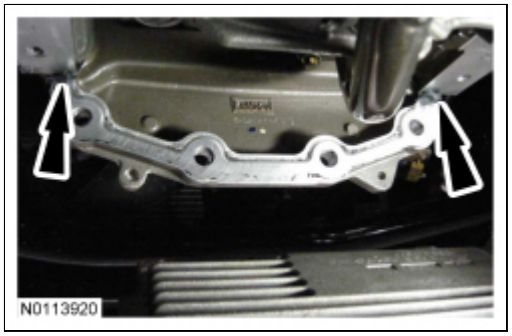
    Clean the sealing surfaces of the cylinder block and engine front cover in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

All vehicles

1. **NOTE:** This step does not apply if the front engine cover is removed.

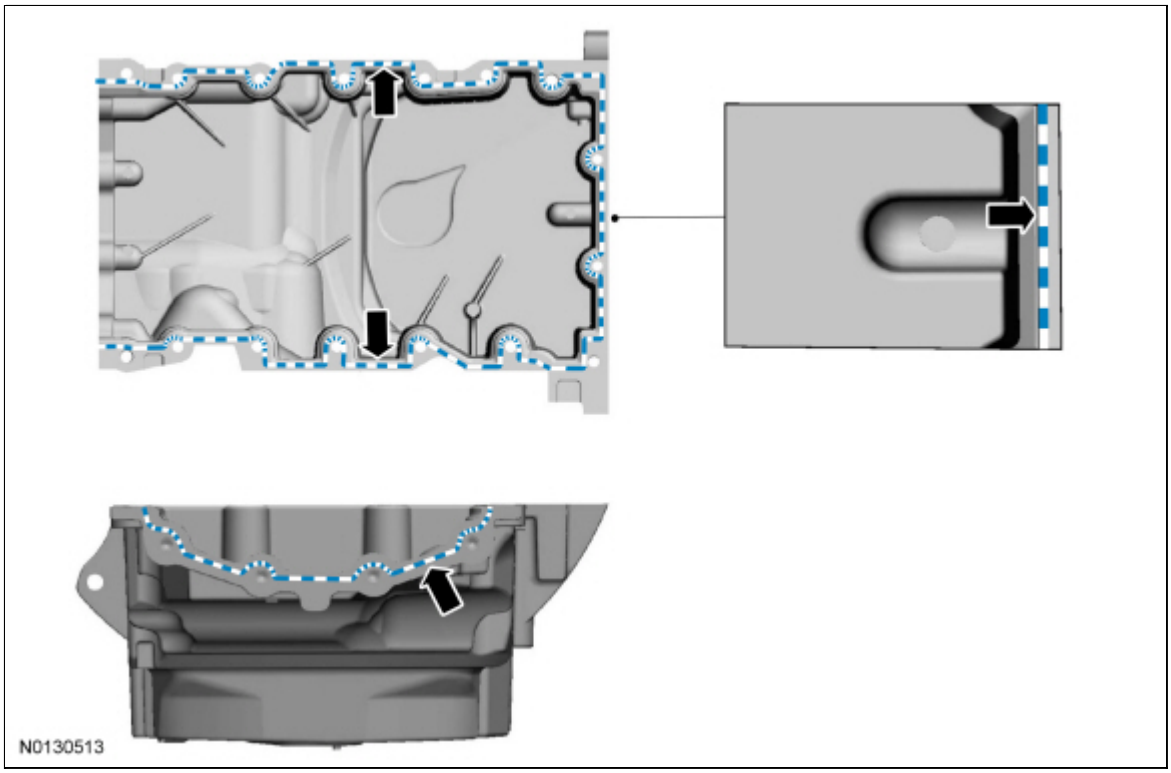
    Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 engine front cover-to-cylinder block joint areas on the sealing surface of the oil pan.



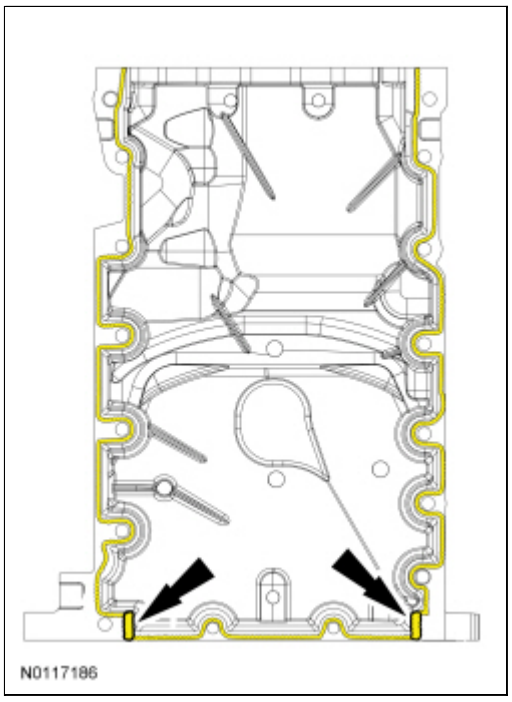
2. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the oil pan to the sealing surface of the oil pan-to-engine block mating surface.



3. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.



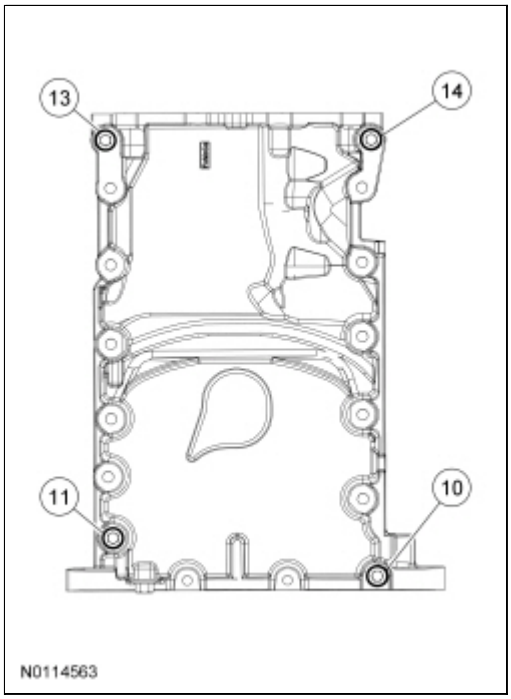
4. **NOTE:** The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.

   NOTE: Keep the oil pan as close as possible to the transmission while installing, then slide forward towards the engine front cover to prevent wiping off of the sealant.

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Install the oil pan and bolts 10, 11, 13 and 14.

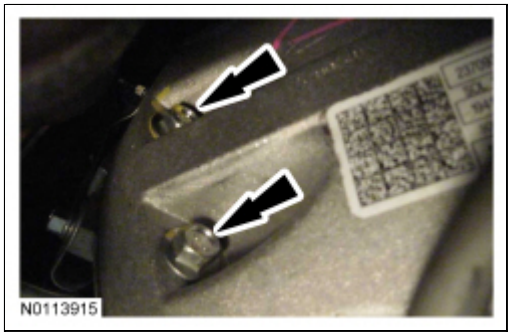
- Tighten finger-tight.



5. **NOTE:** This step does not apply if the front engine cover is removed.

   Install the 2 LH bellhousing-to-engine bolts.

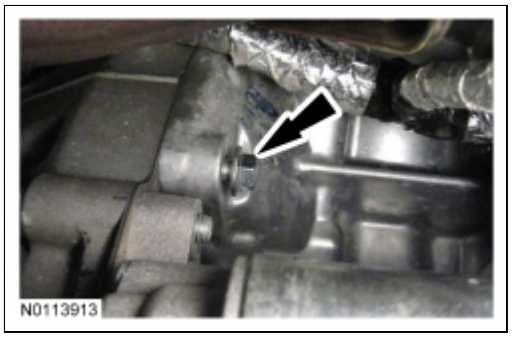
   - Do not torque at this time.



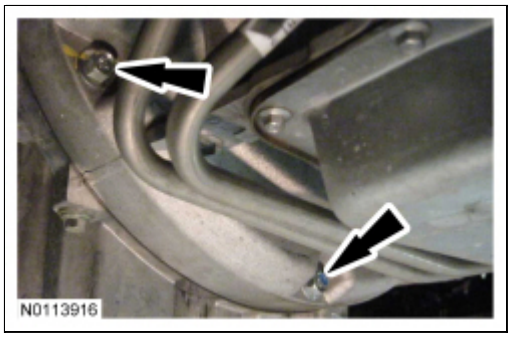
6. **NOTE:** This step does not apply if the front engine cover is removed.

   Install the RH engine-to-bellhousing bolt.

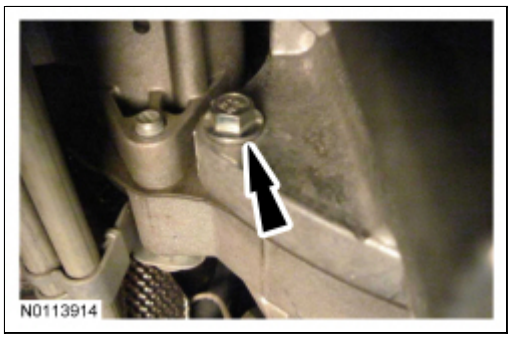
   - Do not torque at this time.



7. Install the 2 LH bellhousing-to-oil pan bolts.
    - Do not torque at this time.

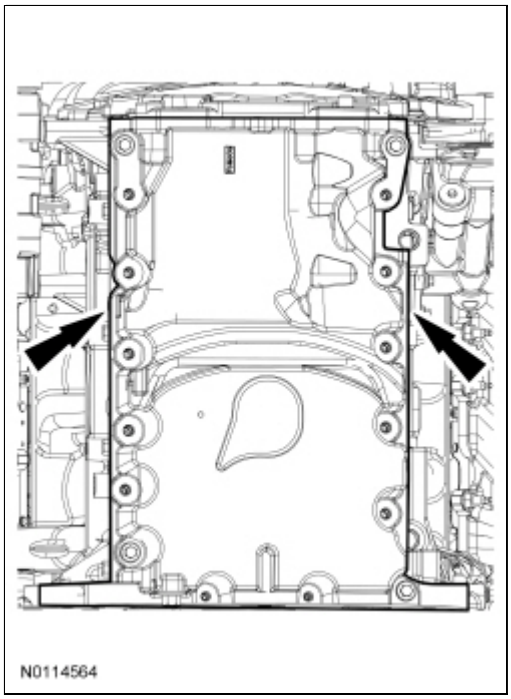


8. Install the RH oil pan-to-bellhousing bolt.
    - Do not torque at this time.

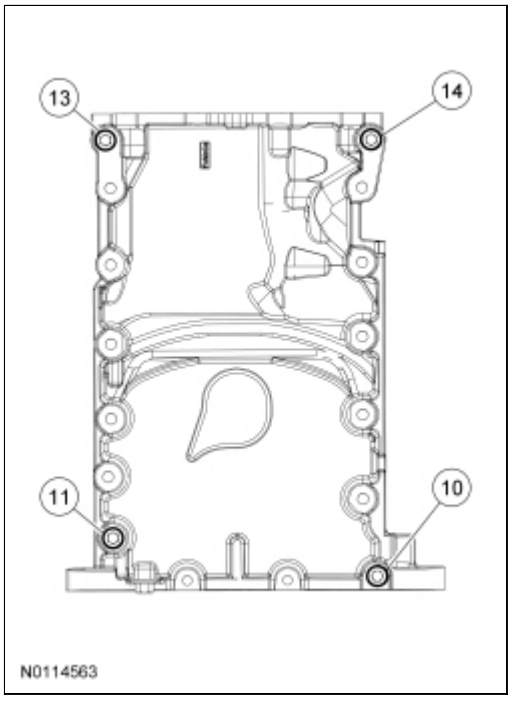


9. Laterally align the oil pan to the block. Make sure the oil pan is flush with the block at these 2 points.

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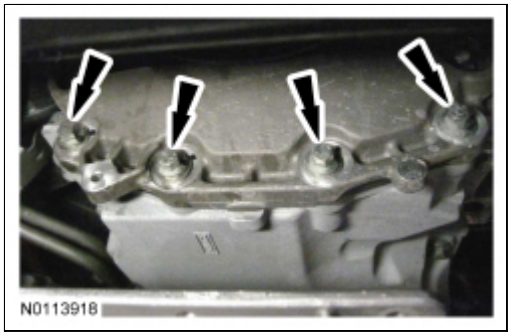


10. Tighten bolts 10, 11, 13 and 14 in the sequence shown.
    - Tighten to 3 Nm (27 lb-in).

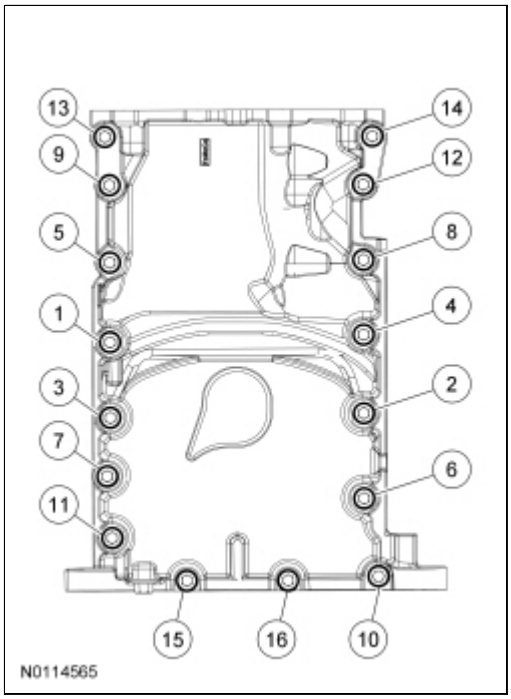


11. **NOTE:** This step does not apply if the front engine cover is removed.

    Install the 4 lower engine front cover bolts.
    - Tighten finger-tight.



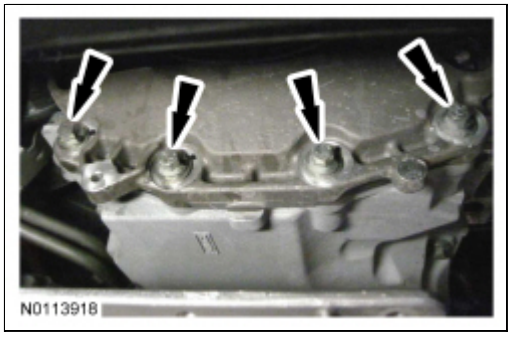
12. Install the remaining oil pan bolts. Tighten in 3 stages in the sequence shown.
    - Stage 1: Tighten bolts 1-9 and 11-14 to 20 Nm (177 lb-in), then rotate an additional 45 degrees.
    - Stage 2: Tighten bolts 15 and 16 to 10 Nm (89 lb-in), then rotate an additional 45 degrees.
    - Stage 3: Tighten bolt 10 to 20 Nm (177 lb-in), then rotate an additional 90 degrees.



13. **NOTE:** This step does not apply if the front engine cover is removed.

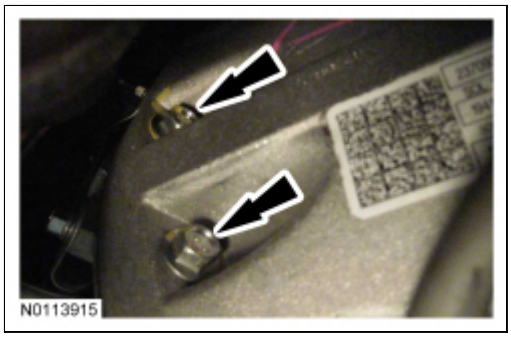
    Tighten the 4 lower engine front cover bolts.
    - Tighten to 24 Nm (18 lb-ft).

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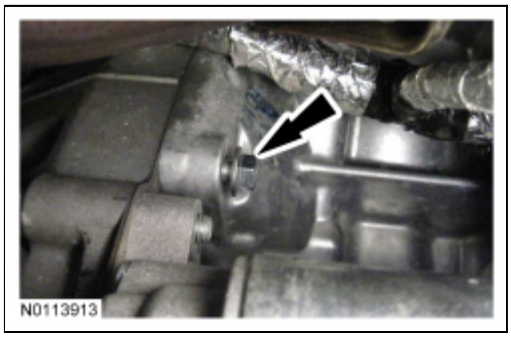
14. **NOTE:** This step does not apply if the front engine cover is removed.

    Tighten the 2 LH bellhousing-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

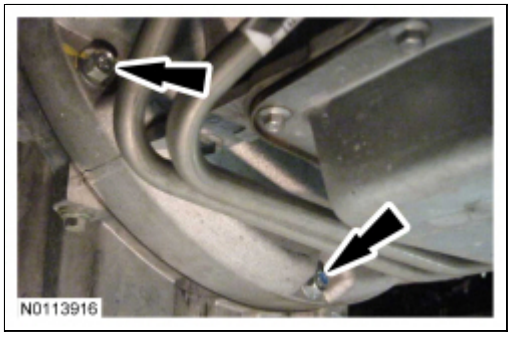


15. **NOTE:** This step does not apply if the front engine cover is removed.

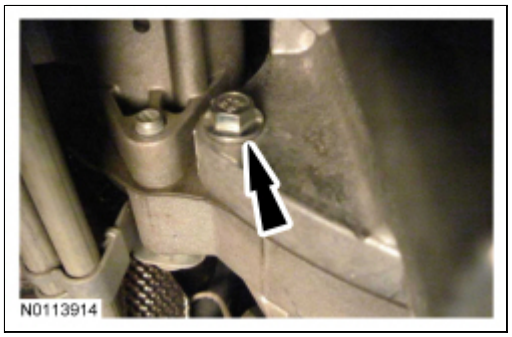
    Tighten the RH engine-to-bellhousing bolt.
    - Tighten to 48 Nm (35 lb-ft).



16. Tighten the 2 LH bellhousing-to-oil pan bolts.
    - Tighten to 48 Nm (35 lb-ft).

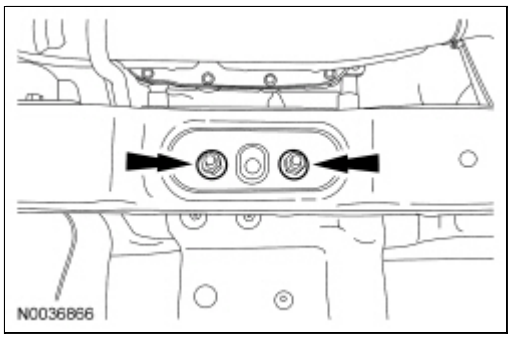


17. Tighten the RH oil pan-to-bellhousing bolt.
    - Tighten to 48 Nm (35 lb-ft).

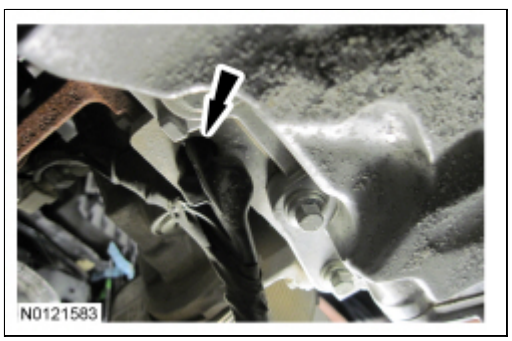


18. **NOTE:** This step does not apply if the front engine cover is removed.

    Tighten the 2 transmission crossmember nuts.
    - Tighten to 103 Nm (75 lb-ft).



19. Attach the generator wiring harness retainer to the engine block.



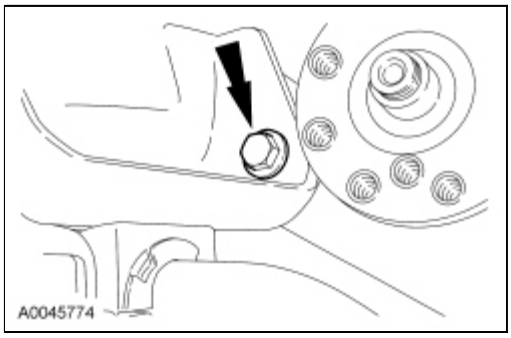
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Four Wheel Drive (4X4) vehicles

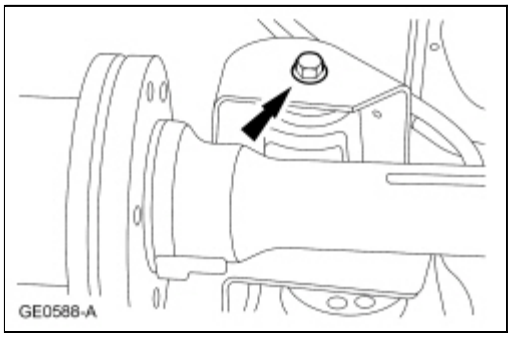
20. ***NOTICE:*** **Use care when positioning the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

    Raise the front axle carrier into position.

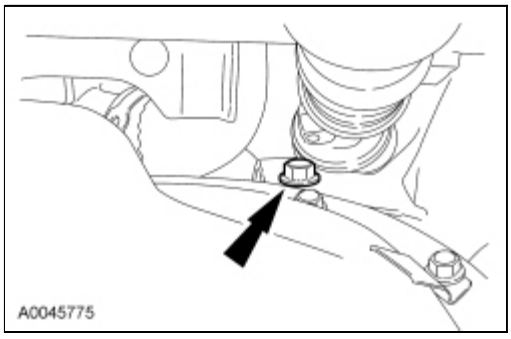
21. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



22. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

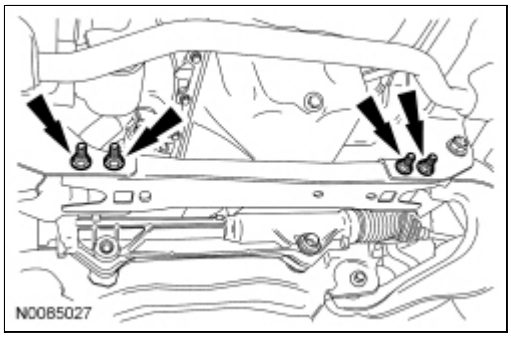


23. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



All vehicles

24. Position the crossmember and install the 4 nuts and bolts.
    - Tighten to 90 Nm (66 lb-ft).



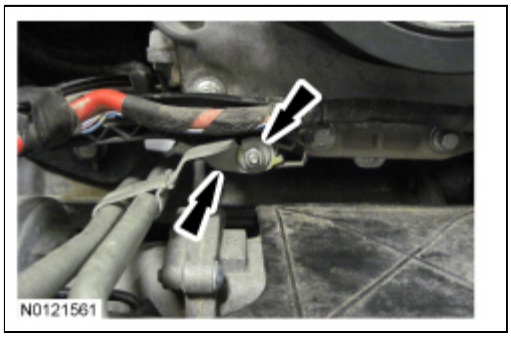
25. **NOTE:** This step does not apply if the front engine cover is removed.

    Attach the generator wiring harness to the engine front cover.



26. **NOTE:** This step does not apply if the front engine cover is removed.

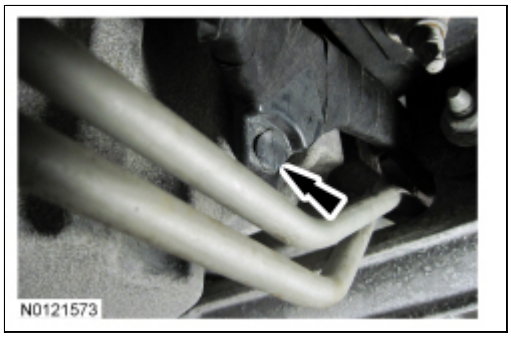
    Install the transmission cooler line bracket and nut to the engine front cover stud bolt.
    - Tighten to 12 Nm (106 lb-in).



27. **NOTE:** This step does not apply if the front engine cover is removed.

    Attach the starter motor wiring harness retainer to the oil pan.

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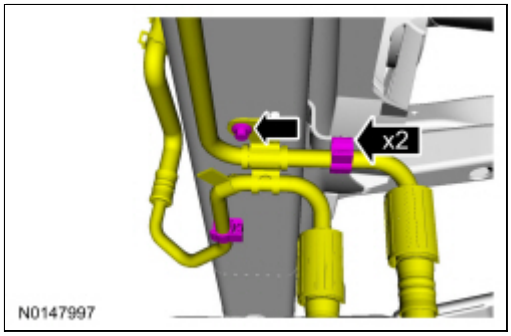


28. Install the starter motor. For additional information, refer to Section 303-06 .

29. **NOTE:** Do not lubricate the engine oil filter gasket.

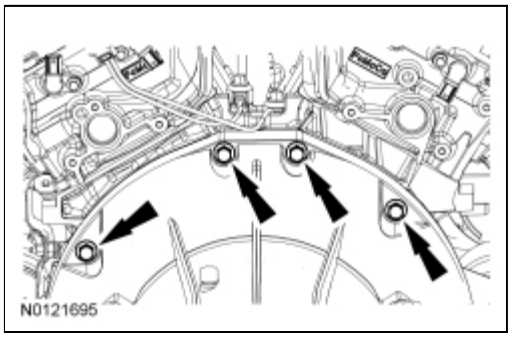
    Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

30. Position the transmission cooler tubes and connect the 2 retainers. Install the bolt for the transmission cooler tube bracket.
    - Tighten to 12 Nm (106 lb-in).



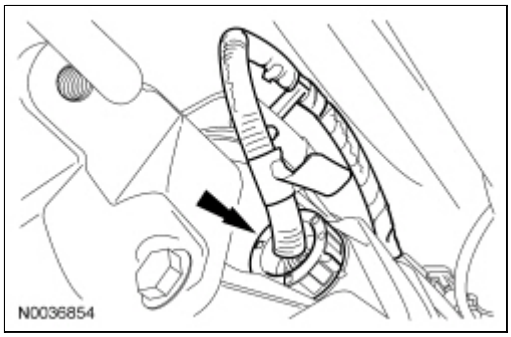
31. **NOTE:** This step does not apply if the front engine cover is removed.

    Tighten the 4 upper bellhousing-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).



32. **NOTE:** This step does not apply if the front engine cover is removed.

    Connect the transmission vehicle harness connector by pushing the connector into the transmission and twisting the outer shell.



33. **NOTE:** This step does not apply if the front engine cover is removed.

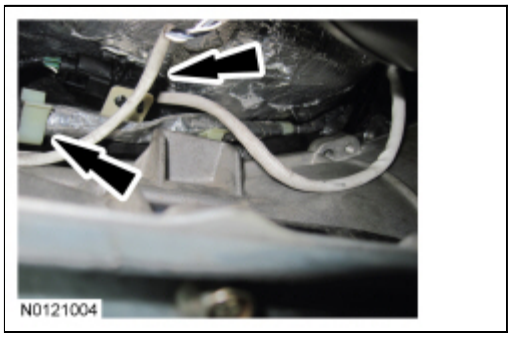
    Connect the electrical connector retainer to the bracket at the rear of the transmission.
    - Connect the Heated Oxygen Sensor (HO2S) electrical connector.



34. **NOTE:** This step does not apply if the front engine cover is removed.

    NOTE: Only one wire harness retainer and one electrical connector shown, others similar.

    If equipped, connect the 5 transmission wire harness retainers to the transfer case wire harness.
    - Connect the 2 HO2S electrical connector retainers.
    - Connect the 2 HO2S electrical connectors.



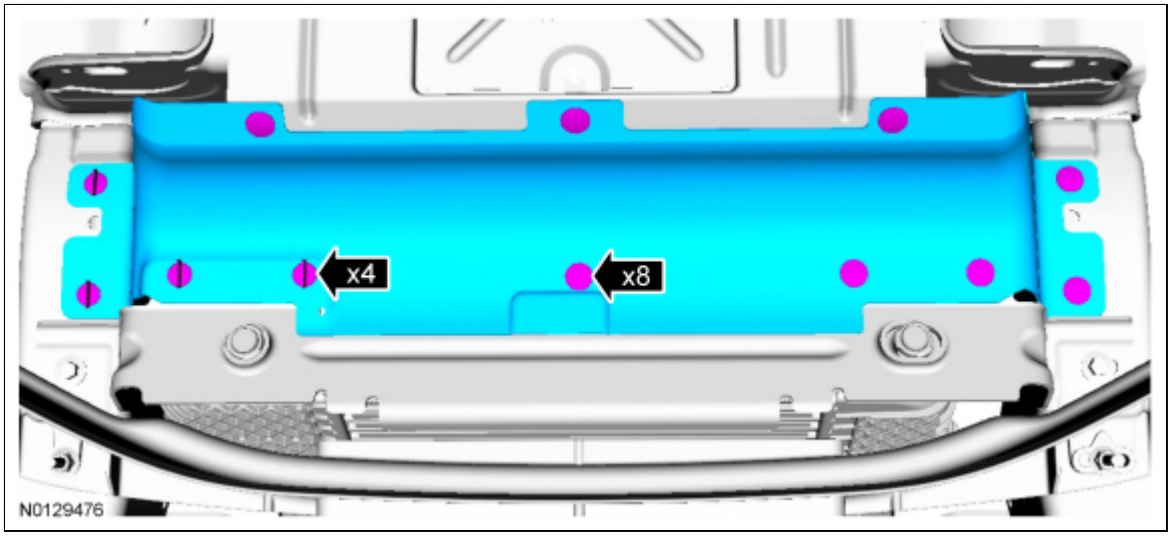
35. Install the front air dam. For additional information, refer to the Front End Body Panels — Exploded View in Section 501-02 .

36. Install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).

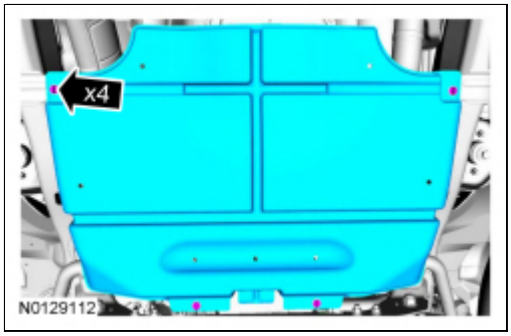
37. **NOTE:** This step does not apply if the front engine cover is removed.

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If equipped, install the lower air deflector and the 8 pushpins. Turn the 4 quarter-turn retainers.

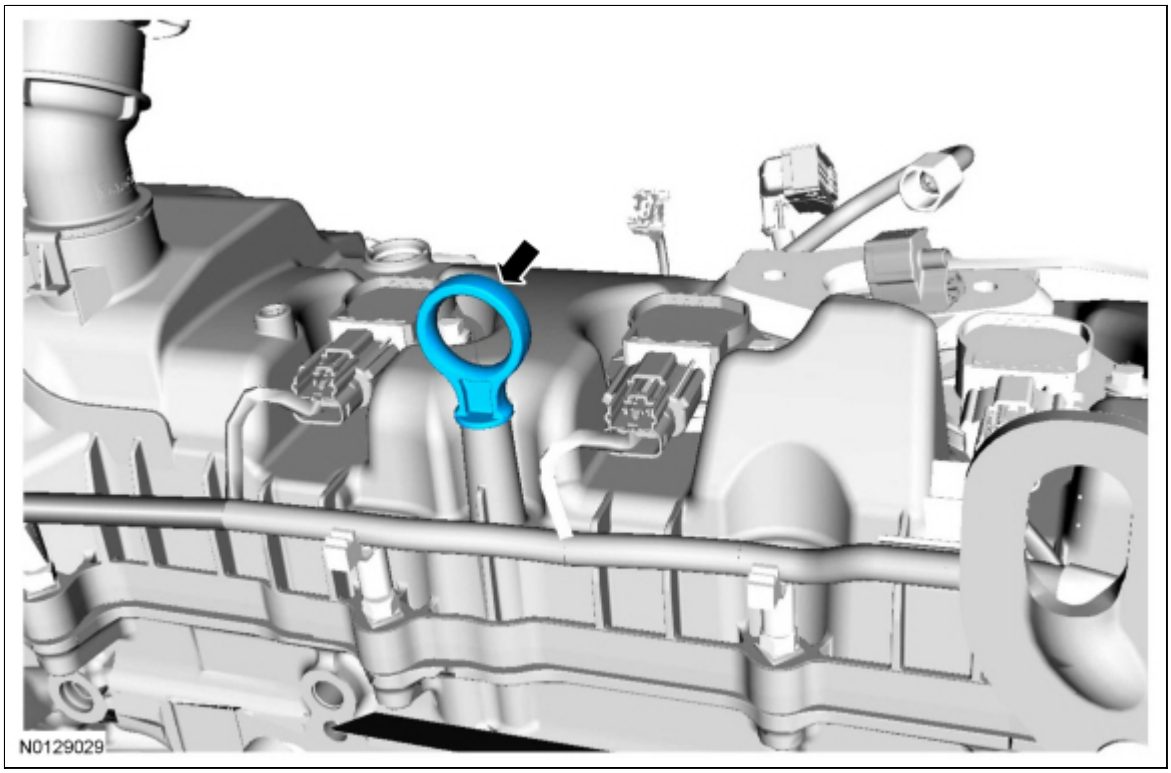


38. If equipped, install the splash shield and the 4 fasteners.



39. **NOTE:** This step does not apply if the front engine cover is removed.

    Install the oil level indicator.



40. **NOTE:** This step does not apply if the front engine cover is removed.

    Fill the engine with clean engine oil.

41. **NOTE:** This step does not apply if the front engine cover is removed.

    Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Oil Pump Screen and Pickup Tube

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.

2. Remove the 3 bolts and the oil pump screen and pickup tube.
   - Discard the O-ring seal.
   - To install, tighten to 10 Nm (89 lb-in).

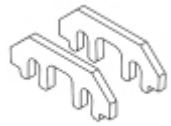
3. **NOTE:** Install a new O-ring seal.

   To install, reverse the removal procedure.

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Oil Pump

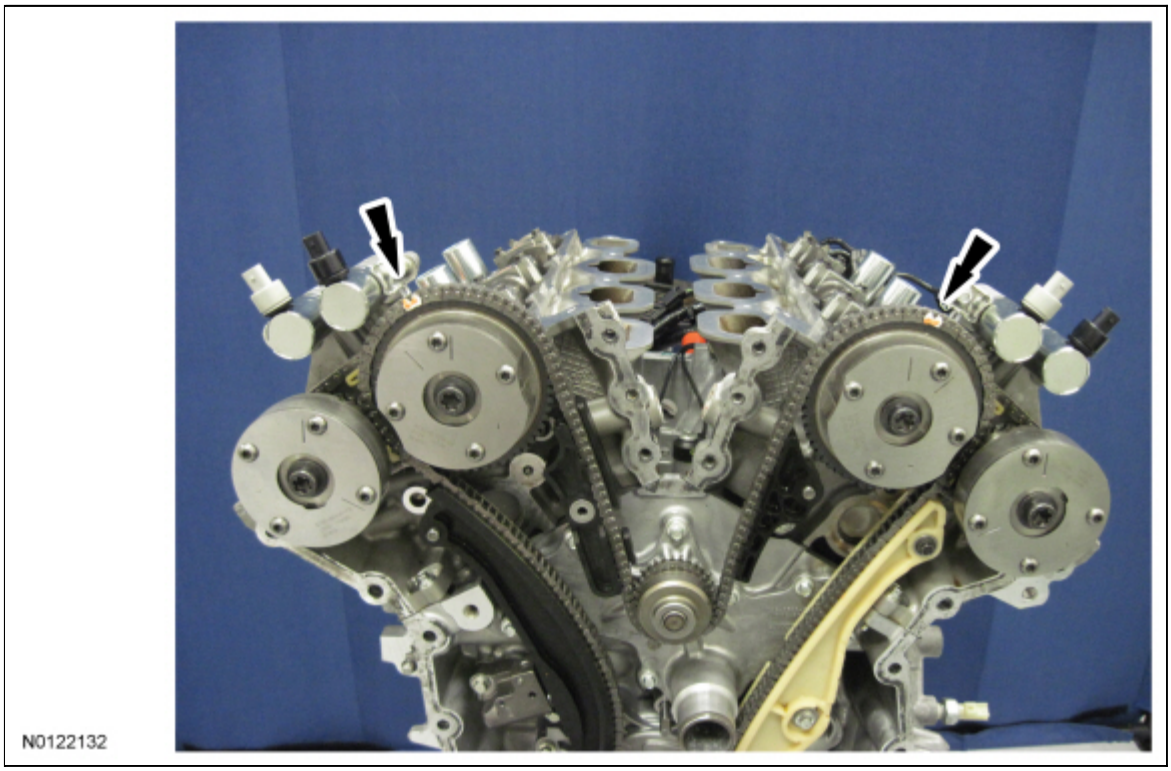
Special Tool(s)

 ST2979-A	Tool, Camshaft Holding 303-1248

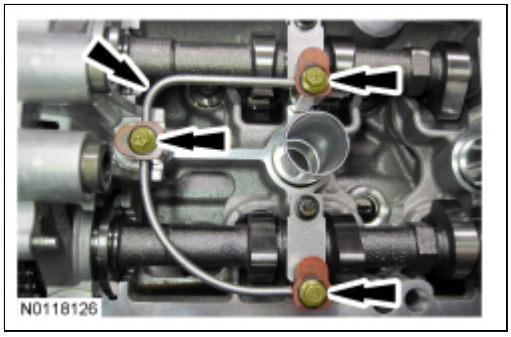
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
3. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown.

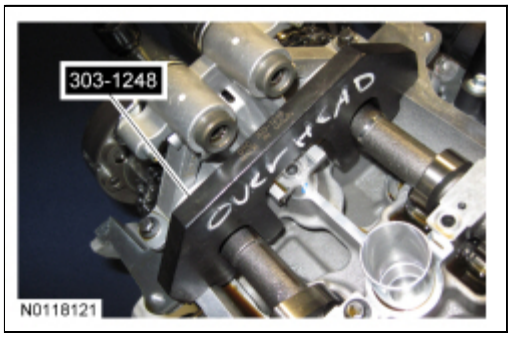


4. Remove the 3 bolts and the LH valve train oil tube.

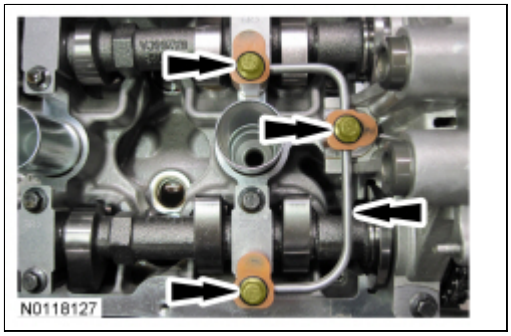


5. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.



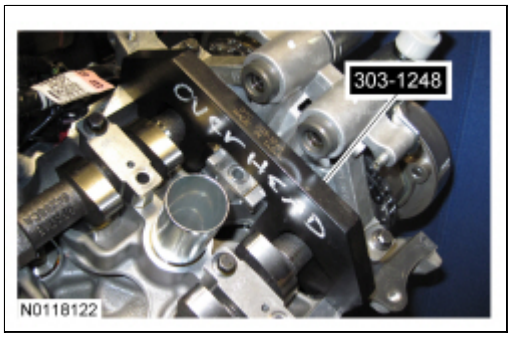
6. Remove the 3 bolts and the RH valve train oil tube.



7. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

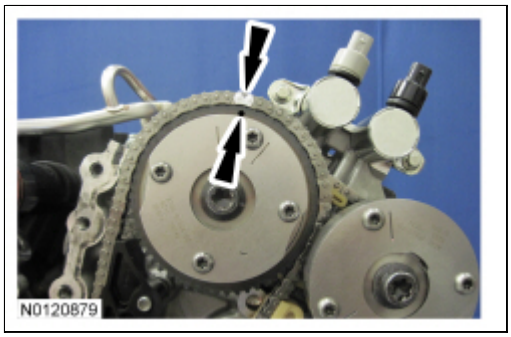
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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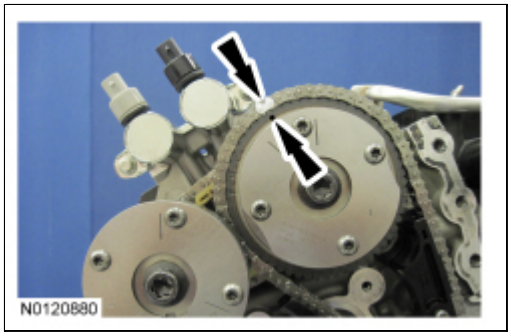


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

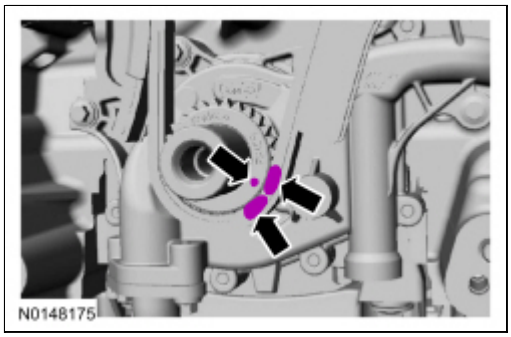


9. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

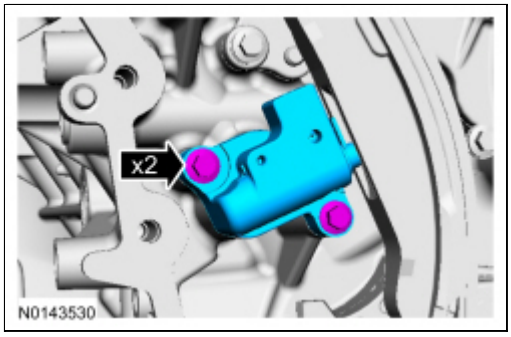


10. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

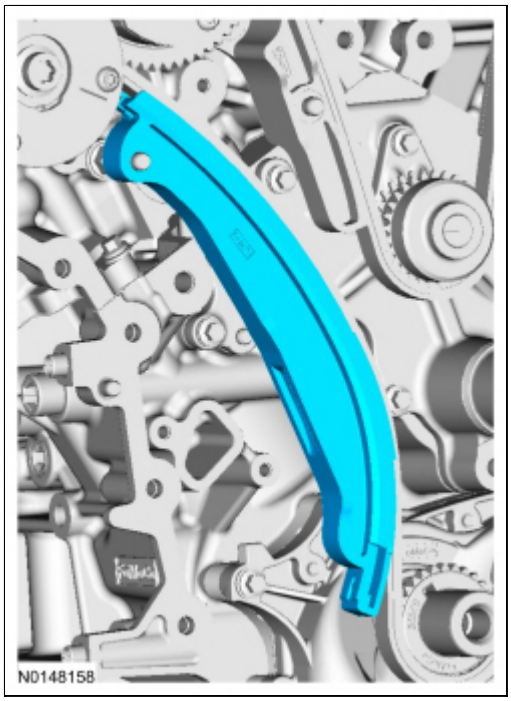
    Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



11. Remove the 2 bolts and the primary timing chain tensioner.

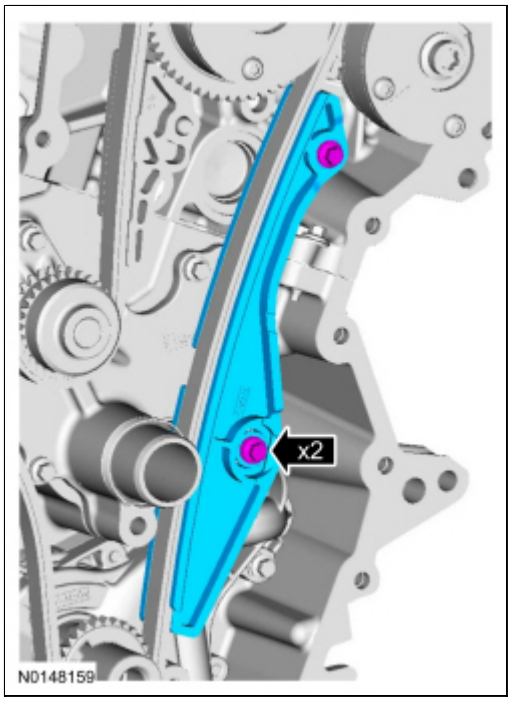


12. Remove the primary timing chain tensioner arm.



13. Remove the 2 bolts and the lower LH primary timing chain guide.

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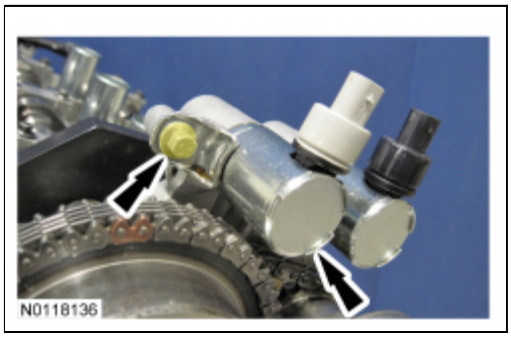


14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.

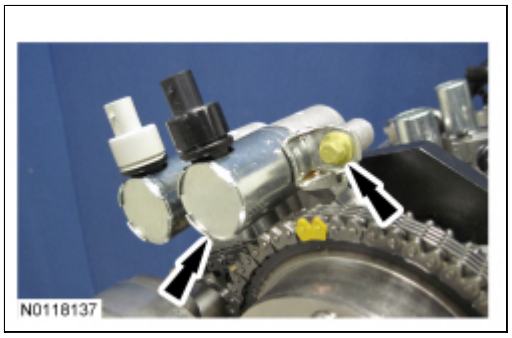


15. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

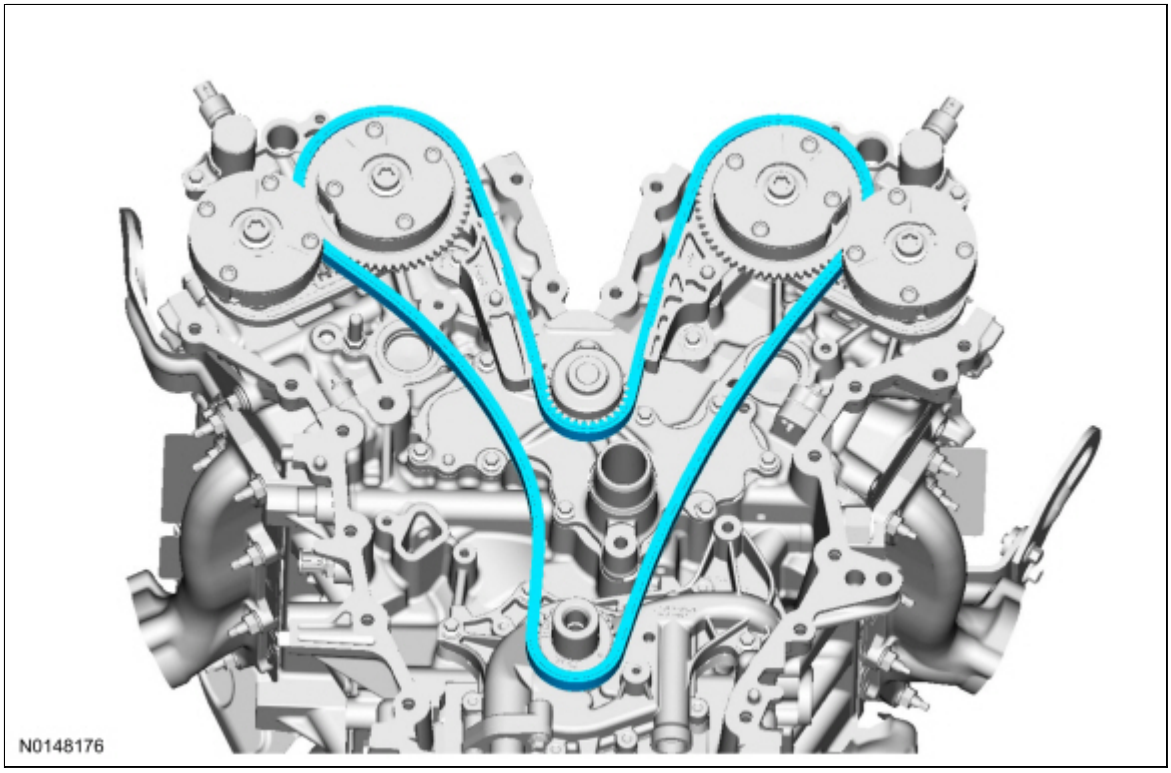
    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.

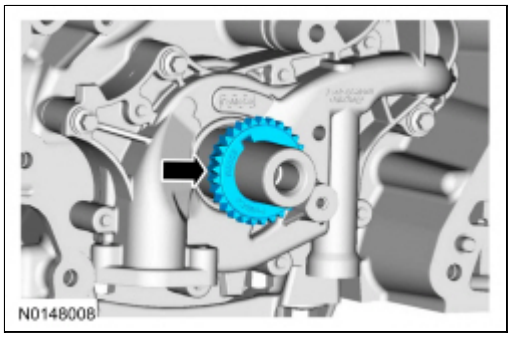


16. Remove the primary timing chain.



17. Remove the oil pan. For additional information, refer to Oil Pan in this section.

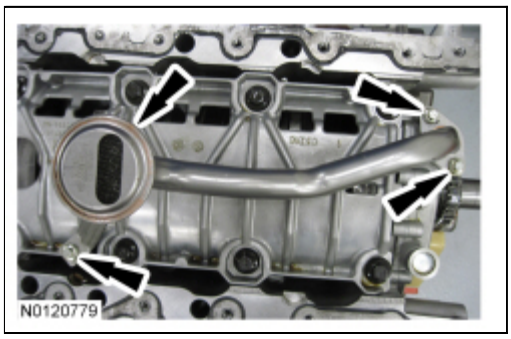
18. Remove the crankshaft timing chain sprocket.



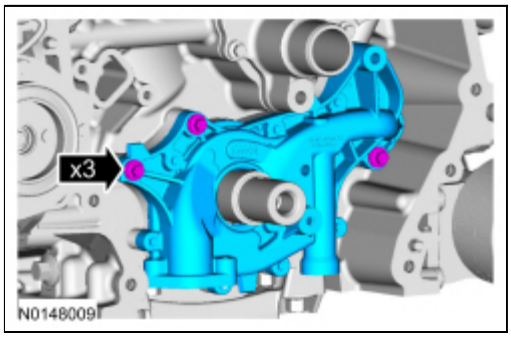
19. Remove the 3 bolts and the oil pump screen and pickup tube.

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- Discard the O-ring seal.

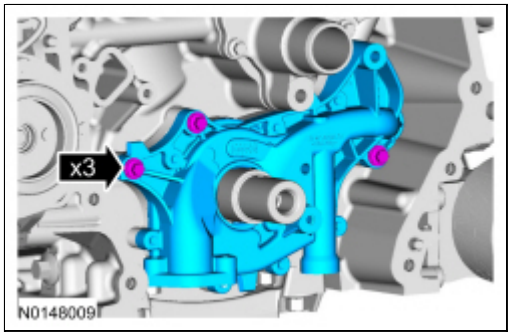


20. Remove the 3 bolts and the oil pump.

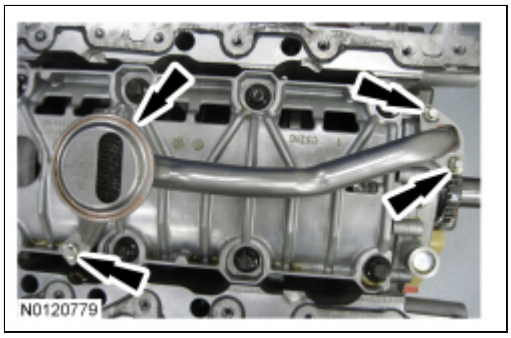


Installation

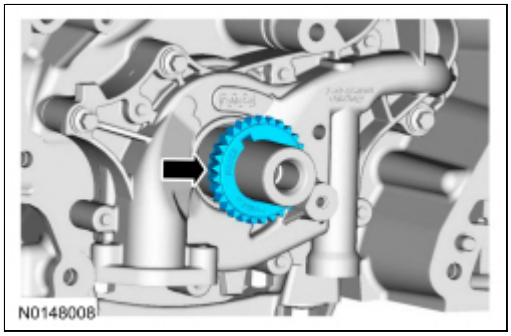
1. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



2. Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



3. Install the crankshaft timing chain sprocket with timing dot mark out.



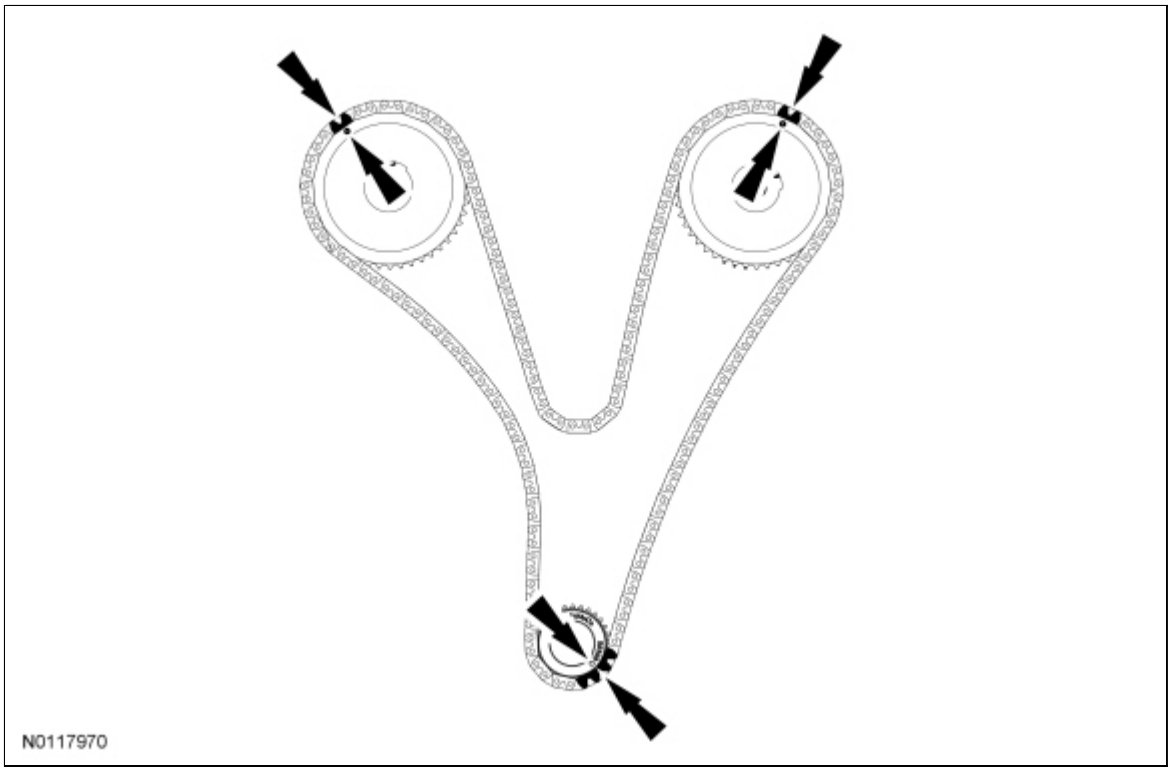
4. **NOTE:** Do not fill with clean engine oil until the engine front cover is installed.

   Install the oil pan. For additional information, refer to Oil Pan in this section.

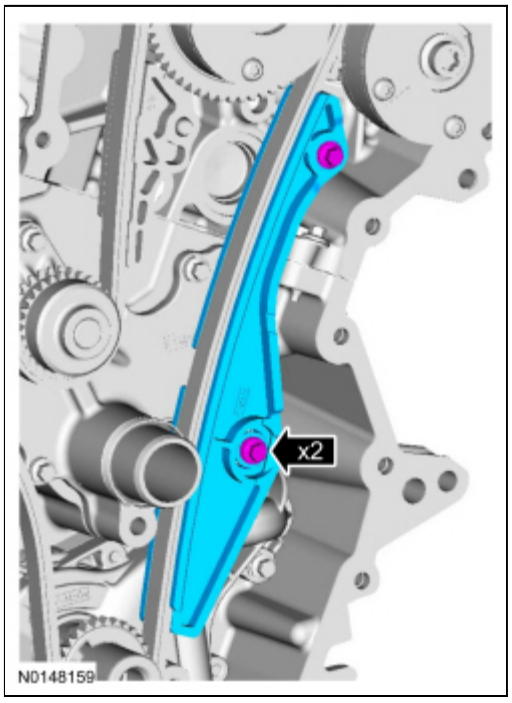
5. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

   Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

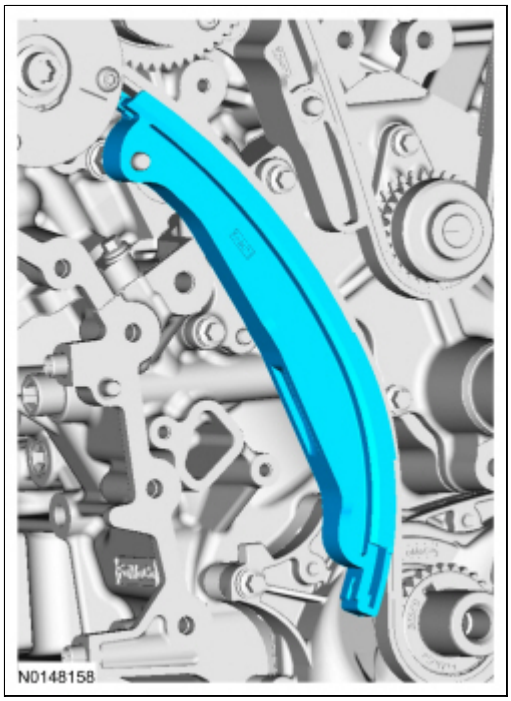
repair4less



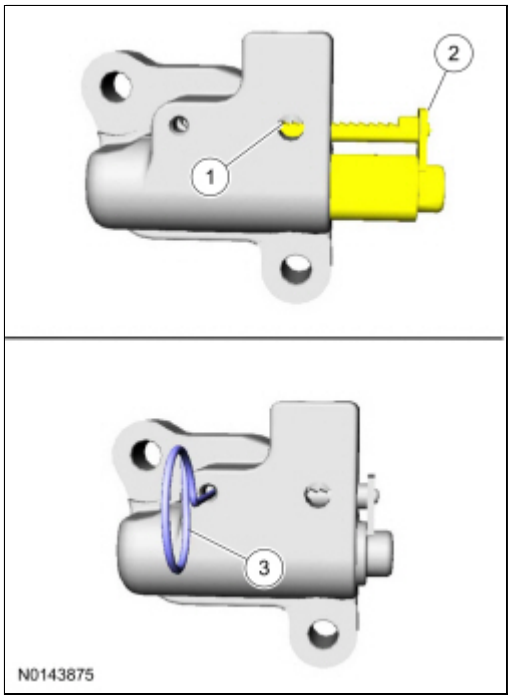
6. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



7. Install the primary timing chain tensioner arm.



8. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin. .

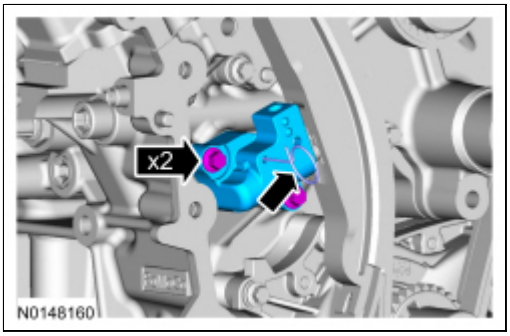


9. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

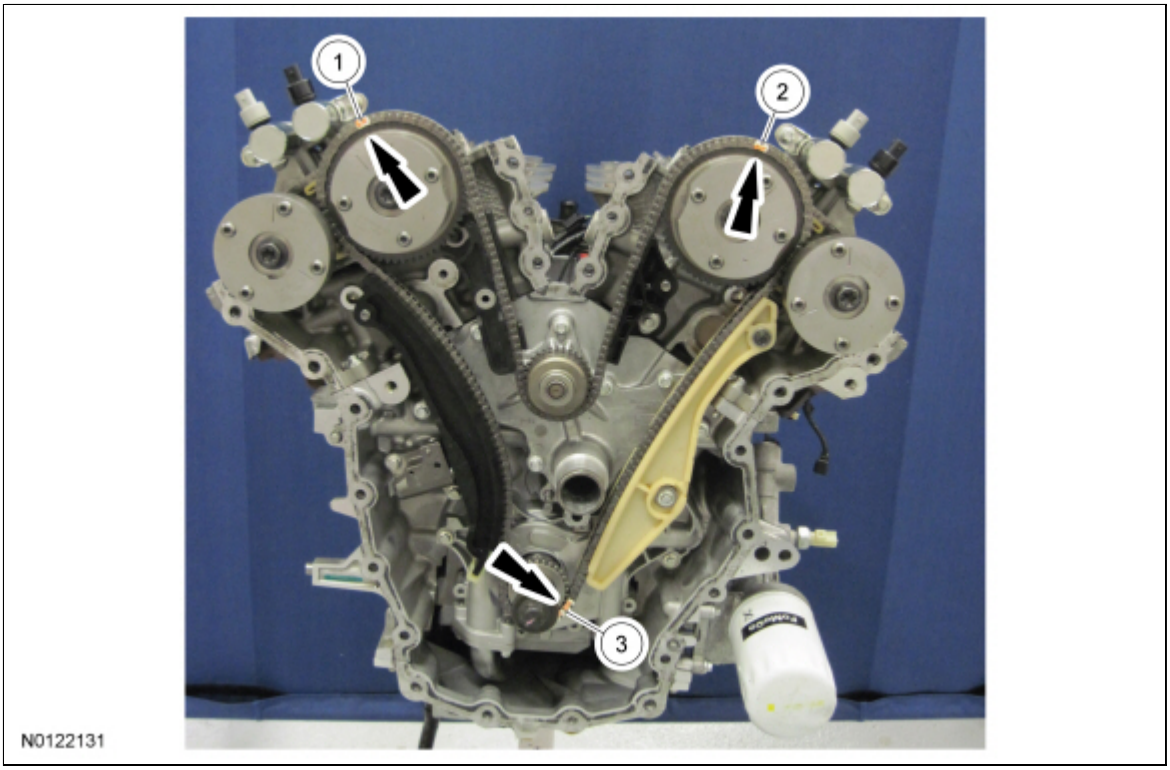
    Install the primary timing chain tensioner and the 2 bolts.

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- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



10. As a post-check, verify correct alignment of all timing marks.
    - There is 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There is 35 links in between RH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



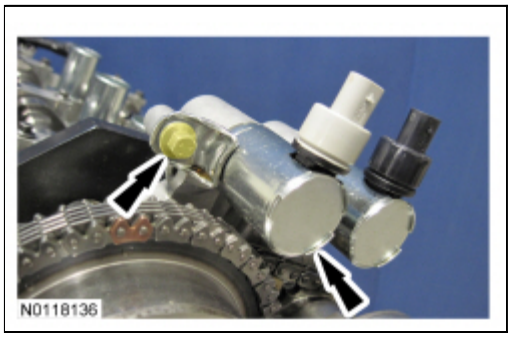
11. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



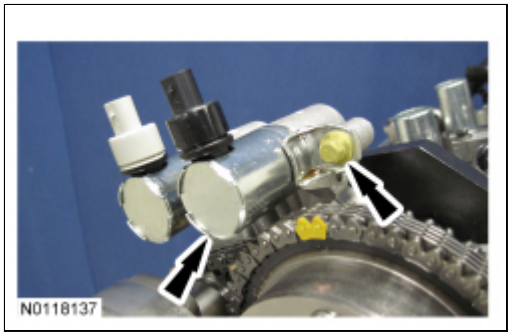
12. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

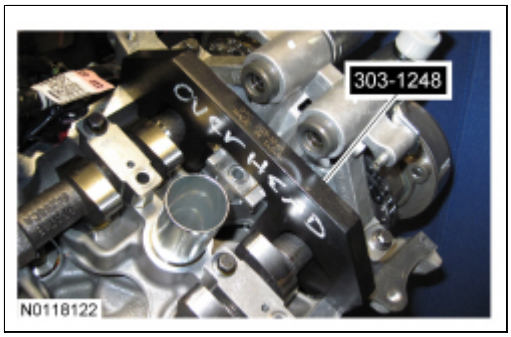
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Install the RH intake VCT oil control solenoid and the bolt.

    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

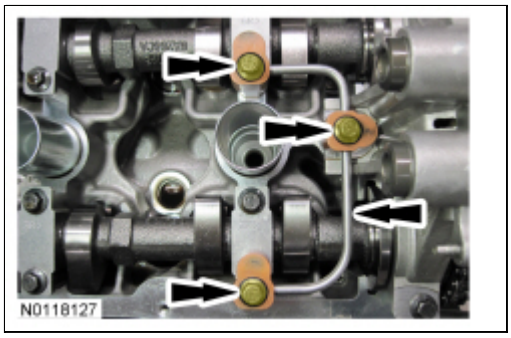


13. Remove the RH Camshaft Holding Tool.

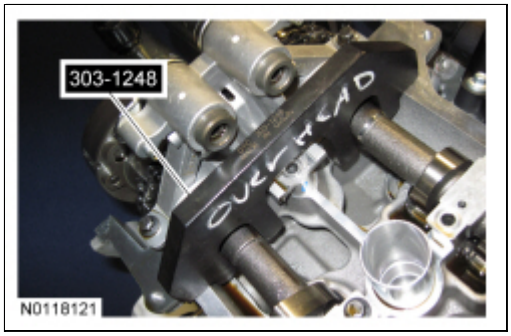


14. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

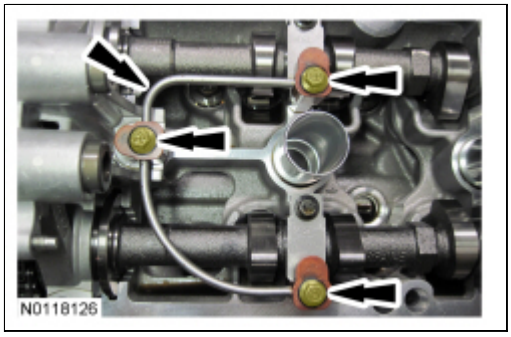
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15. Remove the LH Camshaft Holding Tool.



16. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



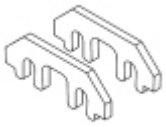
17. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

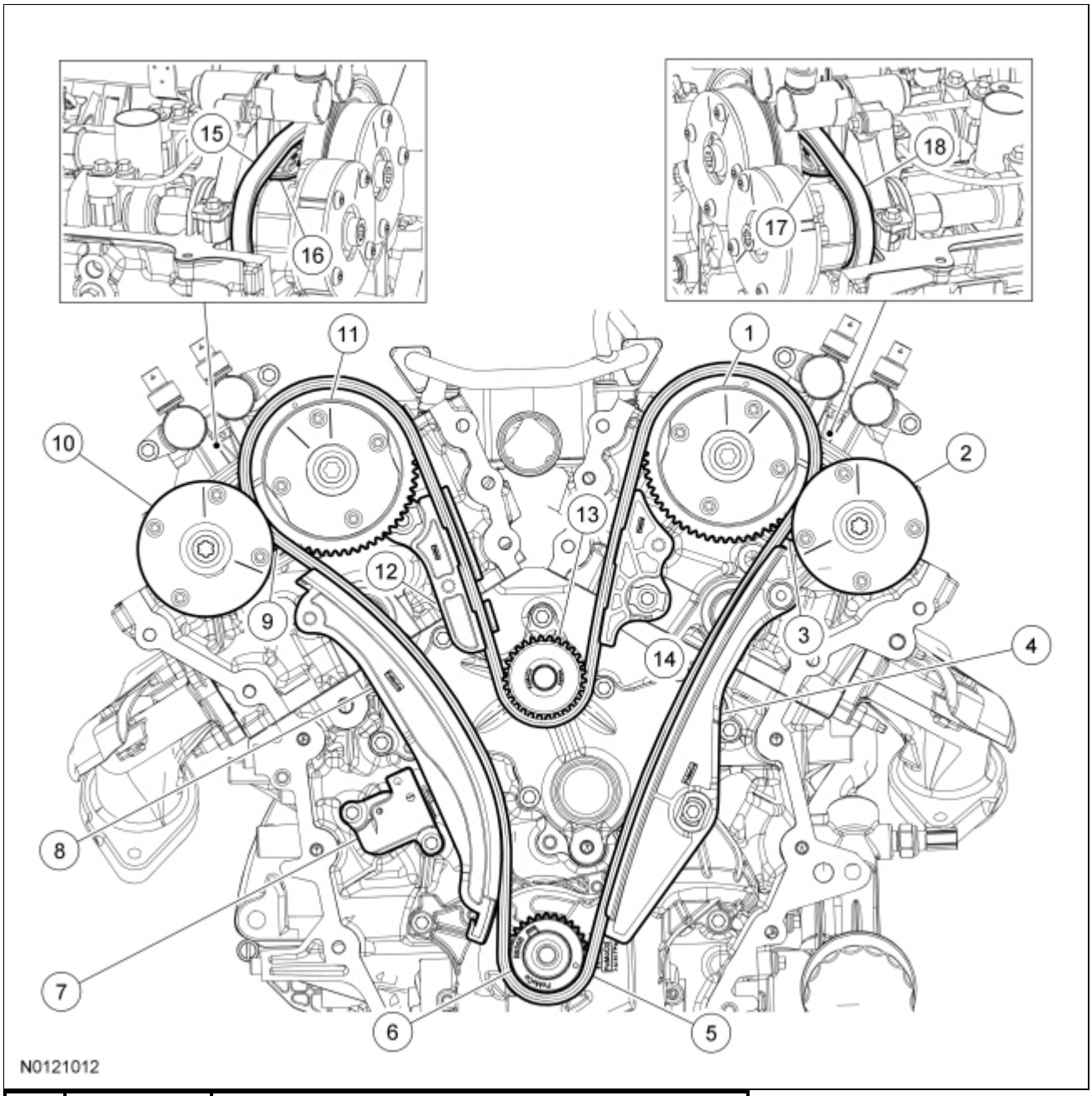
18. Fill the engine with clean engine oil.

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Timing Drive Components

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248



Item	Part Number	Description
1	6256	LH intake Variable Camshaft Timing (VCT) assembly
2	6C525	LH exhaust VCT assembly
3	6K297	LH secondary timing chain tensioner shoe
4	6B274	LH primary timing chain guide
5	6268	Primary timing chain
6	6306	Crankshaft timing chain sprocket
7	6L266	Primary timing chain tensioner
8	6K255	RH primary timing chain tensioner arm
9	6K297	RH secondary timing chain tensioner shoe

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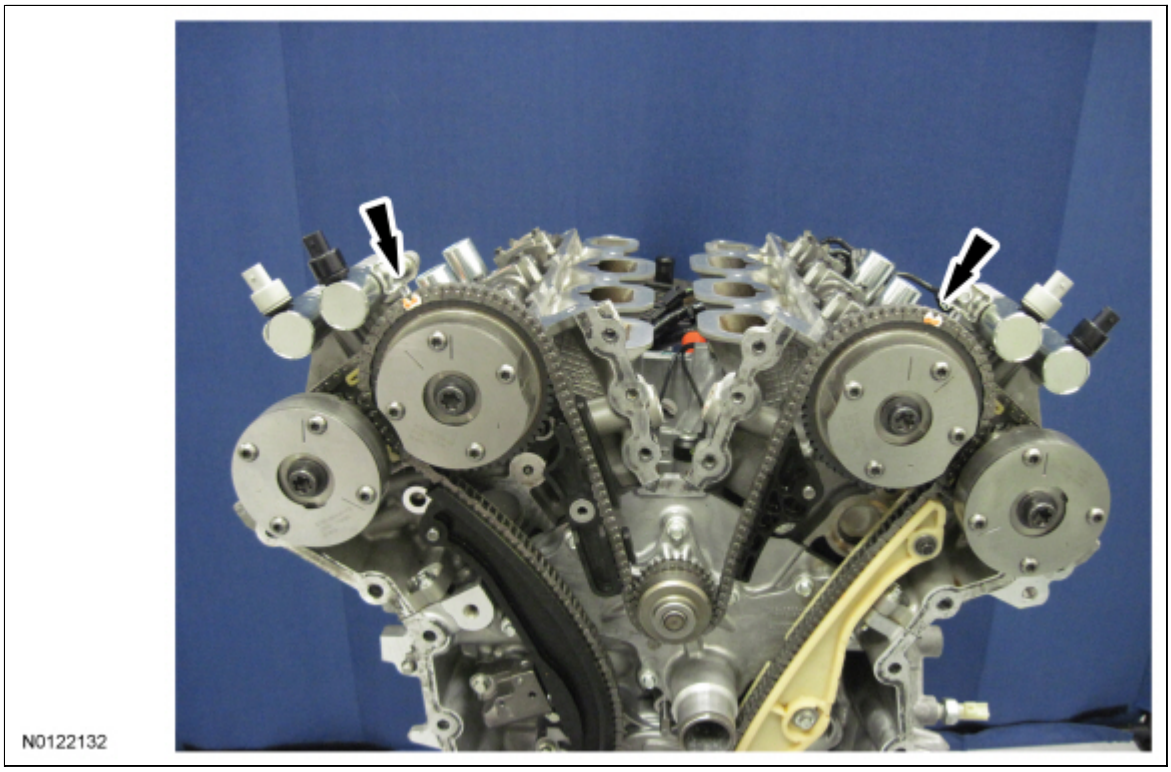
10	6C525	RH exhaust VCT assembly
11	6256	RH intake VCT assembly
12	6K297	RH primary timing chain guide
13	8501	Timing chain gear
14	6K297	LH primary timing chain guide
15	6268	RH secondary timing chain
16	6K254	RH secondary timing chain tensioner
17	6K254	LH secondary timing chain tensioner
18	6268	LH secondary timing chain

Removal

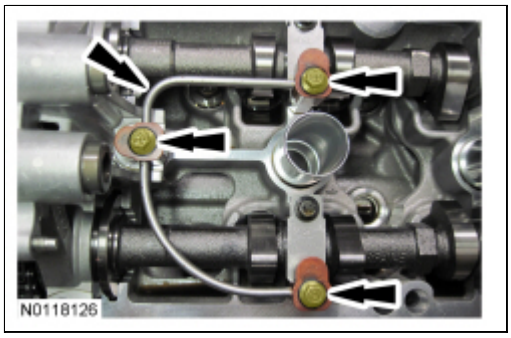
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

All engines

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown.

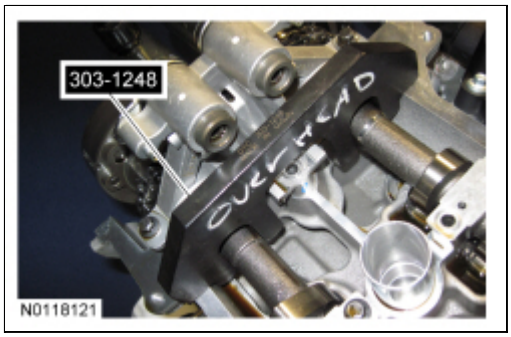


3. Remove the 3 bolts and the LH valve train oil tube.

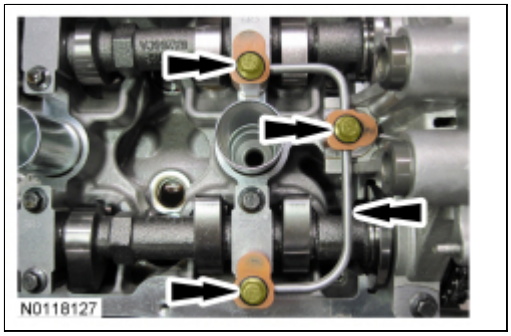


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

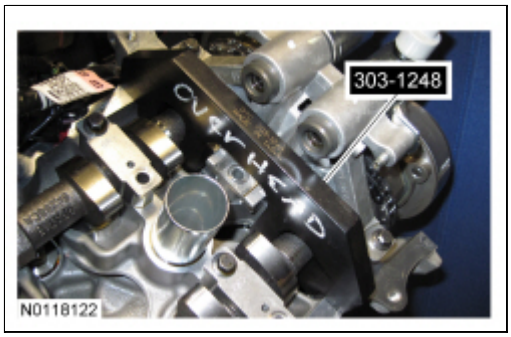


5. Remove the 3 bolts and the RH valve train oil tube.



6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

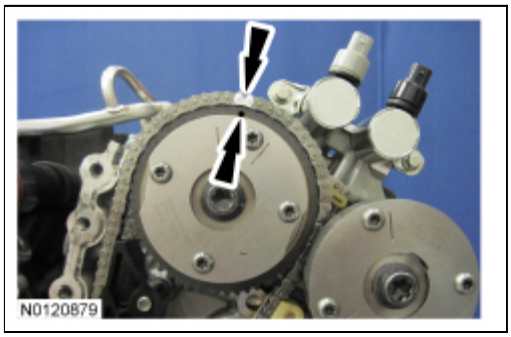
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.



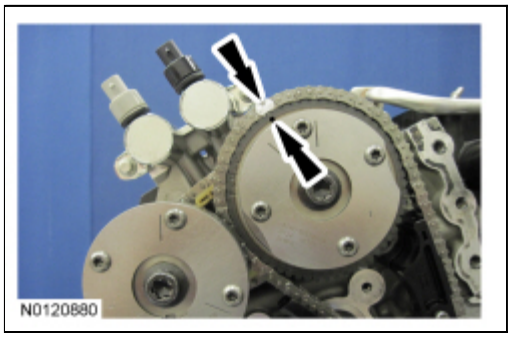
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NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

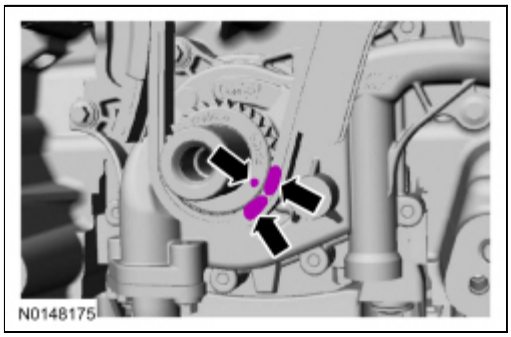


8. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

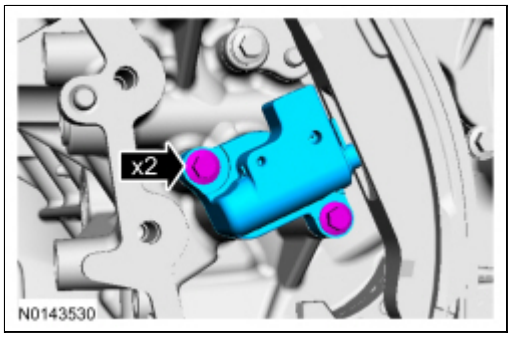


9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

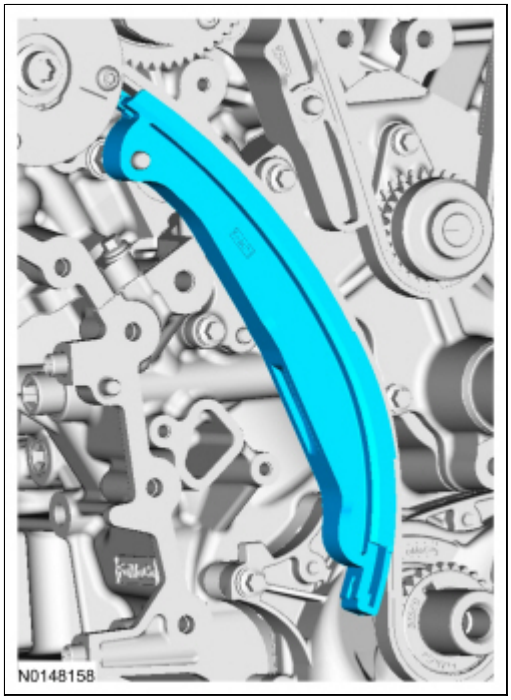
   Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



10. Remove the 2 bolts and the primary timing chain tensioner.

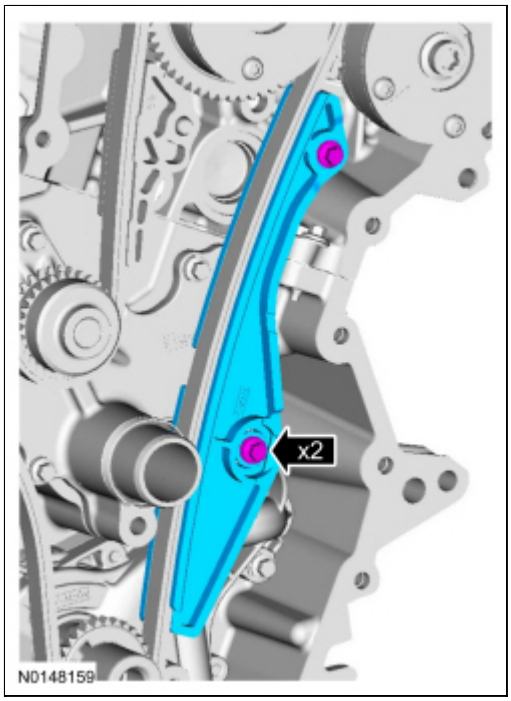


11. Remove the primary timing chain tensioner arm.



12. Remove the 2 bolts and the lower LH primary timing chain guide.

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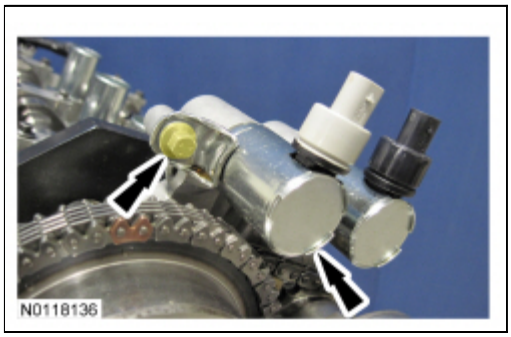


13. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.

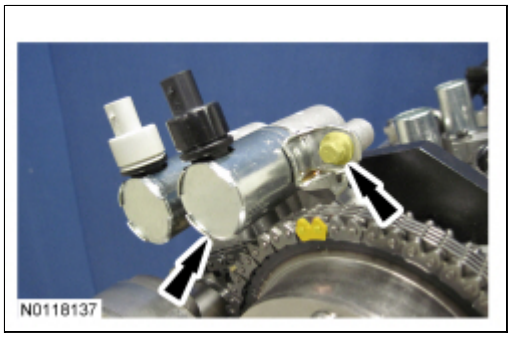


14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

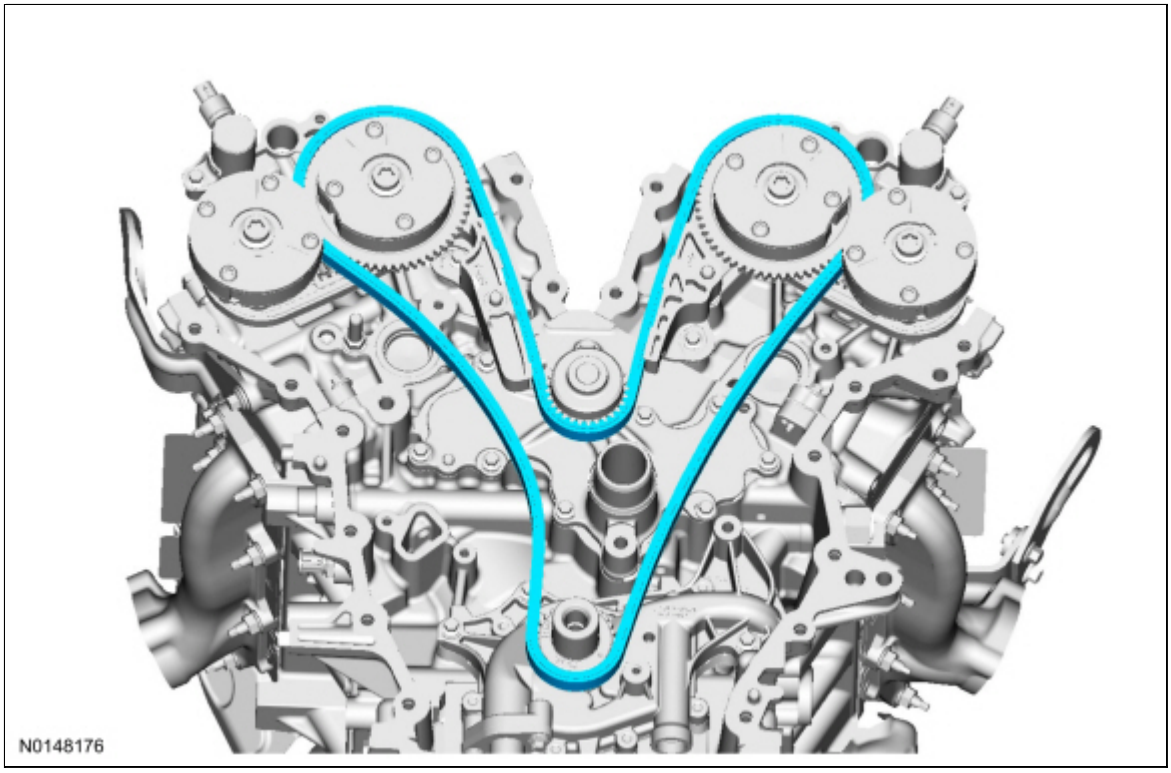
    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

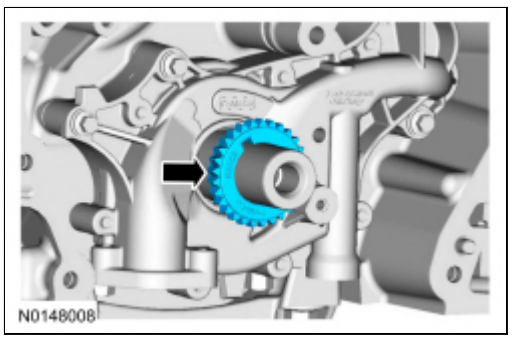
    Remove the bolt and the RH intake VCT oil control solenoid.



15. Remove the primary timing chain.



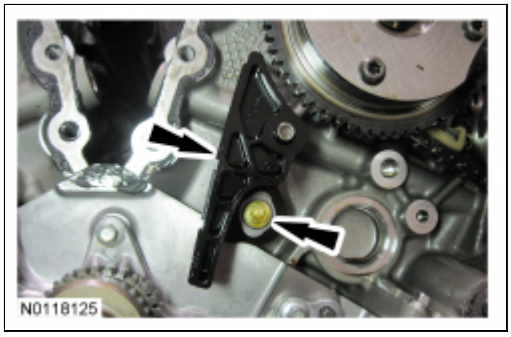
16. Remove the crankshaft timing chain sprocket.



17. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.**

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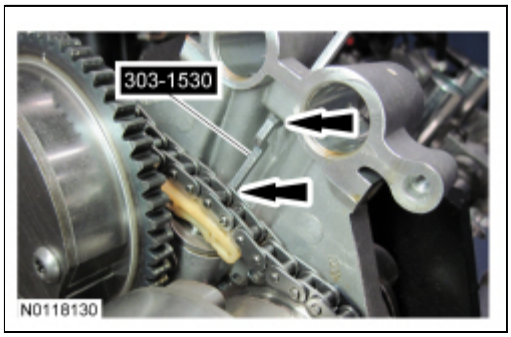
Remove the bolt and the upper LH primary timing chain guide.



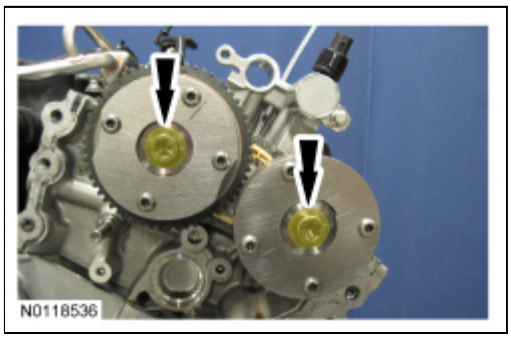
18. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

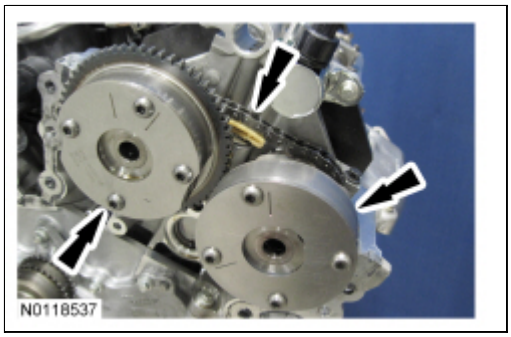
    Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



19. Remove and discard the 2 LH VCT assembly bolts.



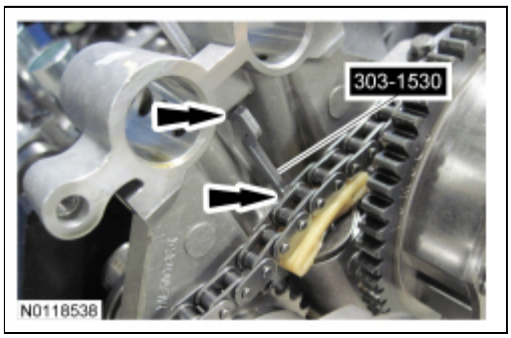
20. Remove the 2 LH VCT assemblies and secondary timing chain.



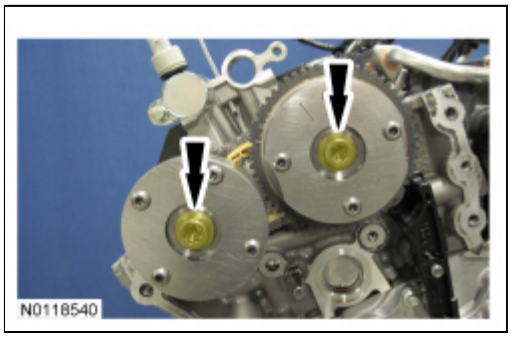
21. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

    Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

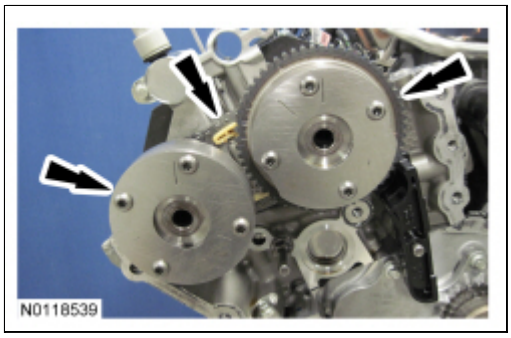


22. Remove and discard the 2 RH VCT assembly bolts.



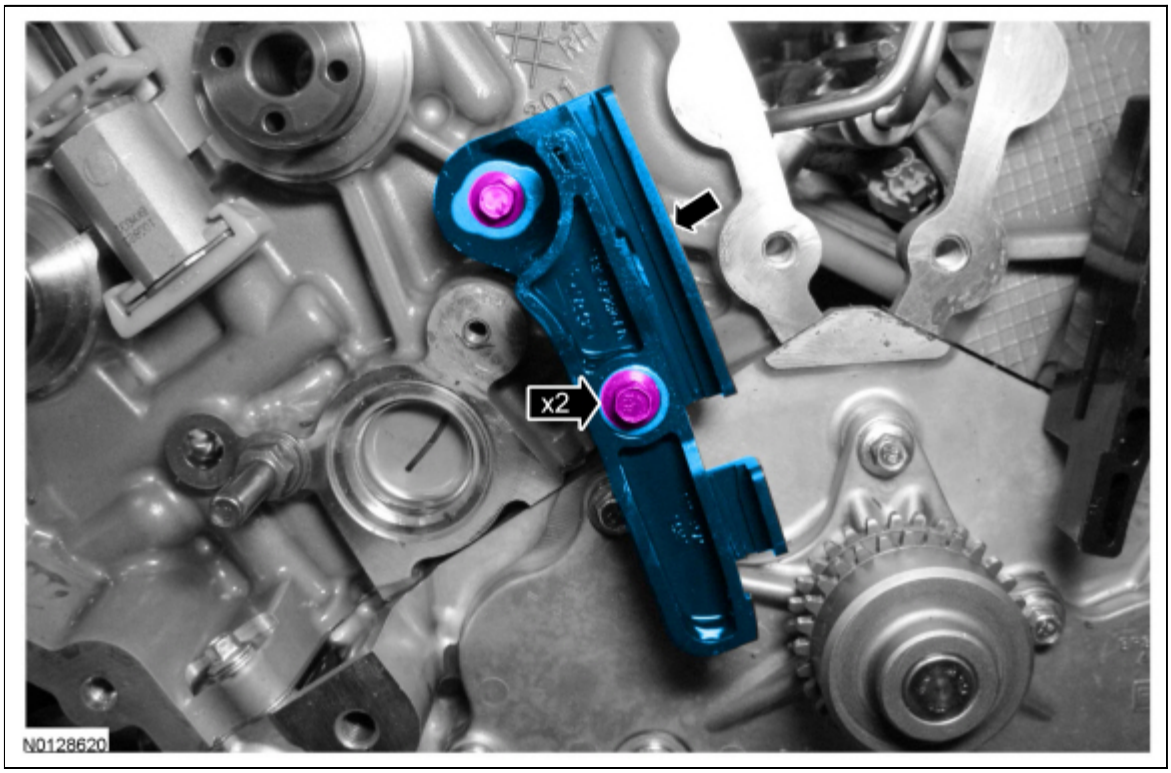
23. Remove the 2 RH VCT assemblies and secondary timing chain.

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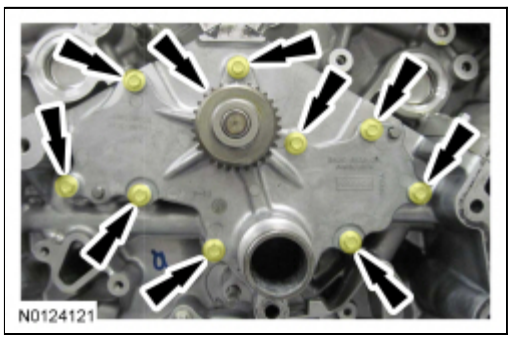


24. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.**

    Remove the 2 bolts and the RH primary timing chain guide.



25. Remove the 9 bolts and the timing chain gear.
    - Discard the gasket.



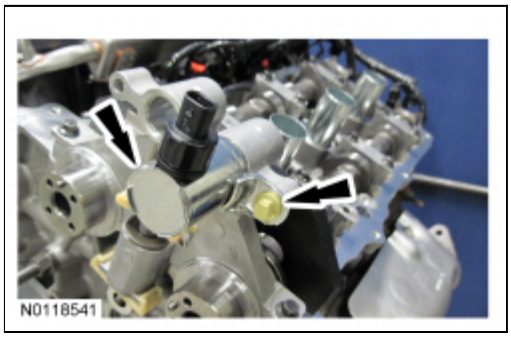
Engines with secondary timing chain tensioner removed

NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed, or damage to the engine may occur.**

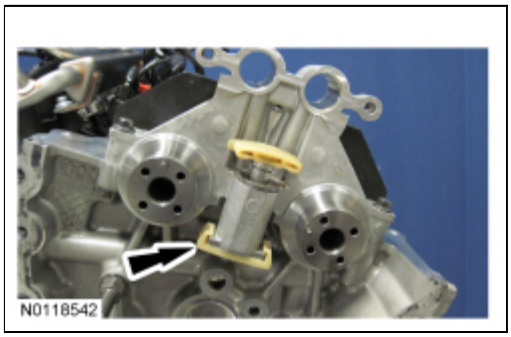
26. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

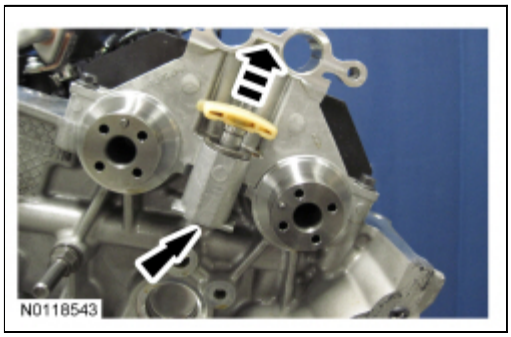
    Remove the LH exhaust VCT oil control solenoid.



27. Remove the LH secondary timing chain tensioner shoe.



28. Remove the LH secondary timing chain tensioner by pushing up from the bottom and remove.

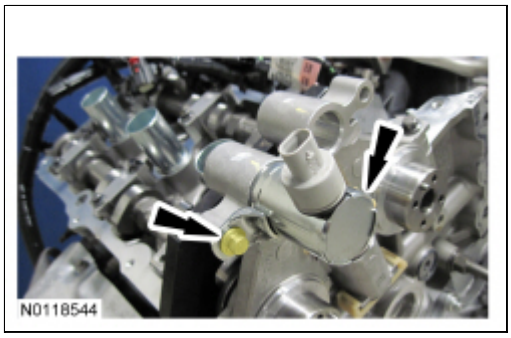


29. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

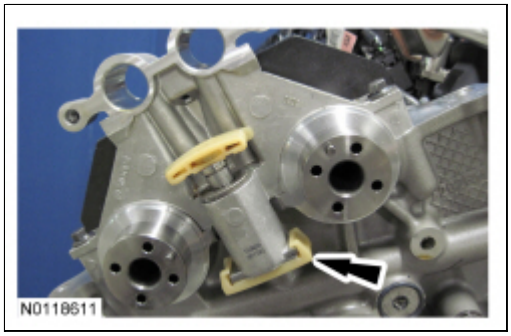
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the RH exhaust VCT oil control solenoid.

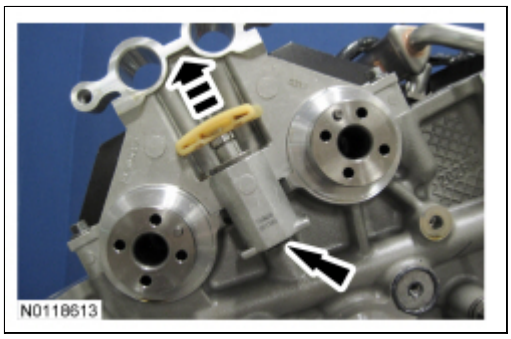
repair4less



30. Remove the RH secondary timing chain tensioner shoe.



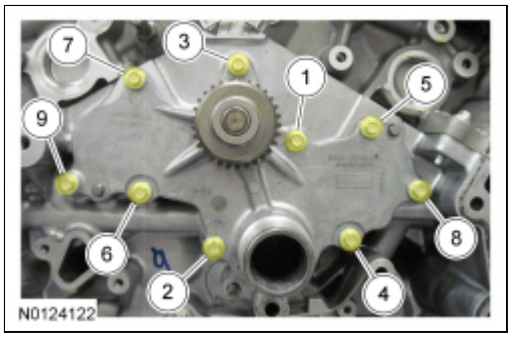
31. Remove the RH secondary timing chain tensioner by pushing up from the bottom and remove.



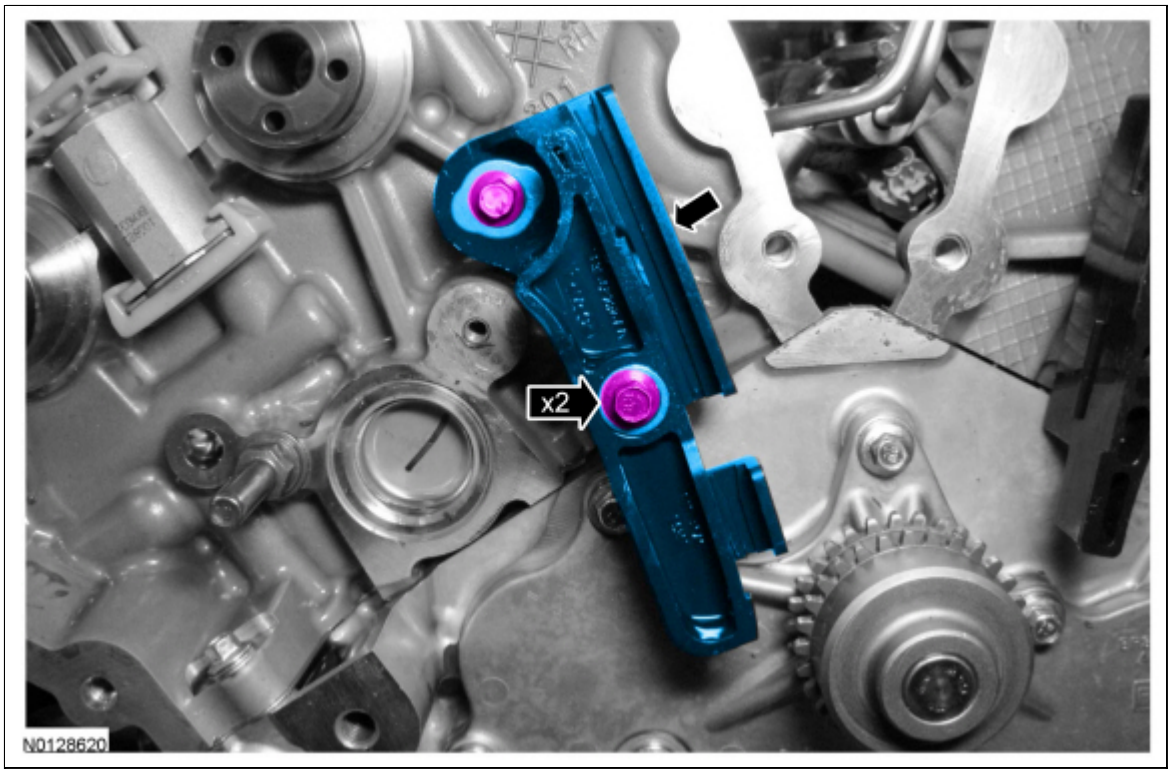
Installation

All engines

1. Using a new gasket, install the timing chain gear and the 9 bolts. Tighten in the sequence shown in 2 stages:
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



2. Install the RH primary timing chain guide and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



Engines with secondary timing chain tensioner removed

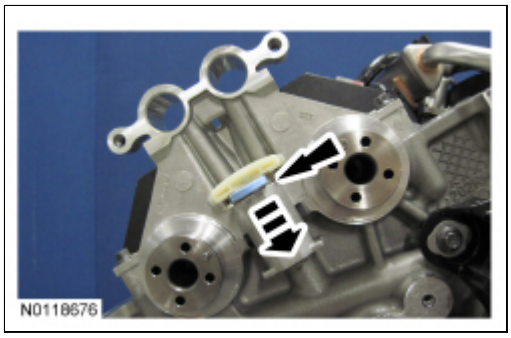
NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed or damage to the engine may occur.**

3. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

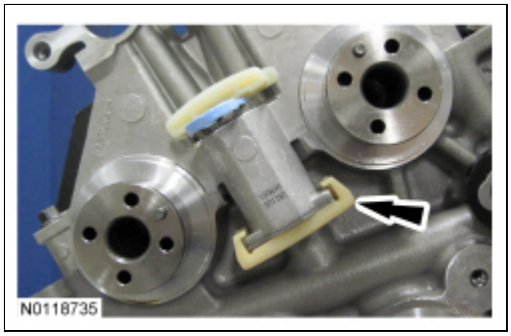
   NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

   Install the RH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.

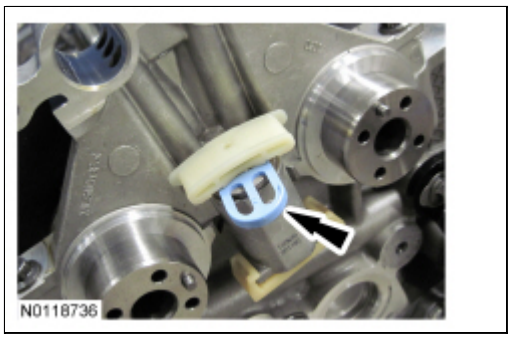
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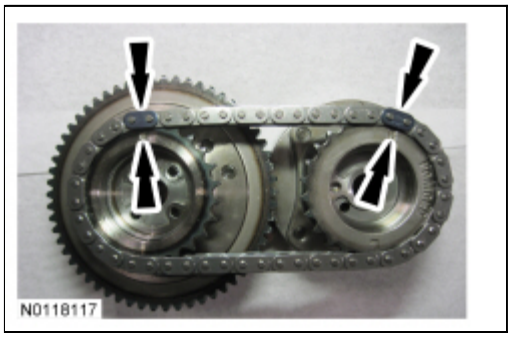
4. Install the RH secondary timing chain tensioner shoe.



5. Remove and discard the RH secondary timing chain tensioner shipping clip.

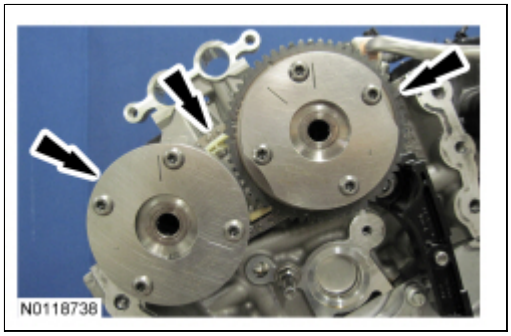


6. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

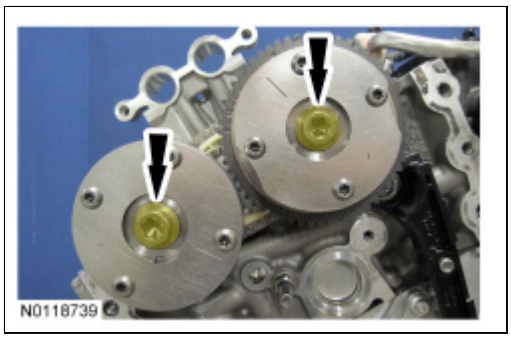


7. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

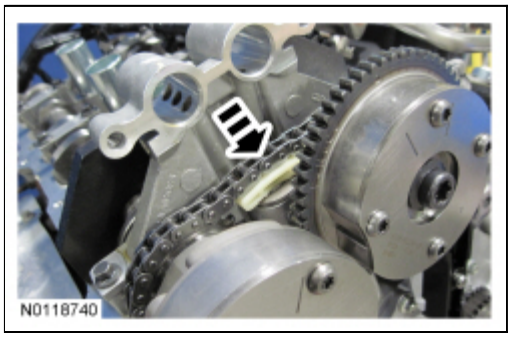
Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



8. Install the 2 new RH VCT bolts and tighten in 4 stages.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 25 Nm (18 lb-ft).
   - Stage 4: Tighten an additional 180 degrees.



9. Activate the RH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



10. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

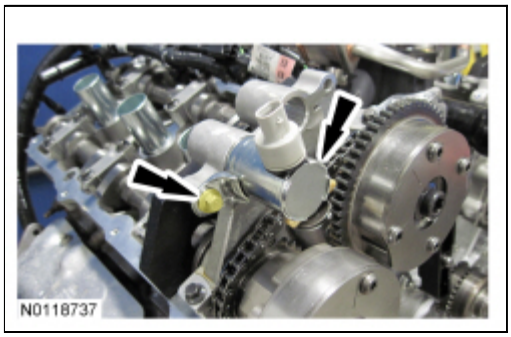
    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

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Install the RH exhaust VCT oil control solenoid.

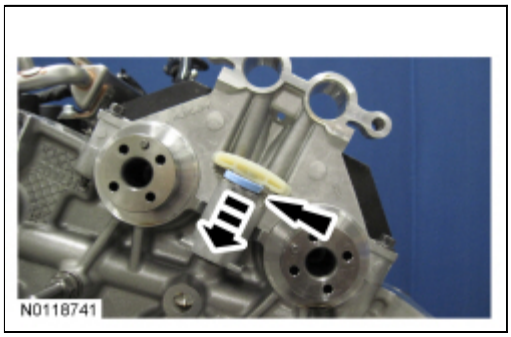
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



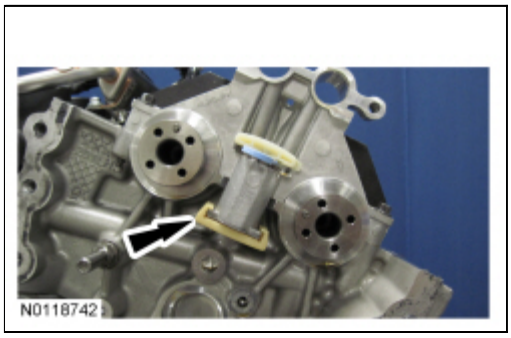
11. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

    NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

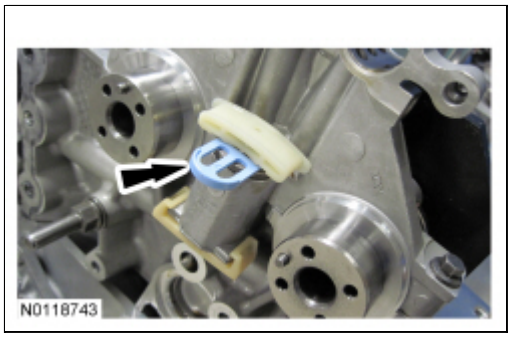
    Install the LH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



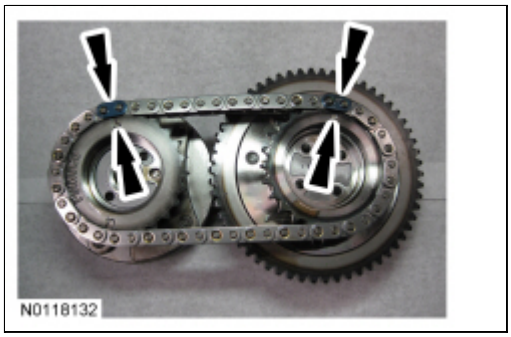
12. Install the LH secondary timing chain tensioner shoe.



13. Remove and discard the LH secondary timing chain tensioner shipping clip.

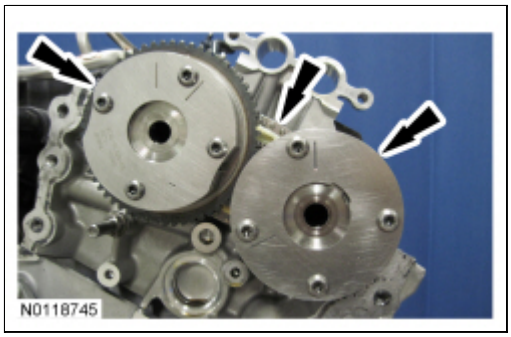


14. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.



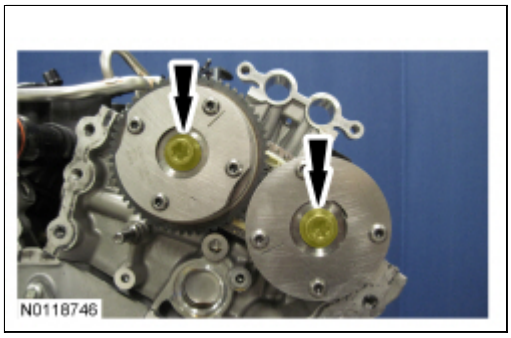
15. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

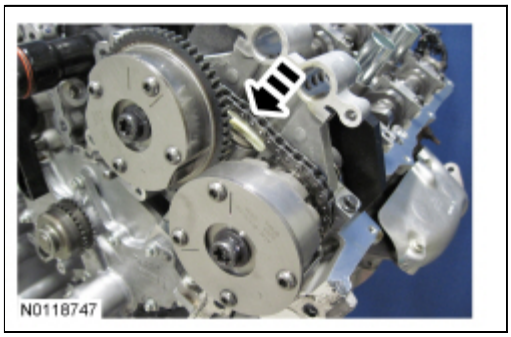


16. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

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17. Activate the LH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.

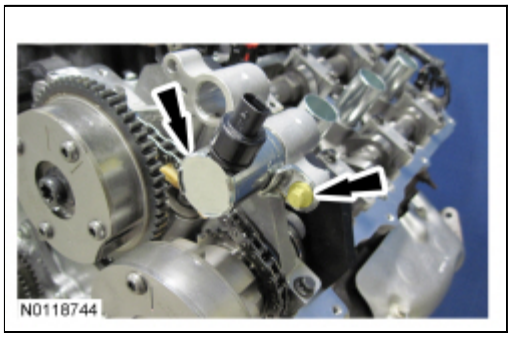


18. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

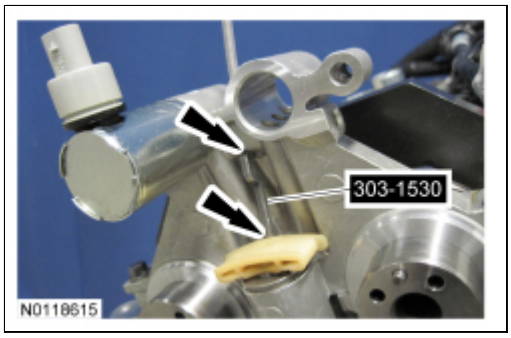
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Install the LH exhaust VCT oil control solenoid.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

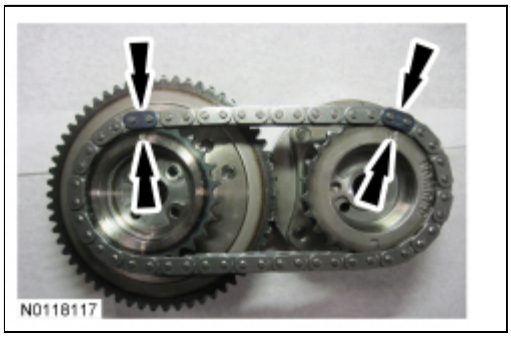


Engines with secondary timing chain tensioner not removed

19. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

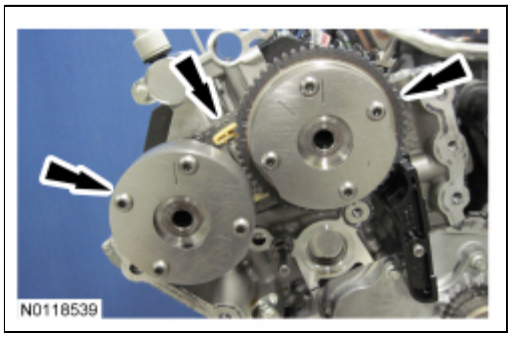


20. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.



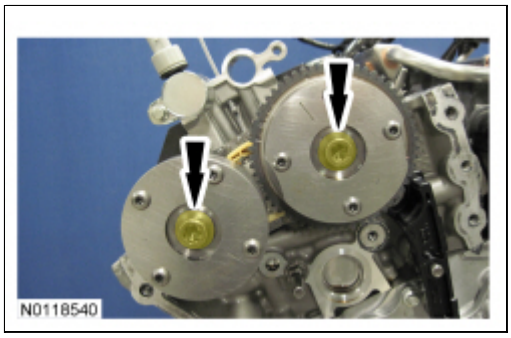
21. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



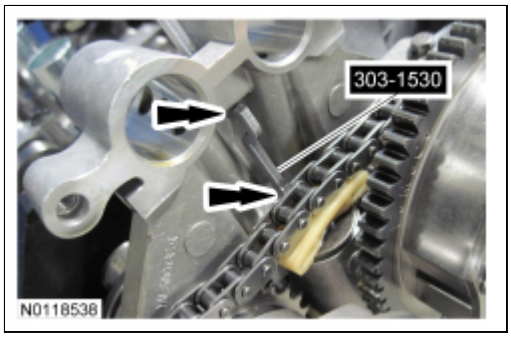
22. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

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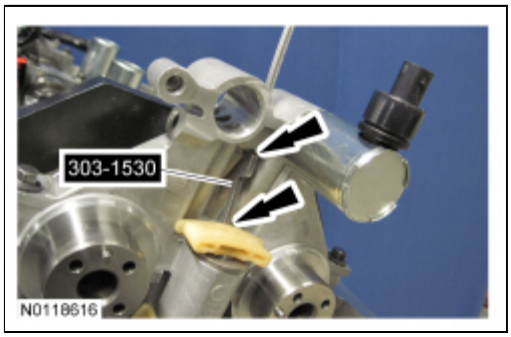


23. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

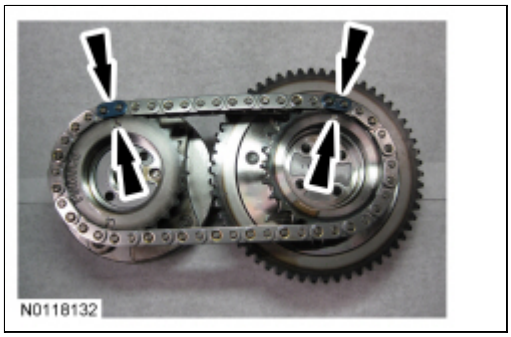
    Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.



24. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

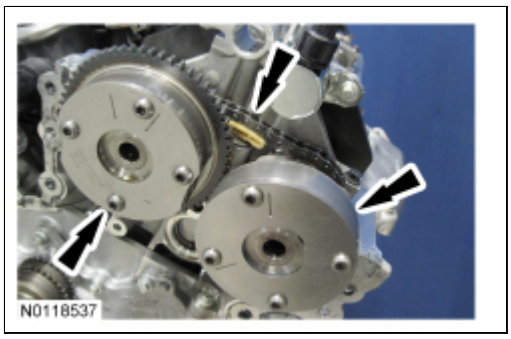


25. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

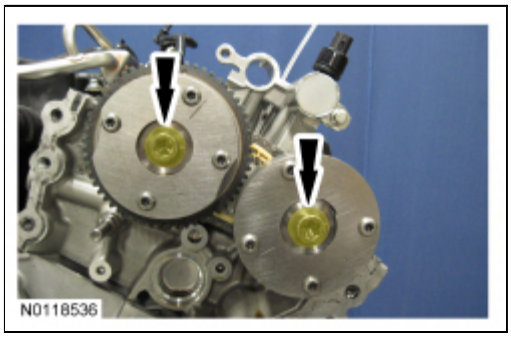


26. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



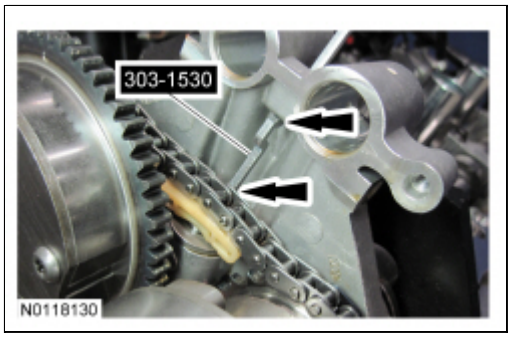
27. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



28. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

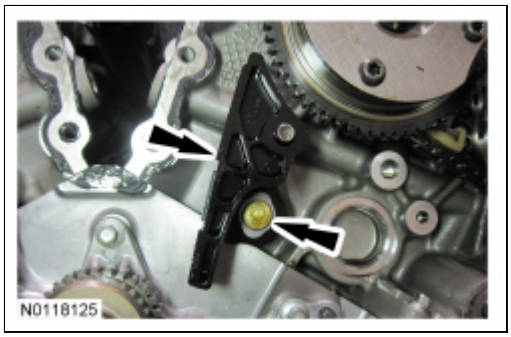
    Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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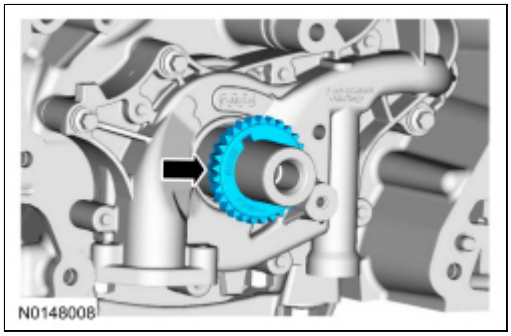


All engines

29. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

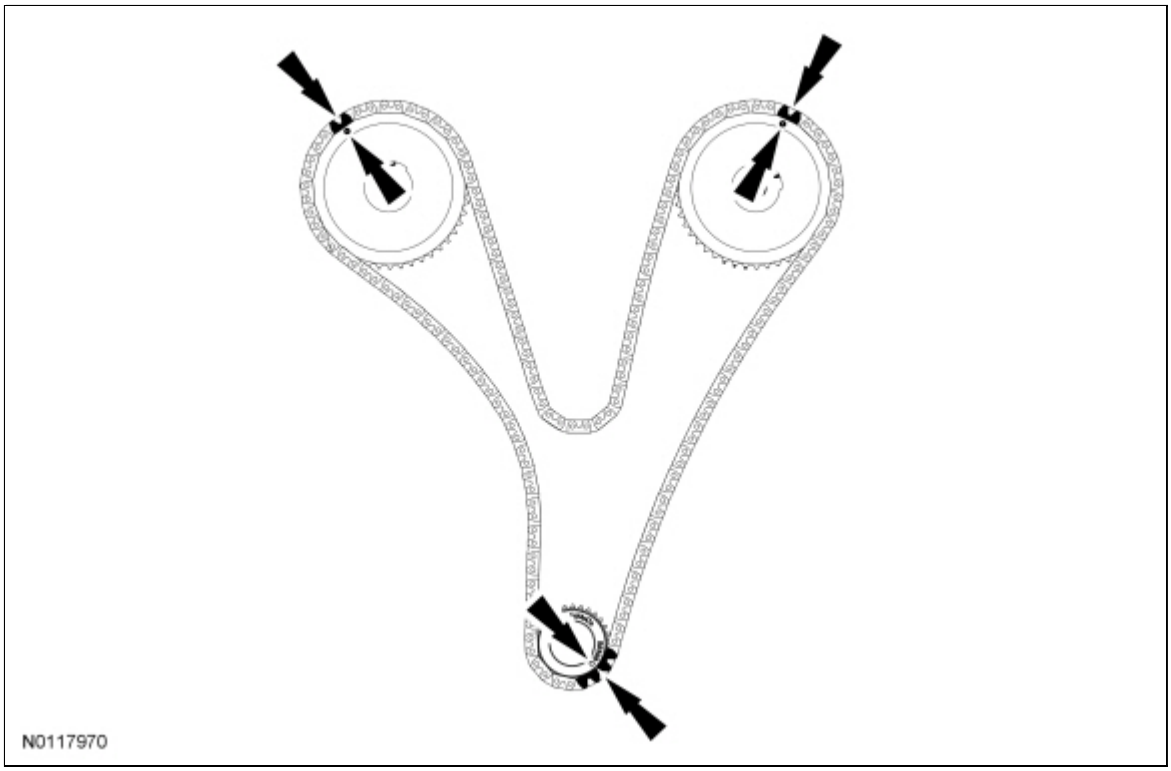


30. Install the crankshaft timing chain sprocket with timing dot mark out.

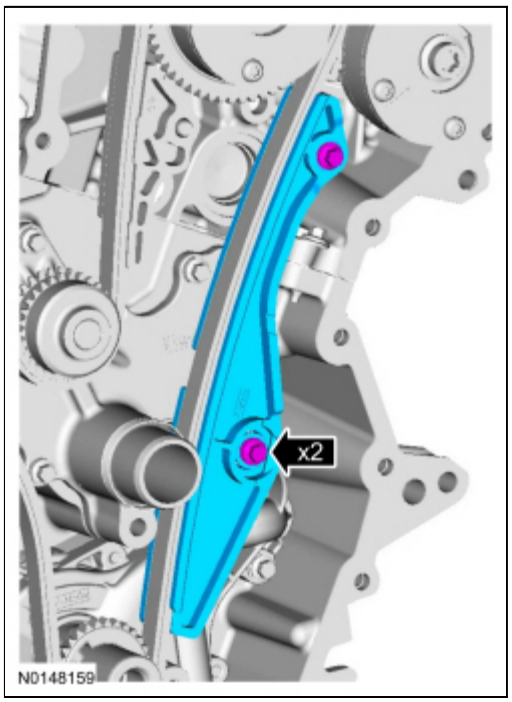


31. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

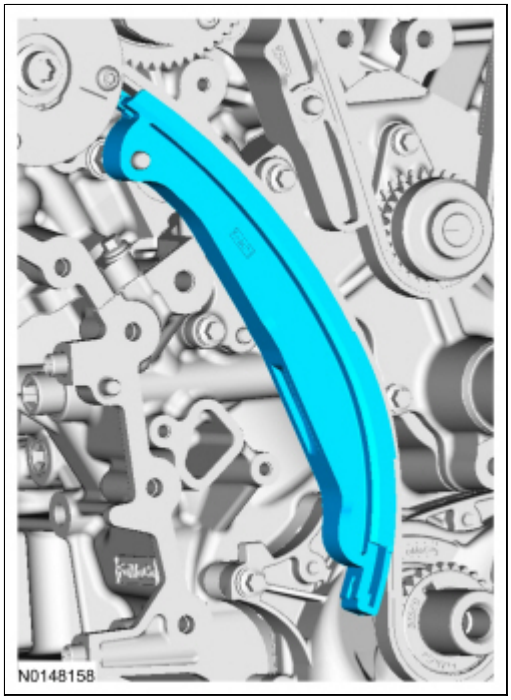


32. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

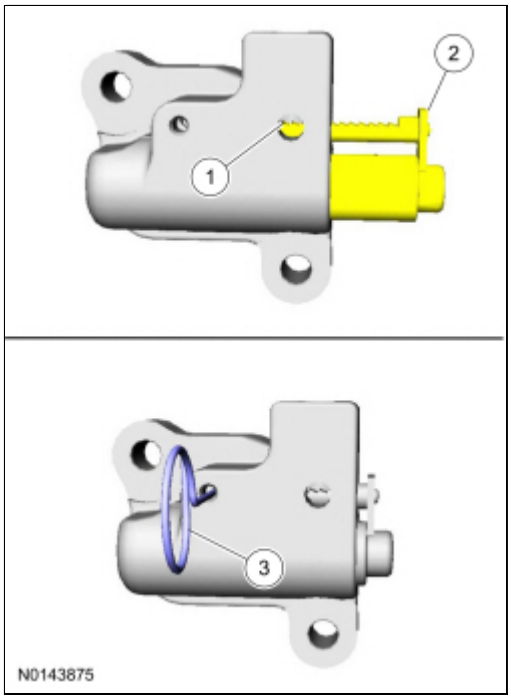


33. Install the primary timing chain tensioner arm.

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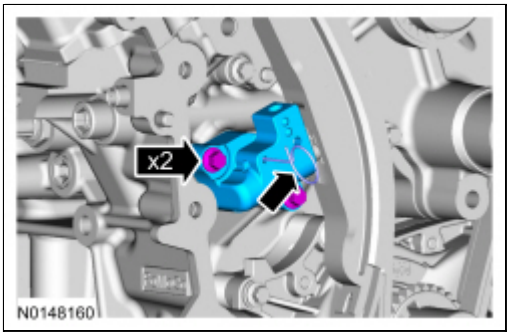
34. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.



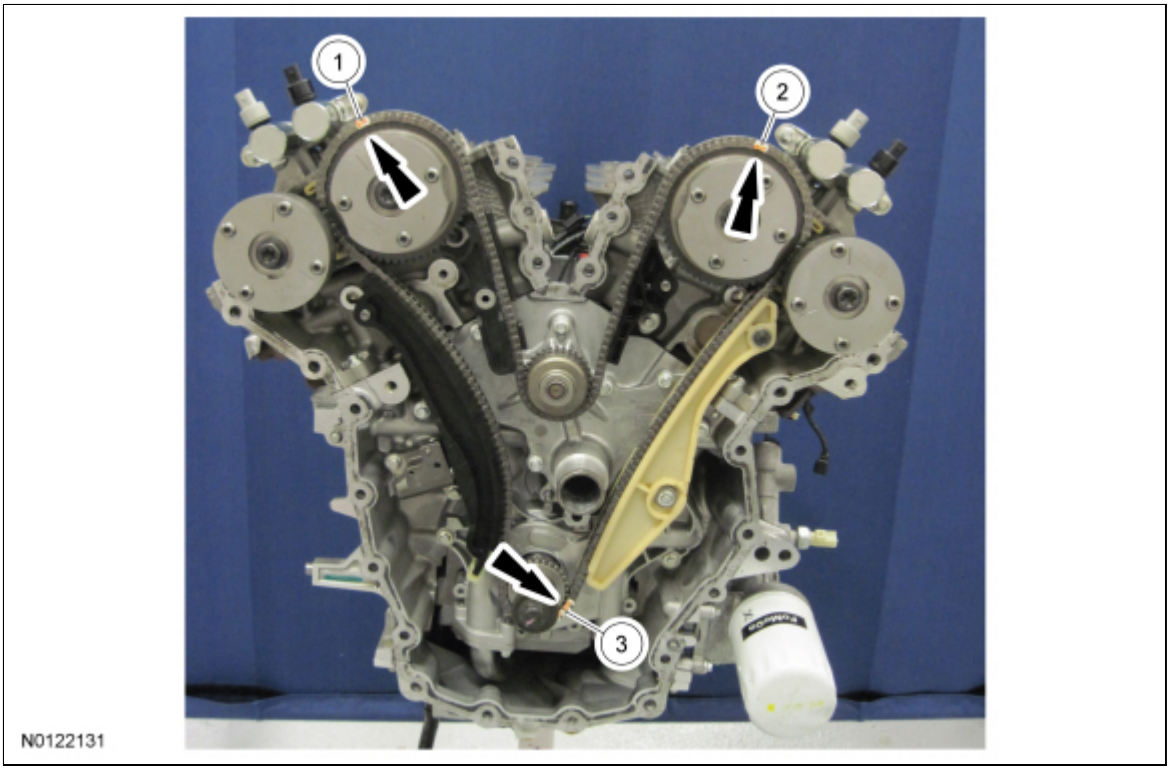
35. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

    Install the primary tensioner and the 2 bolts.

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



36. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



37. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

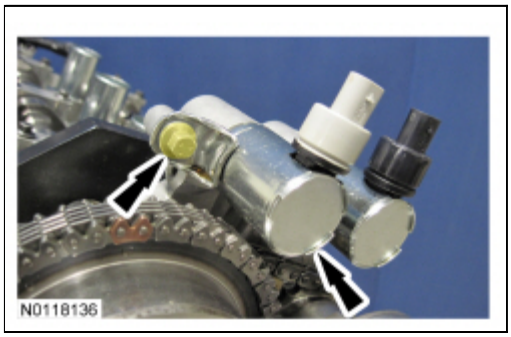
    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

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Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



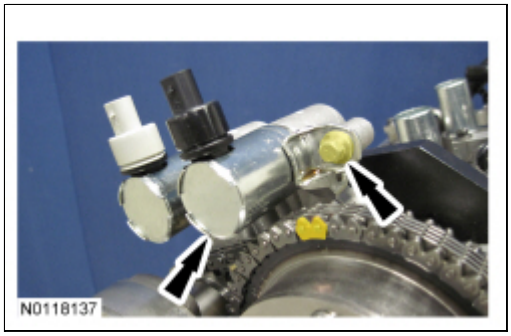
38. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

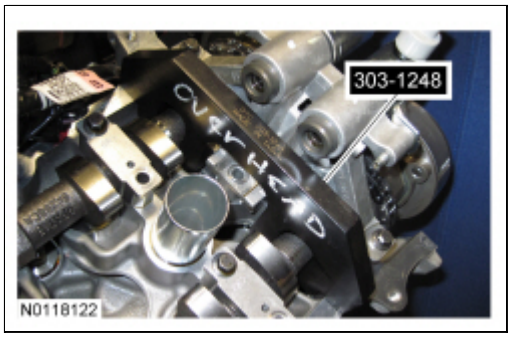
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

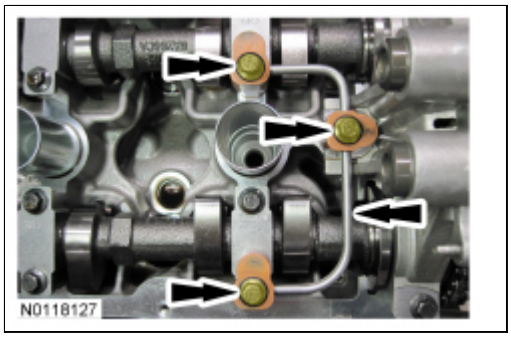
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



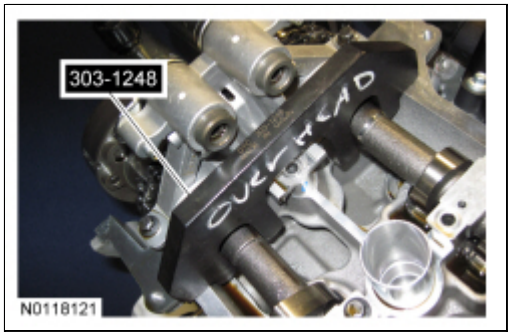
39. Remove the RH Camshaft Holding Tool.



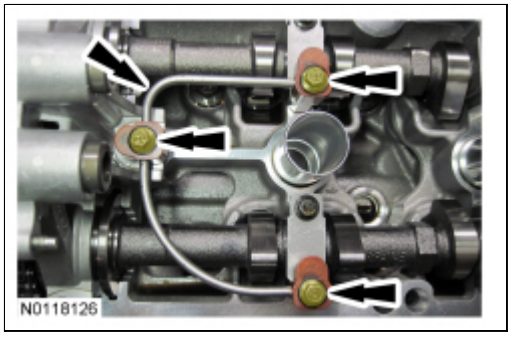
40. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



41. Remove the LH Camshaft Holding Tool.



42. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



43. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

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Valve Cover — LH

Special Tool(s)

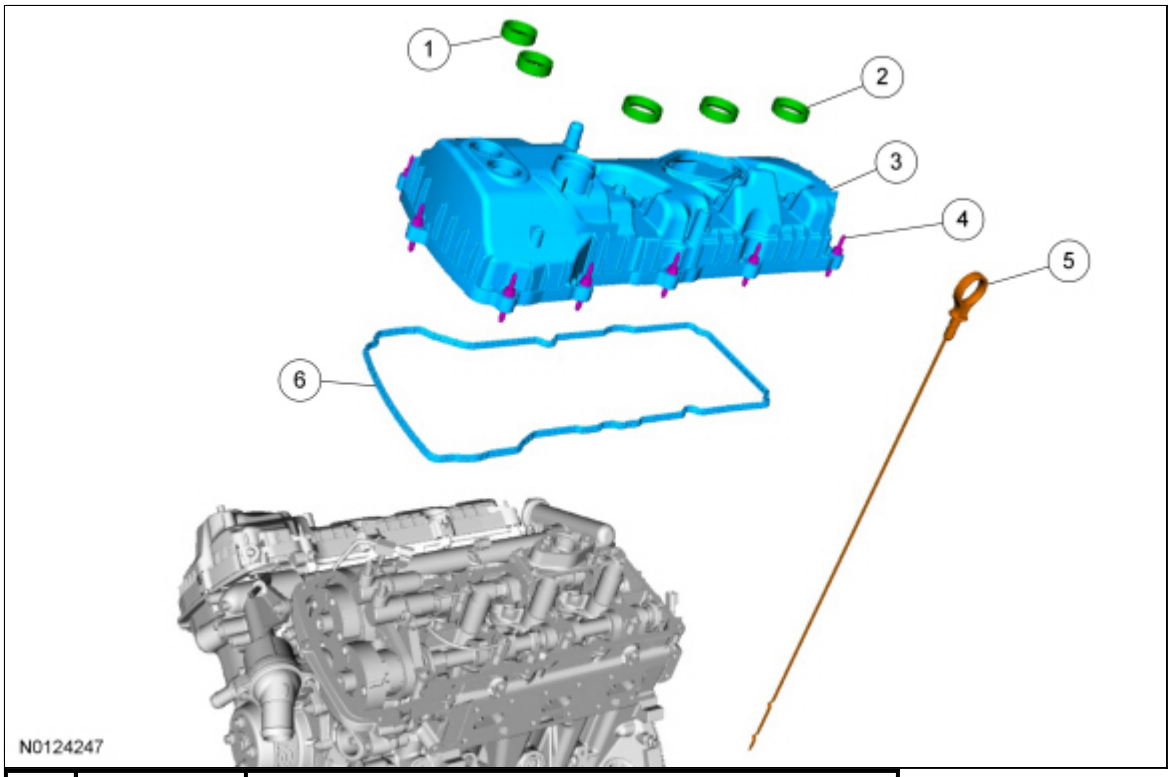
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—

Valve Cover — LH

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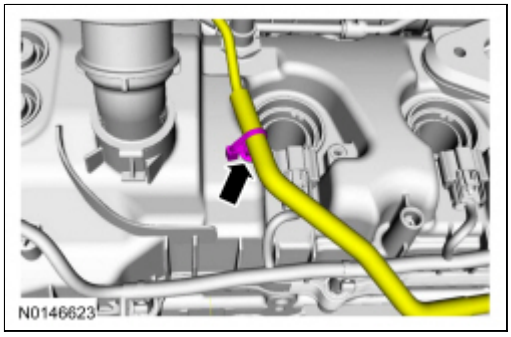
Item	Part Number	Description
1	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
2	6C535	Spark plug tube seal (3 required)
3	6582	LH valve cover
4	00812	Valve cover bolt and sleeve assembly (11 required)
5	6750	Oil level indicator
6	6584	LH valve cover gasket

Removal

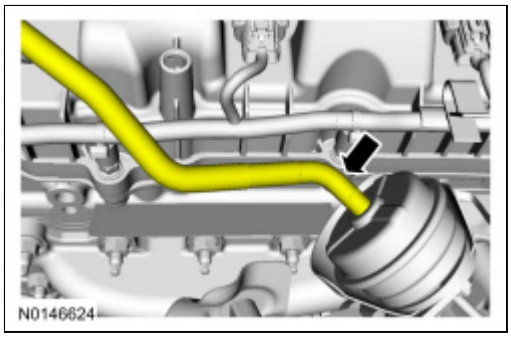
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the engine appearance cover.
2. Remove the Air Cleaner (ACL) outlet pipe and the LH ACL pipe-to-turbocharger pipe. Remove the LH turbocharger-to-Charge Air Cooler (CAC) tube. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .
3. Remove the fuel injection pump. For additional information, refer to Section 303-04A .
4. Remove the ignition coil-over-plugs. for additional information, refer to Section 303-07A .
5. Remove the engine oil level indicator.

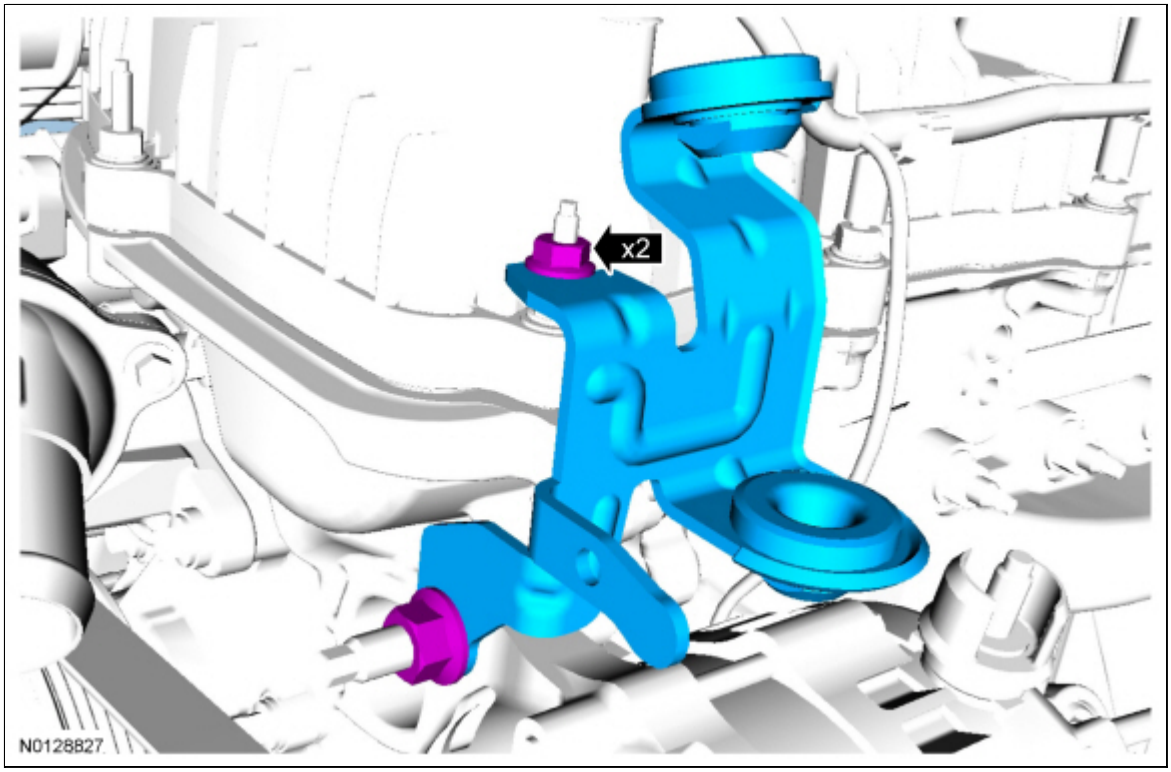
6. Remove the tie strap for the turbocharger wastegate hose.



7. Disconnect the turbocharger wastegate hose and position aside.



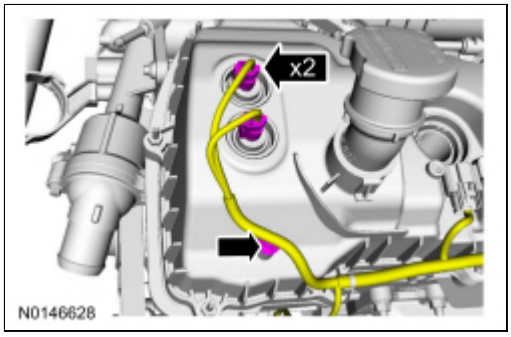
8. Remove the 2 nuts and the CAC tube bracket.



9. Disconnect the 2 LH Variable Camshaft Timing (VCT) solenoid electrical connectors. Remove the tie

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strap.

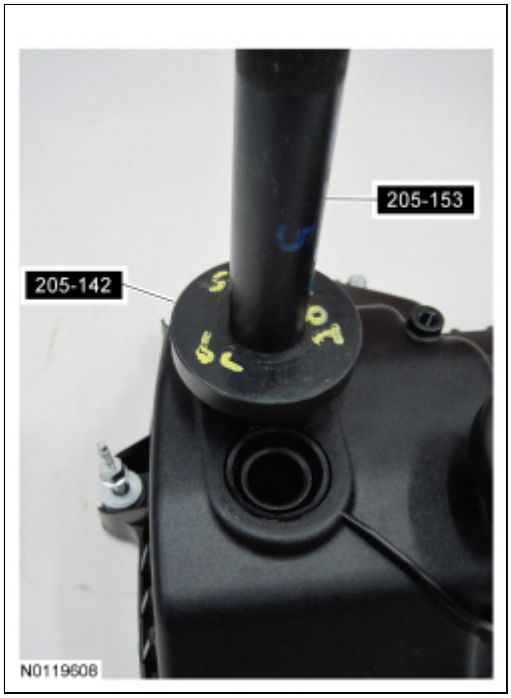


10. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

11. **NOTE:** When removing the valve cover do not apply excessive force to the VCT oil control solenoid. If the VCT solenoid seal sticks to the VCT oil control solenoid carefully wiggle the valve cover until the seal breaks free. After the valve cover is removed, inspect and replace the VCT solenoids if damaged. The plastic electrical connector on the VCT solenoid will normally rotate approximately 12 degrees inside the steel housing.

    Loosen the 11 valve cover bolt and sleeve assemblies and remove the valve cover.
    - Discard the valve cover gasket.

12. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



13. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

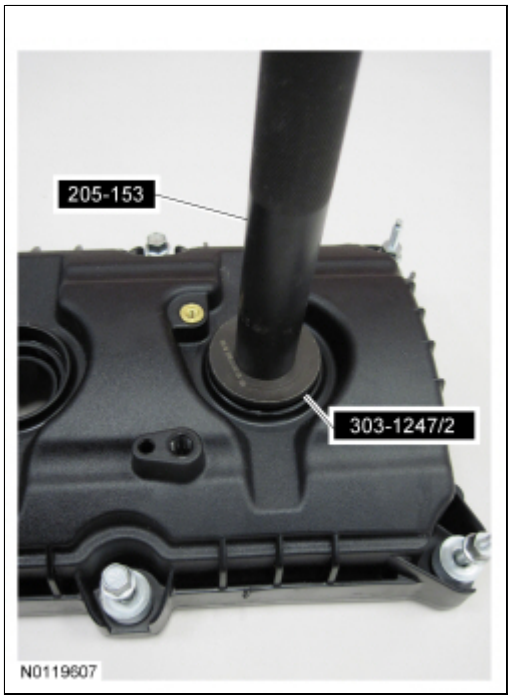


14. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

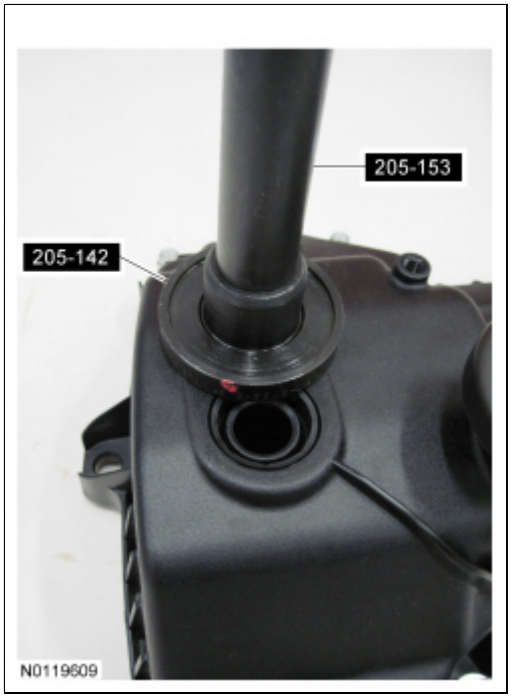
   Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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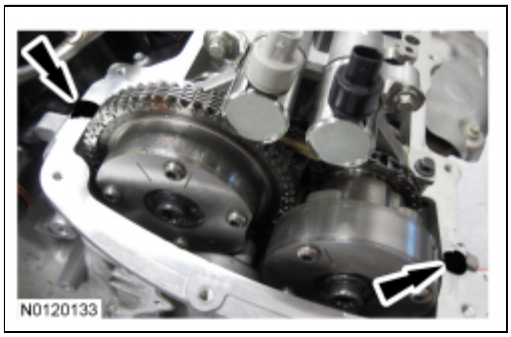
Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



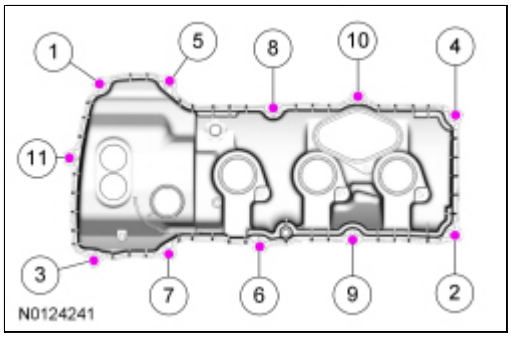
3. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

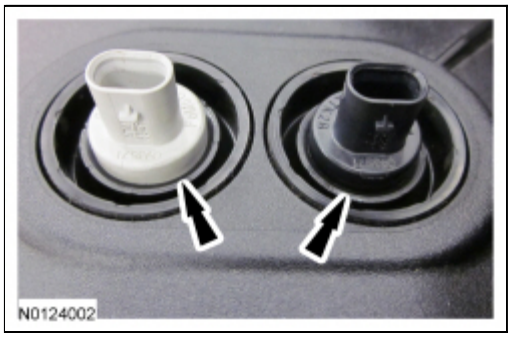
   Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.



4. Using a new gasket, install the LH valve cover and tighten the 11 bolt and sleeve assemblies in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).

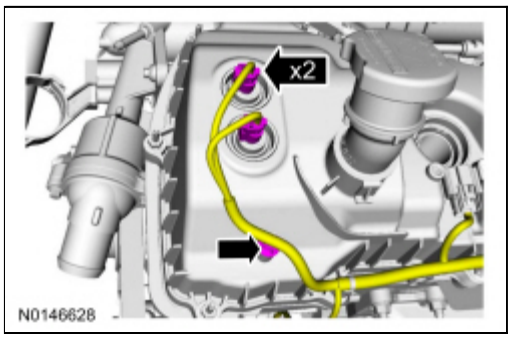


5. Make sure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.



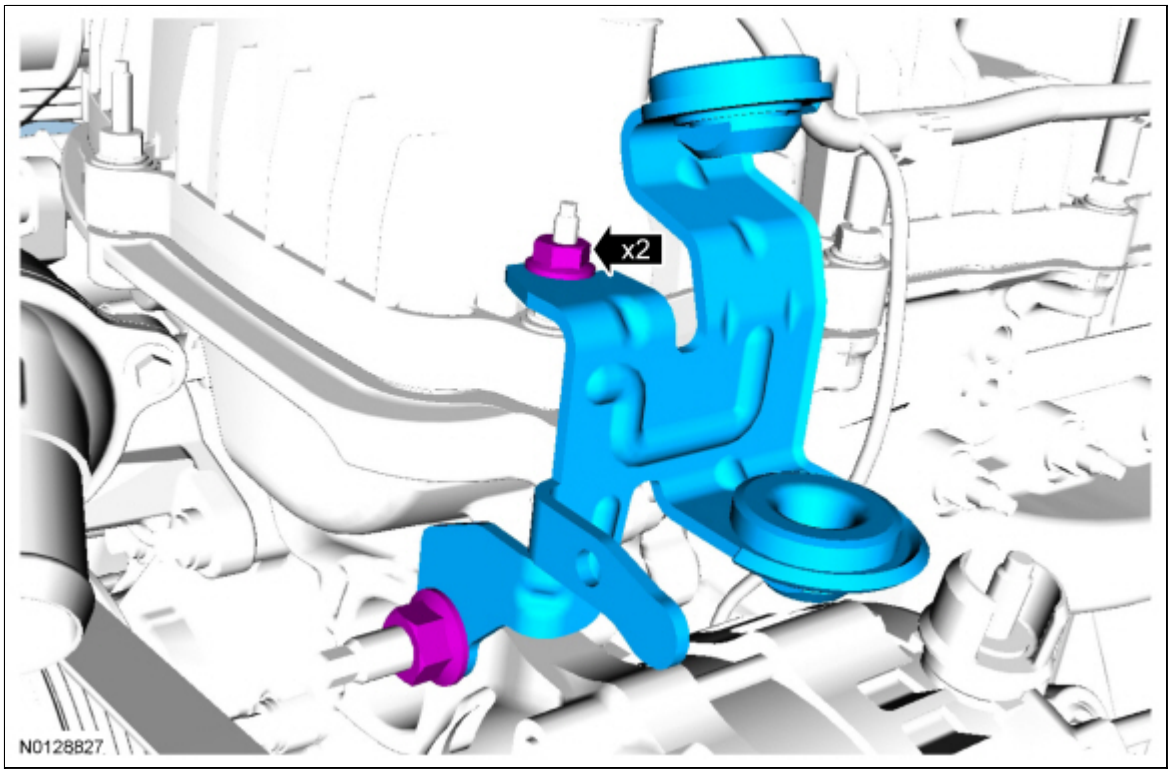
6. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.

7. Connect the 2 LH VCT solenoid electrical connectors. Install a tie strap.

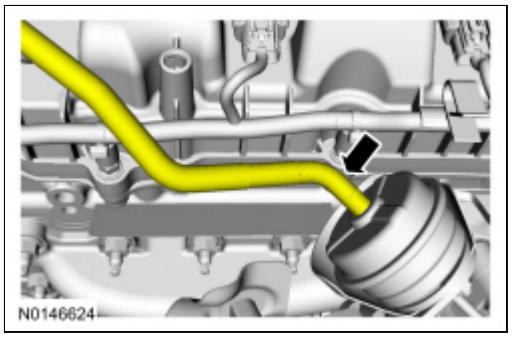


8. Install the CAC tube bracket and the 2 nuts.
   - Tighten the M6 nut to 6 Nm (53 lb-in).
   - Tighten the M10 nut to 48 Nm (35 lb-ft).

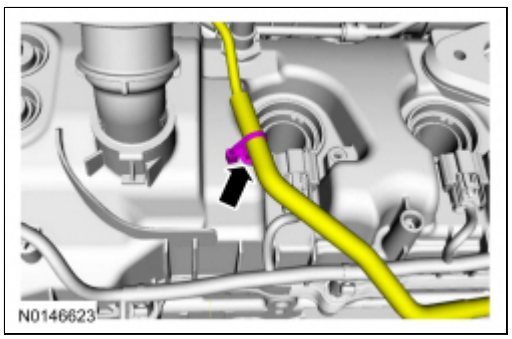
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9. Connect the turbocharger wastegate hose.



10. Install the tie strap for the turbocharger wastegate hose.



11. Install the engine oil level indicator.

12. Install the ignition coil-over-plugs. for additional information, refer to Section 303-07A .

13. Install the fuel injection pump. For additional information, refer to Section 303-04A .

14. Install the LH turbocharger-to- CAC tube. Install the LH ACL pipe-to-turbocharger pipe and the ACL outlet pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

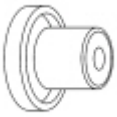
15. Install the engine appearance cover.

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Valve Cover — RH

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

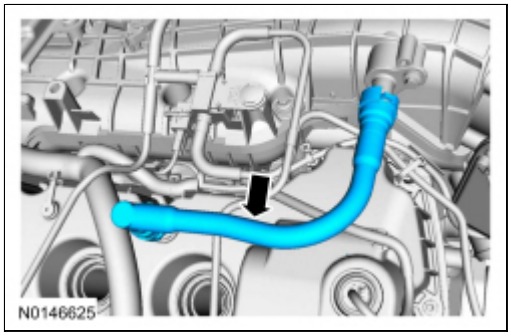
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the engine appearance cover.

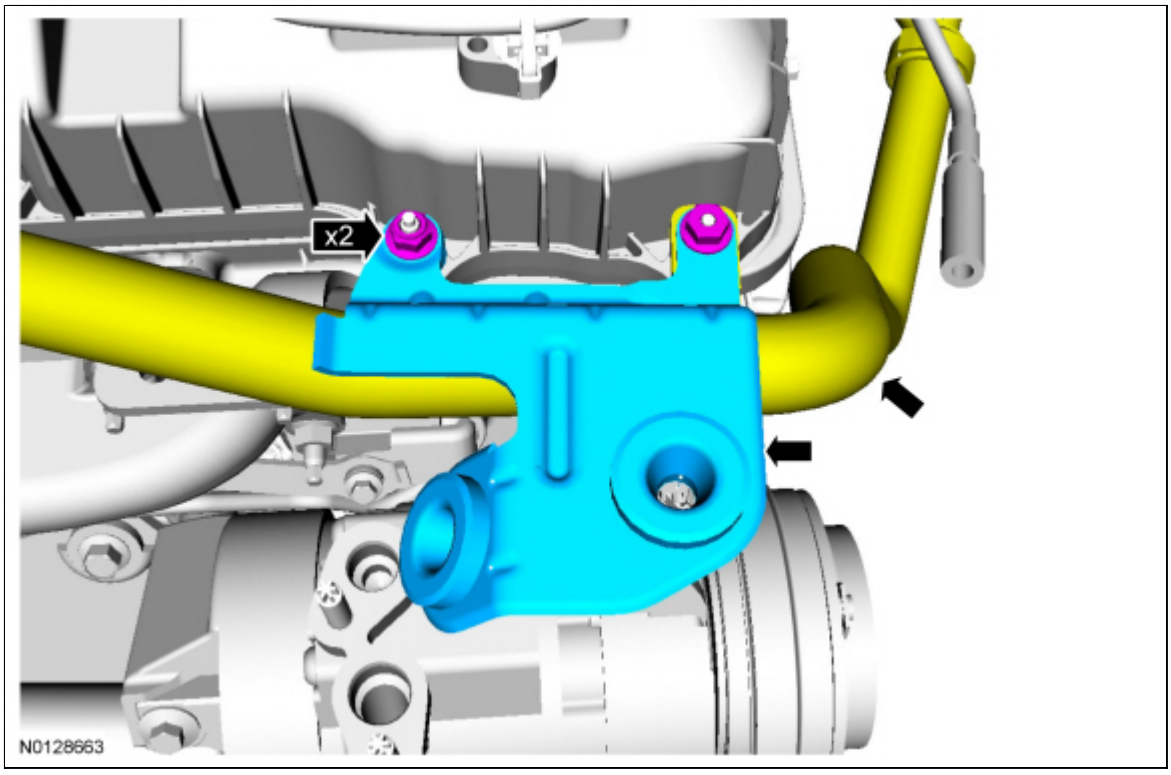
2. Remove the Air Cleaner (ACL) outlet pipe and the RH ACL pipe-to-turbocharger pipe. Remove the RH turbocharger-to-Charge Air Cooler (CAC) tube. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .

3. Remove the ignition coil-over-plugs. for additional information, refer to Section 303-07A .

4. Remove the PCV tube. Refer to Section 310-00 .

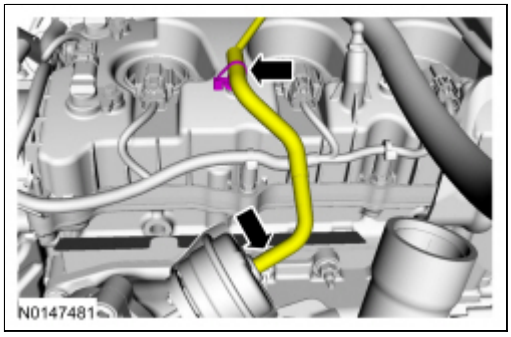


5. Remove the 2 nuts and the CAC tube bracket.
   - Disconnect the coolant hose from the valve cover stud.

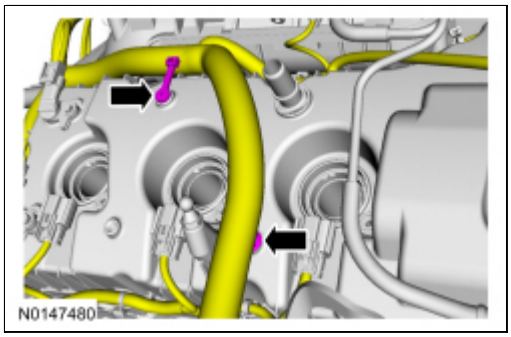


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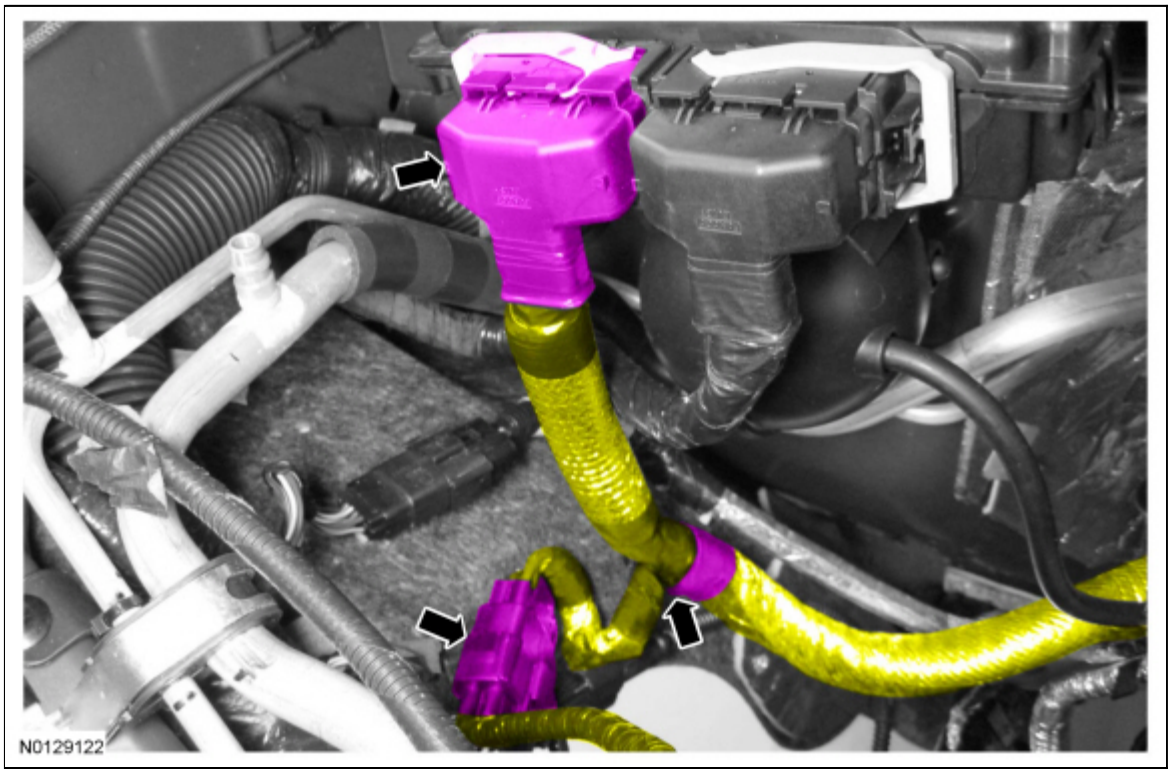
6. Remove the tie strap. Disconnect and position aside the turbocharger wastegate hose.



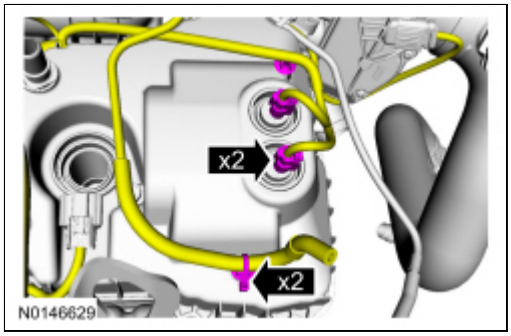
7. Remove the tie strap and disconnect the wire retainer from the valve cover.



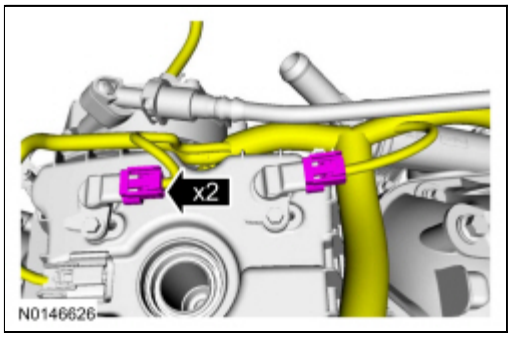
8. Disconnect the PCM electrical connector. Disconnect the electrical connector and the 2 wire retainers. Position aside the engine wire harness.



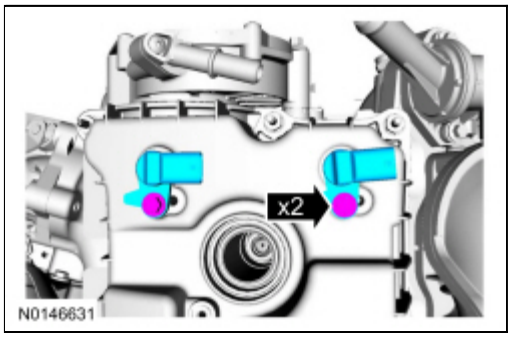
9. Disconnect the 2 RH Variable Camshaft Timing (VCT) solenoid electrical connectors. Remove the tie strap for the turbocharger wastegate hose and engine wiring.



10. Disconnect the 2 Camshaft Position (CMP) sensor electrical connectors.



11. Remove the 2 bolts and the 2 CMP sensors.

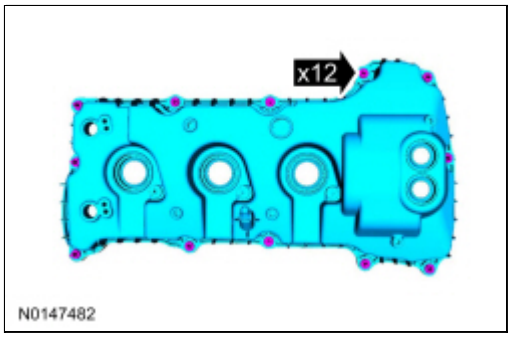


12. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.

13. **NOTE:** When removing the valve cover do not apply excessive force to the VCT oil control solenoid. If the VCT solenoid seal sticks to the VCT oil control solenoid carefully wiggle the valve cover until the seal breaks free. After the valve cover is removed, inspect and replace the VCT solenoids if damaged. The plastic electrical connector on the VCT solenoid will normally rotate approximately 12 degrees inside the steel housing.

    Loosen the 12 valve cover stud bolts and remove the RH valve cover.
    - Discard the valve cover gasket.

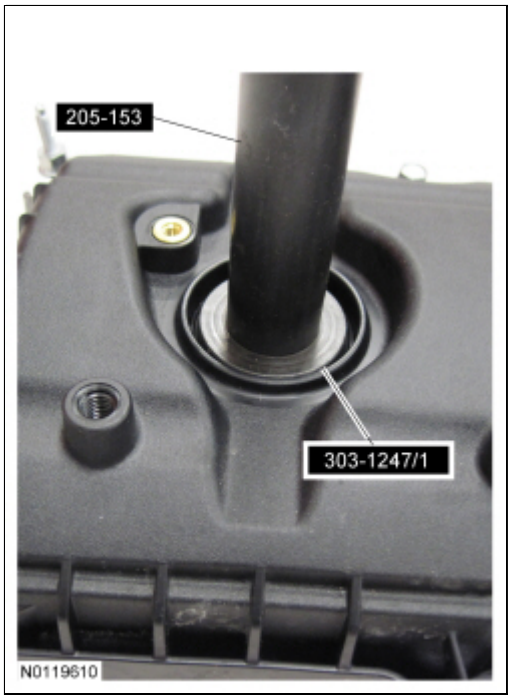
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14. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



15. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



16. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

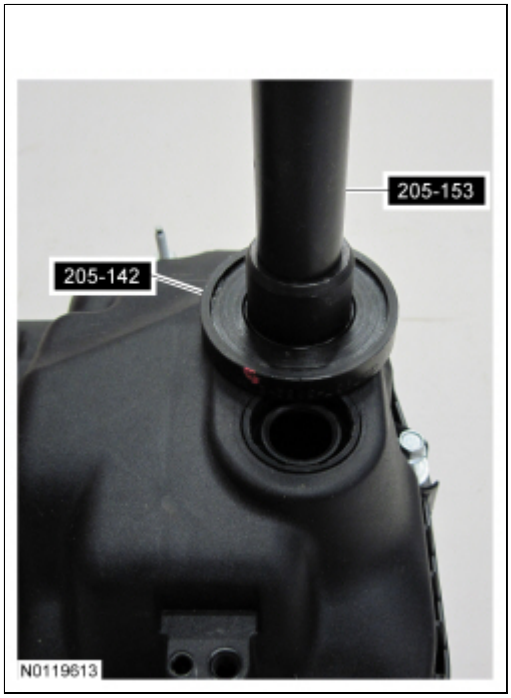
   Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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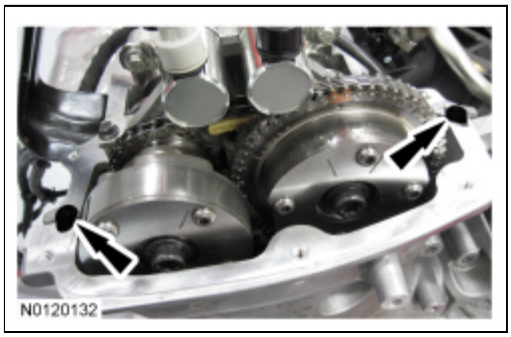
Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



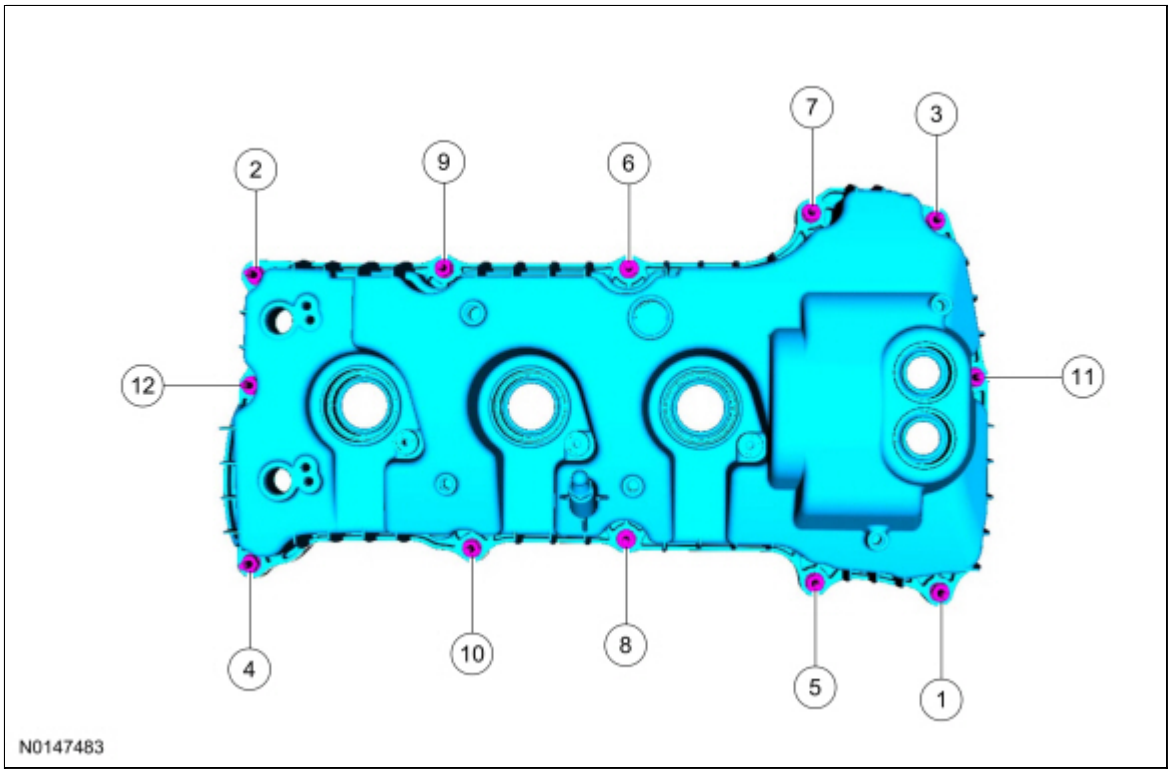
3. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

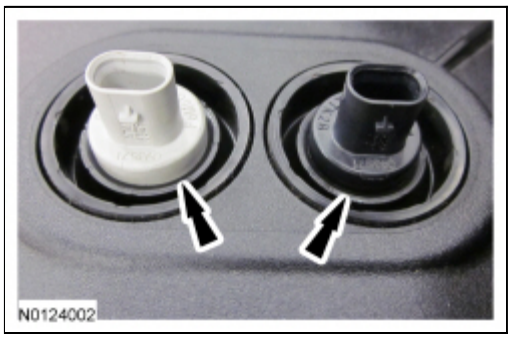
   Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.



4. Using a new gasket, install the RH valve cover, tighten the 12 valve cover stud bolts in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).



5. Make sure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.

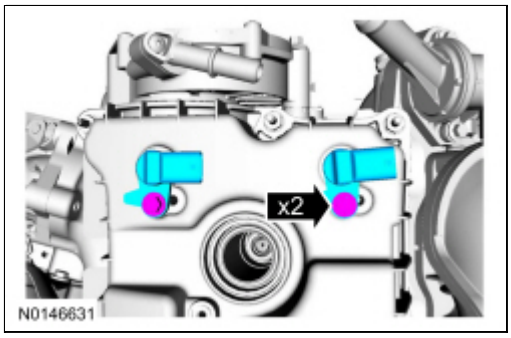


6. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.

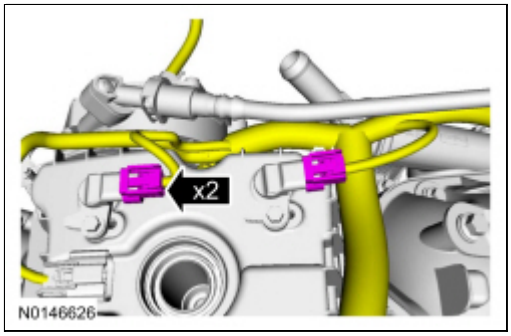
7. **NOTE:** Lubricate the 2 CMP sensor O-rings with clean engine oil.

   Install the 2 CMP sensors and 2 bolts.
   - Tighten to 7 Nm (62 lb-in).

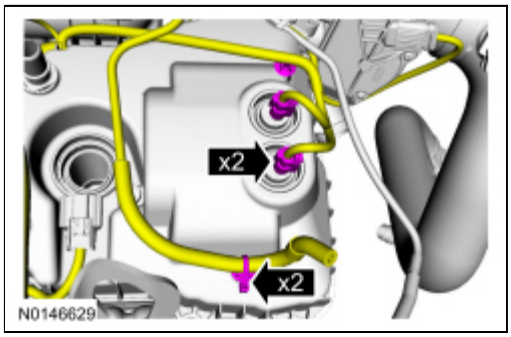
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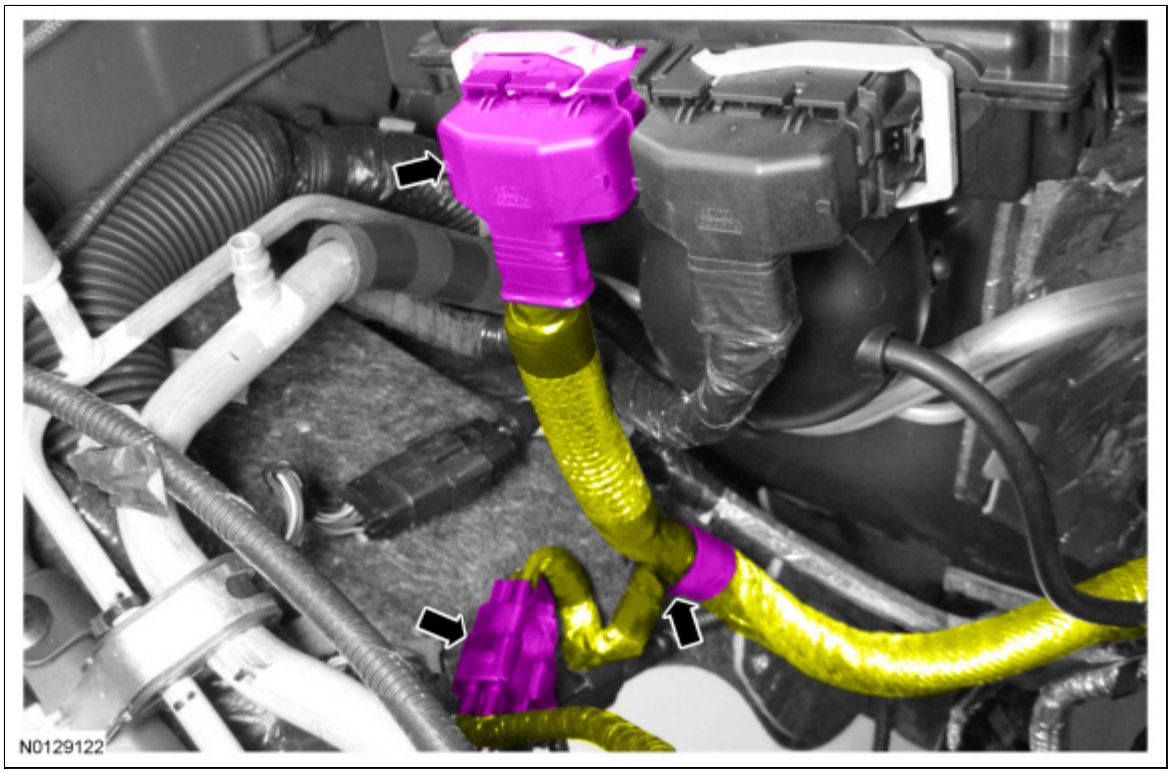
8. Connect the 2 CMP sensor electrical connectors.



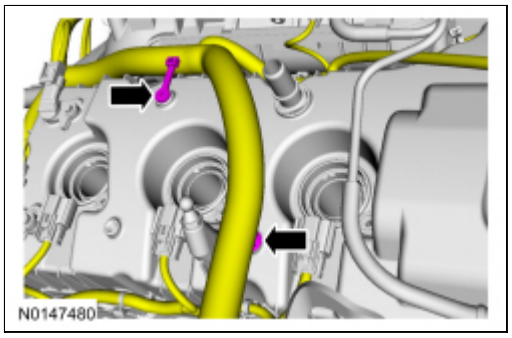
9. Connect the 2 RH VCT solenoid electrical connectors. Install a tie strap for the turbocharger wastegate hose and engine wiring.



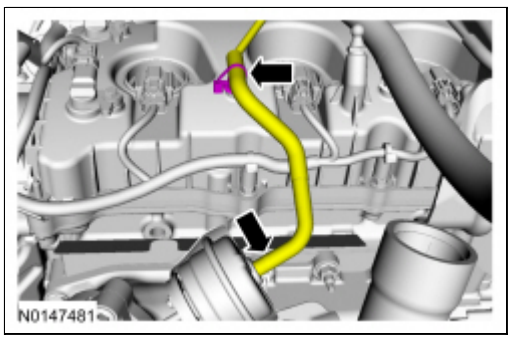
10. Connect the PCM electrical connector. Connect the electrical connector and the 2 wire retainers.



11. Connect the wire retainer to the valve cover. Install a tie strap

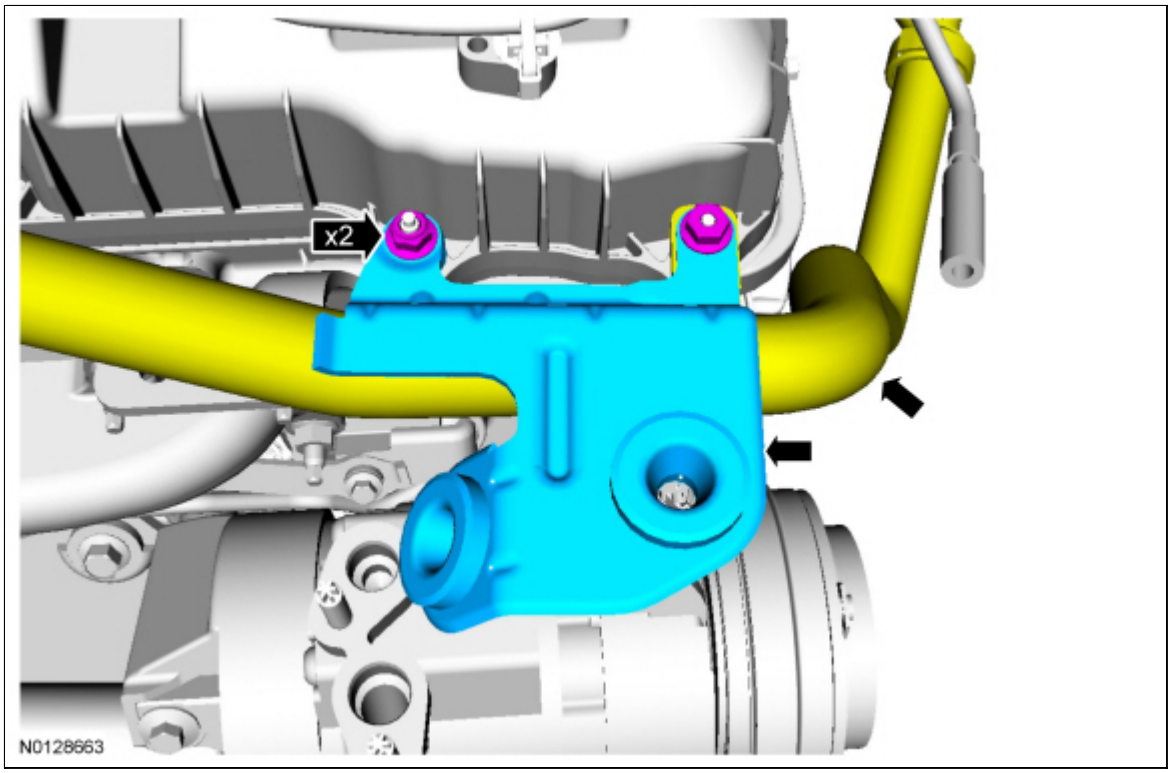


12. Connect the turbocharger wastegate hose. Install a the tie strap

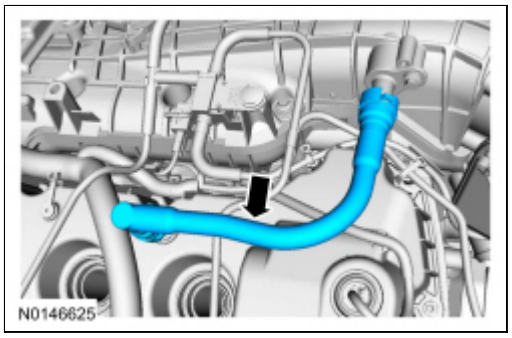


13. Position back the coolant hose to the valve cover stud. Install the CAC tube bracket and the 2 nuts.
    - Tighten to 6 Nm (53 lb-in).

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14. Install the PCV tube. Refer to Section 310-00 .



15. Install the ignition coil-over-plugs. for additional information, refer to Section 303-07A .

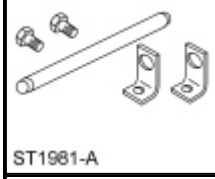
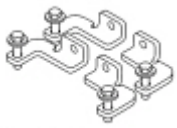
16. Install the RH turbocharger-to- CAC tube. Install the RH ACL pipe-to-turbocharger pipe and the ACL outlet pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

17. Install the engine appearance cover.

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Valve Spring, Retainer and Seal

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303–470 (T94P-6510–CH)

Material

Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the valve tappets from the cylinder being serviced. For additional information, refer to Valve Tappets in this section.

2. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

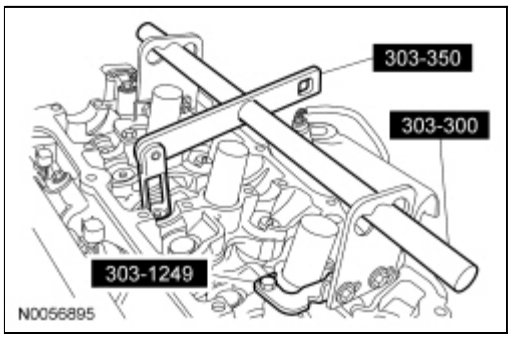
3. ***NOTICE:*** **If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal or engine damage may occur.**

   NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

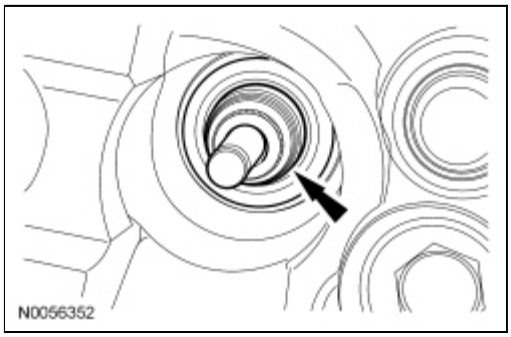
   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head — RH or Cylinder Head — LH in this section.

   Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



5. Remove and discard the valve stem seal.

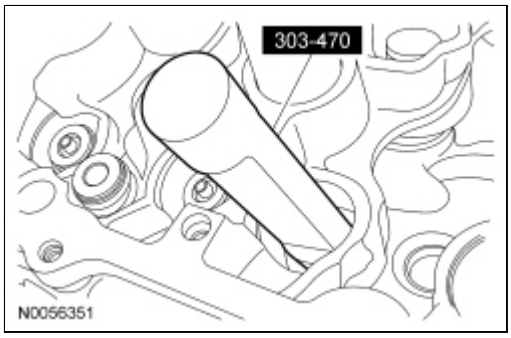


Installation

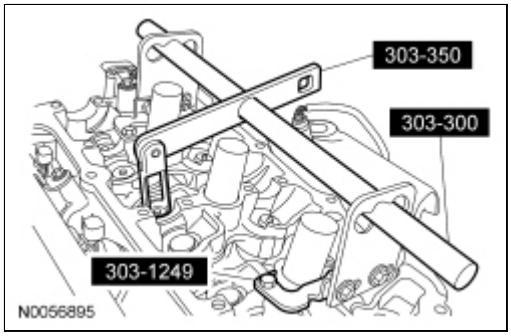
1. **NOTE:** Lubricate the valve stem seal with clean engine oil prior to installation.

   Using the Valve Stem Oil Seal Installer, install a new valve stem seal.

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2. Using the Valve Spring Compressors, install the valve spring, retainer and key.



3. Install the valve tappets. For additional information, refer to Valve Tappets in this section.

Valve Tappets

Material

Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

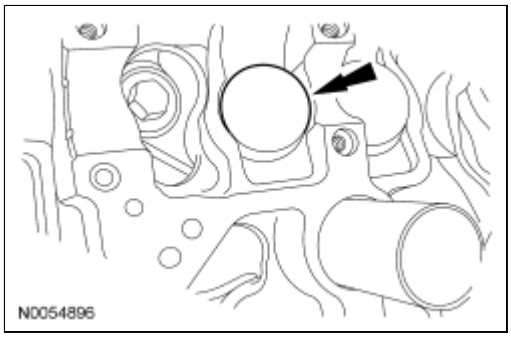
Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Depending on the valve tappets being serviced, remove the LH and/or the RH camshafts. For additional information, refer to Camshaft — RH and/or the Camshaft — LH in this section.

2. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

   Remove the valve tappets from the cylinder head.



3. **NOTE:** The valve tappets must be installed in their original positions.

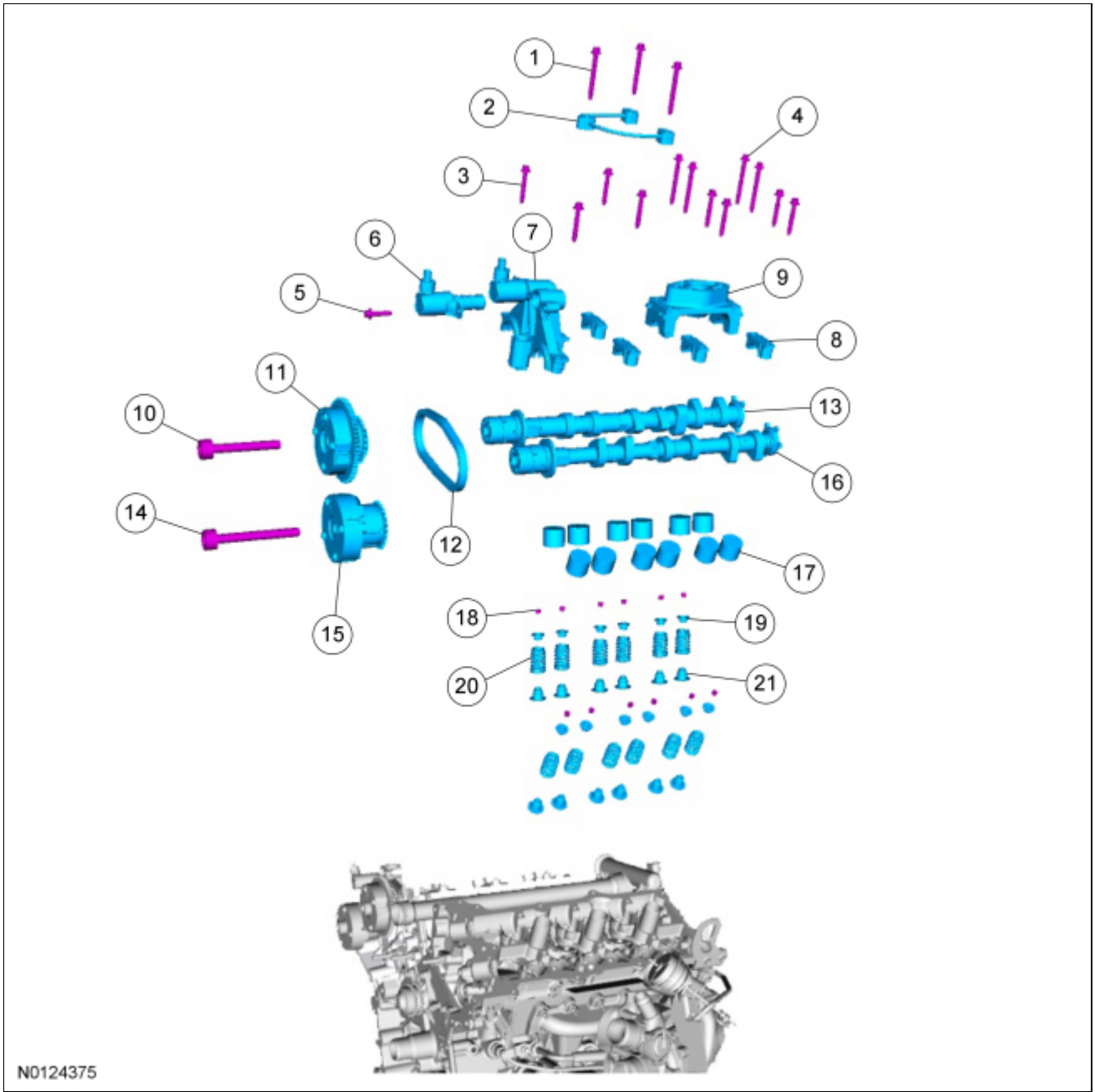
   NOTE: Coat the valve tappets with clean engine oil prior to installation.

   To install, reverse the removal procedure.

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Valve Train Components — Exploded View

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	W500305	Valve train oil tube bolt (3 required)
2	6K602	Valve train oil tube

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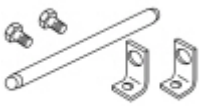
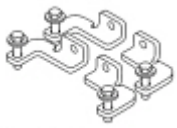
3	W710702	Camshaft cap bolt (8 required)
4	W500306	Camshaft cap bolt (4 required)
5	W500215	Exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid bolt
6	6M280	Exhaust camshaft VCT oil control solenoid
7	6B280	Camshaft mega cap
8	6A258	Camshaft cap (4 required)
9	6A258	Camshaft cap
10	6279	Intake camshaft VCT assembly bolt
11	6256	Intake camshaft VCT assembly
12	6268	LH secondary timing chain
13	6250	Intake camshaft
14	6279	Exhaust camshaft VCT assembly bolt
15	6C525	Exhaust camshaft VCT assembly
16	6250	Exhaust camshaft
17	6500	Valve tappet (12 required)
18	6518	Valve spring retainer key (24 required)
19	6514	Valve spring retainer (12 required)
20	6513	Valve spring (12 required)
21	6571	Valve stem seal (12 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Cylinder Head

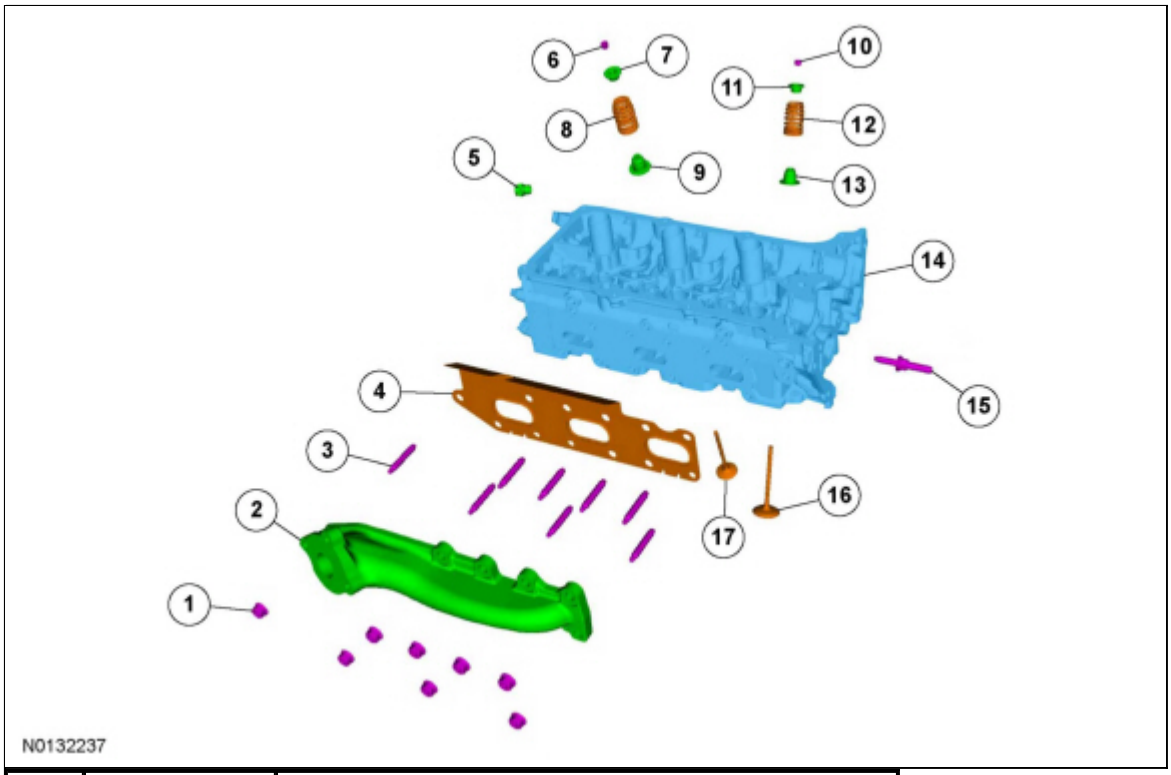
Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

NOTE: RH cylinder head shown, LH cylinder head similar.



Item	Part Number	Description
1	W701706	RH exhaust manifold nut (8 required)
2	9430	RH exhaust manifold
3	W712244	RH exhaust manifold stud (8 required)
4	9448	RH exhaust manifold gasket
5	6A968	Turbocharger coolant return fitting
6	6518	Intake valve spring retainer key (12 required)
7	6514	Intake valve spring retainer (6 required)
8	6513	Intake valve spring (6 required)
9	6571	Intake valve stem seal (6 required)
10	6518	Exhaust valve spring retainer key (12 required)
11	6514	Exhaust valve spring retainer (6 required)
12	6513	Exhaust valve spring (6 required)
13	6571	Exhaust valve stem seal (6 required)
14	6049	RH cylinder head
15	W714090	Timing chain tensioner arm pin
16	6507	Intake valve (6 required)
17	6505	Exhaust valve (6 required)

Disassembly

All cylinder heads

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1. Remove the 8 nuts and the exhaust manifold.
    - Discard the nuts and gasket.

2. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

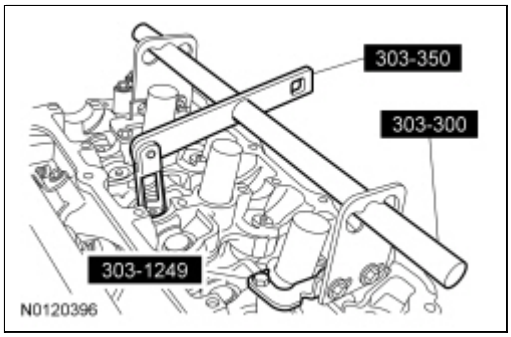
3. Remove and discard the 8 exhaust manifold studs.

4. Remove the timing chain guide pin.

5. Remove the turbocharger coolant return fitting.

6. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

   Using the Valve Spring Compressors, remove the keys, retainer and spring.



7. Remove the valve from the cylinder head.

8. Remove and discard the valve stem seal.

9. Repeat the above steps for each valve.

RH cylinder head

10. Remove the timing chain tensioner arm pin.

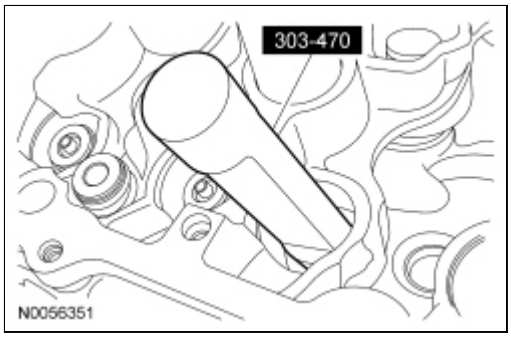
Assembly

All cylinder heads

1. **NOTE:** If the components are to being reinstalled, they must be installed into their original location.

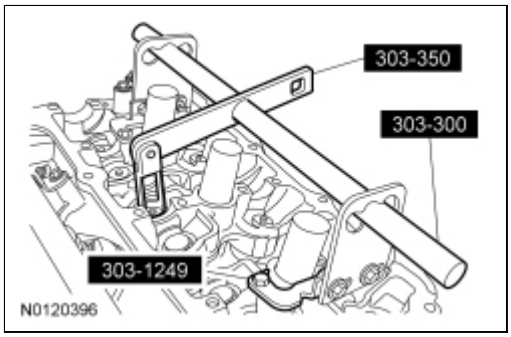
   NOTE: Lubricate the valve stem and valve stem seal with clean engine oil prior to installation.

   Using the Valve Stem Oil Seal Installer, install a new valve stem seal.



2. Install the valve.

3. Using the Valve Spring Compressors, install the valve spring, retainer and key.



4. Repeat the above steps for each valve.

5. Install the timing chain guide pin and tighten in 2 stages.
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten an additional 60 degrees.

6. Install the turbocharger coolant return fitting.
   - Tighten to 18 Nm (159 lb-in).

LH cylinder head

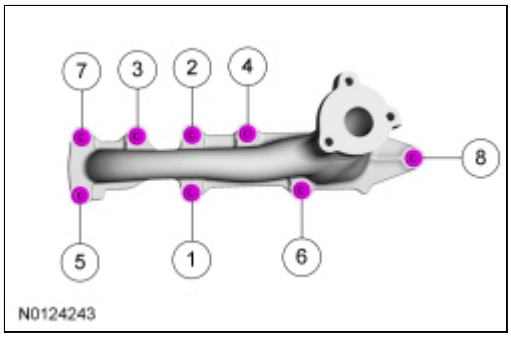
7. Install the timing chain tensioner arm pin and tighten in 2 stages.
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten an additional 60 degrees.

8. Install 8 new LH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).

9. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

   Using a new gasket, install the LH exhaust manifold and 8 new nuts. Tighten in 2 stages in the sequence shown:
   - Stage 1: Tighten to 19 Nm (168 lb-in).
   - Stage 2: Tighten to 25 Nm (18 lb-ft).

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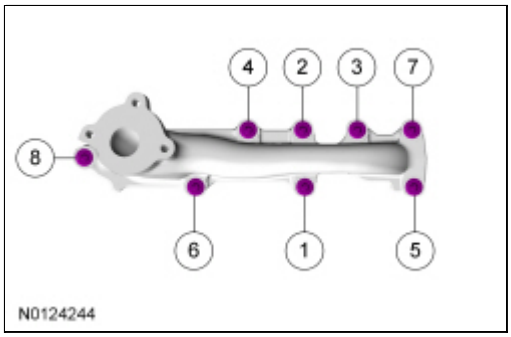


RH cylinder head

10. Install 8 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

11. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the RH exhaust manifold and 8 new nuts. Tighten in 2 stages in the sequence shown:
    - Stage 1: Tighten to 19 Nm (168 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).

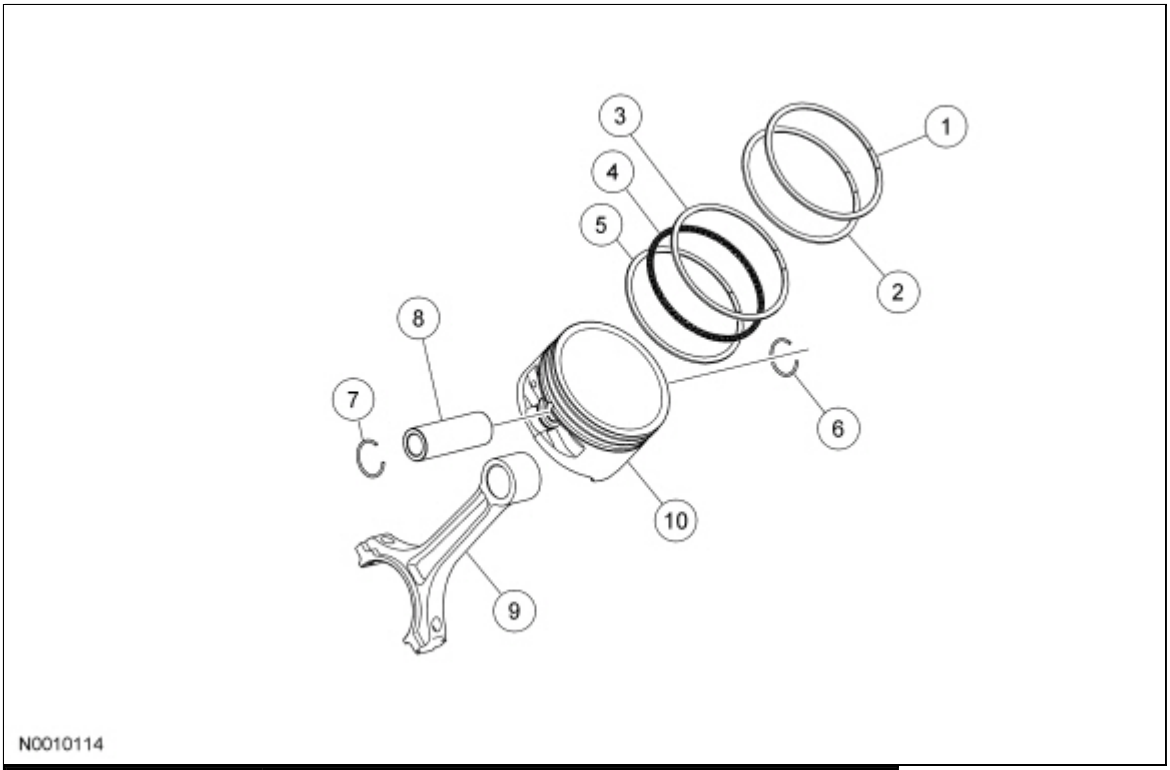


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Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	—	Piston compression upper ring (part of 6148)
2	—	Piston compression lower ring (part of 6148)
3	—	Piston oil control upper segment ring (part of 6148)
4	—	Piston oil control spacer (part of 6148)
5	—	Piston oil control lower segment ring (part of 6148)
6	6140	Piston pin retainer clip
7	6140	Piston pin retainer clip
8	6135	Piston pin

9	6200	Connecting rod
10	6110	Piston

Disassembly

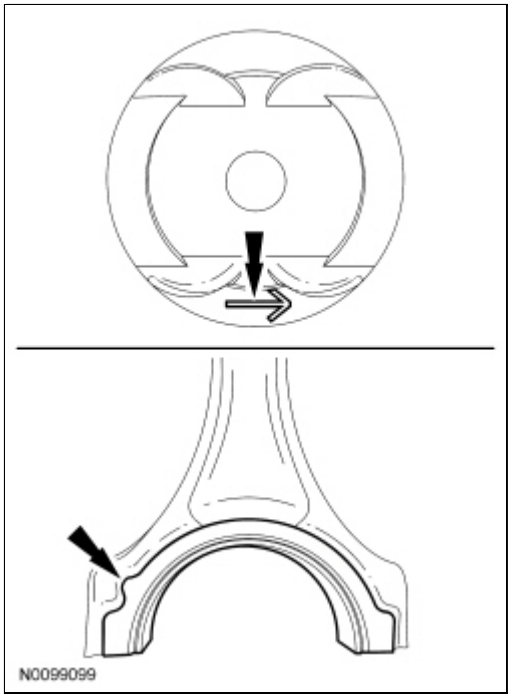
1. Remove the piston rings from the piston.
   - Discard the piston rings.

2. Remove the 2 piston pin retainers and the piston pin.
   - Discard the 2 piston pin retainer clips.

3. **NOTE:** If the piston and/or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

   NOTE: If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

   Separate the piston from the connecting rod.



4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. Align the piston-to-connecting rod orientation marks and position the connecting rod in the piston.

2. Lubricate the piston pin and pin bore with clean engine oil.

3. Install the piston pin in the piston and connecting rod assembly.

4. Install the new piston pin retaining clips in the piston.

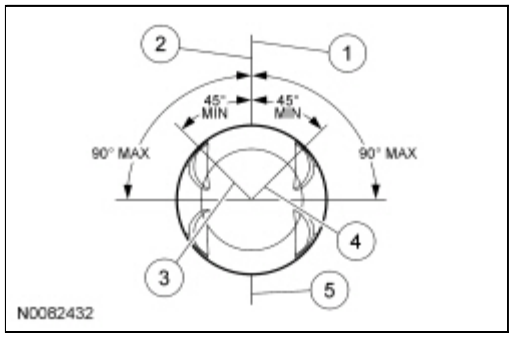
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- The piston pin retaining clip gap orientation must be toward the top or dome of piston.

5. Lubricate the piston and the new piston rings with clean engine oil.

6. **NOTE:** The piston compression upper and lower ring should be installed with the "O" mark on the ring face pointing up toward the top of the piston.

   Install the piston rings onto the piston as shown.
   1. Center line of the piston parallel to the wrist pin bore
   2. Upper compression ring gap location
   3. Upper oil control segment ring gap location
   4. Lower oil control segment ring gap location
   5. Expander ring and lower compression ring gap location



Material

Item	Specification	Fill Capacity
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	5.7L (6.0 qt) includes filter change
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	—
Motorcraft® Silicone Gasket Remover ZC-30	—	—
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B	—
Motorcraft® Threadlock 262 TA-26	WSK-M2G351-A6	—
Motorcraft® Thread Sealant with PTFE TA-24	WSK-M2G350-A2	—

General Specifications

Item	Specification
Engine	
Displacement	3.7L (4V) (226 CID)
No. cylinders	6
Bore/stroke	95.5/86.7 mm (3.759/3.413 in)
Fire order	1-4-2-5-3-6
Spark plug	12405
Oil pressure	Minimum 30 psi @ 1,500 rpm with engine at normal operating temperature
Compression ratio	10.5:1

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Engine weight (without accessory drive components)	161 kg (355 lb)
Engine and transaxle assembly weight (without accessory drive components)	260.8 kg (575 lb)
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	Flat within 0.08 mm (0.003 in) length end to end; area 150 mm (5.9 in) x 150 mm (5.9 in) (or full width) should be less than 0.05 mm (0.002 in)
Combustion chamber volume	56.651 cc (3.46 CI)
Valve tappet clearance — intake	0.15-0.25 mm (0.006-0.01 in)
Valve tappet clearance — exhaust	0.360-0.460 mm (0.0142-0.0181 in) Engine must be at room temperature before measuring
Valve guide bore inner diameter	5.519-5.549 mm (0.217-0.218 in)
Valve stem diameter — intake	5.479-5.497 mm (0.2157-0.2164 in)
Valve stem diameter — exhaust	5.466-5.484 mm (0.2151-0.2159 in)
Valve stem-to-guide clearance — intake	0.022-0.070 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance — exhaust	0.035-0.083 mm (0.0013-0.032 in)
Valve head diameter — intake	37.0 mm (1.46 in)
Valve head diameter — exhaust	31.0 mm (1.22 in)
Valve face runout	0.05 mm (0.0001 in)
Valve face angle	45.25-45.75°
Valve seat width — intake	1.3-1.5 mm (0.051-0.059 in)
Valve seat width — exhaust	1.7-2.0 mm (0.067-0.079 in)
Valve seat runout	0.04 mm (0.0001 in) MAX
Valve seat angle	44.5-45.5°
Valve spring free length (approx.)	48.0 mm (1.889 in)
Valve spring compression pressure (N @ spec. length)	525 N @ 27.0 mm (114.7 lb @ 1.06 in)
Valve spring installed height	37.0 mm (1.45 in)
Valve spring installed height pressure (N @ spec. length)	235 N @ 37.0 mm (53 lb @ 1.45 in)
Valve spring installed pressure — service limit	10% force loss @ specified height
Camshaft	
Theoretical valve lift @ 0 lash — Intake	10.0 mm (0.39 in)
Theoretical valve lift @ 0 lash — Exhaust	9.6798 mm (0.38 in)
Lobe lift — intake	10.0 mm (0.39 in)
Lobe lift — exhaust	9.6798 mm (0.38 in)
Allowable lobe lift loss	0.062 mm (0.0024 in)
Camshaft journal bore inside diameter — 1st journal	39.0375-39.0625 mm (1.536-1.537 in)

Camshaft journal bore inside diameter — intermediate journals	25.9875-26.0125 mm (1.023-1.024 in)
Camshaft bearing outside diameter — 1st journal	38.99-39.01 mm (1.5350-1.5358 in)
Camshaft bearing outside diameter — intermediate journals	25.937-25.963 mm (1.021-1.022 in)
Camshaft journal-to-bearing clearance, 1st journal — service limit	0.0725 mm (0.0029 in) MAX
Camshaft journal-to-bearing clearance, intermediate journals — service limit	0.0755 mm (0.0029 in) MAX
Runout camshaft journals	0.040 mm (0.0015 in) MAX
End play — standard	0.032-0.170 mm (0.0012-0.0066 in)
End play — service limit	0.190 mm (0.00748 in) MAX
Cylinder Block	
Cylinder bore diameter — grade 1	95.500-95.520 mm (3.760-3.761 in)
Cylinder bore roundness	0.013 mm (0.0005 in)
Cylinder bore taper	0.010 mm (0.0004 in) per 25.4 mm (1 in)
Block main bore roundness	0.008 mm (0.003 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.8503-2.8513 in)
Head gasket surface flatness	Flat within 0.150 mm (0.005 in) overall; 0.050 mm (0.001 in) per 150 mm (5.905 in) x 150 mm (5.905 in); 0.025 mm (0.0009 in) per 25 mm (0.98 in) x 25 mm (0.98 in)
Crankshaft	
Main bearing journal diameter	67.5 mm (2.657 in)
Main bearing journal maximum taper	0.004 mm (0.00015 in)
Main bearing journal maximum out-of-round	0.006 mm (0.00023 in)
Main bearing journal-to-main bearing clearance	0.026-0.041 mm (0.0010-0.0016 in)
Connecting rod journal diameter	55.983-56.003 mm (2.204-2.205 in)
Connecting rod journal maximum taper	0.004 mm (0.00015 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.00023 in)
Crankshaft maximum end play	0.051-0.291 mm (0.0020-0.0114 in)
Piston and Connecting Rod	
Piston diameter — single grade	95.490-95.476 mm (3.7594-3.7589 in)
Piston-to-cylinder bore clearance	0.010 to 0.044 mm (0.0003-0.0017 in)
Piston ring end gap — compression (top, gauge diameter)	0.17-0.27 mm (0.0067-0.0106 in)
Piston ring end gap — compression (bottom, gauge diameter)	0.30-0.55 mm (0.0118-0.0216 in)
Piston ring end gap — oil ring (steel rail, gauge	0.15-0.45 mm (0.0059-0.0177 in)

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diameter)	
Piston ring groove width — compression (top)	1.230-1.25 mm (0.0484-0.0492 in)
Piston ring groove width — compression (bottom)	1.530-1.55 mm (0.0602-0.0610 in)
Piston ring groove width — oil ring	2.53-2.55 mm (0.0996-0.1004 in)
Piston ring width — upper compression ring	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width — lower compression ring	1.47-1.49 mm (0.0578-0.0586 in)
Piston ring-to-groove clearance (upper and lower compression rings)	0.040-0.080 mm (0.0015-0.0031 in)
Piston pin bore diameter	23.004-23.008 mm (0.9056-0.9058 in)
Piston pin diameter	22.997-23.000 mm (0.9053-0.9055 in)
Piston pin length	55.975 mm (2.203 in)
Piston pin-to-piston fit	0.004 to 0.011 mm (0.00015-0.00043 in)
Piston-to-connecting rod clearance	2.7 mm (0.1 in)
Connecting rod-to-pin clearance — standard	0.007-0.022 mm (0.0002-0.0009 in)
Connecting rod pin bore diameter	23.007-23.019 mm (0.905-0.906 in)
Connecting rod length (center-to-center)	152.68 mm (6.01 in)
Connecting rod maximum allowed bend	0.038 mm (0.0014 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing bore diameter — grade 1	59.866-59.872 mm (2.3569-2.3571 in)
Connecting rod bearing bore diameter — grade 2	59.873-59.879 mm (2.3572-2.3574 in)
Connecting rod bearing bore diameter — grade 3	59.880-59.886 mm (2.3574-2.3577 in)
Connecting rod bearing-to-crankshaft clearance	0.020-0.054 mm (0.0007-0.0021 in)
Connecting rod side clearance (assembled to crank) — standard	0.175-0.425 mm (0.0068-0.0167 in)
Connecting rod side clearance (assembled to crank) — service limit	0.175-0.425 mm (0.0068-0.0167 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolt, stud bolt and nut	25	18	—
A/C tube nut	15	—	133
Accessory drive belt tensioner bolts	25	18	—
Axle shaft housing carrier bushing bolt	115	85	—
Bellhousing-to-engine bolts and stud bolts	48	35	—
Bellhousing-to-oil pan bolts	48	35	—
Block coolant drain plug — RH [a]	—	—	—

Block coolant drain plug — LH [b]	—	—	—
Block oil gallery plug — LH [c]	48	35	—
Block oil gallery plug — rear [c]	85	63	—
Block oil gallery plug — RH [c]	32	24	—
Camshaft bearing and mega cap bolts [d]	—	—	—
Camshaft Position (CMP) sensor bolts	10	—	89
Catalytic convertor support bracket bolts	90	66	—
Catalytic converter-to-exhaust intermediate pipe bolts [d]	—	—	—
Catalytic converter-to-exhaust manifold nuts	45	35	—
Channel cover plate bolts [d]	—	—	—
Connecting rod cap bolts [d]	—	—	—
Coolant pump bolts [d]	—	—	—
Coolant pump pulley bolts	24	18	—
Crankcase rear seal retainer plate bolts [d]	—	—	—
Crankshaft Position (CKP) sensor bolt	10	—	89
CKP sensor heat shield nut and bolt	10	—	89
CKP sensor wiring harness retainer stud bolt	10	—	89
Crankshaft pulley bolt [d]	—	—	—
Crossmember brace nuts and bolts	90	66	—
Cylinder head bolts [d]	—	—	—
Cylinder head M6 bolt	10	—	89
Cylinder Head Temperature (CHT) sensor	10	—	89
Engine front cover bolts [d]	—	—	—
Engine lift eye	25	18	—
Engine support insulator bolts	175	129	—
Engine support insulator bracket bolts	63	46	—
Engine support insulator nuts	175	129	—
Engine support insulator stud bolts	15	—	133
Engine support insulator through bolts	350	258	—
Engine oil filter [e]	—	—	—
Engine-to-bellhousing bolt	45	35	—
Engine Oil Pressure (EOP) switch [d]	—	—	—
Exhaust manifold heat shield bolts	12	—	106
Exhaust manifold nuts [d]	—	—	—
Exhaust manifold studs	12	—	106
Flexplate bolts [d]	—	—	—
Front air dam	20	—	177

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Generator B+ terminal nut	17	—	150
Generator nut and bolt	48	35	—
Generator stud	8	—	71
Ground strap bolt	10	—	89
Heater hose bracket nut	8	—	71
Hood bolts	12	—	106
Ignition coil-on-plug bolts	7	—	62
Knock Sensor (KS) bolts	20	—	177
Lower front axle carrier mounting bushing bolt	115	85	—
Lower intake manifold bolts [d]	—	—	—
Main bearing bolts [d]	—	—	—
Main bearing cap support brace bolts [d]	—	—	—
Oil cooler bolt	58	43	—
Oil filter adapter bolts [d]	—	—	—
Oil pan bolts [d]	—	—	—
Oil pan drain plug	27	20	—
Oil pan-to-bellhousing bolts	48	35	—
Oil pump bolts	10	—	89
Oil pump screen and pickup tube bolts	10	—	89
Skid plate bolts	48	35	—
Spark plugs	15	—	133
Thermostat housing bolts [d]	—	—	—
Timing chain guide bolts	10	—	89
Timing chain guide pin [d]	—	—	—
Timing chain tensioner arm pin [d]	—	—	—
Timing chain tensioner bolts	10	—	89
Torque converter nuts	44	32	—
Transmission cooler tube bracket bolt	12	—	106
Transmission cooler tube bracket nut	12	—	106
Transmission crossmember nuts	103	76	—
Upper front axle carrier mounting bushing bolt	115	85	—
Upper intake manifold bolts [d]	—	—	—
Upper intake manifold support bracket bolt	10	—	89
Valve cover bolts and stud bolts [d]	—	—	—
Valve train oil tube bolts [d]	—	—	—
Variable Camshaft Timing (VCT) bolts [d]	—	—	—
VCT oil control solenoid bolts [d]	—	—	—

[a] Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

[b] Tighten to 10 Nm (89 lb-in) plus an additional 720 degrees.
[c] Discard original plug and O-ring seal. Install a new plug and O-ring seal to specified torque, no sealer or lubricant required.
[d] Refer to the procedure in this section.
[e] Tighten to 5 Nm (44 lb-in) plus an additional 180 degrees.

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Engine

The 3.7L (4V) is a (TiVct) V6 engine with the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- A composite lower intake manifold and upper intake manifold
- Aluminum cylinder heads
- An aluminum, 60-degree V-cylinder block
- Twin independent Variable Camshaft Timing (VCT) system
- The electronic ignition system with 6 ignition coils
- 305 horsepower

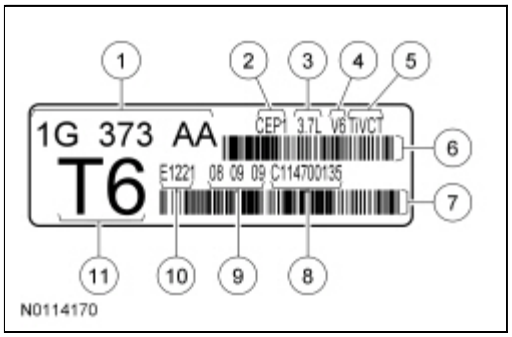
Engine Identification

For quick identification, refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.

Engine Code Information Label

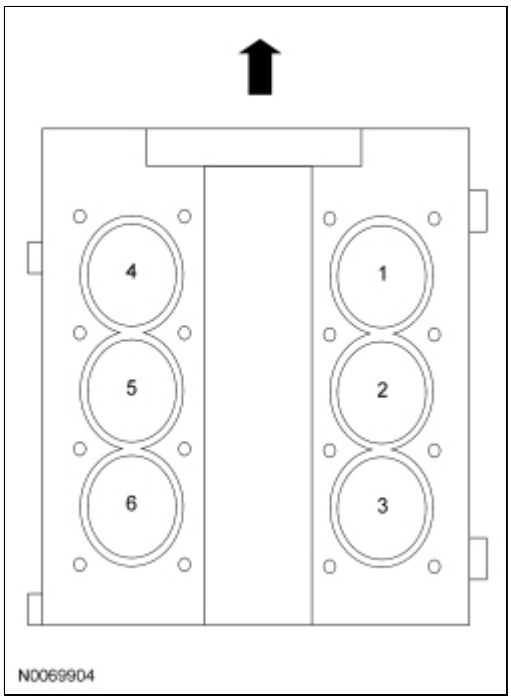
The engine code information label, located on the front side of the valve cover, contains the following:



Item	Description
1	Engine part number
2	Engine plant (Cleveland)
3	Engine displacement
4	Engine configuration
5	Twin independent VCT system

6	Bar code
7	Bar code
8	Running number
9	Engine build date (DDMMYY)
10	Plant shift line
11	Derivative code

Engine Cylinder Identification



Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 6 solenoid-operated fuel injectors:

- are mounted between the fuel rail and the intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.

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Valve Train

The valve train uses Direct Acting Mechanical Buckets (DAMB). The camshaft lobes are positioned directly above mechanical buckets which are positioned on top of the valves.

Twin IndependentVariable Camshaft Timing (VCT) System

The twin independent VCT system allows variable control of intake valve closing which optimizes combustion at full load providing improved power and low speed torque (broadening the torque curve) which enables variable valve overlap which provides better fuel economy and emissions and provides optimized cold start operation with improved exhaust emissions.

PCV System

All engines are equipped with a closed-type PCV system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rod bearings, timing chain tensioners and VCT solenoids. The flow of oil to the valve tappets and valve train is controlled by a restricting orifice located in the cylinder head, valve train oil feed tubes. Die cast aluminum deep sump oil pan for 10,000 mile oil change intervals.

Oil Pump

The lubrication system is designed to provide optimum oil flow to critical components of the engine through its entire operating range.

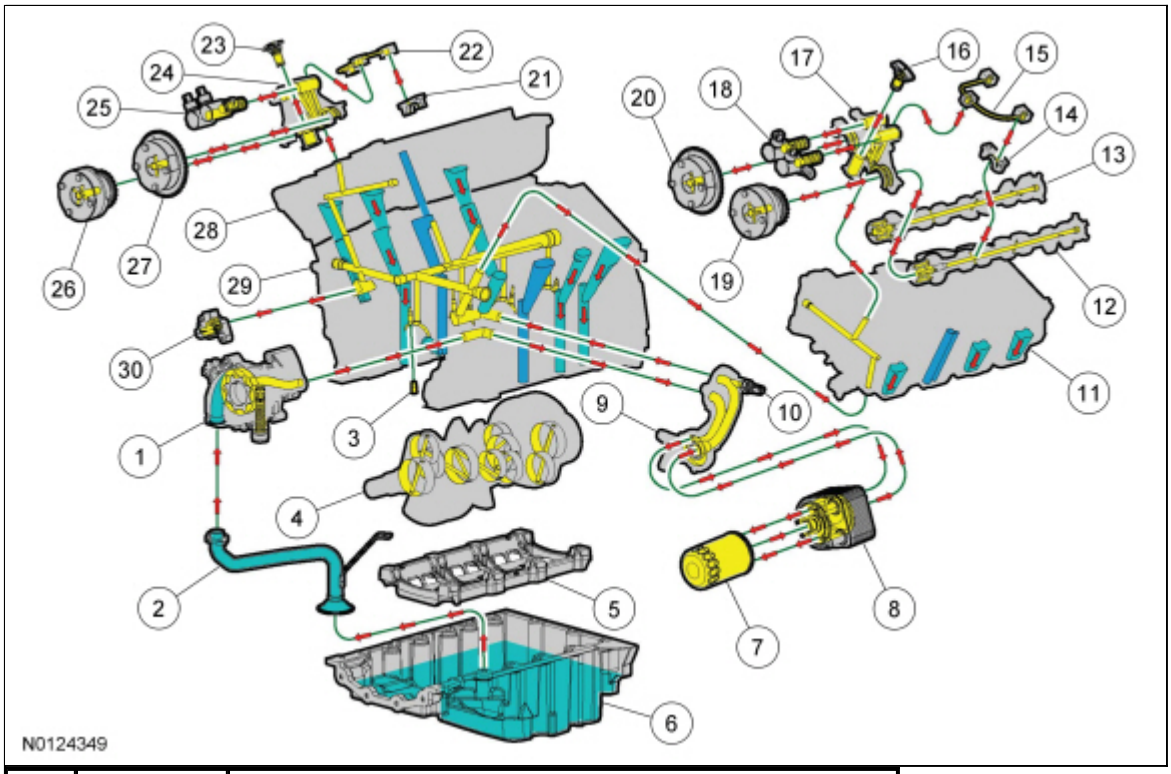
The heart of the system is a positive displacement internal gear oil pump.

Generically, this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high-viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Engine Oil Flow Illustration

Engine Assembly



Item	Part Number	Description
1	6600	Oil pump
2	6622	Oil pump screen and pickup tube
3	—	Piston oil cool valve (part of 6010)
4	6303	Crankshaft
5	6C364	Engine main bearing cap support
6	6675	Oil pan
7	6731	Oil filter
8	6A642	Oil cooler
9	6881	Oil filter adapter
10	9278	Engine Oil Pressure (EOP) switch
11	6049	LH cylinder head
12	6250	Exhaust camshaft
13	6250	Intake camshaft
14	6A258	LH camshaft cap
15	6K602	LH valve train oil feed tube
16	6K254	LH secondary timing chain tensioner

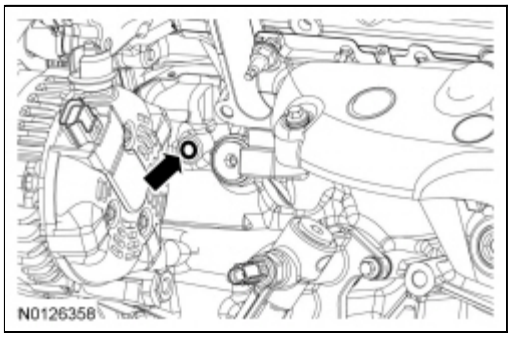
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17	6B280	LH camshaft mega cap
18	6M280	LH intake and exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid
19	6C525	LH exhaust camshaft VCT
20	6256	LH intake camshaft VCT
21	6A280	RH camshaft cap
22	6K602	RH valve train oil feed tube
23	6C270	RH secondary timing chain tensioner
24	6B280	RH camshaft mega cap
25	6M280	RH intake and exhaust camshaft VCT oil control solenoid
26	6C525	RH exhaust camshaft VCT
27	6256	RH intake camshaft VCT
28	6049	RH cylinder head
29	6010	Cylinder block
30	6K254	Primary timing chain tensioner

Cooling System

The engine cooling system includes the following:

- Radiator
- Coolant pump
- Electric fan assembly(s)
- Degas bottle (aids in maintaining the correct volume of engine coolant)
- Coolant thermostat
- Coolant hoses
- Engine oil cooler



The channel cover plate is located under the engine front cover mounted to the block. It contains a timing chain idler and press and place gaskets separating engine coolant and engine oil. A weep hole is provided on the front left side of the engine behind the generator. If oil or coolant is leaking from the weep hole, then a gasket has failed and must be replaced.

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Engine

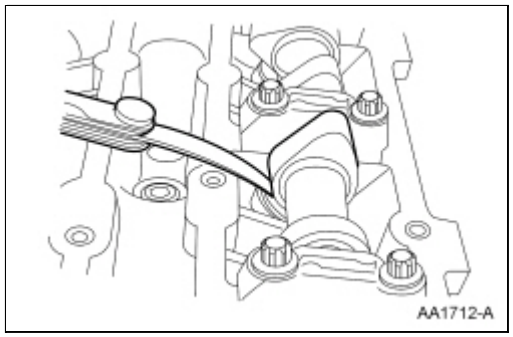
For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Valve Clearance Check

1. Remove the valve covers. For additional information, refer to Valve Cover — LH and Valve Cover — RH in this section.

2. **NOTE:** Engine must be at room temperature before measuring. The valve clearance must be measured with the camshaft at base circle. The engine will have to be rotated with the crankshaft pulley bolt to bring each valve to base circle.

   Use a feeler gauge to measure the clearance of each valve and record its location. A midrange clearance is the most desirable:
   - Intake: 0.15-0.25 mm (0.006-0.01 in)
   - Exhaust: 0.360-0.460 mm (0.0142-0.0181 in)



3. **NOTE:** The number on the valve tappet reflects the thickness of the valve tappet. For example, a tappet with the number 3.310 has the thickness of 3.31 mm (0.13 in).

   If any of the valve clearances are out of specification, select new tappets using this formula: tappet thickness = measured clearance + the base tappet thickness - most desirable thickness.
   Select the tappets and mark the installation location.

4. If required, install the new selected valve tappets in the marked locations. For additional information, refer to Valve Tappets in this section.

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Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST3101-A	Bar, Engine Spreader 303-1454
 ST2976A	Eye, Engine Lift 303-1245
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073)
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A) or equivalent

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

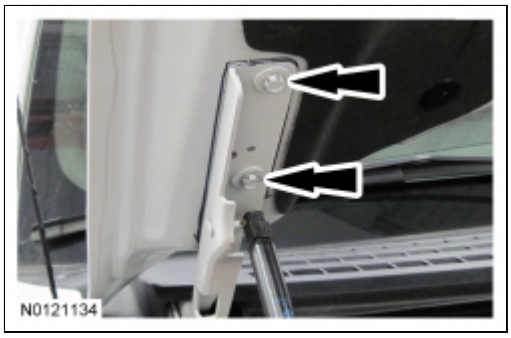
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02 .

2. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

   NOTE: RH shown, LH similar.

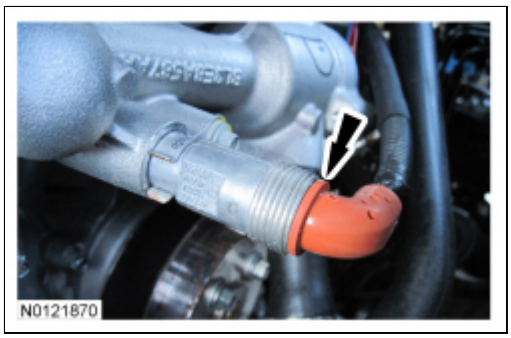
   Remove the 4 bolts (2 shown) and the hood.



3. Release the fuel system pressure. For additional information, refer to Section 310-00 .

4. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

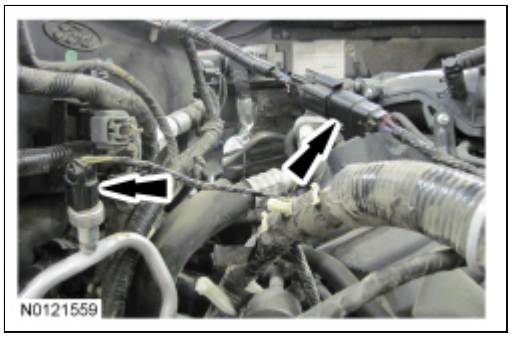
5. If equipped, disconnect the block heater electrical connector at the thermostat housing.
   - Detach the block heater wiring harness retainer from the LH valve cover stud bolt, generator wiring harness and position aside.



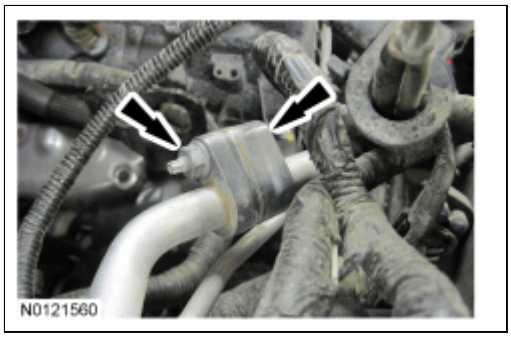
6. Remove the cooling module. For additional information, refer Section 303-03 .

7. Remove the Air Cleaner (ACL) upper tray. For additional information, refer to Intake Air System Components — Exploded View, 3.7L in Section 303-12 .

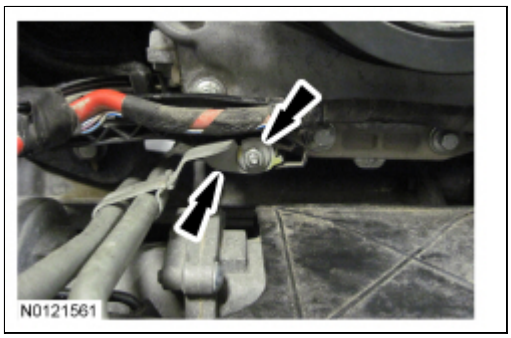
8. Disconnect the Battery Junction Box (BJB) wiring harness and the A/C pressure transducer electrical connectors.



9. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal and gasket seal.



10. Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.

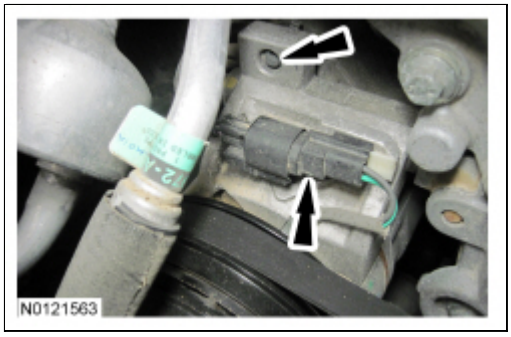


11. Detach the generator wiring harness from the engine front cover.



12. Disconnect the A/C compressor electrical connector.
    - Detach the A/C compressor wiring harness from the A/C compressor.

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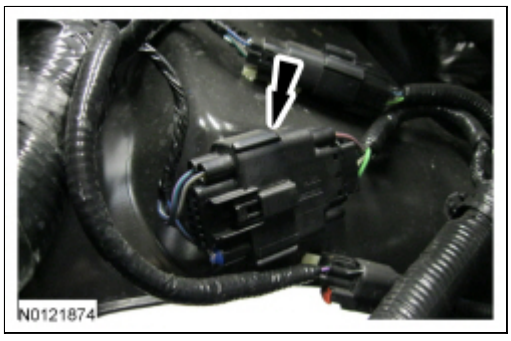
13. Remove the generator. For additional information, refer to Section 414-00 .

14. Remove the Air Conditioning (A/C) compressor belt. For additional information, refer to Section 303-05 .

15. Disconnect the middle PCM electrical connector.
    - Detach the wiring harness retainer from the fender splash shield.

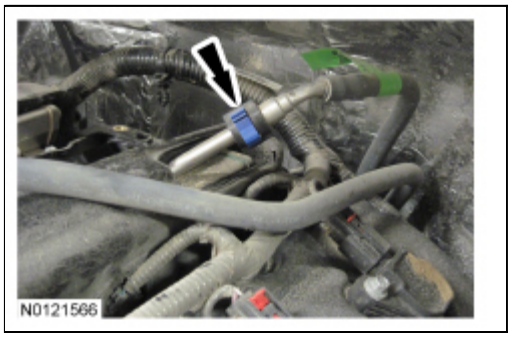


16. Detach and disconnect the engine harness electrical connector.

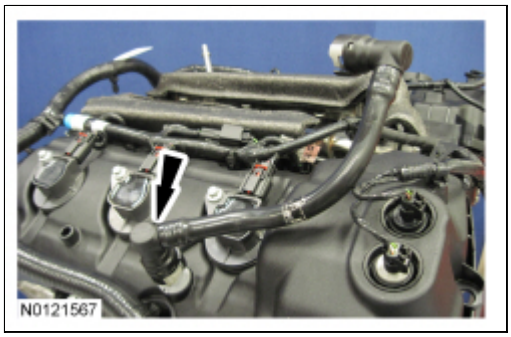


17. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

18. Disconnect the fuel supply tube quick connect coupling from the fuel rail. For additional information, refer to Section 310-00 .



19. Remove the PVC tube quick connect coupling from RH valve cover. For additional information, refer to Section 310-00 .

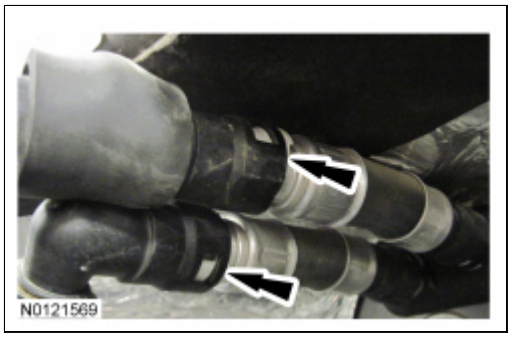


20. Remove the crankcase vent tube quick connect coupling from LH valve cover. For additional information, refer to Section 310-00 .

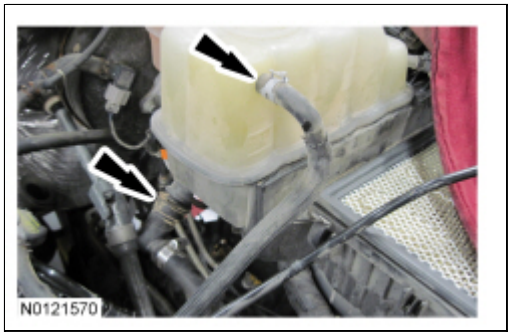


21. Disconnect the 2 heater hose couplings at the rear of the engine.

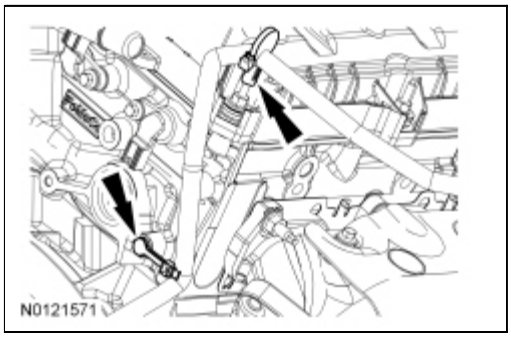
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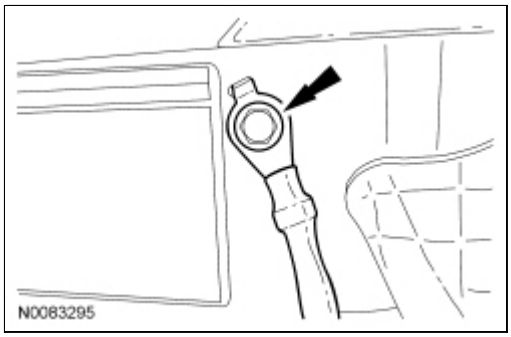
22. Disconnect the 2 coolant hoses from the degas bottle.



23. Detach the wiring harness retainers from the rear of the RH valve cover stud bolt and the rear of the RH cylinder head.

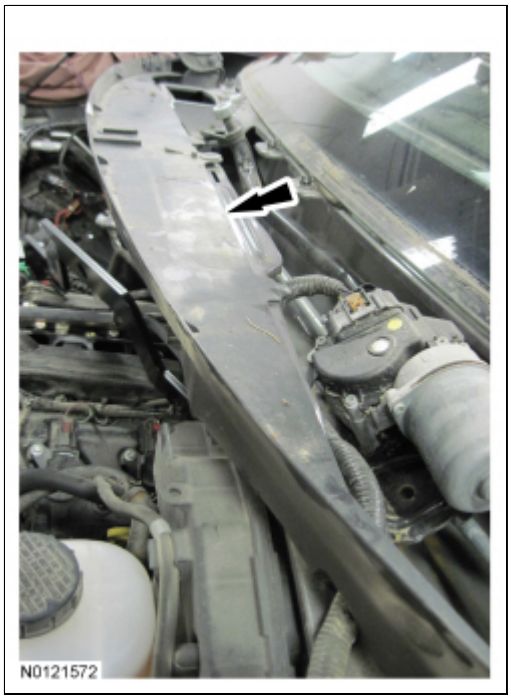


24. Remove the bolt and the ground strap from the cowl.



25. Remove the cowl panel grille. For additional information, refer to Section 501-02 .

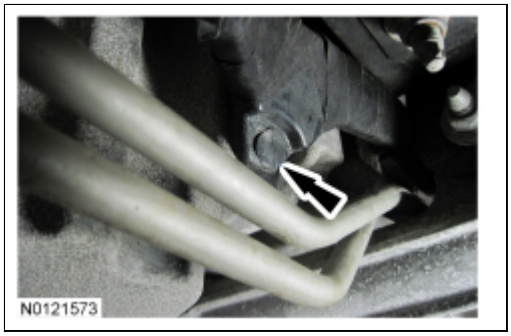
26. Remove the 6 screws and release the 2 cowl panel clips and remove the cowl panel.



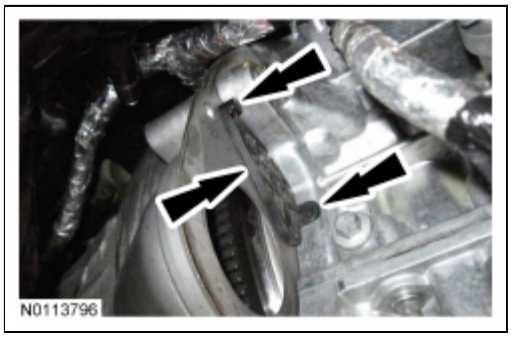
27. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .

28. Remove the starter motor. For additional information, refer to Section 303-06 .

29. Detach the starter motor wiring harness retainer from the oil pan.



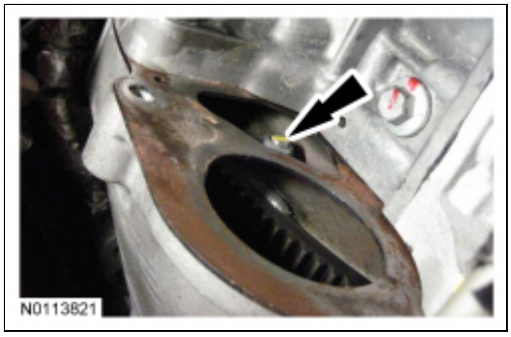
30. Remove the 2 pin-type retainers and the access cover.



31. **NOTE:** Index-mark the end of one torque converter stud and the flexplate for installation.

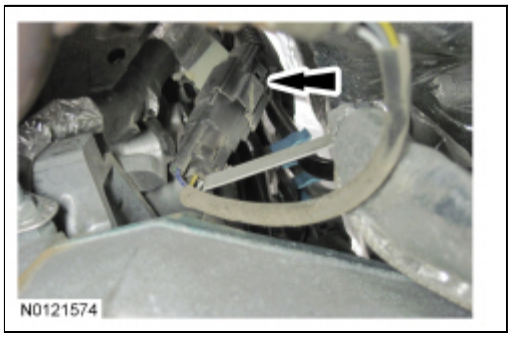
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Remove the 4 torque converter nuts.

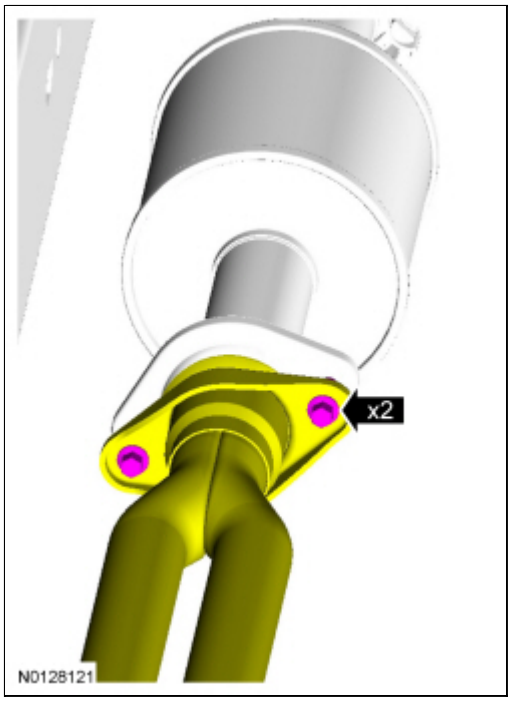


32. **NOTE:** LH shown, RH similar.

    Disconnect the LH and RH Heated Oxygen Sensor (HO2S) electrical connectors.

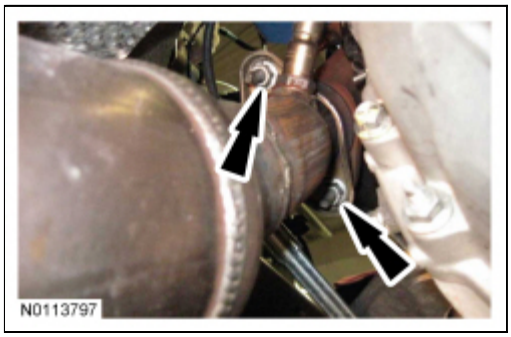


33. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.

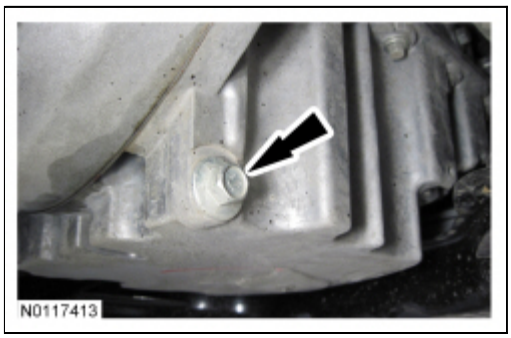


34. **NOTE:** LH shown, RH similar.

    Remove and discard the 2 LH and RH catalytic converter-to-exhaust manifold nuts.



35. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

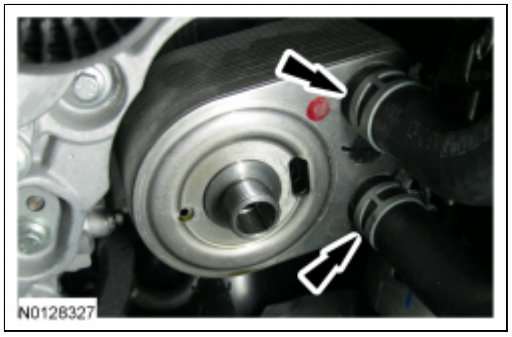


36. Remove and discard the engine oil filter.



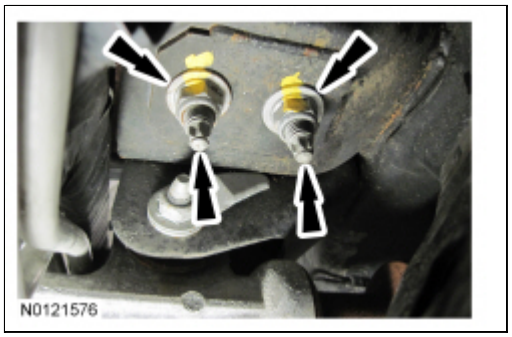
37. If equipped, remove the 2 coolant hoses from the oil cooler.

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38. **NOTE:** The 2 engine mount stud may come off with the nuts.

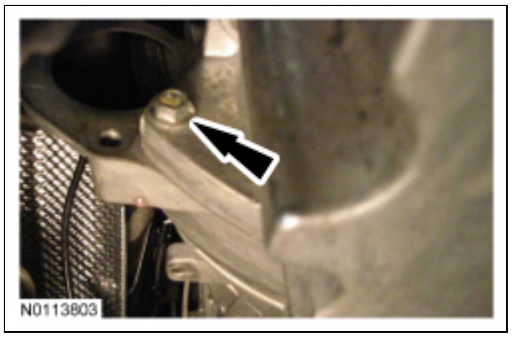
    Remove and discard the 2 RH engine support insulator nuts and studs.



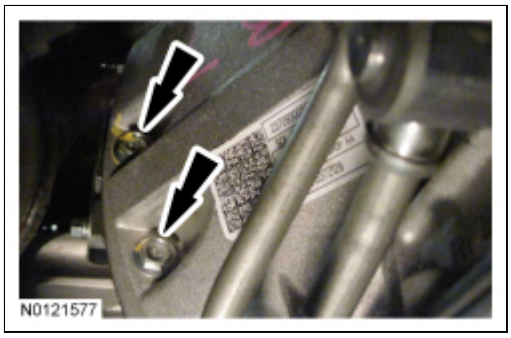
39. Remove the engine-to-bellhousing bolt.



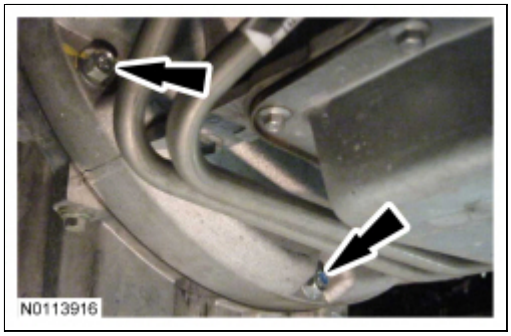
40. Remove the oil pan-to-bellhousing bolt.



41. Remove the 2 LH bellhousing-to-engine bolts.

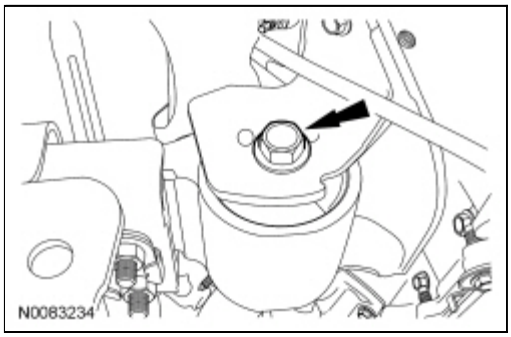


42. Remove the 2 LH bellhousing-to-oil pan bolts.



43. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove and discard the LH engine mount through bolt.

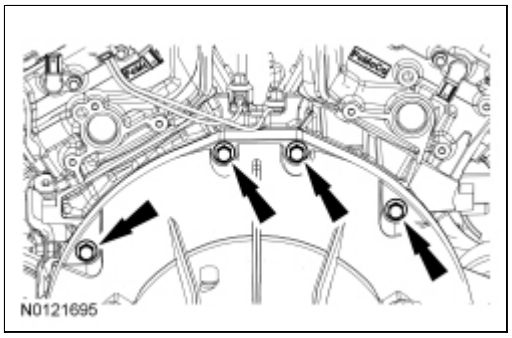


44. ***NOTICE:*** **Do not support the transmission by the fluid pan, failure to follow this instruction may result in serious damage to the transmission.**

    Support the bellhousing of the transmission with a suitable floor jack and a block of wood.

45. Remove the 4 upper bellhousing-to-engine bolts.

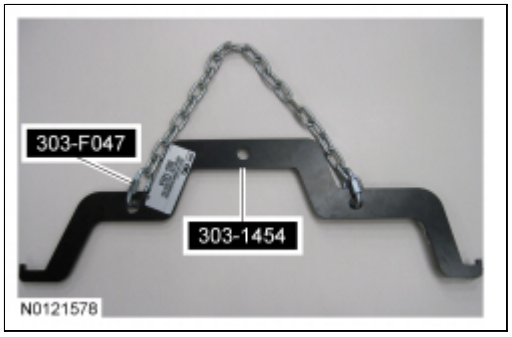
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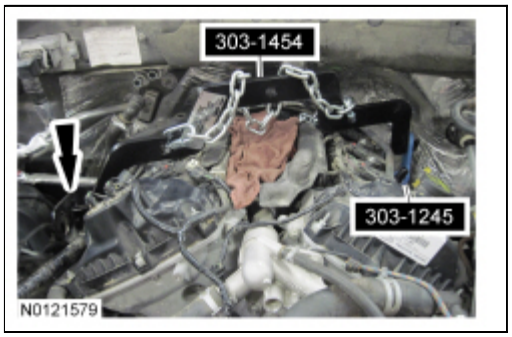
46. Install the LH engine lift eye.



47. Using part of Engine Lifting Bracket and a chain, assemble the Engine Spreader Bar as shown.

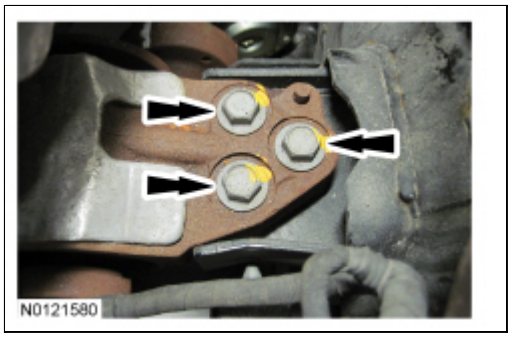


48. Install the Engine Spreader Bar assembly into the Engine Lift Eyes.



49. **NOTE:** After removing the bolts leave the LH engine support insulator in place.

    Remove the 3 bolts for the LH engine support insulator.

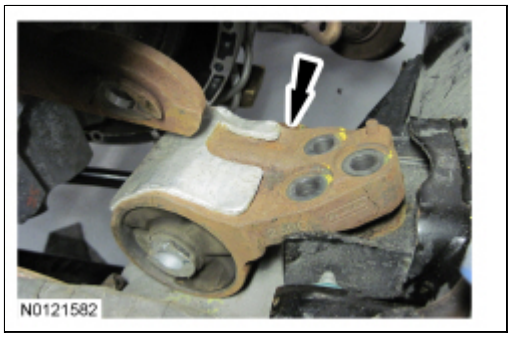


50. **NOTE:** The use of a ratchet strap may be needed to level the engine.

    Using the Heavy Duty Floor Crane and Engine Spreader Bar assembly, raise the engine for clearance to remove the LH engine support insulator.

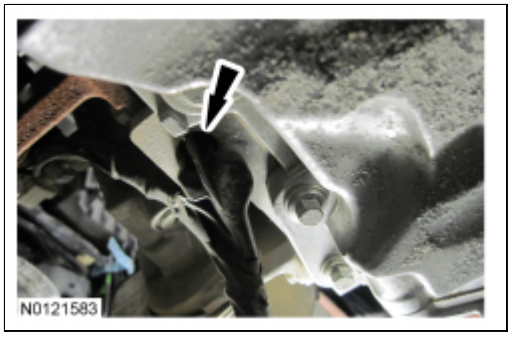


51. Remove the LH engine support insulator.



52. Detach the generator wiring harness retainer from the lower LH side of the engine block.

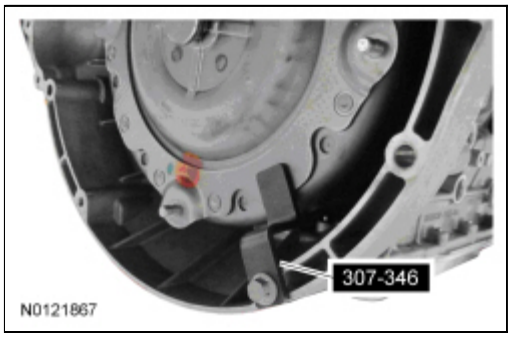
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53. Using the Heavy Duty Floor Crane and Engine Spreader Bar assembly, remove the engine.



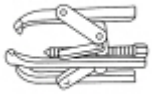
54. Install the Torque Converter Retainer.

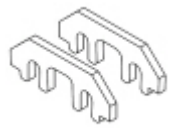


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Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST1184-A	3 Jaw Puller 303-D121
 ST3101-A	Bar, Engine Spreader 303-1454
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
	Installer, Spindle Bearing 205-150 (T80T-4000-S)

 ST2240-A	
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

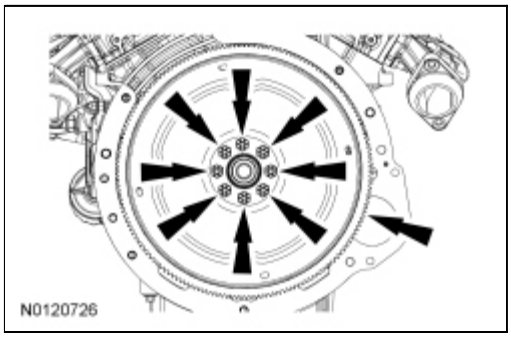
NOTE: If the cylinder head(s) is replaced, a new secondary timing chain tensioner will need to be installed.

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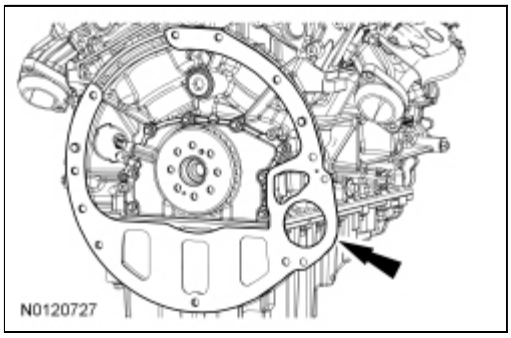
NOTE: For additional information, refer to the exploded view under the Assembly procedure in this section.

All engines

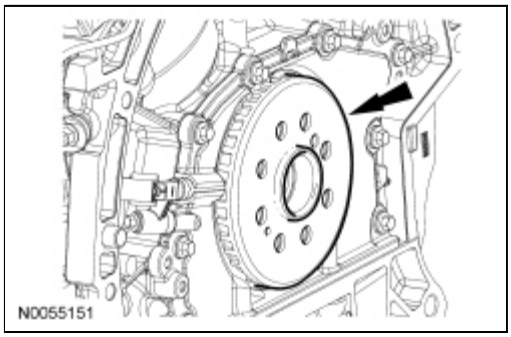
1. Remove the 8 bolts and the flexplate.



2. Remove the spacer plate.

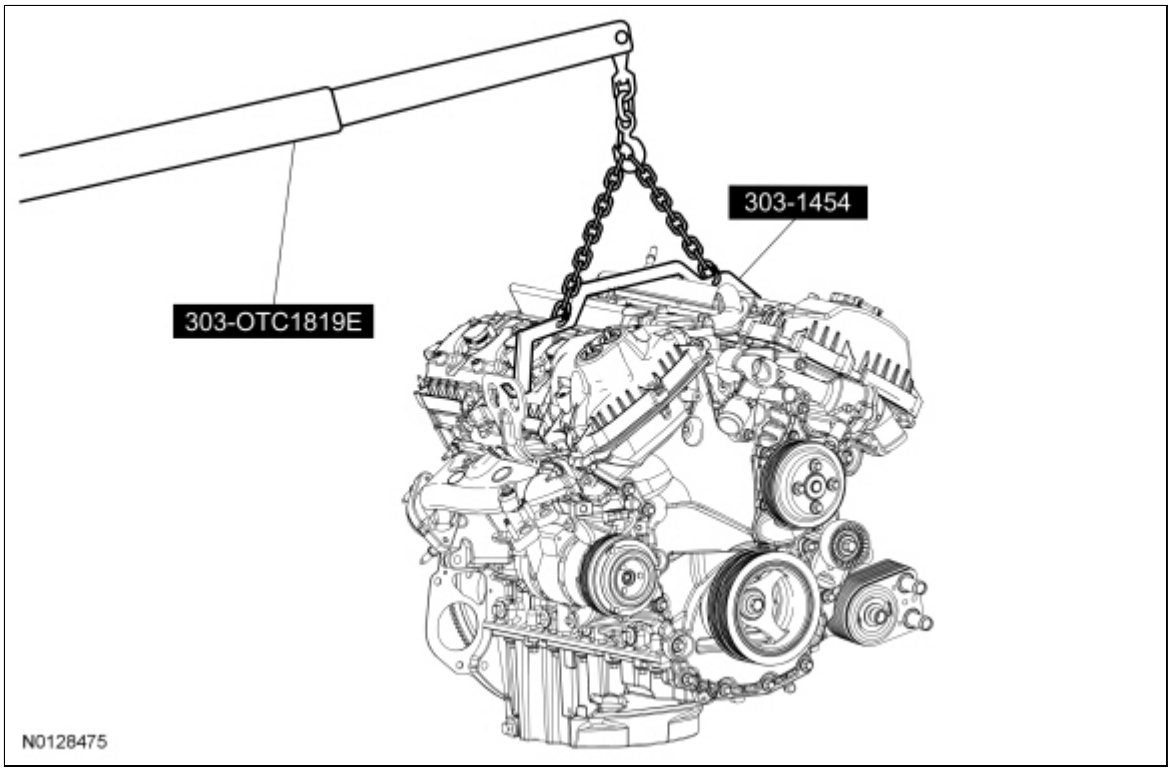


3. Remove the crankshaft sensor ring.



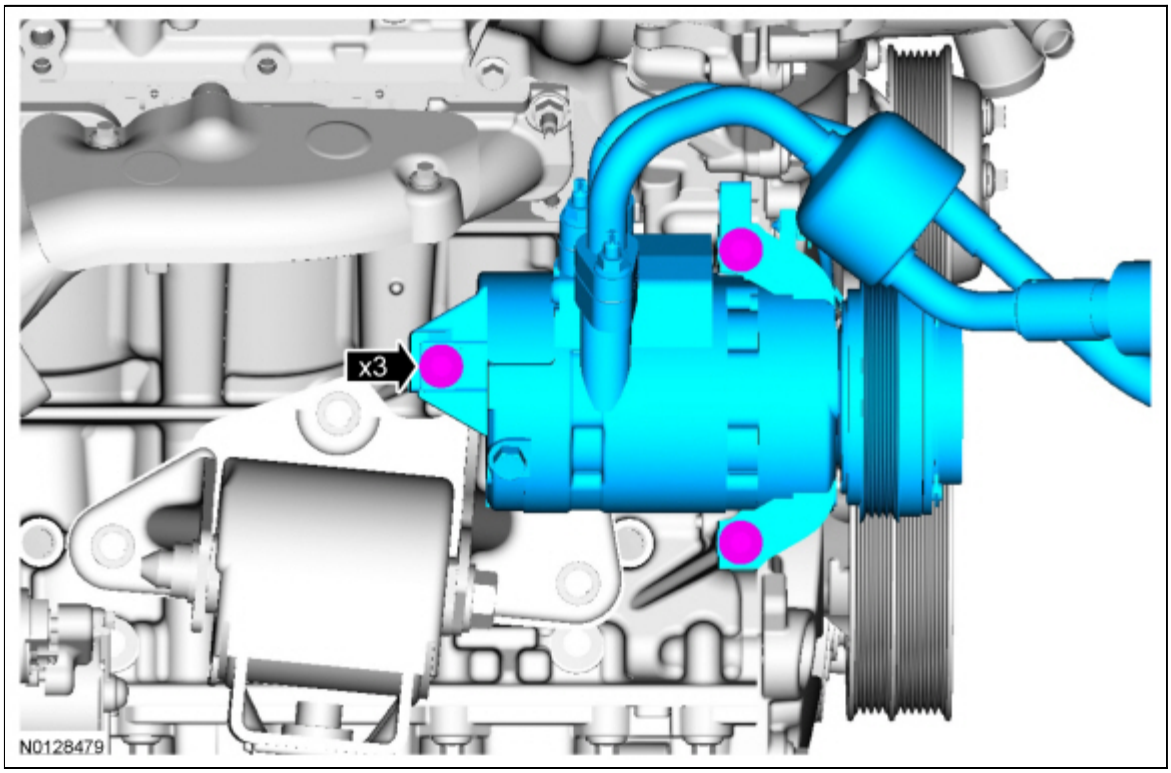
4. **NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

   Using the Heavy Duty Floor Crane and Spreader Bar, mount the engine on a suitable engine stand.



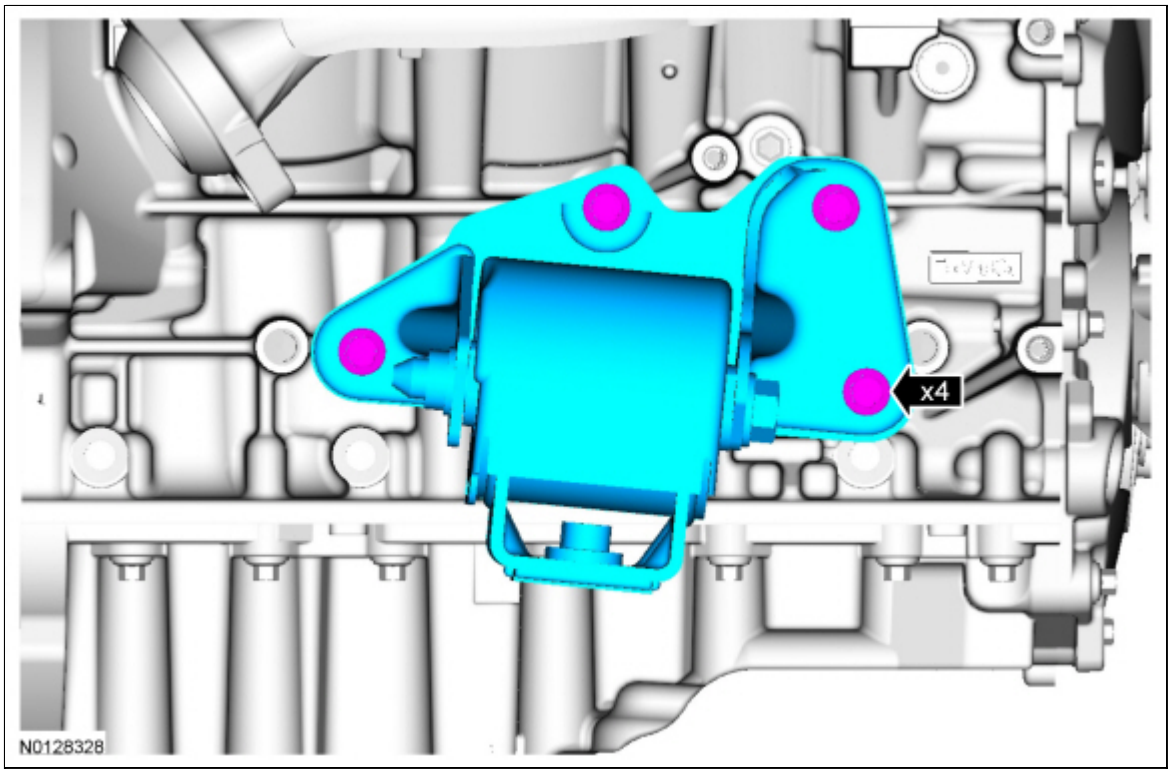
5. Remove the LH and RH engine lift eyes.

6. Remove the 3 bolts and the A/C compressor .

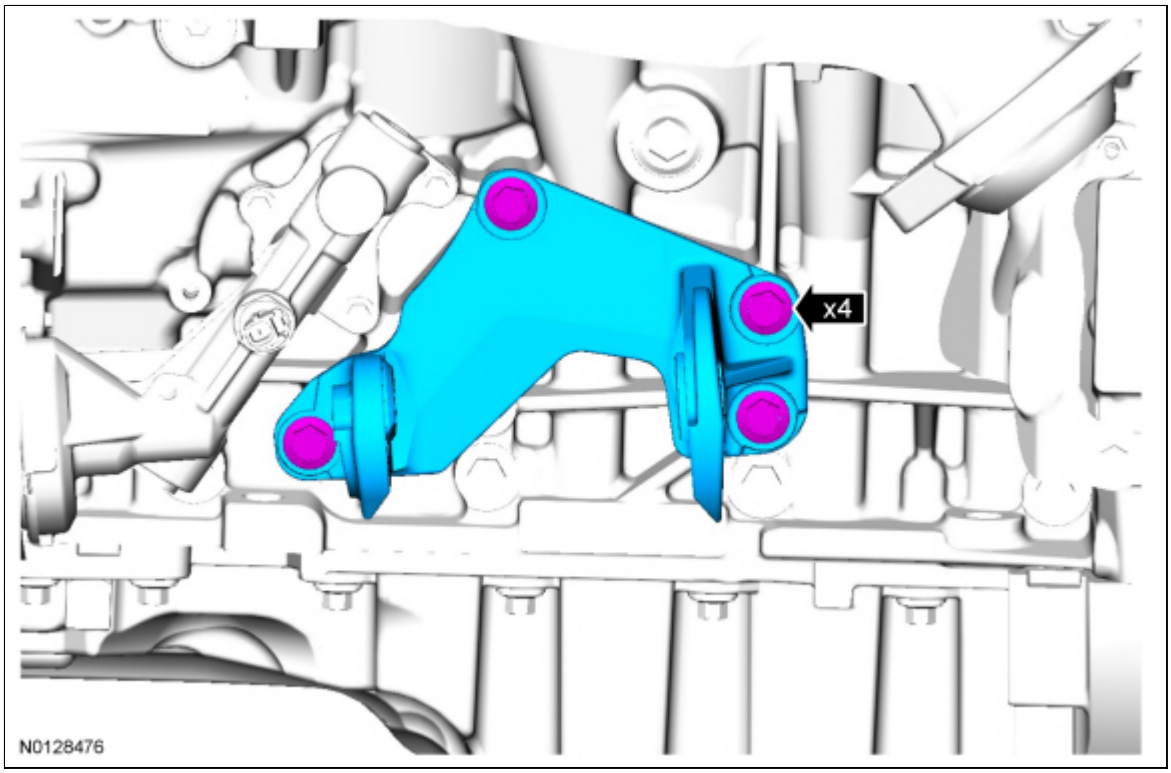


7. Remove the 4 bolts and the RH engine support insulator.

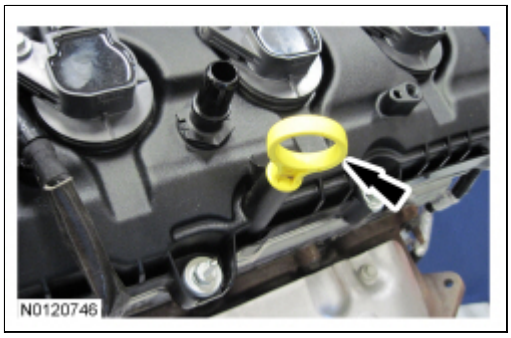
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8. Remove the 4 bolts and the LH engine support insulator-to-cylinder block bracket.



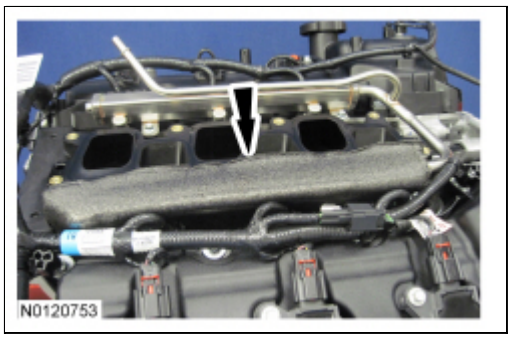
9. Remove the engine oil level indicator.



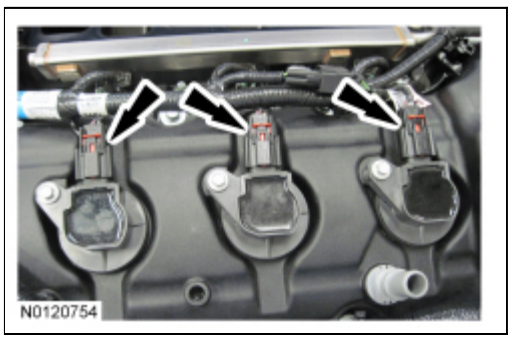
10. Remove the LH fuel rail insulator.



11. Remove the RH fuel rail insulator.

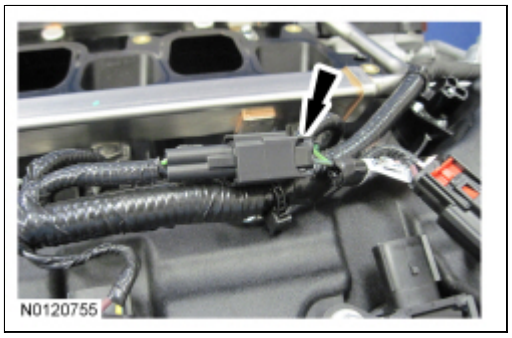


12. Disconnect the 3 RH ignition coil-on-plug electrical connectors.

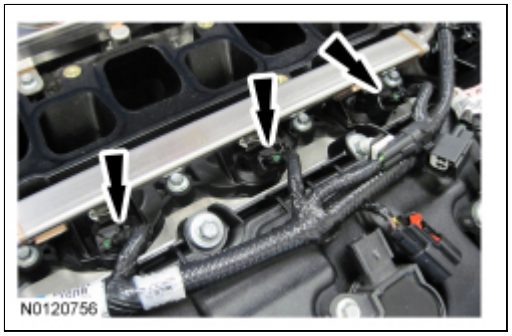


13. Disconnect the Cylinder Head Temperature (CHT) sensor wiring harness jumper electrical connector.

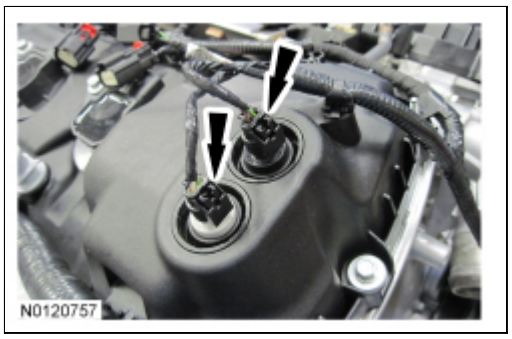
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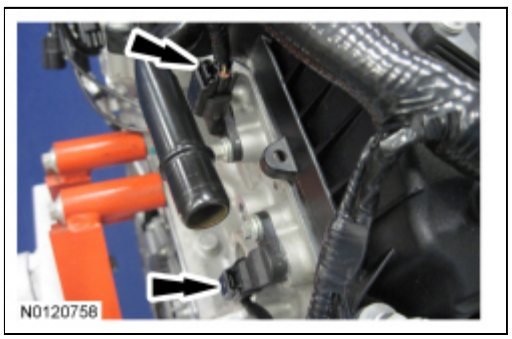
14. Disconnect the 3 RH fuel rail electrical connectors.



15. Disconnect the 2 RH Variable Camshaft Timing (VCT) solenoid electrical connectors.



16. Disconnect the 2 RH Camshaft Position (CMP) sensors electrical connectors.



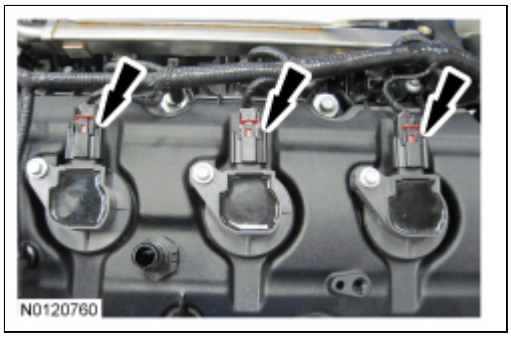
17. Detach all of the wiring harness retainers from the RH cylinder head, valve cover and stud bolts.

18. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

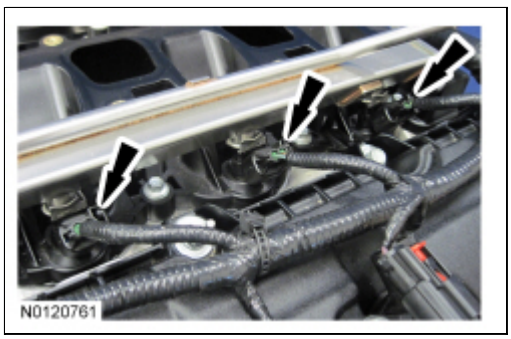
- Detach the EOP switch wiring harness retainer from the cylinder head.



19. Disconnect the 3 LH ignition coil-on-plug electrical connectors.



20. Disconnect the 3 LH fuel rail electrical connectors.

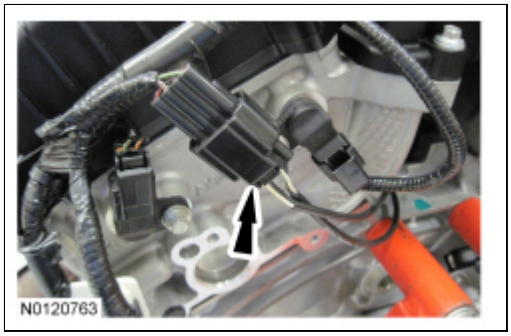


21. Disconnect the 2 LH VCT solenoid electrical connectors.

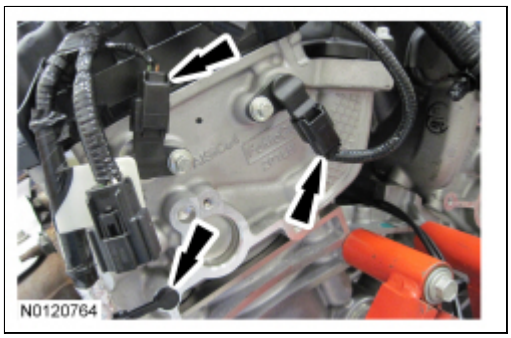
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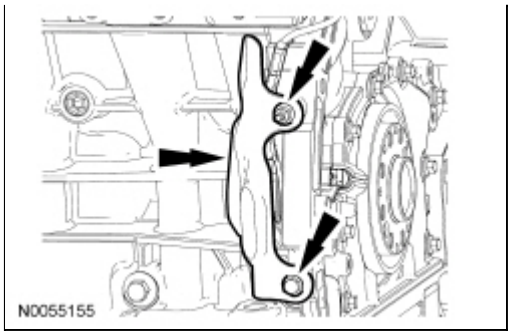
22. Disconnect the Knock Sensor (KS) electrical connector.



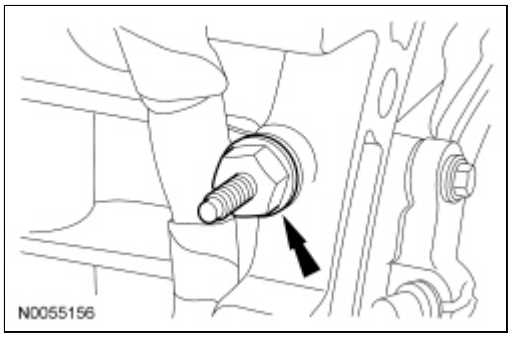
23. Disconnect the 2 LH CMP sensors electrical connectors.
    - Detach the wiring harness retainer from the rear of the cylinder head.



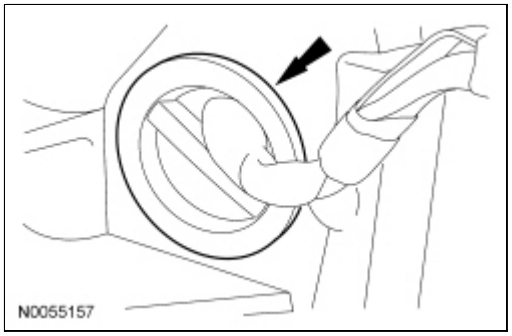
24. Remove the nut, the bolt and the heat shield.



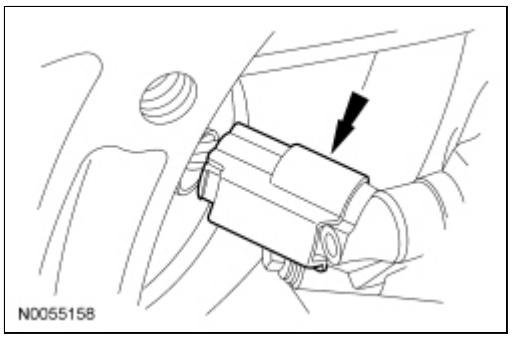
25. Remove the wiring harness retainer stud bolt.



26. Remove the wiring harness grommet.



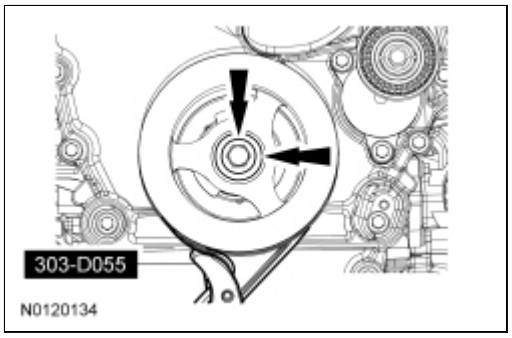
27. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



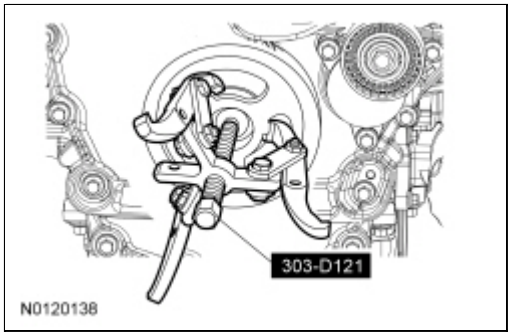
28. Detach all of the wiring harness retainers from the LH cylinder head, valve cover and stud bolts.

29. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Inspect the crankshaft pulley sealing surface for nicks or scratches that may effect the crankshaft front seal lip, replace the crankshaft pulley if necessary.
    - Discard the bolt.

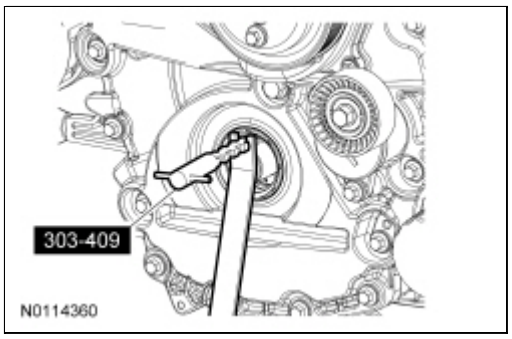
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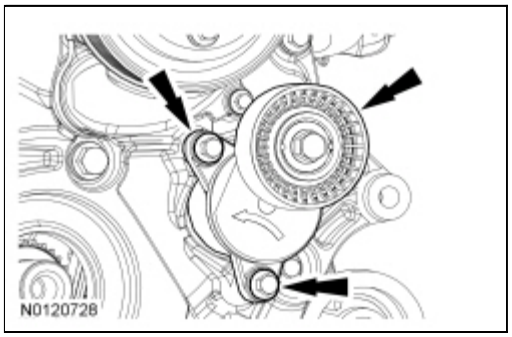
30. Using the 3 Jaw Puller, remove the crankshaft pulley.



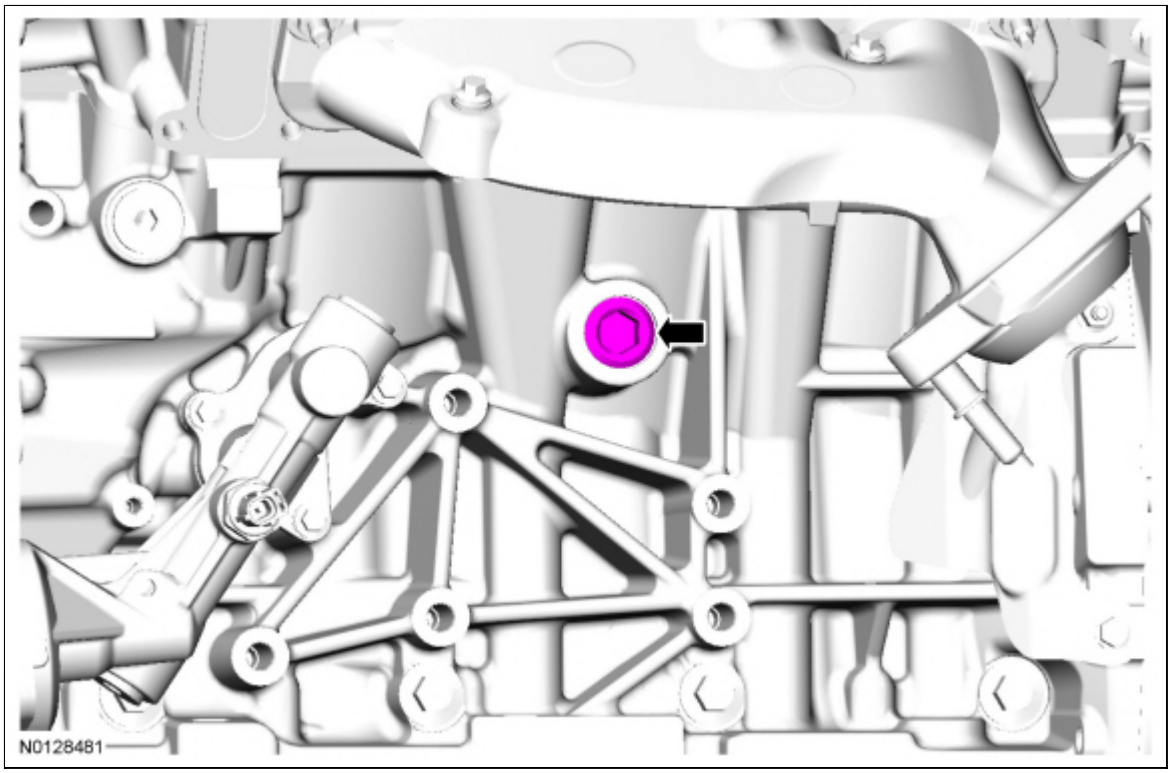
31. Using the Oil Seal Remover, remove and discard the crankshaft front seal.



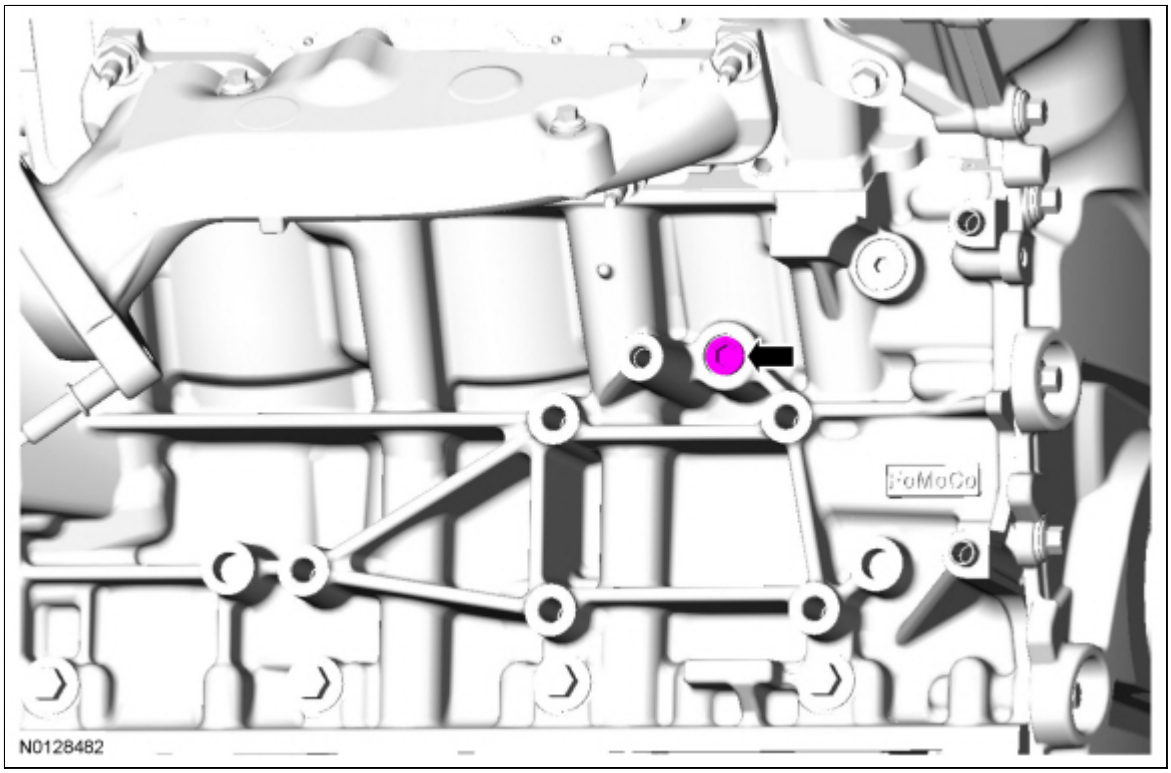
32. Remove the 2 bolts and the accessory drive belt tensioner.



33. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

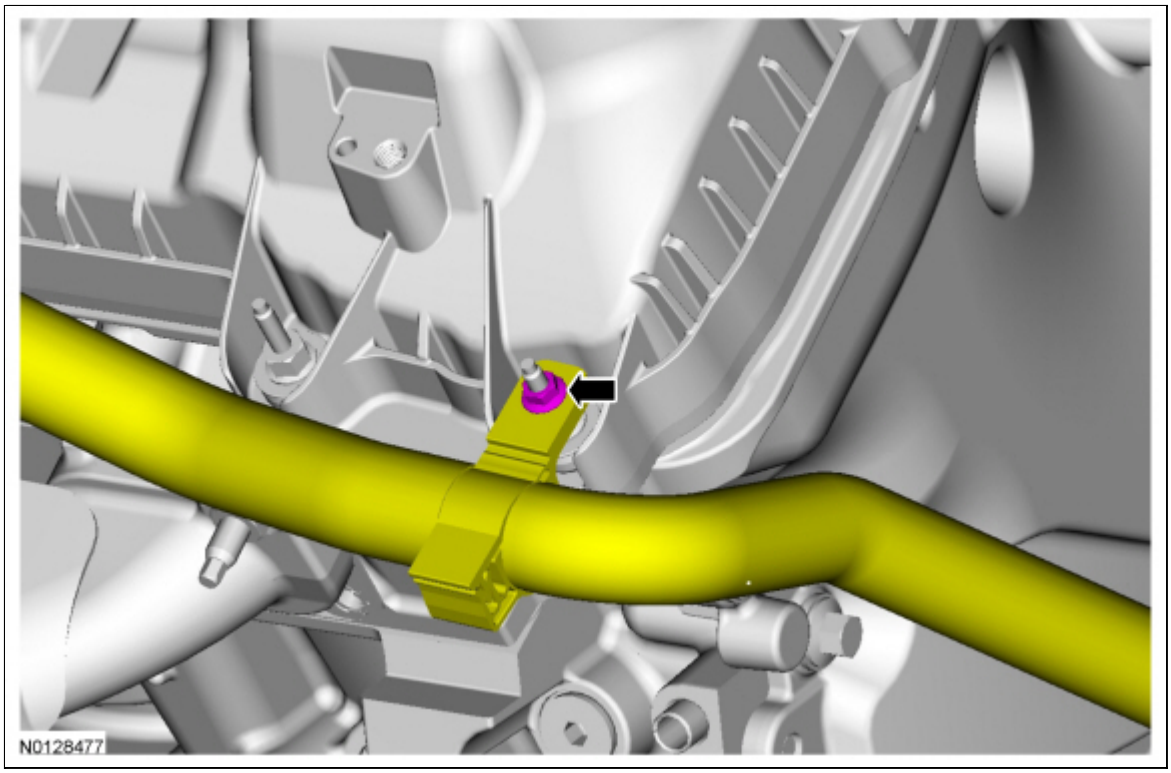


34. Remove the RH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.

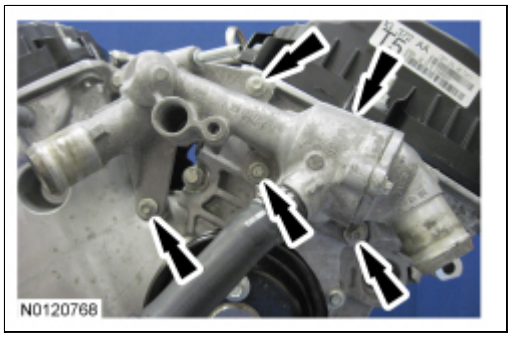


35. Remove the nut and the heater hose bracket from the valve cover stud bolt.

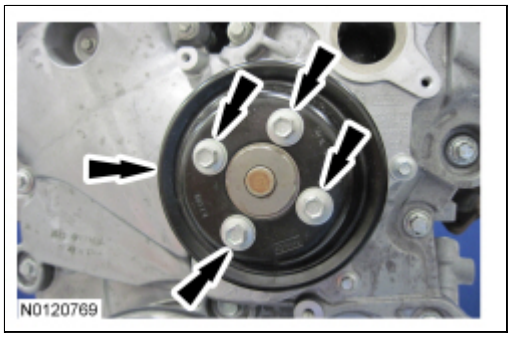
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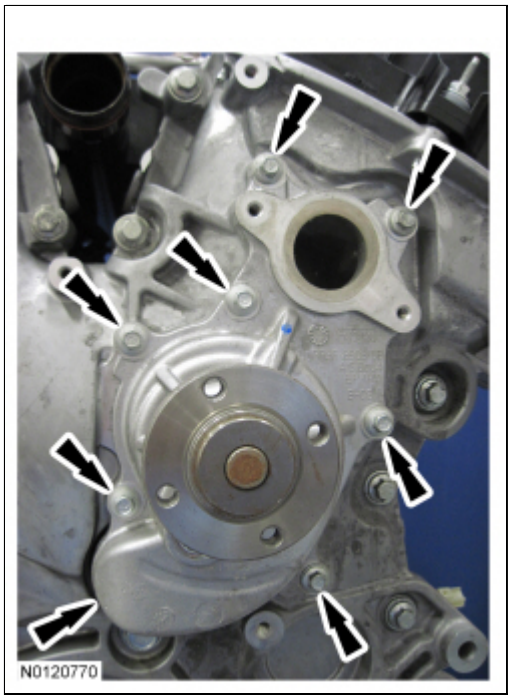
36. Remove the 4 bolts and the thermostat housing.
    - Discard the thermostat housing and coolant inlet tube O-ring seals.



37. Remove the 4 bolts and the coolant pump pulley.

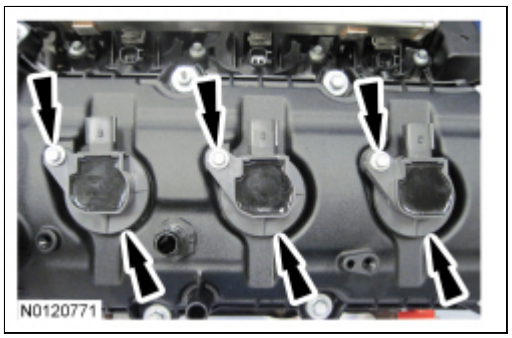


38. Remove the 7 bolts and the coolant pump.
    - Discard the coolant pump gasket and coolant pump O-ring seal.



39. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

    Remove the 3 bolts and the 3 LH ignition coil-on-plugs.



40. ***NOTICE:*** **Only use hand tools when removing the spark plugs, or damage may occur to the cylinder head or spark plug.**

    NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

    Remove the 3 LH spark plugs.

41. ***NOTICE:*** **While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.**

    NOTICE: **If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.**

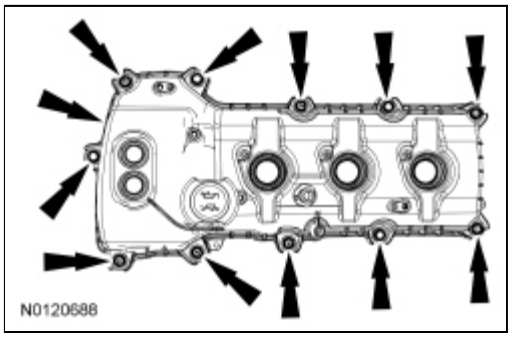
    NOTE: The plastic electrical connector on the VCT oil control solenoid will rotate approximately 12

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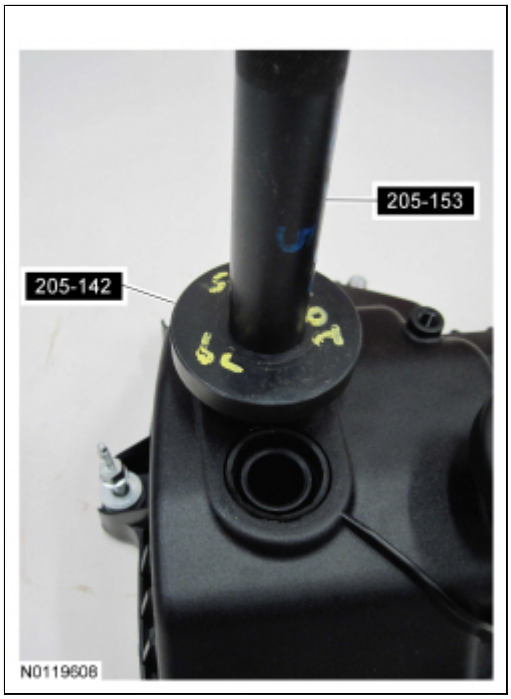
degrees inside the steel housing, which is normal.

Loosen the 7 stud bolts, 4 bolts and remove the LH valve cover.

- Discard the gasket.



42. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).

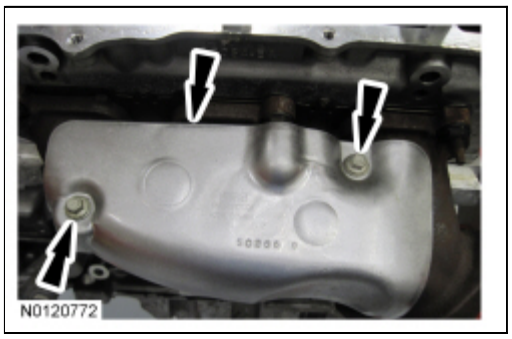


43. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

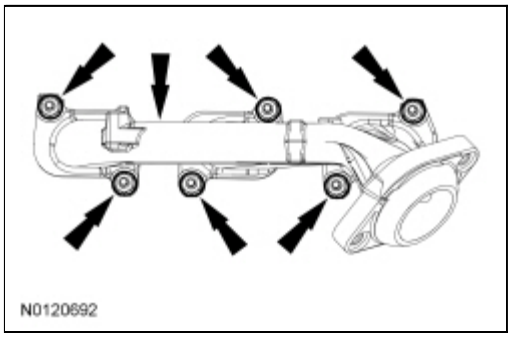


44. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

45. Remove the 2 bolts and the LH exhaust manifold heat shield.



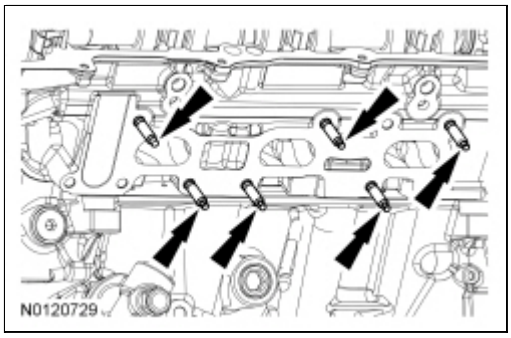
46. Remove the 6 nuts and the LH exhaust manifold.
    - Discard the nuts and exhaust manifold gaskets.



47. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

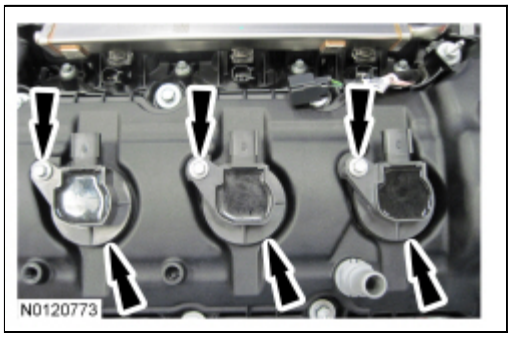
48. Remove and discard the 6 LH exhaust manifold studs.

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49. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

    Remove the 3 bolts and the 3 RH ignition coil-on-plugs.



50. ***NOTICE:*** **Only use hand tools when removing the spark plugs, or damage may occur to the cylinder head or spark plug.**

    NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

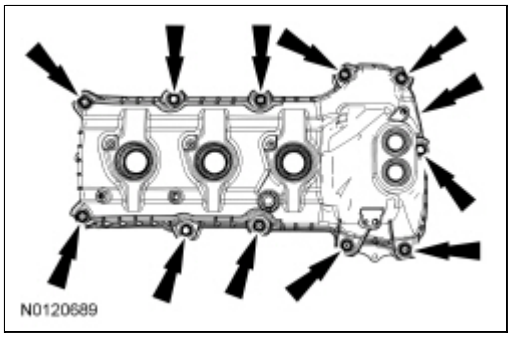
    Remove the 3 RH spark plugs.

51. ***NOTICE:*** **While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.**

    NOTICE: **If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.**

    NOTE: The plastic electrical connector on the VCT oil control solenoid will rotate approximately 12 degrees inside the steel housing, which is normal.

    Loosen the 8 stud bolts, 3 bolts and remove the RH valve cover.
    - Discard the gasket.

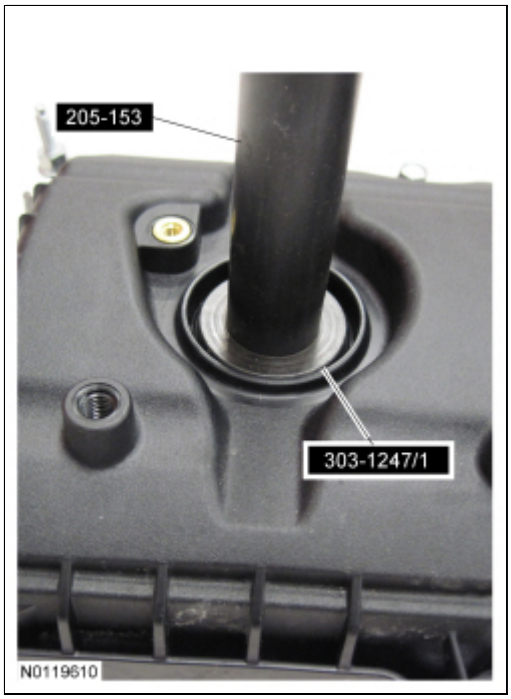


52. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



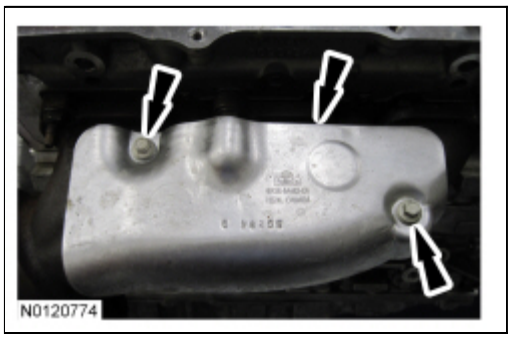
53. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

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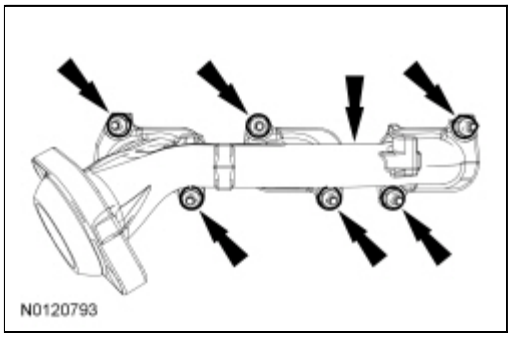


54. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

55. Remove the 2 bolts and the RH exhaust manifold heat shield.

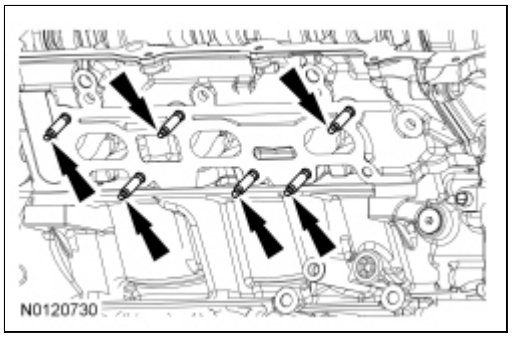


56. Remove the 6 nuts and the RH exhaust manifold.
    - Discard the nuts and exhaust manifold gaskets.

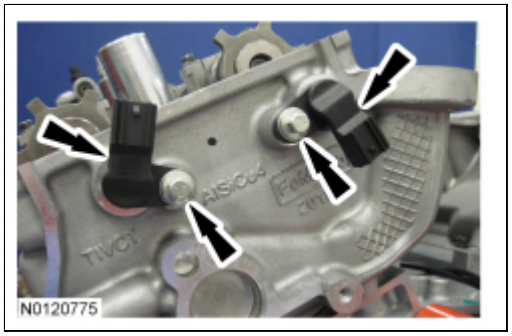


57. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

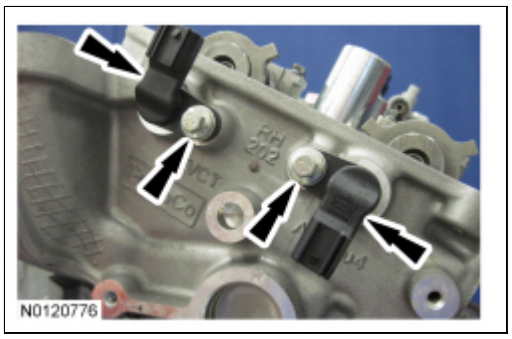
58. Remove and discard the 6 RH exhaust manifold studs.



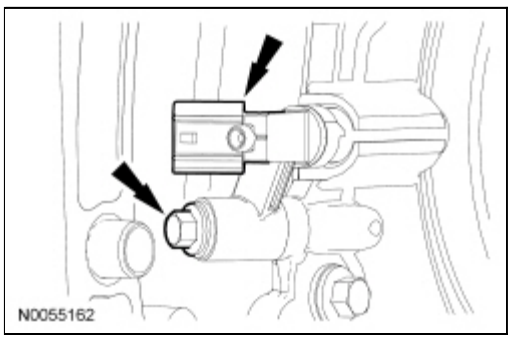
59. Remove the 2 bolts and the LH CMP sensors.



60. Remove the 2 bolts and the RH CMP sensors.



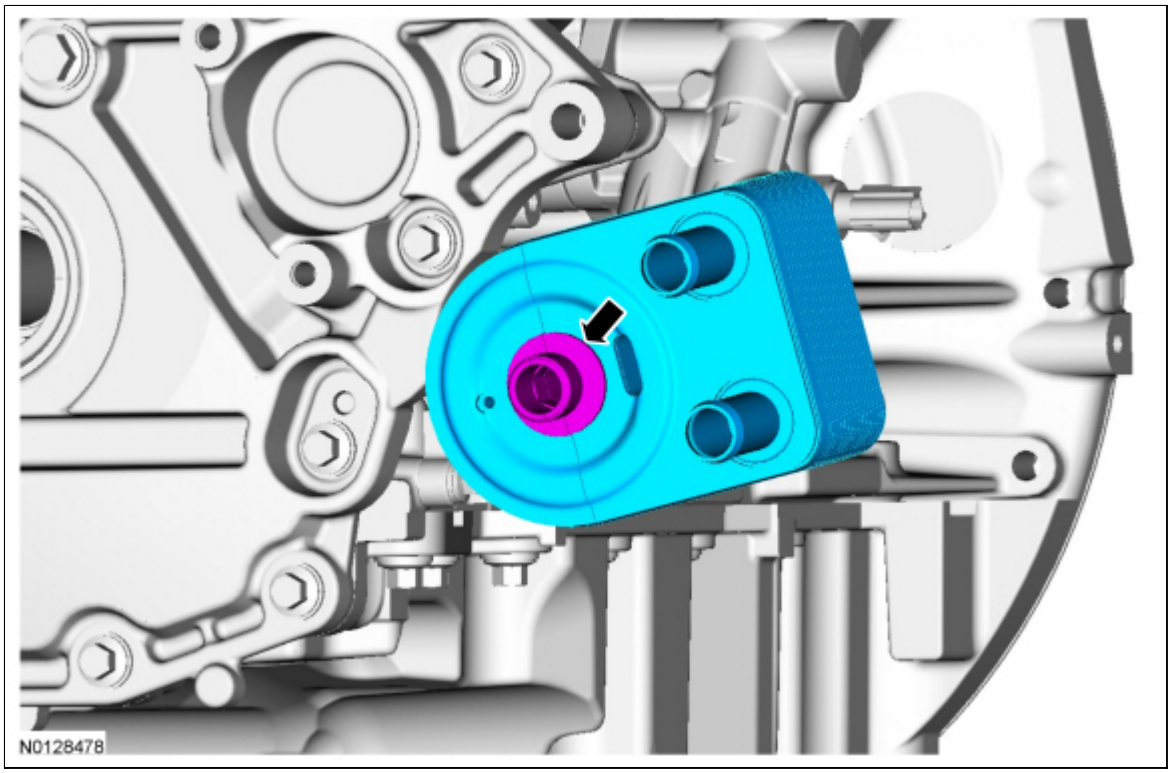
61. Remove the bolt and the CKP sensor.



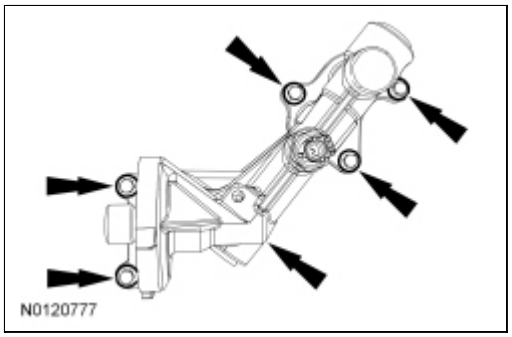
62. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

    If equipped, remove the oil cooler mounting bolt and the oil cooler.

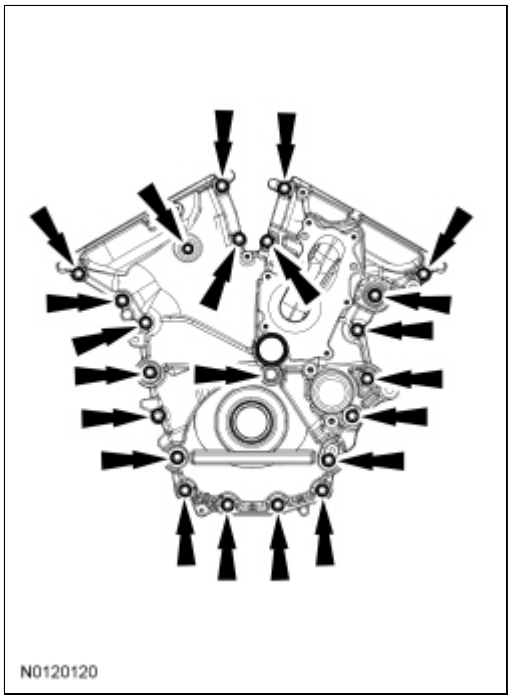
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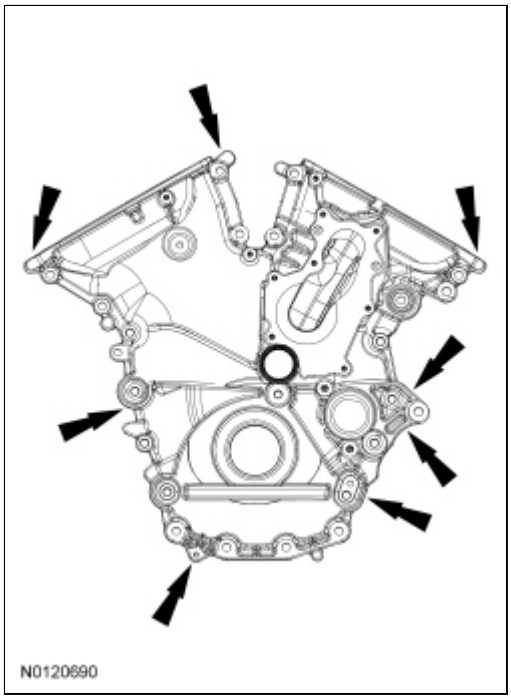
63. Remove the 5 bolts and the oil filter adapter.
    - Discard the gasket.



64. Remove the 22 engine front cover bolts.



65. Using a pry tool, locate the 7 pry pads shown and pry the engine front cover loose and remove.

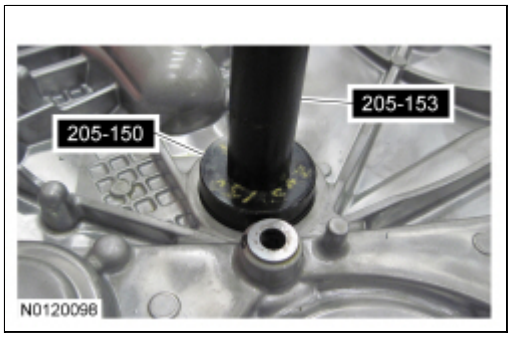


66. **NOTE:** Inspect front cover radial seal and replace if necessary.

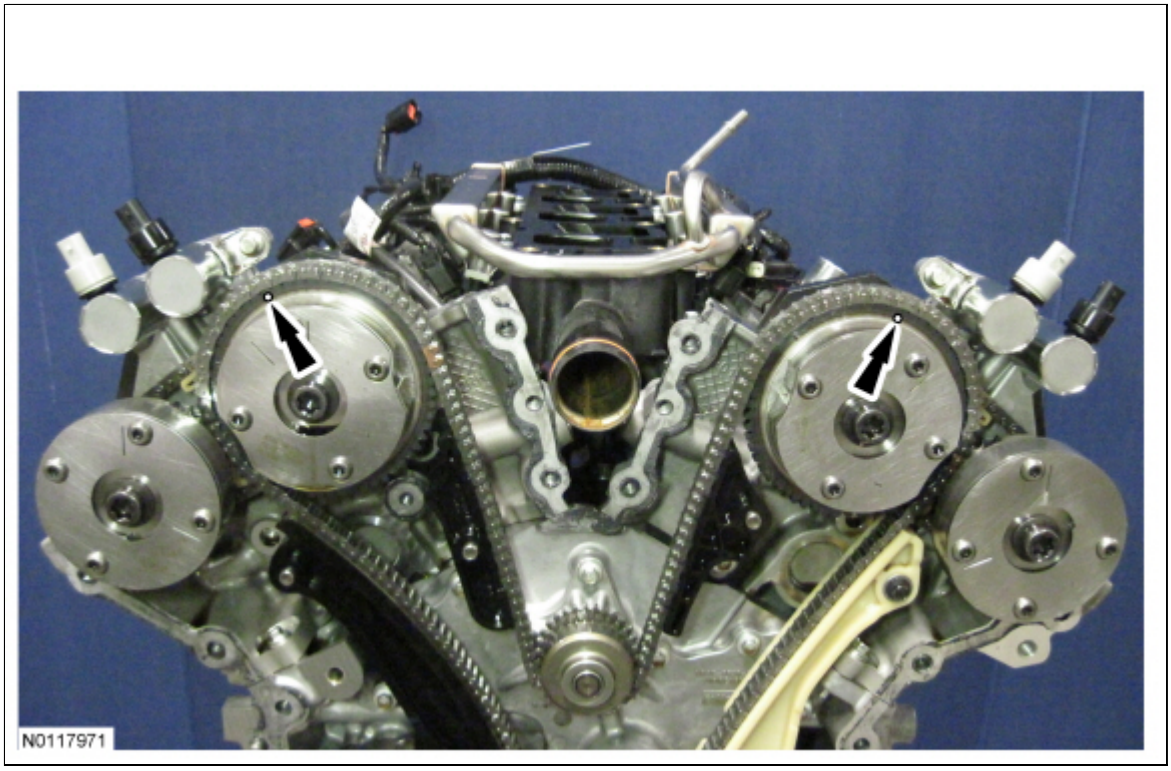
    NOTE: Use Spindle Bearing Installer 205-150 to remove the seal.

    If necessary, using the Spindle Bearing Installer and Handle, remove the front cover radial seal from the rear side of the front cover.

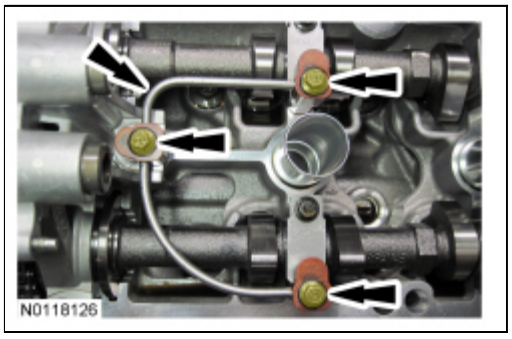
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67. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown.

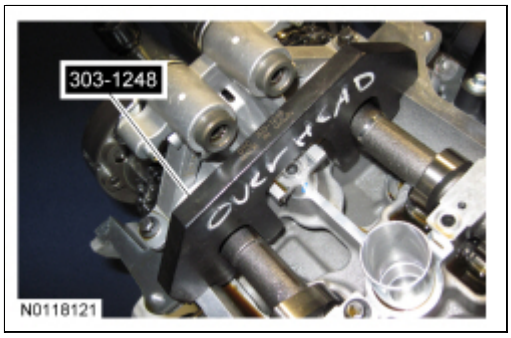


68. Remove the 3 bolts and the LH valve train oil tube.

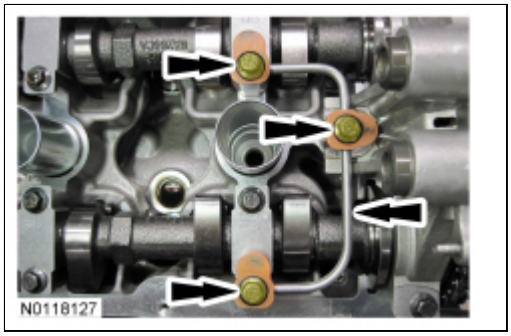


69. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

    Install the Camshaft Holding Tool onto the flats of the LH camshafts.

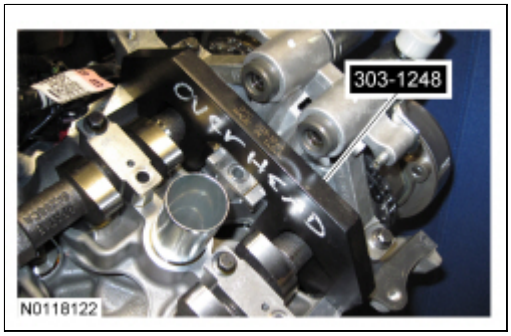


70. Remove the 3 bolts and the RH valve train oil tube.



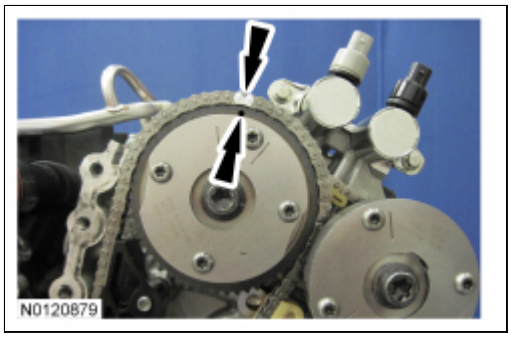
71. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the RH camshafts.



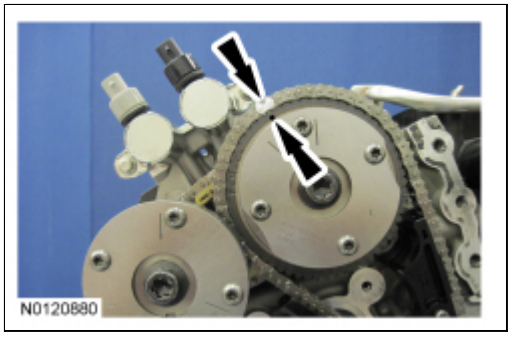
NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

72. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.



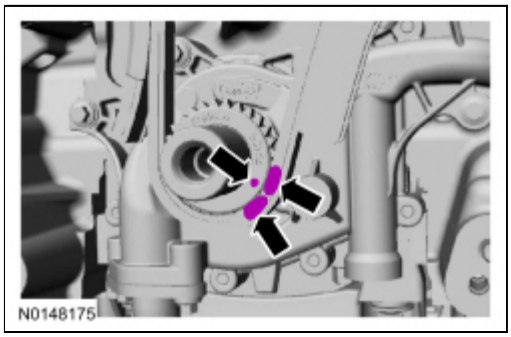
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73. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

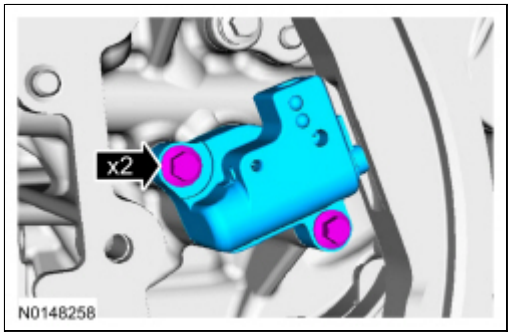


74. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

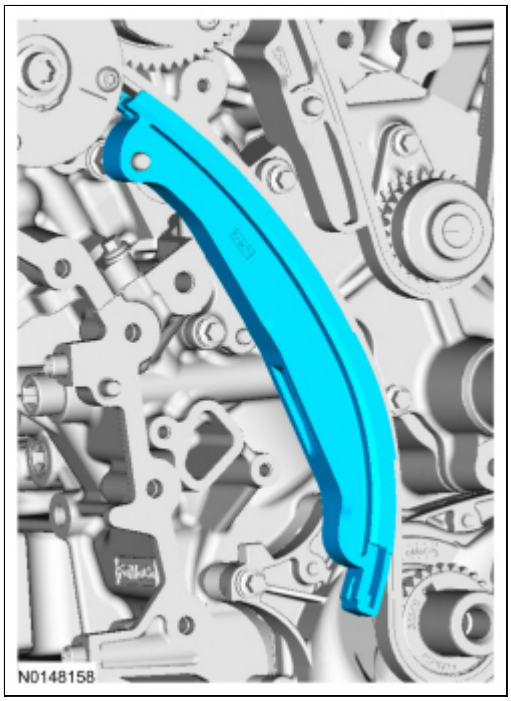
    Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



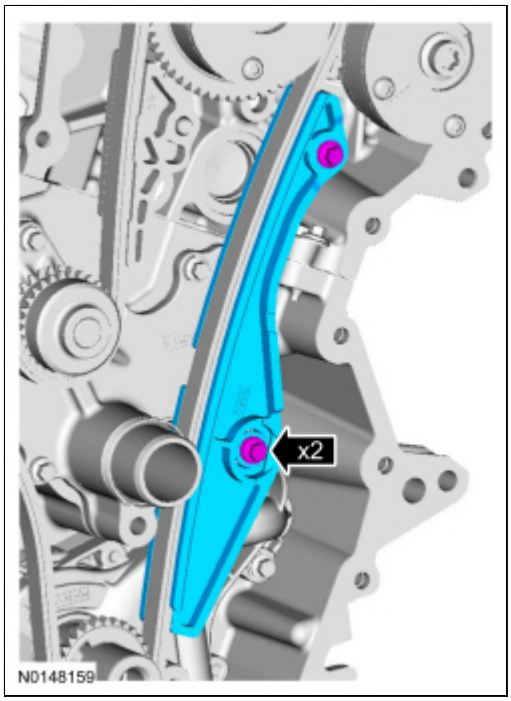
75. Remove the 2 bolts and the primary timing chain tensioner.



76. Remove the primary timing chain tensioner arm.



77. Remove the 2 bolts and the lower LH primary timing chain guide.



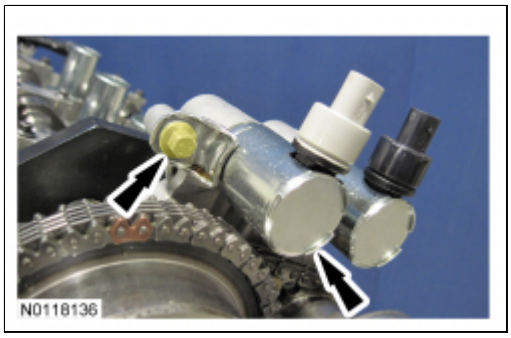
78. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.

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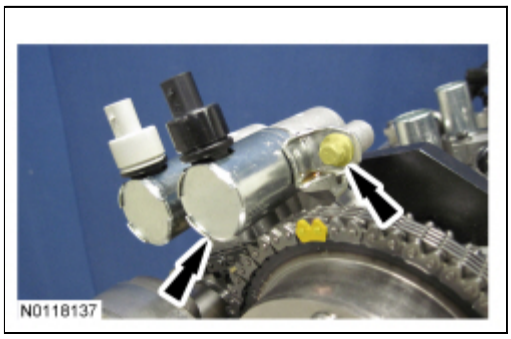


79. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

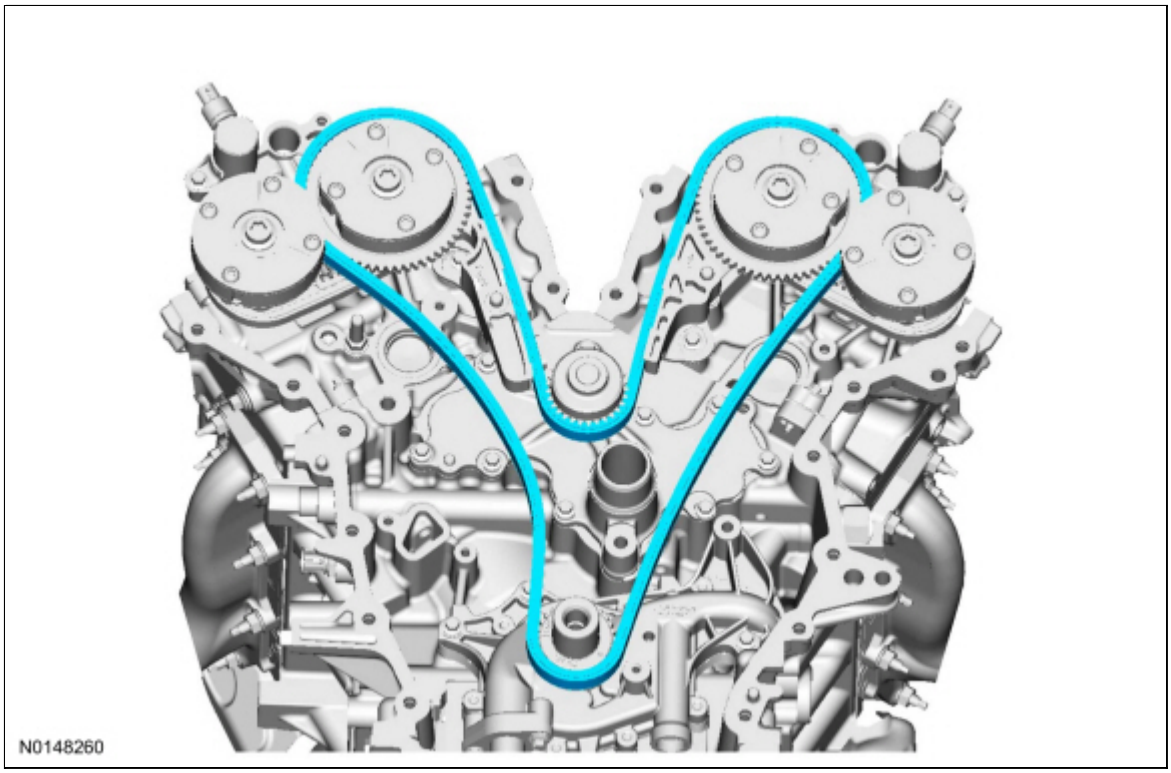
    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

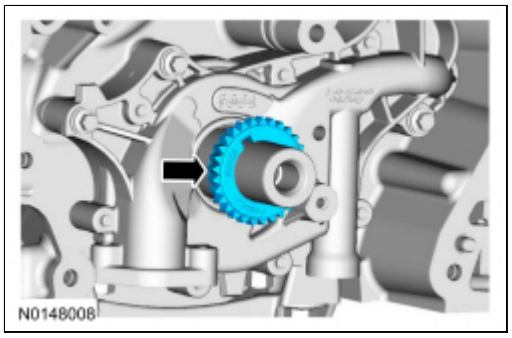
    Remove the bolt and the RH intake VCT oil control solenoid.



80. Remove the primary timing chain.

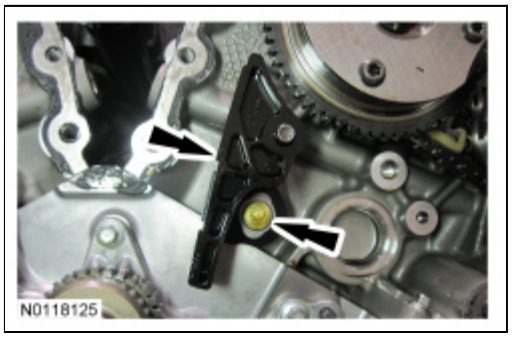


81. Remove the crankshaft timing chain sprocket.



82. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.**

    Remove the bolt and the upper LH primary timing chain guide.

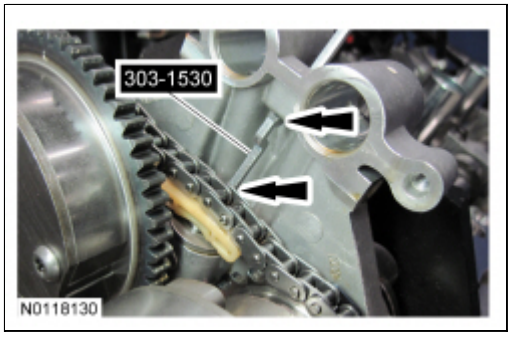


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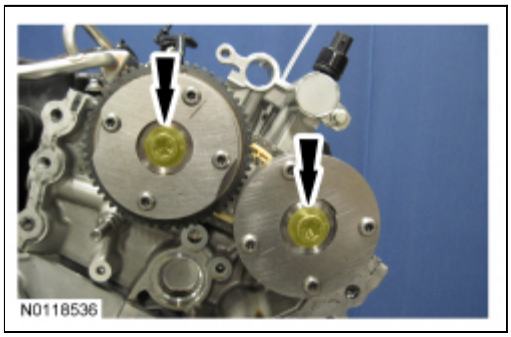
83. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

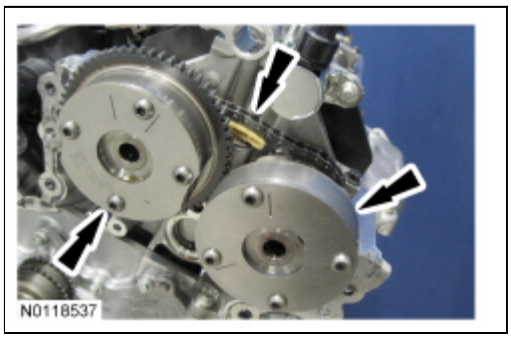
    Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



84. Remove and discard the 2 LH VCT assembly bolts.



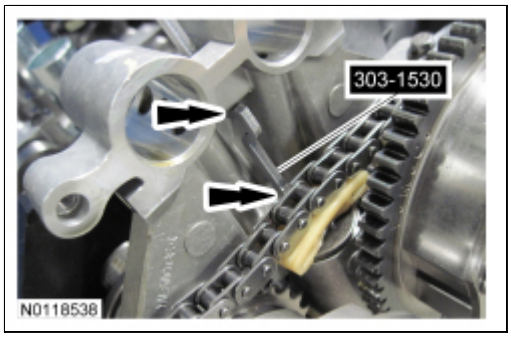
85. Remove the 2 LH VCT assemblies and secondary timing chain.



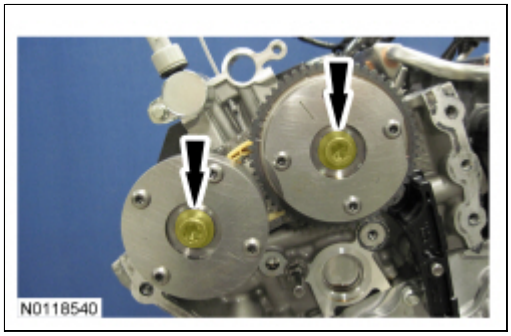
86. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

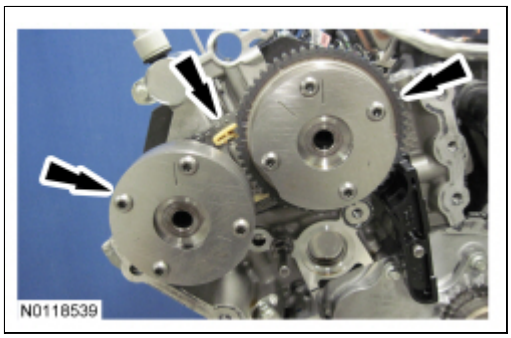
    Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



87. Remove and discard the 2 RH VCT assembly bolts.



88. Remove the 2 RH VCT assemblies and secondary timing chain.



89. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.**

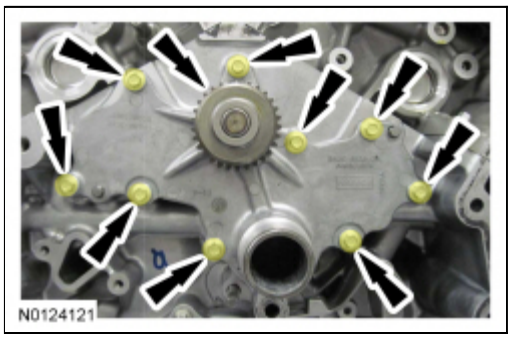
    Remove the bolt and the RH primary timing chain guide.



90. Remove the 9 bolts and the channel cover plate.

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- Discard the gaskets.



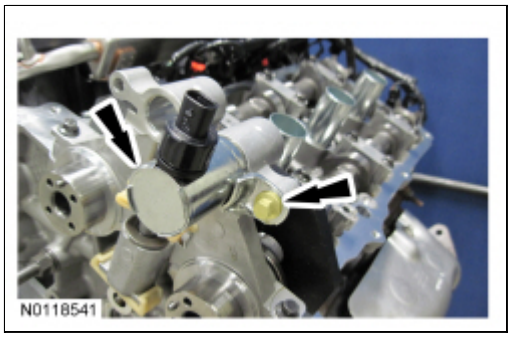
Engines with secondary timing chain tensioner removed

NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed, or damage to the engine may occur.**

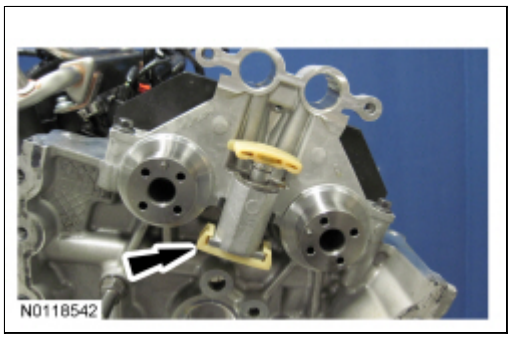
91. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

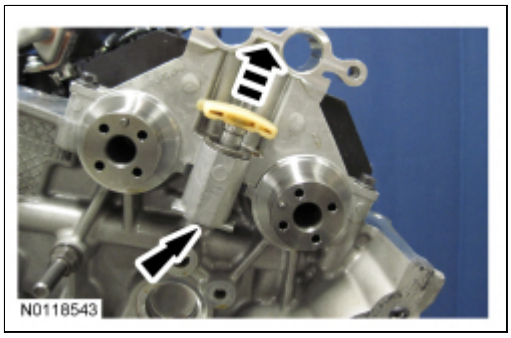
    Remove the LH exhaust VCT oil control solenoid.



92. Remove the LH secondary timing chain tensioner shoe.



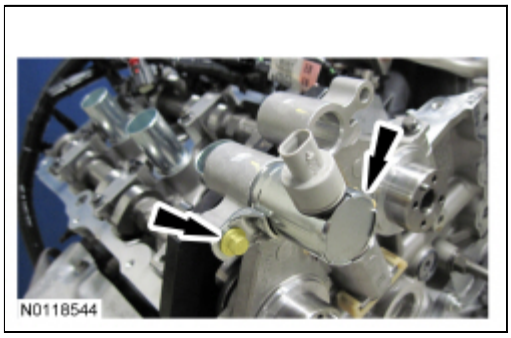
93. Remove the LH secondary timing chain tensioner by pushing up from the bottom and remove.



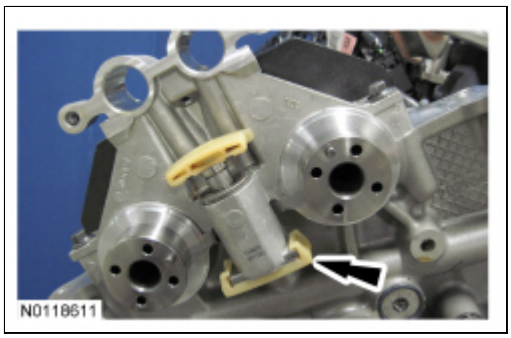
94. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

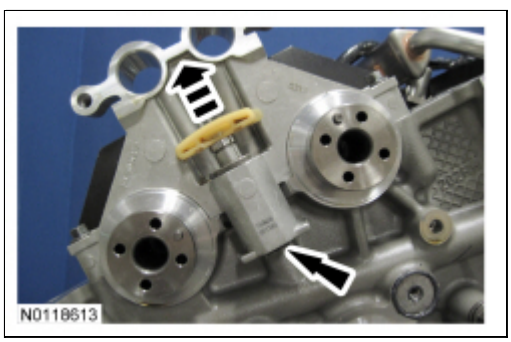
    Remove the RH exhaust VCT oil control solenoid.



95. Remove the RH secondary timing chain tensioner shoe.



96. Remove the RH secondary timing chain tensioner by pushing up from the bottom and remove.

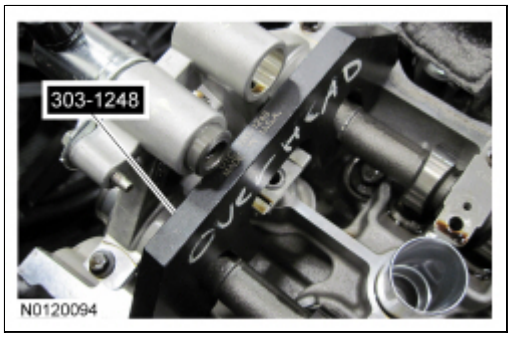


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All engines

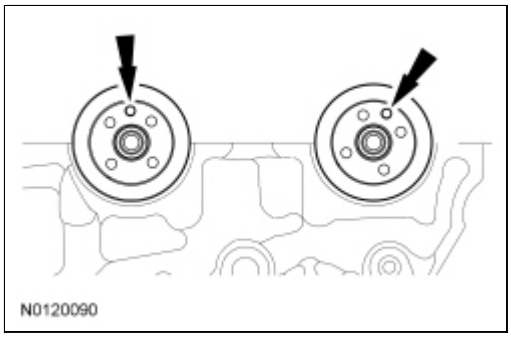
97. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the LH camshafts approximately 3 degrees to a neutral position.

    Remove the Camshaft Holding Tool from the LH camshafts.



98. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

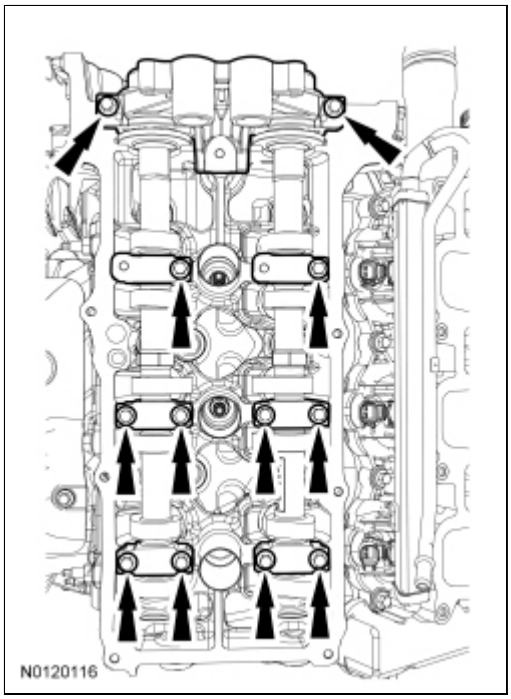
    Verify the LH camshafts are in the neutral position.



99. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

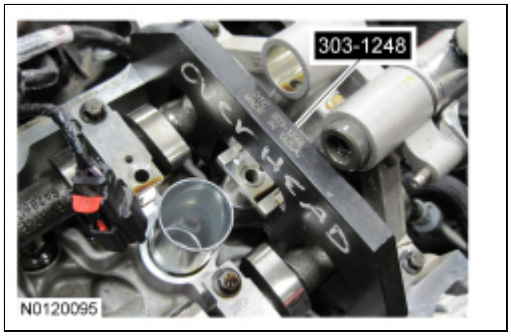
    NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

    Remove the 12 bolts, 6 camshaft caps, mega cap and the LH camshafts.



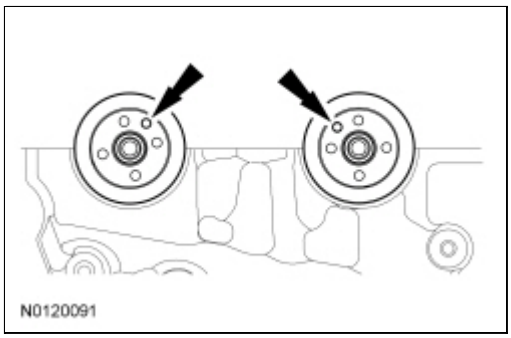
100. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the RH camshafts approximately 3 degrees to a neutral position.

Remove the Camshaft Holding Tool from the RH camshafts.



101. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

Rotate the RH camshafts counterclockwise to the neutral position.

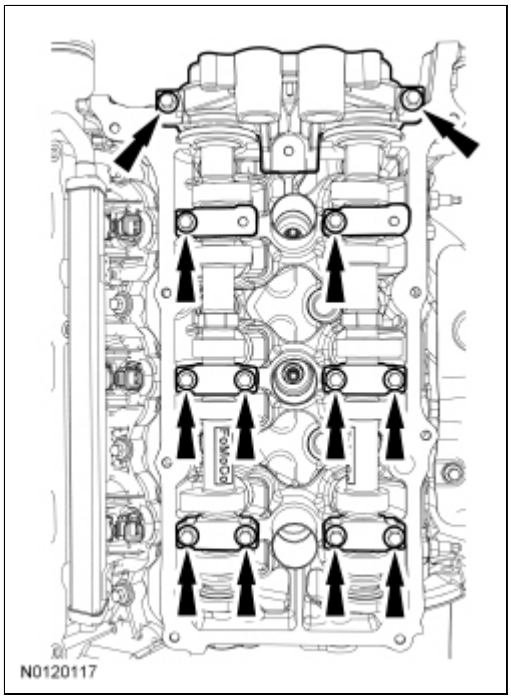


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102. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

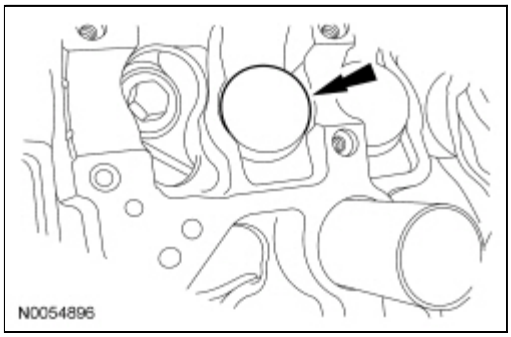
Remove the 12 bolts, 6 camshaft caps, mega cap and the RH camshafts.



103. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

NOTE: LH shown, RH similar.

Remove the valve tappets from the cylinder heads.

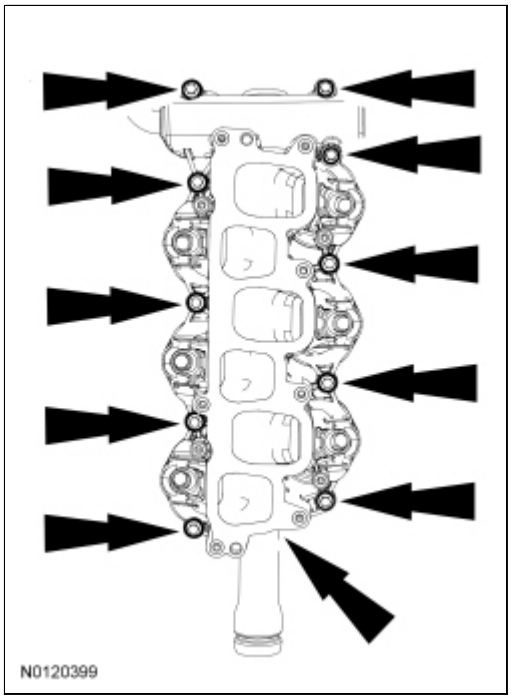


104. Inspect the valve tappets. For additional information, refer to Section 303-00 .

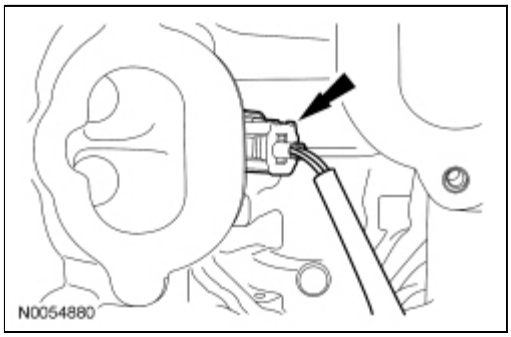
105. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

Remove the 10 bolts and the lower intake manifold.

- Discard the gaskets.



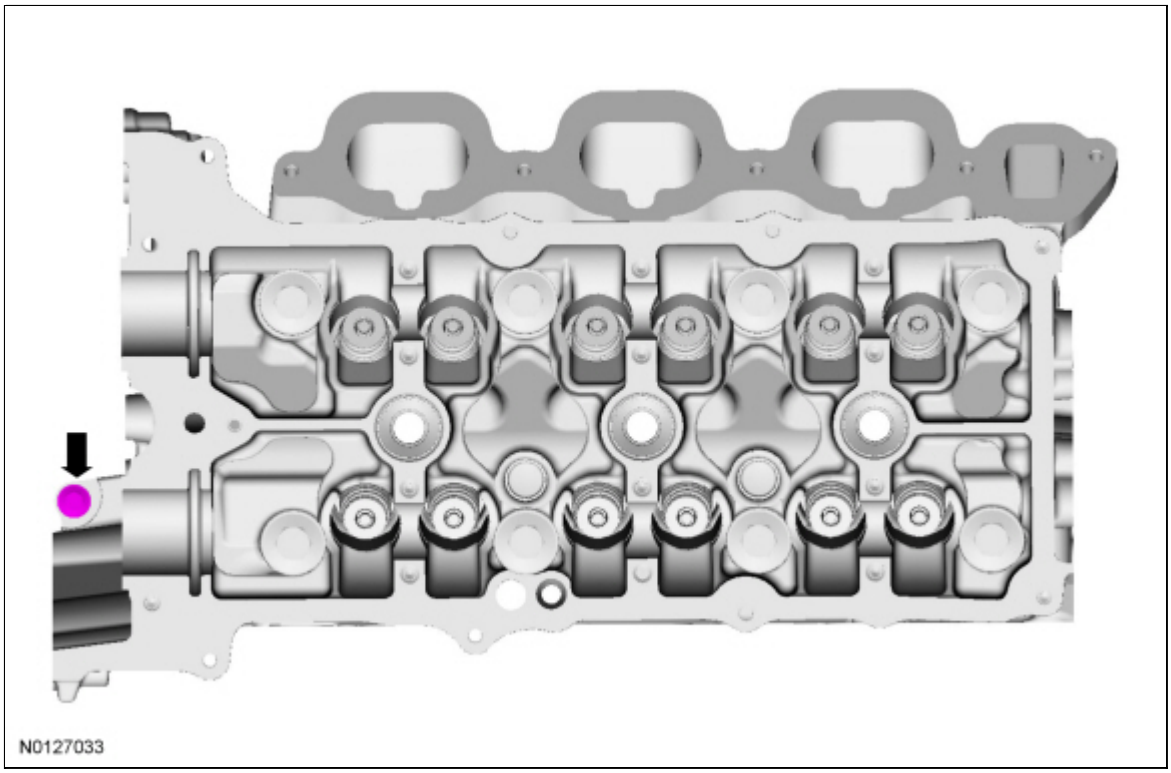
106. Disconnect and remove the CHT sensor jumper harness.



107. **NOTE:** LH shown, RH similar.

Remove and discard the M6 bolt from each cylinder head.

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108. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

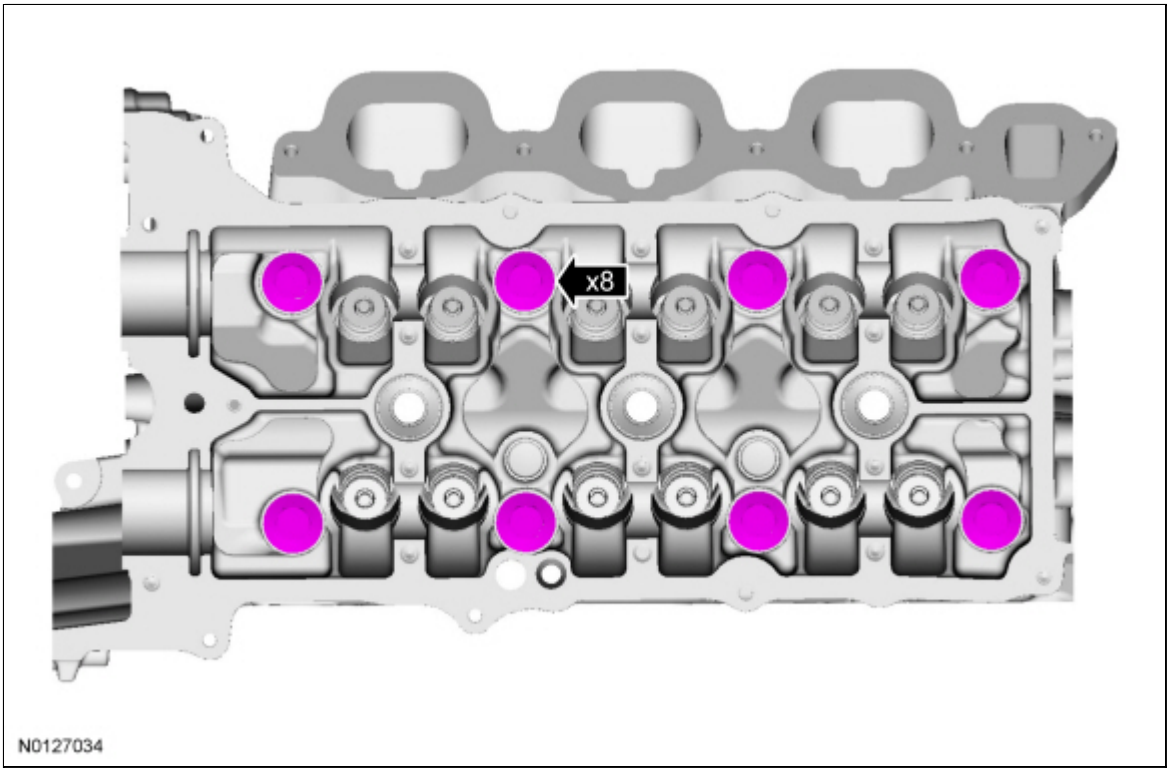
NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTE: LH shown, RH similar.

Remove and discard the 8 bolts from each cylinder head.

- Remove the cylinder heads.
- Discard the cylinder head gaskets.



109. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

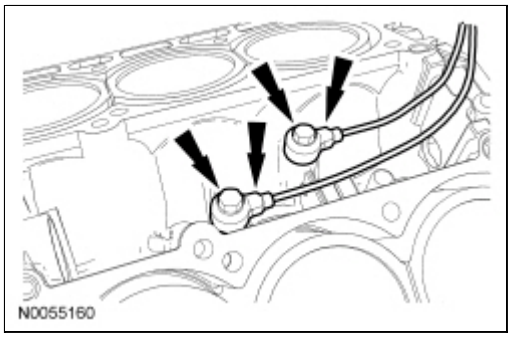
Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

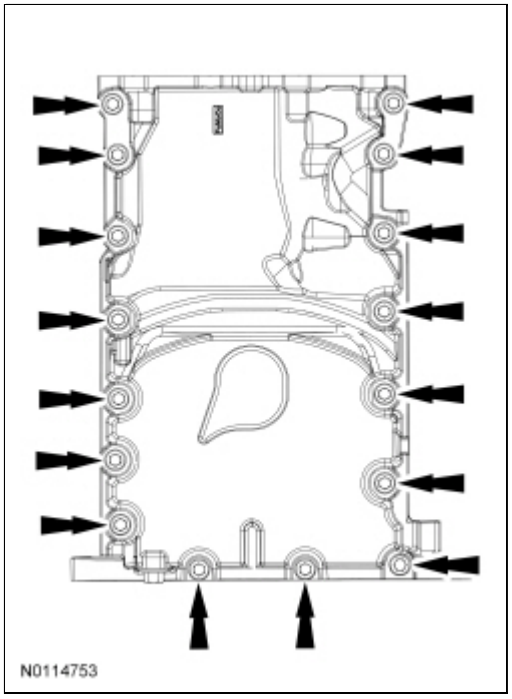
110. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

111. Remove the 2 bolts and the KS .

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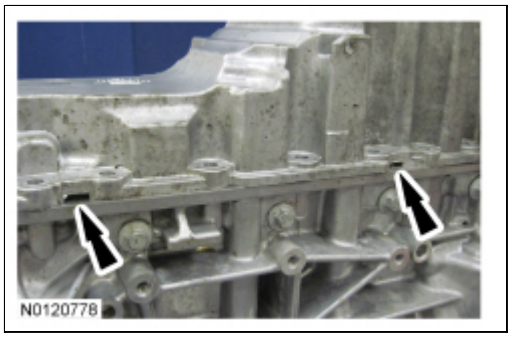


112. Remove the 16 oil pan bolts.

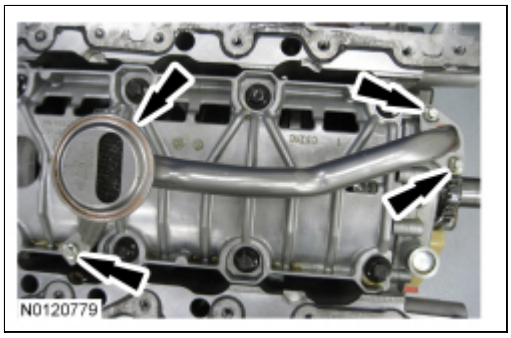


113. **NOTE:** RH shown, LH similar.

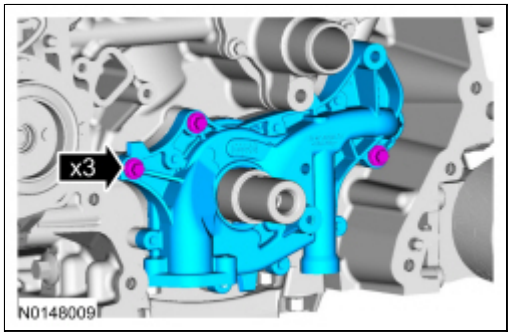
Using a pry tool, locate the 2 pry pads at the LH and RH side of the oil pan and pry the oil pan loose and remove.



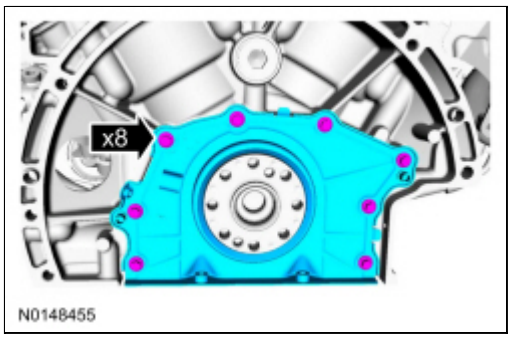
114. Remove the 3 bolts and the oil pump screen and the pickup tube.
    - Discard the O-ring seal.



115. Remove the 3 bolts and the oil pump.



116. Remove the 8 bolts and the crankshaft rear seal retainer plate.
    - Discard the crankshaft rear seal retainer plate.

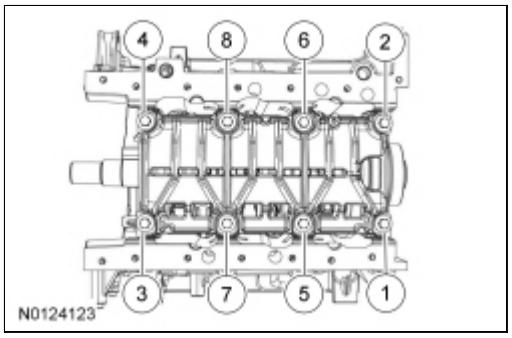


117. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

118. **NOTE:** The main bearing cap support brace bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove the bolts in the sequence shown.
    - Remove the main bearing cap support brace.
    - Discard the bolts.

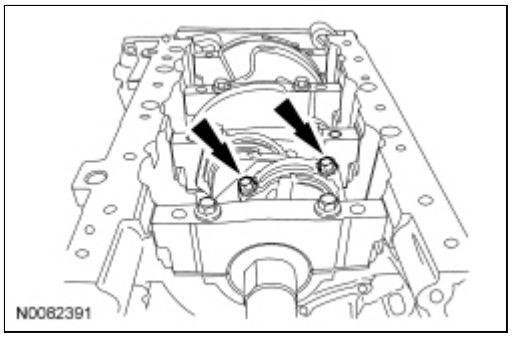
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119. **NOTE:** The connecting rod cap bolts are a tighten-to-yield design. The original connecting rod cap bolts will be used when measuring the connecting rod large end bore during assembly. The connecting rod cap bolts will be discarded after measurement.

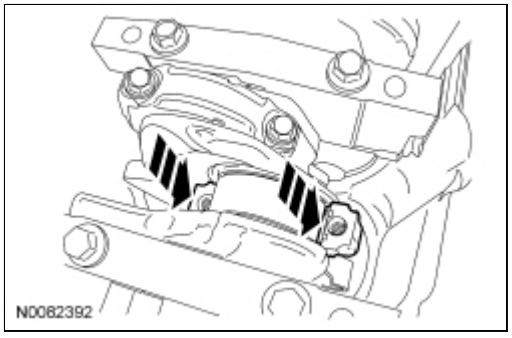
    NOTE: Clearly mark the position and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.

    Remove the connecting rod cap bolts and cap.



120. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    Remove the piston/rod assembly from the engine block.



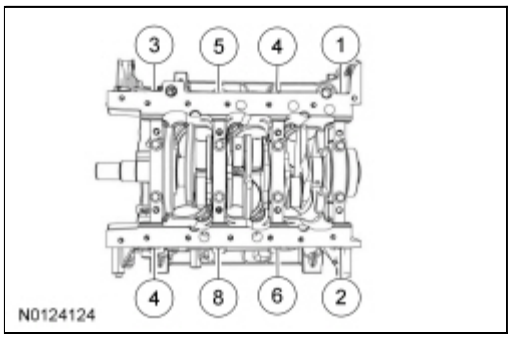
121. Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.

122. **NOTE:** The 8 main bearing cap side bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    NOTE: Clearly mark the position and orientation of the main bearing caps for reassembly.

    Remove the 8 main bearing cap side bolts in the sequence shown.

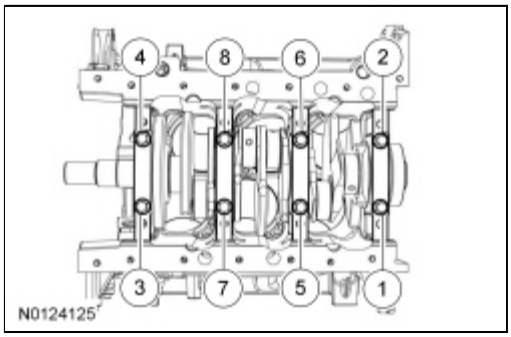
- Discard the bolts.



123. **NOTE:** The 8 main bearing cap bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTE: Clearly mark the position and orientation of the main bearing caps for reassembly.

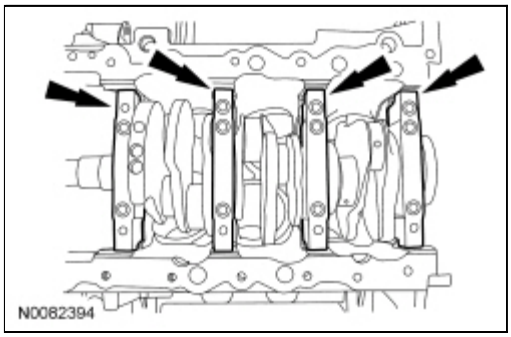
Remove the 8 main bearing cap bolts in the sequence shown.
- Discard the bolts.



124. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

NOTE: Note the position of the thrust washer on the outside of the No. 4 rear main bearing cap.

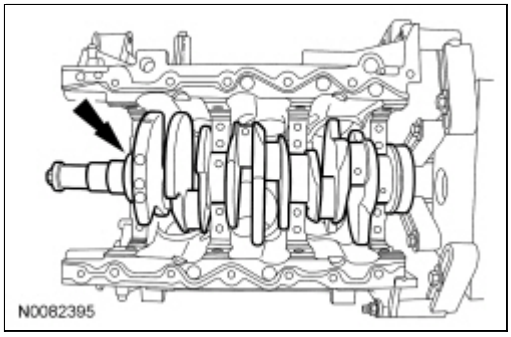
Remove the 4 main bearing caps.



125. **NOTE:** Note the position of the 2 thrust washers on the inside and outside of the rear main bearing bulkhead.

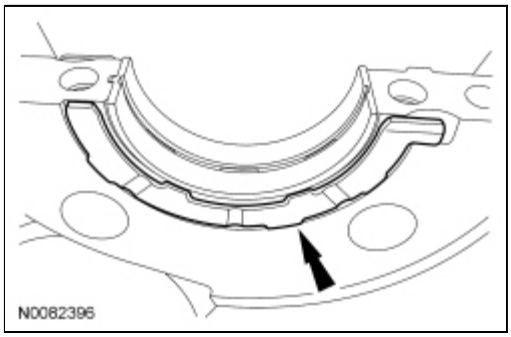
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Remove the crankshaft.



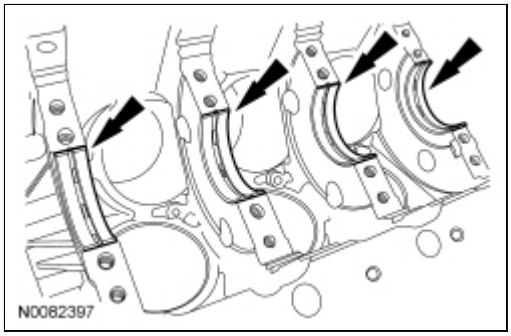
126. **NOTE:** Inside shown, outside similar.

Remove the 2 crankshaft thrust bearings from the rear main bearing bulkhead.



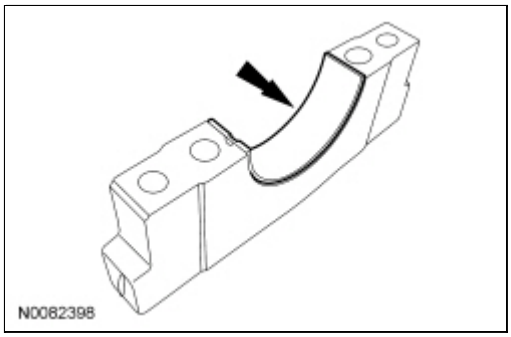
127. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the 4 crankshaft main bearings from the cylinder block.



128. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the 4 crankshaft main bearings from the main bearing caps.



129. Inspect the cylinder block, bearing cap support brace, pistons and connecting rods. For additional information, refer to Section 303-00 .

130. ***NOTICE:*** **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

    Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
    5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

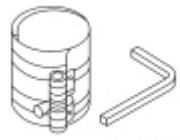
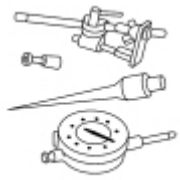
131. ***NOTICE:*** **Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover and oil pan. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover and oil pan. These tools cause scratches and gouges that make leak paths.**

    Clean the engine front cover and oil pan using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.
    - Thoroughly wash the engine front cover and oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

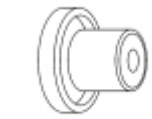
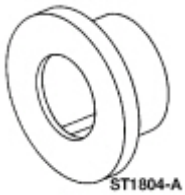
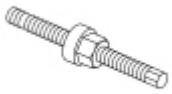
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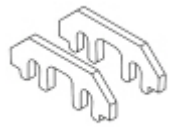
Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST3101-A	Bar, Engine Spreader 303-1454
 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST2976A	Eye, Engine Lift 303-1245
 ST1326-A	Handle 205-153 (T80T-4000-W)
	Hold Down, Secondary Chain 303-1530

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 ST3234-A	
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1804-A	Installer, Spindle Bearing 205-149 (T80T-4000-R)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)
	Tool, Camshaft Holding 303-1248

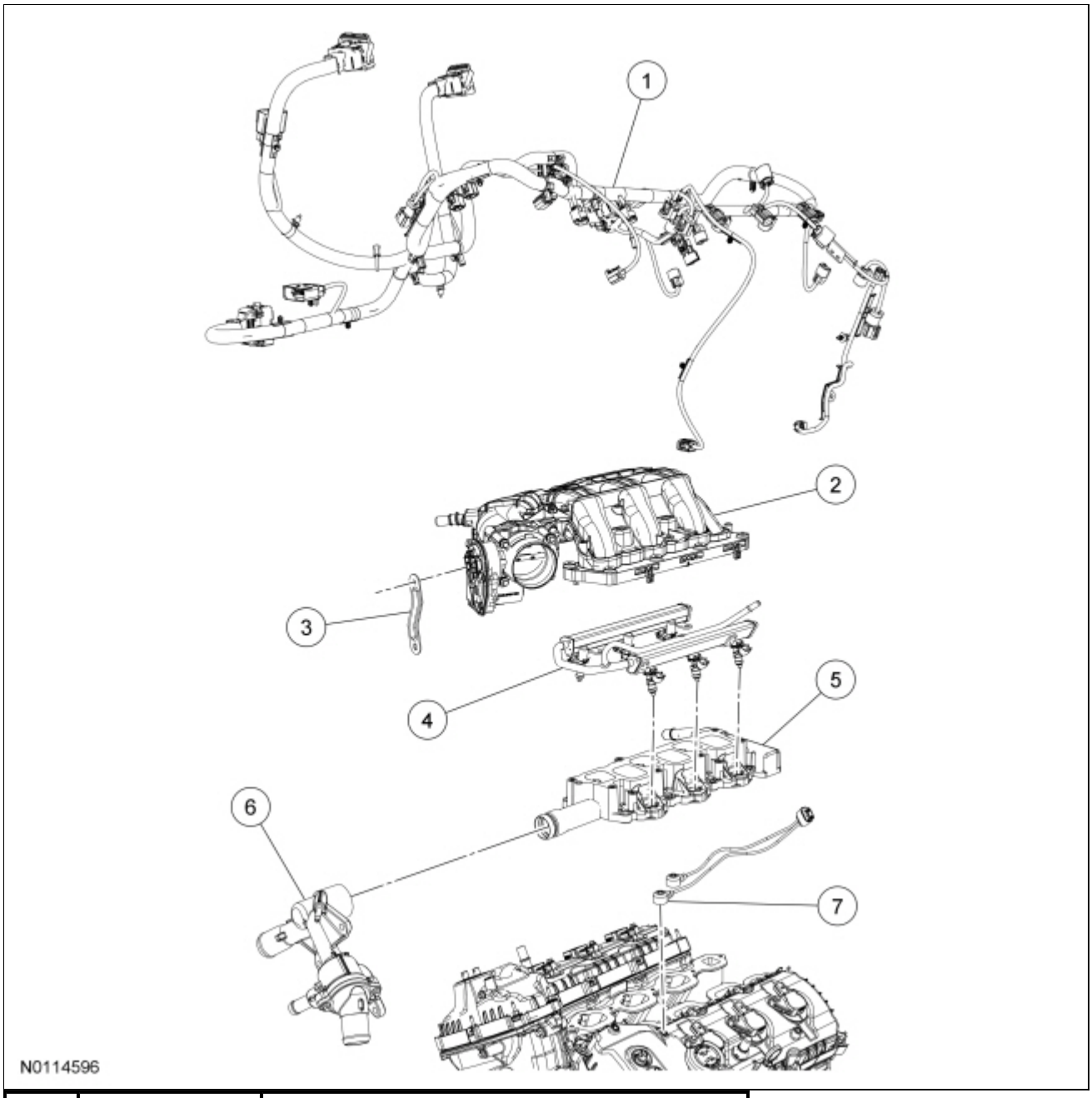
 ST2979-A	

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D
Motorcraft® Silicone Gasket Remover ZC-30	—

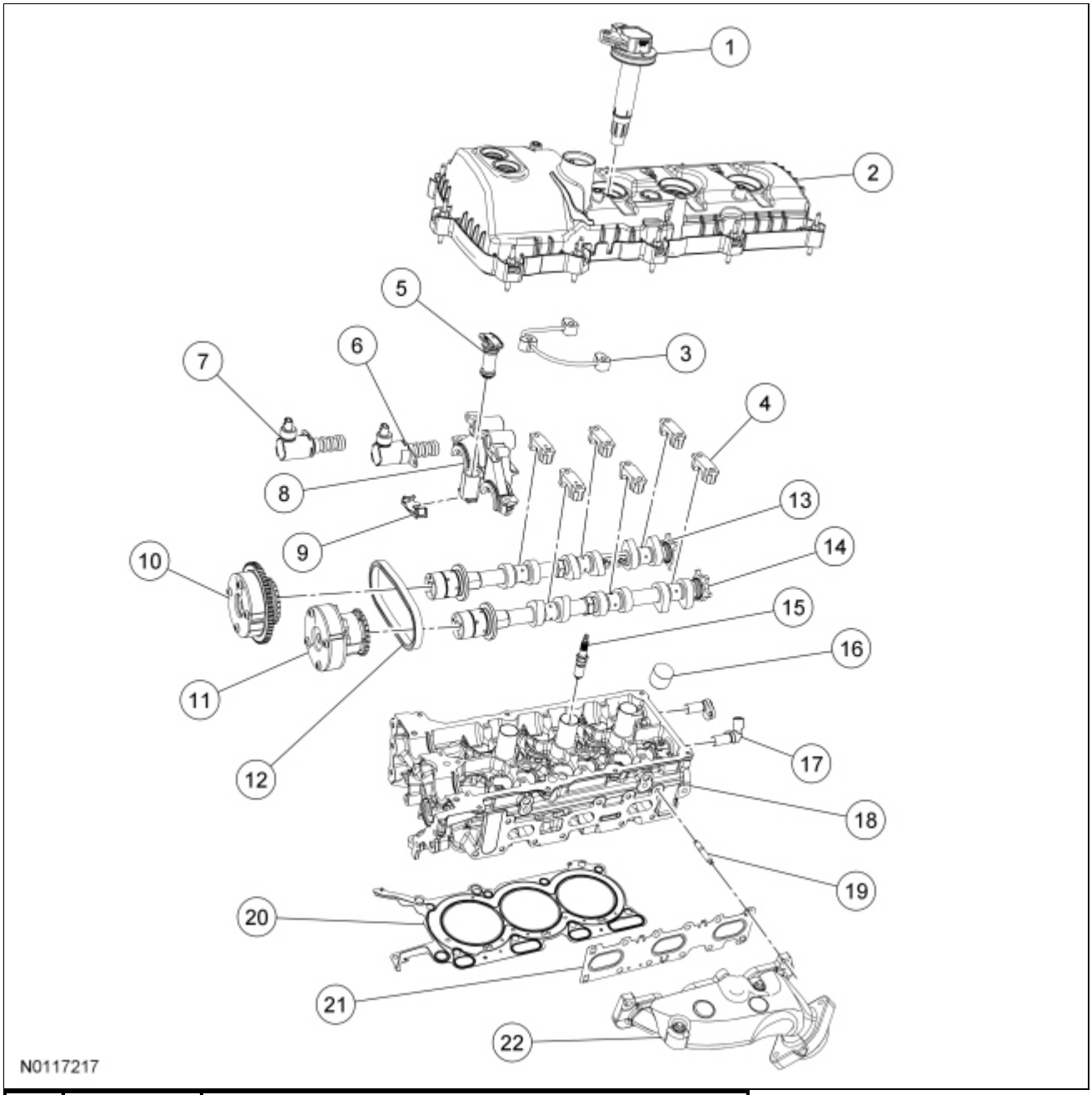
Engine Upper

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Item	Part Number	Description
1	14A411	Engine control harness
2	9424	Upper intake manifold
3	9J444	Upper intake manifold support bracket
4	9F797	Fuel rail
5	9424	Lower intake manifold
6	8A586	Thermostat housing
7	12A699	Knock Sensor (KS)

Engine Upper — LH Cylinder Head

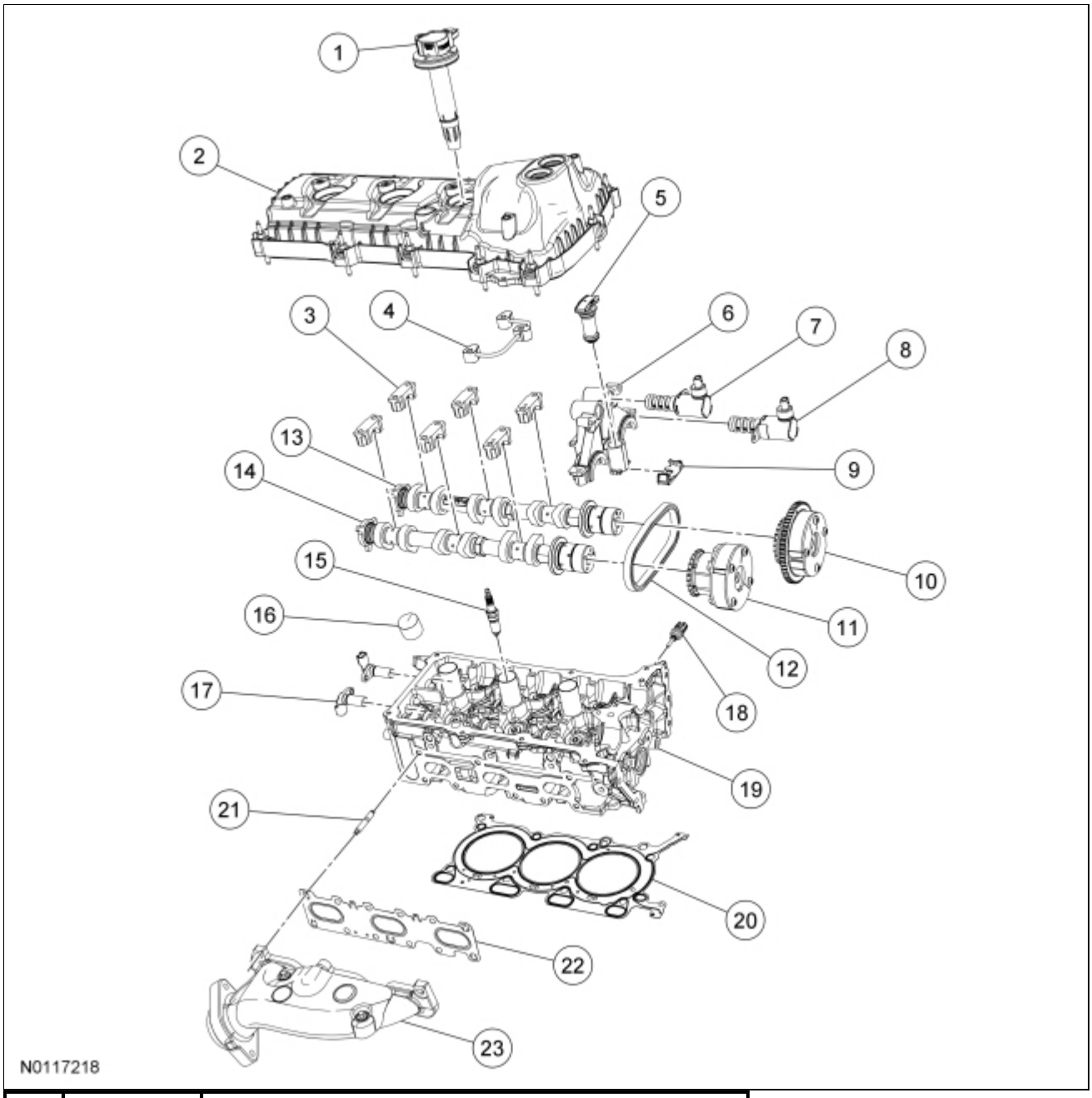


Item	Part Number	Description
1	12029	Ignition coil-on-plug (3 required)
2	6582	LH valve cover
3	6K602	Valve train oil feed tube
4	6A258	LH camshaft cap (6 required)
5	6K254	LH secondary timing chain tensioner
6	6M280	Intake camshaft Variable Camshaft Timing (VCT) oil control solenoid

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7	6M280	Exhaust camshaft VCT oil control solenoid
8	6B280	Camshaft mega cap
9	6K297	LH secondary tensioner shoe
10	6256	Intake camshaft VCT assembly
11	6C525	Exhaust camshaft VCT assembly
12	6268	LH secondary timing chain
13	6250	LH intake camshaft
14	6250	LH exhaust camshaft
15	12405	Spark plug (3 required)
16	6500	Valve tappet (32 required)
17	6B288	LH cylinder head Camshaft Position (CMP) sensor (2 required)
18	6049	LH cylinder head
19	W712244	LH exhaust manifold stud (6 required)
20	6051	LH cylinder head gasket
21	9448	LH exhaust manifold gasket
22	9431	LH exhaust manifold

Engine Upper — RH Cylinder Head

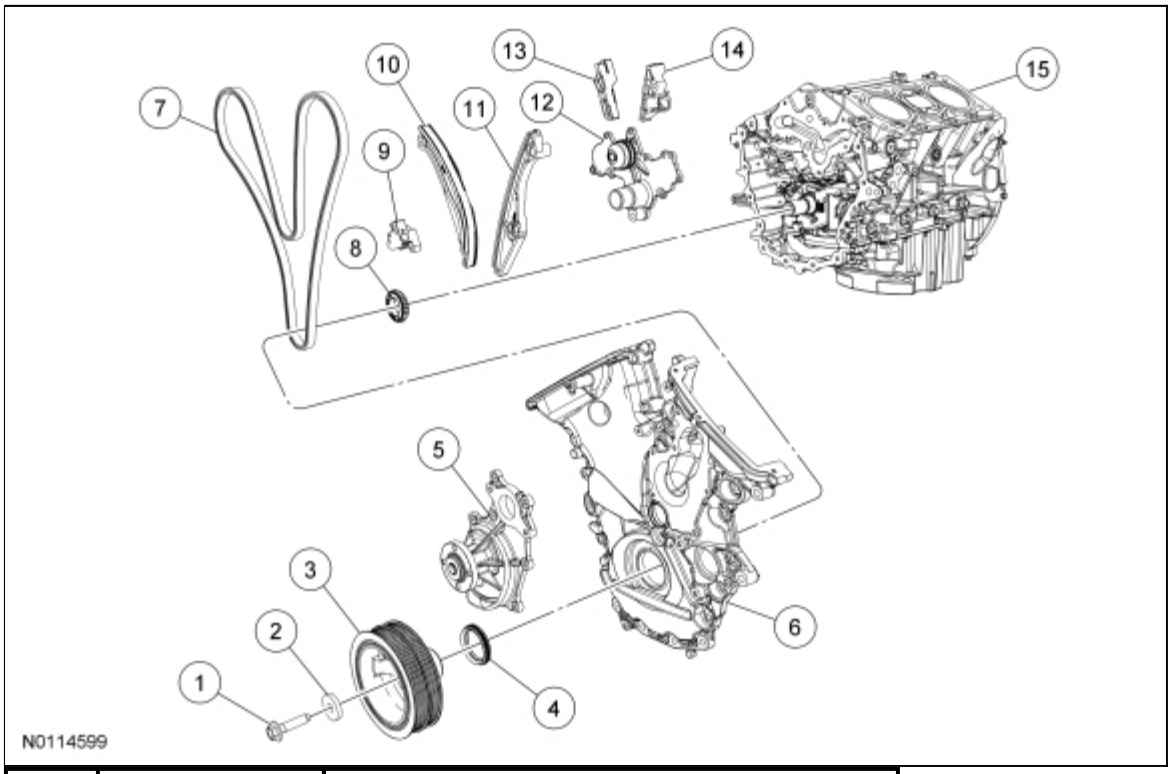


Item	Part Number	Description
1	12029	Ignition coil-on-plug (3 required)
2	6582	RH valve cover
3	6A258	RH camshaft cap (6 required)
4	6K602	Valve train oil feed tube
5	6K254	RH secondary timing chain tensioner
6	6B280	Camshaft mega cap
7	6M280	Intake camshaft Variable Camshaft Timing (VCT) oil control solenoid
8	6M280	Exhaust camshaft VCT oil control solenoid

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9	6K297	RH secondary tensioner shoe
10	6256	Intake camshaft VCT assembly
11	6C525	Exhaust camshaft VCT assembly
12	6268	RH secondary timing chain
13	6250	RH intake camshaft
14	6250	RH exhaust camshaft
15	12405	Spark plug (3 required)
16	6500	Valve tappet (32 required)
17	6B288	RH cylinder head Camshaft Position (CMP) sensor (2 required)
18	6G004	Cylinder Head Temperature (CHT) sensor
19	6049	RH cylinder head
20	6051	RH cylinder head gasket
21	W712244	RH exhaust manifold stud (6 required)
22	9448	RH exhaust manifold gasket
23	9430	RH exhaust manifold

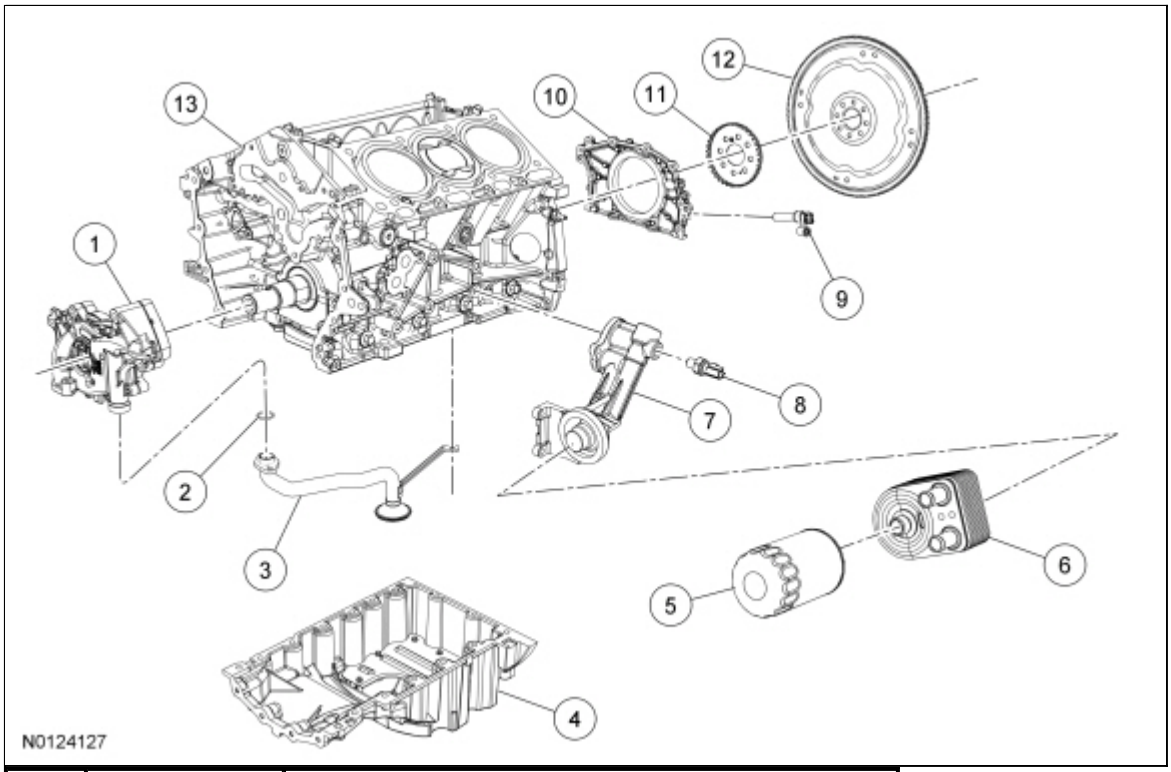
Engine Front



Item	Part Number	Description
1	6A340	Crankshaft pulley bolt

2	6378	Crankshaft pulley washer
3	6312	Crankshaft pulley
4	6700	Crankshaft front seal
5	8501	Coolant pump
6	6019	Engine front cover
7	6268	Timing chain
8	6306	Crankshaft timing sprocket
9	6K254	Primary timing chain tensioner
10	6K255	Primary timing chain tensioner arm
11	6B274	LH lower primary timing chain guide
12	8501	Channel cover plate
13	6M256	RH primary timing chain guide
14	6K297	LH upper primary timing chain guide
15	6010	Cylinder block

Lower Engine Block (View 1)

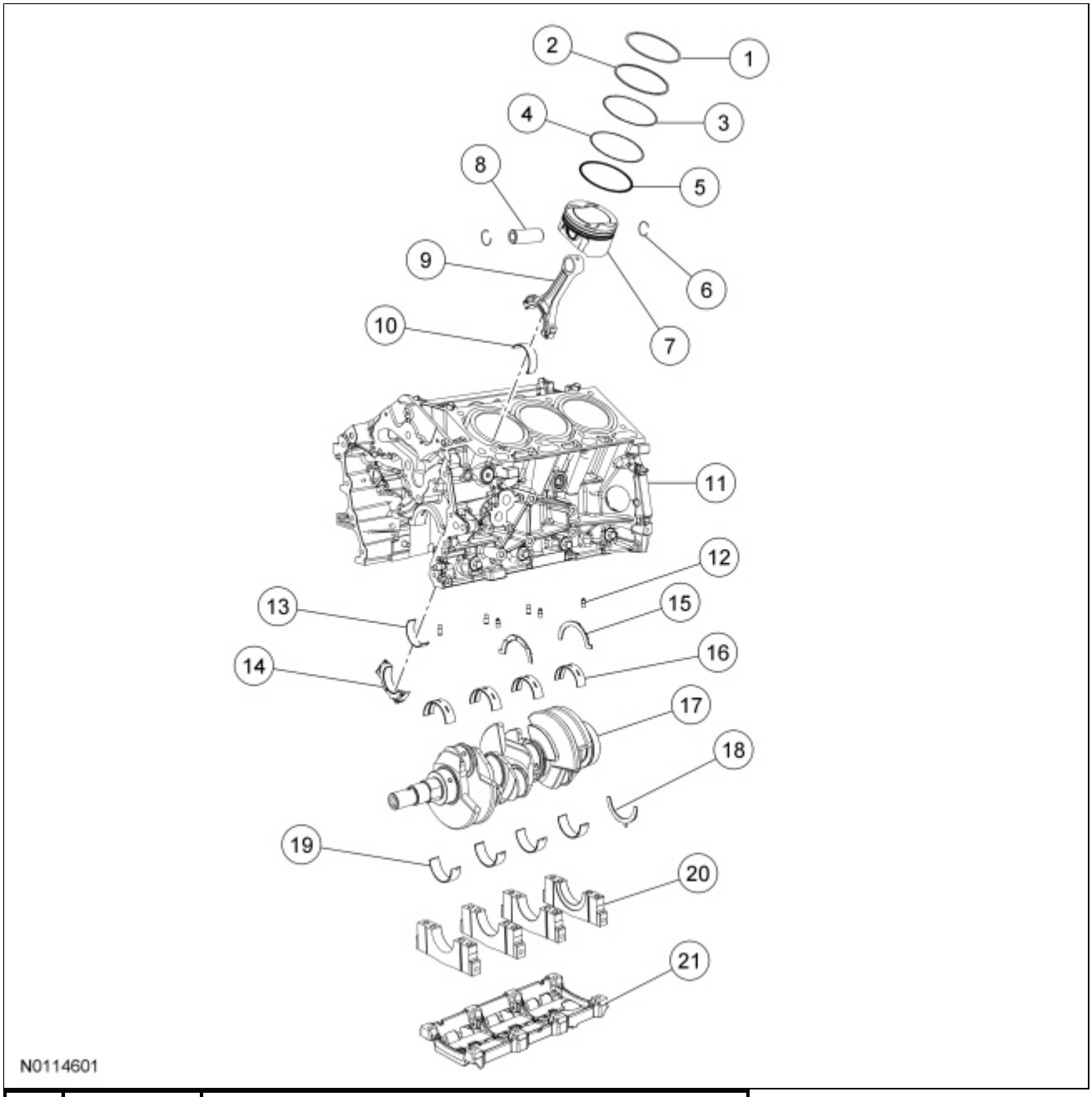


Item	Part Number	Description
1	6600	Oil pump
2	6625	Oil pump screen and pickup tube O-ring seal

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3	6622	Oil pump screen and pickup tube
4	6675	Oil pan
5	6731	Engine oil filter
6	6A642	Oil cooler
7	6881	Oil filter adapter
8	9278	Engine Oil Pressure (EOP) switch
9	6C315	Crankshaft Position (CKP) sensor
10	6K301	Crankshaft rear seal retainer
11	12A227	Crankshaft sensor ring
12	6375	Flexplate
13	6010	Cylinder block

Lower Engine Block (View 2)



Item	Part Number	Description
1	—	Piston compression upper ring (part of 6148) (6 required)
2	—	Piston compression lower ring (part of 6148) (6 required)
3	—	Piston oil control upper segment ring (part of 6148) (6 required)
4	—	Piston oil control spacer (part of 6148) (6 required)
5	—	Piston oil control lower segment ring (part of 6148) (6 required)
6	6140	Piston pin retainer (12 required)

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7	6110	Piston (6 required)
8	6135	Piston pin (6 required)
9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6010	Cylinder block
12	6K868	Piston oil cool valve (6 required)
13	6211	Connecting rod lower bearing (6 required)
14	6200	Connecting rod cap (6 required)
15	6A341	Crankshaft upper thrust washer (2 required)
16	6D309	Cylinder block crankshaft main bearing (4 required)
17	6303	Crankshaft
18	6K302	Crankshaft lower thrust washer
19	6D309	Lower crankshaft main bearing (4 required)
20	6325	Lower crankshaft main bearing cap (4 required)
21	6C364	Main bearing cap support brace

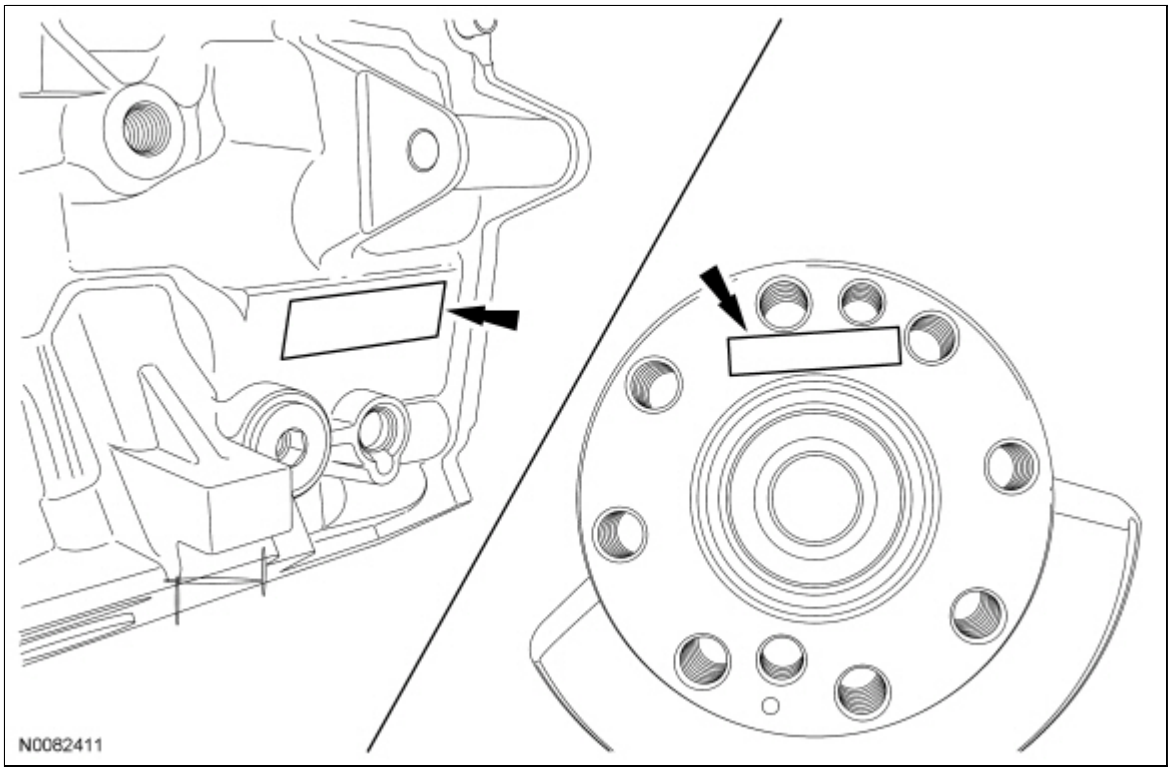
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: Assembly of the engine requires various inspections/measurements of the engine components. These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to Section 303-00 .

All engines

1. **NOTE:** This procedure is for selecting bearings using a new crankshaft.

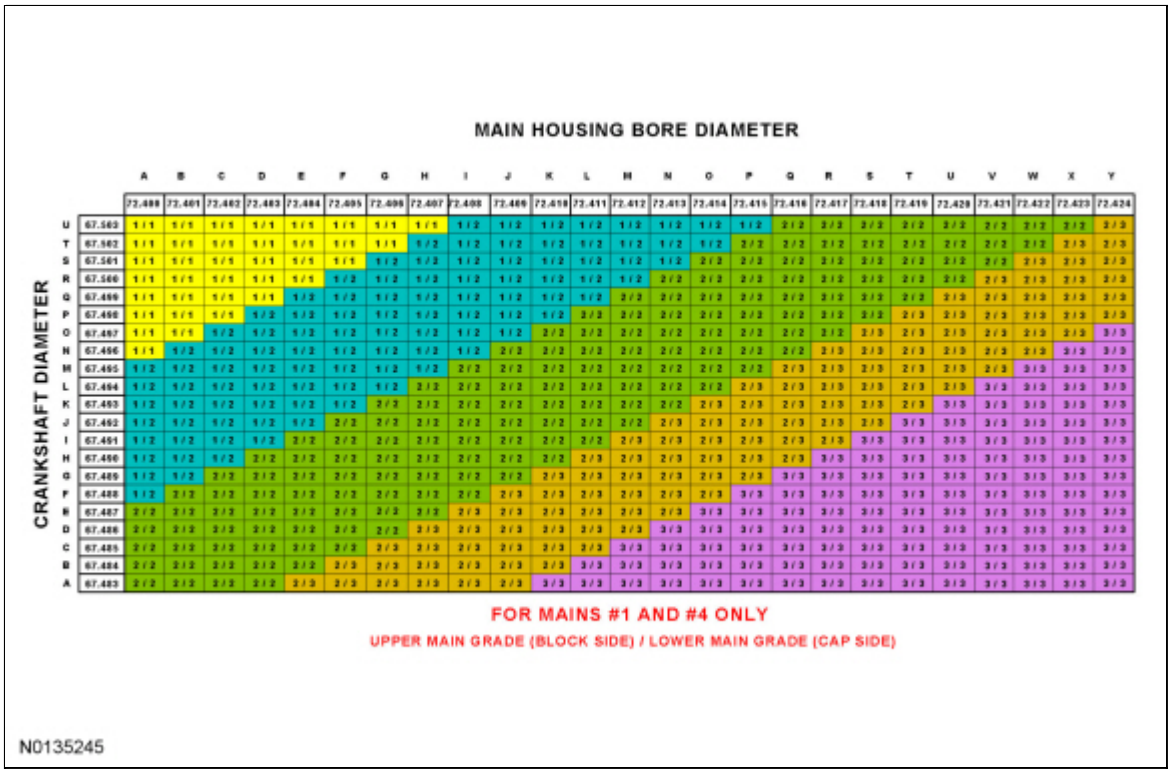
   Select the crankshaft main bearings for each crankshaft journal.
   - Read the code on the crankshaft flange.
   - Read the code on the cylinder block face.
     - The first letter after the first asterisk makes up the code for main No. 1 and the next letter for main No. 2. The first letter after the second asterisk makes up the code for main No. 3 and the last letter for main No. 4.



2. **NOTE:** This chart is for selecting main bearings 1 and 4 only, the remaining bearings will be selected using a different chart in the next step.

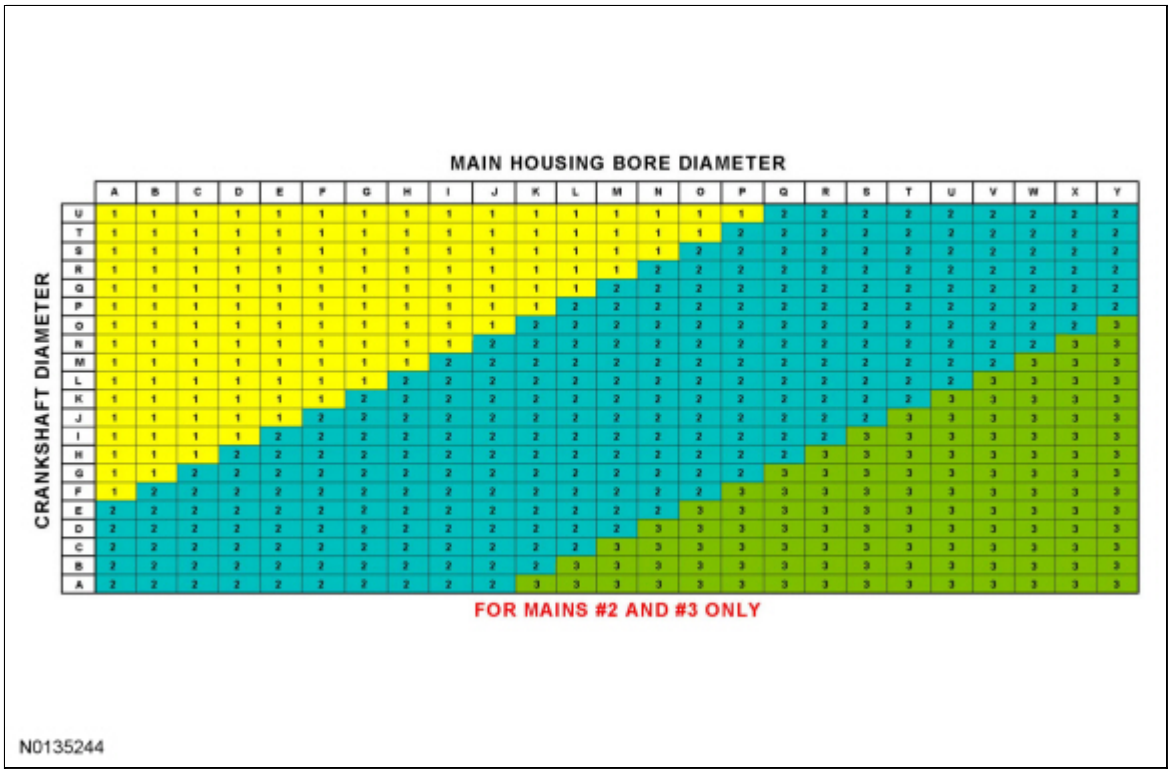
   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 1 and 4.
   - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade(s) for the No. 1 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is a "1" for the upper bearing and a "2" for the lower bearing.
   - Repeat the above steps using the fourth letter of the block and crankshaft codes to select the No. 4 bearing.

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3. **NOTE:** This chart is for selecting main bearings 2 and 3 only.

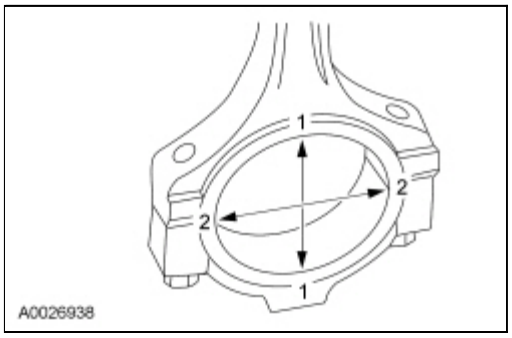
   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 2 and 3.
   - Read the second letter of the engine block main bearing code and the second letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade for the No. 2 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is "1".
   - Repeat the above steps using the third letter of the block and crankshaft codes to select the No. 3.



4. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

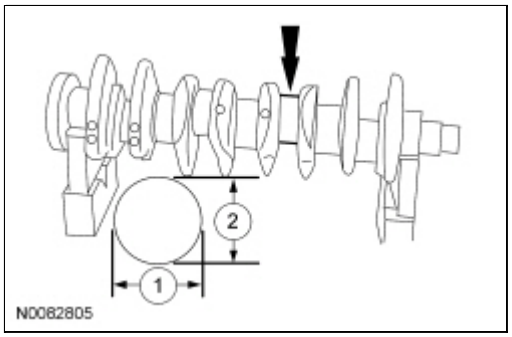
   Using the original connecting rod cap bolts, install the connecting rod caps and bolts.
   - Tighten the bolts in 3 stages:
   - Stage 1: Tighten to 23 Nm (17 lb-ft).
   - Stage 2: Tighten to 43 Nm (32 lb-ft).
   - Stage 3: Tighten an additional 90 degrees.

5. Measure the connecting rod large end bore in 2 directions.
   - Remove the bolts and the rod cap.
     - Discard the connecting rod cap bolts.



6. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.

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7. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

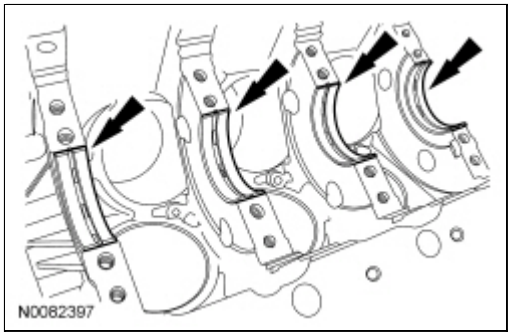
		CONNECTING ROD LARGE END BORE (59.XXX)																				
		1 .866	1 .867	1 .868	1 .869	1 .870	1 .871	1 .872	2 .873	2 .874	2 .875	2 .876	2 .877	2 .878	2 .879	3 .880	3 .881	3 .882	3 .883	3 .884	3 .885	3 .886
CRANK JOURNAL	56.003	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.002	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.001	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.000	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.999	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.996	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.994	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.993	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.992	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.991	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.990	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.989	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.988	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.987	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.986	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.985	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.984	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	55.983	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3

		MINIMUM	MAXIMUM	NOMINAL
WALL GRADES	1	1.918 mm	1.924 mm	1.921 mm
	2	1.921 mm	1.927 mm	1.924 mm
	3	1.925 mm	1.931 mm	1.928 mm

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8. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

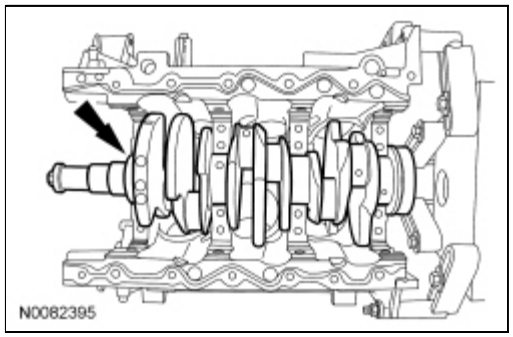
   Lubricate the upper crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the cylinder block.



9. **NOTE:** Do not install the upper thrust bearings until the crankshaft is installed.

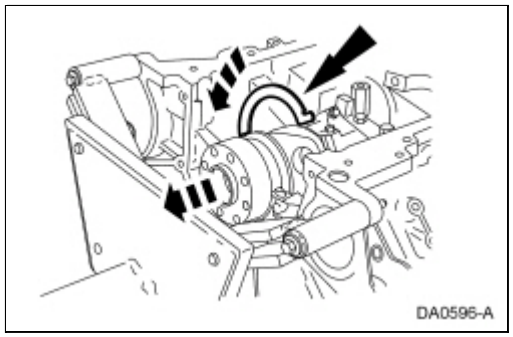
   NOTE: Lubricate the thrust surfaces of the crankshaft with clean engine oil.

   Install the crankshaft onto the upper main bearings.



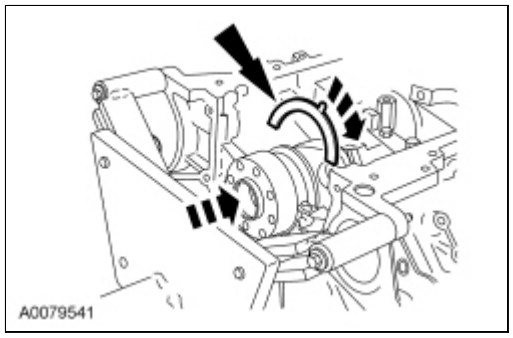
10. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 4 rear bulkhead.



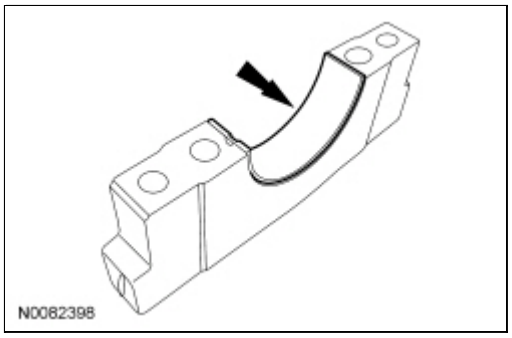
11. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 4 rear bulkhead.

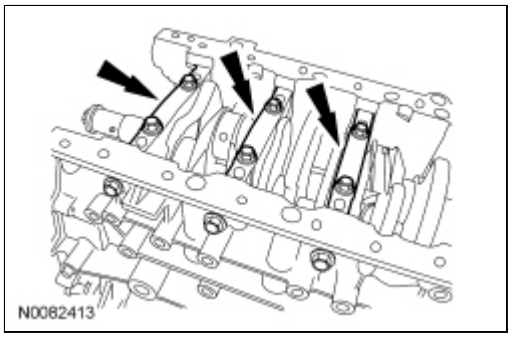


12. Lubricate the crankshaft lower main bearings with clean engine oil and install them into the main bearing caps. Visually check seating and squareness of the bearings to make sure of proper seating in caps.

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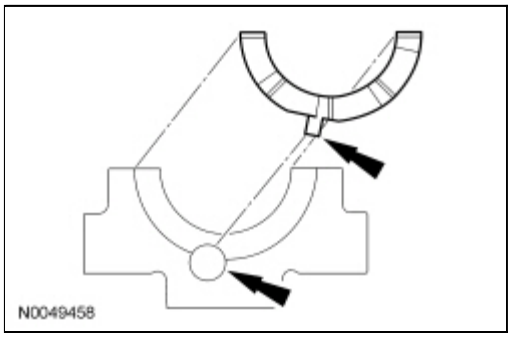
13. Position the No. 1, No. 2 and No. 3 main bearing caps on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the new bolts until the main bearing caps are seated.



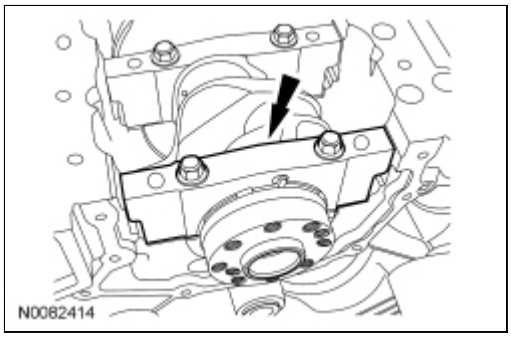
14. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    NOTE: To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

    Install the lower crankshaft thrust washer to the back side of the No. 4 rear main bearing cap, with the tab aligned with the cutout in the main bearing cap.



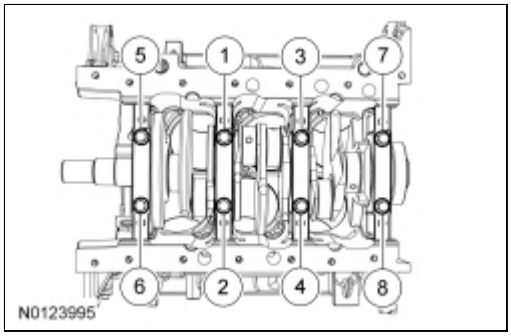
15. Position main bearing cap No. 4 on the cylinder block and keeping the cap as square as possible, alternately draw the cap down evenly using the new bolts until the main bearing cap is seated.



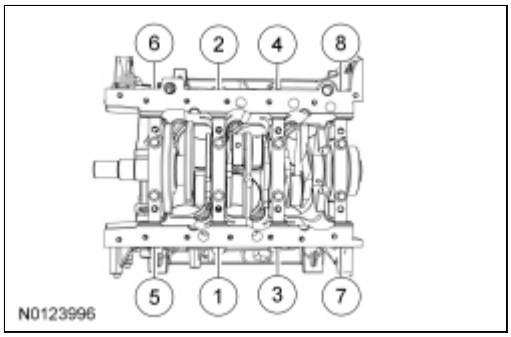
16. Loosen the No. 4 main bearing cap bolts.

17. **NOTE:** While tightening the main bearing vertical bolts, push the crankshaft forward and the No. 4 main bearing cap rearward to seat the crankshaft thrust washers.

    Tighten the main bearing bolts in the sequence shown in 2 stages:
    - Stage 1: Tighten fasteners 1 through 8 to 33 Nm (24 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 135 degrees.

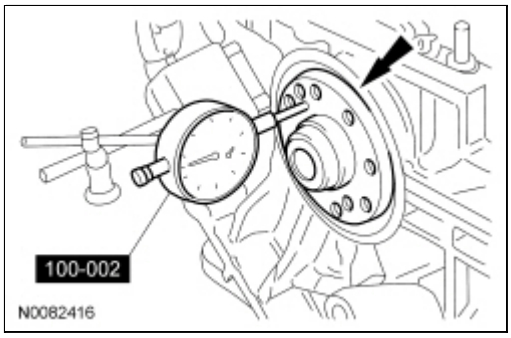


18. Install the new 8 main bearing cap side bolts. Tighten in the sequence shown in 2 stages:
    - Stage 1: Tighten fasteners 1 through 8 to 24 Nm (18 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 180 degrees.



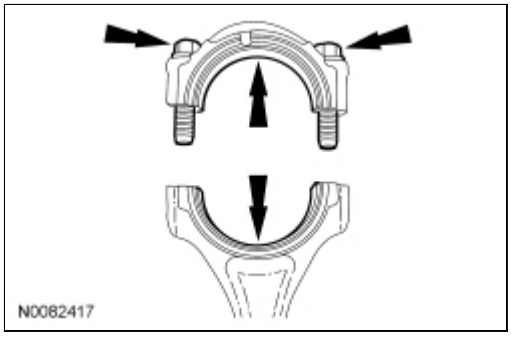
19. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.

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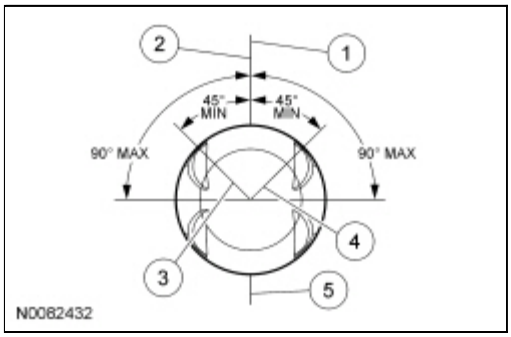


20. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    Prepare the connecting rod and cap.
    - Insert the new bolts in the rod cap.
    - Insert the upper and lower rod bearings into the rod and cap.



21. Before installing the pistons into the cylinder block, verify proper ring gap location.
    1. Center line of the piston parallel to the wrist pin bore
    2. Upper compression ring gap location
    3. Upper oil control segment ring gap location
    4. Lower oil control segment ring gap location
    5. Expander ring and lower compression ring gap location



22. ***NOTICE:*** **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

    NOTE: The next 3 steps are for all 6 connecting rods, rod caps and pistons. Only 1 connecting rod, rod cap and piston is shown.

    NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with

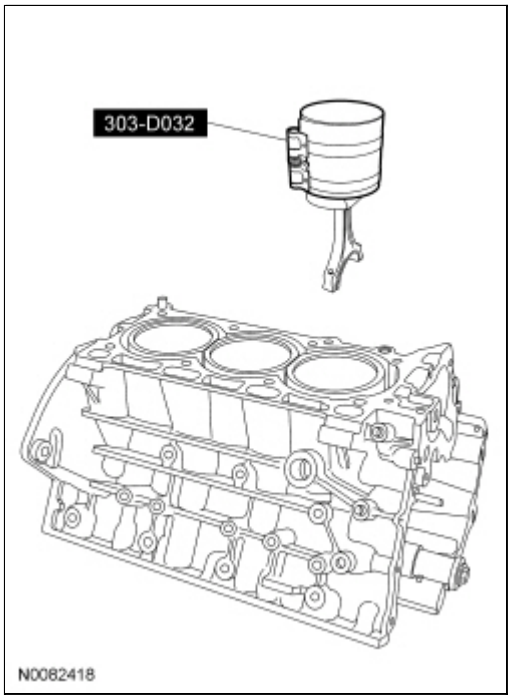
clean engine oil.

NOTE: Make sure the piston rings are positioned to specifications for installation. For additional information, refer to Disassembly and Assembly of Subassemblies - Piston in this section.

NOTE: If the piston and/or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

NOTE: If the piston and connecting rod are to be reinstalled, they must be installed in the same orientation as disassembled.

Using the Piston Ring Compressor, install the piston and connecting rod assemblies.



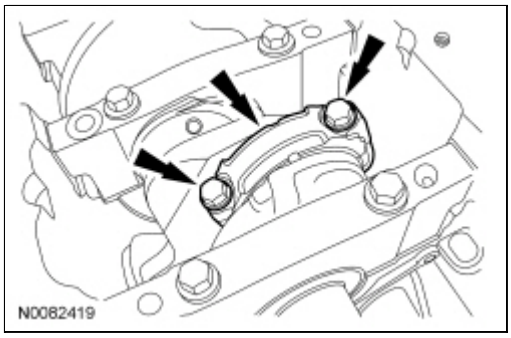
23. Seat the connecting rod on the crankshaft journal.

24. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    NOTE: After installation of each piston, connecting rod, rod cap and bolts, rotate the crankshaft to verify smooth operation.

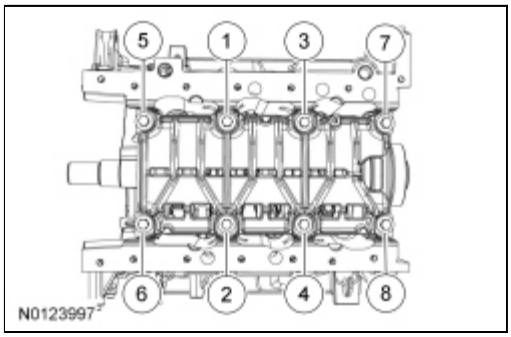
    Install the connecting rod cap and bolts.
    - Tighten the bolts in 3 stages:
    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.

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25. Repeat the previous 3 steps until all 6 piston, connecting rod and connecting rod cap assemblies are installed.

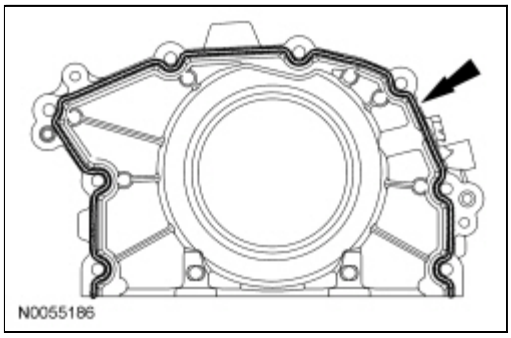
26. Install the main bearing cap support brace and the new bolts. Tighten in the sequence shown in 2 steps.
    - Stage 1: Tighten fasteners to 20 Nm (177 lb-in).
    - Stage 2: Tighten fasteners an additional 180 degrees.



27. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.

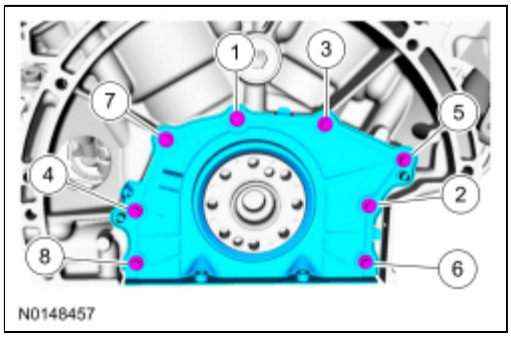


28. **NOTE:** Lubricate the crankshaft rear seal with clean engine oil.

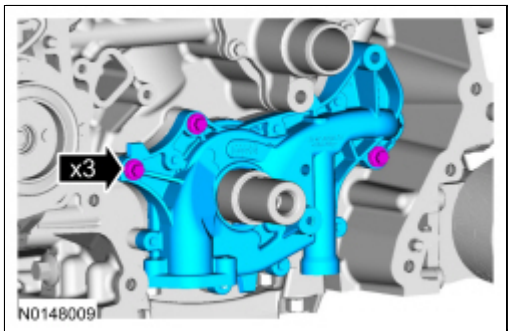
    NOTE: Use the 2 handles during installation to avoid touching the sealant.

Install the 8 crankshaft rear seal retainer plate bolts. Tighten in the sequence shown.

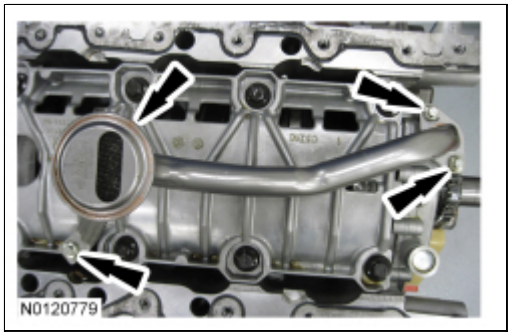
- Tighten to 10 Nm (89 lb-in).



29. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



30. Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

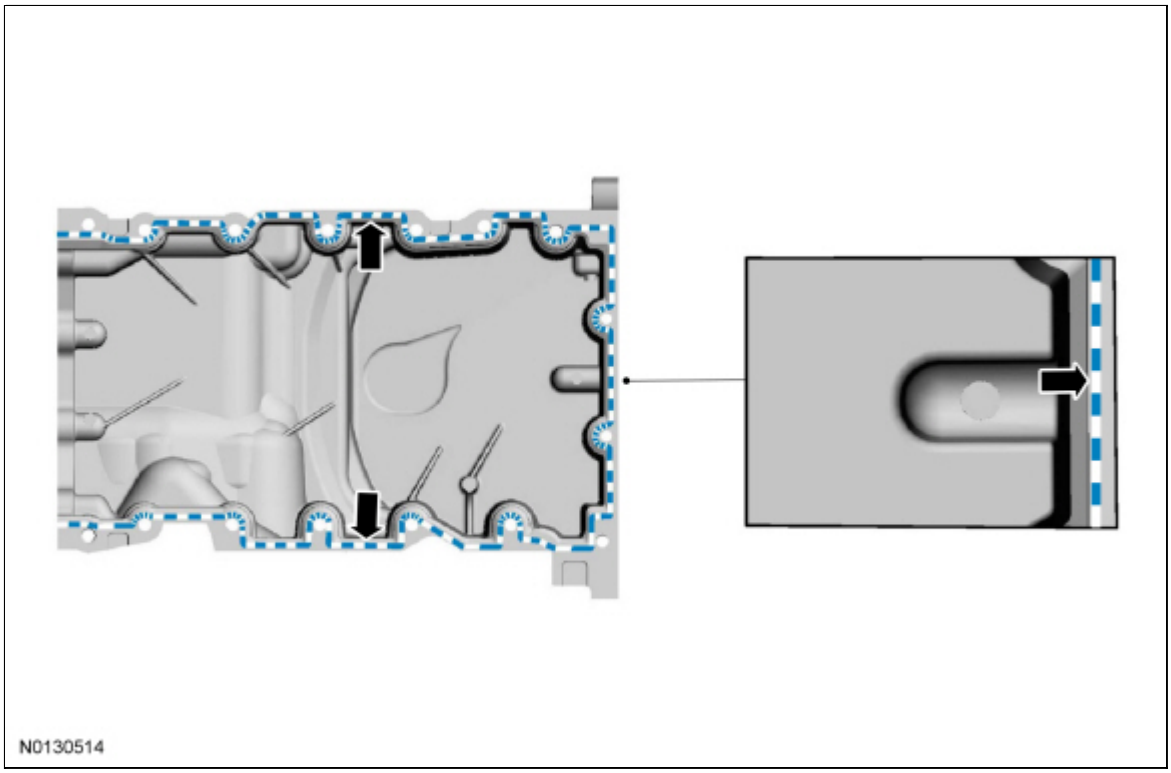


31. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

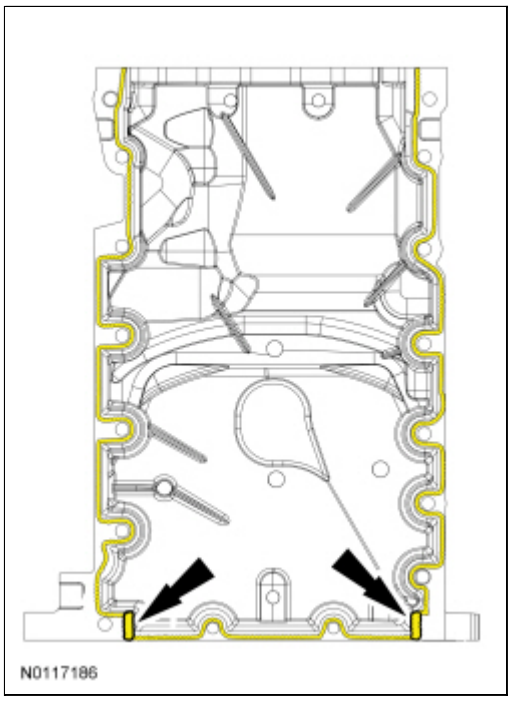
    NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the oil pan to the sealing surface of the oil pan-to-engine block mating surface.

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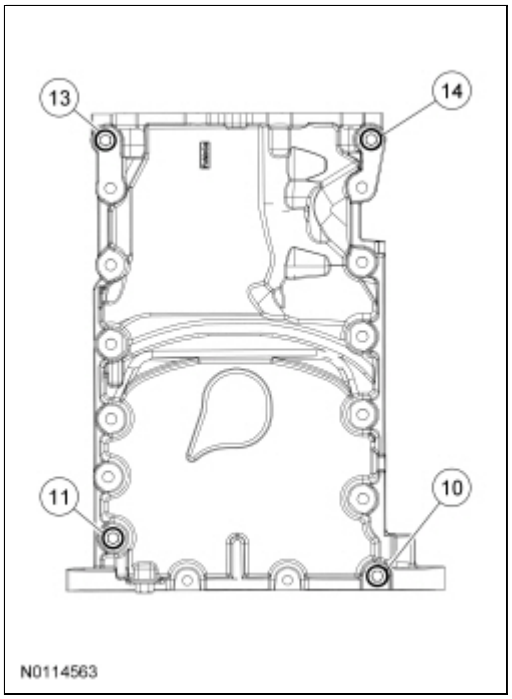


32. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.

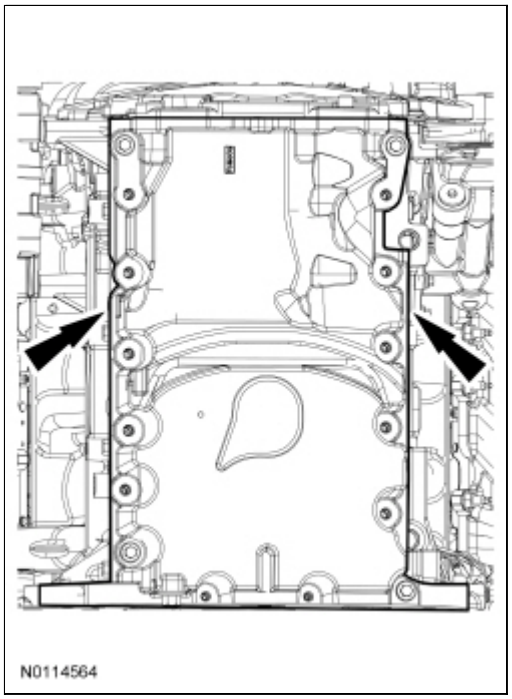


33. **NOTE:** The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.

    Install the oil pan and bolts 10, 11, 13 and 14 finger tight.

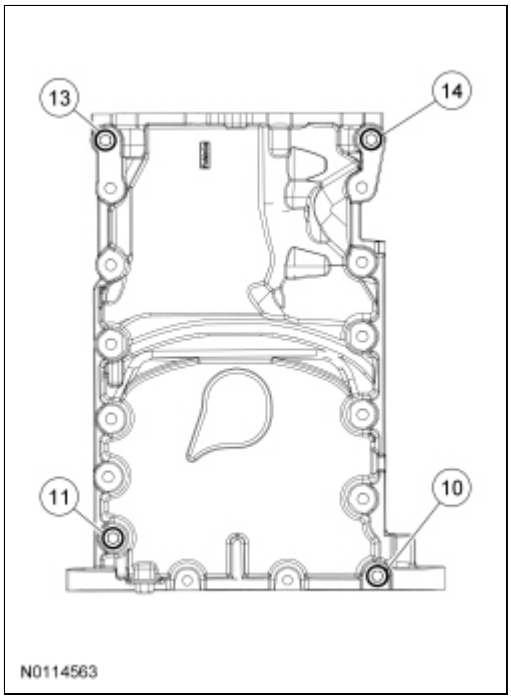


34. Laterally align the oil pan to the block. Make sure the oil pan is flush with the block at these 2 points.

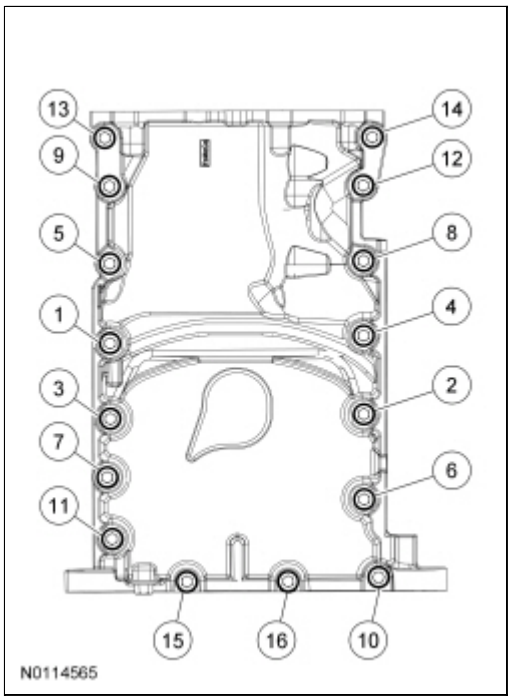


35. Tighten bolts 10, 11, 13 and 14 in the sequence shown to 3 Nm (27 lb-in).

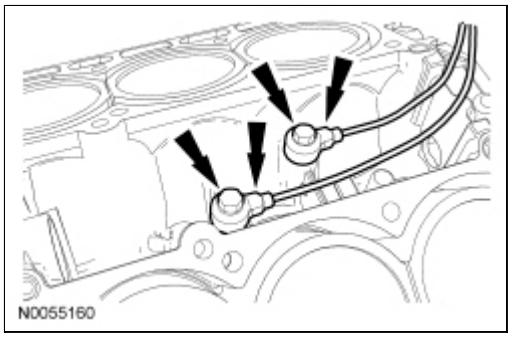
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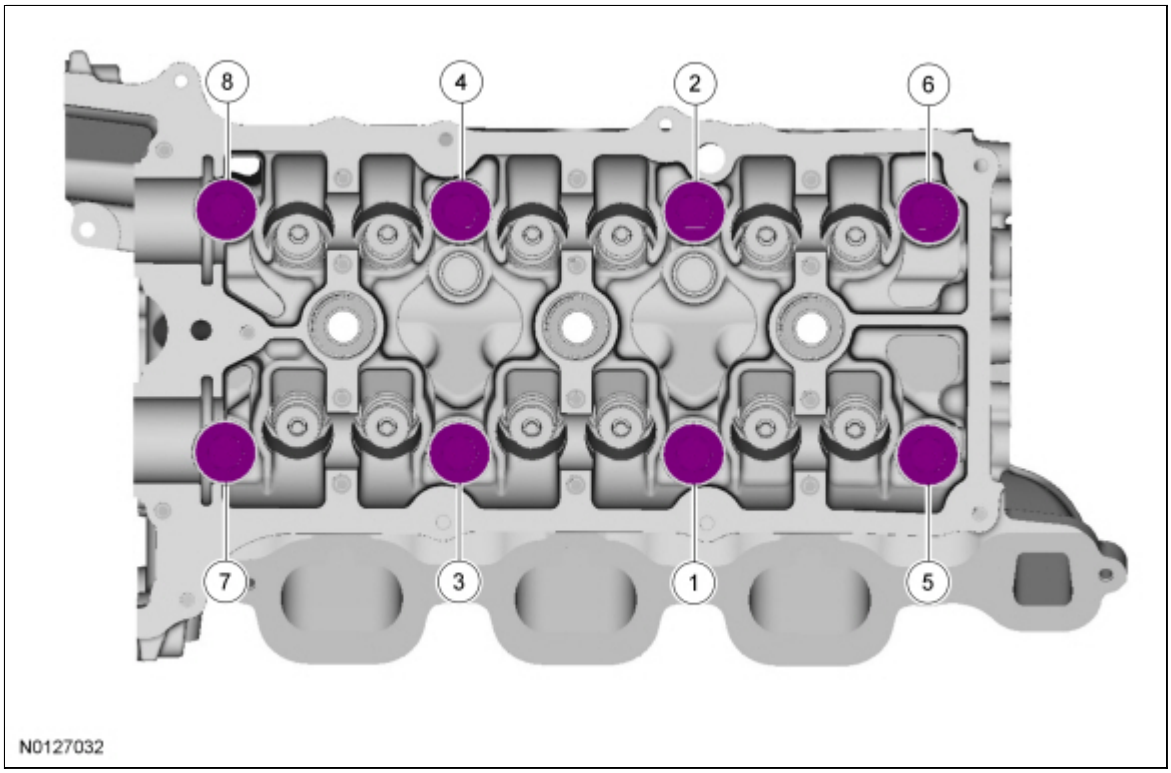
36. Install the remaining oil pan bolts and tighten in the sequence shown.
    - Tighten bolts 1-9 and 11-14 to 20 Nm (177 lb-in), then rotate an additional 45 degrees.
    - Tighten bolts 15 and 16 to 10 Nm (89 lb-in), then rotate an additional 45 degrees.
    - Tighten bolt 10 to 20 Nm (177 lb-in), then rotate an additional 90 degrees.



37. Install the Knock Sensor (KS) and the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).

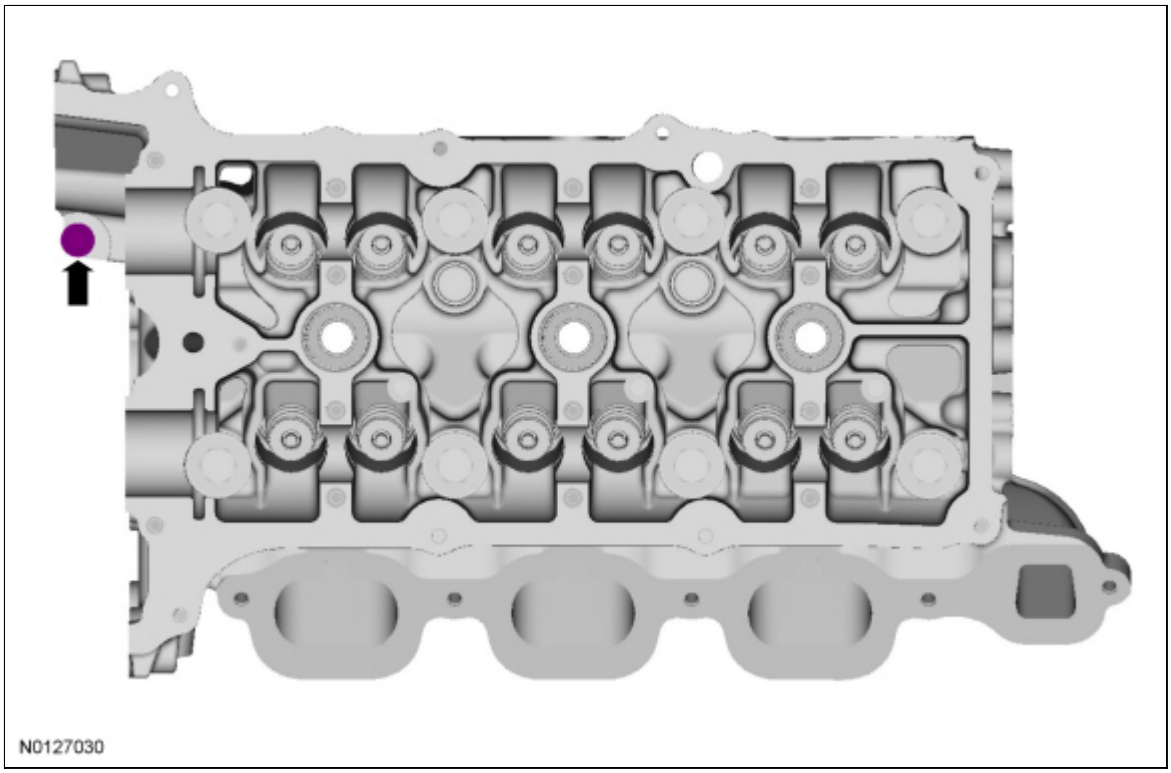


38. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.

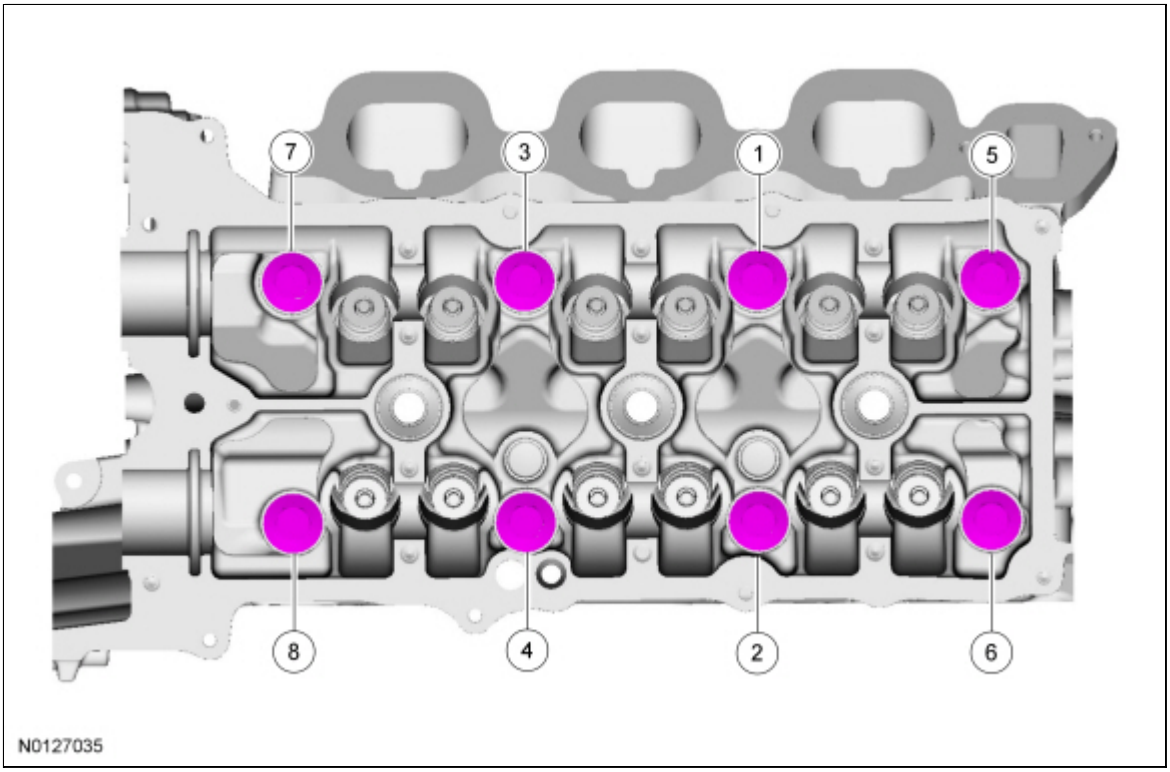


39. Install the RH M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

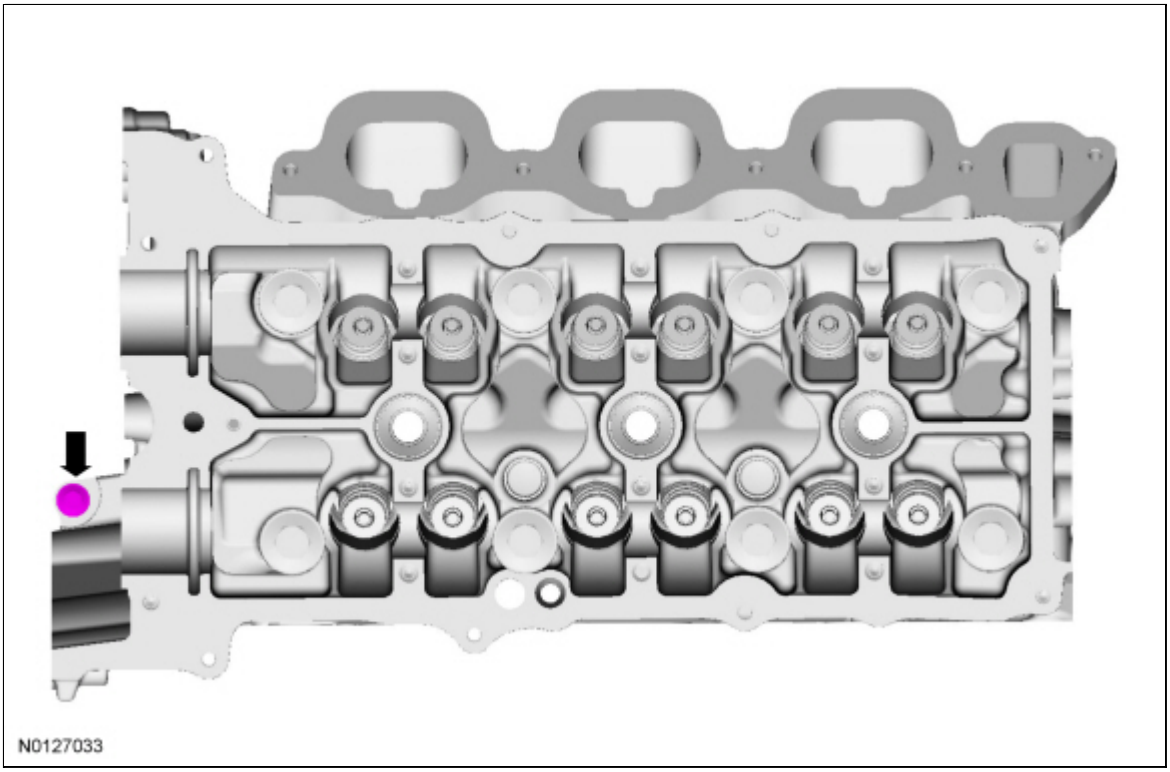
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40. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.

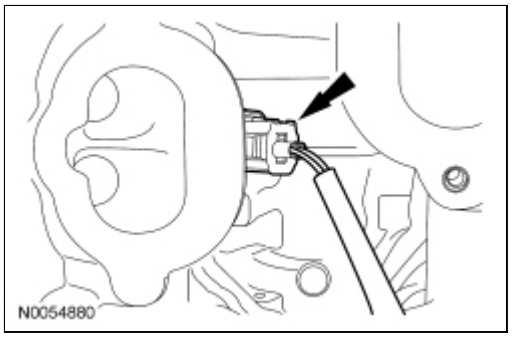


41. Install the LH M6 bolt.
    - Tighten to 10 Nm (89 lb-in).



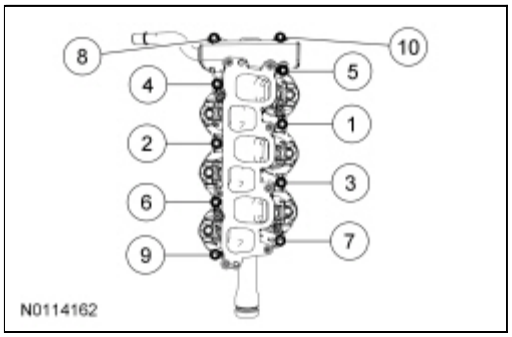
42. Connect the Cylinder Head Temperature (CHT) sensor jumper harness.

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43. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris if found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Using new lower intake manifold gaskets, install the lower intake manifold and the 10 bolts and tighten in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).

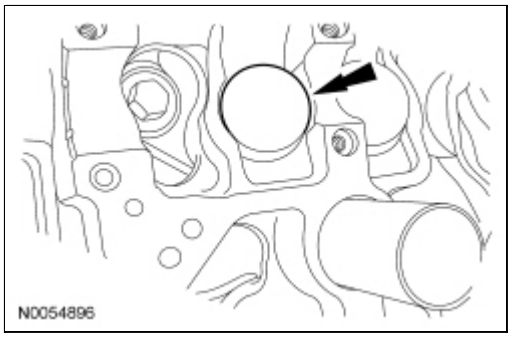


44. **NOTE:** The valve tappets must be installed in their original positions.

    NOTE: Coat the valve tappets with clean engine oil prior to installation.

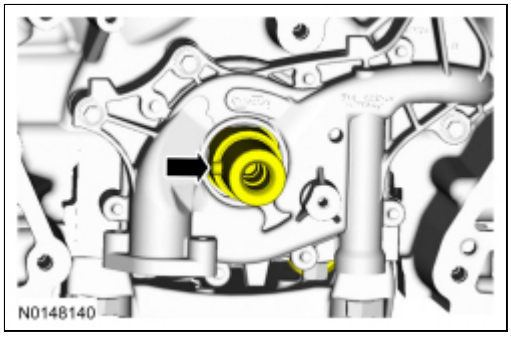
    NOTE: LH shown, RH similar.

    Install the valve tappets.



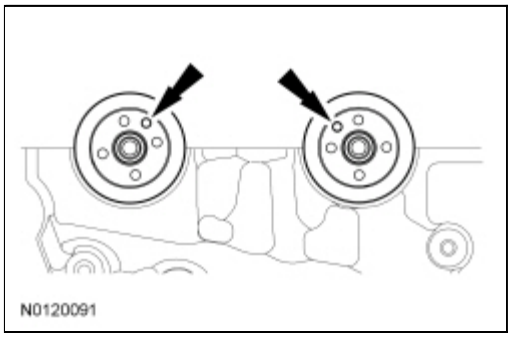
45. ***NOTICE:*** **The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

Position the crankshaft dowel pin in the 9 o'clock position.



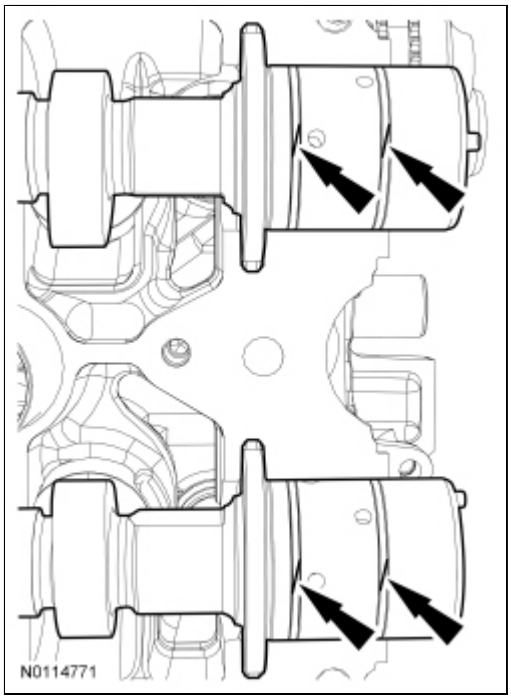
46. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

    Position the camshafts onto the RH cylinder head in the neutral position as shown.



47. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

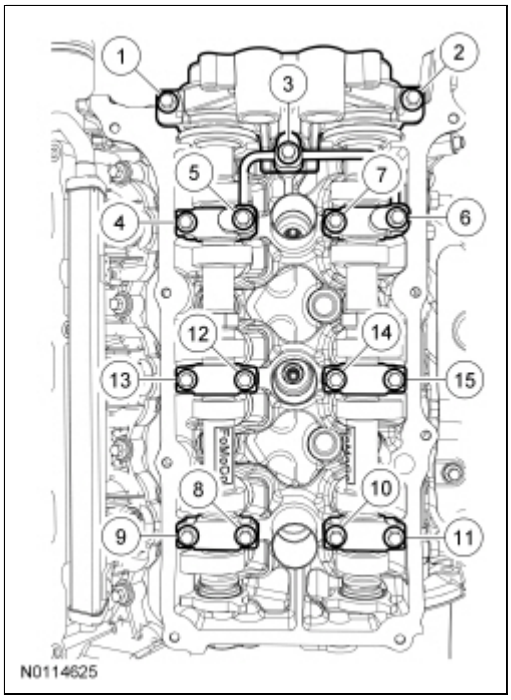
    Position the 4 camshaft seals gaps as shown.



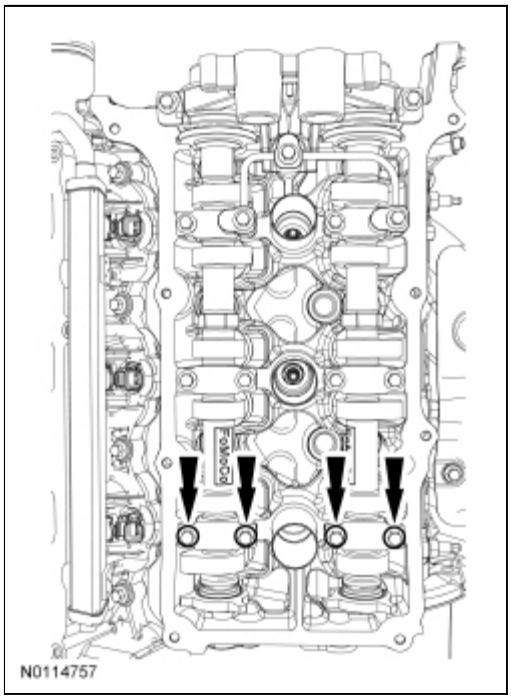
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48. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

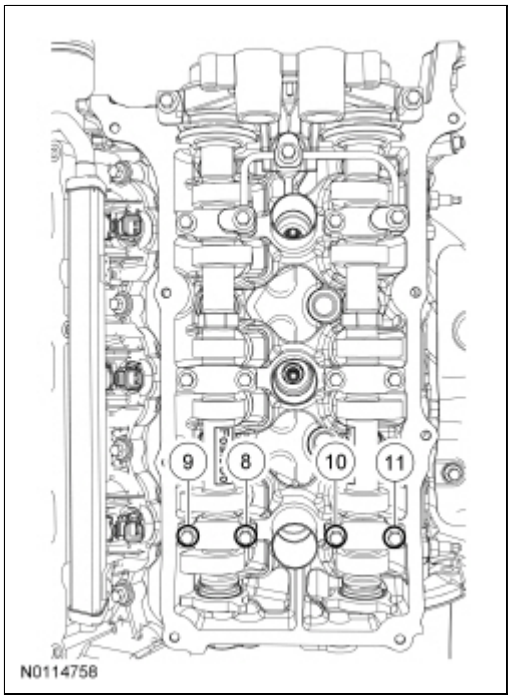
    Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
    - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.



49. Loosen the 4 camshaft caps bolts.



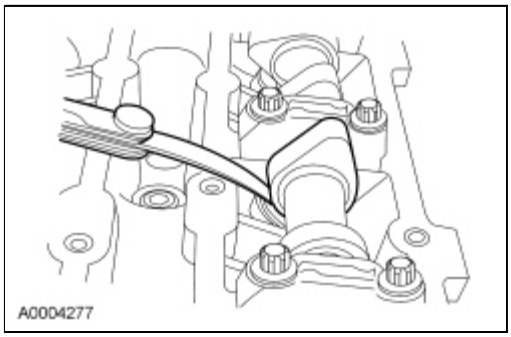
50. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then an additional 45 degrees.



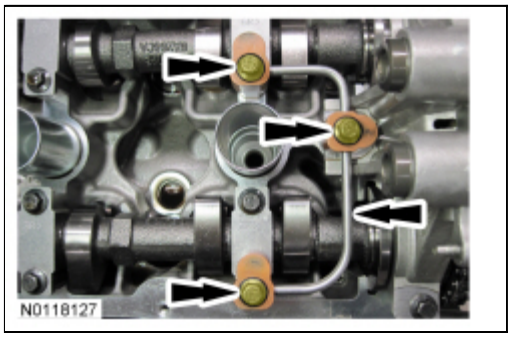
51. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet (s) of the correct size. For additional information, refer to Valve Clearance Check in this section.

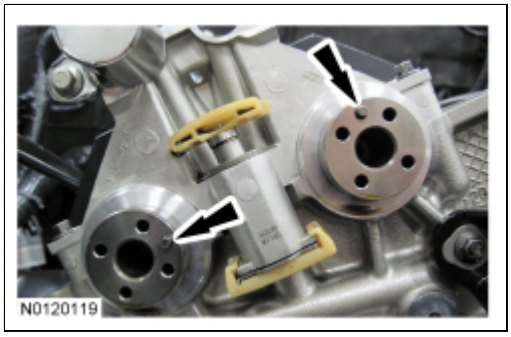


52. Remove the 3 bolts and the RH valve train oil tube.



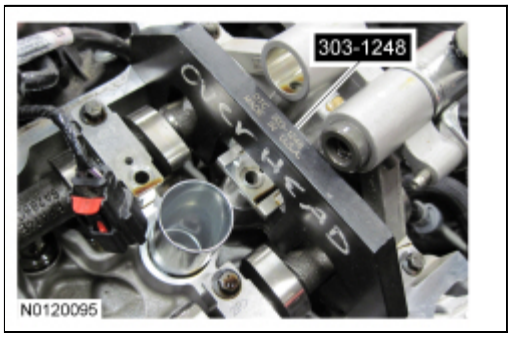
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53. Rotate the RH camshafts to the Top Dead Center (TDC) position as shown.



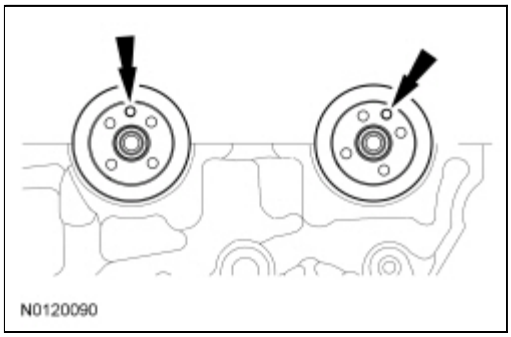
54. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the RH camshafts.



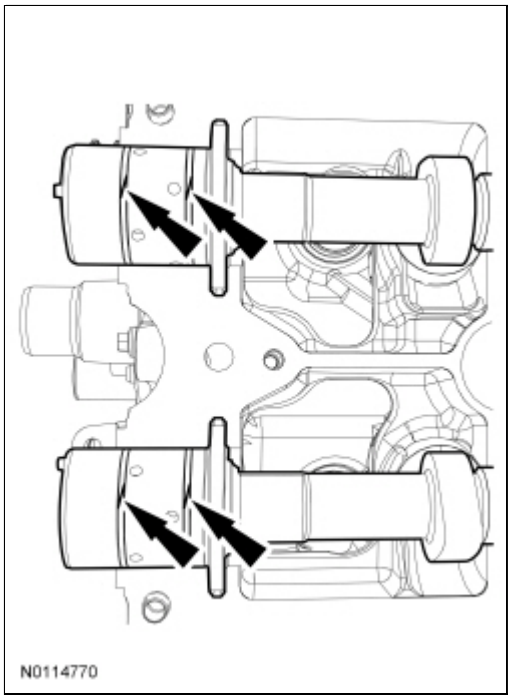
55. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

    Position the camshafts onto the LH cylinder head in the neutral position as shown.



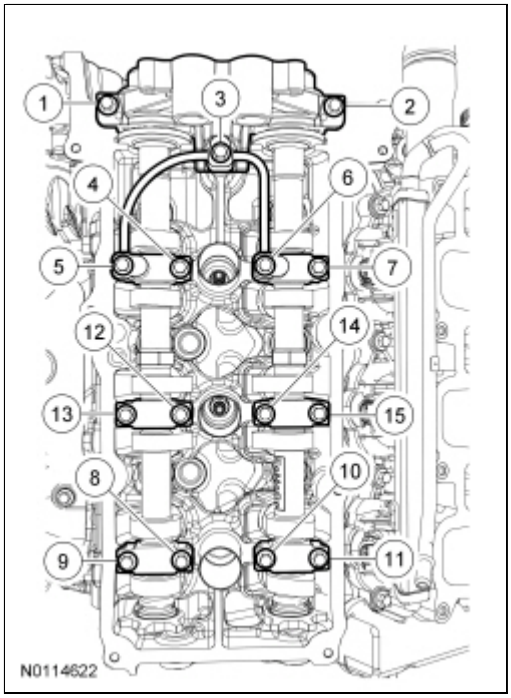
56. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

    Position the 4 camshaft seals gaps as shown.



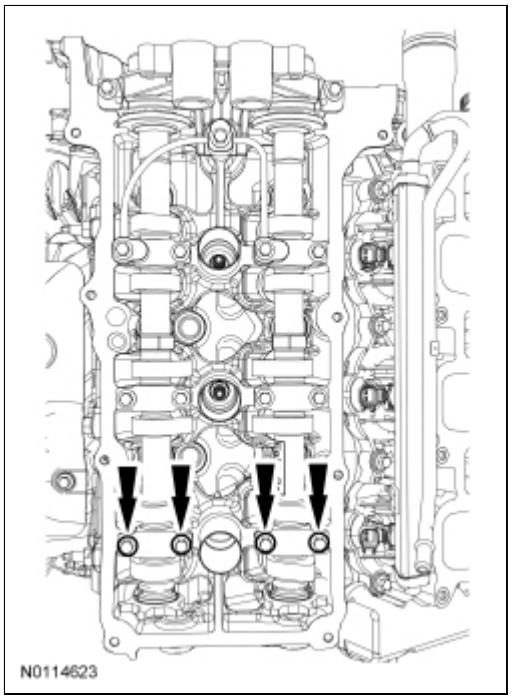
57. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
    - Tighten to 8 Nm (71 lb-in) then an additional 45 degrees.

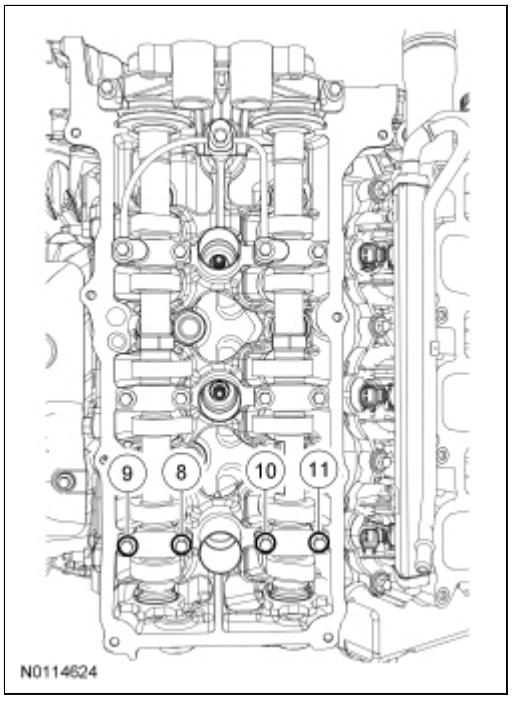


58. Loosen the 4 camshaft caps bolts.

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59. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then an additional 45 degrees.

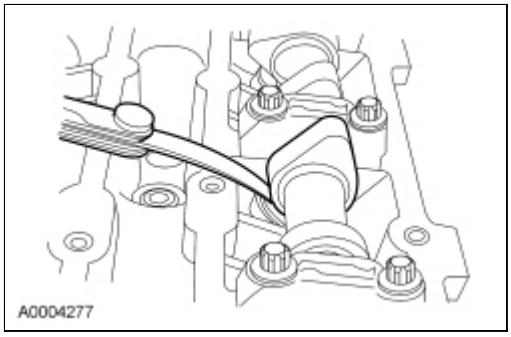


60. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

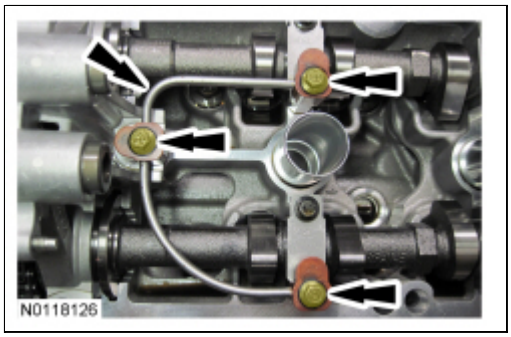
    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet

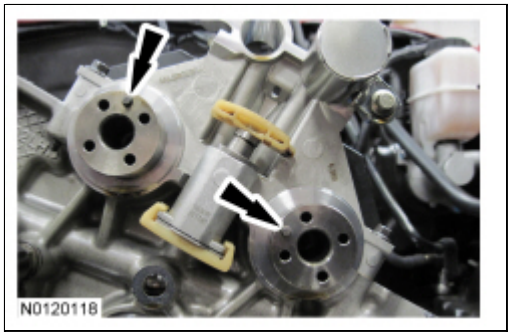
(s) of the correct size. For additional information, refer to Valve Clearance Check in this section.



61. Remove the 3 bolts and the LH valve train oil tube.

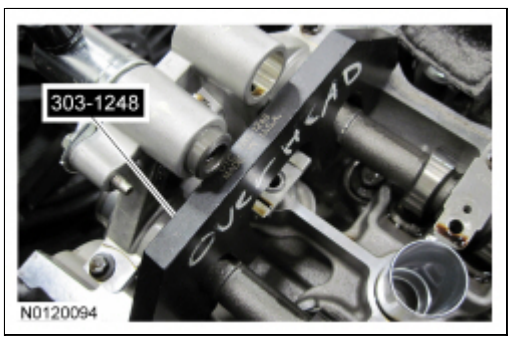


62. Rotate the LH camshafts to the TDC position as shown.



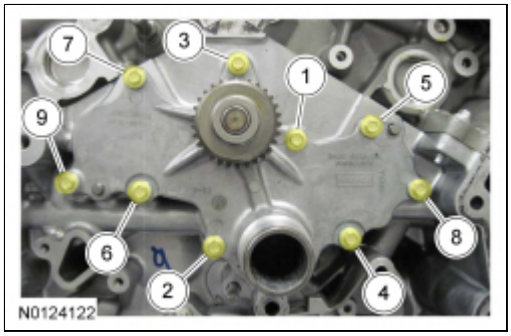
63. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the LH camshafts.



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64. Using new gaskets, install the channel cover plate and the 9 bolts. Tighten in the sequence shown in 2 stages:
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



65. Install the RH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).



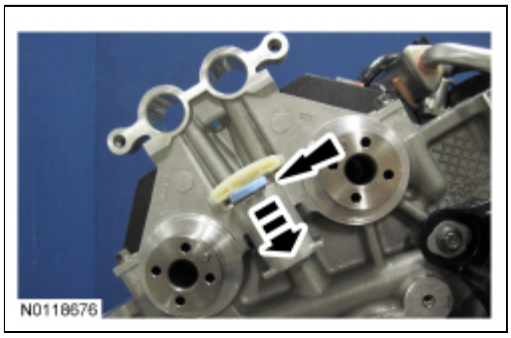
Engines with secondary timing chain tensioner removed

NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed or damage to the engine may occur.**

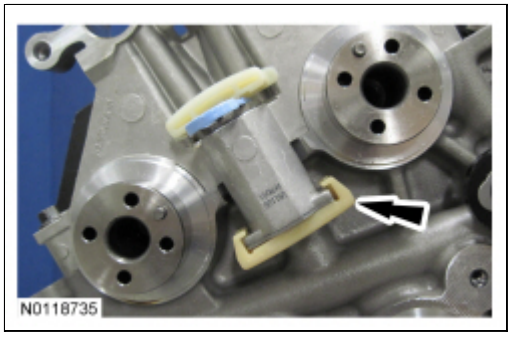
66. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

    NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

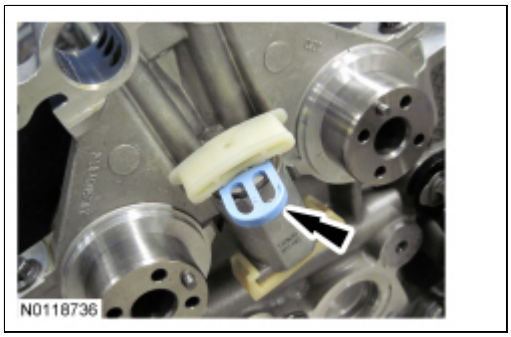
    Install the RH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



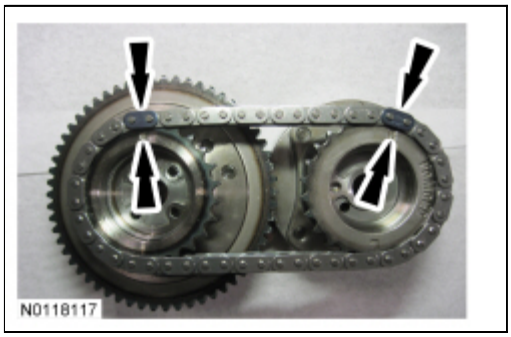
67. Install the RH secondary timing chain tensioner shoe.



68. Remove and discard the RH secondary timing chain tensioner shipping clip.



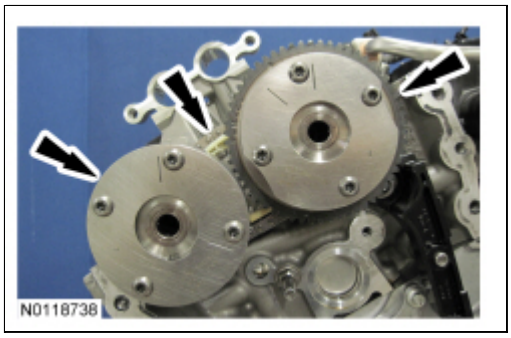
69. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.



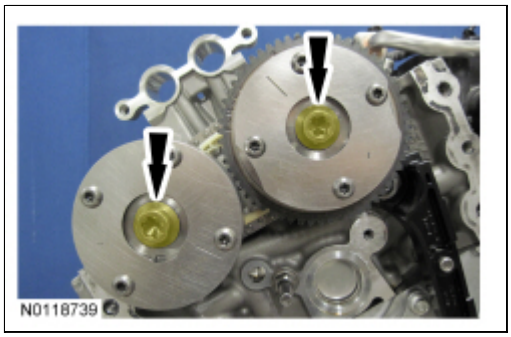
70. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

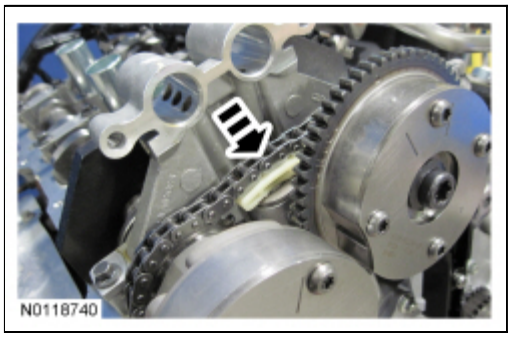
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71. Install the 2 new RH VCT bolts and tighten in 4 stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



72. Activate the RH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.

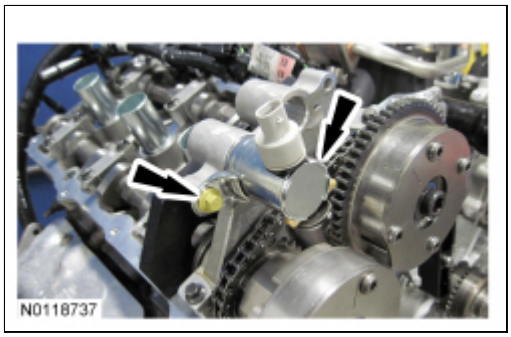


73. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

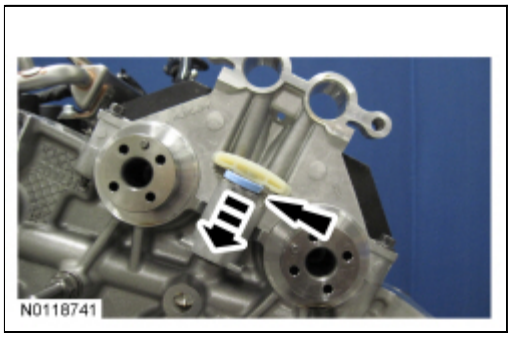
    Install the RH exhaust VCT oil control solenoid.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



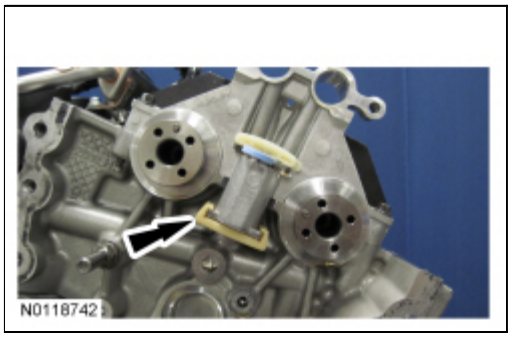
74. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

    NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

    Install the LH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.

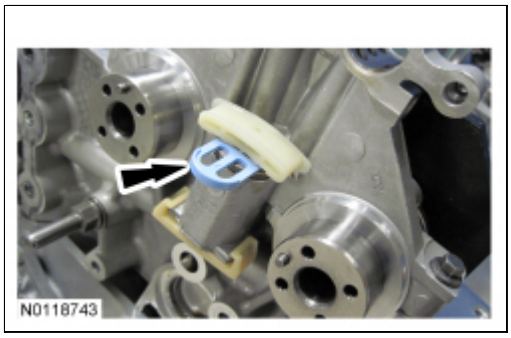


75. Install the LH secondary timing chain tensioner shoe.

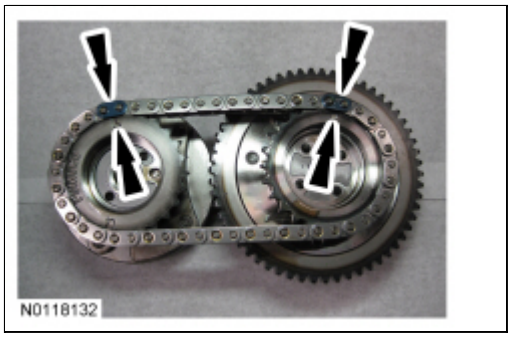


76. Remove and discard the LH secondary timing chain tensioner shipping clip.

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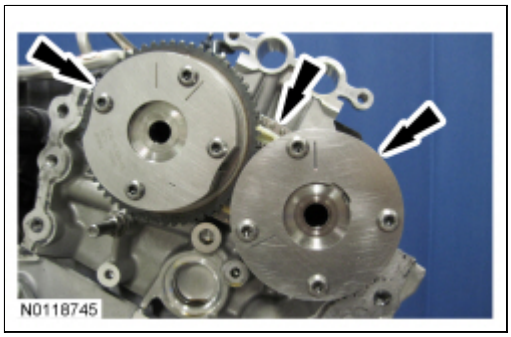


77. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

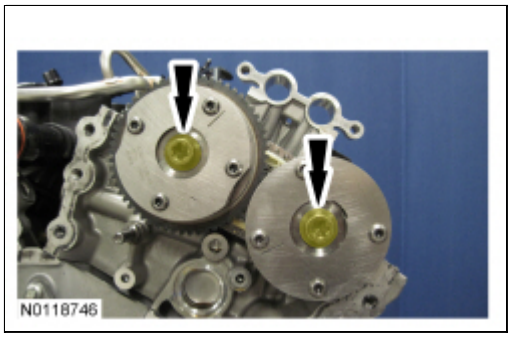


78. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

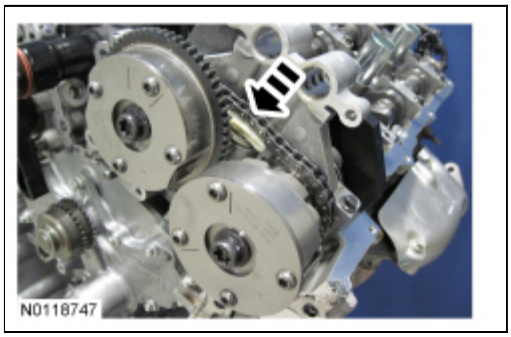
    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



79. Install the 2 new LH VCT bolts and tighten in 4 stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



80. Activate the LH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



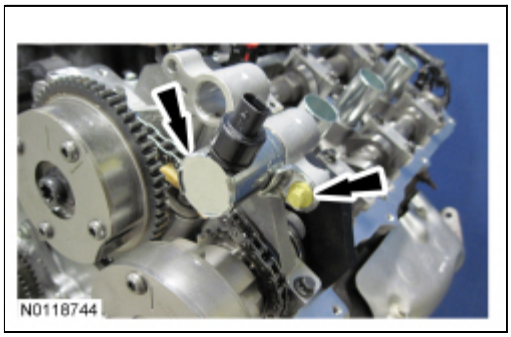
81. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH exhaust VCT oil control solenoid.

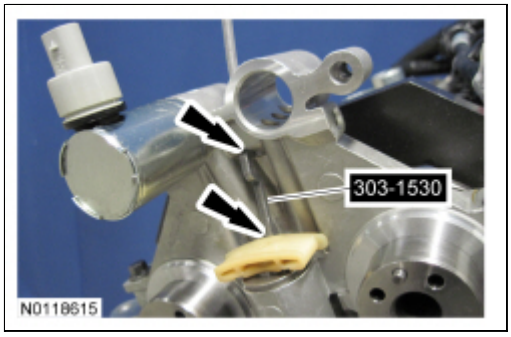
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



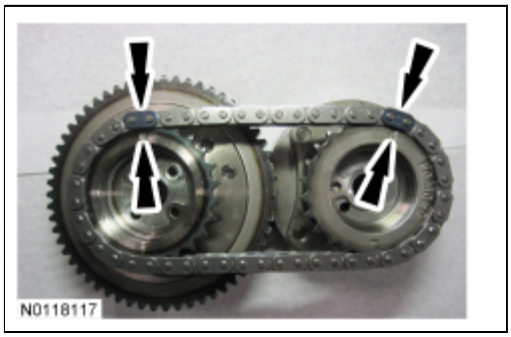
Engines with secondary timing chain tensioner not removed

82. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

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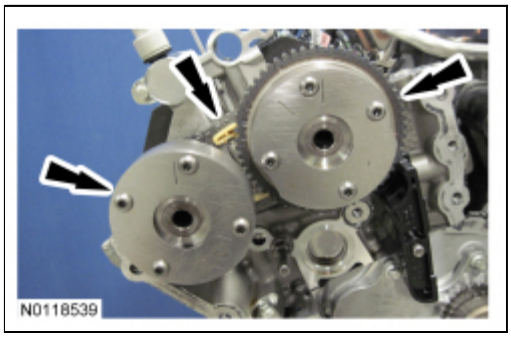


83. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

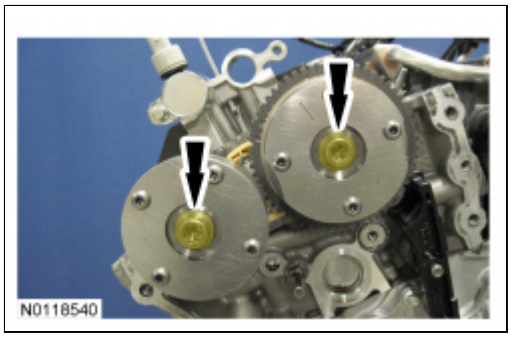


84. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

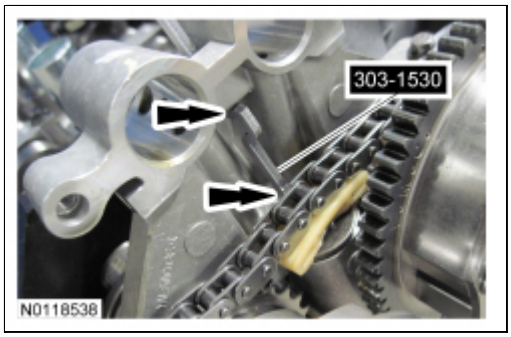


85. Install the 2 new RH VCT bolts and tighten in 4 stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

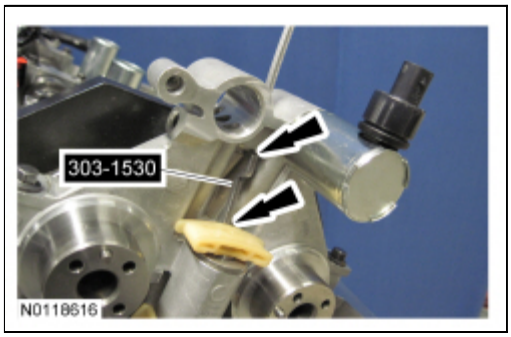


86. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

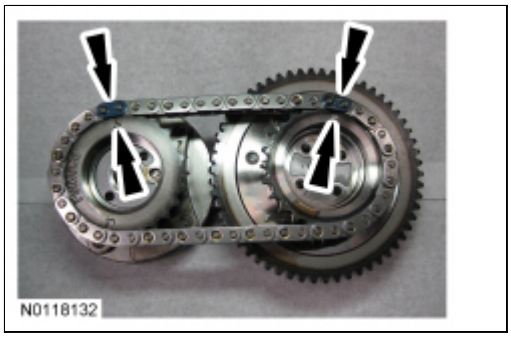


87. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.



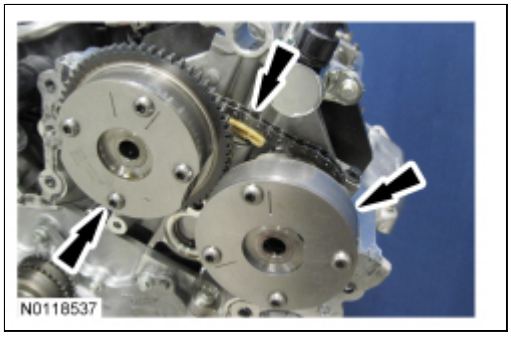
88. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

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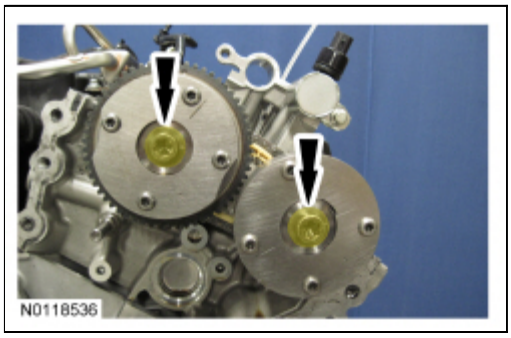


89. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

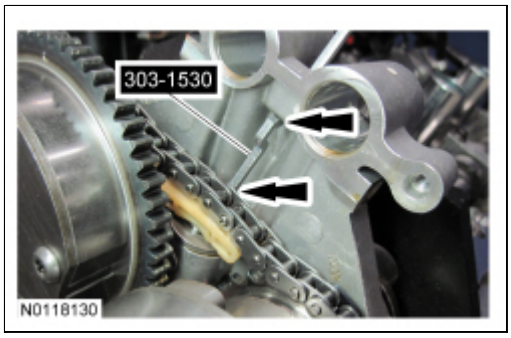


90. Install the 2 new LH VCT bolts and tighten in 4 stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



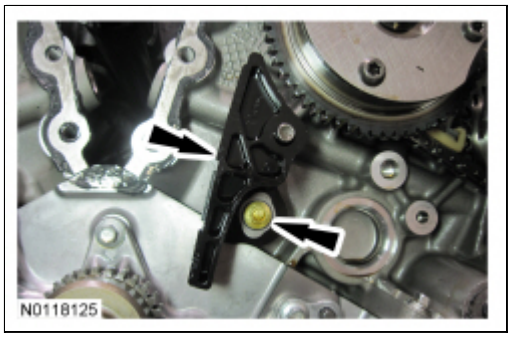
91. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

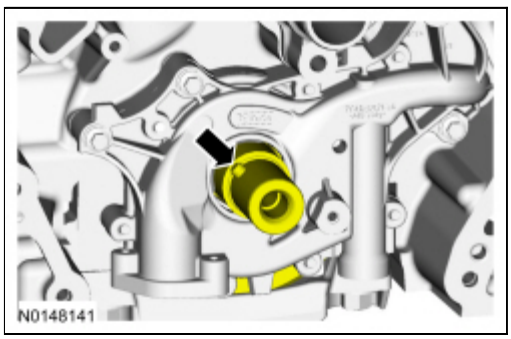


All engines

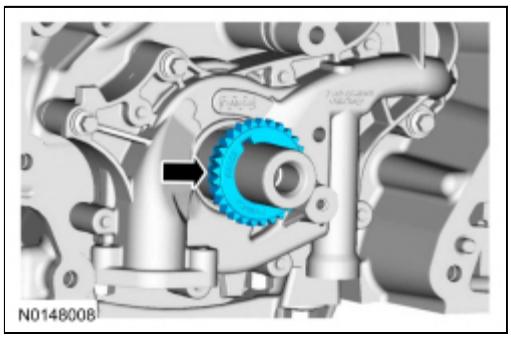
92. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).



93. Rotate the crankshaft clockwise 60 degrees to the Top Dead Center (TDC) position (crankshaft dowel pin at 11 o'clock).



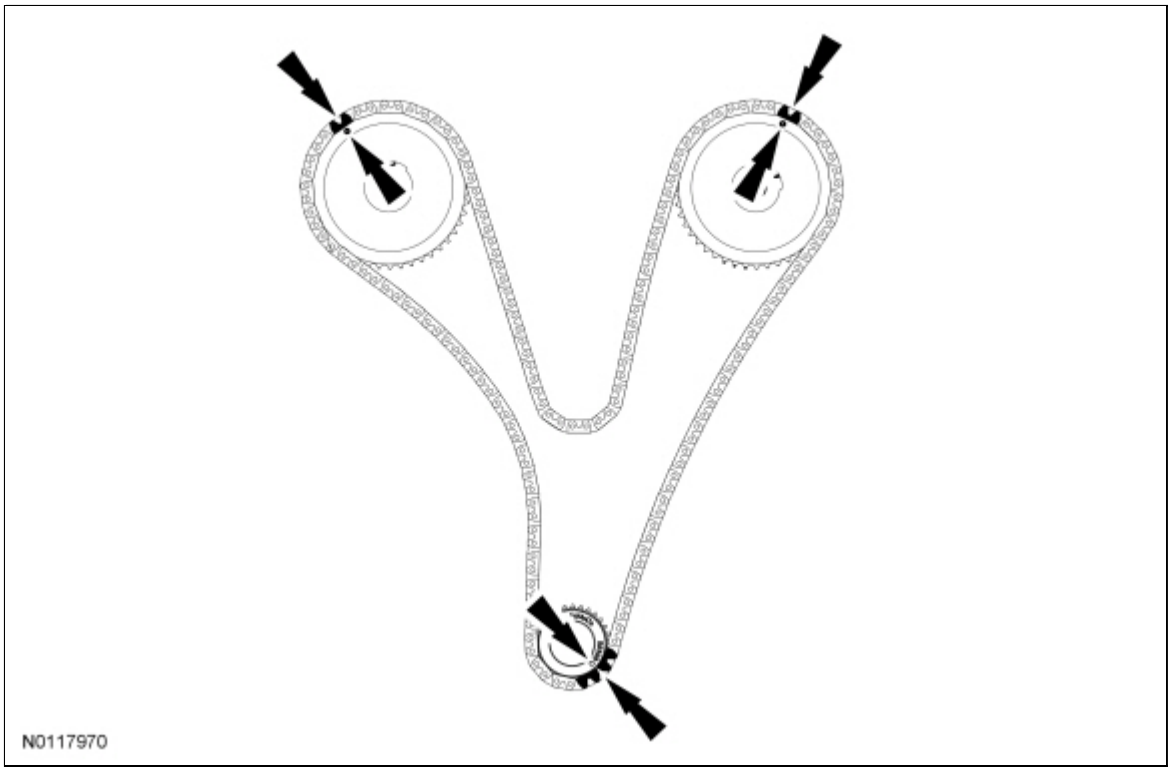
94. Install the crankshaft timing chain sprocket with timing dot mark out.



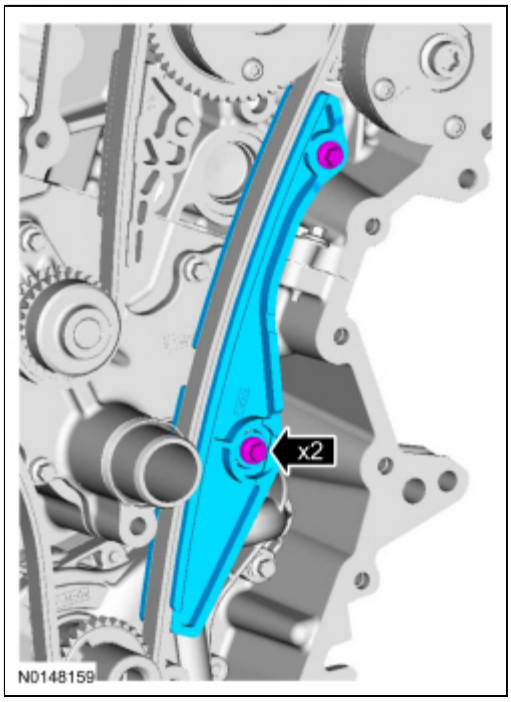
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95. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

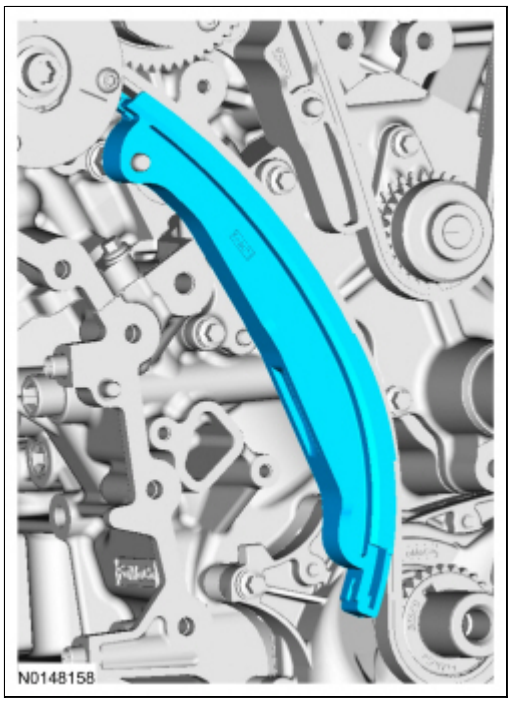
Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



96. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



97. Install the primary timing chain tensioner arm.



98. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.



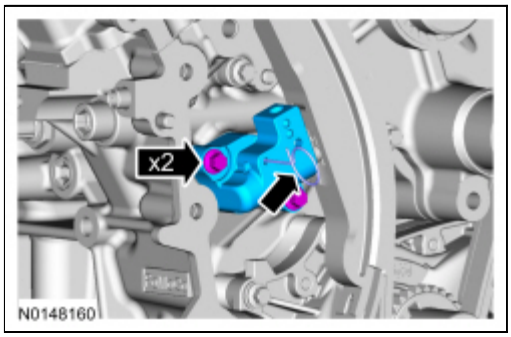
99. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to

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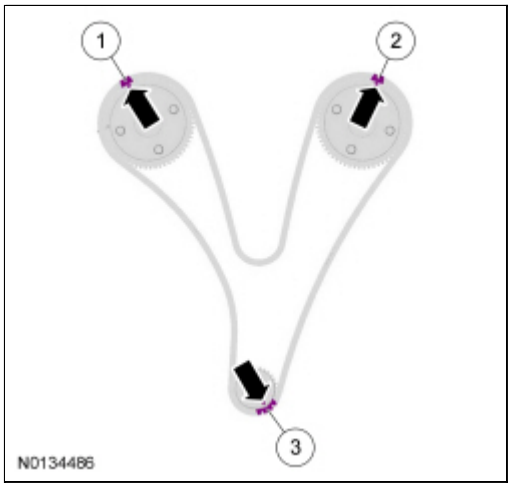
install the tensioner.

Install the primary tensioner and the 2 bolts.

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



100. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



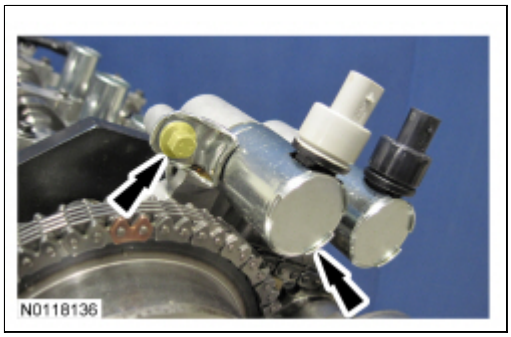
101. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



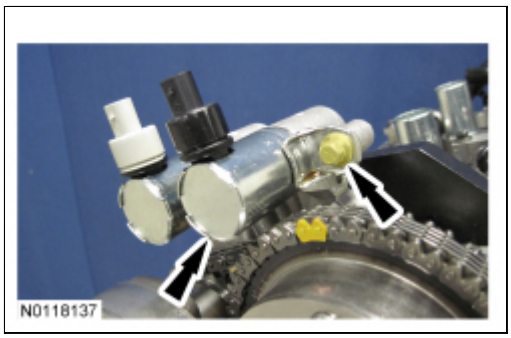
102. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

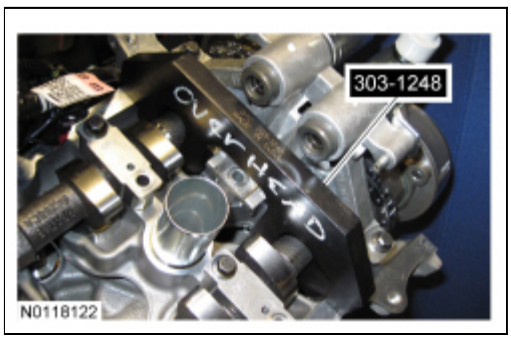
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



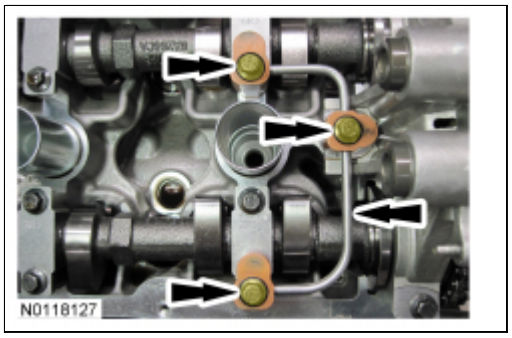
103. Remove the RH Camshaft Holding Tool.



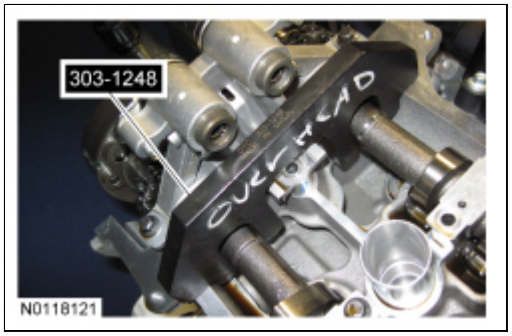
104. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages:

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.

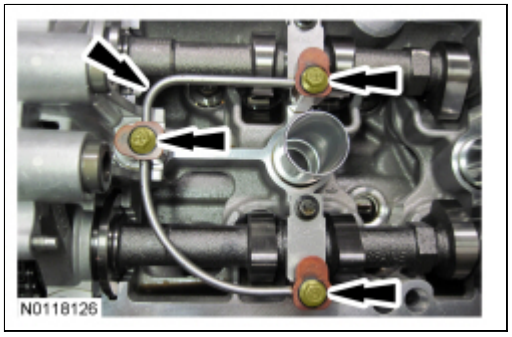
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105. Remove the LH Camshaft Holding Tool.

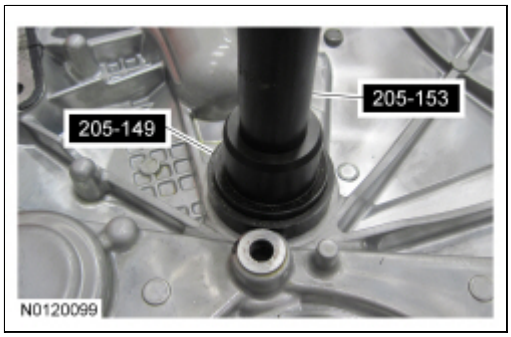


106. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages:
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



107. **NOTE:** Use Spindle Bearing Installer 205-149 to install the seal.

    If removed, using the Spindle Bearing Installer, install the front cover radial seal from the rear side of the front cover.



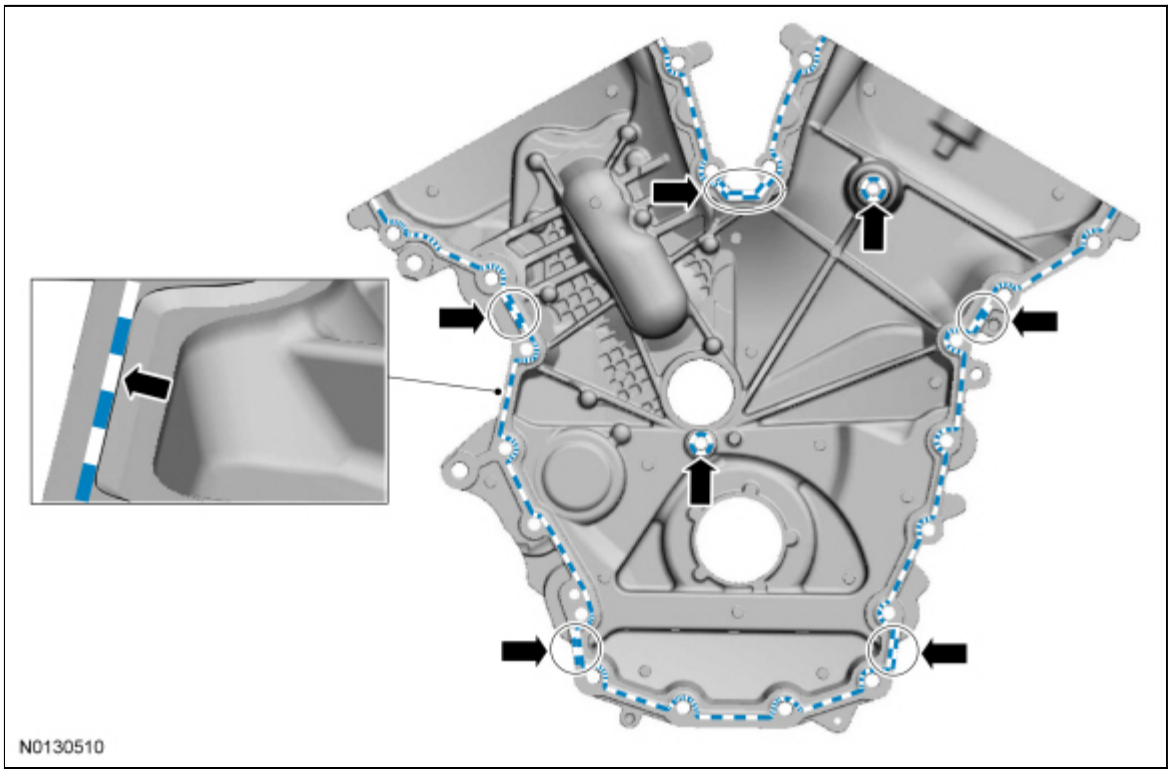
108. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

NOTICE: **Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow these instructions may cause engine oil leakage.**

NOTE: The engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 must be installed within 10 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the engine front cover to the engine front cover sealing surfaces including the 2 engine front cover bolt bosses.

- Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.

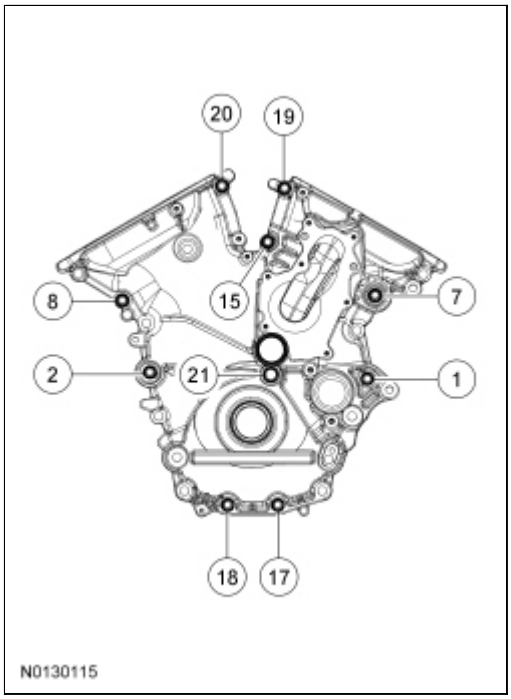


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109. **NOTE:** Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

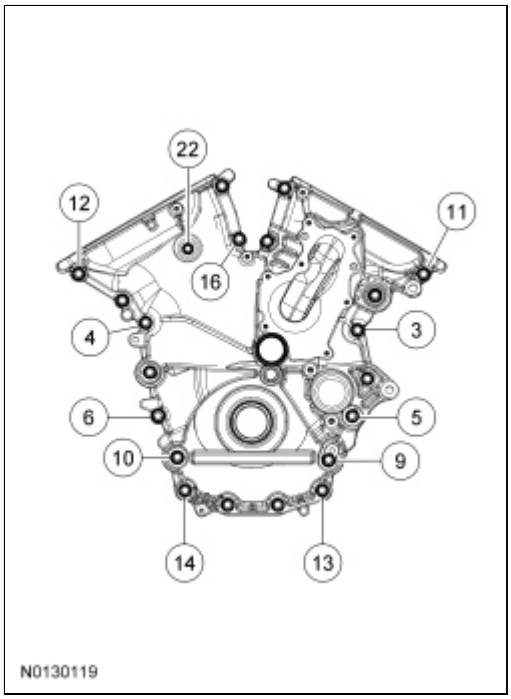
Install the engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 and tighten sequence shown in 3 stages:

- Stage 1: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 in sequence to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19 and 20 in sequence to 20 Nm (177 lb-in) then an additional 45 degrees.
- Stage 3: Tighten bolt 21 to 20 Nm (177 lb-in) then an additional 90 degrees.

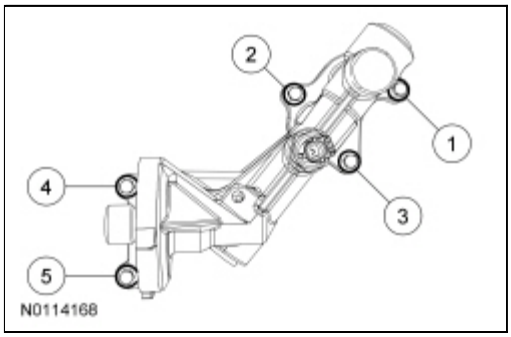


110. Install the remaining 12 engine front cover bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16 and 22. Tighten all of the engine front cover bolts in the sequence shown in 3 stages:

- Stage 1: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14 and 16 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14 and 16 to 20 Nm (177 lb-in) then an additional 45 degrees.
- Stage 3: Tighten bolt 22 to 10 Nm (89 lb-in) then an additional 45 degrees.



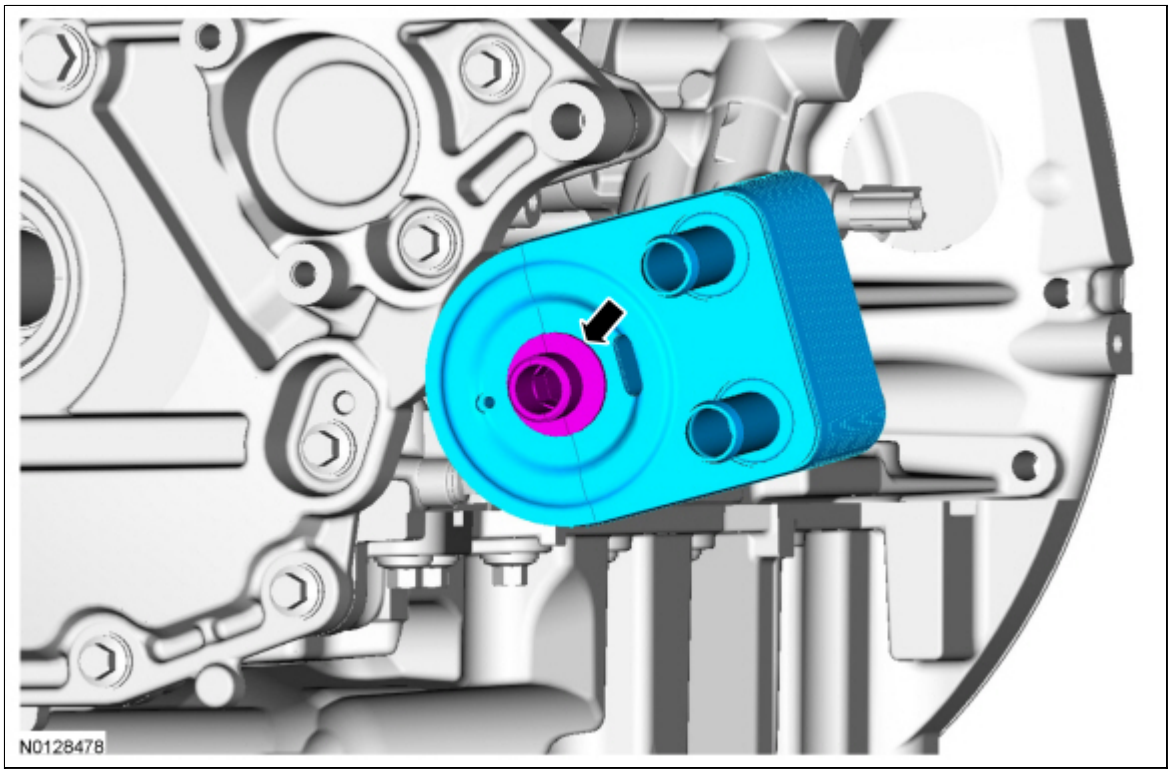
111. Using a new gasket, install the oil filter adapter and the 5 bolts and tighten in sequence shown.
    - Tighten to 10 Nm (89 lb-in) and then an additional 45 degrees.



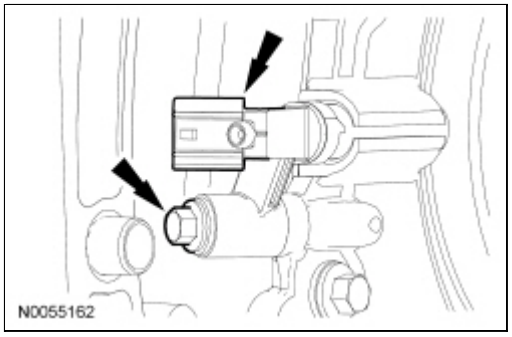
112. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

    If equipped, install the new oil cooler and the mounting bolt.
    - Tighten to 58 Nm (43 lb-ft).

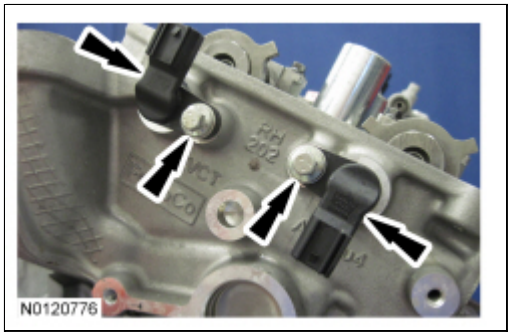
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113. Install the Crankshaft Position (CKP) sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).

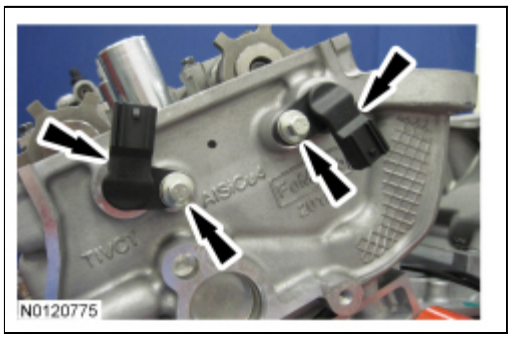


114. Install the 2 RH Camshaft Position (CMP) sensors and the bolts.
    - Tighten to 10 Nm (89 lb-in).

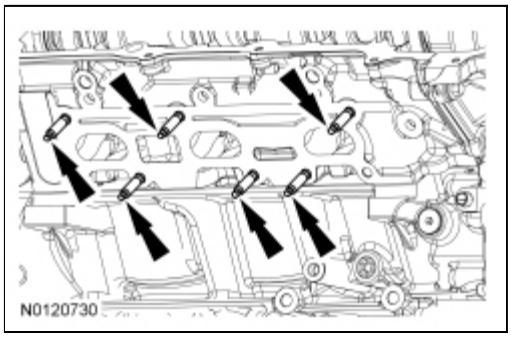


115. Install the 2 LH CMP sensors and the bolts.

- Tighten to 10 Nm (89 lb-in).

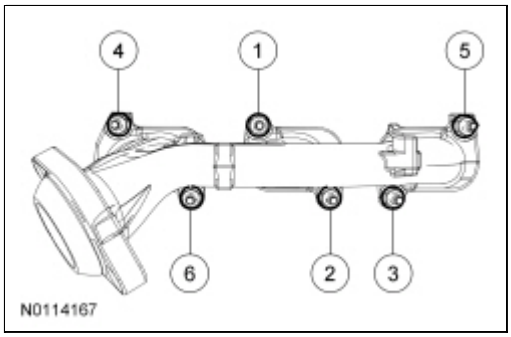


116. Install 6 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).



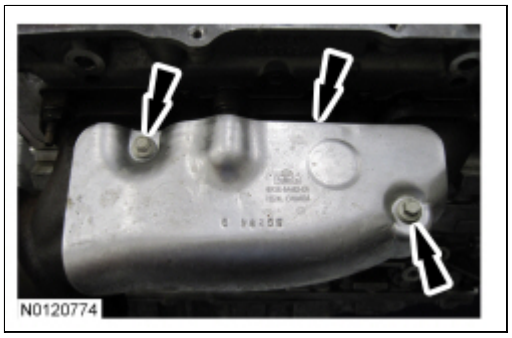
117. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:
    - Stage 1: Tighten to 19 Nm (168 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



118. Install the RH exhaust manifold heat shield and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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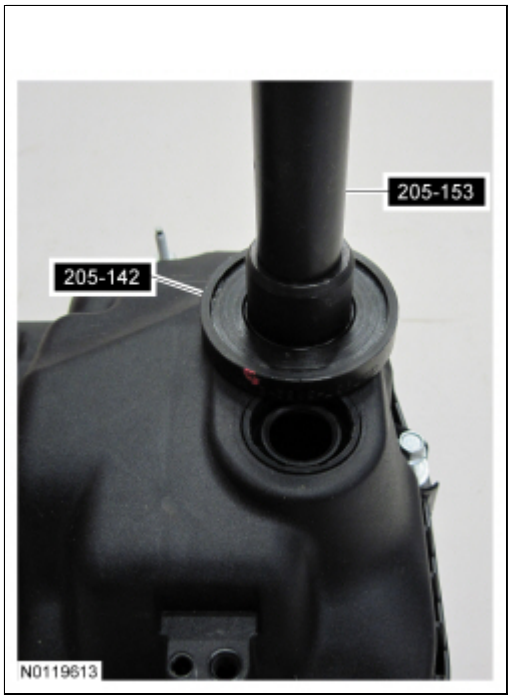
119. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



120. **NOTE:** Installation of new seals is only required if damaged seals were removed.

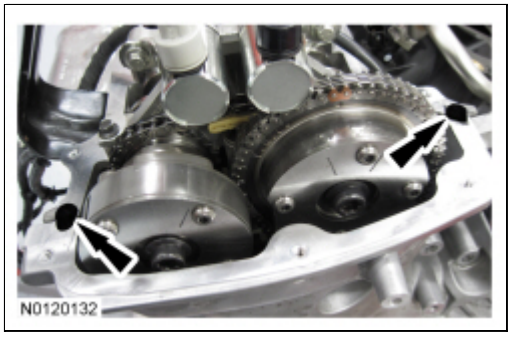
Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



121. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

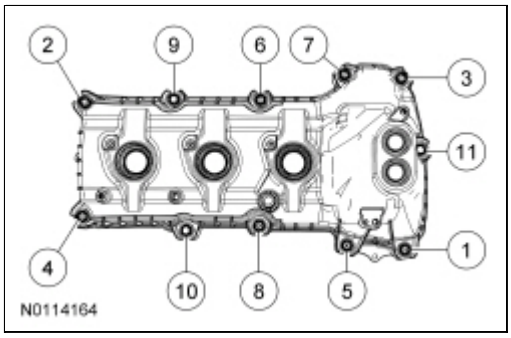
NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.

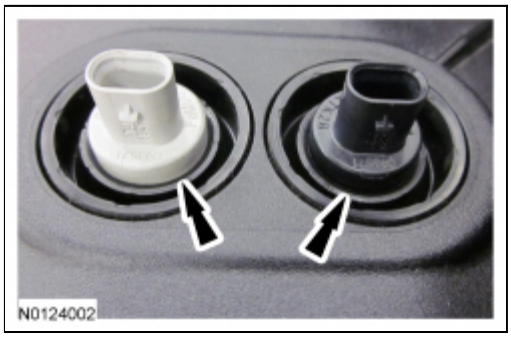


122. Using a new gasket, install the RH valve cover and tighten the 3 bolts and 8 stud bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).

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123. Ensure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.

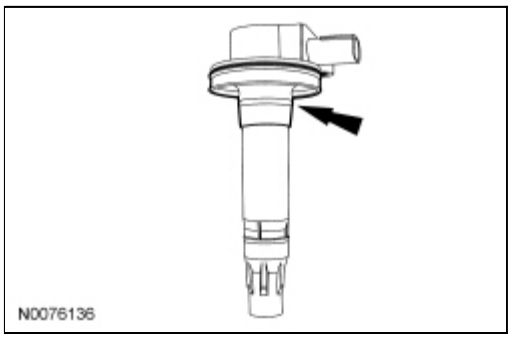


124. ***NOTICE:*** **Only use hand tools when installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

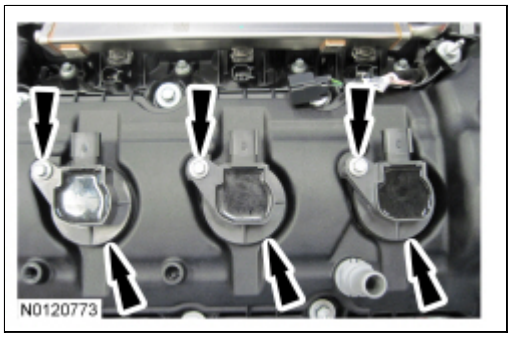
Install the 3 RH spark plugs.

- Tighten to 15 Nm (133 lb-in).

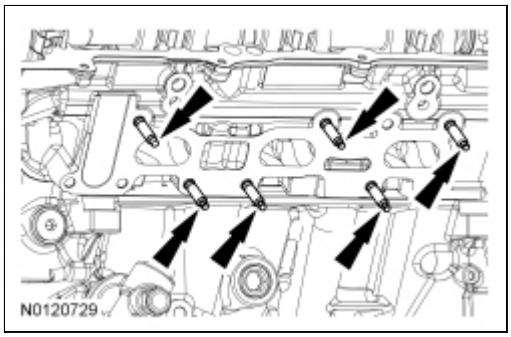
125. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
    - To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.



126. Install the 3 RH ignition coil-on-plug assemblies and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in).

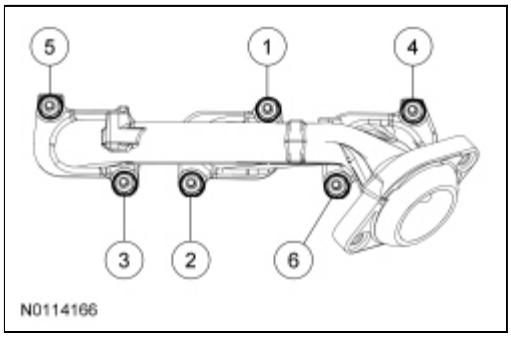


127. Install 6 new LH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).



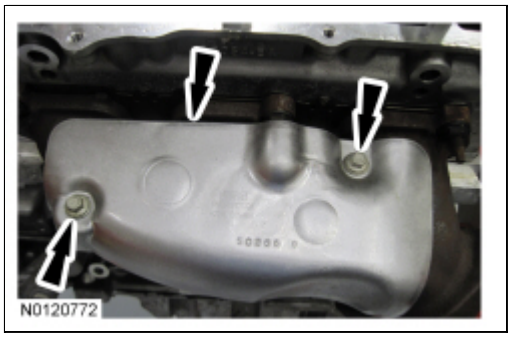
128. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the LH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:
    - Stage 1: Tighten to 19 Nm (168 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



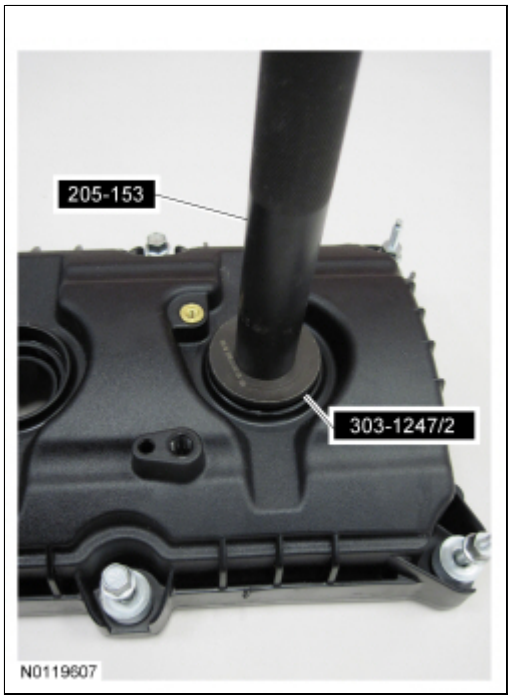
129. Install the LH exhaust manifold heat shield and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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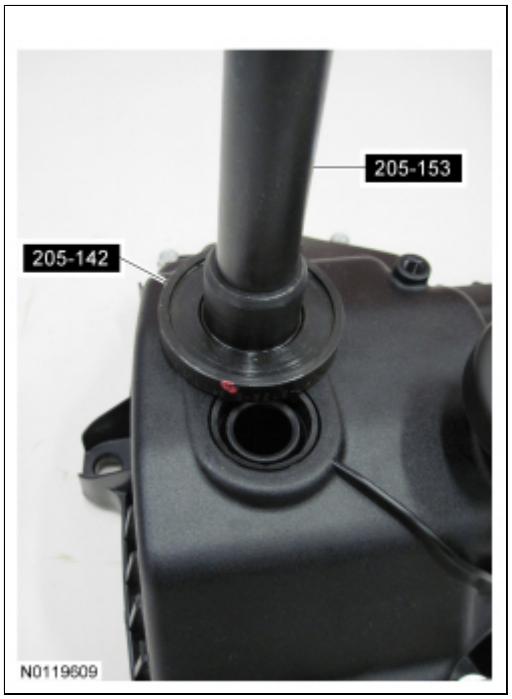
130. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



131. **NOTE:** Installation of new seals is only required if damaged seals were removed.

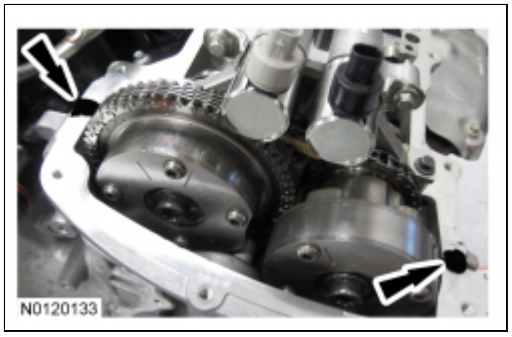
Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



132. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

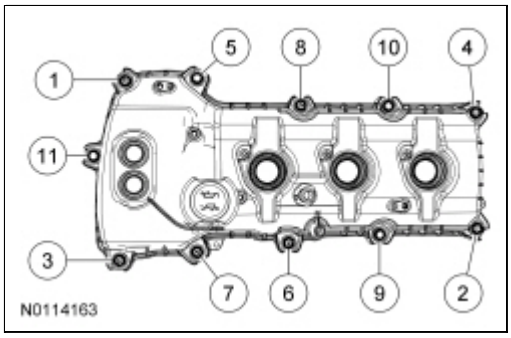
NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.

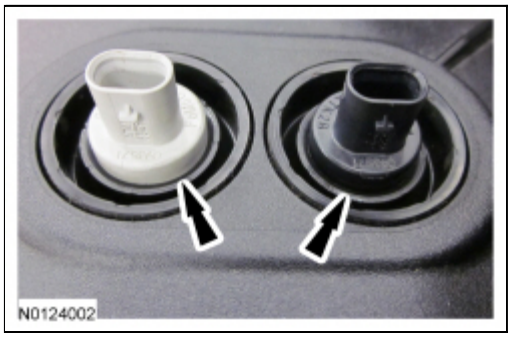


133. Using a new gasket, install the LH valve cover and tighten the 4 bolts and 7 stud bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).

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134. Ensure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.

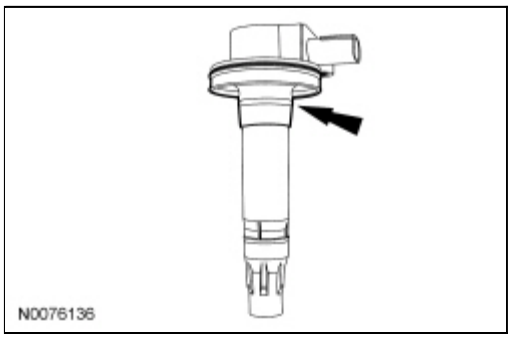


135. ***NOTICE:*** **Only use hand tools when installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

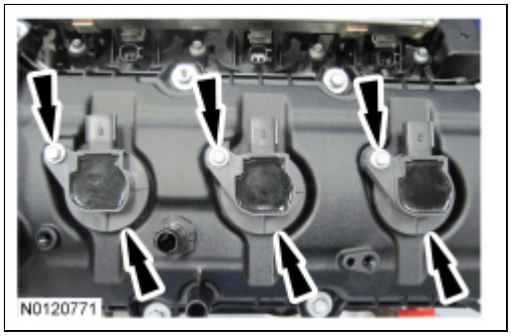
Install the 3 LH spark plugs.

- Tighten to 15 Nm (133 lb-in).

136. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
    - To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.



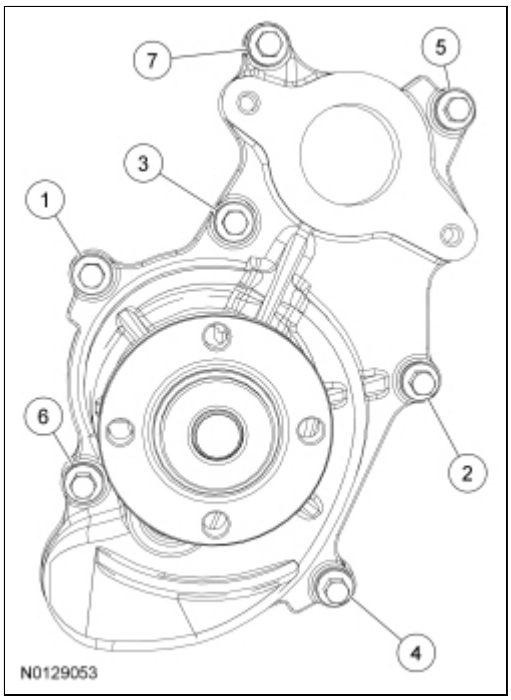
137. Install the 3 LH ignition coil-on-plug assemblies and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in).



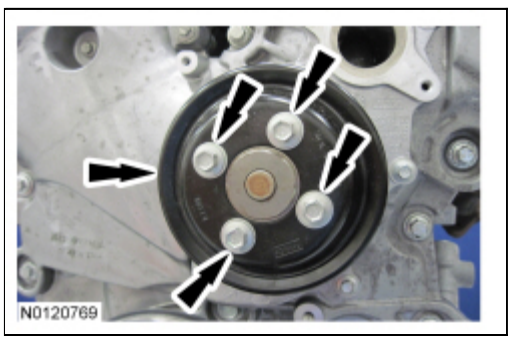
138. **NOTE:** Lubricate the O-ring seal with clean engine coolant.

Using new coolant pump gasket and coolant pump O-ring seal, install the coolant pump and the 7 bolts and tighten in the sequence shown in 2 stages:

- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.



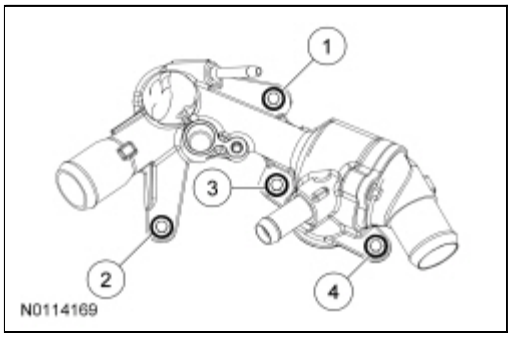
139. Install the coolant pump pulley and the 4 bolts.
    - Tighten to 24 Nm (18 lb-ft).



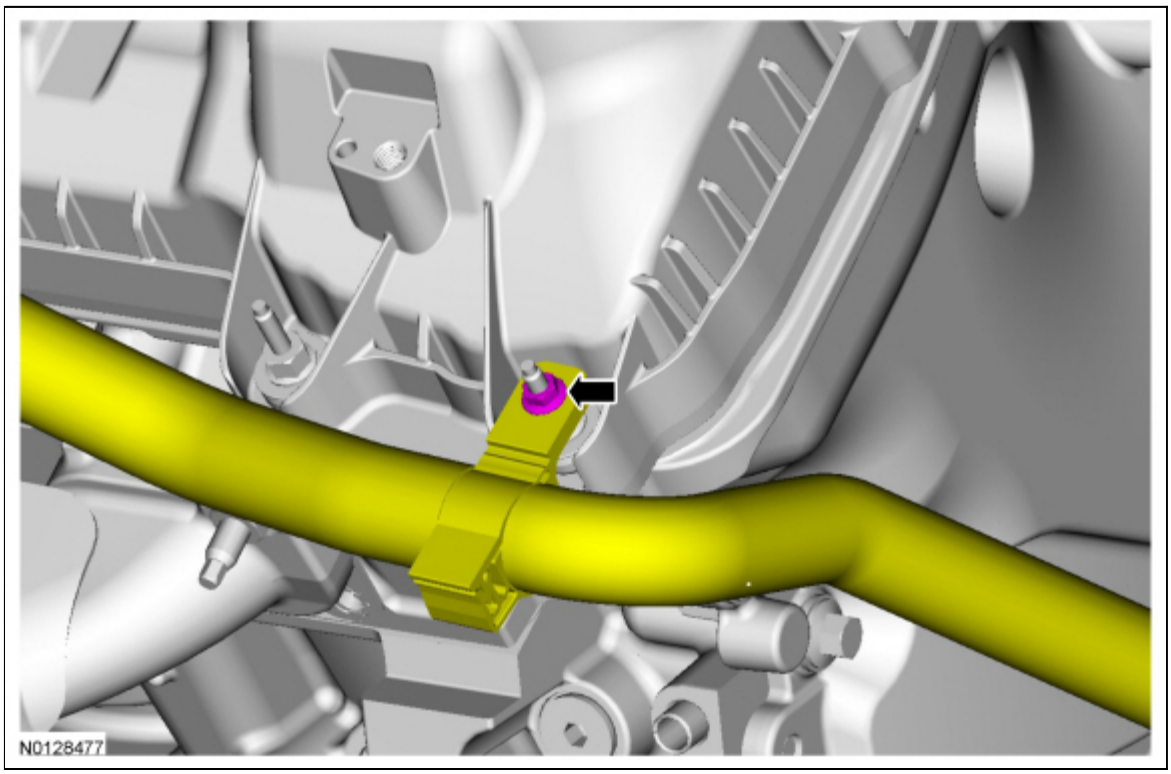
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140. **NOTE:** Lubricate the coolant inlet tube O-ring seal with clean engine coolant.

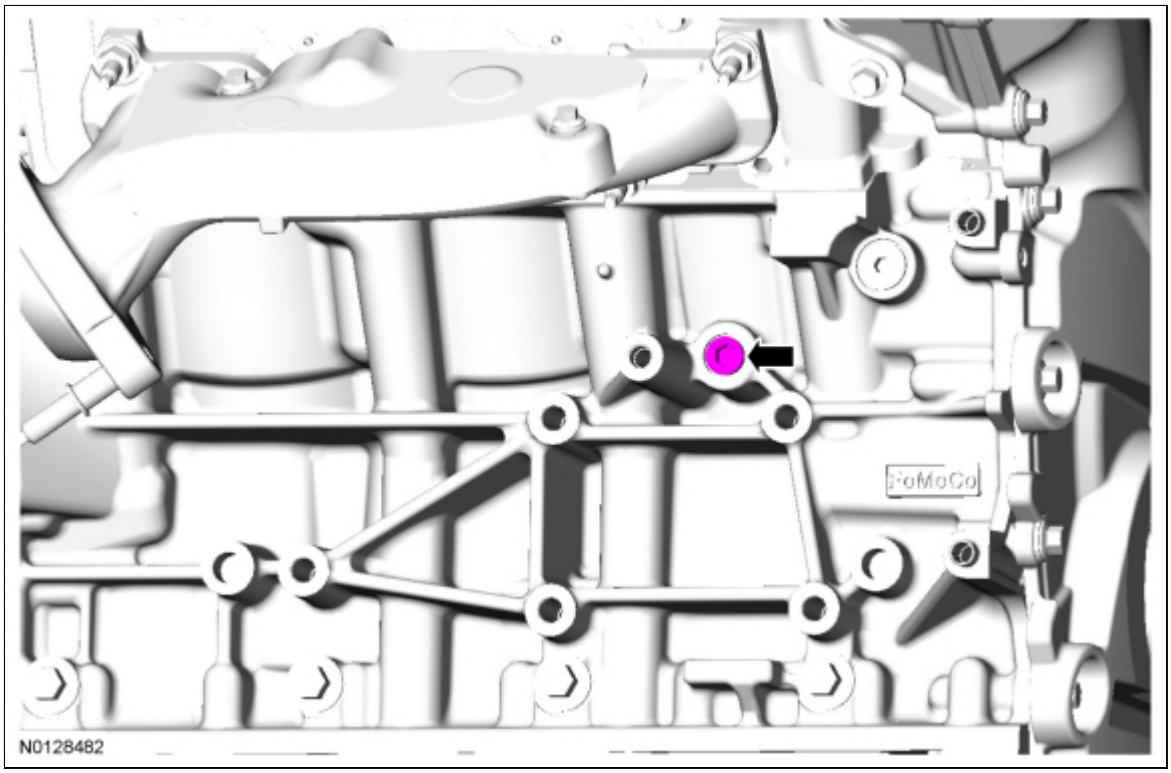
Install the thermostat housing and the 4 bolts and tighten in the sequence shown in 2 stages:
- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



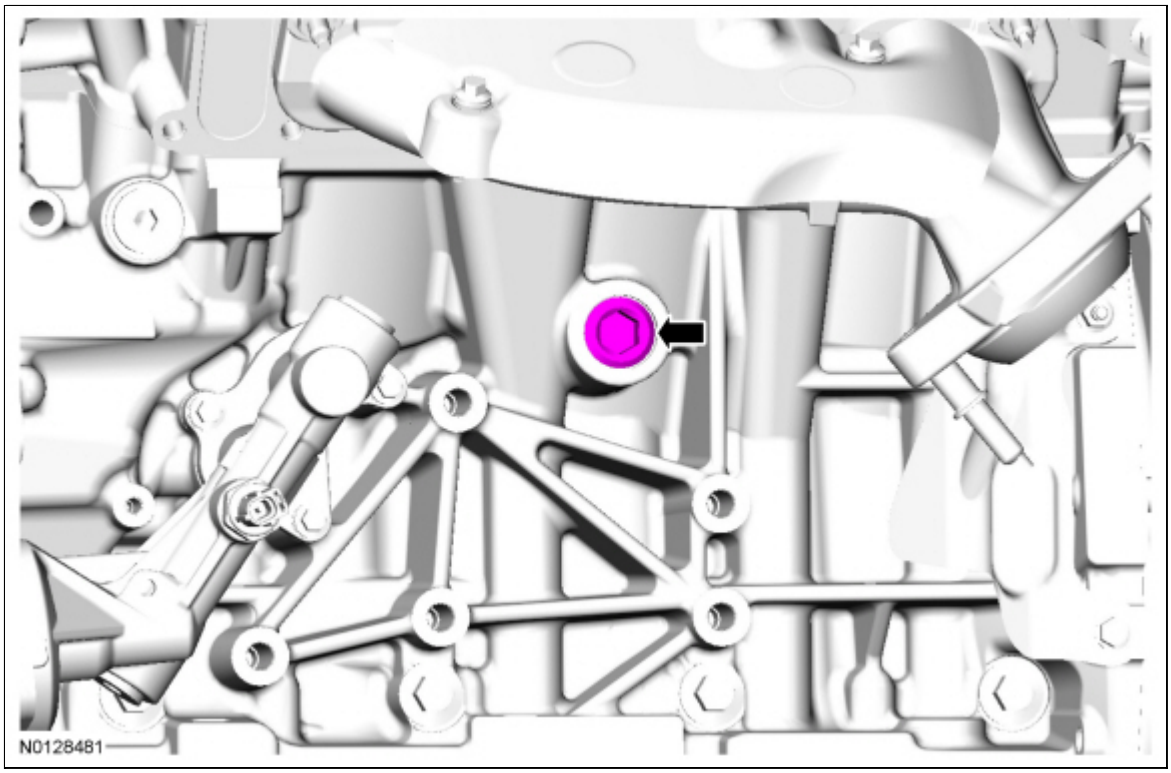
141. Install the heater hose bracket on the valve cover stud bolt and install the nut.
- Tighten to 8 Nm (71 lb-in).



142. Install the RH cylinder block drain plug.
- Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.

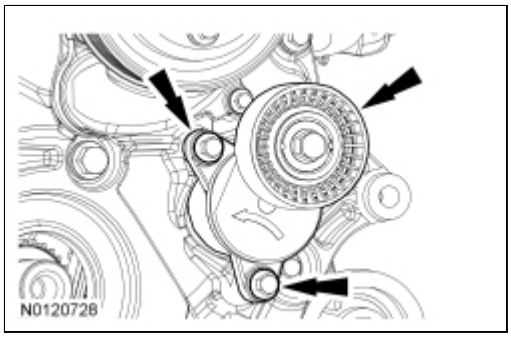


143. Install the LH cylinder block drain plug.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.



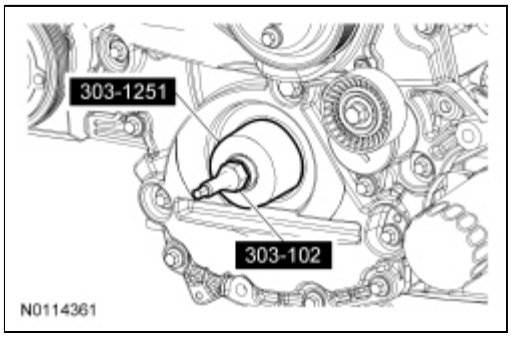
144. Install the accessory drive belt tensioner and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

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145. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

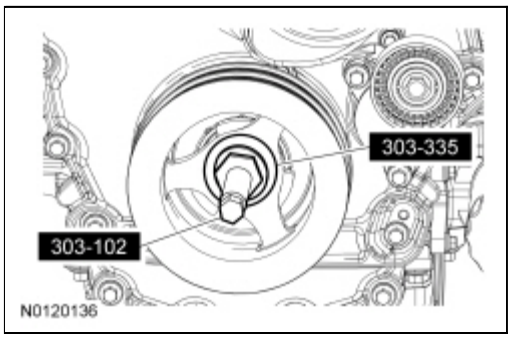
    Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.



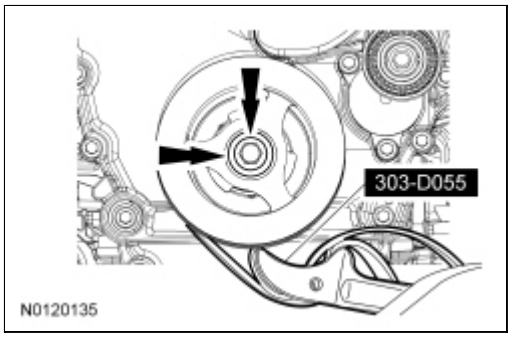
146. Lubricate the crankshaft front seal inner lip with clean engine oil.

147. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

    Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Replacer, install the crankshaft pulley.

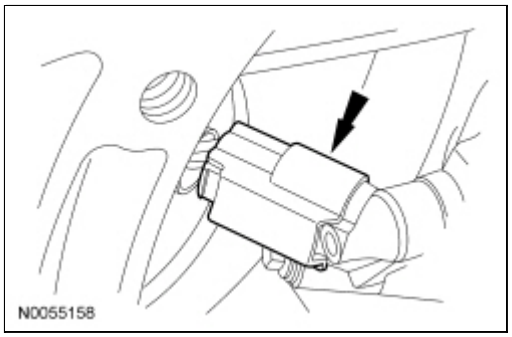


148. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages:
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

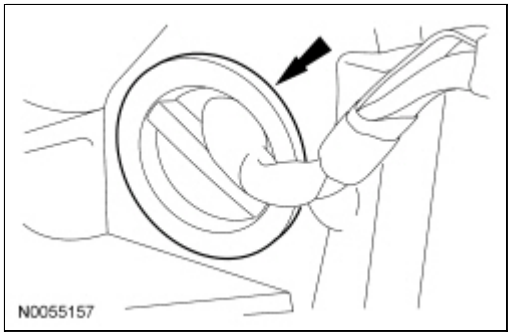


149. Attach all of the wiring harness retainers to the LH cylinder head, valve cover and stud bolts.

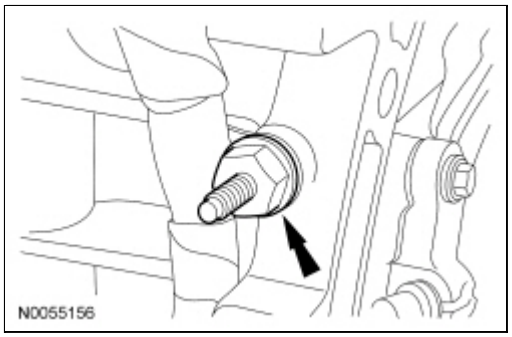
150. Connect the CKP sensor electrical connector.



151. Install the wiring harness grommet.

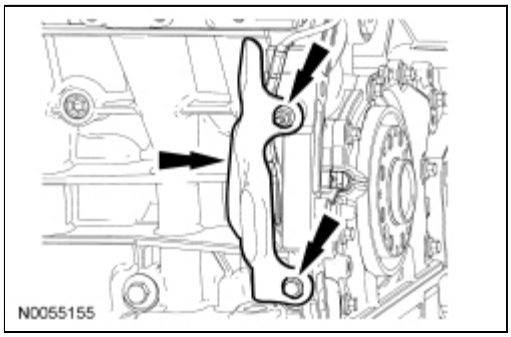


152. Install the wiring harness retainer stud bolt.
    - Tighten to 10 Nm (89 lb-in).

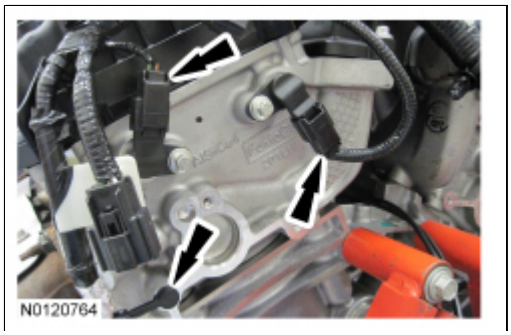


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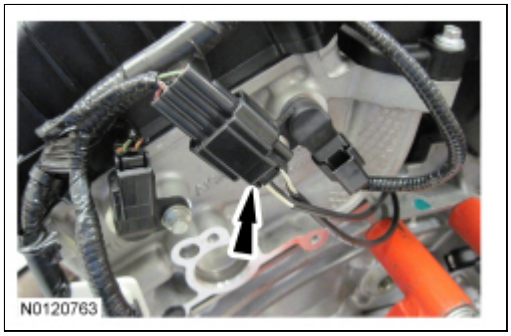
153. Install the heat shield, the nut and the bolt.
    - Tighten to 10 Nm (89 lb-in).



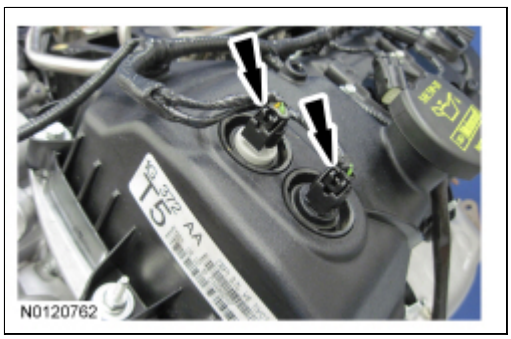
154. Connect the 2 LH CMP sensors electrical connectors.
    - Attach the wiring harness retainer to the rear of the cylinder head.



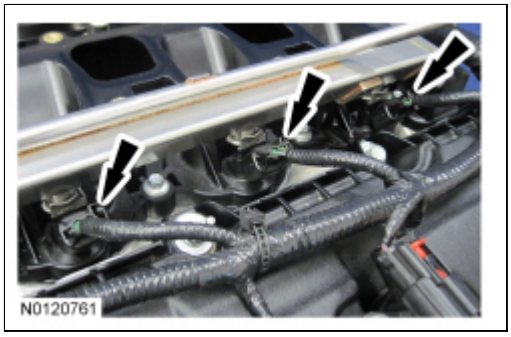
155. Connect the KS electrical connector.



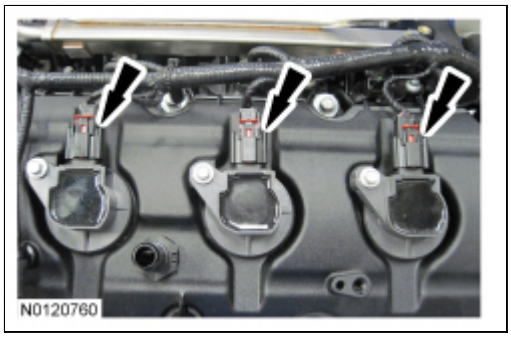
156. Connect the 2 LH VCT solenoid electrical connectors.



157. Connect the 3 LH fuel rail electrical connectors.



158. Connect the 3 LH ignition coil-on-plug electrical connectors.



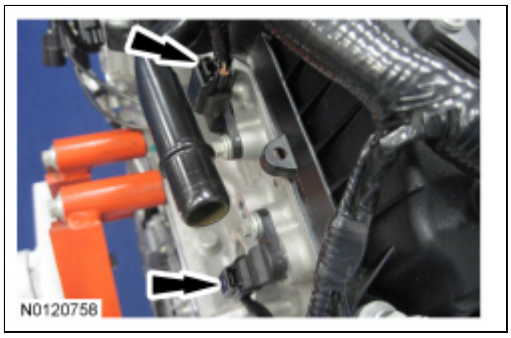
159. Connect the Engine Oil Pressure (EOP) switch electrical connector.
    - Attach the EOP switch wiring harness retainer to the cylinder head.



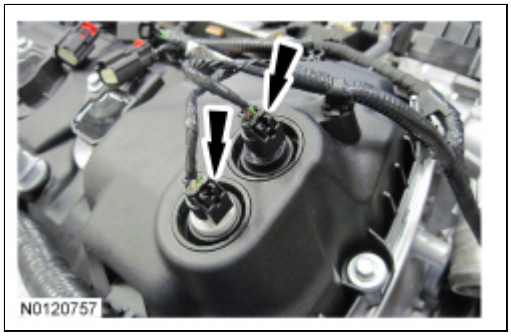
160. Attach all of the wiring harness retainers to the RH cylinder head, valve cover and stud bolts.

161. Connect the 2 RH CMP sensors electrical connectors.

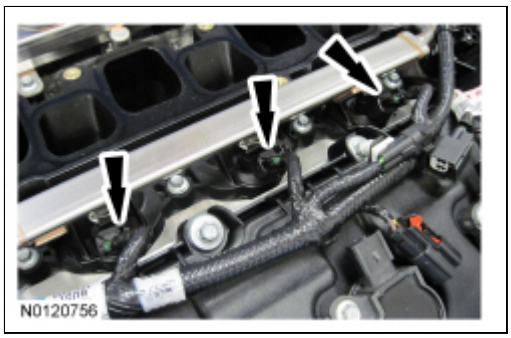
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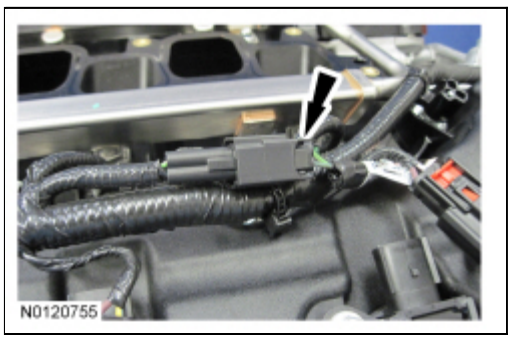
162. Connect the 2 RH VCT solenoid electrical connectors.



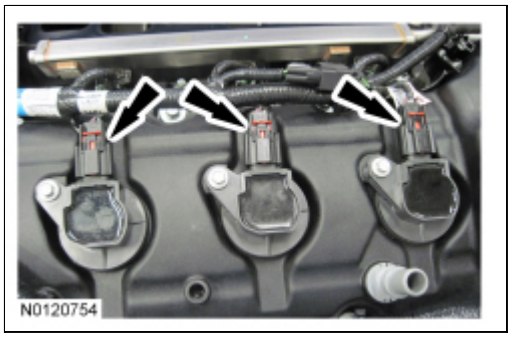
163. Connect the 3 RH fuel rail electrical connectors.



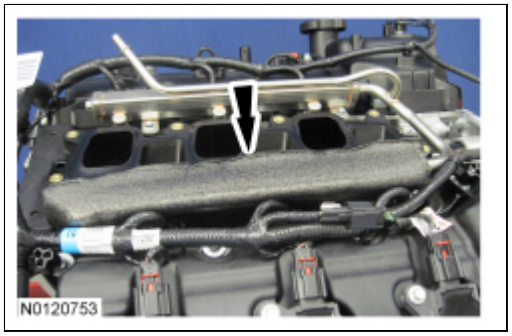
164. Connect the CHT sensor wiring harness jumper electrical connector.



165. Connect the 3 RH ignition coil-on-plug electrical connectors.



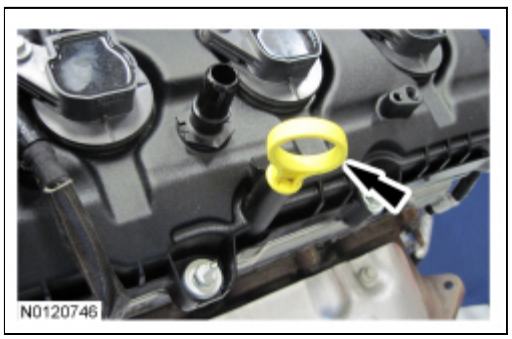
166. Install the RH fuel rail insulator.



167. Install the LH fuel rail insulator.

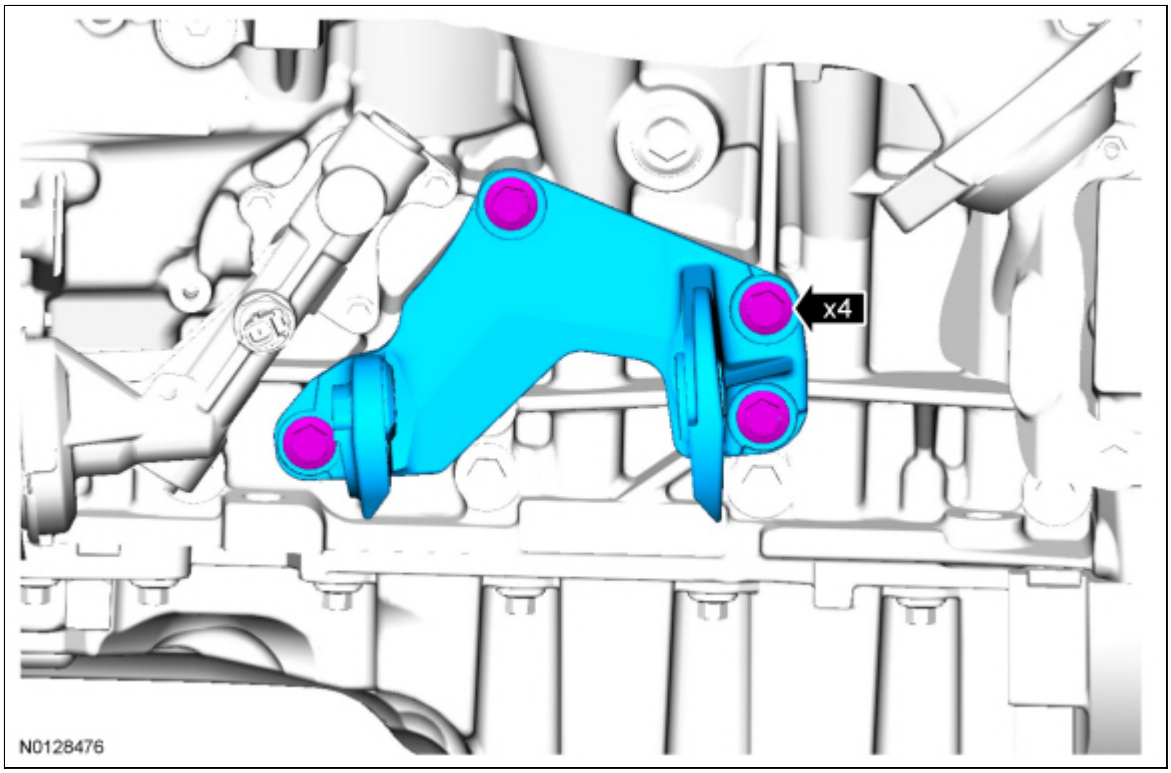


168. Install the engine oil level indicator.

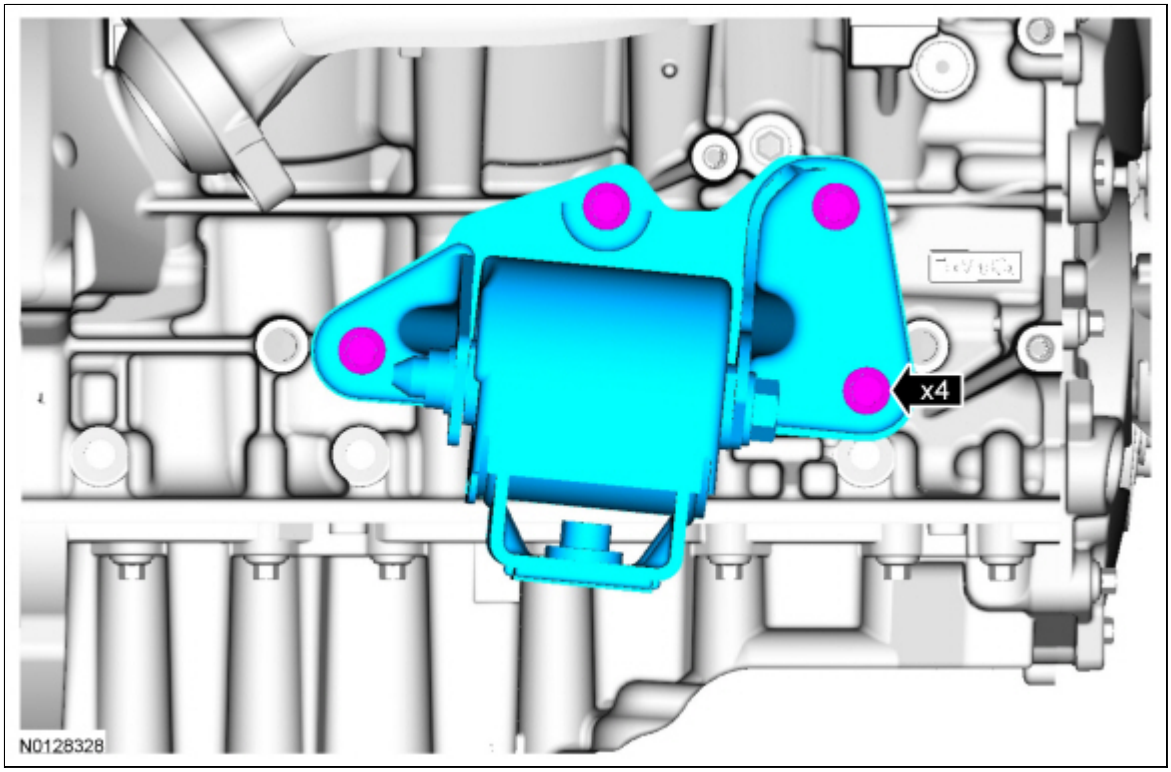


169. Install the LH engine support insulator-to-cylinder block bracket and the 4 bolts.
    - Tighten to 63 Nm (46 lb-ft).

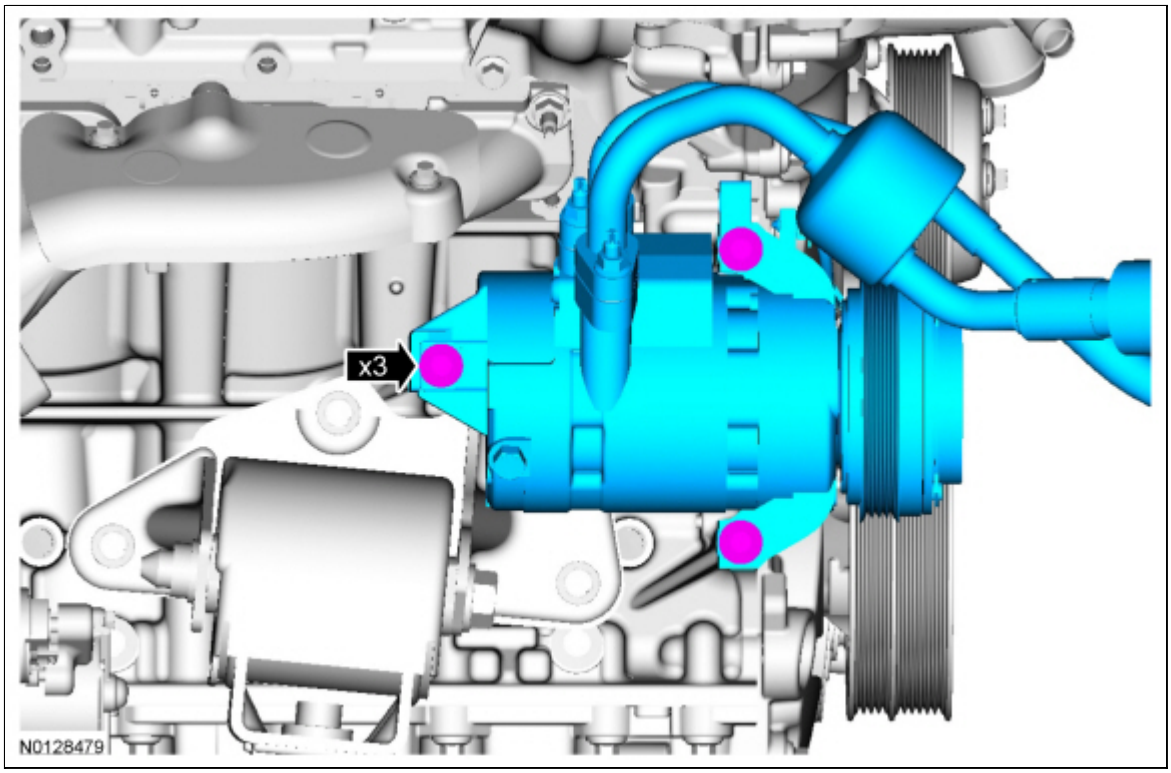
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170. Install the RH engine support insulator and the 4 bolts.
    - Tighten to 63 Nm (46 lb-ft).

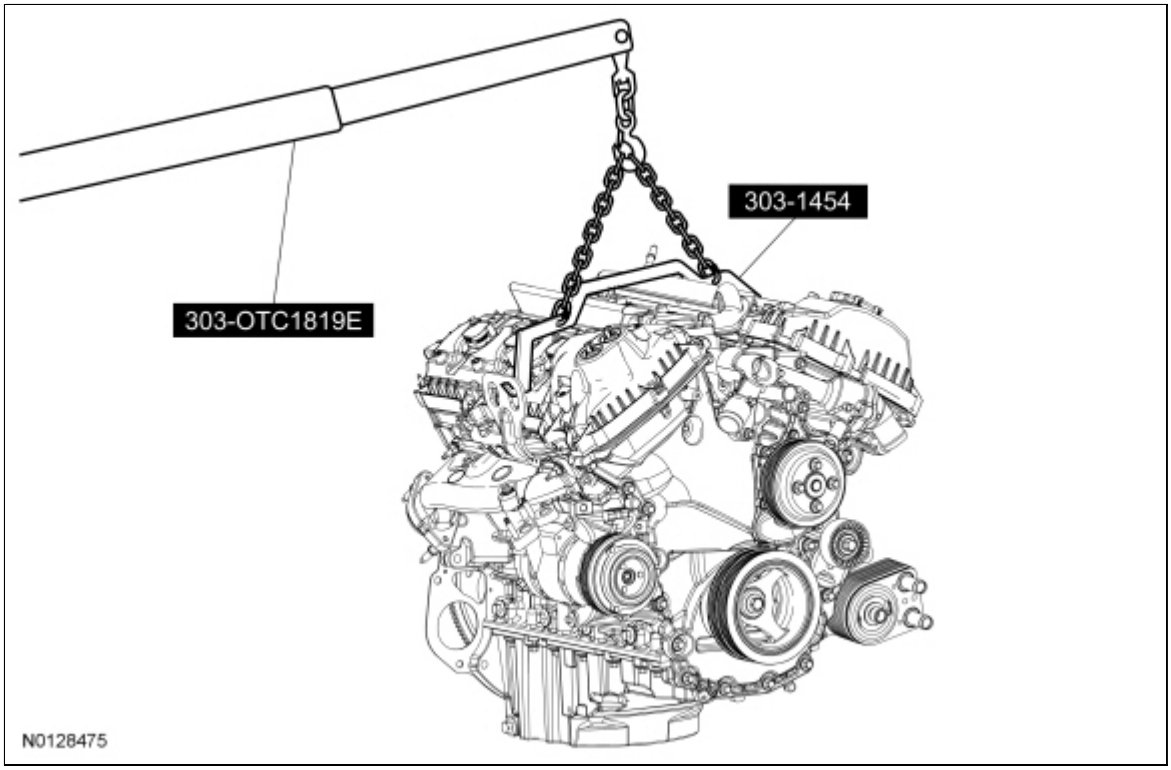


171. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



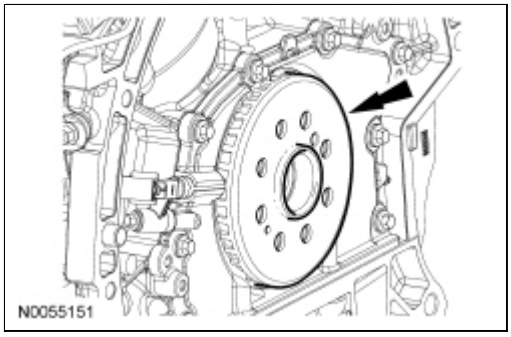
172. Install the LH and RH engine lift eyes.
    - Tighten to 25 Nm (18 lb-ft).

173. Using the Heavy Duty Floor Crane and Spreader Bar, remove the engine from the stand.

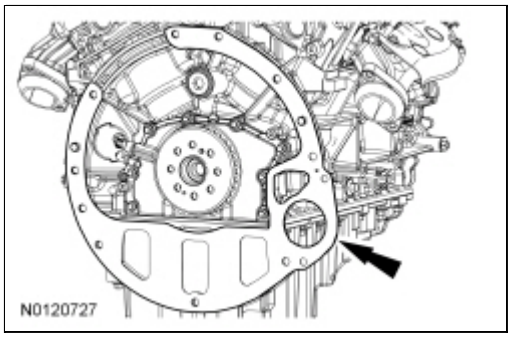


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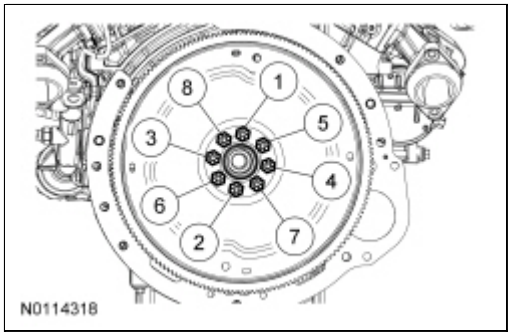
174. Install the crankshaft sensor ring.



175. Install the spacer plate.



176. Install the flexplate and the 8 bolts and tighten is sequence shown.
    - Tighten to 80 Nm (59 lb-ft).



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Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST3101-A	Bar, Engine Spreader 303-1454
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073)

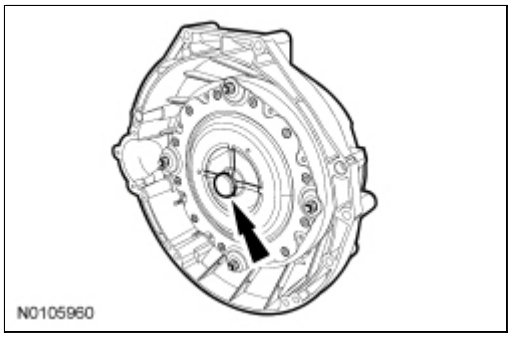
Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B

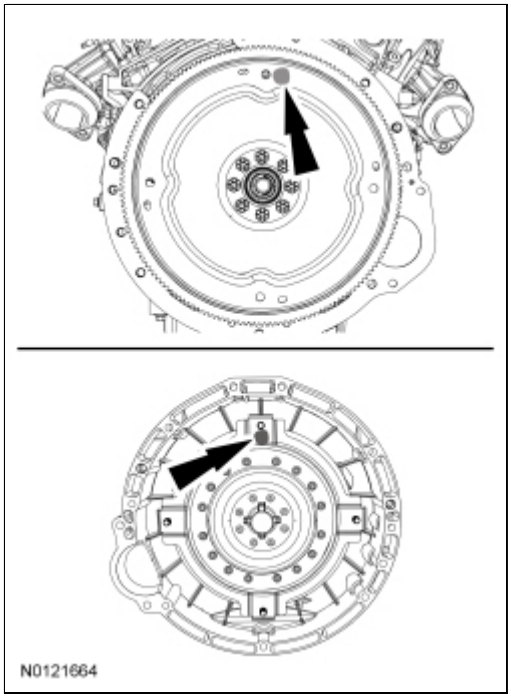
WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. ***NOTICE:*** **Prior to installation of the engine, the torque converter pilot hub must be lubricated with multi-purpose grease or damage to the torque converter or the engine crankshaft can occur**

   Lubricate the torque converter pilot hub with multi-purpose grease.



2. Align the torque converter stud and flexplate hole near the paint marks at the 12 o'clock position.

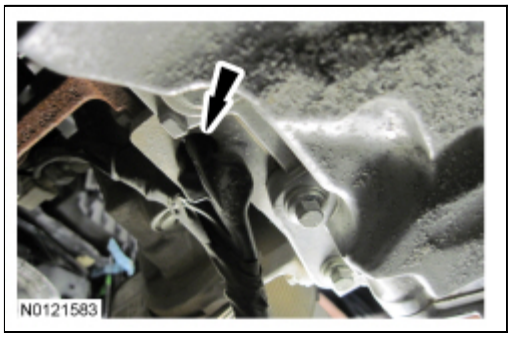


3. Using the Heavy Duty Floor Crane and Engine Spreader Bar, position the engine in the engine compartment.

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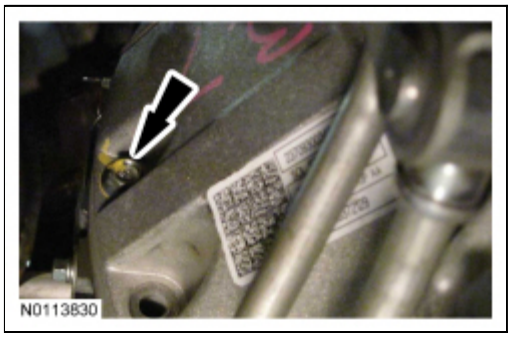
4. Attach the generator wiring harness retainer to the lower LH side of the engine block.



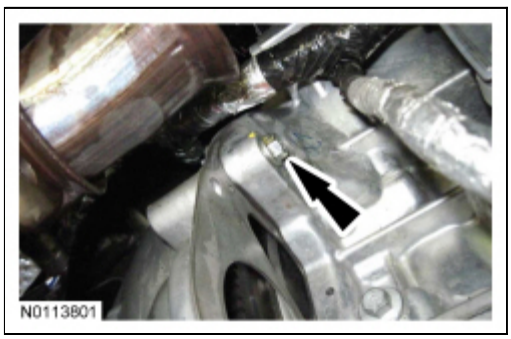
5. Using the Heavy Duty Floor Crane and Engine Spreader Bar, position the engine to the transmission.



6. Align the engine to the transmission and install LH bellhousing-to-engine bolt.
    - Tighten the bolt, it will be torqued at a later step.

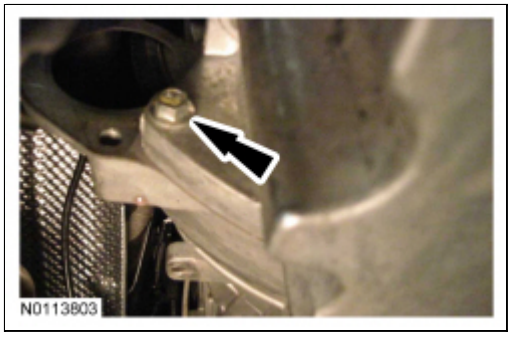


7. Install the engine-to-bellhousing bolt.
    - Tighten the bolt, it will be torqued at a later step.



8. Install the oil pan-to-bellhousing bolt.
    - Tighten to 48 Nm (35 lb-ft).

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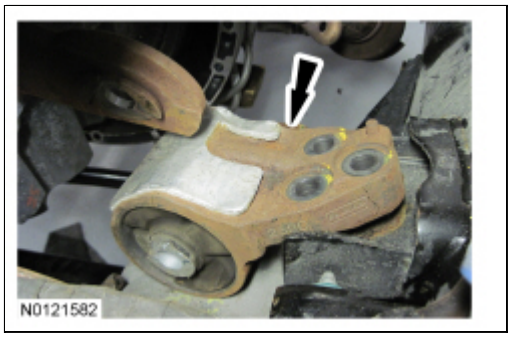
9. Tighten the engine-to-bellhousing bolt.
    - Tighten to 48 Nm (35 lb-ft).



10. Using the Heavy Duty Floor Crane and Engine Spreader Bar, raise the engine for clearance for the LH engine support insulator.



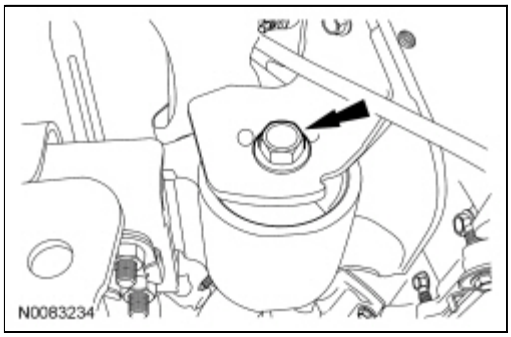
11. Install the LH engine support insulator.



12. ***NOTICE:*** **Use only hand tools when installing the LH engine support insulator through bolt or the engine support insulator may be damaged.**

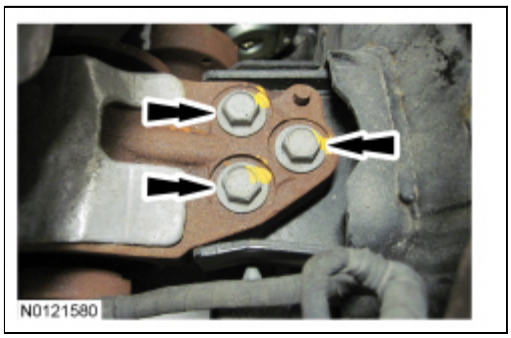
    NOTE: Clean the LH and RH engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

    Install the new LH engine support insulator and the through bolt.
    - Do not torque at this time.



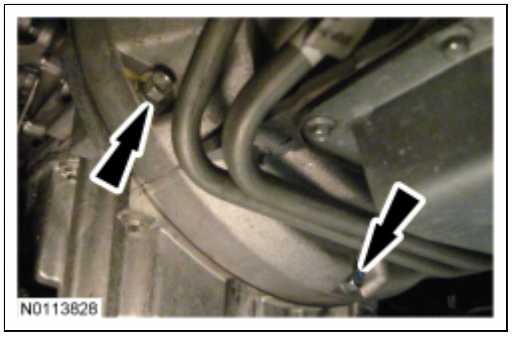
13. Lower the engine.

14. Install the 3 LH engine support insulator bolts.
    - Tighten to 175 Nm (129 lb-ft).

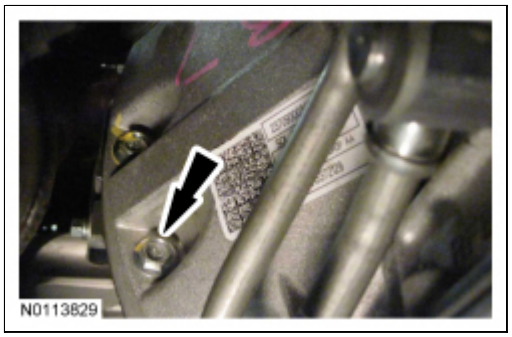


15. Install the 2 LH bellhousing-to-oil pan bolts.
    - Tighten to 48 Nm (35 lb-ft).

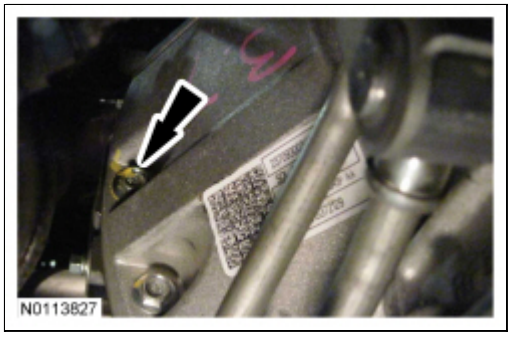
repair4less



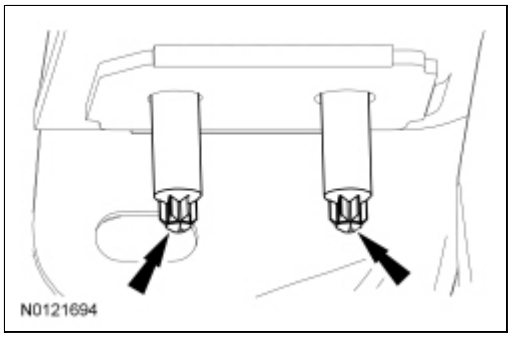
16. Install the LH bellhousing-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



17. Tighten LH bellhousing-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).

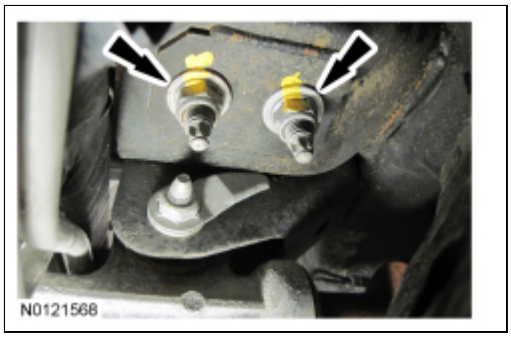


18. Install the 2 new RH engine support insulator studs.
    - Tighten to 30 Nm (22 lb-ft).



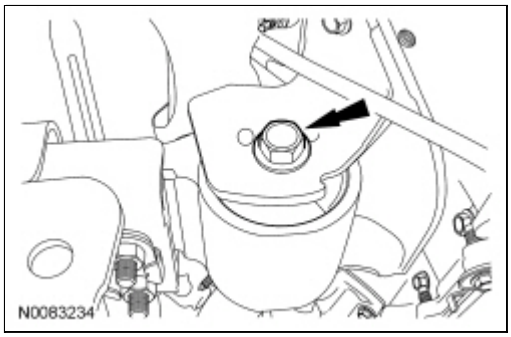
19. ***NOTICE:*** **Use only hand tools when installing the RH engine support insulator nuts or the engine support insulator may be damaged.**

    Install the 2 new RH engine support insulator nuts.
    - Tighten to 175 Nm (129 lb-ft).

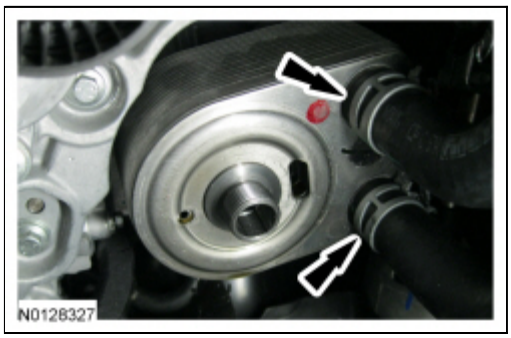


20. ***NOTICE:*** **Use only hand tools when tightening the LH engine support insulator through bolt or the engine support insulator may be damaged.**

    Tighten the LH engine mount through bolt.
    - Tighten to 350 Nm (258 lb-ft).



21. If equipped, install the 2 coolant hoses to the oil cooler.



22. **NOTE:** Do not lubricate the engine oil filter gasket.

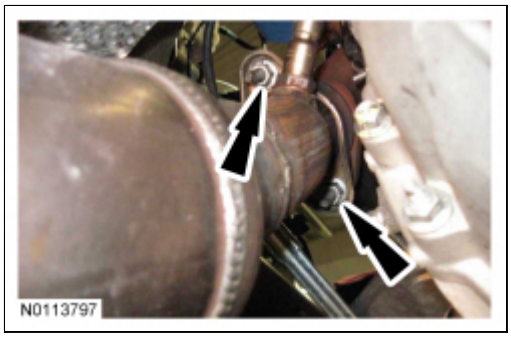
    Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

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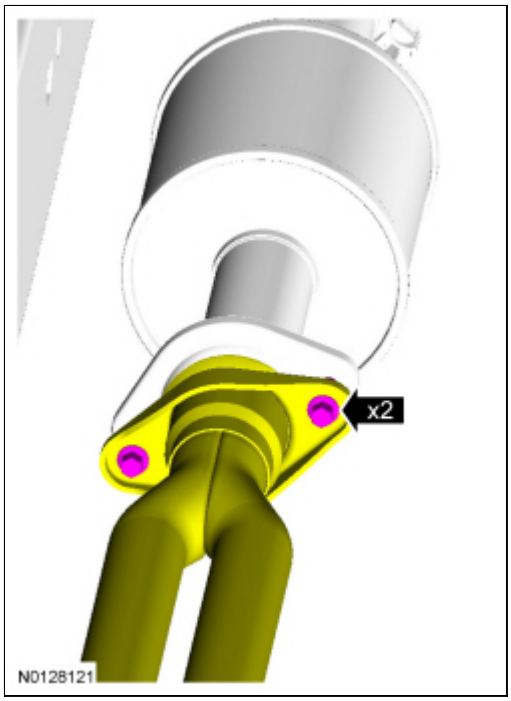


23. **NOTE:** LH shown, RH similar.

    Install the new 2 LH and RH catalytic converter-to-exhaust manifold nuts.
    - Tighten to 45 Nm (35 lb-ft).

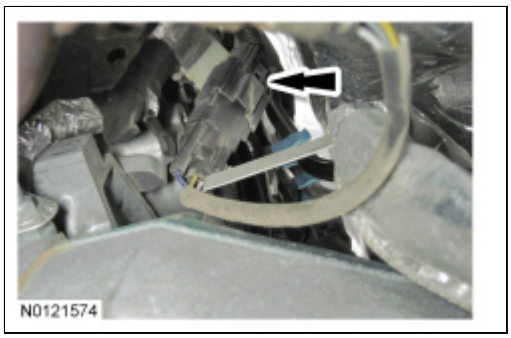


24. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

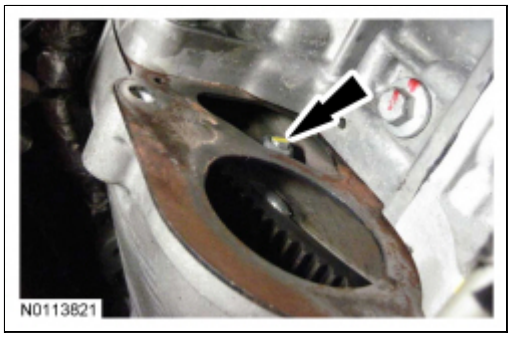


25. **NOTE:** LH shown, RH similar.

    Connect the LH and RH Heated Oxygen Sensor (HO2S) electrical connectors.

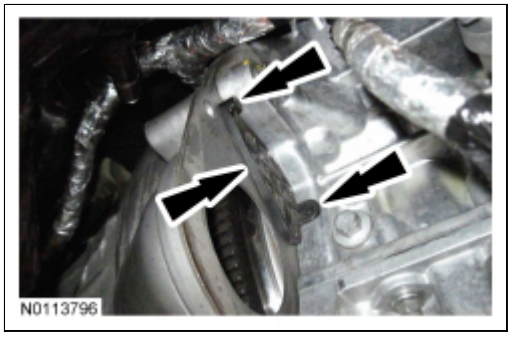


26. Install the 4 torque converter nuts.
    - Tighten to 44 Nm (32 lb-ft).

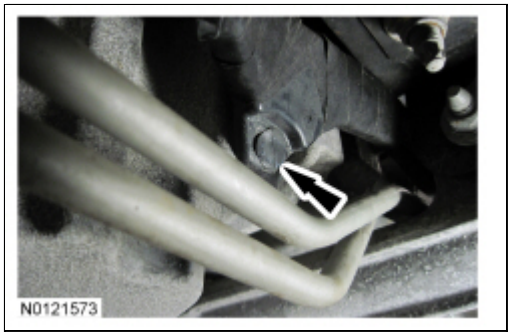


27. Install the access cover and the 2 pin-type retainers.

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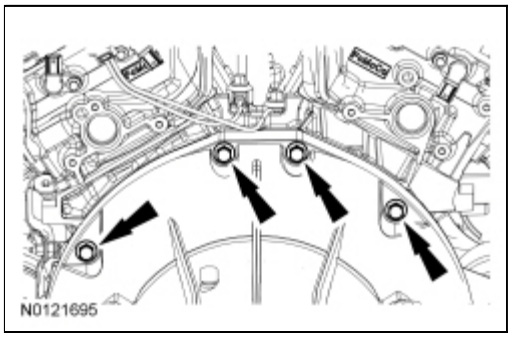
28. Attach the starter motor wiring harness retainer to the oil pan.



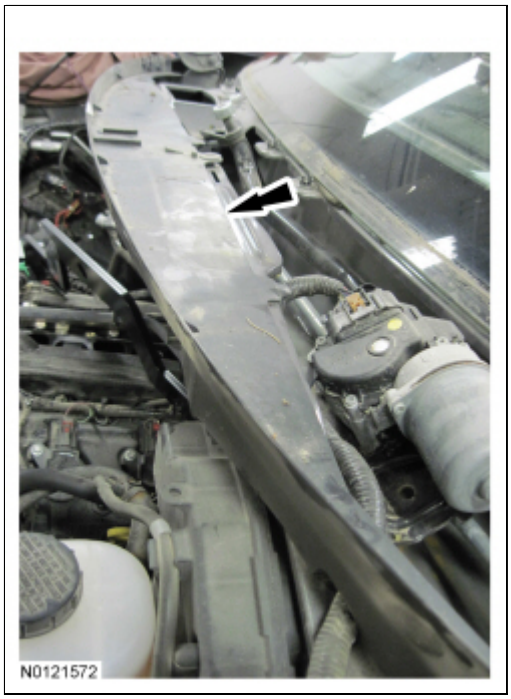
29. Install the starter motor. For additional information, refer to Section 303-06 .

30. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .

31. Install the 4 upper bellhousing-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

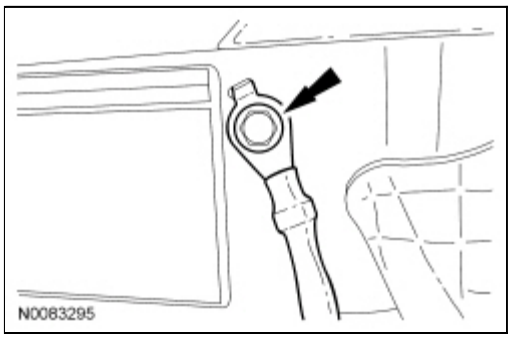


32. Install the cowl panel and attach the 2 clips and install the 6 screws.

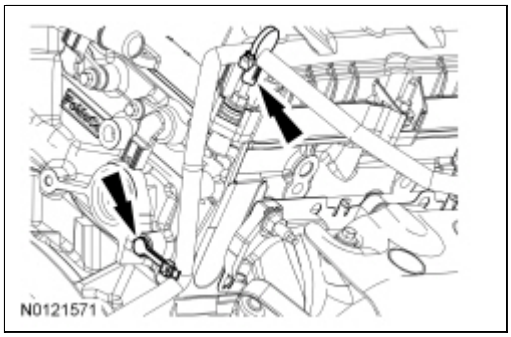


33. Install the cowl panel grille. For additional information, refer to Section 501-02 .

34. Install the ground strap and bolt to the cowl.
    - Tighten to 10 Nm (89 lb-in).

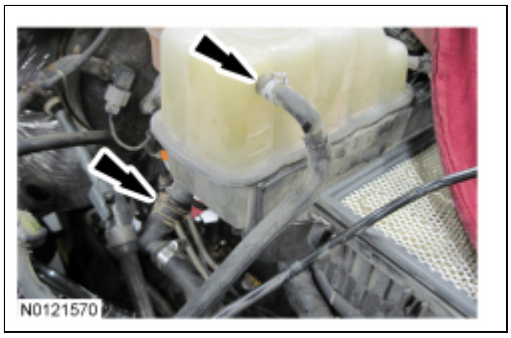


35. Attach the wiring harness retainers to the rear of the RH valve cover stud bolt and the rear of the RH cylinder head.

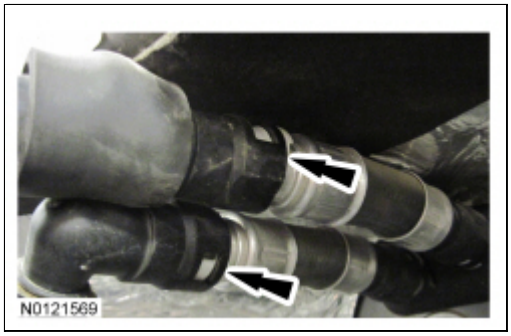


36. Connect the 2 coolant hoses to the degas bottle.

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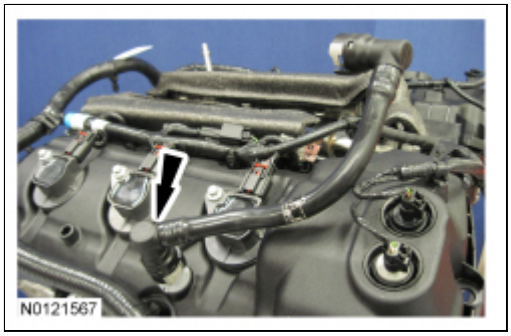
37. Connect the 2 heater hose couplings at the rear of the engine.



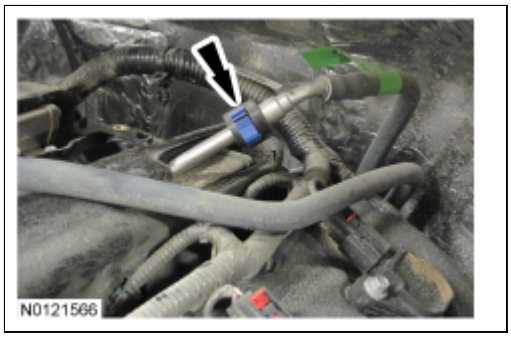
38. Install the crankcase vent tube quick connect coupling to LH valve cover. For additional information, refer to Section 310-00 .



39. Install the PVC tube quick connect coupling to RH valve cover. For additional information, refer to Section 310-00 .

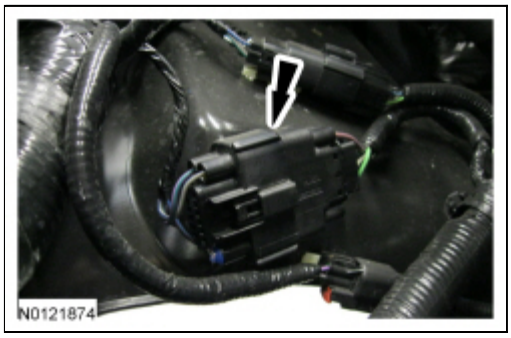


40. Connect the fuel supply tube quick connect coupling to the fuel rail. For additional information, refer to Section 310-00 .



41. Install the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

42. Attach and connect the engine harness electrical connector.



43. Connect the middle PCM electrical connector.
    - Attach the wiring harness retainer to the fender splash shield.

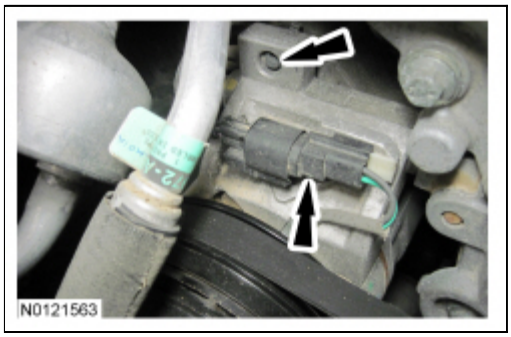


44. Install the Air Conditioning (A/C) compressor belt. For additional information, refer to Section 303-05 .

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45. Install the generator. For additional information, refer to Section 414-00 .

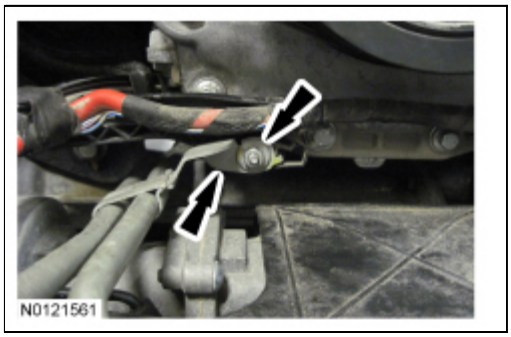
46. Connect the A/C compressor electrical connector.
    - Attach the A/C compressor wiring harness to the A/C compressor.



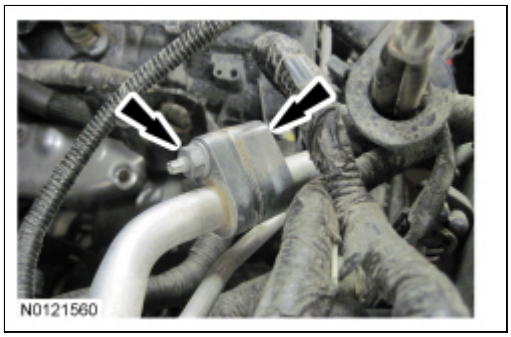
47. Attach the generator wiring harness to the engine front cover.



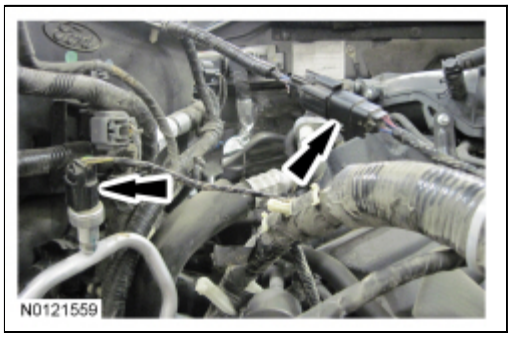
48. Install the transmission cooler line bracket and nut to the engine front cover stud bolt.
    - Tighten to 12 Nm (106 lb-in).



49. Using a new O-ring seal and gasket seal, install the A/C tube and the nut.
    - Tighten to 15 Nm (133 lb-in).



50. Connect the Battery Junction Box (BJB) wiring harness and the A/C pressure transducer electrical connectors.

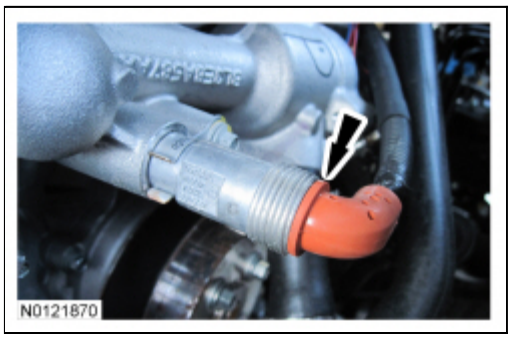


51. Fill the engine with clean engine oil.

52. Install the Air Cleaner (ACL) upper tray. For additional information, refer to Intake Air System Components — Exploded View, 3.7L in Section 303-12 .

53. Install the cooling module. For additional information, refer Section 303-03 .

54. If equipped, connect the block heater electrical connector at the thermostat housing.
    - Attach the block heater wiring harness retainer to the LH valve cover stud bolt.



55. Connect the battery ground cable. For additional information, refer to Section 414-01 .

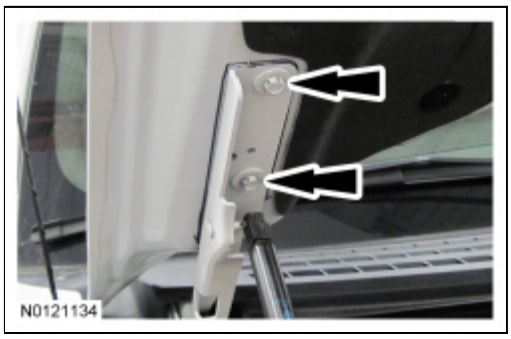
56. **NOTE:** Align the index marks made during hood removal.

    NOTE: RH shown, LH similar.

    Position the hood and install the 4 bolts.

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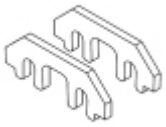
- Tighten to 12 Nm (106 lb-in).



57. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Camshaft — LH

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

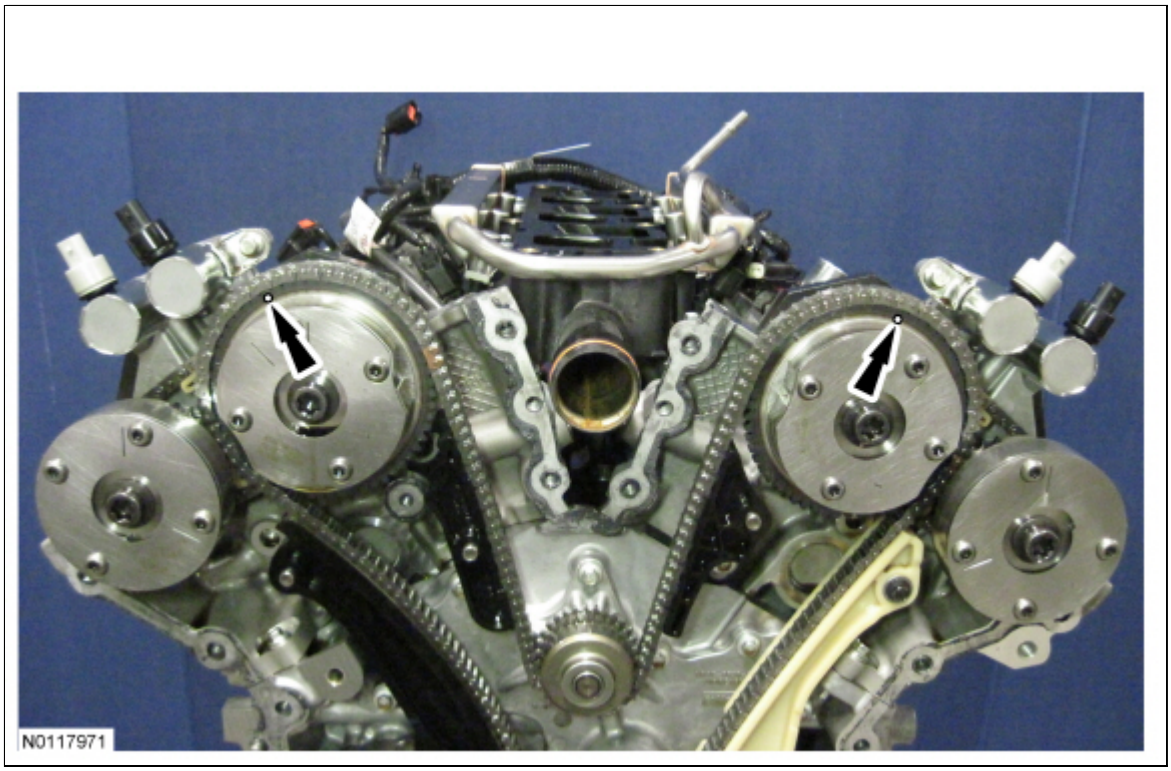
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

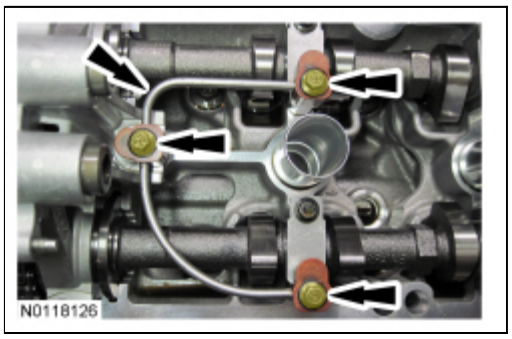
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown.

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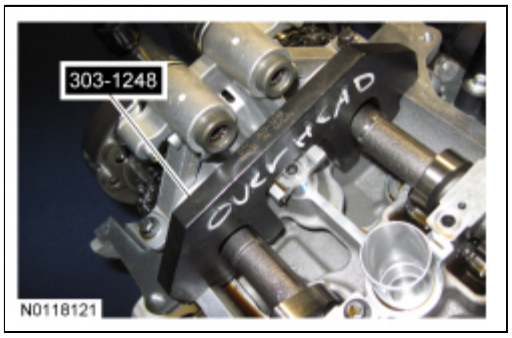


3. Remove the 3 bolts and the LH valve train oil tube.

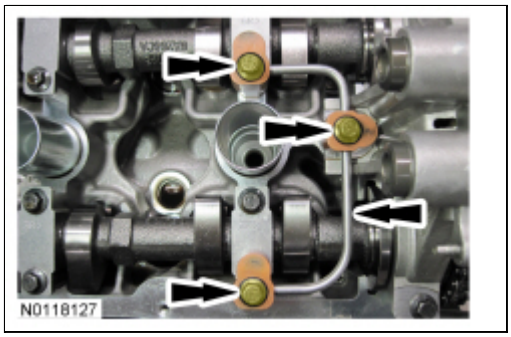


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

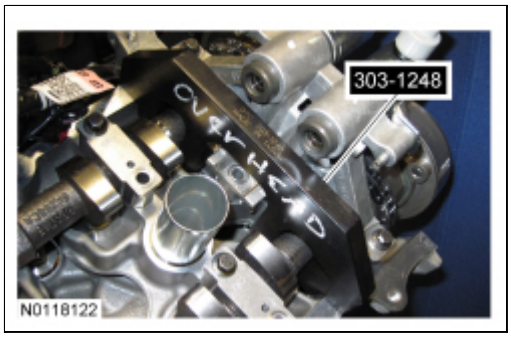


5. Remove the 3 bolts and the RH valve train oil tube.



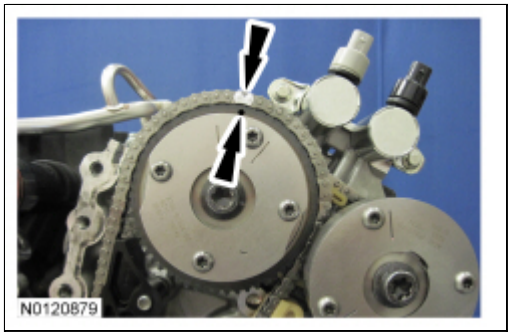
6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

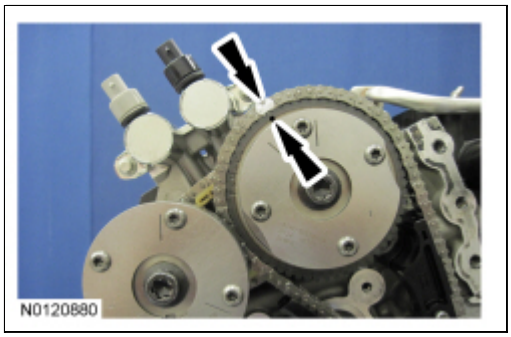


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.



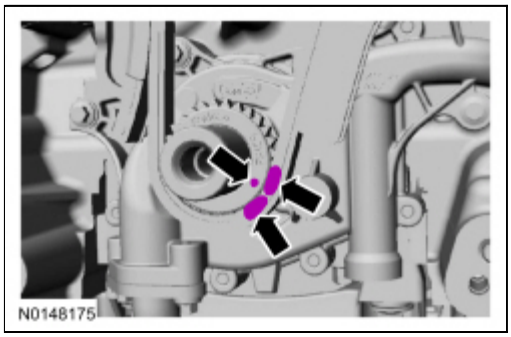
8. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.



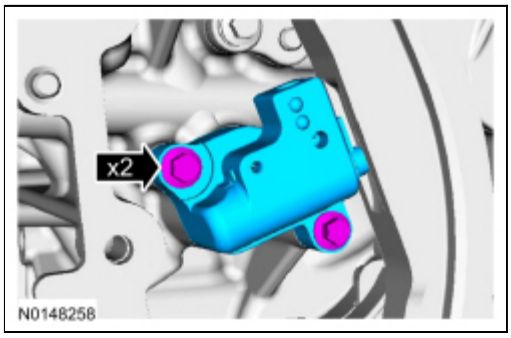
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9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

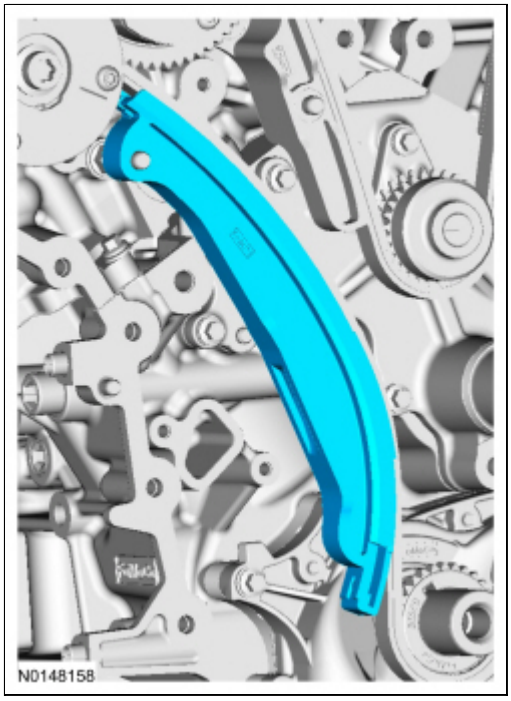
   Mark the 2 timing chain links that aligns with the timing mark on the crankshaft sprocket as shown.



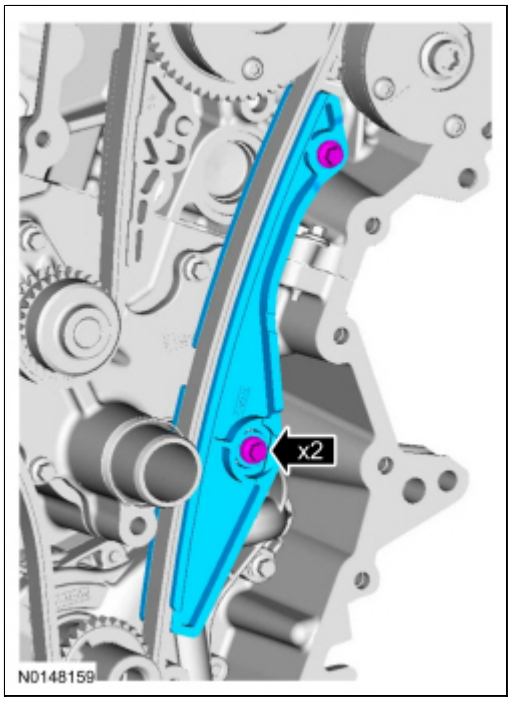
10. Remove the 2 bolts and the primary timing chain tensioner.



11. Remove the primary timing chain tensioner arm.



12. Remove the 2 bolts and the lower LH primary timing chain guide.

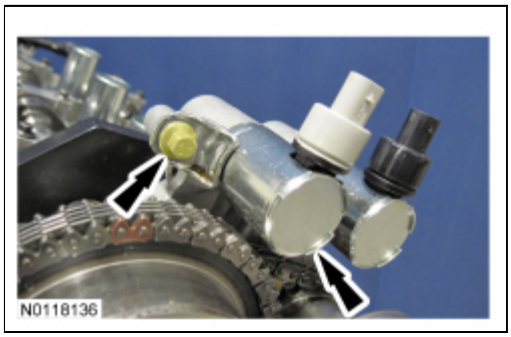


13. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.



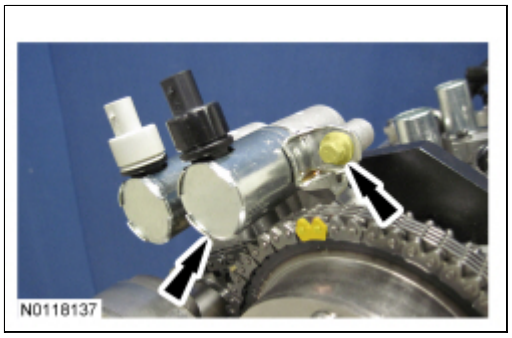
14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

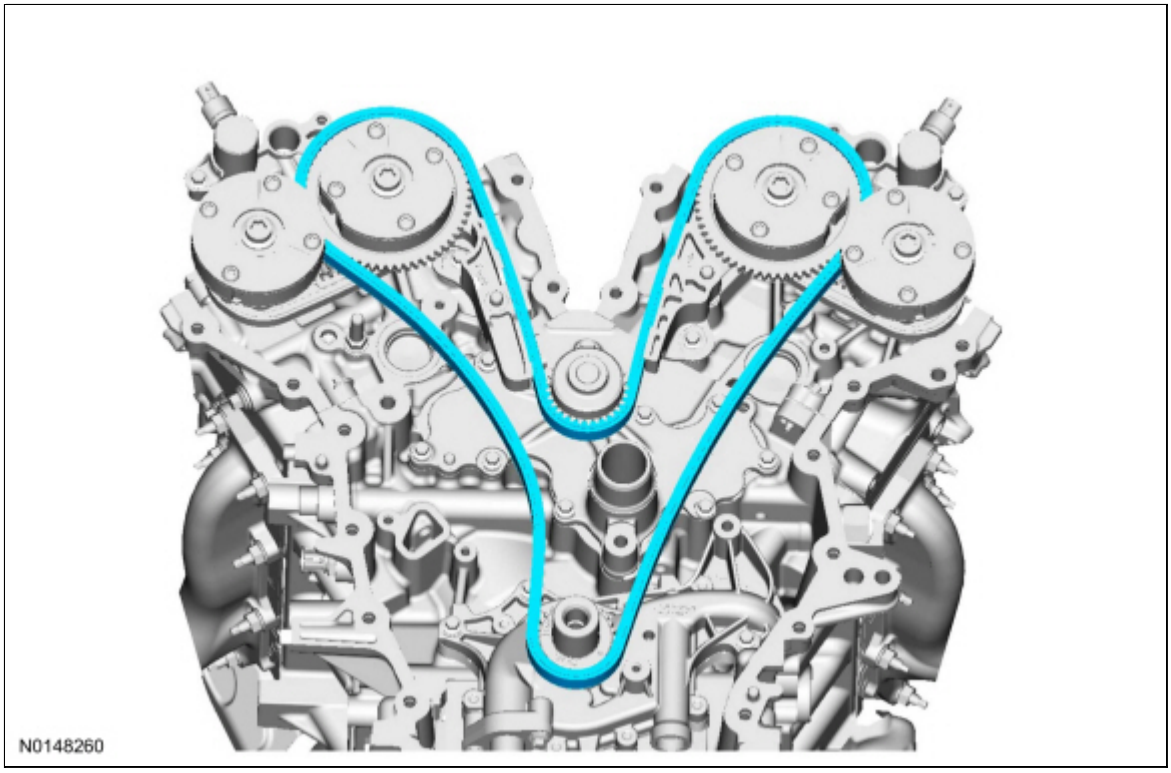
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.

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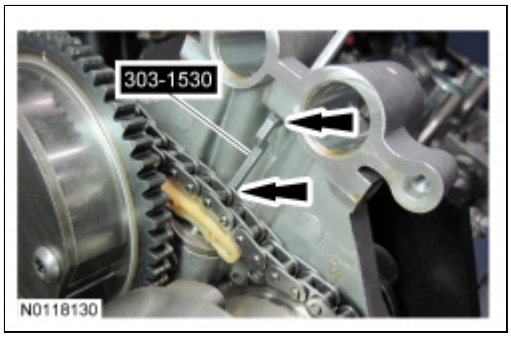
15. Remove the primary timing chain.



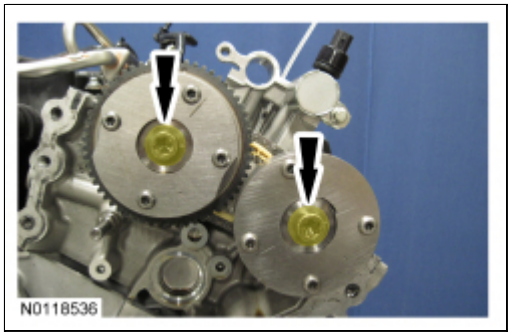
16. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

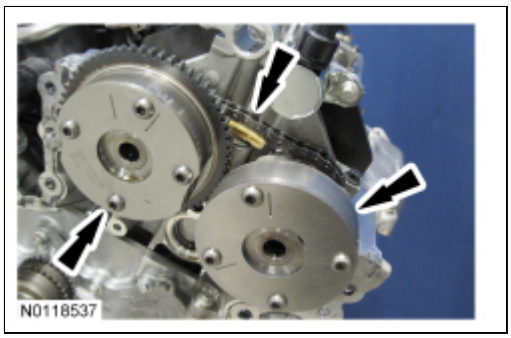
    Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



17. Remove and discard the 2 LH VCT assembly bolts.

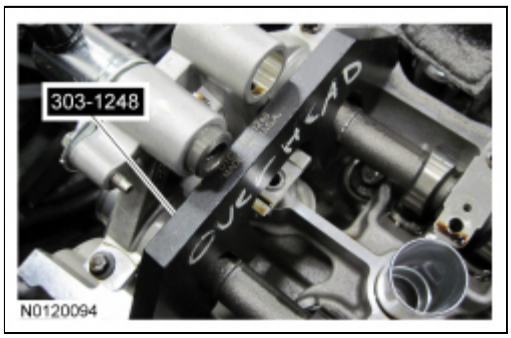


18. Remove the 2 LH VCT assemblies and secondary timing chain.
    - Remove the Secondary Chain Hold Down.



19. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the LH camshafts approximately 3 degrees to a neutral position.

    Remove the Camshaft Holding Tool from the LH camshafts.

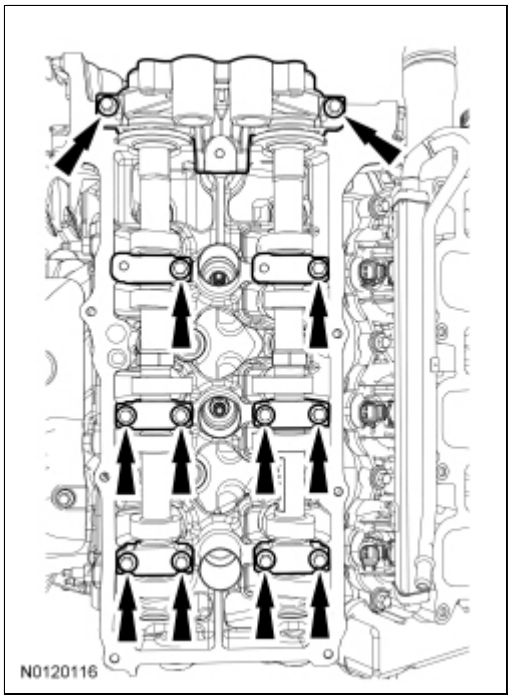


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20. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

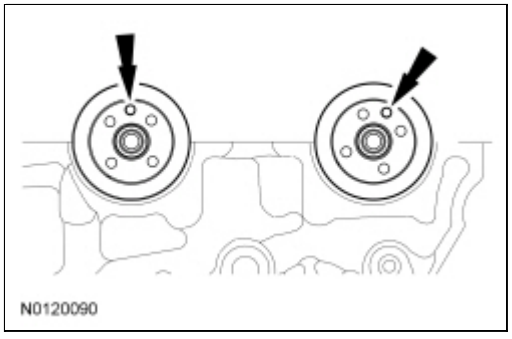
    Remove the 12 bolts, 6 camshaft caps, mega cap and the LH camshafts.



Installation

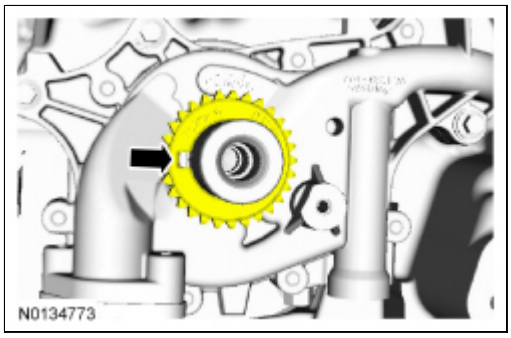
1. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

   Position the camshafts onto the LH cylinder head in the neutral position as shown.



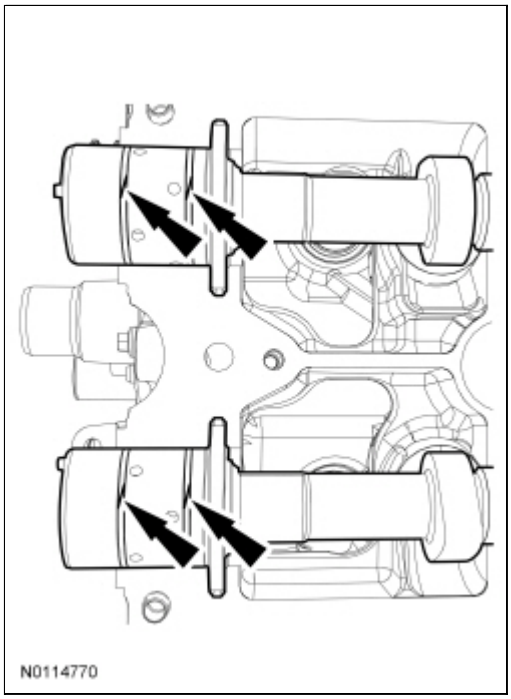
2. ***NOTICE:*** **The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

   Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.



3. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

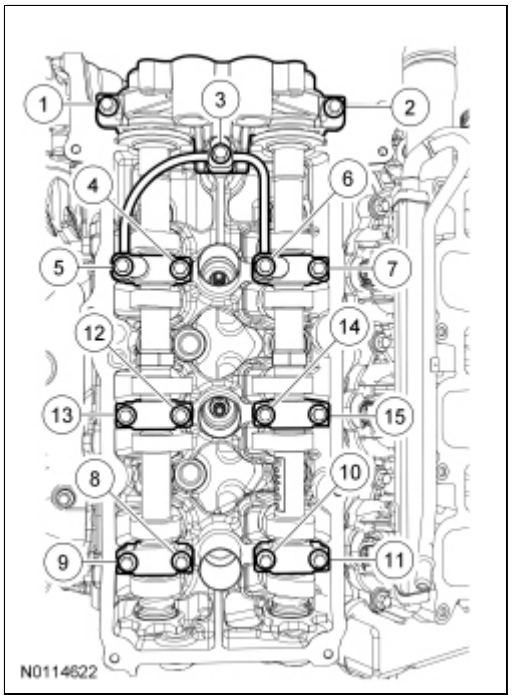
   Position the 4 camshaft seals gaps as shown.



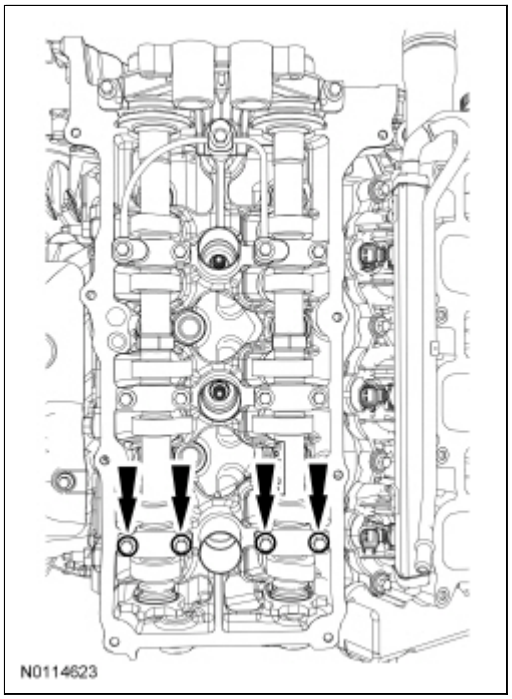
4. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

   Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
   - Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

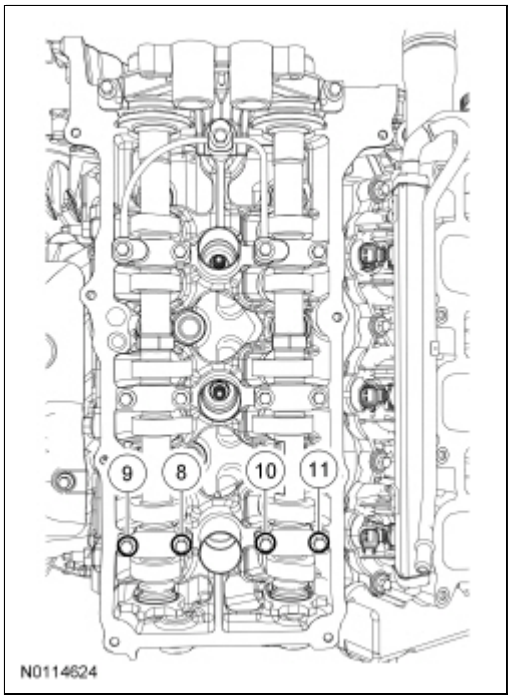
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5. Loosen the 4 camshaft caps bolts.



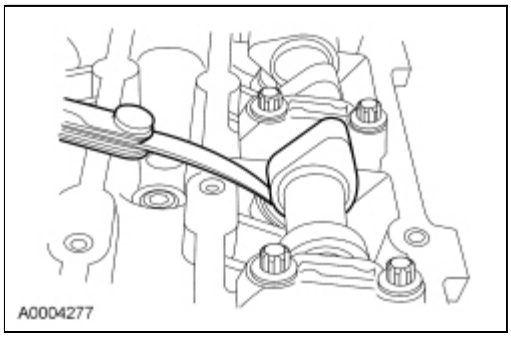
6. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.



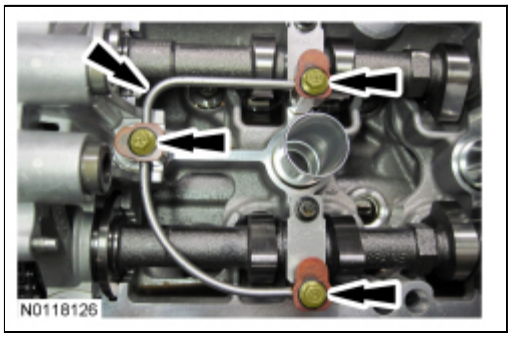
7. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

   NOTE: Use a camshaft sprocket bolt to turn the camshafts.

   Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet (s) of the correct size. For additional information, refer to Valve Clearance Check in this section.

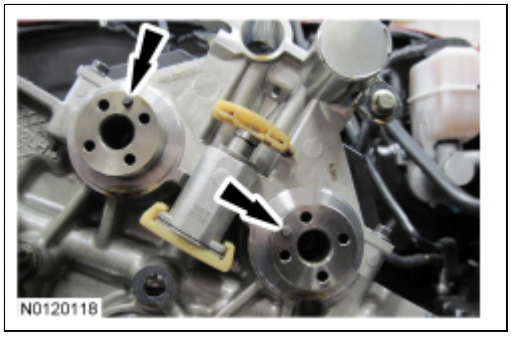


8. Remove the 3 bolts and the LH valve train oil tube.



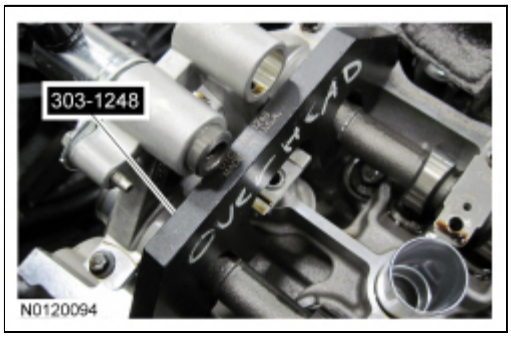
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9. Rotate the LH camshafts to the TDC position as shown.

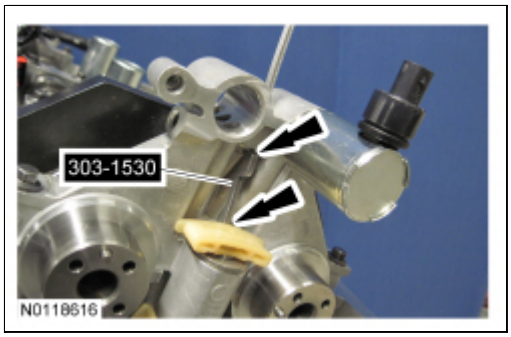


10. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

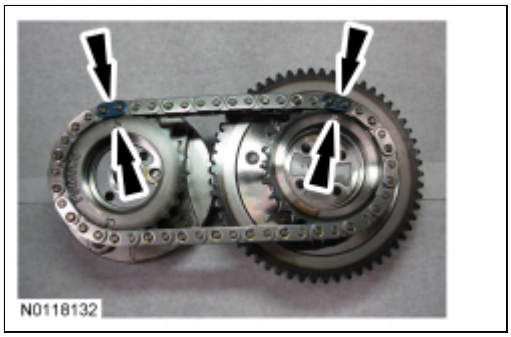
    Install the Camshaft Holding Tool onto the flats of the LH camshafts.



11. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

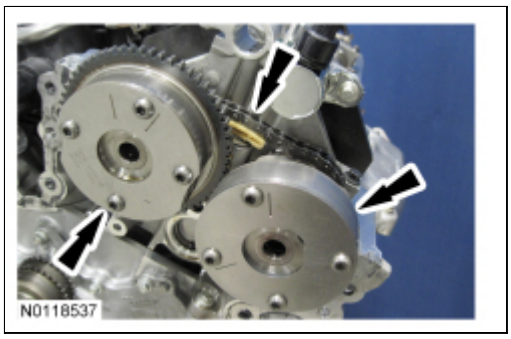


12. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.

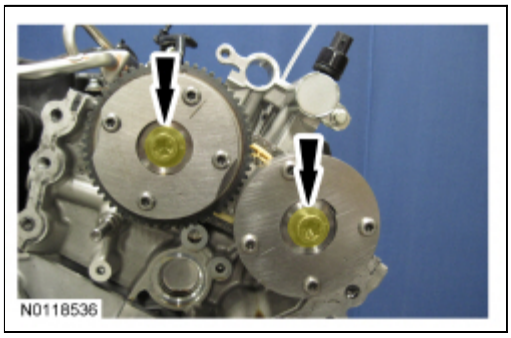


13. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



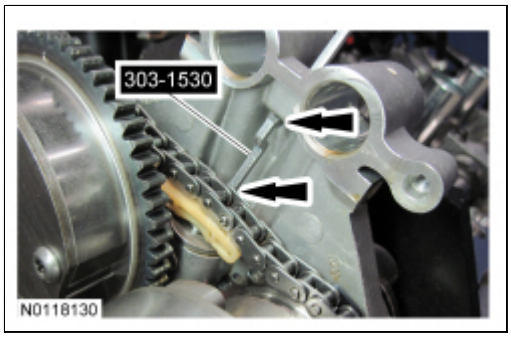
14. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



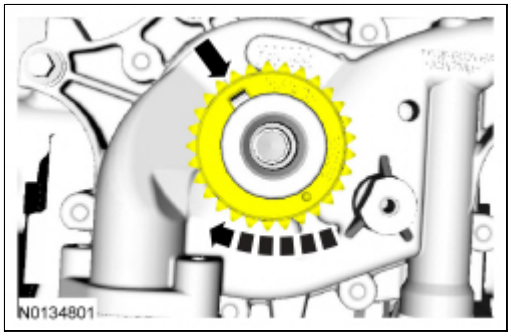
15. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

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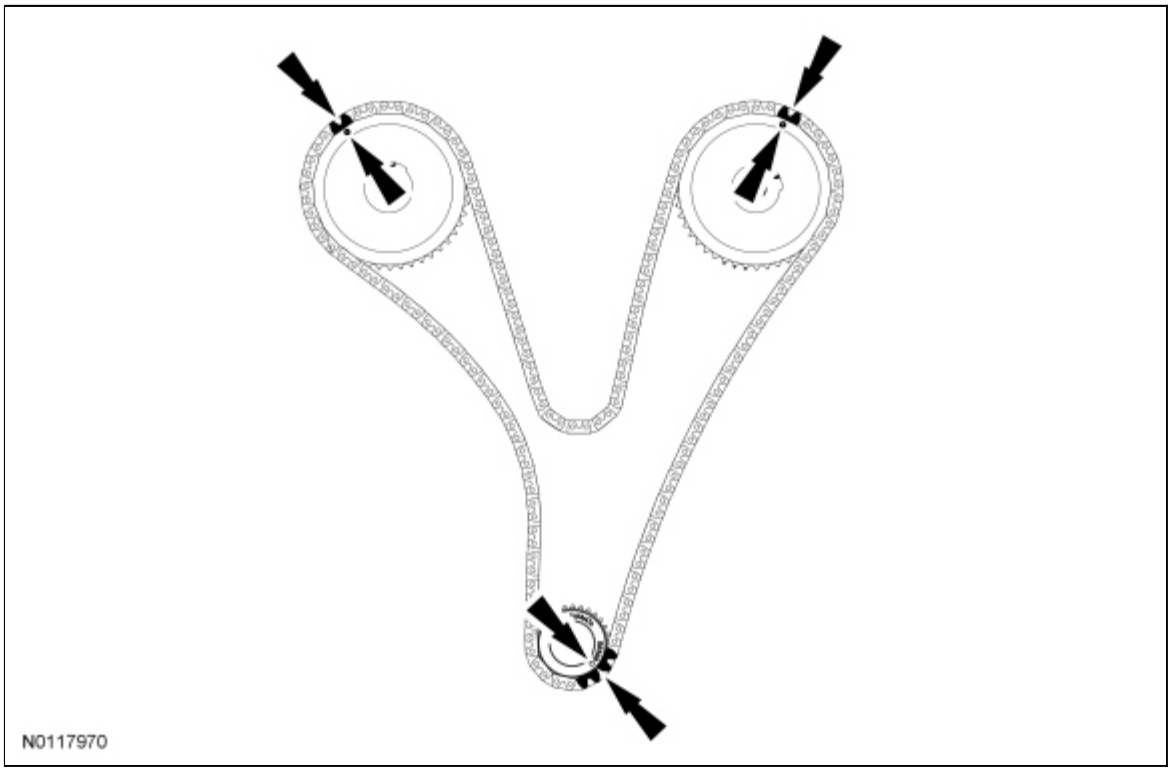


16. Rotate the crankshaft clockwise 60 degrees to the TDC position (crankshaft dowel pin at 11 o'clock).



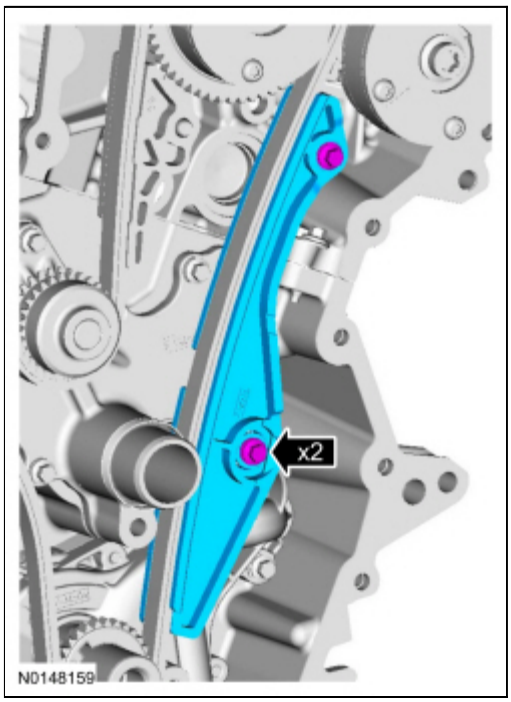
17. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

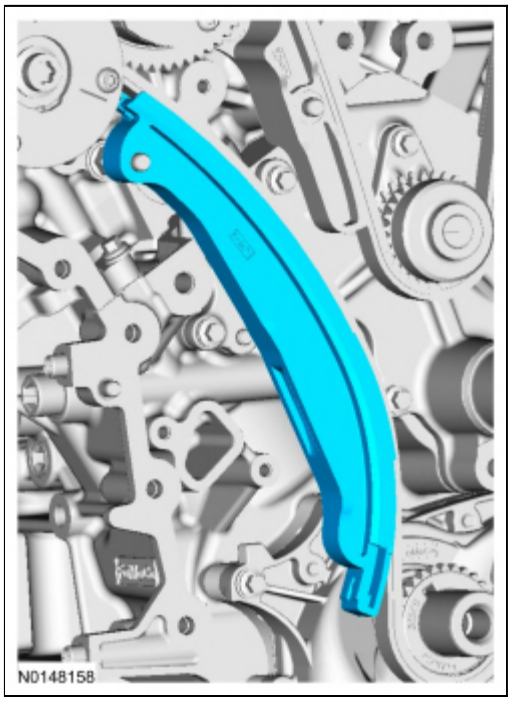


18. Install the lower LH primary timing chain guide and the 2 bolts.

- Tighten to 10 Nm (89 lb-in).



19. Install the primary timing chain tensioner arm.



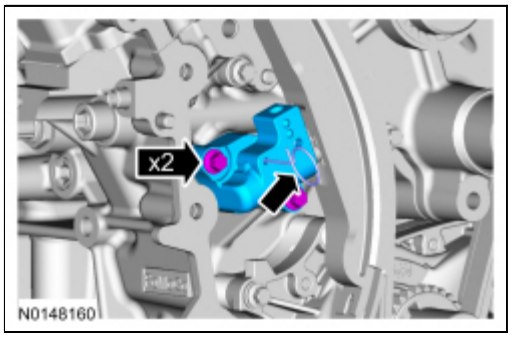
20. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.

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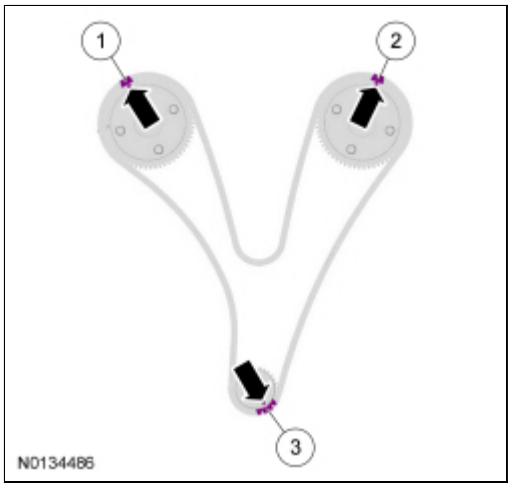


21. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

    Install the primary tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.



22. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



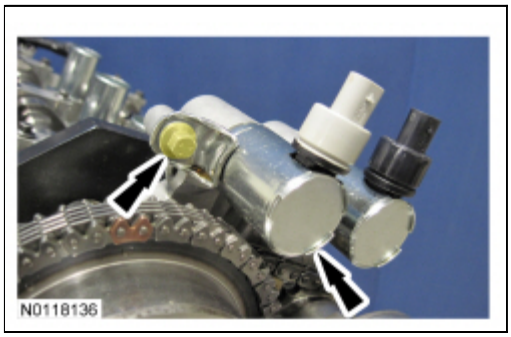
23. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



24. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

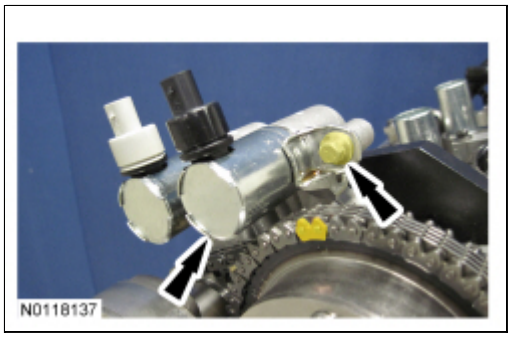
NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

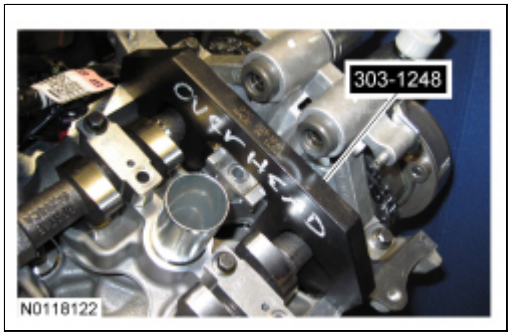
Install the RH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

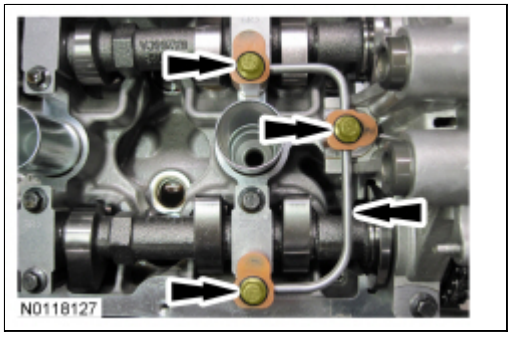
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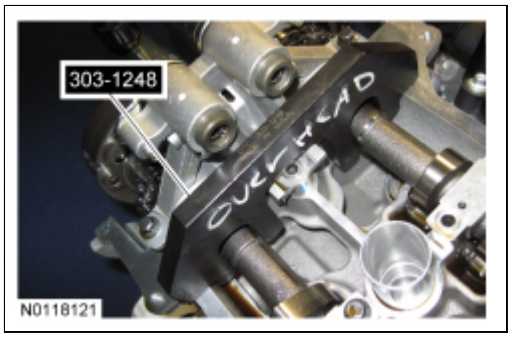
25. Remove the RH Camshaft Holding Tool.



26. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

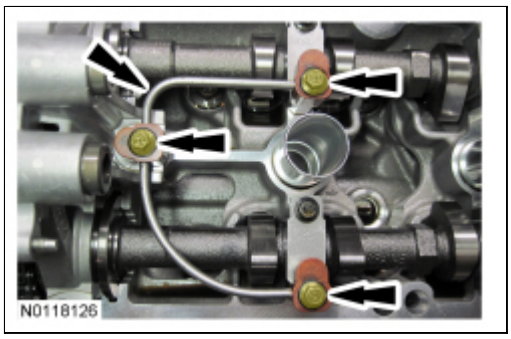


27. Remove the LH Camshaft Holding Tool.



28. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



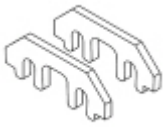
29. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

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Camshaft — RH

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248

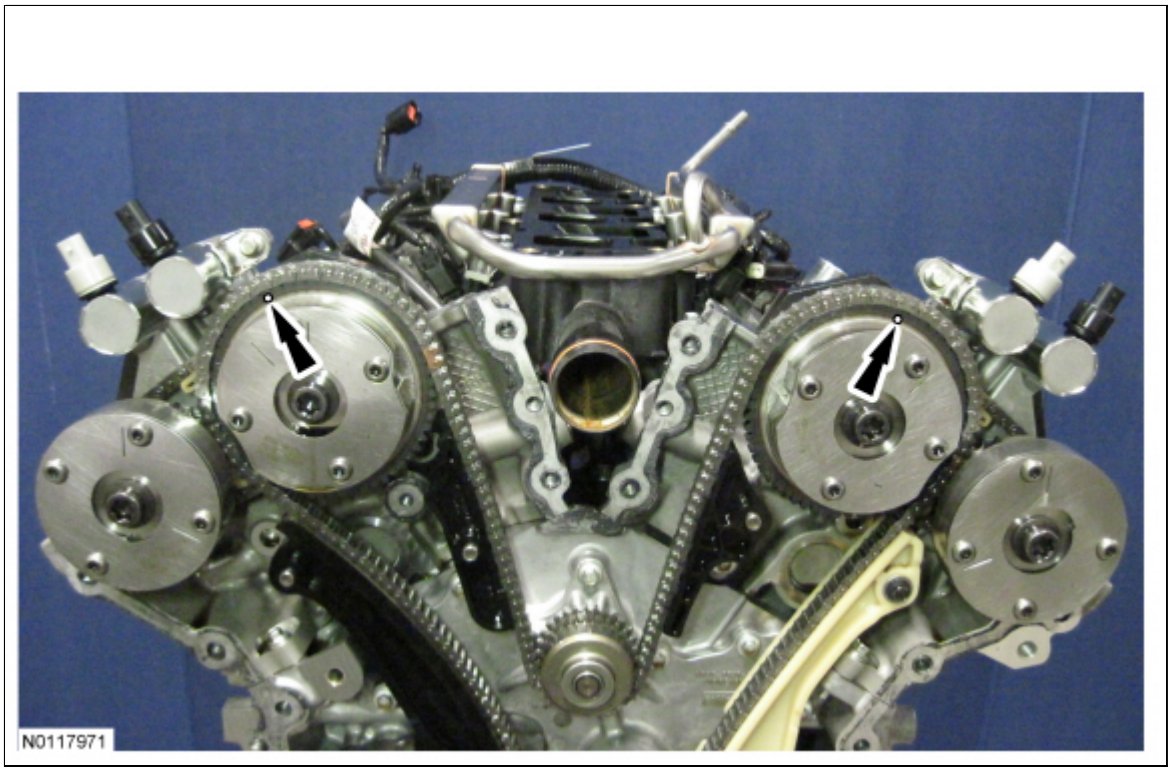
Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

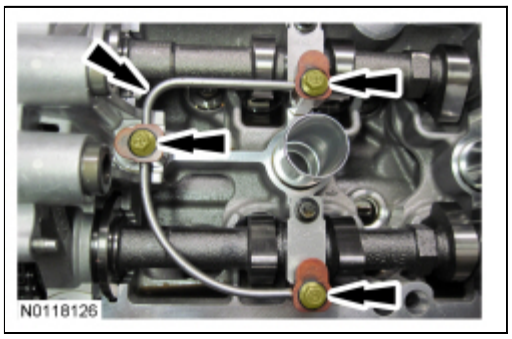
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown.

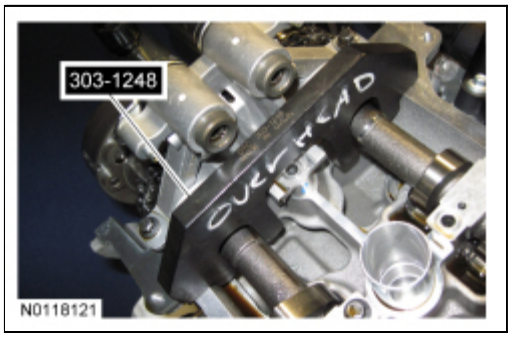


3. Remove the 3 bolts and the LH valve train oil tube.



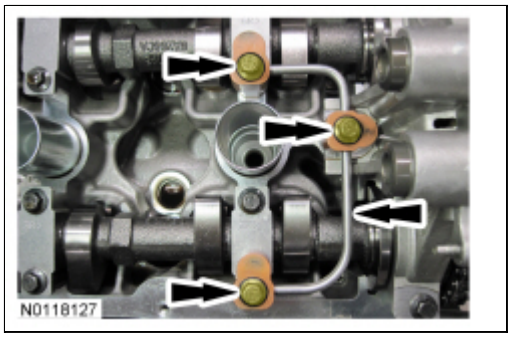
4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.



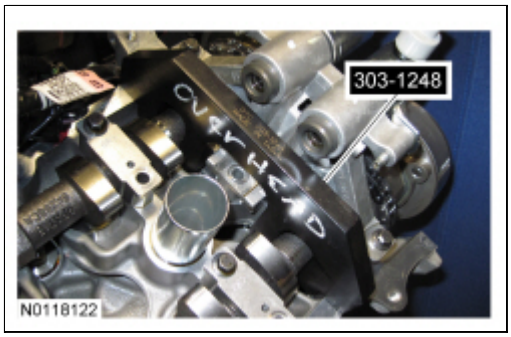
5. Remove the 3 bolts and the RH valve train oil tube.

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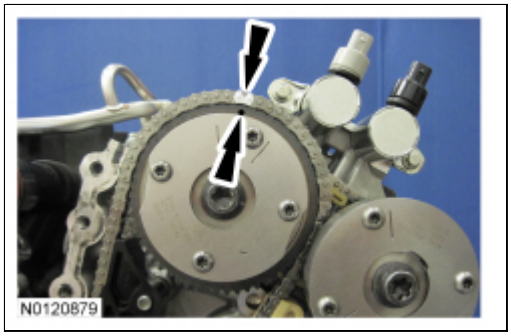
6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

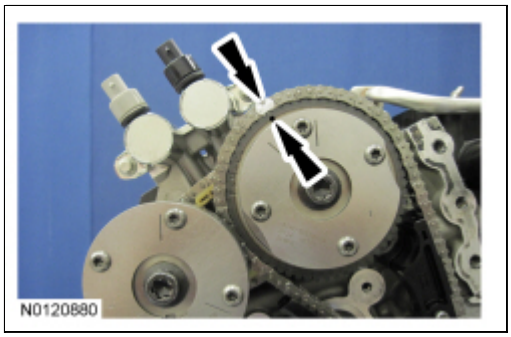


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

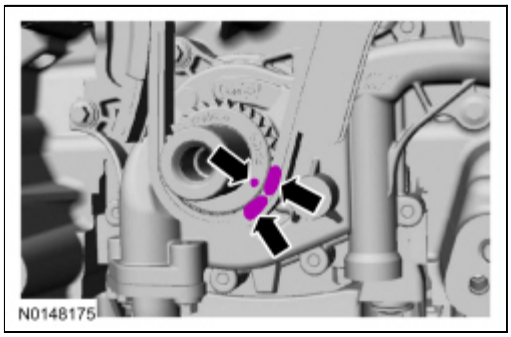


8. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

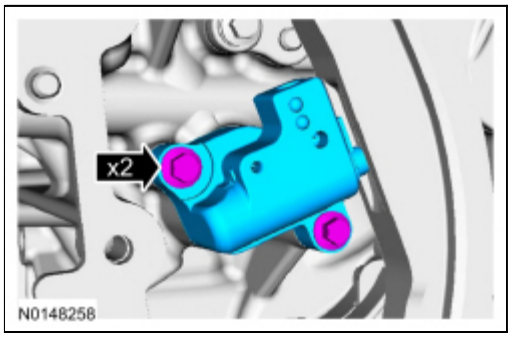


9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

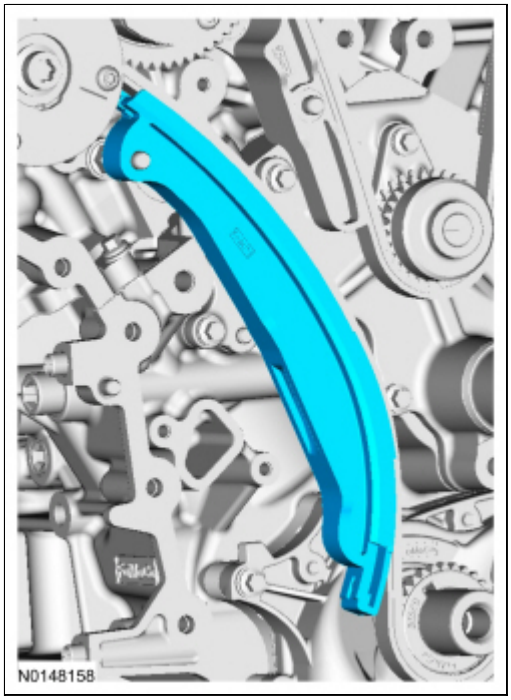
   Mark the 2 timing chain links that aligns with the timing mark on the crankshaft sprocket as shown.



10. Remove the 2 bolts and the primary timing chain tensioner.

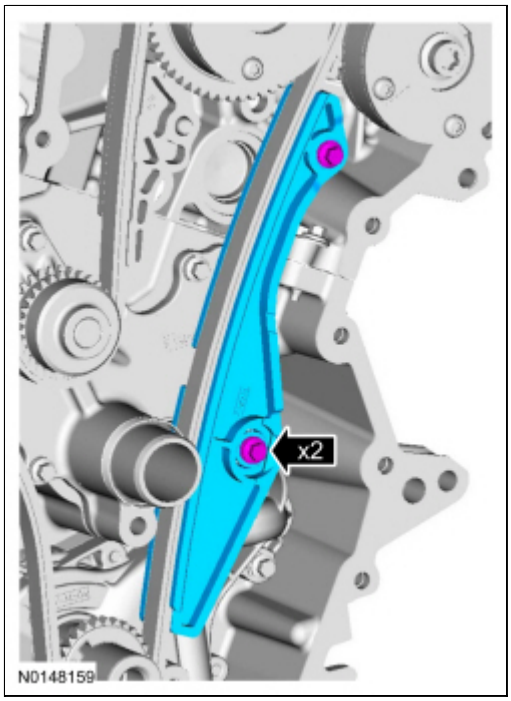


11. Remove the primary timing chain tensioner arm.



12. Remove the 2 bolts and the lower LH primary timing chain guide.

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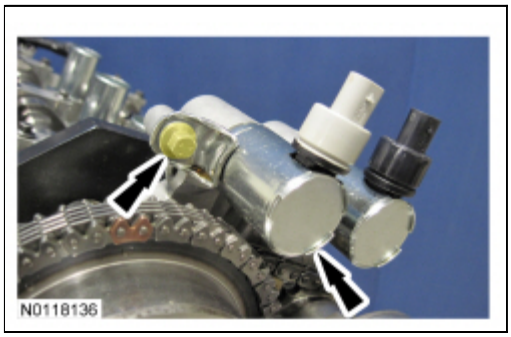


13. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.

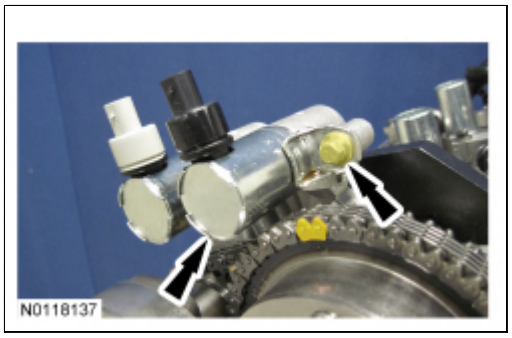


14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

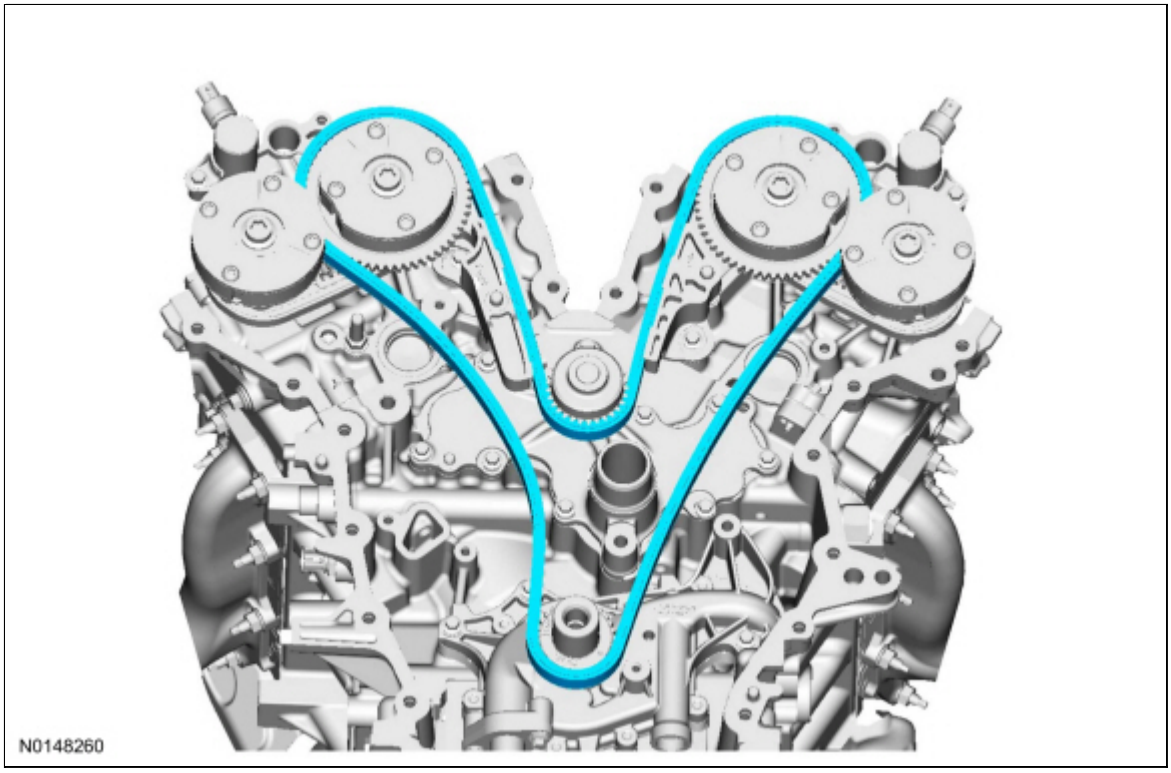
    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.



15. Remove the primary timing chain.

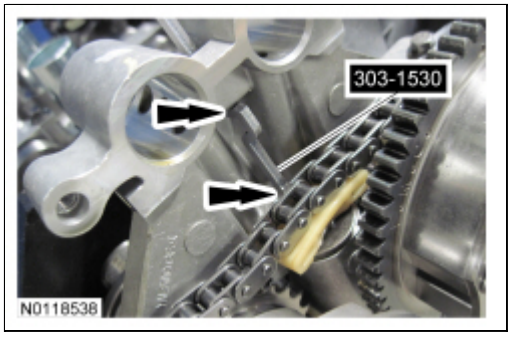


16. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

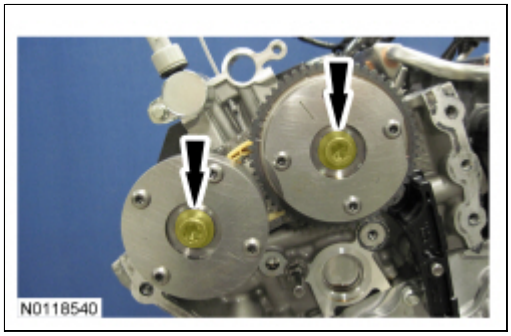
    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

    Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

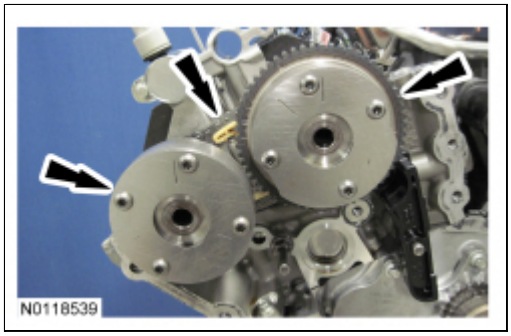
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17. Remove and discard the 2 RH VCT assembly bolts.

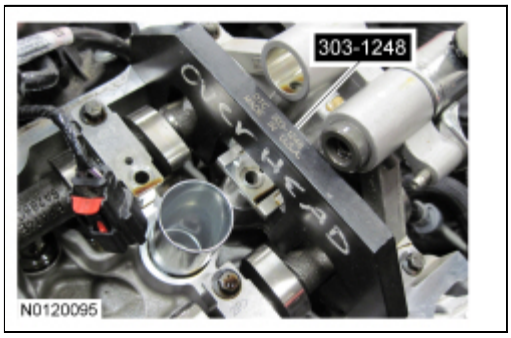


18. Remove the 2 RH VCT assemblies and secondary timing chain.
    - Remove the Secondary Chain Hold Down.



19. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure may rotate the RH camshafts approximately 3 degrees to a neutral position.

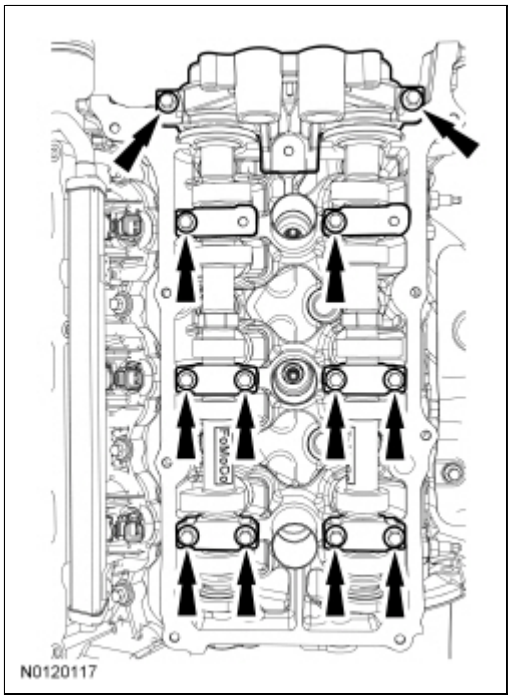
    Remove the Camshaft Holding Tool from the RH camshafts.



20. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    NOTE: Mark the exhaust and intake camshafts for installation into their original locations.

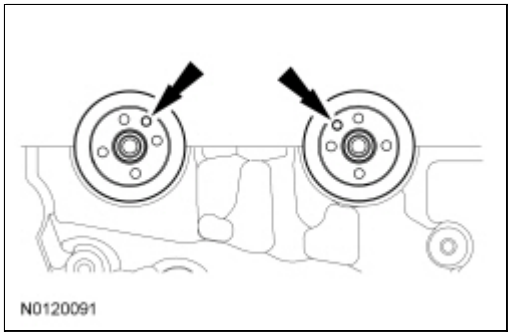
    Remove the 12 bolts, 6 camshaft caps, mega cap and the RH camshafts.



Installation

1. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

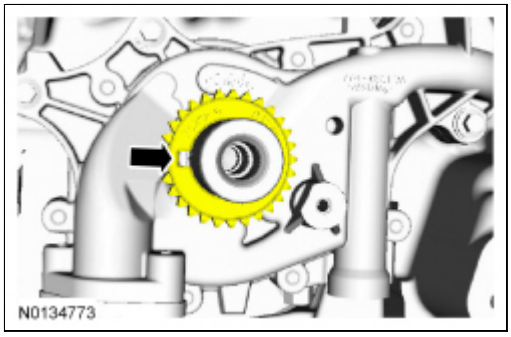
   Position the camshafts onto the RH cylinder head in the neutral position as shown.



2. ***NOTICE:*** **The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

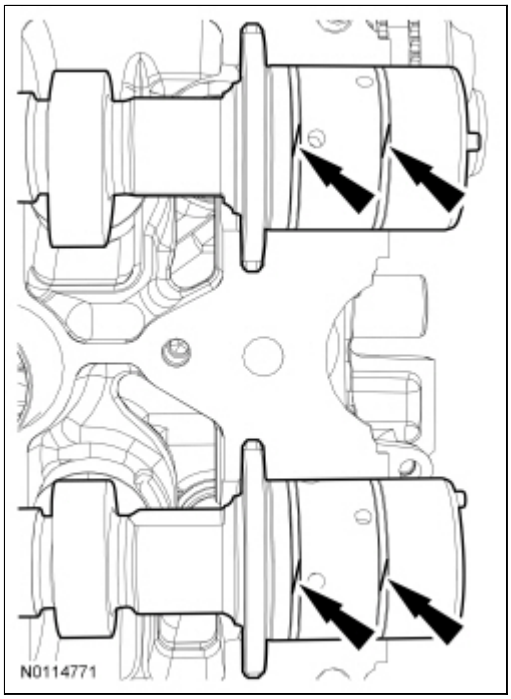
   Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.

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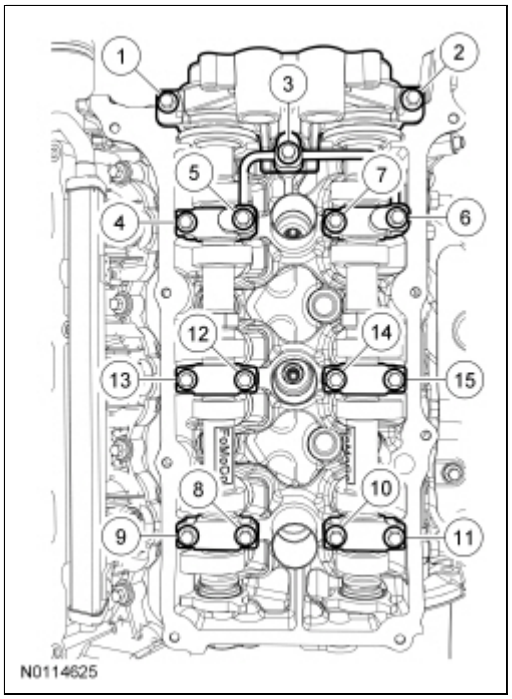
3. ***NOTICE:*** **The camshaft seal gaps must be at the 12 o'clock position or damage to the engine may occur.**

   Position the 4 camshaft seals gaps as shown.

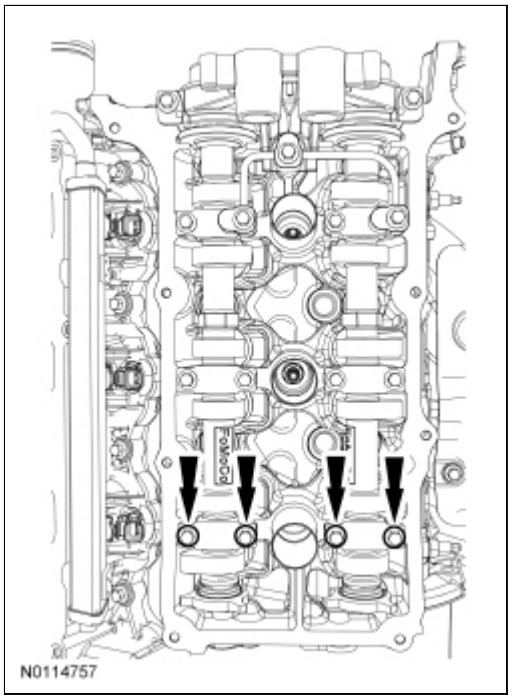


4. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

   Install the 6 camshaft caps, mega cap, valve train oil tube and the 15 bolts in the sequence shown.
   - Tighten to 8 Nm (71 lb-in) then additional 45 degrees.

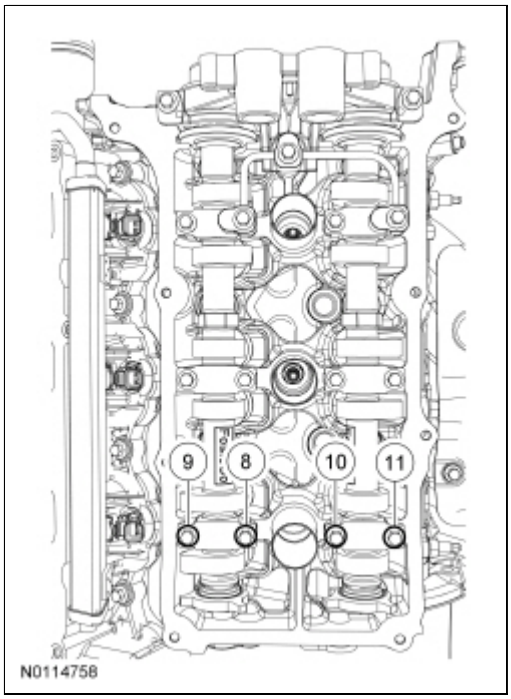


5. Loosen the 4 camshaft caps bolts.



6. Tighten the 4 camshaft caps bolts in the sequence shown.
    - Tighten bolts 8, 9, 10 and 11 to 8 Nm (71 lb-in) then additional 45 degrees.

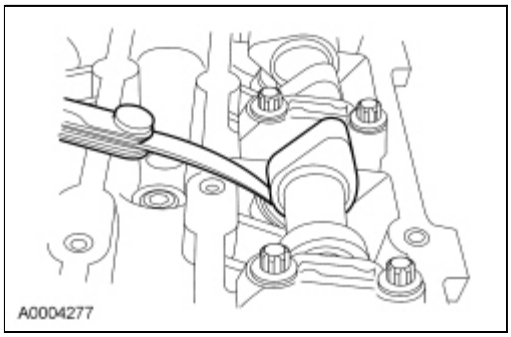
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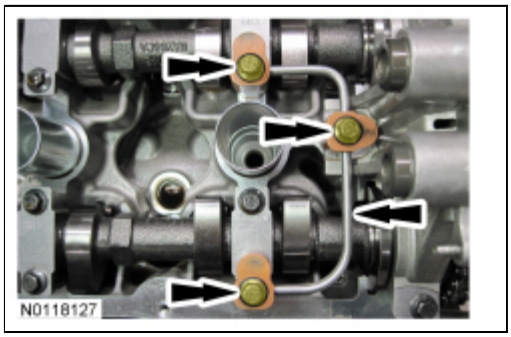
7. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

   NOTE: Use a camshaft sprocket bolt to turn the camshafts.

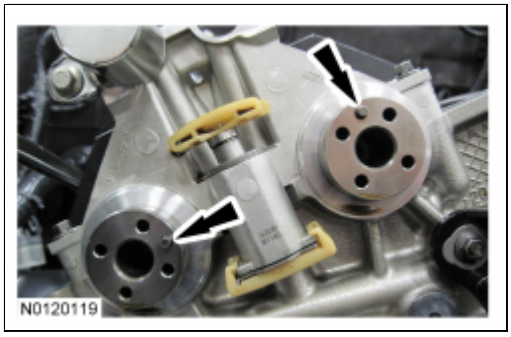
   Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet (s) of the correct size. For additional information, refer to Valve Clearance Check in this section.



8. Remove the 3 bolts and the RH valve train oil tube.

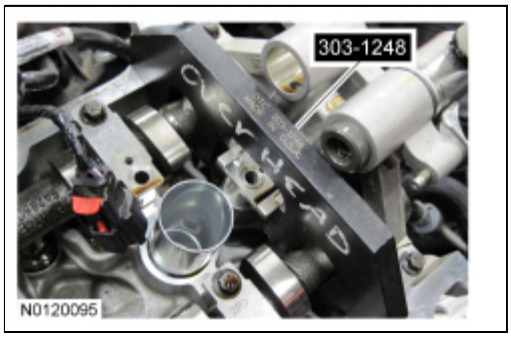


9. Rotate the RH camshafts to the TDC position as shown.

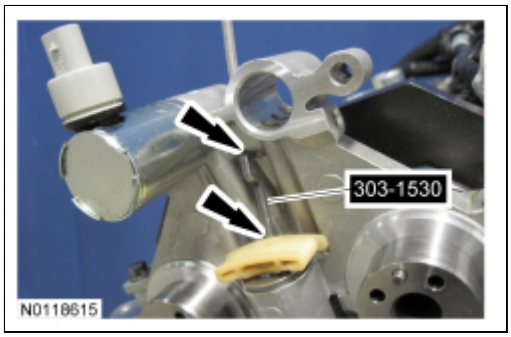


10. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

    Install the Camshaft Holding Tool onto the flats of the RH camshafts.

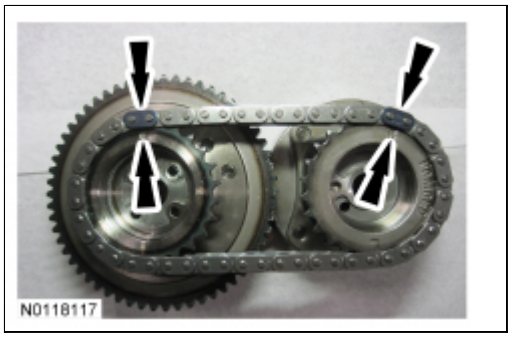


11. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.



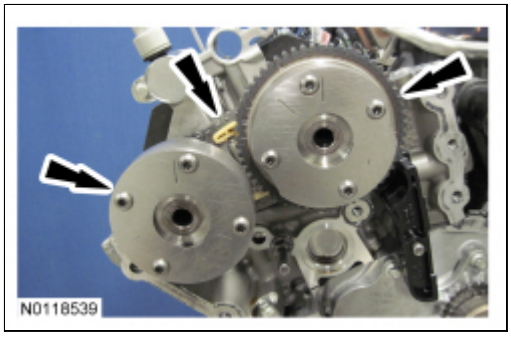
12. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

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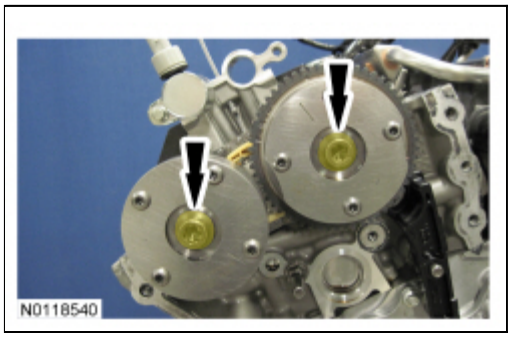


13. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

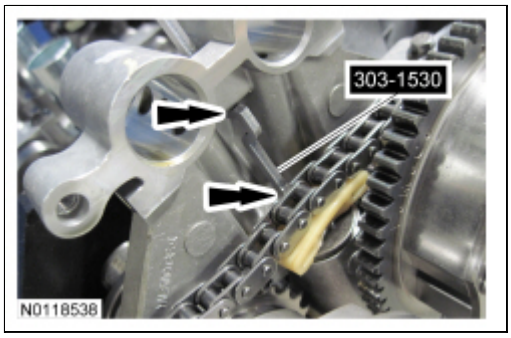


14. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

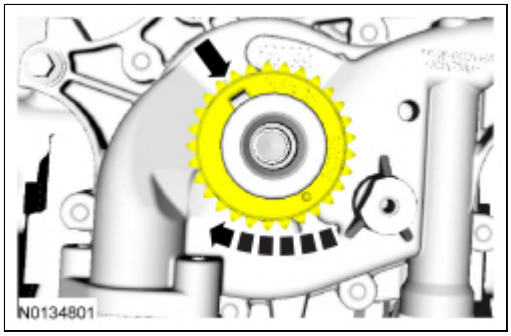


15. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

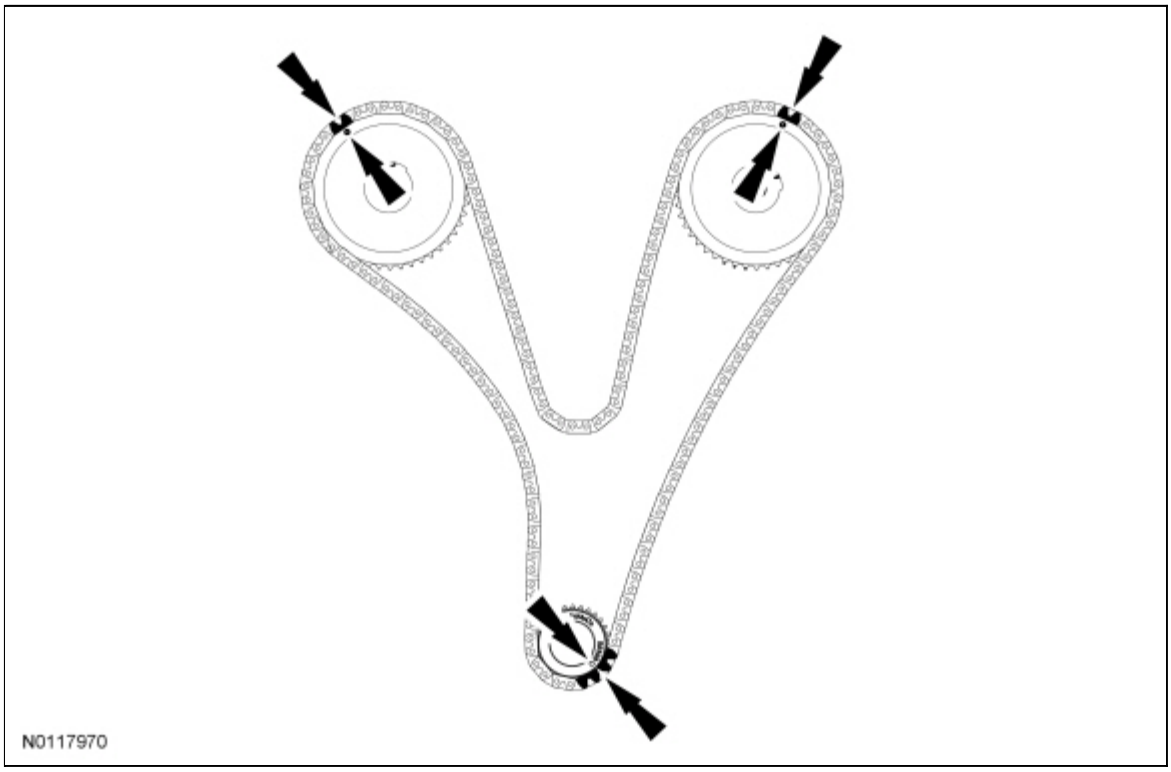


16. Rotate the crankshaft clockwise 60 degrees to the TDC position (crankshaft dowel pin at 11 o'clock).



17. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

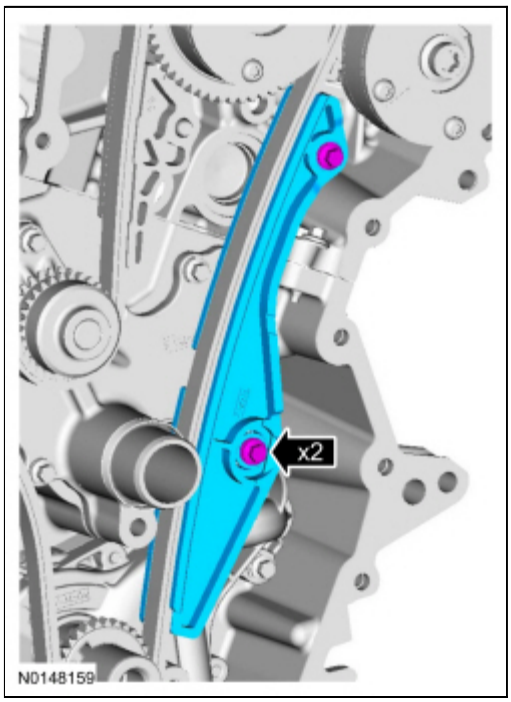
    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



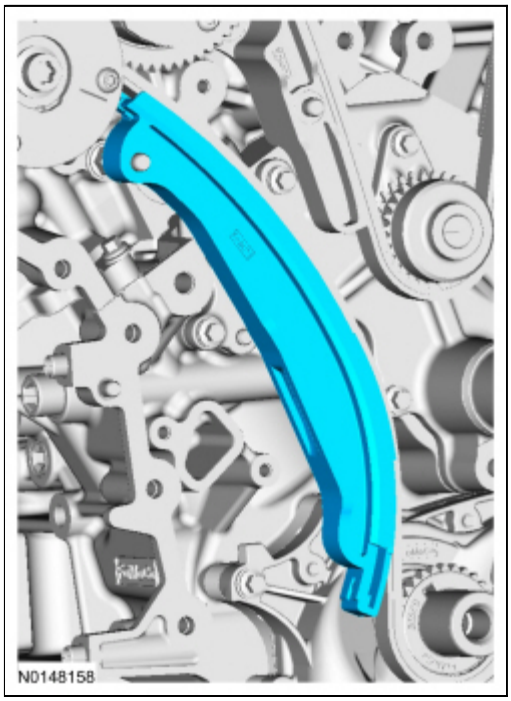
18. Install the lower LH primary timing chain guide and the 2 bolts.

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- Tighten to 10 Nm (89 lb-in).



19. Install the primary timing chain tensioner arm.

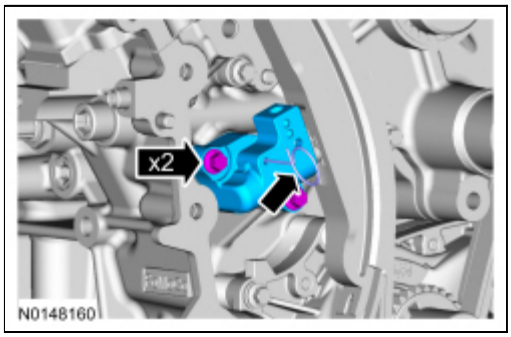


20. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.



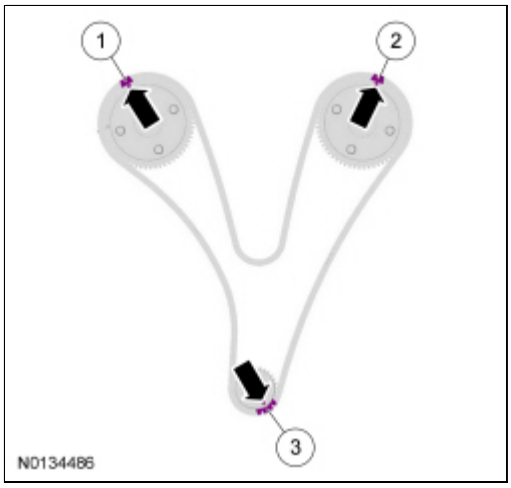
21. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

    Install the primary tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.



22. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).

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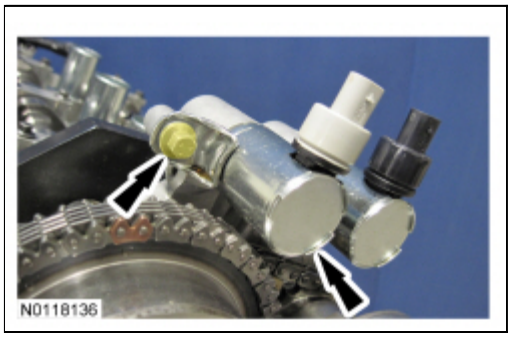
23. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



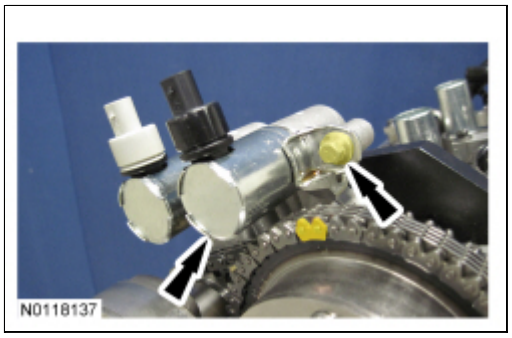
24. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

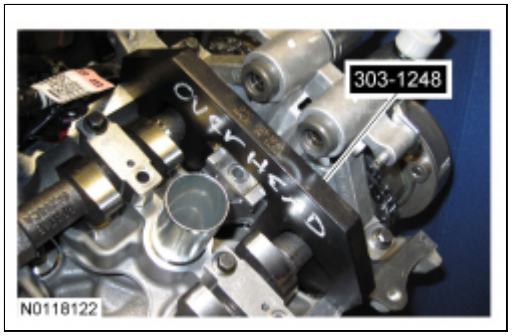
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

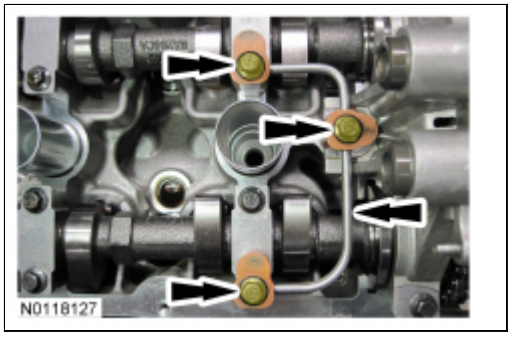
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



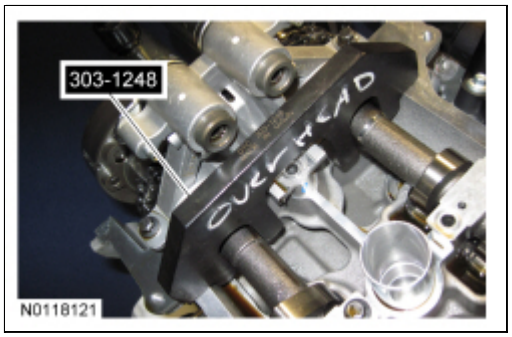
25. Remove the RH Camshaft Holding Tool.



26. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



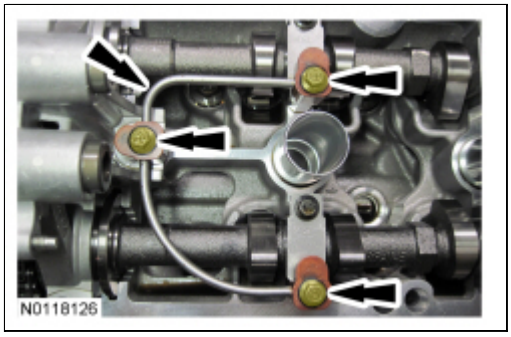
27. Remove the LH Camshaft Holding Tool.



28. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.

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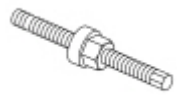
- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



29. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Crankshaft Front Seal

Special Tool(s)

 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)

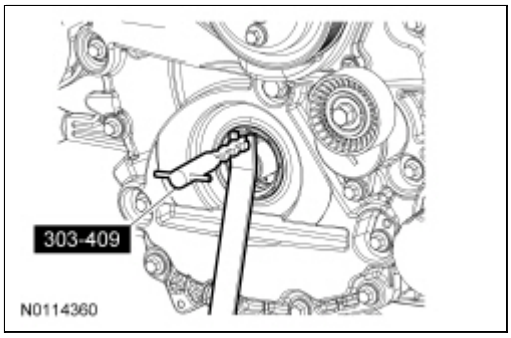
Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
3. Using the Oil Seal Remover, remove and discard the crankshaft front seal.
    - Clean all sealing surfaces with metal surface prep.

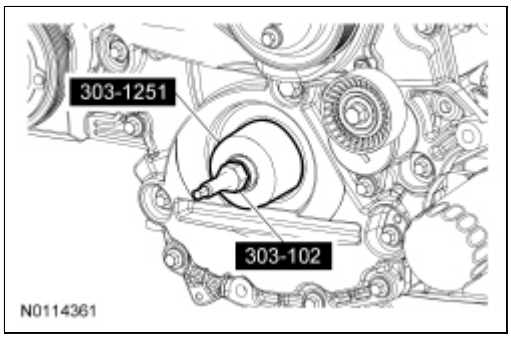
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Installation

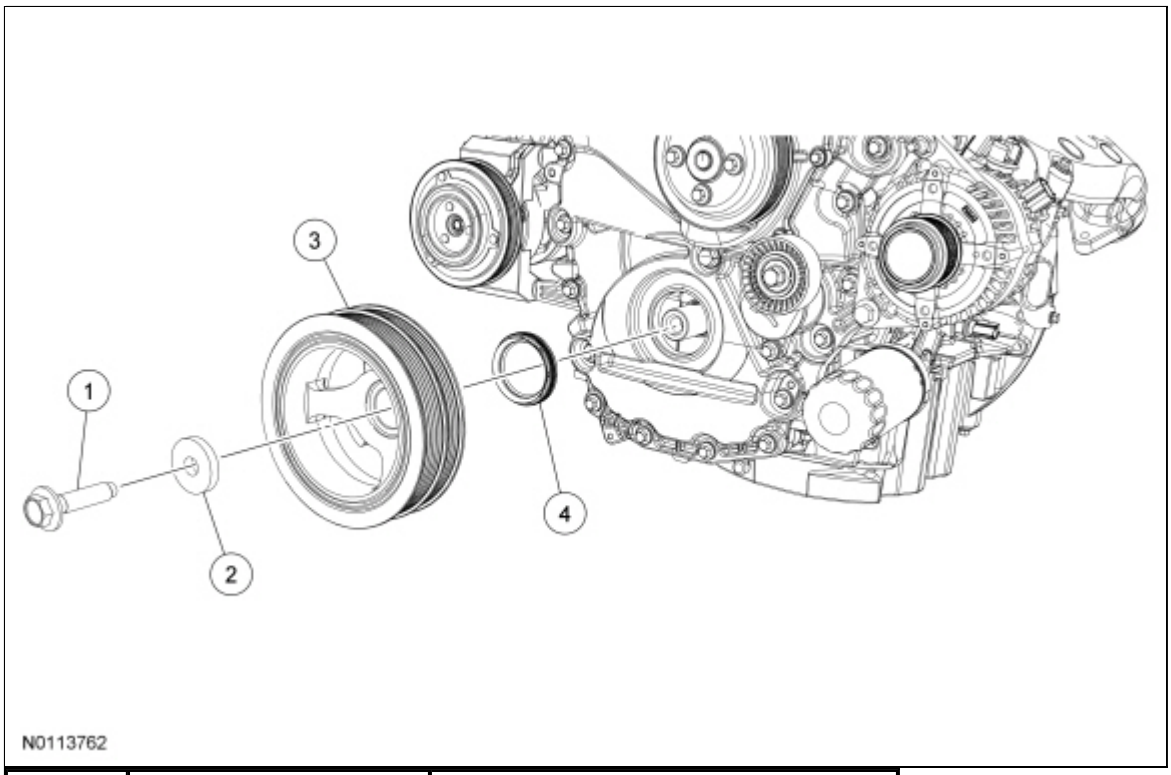
1. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

   Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Crankshaft Pulley and Crankshaft Front Seal — Exploded View



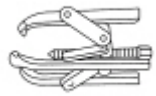
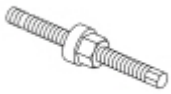
Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Washer
3	6312	Crankshaft pulley
4	6700	Crankshaft front seal

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Crankshaft Pulley

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST1287-A	Replacer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

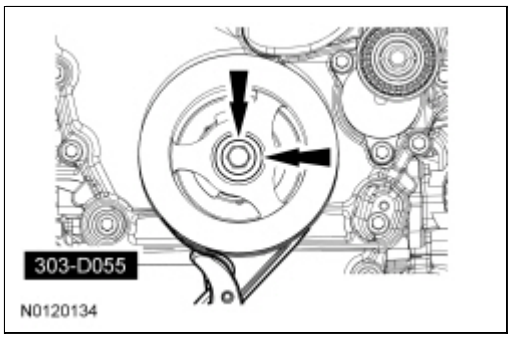
Removal

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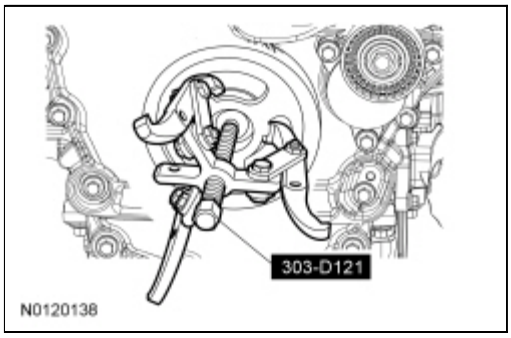
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive belt and the A/C belt. For additional information, refer to Section 303-05 .

3. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
   - Discard the bolt.



4. Using the 3 Jaw Puller, remove the crankshaft pulley.
   - Inspect the crankshaft pulley sealing surface for nicks or scratches that may effect the crankshaft front seal lip, replace the crankshaft pulley if necessary.

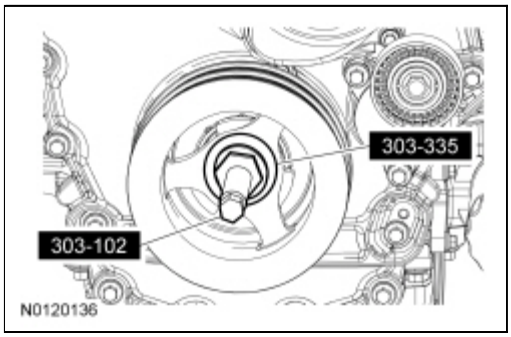


Installation

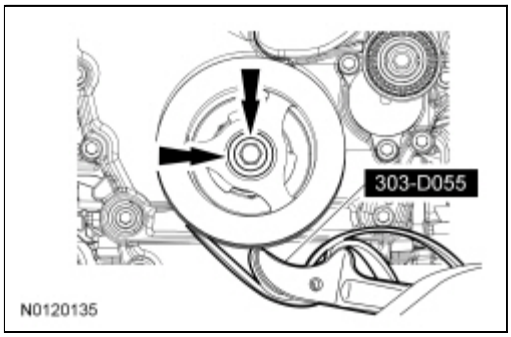
1. Lubricate the crankshaft front seal inner lip with clean engine oil.

2. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

   Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Replacer, install the crankshaft pulley.



3. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



4. Install the accessory drive belt and the A/C belt. For additional information, refer to Section 303-05 .

5. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Crankshaft Rear Seal with Retainer Plate

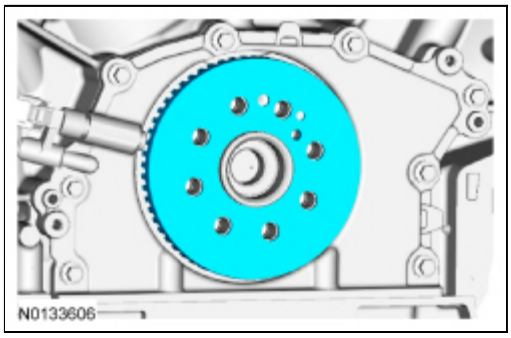
Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—

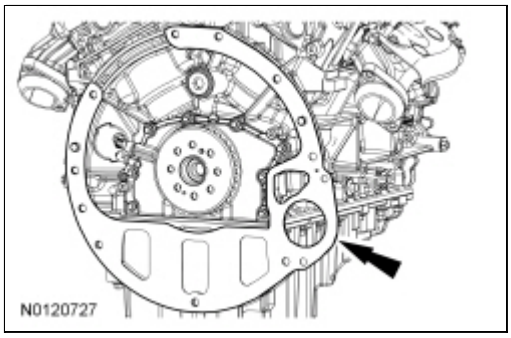
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

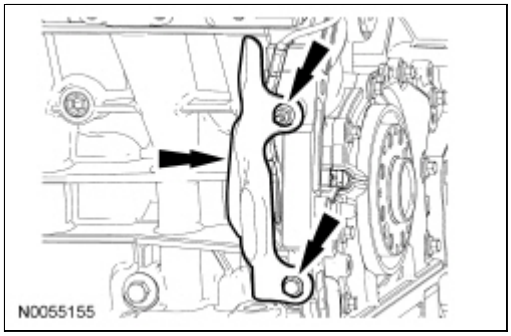
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the flexplate. For additional information, refer to Flexplate in this section.
3. Remove the crankshaft sensor ring.



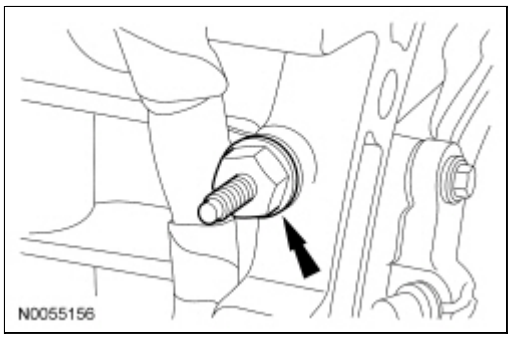
4. Remove the engine-to-transmission spacer plate.



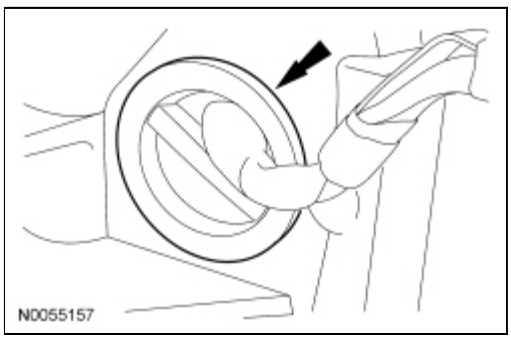
5. Remove the nut, the bolt and the heat shield.



6. Remove the wiring harness retainer stud bolt.

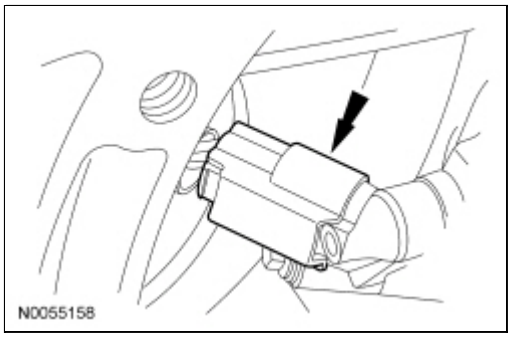


7. Remove the wiring harness grommet.

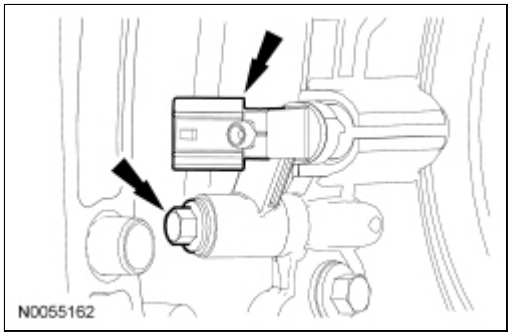


8. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

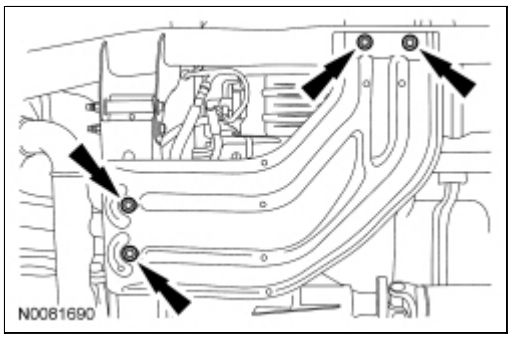
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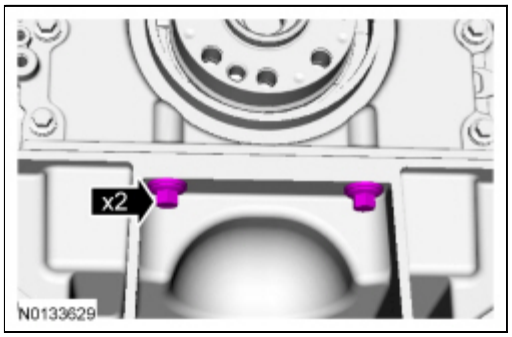
9. Remove the bolt and the CKP sensor.



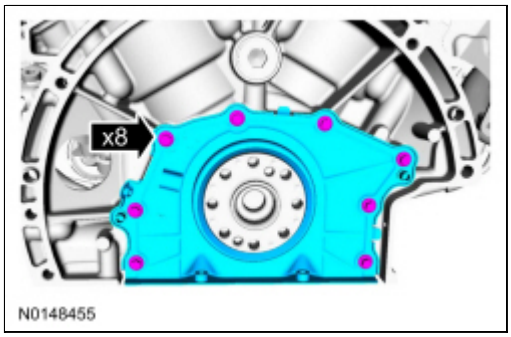
10. If equipped, remove the bolts and the skid plate.



11. Remove the 2 oil pan-to-crankshaft rear seal retainer plate bolts.



12. Remove the 8 bolts and the crankshaft rear seal retainer plate.
    - Discard the crankshaft rear seal retainer plate.



13. ***NOTICE:*** **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

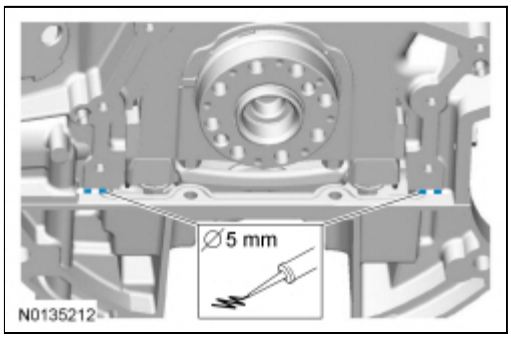
    Clean the sealing surfaces of the cylinder block and oil pan flange in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

1. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

    Apply a 5 mm (0.196 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 cylinder block/oil pan joints.



2. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

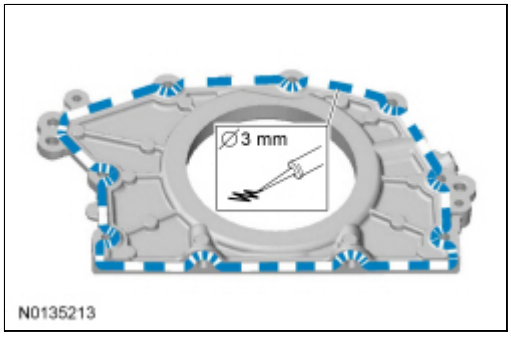
    NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

    NOTE: The stamped steel crankshaft rear seal retainer plate comes with the crankshaft rear seal.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing

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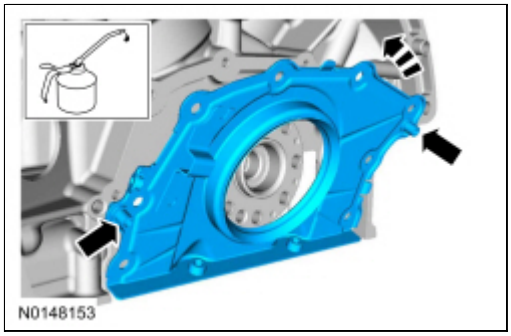
surface of the crankshaft rear seal retainer.



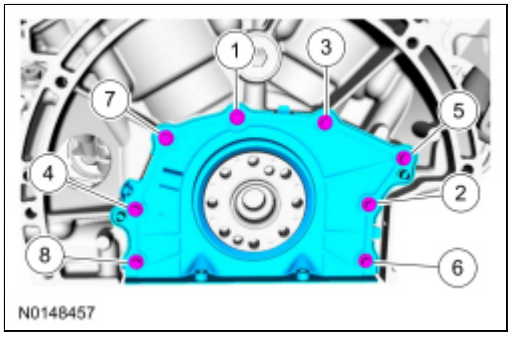
3. **NOTE:** Lubricate the crankshaft rear seal with clean engine oil.

   NOTE: Use the 2 handles during installation to avoid touching the sealant.

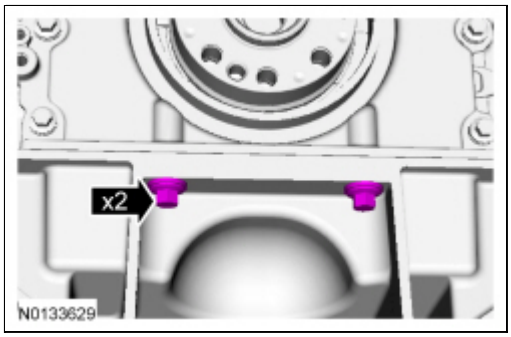
   Install the crankshaft rear seal retainer at an angle above the oil pan flange to avoid scraping off the sealer. Tilt the seal retainer up and onto the rear of the cylinder block.



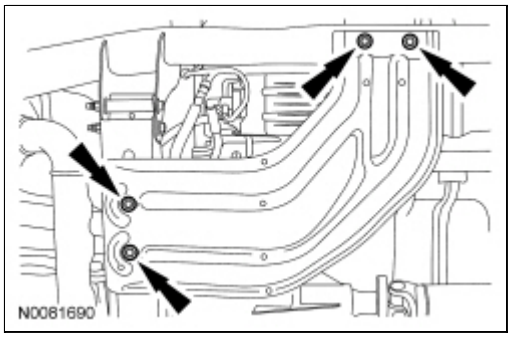
4. Install the 8 crankshaft rear seal retainer plate bolts. Tighten in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).



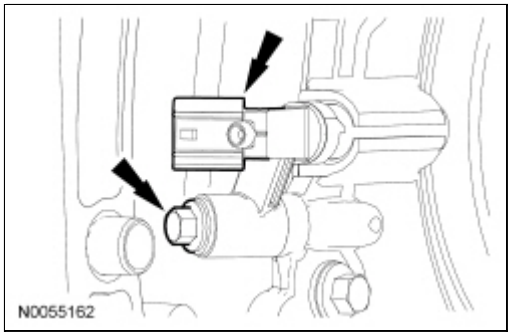
5. Install the 2 oil pan-to-crankshaft rear seal retainer plate bolts.
   - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.



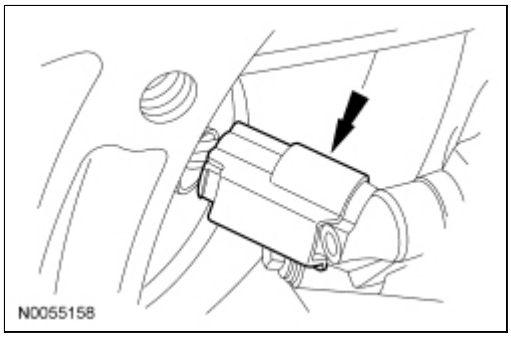
6. If equipped, install the skid plate and the bolts.
    - Tighten to 48 Nm (35 lb-ft).



7. Install the CKP sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).

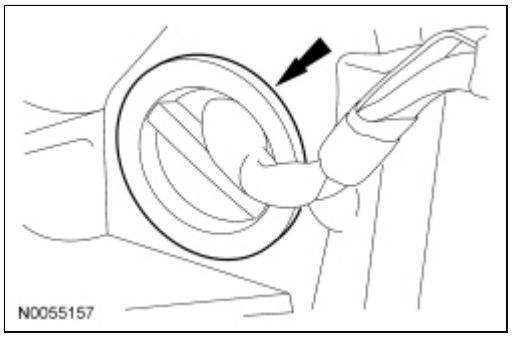


8. Connect the CKP sensor electrical connector.

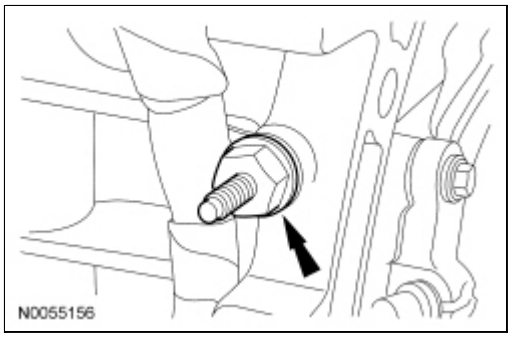


9. Install the wiring harness grommet.

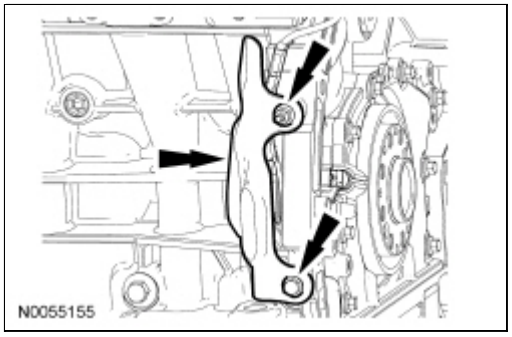
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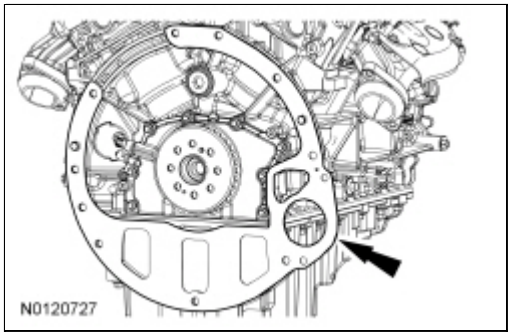
10. Install the wiring harness retainer stud bolt.
    - Tighten to 10 Nm (89 lb-in).



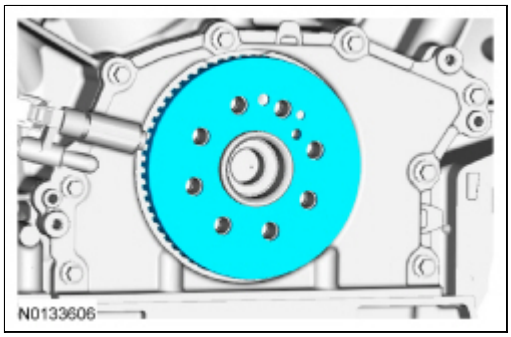
11. Install the heat shield, the nut and the bolt.
    - Tighten to 10 Nm (89 lb-in).



12. Install the engine-to-transmission spacer plate.



13. Install the crankshaft sensor ring.



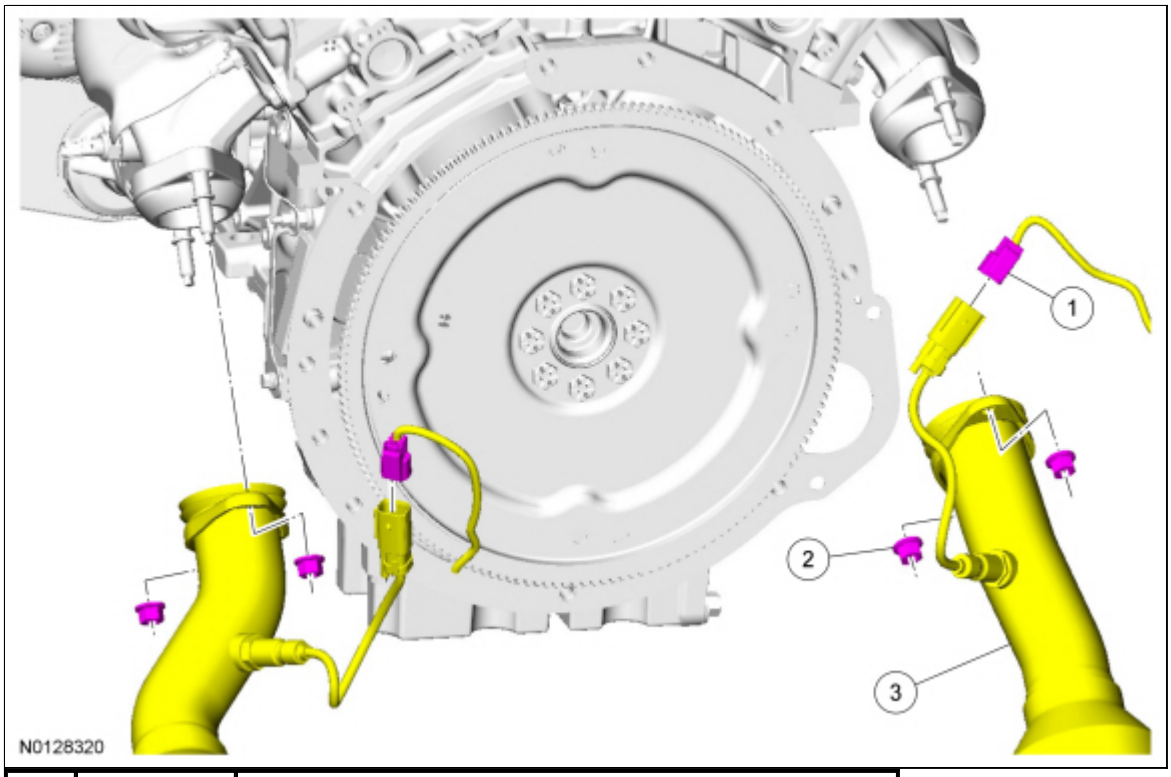
14. Install the flexplate. For additional information, refer to Flexplate in this section.

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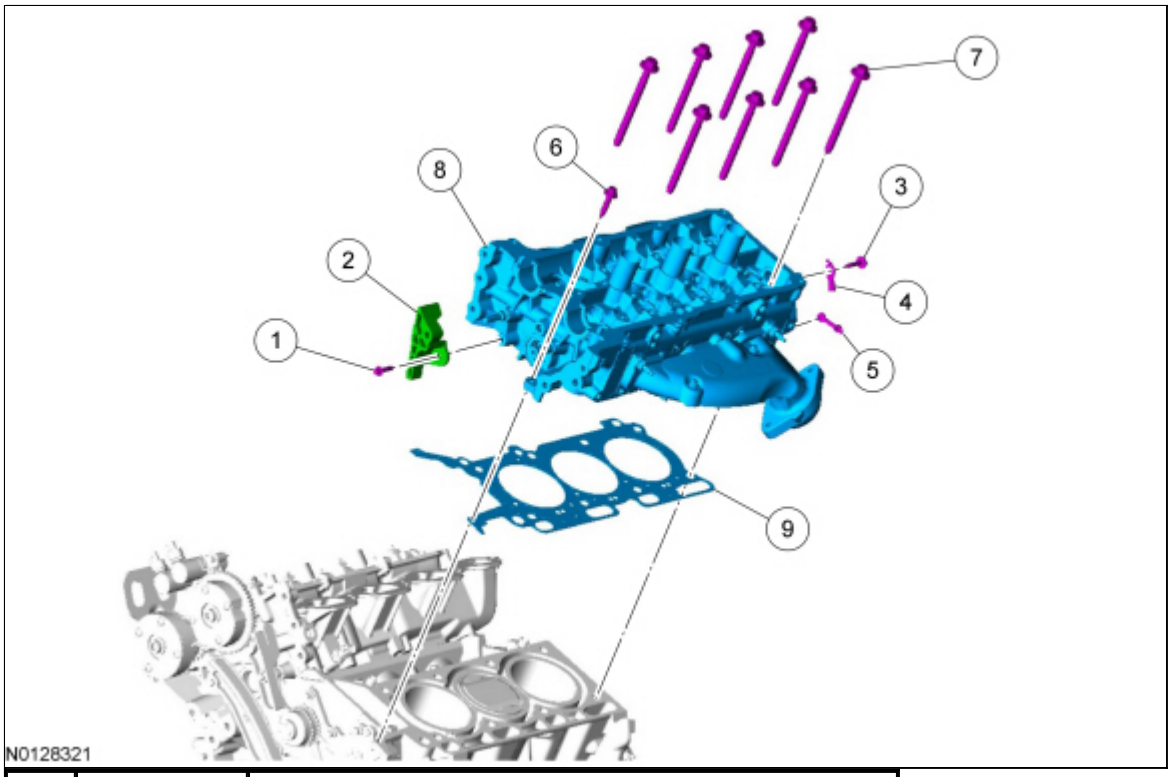
Cylinder Head — LH

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connector (part of 14A411) (2 required)
2	W714265	Catalytic converter-to-exhaust manifold nuts (4 required) - 45 Nm (35 lb-ft)
3	5F250	Catalytic converter assembly (Y-pipe)



Item	Part Number	Description
1	W709818	LH upper primary timing chain guide bolt - 10 Nm (89 lb-in)
2	6K297	LH upper primary timing chain guide
3	W707193	Ground strap bolt - 10 Nm (89 lb-in)
4	19A095	Ground strap
5	—	Wiring harness retainer (part of 14A411)
6	W710702	Cylinder head M6 bolt
7	6065	Cylinder head bolt (8 required)
8	6049	Cylinder head
9	6051	Cylinder head gasket

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio

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equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

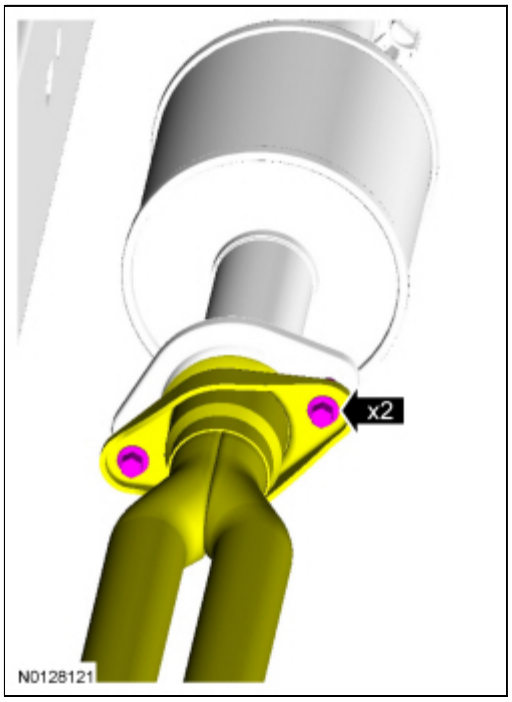
WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Detach and disconnect the RH and LH Heated Oxygen Sensor (HO2S) electrical connectors.
4. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.



5. Remove and discard the LH and RH catalytic convertor-to-exhaust manifold nuts and lower the catalytic convertor assembly.

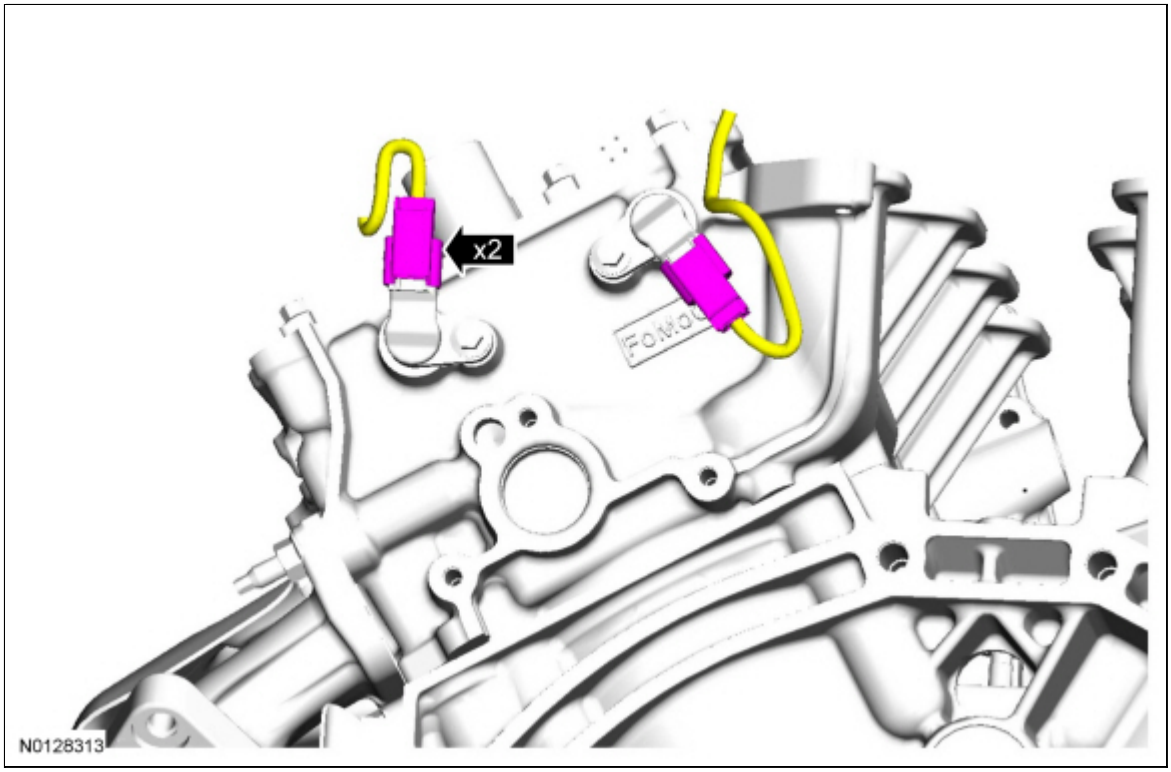
6. Remove the LH camshafts. For additional information, refer to Camshaft — LH in this section.

7. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

8. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.**

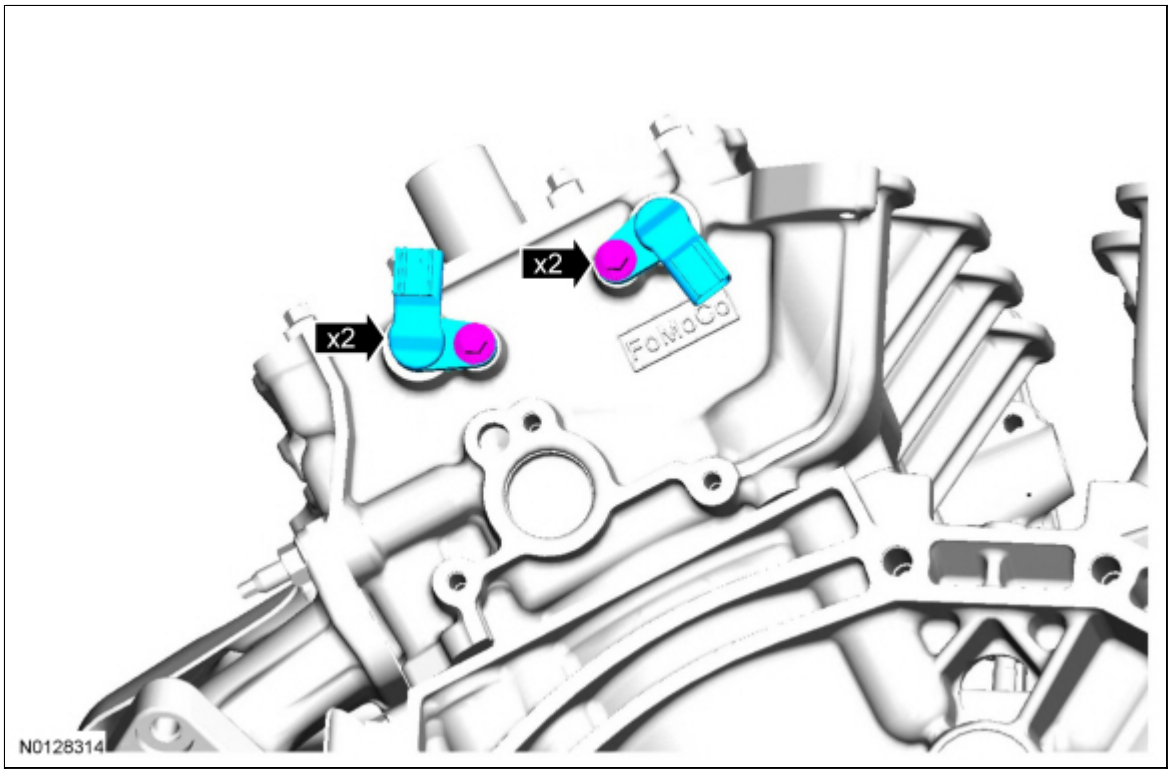
   Remove the bolt and the LH upper primary timing chain guide.

9. Disconnect the 2 LH Camshaft Position (CMP) sensors electrical connectors.

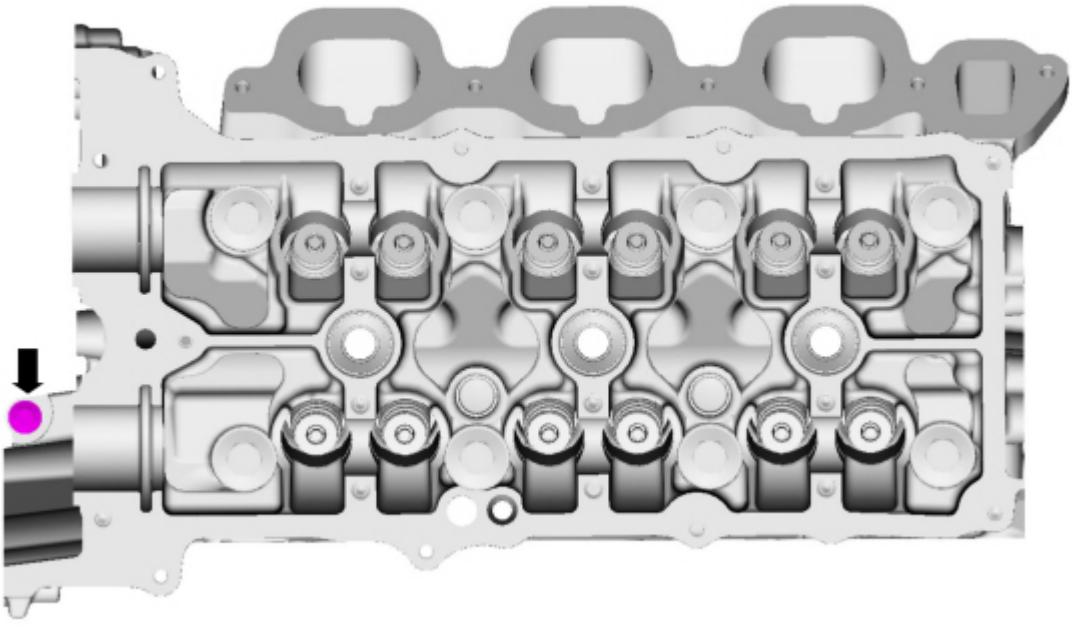


10. Remove the 2 bolts and the 2 LH CMP sensors.

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11. If equipped, remove the bolt and ground strap from the rear of the LH cylinder head.
12. Detach the wiring harness retainer from the rear of the LH cylinder head.
13. Inspect the valve tappets. For additional information, refer to Section 303-00 .
14. Remove and discard the M6 bolt.



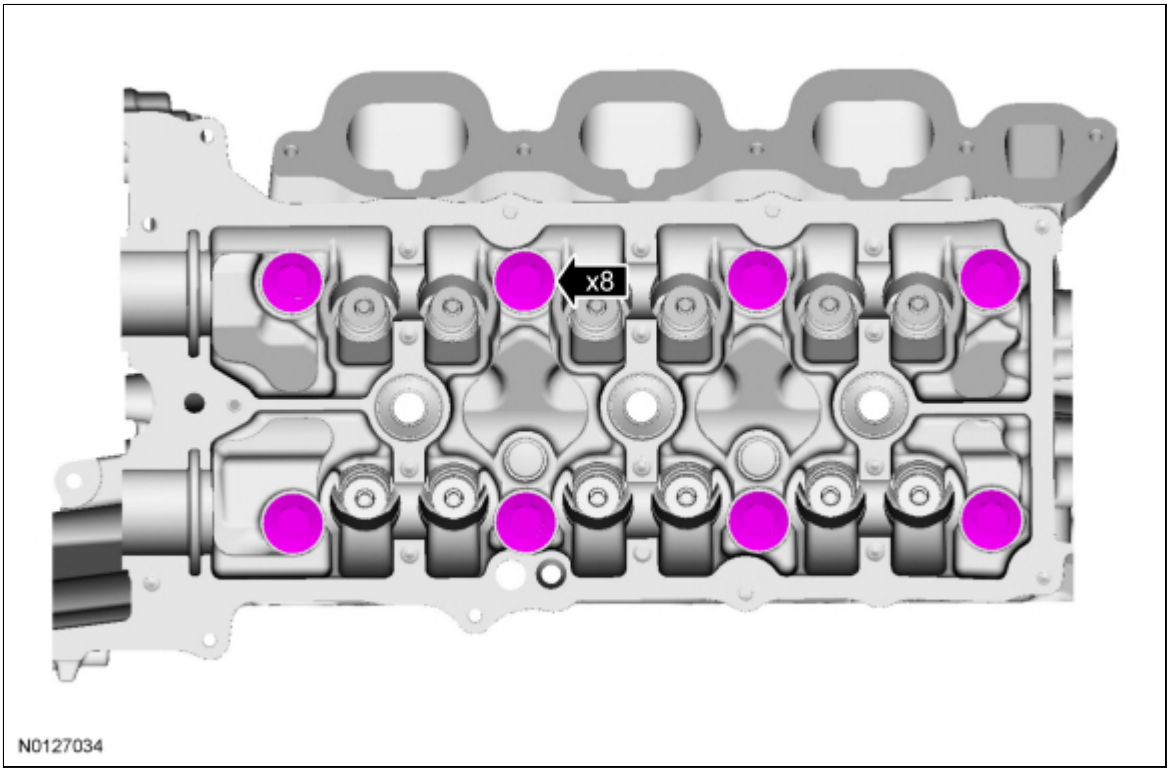
15. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure**

    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove and discard the 8 bolts from the cylinder head.
    - Remove the cylinder head.
    - Discard the cylinder head gasket.

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16. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

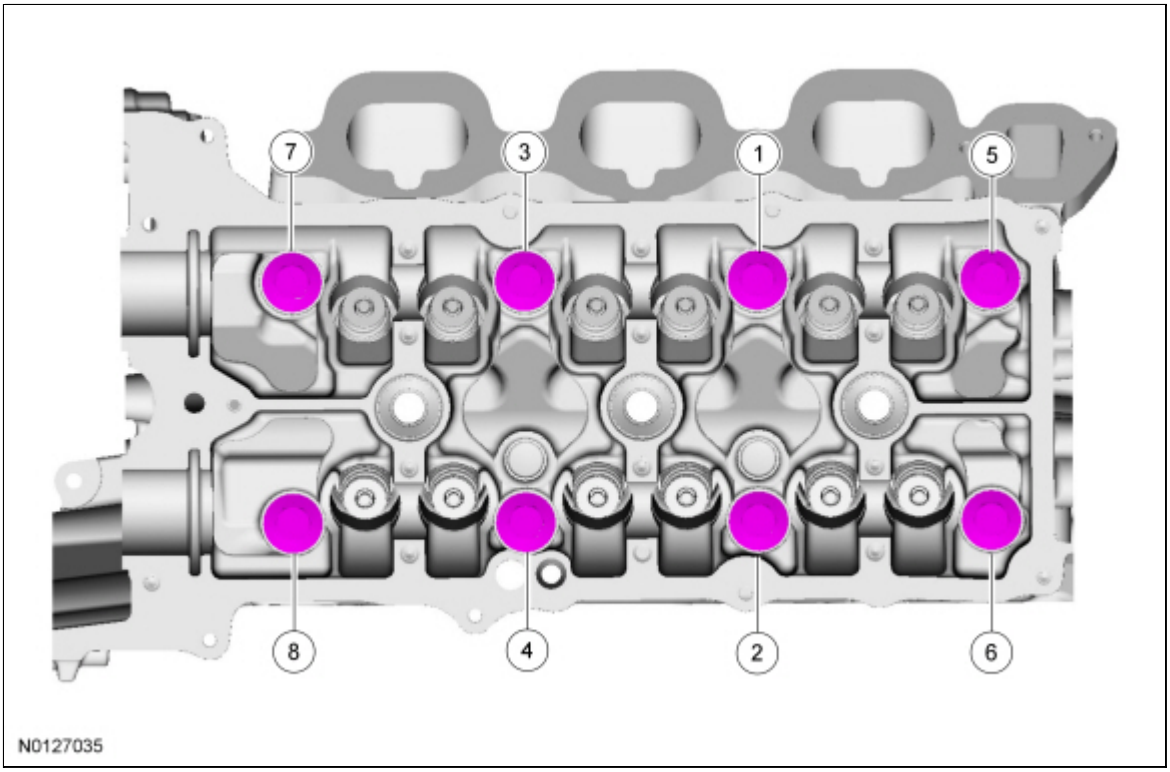
17. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Installation

1. **NOTE:** If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

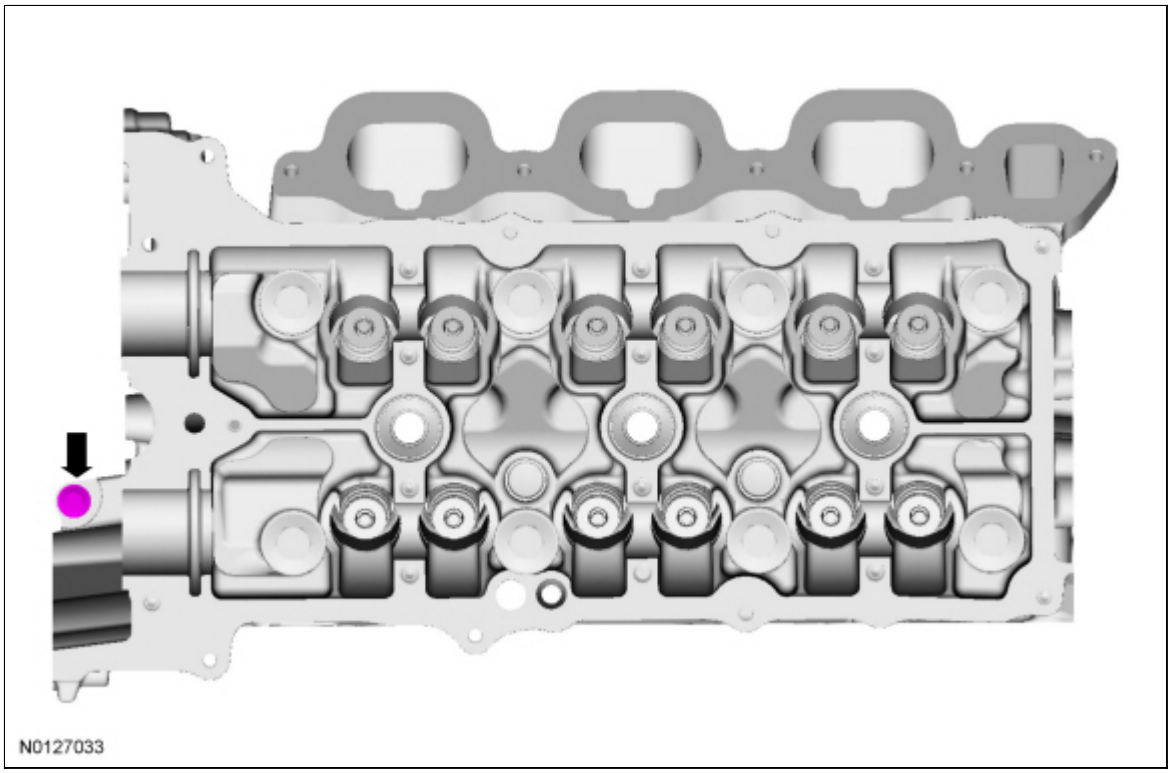
   Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:

- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 35 Nm (26 lb-ft).
- Stage 3: Tighten 90 degrees.
- Stage 4: Tighten 90 degrees
- Stage 5: Tighten 45 degrees.



2. Install the M6 bolt.
    - Tighten to 10 Nm (89 lb-in).

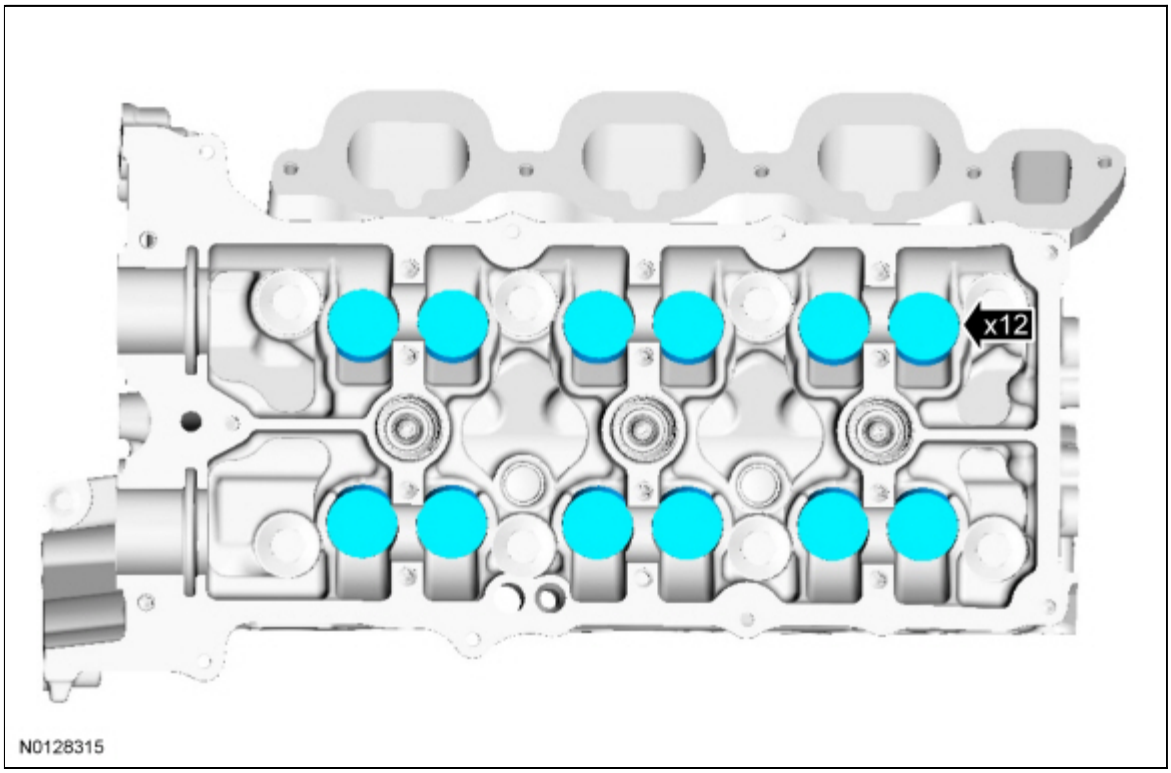
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3. **NOTE:** The valve tappets must be installed in their original positions.

   NOTE: Coat the valve tappets with clean engine oil prior to installation.

   Install the LH valve tappets.

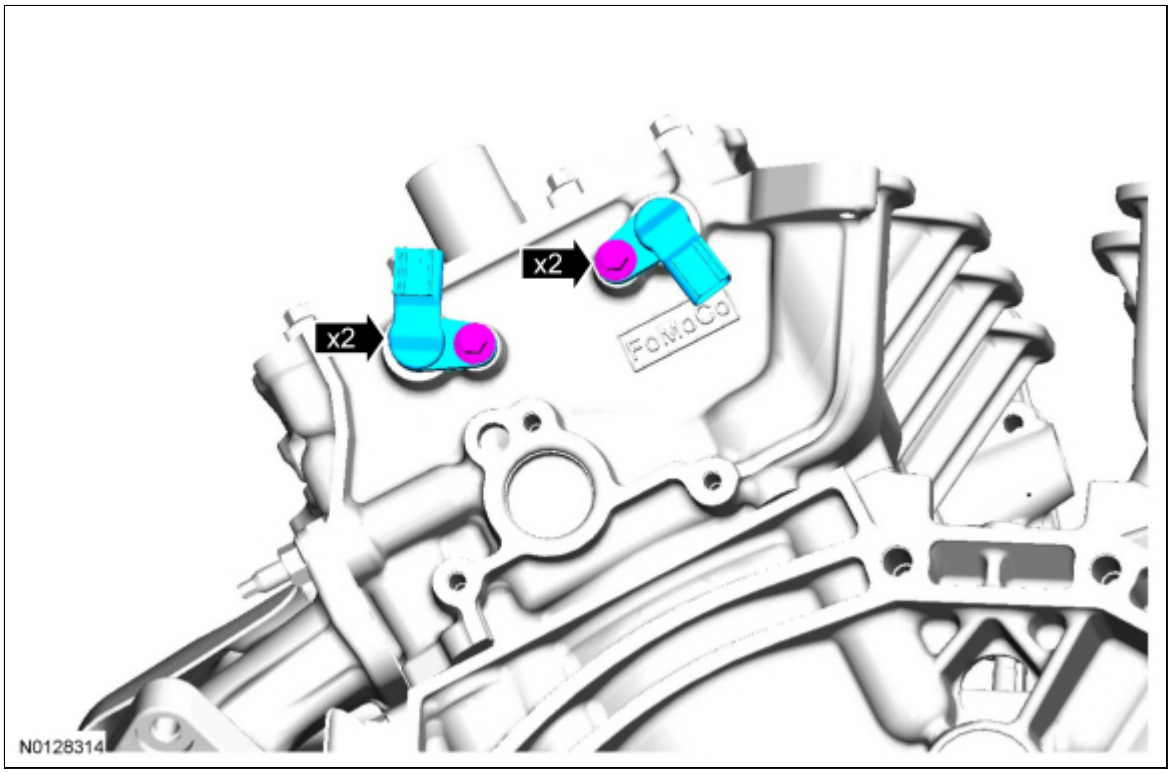


4. Attach the wiring harness retainer to the rear of the LH cylinder head.

5. If equipped, install the ground strap and bolt.
   - Tighten the bolt to 10 Nm (89 lb-in).

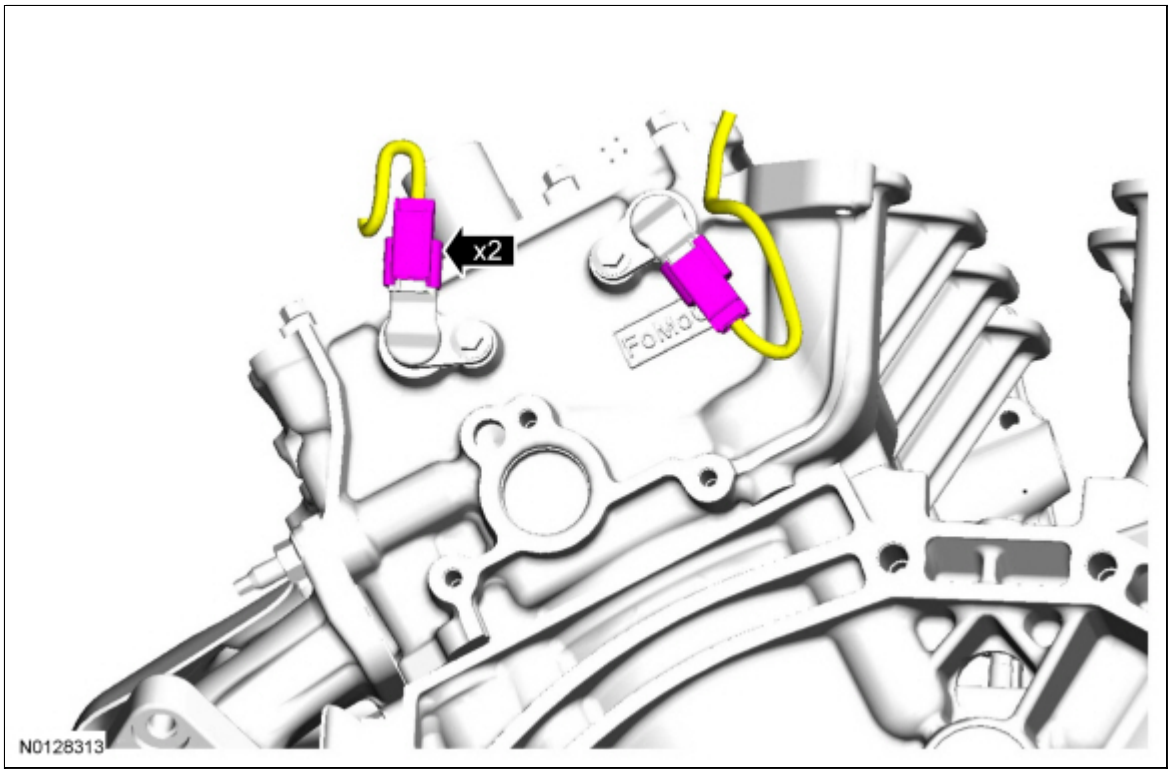
6. **NOTE:** Lubricate the 2 CMP sensor O-ring seals with clean engine oil.

   Install the 2 LH CMP sensors and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



7. Connect the 2 LH CMP sensors electrical connectors.

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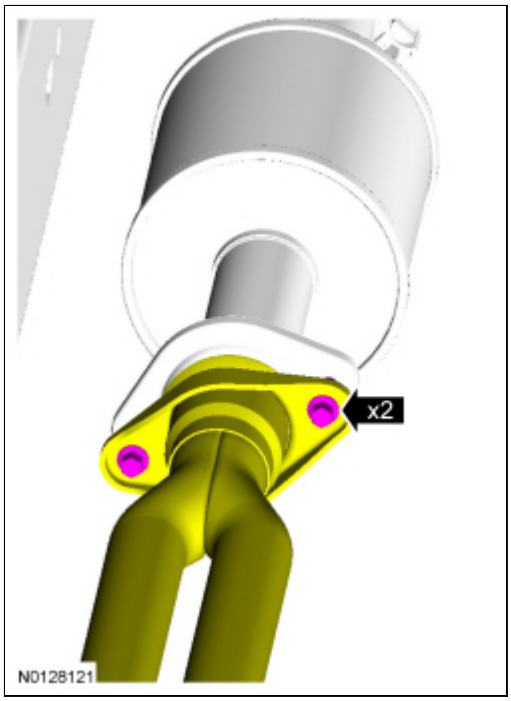
8. Install the LH upper primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

9. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

10. Install the LH camshafts. For additional information, refer to Camshaft — LH in this section.

11. Raise the catalytic convertor and install the new LH and RH catalytic convertor-to-exhaust manifold nuts.
    - Tighten to 45 Nm (35 lb-ft).

12. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



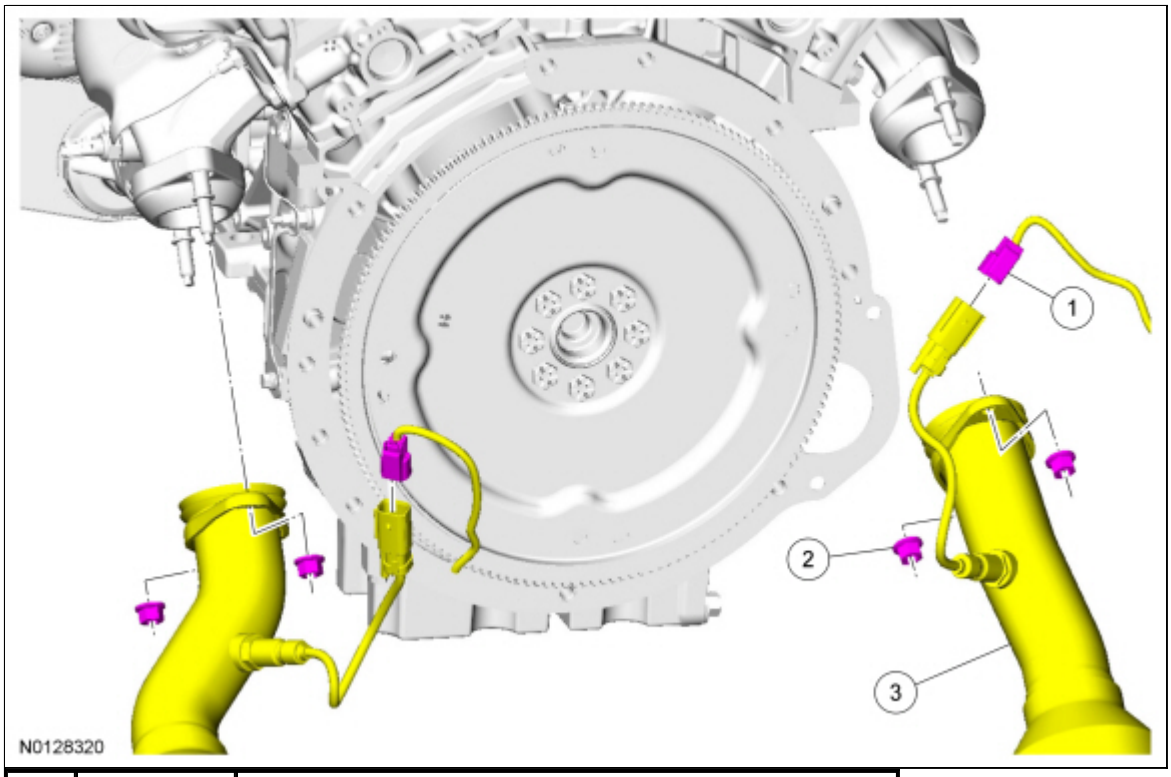
13. Connect and attach the RH and LH HO2S electrical connectors.
14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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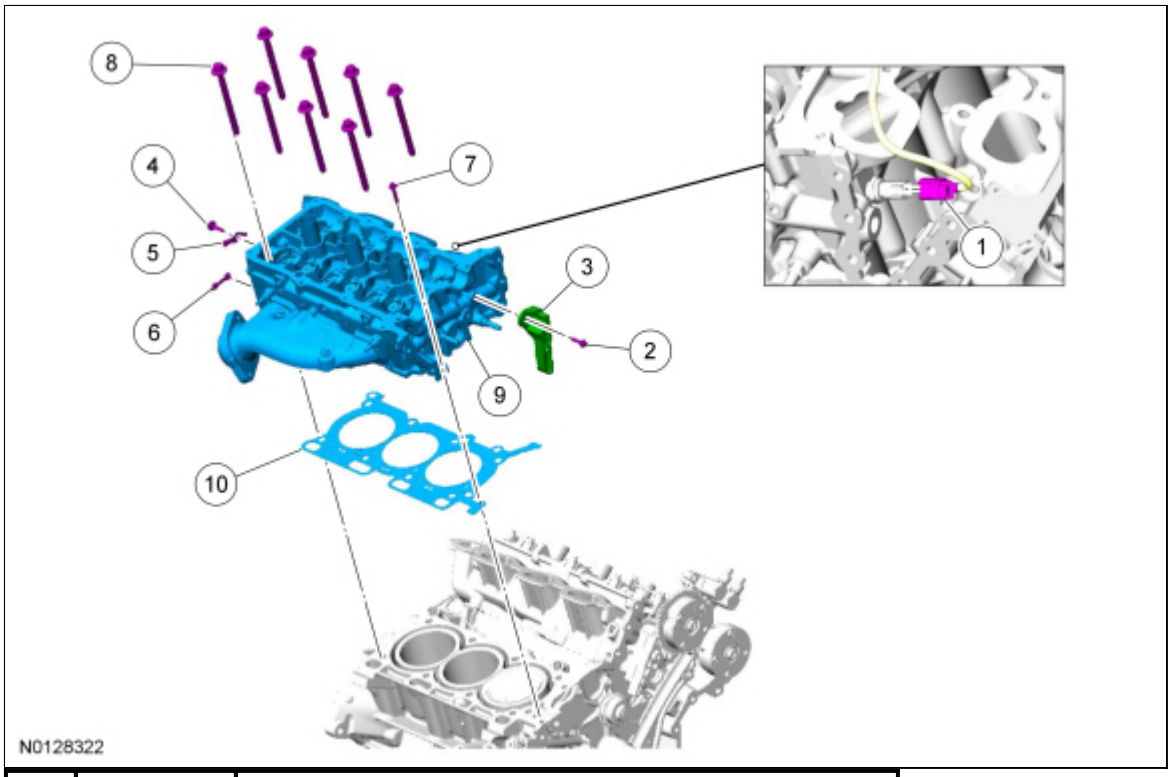
Cylinder Head — RH

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connector (part of 14A411) (2 required)
2	W714265	Catalytic converter-to-exhaust manifold nuts (4 required) - 45 Nm (35 lb-ft)
3	5F250	Catalytic converter assembly (Y-pipe)



Item	Part Number	Description
1	—	Cylinder Head Temperature (CHT) sensor electrical connector (part of 14A411)
2	W715118	RH primary timing chain guide bolt - 10 Nm (89 lb-in)
3	6K297	RH upper primary timing chain guide
4	W705661	Ground wire bolt - 10 Nm (89 lb-in)
5	19A095	Ground wire
6	—	Wiring harness retainer (part of 15525)
7	W710702	Cylinder head M6 bolt
8	6065	Cylinder head bolt (8 required)
9	6049	Cylinder head
10	6051	Cylinder head gasket

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

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WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

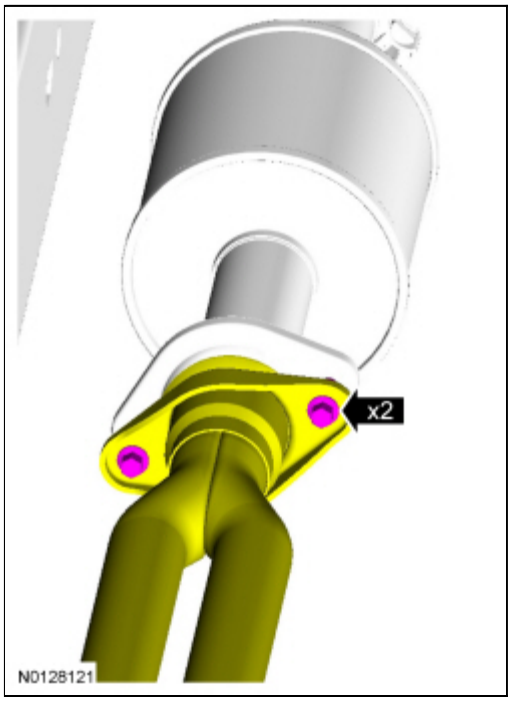
WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

NOTE: If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Detach and disconnect the RH and LH Heated Oxygen Sensor (HO2S) electrical connectors.
4. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.



5. Remove and discard the LH and RH catalytic converter-to-exhaust manifold nuts and lower the catalytic converter assembly.

6. Remove the RH camshafts. For additional information, refer to Camshaft — RH in this section.

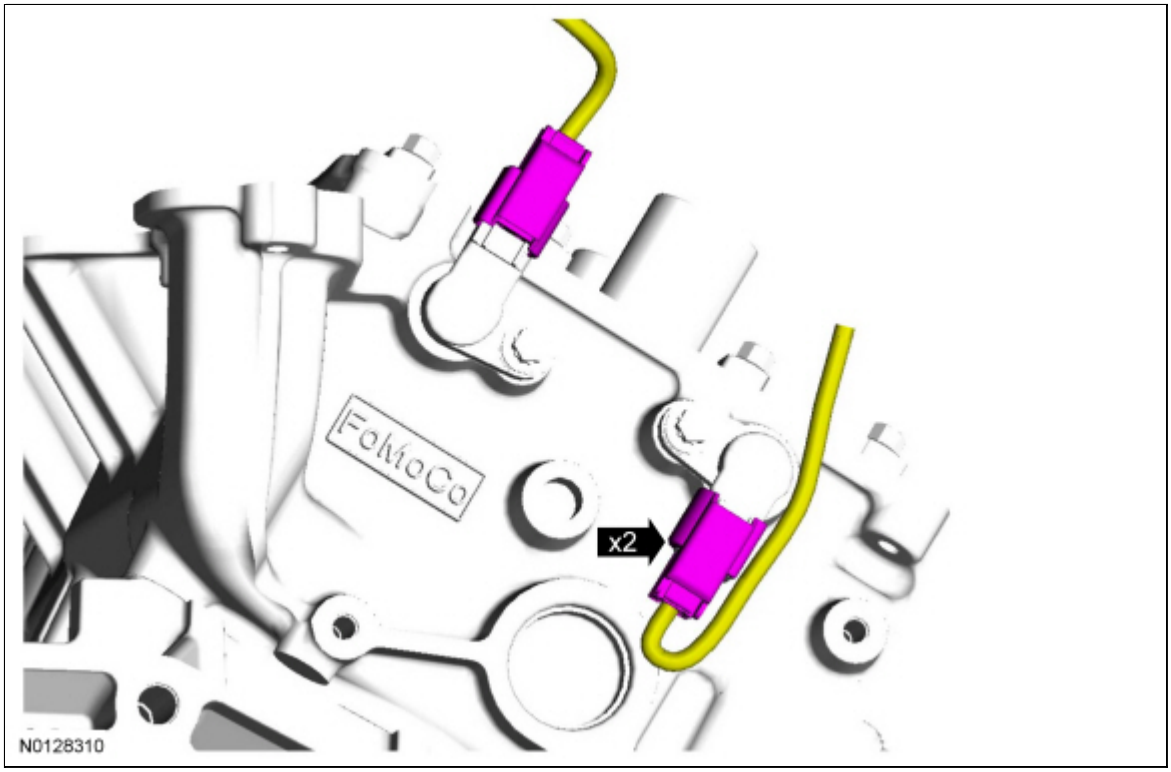
7. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

8. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

9. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.**

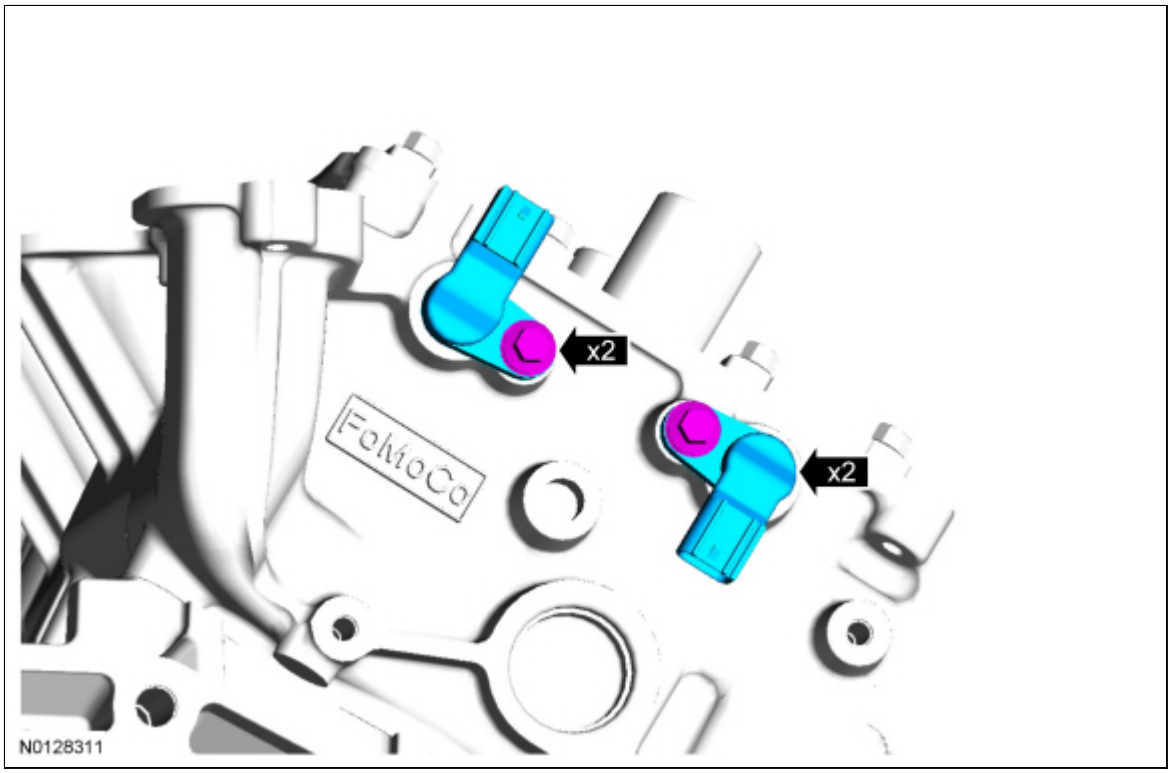
   Remove the bolt and the RH upper primary timing chain guide.

10. Disconnect the 2 RH Camshaft Position (CMP) sensors electrical connectors.

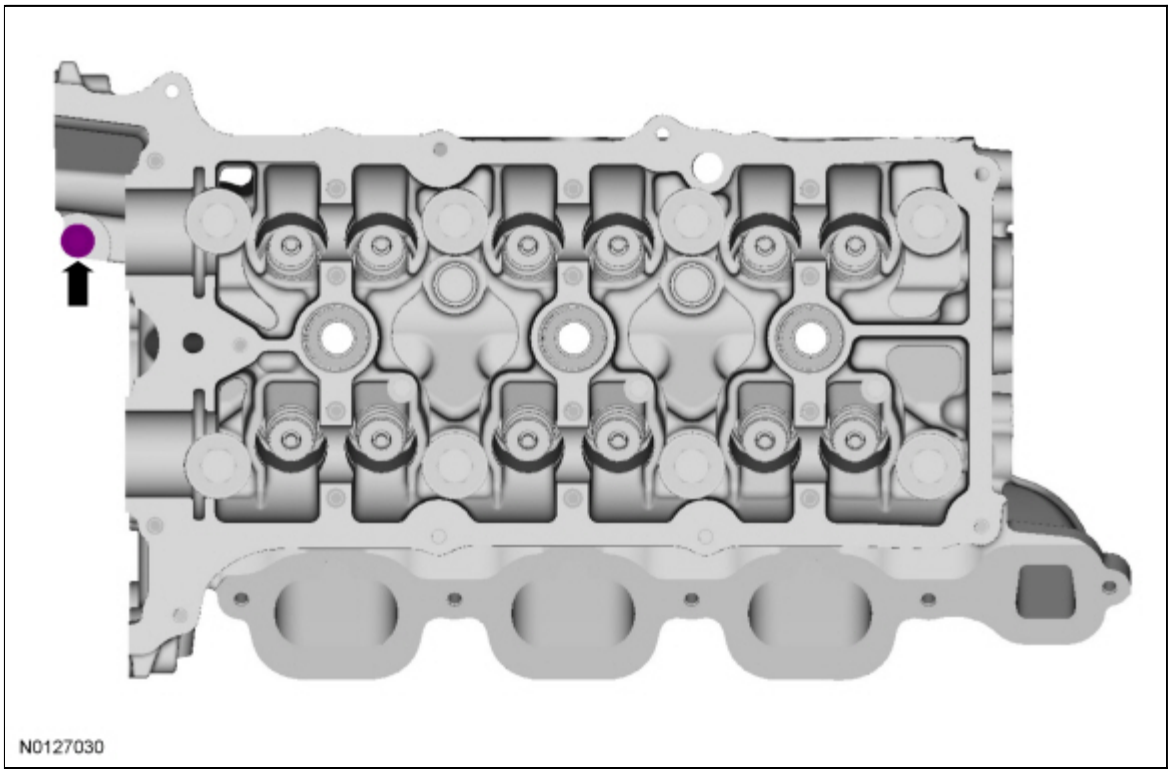


11. Remove the 2 bolts and the 2 RH CMP sensors.

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12. Remove the bolt and ground wire from the rear of the RH cylinder head.
13. Inspect the valve tappets. For additional information, refer to Section 303-00 .
14. Remove and discard the M6 bolt.

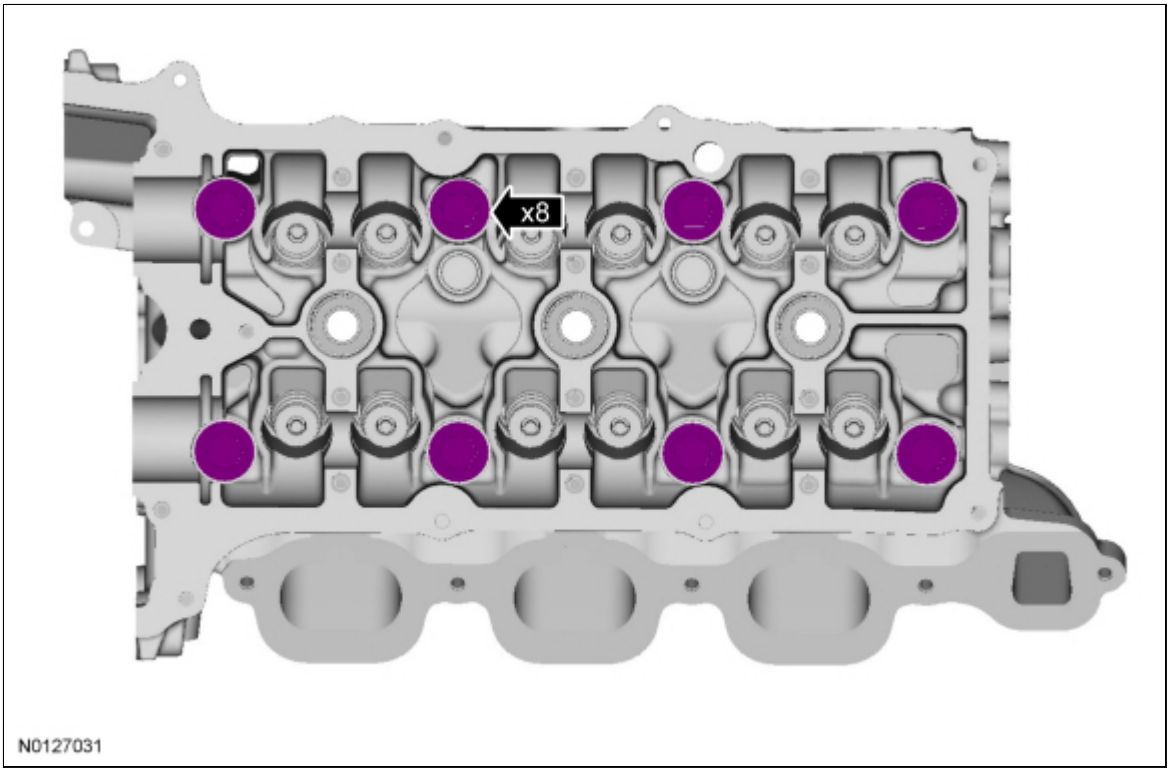


15. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure**

    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove and discard the 8 bolts from the cylinder head.
    - Remove the cylinder head.
    - Discard the cylinder head gasket.



16. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone

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gasket remover may be required if residual traces of silicone or gasket material remain.

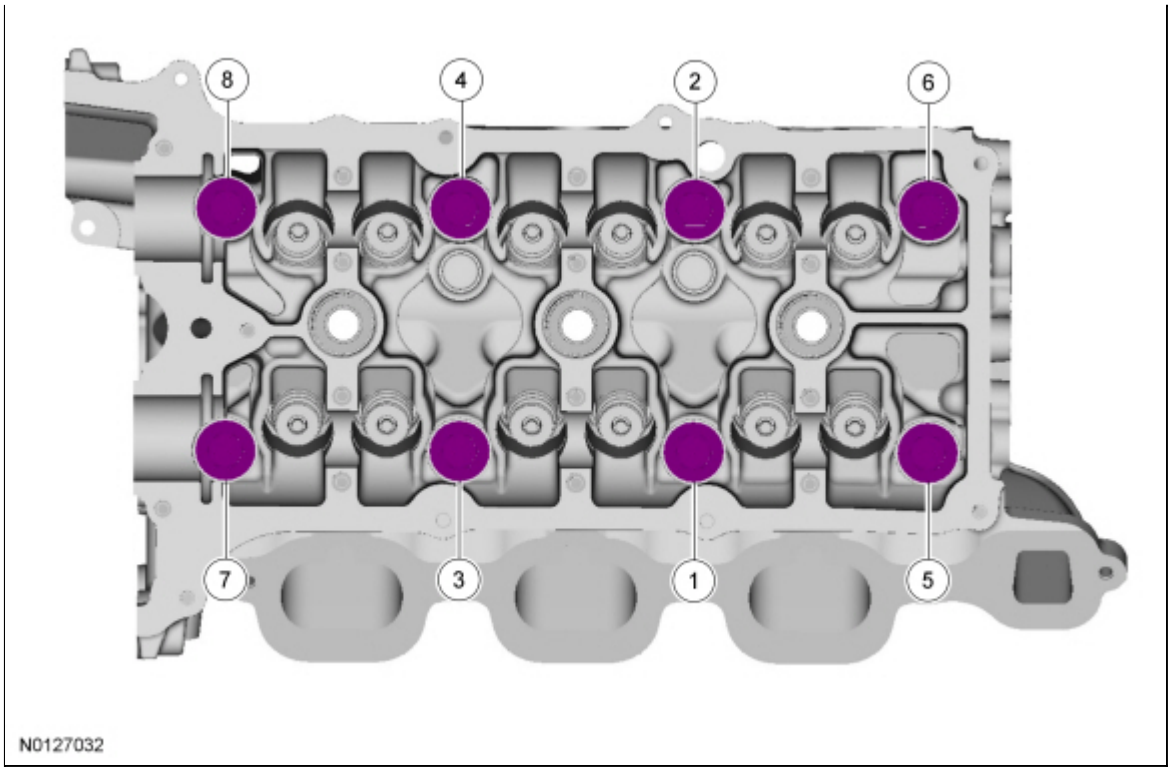
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

17. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

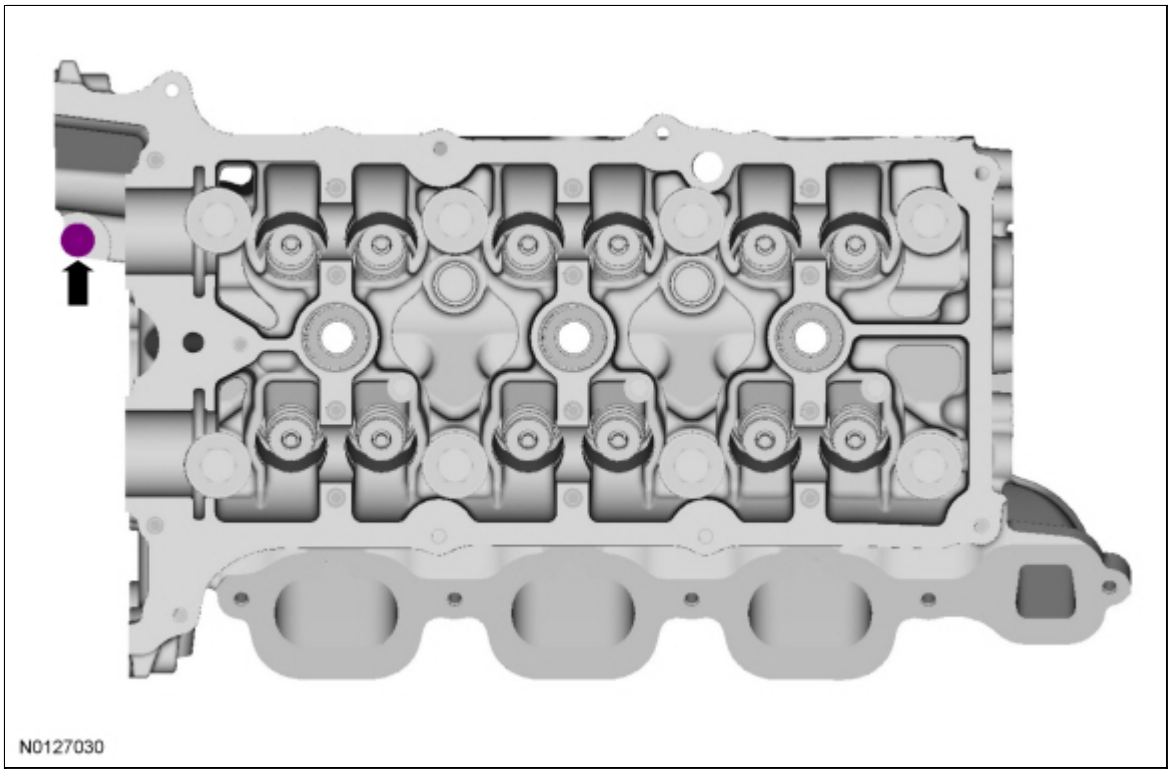
Installation

1. **NOTE:** If the cylinder head is replaced, a new secondary timing chain tensioner will need to be installed.

   Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 35 Nm (26 lb-ft).
   - Stage 3: Tighten 90 degrees.
   - Stage 4: Tighten 90 degrees
   - Stage 5: Tighten 45 degrees.



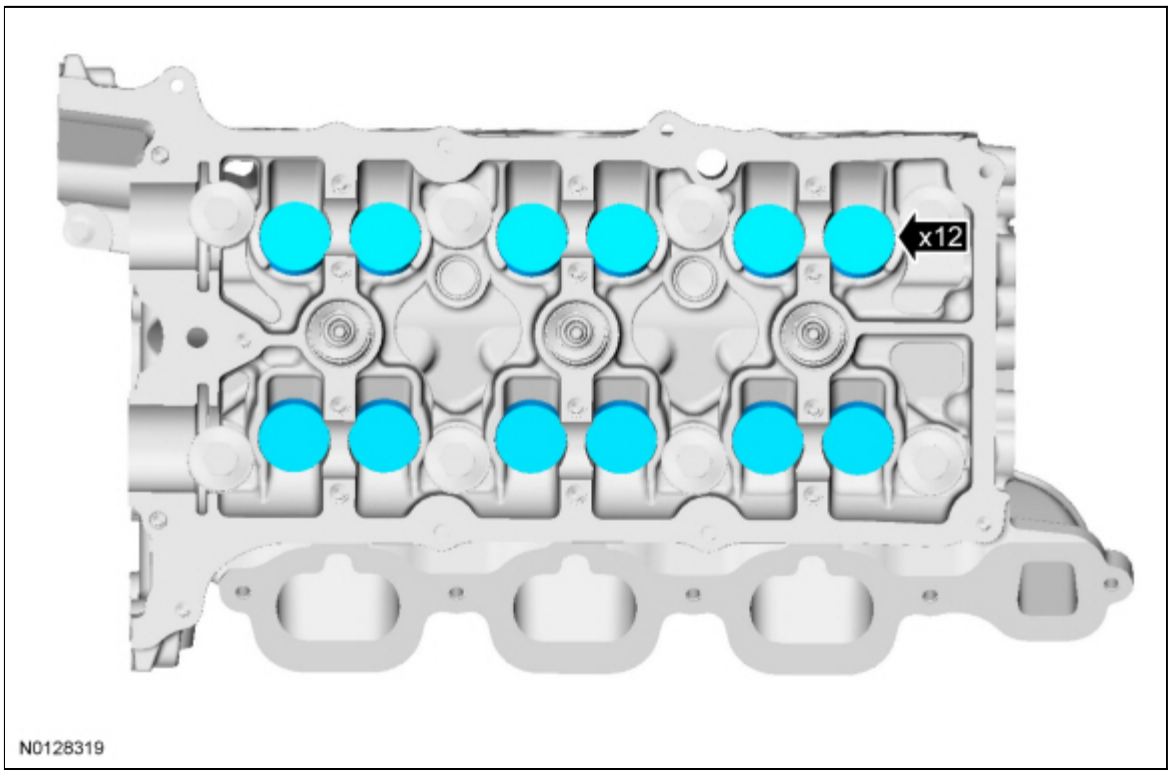
2. Install the M6 bolt.
   - Tighten to 10 Nm (89 lb-in).



3. **NOTE:** The valve tappets must be installed in their original positions.

   NOTE: Coat the valve tappets with clean engine oil prior to installation.

   Install the RH valve tappets.

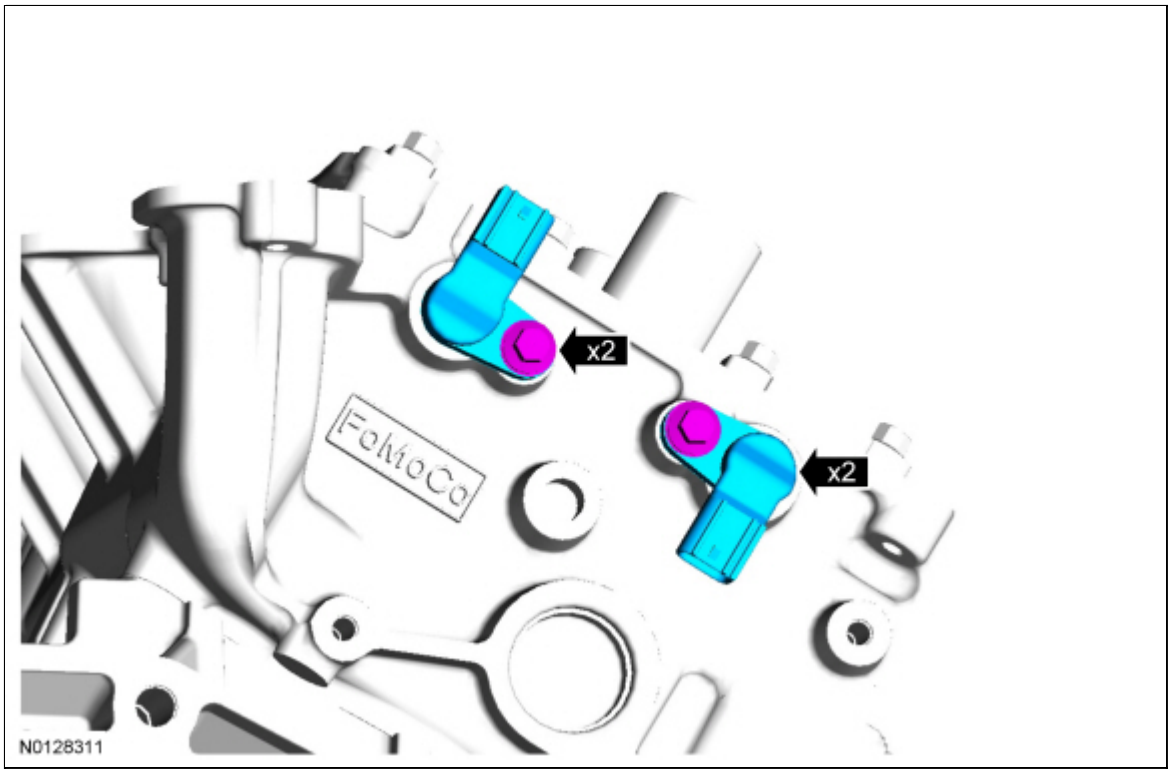


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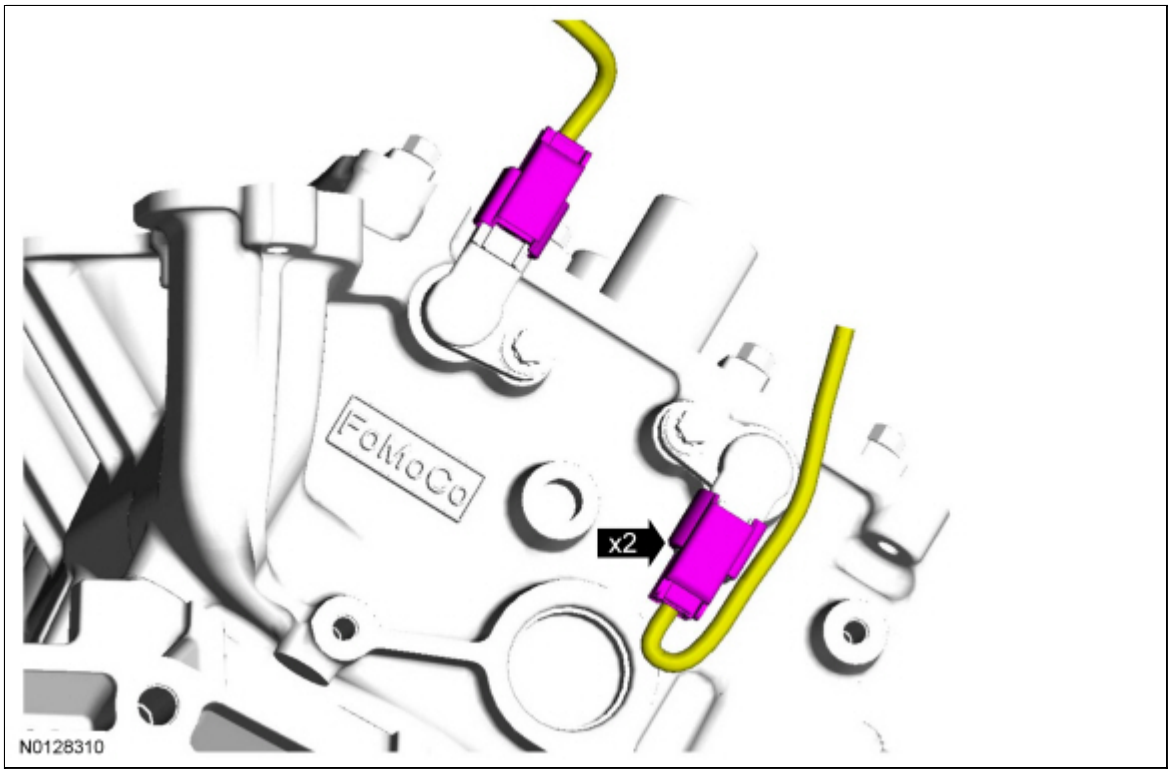
4. Install the ground wire and bolt to the rear of the RH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

5. **NOTE:** Lubricate the 2 CMP sensor O-ring seals with clean engine oil.

   Install the 2 RH CMP sensors and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



6. Connect the 2 RH CMP sensors electrical connectors.



7. Install the RH upper primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

8. Connect the CHT sensor electrical connector.

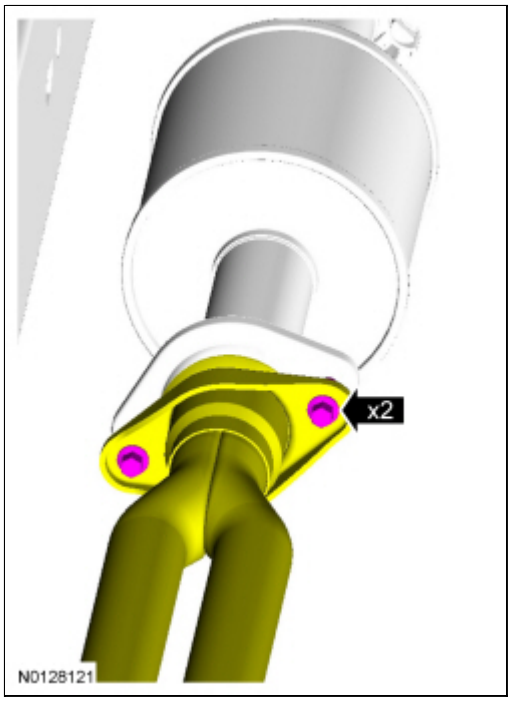
9. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

10. Install the RH camshafts. For additional information, refer to Camshaft — RH in this section.

11. Raise the catalytic converter and install the new LH and RH catalytic converter-to-exhaust manifold nuts.
    - Tighten to 45 Nm (35 lb-ft).

12. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

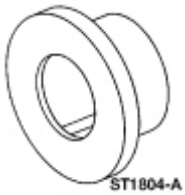
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13. Connect and attach the RH and LH HO2S electrical connectors.
14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Engine Front Cover

Special Tool(s)

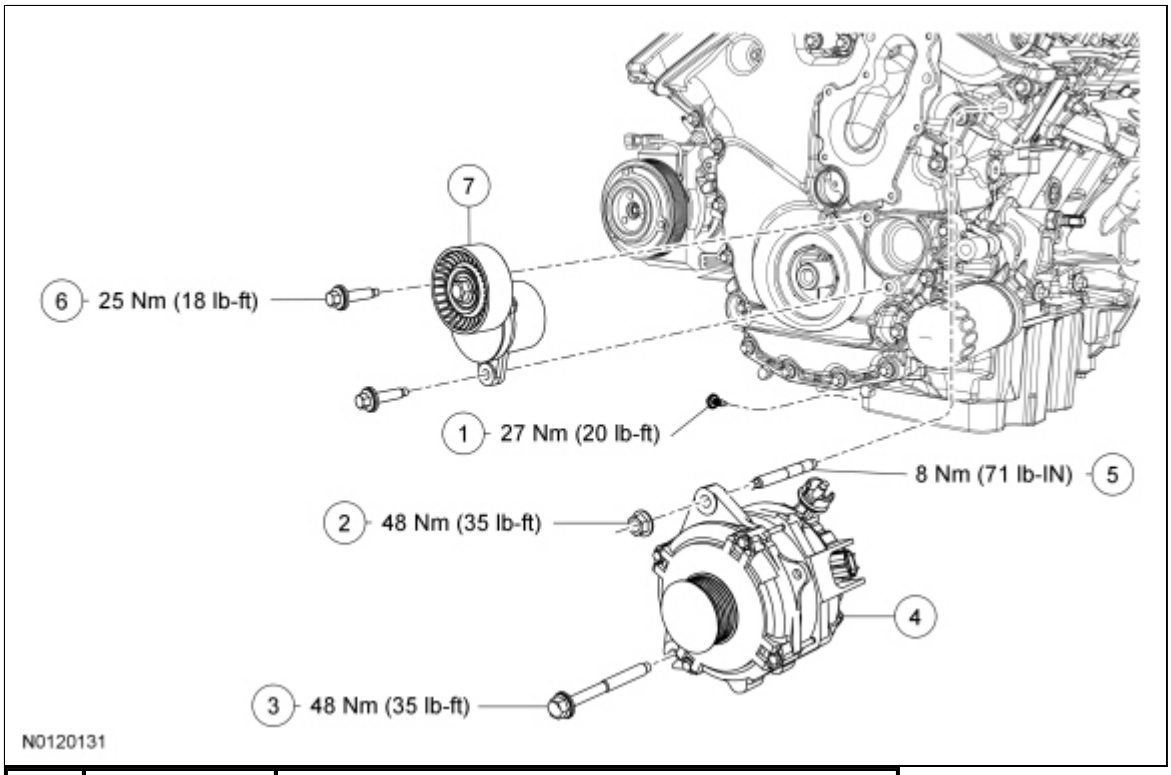
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1804-A	Installer, Spindle Bearing 205-149 (T80T-4000-R)
 ST2240-A	Installer, Spindle Bearing 205-150 (T80T-4000-S)

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—

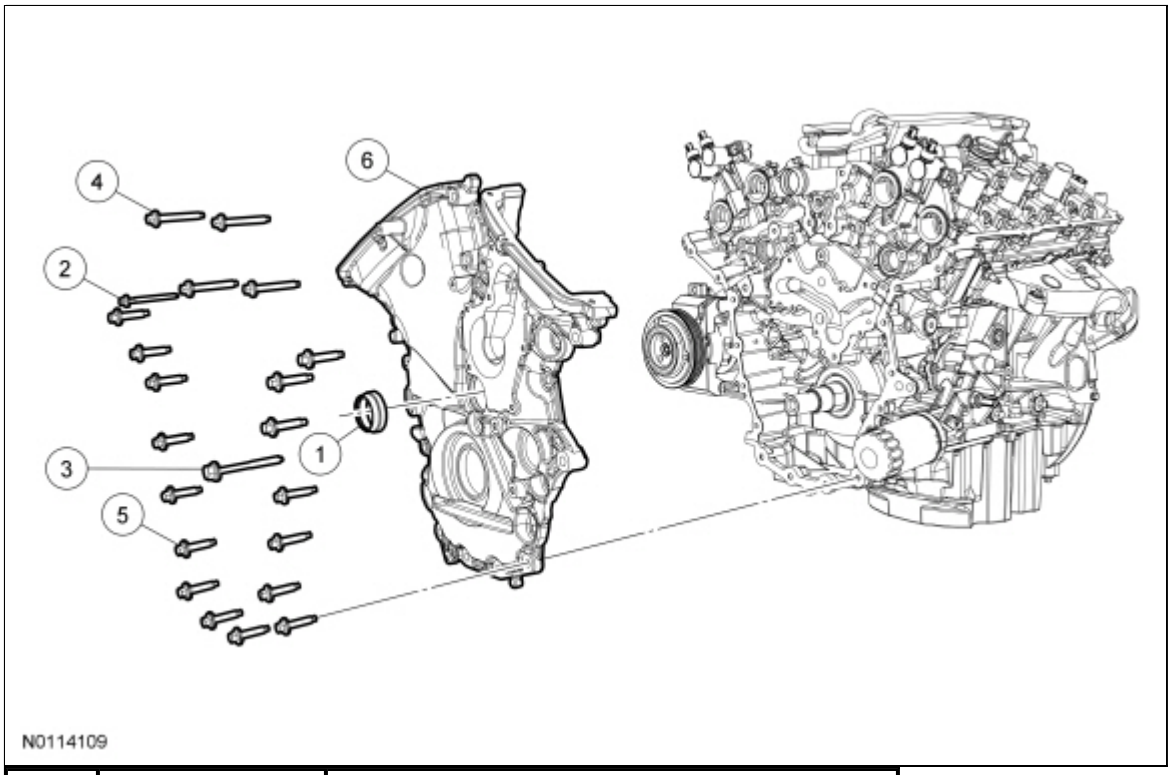
NOTE: Engine Front Cover (View 1 of 2)

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Item	Part Number	Description
1	6730	Oil pan drain plug.
2	W520414	Generator nut
3	W714577	Generator bolt
4	10346	Generator
5	W714329	Generator stud
6	W713261	Accessory drive belt tensioner bolt (2 required)
7	6B209	Accessory drive belt tensioner

NOTE: Engine Front Cover (View 2 of 2)



Item	Part Number	Description
1	6020	Front cover radial seal
2	W503285	Engine front cover bolt
3	W714662	Engine front cover bolt
4	W503301	Engine front cover bolt (4 required)
5	W503297	Engine front cover bolt (16 required)
6	6019	Engine front cover

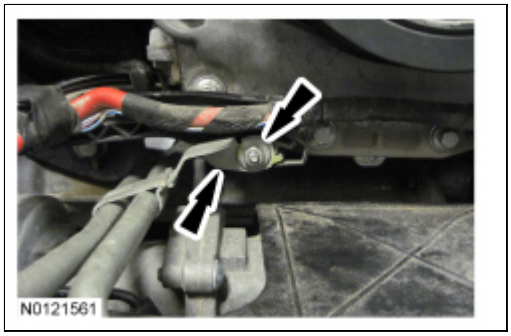
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the LH and RH valve covers. For additional information, refer to Valve Cover — LH and Valve Cover — RH in this section.
4. Remove the drain plug and drain the engine oil.
   - Install the drain plug and tighten to 27 Nm (20 lb-ft).
5. Loosen the 4 coolant pump pulley bolts.
6. Remove the A/C belt. For additional information, refer to Section 303-05 .

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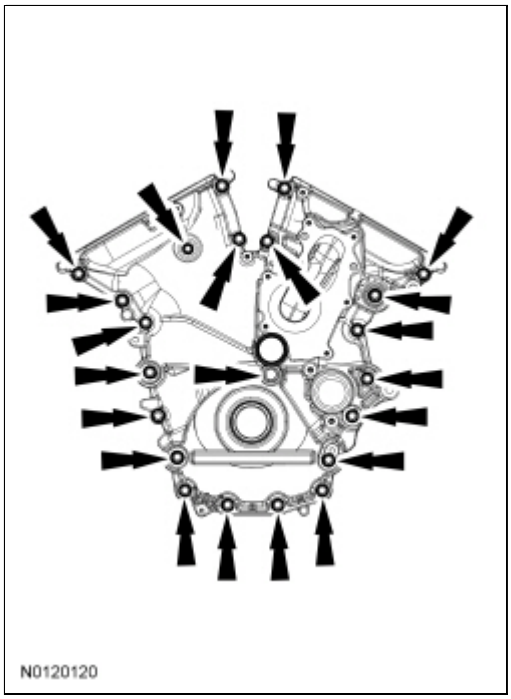
7. Remove the coolant pump. For additional information, refer to Section 303-03 .
8. Remove the nut, bolt and position the generator aside.
9. Remove the generator stud.
10. Remove the 2 bolts and the accessory drive belt tensioner.
11. Remove the crankshaft front seal. For additional information, refer to Crankshaft Front Seal in this section.
12. Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.



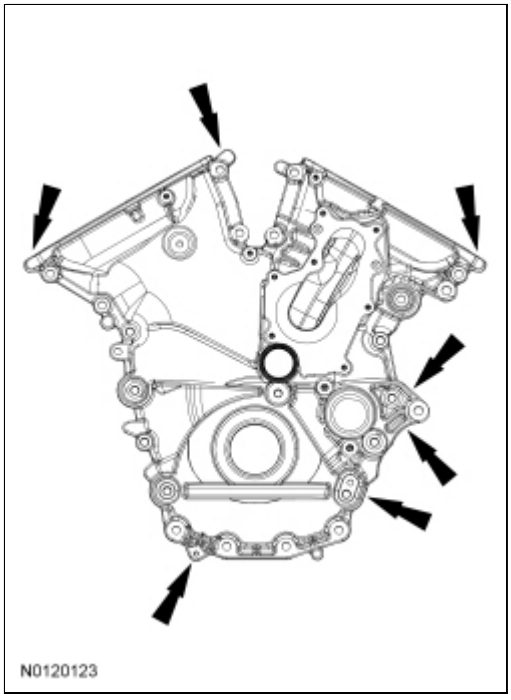
13. Detach the generator wiring harness from the engine front cover.



14. Remove the 22 engine front cover bolts.



15. Using a suitable pry tool, locate the 7 pry pads shown and pry the engine front cover loose and remove.

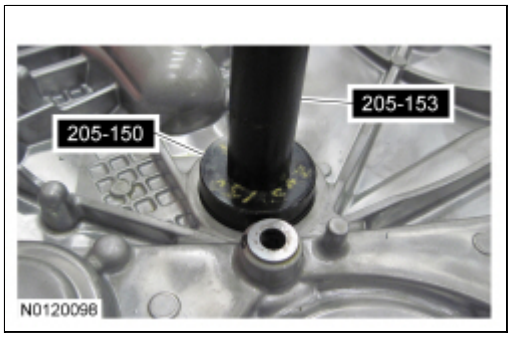


16. **NOTE:** Inspect front cover radial seal and replace if necessary.

    NOTE: Use Spindle Bearing Installer 205-150 to remove the seal.

    If necessary, using the Spindle Bearing Installer and Handle, remove the front cover radial seal from the rear side of the front cover.

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Installation

1. ***NOTICE:*** **Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean. These tools cause scratches and gouges that make leak paths.**

   Clean the engine front cover using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.
   - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

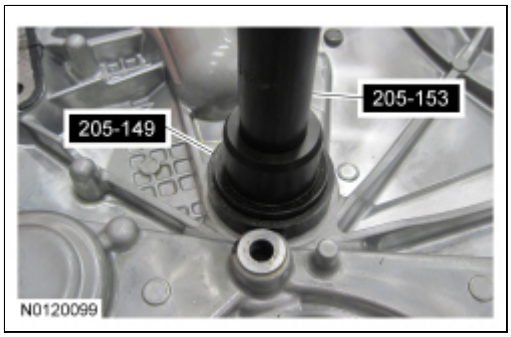
2. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan may cause engine failure.**

   NOTICE: **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

   Clean the sealing surfaces of the cylinder heads, the cylinder block and the oil pan in the following sequence.
   1. Remove any large deposits of silicone or gasket material.
   2. Apply silicone gasket remover and allow to set for several minutes.
   3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
   4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
   5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

3. **NOTE:** Use Spindle Bearing Installer 205-149 to install the seal.

   If removed, using the Spindle Bearing Installer, install the front cover radial seal from the rear side of the front cover.



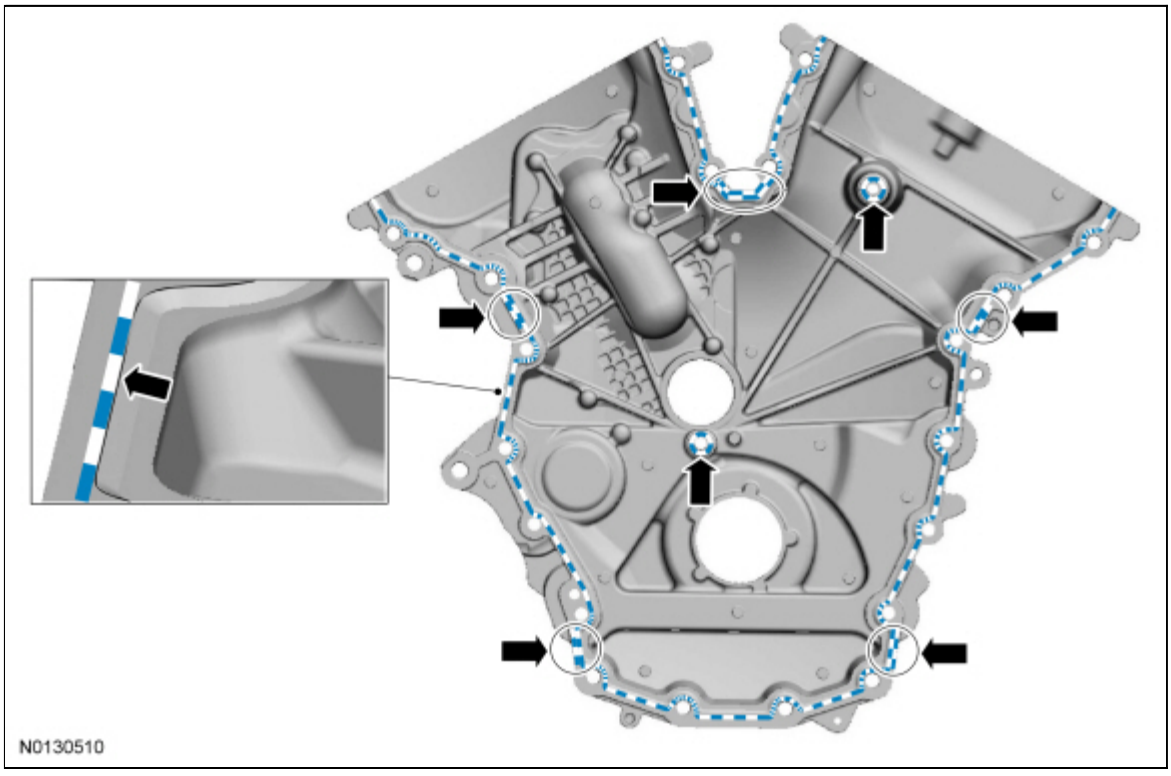
4. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTICE: **Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow these instructions may cause engine oil leakage.**

   NOTE: The engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 must be installed within 10 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the engine front cover to the engine front cover sealing surfaces including the 2 engine front cover bolt bosses.

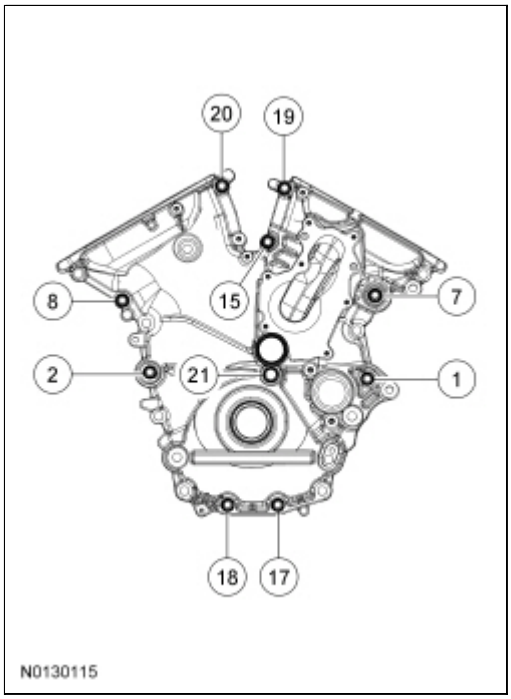
   - Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.



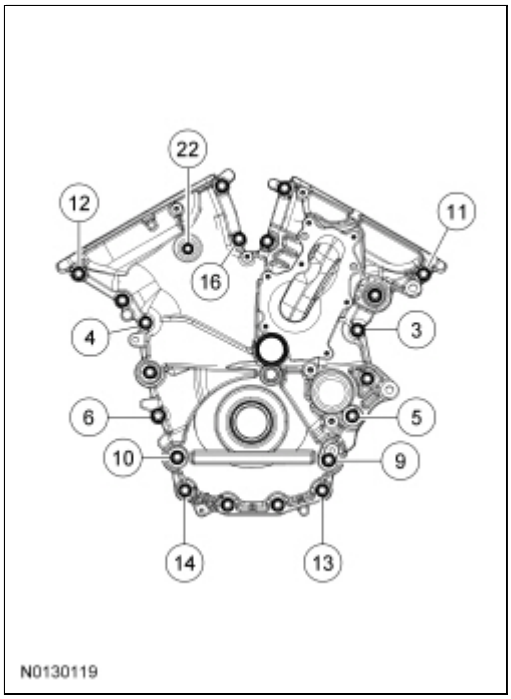
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5. **NOTE:** Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

   Install the engine front cover and bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 and tighten sequence shown in 3 stages:
   - Stage 1: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19, 20 and 21 in sequence to 10 Nm (89 lb-in).
   - Stage 2: Tighten bolts 1, 2, 7, 8, 15, 17, 18, 19 and 20 in sequence to 20 Nm (177 lb-in) then an additional 45 degrees.
   - Stage 3: Tighten bolt 21 to 20 Nm (177 lb-in) then an additional 90 degrees.



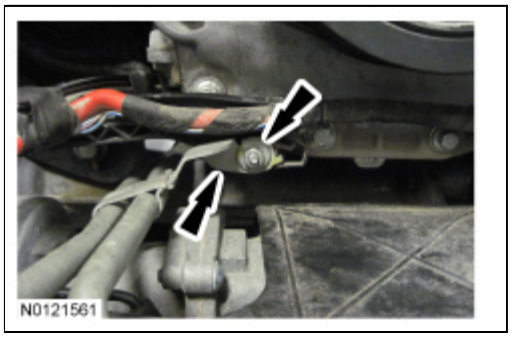
6. Install the remaining 12 engine front cover bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 16 and 22. Tighten all of the engine front cover bolts in the sequence shown in 3 stages:
   - Stage 1: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14 and 16 to 10 Nm (89 lb-in).
   - Stage 2: Tighten bolts 3, 4, 5, 6, 9, 10, 11, 12, 13, 14 and 16 to 20 Nm (177 lb-in) then an additional 45 degrees.
   - Stage 3: Tighten bolt 22 to 10 Nm (89 lb-in) then an additional 45 degrees.



7. Attach the generator wiring harness to the engine front cover.



8. Install the transmission cooler line bracket and nut to the engine front cover stud bolt.
   - Tighten to 12 Nm (106 lb-in).



9. Install the crankshaft front seal. For additional information, refer to Crankshaft Front Seal in this section.

10. Install the accessory drive belt tensioner and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

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11. Install the generator stud.
    - Tighten to 8 Nm (71 lb-in).

12. Position the generator and install the nut and bolt.
    - Tighten to 48 Nm (35 lb-ft).

13. Install the A/C belt. For additional information, refer to Section 303-05 .

14. Install the coolant pump. For additional information, refer to Section 303-03 .

15. Tighten the 4 coolant pump pulley bolts.
    - Tighten to 25 Nm (18 lb-ft).

16. Install the LH and RH valve covers. For additional information, refer to Valve Cover — LH and Valve Cover — RH in this section.

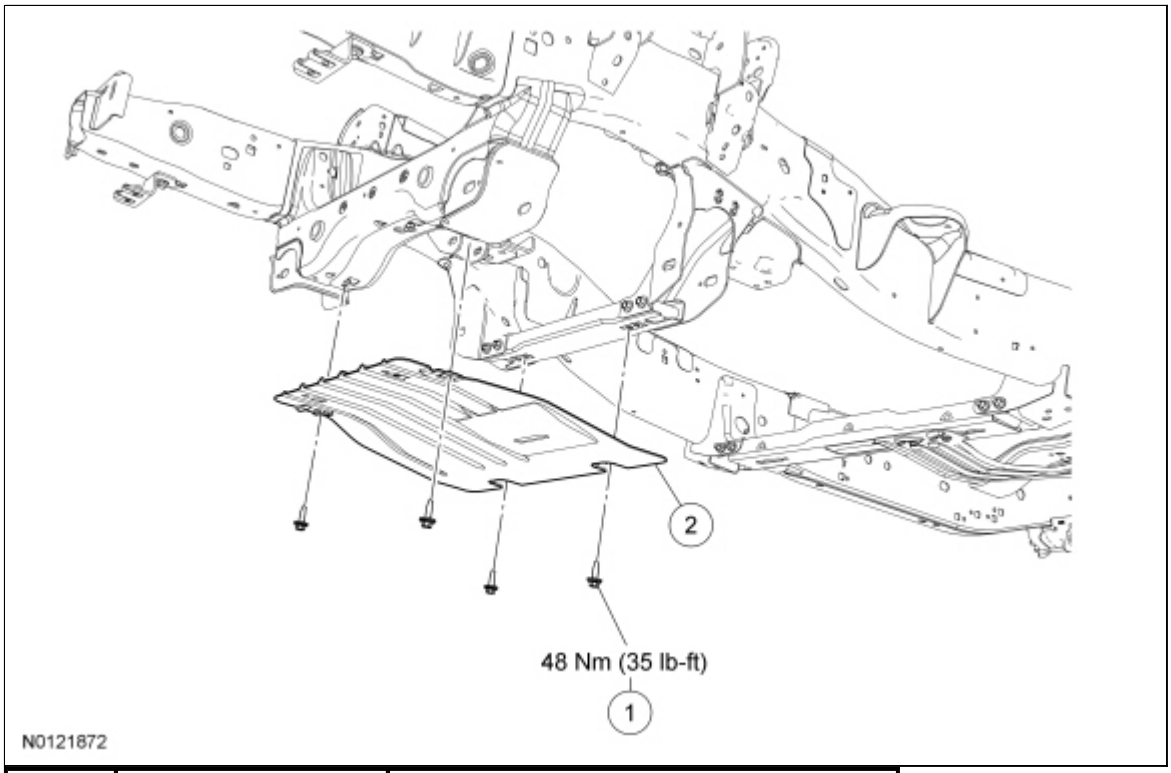
17. Connect the battery ground cable. For additional information, refer to Section 414-01 .

18. Fill the engine with clean engine oil.

Engine Lubrication Components — Exploded View

Skid Plate

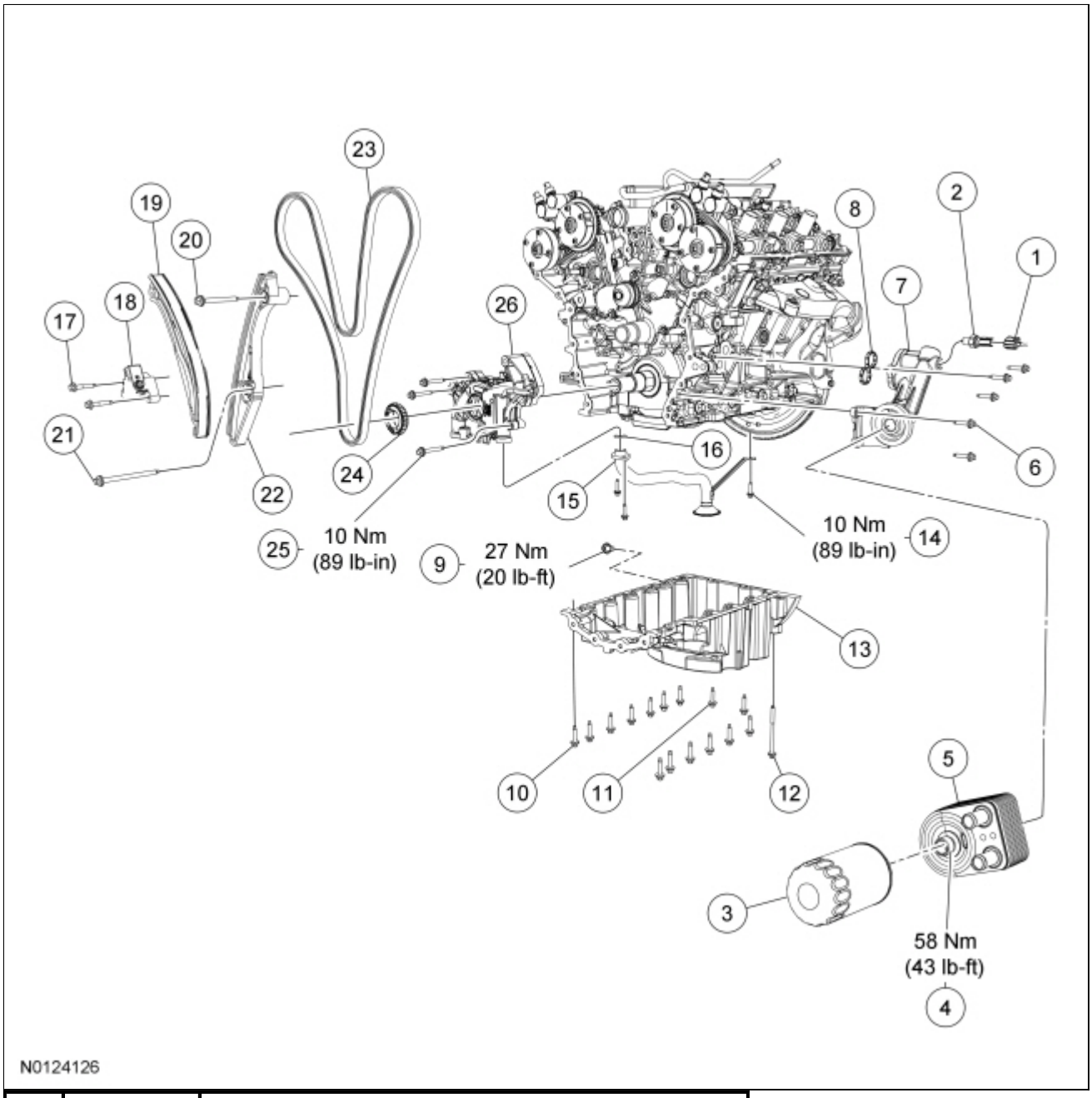
NOTE: For vehicles equipped with skid plate.



Item	Part Number	Description
1	W706894	Skid plate bolt (4 required)
2	5D032	Skid plate

Engine Lubrication Components

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Item	Part Number	Description
1	—	Engine Oil Pressure (EOP) switch electrical connector (part of 14A411)
2	9278	EOP switch
3	6731	Engine oil filter
4	—	Oil cooler bolt (part of 6A642)
5	6A642	Oil cooler
6	W503278	Oil filter adapter bolt (5 required)
7	6881	Oil filter adapter
8	6840	Oil filter adapter gasket

9	6730	Oil pan drain plug
10	W712943	Oil pan bolt (13 required)
11	W503279	Oil pan bolt (2 required)
12	W708221	Oil pan bolt
13	6675	Oil pan
14	W503278	Oil pump screen and pickup tube bolt (3 required)
15	6622	Oil pump screen and pickup tube
16	6625	Oil pump screen and pickup tube O-ring seal
17	W500300	Primary timing chain tensioner bolt (2 required)
18	6L266	Primary timing chain tensioner
19	6K255	RH primary timing chain tensioner arm
20	W503284	LH primary timing chain guide bolt
21	W714094	LH primary timing chain guide bolt
22	6B274	LH primary timing chain guide
23	6268	Primary timing chain
24	6306	Crankshaft timing sprocket
25	W503282	Oil pump bolt (3 required)
26	6600	Oil pump

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Engine Oil Pressure (EOP) Switch

Material

Item	Specification
Motorcraft® Thread Sealant with PTFE TA-24	WSK-M2G350-A2

Removal and Installation

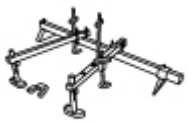
1. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

2. Remove the EOP switch.
    - To install, tighten to 14 Nm (124 lb-in) then an additional 180 degrees.

3. To install, reverse the removal procedure.
    - Apply thread sealant with PTFE to the EOP switch threads prior to installation.

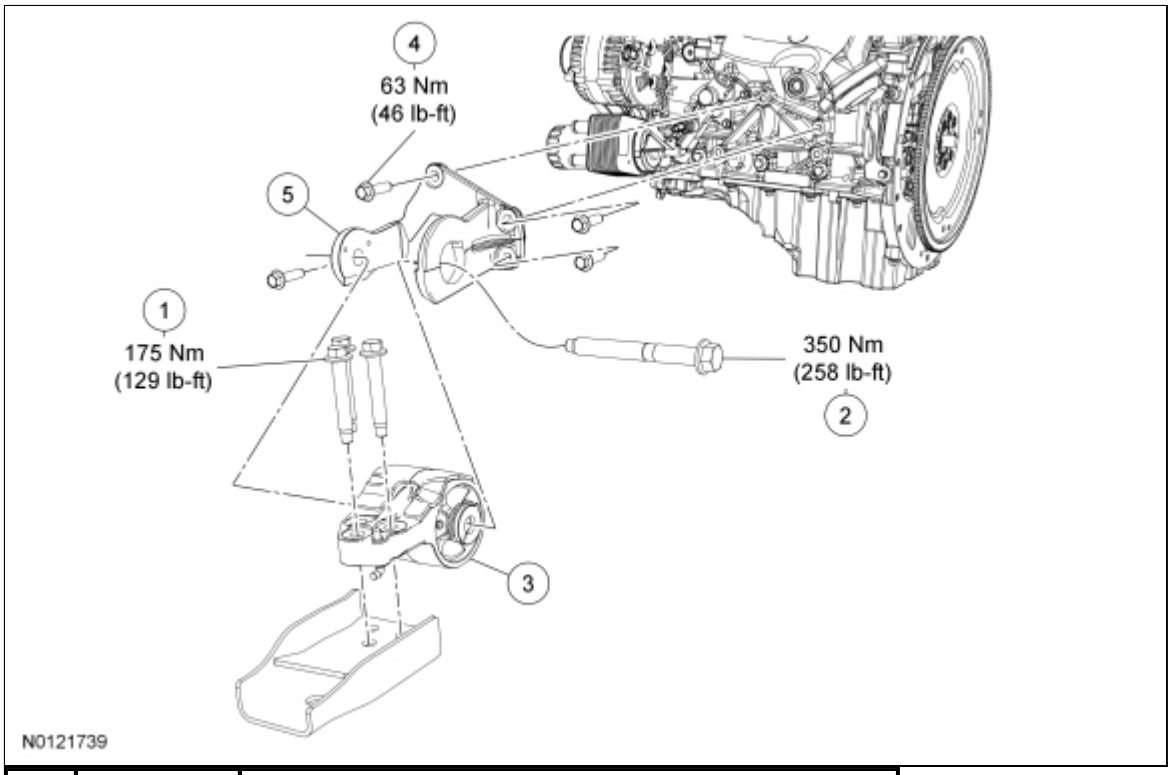
Engine Support Insulators

Special Tool(s)

 ST3101-A	Bar, Engine Spreader 303-1454
 ST2976A	Eye, Engine Lift 303-1245
 ST2176-A	Support Bar, Engine 303-F070

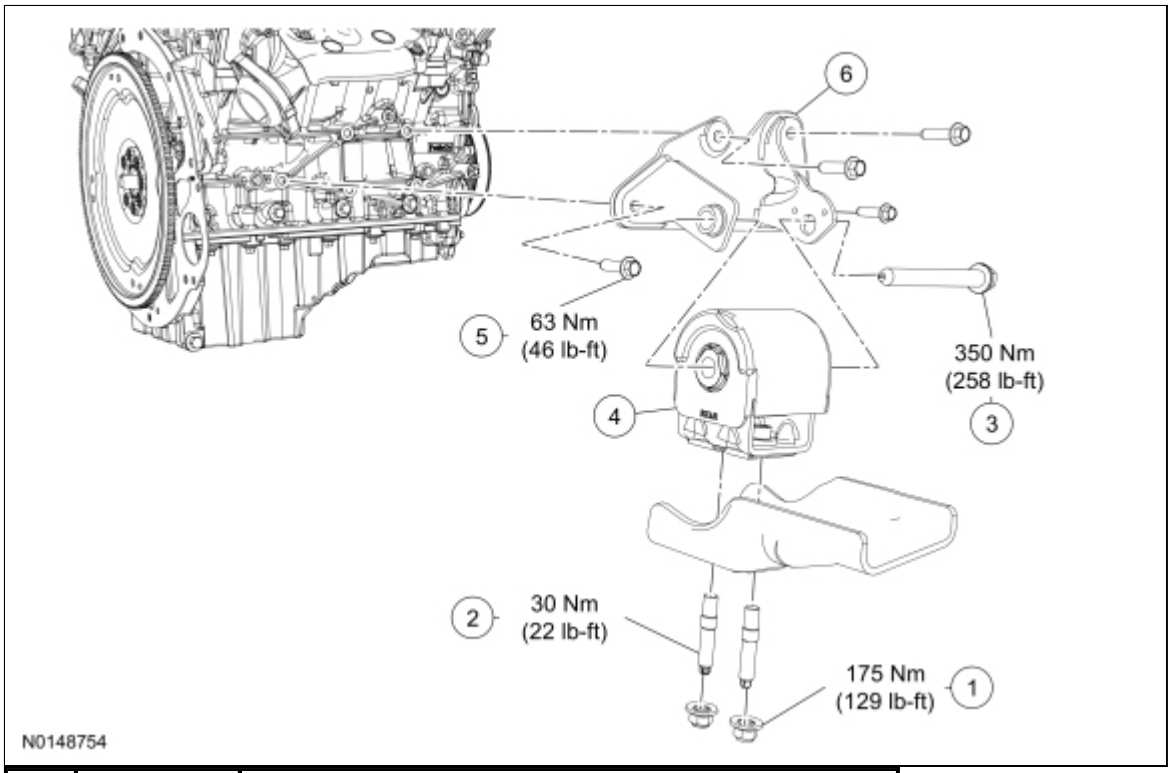
Engine Support Insulator — LH

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Item	Part Number	Description
1	W713244	LH engine support insulator-to-frame bolt (3 required)
2	W715211	LH engine support insulator through bolt
3	6038	LH engine support insulator
4	W714735	LH engine support insulator-to-cylinder block bracket bolt (4 required)
5	6038	LH engine support insulator-to-cylinder block bracket

Engine Support Insulator — RH



Item	Part Number	Description
1	W707251	RH engine support insulator nut (2 required)
2	—	RH engine support insulator stud bolt (part of 6038) (2 required)
3	—	RH engine support insulator through bolt (part of 6038)
4	6038	RH engine support insulator
5	W714735	RH engine support insulator-to-cylinder block bracket bolt (4 required)
6	—	RH engine support insulator-to-cylinder block bracket (part of 6038)

Removal

All engine support insulator

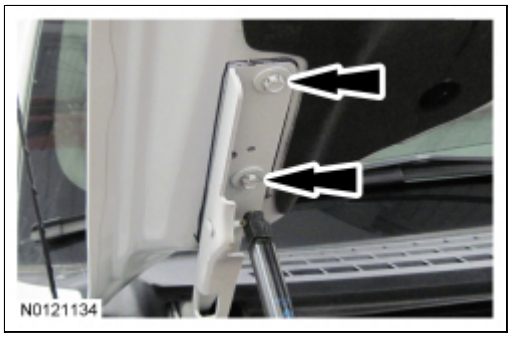
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

   NOTE: RH shown, LH similar.

   Remove the 4 bolts (2 shown) and the hood.

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3. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

4. Remove the cowl panel grille. For additional information, refer to Section 501-02 .

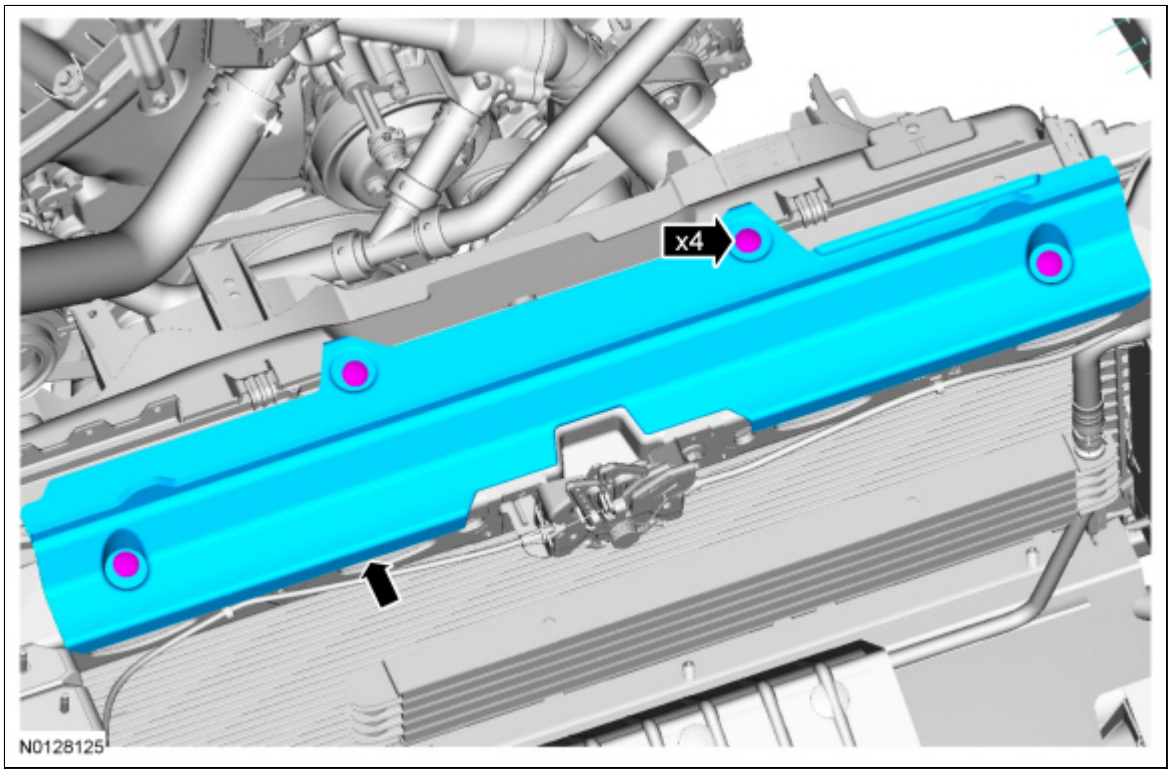
5. Remove the 6 screws and release the 2 cowl panel clips and remove the cowl panel.



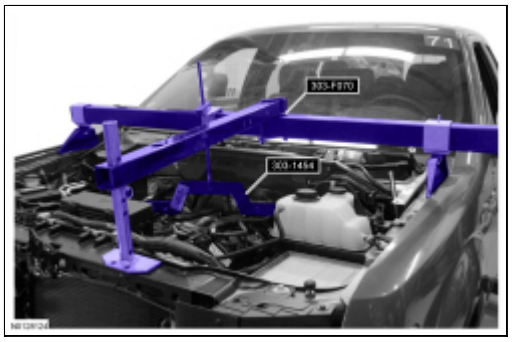
6. Install the LH engine lift eye.



7. Remove the 4 pushpins and the upper radiator air deflector.



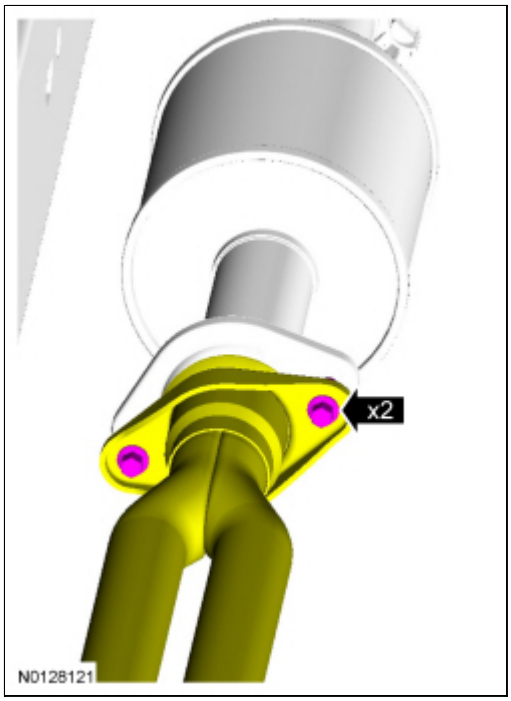
8. Install the Engine Support Bar.



9. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .

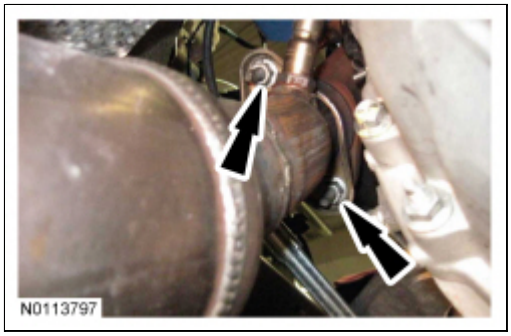
10. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.

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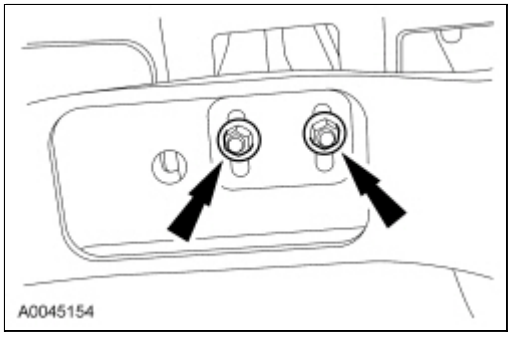
11. **NOTE:** LH shown, RH similar.

    Remove and discard the 2 LH and RH catalytic converter-to-exhaust manifold nuts.



12. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

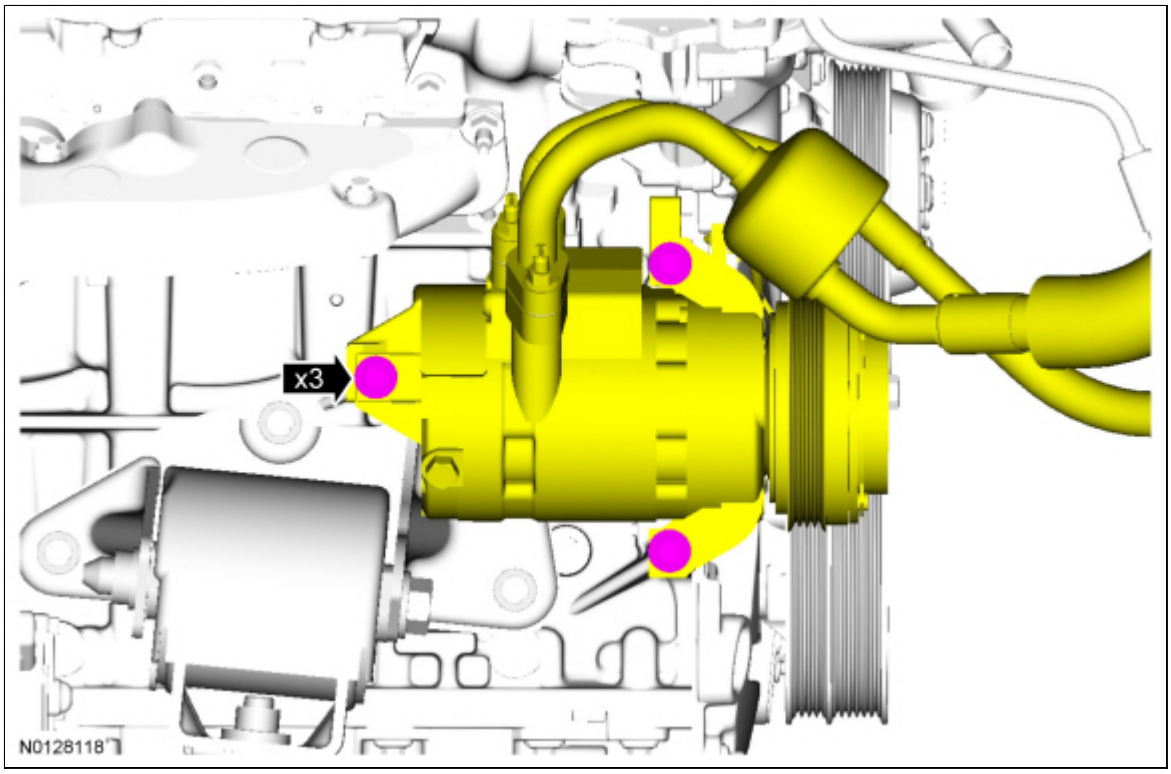
    Loosen the 2 transmission mount-to-crossmember nuts.



RH engine support insulator

13. Remove the Air Conditioning (A/C) compressor belt. For additional information, refer to Section 303-05 .

14. Remove the 3 bolts and position the A/C compressor aside.



15. Remove the starter. For additional information, refer to Section 303-06 .

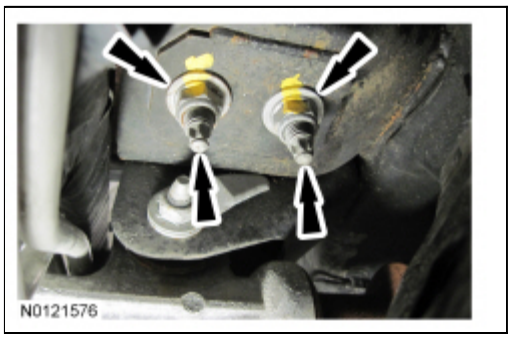
16. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove and discard the RH and LH engine support insulator through bolts.

17. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator nuts or damage to the engine support insulator can occur.**

    NOTICE: **Only use hand tools when removing or installing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

    Remove and discard the 2 RH engine support insulator nuts and stud bolts.



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18. Raise the engine approximately 30 mm (1.18 in).

19. Remove the RH engine support insulator.

20. Remove the 4 bolts and the RH engine support insulator-to-cylinder block bracket.

LH engine support insulator

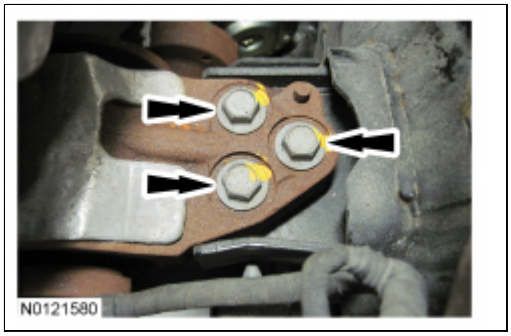
21. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove and discard the LH and RH engine support insulator through bolts.

22. Raise the engine approximately 30 mm (1.18 in).

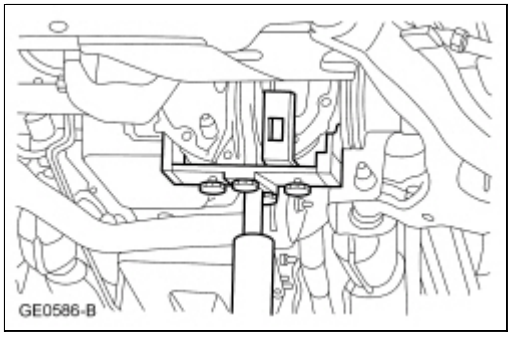
23. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.**

    Remove the 3 LH engine support insulator-to-frame bolts.

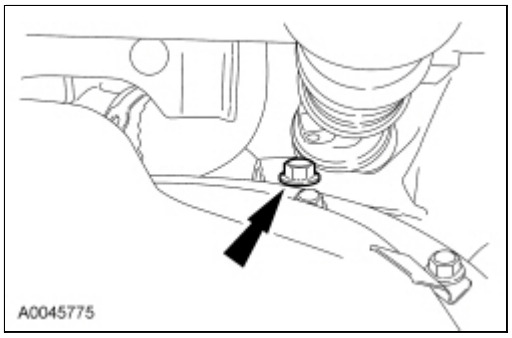


Four-Wheel Drive (4WD) — LH engine support insulator

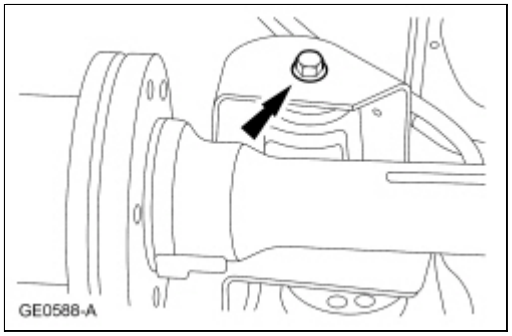
24. Position a suitable hydraulic jack under the front axle. Securely strap the jack to the axle.



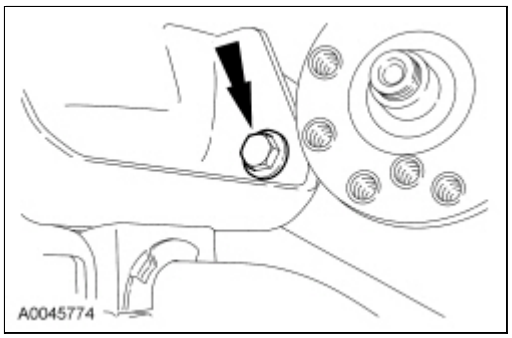
25. Remove the upper front axle carrier mounting bushing bolt.



26. Remove the axle shaft housing carrier bushing bolt.



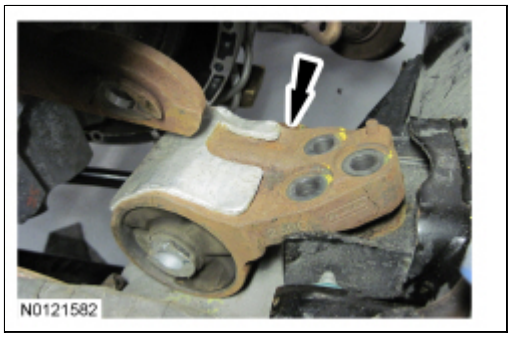
27. Remove the lower front axle carrier mounting bushing bolt.



28. Lower the front axle to allow clearance to the LH engine support insulator.

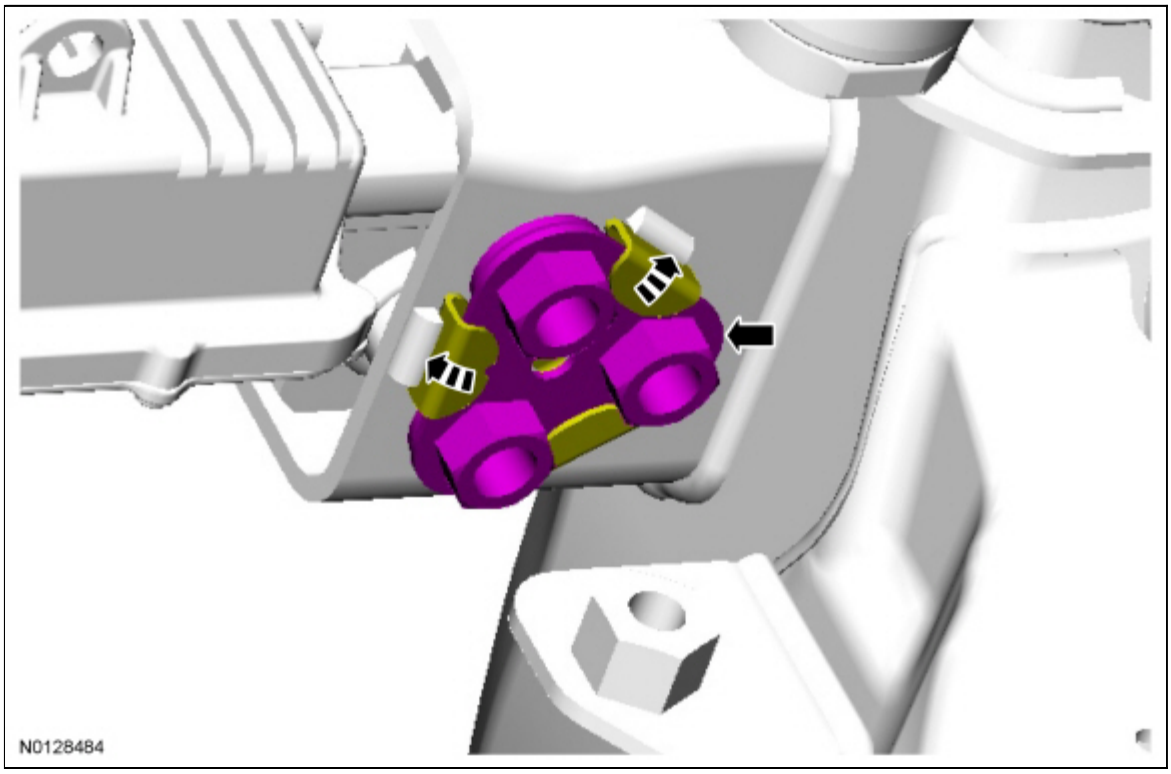
LH engine support insulator

29. Remove the LH engine support insulator.



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30. Inspect the engine support insulator-to-frame nut plate for thread damage. If the nut plate is damaged, bend 2 tabs back and remove the nut plate. Replace the nut plate with service part number 56190 and bend the 2 tabs back to the original position.

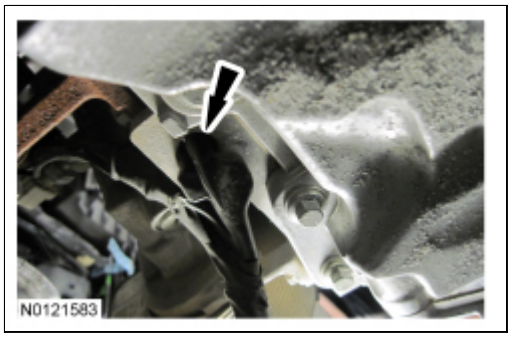


NOTE: If necessary, the following 3 steps are to remove the LH engine support insulator-to-cylinder block bracket.

31. Detach the generator wiring harness from the engine front cover.
    - Detach the generator wiring harness retainer from the oil filter adapter.



32. Detach the generator wiring harness retainer from the lower LH side of the engine block.



33. Remove the 4 bolts and the LH engine support insulator-to-cylinder block bracket.

Installation

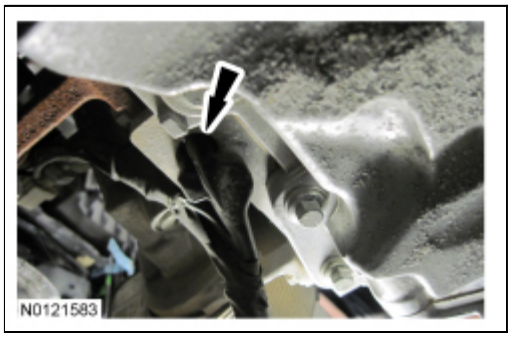
LH engine support insulator

1. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

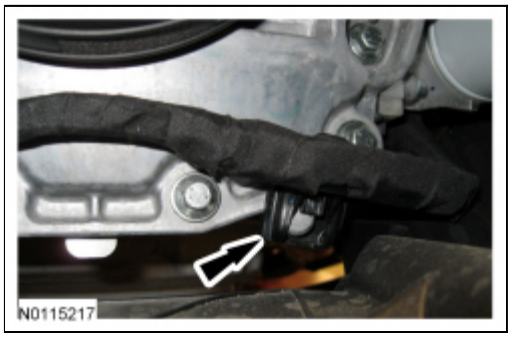
NOTE: If removed, the following 3 steps are to install the LH engine support insulator-to-cylinder block bracket.

2. Install the LH engine support insulator-to-cylinder block bracket and install the 4 bolts.
    - Tighten to 63 Nm (46 lb-ft).

3. Attach the generator wiring harness retainer to the lower LH side of the engine block.

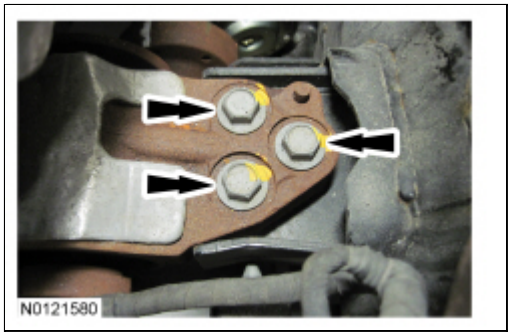


4. Attach the generator wiring harness to the engine front cover.
    - Attach the generator wiring harness retainer to the oil filter adapter.



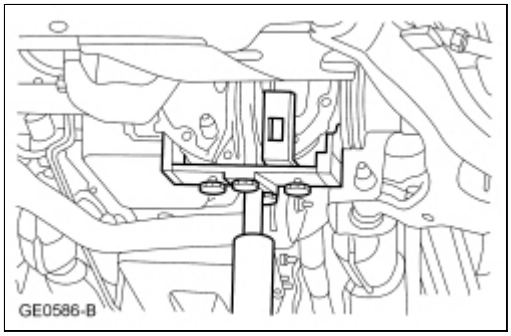
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5. Position the LH engine support insulator and hand start the 3 new engine support insulator-to-frame bolts.
    - Do not torque at this time.

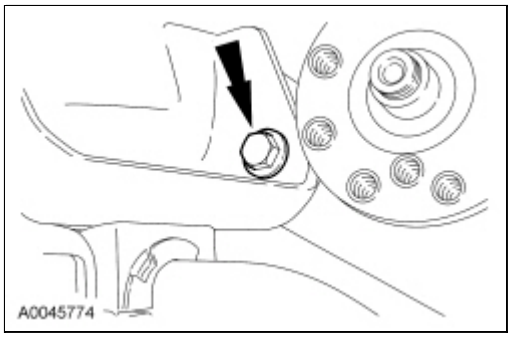


4WD — LH engine support insulator

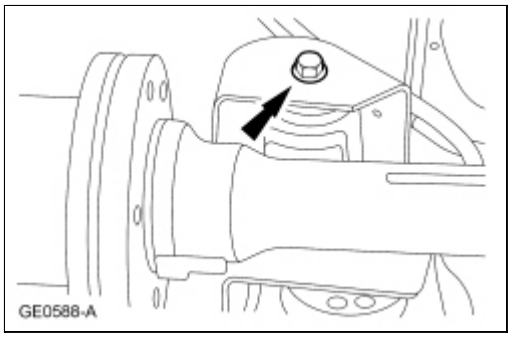
6. Raise the front axle carrier into position.



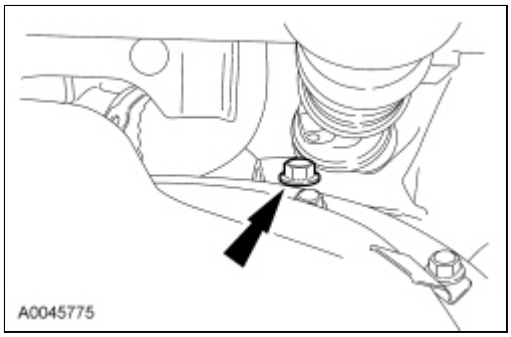
7. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



8. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

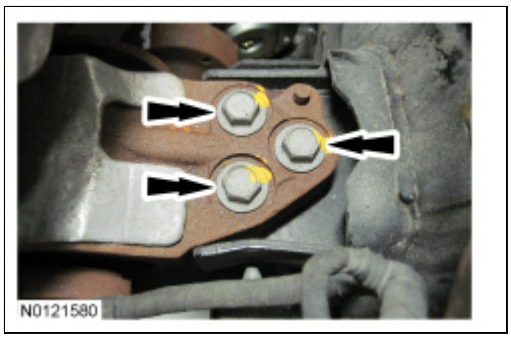


9. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



LH engine support insulator

10. Tighten the LH engine support insulator-to-frame bolts to 175 Nm (129 lb-ft).



11. Lower the engine to the installed position.

12. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Install the new RH and LH engine support insulator through bolts.
    - Tighten to 350 Nm (258 lb-ft).

RH engine support insulator

13. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

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14. Position the RH engine support insulator-to-cylinder block bracket and install the 4 bolts.
    - Tighten to 63 Nm (46 lb-ft).

15. ***NOTICE:*** **Only use hand tools when installing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

    Position the RH engine support insulator into the vehicle and install the 2 new stud bolts.
    - Tighten to 30 Nm (22 lb-ft).

16. ***NOTICE:*** **Only use hand tools when installing the RH engine support insulator nuts or damage to the engine support insulator can occur.**

    Install the 2 new RH engine support insulator nuts.
    - Tighten to 175 Nm (129 lb-ft).

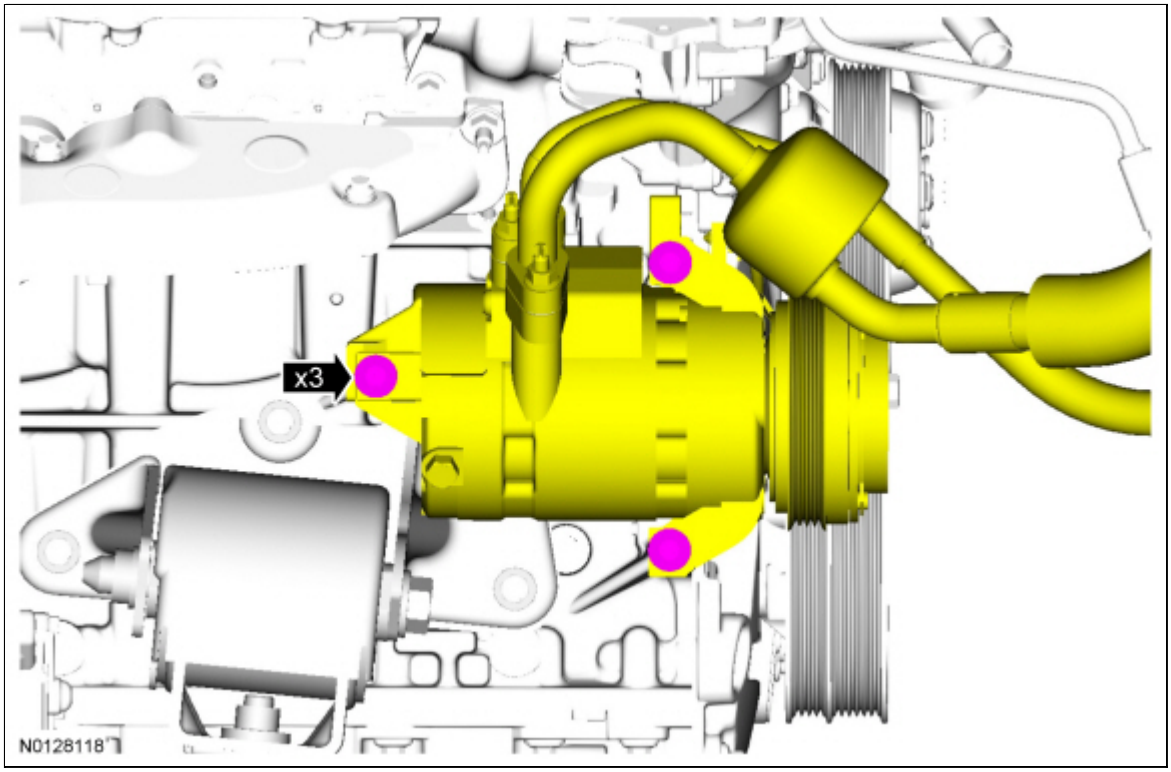
17. Lower the engine to the installed position.

18. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Install the new RH and LH engine support insulator through bolts.
    - Tighten to 350 Nm (258 lb-ft).

19. Install the starter. For additional information, refer to Section 303-06 .

20. Position the A/C compressor and install the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

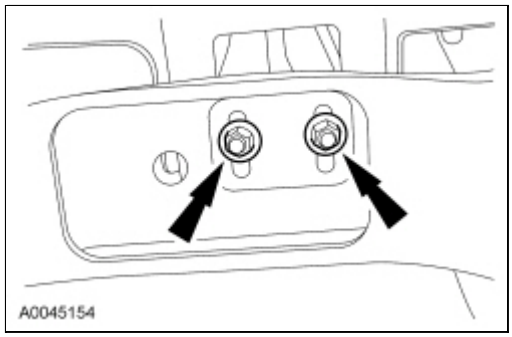


21. Install the A/C compressor belt. For additional information, refer to Section 303-05 .

All vehicles

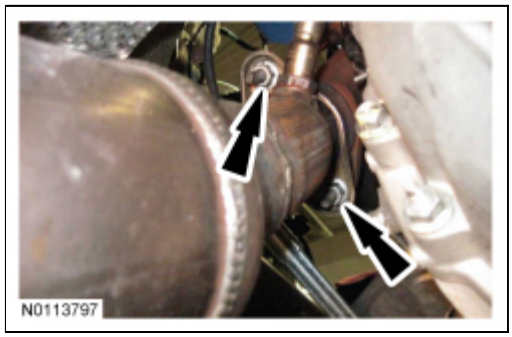
22. ***NOTICE:*** **Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

    Tighten the transmission mount-to-crossmember nuts to 103 Nm (76 lb-ft).



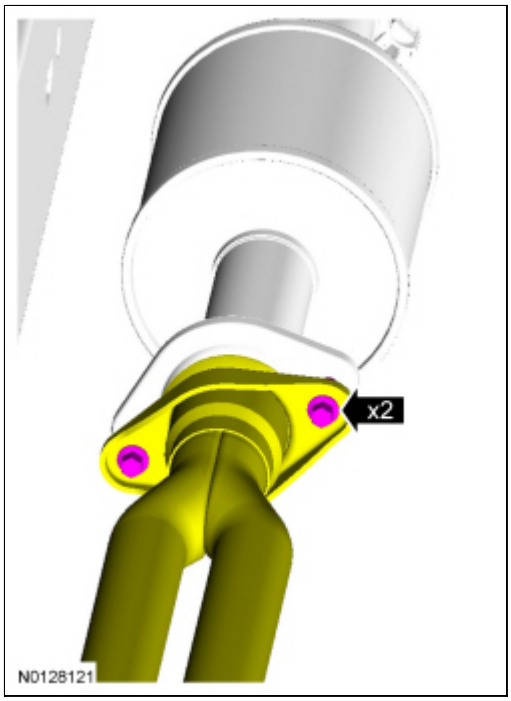
23. **NOTE:** LH shown, RH similar.

    Install the new 2 LH and RH catalytic converter-to-exhaust manifold nuts.
    - Tighten to 45 Nm (35 lb-ft).



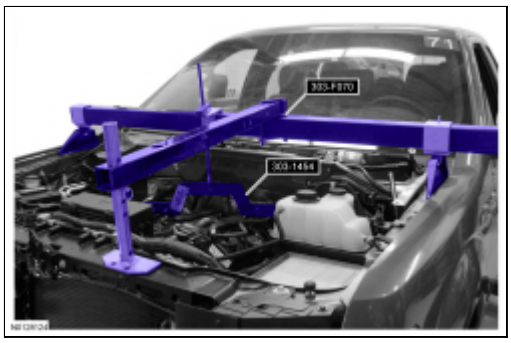
24. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

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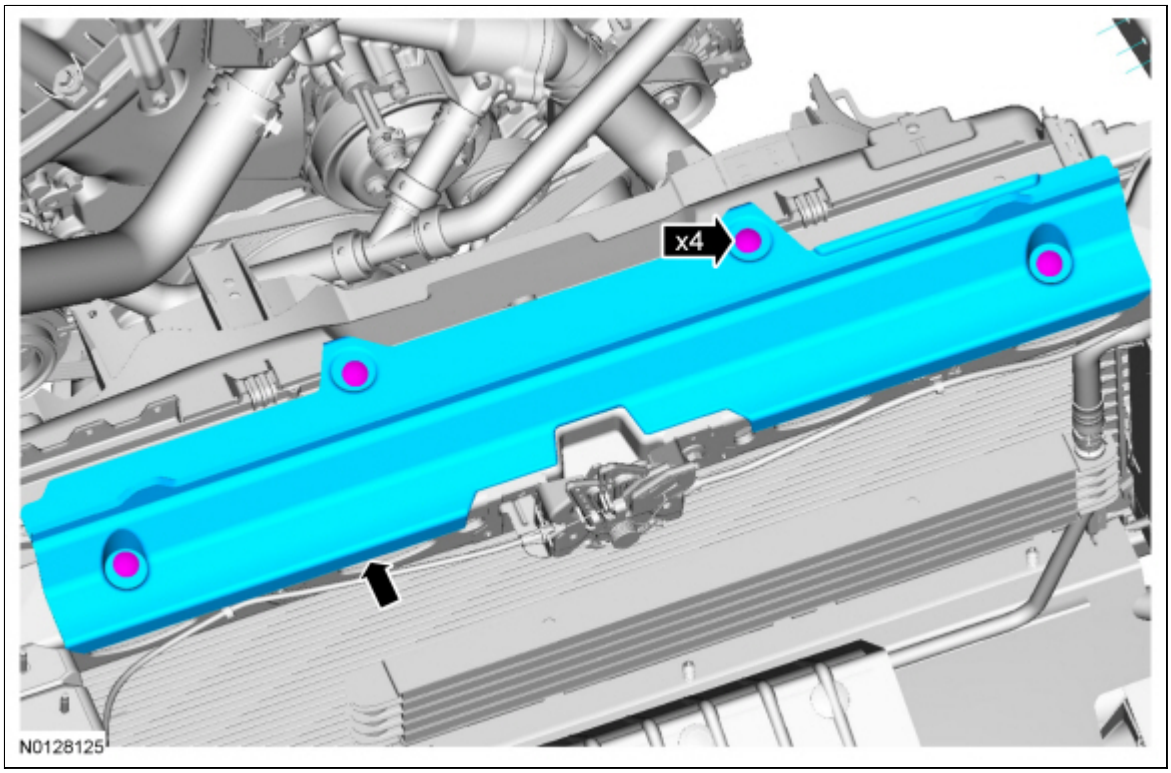


25. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .

26. Remove the Engine Support Bar.



27. Install the upper radiator air deflector and the 4 pushpins.



28. Remove the LH engine lift eye.



29. Install the cowl panel and attach the 2 clips and install the 6 screws.

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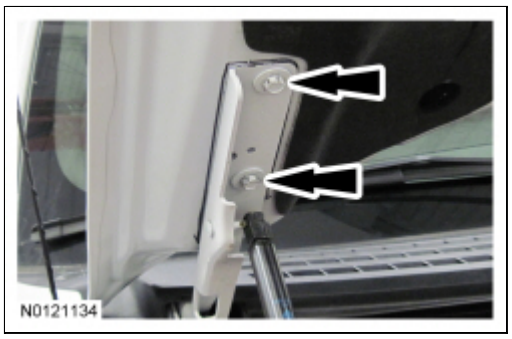
30. Install the cowl panel grille. For additional information, refer to Section 501-02 .

31. Install the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

32. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

    NOTE: RH shown, LH similar.

    Position the hood and install the 4 bolts.
    - Tighten to 12 Nm (106 lb-in).

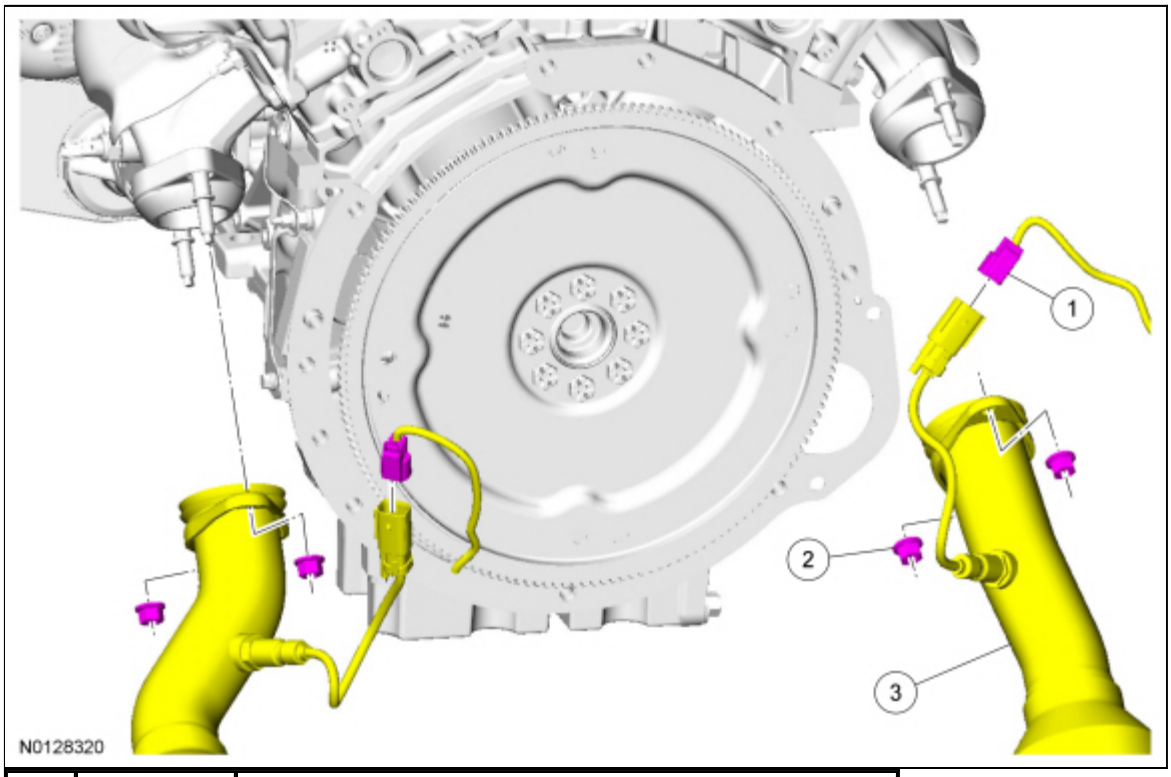


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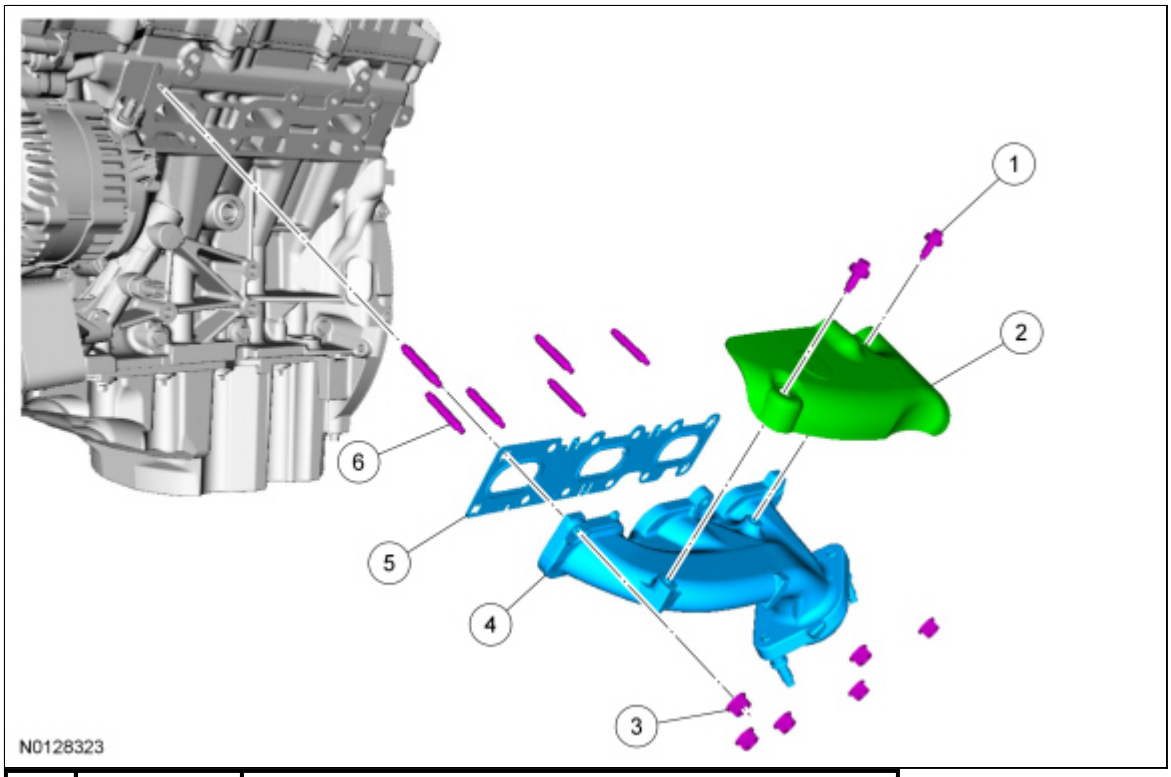
Exhaust Manifold — LH

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—



Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connector (part of 14A411) (2 required)
2	W714265	Catalytic converter-to-exhaust manifold nuts (4 required) - 45 Nm (35 lb-ft)
3	5F250	Catalytic converter assembly (Y-pipe)



Item	Part Number	Description
1	W714133	LH exhaust manifold heat shield bolt (2 required) - 12 Nm (106 lb-in)
2	9Y427	LH exhaust manifold heat shield
3	W701706	LH exhaust manifold nut (6 required)
4	9431	LH exhaust manifold
5	9448	LH exhaust manifold gasket
6	W712244	LH exhaust manifold stud (6 required) - 12 Nm (106 lb-in)

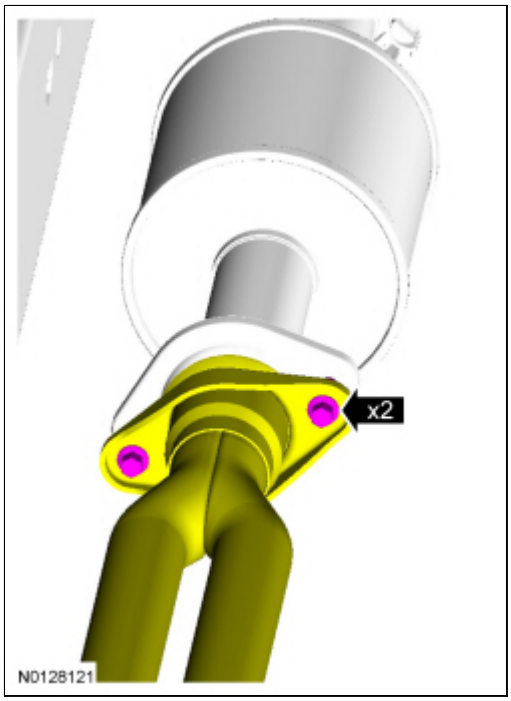
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Detach and disconnect the RH and LH Heated Oxygen Sensor (HO2S) electrical connectors.

3. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
   - Discard the 2 bolts.

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4. Remove and discard the LH and RH catalytic converter-to-exhaust manifold nuts and lower the catalytic converter assembly.

5. Remove the LH front wheel and tire. For additional information, refer to Section 204-04 .

6. Remove the 2 bolts and the LH exhaust manifold heat shield.

7. Remove the 6 nuts and the LH exhaust manifold.
   - Discard the nuts and gasket.

8. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

9. Remove and discard the 6 LH exhaust manifold studs.

10. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

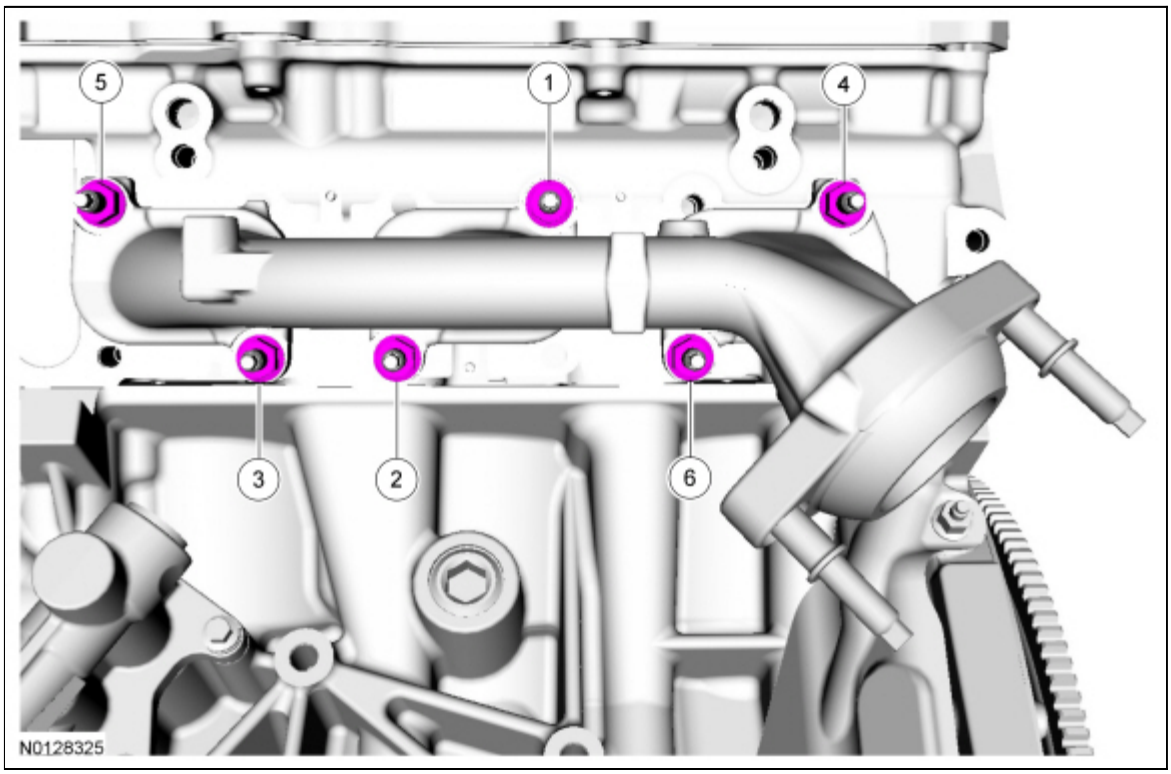
Installation

1. Install 6 new LH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).

2. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

   Using a new gasket, install the LH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:
   - Stage 1: Tighten to 19 Nm (168 lb-in).

- Stage 2: Tighten to 25 Nm (18 lb-ft).



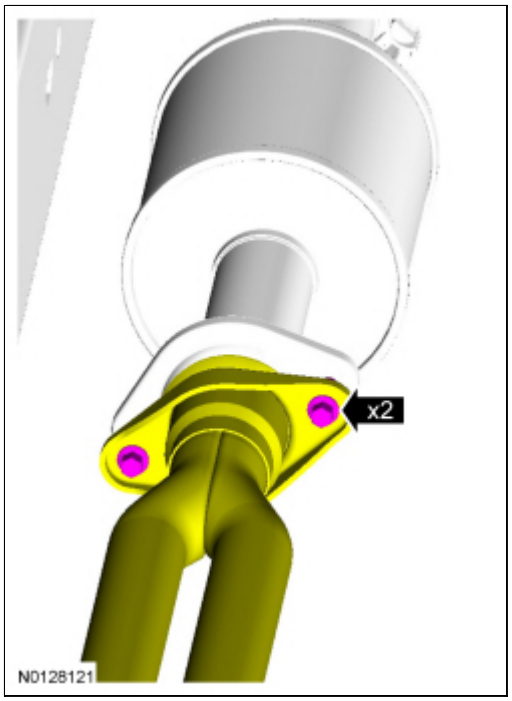
3. Install the LH exhaust manifold heat shield and the 2 bolts.
   - Tighten to 12 Nm (106 lb-in).

4. Install the LH front wheel and tire. For additional information, refer to Section 204-04 .

5. Raise the catalytic converter and install the new LH and RH catalytic converter-to-exhaust manifold nuts.
   - Tighten to 45 Nm (35 lb-ft).

6. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
   - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
   - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

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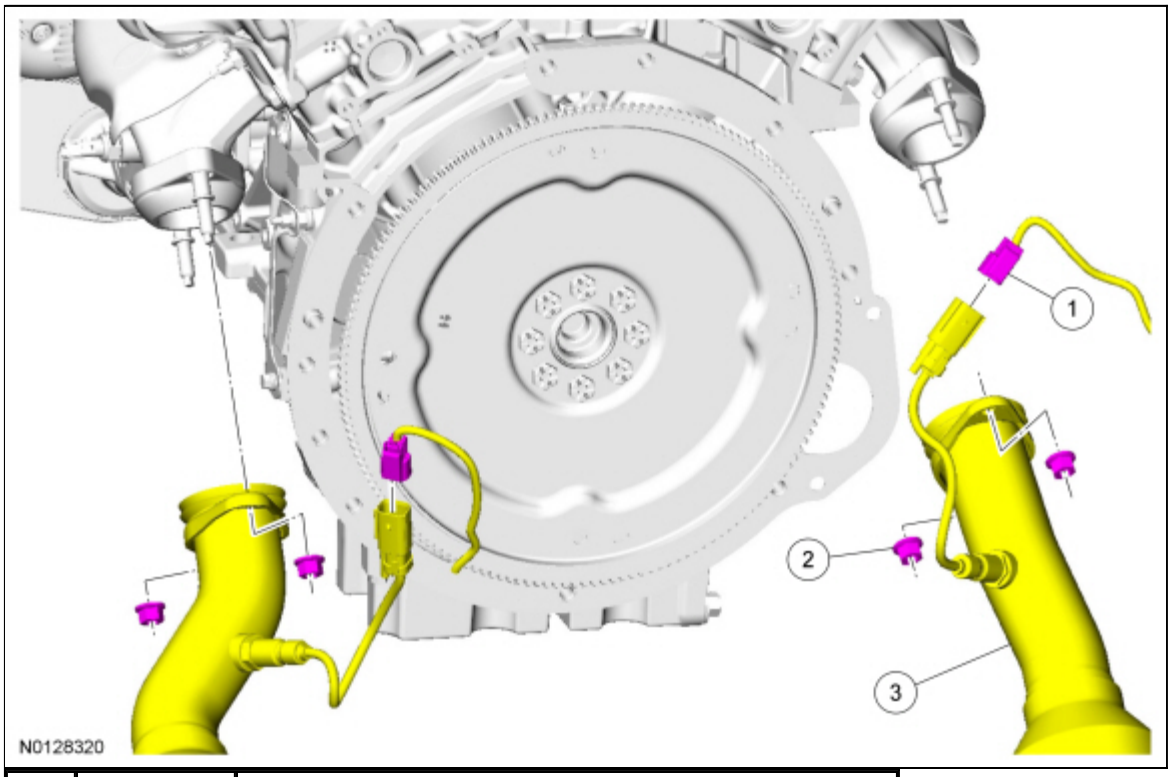


7. Connect and attach the RH and LH HO2S electrical connectors.

Exhaust Manifold — RH

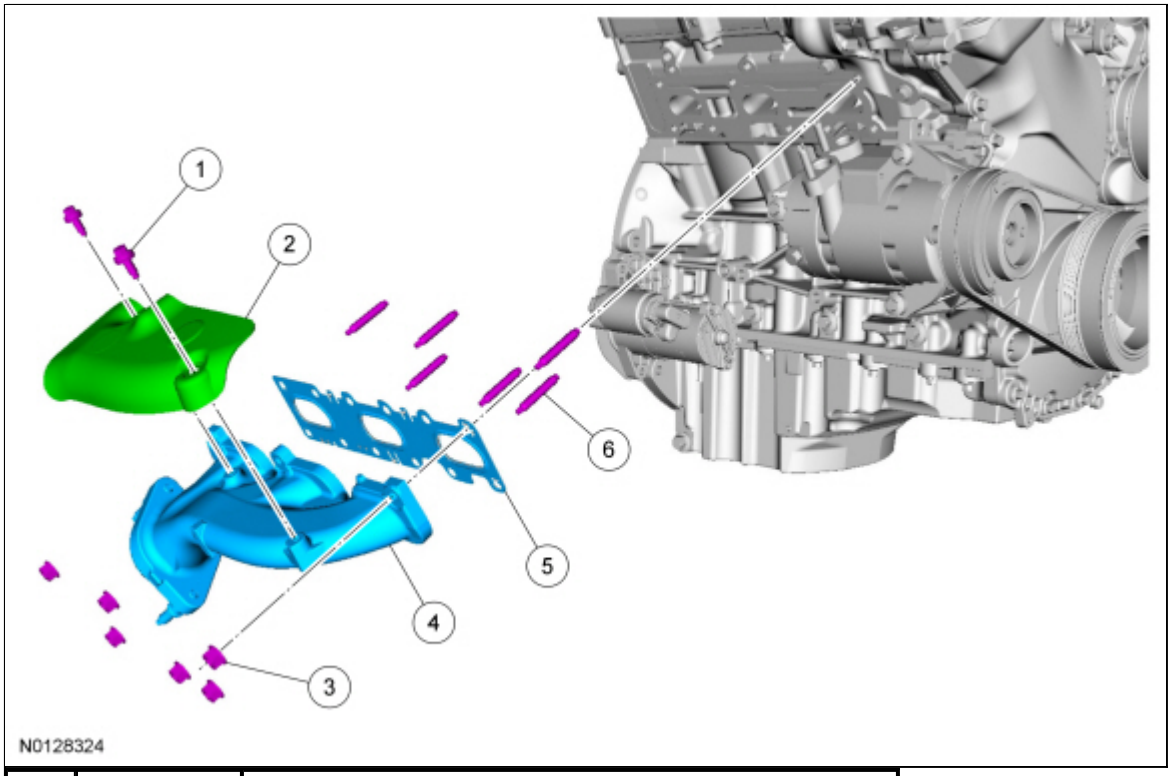
Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—



Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connector (part of 14A411) (2 required)
2	W714265	Catalytic converter-to-exhaust manifold nuts (4 required) - 45 Nm (35 lb-ft)
3	5F250	Catalytic converter assembly (Y-pipe)

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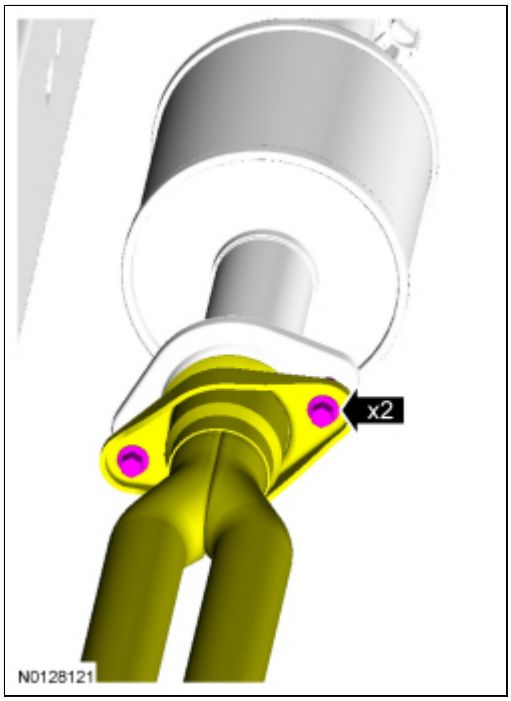
Item	Part Number	Description
1	W714133	RH exhaust manifold heat shield bolt (2 required) - 12 Nm (106 lb-in)
2	9A462	RH exhaust manifold heat shield
3	W701706	RH exhaust manifold nut (6 required)
4	9430	RH exhaust manifold
5	9448	RH exhaust manifold gasket
6	W712244	RH exhaust manifold stud (6 required) - 12 Nm (106 lb-in)

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Detach and disconnect the RH and LH Heated Oxygen Sensor (HO2S) electrical connectors.

3. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
   - Discard the 2 bolts.



4. Remove and discard the LH and RH catalytic converter-to-exhaust manifold nuts and lower the catalytic converter assembly.

5. Remove the RH front wheel and tire. For additional information, refer to Section 204-04 .

6. Remove the 2 bolts and the RH exhaust manifold heat shield.

7. Remove the 6 nuts and the RH exhaust manifold.
   - Discard the nuts and gasket.

8. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

9. Remove and discard the 6 RH exhaust manifold studs.

10. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

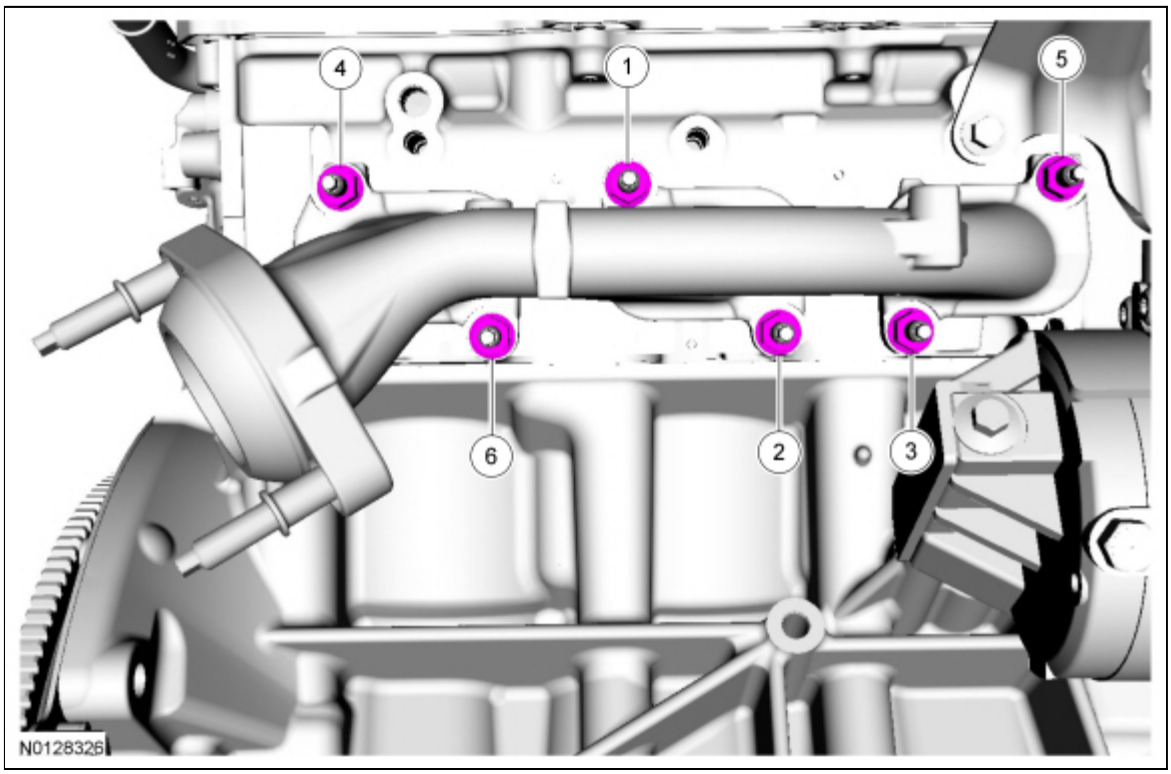
1. Install 6 new RH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).

2. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

   Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:
   - Stage 1: Tighten to 19 Nm (168 lb-in).

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- Stage 2: Tighten to 25 Nm (18 lb-ft).

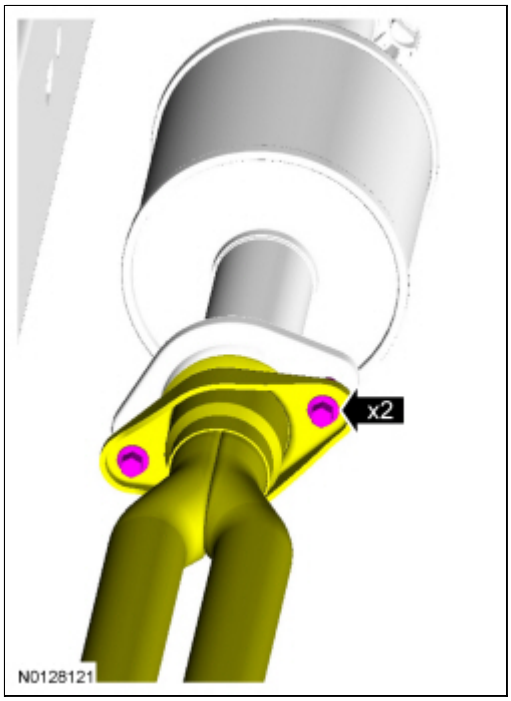


3. Install the RH exhaust manifold heat shield and the 2 bolts.
   - Tighten to 12 Nm (106 lb-in).

4. Install the RH front wheel and tire. For additional information, refer to Section 204-04 .

5. Raise the catalytic converter and install the new LH and RH catalytic converter-to-exhaust manifold nuts.
   - Tighten to 45 Nm (35 lb-ft).

6. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
   - Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
   - Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



7. Connect and attach the RH and LH HO2S electrical connectors.

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Flexplate

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

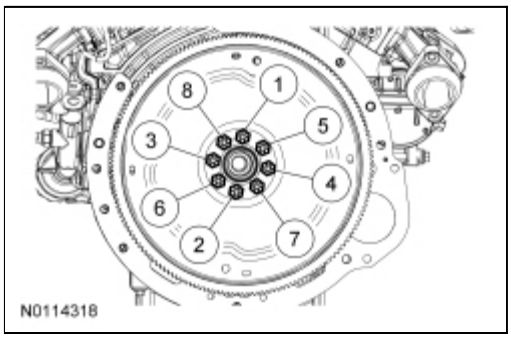
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the automatic transmission. For additional information, refer to Section 307-01 .
3. Remove the 8 bolts and the flexplate.

Installation

1. **NOTE:** One of the 8 flexplate holes are offset so the flexplate can only be installed in one position.

   Install the flexplate and the 8 bolts and tighten in sequence shown.
   - Tighten to 80 Nm (59 lb-ft).



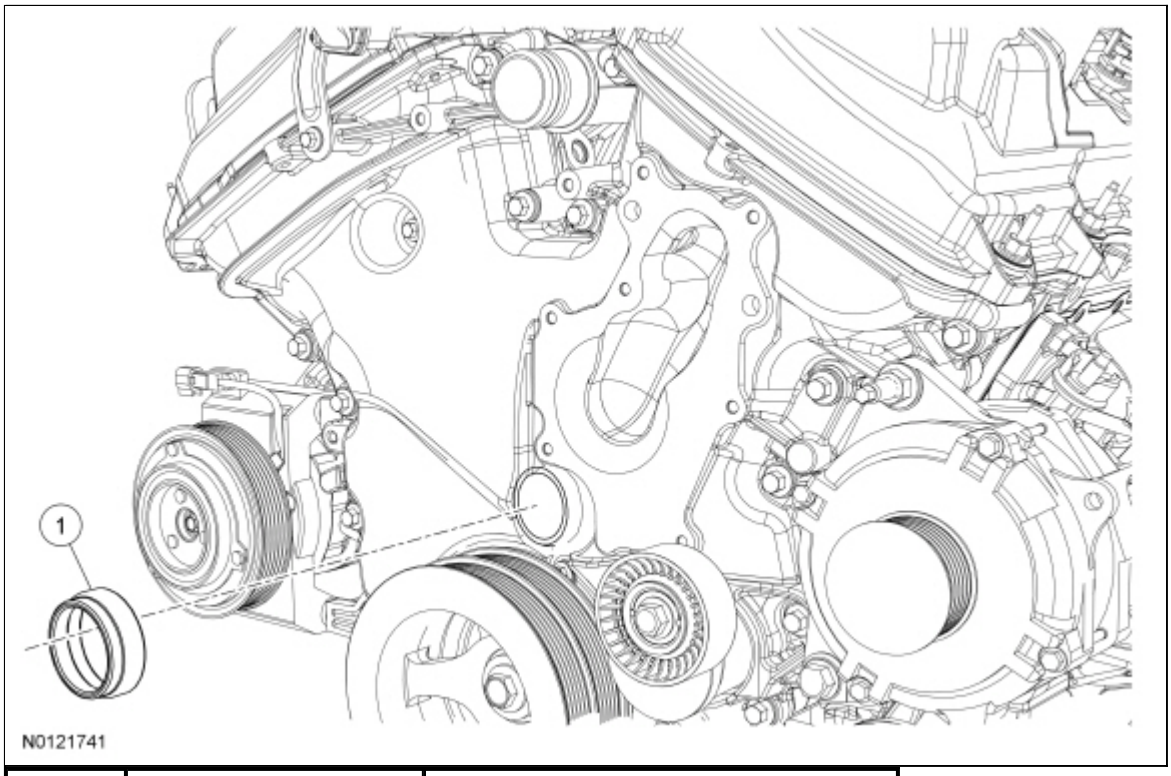
2. Install the automatic transmission. For additional information, refer to Section 307-01 .
3. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Front Cover Radial Seal

Special Tool(s)

 ST3232-A	Remover/Installer, Water Tube Seal 303-1528



Item	Part Number	Description
1	6020	Front cover radial seal

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the Air Conditioning (A/C) compressor belt. For additional information, refer to Section 303-05 .

2. Remove the coolant pump. For additional information, refer to Section 303-03 .

3. Using the Water Tube Seal Remover, remove the front cover radial seal.
    - Reset the Water Tube Seal Remover center bolt to its retracted position.
    - Screw the Water Tube Seal Remover onto the front cover radial seal until it bottoms out.
    - Using a brass hammer, give the Water Tube Seal Remover a slight tap inward to break the front cover radial seal lose.
    - Turn the Water Tube Seal Remover center bolt clockwise and remove the front cover radial seal.



4. Clean the engine front cover radial seal area.

Installation

1. Using the Water Tube Seal Installer, install the front cover radial seal.
    - Position the front cover radial seal on the Water Tube Seal Installer.
    - Position the Water Tube Seal Installer into the engine front cover.
    - Using a brass hammer, tap the Water Tube Seal Installer until the front cover radial seal bottoms out.

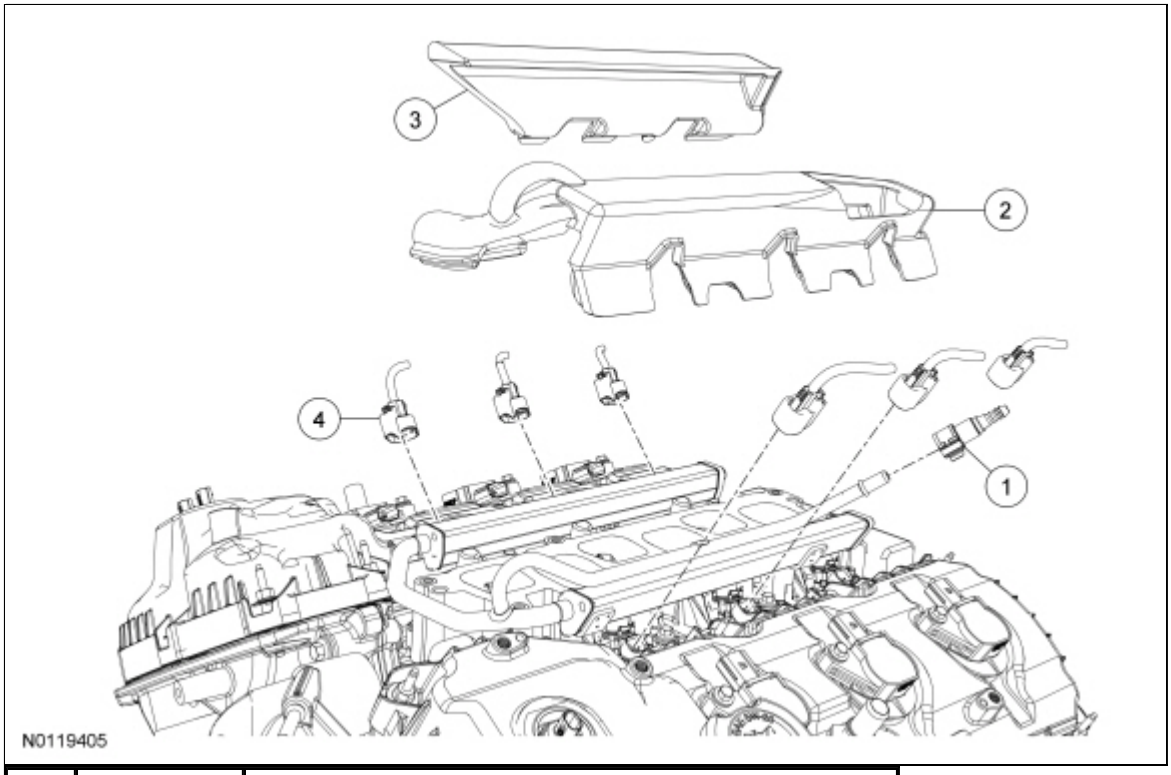


2. Inspect the front cover radial seal for proper installation or damage.
3. Install the coolant pump. For additional information, refer to Section 303-03 .
4. Install the A/C compressor belt. For additional information, refer to Section 303-05 .

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Lower Intake Manifold

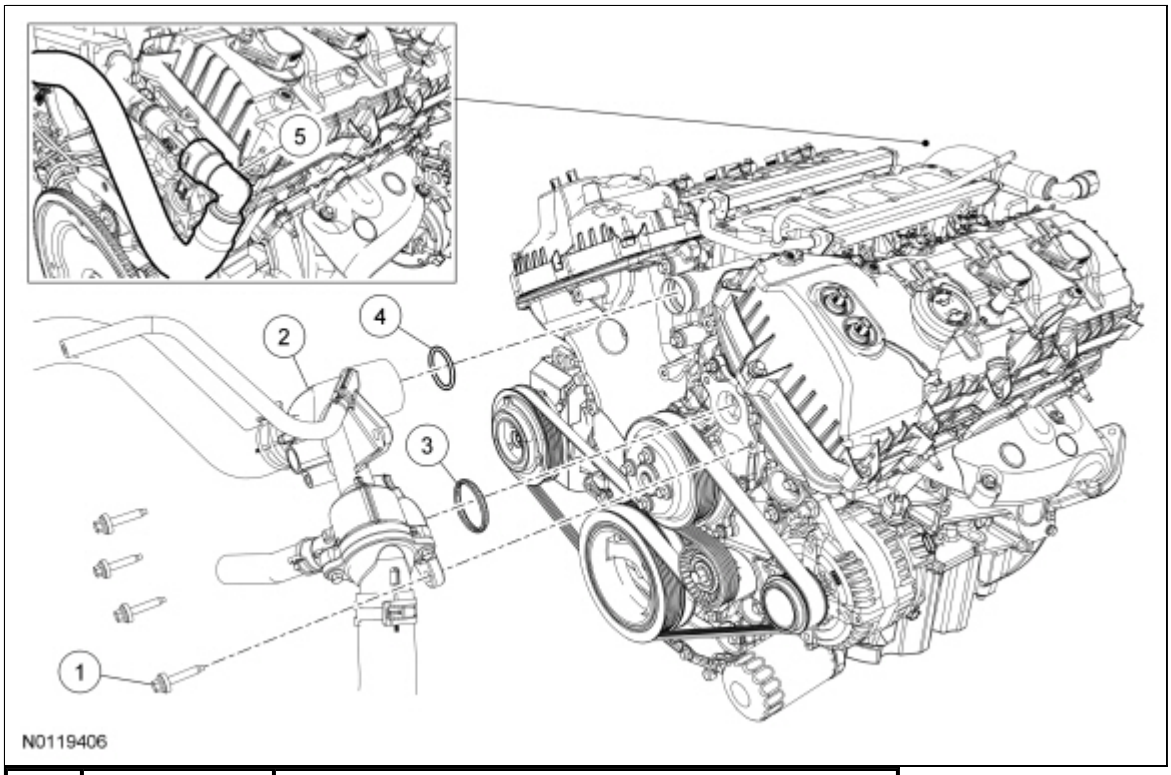
Lower Intake Manifold (View 1 of 3)



Item	Part Number	Description
1	—	Fuel tube-to-fuel rail quick connect coupling (part of 9J280)
2	6P013	LH fuel rail noise insulator shield
3	6P013	RH fuel rail noise insulator shield
4	—	Fuel injector electrical connector (part of 12C508) (6 required)

Lower Intake Manifold (View 2 of 3)

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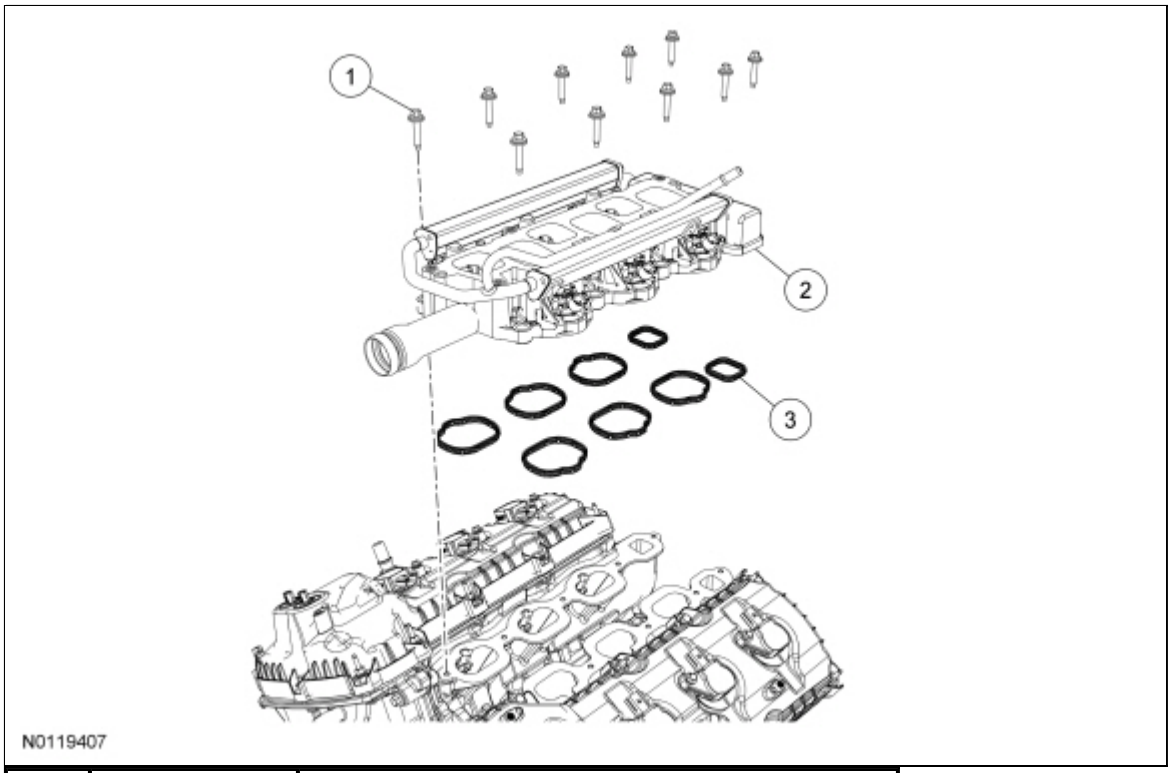


Item	Part Number	Description
1	W714841	Thermostat housing bolt (4 required)
2	8592	Thermostat housing
3	8A571	Thermostat housing gasket
4	9A425	Thermostat housing-to-coolant tube O-ring seal
5	18472	Heater hose-to-lower intake manifold

Lower Intake Manifold (View 3 of 3)

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	W503279	Lower intake manifold bolt (10 required)
2	9424	Lower intake manifold
3	9439	Lower intake manifold gasket (8 required)

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

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WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

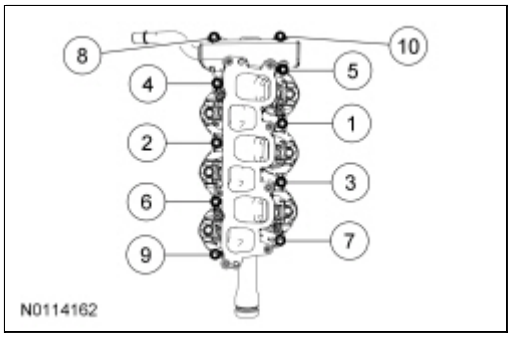
1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Drain the cooling system. For additional information, refer to Section 303-03 .
4. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.
5. Disconnect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .
6. Remove the LH and RH fuel rail noise insulator shields.
7. Disconnect the 6 fuel injector electrical connectors.
8. ***NOTICE:*** **Cover the accessory drive belts to prevent coolant contamination of the belts.**

   Completely cover the accessory drive belts with waterproof plastic.
9. Remove the 4 bolts and remove the thermostat housing from the coolant tube.
   - Remove and discard the thermostat housing gasket and coolant tube O-ring seal.
10. Disconnect the heater hose from the rear of the lower intake manifold.
11. Remove the 10 bolts and the lower intake manifold.
    - Remove and discard the lower intake manifold gaskets.
    - Clean and inspect all sealing surfaces.

Installation

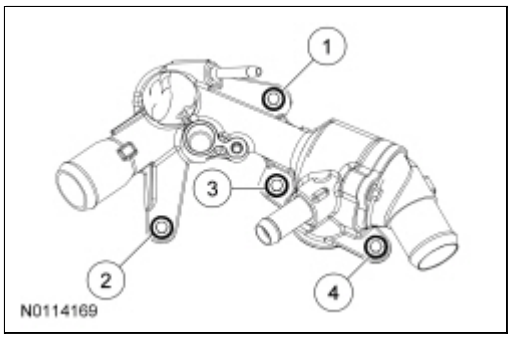
1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris if found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Using new lower intake manifold gaskets, install the lower intake manifold and the 10 bolts and tighten in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).



2. Connect the heater hose to the lower intake manifold.

3. Using a new thermostat housing gasket and coolant tube O-ring seal, install the thermostat housing and the 4 bolts and tighten in the sequence shown in 2 stages.
   - Stage 1: Tighten to 8 Nm (71 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



4. Connect the 6 fuel injector electrical connectors.

5. Install the LH and RH fuel rail noise insulator shields.

6. Connect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

7. Install the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

9. Remove the waterproof plastic from accessory drive belts.

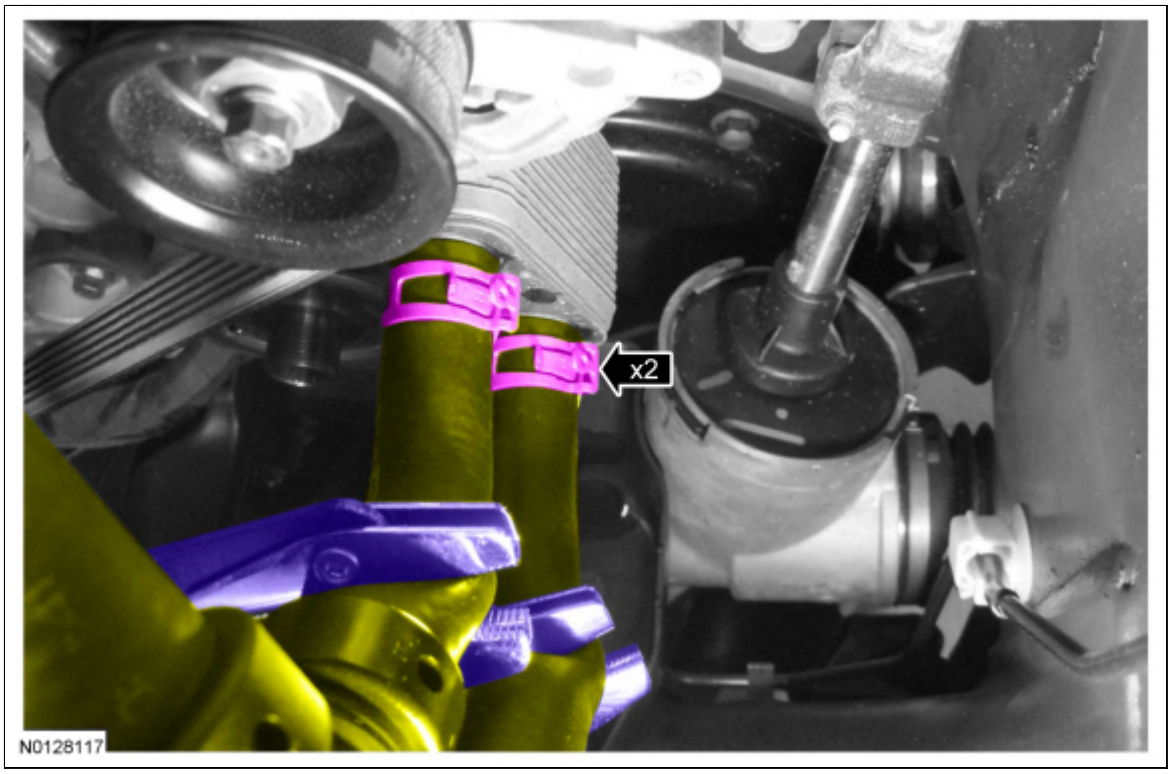
10. Fill and bleed the cooling system. For additional information, refer to Section 303-03 .

repair4less

Oil Cooler

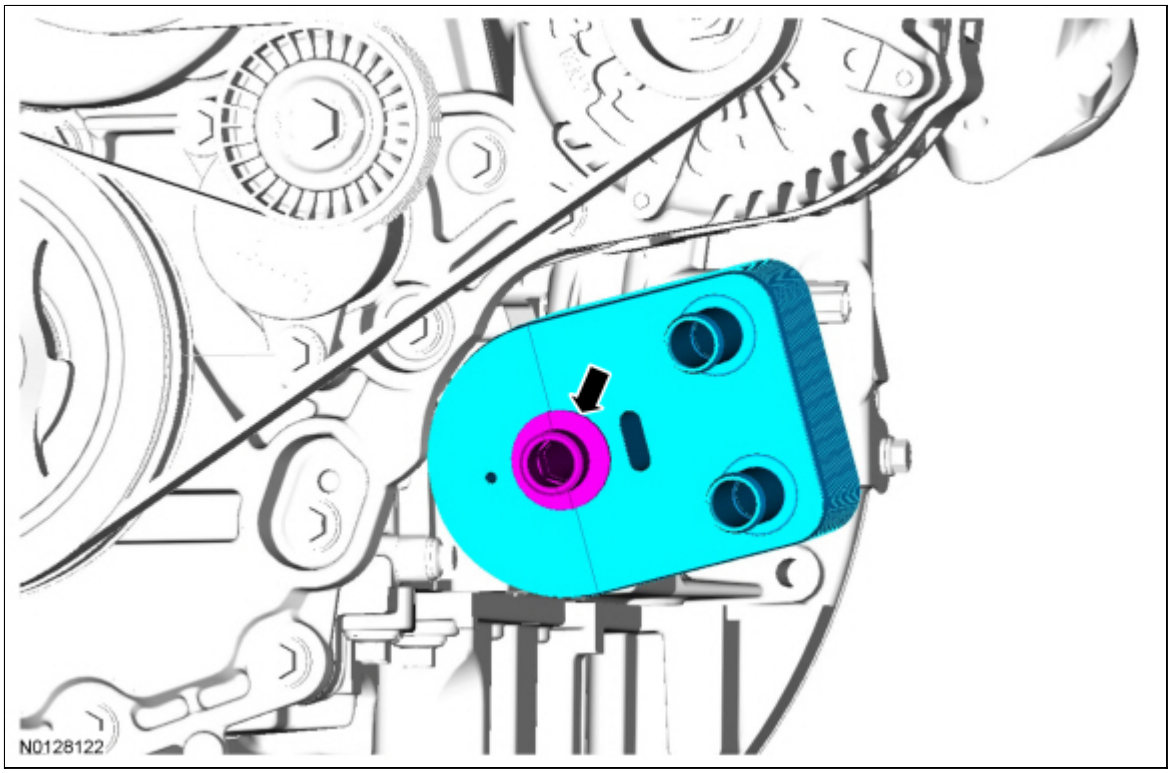
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove and discard the engine oil filter.
3. Using hose clamp pliers, clamp the 2 oil cooler coolant hoses and remove the 2 coolant hoses from the oil cooler.



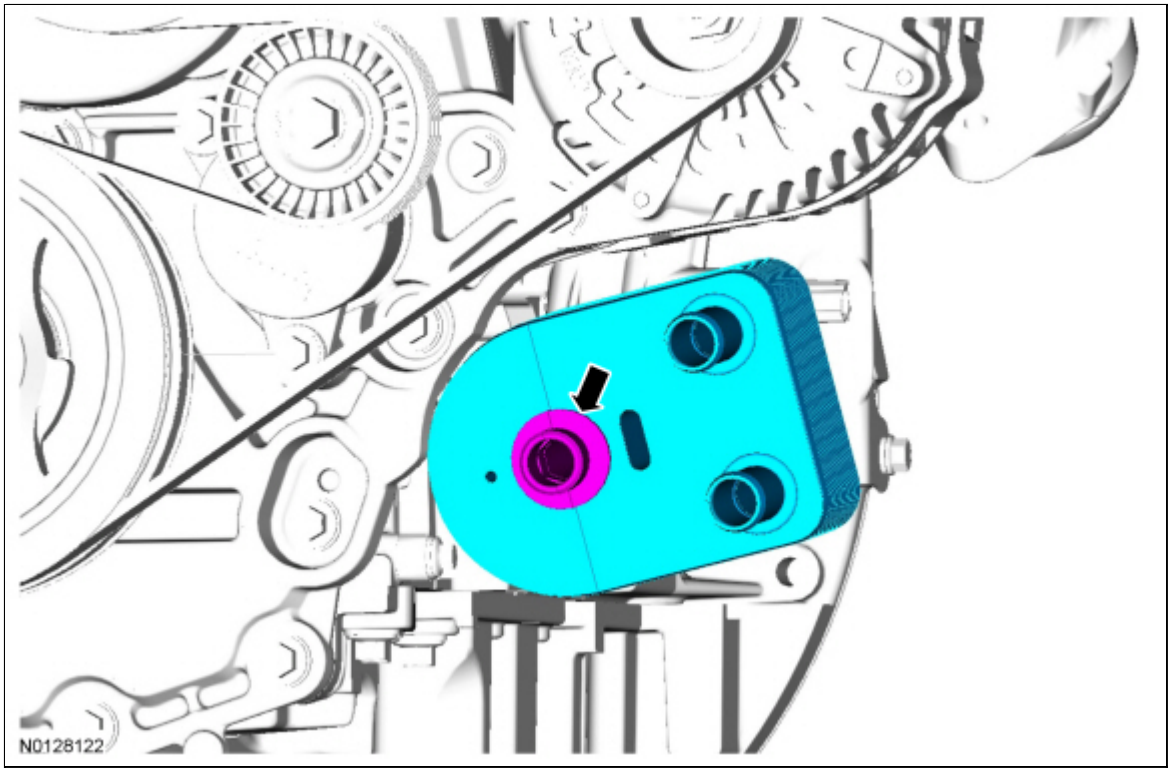
4. Loosen the oil cooler insert bolt and remove the oil cooler.
    - Inspect the oil cooler gasket, replace if necessary.

repair4less

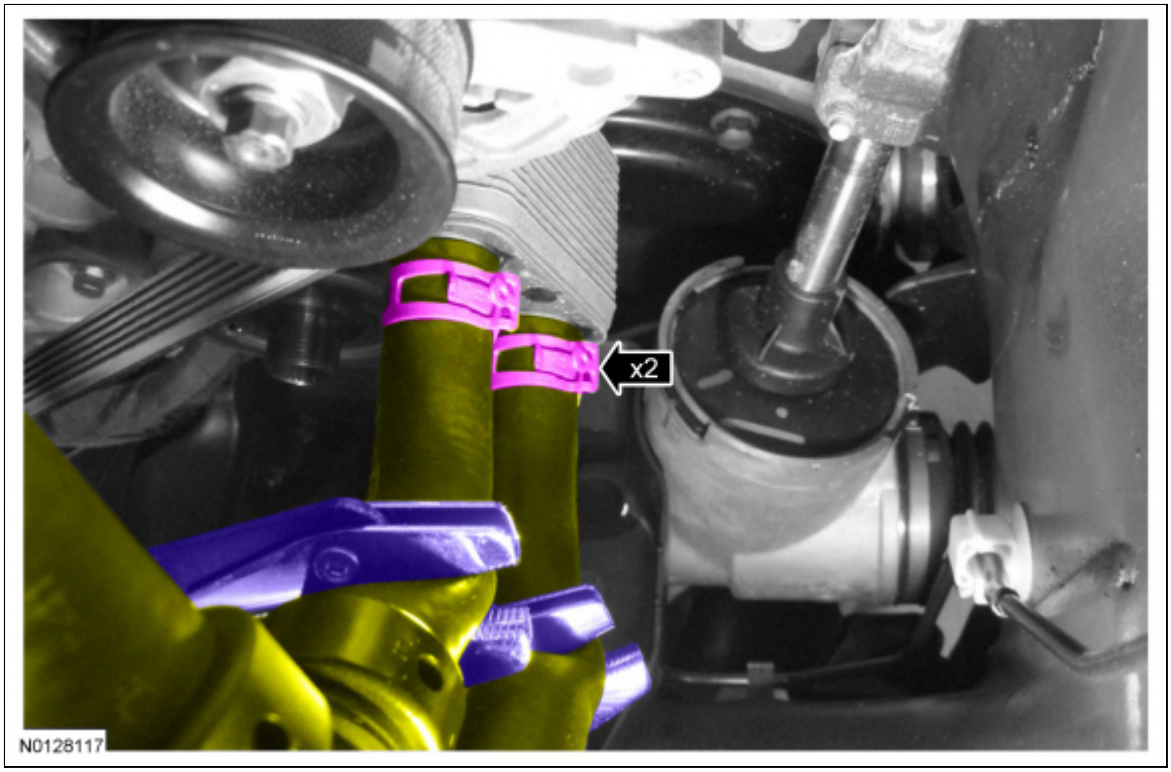


Installation

1. Align the oil cooler to the oil filter adapter and tighten the oil cooler insert bolt.
    - Tighten to 58 Nm (43 lb-ft).



2. Connect the 2 coolant hoses to the engine oil cooler and remove the hose clamp pliers.



3. **NOTE:** Do not lubricate the engine oil filter gasket.

   Install a new engine oil filter.
   - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

4. Inspect and adjust the coolant level in the degas bottle.

5. Inspect and adjust the engine oil level.

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repair4less

Oil Filter Adapter

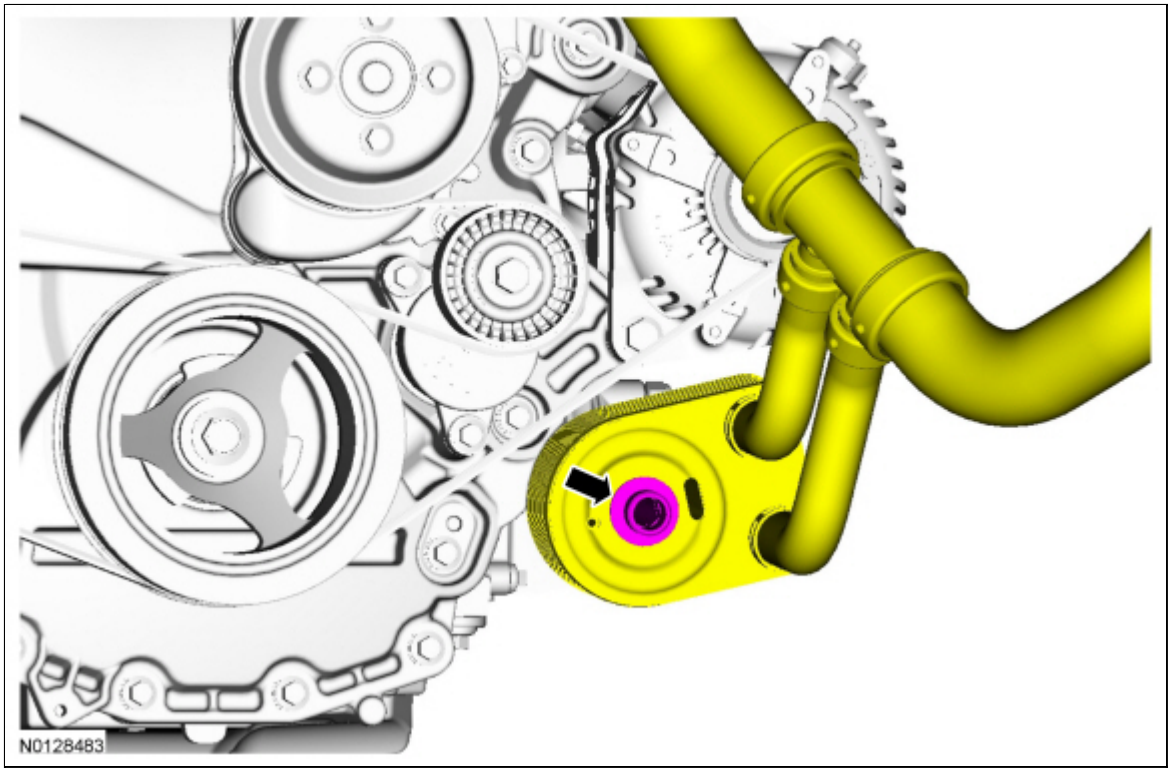
Removal

All engines

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the Air Cleaner (ACL) outlet tube and the ACL upper tray. For additional information, refer to Intake Air System Components — Exploded View, 3.7L in Section 303-12 .
4. Remove and discard the engine oil filter.

Engine with oil cooler

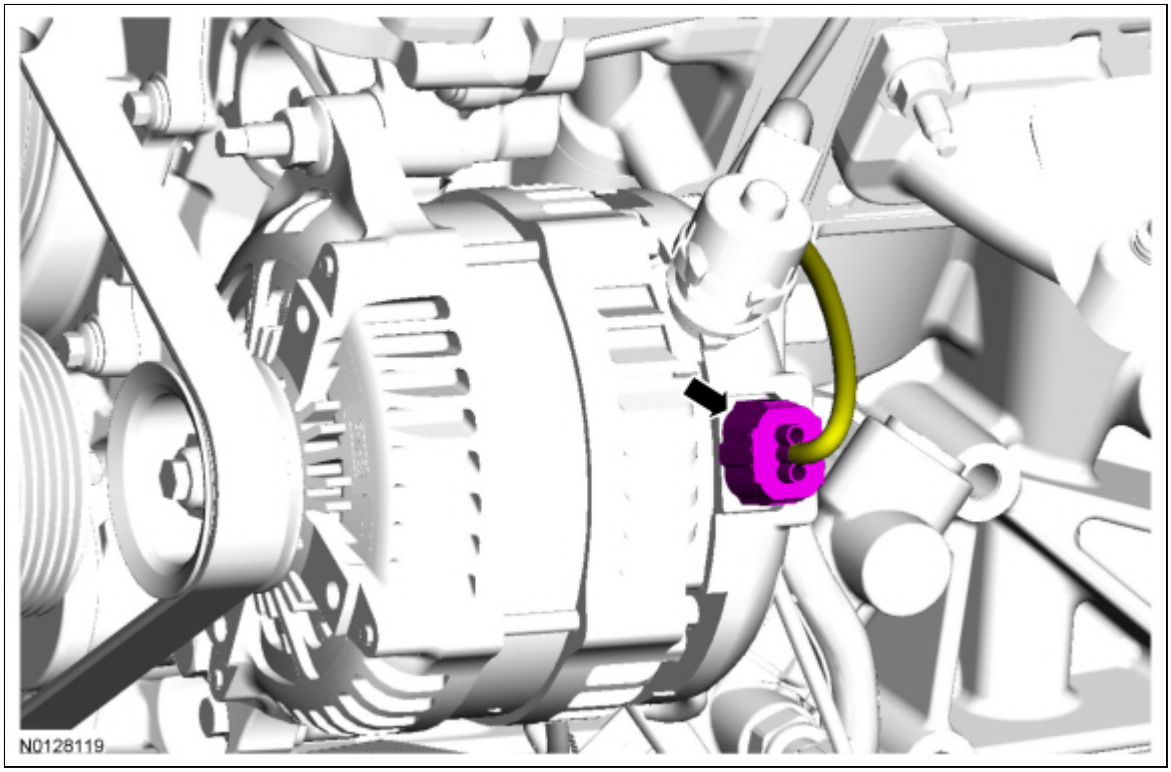
5. Loosen the oil cooler insert bolt and position the oil cooler aside.
    - Inspect the oil cooler gasket, replace if necessary.



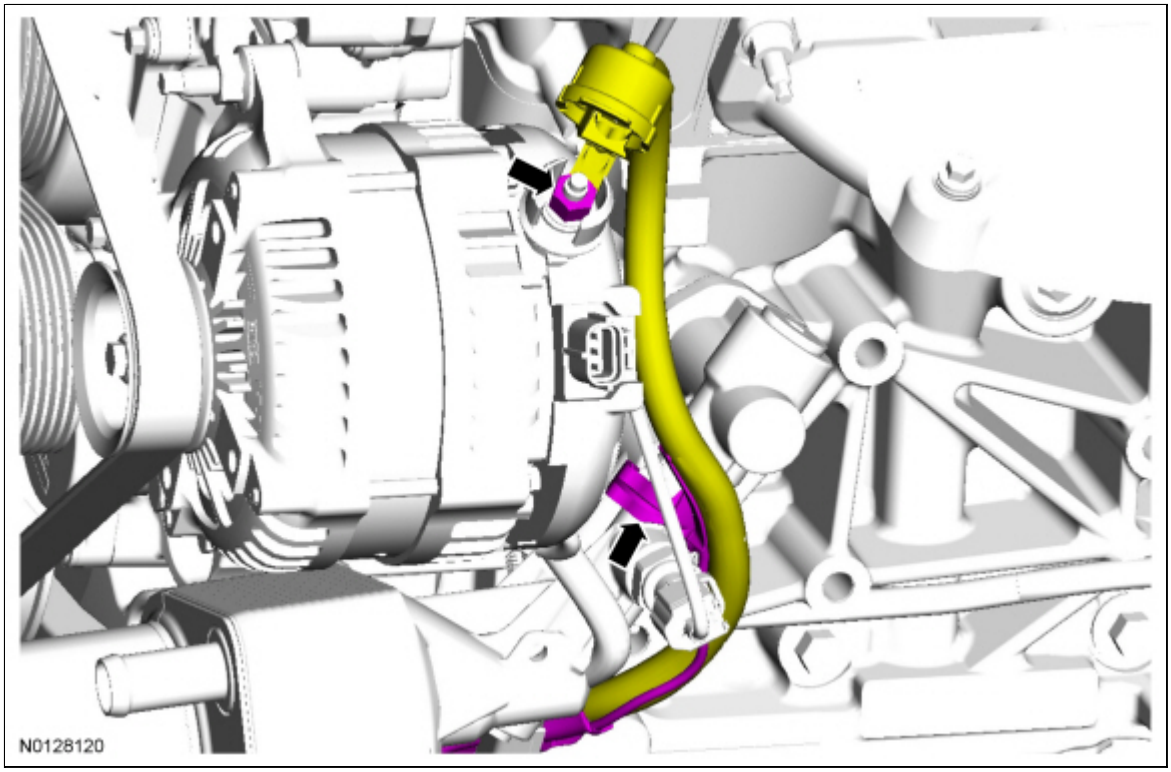
All engines

6. Disconnect the generator electrical connector.

repair4less



7. Position the generator B+ protective boot aside, remove the B+ nut and position the B+ terminal aside.
    - Detach the generator wiring harness retainer from the oil filter adapter and position the generator wiring harness aside.



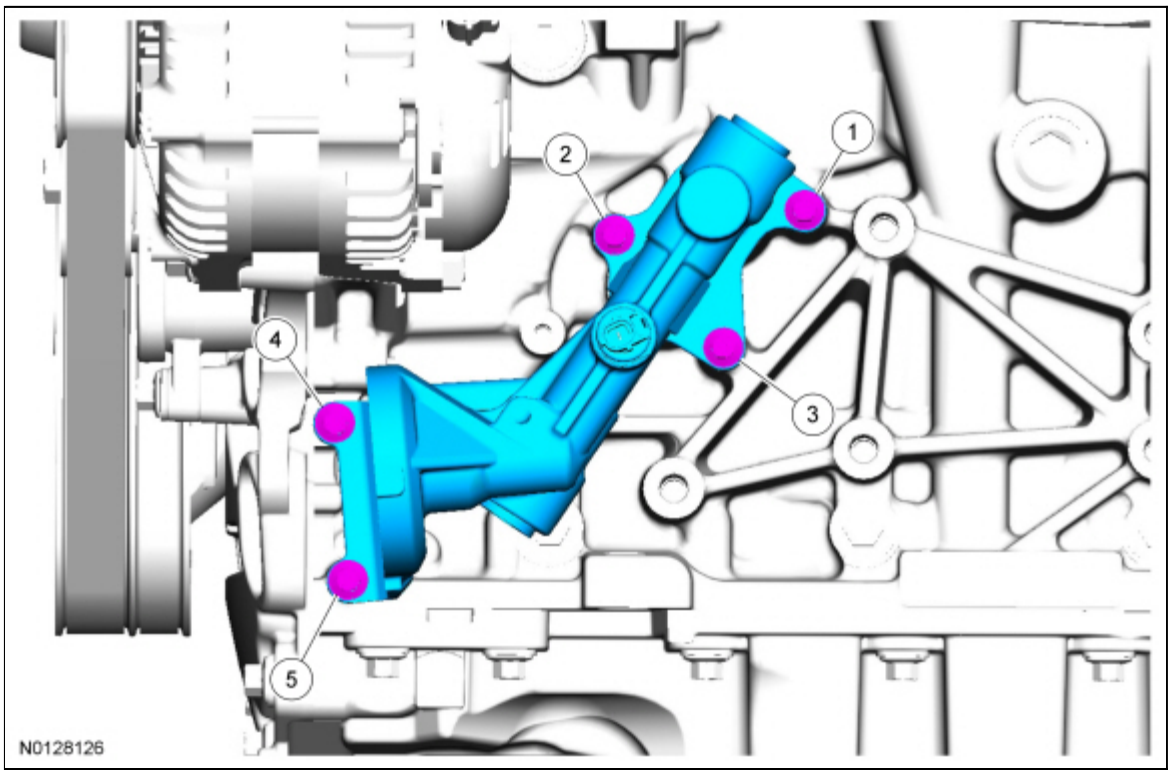
8. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

9. Remove the 5 bolts and the oil filter adapter.
    - Discard the gasket.
    - Clean and inspect all sealing surfaces.

Installation

All engines

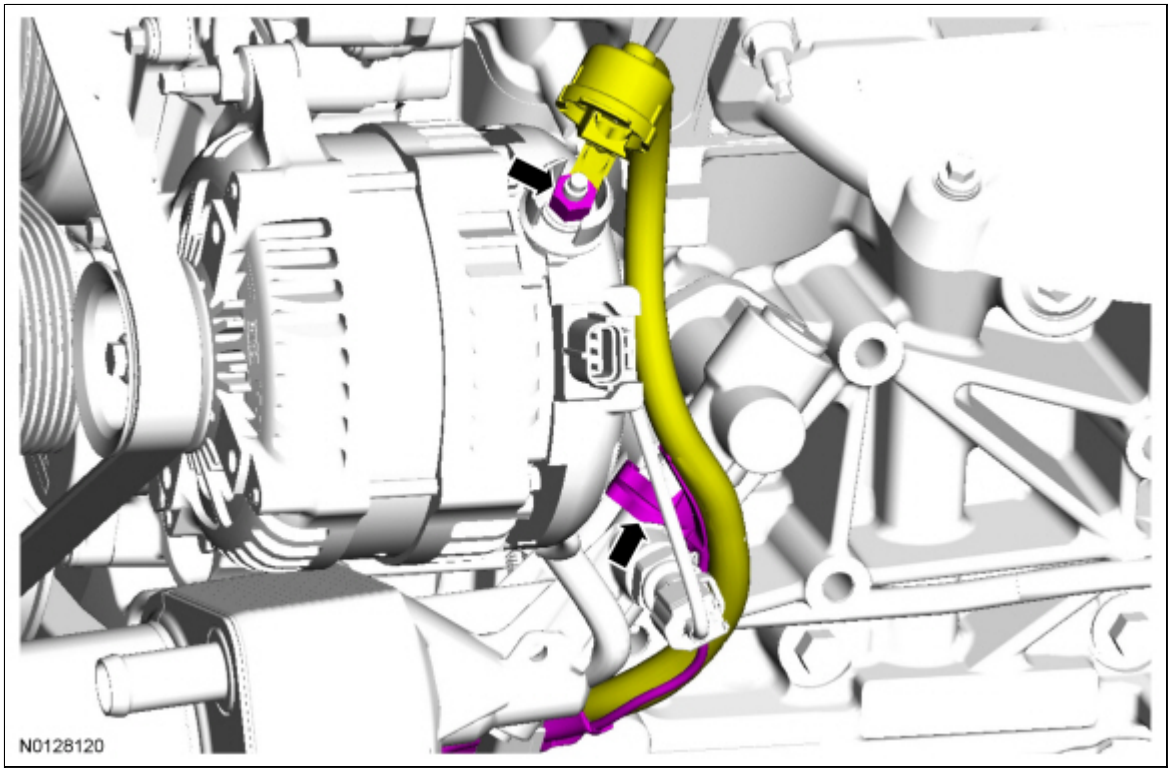
1. Using a new gasket, install the oil filter adapter and the 5 bolts and tighten in sequence shown.
    - Tighten to 10 Nm (89 lb-in) and then an additional 45 degrees.



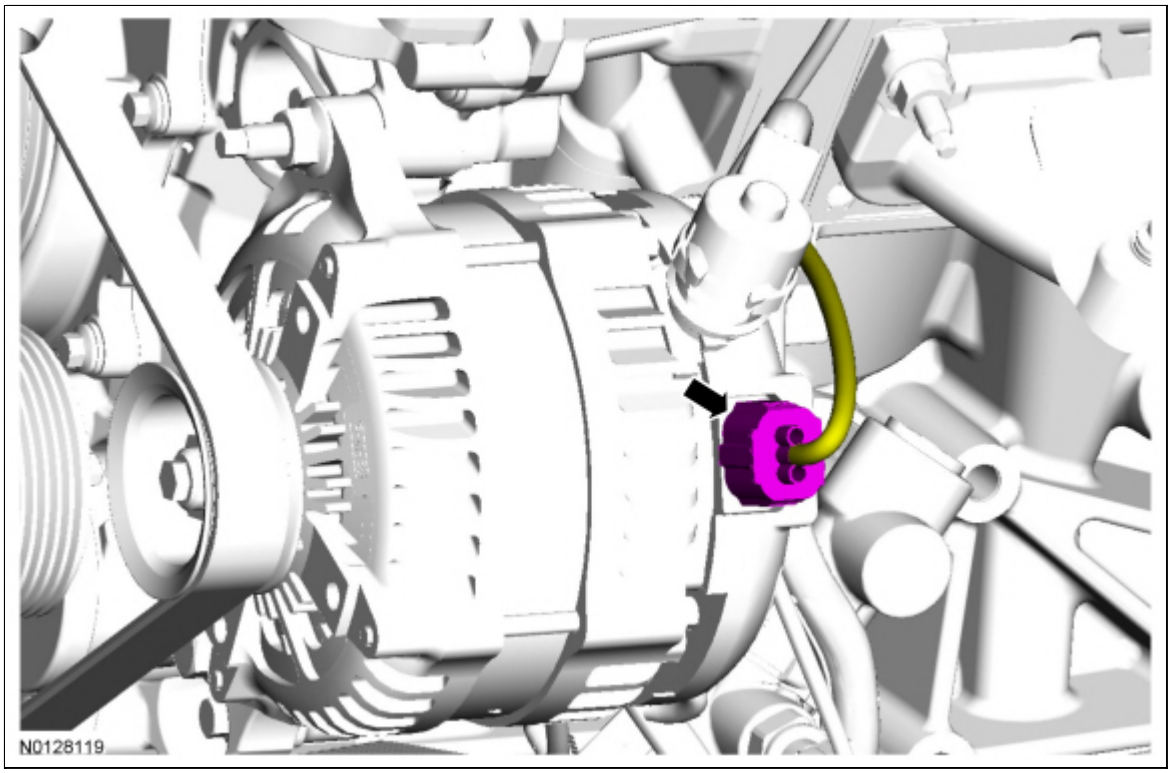
2. Connect the EOP switch electrical connector.
    - Attach the generator wiring harness retainer.

3. Position back the generator wiring harness and B+ terminal and install the nut.
    - Tighten to 17 Nm (150 lb-in).
    - Position back the generator B+ protective boot.
    - Attach the generator wiring harness retainer to the oil filter adapter.

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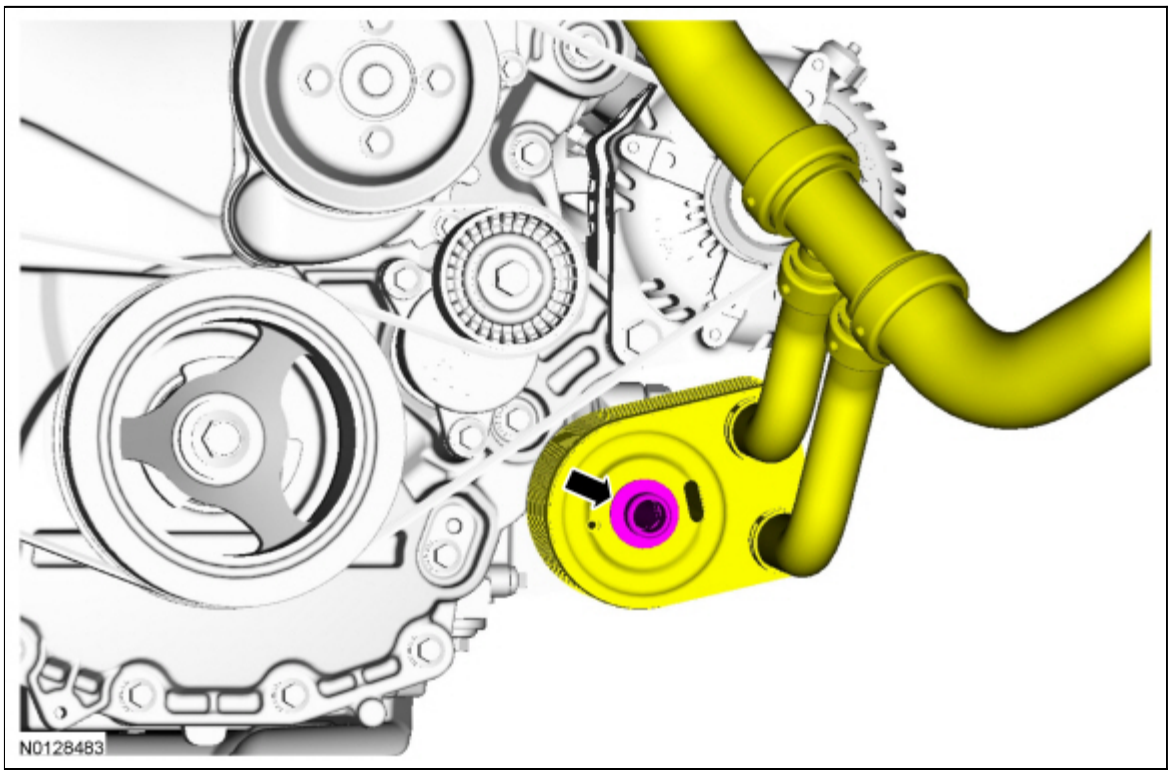
4. Connect the generator electrical connector.



Engine with oil cooler

5. Position the oil cooler and tighten the oil cooler insert bolt.

- Tighten to 58 Nm (43 lb-ft).



All engines

6. **NOTE:** Do not lubricate the engine oil filter gasket.

   Install a new engine oil filter.
   - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

7. Install the ACL outlet tube and the ACL upper tray. For additional information, refer to Intake Air System Components — Exploded View, 3.7L in Section 303-12 .

8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

9. Inspect and adjust the engine oil level.

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repair4less

Oil Pan

Material

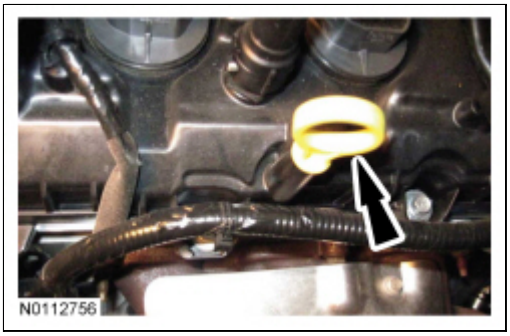
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All vehicles

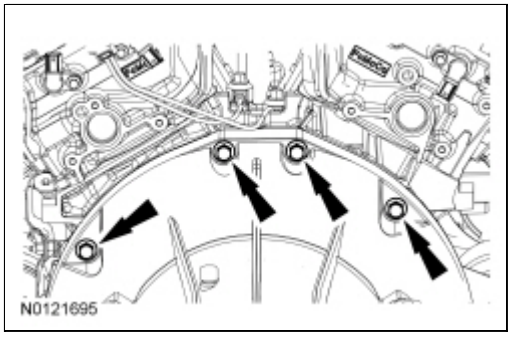
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the oil level indicator.



4. **NOTE:** This step does not apply if the engine front cover is removed.

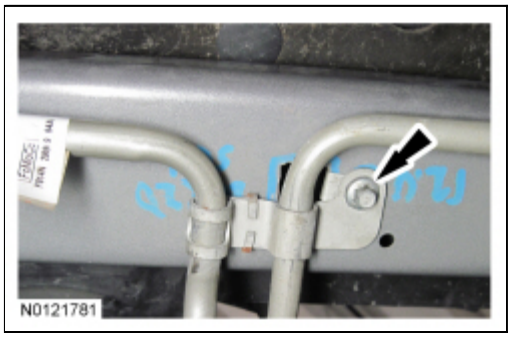
repair4less

Loosen the 4 upper bellhousing-to-engine bolts 5 mm (0.19 in).

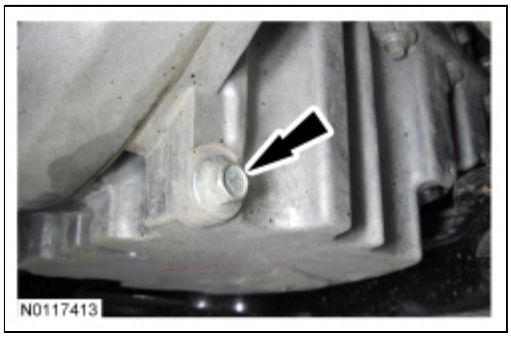


5. If equipped, remove the bolts and the skid plate.

6. Remove the bolt for the transmission cooler tube bracket from the radiator support.



7. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

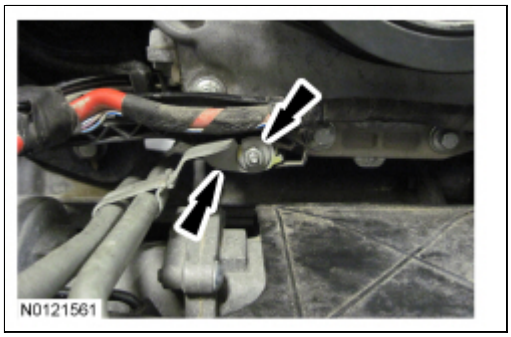


8. Remove and discard the engine oil filter.



9. **NOTE:** This step does not apply if the engine front cover is removed.

   Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.



10. **NOTE:** This step does not apply if the engine front cover is removed.

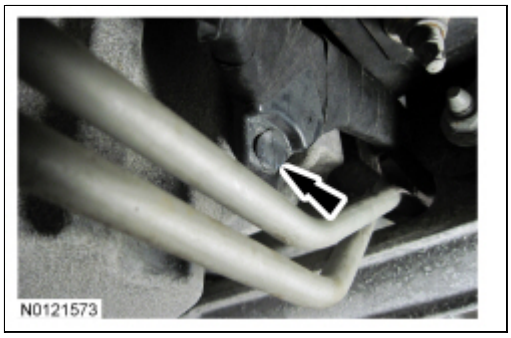
    Detach the generator wiring harness from the engine front cover.



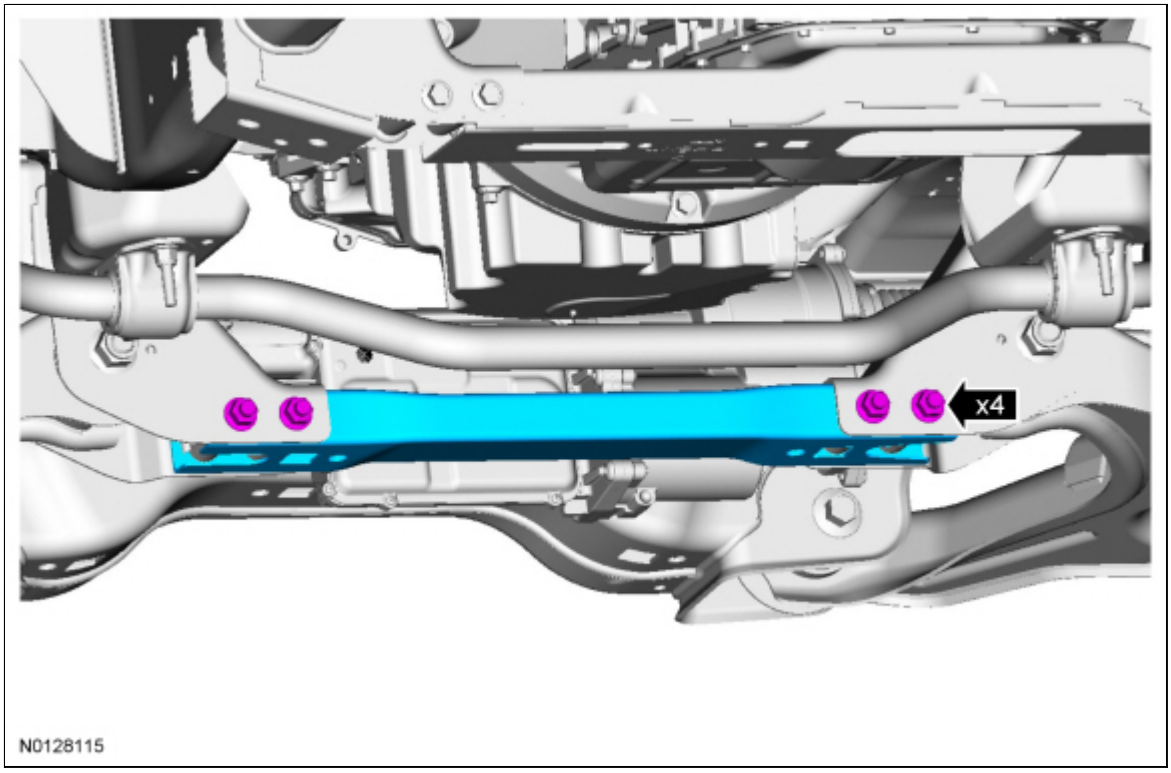
11. Remove the starter motor. For additional information, refer to Section 303-06 .

12. Detach the starter motor wiring harness retainer from the oil pan.

repair4less

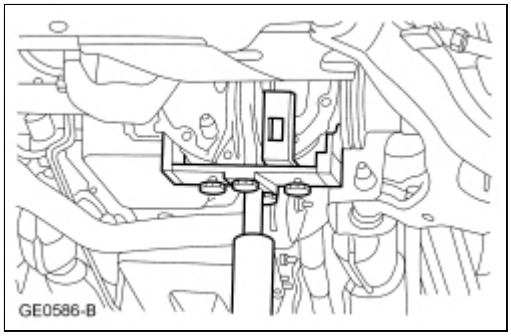


13. Remove the 4 nuts and bolts and the crossmember.

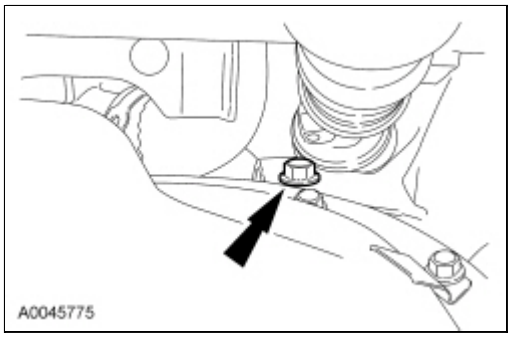


Four Wheel Drive (4X4) vehicles

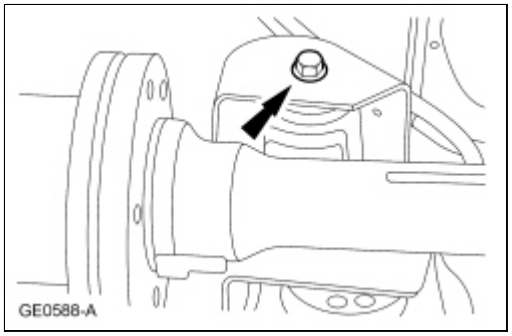
14. Position a suitable hydraulic jack under the front axle. Securely strap the jack to the axle.



15. Remove the upper front axle carrier mounting bushing bolt.

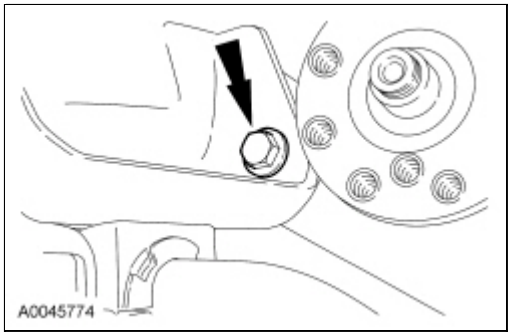


16. Remove the axle shaft housing carrier bushing bolt.



17. **NOTE:** Front driveshaft removed for clarity only.

    Remove the lower front axle carrier mounting bushing bolt.



18. ***NOTICE:*** **Use care when lowering the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

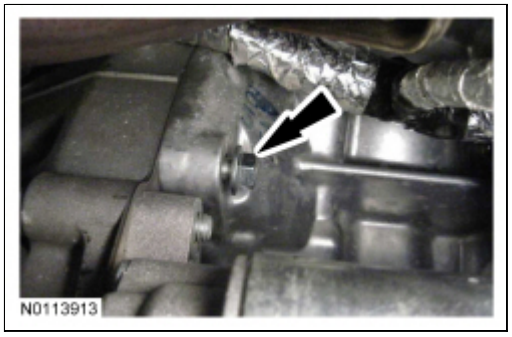
    Lower the axle to allow clearance for the oil pan to be removed.

All vehicles

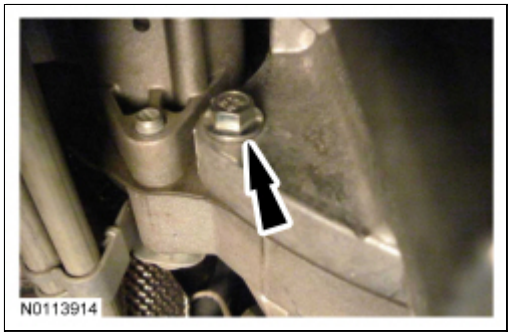
19. **NOTE:** This step does not apply if the engine front cover is removed.

    Loosen the engine-to-bellhousing bolt above the starter motor 5 mm (0.19 in).

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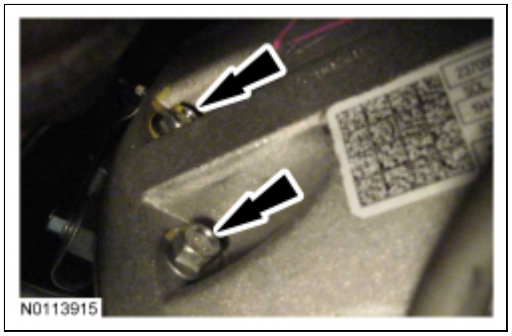


20. Remove the oil pan-to-bellhousing bolt from below the starter motor.

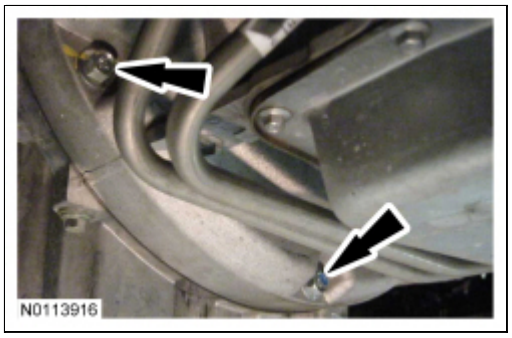


21. **NOTE:** This step does not apply if the engine front cover is removed.

    Loosen the 2 LH bellhousing-to-engine bolts 5 mm (0.19 in).

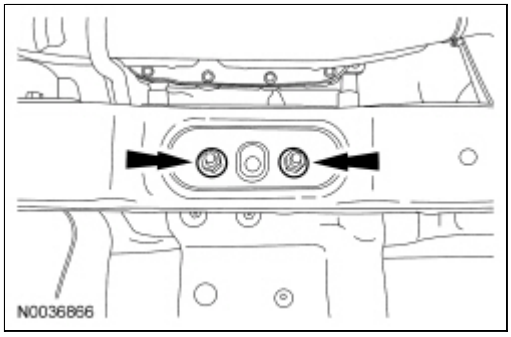


22. Remove the 2 LH bellhousing-to-oil pan bolts.



23. **NOTE:** This step does not apply if the engine front cover is removed.

Loosen the 2 transmission crossmember nuts.

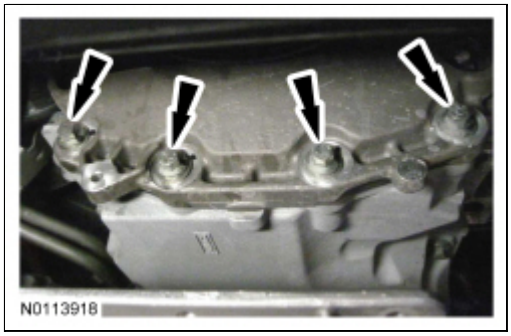


24. **NOTE:** This step does not apply if the engine front cover is removed.

    Slide the transmission rearward 5 mm (0.19 in).

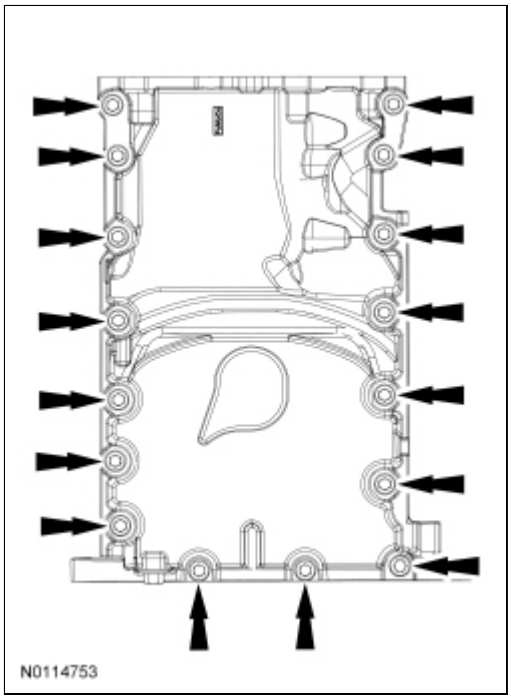
25. **NOTE:** This step does not apply if the engine front cover is removed.

    Remove the 4 lower engine front cover bolts.



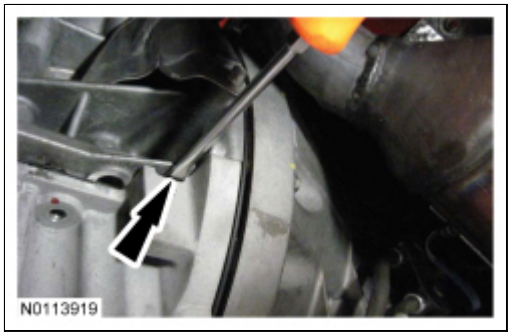
26. Remove the 16 oil pan bolts.

repair4less



27. **NOTE:** LH rear shown, RH front similar.

    Using a suitable pry tool, locate the 2 pry pads at the LH and RH sides of the oil pan and pry the oil pan loose and remove.



28. **NOTE:** The generator wiring harness retainer is being removed for clearance to install the oil pan.

    Detach the generator wiring harness retainer from the engine block.



29. ***NOTICE:*** **Only use a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the oil**

pan. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean. These tools cause scratches and gouges that make leak paths.

Clean the engine oil pan using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

- Thoroughly wash the oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

30. ***NOTICE:*** **Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white, part number 07528) to clean the cylinder block and engine front cover sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

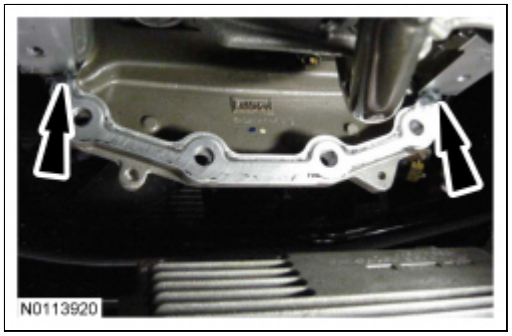
    Clean the sealing surfaces of the cylinder block and engine front cover in the following sequence.
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

All vehicles

1. **NOTE:** This step does not apply if the engine front cover is removed.

    Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 engine front cover-to-cylinder block joint areas on the sealing surface of the oil pan.



2. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

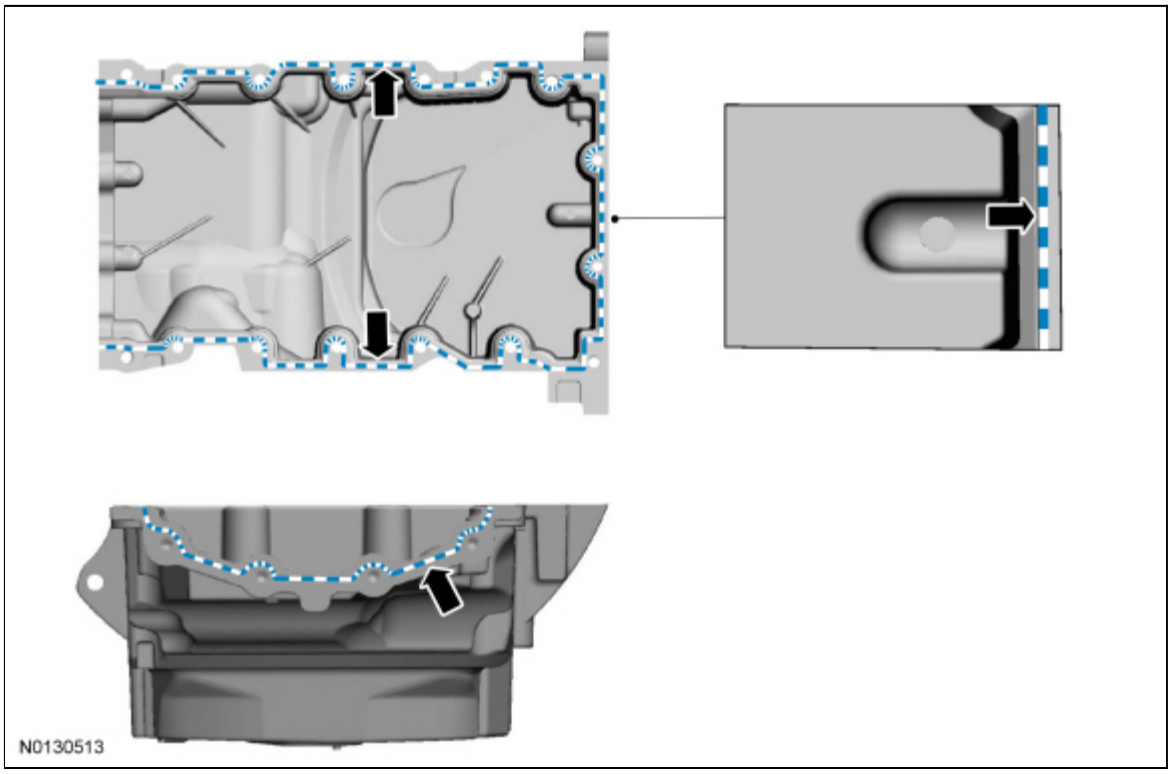
    NOTICE: **Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the oil pan. Failure to follow these instructions may cause engine oil leakage.**

    NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

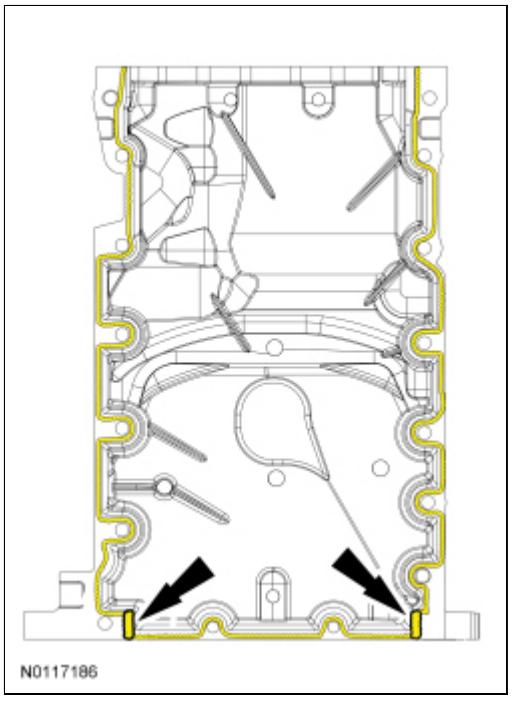
    NOTE: Do not apply Motorcraft® High Performance Engine RTV Silicone to the front edge of the oil pan, if the engine front cover is removed.

repair4less

Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone on the inside edge of the oil pan to the sealing surface of the oil pan-to-engine block and to the oil pan-to-engine front cover mating surface.



3. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.

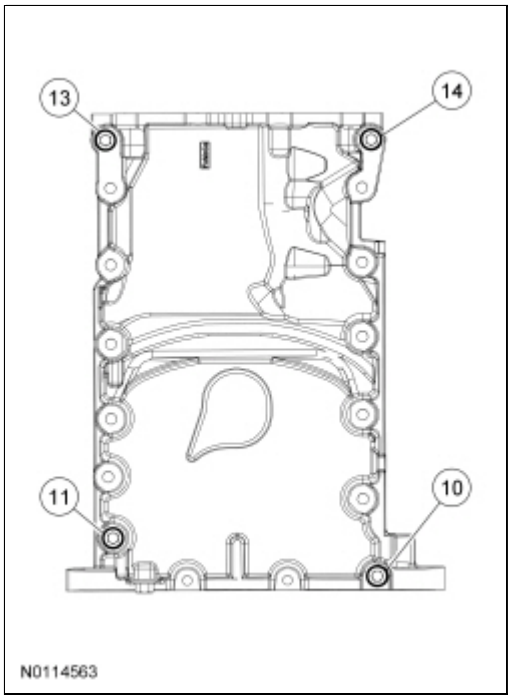


4. **NOTE:** The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant

application.

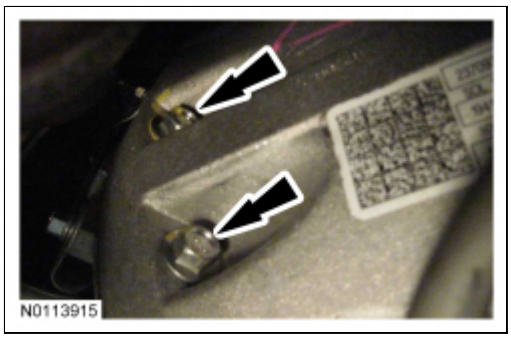
NOTE: Keep the oil pan as close as possible to the transmission while installing, then slide forward towards the engine front cover to prevent wiping off of the sealant.

Install the oil pan and bolts 10, 11, 13 and 14 finger tight.



5. **NOTE:** This step does not apply if the engine front cover is removed.

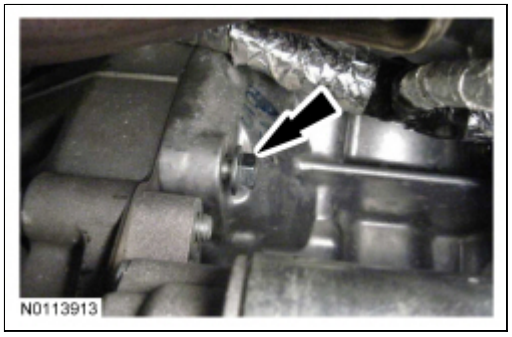
   Tighten the 2 LH bellhousing-to-engine bolts.
   - Do not torque at this time.



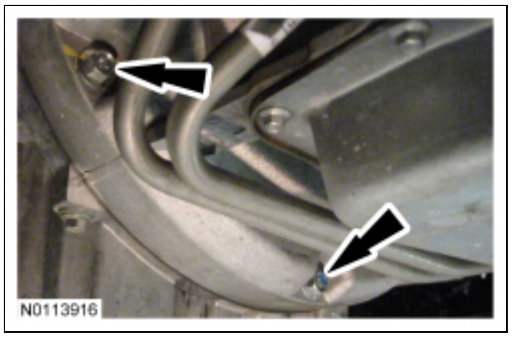
6. **NOTE:** This step does not apply if the engine front cover is removed.

   Tighten the RH engine-to-bellhousing bolt.
   - Do not torque at this time.

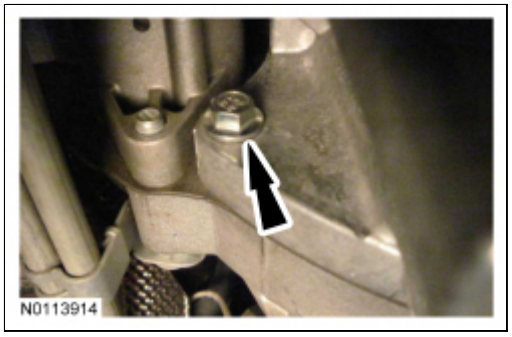
repair4less



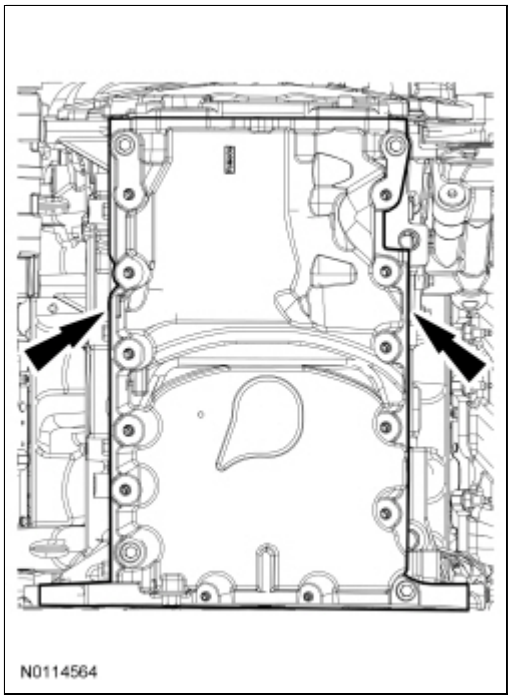
7. Install and tighten the 2 LH bellhousing-to-oil pan bolts.
    - Do not torque at this time.



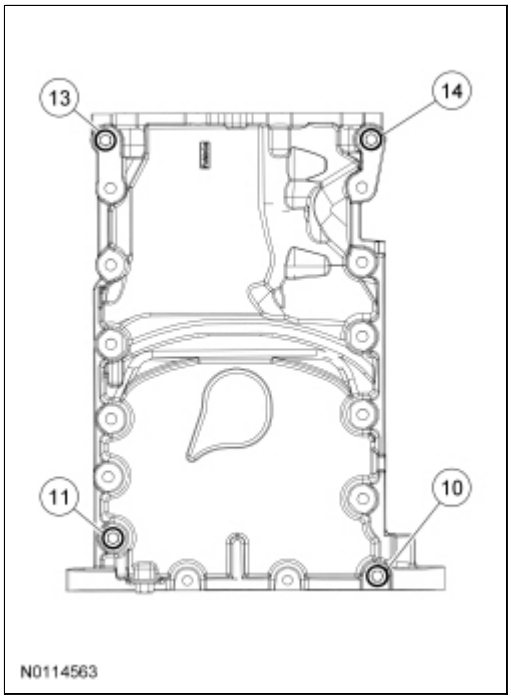
8. Install and tighten the RH oil pan-to-bellhousing bolt.
    - Do not torque at this time.



9. Laterally align the oil pan to the block. Make sure the oil pan is flush with the block at these 2 points.



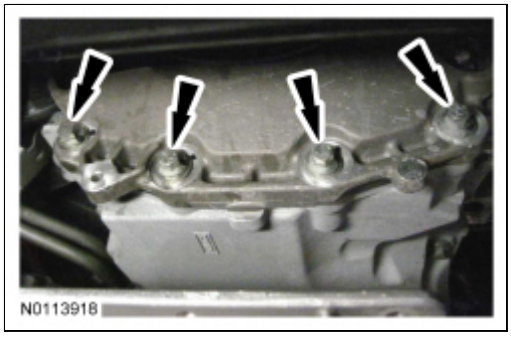
10. Tighten bolts 10, 11, 13 and 14 in the sequence shown to 3 Nm (27 lb-in).



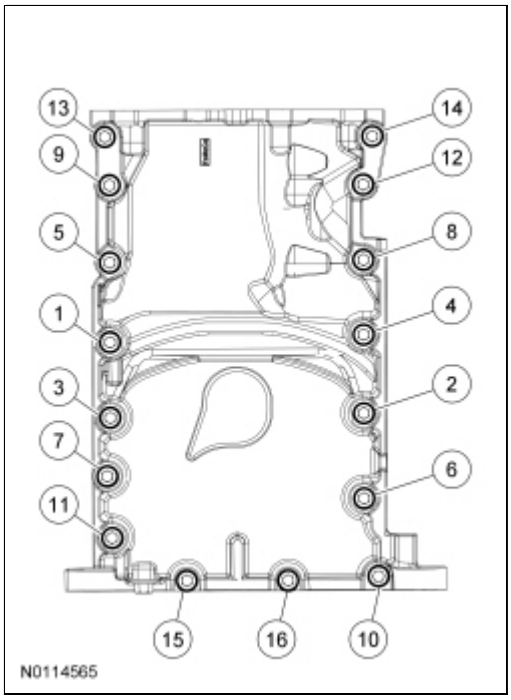
11. **NOTE:** This step does not apply if the engine front cover is removed.

    Install the 4 lower engine front cover bolts finger tight.

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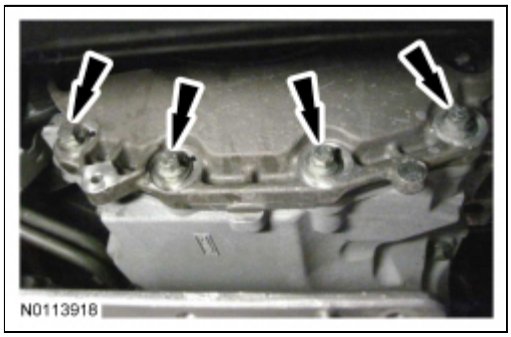


12. Install the remaining oil pan bolts and tighten in the sequence shown.
    - Tighten bolts 1-9 and 11-14 to 20 Nm (177 lb-in), then rotate an additional 45 degrees.
    - Tighten bolts 15 and 16 to 10 Nm (89 lb-in), then rotate an additional 45 degrees.
    - Tighten bolt 10 to 20 Nm (177 lb-in), then rotate an additional 90 degrees.



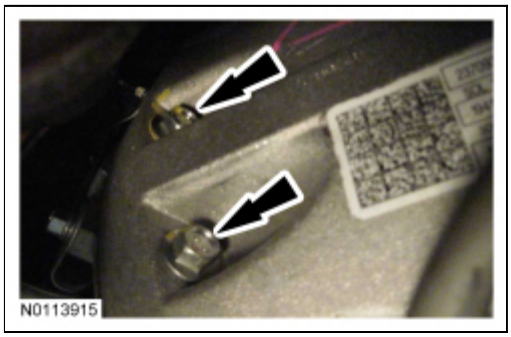
13. **NOTE:** This step does not apply if the engine front cover is removed.

    Tighten the 4 lower engine front cover bolts to 24 Nm (18 lb-ft).



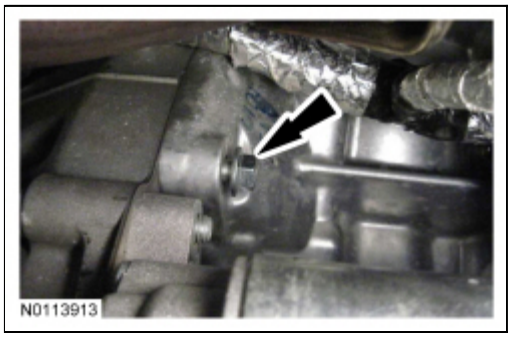
14. **NOTE:** This step does not apply if the engine front cover is removed.

    Tighten the 2 LH bellhousing-to-engine bolts to 48 Nm (35 lb-ft).

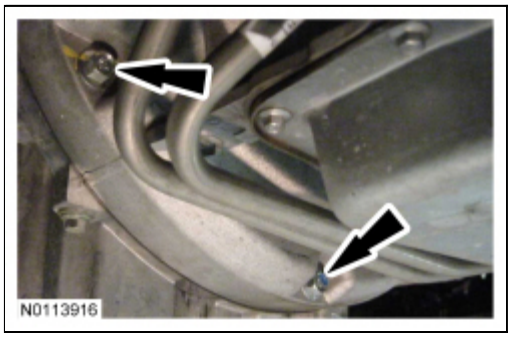


15. **NOTE:** This step does not apply if the engine front cover is removed.

    Tighten the RH engine-to-bellhousing bolt to 48 Nm (35 lb-ft).

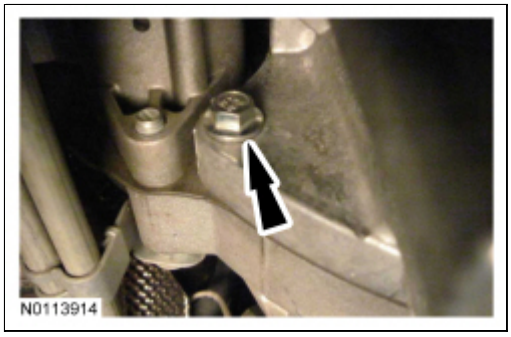


16. Tighten the 2 LH bellhousing-to-oil pan bolts to 48 Nm (35 lb-ft).



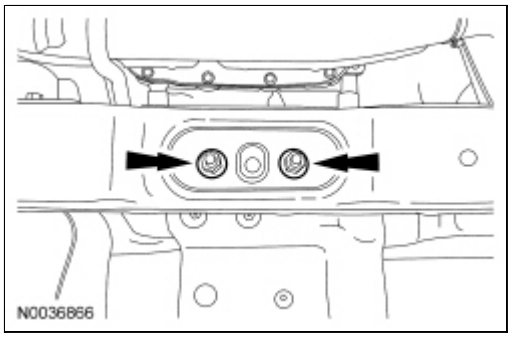
17. Tighten the RH oil pan-to-bellhousing bolt to 48 Nm (35 lb-ft).

repair4less

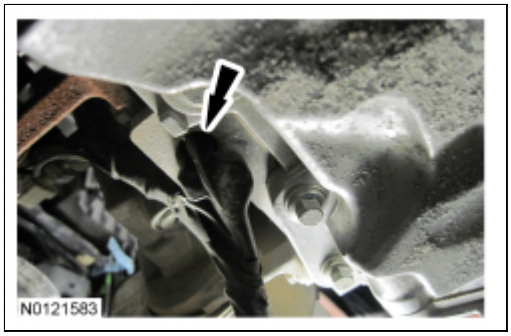


18. **NOTE:** This step does not apply if the engine front cover is removed.

    Tighten the 2 transmission crossmember nuts to 103 Nm (75 lb-ft).



19. Attach the generator wiring harness retainer to the engine block.

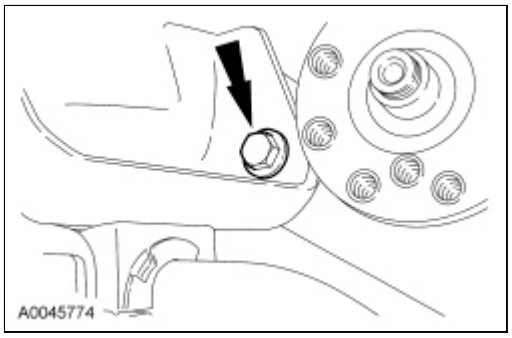


Four Wheel Drive (4X4) vehicles

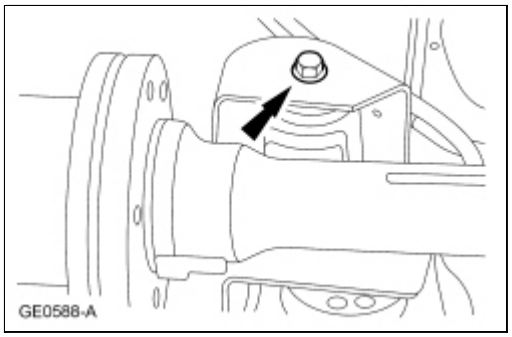
20. ***NOTICE:*** **Use care when positioning the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

    Raise the front axle carrier into position.

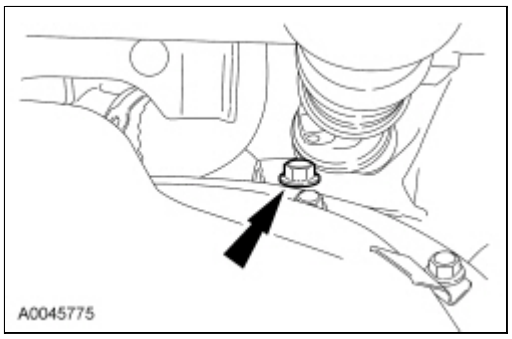
21. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



22. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



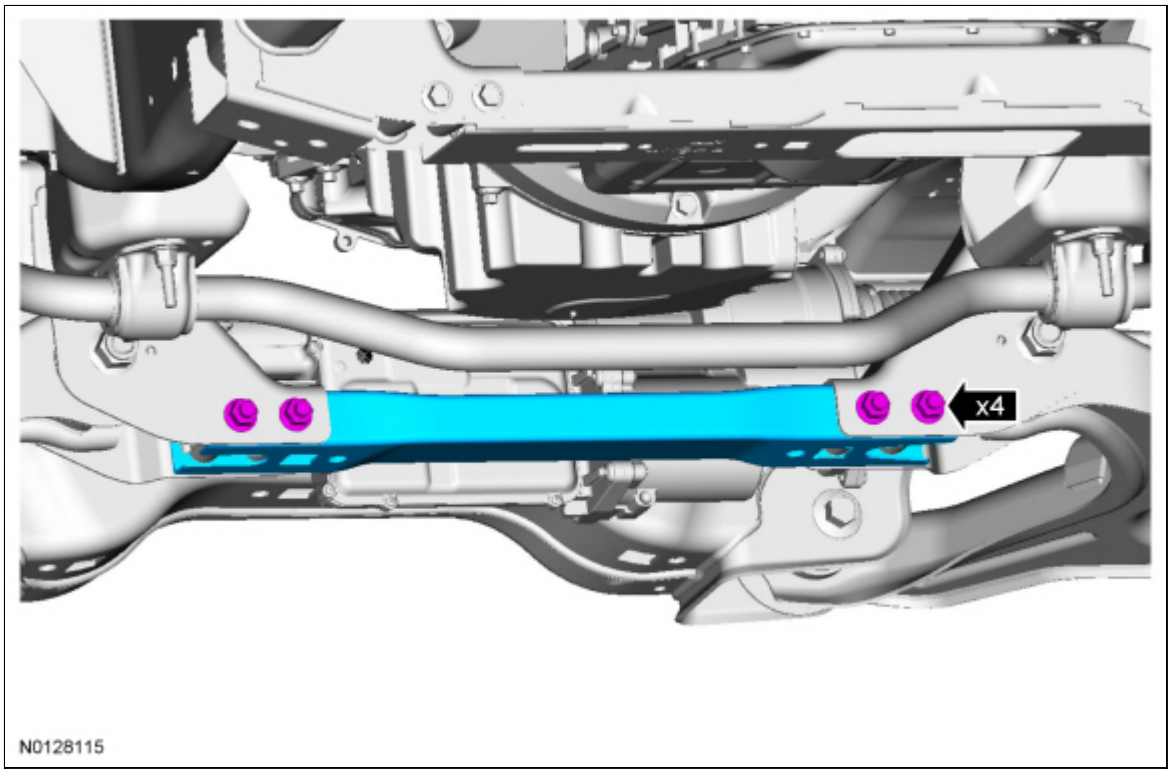
23. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



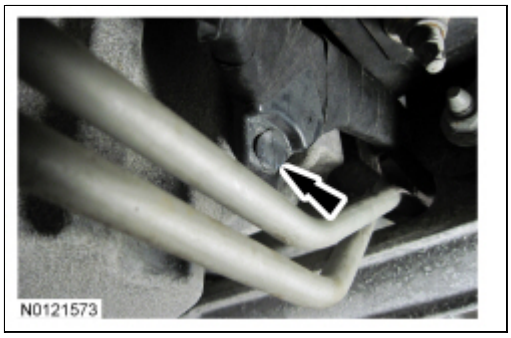
All vehicles

24. Position the crossmember and install the 4 nuts and bolts.
    - Tighten to 90 Nm (66 lb-ft).

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25. Attach the starter motor wiring harness retainer to the oil pan.



26. Install the starter motor. For additional information, refer to Section 303-06 .

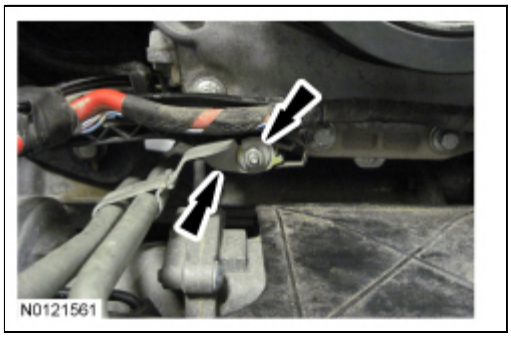
27. **NOTE:** This step does not apply if the engine front cover is removed.

    Attach the generator wiring harness to the engine front cover.



28. **NOTE:** This step does not apply if the engine front cover is removed.

    Install the transmission cooler line bracket and nut to the engine front cover stud bolt.
    - Tighten to 12 Nm (106 lb-in).

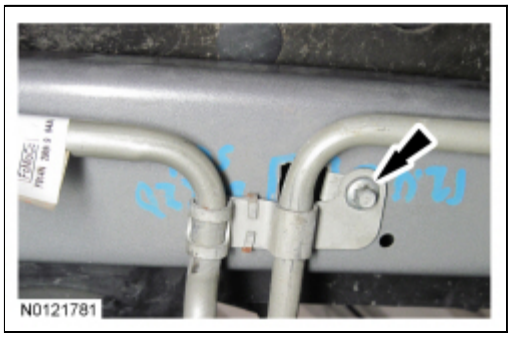


29. **NOTE:** Do not lubricate the engine oil filter gasket.

    Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.



30. Position the transmission cooler tube bracket to the radiator support and install the bolt.
    - Tighten to 12 Nm (106 lb-in).

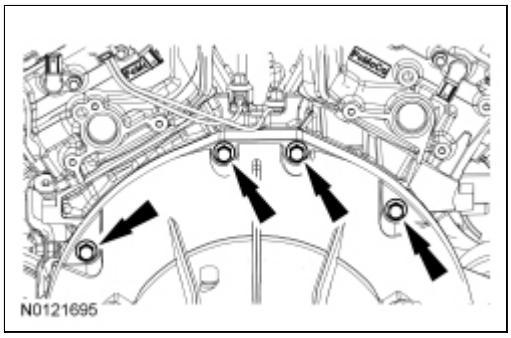


31. If equipped, install the skid plate and the bolts.
    - Tighten to 48 Nm (35 lb-ft).

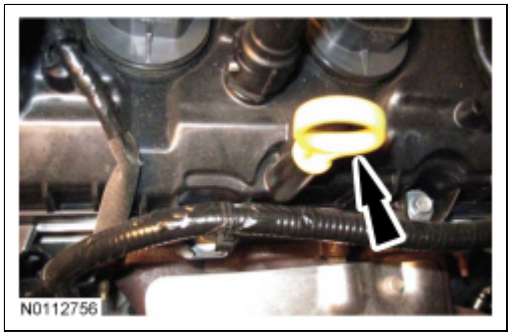
32. **NOTE:** This step does not apply if the engine front cover is removed.

    Tighten the 4 upper bellhousing-to-engine bolts to 48 Nm (35 lb-ft).

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33. Install the oil level indicator.



34. Fill the engine with clean engine oil.

35. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Oil Pump Screen and Pickup Tube

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.

2. Remove the 3 bolts and the oil pump screen and pickup tube.
   - Discard the O-ring seal.
   - To install, tighten to 10 Nm (89 lb-in).

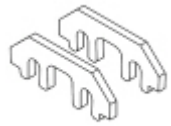
3. **NOTE:** Install a new O-ring seal.

   To install, reverse the removal procedure.

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Oil Pump

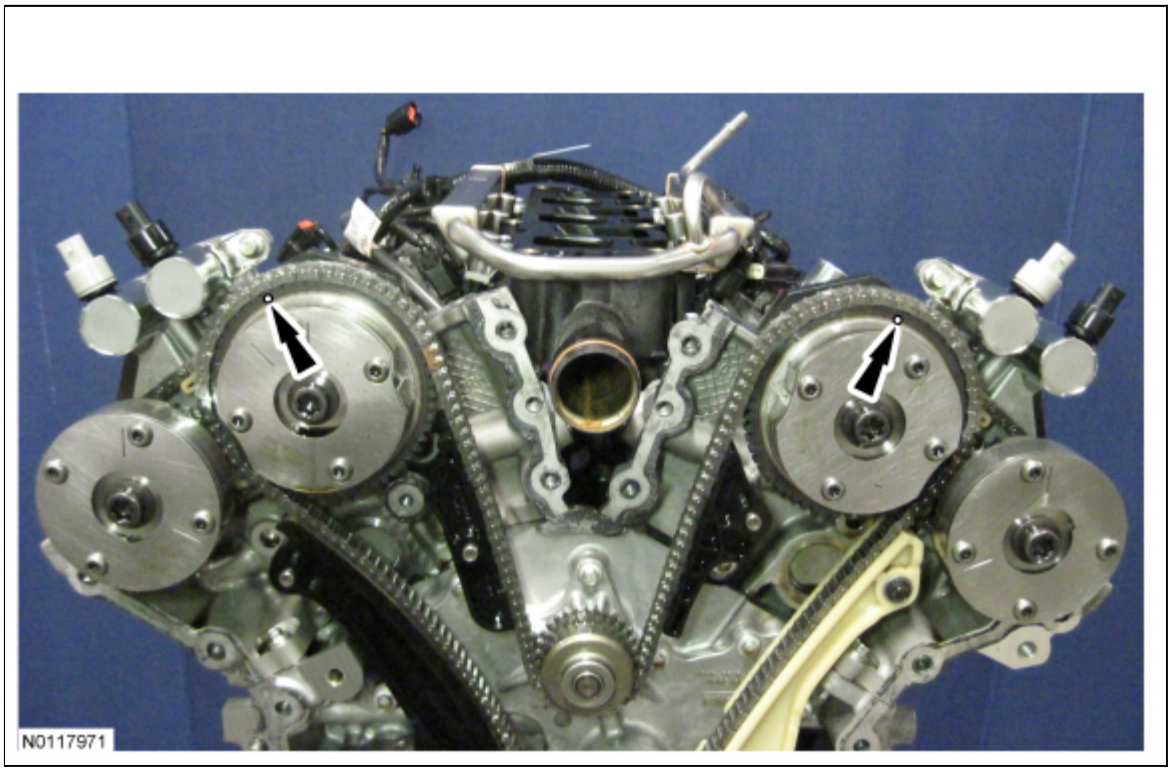
Special Tool(s)

 ST2979-A	Tool, Camshaft Holding 303-1248

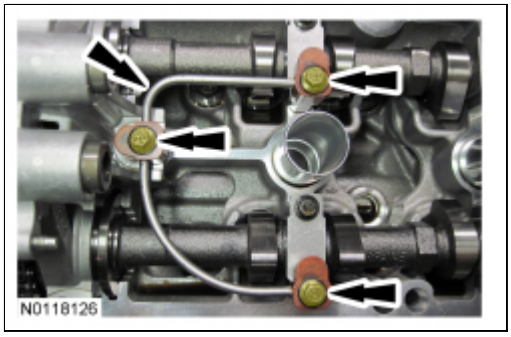
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
3. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown.

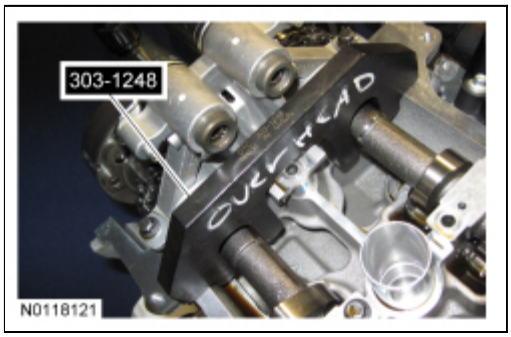


4. Remove the 3 bolts and the LH valve train oil tube.

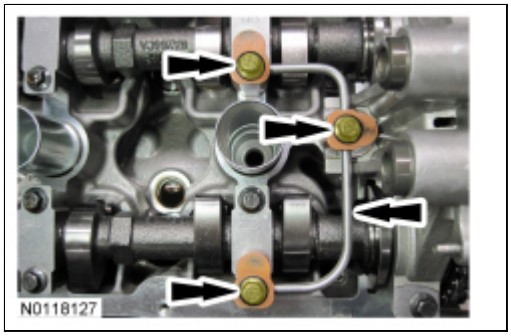


5. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.



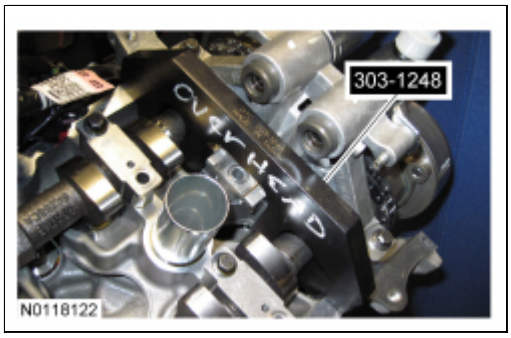
6. Remove the 3 bolts and the RH valve train oil tube.



7. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

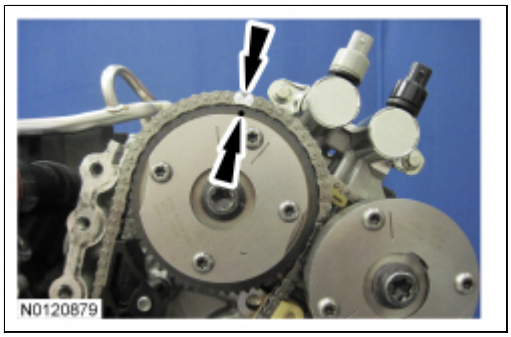
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

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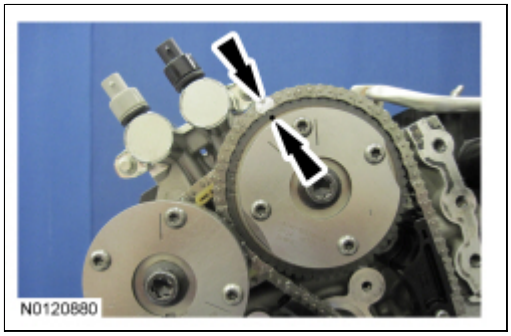


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

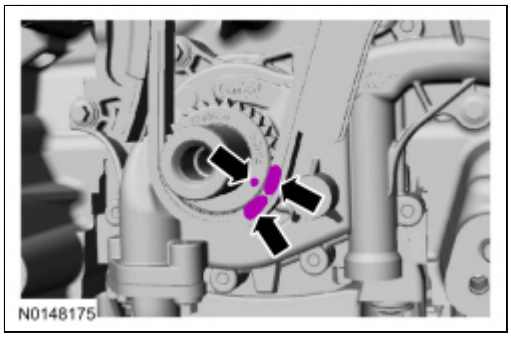


9. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

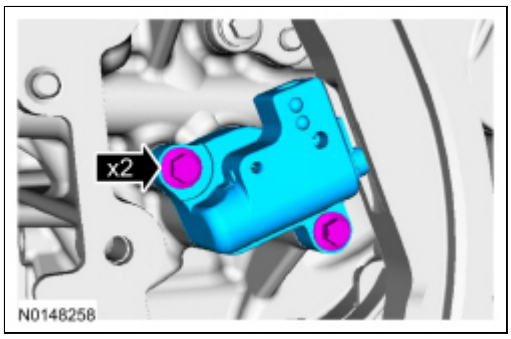


10. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

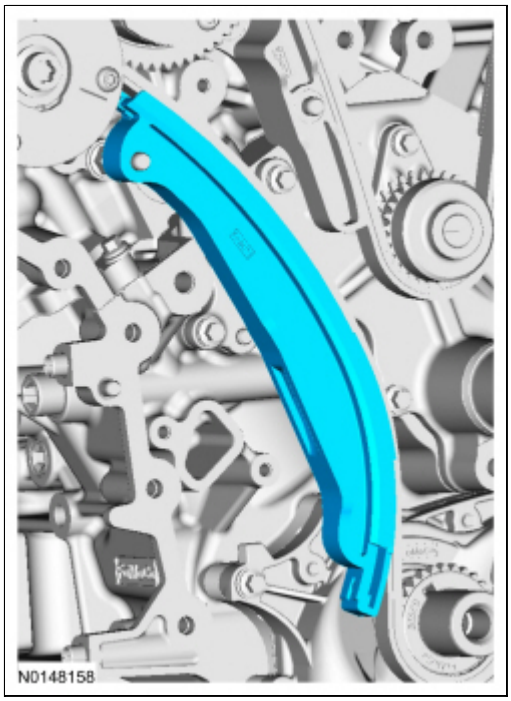
    Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



11. Remove the 2 bolts and the primary timing chain tensioner.

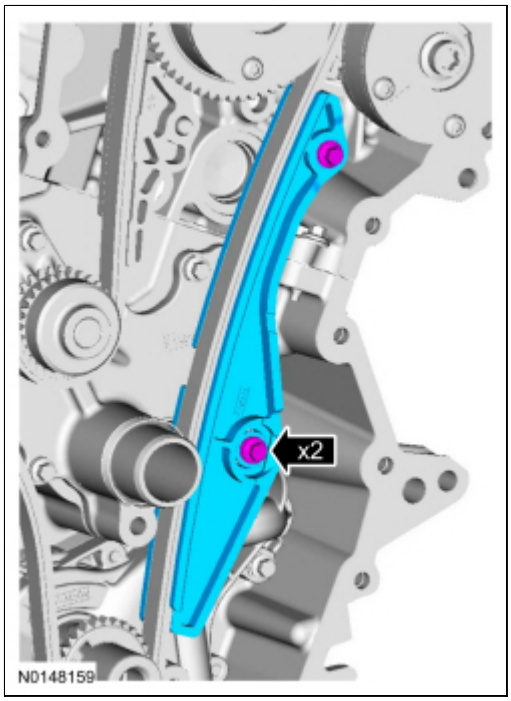


12. Remove the primary timing chain tensioner arm.



13. Remove the 2 bolts and the lower LH primary timing chain guide.

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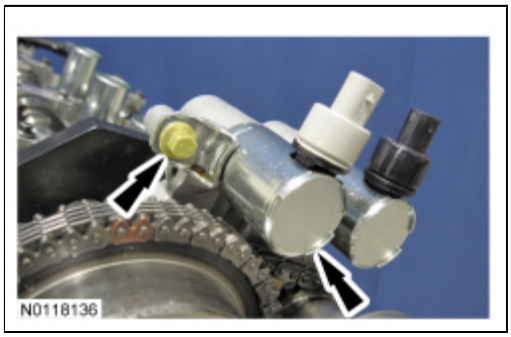


14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.

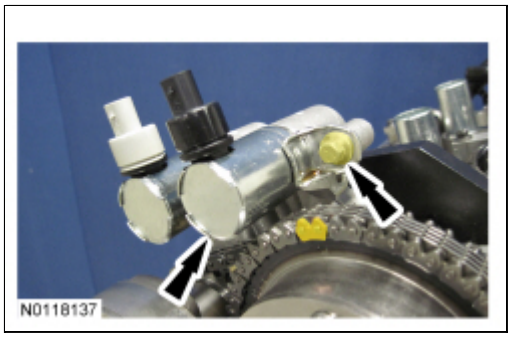


15. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

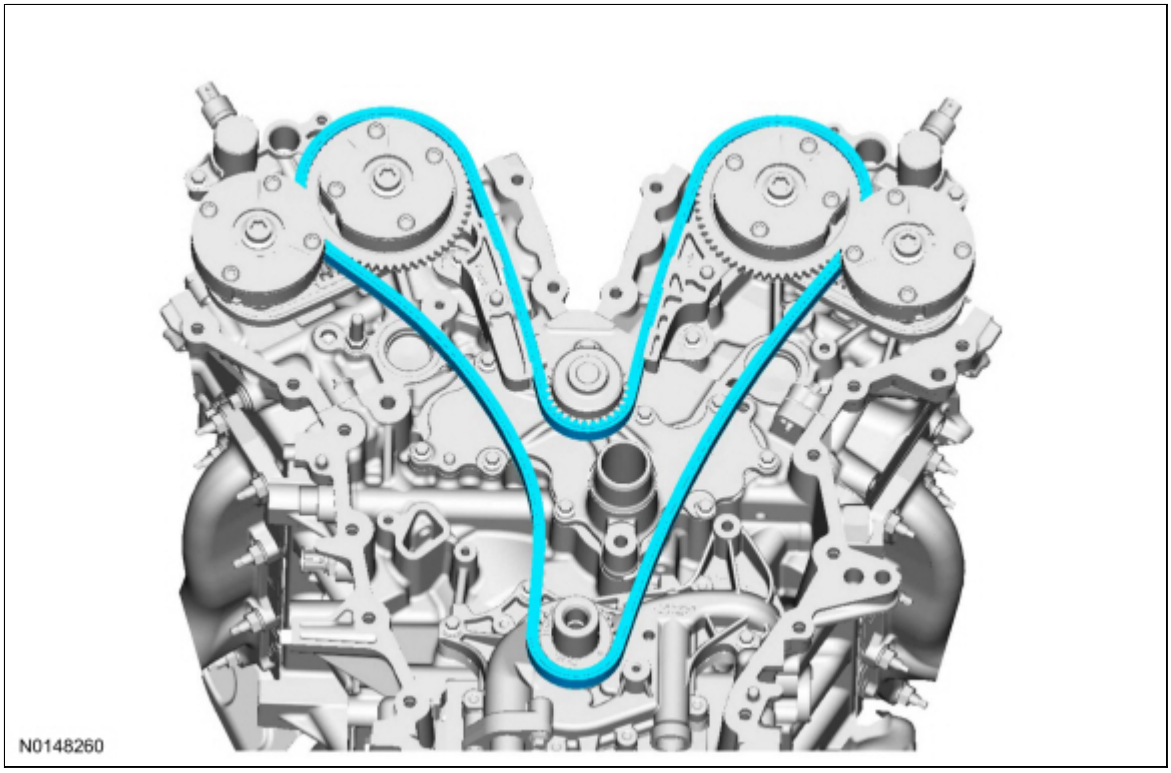
    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.

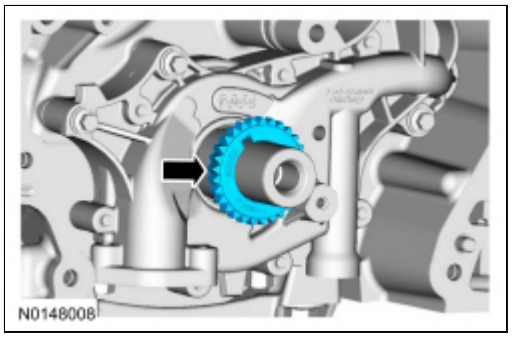


16. Remove the primary timing chain.



17. Remove the oil pan. For additional information, refer to Oil Pan in this section.

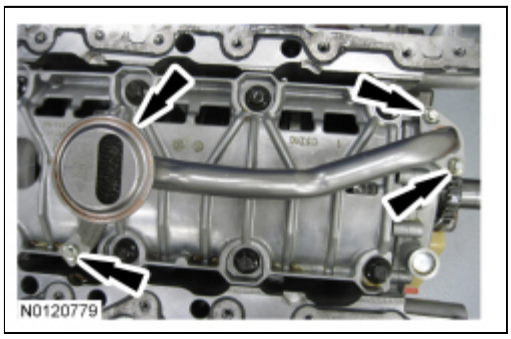
18. Remove the crankshaft timing chain sprocket.



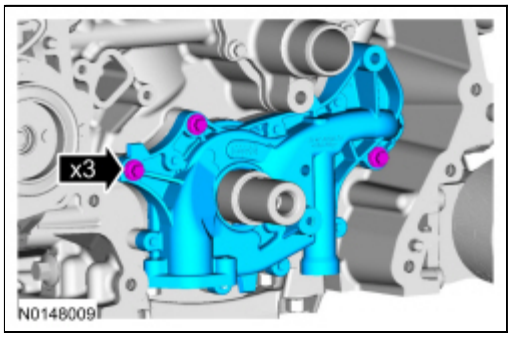
19. Remove the 3 bolts and the oil pump screen and pickup tube.

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- Discard the O-ring seal.

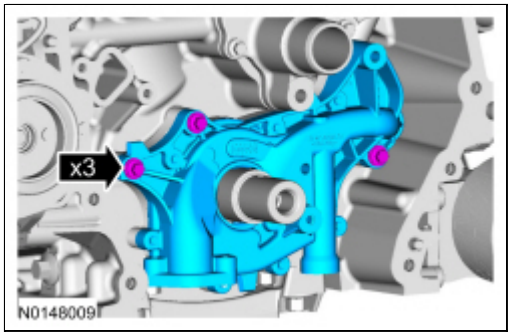


20. Remove the 3 bolts and the oil pump.

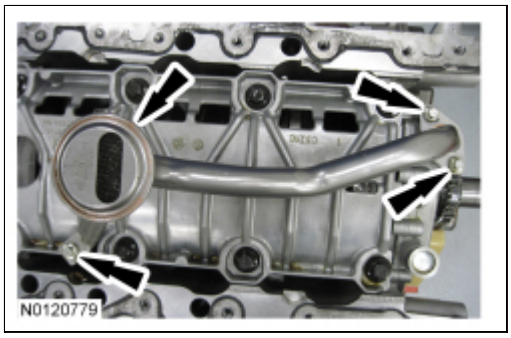


Installation

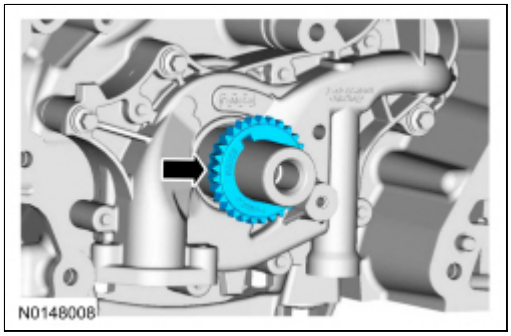
1. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



2. Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



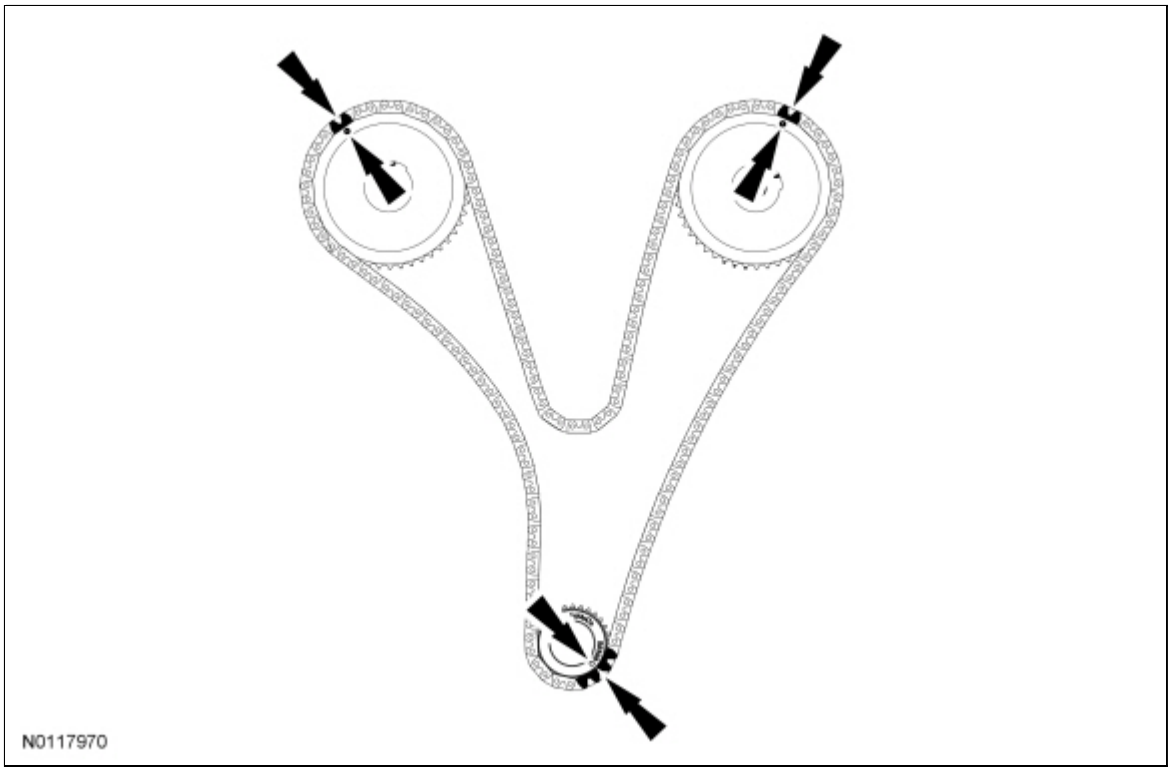
3. Install the crankshaft timing chain sprocket.



4. Install the oil pan. For additional information, refer to Oil Pan in this section.

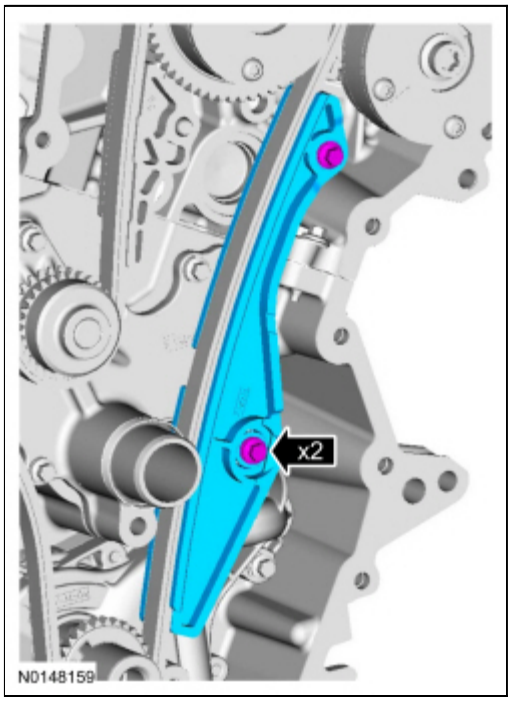
5. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

   Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

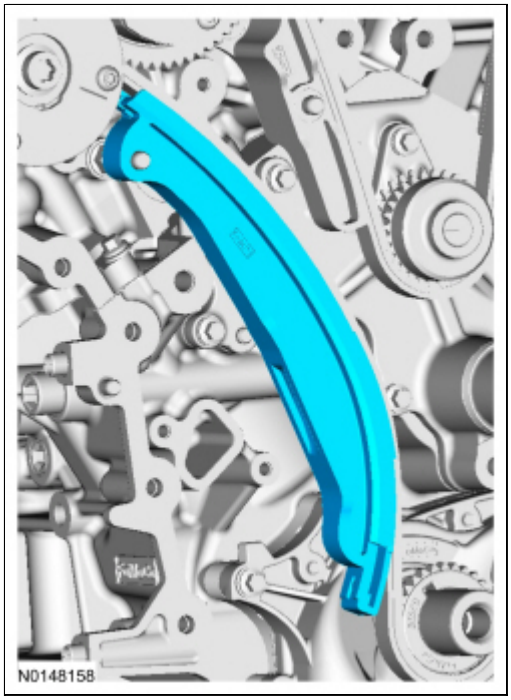


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6. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



7. Install the primary timing chain tensioner arm.



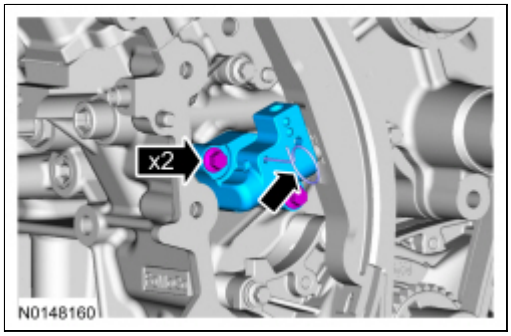
8. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.

- Install a suitable lockpin.



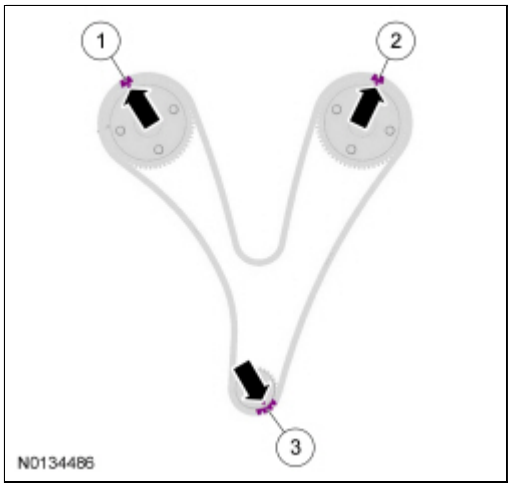
9. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

   Install the primary timing chain tensioner and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
   - Remove the lockpin.



10. As a post-check, verify correct alignment of all timing marks.
    - There is 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There is 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).

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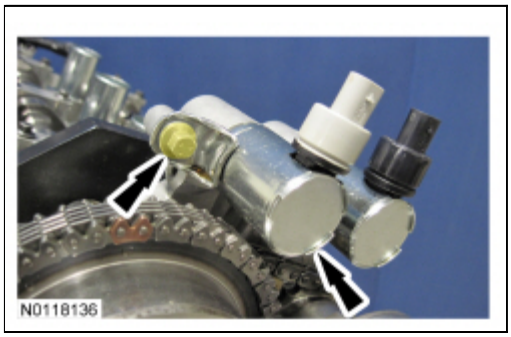


11. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Install the LH intake VCT oil control solenoid and the bolt.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

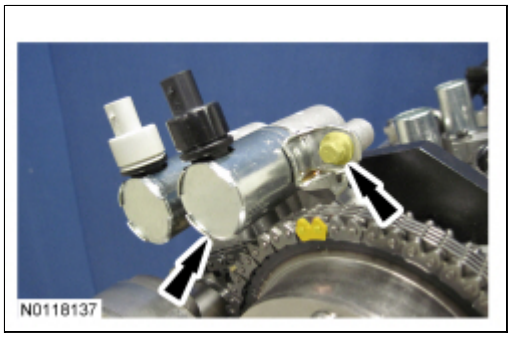


12. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

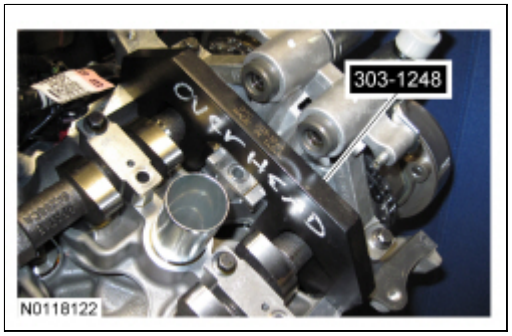
    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

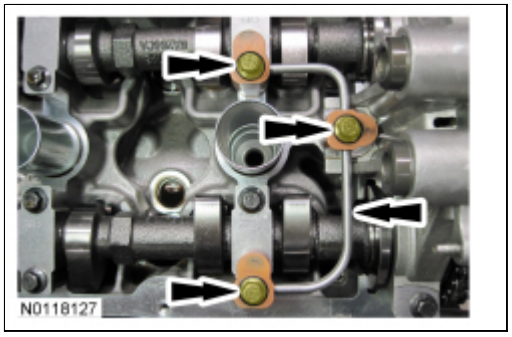
    Install the RH intake VCT oil control solenoid and the bolt.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



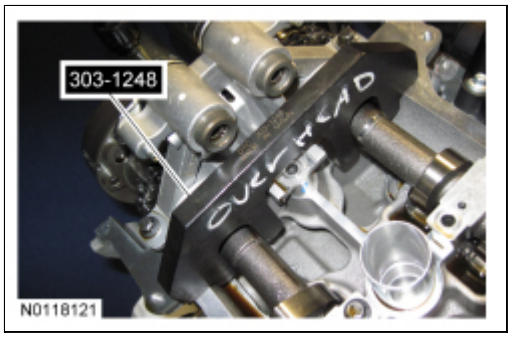
13. Remove the Camshaft Holding Tool.



14. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



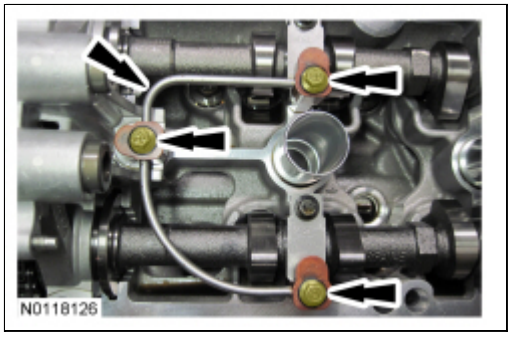
15. Remove the Camshaft Holding Tool.



16. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.

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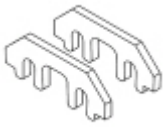
- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



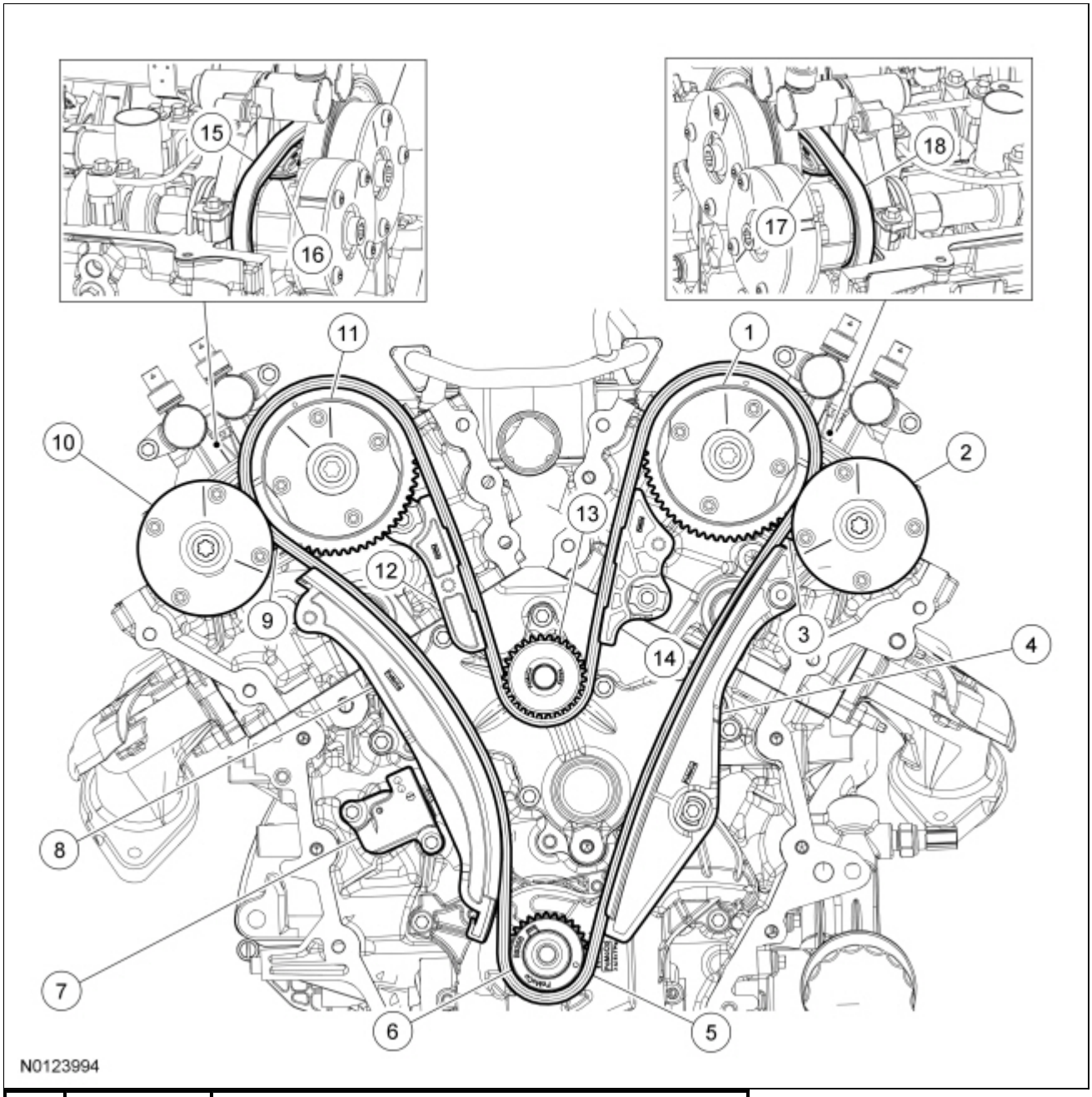
17. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.
18. Fill the engine with clean engine oil.

Timing Drive Components

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248

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Item	Part Number	Description
1	6256	LH intake Variable Camshaft Timing (VCT) assembly
2	6C525	LH exhaust VCT assembly
3	6K297	LH secondary timing chain tensioner shoe
4	6B274	LH primary timing chain guide
5	6268	Primary timing chain
6	6306	Crankshaft timing chain sprocket
7	6L266	Primary timing chain tensioner
8	6K255	RH primary timing chain tensioner arm
9	6K297	RH secondary timing chain tensioner shoe

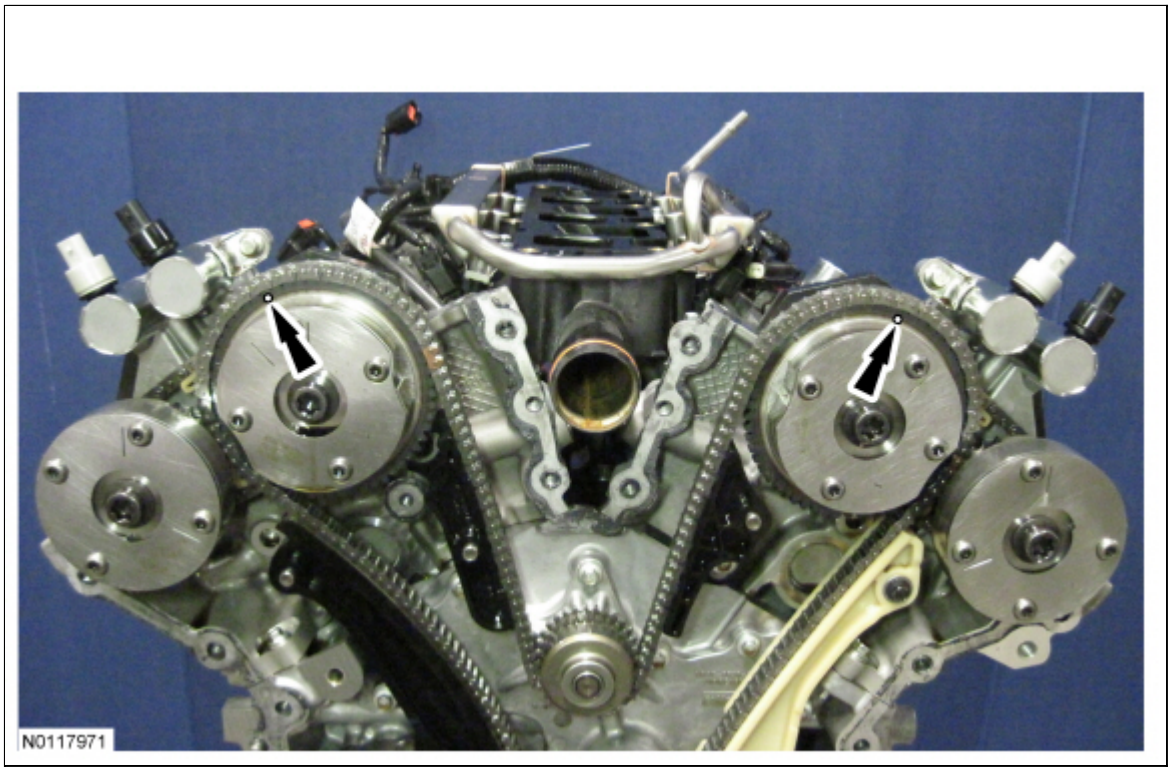
10	6C525	RH exhaust VCT assembly
11	6256	RH intake VCT assembly
12	6K297	RH primary timing chain guide
13	8501	Channel cover plate
14	6K297	LH primary timing chain guide
15	6268	RH secondary timing chain
16	6K254	RH secondary timing chain tensioner
17	6K254	LH secondary timing chain tensioner
18	6268	LH secondary timing chain

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

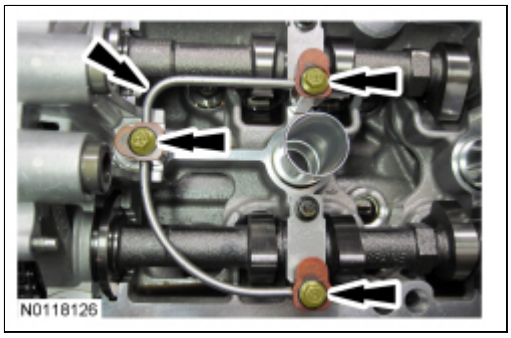
All engines

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown.



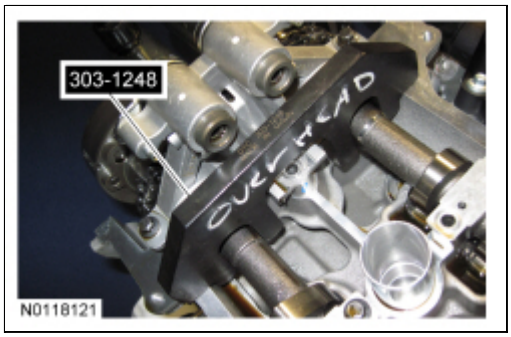
3. Remove the 3 bolts and the LH valve train oil tube.

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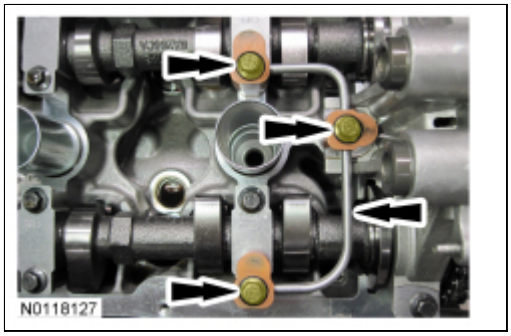


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

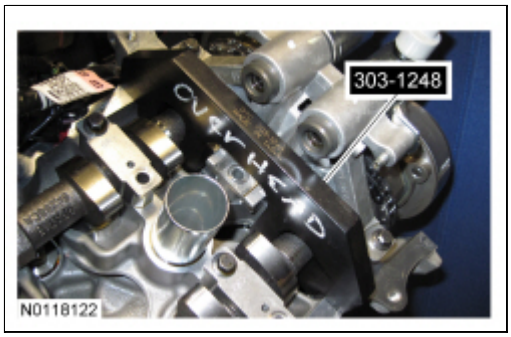


5. Remove the 3 bolts and the RH valve train oil tube.



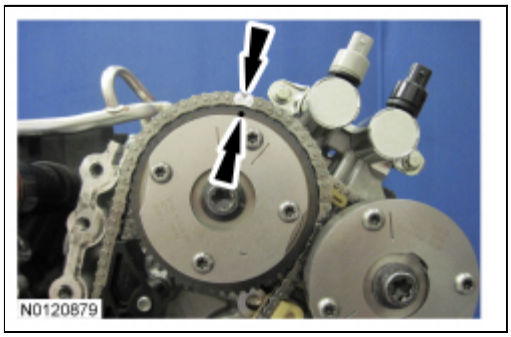
6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

   Install the Camshaft Holding Tool onto the flats of the RH camshafts.

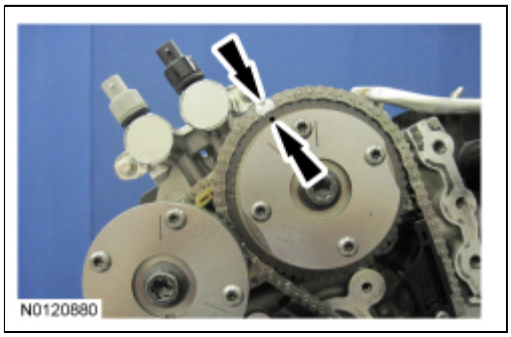


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

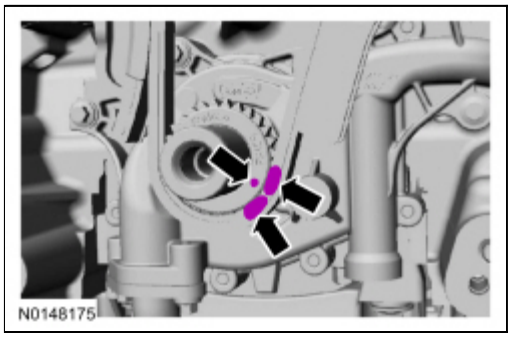


8. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.



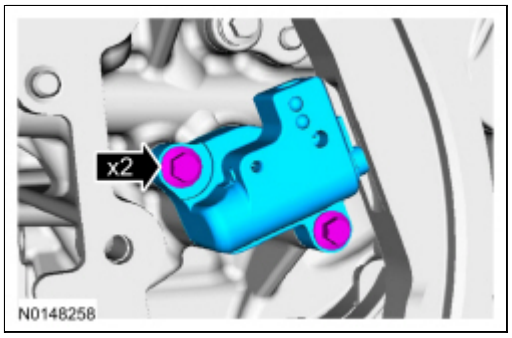
9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

   Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.

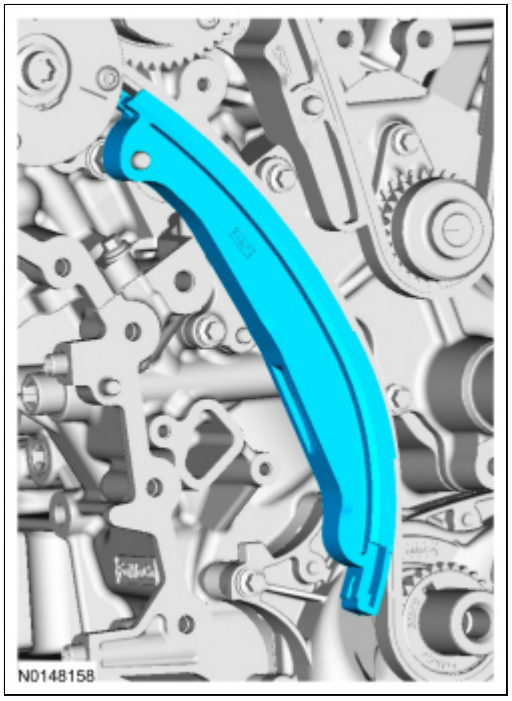


10. Remove the 2 bolts and the primary timing chain tensioner.

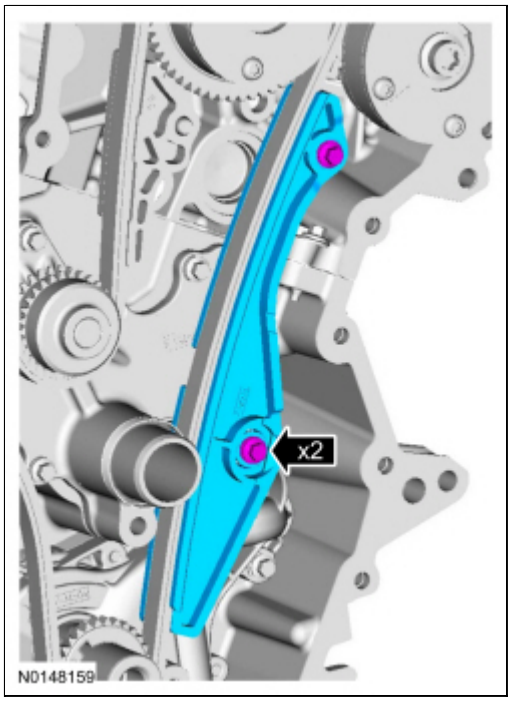
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11. Remove the primary timing chain tensioner arm.



12. Remove the 2 bolts and the lower LH primary timing chain guide.

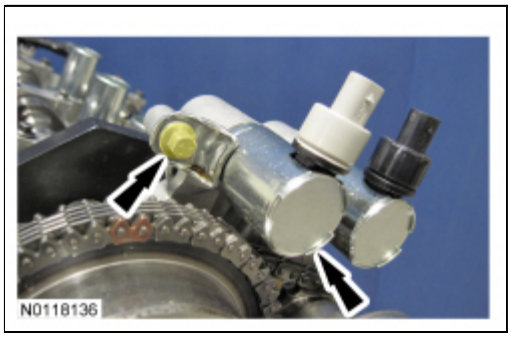


13. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the LH intake VCT oil control solenoid.



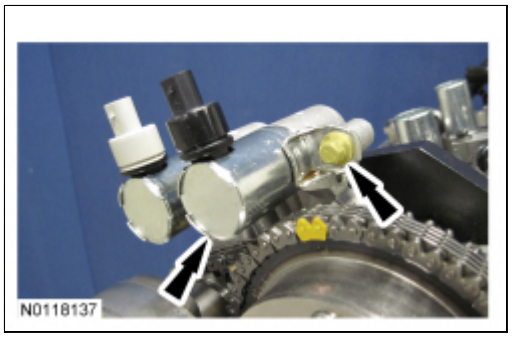
14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

    NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

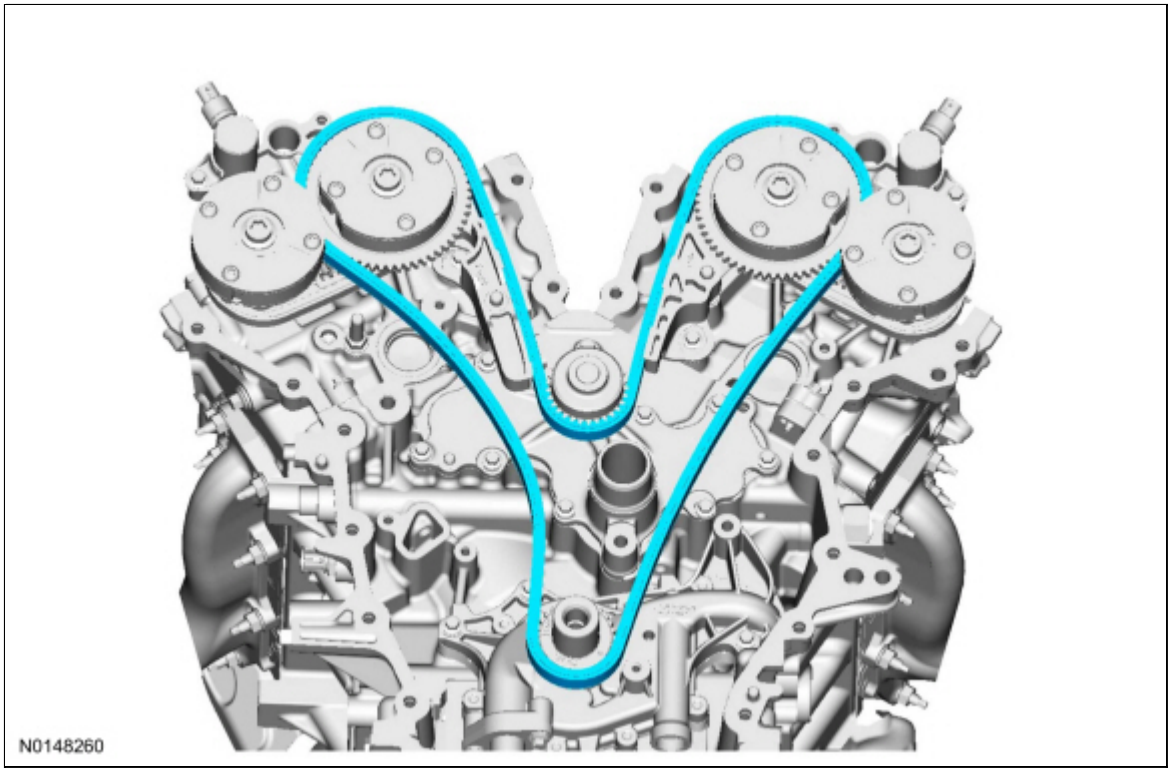
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the bolt and the RH intake VCT oil control solenoid.

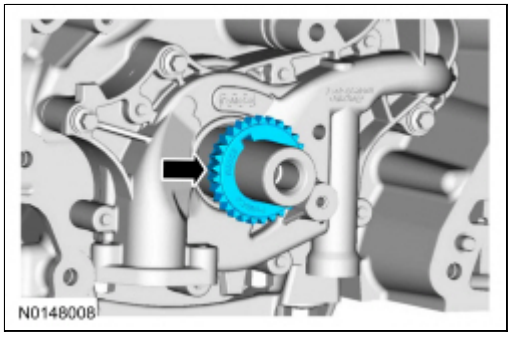
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15. Remove the primary timing chain.

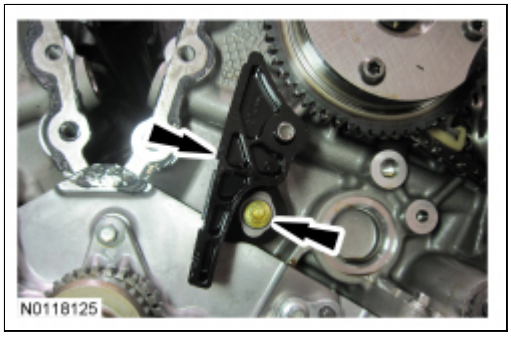


16. Remove the crankshaft timing chain sprocket.



17. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.**

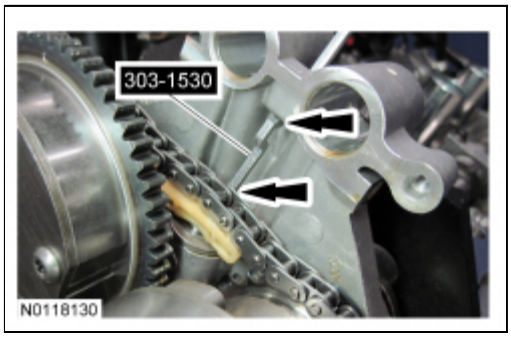
Remove the bolt and the upper LH primary timing chain guide.



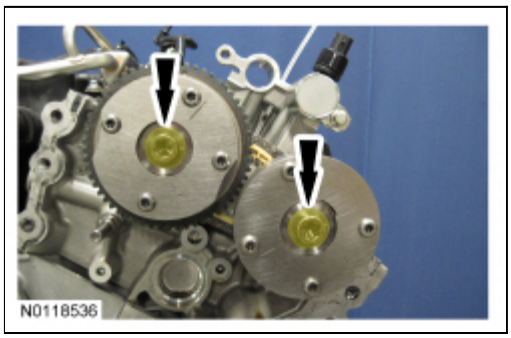
18. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

    Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.

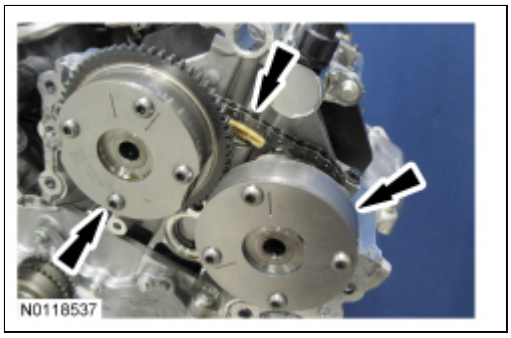


19. Remove and discard the 2 LH VCT assembly bolts.



20. Remove the 2 LH VCT assemblies and secondary timing chain.

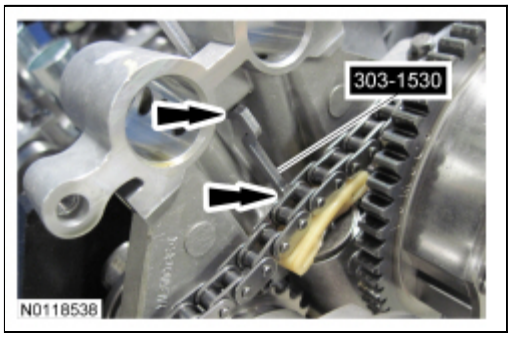
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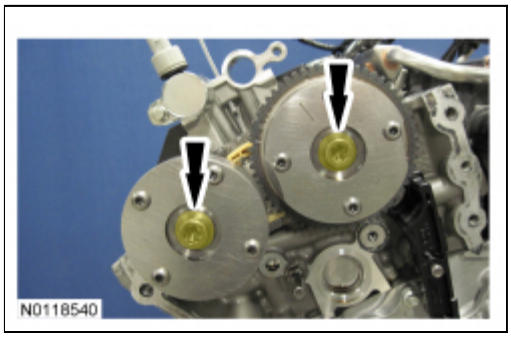
21. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

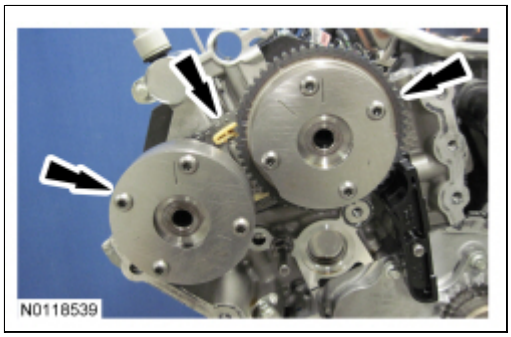
    Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



22. Remove and discard the 2 RH VCT assembly bolts.



23. Remove the 2 RH VCT assemblies and secondary timing chain.

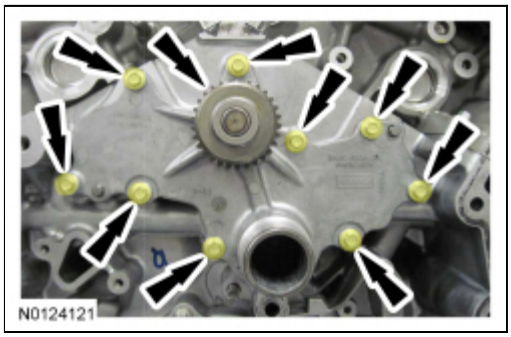


24. ***NOTICE:*** **Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.**

    Remove the bolt and the RH primary timing chain guide.



25. Remove the 9 bolts and the channel cover plate.
    - Discard the gaskets.



Engines with secondary timing chain tensioner removed

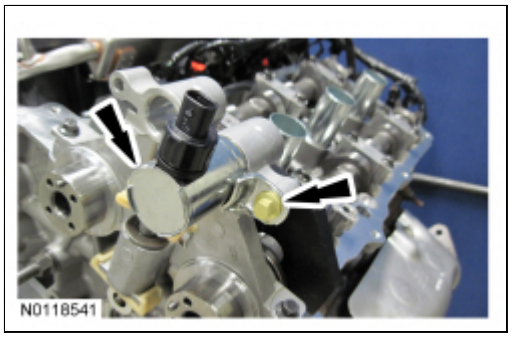
NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed, or damage to the engine may occur.**

26. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

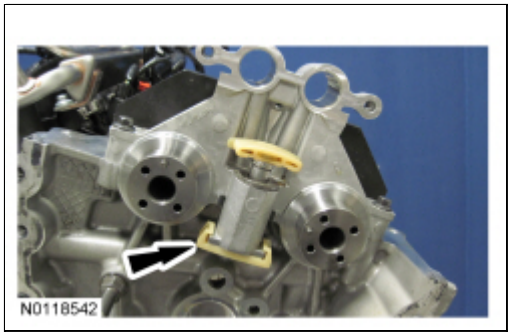
    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Remove the LH exhaust VCT oil control solenoid.

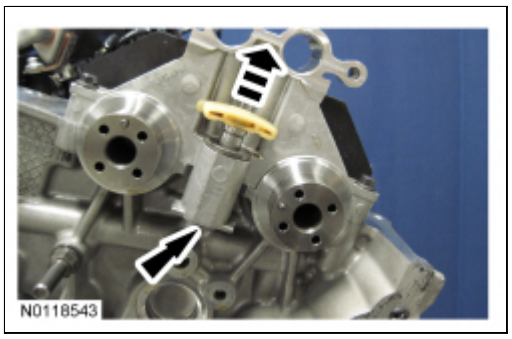
repair4less



27. Remove the LH secondary timing chain tensioner shoe.



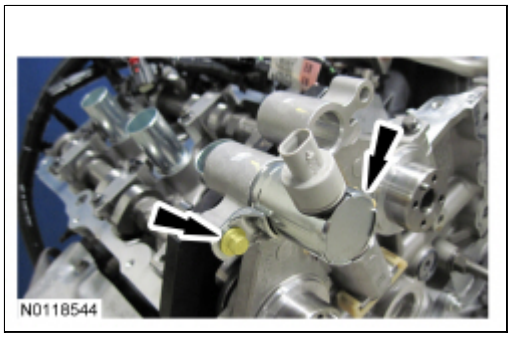
28. Remove the LH secondary timing chain tensioner by pushing up from the bottom and remove.



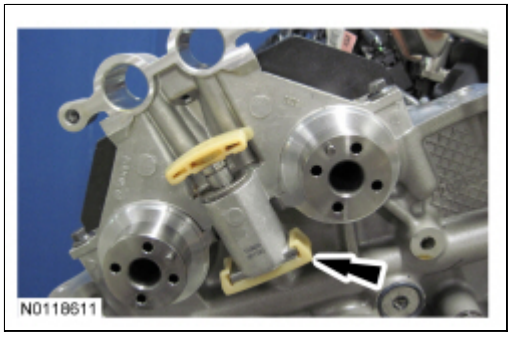
29. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

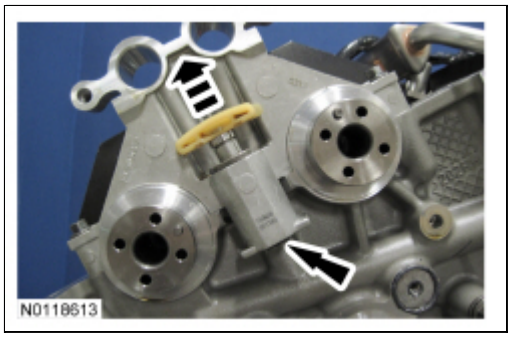
    Remove the RH exhaust VCT oil control solenoid.



30. Remove the RH secondary timing chain tensioner shoe.



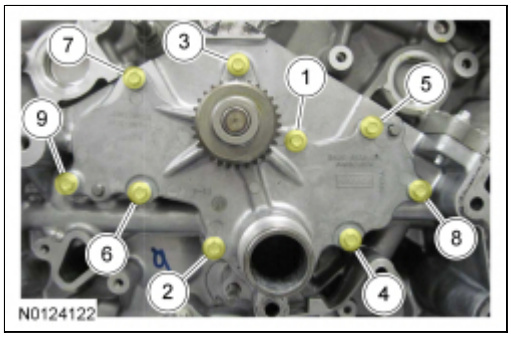
31. Remove the RH secondary timing chain tensioner by pushing up from the bottom and remove.



Installation

All engines

1. Using new gaskets, install the channel cover plate and the 9 bolts. Tighten in the sequence shown in 2 stages:
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



2. Install the RH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

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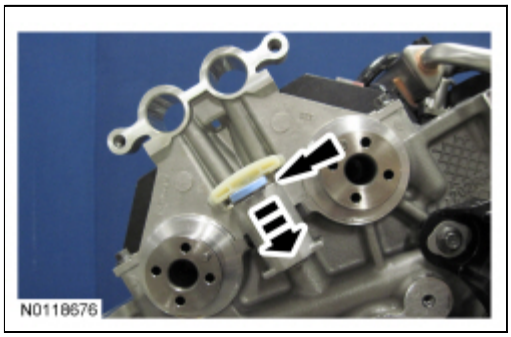
Engines with secondary timing chain tensioner removed

NOTICE: **The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed or damage to the engine may occur.**

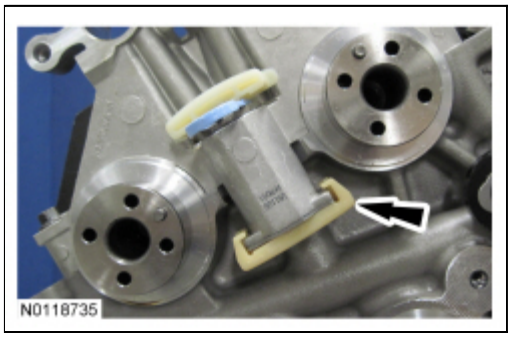
3. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

   NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

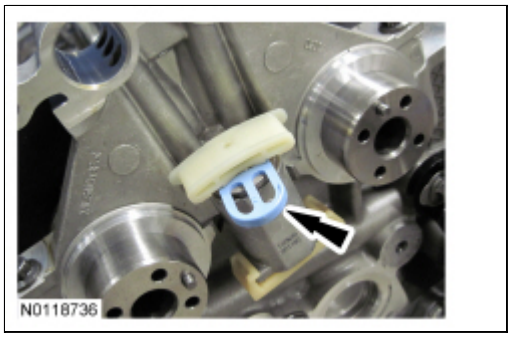
   Install the RH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



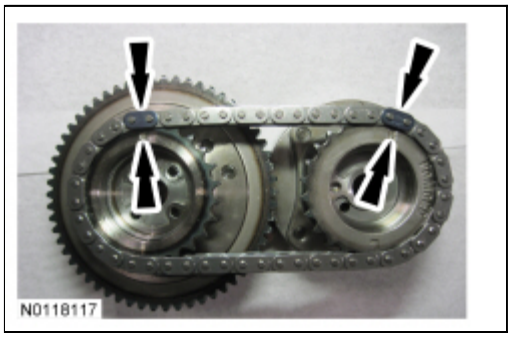
4. Install the RH secondary timing chain tensioner shoe.



5. Remove and discard the RH secondary timing chain tensioner shipping clip.

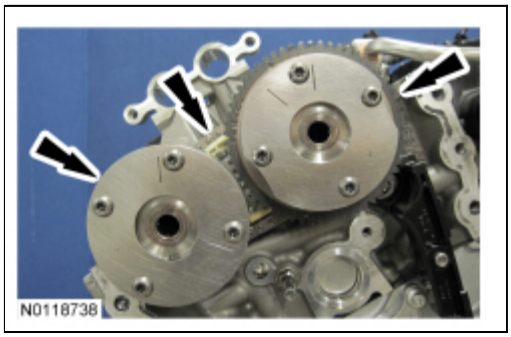


6. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.



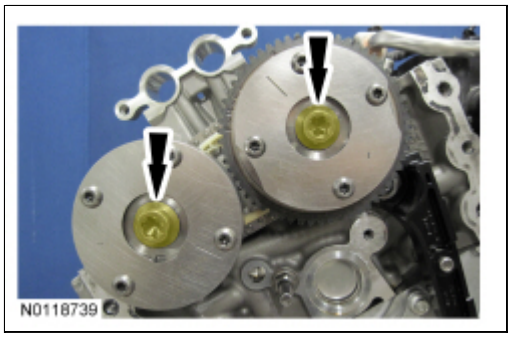
7. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

   Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

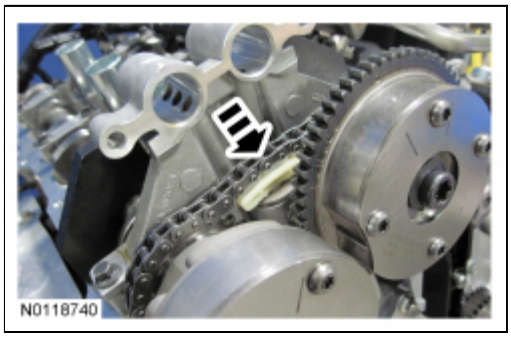


8. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

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9. Activate the RH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



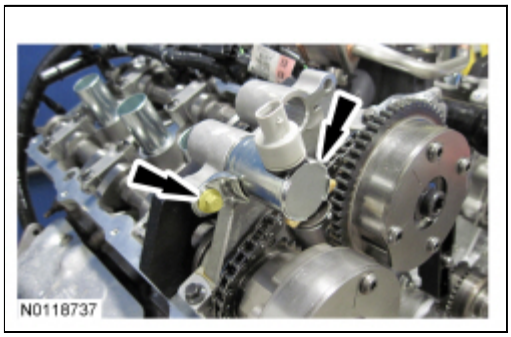
10. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH exhaust VCT oil control solenoid.

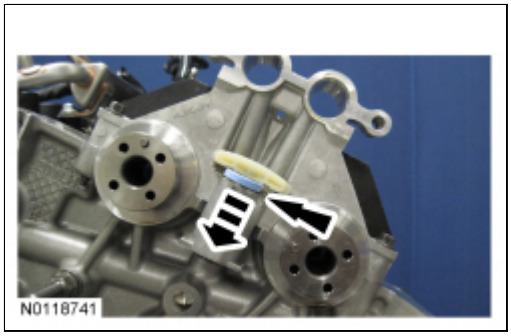
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



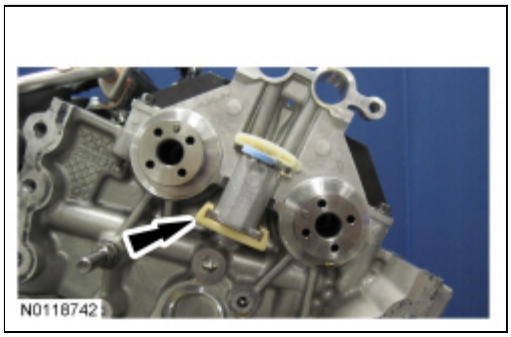
11. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

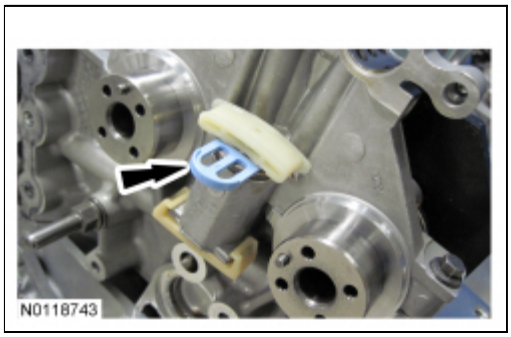
Install the LH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



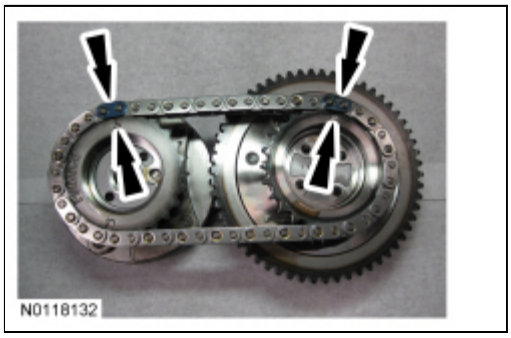
12. Install the LH secondary timing chain tensioner shoe.



13. Remove and discard the LH secondary timing chain tensioner shipping clip.



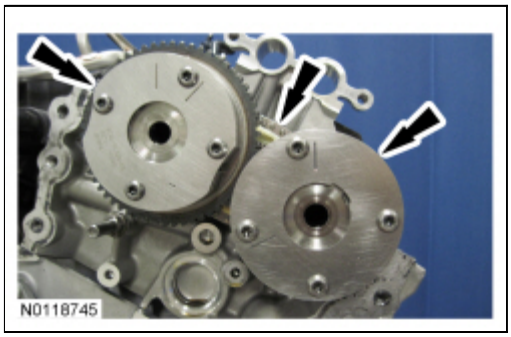
14. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.



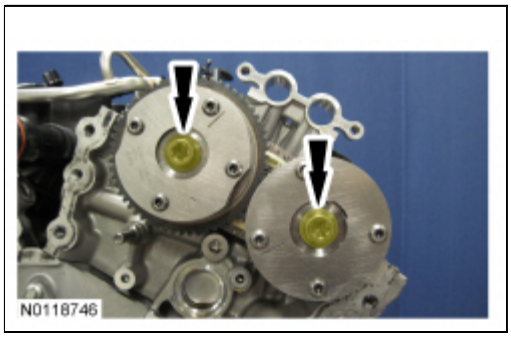
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15. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

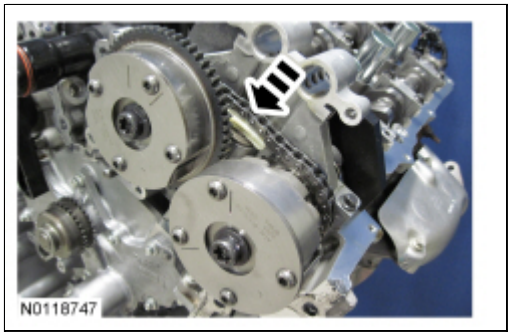
    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



16. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.



17. Activate the LH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



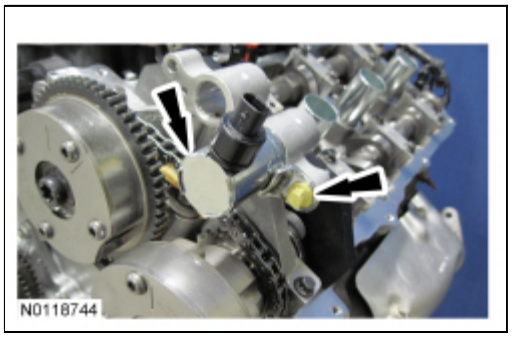
18. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

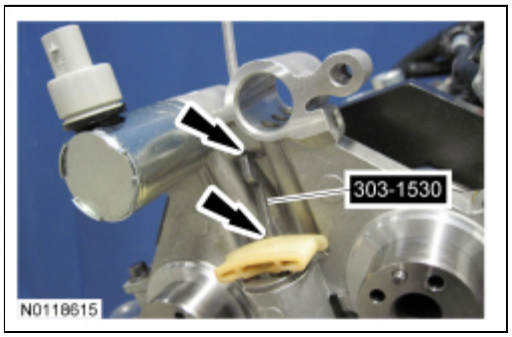
Install the LH exhaust VCT oil control solenoid.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

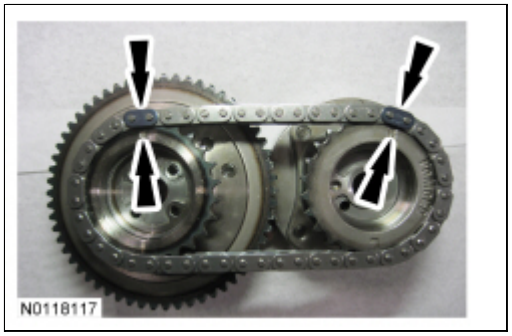


Engines with secondary timing chain tensioner not removed

19. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.



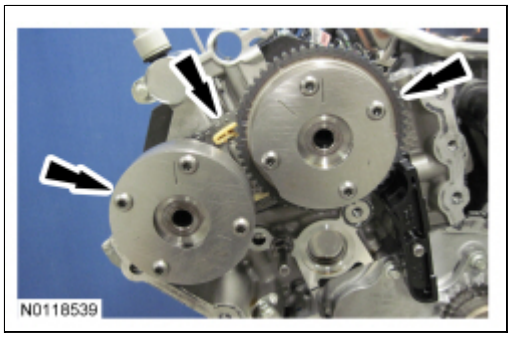
20. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.



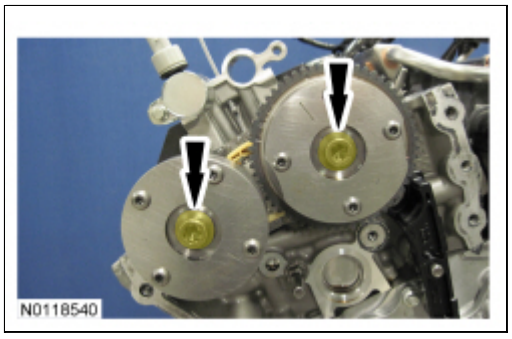
21. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

    Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.

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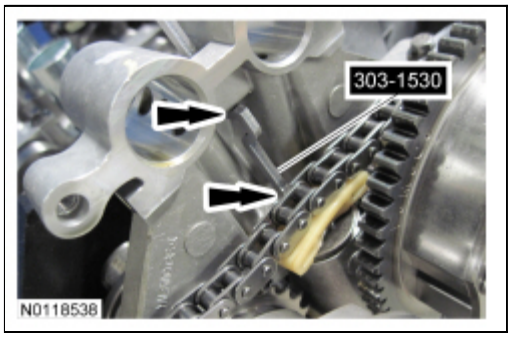


22. Install the 2 new RH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

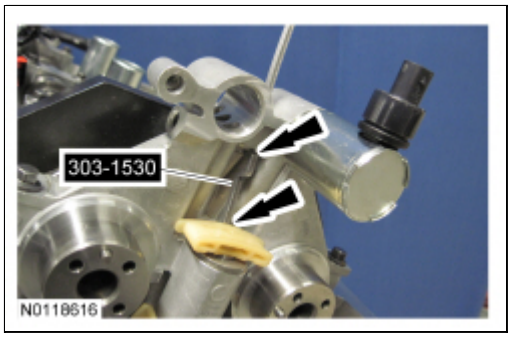


23. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

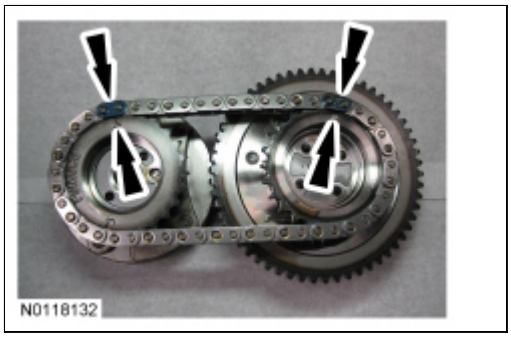
    Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.



24. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.

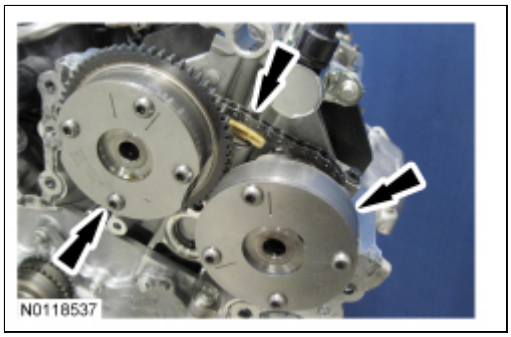


25. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
    - Align the colored links with the timing marks.



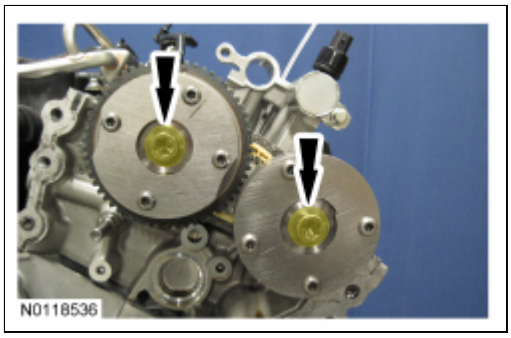
26. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

    Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



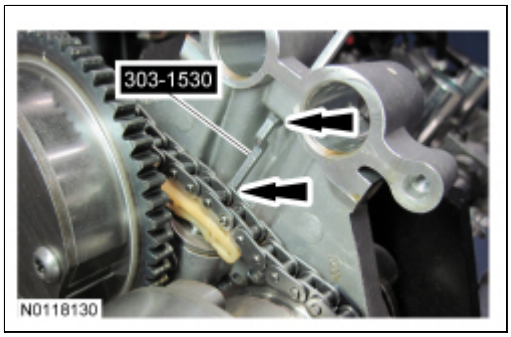
27. Install the 2 new LH VCT bolts and tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 25 Nm (18 lb-ft).
    - Stage 4: Tighten an additional 180 degrees.

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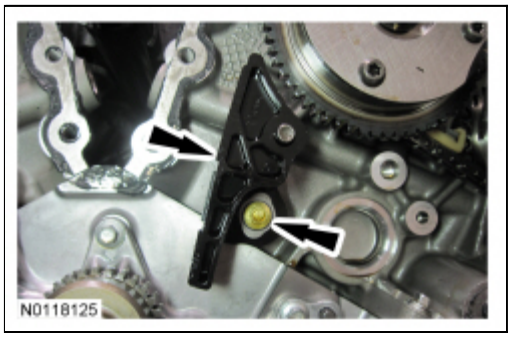
28. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

    Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.
    - Make sure the secondary timing chain is centered on the timing chain tensioner guides.

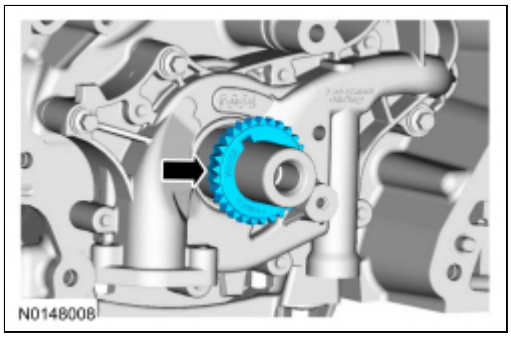


All engines

29. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

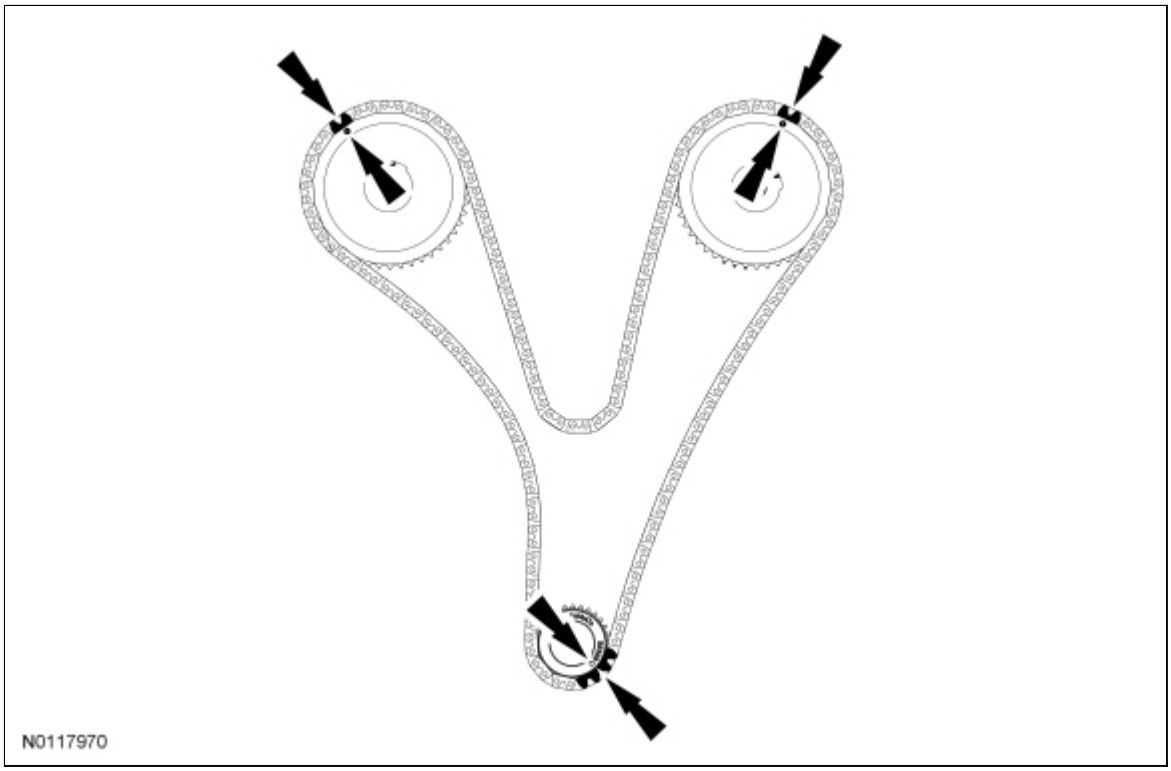


30. Install the crankshaft timing chain sprocket with timing dot mark out.



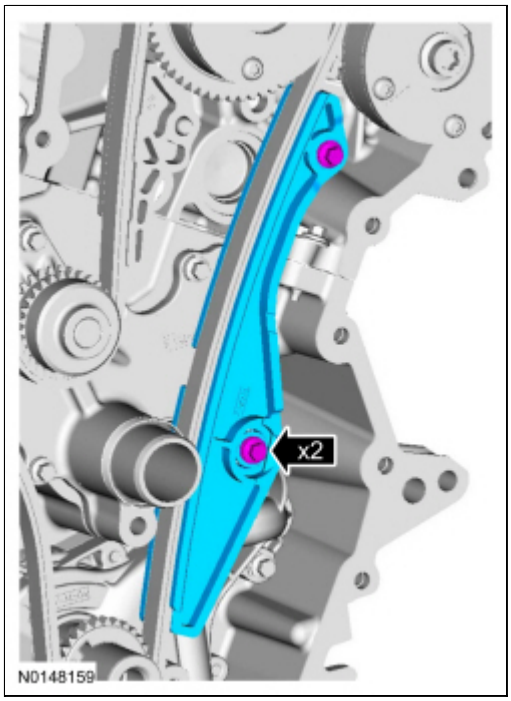
31. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.

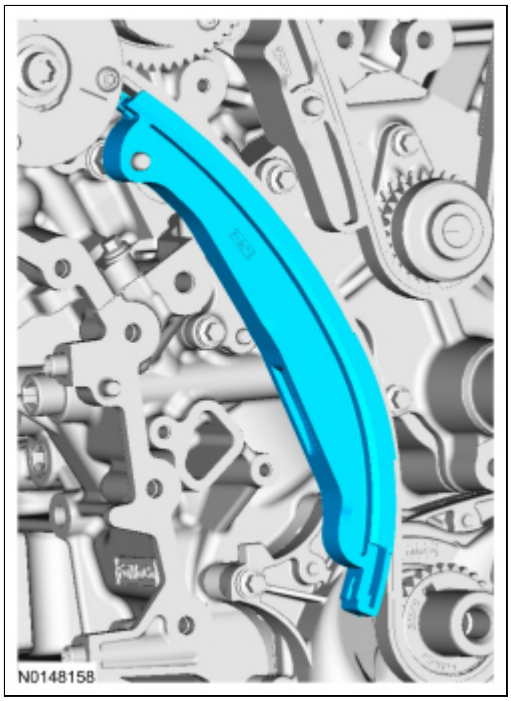


32. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

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33. Install the primary timing chain tensioner arm.

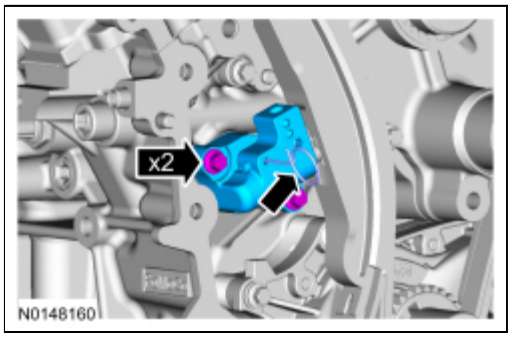


34. Reset the primary timing chain tensioner.
    - Release the ratchet detent.
    - Using a soft-jawed vise, compress the ratchet plunger.
    - Align the hole in the ratchet plunger with the hole in the tensioner housing.
    - Install a suitable lockpin.



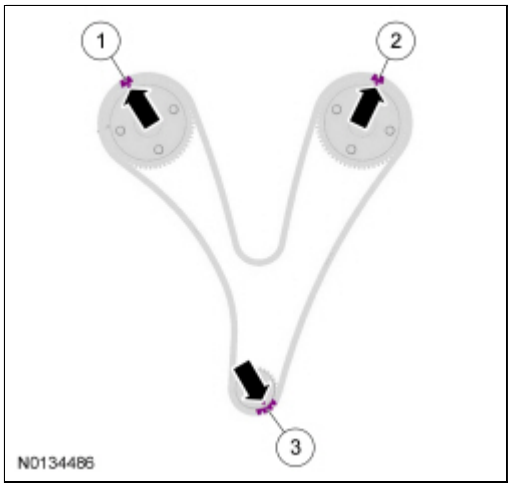
35. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

    Install the primary tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.



36. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).

repair4less

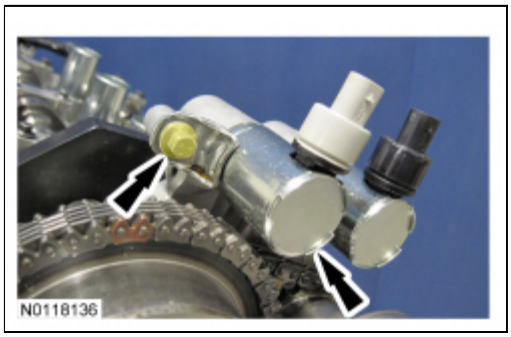


37. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

    Install the LH intake VCT oil control solenoid and the bolt.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.

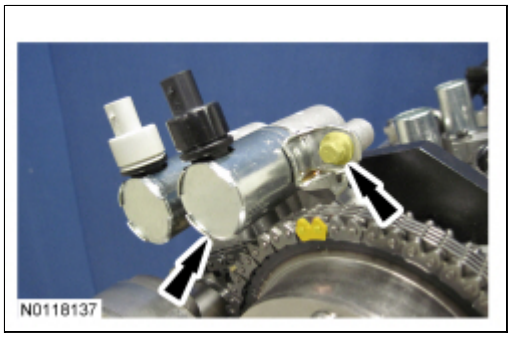


38. ***NOTICE:*** **Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.**

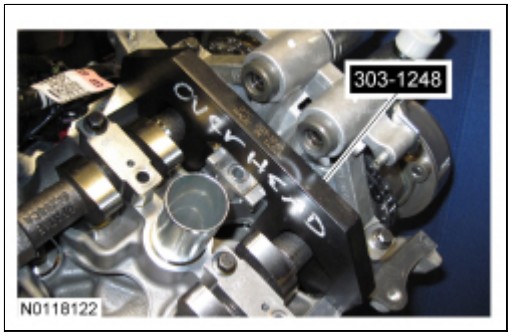
    NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

    NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

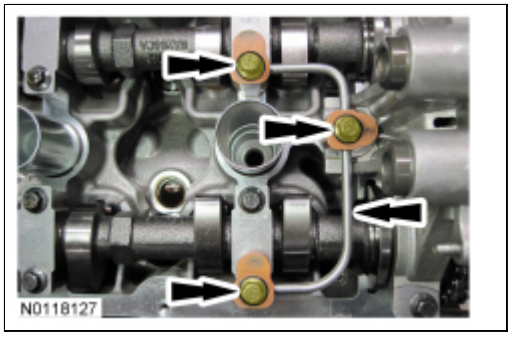
    Install the RH intake VCT oil control solenoid and the bolt.
    - Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



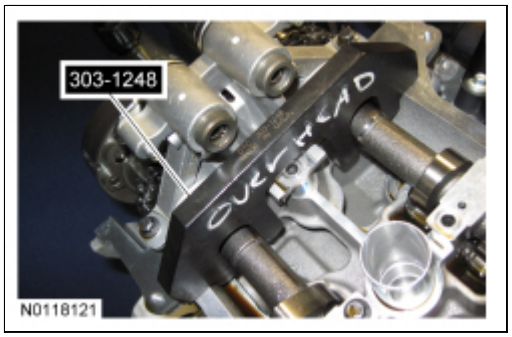
39. Remove the RH Camshaft Holding Tool.



40. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



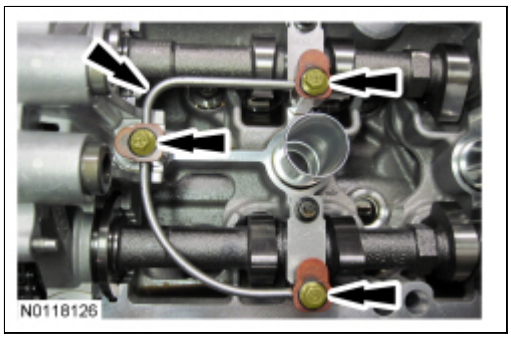
41. Remove the LH Camshaft Holding Tool.



42. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.

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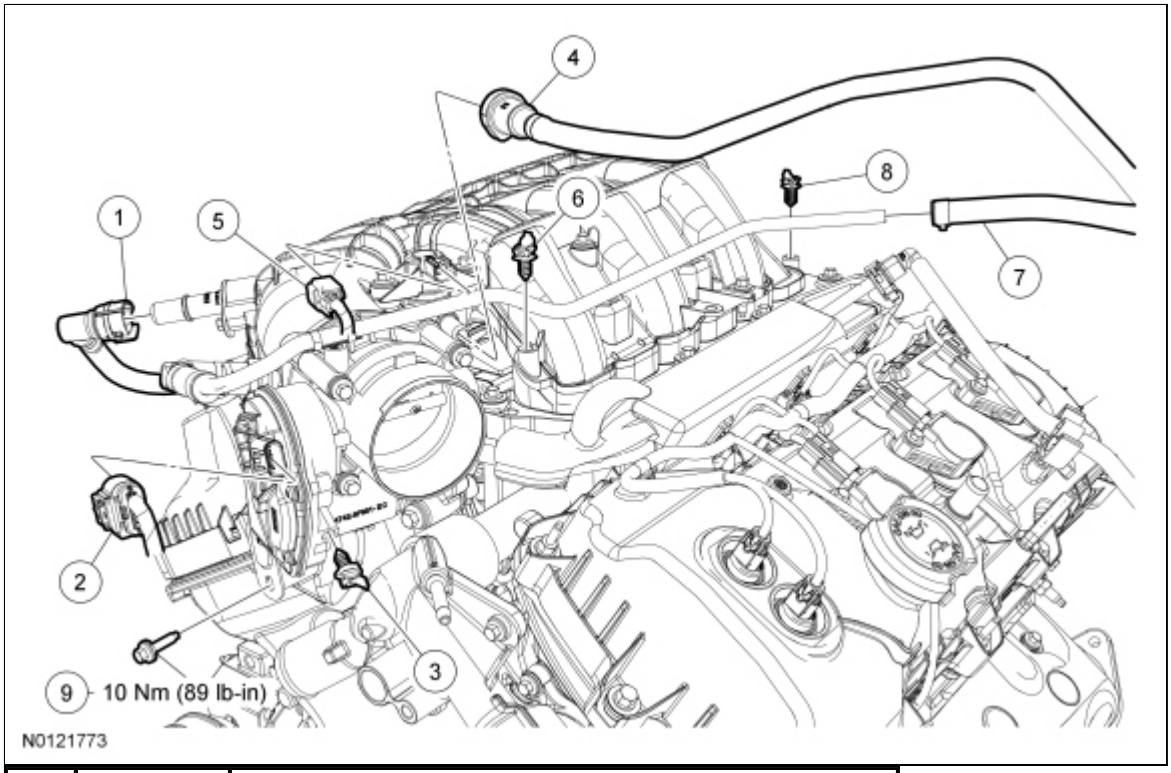
- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



43. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Upper Intake Manifold

Upper Intake Manifold (View 1 of 2)



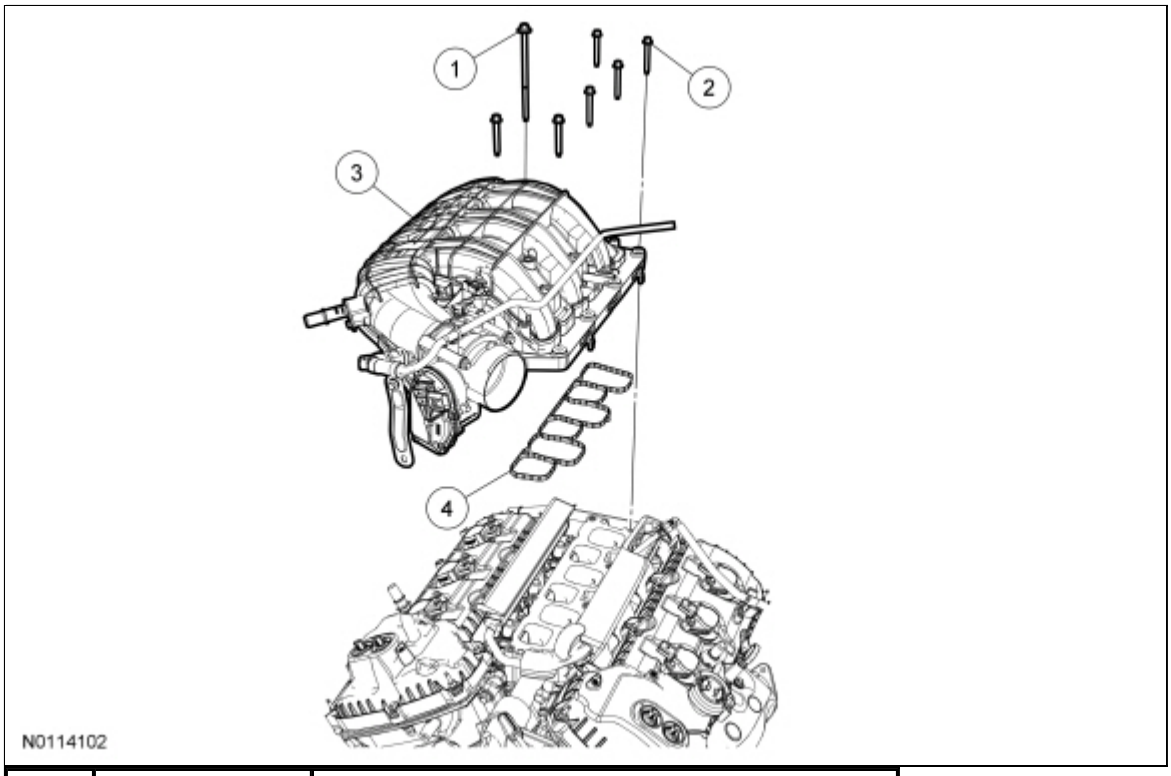
Item	Part Number	Description
1	6A664	PCV tube quick connect coupling
2	—	Throttle Body (TB) electrical connector (part of 14A411)
3	—	TB electrical connector wiring harness pin-type retainer (part of 14A411)
4	9J280	Evaporative Emission (EVAP) tube
5	—	EVAP canister purge valve electrical connector (part of 14A411)
6	—	EVAP canister purge valve electrical connector wiring harness pin-type retainer (part of 14A411)
7	—	Brake booster vacuum hose (part of 9C482)
8	—	Wiring harness pin-type retainer (part of 14A411)
9	W503275	Upper intake manifold support bracket bolt

Upper Intake Manifold (View 2 of 2)

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NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	W715096	Upper intake manifold bolt
2	9Y450	Upper intake manifold bolt (6 required)
3	9424	Upper intake manifold
4	9H486	Upper intake manifold gasket

Removal

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the PCV tube quick connect coupling from the intake manifold. For additional information, refer to Section 310-00 .
3. Disconnect the Throttle Body (TB) electrical connector.
   - Detach the TB electrical connector wiring harness pin-type retainer from the TB .
4. Disconnect Evaporative Emission (EVAP) tube from the EVAP canister purge valve. For additional information, refer to Section 310-00 .
   - Detach the EVAP hose retainer from the intake manifold.
5. Disconnect the EVAP canister purge valve electrical connector.
   - Detach the EVAP canister purge valve electrical connector wiring harness pin-type retainer.

6. Disconnect the brake booster vacuum hose from the engine.

7. Detach the wiring harness pin-type retainer from the rear of the upper intake manifold.

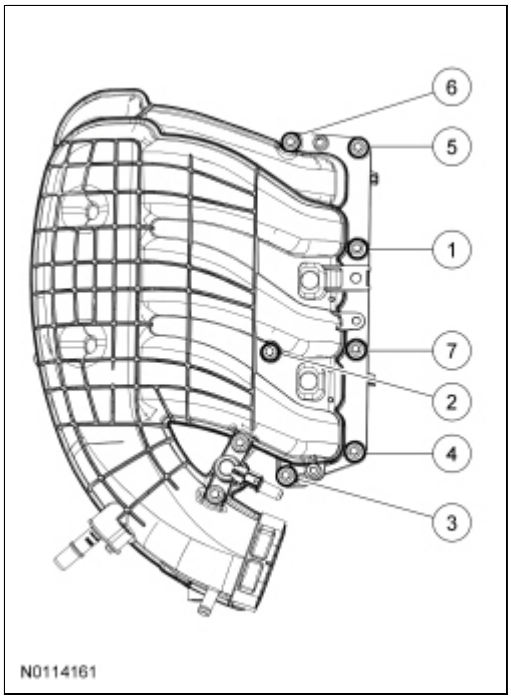
8. Remove the upper intake manifold support bracket bolt from the front of the RH cylinder head.

9. Loosen the 7 bolts and remove the upper intake manifold.
    - Remove and discard the gaskets.
    - Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Using new gaskets, install the upper intake manifold and tighten the 7 bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



2. Install the upper intake manifold support bracket bolt to the RH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

3. Attach the wiring harness pin-type retainer to the rear of the upper intake manifold.

4. Connect the brake booster vacuum hose to the engine.

5. Connect the EVAP canister purge valve electrical connector.
    - Attach the EVAP canister purge valve electrical connector wiring harness pin-type retainer.

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6. Connect EVAP tube to the EVAP canister purge valve. For additional information, refer to Section 310-00 .
    - Attach the EVAP hose retainer to the intake manifold.

7. Connect the TB electrical connector.
    - Attach the TB electrical connector wiring harness pin-type retainer to the TB .

8. Connect the PCV tube quick connect coupling to the intake manifold. For additional information, refer to Section 310-00 .

9. Install the ACL outlet pipe. For additional information, refer to Section 303-12 .

Valve Cover — LH

Special Tool(s)

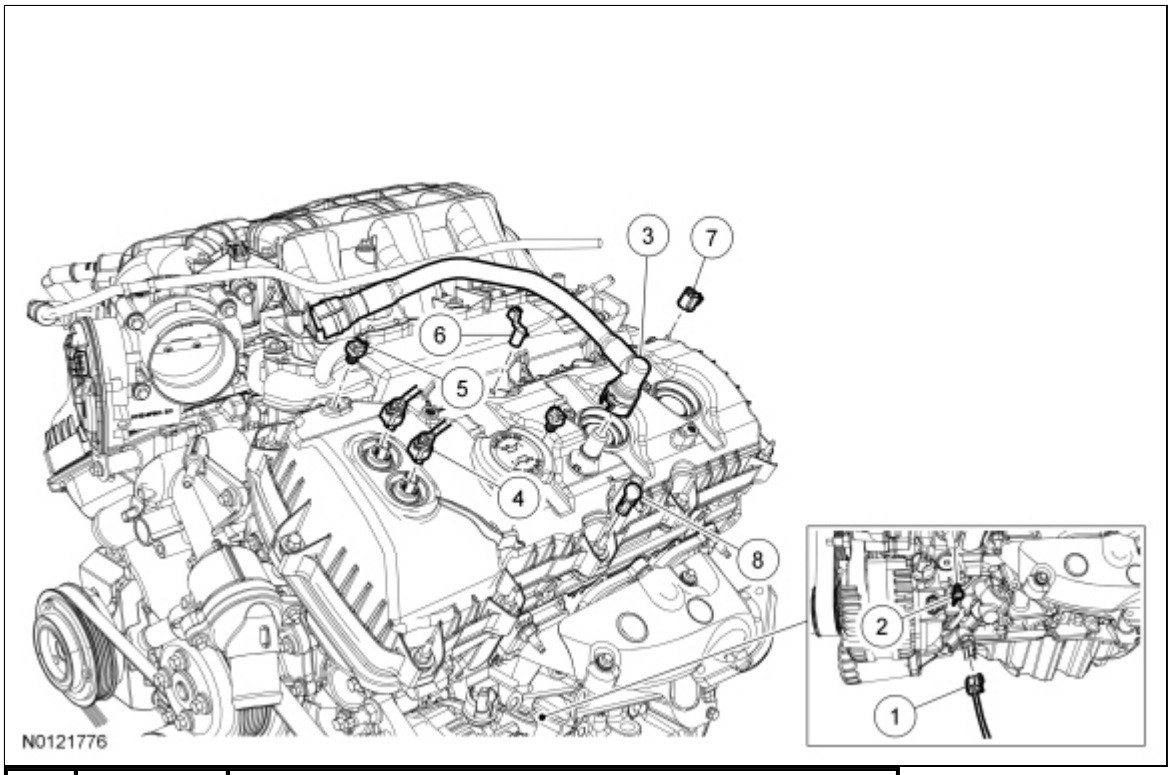
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—

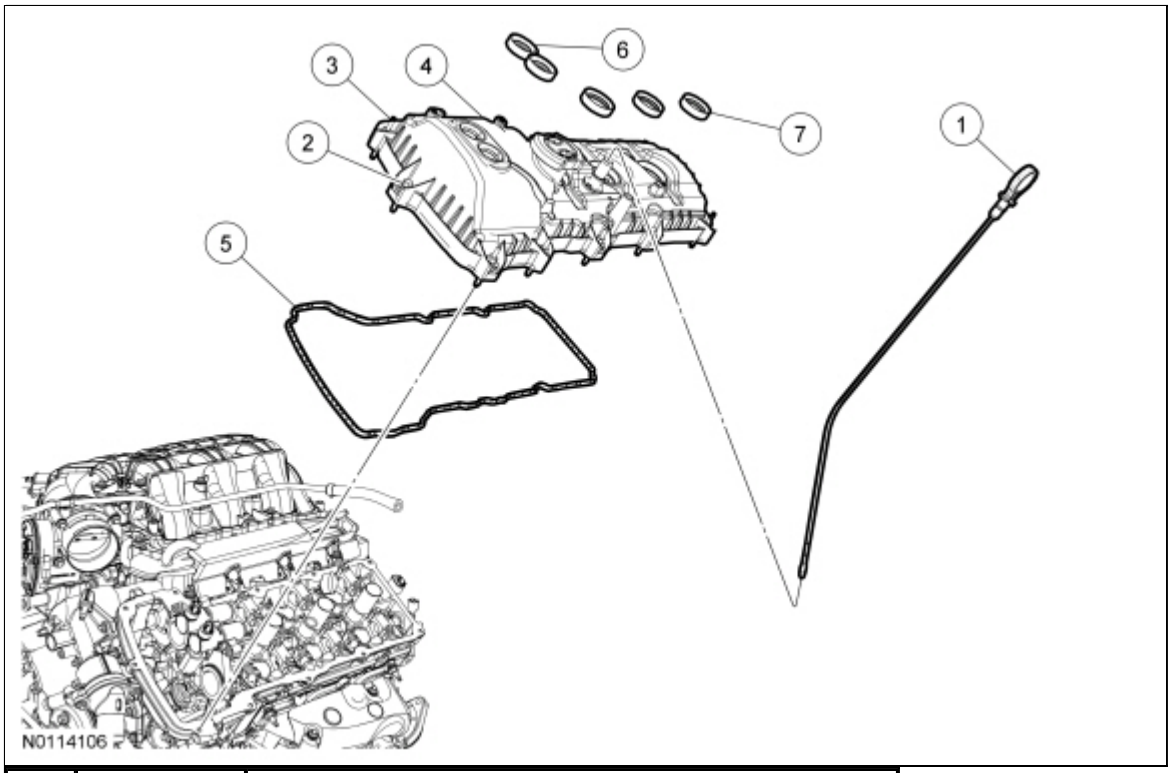
Valve Cover — LH (View 1 of 2)

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Item	Part Number	Description
1	—	Engine Oil Pressure (EOP) switch electrical connector (part of 14A411)
2	—	EOP switch electrical connector wiring harness pin-type retainer (part of 14A411)
3	6758	Crankcase ventilation tube
4	—	LH Variable Camshaft Timing (VCT) electrical connector (part of 14A411) (2 required)
5	—	LH valve cover wiring harness pin-type retainer (part of 14A411) (2 required)
6	—	LH valve cover stud bolt wiring harness retainer (part of 14A411)
7	—	LH valve cover stud bolt wiring harness retainer (part of 14A411)
8	—	LH valve cover stud bolt wiring harness retainer (part of 14A411)

Valve Cover — LH (View 2 of 2)



Item	Part Number	Description
1	6750	Oil level indicator
2	6C519	Valve cover bolt (4 required)
3	6C519	Valve cover stud bolt (7 required)
4	6582	LH valve cover
5	6584	LH valve cover gasket
6	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
7	6C535	Spark plug tube seal (3 required)

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the Air Cleaner (ACL) outlet tube and the ACL upper tray. For additional information, refer to Intake Air System Components — Exploded View, 3.7L in Section 303-12 .

2. Disconnect and remove the crankcase ventilation tube quick connect coupling from the LH valve cover. For additional information, refer to Section 310-00 .

3. Remove the oil level indicator.

4. Remove the LH ignition coils. For additional information, refer to Section 303-07A .

5. Disconnect the 2 LH Variable Camshaft Timing (VCT) solenoid electrical connectors.

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6. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.
    - Detach the EOP switch wiring harness retainer from the cylinder head.

7. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

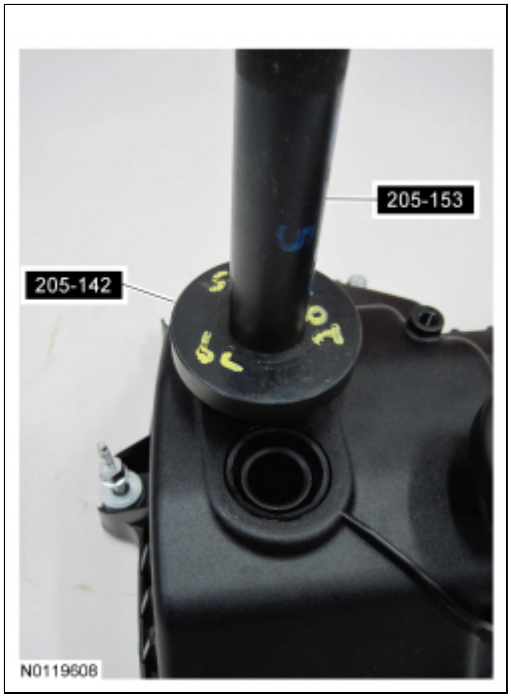
8. ***NOTICE:*** **While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.**

   NOTICE: **If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.**

   NOTE: The plastic electrical connector on the VCT oil control solenoid will rotate approximately 12 degrees inside the steel housing, which is normal.

   Loosen the 7 stud bolts, 4 bolts and remove the LH valve cover.
    - Discard the gasket.

9. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



10. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

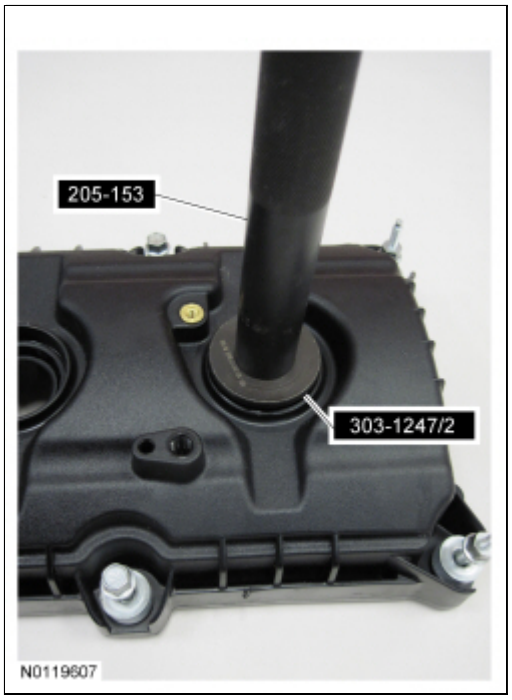


11. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

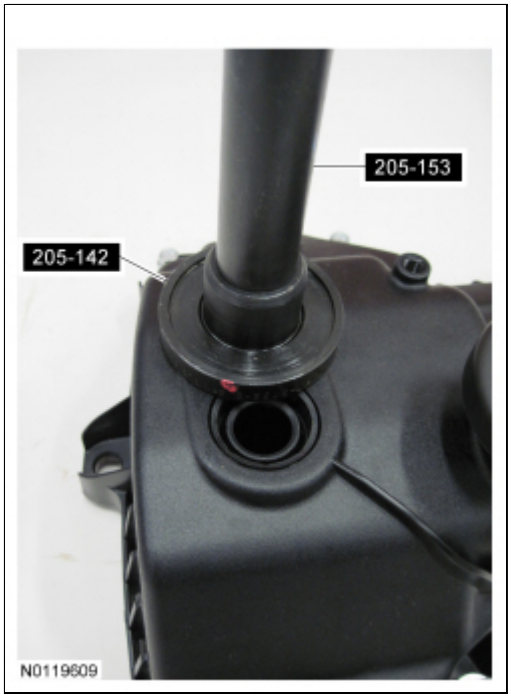
   Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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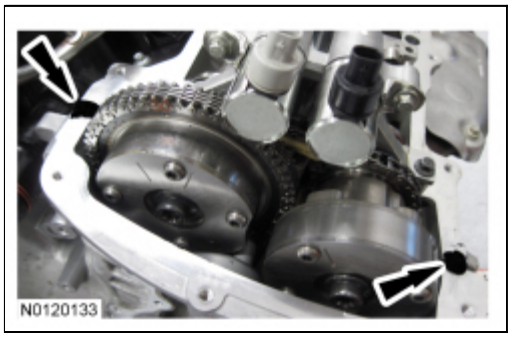
Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



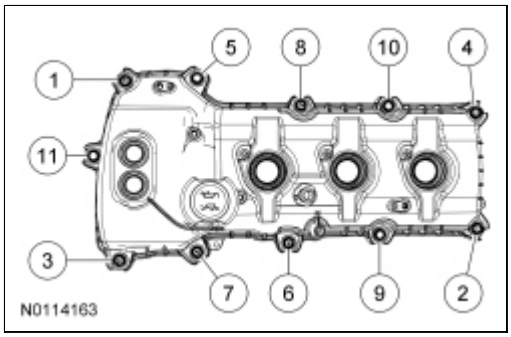
3. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

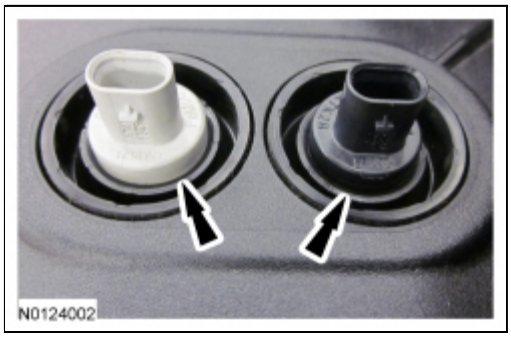
   Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.



4. Using a new gasket, install the LH valve cover and tighten the 4 bolts and 7 stud bolts in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).



5. Ensure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.



6. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.

7. Connect the EOP switch electrical connector.
   - Attach the EOP switch wiring harness retainer to the cylinder head.

8. Connect the 2 LH VCT solenoid electrical connectors.

9. Install the LH ignition coils. For additional information, refer to Section 303-07A .

10. Install the oil level indicator.

11. Connect the crankcase ventilation tube quick connect coupling to the LH valve cover. For additional information, refer to Section 310-00 .

12. Install the ACL outlet tube and the ACL upper tray. For additional information, refer to Intake Air System Components — Exploded View, 3.7L in Section 303-12 .

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Valve Cover — RH

Special Tool(s)

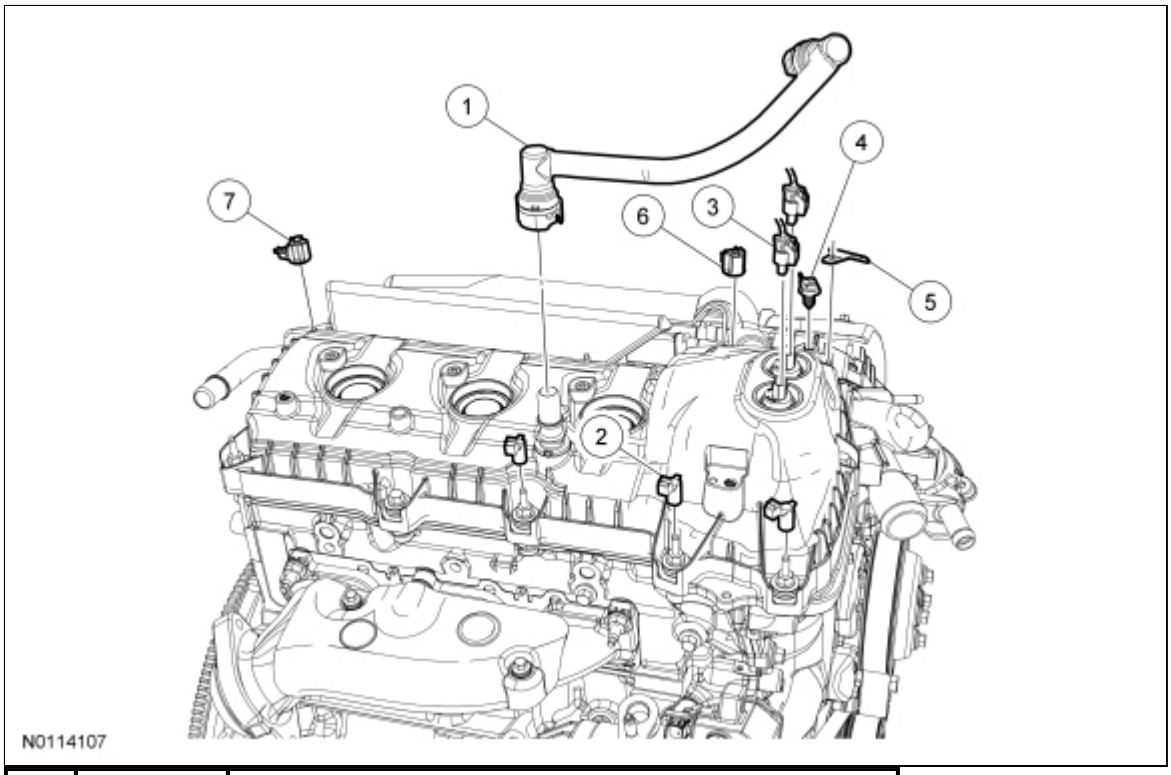
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—

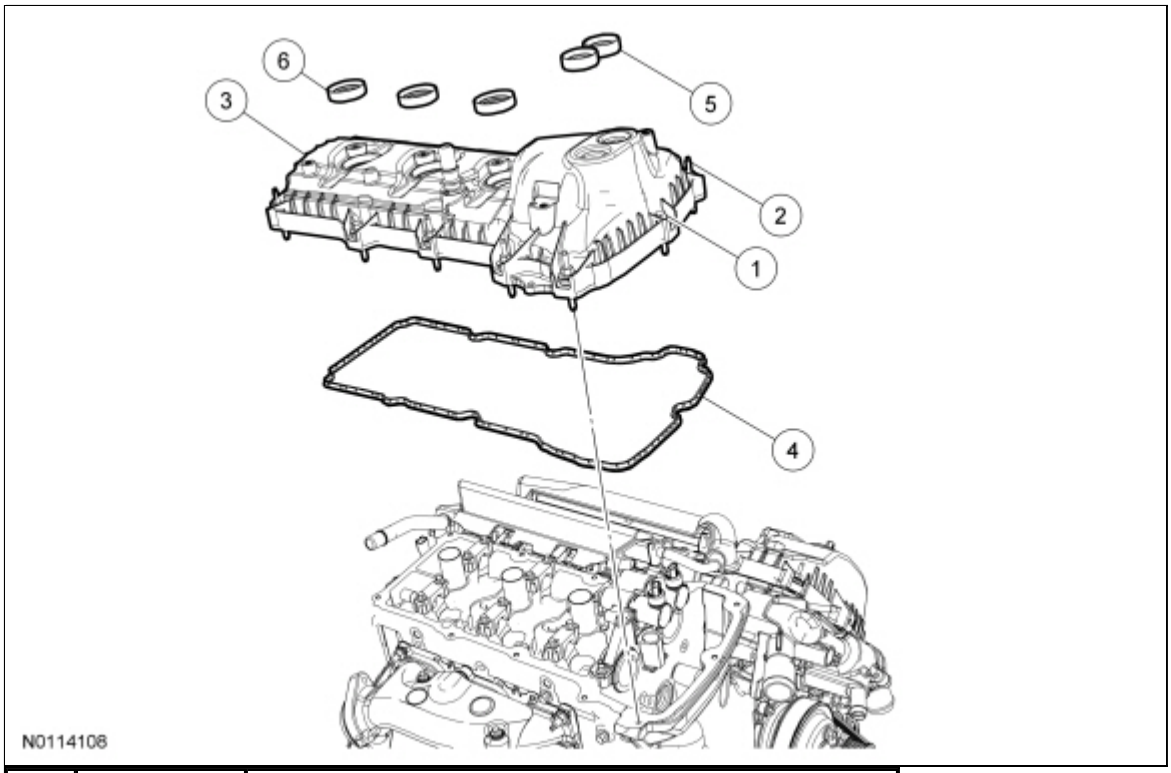
Valve Cover — RH (View 1 of 2)

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Item	Part Number	Description
	—	
1	6A664	PCV tube
2	—	RH valve cover stud bolt wiring harness retainer (part of 14A411) (3 required)
3	—	RH Variable Camshaft Timing (VCT) electrical connector (part of 14A411) (2 required)
4	—	RH valve cover wiring harness pin-type retainer (part of 14A411)
5	—	RH valve cover stud bolt wiring harness retainer (part of 14A411)
6	—	RH valve cover stud bolt wiring harness retainer (part of 14A411)
7	—	RH valve cover stud bolt wiring harness retainer (part of 14A411)

Valve Cover — RH (View 2 of 2)



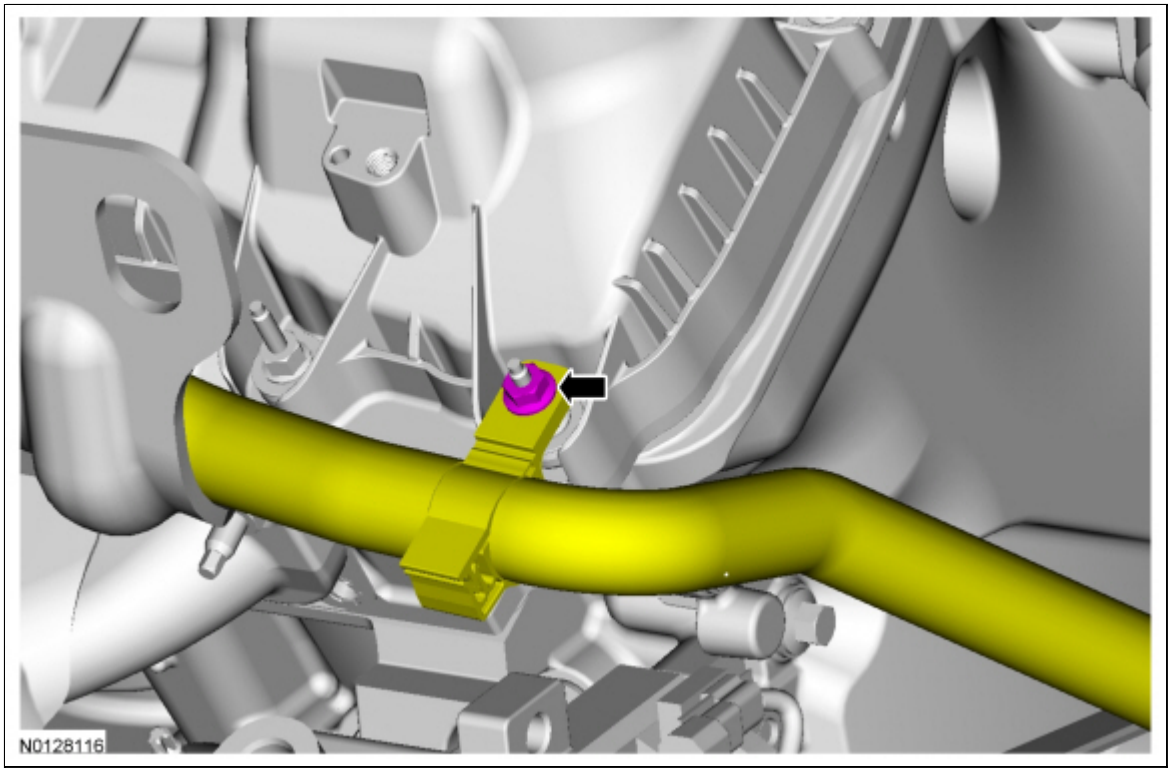
Item	Part Number	Description
1	6C519	Valve cover bolt (3 required)
2	6C519	Valve cover stud bolt (8 required)
3	6582	RH valve cover
4	6584	RH valve cover gasket
5	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
6	6C535	Spark plug tube seal (3 required)

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the RH ignition coils. For additional information, refer to Section 303-07B .
2. Disconnect and remove the PCV tube quick connect coupling from the RH valve cover. For additional information, refer to Section 310-00 .
3. Disconnect the 2 RH Variable Camshaft Timing (VCT) solenoid electrical connectors.
4. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.
5. Remove the nut and position the heater hose and bracket aside.

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6. ***NOTICE:*** **While removing the valve cover do not apply excessive force to the Variable Camshaft Timing (VCT) oil control solenoid or damage may occur.**

   NOTICE: **If the Variable Camshaft Timing (VCT) oil control solenoid sticks to the VCT seal, carefully wiggle the valve cover until the bond breaks free or damage to the VCT seal and VCT oil control solenoid may occur.**

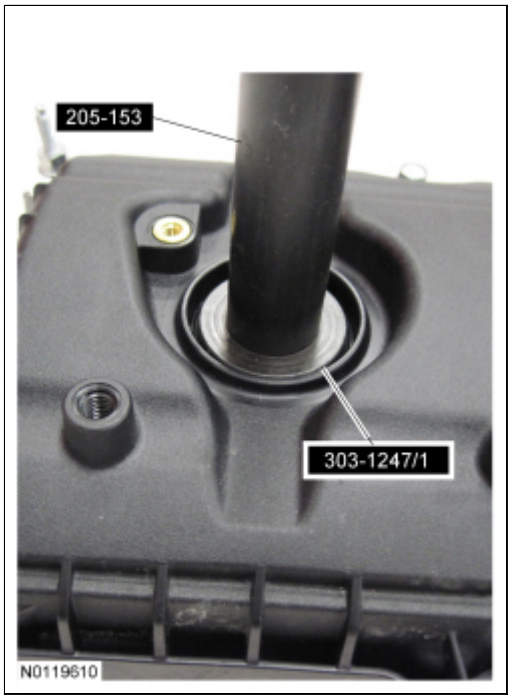
   NOTE: The plastic electrical connector on the VCT oil control solenoid will rotate approximately 12 degrees inside the steel housing, which is normal.

   Loosen the 8 stud bolts, 3 bolts and remove the RH valve cover.
   - Discard the gasket.

7. Inspect the 2 VCT solenoid seals. Remove any damaged seals.
   - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



8. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



9. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

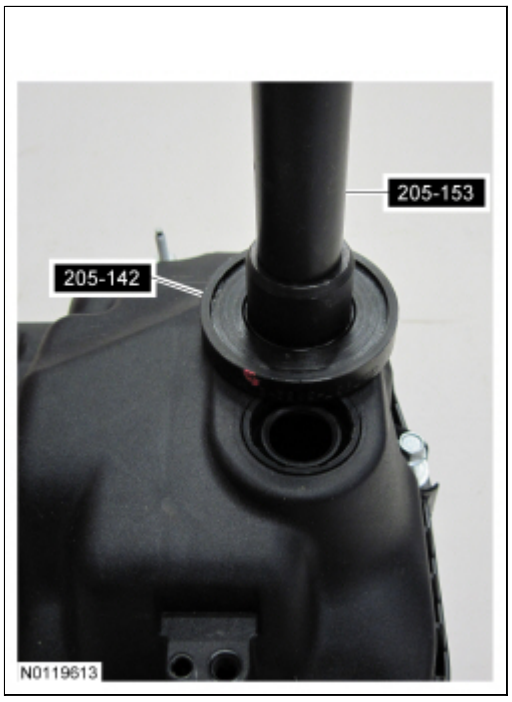
   Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.

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2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

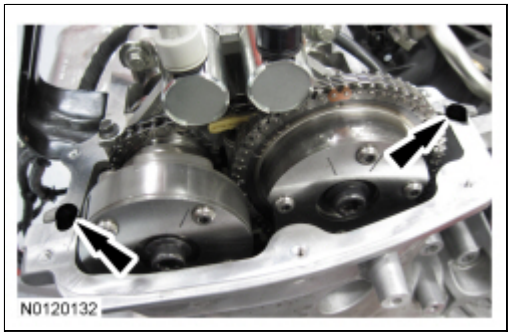
   Using the Differential Bearing Cone Installer and Handle, install new VCT solenoid seal(s).



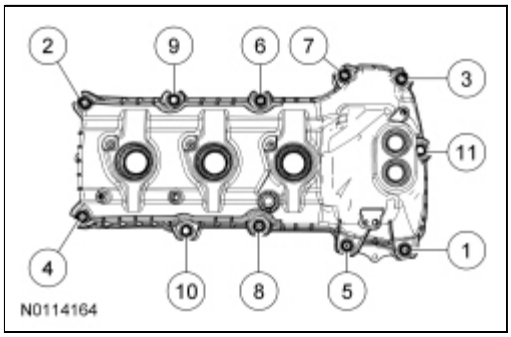
3. ***NOTICE:*** **Failure to use the correct Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

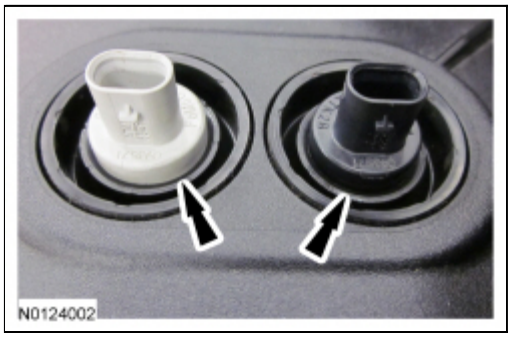
Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.



4. Using a new gasket, install the RH valve cover and tighten the 3 bolts and 8 stud bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).

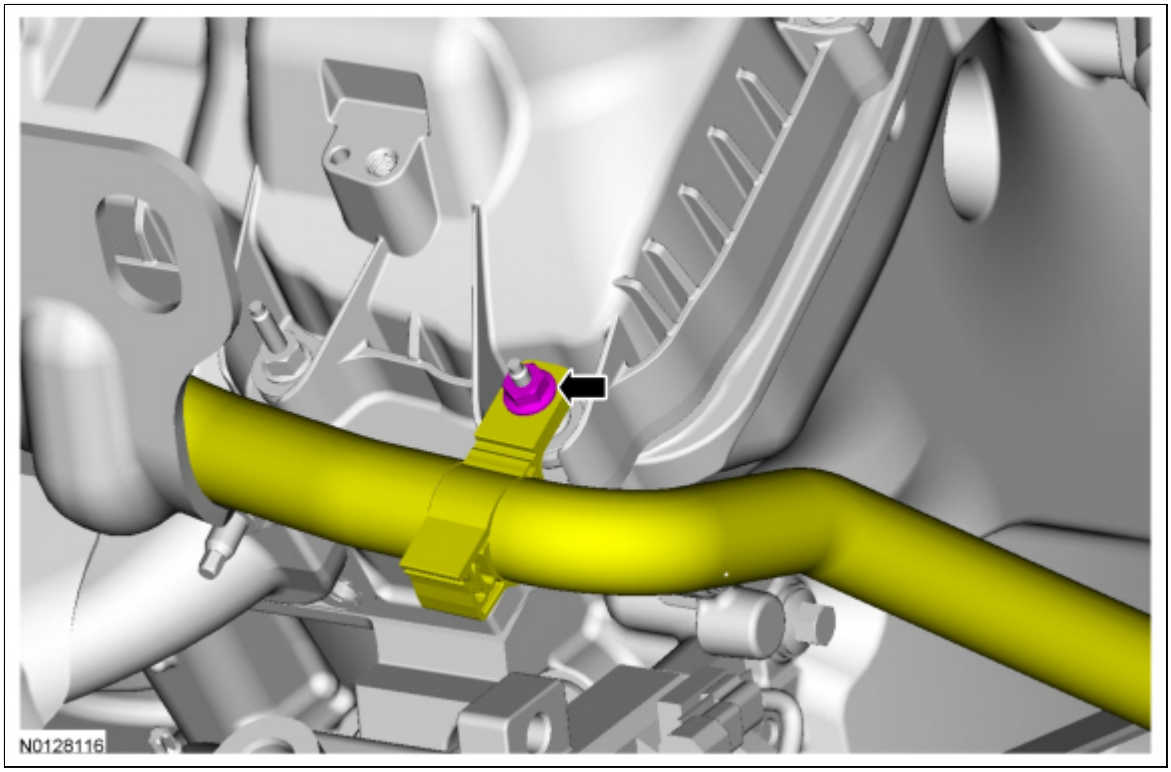


5. Ensure the VCT seals in the valve cover are below the top of the VCT oil control solenoid electrical connector or the VCT seal may leak oil.



6. Position the heater hose and bracket on the valve cover stud bolt and install the nut.
    - Tighten to 8 Nm (71 lb-in).

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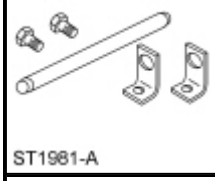
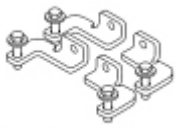


7. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.
8. Connect the 2 RH VCT solenoid electrical connectors.
9. Connect the PCV tube quick connect coupling to the RH valve cover. For additional information, refer to Section 310-00 .
10. Install the RH ignition coils. For additional information, refer to Section 303-07B .

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Valve Spring, Retainer and Seal

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303–470 (T94P-6510–CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the valve tappets from the cylinder being serviced. For additional information, refer to Valve Tappets in this section.

2. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

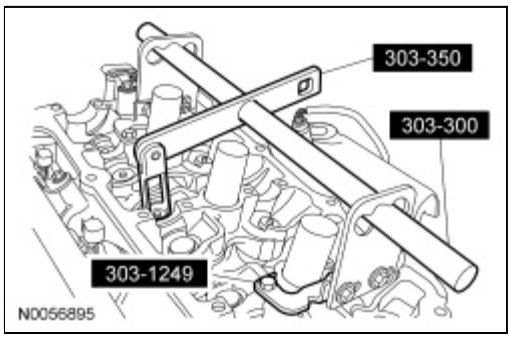
3. ***NOTICE:*** **If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal or engine damage may occur.**

   NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

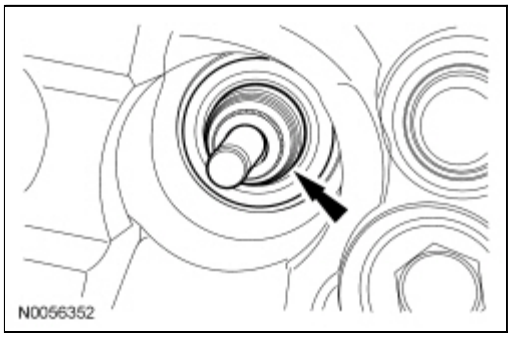
   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head — RH or Cylinder Head — LH in this section.

   Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



5. Remove and discard the valve stem seal.

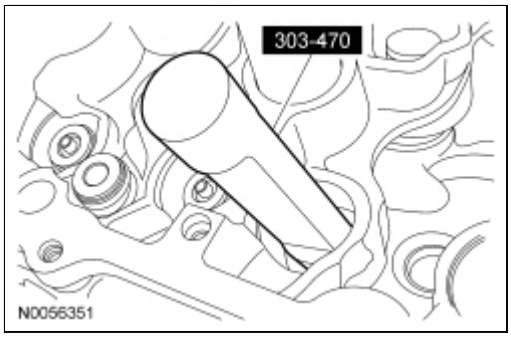


Installation

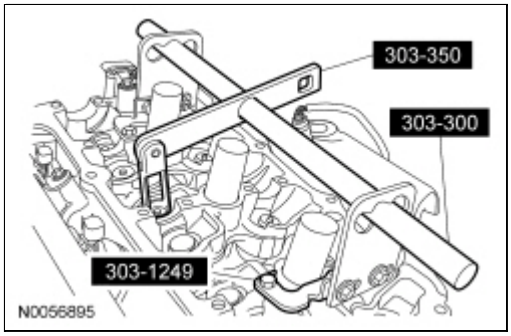
1. **NOTE:** Lubricate the valve stem seal with clean engine oil prior to installation.

   Using the Valve Stem Oil Seal Installer, install a new valve stem seal.

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2. Using the Valve Spring Compressors, install the valve spring, retainer and key.



3. Install the valve tappets. For additional information, refer to Valve Tappets in this section.

Valve Tappets

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

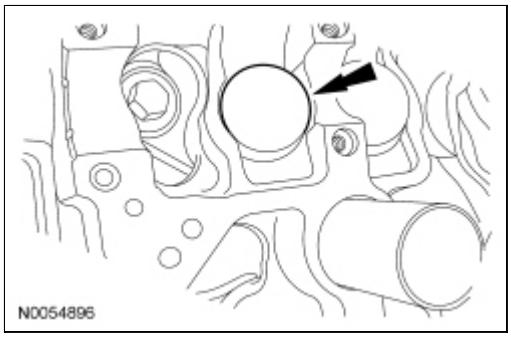
Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Depending on the valve tappets being serviced, remove the LH and/or the RH camshafts. For additional information, refer to Camshaft — RH and/or the Camshaft — LH in this section.

2. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

   Remove the valve tappets from the cylinder head.



3. **NOTE:** The valve tappets must be installed in their original positions.

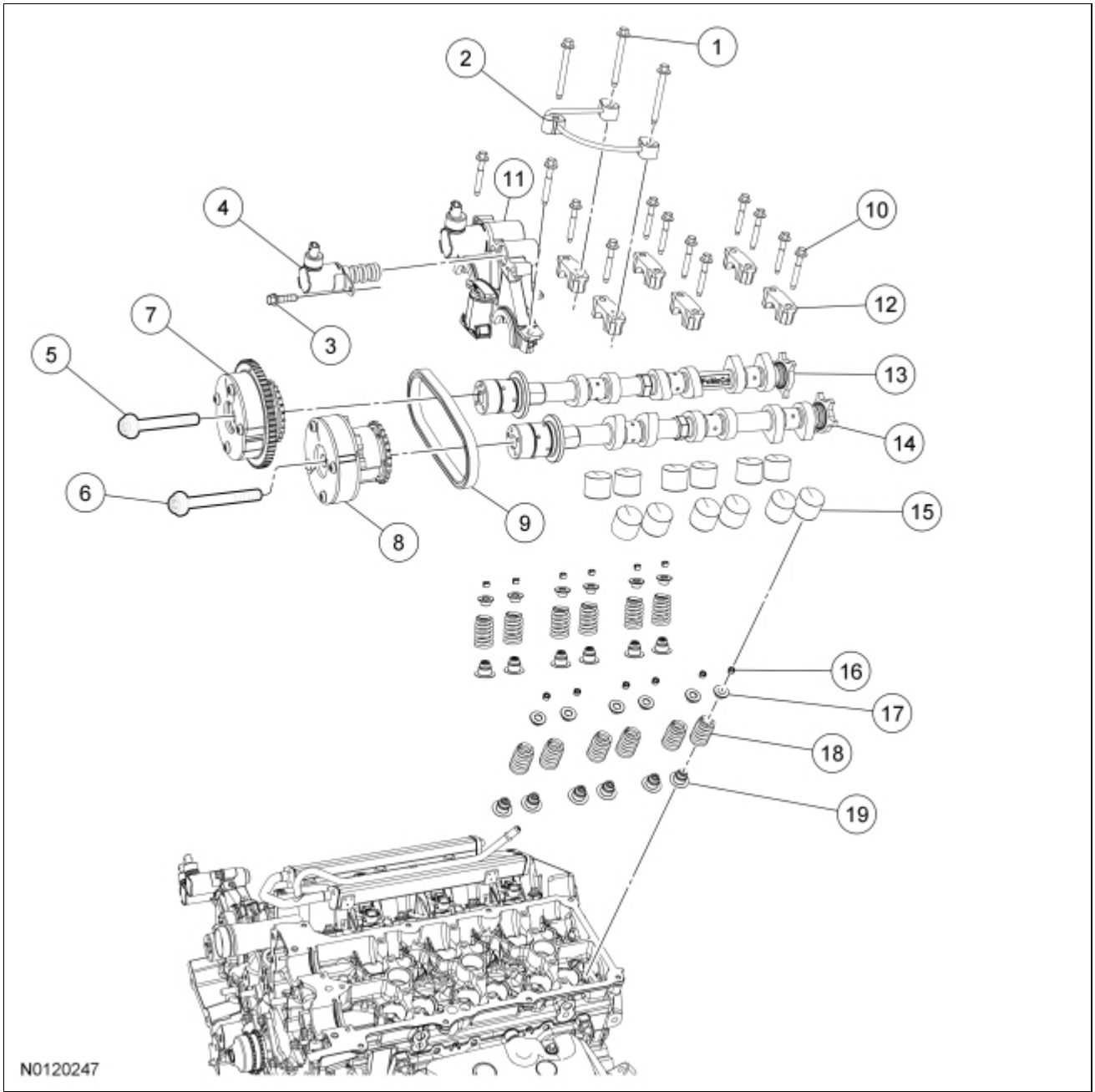
   NOTE: Coat the valve tappets with clean engine oil prior to installation.

   To install, reverse the removal procedure.

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Valve Train Components — Exploded View

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	W500305	Valve train oil tube bolt (3 required)
2	6K602	Valve train oil tube

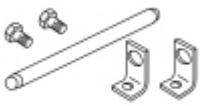
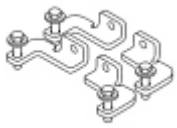
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3	W500215	Exhaust camshaft Variable Camshaft Timing (VCT) oil control solenoid bolt
4	6M280	Exhaust camshaft VCT oil control solenoid
5	6279	Intake camshaft VCT assembly bolt
6	6279	Exhaust camshaft VCT assembly bolt
7	6256	Intake camshaft VCT assembly
8	6C525	Exhaust camshaft VCT assembly
9	6268	LH secondary timing chain
10	W710702	Camshaft cap bolt (12 required)
11	6B280	Camshaft mega cap
12	6A258	Camshaft cap (12 required)
13	6250	Intake camshaft
14	6250	Exhaust camshaft
15	6500	Valve tappet (12 required)
16	6518	Valve spring retainer key (24 required)
17	6514	Valve spring retainer (12 required)
18	6513	Valve spring (12 required)
19	6571	Valve stem seal (12 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

Cylinder Head

Special Tool(s)

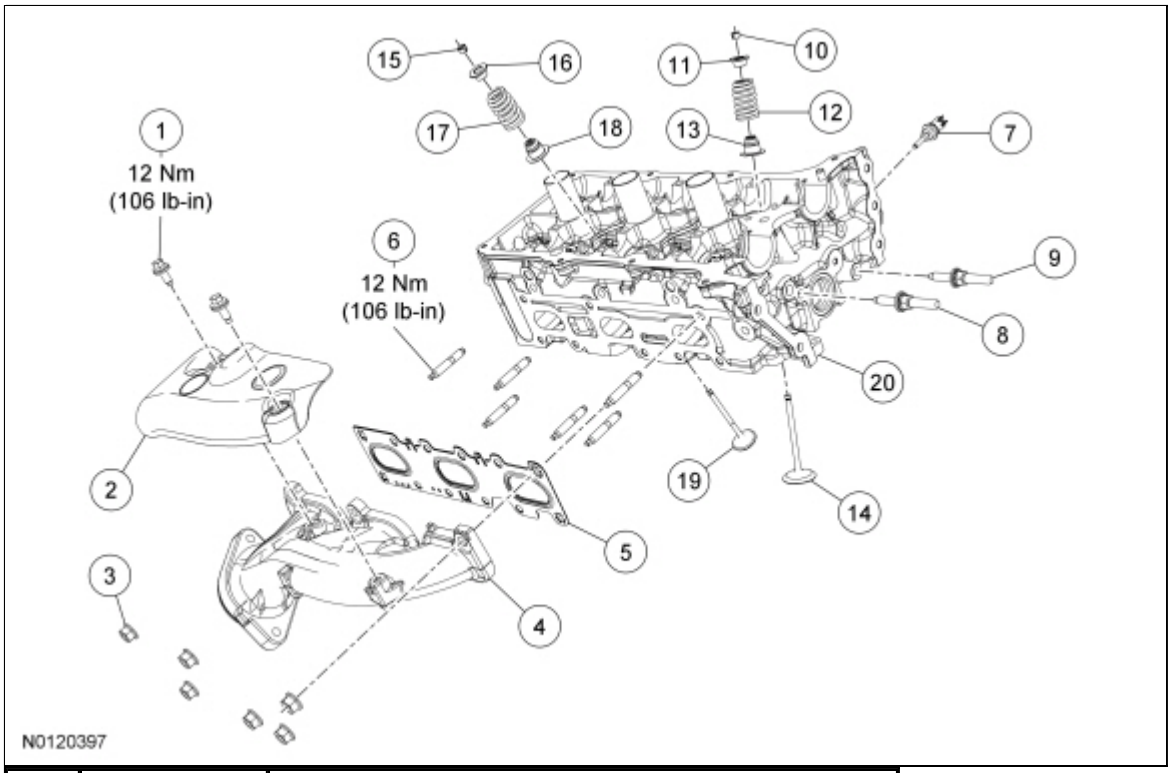
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

NOTE: RH cylinder head shown, LH cylinder head similar.

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Item	Part Number	Description
1	W714133	RH exhaust manifold heat shield bolt (2 required)
2	9A462	RH exhaust manifold heat shield
3	W701706	RH exhaust manifold nut (6 required)
4	9430	RH exhaust manifold
5	9448	RH exhaust manifold gasket
6	W712244	RH exhaust manifold stud (6 required)
7	6G004	Cylinder Head Temperature (CHT) sensor
8	W714090	Timing chain tensioner arm pin
9	W714090	Timing chain guide pin
10	6518	Intake valve spring retainer key (12 required)
11	6514	Intake valve spring retainer (6 required)
12	6513	Intake valve spring (6 required)
13	6571	Intake valve stem seal (6 required)
14	6505	Intake valve (6 required)
15	6518	Exhaust valve spring retainer key (12 required)
16	6514	Exhaust valve spring retainer (6 required)
17	6513	Exhaust valve spring (6 required)
18	6571	Exhaust valve stem seal (6 required)
19	6507	Exhaust valve (6 required)
20	6049	RH cylinder head

Disassembly

All cylinder heads

1. Remove the 2 bolts and the exhaust manifold heat shield.

2. Remove the 6 nuts and the exhaust manifold.
   - Discard the nuts and gasket.

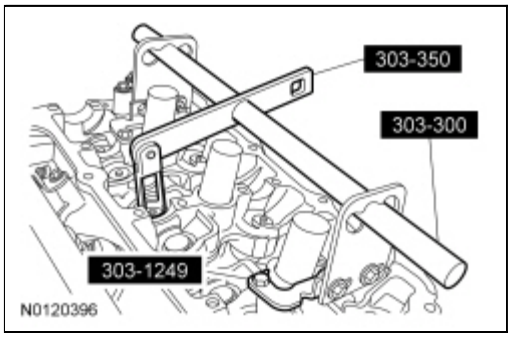
3. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

4. Remove and discard the 6 exhaust manifold studs.

5. Remove the timing chain guide pin.

6. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

   Using the Valve Spring Compressors, remove the keys, retainer and spring.



7. Remove the valve from the cylinder head.

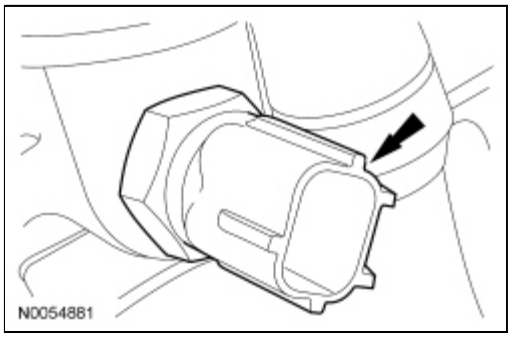
8. Remove and discard the valve stem seal.

9. Repeat the above steps for each valve.

RH cylinder head

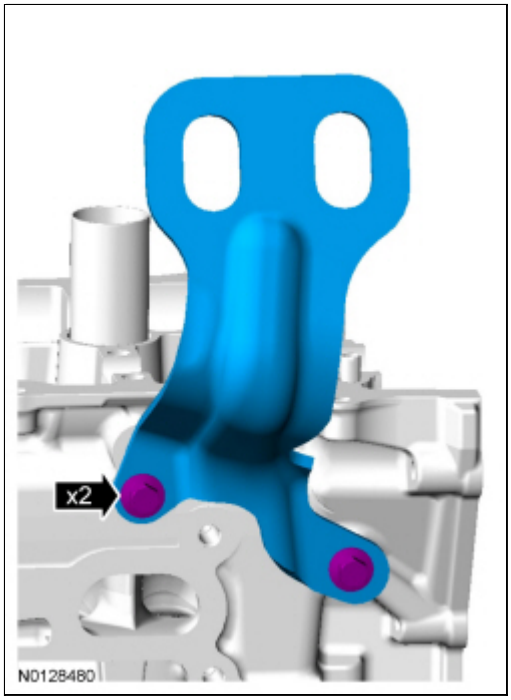
10. Remove the timing chain tensioner arm pin.

11. Remove and discard the Cylinder Head Temperature (CHT) sensor.



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12. Remove the 2 bolts and the engine lift eye.



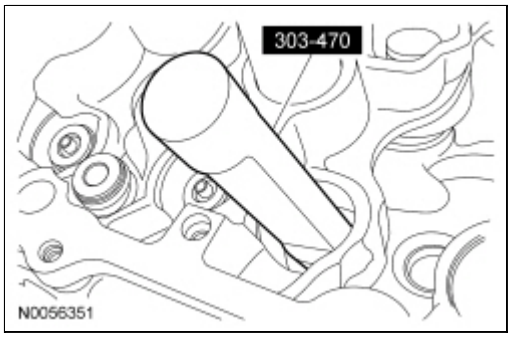
Assembly

All cylinder heads

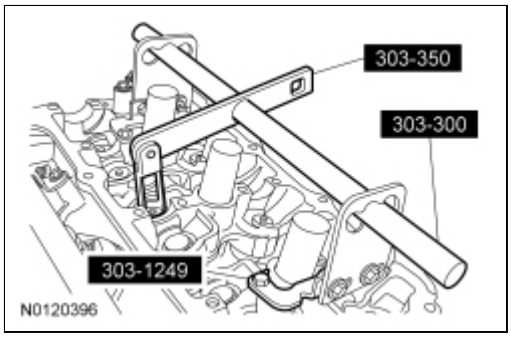
1. **NOTE:** If the components are to being reinstalled, they must be installed into their original location.

   NOTE: Lubricate the valve stem and valve stem seal with clean engine oil prior to installation.

   Using the Valve Stem Oil Seal Installer, install a new valve stem seal.



2. Install the valve.
3. Using the Valve Spring Compressors, install the valve spring, retainer and key.

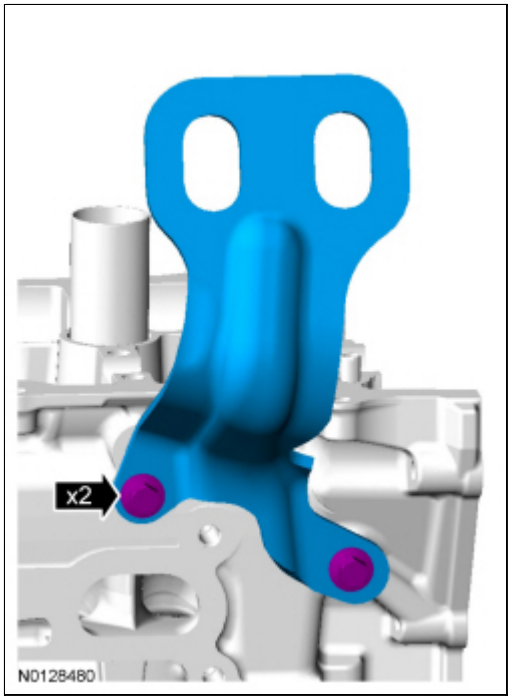


4. Repeat the above steps for each valve.

5. Install the timing chain guide pin and tighten in 2 stages.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten an additional 60 degrees.

RH cylinder head

6. Install the engine lift eye and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).



7. Install a new CHT sensor.
    - Tighten to 10 Nm (89 lb-in).

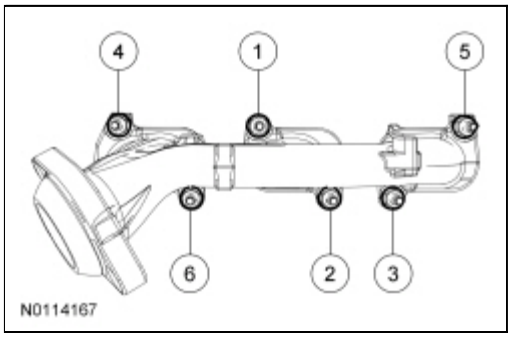
8. Install the timing chain tensioner arm pin and tighten in 2 stages.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten an additional 60 degrees.

9. Install 6 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

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10. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:
    - Stage 1: Tighten to 19 Nm (168 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



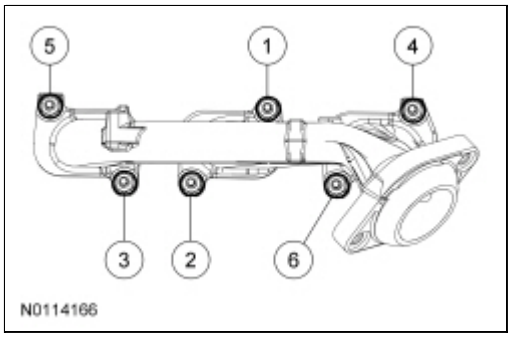
11. Install the RH exhaust manifold heat shield and the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).

LH cylinder head

12. Install 6 new LH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

13. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the LH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:
    - Stage 1: Tighten to 19 Nm (168 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



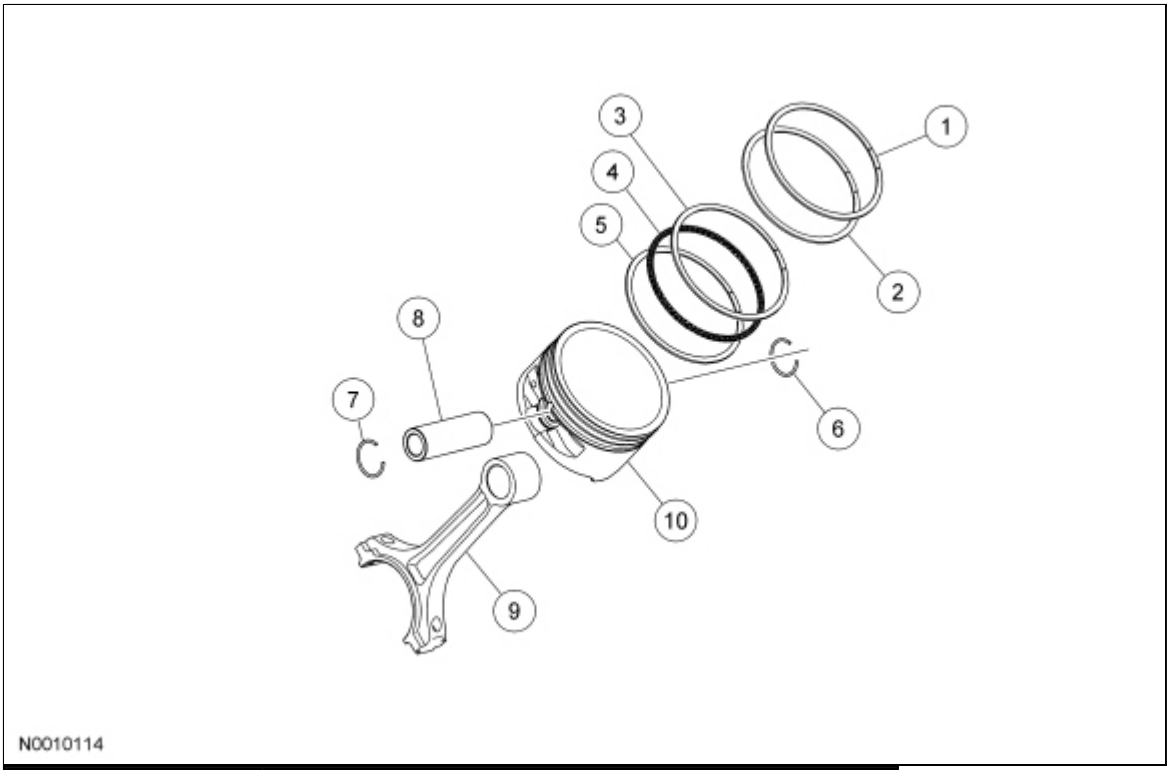
14. Install the LH exhaust manifold heat shield and the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).

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Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	—	Piston compression upper ring (part of 6148)
2	—	Piston compression lower ring (part of 6148)
3	—	Piston oil control upper segment ring (part of 6148)
4	—	Piston oil control spacer (part of 6148)
5	—	Piston oil control lower segment ring (part of 6148)
6	6140	Piston pin retainer clip
7	6140	Piston pin retainer clip
8	6135	Piston pin

9	6200	Connecting rod
10	6110	Piston

Disassembly

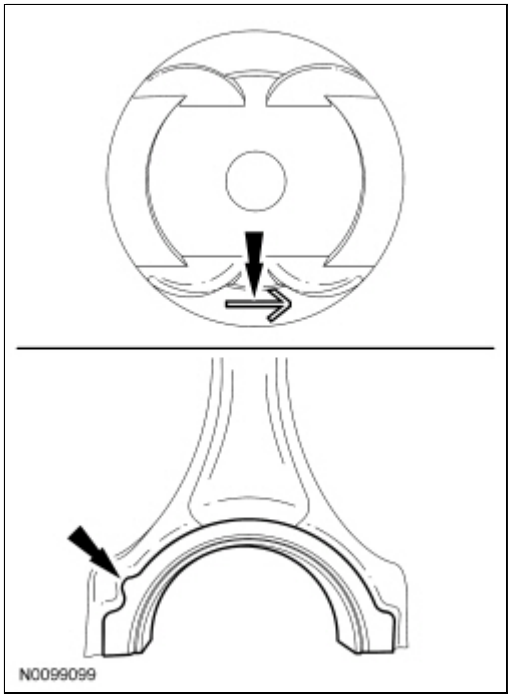
1. Remove the piston rings from the piston.
   - Discard the piston rings.

2. Remove the 2 piston pin retainers and the piston pin.
   - Discard the 2 piston pin retainer clips.

3. **NOTE:** If the piston and/or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

   NOTE: If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

   Separate the piston from the connecting rod.



4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. Align the piston-to-connecting rod orientation marks and position the connecting rod in the piston.

2. Lubricate the piston pin and pin bore with clean engine oil.

3. Install the piston pin in the piston and connecting rod assembly.

4. Install the new piston pin retaining clips in the piston.

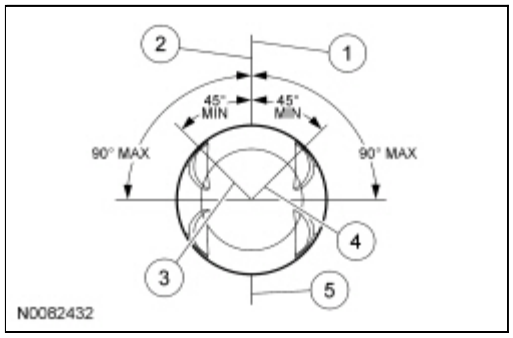
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- The piston pin retaining clip gap orientation must be toward the top or dome of piston.

5. Lubricate the piston and the new piston rings with clean engine oil.

6. **NOTE:** The piston compression upper and lower ring should be installed with the "O" mark on the ring face pointing up toward the top of the piston.

   Install the piston rings onto the piston as shown.
   1. Center line of the piston parallel to the wrist pin bore
   2. Upper compression ring gap location
   3. Upper oil control segment ring gap location
   4. Lower oil control segment ring gap location
   5. Expander ring and lower compression ring gap location



Material

Item	Specification	Fill Capacity
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	7.33 L (7.75 qt)
Motorcraft® Silicone Gasket Remover ZC-30	—	—
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	—
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—
Motorcraft® Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Motorcraft® Threadlock 262 TA-26	WSK-M2G351-A6	—

General Specifications

Item	Specification
Engine	
Displacement	4.957 L (302 CID)
Number of cylinders	8
Bore	92.2 mm (3.629 in)
Stroke	92.7 mm (3.649 in)
Firing order	1-5-4-8-6-3-7-2
Spark plug	12405
Spark plug gap	1.25-1.35 mm (0.049-0.053 in)
Minimum oil pressure at idle (engine at normal operating temperature, transmission in park)	103 kPa (15 psi)
Compression ratio	10.5:1

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Engine weight	197.3 kg (435 lb)
Cylinder Head and Valve Train	
Combustion chamber volume	54.5-57.5 cc (3.33-3.51 cu in)
Valve stem diameter — intake	5.975-5.995 mm (0.2352-0.2360 in)
Valve stem diameter — exhaust	5.950-5.970 mm (0.2342-0.2350 in)
Valve stem-to-guide clearance — intake	0.020-0.069 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance — exhaust	0.045-0.094 mm (0.0018-0.0037 in)
Valve head diameter — intake	37 mm (1.45 in)
Valve head diameter — exhaust	31 mm (1.22 in)
Valve face runout	0.05 mm (0.0019 in)
Valve face angle	45 degrees
Valve seat width — intake	1.3-1.5 mm (0.051-0.059 in)
Valve seat width — exhaust	1.4-1.6 mm (0.059-0.063 in)
Valve seat runout	0.04 mm (0.0016 in)
Valve seat angle	120/90/60 degrees
Valve spring free length — intake	51.32 mm (2.02 in)
Valve spring free length — exhaust	51.32 mm (2.02 in)
Valve spring perpendicularity — intake	3 mm (0.118 in)
Valve spring perpendicularity — exhaust	3 mm (0.118 in)
Valve spring compression force — intake	650 N
Valve spring compression force — exhaust	650 N
Valve spring installed height — intake	40 mm (1.5748 in)
Valve spring installed height — exhaust	40 mm (1.5748 in)
Valve spring installed force — intake	265 N
Valve spring installed force — exhaust	265 N
Roller follower ratio	2:1
Head gasket surface flatness	0.025 mm (0.001 in) in any 25 mm (1 in) x 25 mm (1 in) area; 0.050 mm (0.002 in) in any 150 mm (6 in) x 150 mm (6 in) area; 0.1 mm (0.004 in) overall
Hydraulic Lash Adjuster	
Diameter — intake	11.89-12.00 mm (0.4681-0.472 in)
Diameter — exhaust	11.89-12.00 mm (0.4681-0.472 in)
Clearance-to-bore	0.018-0.050 mm (0.0007-0.0019 in)
Hydraulic leakdown rate — intake	0.45-3 seconds [a]
Hydraulic leakdown rate — exhaust	0.45-3 seconds [a]
Collapsed lash adjuster gap	0.35-0.85 mm (0.0137-0.0334 in)
Camshaft	

Lobe lift — intake	5.258 mm (0.2070 in)
Lobe lift — exhaust	5.488 mm (0.2160 in)
Journal diameter	28.607-28.633 mm (1.1262-1.1272 in)
Journal bore inside diameter	28.682-28.657 mm (1.1292-1.1282 in)
Journal-to-bearing clearance	0.025-0.075 mm (0.001-0.002 in)
Runout	0.04 mm (0.0016 in) (4 places)
End play	0.15 mm (0.0059 in)
Cylinder Block	
Cylinder bore diameter	92.200-92.220 mm (3.6299-3.6307 in)
Cylinder bore maximum taper	0.013 mm (0.0005 in)
Cylinder bore maximum out-of-round	0.010 mm (0.0004 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.850-2.851 in)
Head gasket surface flatness	0.0254 mm (0.001 in) across any 38.1 mm (1.5 in) square
Crankshaft	
Main bearing journal diameter	67.481-67.505 mm (2.657-2.658 in)
Main bearing journal maximum taper	0.004 mm (0.0002 in)
Main bearing journal maximum out-of-round	0.008 mm (0.0003 in) between cross sections
Main bearing journal-to-main bearing clearance	0.025-0.045 mm (0.0009-0.0018 in)
Connecting rod journal diameter	52.983-53.003 mm (2.086-2.087 in)
Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Crankshaft maximum end play	0.28 mm (0.011 in)
Piston and Connecting Rod	
Piston diameter	92.161-92.175 mm (3.6283-3.6289 in)
Piston-to-cylinder bore clearance (at grade size) [b]	0.025-0.059 mm (0.0009-0.0023 in)
Piston ring end gap — top	0.15-0.25 mm (0.0059-0.0098 in)
Piston ring end gap — intermediate	0.30-0.55 mm (0.0118-0.0216 in)
Piston ring gap — oil control	0.15-0.45 mm (0.0059-0.0177 in)
Piston ring groove width — top	1.220-1.250 mm (0.0480-0.0492 in)
Piston ring groove width — intermediate	1.220-1.240 mm (0.0480-0.0488 in)
Piston ring groove width — oil control	2.530-2.550 mm (0.0996-0.1003 in)
Piston ring width — top	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width — intermediate	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring-to-groove clearance — top	0.030-0.080 mm (0.0019-0.0031 in)
Piston ring-to-groove clearance — intermediate	0.030-0.070 mm (0.0019-0.0028 in)
Piston pin bore diameter	22.004-22.010 mm (0.8663-0.8665 in)
Piston pin diameter	21.997-22.000 mm (0.8649-0.8661 in)
Piston pin length	60.7-61.0 mm (2.3897-2.4015 in)
Piston pin-to-piston fit (clearance)	0.004-0.013 mm (0.0002-0.0005 in)

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Connecting rod-to-pin clearance	0.003-0.018 mm (0.0001-0.0007 in)
Connecting rod pin bore diameter	22.003-22.015 mm (0.8663-0.8667 in)
Connecting rod length (centerline bore-to-bore)	150.7 mm (5.933 in)
Connecting rod maximum allowed bend	0.038 mm (0.0015 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing-to-crankshaft clearance	0.028-0.069 mm (0.0011-0.0027 in)
Connecting rod side clearance (as assembled to crank) — standard play	0.325 mm (0.0128 in)
Connecting rod side clearance (as assembled to crank) — max. play	0.500 mm (0.0197 in)

[a] Time required for the plunger to leak down 1.6 mm of travel with 222 N force and leakdown fluid in the lash adjuster.
[b] Before Grafal coating.

Torque Specifications

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner bolt	48	35	—
A/C compressor stud bolts	25	18	—
Camshaft bearing cap bolts [a]	—	—	—
Camshaft bearing mega cap bolts [a]	—	—	—
Camshaft Position (CMP) sensor bolt	10	—	89
Catalytic convertor-to-exhaust manifold nuts	40	30	—
Connecting rod cap bolts [a]	—	—	—
Coolant outlet bolts	10	—	89
Coolant outlet pipe bolt	10	—	89
Coolant pump bolts	20	—	177
Coolant pump pulley bolts	20	—	177
Crankshaft main bearing cap bolts [a]	—	—	—
Crankshaft Position (CKP) sensor bolt	10	—	89
Crankshaft pulley bolt [a]	—	—	—
Crankshaft rear seal retainer plate bolts [a]	—	—	—
Cylinder head bolts [a]	—	—	—
Cylinder Head Temperature (CHT) sensor	11	—	97
Engine front cover bolts [a]	—	—	—
Engine front cover-to-oil filter adapter jackscrew [a]	—	—	—
Engine oil filter [b]	—	—	—
Engine Oil Pressure (EOP) [c]	—	—	—
Engine support insulator bracket bolts	63	46	—

Engine support insulator through bolts	350	258	—
Engine support insulator bolts [a]	—	—	—
Engine support insulator nuts	175	129	—
Engine support insulator studs	15	—	133
Engine-to-transmission bolts and stud bolts	48	35	—
Exhaust H-pipe clamp nuts	48	35	—
Exhaust manifold nuts [a]	—	—	—
Exhaust manifold studs	25	18	—
Flexplate [a]	—	—	—
Flexplate inspection cover bolts	35	26	—
Fuel rail bolts [a]	—	—	—
Generator B+ wire terminal nut	17	—	150
Generator bolt and nut	48	35	—
Ground strap-to-cowl bolt	10	—	89
Ground strap-to-frame bolt	12	—	106
Hood bolts	12	—	106
Ignition coil-on-plug bolt	6	—	53
Intake manifold assembly bolts [a]	—	—	—
Knock Sensor (KS)	20	—	177
Oil filter adapter bolts [a]	—	—	—
Oil pan bolts [a]	—	—	—
Oil pan drain plug	26	19	—
Oil pan stud bolts [a]	—	—	—
Oil pump bolts and stud bolts [a]	—	—	—
Oil pump screen and pickup tube bolts [a]	—	—	—
Oil pump screen and pickup tube spacer	25	18	—
Piston cooling jet bolts [a]	—	—	—
Primary timing chain tensioner bolts	10	—	89
Skid plate	48	35	—
Spark plugs	15	—	133
Thermostat housing bolts	10	—	89
Timing chain guide bolts	10	—	89
Torque converter nuts	40	30	—
Transmission fluid cooler tube bracket-to-flexplate inspection cover stud bolt nut	13	—	115
Transmission fluid cooler tube bracket-to-RH engine support insulator bracket stud bolt nut	48	35	—
Transmission mount-to-crossmember nut	25	18	—
Valve cover bolts [a]	—	—	—

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VCT assembly bolts [a]	—	—	—
Wiring harness-to-frame bracket bolt	20	—	177

[a] Refer to the procedure in this section.
[b] Do not lubricate O-ring seal, tighten to 16 Nm (142 lb-in).
[c] Tighten to 14 Nm (124 lb-in) plus an additional 180 degrees.

Engine

The 5.0L (302 CID) is a V-8 engine with the following features:

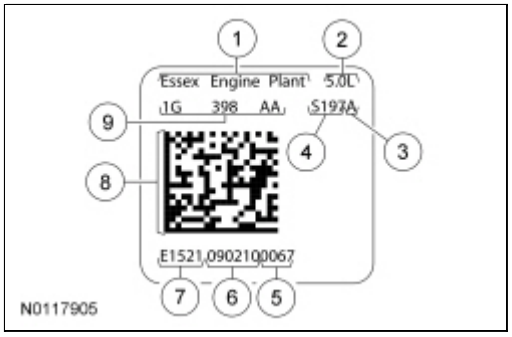
- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- Aluminum cylinder heads
- Aluminum, 90-degree V-cylinder block
- Individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- Electronic ignition system with 8 ignition coils
- Engine oil cooler

Engine Identification

Always refer to these labels when installation of new parts is necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will make sure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their applications.

Engine Code Information Label

The engine code information label, located on the valve cover, contains the following:

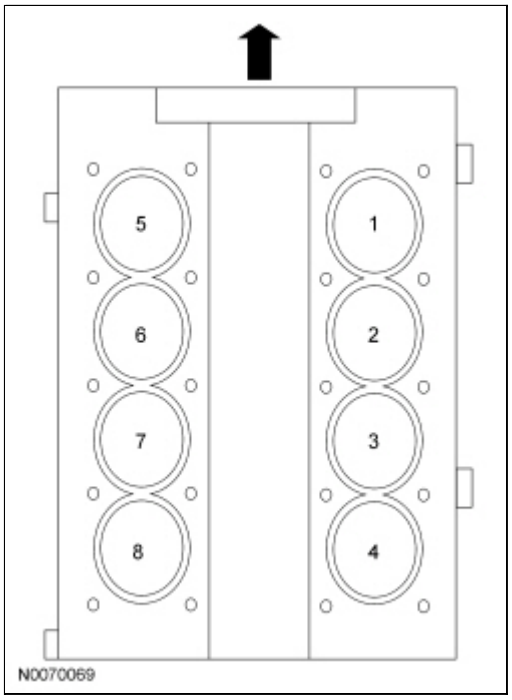


Item	Description
1	Essex engine plant
2	Engine displacement
3	Transmission
4	Vehicle line
5	Sequential number

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6	Engine build date (DDMMYY)
7	Essex engine plant
8	Bar code
9	Engine part number

Engine Cylinder Identification



Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 8 solenoid-operated fuel injectors:

- are mounted in the fuel injection supply manifold and the intake manifold above the cylinder heads.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- supply fuel from the fuel tank by a fuel pump mounted in the fuel tank.

Crankshaft

The crankshaft is supported on the bottom of the cylinder block by 5 crankshaft main bearings.

Camshafts

The camshafts:

- are arranged in pairs, one each (intake and exhaust) on each cylinder head.
- are synchronized through a secondary timing chain.
- depress the roller followers to actuate the valves.

Valve Train

The valves are actuated by a hydraulic lash adjuster and roller follower. The hydraulic lash adjusters and roller followers:

- provide hydraulic lash adjustment.
- ride on the camshaft lobes.

Twin IndependentVariable Camshaft Timing (VCT) System

The twin independent VCT system allows variable control of intake valve closing which optimizes combustion at full load providing improved power and low speed torque (broadening the torque curve) which enables variable valve overlap which provides better fuel economy and emissions and provides optimized cold start operation with improved exhaust emissions.

PCV System

All engines are equipped with a closed-type PCV system recycling the crankcase vapors to the upper intake manifold.

Engine Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the:

- crankshaft main bearings.
- crankshaft thrust main bearing.
- connecting rod bearings.
- oil galleries.
- piston cooling jets.

All other parts are lubricated by splash of the oil.

Oil Pump

The lubrication system of the 5.0L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors.

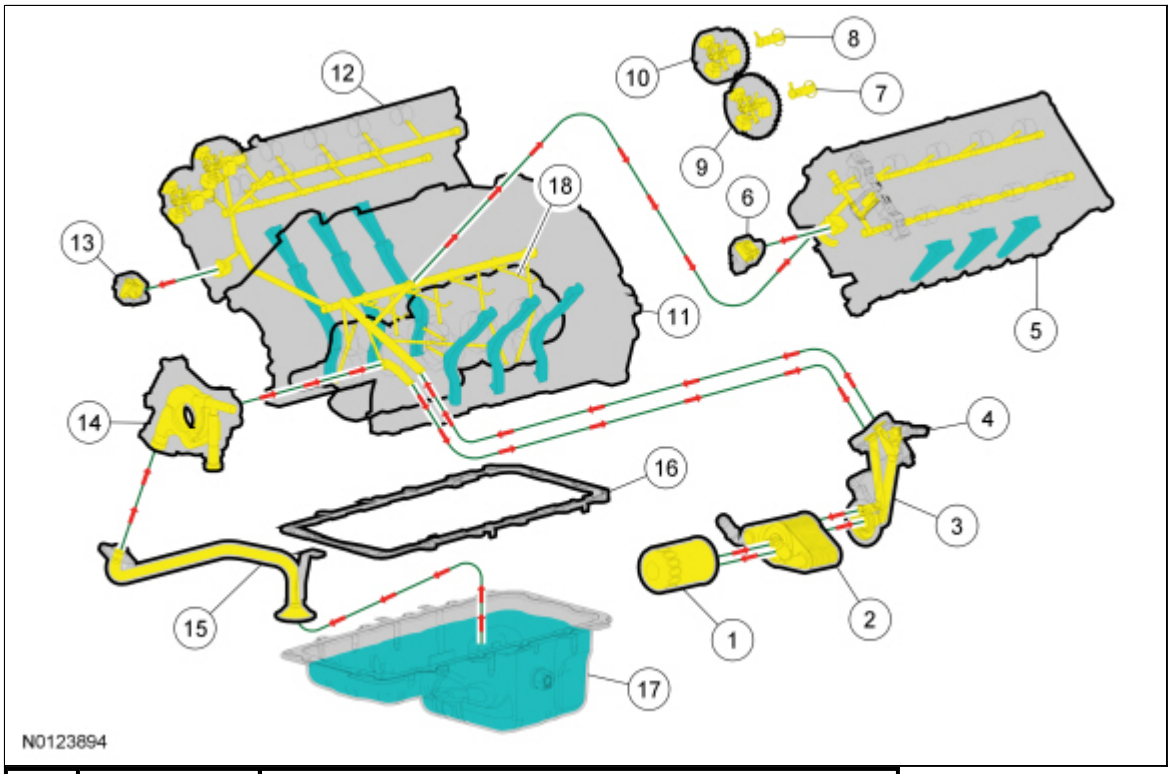
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Generically, this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to make sure of correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Engine Oil Flow Illustration

Engine Assembly



Item	Part Number	Description
1	6714	Oil filter
2	6A642	Oil filter cooler
3	6881	Oil filter adapter
4	9278	Engine Oil Pressure (EOP) switch
5	6049	Cylinder head — LH

6	6L266	Timing chain tensioner — LH
7	6250	Exhaust camshaft
8	6250	Intake camshaft
9	6256	Exhaust camshaft Variable Camshaft Timing (VCT)
10	6256	Intake camshaft VCT
11	6010	Cylinder block
12	6049	Cylinder head — RH
13	6L266	Timing chain tensioner — RH
14	6600	Oil pump
15	6622	Oil pump screen and pickup tube
16	6710	Oil pan gasket
17	6675	Oil pan
18	6K868	Piston cooling jet (4 required)

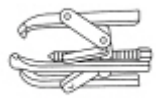
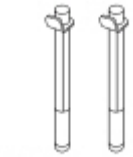
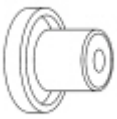
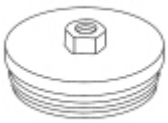
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Engine

For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Engine

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
	Remover, Oil Seal 303-409 (T92C-6700-CH)

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 ST1385-A	
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTICE: **Remove the cylinder heads before removing the crankshaft. Failure to do so can result in engine damage.**

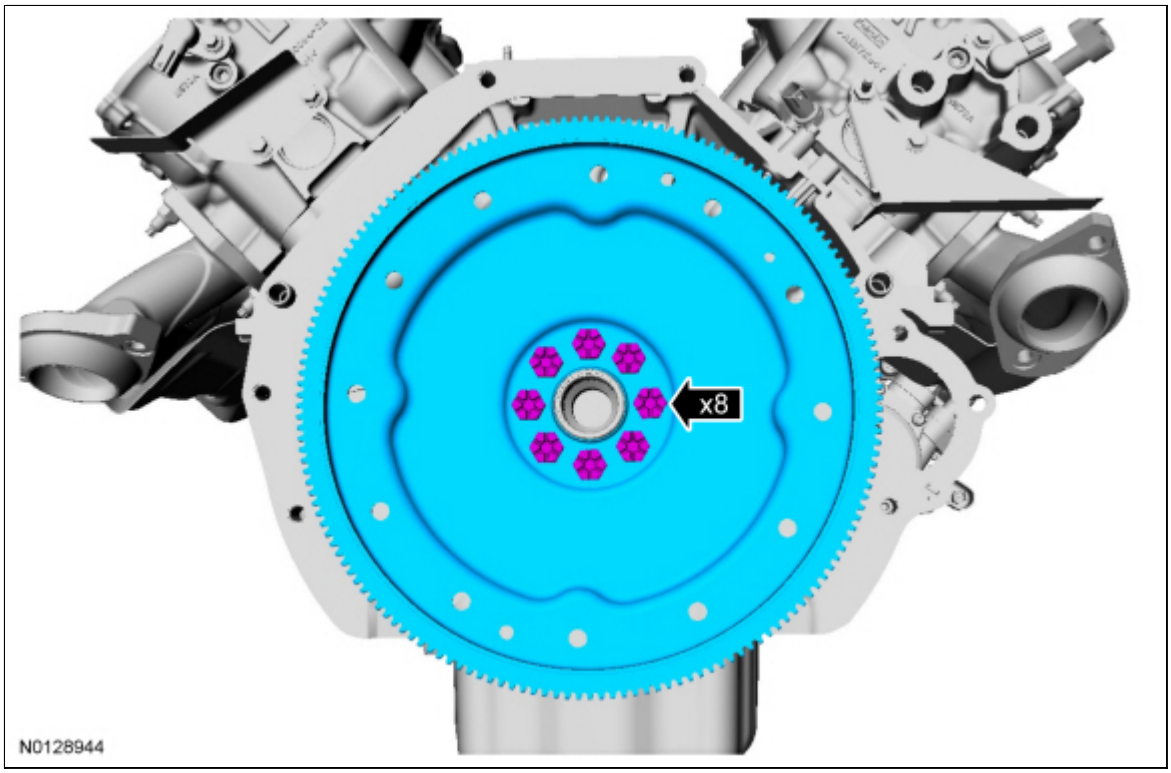
NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

NOTE: For additional information, refer to the exploded view under the Assembly procedure in this section.

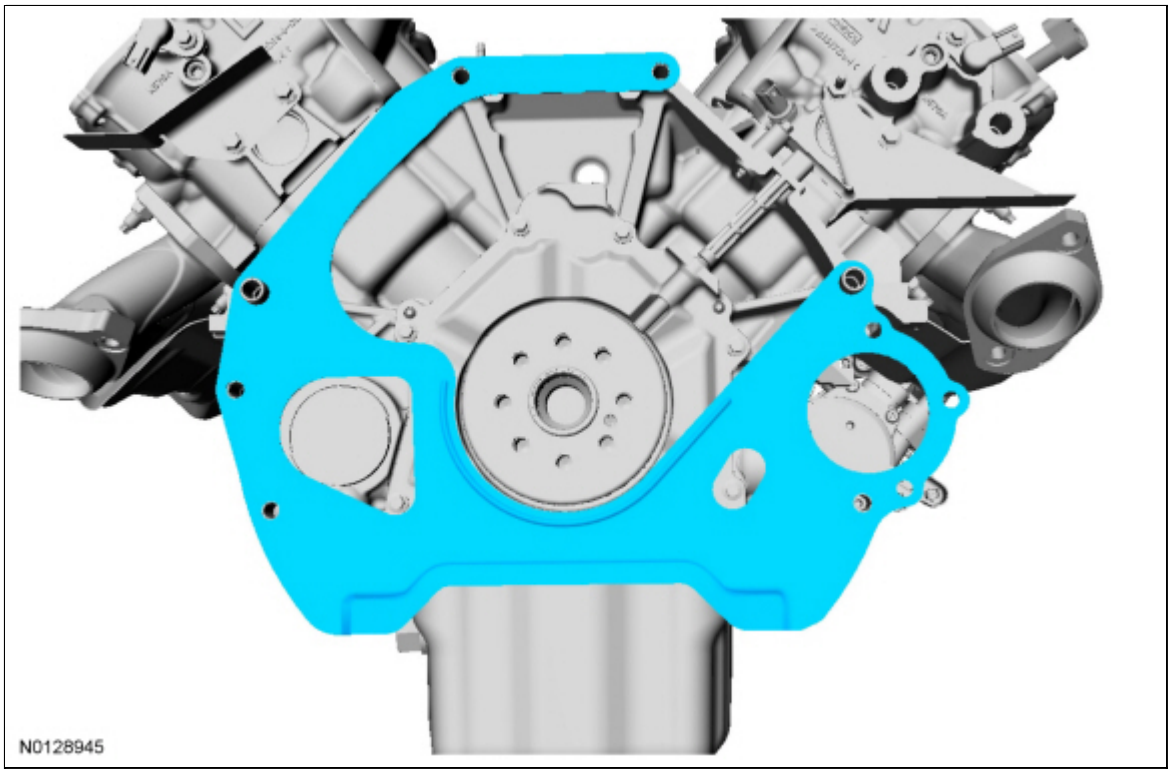
1. Remove the engine. For additional information, refer to Engine in this section.

2. **NOTE:** The flexplate bolts are torque-to-yield design and are not reusable.

   Remove the 8 bolts and the flexplate.
   - Discard the bolts.



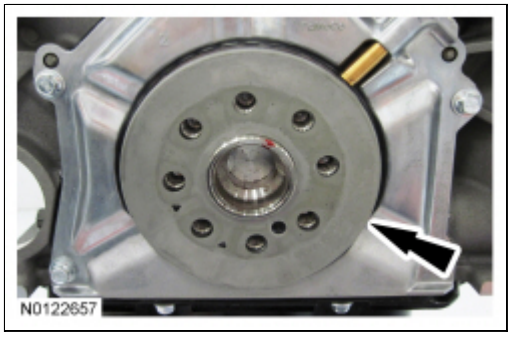
3. Remove the engine separator plate.



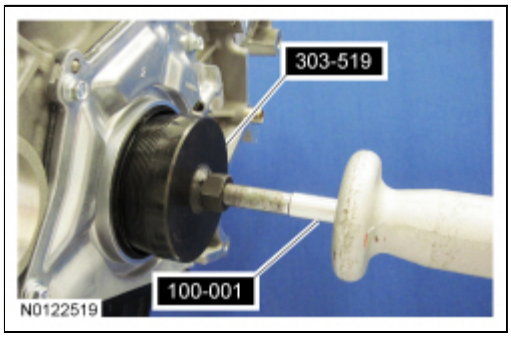
4. **NOTE:** Inspect the crankshaft sensor ring for damage. If the crankshaft sensor ring has been dropped or has any visual damage, it must be discarded.

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Remove the crankshaft sensor ring.

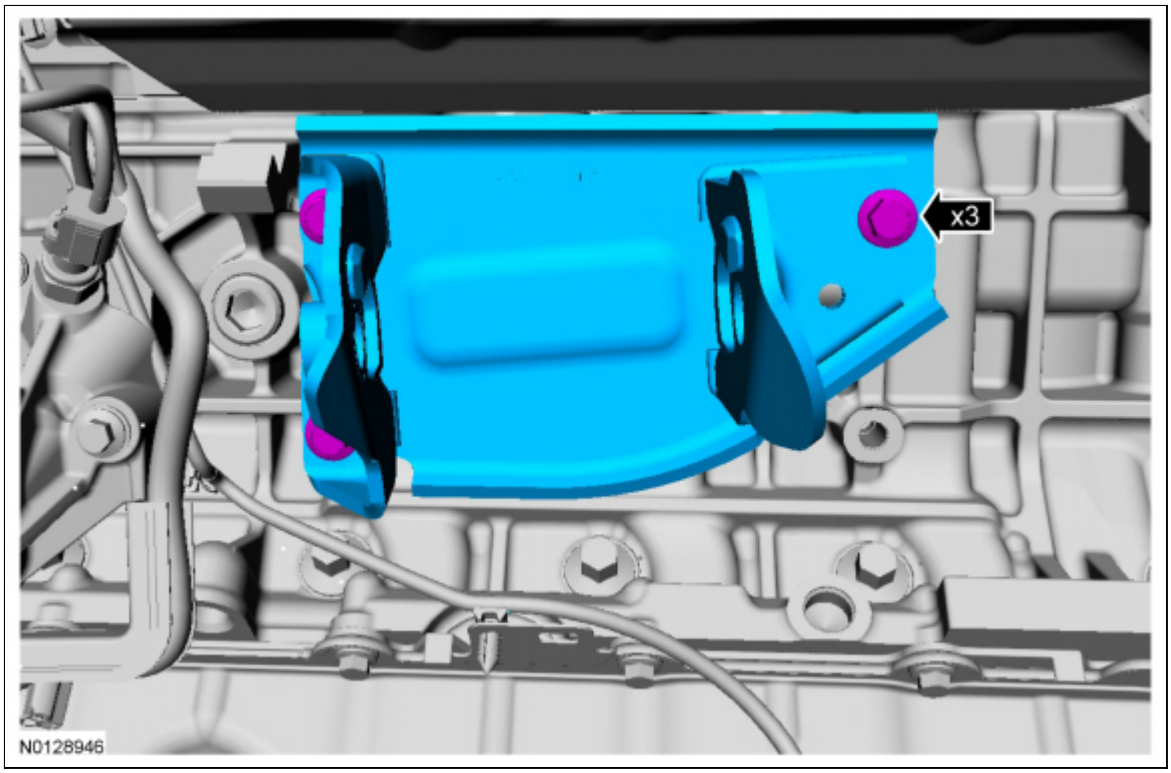


5. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.

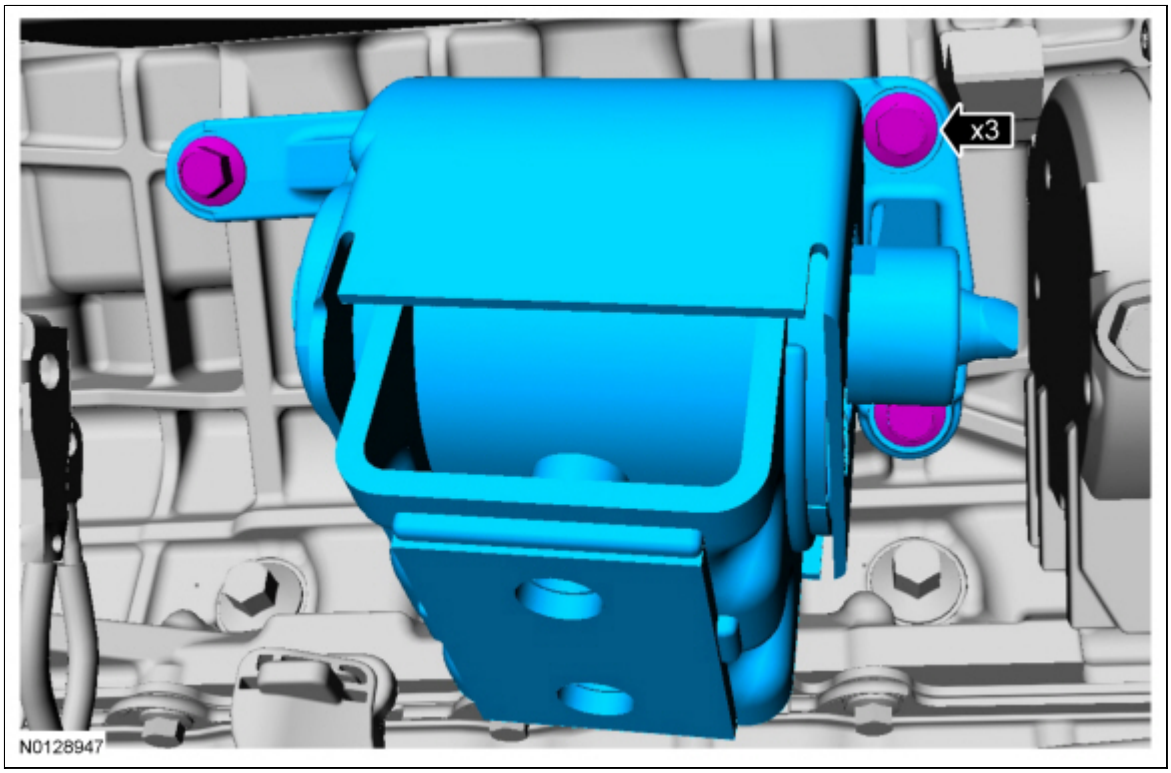


6. Mount the engine on a work stand.

7. Remove the 3 bolts and the LH engine support insulator bracket.

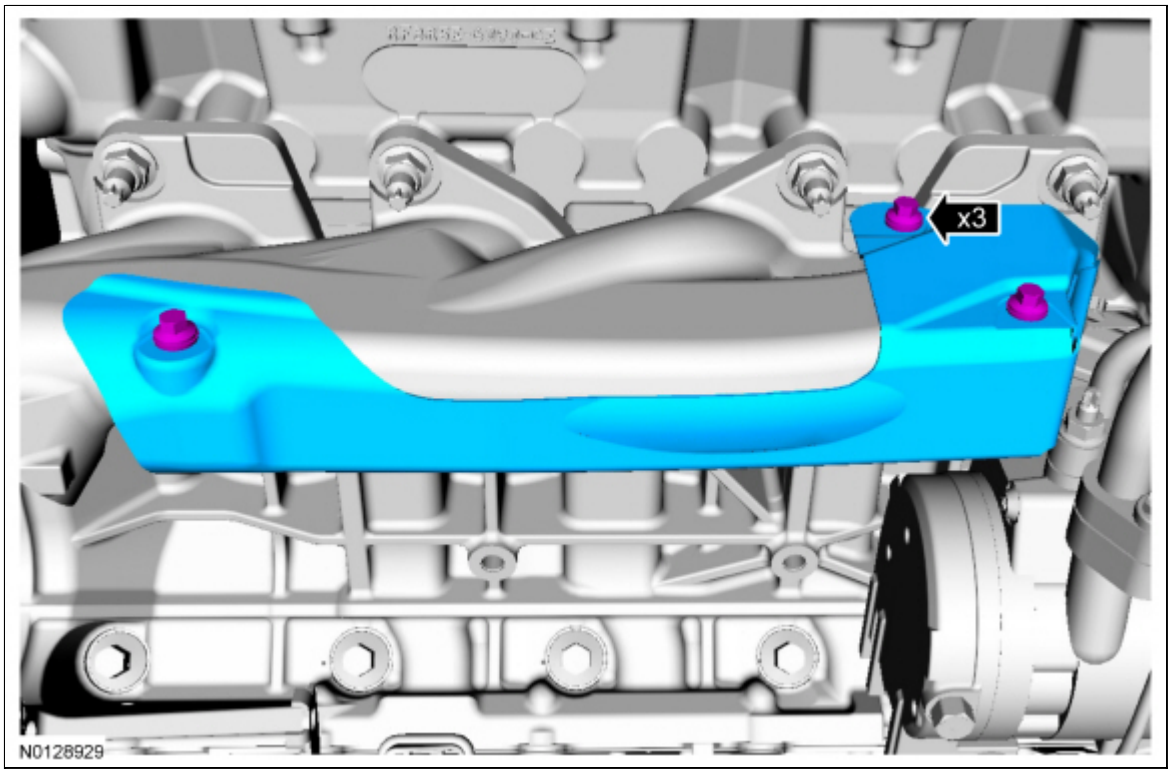


8. Remove the 3 bolts and the RH engine support insulator.

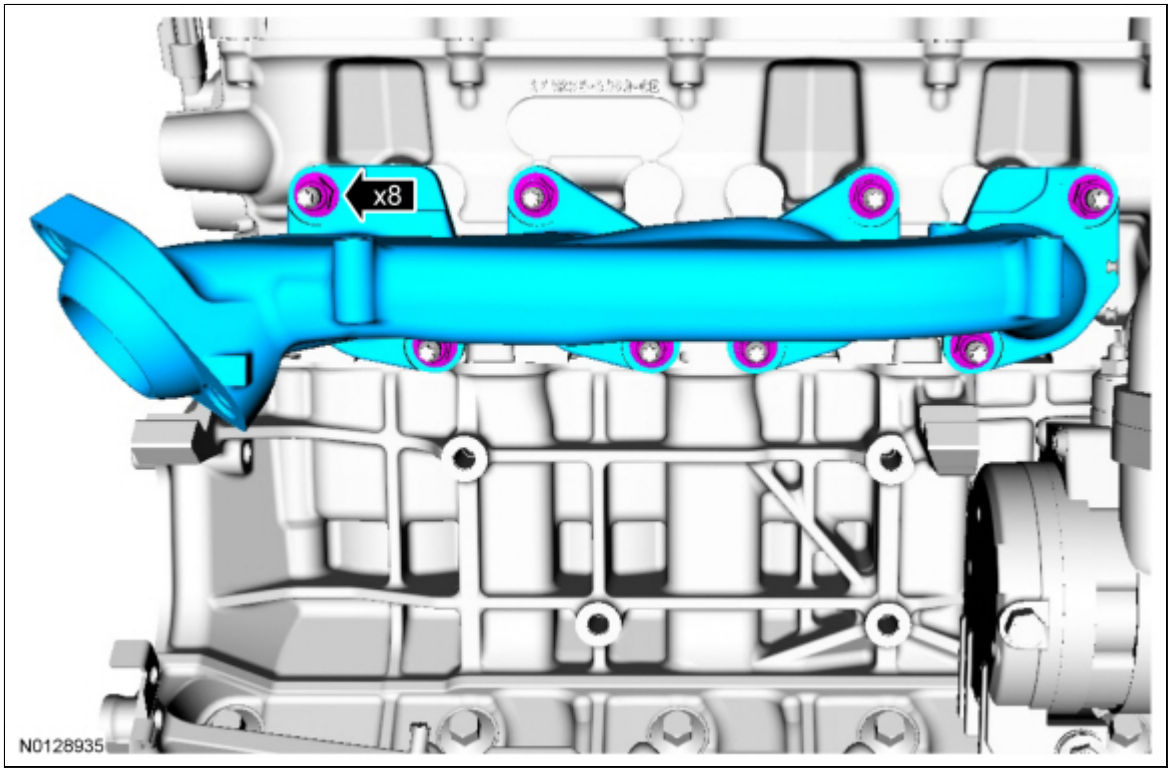


9. Remove the 3 bolts and the RH exhaust manifold heat shield.

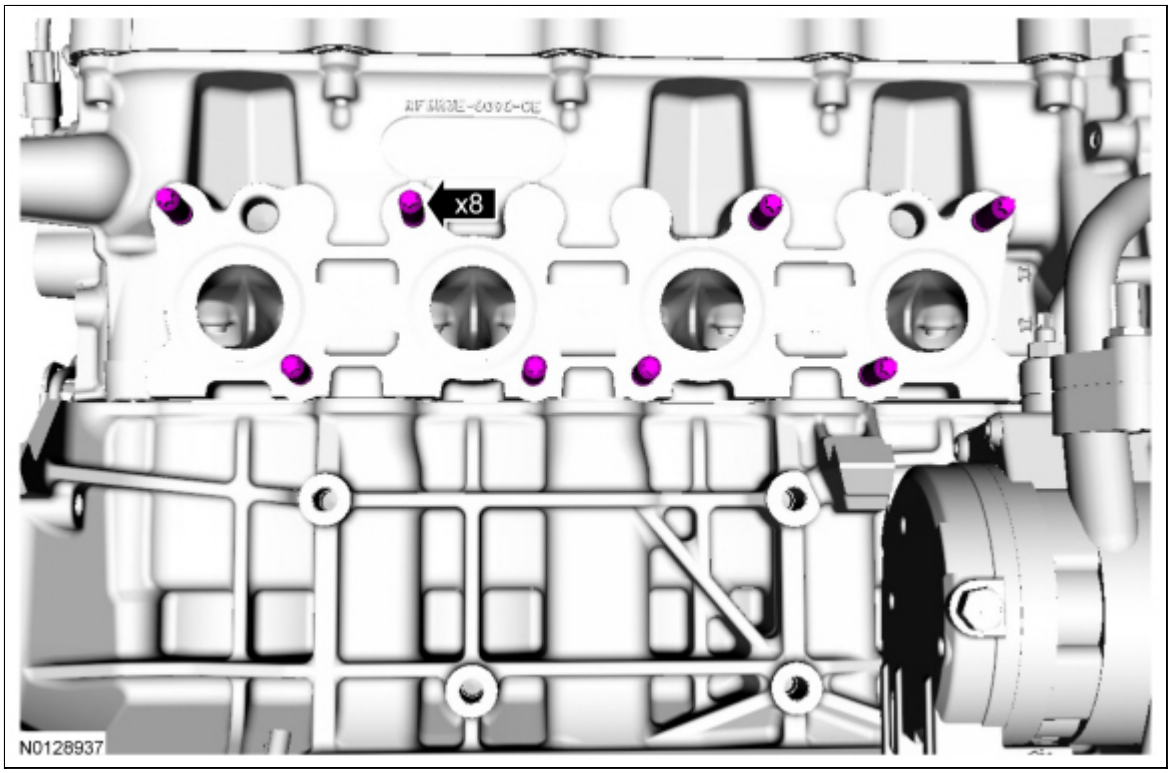
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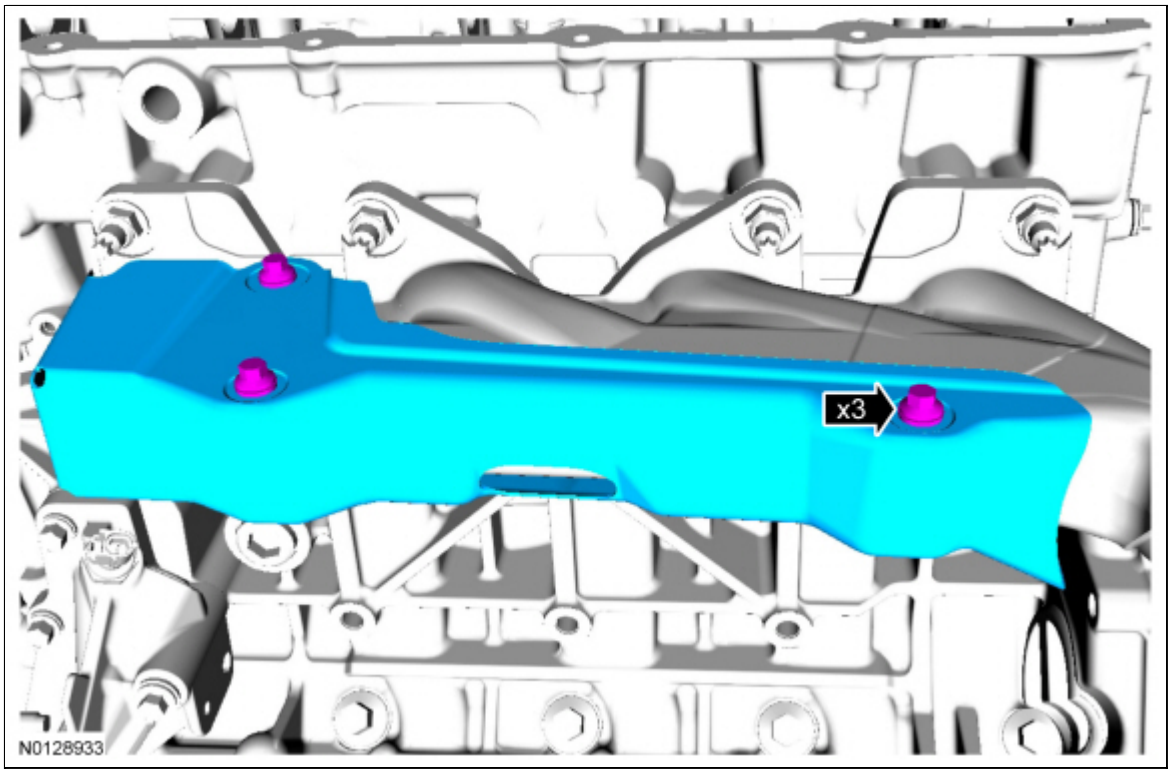
10. Remove the 8 nuts and the RH exhaust manifold.
    - Discard the gasket.



11. Remove and discard the 8 RH exhaust manifold studs.

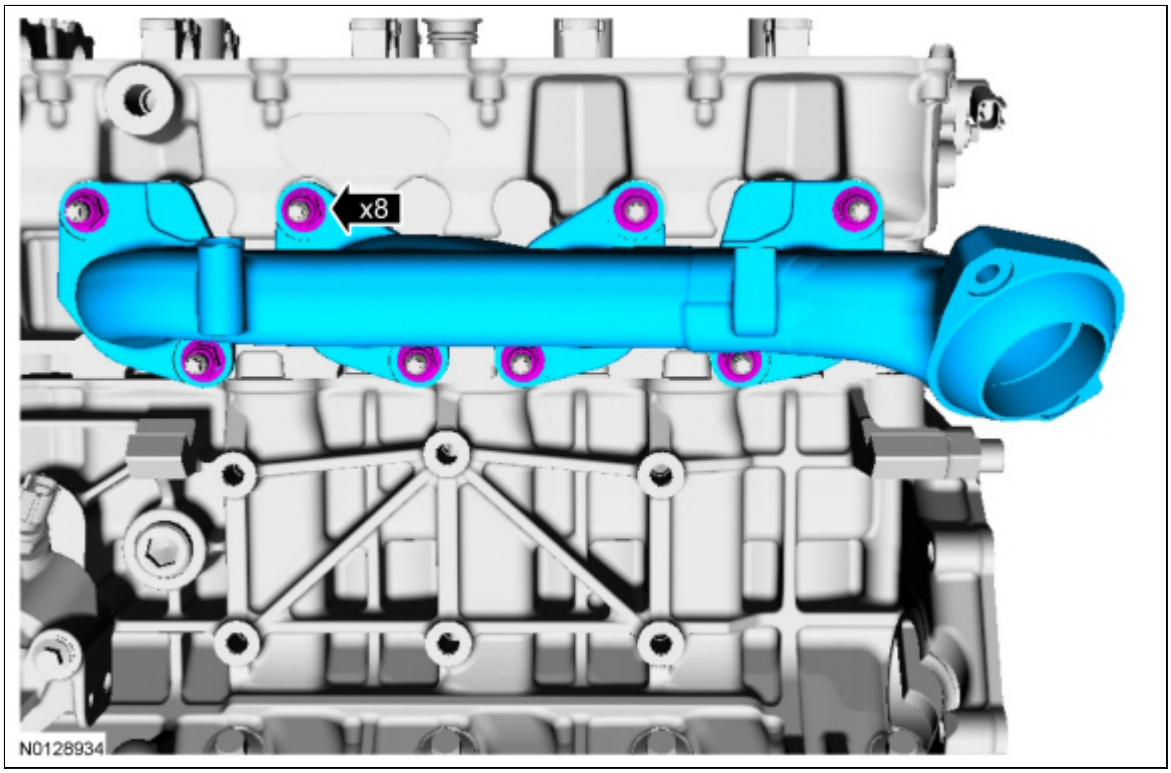


12. Remove the 3 bolts and the LH exhaust manifold heat shield.

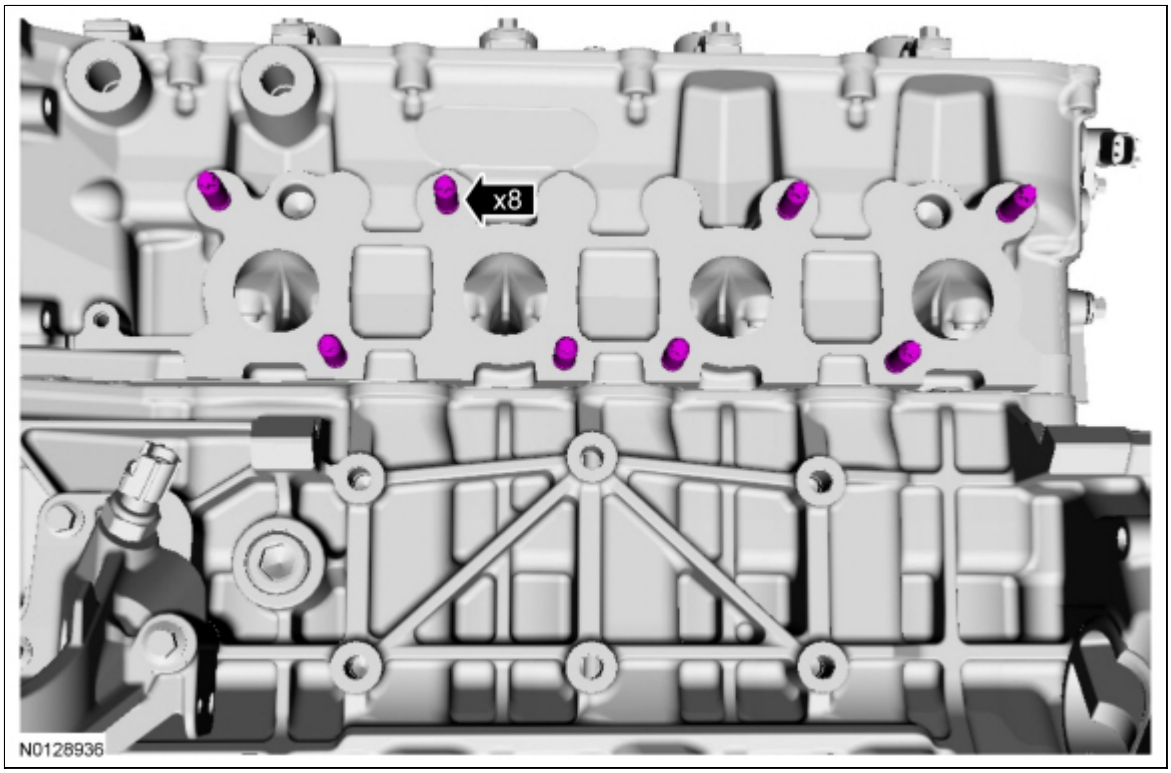


13. Remove the 8 nuts and the LH exhaust manifold.
    - Discard the gasket.

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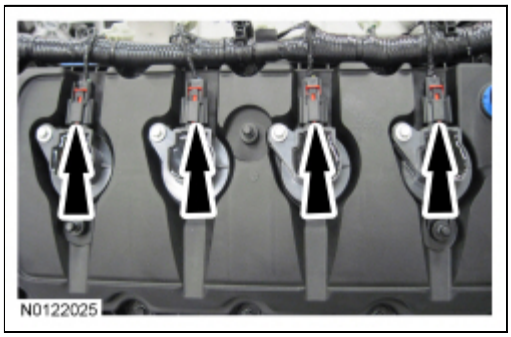
14. Remove and discard the 8 LH exhaust manifold studs.



15. Clean and inspect the RH and LH exhaust manifolds. For additional information, refer to Section 303-00 .

16. **NOTE:** RH shown, LH similar.

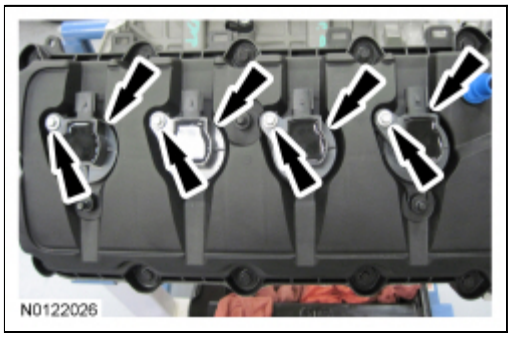
    Disconnect the 8 ignition coil electrical connectors.



17. **NOTE:** RH shown, LH similar.

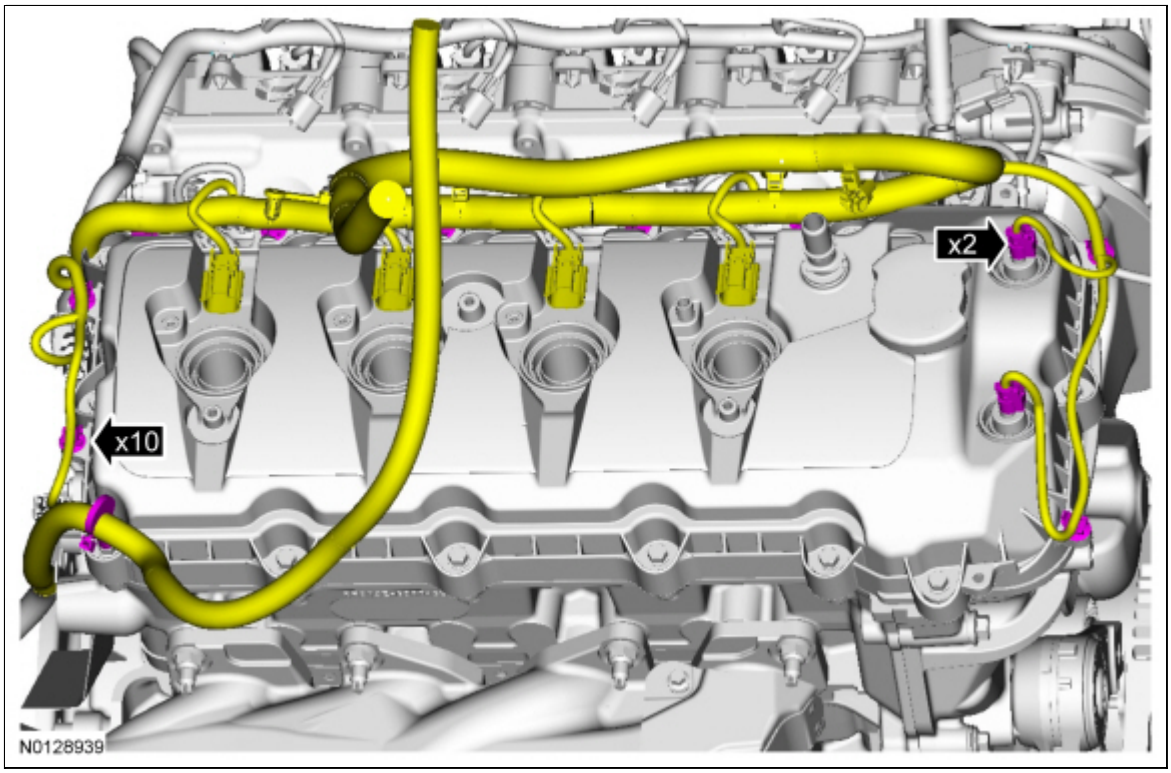
    NOTE: When removing the ignition coils, a slight twisting motion will break the seal and ease removal. RH shown, LH similar.

    Remove the 8 bolts and the 8 ignition coils.

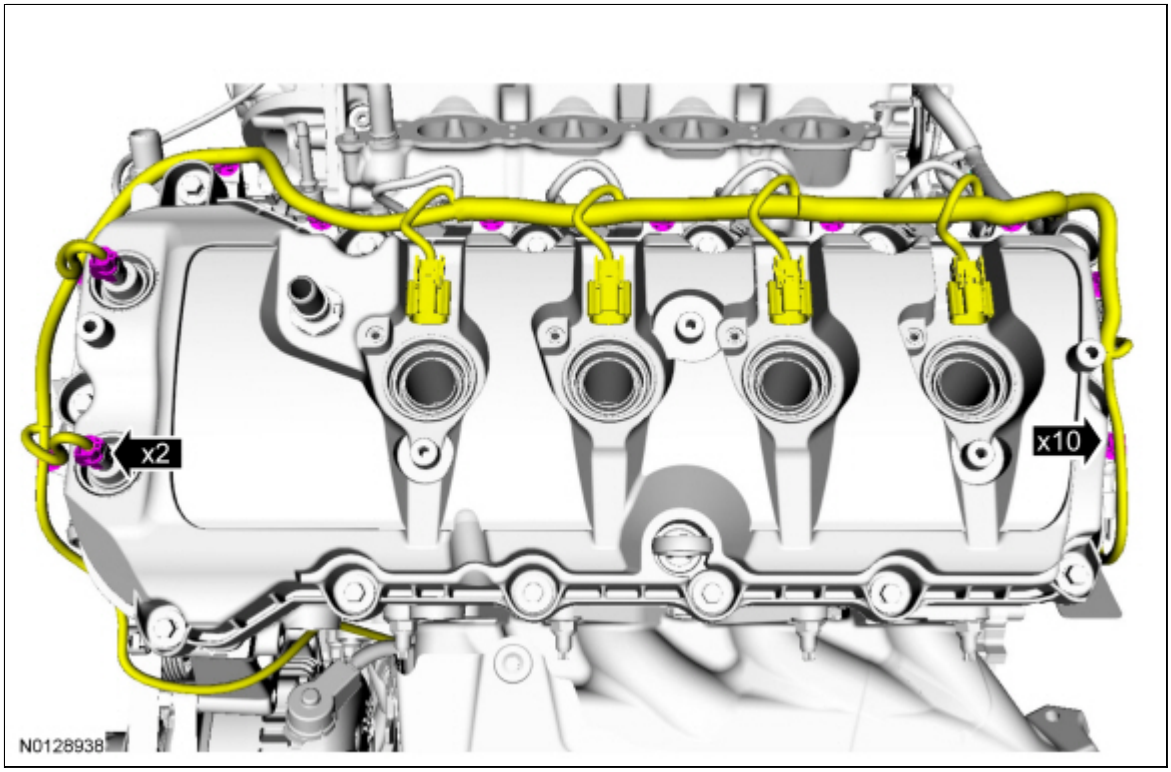


18. Disconnect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers from the RH valve cover.

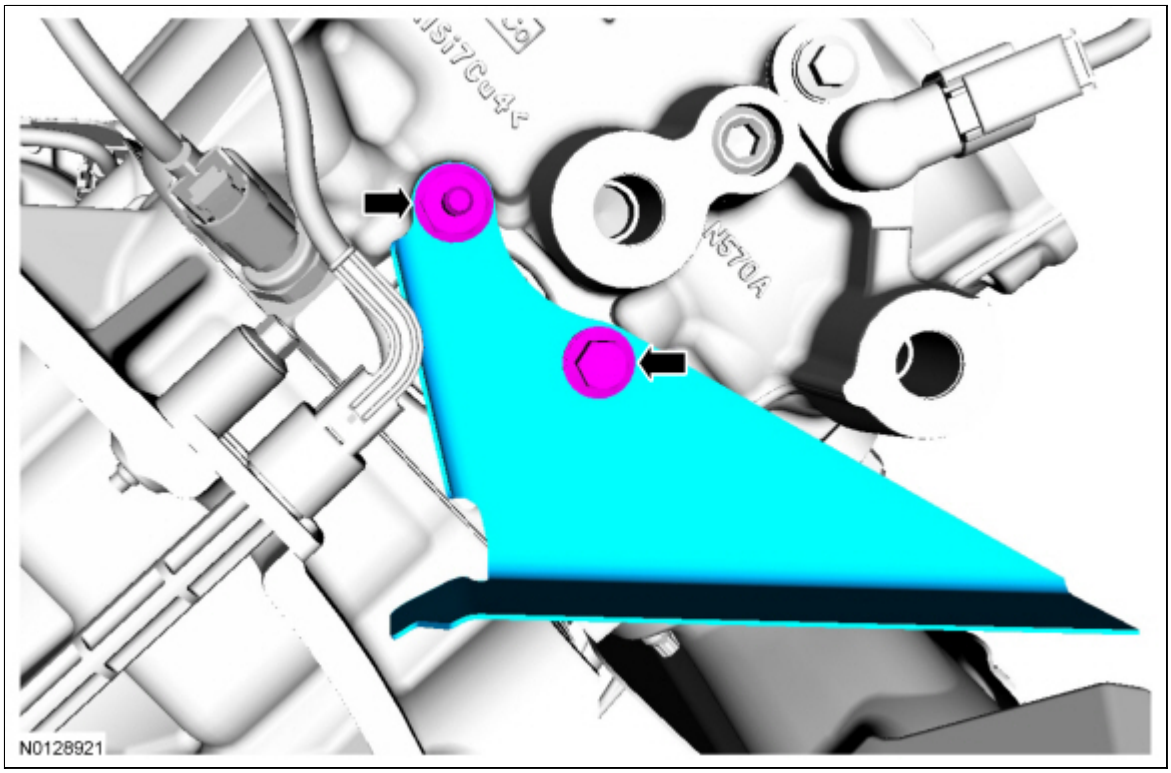
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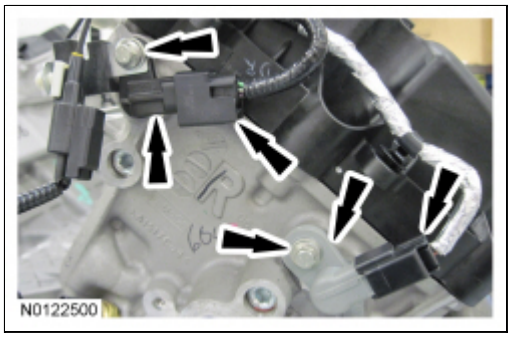
19. Disconnect the 2 VCT variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers from the LH valve cover.



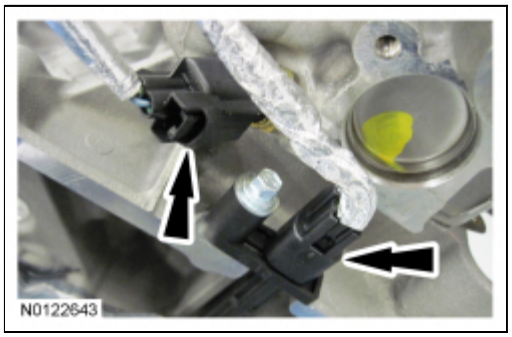
20. Remove the bolt, stud bolt and heat shield from the RH cylinder head.



21. Disconnect the RH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
    - Remove the 2 bolts and the RH intake and exhaust CMP sensors.

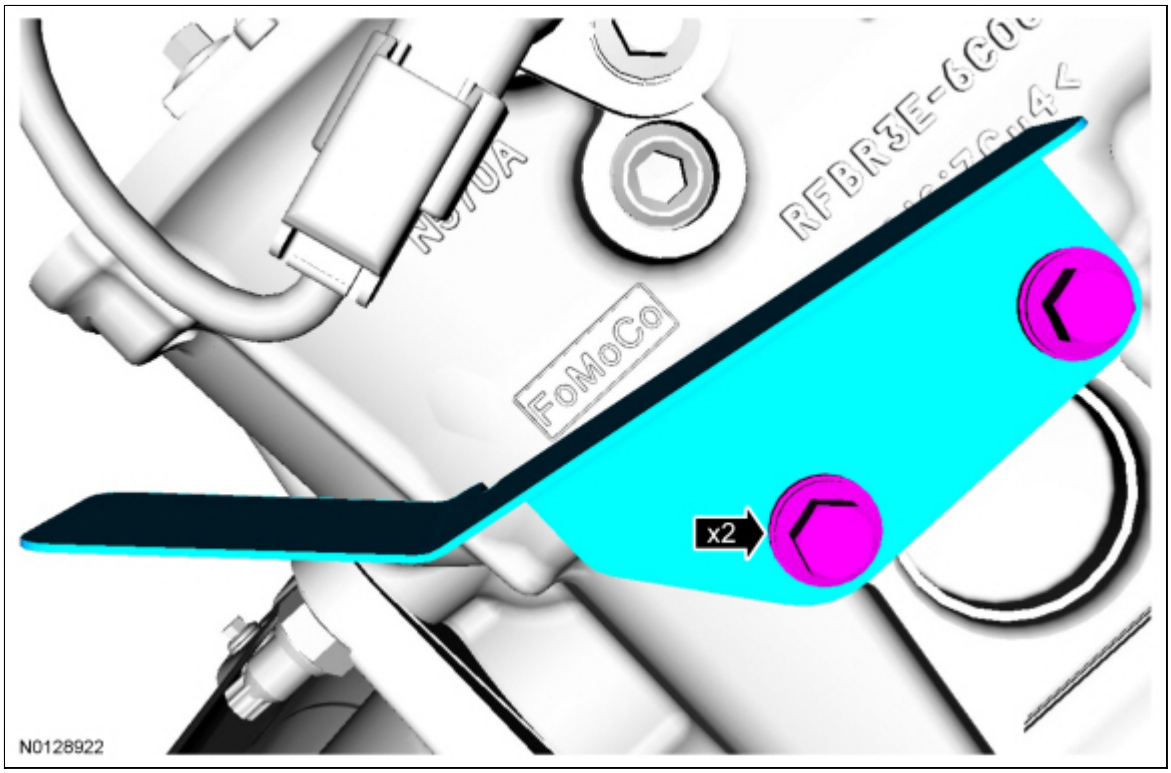


22. Disconnect the Cylinder Head Temperature (CHT) sensor and the Crankshaft Position (CKP) sensor electrical connectors.

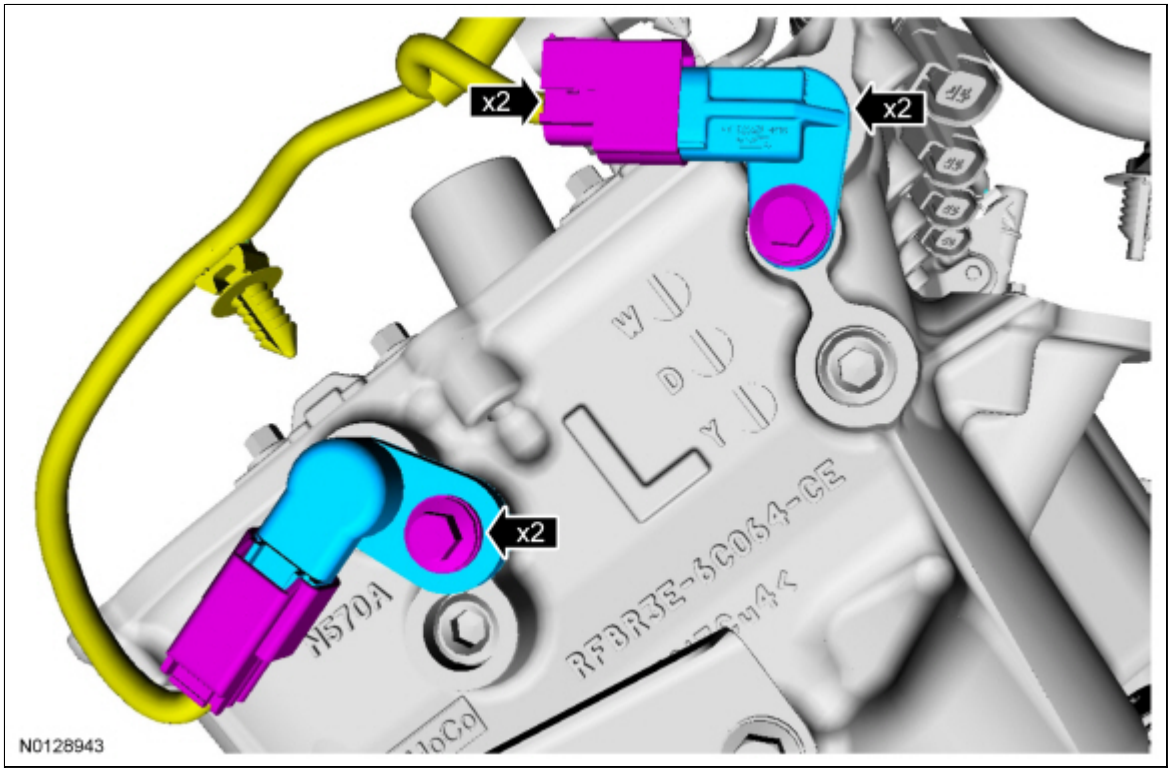


23. Remove the 2 bolts and the heat shield from the LH cylinder head.

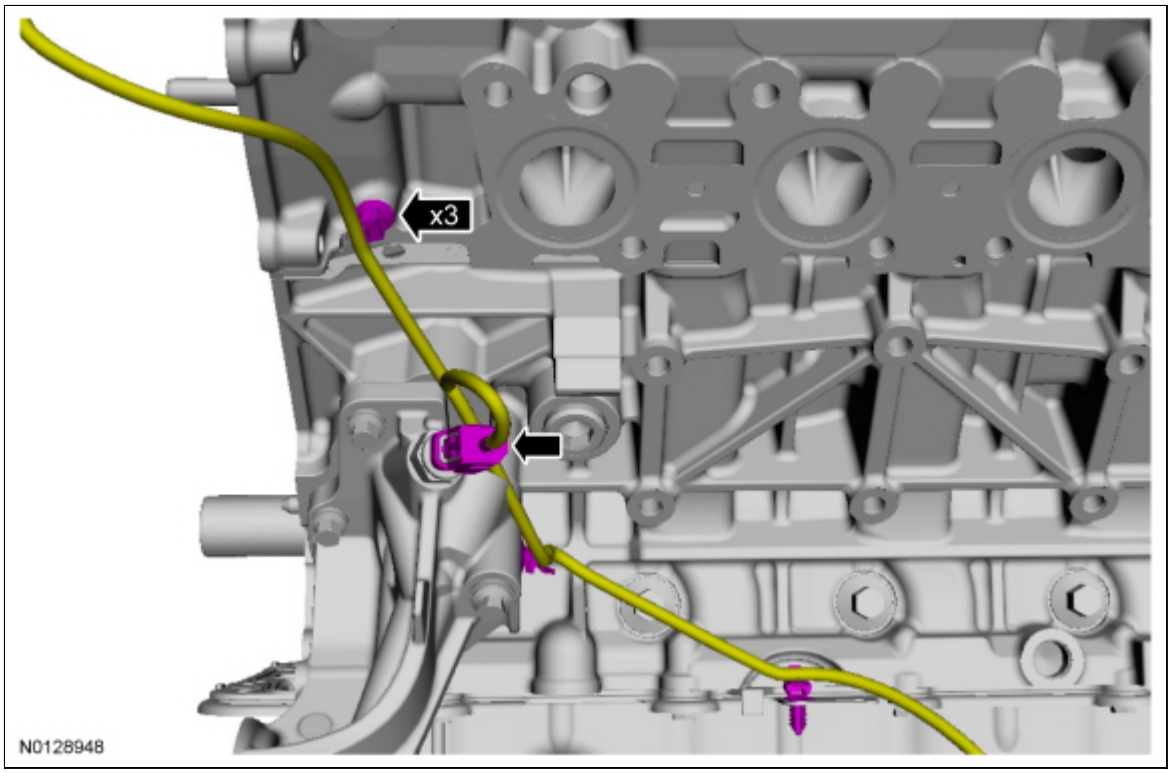
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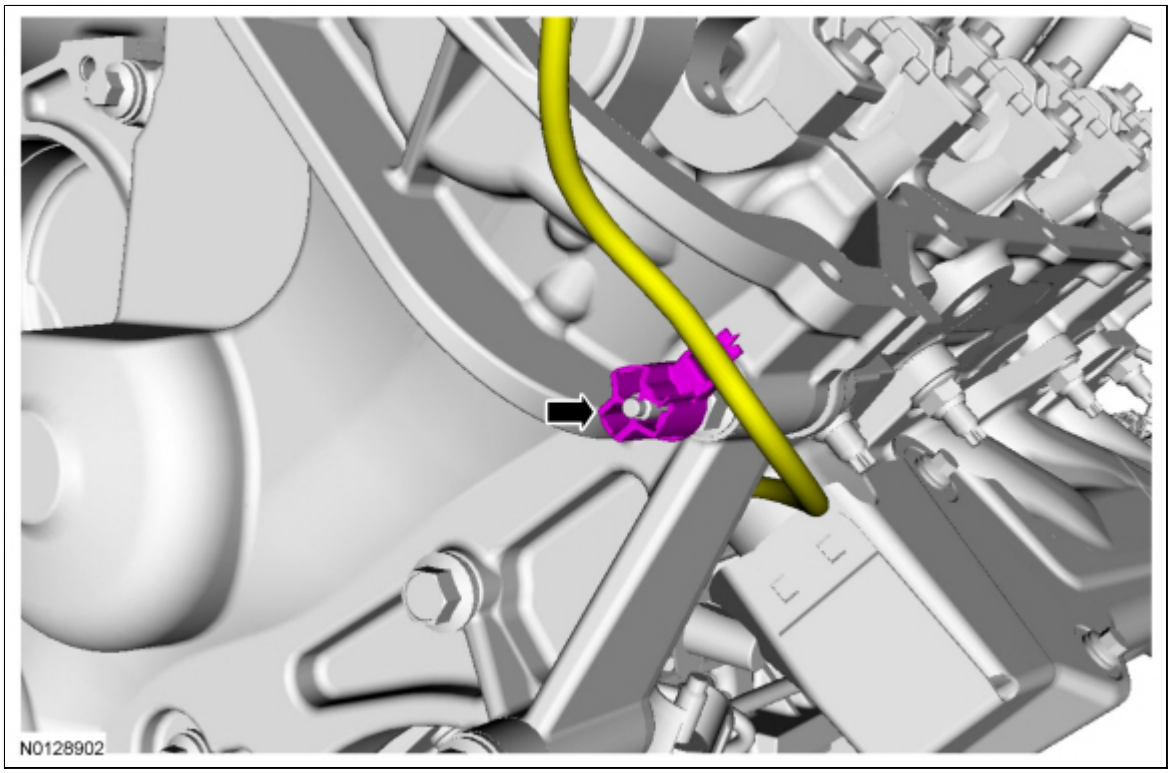
24. Disconnect the LH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
    - Remove the 2 bolts and the LH intake and exhaust CMP sensors.



25. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the 3 wiring harness retainers.

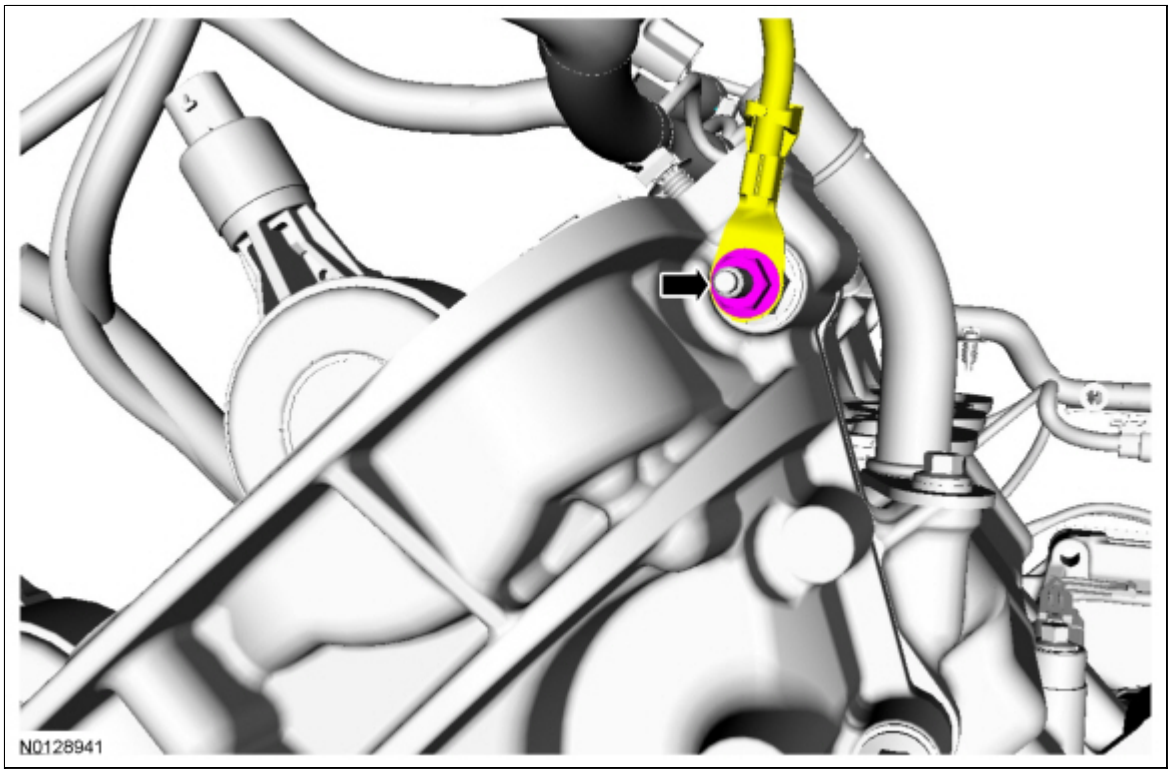


26. Detach the wiring harness retainer from the engine front cover stud bolt.

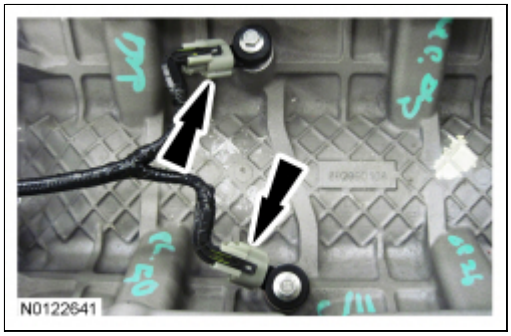


27. Remove the nut and the ground wire from the engine front cover stud bolt.

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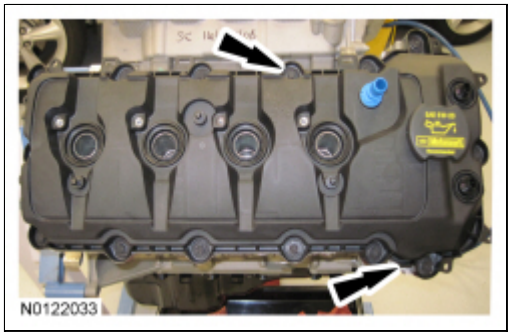


28. Disconnect the 2 Knock Sensor (KS) electrical connectors.
    - Remove the wiring harness from the engine.



29. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

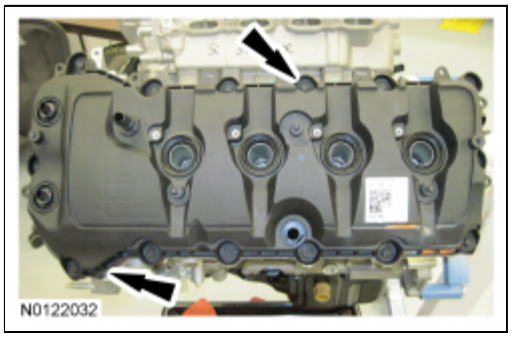
    Loosen the 14 fasteners and remove the RH valve cover and gasket.
    - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



30. Remove the oil level indicator.

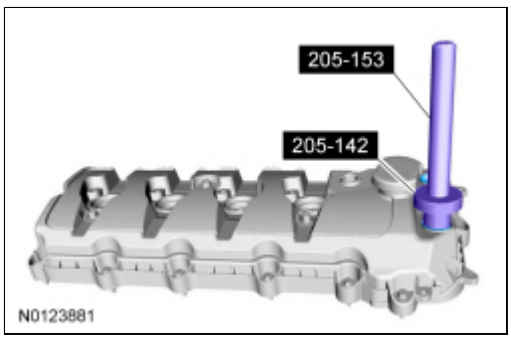
31. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Loosen the 14 fasteners and remove the LH valve cover and gasket.
    - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



32. **NOTE:** RH shown, LH similar.

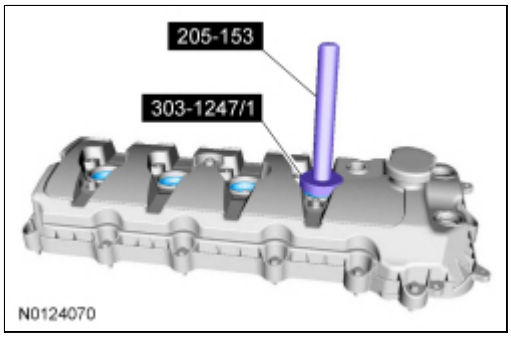
    Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



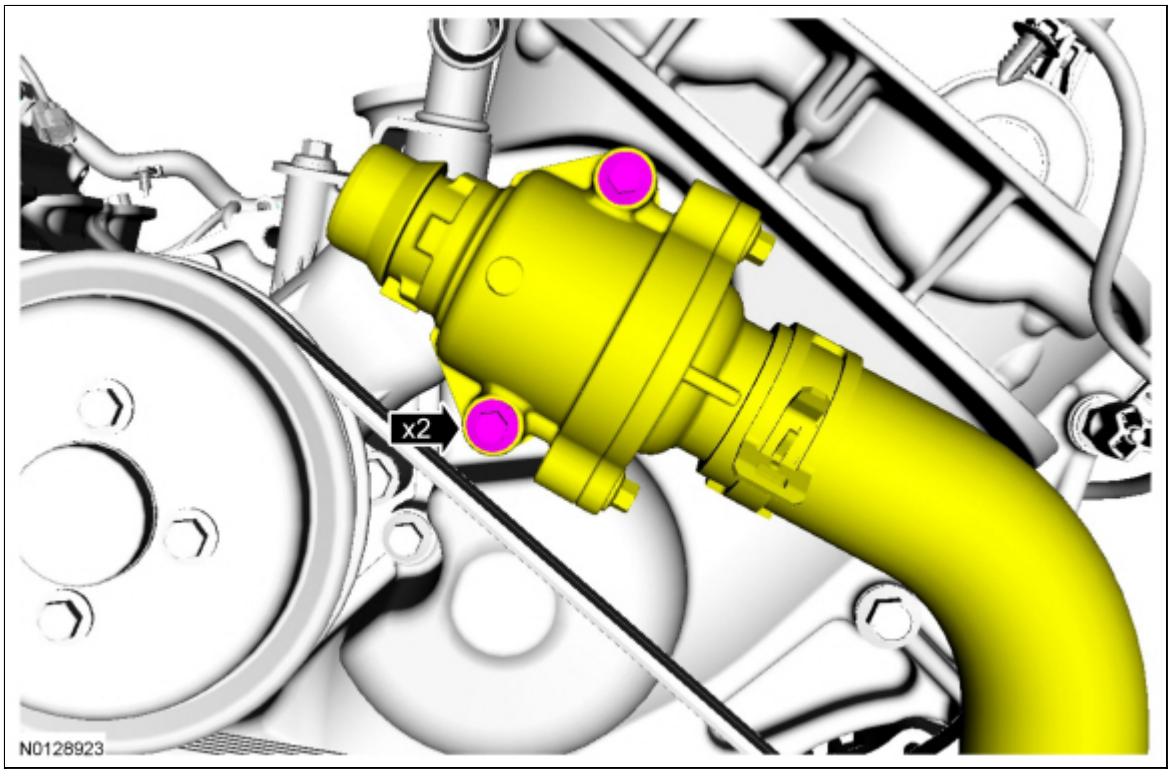
33. **NOTE:** RH shown, LH similar.

    Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

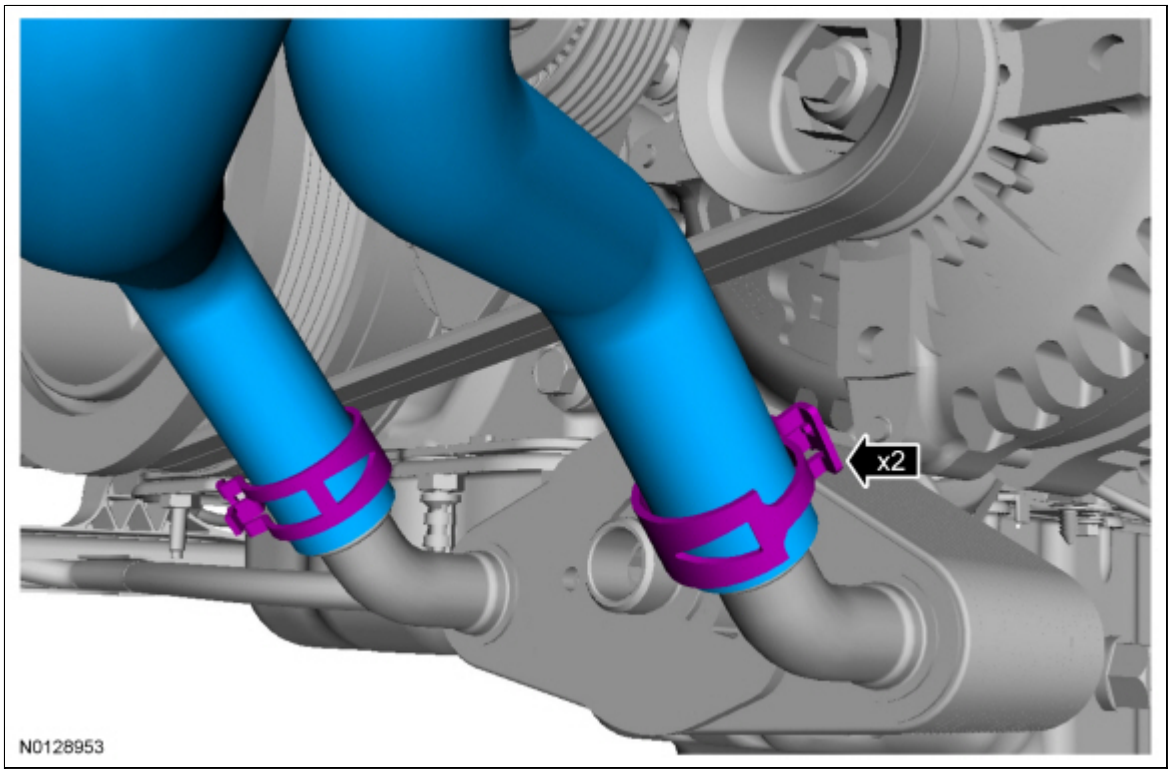
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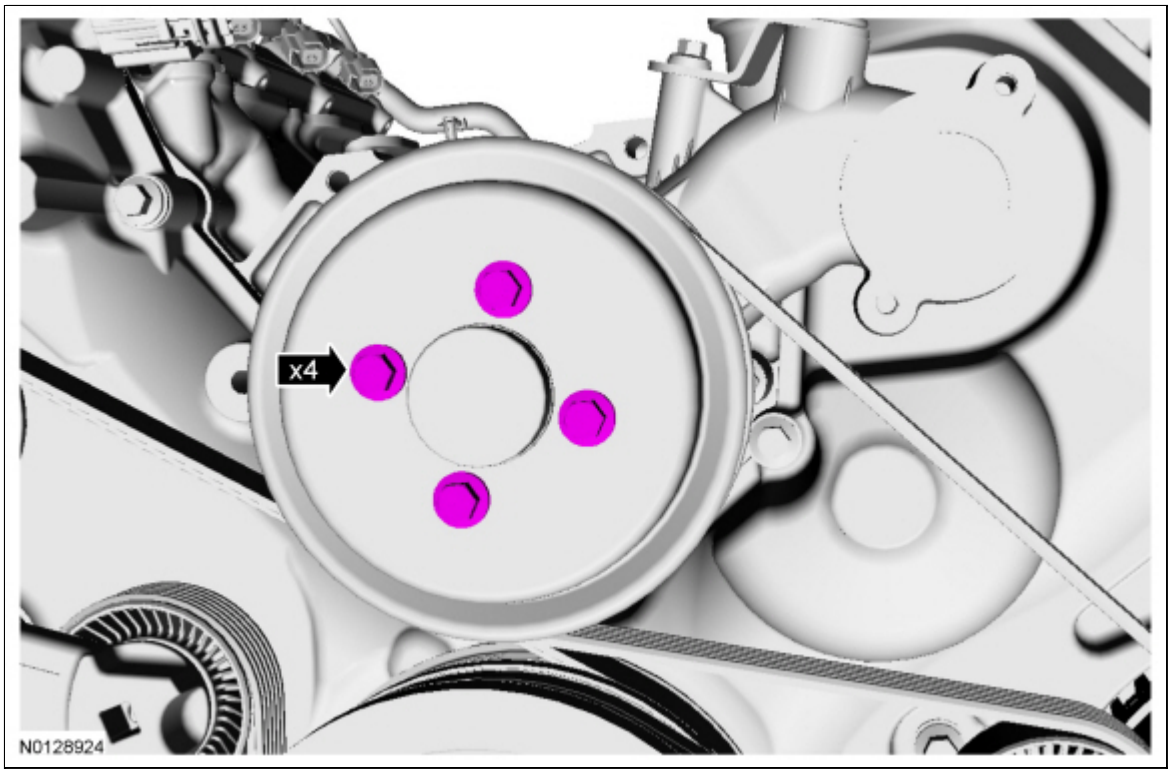
34. Remove the 2 bolts and position the thermostat housing and lower radiator hose aside.
    - Remove and discard the thermostat housing O-ring seal.



35. Release the 2 clamps and disconnect the coolant hoses from the oil cooler.

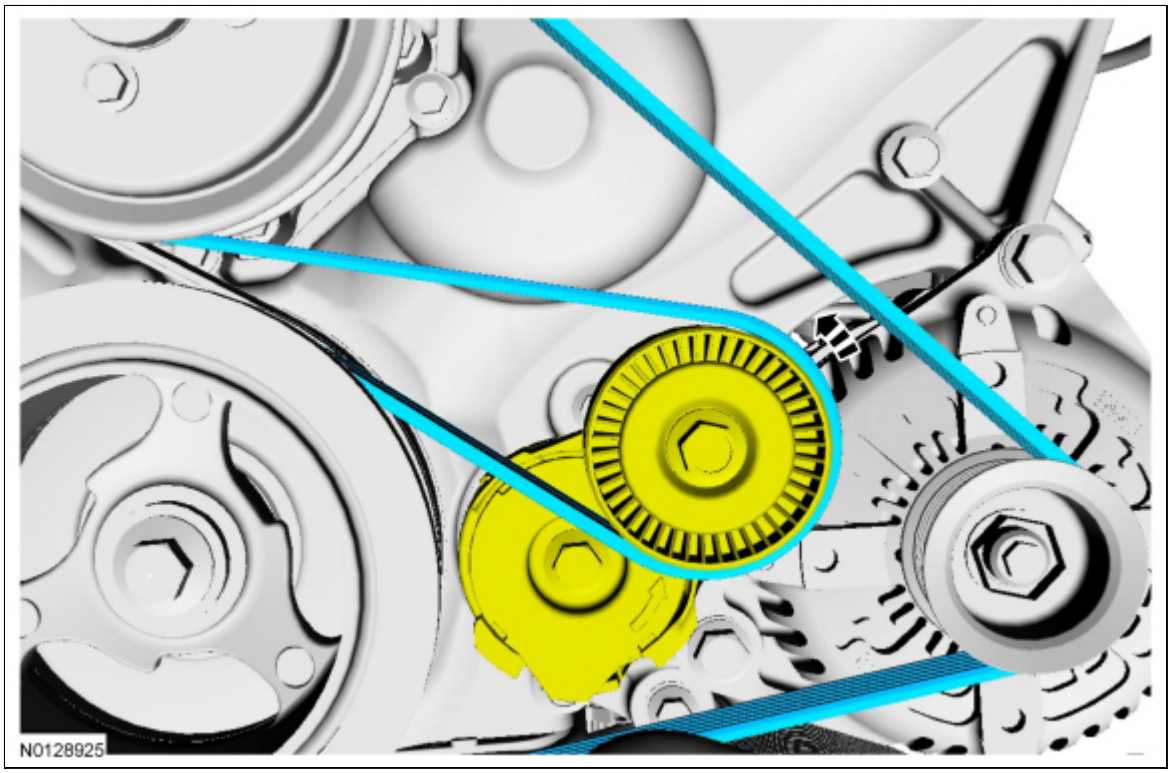


36. Loosen the 4 coolant pump pulley bolts.

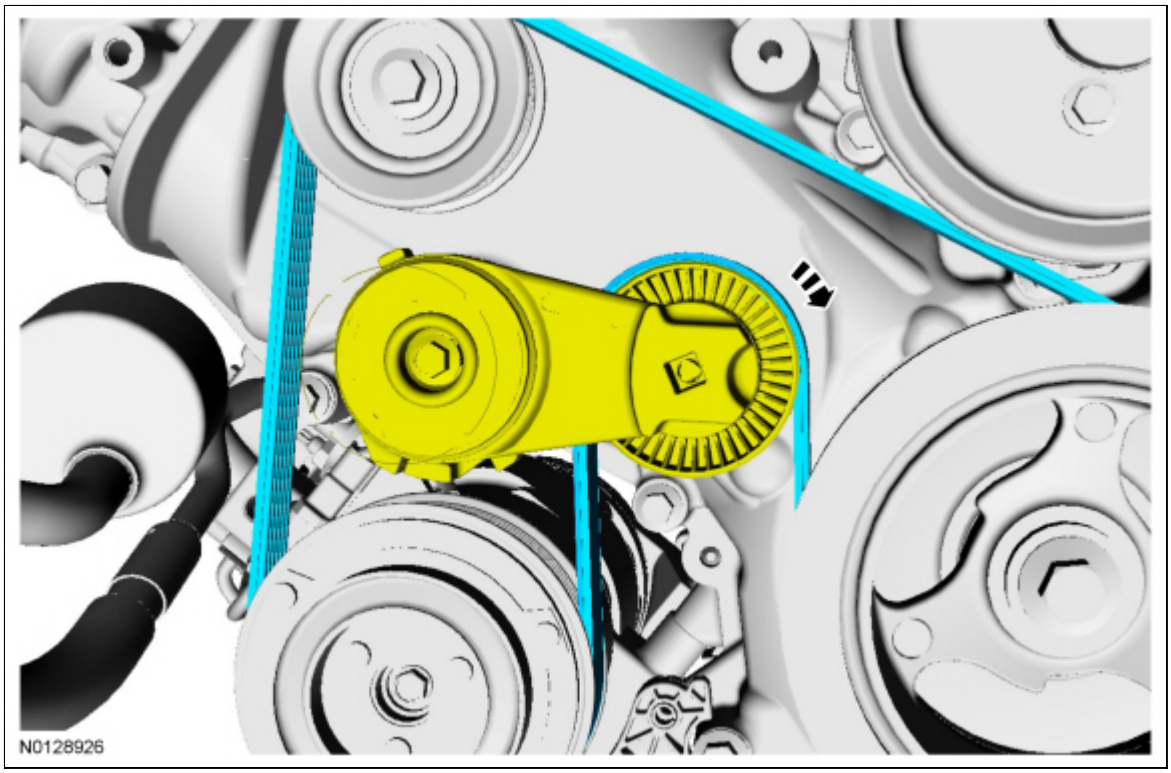


37. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.

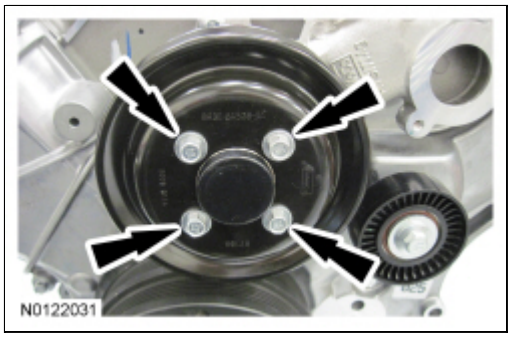
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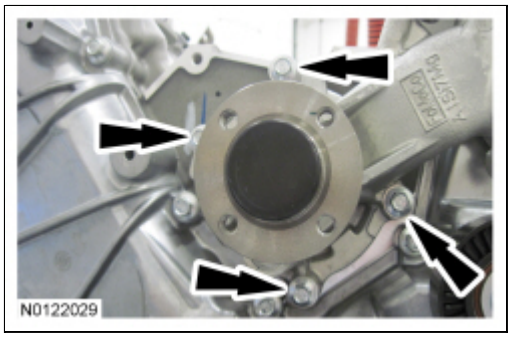
38. Rotate the A/C compressor belt tensioner clockwise and remove the A/C compressor belt.



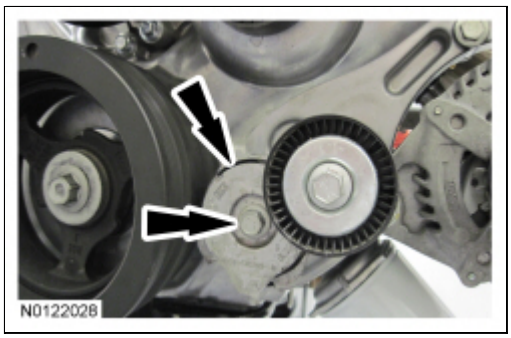
39. Remove the 4 bolts and the coolant pump pulley.



40. Remove the 4 bolts and the coolant pump.
    - Remove and discard the O-ring seal.

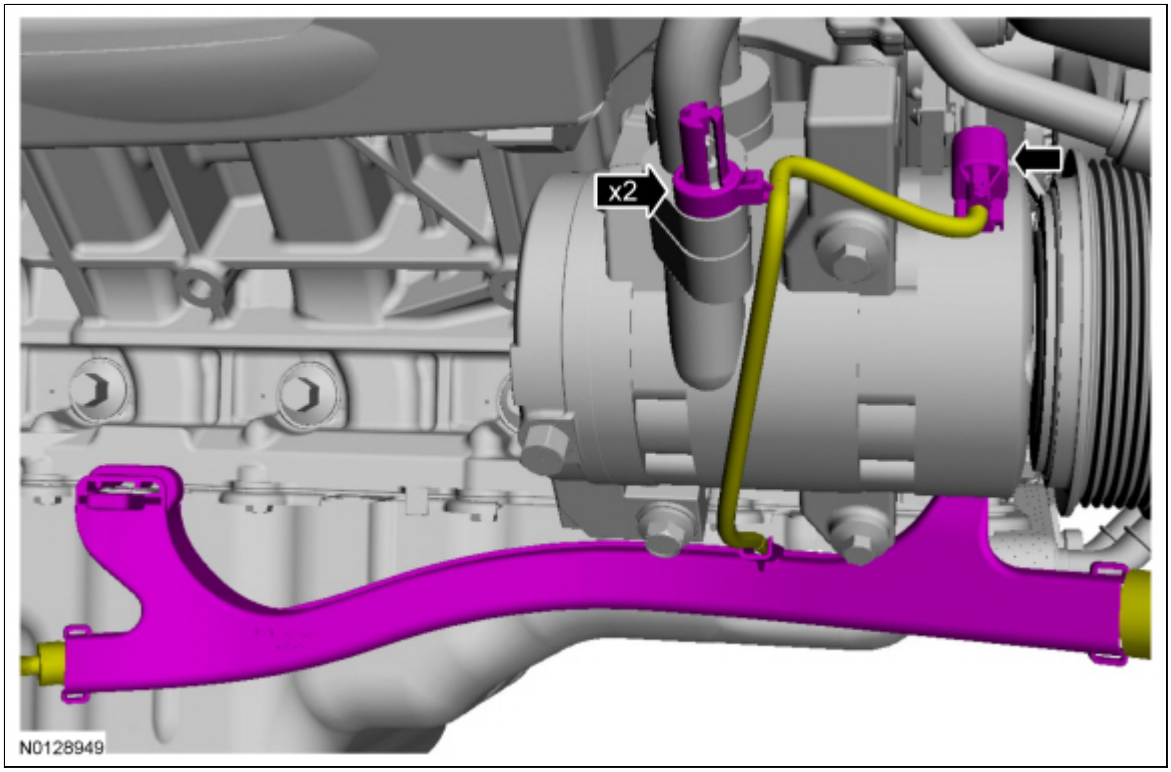


41. Remove the bolt and the accessory drive belt tensioner.

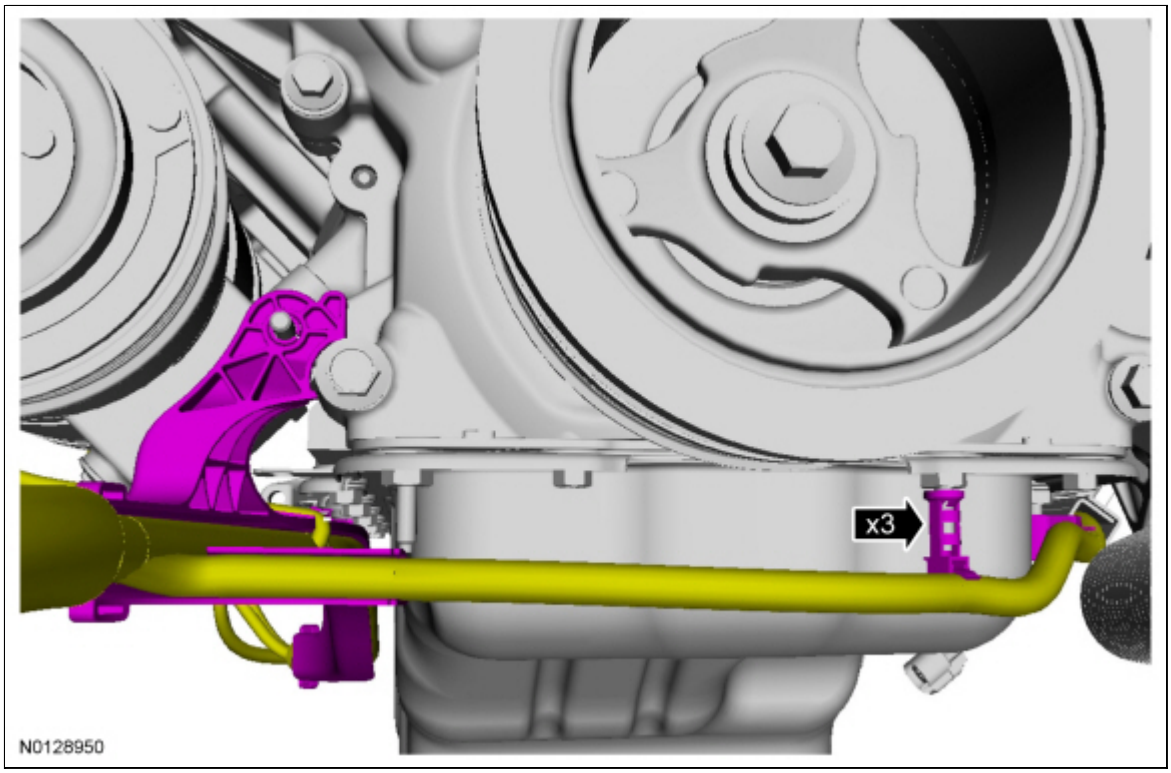


42. Disconnect the A/C compressor electrical connector and the 2 wiring harness retainers.

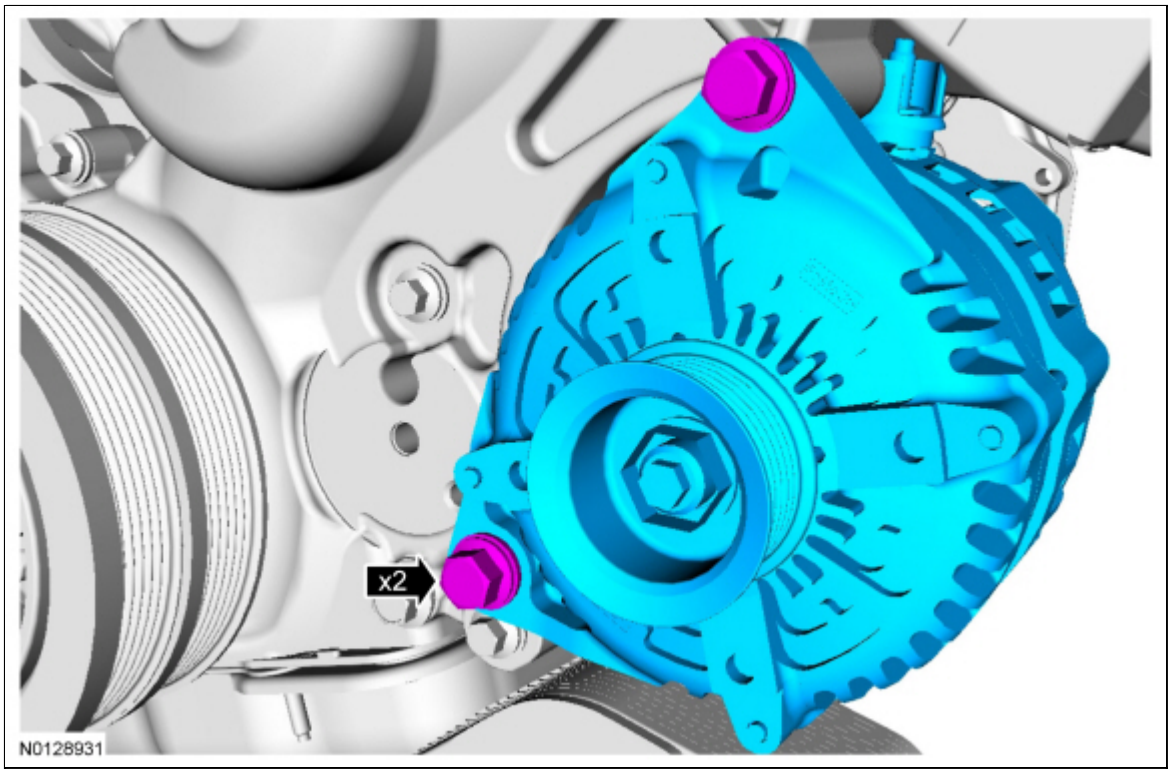
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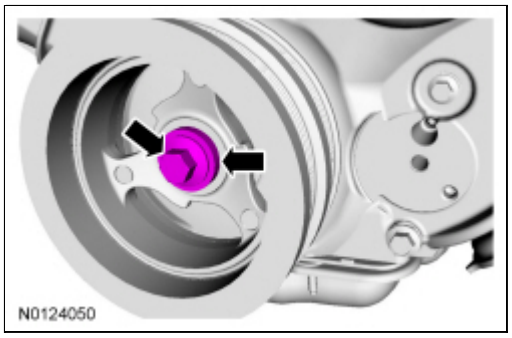
43. Detach the 3 wiring harness retainers.



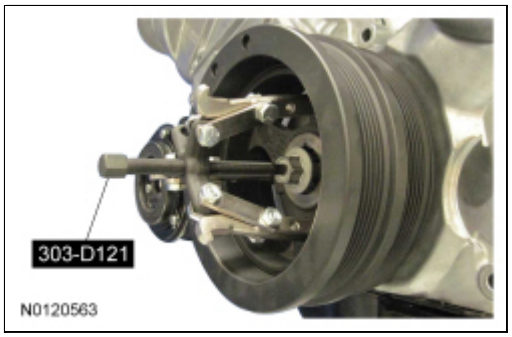
44. Remove the 2 bolts and the generator.



45. Remove the crankshaft pulley bolt and washer.



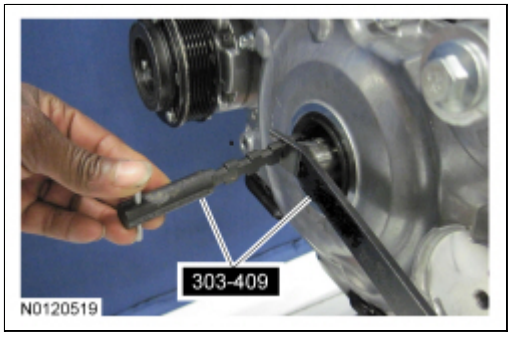
46. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
    - Discard the crankshaft pulley bolt.



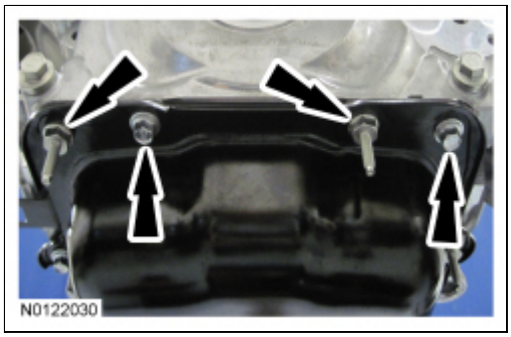
47. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

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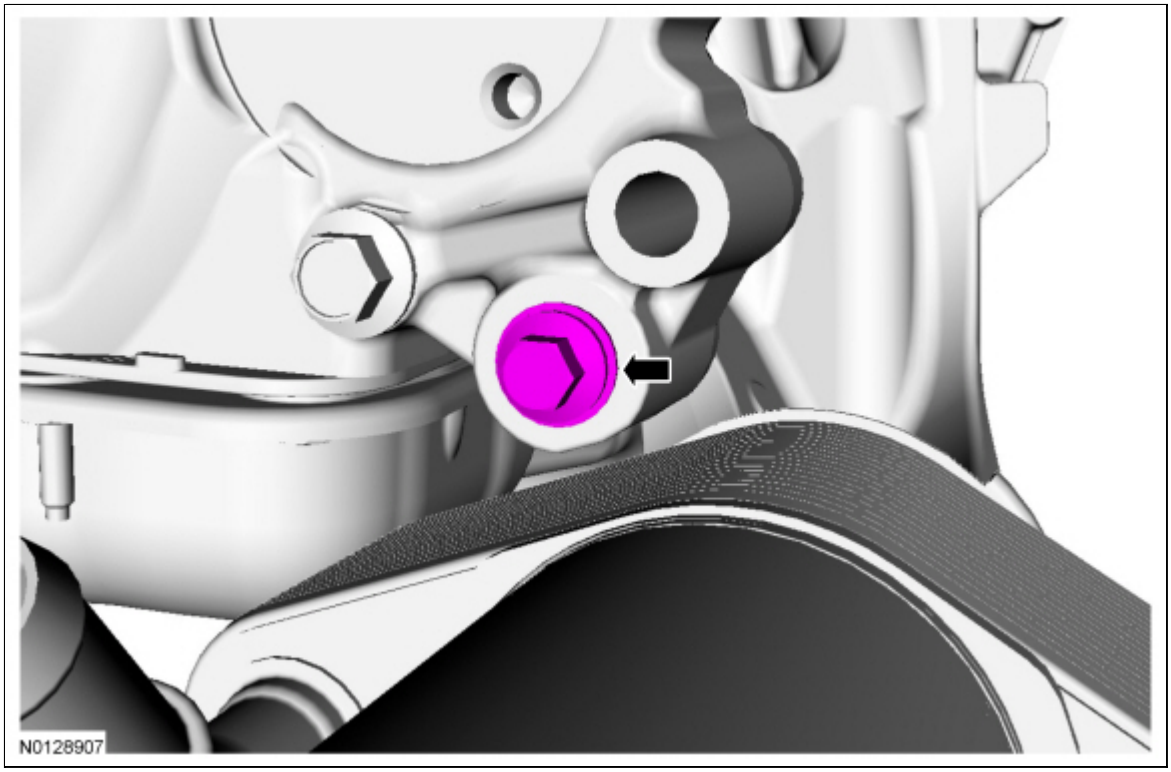
Using the Oil Seal Remover, remove the crankshaft front oil seal.



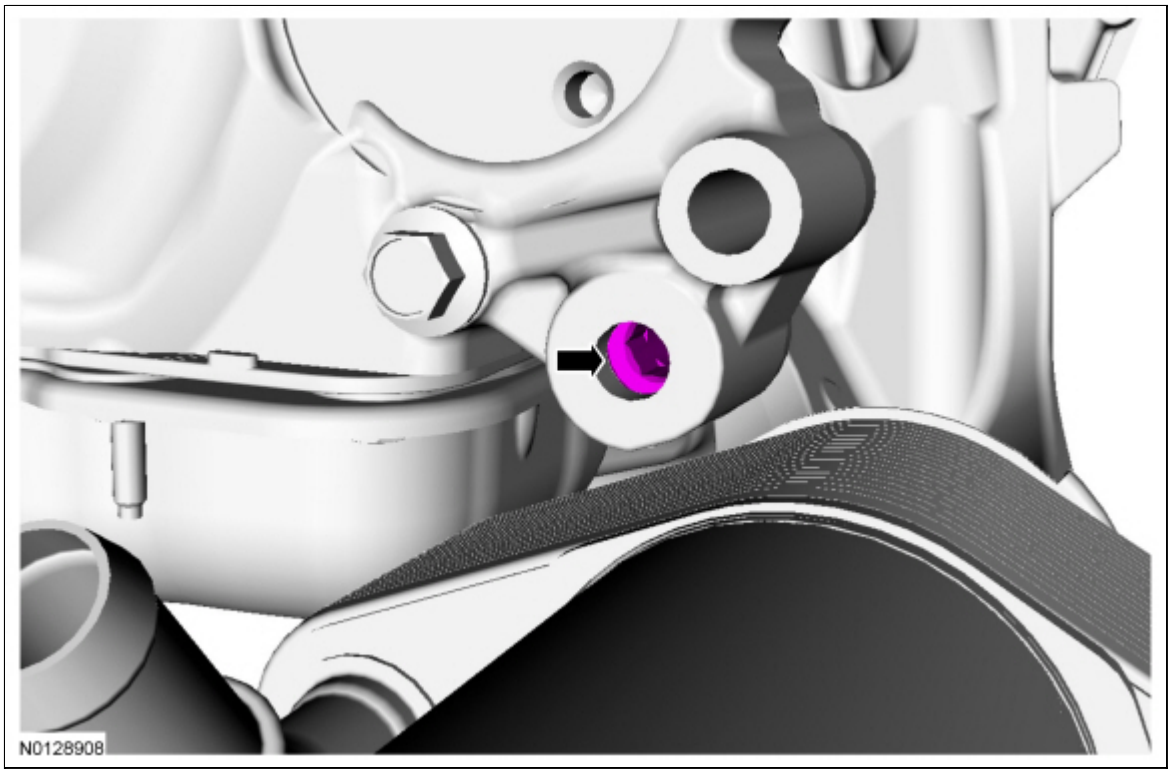
48. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.



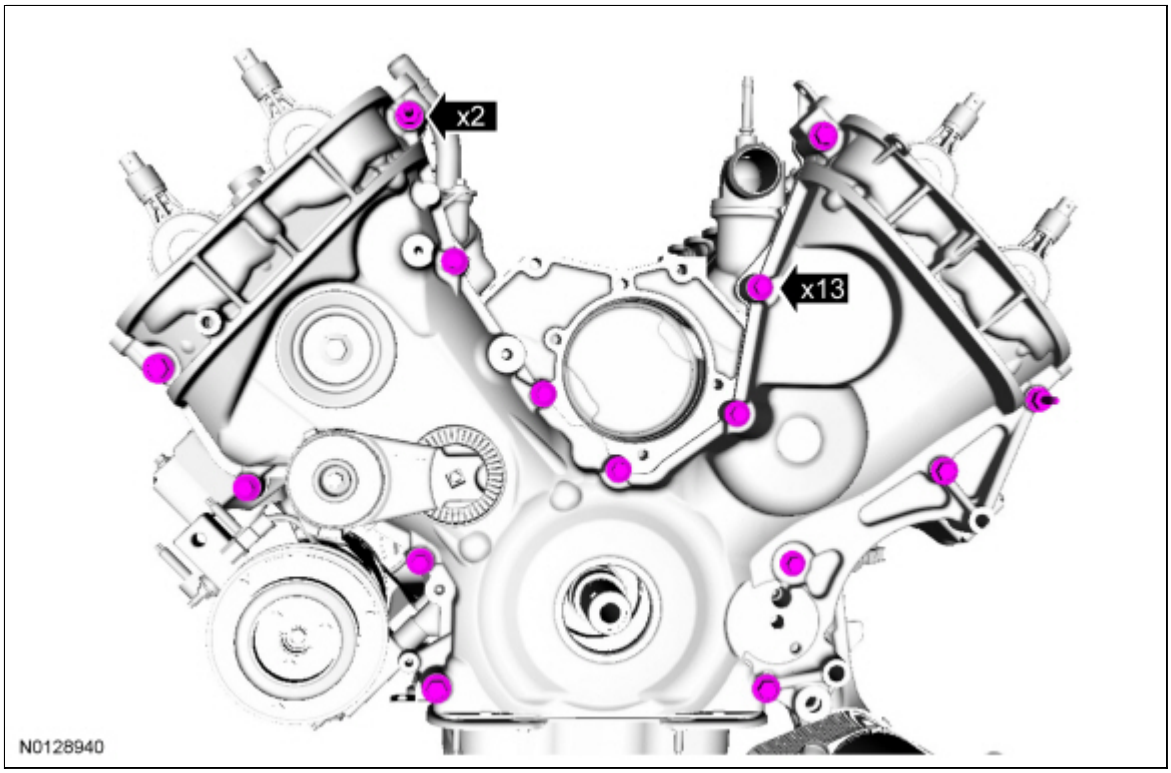
49. Remove the engine front cover-to-oil filter adapter bolt.



50. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



51. Remove the 13 engine front cover bolts and the 2 stud bolts.

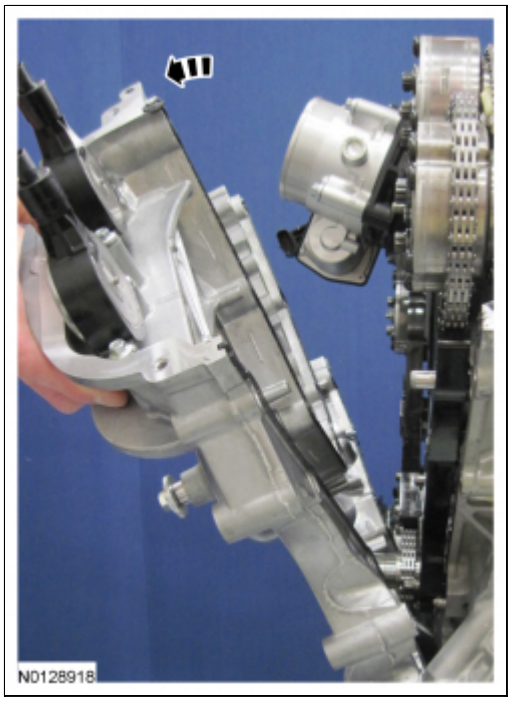


52. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

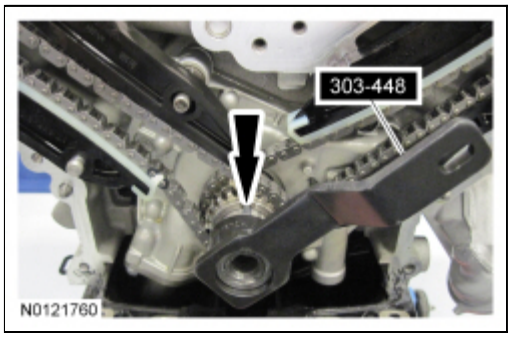
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Remove the engine front cover.

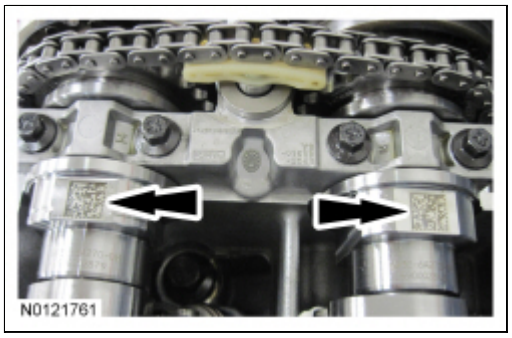
- Remove and discard the engine front cover gaskets.
- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.



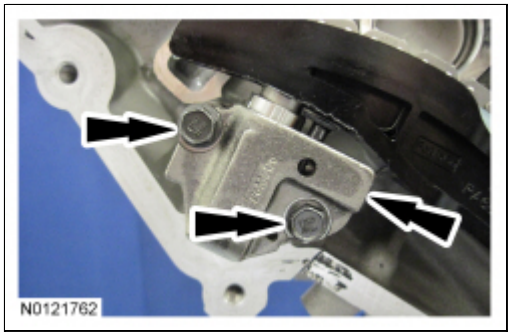
53. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



54. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

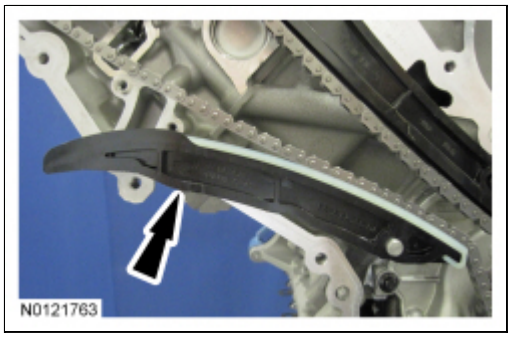


55. Remove the 2 bolts and the RH primary timing chain tensioner.



56. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

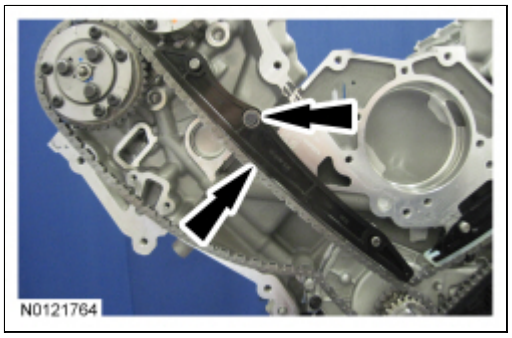
    Remove the RH timing chain tensioner arm.



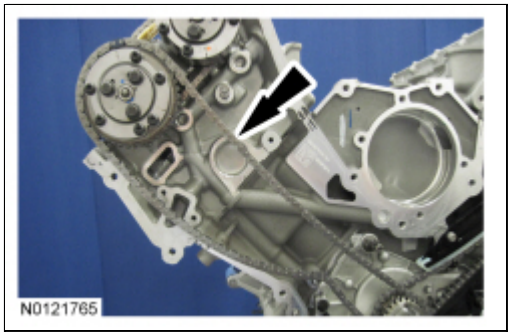
57. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

    Remove the bolt and the RH timing chain guide.

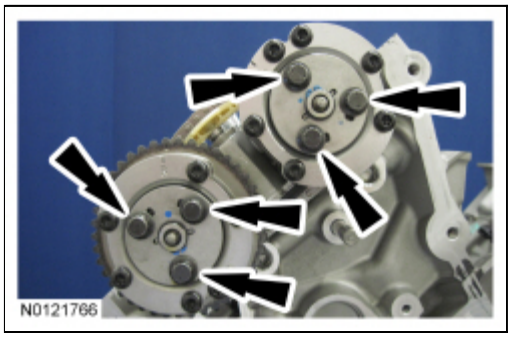
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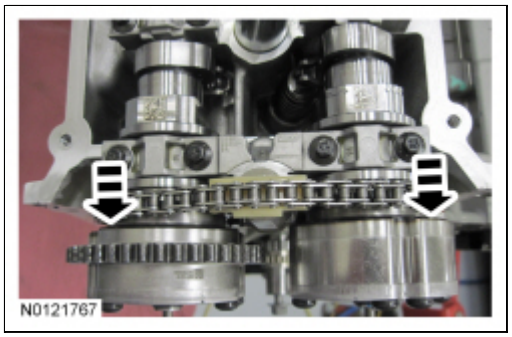
58. Remove the RH primary timing chain.



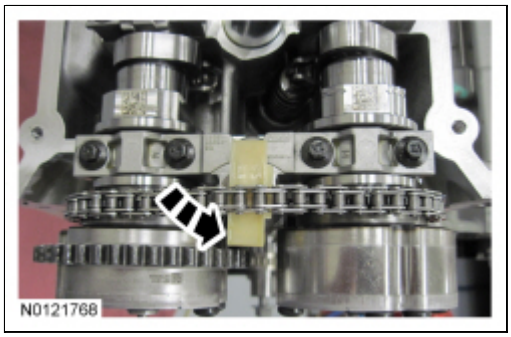
59. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



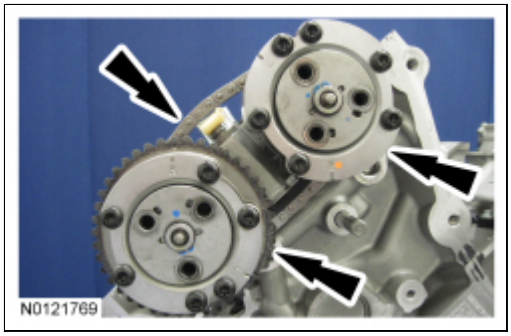
60. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



61. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.

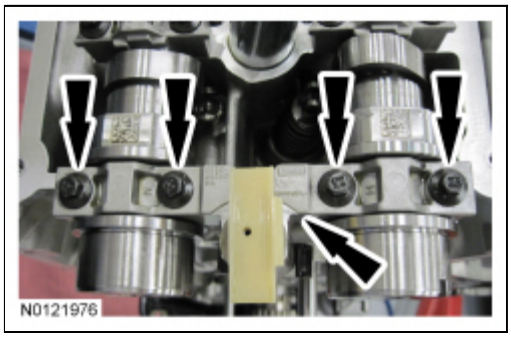


62. Remove the RH VCT assemblies and the RH secondary timing chain.

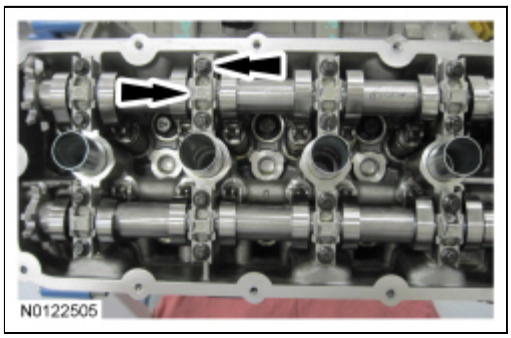


63. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the RH front camshaft bearing mega cap.



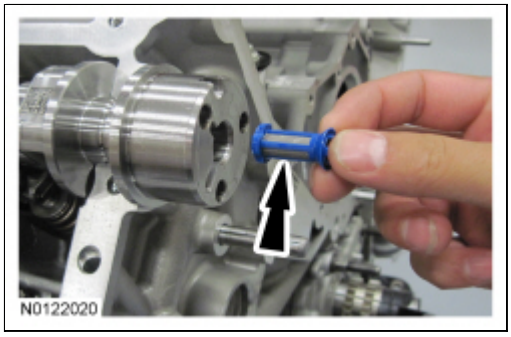
64. Remove the 16 bolts and the 8 camshaft bearing caps.



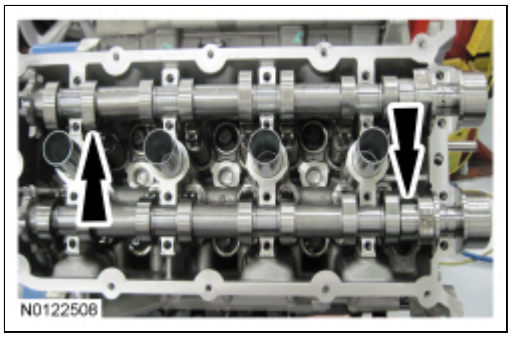
65. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

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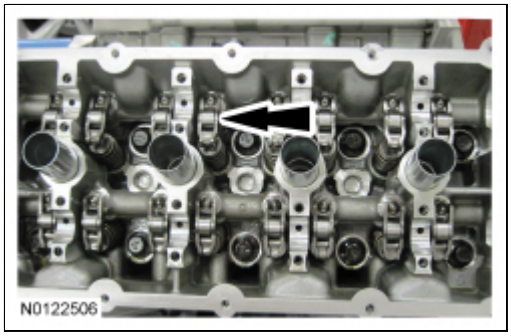
Remove the VCT system oil filter from the intake and exhaust camshafts.



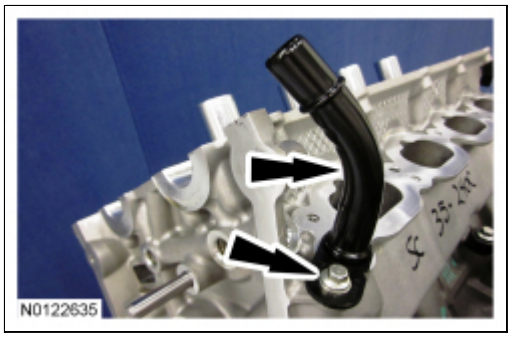
66. Remove the RH intake and exhaust camshafts.



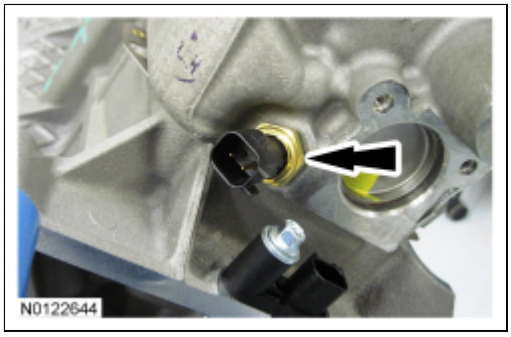
67. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



68. Remove the bolt and the coolant outlet pipe from the RH cylinder head.
    - Remove and discard the O-ring seal.



69. Remove the CHT sensor.



70. ***NOTICE:*** **The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.**

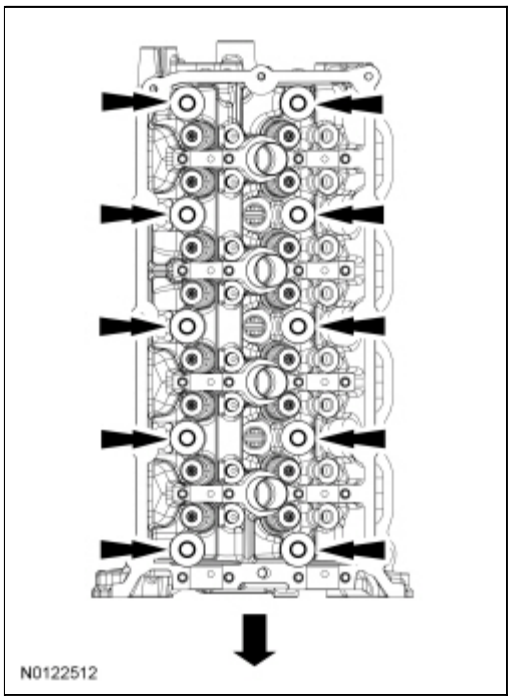
    NOTICE: **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.**

    NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

    NOTICE: **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTICE: **Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    Remove the 10 bolts and the RH cylinder head.
    - Discard the bolts and the cylinder head gasket.



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71. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or notices and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

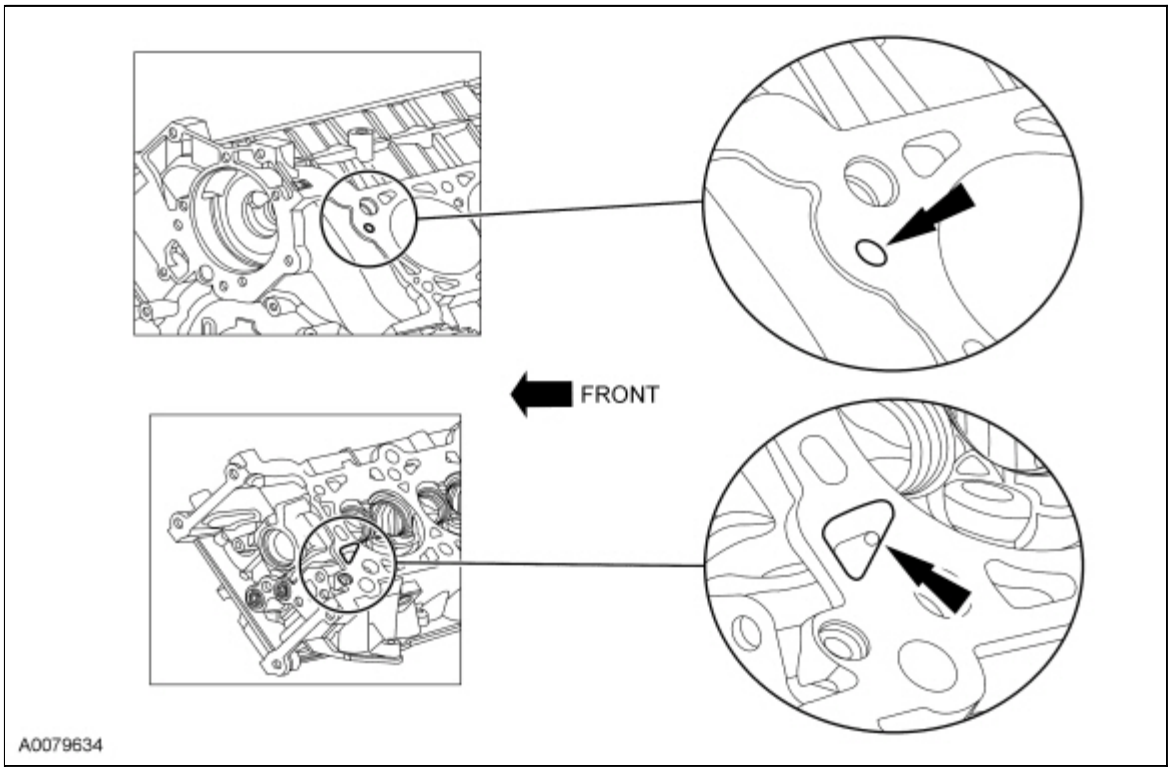
    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

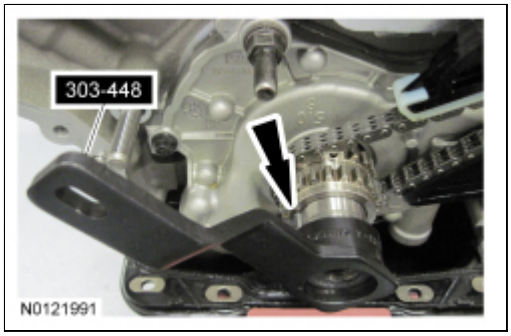
72. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

    NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

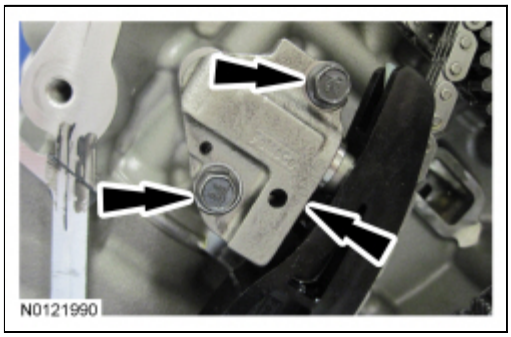
    Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to Section 303-00 .



73. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.

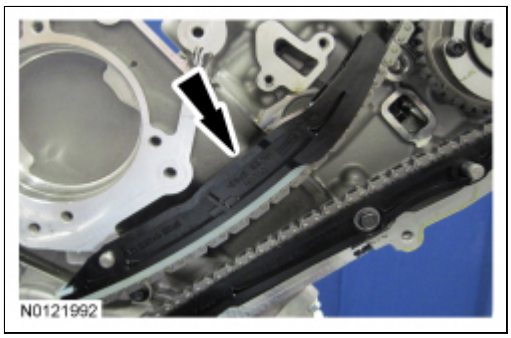


74. Remove the 2 bolts and the LH primary timing chain tensioner.



75. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

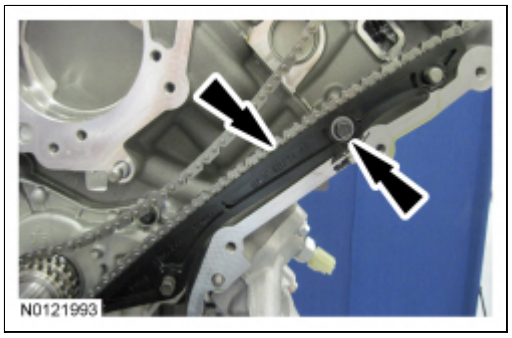
    Remove the LH timing chain tensioner arm.



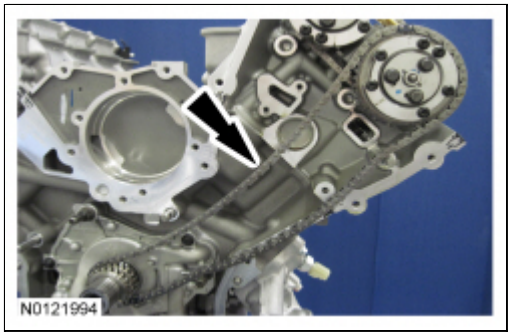
76. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

    Remove the bolt and the LH timing chain guide.

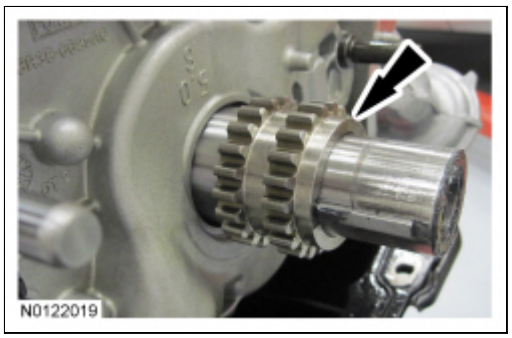
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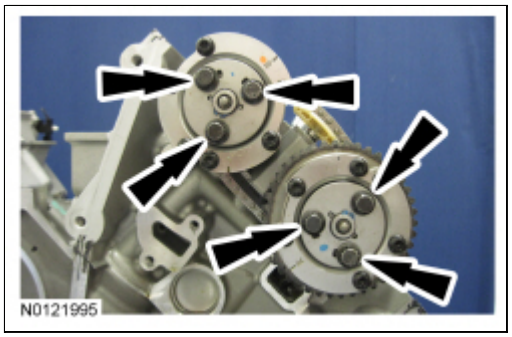
77. Remove the LH primary timing chain.



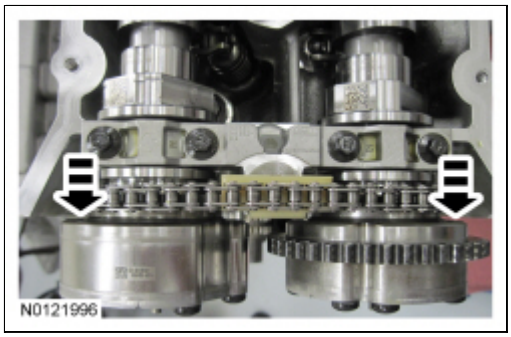
78. Remove the crankshaft sprocket.



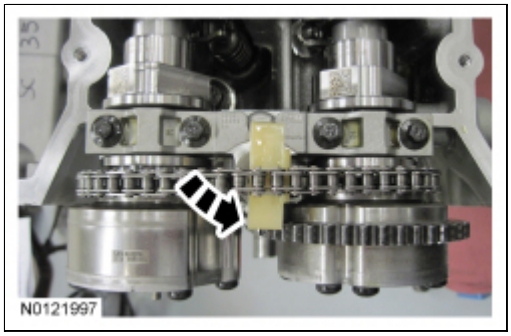
79. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



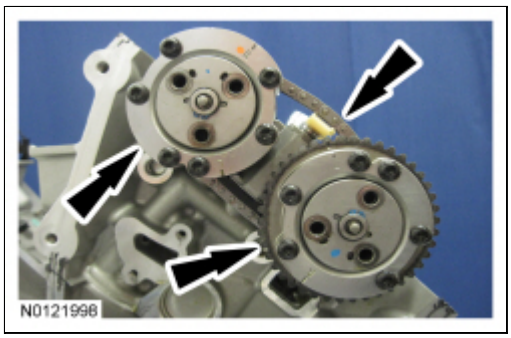
80. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



81. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.

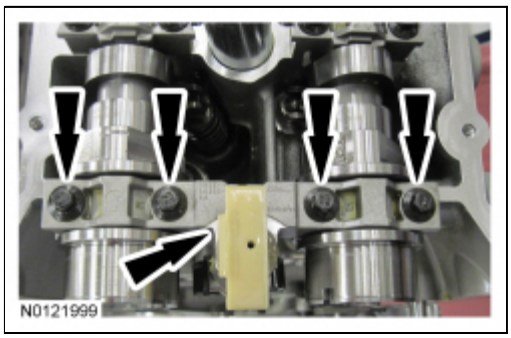


82. Remove the LH VCT assemblies and the LH secondary timing chain.



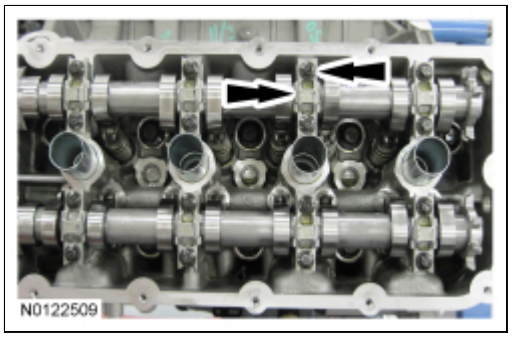
83. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the LH front camshaft bearing mega cap.



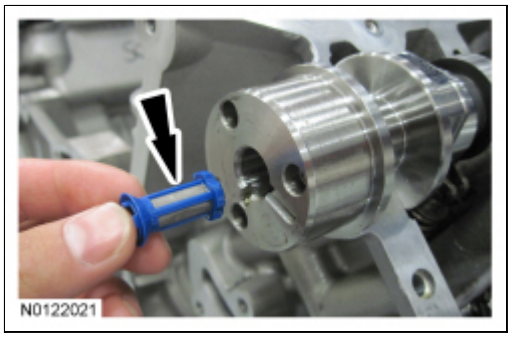
84. Remove the 16 bolts and the 8 camshaft bearing caps.

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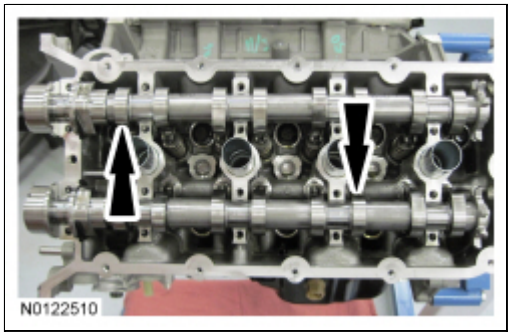


85. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

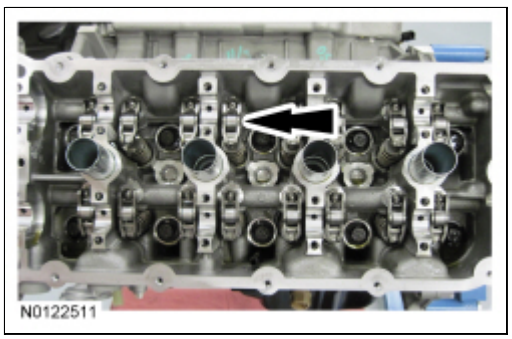
    Remove the VCT system oil filter from the intake and exhaust camshafts.



86. Remove the LH intake and exhaust camshafts.

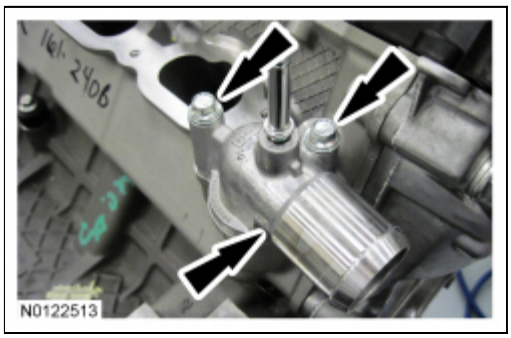


87. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



88. Remove the 2 bolts and the coolant outlet from the LH cylinder head.

- Remove and discard the gasket.



89. ***NOTICE:*** **The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.**

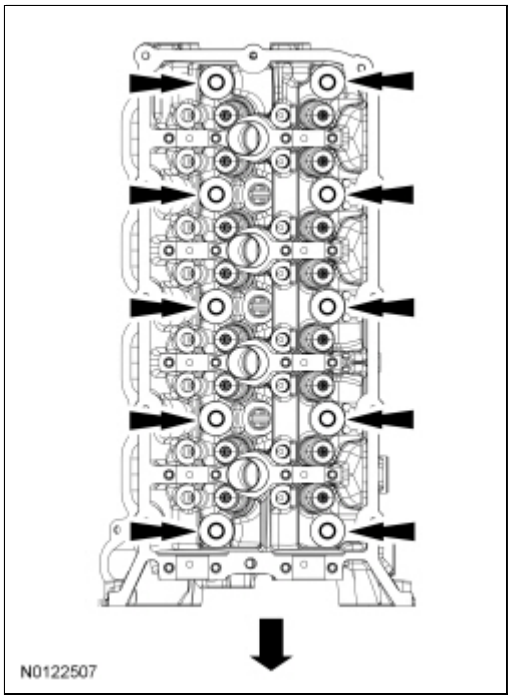
    NOTICE: **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.**

    NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

    NOTICE: **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTICE: **Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    Remove the 10 bolts and the LH cylinder head.
    - Discard the bolts and the cylinder head gasket.



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90. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

NOTE: Observe all warnings or notices and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

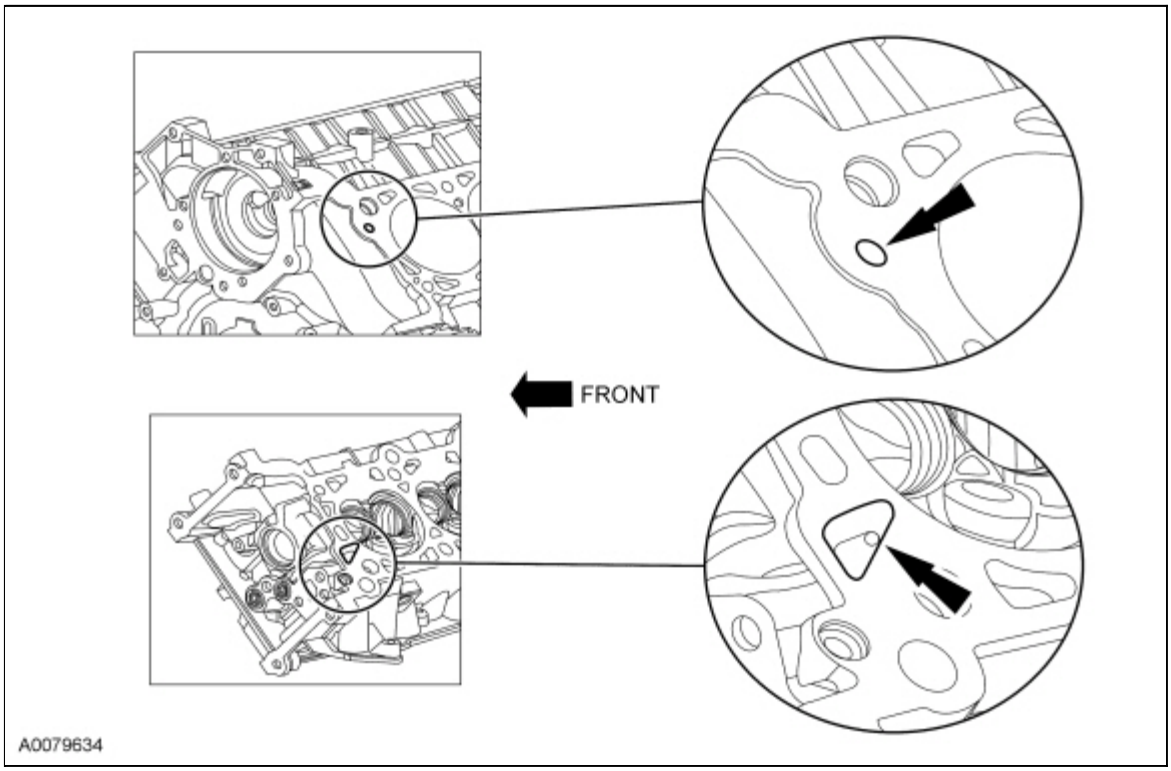
Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

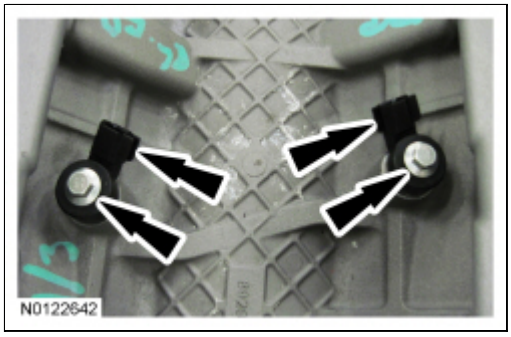
91. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

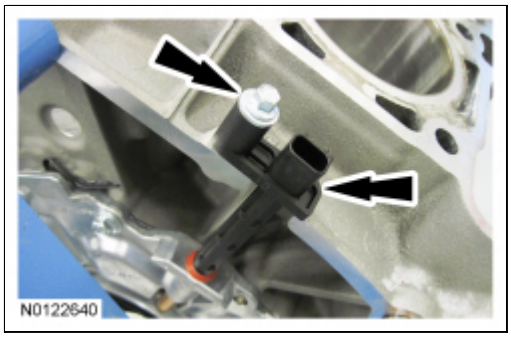
Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to Section 303-00 .



92. Remove the 2 bolts and the 2 KS .



93. Remove the bolt and the Crankshaft Position (CKP) sensor.

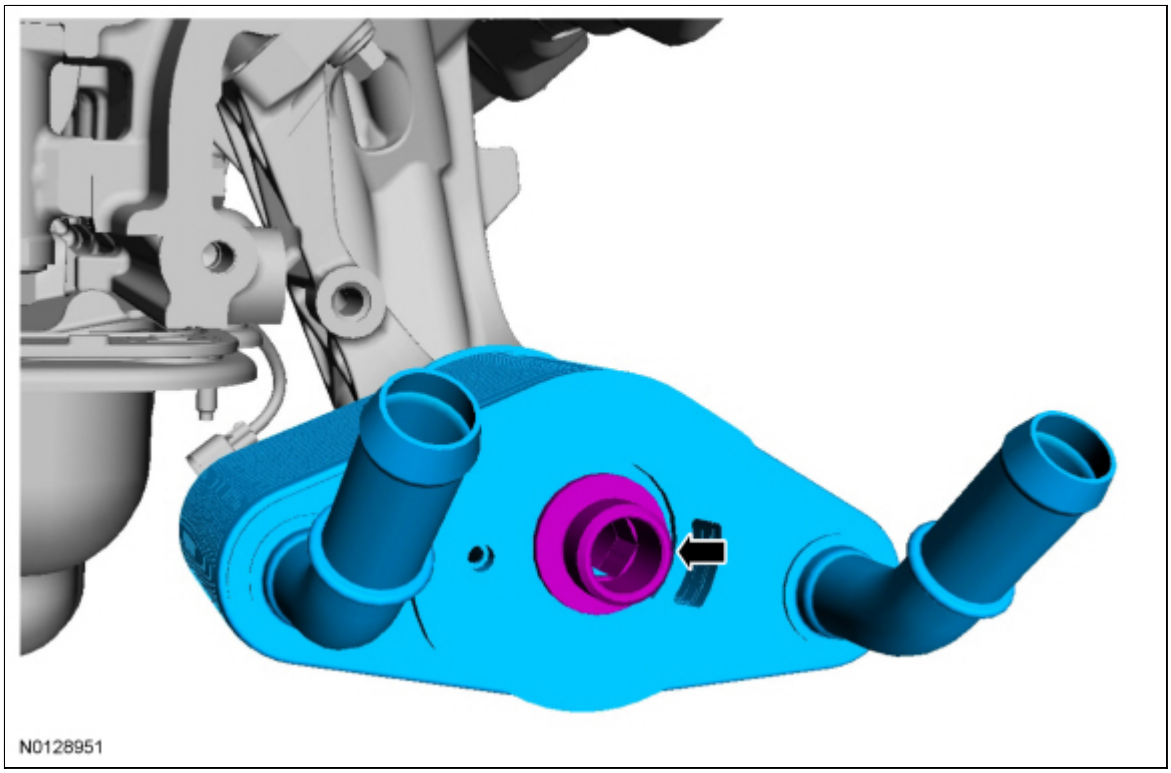


94. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

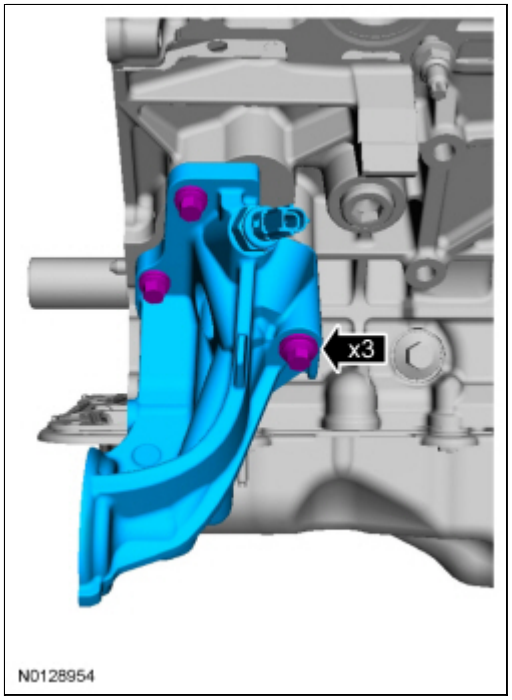
Remove the oil cooler threaded insert and the oil cooler.

- Discard the oil cooler.

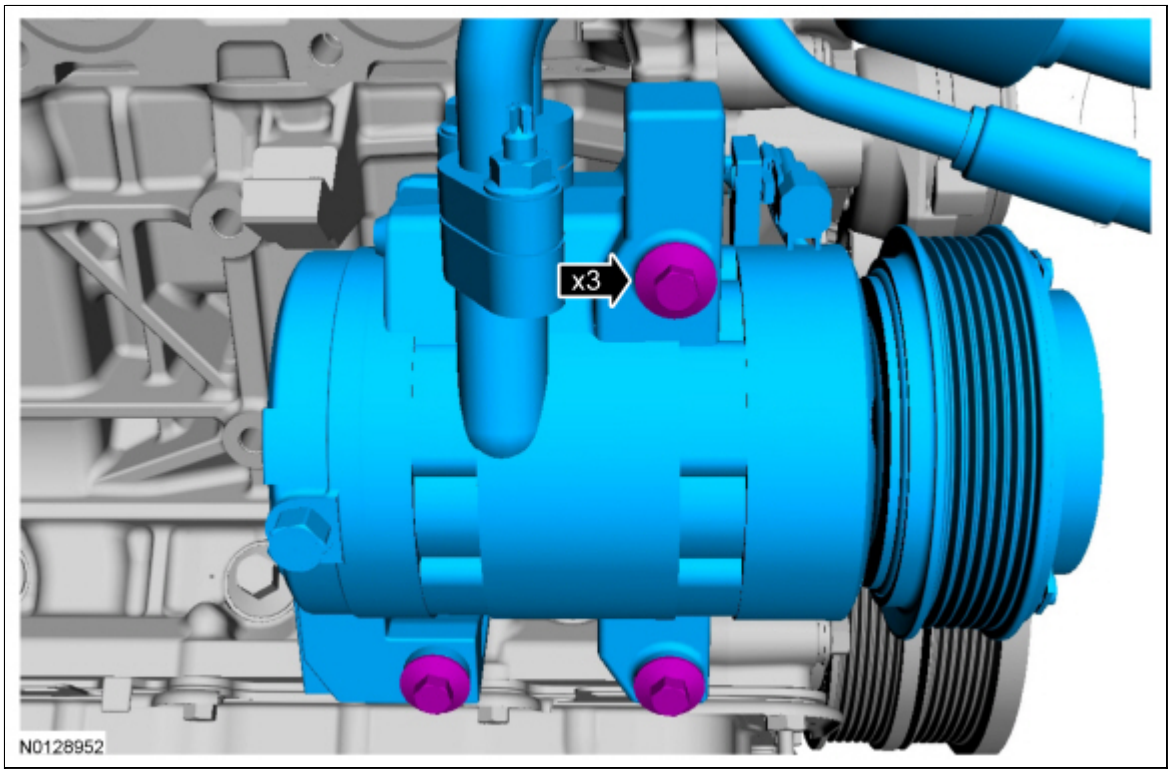
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95. Remove the 3 bolts and the oil filter adapter.
    - Discard the gasket.

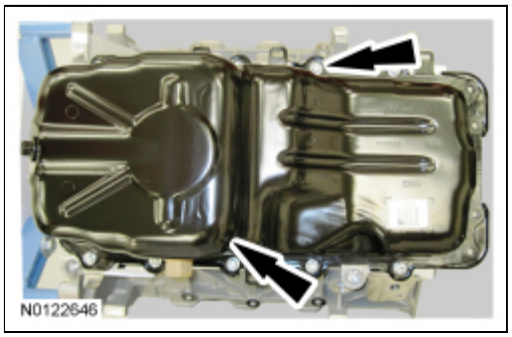


96. Remove the 3 bolts and the A/C compressor.



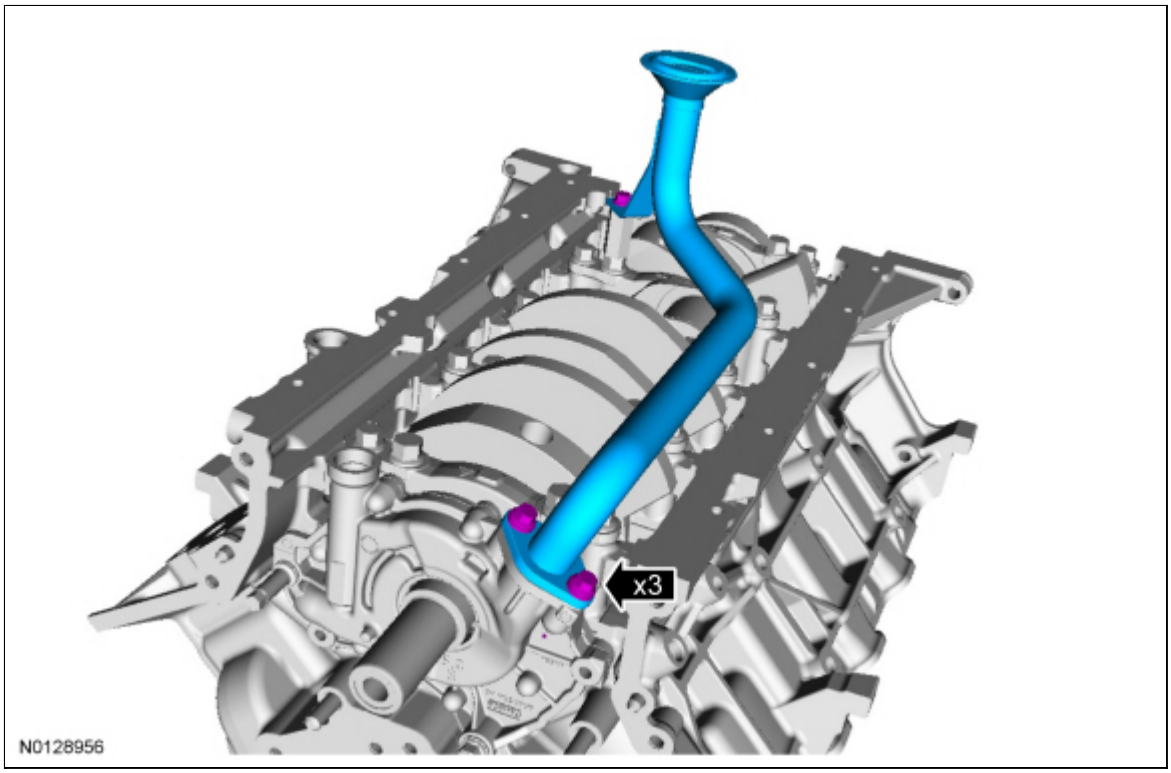
97. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove the bolts and the oil pan.
    - Discard the gasket.
    - Clean and inspect the sealing surface.

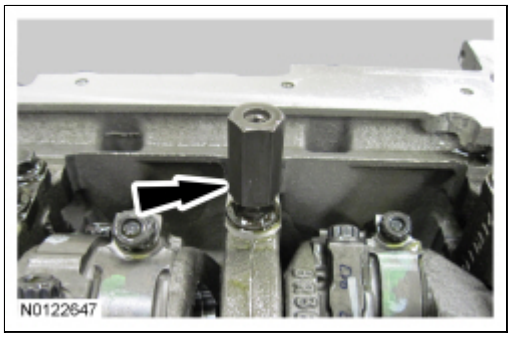


98. Remove the 3 bolts and the oil pump screen and pickup tube.
    - Discard the O-ring seal.

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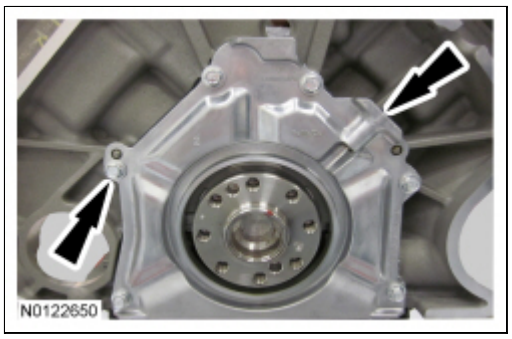


99. Remove the oil pump screen and pickup tube spacer.

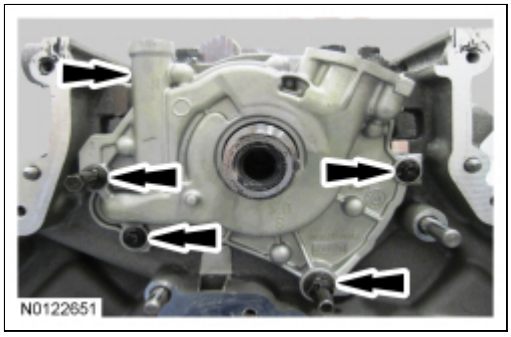


100. Remove the 6 bolts and the crankshaft rear seal retainer plate.
    - ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

      Clean and inspect the sealing surfaces.



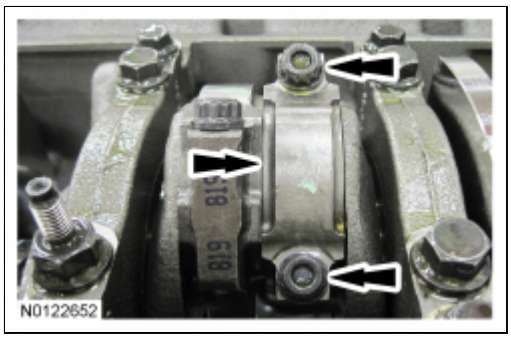
101. Remove the 2 bolts, the 2 stud bolts and the oil pump.



102. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following the manufacturer's instructions.

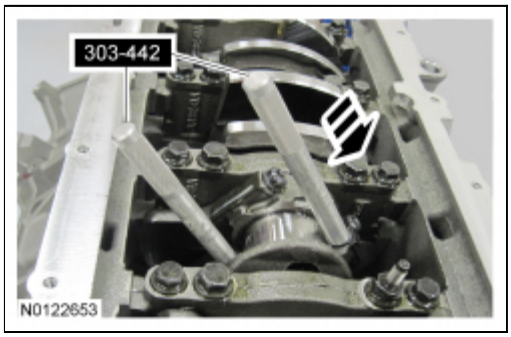
103. ***NOTICE:*** **Verify that the connecting rod and rod cap have orientation numbers cast into them. If not, number the connecting rod and rod cap for correct orientation. Failure to do so can result in engine damage.**

Remove the bolts and the connecting rod cap. Discard the bolts.



104. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.**

Use the Connecting Rod Installer to push the piston through the top of the cylinder block.

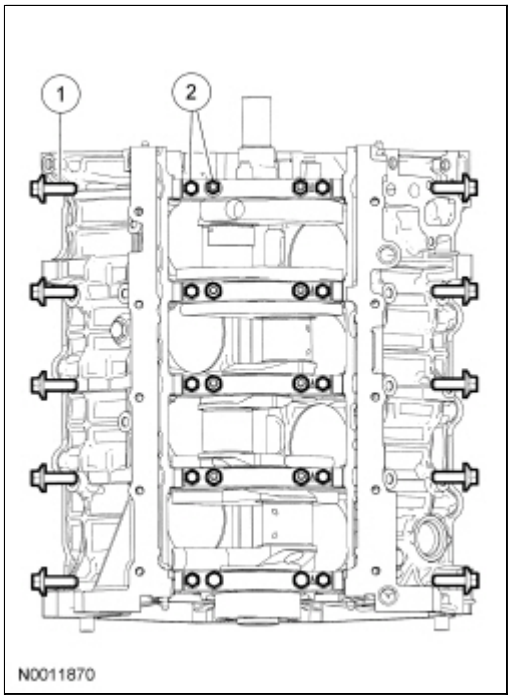


105. Repeat the previous 2 steps for each of the remaining pistons.

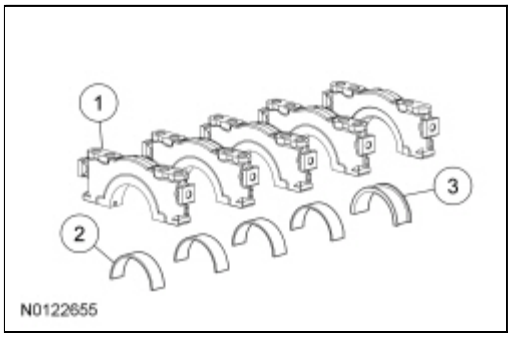
106. Disassemble the 8 pistons. For additional information, refer to Piston in this section.

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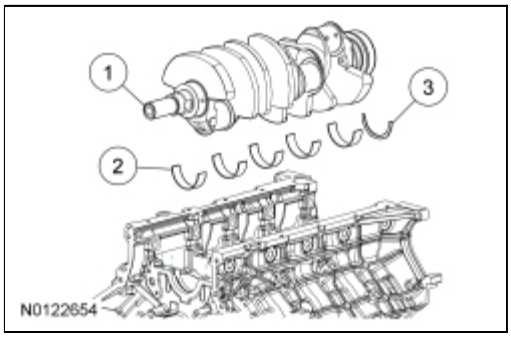
107. Remove the main bearing cap fasteners.
    1. Remove and discard the cross-mounted main cap bolts.
    2. Remove and discard the main bearing cap bolts and stud bolt.



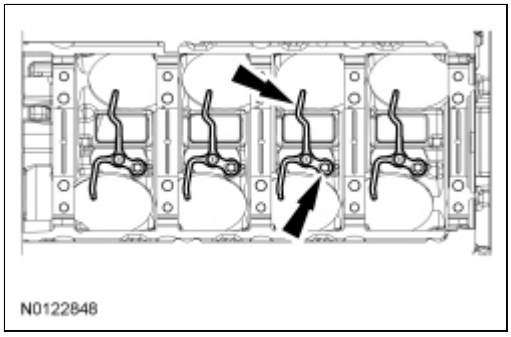
108. Remove the main bearing caps (1), the lower crankshaft main bearings (2) and the lower thrust bearing (3).



109. Remove the crankshaft (1), the upper crankshaft main bearings (2) and the upper thrust washer (3) from the cylinder block.



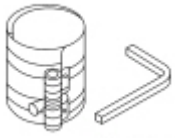
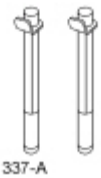
110. Remove the 4 bolts and 4 piston cooling jets from the cylinder block.

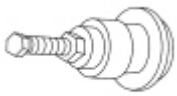
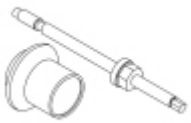


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Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST2806-A	Alignment Pins, Cylinder Head 303-1040 (SR-015486)
 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

 ST2212-A	
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073) or equivalent
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

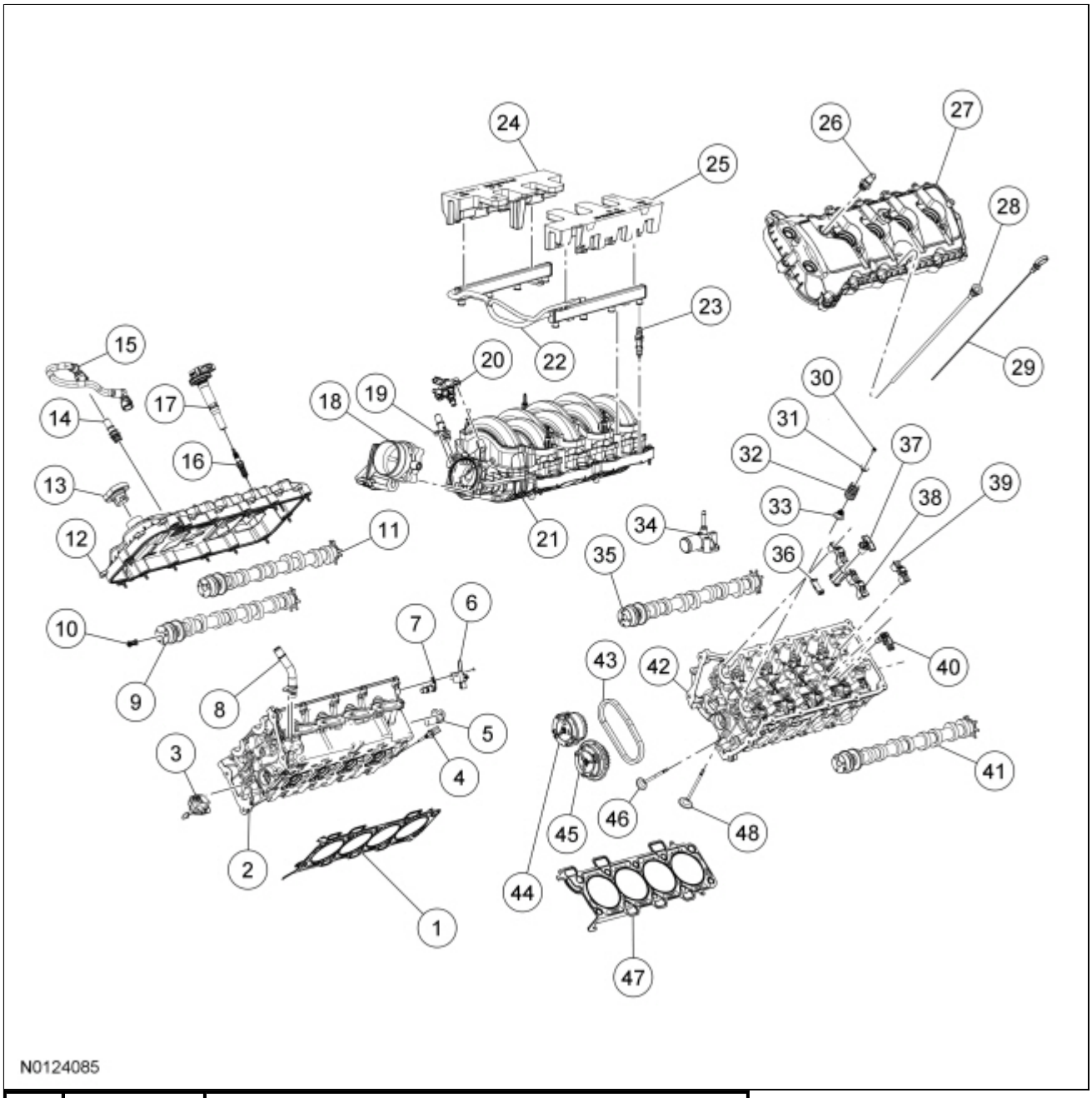
Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US);	WSS-M2C945-A

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Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT or equivalent	WSS-M2C931-B
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Engine — Upper End



Item	Part Number	Description
1	6051	RH cylinder head gasket
2	6049	RH cylinder head
3	6L266	Primary timing chain tensioner (2 required)
4	6G004	Cylinder Head Temperature (CHT) sensor
5	6B288	Intake Camshaft Position (CMP) sensor (2 required)
6	18801	Radio capacitor (2 required)
7	12K073	Exhaust CMP sensor (2 required)
8	18696	Heater supply tube

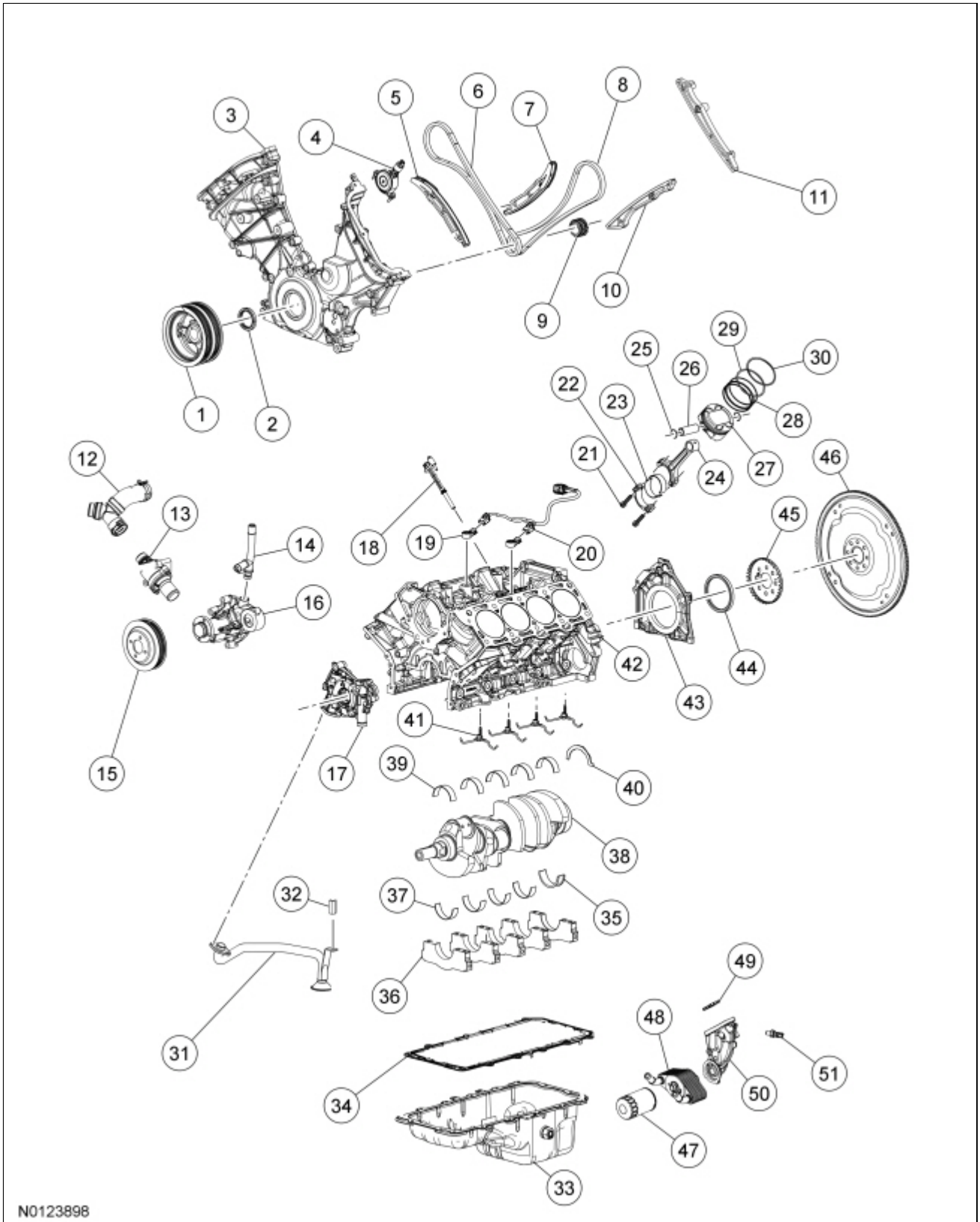
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9	6250	RH exhaust camshaft
10	6C683	Camshaft engine oil filter (4 required)
11	6250	RH intake camshaft
12	6582	RH valve cover
13	6766	Oil filler cap
14	6A666	PCV valve
15	6578	Crankcase vent hose
16	12405	Spark plug (8 required)
17	12029	Ignition coil on plug (8 required)
18	9F991	Throttle Body (TB)
19	9F624	Heat control inlet tube
20	9C915	Fuel vapor purge valve
21	9424	Intake manifold
22	9F792	Fuel rail
23	9F593	Fuel injector (8 required)
24	6P013	RH fuel injector insulator shield
25	6P013	LH fuel injector insulator shield
26	6762	Crankcase vent valve
27	6582	LH valve cover
28	6754	Oil indicator tube
29	6750	Oil indicator
30	6518	Valve spring retainer key (64 required)
31	6514	Valve spring retainer (32 required)
32	6513	Valve spring (32 required)
33	6571	Valve stem seal (32 required)
34	8594	Coolant outlet connector
35	6250	LH intake camshaft
36	6K297	Secondary tensioner shoe (2 required)
37	6K254	Secondary tensioner (2 required)
38	—	Camshaft bearing cap (part of 6049) (2 required)
39	—	Camshaft bearing cap (part of 6049) (16 required)
40	6500/6564	Hydraulic lash adjuster/camshaft roller follower (32 required)
41	6250	LH exhaust camshaft
42	6049	LH cylinder head
43	6268	Secondary timing chain (2 required)
44	6256	Intake camshaft Variable Camshaft Timing (VCT) (2 required)
45	6256	Exhaust camshaft VCT (2 required)

46	6505	Exhaust valve (16 required)
47	6051	LH cylinder head gasket
48	6507	Intake valve (16 required)

Engine — Lower End

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Item	Part Number	Description
1	6316	Crankshaft pulley

2	6700	Crankshaft front oil seal
3	6019	Engine front cover
4	6B297	Variable Camshaft Timing (VCT)variable force solenoid (4 required)
5	6K255	RH timing chain tensioner arm
6	6268	RH primary timing chain
7	6K255	LH timing chain tensioner arm
8	6268	LH primary timing chain
9	6306	Crankshaft sprocket
10	6B274	LH timing chain guide
11	6M256	RH timing chain guide
12	8566	Coolant bypass tee
13	8A586	Thermostat housing
14	18663	Heater outlet tube
15	8509	Coolant pump pulley
16	8501	Coolant pump
17	6600	Oil pump
18	6C315	Crankshaft Position (CKP) sensor
19	12A699	KS (2 required)
20	14A411	KS wiring harness
21	6214	Connecting rod cap bolt (16 required)
22	—	Connecting rod cap (part of 6200) (8 required)
23	6211	Connecting rod bearing (16 required)
24	6200	Connecting rod (8 required)
25	6140	Piston pin retainer (16 required)
26	6135	Piston pin (8 required)
27	6110	Piston (8 required)
28	—	Outer oil control ring (part of 6148) (16 required)
29	—	Lower compression ring (part of 6148) (8 required)
30	—	Upper compression ring (part of 6148) (8 required)
31	6622	Oil pump screen and pickup tube
32	N806180	Oil pump screen and pickup tube spacer
33	6675	Oil pan
34	6710	Oil pan gasket
35	—	Crankshaft main bearing cap (part of 6010) (5 required)
36	6D309	Crankshaft lower main bearing
37	6D309	Crankshaft lower main bearing (4 required)
38	6303	Crankshaft

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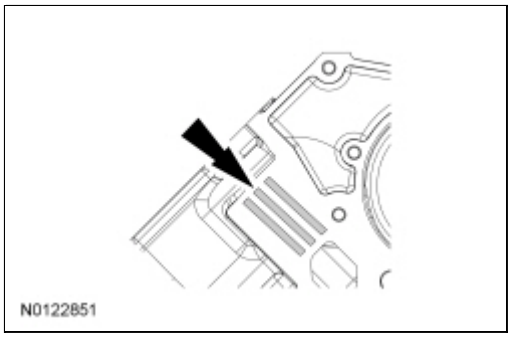
39	6D309	Crankshaft upper main bearing (5 required)
40	6A341	Thrust washer
41	6K868	Piston cooling jets (4 required)
42	6010	Engine block
43	6K318	Crankshaft rear seal retainer plate
44	6701	Crankshaft rear seal
45	12A227	Crankshaft sensor ring
46	6375	Flexplate
47	6731	Oil filter
48	6A642	Oil cooler
49	6840	Oil filter adapter gasket
50	6881	Oil filter adapter
51	9278	Engine Oil Pressure (EOP) switch

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

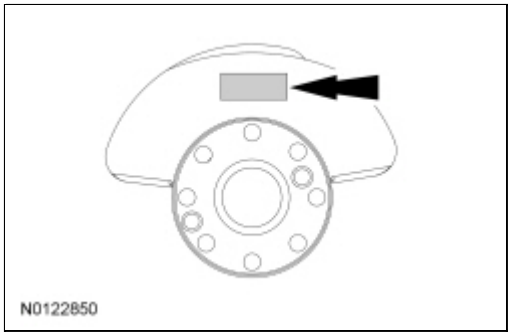
NOTICE: **During engine assembly do not allow the piston connecting rods to come in contact with the piston cooling jets or engine damage may occur.**

NOTE: During engine assembly it may become necessary to check bearing clearances and end play. For additional information, refer to Section 303-00 .

1. Record the main bearing code found on the front of the engine block.

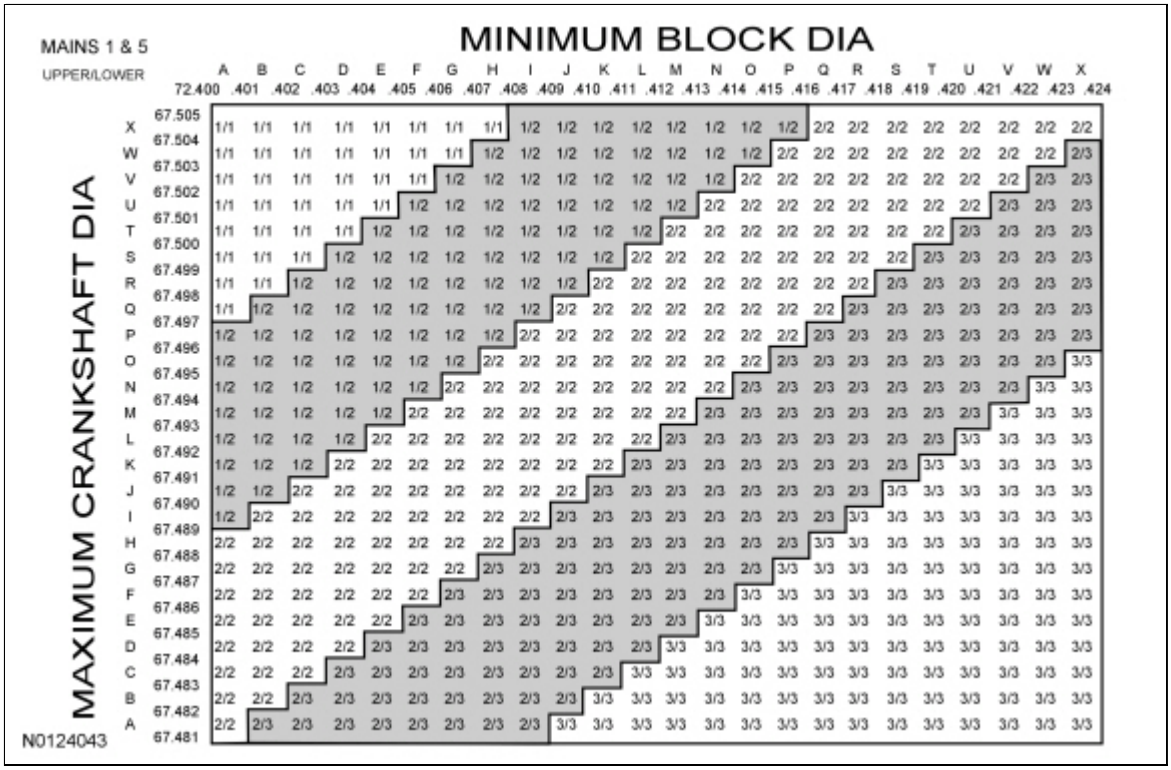


2. Record the main bearing code found on the rear of the crankshaft.



3. **NOTE:** This chart is for selecting main bearings 1 and 5 only, the remaining bearings will be selected using a different chart in the next step.

   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 1 and 5.
   - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade(s) for the No. 1 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is a "1" for the upper bearing and a "2" for the lower bearing.
   - Repeat the above steps using the fifth letter of the block and crankshaft codes to select the No. 5 bearing.



4. **NOTE:** This chart is for selecting main bearings 2, 3 and 4 only.

   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 2, 3 and 4.
   - Read the second letter of the engine block main bearing code and the second letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade(s) for the No. 2 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is a "1" for the upper bearing and a "2" for the lower bearing.
   - Repeat the above steps using the third and fourth letters of the block and crankshaft codes to select the No. 3 and No. 4 bearings.

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MAINS 2, 3 & 4
UPPER/LOWER

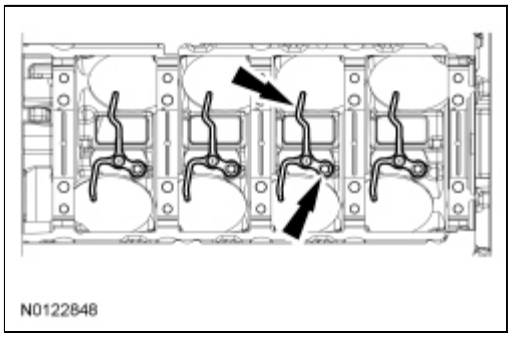
MINIMUM BLOCK DIA

MAXIMUM CRANKSHAFT DIA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
	72.400	.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424
X 67.505	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2
W 67.504	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2
V 67.503	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
U 67.502	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
T 67.501	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	2/2	2/2	2/2	2/2
S 67.500	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3
R 67.499	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3
Q 67.498	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3
P 67.497	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3
O 67.496	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3
N 67.495	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3
M 67.494	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3
L 67.493	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3
K 67.492	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3
J 67.491	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3
I 67.490	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3
H 67.489	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3
G 67.488	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3
F 67.487	1/2	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
E 67.486	1/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
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C 67.484	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
B 67.483	2/2	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
A 67.482	2/2	2/2	2/2	2/2	2/2	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
67.481																									

N0124042

NOTE: Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

5. Install the 4 piston cooling jets and 4 bolts. Tighten in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



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6. Install the crankshaft main bearings.
   - Install the crankshaft upper main bearings into the cylinder block.
   - Install the crankshaft lower main bearings and thrust bearing into the bearing caps.
   - Make sure all oil passages are aligned.
   - Lubricate all main bearings with clean engine oil.

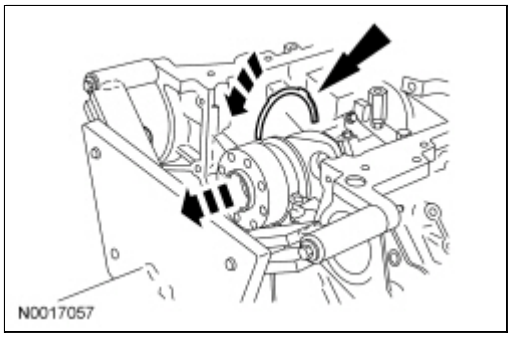
7. **NOTE:** Lubricate the crankshaft bearing journals with clean engine oil.

   Install the crankshaft into the cylinder block.

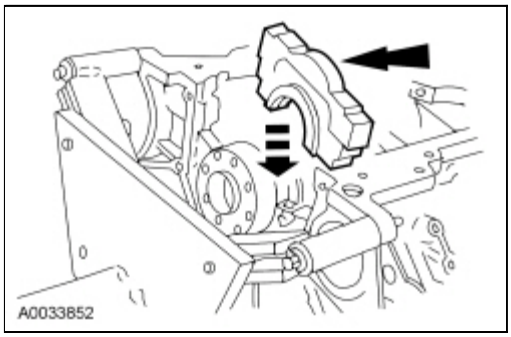
8. **NOTE:** The oil groove on the thrust washer must face toward the rear of the engine (against the

crankshaft thrust surface).

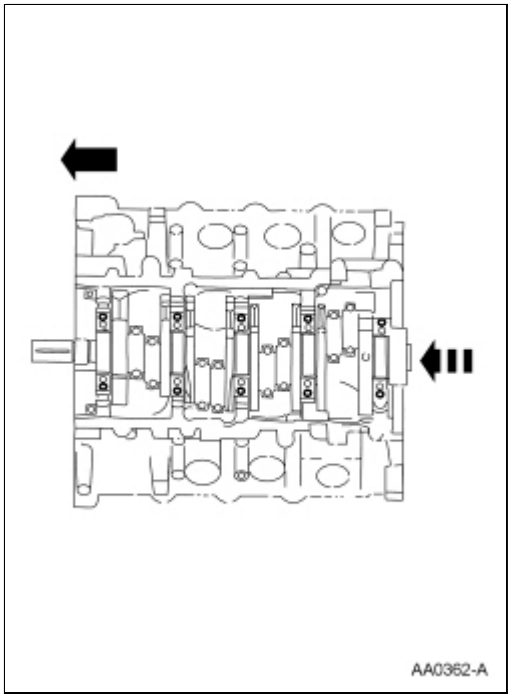
Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 5 main boss.



9. Install the main bearing caps and fasteners on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the cap fasteners.

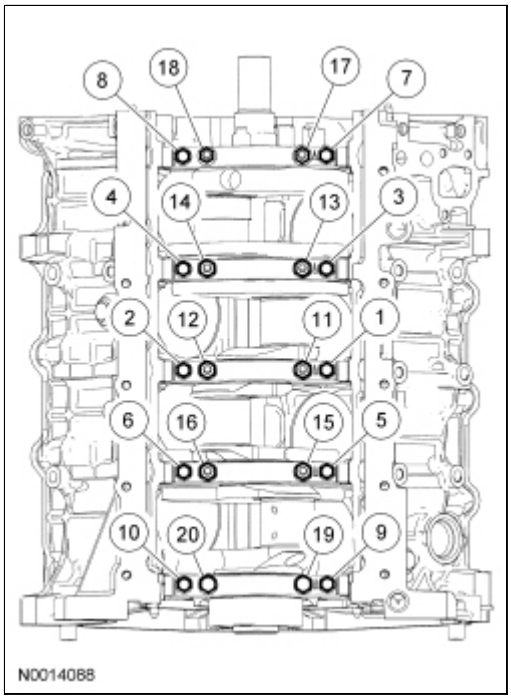


10. Push the crankshaft forward to seat the crankshaft thrust washer. Hold the crankshaft in the forward position.

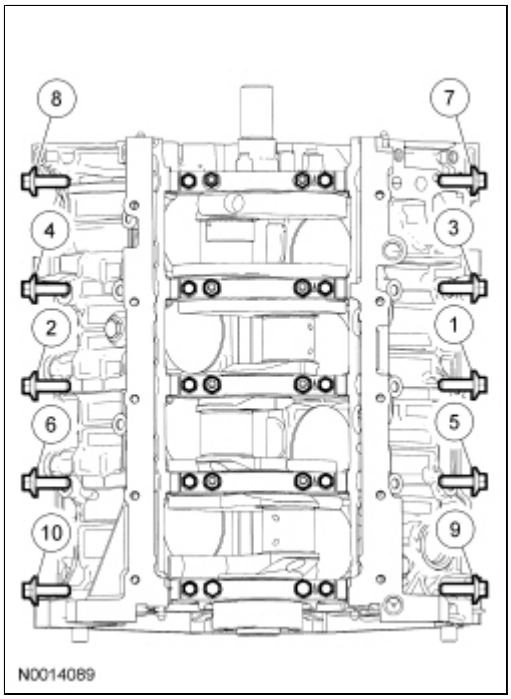


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11. Tighten the vertical main bearing cap fasteners in the sequence shown, in 4 stages.
    - Stage 1: Tighten fasteners 1 through 20 to 20 Nm (177 lb-in).
    - Stage 2: Tighten fasteners 1 through 10 to 40 Nm (30 lb-ft).
    - Stage 3: Tighten fasteners 11 through 20 to 65 Nm (48 lb-ft).
    - Stage 4: Tighten fasteners 1 through 20 an additional 90 degrees.



12. Install the cross-mounted main bearing cap fasteners and tighten in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 30 Nm (22 lb-ft).
    - Stage 3: Tighten an additional 60 degrees.



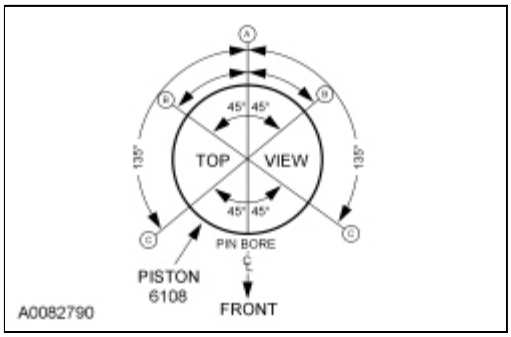
13. Check the crankshaft end play. For additional information, refer to Section 303-00 .

14. Check that crankshaft torque-to-turn does not exceed 6 Nm (53 lb-in).

15. Check the piston-to-cylinder block and piston ring clearances. For additional information, refer to Section 303-00 .

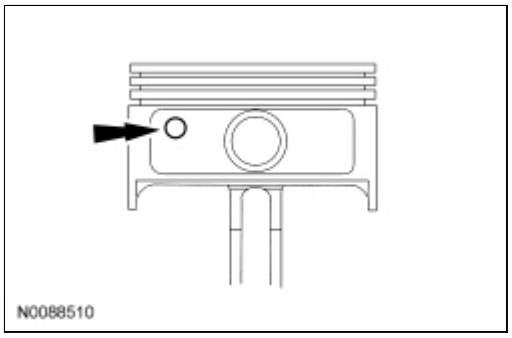
16. Assemble the pistons. For additional information, refer to Piston in this section.

17. Make sure the ring gaps (oil spacer-A, oil ring-B, compression ring-C) are correctly spaced around the circumference of the piston.



18. Make sure the dimple in the piston faces the front of the engine.

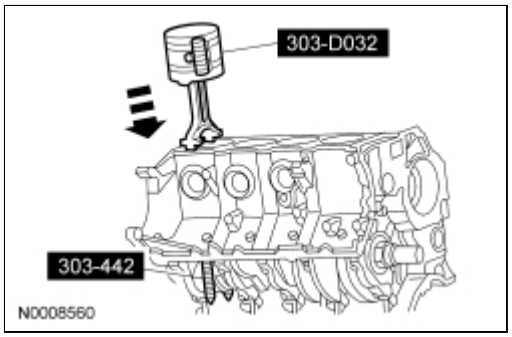
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19. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.**

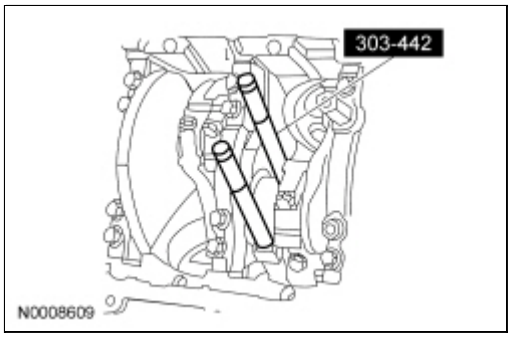
    NOTICE: **Do not allow the piston connecting rods to come in contact with the piston cooling jets or engine damage may occur.**

    Use the Piston Ring Compressor and the Connecting Rod Installers to install the connecting rod with the upper connecting rod bearing in place.
    - Lubricate the piston and ring with clean engine oil.
    - Lubricate the rod bearings with clean engine oil.



20. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.**

    Once the connecting rod is seated on the crankshaft journal, remove the Connecting Rod Installers.



21. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

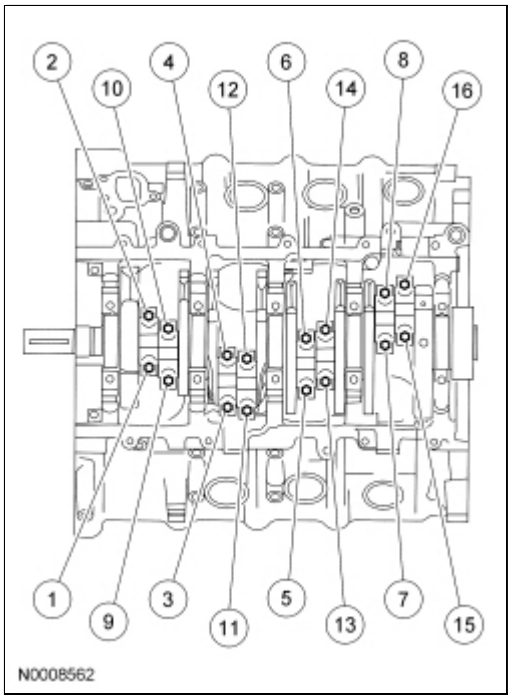
    NOTE: The connecting rod caps are of the "cracked" design and must mate with the connecting rod ends. Excessive bearing clearance will result if not mated correctly.

Position the lower bearing and connecting rod and install the new bolts loosely.

22. Repeat the previous 5 steps for each of the remaining pistons.

23. **NOTE:** Main bearing caps are removed for clarity.

    Tighten the bolts in the sequence shown in 3 stages.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 38 Nm (28 lb-ft).
    - Stage 3: Tighten an additional 105 degrees.

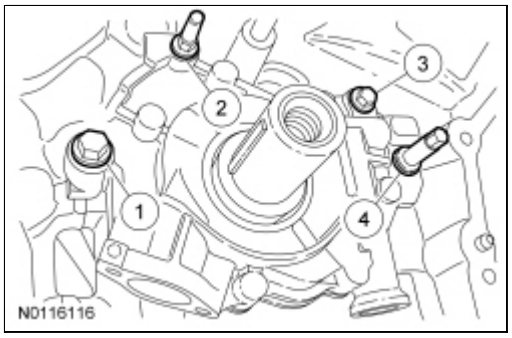


24. Rotate the inner rotor of the oil pump assembly to align the flats on the crankshaft and slip the oil pump over the crankshaft until seated against the block.
    - Rotate the oil pump until the bolt holes are aligned to the block and install the fasteners.

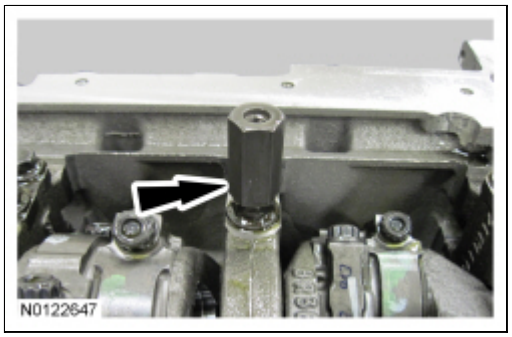
25. **NOTE:** Oil pump must be held against the cylinder block until all bolts are tightened.

    Tighten the fasteners in the sequence shown in 3 stages:
    - Stage 1: Hand tighten.
    - Stage 2: Tighten the bolt (1) to 10 Nm (89 lb-in), the stud bolt (2) to 25 Nm (18 lb-ft), the bolt (3) to 10 Nm (89 lb-in) and the stud bolt (4) to 20 Nm (177 lb-in).
    - Stage 3: Tighten the bolt (1) an additional 45 degrees, the stud bolt (2) an additional 75 degrees, the bolt (3) an additional 45 degrees and the stud bolt (4) an additional 60 degrees.

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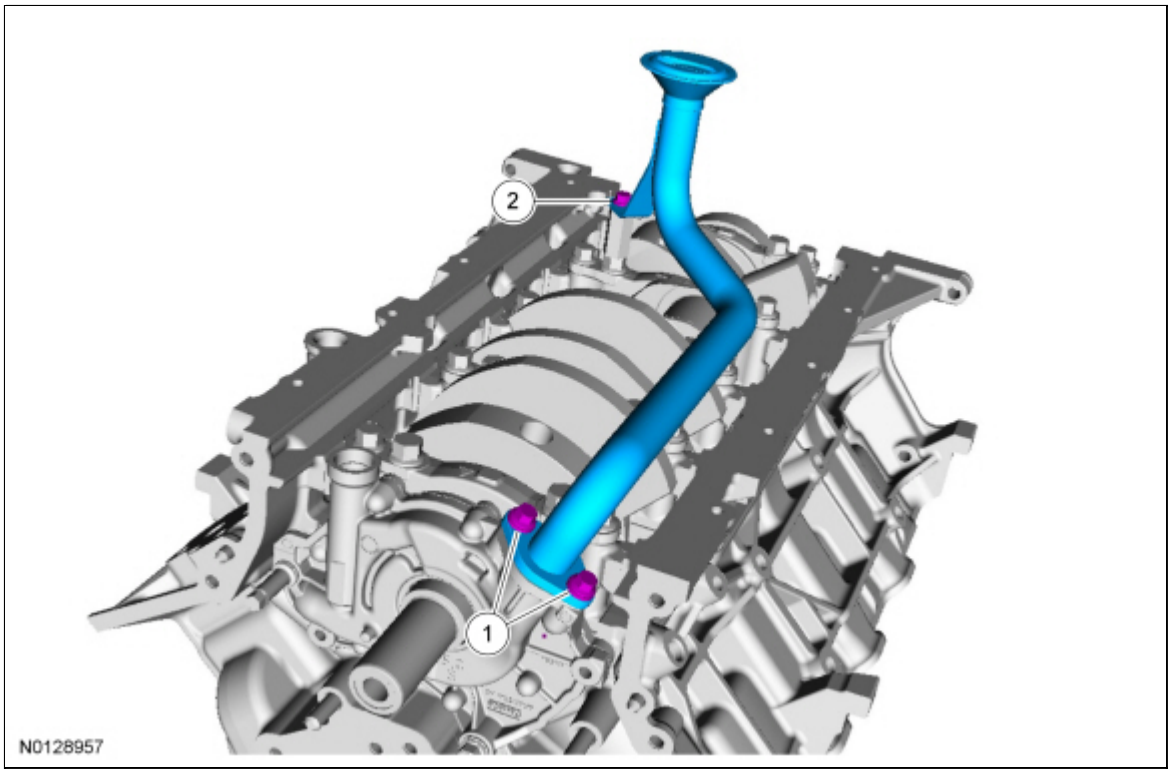


26. Install the oil pump screen and pickup tube spacer.
    - Tighten to 25 Nm (18 lb-ft).



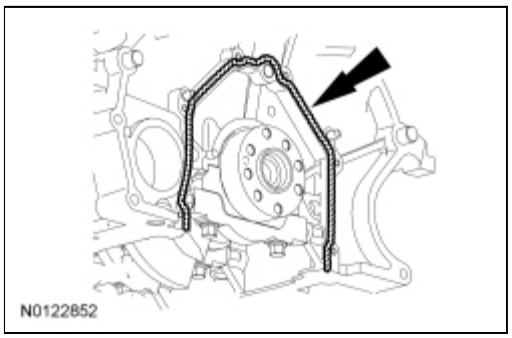
27. **NOTE:** The 2 oil pump screen and pickup tube-to-oil pump bolts must be tightened prior to tightening the oil pump screen and pickup tube-to-spacer bolt.

    Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts.
    1. Tighten the 2 oil pump screen and pickup tube-to-oil pump bolts in 2 stages.
        - Stage 1: Tighten to 10 Nm (89 lb-in).
        - Stage 2: Tighten an additional 45 degrees.
    2. Tighten the oil pump screen and pickup tube-to-spacer bolt to 25 Nm (18 lb-ft).



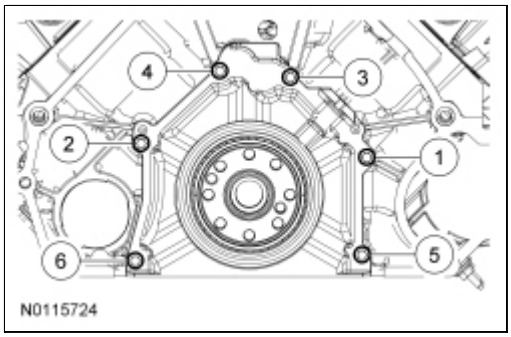
28. **NOTE:** If the rear crankshaft seal retaining plate is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure may cause future oil leaks.

    Apply a 3.75 mm (0.147 in) bead of silicone gasket and sealant to the rear crankshaft seal retainer mating surface on the engine block.



29. Install the crankshaft rear seal retainer plate and the 6 bolts, tighten in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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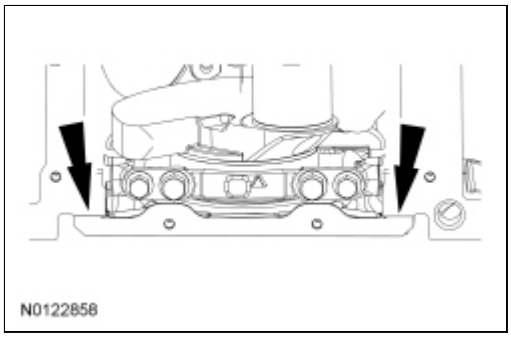


30. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Inspect the oil pan and engine sealing surfaces. Clean the mating surfaces of the engine and oil pan with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

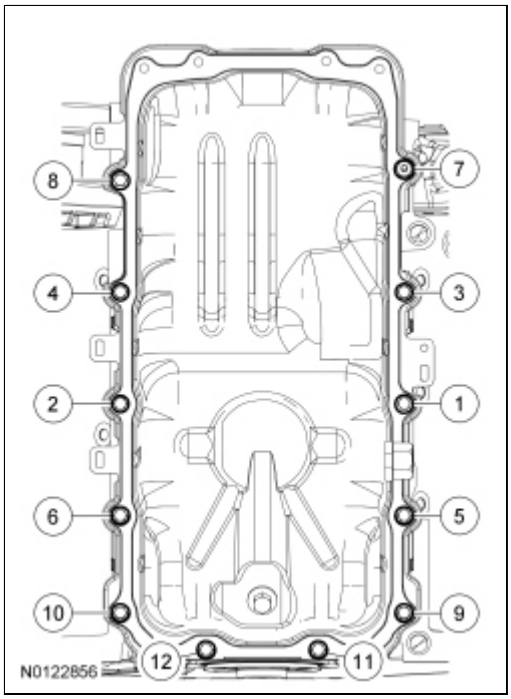
31. **NOTE:** If the oil pan is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage. If this timing cannot be met, tighten fasteners 7, 8, 9 and 10 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer and final torque all of the fasteners within 1 hour of applying the sealer.

    Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the crankshaft rear seal retainer plate-to-cylinder block sealing surfaces and the engine front cover-to-cylinder block sealing surfaces.

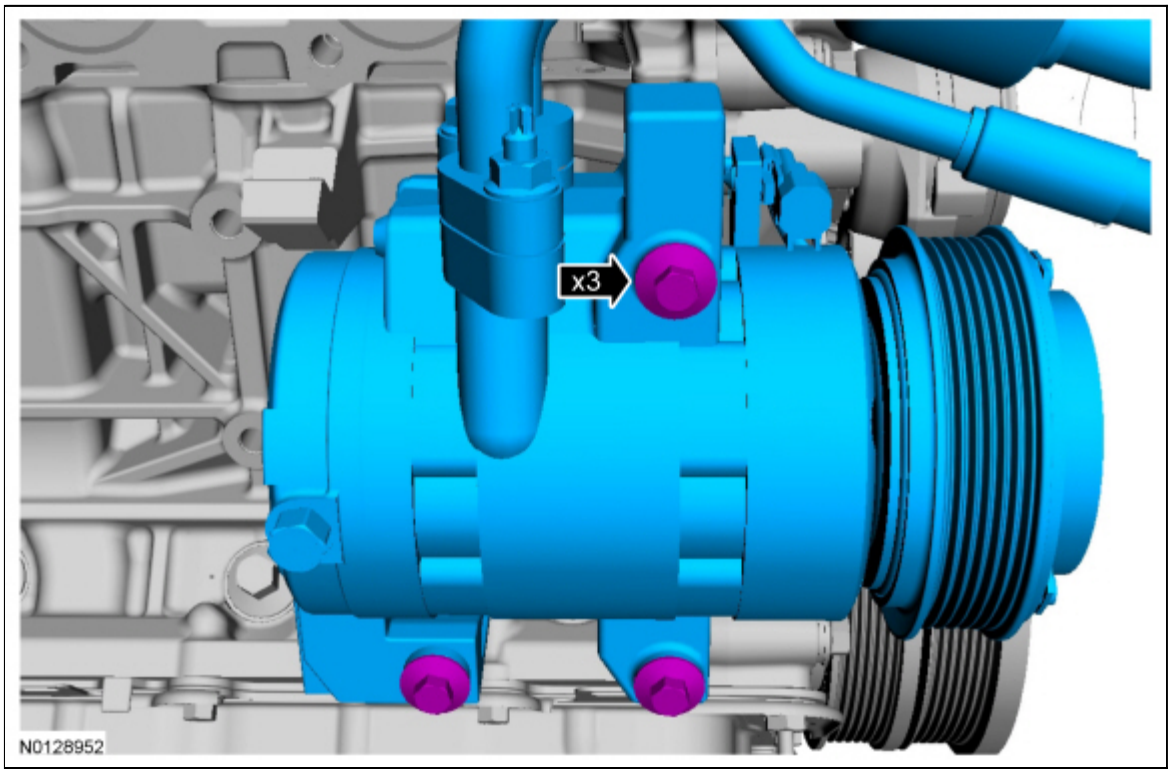


32. **NOTE:** Fastener location 7 is a stud bolt.

    Using a new gasket, install the oil pan and tighten the fasteners in sequence in 3 stages.
    - Stage 1: Tighten to 2 Nm (18 lb-in)
    - Stage 2: Tighten to 10 Nm (89 lb-in).
    - Stage 3: Tighten an additional 45 degrees.



33. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

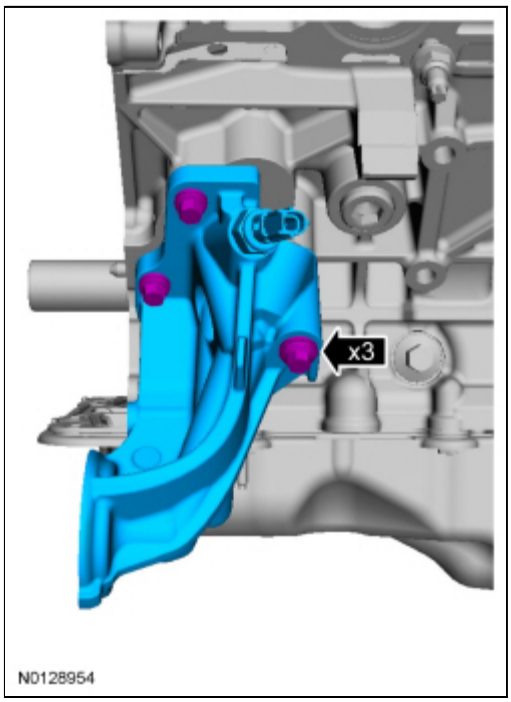


34. **NOTE:** Install a new oil filter adapter gasket.

    Using a new gasket, install the oil filter adapter and the 3 bolts. Tighten the bolts in 2 stages.
    - Stage 1: Tighten the bolts to 20 Nm (177 lb-in).

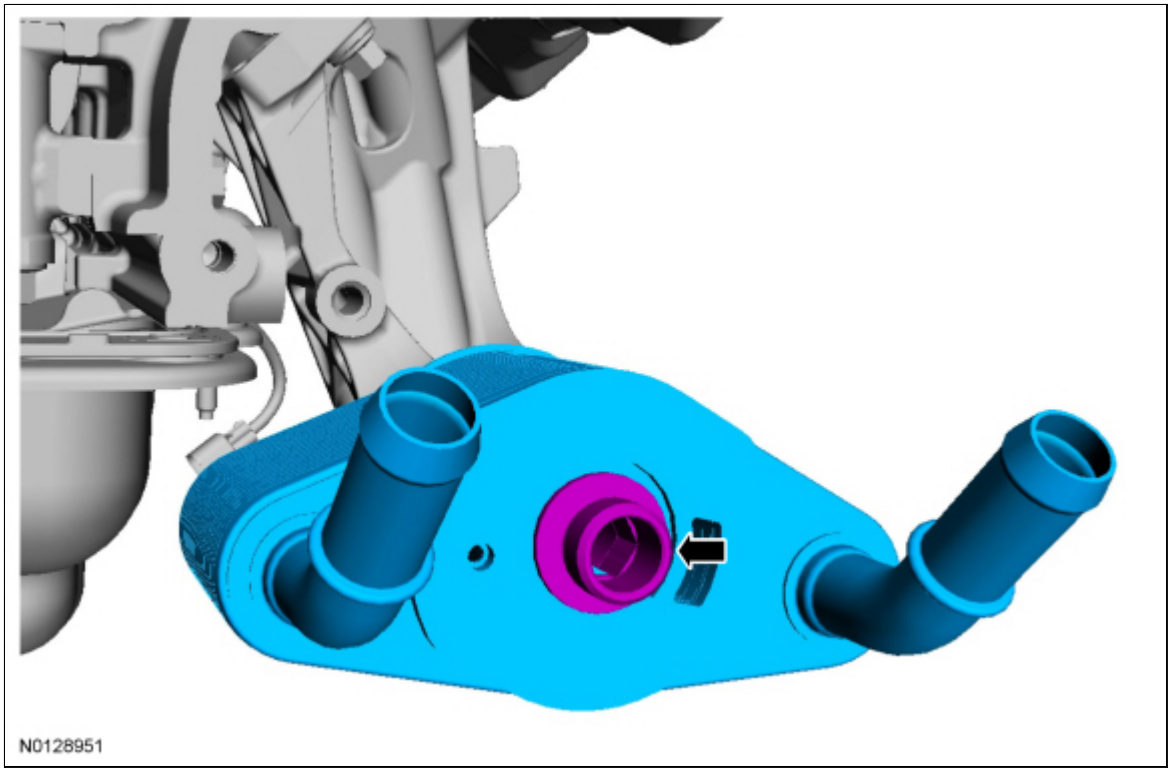
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- Stage 2: Tighten an additional 60 degrees.



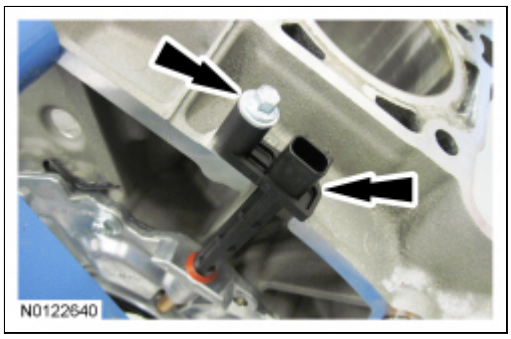
35. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

    Install a new oil cooler and the threaded fitting.
    - Tighten to 57 Nm (42 lb-ft).

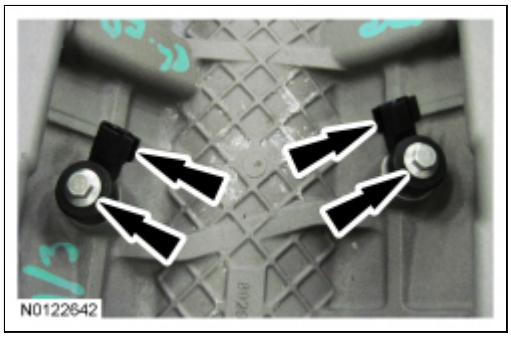


36. ***NOTICE:*** **The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.**

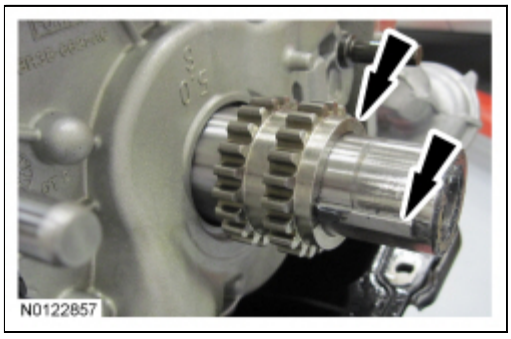
    Position the CKP sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).



37. Install the 2 Knock Sensor (KS) and 2 bolts.
    - Tighten to 20 Nm (177 lb-in).



38. Verify the crankshaft keyway is in the 9 o'clock position and install the crankshaft sprocket with the flange facing forward.



39. ***NOTICE:*** **Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow these instructions may result in engine damage.**

    NOTICE: **The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry. Failure to follow these instructions may result in future oil leakage.**

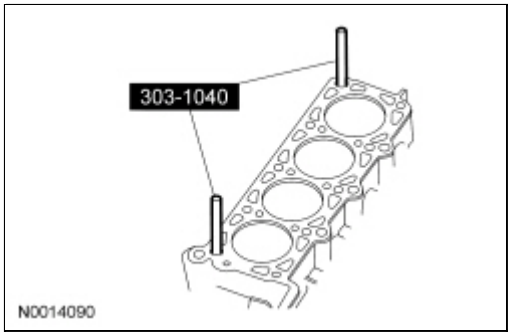
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NOTICE: **The cylinder head bolts must be discarded and new bolts installed. They are a tighten-to-yield design and cannot be reused.**

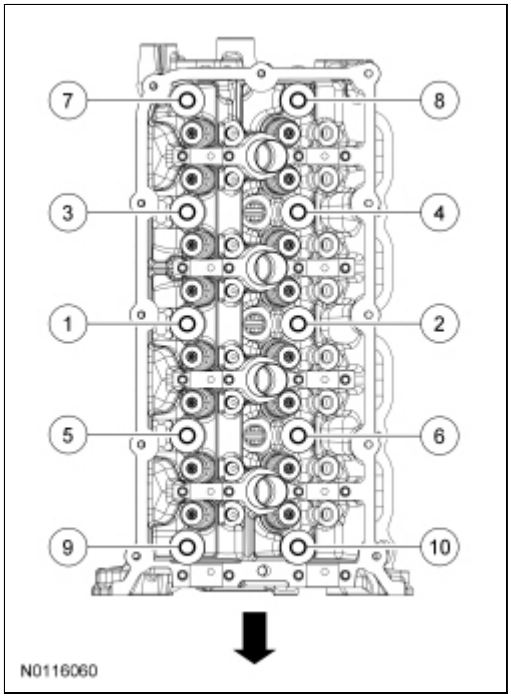
NOTE: Do not turn the crankshaft until instructed to do so.

NOTE: LH shown, RH similar.

Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the cylinder head bolts loosely.



40. Tighten the new RH cylinder head bolts in 4 stages in the sequence shown.
    - Stage 1: Tighten to 25 Nm (18 lb-ft).
    - Stage 2: Tighten to 40 Nm (30 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.
    - Stage 4: Tighten an additional 90 degrees.

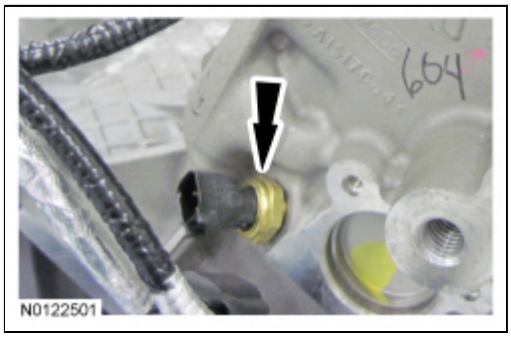


41. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.**

    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the

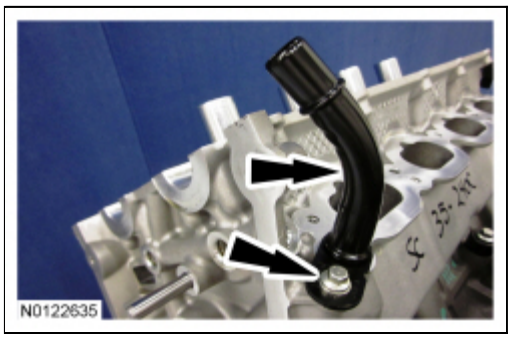
directions on the packaging.

42. Install the Cylinder Head Temperature (CHT) sensor.
    - Tighten to 11 Nm (97 lb-in).



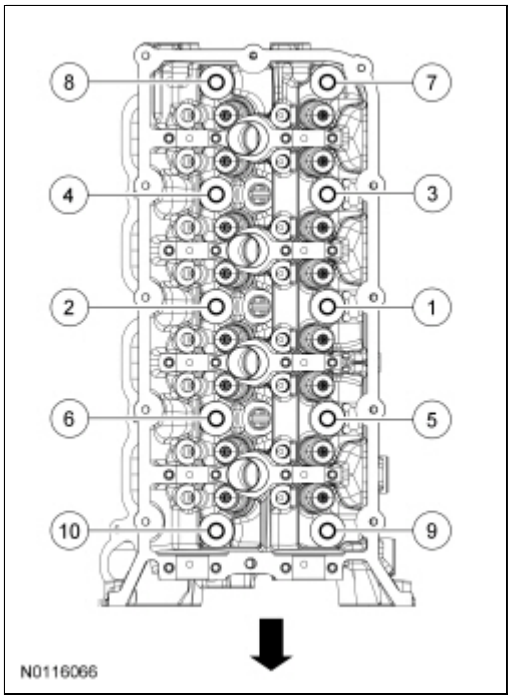
43. ***NOTICE:*** **Lubricate the O-ring seal with clean engine coolant prior to installing.**

    Using a new O-ring seal, install the coolant outlet pipe.
    - Tighten to 10 Nm (89 lb-in).



44. Tighten the new LH cylinder head bolts in 4 stages in the sequence shown.
    - Stage 1: Tighten to 25 Nm (18 lb-ft).
    - Stage 2: Tighten to 40 Nm (30 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.
    - Stage 4: Tighten an additional 90 degrees.

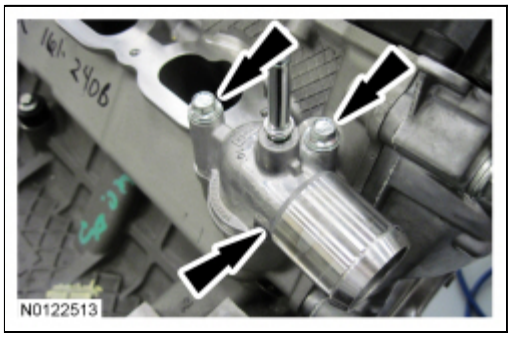
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45. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.**

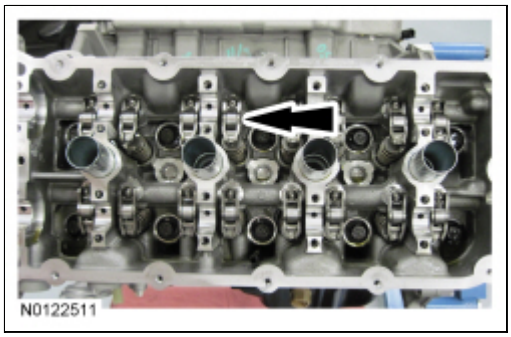
    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

46. Using a new gasket, install the coolant outlet and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



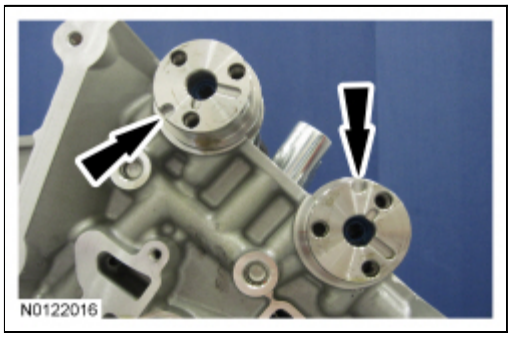
47. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

    Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



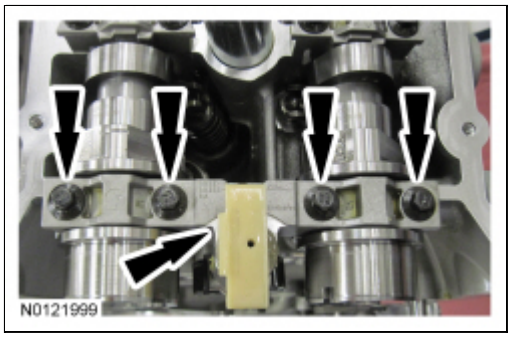
48. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

    Install the LH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



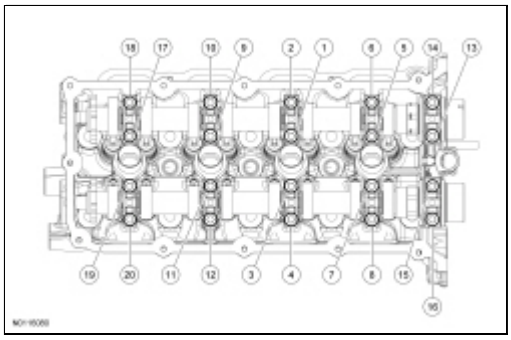
49. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.

50. Install the LH front camshaft bearing mega cap and the 4 bolts. Do not tighten the bolts at this time



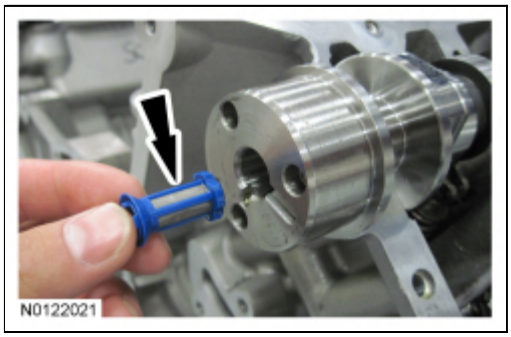
51. Tighten the bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 6 Nm (53 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

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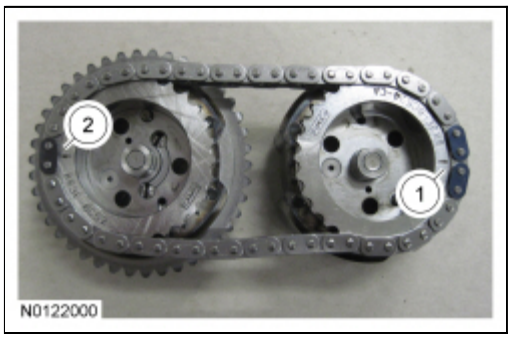


52. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

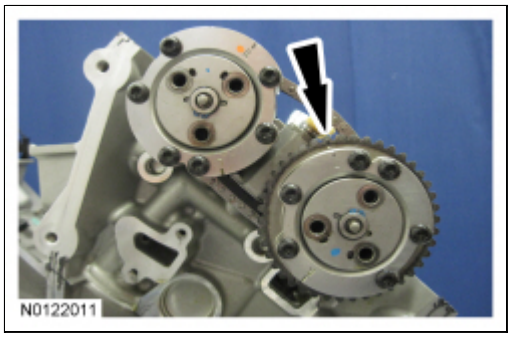
    Install the Variable Camshaft Timing (VCT) system oil filter in the intake and exhaust camshafts.



53. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

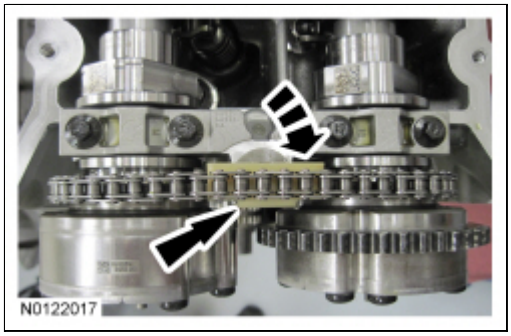


54. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



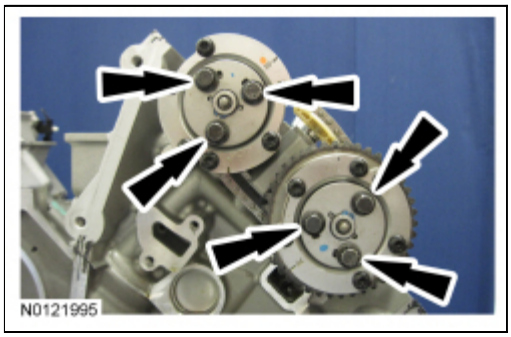
55. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



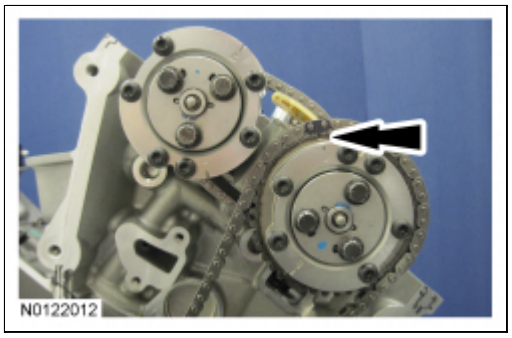
56. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

    Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.
    - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

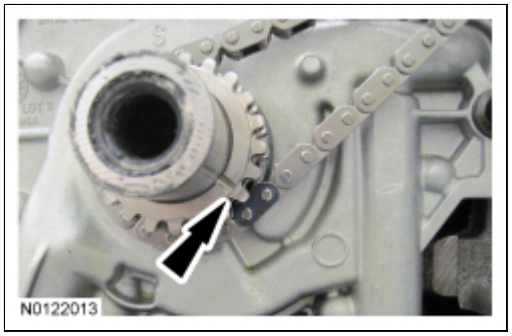


57. Install the LH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.

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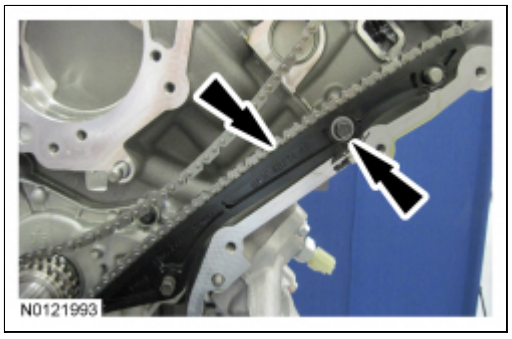


58. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



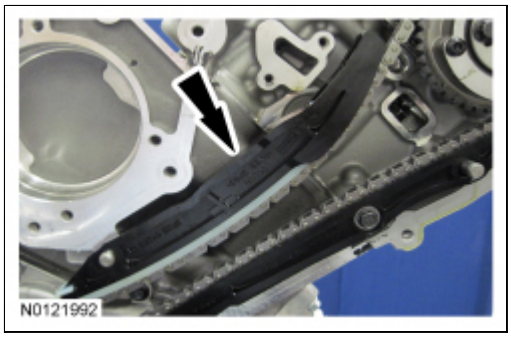
59. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

    Install the LH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



60. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

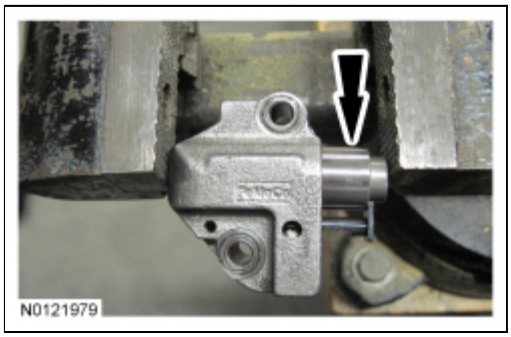
    Install the LH timing chain tensioner arm.



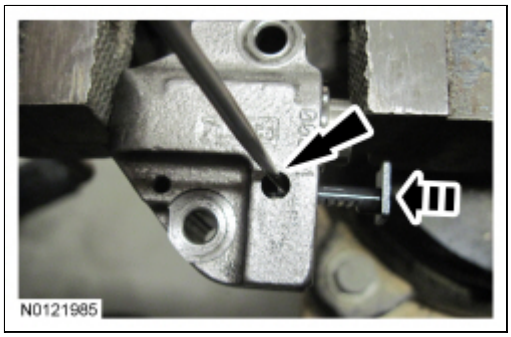
NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

61. ***NOTICE:*** **Do not compress the ratchet assembly or damage to the tensioner will occur.**

    Compress the primary timing chain tensioner plunger, using an edge of a vise.

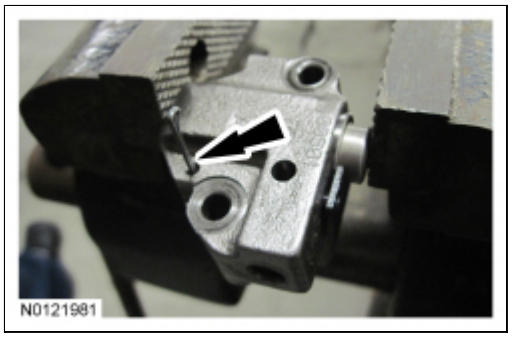


62. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.

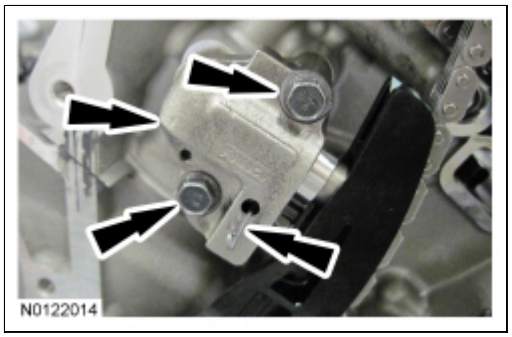


63. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.

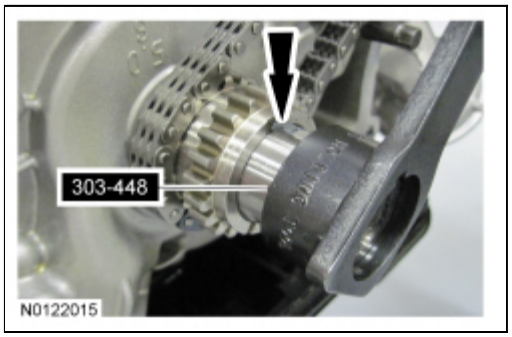
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64. Install the LH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.

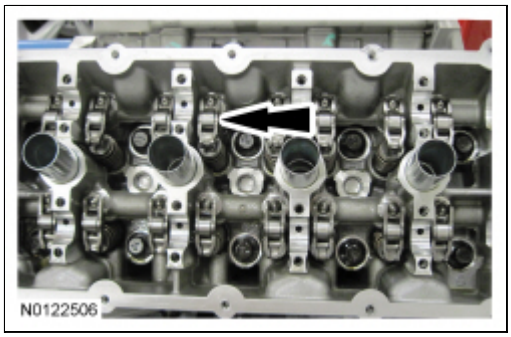


65. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



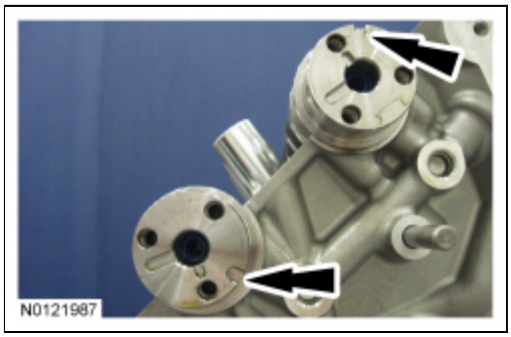
66. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

    Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

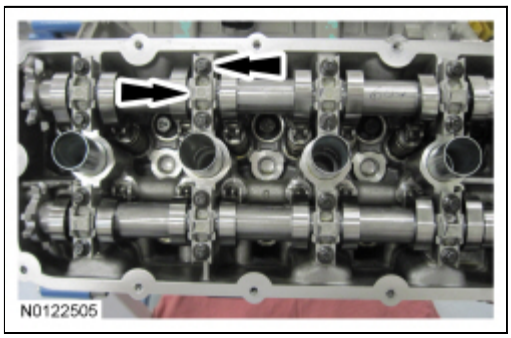


67. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

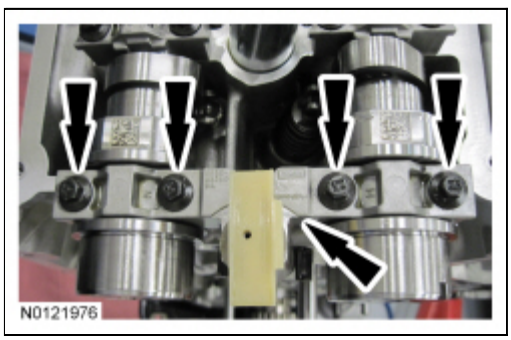
    Install the RH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



68. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.



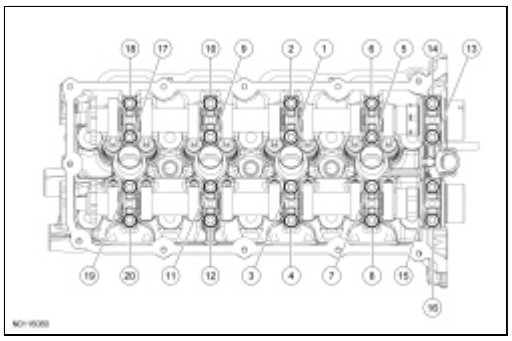
69. Install the RH front camshaft bearing mega cap and the 4 bolts. Do not tighten at this time



70. Tighten the bolts in the sequence shown in 2 stages.

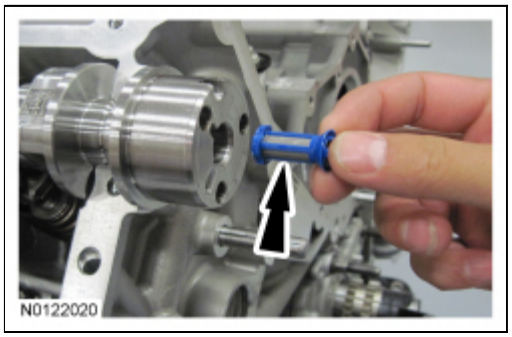
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- Stage 1: Tighten to 6 Nm (53 lb-in).
- Stage 2: Tighten an additional 45 degrees.

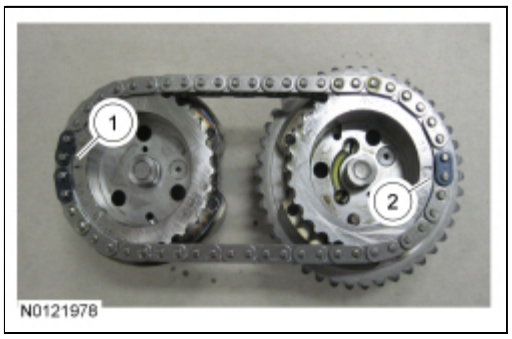


71. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

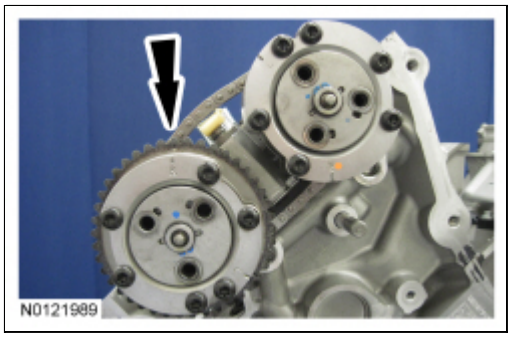
    Install the VCT system oil filter in the intake and exhaust camshafts.



72. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

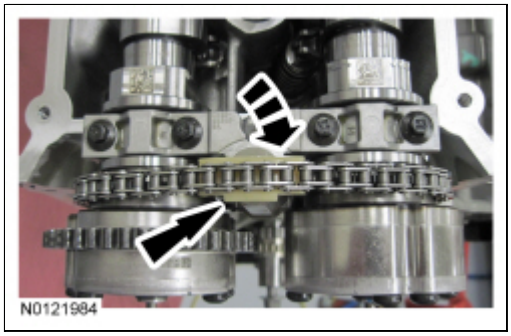


73. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



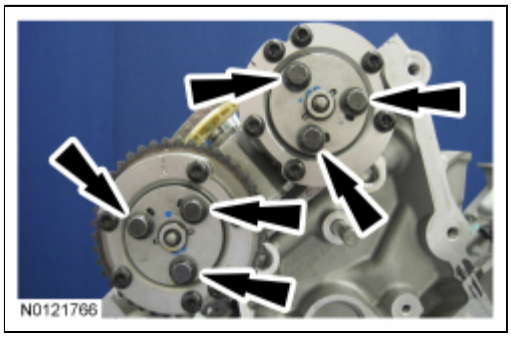
74. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



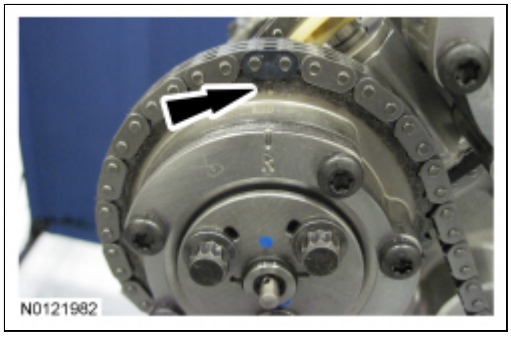
75. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

    Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.
    - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

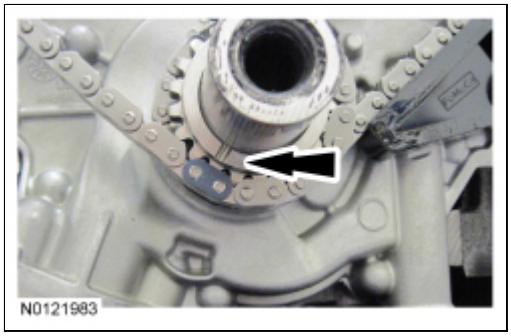


76. Install the RH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.

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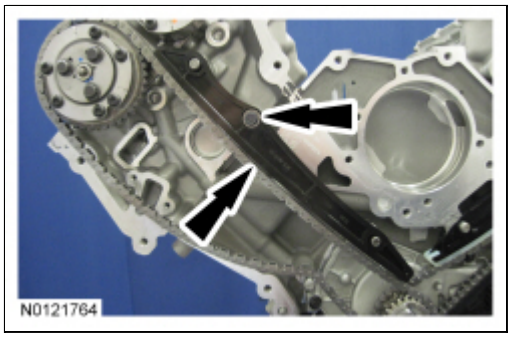


77. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



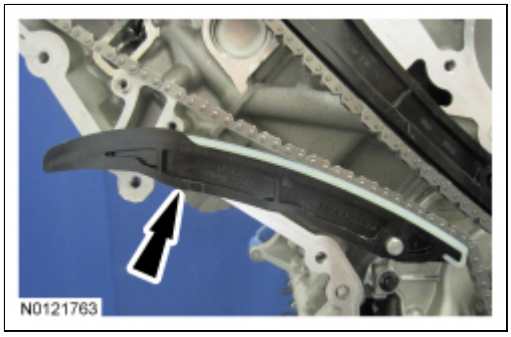
78. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

    Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).

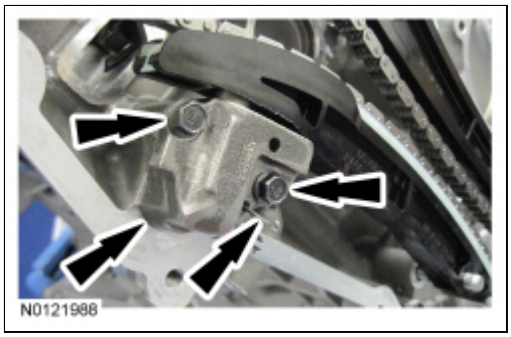


79. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

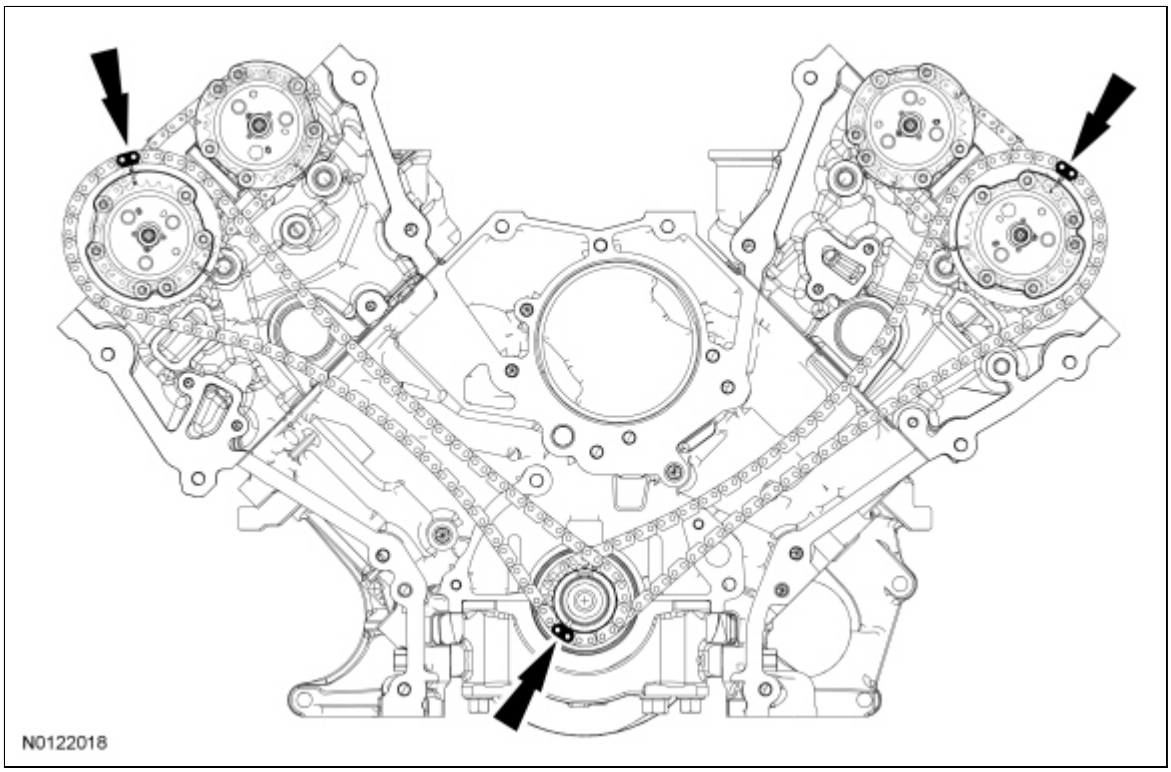
    Install the RH timing chain tensioner arm.



80. Install the RH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



81. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



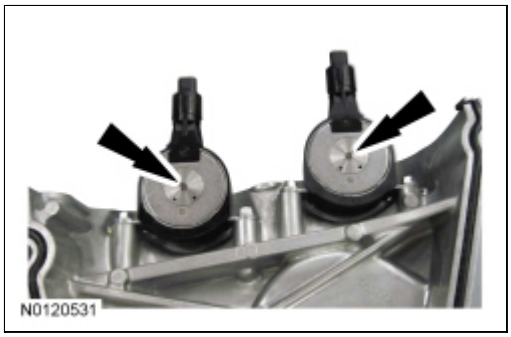
82. ***NOTICE:*** **The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully**

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depressed to avoid interference with the VCT valve tips when installing the engine front cover. Failure to follow these instructions can result in damage to the engine.

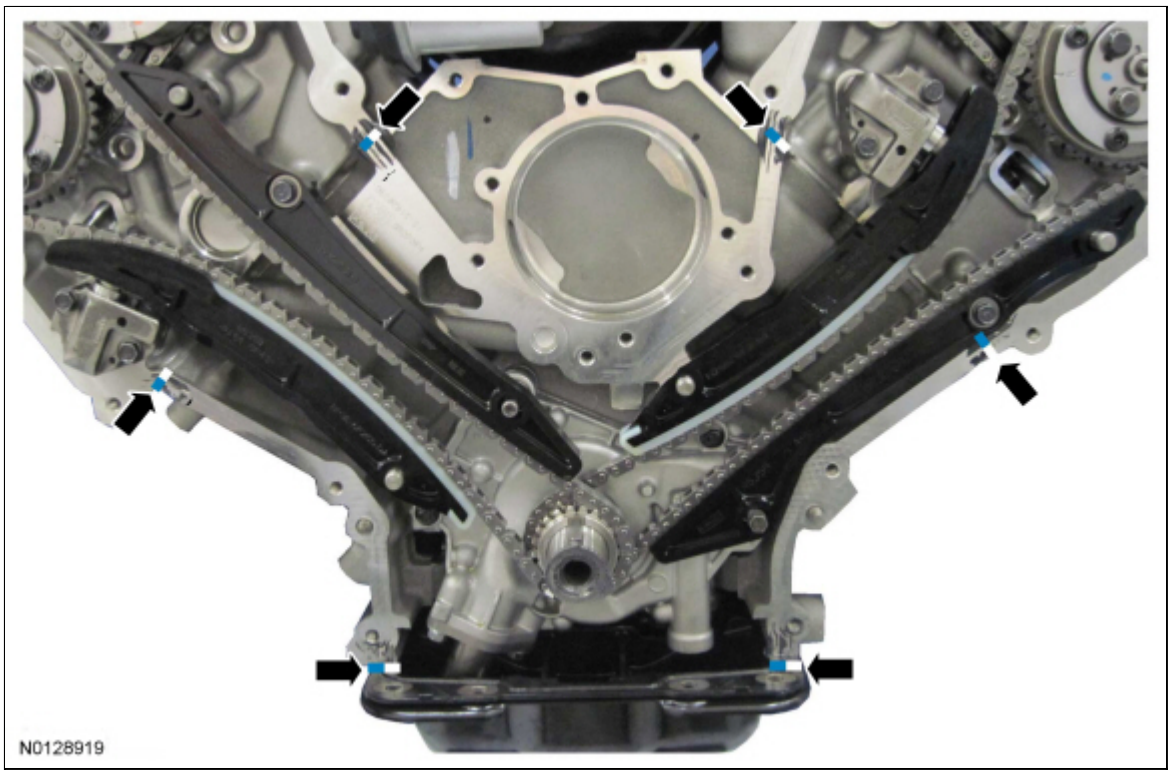
NOTE: LH shown, RH similar.

Fully depress the VCT variable force solenoid pins.



83. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    Apply a bead of silicone gasket and sealant to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.

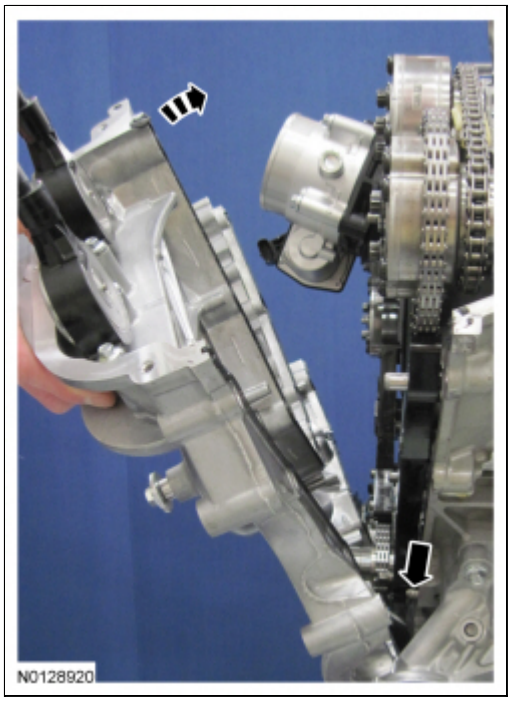


84. **NOTE:** Make sure that the engine front cover gasket is in place on the engine front cover before

installation.

Using new gaskets, position the engine front cover onto the dowels.

- Install the 13 engine front cover bolts, 2 stud bolts, 2 oil pan-to-engine front cover bolts and 2 oil pan-to-engine front cover stud bolts finger-tight.

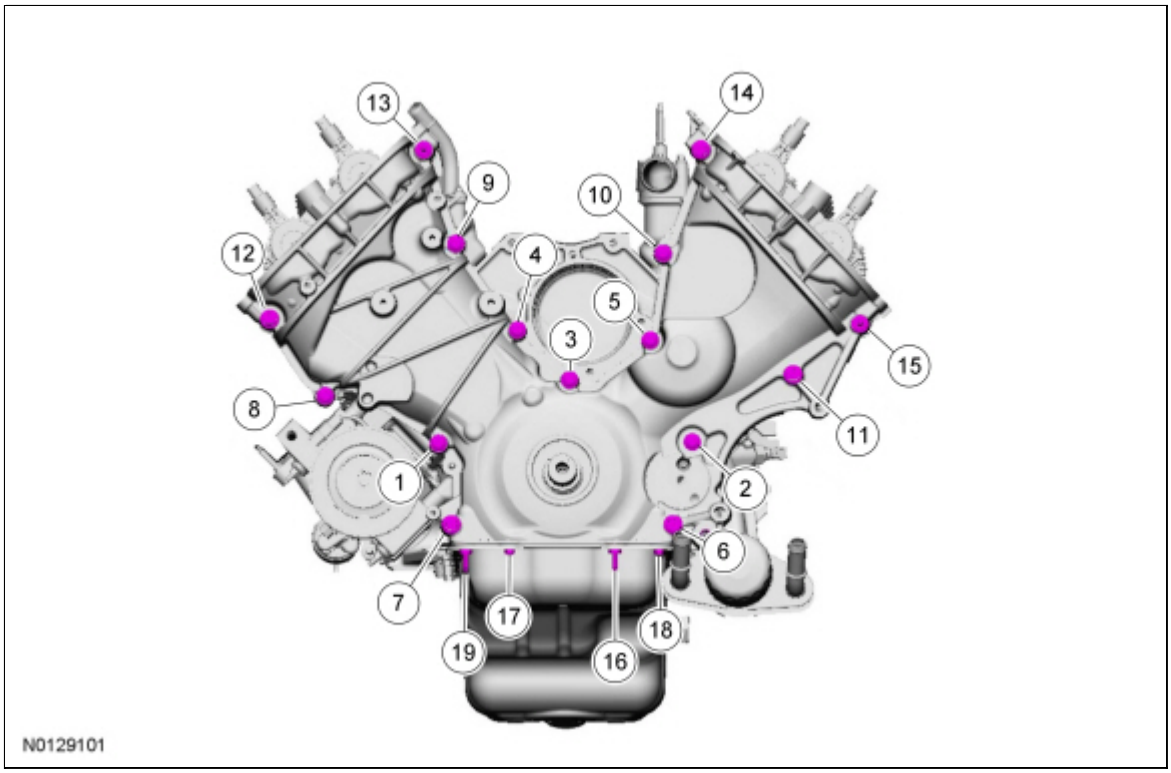


85. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

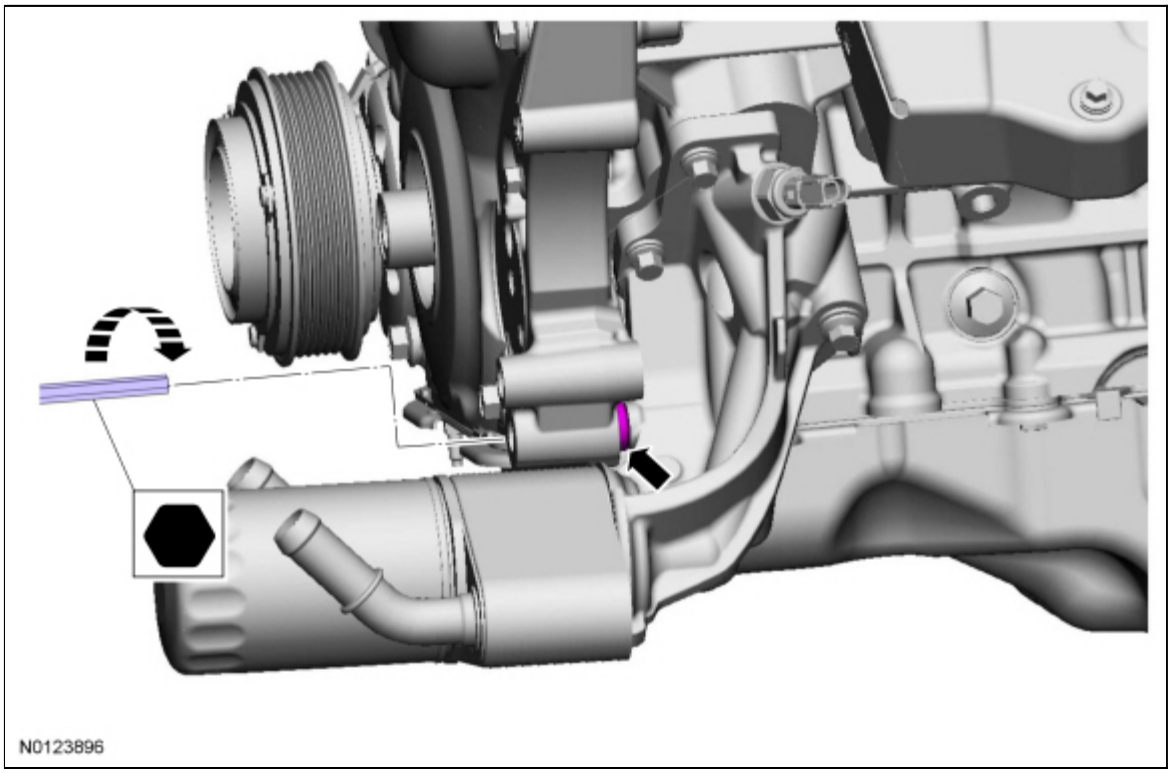
    Tighten the bolts in the sequence shown in 2 stages.

    - Stage 1: Tighten bolts 1-15 to 25 Nm (18 lb-ft) and bolts 16-19 to 10 Nm (89 lb-in).
    - Stage 2: Tighten bolts 1-15 an additional 60 degrees and bolts 16-19 an additional 45 degrees.

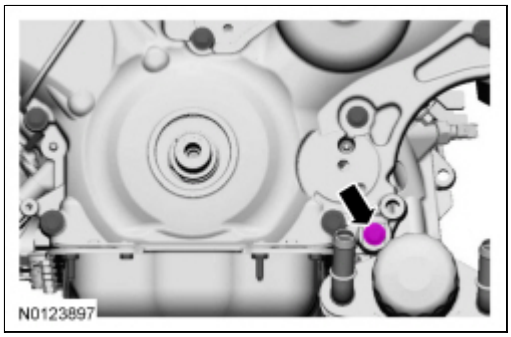
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86. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).

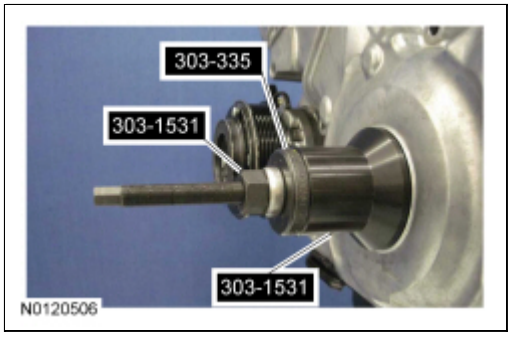


87. Install the engine front cover-to-oil filter adapter bolt and tighten to 25 Nm (18 lb-ft) plus an additional 60 degrees.



88. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

    Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



89. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.

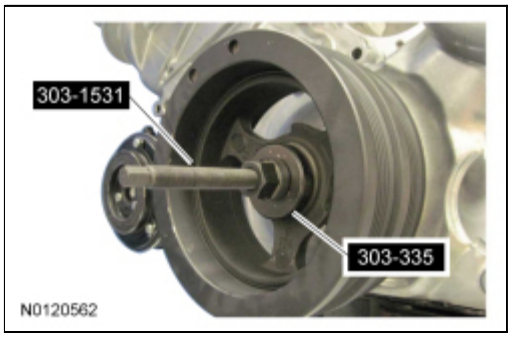


90. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.

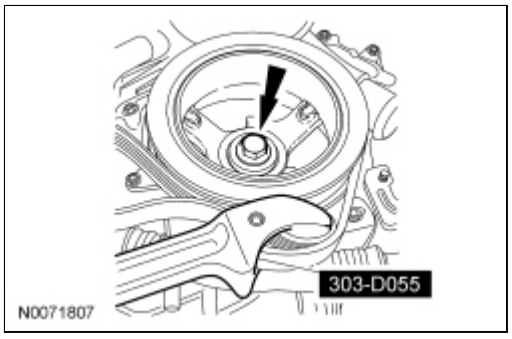
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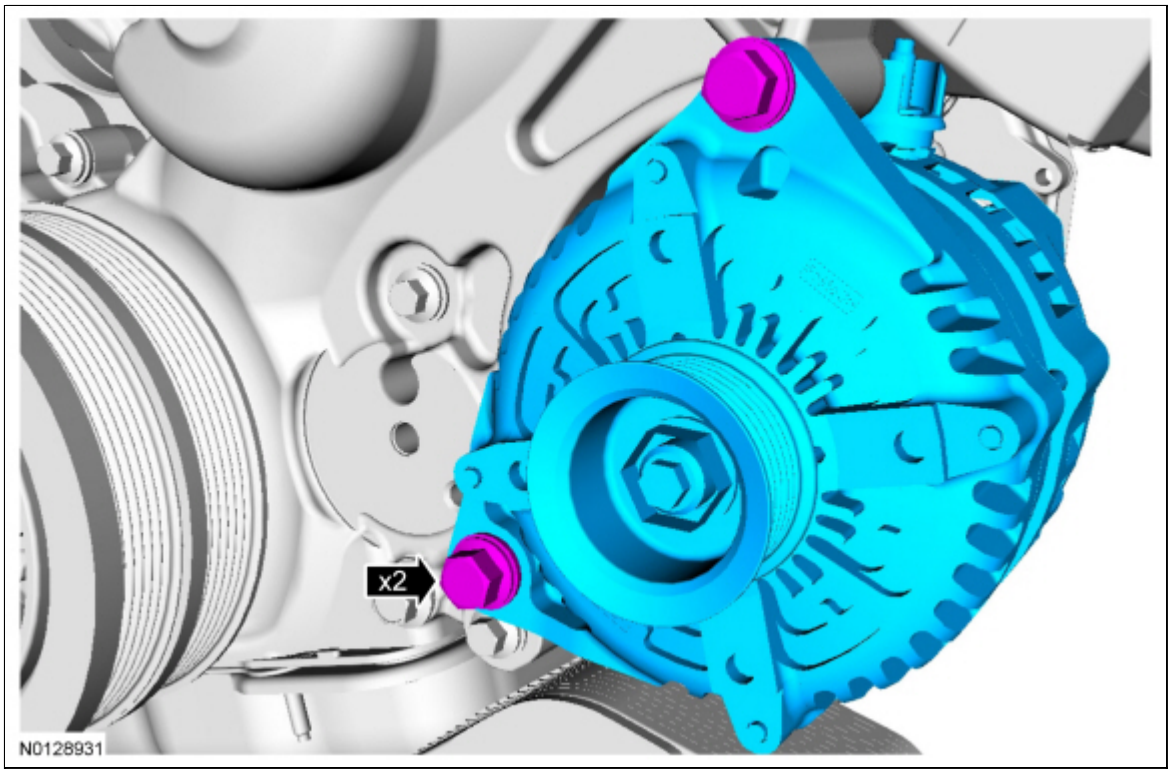
91. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



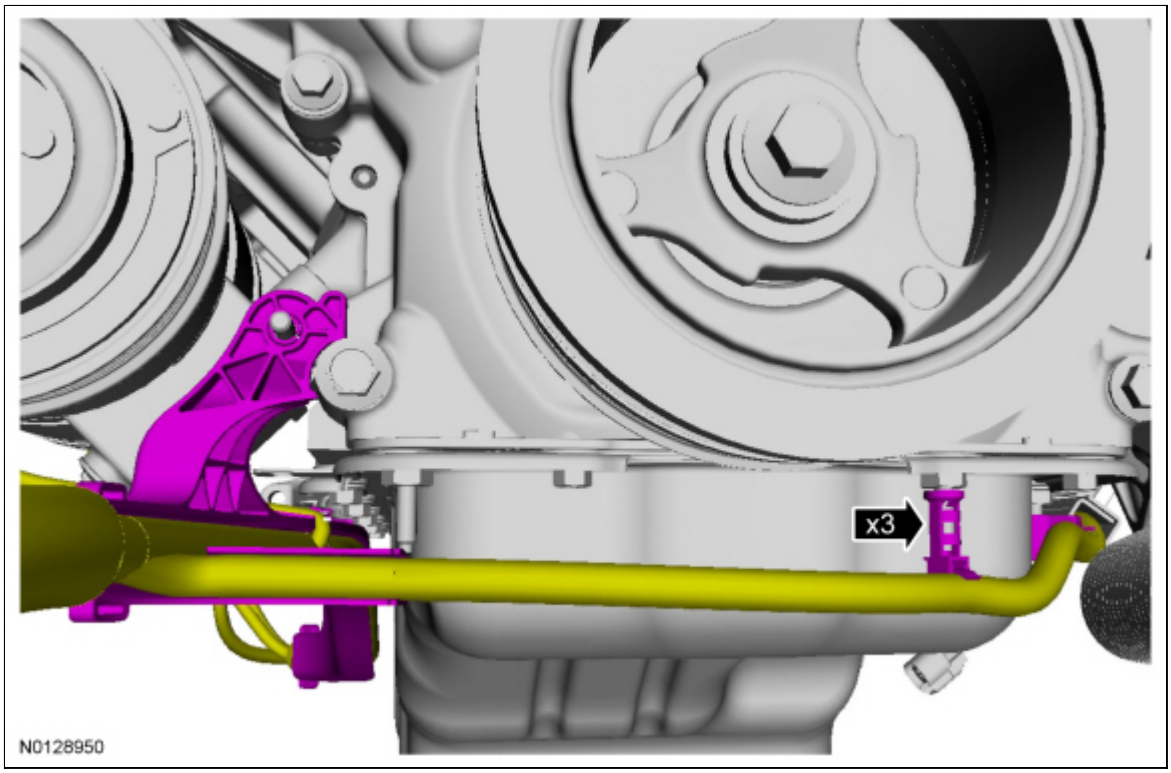
92. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
    - Stage 1: Tighten to 140 Nm (103 lb-ft).
    - Stage 2: Loosen 360 degrees.
    - Stage 3: Tighten to 100 Nm (74 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



93. Install the generator and the 2 bolts.
    - Tighten to 48 Nm (35 lb-ft).

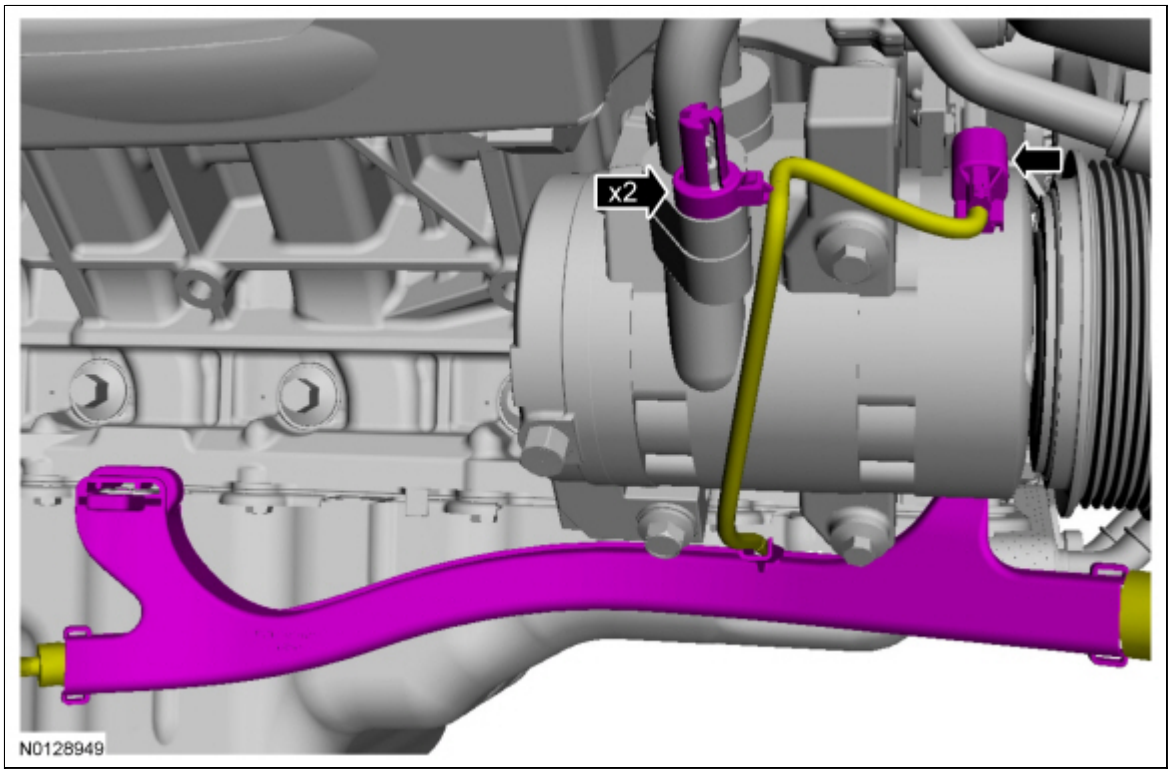


94. Attach the 3 wiring harness retainers.

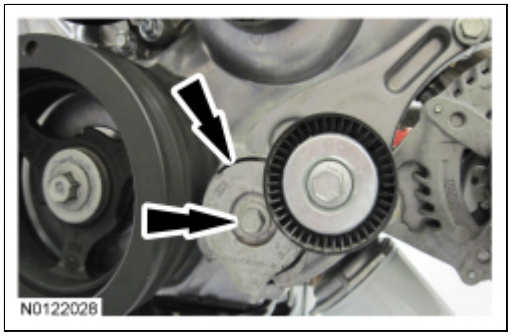


95. Connect the A/C compressor electrical connector and the 2 wiring harness retainers.

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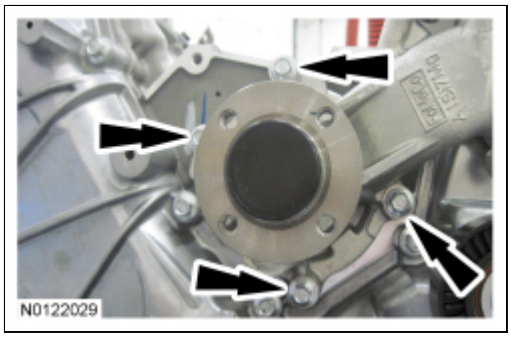


96. Install the accessory drive belt tensioner and the bolt.
    - Tighten to 48 Nm (35 lb-ft).

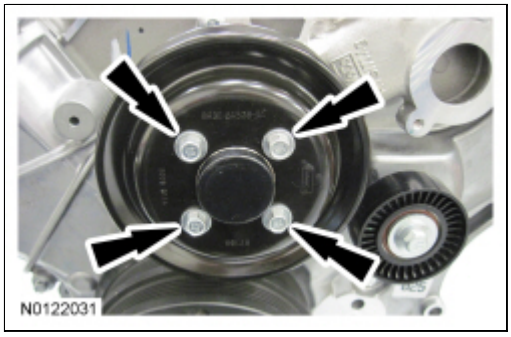


97. **NOTE:** Lubricate the new coolant pump O-ring seal with clean engine coolant.

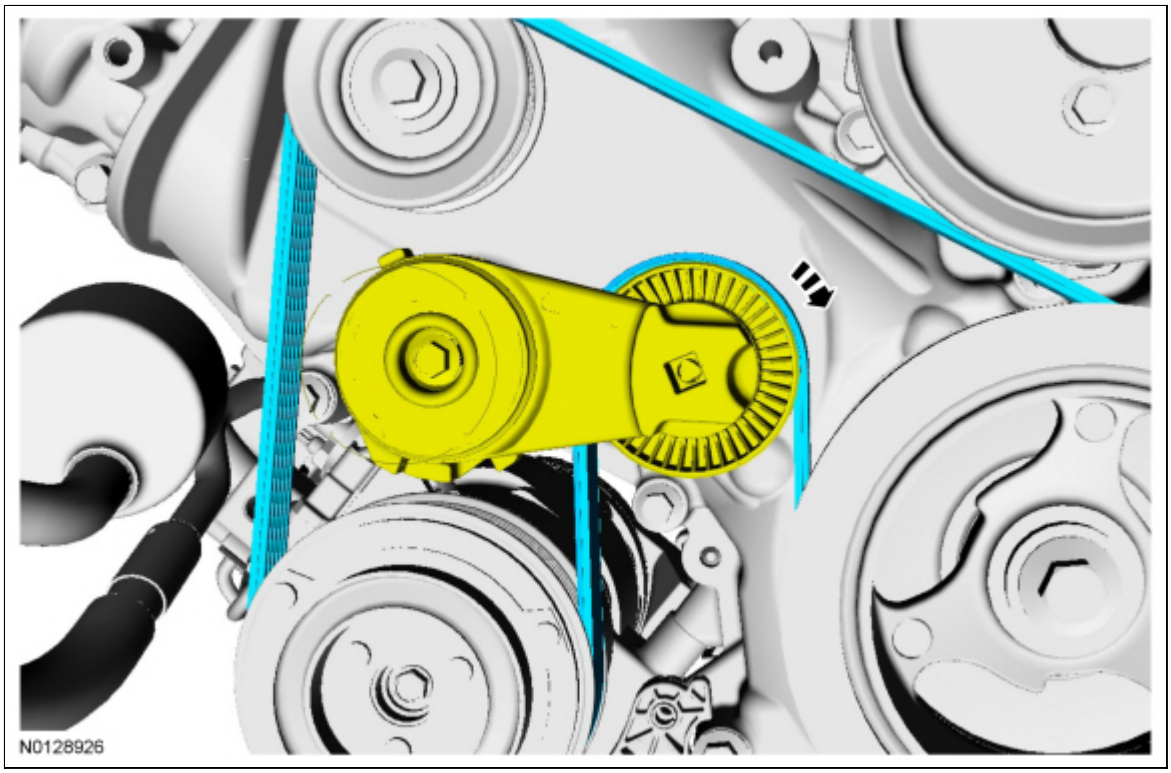
    Using a new O-ring seal, install the coolant pump and the 4 bolts.
    - Tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.



98. Install the coolant pump pulley and the 4 bolts.

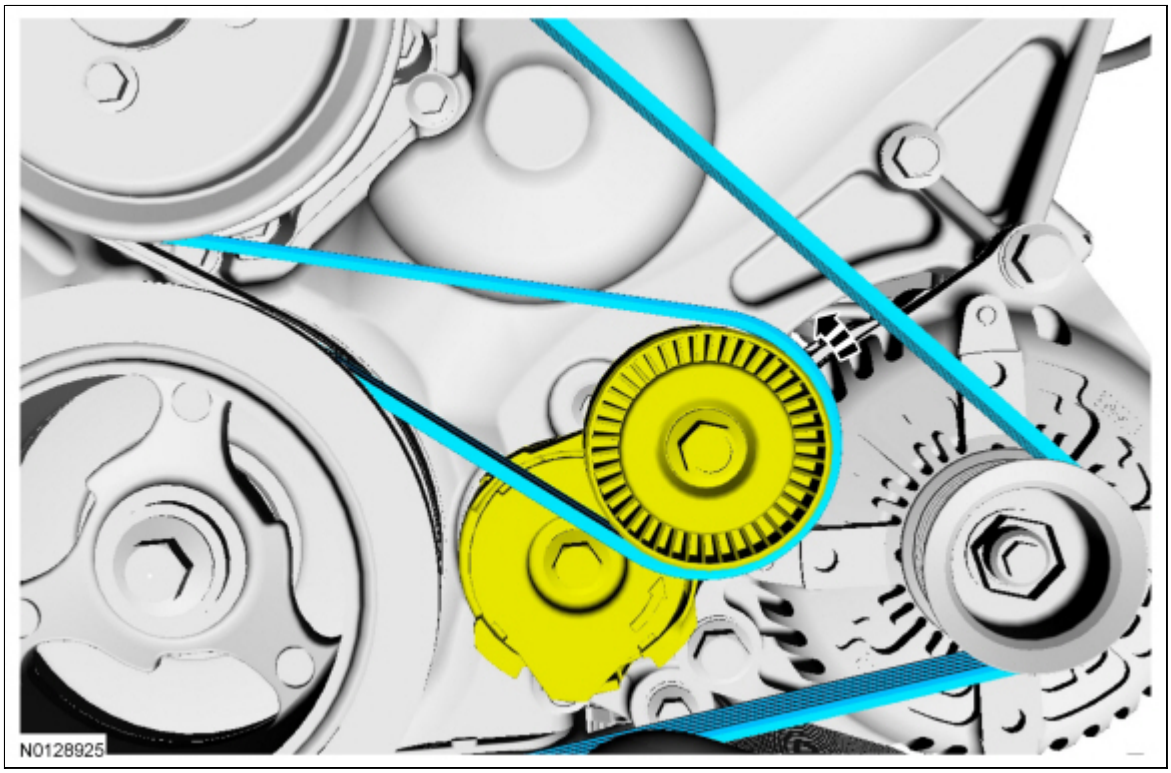


99. Rotate the A/C compressor belt tensioner clockwise and install the A/C compressor belt.

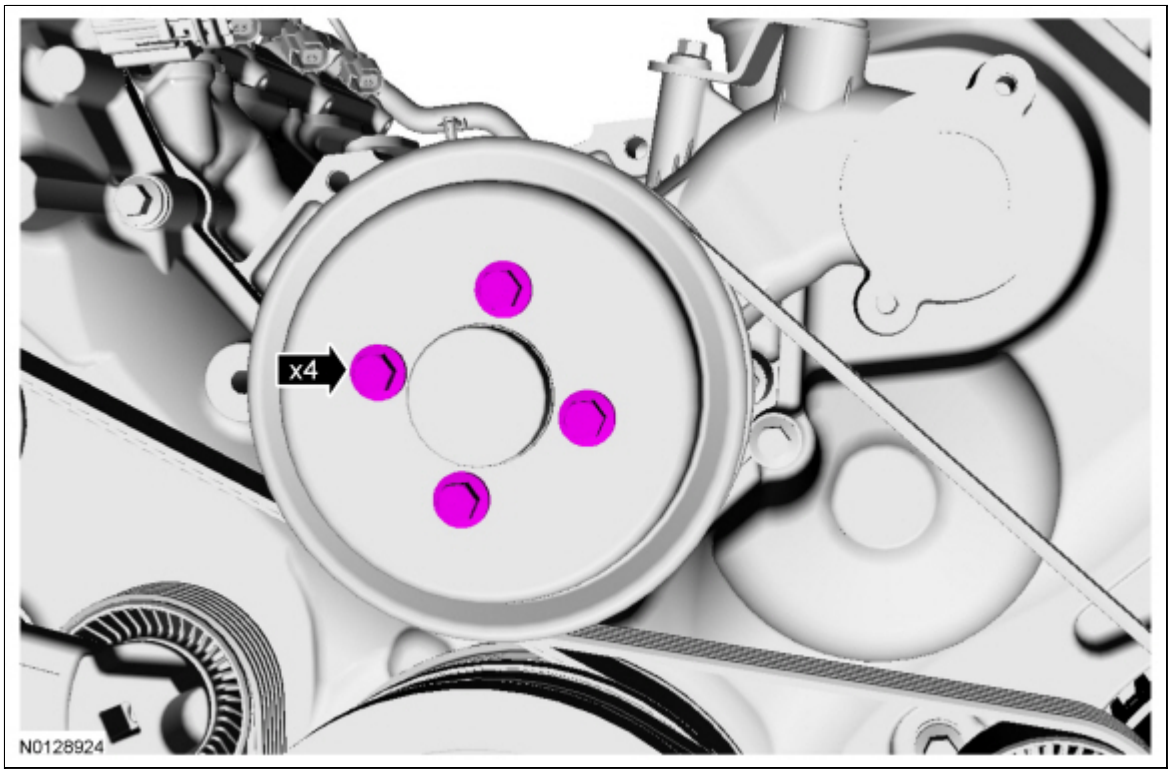


100. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.

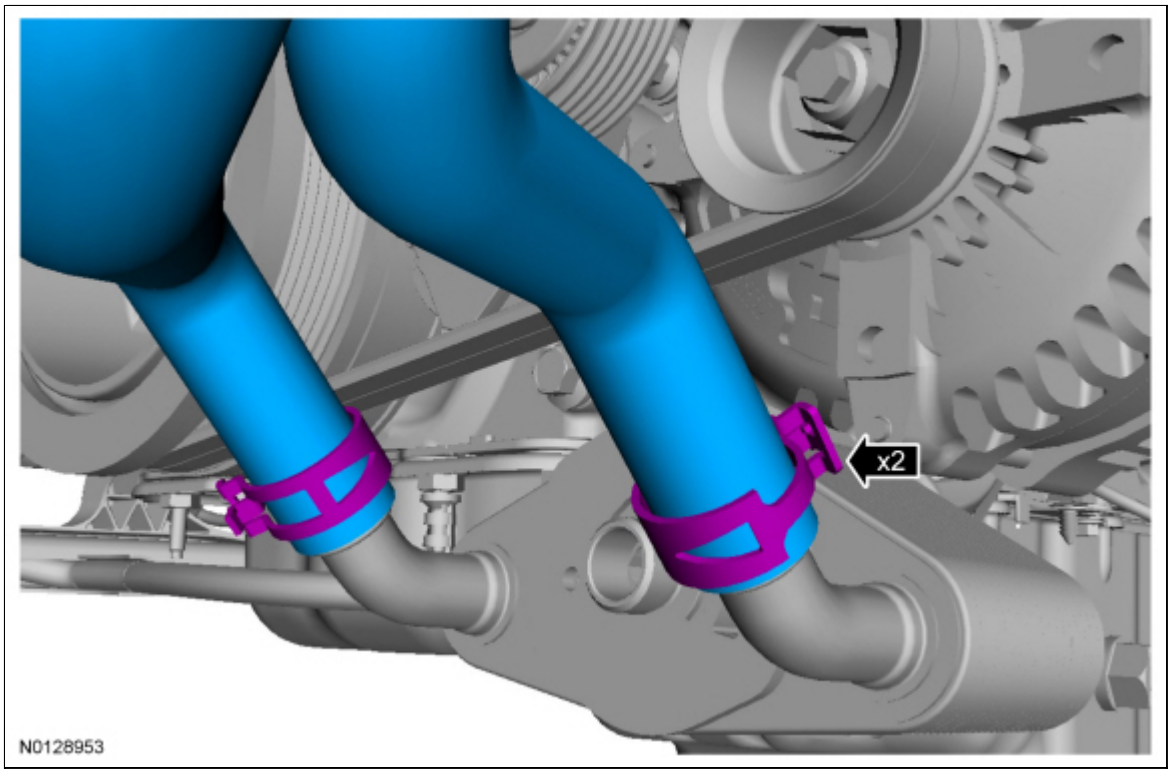
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101. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).



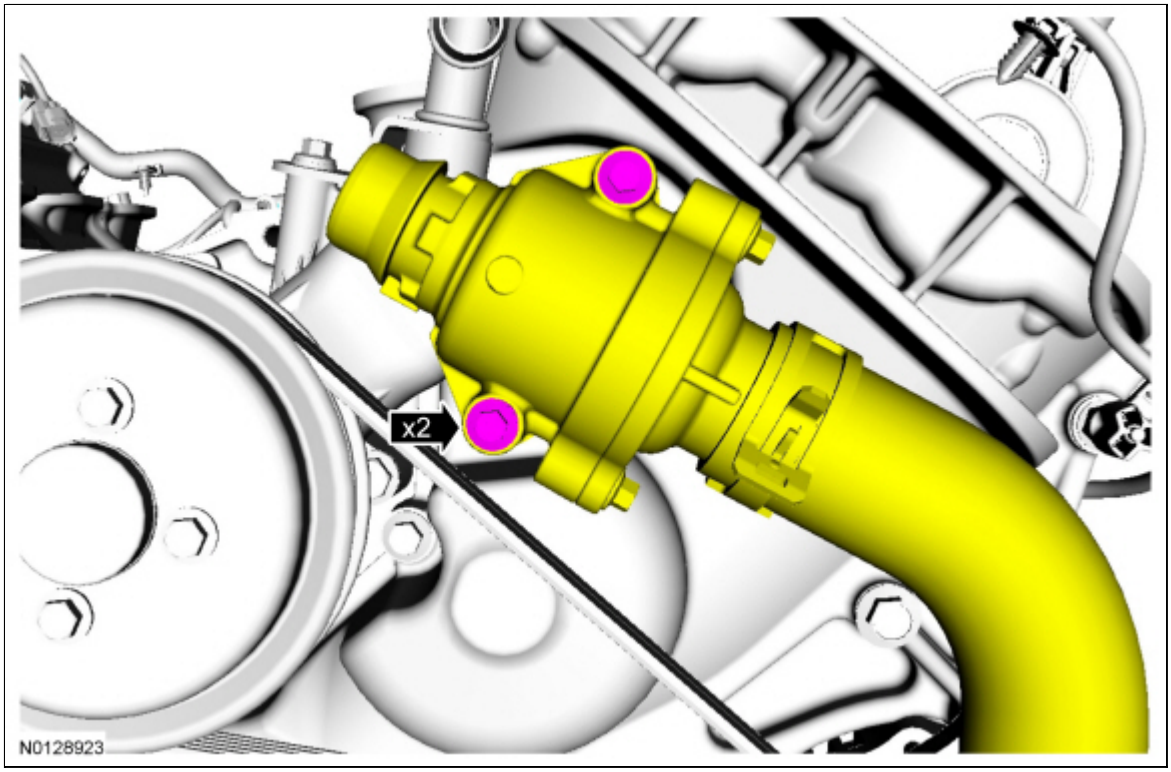
102. Connect the 2 coolant hoses to the oil cooler.



103. **NOTE:** Lubricate the new thermostat housing O-ring seal with clean engine coolant.

Using a new thermostat housing O-ring seal, install the thermostat housing and the 2 bolts.

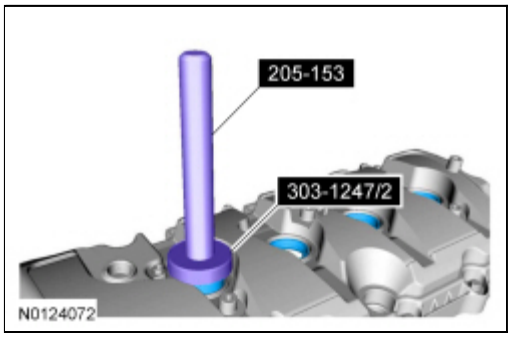
- Tighten to 10 Nm (89 lb-in).



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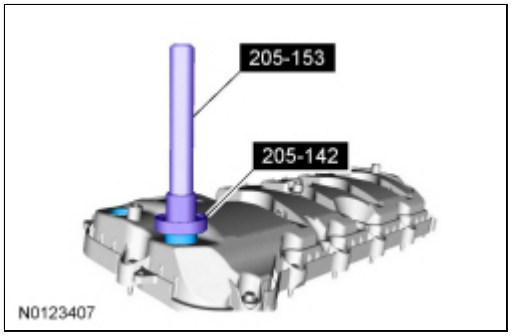
104. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



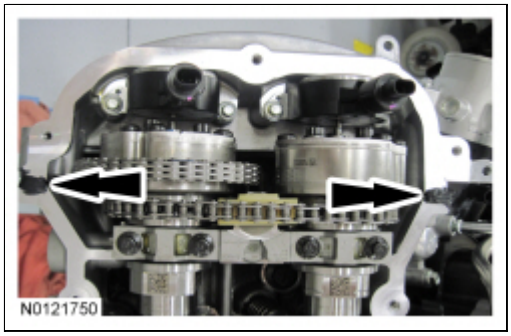
105. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the Differential Bearing Cone Installer and Handle, install new VCT variable force solenoid seal (s).

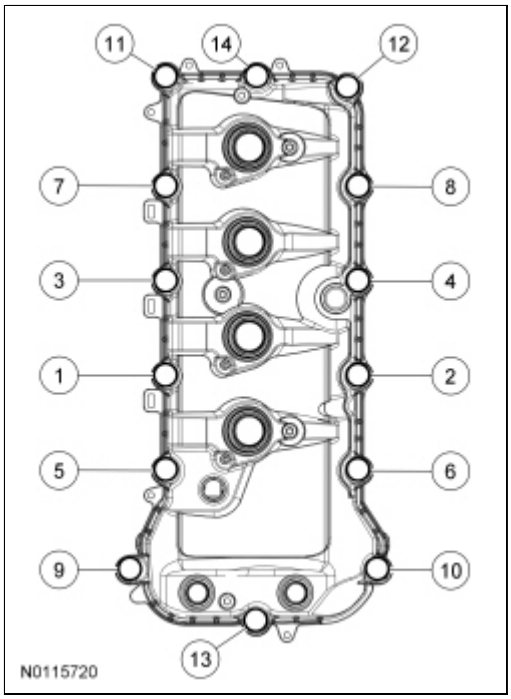


106. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-LH cylinder head joints.



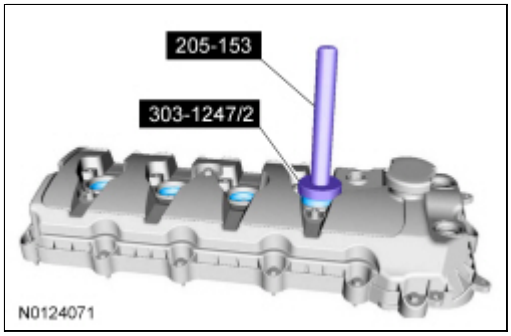
107. Position the LH valve cover and new gasket on the cylinder head.
    - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



108. Install the oil level indicator.

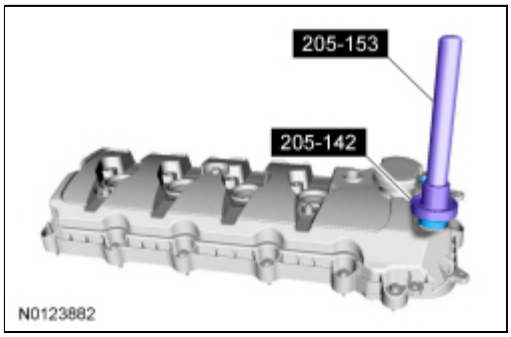
109. **NOTE:** Installation of new seals is only required if damaged seals were removed.

Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



110. **NOTE:** Installation of new seals is only required if damaged seals were removed.

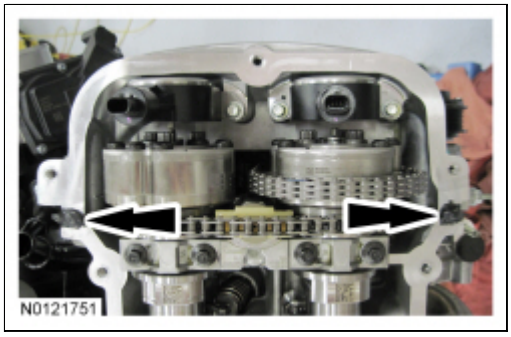
Using the Differential Bearing Cone Installer and Handle, install new VCT variable force solenoid seal (s).



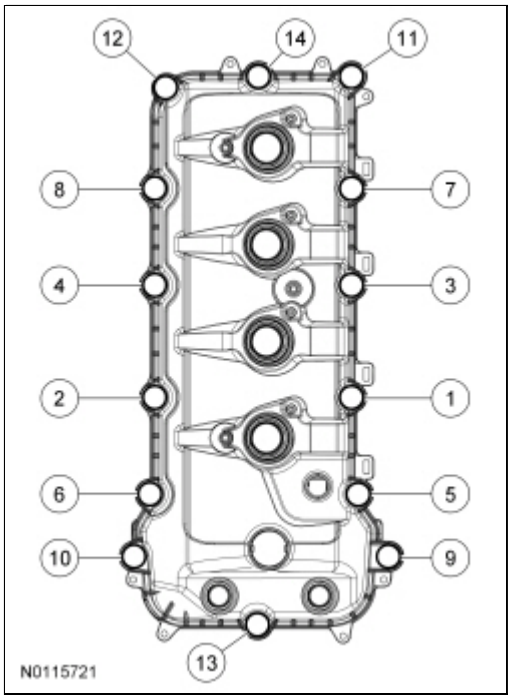
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111. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

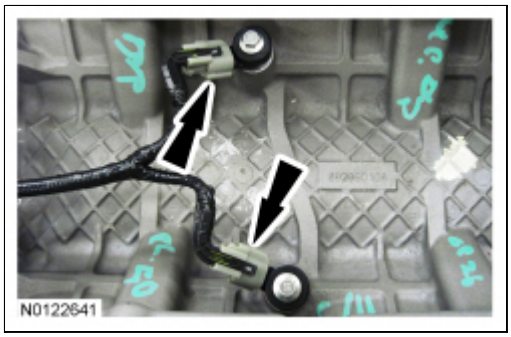
    Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-RH cylinder head joints.



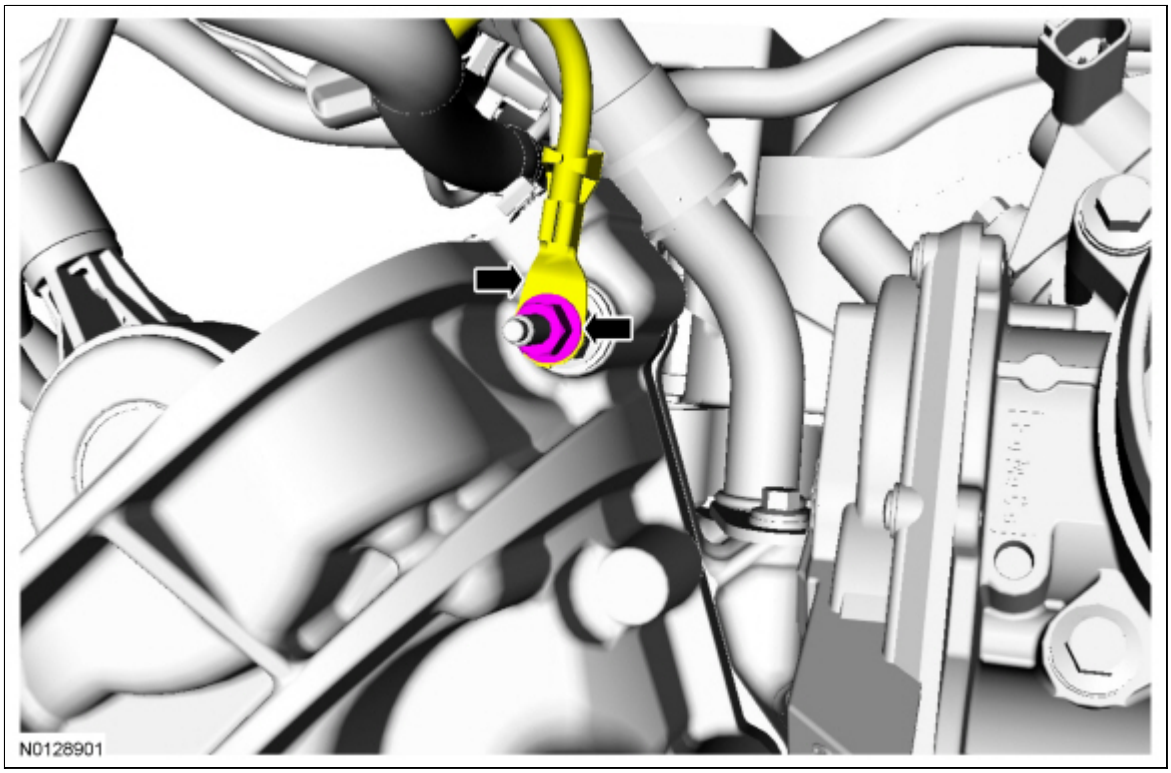
112. Position the RH valve cover and new gasket on the cylinder head.
    - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



113. Position the wiring harness on the engine.
    - Connect the 2 KS electrical connectors.

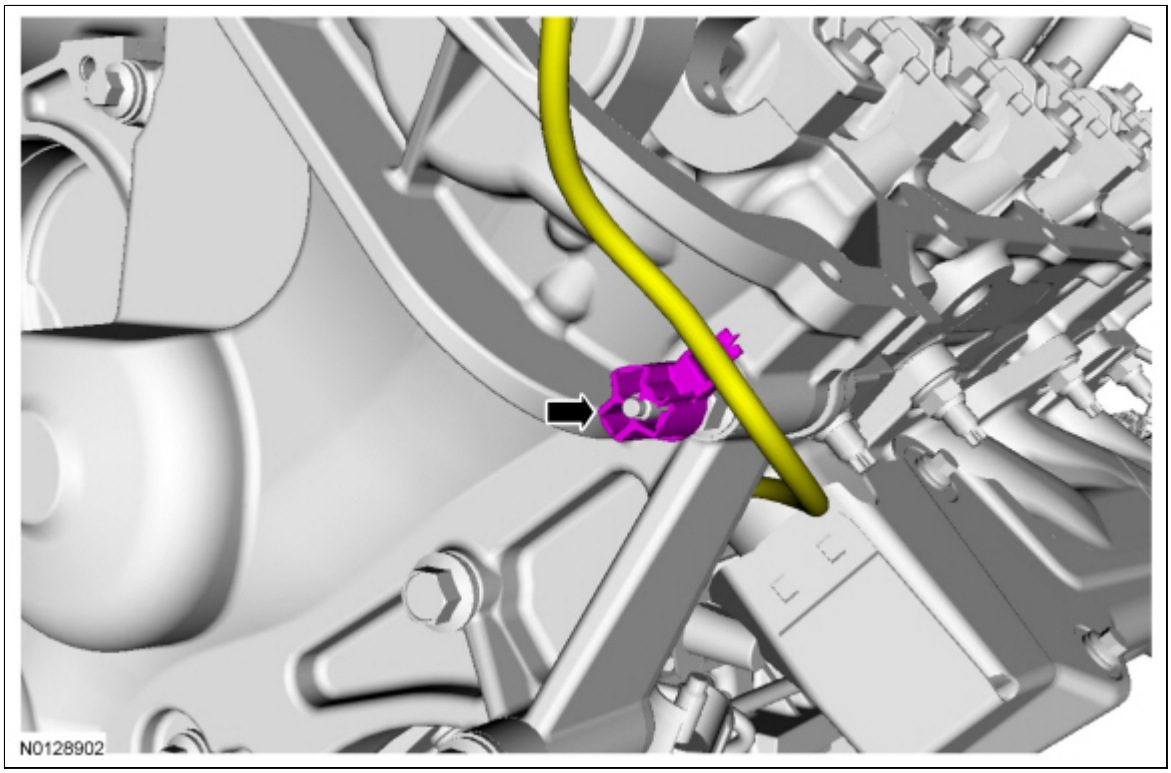


114. Install the ground wire and nut to the engine front cover stud bolt.
    - Tighten to 10 Nm (89 lb-in).

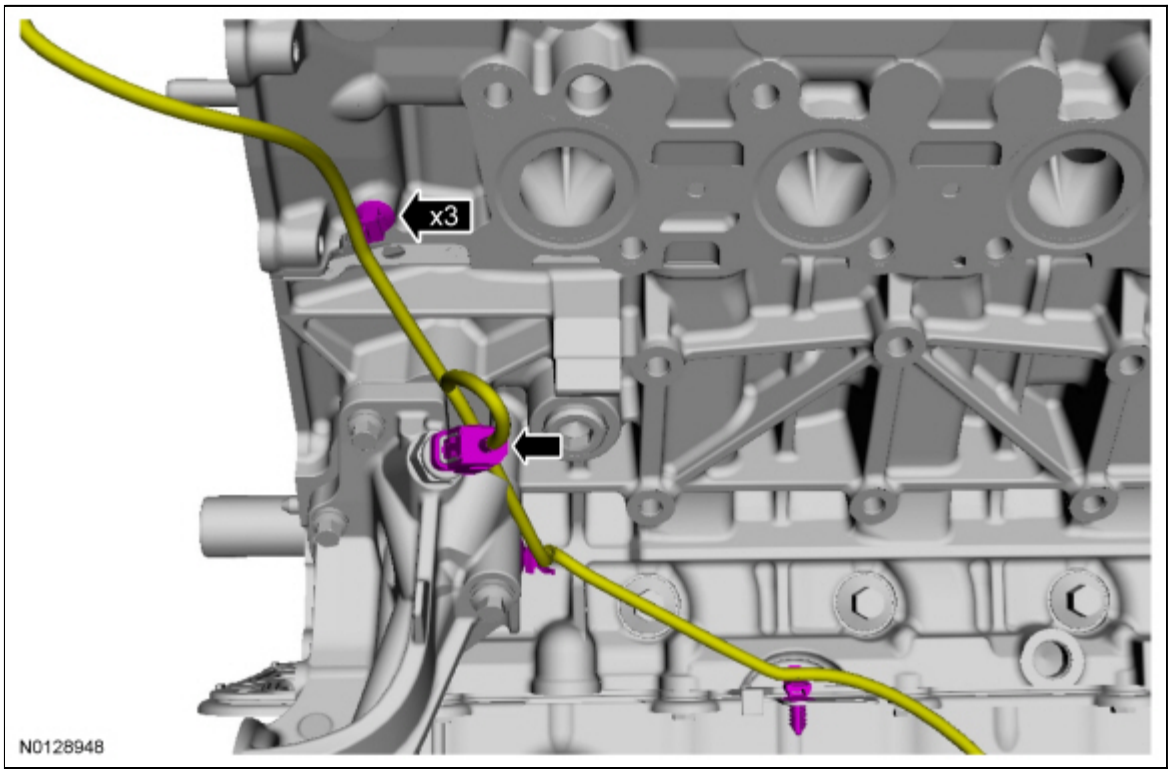


115. Attach the wiring harness retainer to the engine front cover stud bolt.

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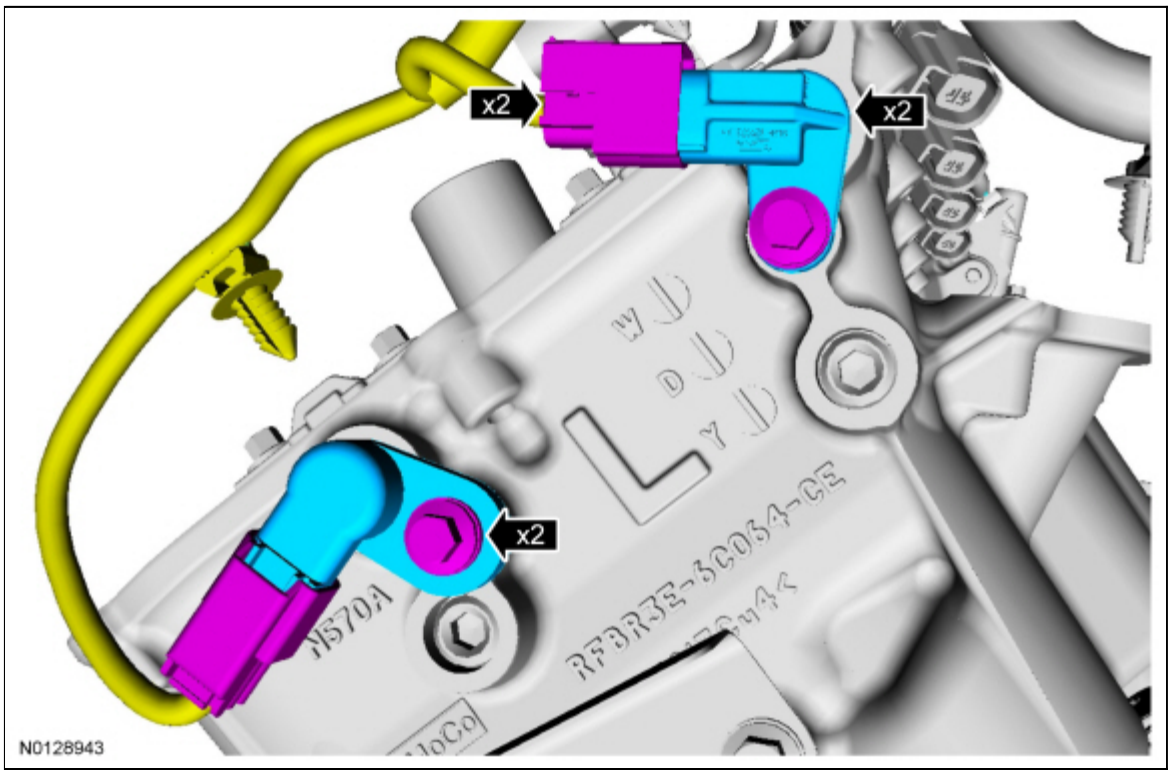


116. Connect the Engine Oil Pressure (EOP) switch electrical connector and the 3 wiring harness retainers.

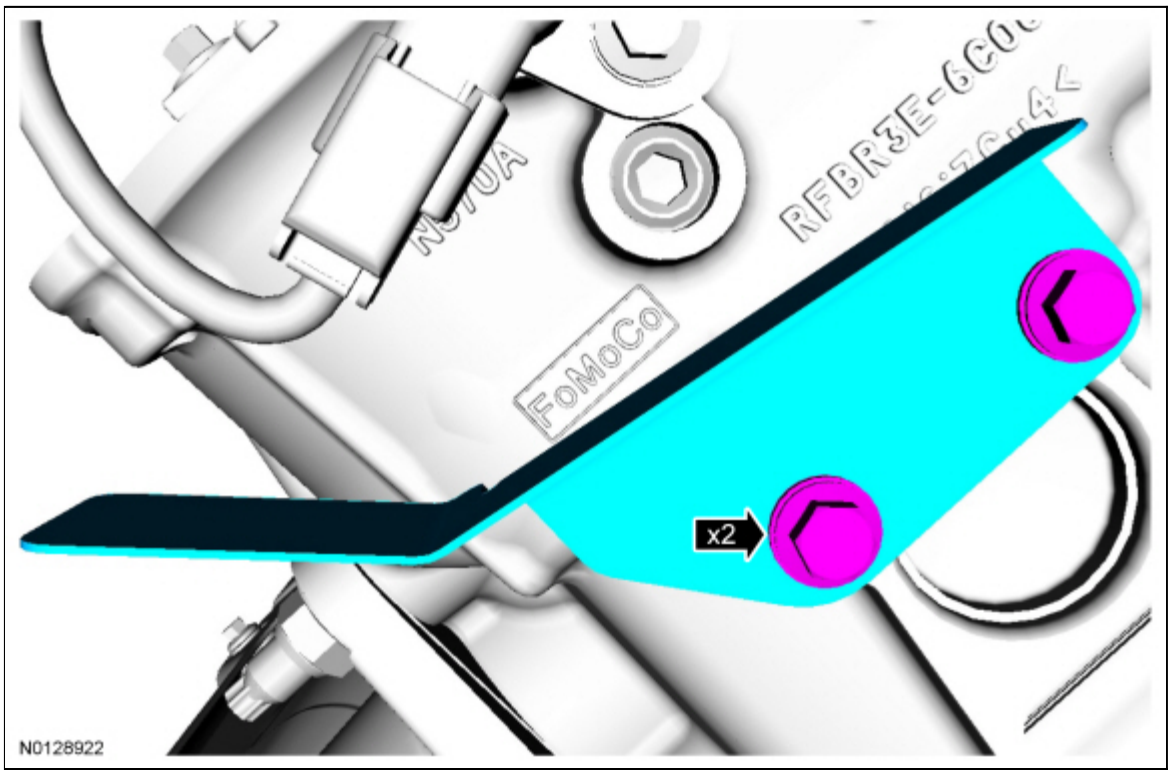


117. If removed, install the LH intake and exhaust Camshaft Position (CMP) sensors and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

- Connect the LH intake and exhaust CMP sensor electrical connectors.

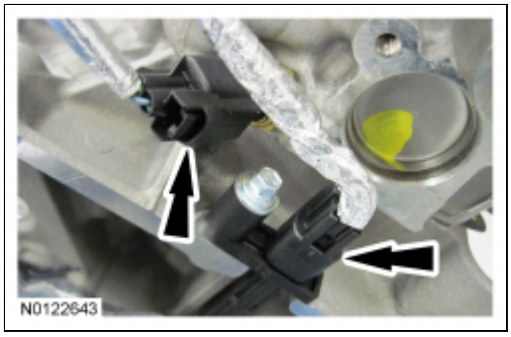


118. Install the heat shield and the 2 bolts to the LH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

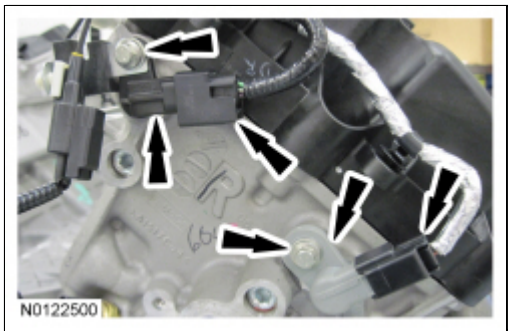


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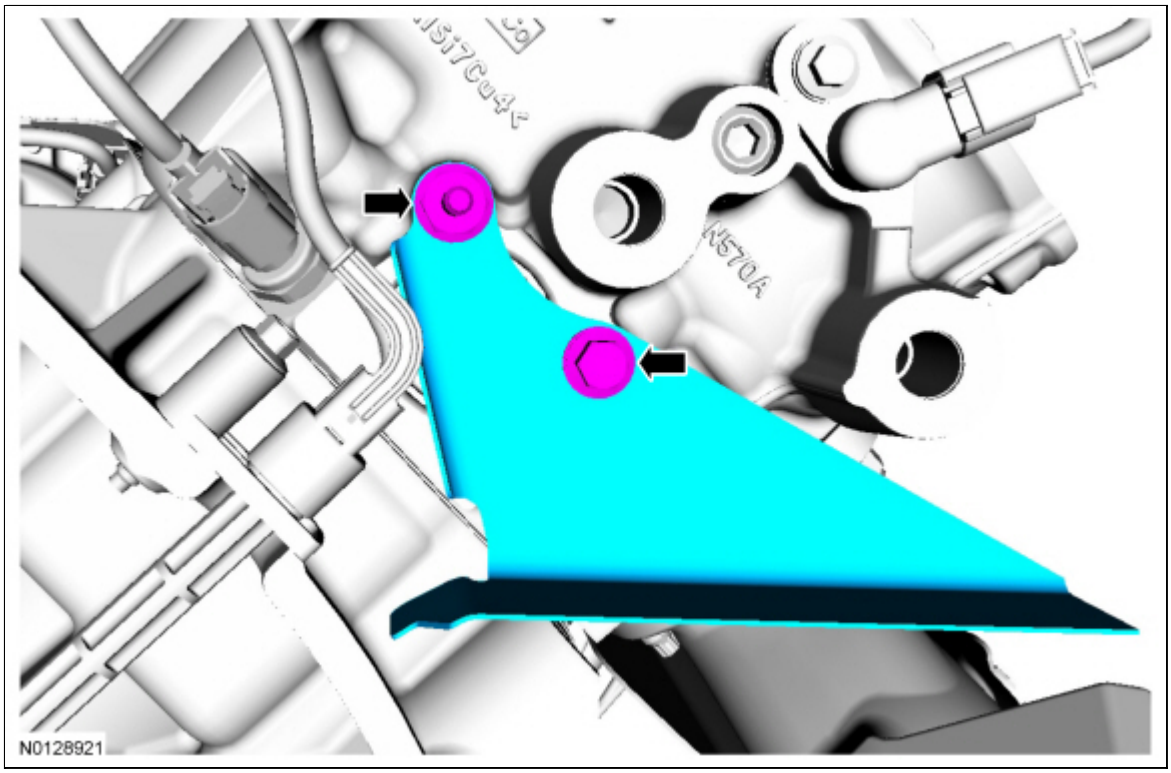
119. Connect the CHT sensor and the CKP sensor electrical connectors.



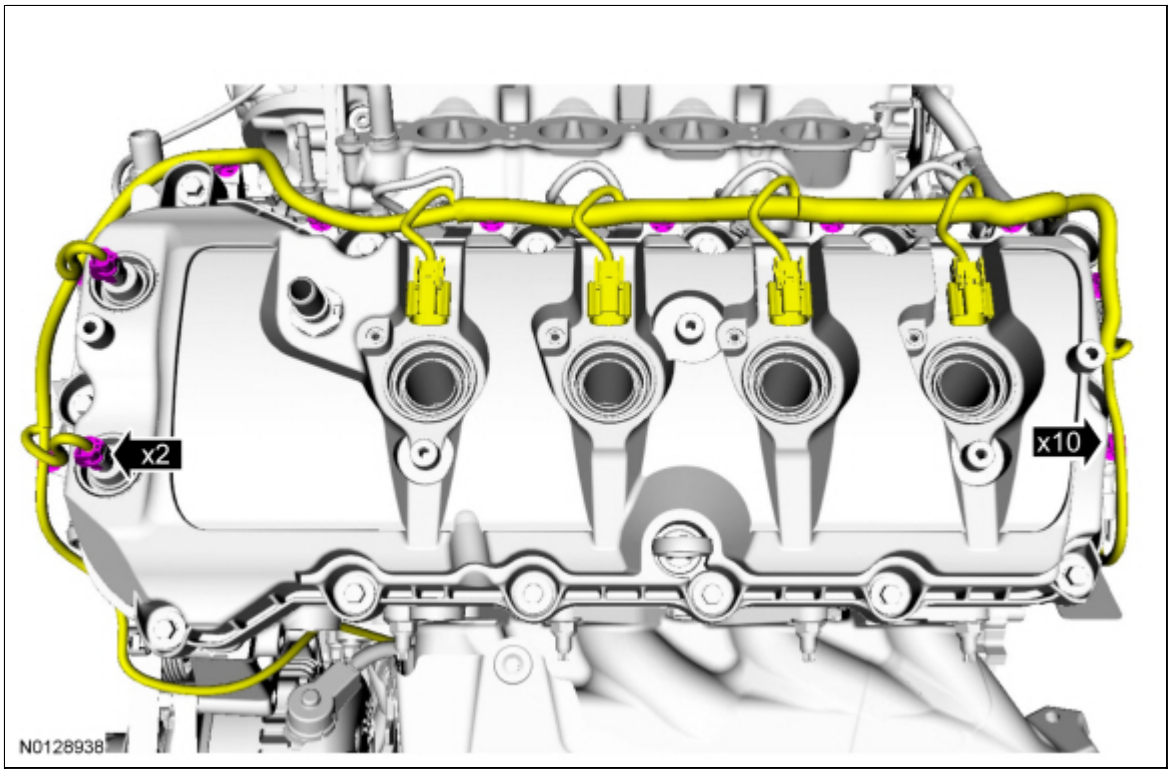
120. Install the RH intake and exhaust CMP sensors and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Connect the RH intake and exhaust CMP sensor electrical connectors.



121. Install the heat shield, the bolt and the stud bolt on the RH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

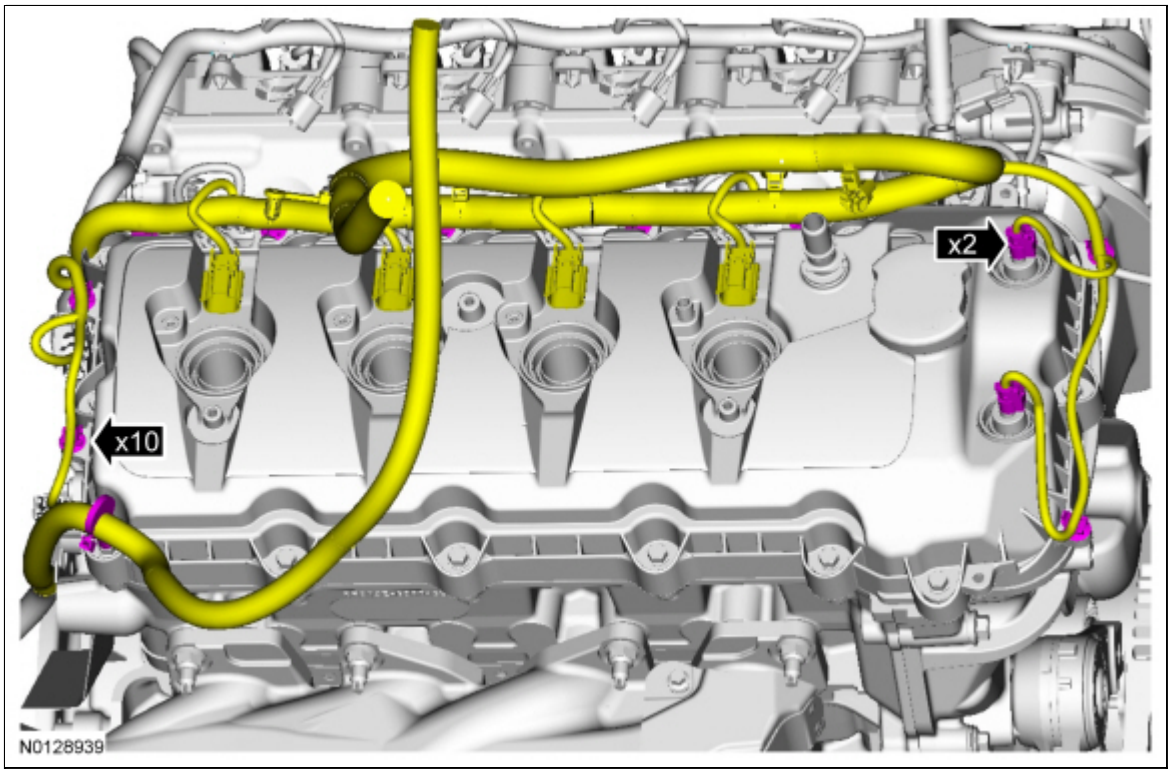


122. Connect the 2 VCT variable force solenoid electrical connectors.
    - Attach the 10 wiring harness retainers to the LH valve cover.

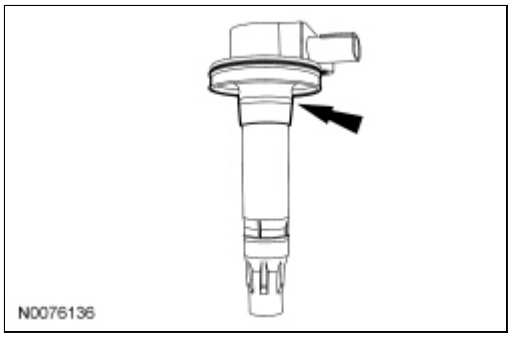


123. Connect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
    - Attach the 10 wiring harness retainers to the RH valve cover.

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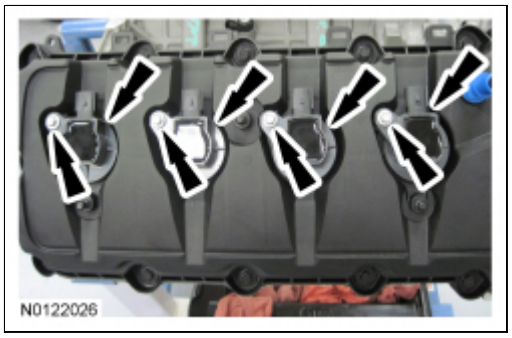


124. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
    - To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.



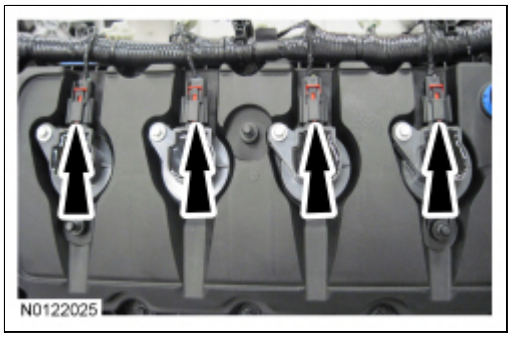
125. **NOTE:** Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs. RH shown, LH similar.

    Install the 8 ignition coils and 8 bolts.
    - Tighten to 6 Nm (53 lb-in).

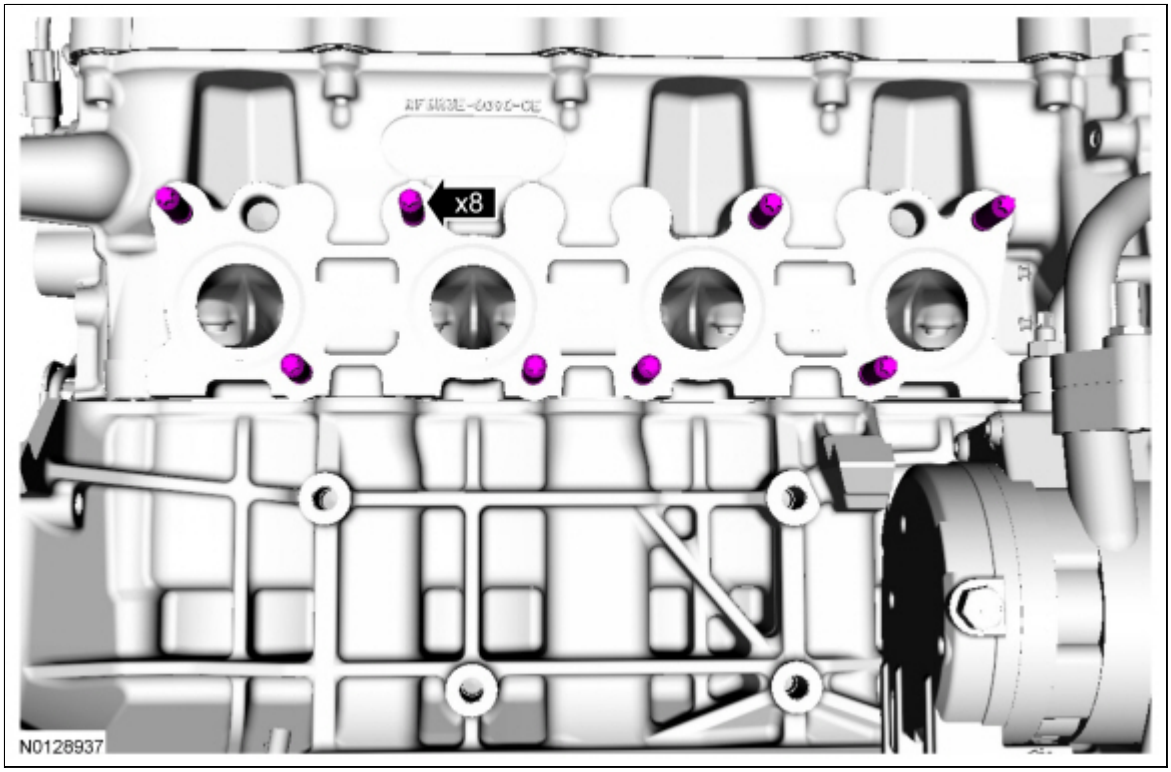


126. **NOTE:** RH shown, LH similar.

Connect the 8 ignition coil electrical connectors.

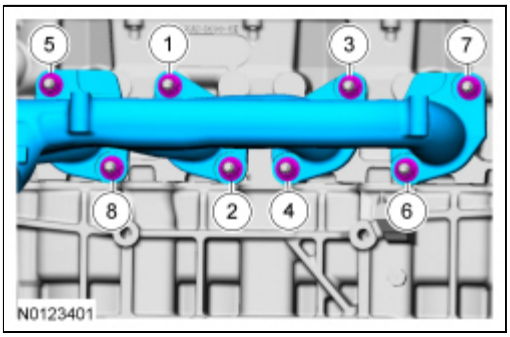


127. Install 8 new RH exhaust manifold studs.
    - Tighten to 25 Nm (18 lb-ft).

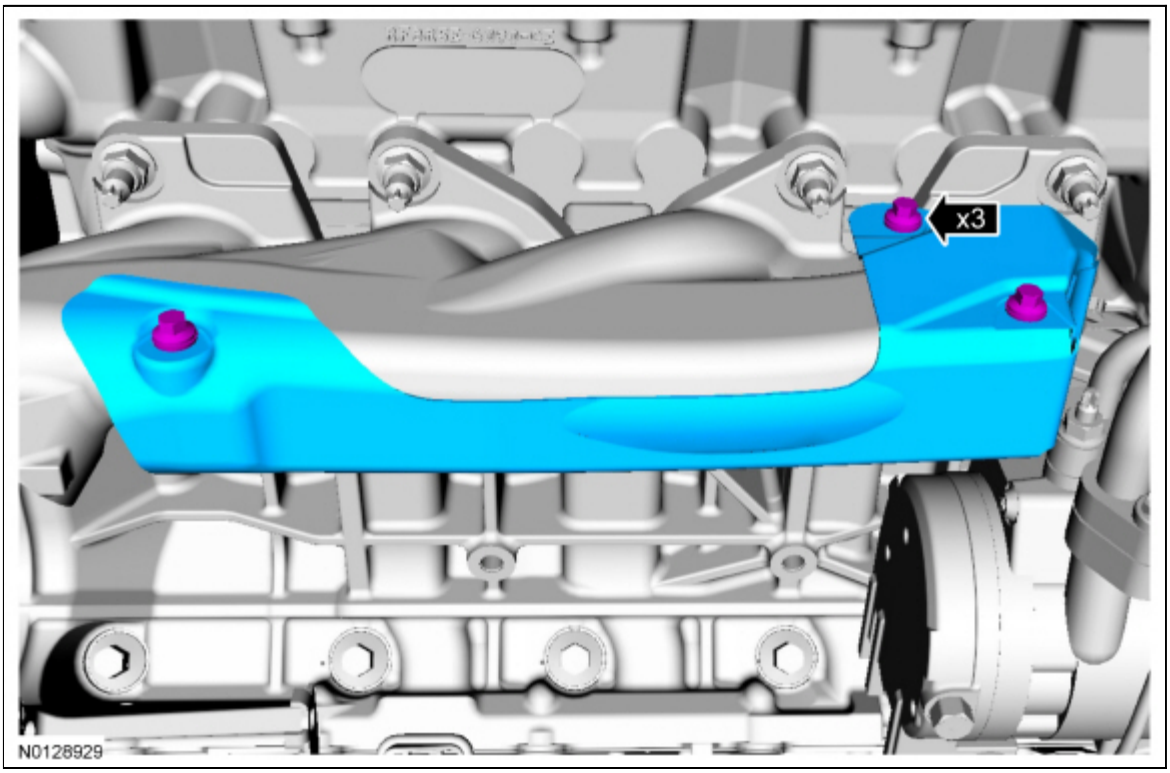


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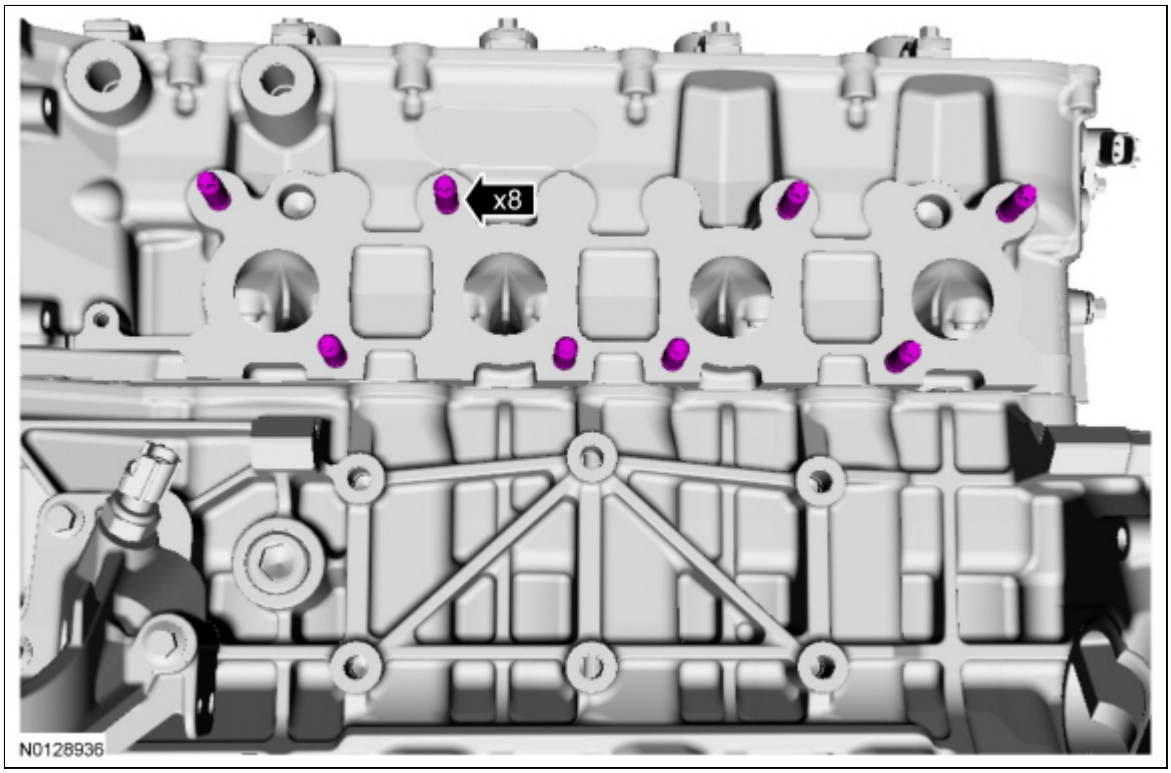
128. Install a new gasket, the RH exhaust manifold and 8 new nuts.
    - Tighten the nuts in the sequence shown in 2 stages.
        - Stage 1: Tighten to 24 Nm (18 lb-ft).
        - Stage 2: Tighten to 32 Nm (24 lb-ft).



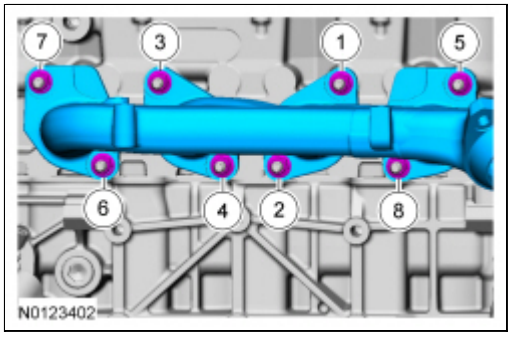
129. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).



130. Install 8 new LH exhaust manifold studs.
    - Tighten to 25 Nm (18 lb-ft).

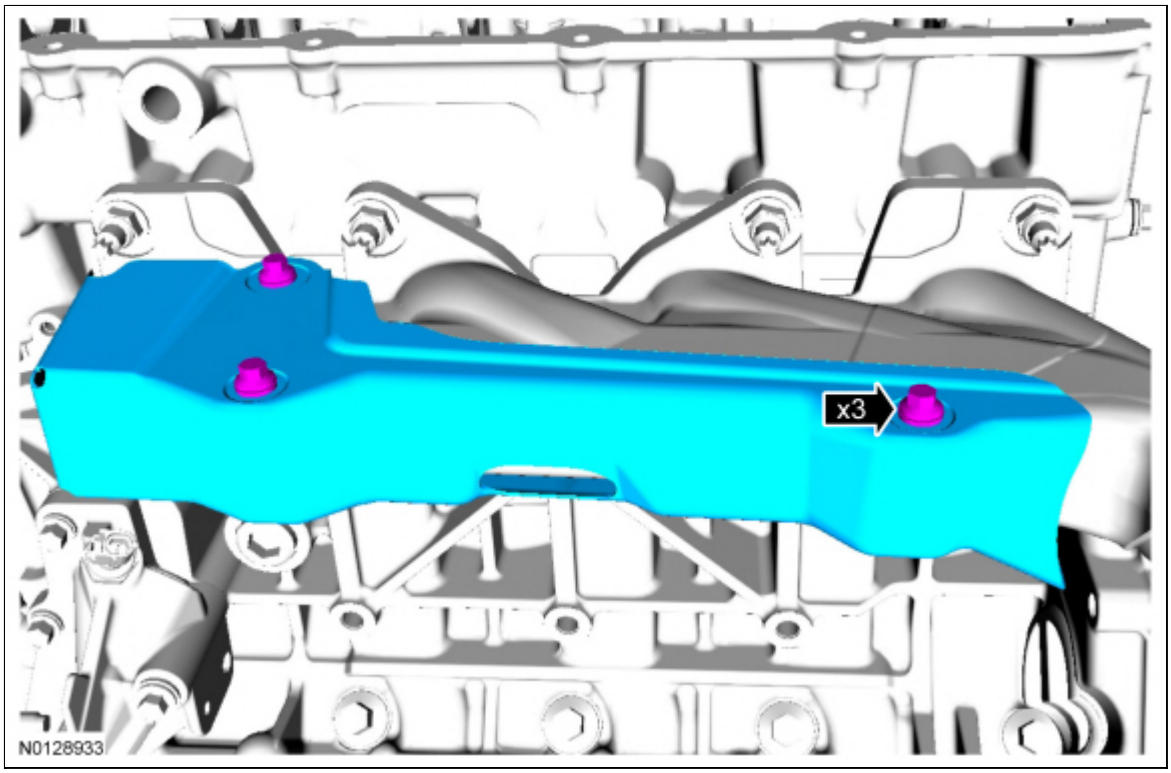


131. Install a new gasket, the LH exhaust manifold and 8 new nuts.
    - Tighten in the sequence shown in 2 stages.
        - Stage 1: Tighten to 24 Nm (18 lb-ft).
        - Stage 2: Tighten to 32 Nm (24 lb-ft).

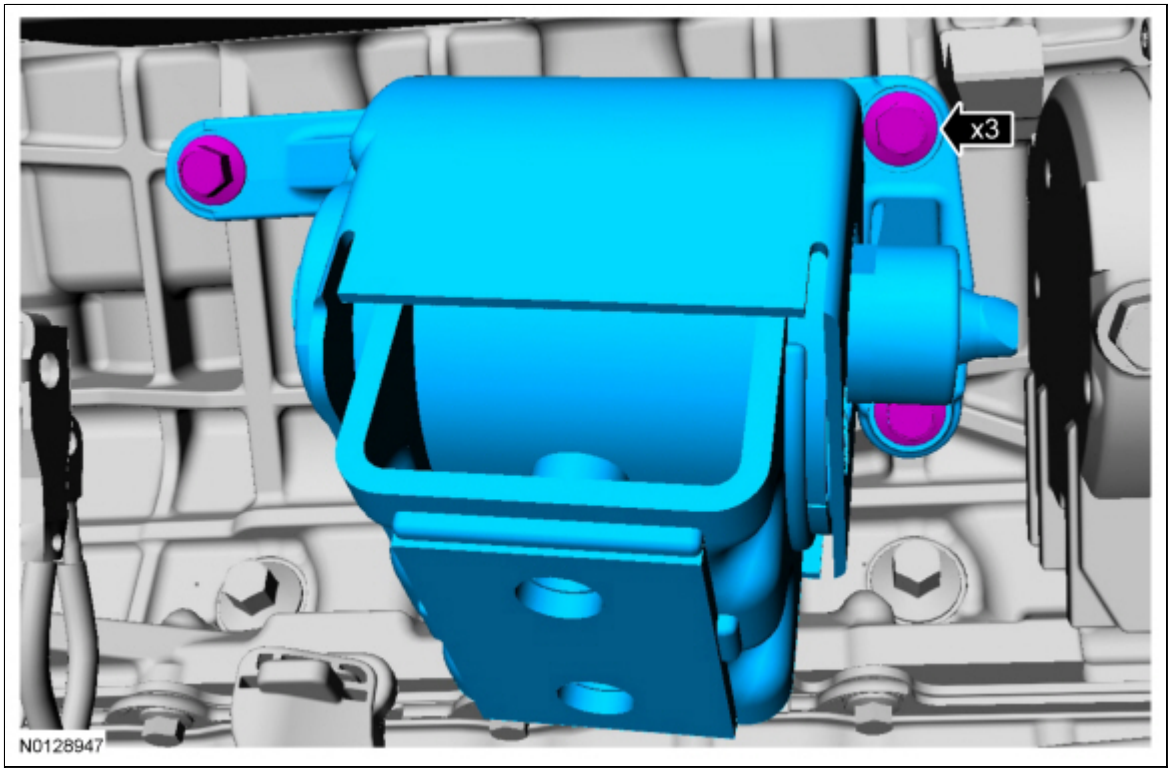


132. Install the LH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).

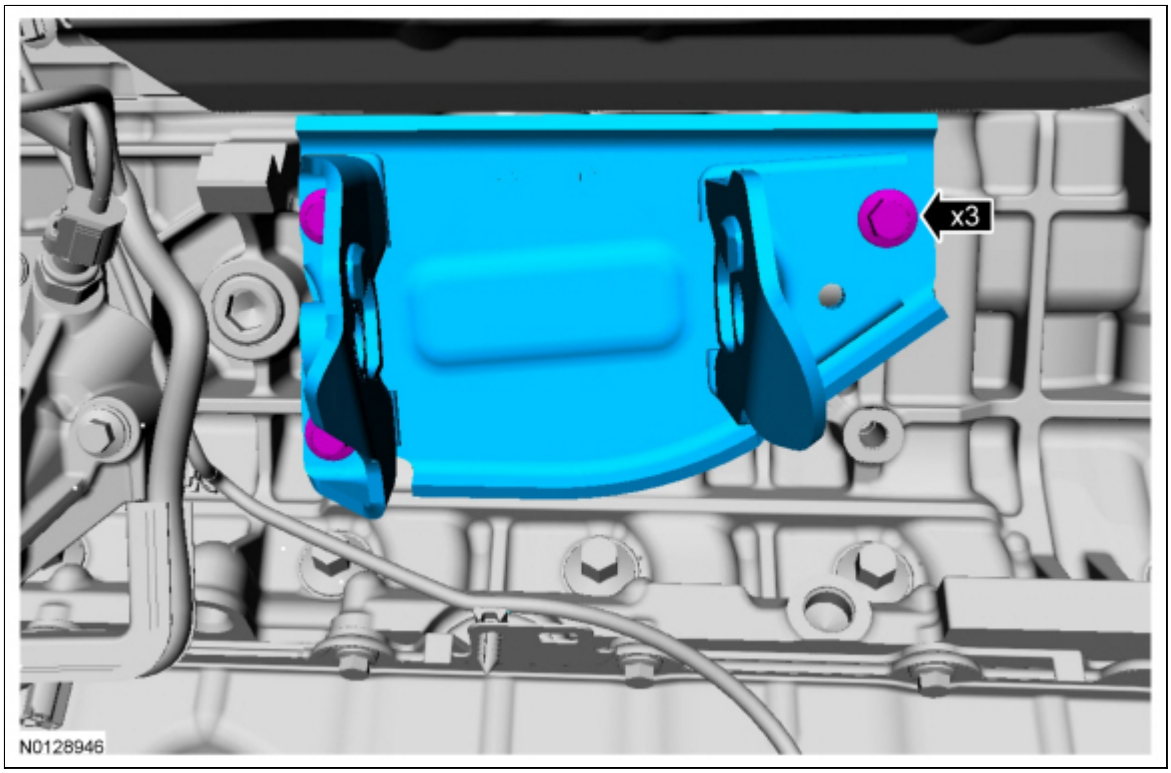
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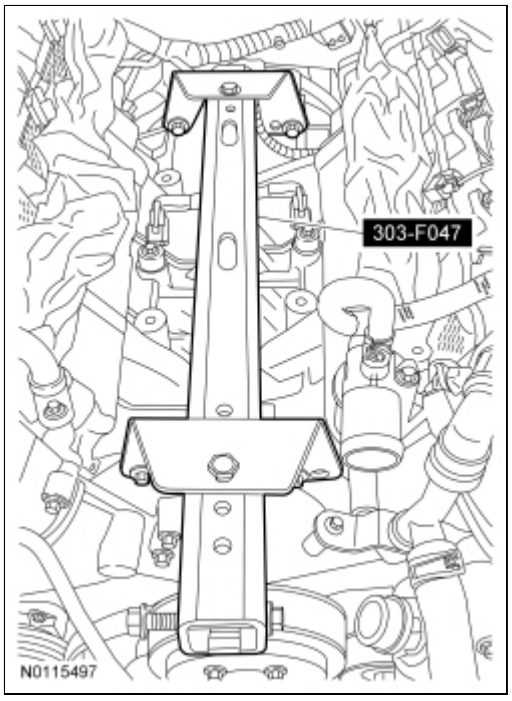
133. Install the RH engine support insulator and the 3 bolts.
    - Tighten to 63 Nm (46 lb-ft).



134. Install the LH engine support insulator bracket and the 3 bolts.
    - Tighten to 63 Nm (46 lb-ft).



135. Install the Engine Lifting Bracket

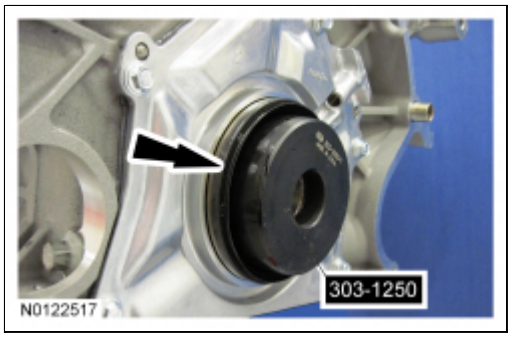


136. Using the Floor Crane, remove the engine from the work stand.

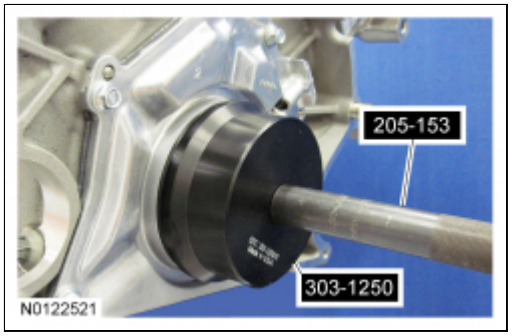
137. **NOTE:** Lubricate the seal lips and bore with clean engine oil prior to installation.

Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.

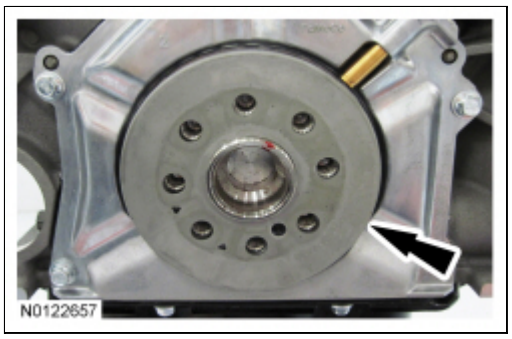
repair4less



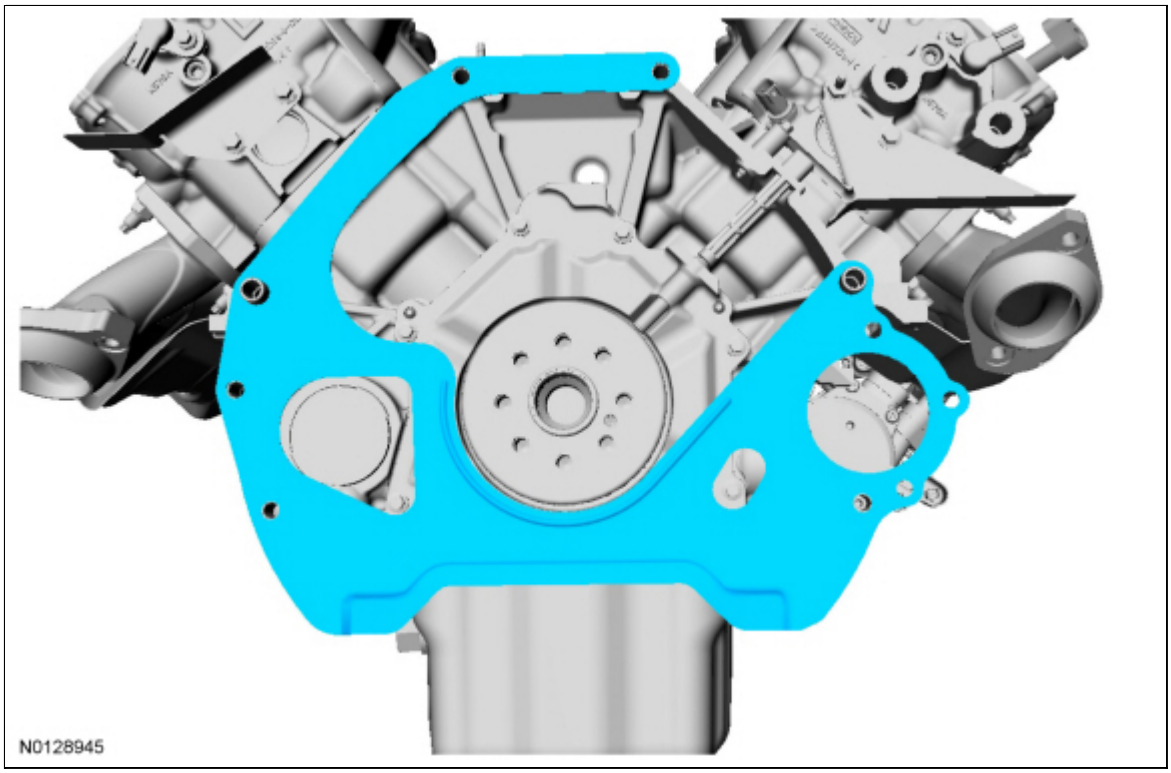
138. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



139. Install the crankshaft sensor ring.



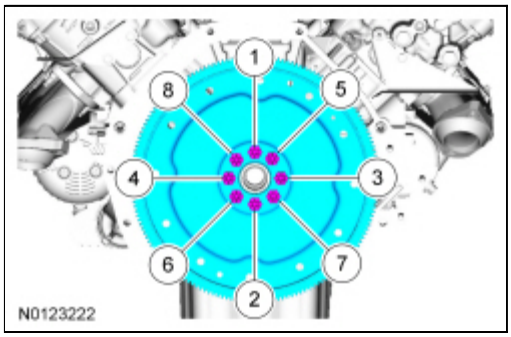
140. Install the engine separator plate.



141. **NOTE:** The flexplate bolts are torque-to-yield design and are not reusable.

Install the engine separator plate, the flexplate and 8 new bolts.

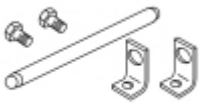
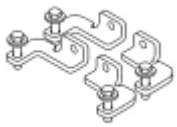
- Tighten in the sequence shown in 2 stages.
  - Stage 1: Tighten to 20 Nm (177 lb-in).
  - Stage 2: Tighten an additional 60 degrees.



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Cylinder Head

Special Tool(s)

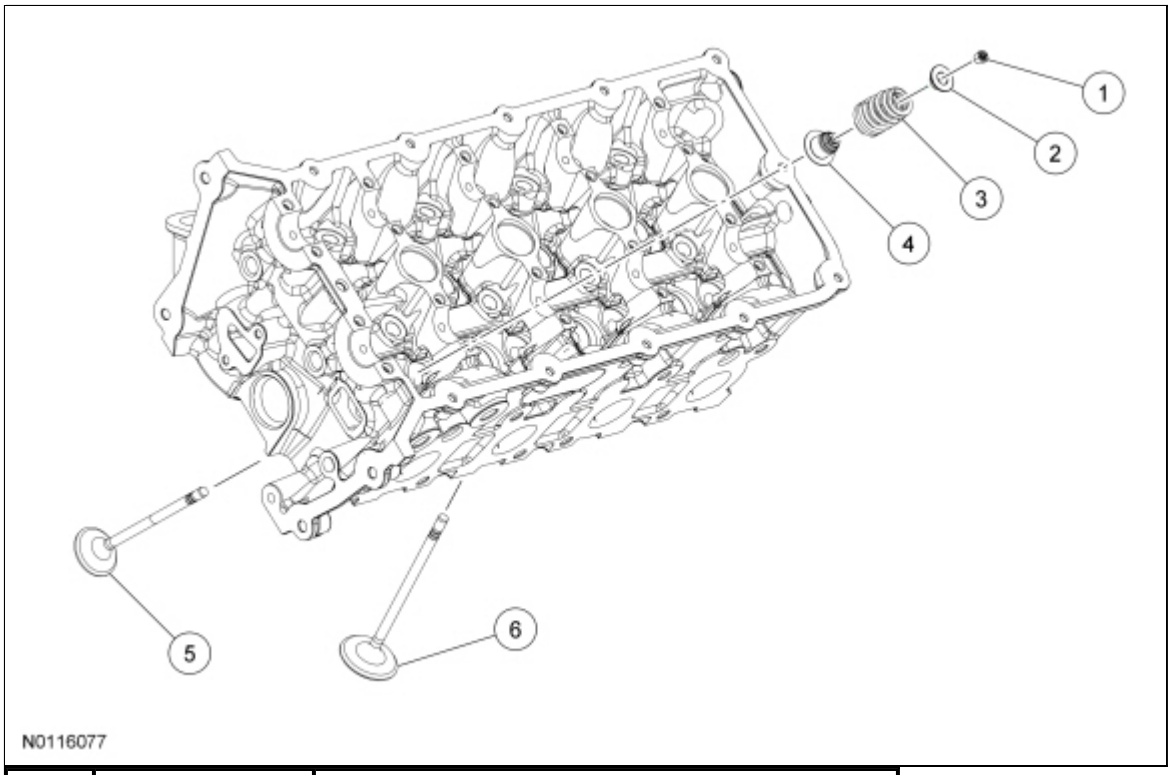
 ST1902-A	Compressor, Valve Spring 303-1418
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

NOTE: LH cylinder head shown, RH cylinder head similar.

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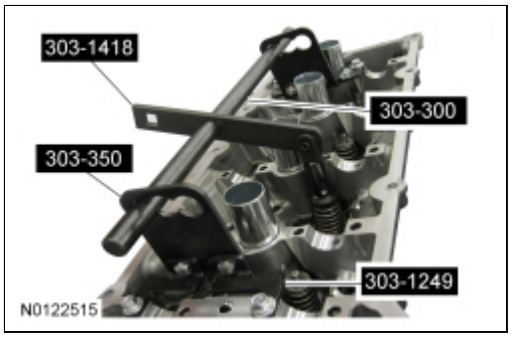
Item	Part Number	Description
1	6518	Valve spring retainer key (32 required)
2	6514	Valve spring retainer (16 required)
3	6513	Valve spring (16 required)
4	6571	Valve seal (16 required)
5	6507	Intake valve (8 required)
6	6505	Exhaust valve (8 required)

Disassembly

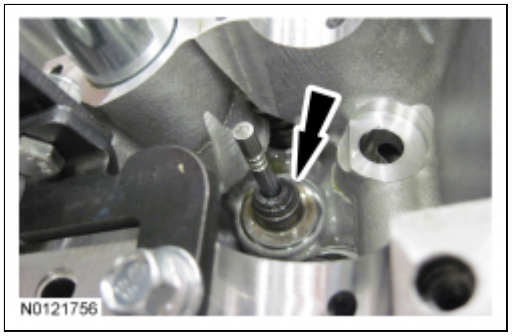
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Using the Valve Spring Compressors, remove the keys, retainer and spring.



2. Remove and discard the valve seal.



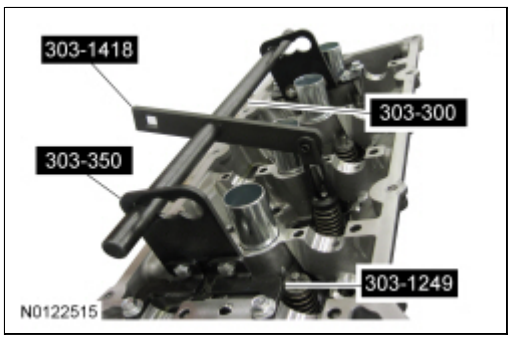
3. Remove the valve from the cylinder head.
4. Repeat the previous steps for each of the remaining valves.

Assembly

NOTE: Apply clean engine oil to the valve seals and the inside diameter of the valve guides prior to assembling the cylinder head components.

1. **NOTE:** The valve seal must be bottomed out on the cylinder head spring seat.

   Install the valve seal.
2. Install the valve into the cylinder head.
3. Using the Valve Spring Compressors, install the spring, retainer and keys.



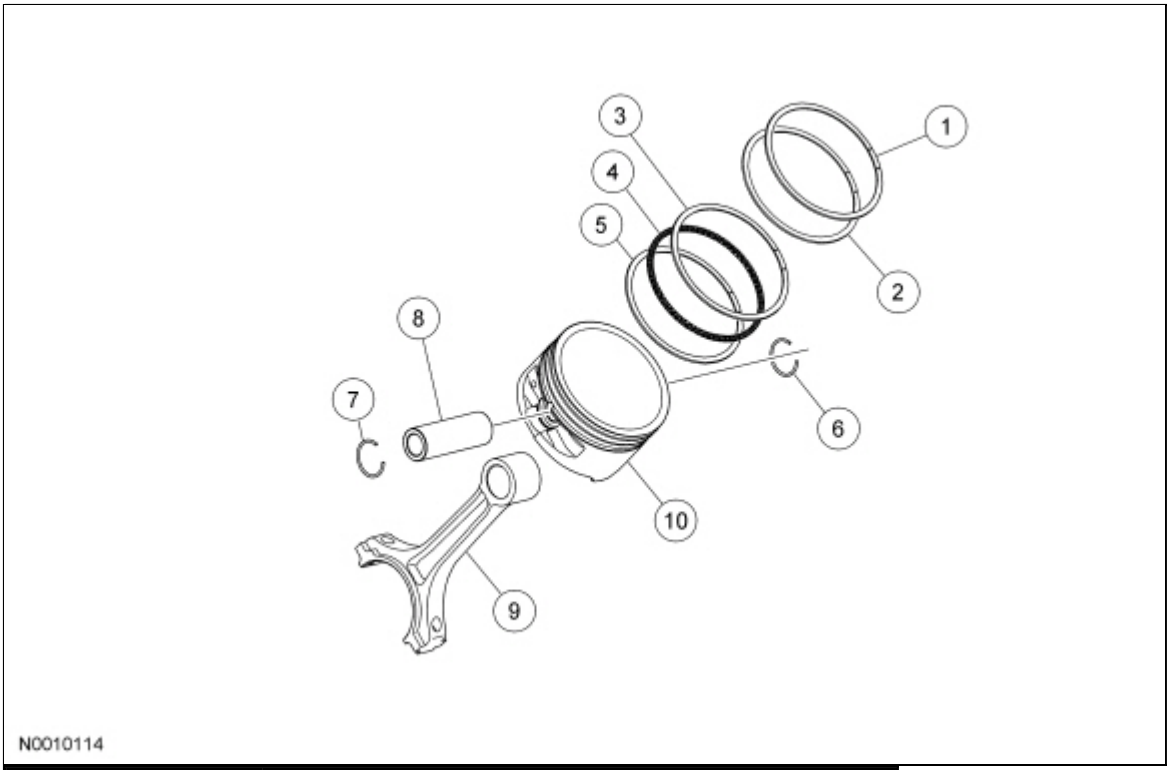
4. Repeat the previous steps for each of the remaining valves.

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Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number	Description
1	—	Piston compression upper ring (part of 6148)
2	—	Piston compression lower ring (part of 6148)
3	—	Piston oil control upper segment ring (part of 6148)
4	—	Piston oil control spacer (part of 6148)
5	—	Piston oil control lower segment ring (part of 6148)
6	6140	Piston pin retainer
7	6140	Piston pin retainer
8	6135	Piston pin

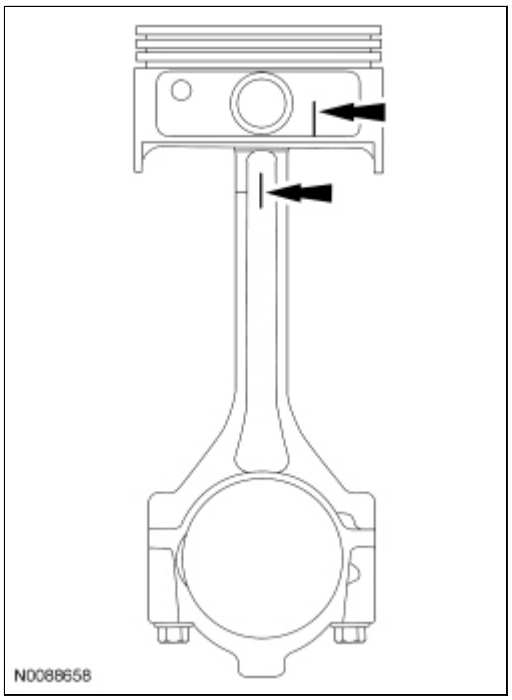
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9	6200	Connecting rod
10	6110	Piston

Disassembly

WARNING: Since the retainer ring has a tendency to spring out, cover the end of the pin bore with a hand or shop rag when removing the ring. Wear eye protection. Failure to follow these instructions may result in serious personal injury.

1. Remove the piston rings from the piston.
   - Discard the piston rings.
2. Mark the piston and the connecting rod on the same side for assembly reference.

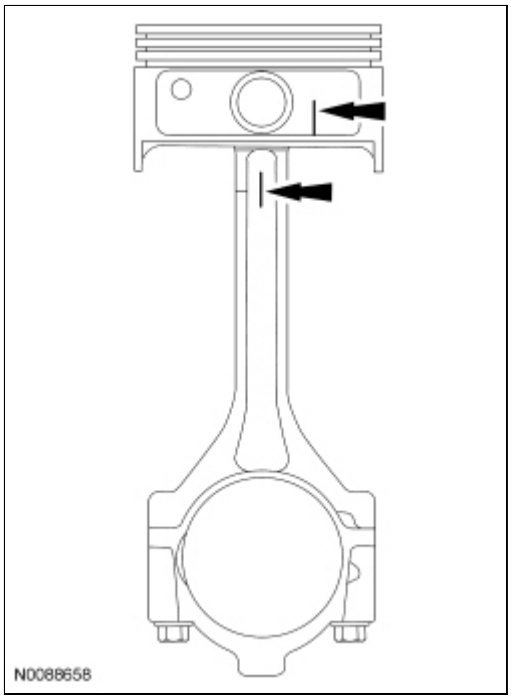


3. Remove the piston pin retainers and the piston pin.
4. Separate the piston from the connecting rod.
5. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. **NOTE:** The connecting rod must be installed into the piston with the marks made during disassembly on the same side. If a new piston or connecting rod is being installed, it can be installed in either direction.

   Position the connecting rod in the piston.



2. Lubricate the piston pin and pin bore with clean engine oil.
3. Install the piston pin in the piston and connecting rod assembly.
4. Install the piston pin retaining clips in the piston.
5. Lubricate the piston and the new piston rings with clean engine oil.
6. Install the piston rings onto the piston.

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Camshaft — LH

Special Tool(s)

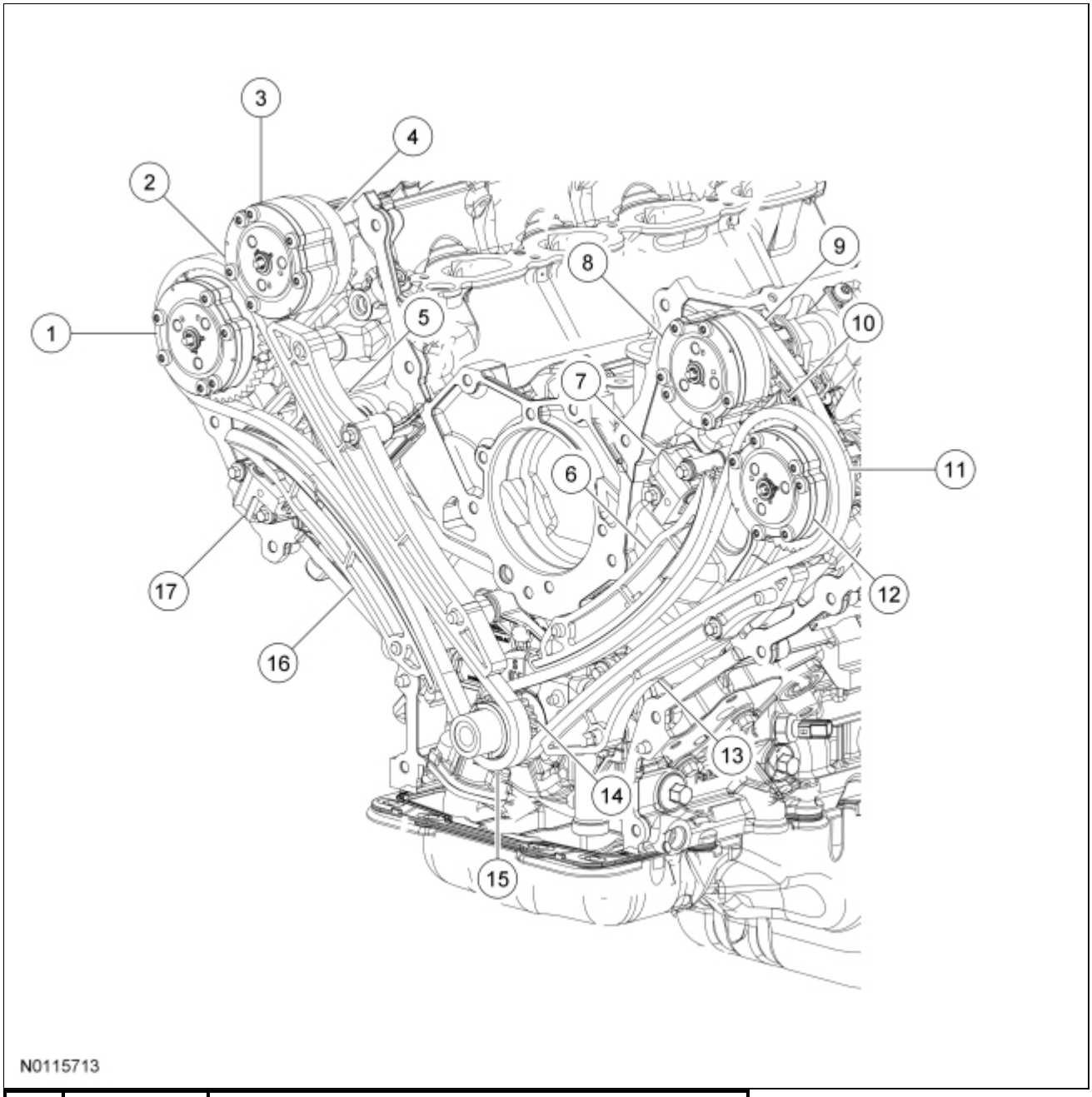
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Timing Drive Components

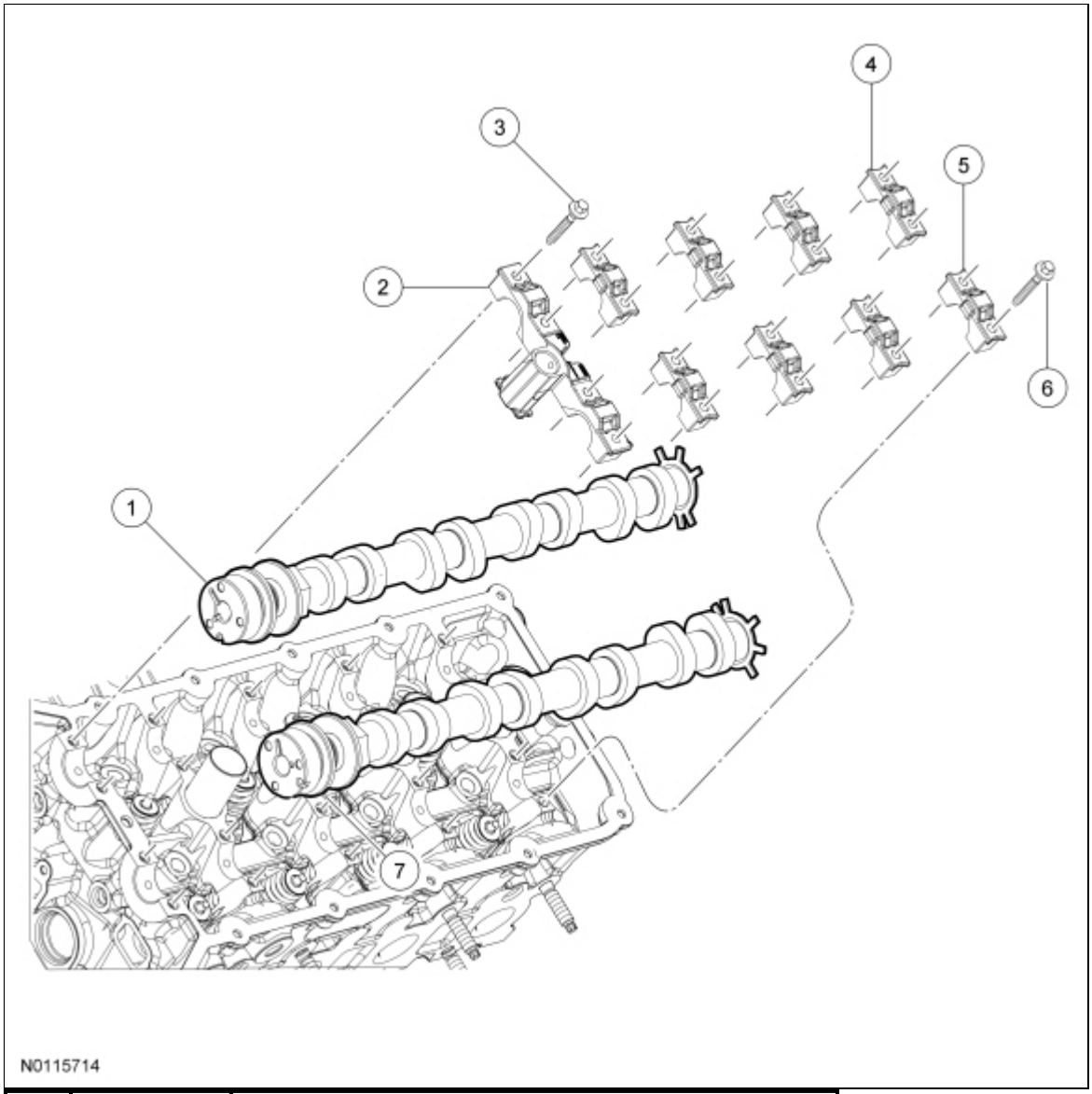
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Item	Part Number	Description
1	6256	RH exhaust Variable Camshaft Timing (VCT) assembly
2	6K254	RH secondary timing chain tensioner
3	6256	RH intake VCT assembly
4	6268	RH secondary timing chain
5	6M256	RH timing chain guide
6	6K255	LH timing chain tensioner arm
7	6L266	LH primary timing chain tensioner
8	6256	LH intake VCT assembly

9	6268	LH secondary timing chain
10	6K254	LH secondary timing chain tensioner
11	6268	LH primary timing chain
12	6256	LH exhaust VCT assembly
13	6B274	LH timing chain guide
14	6306	Crankshaft sprocket
15	6268	RH primary timing chain
16	6K255	RH timing chain tensioner arm
17	6L266	RH primary timing chain tensioner

Camshafts



	Part	

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Item	Number	Description
1	6250	LH intake camshaft
2	—	Front camshaft bearing mega cap (part of 6049)
3	N806183	Front camshaft bearing mega cap bolt (4 required)
4	—	Intake camshaft bearing cap (part of 6049) (4 required)
5	—	Exhaust camshaft bearing cap (part of 6049) (4 required)
6	N806183	Intake/exhaust camshaft bearing cap bolt (16 required)
7	6250	LH exhaust camshaft

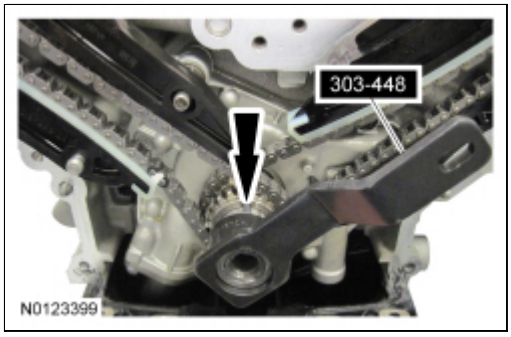
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

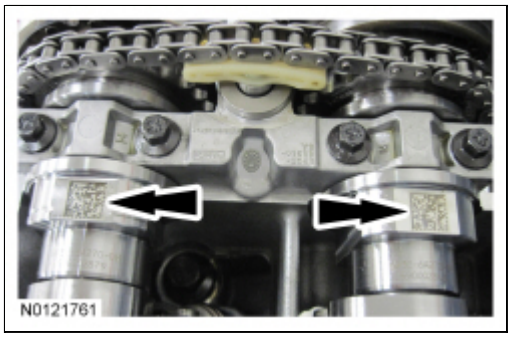
NOTE: If the RH camshafts are being serviced at the same time as the LH camshafts, remove the RH camshafts first. For additional information, refer to Camshaft — RH in this section.

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

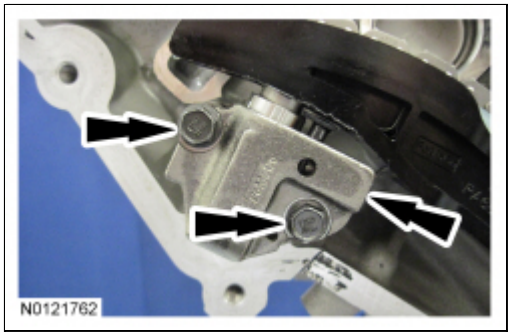
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



3. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

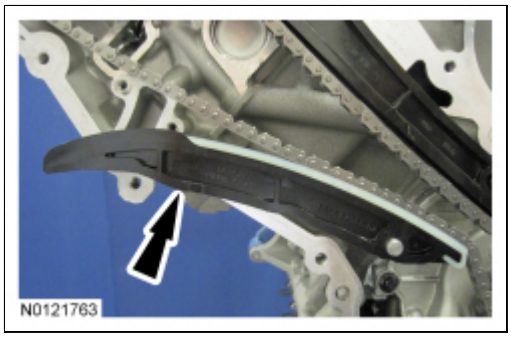


4. Remove the 2 bolts and the RH primary timing chain tensioner.



5. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

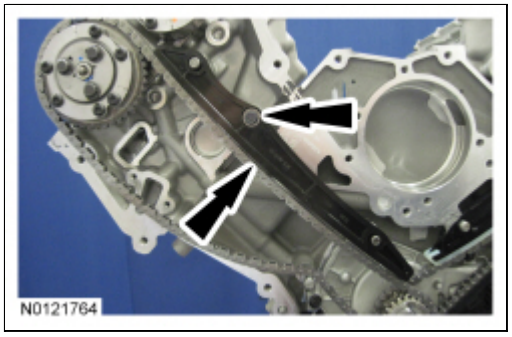
   Remove the RH timing chain tensioner arm.



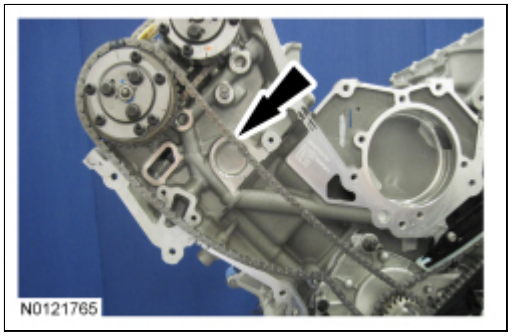
6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

   Remove the bolt and the RH timing chain guide.

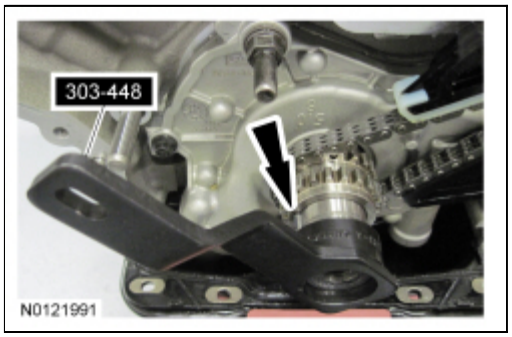
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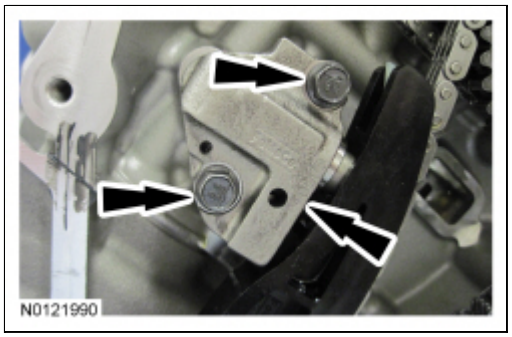
7. Remove the RH primary timing chain.



8. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.

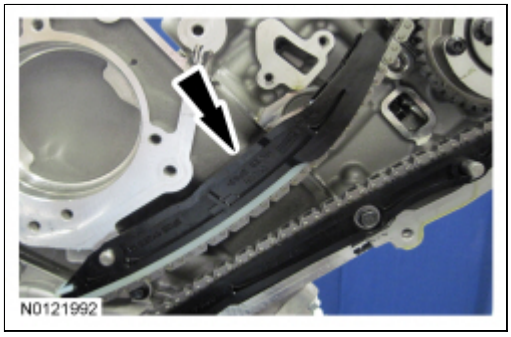


9. Remove the 2 bolts and the LH primary timing chain tensioner.



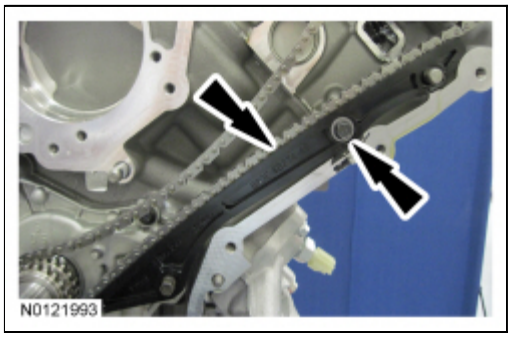
10. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

Remove the LH timing chain tensioner arm.

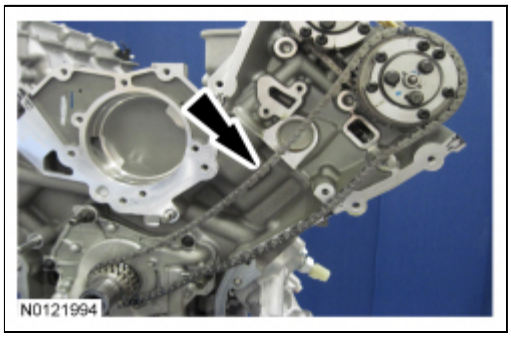


11. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

    Remove the bolt and the LH timing chain guide.

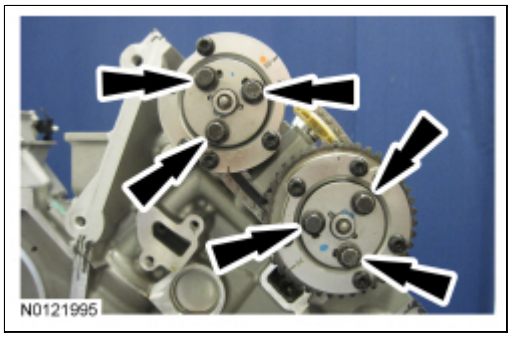


12. Remove the LH primary timing chain.

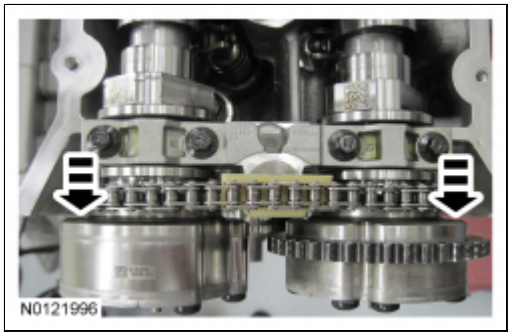


13. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.

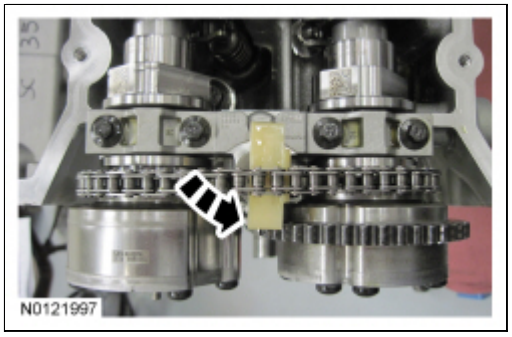
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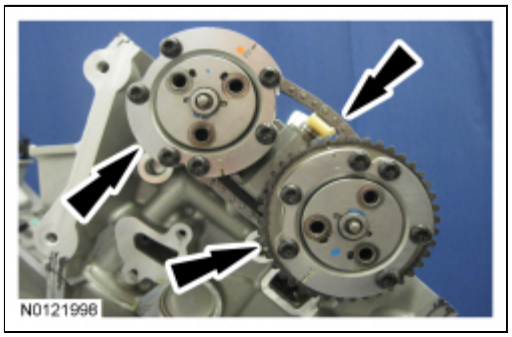
14. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



15. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.

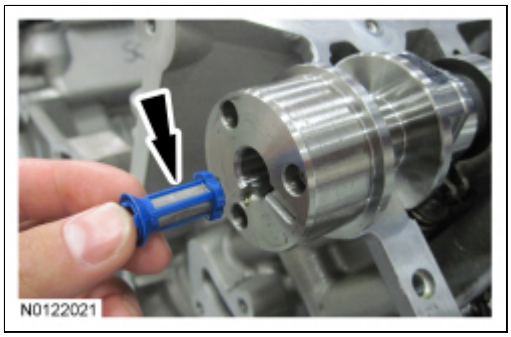


16. Remove the LH VCT assemblies and the LH secondary timing chain.



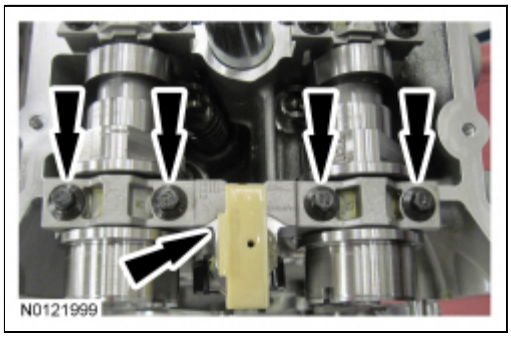
17. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

    Remove the VCT system oil filter from the intake and exhaust camshafts.



18. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the LH front camshaft bearing mega cap.



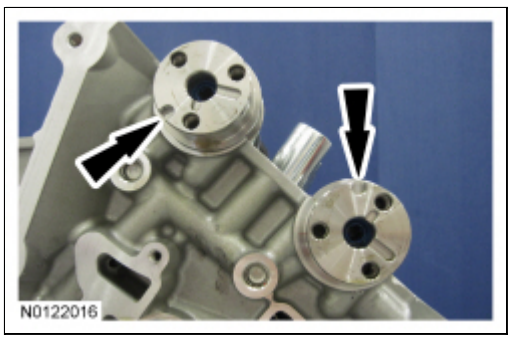
19. Remove the 16 bolts and the 8 camshaft bearing caps.

20. Remove the LH intake and exhaust camshafts.

Installation

1. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

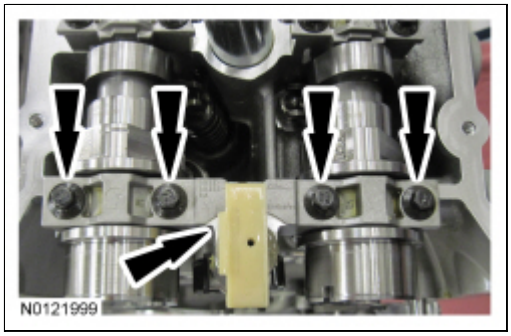
   Install the LH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



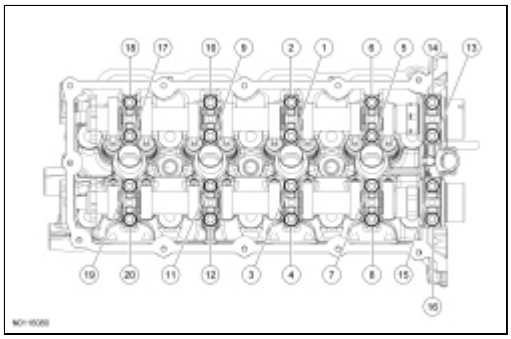
2. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.

3. Install the LH front camshaft bearing mega cap and the 4 bolts. Do not tighten the bolts at this time

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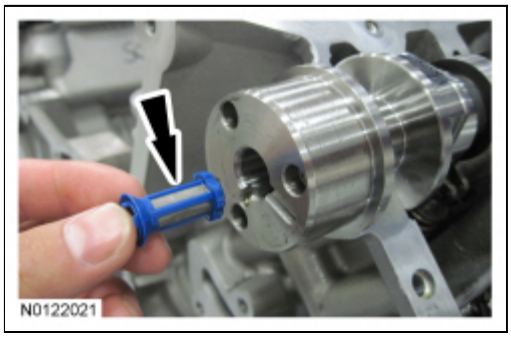


4. Tighten the bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 6 Nm (53 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

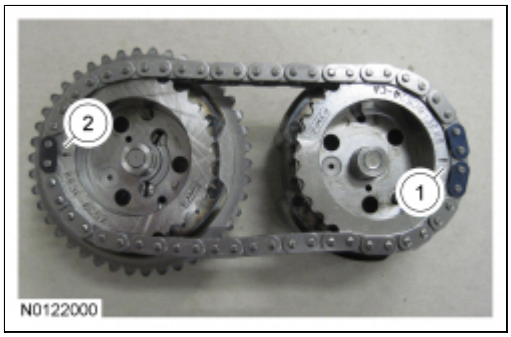


5. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

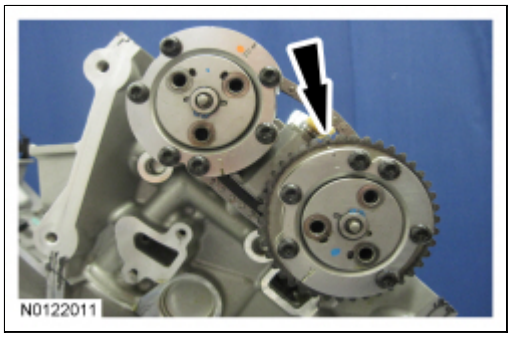
   Install the VCT system oil filter in the intake and exhaust camshafts.



6. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

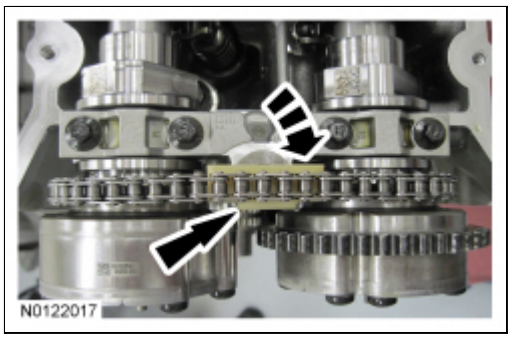


7. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



8. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

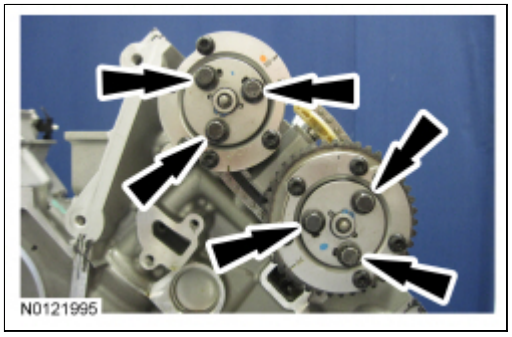
   Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
   - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



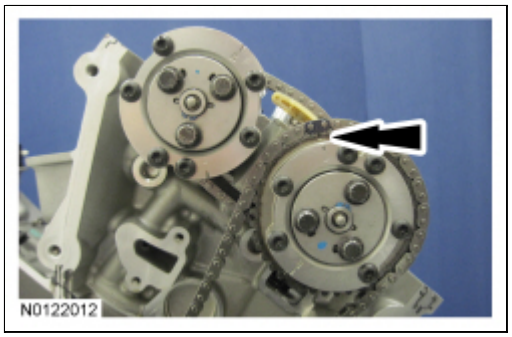
9. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

   Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.
   - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

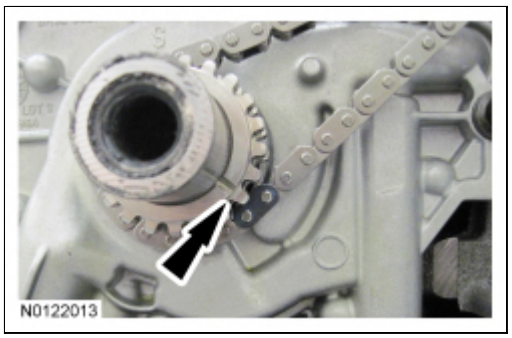
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10. Install the LH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.

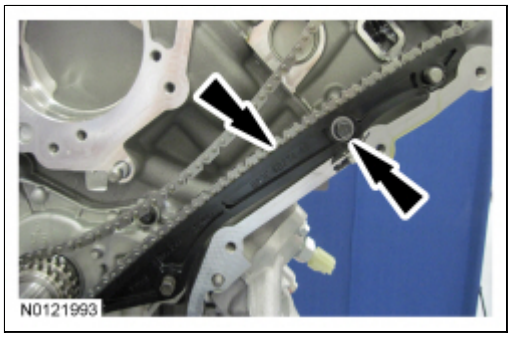


11. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



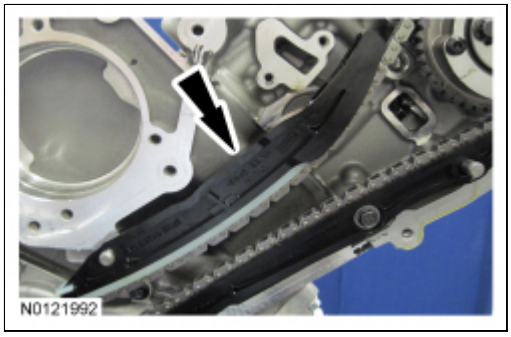
12. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

    Install the LH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



13. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

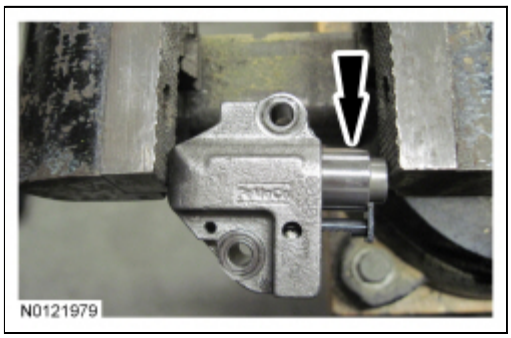
    Install the LH timing chain tensioner arm.



NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

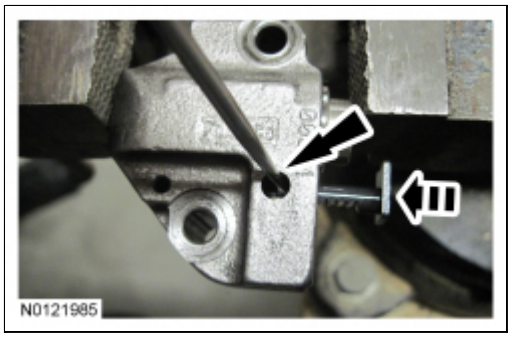
14. ***NOTICE:*** **Do not compress the ratchet assembly or damage to the tensioner will occur.**

    Compress the primary timing chain tensioner plunger, using an edge of a vise.

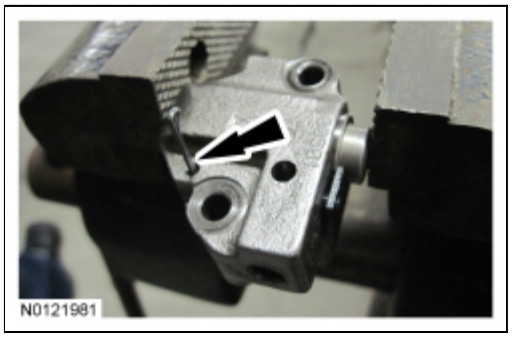


15. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.

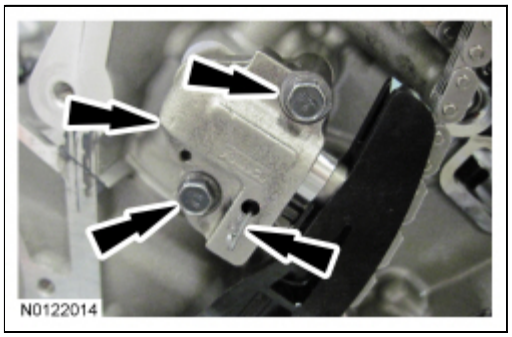
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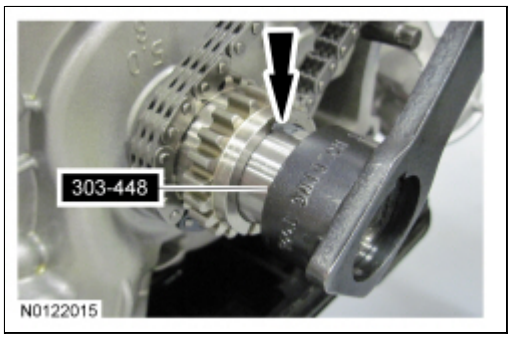
16. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



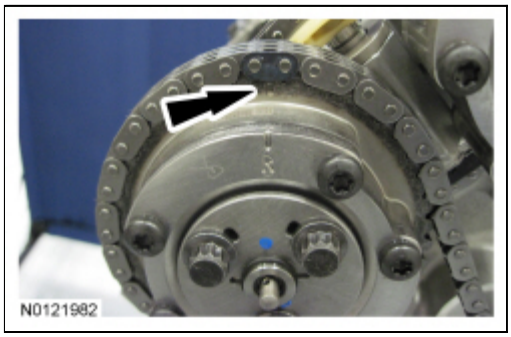
17. Install the LH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



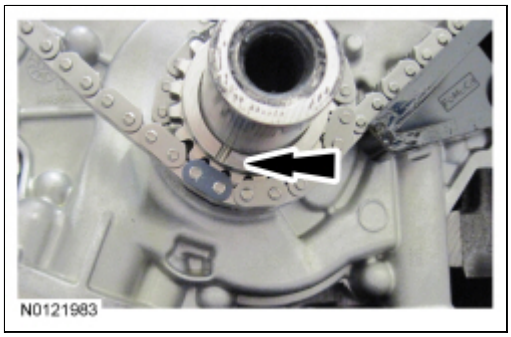
18. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



19. Install the RH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.

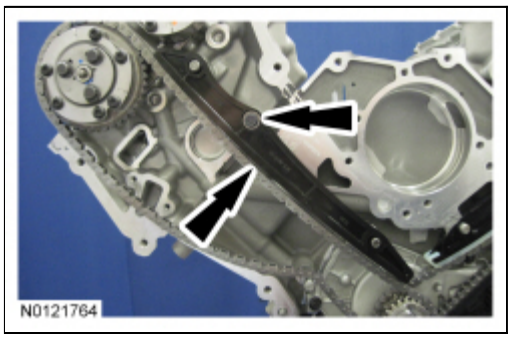


20. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



21. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

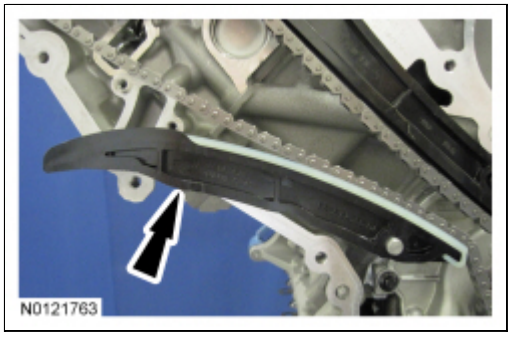
    Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



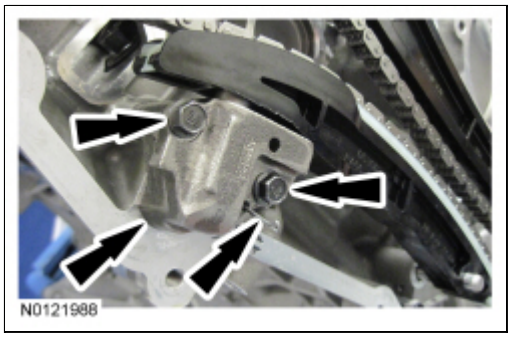
22. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

    Install the RH timing chain tensioner arm.

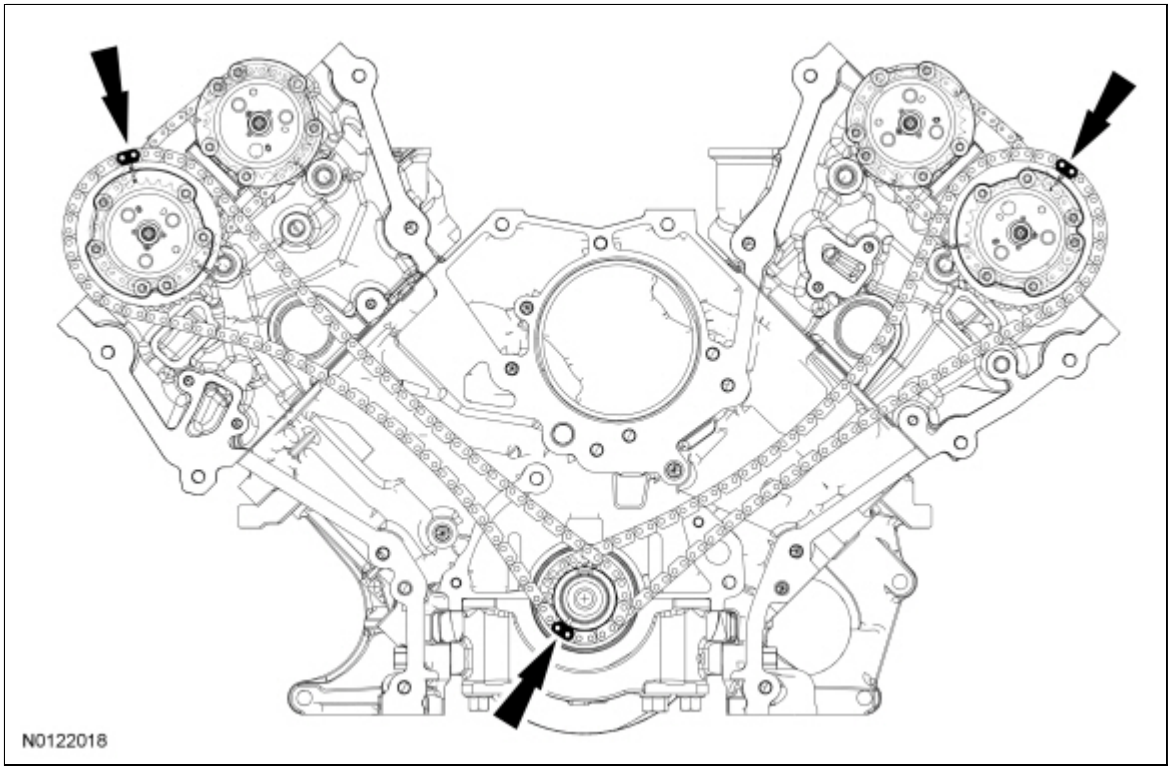
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23. Install the RH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



24. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



25. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

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Camshaft — RH

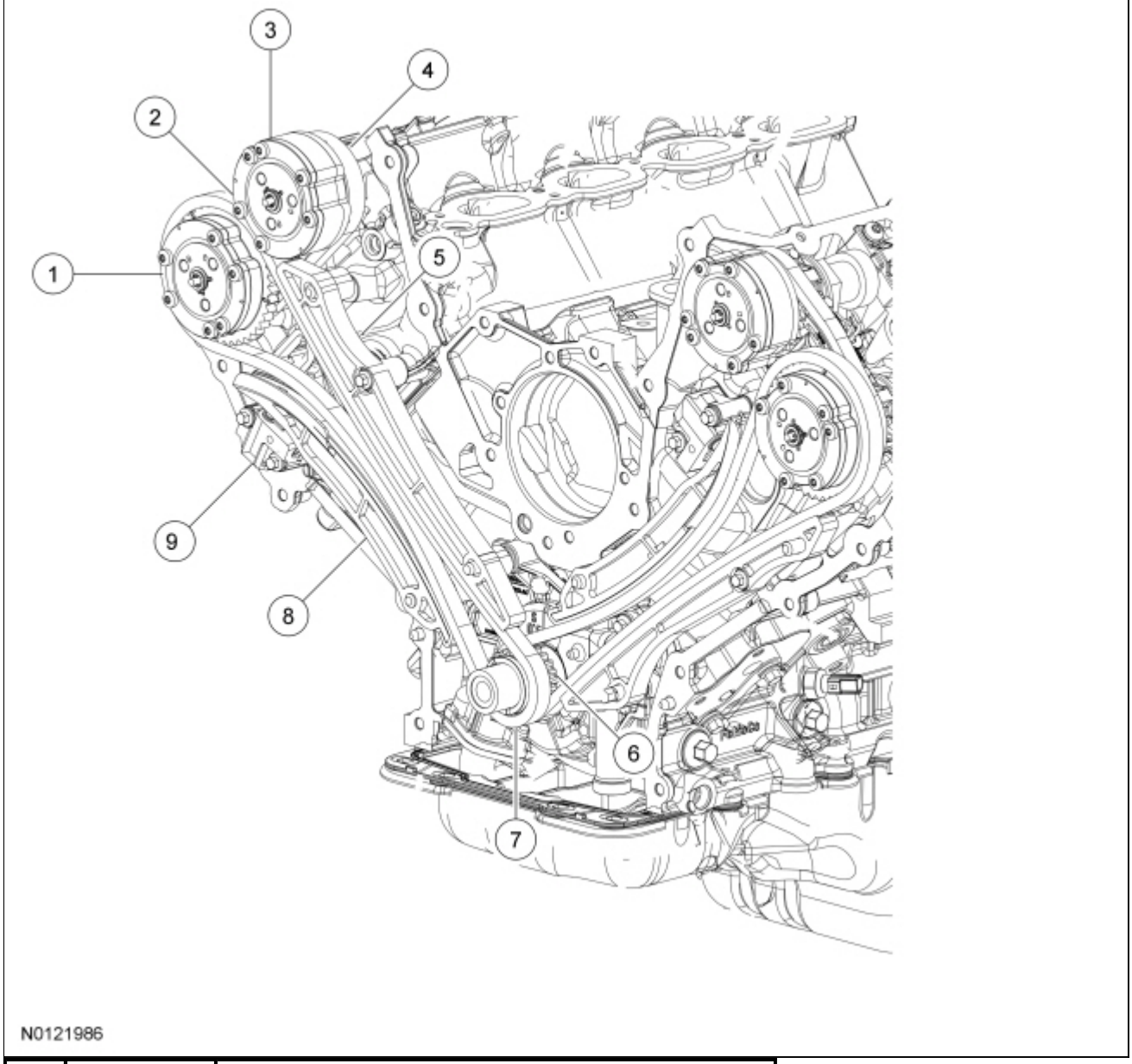
Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Timing Drive Components



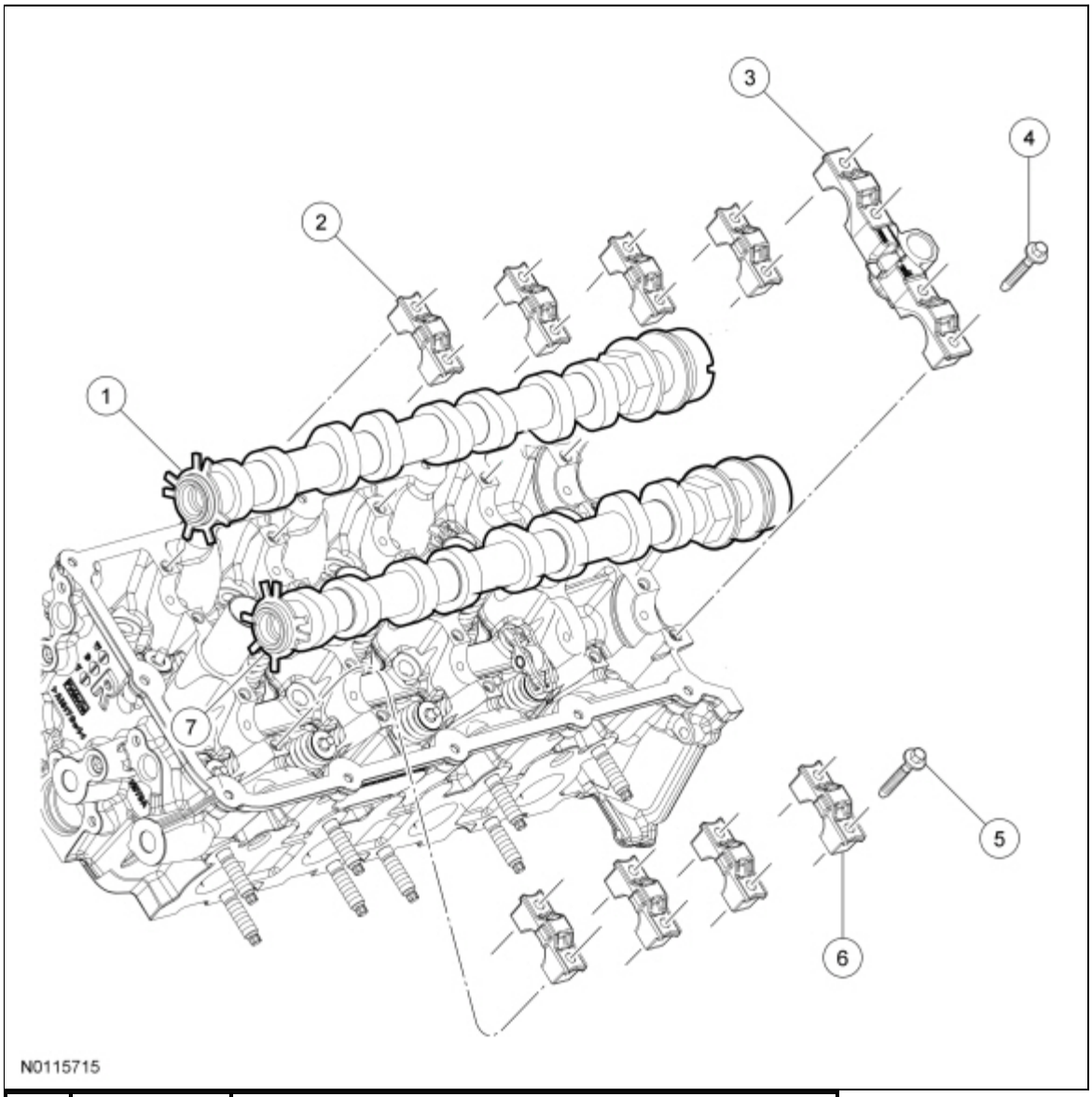
N0121986

Item	Part Number	Description
1	6256	RH exhaust Variable Camshaft Timing (VCT) assembly
2	6K254	RH secondary timing chain tensioner
3	6256	RH intake VCT assembly
4	6268	RH secondary timing chain
5	6M256	RH timing chain guide
6	6306	Crankshaft sprocket
7	6268	RH primary timing chain
8	6K255	RH timing chain tensioner arm

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9	6L266	RH primary timing chain tensioner

Camshafts



Item	Part Number	Description
1	6250	RH intake camshaft
2	—	Intake camshaft bearing cap (part of 6049) (4 required)
3	—	Front camshaft bearing mega cap (part of 6049)
4	N806183	Front camshaft bearing mega cap bolt (4 required)
5	N806183	Intake/exhaust camshaft bearing cap bolt (16 required)
6	—	Exhaust camshaft bearing cap (part of 6049) (4

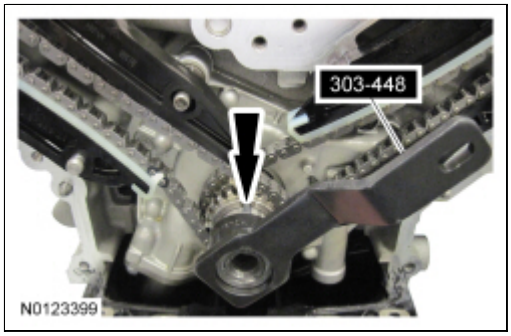
		required)
7	6250	RH exhaust camshaft

Removal

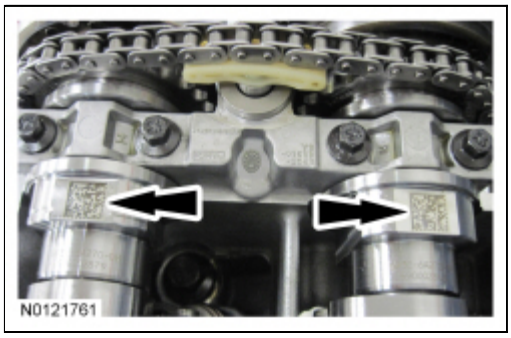
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.

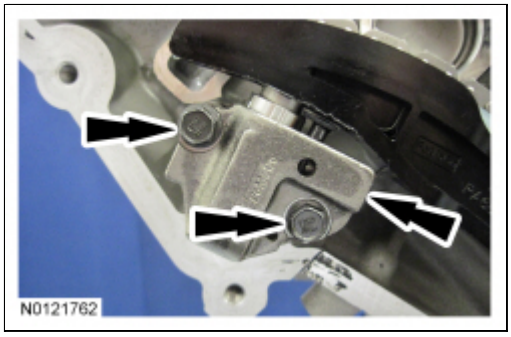


3. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.



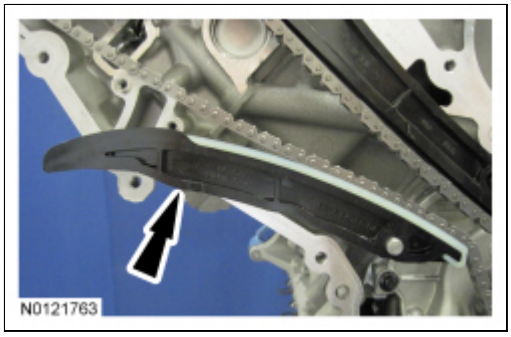
4. Remove the 2 bolts and the RH primary timing chain tensioner.

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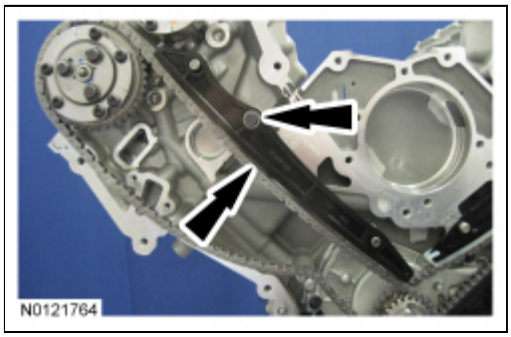
5. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

   Remove the RH timing chain tensioner arm.

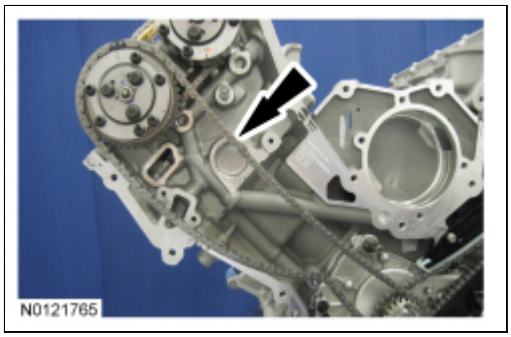


6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

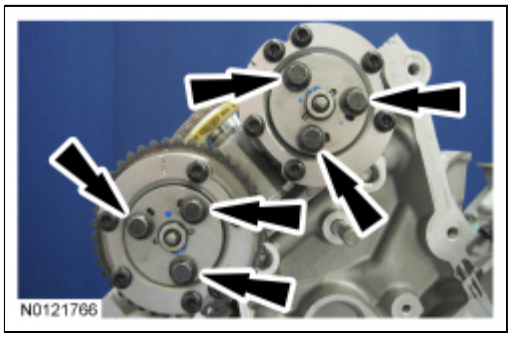
   Remove the bolt and the RH timing chain guide.



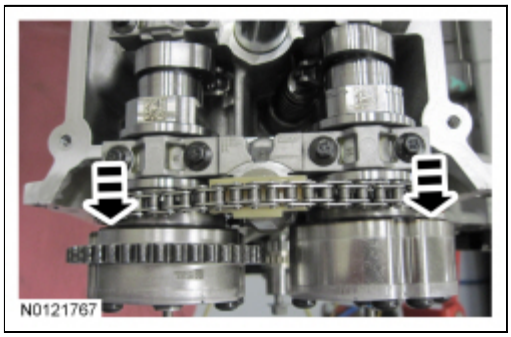
7. Remove the RH primary timing chain.



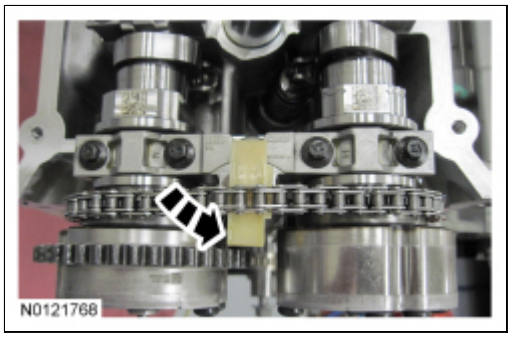
8. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



9. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).

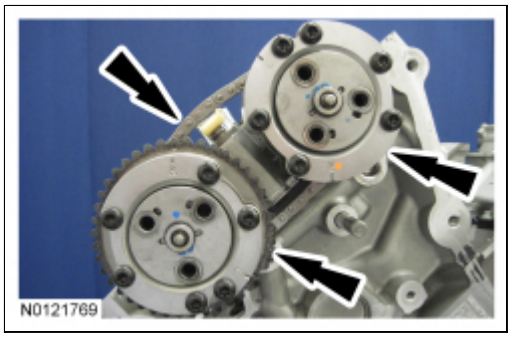


10. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.



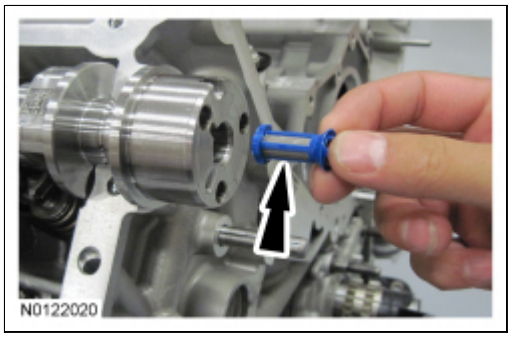
11. Remove the RH VCT assemblies and the RH secondary timing chain.

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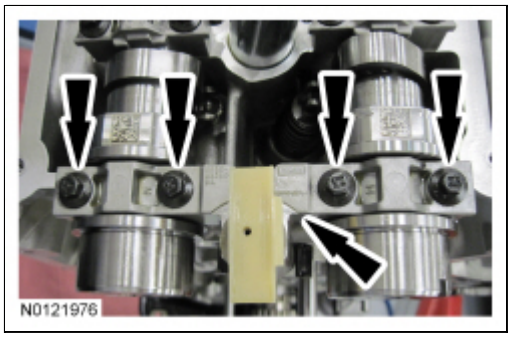
12. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

    Remove the VCT system oil filter from the intake and exhaust camshafts.



13. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the RH front camshaft bearing mega cap.



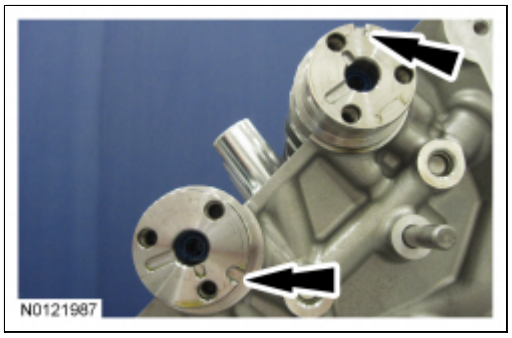
14. Remove the 16 bolts and the 8 camshaft bearing caps.

15. Remove the RH intake and exhaust camshafts.

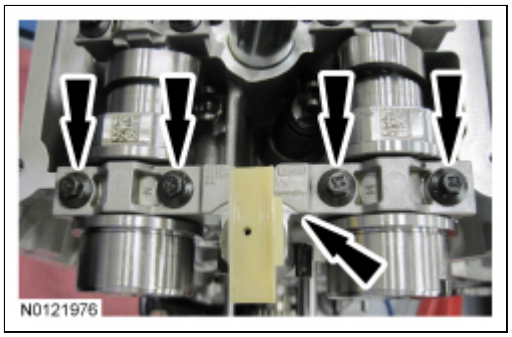
Installation

1. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

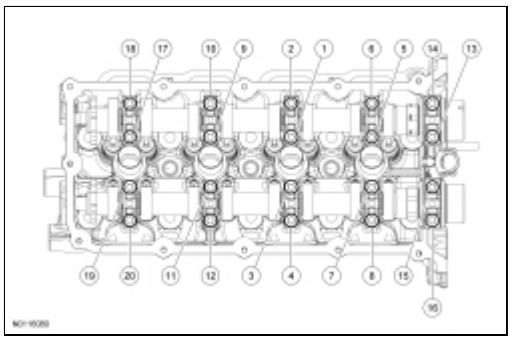
   Install the RH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



2. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.
3. Install the RH front camshaft bearing mega cap and the 4 bolts. Do not tighten at this time



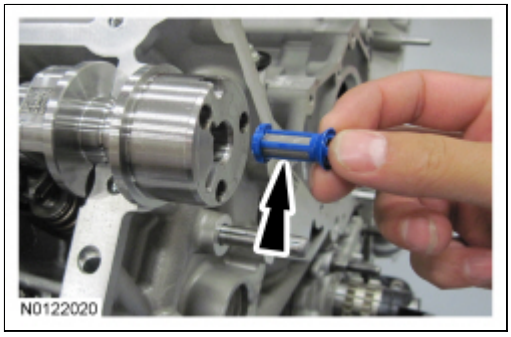
4. Tighten the bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 6 Nm (53 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



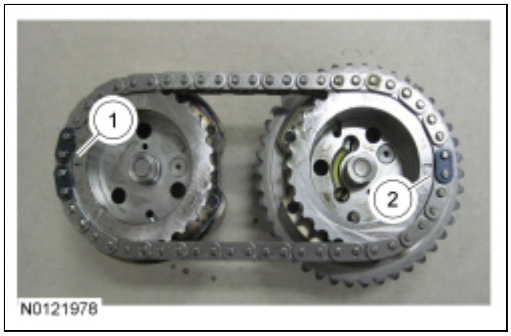
5. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

    Install the VCT system oil filter in the intake and exhaust camshafts.

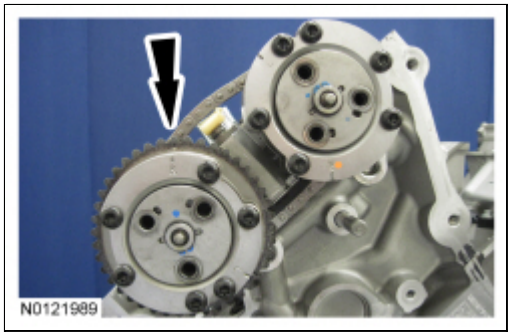
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6. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

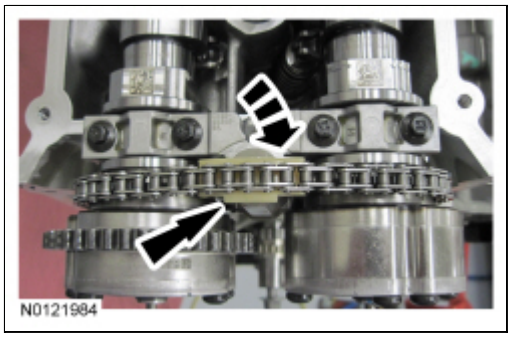


7. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



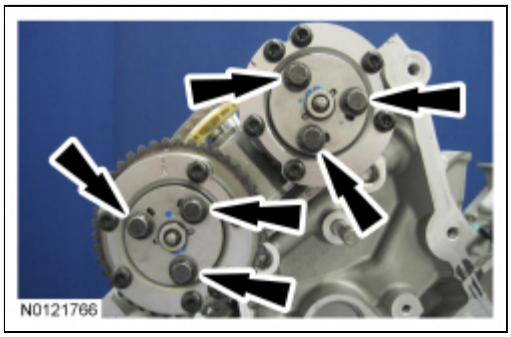
8. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.

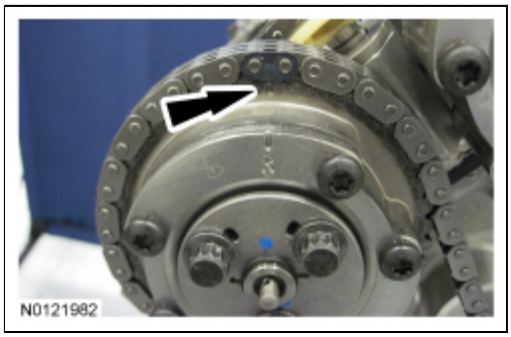


9. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

   Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.
   - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

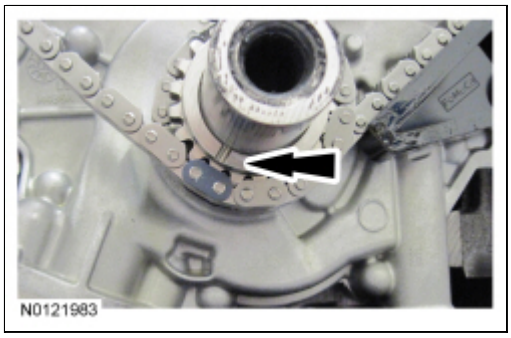


10. Install the RH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



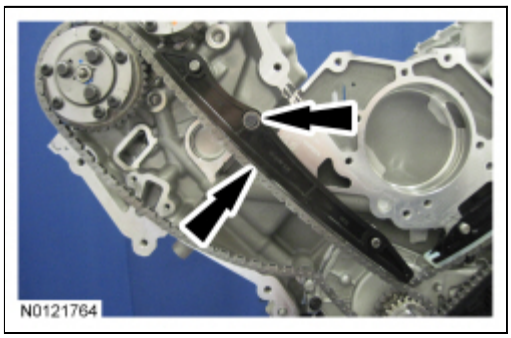
11. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.

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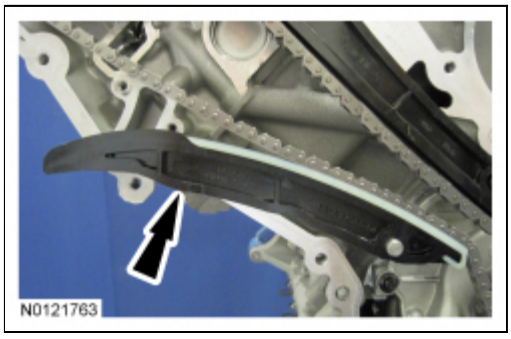
12. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

    Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



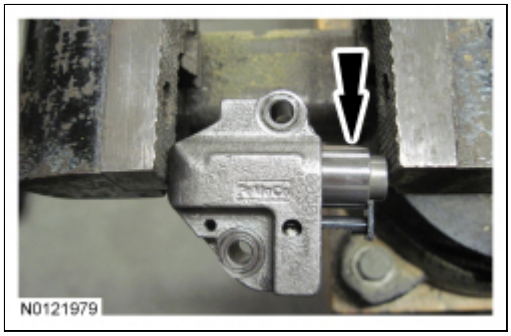
13. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

    Install the RH timing chain tensioner arm.

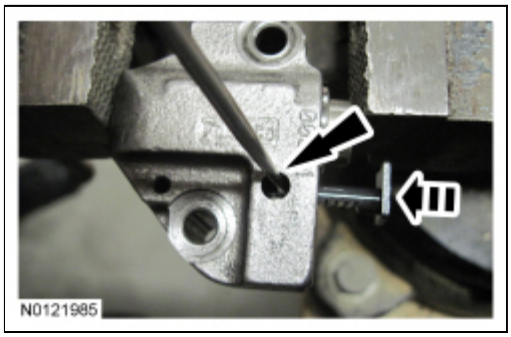


14. ***NOTICE:*** **Do not compress the ratchet assembly or damage to the tensioner will occur.**

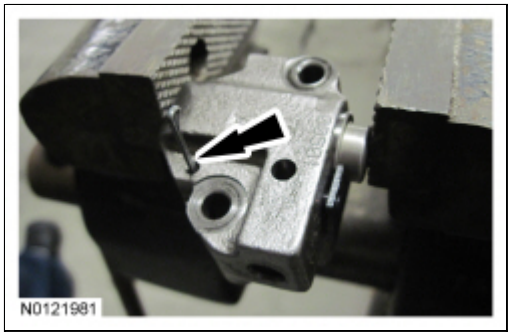
    Compress the primary timing chain tensioner plunger, using an edge of a vise.



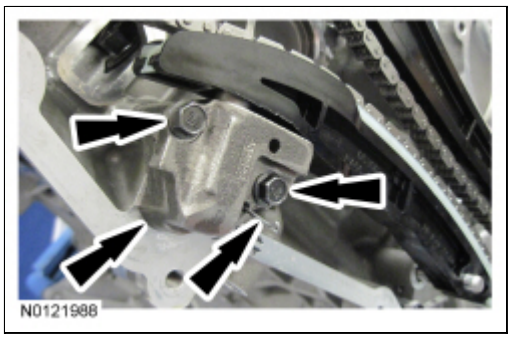
15. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



16. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



17. Install the RH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



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18. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Camshaft Roller Follower

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the camshaft roller follower being serviced. For additional information, refer to Camshaft — RH and/or Camshaft — LH in this section.

2. Remove the camshaft roller follower and hydraulic lash adjuster as an assembly.

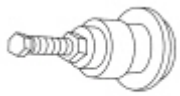
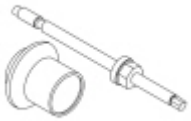
3. Separate the hydraulic lash adjuster from the spring clip on the camshaft roller follower.

4. To install, reverse the removal procedure.
   - Lubricate the camshaft roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.

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Crankshaft Front Seal

Special Tool(s)

 ST132B-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

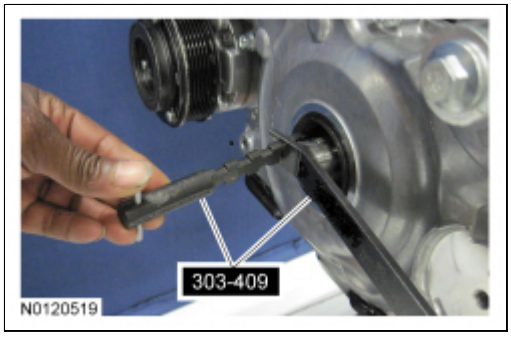
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
3. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

   Using the Oil Seal Remover, remove the crankshaft front oil seal.

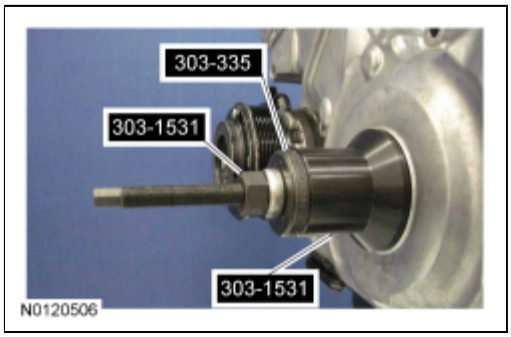
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Installation

1. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

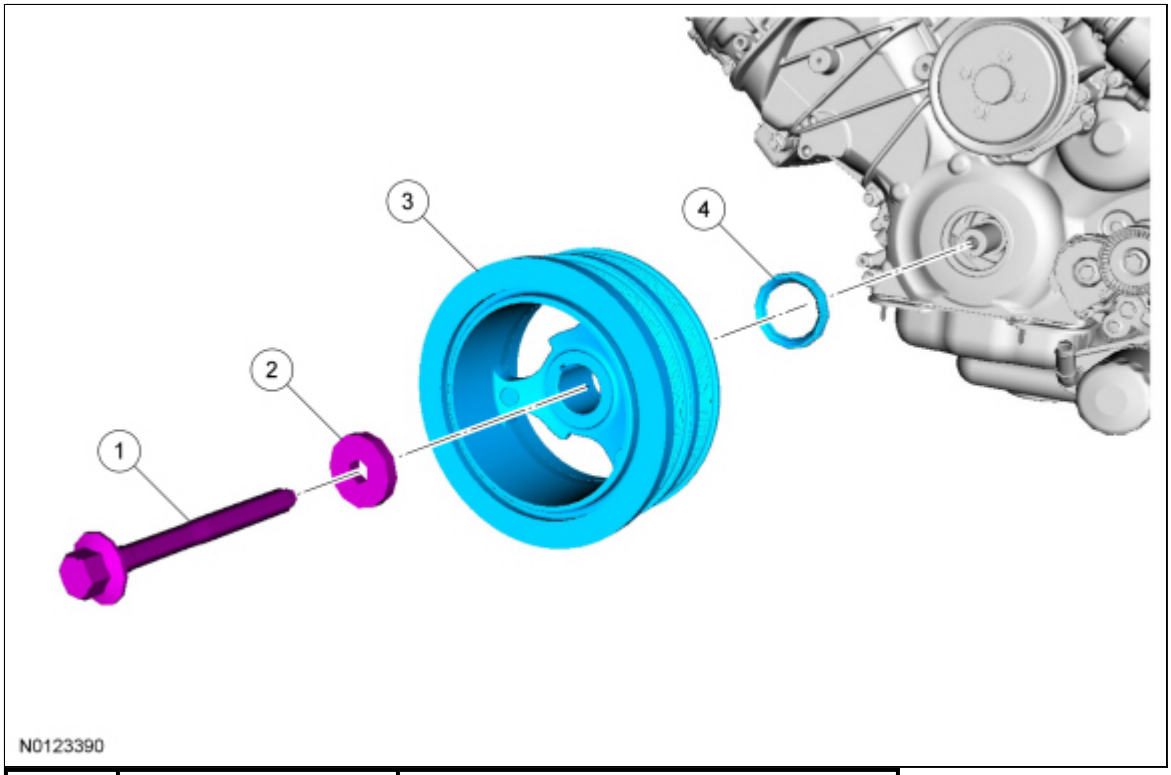
   Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

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Crankshaft Pulley and Crankshaft Front Seal — Exploded View



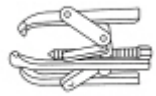
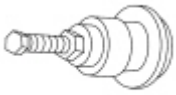
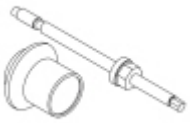
Item	Part Number	Description
1	6A340	Crankshaft pulley bolt
2	N807033	Crankshaft pulley washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Crankshaft Pulley

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

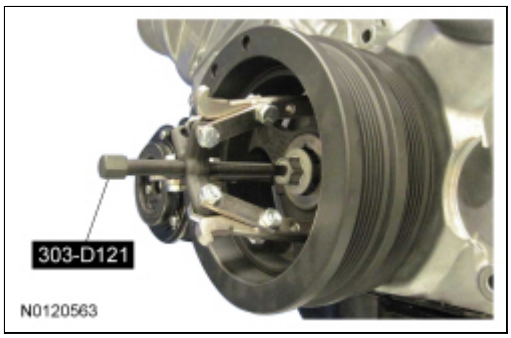
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive and A/C compressor belts. For additional information, refer to Section 303-05 .

3. Remove the crankshaft pulley bolt and washer.

4. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
   - Discard the crankshaft pulley bolt.



Installation

1. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply silicone sealer to the Woodruff key slot in the crankshaft pulley.

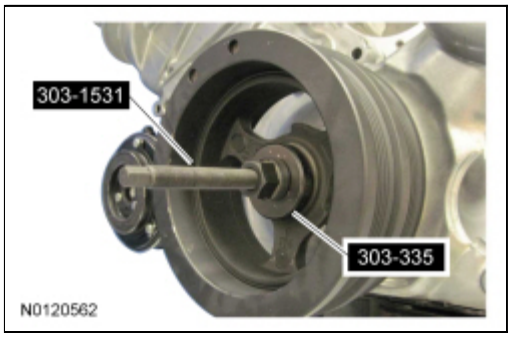


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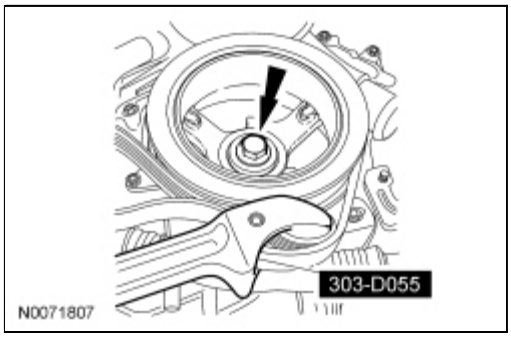
2. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.



3. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



4. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
   - Stage 1: Tighten to 140 Nm (103 lb-ft).
   - Stage 2: Loosen 360 degrees.
   - Stage 3: Tighten to 100 Nm (74 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.



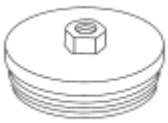
5. Install the accessory drive and A/C compressor belts. For additional information, refer to Section 303-05 .

6. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

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Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. Remove the flexplate. For additional information, refer to Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View and Flexplate .

2. Remove the engine separator plate.

3. **NOTE:** Inspect the crankshaft sensor ring for damage. If the crankshaft sensor ring has been dropped or has any visual damage, it must be discarded.

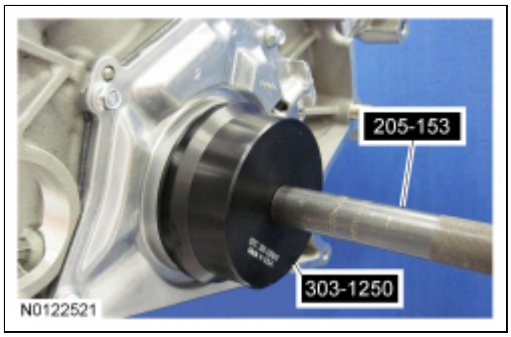
   Remove the crankshaft sensor ring.

4. Remove the oil pan. For additional information, refer to Engine Lubrication Components — Exploded View and Oil Pan in this section.

5. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

6. Remove the bolt and the CKP sensor.

7. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.



8. Remove the 6 bolts and the crankshaft rear seal retainer plate.

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

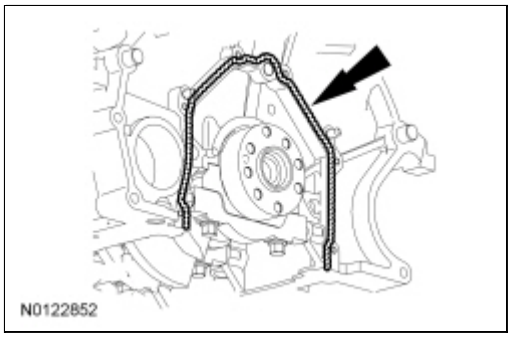
   NOTE: Clean the sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

   Clean and inspect the mating surface.

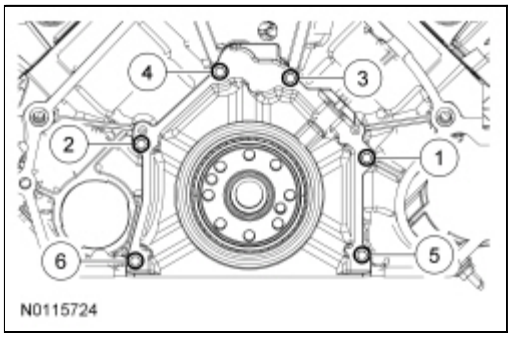
2. **NOTE:** If the rear crankshaft seal retaining plate is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure may cause future oil leaks.

   Apply a 3.75 mm (0.147 in) bead of silicone sealant to the rear crankshaft seal retainer mating surface on the engine block.

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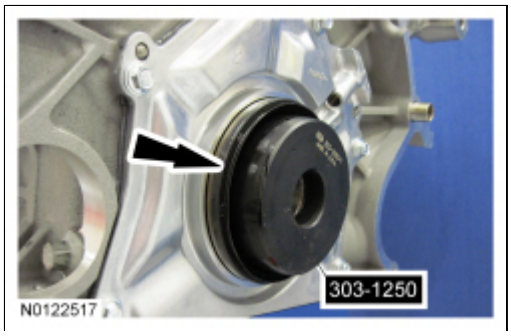


3. Install the crankshaft rear seal retainer plate and the 6 bolts, tighten in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

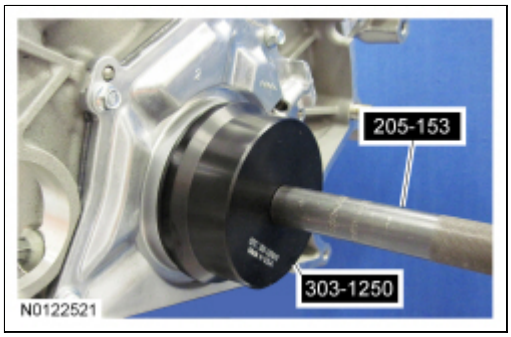


4. **NOTE:** Lubricate the seal lips and bore with clean engine oil prior to installation.

    Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.

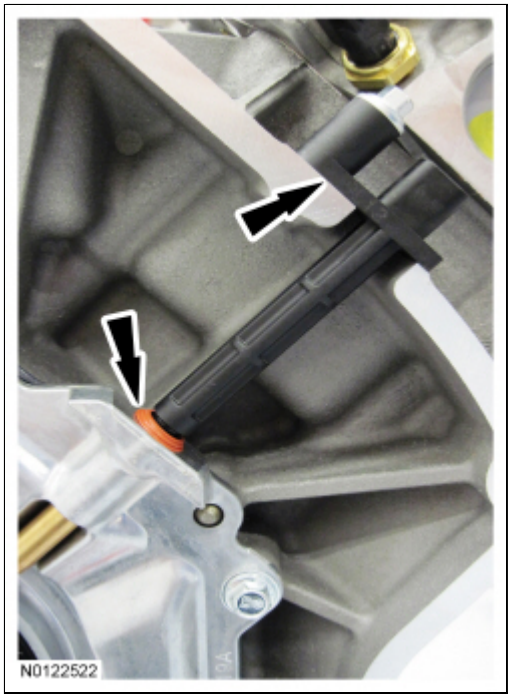


5. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



6. ***NOTICE:*** **The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.**

   Position the CKP sensor and install the bolt.
   - Tighten to 10 Nm (89 lb-in).



7. Connect the CKP sensor electrical connector.

8. Install the oil pan. For additional information, refer to Engine Lubrication Components — Exploded View and Oil Pan in this section.

9. Install the crankshaft sensor ring.

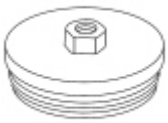
10. Install the engine separator plate.

11. Install the flexplate. For additional information, refer to Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View and Flexplate .

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Crankshaft Rear Seal

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the flexplate. For additional information, refer to Flexplate or Flywheel and Crankshaft Rear

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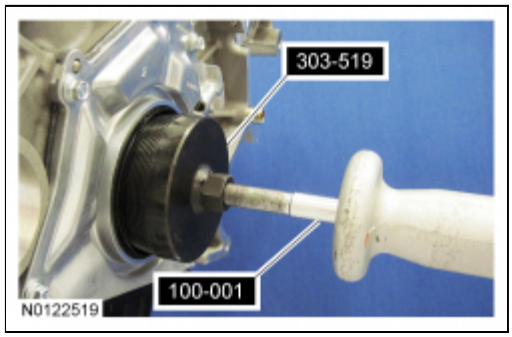
Seal — Exploded View and Flexplate in this section.

3. Remove the engine separator plate.

4. **NOTE:** Inspect the crankshaft sensor ring for damage. If the crankshaft sensor ring has been dropped or has any visual damage, it must be discarded.

   Remove the crankshaft sensor ring.

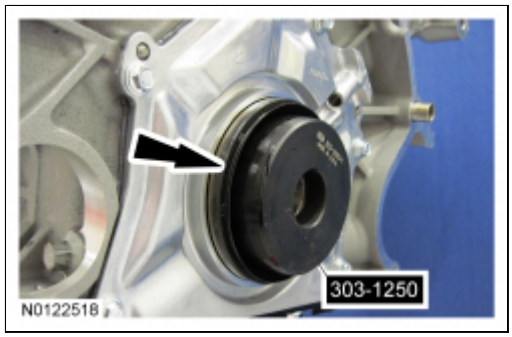
5. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.
   - Clean all sealing surfaces with metal surface prep.



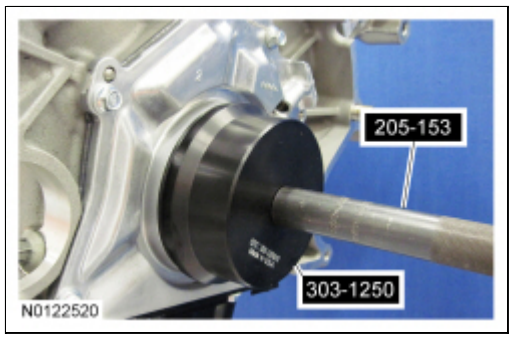
Installation

1. **NOTE:** Lubricate the seal lips and bore with clean engine oil prior to installation.

   Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.



2. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



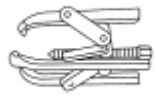
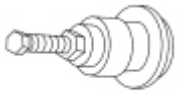
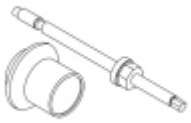
3. Install the crankshaft sensor ring.
4. Install the engine separator plate.
5. Install the flexplate. For additional information, refer to Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View and Flexplate in this section.

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Engine Front Cover

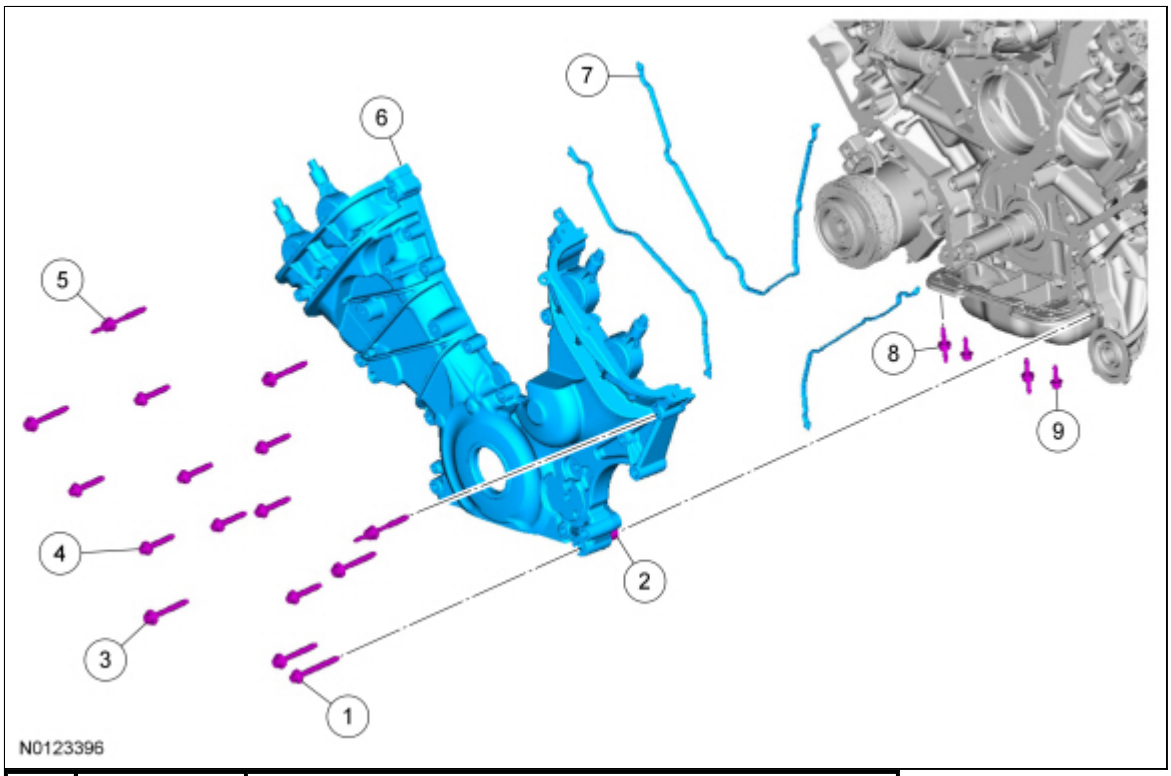
Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—

Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4



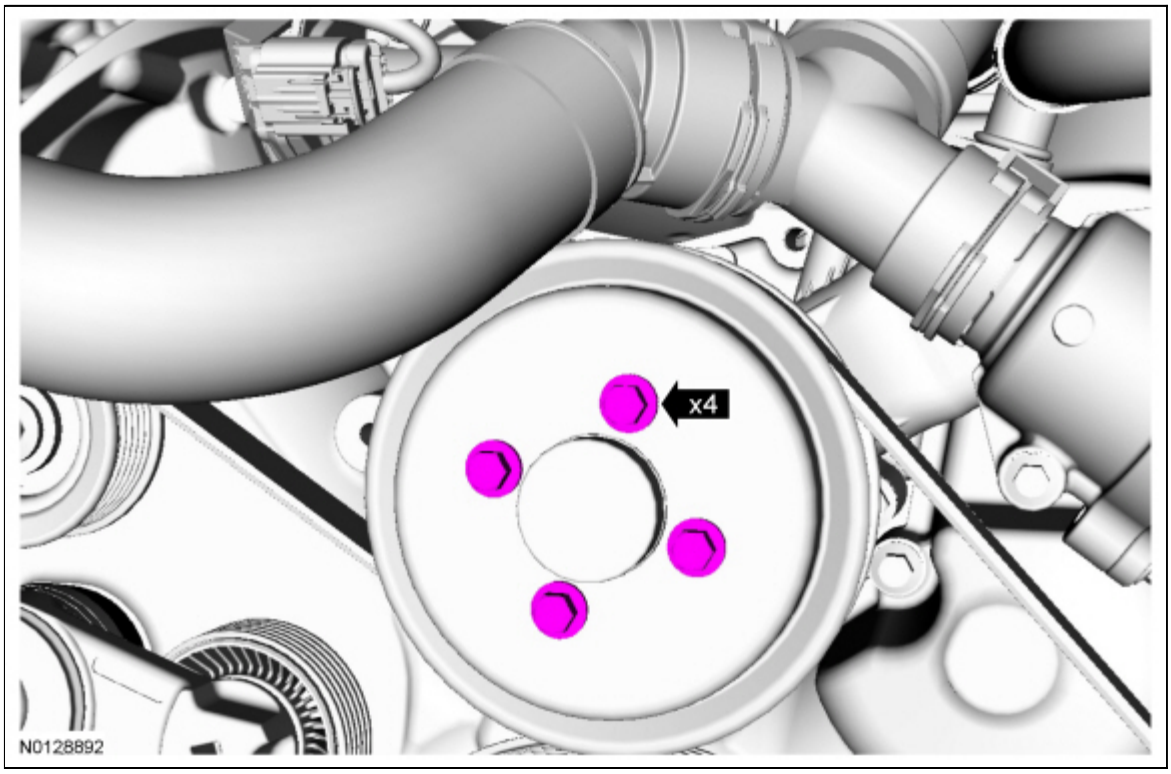
Item	Part Number	Description
1	W503304	Engine front cover-to-oil filter adapter bolt
2	W715209	Engine front cover-to-oil filter adapter jackscrew (part of 6019)
3	W704920	Engine front cover bolt (5 required)
4	W714925	Engine front cover bolt (8 required)
5	W704919	Engine front cover stud bolt (2 required)
6	6019	Engine front cover
7	6020	Engine front cover gasket (3 required)
8	W714963	Oil pan stud bolt (2 required)

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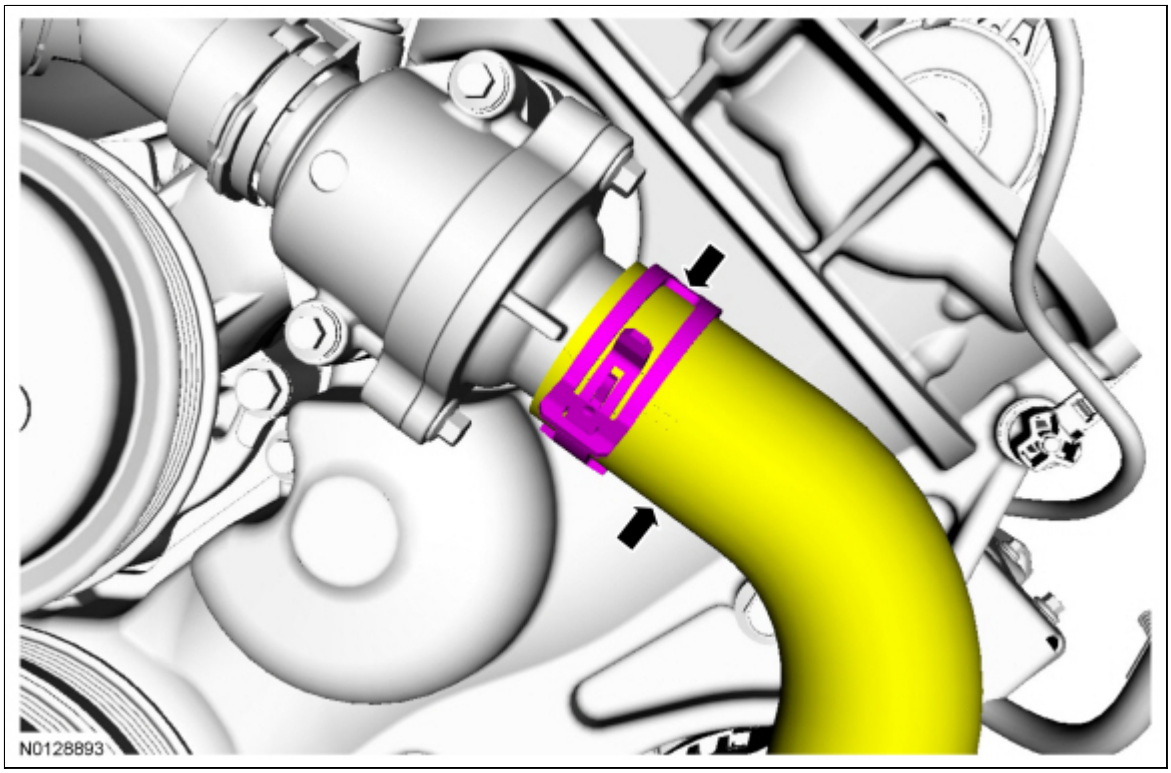
9	W714962	Oil pan bolt (2 required)

Removal

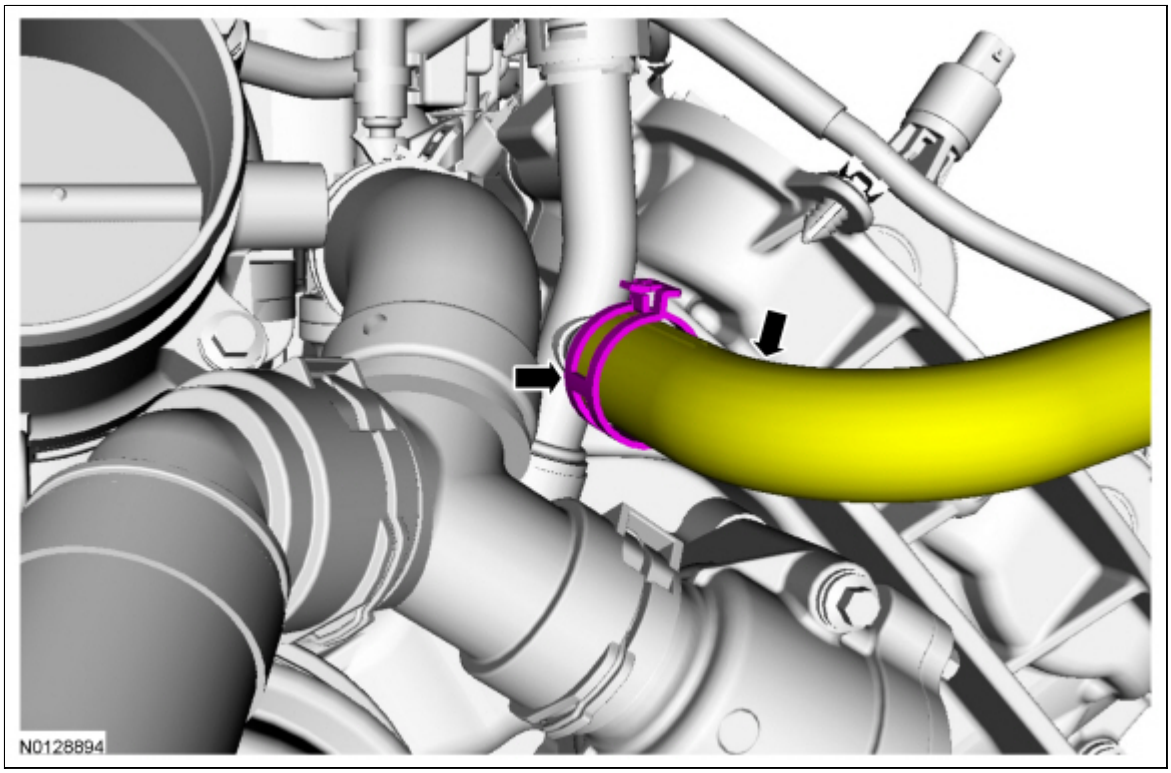
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Drain the engine cooling system. For additional information, refer to Section 303-03 .
4. Remove the RH and LH valve covers. For additional information, refer to Valve Cover — RH and Valve Cover — LH in this section.
5. Loosen the 4 coolant pump pulley bolts.



6. Remove the accessory drive and A/C compressor belts. For additional information, refer to Section 303-05 .
7. Release the clamp and disconnect the lower radiator hose from the thermostat housing assembly.

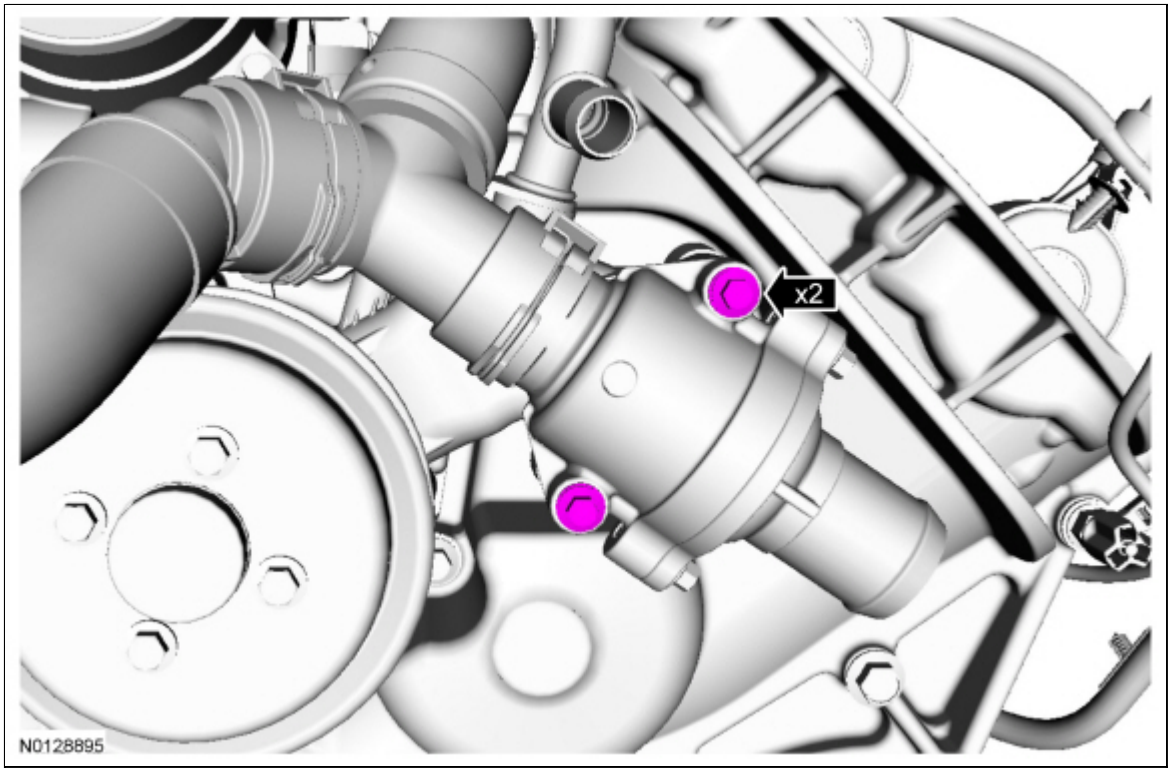


8. Release the clamp and disconnect the degas coolant hose.

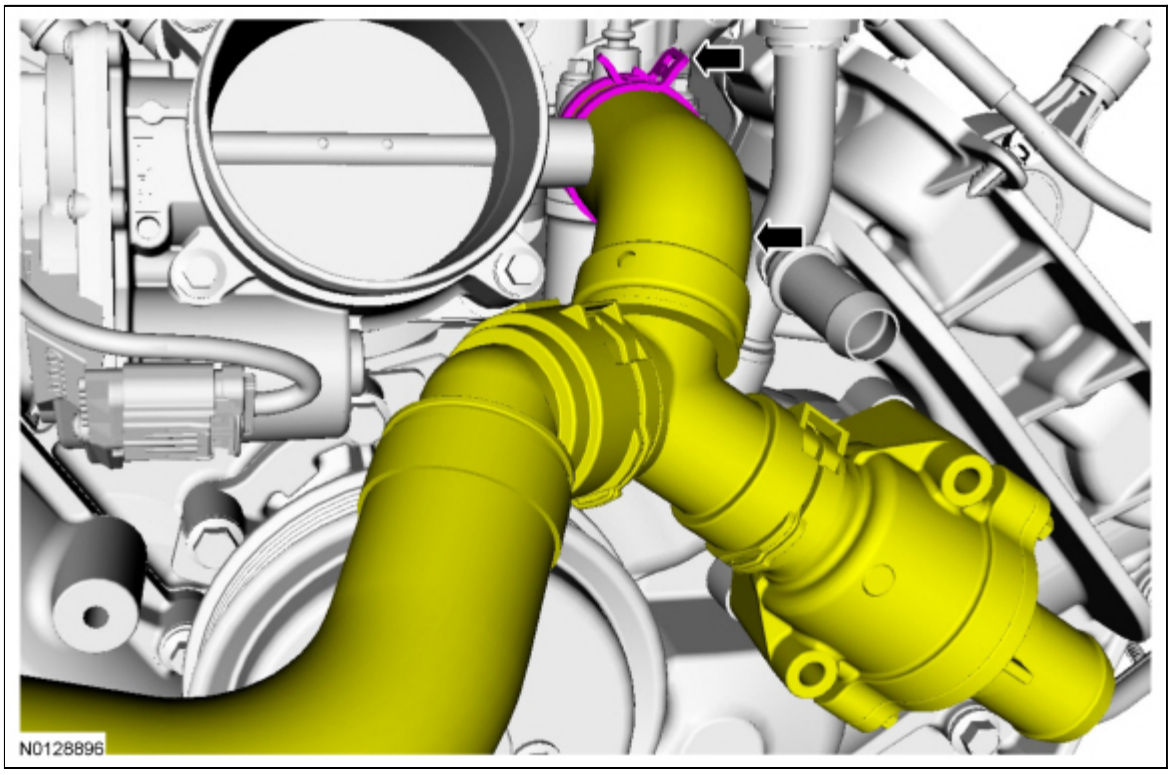


9. Remove the 2 thermostat housing bolts.

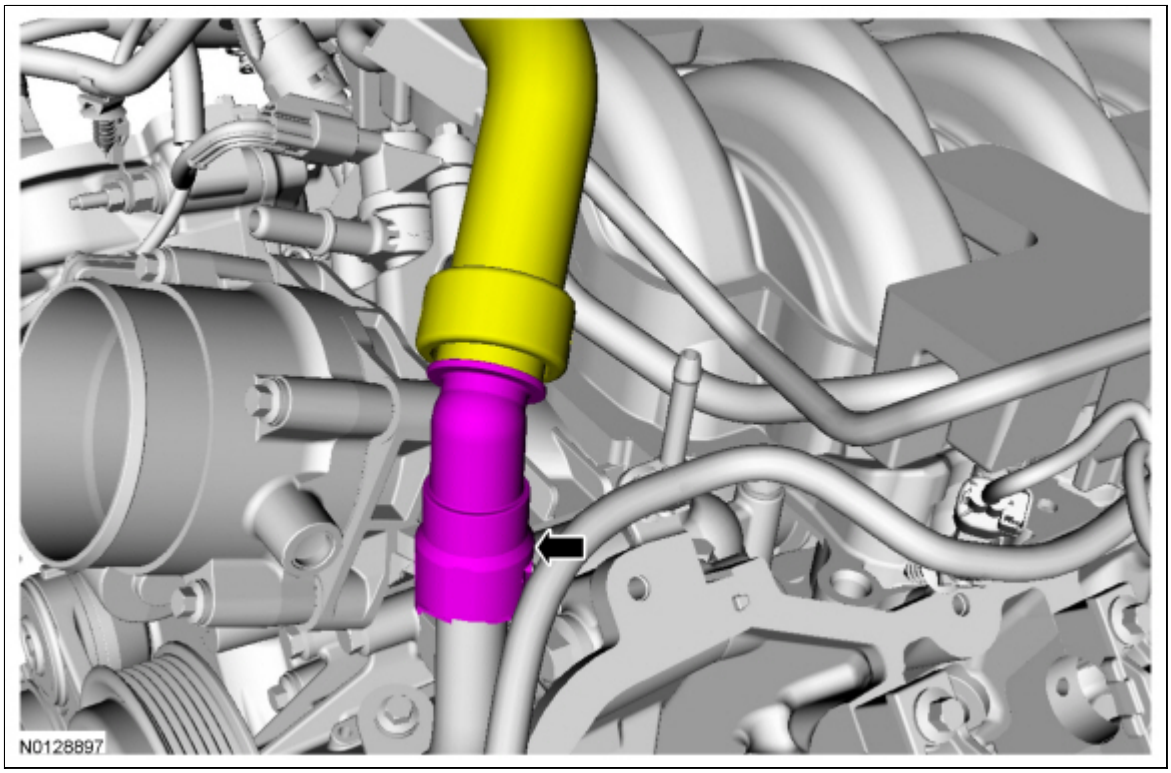
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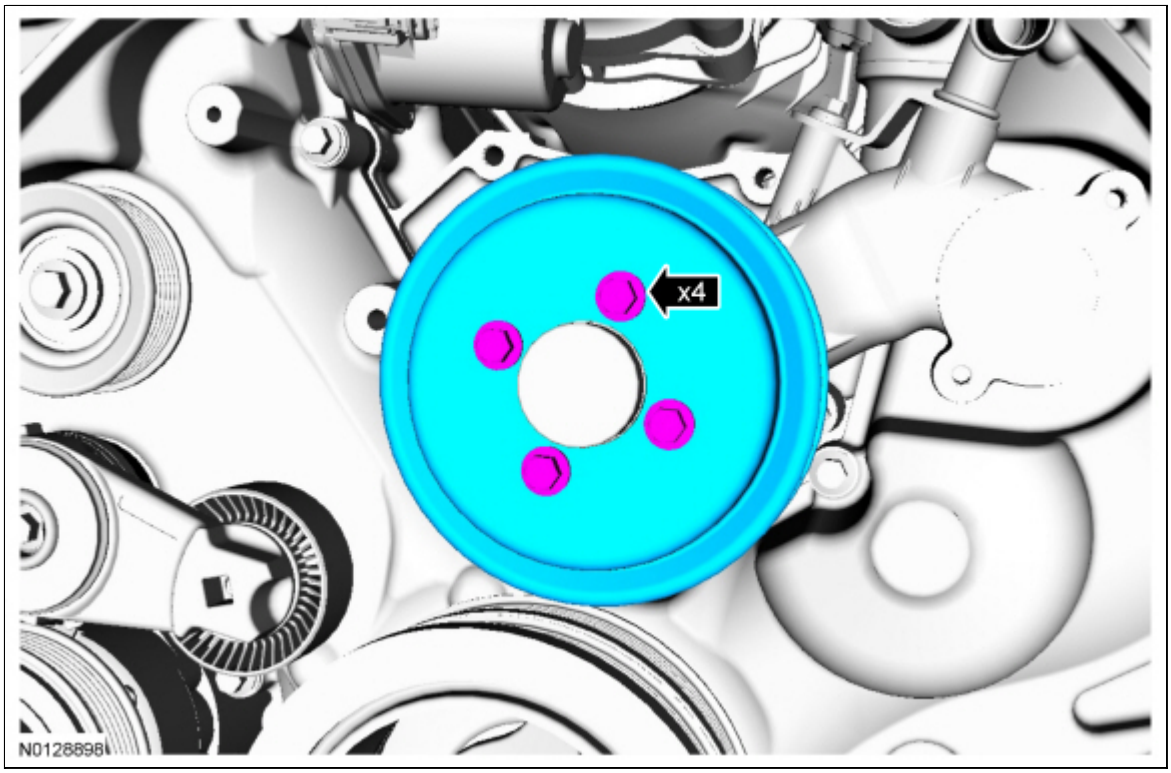
10. Release the clamp and position the upper radiator hose T-connector/thermostat housing assembly aside.
    - Remove and discard the thermostat housing O-ring seal.



11. Disconnect the heater hose.

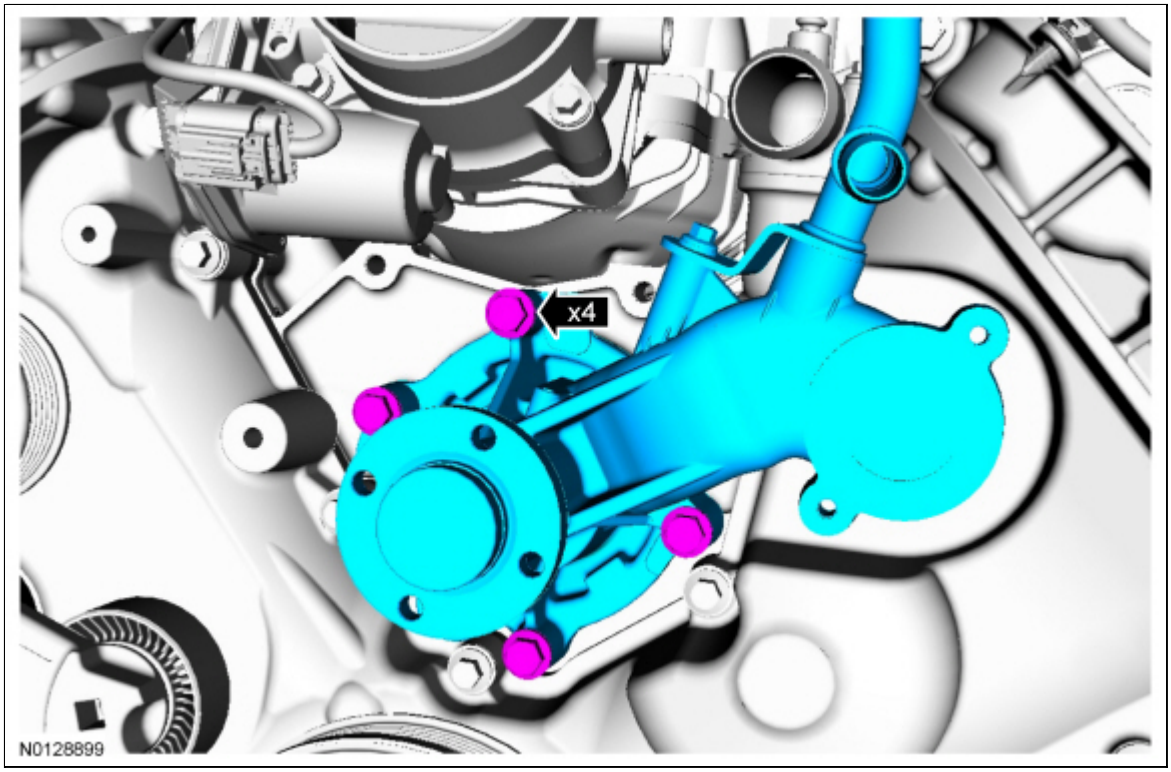


12. Remove the 4 bolts and the coolant pump pulley.

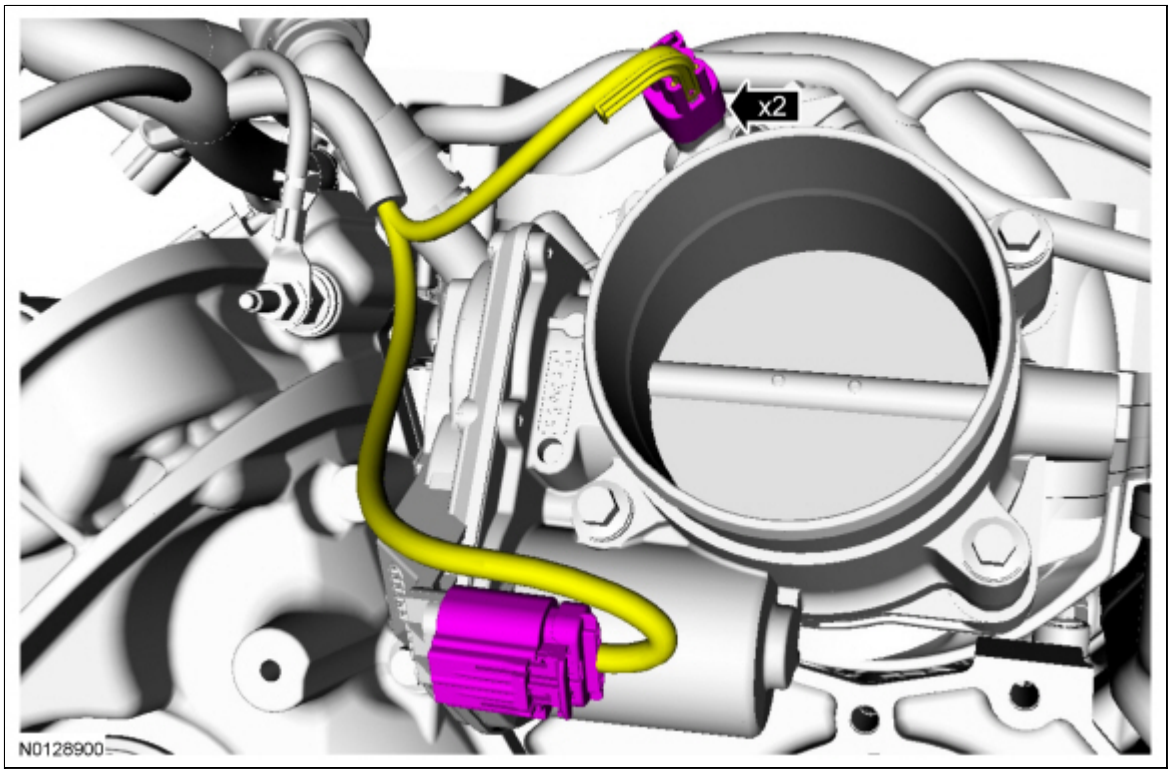


13. Remove the 4 bolts and the coolant pump.
    - Remove and discard the O-ring seal.

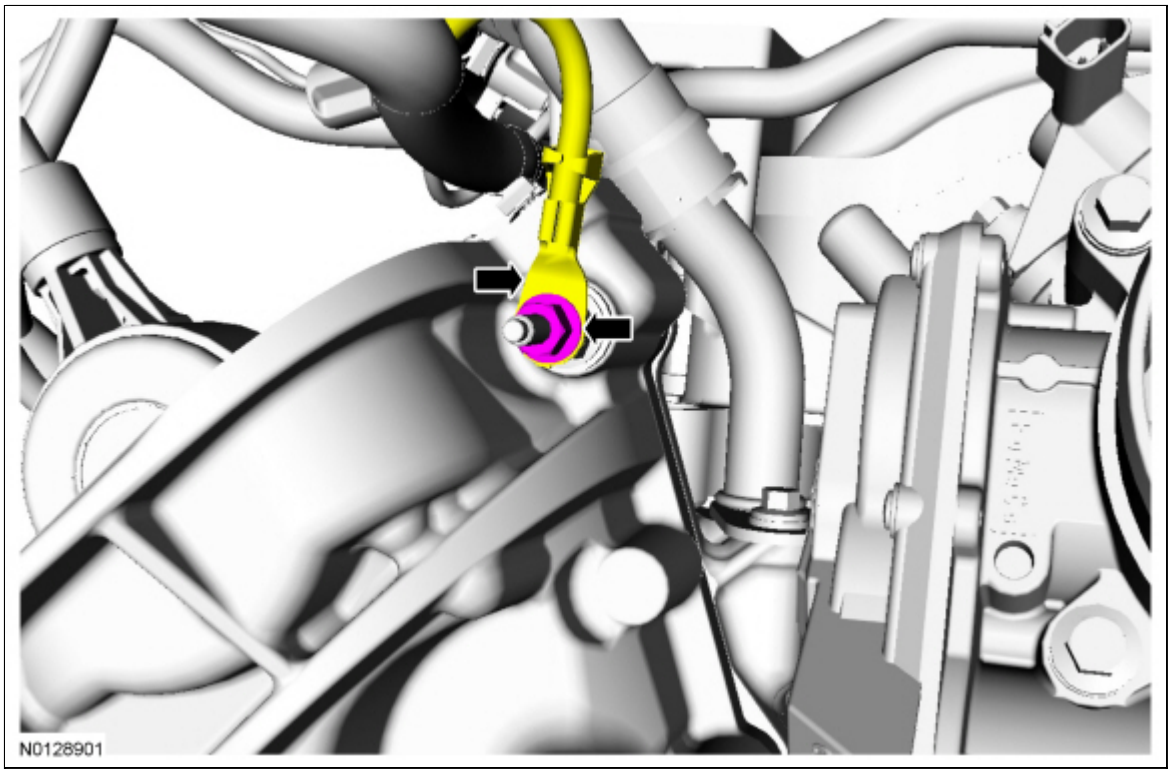
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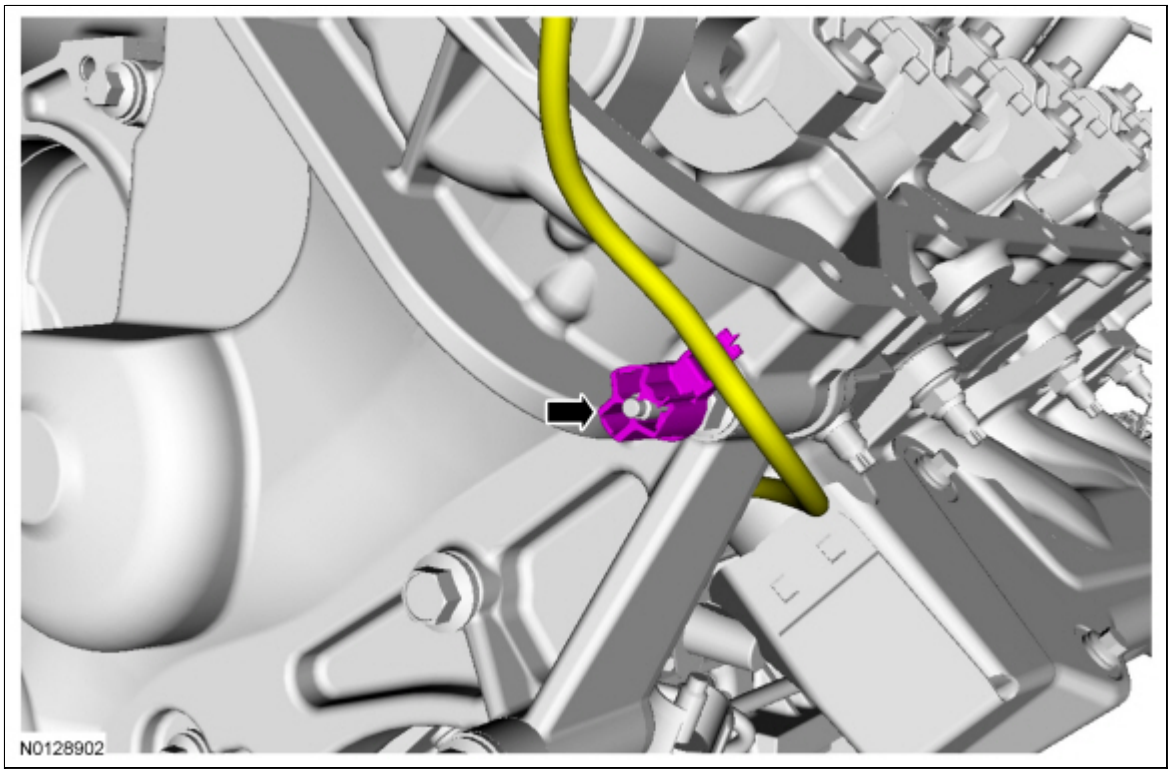
14. Disconnect the throttle body and Evaporative Emission (EVAP) purge valve electrical connectors.



15. Remove the nut and the ground wire from the engine front cover stud bolt.

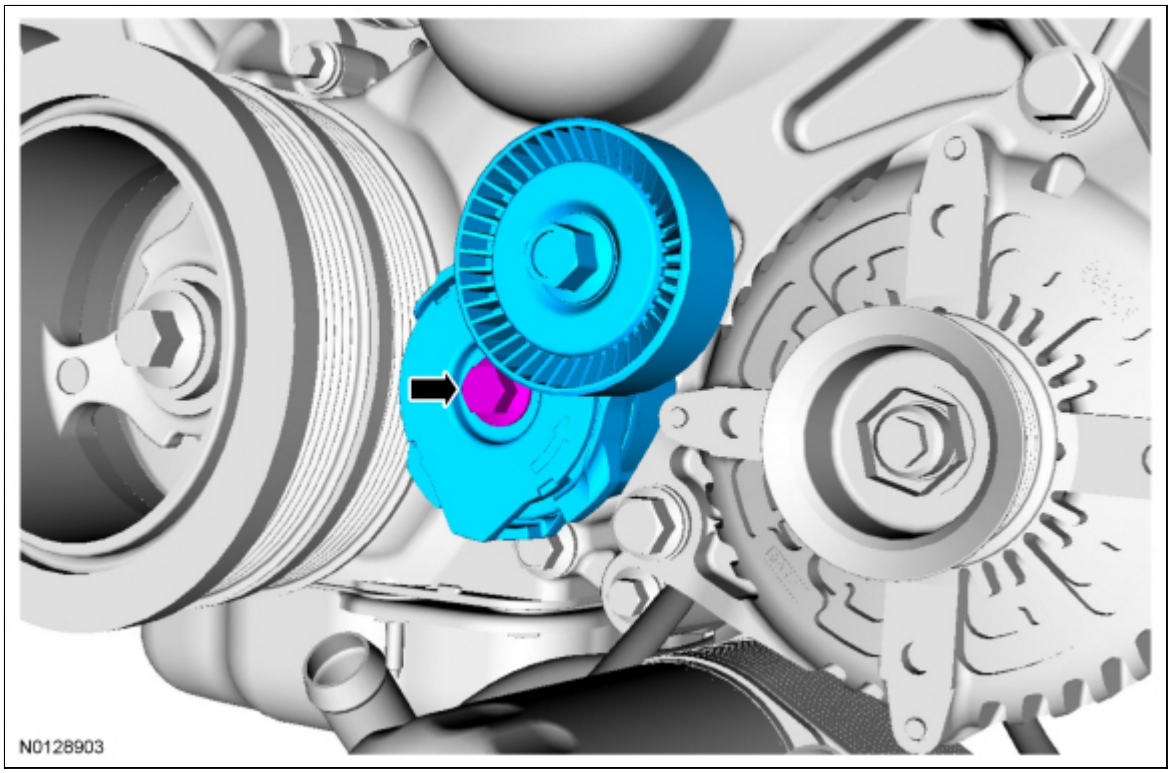


16. Detach the wiring harness retainer from the engine front cover stud bolt.

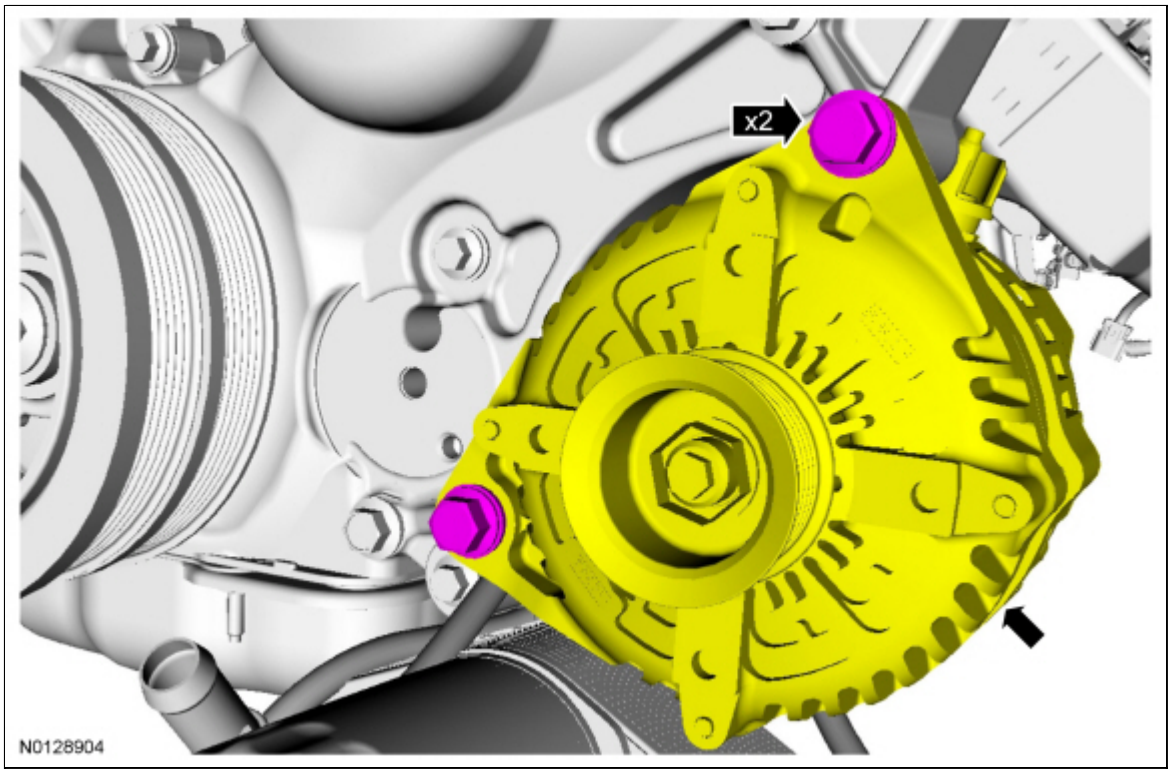


17. Remove the bolt and the accessory drive belt tensioner.

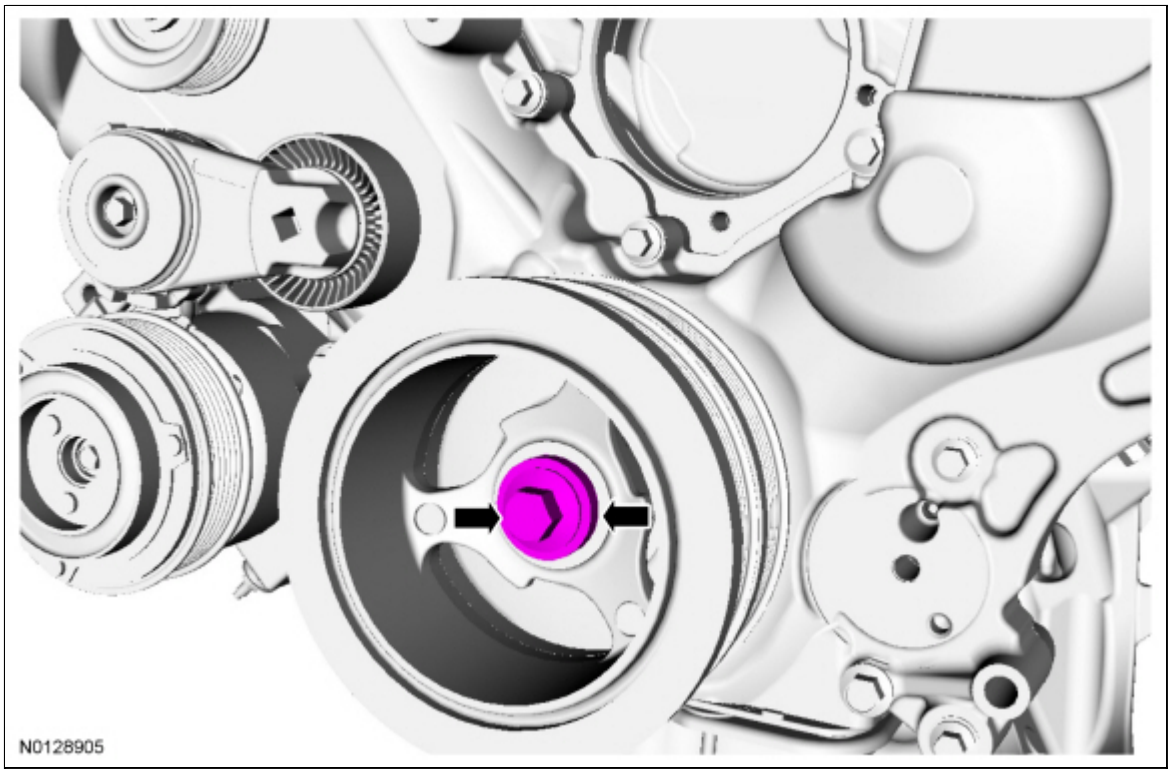
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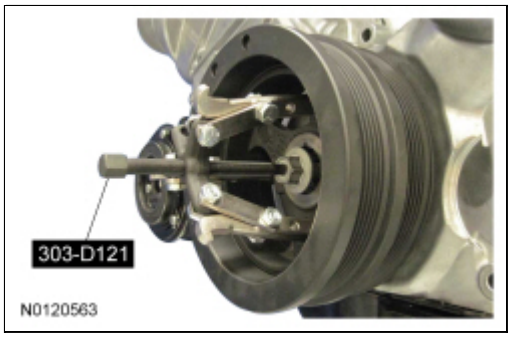
18. Remove the 2 bolts and position the generator aside.



19. Remove the crankshaft pulley bolt and washer.

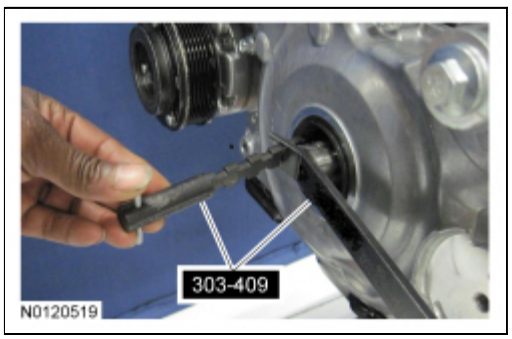


20. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
    - Discard the crankshaft pulley bolt.



21. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

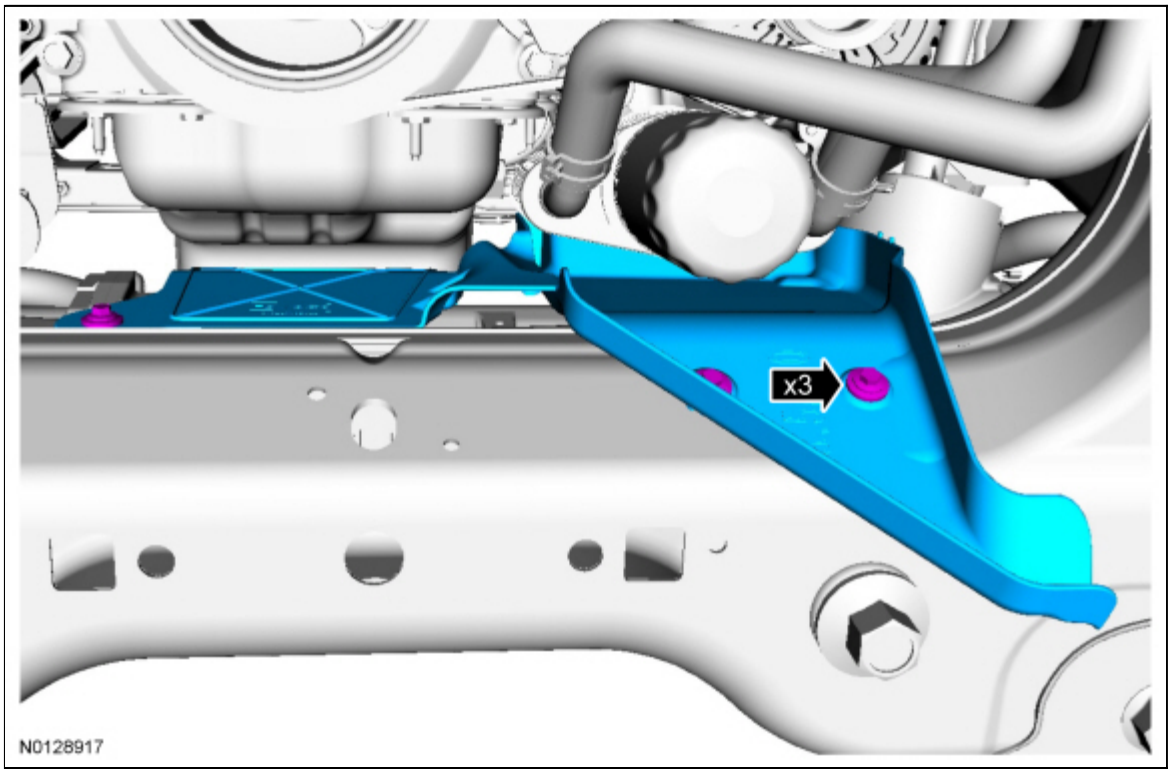
    Using the Oil Seal Remover, remove the crankshaft front oil seal.



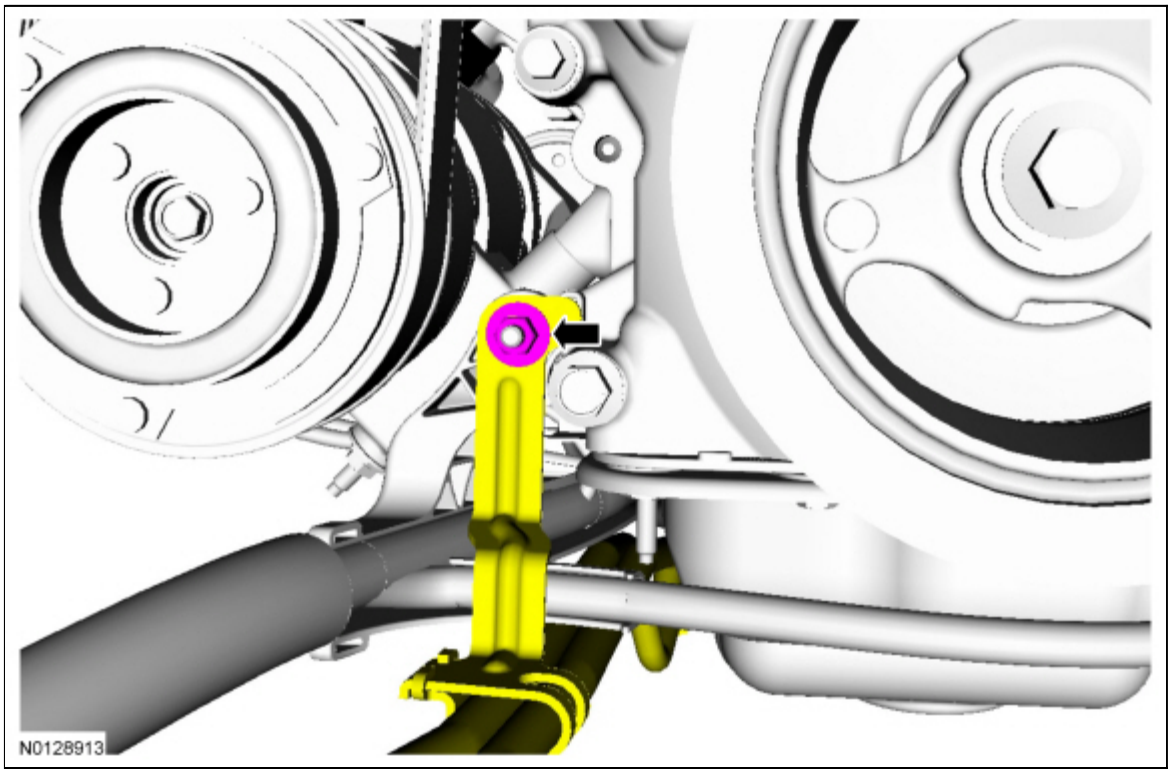
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22. Remove the 4 bolts and the skid plate.

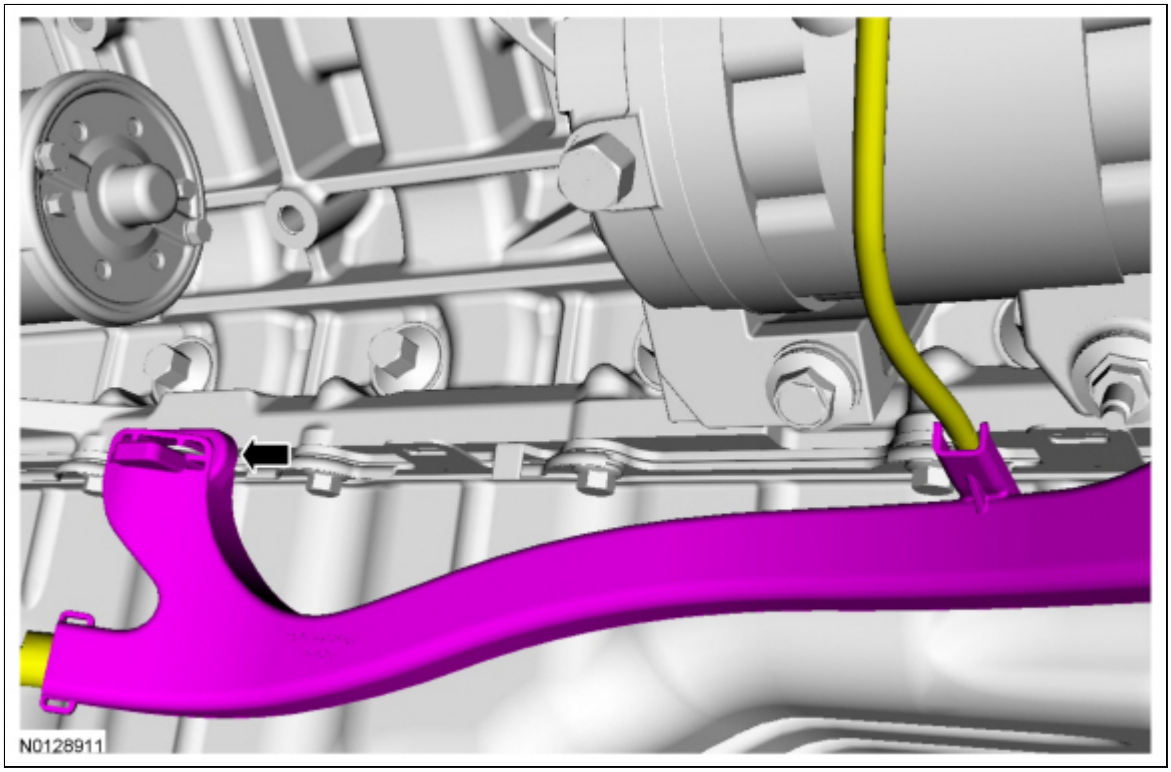
23. Remove the 3 bolts and the oil drain gutter.



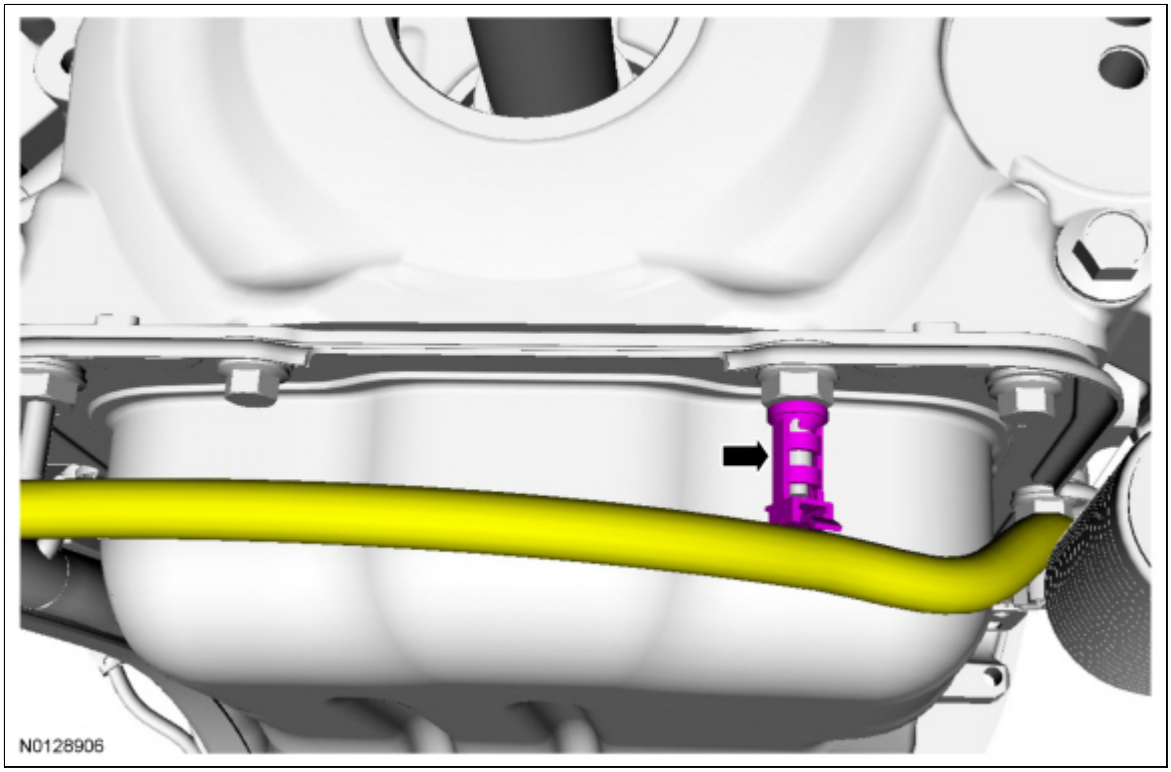
24. Remove the nut and the transmission cooler tube bracket from the engine front cover stud bolt.



25. Detach the starter motor wiring harness retainer from the oil pan.



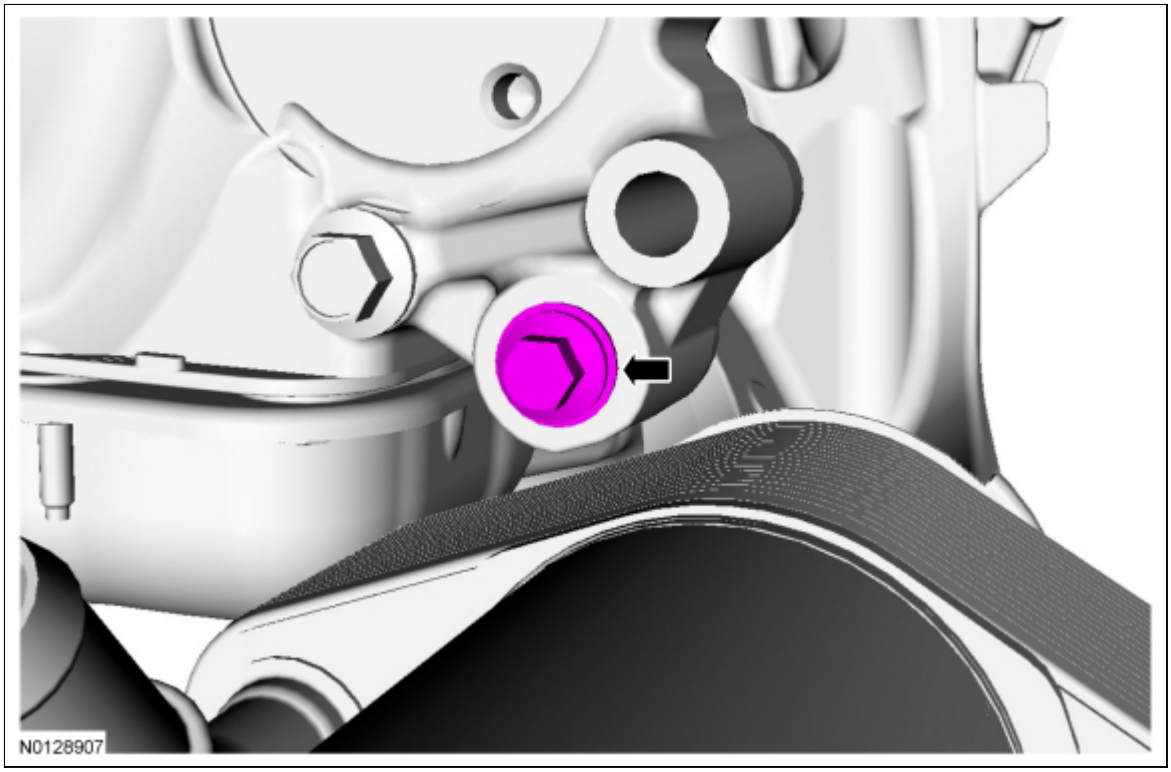
26. Detach the wiring harness retainer from the oil pan stud bolt.



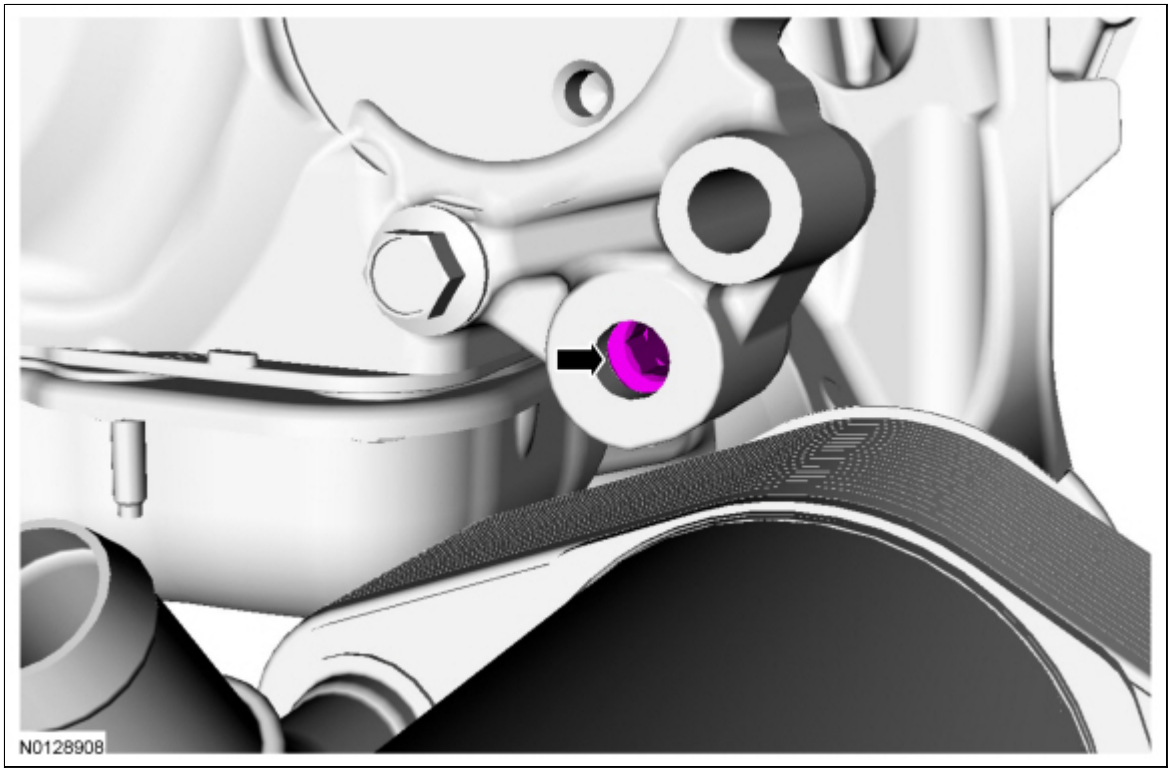
27. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.

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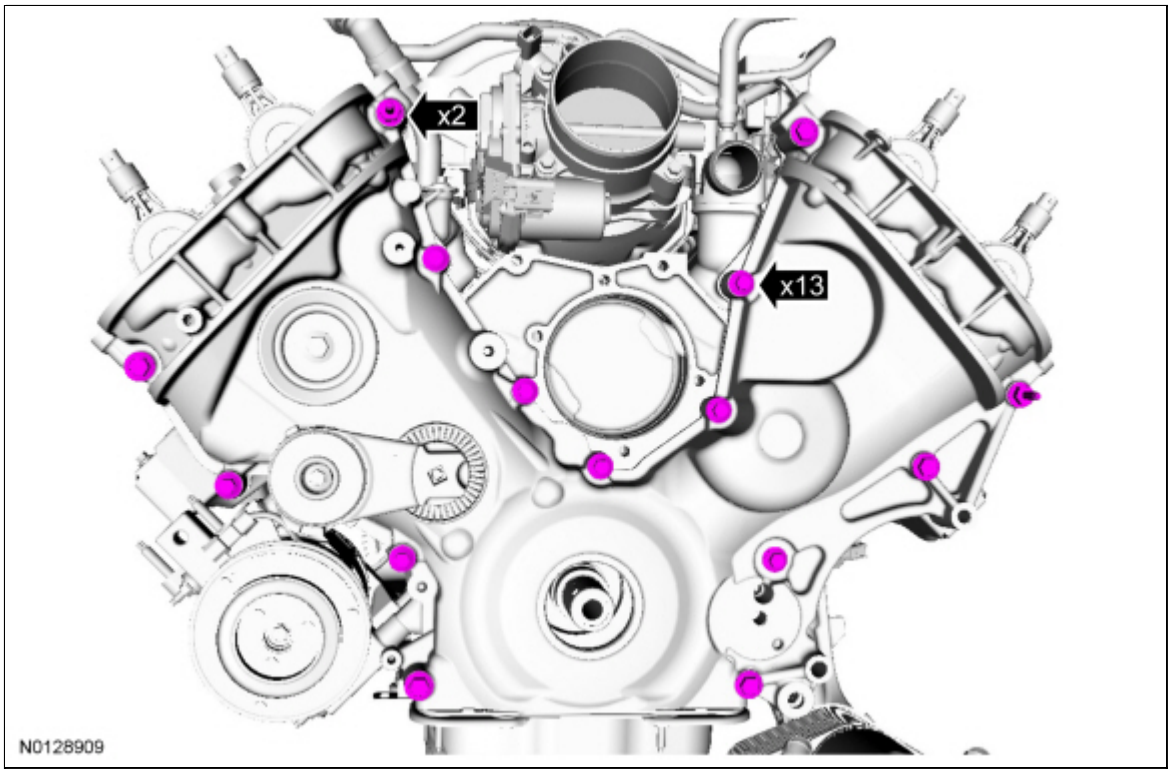
28. Remove the engine front cover-to-oil filter adapter bolt.



29. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



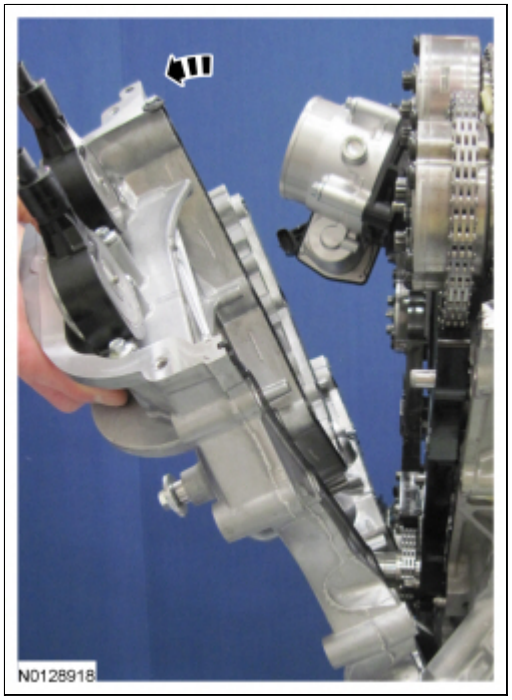
30. Remove the 13 engine front cover bolts and the 2 stud bolts.



31. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove the engine front cover.
    - Remove and discard the engine front cover gaskets.
    - Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.

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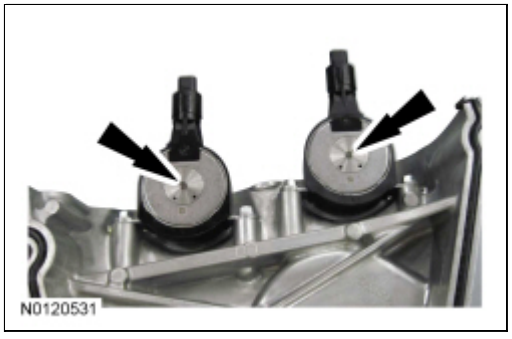
32. Drain the engine oil.
    - Install the drain plug and tighten to 26 Nm (19 lb-ft).

Installation

1. ***NOTICE:*** **The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully depressed to avoid interference with the VCT valve tips when installing the engine front cover. Failure to follow these instructions can result in damage to the engine.**

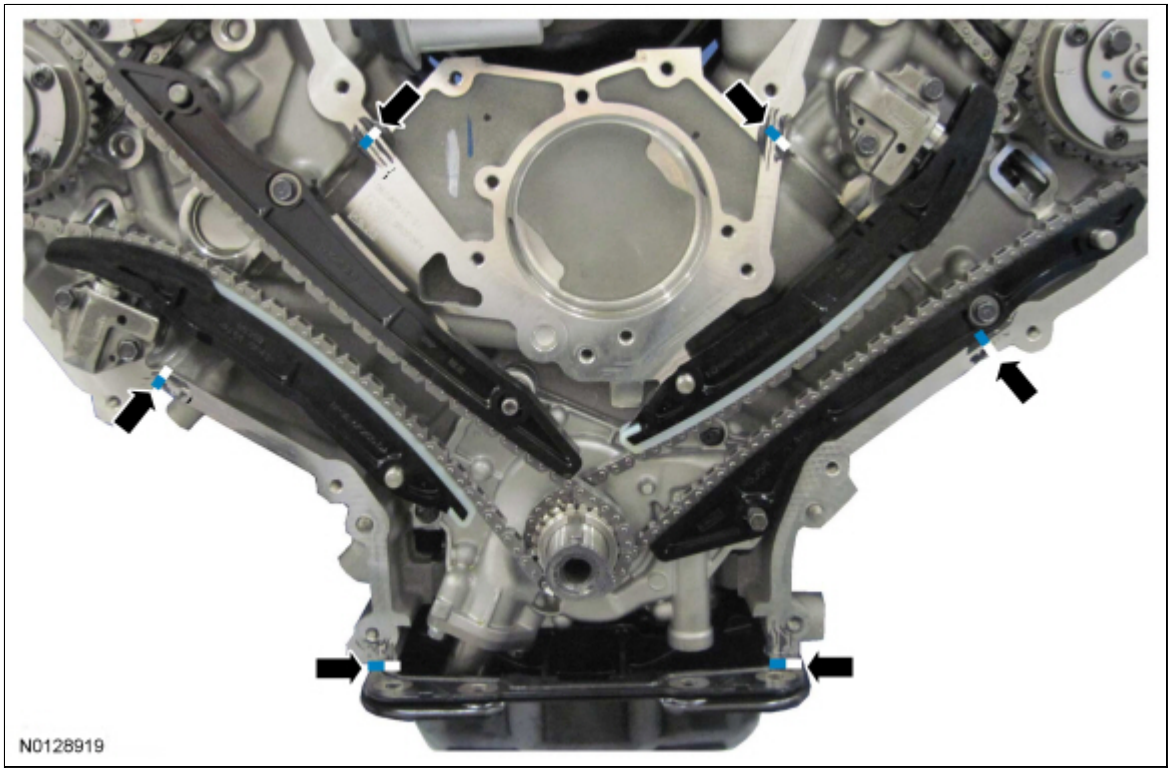
   NOTE: LH shown, RH similar.

   Fully depress the VCT variable force solenoid pins.



2. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

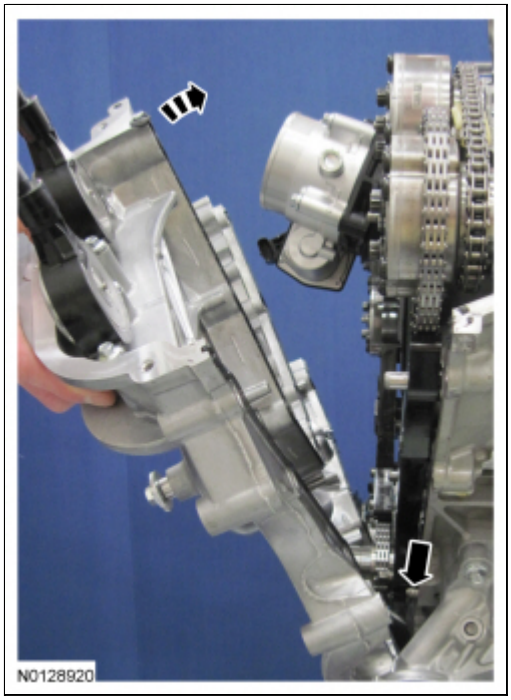
Apply a bead of silicone gasket and sealant to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.



3. **NOTE:** Make sure that the engine front cover gaskets are in place on the engine front cover before installation.

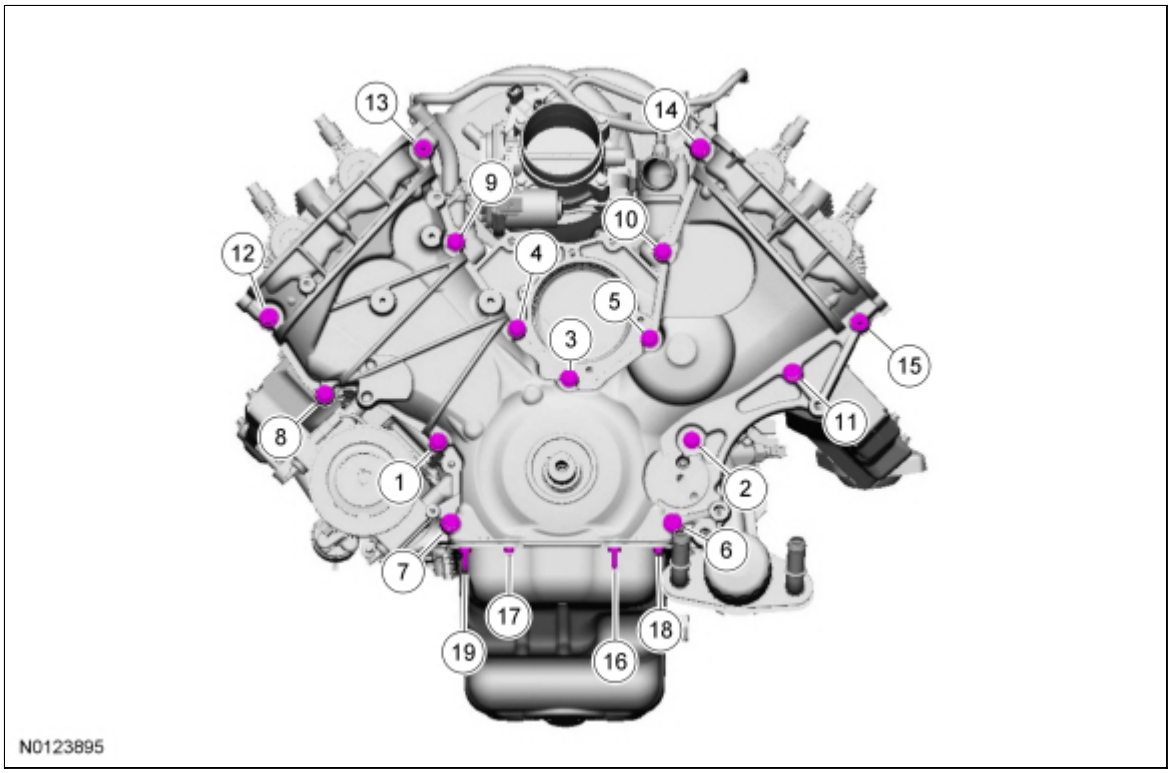
   Using new gaskets, position the engine front cover onto the dowels.
   - Install the 13 engine front cover bolts, 2 stud bolts, the 2 oil pan-to-engine front cover bolts and the 2 oil pan-to-engine front cover stud bolts finger-tight.

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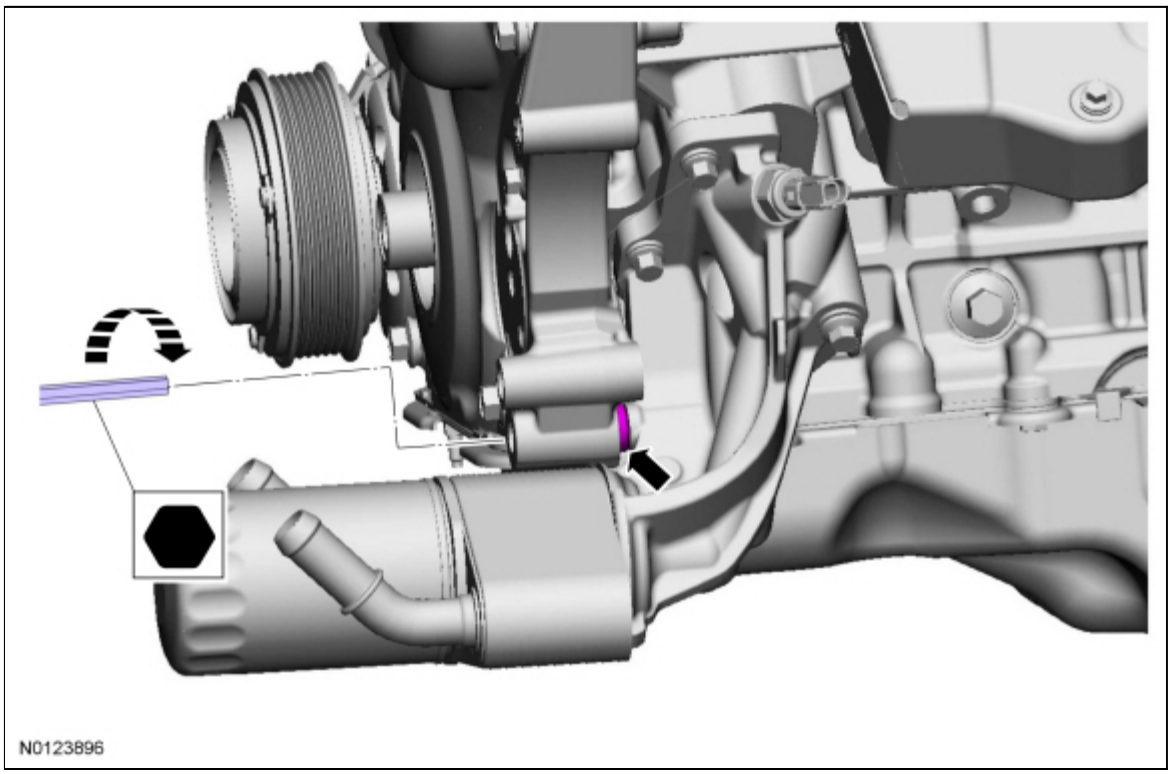


4. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Tighten the bolts in the sequence shown in 2 stages.
   - Stage 1: Tighten bolts 1-15 to 25 Nm (18 lb-ft) and bolts 16-19 to 10 Nm (89 lb-in).
   - Stage 2: Tighten bolts 1-15 an additional 60 degrees and bolts 16-19 an additional 45 degrees.

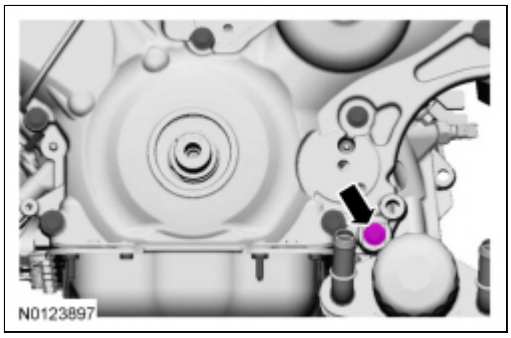


5. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).

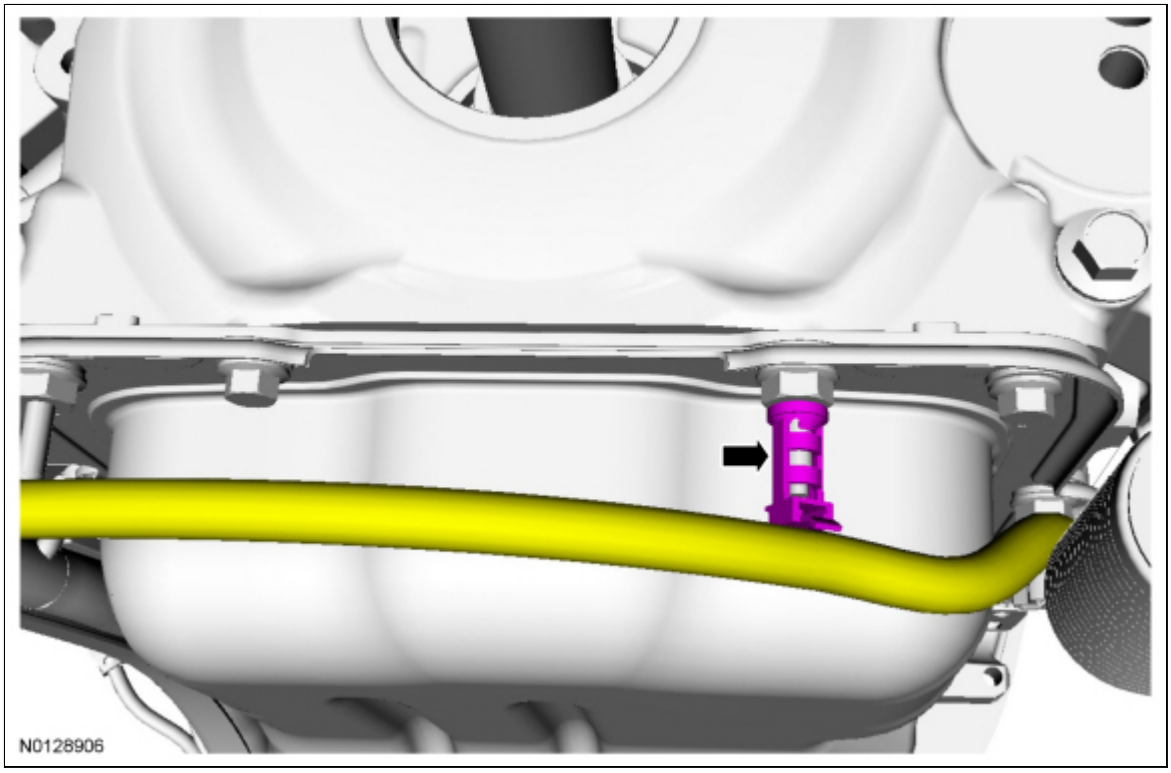


6. Install the engine front cover-to-oil filter adapter bolt and tighten to 25 Nm (18 lb-ft) plus an additional 60 degrees.

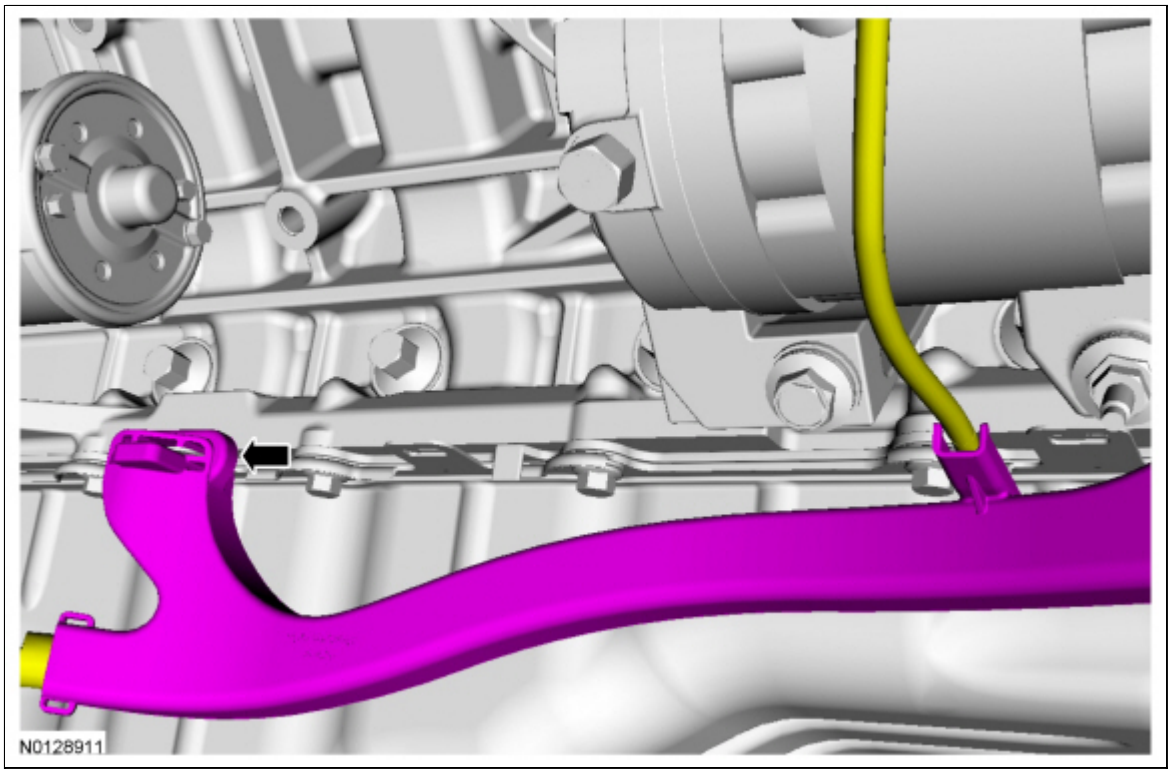
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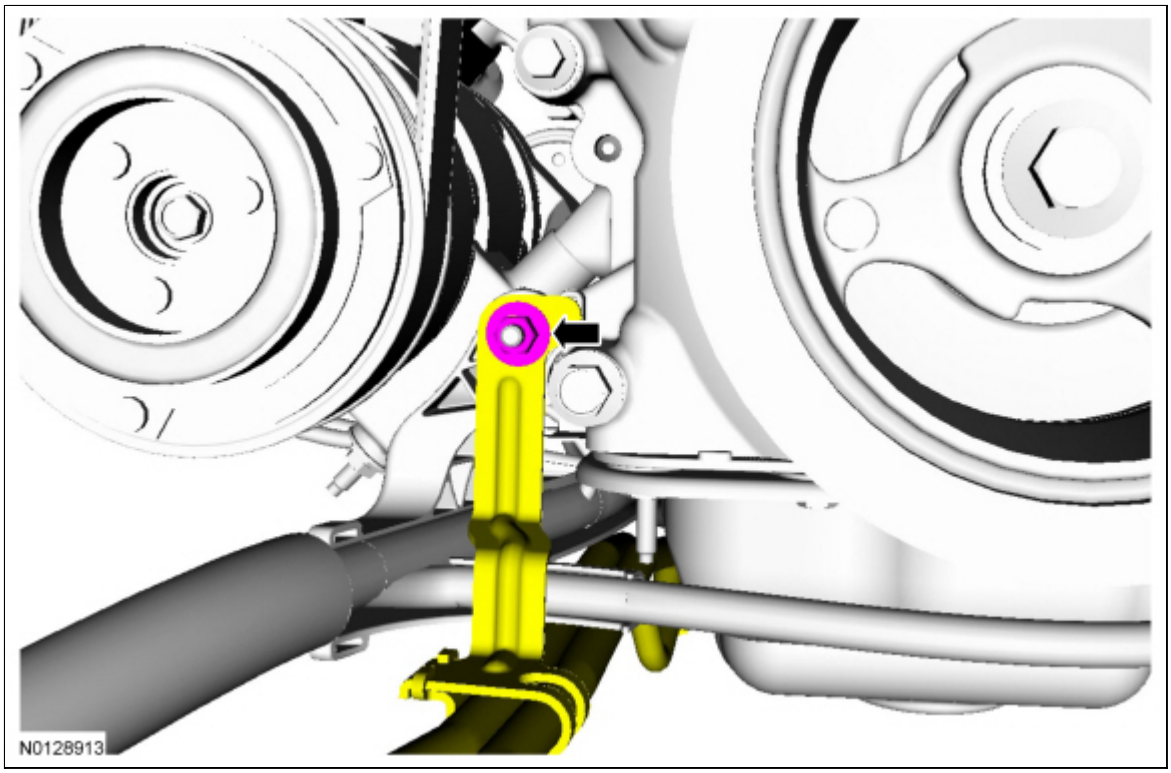
7. Position the wiring harness and install the wiring harness retainer to the oil pan stud bolt.



8. Attach the starter motor wiring harness retainer to the oil pan.

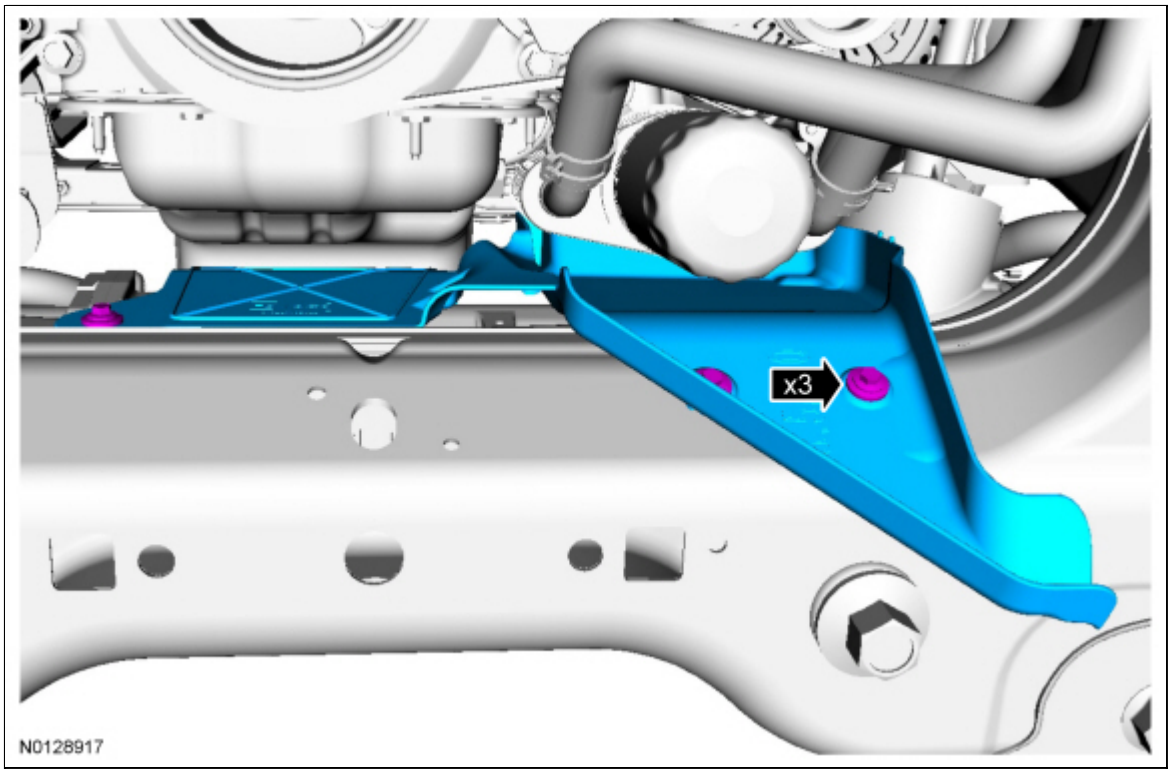


9. Install the transmission cooler line bracket and the nut to the engine front cover stud bolt.
    - Tighten to 13 Nm (115 lb-in).



10. Install the oil drain gutter and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

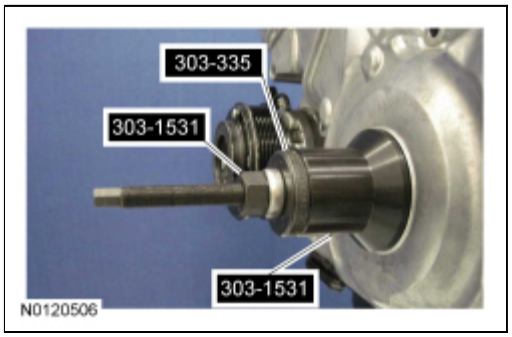
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11. Install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).

12. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

    Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



13. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

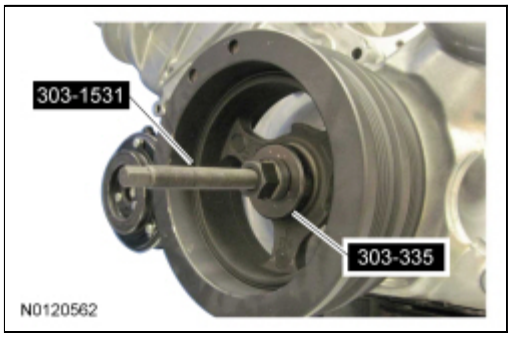
    Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



14. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.

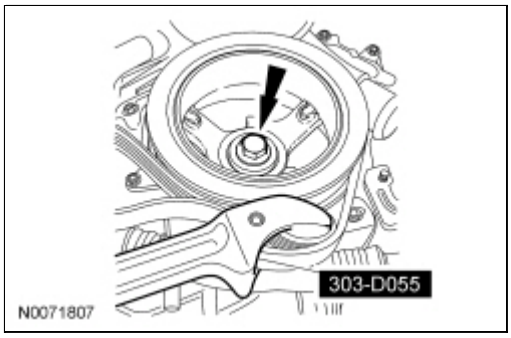


15. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.

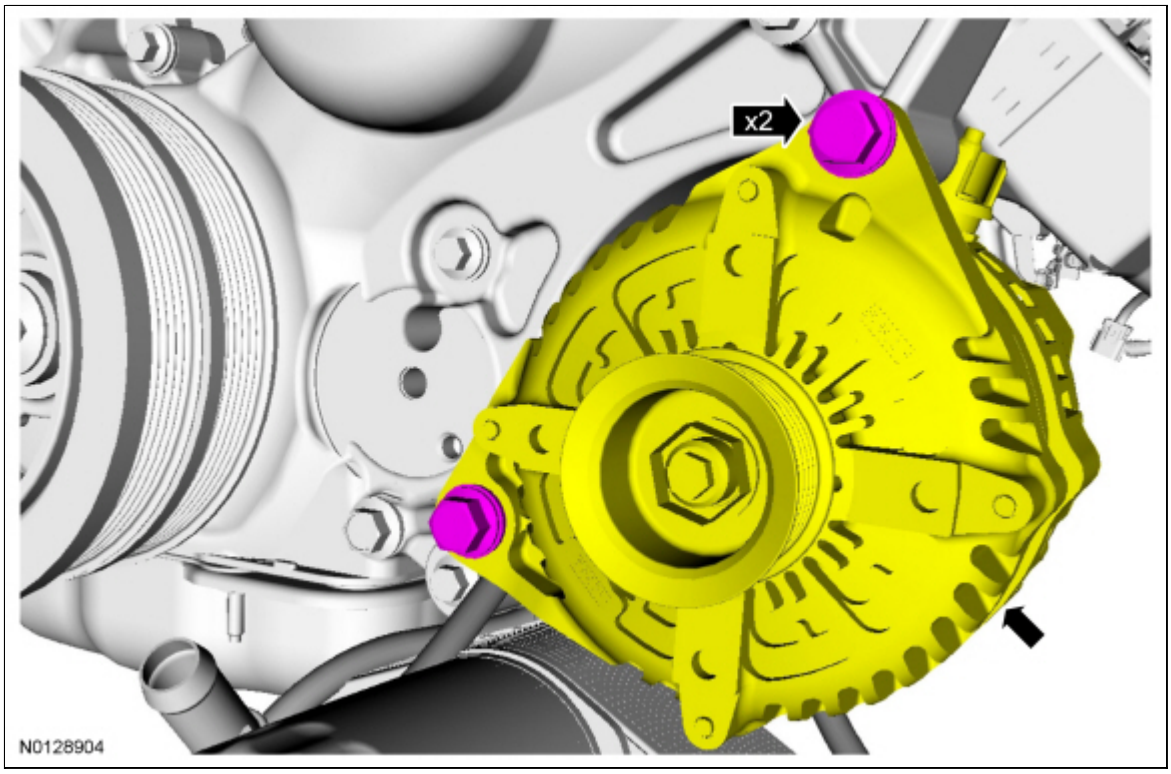


16. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
    - Stage 1: Tighten to 140 Nm (103 lb-ft).
    - Stage 2: Loosen 360 degrees.
    - Stage 3: Tighten to 100 Nm (74 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

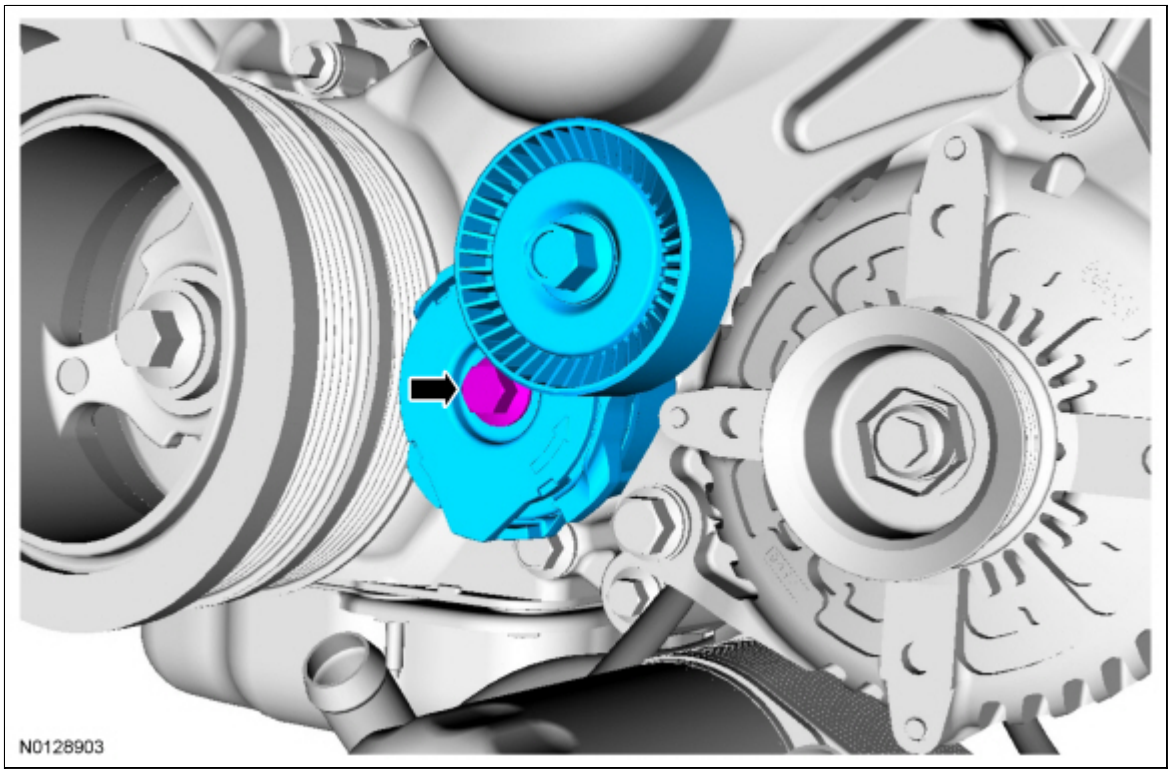
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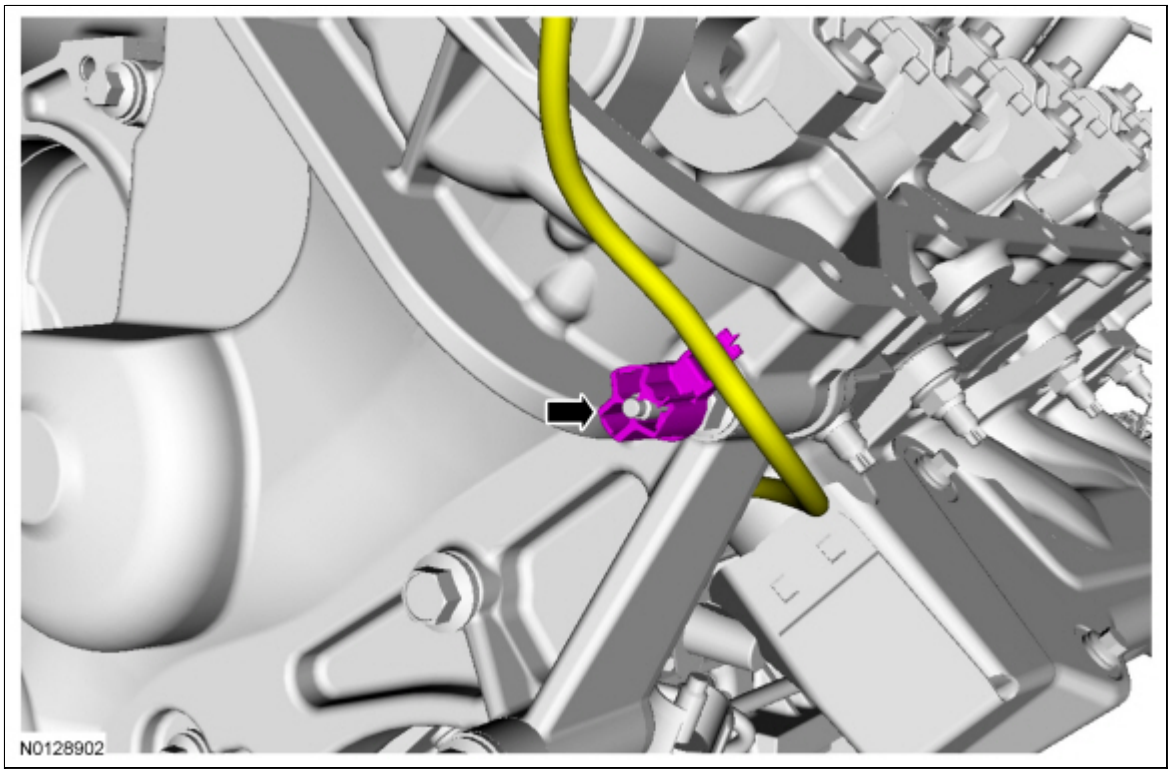
17. Install the generator and the 2 bolts.
    - Tighten to 48 Nm (35 lb-ft).



18. Install the accessory drive belt tensioner and bolt.
    - Tighten to 48 Nm (35 lb-ft).

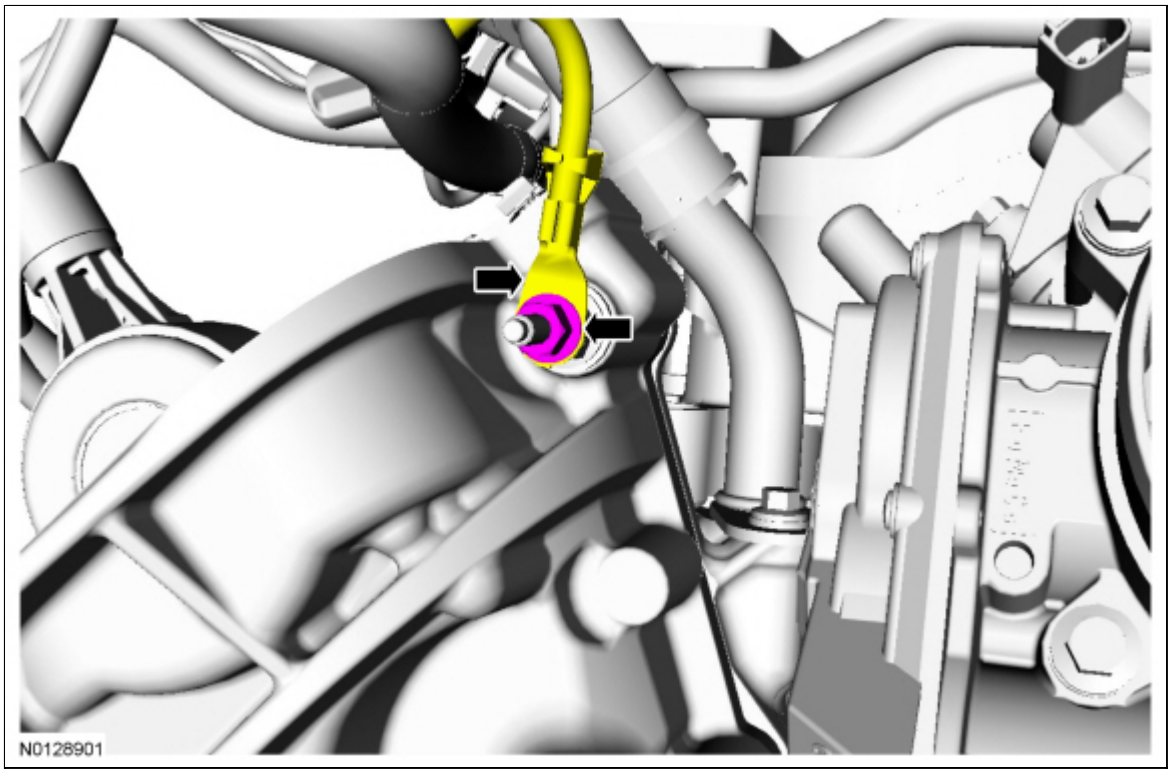


19. Attach the wiring harness retainer to the engine front cover stud bolt.

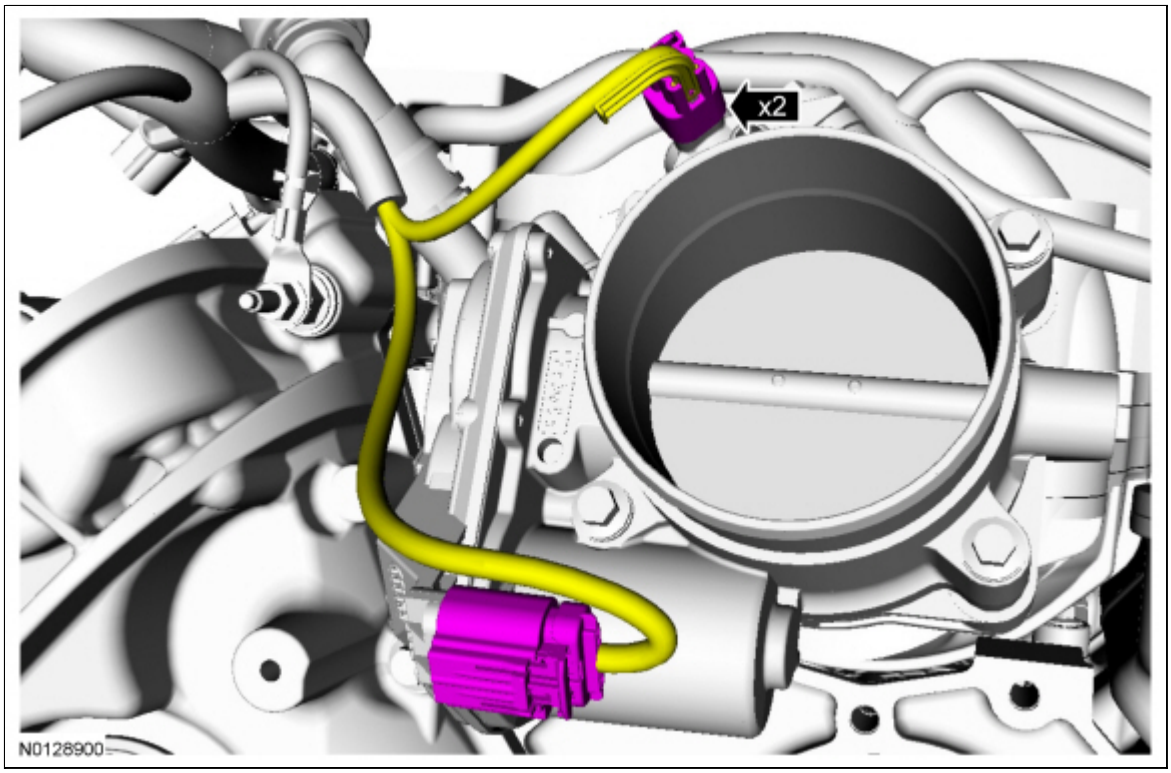


20. Install the ground wire and nut to the engine front cover stud bolt.
    - Tighten to 10 Nm (89 lb-in).

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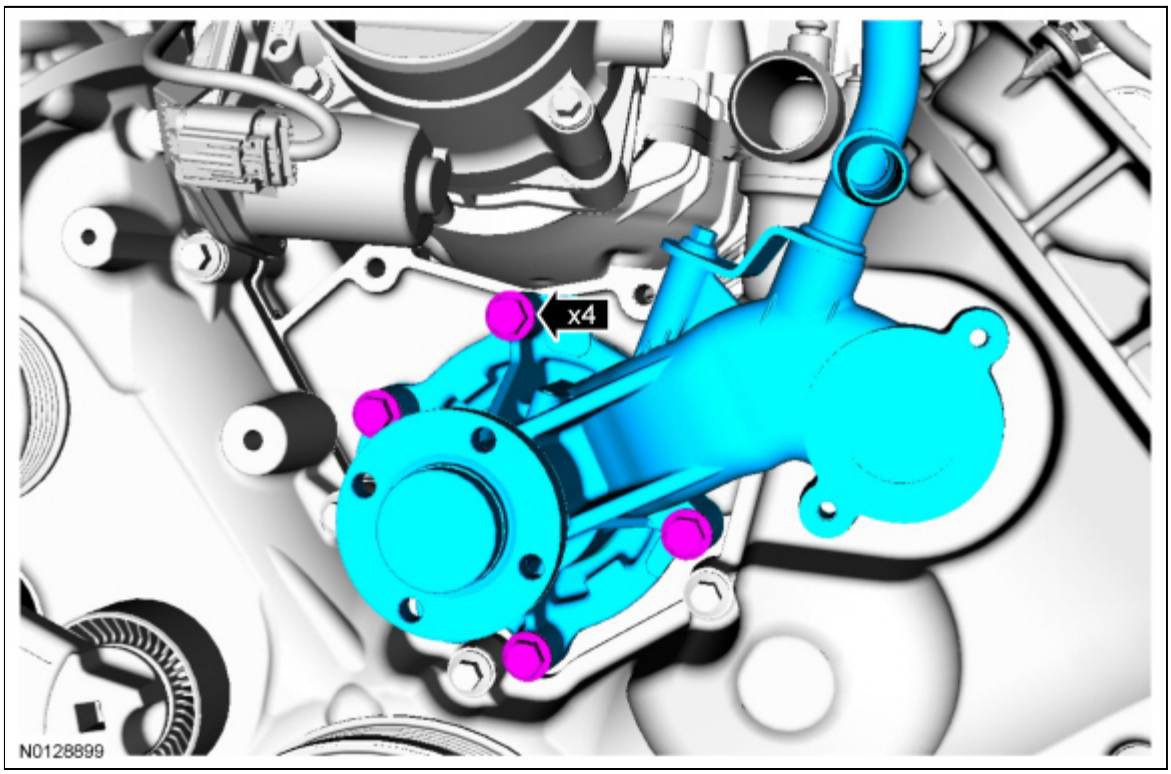
21. Connect the throttle body and EVAP purge valve electrical connectors.



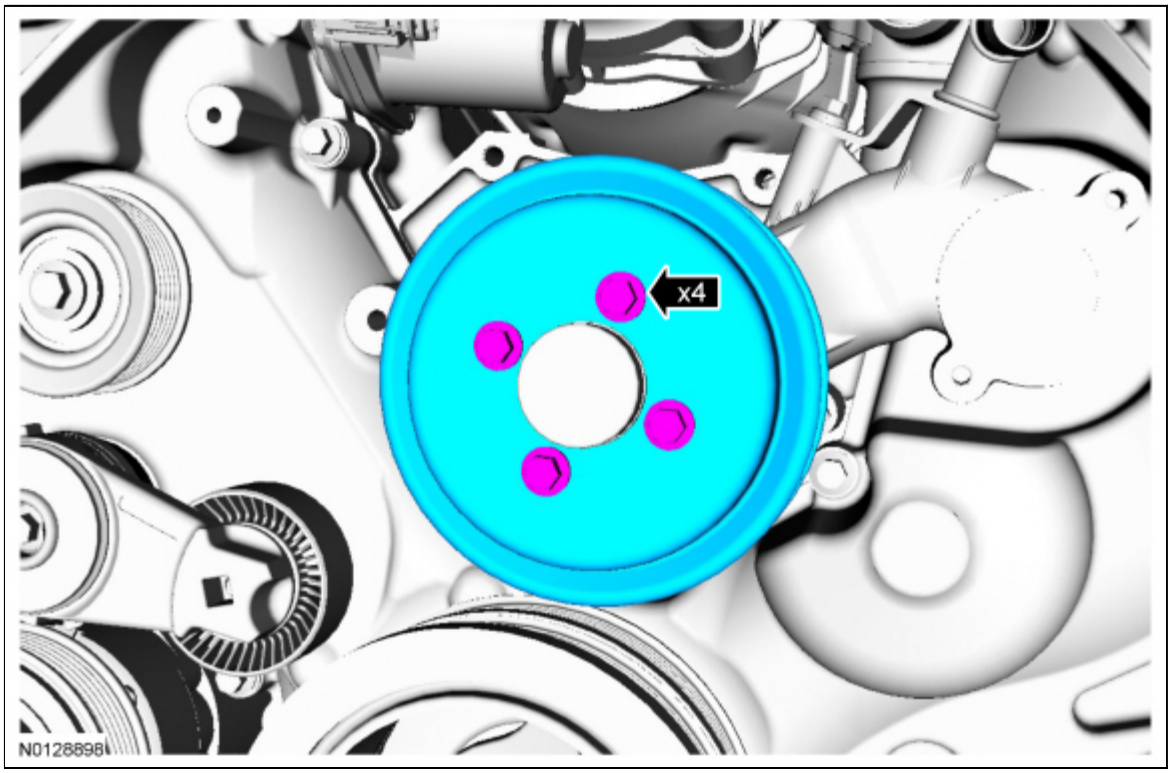
22. **NOTE:** Lubricate the new coolant pump O-ring seal with clean engine coolant.

    Using a new O-ring seal, install the coolant pump and the 4 bolts.

- Tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.

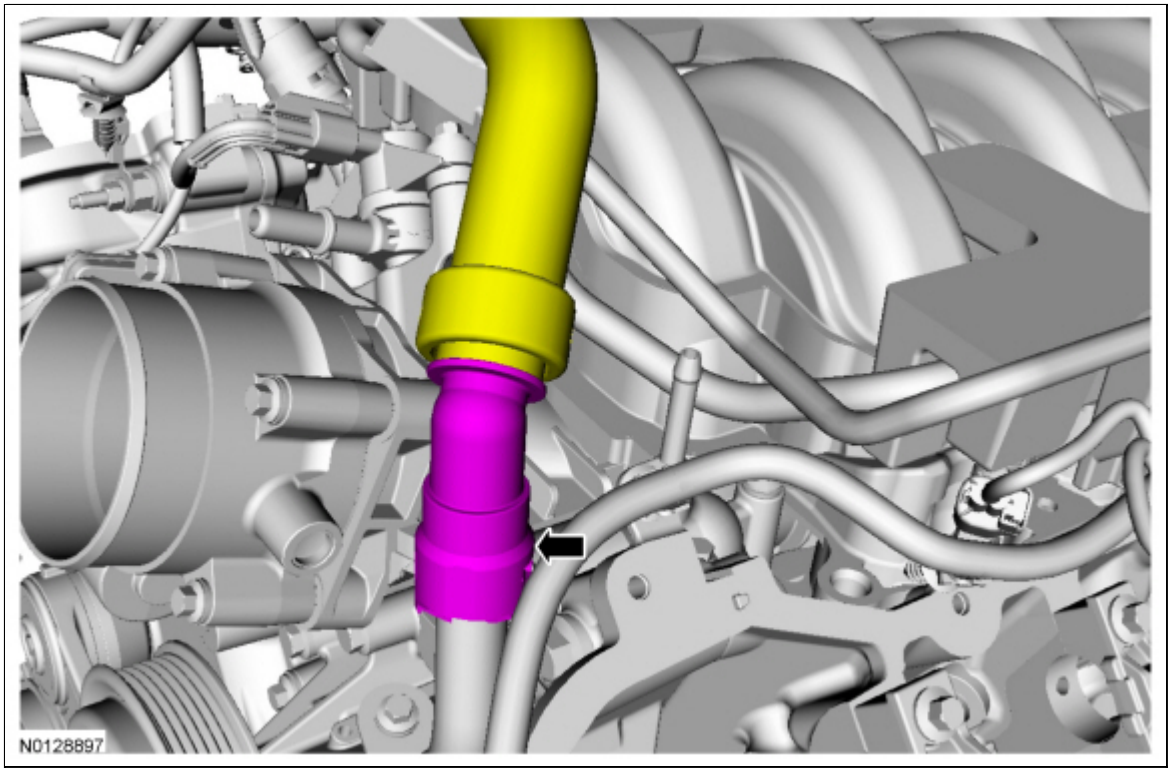


23. Install the coolant pump pulley and the 4 bolts.



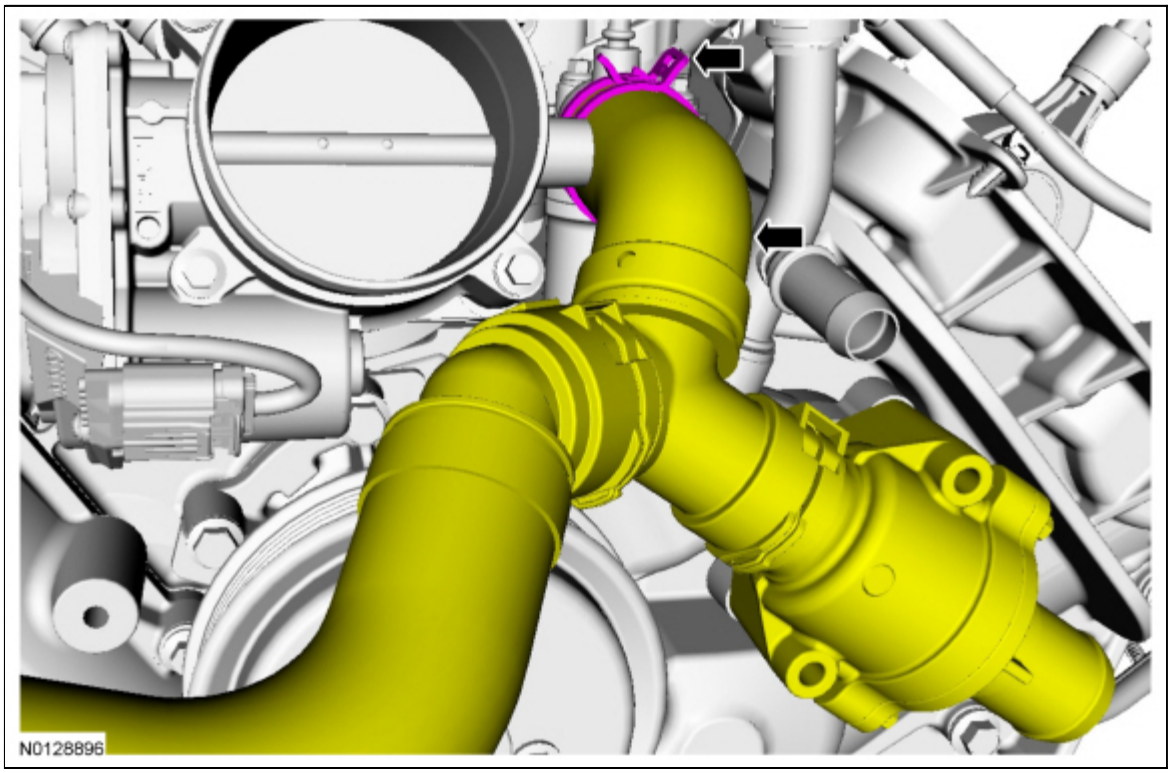
24. Connect the heater hose.

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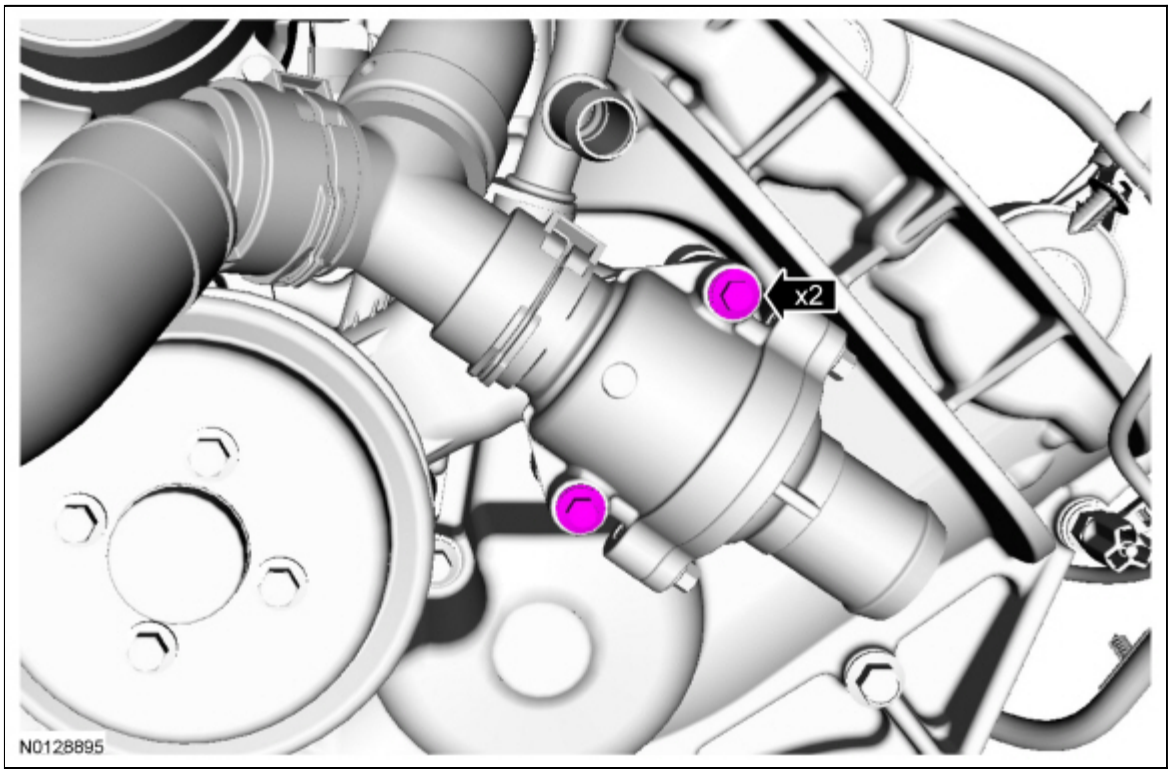


25. **NOTE:** Lubricate the new thermostat housing O-ring seal with clean engine coolant.

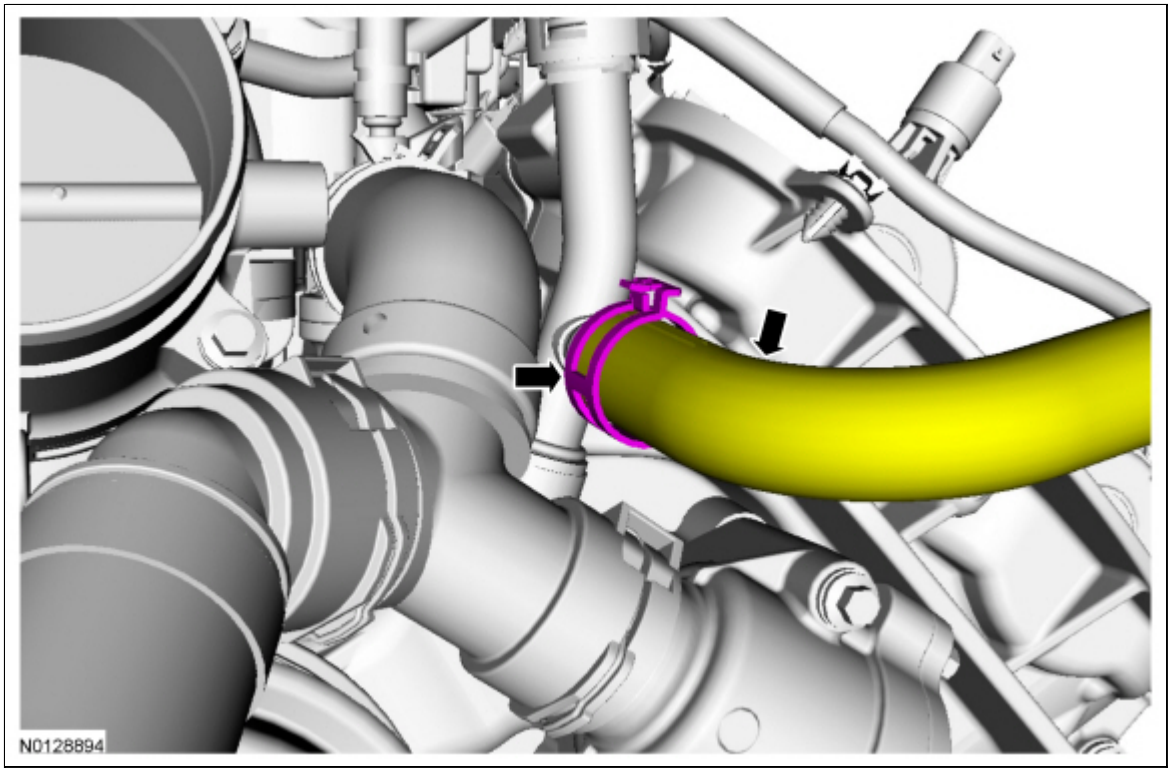
    Using a new thermostat housing O-ring seal, install the upper radiator hose T-connector/thermostat housing assembly and clamp.



26. Install the 2 thermostat housing bolts.
    - Tighten to 10 Nm (89 lb-in).

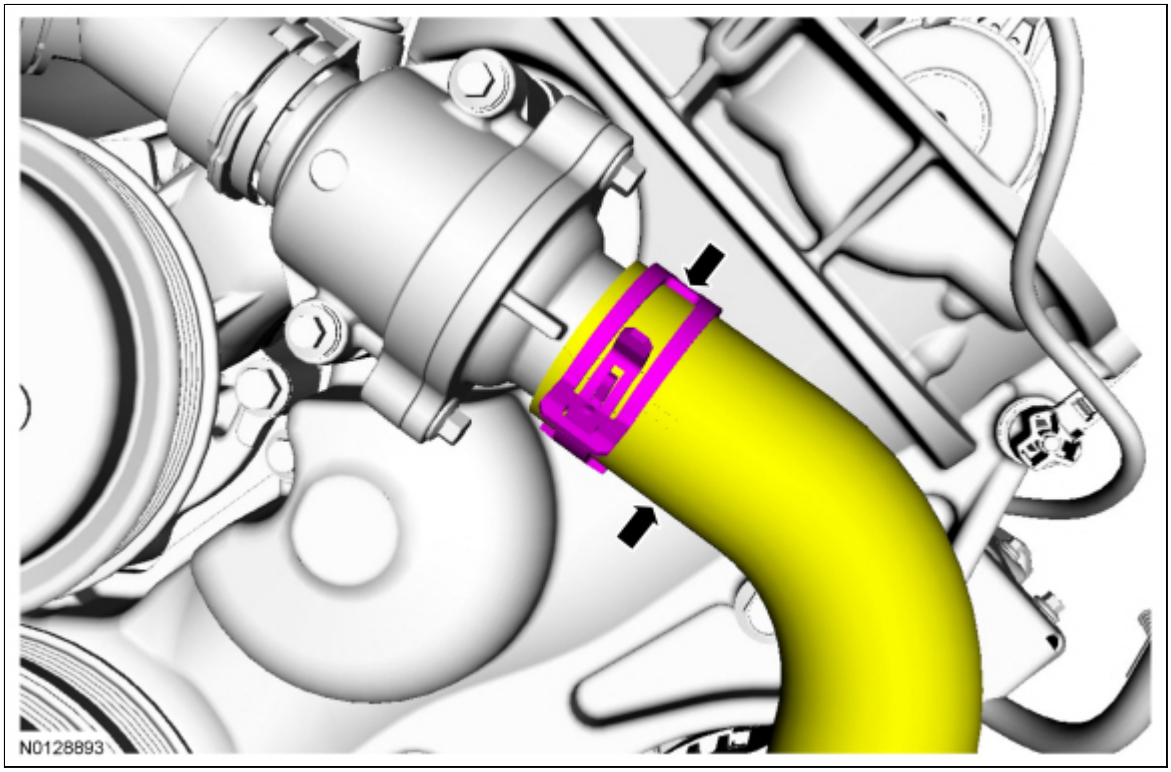


27. Connect the degas coolant hose and clamp.



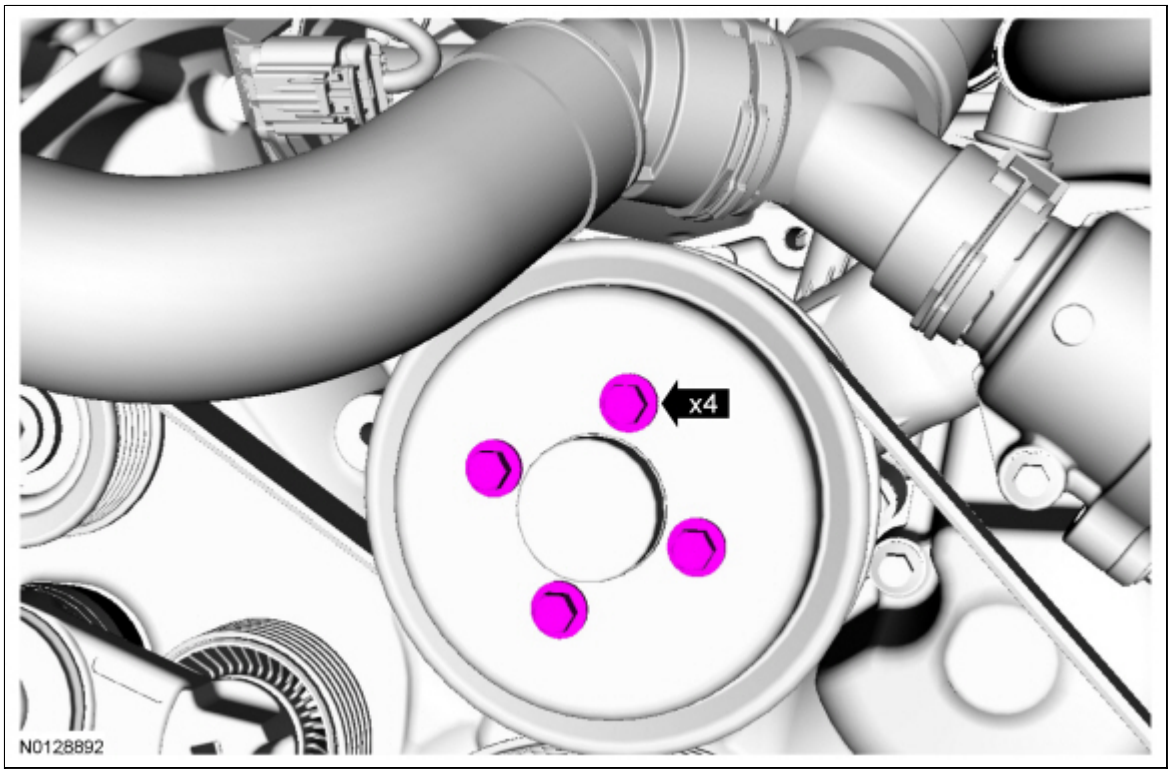
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28. Connect the lower radiator hose and clamp to the thermostat housing assembly.



29. Install the accessory drive and A/C compressor belts. For additional information, refer to Section 303-05 .

30. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).



31. Install the RH and LH valve covers. For additional information, refer to Valve Cover — RH and Valve Cover — LH in this section.

32. Fill the crankcase with clean engine oil.

33. Connect the battery ground cable. For additional information, refer Section 414-01 .

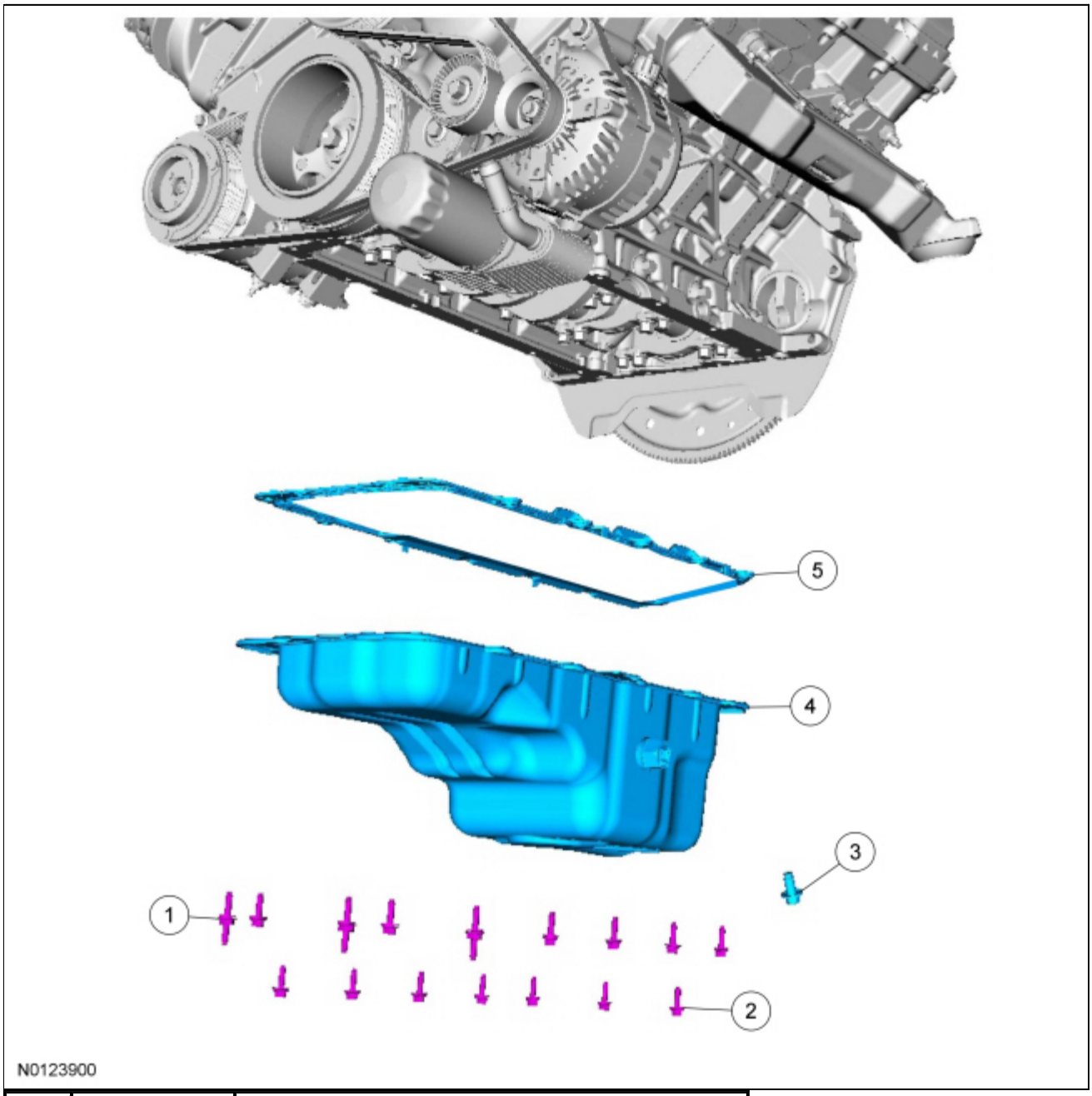
34. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

35. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Engine Lubrication Components — Exploded View

Oil Pan and Gasket

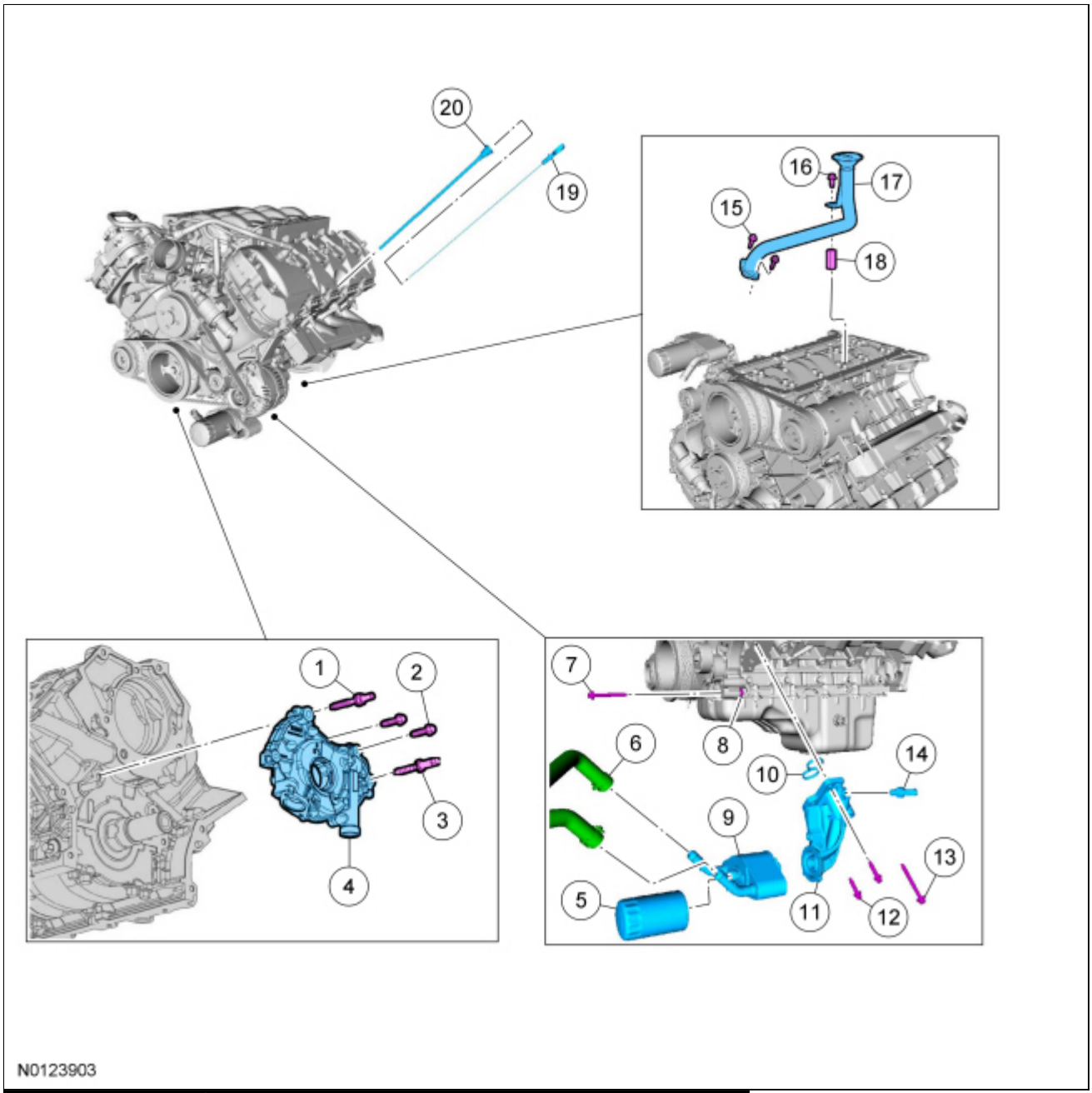


Item	Part Number	Description
1	W714963	Oil pan stud bolt (3 required)

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2	W714962	Oil pan bolt (13 required)
3	—	Oil drain plug (part of 6675) - 26 Nm (19 lb-ft)
4	6675	Oil pan
5	6710	Oil pan gasket

Oil Pump, Oil Filter Adapter, Oil Pump Screen and Pickup Tube and Oil Level Indicator and Tube



Item	Part Number	Description

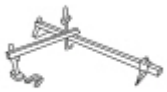
1	W714251	Oil pump stud bolt
2	N806183	Oil pump bolt (2 required)
3	W714252	Oil pump stud bolt
4	6600	Oil pump
5	6731	Oil filter
6	—	Coolant hoses (2 required)
7	W503304	Engine front cover-to-oil filter adapter bolt
8	W715209	Engine front cover-to-oil filter adapter jackscrew (part of 6019)
9	6A642	Oil cooler - 57 Nm (42 lb-ft)
10	6840	Oil filter adapter gasket
11	6881	Oil filter adapter
12	W714974	Oil filter adapter bolt (2 required)
13	W503306	Oil filter adapter bolt
14	9278	Engine Oil Pressure (EOP) switch
15	W714962	Oil pump screen and pickup tube bolt (2 required)
16	N605904	Oil pump screen and pickup tube bolt
17	6622	Oil pump screen and pickup tube
18	N806180	Oil pump screen and pickup tube spacer - 25 Nm (18 lb-ft)
19	6750	Oil indicator
20	6754	Oil indicator tube

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Engine Support Insulators — LH

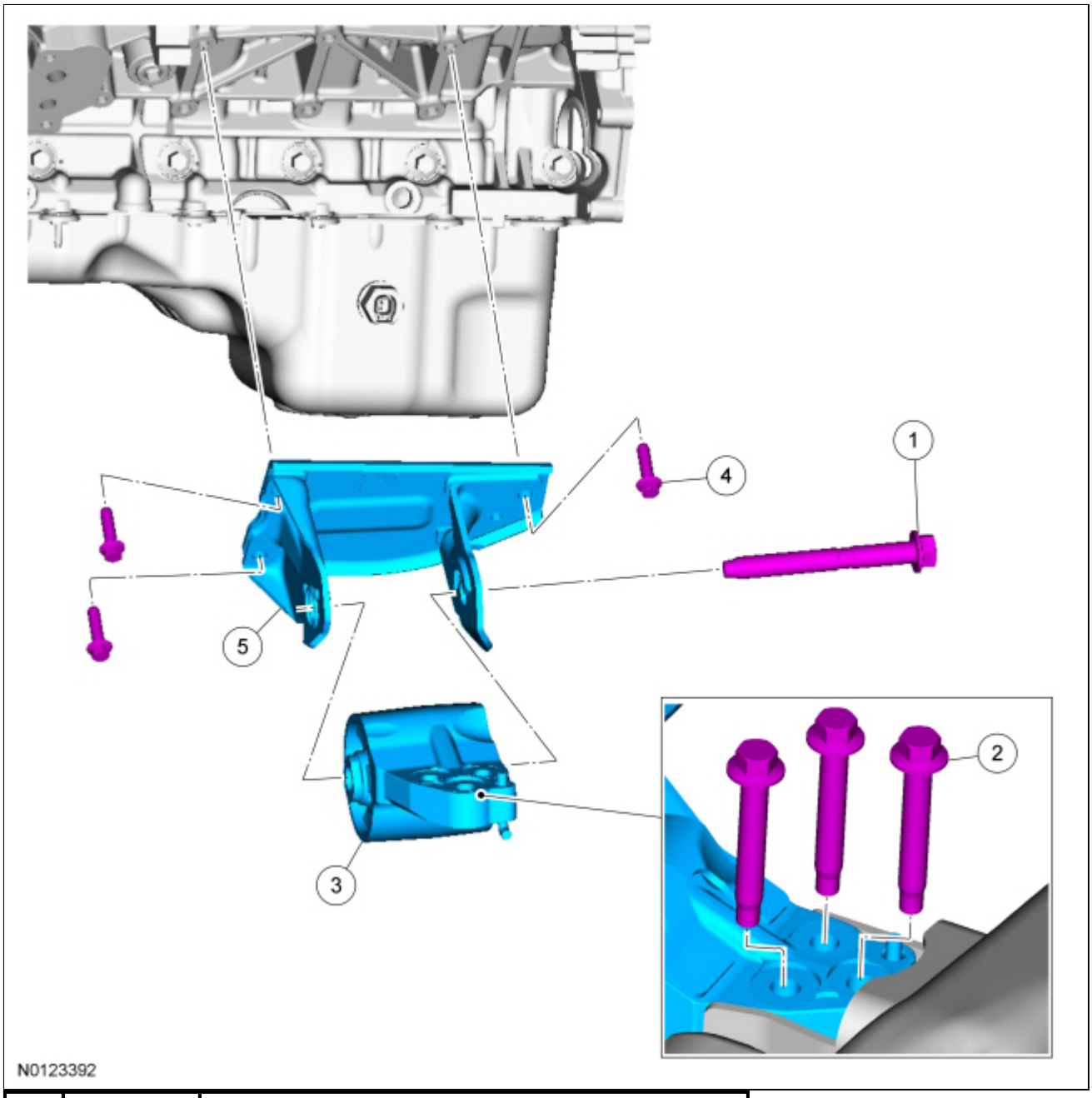
Special Tool(s)

 ST1595-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST2176-B	Support Bar, Engine 303-F070

Material

Item	Specification
Threadlock 262 TA-26	WSK-M2G351-A6

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Item	Part Number	Description
1	W715211	LH engine support insulator through bolt - 350 Nm (258 lb-ft)
2	W713244	LH engine support insulator bolt (3 required)
3	6038	LH engine support insulator
4	W714735	LH engine support insulator bracket bolt (3 required) - 63 Nm (46 lb-ft)
5	—	LH engine support insulator bracket (part of 6038)

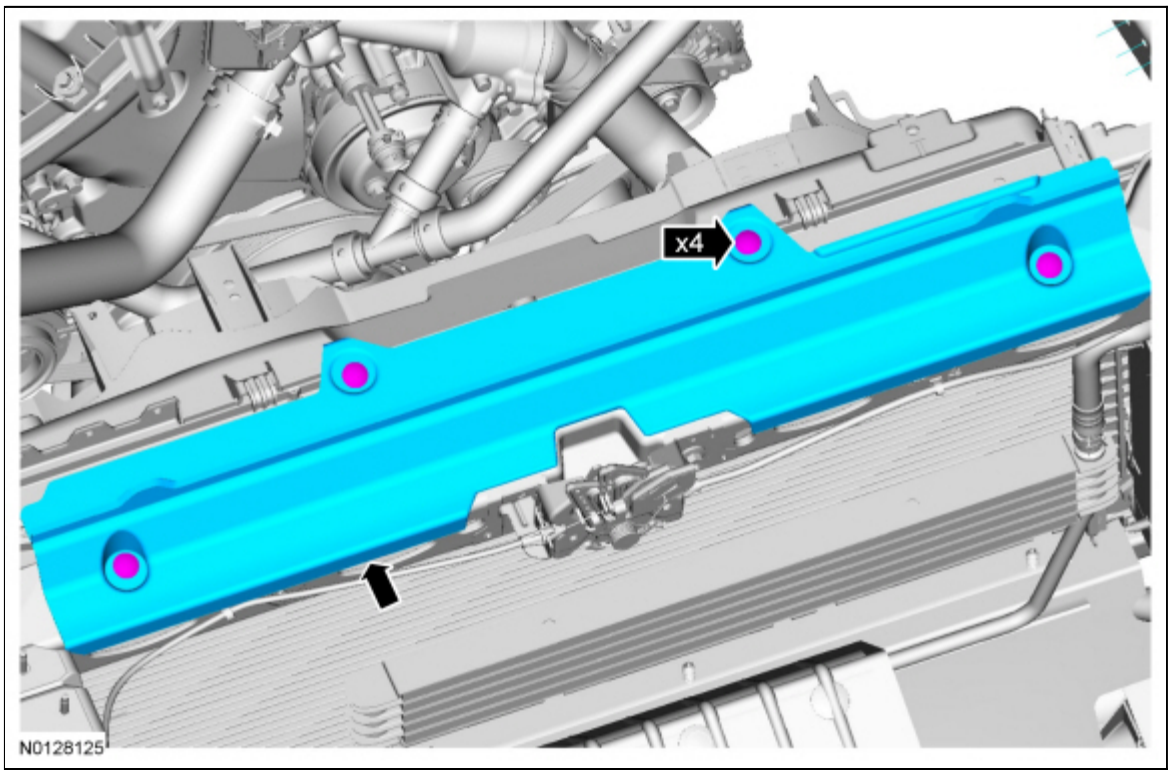
Removal

NOTE: Apply threadlock to the LH and RH engine support insulator through bolt threads prior to installation.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 pin-type retainers and the upper radiator air deflector.

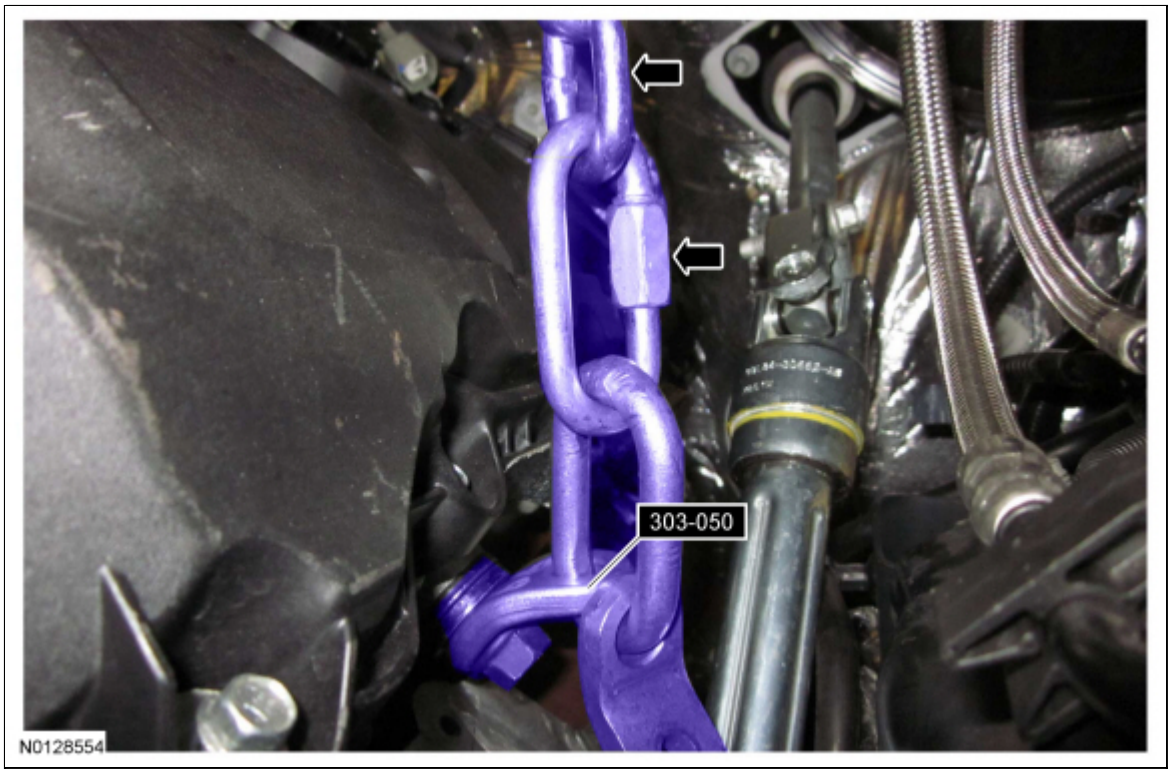


3. Remove the Air Cleaner (ACL) outlet pipe and ACL cover as an assembly. For additional information, refer to Section 303-12 .

4. **NOTE:** It may be necessary to install washers between the Engine Lifting Bracket and the cylinder head to prevent the Engine Lifting Bracket from contacting the valve cover while supporting the engine.

   Install an Engine Lifting Bracket on the side of the LH cylinder head.
   - Attach a length of chain and a connecting link to the Engine Lifting Bracket.

repair4less



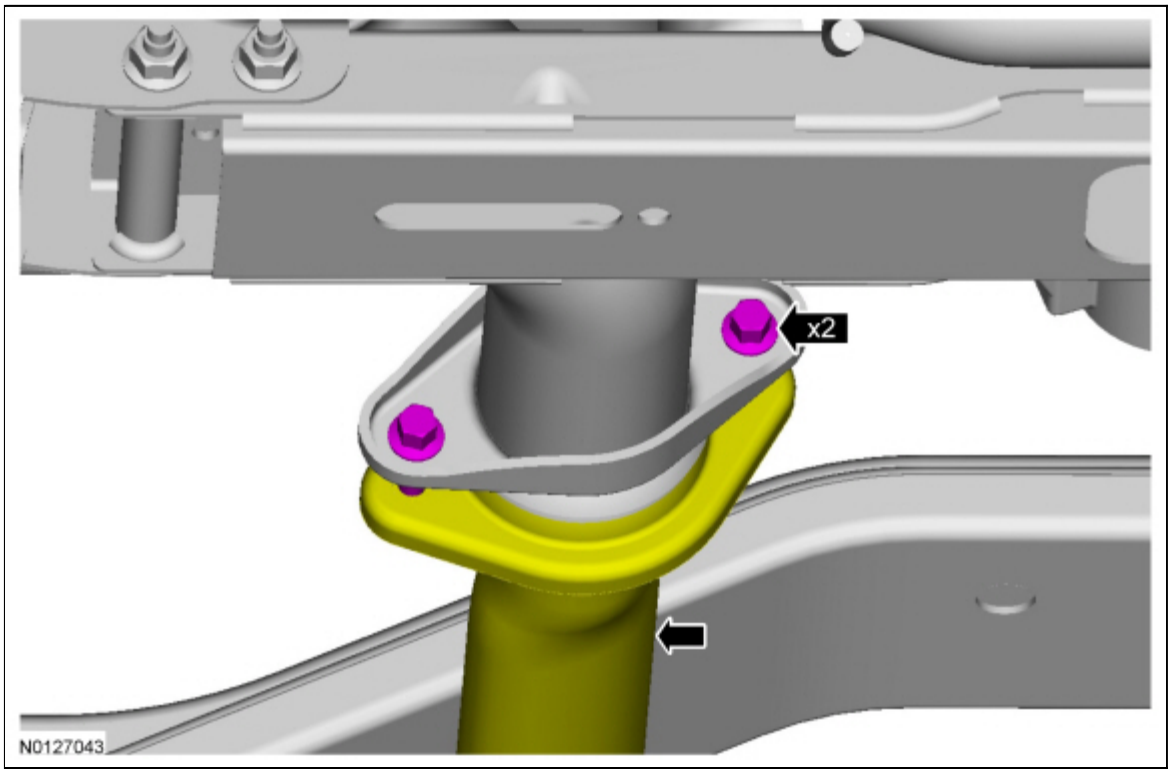
5. Install the Engine Support Bar.
    - Attach the chain installed in the previous step to the Engine Support Bar hook to support the engine.



6. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and

separate.

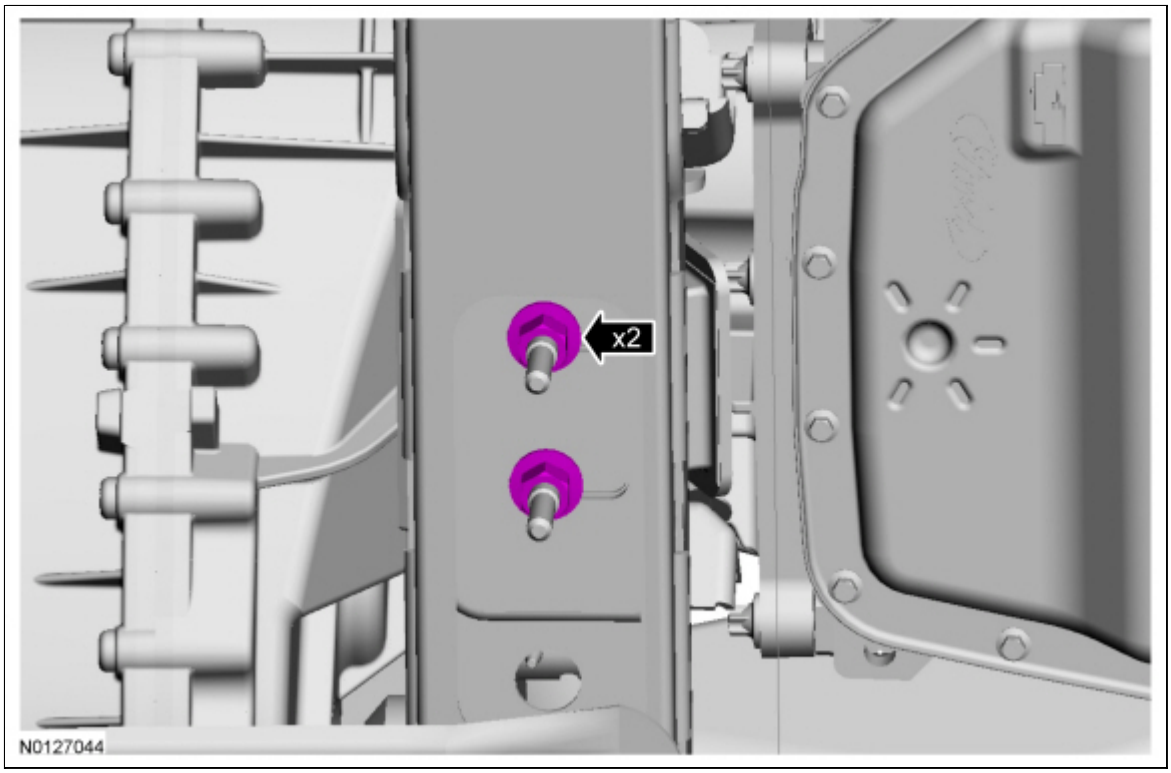
- Discard the 2 bolts.



7. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

   Loosen the 2 transmission mount-to-crossmember nuts.

repair4less

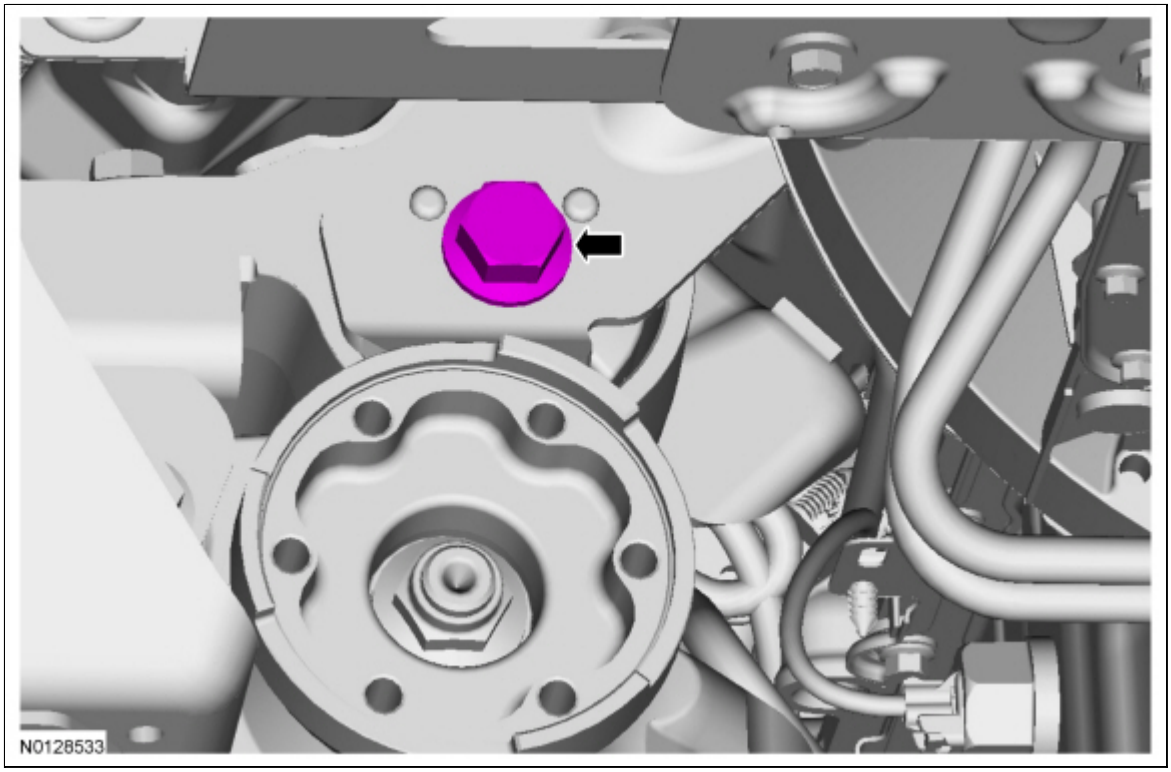


8. Remove the starter. For additional information, refer to Section 303-06 .

9. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .

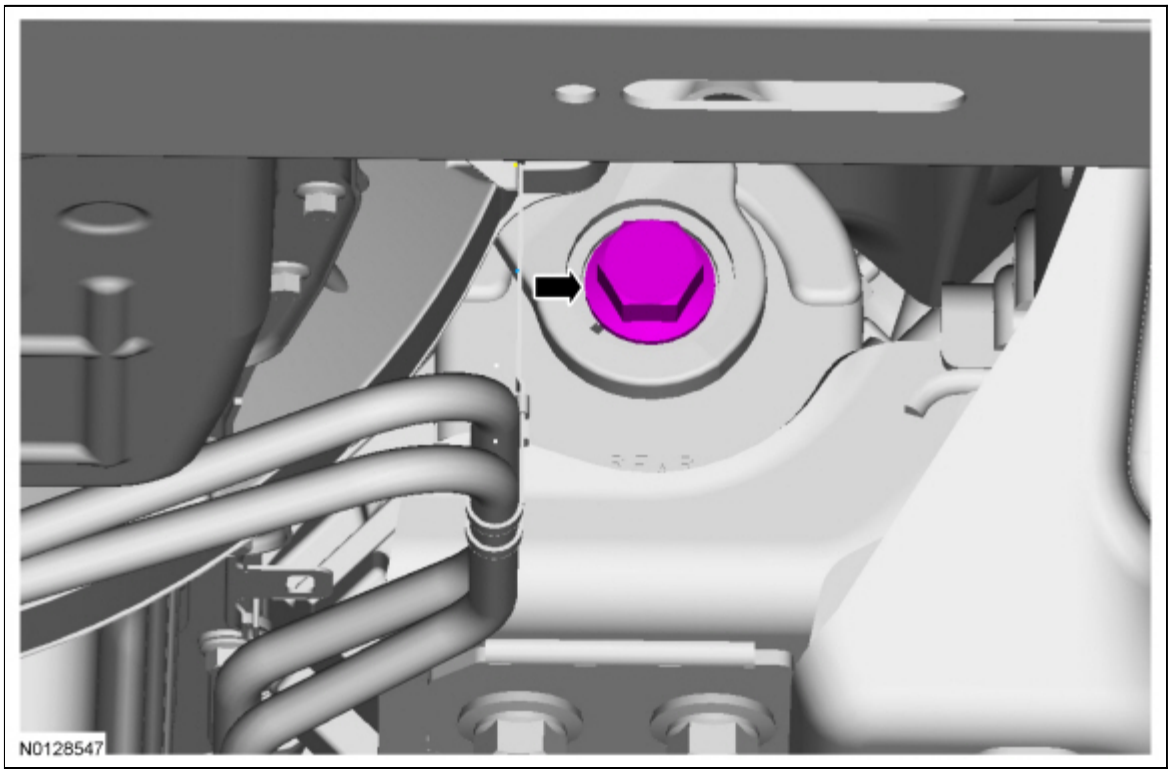
10. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove the LH engine support insulator through bolt.



11. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Loosen the RH engine support insulator through bolt.

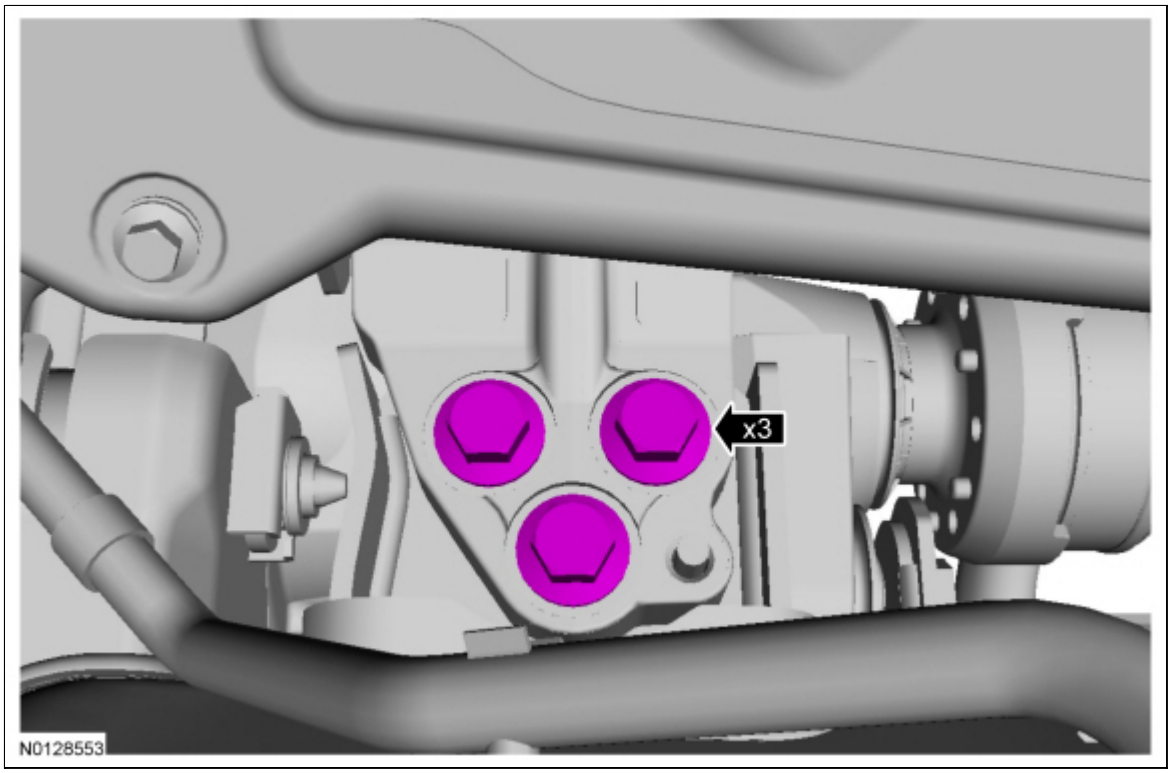


repair4less

12. Raise the LH side of the engine 50 mm (1.968 in).

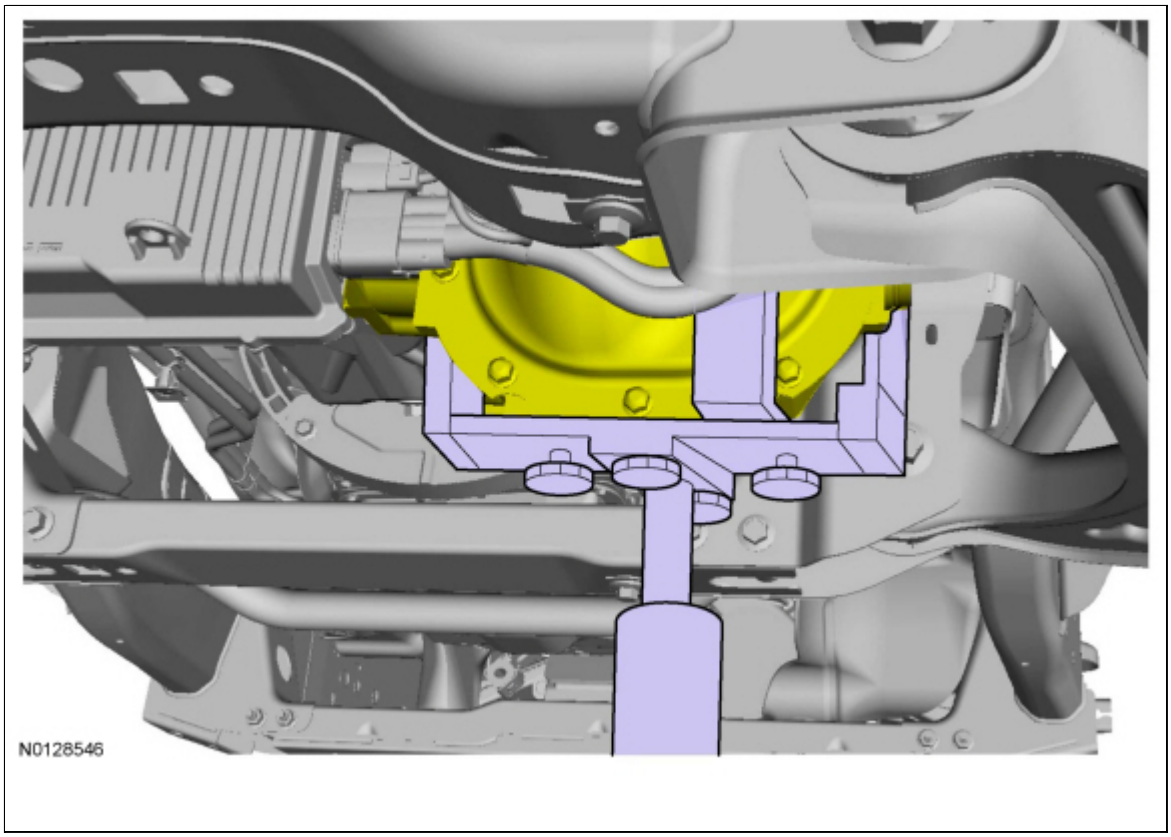
13. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.**

    Remove the 3 LH engine support insulator-to-frame bolts.

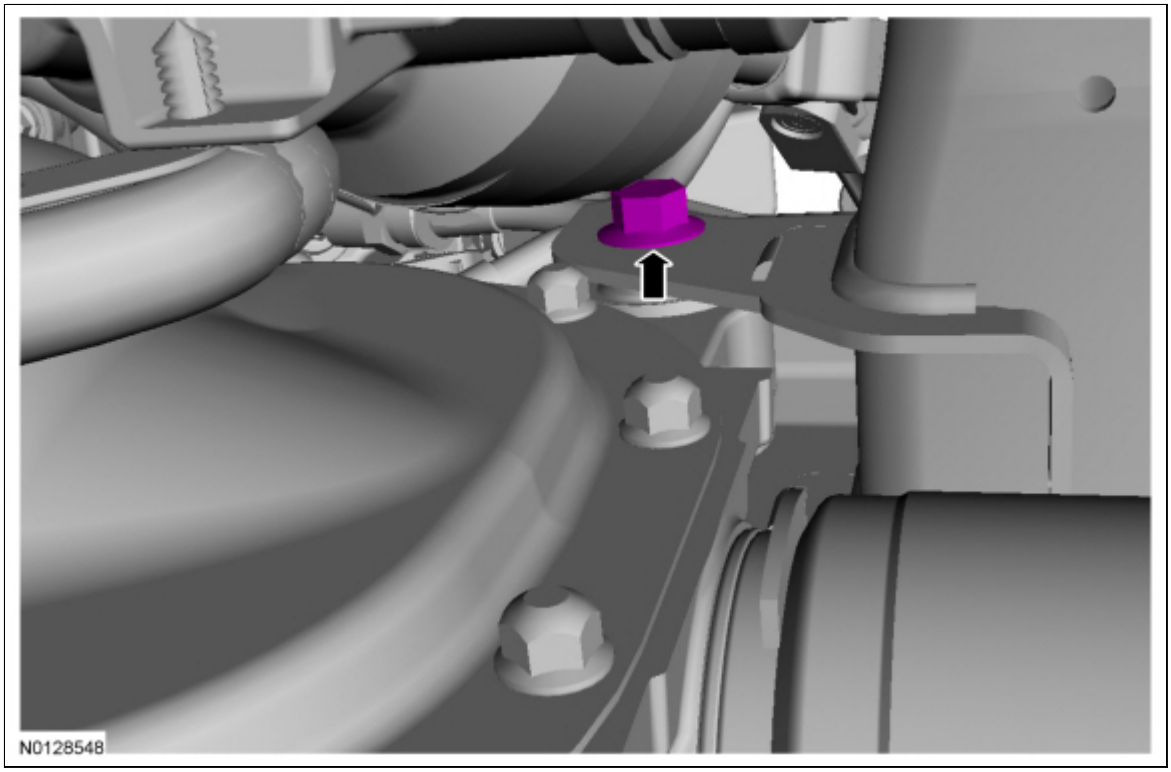


Four-Wheel Drive (4WD) vehicles

14. Position a suitable hydraulic jack under the front axle. Securely strap the jack to the axle.

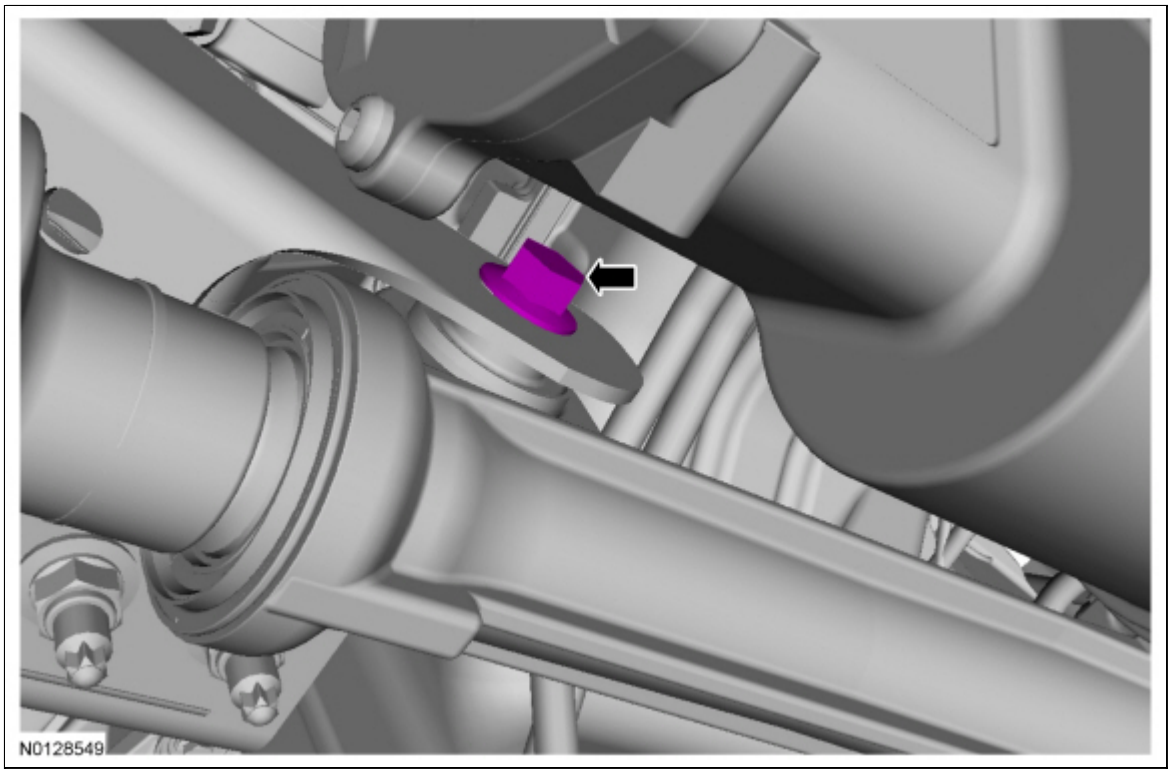


15. Remove the upper front axle carrier mounting bushing bolt.

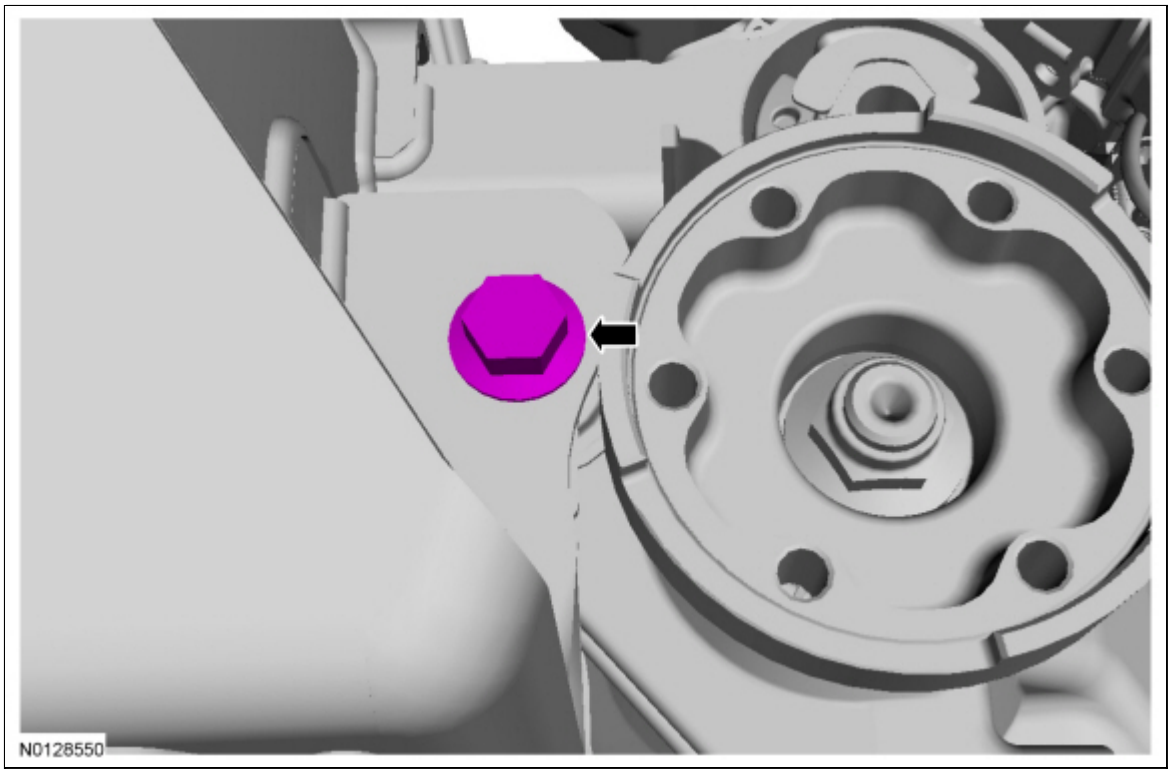


16. Remove the axle shaft housing carrier bushing bolt.

repair4less



17. Remove the lower front axle carrier mounting bushing bolt.

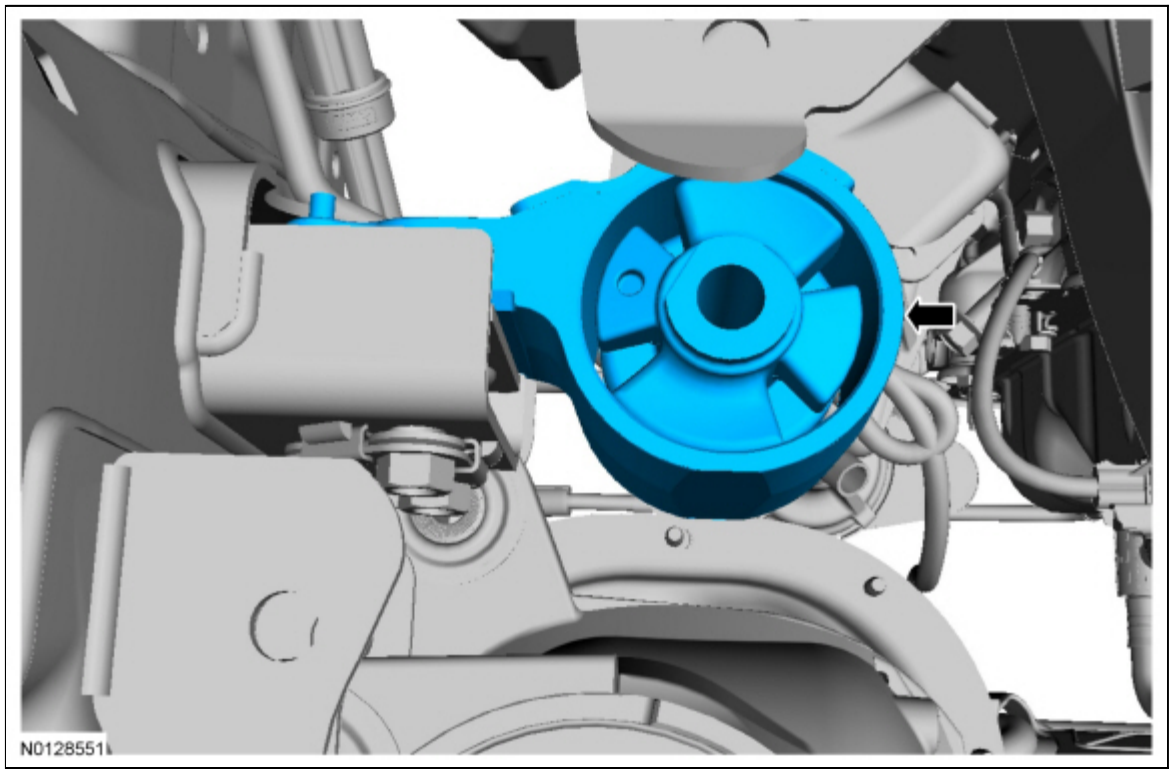


18. ***NOTICE:*** **Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.**

Lower the front axle to allow clearance to the LH engine support insulator.

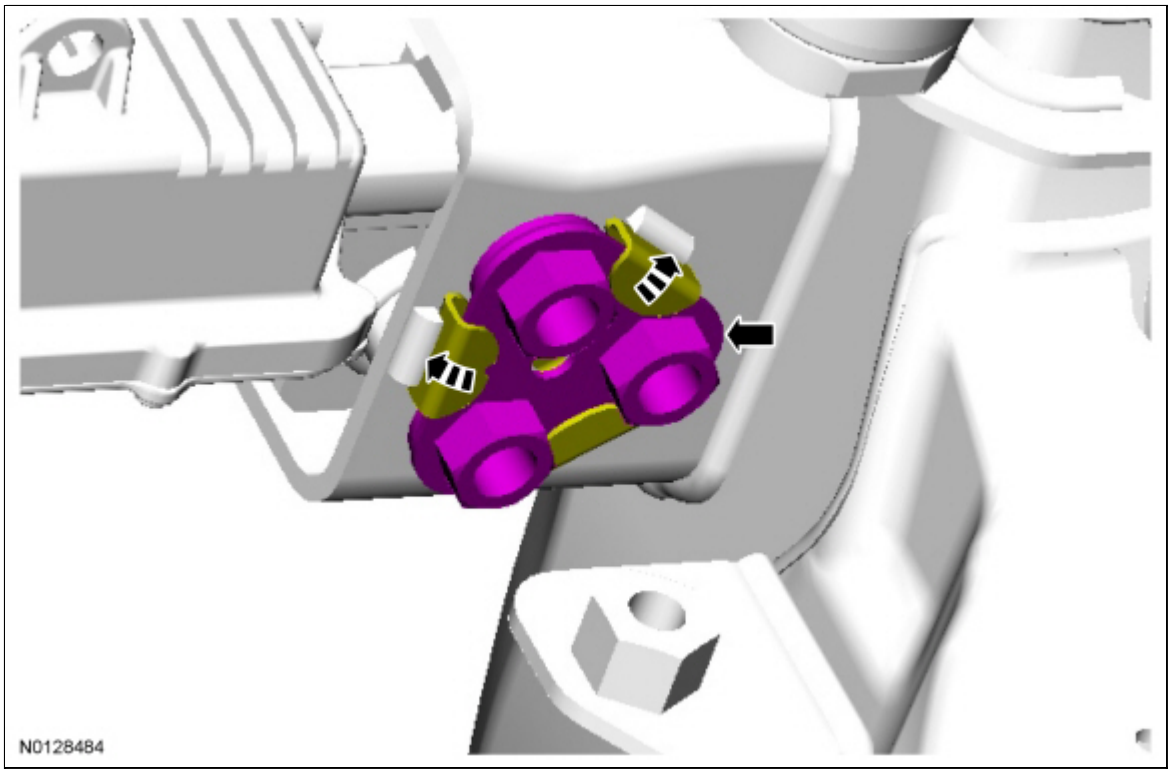
All vehicles

19. Remove the LH engine support insulator.

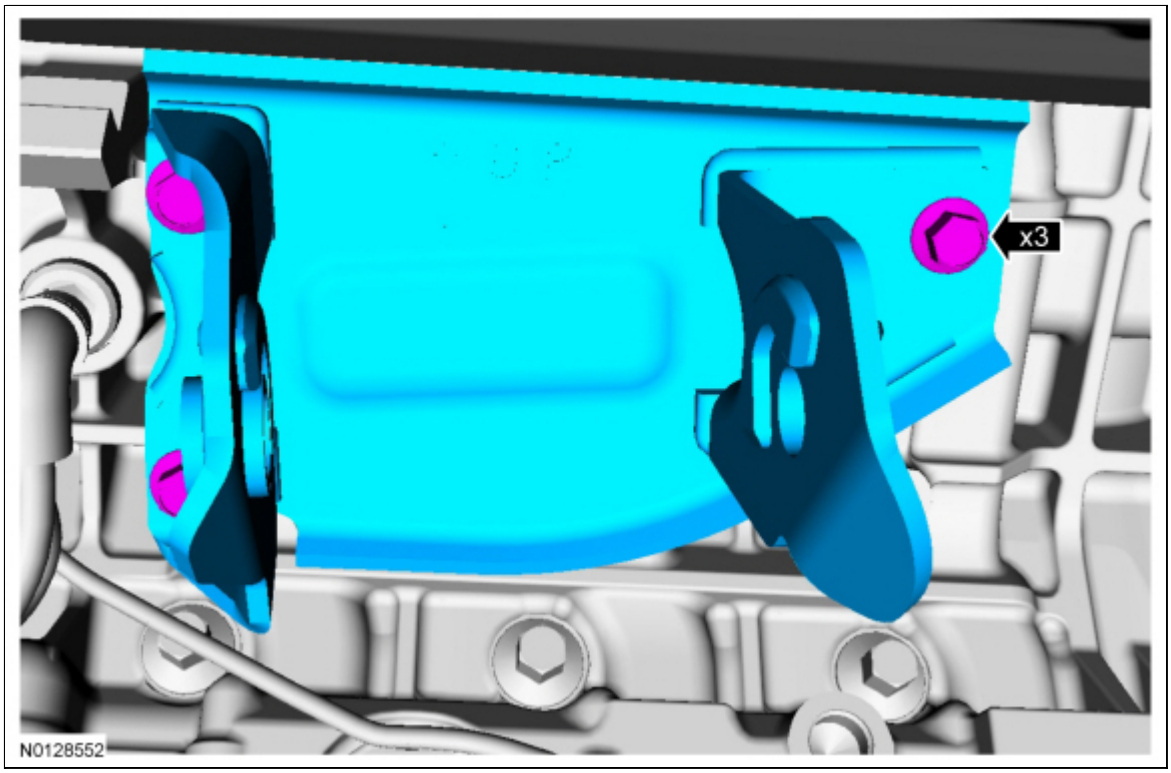


20. Inspect the engine support insulator-to-frame nut plate for thread damage. If the nut plate is damaged, bend 2 tabs back and remove the nut plate. Replace the nut plate with service part number 56190 and bend the 2 tabs back to the original position.

repair4less



21. If necessary, remove the 3 bolts and the LH engine support insulator-to-cylinder block bracket.

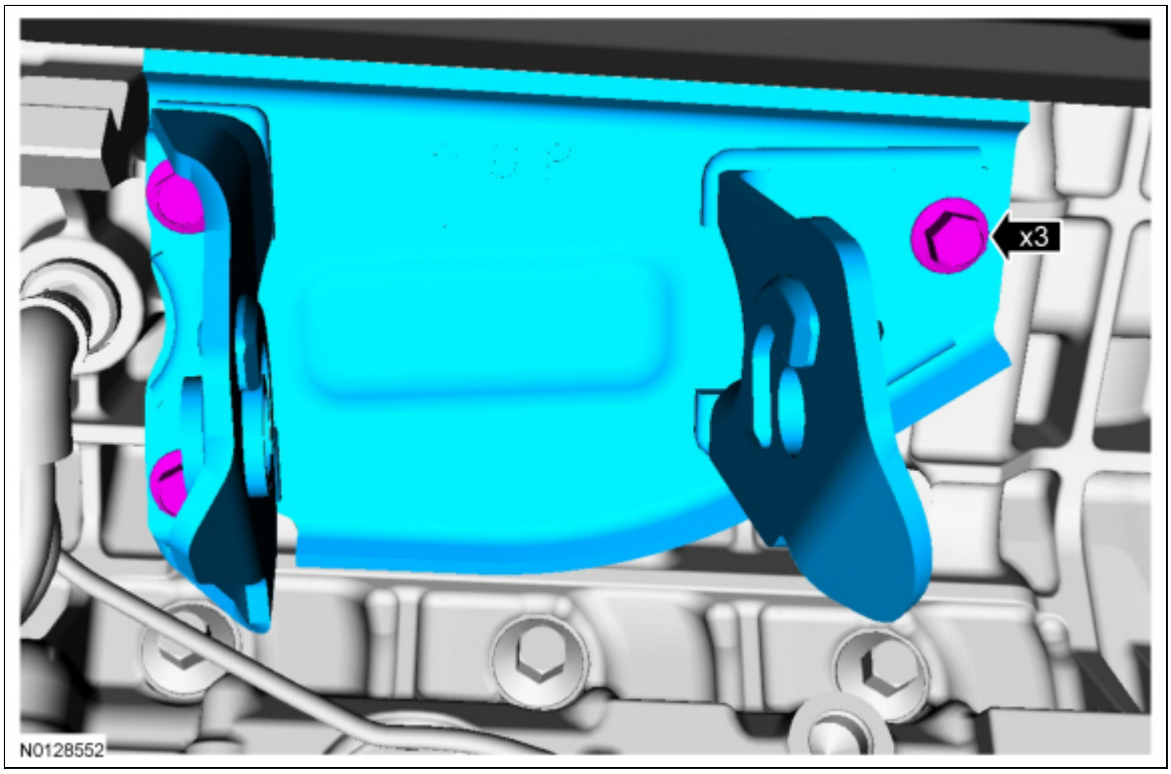


Installation

All vehicles

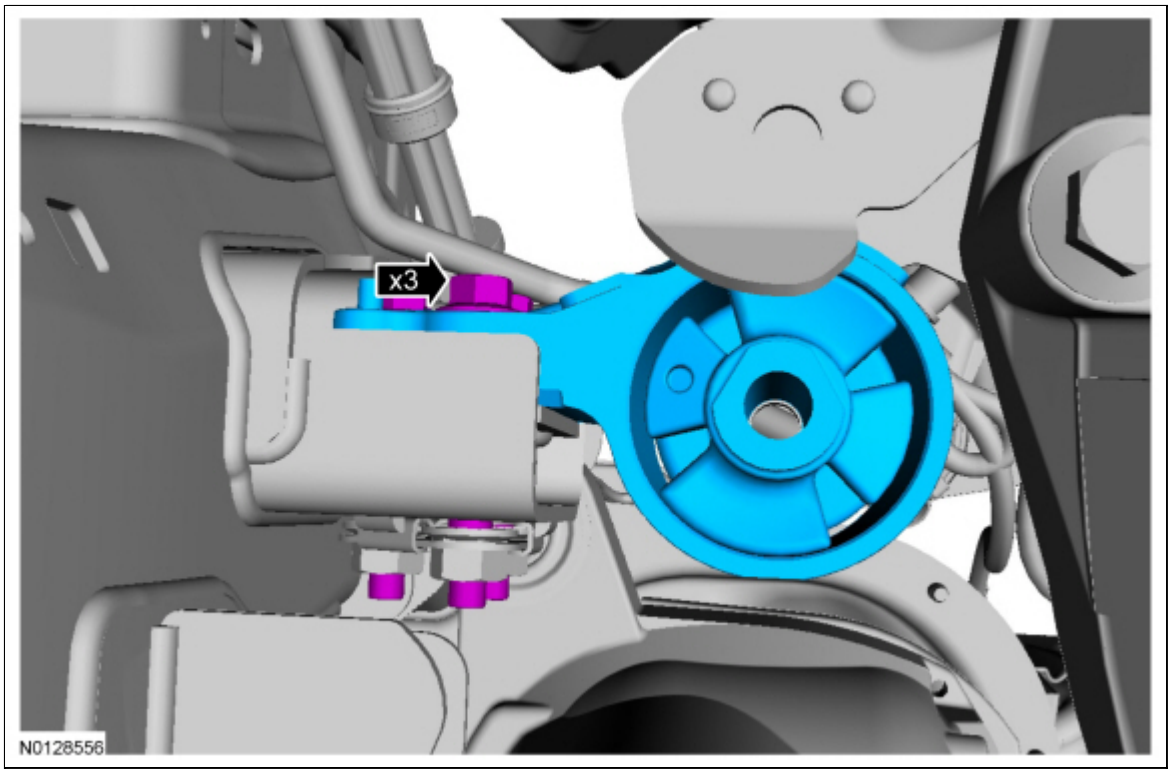
1. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

2. If removed, install the LH engine support insulator-to-cylinder block bracket and install the 3 bolts.
   - Tighten to 63 Nm (46 lb-ft).



3. Position the LH engine support insulator and hand start the 3 new engine support insulator-to-frame bolts.
   - Do not tighten at this time.

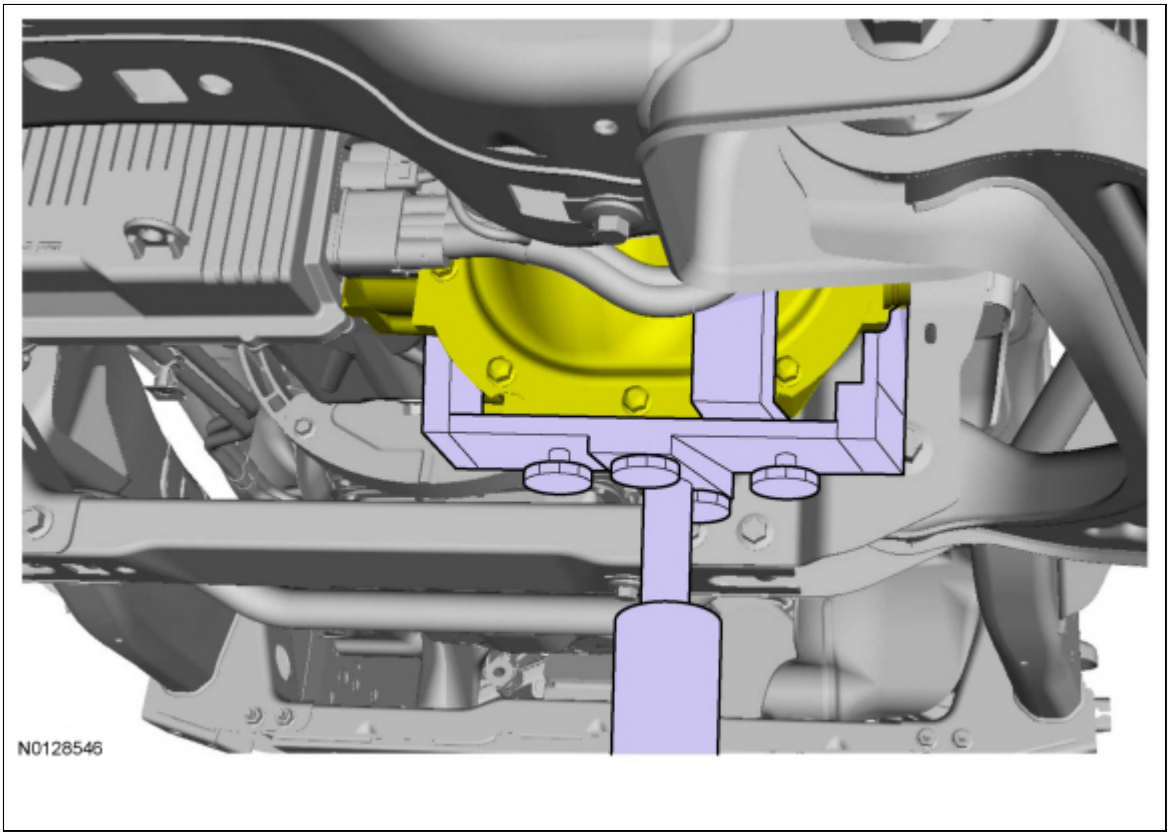
repair4less



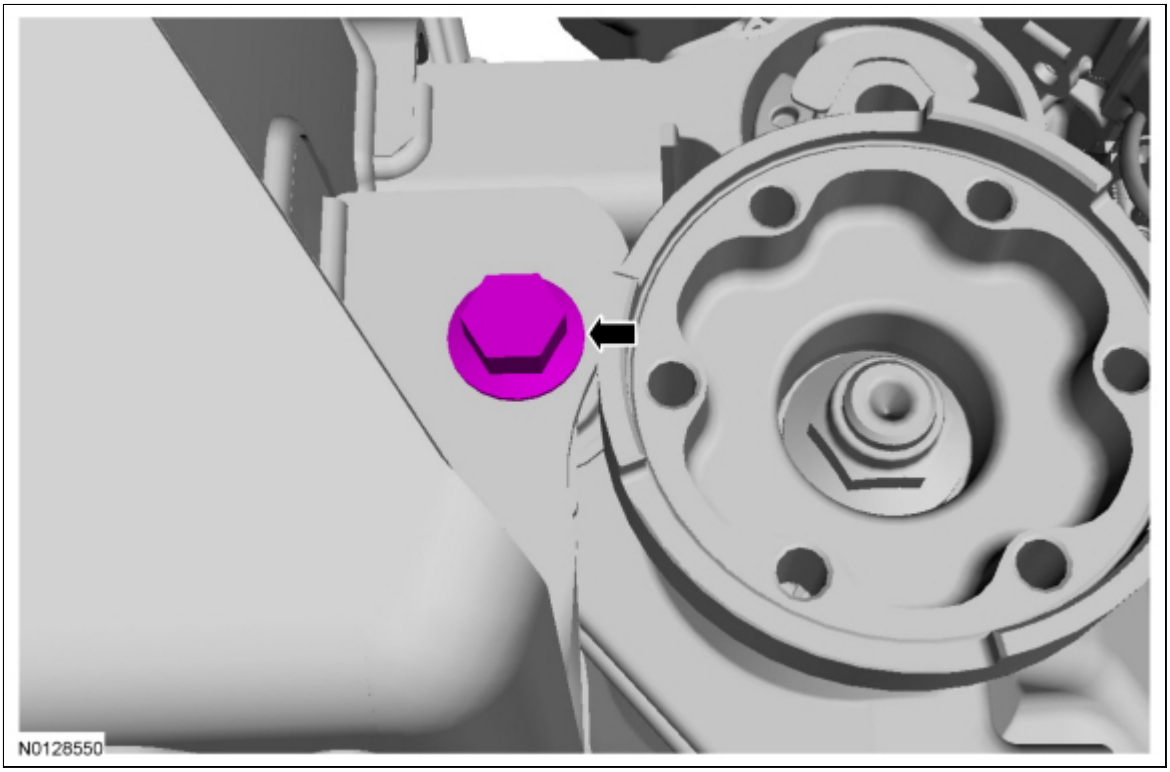
Four-Wheel Drive (4WD) vehicles

4. ***NOTICE:*** **Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.**

   Raise the front axle carrier into position.

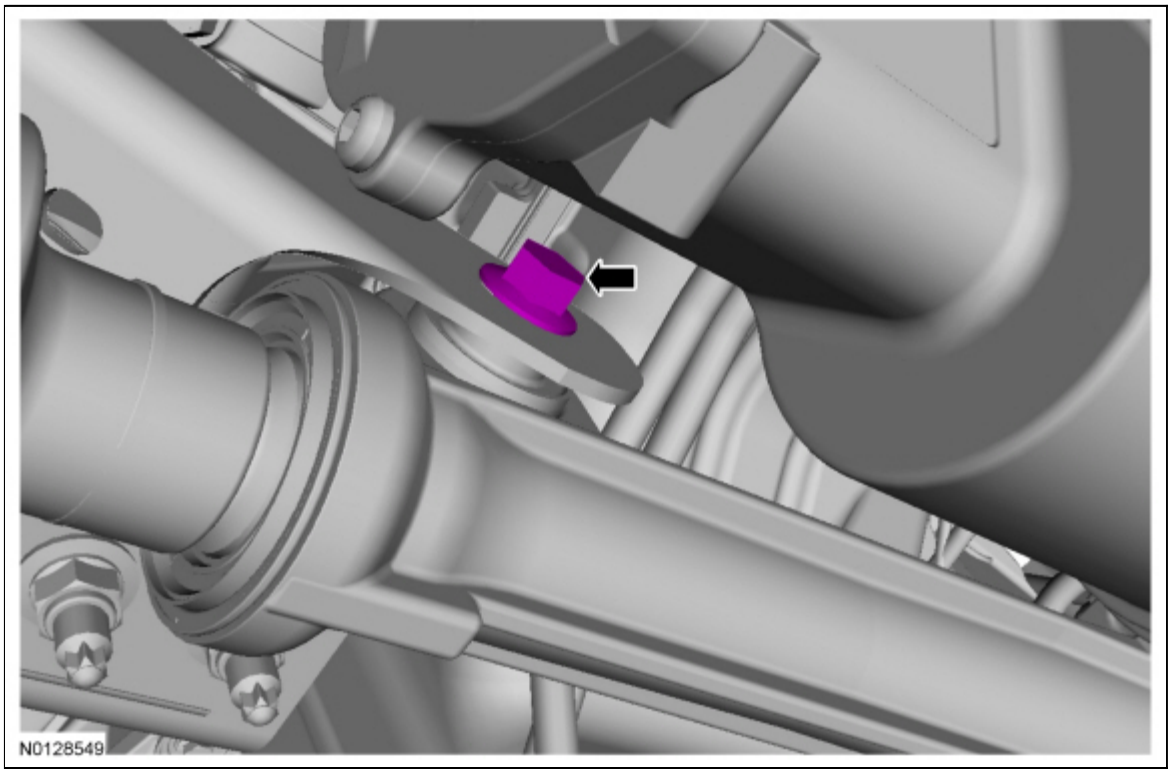


5. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

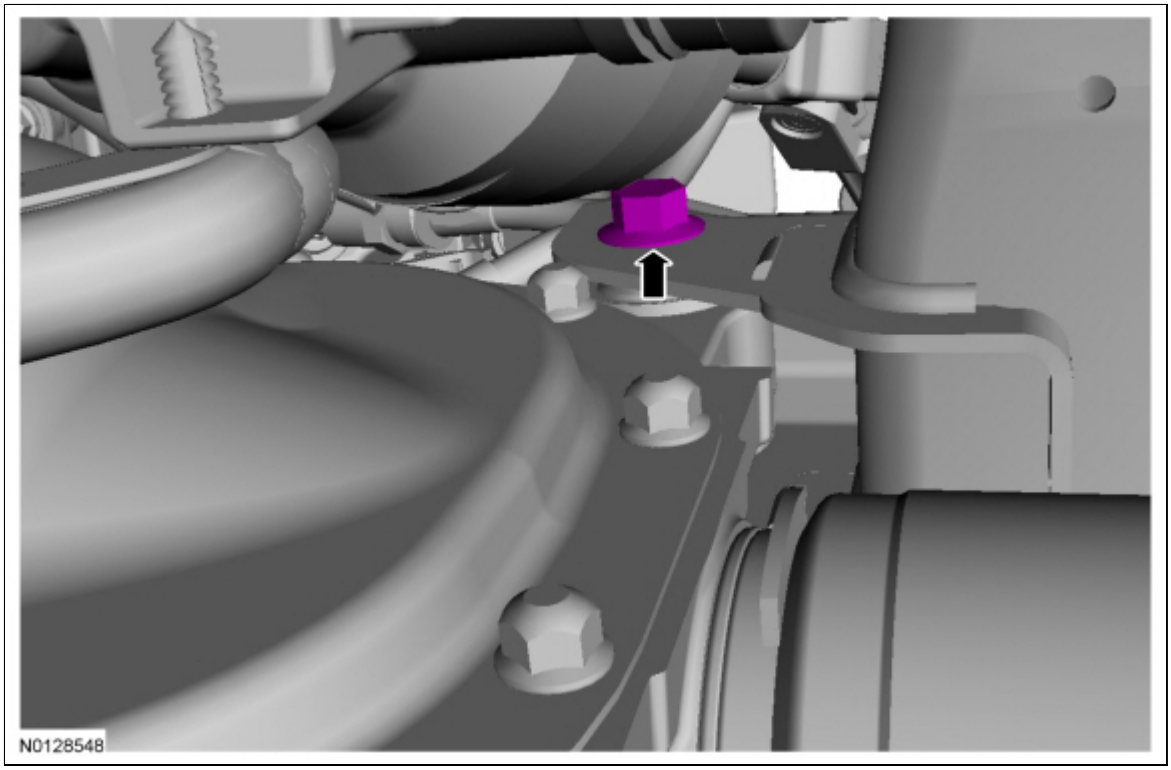


repair4less

6. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

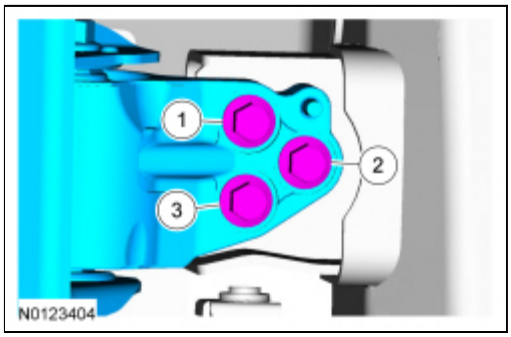


7. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



All vehicles

8. Tighten the 3 LH engine support insulator bolts in the sequence shown to 175 Nm (129 lb-ft).

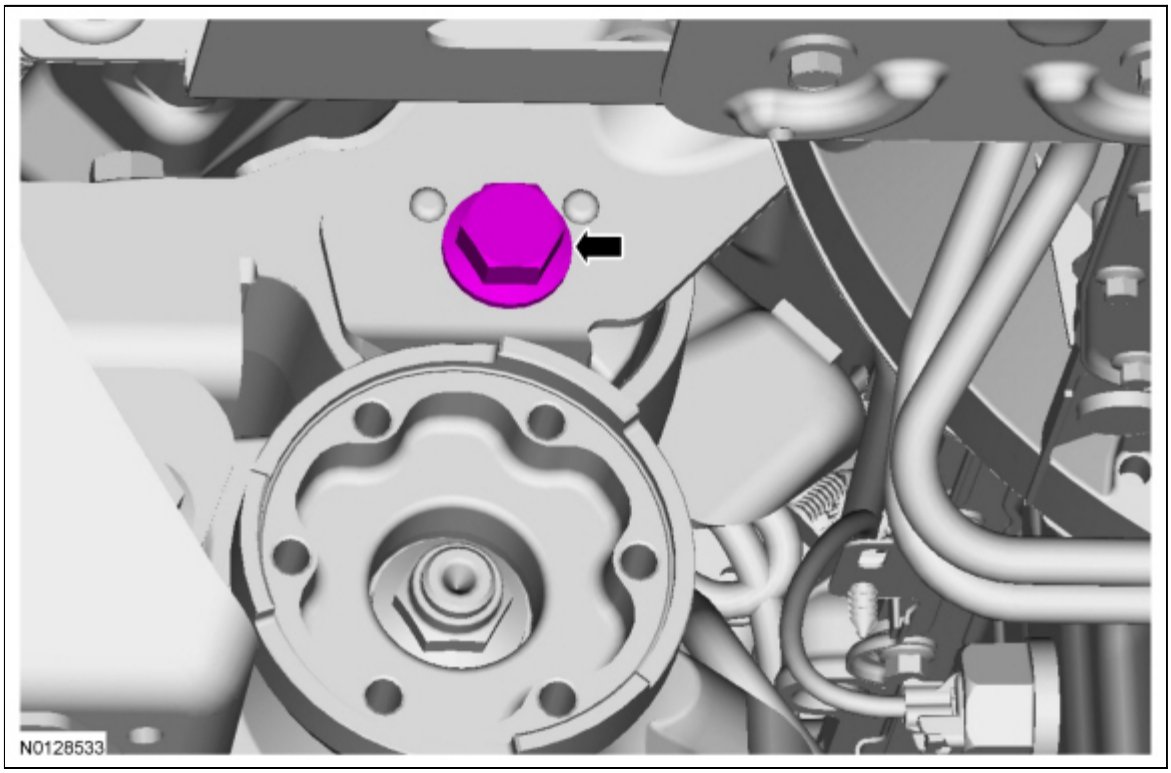


9. Lower the engine to the installed position.

10. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    NOTE: Apply threadlock to the bolt threads prior to installation.

    Install the LH engine support insulator through bolt.
    - Tighten to 350 Nm (258 lb-ft).

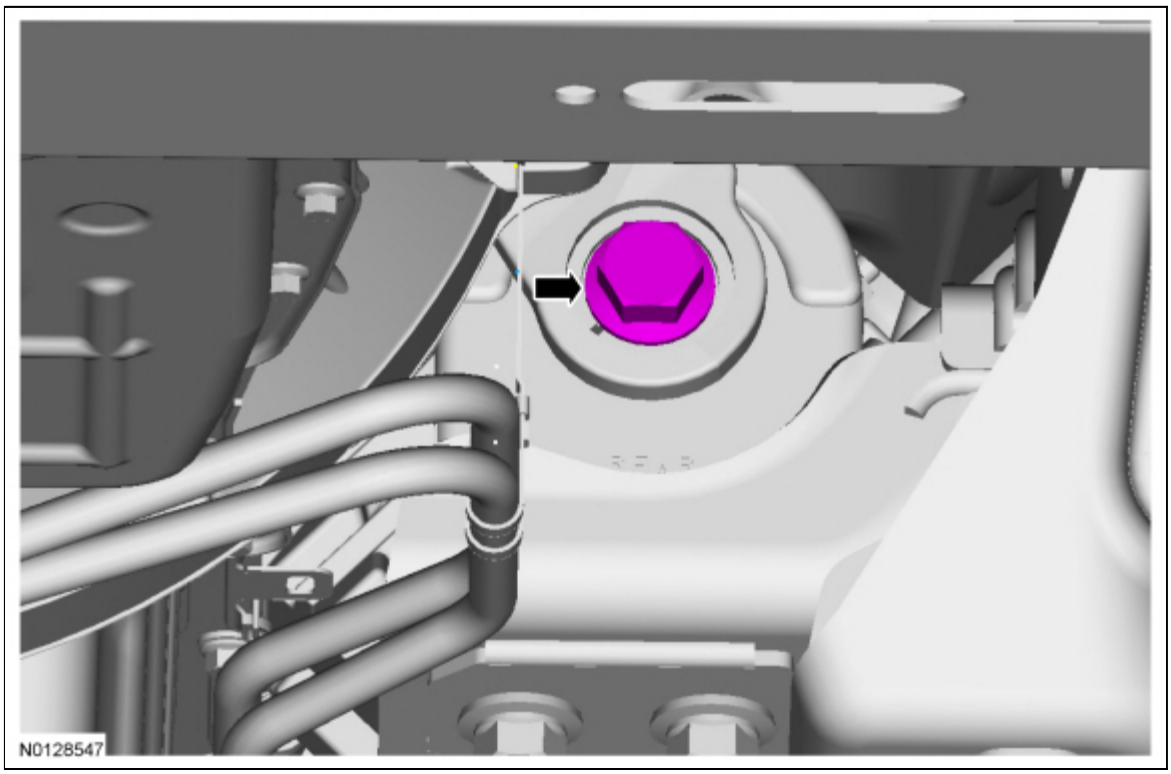


11. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove the RH engine support insulator through bolt and apply threadlock to the bolt threads.

repair4less

- Install the through bolt and tighten to 350 Nm (258 lb-ft).

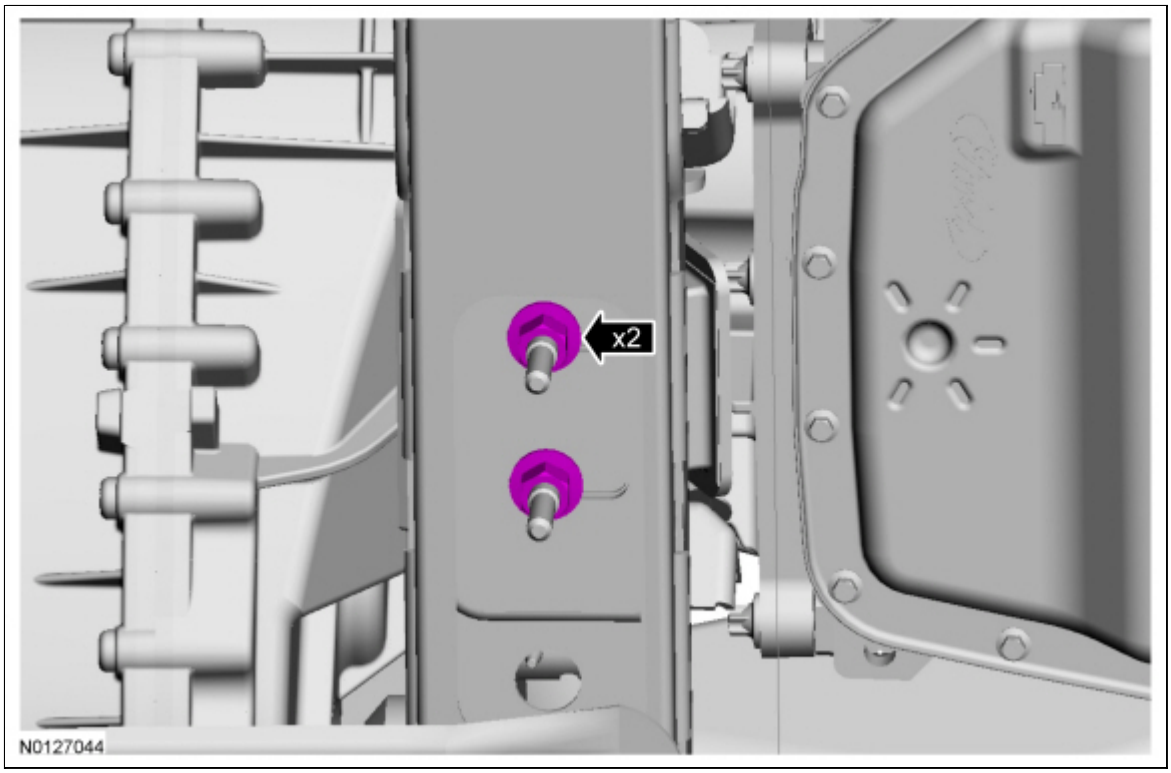


12. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .

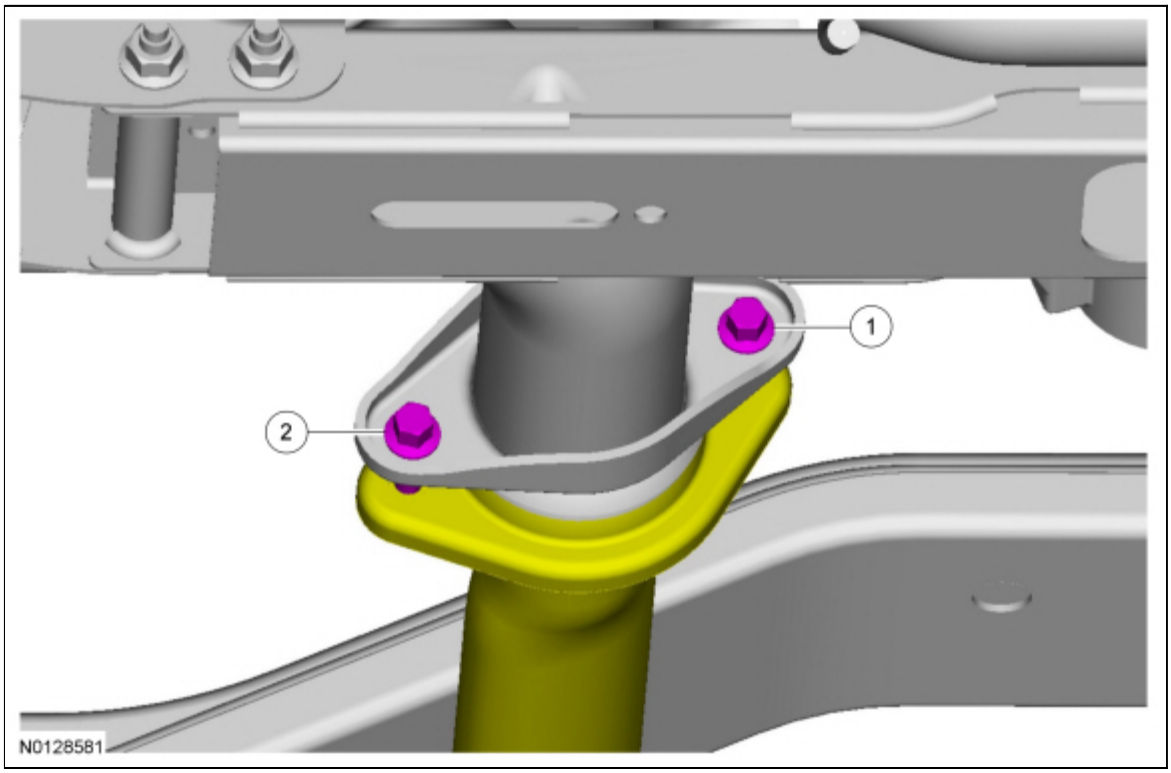
13. Install the starter. For additional information, refer to Section 303-06 .

14. ***NOTICE:*** **Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

    Tighten the transmission mount-to-crossmember nuts to 103 Nm (76 lb-ft).



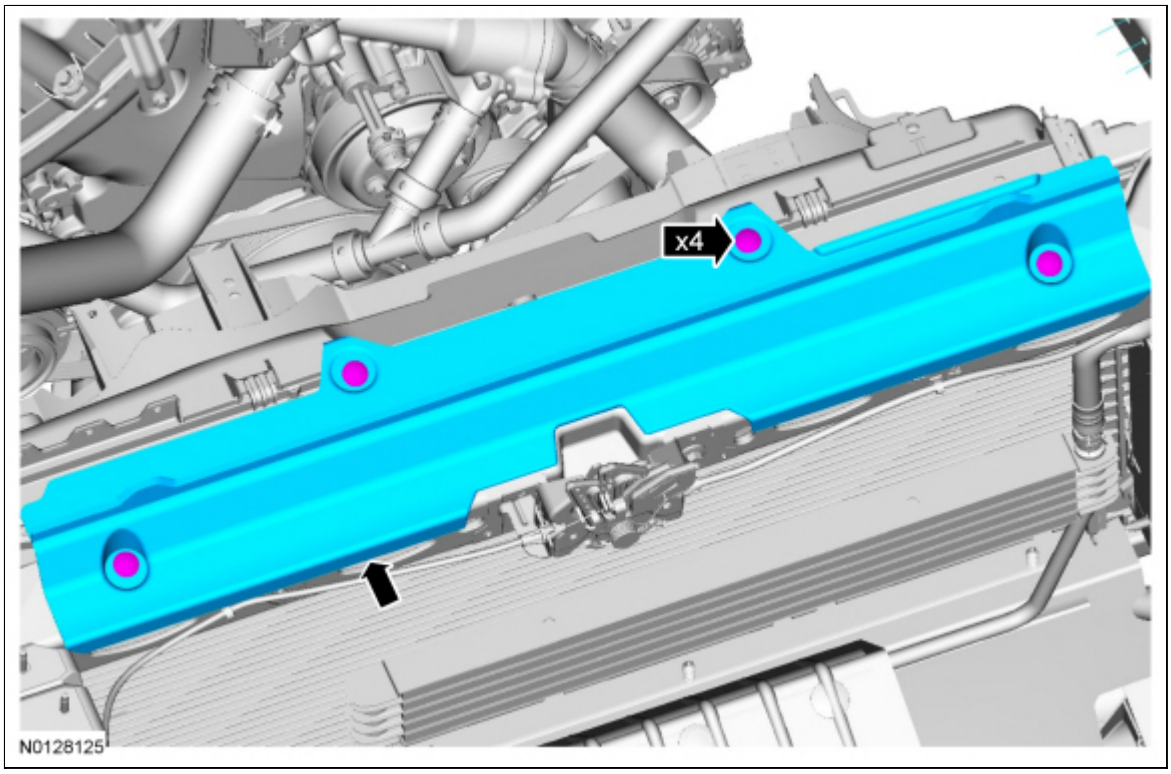
15. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



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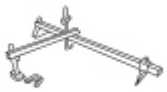
16. Install the Air Cleaner (ACL) outlet pipe and ACL cover assembly. For additional information, refer to Section 303-12 .

17. Install the upper radiator air deflector and the 4 pin-type retainers.



Engine Support Insulators — RH

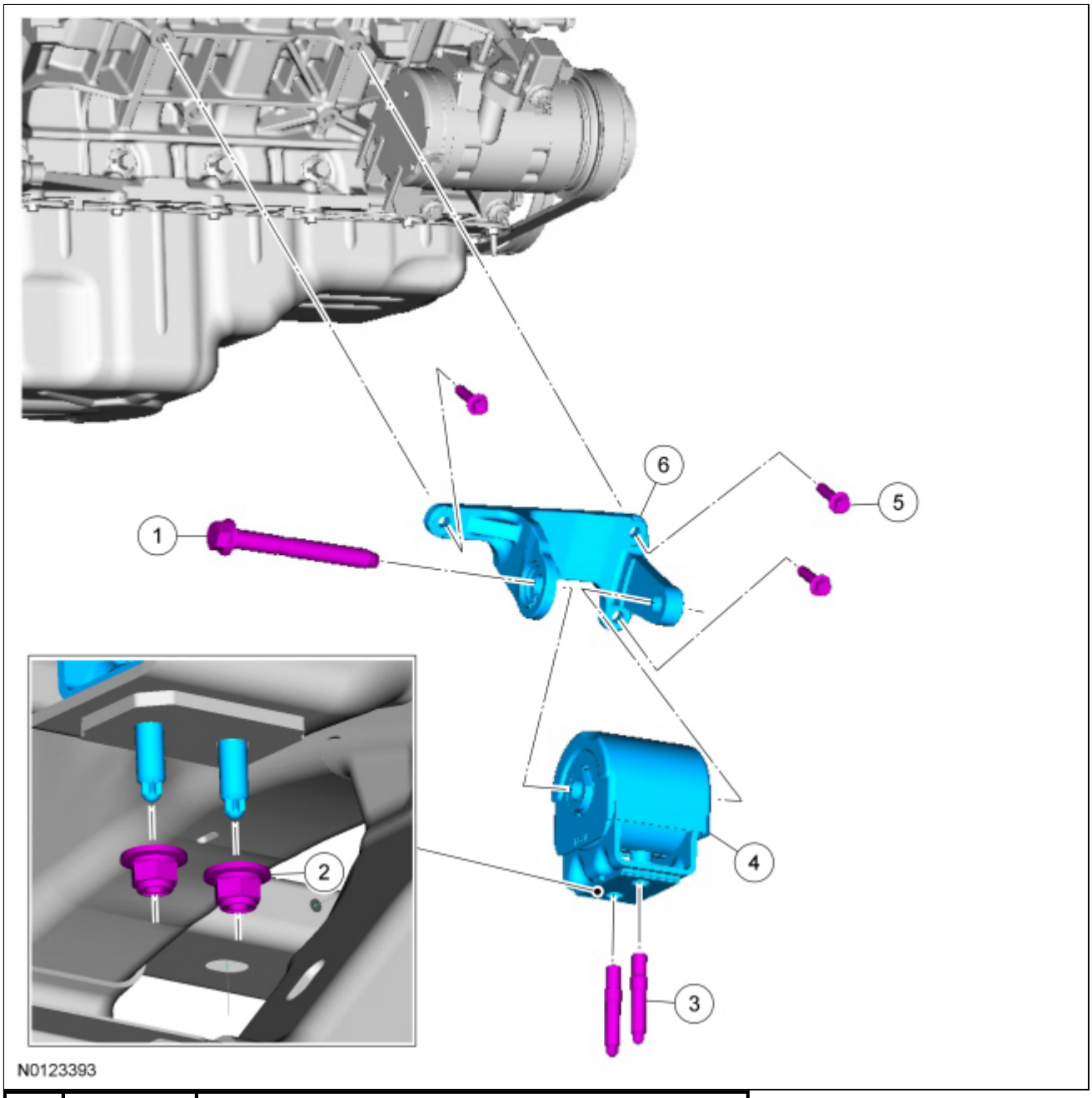
Special Tool(s)

 ST1659-A	Engine Lifting Bracket (D94T-6000-C) 303-D099
 ST2176-B	Support Bar, Engine 303-F070

Material

Item	Specification
Threadlock 262 TA-26	WSK-M2G351-A6

repair4less

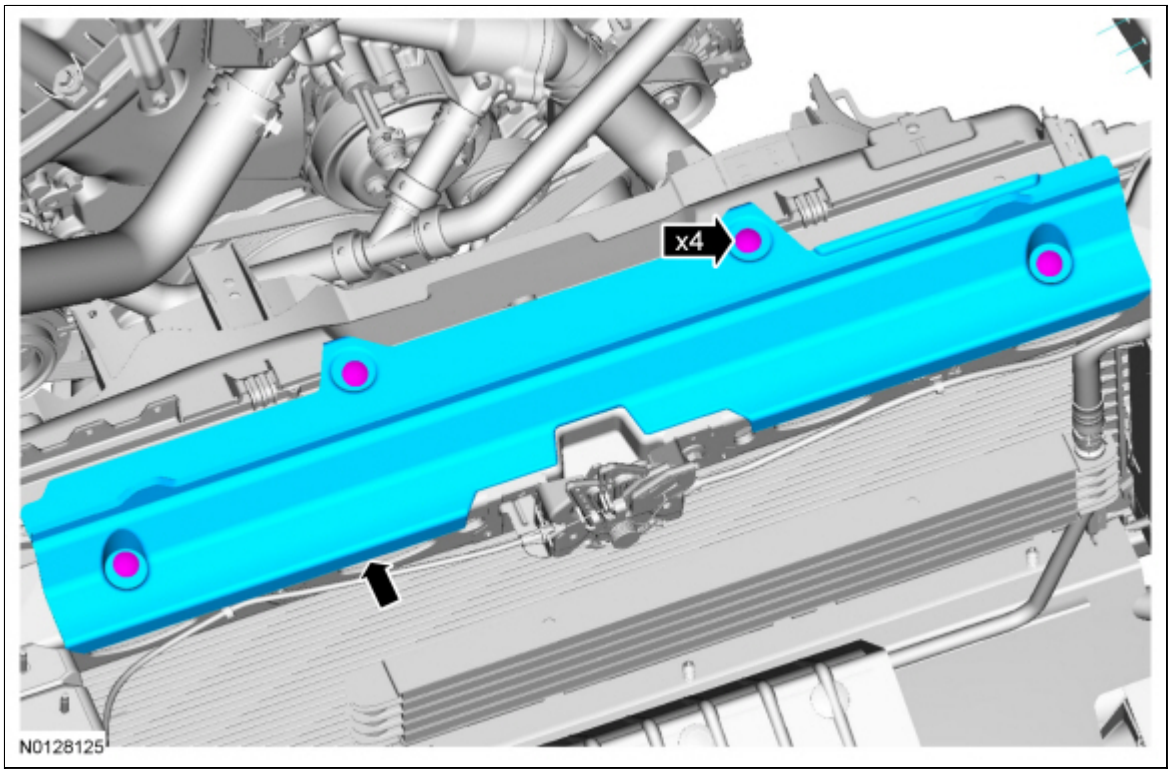


Item	Part Number	Description
1	—	RH engine support insulator through bolt (part of 6038) - 350 Nm (258 lb-ft)
2	W707251	RH engine support insulator nut (2 required) - 175 Nm (129 lb-ft)
3	—	RH engine support insulator stud (part of 6038) (2 required) - 15 Nm (133 lb-in)
4	6038	RH engine support insulator
5	W714735	RH engine support insulator bracket bolt (3 required) - 63 Nm (46 lb-ft)
6	—	RH engine support insulator bracket (part of 6038)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

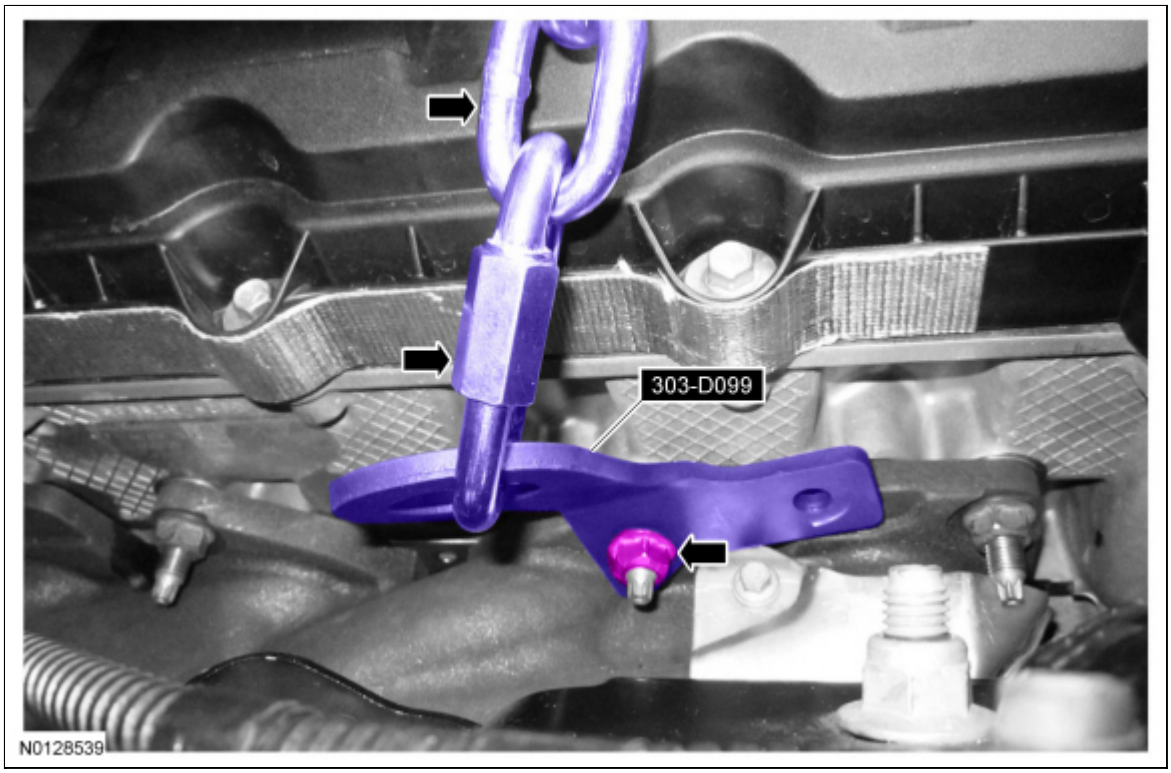
2. Remove the 4 pin-type retainers and the upper radiator air deflector.



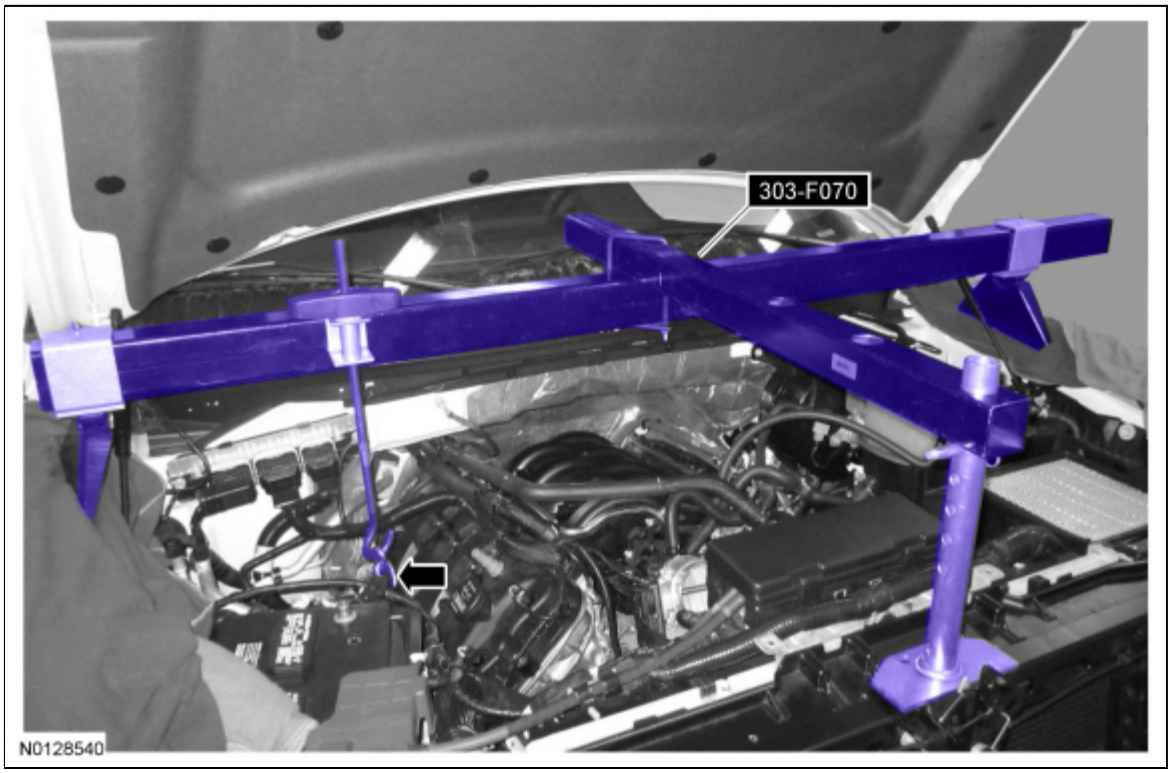
3. Remove the Air Conditioning (A/C) compressor belt . For additional information, refer to Section 303-05 .

4. Remove the exhaust manifold nut and install the Engine Lifting Bracket and nut on the RH exhaust manifold stud.
    - Attach a length of chain and a connecting link to the Engine Lifting Bracket.

repair4less



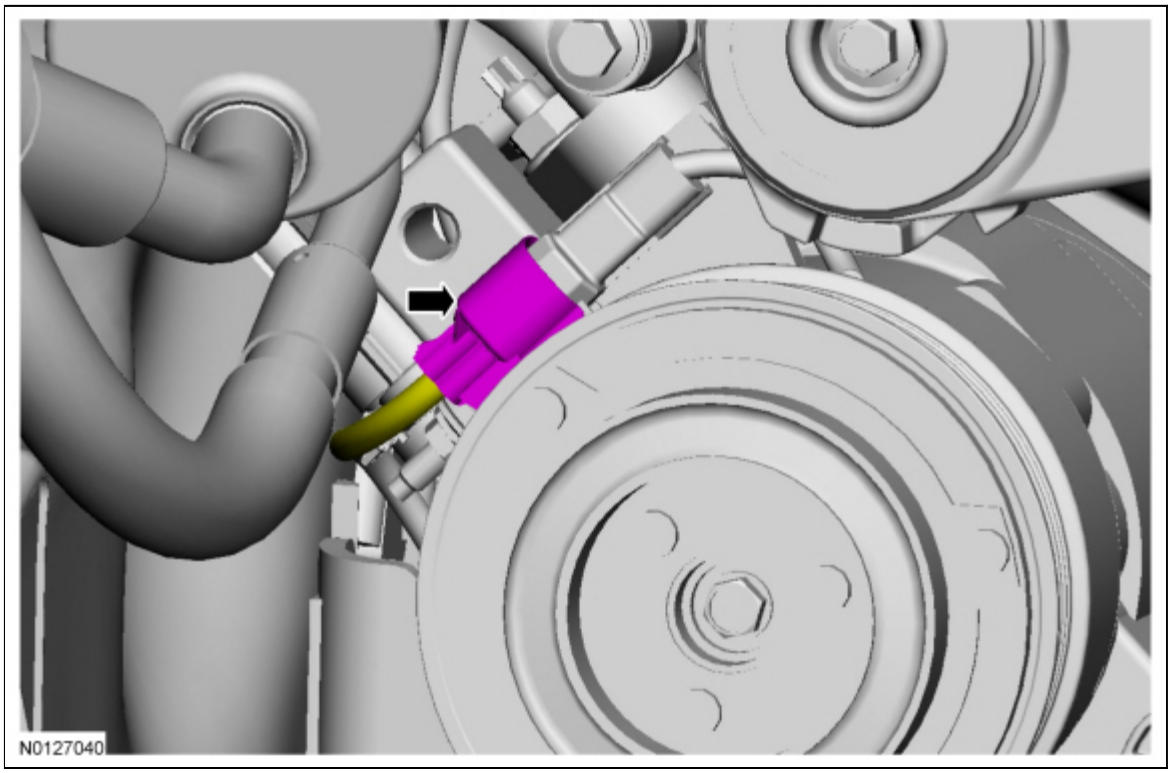
5. Install the Engine Support Bar.
    - Attach the chain installed in the previous step to the Engine Support Bar hook to support the engine.



6. Remove the starter. For additional information, refer to Section 303-06 .

7. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .

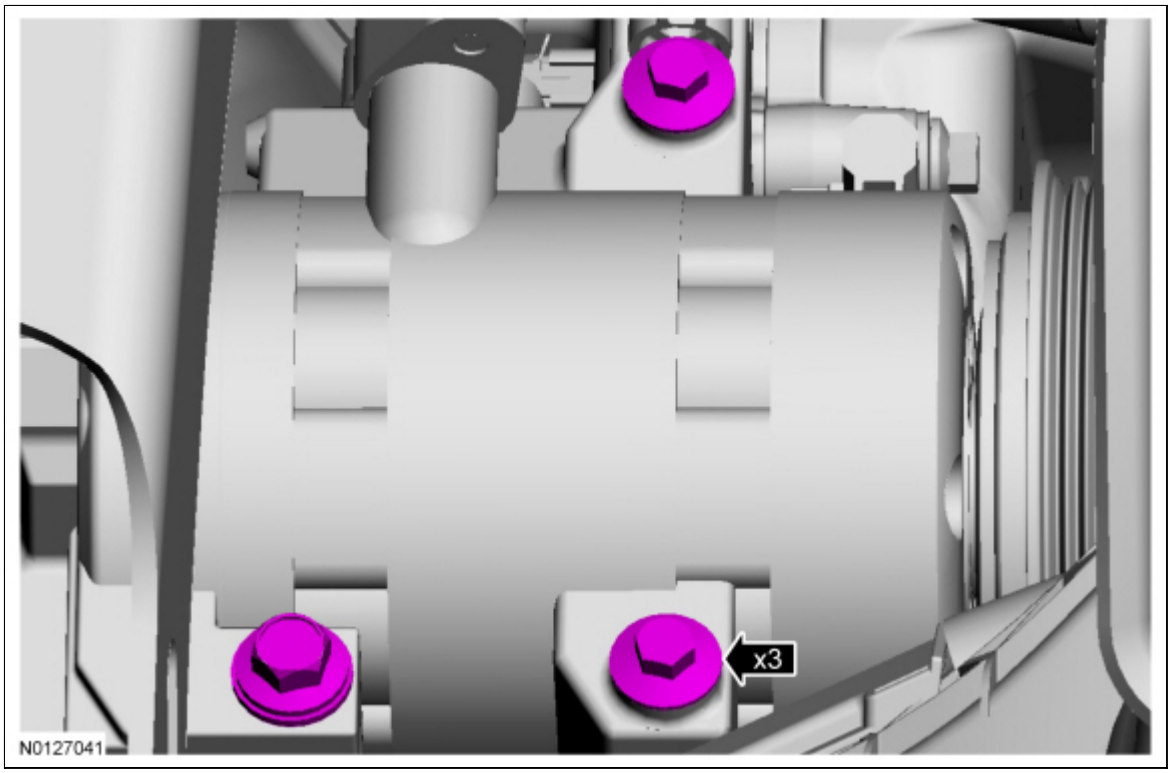
8. Disconnect the A/C compressor electrical connector.



9. ***NOTICE:*** **The upper bolt cannot be completely removed and will remain with the A/C compressor.**

   Remove the 3 bolts and lower the A/C compressor.

repair4less

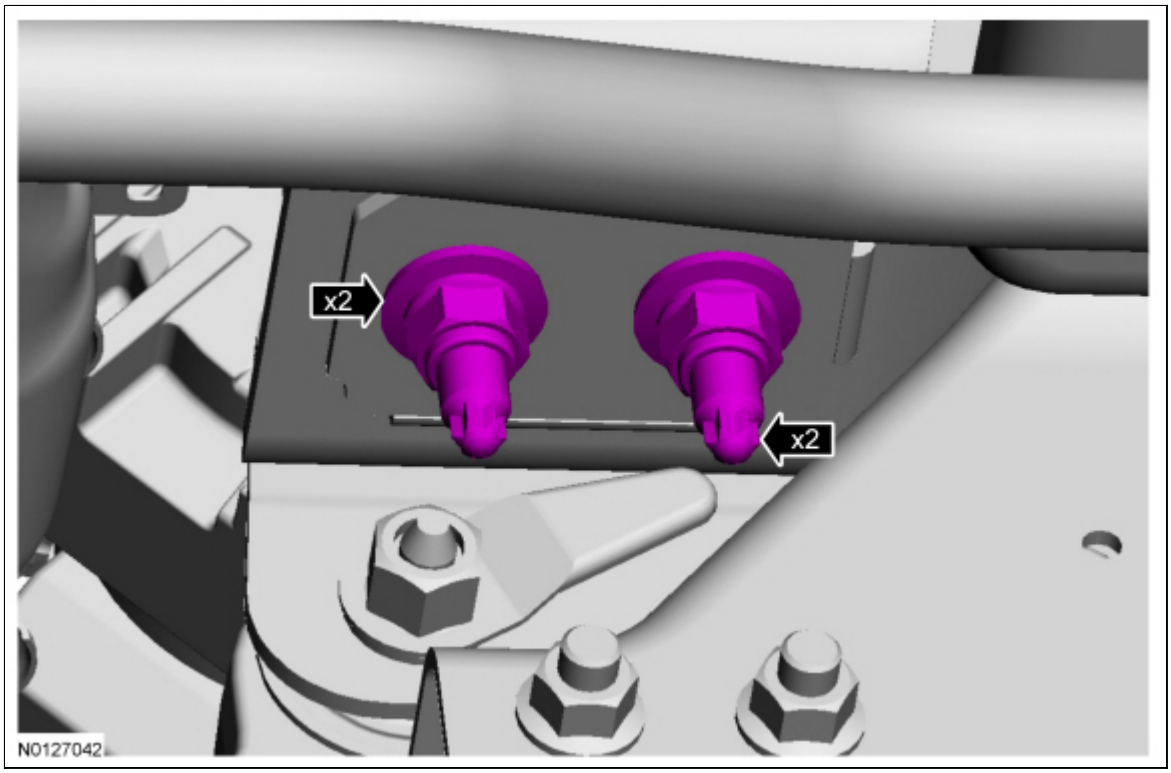


10. ***NOTICE:*** **Only use hand tools when removing or installing the engine support insulator nuts or damage to the engine support insulator can occur.**

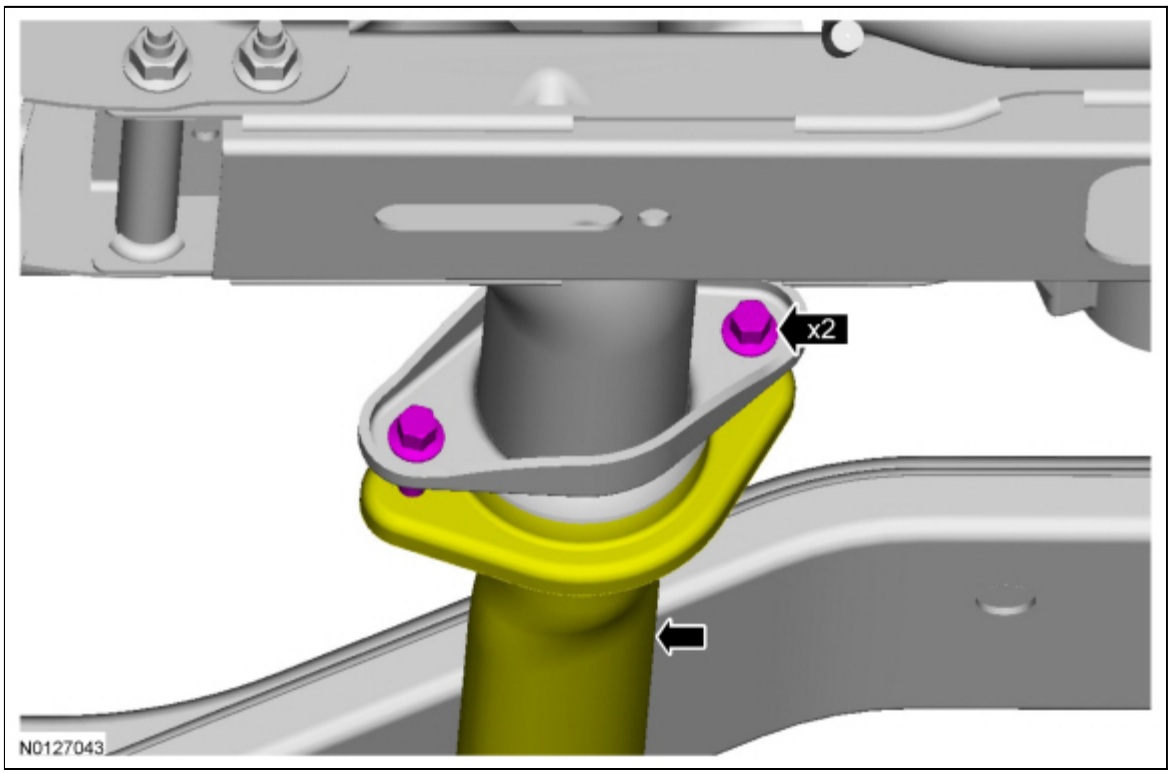
    NOTICE: **Only use hand tools when removing or installing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

    NOTE: If during nut removal the stud is extracted from the engine support insulator, separate the nut from the stud bolt prior to stud installation.

    Remove the 2 RH engine support insulator nuts and studs.



11. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.

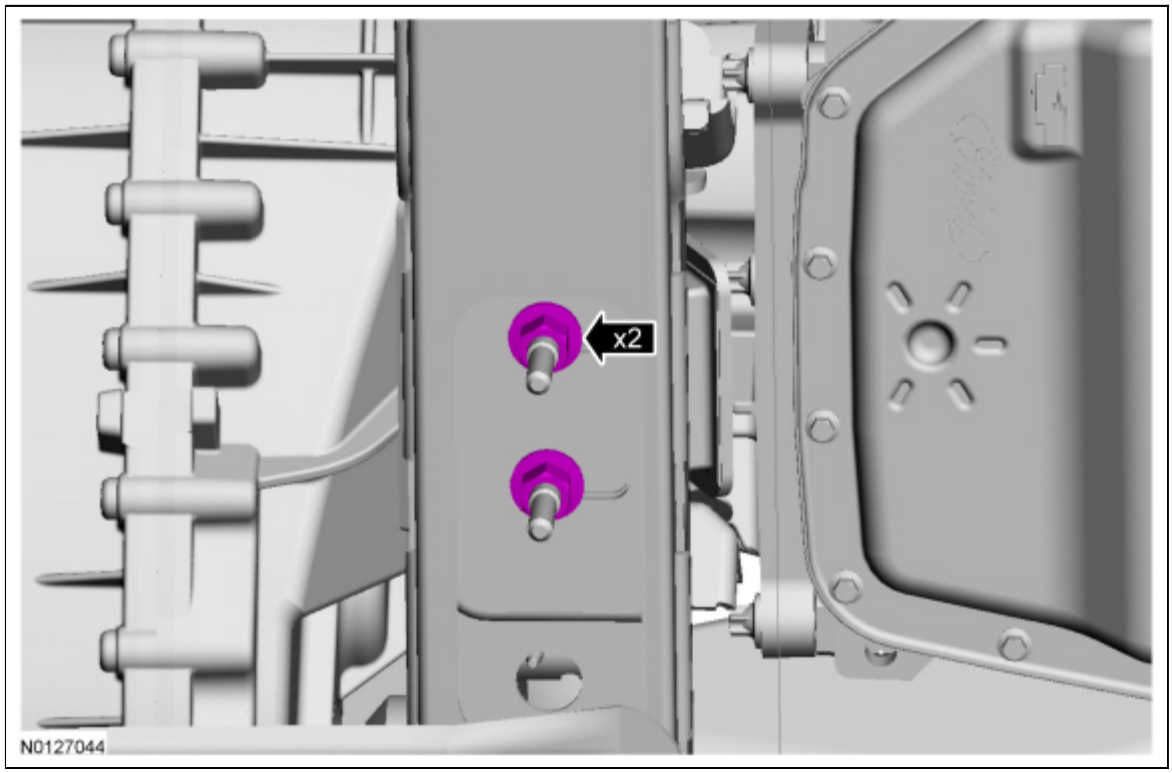


12. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or**

repair4less

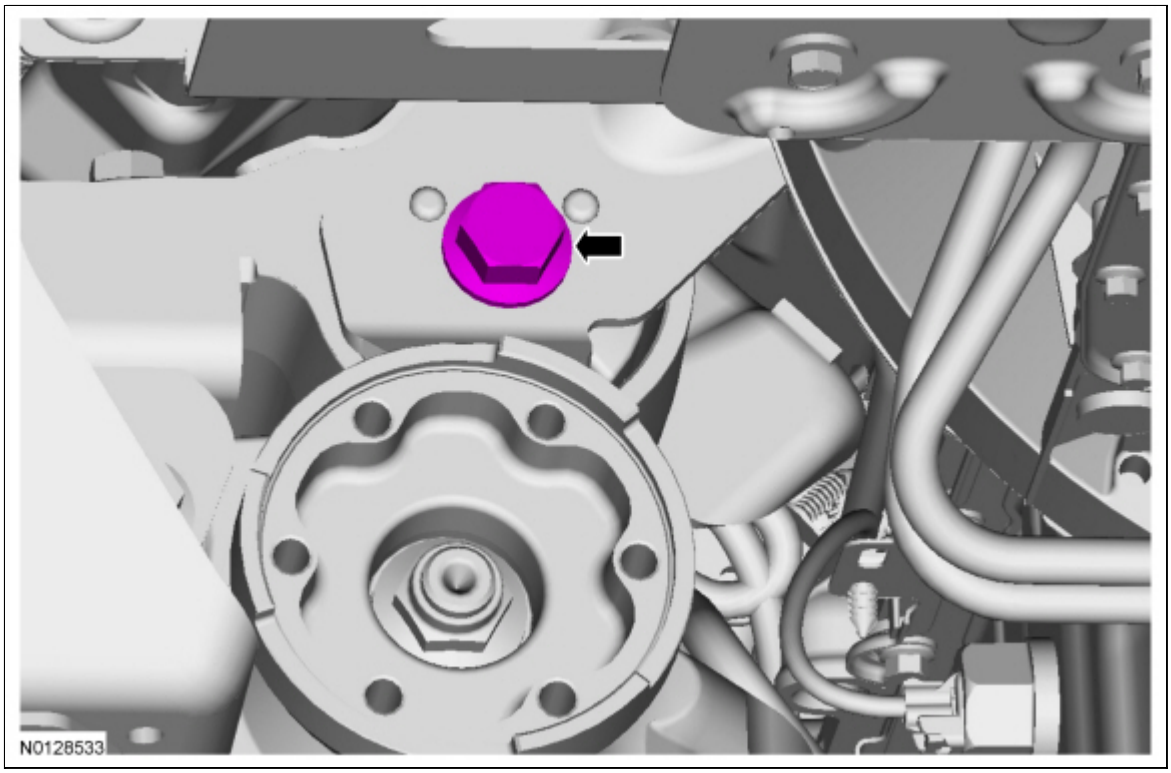
damage to the transmission mount can occur.

Loosen the 2 transmission mount-to-crossmember nuts.



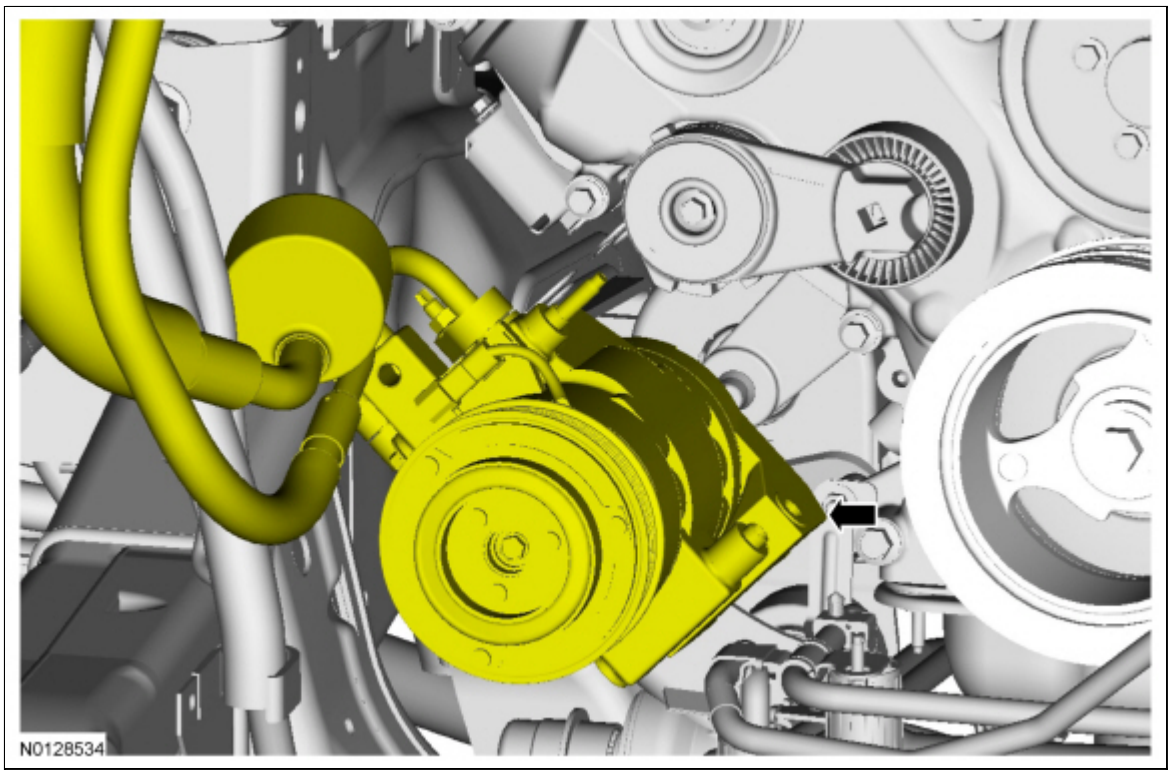
13. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Loosen the LH engine support insulator through bolt.



14. Raise the RH side of the engine 50 mm (1.968 in).

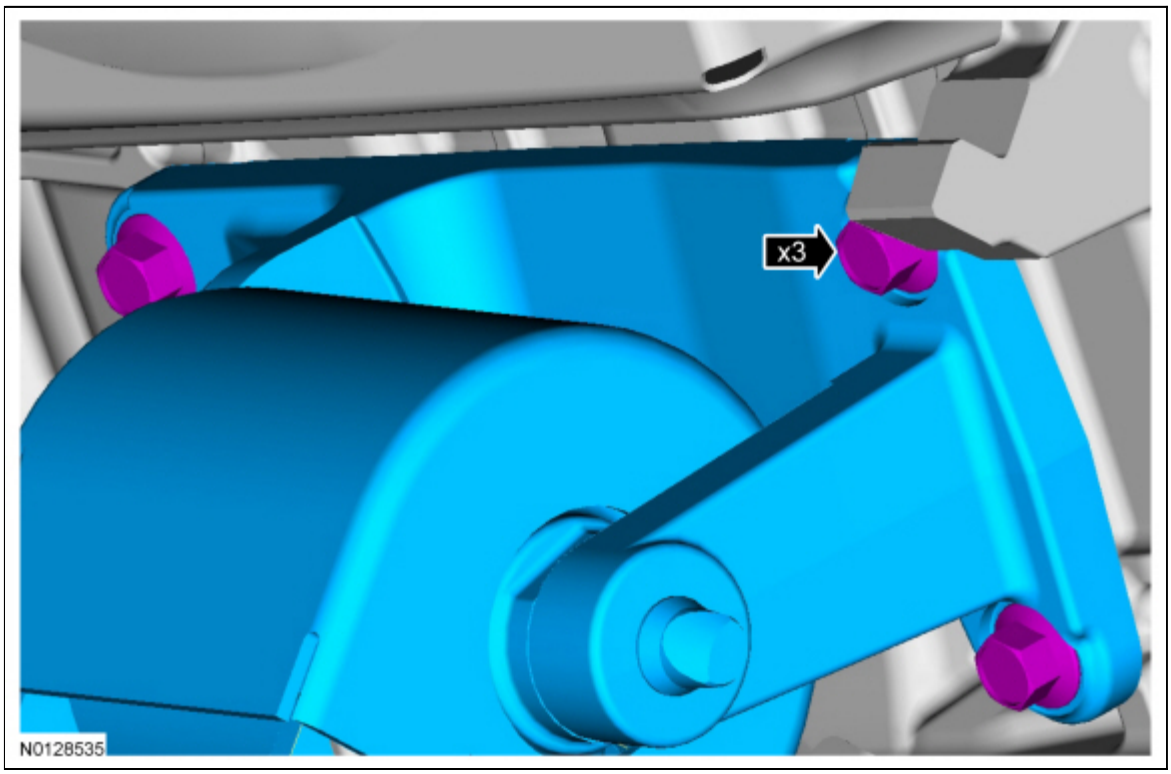
15. Position the A/C compressor aside to access the 2 front engine support insulator bracket bolts.



16. Remove the 3 RH engine support insulator bracket-to-engine bolts.

repair4less

- Remove the RH engine support insulator and bracket as an assembly.

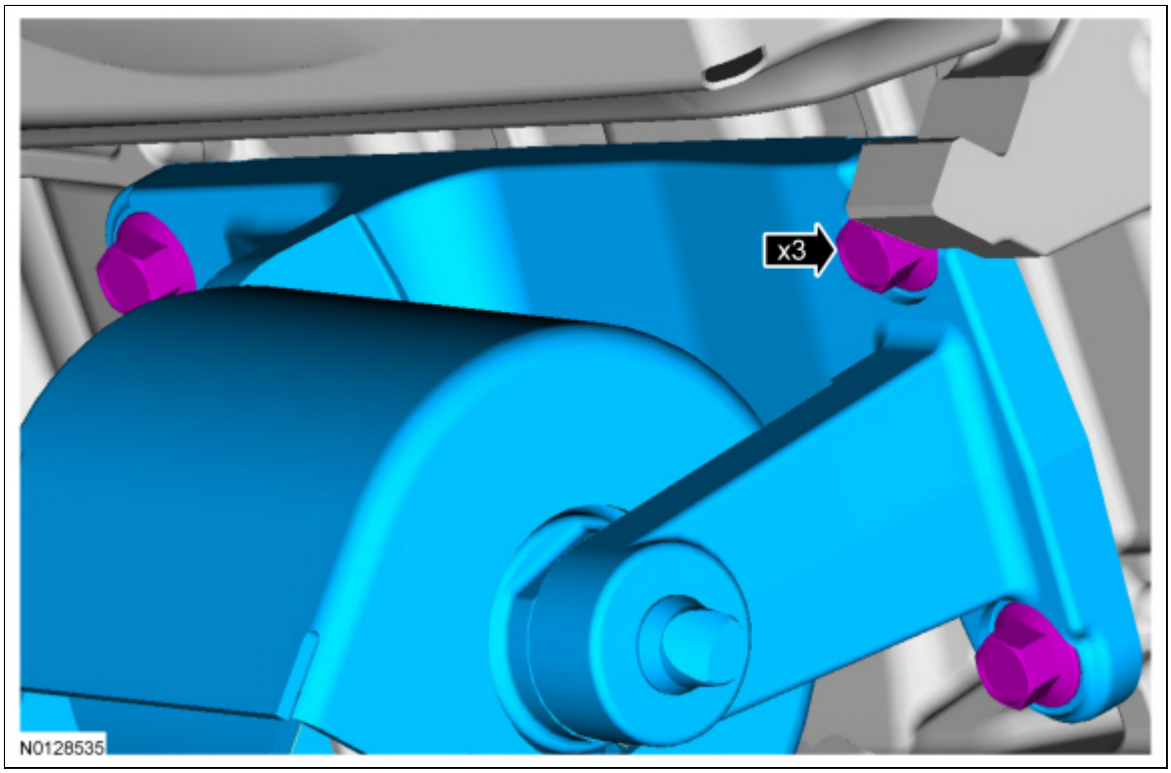


Installation

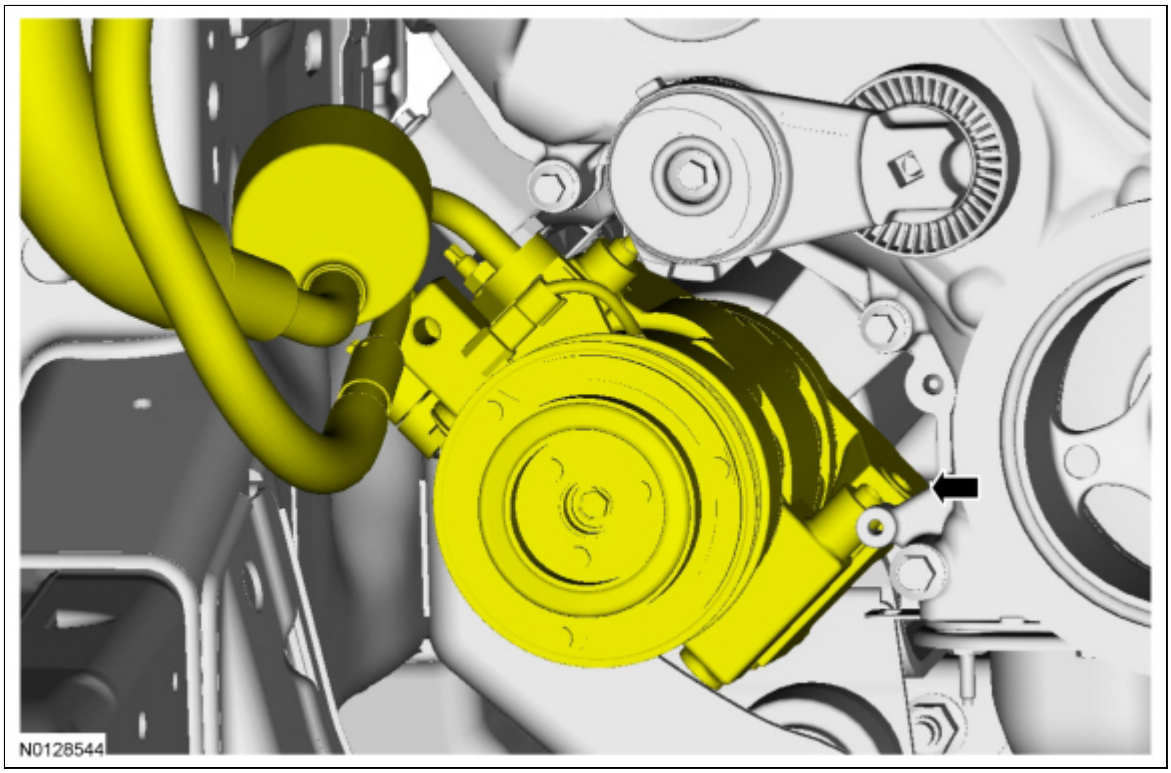
1. Clean the engine support insulator bracket-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

2. **NOTE:** If a new RH engine support insulator is installed, remove the 2 studs prior to positioning the assembly in the vehicle.

   Install the RH engine support insulator and bracket assembly and install the 3 bolts.
   - Tighten to 63 Nm (46 lb-ft).



3. Position the A/C compressor below the RH side of the engine.



4. Lower the engine to the installed position.

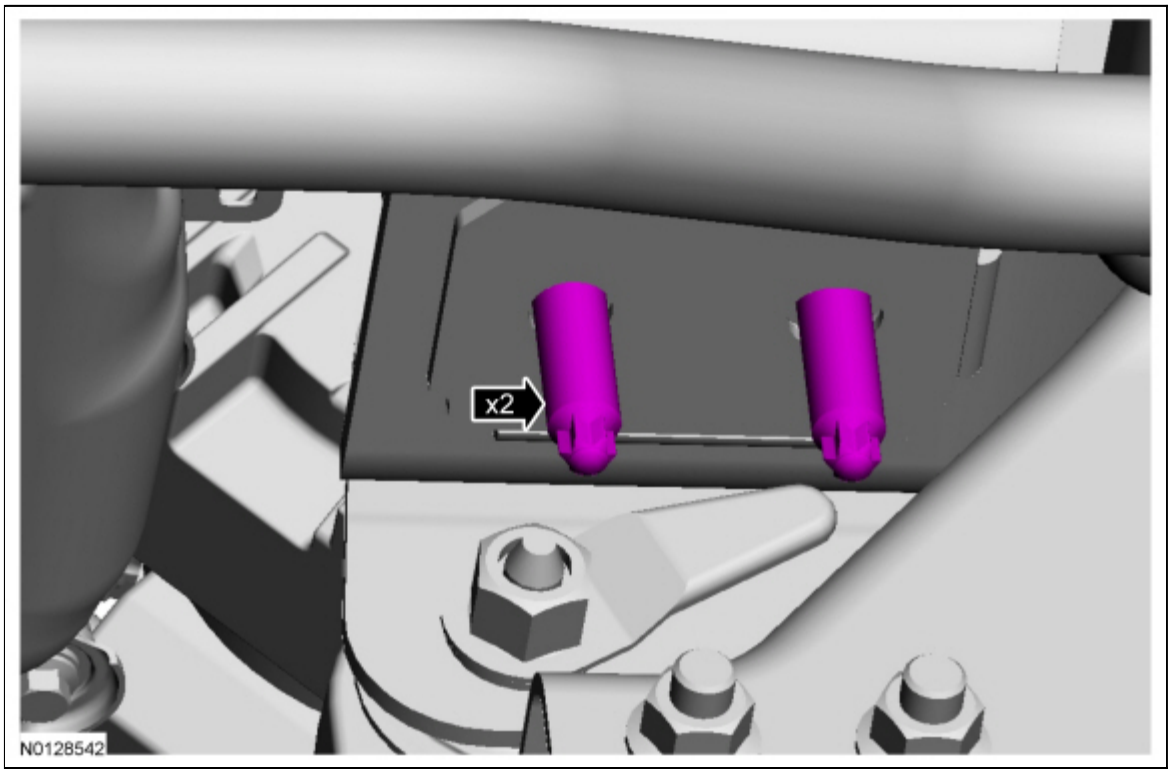
5. ***NOTICE:*** **Only use hand tools when installing the engine support insulator studs or damage to**

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the engine support insulator can occur.

Install the 2 RH engine support insulator studs.

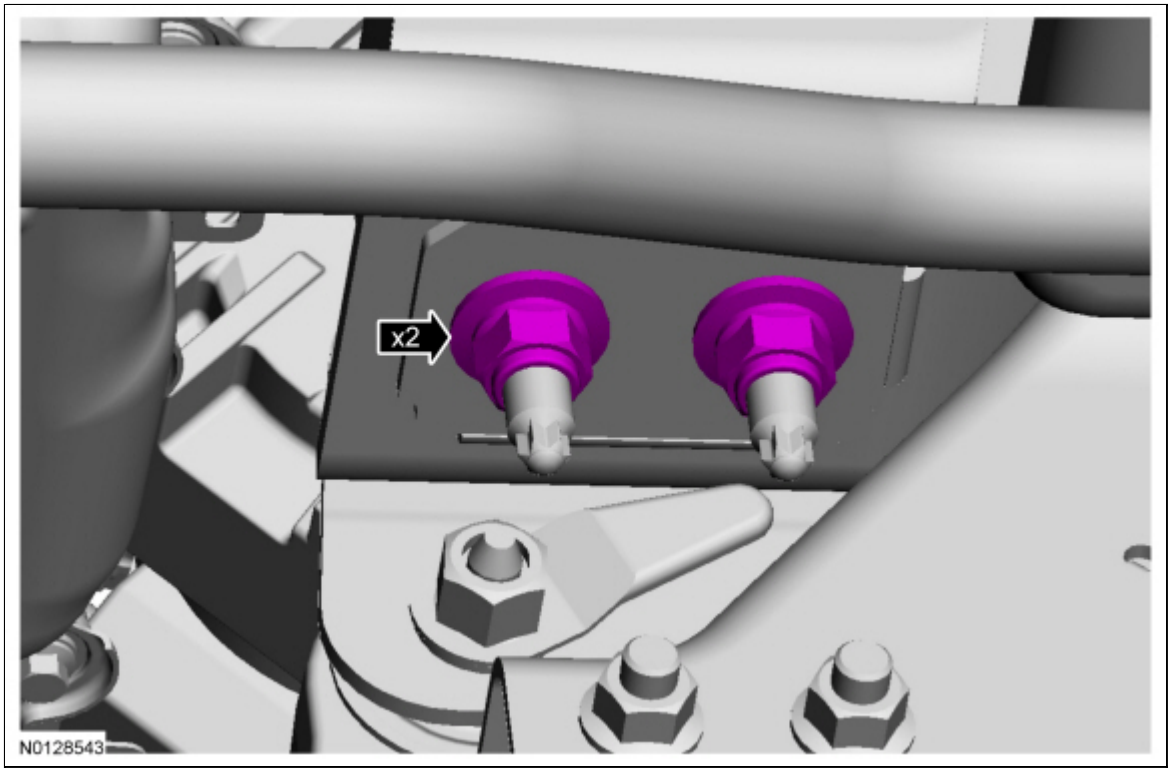
- Tighten to 15 Nm (133 lb-in).



6. ***NOTICE:*** **Only use hand tools when installing the RH engine support insulator nuts or damage to the engine support insulator can occur.**

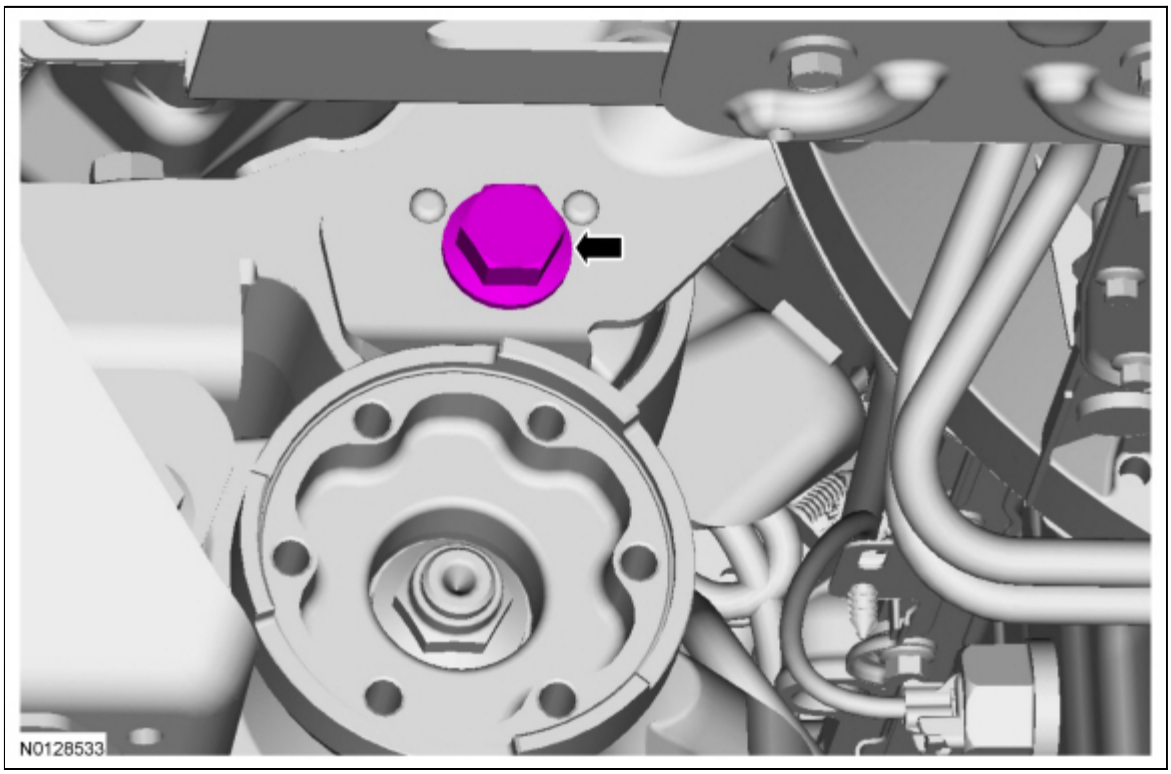
   Install the 2 RH engine support insulator nuts.

   - Tighten to 175 Nm (129 lb-ft).



7. ***NOTICE:*** **Only use hand tools when loosening or tightening the engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.**

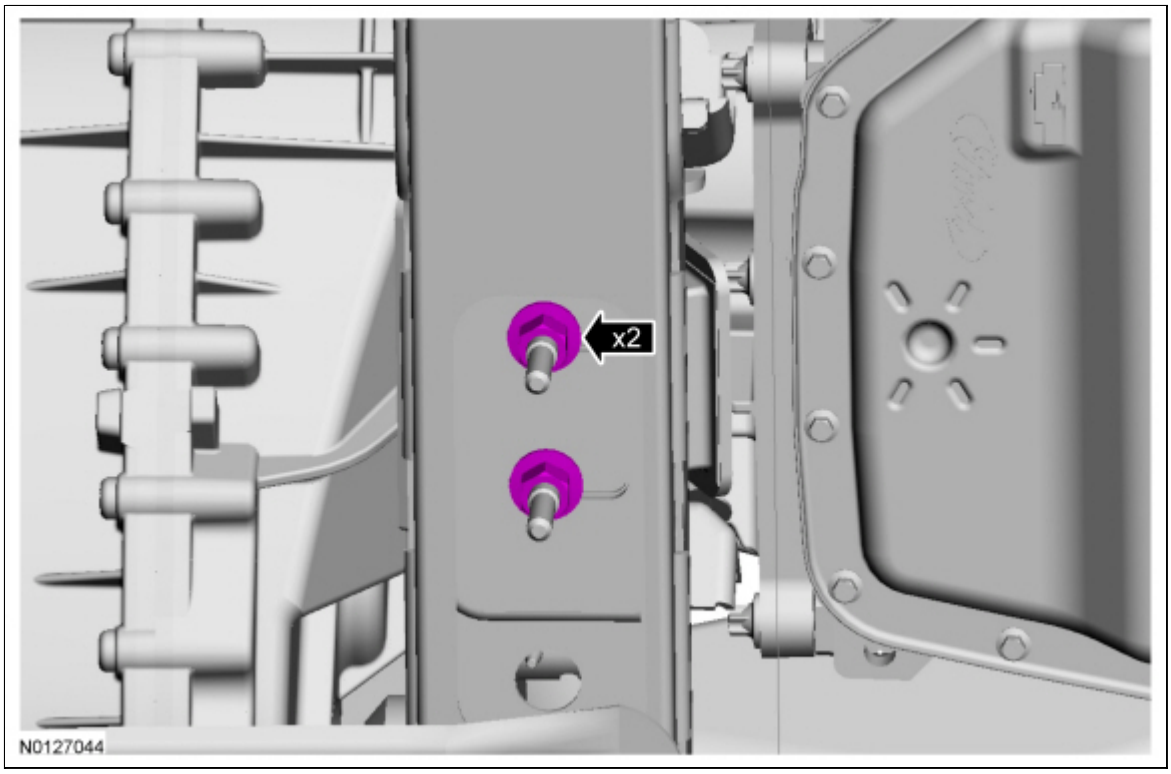
   Remove the LH engine support insulator through bolt and apply threadlock to the bolt threads.
   - Install the through bolt and tighten to 350 Nm (258 lb-ft).



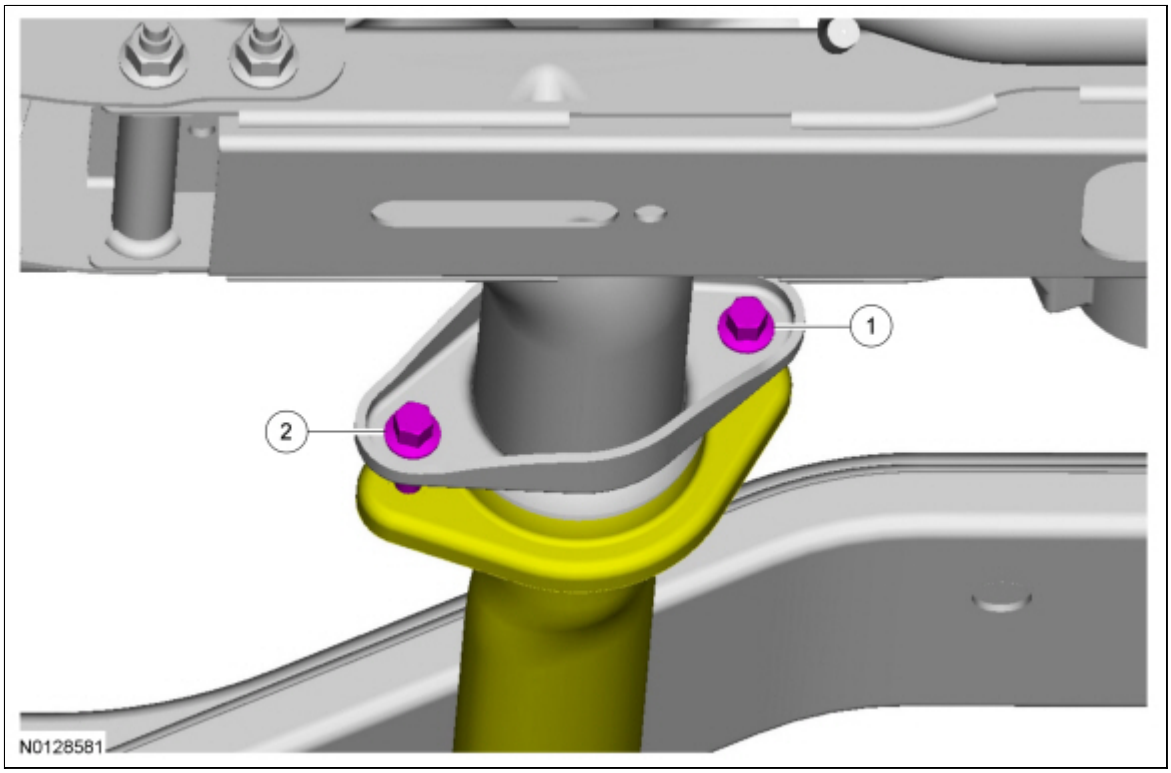
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8. ***NOTICE:*** **Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

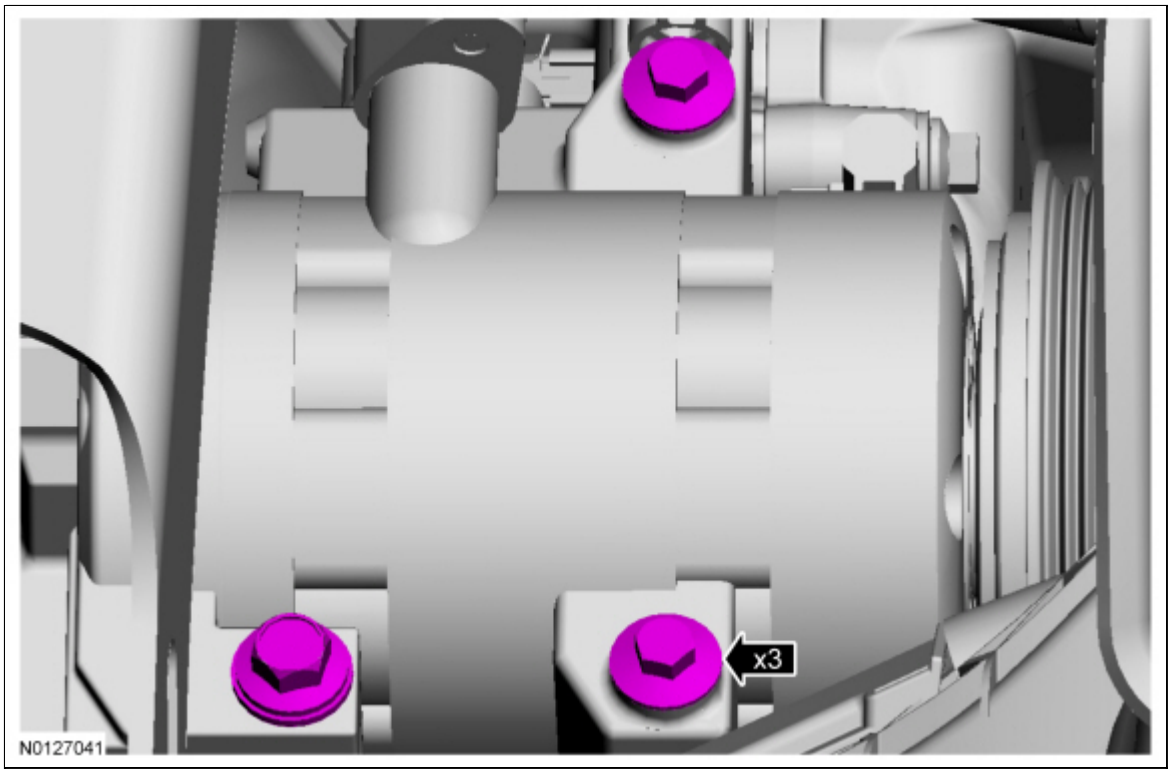
   Tighten the transmission mount-to-crossmember nuts to 103 Nm (76 lb-ft).



9. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
   1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
   2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

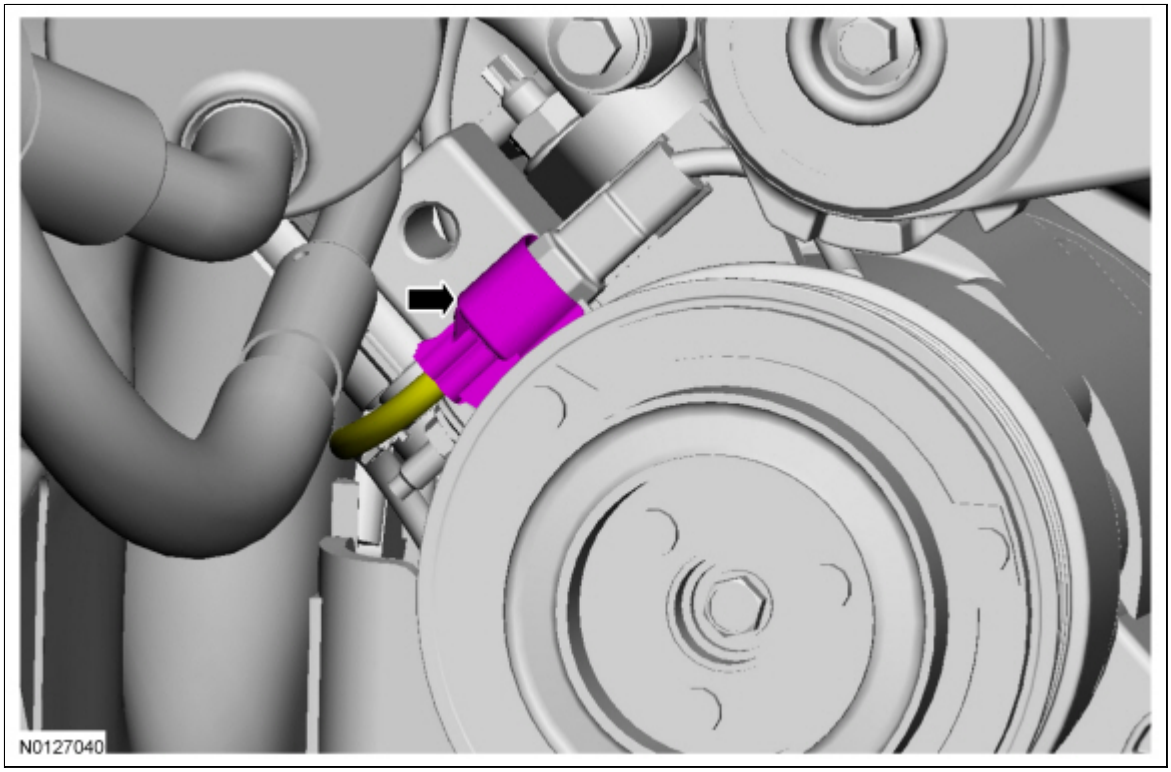


10. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

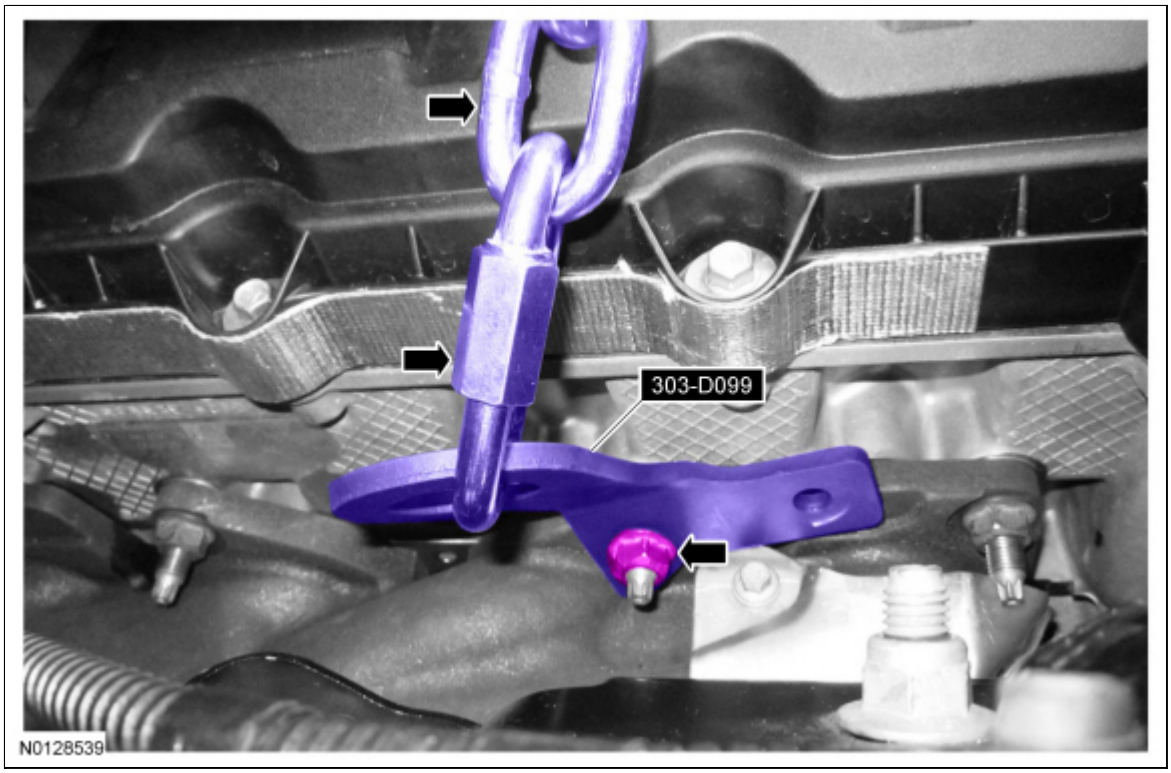


11. Connect the A/C compressor electrical connector.

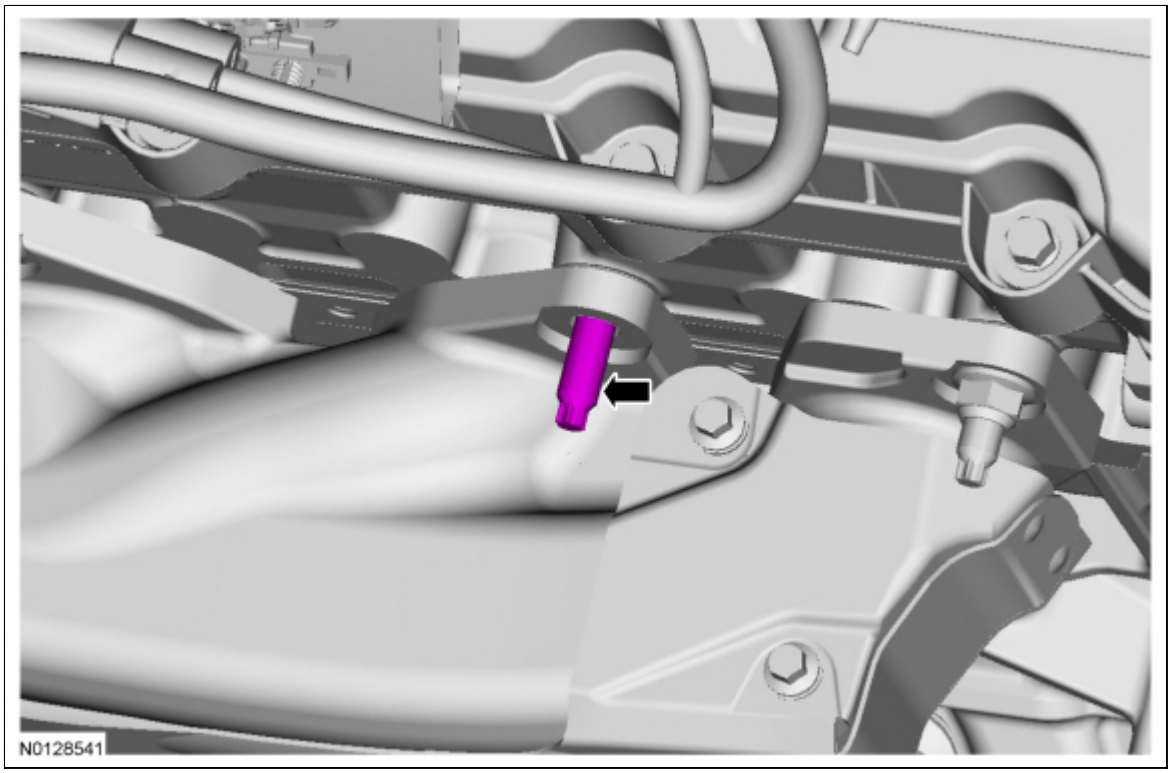
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12. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .
13. Install the starter. For additional information, refer to Section 303-06 .
14. Install the A/C compressor belt. For additional information, refer to Section 303-05 .
15. Remove the Engine Support Bar.
16. Remove the nut, the Engine Lifting Bracket, the connecting link and chain.



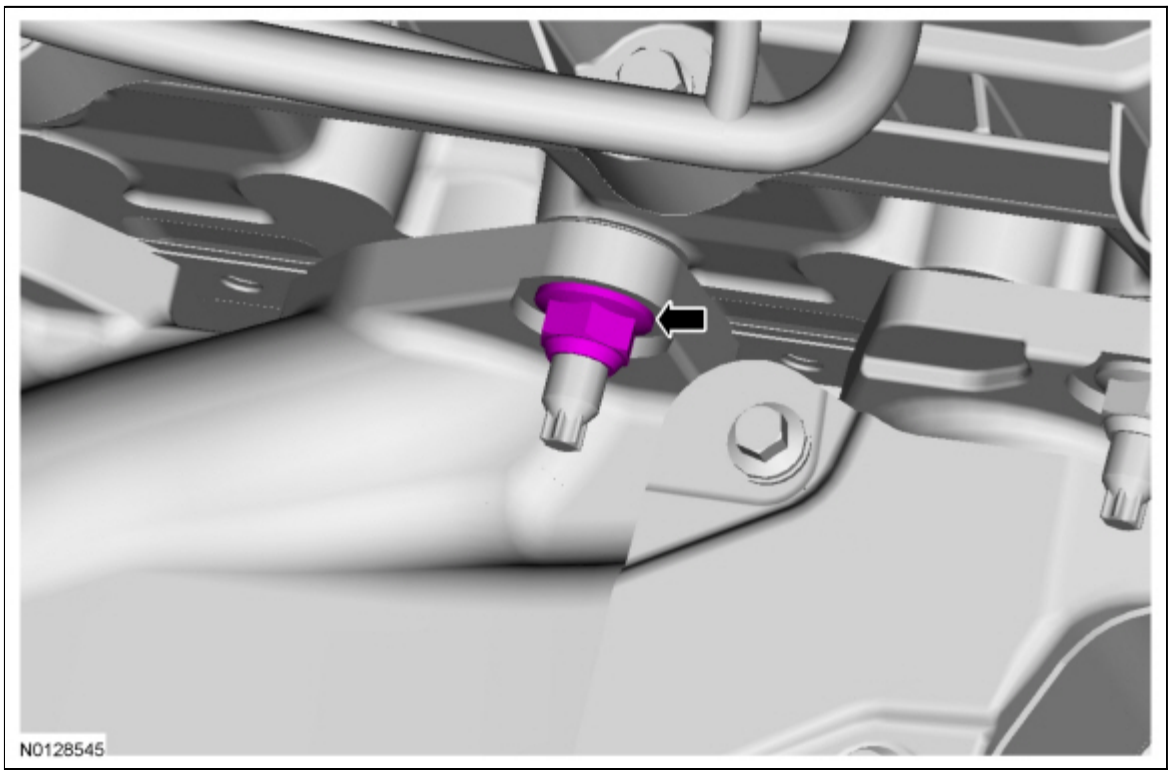
17. Remove and discard the exhaust manifold stud.
    - Install a new exhaust manifold stud and tighten to 25 Nm (18 lb-ft).



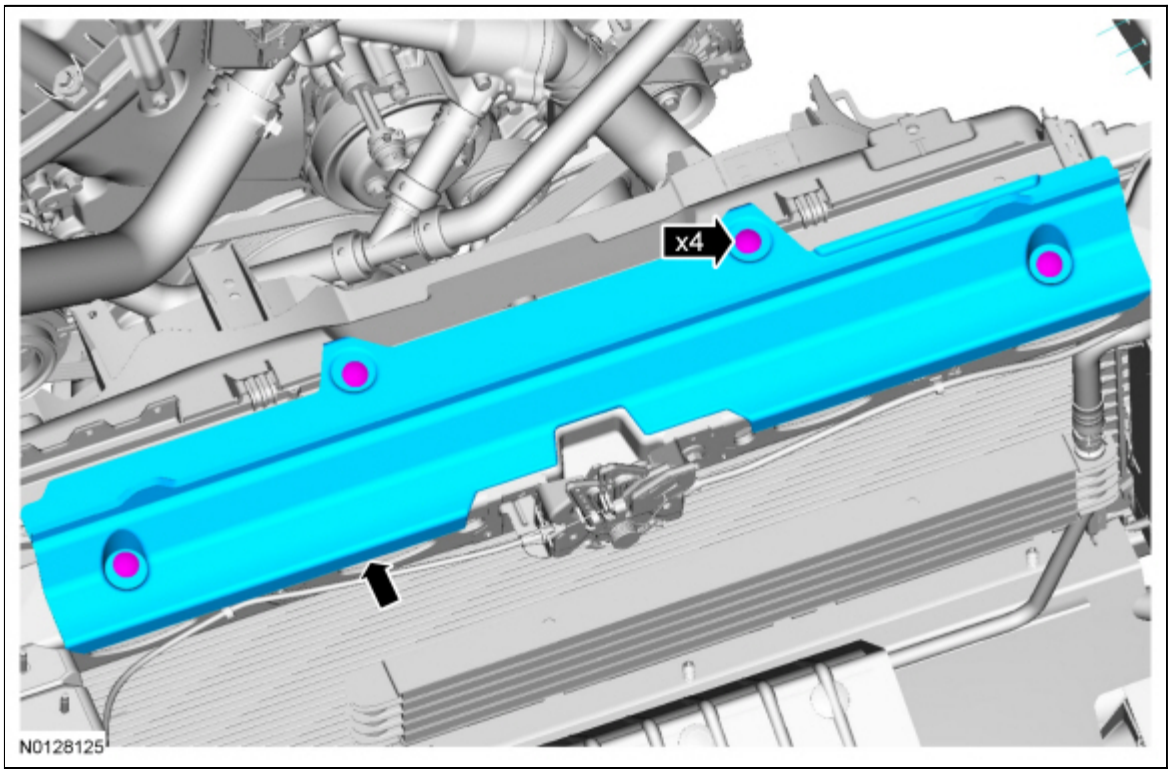
18. Install a new exhaust manifold nut and tighten in 2 stages.
    - Stage 1: Tighten to 24 Nm (18 lb-ft).

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- Stage 2: Tighten to 32 Nm (24 lb-ft).



19. Install the upper radiator air deflector and the 4 pin-type retainers.

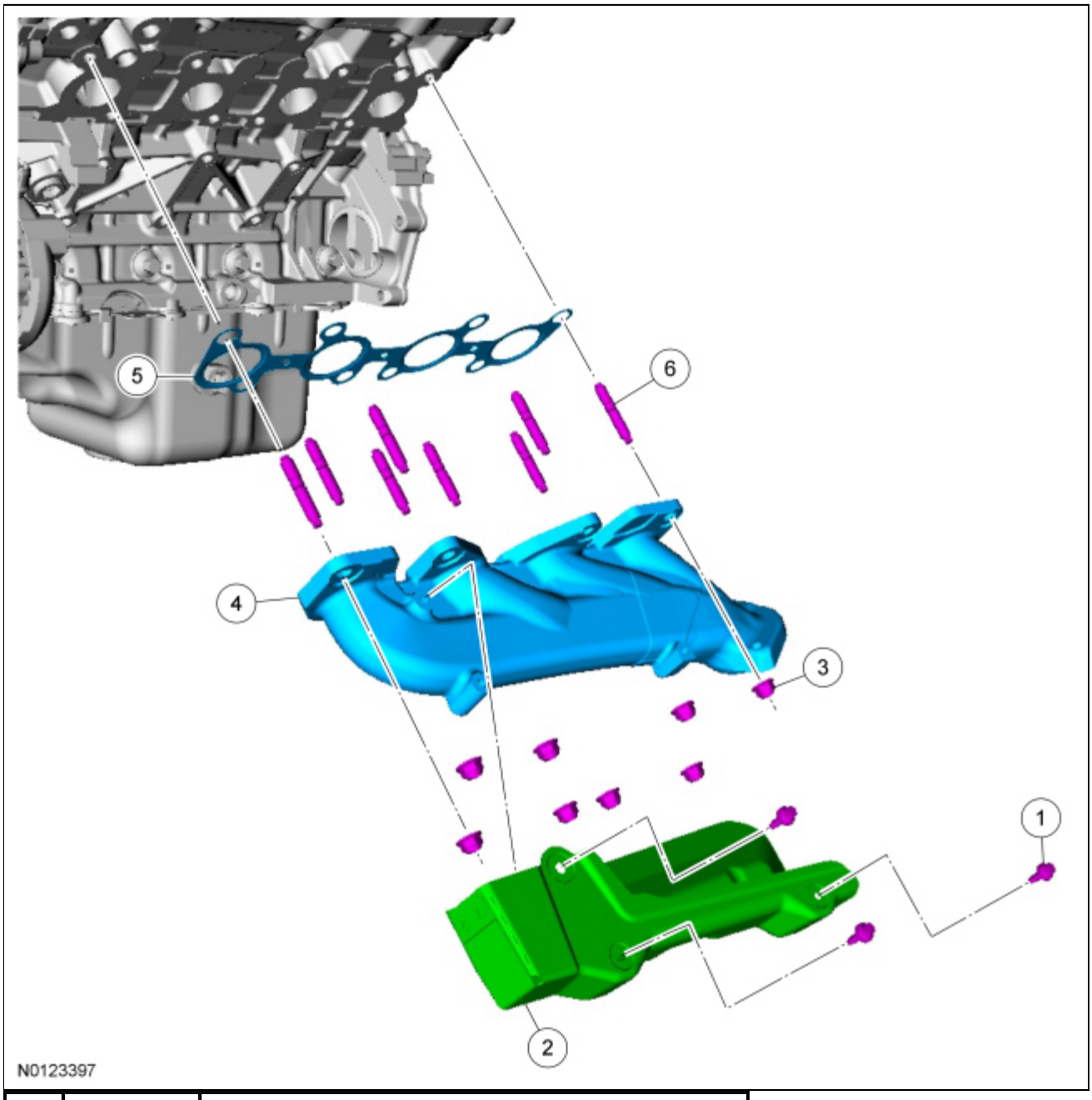


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Exhaust Manifold — LH

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—



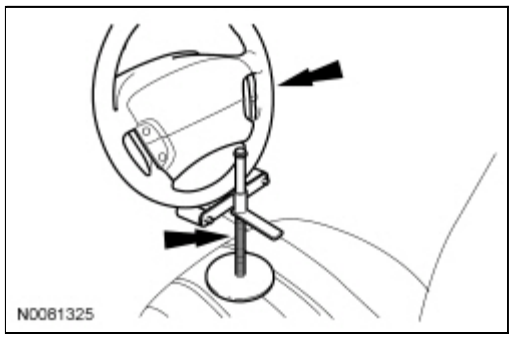
Item	Part Number	Description
1	W714133	LH exhaust manifold heat shield bolts (3 required) - 12 Nm (106 lb-in)
2	9Y427	LH exhaust manifold heat shield
3	W714870	LH exhaust manifold nuts (8 required)
4	9431	LH exhaust manifold
5	9448	LH exhaust manifold gasket
6	W714869	LH exhaust manifold studs (8 required) - 25 Nm (18 lb-ft)

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

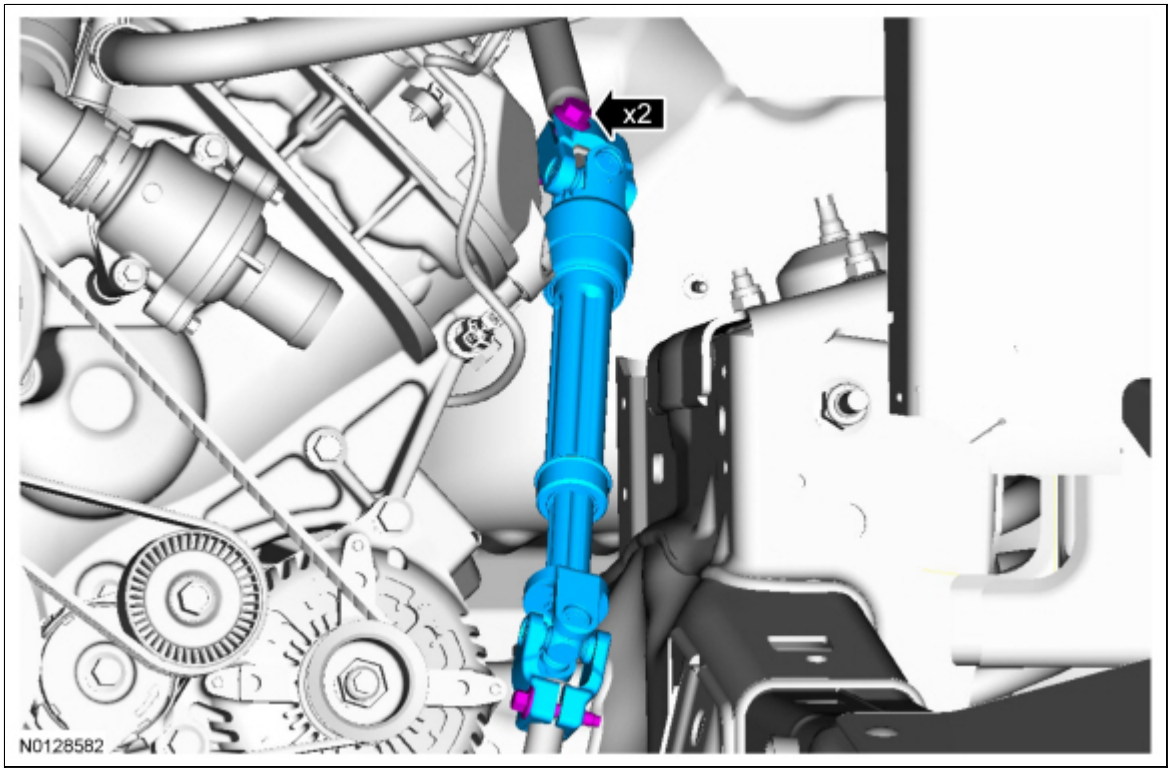
   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



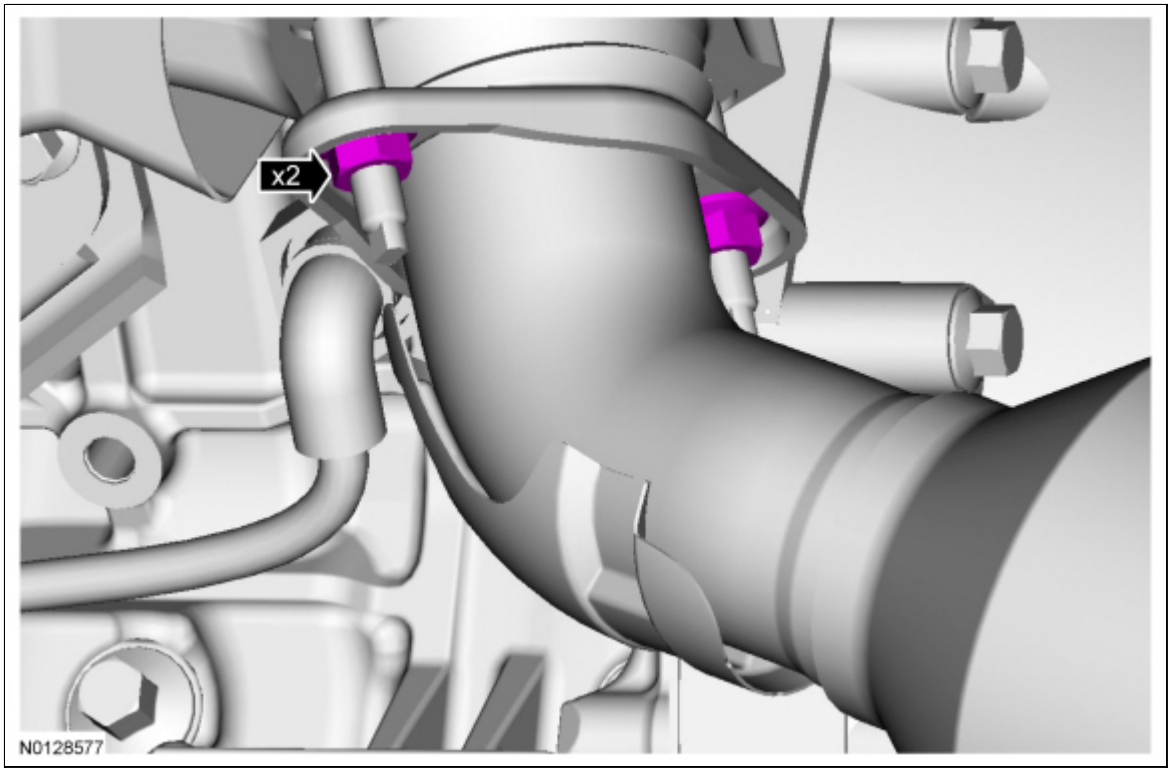
3. Remove the air cleaner outlet pipe and air cleaner cover as an assembly. For additional information, refer to Section 303-12 .

4. Remove the 2 bolts and remove the lower steering column shaft.

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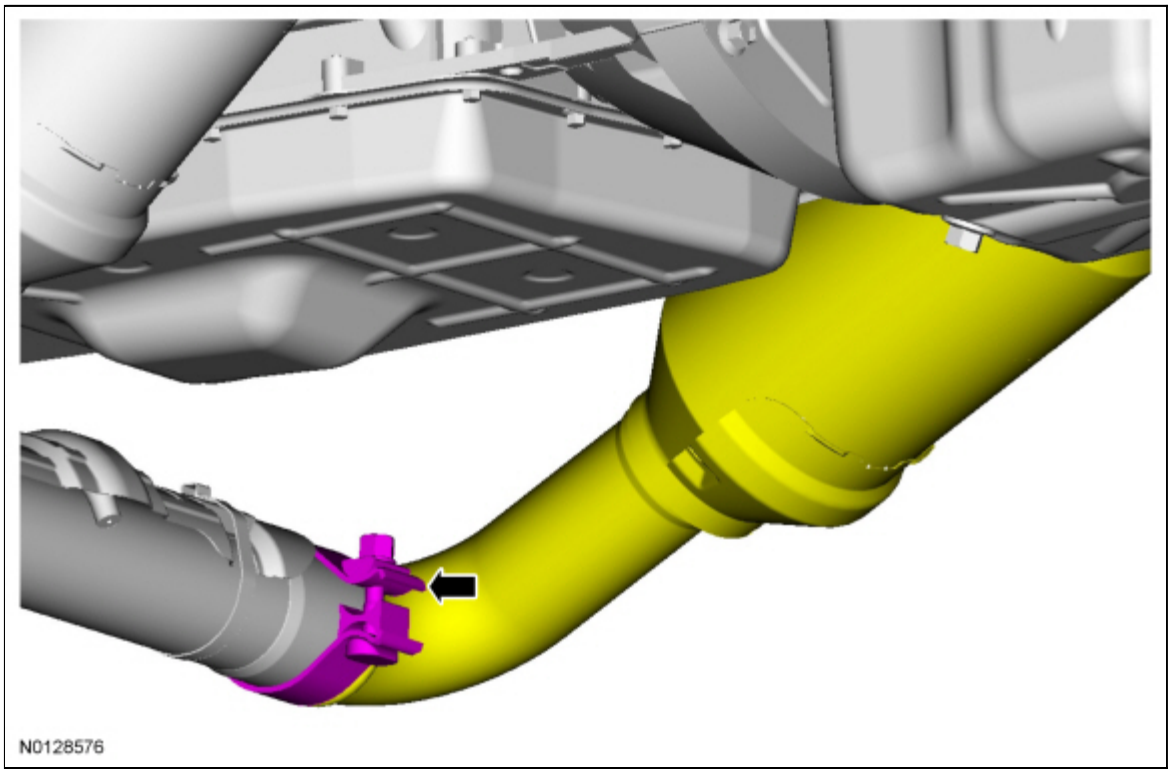


5. Remove the 3 bolts and the LH exhaust manifold heat shield.
6. Remove the 2 catalytic converter-to-LH exhaust manifold nuts.



7. Loosen the LH catalytic converter-to-RH catalytic converter Torca® clamp.

- Lower the catalytic converter to disengage the catalytic converter flange from the LH exhaust manifold studs.



8. Remove the 8 LH exhaust manifold nuts.

9. Working from under the hood, remove the LH exhaust manifold and gasket.
   - Discard the gasket.

10. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

11. Remove and discard the 8 LH exhaust manifold studs.

12. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.**

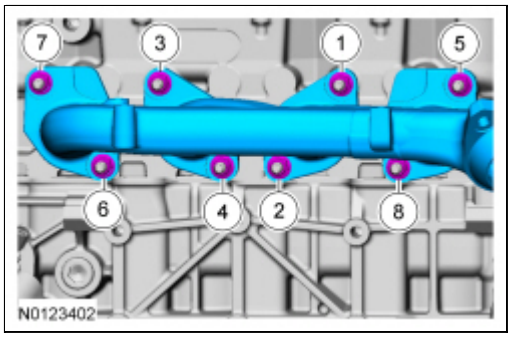
    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

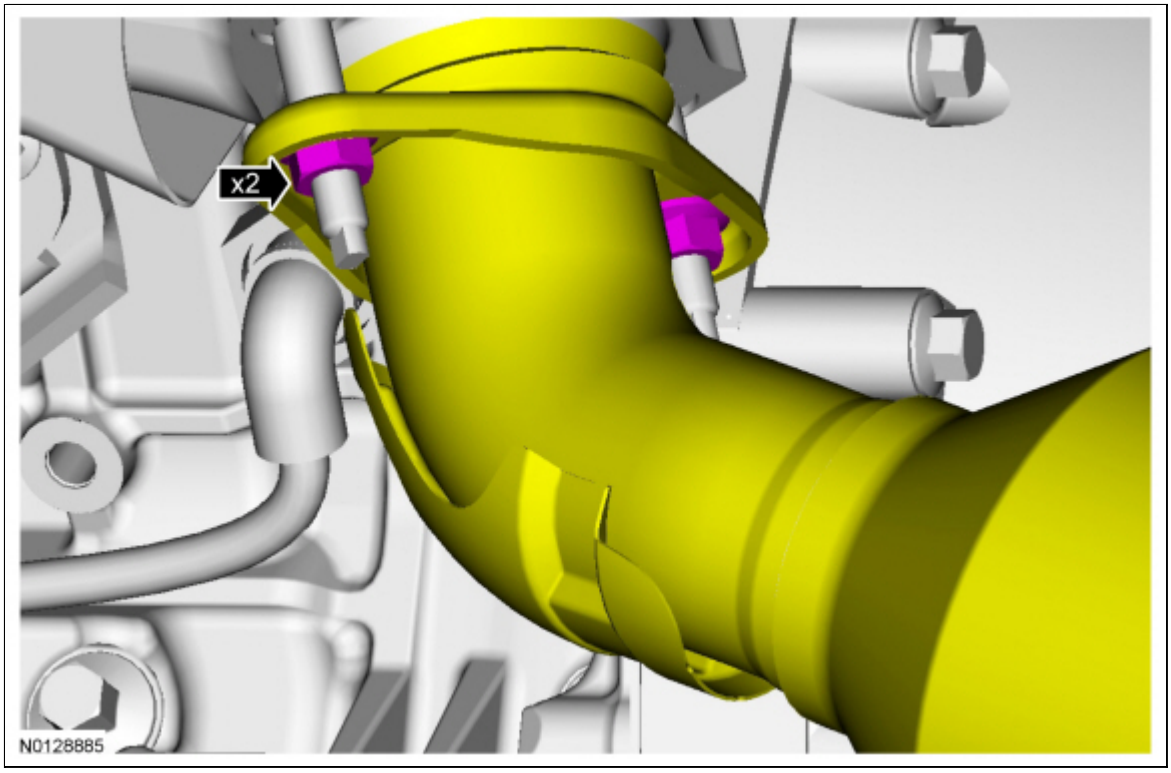
1. Install 8 new LH exhaust manifold studs.
   - Tighten to 25 Nm (18 lb-ft).

2. Install a new gasket, the LH exhaust manifold and 8 new nuts.
   - Tighten in the sequence shown in 2 stages.
     - Stage 1: Tighten to 24 Nm (18 lb-ft).
     - Stage 2: Tighten to 32 Nm (24 lb-ft).

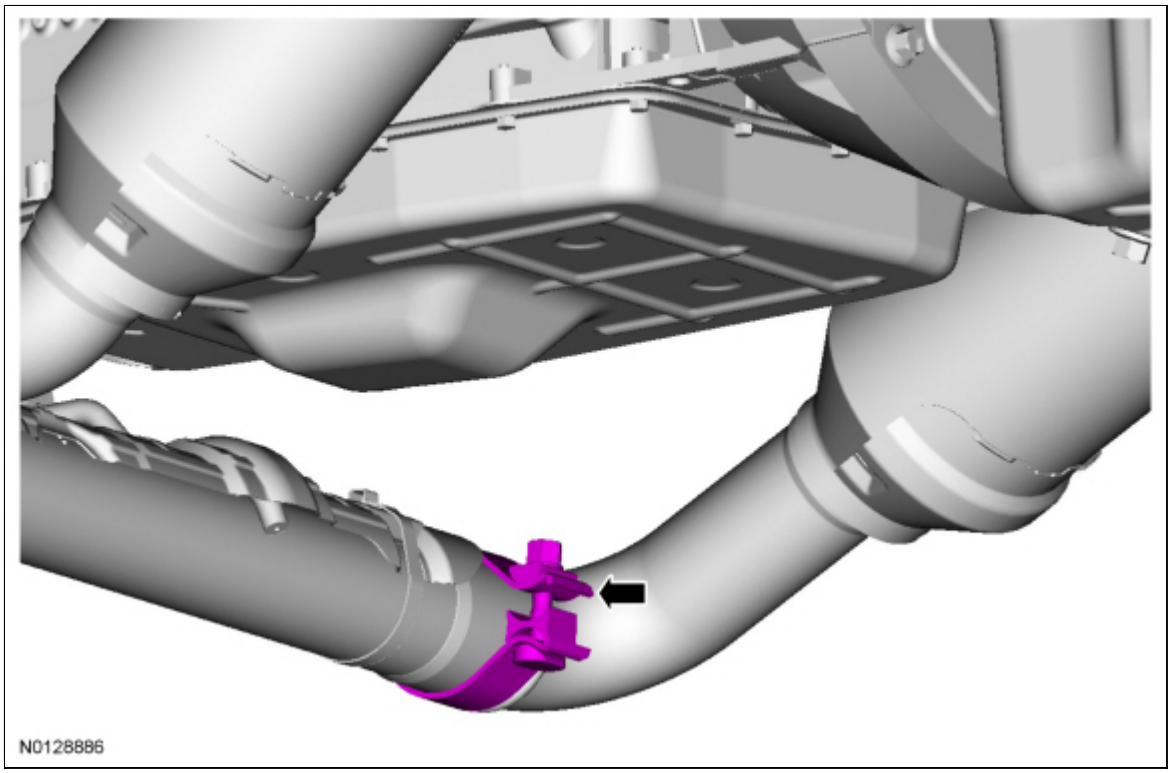
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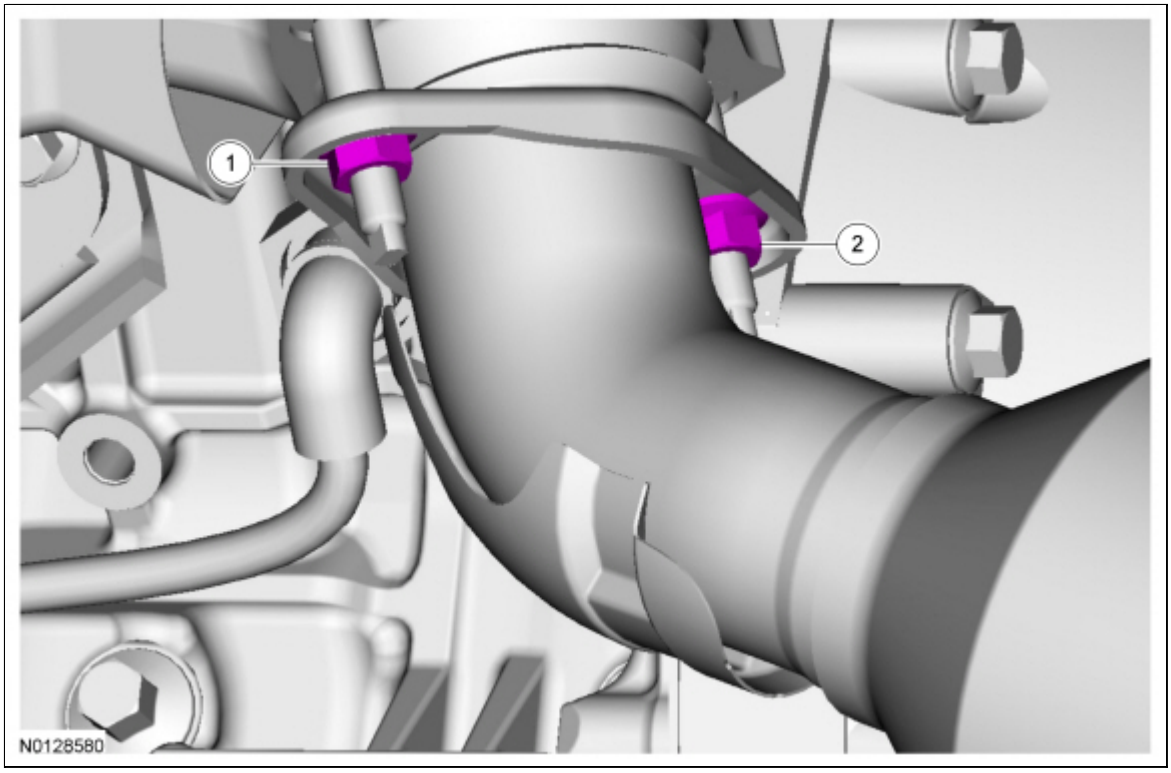
3. Position the LH catalytic converter onto the LH exhaust manifold and loosely install the 2 nuts.



4. Tighten the LH catalytic converter-to-RH catalytic converter Torca® clamp to 55 Nm (41 lb-ft).



5. Tighten the 2 new LH catalytic converter-to-exhaust manifold nuts in the following sequence.
    1. Tighten the LH outer catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).
    2. Tighten the LH inner catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).

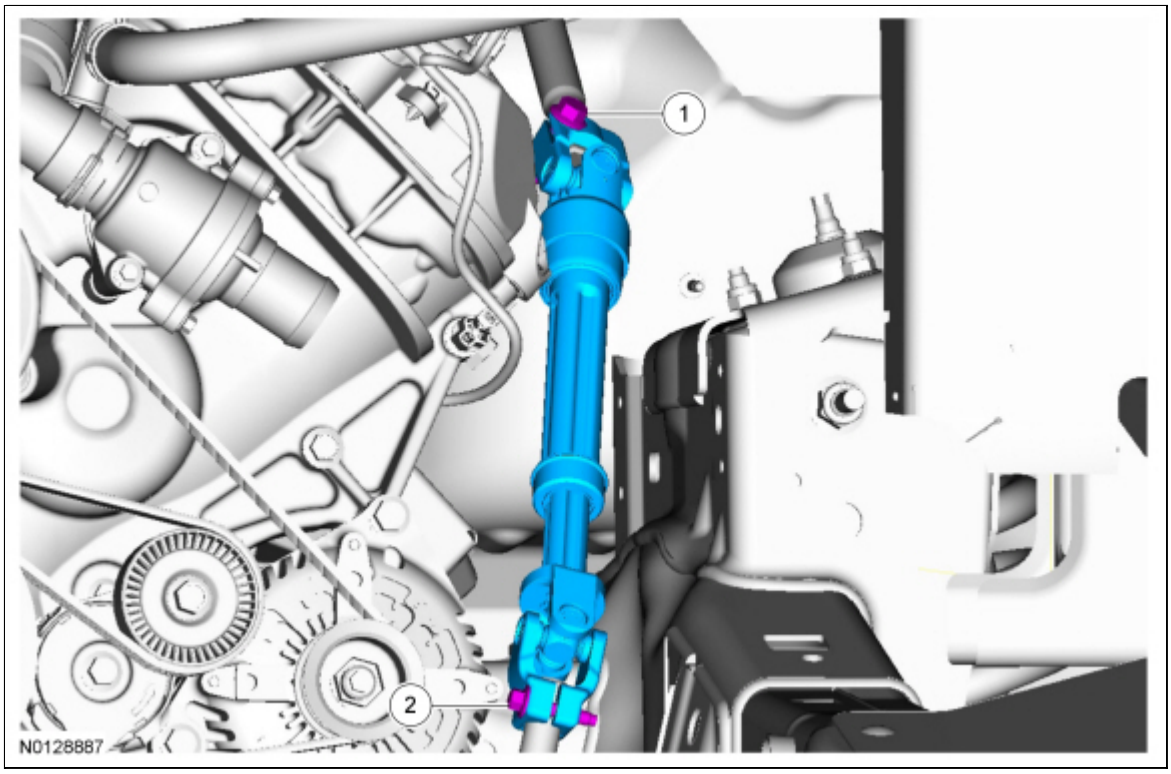


6. Install the LH exhaust manifold heat shield and the 3 bolts.

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- Tighten to 12 Nm (106 lb-in).

7. Install the lower steering column shaft and the 2 bolts.
    1. Tighten the upper bolt to 48 Nm (35 lb-ft).
    2. Tighten the lower bolt to 30 Nm (22 lb-ft).



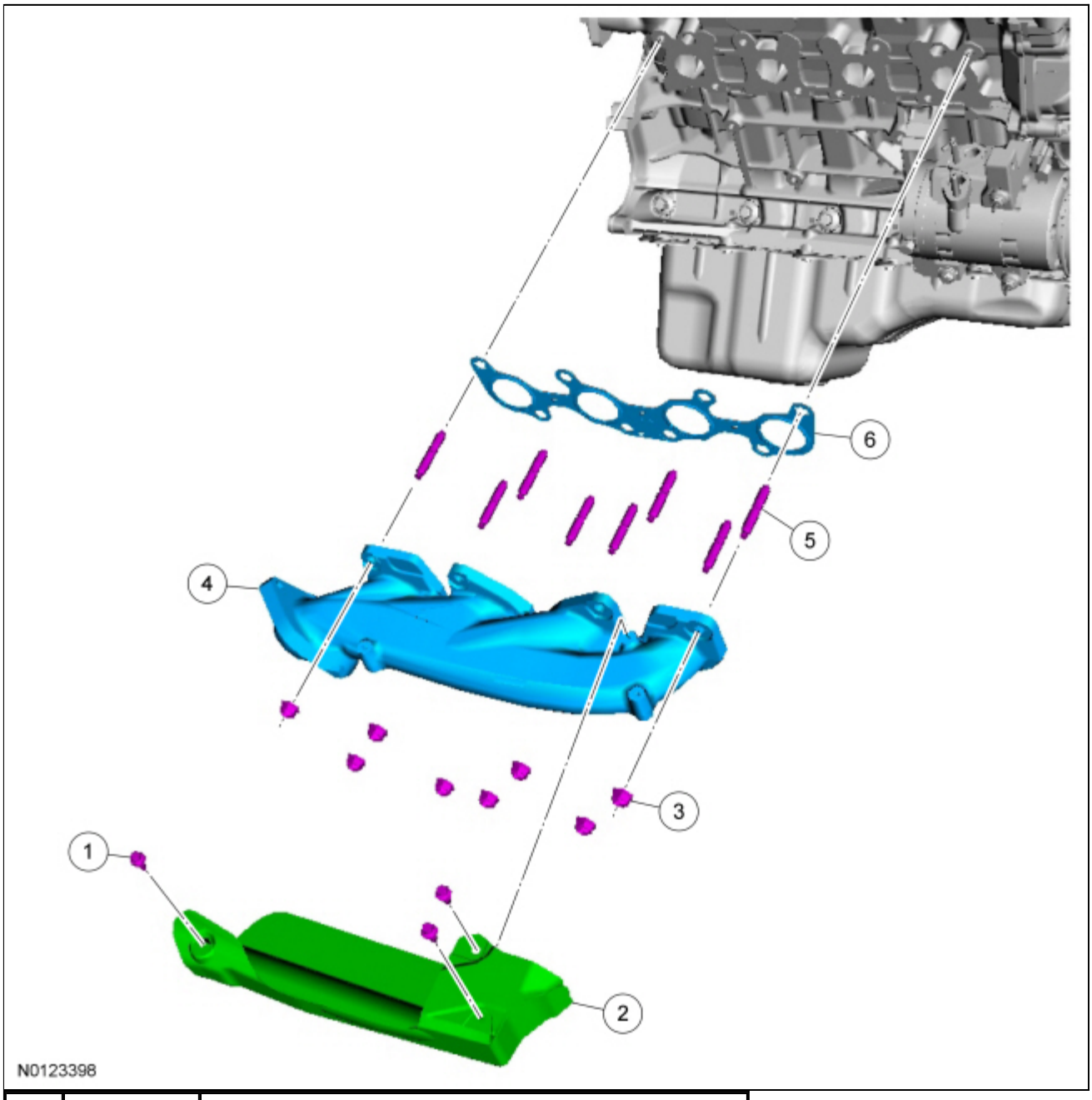
8. Install the air cleaner outlet pipe and air cleaner cover assembly. For additional information, refer to Section 303-12 .

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Exhaust Manifold — RH

Material

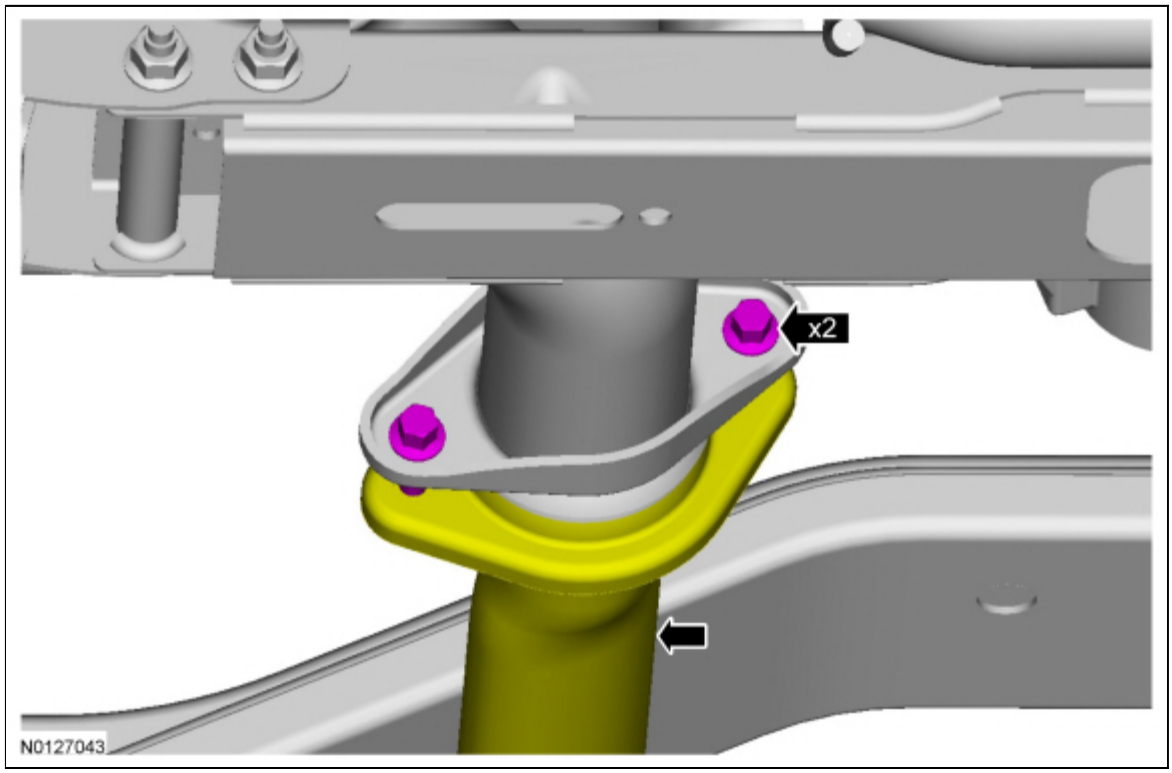
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—



Item	Part Number	Description
1	W714133	RH exhaust manifold heat shield bolts (3 required) - 12 Nm (106 lb-in)
2	9A462	RH exhaust manifold heat shield
3	W714870	RH exhaust manifold nuts (8 required)
4	9430	RH exhaust manifold
5	W714869	RH exhaust manifold studs (8 required) - 25 Nm (18 lb-ft)
6	9448	RH exhaust manifold gasket

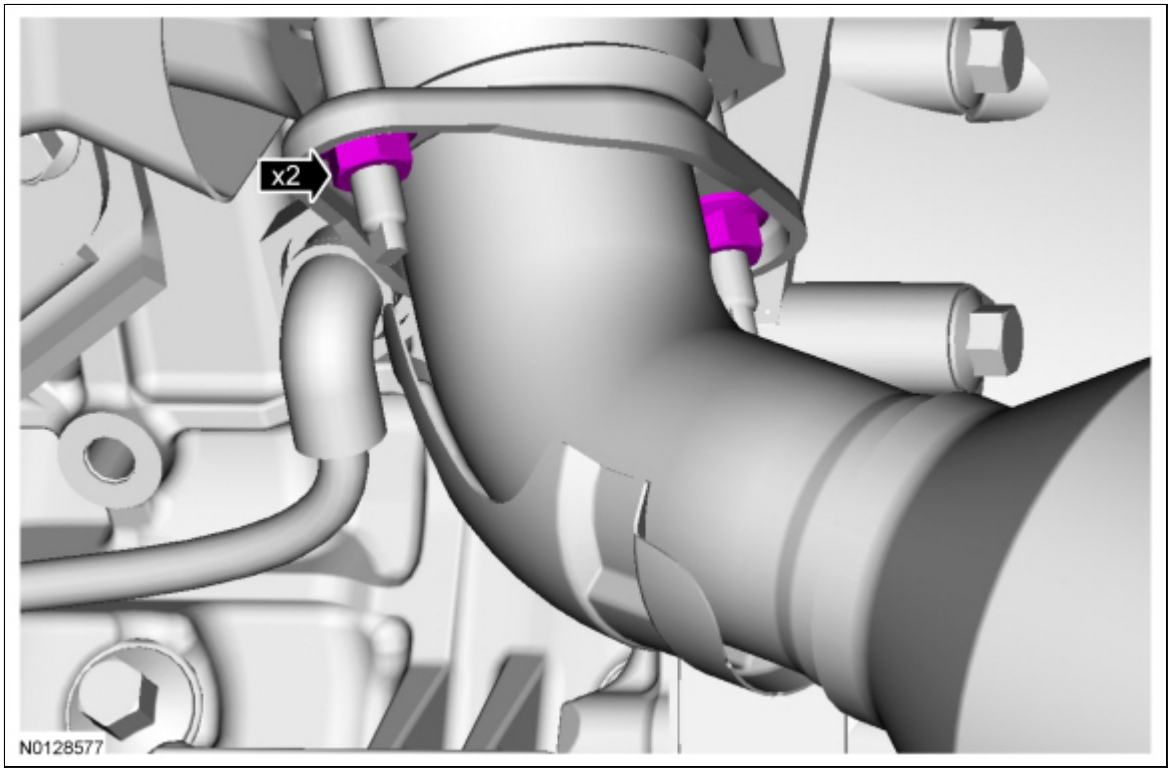
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the A/C compressor. For additional information, refer to Section 412-01 .
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
4. Remove the 3 bolts and the RH exhaust manifold heat shield.
5. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
   - Discard the bolts.

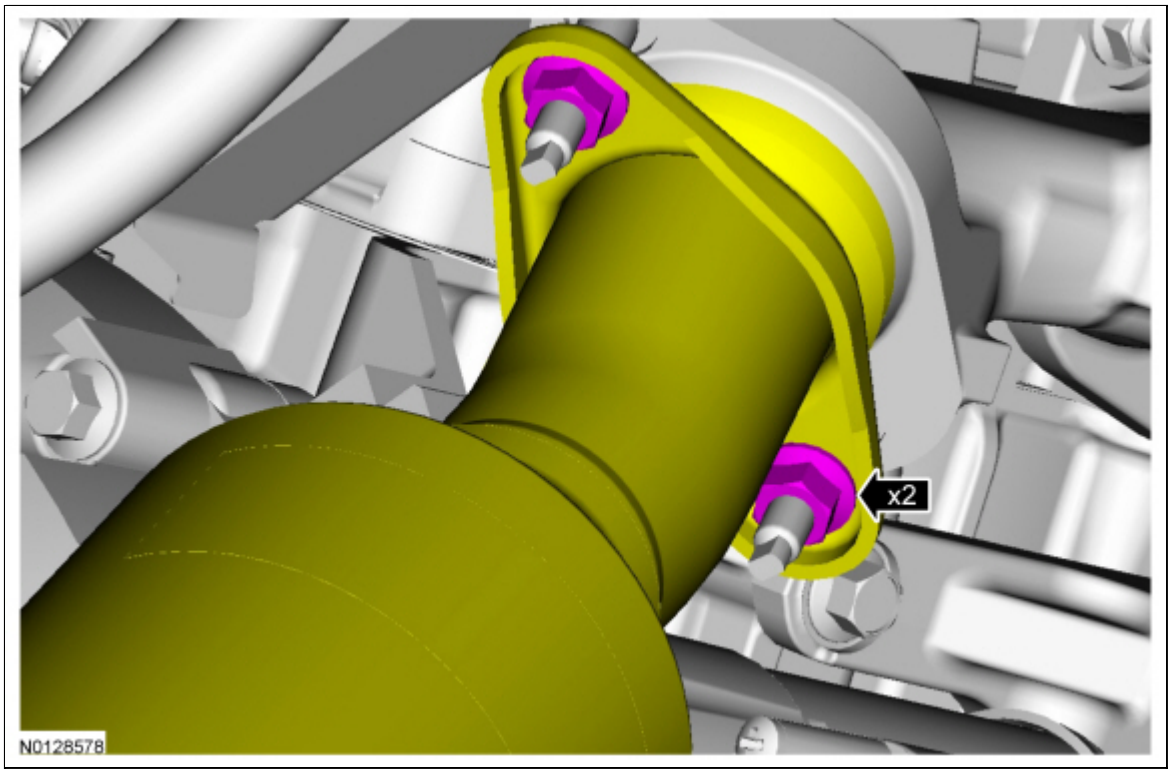


6. Remove the 2 catalytic converter-to-LH exhaust manifold nuts.

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7. Remove the 2 catalytic converter-to-RH exhaust manifold nuts.
    - Separate the exhaust Y-pipe dual catalytic converter from the exhaust manifolds.



8. Remove the 4 lower RH exhaust manifold nuts.

9. Remove the 4 top RH exhaust manifold nuts.
    - Remove and discard the 4 top RH exhaust manifold studs.

10. Working from under the hood, remove the RH exhaust manifold and gasket.
    - Discard the gasket.

11. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

12. Remove and discard the 4 lower RH exhaust manifold studs.

13. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.**

    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

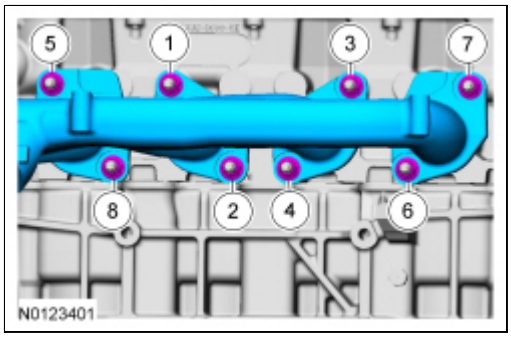
1. Install 4 new lower RH exhaust manifold studs.
    - Tighten to 25 Nm (18 lb-ft).

2. Install a new gasket, the RH exhaust manifold and 4 new lower exhaust manifold nuts.
    - Do not tighten the nuts at this time.

3. Install 4 new upper RH exhaust manifold studs.
    - Tighten to 25 Nm (18 lb-ft).

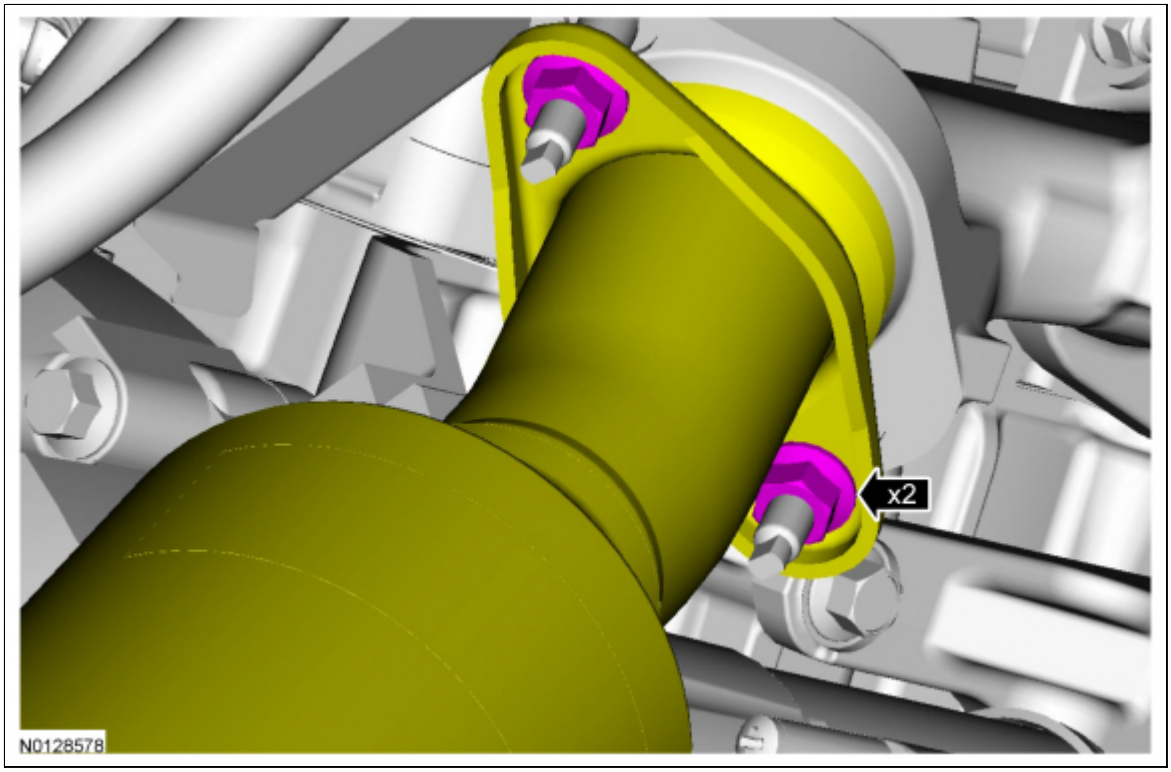
4. Install 4 new upper RH exhaust manifold nuts.
    - Do not tighten the nuts at this time.

5. Tighten the nuts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 24 Nm (18 lb-ft).
    - Stage 2: Tighten to 32 Nm (24 lb-ft).

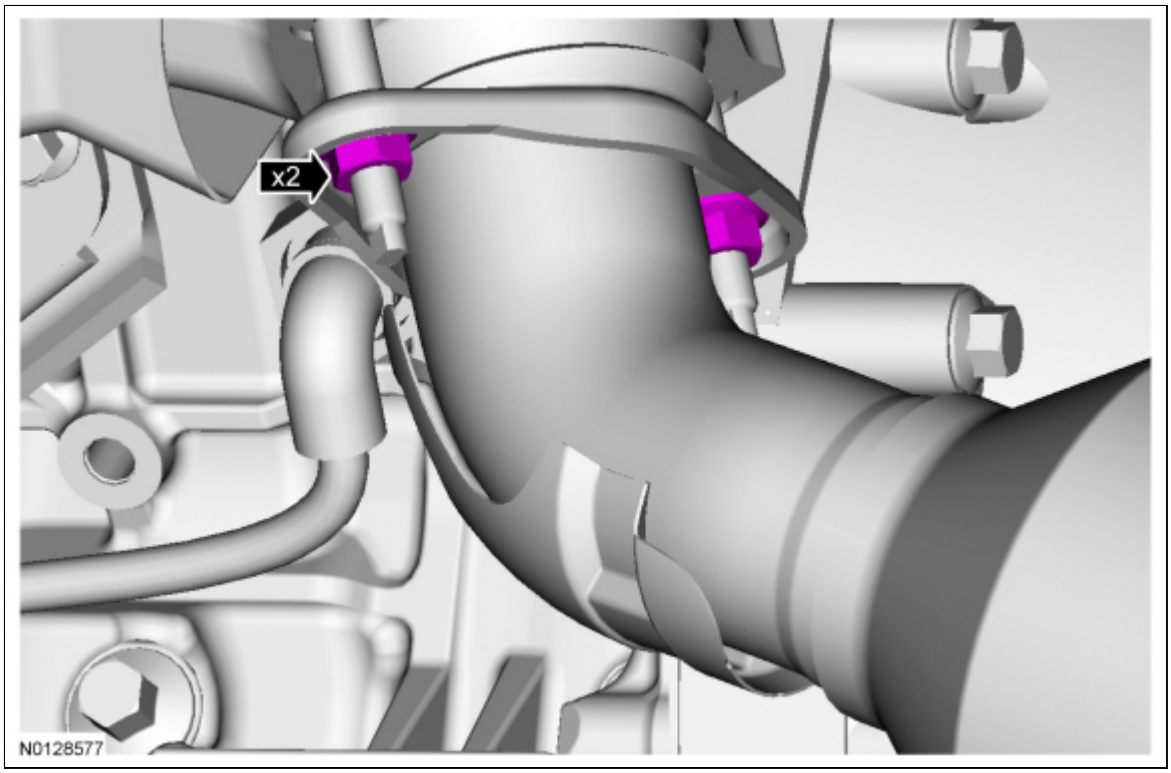


6. Position the exhaust Y-pipe dual catalytic converter onto the exhaust manifolds and loosely install 2 new RH catalytic converter-to-exhaust manifold nuts.

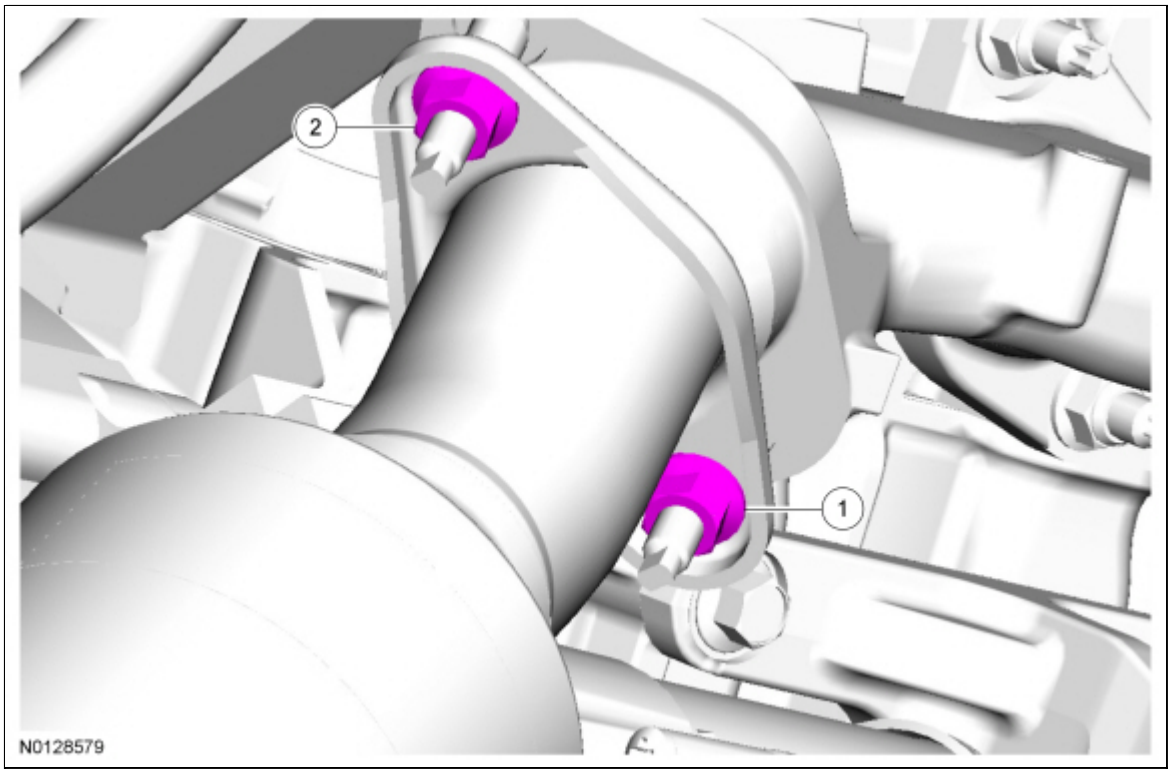
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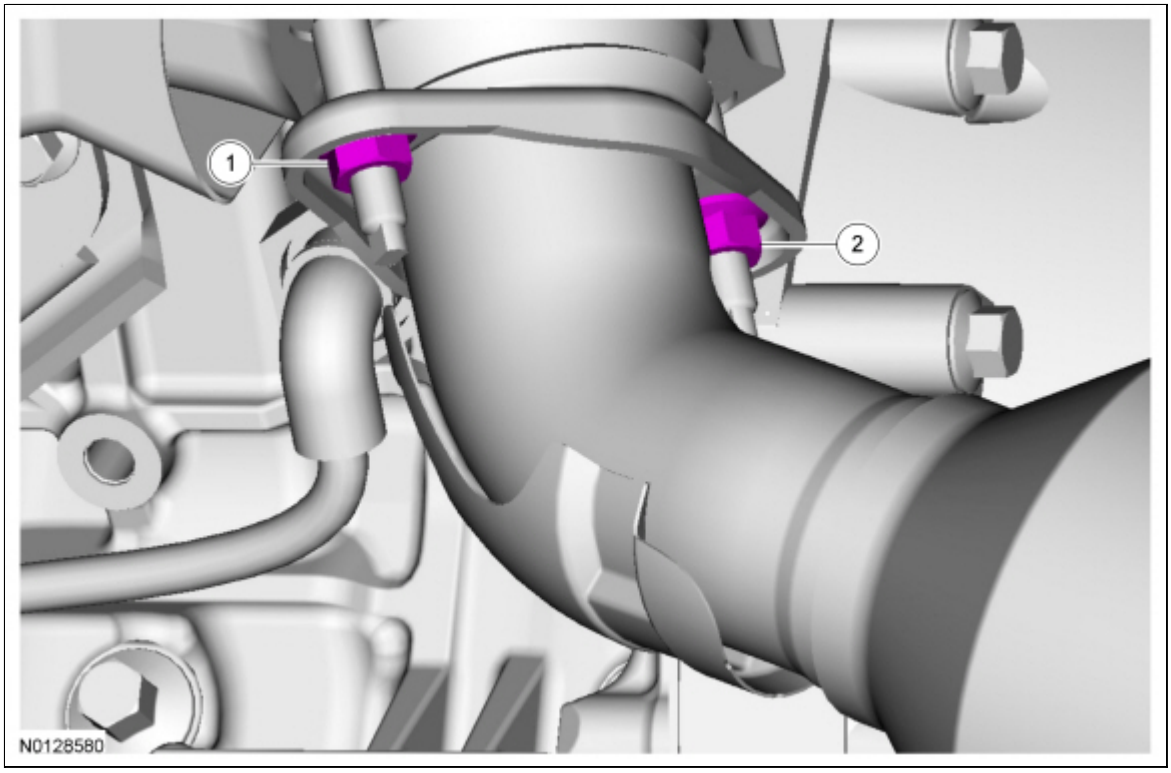
7. Loosely install 2 new LH catalytic converter-to-exhaust manifold nuts.



8. Tighten the 2 new RH catalytic converter-to-exhaust manifold nuts in the following sequence.
    1. Tighten the RH lower catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).
    2. Tighten the RH upper catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).



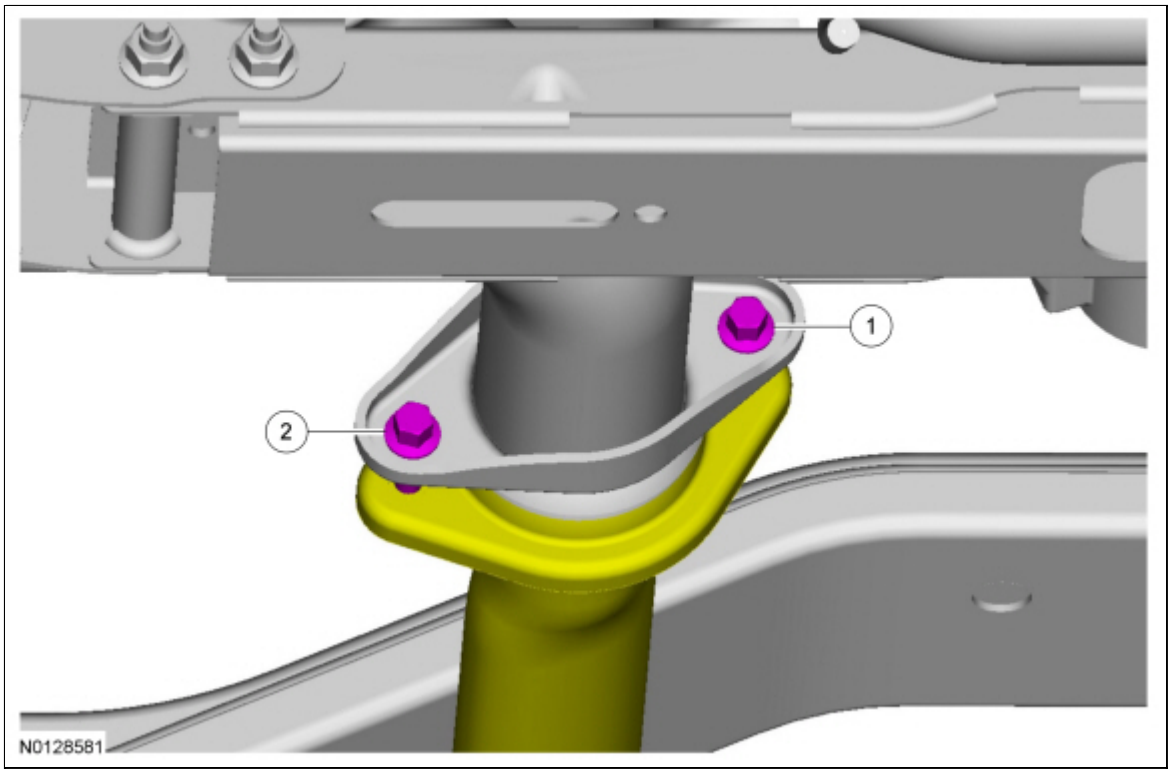
9. Tighten the 2 new LH catalytic converter-to-exhaust manifold nuts in the following sequence.
    1. Tighten the LH outer catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).
    2. Tighten the LH inner catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).



10. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.

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1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



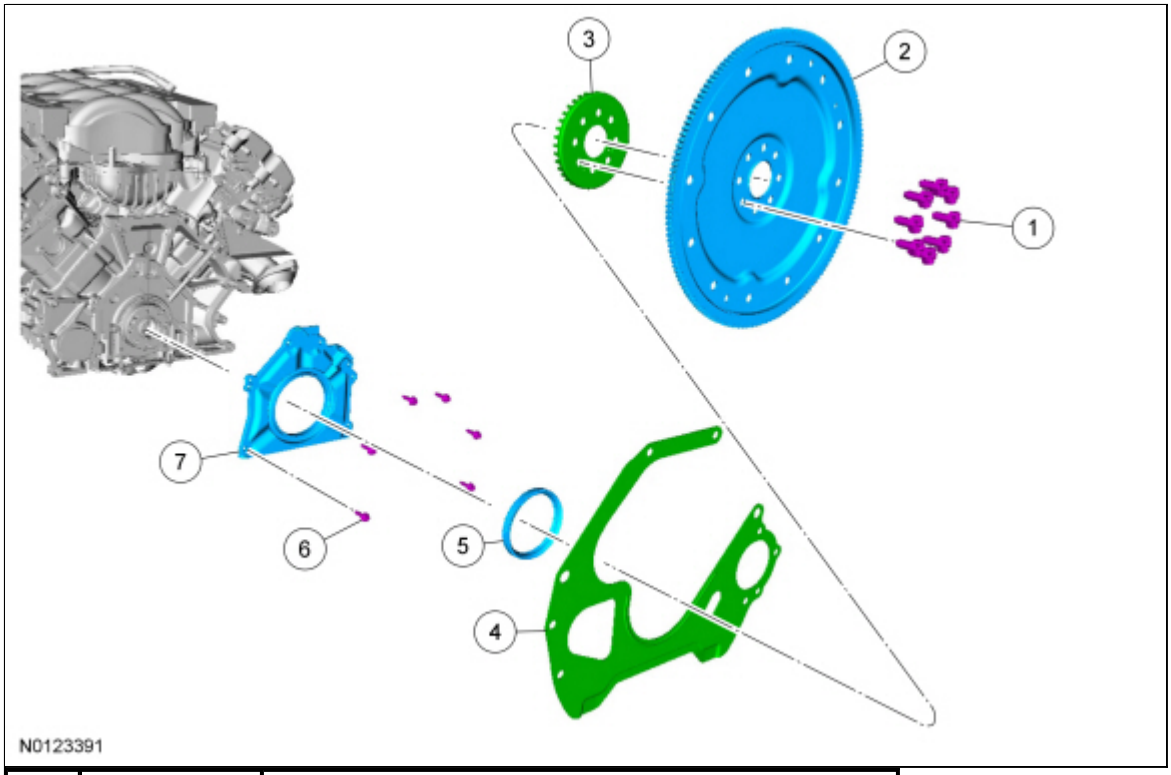
11. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).

12. Connect the battery ground cable. For additional information, refer to Section 414-01 .

13. Install the A/C compressor. For additional information, refer to Section 412-01 .

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Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View



Item	Part Number	Description
1	6379	Flexplate bolt (8 required)
2	6375	Flexplate
3	12A227	Crankshaft sensor ring
4	6A373	Separator plate
5	6701	Crankshaft rear seal
6	W714962	Crankshaft rear seal retainer plate bolt (6 required)
7	6K318	Crankshaft rear seal retainer plate

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Flexplate

Special Tool(s)

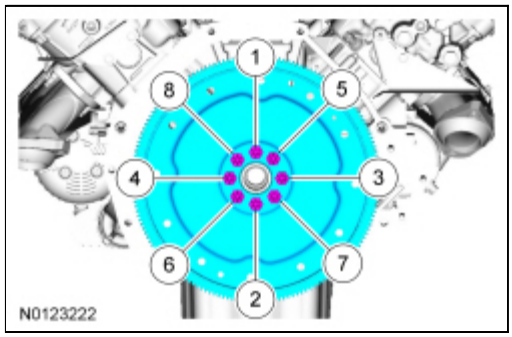
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal and Installation

1. Remove the transmission. For additional information, refer to Section 307-01 .

2. **NOTE:** The flexplate bolts are torque-to-yield design and are not reusable.

   Remove the 8 bolts and the flexplate.
   - Discard the bolts.
   - To install, tighten in the sequence shown in 2 stages.
     - Stage 1: Tighten to 20 Nm (177 lb-in).
     - Stage 2: Tighten an additional 60 degrees.



3. To install, reverse the removal procedure.
   - After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

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Hydraulic Lash Adjuster

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the hydraulic lash adjuster being serviced. For additional information, refer to Camshaft — RH and/or Camshaft — LH in this section.

2. Remove the camshaft roller follower and hydraulic lash adjuster as an assembly.

3. Separate the hydraulic lash adjuster from the spring clip on the camshaft roller follower.

4. To install, reverse the removal procedure.
   - Lubricate the camshaft roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.

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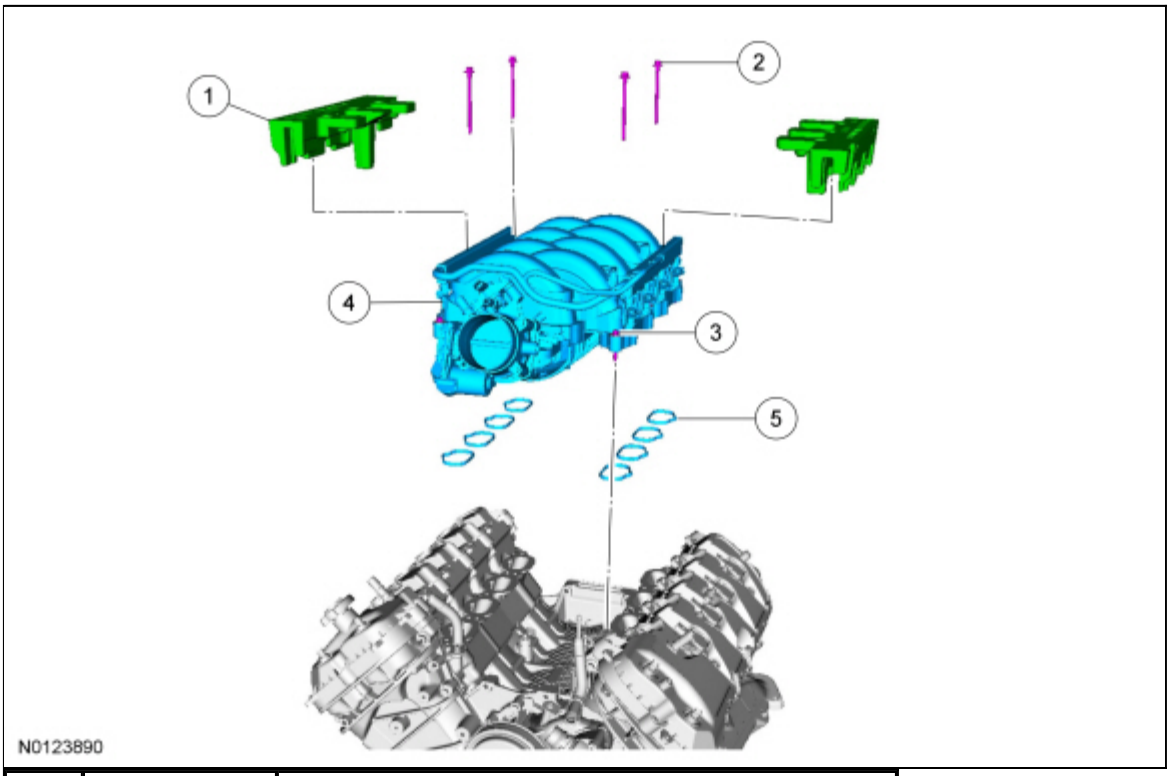
Intake Manifold

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



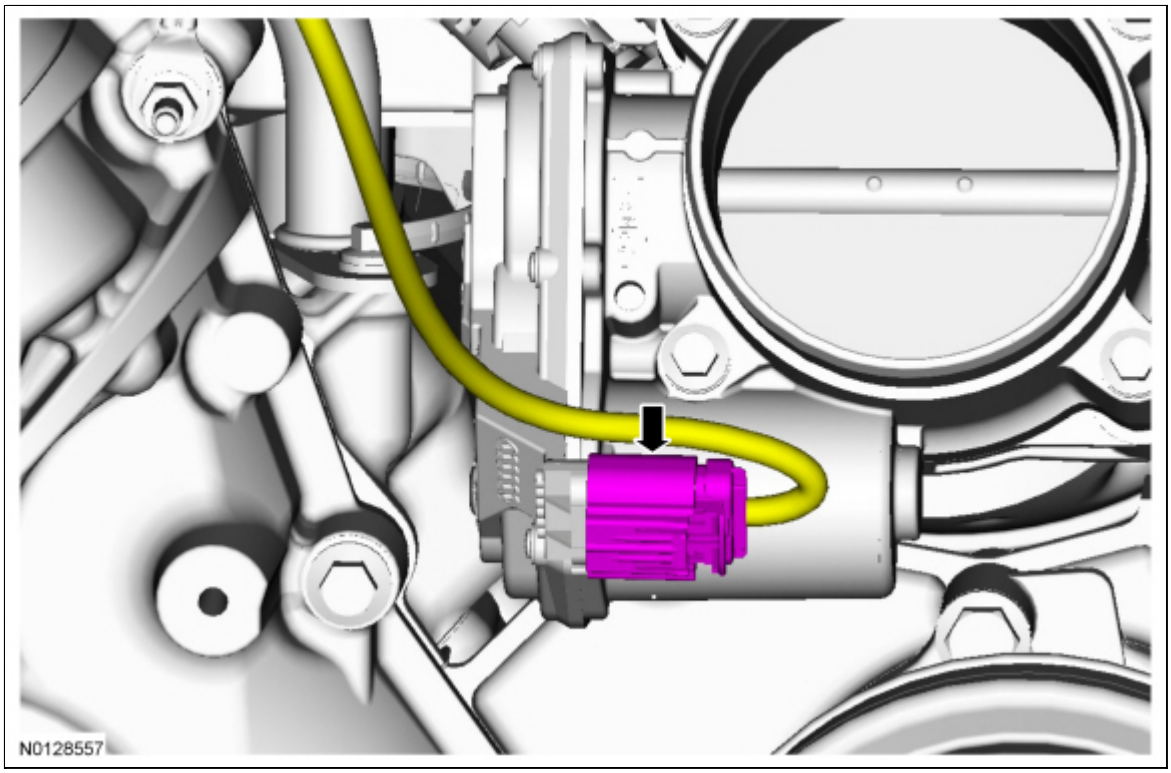
Item	Part Number	Description
1	6P013	Fuel rail insulator (2 required)
2	W714864	Fuel rail bolt (4 required)
3	9Y450	Intake manifold bolt (part of 9424) (6 required)
4	9424	Intake manifold
5	9439	Intake manifold gasket

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

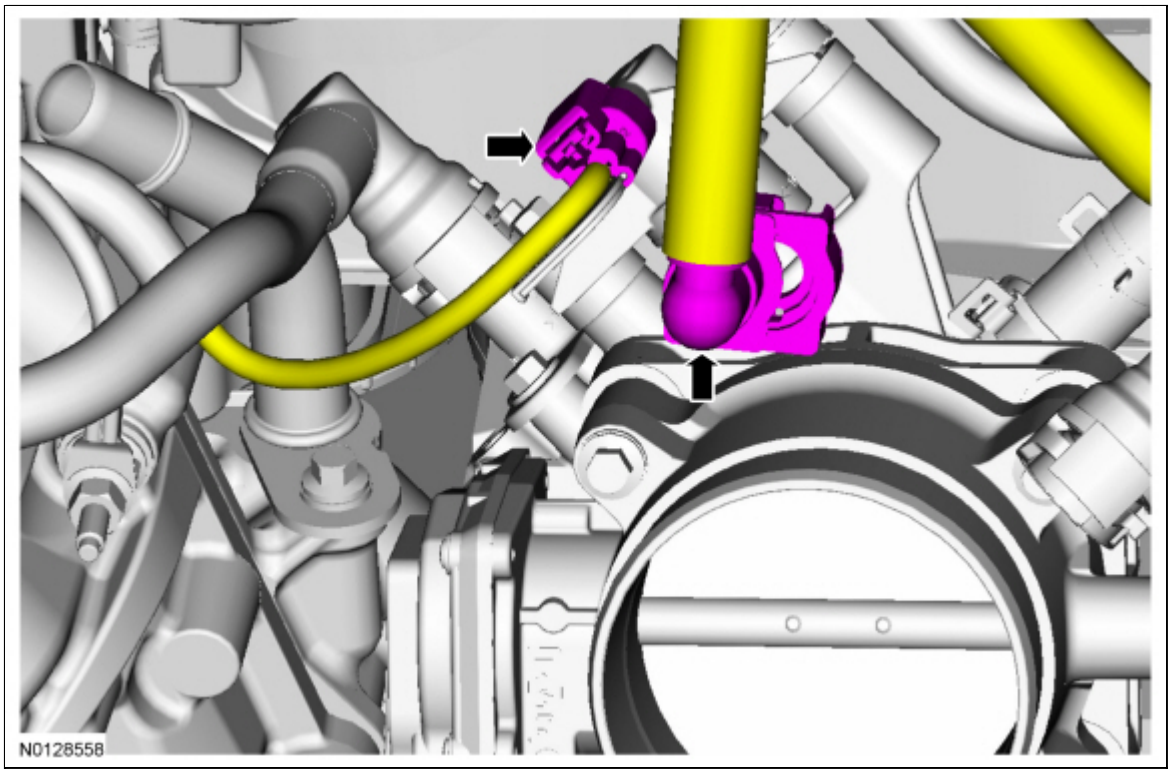
WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
3. Disconnect the Throttle Body (TB) electrical connector.

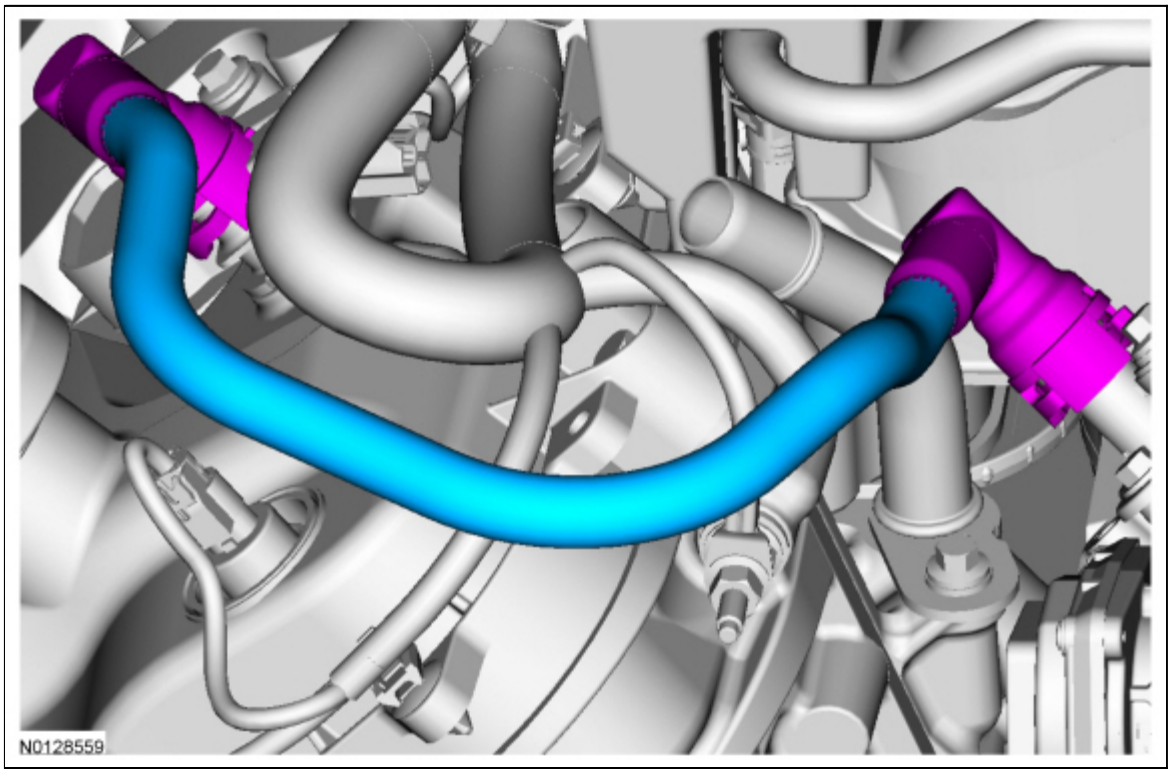


4. Disconnect the Evaporative Emission (EVAP) canister purge valve tube and electrical connector. For additional information, refer to the quick connect coupling procedure in Section 310-00 .
   - Detach the EVAP tube retainer from the fuel rail.

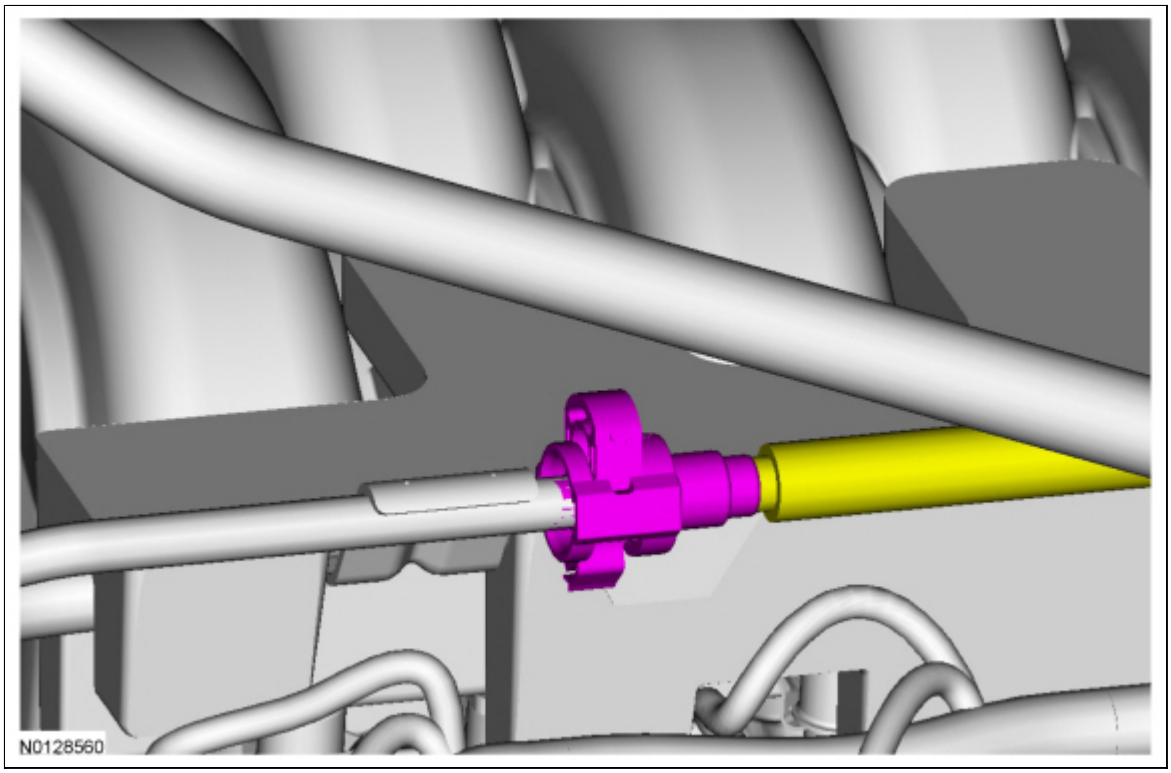
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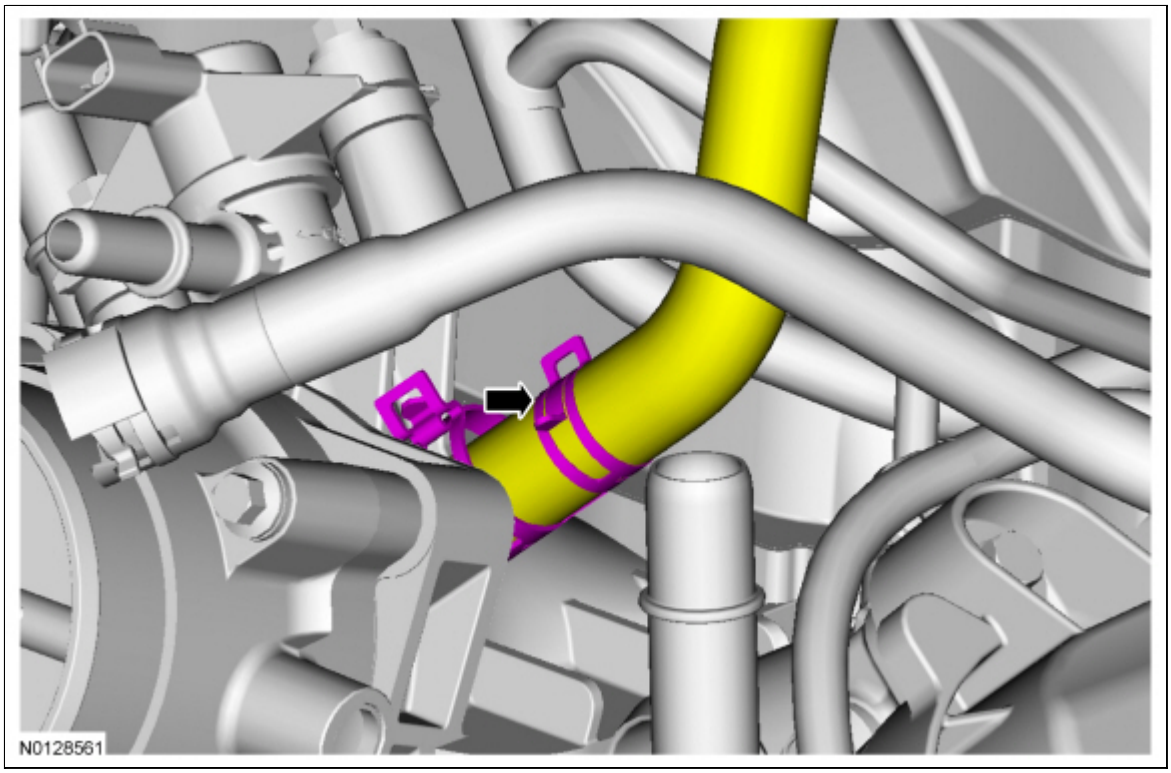
5. Remove the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .



6. Disconnect the fuel supply tube. For additional information refer to the quick connect procedure in Section 310-00 .

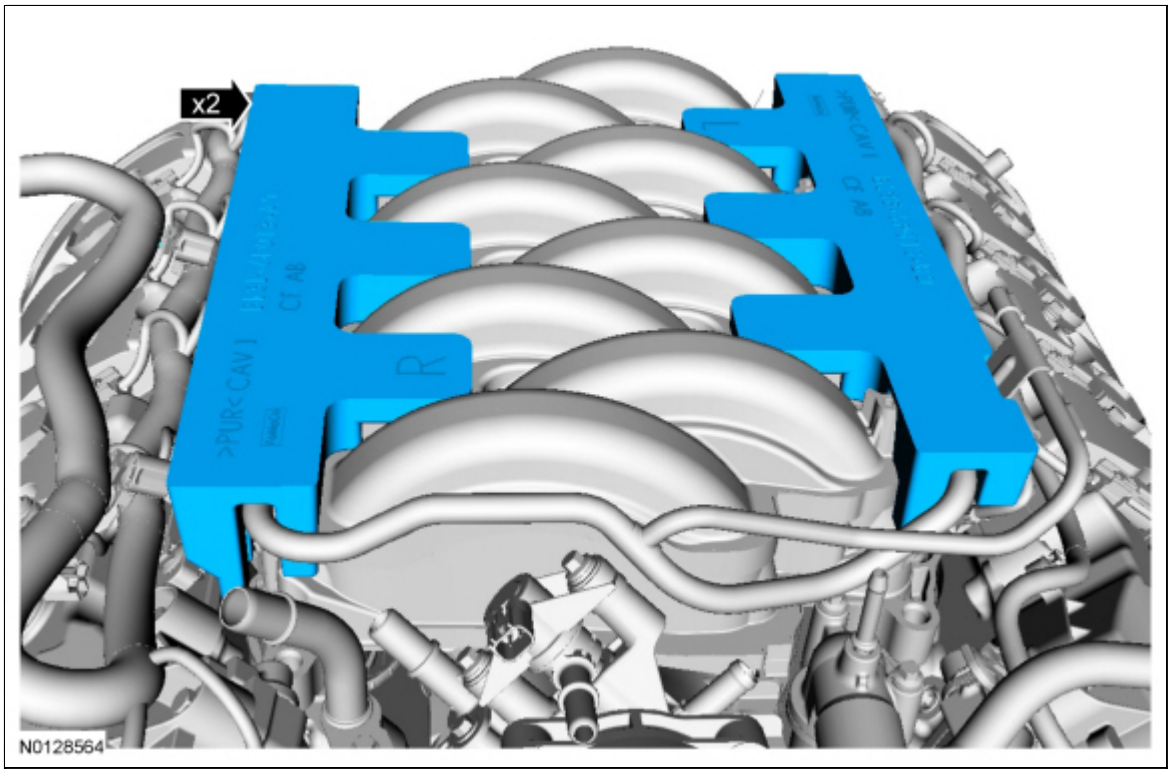


7. Release the clamp and disconnect the vacuum tube from the intake manifold.



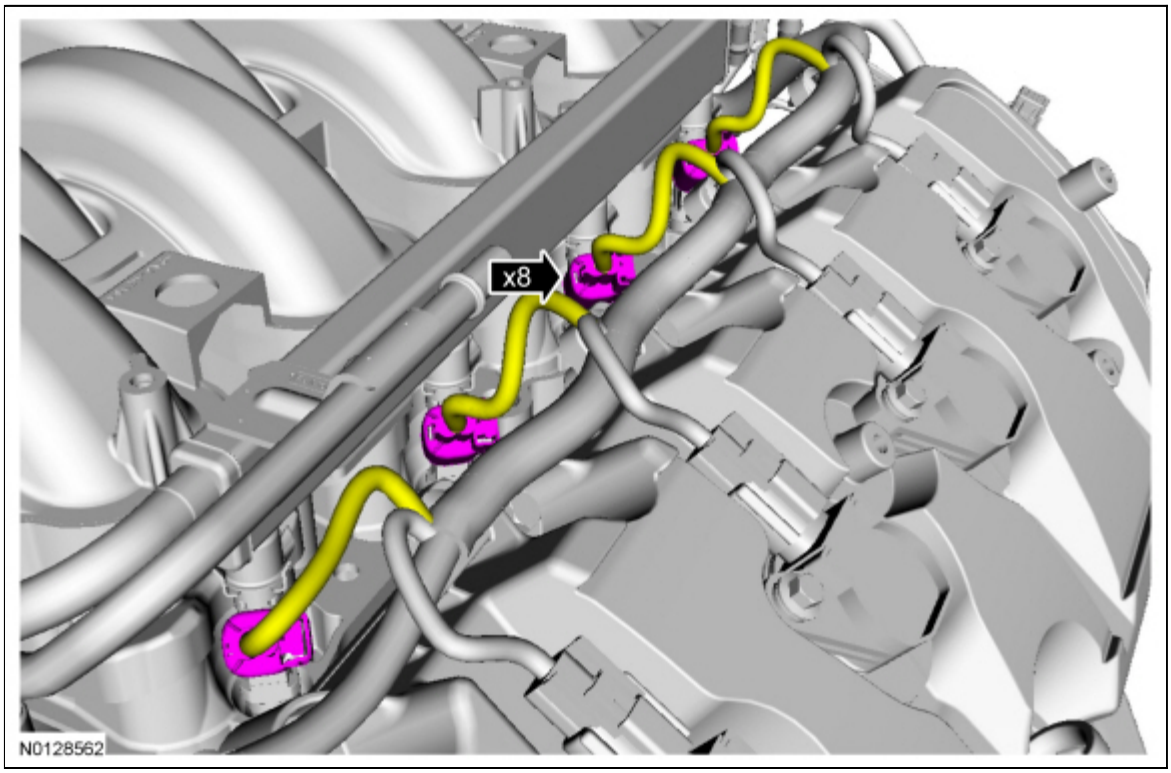
8. Remove the LH and RH fuel rail insulators.

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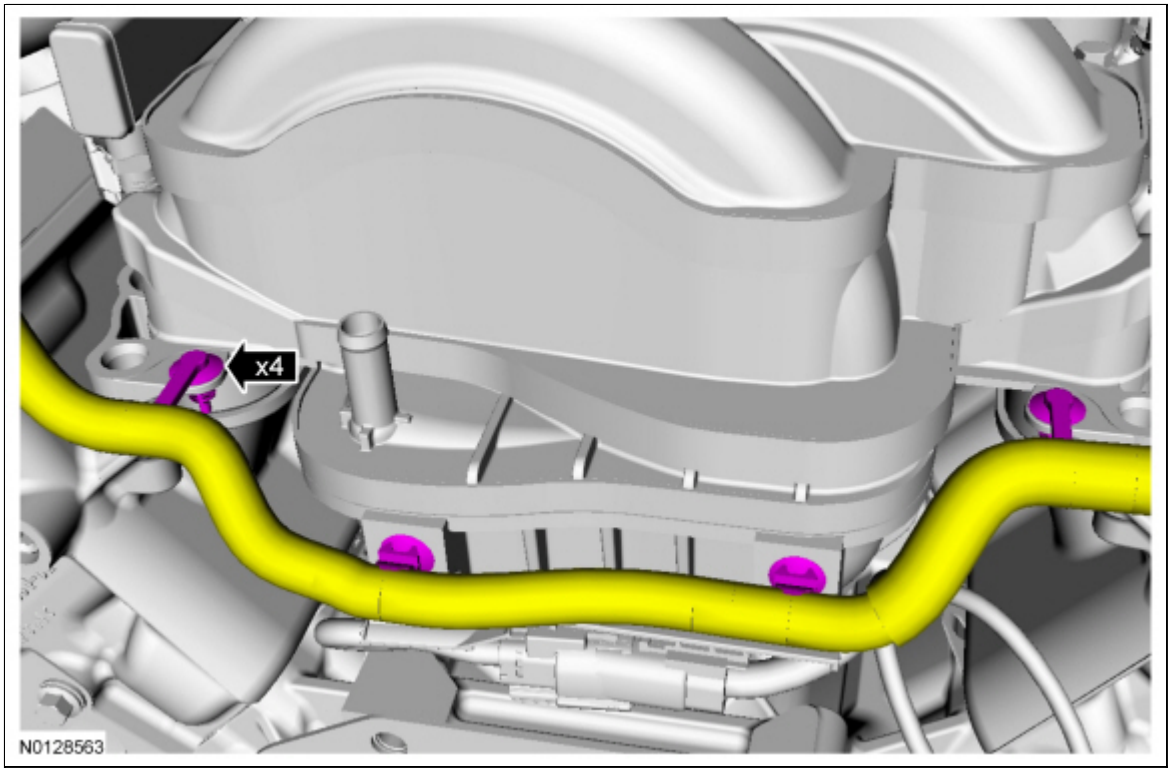


9. **NOTE:** The 4 LH fuel injector electrical connectors are shown, the 4 RH fuel injector electrical connectors are similar.

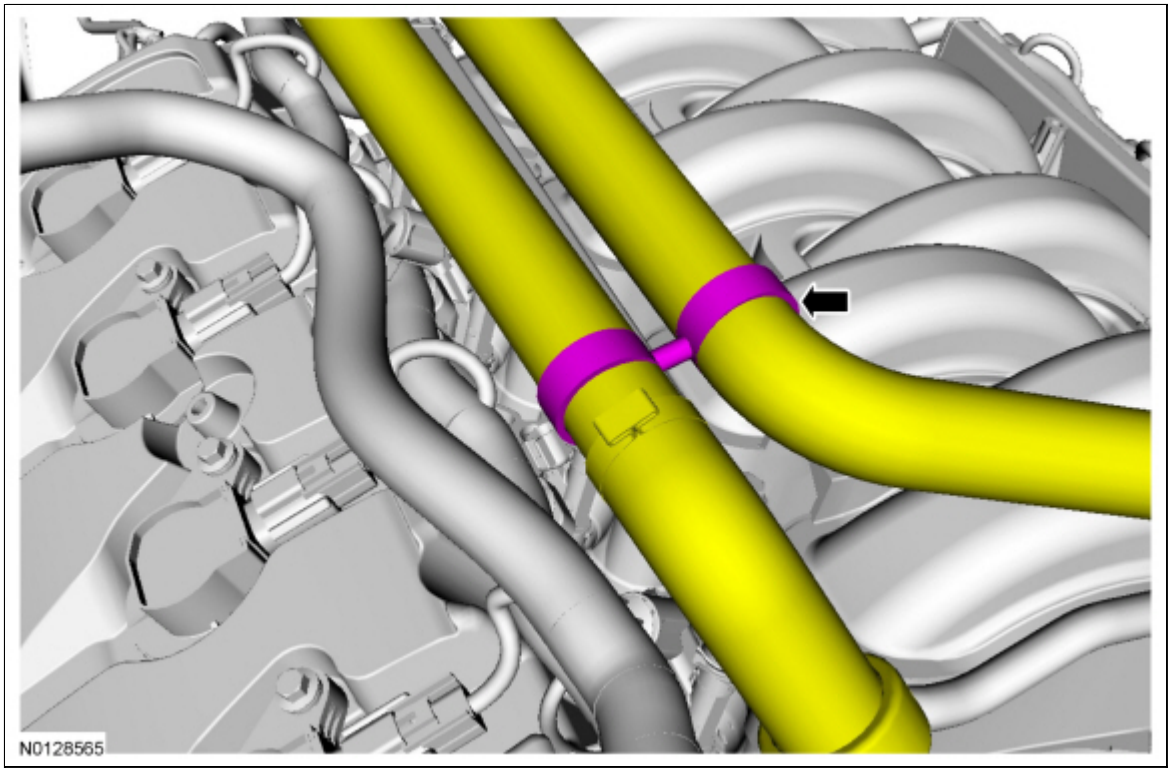
   Disconnect the 8 fuel injector electrical connectors.



10. Detach the 4 wiring harness retainers from the rear of the intake manifold.



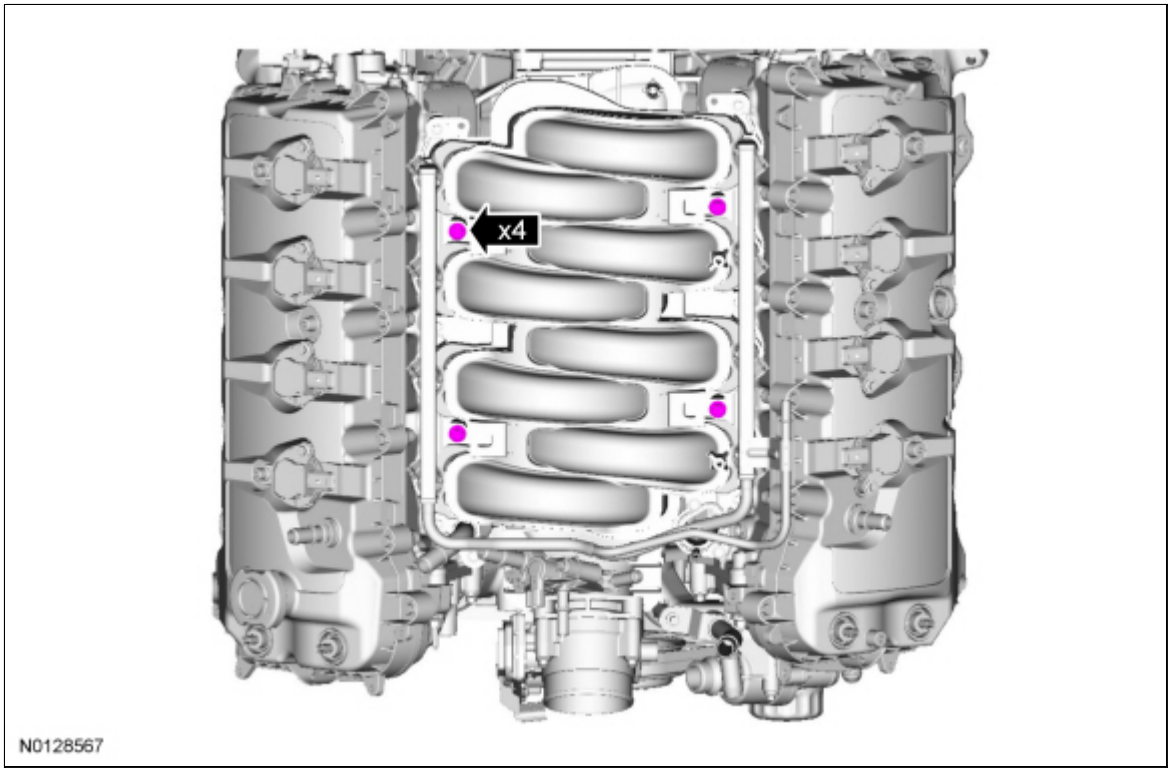
11. Detach the heater hose retainer and position the heater hose aside.



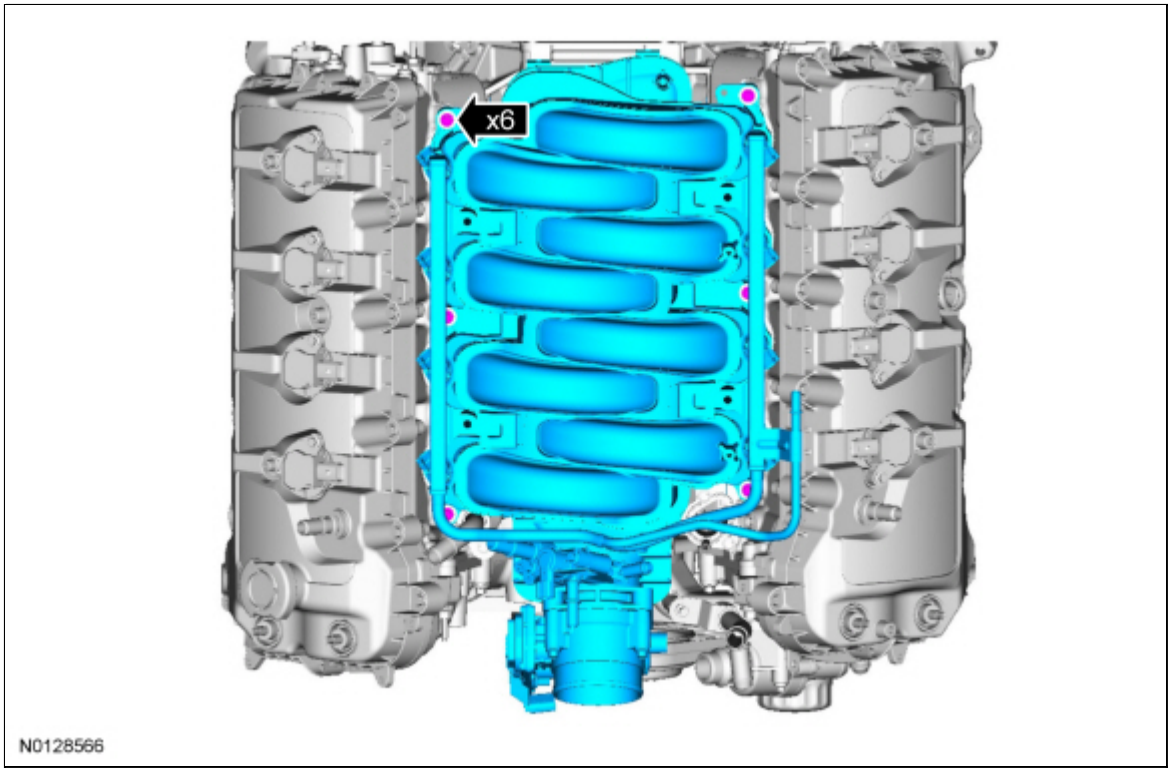
12. **NOTE:** It is not necessary to remove the fuel rail from the intake manifold assembly.

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Remove the 4 fuel rail bolts.



13. Loosen the 6 bolts and remove the intake manifold.
    - Discard the gaskets.

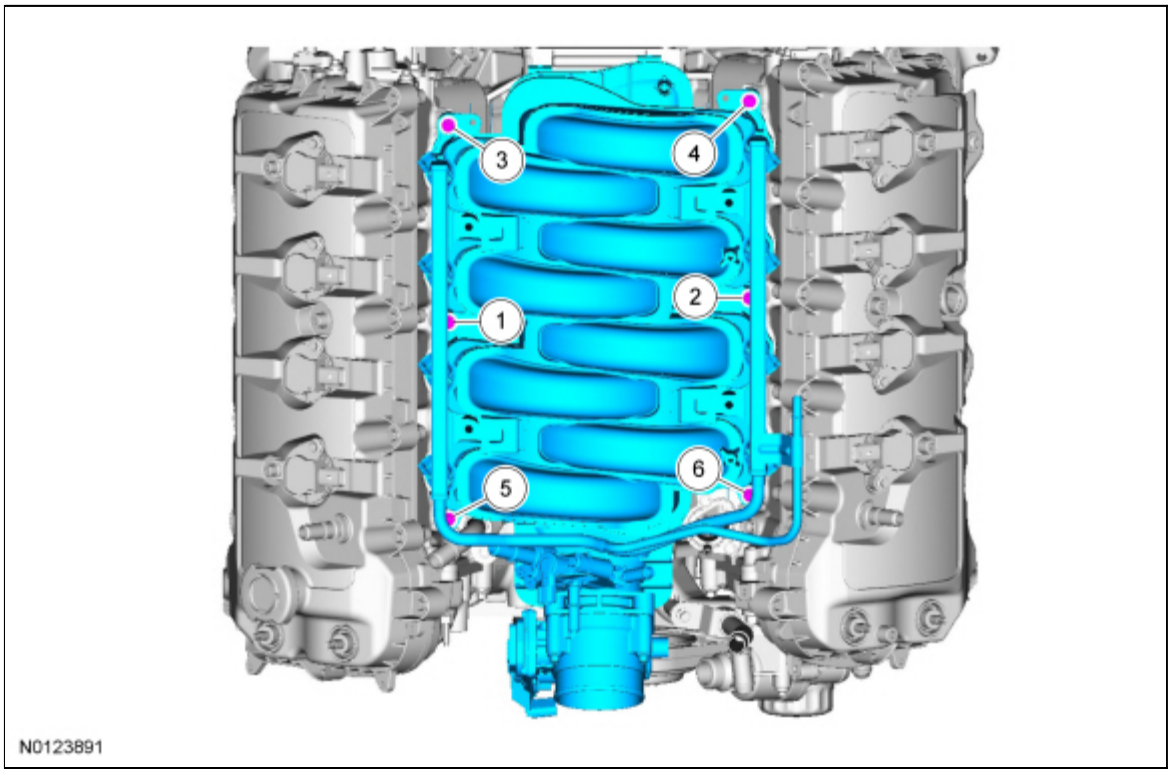


Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris if found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

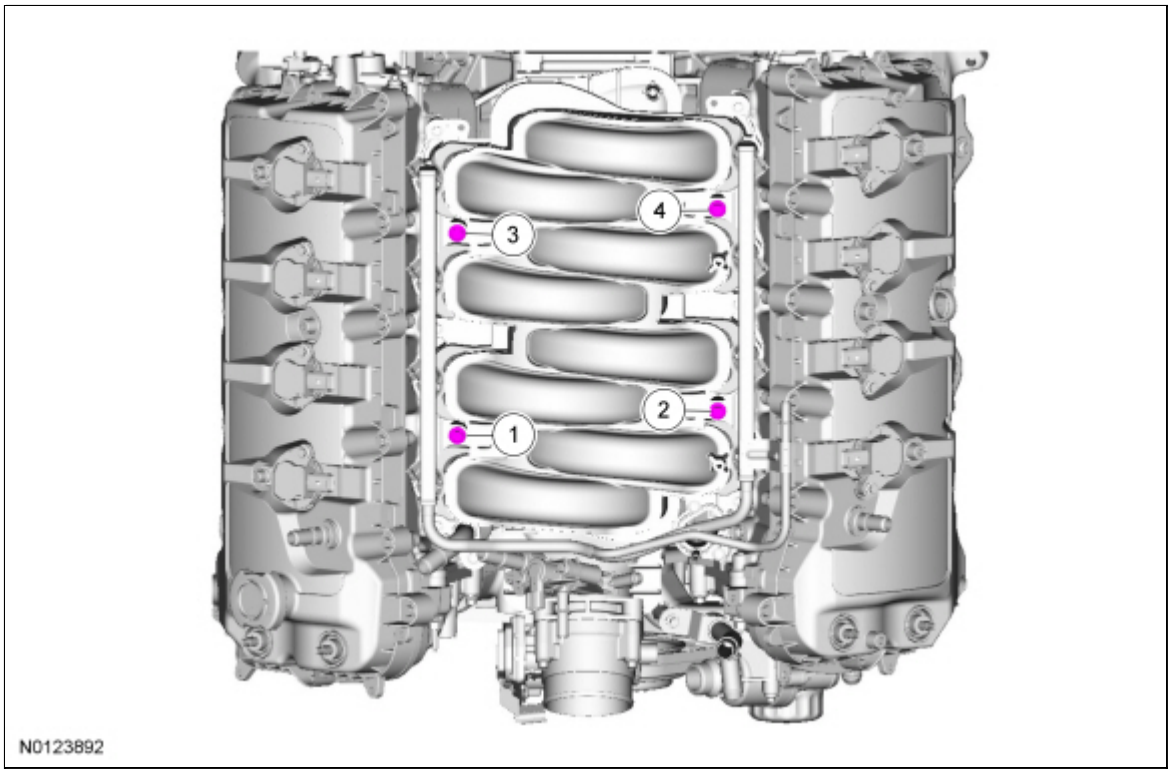
   NOTE: Clean the sealing surfaces with metal surface prep. Follow the directions on the packaging. Inspect the mating surfaces.

   Using new gaskets, install the intake manifold.
   - Tighten the 6 intake manifold bolts in the sequence shown in 2 stages.
     - Stage 1: Tighten to 10 Nm (89 lb-in).
     - Stage 2: Tighten an additional 45 degrees.

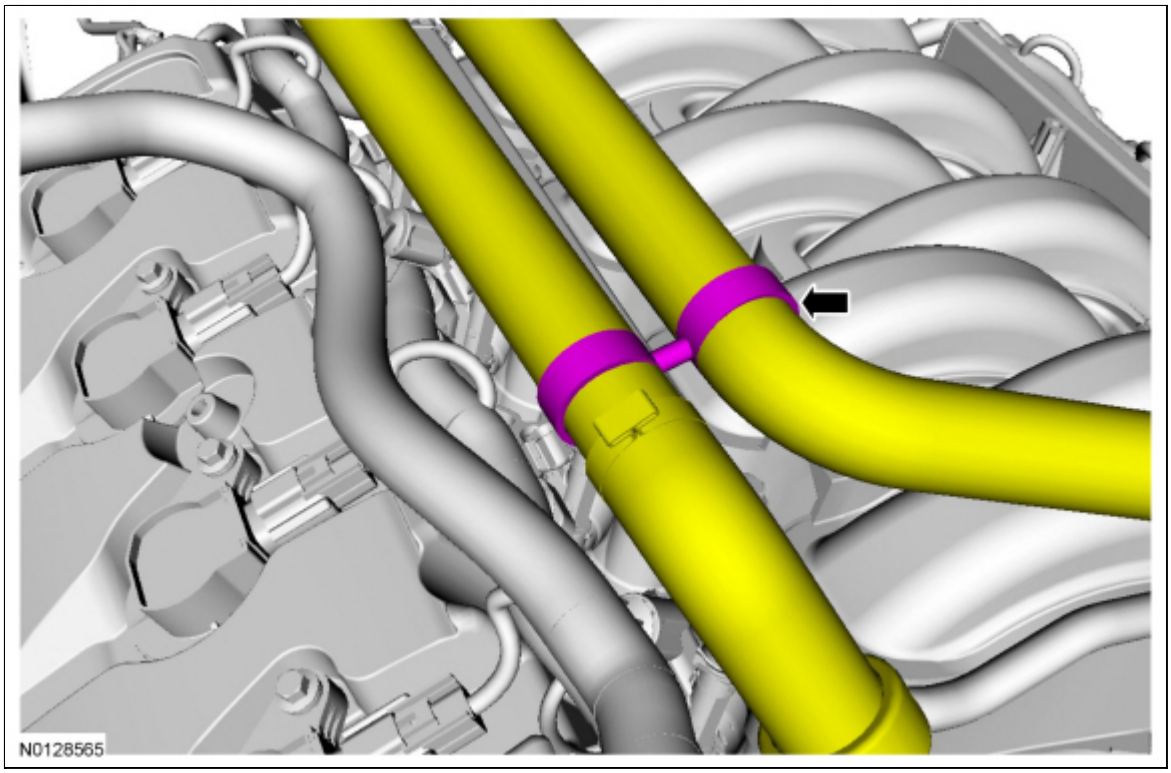


2. Install the 4 fuel rail bolts.
   - Tighten in the sequence shown in 3 stages.
     - Stage 1: Hand tighten.
     - Stage 2: Tighten to 10 Nm (89 lb-in).
     - Stage 2: Tighten an additional 90 degrees.

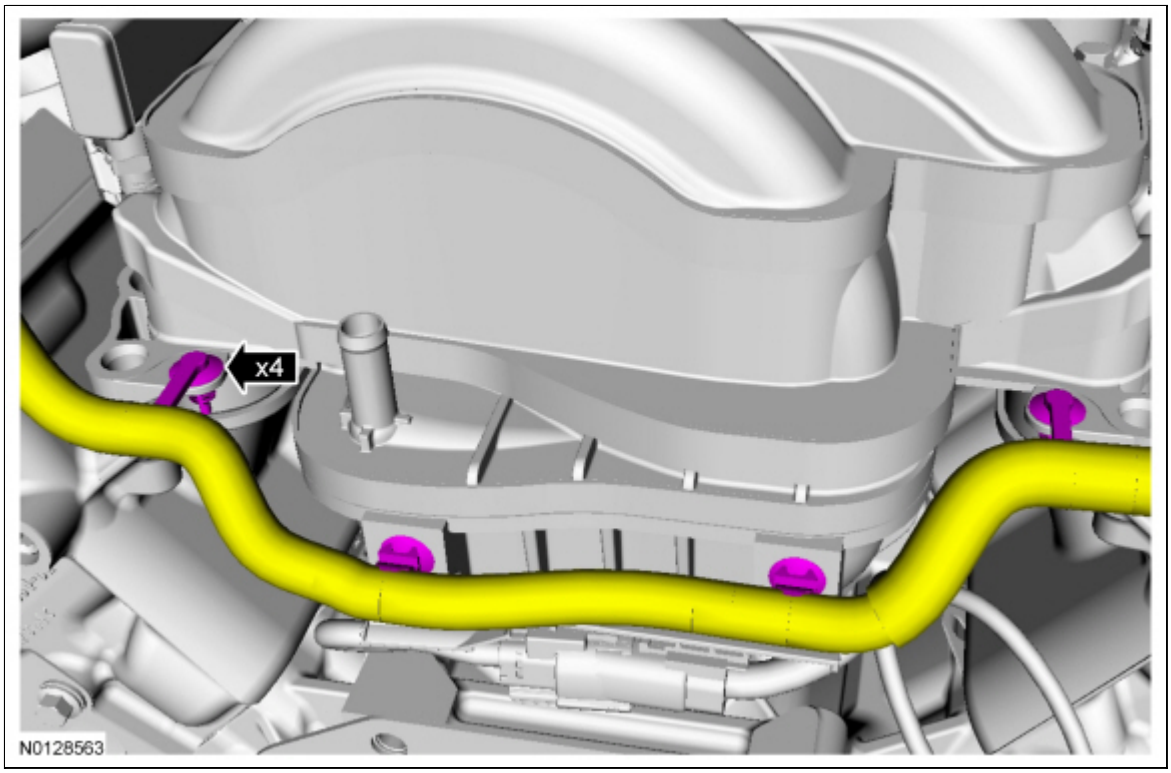
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3. Position the heater hoses and attach the heater hose retainer.

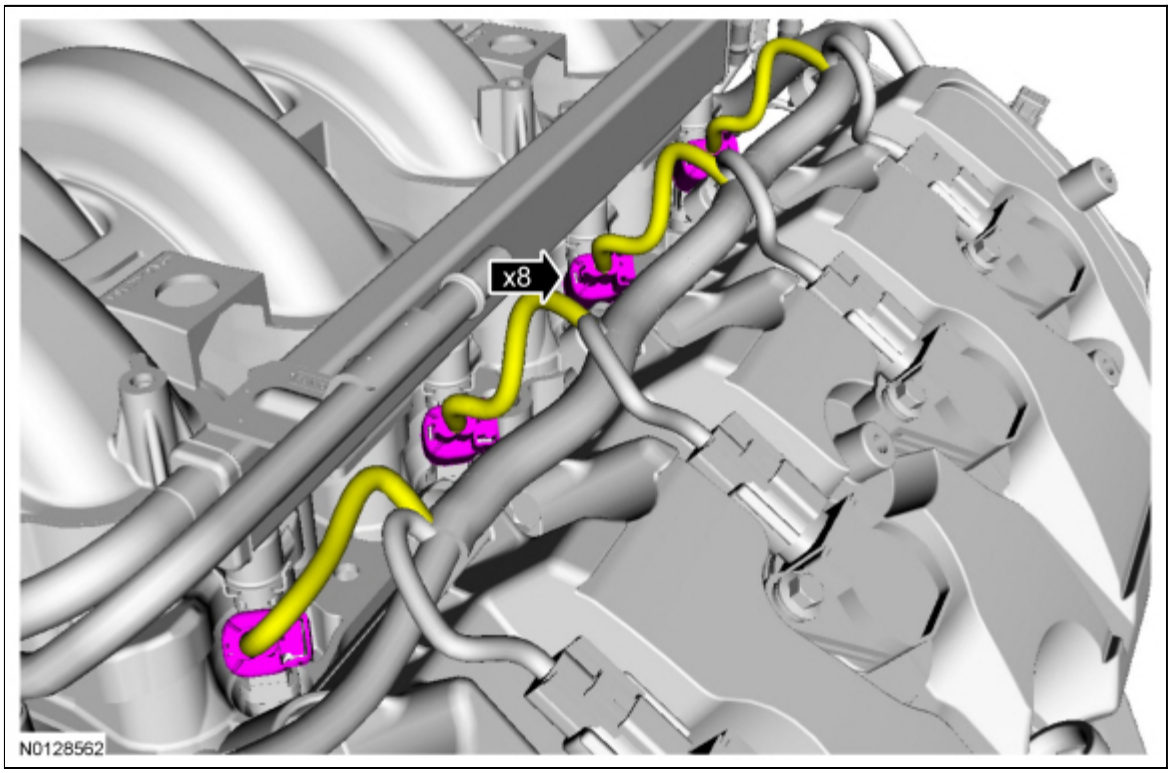


4. Attach the 4 wiring harness retainers to the rear of the intake manifold.



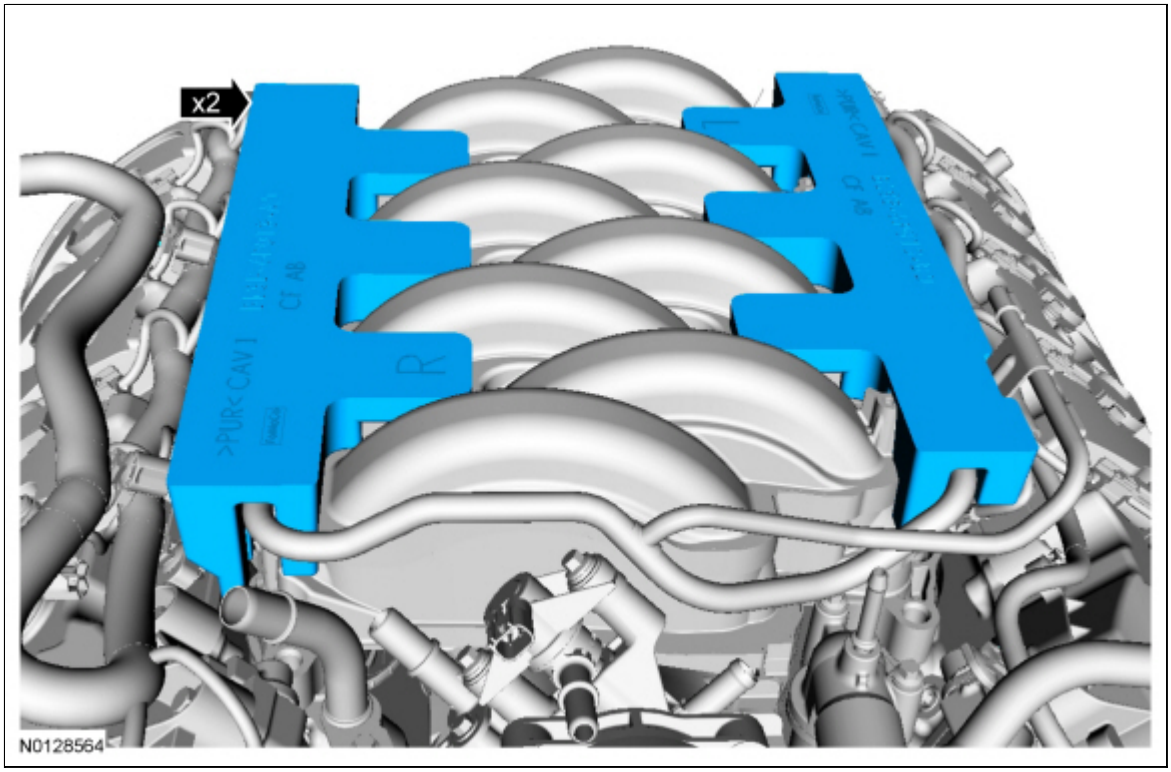
5. **NOTE:** The 4 LH fuel injector electrical connectors are shown, the 4 RH fuel injector electrical connectors are similar.

   Connect the 8 fuel injector electrical connectors.

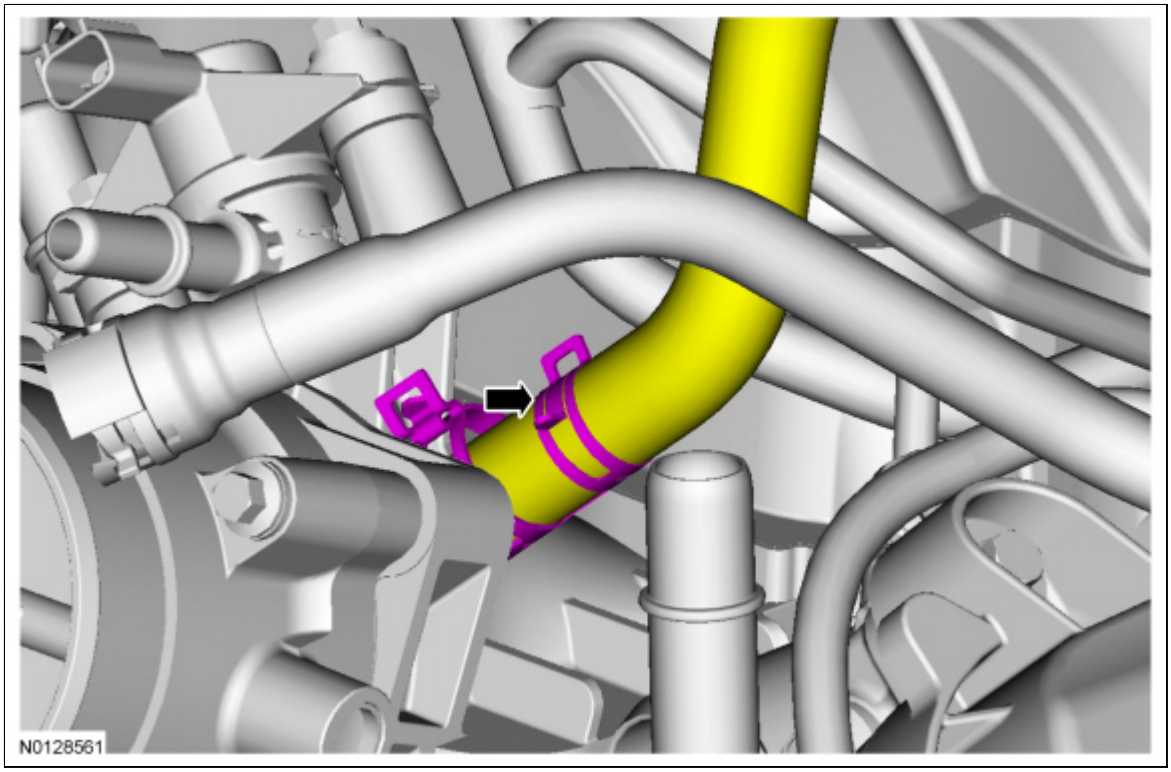


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6. Install the LH and RH fuel rail insulators.

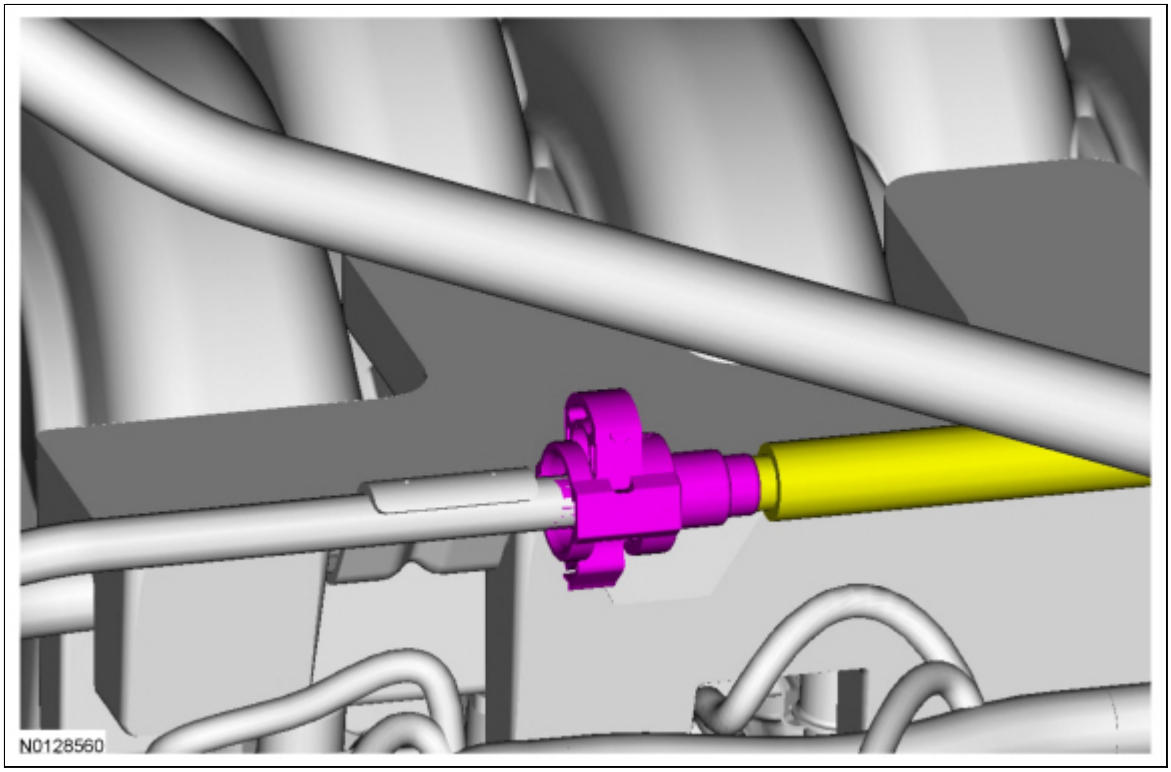


7. Connect the vacuum tube to the intake manifold.

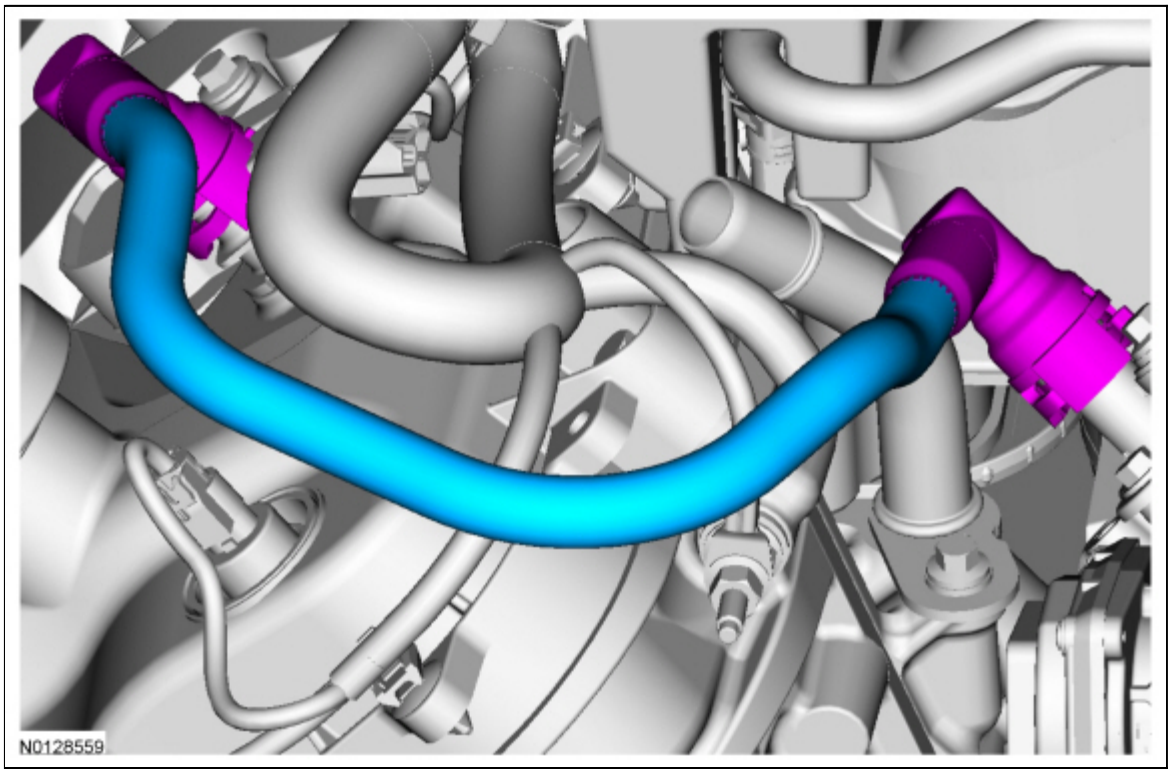


8. Connect the fuel supply tube. For additional information, refer to the quick connect coupling

procedure in Section 310-00 .

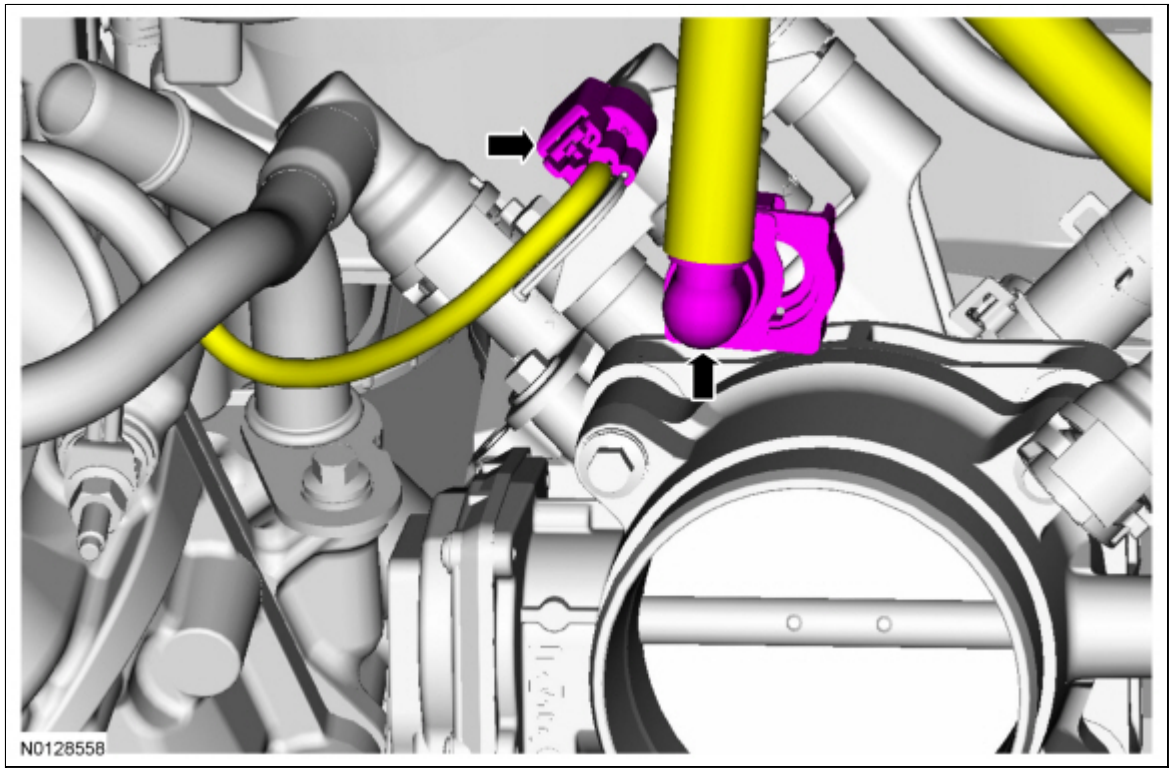


9. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .

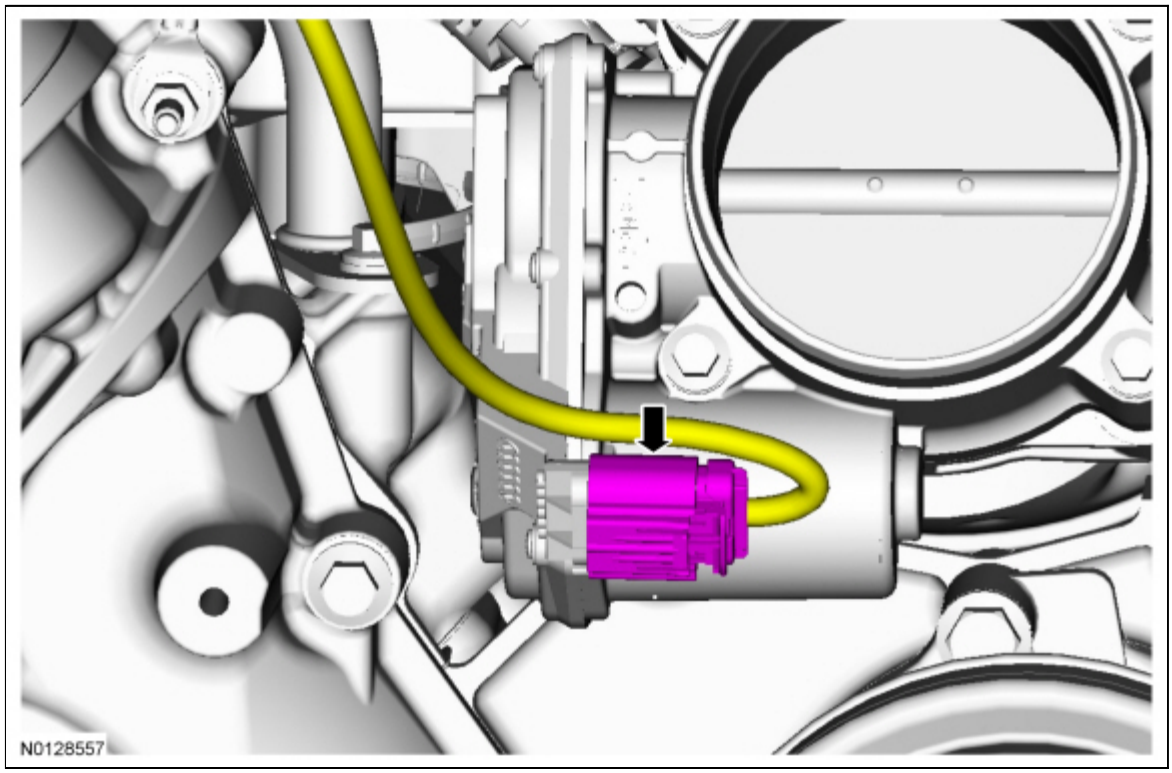


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10. Connect the Evaporative Emission (EVAP) purge valve tube and electrical connector. For additional information, refer to the quick connect coupling procedure in Section 310-00 .
    - Attach the EVAP tube retainer to the fuel rail.



11. Connect the TB electrical connector.



12. Install the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

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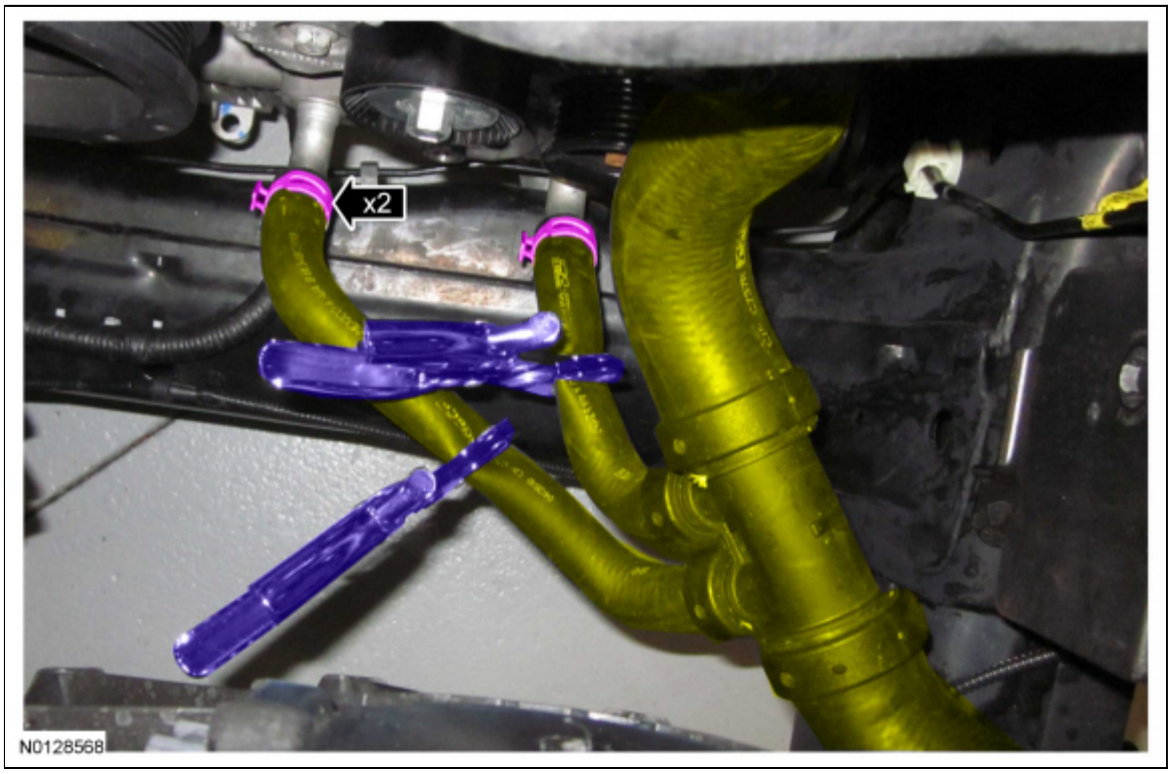
Oil Cooler

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

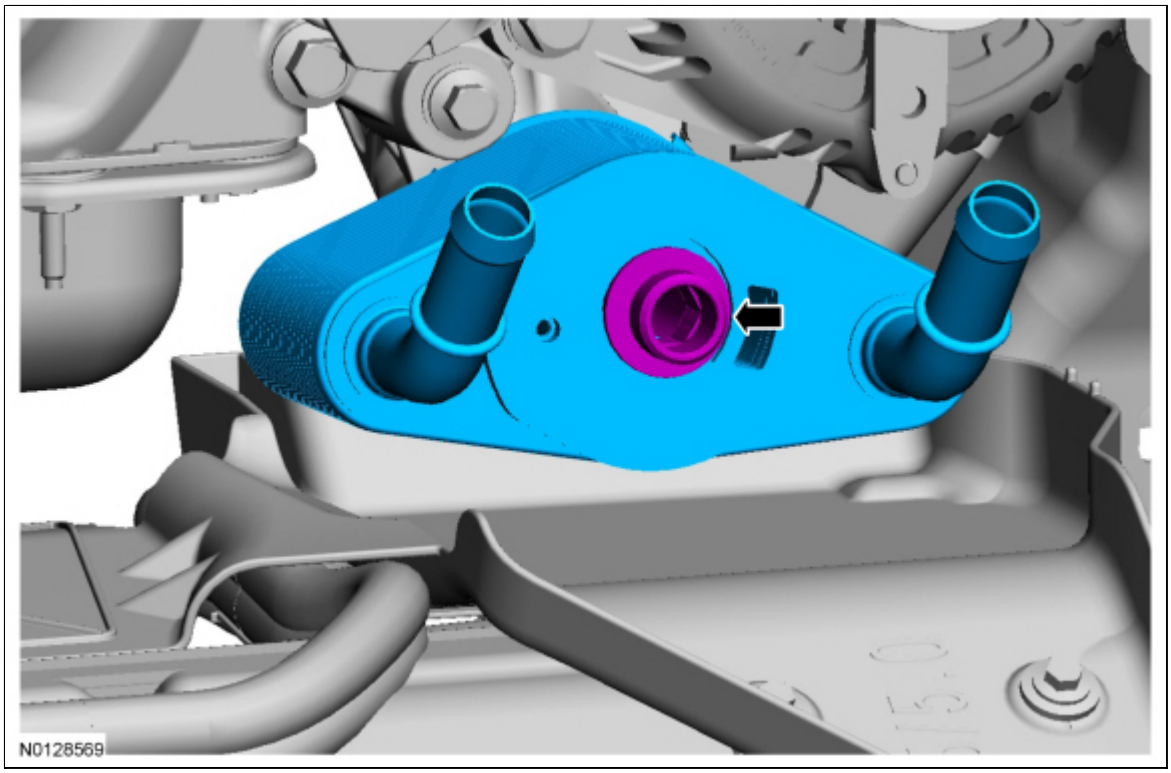
2. Remove and discard the engine oil filter.

3. Using hose clamp pliers, clamp the 2 oil cooler coolant hoses.
   - Disconnect the 2 coolant hoses from the oil cooler.



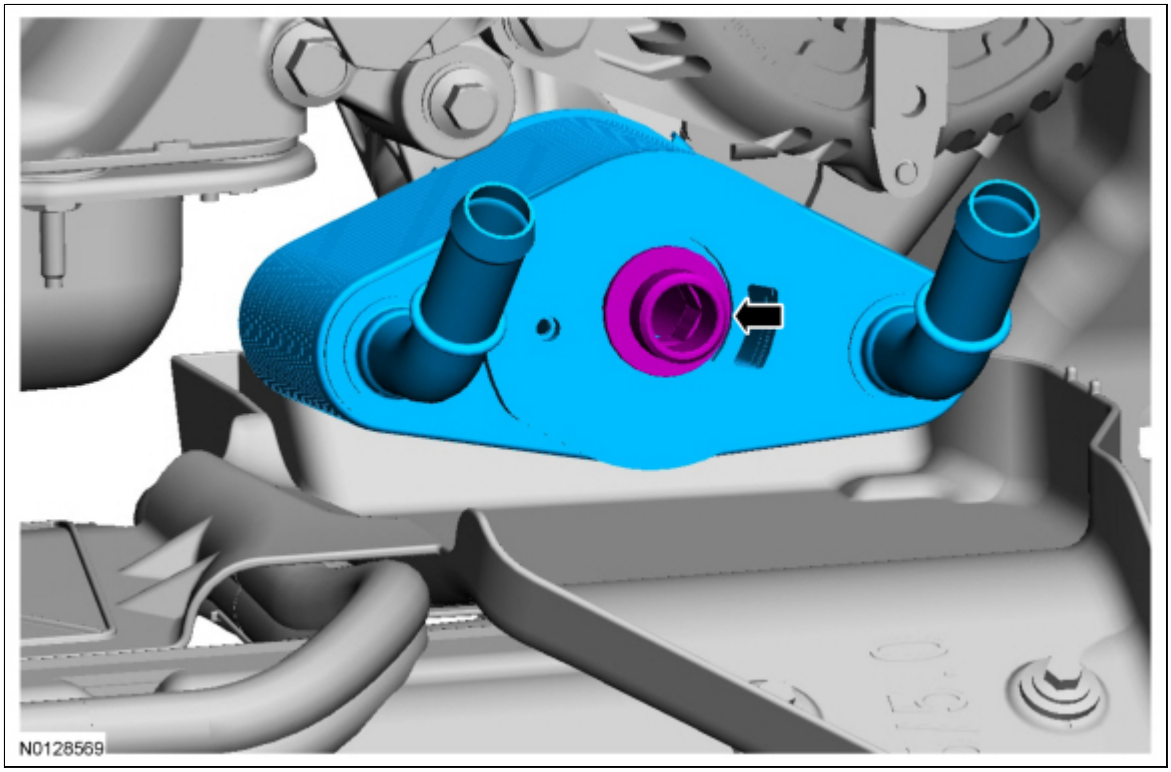
4. ***NOTICE:*** **If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to Section 303-00 .**

   Remove the oil cooler threaded insert and the oil cooler.



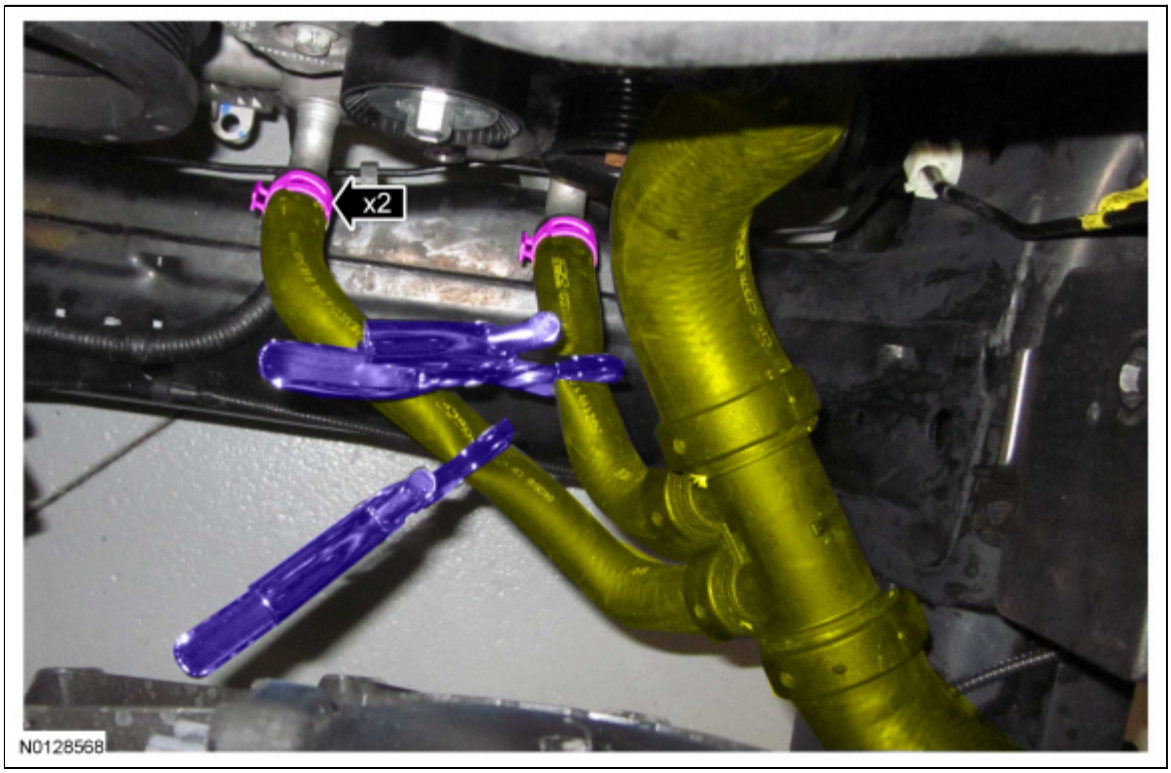
Installation

1. Install the oil cooler and threaded insert.
    - Tighten to 57 Nm (42 lb-ft).



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2. Connect the 2 coolant hoses.
    - Release the hose clamp pliers.



3. **NOTE:** Do not lubricate the O-ring seal.

   Install a new oil filter.
    - Tighten to 16 Nm (142 lb-in).

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Oil Filter Adapter

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTICE: **The engine front cover-to-oil filter adapter bolt must be removed and the engine front cover-to-oil filter adapter jackscrew loosened before removing the oil filter adapter**

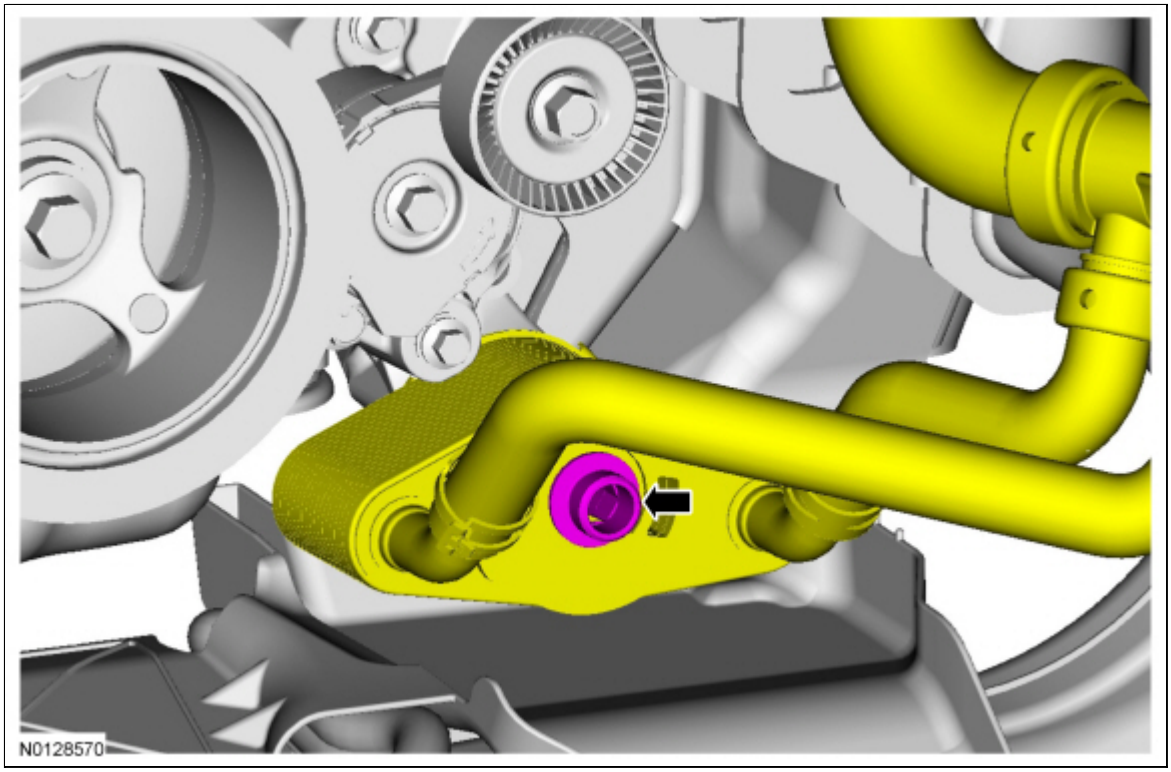
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the generator. For additional information, refer to Section 414-00 .

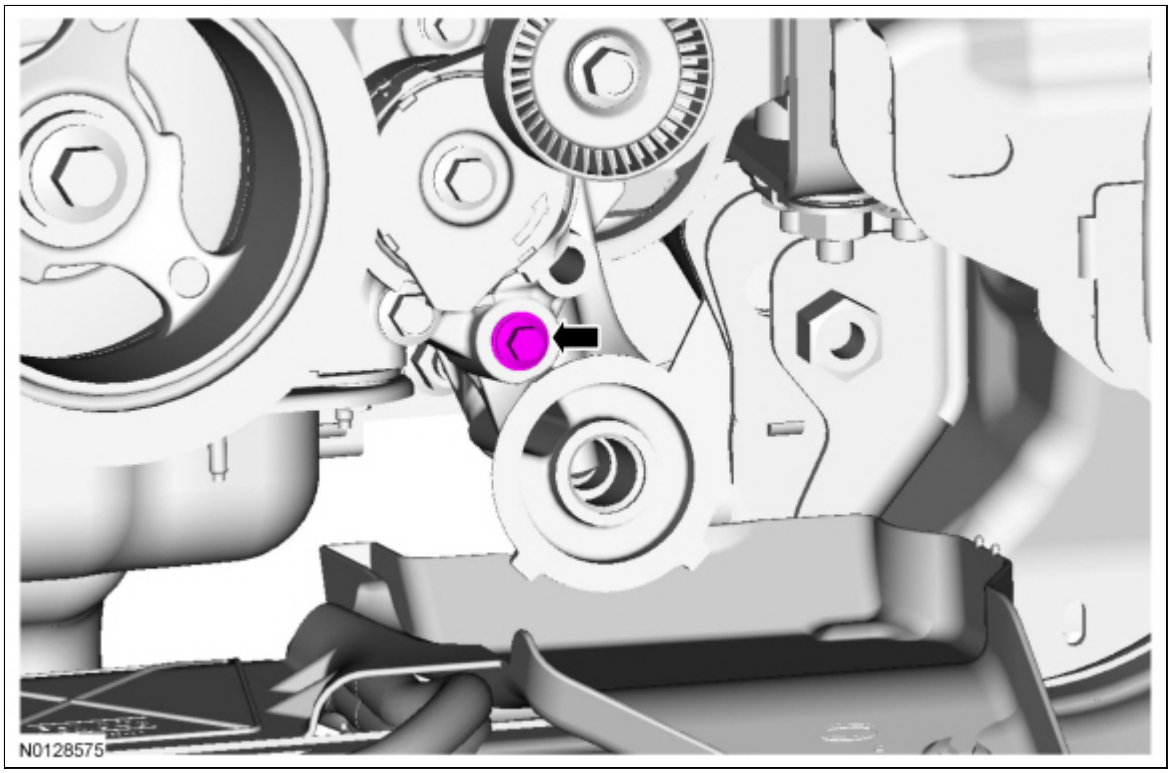
3. Remove and discard the engine oil filter.

4. ***NOTICE:*** **If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to Section 303-00 .**

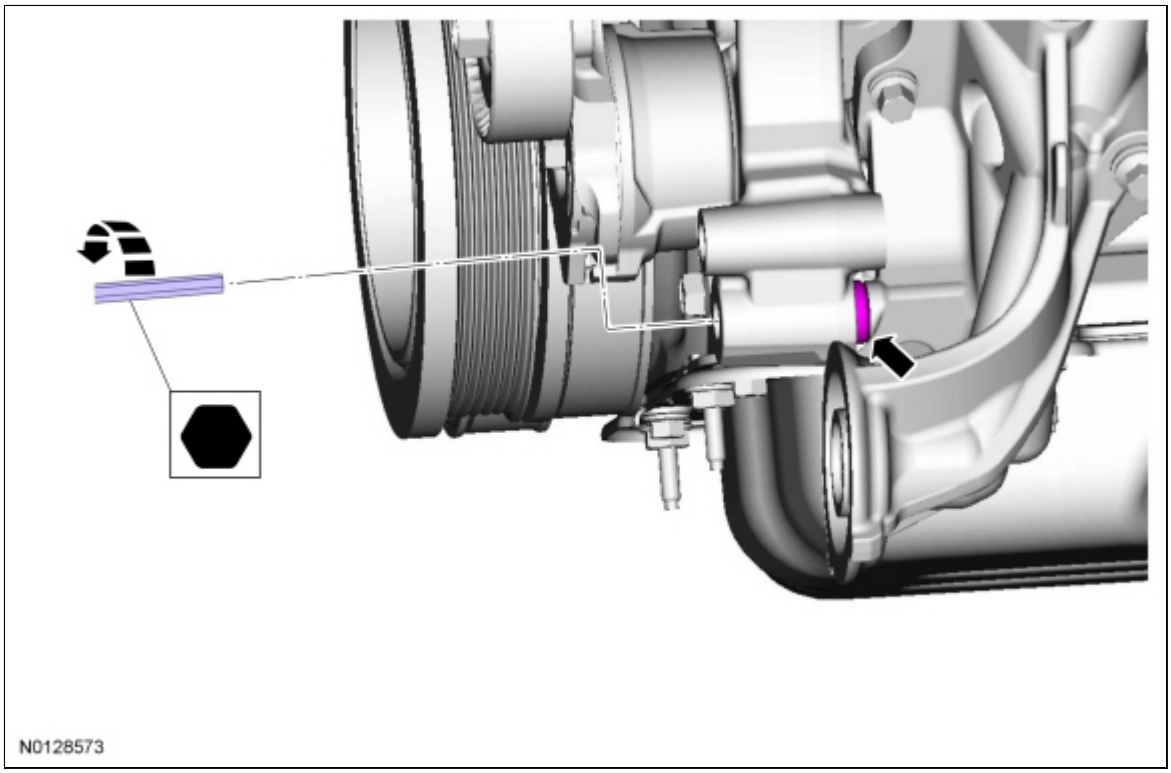
   Remove the oil cooler threaded insert and position the oil cooler and hoses aside.



5. Remove the engine front cover-to-oil filter adapter bolt.

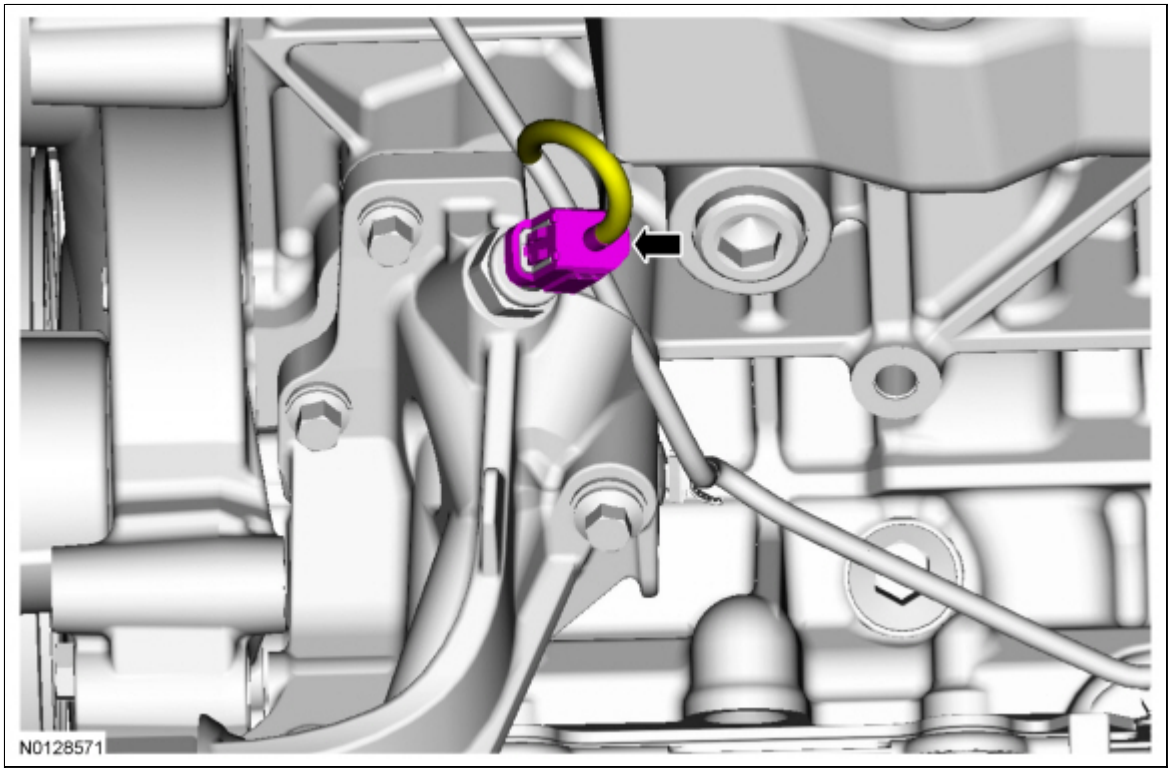


6. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



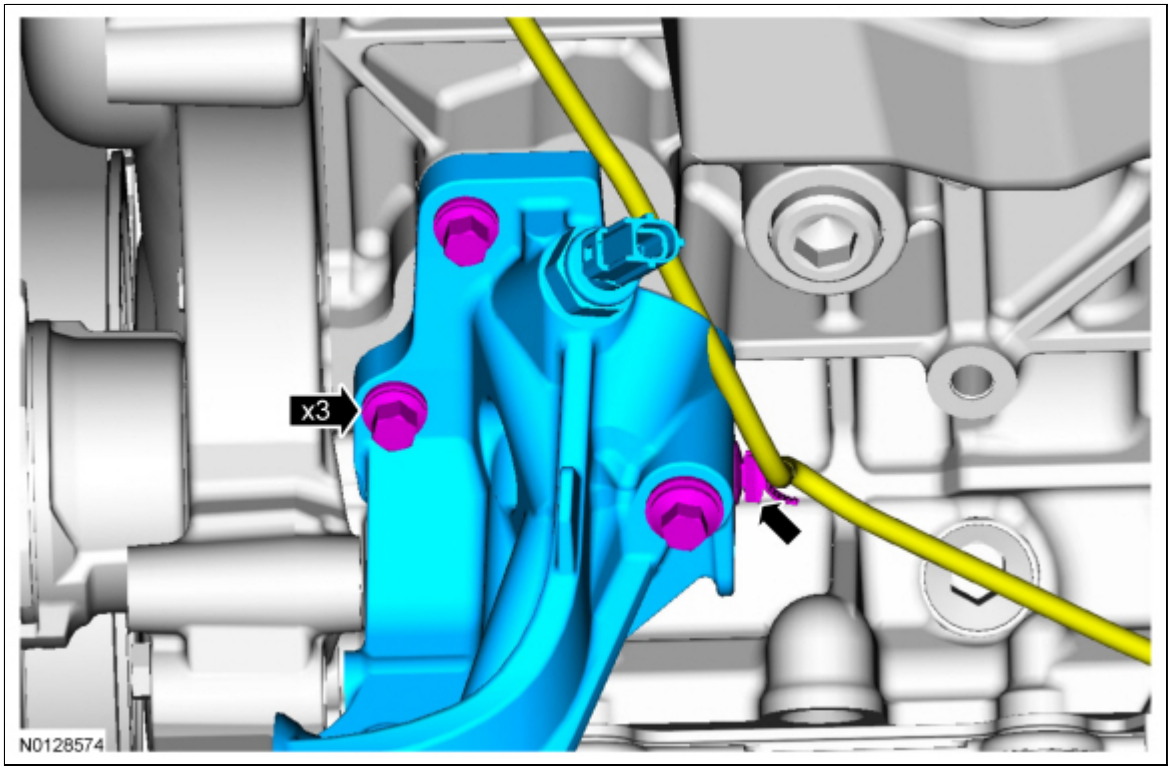
7. Disconnect the engine oil pressure switch electrical connector.

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8. **NOTE:** On 4x4 vehicles, the rear bolt must be removed with the oil filter adapter.

   Remove the 3 oil filter adapter bolts .
   - Position the oil filter adapter aside and detach the wiring harness retainer.
   - Remove the oil filter adapter and discard the gasket.

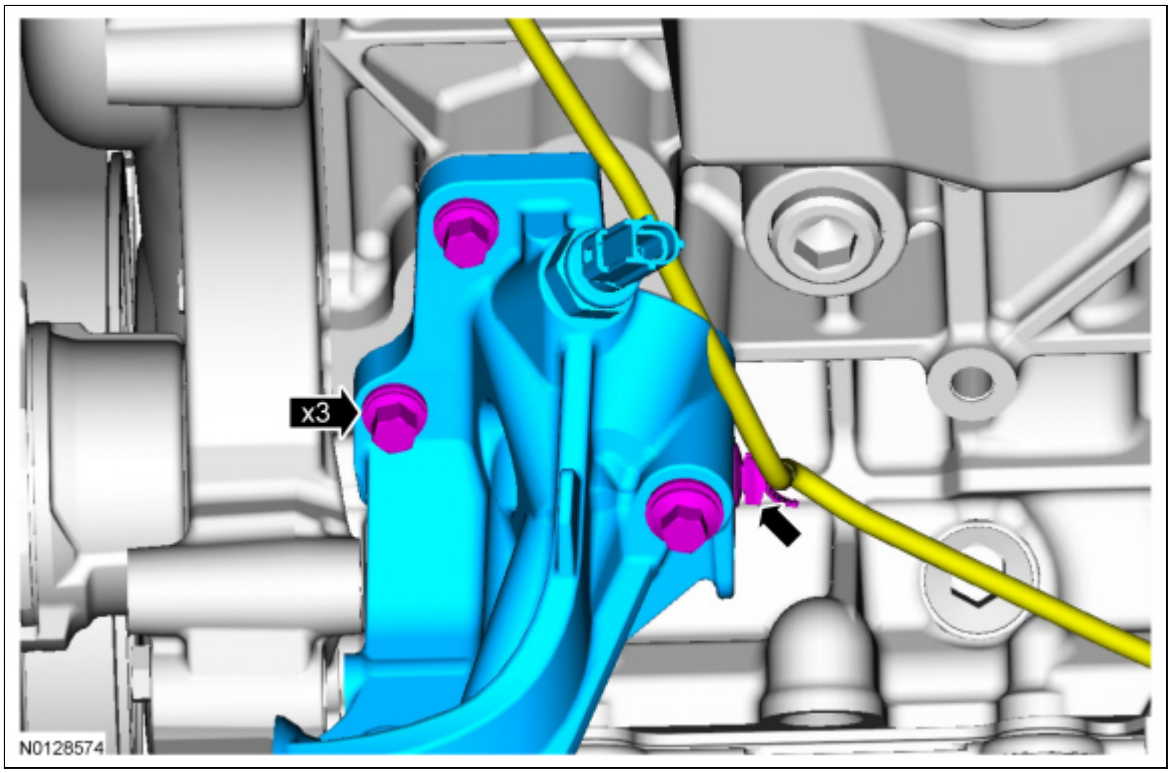


Installation

1. **NOTE:** Install a new oil filter adapter gasket.

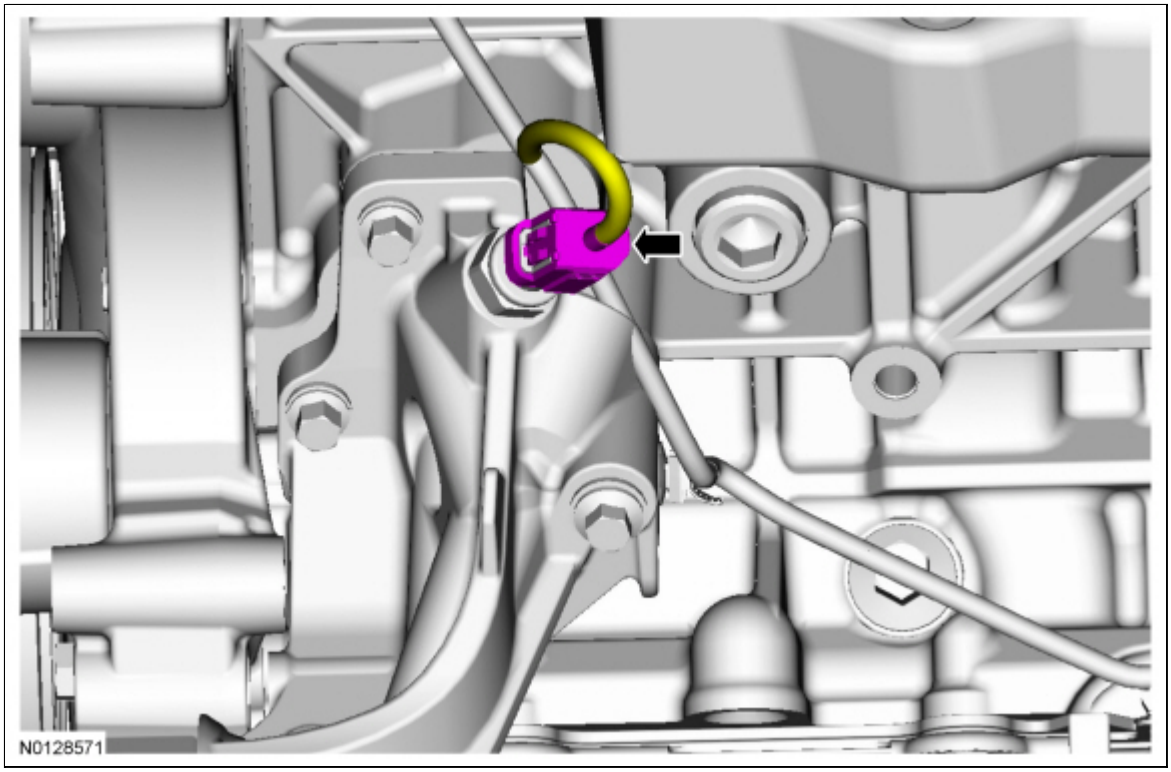
   NOTE: On 4x4 vehicles, the rear bolt must be positioned with the oil filter adapter.

   Using a new gasket, position the oil filter adapter and attach the wiring harness retainer.
   - Install the 3 bolts and tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.

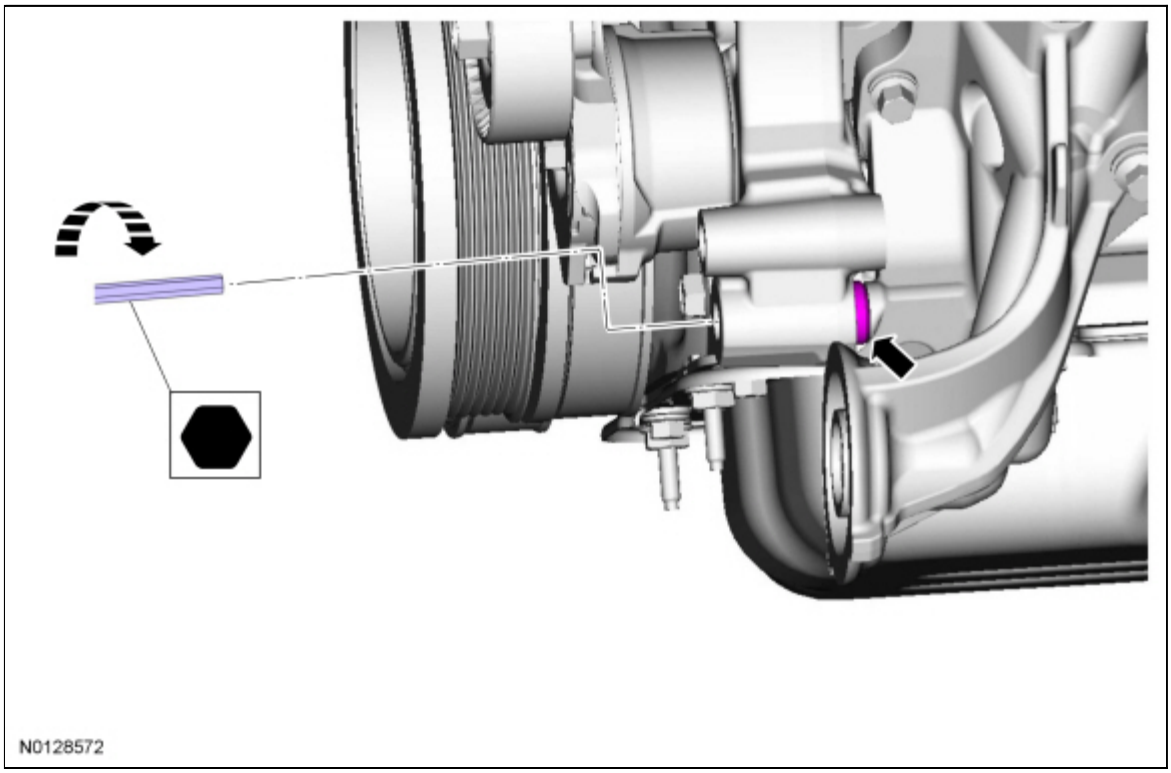


2. Connect the engine oil pressure switch electrical connector.

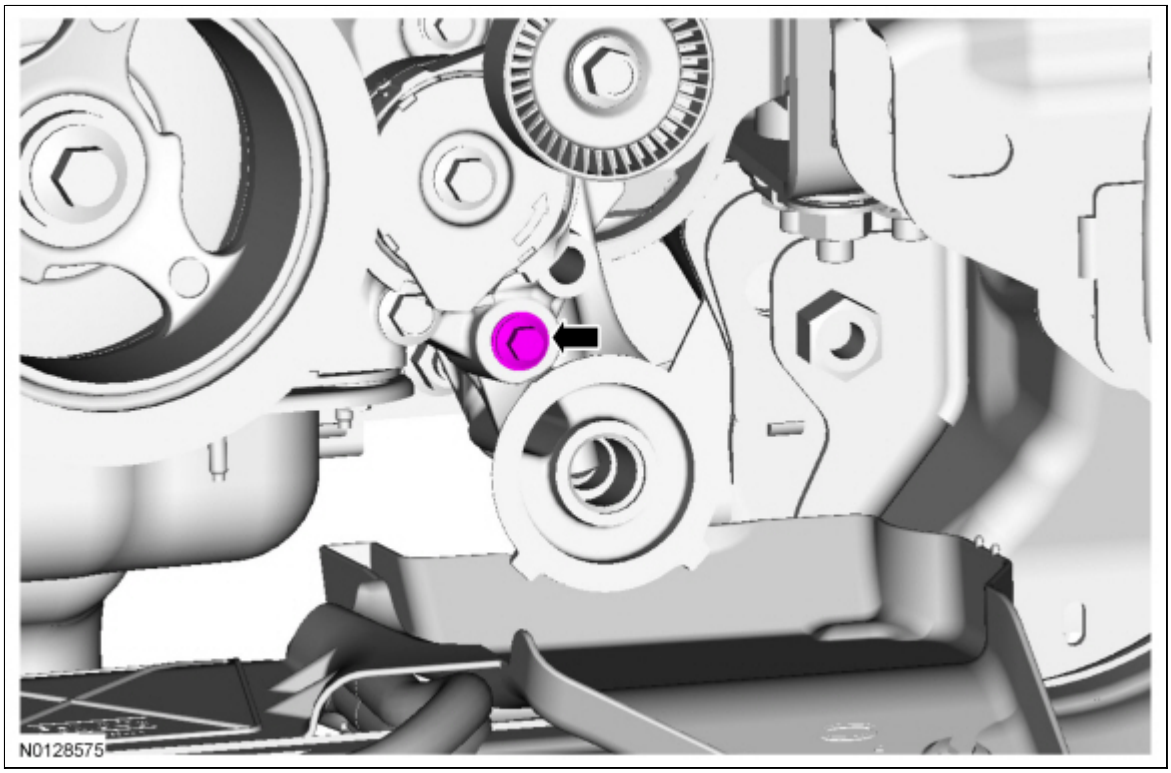
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3. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).



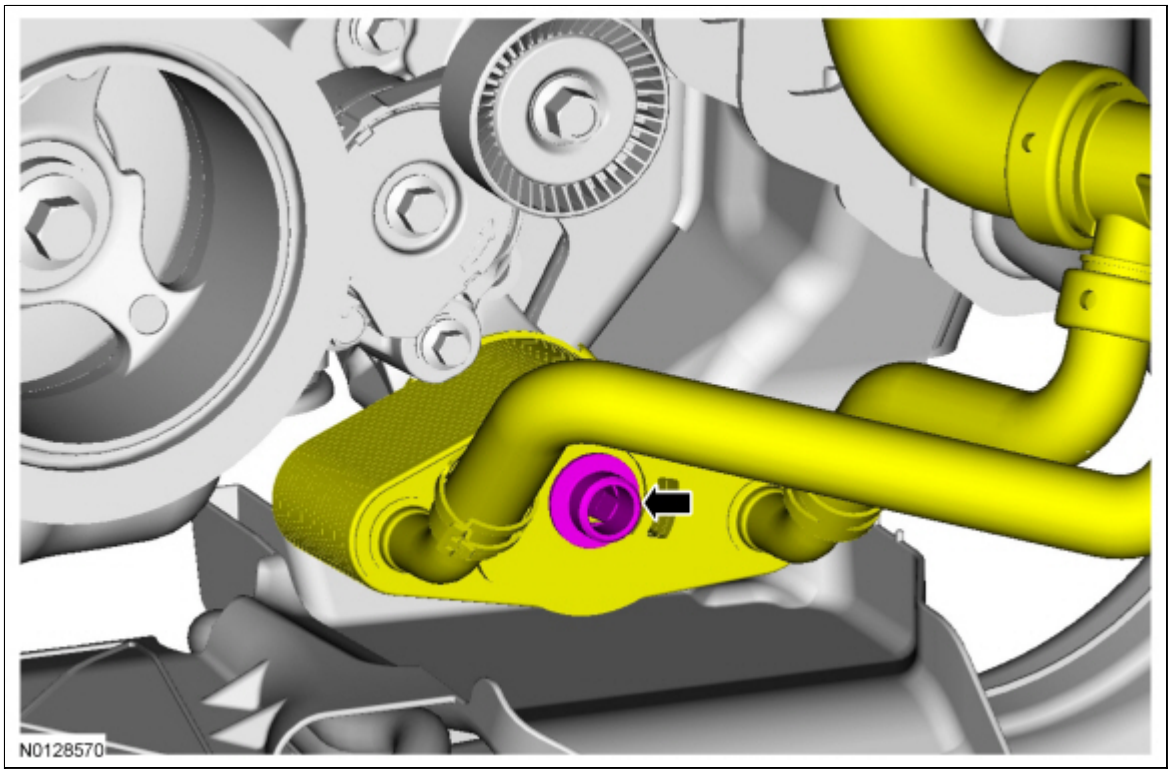
4. Tighten the engine front cover-to-oil filter adapter bolt to 25 Nm (18 lb-ft) plus an additional 60 degrees.



5. ***NOTICE:*** **If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to Section 303-00 .**

   Position the oil cooler and hoses and install the oil cooler threaded insert.
   - Tighten to 57 Nm (42 lb-ft).

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6. **NOTE:** Do not lubricate the O-ring seal.

   Install a new oil filter.
   - Tighten to 16 Nm (142 lb-in).

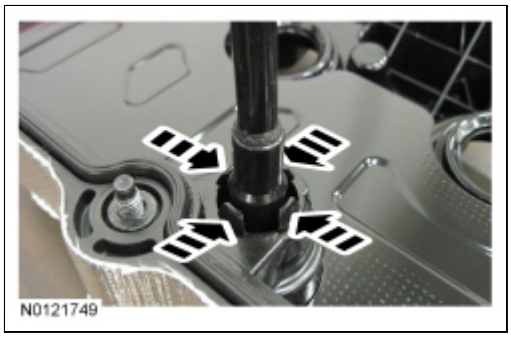
7. Install the generator. For additional information, refer to Section 414-00 .

Oil Level Indicator and Tube

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. Remove the LH valve cover. For additional information, refer to Valve Cover — LH in this section.
2. Depress the 4 tabs and remove the oil level indicator tube.



Installation

1. Install the oil level indicator tube.
    - Push the oil level indicator tube into the valve cover until it clicks into place.
2. Install the LH valve cover. For additional information, refer to Valve Cover — LH in this section.

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Oil Pan

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

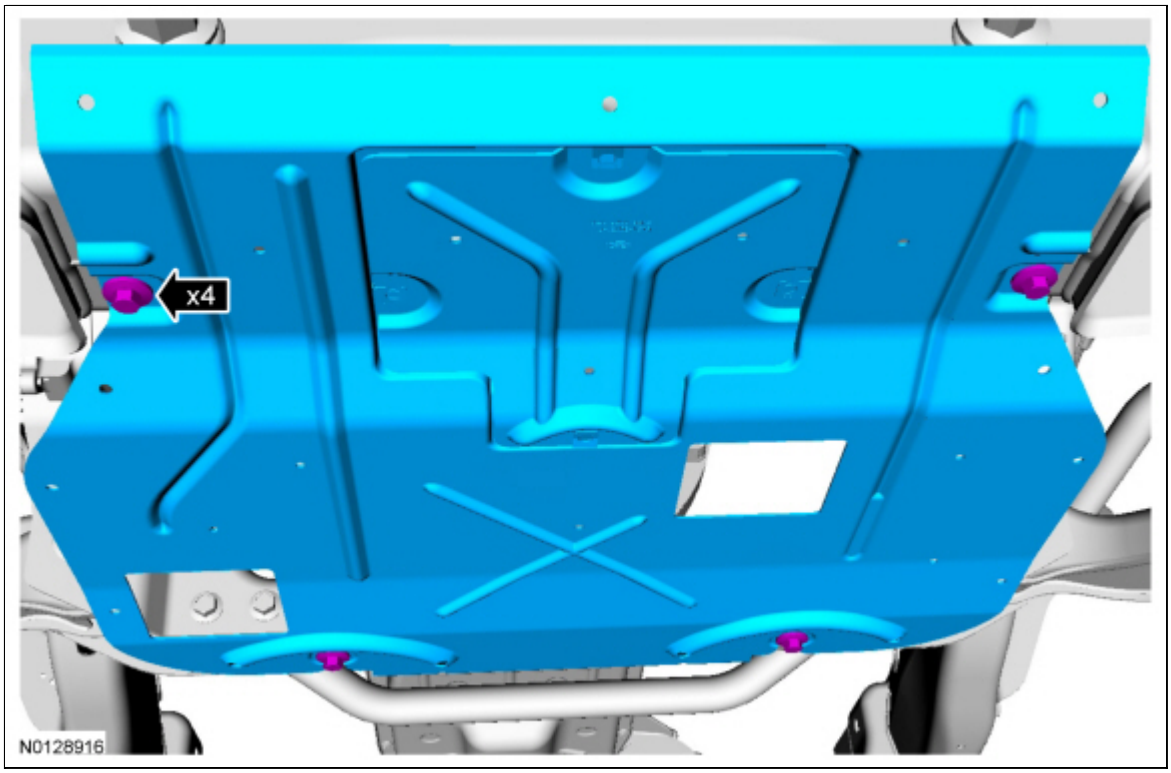
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All vehicles

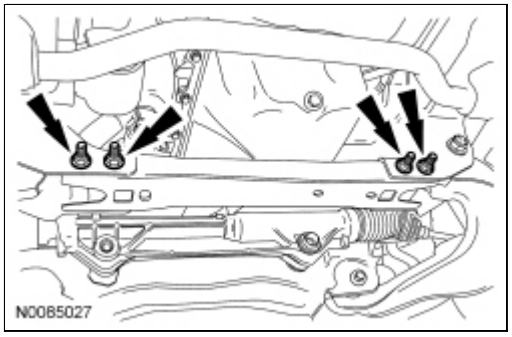
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the oil level indicator.
4. If equipped, remove the 4 bolts and the skid plate.

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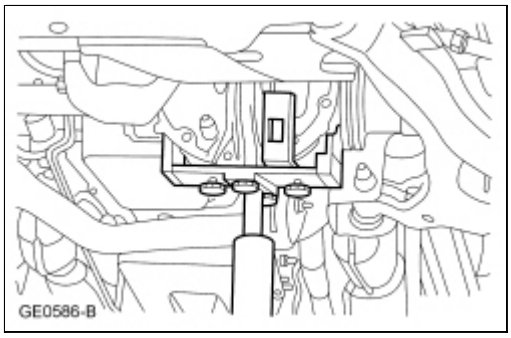
5. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 26 Nm (19 lb-ft).

6. Remove the 4 nuts and bolts and the crossmember.

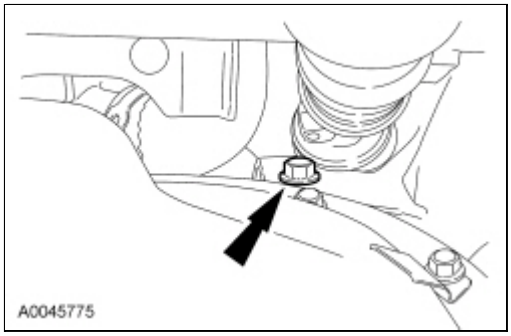


Four Wheel Drive (4X4) vehicles

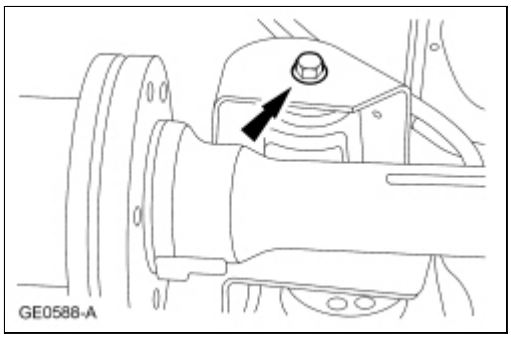
7. Position a suitable hydraulic jack under the front axle.
    - Securely strap the jack to the axle.



8. Remove the upper front axle carrier mounting bushing bolt.

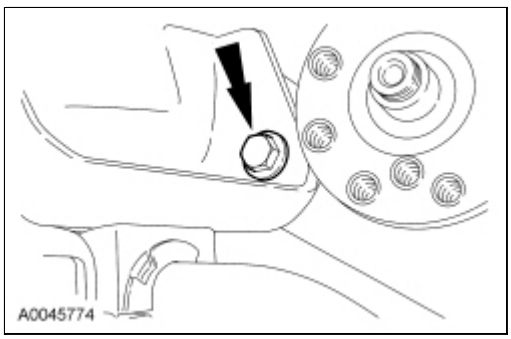


9. Remove the axle shaft housing carrier bushing bolt.



10. **NOTE:** Front driveshaft removed for clarity only.

    Remove the lower front axle carrier mounting bushing bolt.



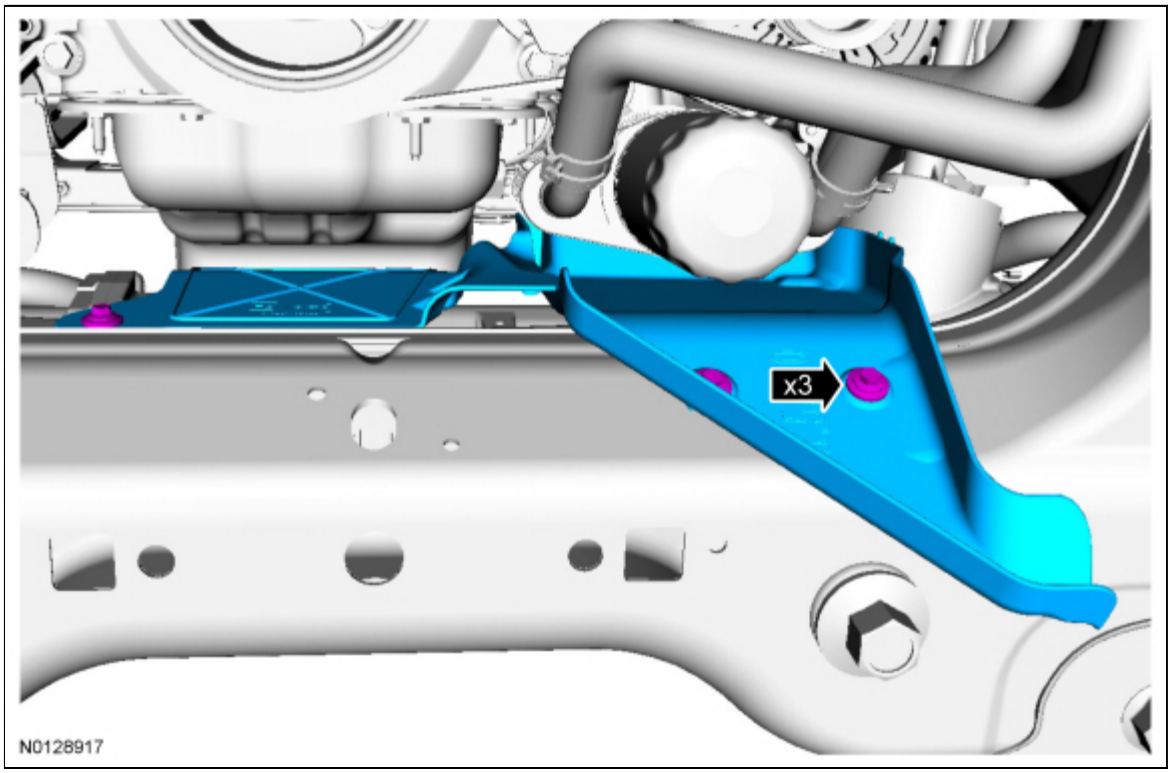
11. ***NOTICE:*** **Use care when lowering the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

repair4less

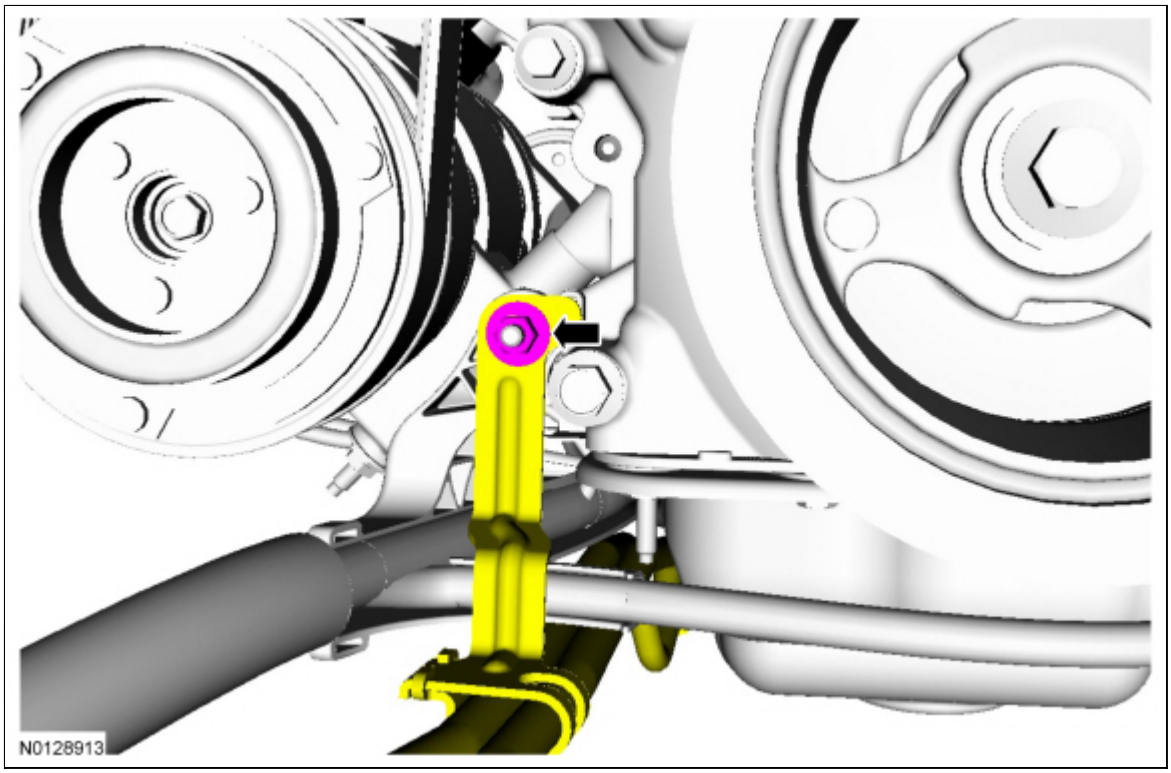
Lower the axle to allow clearance for the oil pan to be removed.

All vehicles

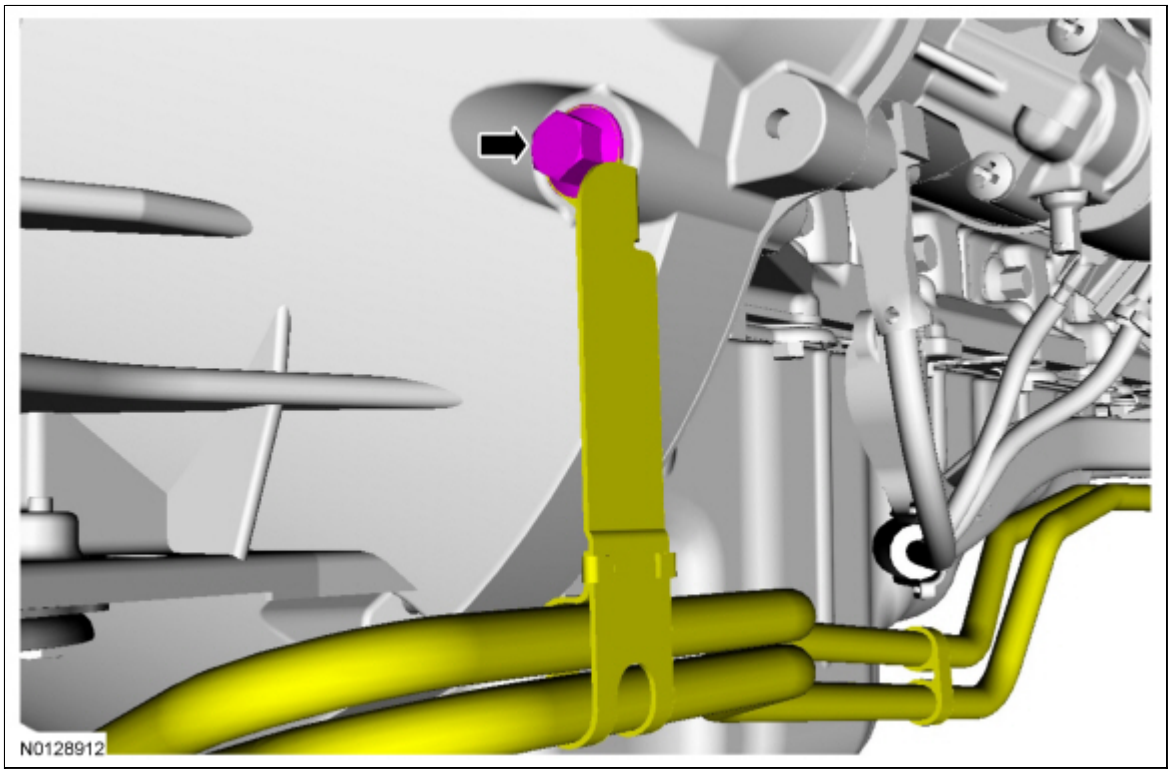
12. Remove the 3 bolts and the oil drain gutter.



13. Remove the nut and the transmission cooler tube bracket from the engine front cover stud bolt.

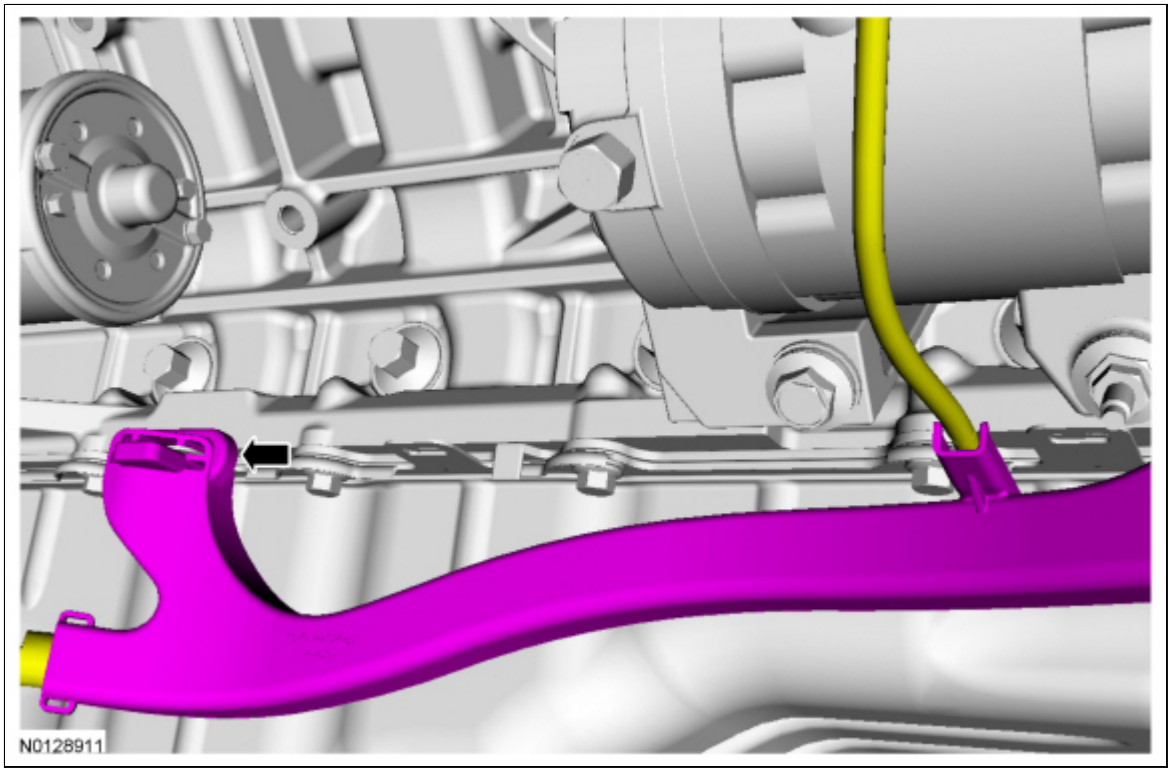


14. Remove the bolt and the transmission cooler tube bracket from the bellhousing.

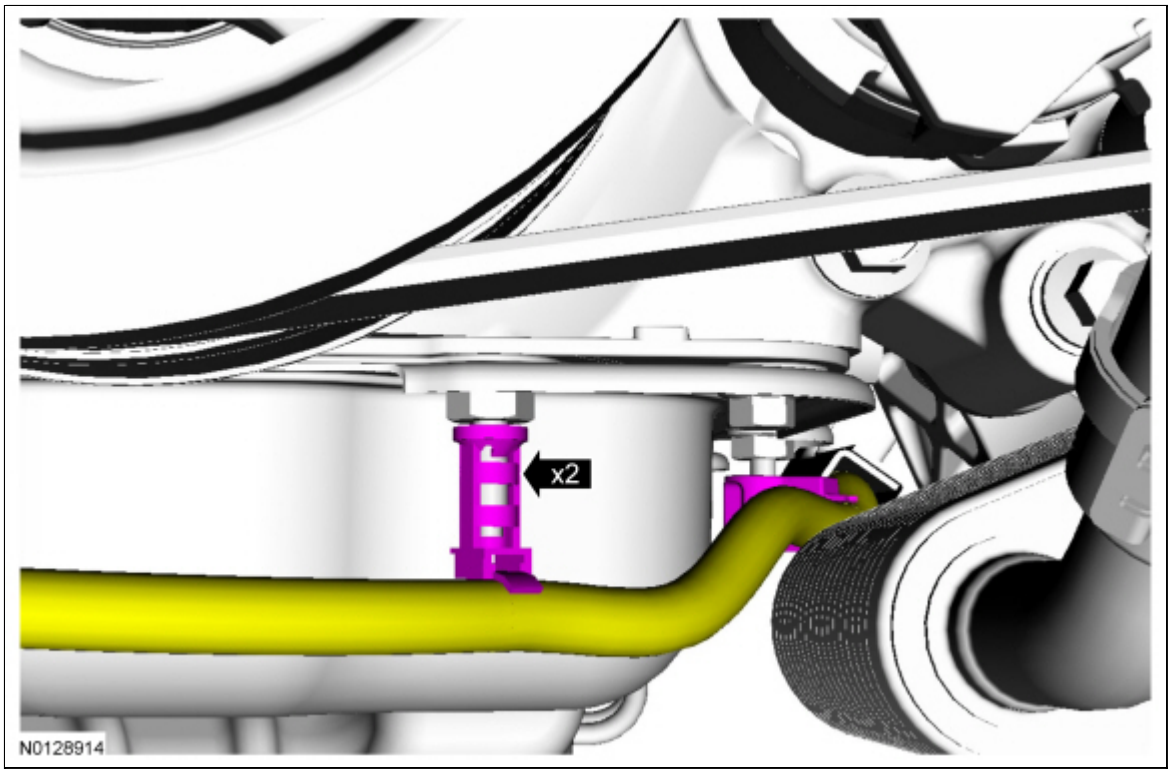


15. Detach the starter motor wiring harness retainer from the oil pan.

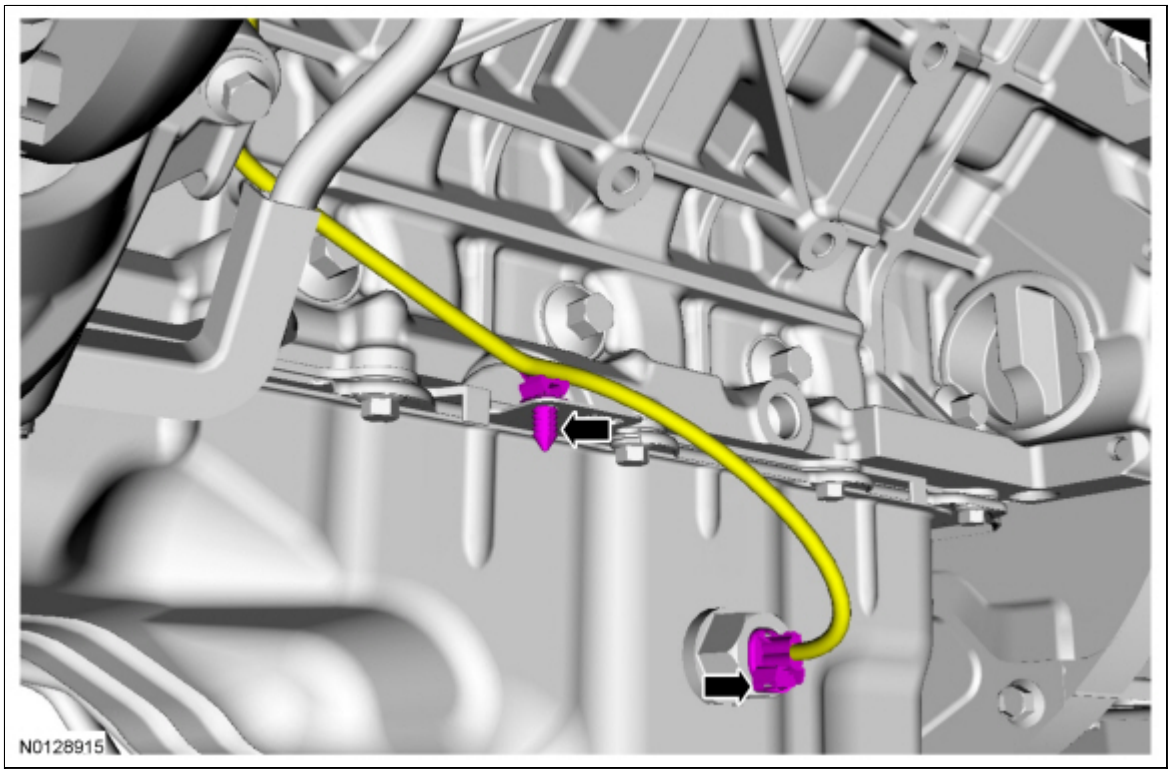
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16. Detach the 2 wiring harness retainers from the oil pan stud bolts.



17. Disconnect the oil level sensor electrical connector and wiring harness retainer.



18. Remove the 3 stud bolts, the 13 bolts and the oil pan.

Installation

All vehicles

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

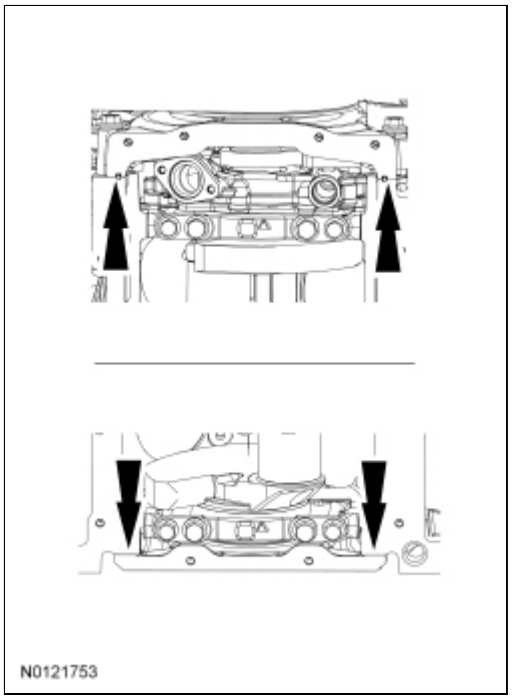
   Inspect the oil pan and engine sealing surfaces. Clean the mating surfaces of the engine and oil pan with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

2. **NOTE:** If the oil pan is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage. If this timing cannot be met, tighten fasteners 7, 8, 9 and 10 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer and final torque all of the fasteners within 1 hour of applying the sealer.

   NOTE: If the engine front cover has been removed, it is only necessary to apply sealant to the crankshaft rear seal retainer plate-to-cylinder block sealing surfaces.

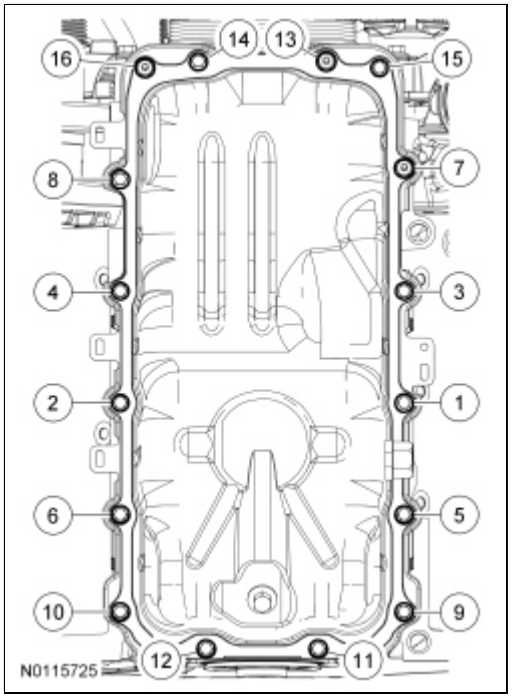
   Apply an 8 mm (0.31 in) bead of silicone sealant to the crankshaft rear seal retainer plate-to-cylinder block sealing surfaces and the engine front cover-to-cylinder block sealing surfaces.

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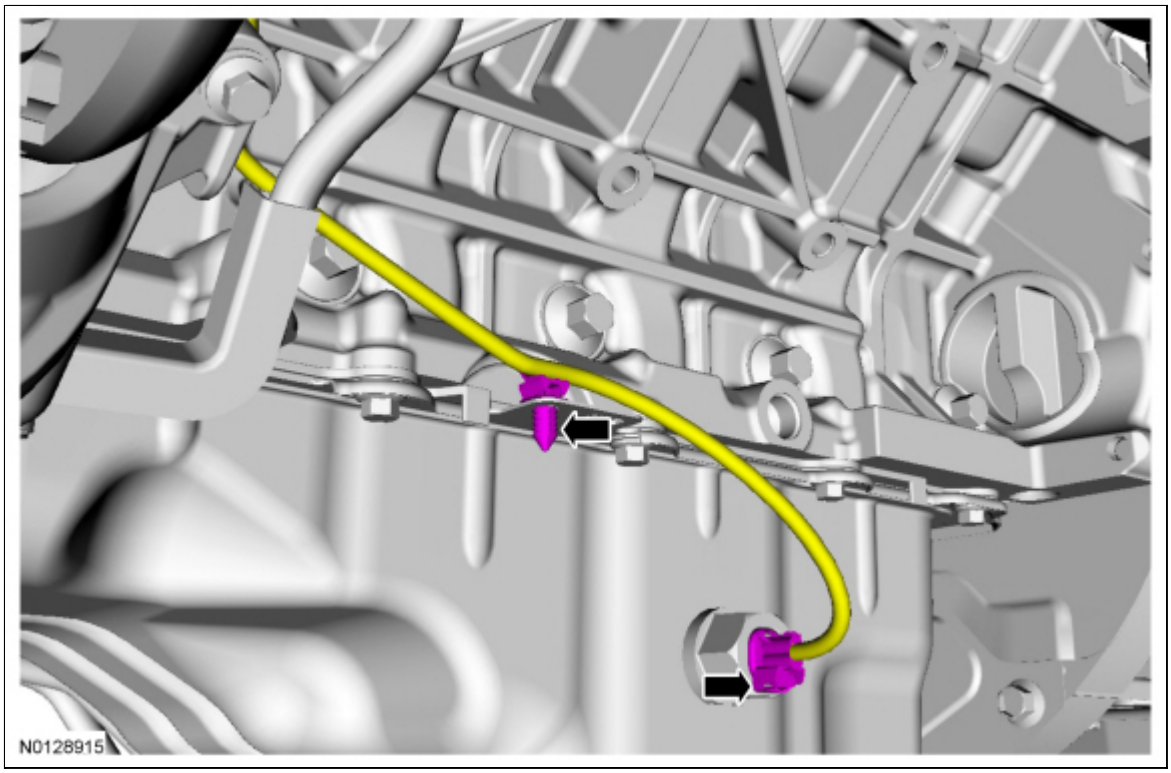


3. **NOTE:** Fastener locations 7, 13 and 16 are stud bolts.

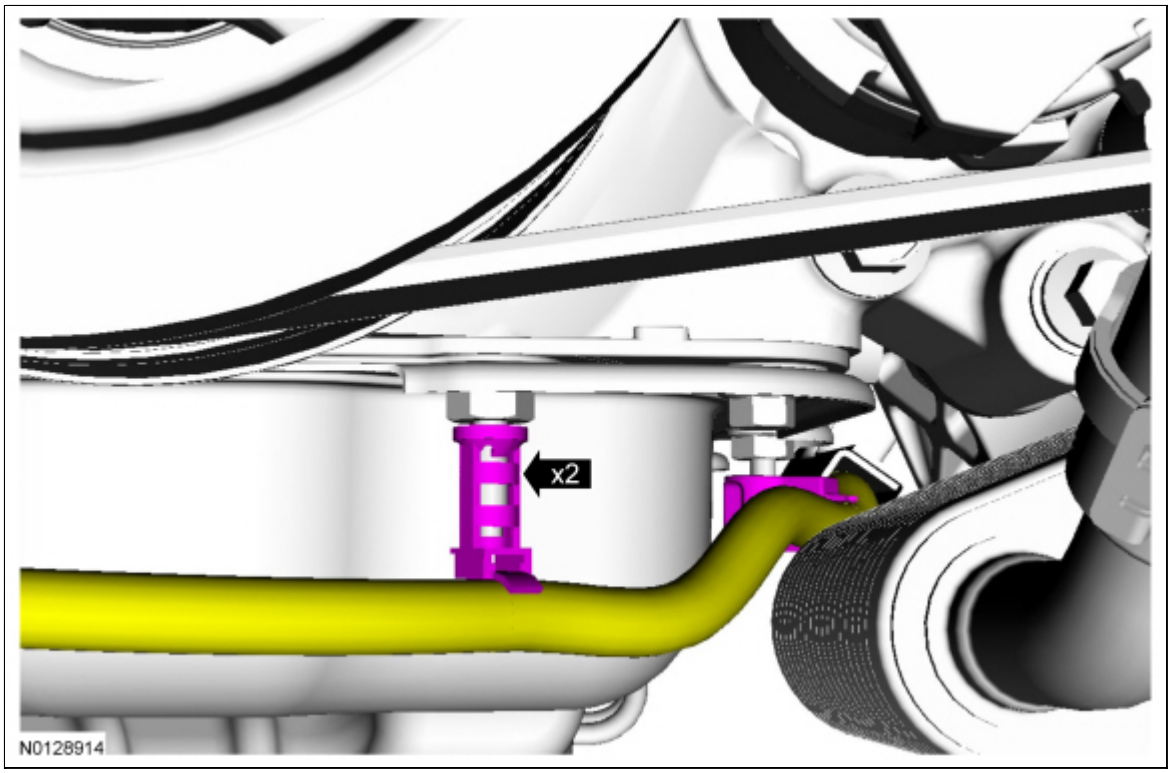
   Using a new gasket, install the oil pan and tighten the fasteners in sequence in 3 stages.
   - Stage 1: Tighten to 2 Nm (18 lb-in)
   - Stage 2: Tighten to 10 Nm (89 lb-in).
   - Stage 3: Tighten an additional 45 degrees.



4. Connect the oil level sensor electrical connector and wiring harness retainer.

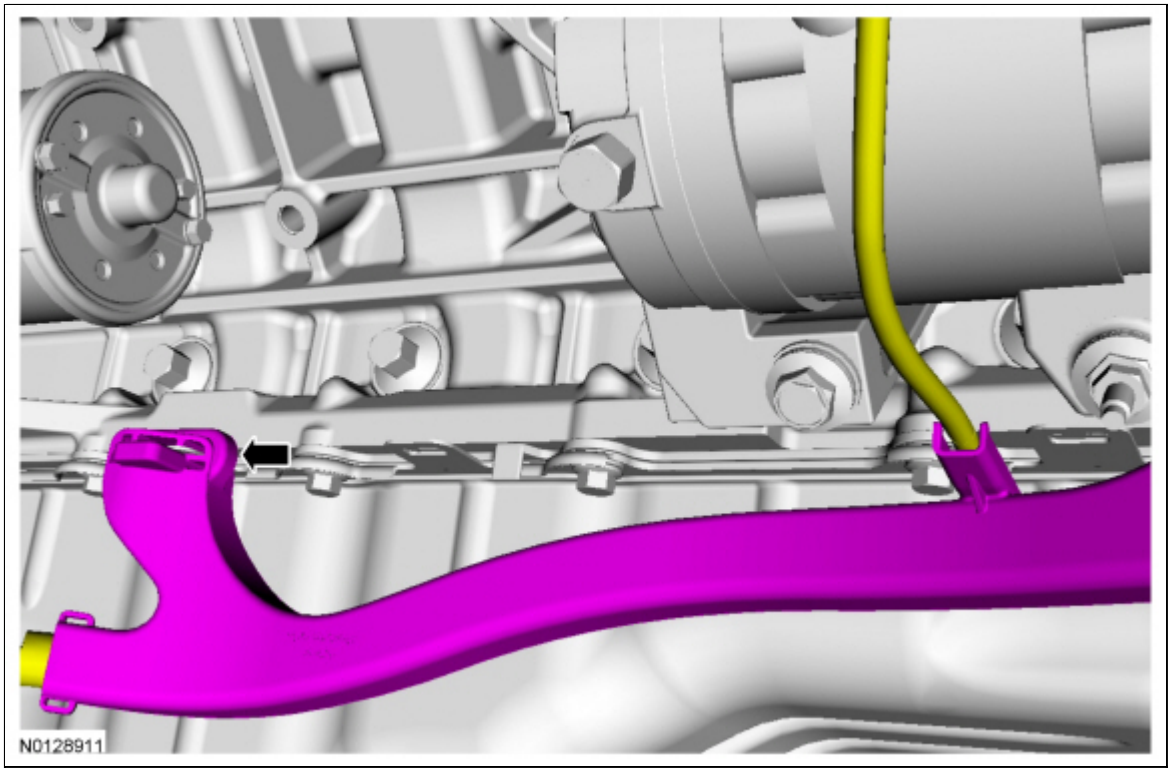


5. Attach the 2 wiring harness retainers to the oil pan stud bolts.

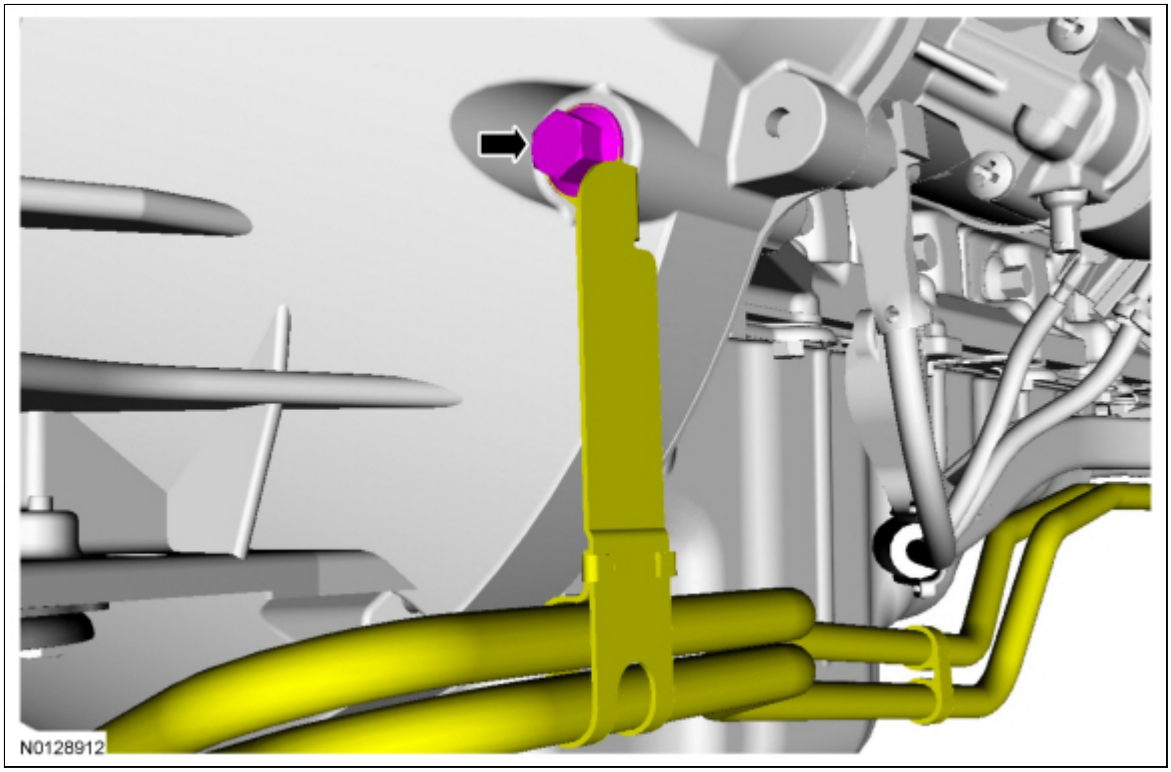


6. Attach the starter motor wiring harness retainer to the oil pan.

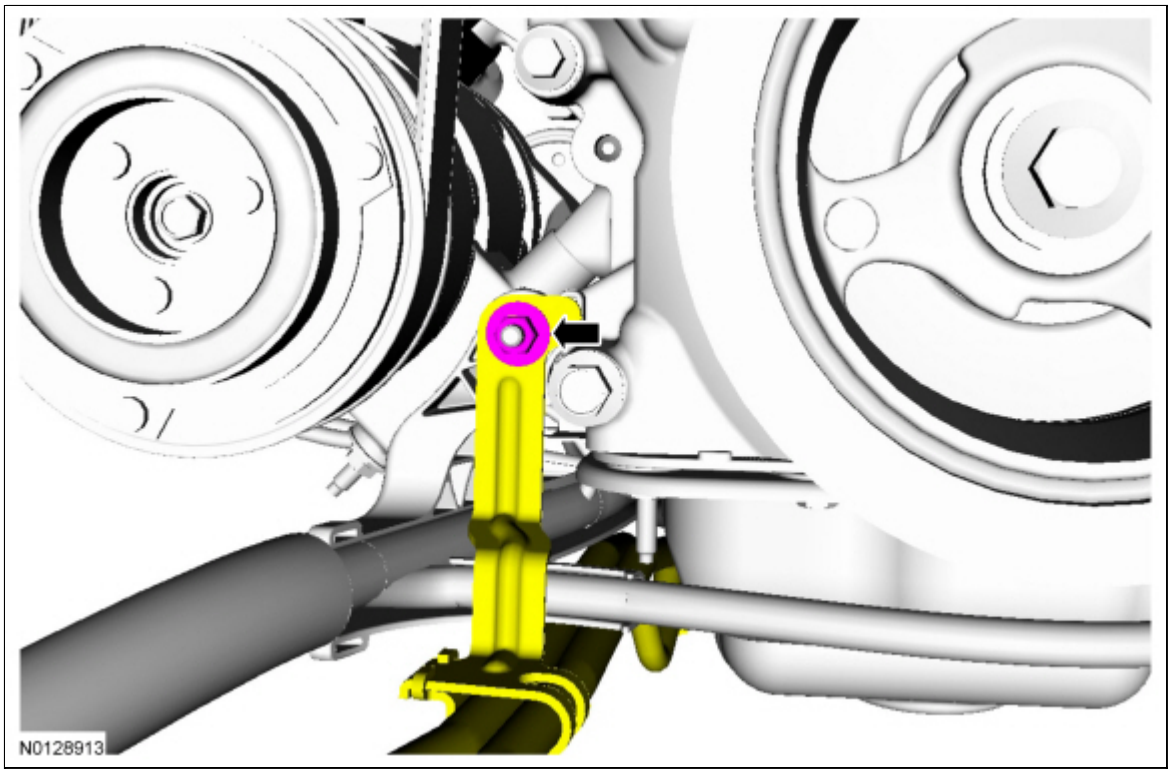
repair4less



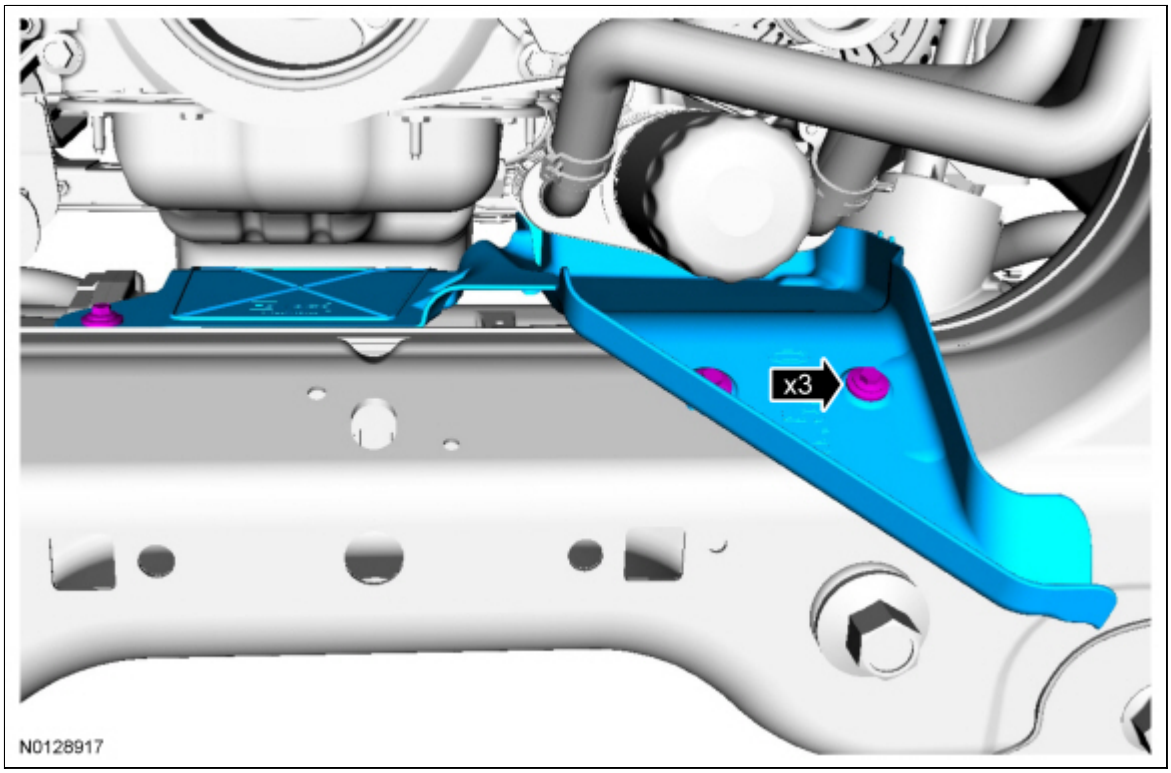
7. Install the transmission cooler tube bracket and the bolt onto the bellhousing.
    - Tighten to 48 Nm (35 lb-ft).



8. Install the transmission cooler tube bracket and the nut onto the engine front cover stud bolt.
    - Tighten to 13 Nm (115 lb-in).



9. Install the oil drain gutter and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



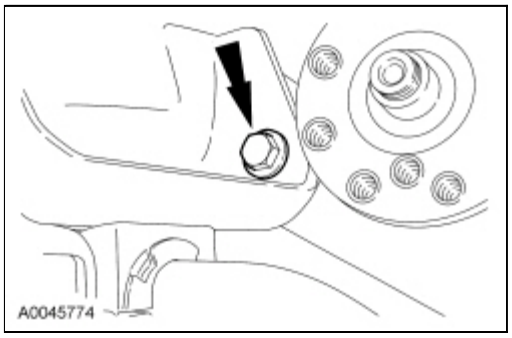
Four Wheel Drive (4X4) vehicles

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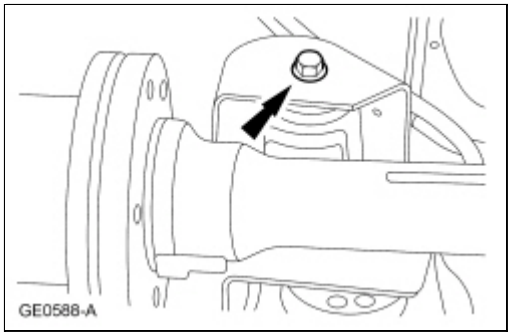
10. ***NOTICE:*** **Use care when positioning the front axle housing, or the vacuum tubes to the axle solenoid may become disconnected or damaged.**

    Raise the front axle carrier into position.

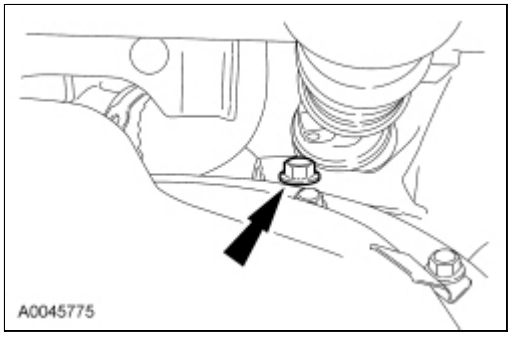
11. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



12. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

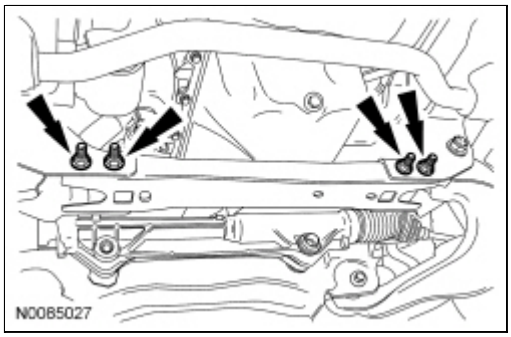


13. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

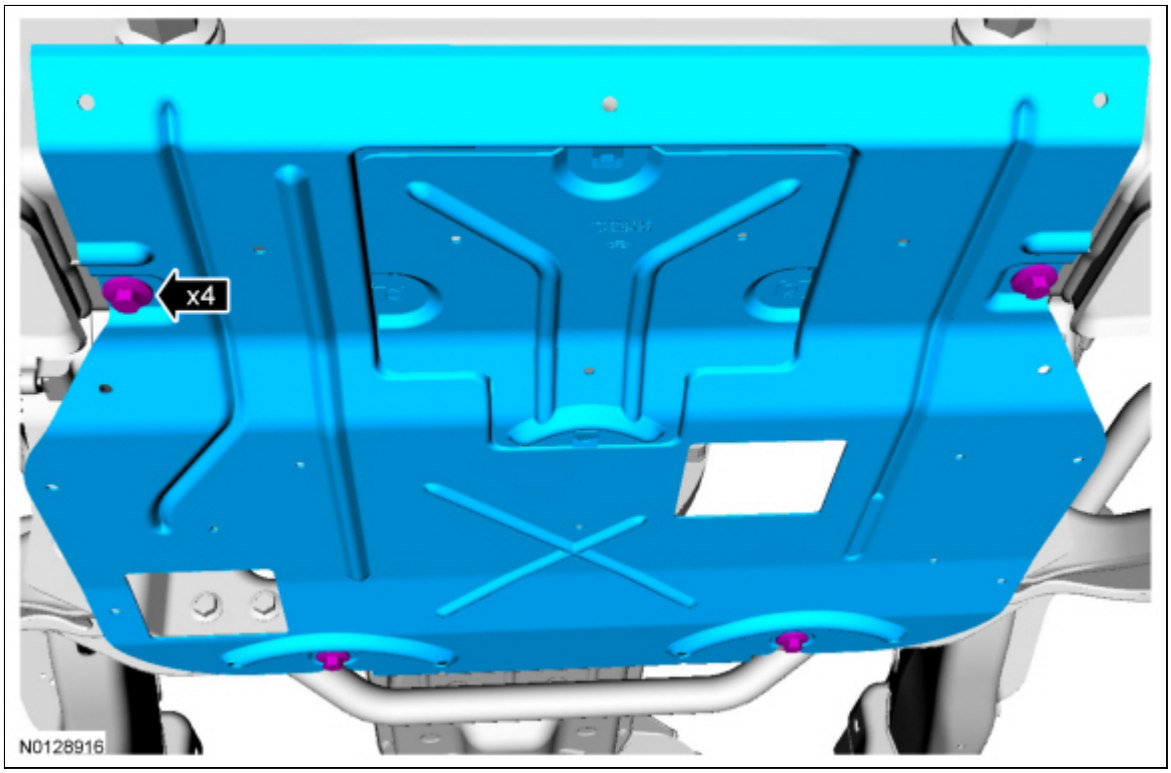


All vehicles

14. Position the crossmember and install the 4 nuts and bolts.
    - Tighten to 90 Nm (66 lb-ft).



15. If equipped, install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).



16. Install the oil level indicator.
17. Fill the engine with clean engine oil.
18. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Oil Pump Screen and Pickup Tube

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the oil pan. For additional information, refer to Engine Lubrication Components — Exploded View and Oil Pan in this section.

3. Remove the 3 bolts and the oil pump screen and pickup tube assembly.
   - Discard the O-ring seal.

Installation

1. **NOTE:** The 2 oil pump screen and pickup tube-to-oil pump bolts must be tightened prior to tightening the oil pump screen and pickup tube-to-spacer bolt.

   Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts. Tighten the 2 oil pump screen and pickup tube-to-oil pump bolts in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.

2. Tighten the oil pump screen and pickup tube-to-spacer bolt to 25 Nm (18 lb-ft).

3. Install the oil pan. For additional information, refer to Engine Lubrication Components — Exploded View and Oil Pan in this section.

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Oil Pump

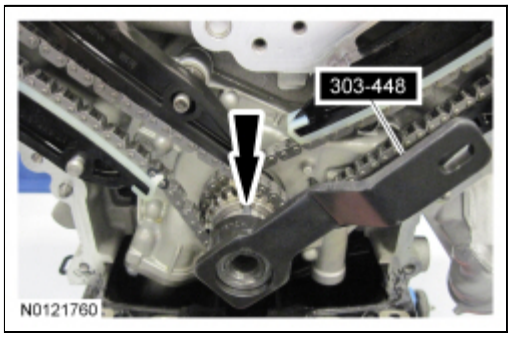
Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Removal

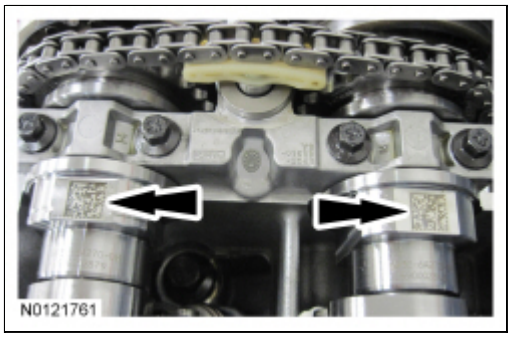
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
3. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.

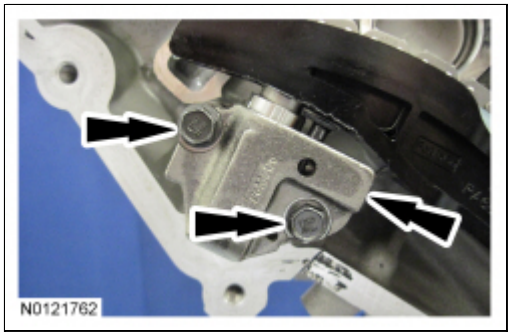


4. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

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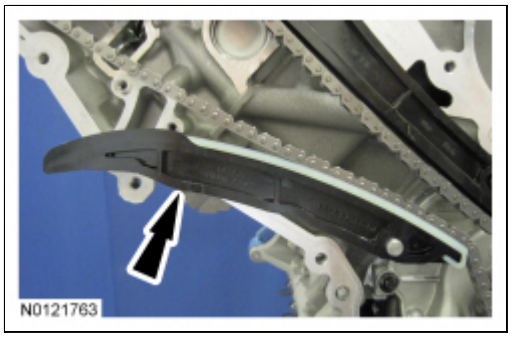


5. Remove the 2 bolts and the RH primary timing chain tensioner.



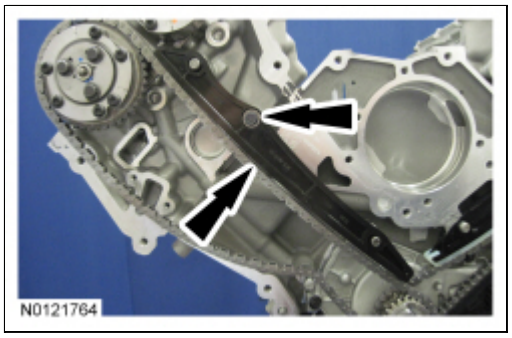
6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

   Remove the RH timing chain tensioner arm.

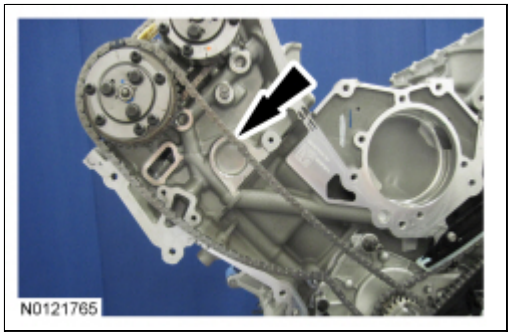


7. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

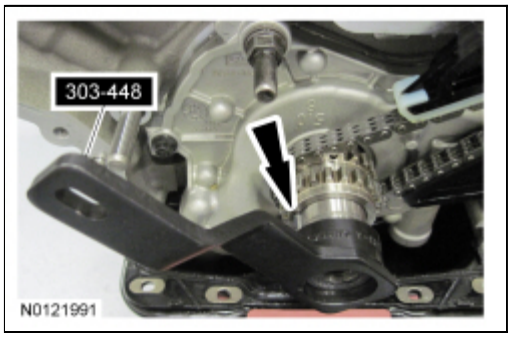
   Remove the bolt and the RH timing chain guide.



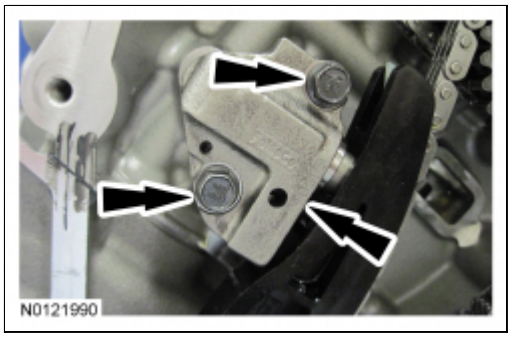
8. Remove the RH primary timing chain.



9. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.



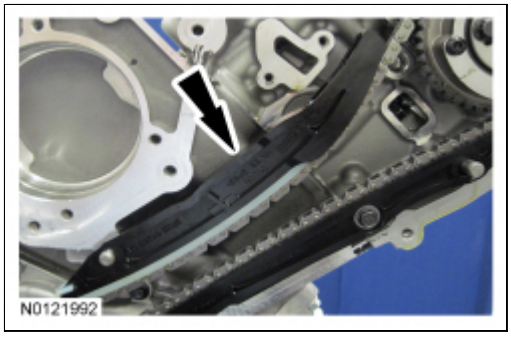
10. Remove the 2 bolts and the LH primary timing chain tensioner.



11. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

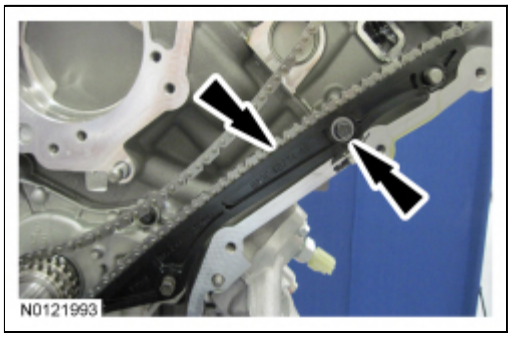
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Remove the LH timing chain tensioner arm.

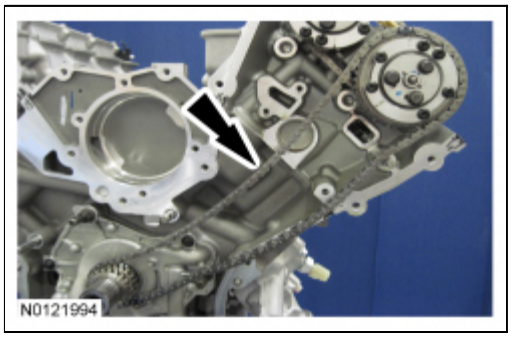


12. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

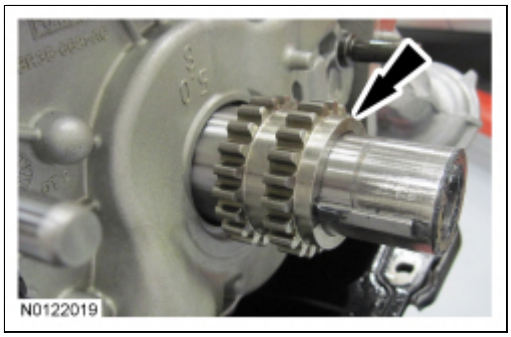
    Remove the bolt and the LH timing chain guide.



13. Remove the LH primary timing chain.



14. Remove the crankshaft sprocket.



15. Remove the oil pump screen and pickup tube. For additional information, refer to Engine Lubrication Components — Exploded View and Oil Pump Screen and Pickup Tube in this section.

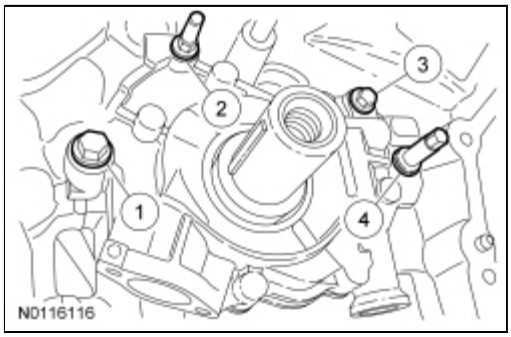
16. Remove the 2 bolts, the 2 stud bolts and the oil pump.

Installation

1. Rotate the inner rotor of the oil pump assembly to align the flats on the crankshaft and slip the oil pump over the crankshaft until seated against the block.
    - Rotate the oil pump until the bolt holes are aligned to the block and install the fasteners.

2. **NOTE:** Oil pump must be held against the cylinder block until all bolts are tightened.

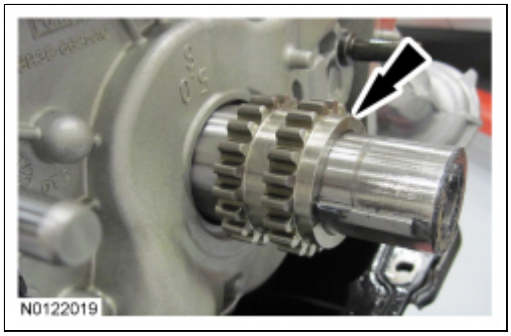
   Tighten the fasteners in the sequence shown in 3 stages:
    - Stage 1: Hand tighten.
    - Stage 2: Tighten the bolt (1) to 10 Nm (89 lb-in), the stud bolt (2) to 25 Nm (18 lb-ft), the bolt (3) to 10 Nm (89 lb-in) and the stud bolt (4) to 20 Nm (177 lb-in).
    - Stage 3: Tighten the bolt (1) an additional 45 degrees, the stud bolt (2) an additional 75 degrees, the bolt (3) an additional 45 degrees and the stud bolt (4) an additional 60 degrees.



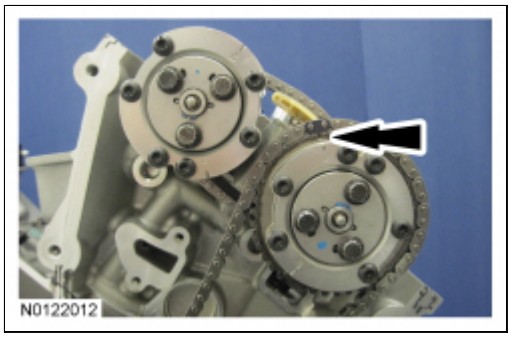
3. Install the oil pump screen and pickup tube. For additional information, refer to Engine Lubrication Components — Exploded View and Oil Pump Screen and Pickup Tube in this section.

4. Install the crankshaft sprocket with the flange facing forward.

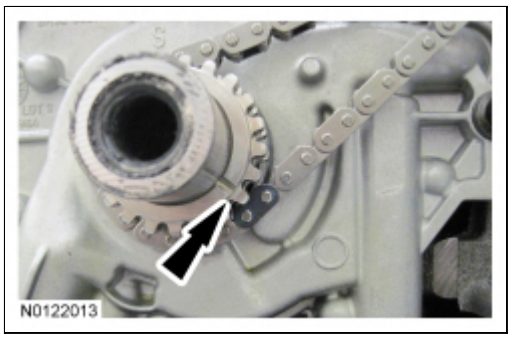
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5. Install the LH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.

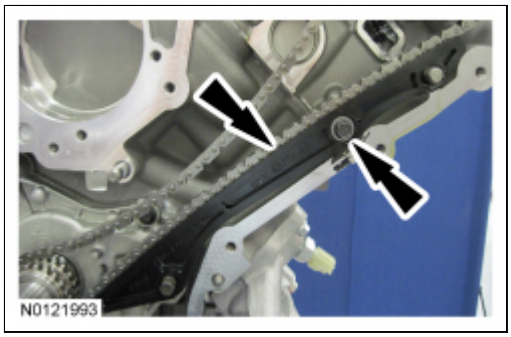


6. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



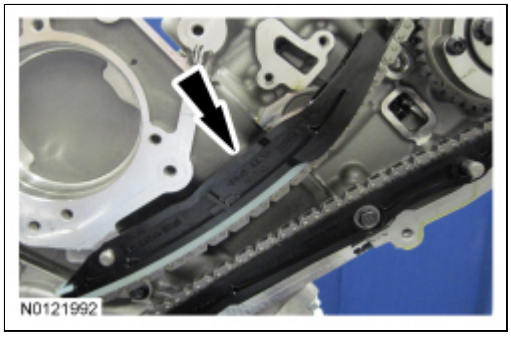
7. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

    Install the LH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



8. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

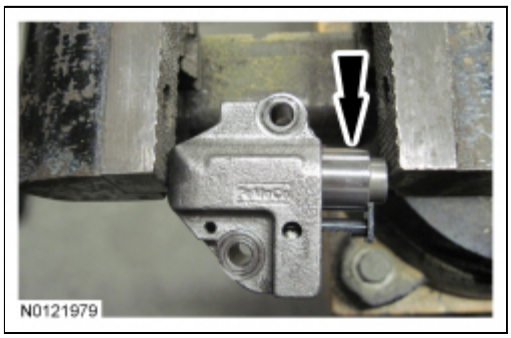
   Install the LH timing chain tensioner arm.



NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

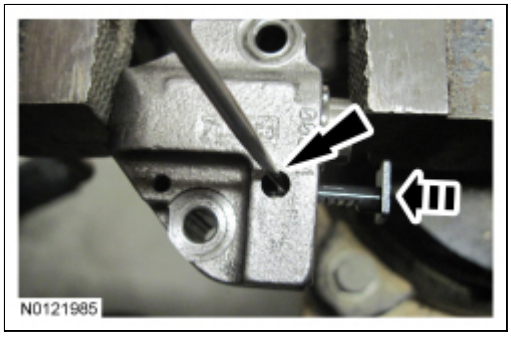
9. ***NOTICE:*** **Do not compress the ratchet assembly or damage to the tensioner will occur.**

   Compress the primary timing chain tensioner plunger, using an edge of a vise.

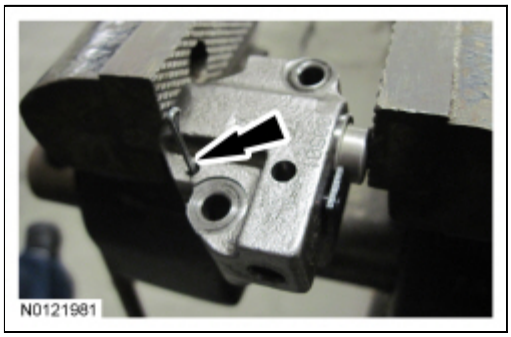


10. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.

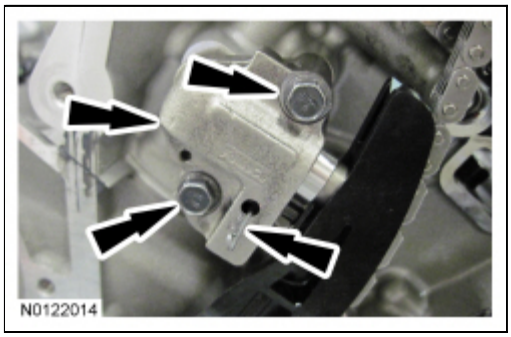
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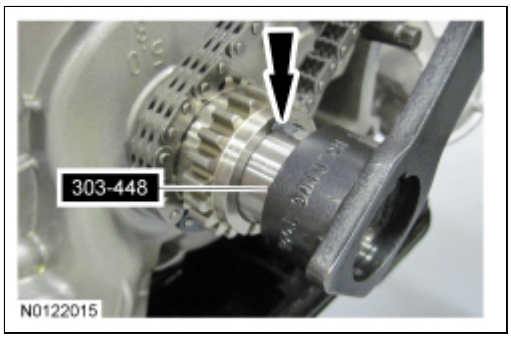
11. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



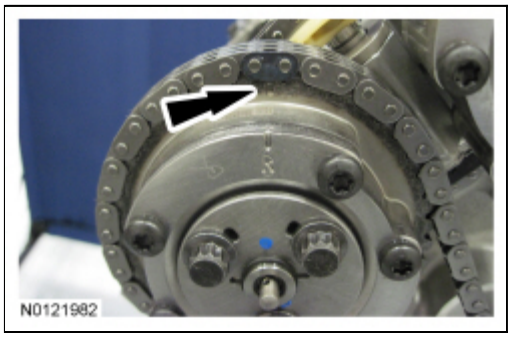
12. Install the LH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



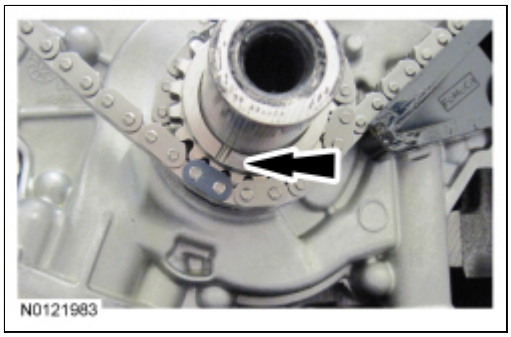
13. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



14. Install the RH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.

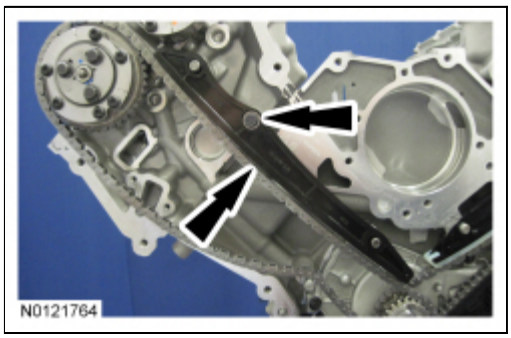


15. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



16. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

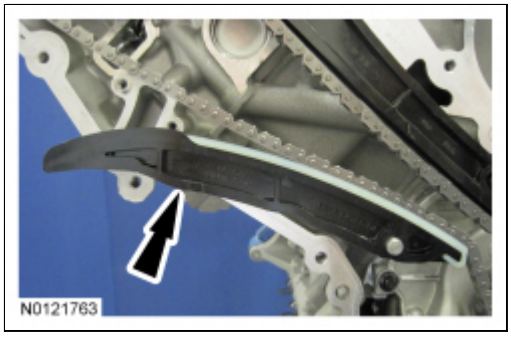
    Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



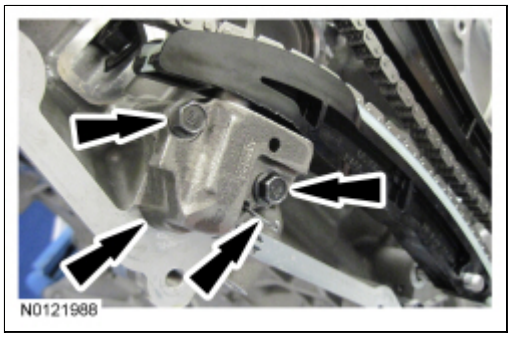
17. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

    Install the RH timing chain tensioner arm.

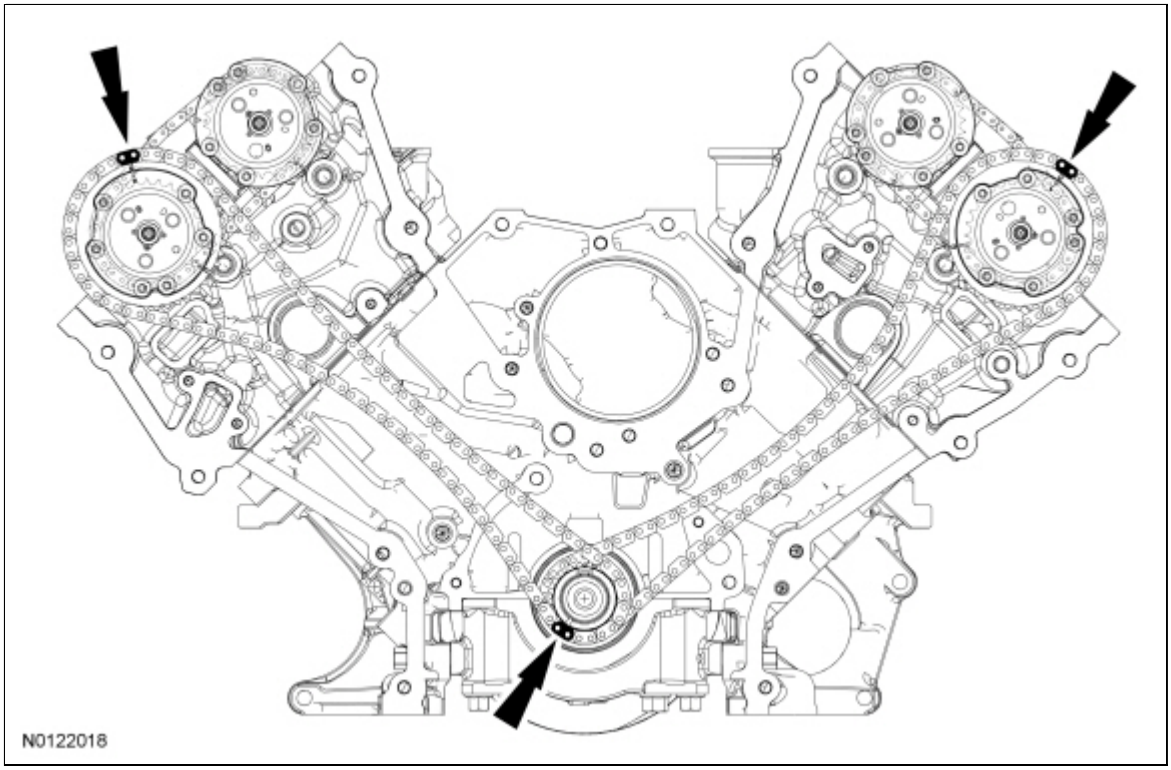
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18. Install the RH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



19. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



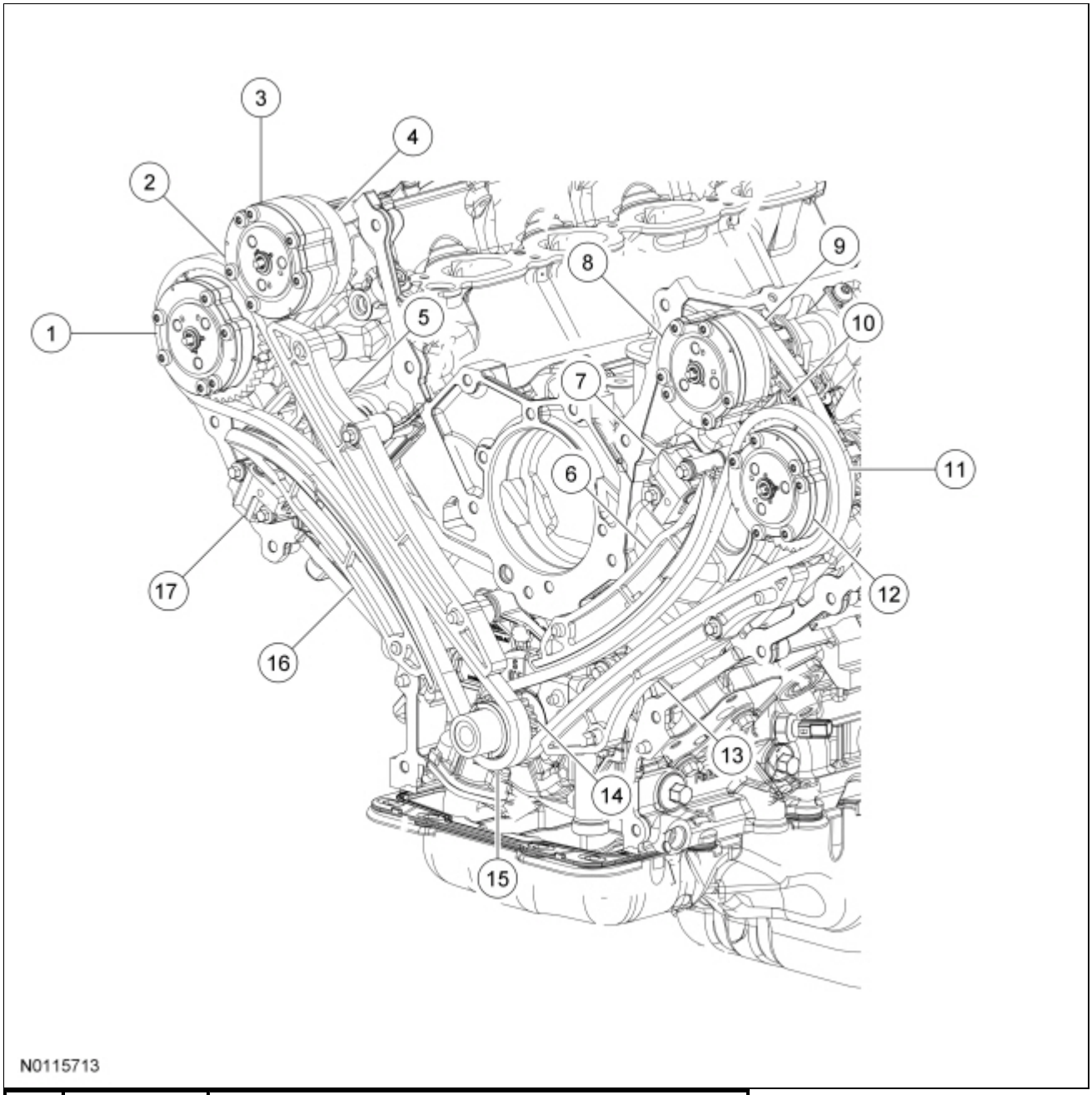
20. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

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Timing Drive Components

Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)



N0115713

Item	Part Number	Description
1	6256	RH exhaust camshaft Variable Camshaft Timing (VCT)
2	6K254	RH secondary tensioner
3	6256	RH intake camshaft VCT
4	6268	RH secondary timing chain
5	6M256	RH timing chain guide
6	6K255	LH timing chain tensioner arm
7	6L266	LH primary tensioner
8	6256	LH intake camshaft VCT

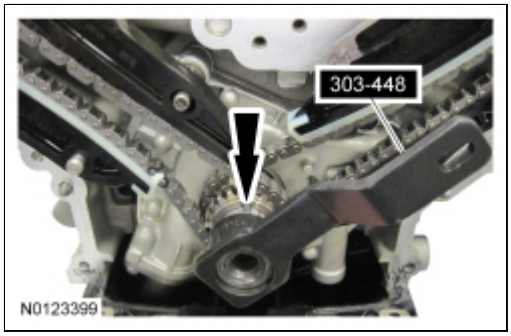
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9	6268	LH secondary timing chain
10	6K254	LH secondary tensioner
11	6268	LH primary timing chain
12	6256	LH exhaust camshaft VCT
13	6B274	LH timing chain guide
14	6306	Crankshaft sprocket
15	6268	RH timing chain
16	6K255	RH timing chain tensioner arm
17	6L266	RH primary tensioner

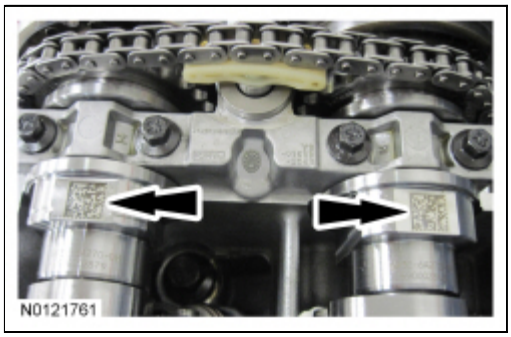
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

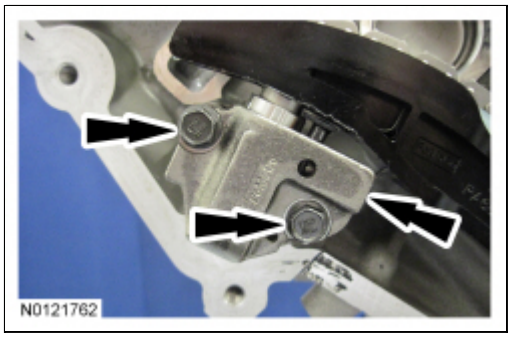
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



3. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

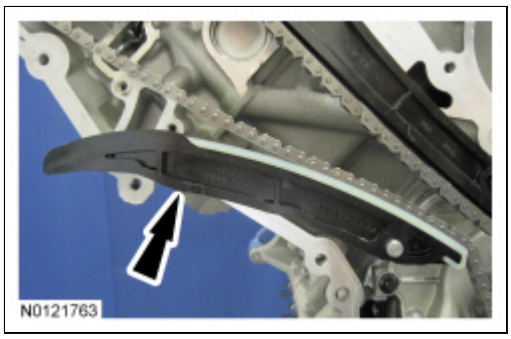


4. Remove the 2 bolts and the RH primary timing chain tensioner.



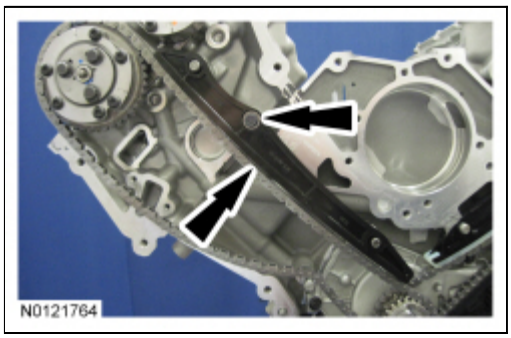
5. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

   Remove the RH timing chain tensioner arm.



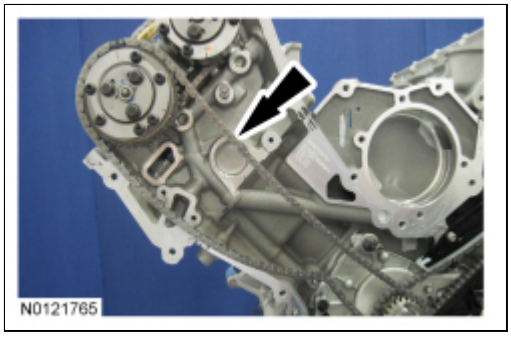
6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

   Remove the bolt and the RH timing chain guide.

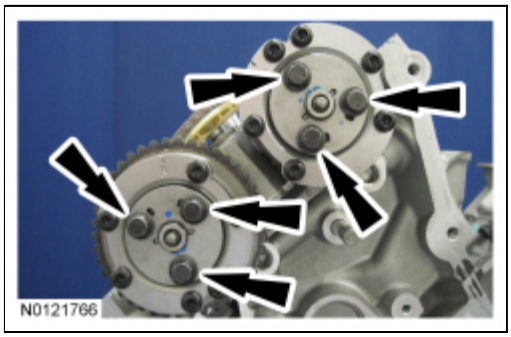


7. Remove the RH primary timing chain.

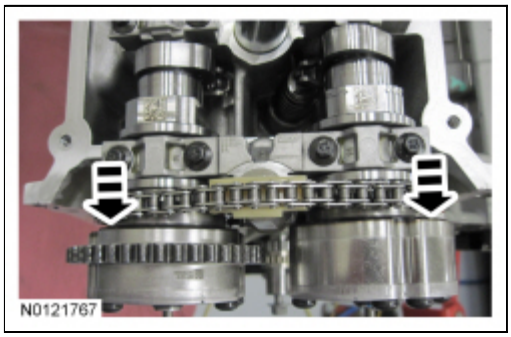
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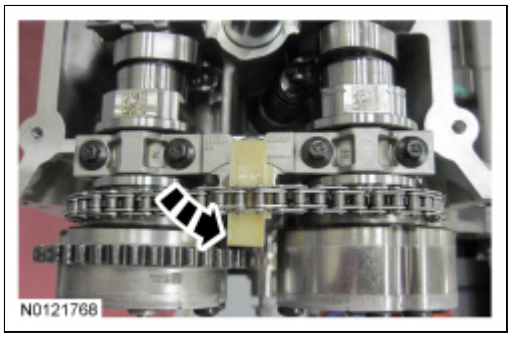
8. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



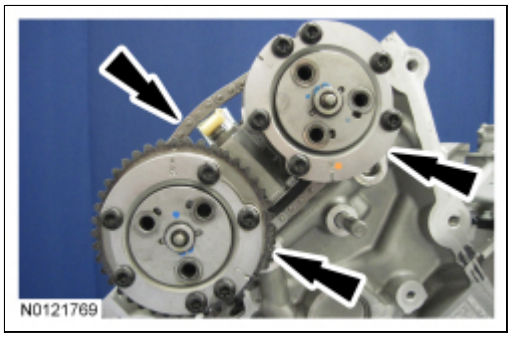
9. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



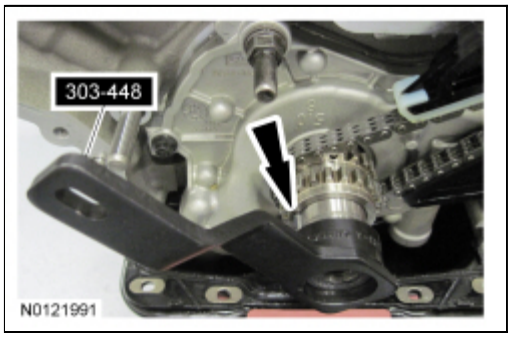
10. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.



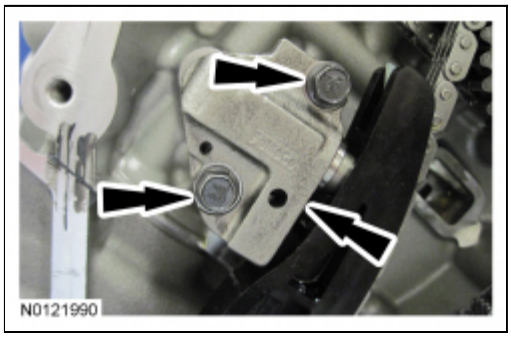
11. Remove the RH VCT assemblies and the RH secondary timing chain.



12. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.

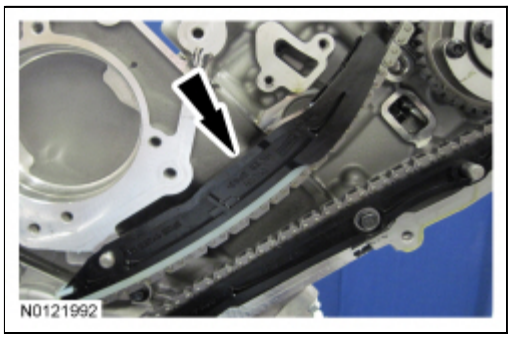


13. Remove the 2 bolts and the LH primary timing chain tensioner.



14. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

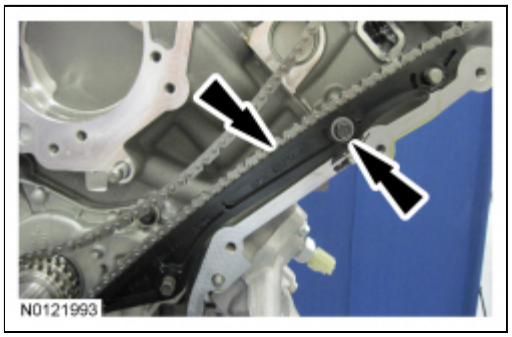
    Remove the LH timing chain tensioner arm.



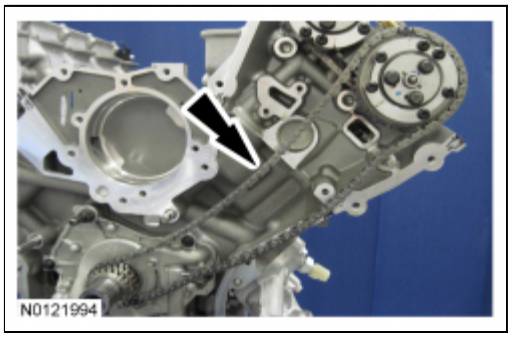
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15. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

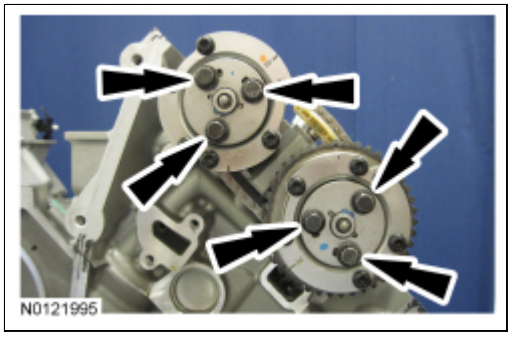
    Remove the bolt and the LH timing chain guide.



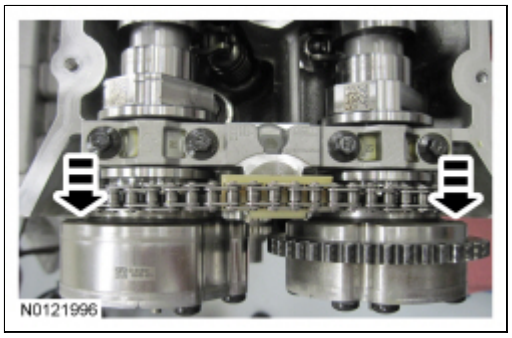
16. Remove the LH primary timing chain.



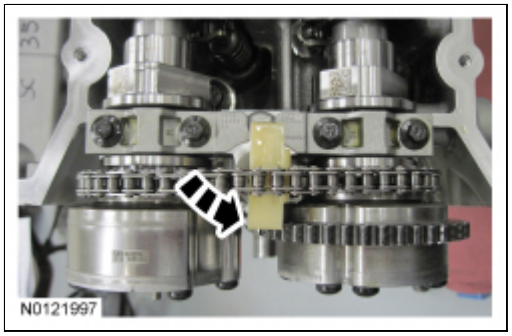
17. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



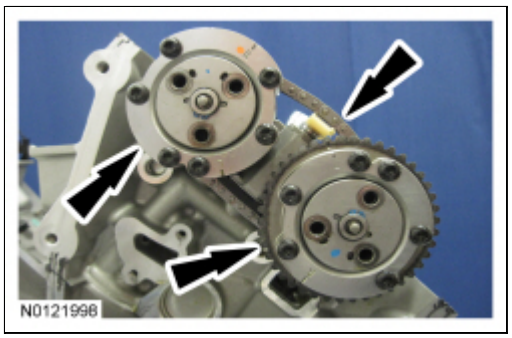
18. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



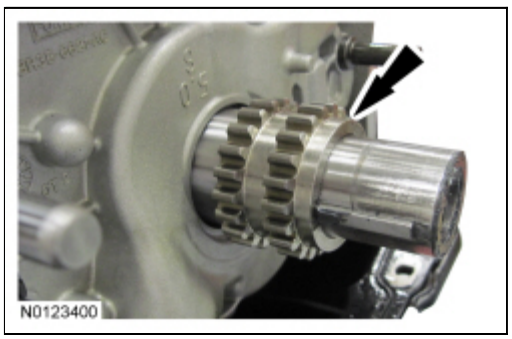
19. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.



20. Remove the LH VCT assemblies and the LH secondary timing chain.



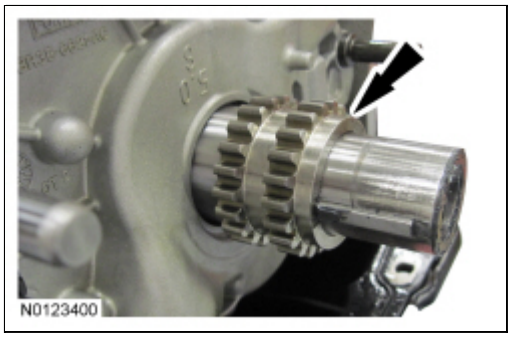
21. Remove the crankshaft sprocket.



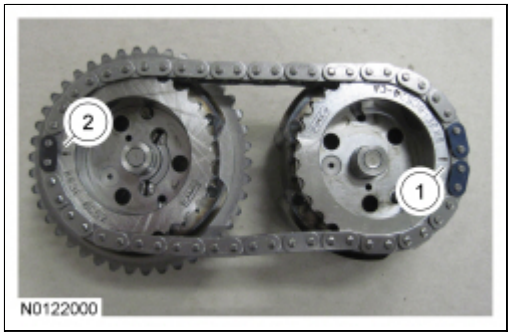
Installation

1. Install the crankshaft sprocket with the flange facing forward.

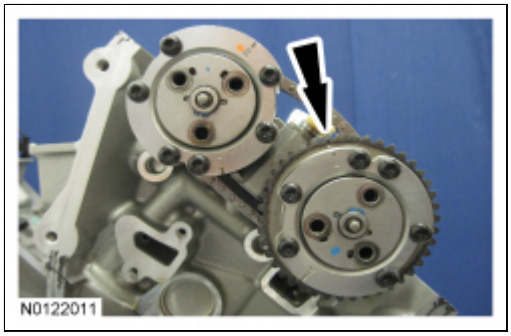
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2. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

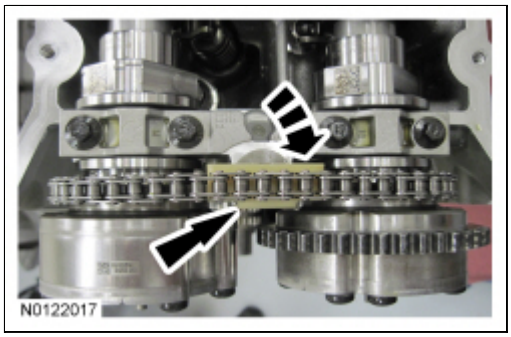


3. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



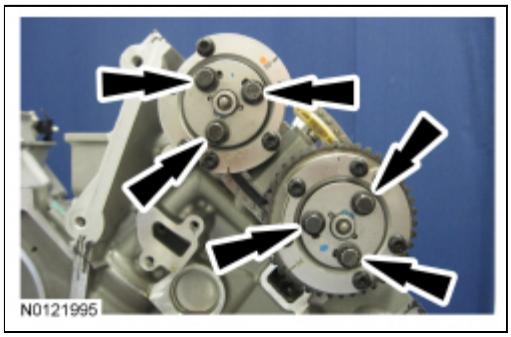
4. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.

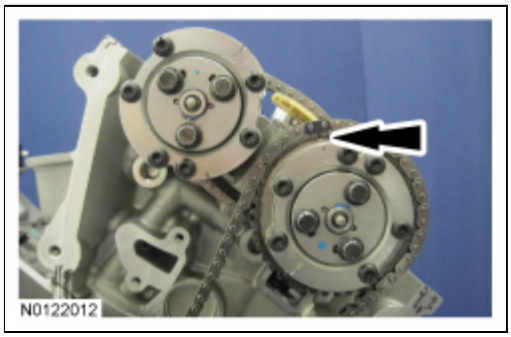


5. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

   Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.
   - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

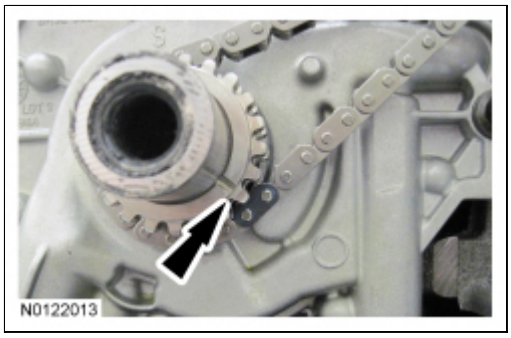


6. Install the LH primary timing chain.
   - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



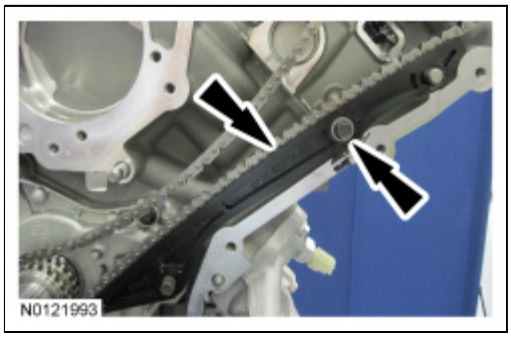
7. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.

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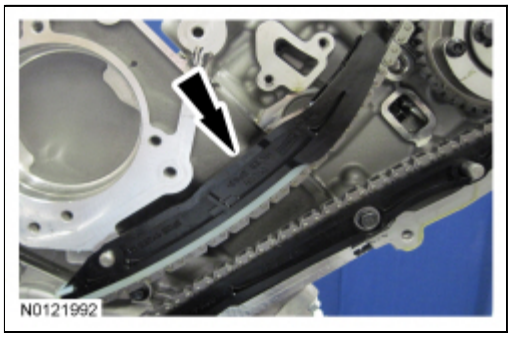
8. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

   Install the LH timing chain guide and bolt.
   - Tighten to 10 Nm (89 lb-in).



9. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

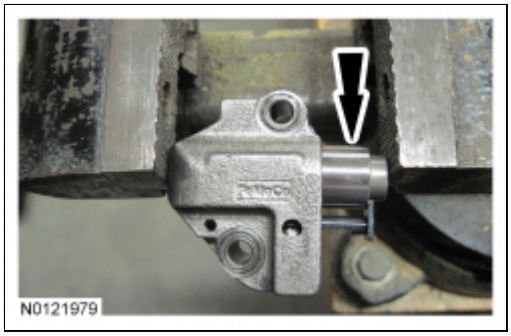
   Install the LH timing chain tensioner arm.



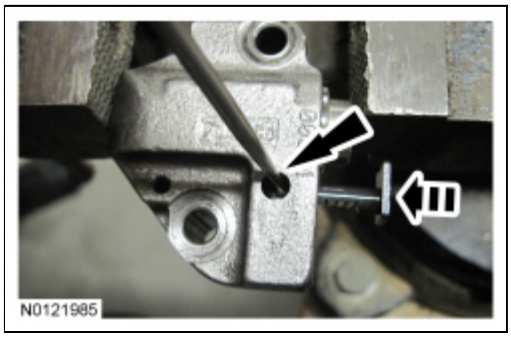
NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

10. ***NOTICE:*** **Do not compress the ratchet assembly or damage to the tensioner will occur.**

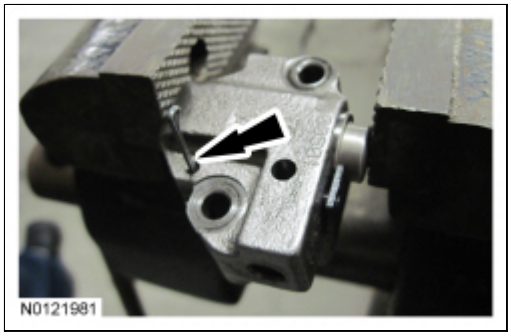
    Compress the primary timing chain tensioner plunger, using an edge of a vise.



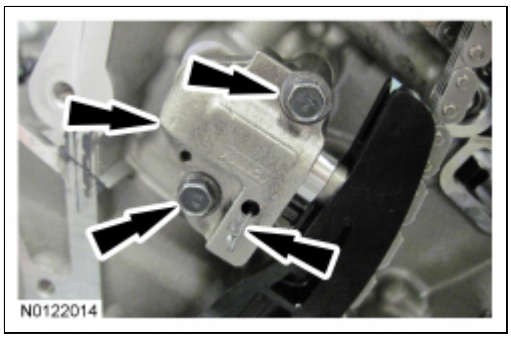
11. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



12. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.

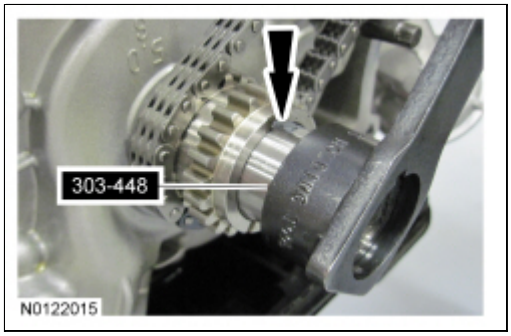


13. Install the LH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.

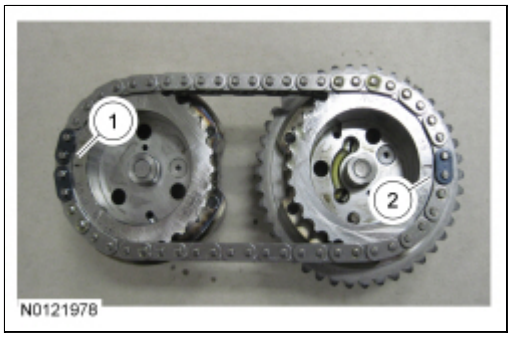


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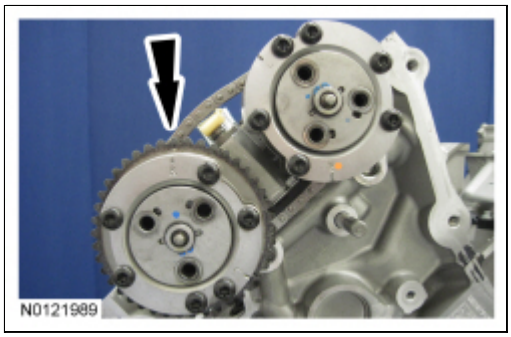
14. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



15. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

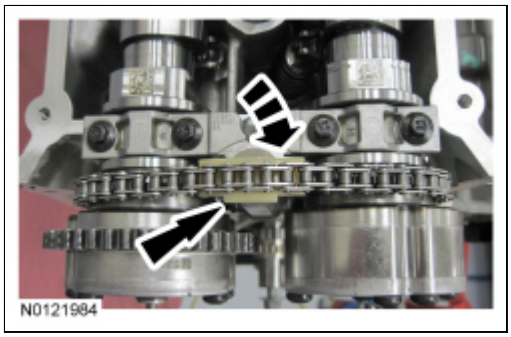


16. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



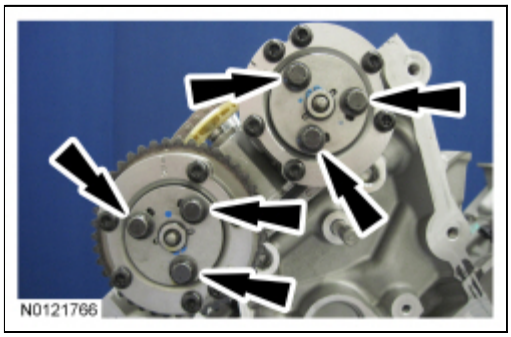
17. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.

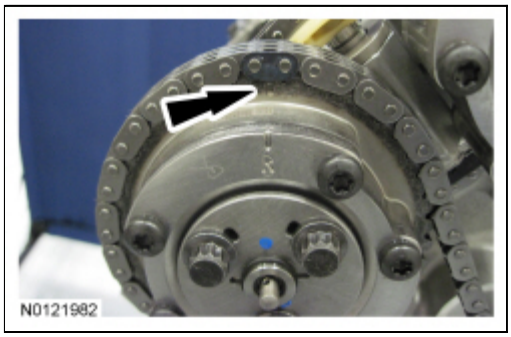


18. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

    Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.
    - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

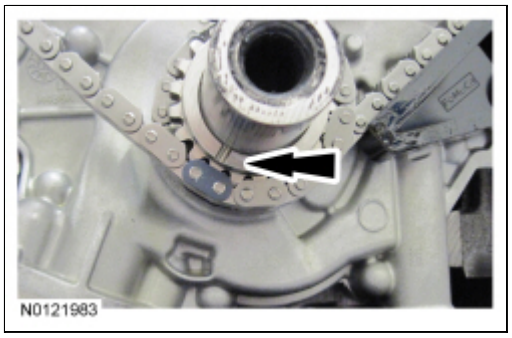


19. Install the RH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



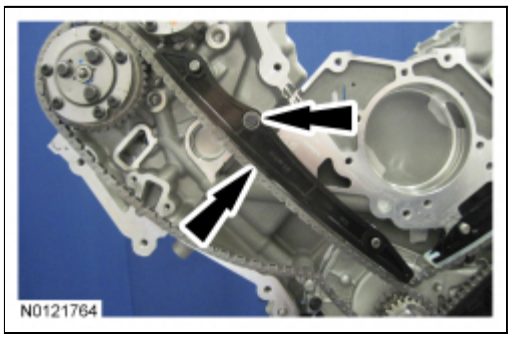
20. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.

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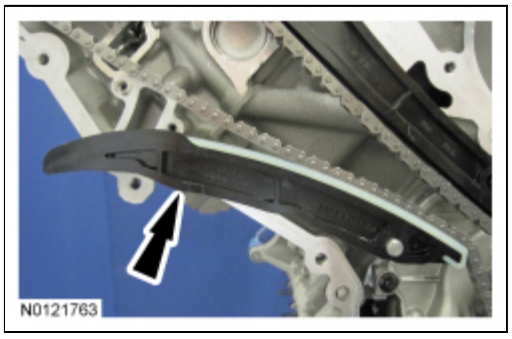
21. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

    Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).

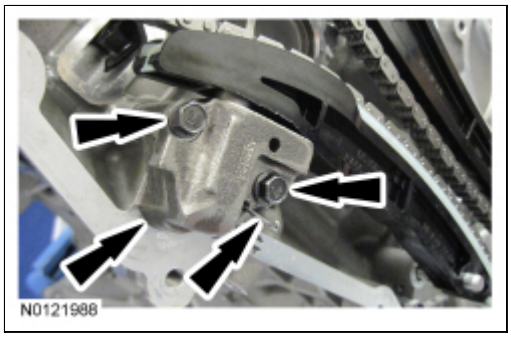


22. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

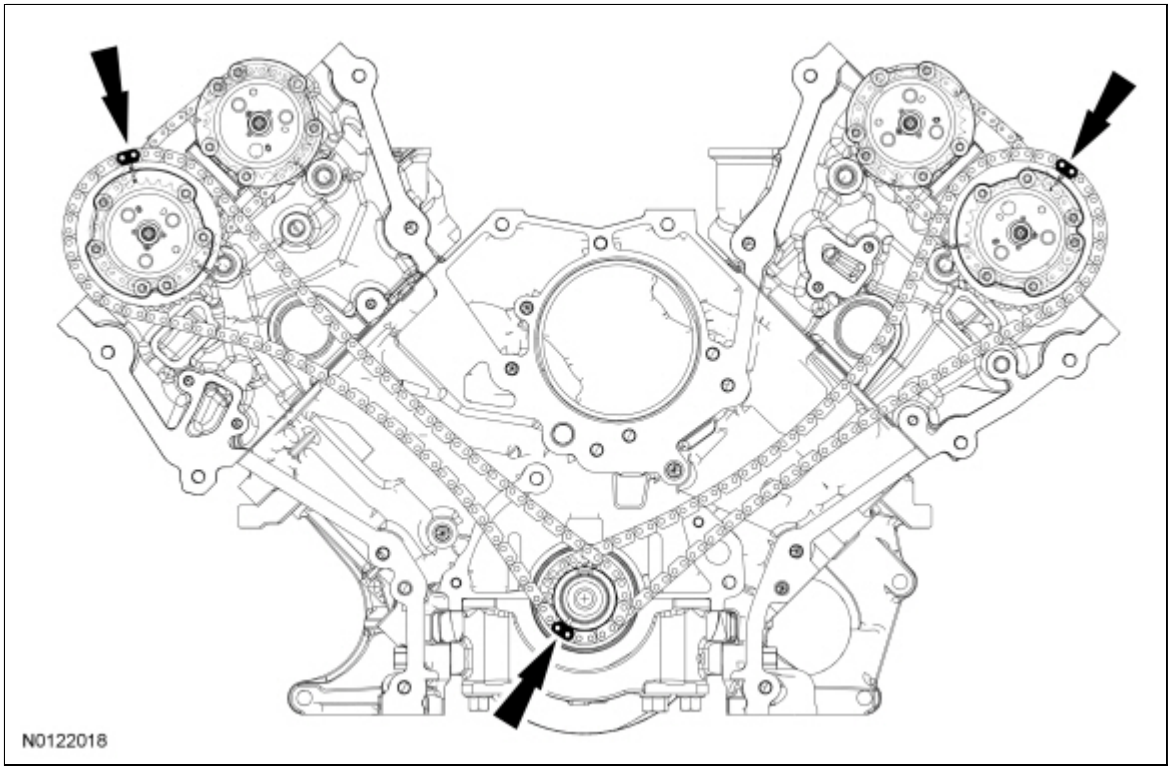
    Install the RH timing chain tensioner arm.



23. Install the RH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



24. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



25. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

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Valve Cover — LH

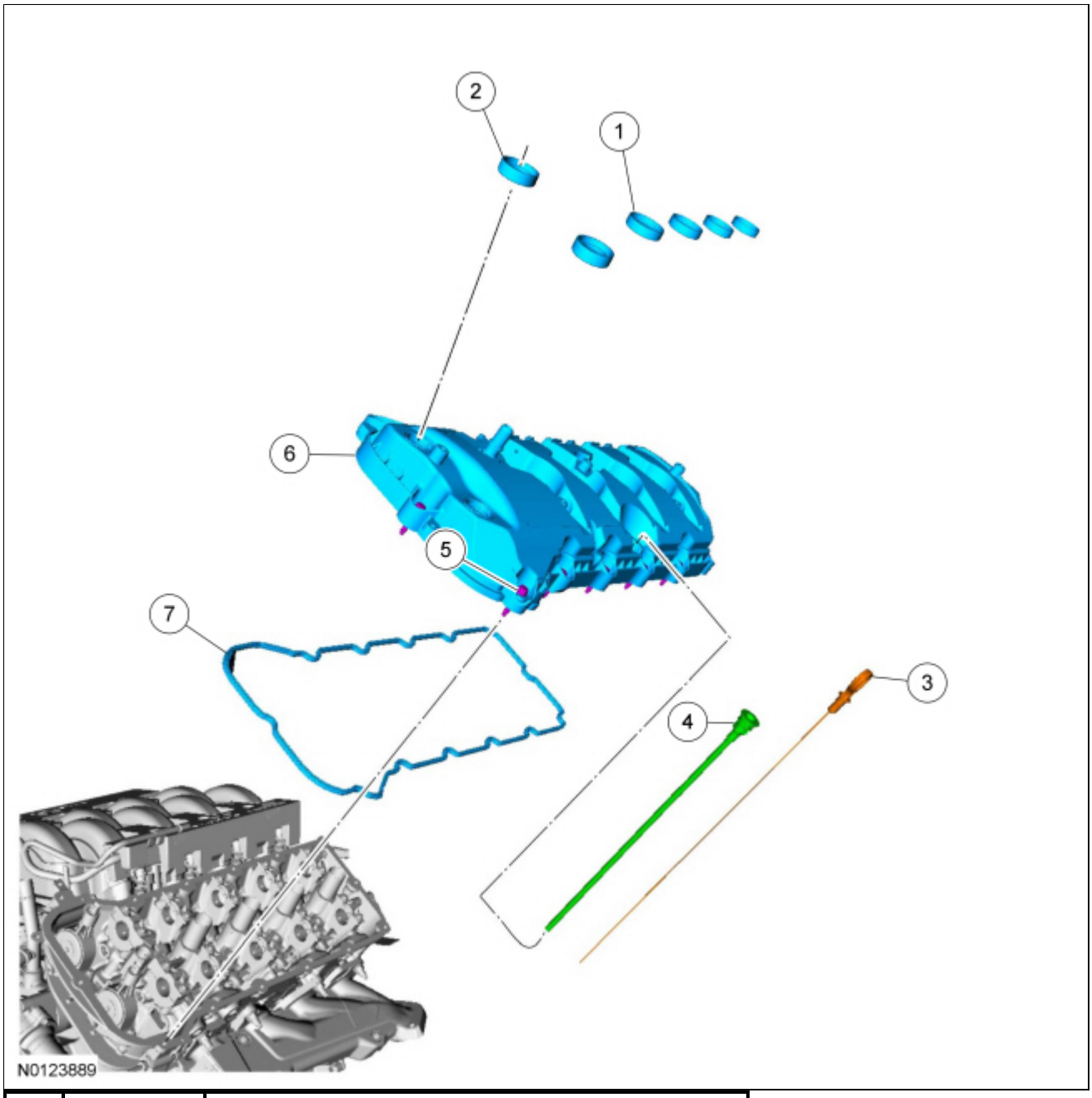
Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

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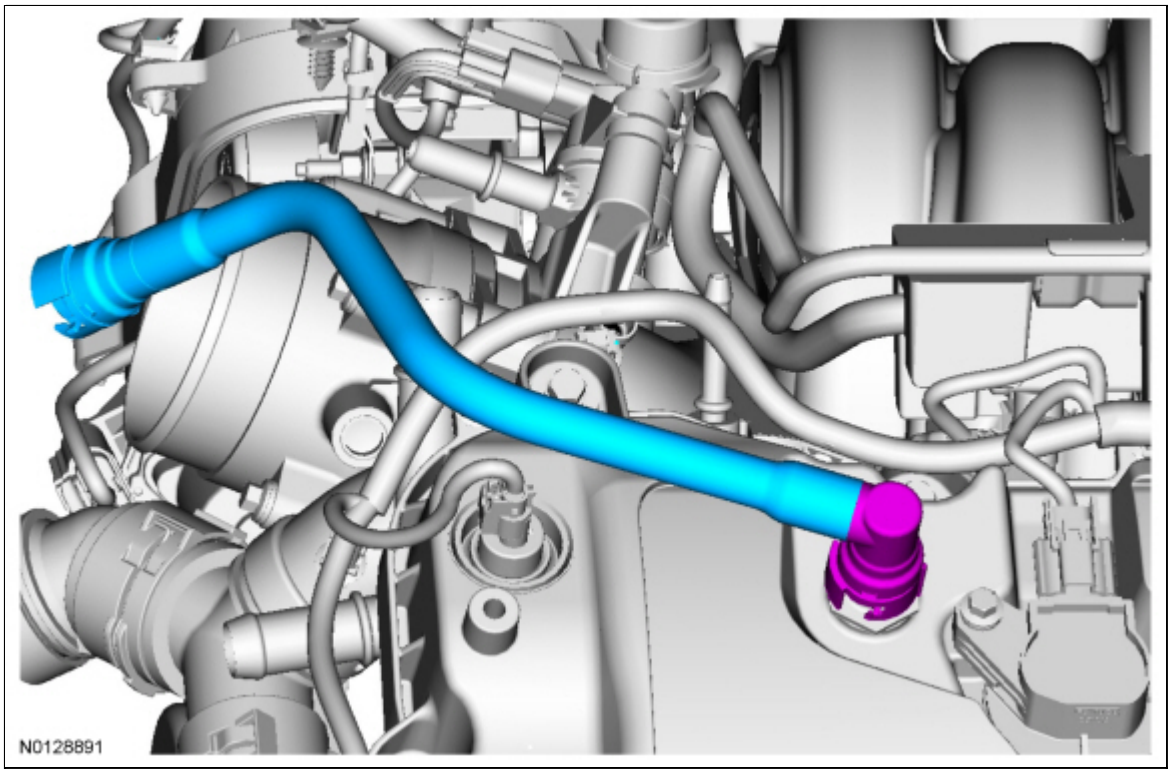
Item	Part Number	Description
1	6C535	Spark plug tube seal (4 required)
2	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
3	6750	Oil level indicator
4	6754	Oil level indicator tube
5	6C519	Valve cover bolt (part of 6582) (14 required)
6	6582	LH valve cover
7	6584	LH valve cover gasket

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. Remove the Air Cleaner (ACL) outlet pipe and the ACL cover as an assembly. For additional information, refer to Section 303-12 .

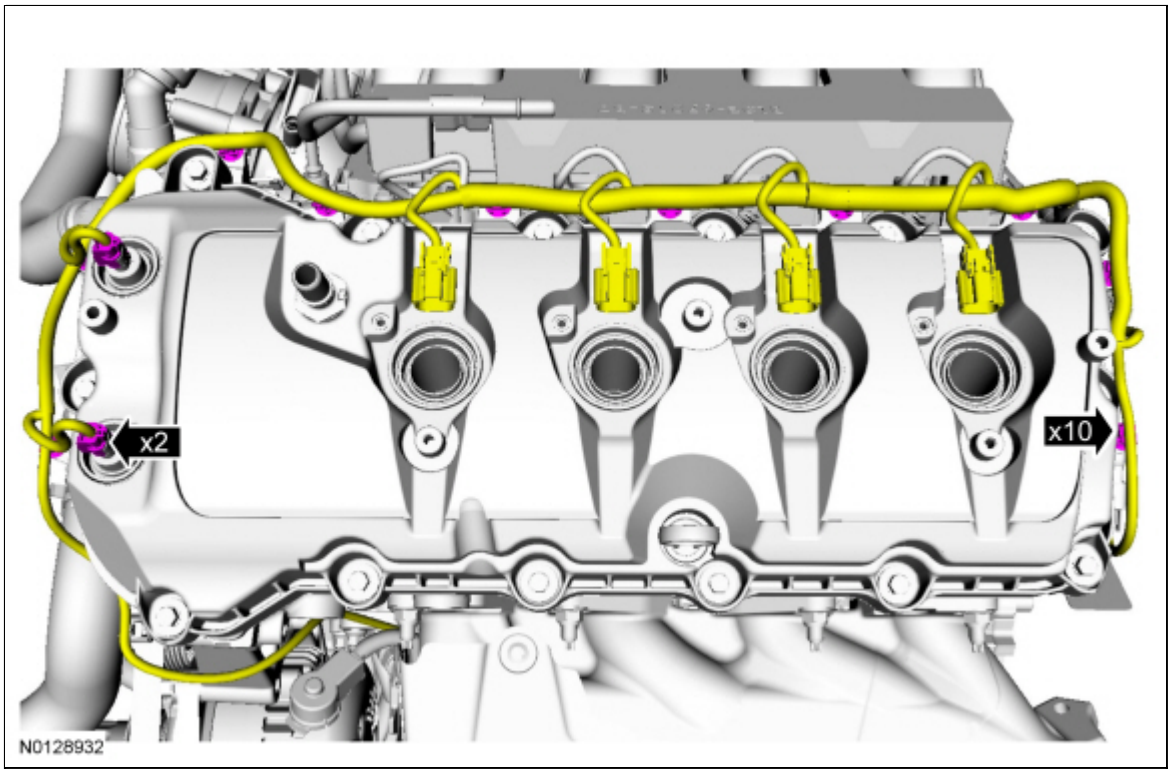
2. Remove the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .



3. Remove the LH ignition coils. For additional information, refer to Section 303-07C .

4. Disconnect the 2 LH Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers.

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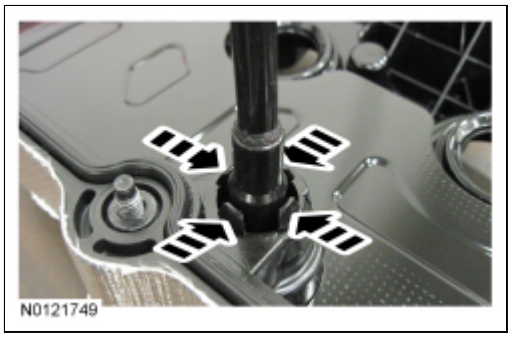


5. Remove the oil level indicator.

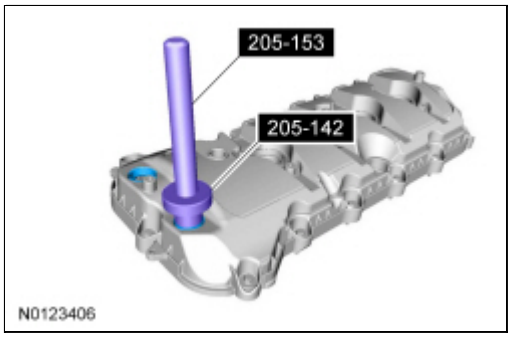
6. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   Loosen the 14 bolts and remove the LH valve cover and gasket.
   - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
   - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

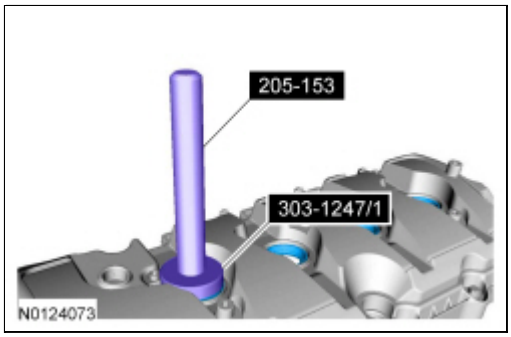
7. Depress the 4 tabs and remove the oil level indicator tube.



8. Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.
   - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



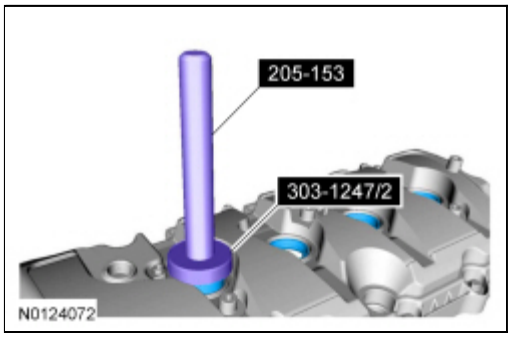
9. Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

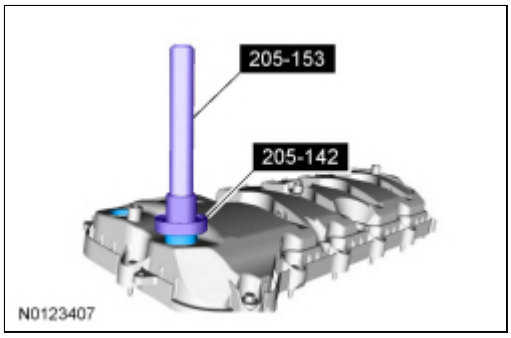
   Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

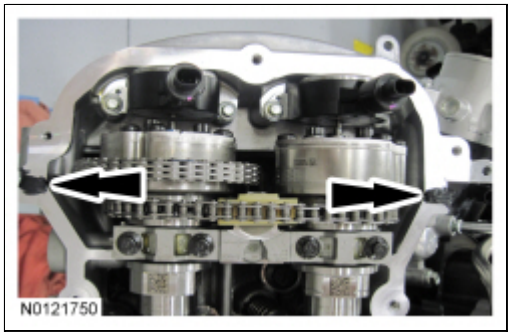
   Using the Differential Bearing Cone Installer and Handle, install new VCT variable force solenoid seal (s).

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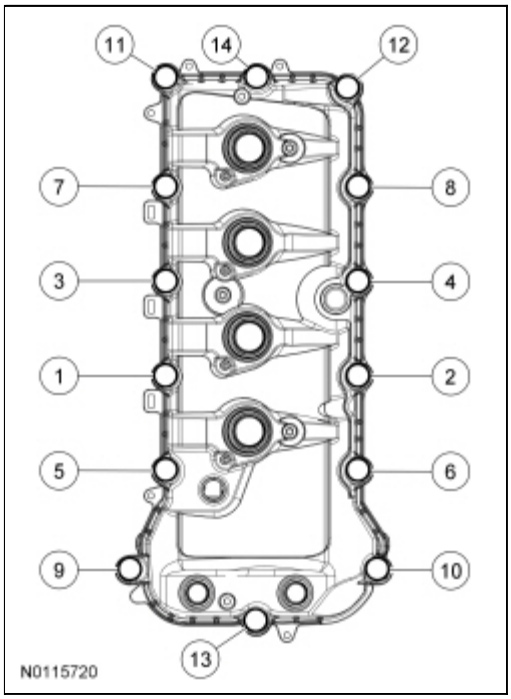


3. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-LH cylinder head joints.



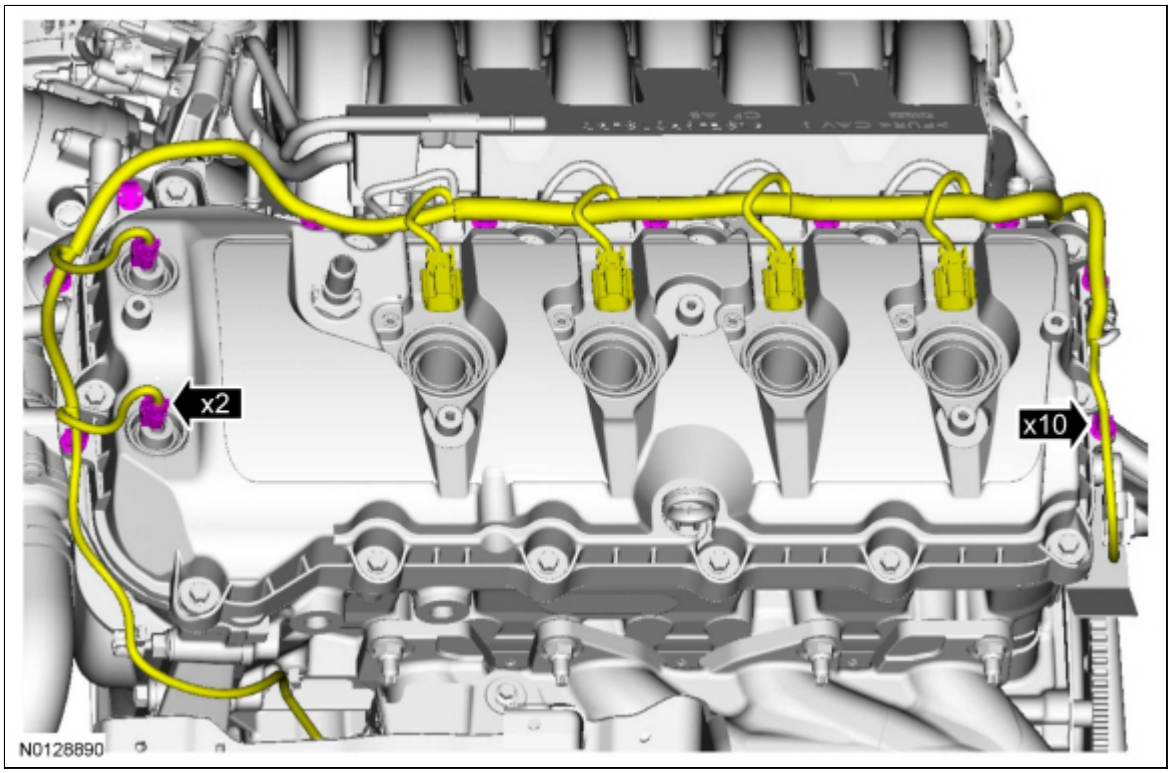
4. Position the LH valve cover and new gasket on the cylinder head.
   - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



5. Install the oil level indicator tube.
    - Push the oil level indicator tube into the valve cover until it clicks into place.

6. Install the oil level indicator.

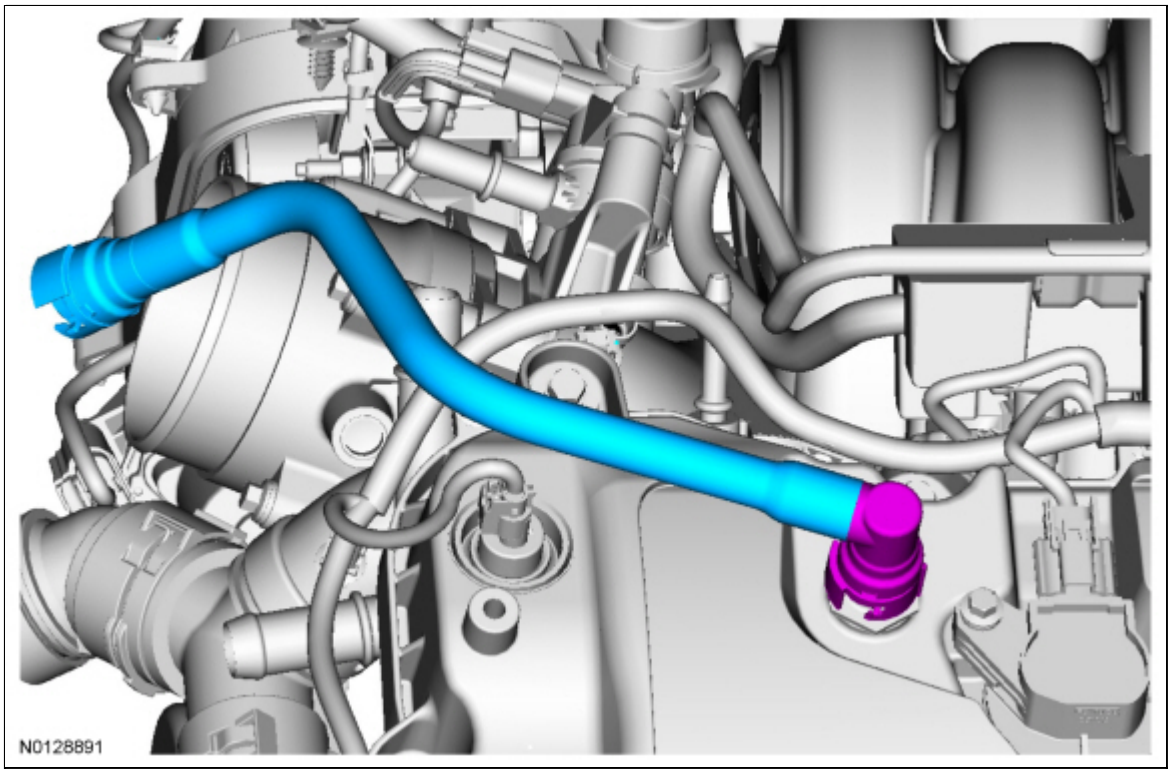
7. Connect the 2 LH VCT variable force solenoid electrical connectors.
    - Attach the 10 wiring harness retainers.



8. Install the LH ignition coils. For additional information, refer to Section 303-07C .

9. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .

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10. Install the Air Cleaner (ACL) outlet pipe and ACL cover assembly. For additional information, refer to Section 303-12 .

Valve Cover — RH

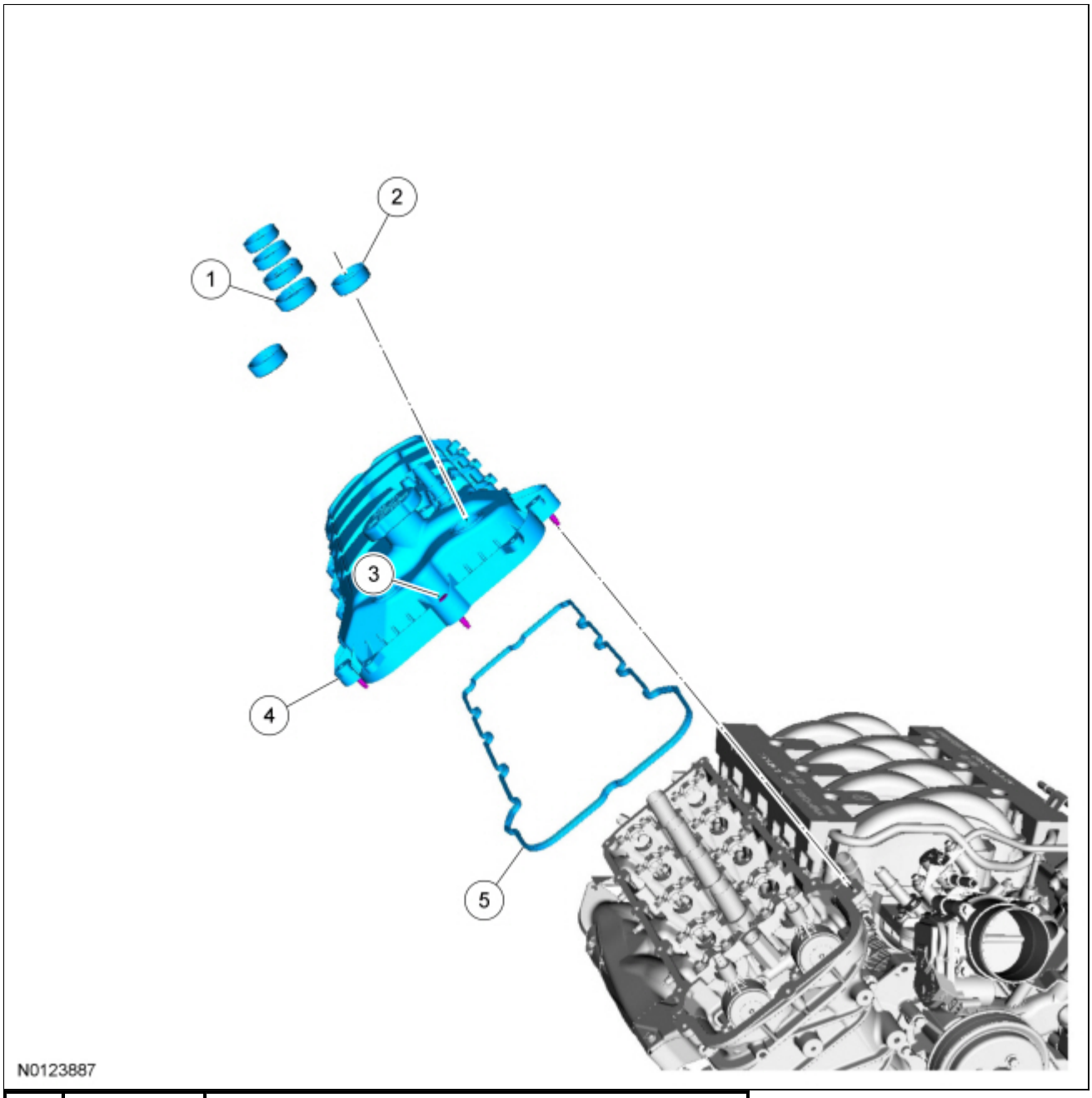
Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

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Item	Part Number	Description
1	6C535	Spark plug tube seal (4 required)
2	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
3	—	Valve cover bolt (part of 6582) (14 required)
4	6582	RH valve cover
5	6584	RH valve cover gasket

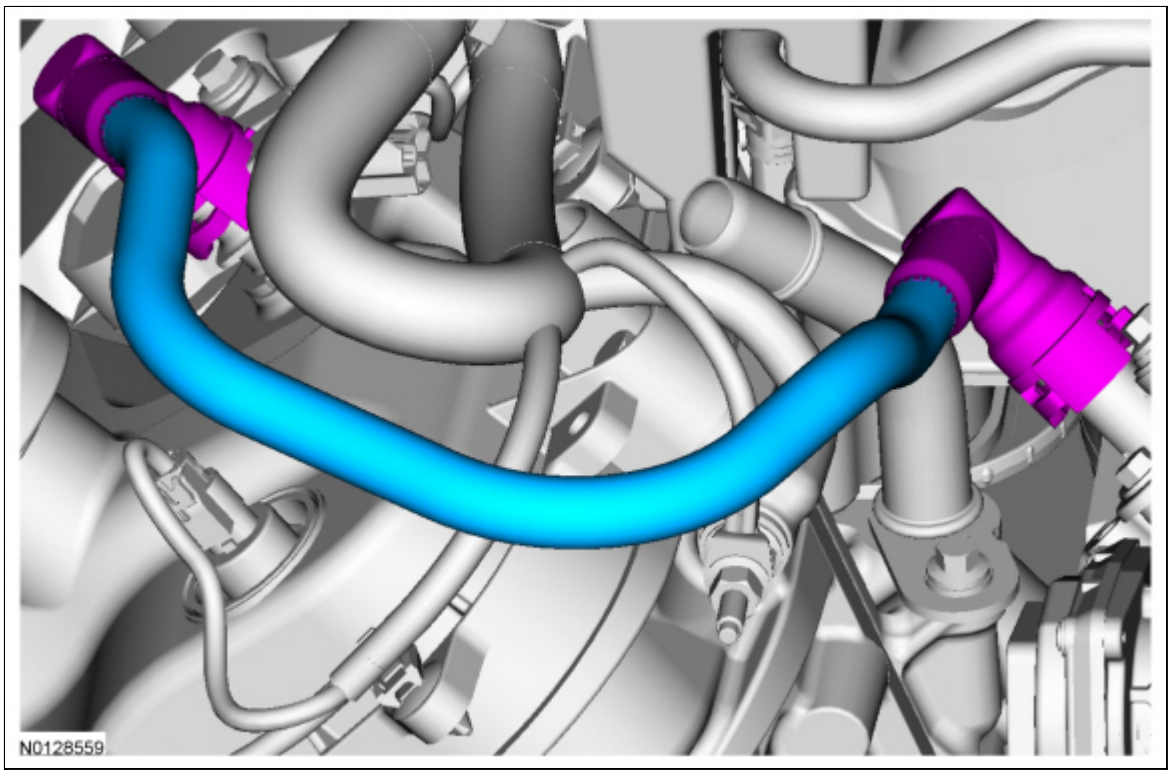
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material,**

including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

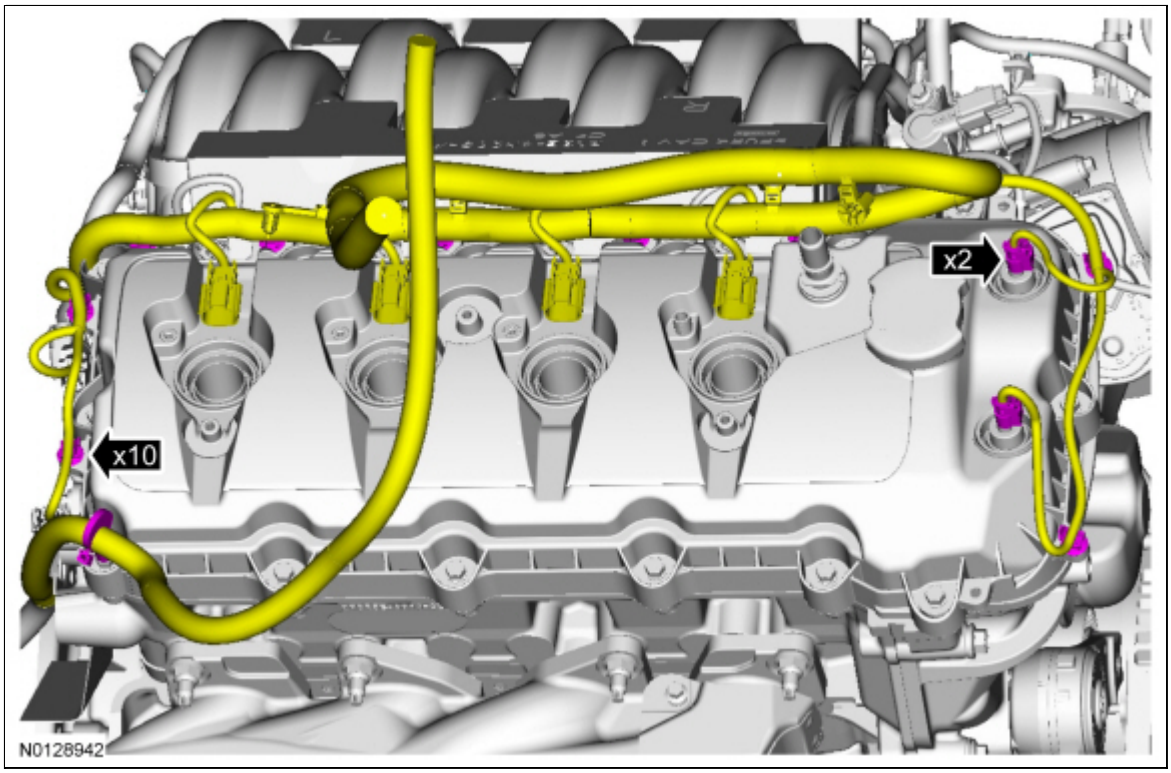
1. Remove the RH ignition coils. For additional information, refer to Section 303-07C .

2. Remove the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .



3. Disconnect the 2 RH Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers.

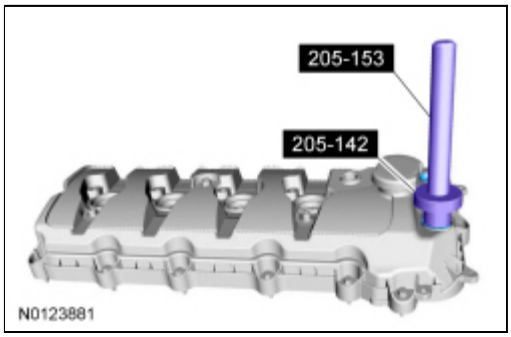
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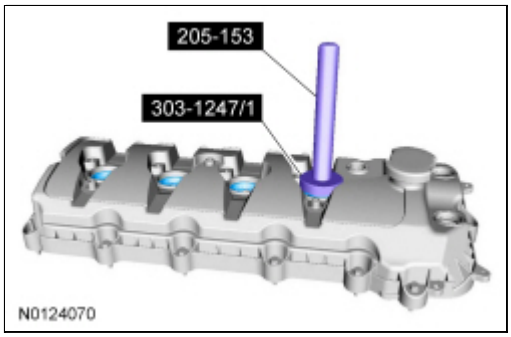
4. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   Loosen the 14 fasteners and remove the RH valve cover and gasket.
   - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
   - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

5. Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.
   - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



6. Inspect the spark plug tube seals. Remove any damaged seals.
   - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

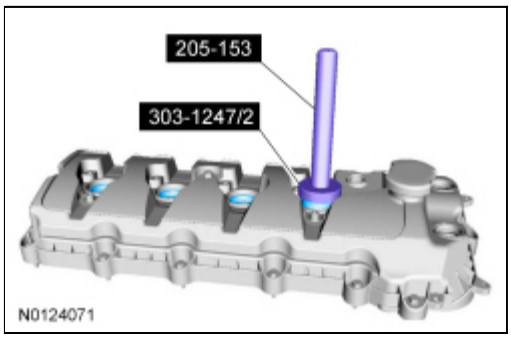


7. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

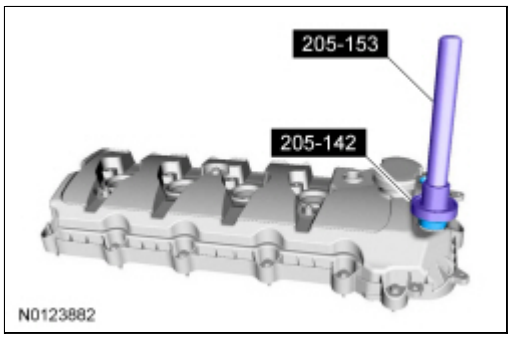
1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

   Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

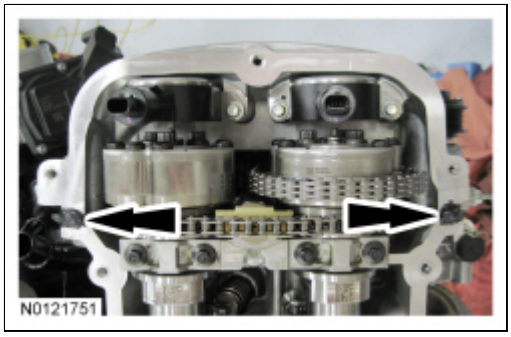
   Using the Differential Bearing Cone Installer and Handle, install new VCT variable force solenoid seal (s).



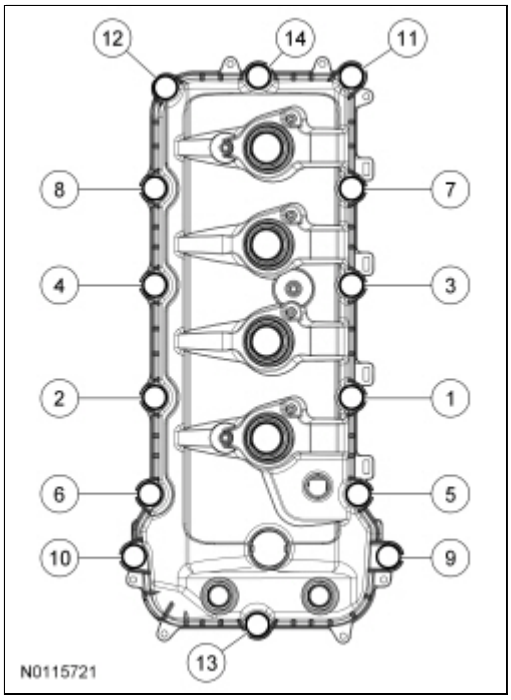
3. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-RH cylinder head joints.

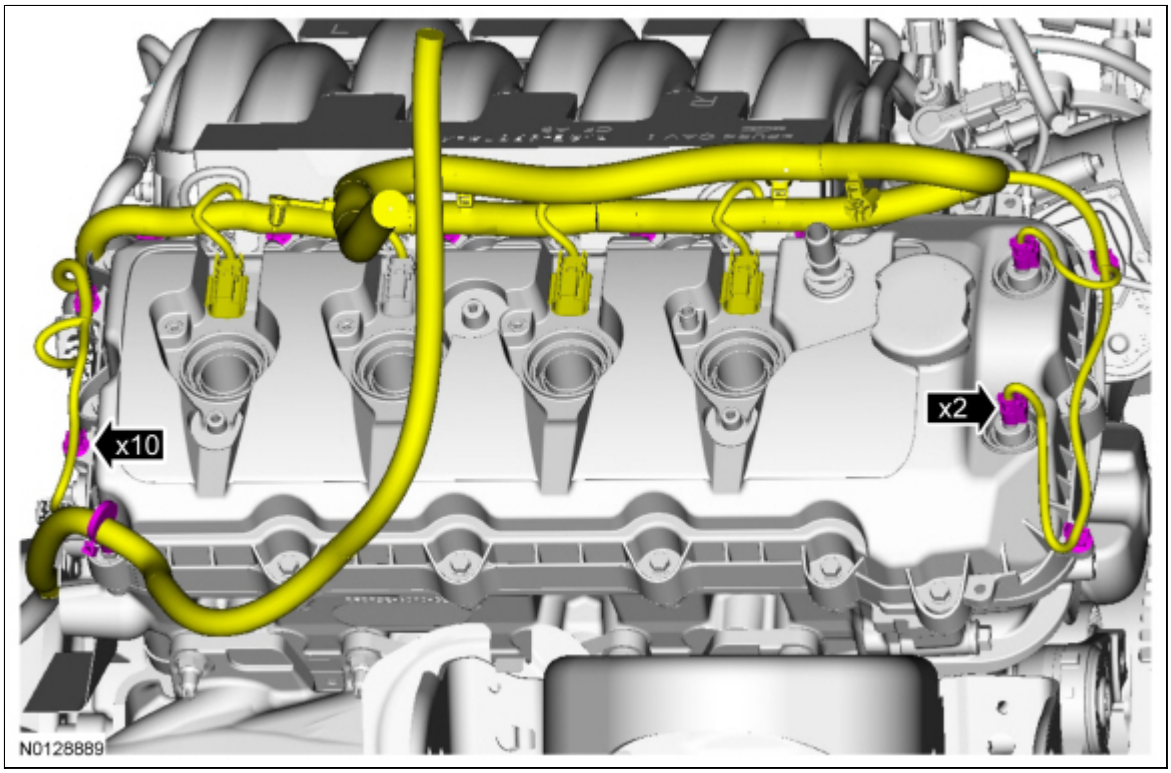
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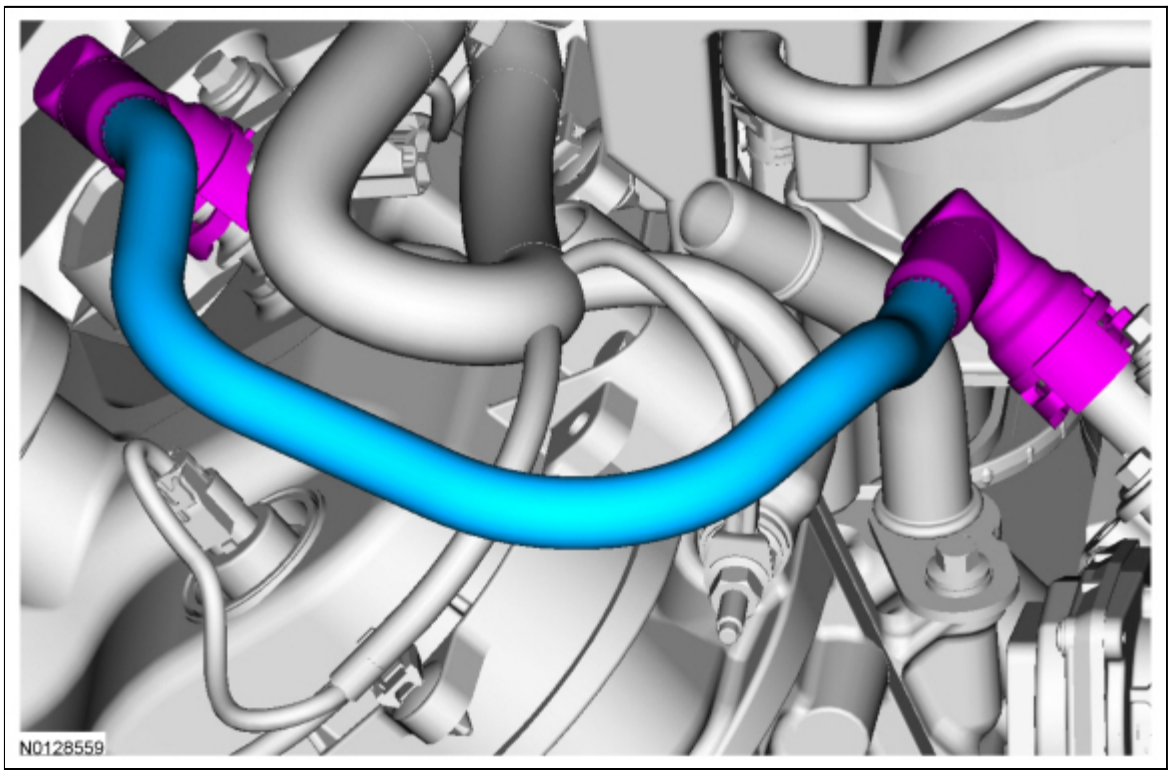
4. Position the RH valve cover and new gasket on the cylinder head.
    - Tighten the fasteners in the sequence shown to 10 Nm (89 lb-in).



5. Connect the 2 RH VCT variable force solenoid electrical connectors.
    - Attach the 10 wiring harness retainers.



6. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .

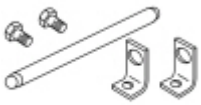
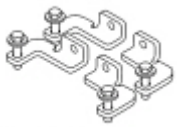


7. Install the RH ignition coils. For additional information, refer to Section 303-07C .

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Valve Seals

Special Tool(s)

 ST1902-A	Compressor, Valve Spring 303-1418
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

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1. Remove the camshaft for the valve seal being serviced. For additional information, refer to Camshaft — RH and/or Camshaft — LH in this section.

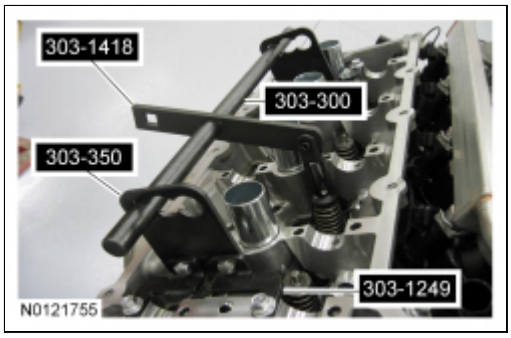
2. Remove the roller follower and hydraulic lash adjuster assembly for the valve seal being serviced.

3. ***NOTICE:*** **If air pressure must be removed, support the valve prior to removal or engine damage may occur.**

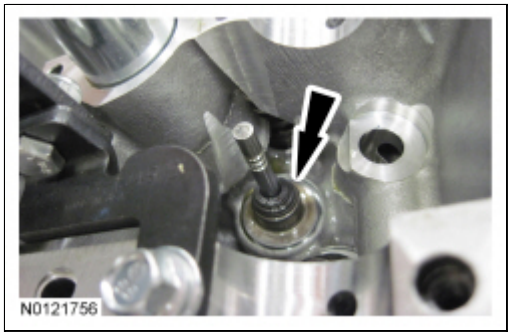
   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head in this section.

   Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



5. Remove and discard the valve seal.

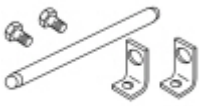
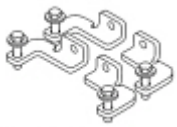


6. To install, reverse the removal procedure.
   - Lubricate the valve seal and the roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.

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Valve Springs

Special Tool(s)

 ST1902-A	Compressor, Valve Spring 303-1418
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the valve spring being serviced. For additional information, refer to Camshaft — RH and/or Camshaft — LH in this section.

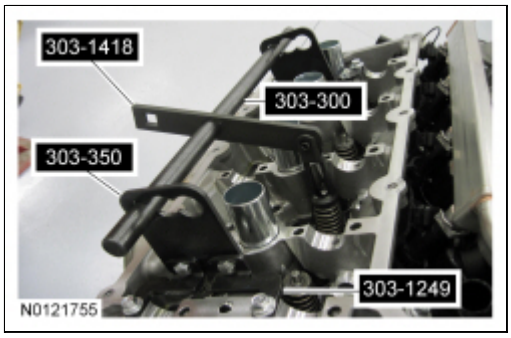
2. Remove the roller follower and hydraulic lash adjuster assembly for the valve spring being serviced.

3. ***NOTICE:*** **If air pressure must be removed, support the valve prior to removal or engine damage may occur.**

   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head in this section.

   Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.

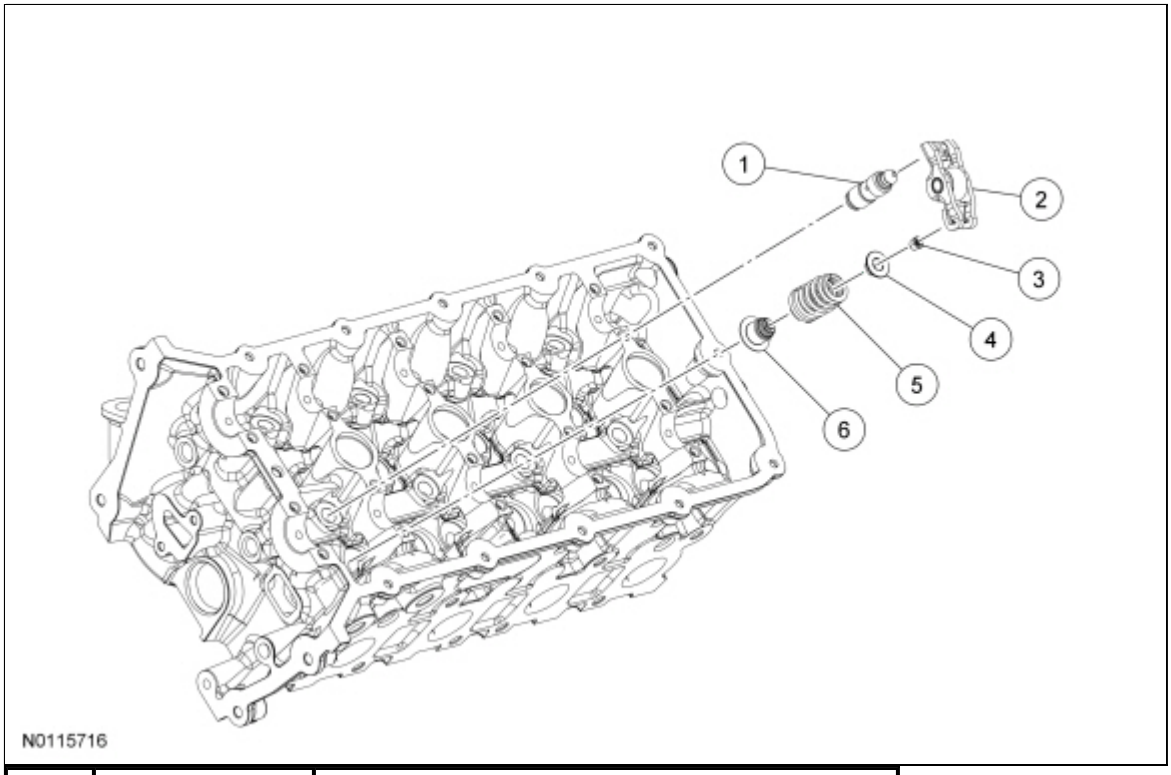


5. To install, reverse the removal procedure.
   - Lubricate the roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.

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Valve Train Components — Exploded View

NOTE: LH cylinder head shown, RH cylinder head similar.



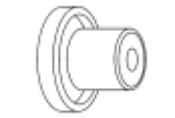
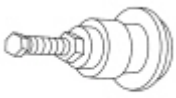
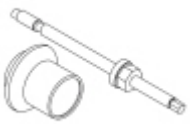
Item	Part Number	Description
1	6500	Hydraulic lash adjuster (32 required)
2	6564	Camshaft roller follower (32 required)
3	6518	Valve spring retainer key (64 required)
4	6514	Valve spring retainer (32 required)
5	6513	Valve spring (32 required)
6	6571	Valve seal (32 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Cylinder Head

Special Tool(s)

 ST2806-A	Alignment Pins, Cylinder Head 303-1040 (SR-015486)
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
	Installer, Spark Plug Tube Seal 303-1247/2

 ST2983-A	
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT or equivalent	WSS-M2C931-B
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

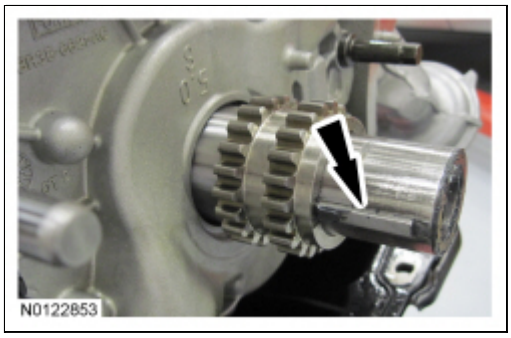
Installation

NOTE: The Boss® 302 requires Motorcraft® SAE 5W-50 Full Synthetic Motor Oil, all other 5.0L (4V) engines require Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil.

All cylinder heads

1. Verify the crankshaft keyway is in the 9 o'clock position.

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2. ***NOTICE:*** **Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow these instructions may result in engine damage.**

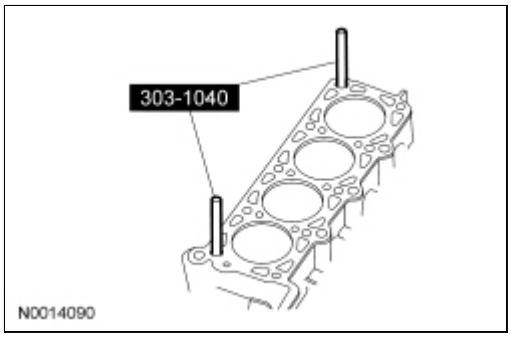
   NOTICE: **The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry. Failure to follow these instructions may result in future oil leakage.**

   NOTICE: **The cylinder head bolts must be discarded and new bolts installed. They are a tighten-to-yield design and cannot be reused.**

   NOTE: Do not turn the crankshaft until instructed to do so.

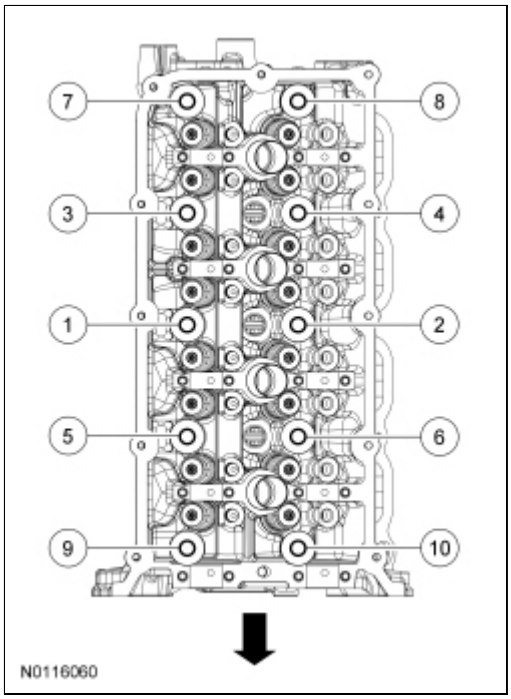
   NOTE: LH shown, RH similar.

   Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the cylinder head bolts loosely.



RH cylinder head

3. Tighten the new RH cylinder head bolts in 4 stages in the sequence shown.
   - Stage 1: Tighten to 25 Nm (18 lb-ft).
   - Stage 2: Tighten to 40 Nm (30 lb-ft).
   - Stage 3: Tighten an additional 90 degrees.
   - Stage 4: Tighten an additional 90 degrees.

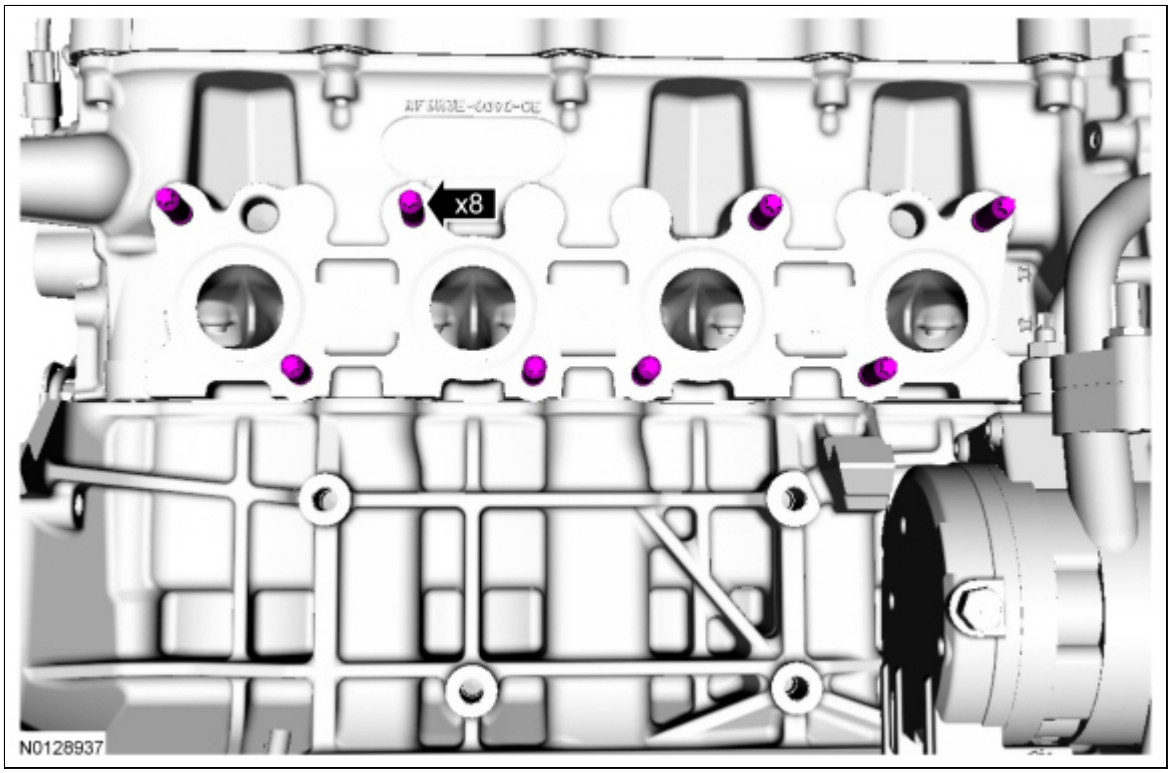


4. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.**

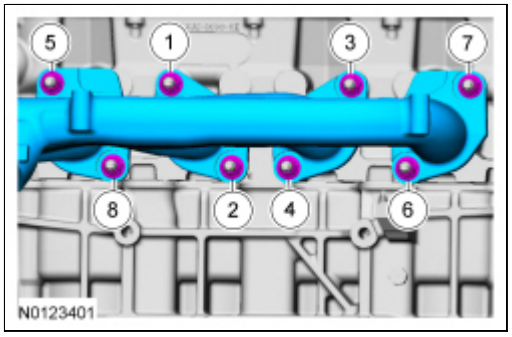
   Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

5. Install 8 new RH exhaust manifold studs.
   - Tighten to 25 Nm (18 lb-ft).

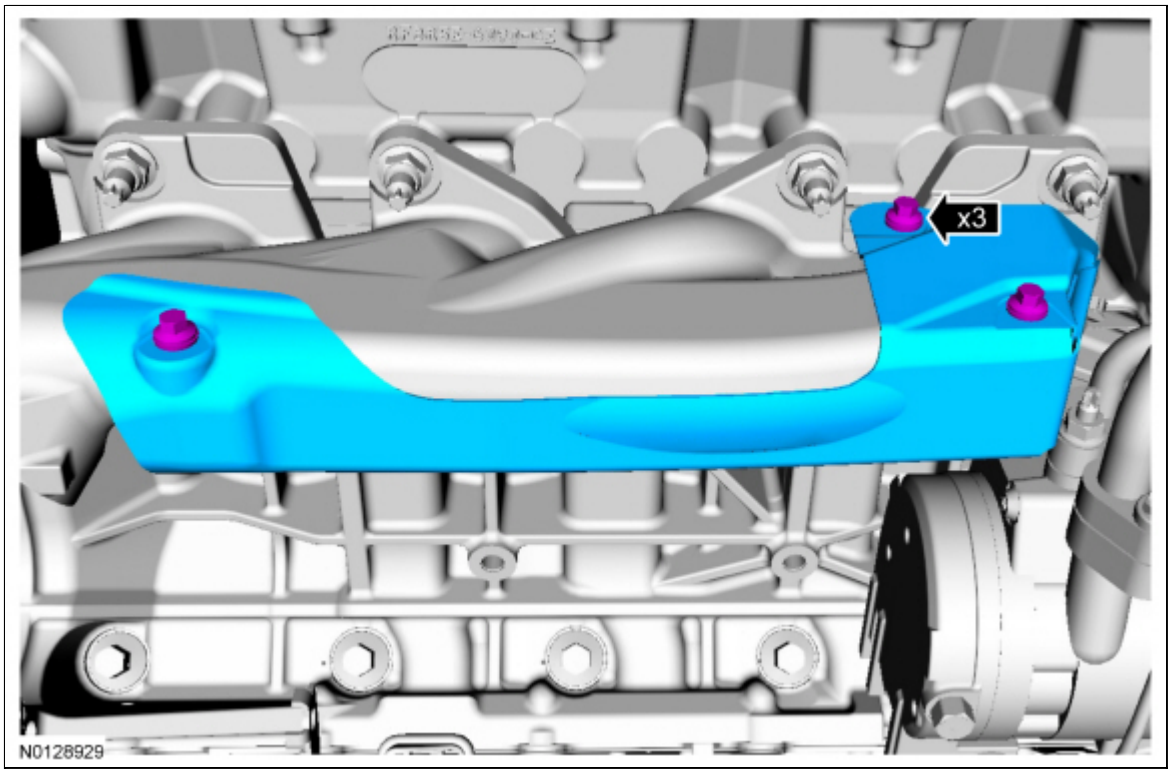
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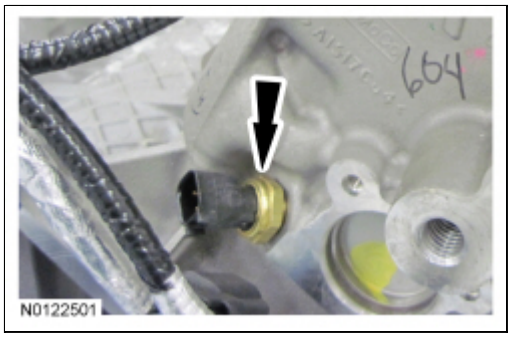
6. Install a new gasket, the RH exhaust manifold and 8 new nuts.
    - Tighten the nuts in the sequence shown in 2 stages.
        - Stage 1: Tighten to 24 Nm (18 lb-ft).
        - Stage 2: Tighten to 32 Nm (24 lb-ft).



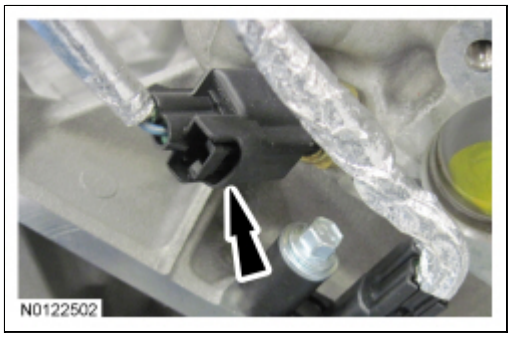
7. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).



8. Install the Cylinder Head Temperature (CHT) sensor.
    - Tighten to 11 Nm (97 lb-in).

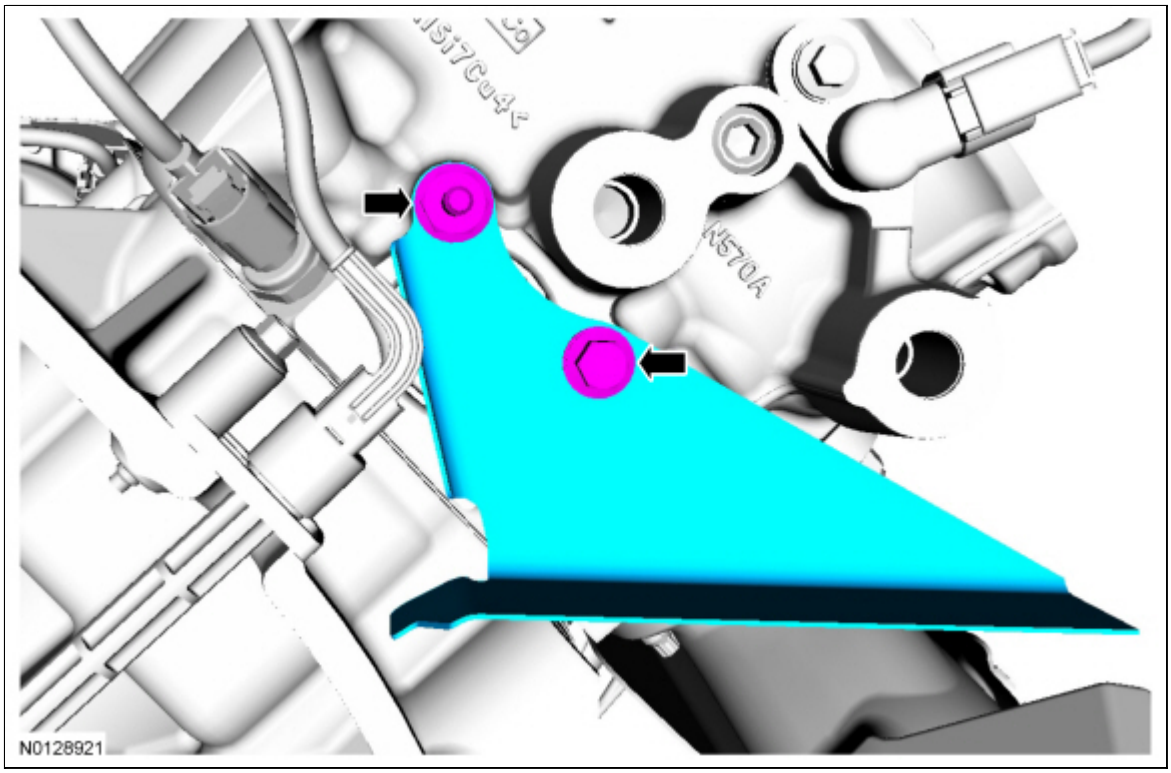


9. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.



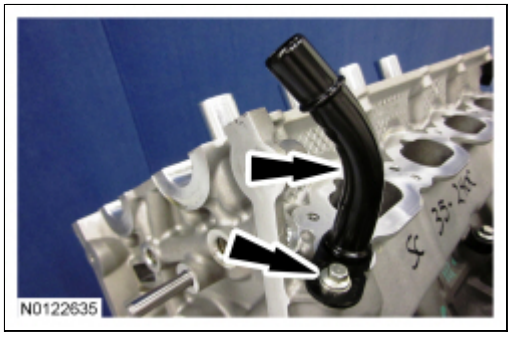
10. Install the heat shield, the bolt and the stud bolt on the RH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

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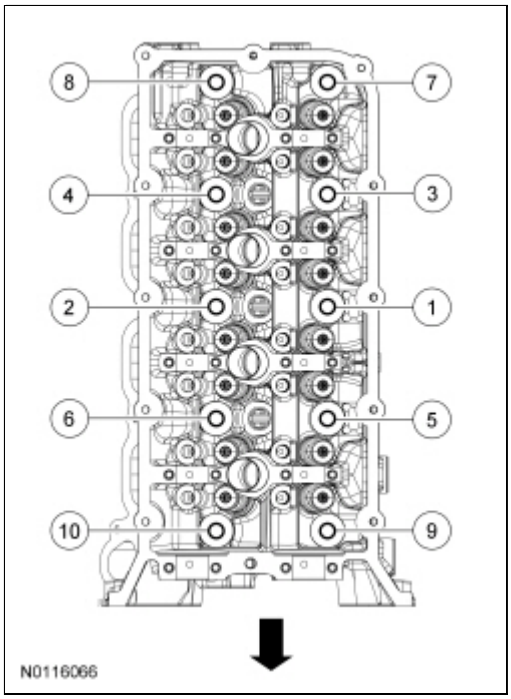
11. ***NOTICE:*** **Lubricate the O-ring seal with clean engine coolant prior to installing.**

    Using a new O-ring seal, install the coolant outlet pipe.
    - Tighten to 10 Nm (89 lb-in).



LH cylinder head

12. Tighten the new LH cylinder head bolts in 4 stages in the sequence shown.
    - Stage 1: Tighten to 25 Nm (18 lb-ft).
    - Stage 2: Tighten to 40 Nm (30 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.
    - Stage 4: Tighten an additional 90 degrees.

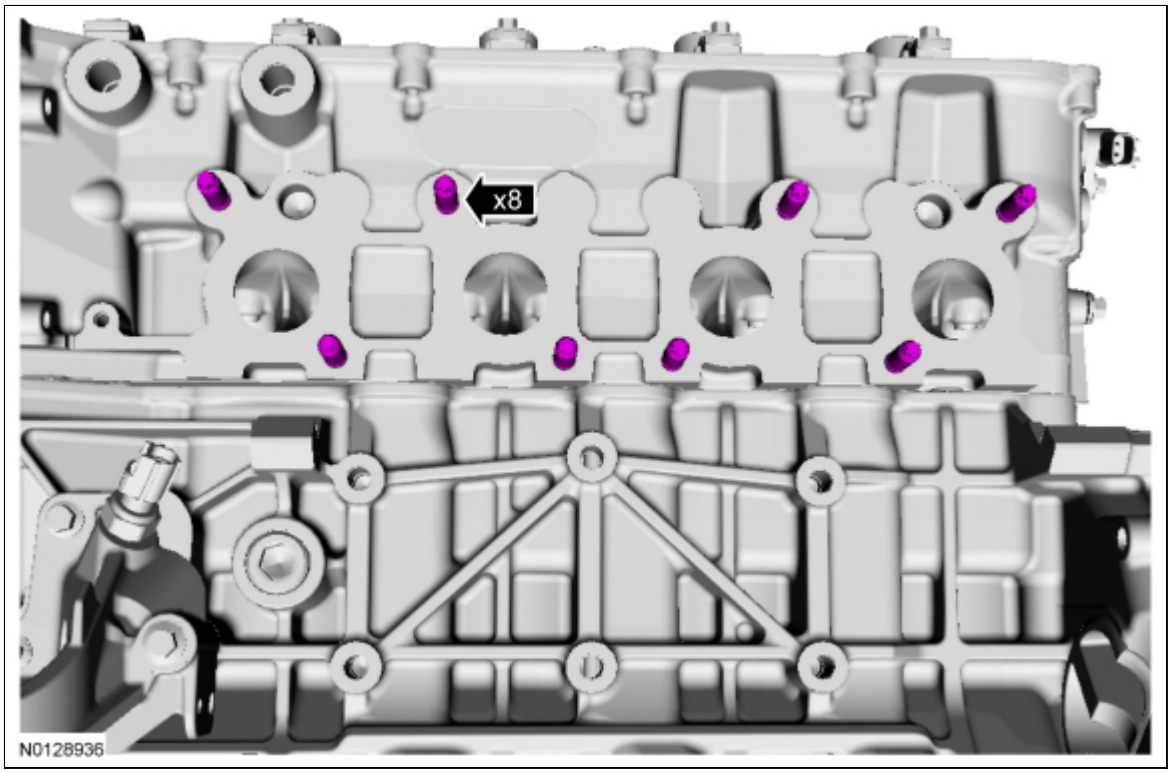


13. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.**

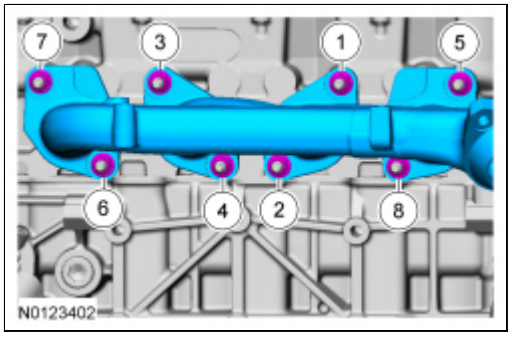
    Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

14. Install 8 new LH exhaust manifold studs.
    - Tighten to 25 Nm (18 lb-ft).

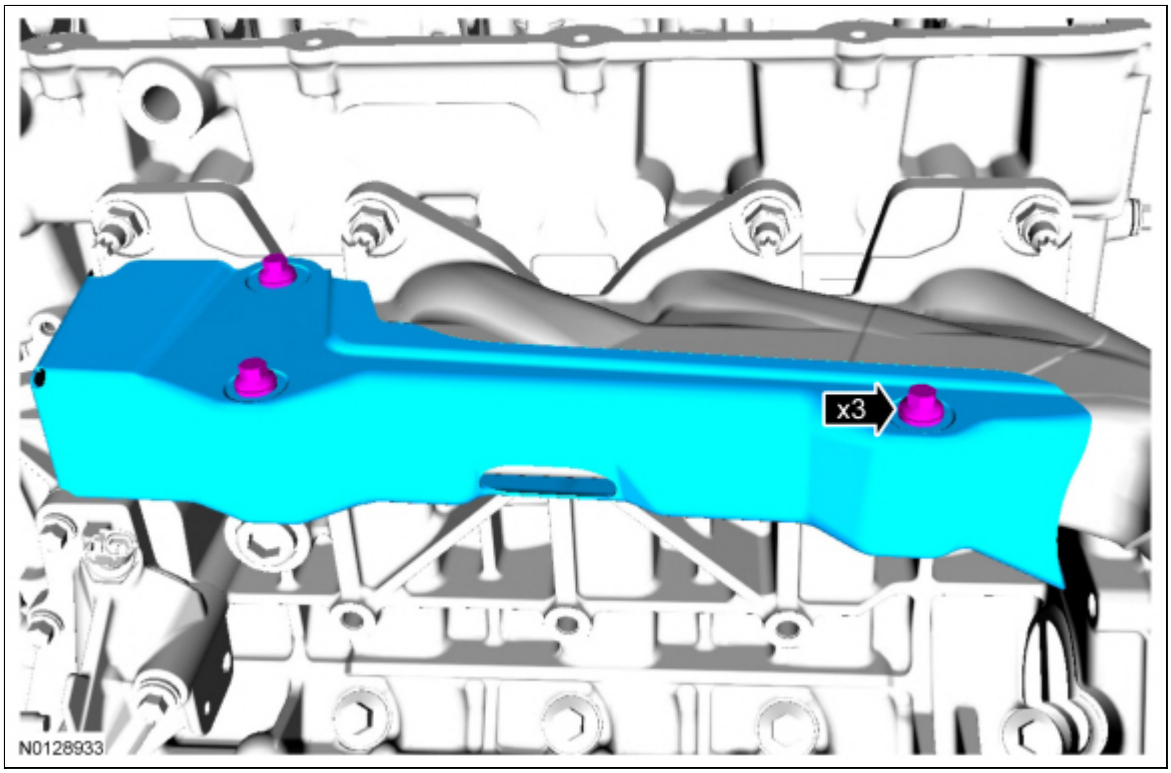
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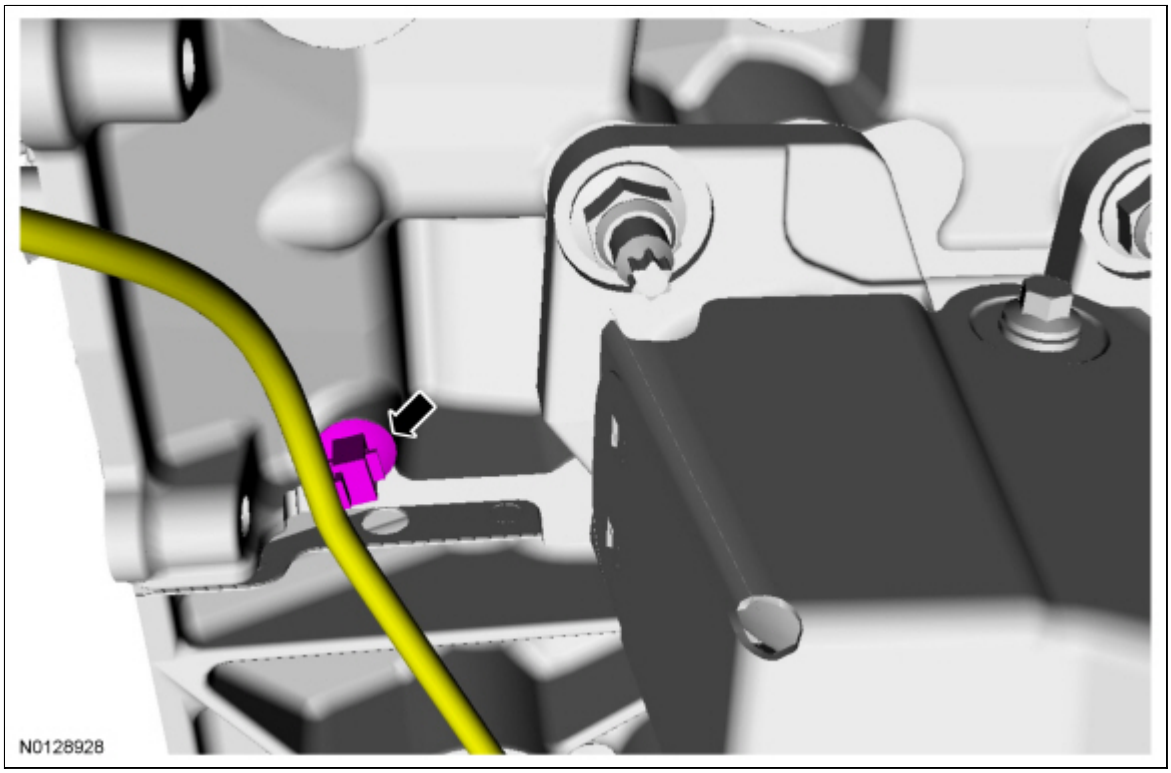
15. Install a new gasket, the LH exhaust manifold and 8 new nuts.
    - Tighten in the sequence shown in 2 stages.
        - Stage 1: Tighten to 24 Nm (18 lb-ft).
        - Stage 2: Tighten to 32 Nm (24 lb-ft).



16. Install the LH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 12 Nm (106 lb-in).

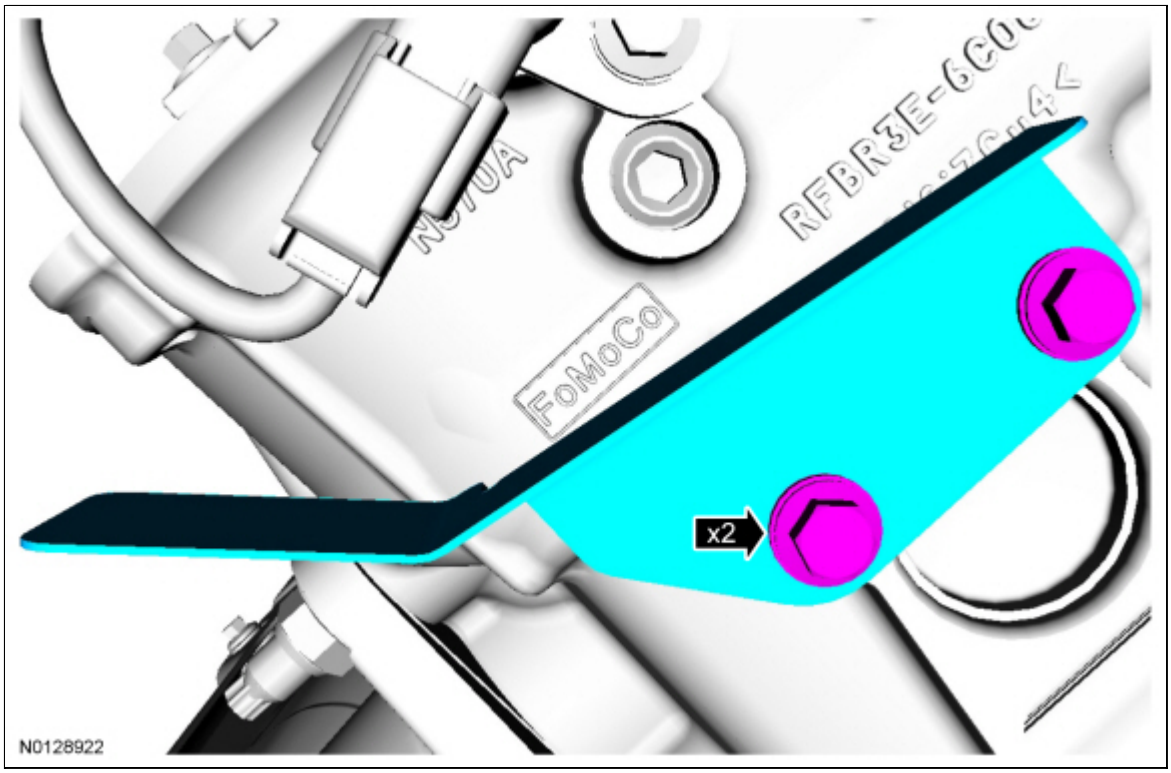


17. Attach the wiring harness retainer to the LH cylinder head.

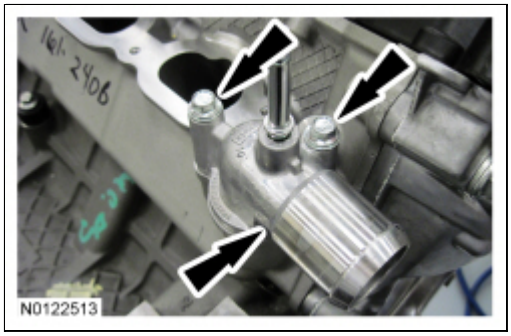


18. Install the heat shield and the 2 bolts to the LH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

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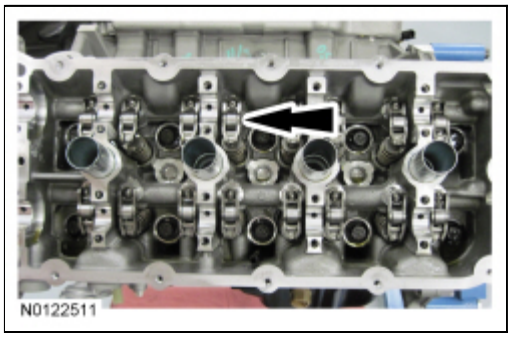


19. Using a new gasket, install the coolant outlet and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



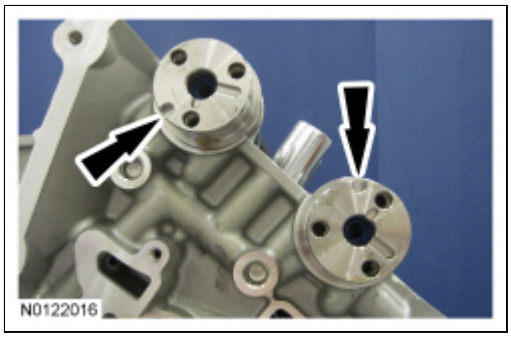
20. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

    Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



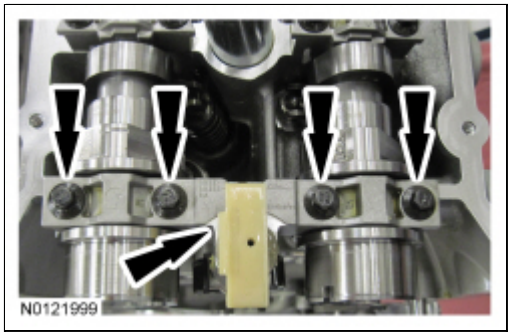
21. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

    Install the LH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.

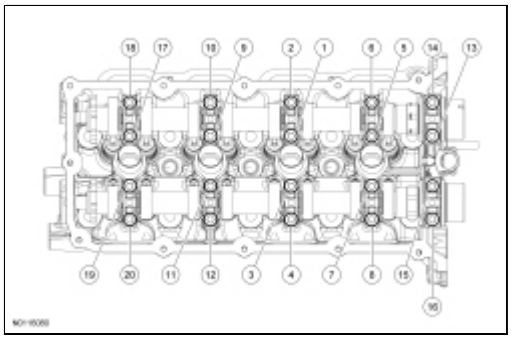


22. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.

23. Install the LH front camshaft bearing mega cap and the 4 bolts. Do not tighten the bolts at this time



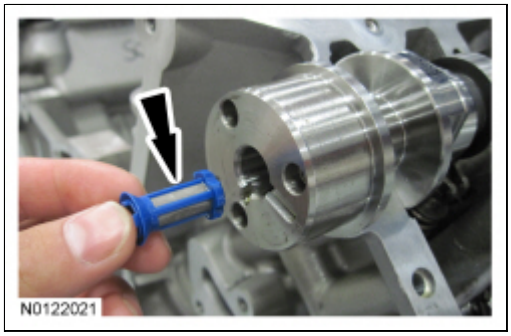
24. Tighten the bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 6 Nm (53 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



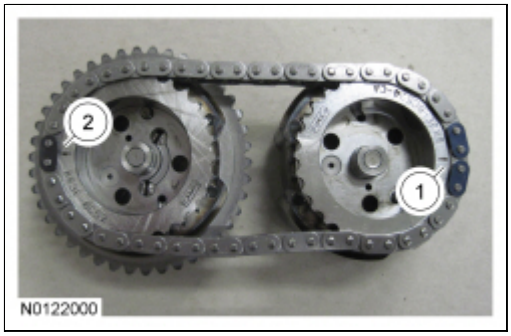
25. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

    Install the Variable Camshaft Timing (VCT) system oil filter in the intake and exhaust camshafts.

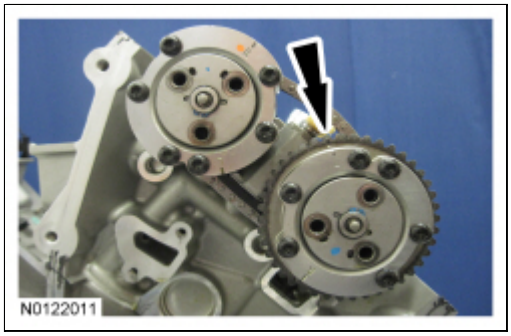
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26. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

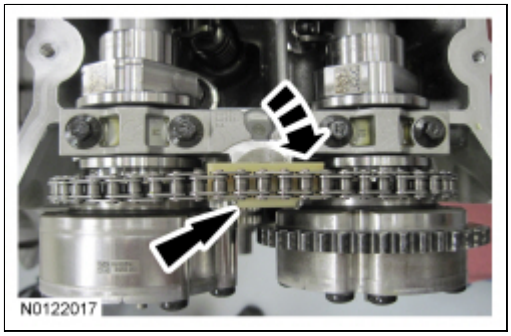


27. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



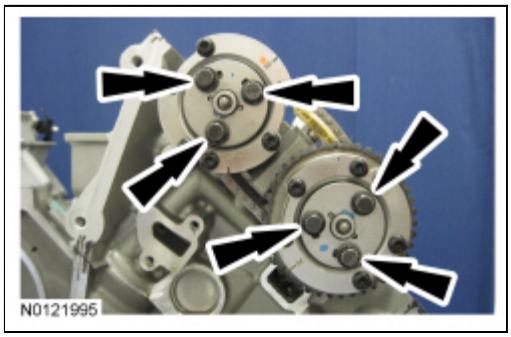
28. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.

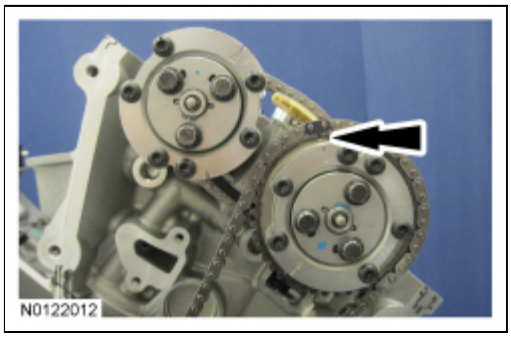


29. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

    Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.
    - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.

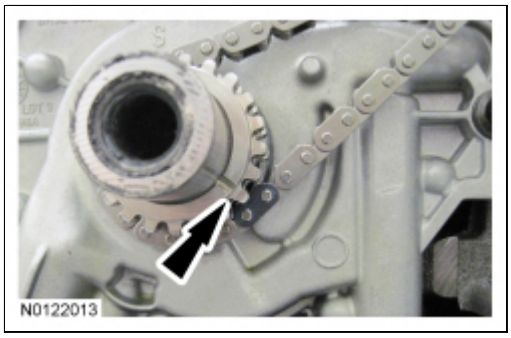


30. Install the LH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



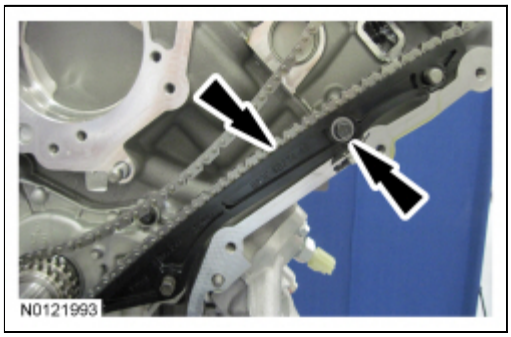
31. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.

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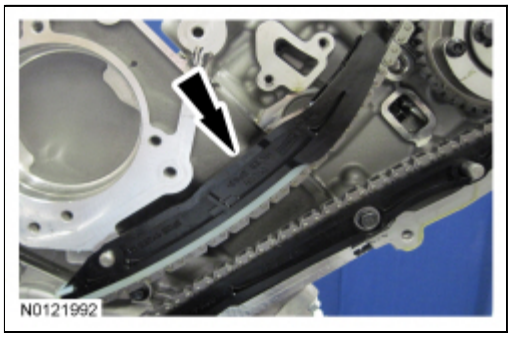
32. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

    Install the LH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



33. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

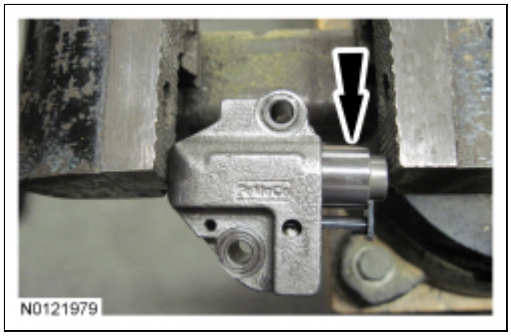
    Install the LH timing chain tensioner arm.



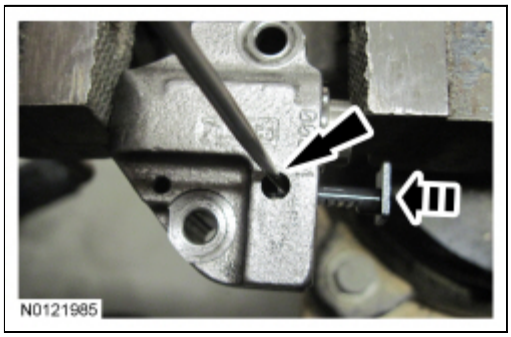
NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

34. ***NOTICE:*** **Do not compress the ratchet assembly or damage to the tensioner will occur.**

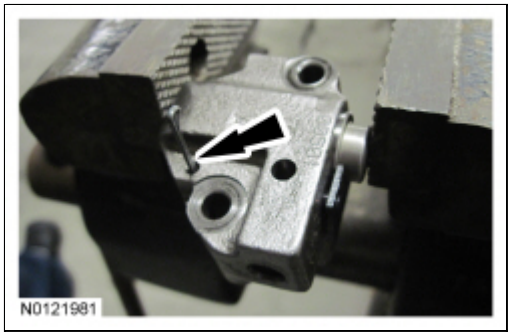
    Compress the primary timing chain tensioner plunger, using an edge of a vise.



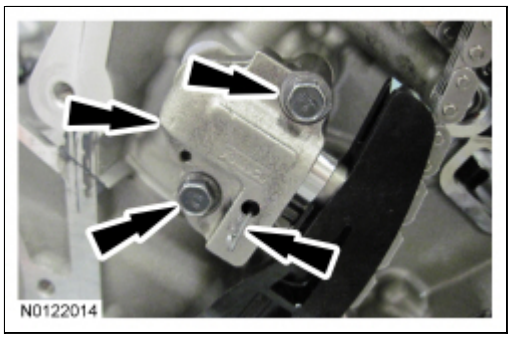
35. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



36. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.

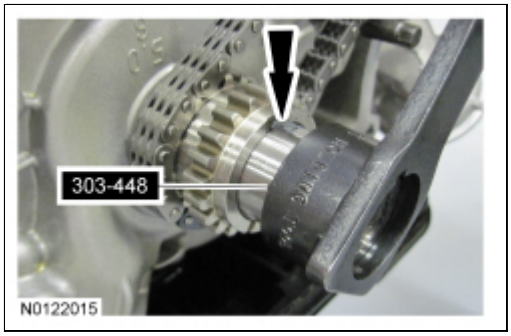


37. Install the LH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.

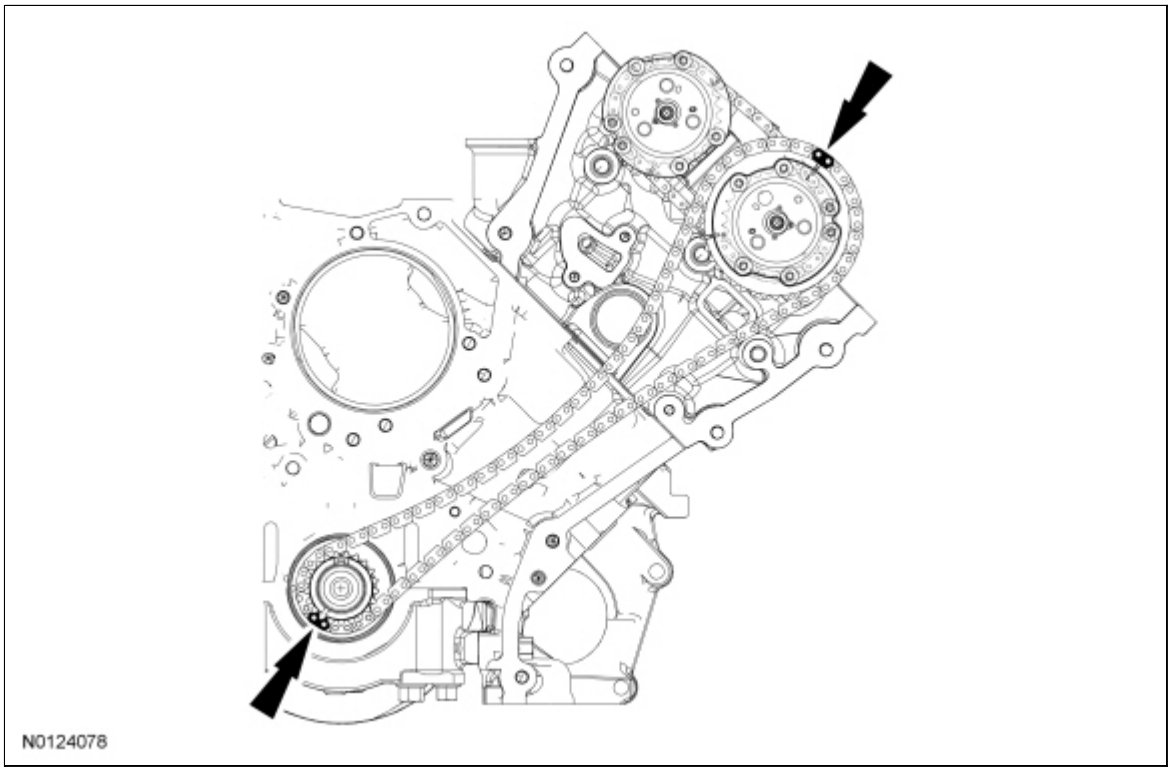


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38. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



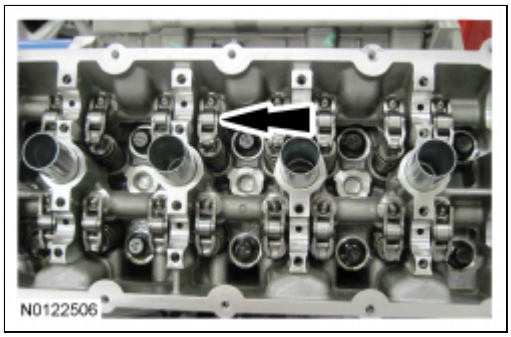
39. With the crankshaft keyway at the 12 o'clock position, verify the timing mark alignment is correct.



RH cylinder head

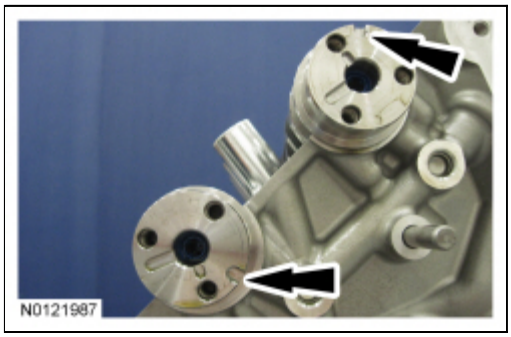
40. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

    Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

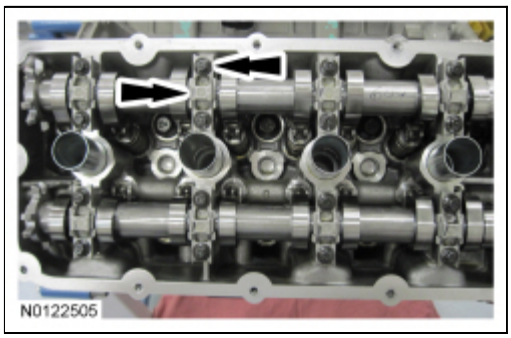


41. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

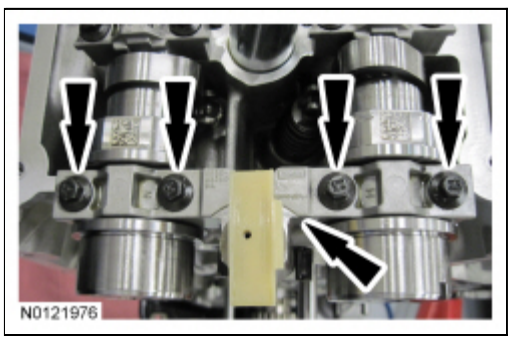
    Install the RH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



42. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.



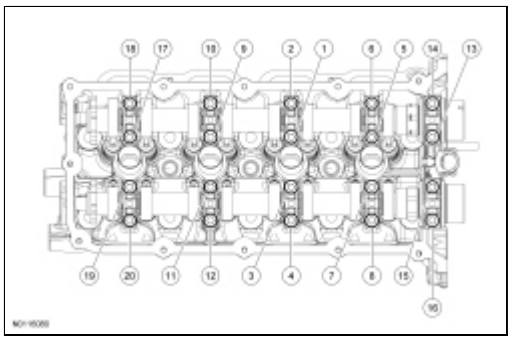
43. Install the RH front camshaft bearing mega cap and the 4 bolts. Do not tighten at this time



44. Tighten the bolts in the sequence shown in 2 stages.

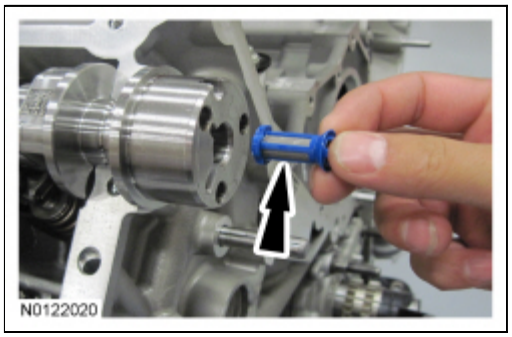
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- Stage 1: Tighten to 6 Nm (53 lb-in).
- Stage 2: Tighten an additional 45 degrees.

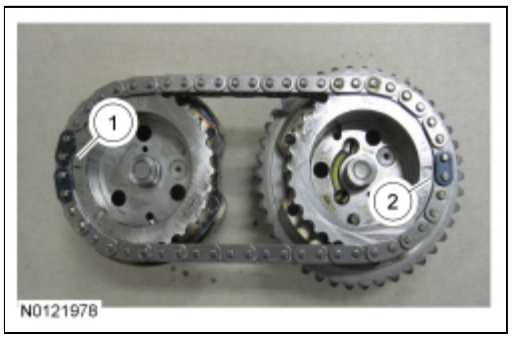


45. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

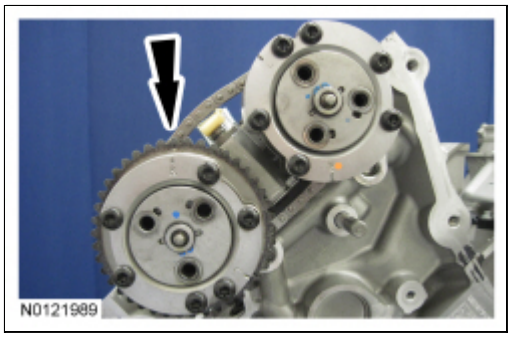
    Install the VCT system oil filter in the intake and exhaust camshafts.



46. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
    1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
    2. The timing mark on the exhaust VCT assembly should align with the single colored link.

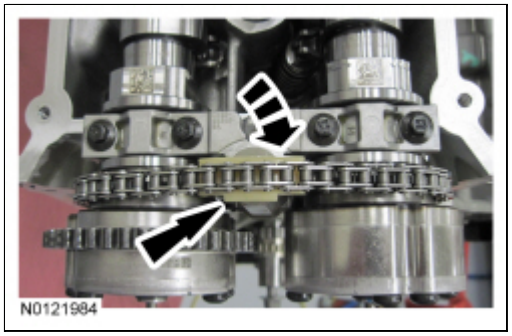


47. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



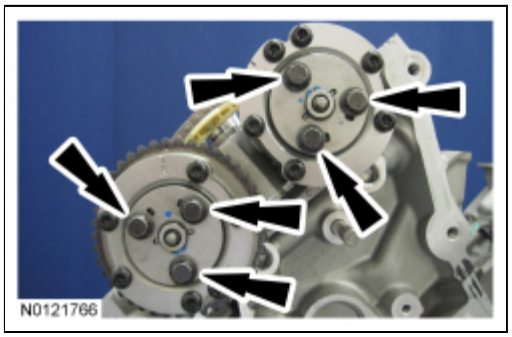
48. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

    Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.
    - If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



49. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

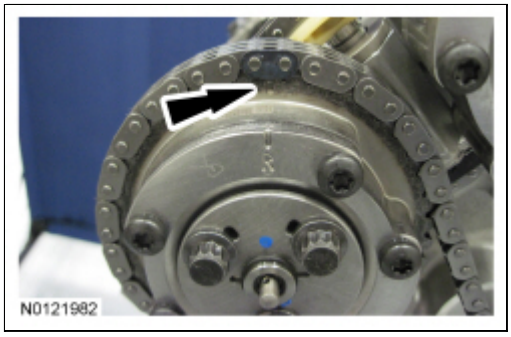
    Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.
    - Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



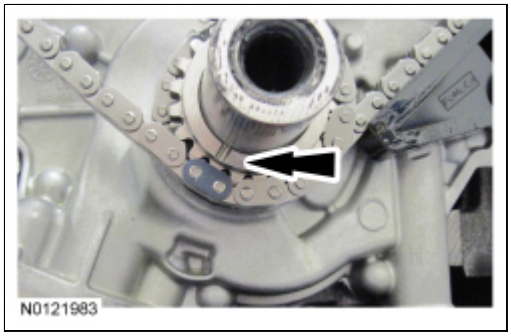
All cylinder heads

50. Install the RH primary timing chain.
    - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.

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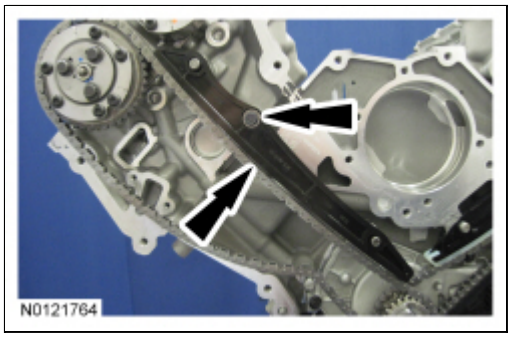


51. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



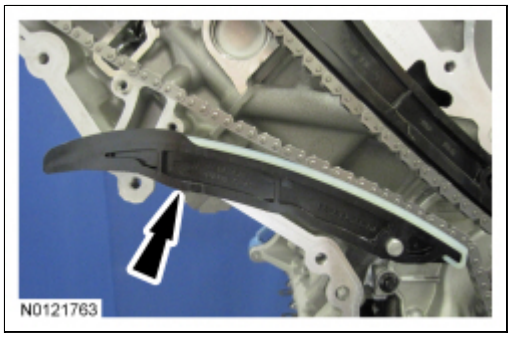
52. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

    Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).

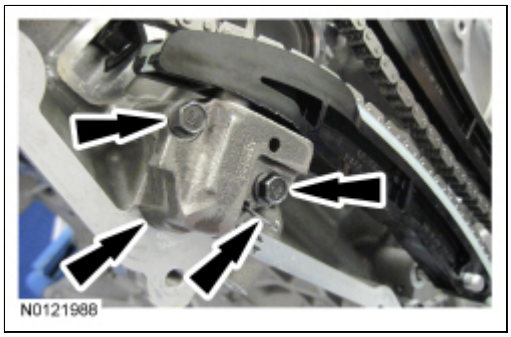


53. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

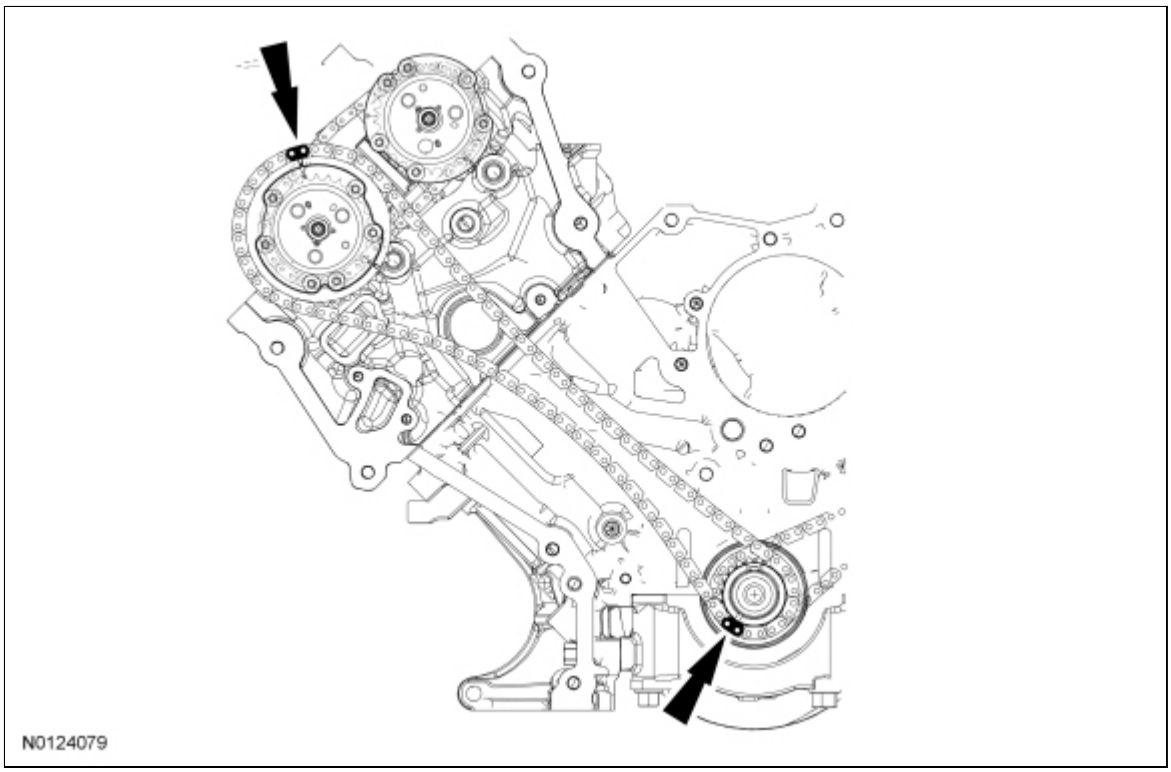
    Install the RH timing chain tensioner arm.



54. Install the RH primary timing chain tensioner and 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Remove the holding pin from the tensioner.



55. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



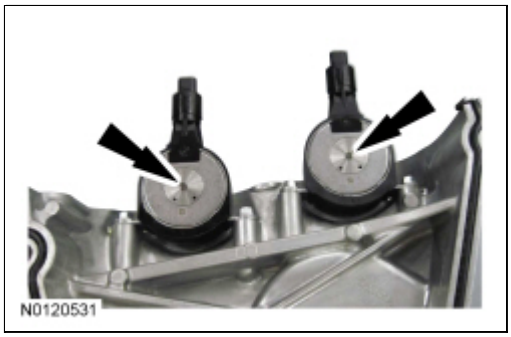
56. ***NOTICE:*** **The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully**

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depressed to avoid interference with the VCT valve tips when installing the engine front cover. Failure to follow these instructions can result in damage to the engine.

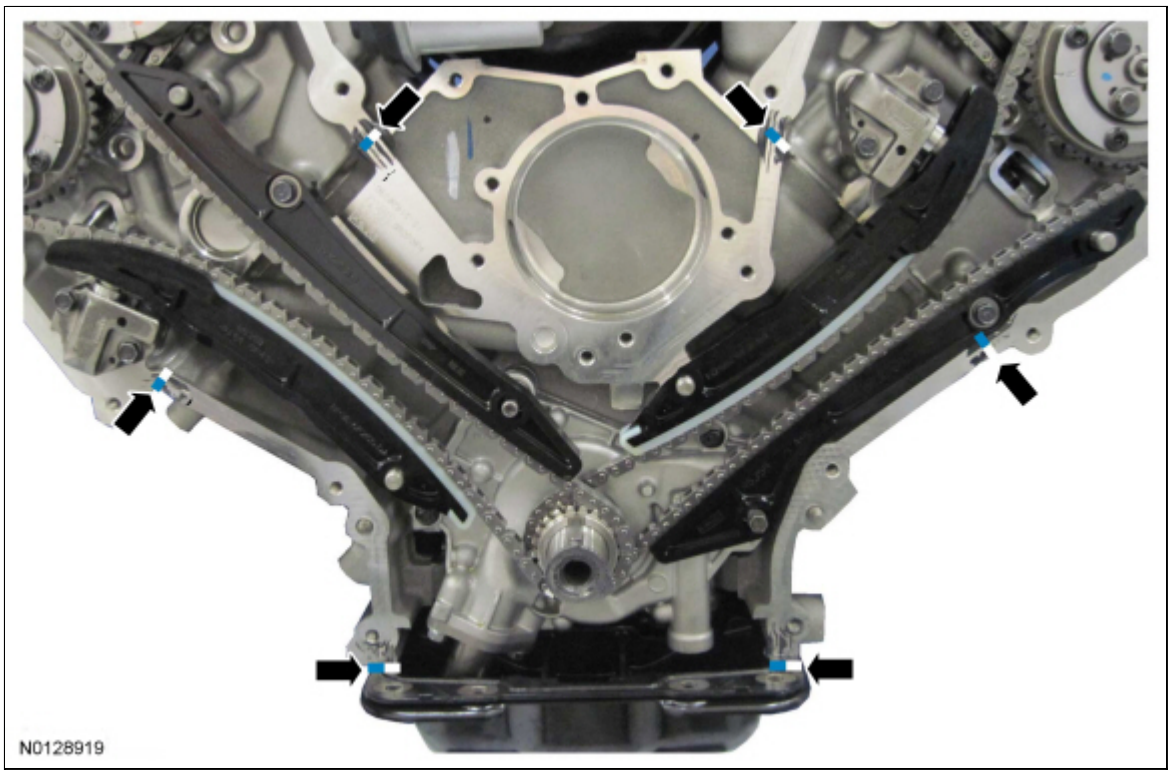
NOTE: LH shown, RH similar.

Fully depress the VCT variable force solenoid pins.



57. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    Apply a bead of silicone gasket and sealant to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.

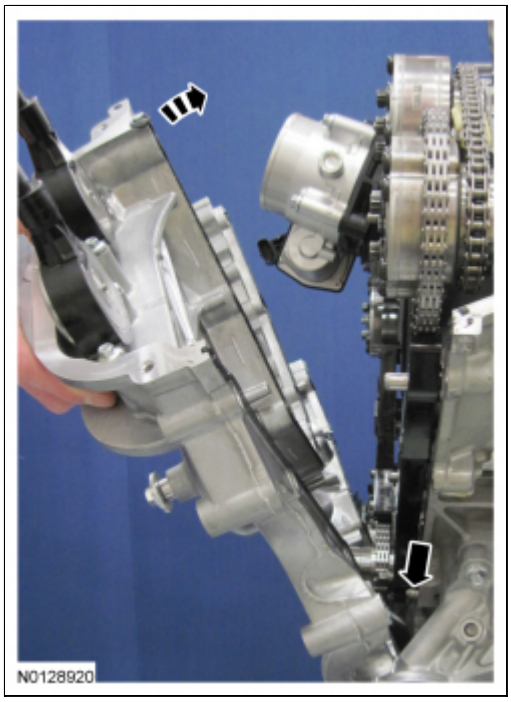


58. **NOTE:** Make sure that the engine front cover gasket is in place on the engine front cover before

installation.

Using new gaskets, position the engine front cover onto the dowels.

- Install the 13 engine front cover bolts, 2 stud bolts, 2 oil pan-to-engine front cover bolts and 2 oil pan-to-engine front cover stud bolts finger-tight.

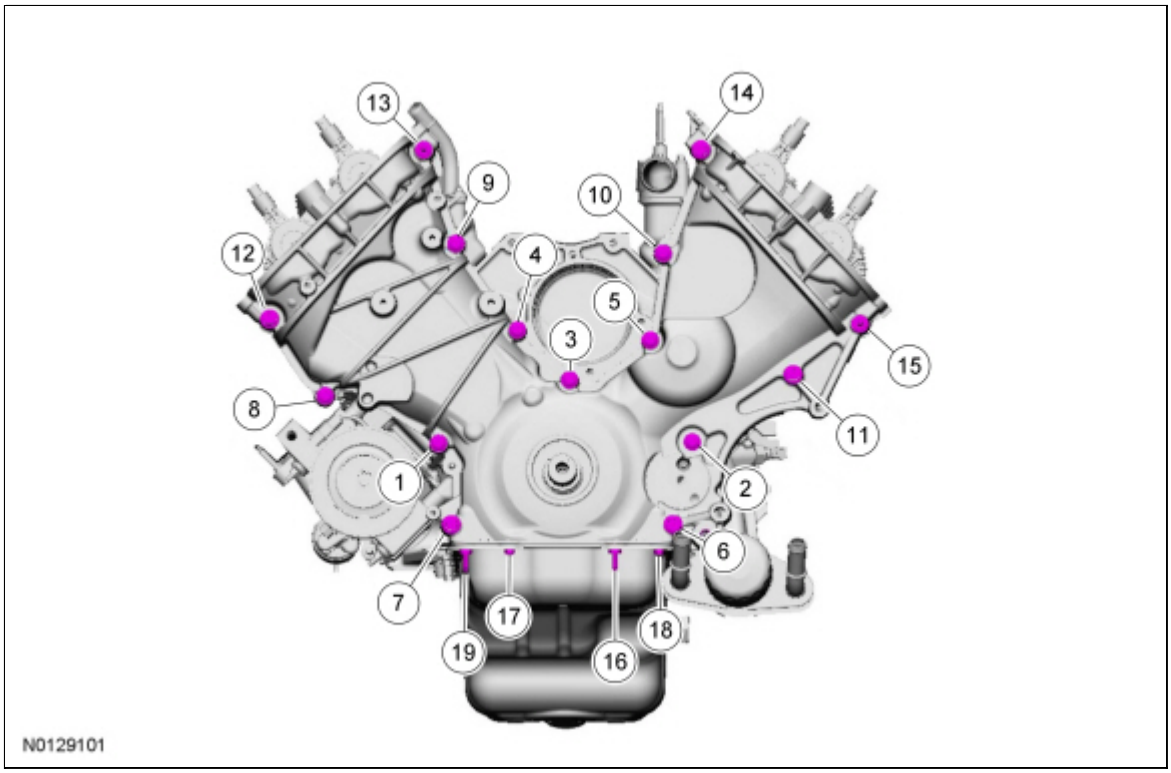


59. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

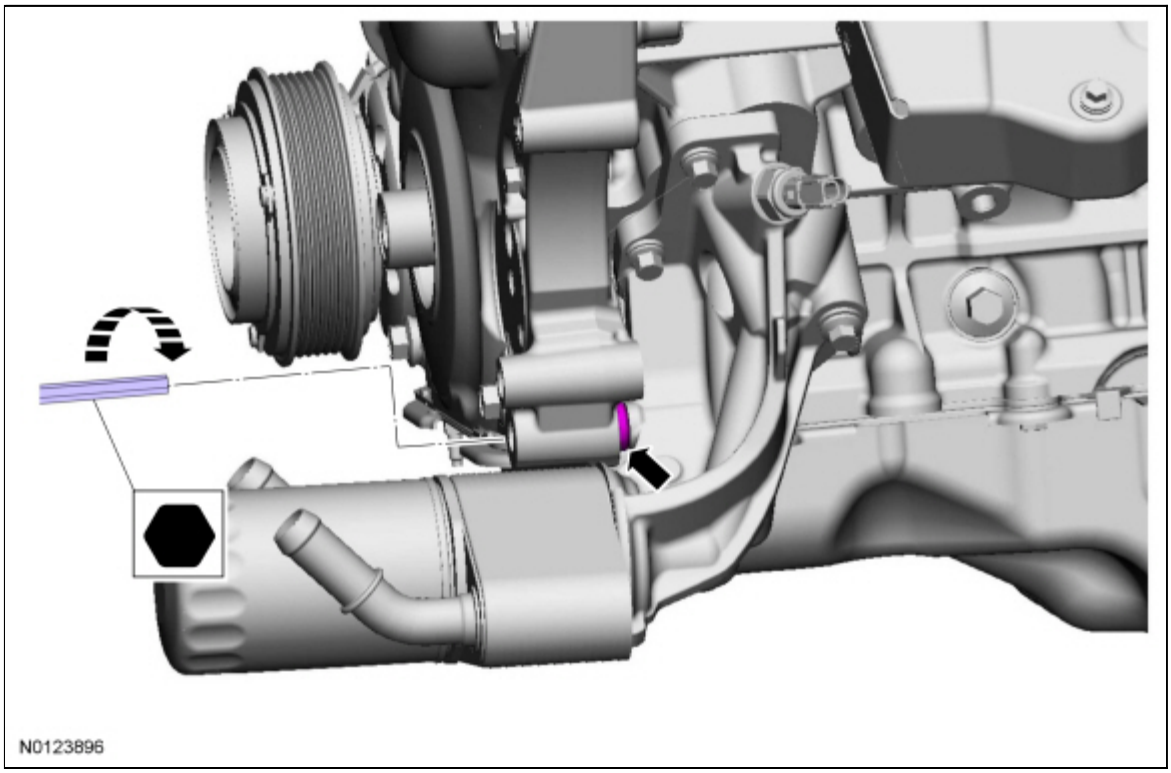
    Tighten the bolts in the sequence shown in 2 stages.

    - Stage 1: Tighten bolts 1-15 to 25 Nm (18 lb-ft) and bolts 16-19 to 10 Nm (89 lb-in).
    - Stage 2: Tighten bolts 1-15 an additional 60 degrees and bolts 16-19 an additional 45 degrees.

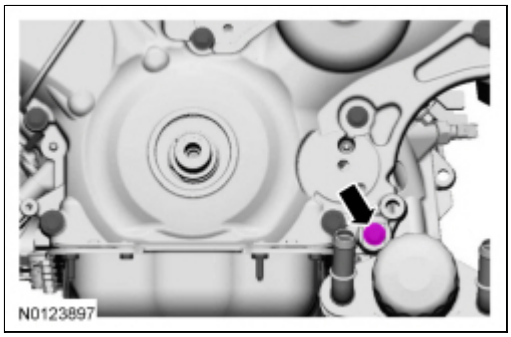
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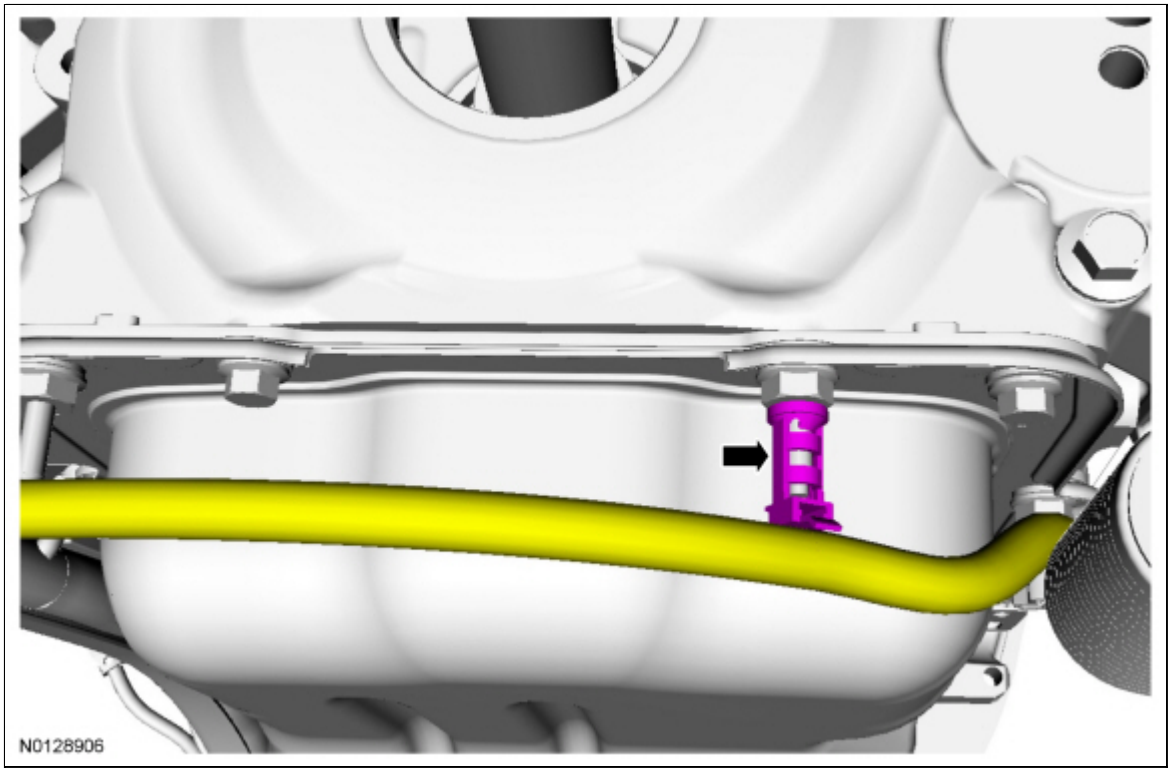
60. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).



61. Install the engine front cover-to-oil filter adapter bolt and tighten to 25 Nm (18 lb-ft) plus an additional 60 degrees.

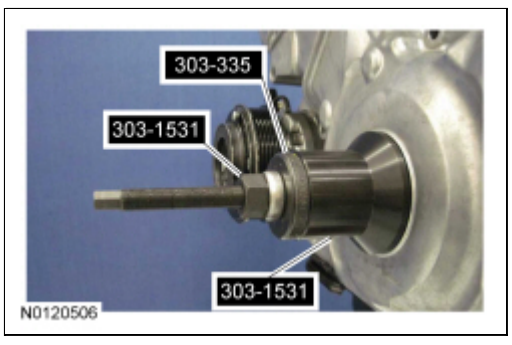


62. Position the wiring harness and install the wiring harness retainer to the oil pan stud bolt.



63. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

    Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



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64. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

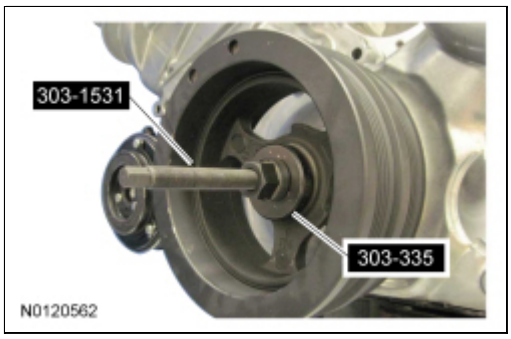
    Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



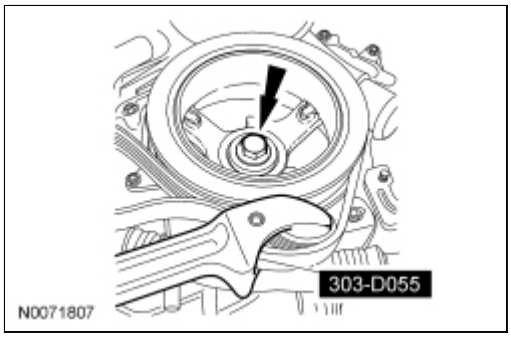
65. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.



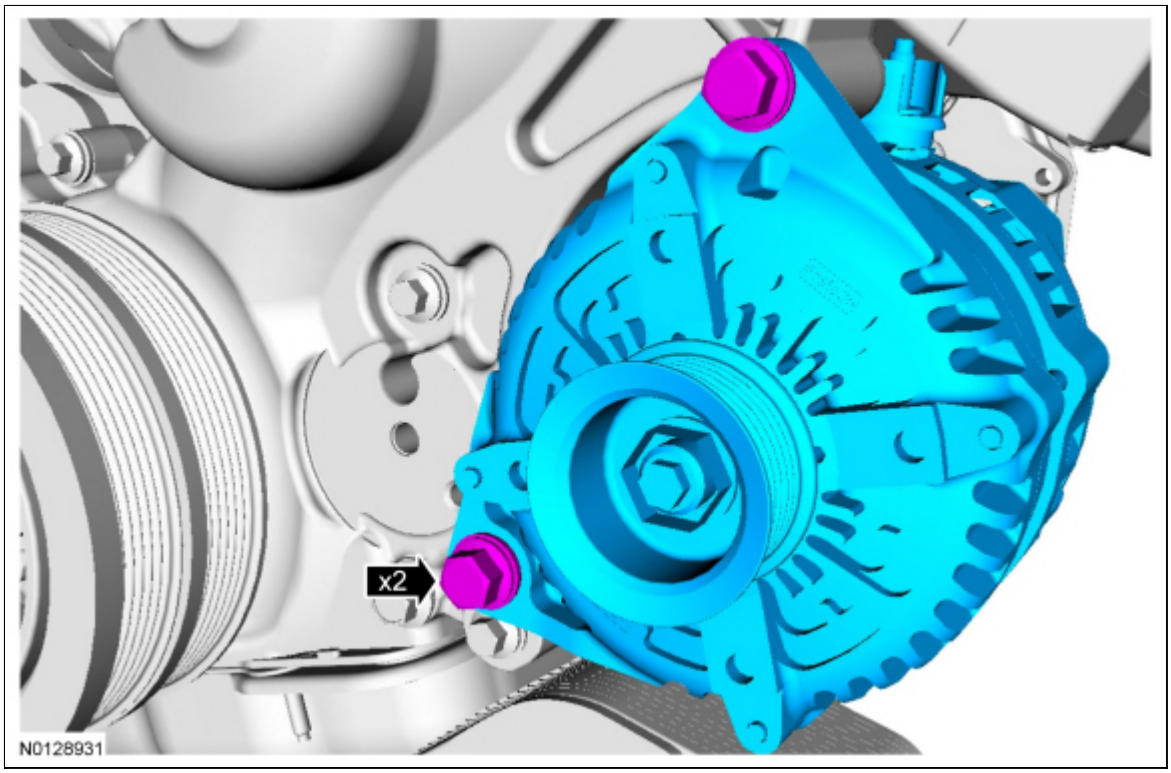
66. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



67. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
    - Stage 1: Tighten to 140 Nm (103 lb-ft).
    - Stage 2: Loosen 360 degrees.
    - Stage 3: Tighten to 100 Nm (74 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

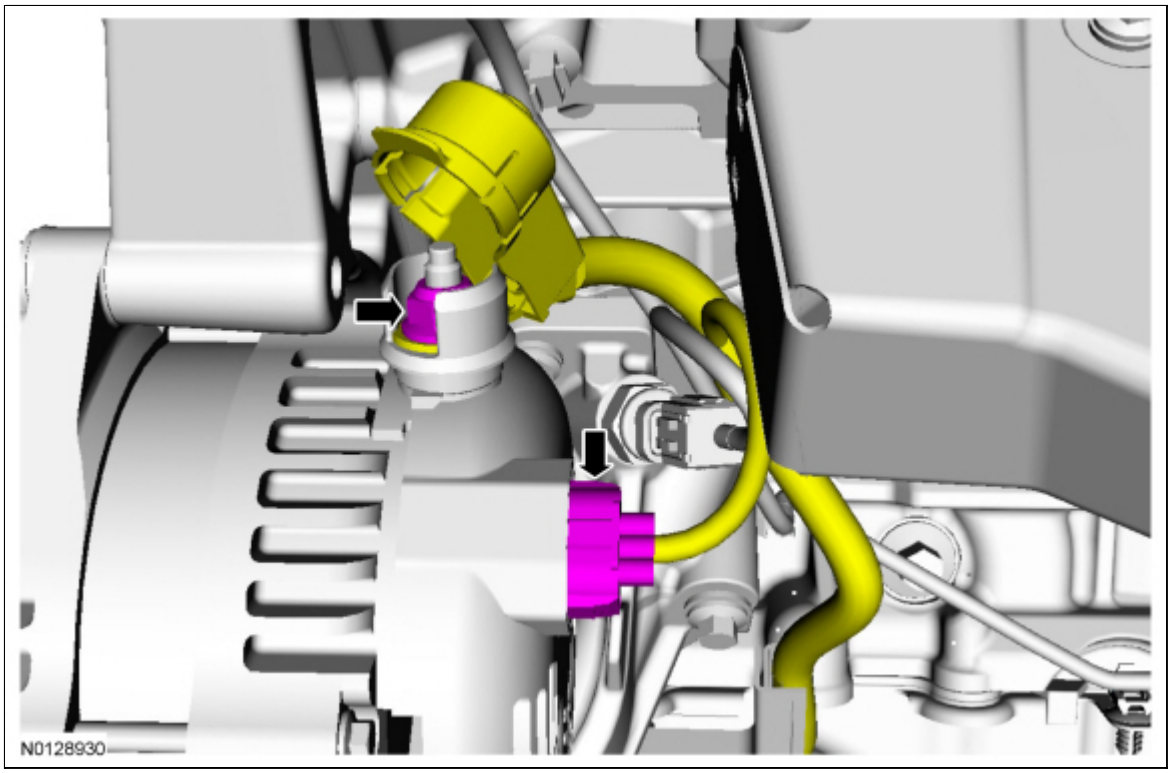


68. Install the generator and the 2 bolts.
    - Tighten to 48 Nm (35 lb-ft).

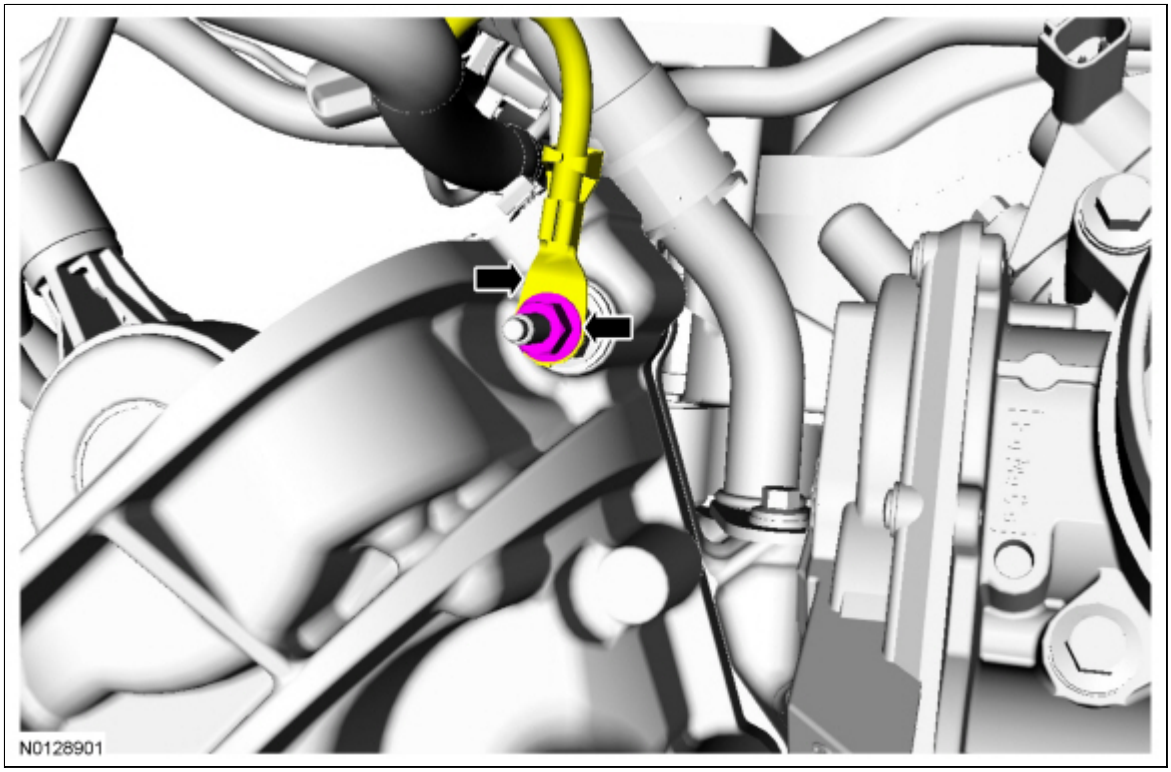


69. Connect the wiring harness connector to the generator.
    - Install the B+ wire and nut onto the generator.
        - Tighten to 17 Nm (150 lb-in).

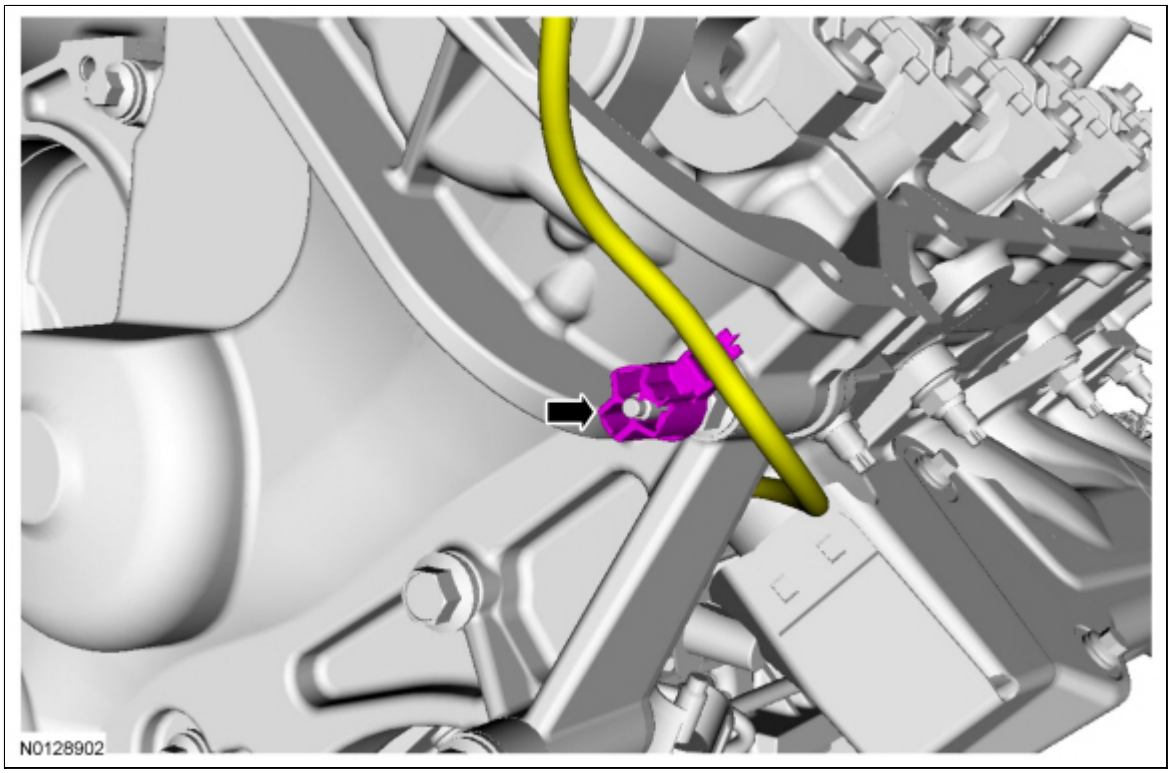
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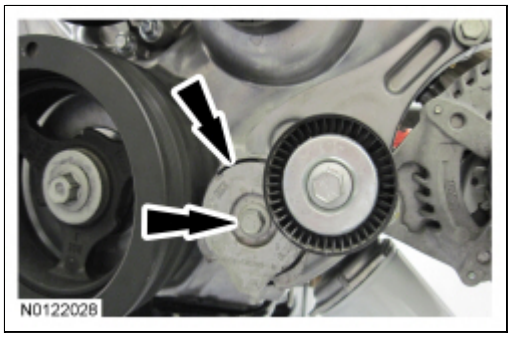
70. Install the ground wire and nut to the engine front cover stud bolt.
    - Tighten to 10 Nm (89 lb-in).



71. Attach the wiring harness retainer to the engine front cover stud bolt.

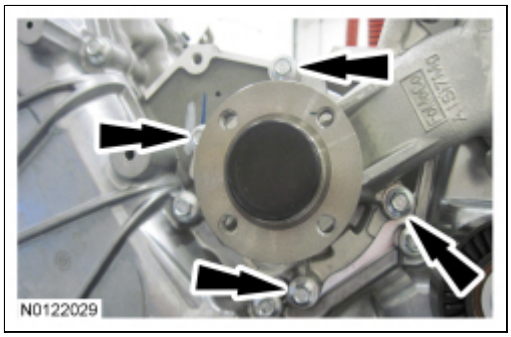


72. Install the accessory drive belt tensioner and the bolt.
    - Tighten to 48 Nm (35 lb-ft).



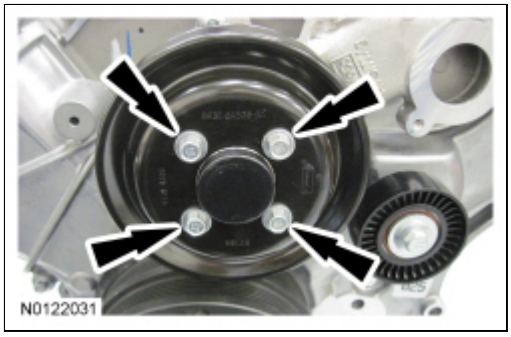
73. **NOTE:** Lubricate the new coolant pump O-ring seal with clean engine coolant.

    Using a new O-ring seal, install the coolant pump and the 4 bolts.
    - Tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.

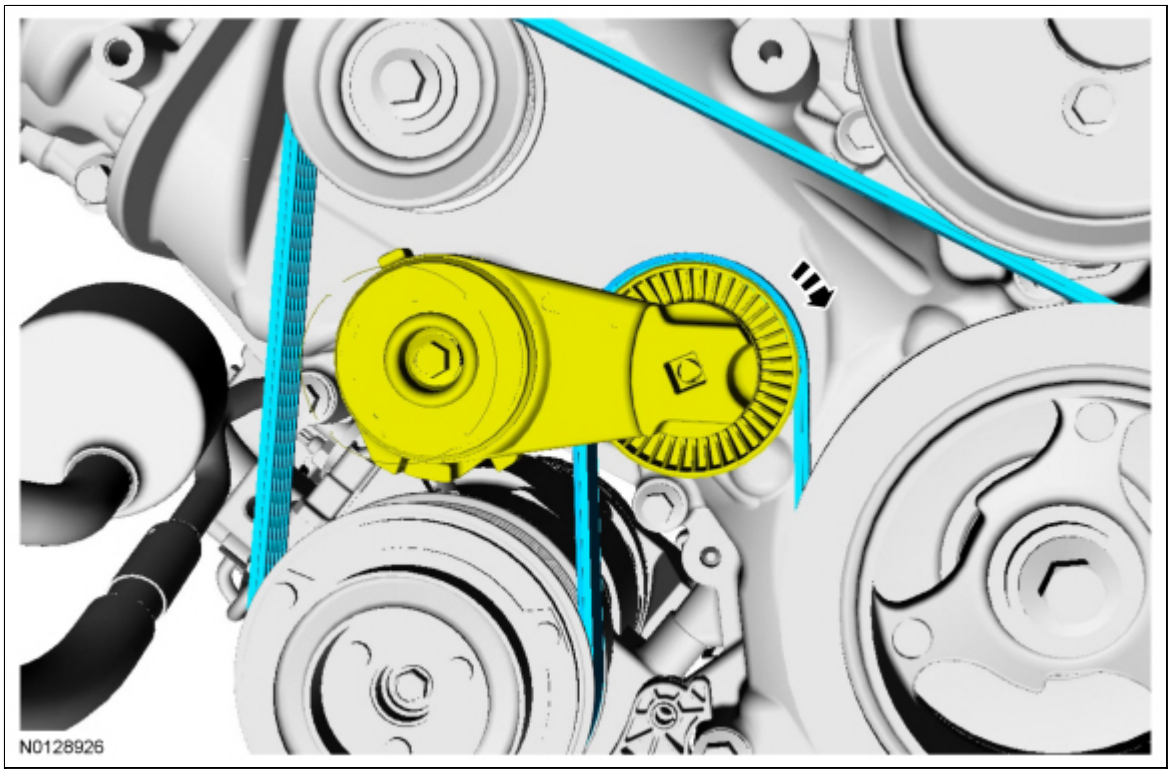


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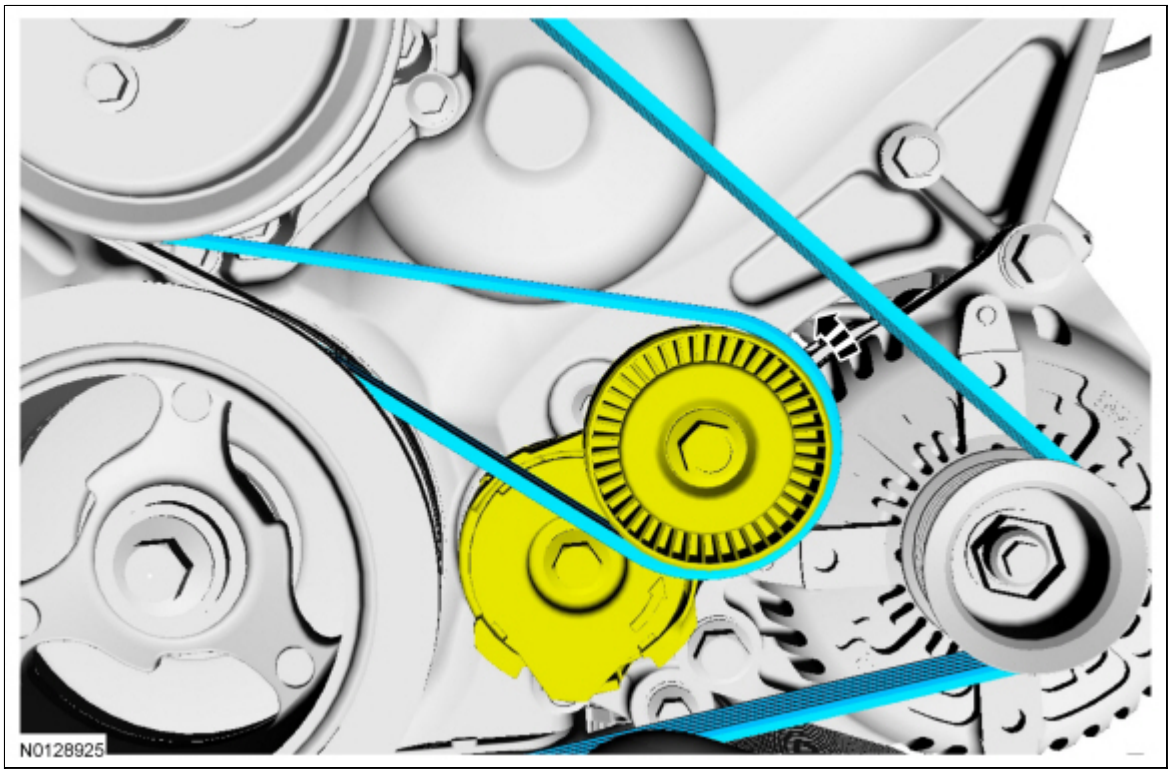
74. Install the coolant pump pulley and the 4 bolts.



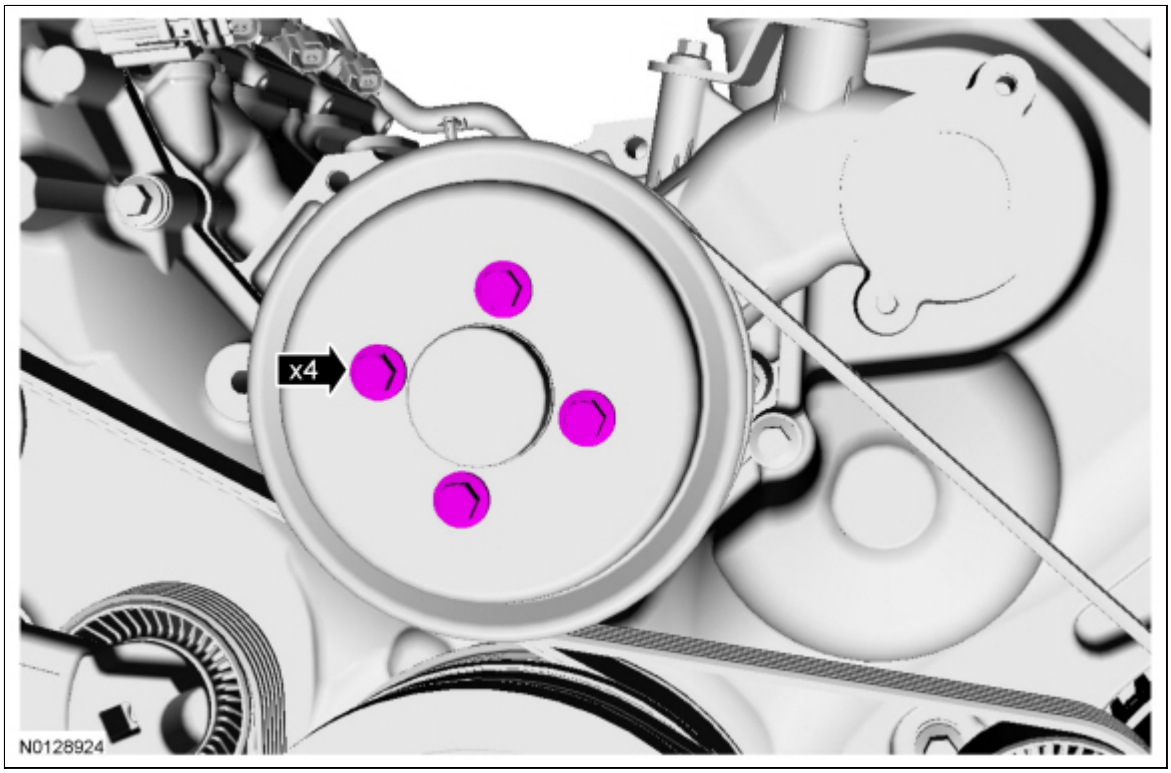
75. Rotate the A/C compressor belt tensioner clockwise and install the A/C compressor belt.



76. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.



77. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).

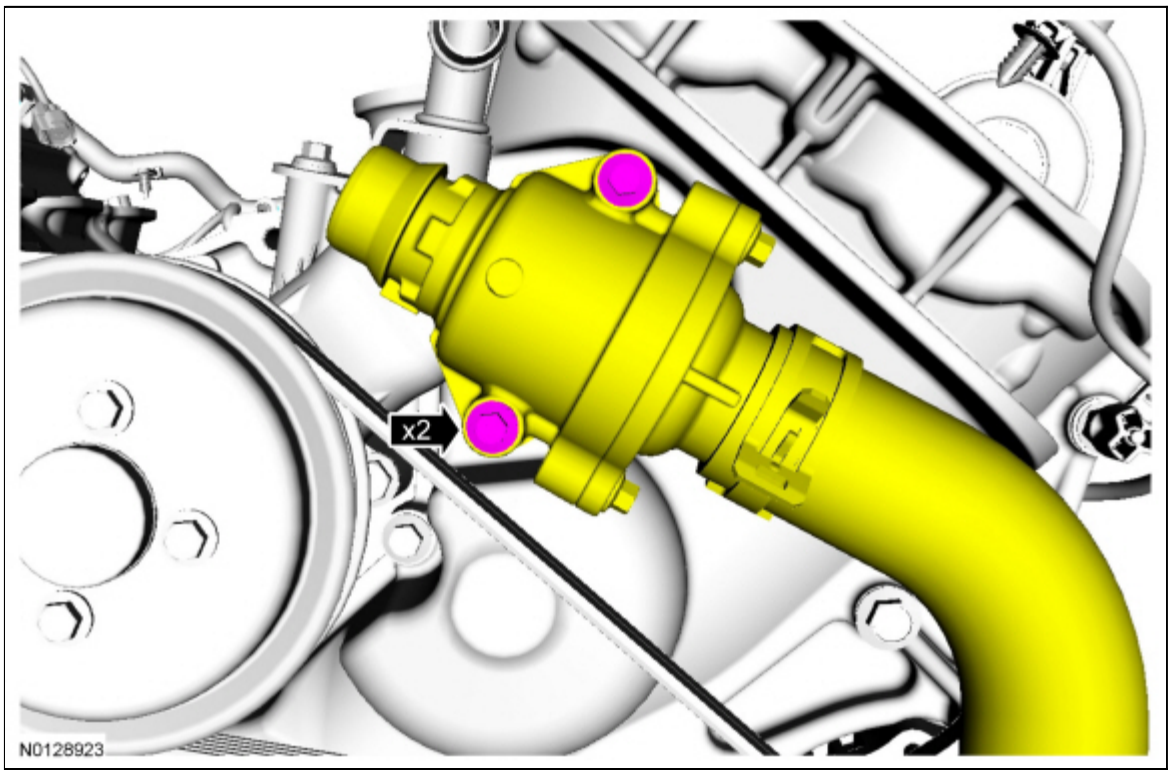


78. **NOTE:** Lubricate the new thermostat housing O-ring seal with clean engine coolant.

    Using a new thermostat housing O-ring seal, install the thermostat housing and the 2 bolts.

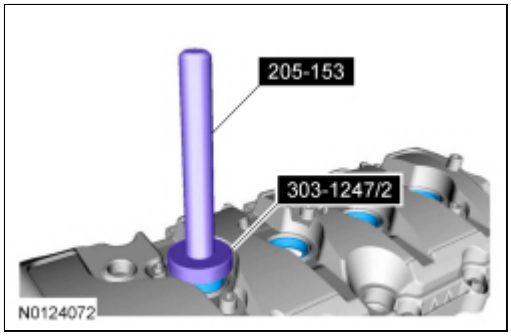
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- Tighten to 10 Nm (89 lb-in).



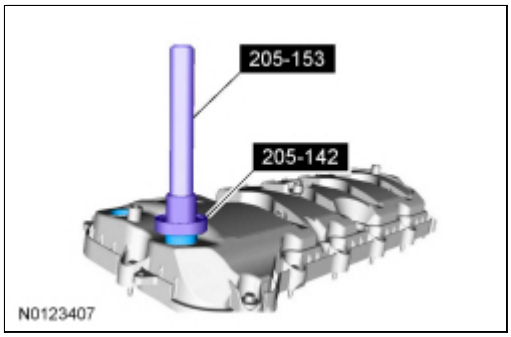
79. **NOTE:** Installation of new seals is only required if damaged seals were removed.

    Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



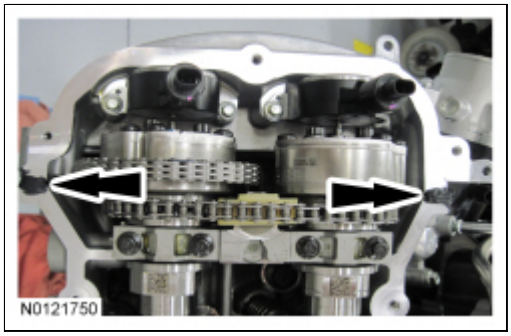
80. **NOTE:** Installation of new seals is only required if damaged seals were removed.

    Using the Differential Bearing Cone Installer and Handle, install new VCT variable force solenoid seal (s).

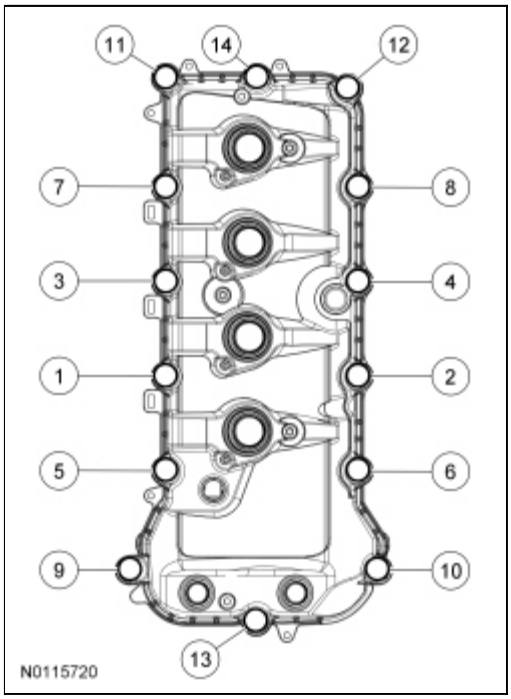


81. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

    Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-LH cylinder head joints.



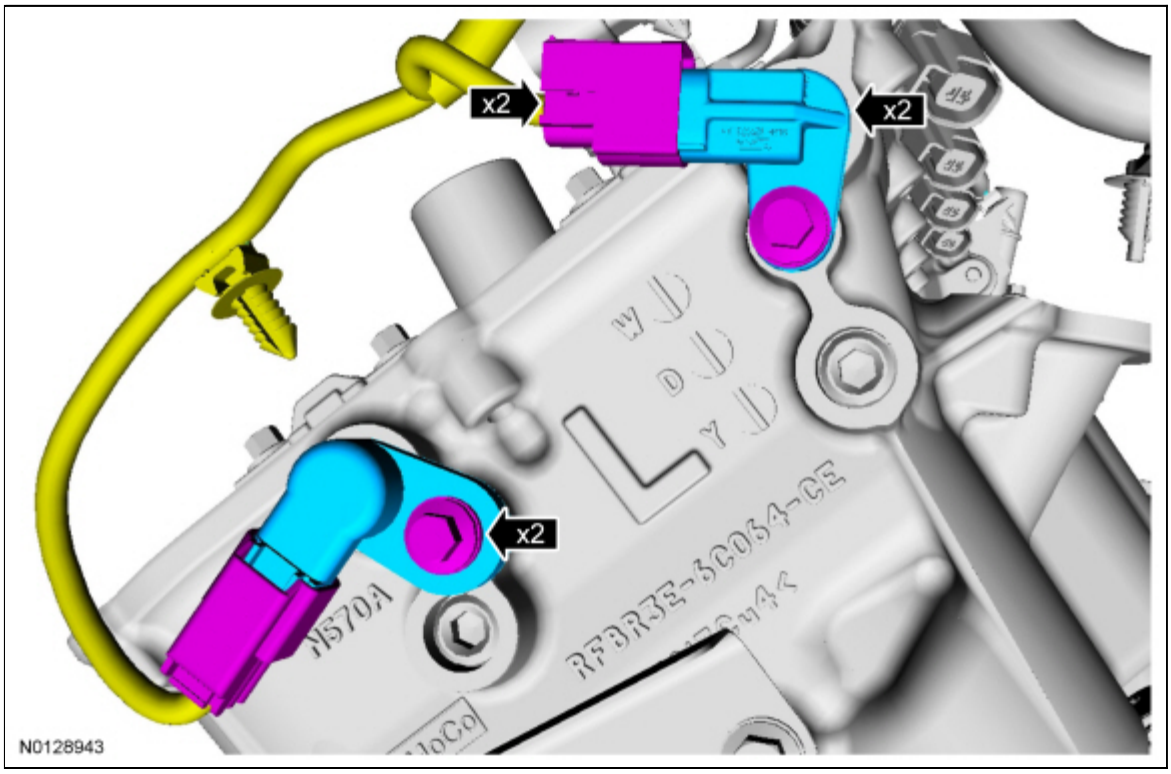
82. Position the LH valve cover and new gasket on the cylinder head.
    - Tighten the fasteners in the sequence shown to 10 Nm (89 lb-in).



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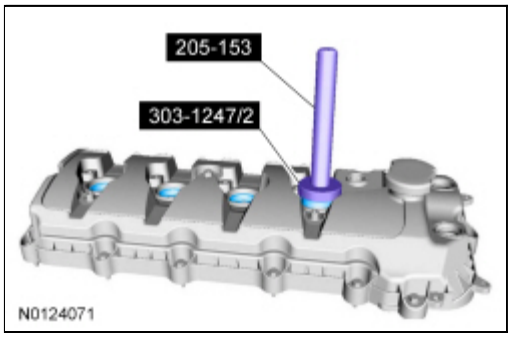
83. Install the oil level indicator.

84. If removed, install the LH intake and exhaust Camshaft Position (CMP) sensors and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Connect the LH intake and exhaust CMP sensor electrical connectors.



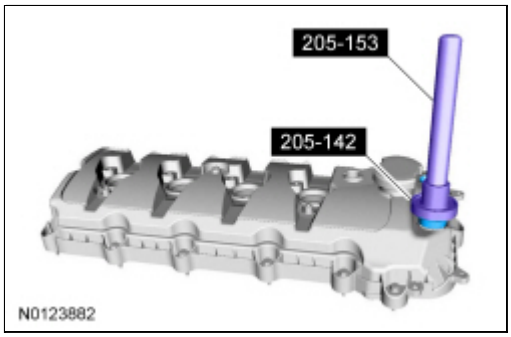
85. **NOTE:** Installation of new seals is only required if damaged seals were removed.

    Using the VCT Spark Plug Tube Seal Installer and Handle, install new spark plug tube seals.



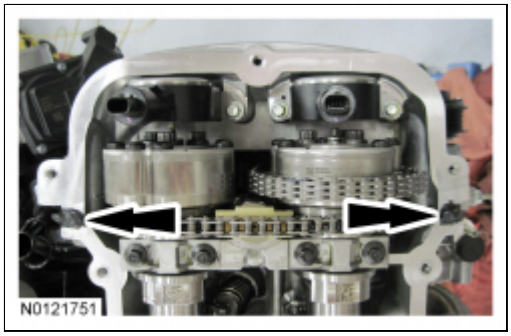
86. **NOTE:** Installation of new seals is only required if damaged seals were removed.

    Using the Differential Bearing Cone Installer and Handle, install new VCT variable force solenoid seal (s).

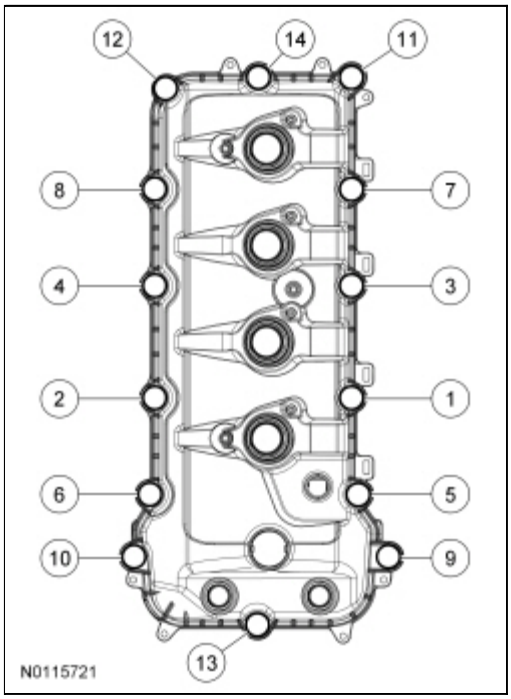


87. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

    Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-RH cylinder head joints.

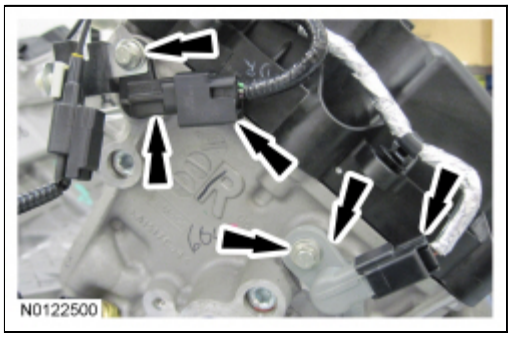


88. Position the RH valve cover and new gasket on the cylinder head.
    - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).

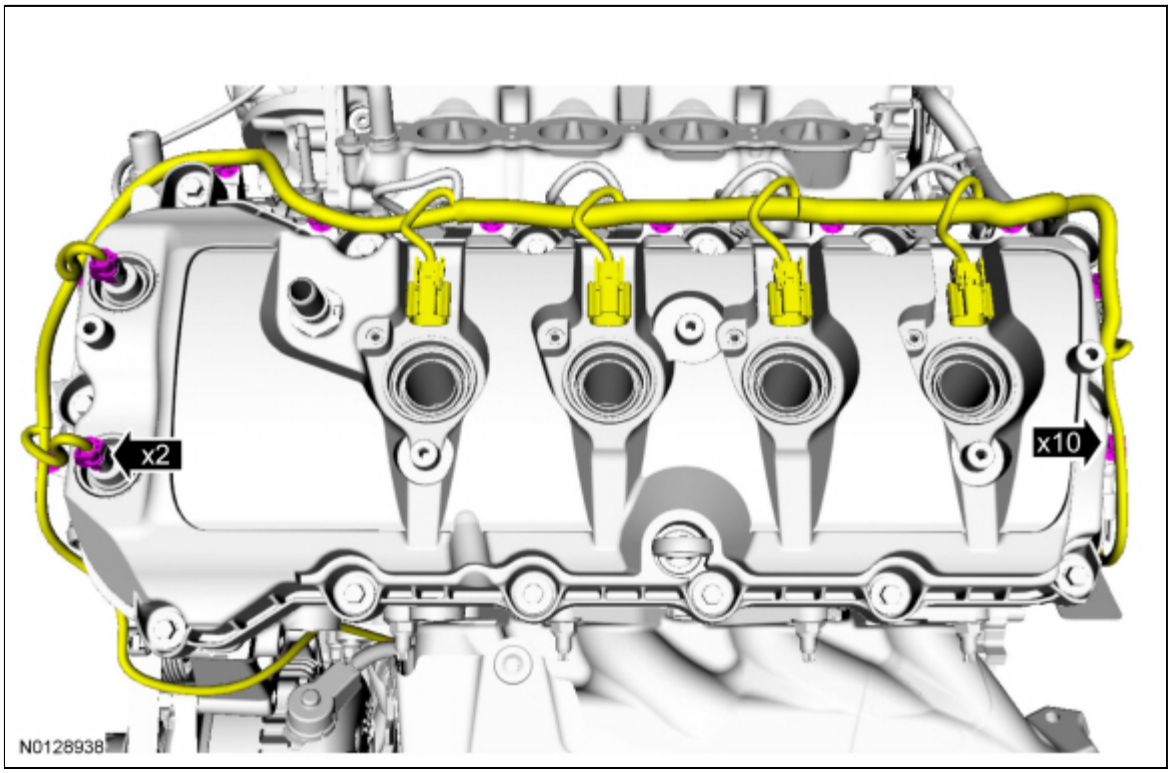


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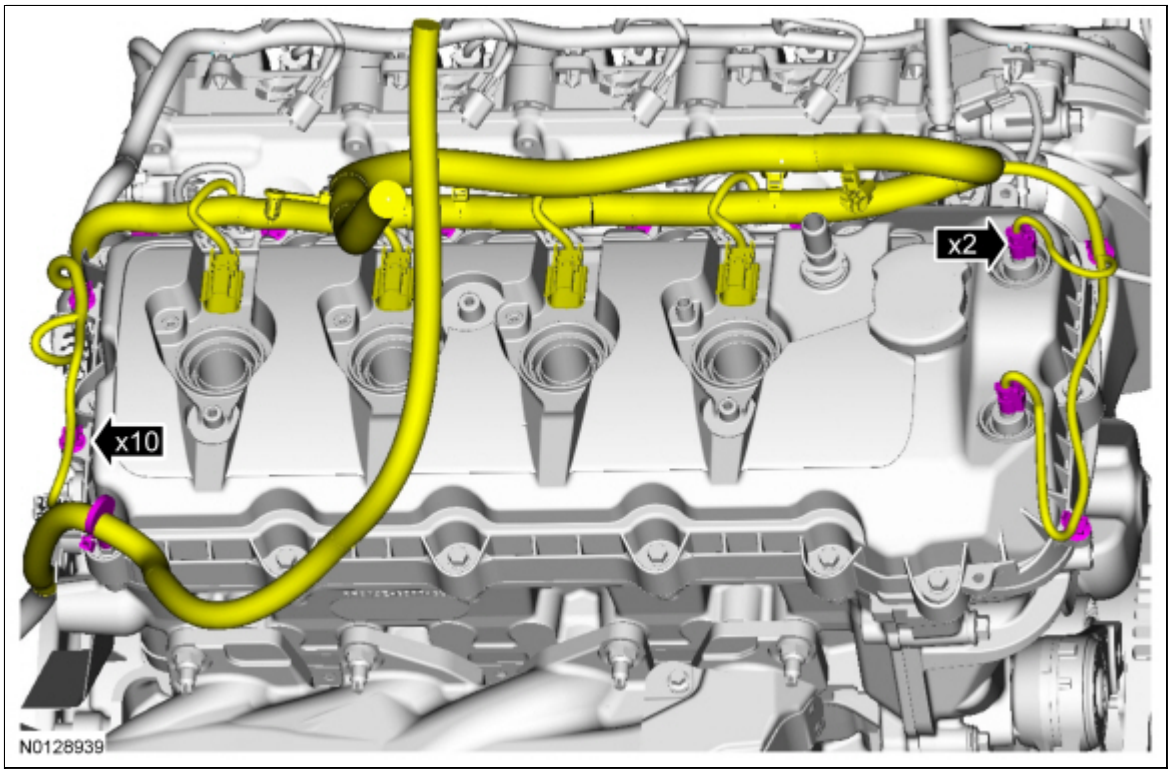
89. If removed, install the RH intake and exhaust CMP sensors and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).
    - Connect the RH intake and exhaust CMP sensor electrical connectors.



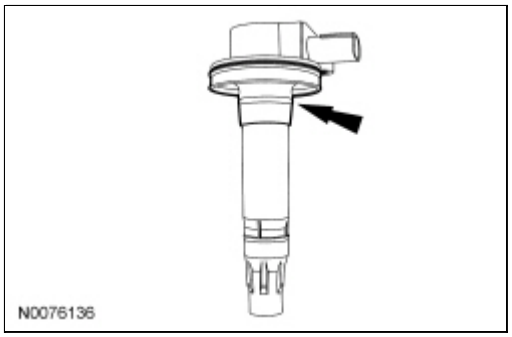
90. Connect the 2 VCT variable force solenoid electrical connectors.
    - Attach the 10 wiring harness retainers to the LH valve cover.



91. Connect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
    - Attach the 10 wiring harness retainers to the RH valve cover.



92. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
    - To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.

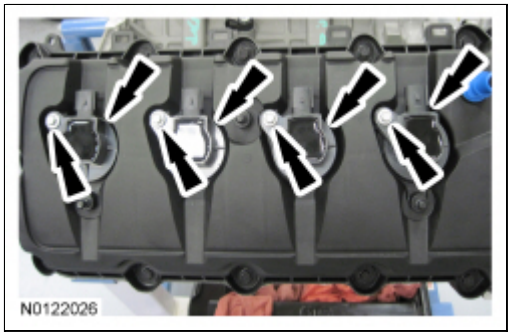


93. **NOTE:** RH shown, LH similar.

    NOTE: Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs. RH shown, LH similar.

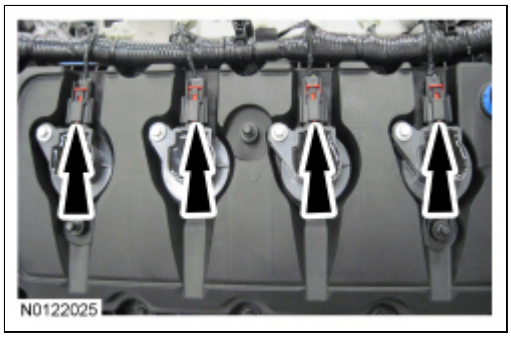
    Install the 8 ignition coils and 8 bolts.
    - Tighten to 6 Nm (53 lb-in).

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94. **NOTE:** RH shown, LH similar.

    Connect the 8 ignition coil electrical connectors.



95. Install the engine. For additional information, refer to Engine in this section.

Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Threadlock 262 TA-26	WSK-M2G351-A6

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

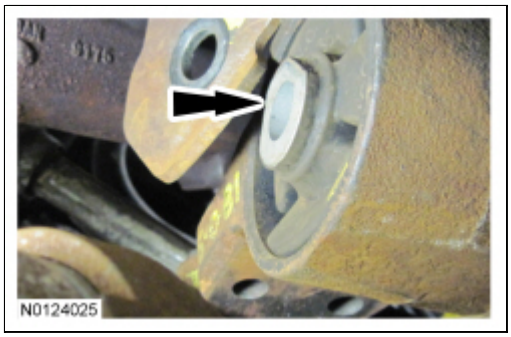
WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, position the engine in the engine compartment leaving access to the LH engine support insulator bolts.

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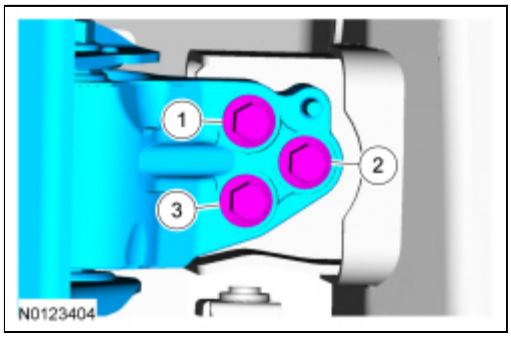
2. **NOTE:** Clean the LH and RH engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

   Install the LH engine support insulator from under the vehicle.



3. **NOTE:** Apply threadlock to the bolt threads prior to installation.

   Using a suitable floor crane, raise the engine assembly to gain access to install the 3 LH engine support insulator bolts.
   - Tighten the 3 LH engine support insulator bolts in the sequence shown to 175 Nm (129 lb-ft).

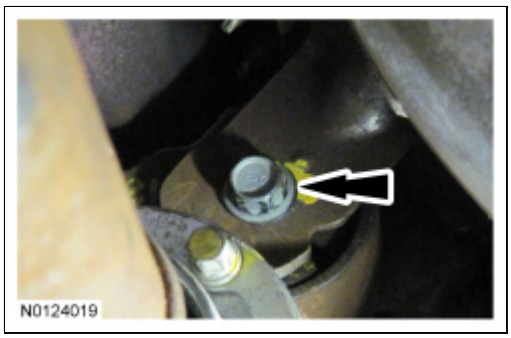


4. Lower the engine.

5. ***NOTICE:*** **Use only hand tools when installing the LH engine support insulator through bolt or the engine support insulator may be damaged.**

   NOTE: Apply threadlock to the bolt threads prior to installation.

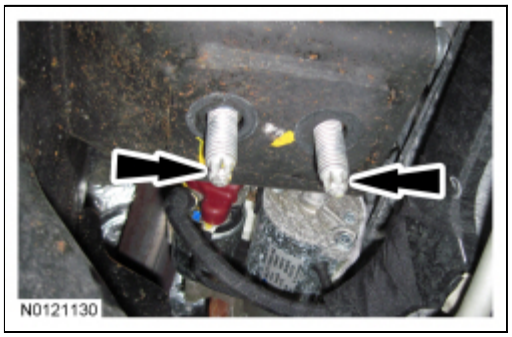
   Install the LH engine mount through bolt.
   - Tighten to 350 Nm (258 lb-ft).



6. ***NOTICE:*** **Use only hand tools when installing the RH engine support insulator studs or the engine support insulator may be damaged.**

   NOTE: Apply threadlock to the stud threads prior to installation.

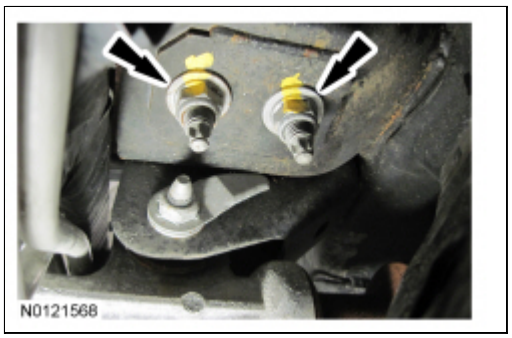
   Install the 2 RH engine support insulator studs.
   - Tighten to 15 Nm (133 lb-in).



7. ***NOTICE:*** **Use only hand tools when installing the RH engine support insulator nuts or the engine support insulator may be damaged.**

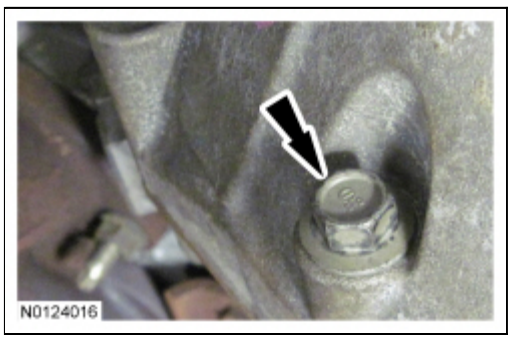
   NOTE: Apply threadlock to the nut threads prior to installation.

   Install the 2 RH engine support insulator nuts.
   - Tighten to 175 Nm (129 lb-ft).



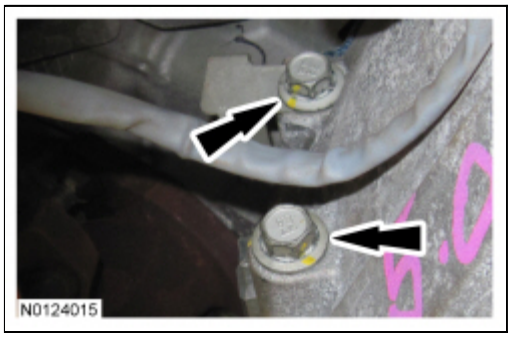
8. **NOTE:** The 2 upper transmission-to-engine bolt will be installed later.

   Install the lower transmission-to-engine bolt.
   - Tighten to 48 Nm (35 lb-ft).

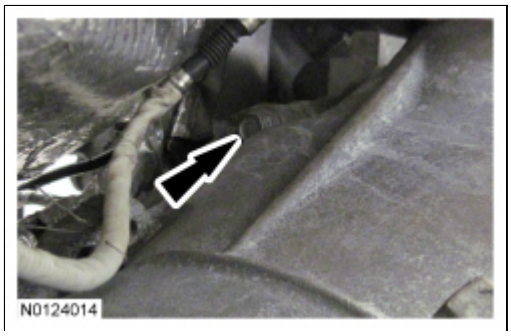


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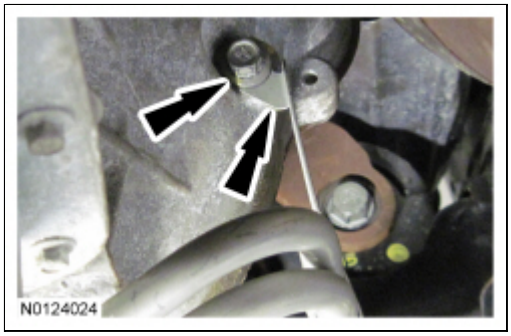
9. Install the 2 lower transmission-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).



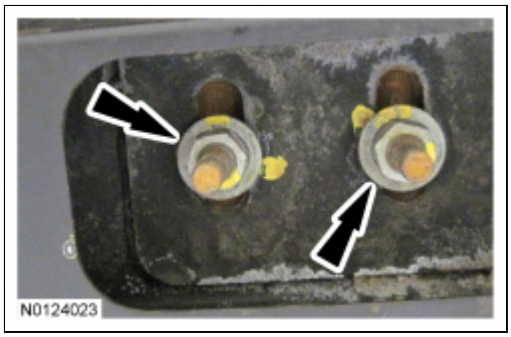
10. Install the lower transmission-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



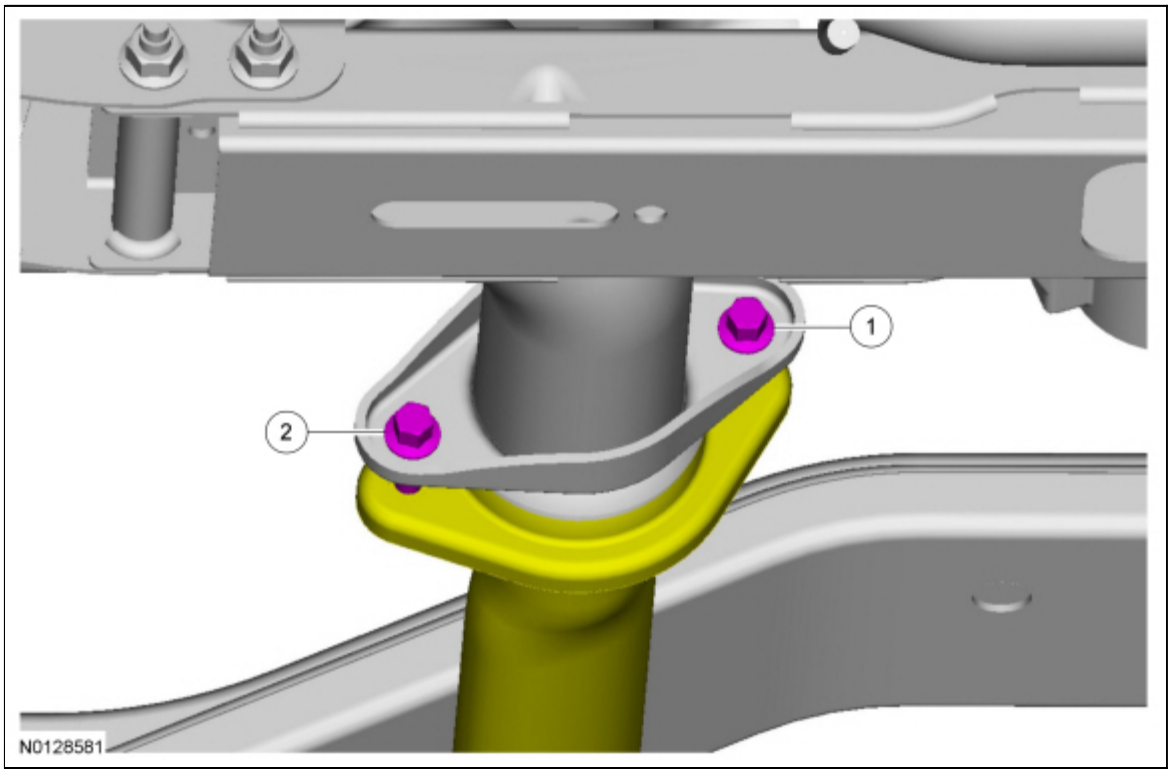
11. Install the transmission cooler tube support bracket and the transmission-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



12. Tighten the 2 transmission mount-to-crossmember nuts.
    - Tighten to 25 Nm (18 lb-ft).

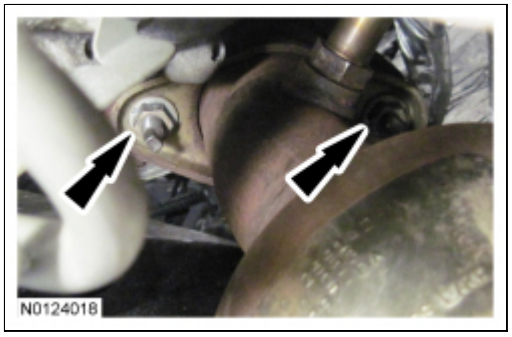


13. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
    1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

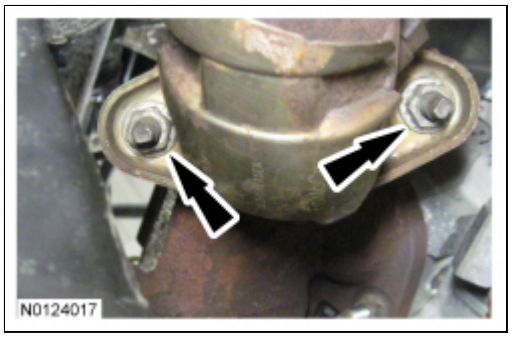


14. Install 2 new RH catalytic converter-to-exhaust manifold nuts.
    - Tighten to 40 Nm (30 lb-ft).

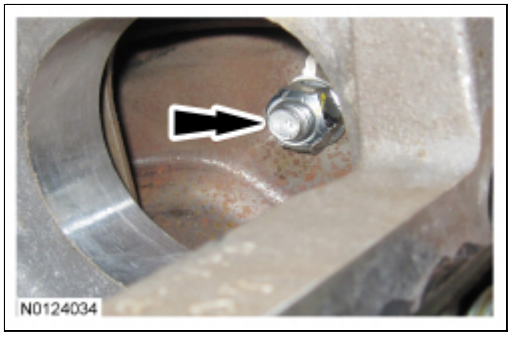
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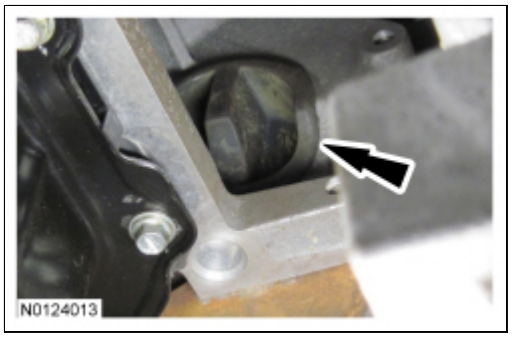
15. Install 2 new LH catalytic converter-to-exhaust manifold nuts.
    - Tighten to 40 Nm (30 lb-ft).



16. Install 4 new torque converter-to-flexplate nuts.
    - Tighten to 35 Nm (26 lb-ft).

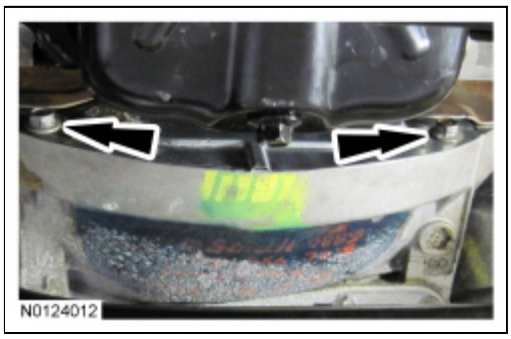


17. Install the cylinder block opening cover.



18. Install the flexplate inspection cover and the 2 bolts.

- Tighten to 35 Nm (26 lb-ft).



19. **NOTE:** Do not lubricate the O-ring seal.

    Install a new oil filter.
    - Tighten to 16 Nm (142 lb-in).



20. Connect the oil level sensor electrical connector.

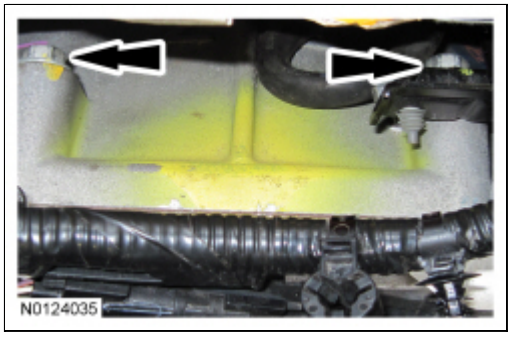


21. Install the starter. For additional information, refer to Section 303-06 .

22. If equipped, install the front driveshaft. For additional information, refer to Section 205-01 .

23. Install the 2 upper transmission-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

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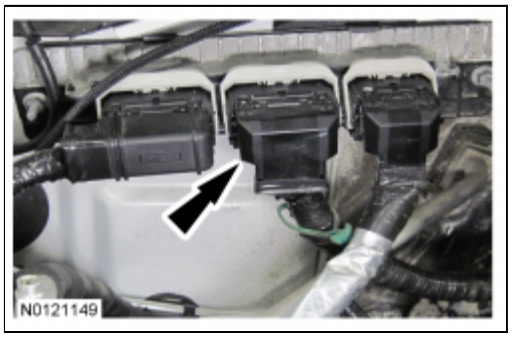
24. Attach the PCM wiring harness retainer to the valve cover bolt stud.



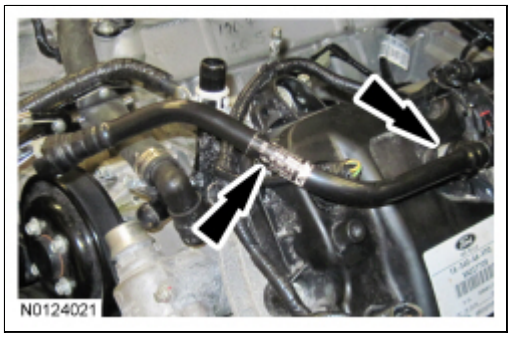
25. Attach and connect the engine harness electrical connector.



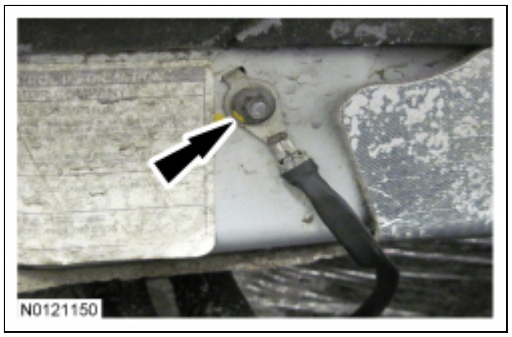
26. Connect the middle PCM electrical connector.



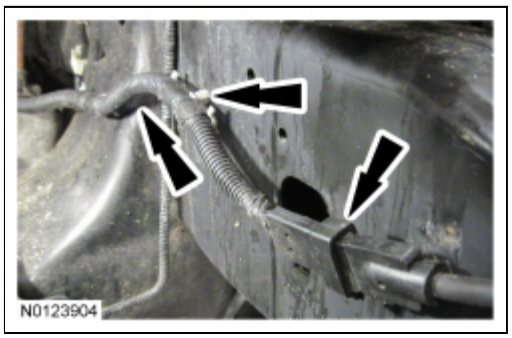
27. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in Section 310-00 .



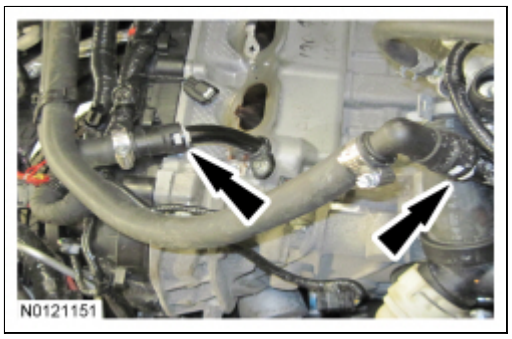
28. Install the ground strap and bolt to the cowl.
    - Tighten to 10 Nm (89 lb-in).



29. If equipped, attach and connect the block heater electrical connector and the 2 wiring harness retainers.

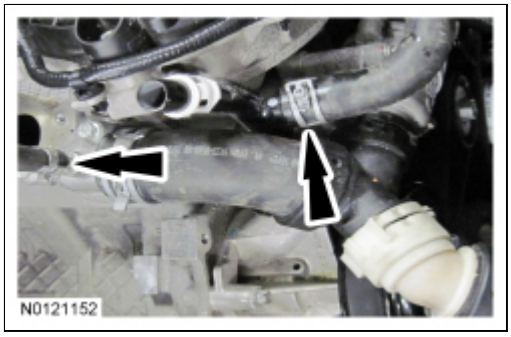


30. Connect the 2 heater hose quick connect couplings. For additional information, refer to Section 412-00 .

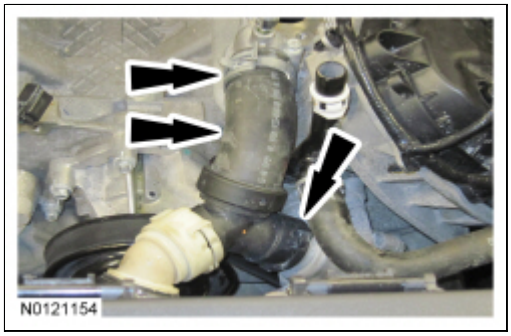


31. Connect the 2 coolant hoses.

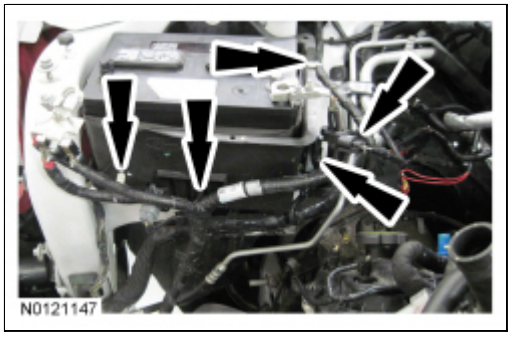
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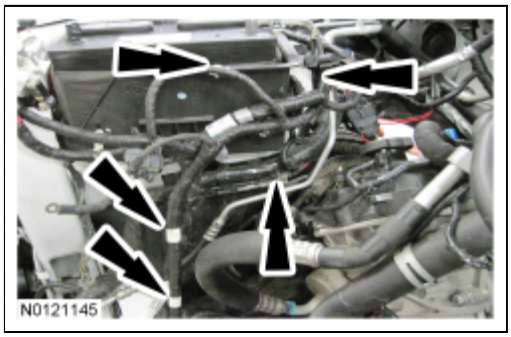
32. Install the spring clip, the clamp and connect the coolant bypass T assembly to the engine.



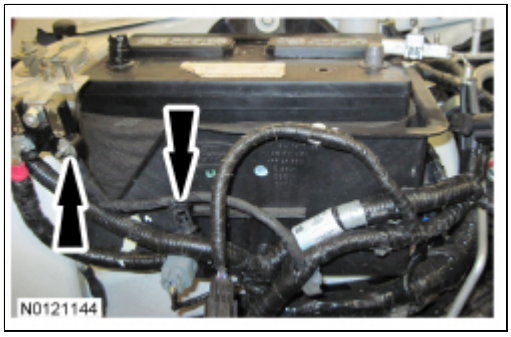
33. Connect the 2 wiring harness connectors and attach the 3 wiring harness retainers.



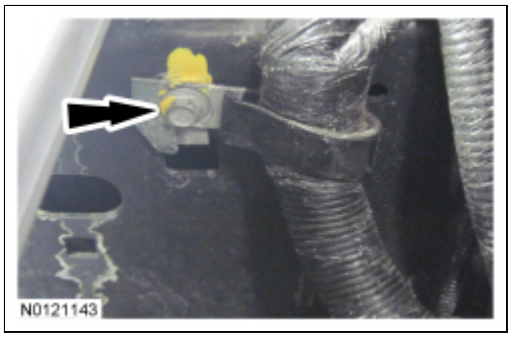
34. Attach the 5 wiring harness retainers.



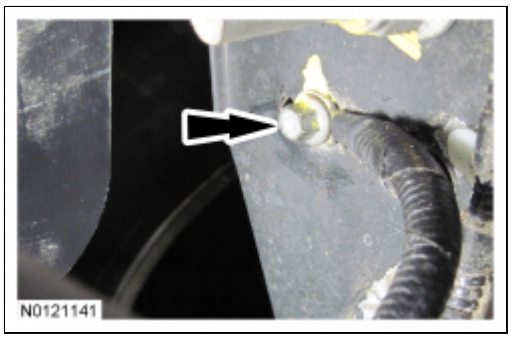
35. Connect the B+ wire and nut.
    - Tighten to 17 Nm (150 lb-in).
    - Attach the wiring harness retainer to the battery tray.



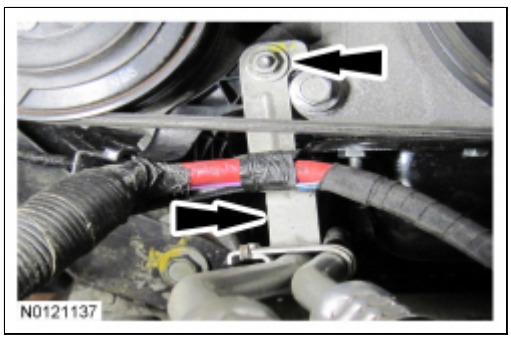
36. Install the wiring harness bracket and the bolt to the RH frame rail.
    - Tighten to 20 Nm (177 lb-in).



37. Install the ground wire and the bolt to the RH frame rail.
    - Tighten to 12 Nm (106 lb-in).

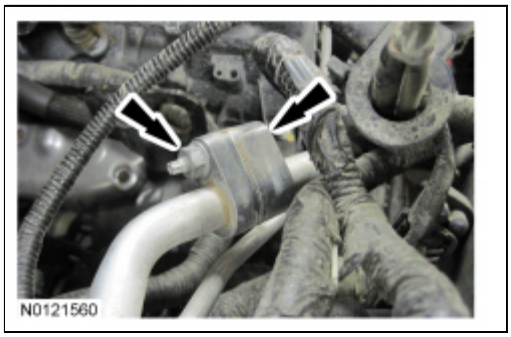


38. Install the transmission cooler line bracket and the nut to the engine front cover stud bolt.
    - Tighten to 13 Nm (115 lb-in).

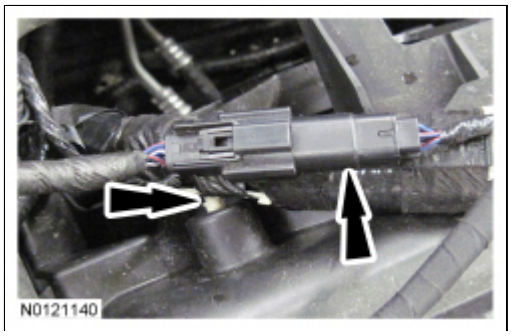


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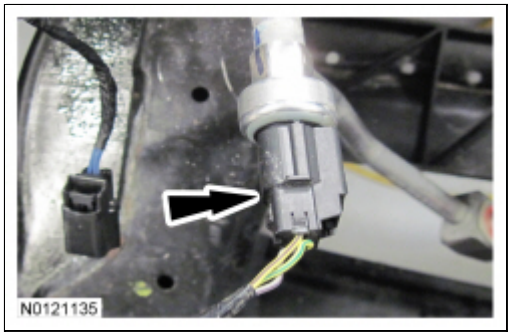
39. Using a new O-ring seal and gasket, install the A/C tube and the nut.
    - Tighten to 15 Nm (133 lb-in).



40. Connect the wiring harness electrical connector and pin-type retainer.
    - Position the Power Distribution Box (PDB) and wiring harness toward the engine.



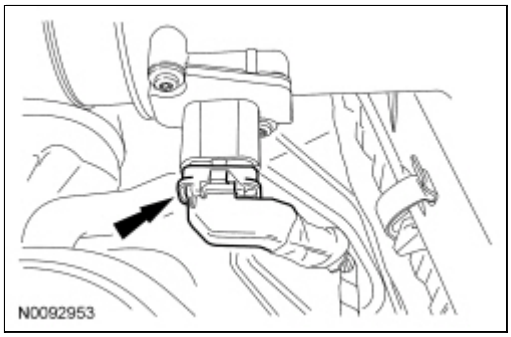
41. Connect the A/C pressure transducer electrical connector.



42. Install the cooling module. For additional information, refer to Section 303-03 .

43. Install the Air Cleaner (ACL) element and ACL upper tray. For additional information, refer to Section 303-12

44. Connect the Mass Air Flow (MAF) sensor electrical connector.



45. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Install the intake manifold. For additional information, refer to Intake Manifold in this section.

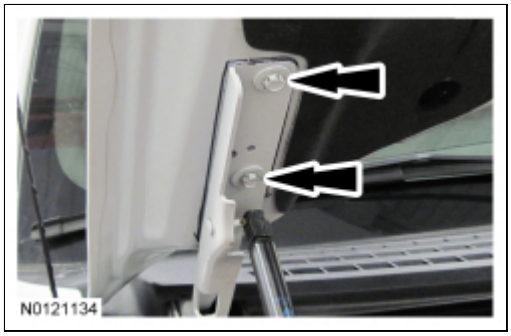
46. Fill the engine with clean engine oil.

47. Connect the battery ground cable. For additional information, refer to Section 414-01 .

48. **NOTE:** Align the index marks made during hood removal.

    NOTE: RH shown, LH similar.

    Install the hood and the 4 bolts.
    - Tighten to 12 Nm (106 lb-in).

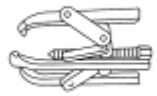


49. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Cylinder Head

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—

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Motorcraft® Silicone Gasket Remover ZC-30	—

Removal

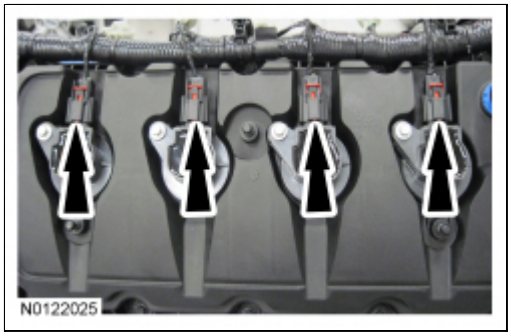
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

All cylinder heads

1. Remove the engine. For additional information, refer to Engine in this section.
2. Mount the engine on a work stand.
3. **NOTE:** RH shown, LH similar.

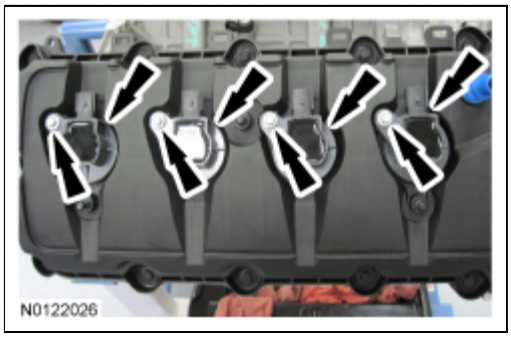
   Disconnect the 8 ignition coil electrical connectors.



4. **NOTE:** RH shown, LH similar.

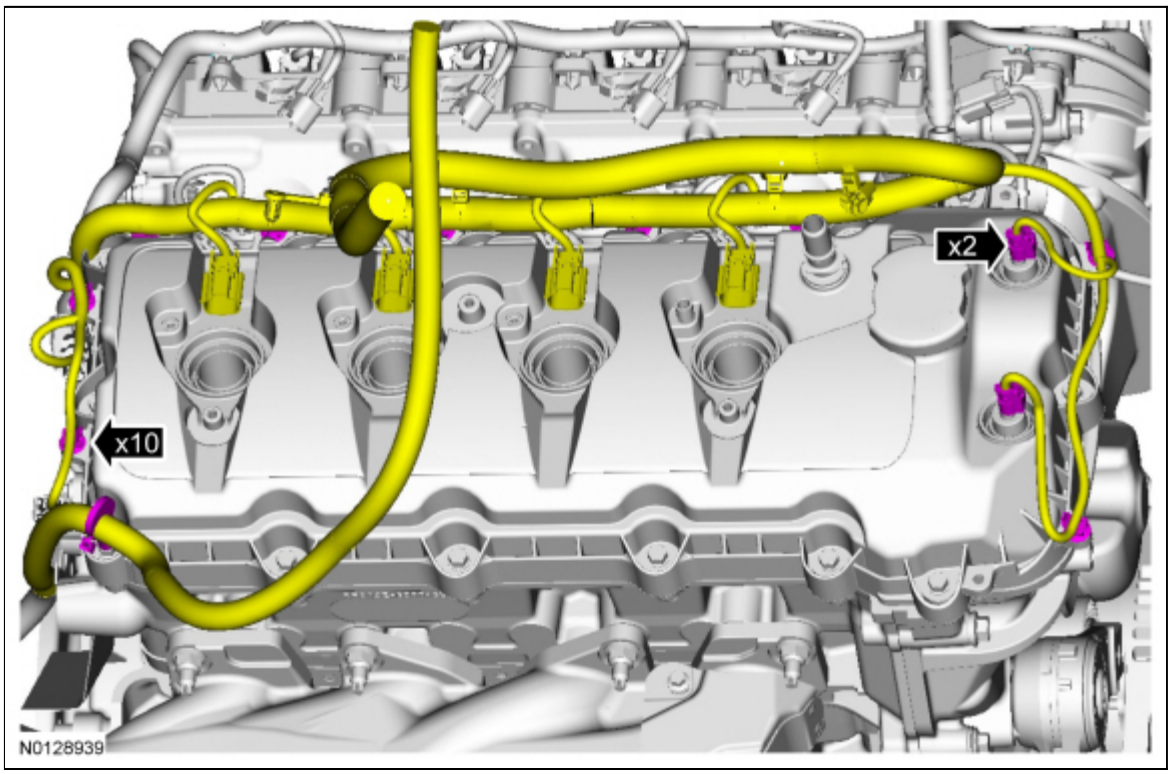
   NOTE: When removing the ignition coils, a slight twisting motion will break the seal and ease removal. RH shown, LH similar.

   Remove the 8 bolts and the 8 ignition coils.

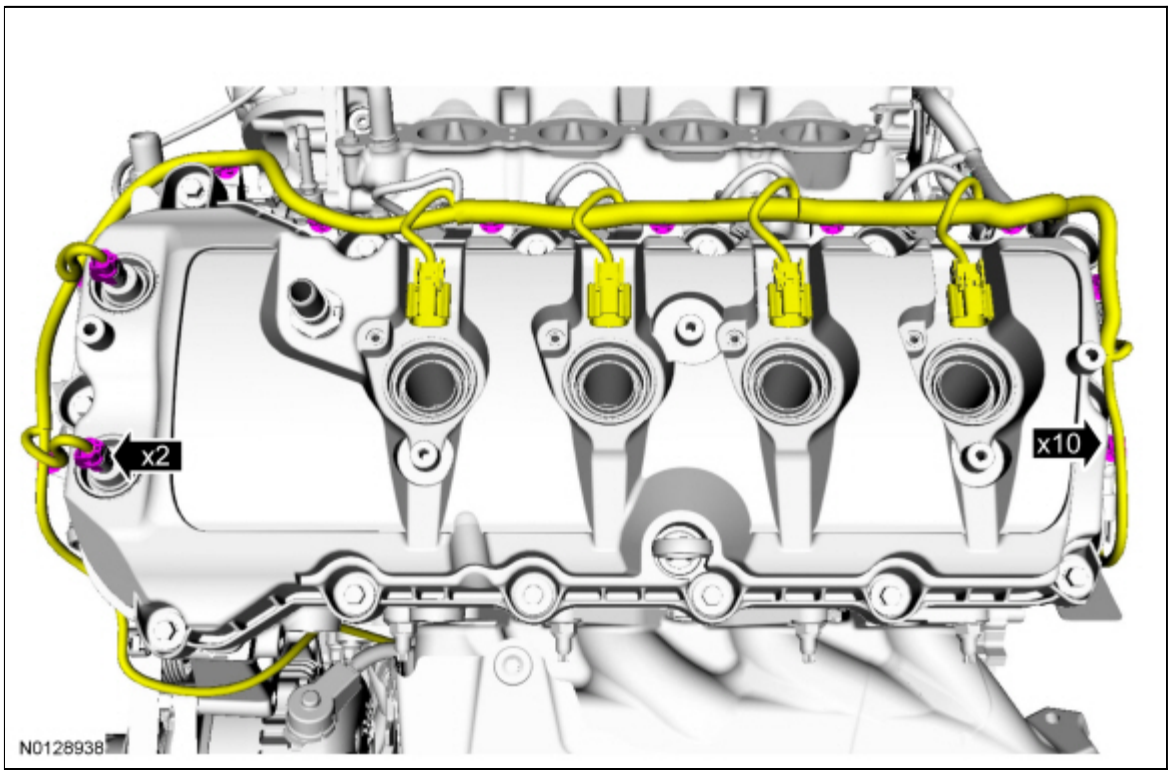


5. Disconnect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.

- Detach the 10 wiring harness retainers from the RH valve cover.



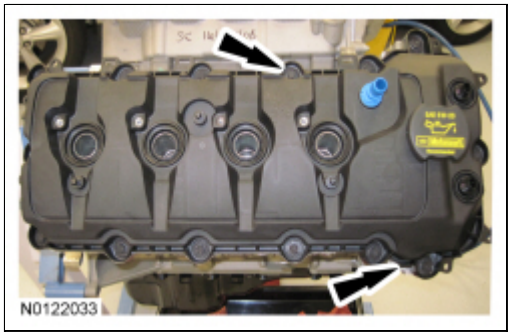
6. Disconnect the 2 VCT variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers from the LH valve cover.



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7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

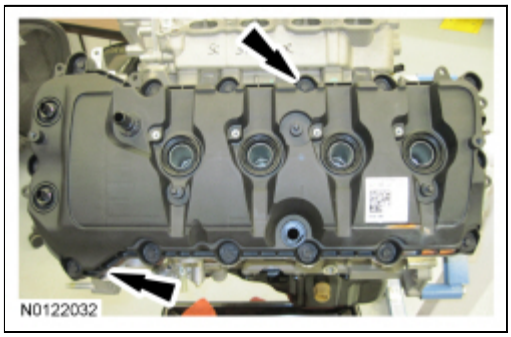
   Loosen the 14 fasteners and remove the RH valve cover and gasket.
   - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
   - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



8. Remove the oil level indicator.

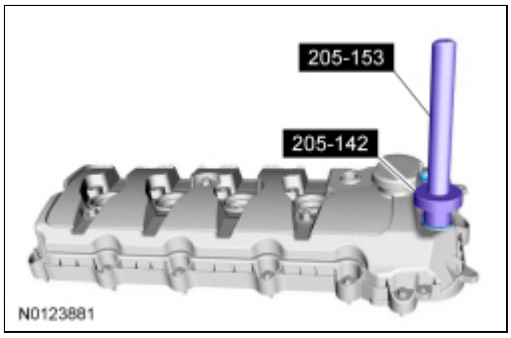
9. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   Loosen the 14 fasteners and remove the LH valve cover and gasket.
   - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
   - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



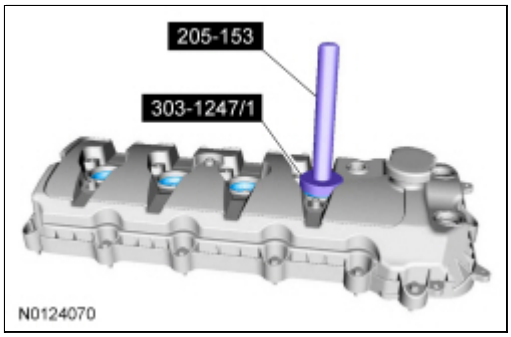
10. **NOTE:** RH shown, LH similar.

    Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).

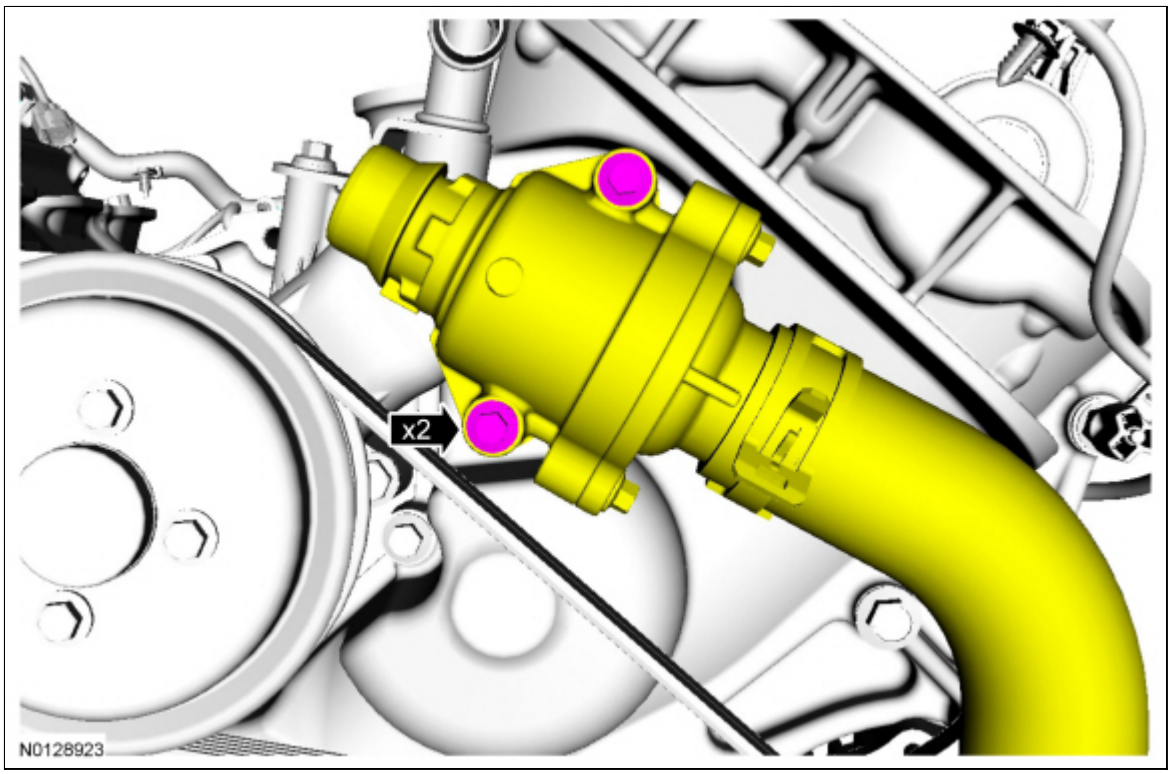


11. **NOTE:** RH shown, LH similar.

    Inspect the spark plug tube seals. Remove any damaged seals.
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).

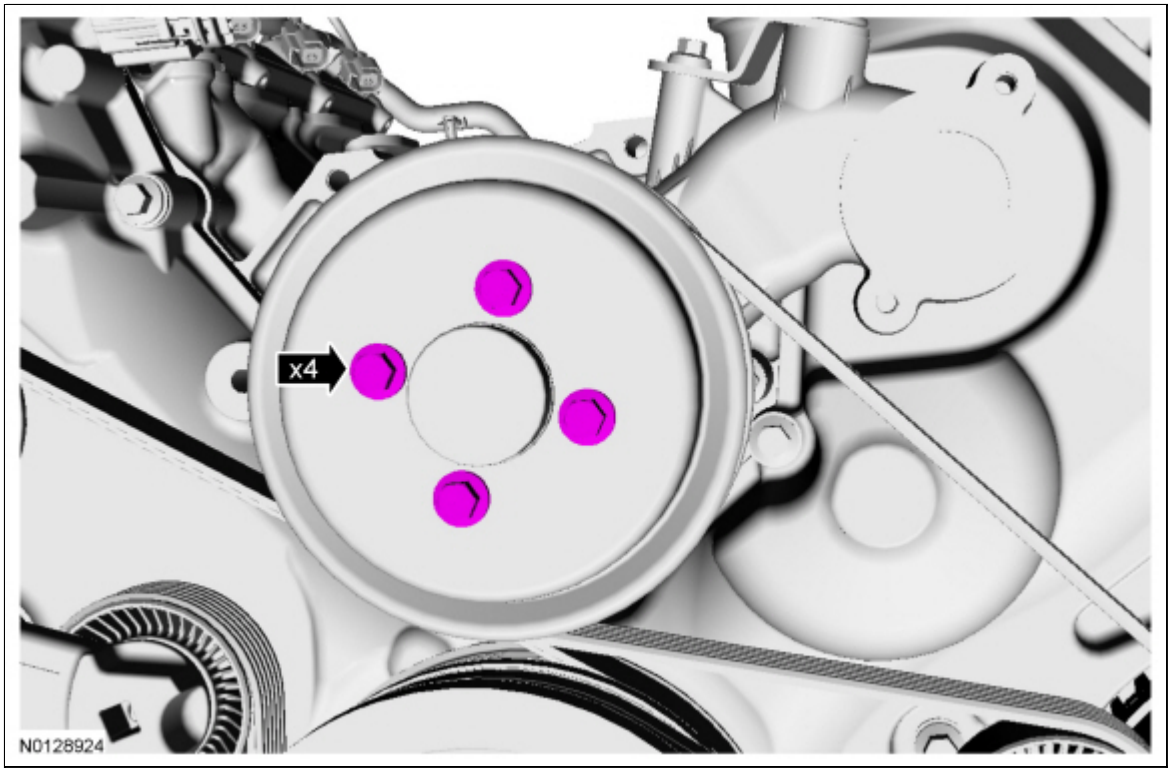


12. Remove the 2 bolts and position the thermostat housing and lower radiator hose aside.
    - Remove and discard the thermostat housing O-ring seal.

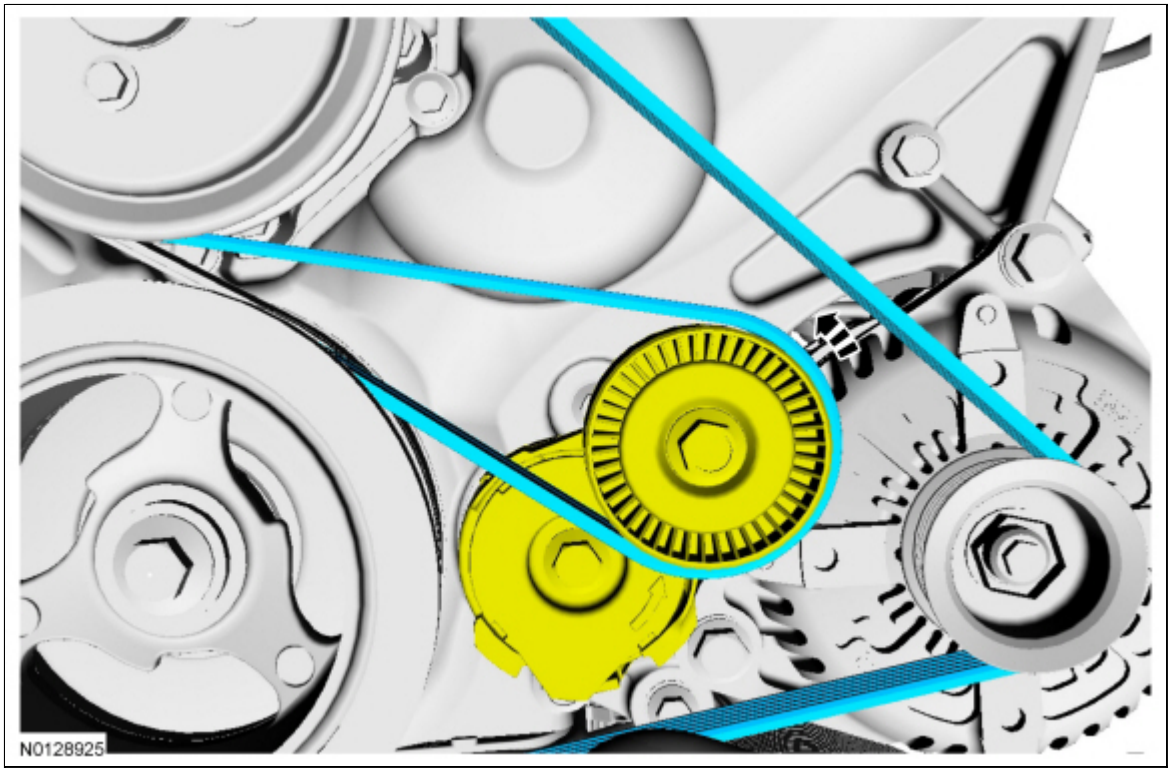


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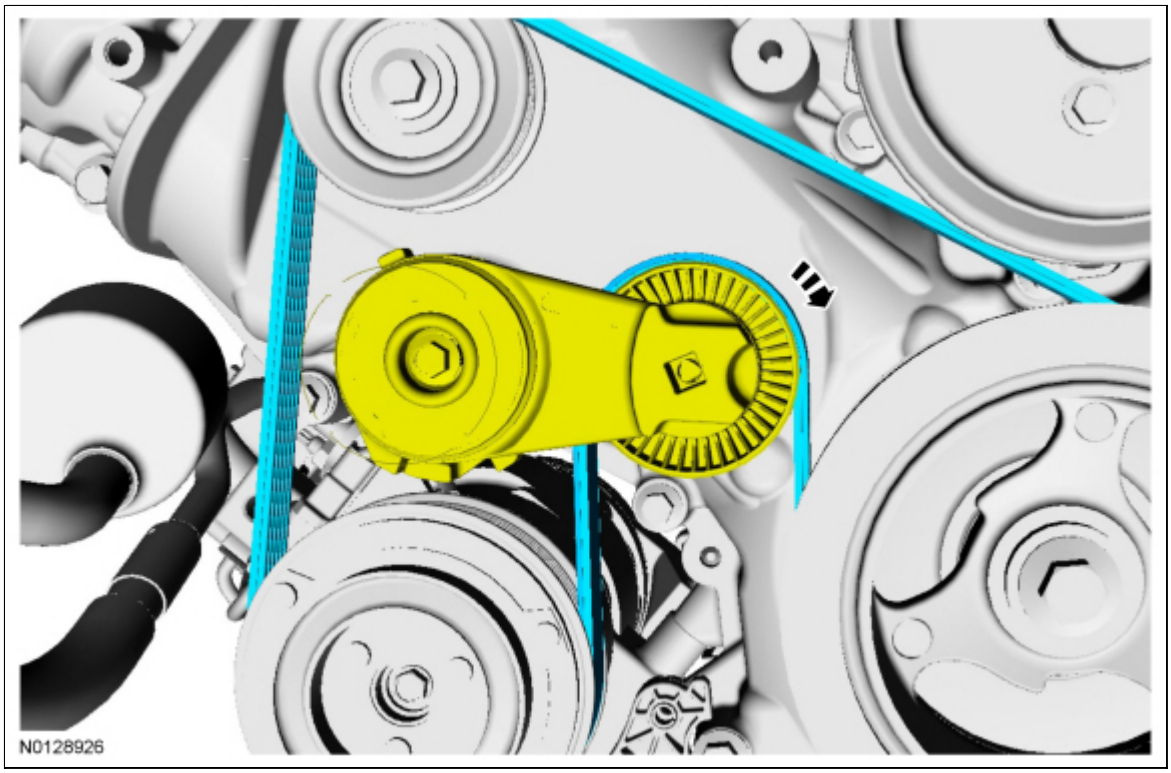
13. Loosen the 4 coolant pump pulley bolts.



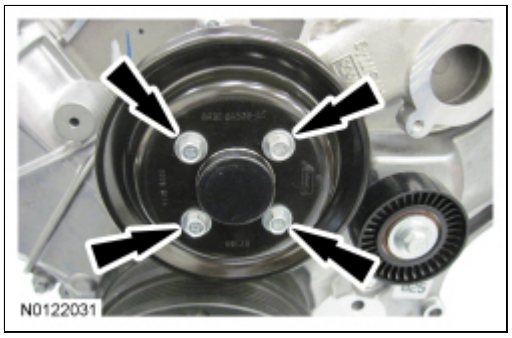
14. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.



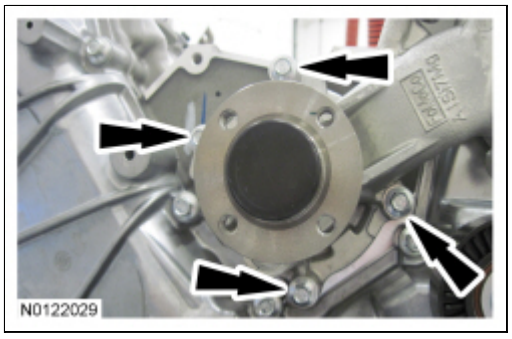
15. Rotate the A/C compressor belt tensioner clockwise and remove the A/C compressor belt.



16. Remove the 4 bolts and the coolant pump pulley.

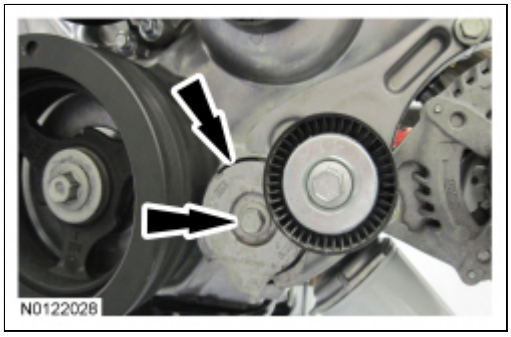


17. Remove the 4 bolts and the coolant pump.
    - Remove and discard the O-ring seal.

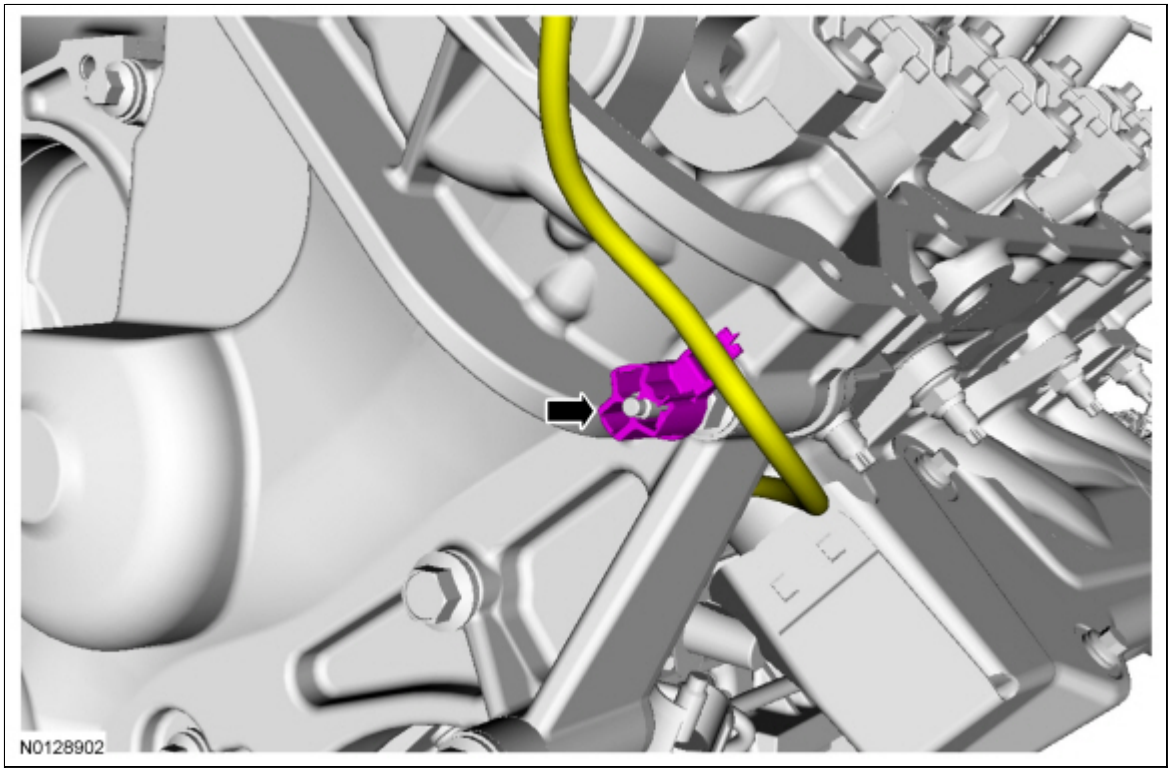


18. Remove the bolt and the accessory drive belt tensioner.

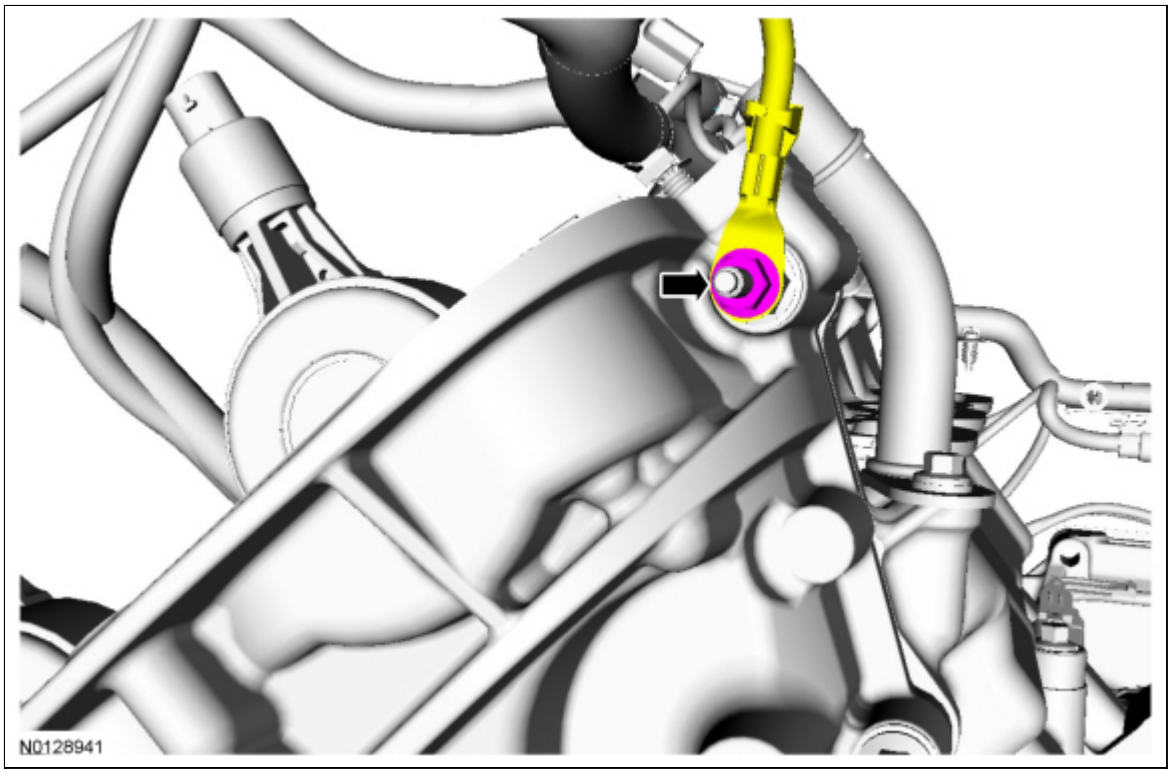
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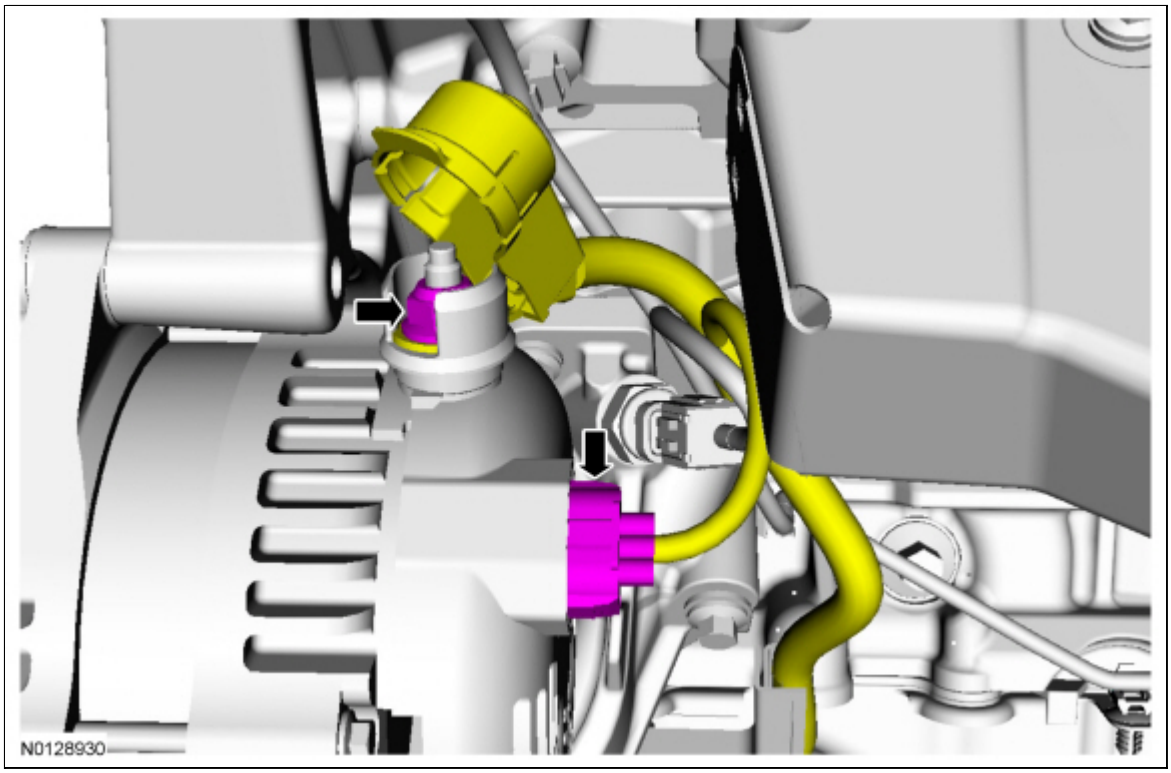
19. Detach the wiring harness retainer from the engine front cover stud bolt.



20. Remove the nut and the ground wire from the engine front cover stud bolt.

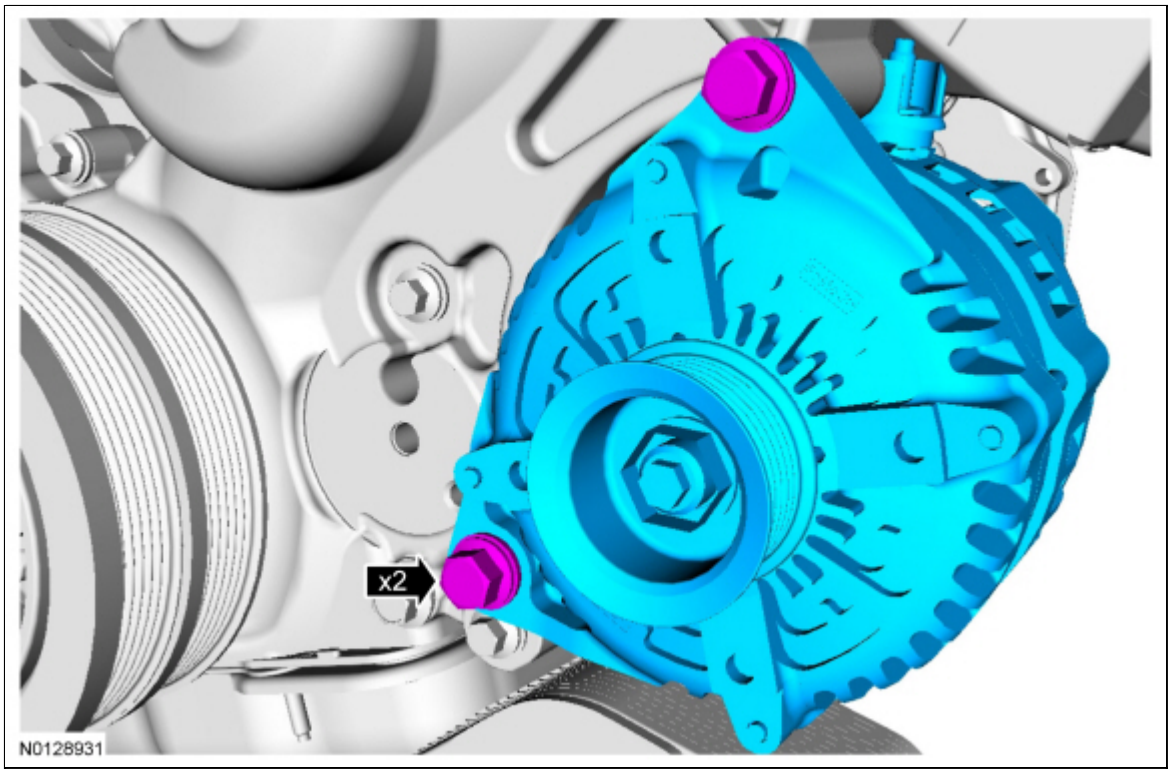


21. Remove the nut and the B+ wire from the generator.
    - Disconnect the wiring harness connector from the generator.

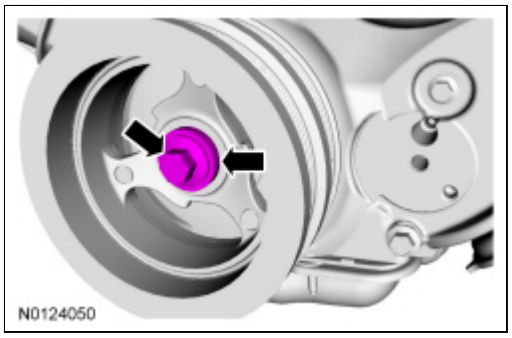


22. Remove the 2 bolts and the generator.

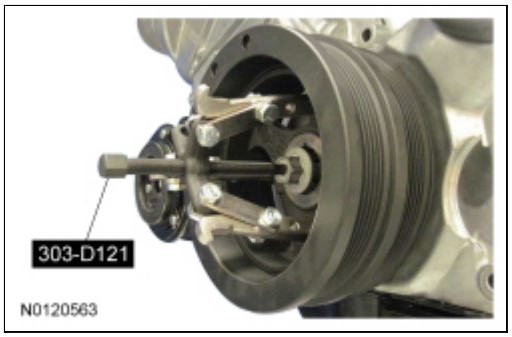
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23. Remove the crankshaft pulley bolt and washer.

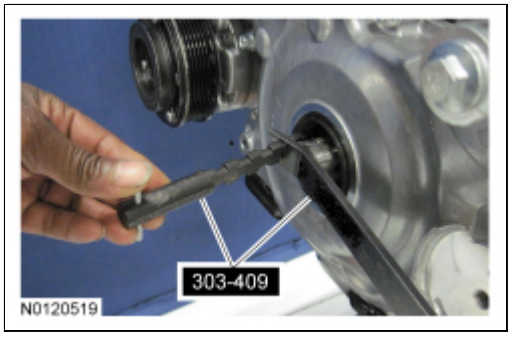


24. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
    - Discard the crankshaft pulley bolt.

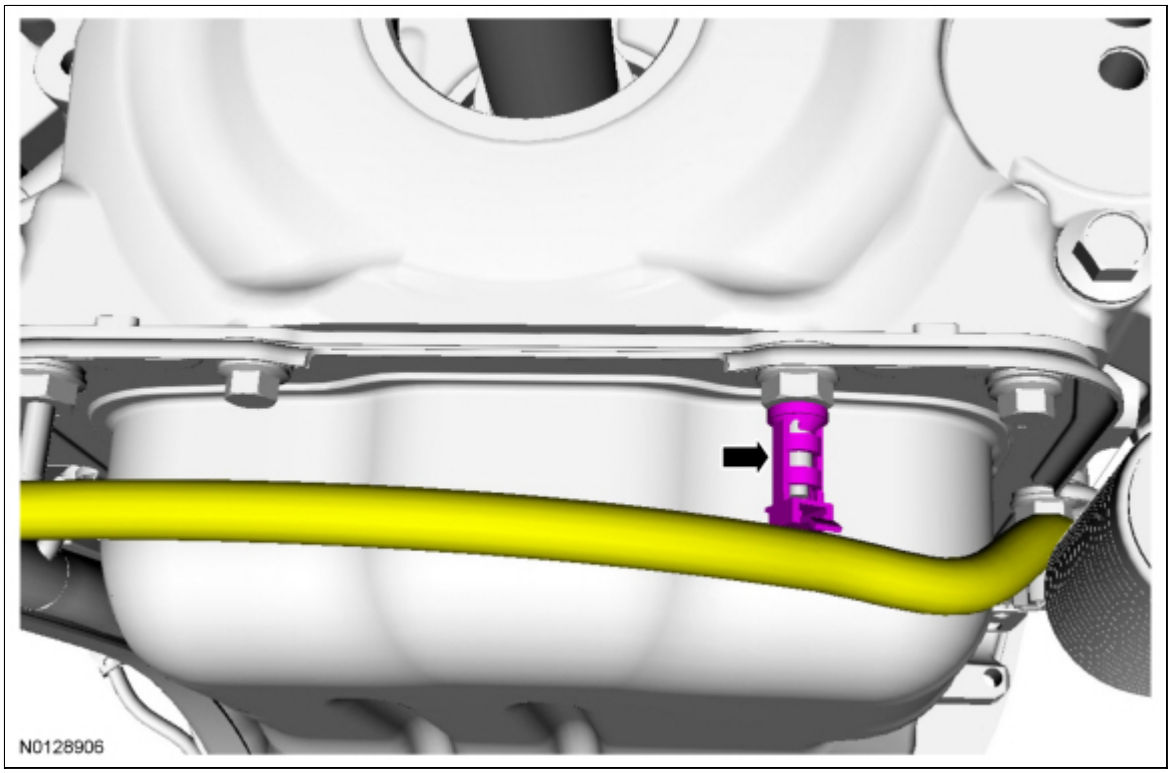


25. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

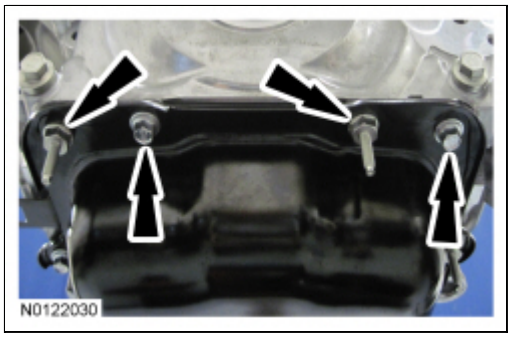
Using the Oil Seal Remover, remove the crankshaft front oil seal.



26. Detach the wiring harness retainer from the oil pan stud bolt.

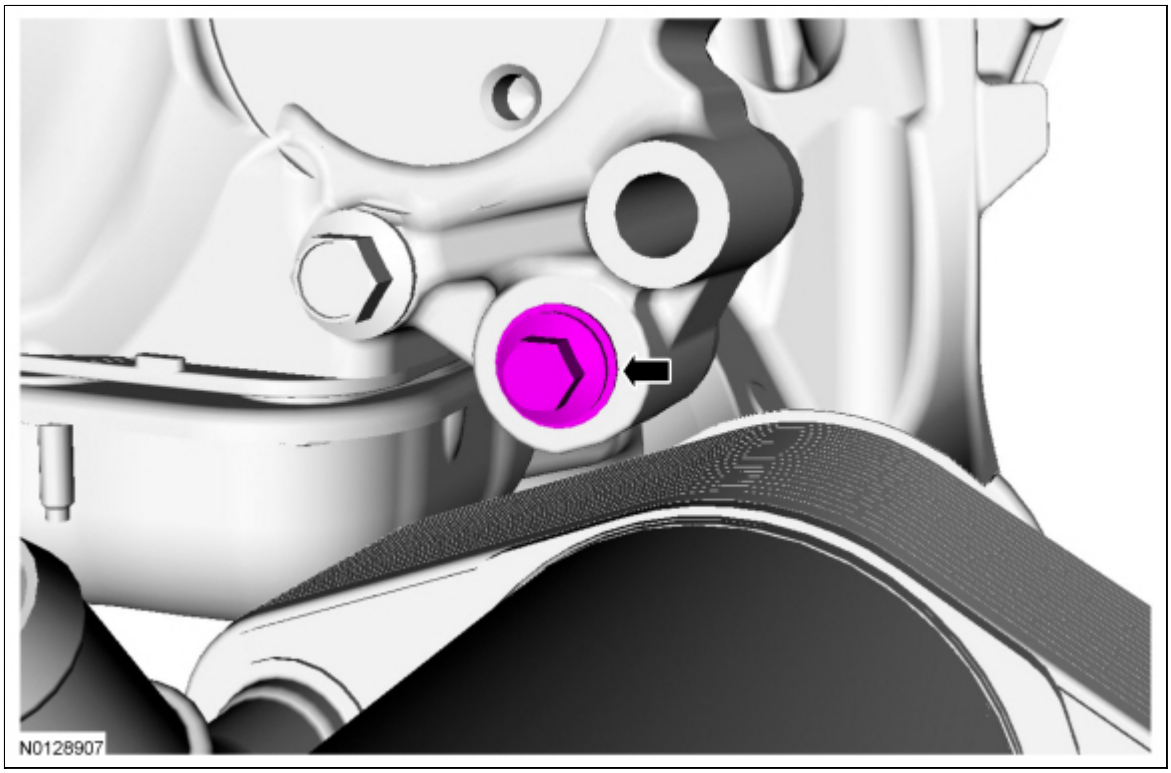


27. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.

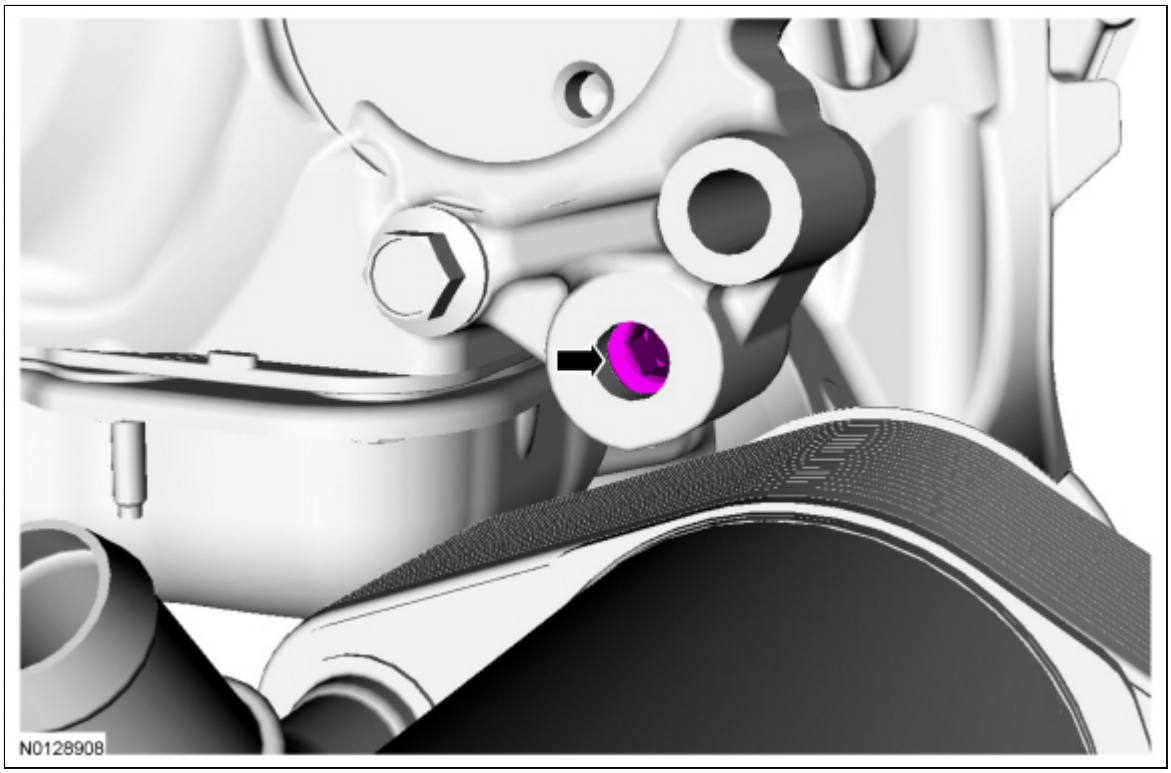


28. Remove the engine front cover-to-oil filter adapter bolt.

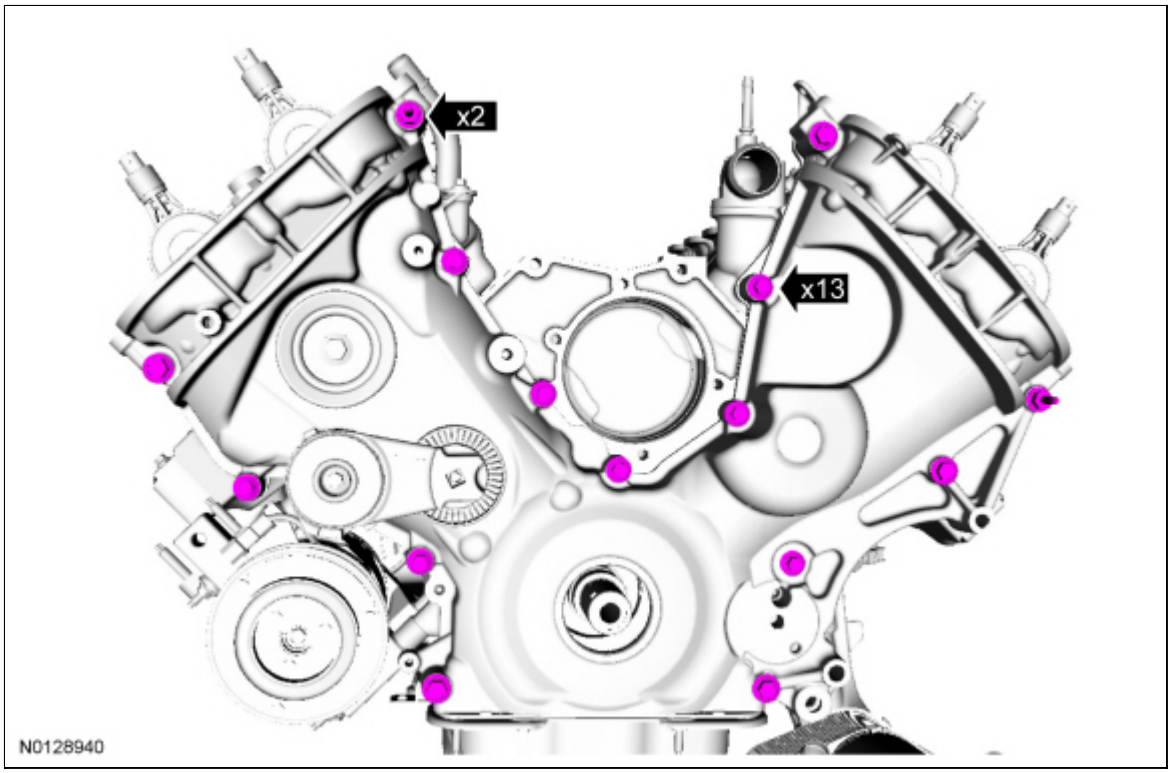
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29. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



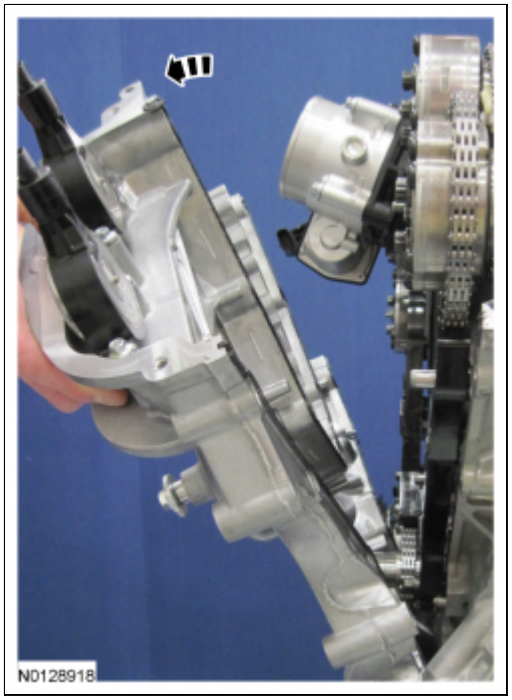
30. Remove the 13 engine front cover bolts and the 2 stud bolts.



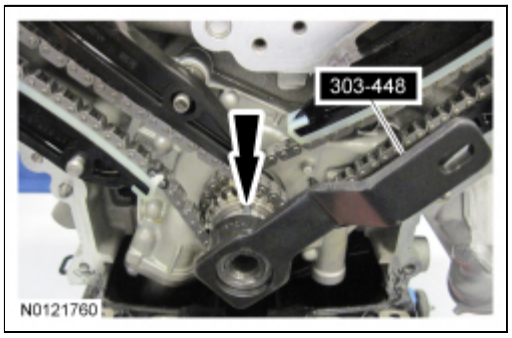
31. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove the engine front cover.
    - Remove and discard the engine front cover gaskets.
    - Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.

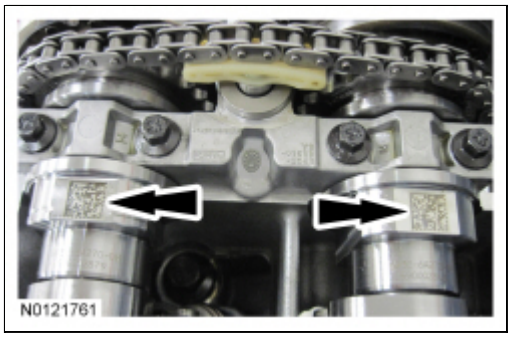
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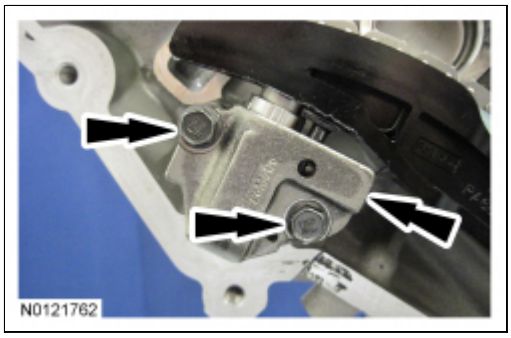
32. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



33. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

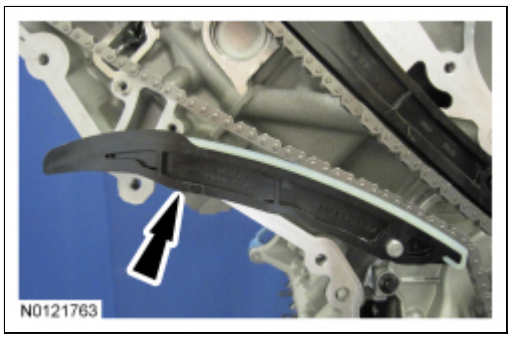


34. Remove the 2 bolts and the RH primary timing chain tensioner.



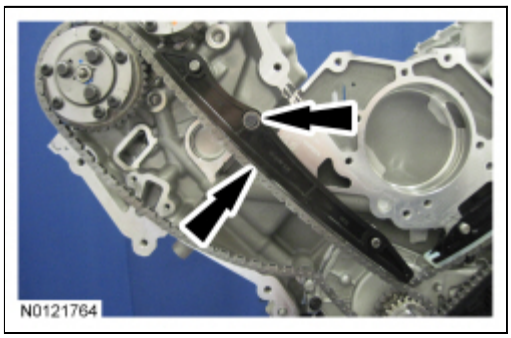
35. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

    Remove the RH timing chain tensioner arm.



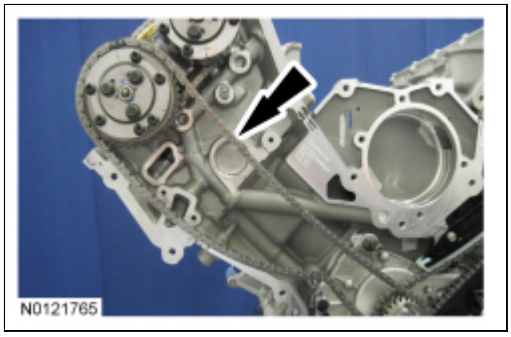
36. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

    Remove the bolt and the RH timing chain guide.



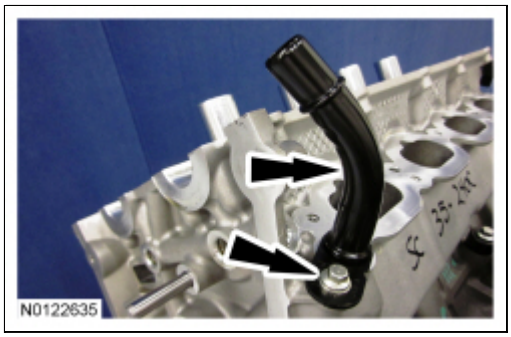
37. Remove the RH primary timing chain.

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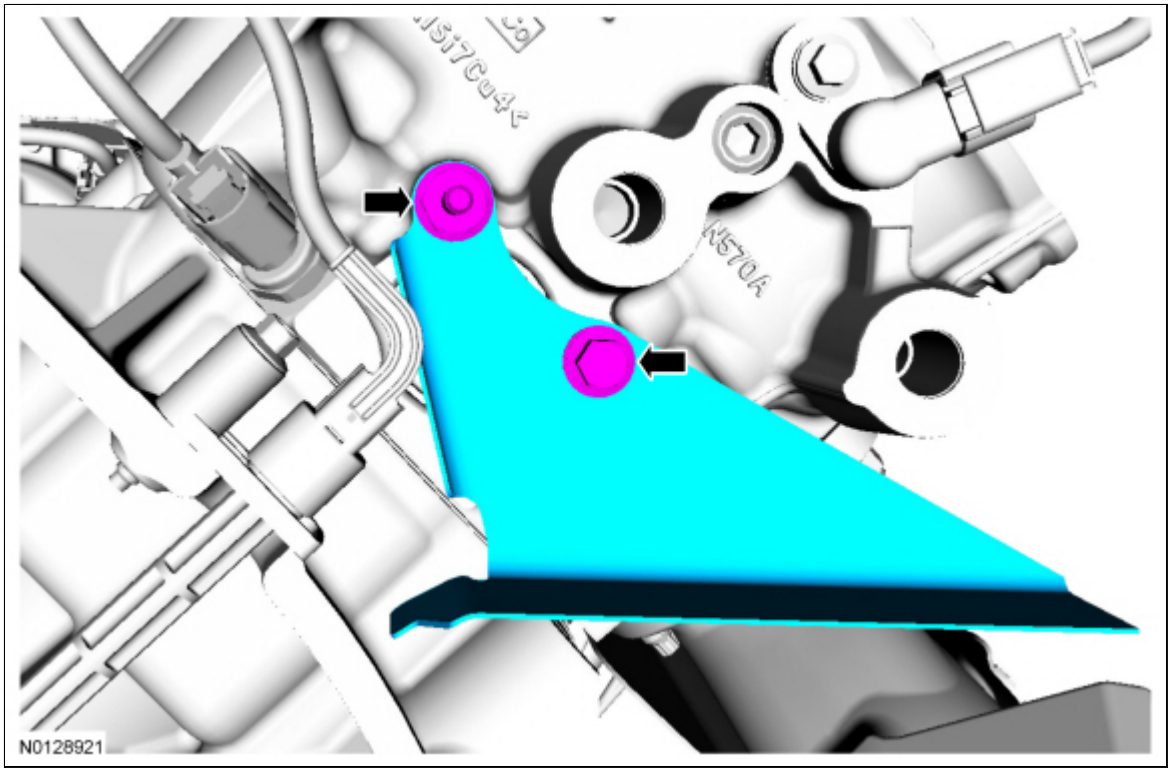


RH cylinder head

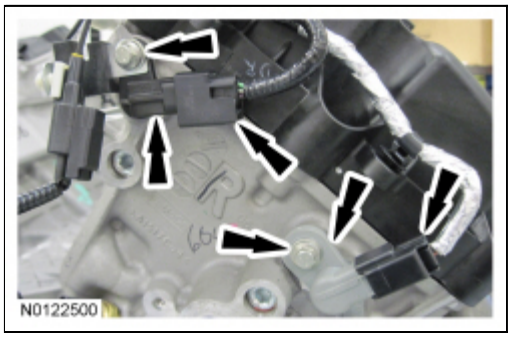
38. Remove the bolt and the coolant outlet pipe from the RH cylinder head.
    - Remove and discard the O-ring seal.



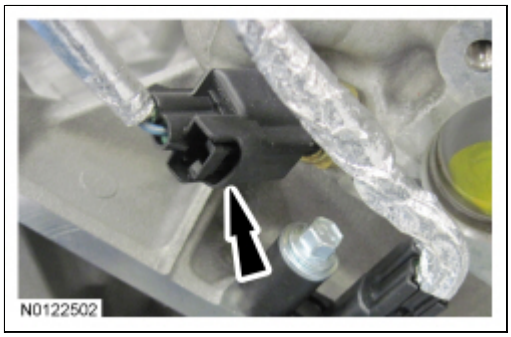
39. Remove the bolt, stud bolt and heat shield from the RH cylinder head.



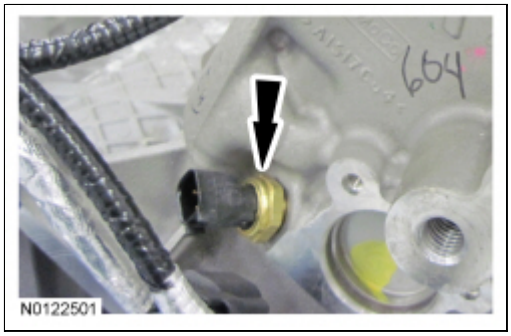
40. Disconnect the RH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
    - Remove the 2 bolts and the RH intake and exhaust CMP sensors.



41. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

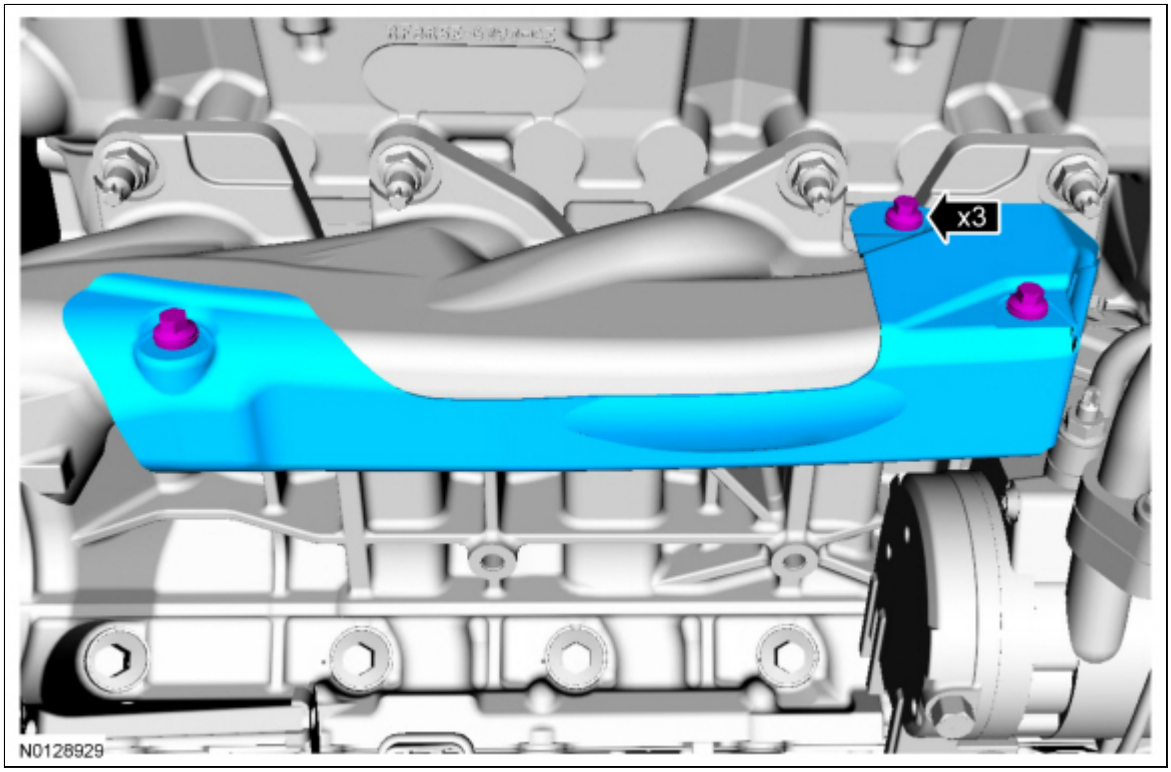


42. Remove the CHT sensor.

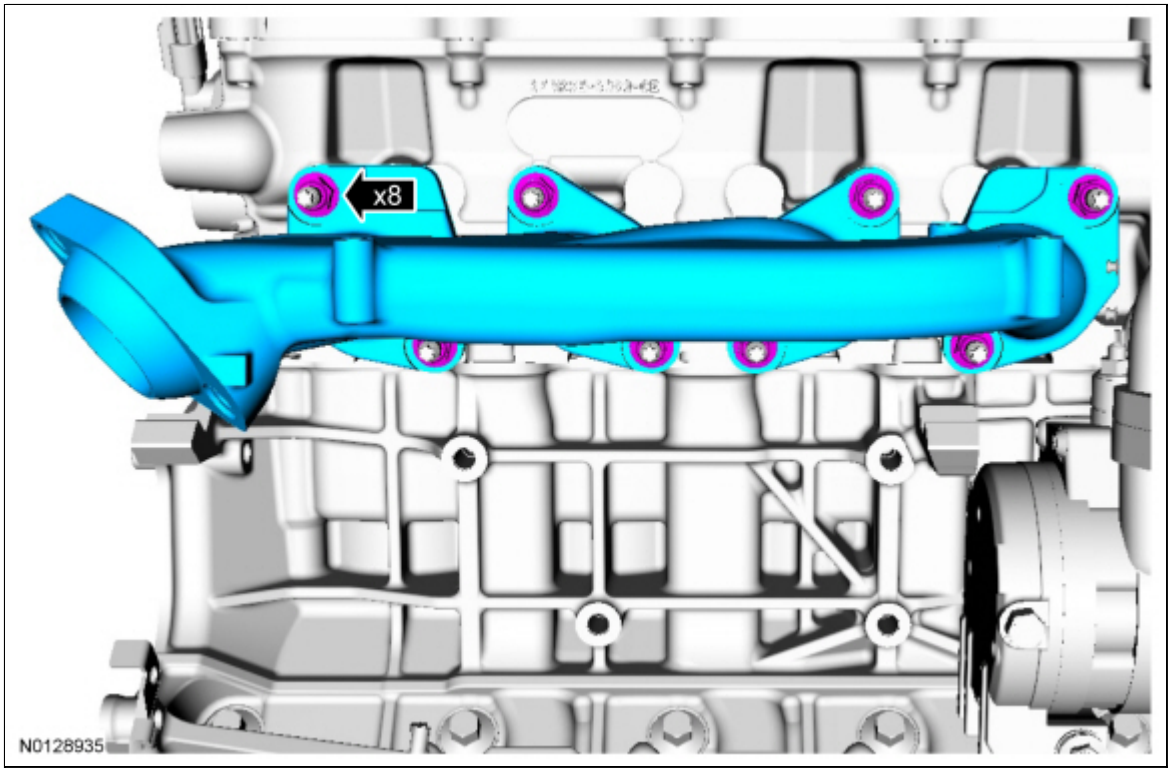


43. Remove the 3 bolts and the RH exhaust manifold heat shield.

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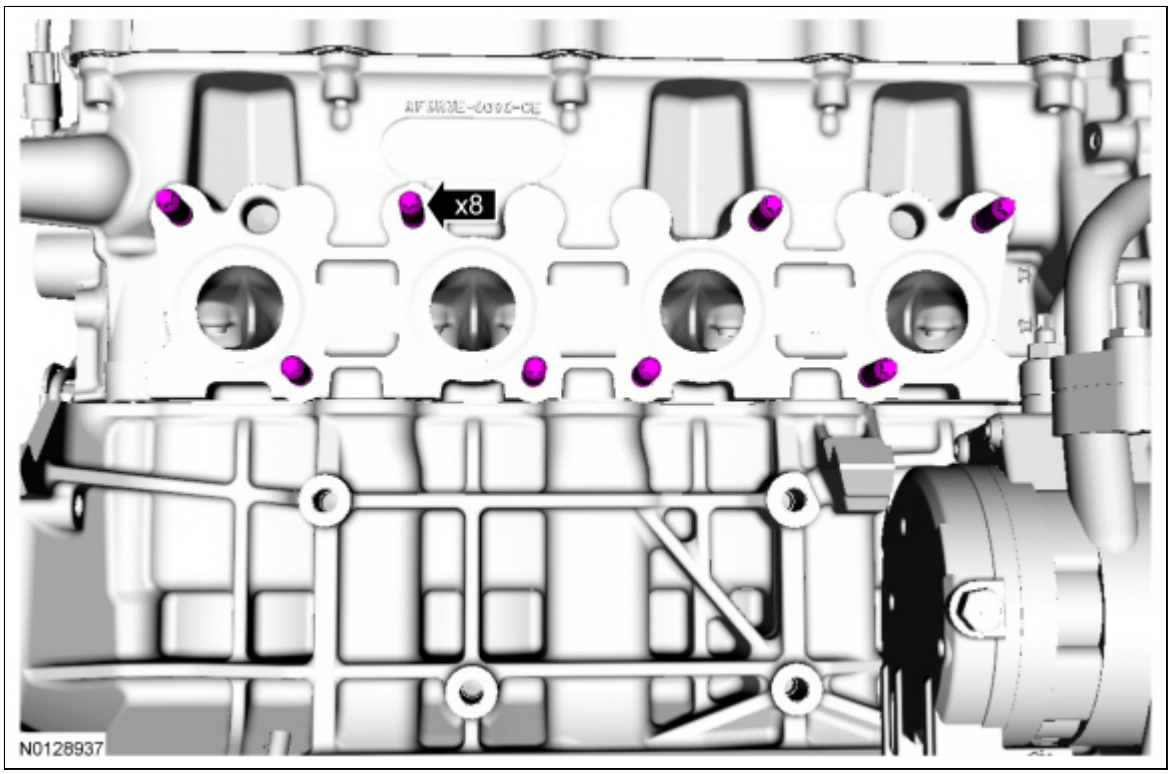


44. Remove the 8 nuts and the RH exhaust manifold.
    - Discard the gasket.

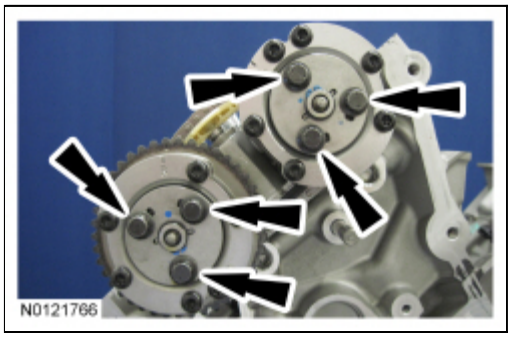


45. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

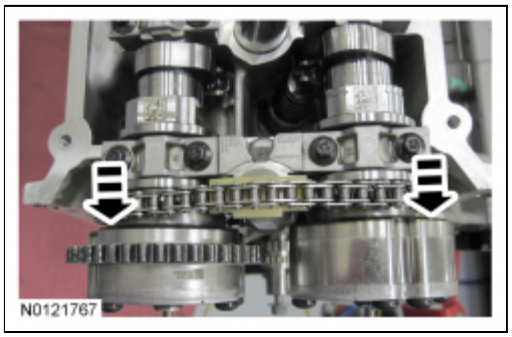
46. Remove and discard the 8 RH exhaust manifold studs.



47. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.

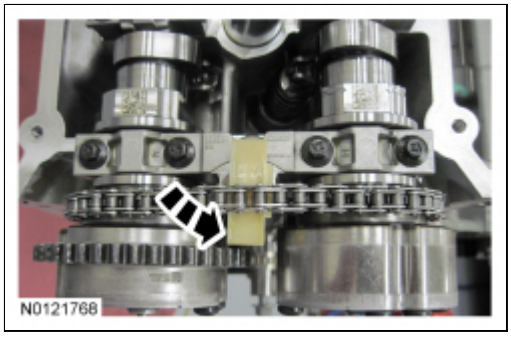


48. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).

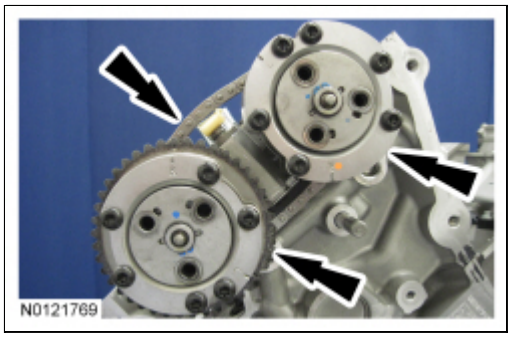


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49. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.

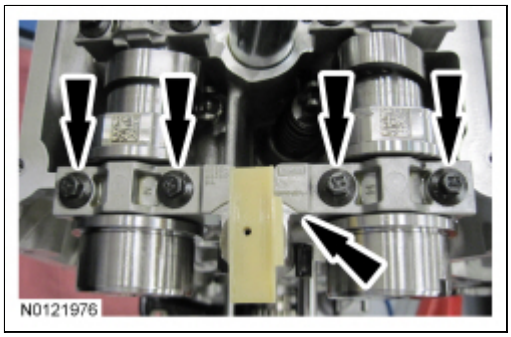


50. Remove the RH VCT assemblies and the RH secondary timing chain.

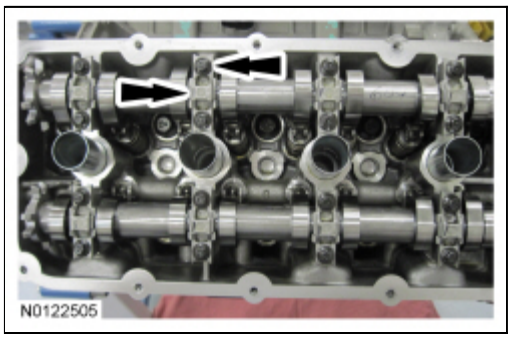


51. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the RH front camshaft bearing mega cap.

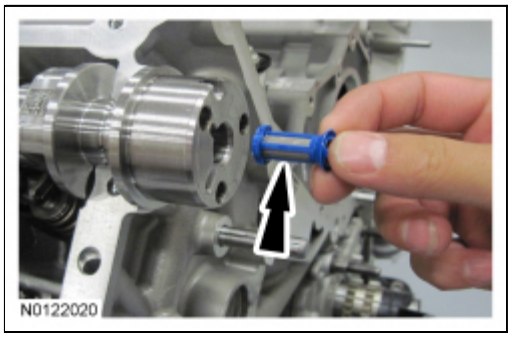


52. Remove the 16 bolts and the 8 camshaft bearing caps.

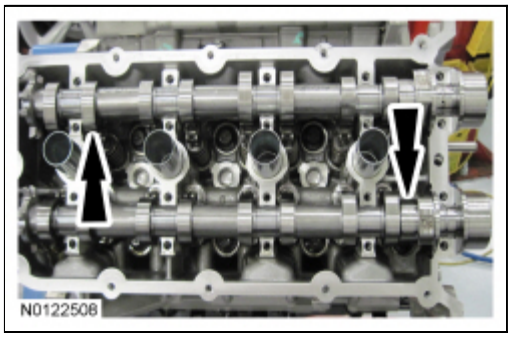


53. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

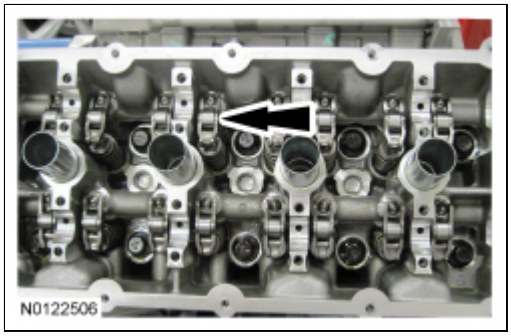
    Remove the VCT system oil filter from the intake and exhaust camshafts.



54. Remove the RH intake and exhaust camshafts.



55. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



56. ***NOTICE:*** **The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.**

    NOTICE: **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.**

    NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

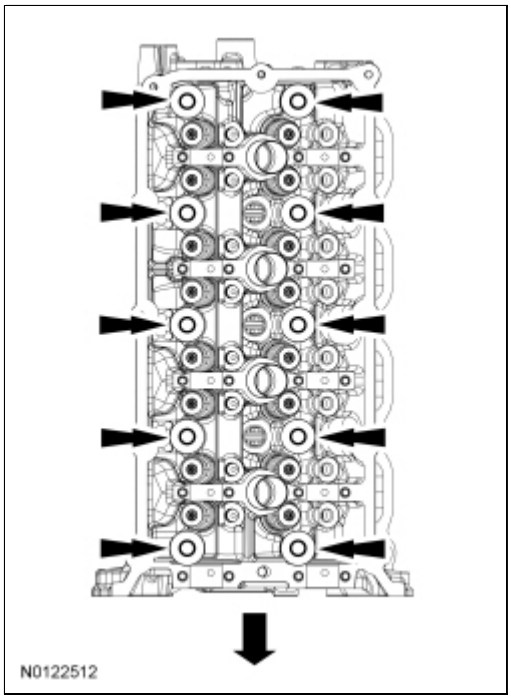
    NOTICE: **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

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NOTICE: **Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

Remove the 10 bolts and the RH cylinder head.

- Discard the bolts and the cylinder head gasket.



57. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or notices and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

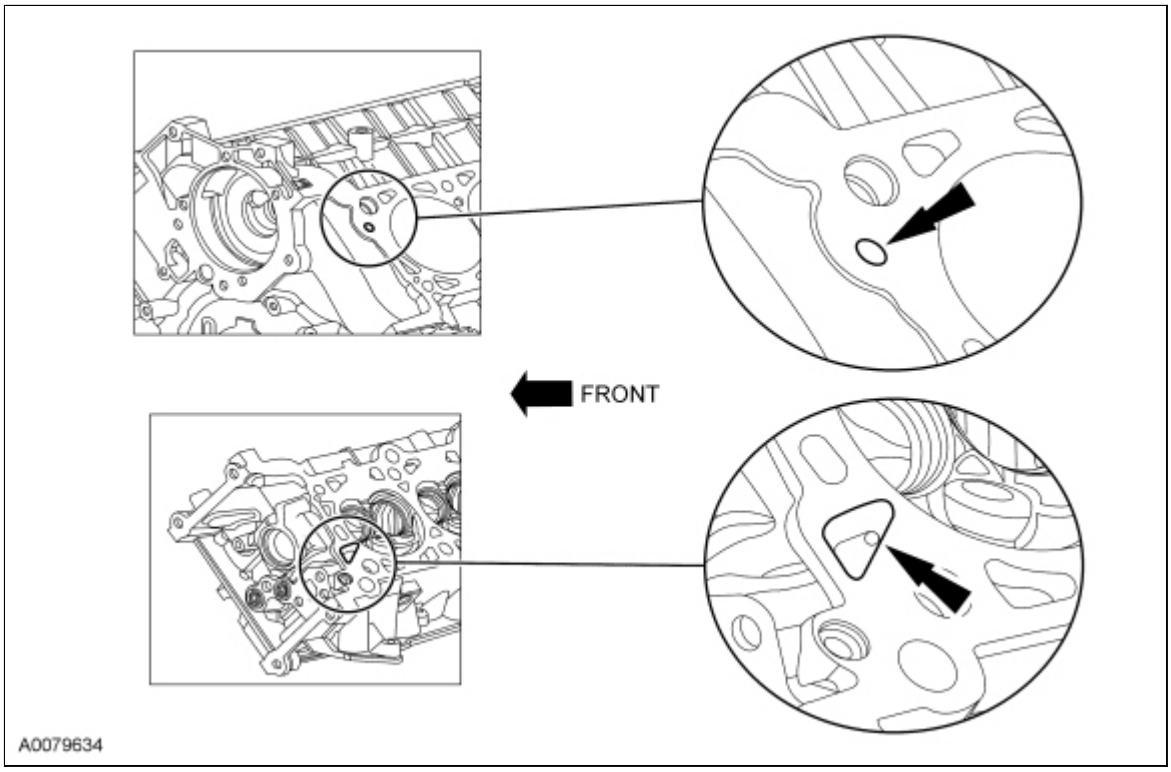
    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

58. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

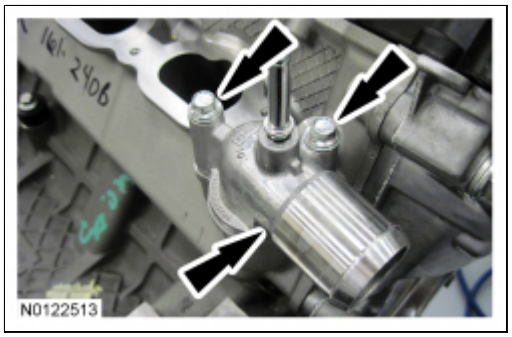
    NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to Section 303-00 .



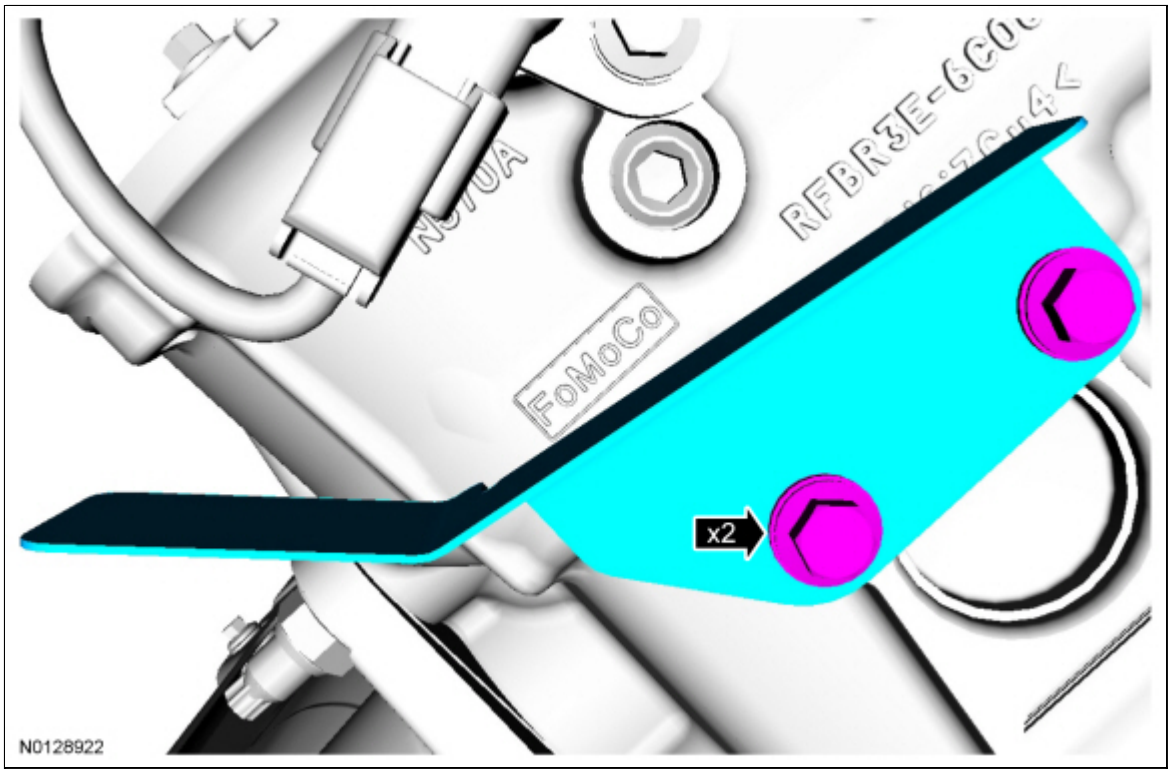
LH cylinder head

59. Remove the 2 bolts and the coolant outlet from the LH cylinder head.
    - Remove and discard the gasket.

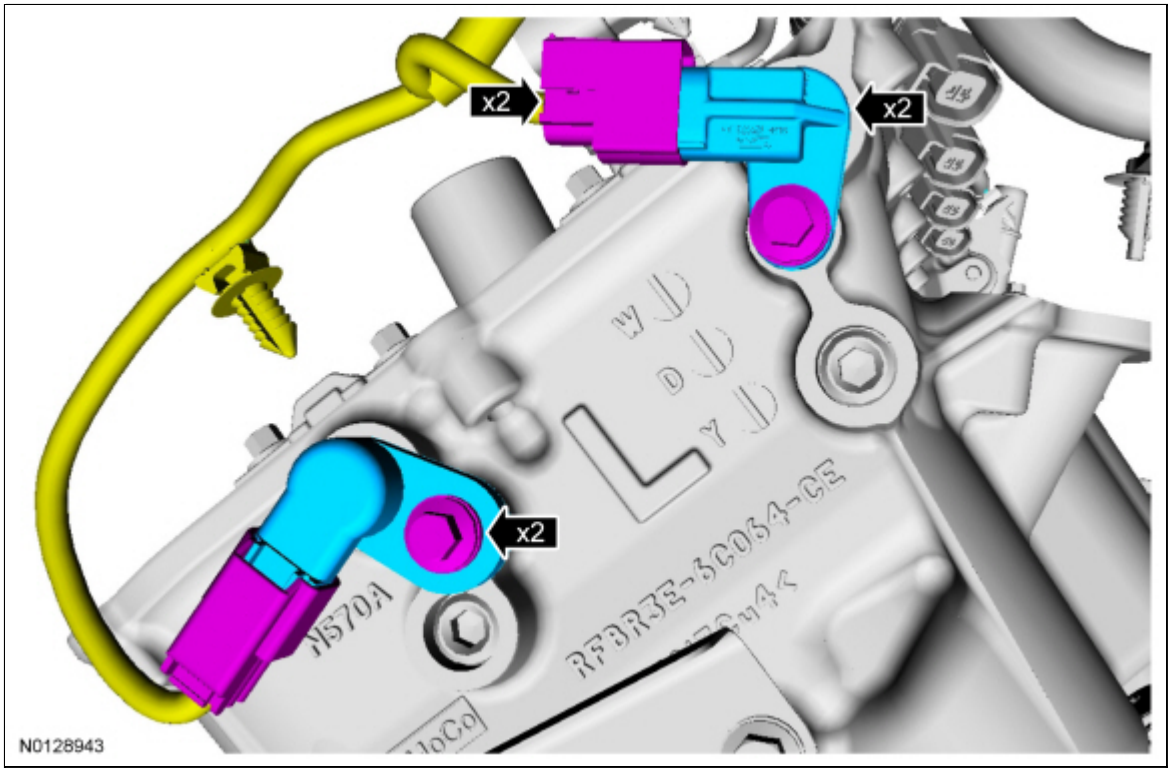


60. Remove the 2 bolts and the heat shield from the LH cylinder head.

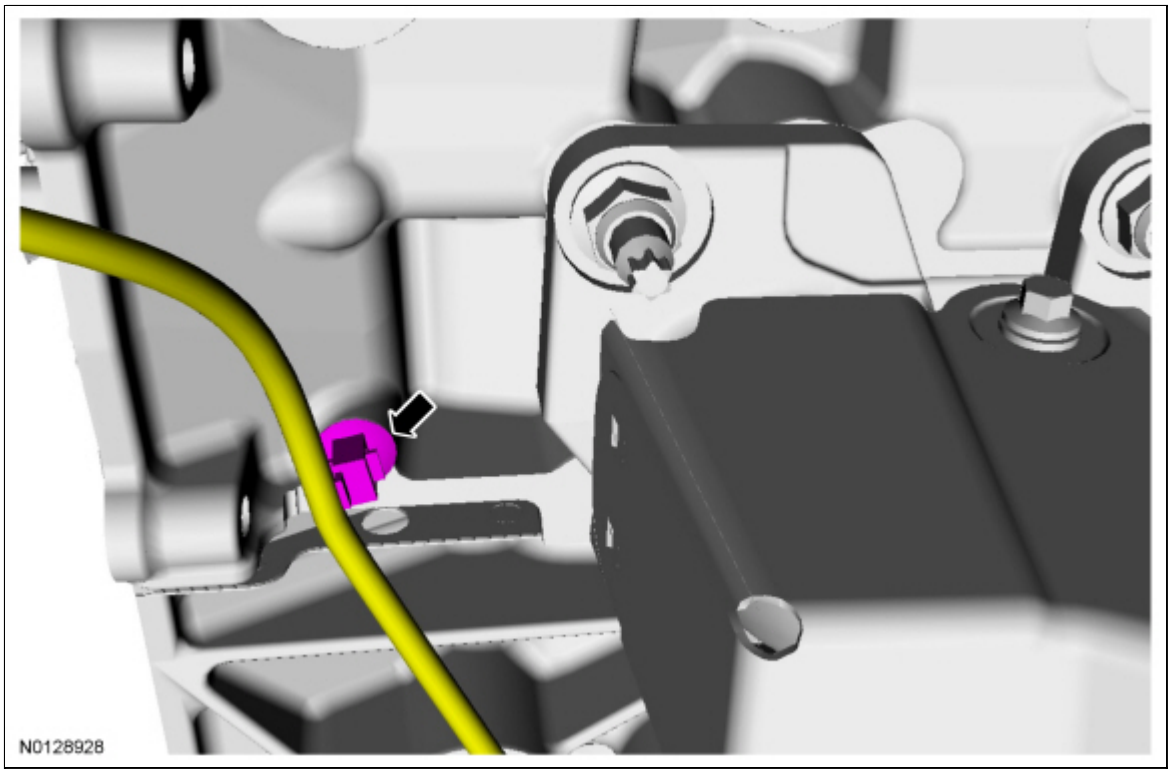
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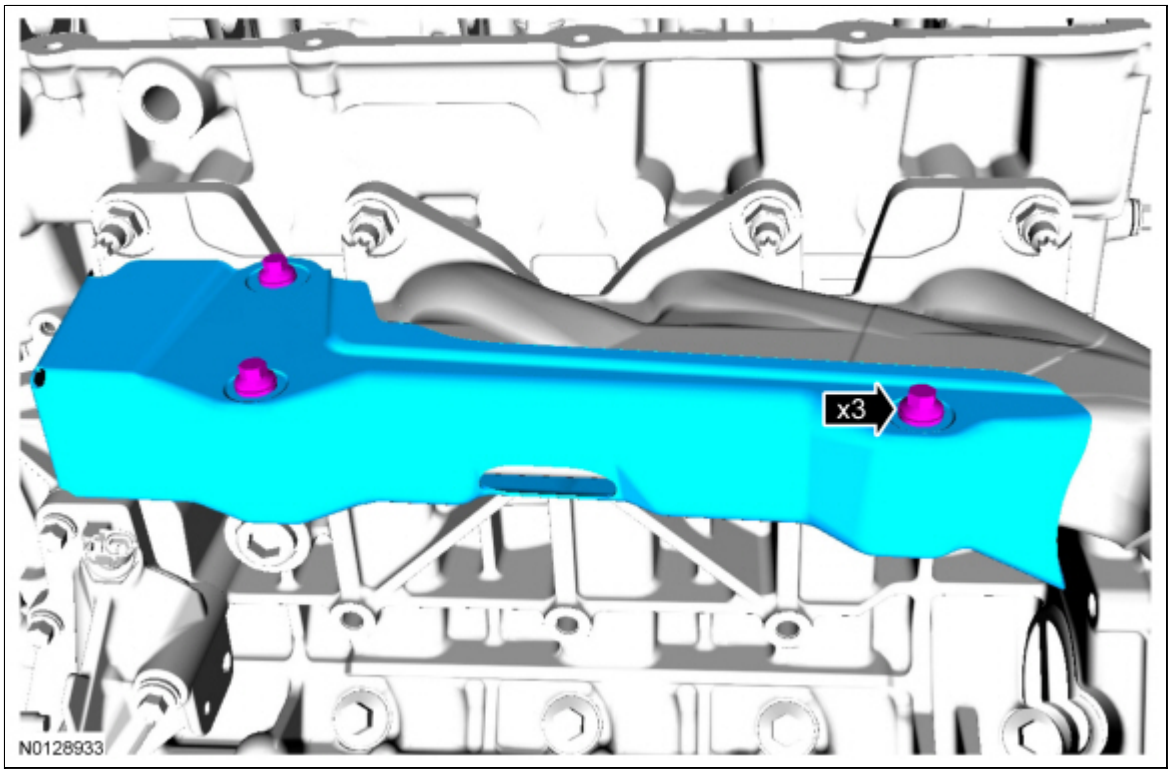
61. Disconnect the LH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
    - Remove the 2 bolts and the LH intake and exhaust CMP sensors.



62. Detach the wiring harness retainer from the LH cylinder head.

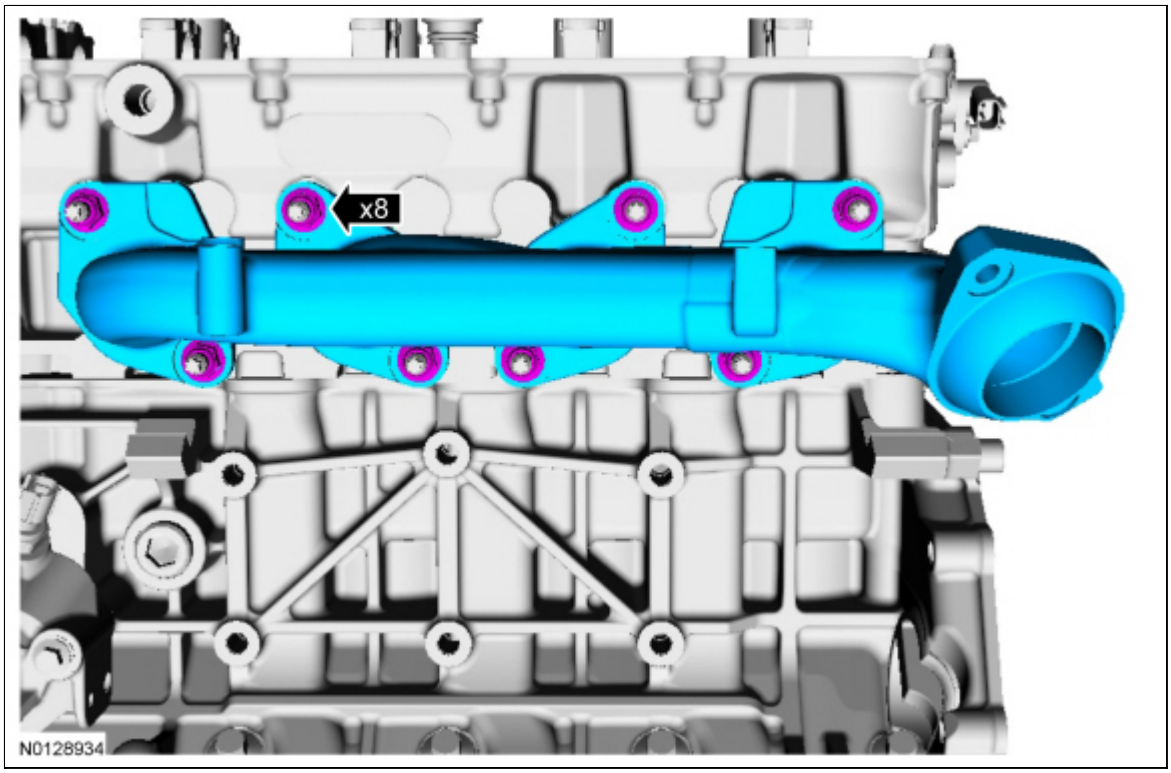


63. Remove the 3 bolts and the LH exhaust manifold heat shield.



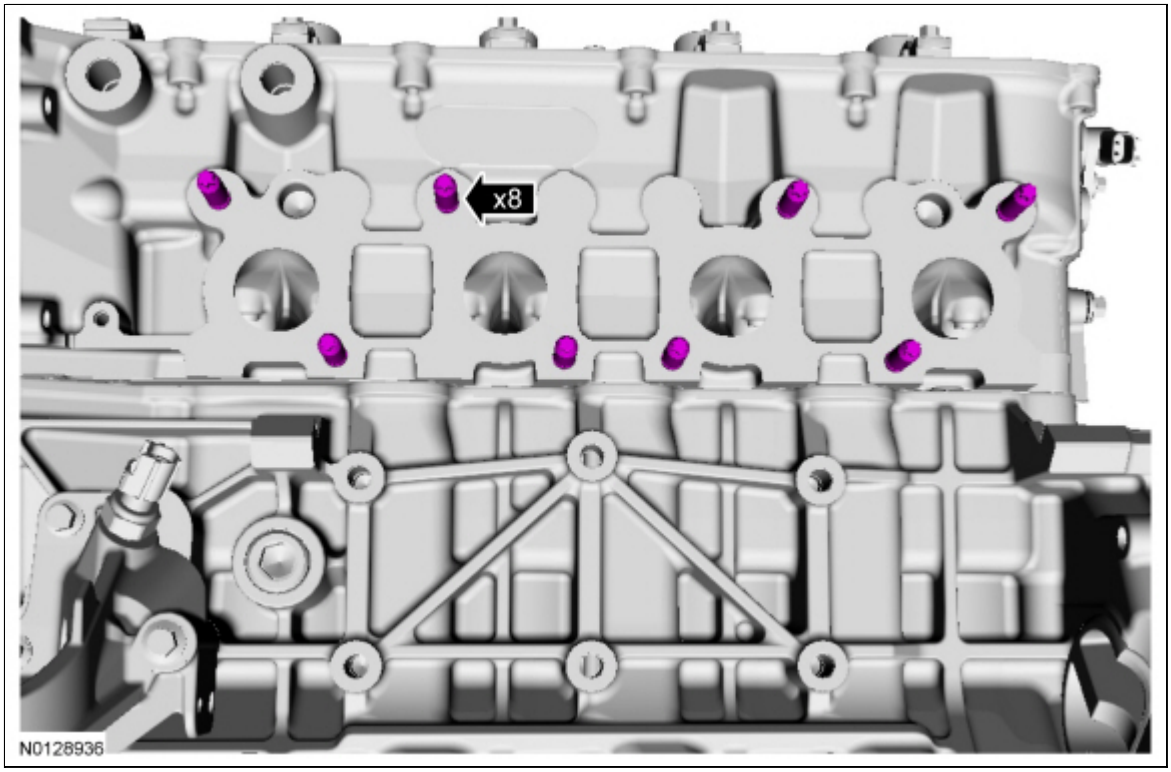
64. Remove the 8 nuts and the LH exhaust manifold.
    - Discard the gasket.

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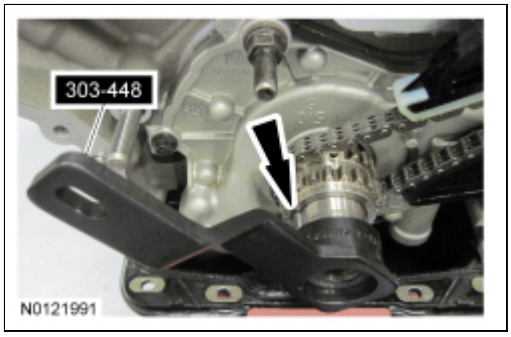
65. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

66. Remove and discard the 8 LH exhaust manifold studs.

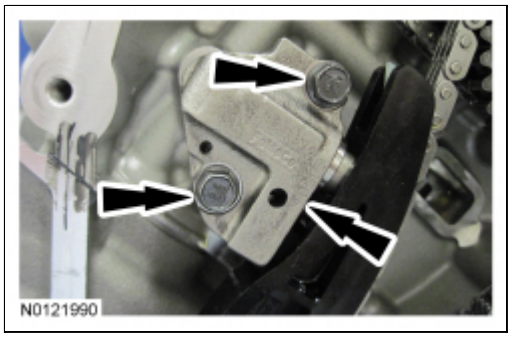


67. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway

is at the 9 o'clock position.

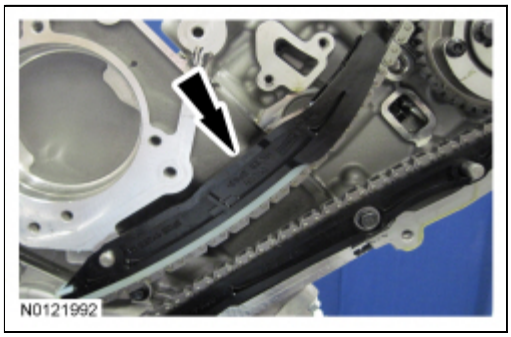


68. Remove the 2 bolts and the LH primary timing chain tensioner.



69. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

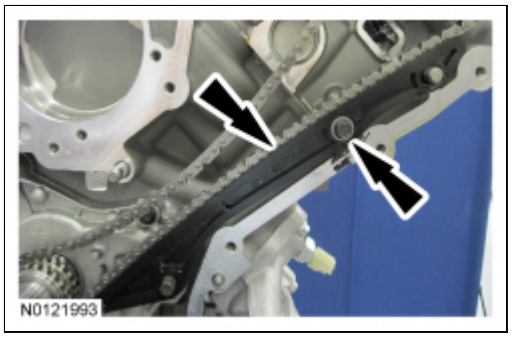
    Remove the LH timing chain tensioner arm.



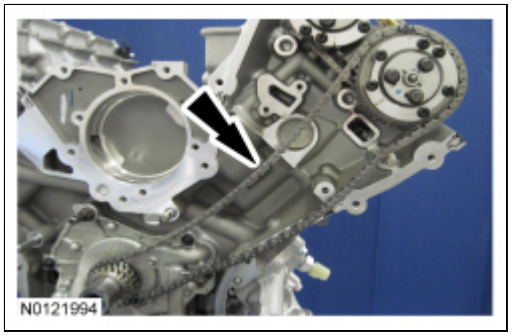
70. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

    Remove the bolt and the LH timing chain guide.

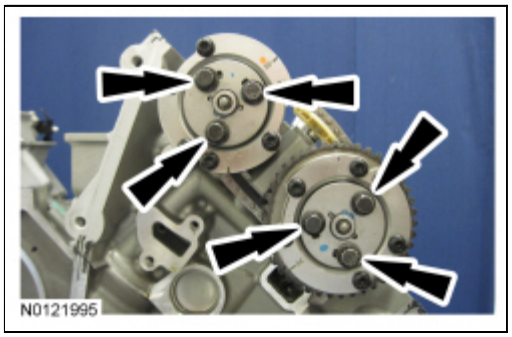
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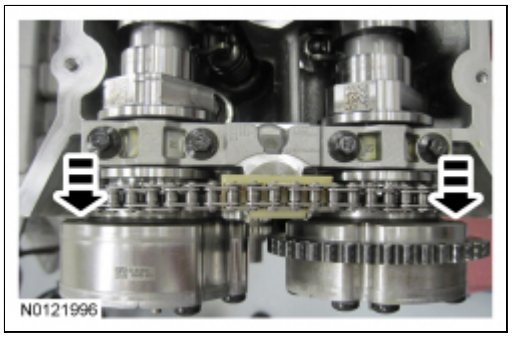
71. Remove the LH primary timing chain.



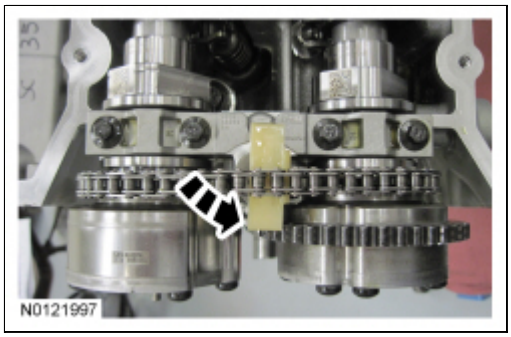
72. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



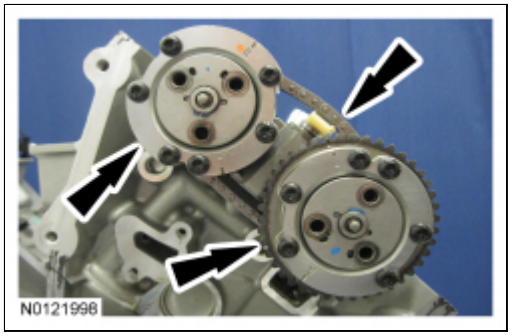
73. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



74. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.

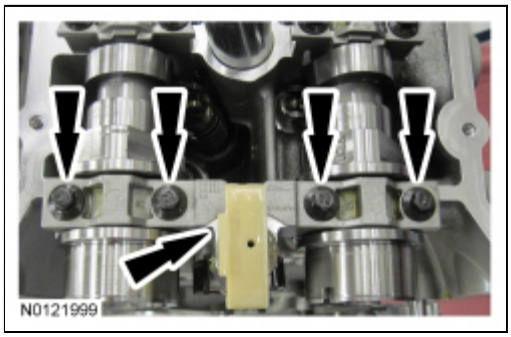


75. Remove the LH VCT assemblies and the LH secondary timing chain.

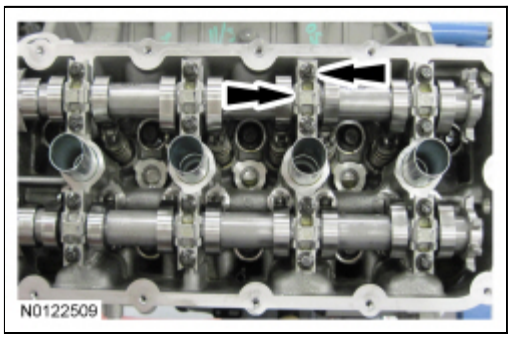


76. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the LH front camshaft bearing mega cap.



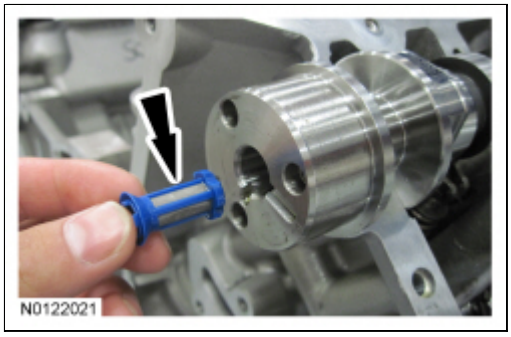
77. Remove the 16 bolts and the 8 camshaft bearing caps.



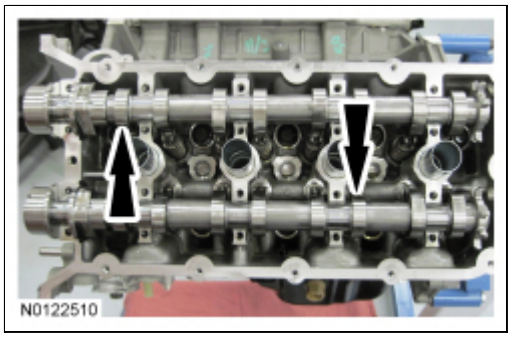
78. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

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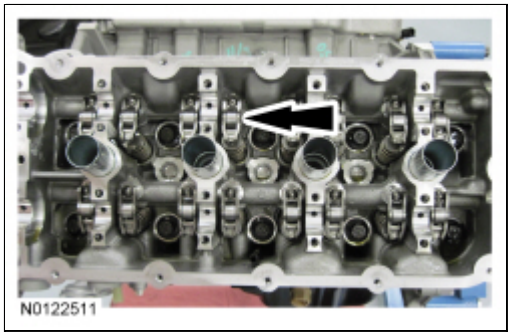
Remove the VCT system oil filter from the intake and exhaust camshafts.



79. Remove the LH intake and exhaust camshafts.



80. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



81. ***NOTICE:*** **The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.**

    NOTICE: **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.**

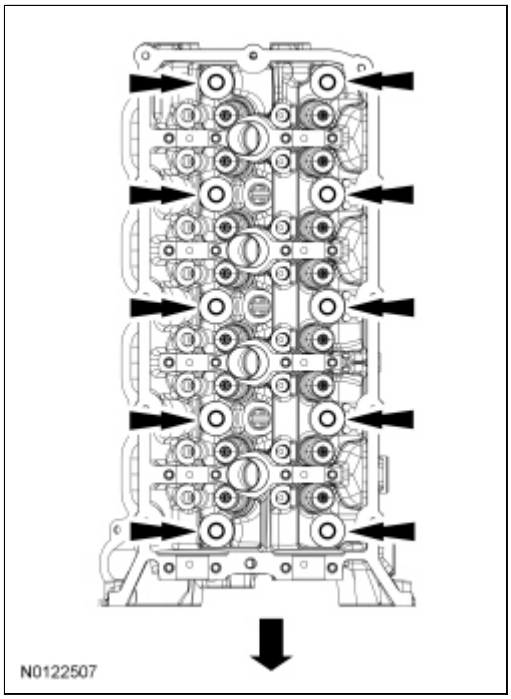
    NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

    NOTICE: **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTICE: **Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

Remove the 10 bolts and the LH cylinder head.

- Discard the bolts and the cylinder head gasket.



82. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or notices and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.

    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

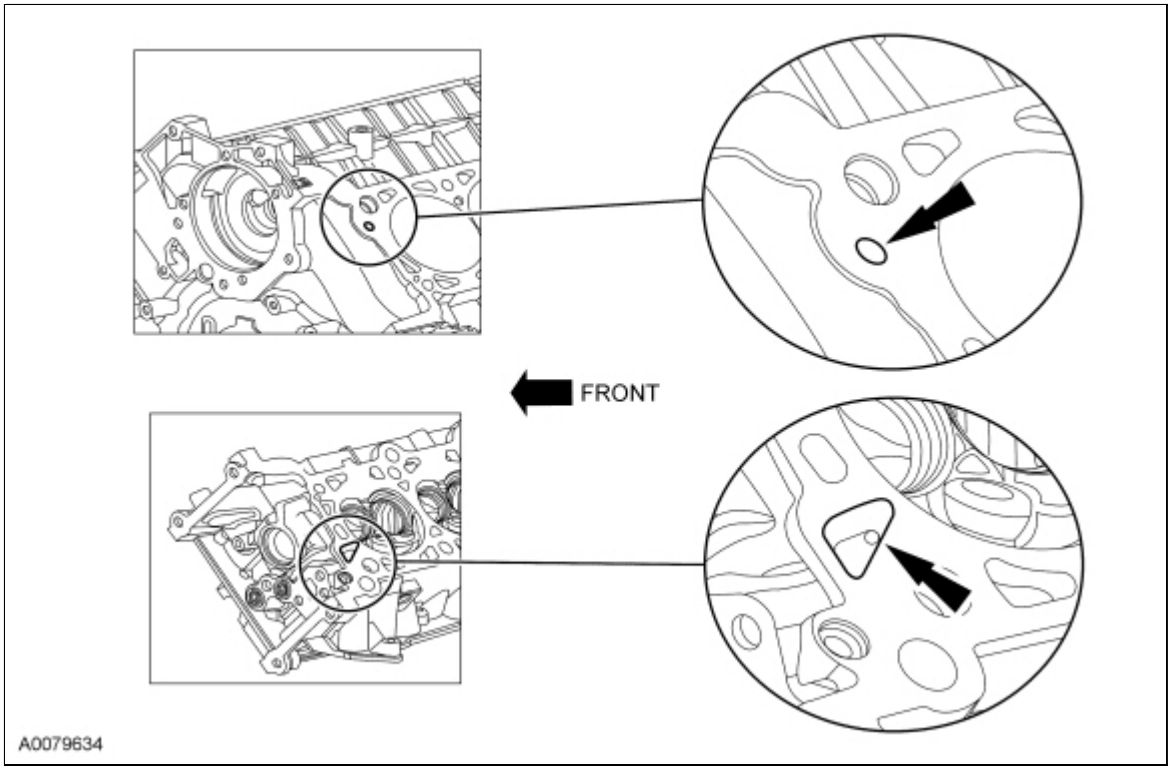
83. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

    NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

    Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area.

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For additional information, refer to Section 303-00 .



Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073)

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

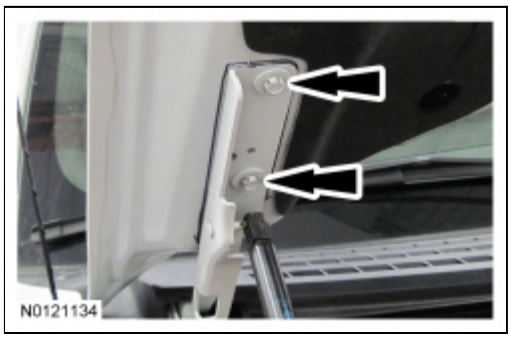
WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

   NOTE: RH shown, LH similar.

   Remove the 4 bolts (2 shown) and the hood.

   
   N0121134

3. Release the fuel system pressure. For additional information, refer to Section 310-00 .

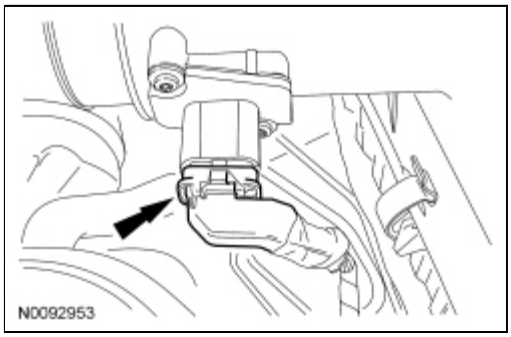
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4. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

5. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Remove the intake manifold. For additional information, refer to Intake Manifold in this section.

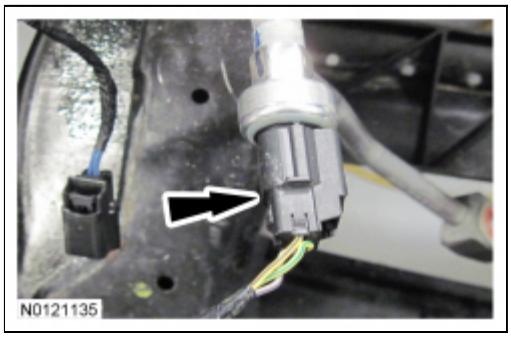
6. Disconnect the Mass Air Flow (MAF) sensor electrical connector.



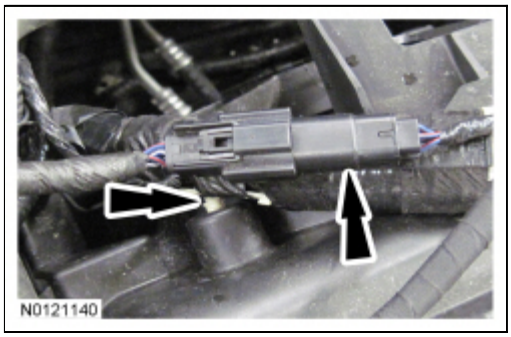
7. Remove the Air Cleaner (ACL) upper tray and the ACL element. For additional information, refer to Section 303-12 .

8. Remove the cooling module. For additional information, refer to Section 303-03 .

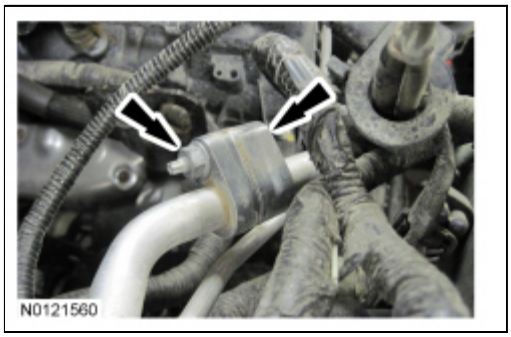
9. Disconnect the A/C pressure transducer electrical connector.



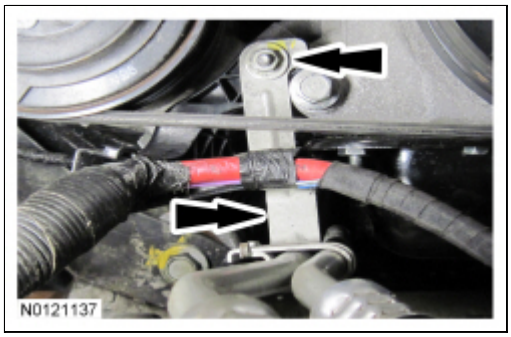
10. Disconnect the wiring harness electrical connector and pin-type retainer.
    - Position the Power Distribution Box (PDB) and wiring harness aside.



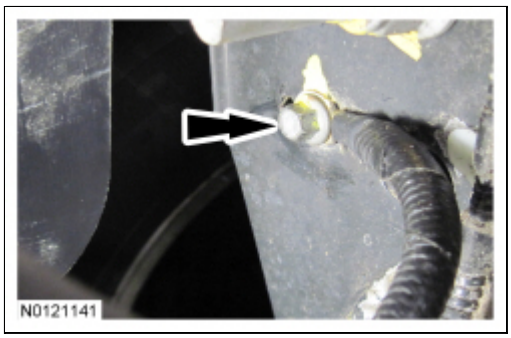
11. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal and gasket.



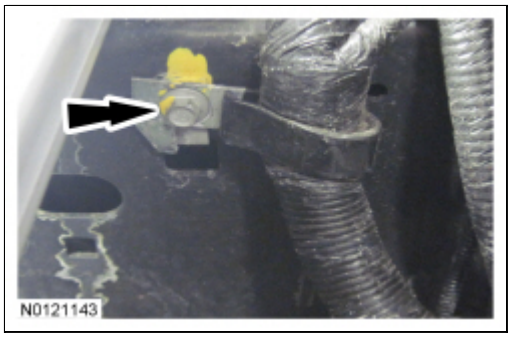
12. Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.



13. Remove the bolt and the ground wire from the RH frame rail.

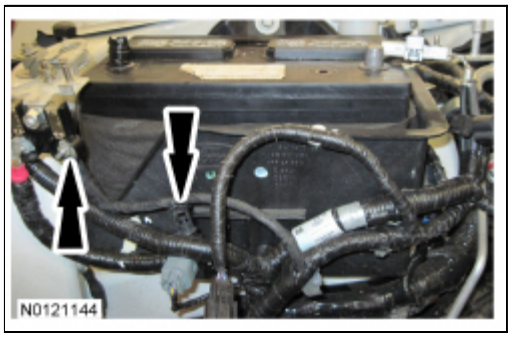


14. Remove the bolt and the wiring harness bracket from the RH frame rail.

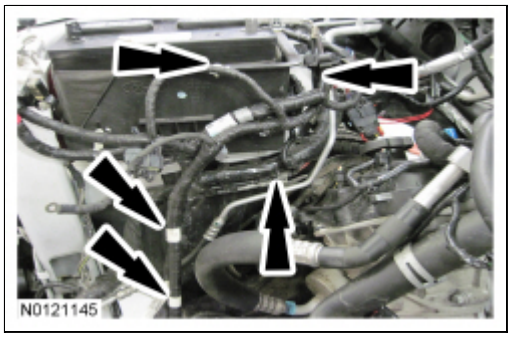


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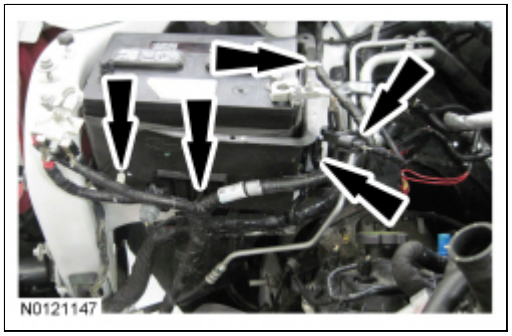
15. Remove the nut and disconnect the B+ wire.
    - Detach the wiring harness retainer from the battery tray.



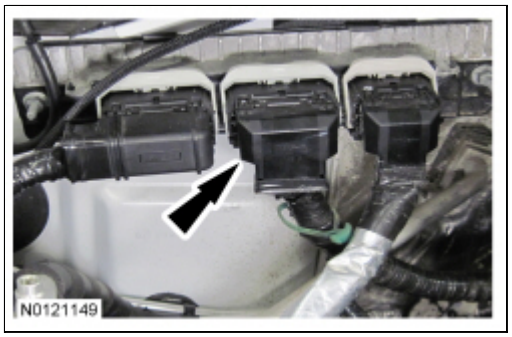
16. Detach the 5 wiring harness retainers.



17. Disconnect the 2 wiring harness connectors and detach the 3 wiring harness retainers.



18. Disconnect the middle PCM electrical connector.



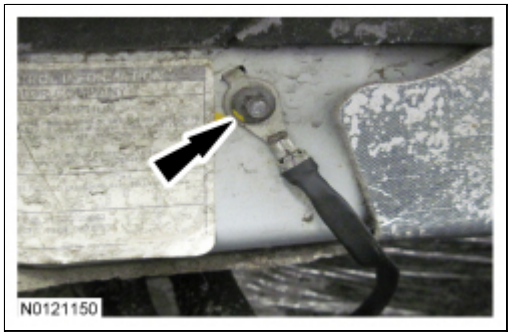
19. Detach and disconnect the engine harness electrical connector.



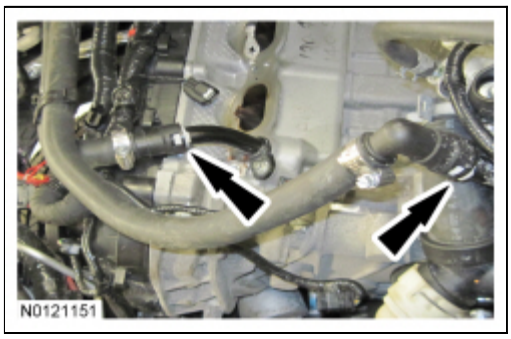
20. Detach the PCM wiring harness retainer from the valve cover bolt stud.



21. Remove the bolt and the ground strap from the cowl.

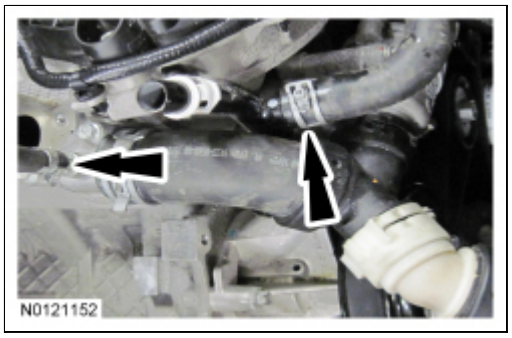


22. Disconnect the 2 heater hose quick connect couplings. For additional information, refer to Section 412-00 .

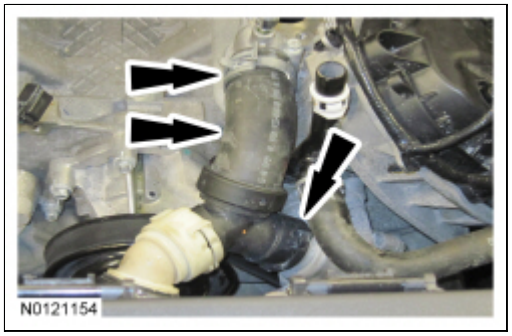


23. Disconnect the 2 coolant hoses and position aside.

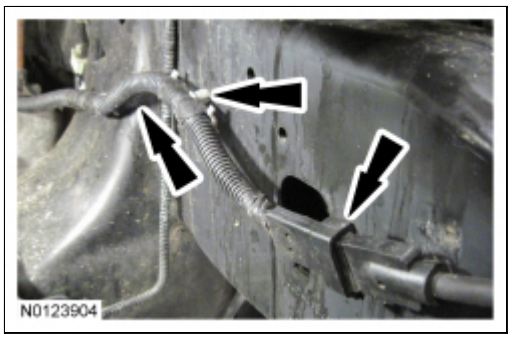
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24. Remove the spring clip, the clamp and disconnect the coolant bypass T assembly from the engine.



25. If equipped, disconnect the block heater electrical connector and the 2 wiring harness retainers.



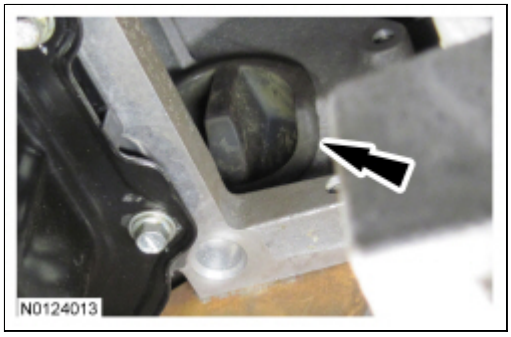
26. If equipped, remove the front driveshaft. For additional information, refer to Section 205-01 .

27. Remove the starter. For additional information, refer to Section 303-06 .

28. Remove the 2 bolts and the flexplate inspection cover.

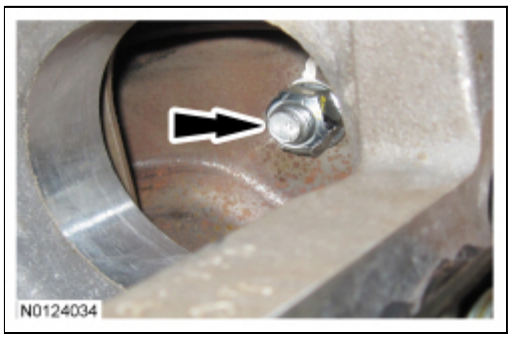


29. Remove the cylinder block opening cover.



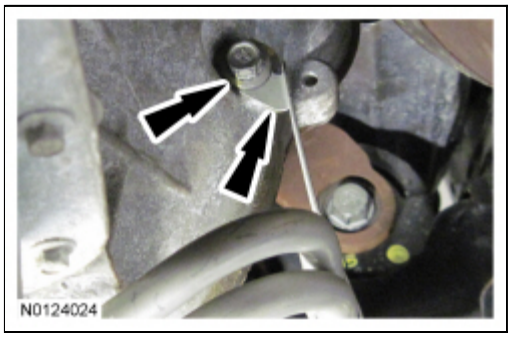
30. **NOTE:** Index-mark the end of one torque converter stud and the flexplate for installation.

    Remove the 4 torque converter-to-flexplate nuts.
    - Discard the nuts.



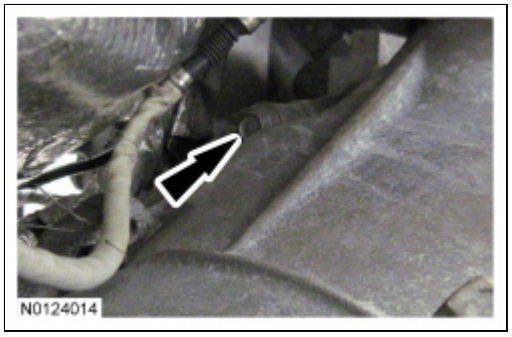
31. **NOTE:** The 2 upper transmission-to-engine bolts will be removed later.

    Remove the transmission-to-engine bolt and transmission cooler tube support bracket.

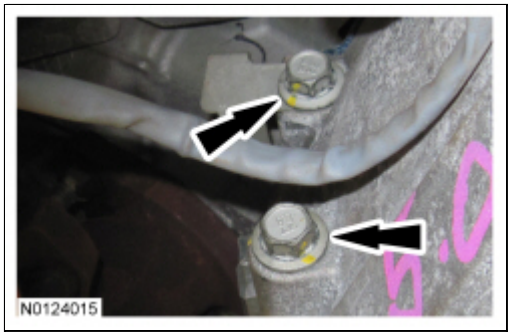


32. Remove the lower transmission-to-engine bolt.

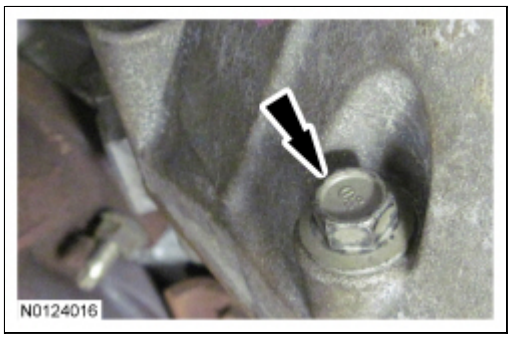
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33. Remove the 2 lower transmission-to-engine bolts.



34. Remove the lower transmission-to-engine bolt.

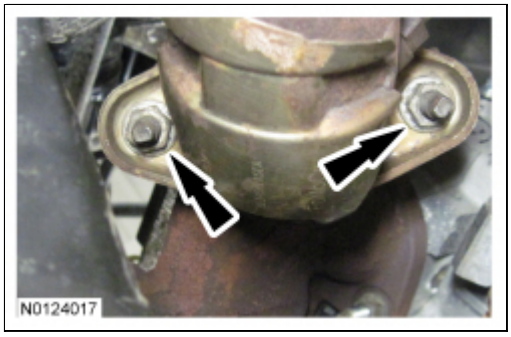


35. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 26 Nm (19 lb-ft).

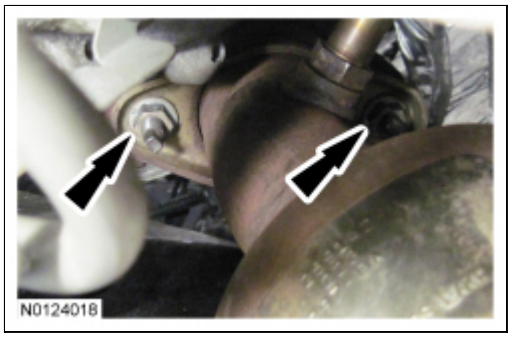
36. Remove and discard the engine oil filter.



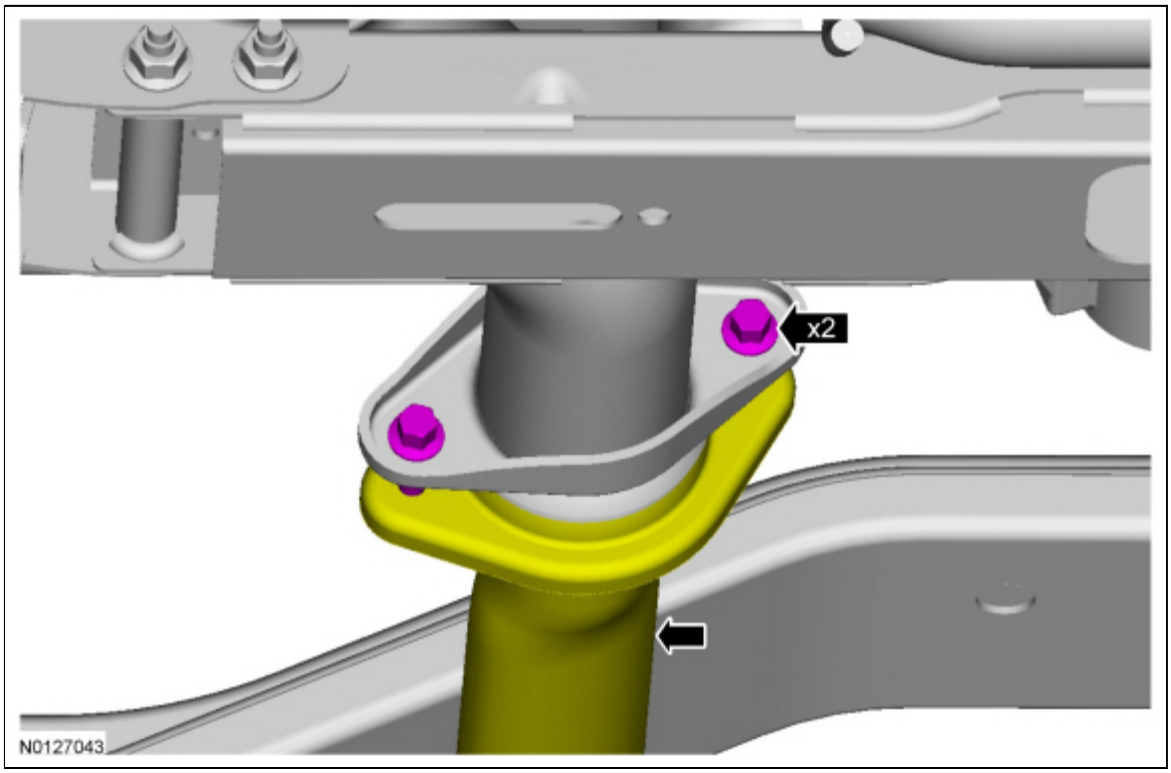
37. Remove and discard the 2 LH catalytic converter-to-exhaust manifold nuts.



38. Remove and discard the RH catalytic converter-to-exhaust manifold nut.



39. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
    - Discard the 2 bolts.

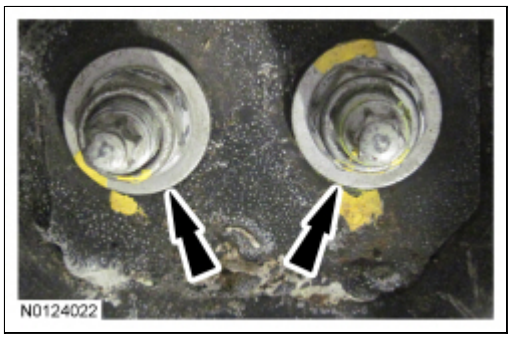


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40. ***NOTICE:*** **Only use hand tools when removing the engine support insulator nuts or the engine support insulator may be damaged.**

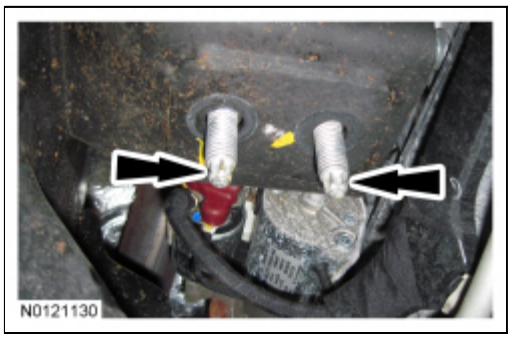
    NOTE: If during nut removal the stud is extracted from the engine support insulator, separate the nut from the stud prior to installing the stud.

    Remove the 2 RH engine support insulator nuts.



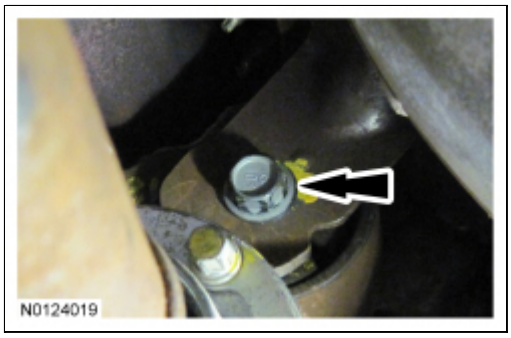
41. ***NOTICE:*** **Only use hand tools when removing the engine support insulator stud or the engine support insulator may be damaged.**

    Remove the 2 RH engine support insulator studs.

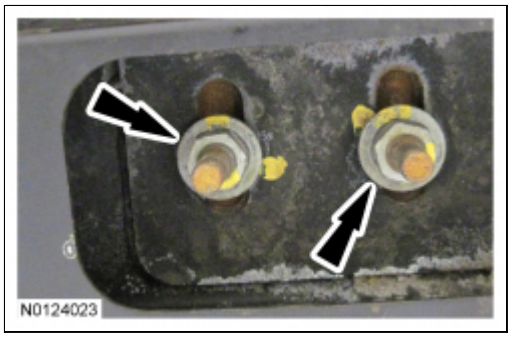


42. ***NOTICE:*** **Only use hand tools when loosening the engine support insulator through bolt or the engine support insulator may be damaged.**

    Remove the LH engine support insulator bolt.



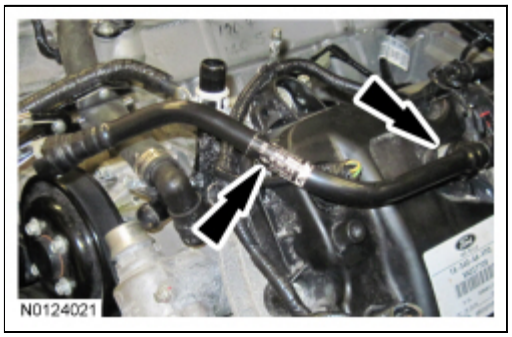
43. Loosen the 2 transmission mount-to-crossmember nuts.



44. Disconnect the oil level sensor electrical connector.



45. Disconnect the quick connect coupling and remove the crankcase ventilation tube. For additional information, refer to Section 310-00 .



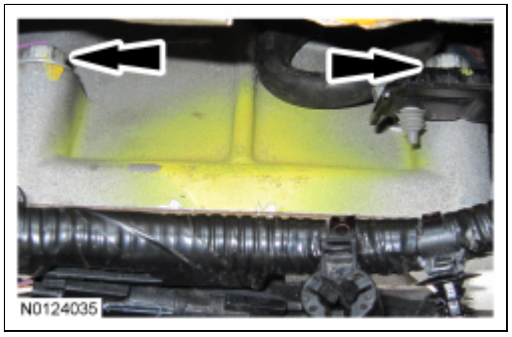
46. ***NOTICE:*** **Do not support the transmission by the fluid pan, failure to follow this instruction may result in serious damage to the transmission.**

    Support the bellhousing of the transmission with a suitable floor jack and a block of wood.

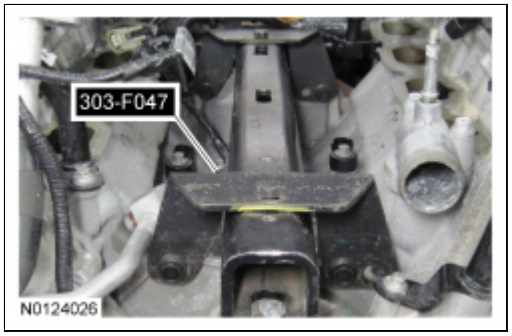
47. **NOTE:** On Four-Wheel Drive (4WD) vehicles, it may be necessary to reposition the transfer case vent hose to access the bolts.

    Remove the upper 2 transmission-to-engine bolts.

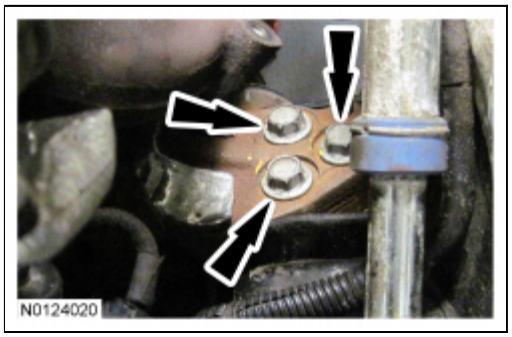
repair4less



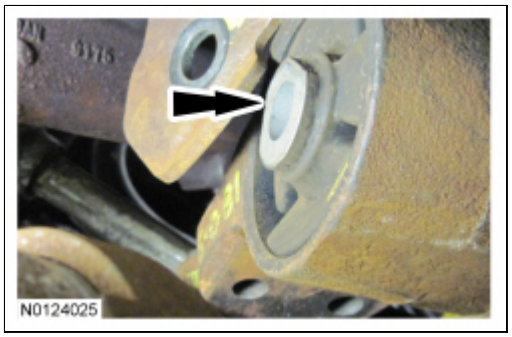
48. Install the Engine Lifting Bracket.



49. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, raise the engine assembly to gain access to the 3 LH engine support insulator bolts.



50. Remove the LH engine support insulator from under the vehicle.



51. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, remove the engine assembly from the vehicle.

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Camshaft — LH

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

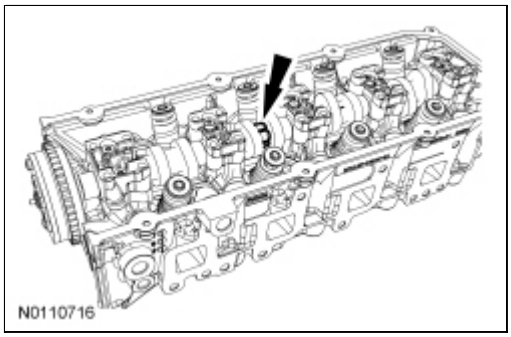
Removal

1. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

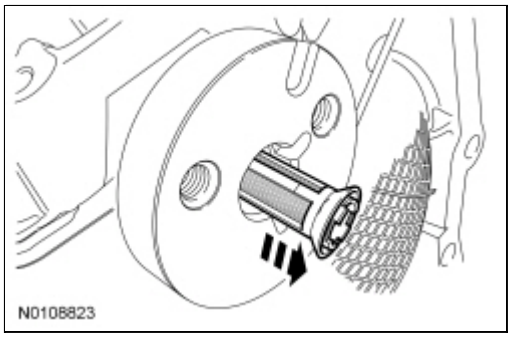
2. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to remove the camshaft phaser and sprocket assembly or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, remove the 3 LH camshaft phaser and sprocket bolts and the camshaft phaser and sprocket.
   - Discard the 3 camshaft phaser and sprocket bolts.



3. Remove and discard the Variable Camshaft Timing (VCT) system oil filter.



4. ***NOTICE:*** **The camshaft bearing caps must be installed in their original locations. Record camshaft bearing cap locations. Failure to follow these instructions may result in engine damage.**

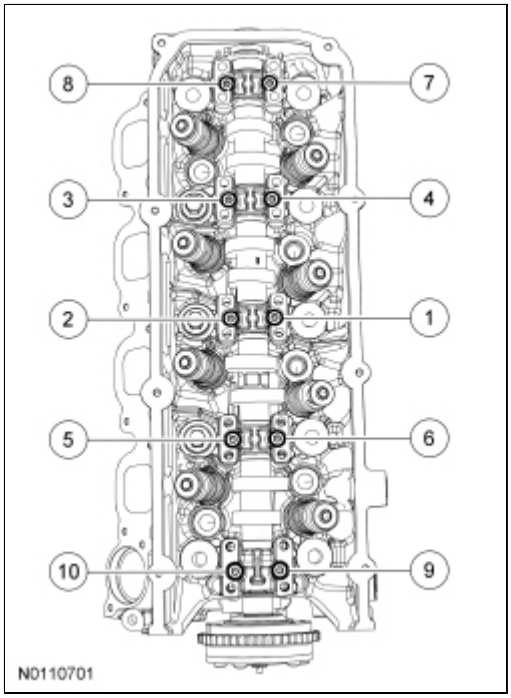
   Remove the 10 bolts and remove the 5 camshaft bearing caps.

5. Remove the camshaft.
   - Inspect the camshaft. For additional information, refer to Section 303-00 .

Installation

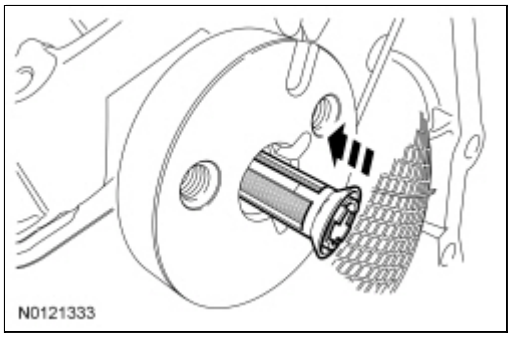
1. Lubricate the camshaft and camshaft journals with clean engine oil and install the camshaft.

2. Position the 5 camshaft bearing caps in their original locations and install the 10 bolts in the sequence shown, in 2 stages.
   - Stage 1: Tighten to 6 Nm (53 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



3. Install a new VCT system oil filter with the open end facing the front of the engine.

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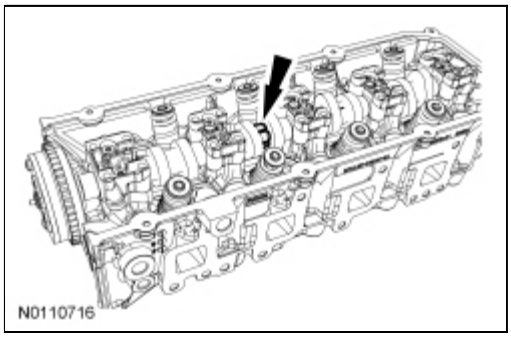
4. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   Position the camshaft phaser and sprocket with the alignment pin in the alignment slot of the camshaft and install 3 new camshaft phaser and sprocket bolts finger-tight.

5. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to install the camshaft phaser and sprocket bolt or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, tighten the 3 new LH camshaft phaser and sprocket bolts in 2 stages.
   - Stage 1: Tighten to 9 Nm (80 lb-in).
   - Stage 2: Tighten an additional 90 degrees.



6. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

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Camshaft — RH

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

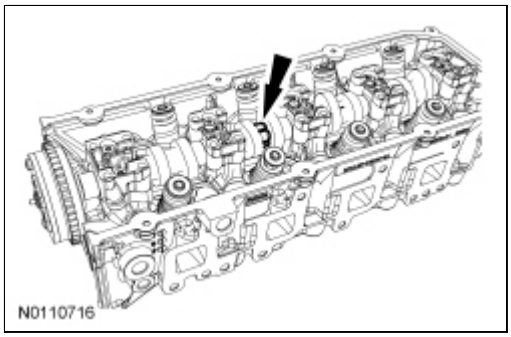
Removal

1. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

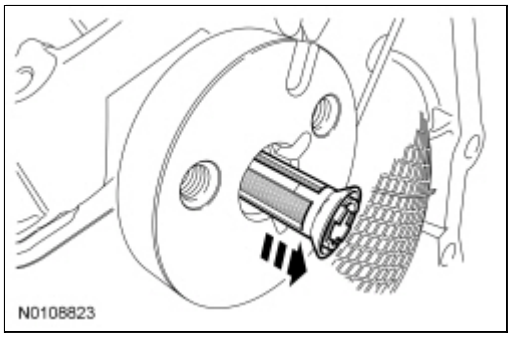
2. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to remove the camshaft phaser and sprocket assembly or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, remove the 3 RH camshaft phaser and sprocket bolts and the camshaft phaser and sprocket.
   - Discard the 3 camshaft phaser and sprocket bolts.



3. Remove and discard the Variable Camshaft Timing (VCT) system oil filter.



4. ***NOTICE:*** **The camshaft bearing caps must be installed in their original locations. Record camshaft bearing cap locations. Failure to follow these instructions may result in engine damage.**

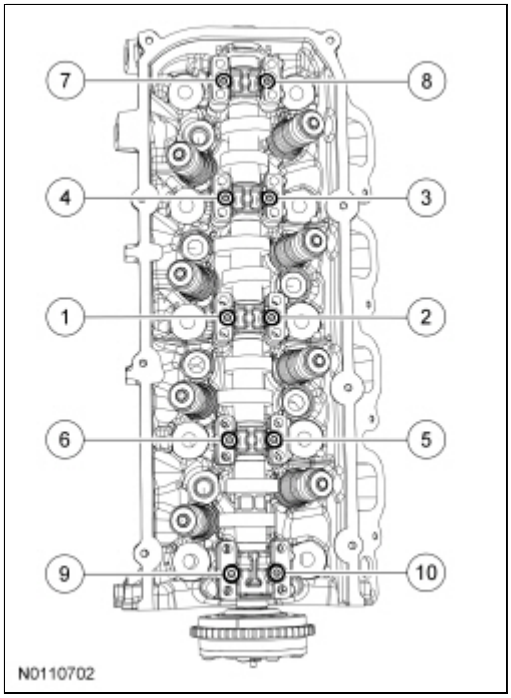
   Remove the 10 bolts and remove the 5 camshaft bearing caps.

5. Remove the camshaft.
   - Inspect the camshaft. For additional information, refer to Section 303-00 .

Installation

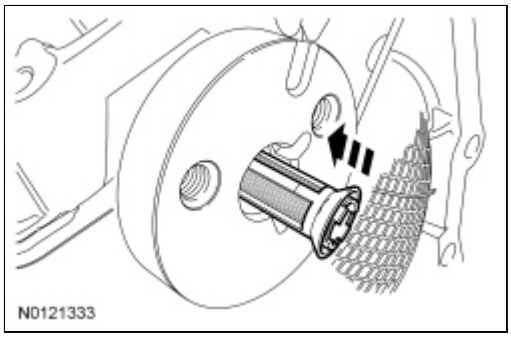
1. Lubricate the camshaft and camshaft journals with clean engine oil and install the camshaft.

2. Position the 5 camshaft bearing caps in their original locations and install the 10 bolts in the sequence shown, in 2 stages.
   - Stage 1: Tighten to 6 Nm (53 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



3. Install a new VCT system oil filter with the open end facing the front of the engine.

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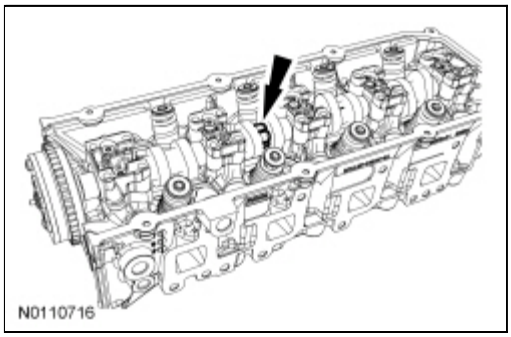
4. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   Position the camshaft phaser and sprocket with the alignment pin in the alignment slot of the camshaft and install 3 new camshaft phaser and sprocket bolts finger-tight.

5. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to install the camshaft phaser and sprocket bolt or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, tighten the 3 new LH camshaft phaser and sprocket bolts in 2 stages.
   - Stage 1: Tighten to 9 Nm (80 lb-in).
   - Stage 2: Tighten an additional 90 degrees.



6. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

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Camshaft Phaser and Sprocket — LH

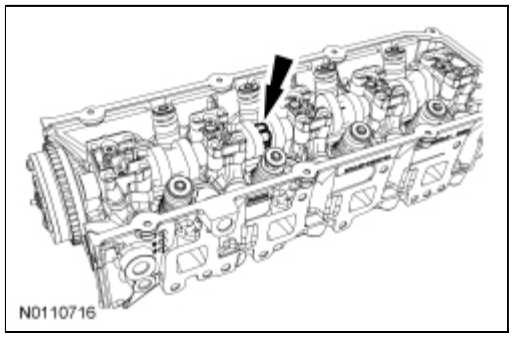
Removal

1. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

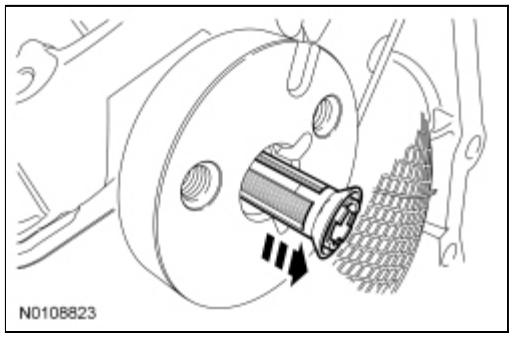
2. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to remove the camshaft phaser and sprocket assembly or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, remove the 3 LH camshaft phaser and sprocket bolts and the camshaft phaser and sprocket.
   - Discard the 3 camshaft phaser and sprocket bolts.



3. Remove and discard the Variable Camshaft Timing (VCT) system oil filter.



Installation

1. Install a new VCT system oil filter with the open end facing the front of the engine.

2. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

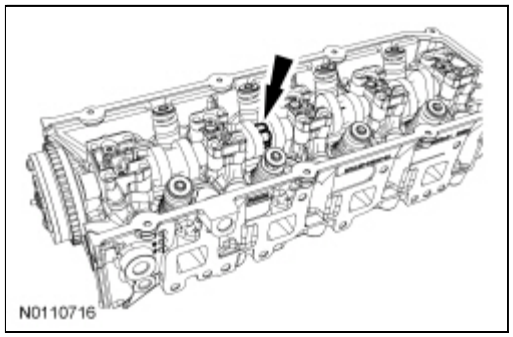
   Position the camshaft phaser and sprocket with the alignment pin in the alignment slot of the

camshaft and install 3 new camshaft phaser and sprocket bolts finger-tight.

3. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to install the camshaft phaser and sprocket bolt or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, tighten the 3 new LH camshaft phaser and sprocket bolts in 2 stages.
   - Stage 1: Tighten to 9 Nm (80 lb-in).
   - Stage 2: Tighten an additional 90 degrees.



4. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

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Camshaft Phaser and Sprocket — RH

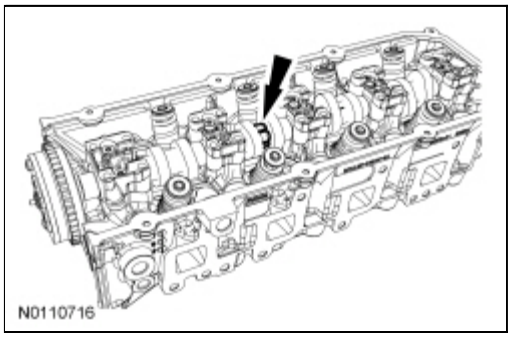
Removal

1. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

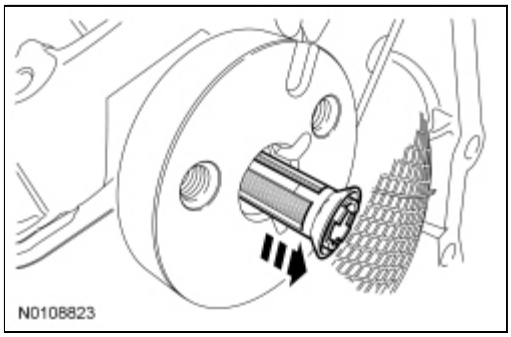
2. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to remove the camshaft phaser and sprocket assembly or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, remove the 3 RH camshaft phaser and sprocket bolts and the camshaft phaser and sprocket.
   - Discard the 3 camshaft phaser and sprocket bolts.

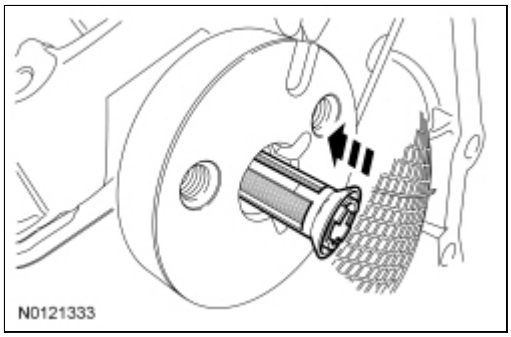


3. Remove and discard the Variable Camshaft Timing (VCT) system oil filter.



Installation

1. Install a new VCT system oil filter with the open end facing the front of the engine.



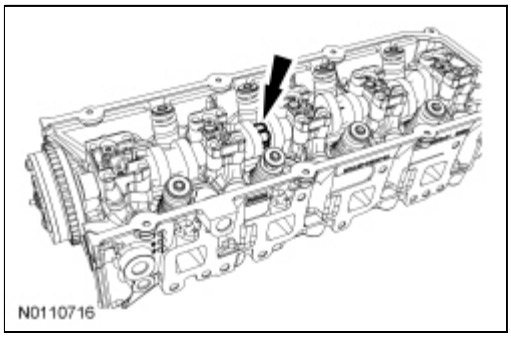
2. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   Position the camshaft phaser and sprocket with the alignment pin in the alignment slot of the camshaft and install 3 new camshaft phaser and sprocket bolts finger-tight.

3. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

   NOTICE: **Only use hand tools to install the camshaft phaser and sprocket bolt or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using a 26 mm (1.023 in) wrench on the flats of the camshaft to secure the camshaft, tighten the 3 new LH camshaft phaser and sprocket bolts in 2 stages.
   - Stage 1: Tighten to 9 Nm (80 lb-in).
   - Stage 2: Tighten an additional 90 degrees.

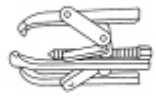
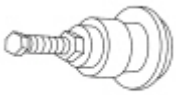


4. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

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Crankshaft Front Seal

Special Tool(s)

 ST1184-A	3-Jaw Puller or equivalent 303-D121
 ST2132-A	Adapter Set, Step Plate 205-DS011 or equivalent
 ST3245-A	Installer, Crankshaft Damper and Crankshaft Front Seal 303-1508
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

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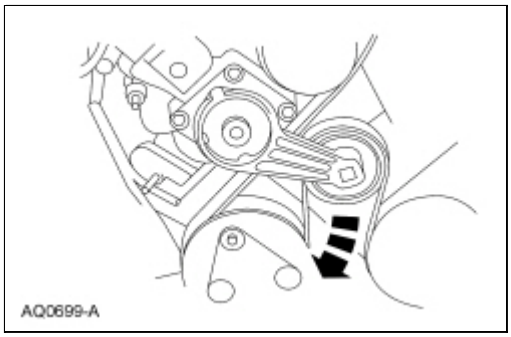
 ST2834-A	

Material

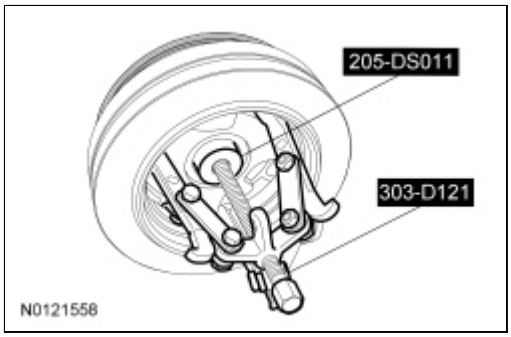
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Rotate the tensioner clockwise and remove the accessory drive belt from the crankshaft pulley.

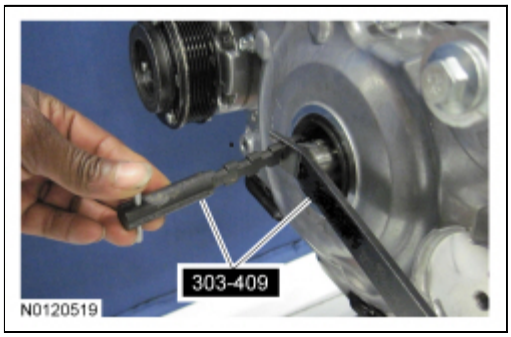


3. Remove and discard the crankshaft pulley bolt.
4. Using the 3 Jaw Puller and Step Plate, remove the crankshaft pulley.



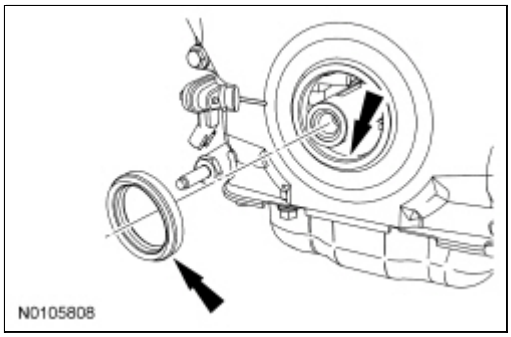
5. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

   Using the Oil Seal Remover, remove the crankshaft front oil seal.



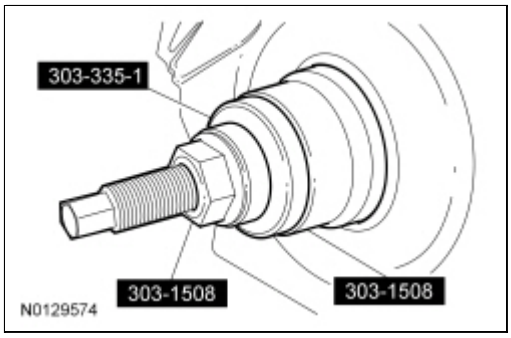
Installation

1. Lubricate the engine front cover and the new crankshaft seal inner lip with clean engine oil.



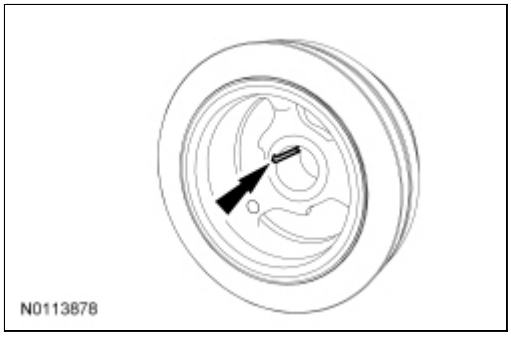
2. Using the Crankshaft Damper and Crankshaft Front Seal Installer and the Front Cover Oil Seal Installer, install the new crankshaft front seal into the engine front cover.

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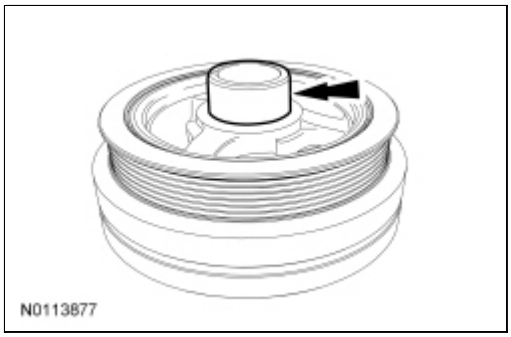


3. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep and silicone gasket remover. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

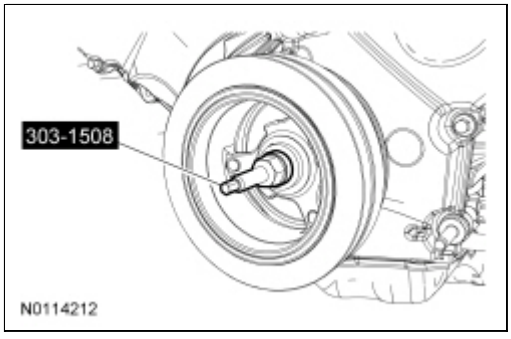
   Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



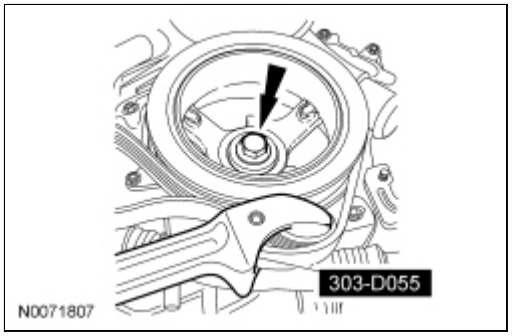
4. Lubricate the crankshaft pulley sealing area with clean engine oil prior to installation.



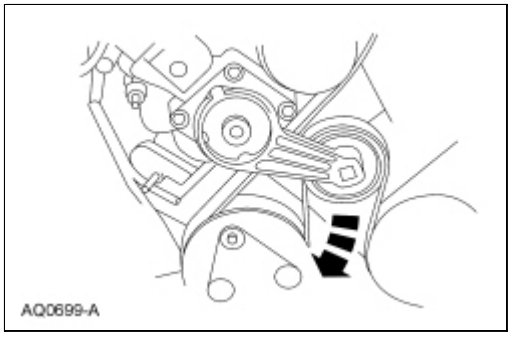
5. Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.



6. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 2 stages:
    - Stage 1: Tighten to 175 Nm (129 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



7. Rotate the tensioner clockwise and install the accessory drive belt onto the crankshaft pulley.

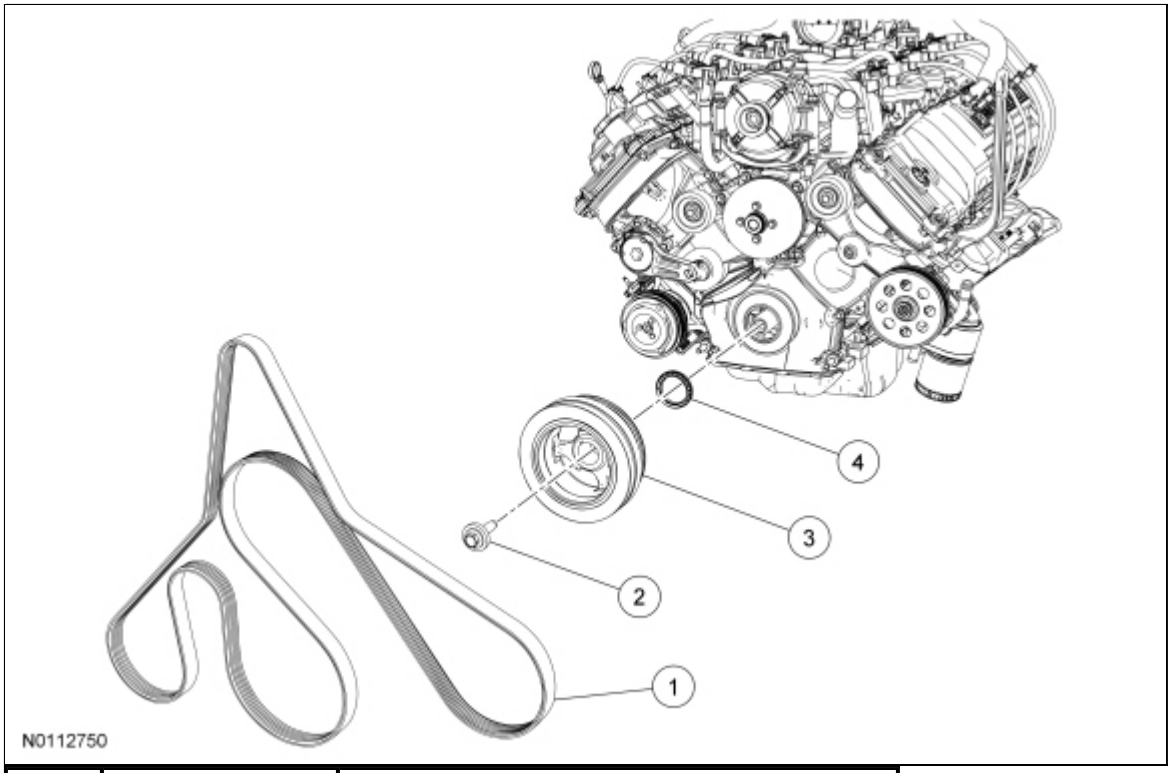


8. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

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Crankshaft Pulley and Crankshaft Front Seal — Exploded View



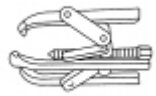
Item	Part Number	Description
1	8620	Accessory drive belt
2	6A340	Crankshaft pulley bolt and washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Crankshaft Pulley

Special Tool(s)

 ST1184-A	3-Jaw Puller 303-D121 or equivalent
 ST2132-A	Adapter Set, Step Plate 205-DS011 or equivalent
 ST2428-A	Installer, Crankshaft Damper 303-1508
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

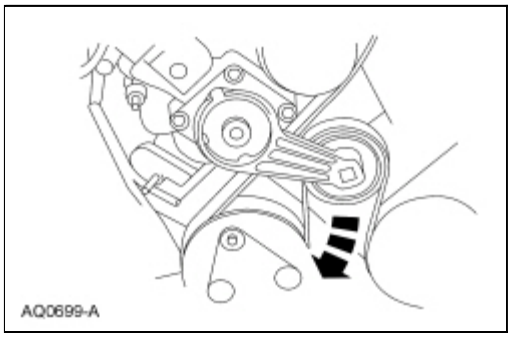
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Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

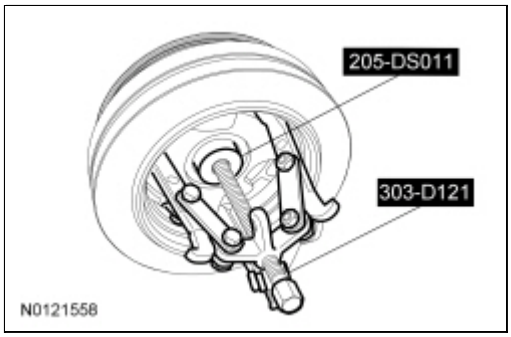
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Rotate the tensioner clockwise and remove the accessory drive belt from the crankshaft pulley.



3. Remove the crankshaft pulley bolt.
   - Discard the crankshaft pulley bolt.

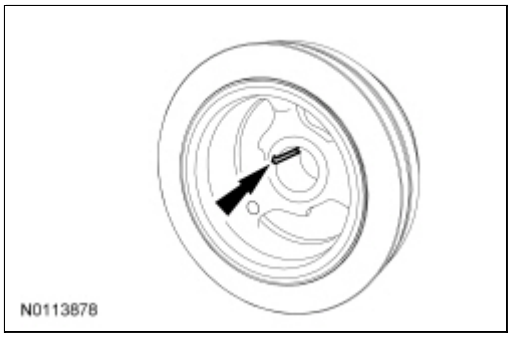
4. Using the 3 Jaw Puller and Step Plate, remove the crankshaft pulley.



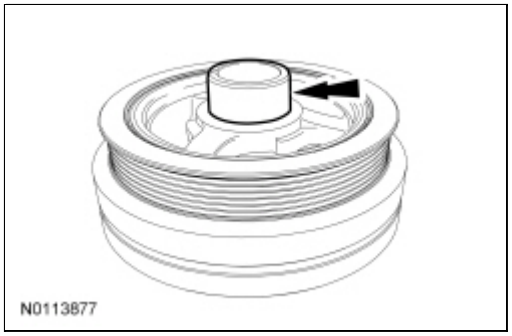
Installation

1. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep and silicone gasket remover. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

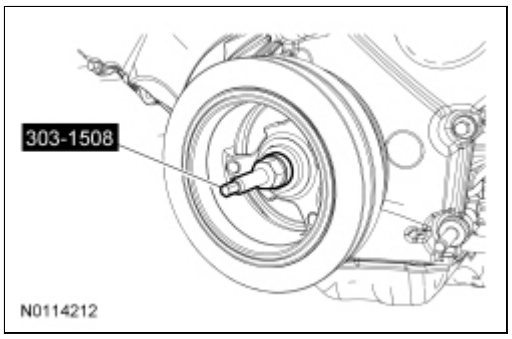
   Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



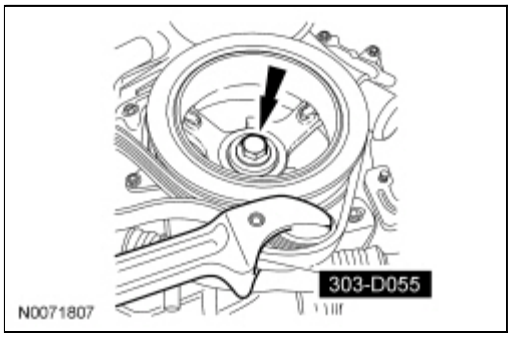
2. Lubricate the crankshaft pulley sealing area with clean engine oil prior to installation.



3. Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.

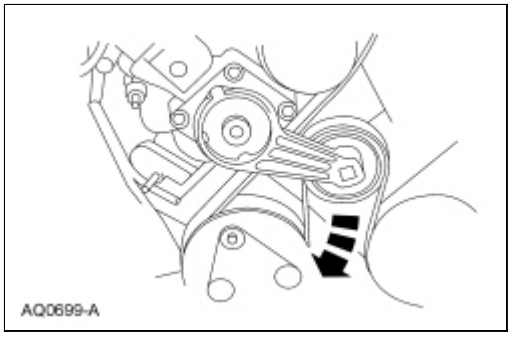


4. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 2 stages:
    - Stage 1: Tighten to 175 Nm (129 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



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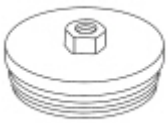
5. Rotate the tensioner clockwise and install the accessory drive belt onto the crankshaft pulley.



6. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

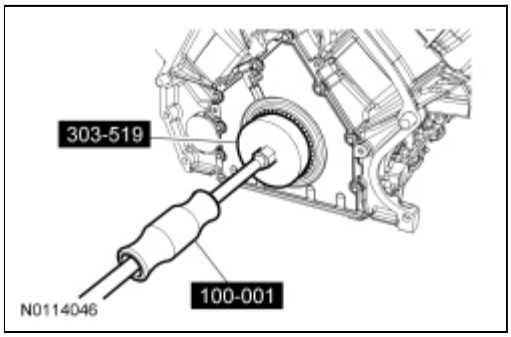
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Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	—

Removal

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the flexplate. For additional information, refer to Flexplate in this section.
3. Remove the engine rear cover plate.
4. **NOTE:** Inspect the ignition pulse ring for damage. If the ignition pulse ring has been dropped or has any visual damage, it must be discarded.

   Remove the crankshaft ignition pulse ring.
5. Disconnect the Crankshaft Position (CKP) sensor electrical connector.
6. Remove the bolt and the CKP sensor.
7. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.



8. Remove the 8 bolts and the crankshaft rear seal retainer plate.

Installation

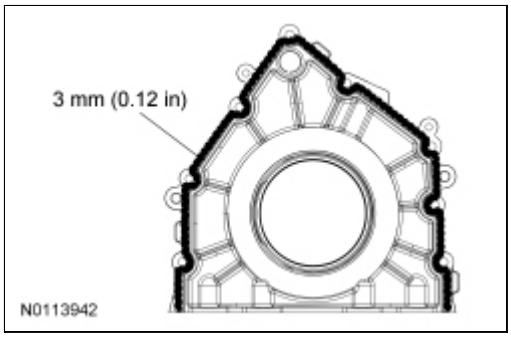
1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   NOTE: Clean the sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

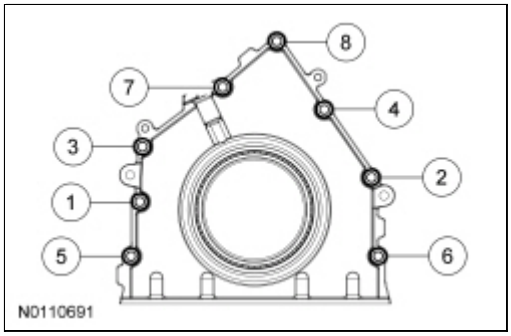
   Clean and inspect the mating surface.
2. **NOTE:** If the rear crankshaft seal retaining plate is not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever

is longer. Failure to follow this procedure may cause future oil leaks.

Apply a bead of silicone gasket and sealant around the groove along the rear of crankshaft rear seal retainer plate sealing surface.

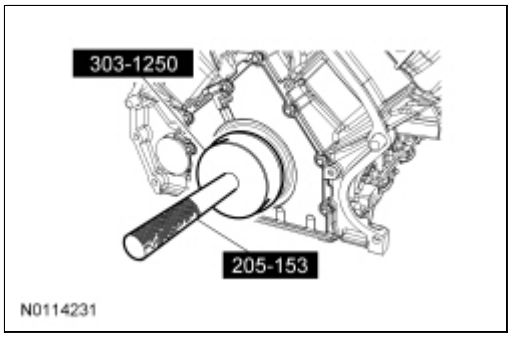


3. Install the crankshaft rear seal retainer plate and the 8 bolts in the sequence shown, in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



4. **NOTE:** Lubricate the crankshaft rear seal with clean engine oil prior to installation.

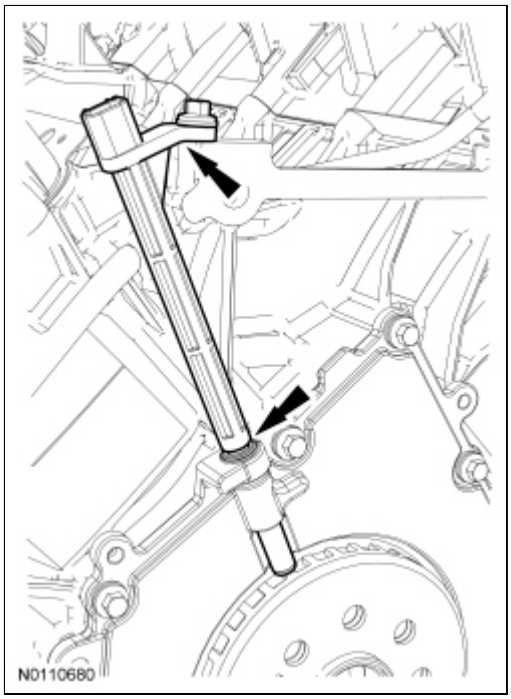
   Using the Rear Main Seal Installer and Handle, install a new crankshaft rear seal.



5. ***NOTICE:*** **The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.**

   Position the CKP sensor and install the bolt.
   - Tighten to 10 Nm (89 lb-in).

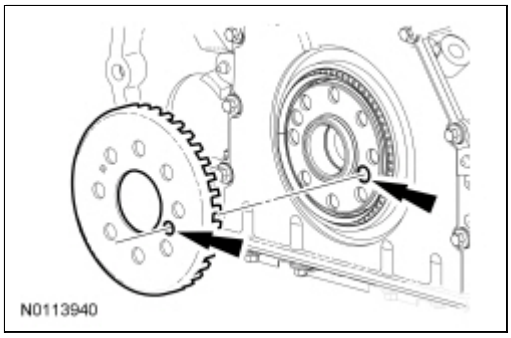
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6. Connect the CKP sensor electrical connector.

7. **NOTE:** Inspect the ignition pulse ring for damage. If the ignition pulse ring has been dropped or has any visual damage, it must be discarded.

   With the inset hole on the crankshaft ignition pulse ring aligned with the inset hole on the crankshaft flange, install the crankshaft ignition pulse ring.



8. Install the engine rear cover plate.

9. Install the flexplate. For additional information, refer to Flexplate in this section.

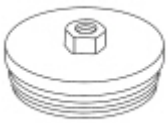
10. Install the oil pan. For additional information, refer to Oil Pan in this section.

11. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

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Crankshaft Rear Seal

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

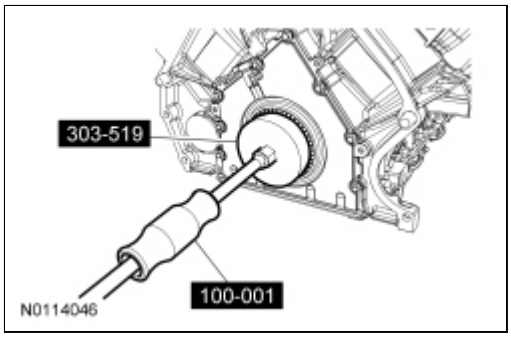
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. Remove the flexplate. For additional information, refer to Flexplate in this section.
2. Remove the engine rear cover plate.
3. **NOTE:** Inspect the ignition pulse ring for damage. If the ignition pulse ring has been dropped or has any visual damage, it must be discarded.

Remove the crankshaft ignition pulse ring.

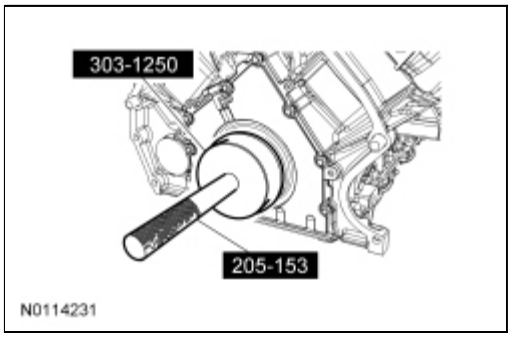
4. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.



Installation

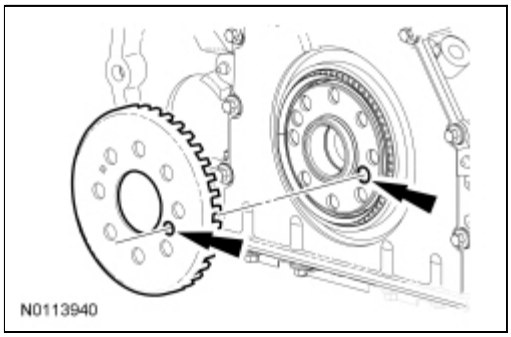
1. **NOTE:** Lubricate the crankshaft rear seal with clean engine oil prior to installation.

   Using the Rear Main Seal Installer and Handle, install a new crankshaft rear seal.



2. **NOTE:** Inspect the ignition pulse ring for damage. If the ignition pulse ring has been dropped or has any visual damage, it must be discarded.

   With the inset hole on the crankshaft ignition pulse ring aligned with the inset hole on the crankshaft flange, install the crankshaft ignition pulse ring.



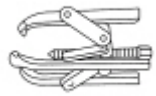
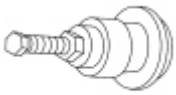
3. Install the engine rear cover plate.

4. Install the flexplate. For additional information, refer to Flexplate in this section.

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Engine Front Cover

Special Tool(s)

 ST1184-A	3 Jaw Puller or equivalent 303-D121
 ST2132-A	Adapter Set, Step Plate 205-DS011 or equivalent
 ST3245-A	Installer, Crankshaft Damper and Crankshaft Front Seal 303-1508
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

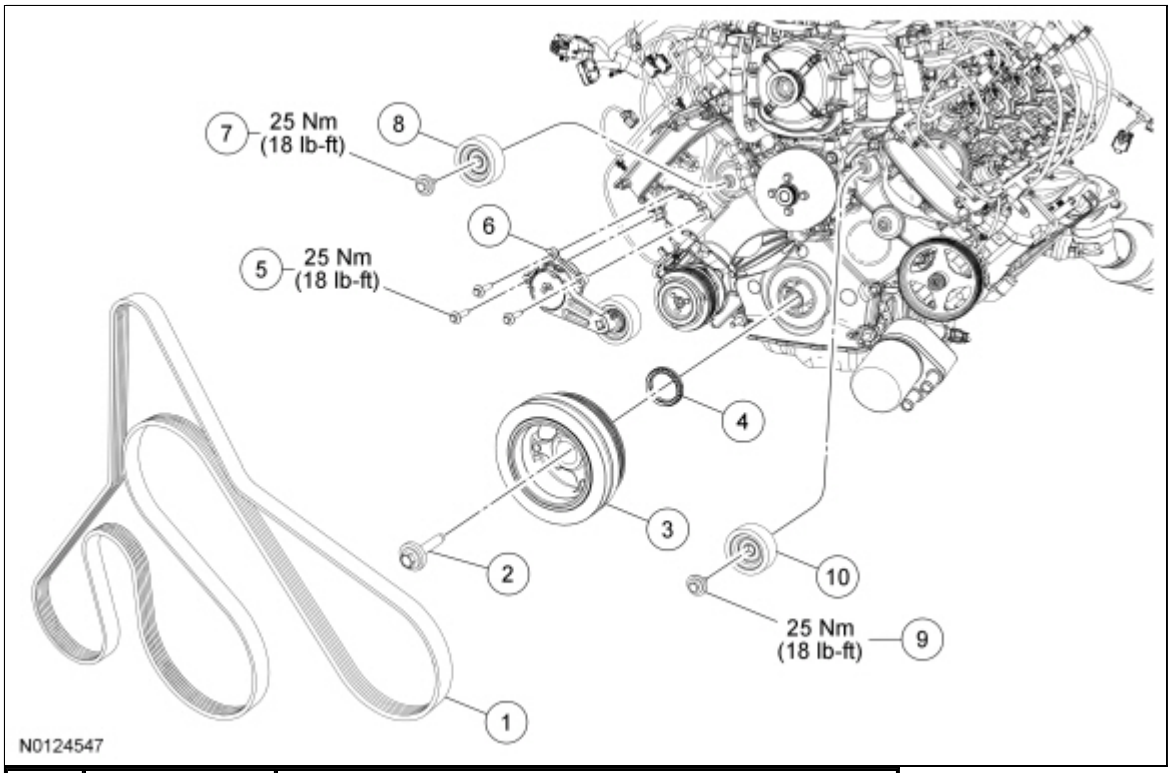
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 ST2834-A	

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

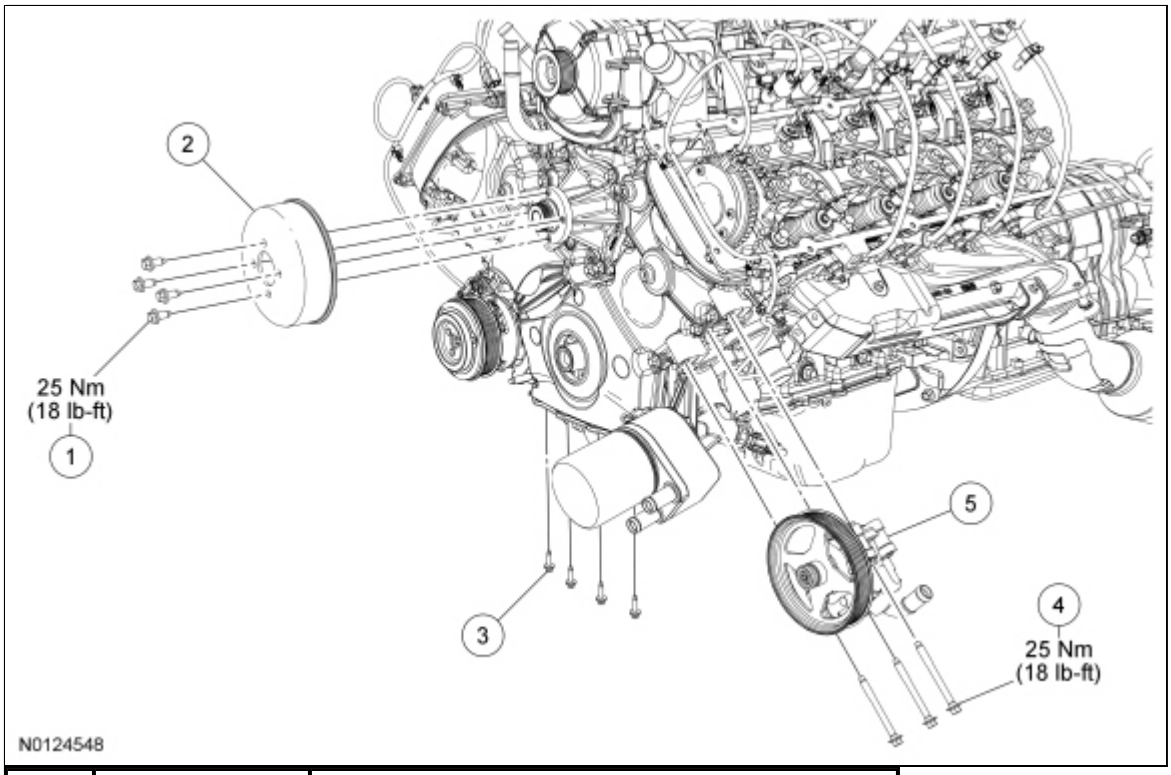
Front End Accessory Drive (FEAD), Crankshaft Pulley and Crankshaft Front Seal



Item	Part Number	Description
1	8620	Accessory drive belt
2	W701512	Crankshaft pulley bolt
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal
5	N808920	Accessory drive belt tensioner bolt (3 required)
6	6B209	Accessory drive belt tensioner
7	N808102	RH accessory drive belt idler pulley bolt
8	19A216	RH accessory drive belt idler pulley
9	N808102	LH accessory drive belt idler pulley bolt
10	19A216	LH accessory drive belt idler pulley

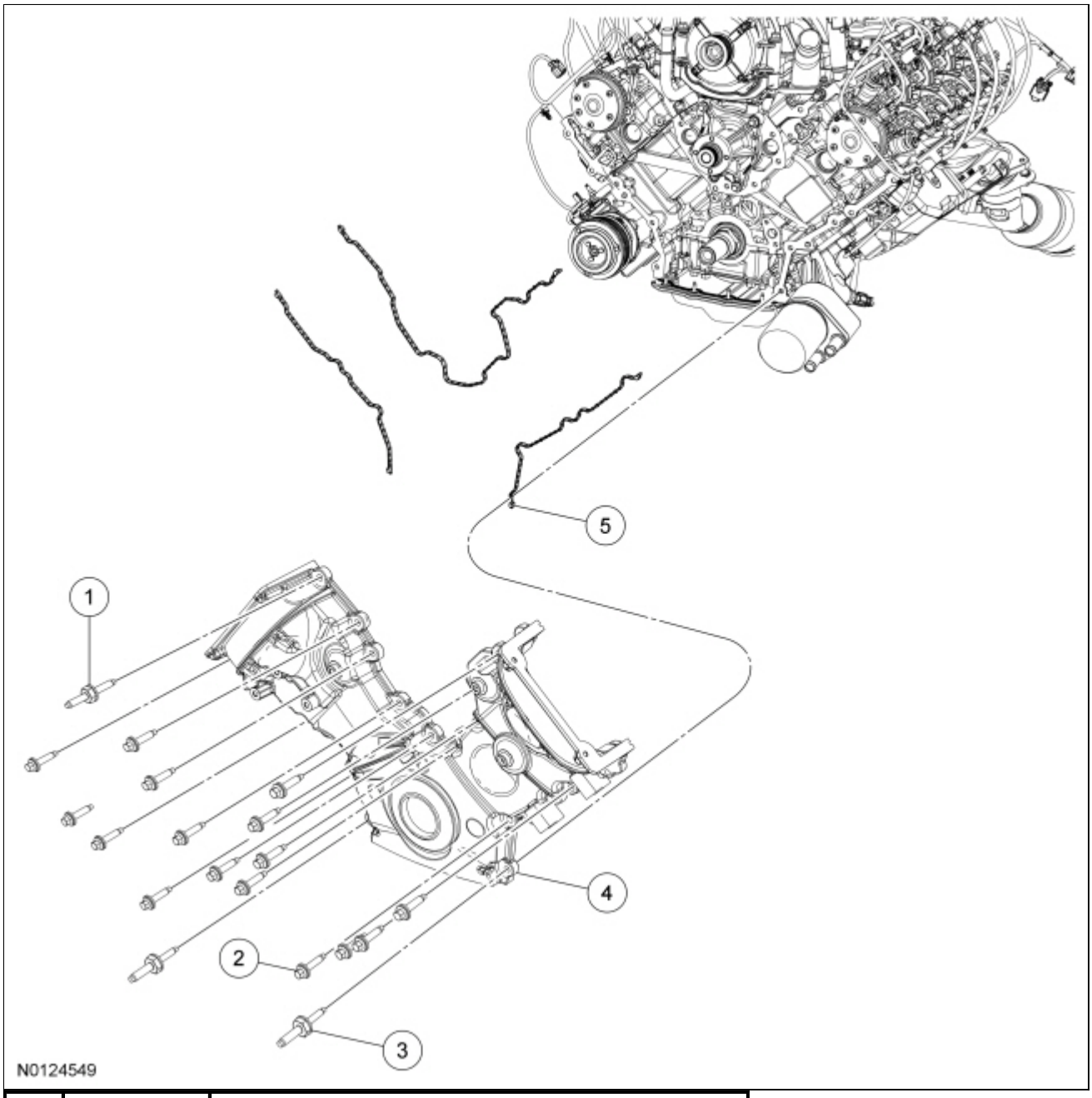
Coolant Pump Pulley, Power Steering Pump and Front Oil Pan Bolts

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Item	Part Number	Description
1	N806282	Coolant pump pulley bolt (4 required)
2	8A528	Coolant pump pulley
3	W701605	Oil pan bolt (4 required)
4	—	Power steering pump bolts (3 required)
5	—	Power steering pump

Engine Front Cover and Gaskets



Item	Part Number	Description
1	W713461	Engine front cover stud
2	W713261	Engine front cover bolt (17 required)
3	W713462	Engine front cover stud (2 required)
4	6C086	Engine front cover
5	—	Engine front cover gasket (part of 6C086) (3 required)

Removal

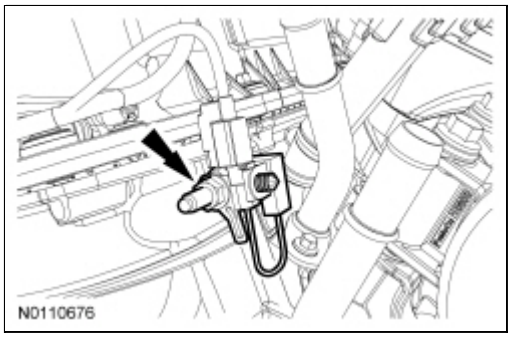
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

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02 .

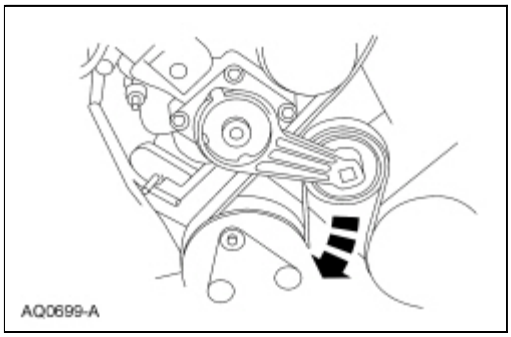
2. Remove the RH and LH Variable Camshaft Timing (VCT) variable force solenoids. For additional information, refer to Section 303-14 .

3. Remove the nut and the position the radio ignition interference capacitor aside.



4. Loosen the 4 coolant pump pulley bolts.

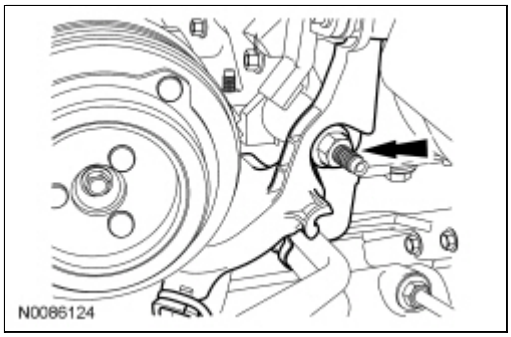
5. Rotate the tensioner clockwise and remove the accessory drive belt.



6. Remove the 4 bolts and the coolant pump pulley.

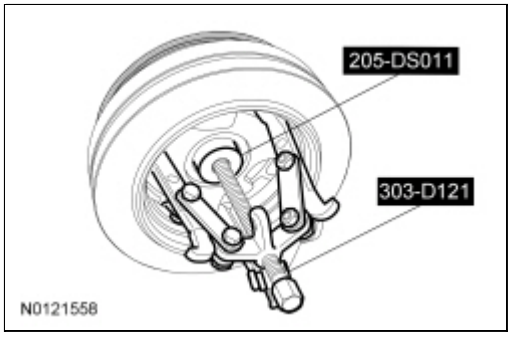
7. Drain the engine oil.

8. Remove the nut and position aside the transmission cooler tube support bracket and the starter wiring harness support bracket.



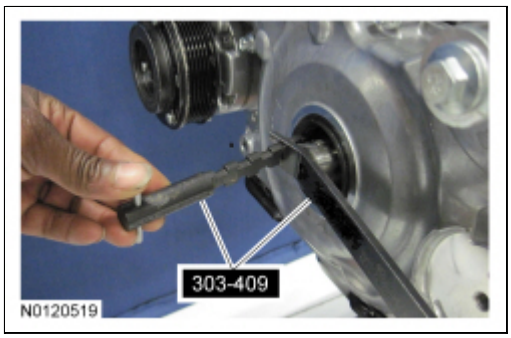
9. Remove the crankshaft pulley bolt.
    - Discard the crankshaft pulley bolt.

10. Using the 3 Jaw Puller and Step Plate, remove the crankshaft pulley.



11. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

    Using the Oil Seal Remover, remove the crankshaft front oil seal.



12. Remove the 2 bolts and the 2 accessory drive idler pulleys.

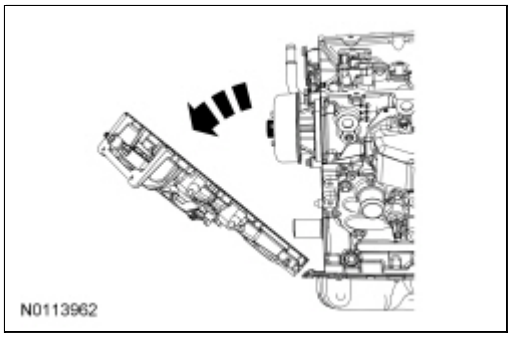
13. Remove the 3 bolts and the accessory drive belt tensioner.

14. Remove the 4 front oil pan bolts.

15. Remove the power steering pump. For additional information, refer to Section 211-02 .

16. Remove the 17 bolts and the 3 studs.

17. Remove the engine front cover from the front cover-to-cylinder block dowel.
    - Remove and discard the engine front cover gaskets.



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18. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.

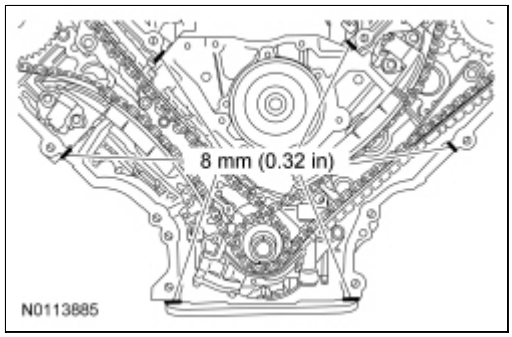
Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

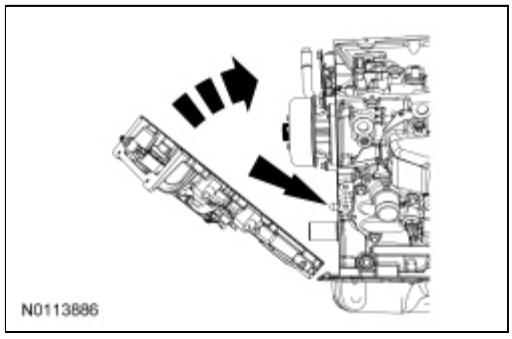
   NOTE: If the engine front cover is not secured within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   NOTE: Make sure that the engine front cover gasket is in place on the engine front cover before installation.

   Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface, at the locations shown.

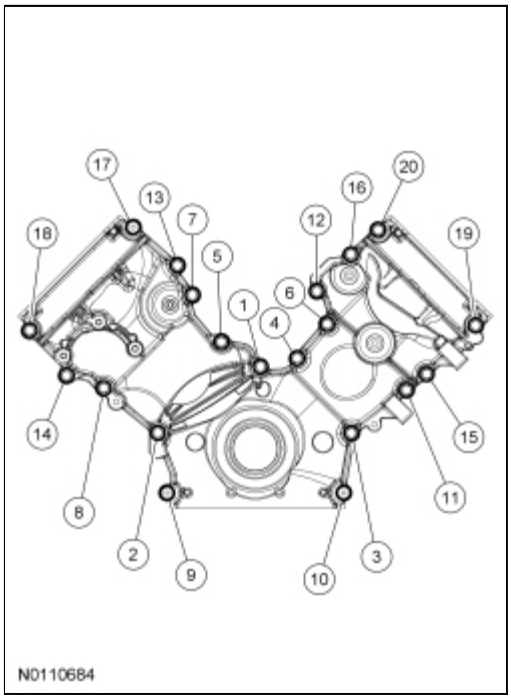


2. Install new engine front cover gaskets on the engine front cover. Position the engine front cover onto the dowels. Install the fasteners finger-tight.



3. Tighten the 20 engine front cover fasteners in the sequence shown in 2 stages.
   Stage 1: Tighten all fasteners to 10 Nm (89 lb-in).
   Stage 2: Tighten all fasteners to 20 Nm (177 lb-in).
   Stage 3: Tighten all fasteners an additional 45 degrees.

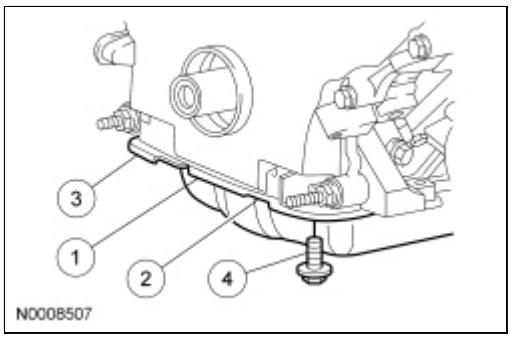
Item	Part Number	Description
1	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
2	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
3	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
4	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
5	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
6	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
7	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
8	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
9	W713462	Stud, Hex Head Pilot, M8 x 33 + M10 x 30
10	W713462	Stud, Hex Head Pilot, M8 x 33 + M10 x 30
11	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
12	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
13	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
14	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
15	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
16	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
17	W713461	Stud, Hex Head Pilot, M8 x 33 + M8 x 27
18	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
19	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
20	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33



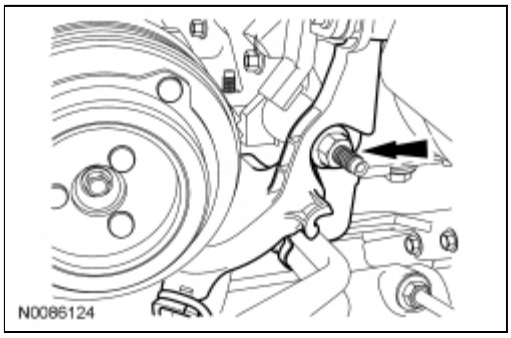
4. Loosely install the 4 bolts, then tighten in 2 stages, in the sequence shown.

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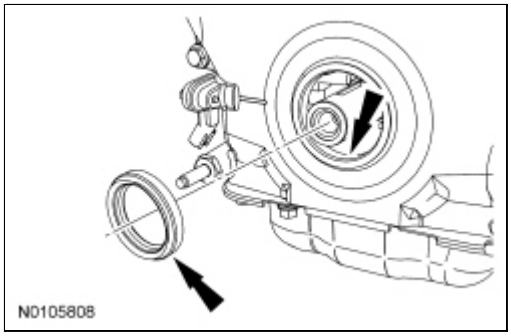
- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.



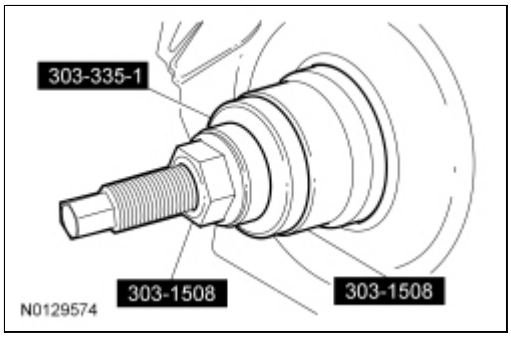
5. Position the starter wiring harness support bracket and the transmission fluid cooler tube support bracket and tighten the nut.
    - Tighten to 10 Nm (89 lb-in).



6. Lubricate the engine front cover and the crankshaft seal inner lip with clean engine oil.

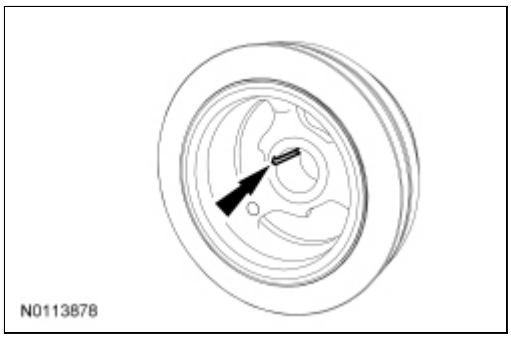


7. Using the Crankshaft Damper and Crankshaft Front Seal Installer and the Front Cover Oil Seal Installer, install a new crankshaft front seal into the engine front cover.

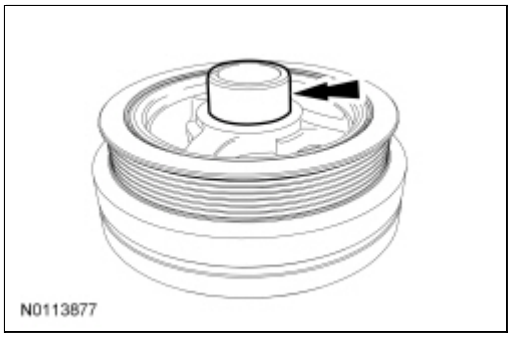


8. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep and silicone gasket remover. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

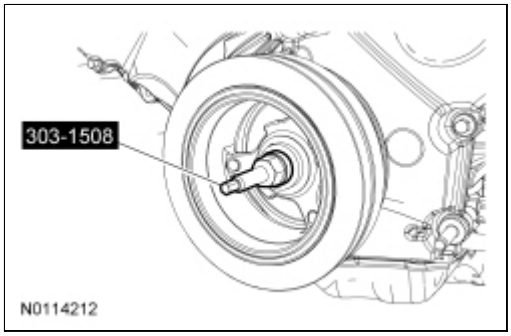
   Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



9. Lubricate the crankshaft pulley sealing area with clean engine oil prior to installation.

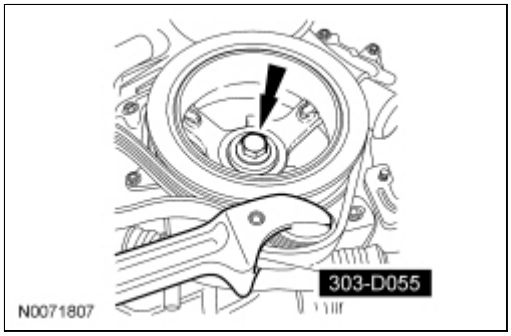


10. Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.



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11. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 2 stages:
    - Stage 1: Tighten to 175 Nm (129 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



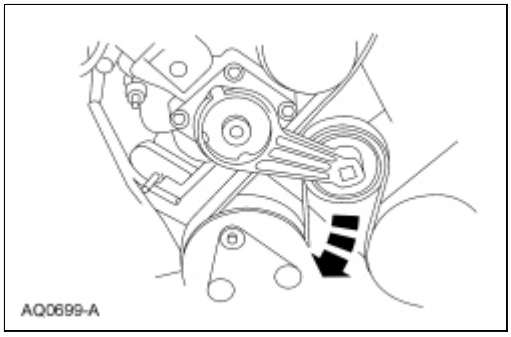
12. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

13. Install the 2 accessory drive idler pulleys and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

14. Position the coolant pump pulley and install the 4 bolts finger-tight.

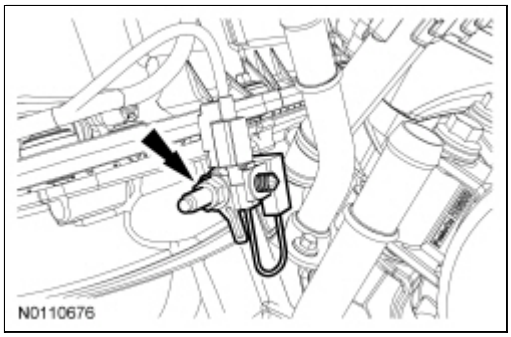
15. Install the power steering pump. For additional information, refer to Section 211-02 .

16. Rotate the tensioner clockwise and install the accessory drive belt.



17. Tighten the 4 coolant pump pulley bolts.
    - Tighten to 25 Nm (18 lb-ft).

18. Position the radio ignition interference capacitor and install the nut.
    - Tighten to 25 Nm (18 lb-ft).



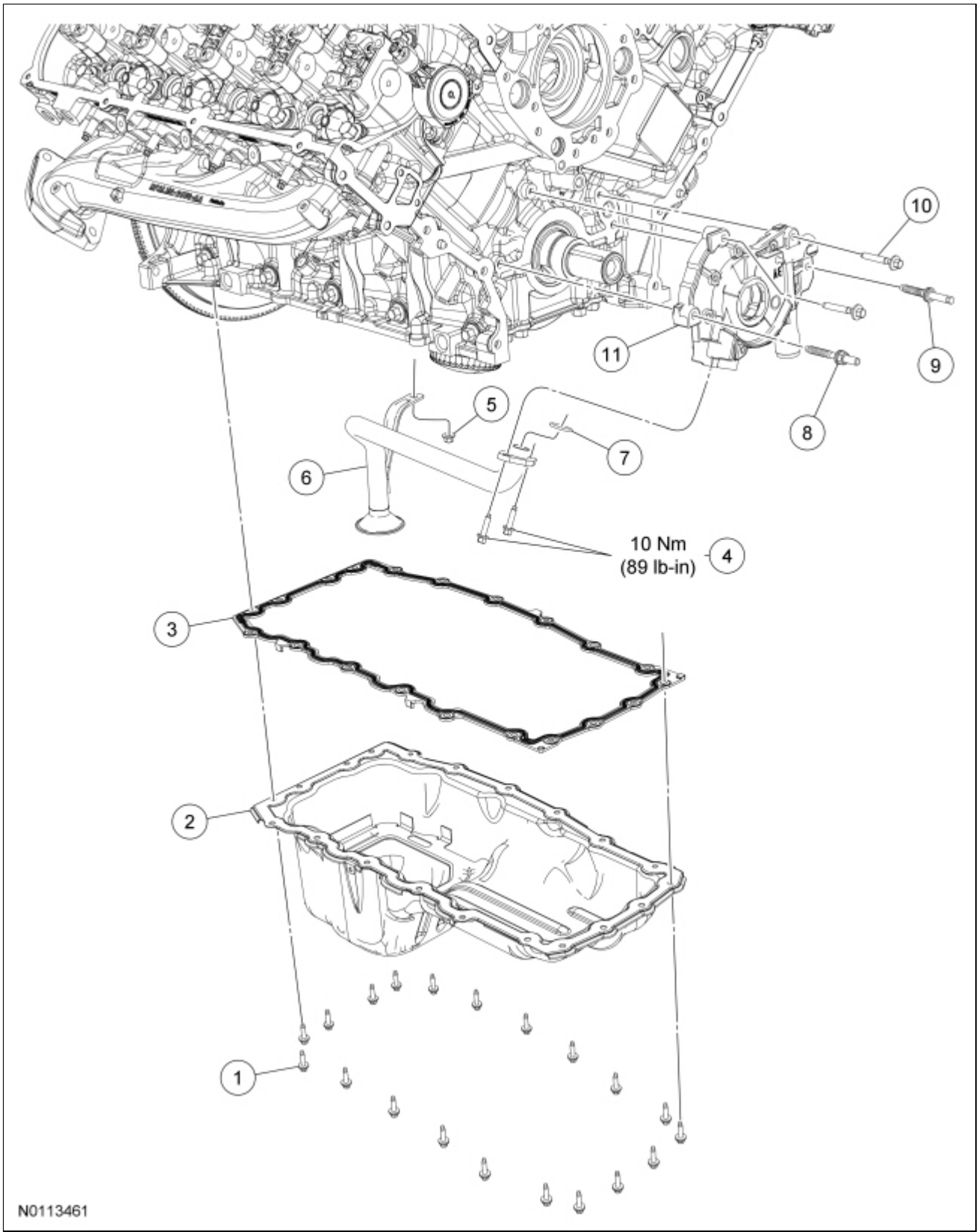
19. Install the RH and LH VCT variable force solenoids. For additional information, refer to Section 303-14 .

20. Fill the crankcase with clean engine oil.

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Engine Lubrication Components — Exploded View



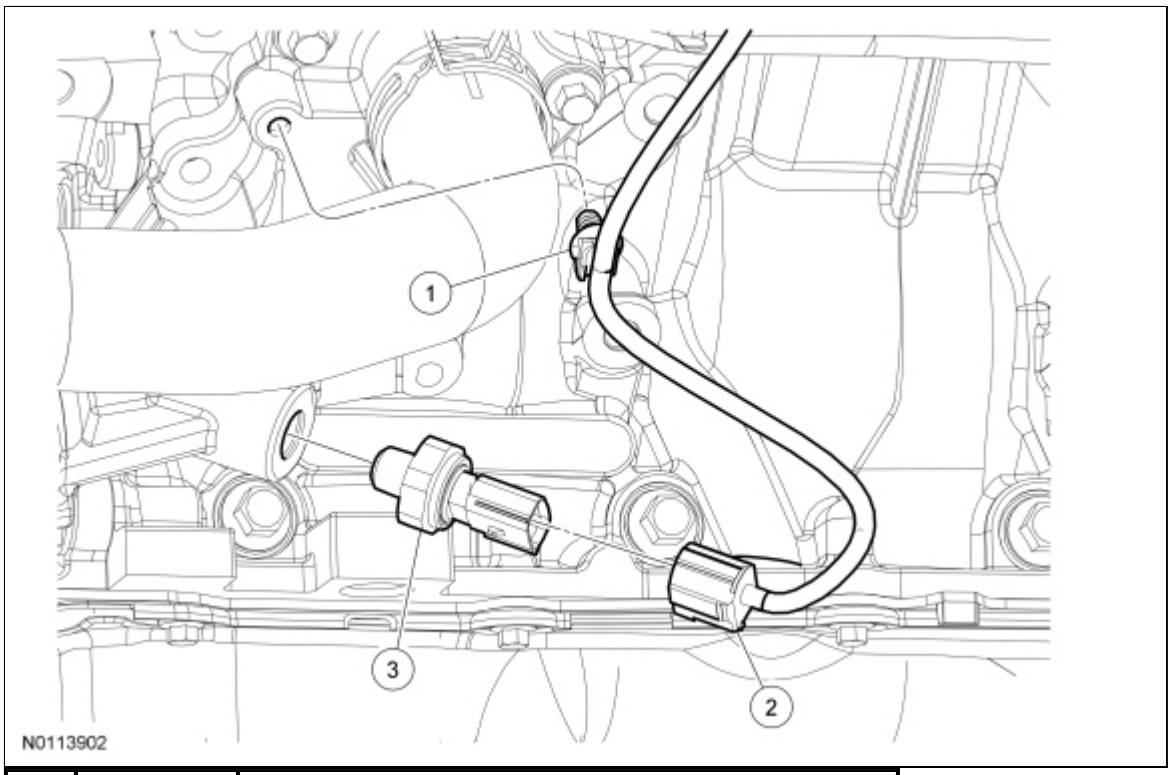
Item	Part Number	Description
1	W503276	Oil pan bolt (20 required)

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2	6675	Oil pan
3	6710	Oil pan gasket
4	N503276	Oil pump screen and pickup tube-to-oil pump bolts (2 required)
5	W701706	Oil pump screen and pickup tube support bracket nut
6	6622	Oil pump screen and pickup tube
7	6625	Oil pump screen and pickup tube O-ring seal
8	W713654	Oil pump stud bolt
9	W713655	Oil pump stud
10	N806183	Oil pump bolts (2 required)
11	6621	Oil pump

1. For additional information, refer to the procedures in this section.

Engine Oil Pressure (EOP) Switch



Item	Part Number	Description
1	—	Engine Oil Pressure (EOP) switch electrical connector (part 12C508)
2	—	EOP switch wiring harness retainer (part 12C508)
3	9278	EOP switch

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the Engine Oil Pressure (EOP) switch wiring harness retainer and the electrical connector.
3. Remove the EOP switch.

Installation

1. Install the EOP switch.
   - Stage 1: Tighten to 14 Nm (124 lb-in).
   - Stage 2: Tighten an additional 180 degrees.

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2. Connect the EOP switch electrical connector and attach the wiring harness retainer.

Engine Support Insulators

Special Tool(s)

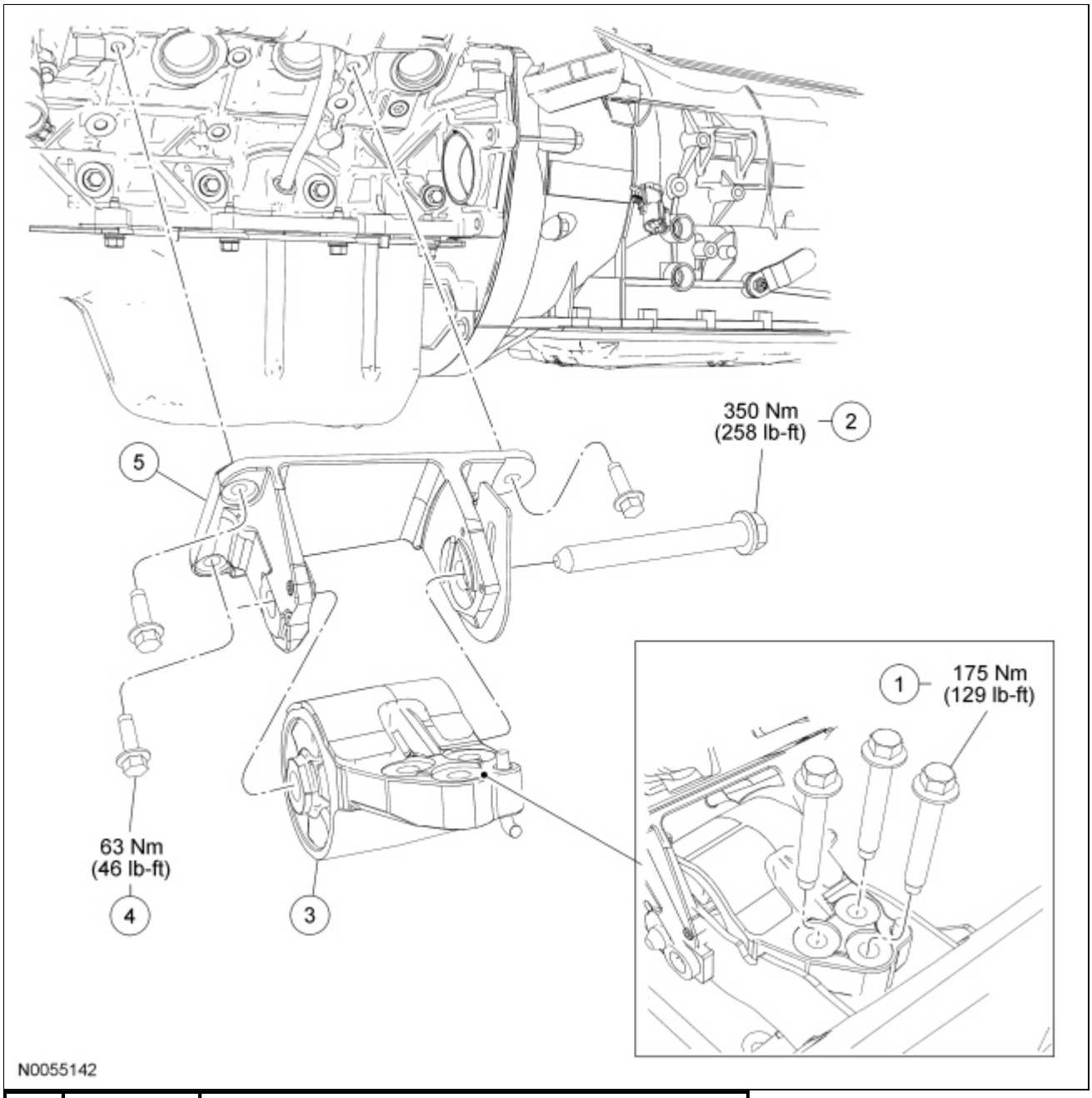
 ST2176-B	Support Bar, Engine 303-F070
 ST3110-A	Support Brackets, Engine 303-1507 or equivalent

Material

Item	Specification
Threadlock 262 TA-26	WSK-M2G351-A6

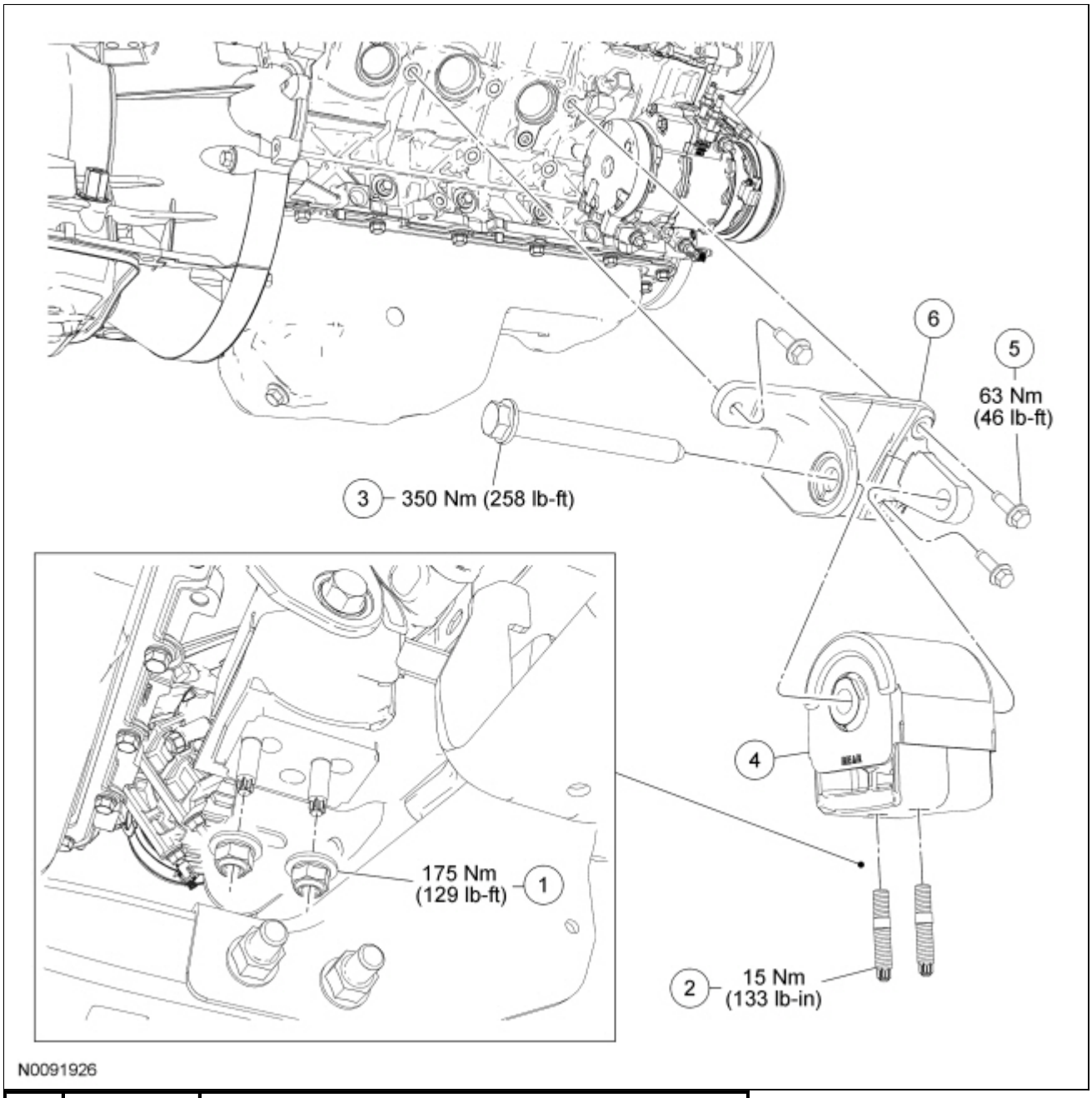
LH Engine Support Insulator

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Item	Part Number	Description
1	W712805	LH engine support insulator-to-frame bolt (3 required)
2	W711142	LH engine support insulator through bolt
3	6B032	LH engine support insulator
4	W711141	LH engine support insulator-to-cylinder block bracket bolt (3 required)
5	6061	LH engine support insulator-to-cylinder block bracket

RH Engine Support Insulator



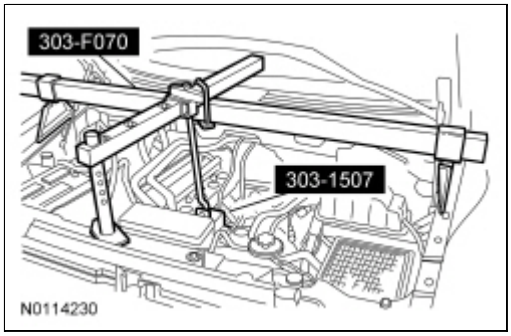
Item	Part Number	Description
1	W707251	RH engine support insulator-to-frame nut (2 required)
2	W711144	RH engine support insulator-to-frame stud bolt (2 required)
3	W711142	RH engine support insulator through bolt
4	6H028	RH engine support insulator
5	W711141	RH engine support insulator-to-cylinder block bracket bolt (3 required)
6	—	RH engine support insulator-to-cylinder block bracket

Removal

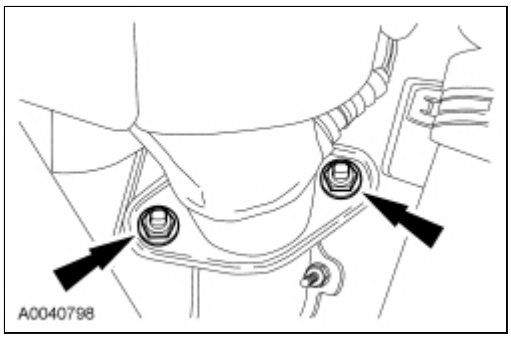
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All engine support insulators

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
3. Remove the starter. For additional information, refer to Section 303-06 .
4. Remove the front drive shaft. For additional information, refer to Section 205-01 .
5. Install the Engine Support Bar and Engine Support Bracket.

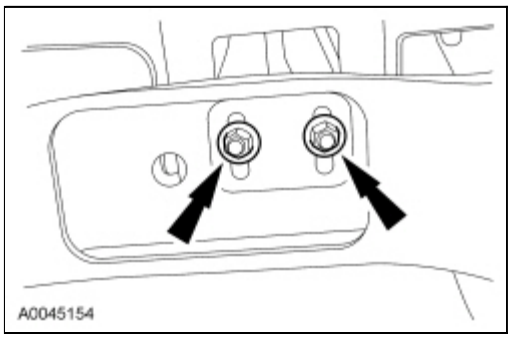


6. Remove the 4 Y-pipe flange nuts (2 RH and 2 LH).



7. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

   Loosen the 2 transmission mount-to-crossmember nuts.



RH engine support insulator

8. ***NOTICE:*** **Only use hand tools when loosening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

   Loosen the LH engine support insulator through bolt.

9. ***NOTICE:*** **Only use hand tools when removing the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

   Remove the RH engine support insulator through bolt.

10. ***NOTICE:*** **Only use hand tools when removing the engine support insulator nuts or damage to the engine support insulator can occur.**

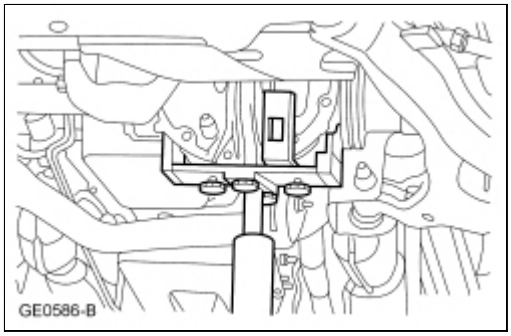
    NOTE: If during nut removal the stud bolt is extracted from the engine support insulator, separate the nut from the stud bolt prior to stud bolt installation.

    Remove the 2 RH engine support insulator nuts.

11. ***NOTICE:*** **Only use hand tools when removing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

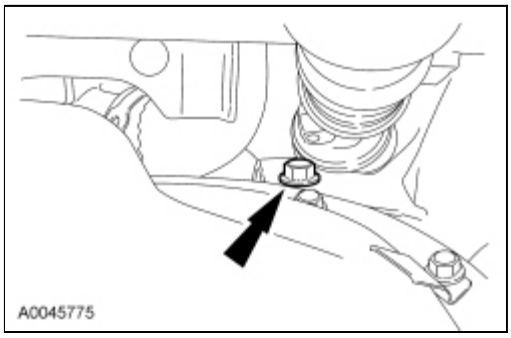
    Remove the 2 RH engine support insulator stud bolts.

12. Position a suitable hydraulic jack under the front axle. Securely strap the jack to the axle.



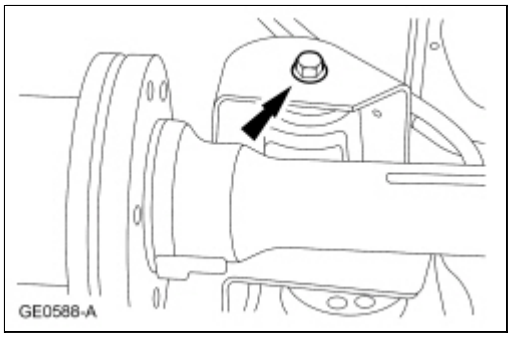
13. **NOTE:** Rotate the steering column so the pinch bolt for the steering column coupling allows clearance for the isolator bolt.

    Remove the upper front axle carrier mounting bushing bolt.

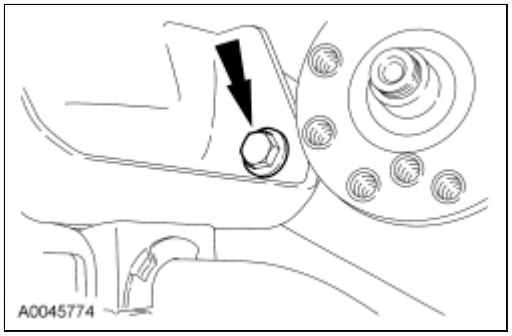


14. Remove the axle shaft housing carrier bushing bolt.

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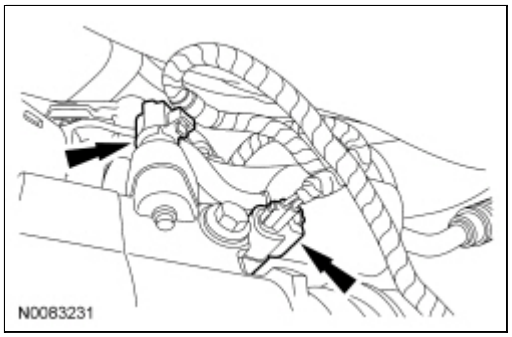
15. Remove the lower front axle carrier mounting bushing bolt.



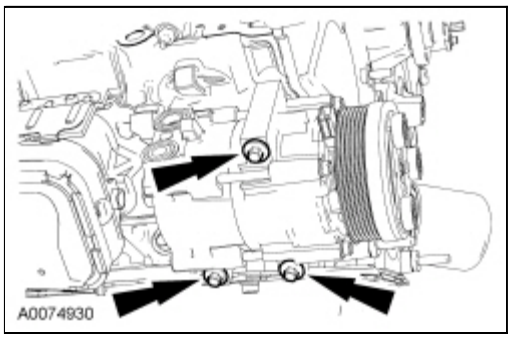
16. ***NOTICE:*** **Use care when lowering the front axle housing or when vacuum lines to the axle solenoid may become disconnected or damaged.**

    Lower the axle to allow clearance to the RH lower front mount bracket bolt.

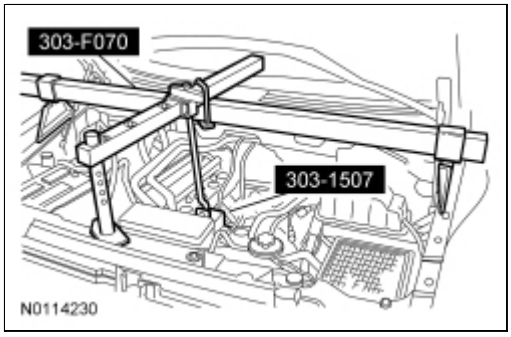
17. Disconnect the A/C compressor electrical connector and the wiring harness retainer.



18. Remove the 3 bolts and position the A/C compressor aside.



19. Using the Engine Support Bar and Engine Support Bracket, raise the engine.



20. Remove the 3 bolts and the RH engine support insulator-to-cylinder block bracket.

21. Remove the RH engine support insulator.

LH engine support insulator

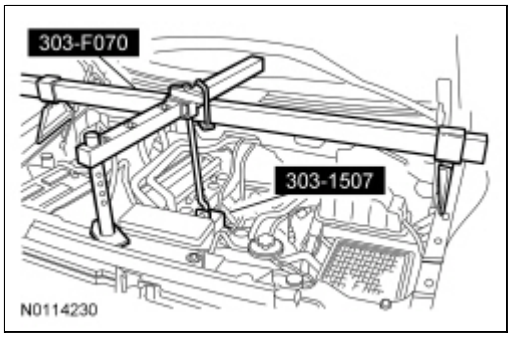
22. ***NOTICE:*** **Only use hand tools when loosening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Loosen the RH engine support insulator through bolt.

23. ***NOTICE:*** **Only use hand tools when removing the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.**

    Remove the LH engine support insulator through bolt.

24. Using the Engine Support Bar and Engine Support Bracket, raise the engine.



25. ***NOTICE:*** **Only use hand tools when removing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.**

    Remove the 3 engine support insulator-to-frame bolts.
    - Discard the 3 bolts.

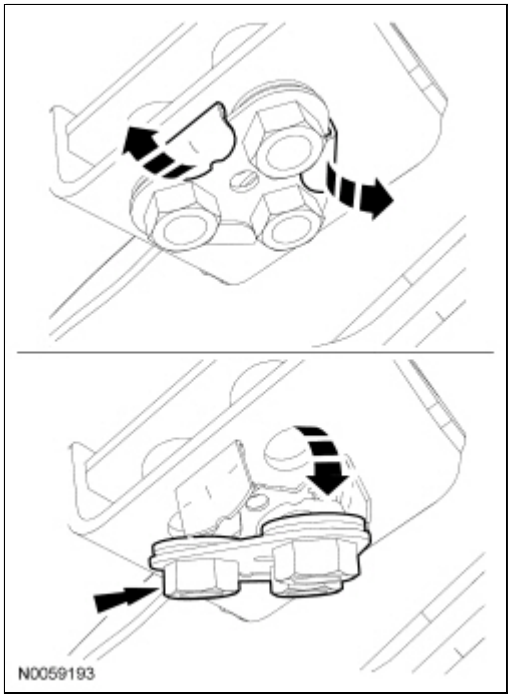
26. Remove the 3 bolts and the LH engine support insulator-to-cylinder block bracket.

27. Remove the LH engine support insulator.

28. Inspect the engine support insulator-to-frame nut plate for thread damage. If the nut plate is damaged, bend 2 tabs back and remove the nut plate. Replace the nut plate with service part number

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56190 and bend the 2 tabs back to the original position.



Installation

RH engine support insulator

1. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

2. ***NOTICE:*** **Only use hand tools when installing the engine support insulator stud bolts or damage to the engine support insulator can occur.**

   Position the RH engine support insulator into the vehicle and install the 2 stud bolts.
   - Tighten to 15 Nm (133 lb-in).

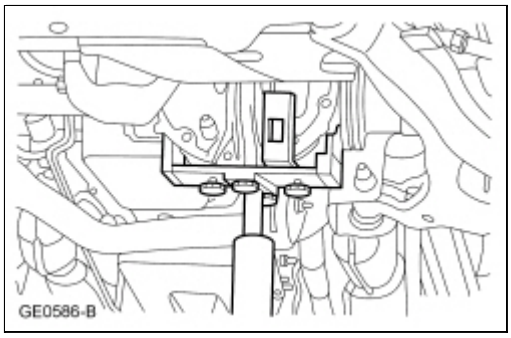
3. Position the RH engine support insulator-to-cylinder block bracket and install the 3 bolts.
   - Tighten to 63 Nm (46 lb-ft).

4. ***NOTICE:*** **Only use hand tools when installing the RH engine support insulator nuts or damage to the engine support insulator can occur.**

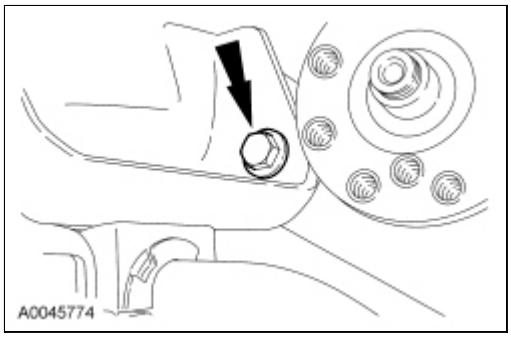
   Install the 2 RH engine support insulator nuts.
   - Tighten to 175 Nm (129 lb-ft).

5. ***NOTICE:*** **Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.**

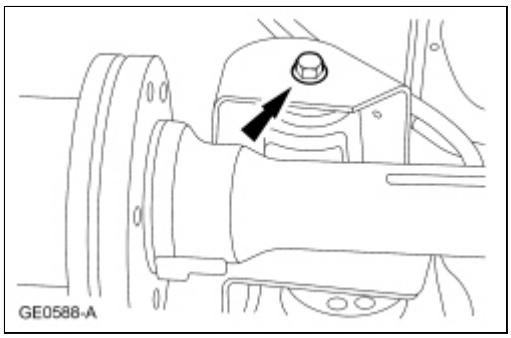
   Raise the front axle carrier into position.



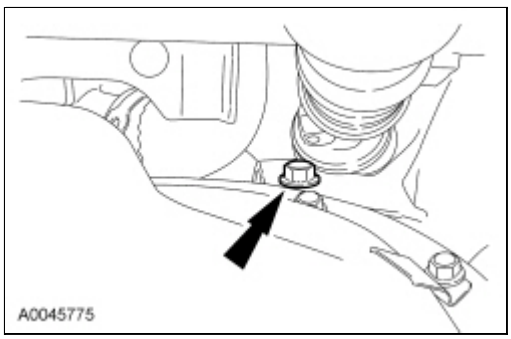
6. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



7. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

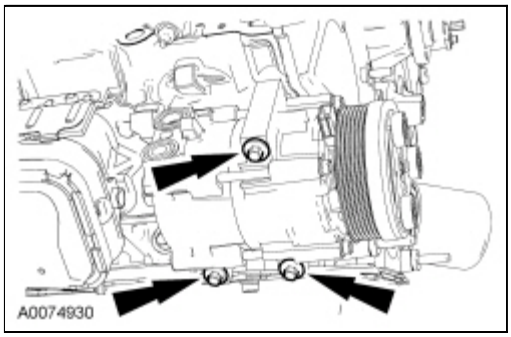


8. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

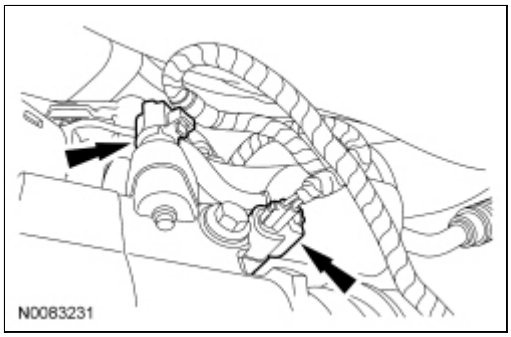


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9. Position the A/C compressor and install the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



10. Connect the A/C compressor electrical connector and the wiring harness retainer.



LH engine support insulator

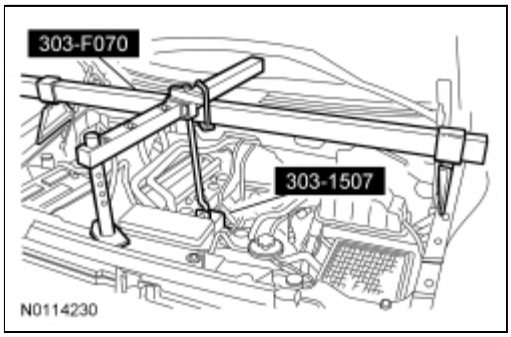
11. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

12. Position the LH engine support insulator and hand start the 3 new engine support insulator-to-frame bolts.
    - Tighten to 175 Nm (129 lb-ft).

13. Position the LH engine support insulator-to-cylinder block bracket and install the 3 bolts.
    - Tighten to 63 Nm (46 lb-ft).

All engine support insulators

14. Using the Engine Support Bar and Engine Support Bracket, lower the engine into position.

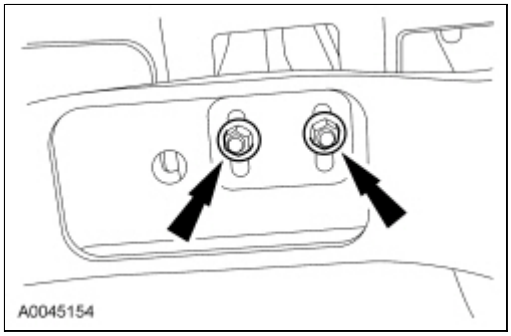


15. ***NOTICE:*** **Only use hand tools when installing the engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.**

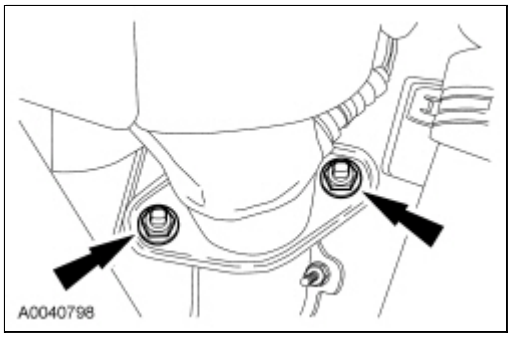
    Install the LH and RH engine support insulator through bolts.
    - Apply threadlock to the bolt threads prior to installation.
    - Tighten to 350 Nm (258 lb-ft).

16. ***NOTICE:*** **Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

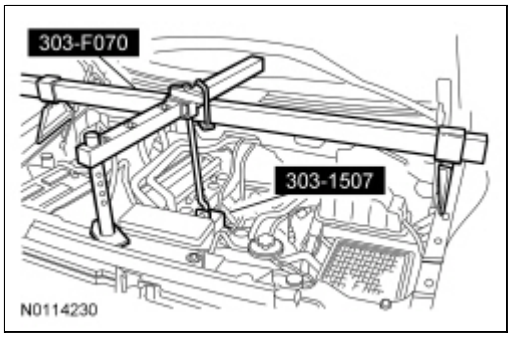
    Install the transmission mount-to-crossmember nuts.
    - Tighten to 103 Nm (76 lb-ft).



17. Position the Y-pipe and install the 4 nuts (2 RH and 2 LH).
    - Tighten to 40 Nm (30 lb-ft).



18. Remove the Engine Support Bar and Engine Support Bracket.



19. Install the starter. For additional information, refer to Section 303-06 .

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20. Install the front driveshaft. For additional information, refer to Section 205-01 .

21. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

Exhaust Manifold — LH

Special Tool(s)

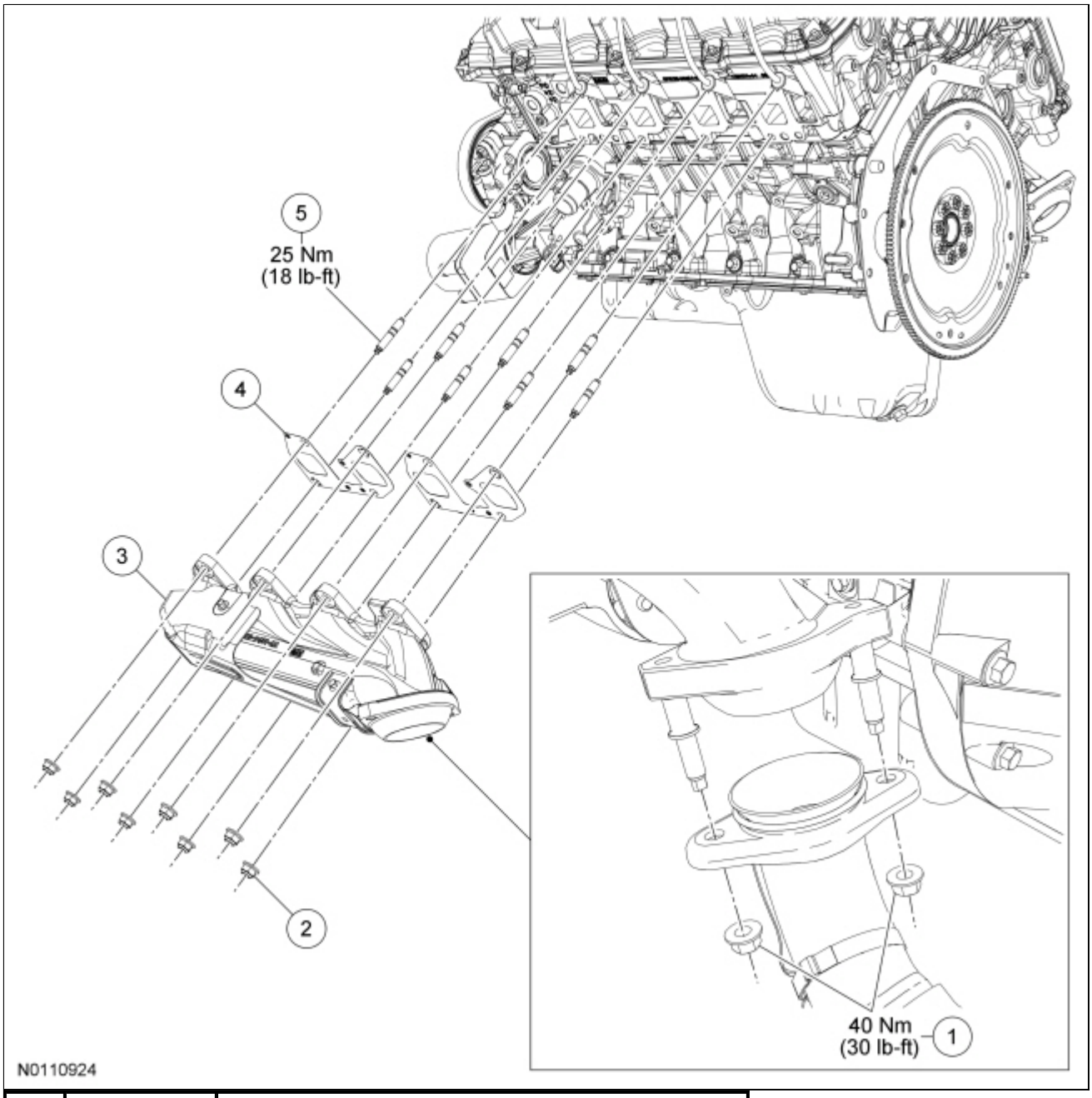
 ST2176-B	Support Bar, Engine 303-F070 or equivalent
 ST3110-A	Support Brackets, Engine 303-1507 or equivalent

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Threadlock 262 TA-26	WSK-M2G351-A6

Exhaust Manifold — LH

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Item	Part Number	Description
1	W705443	Exhaust Y-pipe flange nuts (2 required)
2	W714870	LH exhaust manifold nut (8 required)
3	9431	LH exhaust manifold
4	9448	LH exhaust manifold gasket (2 required)
5	W714869	Exhaust manifold-to-cylinder head stud (8 required)

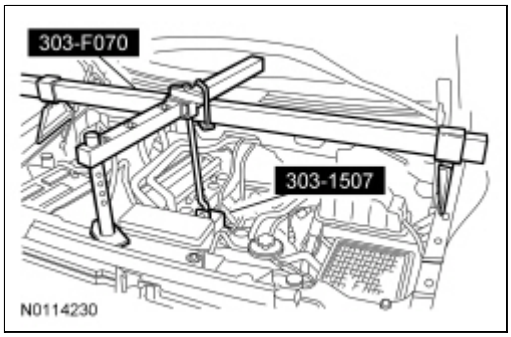
Removal

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

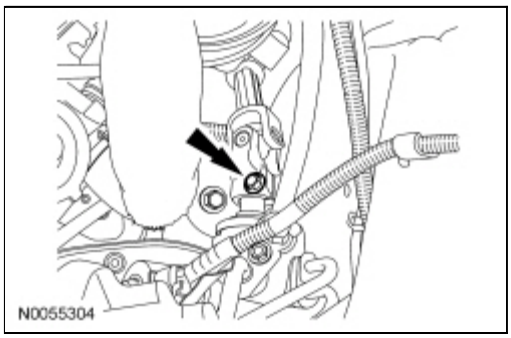
02 .

2. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
3. Remove the LH inner fenderwell. For additional information, refer to Section 501-02 .
4. Install the Engine Support Bar and the Engine Support Bracket.

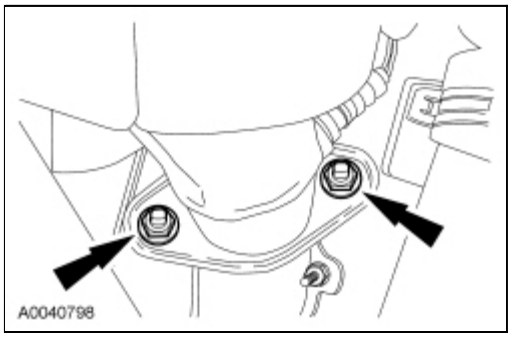


5. ***NOTICE:*** **Do not allow the steering column shaft to rotate while the intermediate shaft is disconnected or damage to the clockspring can result. If there is evidence that the shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and disconnect the steering shaft and position aside.



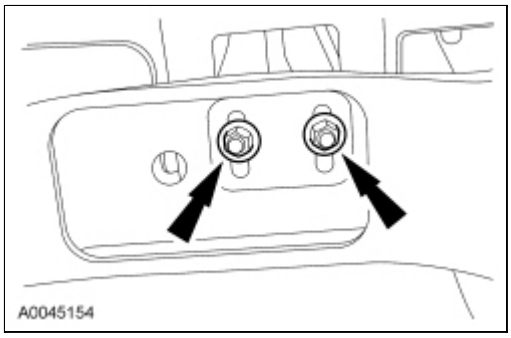
6. Remove the 4 exhaust manifold-to-catalytic converter nuts (2 LH and 2 RH).



7. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

   Loosen the 2 transmission mount-to-crossmember nuts.

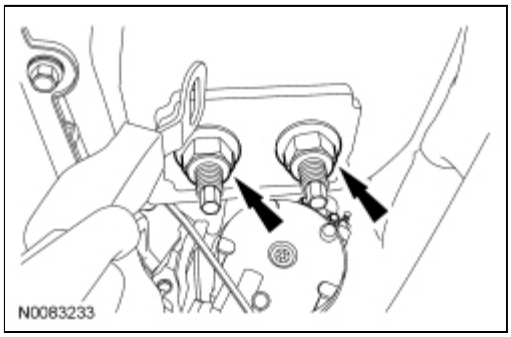
repair4less



8. ***NOTICE:*** **Only use hand tools when removing the engine support insulator nuts or the engine support insulator may be damaged.**

   NOTE: If during nut removal the stud bolt is extracted from the engine support insulator, separate the nut from the stud bolt prior to stud bolt installation.

   Remove the 2 RH engine support insulator nuts.



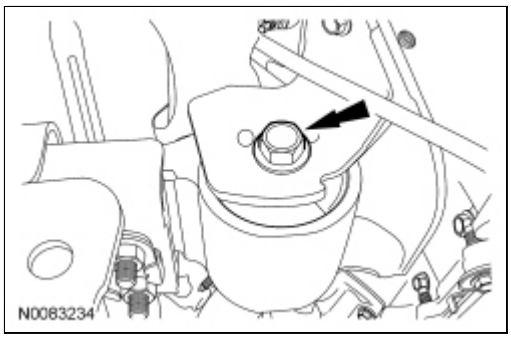
Four-Wheel Drive (4WD) vehicles

9. Remove the front driveshaft. For additional information, refer to Section 205-01 .

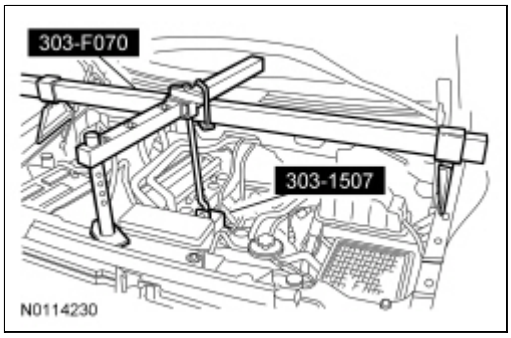
All vehicles

10. ***NOTICE:*** **Only use hand tools when removing the engine support insulator through bolt or the engine support insulator may be damaged.**

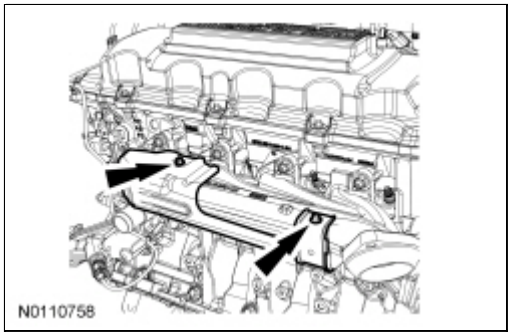
    Remove the LH engine support insulator bolt.



11. Using the Engine Support Bar and Engine Support Bracket, raise the engine.



12. Remove the 2 bolts and the exhaust shield.



13. Remove the 8 exhaust manifold nuts, the 8 studs, the exhaust manifold and the 2 exhaust manifold gaskets.
    - Discard the exhaust manifold nuts, studs and gaskets.

14. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

    NOTE: Clean the sealing surfaces with metal surface prep. Follow the directions on the packaging.

    Remove and discard the 2 exhaust manifold gaskets. Clean the sealing surfaces with metal surface prep.

15. Inspect the exhaust manifold. For additional information, refer to Section 303-00 .

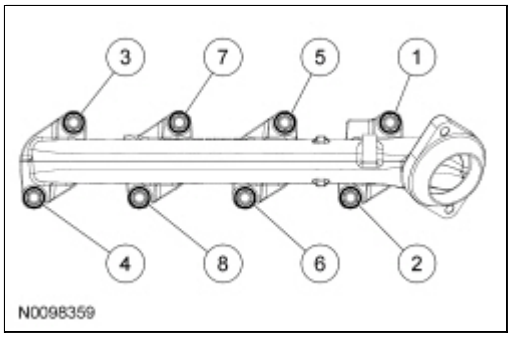
Installation

All vehicles

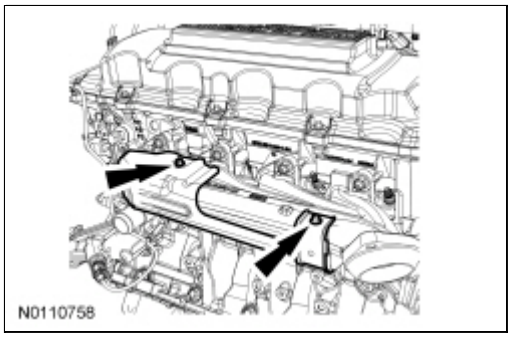
1. Using 2 new exhaust manifold gaskets and 8 new studs, position the 2 gaskets and exhaust manifold and install the 8 studs.
    - Tighten to 25 Nm (18 lb-ft).

2. Using new exhaust manifold nuts, install the 8 nuts in 2 stages in the sequence shown.
    - Stage 1: Tighten to 25 Nm (18 lb-ft).
    - Stage 2: Tighten to 32 Nm (24 lb-ft).

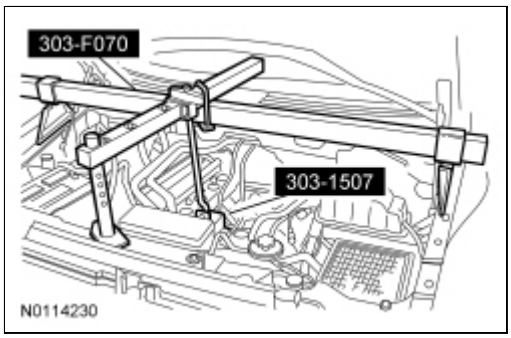
repair4less



3. Position the exhaust manifold heat shield and install the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).

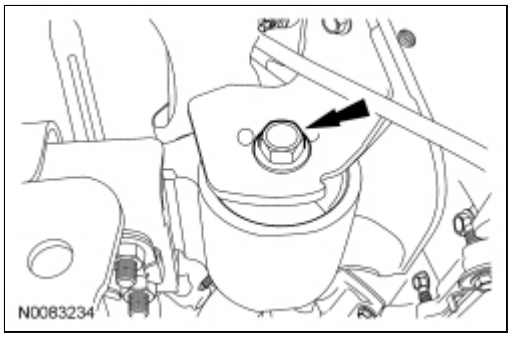


4. Using the Engine Support Bar and Engine Support Bracket, lower the engine.



5. ***NOTICE:*** **Only use hand tools when tightening the engine support insulator through bolt or the engine support insulator may be damaged.**

   Apply threadlock to the bolt threads and install the LH engine support insulator bolt.
    - Tighten to 350 Nm (258 lb-ft).



Four-Wheel Drive (4WD) vehicles

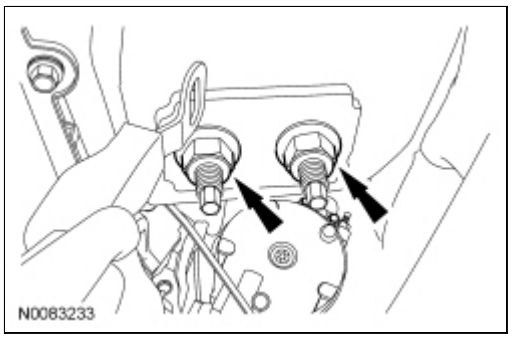
6. Install the front driveshaft. For additional information, refer to Section 205-01 .

All vehicles

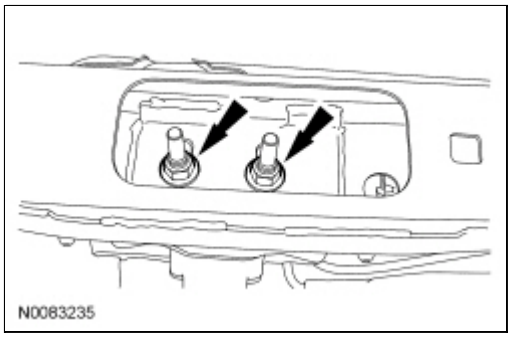
7. ***NOTICE:*** **Only use hand tools when tightening the engine support insulator nuts or the engine support insulator may be damaged.**

   NOTE: Make sure the RH engine support insulator mating surfaces and the washer mating surface are free of foreign material and corrosion before installation. Install a new washer.

   Apply threadlock to the stud threads and install the RH engine support insulator washer and nuts.
   - Tighten to 175 Nm (129 lb-ft).

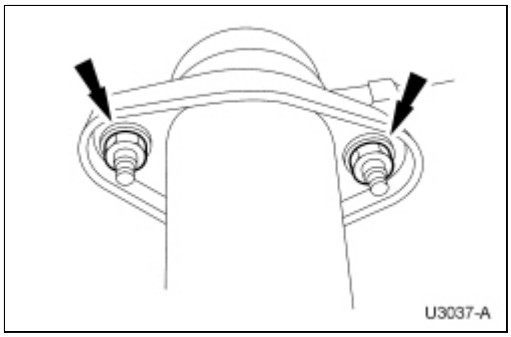


8. Tighten the 2 transmission mount nuts.
   - Tighten to 103 Nm (76 lb-ft).



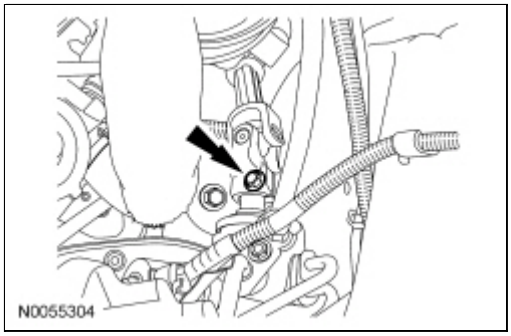
9. Install the 4 exhaust Y-pipe flange nuts (2 RH and 2 LH).
   - Tighten to 40 Nm (30 lb-ft).

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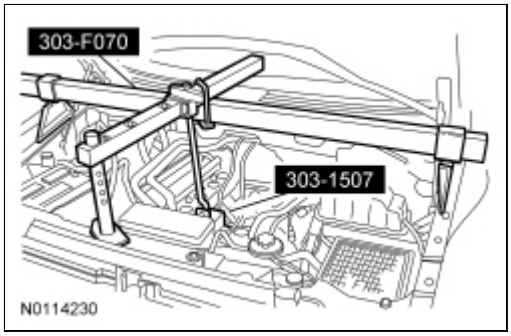
10. ***NOTICE:*** **Do not allow the steering column shaft to rotate while the intermediate shaft is disconnected or damage to the clockspring can result. If there is evidence that the shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    Connect the steering shaft and install the bolt.
    - To install, tighten to 30 Nm (22 lb-ft).



11. Install the LH inner fenderwell. For additional information, refer to Section 501-02 .

12. Remove the Engine Support Bar and Engine Support Bracket.



13. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

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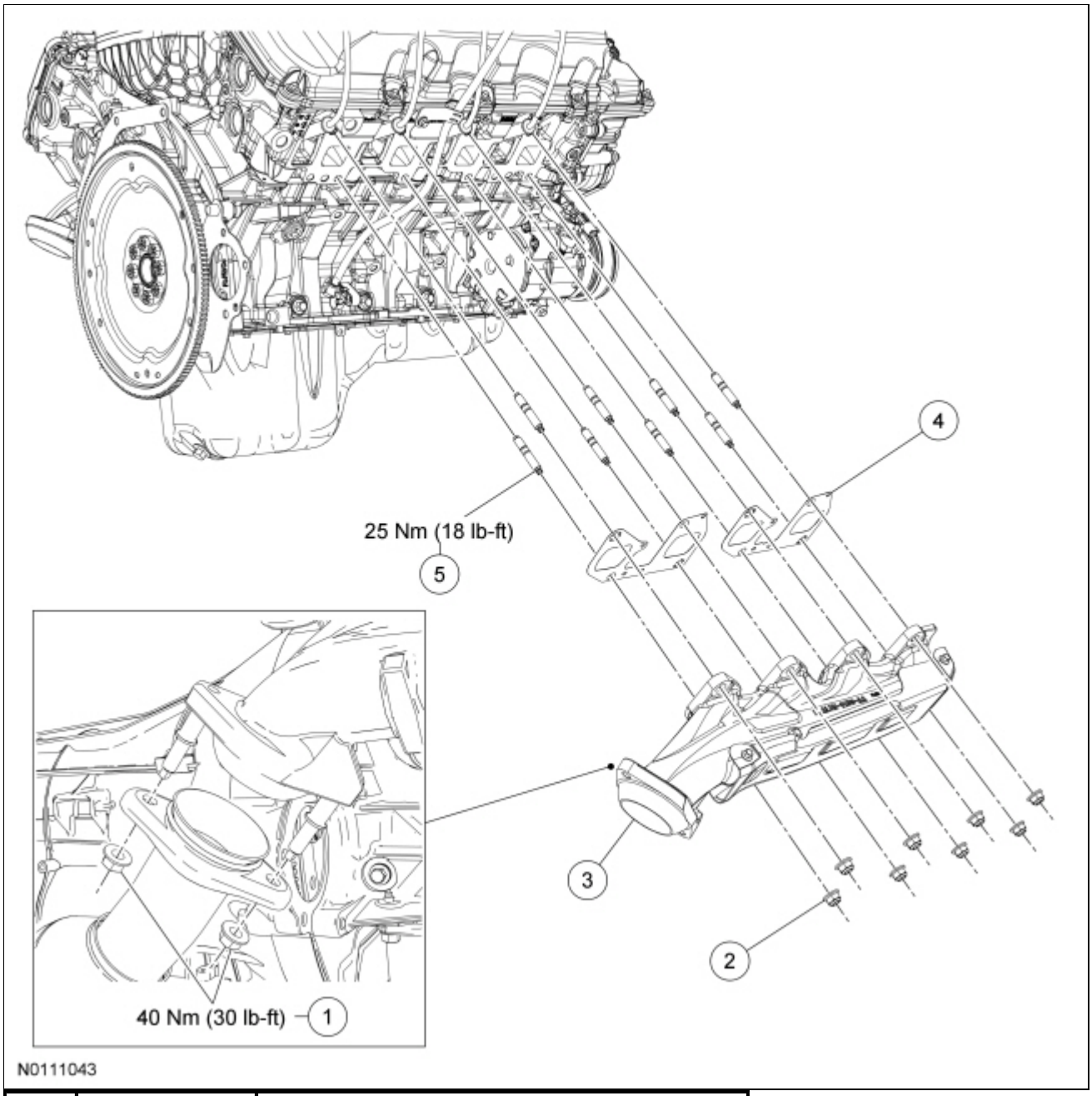
Exhaust Manifold — RH

Special Tool(s)

 ST2176-B	Support Bar, Engine 303-F070 or equivalent
 ST3110-A	Support Brackets, Engine 303-1507 or equivalent

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Threadlock 262 TA-26	WSK-M2G351-A6



Item	Part Number	Description
1	W705443	Exhaust Y-pipe flange nuts (2 required)
2	W701706	Exhaust manifold nut (8 required)
3	9430	Exhaust manifold
4	9Y431	Exhaust manifold gasket (2 required)
5	W707747	Exhaust manifold stud (8 required)

Removal

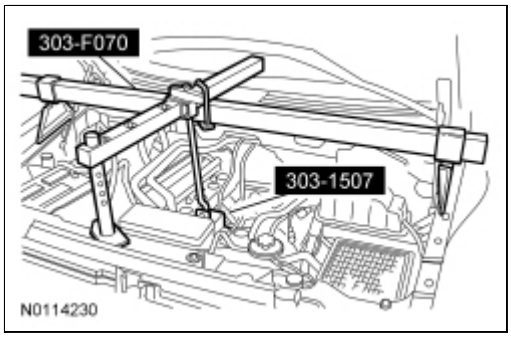
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

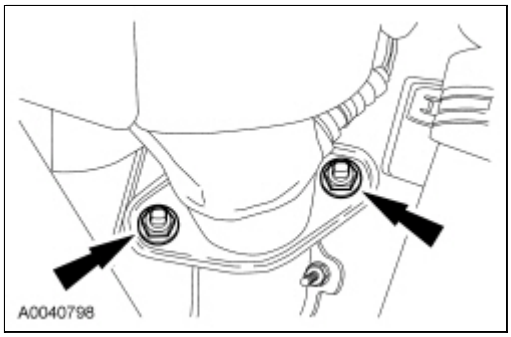
repair4less

02 .

2. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
3. Remove the RH inner fenderwell. For additional information, refer to Section 501-02 .
4. Install the Engine Support Bar and the Engine Support Bracket.

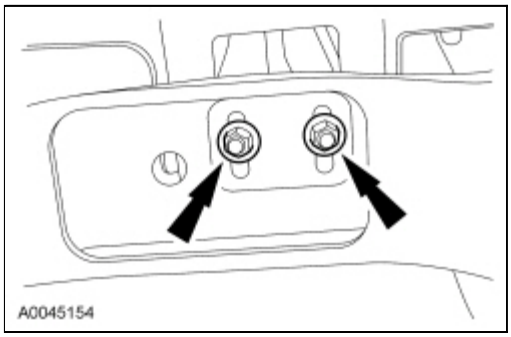


5. Remove the starter. For additional information, refer to Section 303-06 .
6. Remove the 4 exhaust manifold-to-catalytic converter nuts (2 LH and 2 RH).



7. ***NOTICE:*** **Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.**

   Loosen the 2 transmission mount-to-crossmember nuts.

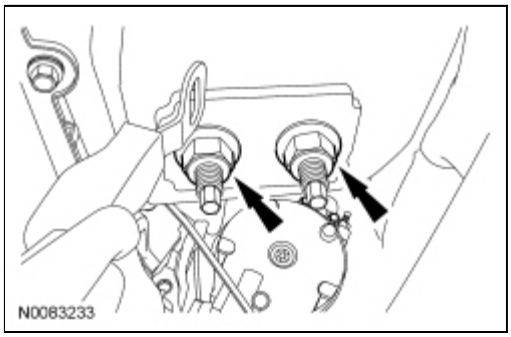


8. ***NOTICE:*** **Only use hand tools when removing the engine support insulator nuts or the engine support insulator may be damaged.**

   NOTE: If during nut removal the stud bolt is extracted from the engine support insulator, separate the

nut from the stud bolt prior to stud bolt installation.

Remove the 2 RH engine support insulator nuts.



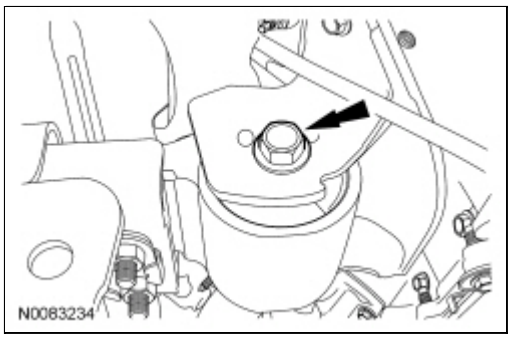
Four-Wheel Drive (4WD) vehicles

9. Remove the front drive shaft. For additional information, refer to Section 205-01 .

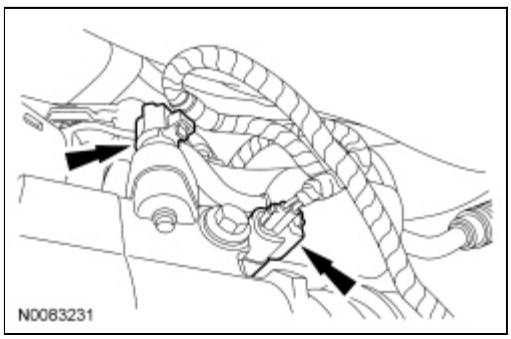
All vehicles

10. ***NOTICE:*** **Only use hand tools when removing the engine support insulator through bolt or the engine support insulator may be damaged.**

    Remove the LH engine support insulator bolt.

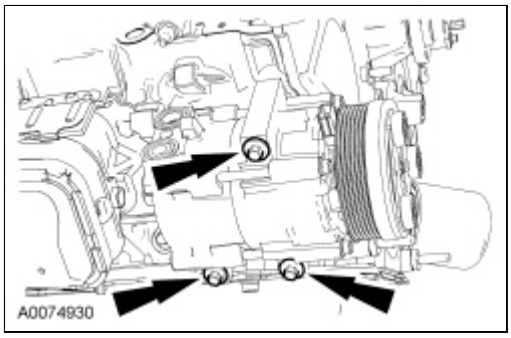


11. Disconnect the A/C compressor electrical connector and the wiring harness retainer.

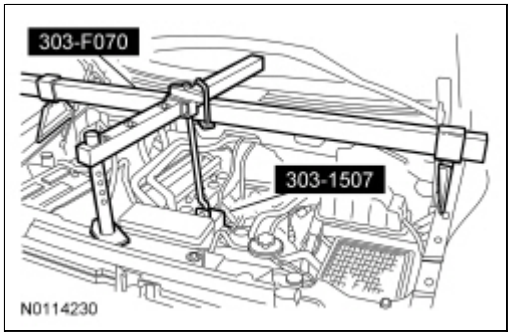


12. Remove the 3 bolts and position the A/C compressor aside.

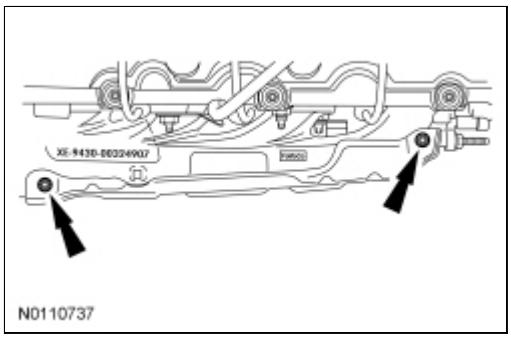
repair4less



13. Using the Engine Support Bar and Engine Support Bracket, raise the engine.



14. Remove the 2 bolts and the exhaust shield.



15. Remove the 8 exhaust manifold nuts, the 8 studs, the exhaust manifold and the 2 exhaust manifold gaskets.
    - Discard the exhaust manifold nuts, studs and gaskets.

16. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

    NOTE: Clean the sealing surfaces with metal surface prep. Follow the directions on the packaging.

    Remove and discard the 2 exhaust manifold gaskets. Clean the sealing surfaces with metal surface prep.

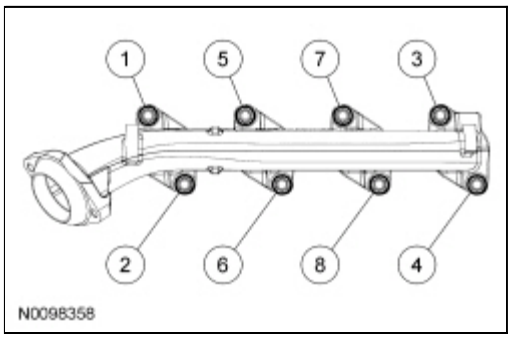
17. Inspect the exhaust manifold. For additional information, refer to Section 303-00 .

Installation

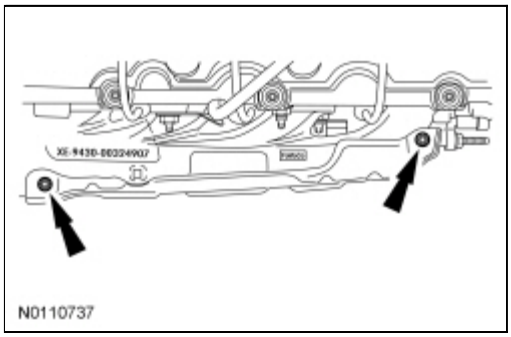
All vehicles

1. Using 2 new exhaust manifold gaskets and 8 new studs, position the 2 gaskets and exhaust manifold and install the 8 studs.
    - Tighten to 25 Nm (18 lb-ft).

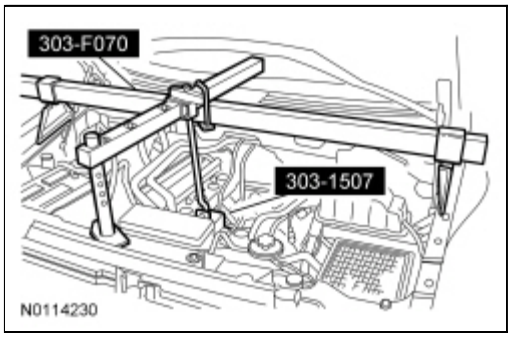
2. Using new exhaust manifold nuts, install the 8 nuts in 2 stages in the sequence shown.
    - Stage 1: Tighten to 25 Nm (18 lb-ft).
    - Stage 2: Tighten to 32 Nm (24 lb-ft).



3. Position the exhaust manifold heat shield and install the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).



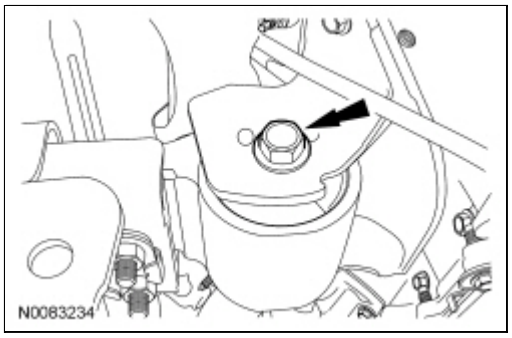
4. Using the Engine Support Bar and Engine Support Bracket, lower the engine.



5. ***NOTICE:*** **Only use hand tools when tightening the engine support insulator through bolt or the engine support insulator may be damaged.**

   Apply threadlock to the bolt threads and install the LH engine support insulator bolt.
    - Tighten to 350 Nm (258 lb-ft).

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Four-Wheel Drive (4WD) vehicles

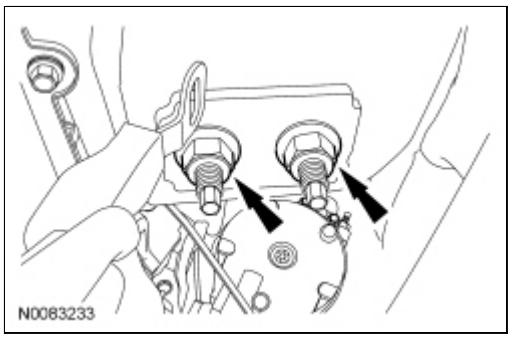
6. Install the front drive shaft. For additional information, refer to Section 205-01 .

All vehicles

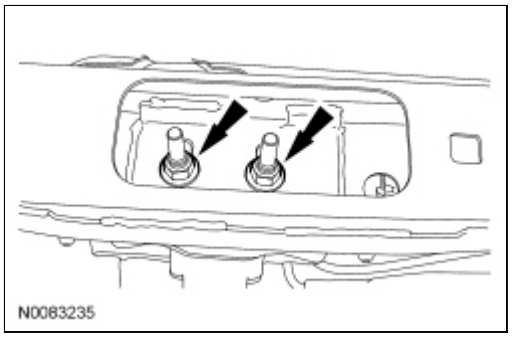
7. ***NOTICE:*** **Only use hand tools when tightening the engine support insulator nuts or the engine support insulator may be damaged.**

   NOTE: Make sure the RH engine support insulator mating surfaces and the washer mating surface are free of foreign material and corrosion before installation. Install a new washer.

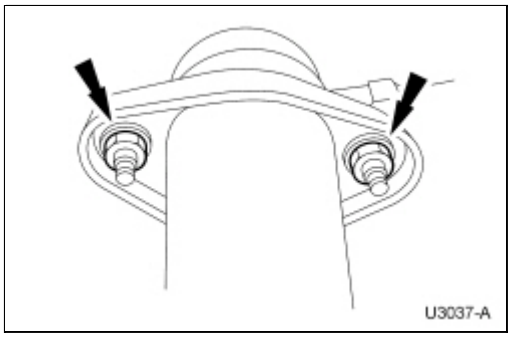
   Apply threadlock to the stud threads and install the RH engine support insulator washer and nuts.
   - Tighten to 175 Nm (129 lb-ft).



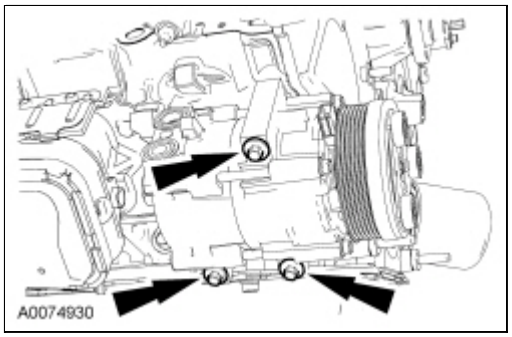
8. Tighten the 2 transmission mount nuts.
   - Tighten to 103 Nm (76 lb-ft).



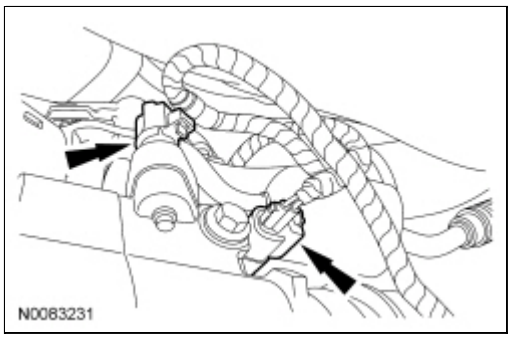
9. Install the 4 exhaust Y-pipe flange nuts (2 RH and 2 LH).
   - Tighten to 40 Nm (30 lb-ft).



10. Position the A/C compressor and install the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

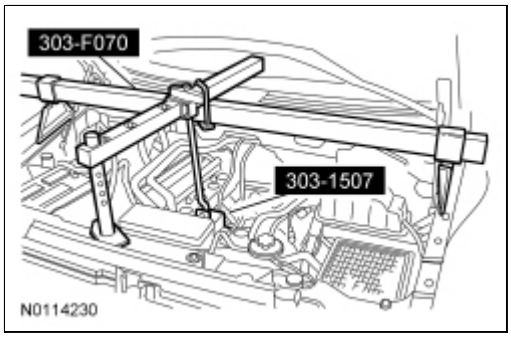


11. Connect the A/C compressor electrical connector and the wiring harness retainer.



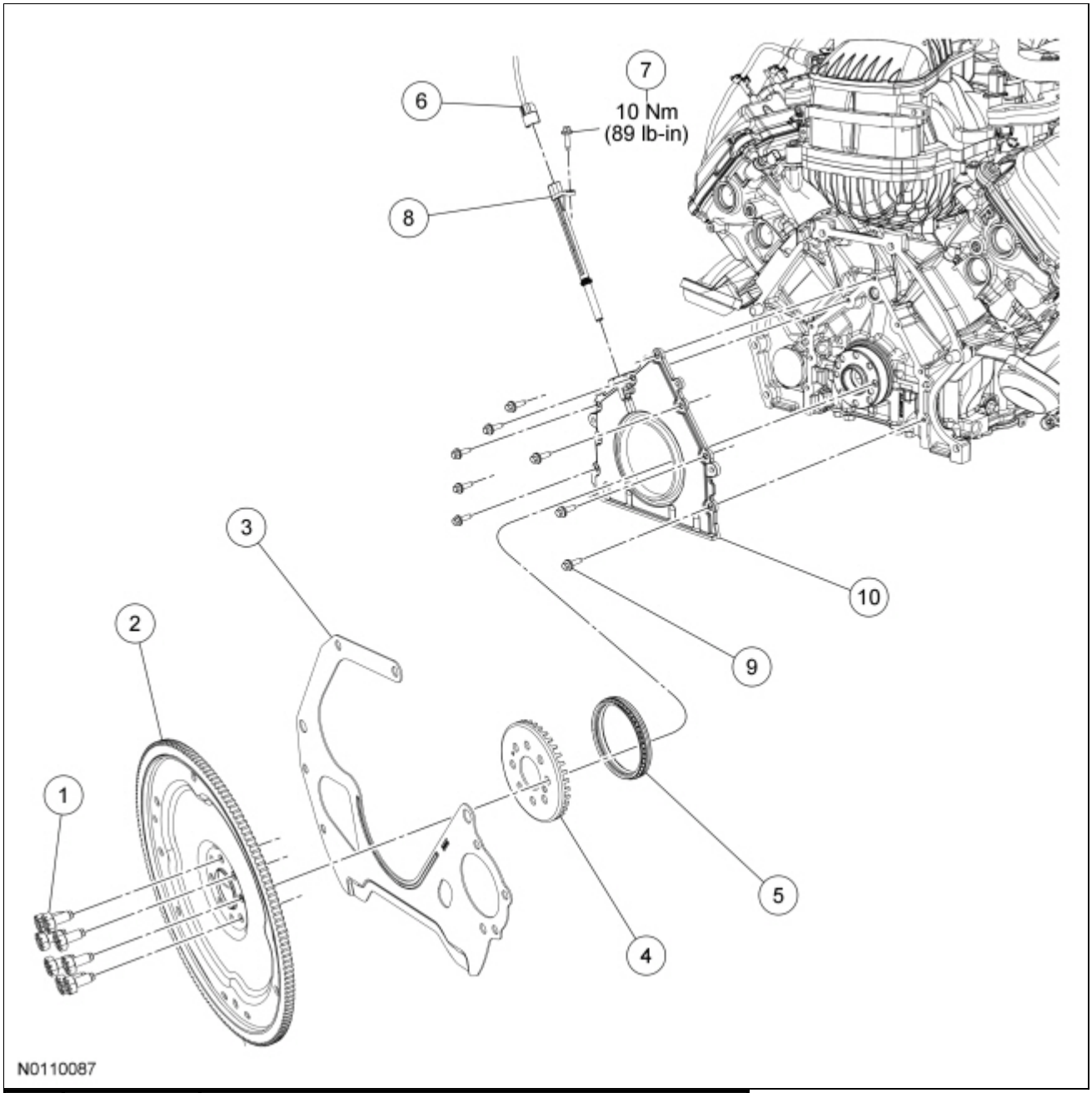
12. Install the starter. For additional information, refer to Section 303-06 .
13. Install the RH inner fenderwell. For additional information, refer to Section 501-02 .
14. Remove the Engine Support Bar and Engine Support Bracket.

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15. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View



Item	Part Number	Description
1	6379	Flexplate bolt (8 required)
2	6375	Flexplate
3	6A373	Rear cover plate
4	12A227	Ignition pulse ring

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5	6701	Crankshaft rear seal
6	—	Crankshaft Position (CKP) sensor electrical connector (part of 12C508)
7	W503276	CKP sensor bolt
8	6C315	CKP sensor
9	W503276	Crankshaft rear seal retainer plate bolt (6 required)
10	6K318	Crankshaft rear seal retainer plate

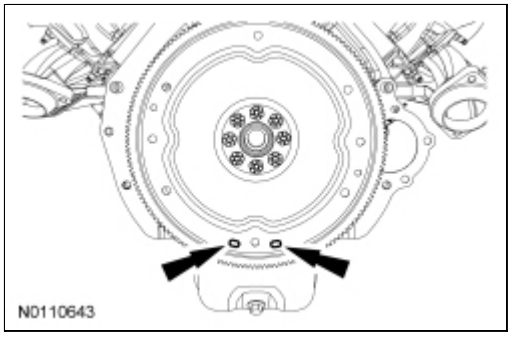
1. For additional information, refer to the procedures in this section.

Flexplate

Removal and Installation

1. Remove the transmission. For additional information, refer to Section 307-01 .

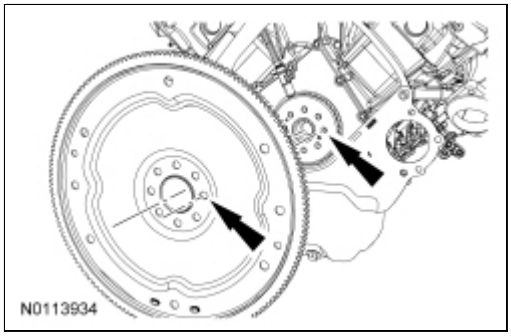
2. Rotate the engine clockwise until the 2 slotted holes on the flexplate are at the 6 o'clock position as shown.



3. Remove the 8 bolts and the flexplate.
   - Discard the 8 flexplate bolts.

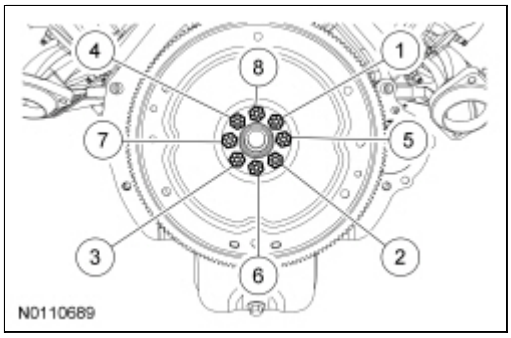
Installation

1. With the offset hole on the crankshaft ignition pulse ring aligned with the offset hole on the flexplate, position the flexplate and install 8 new bolts finger-tight.

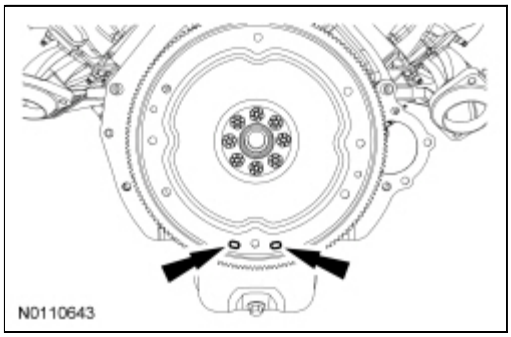


2. Tighten the 8 new bolts in 6 stages.
   - Stage 1: Tighten fasteners 1 through 4 in sequence to 20 Nm (177 lb-in).
   - Stage 2: Tighten fasteners 1 through 4 in sequence to 35 Nm (26 lb-ft).
   - Stage 3: Tighten fasteners 1 through 4 sequence an additional 60 degrees.
   - Stage 4: Tighten fasteners 5 through 8 in sequence to 20 Nm (177 lb-in).
   - Stage 5: Tighten fasteners 5 through 8 in sequence to 35 Nm (26 lb-ft).
   - Stage 6: Tighten fasteners 5 through 8 in sequence an additional 60 degrees.

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3. Verify that the 2 flexplate slotted holes are at the 6 o'clock position as shown prior to transmission installation.



4. Install the transmission. For additional information, refer to Section 307-01 .

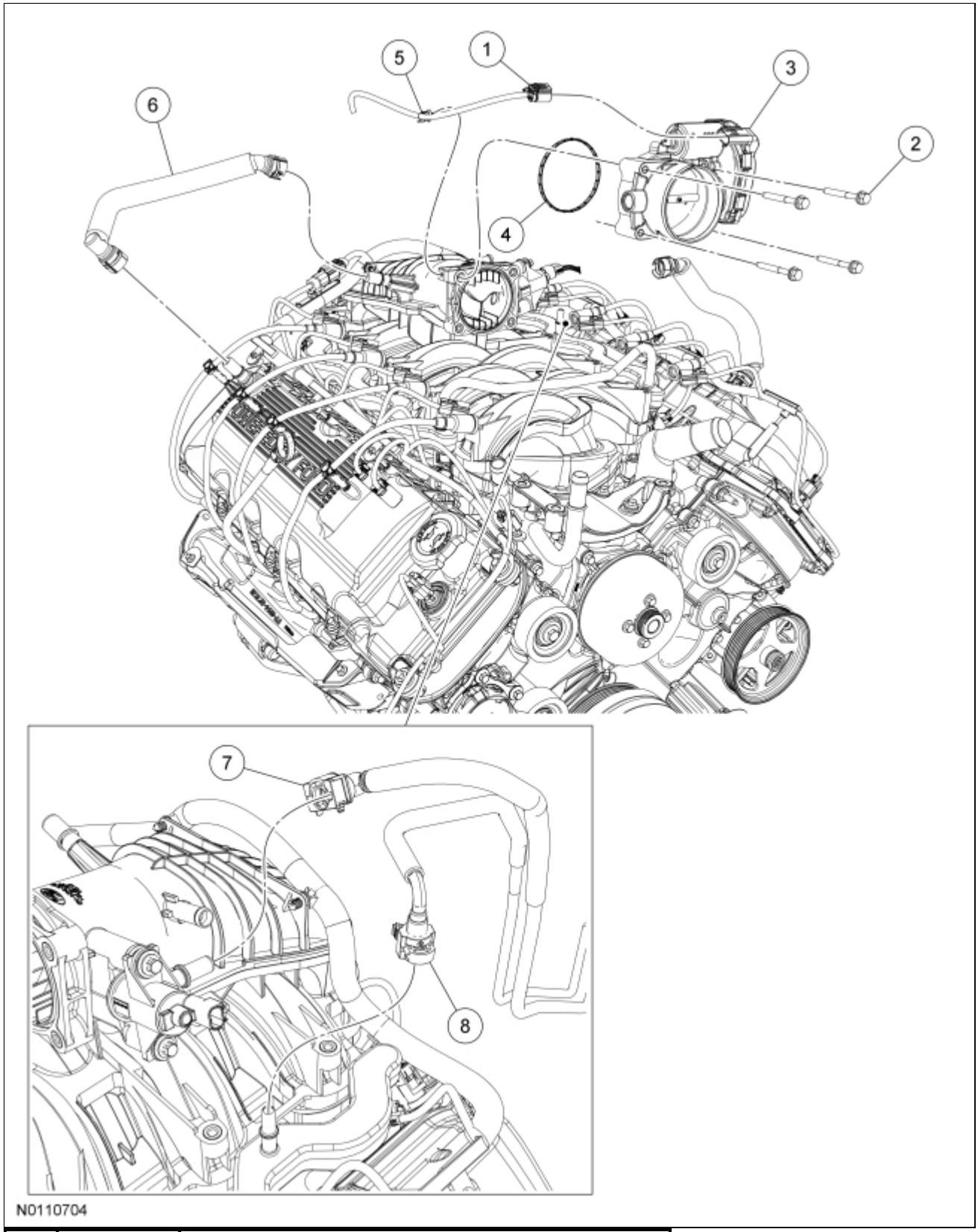
Intake Manifold

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—

Evaporative Emission (EVAP) Tube Quick Connect Fitting, Fuel Supply Tube Quick Connect Fitting, Throttle Body (TB), PCV Tube and Electrical Connectors

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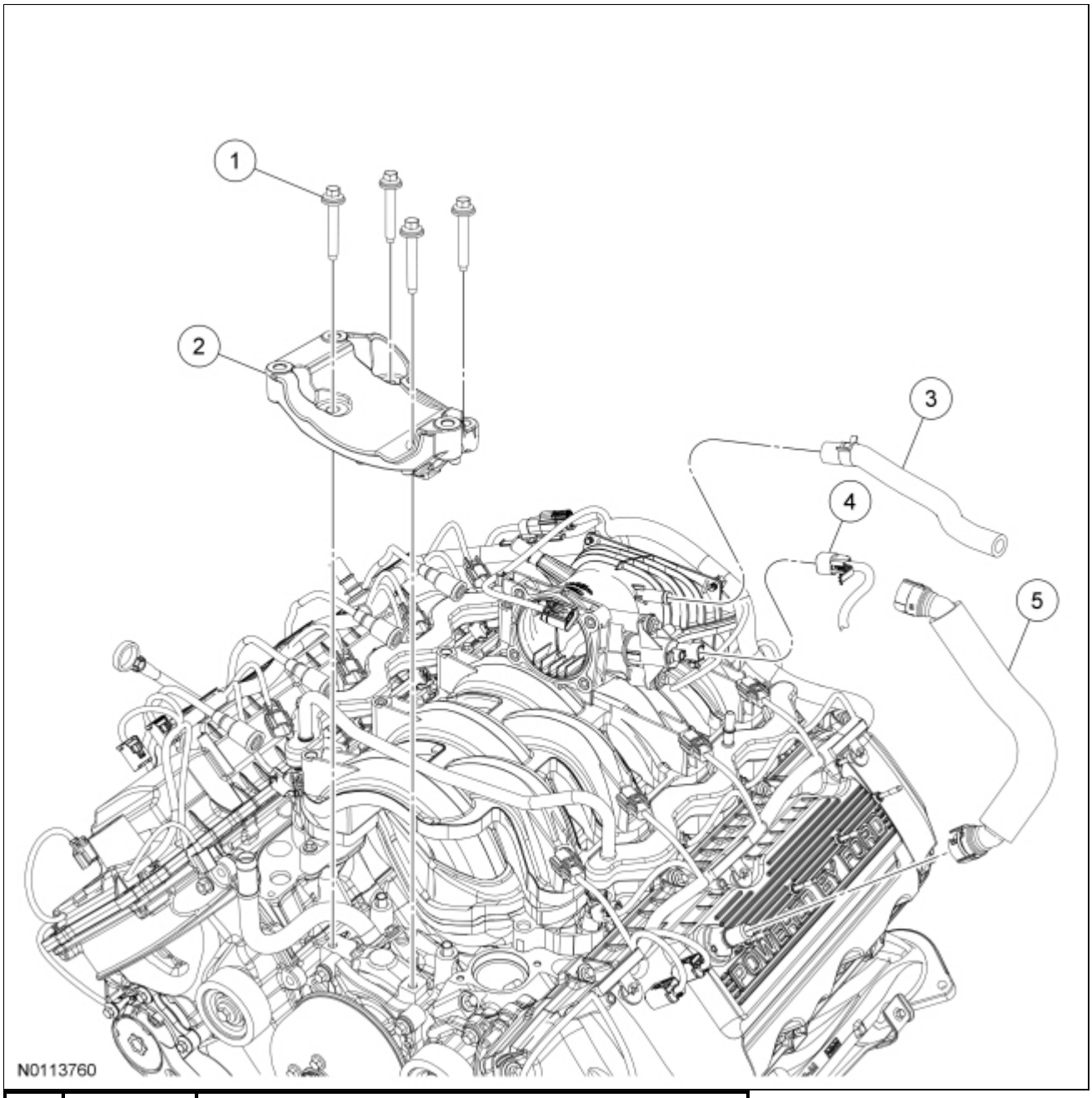
N0110704

Item	Part Number	Description
1	—	Electronic Throttle Control (ETC) electrical connector

		(part of 12C508)
2	W709168	TB bolt (4 required)
3	9F991	TB
4	9E936	TB O-ring seal
5	—	ETC wiring harness retainer (part of 12C508)
6	6A664	PCV tube
7	—	Evaporative Emission (EVAP) tube quick connect coupling
8	—	Fuel supply tube quick connect coupling

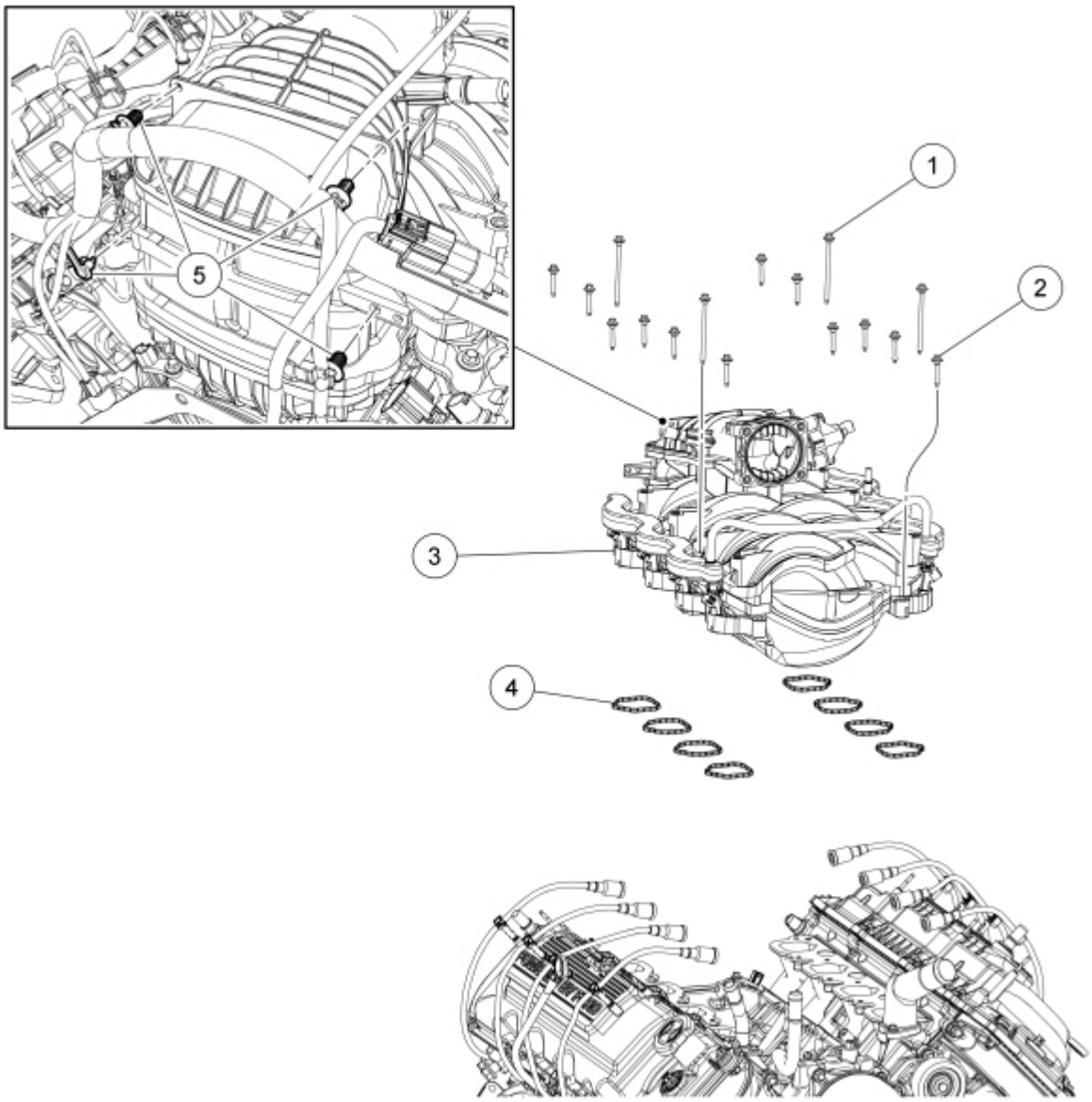
Crankcase Ventilation Tube and Generator Support Bracket

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Item	Part Number	Description
1	W503300	Generator support bracket bolt (4 required)
2	10239	Generator support bracket
3	—	Brake booster vacuum hose
4	—	Evaporative Emission (EVAP) purge valve electrical connector (part of 12C508)
5	6758	Crankcase ventilation tube

Wiring Harness Retainers, Intake Manifold and Gaskets



Item	Part Number	Description
1	W714633	Fuel rail bolt (4 required)
2	9Y450	Intake manifold bolt (12 required)
3	9424	Intake manifold
4	9439	Intake manifold gasket (8 required)
5	—	Engine wiring harness retainers (part of 12C508) (4 required)

Removal

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WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. Release the fuel pressure. For additional information, refer to Section 310-00 .
2. Drain the cooling system. For additional information, refer to Section 303-03 .
3. Remove the generator. For additional information, refer to Section 414-00 .
4. Remove the 2 bolts, position aside the thermostat housing.
   - Discard the O-ring seal.
5. Remove the 8 ignition coils. For additional information, refer to Section 303-07D .
6. Remove the 4 bolts and the generator support bracket.
7. Disconnect the fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .
8. Disconnect the Electronic Throttle Control (ETC) electrical connector and wiring harness retainer.
9. Remove the 4 bolts and the Throttle Body (TB).
   - Inspect the TB O-ring seal and install a new O-ring seal if necessary.
10. Disengage the clamp and disconnect the brake booster vacuum hose from the intake manifold.
11. Disconnect the Evaporative Emission (EVAP) tube quick connect coupling from the EVAP canister purge valve. For additional information, refer to Section 310-00 .
12. Disconnect the EVAP canister purge valve electrical connector and detach wiring harness retainer.
13. Disconnect the quick connect couplings and remove the PCV tube. For additional information, refer to Section 310-00 .
14. Disconnect the 8 fuel injector electrical connectors.
15. **NOTE:** The fuel rail is removed with the intake manifold as an assembly.

    Remove the 4 fuel rail bolts.
16. Disconnect the 4 wiring harness retainers from the rear of the intake manifold.
17. Loosen the 12 intake manifold bolts.
18. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make**

leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove the intake manifold.

- Clean and inspect the cylinder head sealing surfaces with metal surface prep. Follow the directions on the packaging.
- Inspect the 8 intake manifold gaskets for damage and install new gaskets if necessary.

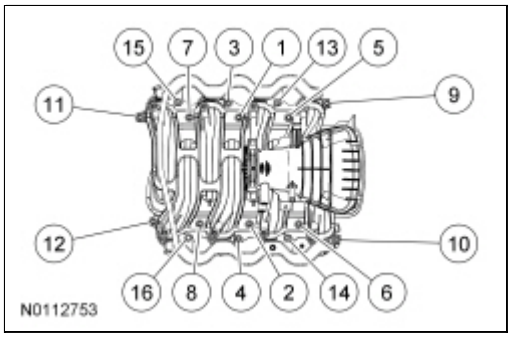
Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Position the intake manifold onto the engine.

2. Loosely install the 4 fuel rail bolts.

3. Tighten the 12 intake manifold bolts and install the 4 fuel rail bolts in 4 stages in the sequence shown.
   - Stage 1: Tighten the 12 intake manifold bolts to 10 Nm (89 lb-in).
   - Stage 2: Tighten the 12 intake manifold bolts an additional 45 degrees.
   - Stage 3: Tighten the 4 fuel rail bolts to 10 Nm (89 lb-in).
   - Stage 4: Tighten the 4 fuel rail bolts an additional 90 degrees.



4. Connect the 4 wiring harness retainers to the rear of the intake manifold.

5. Connect the 8 fuel injector electrical connectors.

6. Position the PCV tube and connect the quick connect couplings. For additional information, refer to Section 310-00 .

7. Attach wiring harness retainer, connect the electrical connector and the EVAP tube quick connect coupling to the EVAP canister purge valve. For additional information, refer to Section 310-00 .

8. Position the TB and tighten the 4 bolts in 2 stages.
   - Stage 1: Tighten to 12 Nm (106 lb-in).
   - Stage 2: Tighten an additional 60 degrees.

9. Connect the ETC electrical connector and wiring harness retainer.

10. Connect the brake booster vacuum hose to the intake manifold and install the clamp.

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11. Connect the fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .

12. Position the generator support bracket and install the 4 bolts.
    - Stage 1: Tighten to 20 Nm.
    - Stage 2: Tighten an addition 45 degrees.

13. Install the 8 ignition coils. For additional information, refer to Section 303-07D .

14. Position back thermostat housing.
    - Install a new O-ring seal.
    - To install, tighten to 10 Nm (89 lb-in).

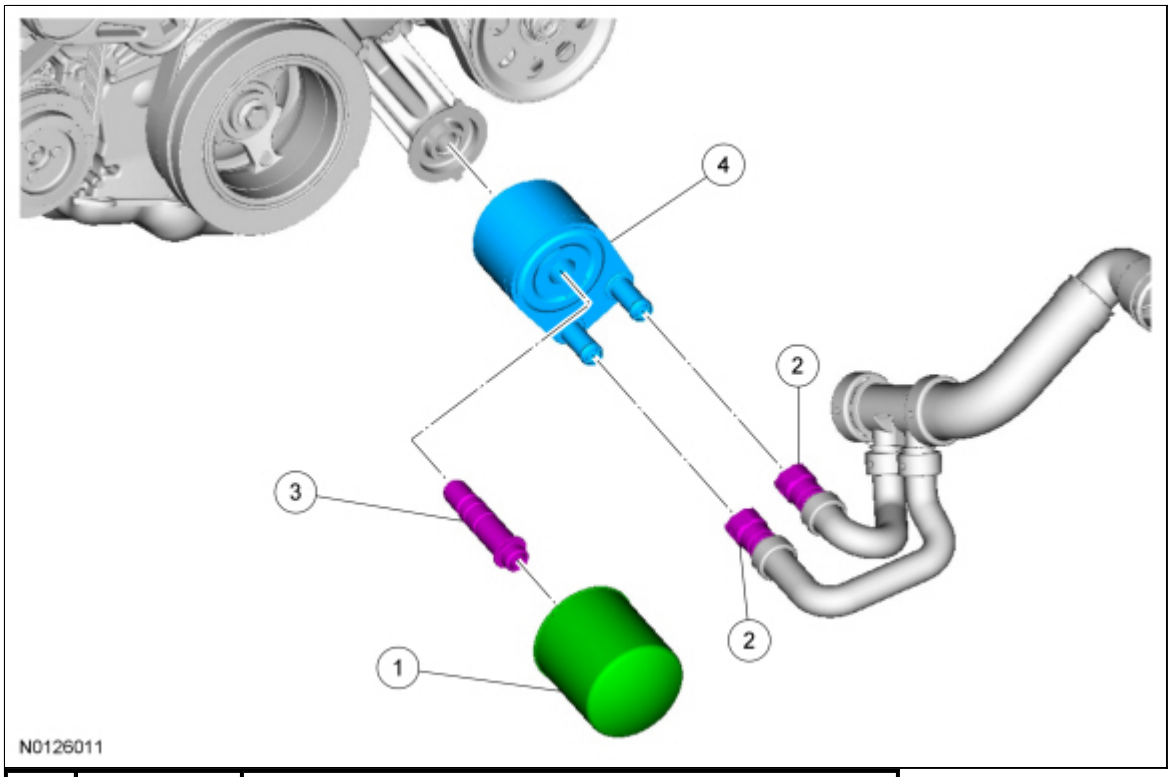
15. Install the generator. For additional information, refer to Section 414-00 .

16. Fill and bleed the cooling system. For additional information, refer to Section 303-03 .

Oil Cooler

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	6714	Oil filter
2	—	Oil cooler coolant hose quick connect couplings (part of 8B273)
3	6L626	Oil cooler threaded shaft
4	6A642	Oil cooler

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

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02 .

2. Drain the engine cooling system. For additional information, refer to Section 303-03 .

3. Remove and discard the oil filter.

4. Disconnect the oil cooler coolant hose quick connect couplings and position aside. For additional information, refer to Section 310-00 .

5. ***NOTICE:*** **If metal foreign material is present in the oil cooler, mechanical concerns exist. To diagnose mechanical concerns, refer to Section 303-00 .**

   Remove the threaded shaft and the oil cooler. Inspect the engine oil cooler.

Installation

1. Position the oil cooler and install the threaded shaft.
   - Tighten to 58 Nm (43 lb-ft).

2. Connect the oil cooler coolant hose quick connect couplings. For additional information, refer to Section 310-00 .

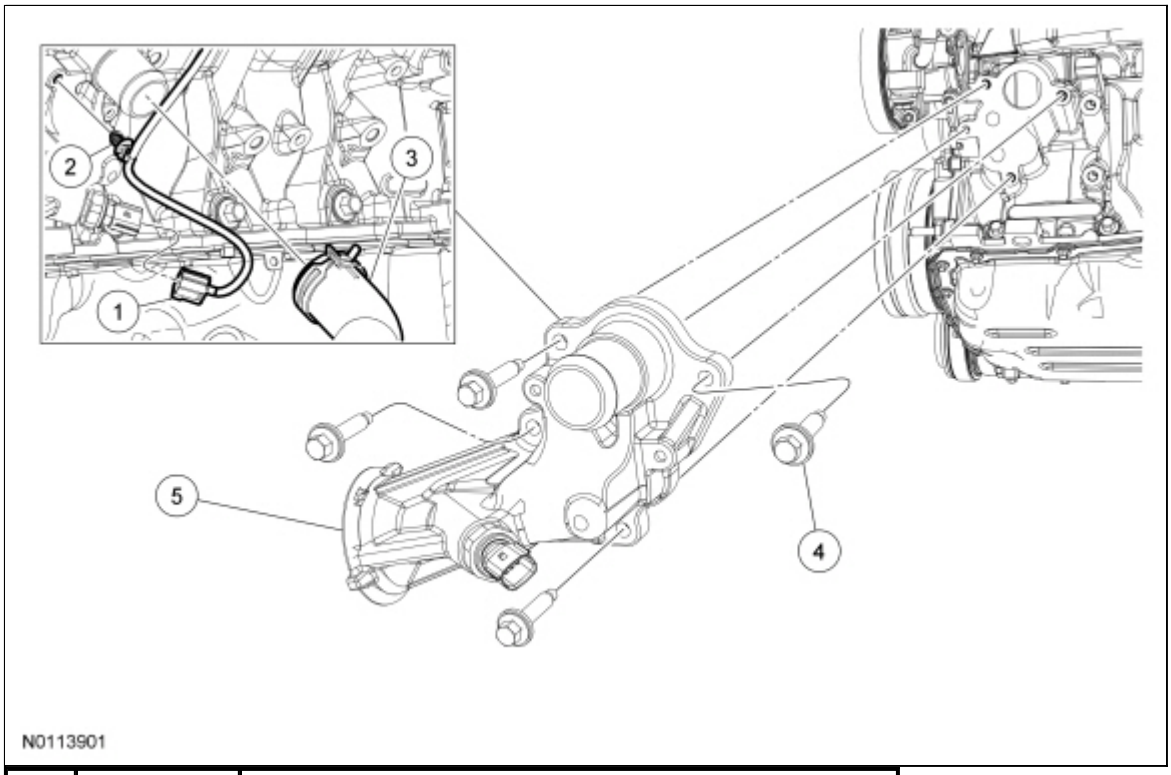
3. Install a new oil filter in 2 stages.
   - Stage 1: Tighten to 5 Nm (44 lb-in).
   - Stage 2: Tighten an additional 180 degrees.

4. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

Oil Filter Adapter

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—



Item	Part Number	Description
1	—	Engine Oil Pressure (EOP) switch electrical connector (part of 12B637)
2	—	EOP switch wiring harness retainer (part of 12B637)
3	8B273	Lower radiator hose

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4	W705128	Oil filter adapter bolt (4 required)
5	6881	Oil filter adapter

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine oil cooler. For additional information, refer to Oil Cooler in this section.

3. Drain the engine oil.
   - Install the drain plug and tighten to 23 Nm (17 lb-ft).

4. Disconnect the Engine Oil Pressure (EOP) switch wiring harness retainer and the electrical connector.

5. Disconnect the lower radiator hose and position it aside.

6. Remove the 4 bolts and the oil filter adapter.

7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

   Inspect the 3 gaskets for damage and install new gaskets if necessary.
   - Clean and inspect the cylinder block sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

Installation

1. Position the oil filter adapter and install the 4 bolts in 2 stages.
   - Stage 1: Tighten to 20 Nm (15 lb-ft).
   - Stage 1: Tighten an additional 60 degrees.

2. Connect the EOP switch electrical connector and attach the wiring harness retainer.

3. Connect the lower radiator hose.

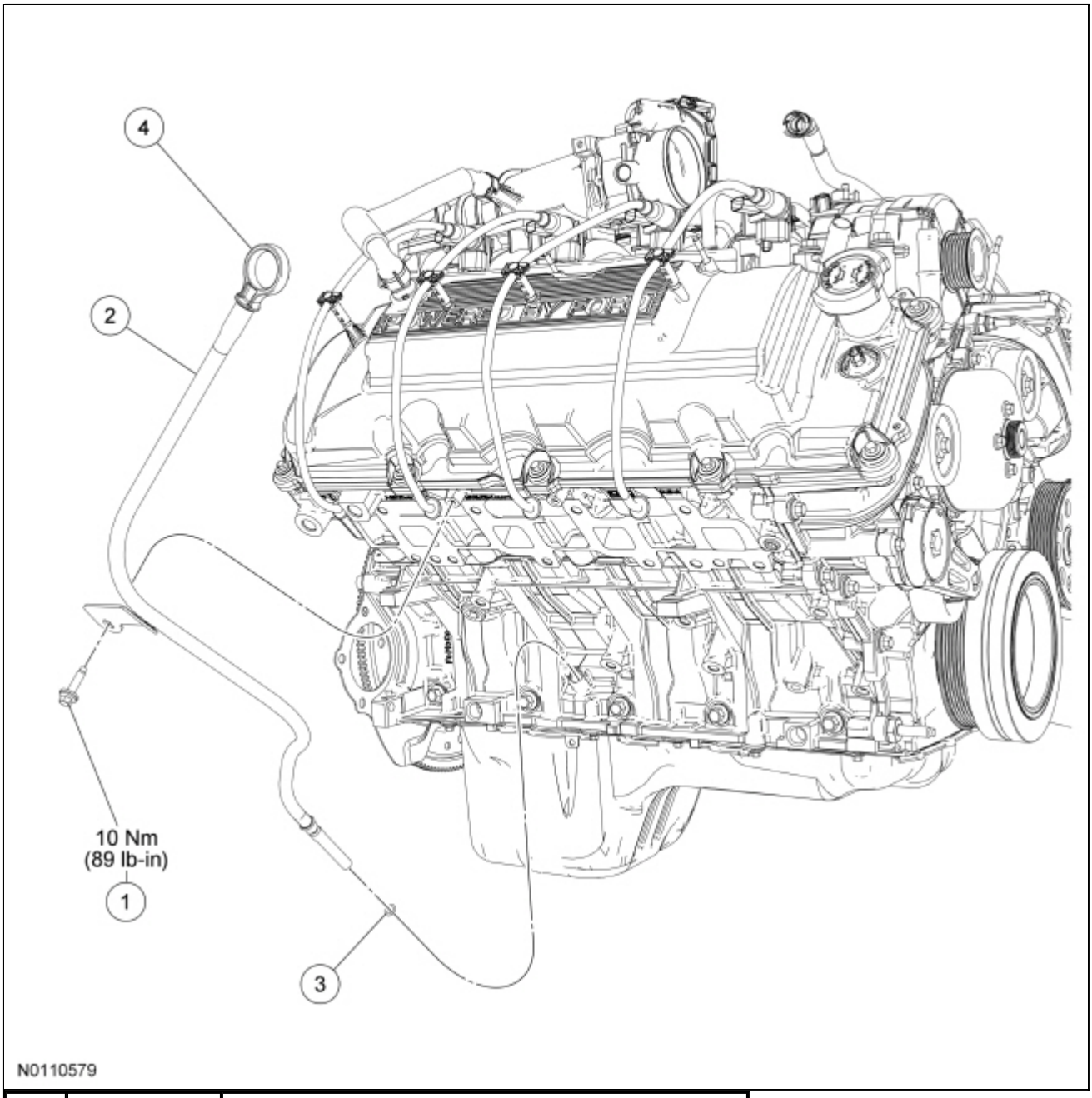
4. Install the engine oil cooler. For additional information, refer to Oil Cooler in this section.

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Oil Level Indicator and Tube

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	W503276	Oil level indicator and tube bolt
2	6B667	Oil level indicator tube
3	—	Oil level indicator tube O-ring seal (part of 6B667)
4	—	Oil level indicator

Removal and Installation

1. Remove the RH exhaust manifold. For additional information, refer to Exhaust Manifold — RH in this section.

2. Remove the oil level indicator from the oil level indicator tube.

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3. Remove the oil level indicator and tube bolt.
    - To install, tighten to 10 Nm (89 lb-in).

4. Remove the oil level indicator tube from the cylinder block.
    - Discard the O-ring seal.

5. **NOTE:** Lubricate the new oil level indicator tube O-ring seal with clean engine oil prior to installation.

   To install, reverse the removal procedure.
    - Install a new O-ring seal.

Oil Pan

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	—

Removal

All vehicles

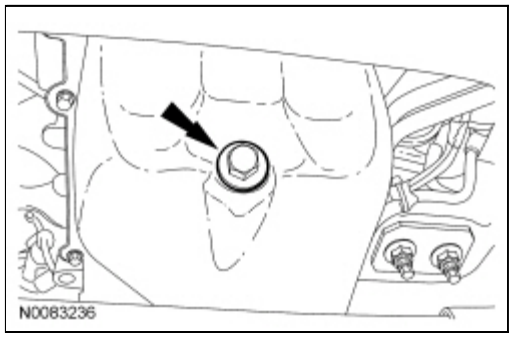
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

Four-Wheel Drive (4WD) vehicles

2. Remove the 4 bolts and the skidplate.

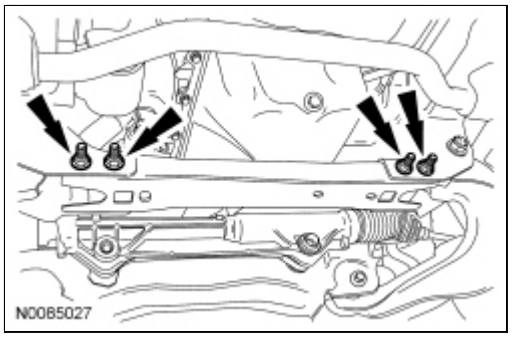
All vehicles

3. Remove the oil drain plug and drain the engine oil. Install the drain plug when finished.
   - Tighten to 23 Nm (17 lb-ft).



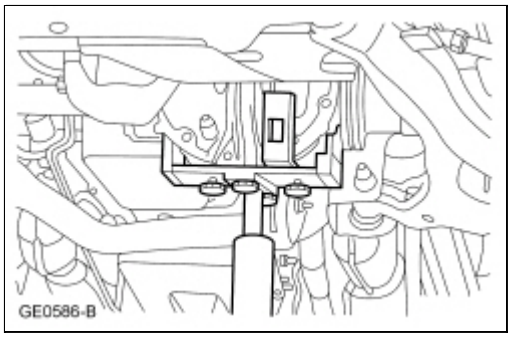
4. Remove the 4 nuts, the 4 bolts and the crossmember.

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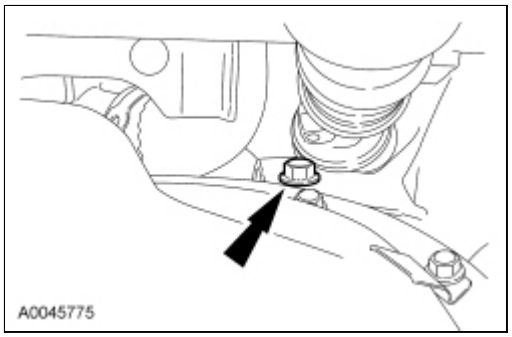
Four-Wheel Drive (4WD) vehicles

5. Position a suitable hydraulic jack under the front axle. Securely strap the jack to the axle.

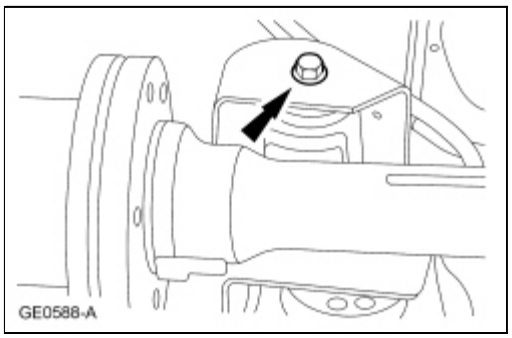


6. **NOTE:** Rotate the steering column so the pinch bolt for the steering column coupling allows clearance for the isolator bolt.

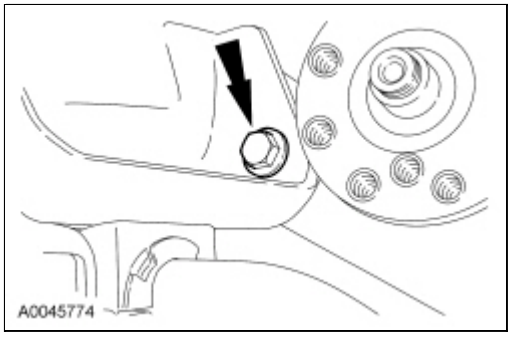
   Remove the upper front axle carrier mounting bushing bolt.



7. Remove the axle shaft housing carrier bushing bolt.



8. Remove the lower front axle carrier mounting bushing bolt.

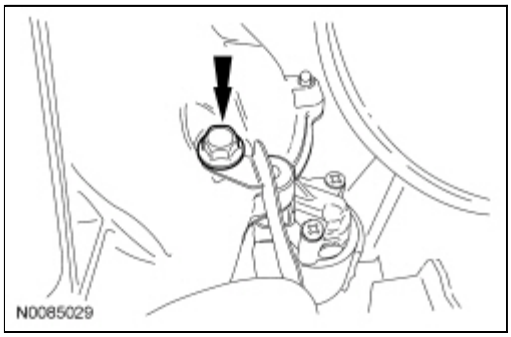


9. ***NOTICE:*** **Use care when lowering the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.**

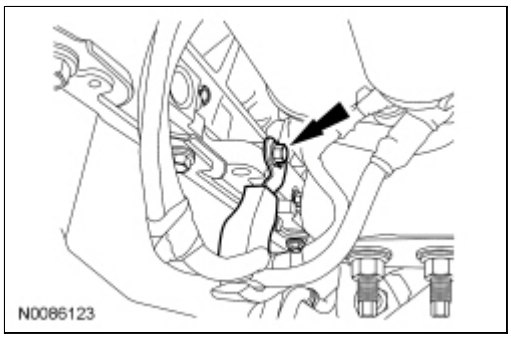
   Lower the axle to allow clearance for the oil pan to be removed.

All vehicles

10. Remove the bolt and position the transmission fluid cooling tubes rear support bracket aside.

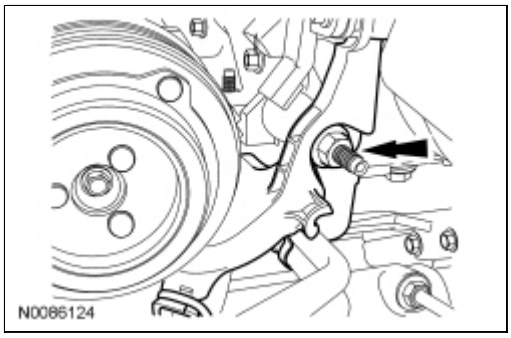


11. Remove the starter wiring harness rear support bracket pushpin.

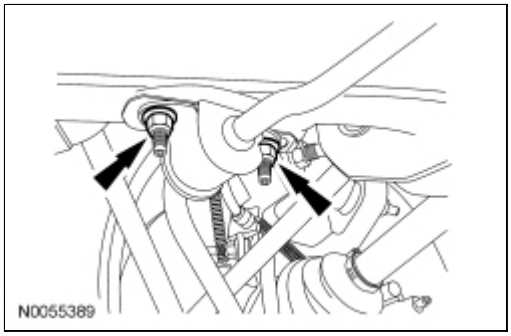


12. Remove the nut and position the starter wiring harness and the transmission fluid cooler tubes aside.

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13. Remove and discard the 4 stabilizer bar bracket nuts and allow the stabilizer bar to swing downward.



14. Remove the 20 bolts, the oil pan and the gasket.
    - Discard the gasket.

15. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

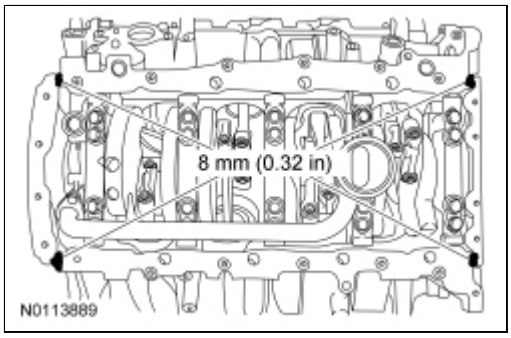
    Inspect the oil pan. Clean the gasket mating surfaces of the oil pan and engine block with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

Installation

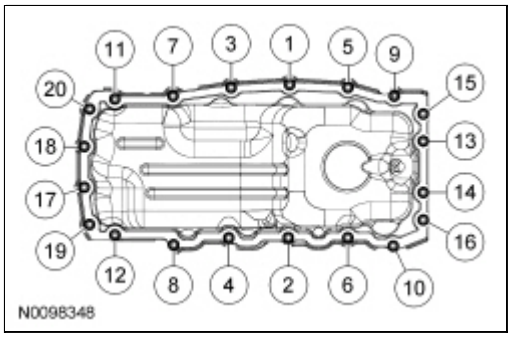
All vehicles

1. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

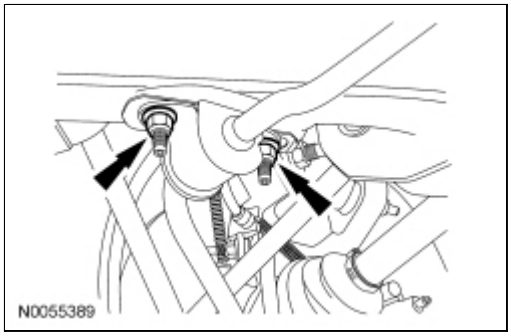
   Apply silicone gasket and sealant at the crankshaft rear seal retainer plate-to-cylinder block sealing surface and at the engine front cover-to-cylinder block sealing surface.



2. Position a new gasket and the oil pan and install the 20 bolts.
    - Tighten the bolts in the sequence shown in 3 stages.
        - Stage 1: Tighten to 2 Nm (18 lb-in).
        - Stage 2: Tighten to 10 Nm (89 lb-in).
        - Stage 3: Tighten an additional 45 degrees.

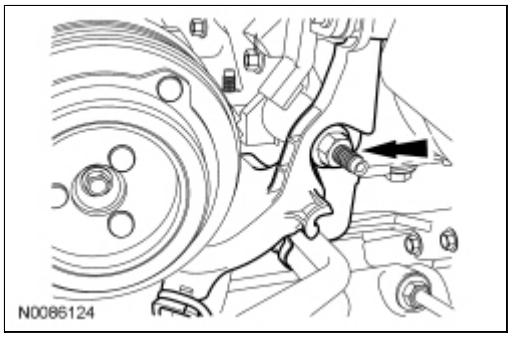


3. Postion the swaybar and install the 4 new stabilizer bar brackets nuts.
    - Tighten to 55 Nm (41 lb-ft).

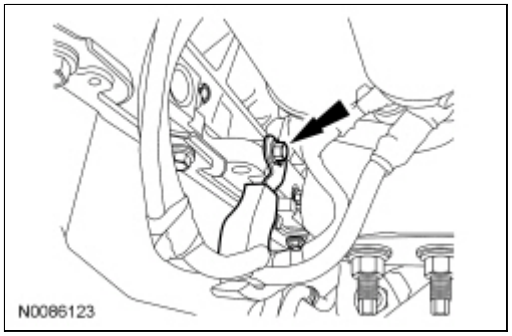


4. Position the transmission fluid cooler tube support bracket, the starter wiring harness support bracket and install the nut.
    - Tighten to 10 Nm (89 lb-in).

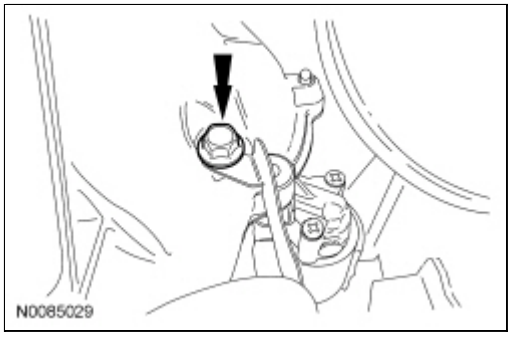
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5. Position the starter wiring harness and install the starter wiring harness rear support bracket pushpin.



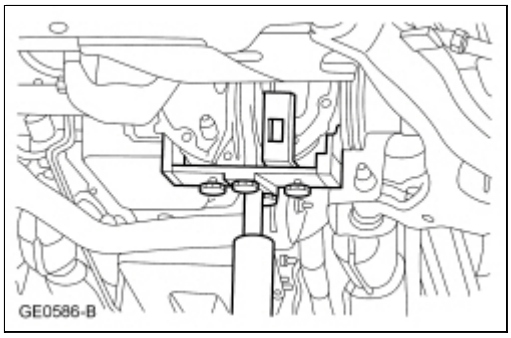
6. Install the transmission fluid cooling tubes rear support bracket bolt.
    - Tighten to 48 Nm (35 lb-ft).



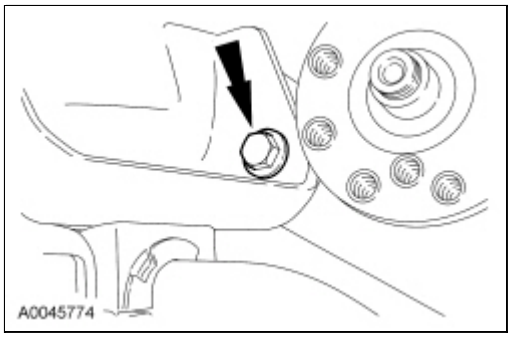
Four-Wheel Drive (4WD) vehicles

7. ***NOTICE:*** **Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.**

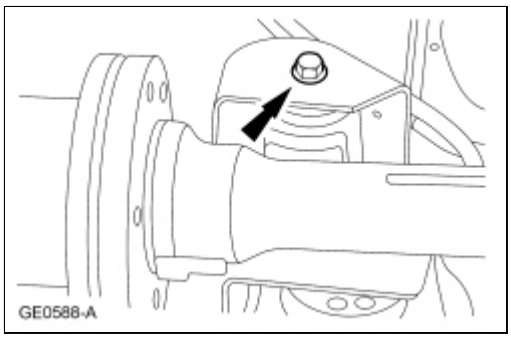
    Raise the front axle carrier into position.



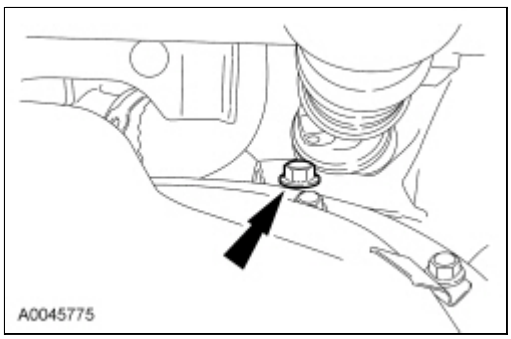
8. Install the lower front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



9. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



10. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

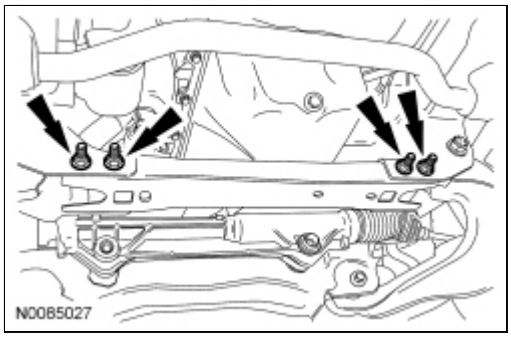


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11. Install the skid plate and 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).

All vehicles

12. Position the crossmember and Install the 4 bolts and the 4 nuts.
    - Tighten to 90 Nm (66 lb-ft).



13. Fill the engine with clean engine oil.

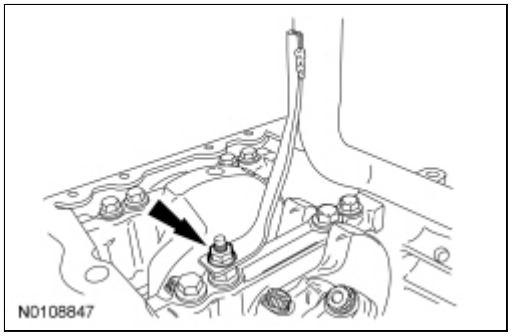
Oil Pump Screen and Pickup Tube

Material

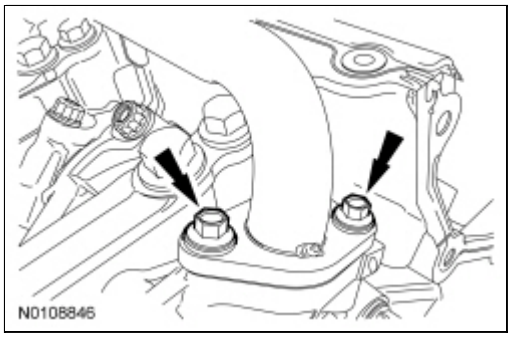
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. Remove the oil pump screen and pickup tube support bracket nut.



3. Remove the 2 bolts and the oil pump screen and pickup tube.



Installation

1. ***NOTICE:*** **Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.**

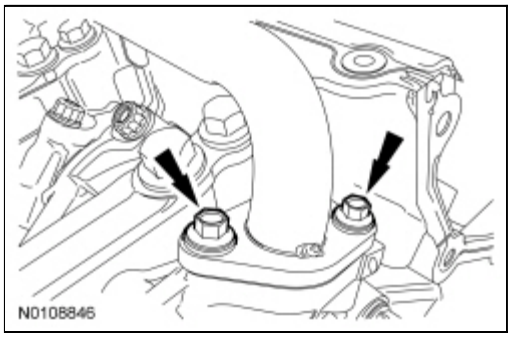
   NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate the O-ring with

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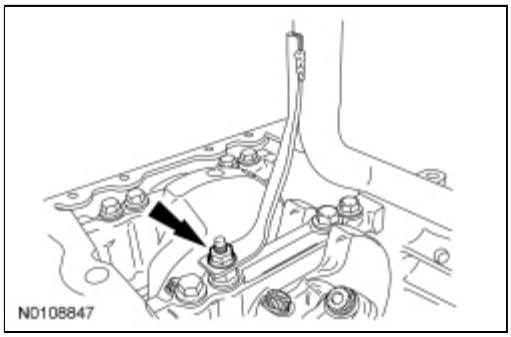
clean engine oil prior to installation.

Position the oil pump screen and pickup tube and install the 2 front bolts.

- Tighten to 10 Nm (89 lb-in).



2. Install the oil pump screen and pickup tube support bracket nut.
   - Tighten to 24 Nm (18 lb-ft).



3. Install the oil pan. For additional information, refer to Oil Pan in this section.

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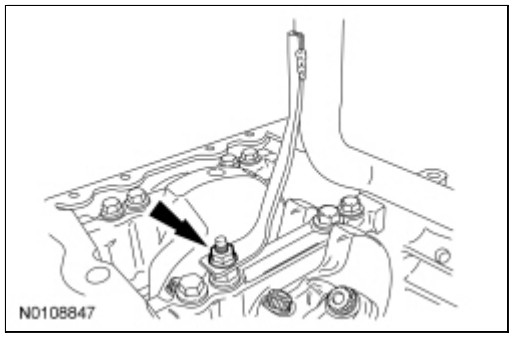
Oil Pump

Material

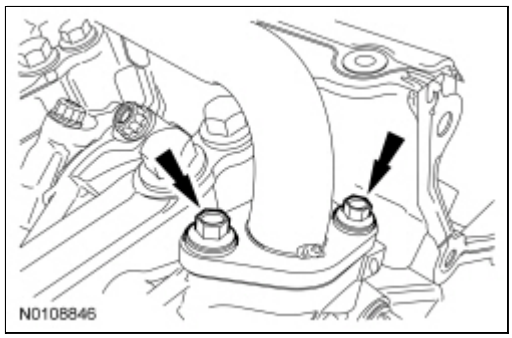
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

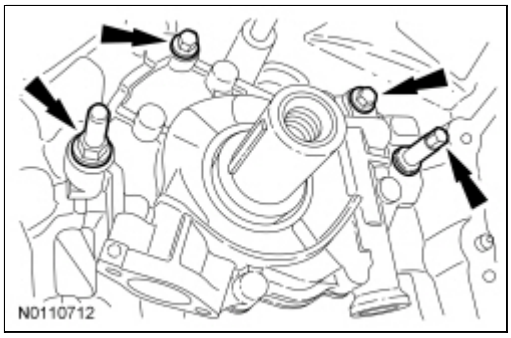
1. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.
2. Remove the oil pan. For additional information, refer to Oil Pan in this section.
3. Remove the oil pump screen and pickup tube support bracket nut.



4. Remove the 2 bolts and the oil pump screen and pickup tube.



5. Remove the 2 upper bolts, the 2 lower stud bolts and the oil pump.

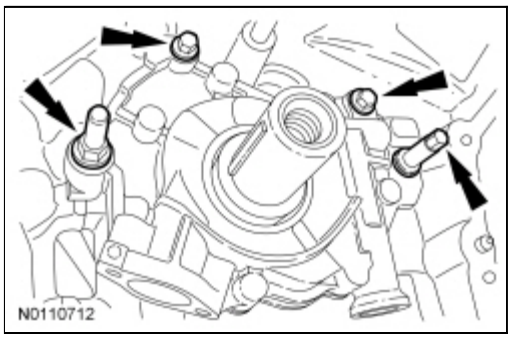


Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   Clean the sealing surfaces with metal surface prep. Follow the directions on the packaging. Inspect the mating surfaces.

2. Position the oil pump and install the 2 upper bolts and the 2 lower stud bolts in 5 stages.
   - Stage 1: Tighten all fasteners to 2 Nm (18 lb-in).
   - Stage 2: Tighten the 2 upper bolts to 10 Nm (89 lb-in).
   - Stage 3: Tighten the 2 lower stud bolts to 20 Nm (177 lb-in).
   - Stage 4: Tighten the 2 upper bolts an additional 45 degrees.
   - Stage 5: Tighten the 2 lower stud bolts an additional 60 degrees.

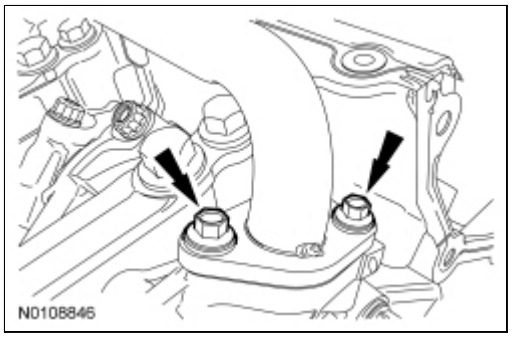


3. ***NOTICE:*** **Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.**

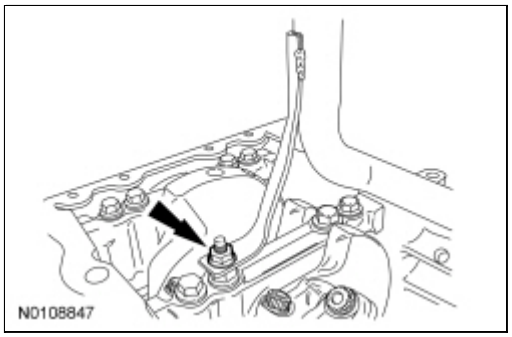
   NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate the O-ring with clean engine oil prior to installation.

   Position the oil pump screen and pickup tube and install the 2 front bolts.
   - Tighten to 10 Nm (89 lb-in).

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4. Install the oil pump screen and pickup tube support bracket nut.
    - Tighten to 24 Nm (18 lb-ft).



5. Install the oil pan. For additional information, refer to Oil Pan in this section.

6. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

Rocker Arm

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal

LH cylinder head rocker arm shafts

NOTICE: **If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations. Failure to follow these instructions may result in engine damage.**

1. Remove the LH valve cover. For additional information, refer to Valve Cover — LH in this section.
2. Disconnect the 4 LH ignition wires from the LH cylinder head 4 lower spark plugs.
3. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

   NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

   Remove the 4 lower spark plugs from the LH cylinder head.
4. Rotate the engine clockwise until the No. 6 cylinder camshaft intake valve is open.
5. Remove the 10 bolts and the LH intake rocker arm shaft assembly.
6. Rotate the engine clockwise until the No. 6 cylinder camshaft exhaust valve is open.
7. Remove the 10 bolts and the LH exhaust rocker arm shaft assembly.

RH cylinder head rocker arm shafts

8. Remove the RH valve cover. For additional information, refer to Valve Cover — RH in this section.
9. Disconnect the 4 LH ignition wires from the RH cylinder head 4 lower spark plugs.

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10. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

    NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

    Remove the 4 lower spark plugs from the RH cylinder head.

11. Rotate the engine clockwise until the No. 1 cylinder camshaft lobe intake valve is closed.

12. Remove the 10 bolts and the RH intake rocker arm shaft assembly.

13. Rotate the engine clockwise until the No. 1 cylinder camshaft lobe exhaust valve is closed.

14. Remove the 10 bolts and the RH exhaust rocker arm shaft assembly.

Installation

NOTICE: **If the components are to be reinstalled, they must be installed in the same positions. Failure to follow this instruction may result in engine damage.**

All rocker arm shafts

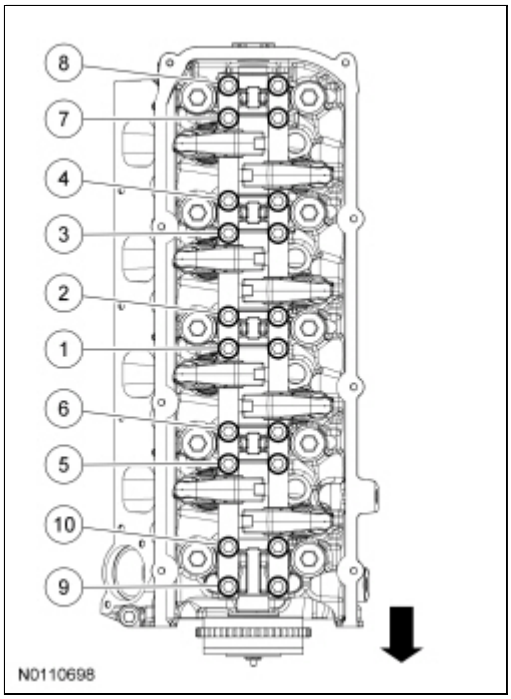
1. Lubricate the rocker arm shaft-to-valve tip and rocker arm-to-camshaft lobe contact area with clean engine oil prior to installation.

LH cylinder head rocker arm shafts

2. Rotate the engine clockwise until the No. 6 cylinder camshaft intake lobe is positioned so that the intake valve would be fully opened.

3. Position the LH intake rocker arm shaft assembly and install the bolts finger-tight.

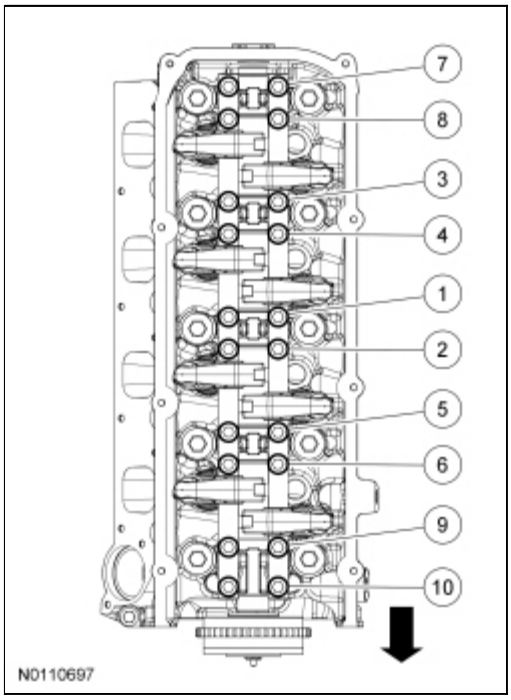
4. Tighten the 10 LH intake rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.



5. Rotate the engine clockwise until the No. 6 cylinder camshaft exhaust lobe is positioned so that the exhaust valve would be fully opened.

6. Position the LH exhaust rocker arm shaft assembly and install the bolts finger-tight.

7. Tighten the 10 LH exhaust rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten to 20 Nm (177 lb-in).
   - Stage 3: Tighten an additional 60 degrees.



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8. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

   Install the LH cylinder head lower 4 spark plugs.
   - Tighten to 18 Nm (159 lb-in).

9. Connect the 4 LH cylinder head ignition wires to the LH cylinder head lower 4 spark plugs.
   - Apply a light coat of dielectric compound to the inside of the ignition wire boots prior to installation.

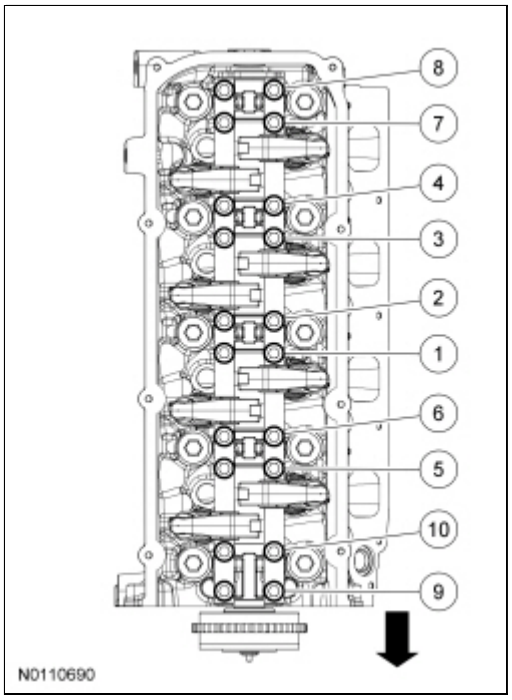
10. Install the LH valve cover. For additional information, refer to Valve Cover — LH in this section.

RH cylinder head rocker arm shafts

11. Rotate the engine clockwise until the No. 1 cylinder camshaft intake lobe is positioned so that the intake valve would be fully closed.

12. Position the RH intake rocker arm shaft assembly and install the bolts finger-tight.

13. Tighten the 10 RH intake rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.

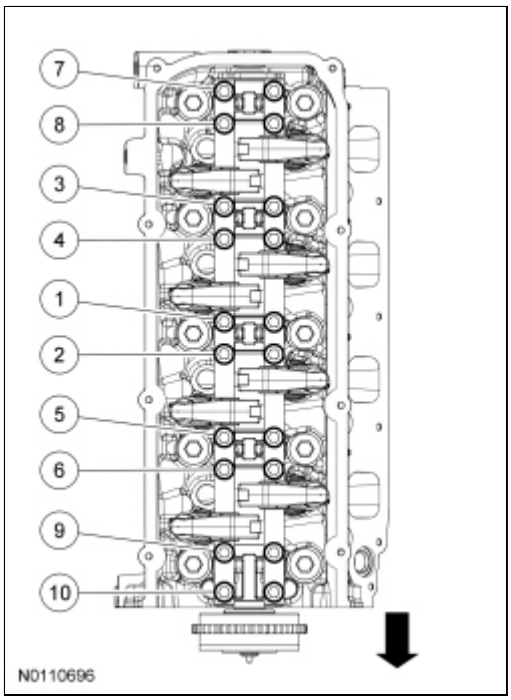


14. Rotate the engine clockwise until the No. 1 cylinder camshaft exhaust lobe is positioned so that the exhaust valve would be fully closed.

15. Position the RH exhaust rocker arm shaft assembly and install the bolts finger-tight.

16. Tighten the 10 RH exhaust rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).

- Stage 2: Tighten to 20 Nm (177 lb-in).
- Stage 3: Tighten an additional 60 degrees.



17. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

    Install the RH cylinder head lower 4 spark plugs.
    - Tighten to 18 Nm (159 lb-in).

18. Connect the 4 RH cylinder head ignition wires to the RH cylinder head lower 4 spark plugs.
    - Apply a light coat of dielectric compound to the inside of the ignition wire boots prior to installation.

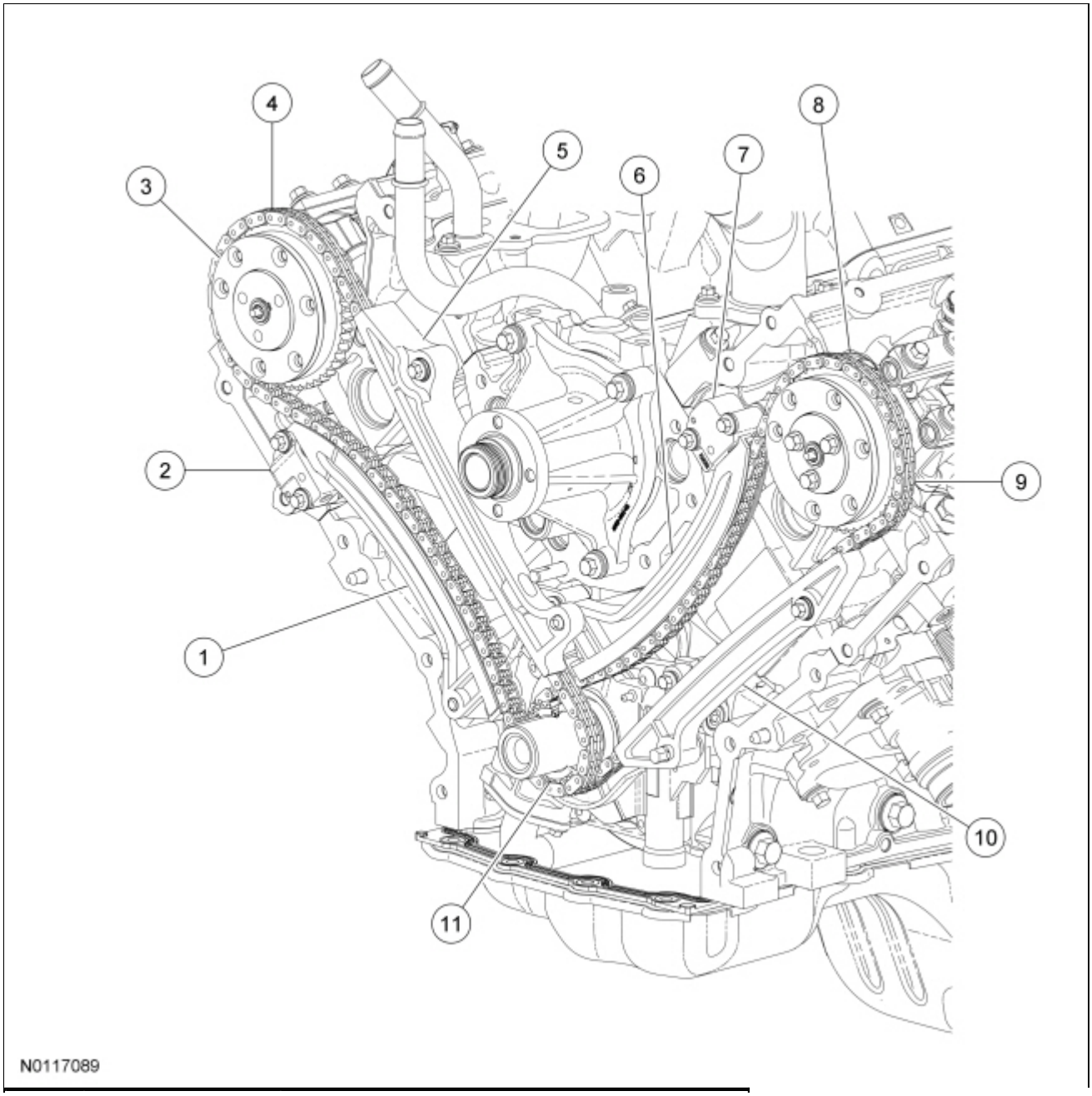
19. Install the RH valve cover. For additional information, refer to Valve Cover — RH in this section.

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Timing Drive Components

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A



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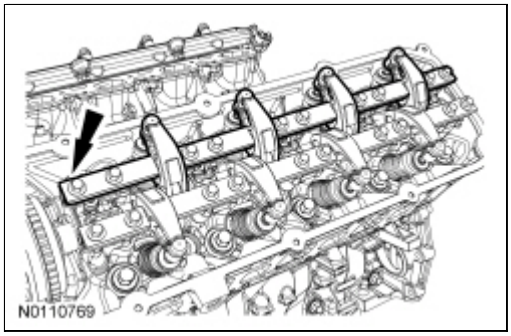
Item	Part Number	Description
1	6K255	RH timing chain tensioner arm
2	6L266	RH timing chain tensioner
3	6256	RH camshaft phaser and sprocket
4	6268	RH timing chain
5	6M256	RH timing chain guide
6	6K255	LH timing chain tensioner arm
7	6L266	LH timing chain tensioner
8	6268	LH timing chain
9	6256	LH camshaft phaser and sprocket
10	6B274	LH timing chain guide
11	6306	Crankshaft sprocket

Removal

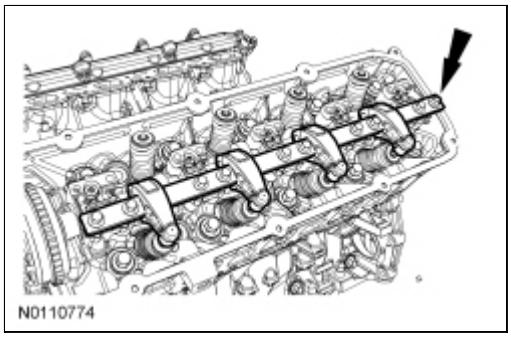
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Disconnect the 8 ignition wires from the lower 8 spark plugs.
3. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

   NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

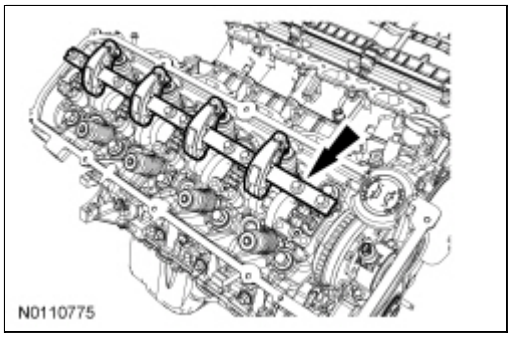
   Remove the lower 8 spark plugs.
4. Rotate the engine clockwise until the No. 1 intake valve is open.
5. Remove the 10 bolts and the LH intake rocker arm shaft assembly.



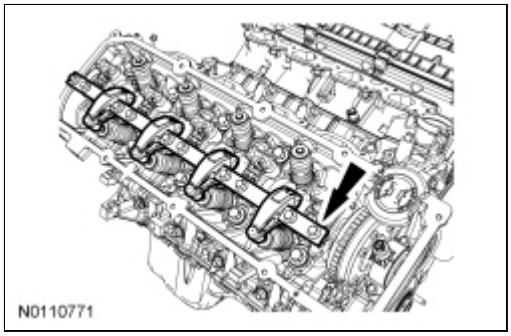
6. Rotate the engine clockwise until the No. 1 exhaust valve is open.
7. Remove the 10 bolts and the LH exhaust rocker arm shaft assembly.



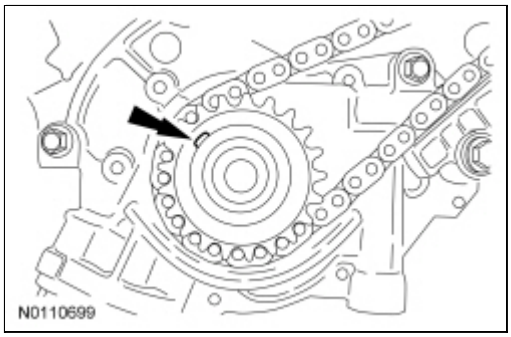
8. Rotate the engine clockwise until the No. 1 intake valve is closed.
9. Remove the 10 bolts and the RH intake rocker arm shaft assembly.



10. Rotate the engine clockwise until the No. 1 exhaust valve is closed.
11. Remove the 10 bolts and the RH exhaust rocker arm shaft assembly.

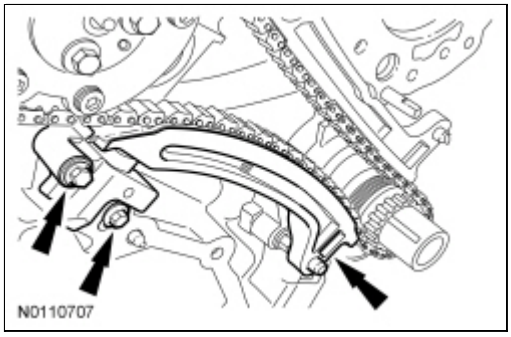


12. Position the crankshaft keyway at the 11 o'clock position.

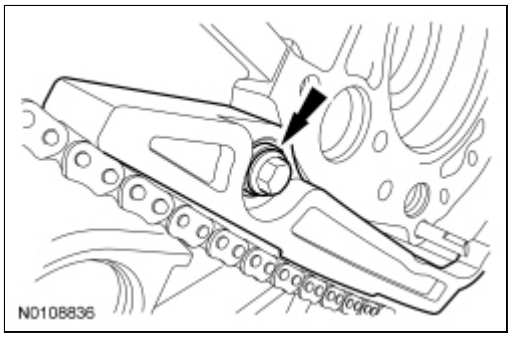


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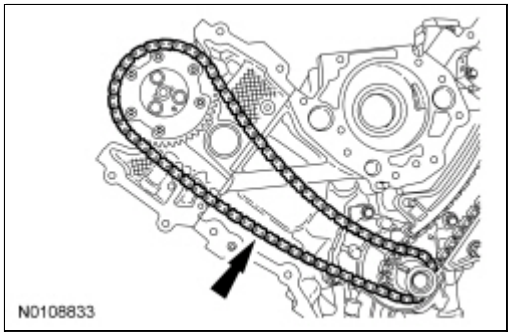
13. Remove the 2 bolts, the RH timing chain tensioner and tensioner arm.



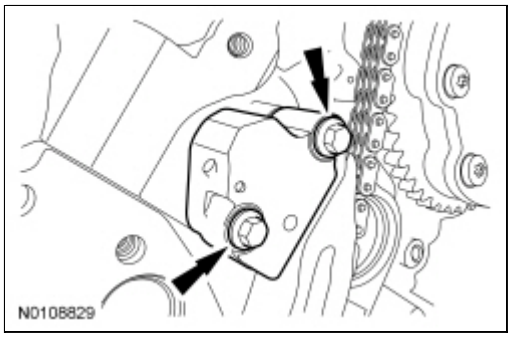
14. Remove the bolt and the RH timing chain guide.



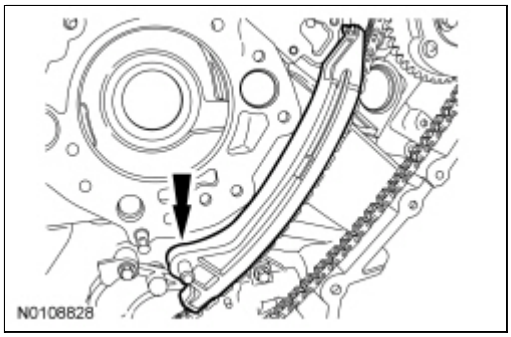
15. Remove the RH timing chain.



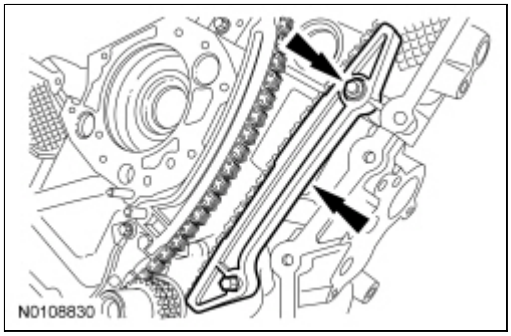
16. Remove the 2 bolts and the LH timing chain tensioner.



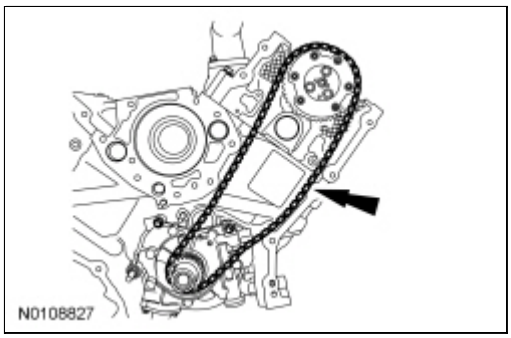
17. Remove the LH timing chain tensioner arm.



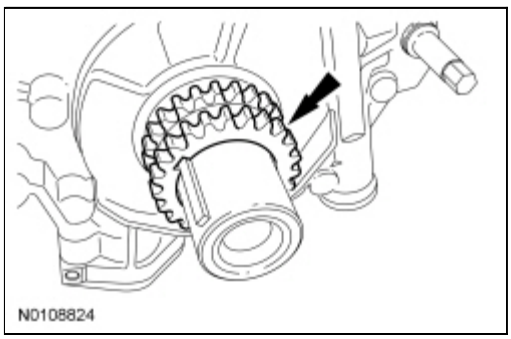
18. Remove the bolt and the LH timing chain guide.



19. Remove the LH timing chain.



20. Remove the crankshaft sprocket.

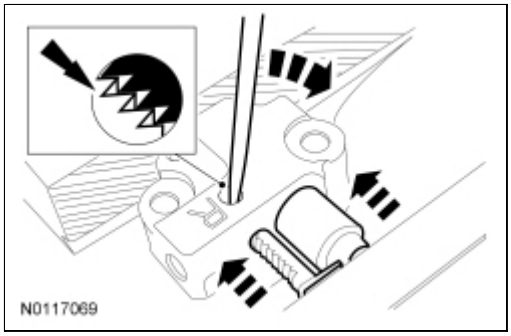


Installation

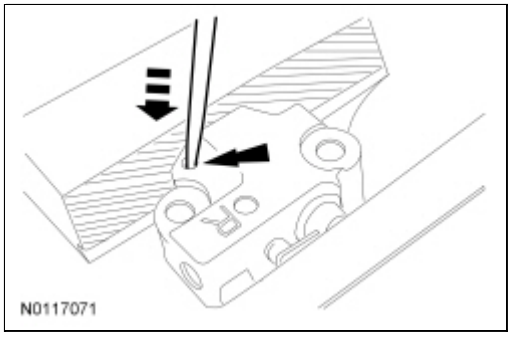
NOTICE: **Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

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1. Using a small pick, carefully push the tensioner rack pawl retainer away from the rack pawl and compress the tensioner plunger and rack using a vise.

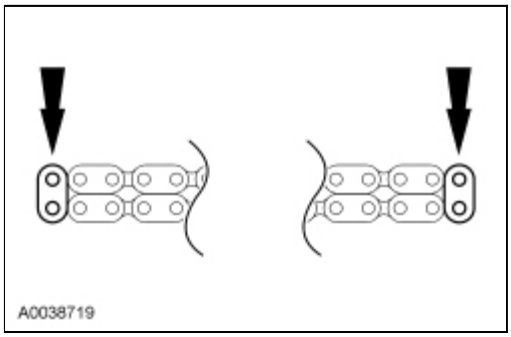


2. Install a small pick into the tensioner to hold the rack pawl and plunger in the seated position for tensioner installation.



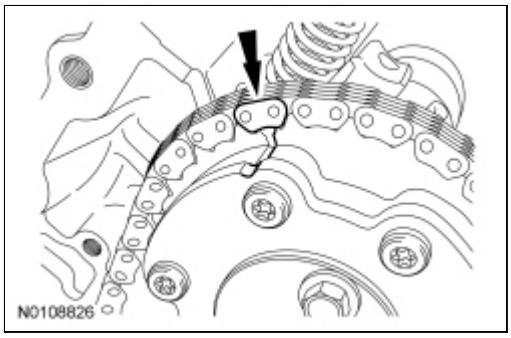
3. Remove the tensioner from the vise.

4. If the blue links are not visible, mark 2 links on each end, and use as timing marks.

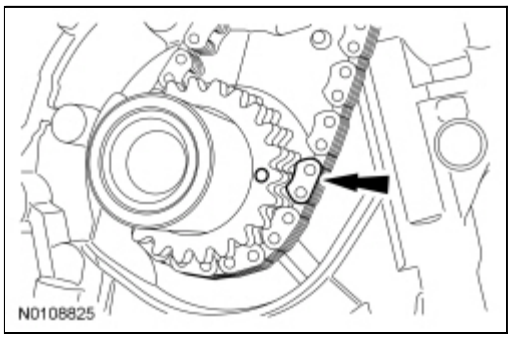


5. **NOTE:** Make sure the upper half of the timing chain is below the tensioner arm dowel and above the chain guide pin.

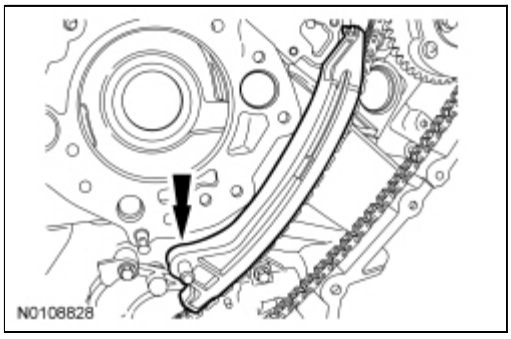
   Position the upper end of the LH (inner) timing chain on the LH camshaft phaser and sprocket, aligning the timing mark on the outer flange of the camshaft phaser and sprocket with the single blue (marked) link on the chain.



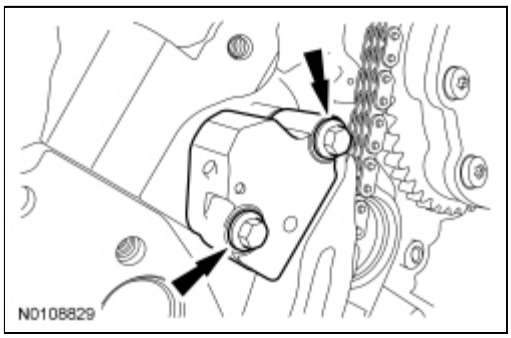
6. Position the lower end of the LH (inner) timing chain on the crankshaft sprocket, aligning the timing mark on the outer flange of the crankshaft sprocket with the single blue (marked) link on the chain and install the crankshaft sprocket onto the crankshaft and verify the crankshaft keyway is at the 11 o'clock position.



7. Install the LH timing chain tensioner arm.

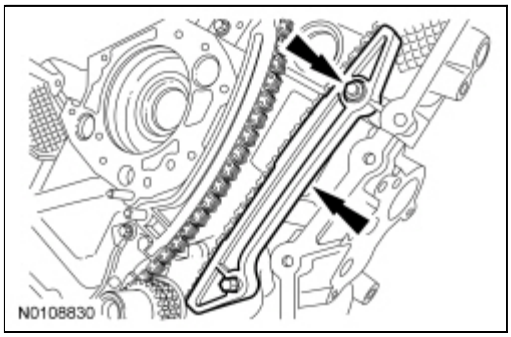


8. Position the LH timing chain tensioner and install the 2 bolts in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



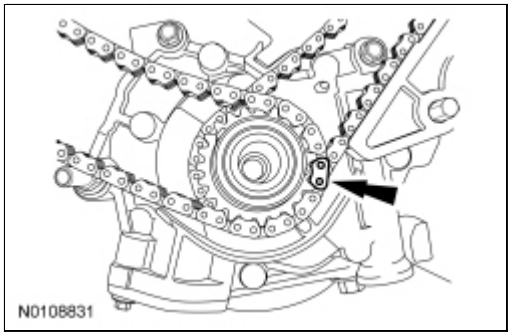
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9. Position the LH timing chain guide and install the bolt in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

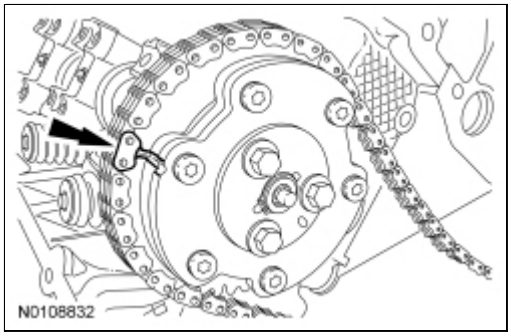


10. Remove the retaining clip from the LH timing chain tensioner.

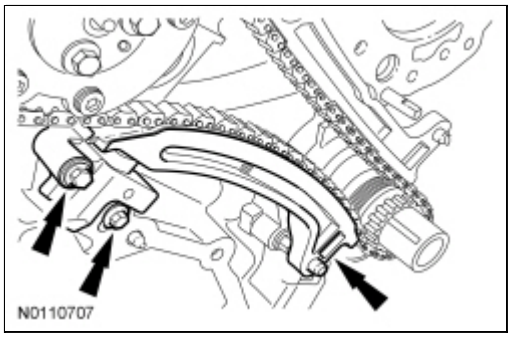
11. Position the lower end of the RH (outer) timing chain on the crankshaft sprocket, aligning the timing mark on the sprocket with the single blue (marked) chain link.



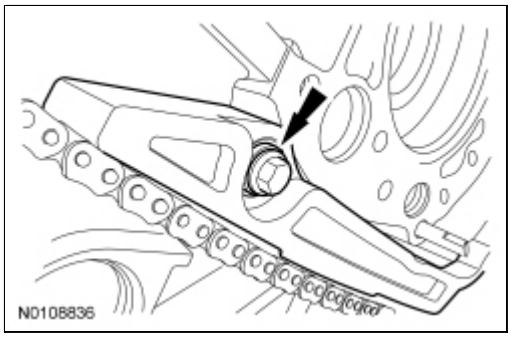
12. Position the upper end of the RH (outer) timing chain on the RH camshaft phaser and sprocket, aligning the timing mark on the outer flange of the camshaft phaser and sprocket with the single blue (marked) link on the chain.



13. Position the RH timing chain tensioner arm on the dowel pin and the RH timing chain tensioner and install the 2 bolts in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

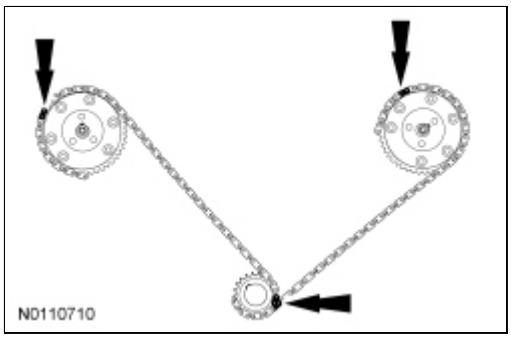


14. Position the RH timing chain guide and install the bolt in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



15. Remove the retaining clip from the RH timing chain tensioner.

16. As a post-check, verify correct alignment of all timing marks.



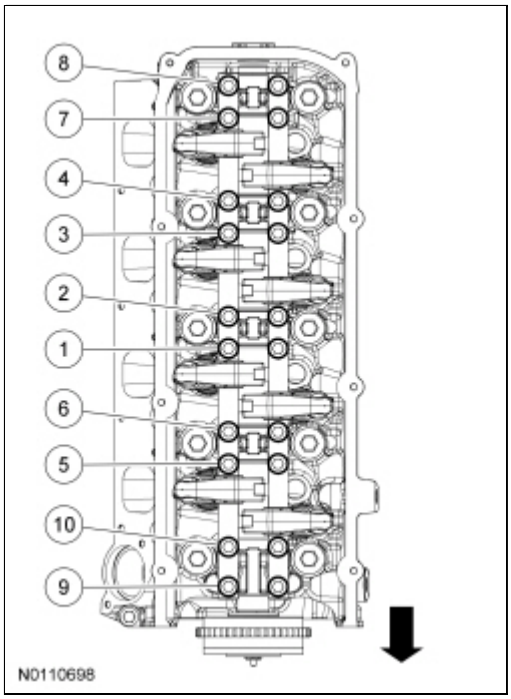
17. Lubricate the rocker arm shaft-to-valve tip and rocker arm-to-camshaft lobe contact area with clean engine oil prior to installation.

18. Rotate the engine clockwise until the No. 1 cylinder camshaft intake lobe is positioned so that the intake valve would be fully opened.

19. Position the LH intake rocker arm shaft assembly and install the bolts finger-tight.

20. Tighten the 10 LH intake rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.

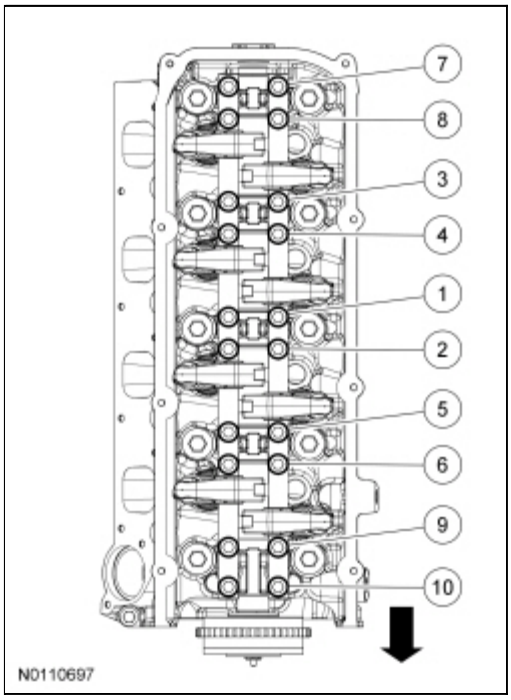
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21. Rotate the engine clockwise until the No. 1 cylinder camshaft exhaust lobe is positioned so that the exhaust valve would be fully opened.

22. Position the LH exhaust rocker arm shaft assembly and install the bolts finger-tight.

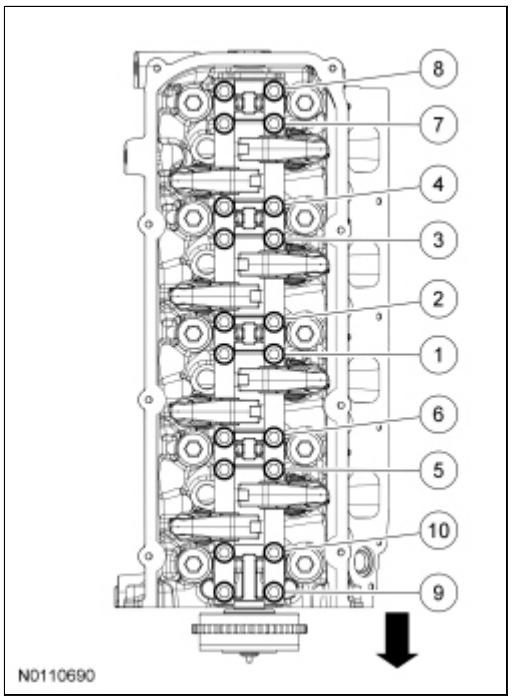
23. Tighten the 10 LH exhaust rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.



24. Rotate the engine clockwise until the No. 1 cylinder camshaft intake lobe is positioned so that the intake valve would be fully closed.

25. Position the RH intake rocker arm shaft assembly and install the bolts finger-tight.

26. Tighten the 10 RH intake rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.

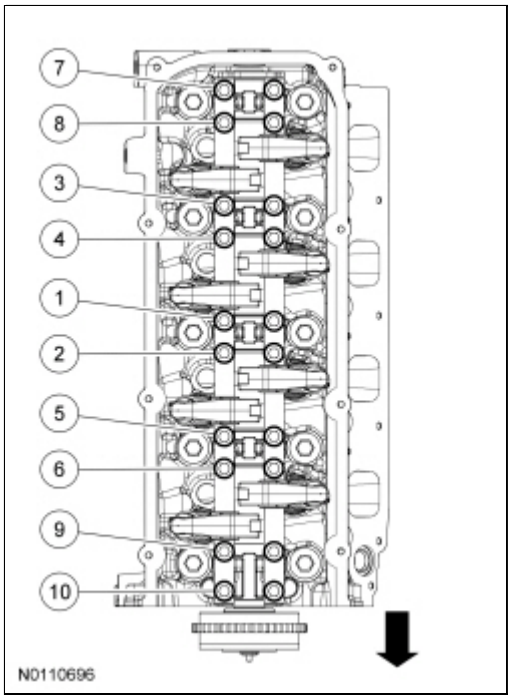


27. Rotate the engine clockwise until the No. 1 cylinder camshaft exhaust lobe is positioned so that the exhaust valve would be fully closed.

28. Position the RH exhaust rocker arm shaft assembly and install the bolts finger-tight.

29. Tighten the 10 RH exhaust rocker arm shaft assembly bolts in the sequence shown, in 3 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.

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30. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

    Install the lower 8 spark plugs.
    - Tighten to 18 Nm (159 lb-in).

31. Connect the 8 ignition wires to the lower 8 spark plugs.
    - Apply a light coat of dielectric compound to the inside of the ignition wire boots prior to installation.

32. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

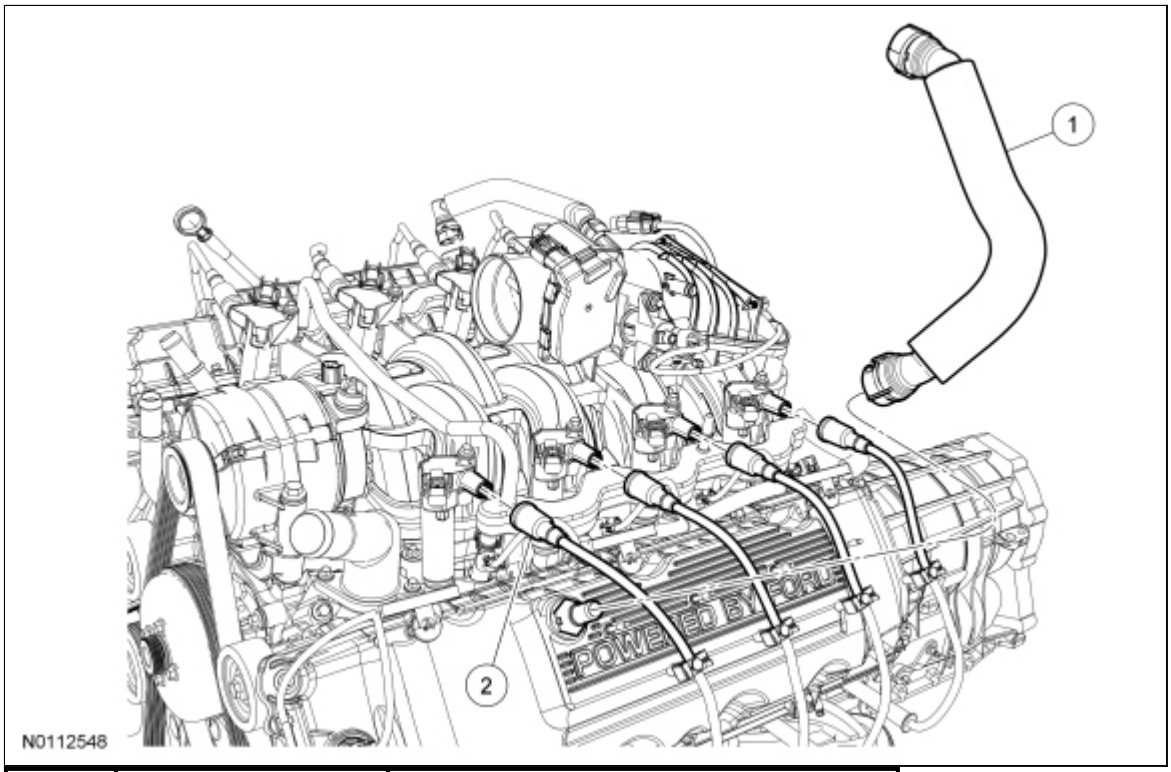
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Valve Cover — LH

Material

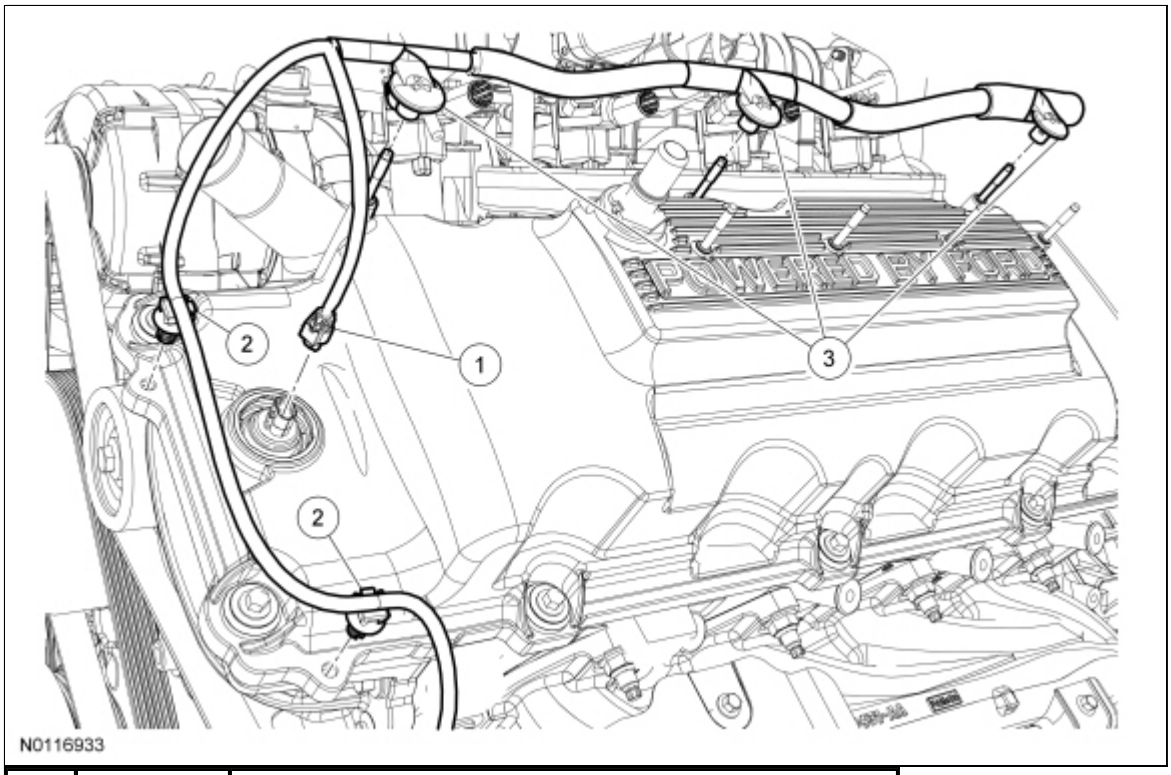
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	—

PCV Tube and LH Ignition Wires



Item	Part Number	Description
1	6K817	Crankcase ventilation tube
2	12286	Ignition wire (4 required)

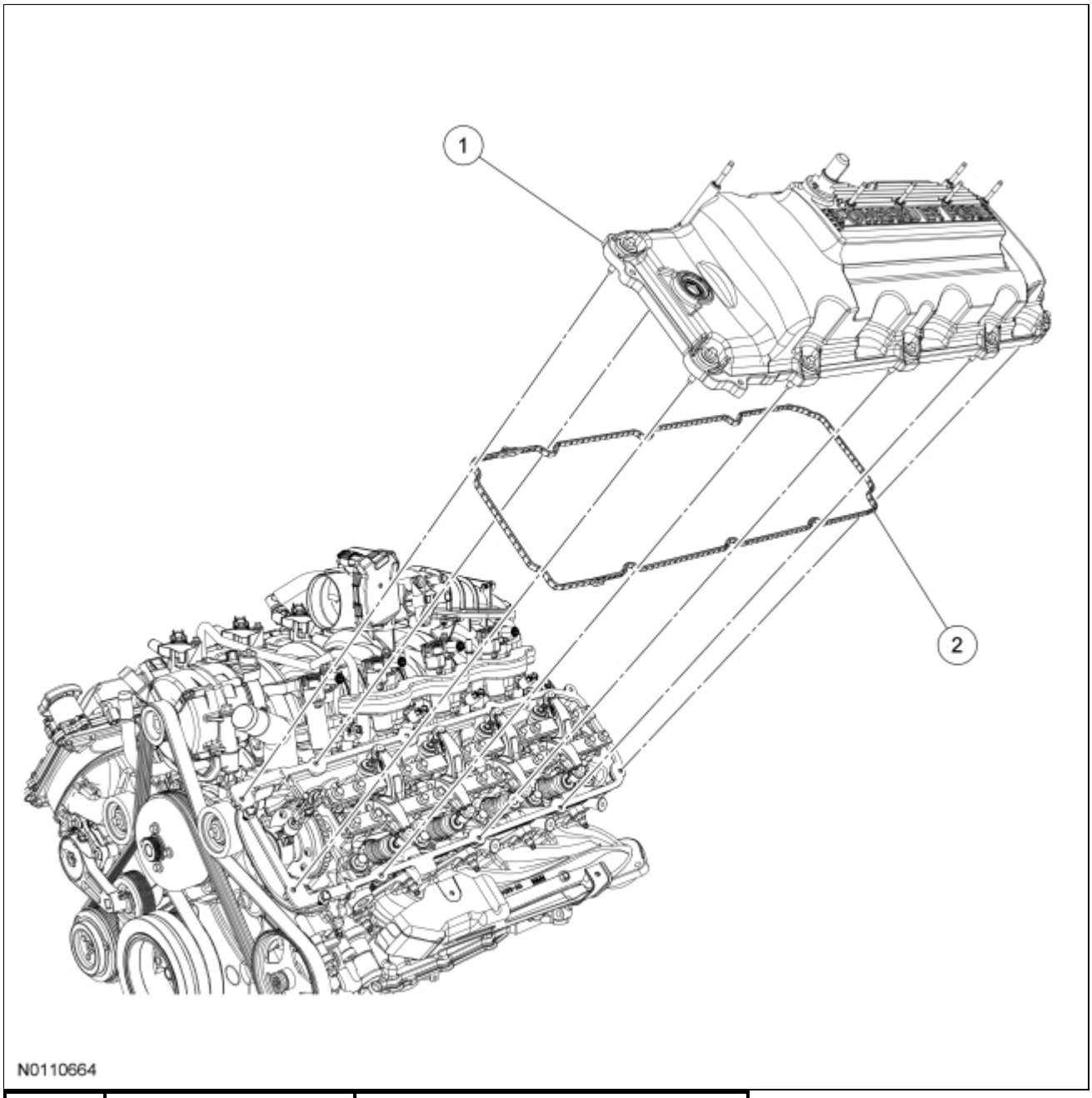
LH Variable Camshaft Timing (VCT) Electrical Connector and Engine Wiring Harness Retainers



Item	Part Number	Description
1	—	LH Variable Camshaft Timing (VCT) solenoid electrical connector (part of 12C508)
2	—	Engine wiring harness-to-LH valve cover retainers (part of 12C508) (2 required)
3	—	Engine wiring harness-to-LH valve cover retainers (part of 12C508) (3 required)

LH Valve Cover and Gasket

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Item	Part Number	Description
1	6762	LH valve cover
2	6584	LH valve cover gasket

Removal

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the quick connect couplings and remove the crankcase ventilation tube. For additional information, refer to Section 310-00 .
3. Disconnect the 4 LH ignition wires from the 4 LH ignition coils.

4. Disconnect the 4 LH ignition wire retainers from the valve cover.

5. Disconnect the LH Variable Camshaft Timing (VCT) variable force solenoid electrical connector.

6. Disconnect the 2 wiring harness retainers from the front and the 3 wiring harness retainers from the top of the LH valve cover.

7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   NOTICE: **When removing the valve cover, make sure to avoid damaging the Variable Camshaft Timing (VCT) variable force solenoid.**

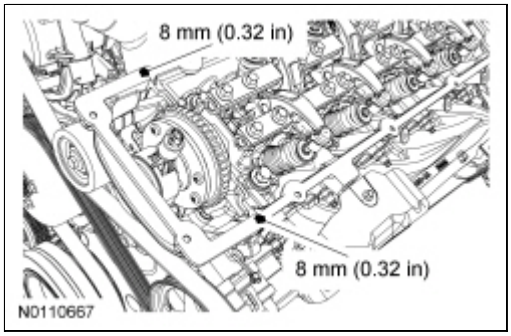
   NOTE: The fasteners are part of the valve cover and should not be removed.

   Loosen the 10 fasteners and remove the LH valve cover and gasket.
   - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
   - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

Installation

1. **NOTE:** If the valve cover is not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

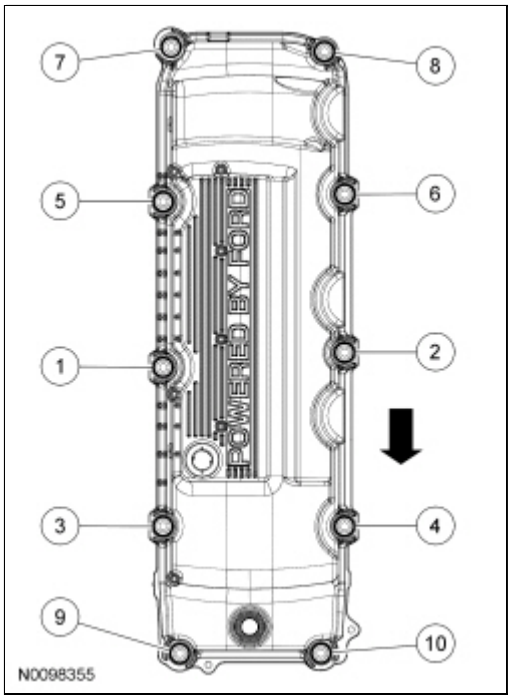
   Apply a bead of silicone gasket and sealant in 2 places where the engine front cover meets the cylinder head.

2. ***NOTICE:*** **When installing the valve cover, make sure to avoid damaging the Variable Camshaft Timing (VCT) variable force solenoid.**

   Position the LH valve cover and new gasket on the cylinder head and tighten the 10 fasteners in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).

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3. Connect the 3 wiring harness retainers to the top and the 2 wiring harness retainers to the front of the LH valve cover.
4. Connect the LH VCT solenoid electrical connector.
5. Connect the 4 LH ignition wire retainers to the valve cover.
6. Connect the 4 LH ignition wires to the 4 LH ignition coils.
7. Position the crankcase ventilation tube and connect the quick connect couplings. For additional information, refer to Section 310-00 .
8. Install the ACL outlet pipe. For additional information, refer to Section 303-12 .

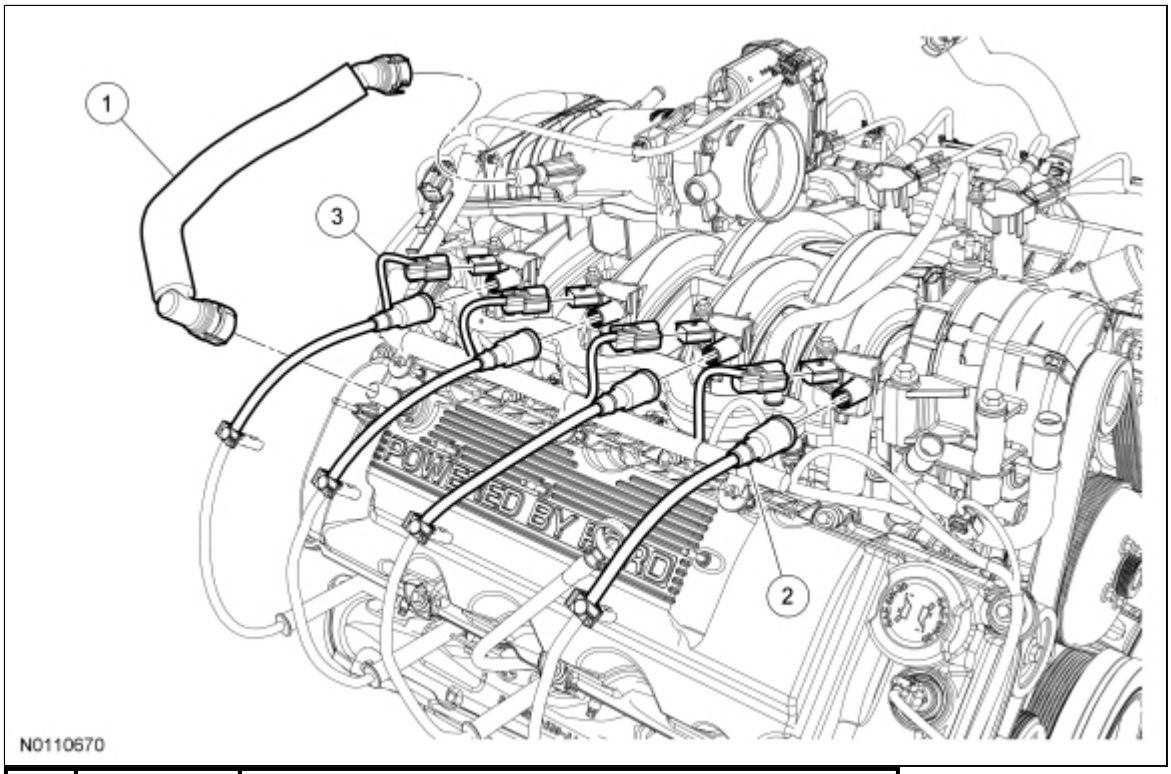
repair4less

Valve Cover — RH

Material

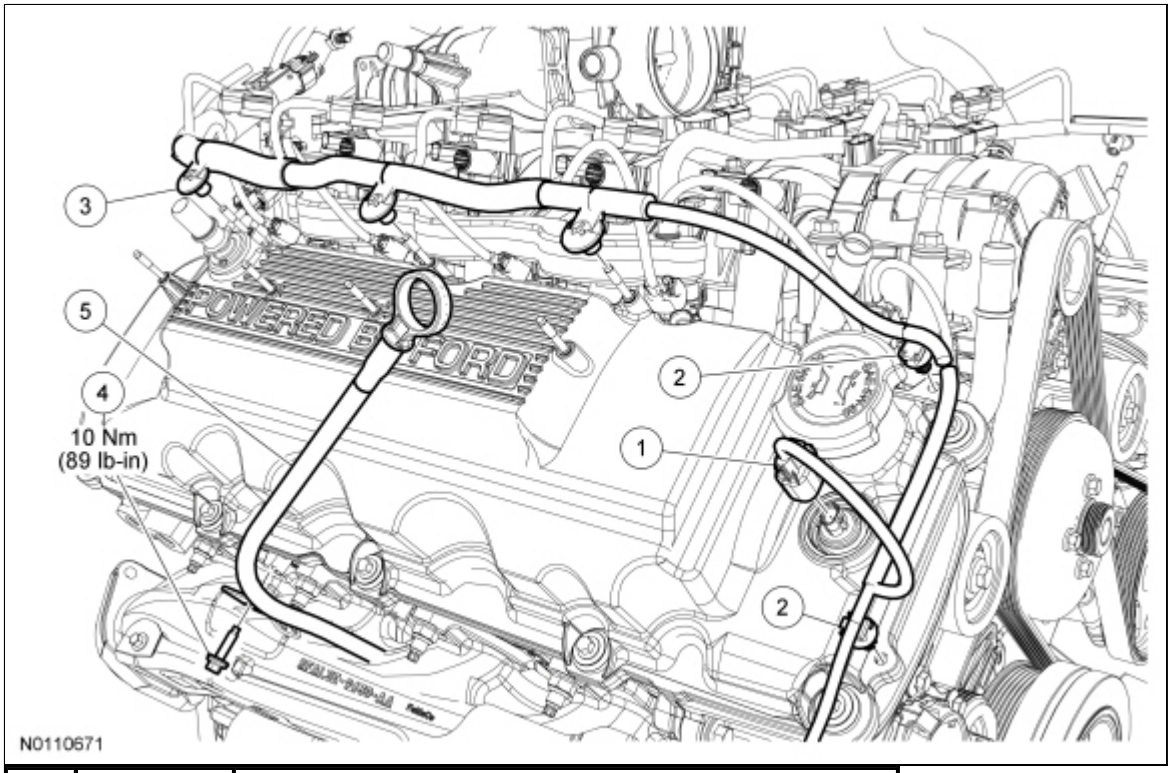
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	—

RH Ignition Wires, RH Fuel Injector Electrical Connectors and PCV Tube



Item	Part Number	Description
1	6K817	Crankcase ventilation tube
2	12286	Ignition wire (4 required)
3	—	RH ignition coil electrical connectors (part of 12C508) (4 required)

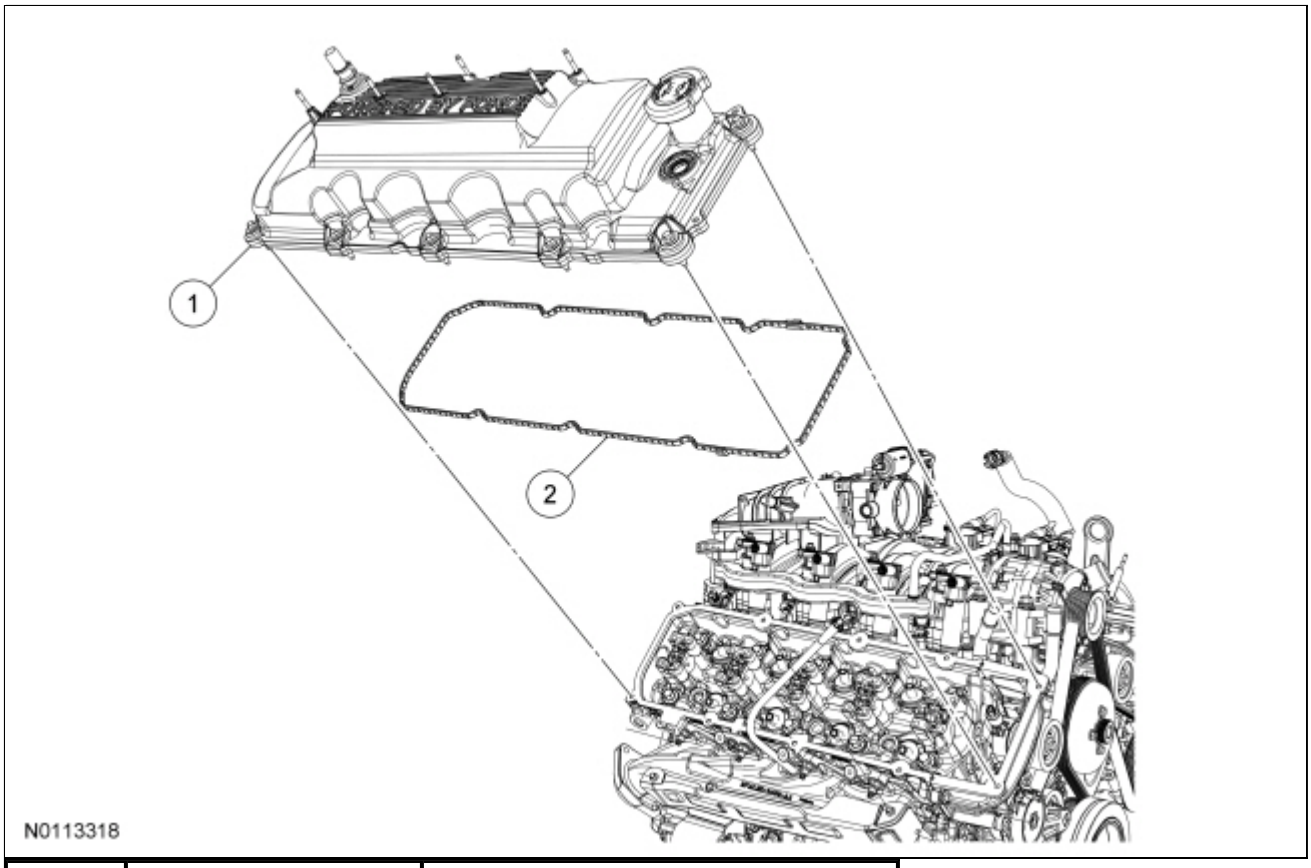
RH Variable Camshaft Timing (VCT) Electrical Connector, Engine Wiring Harness Retainers and Engine Oil Level Indicator Tube Bolt



Item	Part Number	Description
1	—	RH Variable Camshaft Timing (VCT) solenoid electrical connector (part of 12C508)
2	—	Engine wiring harness-to-RH valve cover retainers (part of 12C508) (2 required)
3	—	Engine wiring harness-to-RH valve cover retainers (part of 12C508) (3 required)
4	W503276	Engine oil level indicator tube bolt
5	6B667	Engine oil level indicator tube

RH Valve Cover and Gasket

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Item	Part Number	Description
1	6582	RH valve cover
2	6584	RH valve cover gasket

Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the quick connect couplings and remove the PCV tube. For additional information, refer to Section 310-00 .
3. Disconnect the 4 RH ignition wires from the 4 RH ignition coils.
4. Disconnect the 4 RH ignition wire retainers from the valve cover.
5. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.
6. Disconnect the 6 wiring harness retainers from the RH valve cover.
7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   NOTICE: **When removing the valve cover, make sure to avoid damaging the Variable Camshaft Timing (VCT) solenoid.**

   NOTE: The fasteners are part of the valve cover and should not be removed.

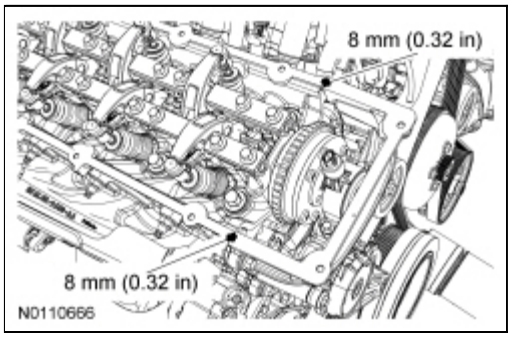
Loosen the 10 fasteners and remove the RH valve cover and gasket.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

Installation

1. **NOTE:** If the valve cover is not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

   Apply a bead of silicone gasket and sealant in 2 places where the engine front cover meets the cylinder head.

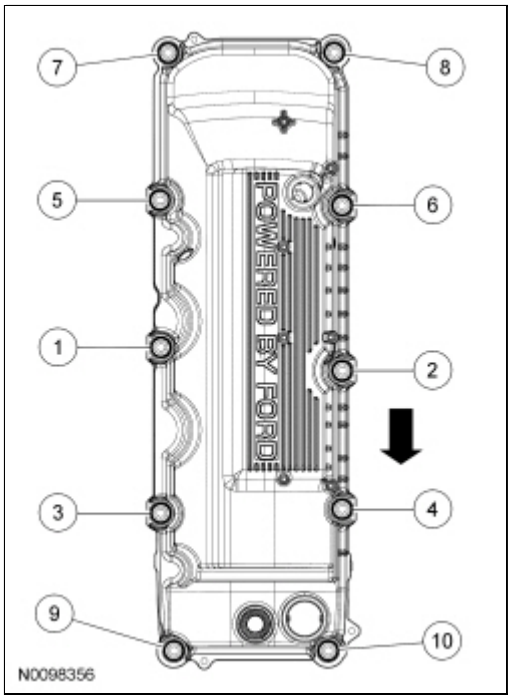


2. ***NOTICE:*** **When installing the valve cover, make sure to avoid damaging the Variable Camshaft Timing (VCT) solenoid.**

   Position the RH valve cover and new gasket on the cylinder head and tighten the 10 fasteners in the sequence shown.

   - Tighten to 10 Nm (89 lb-in).

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3. Connect the 6 wiring harness retainers to the RH valve cover.
4. Connect the RH VCT solenoid electrical connector.
5. Connect the 4 RH ignition wire retainers to the valve cover.
6. Connect the 4 RH ignition wires to the 4 RH ignition coils.
7. Position the PCV tube and connect the quick connect couplings. For additional information, refer to Section 310-00 .

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Valve Seals

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. Remove the rocker arm shaft assembly from the cylinder head being serviced. For additional information, refer to Rocker Arm in this section.

2. Remove the lower spark plug for the cylinder being serviced. For additional information, refer to Section 303-07D.

3. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

4. Use compressed air in the cylinder being serviced to hold both valves in position.
   - Apply a minimum of 965 kPa (140 psi) of compressed air into the cylinder.

5. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations. Failure to follow these instructions may result in engine damage.**

   NOTE: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal. If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head in this section.

   Using a valve spring compressor, compress the valve spring and remove the valve spring retainer keys.

6. Remove the valve spring retainer, the valve spring and the valve seal.
   - Discard the valve seal.

7. Inspect the components. For additional information, refer to Section 303-00.

Installation

1. **NOTE:** Lubricate the valve seal and valve stem with clean engine oil prior to installation.

   Position a new valve seal onto the valve stem.

2. Using a valve stem oil seal installer, install the new valve seal.

3. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in the same positions. Failure to follow this instruction may result in engine damage.**

   Using a valve spring compressor, install the valve spring, the valve spring retainer and the valve spring retainer keys.

4. Relieve the air pressure from the cylinder.

5. Install the lower spark plug. For additional information, refer to Section 303-07D .

6. Install the rocker arm shaft assembly onto the cylinder head being serviced. For additional information, refer to Rocker Arm in this section.

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Valve Springs

Removal

1. Remove the rocker arm shaft assembly from the cylinder head being serviced. For additional information, refer to Rocker Arm in this section.

2. Remove the lower spark plug for the cylinder being serviced. For additional information, refer to Section 303-07D .

3. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

4. Use compressed air in the cylinder being serviced to hold both valves in position.
   - Apply a minimum of 965 kPa (140 psi) of compressed air into the cylinder.

5. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations. Failure to follow these instructions may result in engine damage.**

   NOTE: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal. If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head in this section.

   Using a valve spring compressor, compress the valve spring and remove the valve spring retainer keys.

6. Remove the valve spring retainer and the valve spring.

7. Inspect the valve spring. For additional information, refer to Section 303-00 .

Installation

1. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in the same positions. Failure to follow this instruction may result in engine damage.**

   Using a valve spring compressor, install the valve spring, the valve spring retainer and the valve spring retainer keys.

2. Relieve the air pressure from the cylinder.

3. Install the lower spark plug. For additional information, refer to Section 303-07D .

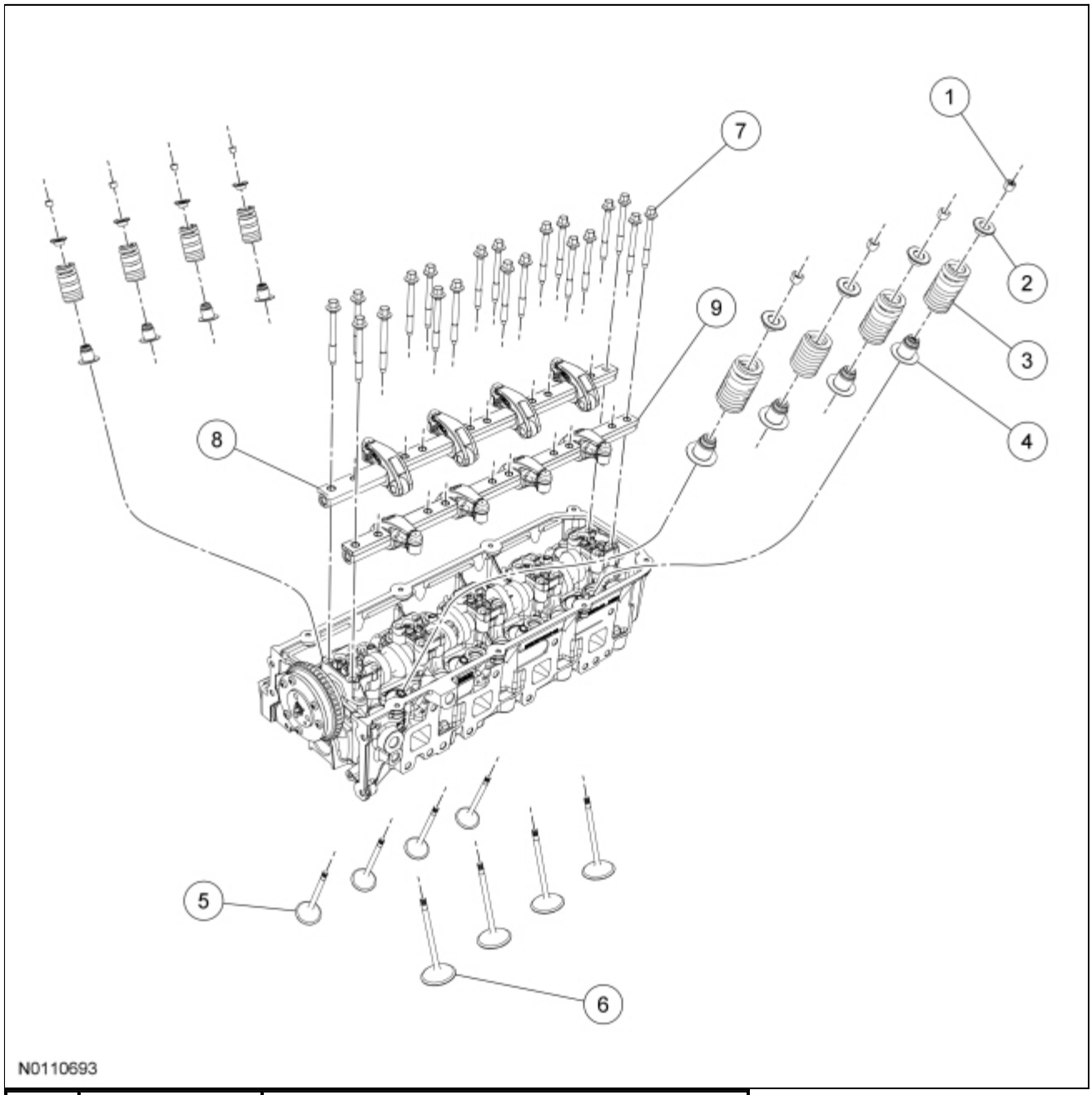
4. Install the rocker arm shaft assembly onto the cylinder head being serviced. For additional information, refer to Rocker Arm in this section.

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Valve Train Components — Exploded View

Rocker Arm Shafts, Valves, Valve Springs, Valve Spring Retainer Keys and Retainers

NOTE: LH shown, RH similar.



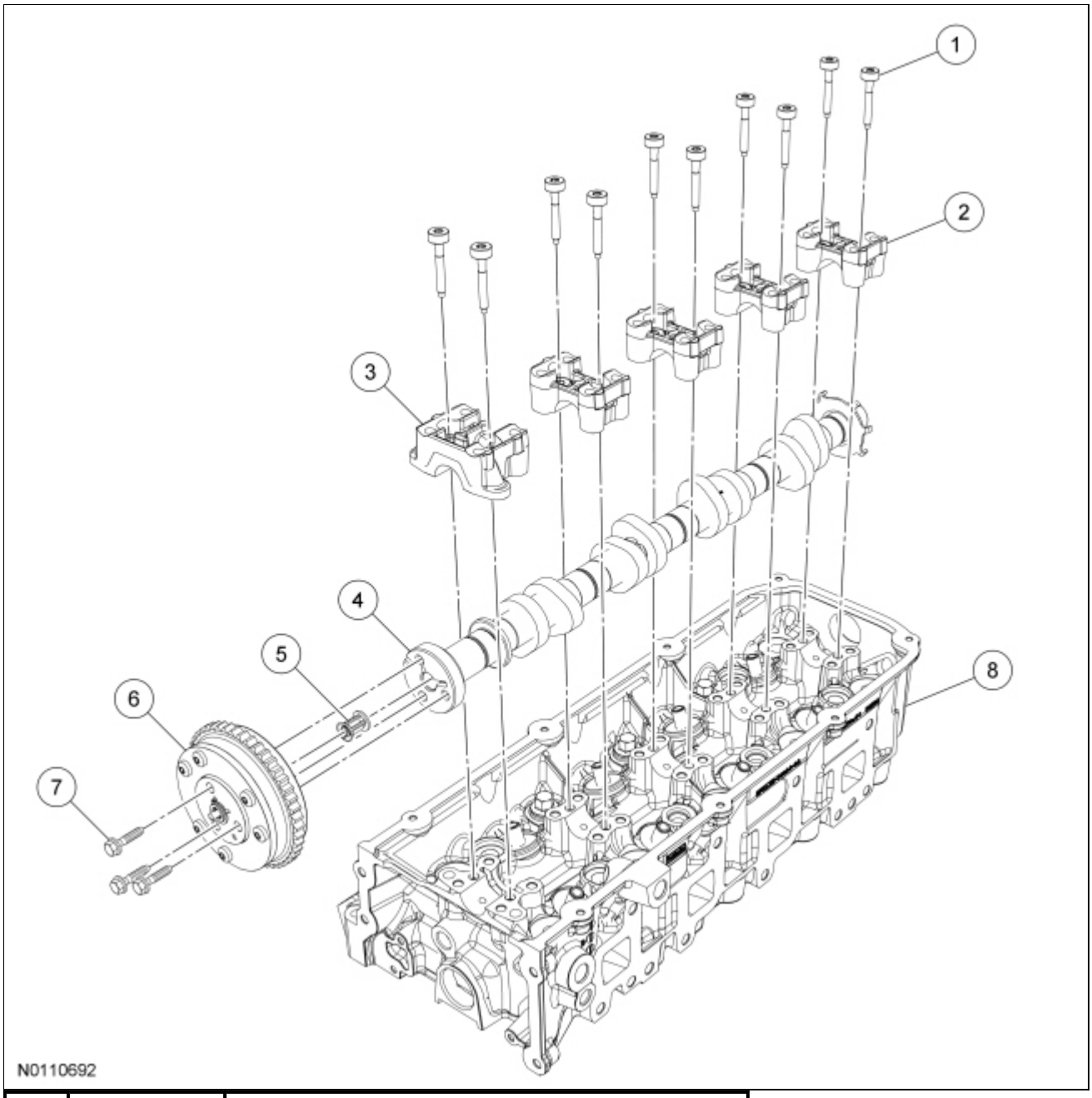
Item	Part Number	Description

1	6518	Valve spring retainer key (16 required)
2	6514	Valve spring retainer (8 required)
3	6513	Valve spring (8 required)
4	6A517	Valve seal (8 required)
5	6505	Exhaust valve (4 required)
6	6507	Intake valve (4 required)
7	W713746	Rocker arm shaft bolt (20 required)
8	6C553	Intake rocker arm shaft assembly
9	6C552	Exhaust rocker arm shaft assembly

Camshaft Phaser and Sprocket, VCT System Oil Filter, Camshaft Bearing Caps and Camshaft

NOTE: LH shown, RH similar.

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Item	Part Number	Description
1	W714203	Camshaft bearing cap bolt (10 required)
2	6B284	Camshaft bearing cap (4 required)
3	6B280	Camshaft front bearing cap
4	6A274	Camshaft
5	6C683	Variable Camshaft Timing (VCT) system oil filter
6	W712998	Camshaft phaser and sprocket bolt (3 required)
7	6C524	Camshaft phaser and sprocket
8	6050	Cylinder head

1. For additional information, refer to the procedures in this section.

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Variable Camshaft Timing (VCT) System Oil Filter

Removal and Installation

1. Remove the camshaft phaser and sprocket. For additional information, refer to Camshaft Phaser and Sprocket — LH or Camshaft Phaser and Sprocket — RH in this section.

2. Remove and discard the Variable Camshaft Timing (VCT) system oil filter.

Installation

1. Install the new VCT system oil filter with the open end facing the front of the engine.

2. Install the camshaft phaser and sprocket. For additional information, refer to Camshaft Phaser and Sprocket — LH or Camshaft Phaser and Sprocket — RH in this section.

Material

Item	Specification	Fill Capacity
Motorcraft® Metal Surface Prep ZC-31-A	—	—
Motorcraft® Premium Cooling System Flush VC-1	ESR-M14P7-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—	—
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	3.5L Gasoline Turbocharged Direct Injection (GTDI) — 15.6L (16.5 qt), 3.7L — 15.1L (16.0 qt), 5.0L — 16.1L (17.0 qt), 6.2L — 18.5L (19.5 qt)
Motorcraft® Orange Antifreeze/Coolant Prediluted VC-3DIL-B (US); CVC-3DIL-B (Canada)	WSS-M97B44-D2	3.5L Gasoline Turbocharged Direct Injection (GTDI) — 15.6L (16.5 qt), 3.7L — 15.1L (16.0 qt), 5.0L — 16.1L (17.0 qt), 6.2L — 18.5L (19.5 qt)

General Specifications

Item	Specification
Pressure Tests	
Complete cooling system maximum pressure	110 kPa (16 psi)
Pressure relief cap	110 kPa (16 psi)
Radiator (out of vehicle)	138 kPa (20 psi)
Thermostat Opening Temperatures — 3.5L Gasoline Turbocharged Direct Injection (GTDI)	
Starts to open	83.8-90.6°C (183-195°F)
Fully open	98.8°C (210°F)
Thermostat Opening Temperatures — 3.7L	
Starts to open	83.8-90.6°C (183-195°F)

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Fully open	98.8°C (210°F)
Thermostat Opening Temperatures — 5.0L	
Starts to open	87.5°C (189.5°F)
Fully open	100°C (212°F)
Thermostat Opening Temperatures — 6.2L (2V)	
Starts to open	88-92°C (190.4-197.6°F)
Fully open	104°C (219.2°F)

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C fitting nut and bolt	15	—	133
Air dam bolts	20	—	177
Air dam nuts	20	—	177
Battery Junction Box (BJB) bolts	10	—	89
Block heater - 5.0L, 6.2L	40	30	—
Block heater bolt - 3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L	6	—	53
Coolant crossover manifold assembly bolts [a]	—	—	—
Coolant expansion tank module bolts	15	—	133
Coolant inlet connector bolt - 3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L, 5.0L	10	—	89
Coolant outlet connection bolts — 6.2L	10	—	89
Coolant pump bolts — 3.5L GTDI , 3.7L [a]	—	—	—
Coolant pump bolts — 5.0L [a]	—	—	—
Coolant pump bolts — 6.2L [a]	—	—	—
Coolant pump pulley bolts	25	18	—
Cooling fan motor and shroud bolts	7	—	62
Cooling module bolts	30	22	—
Degas bottle bolts	17	—	150
Front bumper cover bracket bolts	3	—	27
Front wheel moulding nuts	3	—	27
Front bumper cover bracket bolts	3	—	27
Generator positive cable nut	9	—	80
Heater outlet tube bolt	10	—	89
Hood latch bolts	25	18	—
Hood latch release handle bolt	8	—	71
Intake manifold bolt	10	—	89
LH turbocharger-to-Charge Air Cooler (CAC) tube bracket bolt	6	—	53

LH turbocharger-to- CAC tube clamp	5	—	44
Positive battery cable nut — 6.2L	9	—	80
Power steering fluid reservoir bolt	11	—	97
Radiator bolts	15	—	133
Thermostat housing bolts — 3.5L GTDI , 3.7L [a]	—	—	—
Thermostat housing bolts — 5.0L	10	—	89
Transmission cooler tube bolt — 3.5L GTDI , 3.7L and 5.0L engines	12	—	106

[a] Refer to the procedure in this section.

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Engine Cooling

NOTICE: **Vehicle cooling systems are filled with Motorcraft® Orange Antifreeze/Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTE: During normal vehicle operation, Motorcraft® Orange Antifreeze/Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

The cooling system consists of the following components:

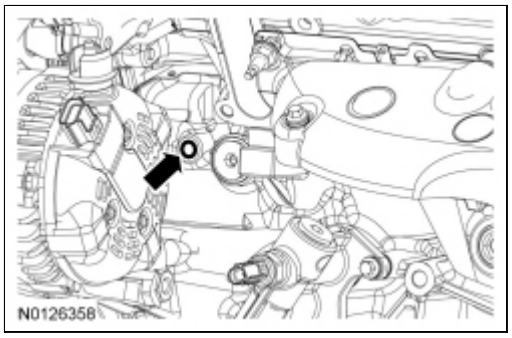
- Block heater (located in the thermostat housing for 3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L engines, the LH front of the 5.0L engine cylinder block and the LH rear of the 6.2L engine cylinder block.)
- Coolant expansion tank (6.2L engine)
- Degas bottle (3.5L GTDI , 3.7L and 5.0L engines)
- Electric cooling fan and shroud assembly
- Radiator
- Pressure relief cap (located on the radiator for the 6.2L engine and on the degas bottle for the 3.5L GTDI , 3.7L and 5.0L engines)
- Radiator draincock (located in the RH corner of the radiator)
- Upper and lower radiator hoses
- Coolant pump
- Coolant thermostat

Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle or coolant expansion tank.

When adding engine coolant, use a 48/52 to 50/50 mixture of engine coolant and distilled water, which equates to a freeze point between -31°C (-30°F) and -37°C (-34°F).

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft® Orange Antifreeze/Coolant or equivalent.
- Do not add/mix any other engine coolant. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, brine or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant. Use of such coolants may harm the engine and cooling system components. Do not mix coolant types.



On 3.5L GTDI and 3.7L engines, a channel cover plate is located behind the front cover. It contains a timing chain idler and press in place gaskets separating engine coolant and engine oil. A weep hole is provided on the front left side of the engine behind the generator. If oil or coolant is leaking from the weep hole, then a gasket has failed and must be replaced. Refer to Section 303-01A for 3.5L GTDI engines or Section 303-01B for 3.7L engines.

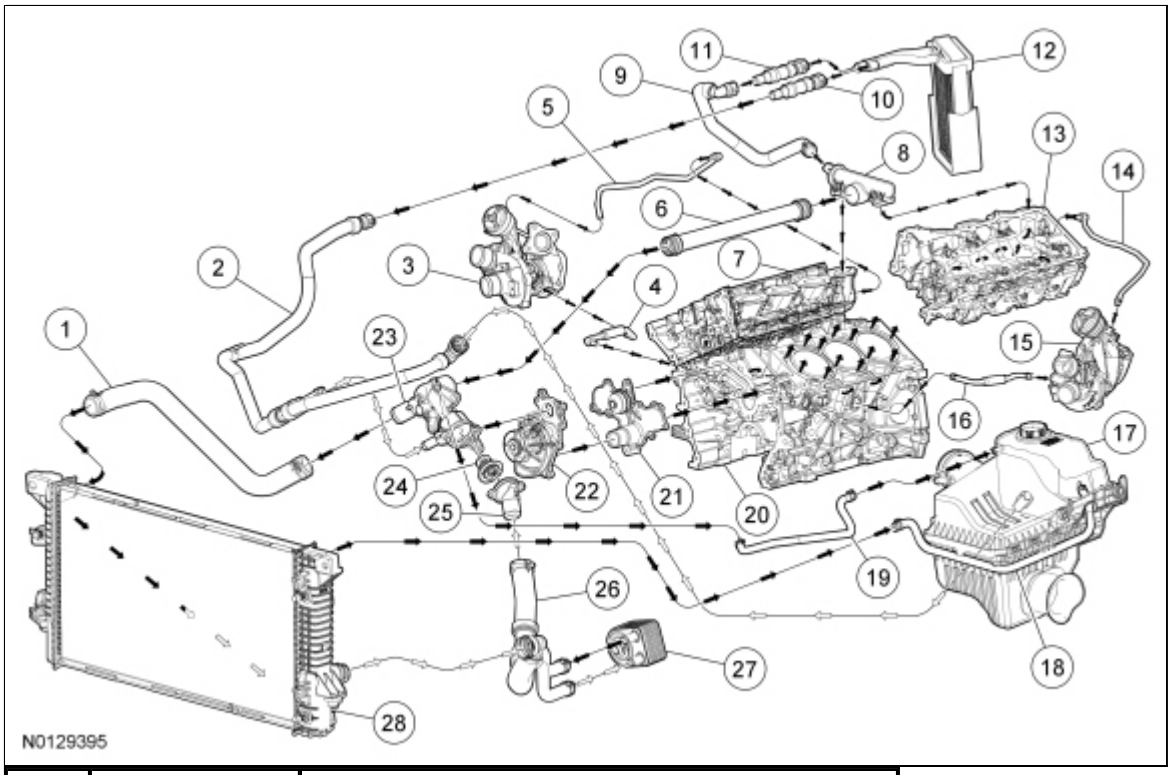
The 3.5L GTDI , 3.7L and 5.0L engines use a cold side thermostat. This means the thermostat controls the flow of cooled radiator coolant into the warmer engine cooling circuit. The thermostat is located at the lower radiator hose connection to the engine. During initial warm-up, the engine coolant increases in temperature, causing the thermostat to open. The cooler coolant from the radiator mixes with the warm engine coolant, causing the thermostat to close. The thermostat opens and closes several times before the engine coolant is warm enough to allow the thermostat to remain open. The engine must run much longer than a vehicle with a hot side thermostat before the thermostat remains fully opened.

The 6.2L engine uses a typical hot side thermostat.

Coolant Flow Diagram, 3.5L Gasoline Turbocharged Direct Injection (GTDI)

NOTE: Black arrows indicate hot, white arrows indicate cold.

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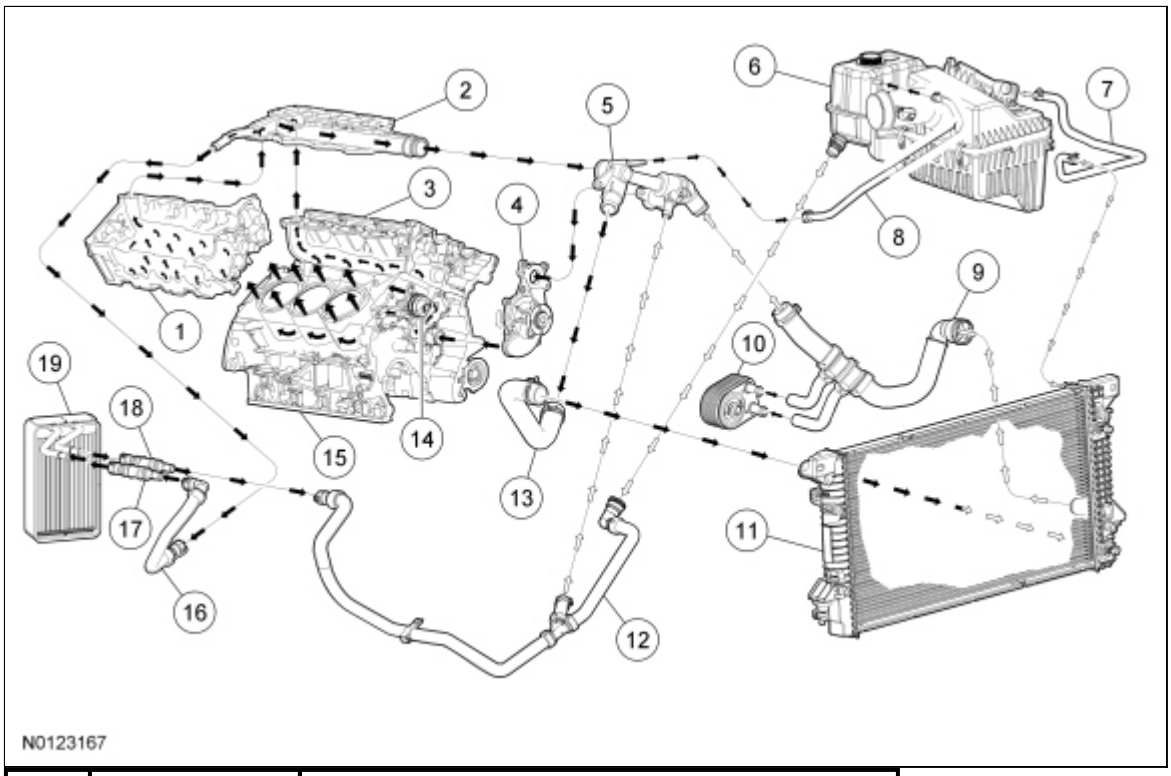


Item	Part Number	Description
1	8260	Upper radiator hose and clamp assembly
2	18472	Heater outlet hose
3	63K682	RH turbocharger
4	8K153	RH engine-to-turbocharger hose
5	8A520	RH turbocharger-to-engine hose
6	8A505	Coolant inlet pipe
7	6049	RH cylinder head
8	8C368	Coolant crossover manifold assembly
9	18472	Heater inlet hose
10	18472	Heater inlet restrictor
11	18472	Heater outlet restrictor
12	18476	Heater core
13	6049	LH cylinder head
14	8A520	LH turbocharger-to-engine hose
15	6K682	LH turbocharger
16	8K153	LH engine-to-turbocharger hose
17	8A080	Degas bottle
18	8075	Radiator-to-degas bottle hose
19	8276	Thermostat housing-to-degas bottle hose
20	6010	Cylinder block
21	8501	Cylinder block coolant pump hole cover

22	8501	Coolant pump
23	—	Thermostat housing (part of 8592)
24	8575	Thermostat (part of 8592)
25	—	Coolant inlet connection (part of 8592)
26	8286	Lower radiator hose and clamp assembly
27	6A642	Oil cooler
28	8005	Radiator

Coolant Flow Diagram, 3.7L

NOTE: Black arrows indicate hot, white arrows indicate cold.



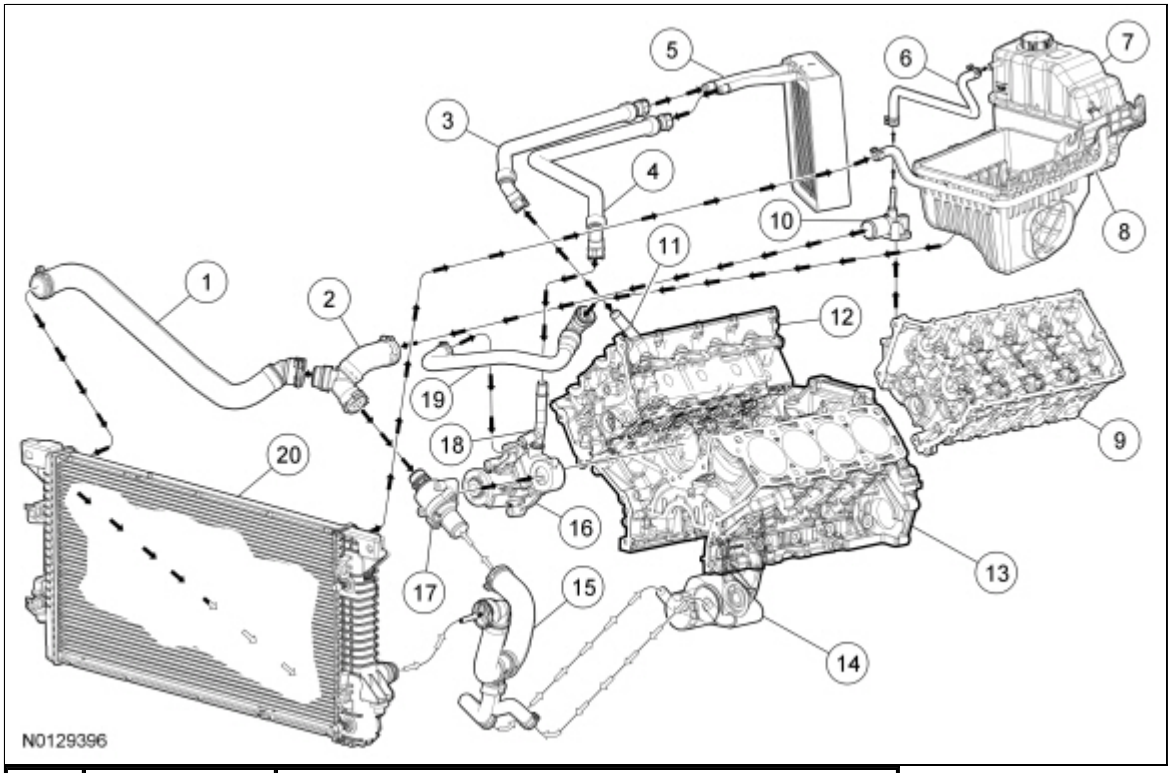
Item	Part Number	Description
1	6049	RH cylinder head
2	9424	Lower intake manifold
3	6049	LH cylinder head
4	8501	Coolant pump
5	8592	Thermostat housing
6	8A080	Degas bottle
7	8075	Radiator-to-degas bottle hose
8	8276	Thermostat housing-to-degas bottle hose

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9	8286	Lower radiator hose and clamp assembly
10	6A642	Engine oil cooler (if equipped)
11	8005	Radiator
12	18472	Heater outlet hose
13	8260	Upper radiator hose and clamp assembly
14	8501	Cylinder block coolant pump hole cover
15	6010	Cylinder block
16	18472	Heater inlet hose
17	18472	Heater outlet jumper
18	18472	Heater inlet jumper
19	18476	Heater core

Coolant Flow Diagram, 5.0L

NOTE: Black arrows indicate hot, white arrows indicate cold.

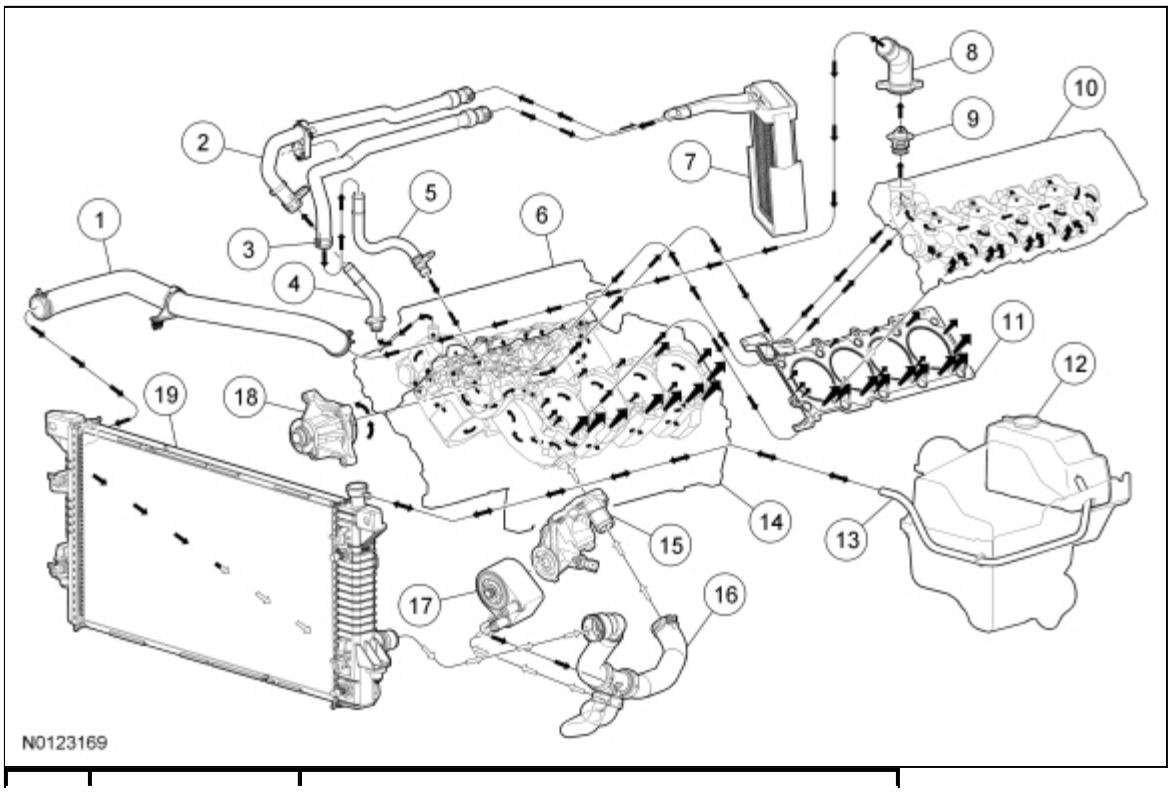


Item	Part Number	Description
1	8260	Upper radiator hose and clamp assembly
2	8566	Coolant bypass T-connector
3	18472	Heater inlet hose
4	18472	Heater outlet hose

5	18476	Heater core
6	8276	Coolant outlet connection-to-degas bottle hose
7	8A080	Degas bottle
8	8075	Radiator-to-degas bottle hose
9	6048	LH cylinder head
10	8592	Coolant outlet connection
11	18696	Heater inlet tube
12	6049	RH cylinder head
13	6010	Cylinder block
14	6A642	Engine oil cooler
15	8286	Lower radiator hose and clamp assembly
16	8501	Coolant pump
17	8592	Thermostat housing
18	18663	Heater outlet tube
19	8C350	Degas bottle-to-heater outlet tube hose
20	8005	Radiator

Coolant Flow Diagram, 6.2L

NOTE: Black arrows indicate hot, white arrows indicate cold.

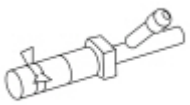


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Item	Part Number	Description
1	8260	Upper radiator hose
2	18472	Heater inlet hose
3	18472	Heater outlet hose
4	18696	Heater inlet tube
5	18663	Heater outlet tube
6	6049	RH cylinder head
7	18476	Heater core
8	8592	Coolant outlet connection
9	8575	Thermostat
10	6049	LH cylinder head
11	6051	LH cylinder head gasket
11	6051	RH cylinder head gasket
12	8A080	Coolant expansion tank
13	8N029	Radiator overflow hose
14	6010	Cylinder block
15	6881	Oil filter adapter
16	8286	Lower radiator hose and clamp assembly
17	6A642	Engine oil cooler
18	8501	Coolant pump
19	8005	Radiator

Engine Cooling

Special Tool(s)

 ST3106-A	3-Way HD Antifreeze Coolant Test Kit 328-00001 or equivalent
 ST1720-A	Coolant/Battery Refractometer 300-ROB75240 or equivalent
 ST3280-A	D-Gas Adapter 014-R1068 or equivalent
 ST3281-A	Radiator Tester STN12270 or equivalent
 ST3254-A	UView® Combustion Leak Tester UVU560000-R or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent scan tool

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated	WSS-M97B44-D

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VC-3-B (US); CVC-3-B2 (Canada)	
Motorcraft® Orange Antifreeze/Coolant Prediluted VC-3DIL-B (US); CVC-3DIL-B (Canada)	WSS-M97B44-D2

Principles of Operation

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump is operated by engine rotation through a pulley which is driven by the accessory drive belt to circulate the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit to transfer engine-generated heat to the outside air.

The degas bottle (3.5L GTDI, 3.7L and 5.0L engines) removes air from the cooling system. It also allows for coolant expansion and system pressurization, replenishes coolant to the cooling system and serves as the location for service fill.

The coolant expansion tank (6.2L engines) holds surplus coolant, allows for coolant expansion and replenishes coolant to the cooling system. It is equipped with a non-pressurized cap which allows coolant to be added to the tank to keep it filled to prescribed levels.

The cooling fan draws air through the radiator to help cool the system coolant as it passes through the radiator.

The thermostat monitor is a function of the PCM and is designed to verify correct thermostat operation. The monitor executes once per drive cycle and has a monitor run duration of 300-800 seconds. If a malfunction occurs, DTC P0125 or P0128 is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Inspection and Verification

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

NOTICE: **The engine cooling system is filled with Motorcraft® Orange Antifreeze/Coolant. Do not mix coolant types. Mixing coolant types degrades the corrosion protection of Motorcraft® Orange Antifreeze/Coolant. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTE: During normal vehicle operation, Motorcraft Orange Antifreeze/Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

1. Verify the customer concern.
2. Visually check the engine coolant level at the degas bottle when the system is cold.
3. Make sure the pressure relief cap is installed correctly.
4. Record any cooling system DTCs retrieved. Refer to the PCM DTC Chart in this section for DTC descriptions.
5. **NOTE:** Take note of any coolant odor or steam coming from cooling system components.

   If the system coolant is filled correctly and no DTCs associated with fail-safe cooling are retrieved, verify the customer's concern by operating the engine to duplicate the condition.
6. **NOTE:** For the coolant flow diagram, refer to Engine Cooling in the Description and Operation portion of this section.

   Visually inspect for obvious signs of any mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Leaks or weeps at: ▪ Hoses ▪ Tubes ▪ Clamp joints ▪ Gaskets ▪ O-rings ▪ Thermostat housing ▪ Radiator ▪ Pressure relief cap ▪ Coolant pump ▪ Heater core (wet floor or coolant odor in vehicle) ▪ Coolant crossover manifold assembly (if equipped) ▪ Oil filter adapter (if equipped) ▪ Oil cooler (if equipped) ▪ Coolant expansion tank (if equipped) ▪ Degas bottle (if equipped) ▪ Cylinder block core plugs ▪ Cylinder head core plugs ▪ Block heater (if equipped) ▪ Turbochargers (if equipped)	• Inoperative or damaged: ▪ Electric cooling fan ▪ Wiring, connectors, relays or modules ▪ Cylinder Head Temperature (CHT) sensor ▪ Vehicle Speed Sensor (VSS)
• Cracked or damaged: ▪ Hoses ▪ Tubes ▪ Hose clamps ▪ Thermostat housing ▪ Radiator ▪ Pressure relief cap ▪ Cooling fan ▪ Coolant pump ▪ Coolant expansion tank (if equipped)	

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▪ Degas bottle (if equipped) ▪ Oil filter adapter (if equipped) ▪ Oil cooler (if equipped) ▪ Coolant crossover manifold assembly (if equipped) ▪ Cylinder block core plugs ▪ Cylinder head core plugs ▪ Block heater (if equipped) ▪ Tirbochargers (if equipped) • Restricted airflow through the A/C condenser/radiator • Drive belt loose, worn or installed incorrectly • Broken or weak drive belt tensioner • Excessive white or light gray exhaust smoke (may have burnt coolant odor) • Coolant in engine oil • Engine oil in coolant • Coolant in automatic transmission fluid • Automatic transmission fluid in coolant	

7. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary. Test the system for normal operation.

8. Inspect the coolant condition.
    1. Inspect the coolant color.
        - Discoloration may indicate that incorrect coolant may have been added to the system. Use of incorrect (green or yellow in color) coolant degrades the corrosion protection of Motorcraft® Orange Antifreeze/Coolant. Addition of Motorcraft® Specialty Green Engine Coolant may cause the color to appear to be a murky green-brown color. The addition of Motorcraft® Gold Antifreeze/Coolant, however, may not change the color or appearance of the orange colored coolant. Detection of contamination with Motorcraft® Gold Antifreeze/Coolant is determined by the presence of nitrite. If contamination with Motorcraft® Gold Antifreeze/Coolant is suspected, test the coolant with the 3-Way HD Antifreeze Coolant Test Kit. Follow the nitrite testing directions in the kit to determine if nitrite is present in the system. If nitrite is present, flush the system and refill with the correct mixture of distilled water and Motorcraft® Orange Antifreeze/Coolant. Refer to Cooling System Flushing in this section.
        - A darker orange with the presence of debris could indicate a commercially available stop leak may have been used and could result in loss of coolant flow to critical parts of the engine. If sediment is present in the coolant sample, flush the system and refill with the correct mixture of distilled water and Motorcraft® Orange Antifreeze/Coolant. Refer to Cooling System Flushing in this section.
        - A light or reddish brown color indicates that rust may be present in the cooling system. Flush the system and refill with the correct mixture of distilled water and Motorcraft® Orange Antifreeze/Coolant. Refer to Cooling System Flushing in this section.
        - An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For engine diagnosis, refer to Section 303-00 . Flush the cooling system and refill with the correct mixture of distilled water and Motorcraft® Orange Antifreeze/Coolant. Refer to Cooling System Flushing in this section.
        - A milky brown color may indicate that engine oil is entering the cooling system. Pressure test the cooling system. Refer to the Component Tests in this section. If engine oil is suspected, the cause of the leak may be internal to the engine. For engine diagnosis, refer to Section 303-00 . Flush the cooling system and refill with the correct mixture of distilled water and Motorcraft® Orange Antifreeze/Coolant. Refer to Cooling System Flushing in this section.
    2. If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Coolant/Battery Refractometer. Maintain the coolant concentration within 48% to 50%, which equates to a freeze point between -31˚C and -37˚C (-30˚F and -34˚F). If the vehicle is

driven in cold climates less than -37°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 48/52 to 50/50 (freeze protection -31°C [-30°F] to -34°C [-34°F]) engine coolant to distilled water.
    - Maximum coolant concentration is 60/40 for cold weather areas.
    - Minimum coolant concentration is 40/60 for warm weather areas.
3. Adjust coolant range and level if necessary:
    - If coolant is low, add specified coolant mixture only.
    - If the engine coolant tests too weak, remove some of the engine coolant and add undiluted engine coolant until the readings are within acceptable levels.
    - If the engine coolant tests strong, remove some of the engine coolant and add distilled water until the readings are within acceptable levels.

9. If an obvious cause for an observed or reported concern is found, correct the cause and test the system for normal operation before proceeding to the next step.

10. **NOTE:** Make sure to use the latest scan tool software release.

    If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

11. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

    If the scan tool does not communicate with the VCM:
    - check the VCM connection to the vehicle.
    - check the scan tool connection to the VCM.
    - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

12. If the scan tool does not communicate with the vehicle:
    - verify the ignition key is in the ON position.
    - verify the scan tool operation with a known good vehicle.
    - refer to Section 418-00 The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

13. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
    - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

14. Clear the CMDTCs and carry out the self-test diagnostics for the PCM.

15. If the DTCs recovered are related to the concern, go to the PCM DTC Chart. For all other PCM DTCs, refer to Section 303-14.

16. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

PCM DTC Chart

PCM DTC Chart

DTC	Description	Action

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P0217	Engine Coolant Over Temperature Condition	GO to Pinpoint Test B .
P1285	Cylinder Head Over Temperature Condition	GO to Pinpoint Test B .
P1299	Cylinder Head Over Temperature Protection Active	GO to Pinpoint Test B .
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control	GO to Pinpoint Test C .
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	GO to Pinpoint Test C .
P0480 P0481 P0482	Fan 1, 2 or 3 Control Circuit, Respectively	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
All Other PCM DTCs	—	REFER to Section 303-14 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Loss of coolant	• Coolant hoses or tubes • Hose clamps • Coolant pump O-ring seal • Thermostat O-ring seal • Thermostat housing • Radiator • Transmission fluid cooler (in radiator) (may leak internally or externally) • Coolant expansion tank • Degas bottle • Pressure relief cap • Coolant pump leaking from weep hole • Cylinder block coolant pump hole cover • Heater core • Coolant crossover manifold assembly • Engine gaskets (may leak internally or externally) • Oil filter adapter (may leak internally or externally) • Oil cooler (may leak internally or externally) • Cylinder block core plugs • Cylinder head core plugs • Block heater (if equipped) • Turbochargers (if equipped)	• GO to Pinpoint Test A .

• The engine overheats	• Low coolant level • External engine coolant leak • Airlock in system • Pressure relief cap installation • Restricted airflow through the A/C condenser/radiator • Internal engine coolant leak • Coolant condition/concentration • Accessory drive components • Non-OEM engine enhancement components • Electric cooling fan • Radiator • Thermostat • Temperature gauge • Cylinder Head Temperature (CHT) sensor • Coolant pump • Coolant flow restriction	• GO to Pinpoint Test B .
• The engine does not reach normal operating temperature	• Low coolant level • Thermostat • Electric cooling fan always on • ECT gauge • CHT sensor	• GO to Pinpoint Test C .
• The block heater does not operate correctly	• Block heater power cable • Block heater	• CHECK continuity in all 3 power cable circuits. If any circuit measures more than 5 ohms, INSTALL a new power cable. • CHECK the resistance of the block heater. If the resistance does not measure between 12.5 and 17.0 ohms, INSTALL a new block heater.
• The electric cooling fan is inoperative in one or more speeds or does not operate correctly	• Wiring • Relays • Fuses • Cooling fan motor	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• The electric cooling fan stays on all the time	• Wiring • Relays	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Noisy electric cooling fan	• Foreign material contamination • Fan motor	• REMOVE the foreign material from the cooling fan and shroud. TEST the system for normal

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		operation. If still noisy, INSTALL a new cooling fan assembly.
	• Fan blade detached from fan motor	• INSTALL a new cooling fan assembly.

Pinpoint Tests

Pinpoint Test A: Loss of Coolant

Normal Operation

The engine cooling system is a closed system providing for coolant expansion and contraction as well as changes in pressure as coolant warms and cools with engine operation. Various gaskets, seals, hoses and clamps contain coolant within the cooling system and keep other fluids and contaminants from entering the cooling system.

Coolant loss can be attributed to either external or internal leaks anywhere within the cooling system.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

This pinpoint test is intended to diagnose the following:

- Coolant hoses or tubes
- Hose clamps
- Thermostat O-ring seal
- Coolant pump gasket or O-ring seal
- Thermostat housing
- Radiator
- Transmission fluid cooler (in radiator)
- Pressure relief cap
- Coolant pump leaking from weep hole
- Cylinder block coolant pump hole cover
- Heater core
- Coolant crossover manifold assembly
- Engine gaskets (may leak internally or externally)
- Oil filter adapter (may leak internally or externally)
- Oil cooler (may leak internally or externally)
- Coolant expansion tank
- Degas bottle
- Cylinder block core plugs
- Cylinder head core plugs
- Block heater (if equipped)
- Turbochargers (if equipped)

PINPOINT TEST A: LOSS OF COOLANT

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew

the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step	Result / Action to Take
A1 CARRY OUT INSPECTION AND VERIFICATION • Carry out the inspection and verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to A2.
A2 CHECK THE ENGINE COOLANT LEVEL **NOTE:** Allow the engine to cool before checking the engine coolant level. • Ignition OFF. • Visually inspect the engine coolant level at the coolant expansion tank. • **Is the engine coolant level within specifications?**	**Yes** GO to A3. **No** ADJUST the engine coolant level as necessary. GO to A3.
A3 PRESSURE TEST THE ENGINE COOLING SYSTEM • Pressure test the engine cooling system. For 3.5L GTDI, 3.7L or 5.0L engines, refer to Component Tests, Cooling System Pressure Test - Degas Bottle Systems in this section. For 6.2L engines, refer to Component Tests, Cooling System Pressure Test - Coolant Expansion Tank Systems in this section. • **Does the engine cooling system leak externally?**	**Yes** REPAIR or INSTALL new components. TEST the system for normal operation. **No** GO to A4.
A4 CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK • Inspect the engine coolant in the degas bottle or the coolant expansion tank and the radiator for signs of engine oil or transmission fluid. • **Is engine oil or transmission fluid evident in the coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 for engine diagnosis. If transmission fluid is evident, INSTALL a new radiator. REPAIR the transmission as necessary. Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation. **No** GO to A5.
A5 CHECK THE ENGINE OIL AND TRANSMISSION FLUID FOR COOLANT • Remove the oil level indicators from the engine and the transmission. • **Is coolant evident in the oil or transmission fluid?**	**Yes** If coolant is in the engine oil, GO to Section 303-00. If coolant is in the transmission fluid, INSTALL a new radiator. REPAIR the transmission as necessary. Refer to the appropriate section in Group 307 for the procedure.

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	No GO to A6 .
A6 CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
• **NOTE:** Use UView® Combustion Leak Tester part number UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • **Are combustion gases present?**	**Yes** GO to Section 303-00 for engine diagnosis. **No** The cooling system is operational.

Pinpoint Test B: The Engine Overheats

Normal Operation

The engine cooling system maintains the engine temperature during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump, operated by engine rotation through a pulley driven by the accessory drive belt, circulates the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit to transfer engine-generated heat to the outside air.

Engine overheating generally occurs when there is a disruption in the ability to control either coolant flow at the proper rate, the inability to transfer heat from the engine through the coolant (including low coolant) or an inability to transfer engine generated heat to the outside air through the radiator.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0217 (Engine Coolant Over Temperature Condition) — Indicates an engine overheat condition was detected by the Cylinder Head Temperature (CHT) sensor.
- DTC P1285 (Cylinder Head Over Temperature Condition) — Indicates an engine overheat condition was sensed by the CHT sensor.
- DTC P1299 (Cylinder Head Over Temperature Protection Active) — Indicates an engine overheat condition was detected by the CHT sensor. A failure mode effects management strategy called fail-safe cooling was activated to cool the engine.

This pinpoint test is intended to diagnose the following:

- Low coolant level
- External engine coolant leak
- Airlock in system
- Pressure relief cap installation
- Restricted airflow through the A/C condenser/radiator
- Internal engine coolant leak
- Coolant condition/concentration
- Accessory drive components
- Non-OEM engine enhancement components

- Electric cooling fan
- Temperature gauge
- CHT sensor
- Coolant pump
- Coolant flow restriction
- Radiator
- Thermostat

PINPOINT TEST B: THE ENGINE OVERHEATS

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step	Result / Action to Take
B1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the inspection and verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to B2.
B2 CHECK FOR DTCs	
• Check for DTC P0217, P1285 or P1299. • **Is DTC P0217, P1285 or P1299 present?**	**Yes** GO to B3. **No** Actual engine overheating has not been verified. CHECK the engine coolant temperature gauge operation. REFER to Section 413-01. If any other PCM DTCs are retrieved, REFER to Section 303-14.
B3 CHECK FOR AN AIRFLOW OBSTRUCTION	
• Check the radiator or A/C condenser for an obstruction such as leaves or cardboard. • **Is an obstruction present?**	**Yes** REMOVE the obstruction. TEST the system for normal operation. **No** GO to B4.
B4 CHECK THE ENGINE COOLANT LEVEL	
NOTE: Allow the engine to cool before checking the coolant level. • Ignition OFF. • Visually check the engine coolant level in the coolant expansion tank. • **Is the engine coolant level within specification?**	**Yes** GO to B5. **No** ADJUST the engine coolant level as necessary. GO to B5.

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B5 PRESSURE TEST THE ENGINE COOLING SYSTEM	
• Pressure test the engine cooling system. For 3.5L GTDI, 3.7L or 5.0L engines, refer to Component Tests, Cooling System Pressure Test - Degas Bottle System in this section. For 6.2L engines, refer to Component Tests, Cooling System Pressure Test - Coolant Expansion Tank System in this section. • **Does the engine cooling system leak externally?**	**Yes** REPAIR or INSTALL new components. TEST the system for normal operation. **No** For 6.2L engines, GO to B6 . For 3.5L GTDI, 3.7L or 5.0L engines, GO to B7 .
B6 CHECK THE PRESSURE RELIEF CAP	
• Carry out the Pressure Relief Cap Pressure Test. Refer to Component Test, Pressure Relief Cap Pressure Test in this section. • **Is the pressure relief cap OK?**	**Yes** GO to B7 . **No** INSTALL a new pressure relief cap. TEST the system for normal operation.
B7 CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
• Inspect the engine coolant in the degas bottle or the coolant expansion tank and the radiator for signs of engine oil or transmission fluid. • **Is engine oil or transmission fluid evident in the coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 for engine diagnosis. If transmission fluid is evident, INSTALL a new radiator. REPAIR the transmission as necessary. Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation. **No** GO to B8 .
B8 CHECK THE ENGINE OIL AND TRANSMISSION FLUID FOR COOLANT	
• Remove the oil level indicators from the engine and the transmission. • **Is coolant evident in the oil or transmission fluid?**	**Yes** If coolant is in the engine oil, GO to Section 303-00 . If coolant is in the transmission fluid, INSTALL a new radiator. REPAIR the transmission as necessary. Refer to the appropriate section in Group 307 for the procedure. **No** GO to B9 .
B9 CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
• **NOTE:** Use UView® Combustion Leak Tester part number UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • **Are combustion gases present?**	**Yes** GO to Section 303-00 for engine diagnosis. **No** GO to B10 .
B10 CHECK COOLANT CONDITION	

• Check the coolant for dirt, rust or contamination and check the coolant concentration. • **Is the coolant condition OK?**	**Yes** GO to B11 . **No** FLUSH the engine cooling system. REFER to Cooling System Flushing in this section. TEST the system for normal operation.
B11 CHECK THE ELECTRIC COOLING FAN OPERATION	
• Start the engine. • Place the climate control function selector in the MAX A/C position and the blower motor switch in the HI position. • **Did the electric cooling fan operate?**	**Yes** GO to B12 . **No** DIAGNOSE the electric cooling fan operation. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B12 CHECK THE COOLANT PUMP OPERATION	
• Start the engine. • Allow the engine to run for 10 minutes. Place the climate control function selector in the MAX HEAT position. Feel the heater outlet hose. • **Is the heater outlet hose hot?**	**Yes** GO to B13 . **No** INSTALL a new coolant pump. TEST the system for normal operation.
B13 CHECK THE THERMOSTAT OPERATION	
• Start the engine. • Allow the engine to run for 10 minutes (6.2L engines) or 30 minutes (3.5L GTDI, 3.7L or 5.0L engines). Feel the upper radiator hose. • **Is the upper radiator hose hot?**	**Yes** CHECK the engine coolant temperature gauge operation. REFER to Section 413-01 . **No** GO to B14 .
B14 VISUALLY INSPECT THE THERMOSTAT	
• Carry out the Thermostat Visual Inspection in the Component Tests portion of this section. • **Is the thermostat damaged?**	**Yes** INSTALL a new thermostat. TEST the system for normal operation. **No** INSTALL a new thermostat. TEST the system for normal operation. If the engine still overheats, INSTALL a new radiator. TEST the system for normal operation.

Pinpoint Test C: The Engine Does Not Reach Normal Operating Temperature

Normal Operation

The engine cooling system maintains engine temperature during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump, operated by engine rotation through a pulley driven by the accessory drive belt, circulates the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit

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and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit to transfer engine generated heat to the outside air.

Concerns of engine inability to reach normal operating temperature typically occur when the rate of coolant flow through some coolant circuits (radiator, heater core) is more than expected given the conditions, or when the cooling fans operate all of the time. Heat is not allowed to build in the engine because a heat exchanger is removing too much heat, including the radiator, heater core and oil cooler. In addition, perceived concerns that the engine does not reach normal operating temperature can be related to a low coolant level or trapped air which does not allow for hot coolant to be available at the heater core, an inoperative climate control system, or for concerns perceived or related to an incorrect engine temperature gauge indication.

- DTC P0125 (Insufficient Coolant Temperature For Closed Loop Fuel Control) — Indicates the Cylinder Head Temperature (CHT) sensor has not achieved the required temperature level to enter closed loop operating conditions within a specified amount of time after starting the engine.
- DTC P0128 (Coolant Thermostat [Coolant Temperature Below Thermostat Regulating Temperature]) — Indicates the thermostat monitor has not achieved the required engine operating temperature within a specified amount of time after starting the engine.

This pinpoint test is intended to diagnose the following:

- Low coolant level
- Thermostat
- Temperature gauge
- Electric cooling fan always on
- Cylinder Head Temperature (CHT) sensor

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step	Result / Action to Take
C1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the inspection and verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to C2 .
C2 CHECK FOR DTC P0125 or P0128	
• Check for DTC P0125 or P0128. • **Is DTC P0125 or P0128 present?**	**Yes** GO to C3 . **No** The cooling system is operational. If an inoperative engine coolant temperature gauge is suspected, CHECK the engine coolant

	temperature gauge operation. REFER to Section 413-01 . If an inoperative climate control system is suspected, CHECK the climate control system operation. REFER to Section 412-00 . If any other PCM DTCs are retrieved, REFER to Section 303-14 .
C3 CHECK THE ELECTRIC COOLING FAN OPERATION • Allow the engine to cool. • Make sure the A/C switch is OFF. • Start the engine. • Check the electric cooling fan. • **Is the electric cooling fan on all the time?**	**Yes** DIAGNOSE the electric cooling fan operation. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to C4 .
C4 CHECK THE COOLANT LEVEL • **NOTE:** Allow the engine to cool before checking the coolant level. • Visually check the engine coolant level in the coolant expansion tank. • **Is the engine coolant level within specification?**	**Yes** INSTALL a new thermostat. TEST the system for normal operation. **No** GO to Pinpoint Test A to diagnose a coolant leak.

Component Tests

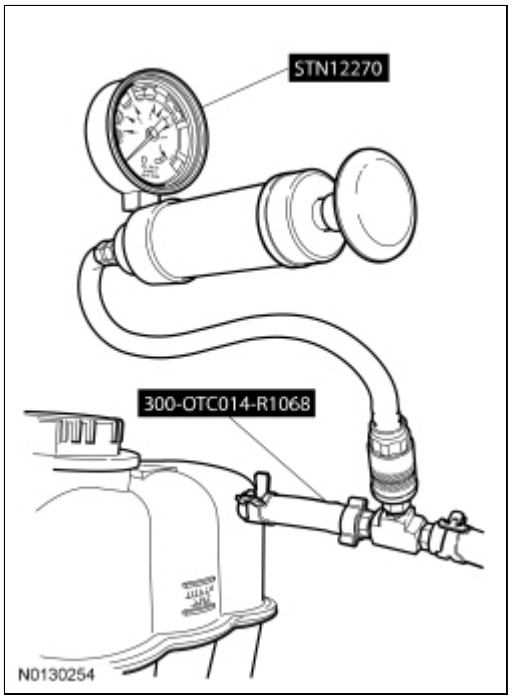
Cooling System Pressure Test - Degas Bottle Systems

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

NOTE: Vehicles equipped with a degas bottle system have the pressure relief cap on the degas bottle and no radiator cap. The pressure relief cap is tested as part of the cooling system pressure test.

1. Turn the engine off.
2. Check the engine coolant level. Adjust the coolant level as necessary.
3. Attach the D-Gas Adapter to the degas bottle nipple and overflow hose. Install the Radiator Tester to the quick connect fitting of the D-Gas Adapter.

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4. ***NOTICE:*** **Do not pressurize the cooling system beyond the maximum pressure listed in the specifications table in this section or cooling system components may be damaged.**

   NOTE: If the plunger of the pressure tester is pressed too fast, an erroneous pressure reading results.

   Slowly press the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained. If the pressure reading exceeds the maximum cap pressure listed in the specifications table, install a new pressure relief cap.

5. If the system does not hold pressure, remove the pressure relief cap and wash in clean water to dislodge all of the foreign material from the gasket. Check the sealing surface in the filler neck of the degas bottle for nicks or cuts. Install the pressure relief cap.

6. Pressurize the engine cooling system as described in Step 4. Observe the gauge reading for approximately 2 minutes. Pressure should not drop during this time. If the pressure drops, inspect for leaks and repair as necessary.

7. If no leaks are found and the pressure drops, the pressure relief cap may be leaking. Install a new pressure relief cap and retest the system.

8. If no leaks are found after a new pressure relief cap is installed, and the pressure drops, the leak may be internal to the engine. Inspect the coolant for engine oil and the engine oil for coolant. Refer to Section 303-00 to diagnose the engine.

9. Release the system pressure by loosening the pressure relief cap. Check the coolant level and adjust as necessary.

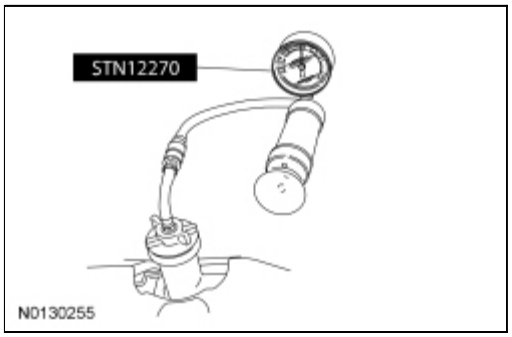
Coolant System Pressure Test - Coolant Expansion Tank Systems

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

NOTE: Vehicles equipped with a coolant expansion tank have the pressure relief cap on the radiator. The pressure relief cap is tested separately.

1. Turn the engine off.

2. Remove the pressure relief cap. Fill the radiator with coolant if needed.



3. Fit the Radiator Tester to the radiator fill neck.

4. ***NOTICE:*** **Do not pressurize the cooling system beyond the maximum pressure listed in the specifications table in this section, or cooling system components can be damaged.**

   NOTE: If the plunger of the pressure tester is pressed too fast, an erroneous pressure reading results.

   Slowly press the plunger of the pressure test pump to the maximum allowed pressure and hold for 2 minutes. If the pressure drops within this time, inspect for leaks and repair as necessary.

5. If no leaks are found and the pressure drops, the leak may be internal to the radiator transmission cooler. Inspect the coolant for transmission fluid and the transmission fluid for coolant. Repair as necessary.

6. If there is no contamination of the coolant or transmission fluid, the leak may be internal to the engine. Inspect the coolant for engine oil and the engine oil for coolant. Refer to Section 303-00 to diagnose the engine.

Pressure Relief Cap Pressure Test

1. Inspect the pressure relief cap and seals for damage or deterioration. Install a new pressure relief cap if necessary.

2. Using the correct adapter, fit the pressure relief cap to the Radiator Tester.

3. **NOTE:** If the plunger of the pressure tester is pressed to fast, an incorrect pressure reading results.

   Slowly press the plunger of the pressure test pump until the pressure gauge stops increasing and note the highest pressure reading. Release the pressure and repeat the test. Install a new pressure relief cap if the pressure is not within the pressure listed in the Specifications table in this section.

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Thermostat

A new thermostat should be installed only after the following tests and checks have been carried out:

- Pinpoint Test B or C
- Thermostat Visual Inspection

Thermostat Visual Inspection

1. Remove the thermostat.

2. Examine the thermostat for signs of damage including:
    - Valve not fully seated (light visible through the valve)
    - Foreign material lodged in the main valve
    - Bent or broken frame or flange
    - Bent or broken spring
    - Bent or broken valve or valve stem
    - Wax leaking from wax reservoir or a bulge in the reservoir
    - Any other damage or distortion

3. **NOTE:** If no damage is found during the inspection, do not attempt to open the thermostat using hot water or other heat sources. This method is not an accurate means to test the function of the thermostat and may damage the thermostat.

    If damage is found during the inspection, remove any foreign material or broken pieces and install a new thermostat.

Radiator Leak Test, Removed From Vehicle

NOTICE: **Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.**

NOTE: Always install plugs in the transmission fluid cooler fittings before leak testing or cleaning any radiator.

NOTE: Clean the radiator before leak testing to avoid contamination of tank.

Leak test the radiator in clean water with air pressurized to the maximum pressure listed in the Specifications.

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Cooling System Draining, Filling and Bleeding

Special Tool(s)

 ST2818-A	Air Lift Cooling System Tester UVU550000 or equivalent

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D
Motorcraft® Orange Antifreeze/Coolant Prediluted VC-3DIL-B (US); CVC-3DIL-B (Canada)	WSS-M97B44-D2

Draining

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

NOTICE: **The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated it must be recycled or disposed of correctly. Failure to follow these instructions may result in engine or cooling system damage.**

NOTE: Less than 80% of the coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

NOTE: During normal vehicle operation, Motorcraft Orange Antifreeze/Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Make sure the engine is cool.
3. Wrap a thick cloth around the pressure relief cap. Slowly turn the cap counterclockwise until the

pressure begins to release.

4. Step back while the pressure releases.

5. When sure all the pressure has been released, use the cloth to turn and remove the cap.

6. Place a suitable container below the radiator draincock. Drain the coolant.
    - Tighten the radiator draincock when finished.

Filling and Bleeding with a Vacuum Cooling System Filler - Degas Bottle Systems

NOTICE: **The engine cooling system is filled with Motorcraft® Orange Antifreeze/Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection, and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

To maintain the integrity of the coolant and the cooling system:

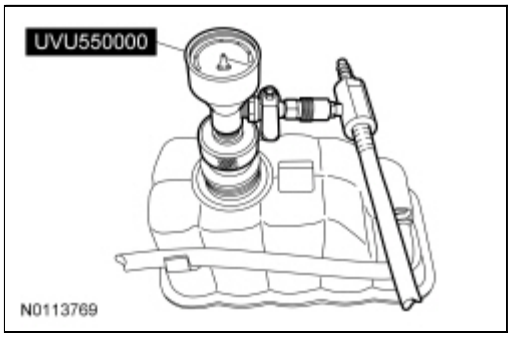
- **Add Motorcraft® Orange Antifreeze/Coolant or equivalent. Do not mix coolant types.**
- **Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.**
- **Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.**
- **Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Orange Antifreeze/Coolant since a Ford-approved recycling process is not yet available.**

1. Install the vacuum cooling system filler and follow the manufacturer's instructions to fill and bleed the cooling system.
   When adding or topping of the engine coolant:
    1. Measure the coolant concentration in the vehicle using the Coolant/Battery Refractometer 300-ROB75240 or equivalent.
    2. Determine the concentration desired based on the vehicle duty cycle of extreme hot or cold operating conditions.
    3. Add/top off or adjust coolant as follows:
        - For concentrations measured 48/52 to 50/50 (equates to a freeze point between -31°C [-30°F] and -34°C [-37°F]), use Motorcraft® Orange Antifreeze/Coolant Prediluted to maintain a coolant concentration in this same range.
        - For all other concentrations, use Motorcraft® Orange Antifreeze/Coolant Concentrated and/or distilled water to get to the desired concentration.
        - When refilling the engine coolant after a flush procedure, use a mixture of Motorcraft® Orange Antifreeze/Coolant Concentrated and distilled water to get to the desired concentration.
    4. Recommended coolant concentration is 48/52 to 50/50 engine coolant to distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]).
    5. For extremely cold climates (less than -37°C [-34°F]):
        - It may be necessary to increase the coolant concentration above 50%.
        - NEVER increase the coolant concentration above 60%.
        - Maximum coolant concentration is 60/40 for cold weather areas.

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- A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
- Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.

6. For extremely hot climates:
   - It is still necessary to maintain the coolant concentration above 40%.
   - NEVER decrease the coolant concentration below 40%.
   - Minimum coolant concentration is 40/60 for warm weather areas.
   - A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
   - Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
7. Vehicles driven year-round in non-extreme climates should use a 48/52 to 50/50 mixture of engine coolant and distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]) for optimum cooling system and engine protection.



Filling and Bleeding without a Vacuum Cooling System Filler - Degas Bottle Systems

NOTICE: **The engine cooling system is filled with Motorcraft® Orange Antifreeze/Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

To maintain the integrity of the coolant and the cooling system:

- **Add Motorcraft® Orange Antifreeze/Coolant or equivalent. Do not mix coolant types.**
- **Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.**
- **Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.**
- **Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Orange Antifreeze/Coolant since a Ford-approved recycling process is not yet available.**

1. Fill the radiator through the degas bottle until the coolant level is between the COOLANT FILL LEVEL marks.
   When adding or topping of the engine coolant:
   1. Measure the coolant concentration in the vehicle using the Coolant/Battery Refractometer 300-ROB75240 or equivalent.
   2. Determine the concentration desired based on the vehicle duty cycle of extreme hot or cold

operating conditions.

3. Add/top off or adjust coolant as follows:
    - For concentrations measured 48/52 to 50/50 (equates to a freeze point between -31°C [-30°F] and -34°C [-37°F]), use Motorcraft® Orange Antifreeze/Coolant Prediluted to maintain a coolant concentration in this same range.
    - For all other concentrations, use Motorcraft® Orange Antifreeze/Coolant Concentrated and/or distilled water to get to the desired concentration.
    - When refilling the engine coolant after a flush procedure, use a mixture of Motorcraft® Orange Antifreeze/Coolant Concentrated and distilled water to get to the desired concentration.
4. Recommended coolant concentration is 48/52 to 50/50 engine coolant to distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]).
5. For extremely cold climates (less than -37°C [-34°F]):
    - It may be necessary to increase the coolant concentration above 50%.
    - NEVER increase the coolant concentration above 60%.
    - Maximum coolant concentration is 60/40 for cold weather areas.
    - A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
    - Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
6. For extremely hot climates:
    - It is still necessary to maintain the coolant concentration above 40%.
    - NEVER decrease the coolant concentration below 40%.
    - Minimum coolant concentration is 40/60 for warm weather areas.
    - A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
    - Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
7. Vehicles driven year-round in non-extreme climates should use a 48/52 to 50/50 mixture of engine coolant and distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]) for optimum cooling system and engine protection.

2. Select the maximum heater temperature and blower motor speed settings. Position the control to discharge air at A/C vents in instrument panel.

3. Start the engine and allow to idle. While engine is idling, feel for hot air at A/C vents.

4. ***NOTICE:*** **If the air discharge remains cool and the Engine Coolant Temperature (ECT) gauge does not move, the engine coolant level is low and must be filled. Stop the engine, allow the engine to cool and fill cooling system. Failure to follow these instructions may result in damage to the engine.**

   Start the engine and allow it to idle until normal operating temperature is reached. Hot air should discharge from A/C vents. The Engine Coolant Temperature (ECT) gauge should maintain a stabilized reading in the middle of the NORMAL range. The upper radiator hose should feel hot to the touch.

5. Shut the engine off and allow the engine to cool.

6. Check the engine coolant level in the degas bottle and fill as necessary.

7. Repeat the previous 4 steps as necessary.

Filling and Bleeding with a Vacuum Cooling System Filler - Coolant Expansion Tank System

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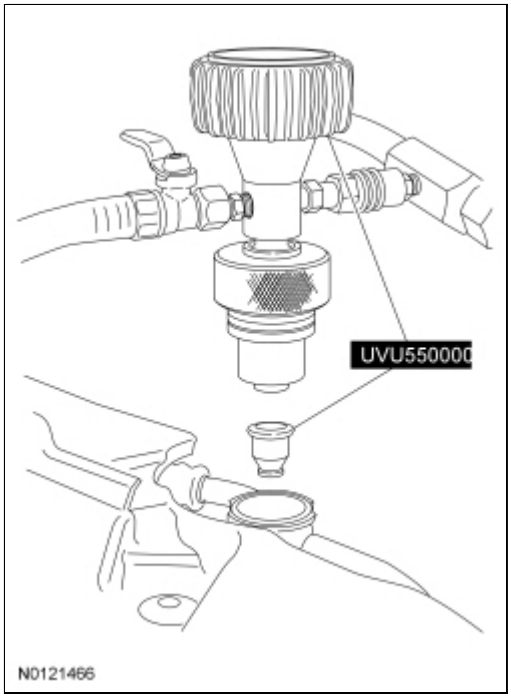
NOTICE: **Vehicle cooling systems are filled with Motorcraft® Orange Antifreeze/Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level. Failure to follow these instructions may damage the engine or cooling system.**

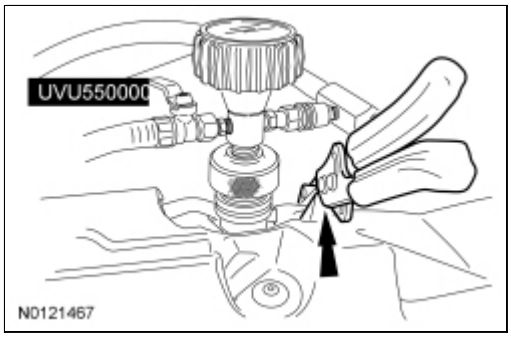
To maintain the integrity of the coolant and the cooling system:

- **Add Motorcraft® Orange Antifreeze/Coolant or equivalent. Do not mix coolant types.**
- **Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.**
- **Do not add alcohol, methanol or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.**
- **Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Orange Antifreeze/Coolant since a Ford-approved recycling process is not yet available.**

1. Connect the vacuum cooling system filler and the appropriate rubber adapter to the radiator.



2. Clamp the radiator-to-coolant expansion tank hose near the radiator.



3. Follow the vacuum cooling system filler manufacturer's instructions to fill and bleed the cooling system.
   When adding or topping of the engine coolant:
   1. Measure the coolant concentration in the vehicle using the Coolant/Battery Refractometer 300-ROB75240 or equivalent.
   2. Determine the concentration desired based on the vehicle duty cycle of extreme hot or cold operating conditions.
   3. Add/top off or adjust coolant as follows:
      - For concentrations measured 48/52 to 50/50 (equates to a freeze point between -31°C [-30°F] and -34°C [-37°F]), use Motorcraft® Orange Antifreeze/Coolant Prediluted to maintain a coolant concentration in this same range.
      - For all other concentrations, use Motorcraft® Orange Antifreeze/Coolant Concentrated and/or distilled water to get to the desired concentration.
      - When refilling the engine coolant after a flush procedure, use a mixture of Motorcraft® Orange Antifreeze/Coolant Concentrated and distilled water to get to the desired concentration.
   4. Recommended coolant concentration is 48/52 to 50/50 engine coolant to distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]).
   5. For extremely cold climates (less than -37°C [-34°F]):
      - It may be necessary to increase the coolant concentration above 50%.
      - NEVER increase the coolant concentration above 60%.
      - Maximum coolant concentration is 60/40 for cold weather areas.
      - A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
      - Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
   6. For extremely hot climates:
      - It is still necessary to maintain the coolant concentration above 40%.
      - NEVER decrease the coolant concentration below 40%.
      - Minimum coolant concentration is 40/60 for warm weather areas.
      - A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
      - Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
   7. Vehicles driven year-round in non-extreme climates should use a 48/52 to 50/50 mixture of engine coolant and distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]) for optimum cooling system and engine protection.

Filling and Bleeding without a Vacuum Cooling System Filler - Coolant Expansion Tank Systems

NOTICE: **Vehicle cooling systems are filled with Motorcraft® Orange Antifreeze/Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

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NOTICE: **Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level. Failure to follow these instructions may damage the engine or cooling system.**

To maintain the integrity of the coolant and the cooling system:

- **Add Motorcraft® Orange Antifreeze/Coolant or equivalent. Do not mix coolant types.**
- **Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.**
- **Do not add alcohol, methanol or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.**
- **Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Orange Antifreeze/Coolant since a Ford-approved recycling process is not yet available.**

Vehicles equipped with a 6.2L engine

1. **NOTE:** For coolant flow diagrams, refer to Engine Cooling in Description and Operation in this section.

   Release the clamp and disconnect the heater inlet hose from the heater inlet tube.

2. Fill the radiator through the radiator fill neck until engine coolant flows from the heater inlet tube. When adding or topping of the engine coolant:
   1. Measure the coolant concentration in the vehicle using the Coolant/Battery Refractometer 300-ROB75240 or equivalent.
   2. Determine the concentration desired based on the vehicle duty cycle of extreme hot or cold operating conditions.
   3. Add/top off or adjust coolant as follows:
      - For concentrations measured 48/52 to 50/50 (equates to a freeze point between -31°C [-30°F] and -34°C [-37°F]), use Motorcraft® Orange Antifreeze/Coolant Prediluted to maintain a coolant concentration in this same range.
      - For all other concentrations, use Motorcraft® Orange Antifreeze/Coolant Concentrated and/or distilled water to get to the desired concentration.
      - When refilling the engine coolant after a flush procedure, use a mixture of Motorcraft® Orange Antifreeze/Coolant Concentrated and distilled water to get to the desired concentration.
   4. Recommended coolant concentration is 48/52 to 50/50 engine coolant to distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]).
   5. For extremely cold climates (less than -37°C [-34°F]):
      - It may be necessary to increase the coolant concentration above 50%.
      - NEVER increase the coolant concentration above 60%.
      - Maximum coolant concentration is 60/40 for cold weather areas.
      - A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
      - Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
   6. For extremely hot climates:
      - It is still necessary to maintain the coolant concentration above 40%.
      - NEVER decrease the coolant concentration below 40%.
      - Minimum coolant concentration is 40/60 for warm weather areas.
      - A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
      - Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
   7. Vehicles driven year-round in non-extreme climates should use a 48/52 to 50/50 mixture of

engine coolant and distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]) for optimum cooling system and engine protection.

3. Connect the heater inlet hose to the heater inlet tube and position the clamp.

All vehicles

4. Fill the radiator through the radiator fill neck until the coolant level is at the bottom of the filler neck. When adding or topping of the engine coolant:
    1. Measure the coolant concentration in the vehicle using the Coolant/Battery Refractometer 300-ROB75240 or equivalent.
    2. Determine the concentration desired based on the vehicle duty cycle of extreme hot or cold operating conditions.
    3. Add/top off or adjust coolant as follows:
        - For concentrations measured 48/52 to 50/50 (equates to a freeze point between -31°C [-30°F] and -34°C [-37°F]), use Motorcraft® Orange Antifreeze/Coolant Prediluted to maintain a coolant concentration in this same range.
        - For all other concentrations, use Motorcraft® Orange Antifreeze/Coolant Concentrated and/or distilled water to get to the desired concentration.
        - When refilling the engine coolant after a flush procedure, use a mixture of Motorcraft® Orange Antifreeze/Coolant Concentrated and distilled water to get to the desired concentration.
    4. Recommended coolant concentration is 48/52 to 50/50 engine coolant to distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]).
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        - A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
        - Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
    7. Vehicles driven year-round in non-extreme climates should use a 48/52 to 50/50 mixture of engine coolant and distilled water (freeze protection -31°C [-30°F] to -34°C [-37°F]) for optimum cooling system and engine protection.

5. Install the radiator cap.

6. Fill the coolant expansion tank until the coolant reaches the COLD FILL mark.

7. Select the maximum heater temperature and blower motor speed settings. Position the control to discharge air at A/C vents in instrument panel.

8. ***NOTICE:*** **If the air discharge remains cool and the engine coolant temperature gauge does not move, the engine coolant level is low in the engine and must be filled. Stop the engine, allow it to cool and fill the cooling system. Failure to follow this instruction may result in damage to the engine.**

    Run the engine at idle until it reaches normal operating temperature.

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9. Turn the engine off and allow it to cool.

10. Add the correct coolant mixture to the coolant expansion tank until the coolant level is at the COLD FILL mark.

11. Start the engine and allow it to idle until it reaches normal operating temperature. While the engine is idling, feel for hot air from the A/C vents.
    - Hot air should discharge from the A/C vents. The engine coolant temperature gauge should maintain a stabilized reading in the middle of the NORMAL range and the upper radiator hose should feel hot to the touch.

12. Check the engine coolant level in the coolant expansion tank and fill it as necessary.

13. Repeat the previous 5 steps as necessary.

Cooling System Flushing

Material

Item	Specification
Motorcraft® Premium Cooling System Flush VC-1	ESR-M14P7-A

1. **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the thermostat. For additional information, refer to Thermostat — 3.5L GTDI, Thermostat — 3.7L, Thermostat — 5.0L or Thermostat — 6.2L in this section.

3. Install the coolant inlet connection (3.5L GTDI, 3.7L or 5.0L engines) or the coolant outlet connection (6.2L engines) without the thermostat.

4. **NOTE:** Refer to the cooling system flusher manufacturer's operating instructions for specific vehicle hook-up.

   Use a cooling system flusher to flush the engine and radiator.
   - Use Motorcraft® Premium Cooling System Flush and follow the directions on the packaging.

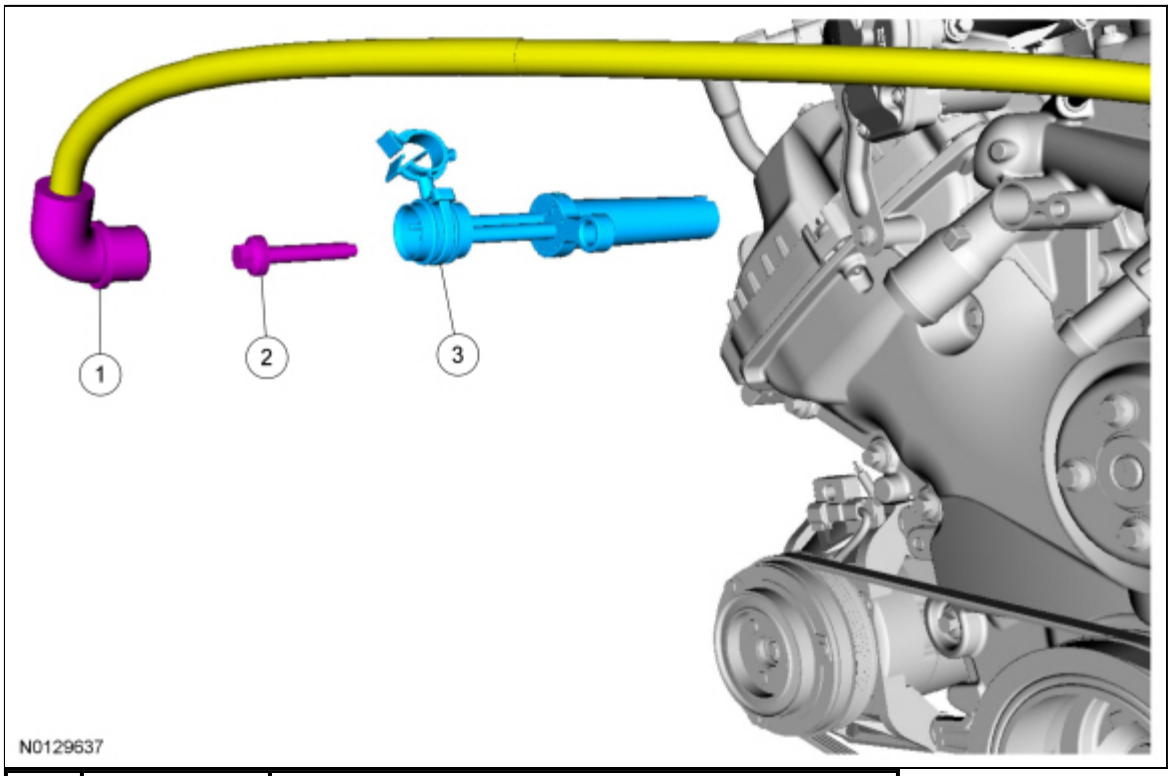
5. Install the thermostat. For additional information, refer to Thermostat — 3.5L GTDI, Thermostat — 3.7L, Thermostat — 5.0L or Thermostat — 6.2L in this section.

6. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

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Block Heater

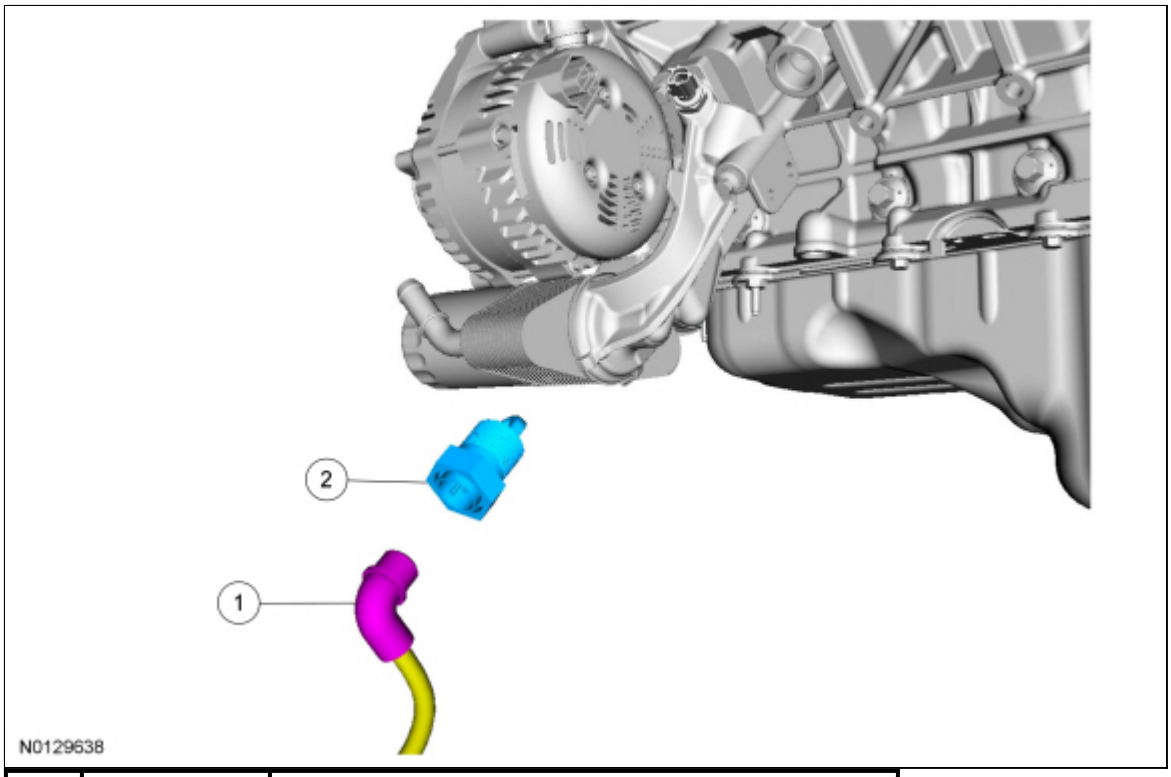
3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L Engines



Item	Part Number	Description
1	—	Block heater electrical connector (part of 6B018)
2	W503277	Block heater bolt - 6 Nm (53 lb-in)
3	6A051	Block heater

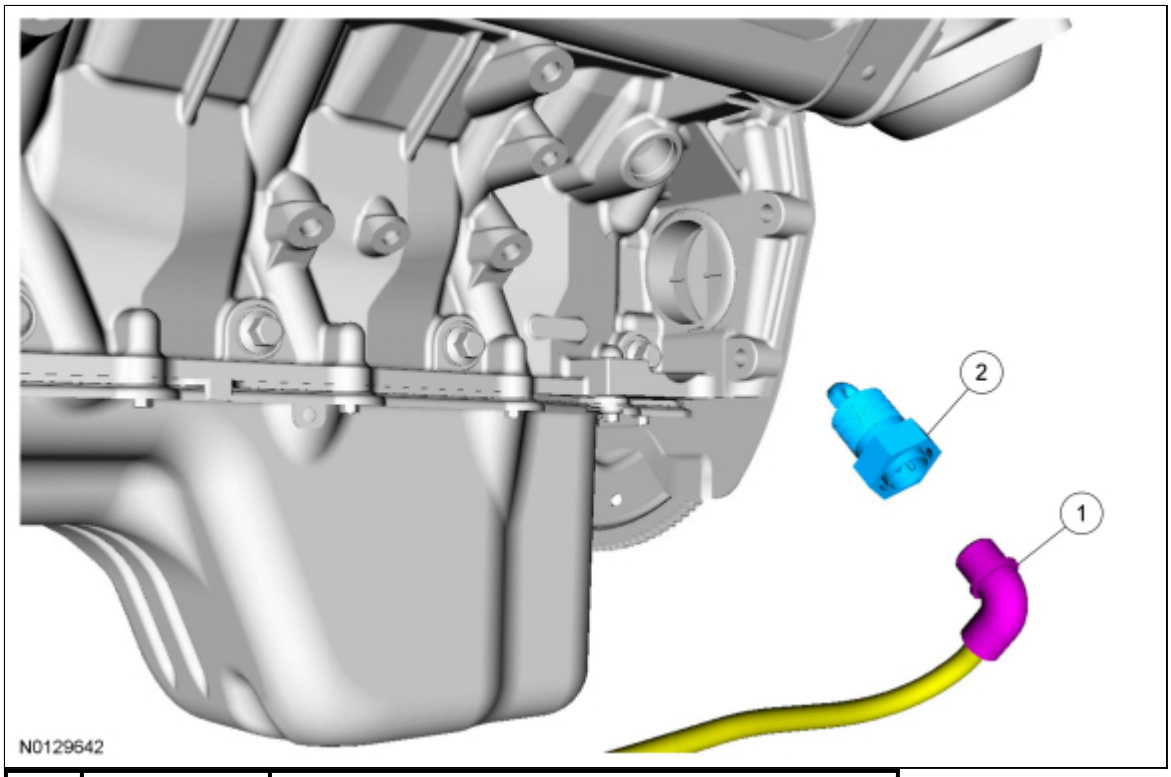
5.0L Engine

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Item	Part Number	Description
1	—	Block heater electrical connector (part of 6B018)
2	6A051	Block heater - 40 Nm (30 lb-ft).

6.2L Engine



Item	Part Number	Description
1	—	Block heater electrical connector (part of 6B018)
2	6A051	Block heater - 40 Nm (30 lb-ft).

Removal and Installation

5.0L and 6.2L engines

1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L engines

2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

All engines

3. ***NOTICE:*** **To install, route the block heater power cable away from hot or rotating components, or the cable can be damaged.**

   Disconnect the block heater electrical connector.

3.5L GTDI and 3.7L engines

4. Remove the bolt and the block heater.
   - To install, tighten to 6 Nm (53 lb-in).

5.0L and 6.2L engines

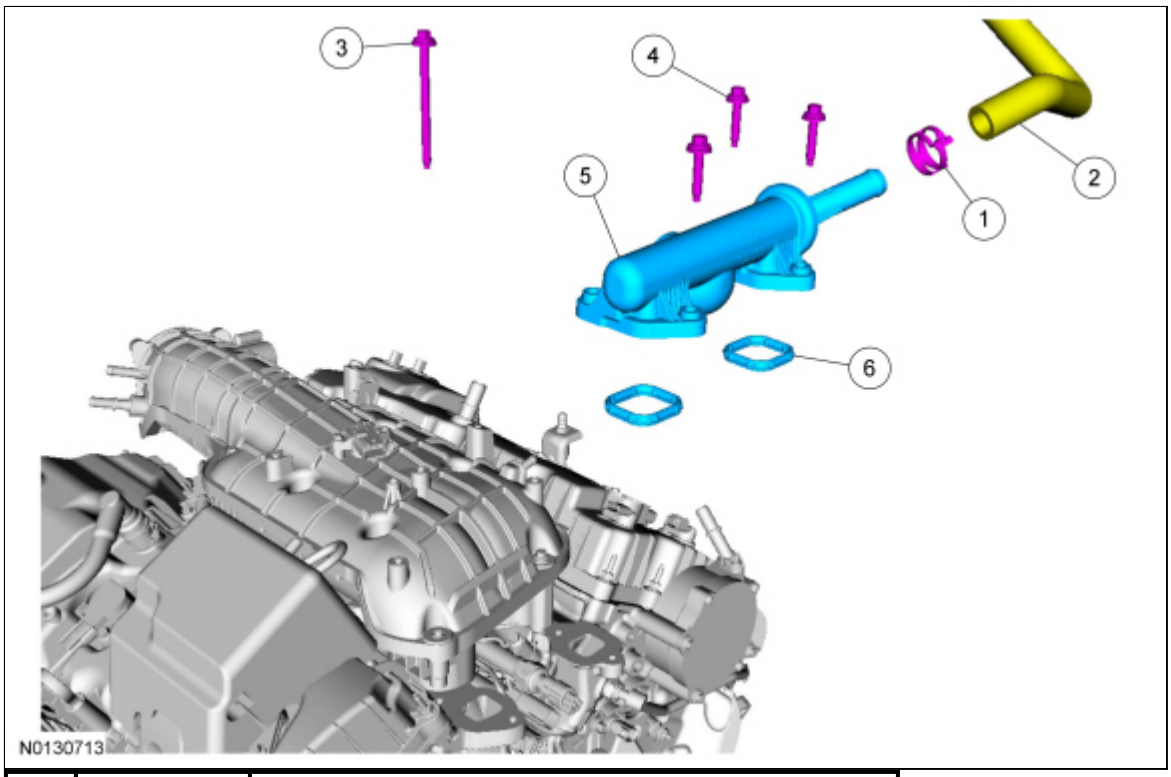
repair4less

5. Remove the block heater.
    - To install, tighten to 40 Nm (30 lb-ft).

All engines

6. To install, reverse the removal procedure.

Coolant Crossover Manifold Assembly — 3.5L GTDI



Item	Part Number	Description
1	W527362	Heater hose clamp
2	18472	Heater hose
3	W714988	Intake manifold bolt
4	W503279	Coolant crossover manifold assembly bolt (3 required)
5	8C368	Coolant crossover manifold assembly
6	9439	Coolant crossover manifold assembly gasket (2 required)

Removal

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
2. Release the clamp and disconnect the heater hose from the coolant crossover manifold assembly.
3. Remove the LH rear intake manifold bolt.
4. Remove the 3 bolts and the coolant crossover manifold assembly.

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- Remove and discard the gaskets.

Installation

1. Install new gaskets, position the coolant crossover manifold assembly and install the bolts finger tight.

2. Tighten the bolts in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.

3. Install the LH rear intake manifold bolt.
   - Tighten to 10 Nm (89 lb-in).

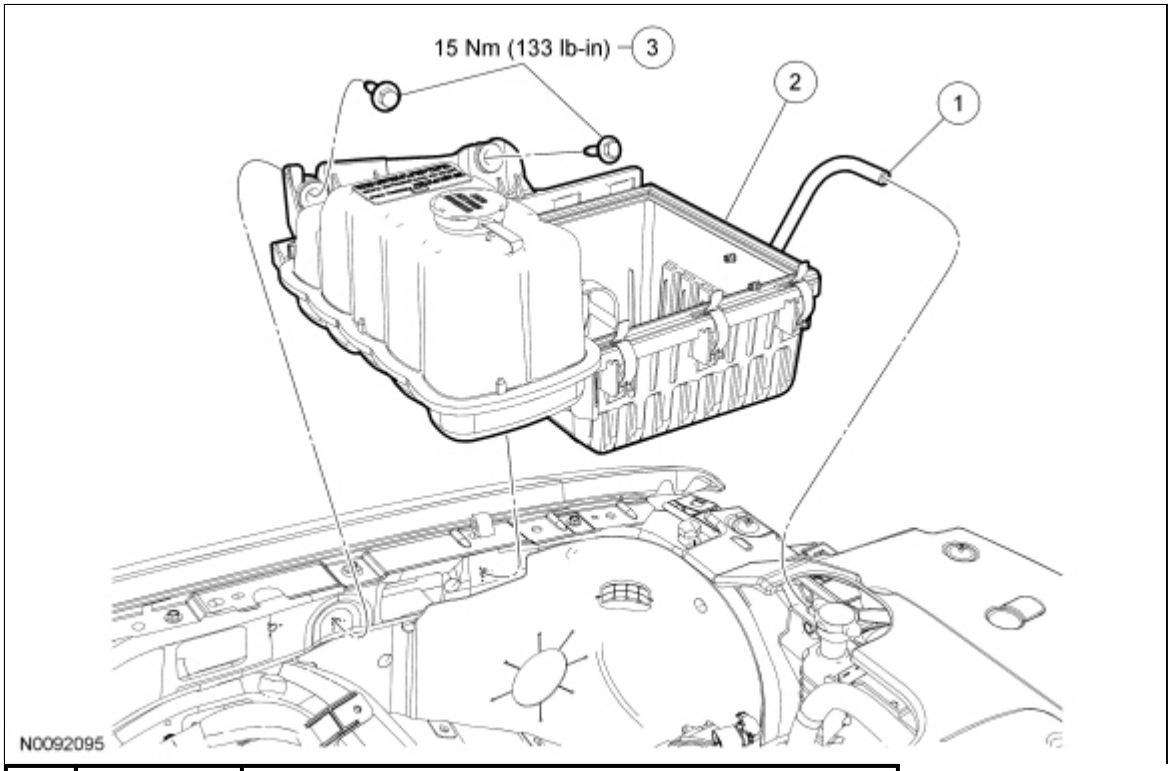
4. Connect the heater hose and position the clamp.

5. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Coolant Expansion Tank — 6.2L

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	8N029	Coolant overflow hose
2	8A080	Coolant expansion tank/lower Air Cleaner (ACL) housing assembly
3	W701835	Coolant expansion tank bolts (2 required)

Removal and Installation

1. ***NOTICE:*** **Allow the engine to cool before removing the coolant expansion tank. The radiator draws coolant from the coolant expansion tank as the engine cools. If the coolant expansion tank is removed before the engine cools, the radiator will draw air into the system, resulting in possible engine damage.**

   NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change

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color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

Using a suitable suction device, siphon the coolant from the coolant expansion tank.

2. Remove the Air Cleaner (ACL) element. For additional information, refer to Section 303-12 .

3. Disconnect the coolant overflow hose from the radiator.

4. Remove the 2 bolts and the coolant expansion tank/lower ACL housing assembly.
   - To install, tighten to 15 Nm (133 lb-in).

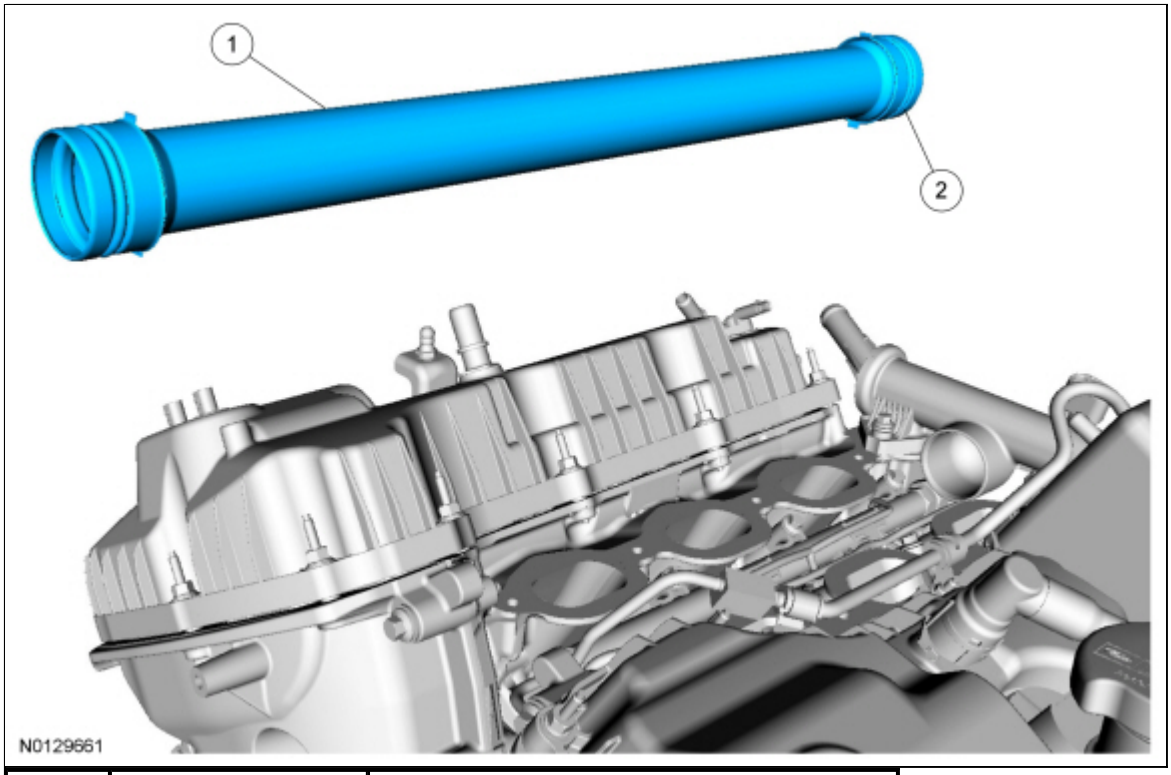
5. To install, reverse the removal procedure.
   - Fill the coolant expansion tank with a 50/50 mixture of coolant and distilled water.

Coolant Inlet Pipe — 3.5L GTDI

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D

NOTE: Intake manifold removed for clarity.



Item	Part Number	Description
1	8A505	Coolant inlet pipe
2	8527	Coolant inlet pipe O-ring seal

Removal and Installation

1. Remove the thermostat housing. For additional information, refer to Thermostat Housing — 3.5L GTDI in this section.
2. Remove the cooling fan motor and shroud. For additional information, refer to Cooling Fan Motor and Shroud .
3. Remove the coolant inlet pipe.

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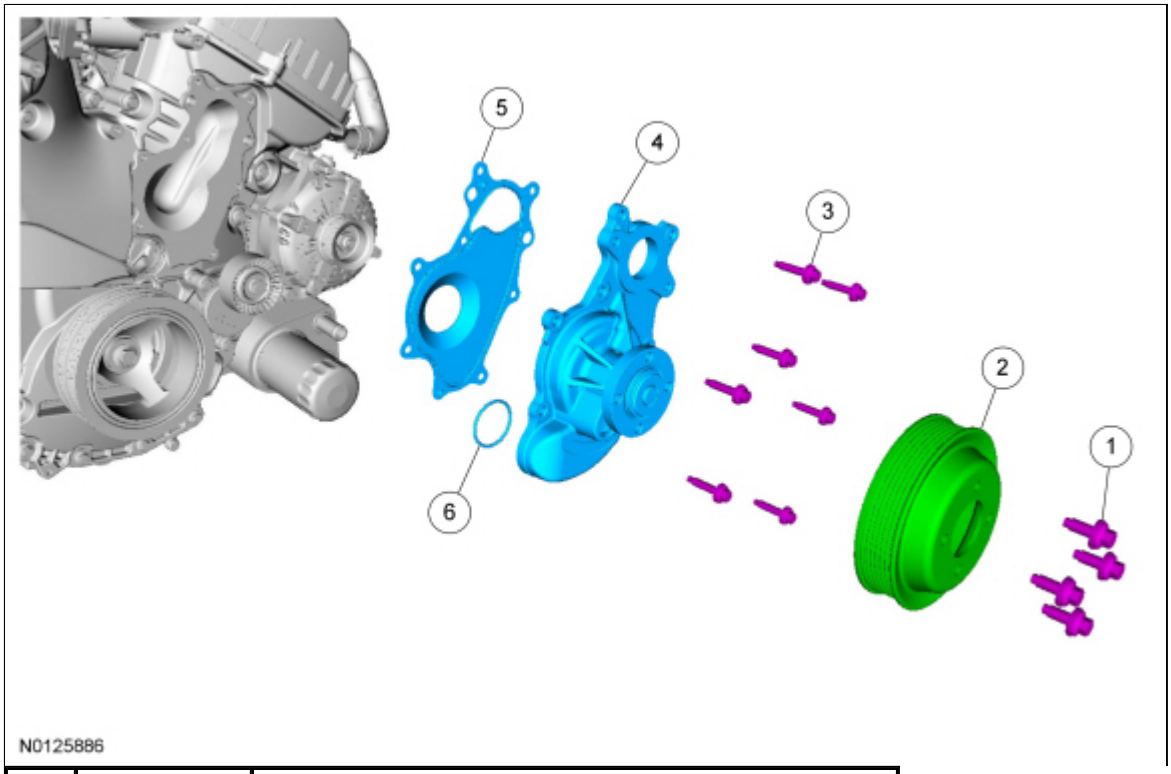
- Remove and discard the O-ring seal.

4. To install, reverse the removal procedure.
    - Install a new O-ring seal and lubricate it with clean engine coolant.

Coolant Pump — 3.5L GTDI, 3.7L

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	W503291	Coolant pump pulley bolt - 25 Nm (18 lb-ft) (4 required)
2	8A528	Coolant pump pulley
3	W503278	Coolant pump bolt (7 required)
4	8501	Coolant pump
5	8507	Coolant pump gasket (part of 8501)
6	8565	Coolant pump O-ring seal (part of 8501)

Removal

1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

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2. Loosen the 4 coolant pump pulley bolts.

3. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

4. ***NOTICE:*** **Cover the A/C compressor belt to prevent coolant contamination of the belt.**

   Completely cover the A/C compressor belt with waterproof plastic.

5. Remove the thermostat housing. For additional information, refer to Thermostat Housing — 3.5L GTDI or Thermostat Housing — 3.7L in this section.

6. Remove the 4 bolts and the coolant pump pulley.

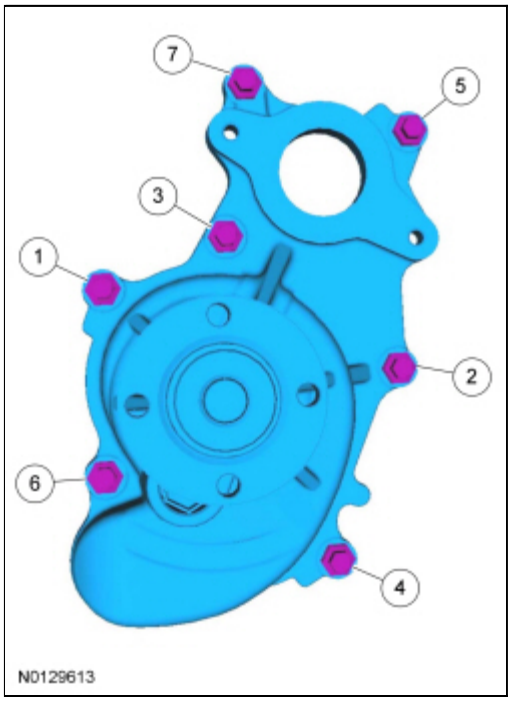
7. Remove the 7 bolts and the coolant pump.
   - Remove and discard the gasket and the O-ring seal in the coolant pump.

Installation

1. Install a new O-ring seal in the coolant pump and lubricate it with clean engine coolant.

2. Position a new gasket, press the coolant pump over the channel cover plate snout protruding from the engine front cover and install the 7 bolts finger tight.

3. Tighten the coolant pump bolts in the sequence shown in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.



4. Position the coolant pump pulley and install the 4 bolts finger tight.

5. Install the thermostat housing. For additional information, refer to Thermostat Housing — 3.5L GTDI or Thermostat Housing — 3.7L in this section.

6. Remove the plastic from the A/C compressor belt.

7. Install the accessory drive belt. For additional information, refer to Section 303-05 .

8. Tighten the 4 coolant pump pulley bolts.
   - Tighten to 25 Nm (18 lb-ft).

9. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

10. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

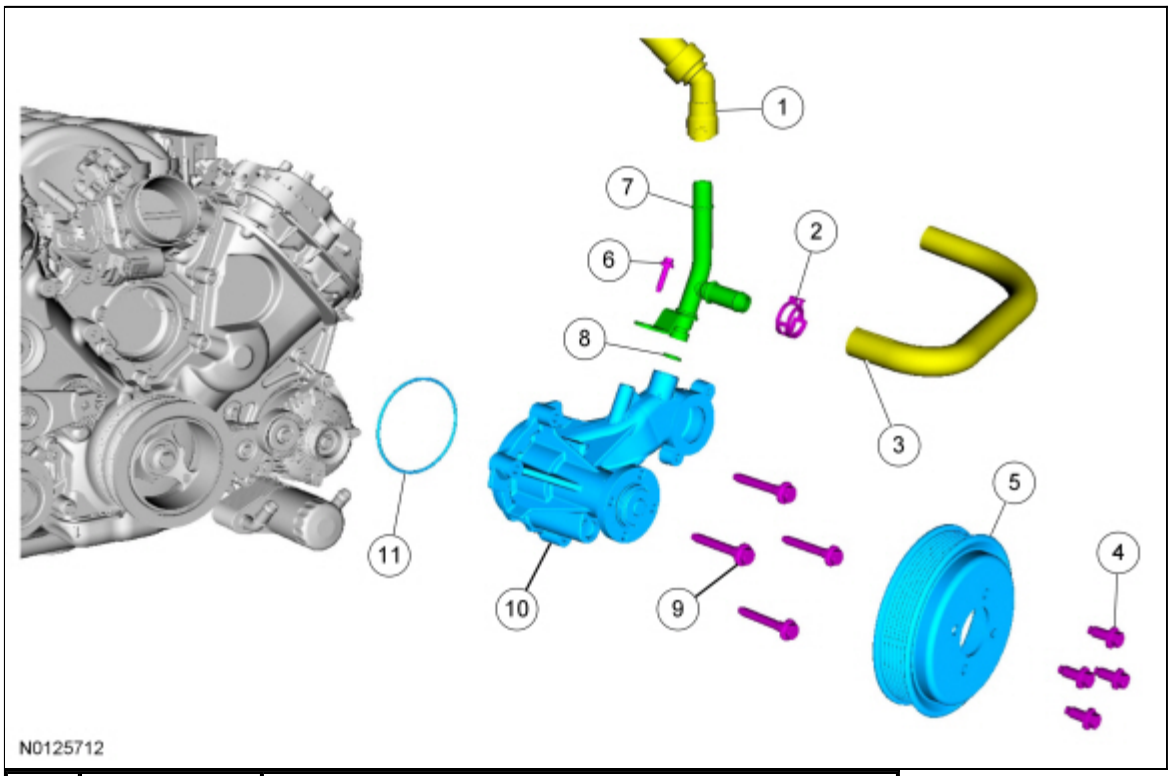
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Coolant Pump — 5.0L

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	18472	Heater outlet hose
2	—	Degas bottle-to-engine hose clamp (part of 8C350)
3	8C350	Degas bottle-to-engine hose
4	N806282	Coolant pump pulley bolt (4 required)
5	8509	Coolant pump pulley
6	W503277	Heater outlet tube bolt - 10 Nm (89 lb-in)
7	18663	Heater outlet tube
8	8565	Heater outlet tube O-ring seal
9	W714925	Coolant pump bolt (4 required)

10	8501	Coolant pump
11	8507	Coolant pump O-ring seal (part of 8501)

Removal

All vehicles

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
3. Loosen the 4 coolant pump pulley bolts.
4. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

Vehicles with an A/C compressor belt tensionser

5. ***NOTICE:*** **Remove the A/C compressor belt to prevent coolant contamination of the belt.**

   Remove the A/C compressor belt.

Vehicles without an A/C compressor belt tensioner

6. ***NOTICE:*** **Cover the A/C compressor belt to prevent coolant contamination of the belt.**

   Completely cover the A/C compressor belt with waterproof plastic.

All vehicles

7. Remove the thermostat housing. For additional information, refer to Thermostat Housing — 5.0L in this section.
8. Remove the bolts and the coolant pump pulley.
9. Disconnect the heater outlet hose from the heater outlet tube.
10. Release the clamp and disconnect the degas bottle-to-engine hose from the heater outlet tube.
11. Remove the 4 bolts and the coolant pump.
12. If a new coolant pump is being installed, remove the bolt and the heater outlet tube.
    - Remove and discard the O-ring seal.

Installation

All vehicles

1. If a new coolant pump is being installed, install a new O-ring seal on the heater outlet tube and lubricate it with clean engine coolant.
2. Install the heater outlet tube and the bolt.

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- Tighten to 10 Nm (89 lb-in).

3. Inspect the sealing surfaces and clean with metal surface prep. Follow the directions on the packaging.

4. ***NOTICE:*** **Align the bolt holes with the bosses prior to insertion of the coolant pump and insert the pump straight into the coolant pump cavity. Do not rotate the coolant pump once installed in the coolant pump cavity or the O-ring seal can be damaged, causing the coolant pump to leak.**

   NOTE: Install a new O-ring seal and lubricate it with clean engine coolant.

   Install the coolant pump and the bolts
   - Tighten the coolant pump bolts in 2 stages.
     - Stage 1: Tighten to 20 Nm (177 lb-in).
     - Stage 2: Tighten an additional 60 degrees.

5. Connect the degas bottle-to-engine hose to the heater outlet tube and position the clamp.

6. Connect the heater outlet hose to the heater outlet tube.

7. Position the coolant pump pulley and install the bolts finger tight.

8. Install the thermostat housing. For additional information, refer to Thermostat Housing — 5.0L in this section.

Vehicles without an A/C compressor belt tensioner

9. Remove the plastic from the A/C compressor belt.

Vehicles with an A/C compressor belt tensioner

10. Install the A/C compressor belt. For additional information, refer to Section 303-05 .
    - Rinse off any coolant from the accessory drive pulleys using clear water prior to belt installation.

All vehicles

11. Install the accessory drive belt. For additional information, refer to Section 303-05 .
    - Rinse off any coolant from the accessory drive pulleys using clear water prior to belt installation.

12. Tighten the coolant pump pulley bolts in a criss-cross pattern.
    - Tighten to 25 Nm (18 lb-ft).

13. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

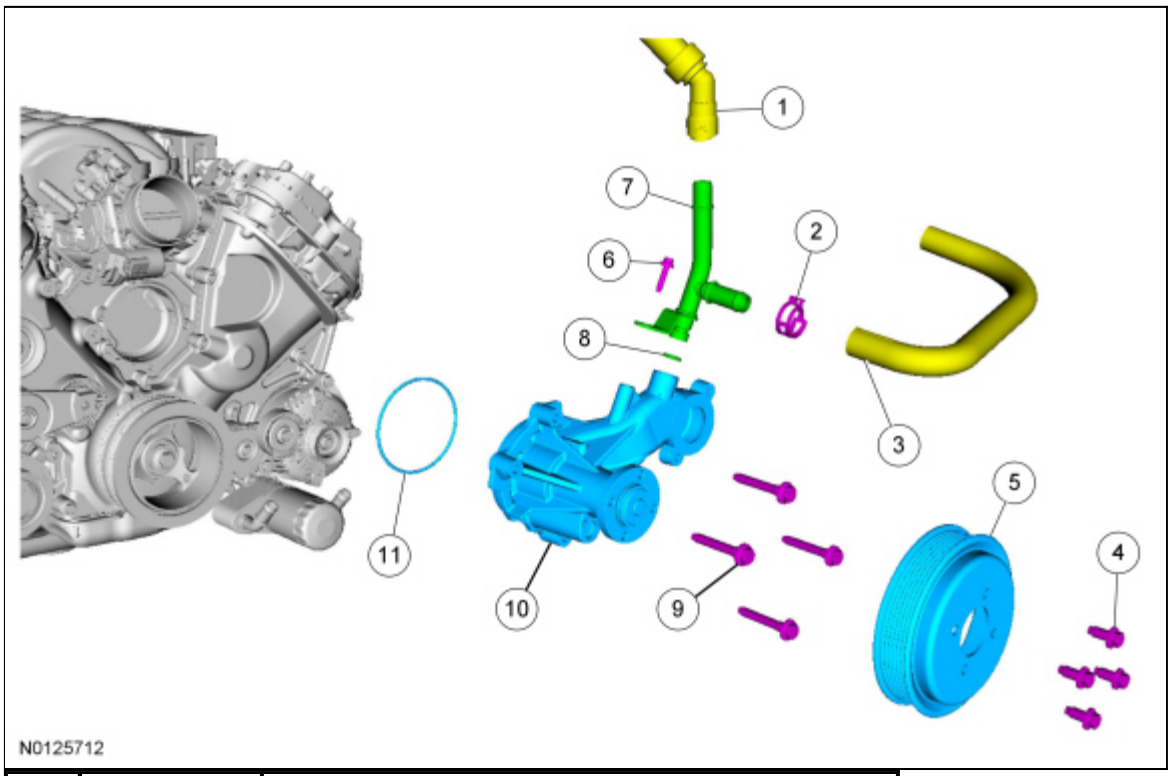
14. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

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Coolant Pump — 5.0L

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	18472	Heater outlet hose
2	—	Degas bottle-to-engine hose clamp (part of 8C350)
3	8C350	Degas bottle-to-engine hose
4	N806282	Coolant pump pulley bolt (4 required)
5	8509	Coolant pump pulley
6	W503277	Heater outlet tube bolt - 10 Nm (89 lb-in)
7	18663	Heater outlet tube
8	8565	Heater outlet tube O-ring seal
9	W714925	Coolant pump bolt (4 required)

10	8501	Coolant pump
11	8507	Coolant pump O-ring seal (part of 8501)

Removal

All vehicles

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
3. Loosen the 4 coolant pump pulley bolts.
4. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

Vehicles with an A/C compressor belt tensionser

5. ***NOTICE:*** **Remove the A/C compressor belt to prevent coolant contamination of the belt.**

   Remove the A/C compressor belt.

Vehicles without an A/C compressor belt tensioner

6. ***NOTICE:*** **Cover the A/C compressor belt to prevent coolant contamination of the belt.**

   Completely cover the A/C compressor belt with waterproof plastic.

All vehicles

7. Remove the thermostat housing. For additional information, refer to Thermostat Housing — 5.0L in this section.
8. Remove the bolts and the coolant pump pulley.
9. Disconnect the heater outlet hose from the heater outlet tube.
10. Release the clamp and disconnect the degas bottle-to-engine hose from the heater outlet tube.
11. Remove the 4 bolts and the coolant pump.
12. If a new coolant pump is being installed, remove the bolt and the heater outlet tube.
    - Remove and discard the O-ring seal.

Installation

All vehicles

1. If a new coolant pump is being installed, install a new O-ring seal on the heater outlet tube and lubricate it with clean engine coolant.
2. Install the heater outlet tube and the bolt.

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- Tighten to 10 Nm (89 lb-in).

3. Inspect the sealing surfaces and clean with metal surface prep. Follow the directions on the packaging.

4. ***NOTICE:*** **Align the bolt holes with the bosses prior to insertion of the coolant pump and insert the pump straight into the coolant pump cavity. Do not rotate the coolant pump once installed in the coolant pump cavity or the O-ring seal can be damaged, causing the coolant pump to leak.**

   NOTE: Install a new O-ring seal and lubricate it with clean engine coolant.

   Install the coolant pump and the bolts
   - Tighten the coolant pump bolts in 2 stages.
     - Stage 1: Tighten to 20 Nm (177 lb-in).
     - Stage 2: Tighten an additional 60 degrees.

5. Connect the degas bottle-to-engine hose to the heater outlet tube and position the clamp.

6. Connect the heater outlet hose to the heater outlet tube.

7. Position the coolant pump pulley and install the bolts finger tight.

8. Install the thermostat housing. For additional information, refer to Thermostat Housing — 5.0L in this section.

Vehicles without an A/C compressor belt tensioner

9. Remove the plastic from the A/C compressor belt.

Vehicles with an A/C compressor belt tensioner

10. Install the A/C compressor belt. For additional information, refer to Section 303-05 .
    - Rinse off any coolant from the accessory drive pulleys using clear water prior to belt installation.

All vehicles

11. Install the accessory drive belt. For additional information, refer to Section 303-05 .
    - Rinse off any coolant from the accessory drive pulleys using clear water prior to belt installation.

12. Tighten the coolant pump pulley bolts in a criss-cross pattern.
    - Tighten to 25 Nm (18 lb-ft).

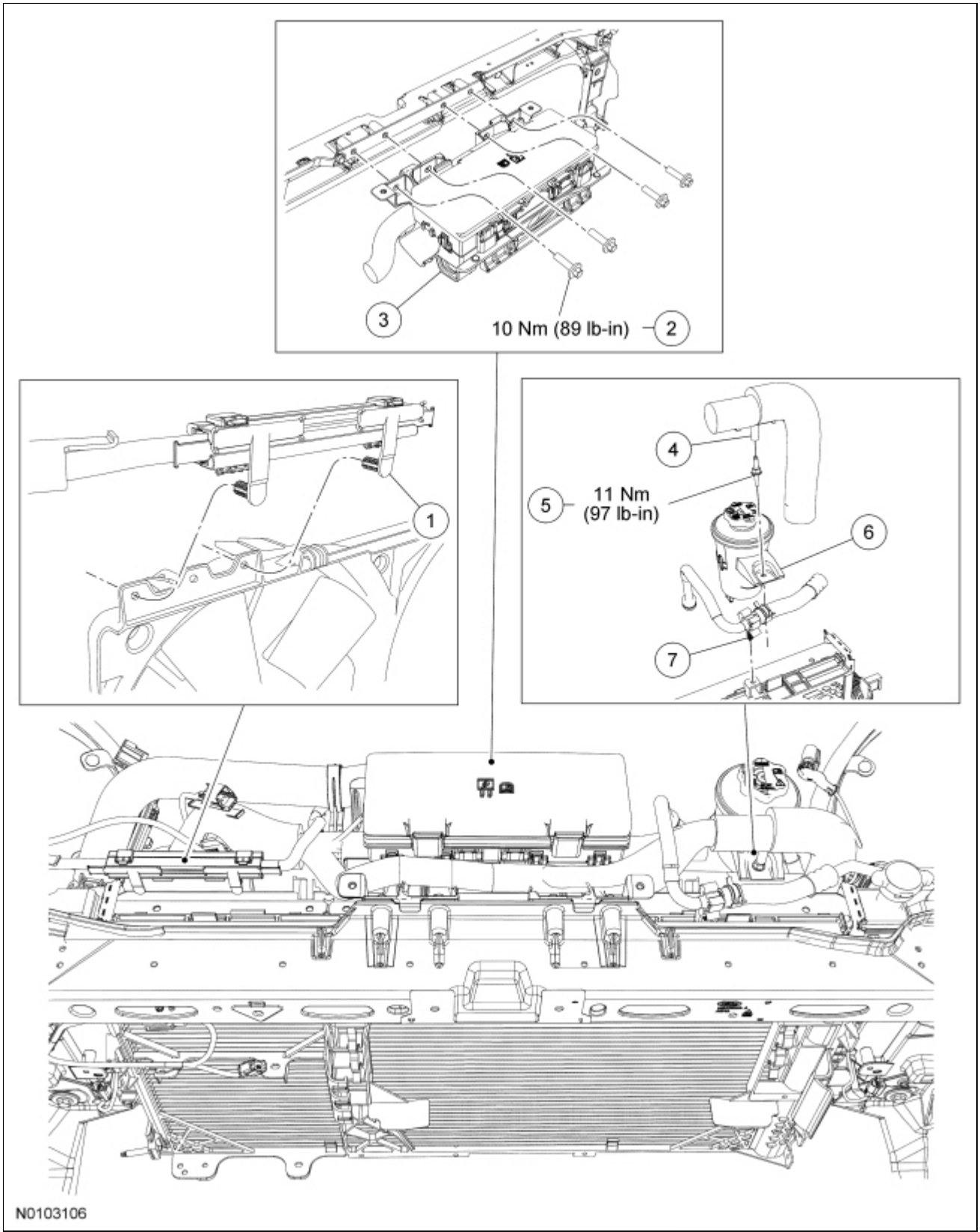
13. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

14. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

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Cooling Fan Motor and Shroud

Wiring Harness and Power Steering Fluid Reservoir - 6.2L Engine

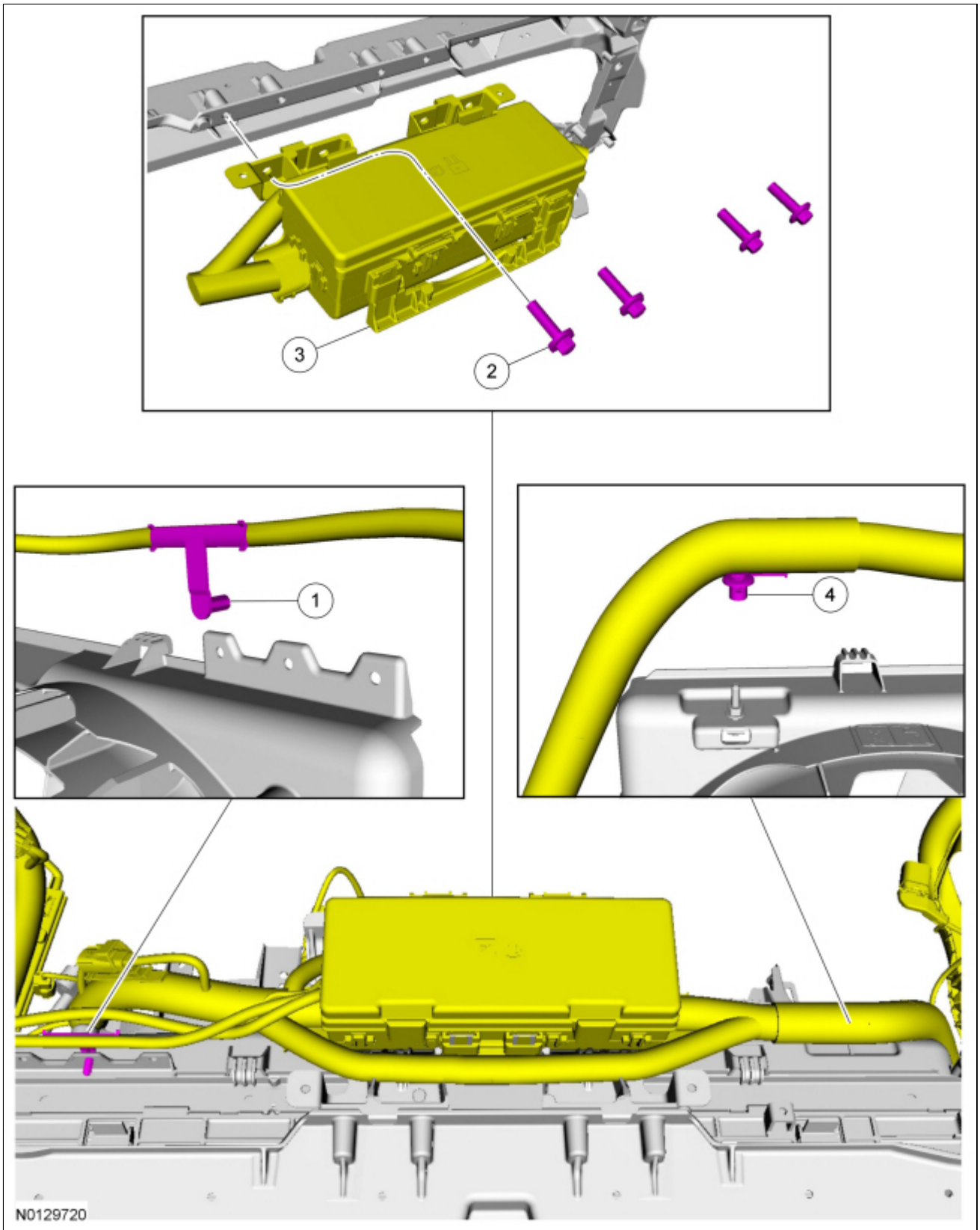


Item	Part Number	Description
1	—	Generator battery positive cable retainer (part of

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		14305)
2	W711851	Battery Junction Box (BJB) bracket bolt (4 required)
3	14A65	BJB bracket
4	—	Wiring harness retainer (part of 12A581)
5	W710897	Power steering fluid reservoir stud bolt (6.2L engine only)
6	3E764	Power steering fluid reservoir (6.2L engine only)
7	—	Power steering fluid cooler hose retainer (part of 3A713) (6.2L engine only)

3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L Engines

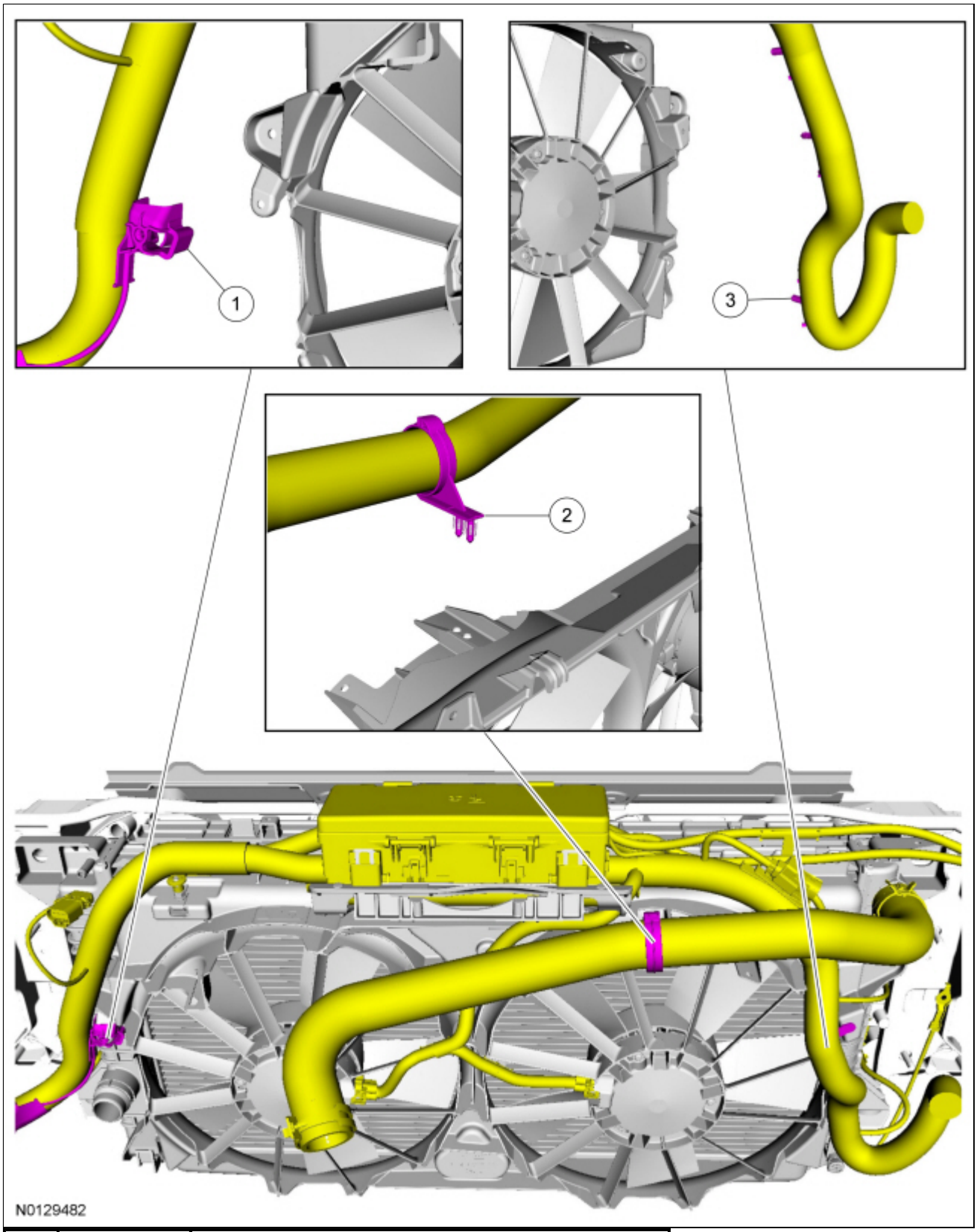


Item	Part Number	Description
1	—	Battery positive cable retainer (part of 14305)
2	W711851	Battery Junction Box (BJB) bracket bolt (4 required)

repair4less

3	14A65	BJB bracket
4	—	Wiring harness retainer (part of 12A581)

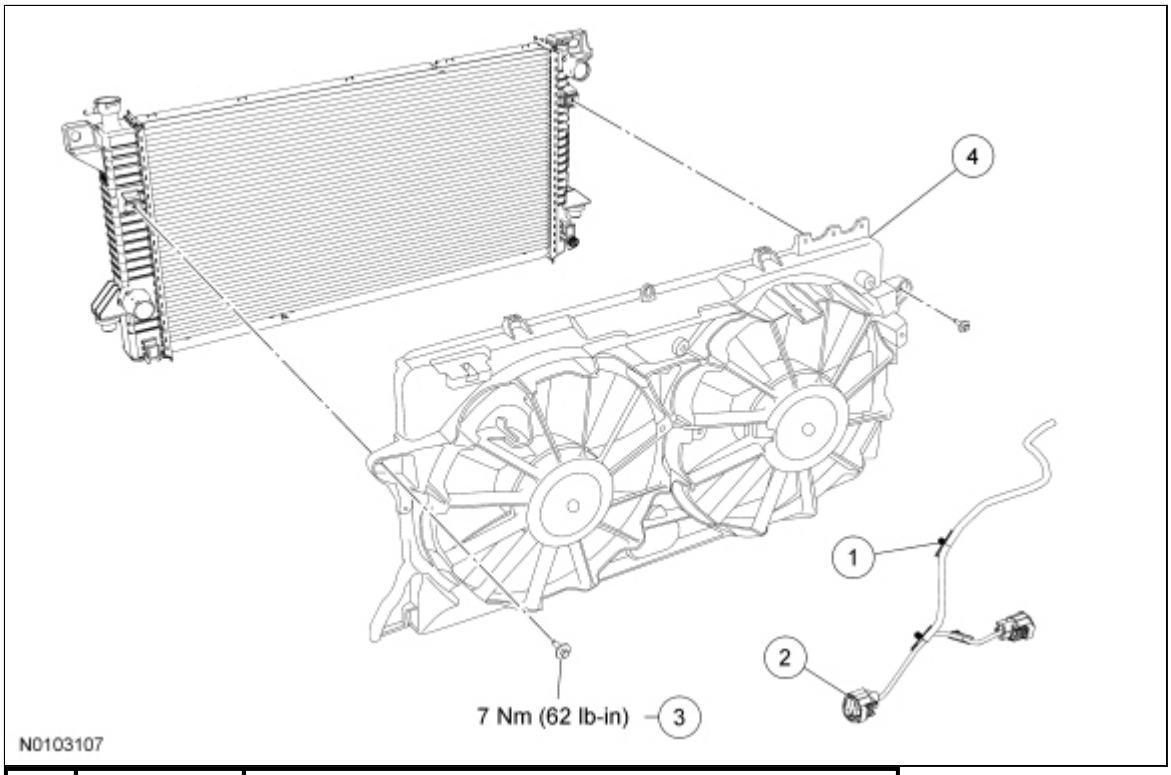
Wiring Harness and Radiator Hose Retainers



Item	Part Number	Description
1	—	Wiring harness retainer (part of 12A581)
2	8W287	Upper radiator hose retainer (6.2L only)

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3	—	Wiring harness retainer (part of 12A581) (3 required)

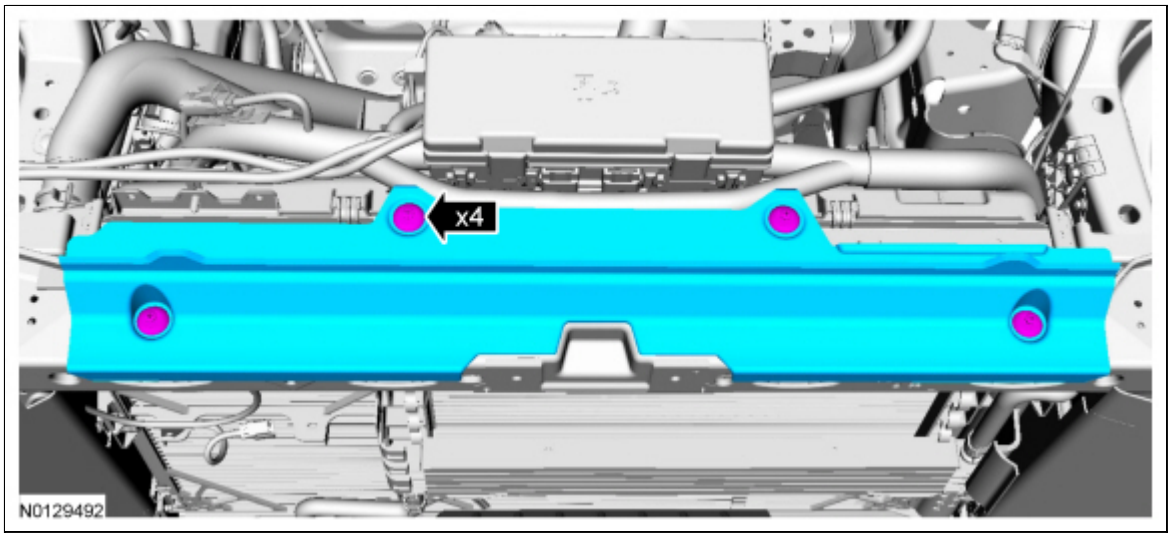


Item	Part Number	Description
1	—	Cooling fan wiring harness retainer (part of 12A581) (3 required)
2	—	Cooling fan electrical connector (part of 12A581) (2 required)
3	W503924	Cooling fan motor and shroud bolt (2 required)
4	8600	Cooling fan motor and shroud

Removal and Installation

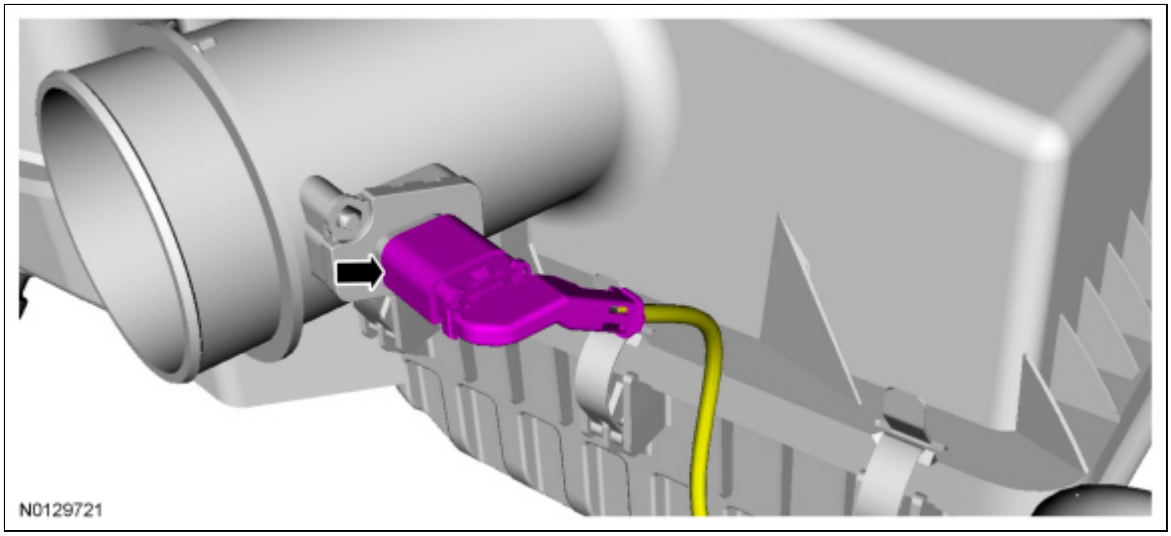
All engines

1. Disconnect the battery negative cable. For additional information, refer to Section 414-01 .
2. Remove the Air Cleaner (ACL) outlet tube. For additional information, refer to Section 303-12 .
3. Remove the 4 pushpins and the upper radiator air deflector.

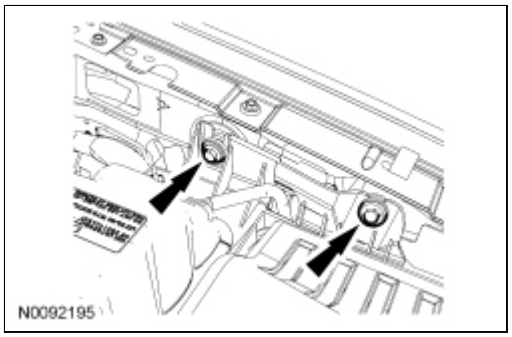


6.2L engines

4. Disconnect the Mass Air Flow (MAF) sensor electrical connector.



5. Remove the 2 bolts and position the coolant expansion tank aside.

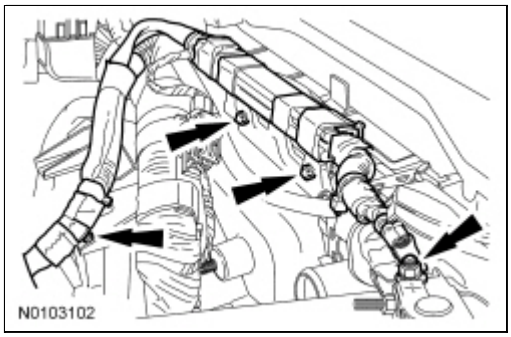


6. Detach the power steering fluid cooler hose retainer from the cooling fan motor and shroud.

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7. Detach the wiring harness retainer from the power steering fluid reservoir stud bolt.

8. Remove the nut, detach the generator battery positive cable from the positive battery terminal, detach the 3 wiring harness retainers from the cooling fan shroud and position the wiring harness aside.
    - To install, tighten to 9 Nm (80 lb-in).



9. Detach the upper radiator hose retainer from the cooling fan motor and shroud.

3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L engines

10. Detach the wiring harness retainer from the stud bolt on the LH side of the cooling fan shroud.

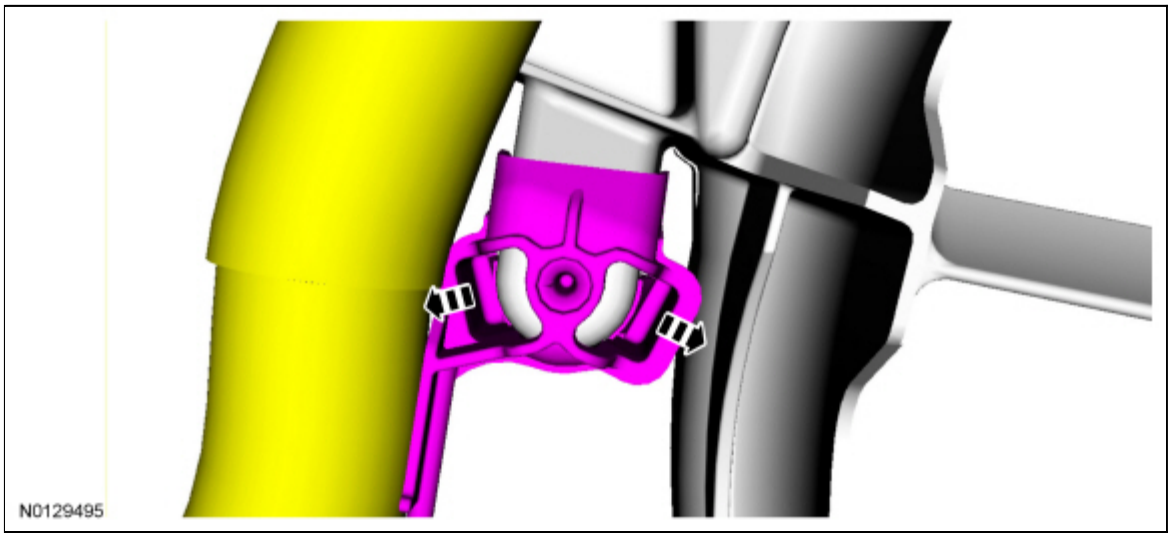
11. Disconnect the positive battery cable. For additional information, refer to Section 414-01 .

12. Detach the battery cable retainer from the cooling fan shroud.

All engines

13. **NOTE:** Push the 2 LH wiring harness retainer tabs outward to release.

    Detach the LH wiring harness retainer and the 3 RH wiring harness pushpins.



14. Disconnect the 2 cooling fan electrical connectors.

15. Detach the 3 cooling fan wiring harness retainers.

16. Remove the 4 Battery Junction Box (BJB) bracket bolts.
    - To install, tighten to 10 Nm (89 lb-in).

3.5L GTDI , 3.7L and 5.0L Engines

17. Position the wiring harness aside.

6.2L engines

18. Remove the power steering fluid reservoir stud bolt and position the power steering fluid reservoir and the wiring harness aside.
    - To install, tighten to 11 Nm (97 lb-in).

All engines

19. Remove the 2 bolts and the cooling fan motor and shroud.
    - To install, tighten to 7 Nm (62 lb-in).

20. To install, reverse the removal procedure.

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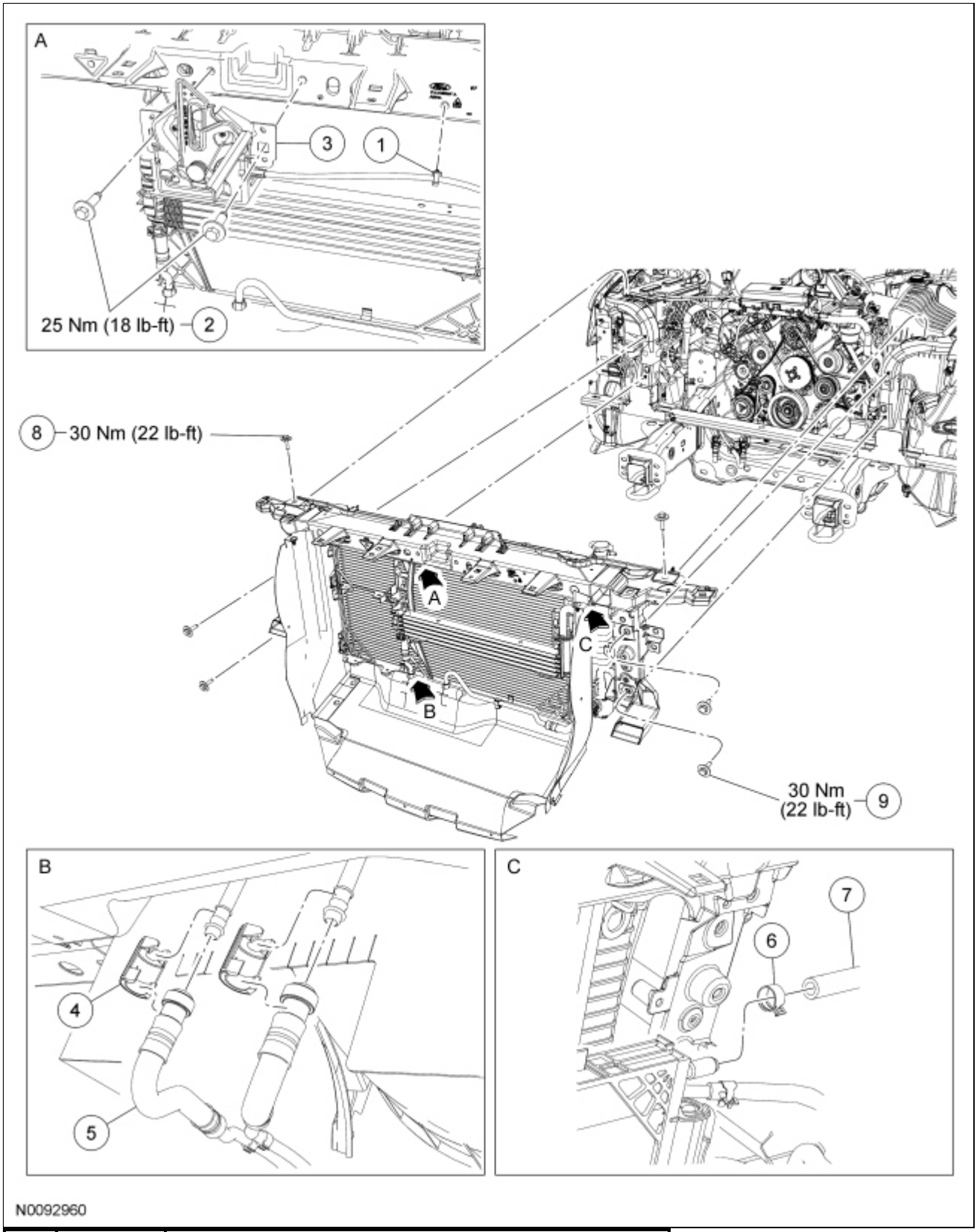
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Cooling Module

Special Tool(s)

 ST2935A	Disconnect Tool, Transmission Cooler Line 307-569

Hood Latch, Transmission Cooler Tubes, Power Steering Cooler Tubes (6.2L) and Cooling Module Bolts



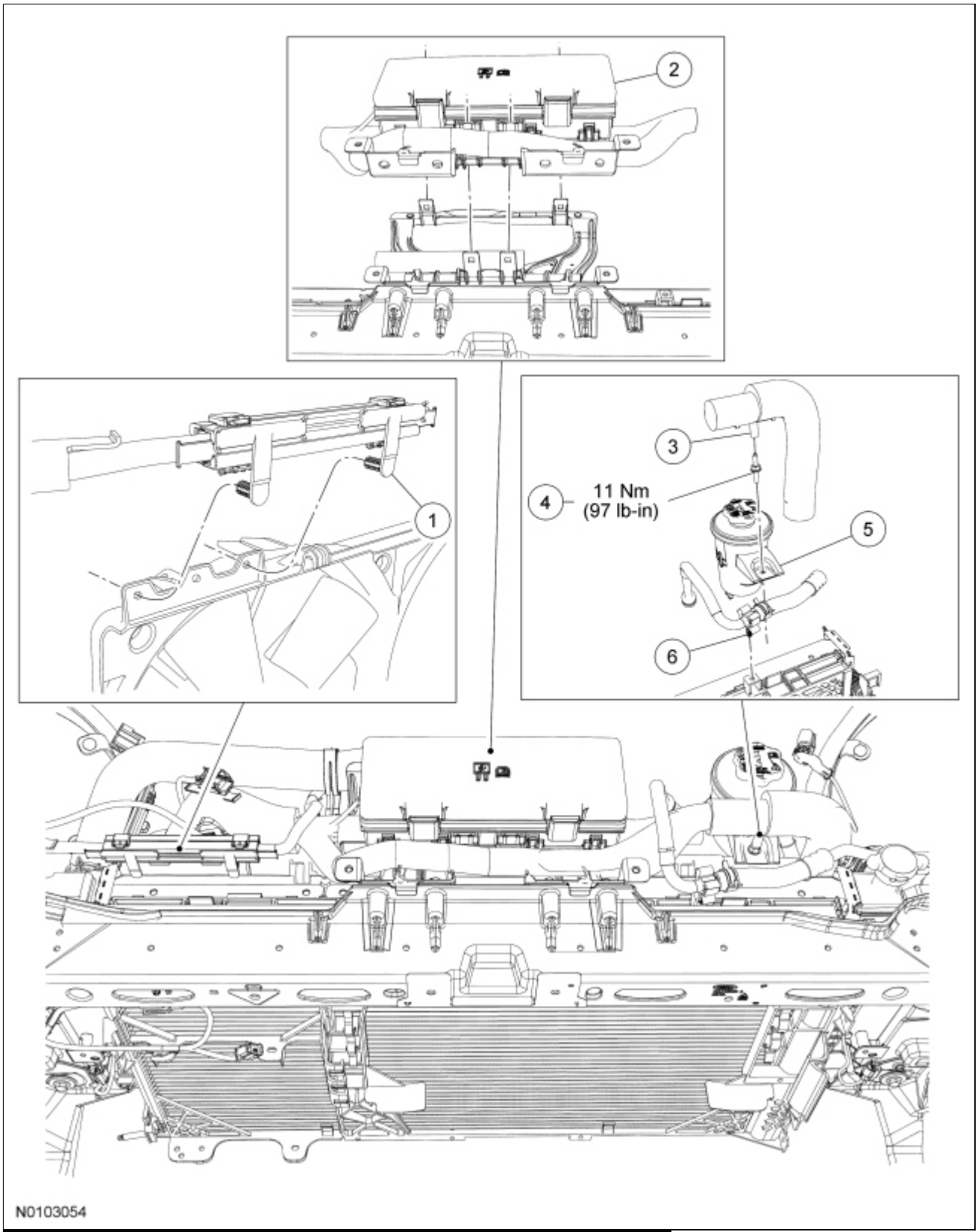
N0092960

Item	Part Number	Description
1	16B975	Hood latch assembly cable retainer

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2	W711848	Hood latch assembly bolts (2 required)
3	6100	Hood latch assembly
4	7J801	Transmission fluid cooler tube secondary latch (2 required) (6.2L shown, 3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L similar)
5	7H420	Transmission fluid cooler tube (2 required) (6.2L shown, 3.5L GTDI, 3.7L and 5.0L similar)
6	—	Power steering fluid cooler hose clamp (2 required) (6.2L only)
7	3A713	Power steering gear-to-fluid cooler return hose (6.2L only)
8	W701835	Cooling module upper bolt (2 required)
9	W701835	Cooling module front bolt (4 required)

Wiring Harness and Power Steering Fluid Reservoir - 6.2L

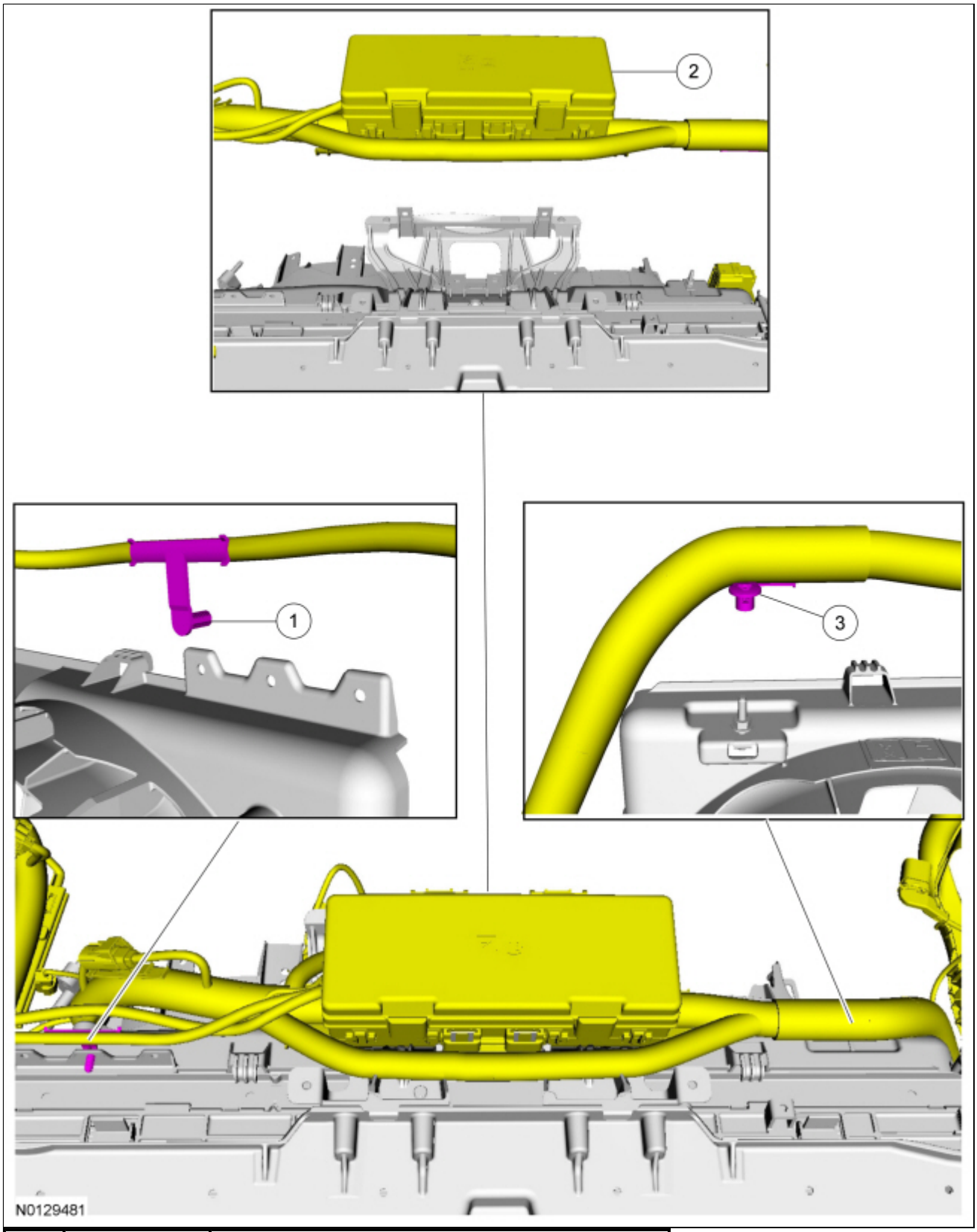


Item	Part Number	Description
1	—	Generator battery positive cable retainer (part of

repair4less

		14305)
2	—	Battery Junction Box (BJB) (part of 12A581)
3	—	Wiring harness retainer (part of 12A581)
4	W710897	Power steering fluid reservoir stud bolt (6.2L only)
5	3E764	Power steering fluid reservoir (6.2L only)
6	—	Power steering fluid cooler hose retainer (part of 3A713) (6.2L only)

Wiring Harness - 3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L

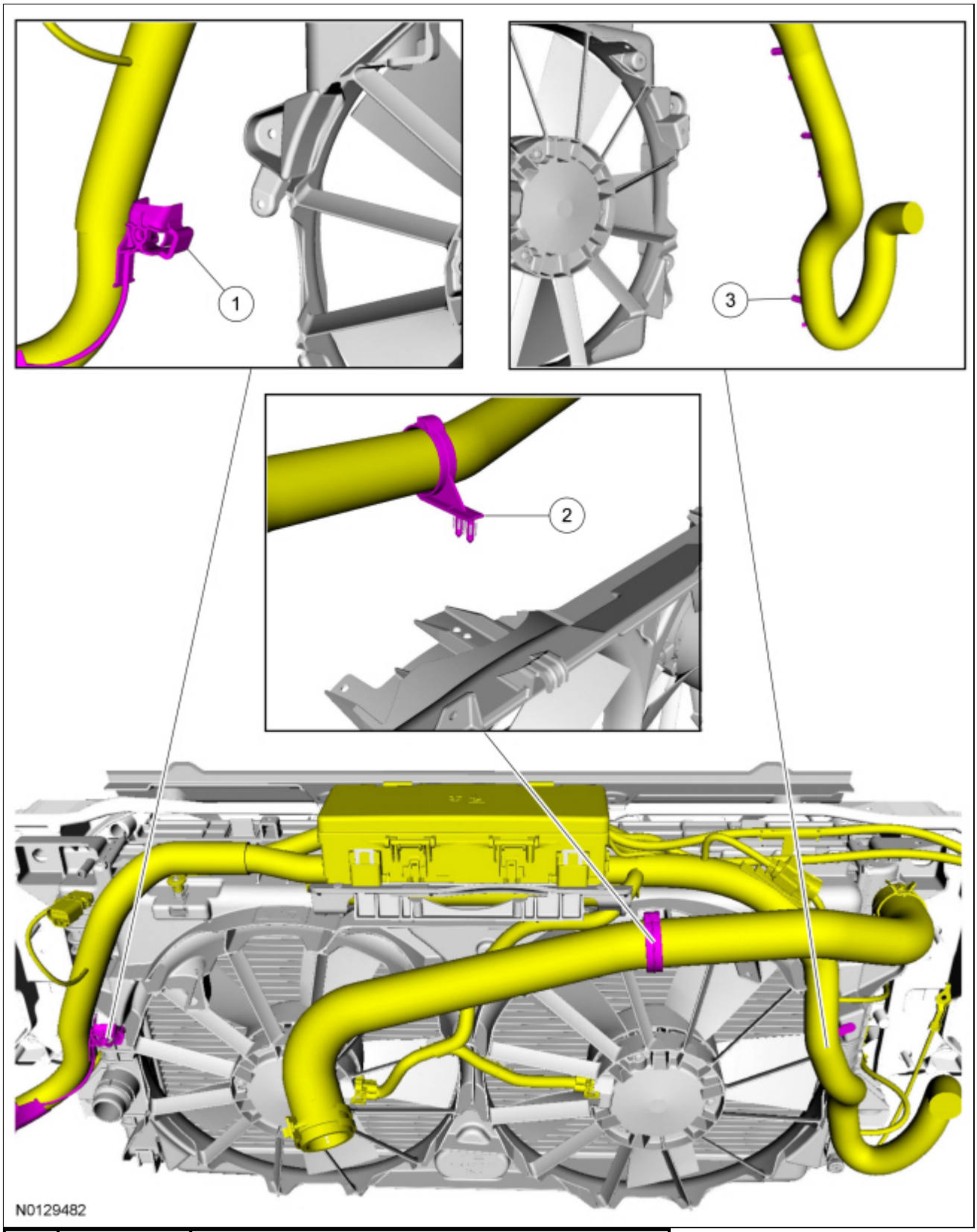


Item	Part Number	Description
1	—	Battery positive cable retainer (part of 14305)
2	—	Battery Junction Box (BJB) (part of 12A581)

repair4less

3	—	Wiring harness retainer (part of 12A581)

Wiring Harness and Radiator Hose Retainers

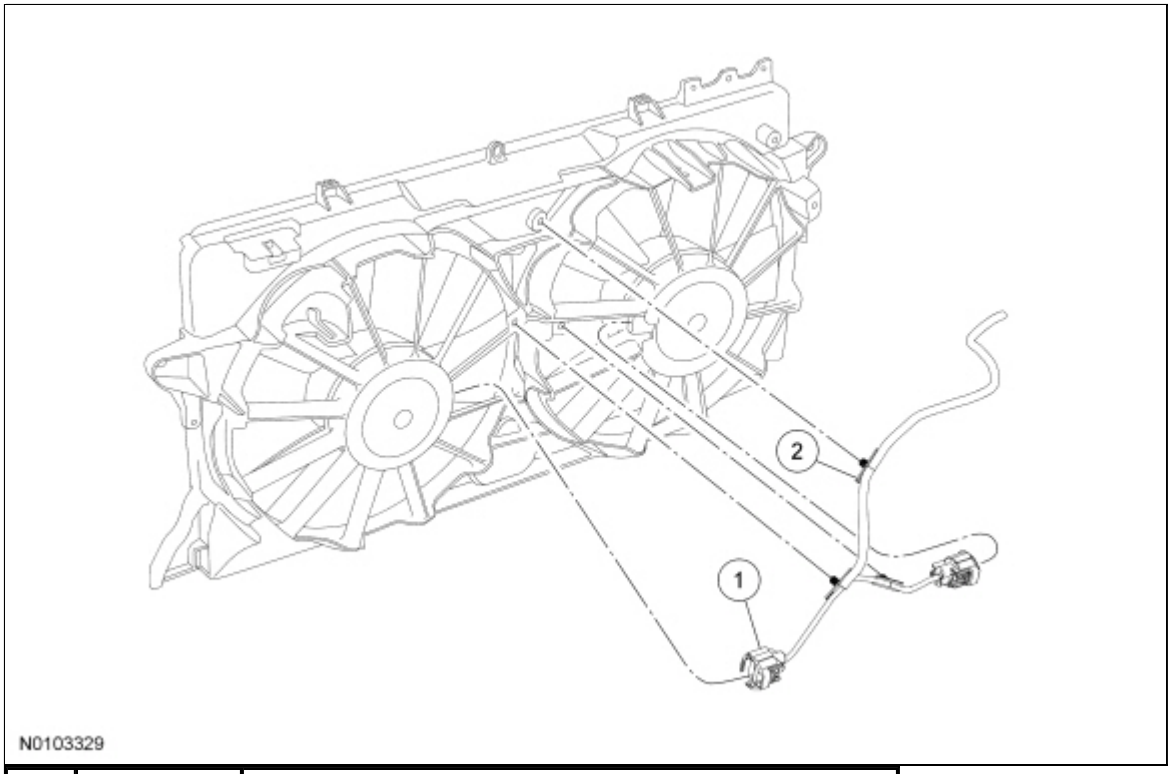


Item	Part Number	Description
1	—	Wiring harness retainer (part of 12A581)
2	8W287	Upper radiator hose retainer (6.2L only)

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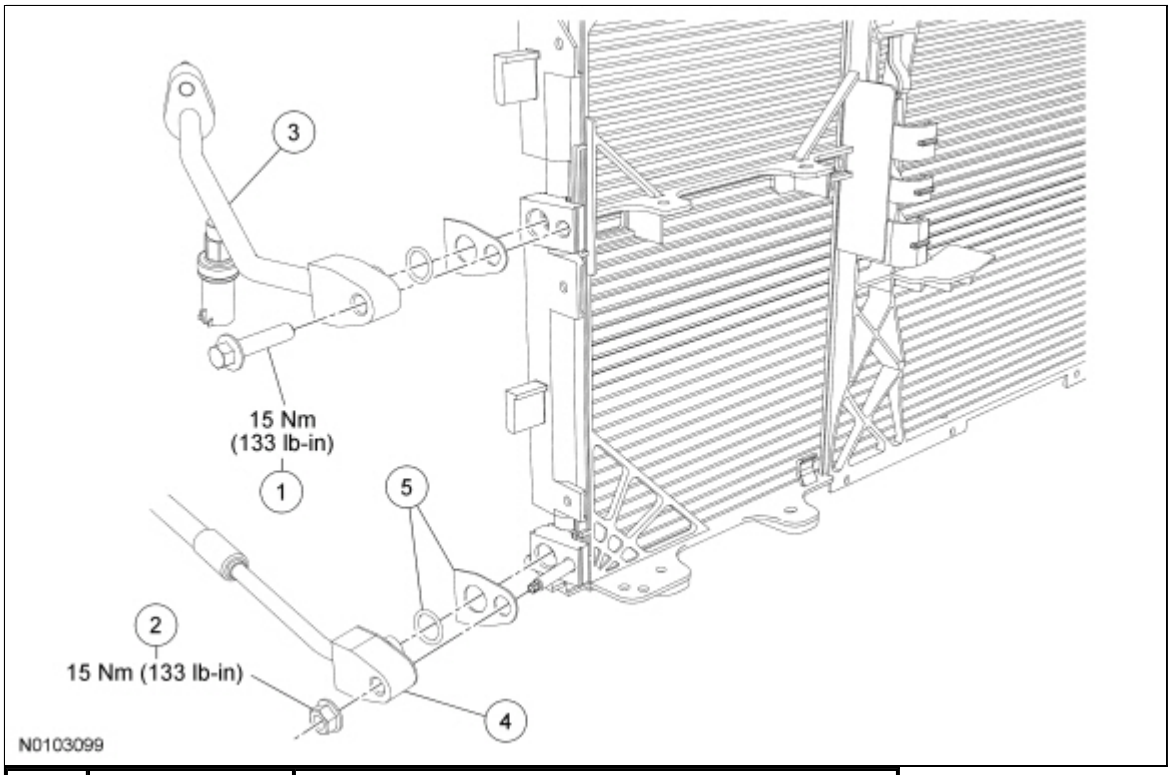
3	—	Wiring harness retainer (part of 12A581) (3 required)

Cooling Fan Wiring



Item	Part Number	Description
1	—	Cooling fan electrical connector (part of 12A581) (2 required)
2	—	Cooling fan wiring harness retainer (part of 12A581) (3 required)

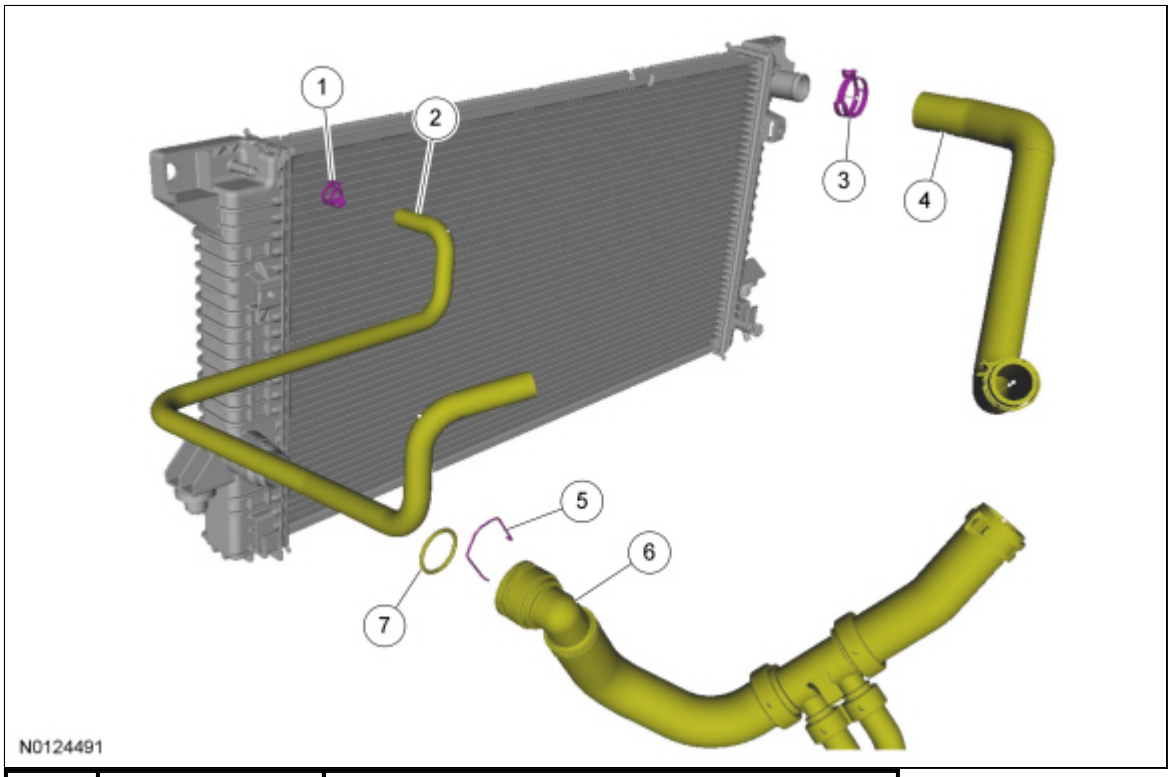
A/C Fittings



Item	Part Number	Description
1	W500110	Condenser inlet fitting bolt
2	W520413	Condenser outlet fitting nut
3	19E558	Condenser inlet jumper line fitting
4	—	Condenser outlet fitting (part of 19A834)
5	19B596	O-ring seal and gasket seal kit (2 required)

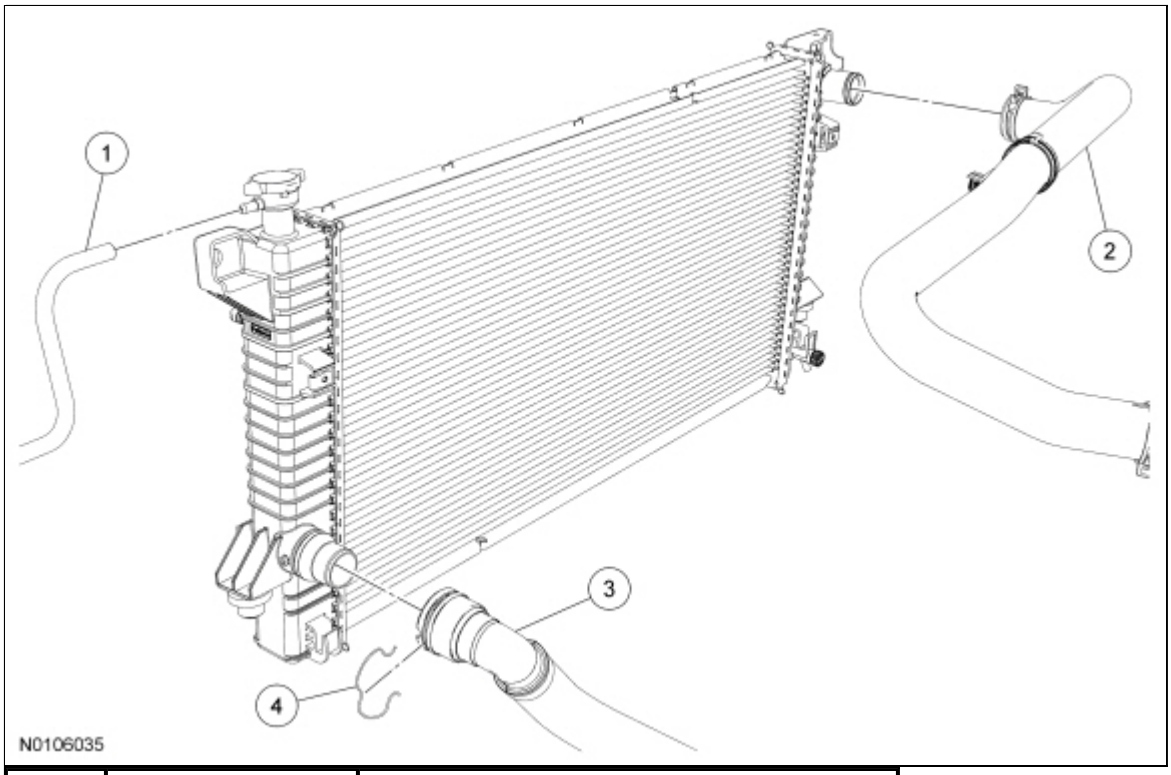
Radiator Hoses - 3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L

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Item	Part Number	Description
1	15161	Radiator-to-degas bottle hose clamp
2	8W005	Radiator-to-degas bottle hose
3	15161	Upper radiator hose clamp
4	8260	Upper radiator hose
5	8D037	Lower radiator hose spring clip
6	8286	Lower radiator hose
7	8D038	Lower radiator hose O-ring seal

Radiator Hoses - 6.2L



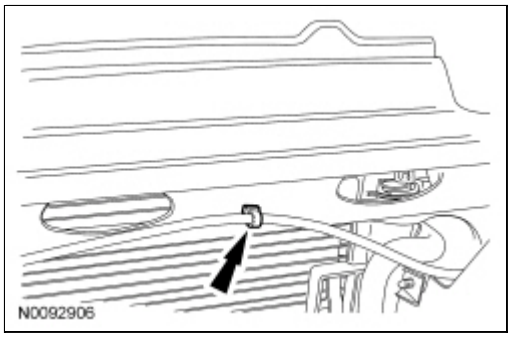
Item	Part Number	Description
1	8N029	Radiator overflow hose
2	8B274	Upper radiator hose
3	8B273	Lower radiator hose
4	8B365	Lower radiator hose spring clip

Removal

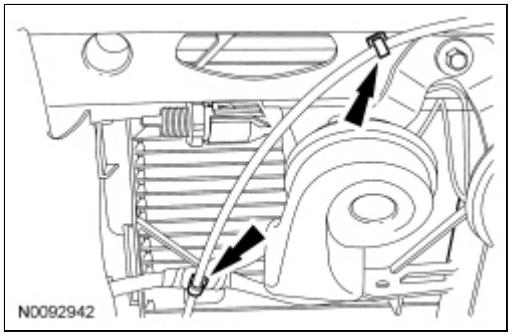
All engines

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Evacuate the A/C system. For additional information, refer to Section 412-00 .
4. Disconnect the battery ground. For additional information, refer to Section 414-01 .
5. Remove the headlights. For additional information, refer to Section 417-01 .
6. Detach the LH hood latch cable retainer.

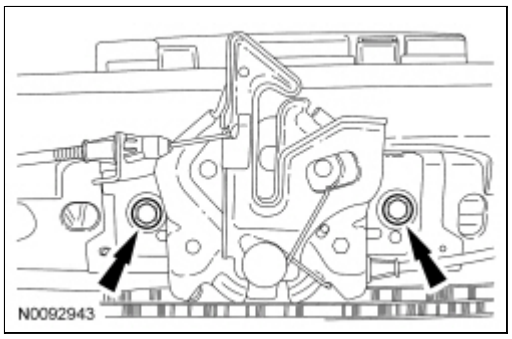
repair4less



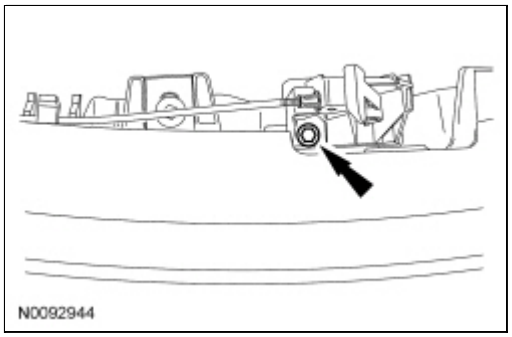
7. Detach the 2 RH hood latch cable retainers.



8. Remove the bolts and position the hood latch aside.

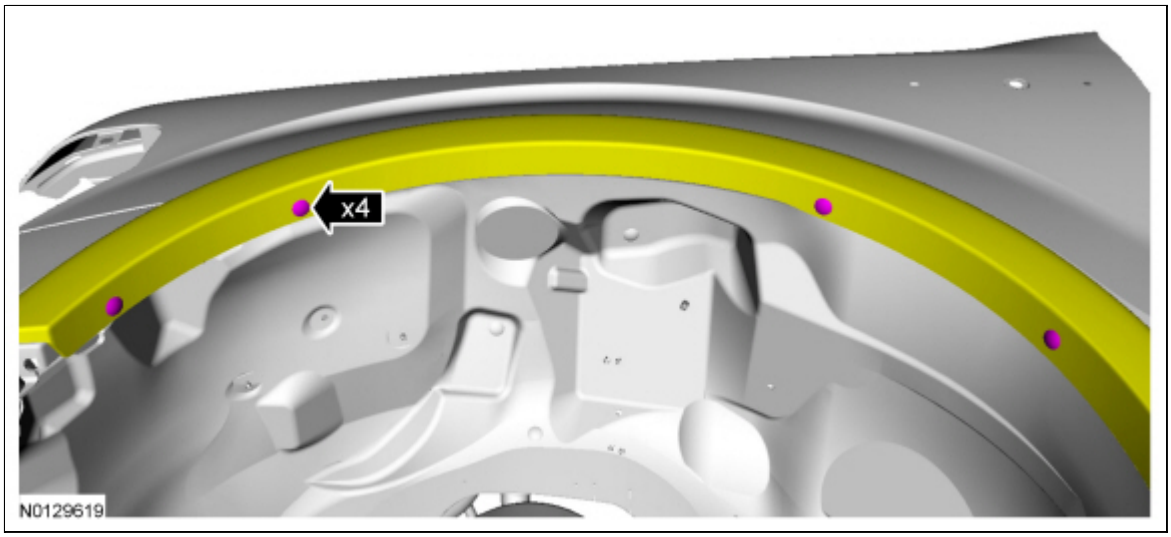


9. Remove the bolt, detach the hood latch release handle and the cable from the front bumper cover, and position the hood latch release handle aside.



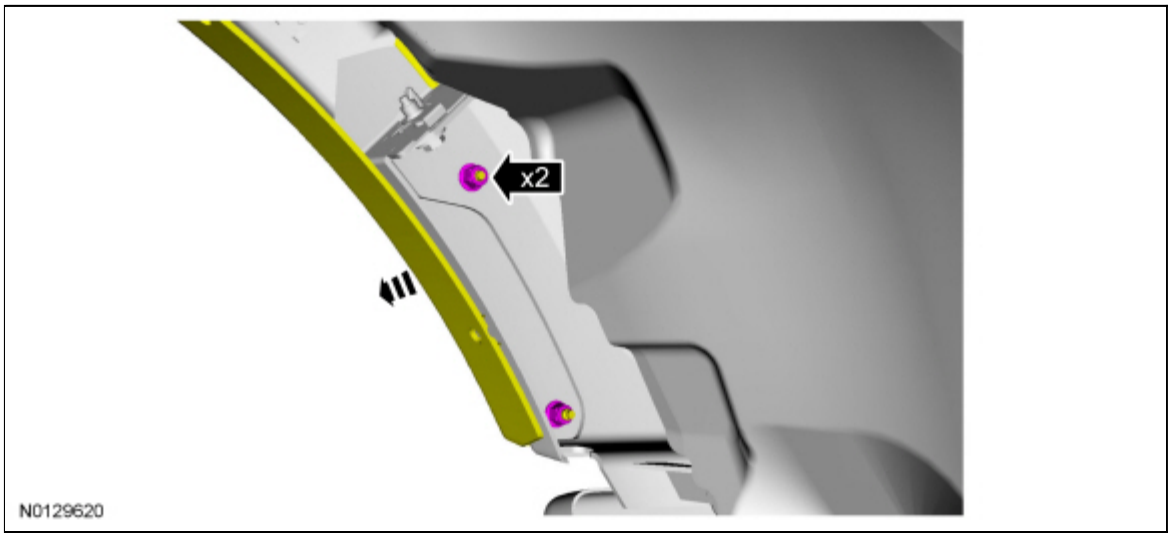
10. **NOTE:** LH shown, RH similar.

    If equipped, remove the 4 LH and 4 RH front wheel moulding pushpins.



11. **NOTE:** LH shown, RH similar.

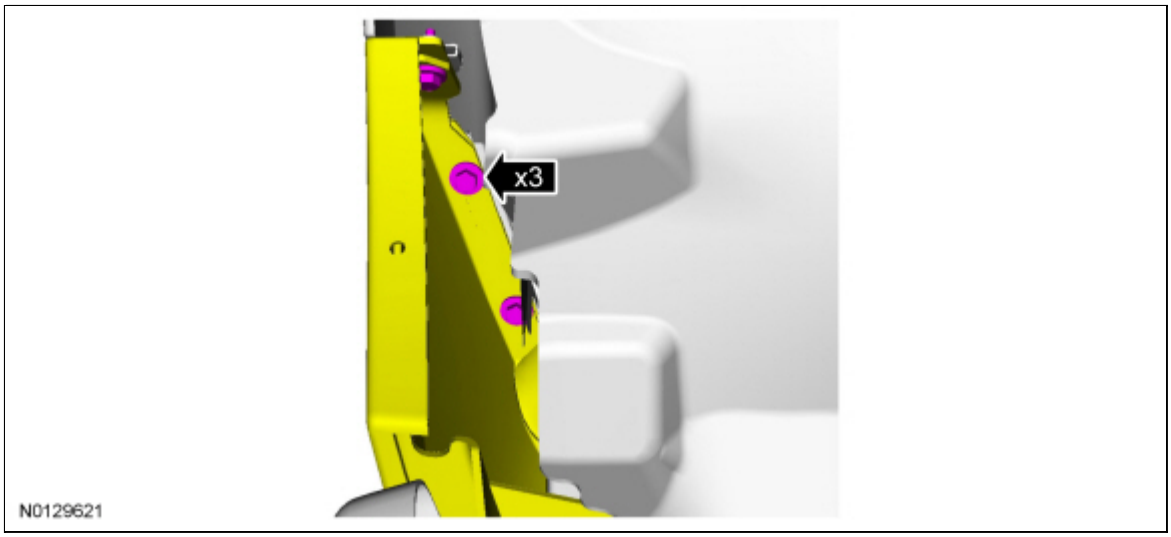
    If equipped, remove the 2 LH and 2 RH front wheel moulding nuts and detach the front wheel mouldings far enough to remove the front bumper cover.



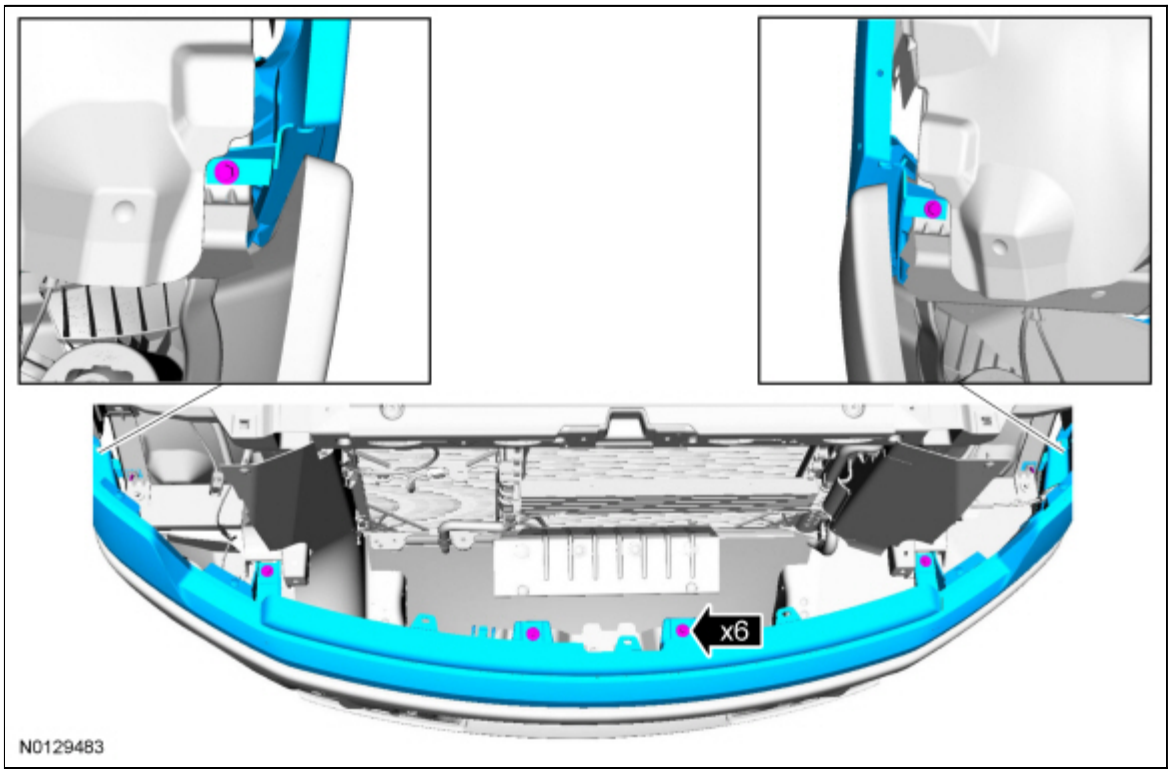
12. **NOTE:** LH shown, RH similar.

    Remove the 3 LH and 3 RH bumper cover-to-fender bolts.

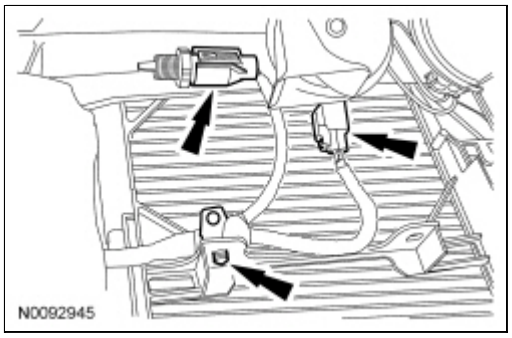
repair4less



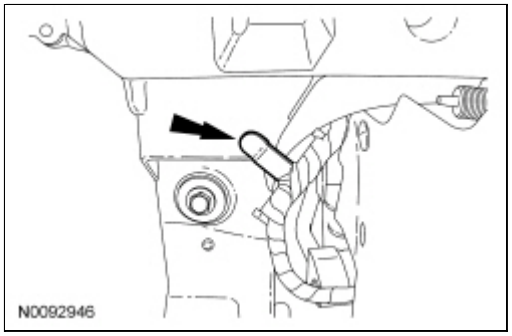
13. Remove the 6 bumper cover bracket bolts and remove the bumper cover and the brackets as an assembly.



14. Disconnect the horn electrical connector and detach the wiring harness and ambient temperature sensor retainers. Position the wiring harness aside.

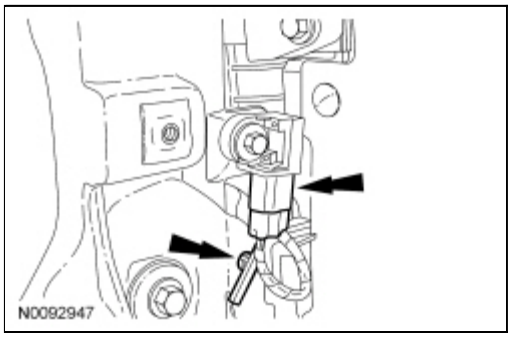


15. Detach the wiring harness retainer from the RH side of the radiator grille support.



16. **NOTE:** RH shown, LH similar.

    Disconnect the RH and LH front impact severity sensor electrical connectors and 2 wiring harness retainers. Position the wiring harnesses aside.

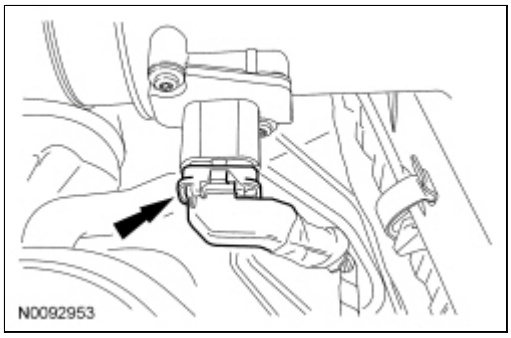


17. Release the clamp and disconnect the upper radiator hose from the radiator.

18. Remove the Air Cleaner (ACL) outlet tube. For additional information, refer to Section 303-12 .

19. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

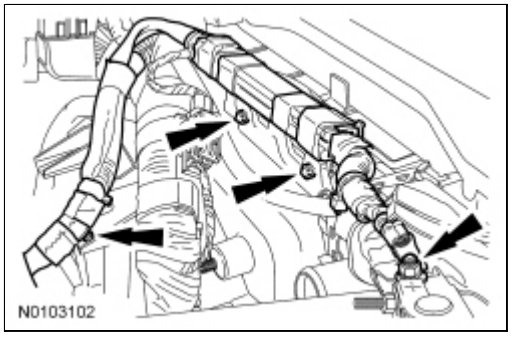
repair4less



6.2L engines

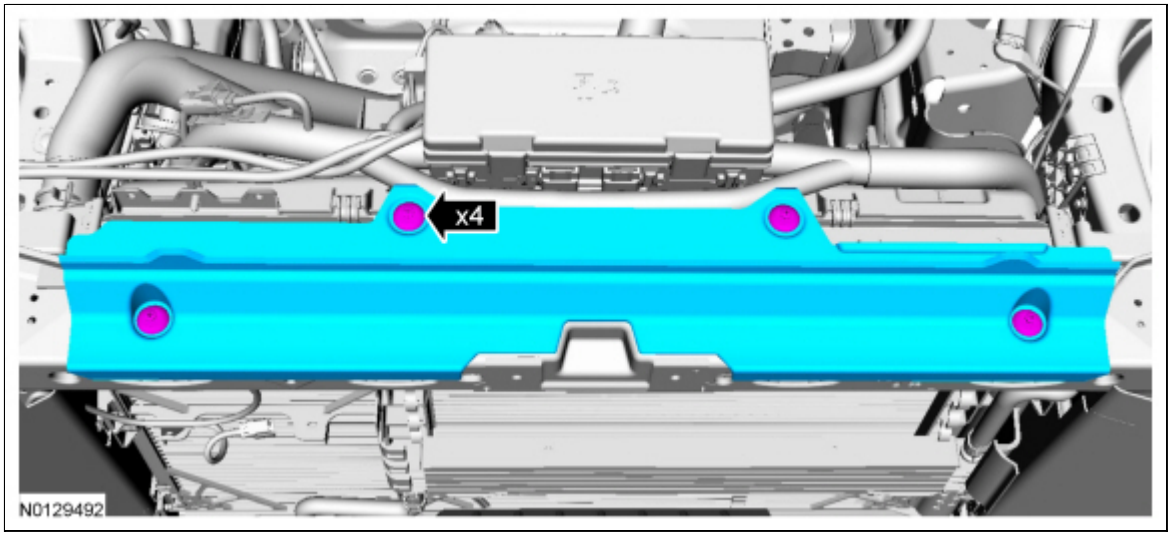
20. Detach the upper radiator hose retainer from the cooling fan motor and shroud.

21. Remove the nut, detach the generator battery positive cable, detach the 3 wiring harness retainers from the cooling fan shroud and position the wiring harness aside.



3.5L GTDI , 3.7L and 5.0L engines

22. Remove the 4 pushpins and the upper radiator air deflector.



23. Detach the wiring harness retainer from the stud bolt on the LH side of the cooling fan shroud.

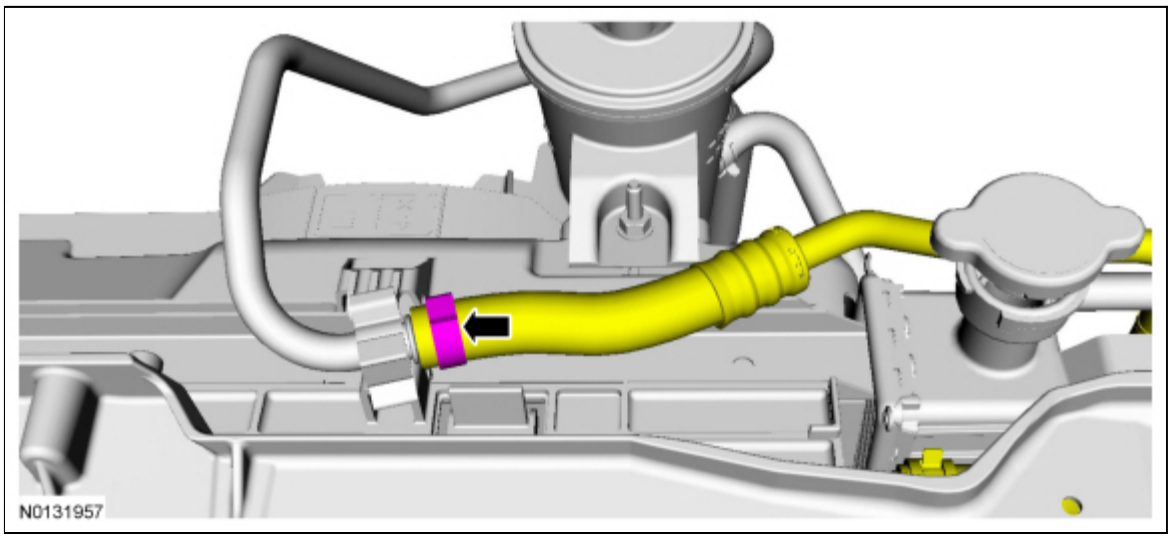
24. Disconnect the positive battery cable. For additional information, refer to Section 414-01 .

25. Detach the battery cable retainer from the cooling fan shroud.

6.2L engines

26. Detach the power steering fluid cooler hose retainer and position the hose aside.

27. Syphon the power steering fluid from the power steering reservoir, release the clamp and disconnect the power steering fluid cooler return hose on top of the radiator.



28. Detach the wiring harness retainer from the power steering fluid reservoir stud bolt.

29. Remove the power steering fluid reservoir stud bolt and position aside the reservoir.

All engines

30. If equipped, cut the block heater tie strap.

31. Remove the bolt and nut, and disconnect the A/C tube fittings from the A/C condenser.
    - Discard the O-ring seals and gaskets.

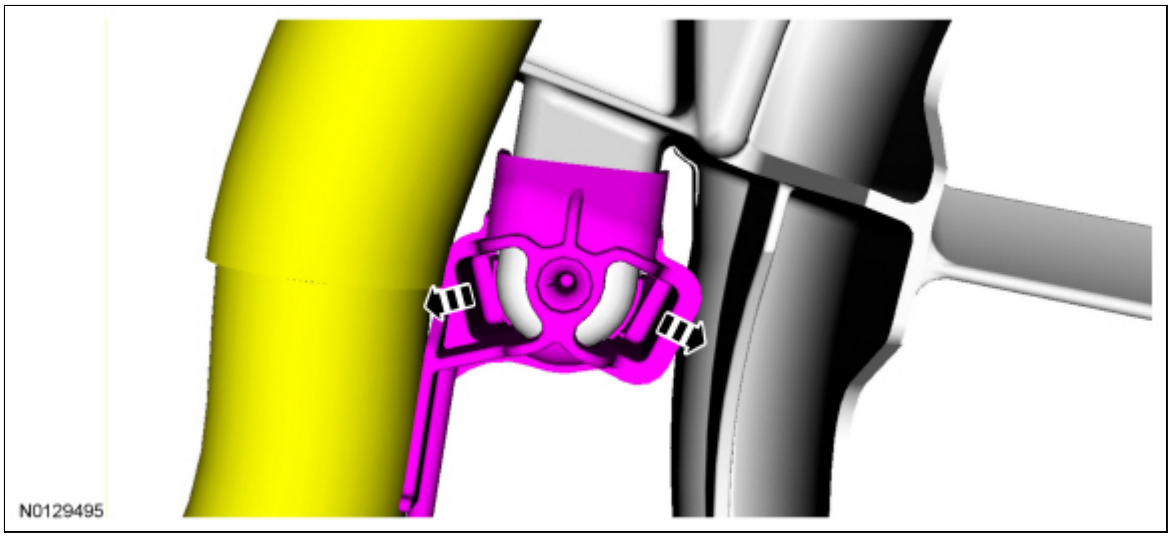
32. Disconnect the 2 cooling fan electrical connectors and detach the 3 cooling fan wiring harness retainers.

33. Release the 4 Battery Junction Box (BJB) retaining tabs and detach the BJB from the bracket.

34. **NOTE:** Push the 2 LH wiring harness retainer tabs outward to release.

    Detach the LH wiring harness retainer and the 3 RH wiring harness pushpins and position the BJB , the wiring harness.

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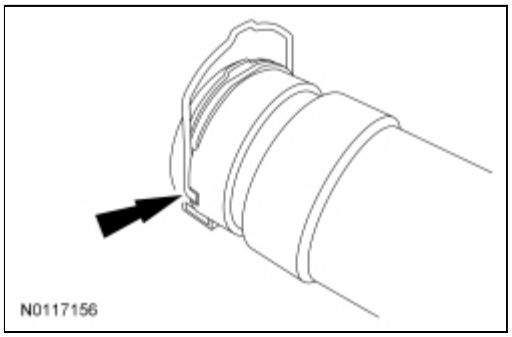


3.5L GTDI , 3.7L and 5.0L engines

35. Release the clamp and disconnect the radiator-to-degas bottle hose from the radiator.

36. **NOTE:** The quick connect coupling illustrated is to show the spring clip release location only. The quick connect coupling on the hose may differ.

    Pull the lower radiator hose spring clip up until the end of the clip is in the detent on the quick connect coupling and disconnect the lower radiator hose from the radiator.

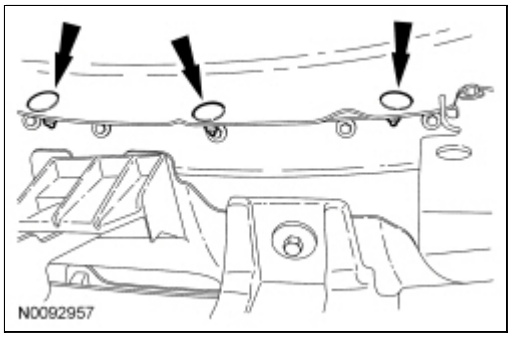


6.2L engines

37. Remove the spring clip and disconnect the lower radiator hose from the radiator.

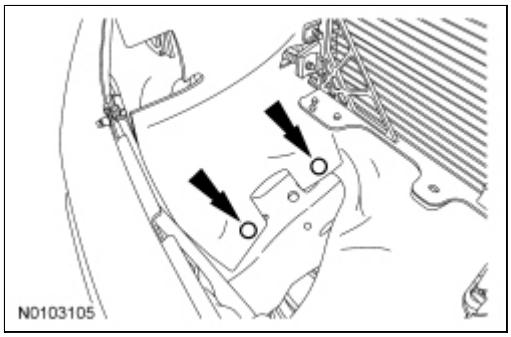
38. Disconnect the radiator overflow hose from the radiator.

39. Remove the 3 front air deflector-to-bumper pushpins.



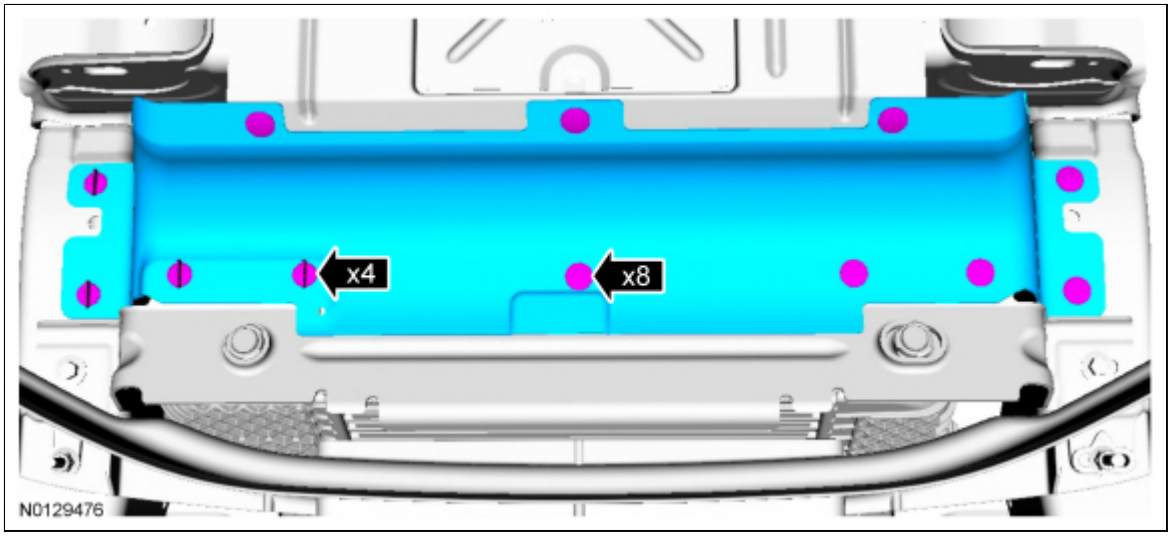
All engines

40. Remove the 2 RH air deflector-to-frame rail pushpins.



3.5L GTDI engines

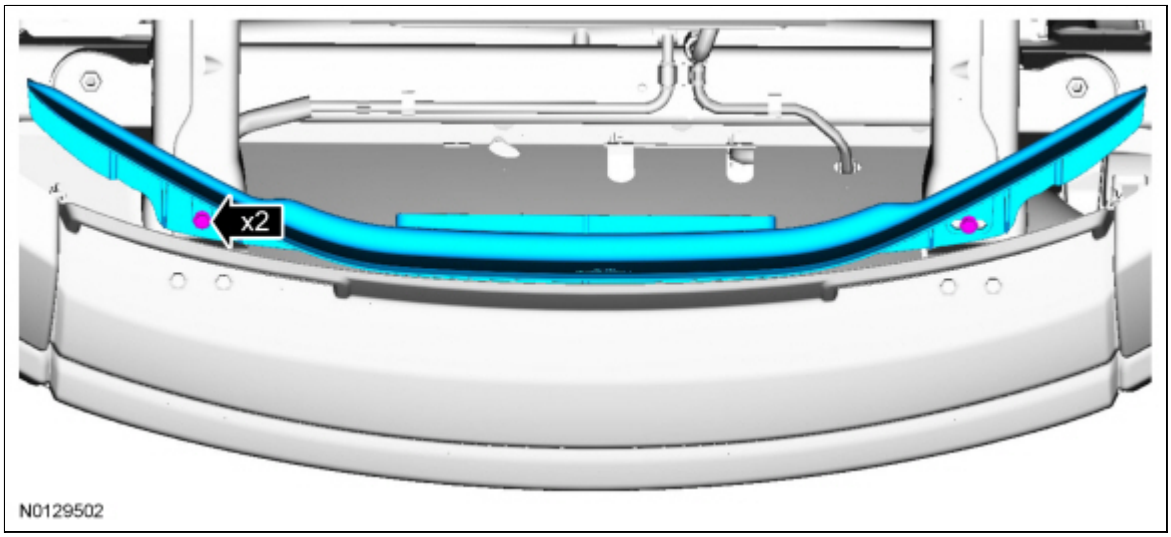
41. Turn the 4 quarter-turn retainers, detach the 8 pushpins and remove the lower air deflector.



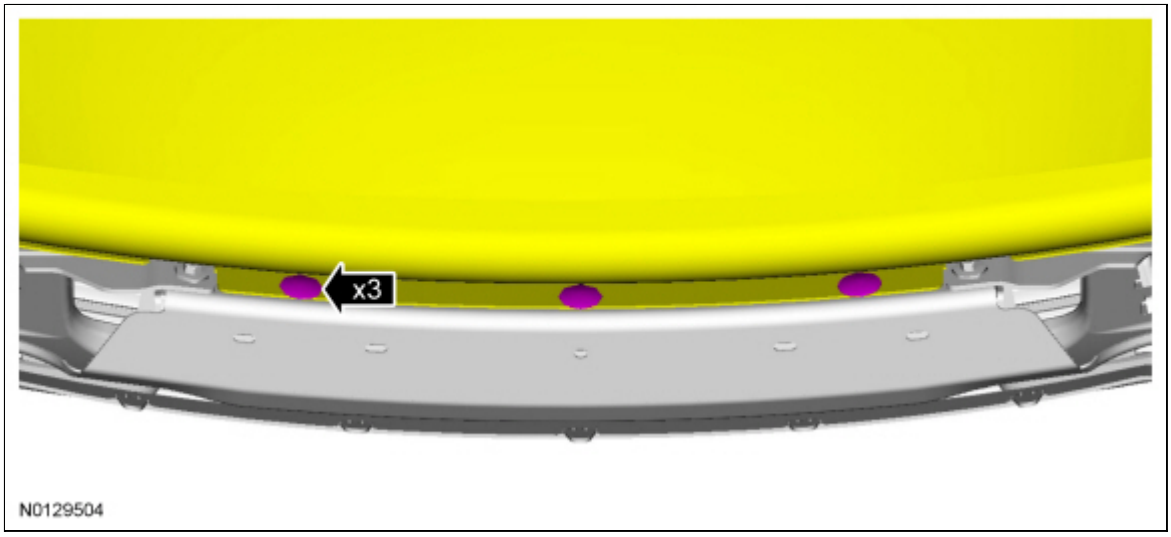
3.7L and 5.0L engines

42. Remove the 2 air dam bolts and the air dam.

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43. Remove the 3 front air deflector-to-bumper pushpins.

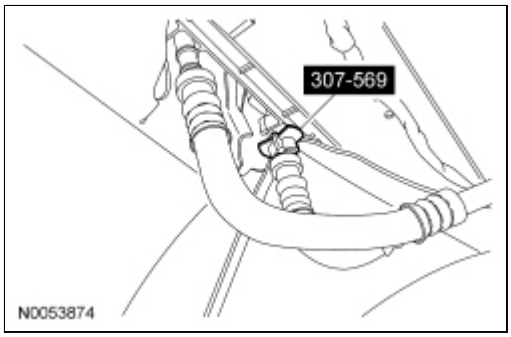


All engines

44. Remove the 2 transmission cooler tube latch assemblies.

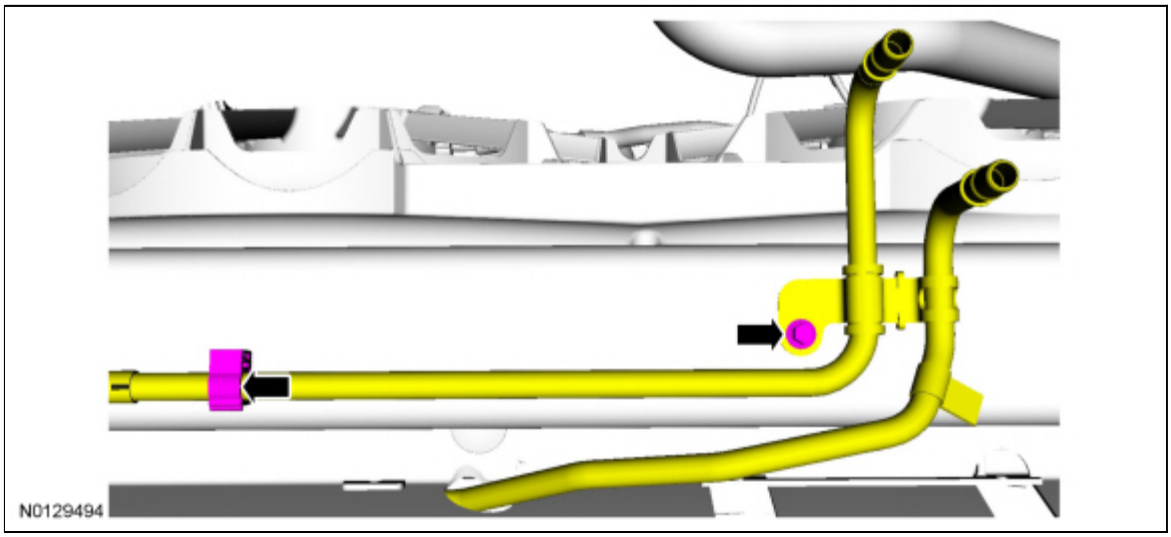
45. **NOTE:** 6.2L shown, 3.5L GTDI , 3.7L and 5.0L similar.

    Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes.

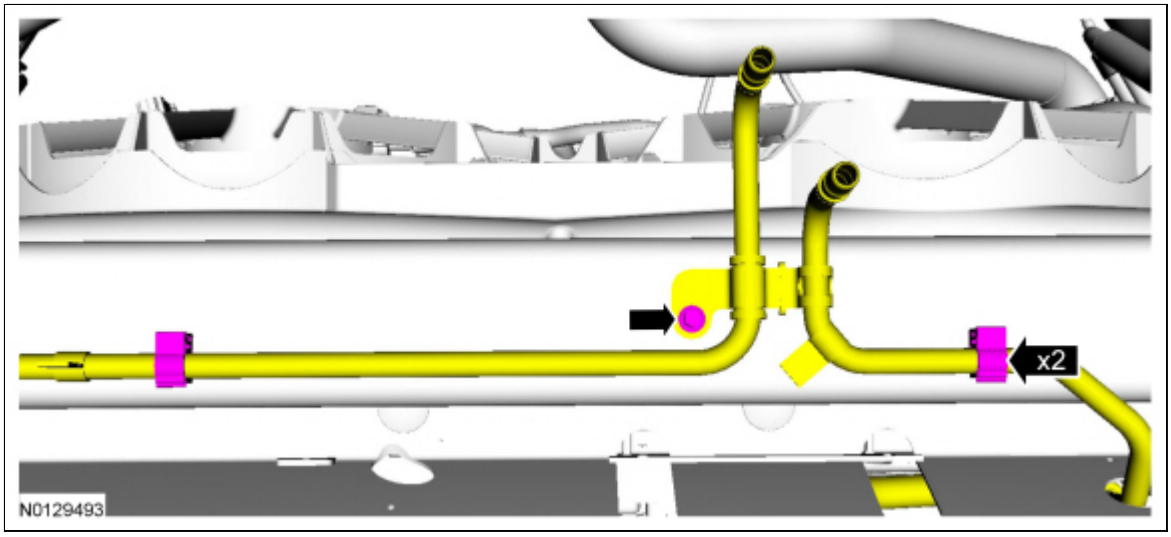


3.5L GTDI , 3.7L and 5.0L engines

46. For vehicles without an auxiliary transmission fluid cooler, remove the transmission cooler tube bracket bolt and detach the transmission cooler tube retainer from the crossmember.



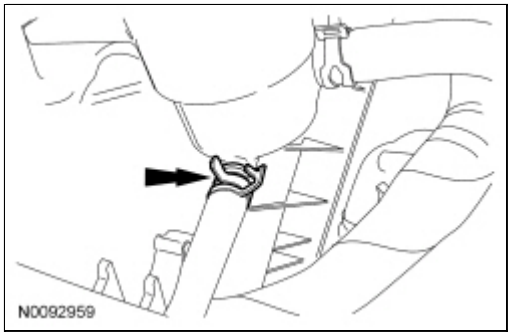
47. For vehicles with an auxiliary transmission fluid cooler, remove the transmission cooler tube bracket bolt and detach the 2 transmission cooler tube retainers from the crossmember.



6.2L engines

repair4less

48. Disconnect the power steering cooler-to-power steering fluid reservoir hose from the power steering fluid reservoir.



All engines

49. Remove the 6 cooling module bolts.

50. Remove the cooling module.

Installation

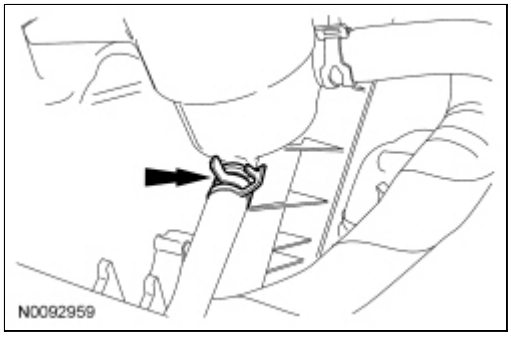
All engines

1. Position the cooling module into the vehicle.

2. Install the 6 cooling module bolts.
    - Tighten to 30 Nm (22 lb-ft).

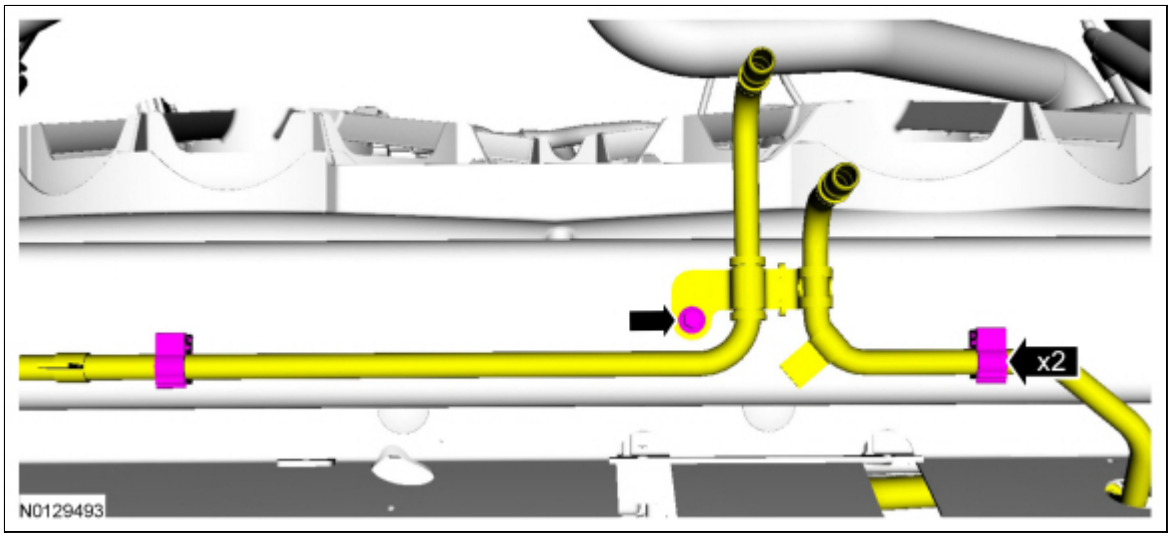
6.2L engines

3. Connect the power steering cooler-to-power steering fluid reservoir hose at the power steering reservoir.

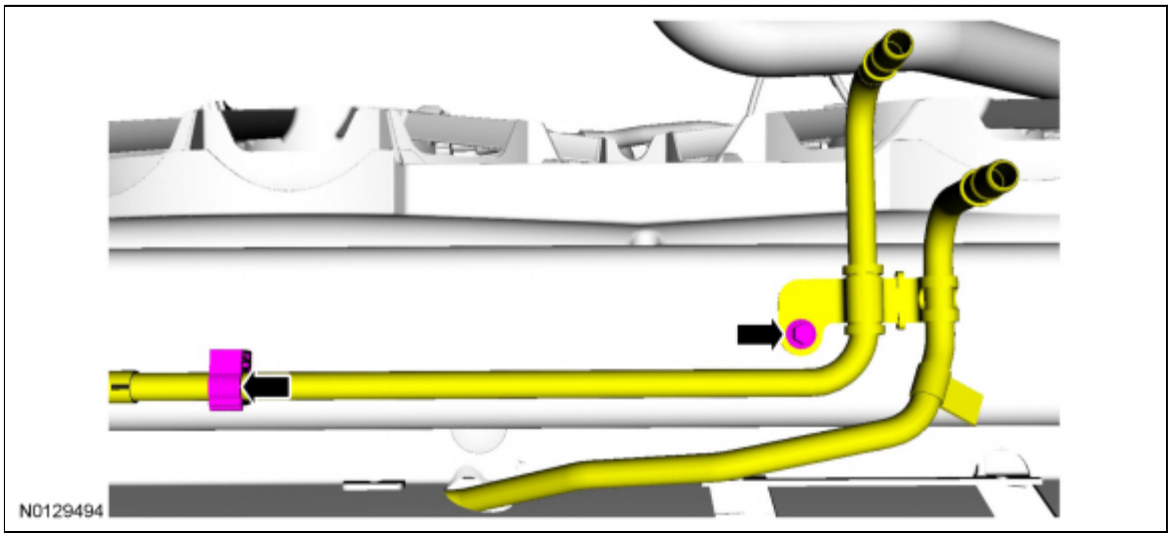


3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L engines

4. For vehicles with an auxiliary transmission fluid cooler, attach the 2 transmission cooler tube retainers and install the transmission cooler tube bracket bolt.
    - Tighten to 12 Nm (106 lb-in).



5. For vehicles without an auxiliary transmission fluid cooler, attach the transmission cooler tube retainer and install the transmission cooler tube bracket bolt.
    - Tighten to 12 Nm (106 lb-in).



All vehicles

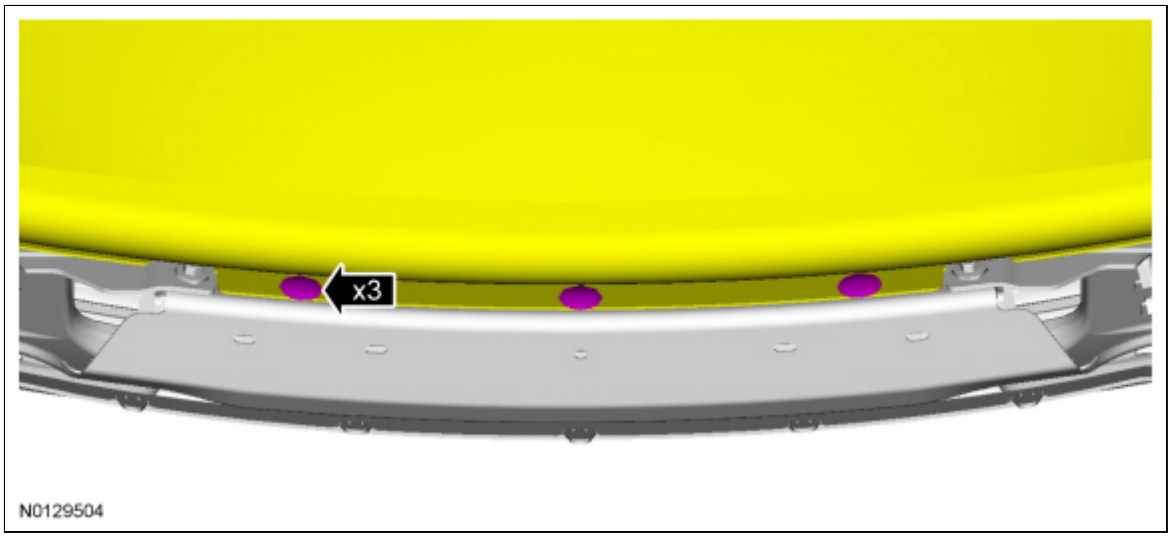
6. Connect the transmission cooler tubes.

7. Install the transmission cooler tube latch assemblies.

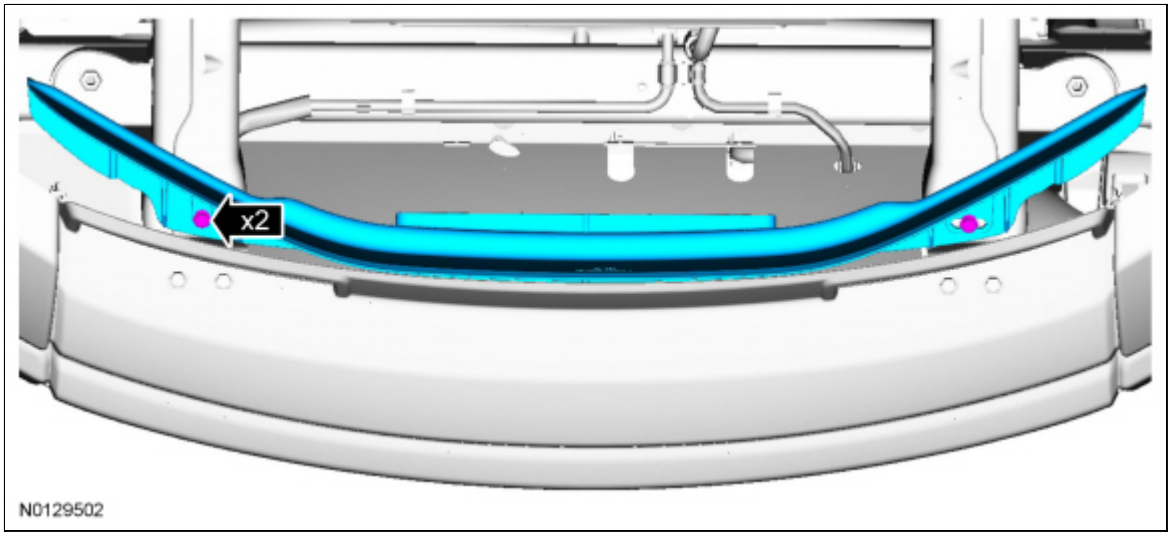
3.7L and 5.0L engines

8. Install the 3 air deflector-to-front bumper pushpins.

repair4less

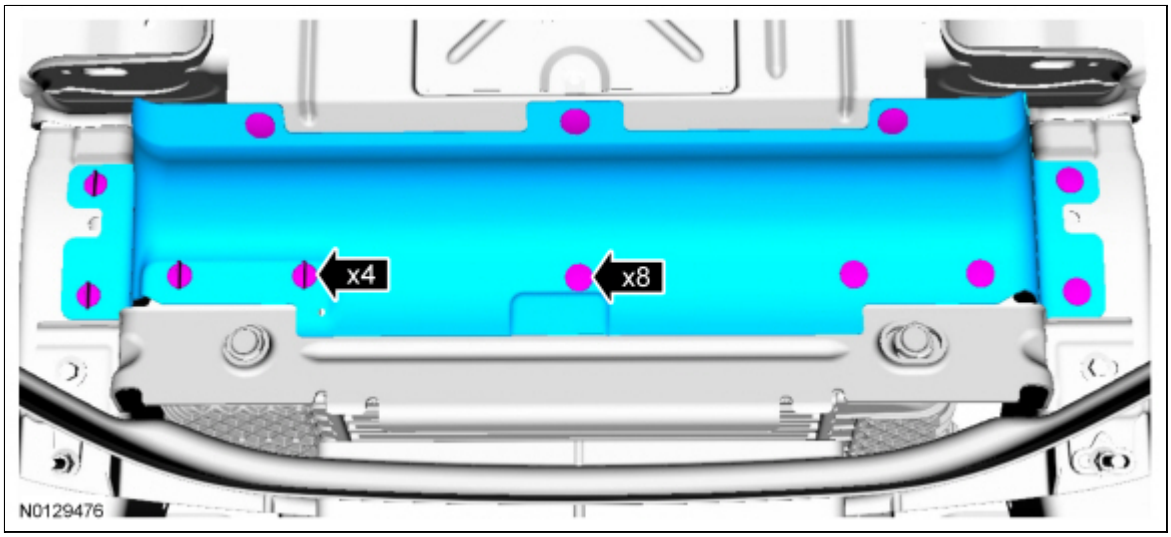


9. Position the air dam and install the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).



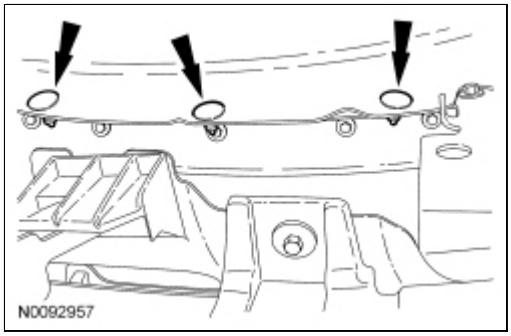
3.5L GTDI engines

10. Position the lower air deflector, attach the 8 pushpins and turn the 4 quarter-turn retainers.



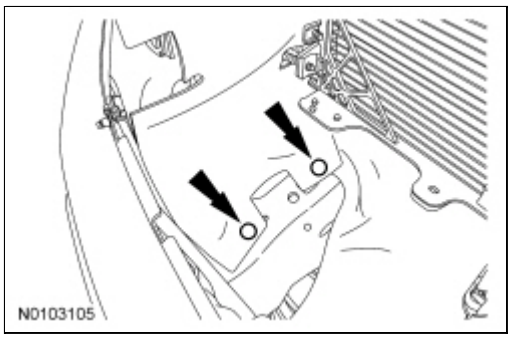
6.2L engines

11. Install the 3 front air deflector-to-bumper pushpins.



All engines

12. Install the 2 RH air deflector-to-frame rail pushpins.



3.5L GTDI , 3.7L and 5.0L engines

13. Push the spring clip in place and connect the lower radiator hose quick connect coupling to the radiator, making sure the coupling is secure.

14. Connect the radiator-to-degas bottle hose to the radiator and position the clamp.

repair4less

6.2L engines

15. Connect the radiator overflow hose to the radiator.

16. Connect the lower radiator hose to the radiator and install the spring clip.

All engines

17. Position the BJB and wiring harness into place, connect the BJB retaining tabs, and attach the LH wiring harness retainer and the 3 RH wiring harness pushpins.

18. Attach the 3 cooling fan wiring harness retainers and connect the 2 cooling fan electrical connectors.

19. Install new O-ring seals and gaskets on the A/C condenser fittings.

20. Connect the A/C fittings to the A/C condenser and install the bolt and the nut.
    - Tighten to 15 Nm (133 lb-in).

21. If equipped, install a new block heater tie strap.

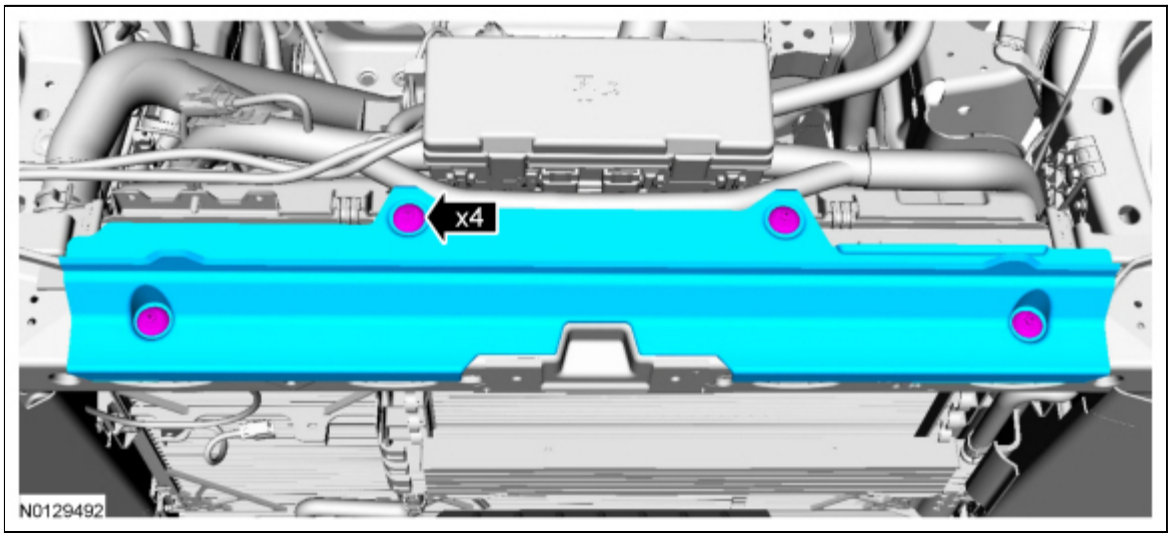
3.5L GTDI, 3.7L and 5.0L engines

22. Attach the wiring harness retainer to the stud bolt on the LH side of the cooling fan shroud.

23. Connect the battery positive cable. For additional information, refer to Section 414-01.

24. Attach the battery cable retainer to the cooling fan shroud.

25. Install the upper radiator air deflector and install the 4 pushpins.

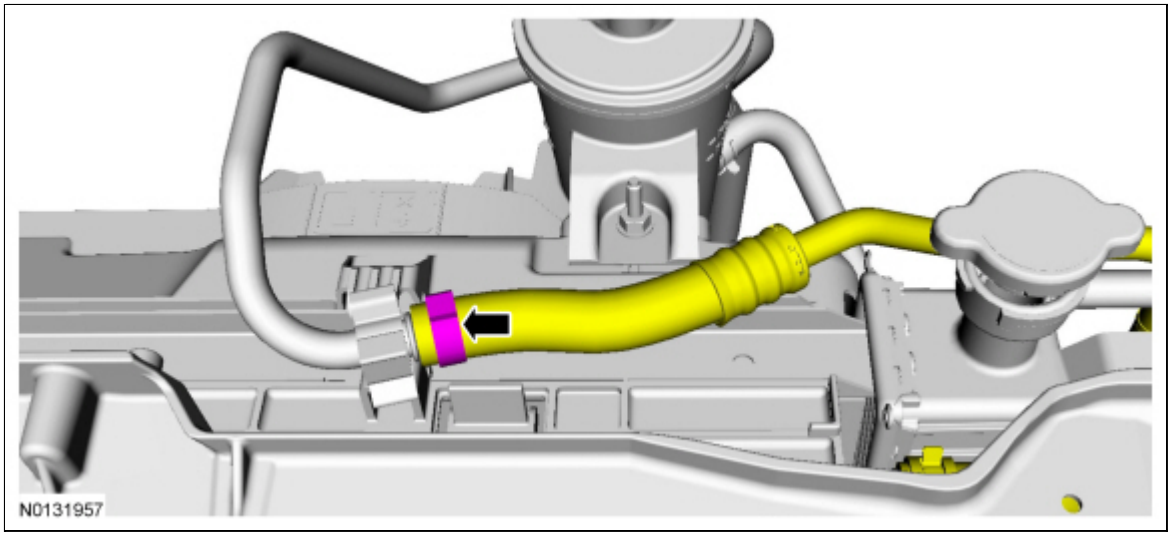


6.2L engines

26. Position the power steering fluid reservoir and install the stud bolt.
    - Tighten to 11 Nm (97 lb-in).

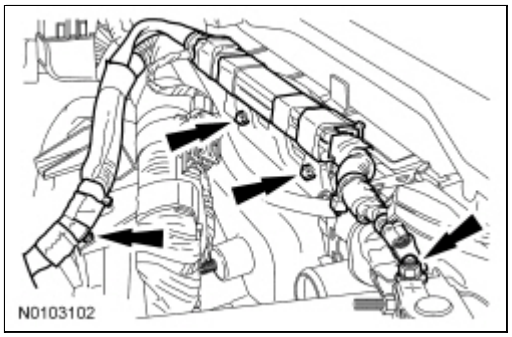
27. Attach the wiring harness retainer to the power steering fluid reservoir stud bolt.

28. Connect the power steering fluid cooler return hose on top of the radiator.



29. Connect the power steering fluid cooler hose retainer.

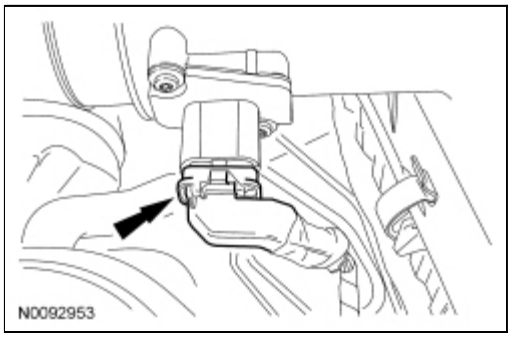
30. Position the wiring harness, attach the 3 wiring harness retainers to the cooling fan shroud, attach the generator battery positive cable and install the nut.
    - Tighten to 9 Nm (80 lb-in).



31. Attach the upper radiator hose retainer to the cooling fan motor and shroud.

All engines

32. Connect the MAF sensor electrical connector.



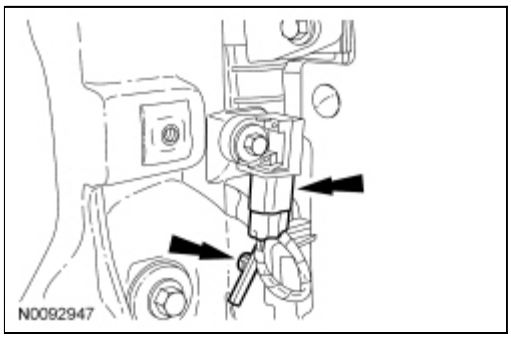
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33. Install the ACL outlet tube. For additional information, refer to Section 303-12 .

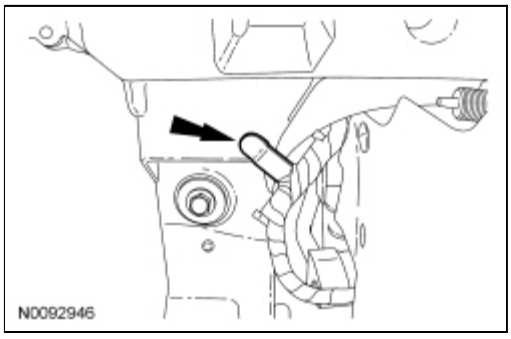
34. Connect the upper radiator hose to the radiator and install the clamp.

35. **NOTE:** RH shown, LH similar.

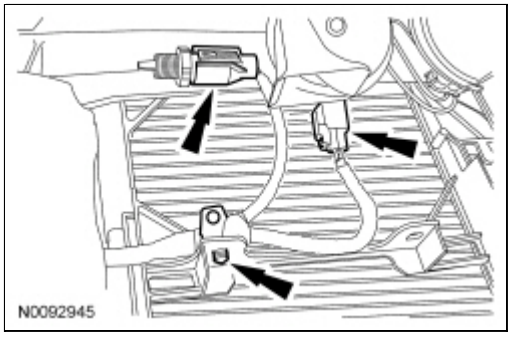
    Position the wiring harness into place and connect the RH and LH front impact severity sensor electrical connectors and wiring harness pushpin retainers.



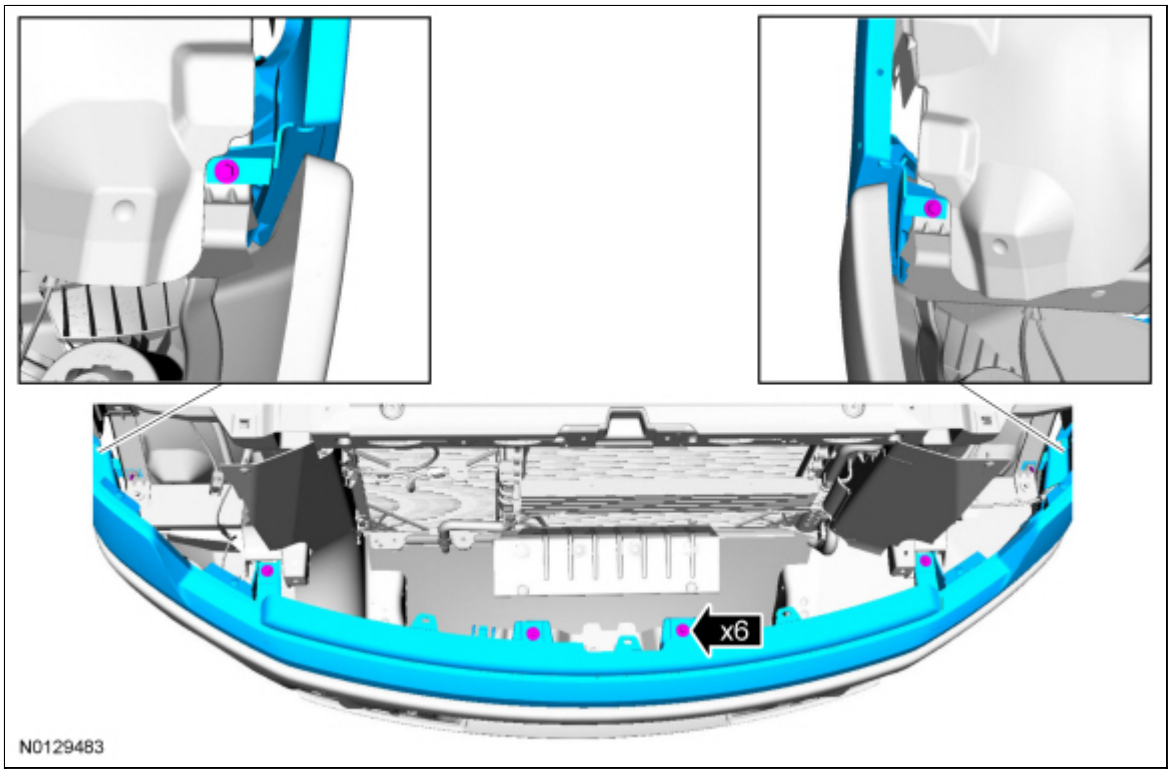
36. Attach the wiring harness retainer to the RH side of the radiator grille support.



37. Position the wiring harness into place and connect the horn and ambient temperature sensor electrical connectors and attach the pushpin retainer.

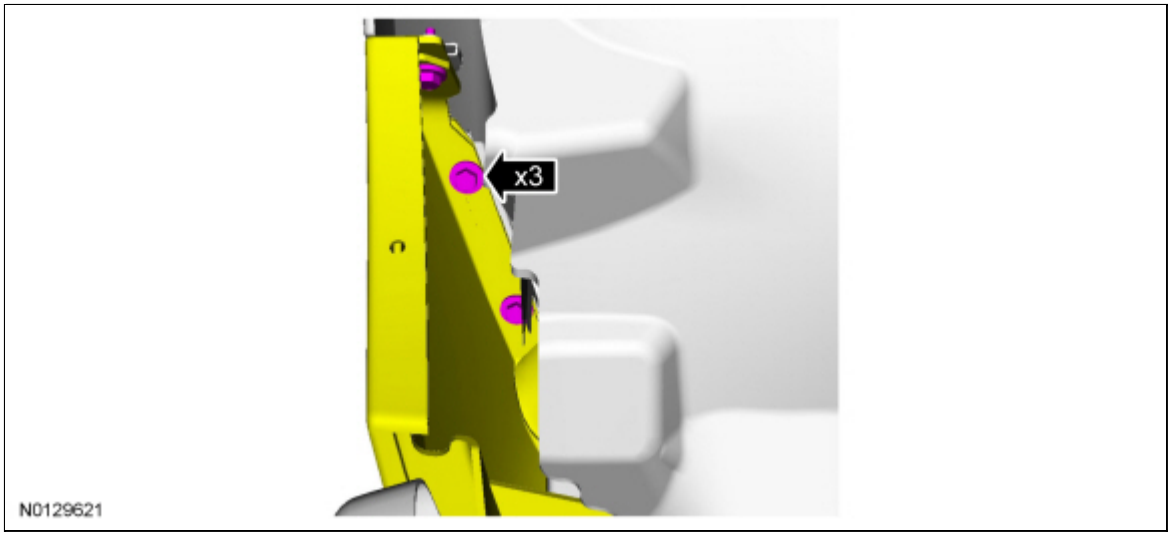


38. Position the front bumper cover and the brackets as an assembly and install the 6 bumper cover bracket bolts.
    - Tighten to 3 Nm (27 lb-in).



39. **NOTE:** LH shown, RH similar.

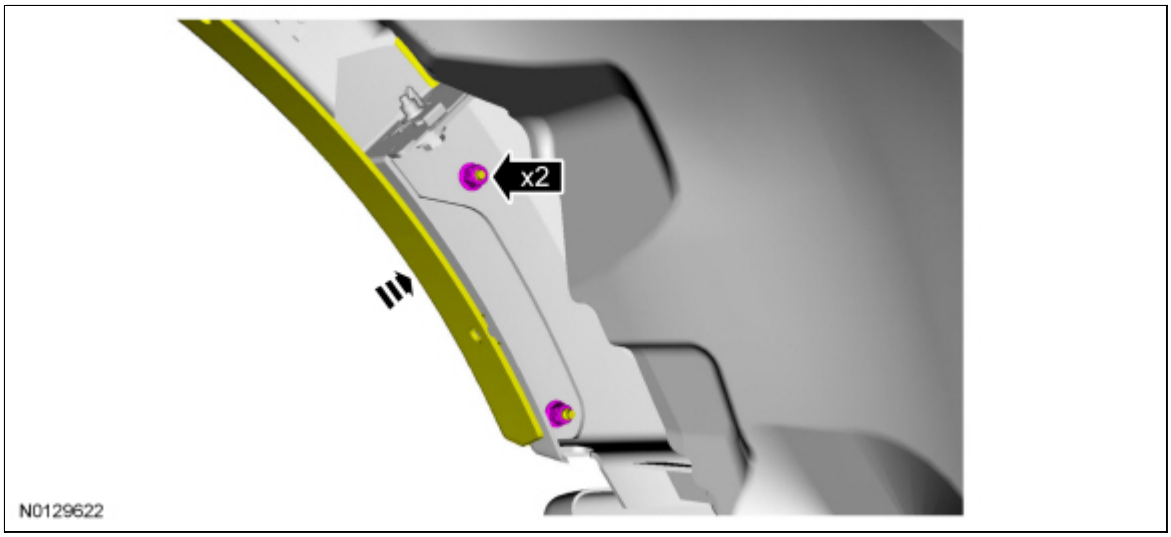
    Install the 3 LH and 3 RH bumper cover-to-fender bolts.
    - Tighten to 3 Nm (27 lb-in).



40. **NOTE:** LH shown, RH similar.

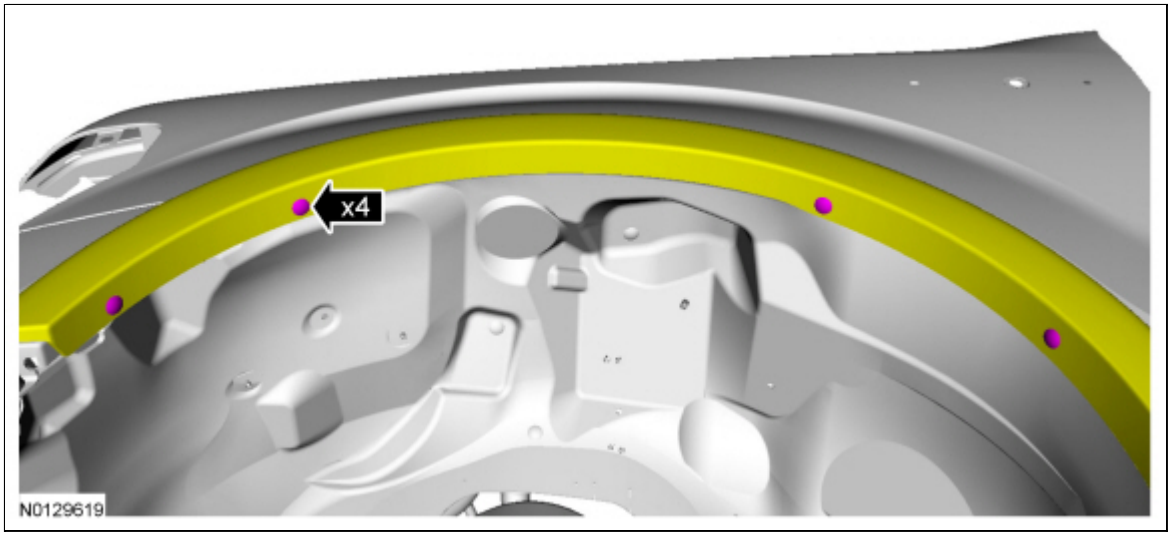
    If equipped, attach the front wheel mouldings and install the 2 LH and 2 RH nuts.
    - Tighten to 3 Nm (27 lb-in).

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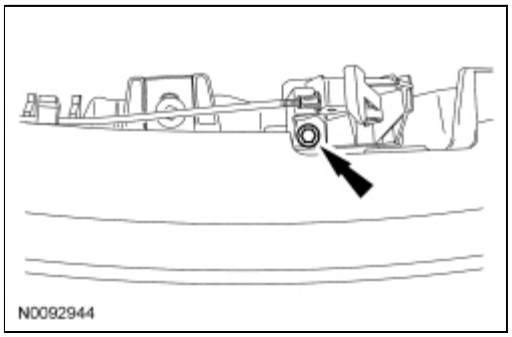


41. **NOTE:** LH shown, RH similar.

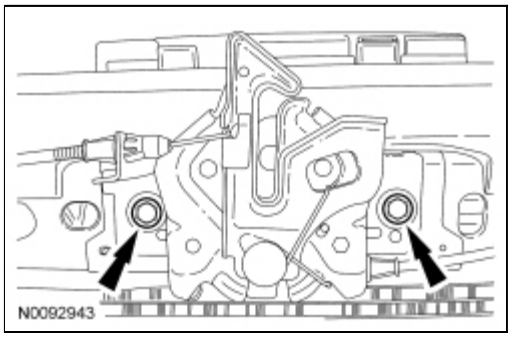
    If equipped, install the 4 LH and 4 RH front wheel moulding pushpins.



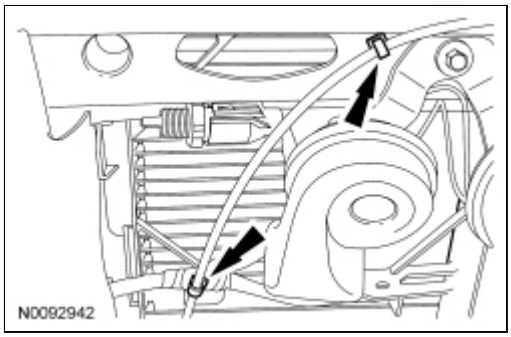
42. Position and attach the hood latch release handle and cable onto the front bumper cover and install the bolt.
    - Tighten to 8 Nm (71 lb-in).



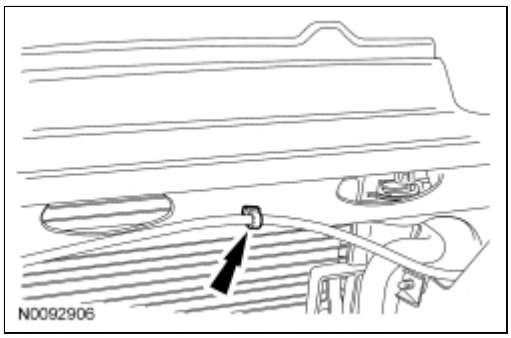
43. Position the hood latch into place and install the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).



44. Attach the 2 RH hood latch cable pushpin retainers.



45. Attach the LH hood latch cable pushpin retainers.



46. Install the headlights. For additional information, refer to Section 417-01 .

47. Connect the battery ground cable. For additional information, refer to Section 414-01 .

48. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

49. Recharge the A/C system. For additional information, refer to Section 412-00 .

50. If equipped, fill the power steering system. For additional information, refer to Section 211-00B .

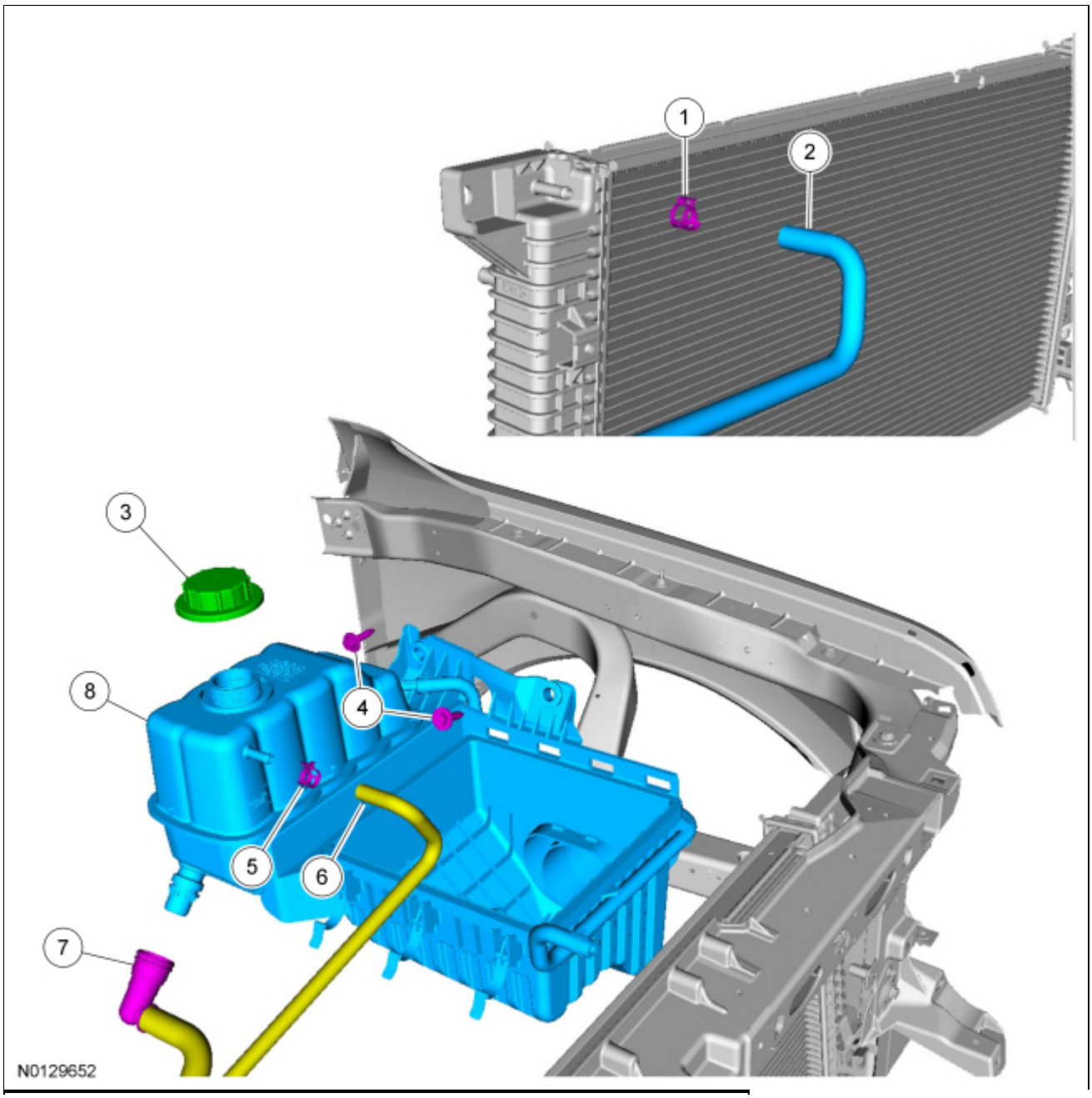
51. Check the transmission fluid and fill as necessary. For additional information, refer to Section 307-01 .

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Degas Bottle — 3.5L GTDI, 3.7L, 5.0L

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



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Item	Part Number	Description
1	—	Radiator-to-degas bottle hose clamp (part of 8075)
2	8075	Radiator-to-degas bottle hose
3	8101	Pressure relief cap
4	W707108	Degas bottle/lower air cleaner tray bolts - 17 Nm (150 lb-in) (2 required)
5	—	Thermostat housing-to-degas bottle hose clamp (part of 8276)
6	8276	Thermostat housing-to-degas bottle hose
7	18472	Heater outlet hose (3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L engines)
7	8C350	Degas bottle-to-heater outlet tube hose (5.0L engines)
8	8A080	Degas bottle/lower air cleaner tray assembly

Removal and Installation

1. **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   NOTE: During normal vehicle operation, Motorcraft Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

   Release the pressure in the cooling system by slowly turning the pressure relief cap one half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

2. Using hose pinch pliers, clamp the heater outlet hose near the degas bottle.

3. Using a suitable suction device, siphon the coolant from the degas bottle.

4. Release the clamp and disconnect the radiator-to-degas bottle from the radiator.

5. Release the clamp and disconnect the thermostat housing-to-degas bottle hose from the degas bottle.

6. Remove the spring clip and disconnect the heater outlet hose (3.5L GTDI or 3.7L engines) or the degas bottle-to-heater outlet tube hose (5.0L engines) from the degas bottle.

7. Remove the 2 bolts and the degas bottle/lower air cleaner tray assembly.
   - To install, tighten to 17 Nm (150 lb-in).

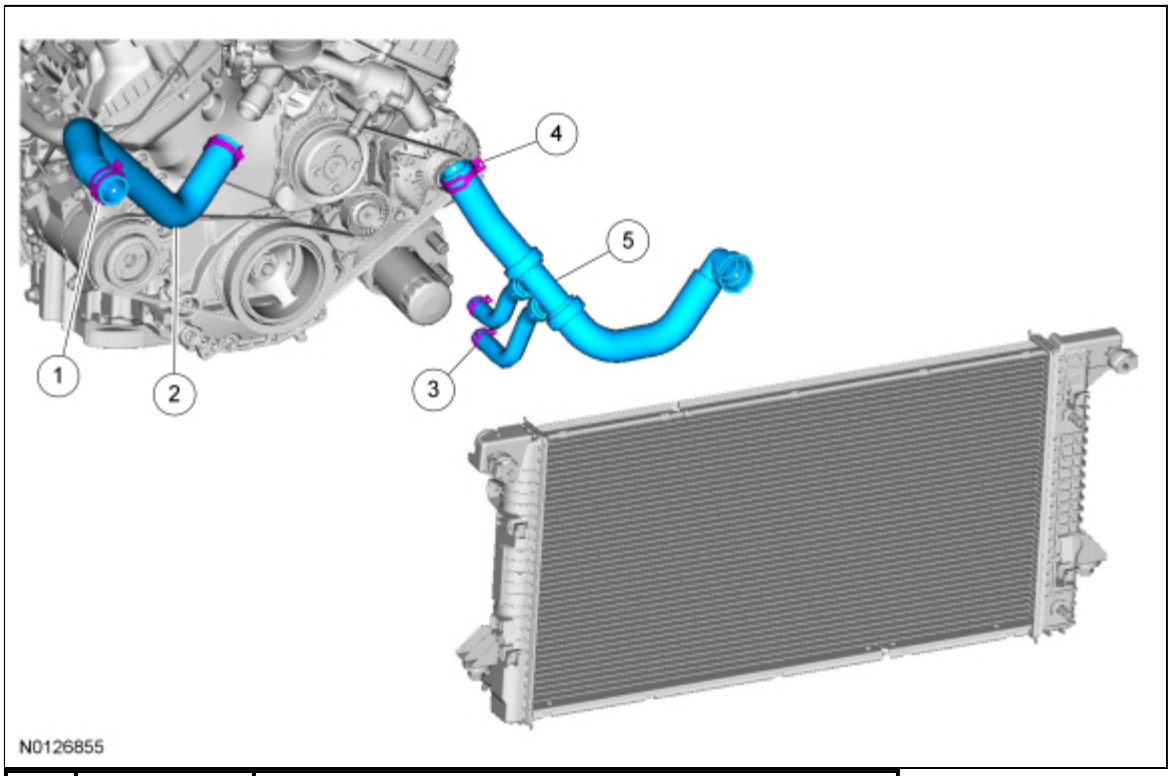
8. To install, reverse the removal procedure.

9. Fill the degas bottle with a 50/50 mixture of coolant and distilled water.

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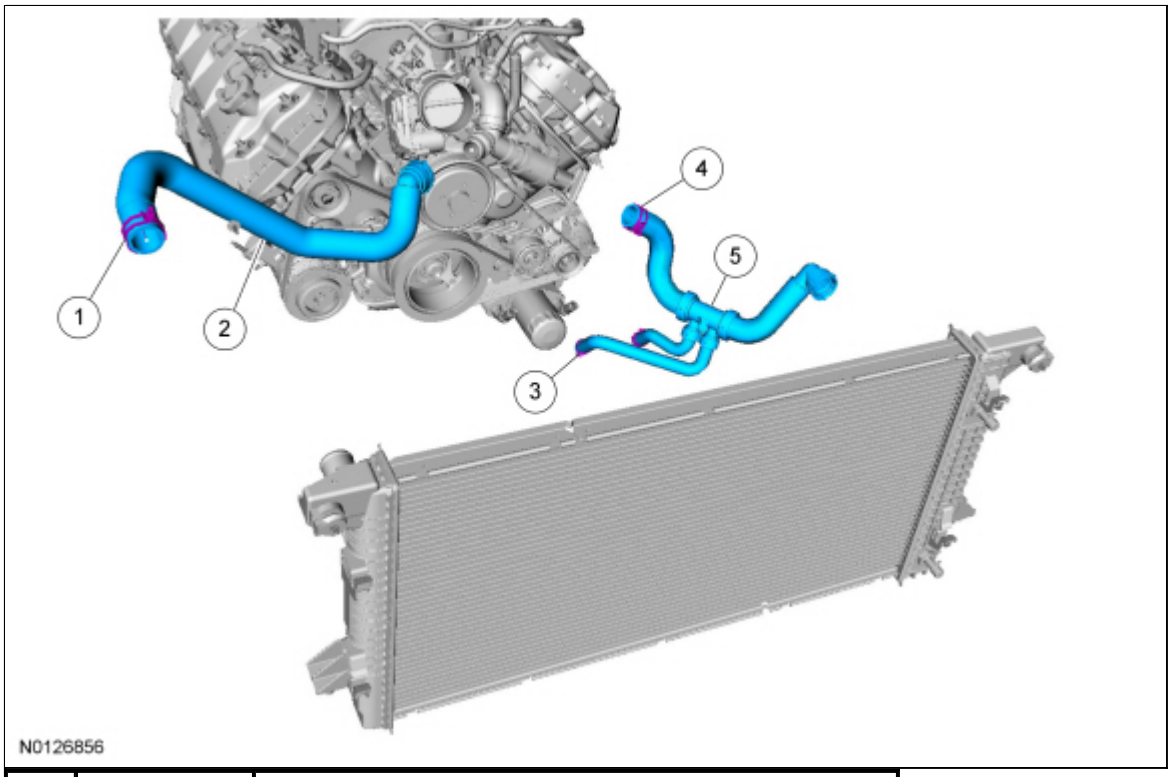
Radiator Hose

3.5L GTDI and 3.7L Engines



Item	Part Number	Description
1	—	Upper radiator hose clamp (2 required) (part of 8260)
2	8260	Upper radiator hose
3	—	Oil cooler hose clamp (2 required) (part of 8286)
4	—	Lower radiator hose clamp (part of 8286)
5	8286	Lower radiator hose

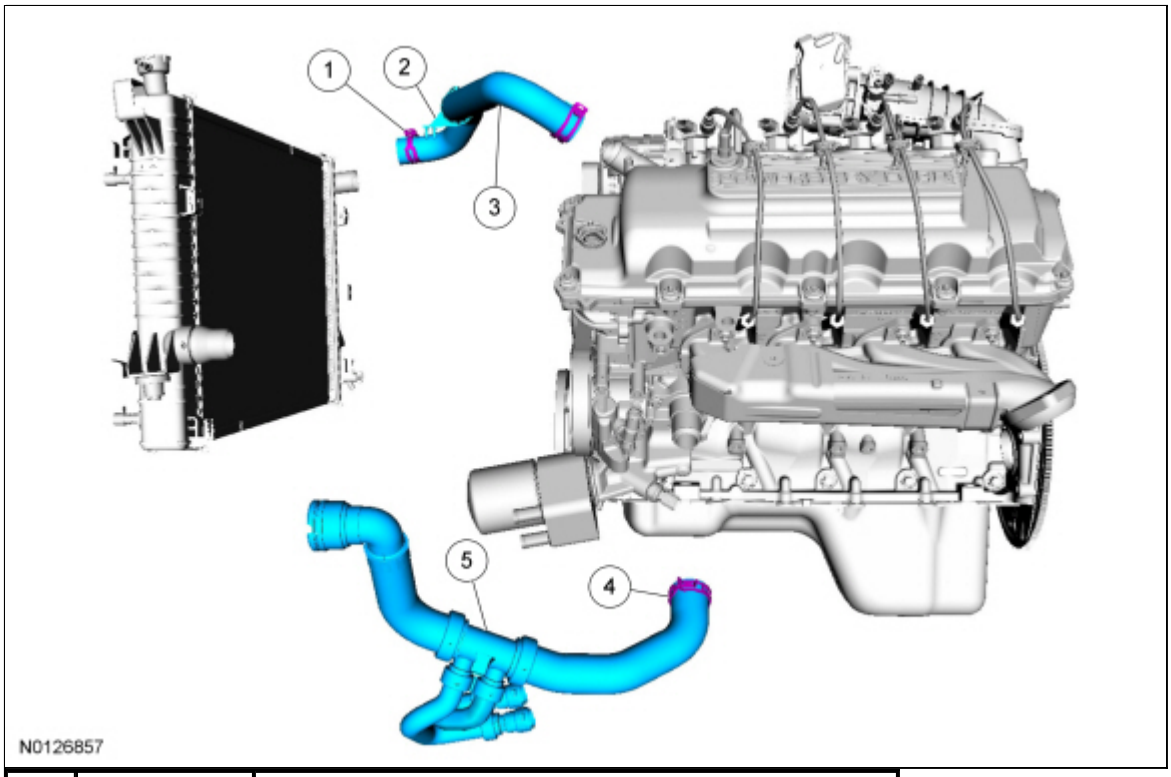
5.0L Engine



Item	Part Number	Description
1	—	Upper radiator hose clamp (2 required) (part of 8260)
2	8260	Upper radiator hose
3	—	Oil cooler hose clamp (2 required) (part of 8286)
4	—	Lower radiator hose clamp (part of 8286)
5	8286	Lower radiator hose

6.2L Engine

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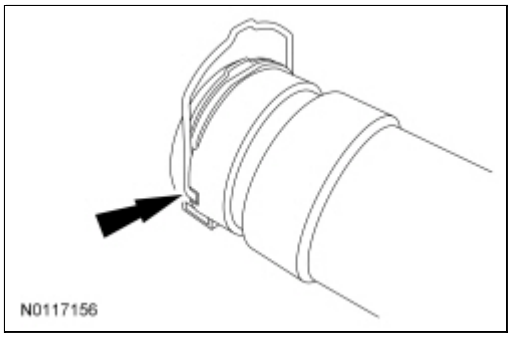
Item	Part Number	Description
1	—	Upper radiator hose clamp (2 required) (part of 8260)
2	8W287	Upper radiator hose retainer (part of 8286)
3	8260	Upper radiator hose
4	—	Lower radiator hose clamp (part of 8286)
5	8286	Lower radiator hose

1. ***NOTICE:*** **Cover the accessory drive belts to prevent coolant contamination of the belts.**

   For 3.5L GTDI, 3.7L and 5.0L engines, completely cover the accessory drive belts with waterproof plastic.

2. **NOTE:** The quick connect coupling illustrated is to show the spring clip release location only. The quick connect coupling on the hose may differ.

   For radiator hose quick connect couplings, pull the radiator hose spring clip up until the end of the clip is in the detent on the quick connect coupling and disconnect the radiator hose.
   - To install, push the spring clip in place and connect the radiator hose quick connect coupling, making sure the coupling is secure.



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Radiator

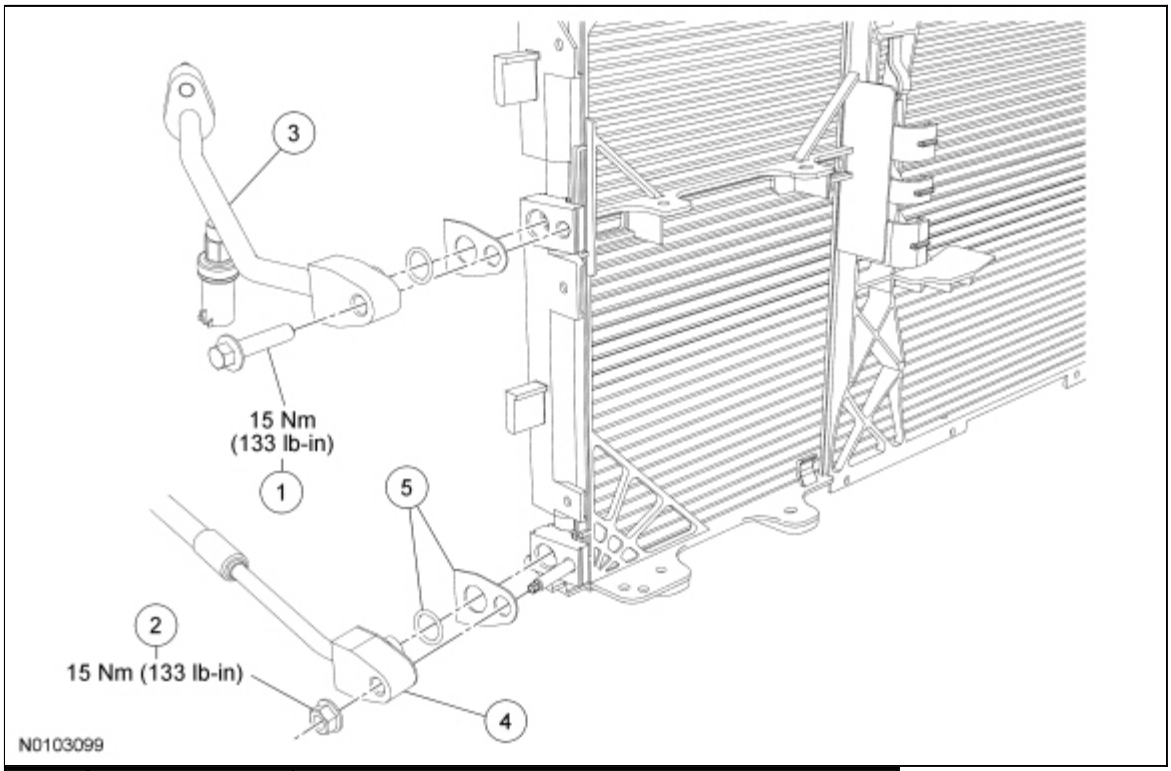
Special Tool(s)

 ST2935A	Disconnect Tool, Transmission Cooler Line 307-569

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V

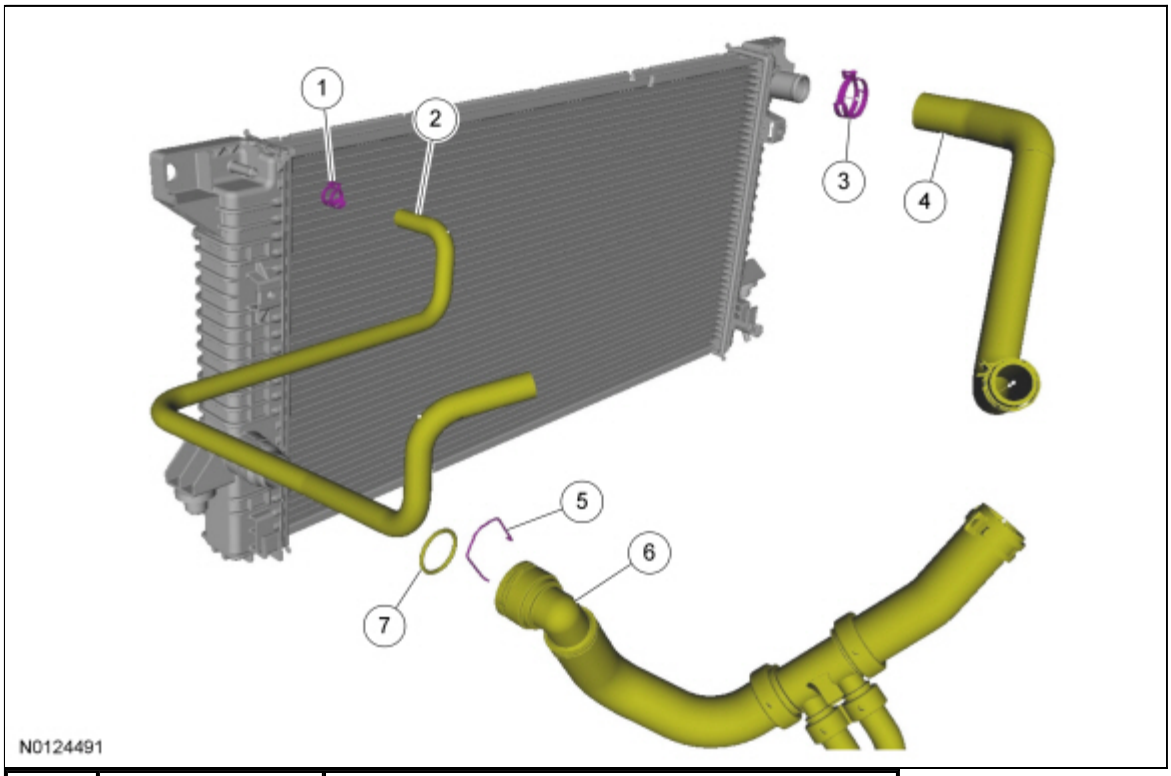
A/C Condenser Fittings



Item	Part Number	Description

1	W500110	Condenser inlet fitting bolt
2	W520413	Condenser outlet fitting nut
3	19E558	Condenser inlet jumper line fitting
4	—	Condenser outlet fitting (part of 19A834)
5	19B596	O-ring seal and gasket seal kit (2 required)

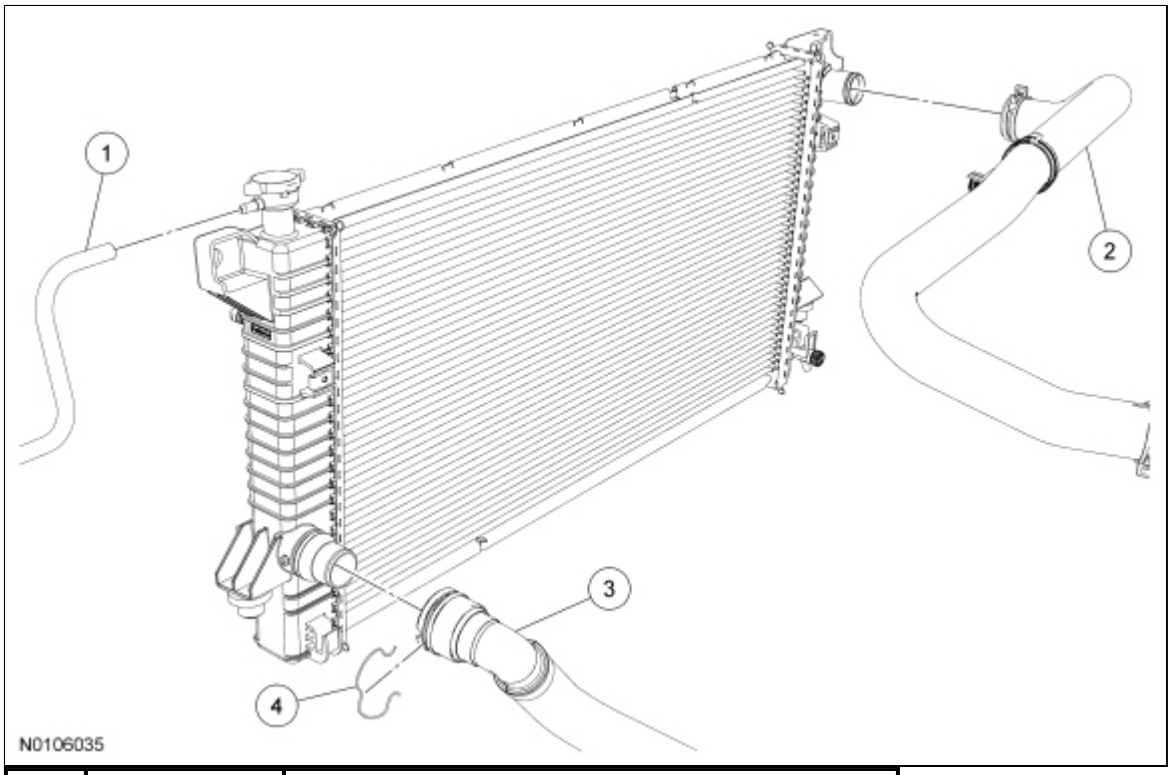
Radiator Hoses - 3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L



Item	Part Number	Description
1	15161	Radiator-to-degas bottle hose clamp
2	8W005	Radiator-to-degas bottle hose
3	15161	Upper radiator hose clamp
4	8260	Upper radiator hose
5	8D037	Lower radiator hose spring clip
6	8286	Lower radiator hose
7	8D038	Lower radiator hose O-ring seal

Radiator Hoses 6.2L

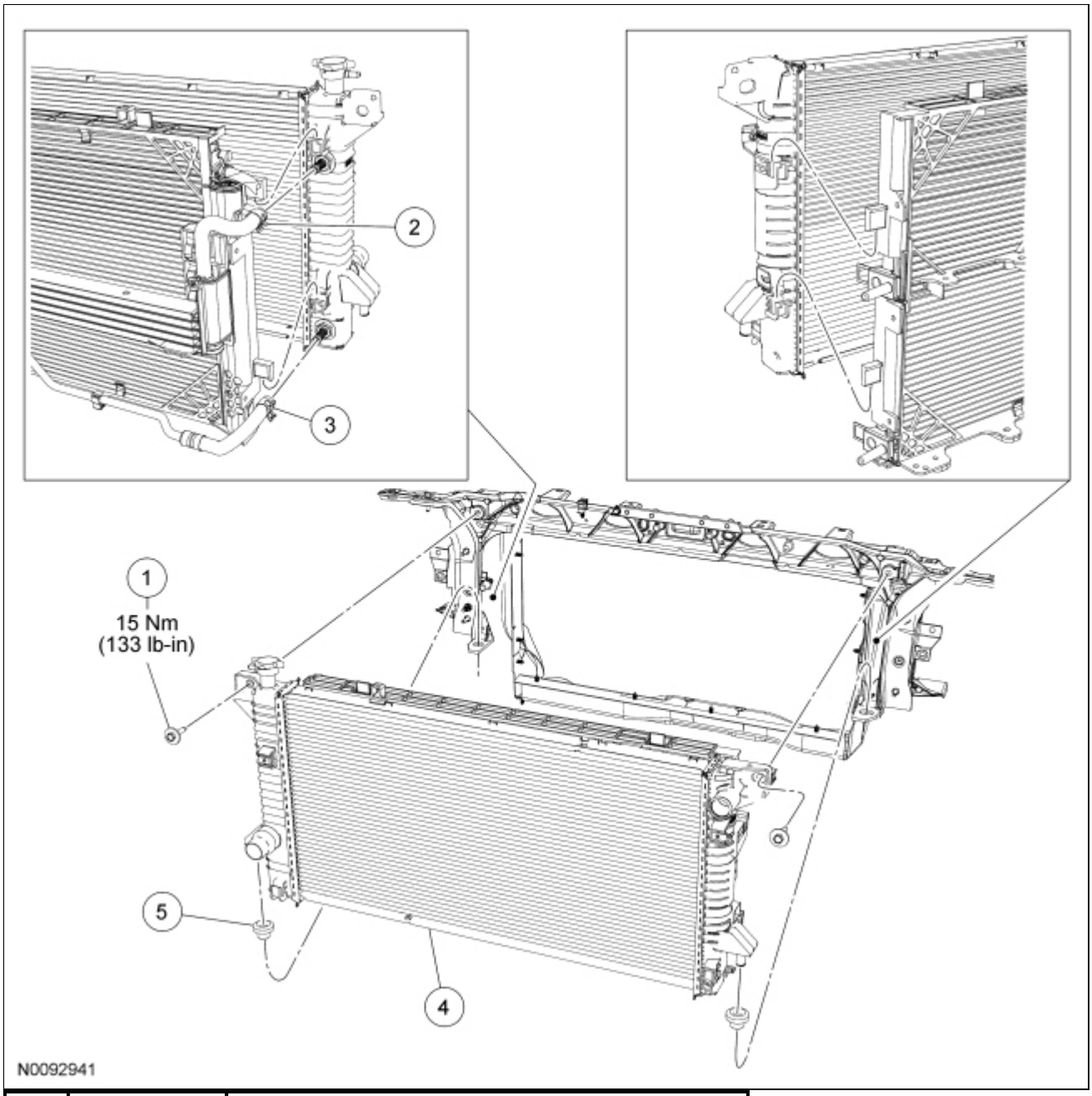
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Item	Part Number	Description
1	8N029	Radiator overflow hose
2	8D037	Lower radiator hose spring clip (part of 8286)
3	8286	Lower radiator hose
4	8260	Upper radiator hose

Radiator

NOTE: 6.2L shown, 3.5L GTDI GTDI , 3.7L and 5.0L similar.



Item	Part Number	Description
1	W503924	Radiator bolt (2 required)
2	7F113	Transmission fluid cooler-to-radiator upper hose
3	7B028	Transmission fluid cooler-to-radiator lower hose
4	8005	Radiator
5	8B204	Radiator insulator (2 required)

Removal

All engines

1. Recover the A/C system. For additional information, refer to Section 412-00 .

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2. Drain the cooling system.

3. Remove the cooling fan motor and shroud. For additional information, refer to Cooling Fan Motor and Shroud in this section.

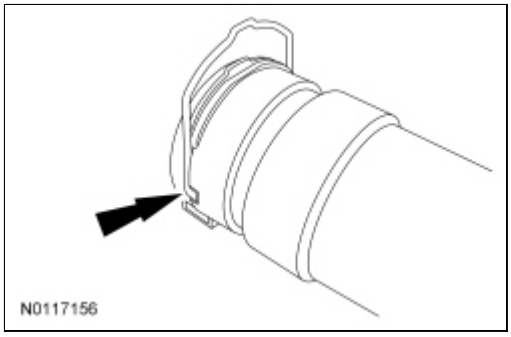
3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L engines

4. Release the clamp and disconnect the upper radiator hose from the radiator.

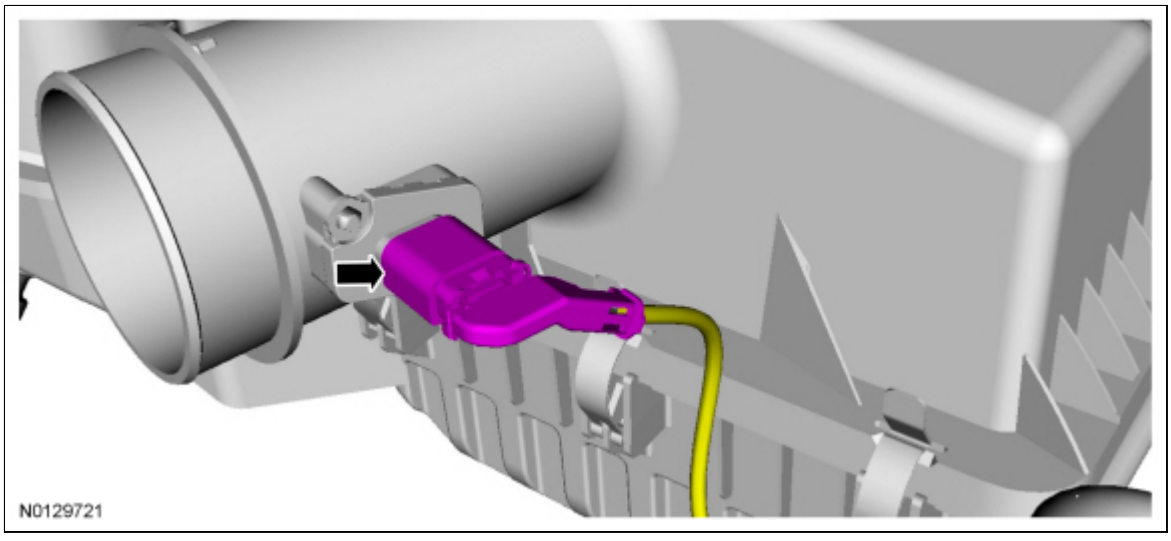
5. Release the clamp and disconnect the radiator-to-degas bottle hose from the radiator.

6. **NOTE:** The quick connect coupling illustrated is to show the spring clip release location only. The quick connect coupling on the hose may differ.

   Pull the lower radiator hose spring clip up until the end of the clip is in the detent on the quick connect coupling and disconnect the lower radiator hose from the radiator.

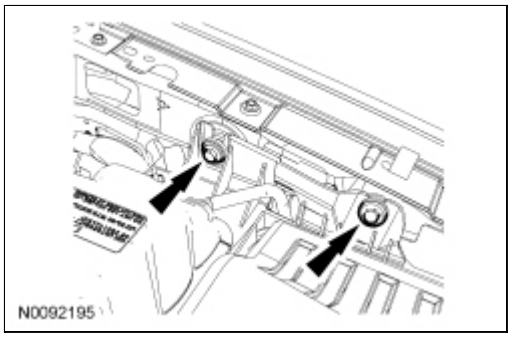


7. Disconnect the Mass Air Flow (MAF) sensor electrical connector.



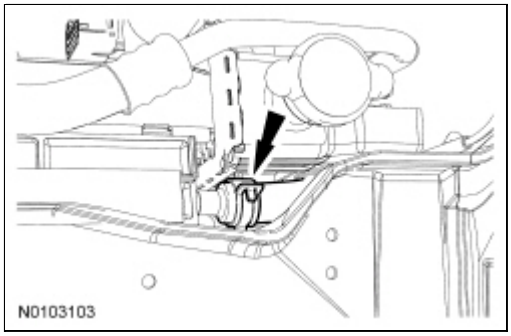
8. **NOTE:** 6.2L shown, 3.5L GTDI, 3.7L and 5.0L similar.

   Remove the 2 bolts and position the coolant expansion tank (6.2L) or the degas bottle (3.5L GTDI, 3.7L and 5.0L) aside.



6.2L engines

9. Release the clamp and disconnect the upper radiator hose from the radiator.
10. Disconnect the overflow hose from the radiator.
11. Remove the spring clip and disconnect the lower radiator hose from the radiator.
12. Release the clamp and disconnect the power steering cooler hose from the power steering cooler.



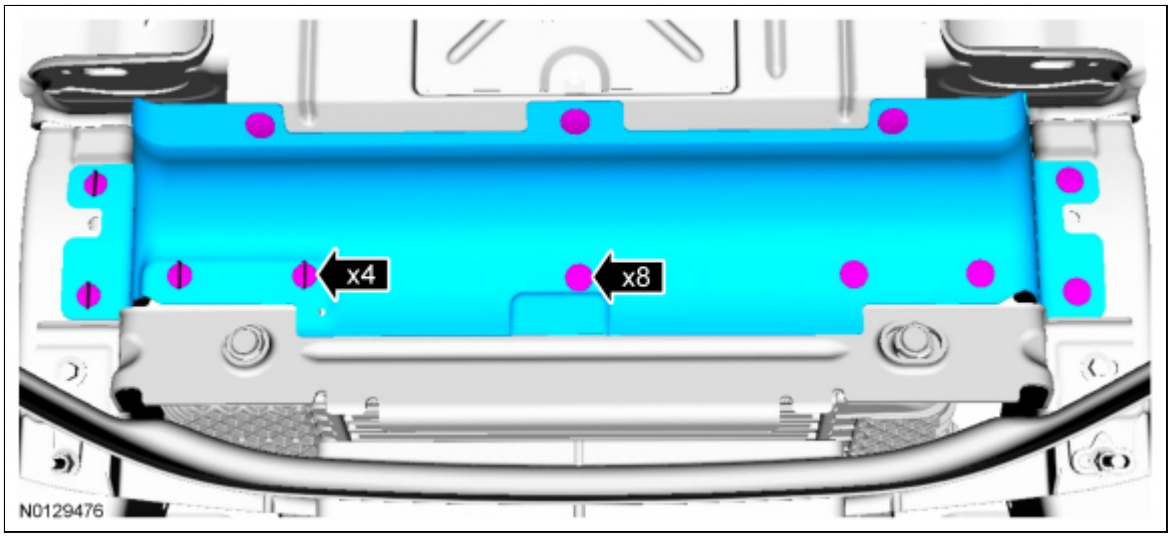
All engines

13. Disconnect the 3 RH and 2 LH air deflector-to-condenser pushpin retainers.

3.5L GTDI engines

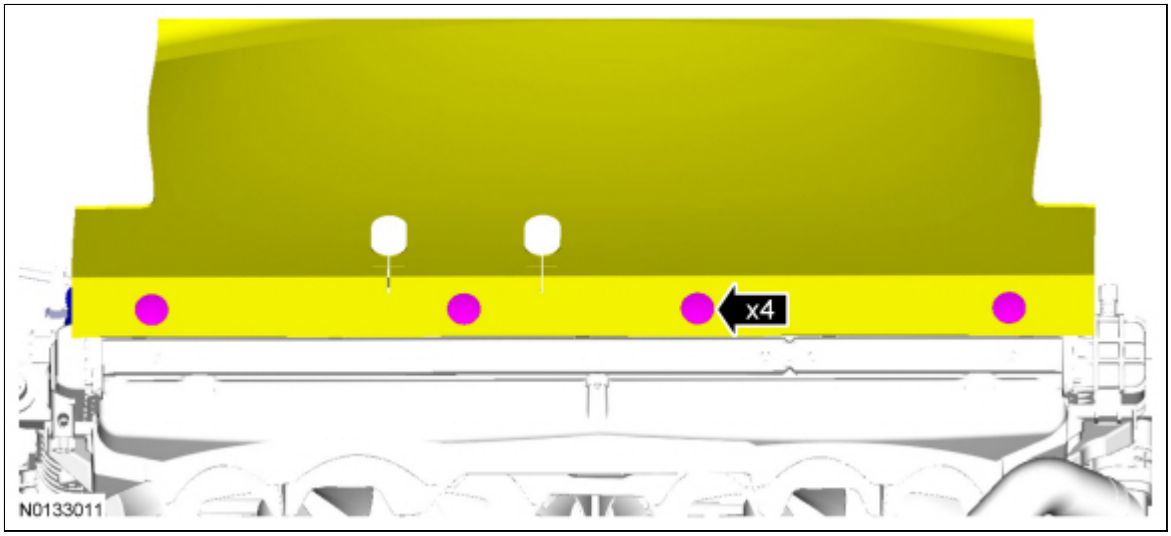
14. Turn the 4 quarter-turn retainers, detach the 8 pushpins and remove the lower air deflector.

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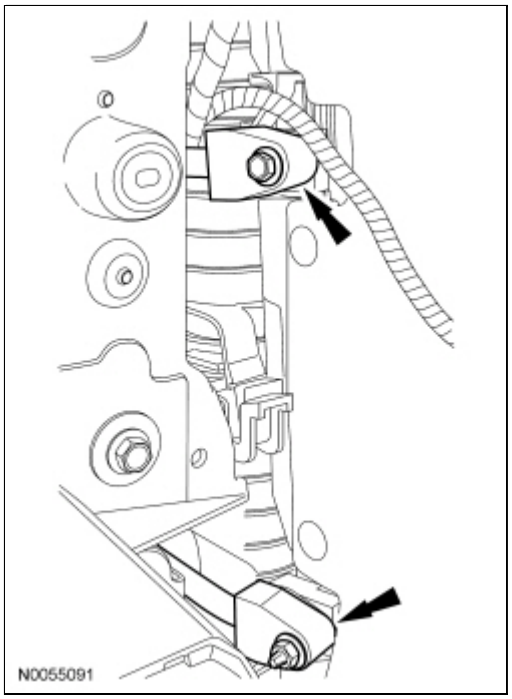
3.7L, 5.0L and 6.2L engines

15. Remove the 4 lower radiator air deflector-to-A/C condenser pushpins.



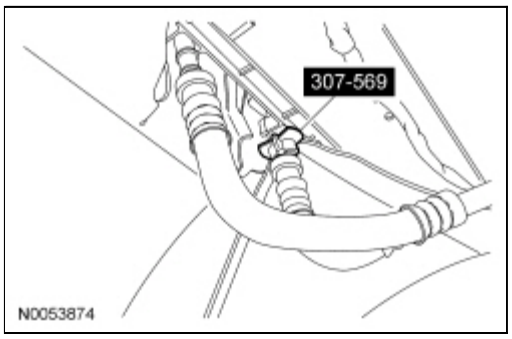
All engines

16. Remove the bolt and the nut and disconnect the A/C condenser fittings.
    - Discard the gasket seals and the O-ring seals.

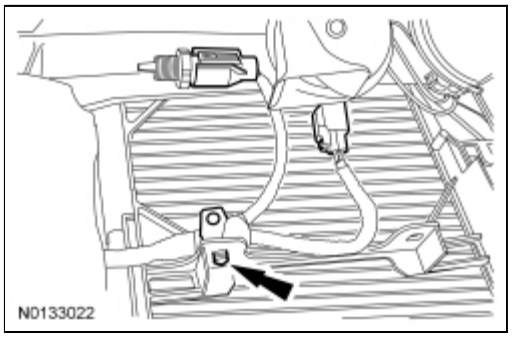


17. Remove the transmission cooler tube secondary latches.

18. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes.



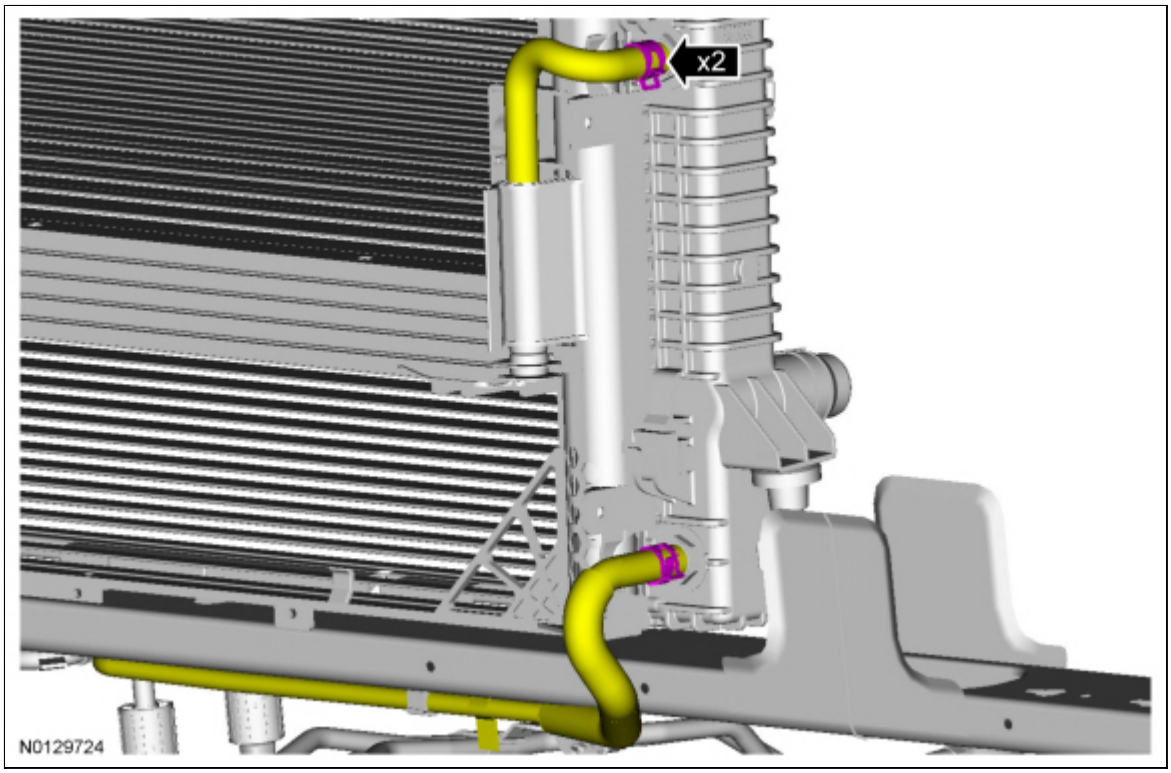
19. Detach the wiring harness retainer.



20. **NOTE:** Hoses with an auxiliary transmission fluid cooler shown, hoses without an auxiliary transmission fluid cooler similar.

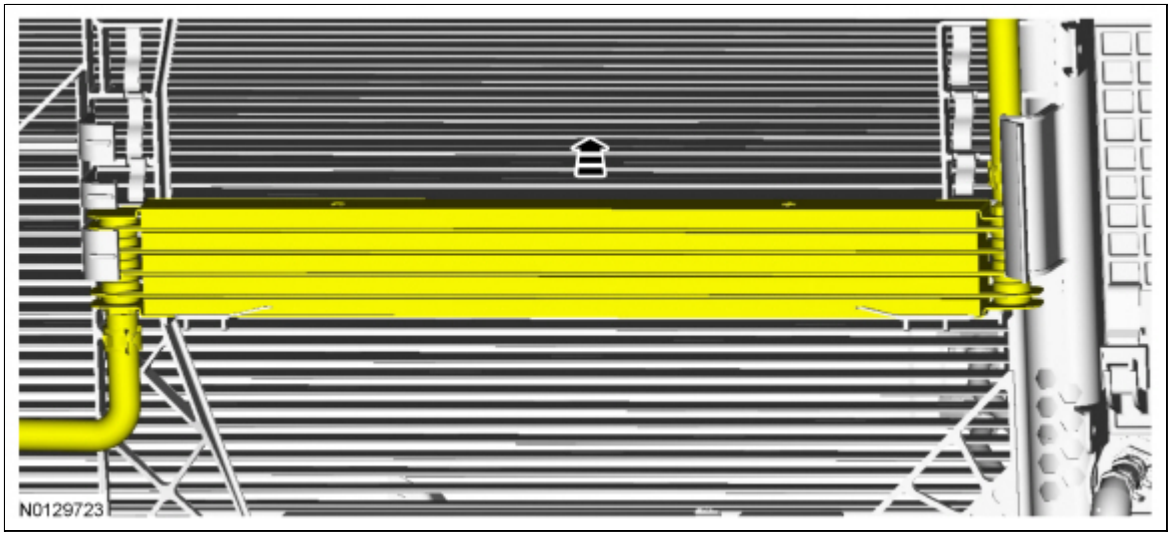
    Disconnect the 2 transmission fluid cooler hoses from the radiator.

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3.5L GTDI , 3.7L and 5.0L engines

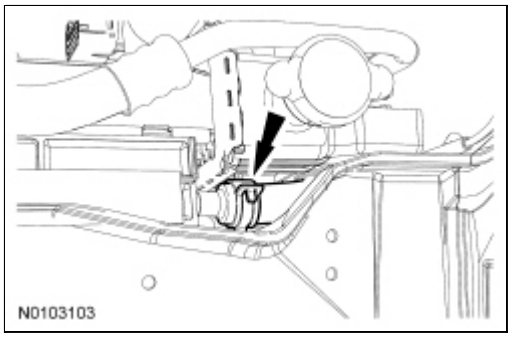
21. If equipped, detach the auxiliary transmission fluid cooler from the A/C condenser and position aside.



6.2L engine

22. Using a suction device, syphon the power steering fluid from the power steering fluid reservoir.

23. Release the clamp and disconnect the power steering fluid cooler hose from the power steering fluid cooler.



All engines

24. Remove the radiator/condenser core as an assembly.
25. Release the lock tabs and separate the radiator from the condenser core.

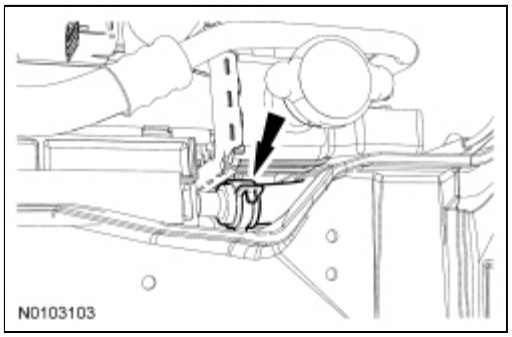
Installation

All engines

1. Position the condenser core into the radiator locking tabs.
2. Position the radiator/condenser core assembly into the vehicle and onto the radiator insulators.

6.2L engine

3. Connect the power steering cooler hose to the power steering cooler and position the clamp.



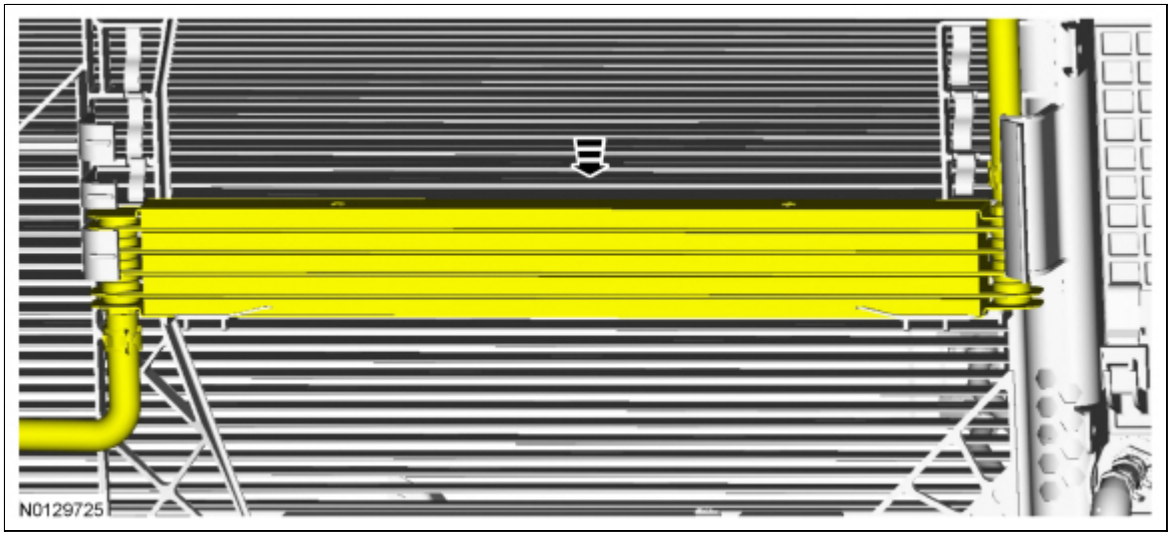
All engines

4. Install the 2 radiator bolts.
    - Tighten to 15 Nm (133 lb-in).

3.5L GTDI , 3.7L and 5.0L engines

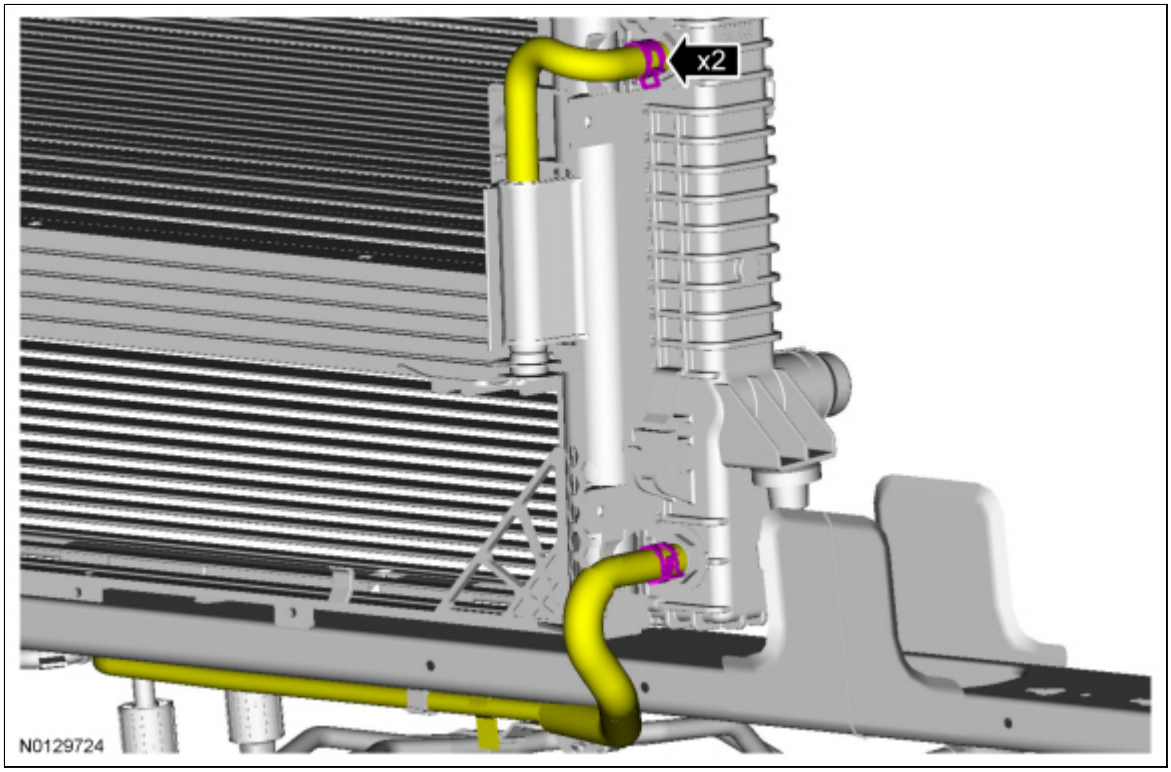
5. If equipped, attach the auxiliary transmission fluid cooler to the A/C condenser.

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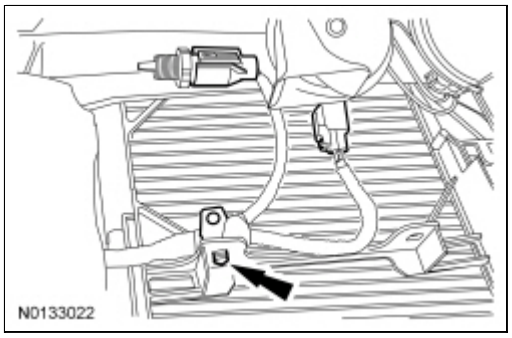


All engines

6. Connect the transmission fluid cooler hoses to the radiator.



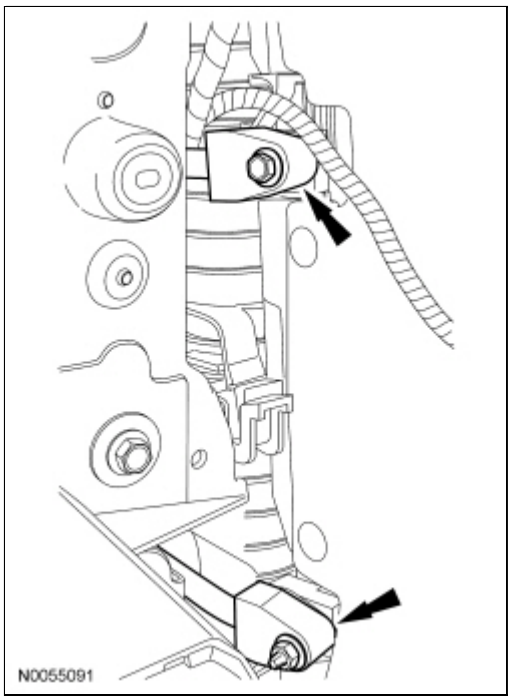
7. Connect the wiring harness retainer.



8. Connect the transmission fluid cooler tubes.

9. Install the transmission cooler tube secondary latches.

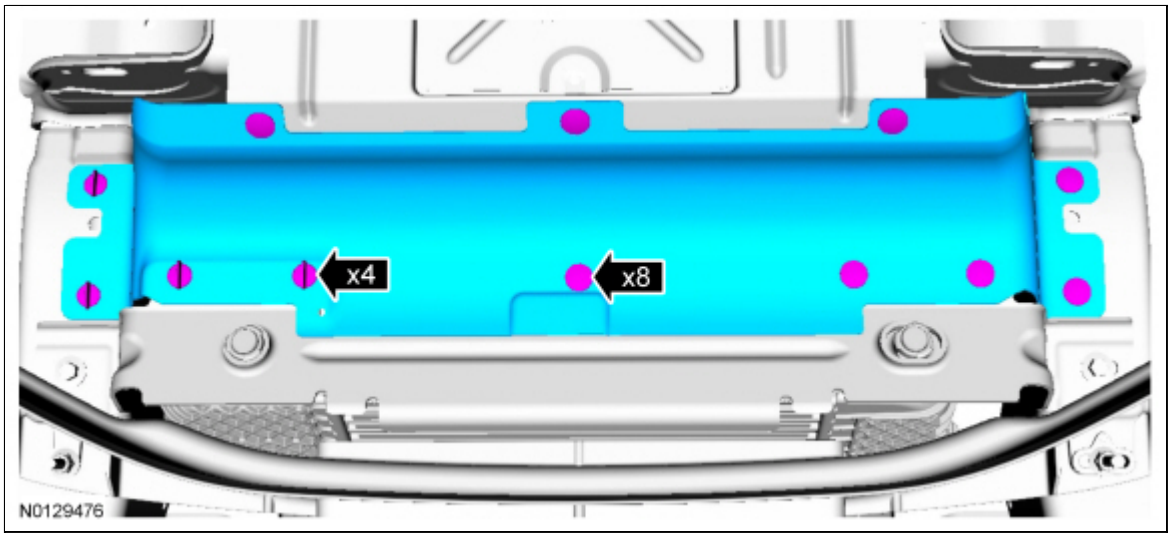
10. Using new gasket seals and O-ring seals, connect the A/C condenser fittings and install the bolt and nut.
    - Tighten to 15 Nm (133 lb-in).



3.5L GTDI engines

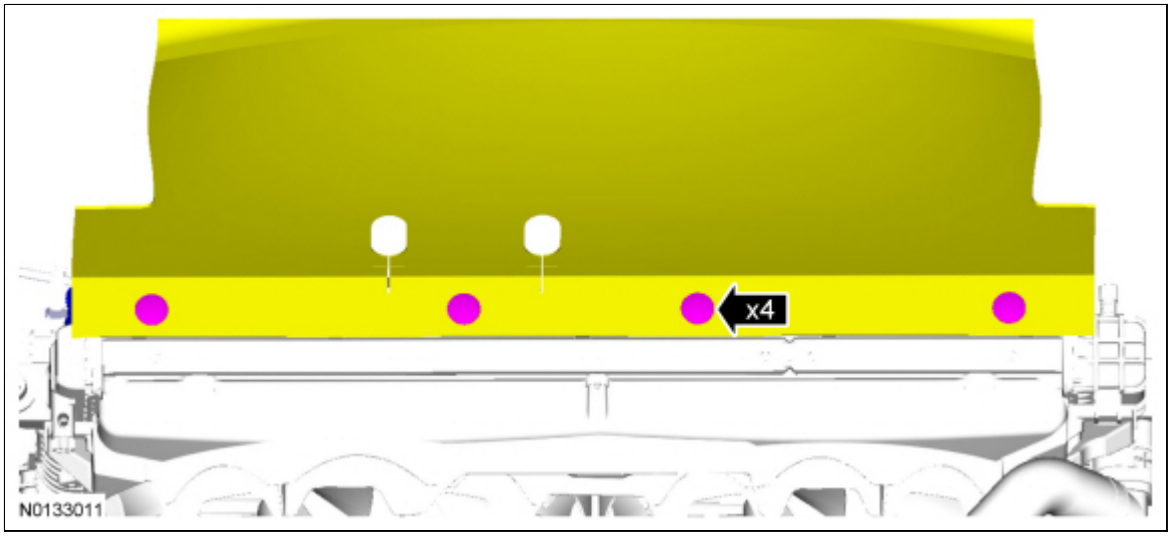
11. Position the lower air deflector, attach the 8 pushpins and turn the 4 quarter-turn retainers.

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3.7L, 5.0L and 6.2L engines

12. Install the 4 lower radiator air deflector-to-condenser pushpins.

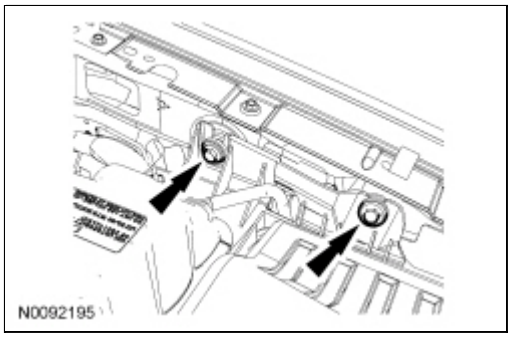


All vehicles

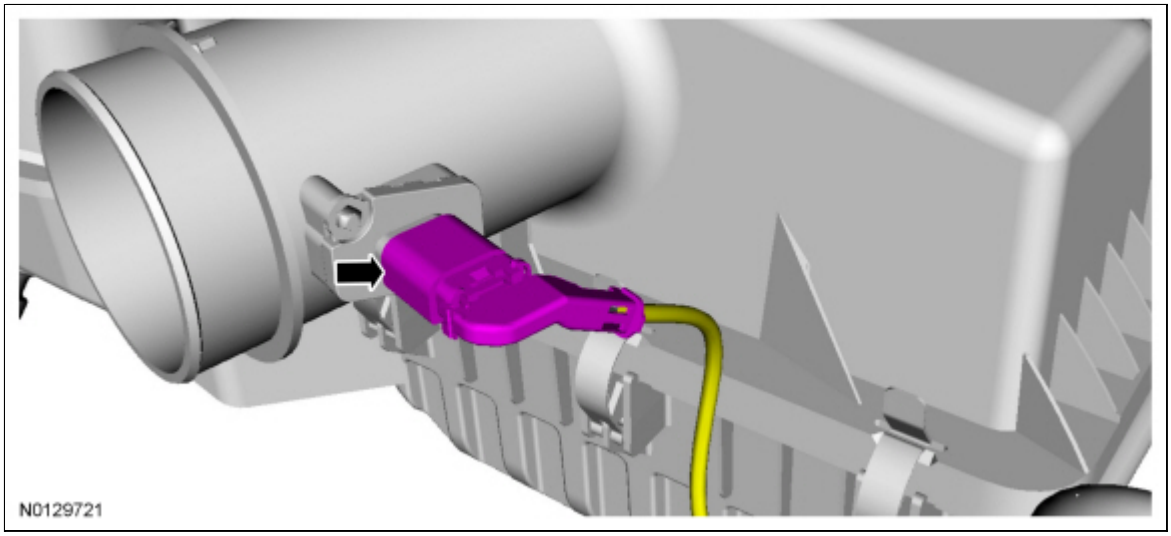
13. Connect the 3 RH and 2 LH air deflector-to-condenser pushpin retainers.

3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L engines

14. Install the degas bottle and the 2 bolts.
    - Tighten to 17 Nm (150 lb-in).



15. Connect the MAF sensor electrical connector.



16. Push the spring clip in place and connect the lower radiator hose quick connect coupling to the radiator, making sure the coupling is secure.
17. Connect the radiator-to-degas bottle hose to the radiator and position the clamp.
18. Connect the upper radiator hose to the radiator and position the clamp.

6.2L engines

19. Install lower radiator hose and the spring clip.
20. Connect the radiator overflow hose.
21. Connect the upper radiator hose and position the clamp.

All engines

22. Install the cooling fan motor and shroud. For additional information, refer to Cooling Fan Motor and Shroud in this section.

6.2L engine

23. Fill the power steering fluid reservoir with MERCON® V.

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All engines

24. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

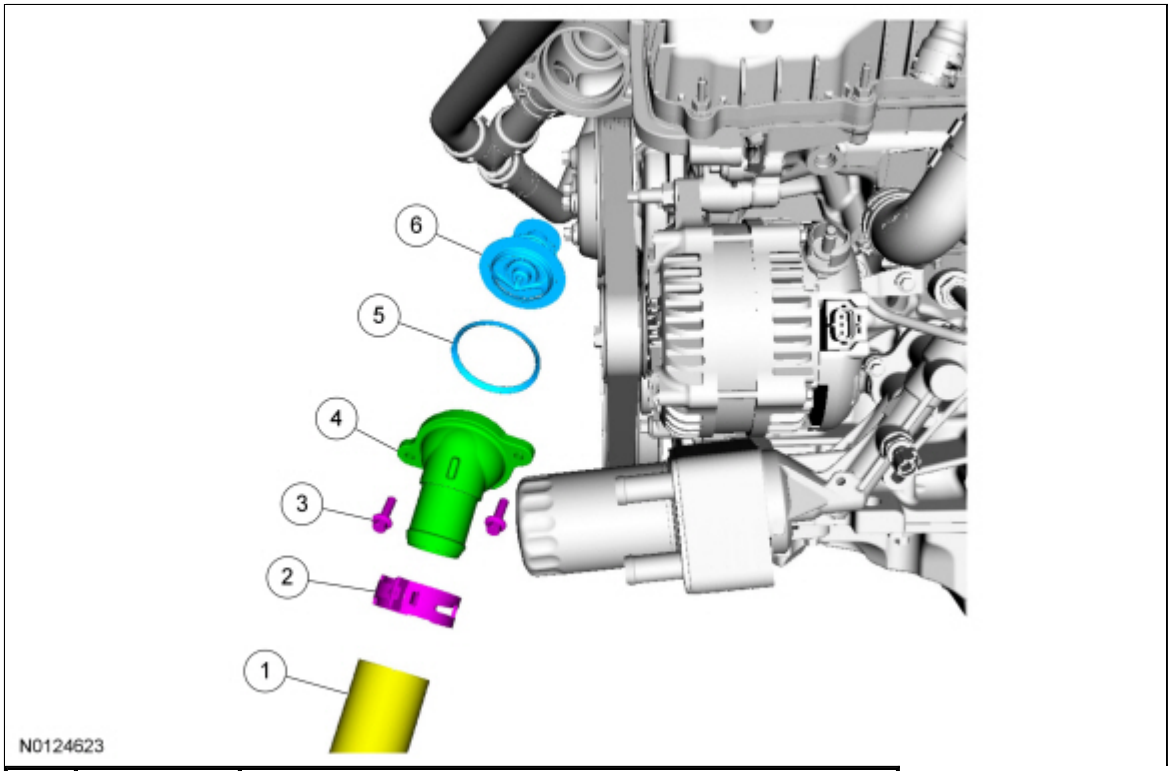
25. Recharge the A/C system. For additional information, refer to Section 412-00 .

26. Check the transmission fluid and fill as necessary. For additional information, refer to Section 307-01 .

Thermostat — 3.5L GTDI

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	8286	Lower radiator hose
2	—	Lower radiator hose clamp (part of 8286)
3	W500014	Coolant inlet connector bolt - 10 Nm (89 lb-in) (2 required) (part of 8592)
4	—	Coolant inlet connector (part of 8592)
5	8255	Thermostat O-ring seal (part of 8592)
6	8575	Thermostat (part of 8592)

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and

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Bleeding in this section.

2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

3. ***NOTICE:*** **Cover the accessory drive belts to prevent coolant contamination of the belts.**

   Completely cover the accessory drive belts with waterproof plastic.

4. If installing a new coolant connector, release the clamp and disconnect the lower radiator hose.

5. Remove the bolts and detach the coolant inlet connector.
   - To install, tighten to 10 Nm (89 lb-in).

6. Remove the thermostat and the O-ring seal.
   - Discard the O-ring seal.

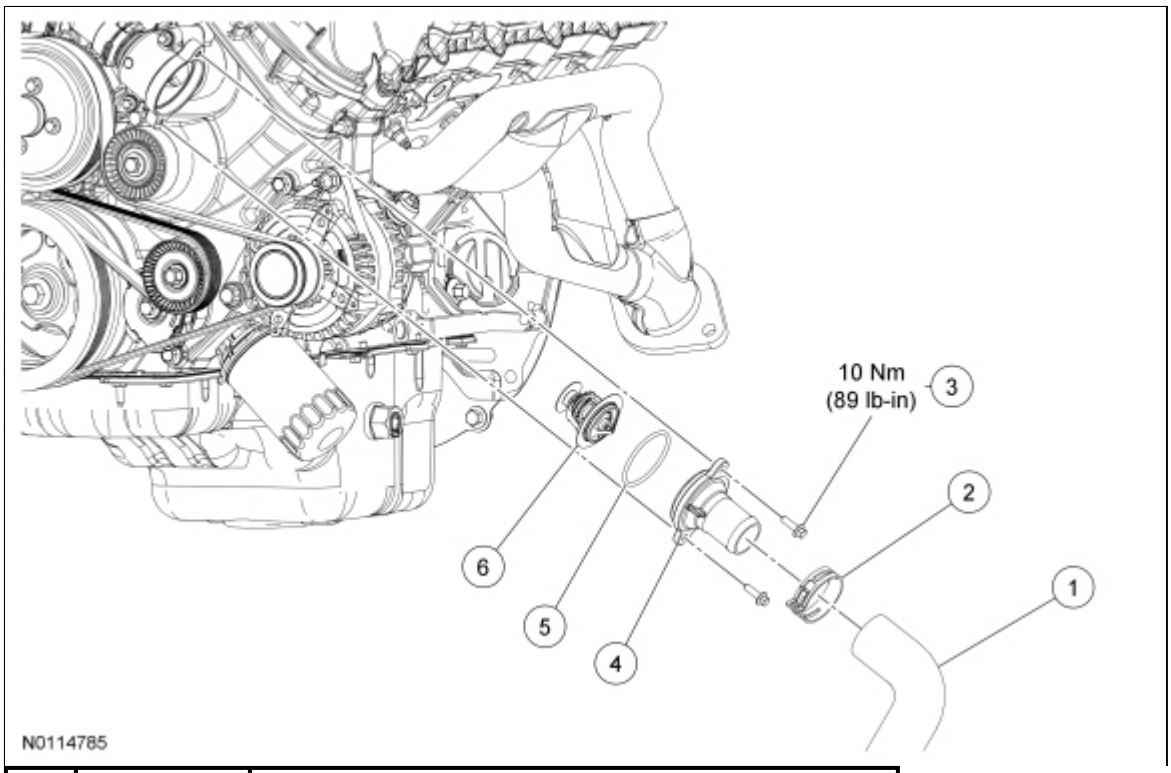
7. To install, reverse the removal procedure.
   - Install a new O-ring seal and lubricate it with clean engine coolant.

8. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat — 5.0L

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	8286	Lower radiator hose
2	15161	Lower radiator hose clamp
3	W500014	Coolant inlet connection bolt (2 required) (part of 8A586)
4	8K528	Coolant inlet connection (part of 8592)
5	8255	Thermostat O-ring seal (part of 8592)
6	8575	Thermostat (part of 8592)

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and

repair4less

Bleeding in this section.

2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

3. ***NOTICE:*** **Remove the accessory drive belt to prevent coolant contamination of the belt.**

   Remove the accessory drive belt. For additional information, refer to Section 303-05 .
   - To install, rinse off any coolant from the accessory drive pulleys using clear water.

4. ***NOTICE:*** **Cover the A/C compressor drive belt to prevent coolant contamination of the belt.**

   Completely cover the A/C compressor drive belt with waterproof plastic.

5. If installing a new coolant inlet connection, release the clamp and disconnect the lower radiator hose.

6. Remove the bolts and the coolant inlet connection.
   - To install, tighten to 10 Nm (89 lb-in).

7. Remove the thermostat and the O-ring seal.
   - Discard the O-ring seal.

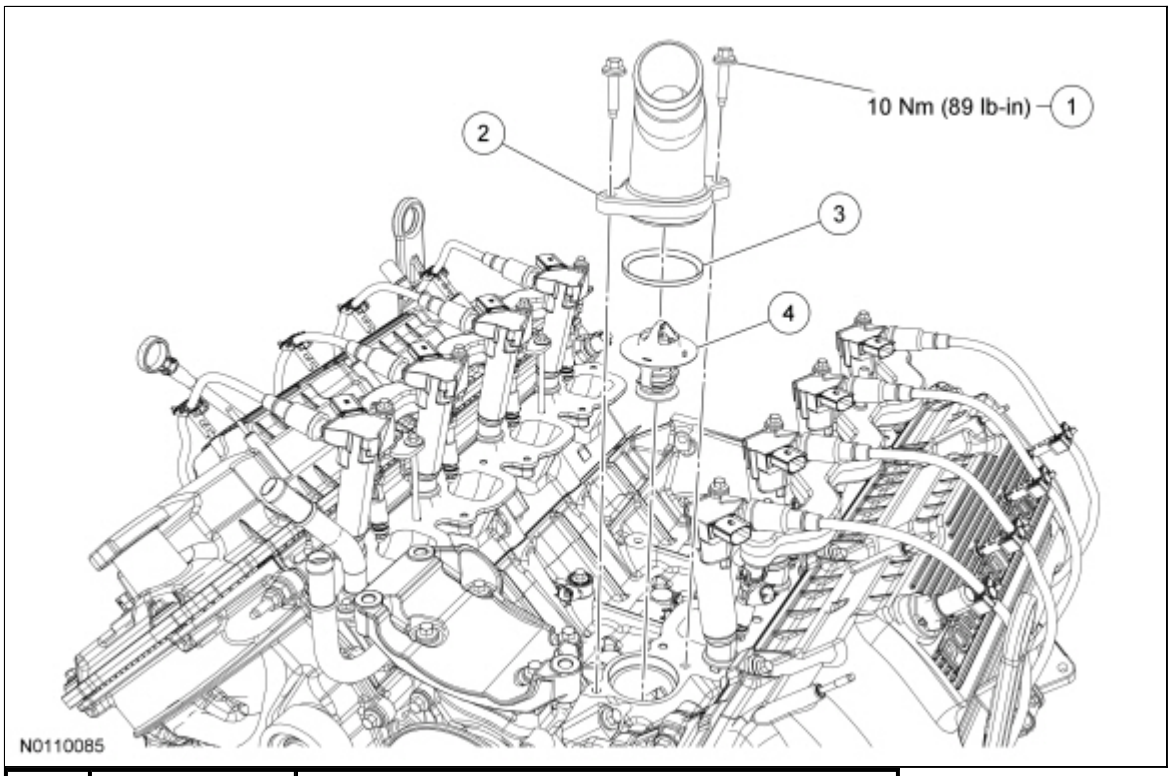
8. To install, reverse the removal procedure.
   - Use a new O-ring seal and lubricate it with clean engine coolant.

9. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat — 6.2L

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—



Item	Part Number	Description
1	W503278	Coolant outlet connection bolt (2 required)
2	8594	Coolant outlet connection
3	N806807	O-ring seal
4	8575	Thermostat

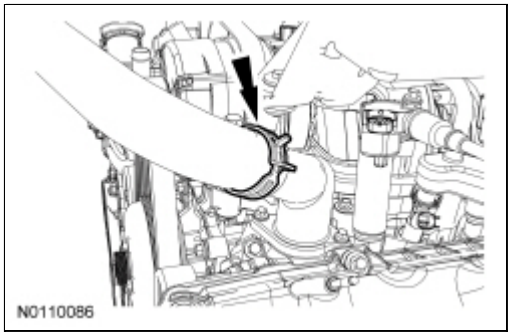
Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

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3. If a new coolant outlet connection is being installed, release the clamp and disconnect the upper radiator hose.



4. Remove the 2 bolts, the thermostat housing and the thermostat. Discard the O-ring seal.
    - Inspect the mating surfaces. Clean the sealing surfaces with metal surface prep and silicone gasket remover. Follow the directions on the packaging.
    - If necessary, install a new thermostat with the spring facing down.
    - Install a new O-ring seal.
    - **NOTE:** Make sure the thermostat housing is seated evenly by hand tightening the 2 coolant outlet connection bolts prior to final tightening.

      To install, tighten to 10 Nm (89 lb-in).

5. To install, reverse the removal procedure.

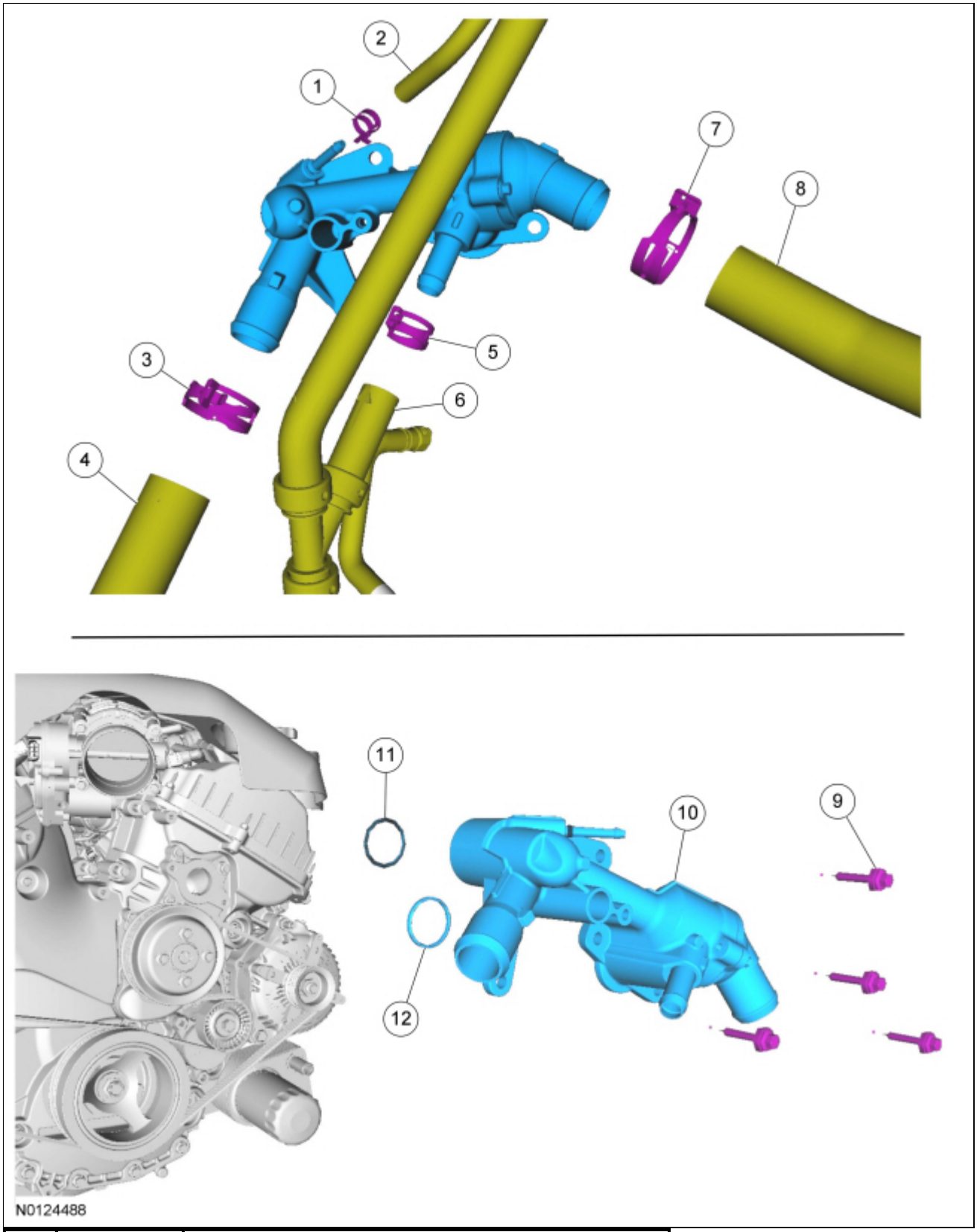
6. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat Housing — 3.5L GTDI

Material

Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D

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Item	Part Number	Description
1	—	Thermostat housing-to-degas bottle hose clamp (part

		of 8276)
2	8276	Thermostat housing-to-degas bottle hose
3	—	Upper radiator hose clamp (part of 8260)
4	8260	Upper radiator hose
5	—	Heater outlet hose clamp (part of 18472)
6	18472	Heater outlet hose
7	—	Lower radiator hose clamp (part of 8286)
8	8286	Lower radiator hose
9	W714841	Thermostat housing bolts
10	8592	Thermostat housing
11	8527	Coolant inlet tube O-ring seal
12	8590	Thermostat housing inlet gasket (part of 8592)

Removal

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the Air Cleaner (ACL) outlet pipe, the ACL outlet pipe-to-LH turbocharger pipe and the LH turbocharger-to-Charge Air Cooler (CAC) pipe. For additional information, refer to Section 303-12 .

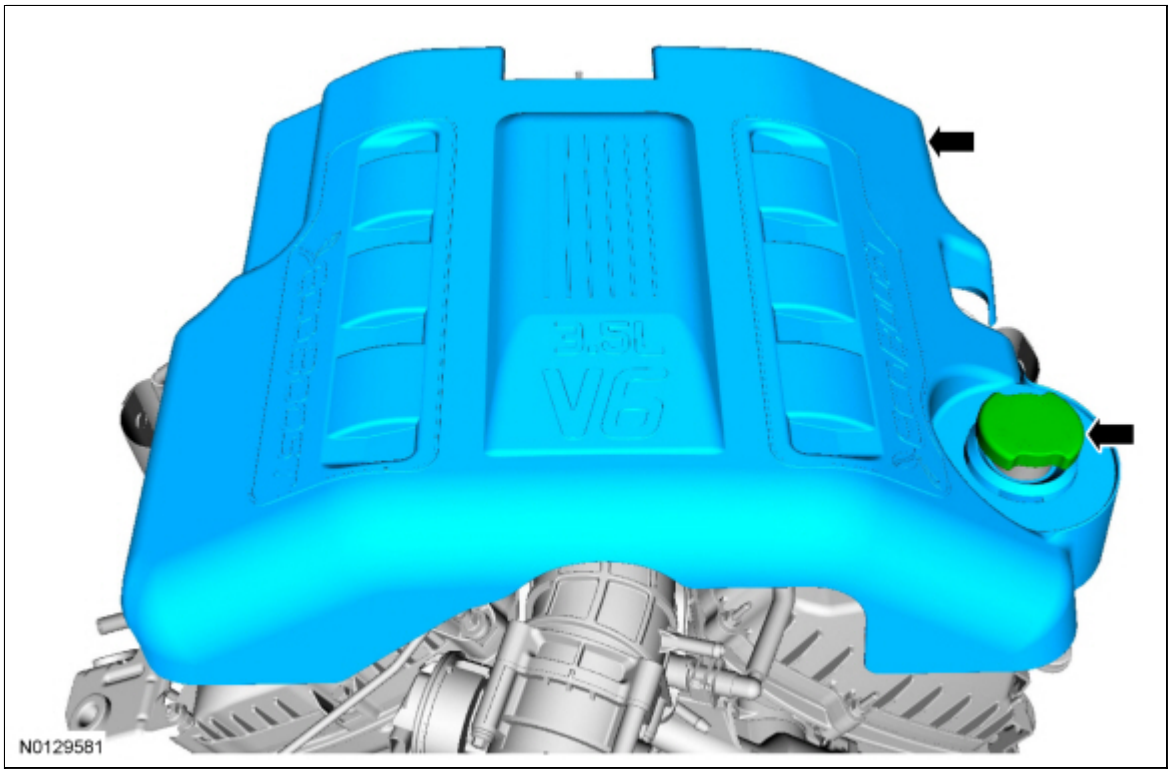
3. ***NOTICE:*** **Cover the accessory drive belts to prevent coolant contamination of the belts.**

   Completely cover the accessory drive belts with waterproof plastic.

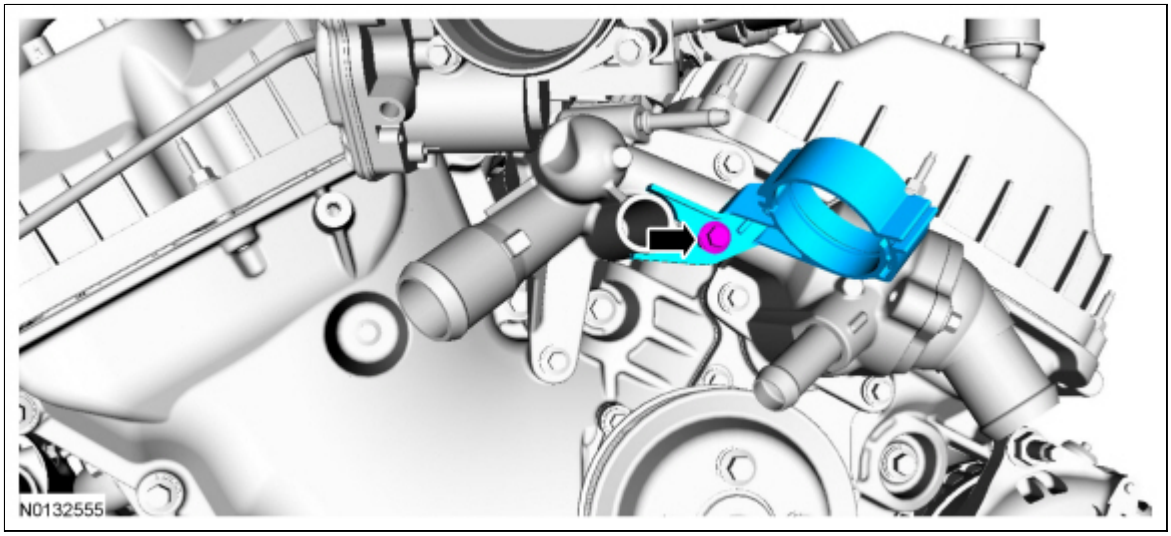
4. ***NOTICE:*** **Install the oil fill cap to prevent debris from falling into the engine.**

   Remove the oil fill cap and the engine appearance cover.
   - Install the oil fill cap.

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5. If equipped, disconnect the block heater electrical connector.
6. Remove the bolt and the LH turbocharger-to CAC tube bracket.



7. Release the clamp and disconnect the degas bottle-to-thermostat housing hose from the thermostat housing.
8. Release the clamp and disconnect the lower radiator hose from the thermostat housing.
9. Release the clamp and disconnect the heater outlet hose from the thermostat housing.
10. Release the clamp and disconnect the upper radiator hose from the thermostat housing.

11. Remove the 4 thermostat housing bolts.

12. ***NOTICE:*** **Do not allow the coolant inlet pipe to come out of the coolant crossover manifold assembly or the coolant inlet pipe O-ring seal may be damaged.**

    NOTE: Use the ear on the top of the coolant inlet pipe to prevent the coolant pipe from coming out of the coolant crossover manifold assembly.

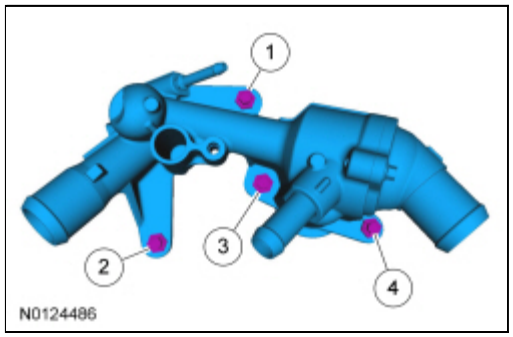
    Remove the thermostat housing.

13. Remove and discard the gasket and the O-ring seal.

Installation

1. Install a new gasket and a new O-ring seal.
    - Lubricate the O-ring seal with clean engine coolant.

2. Position the thermostat housing, install the 4 bolts and tighten the 4 bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 8 Nm (71 lb-in)
    - Stage 2: Tighten an additional 45 degrees.



3. Connect the upper radiator hose to the thermostat housing and position the clamp.

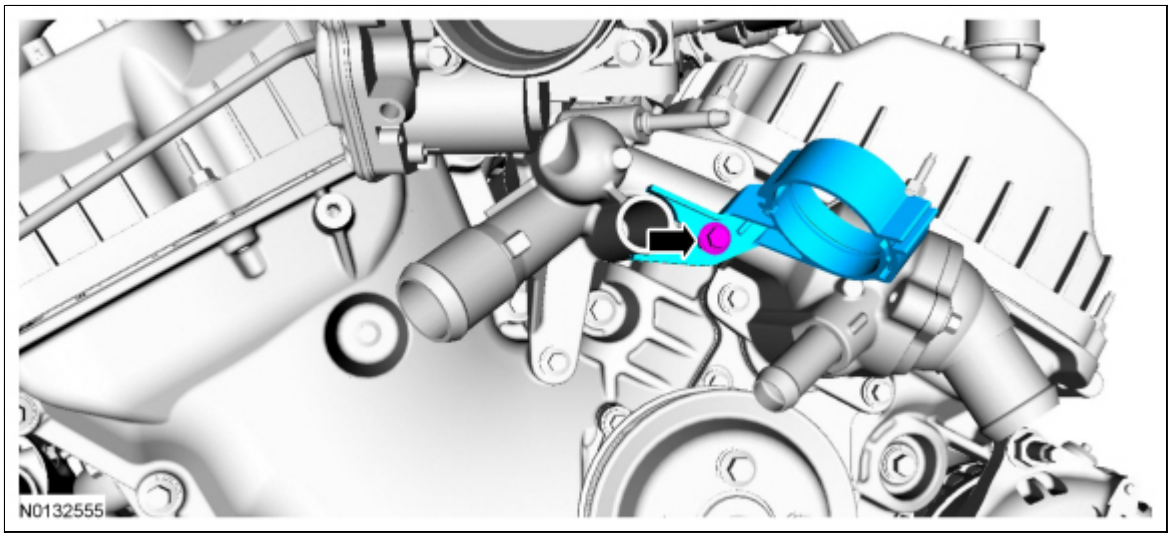
4. Connect the heater outlet hose to the thermostat housing and position the clamp.

5. Connect the lower radiator hose to the thermostat housing and position the clamp.

6. Connect the degas bottle-to-thermostat housing hose to the thermostat housing and position the clamp.

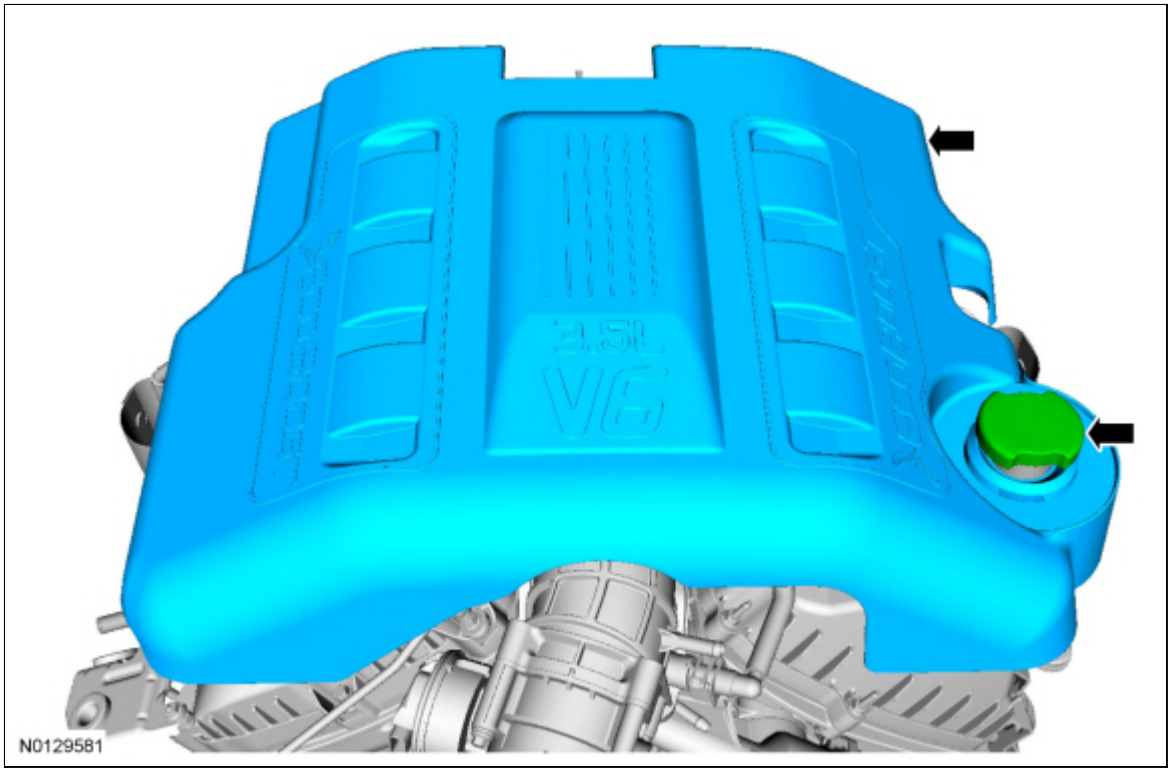
7. Install the LH turbocharger-to- CAC tube bracket and the bolt.
    - Tighten to 6 Nm (53 lb-in).

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8. If equipped, connect the block heater electrical connection.

9. Remove the oil fill cap and install the engine appearance cover.
   - Install the oil fill cap.



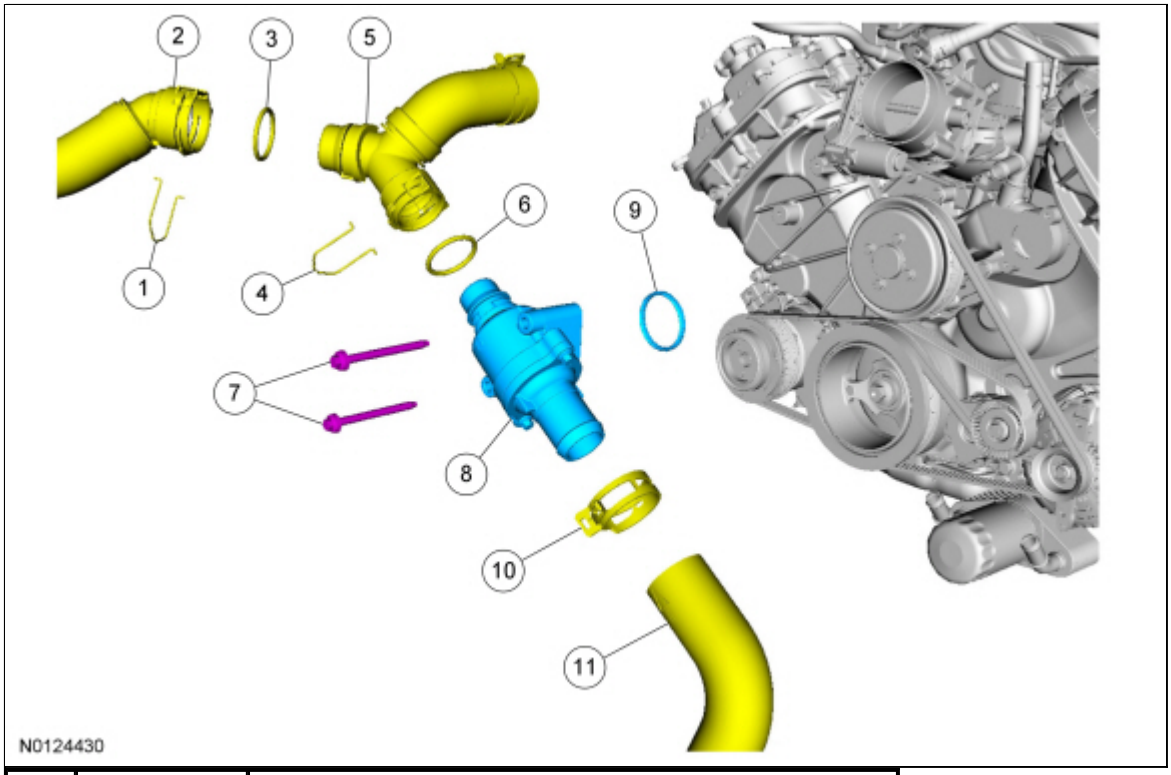
10. Remove the waterproof plastic from the accessory drive belts.

11. Install the LH turbocharger-to-Charge Air Cooler (CAC) pipe, the ACL outlet pipe-to-LH turbocharger pipe and the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

12. Fill and bleed the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

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Thermostat Housing — 5.0L



Item	Part Number	Description
1	8B365	Upper radiator hose spring clip (part of 8260)
2	8260	Upper radiator hose
3	8590	Upper radiator hose O-ring seal (part of 8260)
4	8B365	Upper radiator hose T-connector spring clip (part of 8566)
5	8590	Upper radiator hose T-connector O-ring seal (part of 8566)
6	8566	Upper radiator hose T-connector
7	W713197	Thermostat housing bolts - 10 Nm (89 lb-in) (2 required)
8	8592	Thermostat housing
9	8590	Thermostat housing gasket (part of 8592)
10	—	Lower radiator hose clamp (part of 8286)
11	8286	Lower radiator hose

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and

Bleeding in this section.

2. ***NOTICE:*** **Remove the accessory drive belt to prevent coolant contamination of the belt.**

   Remove the accessory drive belt. For additional information, refer to Section 303-05 .
   - To install, rinse off any coolant from the accessory drive pulleys using clear water.

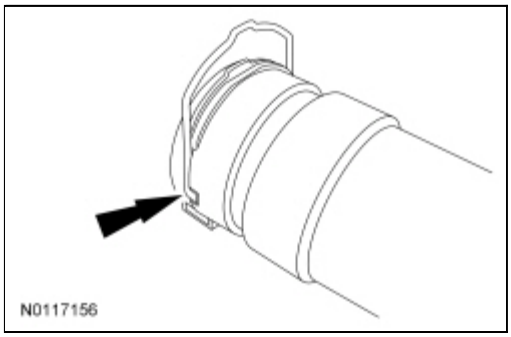
3. ***NOTICE:*** **Cover the A/C compressor drive belt to prevent coolant contamination of the belt.**

   Completely cover the A/C compressor belt with waterproof plastic.

4. Release the clamp and disconnect the lower radiator hose from the coolant inlet connection.

5. **NOTE:** The quick connect coupling illustrated is to show the spring clip release location only. The quick connect coupling on the hose may differ.

   Pull the upper radiator hose spring clip up until the end of the clip is in the detent on the quick connect coupling and disconnect the upper radiator hose from the upper radiator hose T-connector.
   - To install, push the spring clip in place and connect the upper radiator hose quick connect coupling, making sure the coupling is secure.

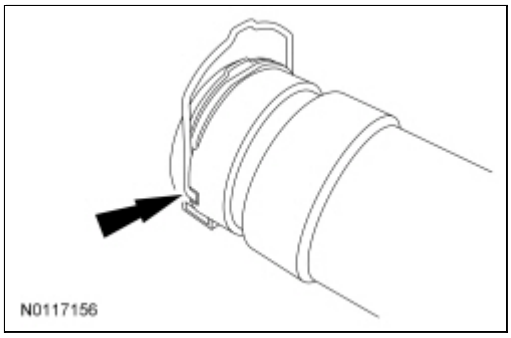


6. Remove the thermostat housing bolts.
   - To install, tighten to 10 Nm (89 lb-in).

7. **NOTE:** The quick connect coupling illustrated is to show the spring clip release location only. The quick connect coupling on the hose may differ.

   Pull the upper radiator hose T-connector spring clip up until the end of the clip is in the detent on the quick connect coupling and remove the thermostat housing from the upper radiator hose T-connector.
   - Remove and discard the thermostat housing gasket.
   - To install, align the tab on the thermostat housing with the slot in the upper radiator hose T-connector.
   - To install, push the spring clip in place and connect the thermostat housing to the upper radiator hose T-connector quick connect coupling, making sure the coupling is secure.

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8. To install, reverse the removal procedure.
    - Use a new thermostat housing gasket.

9. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada); or equivalent	WSS-M2C946-A, 5W30;	—
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Charge Air Cooler (CAC) outlet tube-to-Throttle Body (TB) clamp	5	—	44
Fuel injection pump bolts [a]	—	—	—
Fuel injection pump mounting plate bolt	10	—	89
Fuel Pump Control Module (FPCM) bolts	9	—	80
Fuel rail bolts [a]	—	—	—
High pressure fuel tube bracket bolt [a]	—	—	—
High pressure fuel tube flare nut [a]	—	—	—
High pressure fuel tube bracket nut	8	—	71
TB bolts	10	—	89

[a] Refer to the procedure in this section.

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Fuel Charging and Controls

3.5L Gasoline Turbocharged Direct Injection (GTDI)

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

The fuel charging and controls system consists of the:

- fuel injectors.
- fuel injection pump.
- Fuel Pump Control Module (FPCM).
- fuel rails.
- Throttle Body (TB).

The fuel charging and controls system is:

- a Gasoline Turbocharged Direct Injection (GTDI) system.
- Pulse Width Modulated (PWM).

Fuel is metered directly into the combustion chamber. Fuel injectors pulse to follow engine firing order, in accordance with engine demand.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Fuel Injectors

NOTICE: **Handle the fuel injectors and fuel rail with extreme care to prevent damage to the fuel inlet of the fuel rail, fuel injector sealing areas, and sensitive fuel-metering orifices.**

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid that opens a needle valve, which injects fuel directly into the combustion chamber.
- are deposit resistant.

Fuel Injection Pump

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The fuel injection pump is a single piston and a delivery-on-demand design. The pump is driven from an eccentric on the LH intake camshaft. It can raise fuel pressure from 448 kPa (65 psi) to anywhere between 1,516 and 14,823 kPa (220 and 2,150 psi). The fuel is then supplied to the fuel injectors for distribution into the cylinders.

Fuel Pump Control Module (FPCM)

The FPCM is electronically operated by the PCM and controls the voltage to the FP depending on engine load.

Fuel Rails

NOTICE: **Handle the fuel injectors and fuel rail with extreme care to prevent damage to the fuel inlet of the fuel rail, fuel injector sealing areas, and sensitive fuel-metering orifices.**

The fuel rails:

- receive and store high pressure fuel from the fuel injection pump.
- deliver fuel to the fuel injectors.

Throttle Body (TB)

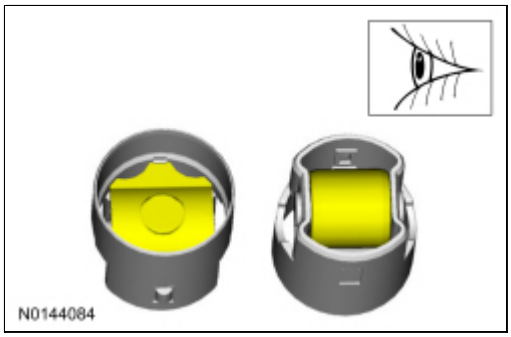
The TB :

- controls air supply to the intake manifold by electronically positioning the throttle plate.
- is not adjustable.

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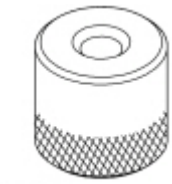
Fuel Injection Pump Roller Tappet Inspection

1. Inspect the fuel injection pump tappet for flat spots or scoring. If any damage is found, inspect the fuel injection pump and the fuel injection pump tappet drive lobe. Install new components as necessary.



Fuel Rail

Special Tool(s)

 ST3096-A	Brush, Fuel Injector 310-205
 ST3095-A	Remover, Fuel Injector 310-206
 ST3097-A	Seal Installer, Fuel Injector 310-207
 ST3266-A	Sizer, Teflon® Seal 303-1567
 ST3089-A	Slide Hammer 307-005 (T59L-100-B) or equivalent

Material

Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Orange Antifreeze/Coolant Concentrated	WSS-M97B44-D

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VC-3-B (US); CVC-3-B2 (Canada)	

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

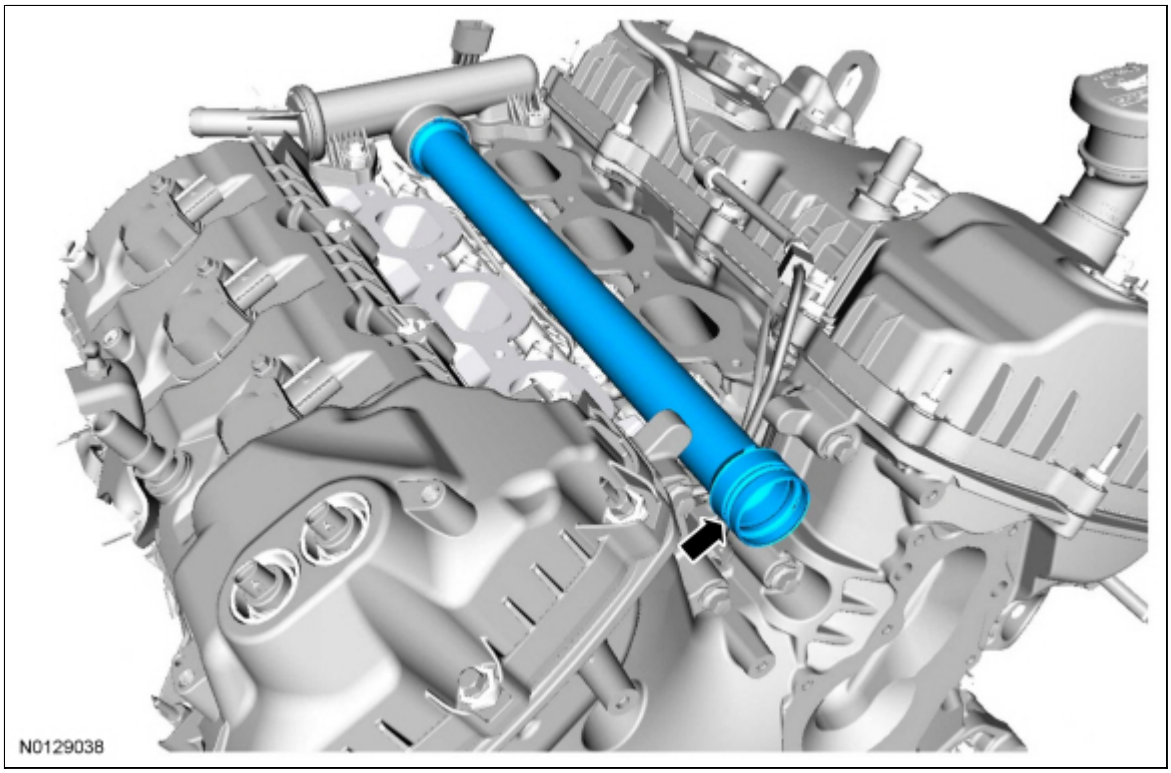
WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

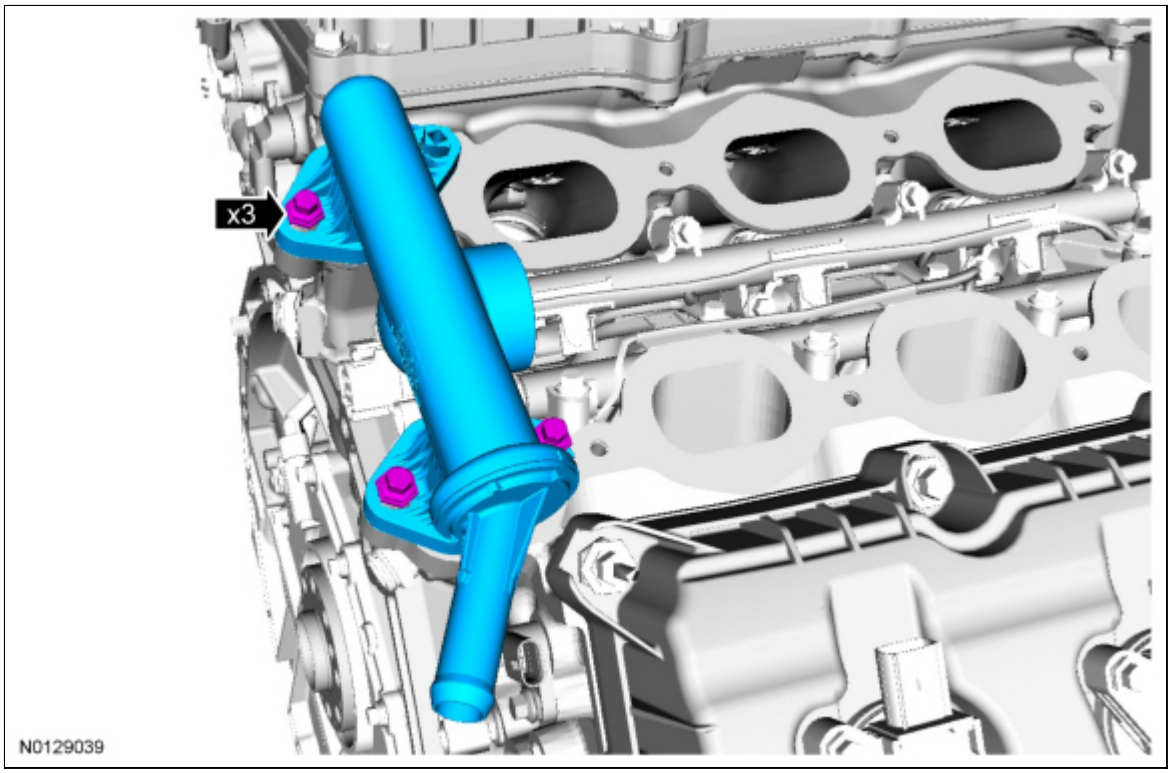
WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: A clean working environment is essential to prevent dirt or foreign material contamination.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Remove the intake manifold. For additional information, refer to Section 303-01A .
3. Remove the thermostat housing. For additional information, refer to Section 303-03 .
4. Remove the coolant inlet pipe.
   - Remove and discard the coolant inlet pipe O-ring seals.



5. Remove the 3 bolts and position aside the coolant crossover assembly.
    - Remove and discard the 2 gaskets.



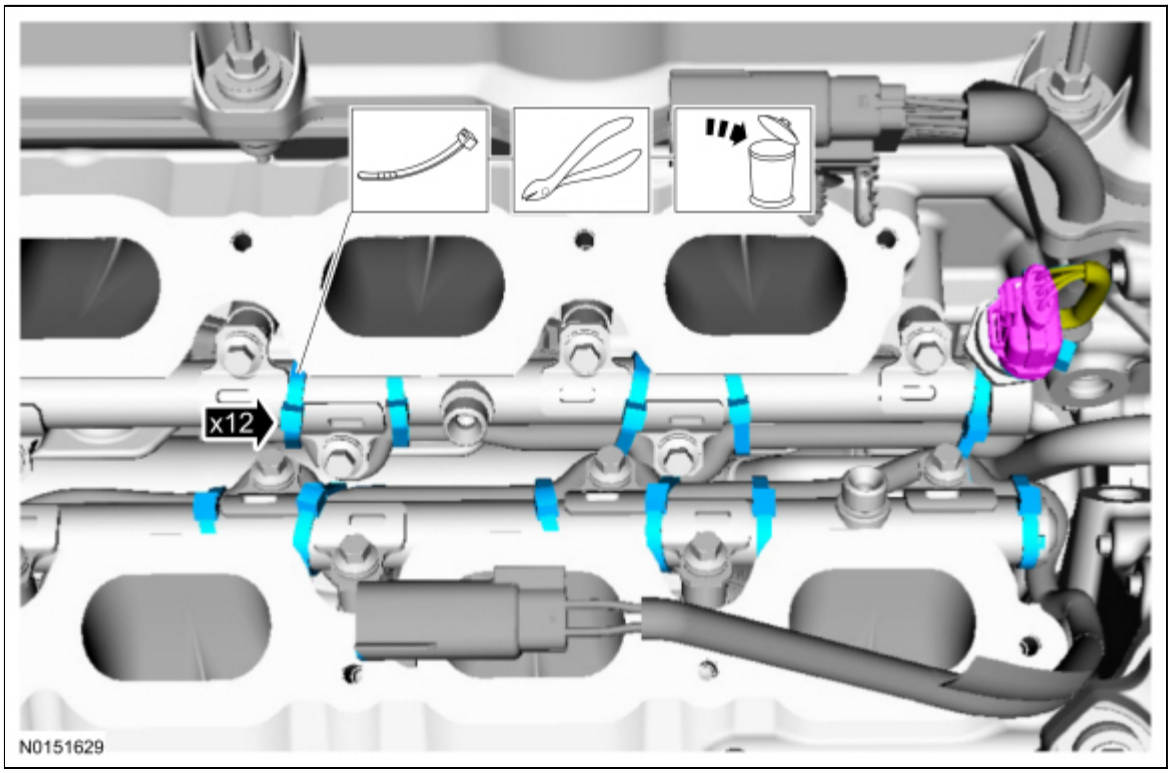
6. Remove the high-pressure fuel tube bracket bolt.

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7. Loosen the 2 flare nuts, remove and discard the high-pressure fuel tube.

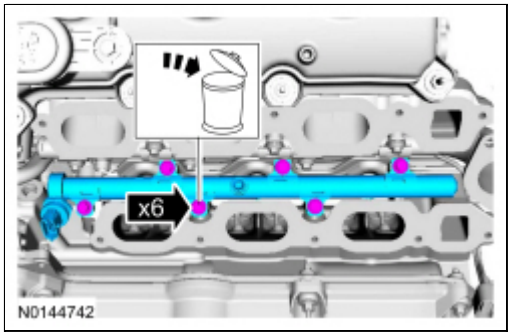
8. ***NOTICE:*** **It is very important to note the routing of the fuel charge wire harnesses on the fuel rails and index-mark the location of the tie straps prior to removal or damage may occur to the wire harnesses during installation.**

   NOTE: Use compressed air and remove any dirt or foreign material from the cylinder head, block and general surrounding area of the fuel rail and injectors.



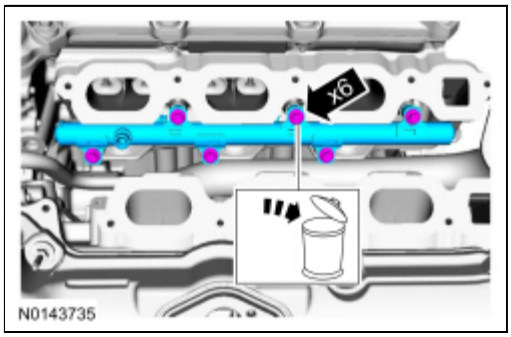
9. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

   NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder heads and require the use of a Fuel Injector Remover tool to extract. Wiggling the injector by hand to break it loose may allow the injector to be removed by hand.

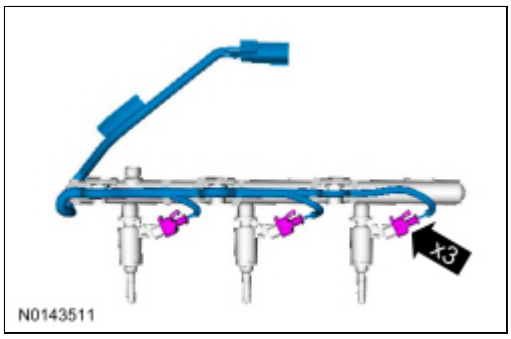


10. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

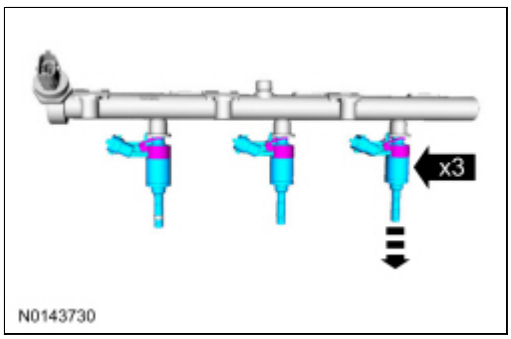
NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder heads and require the use of a Fuel Injector Remover tool to extract. Wiggling the injector by hand to break it loose may allow the injector to be removed by hand.



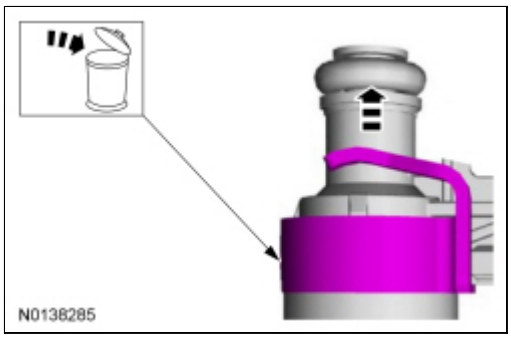
11. **NOTE:** RH shown, LH similar.



12. **NOTE:** LH shown, RH similar.

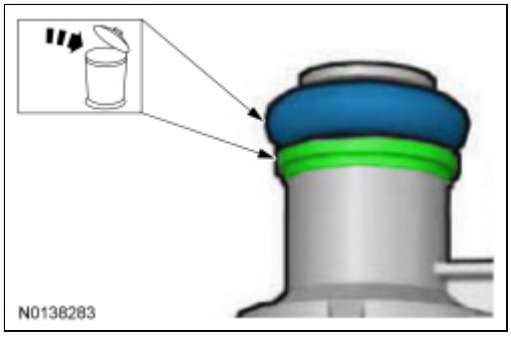


13.

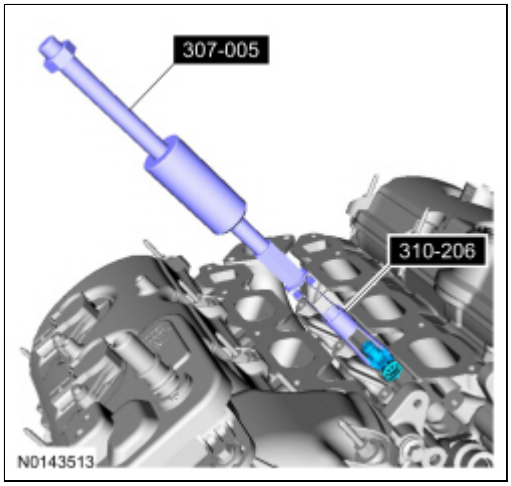


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14.



15. Using the Slide Hammer and the Fuel Injector Remover, remove any of the fuel injectors that remained in the cylinder head.
    - Special Tool(s): Slide Hammer 307-005 (T59L-100-B) or equivalent.
    - Special Tool(s): Remover, Fuel Injector 310-206.

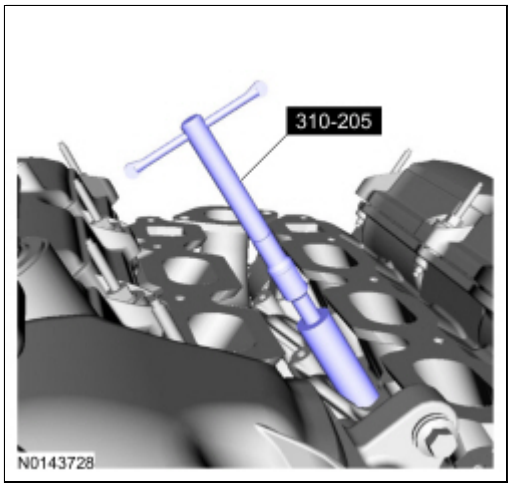


16. **NOTE:** Make sure to thoroughly clean any residual fuel or foreign material from the cylinder head, block and the general surrounding area of the fuel rails and injectors.

    NOTE: Do not use compressed air to clean the tip of the fuel injector.

    NOTE: Do not use a brush to clean the tip of the fuel injector.

    Using the Fuel Injector Brush, clean the fuel injector bore in the cylinder head. Special Tool(s): 310-205.



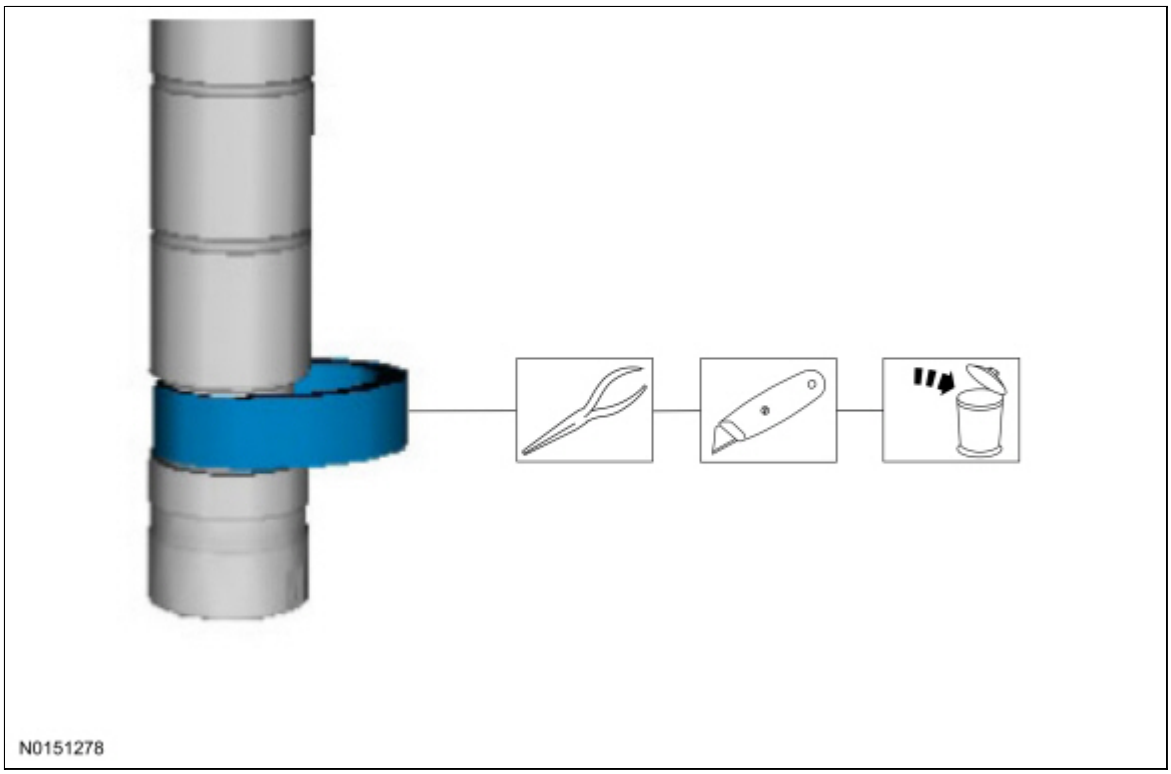
Installation

NOTE: A clean working environment is essential to prevent dirt or foreign material contamination.

1. ***NOTICE:*** **Do not attempt to cut the lower Teflon® seal without first pulling it away from the fuel injector or damage to the injector may occur.**

   NOTICE: **Use care when removing the lower Teflon® seals, not to scratch, nick or gouge the fuel injectors.**

   1. Pull the lower Teflon® seal away from the injector.
   2. Carefully cut and discard the lower fuel injector Teflon® seals.



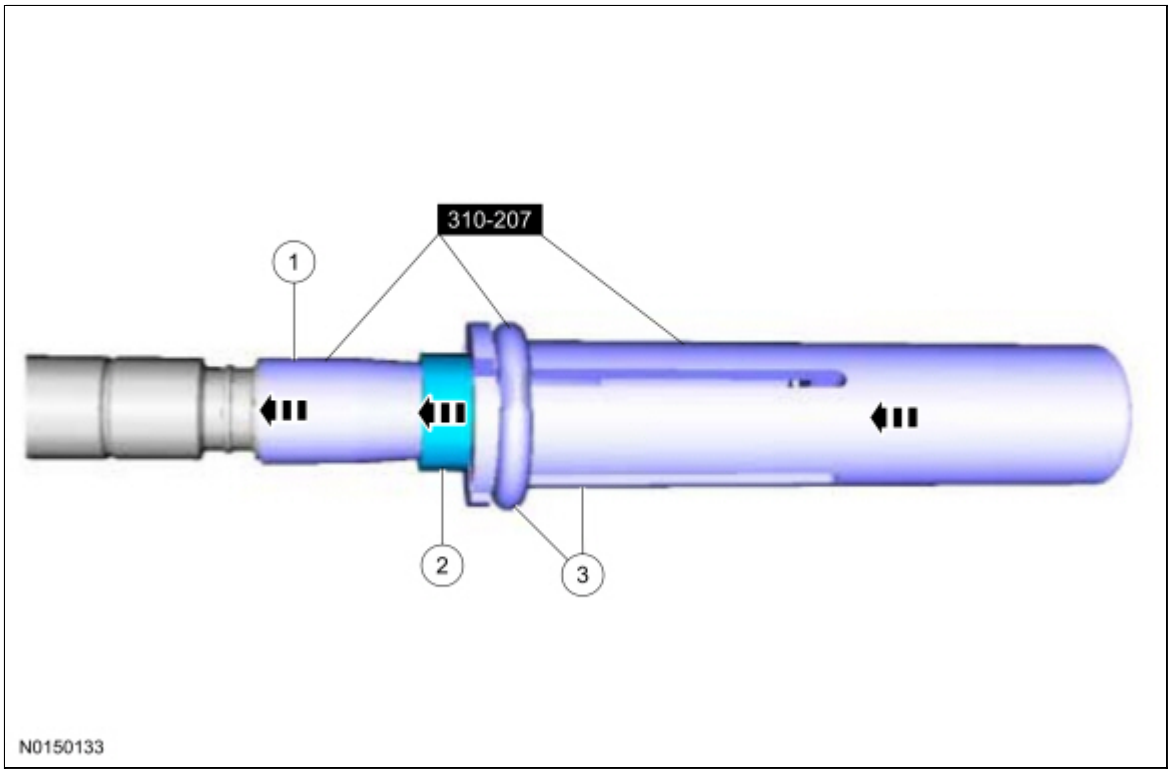
2. **NOTE:** Do not lubricate the new lower Teflon® fuel injector seals.

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1. Special Tool(s): 310-207.
2. ***NOTICE:*** **Once the Teflon® seal is installed on the Teflon® Seal Guide 310-207 (part of the Fuel Injector Seal Installer), it should immediately be installed onto the fuel injector to avoid excessive expansion of the Teflon® seal.**

   NOTE: Make sure that new lower fuel injector Teflon® seals are installed.

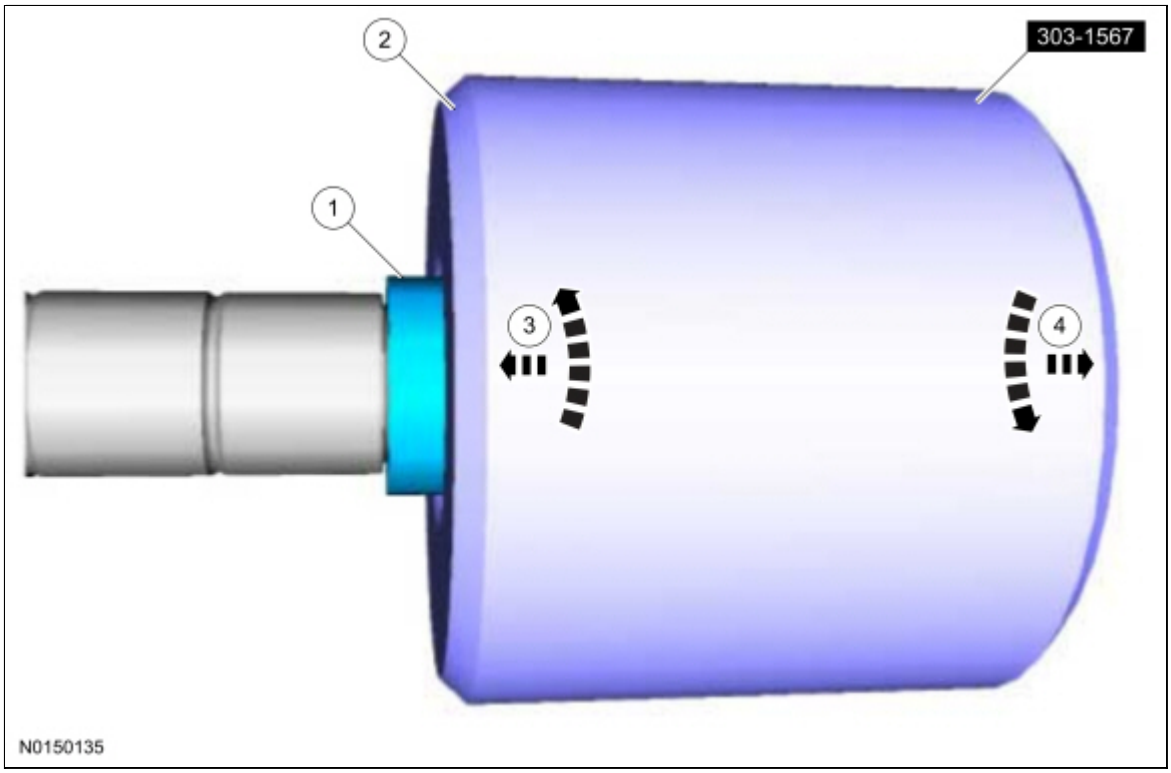
   Special Tool(s): 310-207.
3. Using the Pusher Tool 310-207 (part of the Fuel Injector Seal Installer), slide the Teflon® seals off of the Teflon® Seal Guide and into the groove on the fuel injectors. Special Tool(s): 310-207.



3. ***NOTICE:*** **Install the fuel injectors into the cylinder head within 15 minutes of sizing the seals due to Teflon® seal expansion.**

   1. **NOTE:** Make sure the Teflon® seal is fully seated in the groove on the fuel injector before sizing the Teflon® seal.

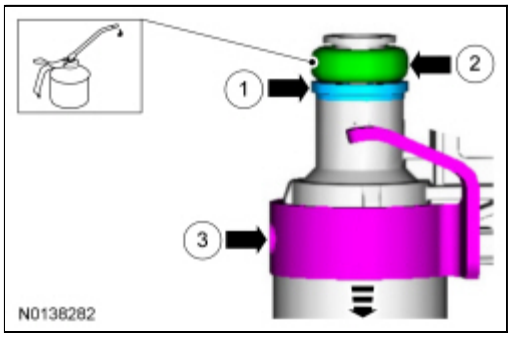
      Some Teflon® seal massaging with your fingers before the Teflon® seal sizer tool is installed will aid in installing the Teflon® seal sizer tool.
   2. Position the Teflon® seal sizer tool 303-1567 with the larger opening towards the Teflon® seal. Push while turning the Teflon® seal sizer tool 180 degrees. Special Tool(s): 303-1567.
   3. Once the Teflon® seal sizer tool 303-1567 is installed, check and make sure the Teflon® seal is in the sizing portion of the Teflon® seal sizer tool. After one minute, turn the Teflon® seal sizer tool back 180 degrees and remove.



4. ***NOTICE:*** **Use fuel injector O-ring seals that are made of special fuel-resistant material. The use of ordinary O-ring seals may cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: Make sure that new upper fuel injector O-ring seals, upper fuel injector O-ring seal support rings and fuel injector retainer clips are installed.

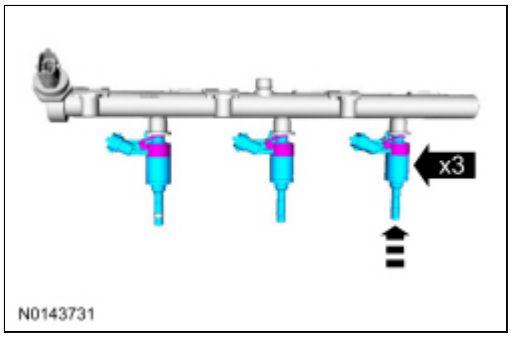
   Material: Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada); or equivalent.



5. **NOTE:** LH shown, RH similar.

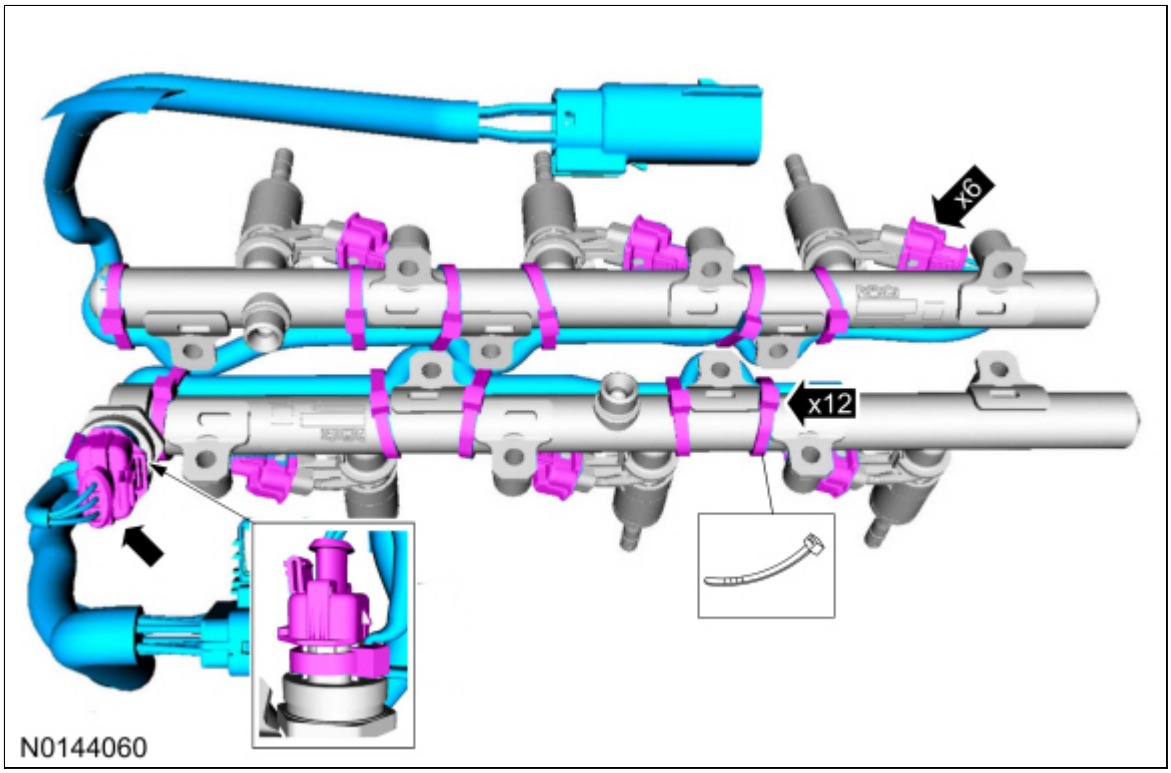
   NOTE: The anti-rotation finger of the fuel injector clip must slip into the groove of the fuel rail cup.

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6. ***NOTICE:*** **It is very important to note the routing of the fuel charge wiring harnesses on the fuel rails and index-mark the location of the tie straps prior to removal or damage may occur to the wire harnesses during installation. The illustration details the correct fuel charge wire harness routing and tie strap positioning for installation.**

   Install the fuel charge wire harnesses and tie straps to the index-marked locations on the fuel rails. Start by attaching the first tie strap farthest down the wire harness and continue to the connector end of the harness, leaving ample slack between the fuel injectors.



7. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

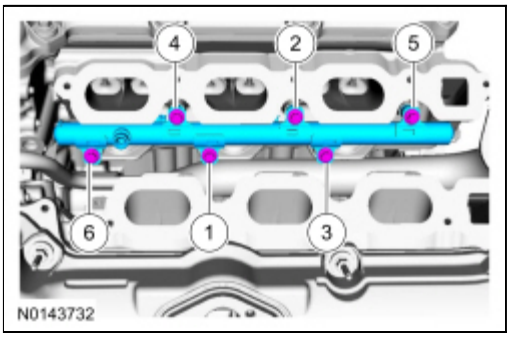
   NOTICE: **Do not lubricate the new lower Teflon® fuel injector seals.**

   NOTE: Make sure that 6 new fuel rail bolts are installed.

   NOTE: Tighten the bolts in a method that draws the fuel rail evenly to the head, preventing a rocking motion.

Tighten the 6 fuel rail bolts in the following 3 stages.

- Stage 1: Push down on the fuel rail face above the injectors.
- Stage 1: Tighten to 10 Nm (89 lb-in) in the sequence shown.
- Stage 2: Tighten an additional 45 degrees in the sequence shown.



8. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

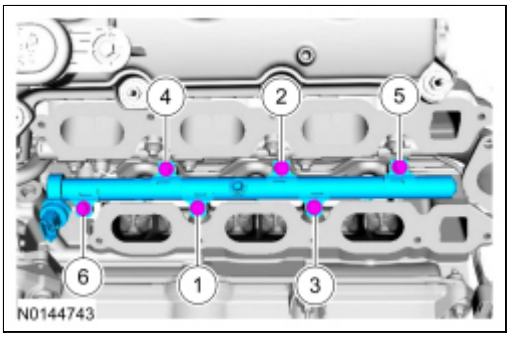
   NOTICE: **Do not lubricate the new lower Teflon® fuel injector seals.**

   NOTE: Make sure that 6 new fuel rail bolts are installed.

   NOTE: Tighten the bolts in a method that draws the fuel rail evenly to the head, preventing a rocking motion.

   Tighten the 6 fuel rail bolts in the following 3 stages.

   - Stage 1: Push down on the fuel rail face above the injectors.
   - Stage 1: Tighten to 10 Nm (89 lb-in) in the sequence shown.
   - Stage 2: Tighten an additional 45 degrees in the sequence shown.



9. **NOTE:** Apply clean engine oil to the threads of the 3 high-pressure fuel tube flare nuts.

   Position the new high-pressure fuel tube and hand start the flare nuts in 3 stages.

   - Stage 1: Hand tighten the high-pressure fuel tube-to-RH fuel rail flare nut.
   - Stage 2: Hand tighten the high-pressure fuel tube-to-LH fuel rail flare nut.
   - Stage 3: Hand tighten the high-pressure fuel tube-to-fuel injection pump flare nut.

10. Loosely install the new high-pressure fuel tube bracket nut and bolt.

11. Tighten the 3 high-pressure fuel tube flare nuts in 9 stages:

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- Stage 1: Tighten the high-pressure fuel tube-to-RH fuel rail flare nut to 15 Nm (133 lb-in).
- Stage 2: Tighten an additional 30 degrees.
- Stage 3: Tighten to 32 Nm (24 lb-ft).
- Stage 4: Tighten the high-pressure fuel tube-to-LH fuel rail flare nut to 15 Nm (133 lb-in).
- Stage 5: Tighten an additional 30 degrees.
- Stage 6: Tighten to 32 Nm (24 lb-ft).
- Stage 7: Tighten the high-pressure fuel tube-to-fuel injection pump flare nut to 15 Nm (133 lb-in).
- Stage 8: Tighten an additional 30 degrees.
- Stage 9: Tighten to 32 Nm (24 lb-ft).

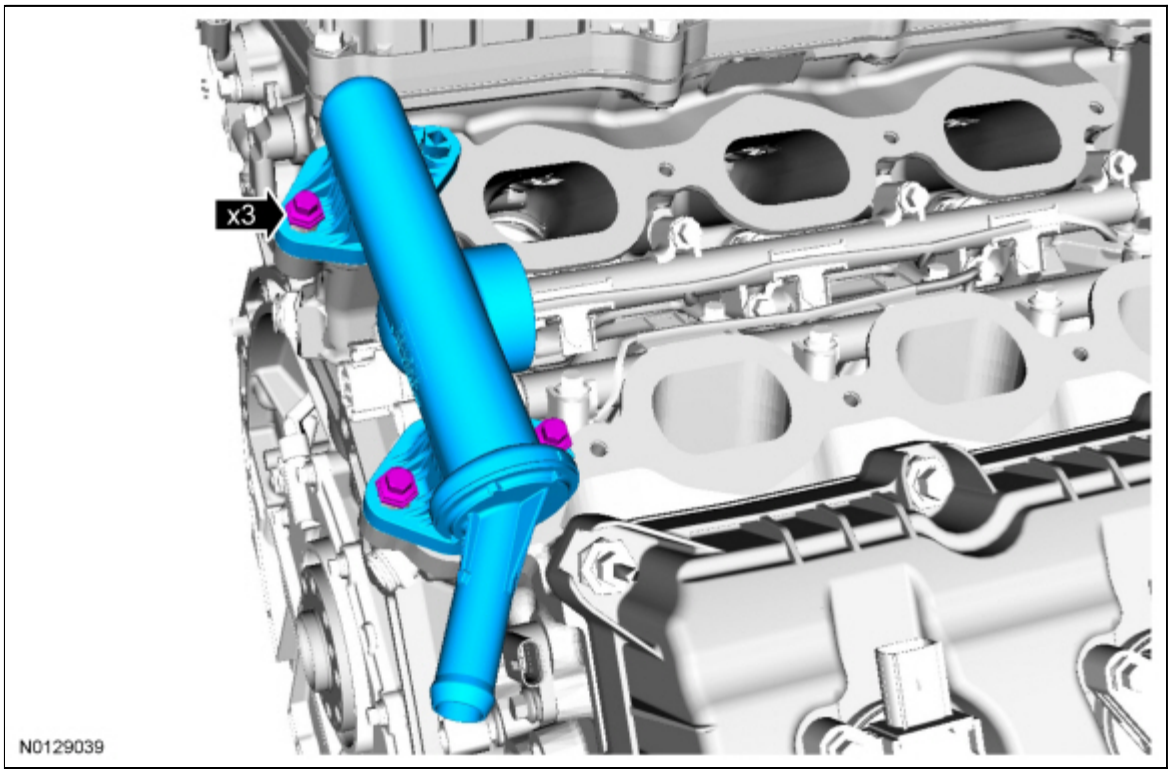
12. Tighten the high-pressure fuel tube bracket bolt in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

13. Tighten the high-pressure fuel tube bracket nut.
    - Tighten to 8 Nm (71 lb-in).

14. **NOTE:** Use care when installing the fuel injection pump noise insulator. Spreading the openings will aid in installing the fuel injection pump noise insulator and reduce the risk of damage.

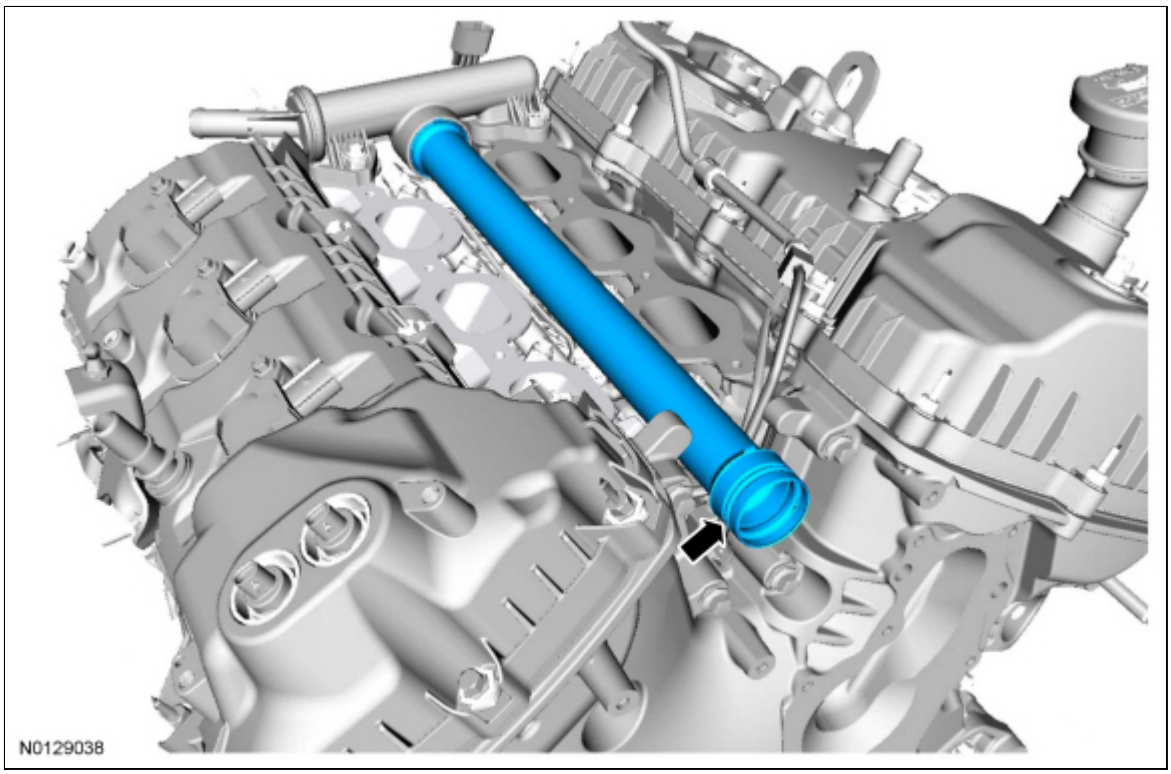
    Install the fuel injection pump noise insulator shield.

15. Using new gaskets, position back the coolant crossover manifold assembly and install the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.



16. **NOTE:** Lubricate the O-ring seals with clean engine coolant.

Using new O-ring seals, install the coolant inlet pipe.

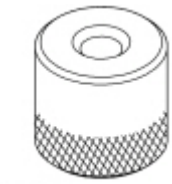


17. Install the thermostat housing. For additional information, refer to Section 303-03 .
18. Install the intake manifold. For additional information, refer to Section 303-01A .

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Fuel Rail

Special Tool(s)

 ST3096-A	Brush, Fuel Injector 310-205
 ST3095-A	Remover, Fuel Injector 310-206
 ST3097-A	Seal Installer, Fuel Injector 310-207
 ST3266-A	Sizer, Teflon® Seal 303-1567
 ST3089-A	Slide Hammer 307-005 (T59L-100-B) or equivalent

Material

Item	Specification
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Motorcraft® Orange Antifreeze/Coolant Concentrated	WSS-M97B44-D

VC-3-B (US); CVC-3-B2 (Canada)	

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

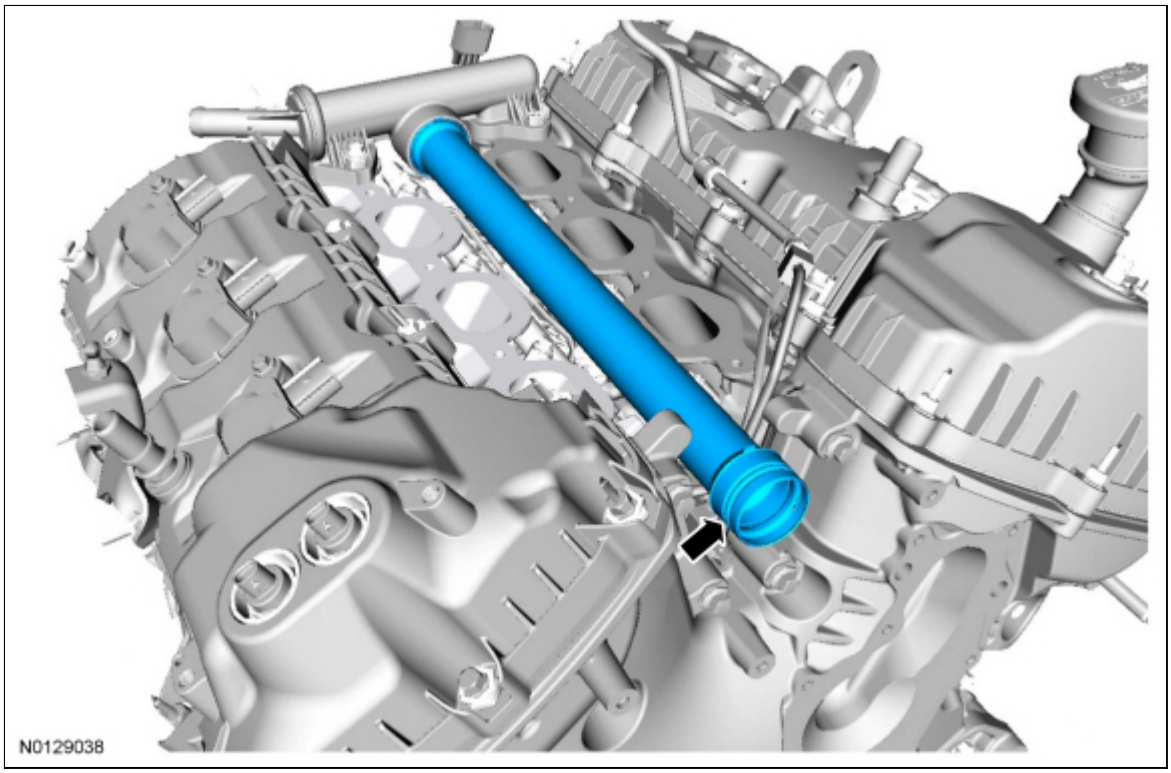
WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

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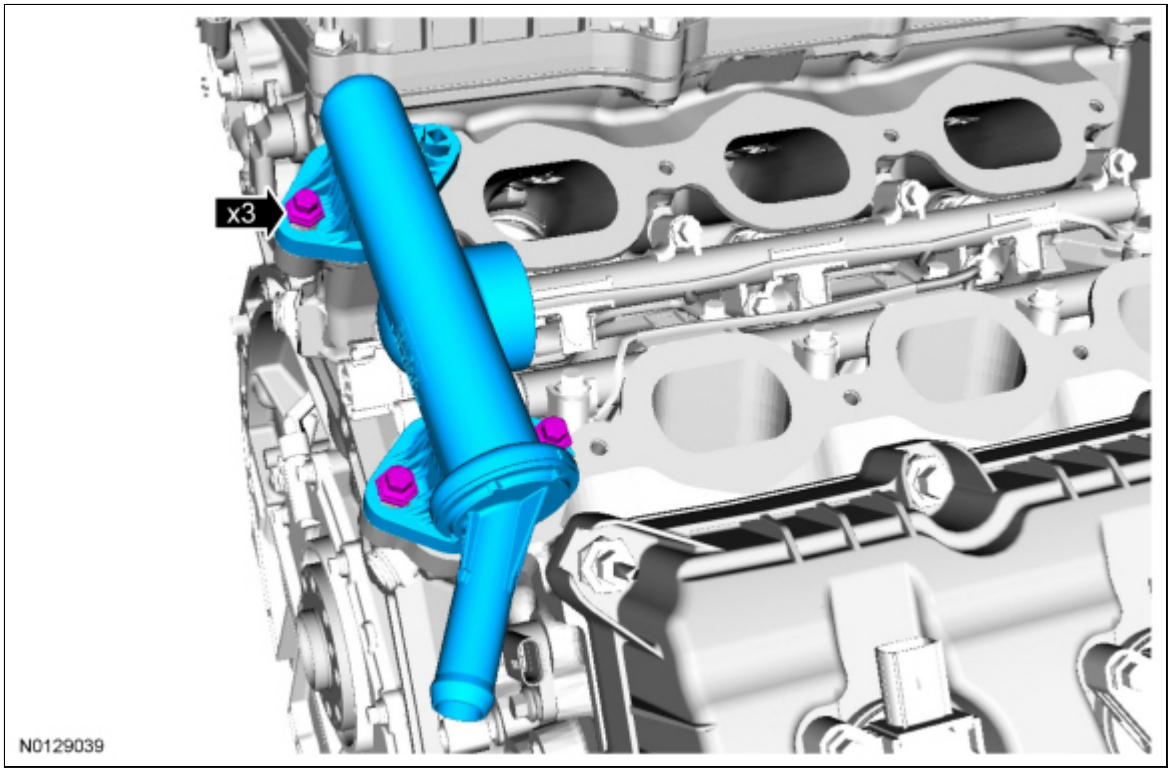
NOTE: A clean working environment is essential to prevent dirt or foreign material contamination.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Remove the intake manifold. For additional information, refer to Section 303-01A .
3. Remove the thermostat housing. For additional information, refer to Section 303-03 .
4. Remove the coolant inlet pipe.
   - Remove and discard the coolant inlet pipe O-ring seals.

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5. Remove the 3 bolts and position aside the coolant crossover assembly.
    - Remove and discard the 2 gaskets.

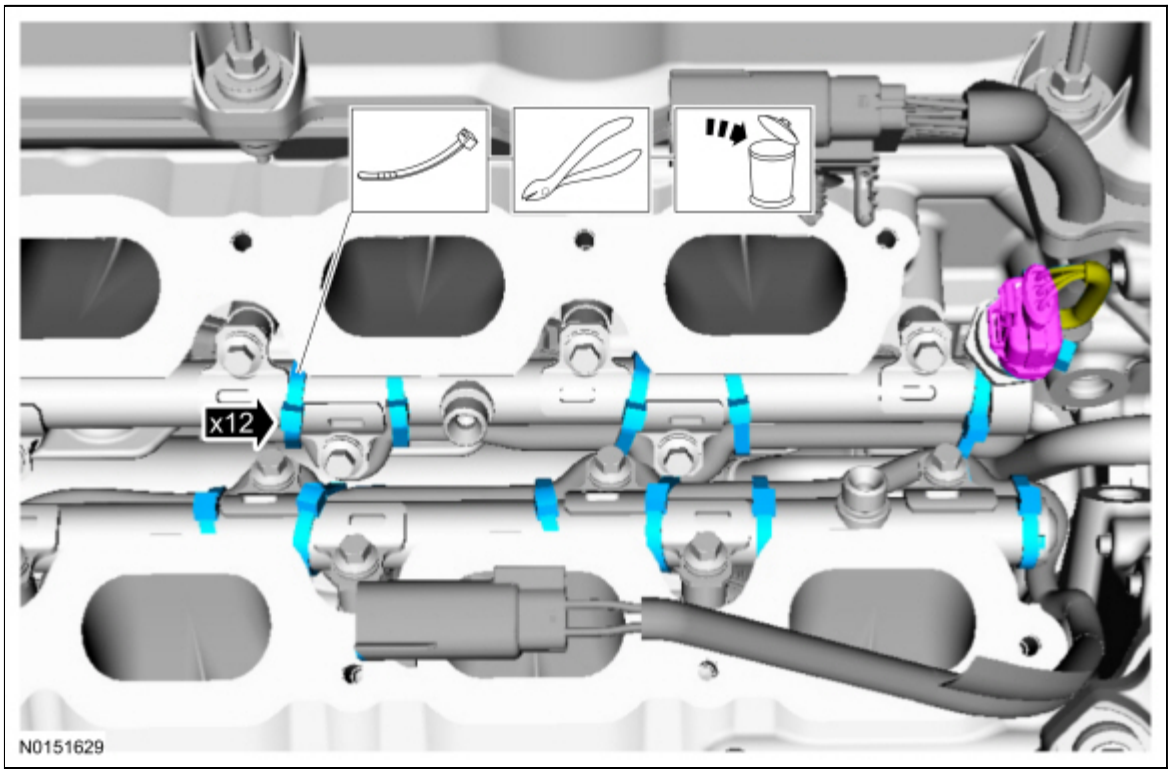


6. Remove the high-pressure fuel tube bracket bolt.

7. Loosen the 2 flare nuts, remove and discard the high-pressure fuel tube.

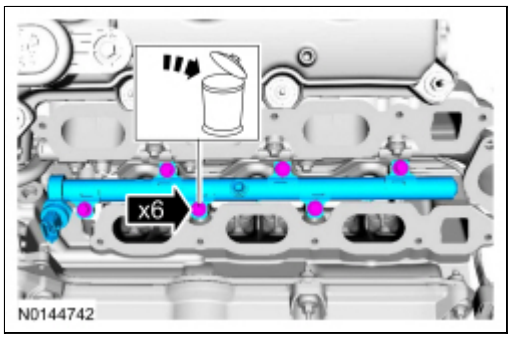
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   NOTE: Use compressed air and remove any dirt or foreign material from the cylinder head, block and general surrounding area of the fuel rail and injectors.



9. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

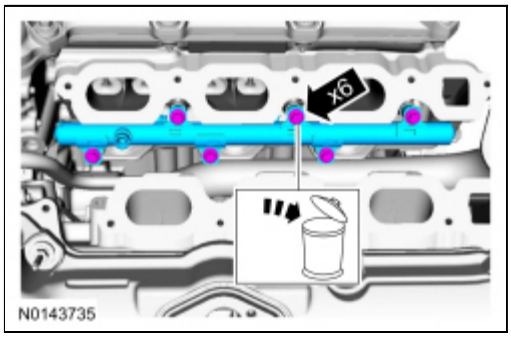
   NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder heads and require the use of a Fuel Injector Remover tool to extract. Wiggling the injector by hand to break it loose may allow the injector to be removed by hand.



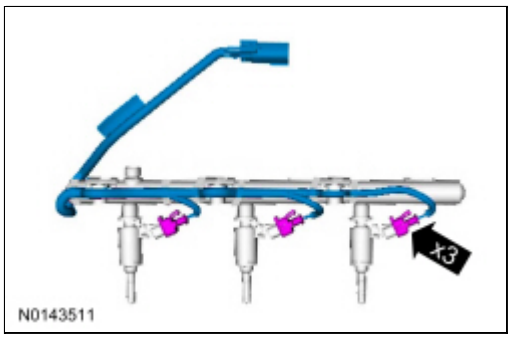
10. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

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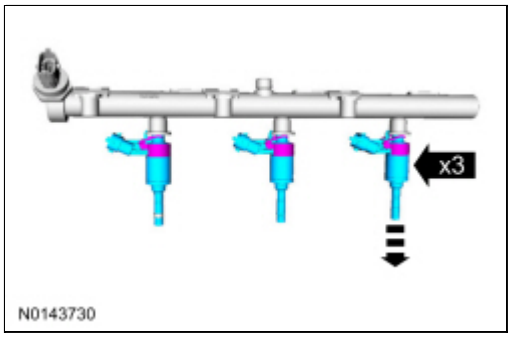
NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder heads and require the use of a Fuel Injector Remover tool to extract. Wiggling the injector by hand to break it loose may allow the injector to be removed by hand.



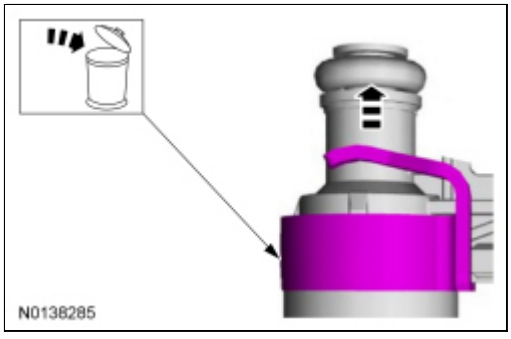
11. **NOTE:** RH shown, LH similar.



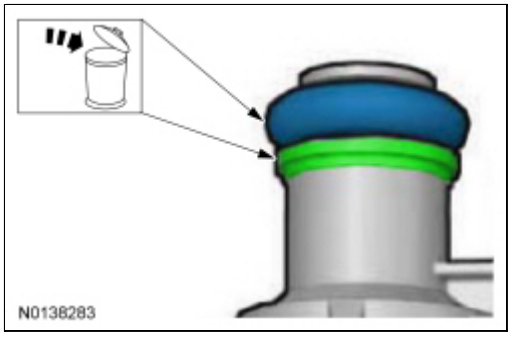
12. **NOTE:** LH shown, RH similar.



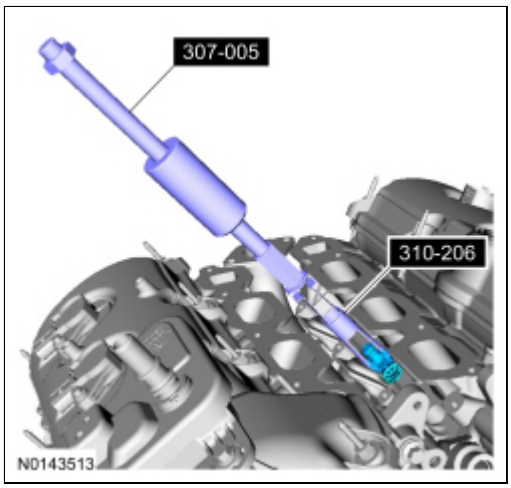
13.



14.



15. Using the Slide Hammer and the Fuel Injector Remover, remove any of the fuel injectors that remained in the cylinder head.
    - Special Tool(s): Slide Hammer 307-005 (T59L-100-B) or equivalent.
    - Special Tool(s): Remover, Fuel Injector 310-206.



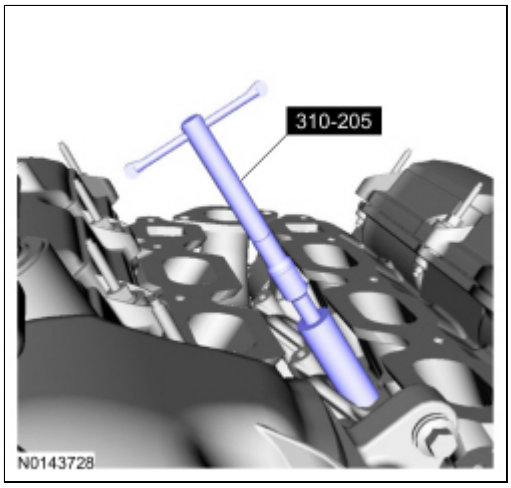
16. **NOTE:** Make sure to thoroughly clean any residual fuel or foreign material from the cylinder head, block and the general surrounding area of the fuel rails and injectors.

    NOTE: Do not use compressed air to clean the tip of the fuel injector.

    NOTE: Do not use a brush to clean the tip of the fuel injector.

    Using the Fuel Injector Brush, clean the fuel injector bore in the cylinder head. Special Tool(s): 310-205.

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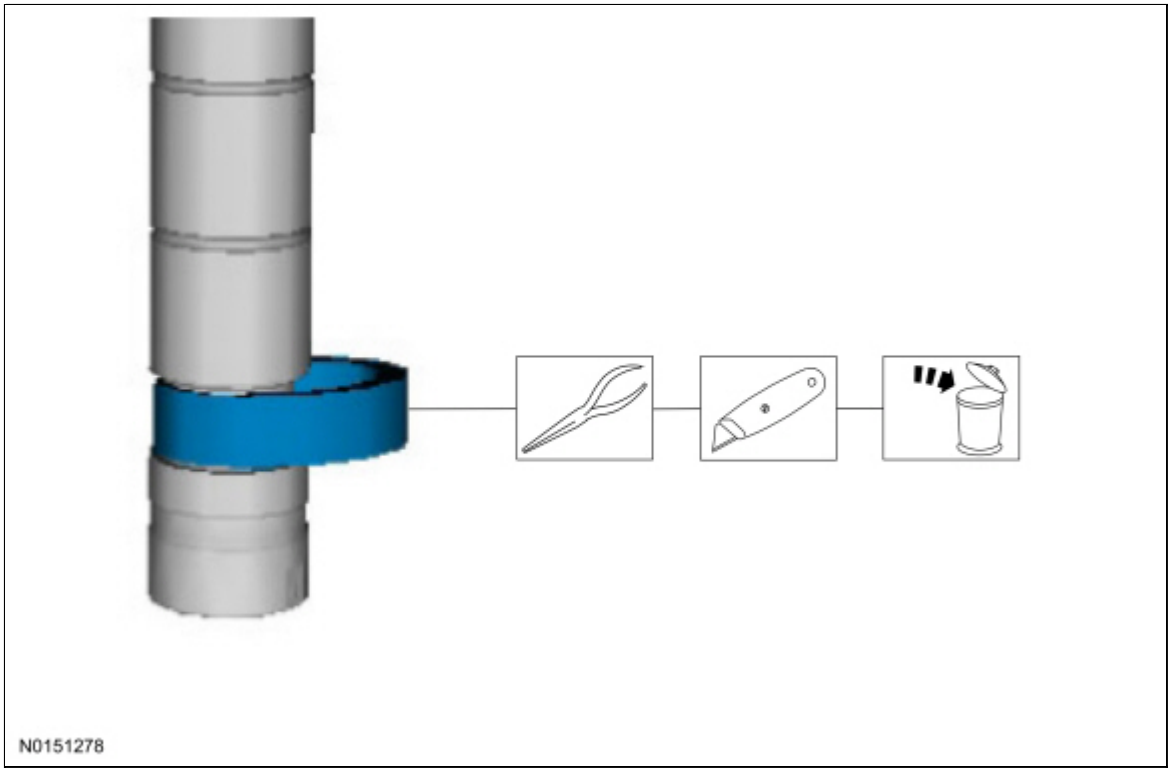
Installation

NOTE: A clean working environment is essential to prevent dirt or foreign material contamination.

1. ***NOTICE:*** **Do not attempt to cut the lower Teflon® seal without first pulling it away from the fuel injector or damage to the injector may occur.**

   NOTICE: **Use care when removing the lower Teflon® seals, not to scratch, nick or gouge the fuel injectors.**

   1. Pull the lower Teflon® seal away from the injector.
   2. Carefully cut and discard the lower fuel injector Teflon® seals.

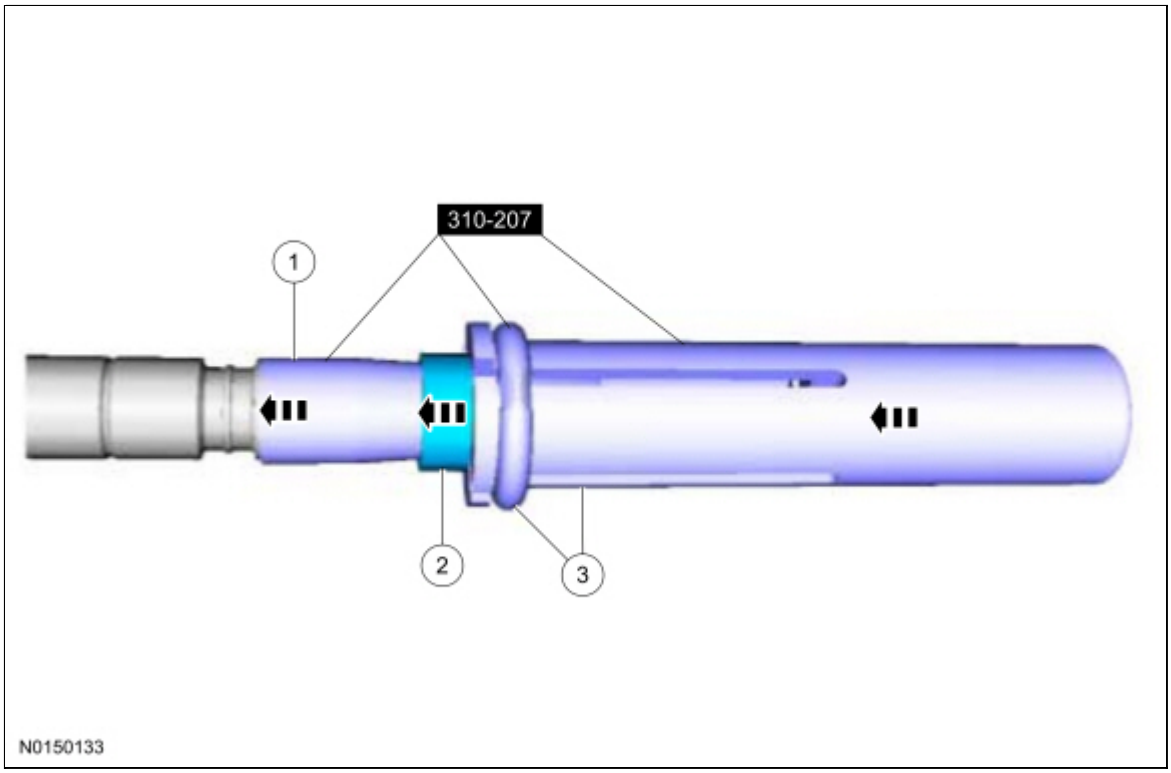


2. **NOTE:** Do not lubricate the new lower Teflon® fuel injector seals.

1. Special Tool(s): 310-207.
2. ***NOTICE:*** **Once the Teflon® seal is installed on the Teflon® Seal Guide 310-207 (part of the Fuel Injector Seal Installer), it should immediately be installed onto the fuel injector to avoid excessive expansion of the Teflon® seal.**

   NOTE: Make sure that new lower fuel injector Teflon® seals are installed.

   Special Tool(s): 310-207.
3. Using the Pusher Tool 310-207 (part of the Fuel Injector Seal Installer), slide the Teflon® seals off of the Teflon® Seal Guide and into the groove on the fuel injectors. Special Tool(s): 310-207.

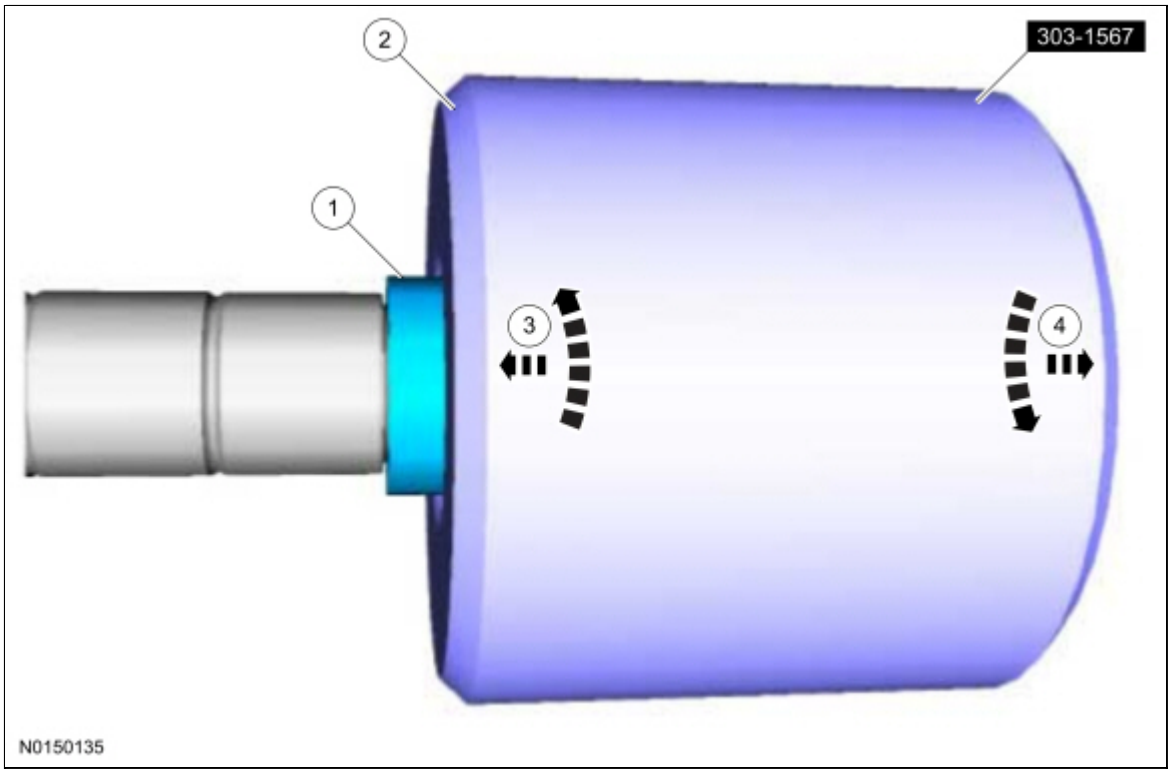


3. ***NOTICE:*** **Install the fuel injectors into the cylinder head within 15 minutes of sizing the seals due to Teflon® seal expansion.**

   1. **NOTE:** Make sure the Teflon® seal is fully seated in the groove on the fuel injector before sizing the Teflon® seal.

      Some Teflon® seal massaging with your fingers before the Teflon® seal sizer tool is installed will aid in installing the Teflon® seal sizer tool.
   2. Position the Teflon® seal sizer tool 303-1567 with the larger opening towards the Teflon® seal. Push while turning the Teflon® seal sizer tool 180 degrees. Special Tool(s): 303-1567.
   3. Once the Teflon® seal sizer tool 303-1567 is installed, check and make sure the Teflon® seal is in the sizing portion of the Teflon® seal sizer tool. After one minute, turn the Teflon® seal sizer tool back 180 degrees and remove.

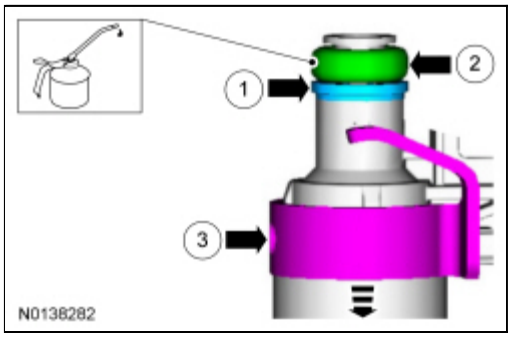
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4. ***NOTICE:*** **Use fuel injector O-ring seals that are made of special fuel-resistant material. The use of ordinary O-ring seals may cause the fuel system to leak. Do not reuse the O-ring seals.**

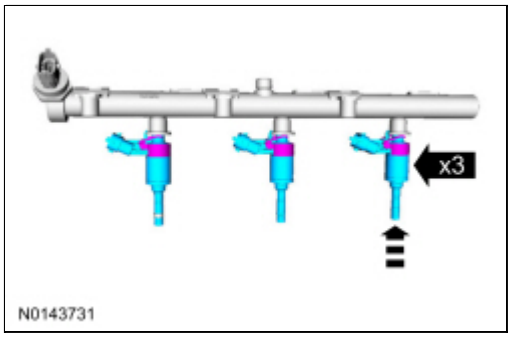
   NOTE: Make sure that new upper fuel injector O-ring seals, upper fuel injector O-ring seal support rings and fuel injector retainer clips are installed.

   Material: Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada); or equivalent.



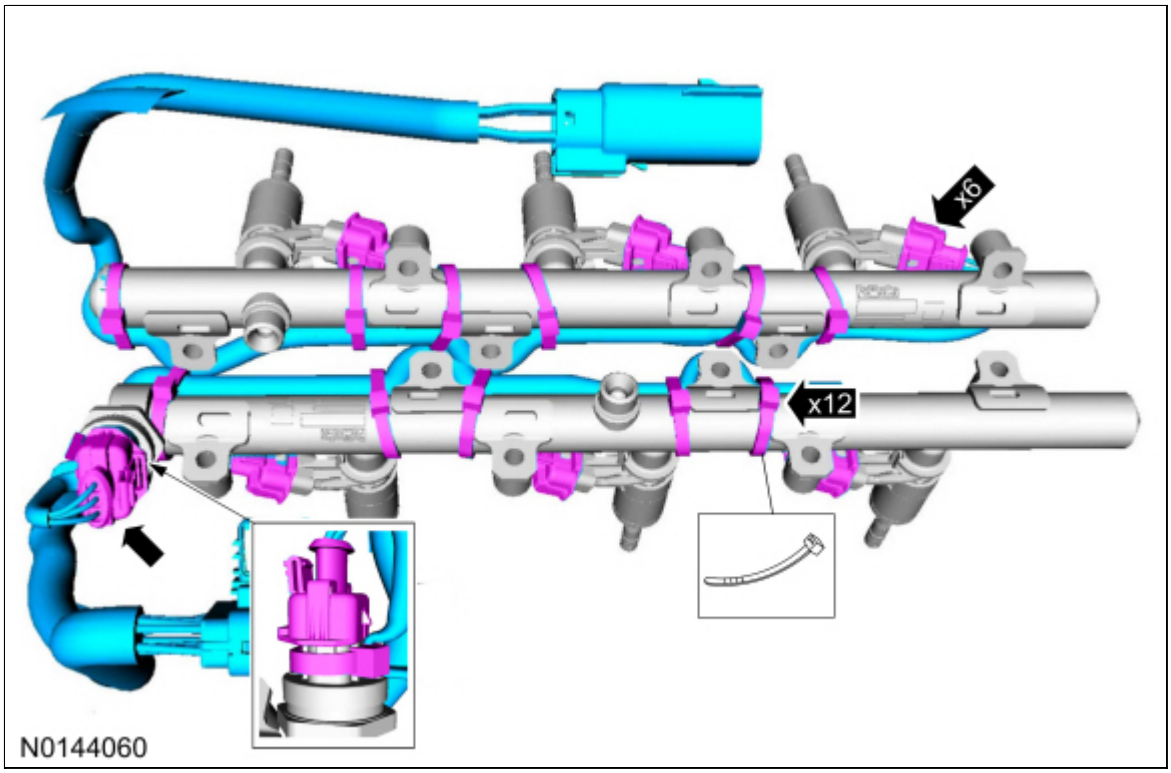
5. **NOTE:** LH shown, RH similar.

   NOTE: The anti-rotation finger of the fuel injector clip must slip into the groove of the fuel rail cup.



6. ***NOTICE:*** **It is very important to note the routing of the fuel charge wiring harnesses on the fuel rails and index-mark the location of the tie straps prior to removal or damage may occur to the wire harnesses during installation. The illustration details the correct fuel charge wire harness routing and tie strap positioning for installation.**

   Install the fuel charge wire harnesses and tie straps to the index-marked locations on the fuel rails. Start by attaching the first tie strap farthest down the wire harness and continue to the connector end of the harness, leaving ample slack between the fuel injectors.



7. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

   NOTICE: **Do not lubricate the new lower Teflon® fuel injector seals.**

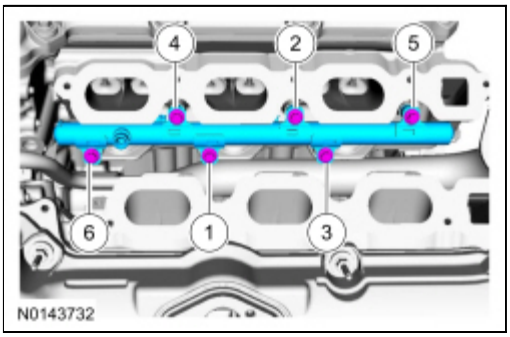
   NOTE: Make sure that 6 new fuel rail bolts are installed.

   NOTE: Tighten the bolts in a method that draws the fuel rail evenly to the head, preventing a rocking motion.

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Tighten the 6 fuel rail bolts in the following 3 stages.

- Stage 1: Push down on the fuel rail face above the injectors.
- Stage 1: Tighten to 10 Nm (89 lb-in) in the sequence shown.
- Stage 2: Tighten an additional 45 degrees in the sequence shown.



8. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

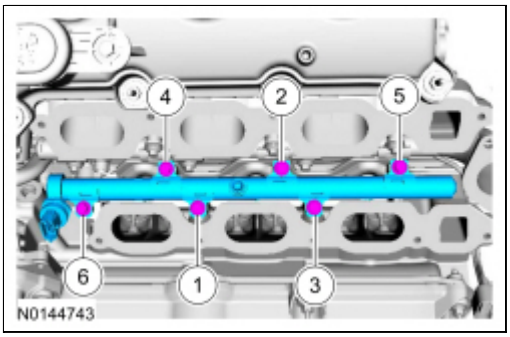
   NOTICE: **Do not lubricate the new lower Teflon® fuel injector seals.**

   NOTE: Make sure that 6 new fuel rail bolts are installed.

   NOTE: Tighten the bolts in a method that draws the fuel rail evenly to the head, preventing a rocking motion.

   Tighten the 6 fuel rail bolts in the following 3 stages.

   - Stage 1: Push down on the fuel rail face above the injectors.
   - Stage 1: Tighten to 10 Nm (89 lb-in) in the sequence shown.
   - Stage 2: Tighten an additional 45 degrees in the sequence shown.



9. **NOTE:** Apply clean engine oil to the threads of the 3 high-pressure fuel tube flare nuts.

   Position the new high-pressure fuel tube and hand start the flare nuts in 3 stages.

   - Stage 1: Hand tighten the high-pressure fuel tube-to-RH fuel rail flare nut.
   - Stage 2: Hand tighten the high-pressure fuel tube-to-LH fuel rail flare nut.
   - Stage 3: Hand tighten the high-pressure fuel tube-to-fuel injection pump flare nut.

10. Loosely install the new high-pressure fuel tube bracket nut and bolt.

11. Tighten the 3 high-pressure fuel tube flare nuts in 9 stages:

- Stage 1: Tighten the high-pressure fuel tube-to-RH fuel rail flare nut to 15 Nm (133 lb-in).
- Stage 2: Tighten an additional 30 degrees.
- Stage 3: Tighten to 32 Nm (24 lb-ft).
- Stage 4: Tighten the high-pressure fuel tube-to-LH fuel rail flare nut to 15 Nm (133 lb-in).
- Stage 5: Tighten an additional 30 degrees.
- Stage 6: Tighten to 32 Nm (24 lb-ft).
- Stage 7: Tighten the high-pressure fuel tube-to-fuel injection pump flare nut to 15 Nm (133 lb-in).
- Stage 8: Tighten an additional 30 degrees.
- Stage 9: Tighten to 32 Nm (24 lb-ft).

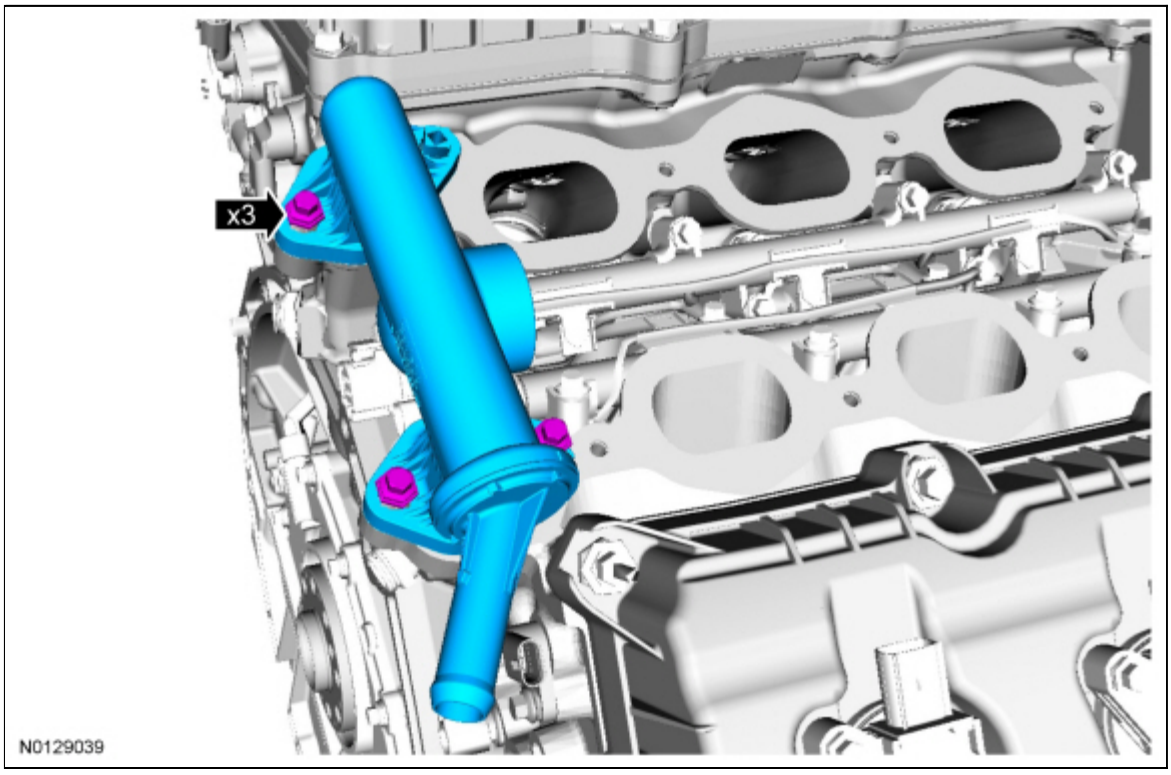
12. Tighten the high-pressure fuel tube bracket bolt in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

13. Tighten the high-pressure fuel tube bracket nut.
    - Tighten to 8 Nm (71 lb-in).

14. **NOTE:** Use care when installing the fuel injection pump noise insulator. Spreading the openings will aid in installing the fuel injection pump noise insulator and reduce the risk of damage.

    Install the fuel injection pump noise insulator shield.

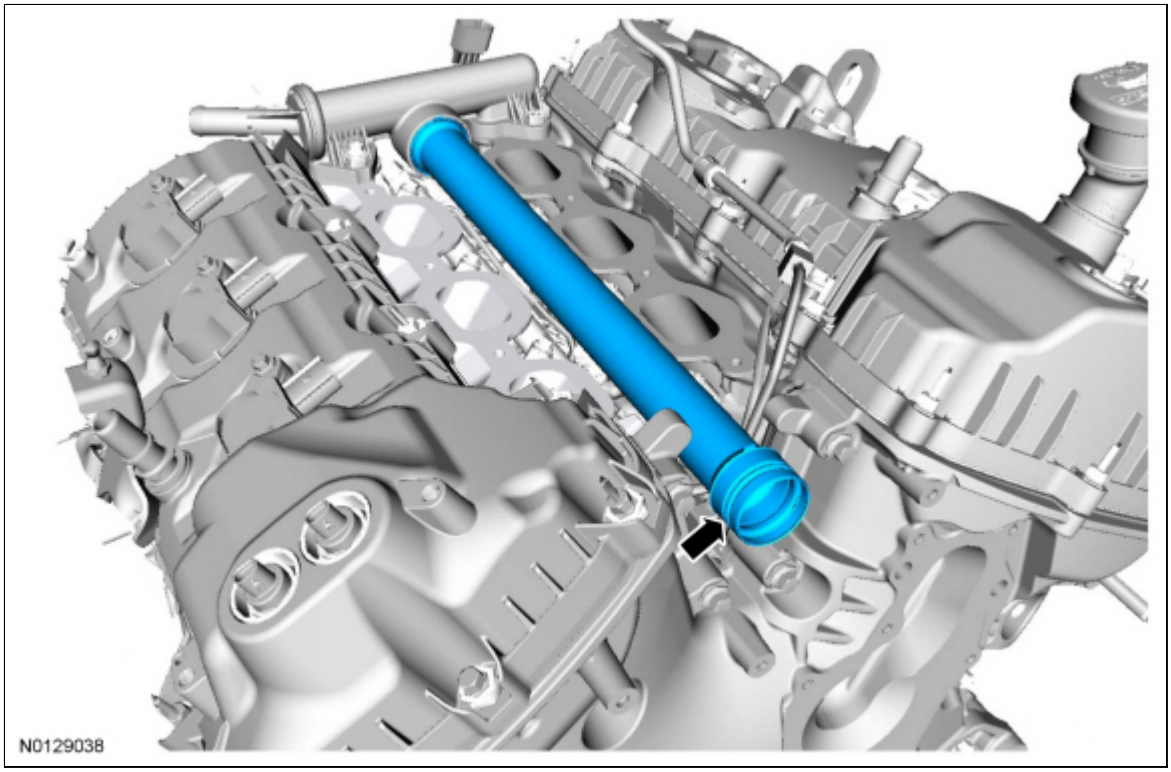
15. Using new gaskets, position back the coolant crossover manifold assembly and install the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.



16. **NOTE:** Lubricate the O-ring seals with clean engine coolant.

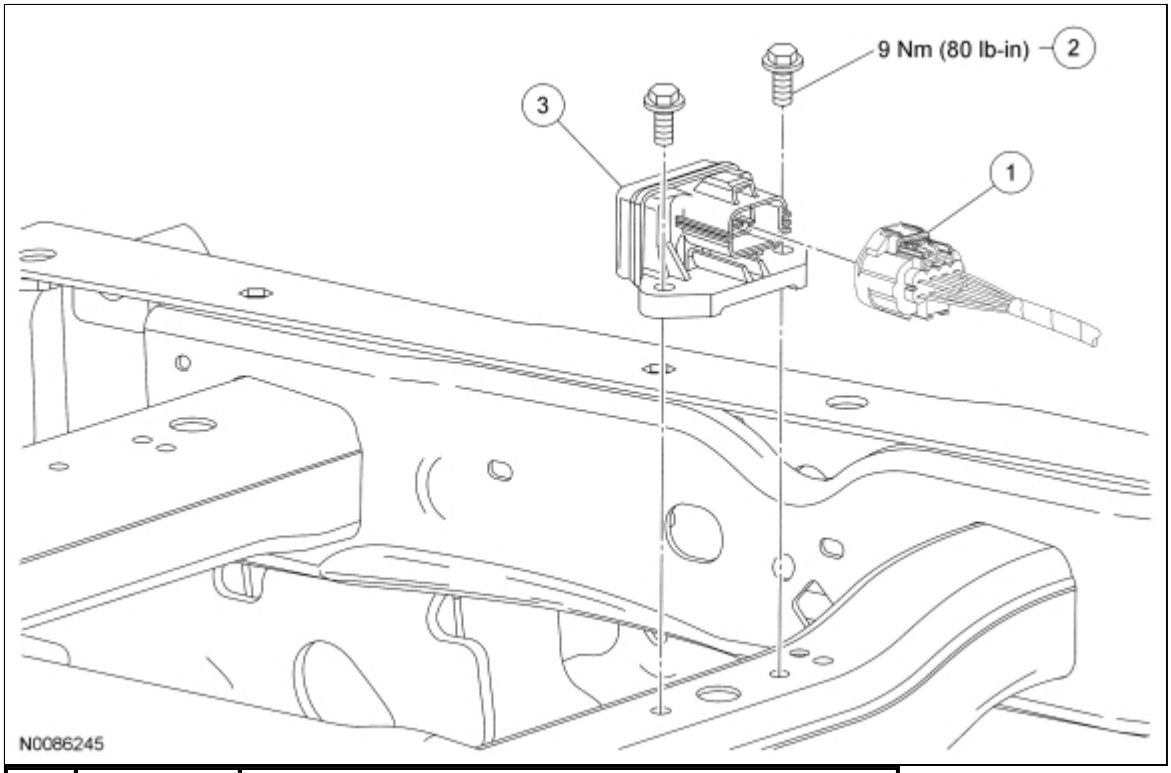
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Using new O-ring seals, install the coolant inlet pipe.



17. Install the thermostat housing. For additional information, refer to Section 303-03 .
18. Install the intake manifold. For additional information, refer to Section 303-01A .

Fuel Pump Control Module



Item	Part Number	Description
1	—	Fuel Pump Control Module (FPCM) electrical connector (part of 14404)
2	W706027	FPCM bolt (2 required)
3	9345	FPCM

Removal and Installation

1. Disconnect theFuel Pump Control Module (FPCM) electrical connector.

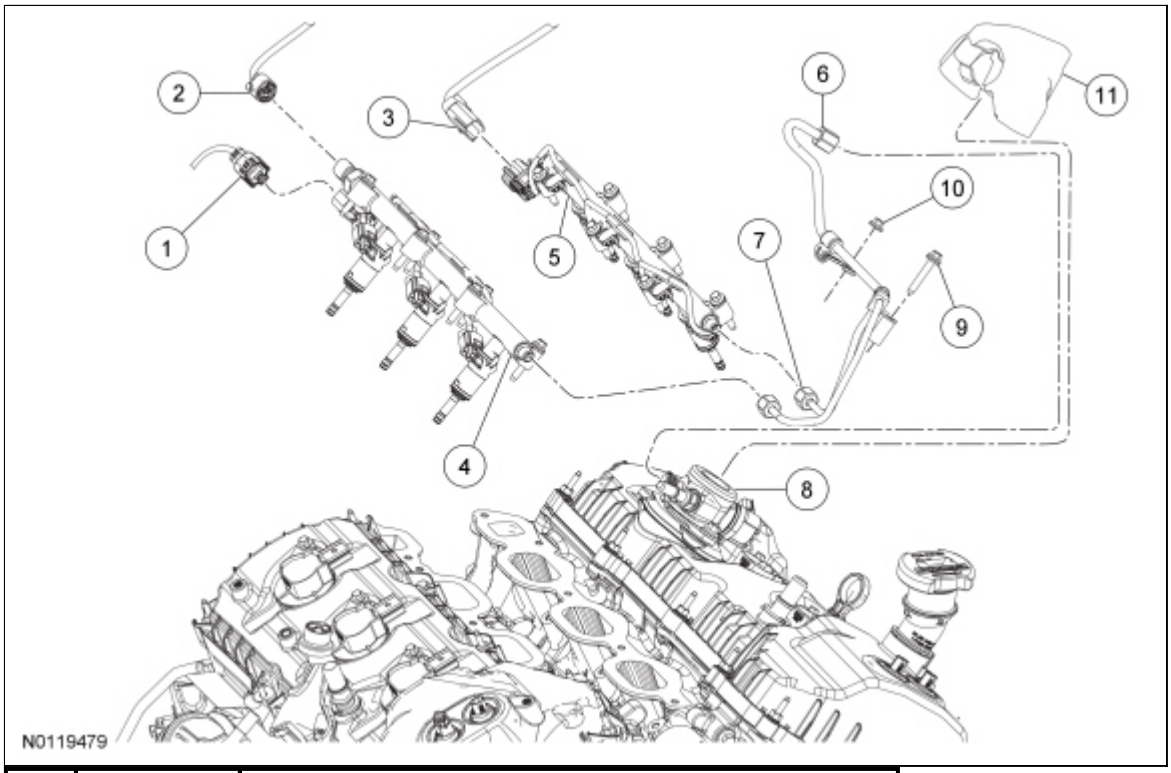
2. Remove the 2 bolts and the FPCM .
   - To install, tighten to 9 Nm (80 lb-in).

3. To install, reverse the removal procedure.

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Fuel Rail and Fuel Injector — Exploded View

3.5L Gasoline Turbocharged Direct Injection (GTDI) Fuel Rails and High Pressure Fuel Tube

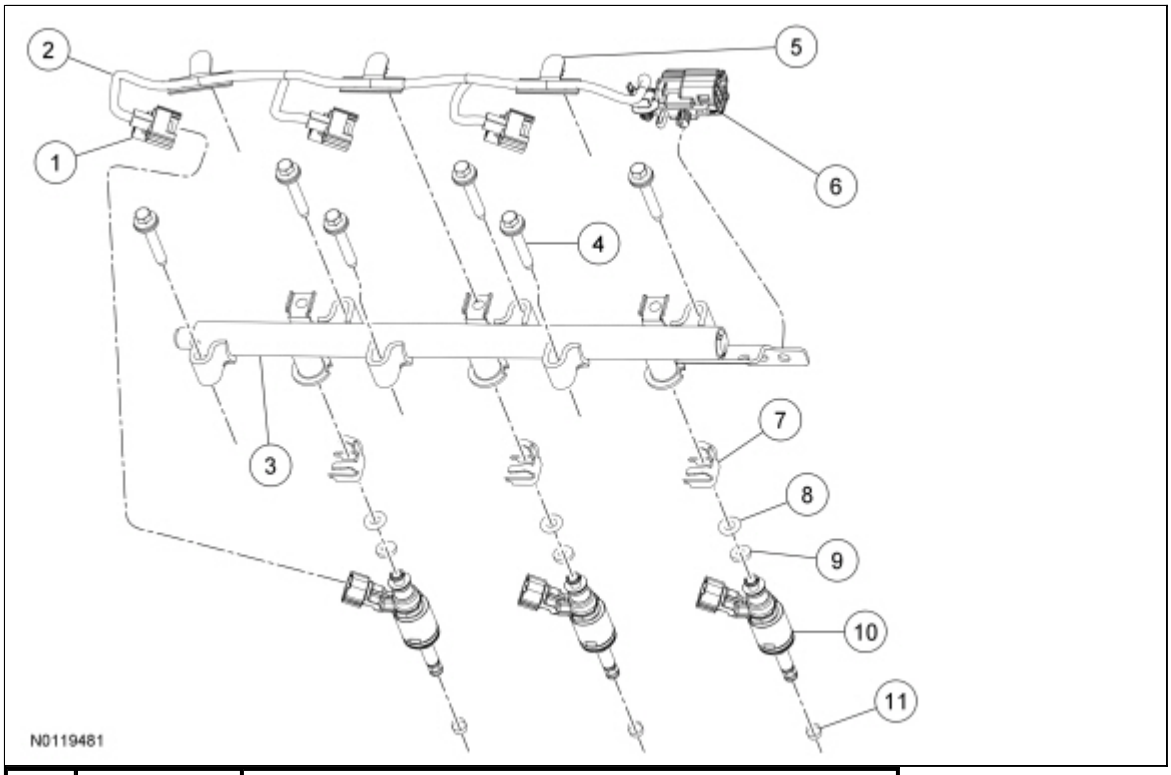


Item	Part Number	Description
1	—	RH fuel charge wire harness electrical connector (part of 12A581)
2	—	Fuel Rail Pressure (FRP) sensor electrical connector (part of 12A581)
3	—	LH fuel charge wire harness electrical connector (part of 12A581)
4	9D280	RH fuel rail
5	9D280	LH fuel rail
6	—	High pressure fuel tube-to-fuel injection pump flare nut (part of 9J323)
7	—	High pressure fuel tube-to-fuel rail flare nut (part of 9J323)
8	9350	Fuel injection pump
9	W503282	High pressure fuel tube bracket bolt

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10	W520100	High pressure fuel tube bracket nut
11	9K540	Fuel injection pump noise insulator shield

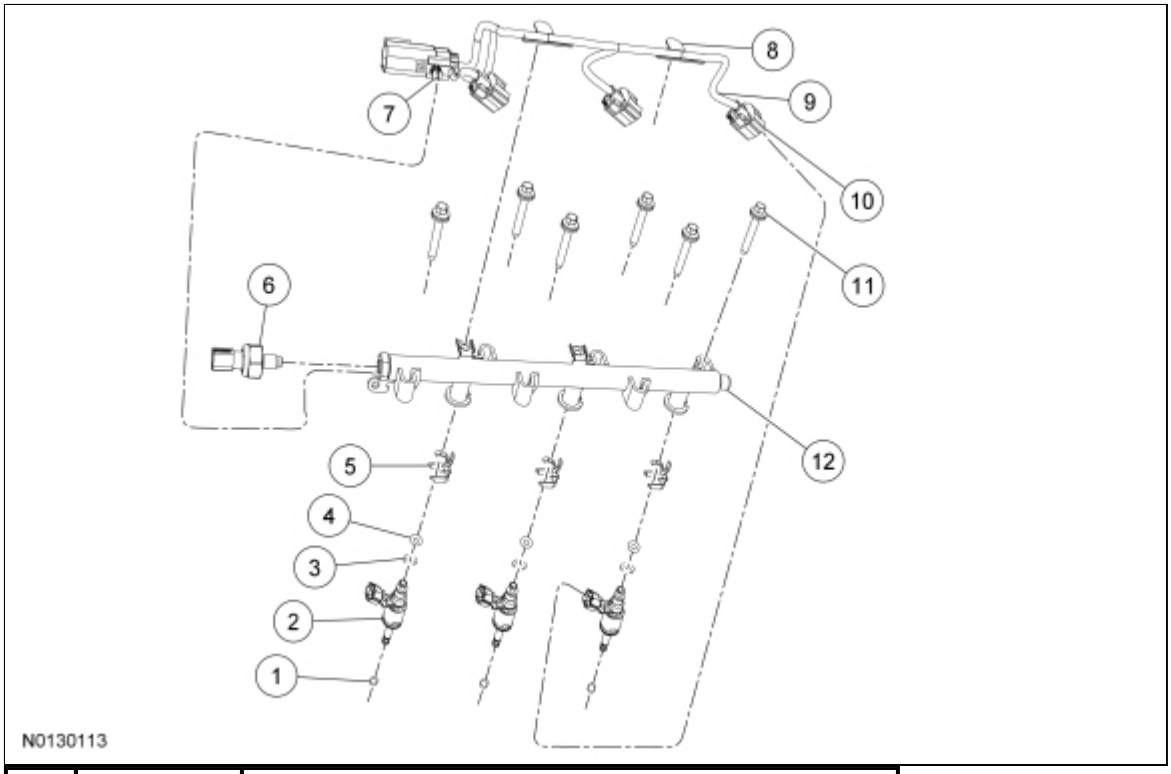
3.5L GTDI LH Fuel Rail and Fuel Injectors



Item	Part Number	Description
1	—	Fuel injector electrical connector (part of 12B637) (3 required)
2	12B637	LH fuel charge wire harness
3	9D280	LH fuel rail
4	W503280	Fuel rail bolt (6 required)
5	13A506	LH fuel charge wire harness retainer (3 required)
6	—	LH fuel charge wire harness electrical connector (part of 12B637)
7	—	Fuel injector clip (part of 9229) (3 required)
8	—	Upper fuel injector O-ring seal (part of 9229)(3 required)
9	—	Upper fuel injector O-ring seal support ring (part of 9229)(3 required)
10	9F593	Fuel injector (3 required)
11	—	Lower fuel injector Teflon® seal (part of 9229) (3

		required)

3.5L GTDI RH Fuel Rail and Fuel Injectors



Item	Part Number	Description
1	—	Lower fuel injector Teflon® seal (part of 9229) (3 required)
2	9F593	Fuel injector (3 required)
3	—	Upper fuel injector O-ring seal support ring (part of 9229)(3 required)
4	—	Upper fuel injector O-ring seal (part of 9229) (3 required)
5	—	Fuel injector clip (part of 9229) (3 required)
6	9F972	FRP sensor
7	—	RH fuel charge wire harness electrical connector (part of 12B637)
8	13A506	RH fuel charge wire harness retainer (2 required)
9	12B637	RH fuel charge wire harness
10	—	Fuel injector electrical connector (part of 12B637) (3 required)
11	W503280	Fuel rail bolt (6 required)

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12	9D280	RH fuel rail

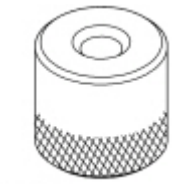
NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view. requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.

1. For additional information, refer to the procedures in this section.

Fuel Rail

Special Tool(s)

 ST3096-A	Brush, Fuel Injector 310-205
 ST3095-A	Remover, Fuel Injector 310-206
 ST3097-A	Seal Installer, Fuel Injector 310-207
 ST3266-A	Sizer, Teflon® Seal 303-1567
 ST3089-A	Slide Hammer 307-005 (T59L-100-B) or equivalent

Material

Item	Specification
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A
Motorcraft® Orange Antifreeze/Coolant Concentrated	WSS-M97B44-D

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VC-3-B (US); CVC-3-B2 (Canada)	

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

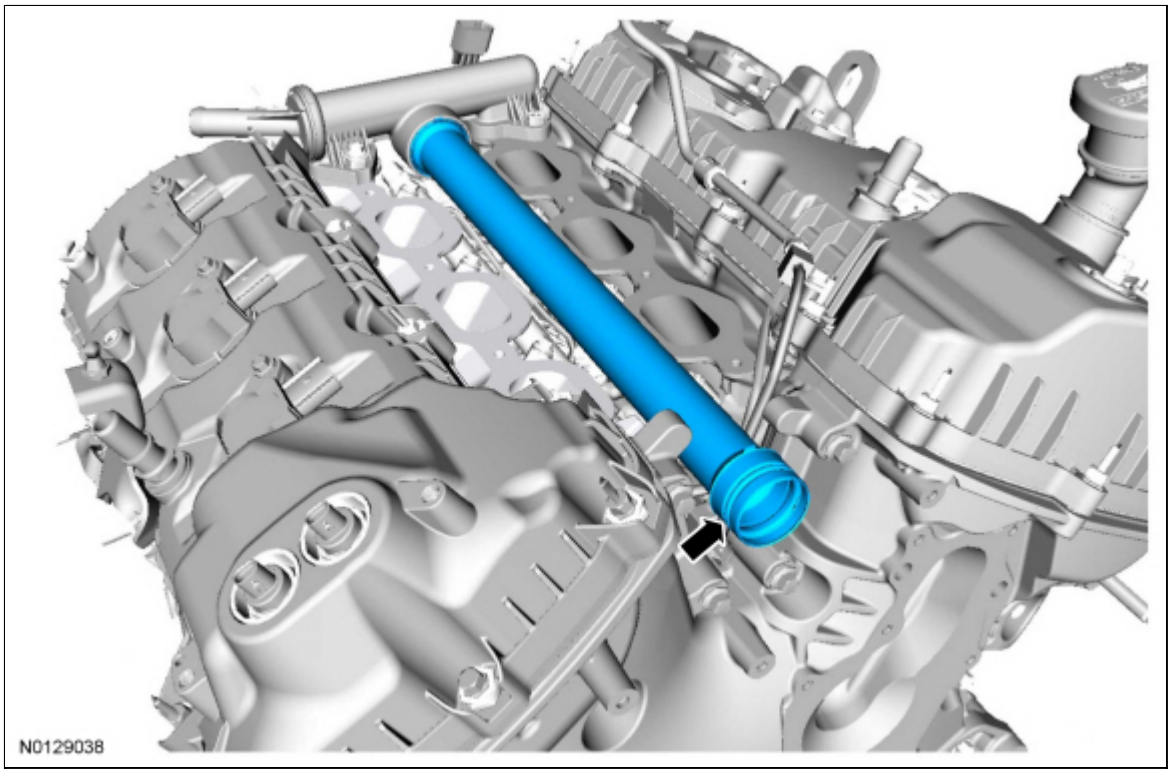
WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

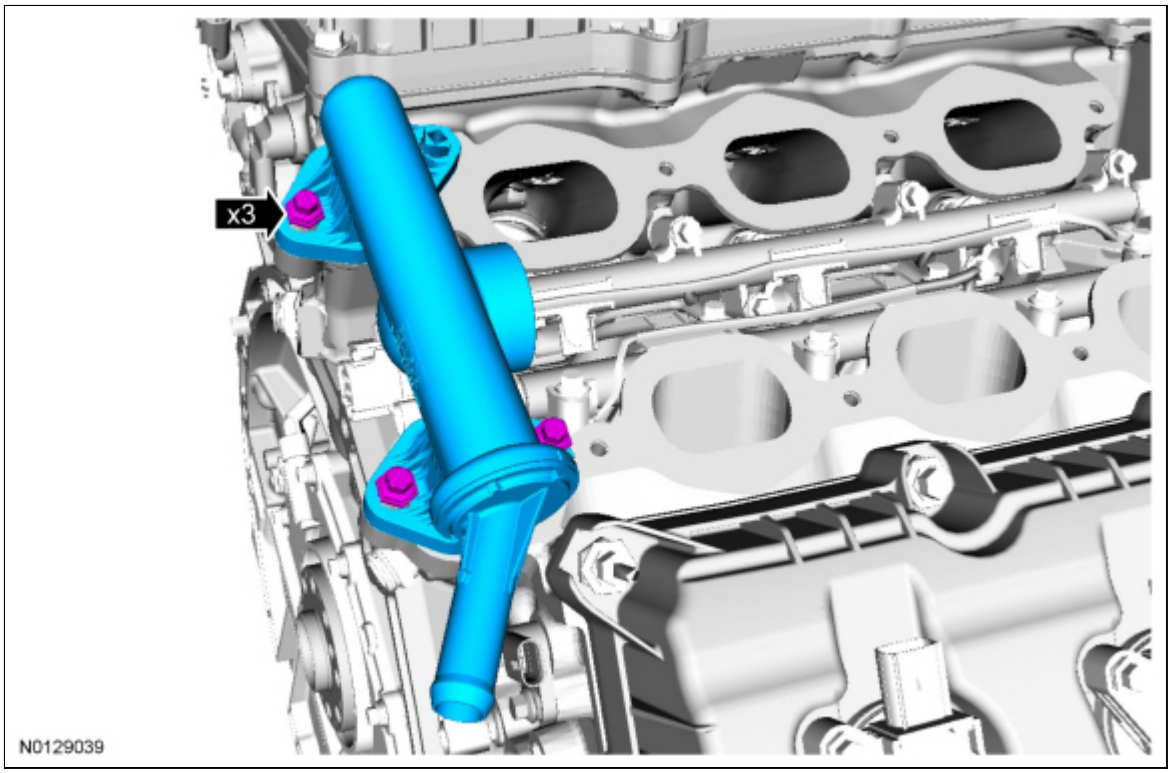
WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: A clean working environment is essential to prevent dirt or foreign material contamination.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Remove the intake manifold. For additional information, refer to Section 303-01A .
3. Remove the thermostat housing. For additional information, refer to Section 303-03 .
4. Remove the coolant inlet pipe.
   - Remove and discard the coolant inlet pipe O-ring seals.



5. Remove the 3 bolts and position aside the coolant crossover assembly.
    - Remove and discard the 2 gaskets.



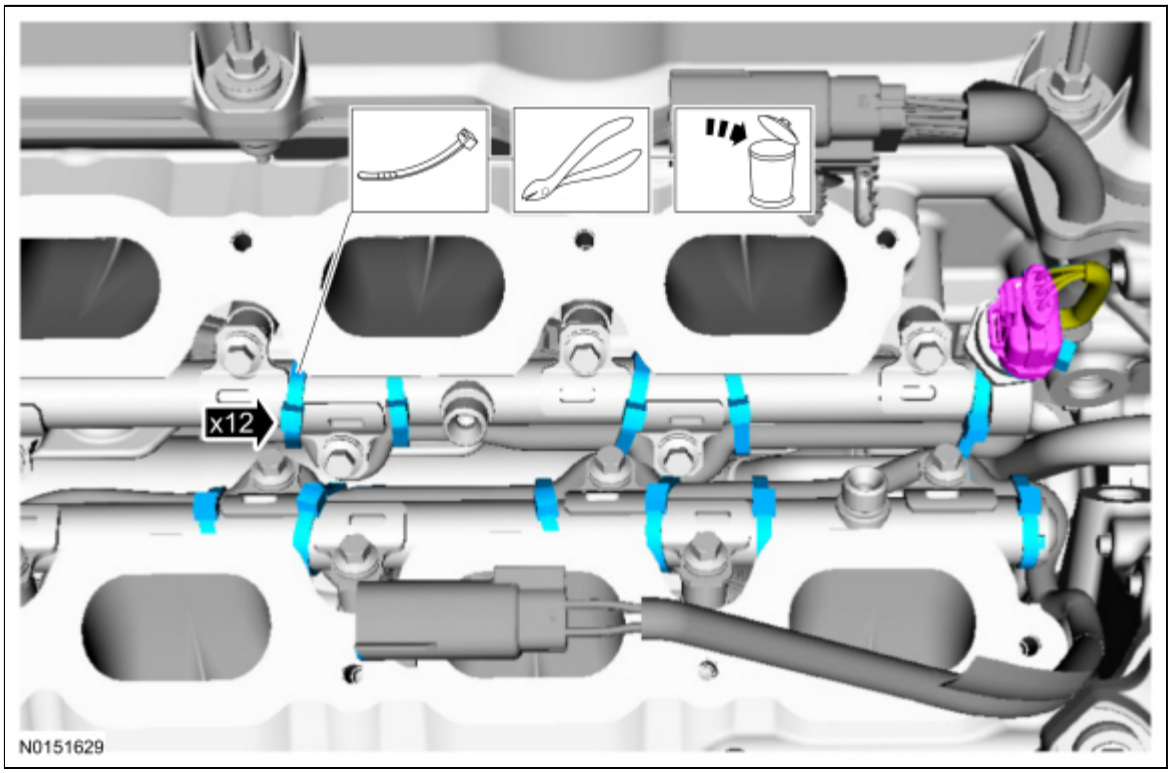
6. Remove the high-pressure fuel tube bracket bolt.

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7. Loosen the 2 flare nuts, remove and discard the high-pressure fuel tube.

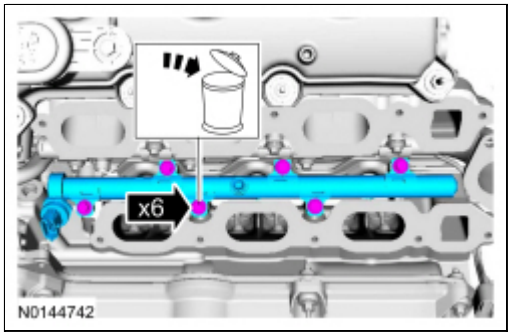
8. ***NOTICE:*** **It is very important to note the routing of the fuel charge wire harnesses on the fuel rails and index-mark the location of the tie straps prior to removal or damage may occur to the wire harnesses during installation.**

   NOTE: Use compressed air and remove any dirt or foreign material from the cylinder head, block and general surrounding area of the fuel rail and injectors.



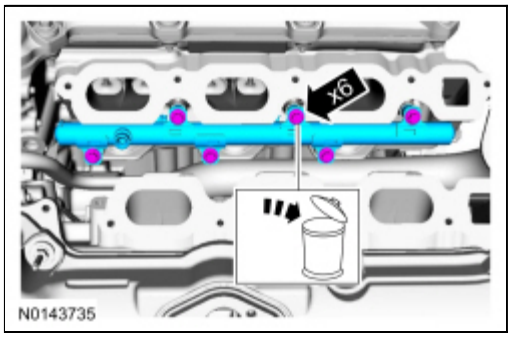
9. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

   NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder heads and require the use of a Fuel Injector Remover tool to extract. Wiggling the injector by hand to break it loose may allow the injector to be removed by hand.

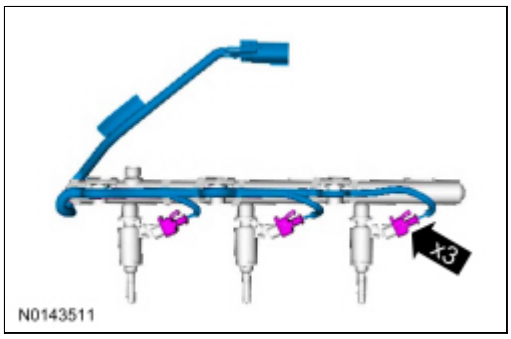


10. ***NOTICE:*** **Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

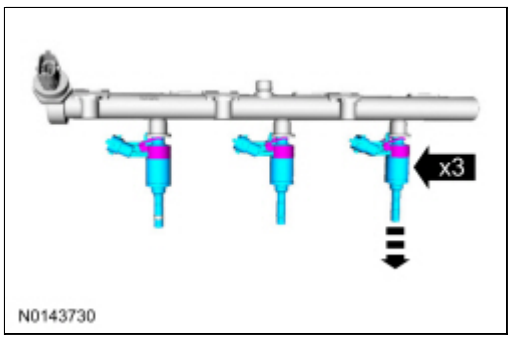
NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder heads and require the use of a Fuel Injector Remover tool to extract. Wiggling the injector by hand to break it loose may allow the injector to be removed by hand.



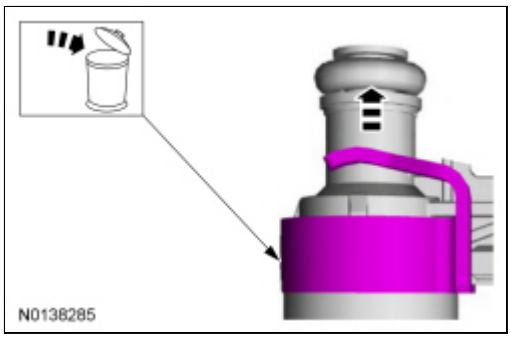
11. **NOTE:** RH shown, LH similar.



12. **NOTE:** LH shown, RH similar.

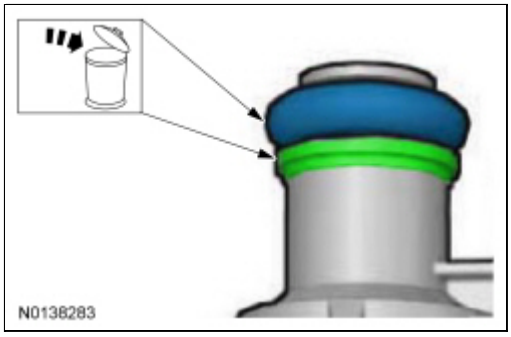


13.

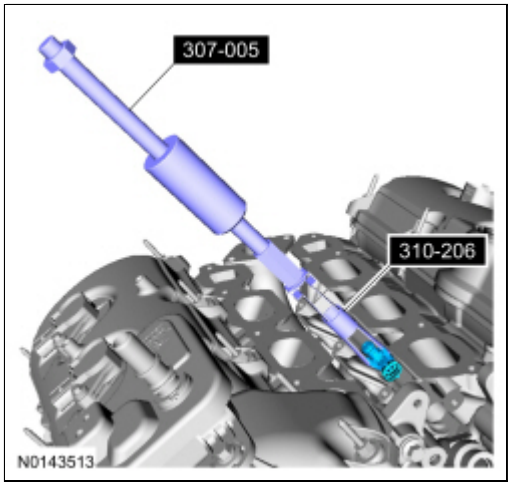


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14.



15. Using the Slide Hammer and the Fuel Injector Remover, remove any of the fuel injectors that remained in the cylinder head.
    - Special Tool(s): Slide Hammer 307-005 (T59L-100-B) or equivalent.
    - Special Tool(s): Remover, Fuel Injector 310-206.

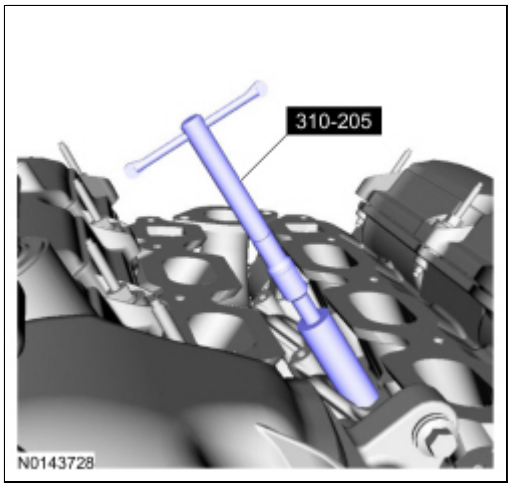


16. **NOTE:** Make sure to thoroughly clean any residual fuel or foreign material from the cylinder head, block and the general surrounding area of the fuel rails and injectors.

    NOTE: Do not use compressed air to clean the tip of the fuel injector.

    NOTE: Do not use a brush to clean the tip of the fuel injector.

    Using the Fuel Injector Brush, clean the fuel injector bore in the cylinder head. Special Tool(s): 310-205.



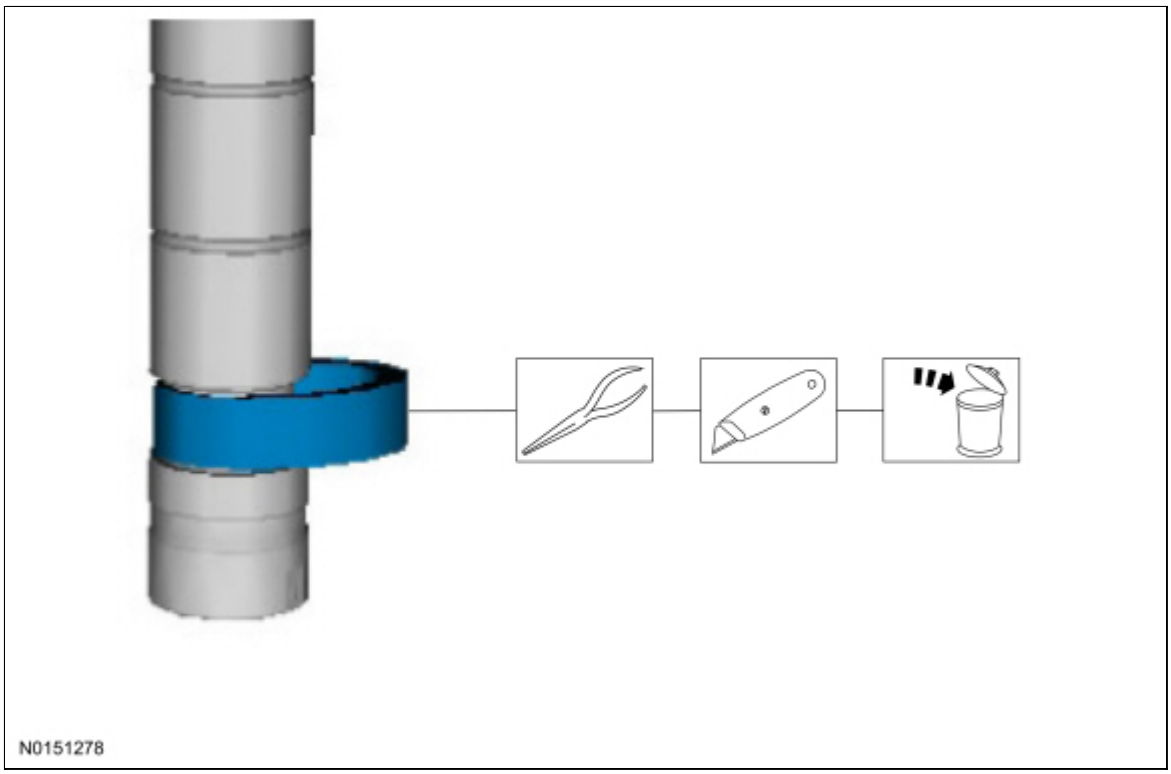
Installation

NOTE: A clean working environment is essential to prevent dirt or foreign material contamination.

1. ***NOTICE:*** **Do not attempt to cut the lower Teflon® seal without first pulling it away from the fuel injector or damage to the injector may occur.**

   NOTICE: **Use care when removing the lower Teflon® seals, not to scratch, nick or gouge the fuel injectors.**

   1. Pull the lower Teflon® seal away from the injector.
   2. Carefully cut and discard the lower fuel injector Teflon® seals.



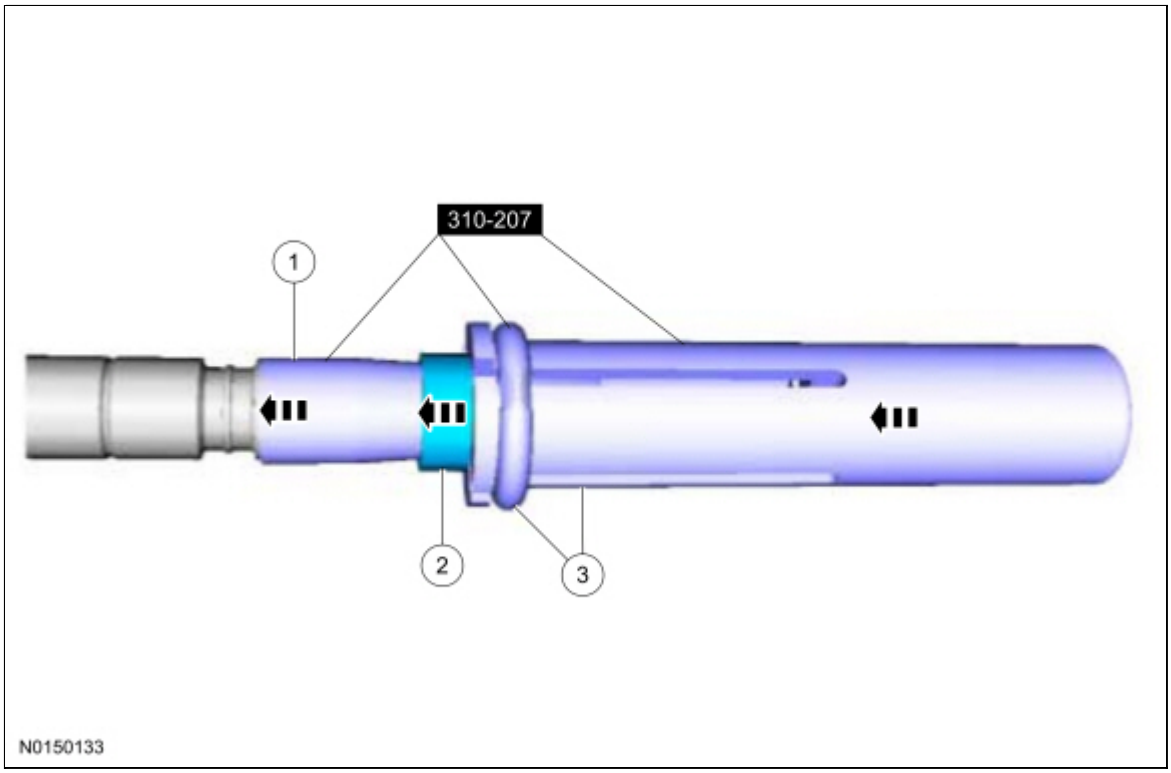
2. **NOTE:** Do not lubricate the new lower Teflon® fuel injector seals.

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1. Special Tool(s): 310-207.
2. ***NOTICE:*** **Once the Teflon® seal is installed on the Teflon® Seal Guide 310-207 (part of the Fuel Injector Seal Installer), it should immediately be installed onto the fuel injector to avoid excessive expansion of the Teflon® seal.**

   NOTE: Make sure that new lower fuel injector Teflon® seals are installed.

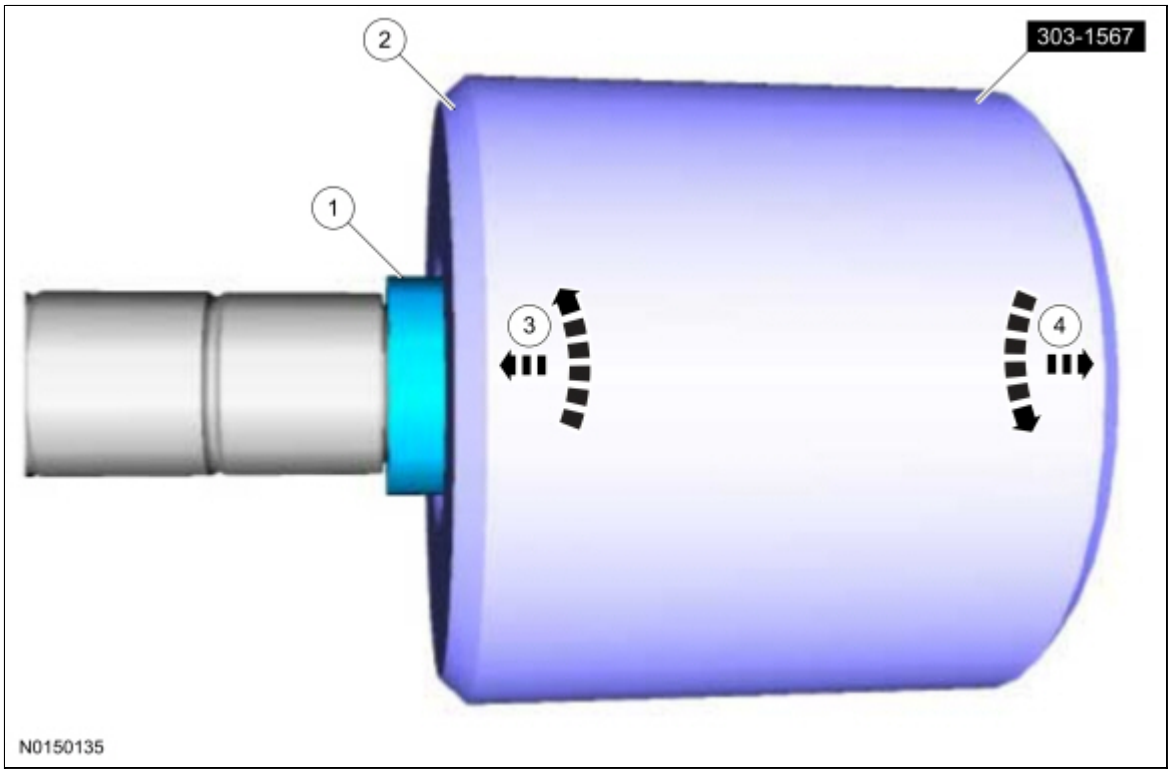
   Special Tool(s): 310-207.
3. Using the Pusher Tool 310-207 (part of the Fuel Injector Seal Installer), slide the Teflon® seals off of the Teflon® Seal Guide and into the groove on the fuel injectors. Special Tool(s): 310-207.



3. ***NOTICE:*** **Install the fuel injectors into the cylinder head within 15 minutes of sizing the seals due to Teflon® seal expansion.**

   1. **NOTE:** Make sure the Teflon® seal is fully seated in the groove on the fuel injector before sizing the Teflon® seal.

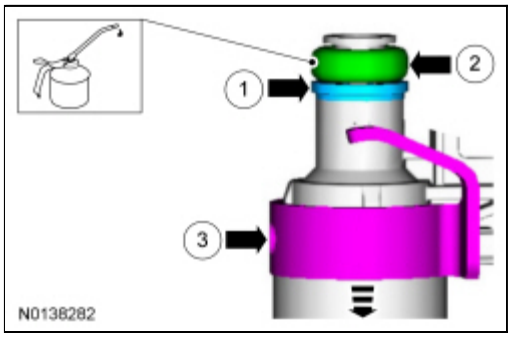
      Some Teflon® seal massaging with your fingers before the Teflon® seal sizer tool is installed will aid in installing the Teflon® seal sizer tool.
   2. Position the Teflon® seal sizer tool 303-1567 with the larger opening towards the Teflon® seal. Push while turning the Teflon® seal sizer tool 180 degrees. Special Tool(s): 303-1567.
   3. Once the Teflon® seal sizer tool 303-1567 is installed, check and make sure the Teflon® seal is in the sizing portion of the Teflon® seal sizer tool. After one minute, turn the Teflon® seal sizer tool back 180 degrees and remove.



4. ***NOTICE:*** **Use fuel injector O-ring seals that are made of special fuel-resistant material. The use of ordinary O-ring seals may cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: Make sure that new upper fuel injector O-ring seals, upper fuel injector O-ring seal support rings and fuel injector retainer clips are installed.

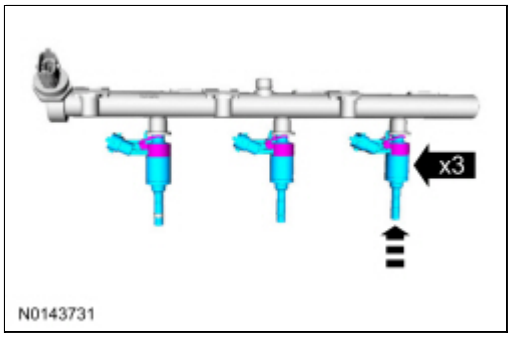
   Material: Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada); or equivalent.



5. **NOTE:** LH shown, RH similar.

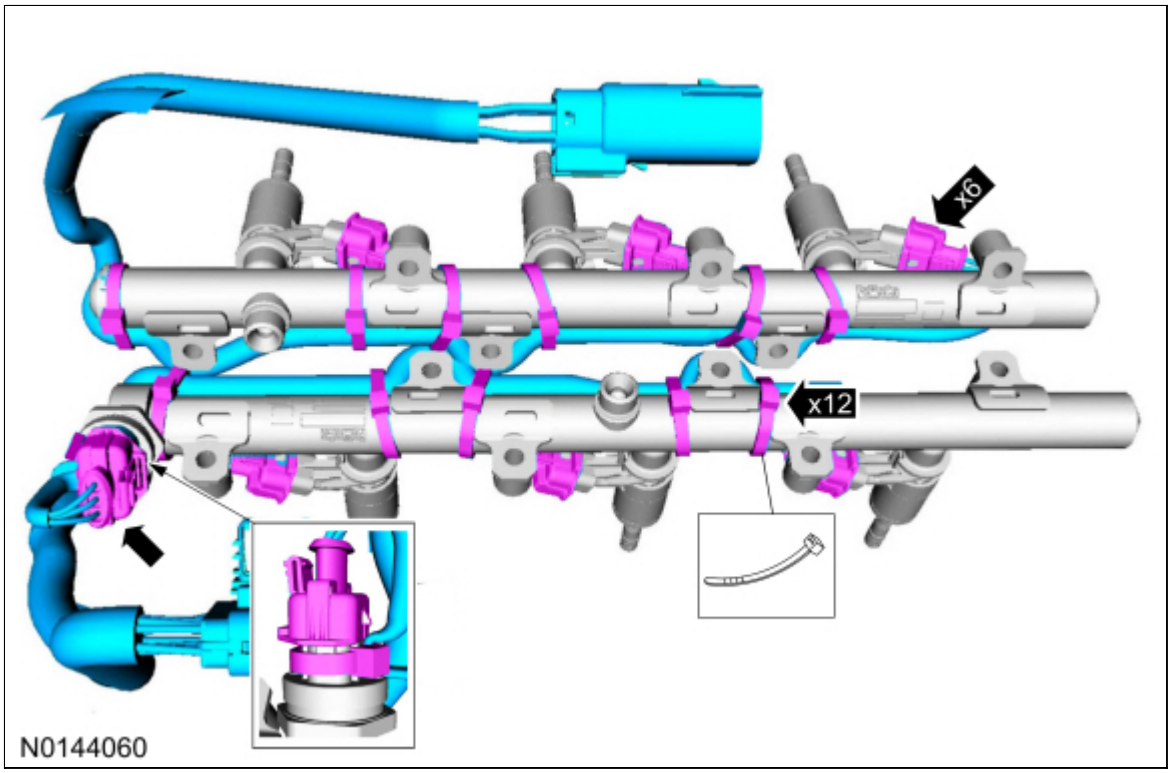
   NOTE: The anti-rotation finger of the fuel injector clip must slip into the groove of the fuel rail cup.

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6. ***NOTICE:*** **It is very important to note the routing of the fuel charge wiring harnesses on the fuel rails and index-mark the location of the tie straps prior to removal or damage may occur to the wire harnesses during installation. The illustration details the correct fuel charge wire harness routing and tie strap positioning for installation.**

   Install the fuel charge wire harnesses and tie straps to the index-marked locations on the fuel rails. Start by attaching the first tie strap farthest down the wire harness and continue to the connector end of the harness, leaving ample slack between the fuel injectors.



7. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

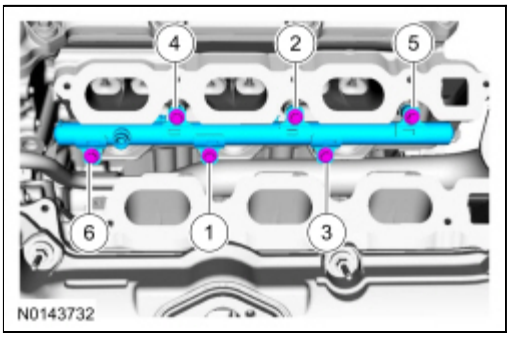
   NOTICE: **Do not lubricate the new lower Teflon® fuel injector seals.**

   NOTE: Make sure that 6 new fuel rail bolts are installed.

   NOTE: Tighten the bolts in a method that draws the fuel rail evenly to the head, preventing a rocking motion.

Tighten the 6 fuel rail bolts in the following 3 stages.

- Stage 1: Push down on the fuel rail face above the injectors.
- Stage 1: Tighten to 10 Nm (89 lb-in) in the sequence shown.
- Stage 2: Tighten an additional 45 degrees in the sequence shown.



8. ***NOTICE:*** **It is very important to visually inspect the routing of the fuel charge wire harness to make sure that they will not be pinched or damaged between the fuel rail and the cylinder head during installation.**

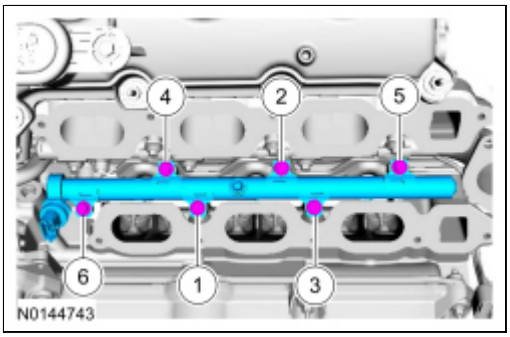
   NOTICE: **Do not lubricate the new lower Teflon® fuel injector seals.**

   NOTE: Make sure that 6 new fuel rail bolts are installed.

   NOTE: Tighten the bolts in a method that draws the fuel rail evenly to the head, preventing a rocking motion.

   Tighten the 6 fuel rail bolts in the following 3 stages.

   - Stage 1: Push down on the fuel rail face above the injectors.
   - Stage 1: Tighten to 10 Nm (89 lb-in) in the sequence shown.
   - Stage 2: Tighten an additional 45 degrees in the sequence shown.



9. **NOTE:** Apply clean engine oil to the threads of the 3 high-pressure fuel tube flare nuts.

   Position the new high-pressure fuel tube and hand start the flare nuts in 3 stages.

   - Stage 1: Hand tighten the high-pressure fuel tube-to-RH fuel rail flare nut.
   - Stage 2: Hand tighten the high-pressure fuel tube-to-LH fuel rail flare nut.
   - Stage 3: Hand tighten the high-pressure fuel tube-to-fuel injection pump flare nut.

10. Loosely install the new high-pressure fuel tube bracket nut and bolt.

11. Tighten the 3 high-pressure fuel tube flare nuts in 9 stages:

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- Stage 1: Tighten the high-pressure fuel tube-to-RH fuel rail flare nut to 15 Nm (133 lb-in).
- Stage 2: Tighten an additional 30 degrees.
- Stage 3: Tighten to 32 Nm (24 lb-ft).
- Stage 4: Tighten the high-pressure fuel tube-to-LH fuel rail flare nut to 15 Nm (133 lb-in).
- Stage 5: Tighten an additional 30 degrees.
- Stage 6: Tighten to 32 Nm (24 lb-ft).
- Stage 7: Tighten the high-pressure fuel tube-to-fuel injection pump flare nut to 15 Nm (133 lb-in).
- Stage 8: Tighten an additional 30 degrees.
- Stage 9: Tighten to 32 Nm (24 lb-ft).

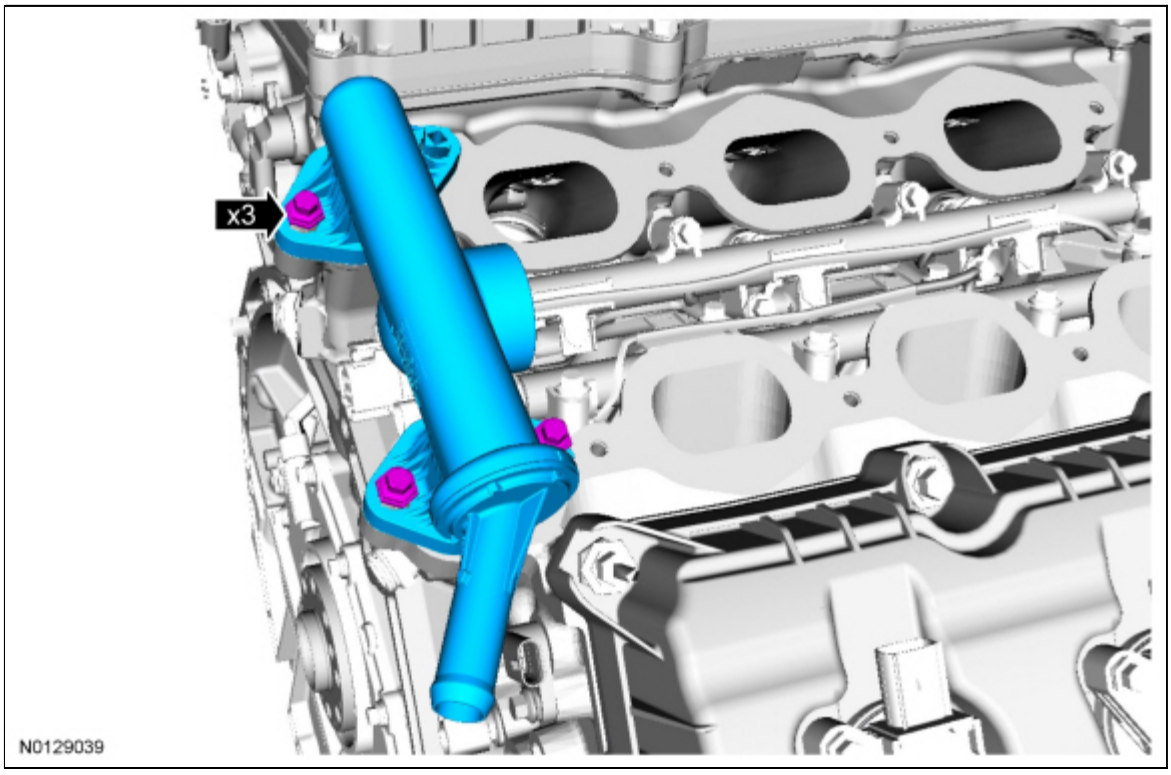
12. Tighten the high-pressure fuel tube bracket bolt in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

13. Tighten the high-pressure fuel tube bracket nut.
    - Tighten to 8 Nm (71 lb-in).

14. **NOTE:** Use care when installing the fuel injection pump noise insulator. Spreading the openings will aid in installing the fuel injection pump noise insulator and reduce the risk of damage.

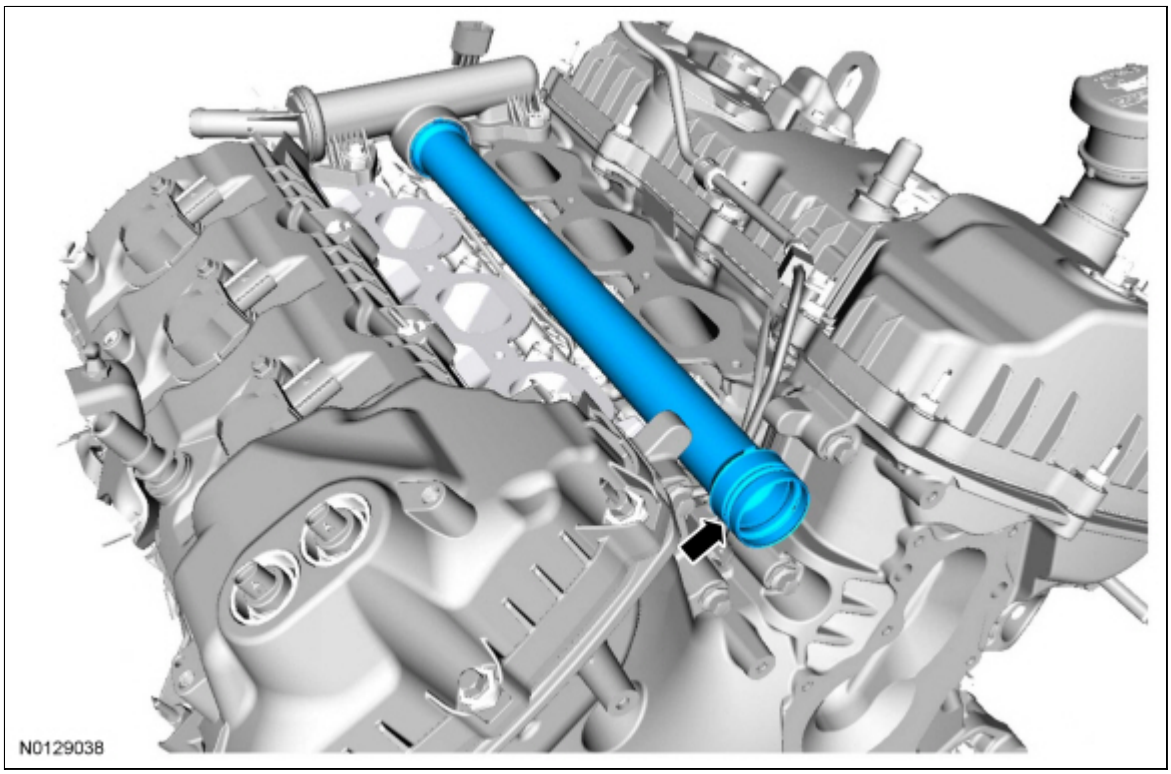
    Install the fuel injection pump noise insulator shield.

15. Using new gaskets, position back the coolant crossover manifold assembly and install the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.



16. **NOTE:** Lubricate the O-ring seals with clean engine coolant.

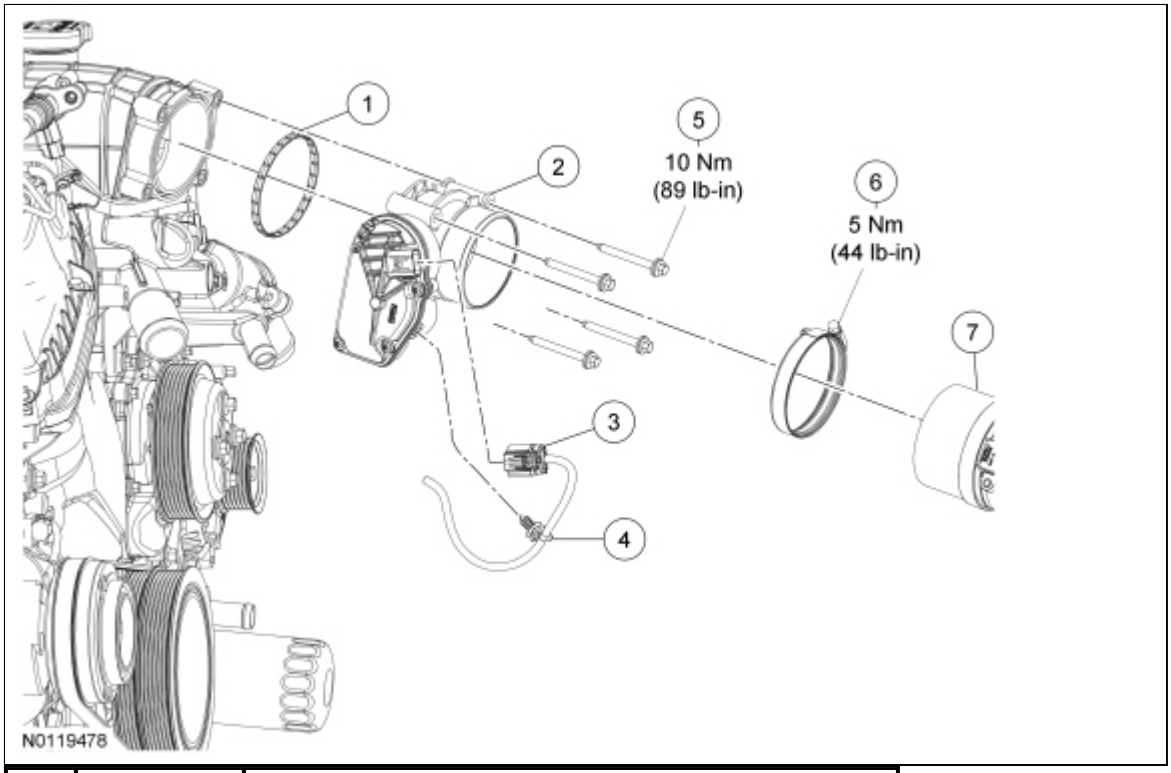
Using new O-ring seals, install the coolant inlet pipe.



17. Install the thermostat housing. For additional information, refer to Section 303-03 .
18. Install the intake manifold. For additional information, refer to Section 303-01A .

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Throttle Body



Item	Part Number	Description
1	9E936	Throttle Body (TB) gasket
2	9E926	TB
3	—	TB electrical connector (part of 12A581)
4	—	TB wiring harness retainer (part of 12A581)
5	W713443	TB bolt (4 required)
6	—	Charge Air Cooler (CAC) outlet pipe-to- TB clamp (part of 6F073)
7	6F073	CAC outlet pipe

Removal and Installation

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the Throttle Body (TB) electrical connector.
3. Loosen the clamp and disconnect the Charge Air Cooler (CAC) outlet pipe-to- TB .
   - To install, tighten to 5 Nm (44 lb-in).
4. Remove the 4 bolts and the TB .

- Discard the TB gasket.
- To install, tighten to 10 Nm (89 lb-in).

5. **NOTE:** Install a new TB gasket.

   To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	—

Torque Specifications

Description	Nm	lb-in
Fuel Pump Control Module (FPCM) bolts	9	80
Fuel rail bolts	10	89
Intake manifold vacuum tube bolt	10	89
Throttle Body (TB) bolts	10	89

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- electronic Throttle Body (TB).
- fuel injectors.
- fuel rail.
- Fuel Pump Control Module (FPCM).

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order, in accordance with engine demand, on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the intake manifold by electronically positioning the throttle plates.
- is not adjustable.

Fuel Rail

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

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Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid which opens a needle valve to inject fuel into the intake manifold.
- are deposit-resistant.

Fuel Pump Control Module (FPCM)

The FPCM :

- is electronically operated by the PCM.
- controls voltage (10 or 12 volts) to the FPCM depending on load.

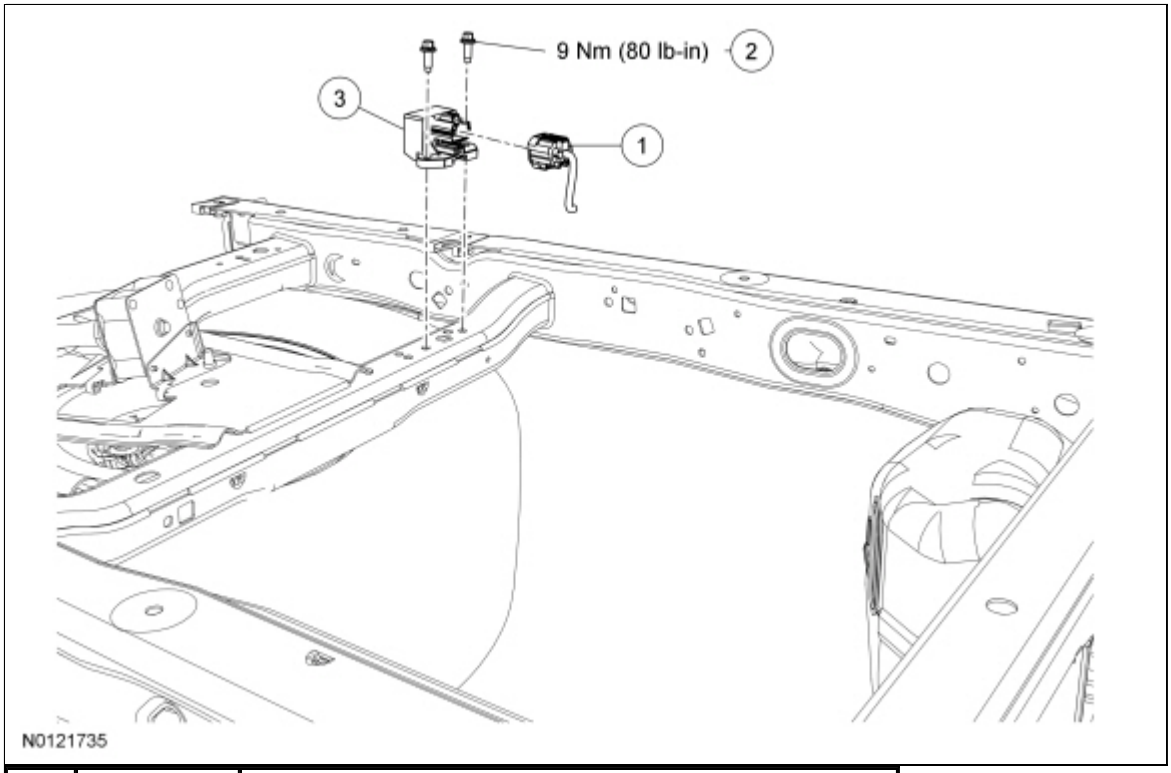
Fuel Injectors

Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector — Exploded View and Fuel Rail in this section.

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Fuel Pump Control Module



Item	Part Number	Description
1	—	Fuel Pump Control Module (FPCM) electrical connector (part of 14405)
2	W705549	FPCM bolt (2 required)
3	9D370	FPCM

Removal and Installation

1. Disconnect the Fuel Pump Control Module (FPCM) electrical connector.

2. Remove the 2 bolts and the FPCM .
   - To install, tighten to 9 Nm (80 lb-in).

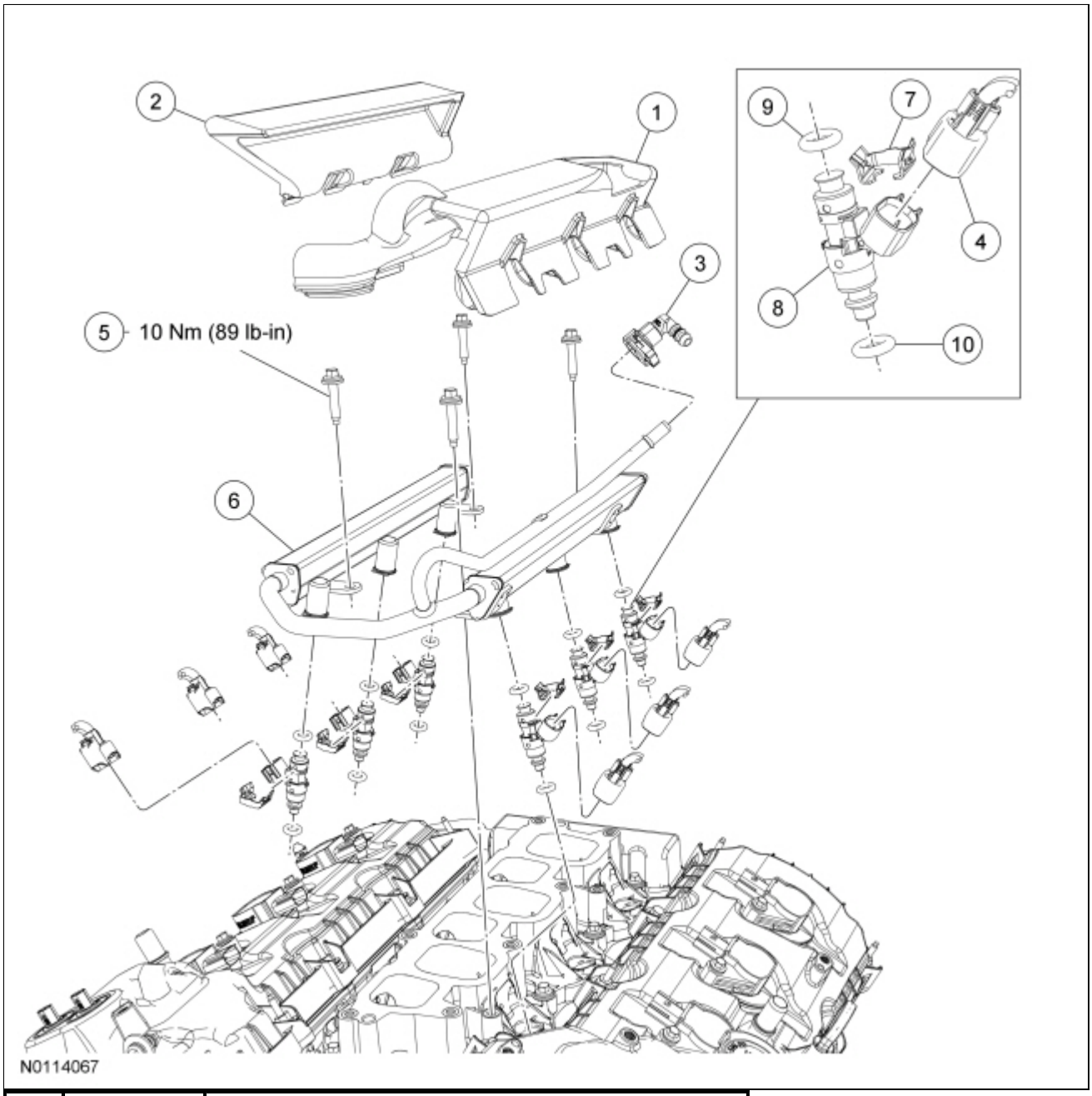
3. To install, reverse the removal procedure.

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Fuel Rail and Fuel Injector — Exploded View

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description

1	6P013	LH fuel rail noise insulator shield
2	6P013	RH fuel rail noise insulator shield
3	—	Fuel tube-to-fuel rail quick connect coupling (part of 9J280)
4	—	Fuel injector electrical connector (part of 14A411) (6 required)
5	W503279	Fuel rail bolt (4 required)
6	9F792	Fuel rail
7	9C995	Fuel injector clip (6 required)
8	9F593	Fuel injector (6 required)
9	9229	Upper fuel injector O-ring seal (6 required)
10	9229	Lower fuel injector O-ring seal (6 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Fuel Rail

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the upper intake manifold. For additional information, refer to Section 303-01B .
4. Disconnect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

5. Remove the LH and RH fuel rail noise insulator shields.

6. Disconnect the 6 fuel injector electrical connectors.

7. Remove the 4 fuel rail bolts.

8. Remove the fuel rail and injectors as an assembly.

9. Remove the 6 fuel injector clips and the 6 fuel injectors.
    - Remove and discard the 12 fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings may cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: The upper and lower fuel injector O-ring seals are similar in appearance, but are not interchangeable.

   Install the new O-ring seals onto the fuel injectors and lubricate them with clean engine oil.

2. Install the 6 fuel injectors and the 6 fuel injector clips into the fuel rail.

3. Install the fuel rail and fuel injectors as an assembly.

4. Install the 4 fuel rail bolts.
    - Tighten to 10 Nm (89 lb-in).

5. Connect the 6 fuel injector electrical connectors.

6. Install the LH and RH fuel rail noise insulator shields.

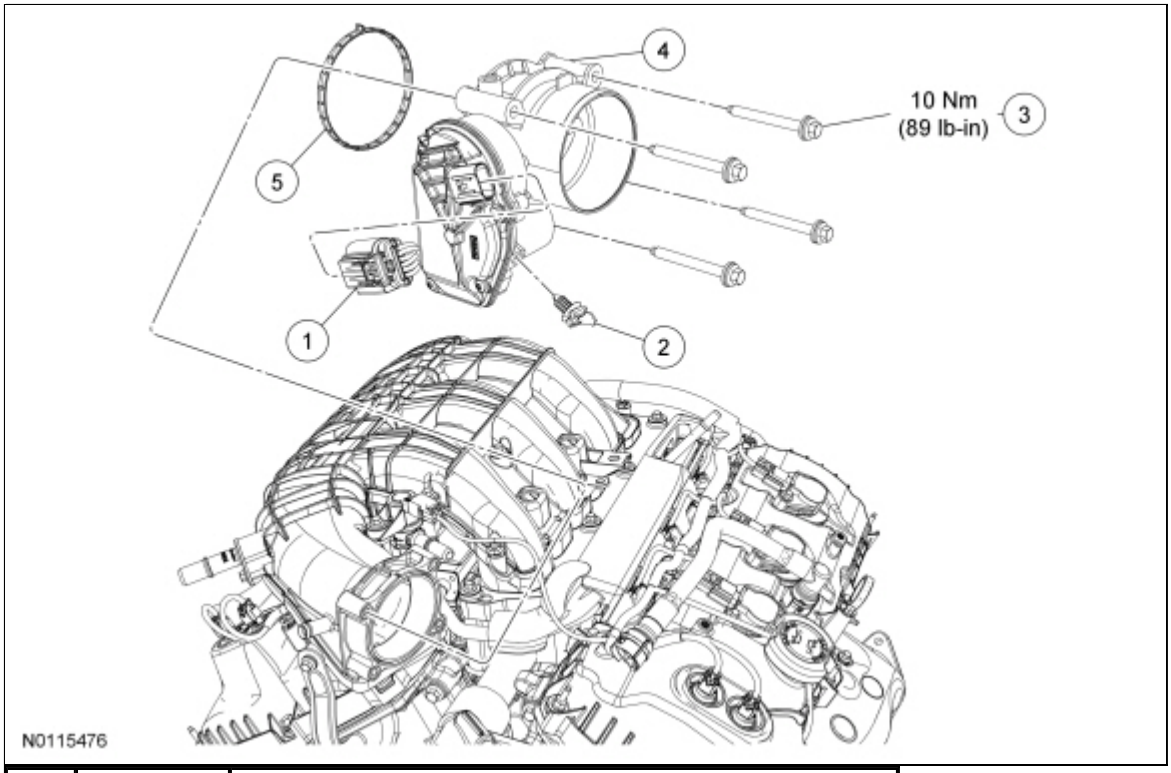
7. Connect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

8. Install the upper intake manifold. For additional information, refer to Section 303-01B .

9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Throttle Body



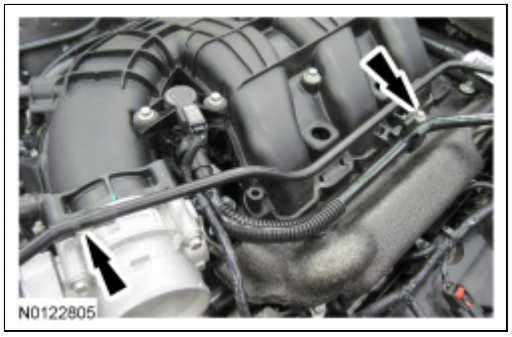
Item	Part Number	Description
1	—	Electronic throttle control electrical connector (part of 14A411)
2	—	Electronic throttle control electrical connector wiring harness pin-type retainer (part of 14A411)
3	W713443	Throttle Body (TB) bolt (4 required)
4	9F991	TB
5	9E936	TB gasket

Removal and Installation

1. Remove the engine Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .

2. Remove the bolt for the intake manifold vacuum tube.
   - Detach the intake manifold vacuum tube pin-type retainer from the Throttle Body (TB).
   - To install, tighten to 10 Nm (89 lb-in).

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3. Disconnect the electronic throttle control electrical connector.
    - Detach the electronic throttle control electrical connector wiring harness pin-type retainer.

4. Remove the 4 bolts and the TB .
    - Discard the TB gasket.
    - To install, tighten to 10 Nm (89 lb-in).

5. **NOTE:** Install a new TB gasket.

    To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	—

Torque Specifications

Description	Nm	lb-in
Fuel pump control module nuts	8	71
Fuel rail bolts [a]	—	—
Throttle Body (TB) bolts [a]	—	—

[a] Refer to the procedure.

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Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- electronic Throttle Body (TB).
- fuel injectors.
- fuel rail.
- fuel pump control module.

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order, in accordance with engine demand, on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the intake manifold by electronically positioning the throttle plate.
- is not adjustable.

Fuel Rail

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid which opens a needle valve to inject fuel into the intake manifold.
- are deposit-resistant.

Fuel Pump Control Module

The fuel pump control module:

- controls the voltage to the Fuel Pump (FP) based on the duty cycle request from the PCM.

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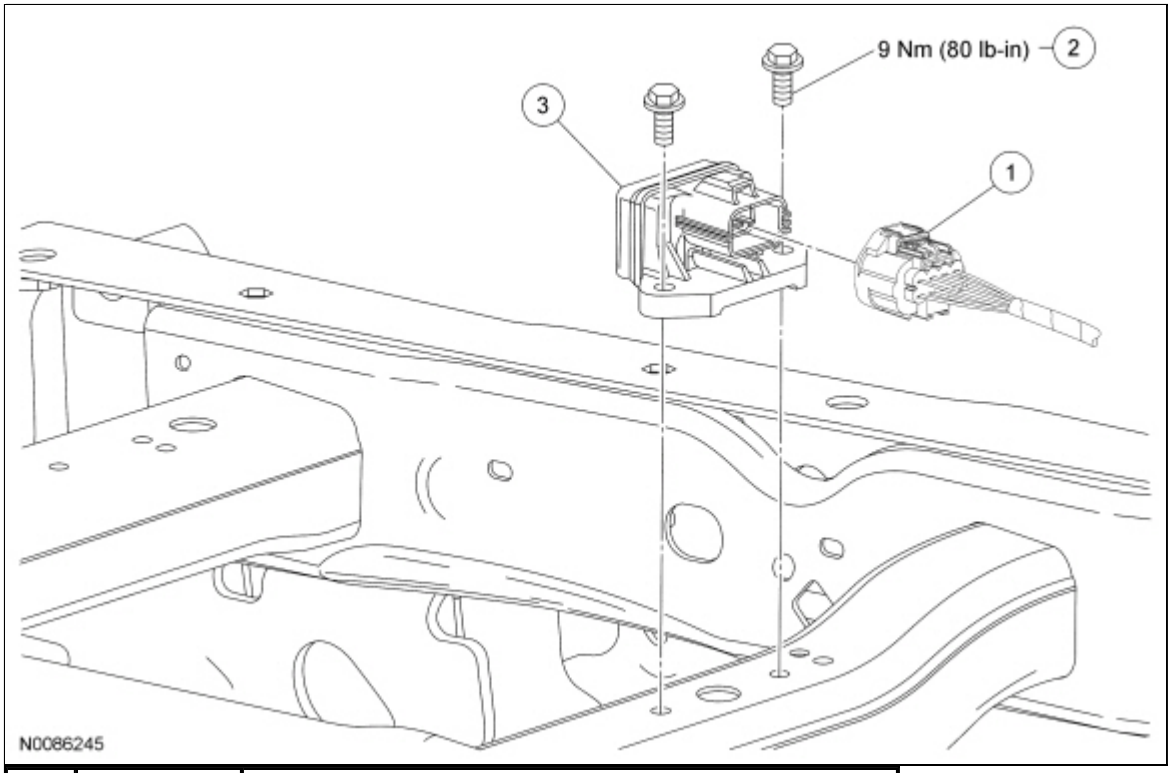
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Fuel Injectors

Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector — Exploded View and Fuel Rail in this section.

Fuel Pump Control Module



Item	Part Number	Description
1	14A464	Fuel Pump (FP) control module electrical connector (part of 14404)
2	W705549	FP control module bolt (2 required)
3	9D412	FP control module

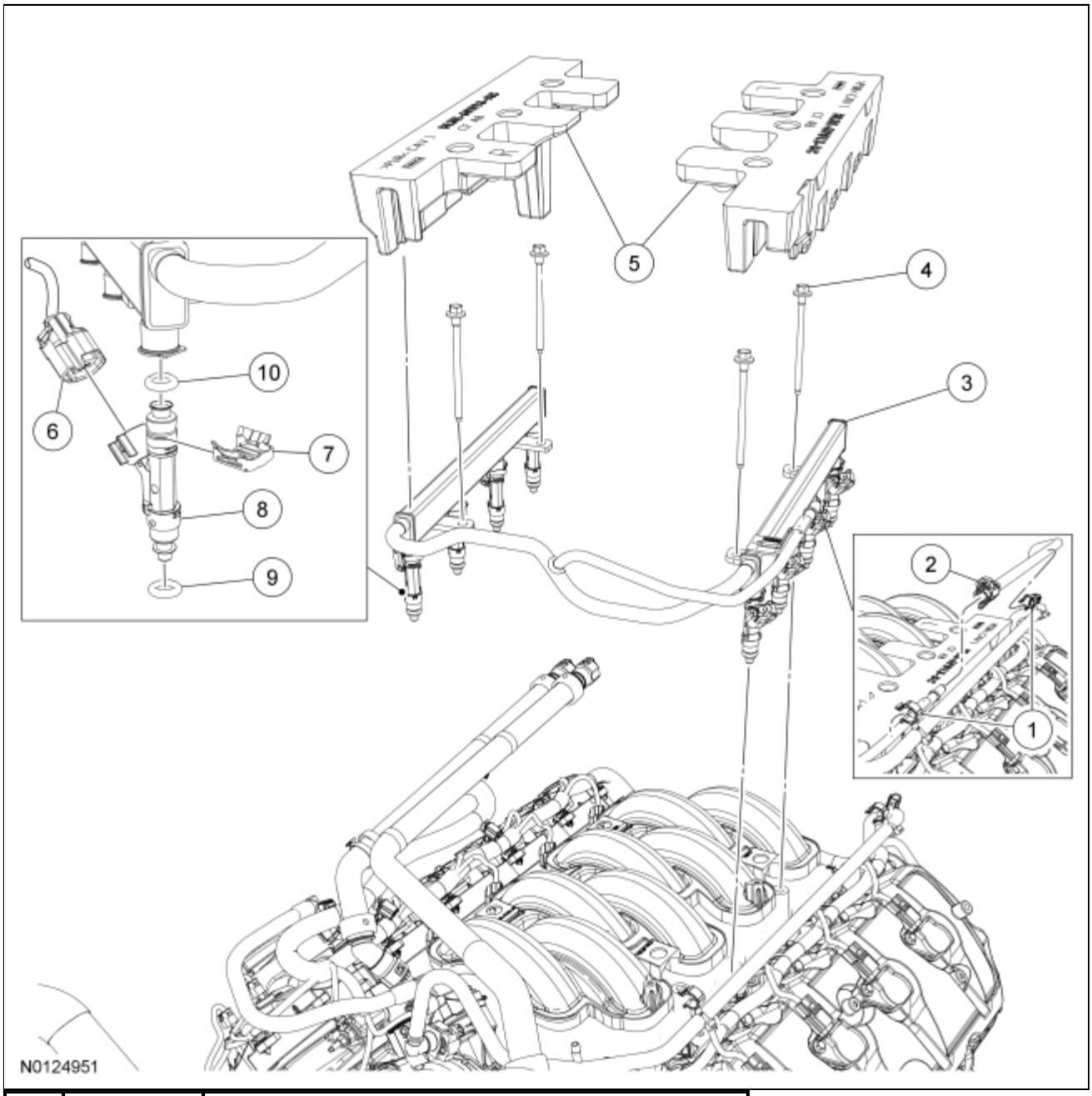
Removal and Installation

1. Disconnect the Fuel Pump (FP) control module electrical connector.
2. Remove the 2 bolts and the FP control module.
   - To install, tighten to 9 Nm (80 lb-in).
3. To install, reverse the removal procedure.

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Fuel Rail and Fuel Injector — Exploded View

Fuel Rail Insulators, Fuel Rail and Fuel Injectors



Item	Part Number	Description
1	—	Evaporative Emission (EVAP) tube retaining clips

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		(part of 9J280)
2	9J280	Fuel supply tube
3	9F792	Fuel rail
4	W714864	Fuel rail bolt (4 required)
5	6P013	Fuel rail insulators
6	—	Fuel injector electrical connector (part of 12A581) (8 required)
7	9C995	Fuel injector clip (8 required)
8	9F593	Fuel injector (8 required)
9	9229	Lower fuel injector O-ring seal (8 required)
10	9229	Upper fuel injector O-ring seal (8 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

Fuel Rail

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Disconnect the 2 Evaporative Emission (EVAP) tube retaining clips from the fuel rail.
4. Remove the LH and RH fuel rail insulators.
5. Disconnect the 8 fuel injector electrical connectors.

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6. Disconnect the fuel supply tube. For additional information, refer to the quick connect procedure in Section 310-00 .

7. Remove the 4 fuel rail bolts.

8. Remove the fuel rail and fuel injectors as an assembly from the intake manifold.

9. Remove the retaining clips and fuel injectors from the fuel rail.

10. ***NOTICE:*** **Do not reuse the O-ring seals. Failure to follow this direction may cause the fuel system to leak.**

    Remove and discard the fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-ring seals may cause the fuel system to leak.**

   Install new O-ring seals on the fuel injectors.

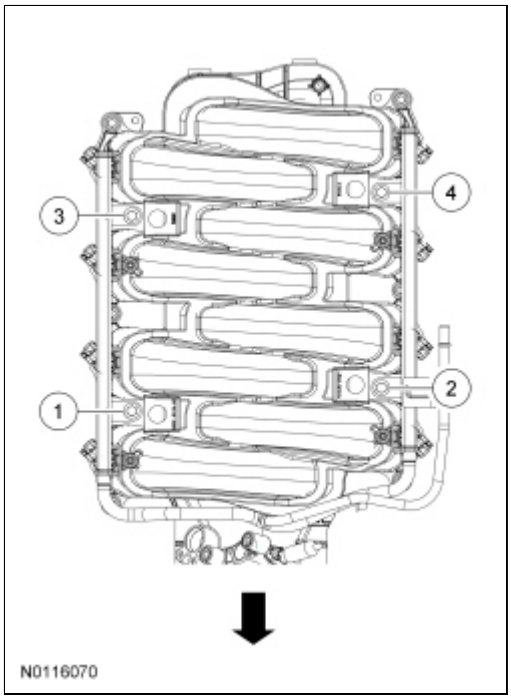
2. **NOTE:** The fuel injector clip can be reused if it is not damaged during removal. If the clip is reused, the 2 sides of the clip should be squeezed back into shape by placing it between index finger and thumb.

   NOTE: Lubricate the upper and lower fuel injector O-ring seals with clean engine oil prior to installation.

   Install the fuel injectors and retaining clips onto the fuel rail.

3. Install the fuel rail and fuel injectors as an assembly onto the intake manifold.

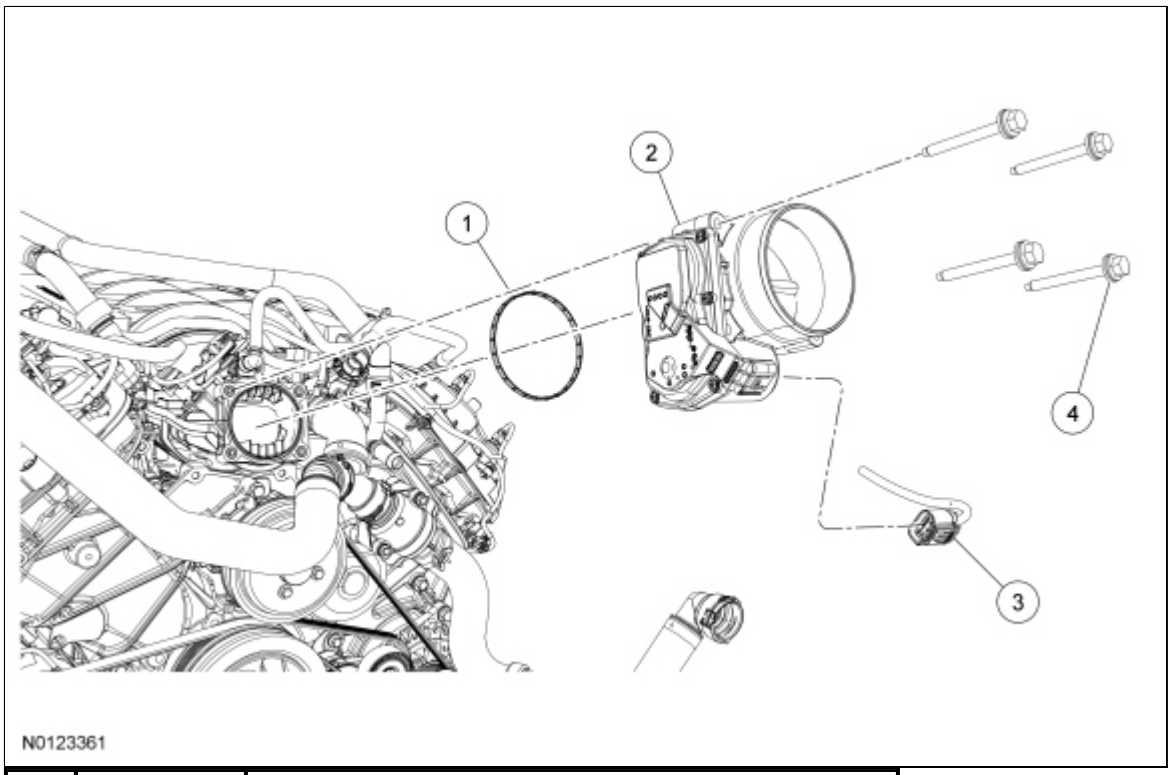
4. Install the 4 bolts and tighten in the sequence shown in 3 stages.
   - Stage 1: Hand tighten.
   - Stage 2: Tighten to 10 Nm (89 lb-in).
   - Stage 3: Tighten an additional 90 degrees.



5. Connect the fuel supply tube. For additional information, refer to the quick connect procedure in Section 310-00 .
6. Connect the 8 fuel injector electrical connectors.
7. Install the LH and RH fuel rail insulators.
8. Connect the 2 EVAP tube retaining clips to the fuel rail.
9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Throttle Body



Item	Part Number	Description
1	9E936	Throttle Body (TB) gasket
2	9E926	TB
3	—	Electronic throttle control electrical connector (part of 12A581)
4	W714866	TB bolt (4 required)

Removal

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the Electronic Throttle Control (ETC) electrical connector.
3. Remove the 4 bolts and the Throttle Body (TB)
   - Discard the gasket.

Installation

1. Using a new gasket, position the TB and install the 4 bolts loosely.
2. While holding the TB in the most upward position tighten the 4 bolts in 2 stages.

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- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.

3. Connect the ETC electrical connector.

4. Install the ACL outlet pipe. For additional information, refer to Section 303-12 .

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	—

Torque Specifications

Description	Nm	lb-in
Air Cleaner (ACL) outlet pipe-to-Throttle Body (TB) adapter bolts	10	89
Fuel Pump (FP) control module bolts	9	80
Fuel rail bolts [a]	—	—
TB adapter-to- TB clamp	5	44
TB bolts [a]	—	—

[a] Refer to the procedure in this section.

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Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

The fuel charging and controls system consists of the following:

- Throttle Body (TB)
- Fuel injectors
- Fuel rail

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order, in accordance with engine demand, on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the intake manifold by electronically positioning the throttle plate.
- is not adjustable.

Refer to Throttle Body in this section.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid that opens a needle valve, which injects fuel into the intake port in the cylinder head.
- are deposit resistant.

For removal and installation, refer to Fuel Rail and Fuel Injector — Exploded View and Fuel Rail in this section.

Fuel Rail

NOTICE: **The fuel injectors and the fuel rail must be handled with extreme care to prevent damage to sealing areas and sensitive fuel-metering orifices.**

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

For removal and installation, refer to Fuel Rail and Fuel Injector — Exploded View and Fuel Rail in this section.

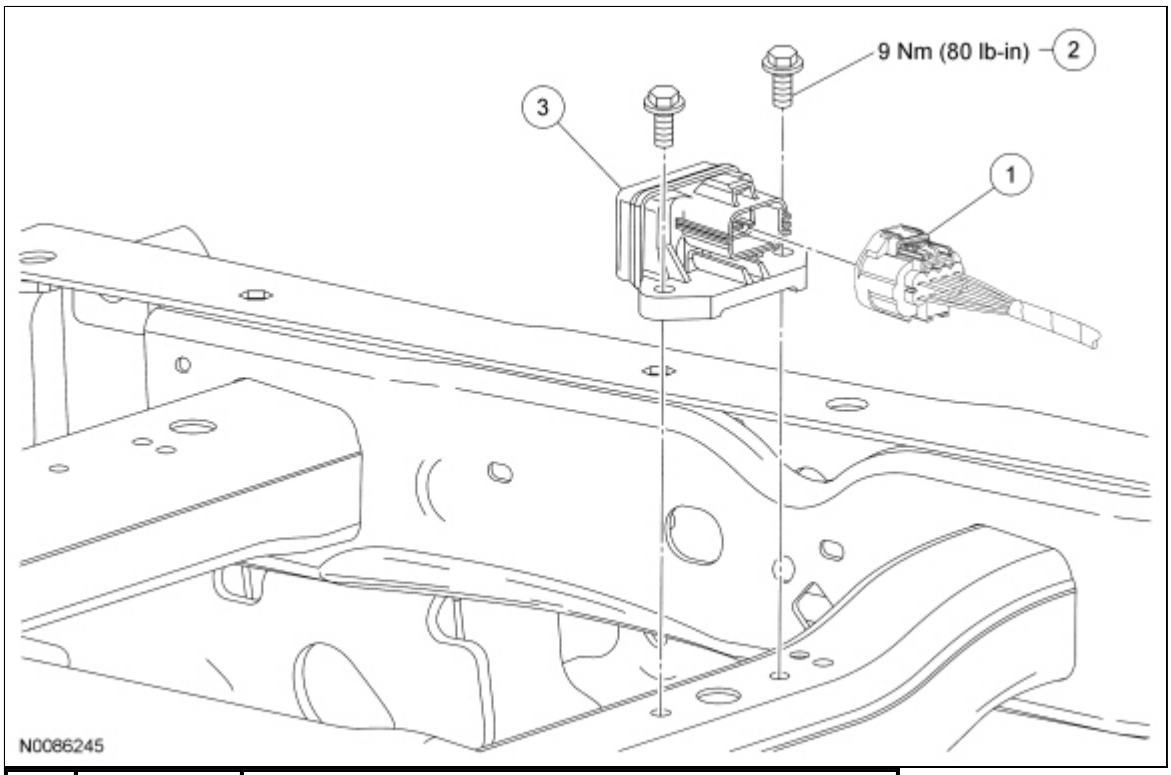
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Fuel Injector

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector — Exploded View and Fuel Rail in this section.

Fuel Pump Control Module



Item	Part Number	Description
1	14A464	Fuel Pump (FP) control module electrical connector (part of 14404)
2	W705549	FP control module bolt (2 required)
3	9D412	FP control module

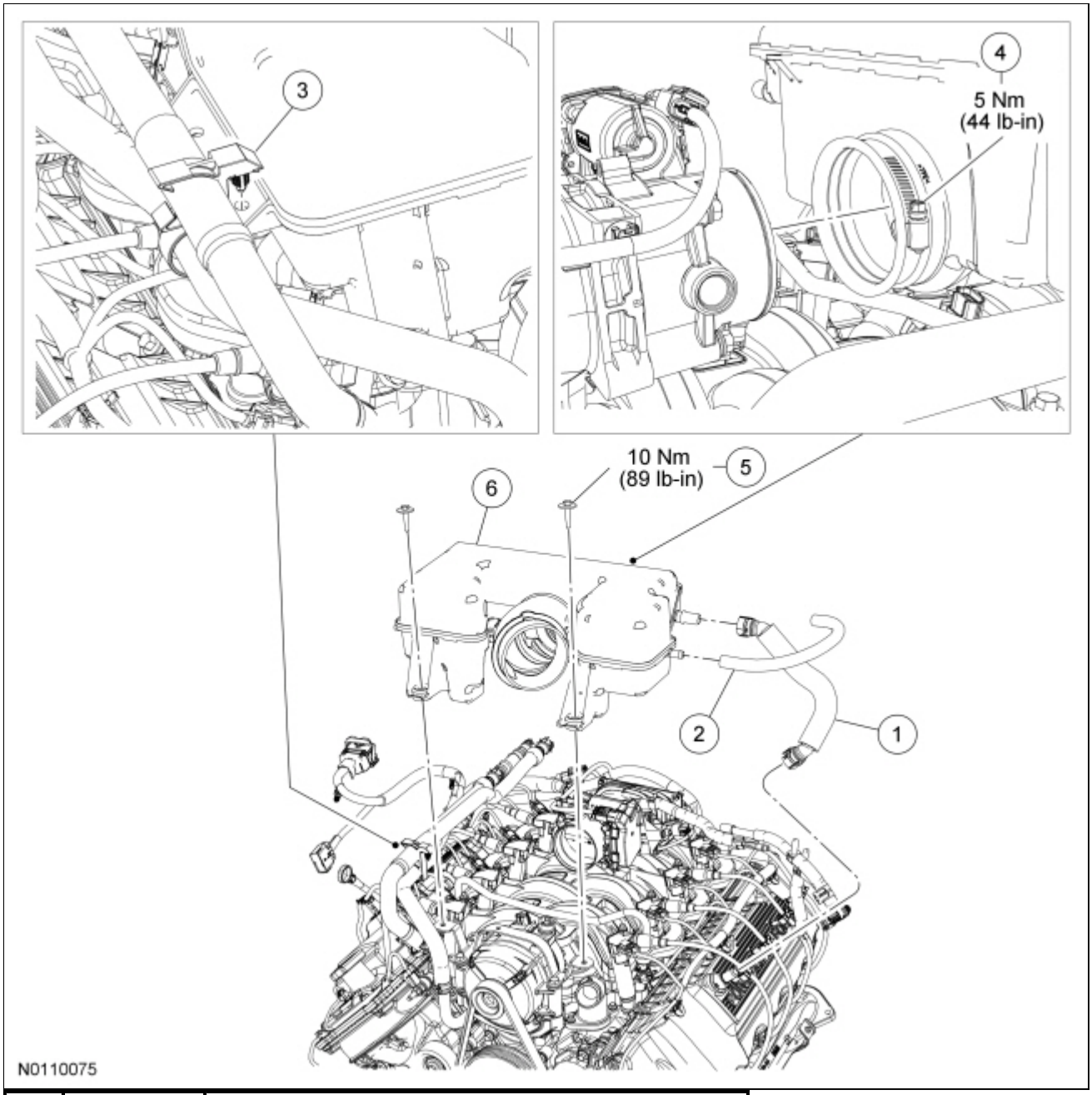
Removal and Installation

1. Disconnect the Fuel Pump (FP) control module electrical connector.
2. Remove the 2 bolts and the FP control module.
   - To install, tighten to 9 Nm (80 lb-in).
3. To install, reverse the removal procedure.

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Fuel Rail and Fuel Injector — Exploded View

Air Cleaner (ACL) Outlet Pipe-to-Throttle Body (TB) Adapter

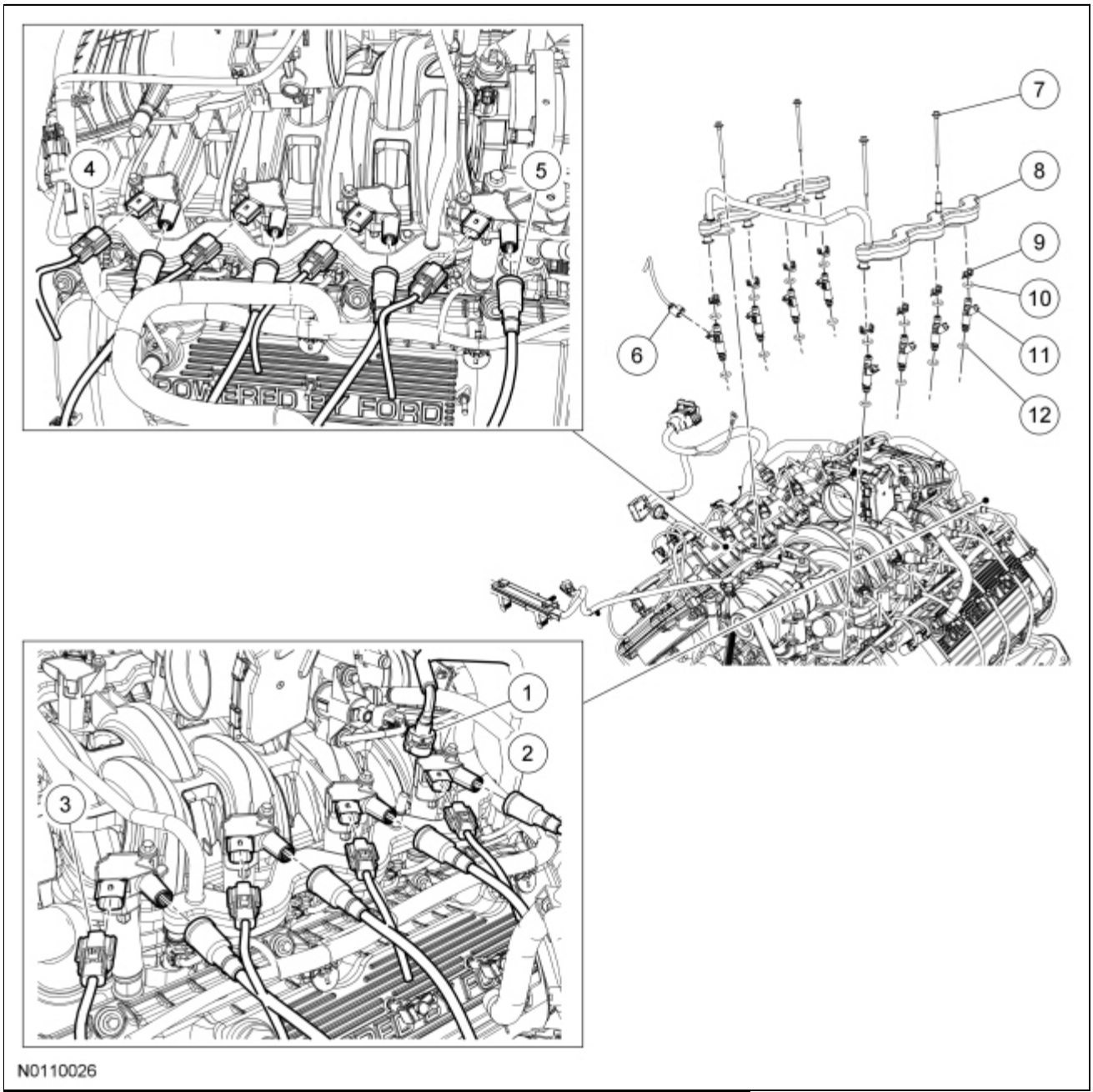


Item	Part Number	Description
1	6758	Crankcase ventilation tube
2	9C490	Brake booster vacuum hose

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3	—	Heater coolant hose position retainer
4	—	Throttle Body (TB) adapter-to- TB clamp (part of 9F805)
5	W505426	Air Cleaner (ACL) outlet pipe-to- TB adapter bolt (2 required)
6	9A589	ACL outlet pipe-to- TB adapter

Fuel Rail and Fuel Injectors



N0110026

Item	Part Number	Description

1	—	Fuel supply tube quick connect coupling
2	12286	LH ignition wire (4 required)
3	12029	LH ignition coil electrical connector (part of 12B637) (4 required)
4	12029	RH ignition coil electrical connector (part of 12B637) (4 required)
5	12286	RH ignition wire (4 required)
6	14A464	Fuel injector electrical connector (part of 12B637) (8 required)
7	W714633	Fuel rail bolt (4 required)
8	9F792	Fuel rail
9	9C995	Fuel injector-to-fuel rail locking clip (8 required)
10	9U509	Fuel injector-to-fuel rail O-ring (8 required)
11	9F593	Fuel injector (8 required)
12	9U509	Fuel injector-to-intake manifold O-ring (8 required)

1. For additional information, refer to the procedures in this section.

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Fuel Rail

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or tubes.**

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube.**

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the Air Cleaner (ACL) outlet tube. For additional information, refer to Section 303-12 .
3. Disconnect the heater coolant hose retainer from the ACL outlet pipe-to-Throttle Body (TB) adapter.
4. Disconnect the crankcase ventilation tube quick connect fitting from the ACL outlet pipe-to- TB adapter. For additional information, refer to Section 310-00 .
5. Disconnect the brake booster vacuum hose from the ACL outlet pipe-to- TB adapter.
6. Loosen the clamp and disconnect the TB adapter from the TB .
7. Remove the 2 bolts and the ACL outlet pipe-to- TB adapter.
8. Disconnect the fuel tube quick connect coupling. For additional information, refer to Section 310-00 .

9. Disconnect the 8 ignition coil electrical connectors.
10. Disconnect the 8 ignition wires from the 8 ignition coils.
11. Disconnect the 8 fuel injector electrical connectors.
12. Remove the 4 fuel rail bolts and the fuel rail and injectors as an assembly.
13. Remove the fuel injector-to-fuel rail locks and separate the 8 fuel injectors from the fuel rail.
    - Discard the upper and lower fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-rings can cause the fuel system to leak.**

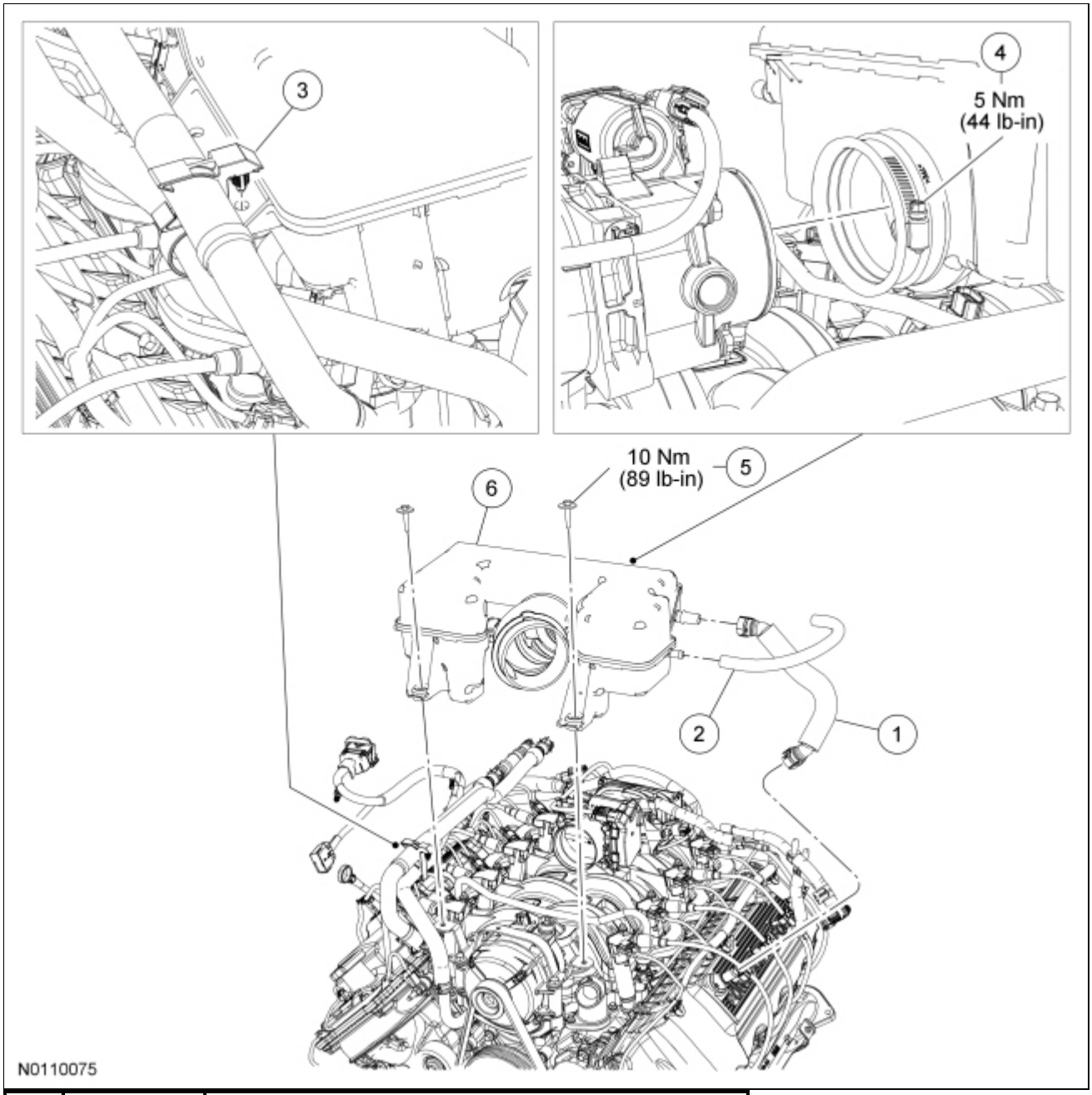
   NOTE: Lubricate the new O-ring seals with clean engine oil prior to installation.

   Install 16 new O-ring seals on each of the fuel injectors.
2. Assemble the 8 fuel injectors onto the fuel rail and install the 8 fuel injector retaining clips.
3. Install the fuel rail and fuel injectors as an assembly onto the intake manifold.
4. Install the 4 fuel rail bolts in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 90 degrees.
5. Connect the 8 fuel injector electrical connectors.
6. Connect the 8 ignition wires to the 8 ignition coils.
7. Connect the 8 ignition coil electrical connectors.
8. Connect the fuel tube quick connect coupling. For additional information, refer to Section 310-00 .
9. Position the ACL outlet pipe-to- TB adapter and install the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
10. Tighten the TB adapter-to- TB clamp.
    - Tighten to 5 Nm (44 lb-in).
11. Connect the brake booster vacuum hose from the ACL outlet pipe-to- TB adapter.
12. Connect the crankcase ventilation tube quick connect fitting to the ACL outlet pipe-to- TB adapter. For additional information, refer to Section 310-00 .
13. Connect the heater coolant hose retainer to the ACL outlet pipe-to- TB adapter.
14. Install the ACL outlet tube. For additional information, refer to Section 303-12 .
15. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Throttle Body

Air Cleaner (ACL) Outlet Pipe-to-Throttle Body (TB) Adapter

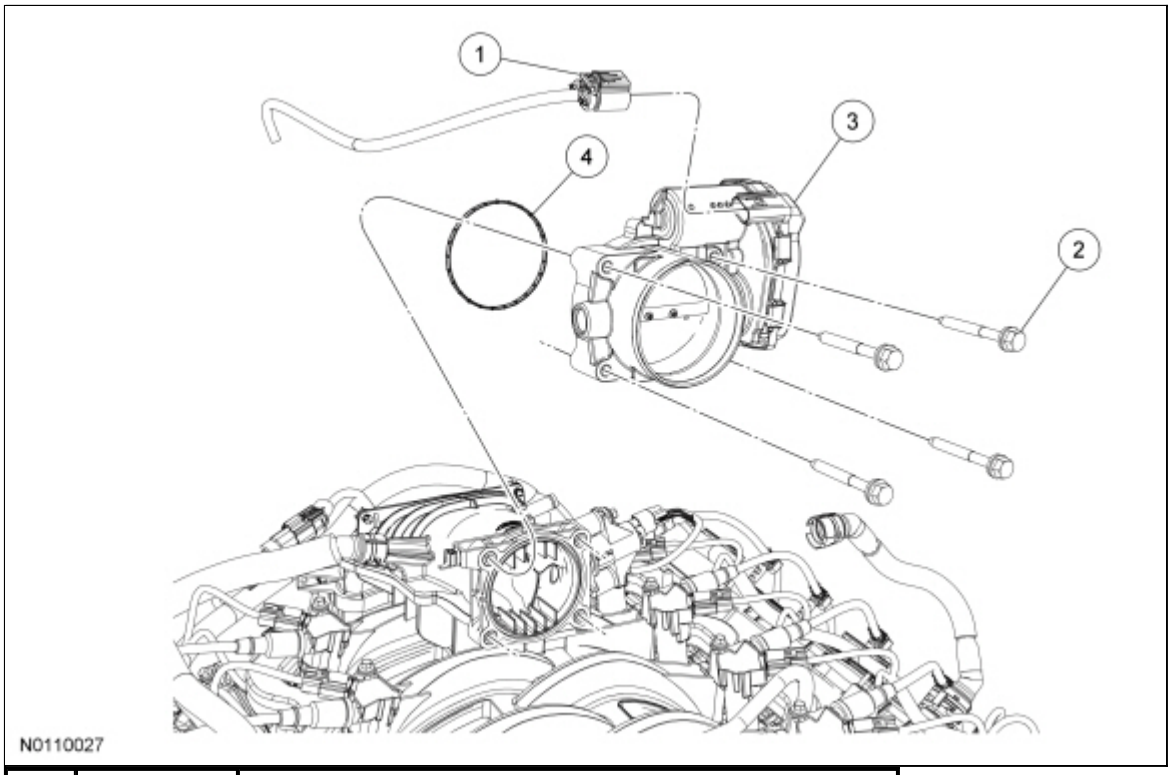


Item	Part Number	Description
1	6758	Crankcase ventilation tube
2	9C490	Brake booster vacuum hose

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3	—	Heater coolant hose position retainer
4	—	Throttle Body (TB) adapter-to- TB clamp (part of 9F805)
5	W505426	Air Cleaner (ACL) outlet pipe-to- TB adapter bolt (2 required)
6	9A589	ACL outlet pipe-to- TB adapter

Throttle Body (TB)



Item	Part Number	Description
1	—	Electronic Throttle Control (ETC) electrical connector (part of 12B637)
2	N709168	Throttle Body (TB) bolt (4 required)
3	9F991	TB
4	9E936	TB O-ring seal

Removal

1. Remove the Air Cleaner (ACL) outlet tube. For additional information, refer to Section 303-12 .
2. Disconnect the heater coolant hose retainer from the ACL outlet pipe-to-Throttle Body (TB) adapter.
3. Disconnect the crankcase ventilation tube quick connect fitting from ACL outlet pipe-to- TB adapter. For additional information, refer to Section 310-00 .

4. Disconnect the brake booster vacuum hose from the ACL outlet pipe-to- TB adapter.

5. Remove the 2 bolts and the ACL outlet pipe-to- TB adapter.

6. Loosen the clamp and disconnect the TB adapter from the TB .

7. Disconnect the Electronic Throttle Control (ETC) electrical connector.

8. Remove the 4 bolts and the TB assembly.
    - Discard the TB O-ring seal.

Installation

1. Using a new O-ring seal, position the TB and tighten the 4 bolts in 2 stages.
    - Stage 1: Tighten to 12 Nm (106 lb-in).
    - Stage 2: Tighten an additional 60 degrees.

2. Connect the ETC electrical connector.

3. Position the TB adapter onto the TB and install the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

4. Tighten the TB adapter-to- TB clamp.
    - Tighten to 5 Nm (44 lb-in).

5. Connect the crankcase ventilation tube quick connect coupling to the ACL outlet pipe-to- TB adapter. For additional information, refer to Section 310-00 .

6. Connect the brake booster vacuum hose to the ACL outlet pipe-to- TB adapter.

7. Connect the crankcase ventilation tube quick connect fitting to the ACL outlet pipe-to- TB adapter. For additional information, refer to Section 310-00 .

8. Connect the heater coolant hose retainer to the ACL outlet pipe-to- TB adapter.

9. Install the ACL outlet tube. For additional information, refer to Section 303-12 .

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Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Charge Air Cooler (CAC) tube clamp	5	—	44
Exhaust system heat shield bolts	20	—	177
Transmission crossmember bolts	90	66	—
Transmission insulator and retainer bolts	90	66	—
Transmission insulator and retainer nuts	103	75	—
Turbocharger bracket bolts	28	21	—
Turbocharger bracket-to-cylinder block bolts	10	—	89
Turbocharger exhaust flange stud bolts	40	30	—
Turbocharger heat shield bolts	6	—	53
Turbocharger intake tube clamp	5	—	44
Turbocharger mounting bolts	32	24	—
Turbocharger oil return tube bolt [a]	—	—	—
Turbocharger oil supply tube bolt [a]	—	—	—
Turbocharger oil tube assembly bolts [a]	—	—	—

[a] Refer to the procedure in this section.

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Turbocharger

NOTICE: **When removing the turbocharger air intake system components, cover the open ports to prevent debris from entering the system. The turbocharger compressor blades are susceptible to damage from even small particles. Inspect and clean all components if necessary, prior to installation or reassembly.**

The turbocharger assembly consists of LH and RH turbochargers.

The turbocharger is an exhaust-driven centrifugal air compressor used to increase power output by supplying compressed air to the engine. The internal components are oil, coolant and air cooled. Engine oil and coolant are circulated through the center housing which acts as a heat barrier between the hot turbine and the cold compressor. Bearings are sleeve type and lubricated by engine oil. Oil is circulated to the turbocharger center housing and returned to the sump through an oil drain in the center housing.

Expanding exhaust gases drive the turbine shaft assembly to speeds ranging from 10,000 to 185,000 rpm. Filtered air entering the compressor side of the turbocharger is compressed and delivered through a Charge Air Cooler (CAC). The very hot compressed air is cooled, then continues on to fill the intake manifold at a higher pressure than atmospheric pressure. Because more air is forced into the intake manifold, the results are increased power, fuel efficiency and the ability to maintain power at higher altitudes.

The EcoBoost™ twin turbochargers are used in a parallel arrangement with one turbocharger connected to each cylinder bank. This configuration improves engine responsiveness due to the reduced inertia of 2 small turbochargers. This also leads to an improved turbocharger package and better utilization of heat energy from the compact exhaust manifolds. The compact design of the system allows the catalysts to be located very close to the turbocharger outlet for improved emissions.

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Turbocharger

Principles of Operation

The turbocharger is an exhaust-driven centrifugal air compressor used to increase power output by supplying compressed air to the engine. The internal components are oil, coolant and air cooled. Engine oil and coolant are circulated through the center housing which acts as a heat barrier between the hot turbine and the cold compressor. Bearings are sleeve type and lubricated by engine oil. Oil is circulated to the turbocharger center housing and returned to the sump through an oil drain in the center housing.

Expanding exhaust gases drive the turbine shaft assembly to speeds ranging from 10,000 to 185,000 rpm. Filtered air entering the compressor side of the turbocharger is compressed and delivered through a Charge Air Cooler (CAC). The very hot compressed air is cooled, then continues on to fill the intake manifold at a higher pressure than atmospheric pressure. Because more air is forced into the intake manifold, the results are increased power, fuel efficiency and the ability to maintain power at higher altitudes.

Inspection and Verification

NOTE: This section provides mechanical diagnosis of the turbocharger assembly. If there is a Malfunction Indicator Lamp (MIL) illuminated, or DTCs are present, these should be diagnosed prior to performing turbocharger mechanical diagnosis. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

1. Verify the customer concern.

2. Inspect the entire turbocharger system for obvious signs of damage or other mechanical concerns, using the following chart.

   Visual Inspection Chart

Mechanical
• Oil inlet pipe and connection • Oil outlet pipe and connection • Compressor housing inlet circuit and piping • Compressor housing outlet circuit and piping • Turbine housing inlet circuit and piping • Turbine housing outlet circuit and piping • Turbocharger actuator tubing or linkage • Wastegate actuator rod

3. If the concern(s) remains after the inspection, GO to Symptom Chart.

4. If a driveability condition still exists, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Loss of power/performance	• Clogged Air Cleaner (ACL) element	• INSTALL a new ACL element. REFER to Section 303-12 . TEST the system for normal operation.
	• Loose connections or damage to air intake hoses and tubes	• TIGHTEN the hose clamps. INSPECT for damage and REPAIR as necessary.
	• Malfunctioning fuel system	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Poor fuel quality	• DRAIN and FILL with fresh fuel.
	• Engine wear (piston rings, valve guides)	• REPAIR as required.
	• Turbocharger turbine or compressor wheel damage	• INSPECT the turbocharger. REFER to the Check for Free Rotation — Off Vehicle in this section.
	• Damaged exhaust or exhaust leaks at turbocharger housing or exhaust manifolds	• INSPECT for leaks. Leaks can usually be detected audibly or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as required.
	• Malfunctioning turbocharger bypass valve	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Obstructed wastegate actuator linkage	• INSPECT the suspect turbocharger wastegate linkage for obstruction. REPAIR as necessary.
	• Damaged wastegate actuator linkage	• INSPECT the suspect turbocharger wastegate linkage for damage. INSTALL a new turbocharger.
	• Wastegate actuator operation	• TEST the wastegate actuator operation. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• PCM — DTCs	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED)

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		manual.
• Excessive oil consumption	• Incorrect type or grade of oil	• DRAIN and FILL with specified oil.
	• Oil in exhaust manifolds	• REPAIR as required.
	• Clogged ACL element	• INSTALL a new ACL element. REFER to Section 303-12 . TEST the system for normal operation.
	• Blocked or restricted turbocharger oil drain pipes	• INSPECT the turbocharger oil drain pipes. REPAIR as necessary.
	• Damaged or collapsed air intake hoses and tubes	• TIGHTEN hose clamps. INSPECT for damage and REPAIR as necessary.
	• Damaged exhaust or exhaust leaks at turbocharger housing or exhaust manifolds	• INSPECT for leaks. Leaks can usually be detected audibly or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as required.
	• Turbocharger oil seals leaking	• REFER to Turbocharger Internal Oil Leak Test in this section.
	• Damaged crankcase ventilation system	• Visually INSPECT the crankcase ventilation system.
• Excessive noise	• Turbocharger compressor air intake pipe leaking	• REPAIR or INSTALL a new pipe as required.
	• Loose connections or damage to air intake hoses and tubes	• TIGHTEN hose clamps. INSPECT for damage and REPAIR as necessary.
	• Air leaks at turbine housing, blown joints or damaged exhaust	• INSPECT for leaks. Leaks can usually be detected audibly or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as required.
	• Carbon build up in the turbine housing causing contact with turbine wheel	• INSPECT the turbocharger. REFER to the Check for Free Rotation — Off Vehicle in this section.
	• Turbocharger imbalance due to foreign object/damage	• REPAIR as required.
	• Turbine bearing failure	• INSPECT the turbocharger. REFER to the Check for Free Rotation — Off Vehicle in

		this section.
	• Change to the wastegate nut location	• INSPECT the turbocharger paint mark location. If the paint marks are not aligned, INSTALL a new turbocharger.
	• Inoperative turbocharger bypass valve	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Engine emits excessive smoke (black/blue/white)	• Clogged ACL element	• INSTALL a new ACL element. REFER to Section 303-12 . TEST the system for normal operation.
	• Incorrect type or grade of oil	• DRAIN and FILL with specified oil.
	• Blocked or restricted turbocharger oil drain pipes	• INSPECT the turbocharger oil drain pipes. REPAIR as necessary.
	• Damaged/restricted or leaking turbocharger compressor air intake pipe	• REPAIR or INSTALL a new pipe as required.
	• Engine wear (piston rings, valve guides)	• REPAIR as required.
	• Plugged crankcase ventilation system	• Visually INSPECT the crankcase ventilation system.
	• Turbocharger oil seals leaking	• REFER to Turbocharger Internal Oil Leak Test in this section.

Component Tests

Turbocharger Internal Oil Leak Test

NOTE: Some engine oil may be present in the turbocharger compressor inlet and in the air inlet components due to the crankcase breather system.

Check the turbocharger compressor inlet for evidence of oil. If excessive oil is present, this indicates that the failure could be in the engine or turbocharger. Refer to Section 303-00 or the following turbocharger check. If excessive oil is found in the turbocharger compressor outlet, check the Charge Air Cooler (CAC) for oil contamination. If contamination is present, flush the CAC . Refer to Section 303-12 .

Check the turbocharger turbine outlet for evidence of oil. If excess oil is present in the outlet, remove the turbocharger from the engine and examine the oil supply and return passages in the turbocharger and engine block for restriction. If no restriction is found, install a new turbocharger.

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Check for Free Rotation — Off Vehicle

NOTE: Pre-oil the turbocharger before carrying out this check.

NOTE: Turbine and compressor wheels must spin freely when turned by hand. No housing contact is permitted.

Inspect the turbocharger compressor and turbine blades for damage. If the compressor or turbine wheel blades are damaged, replace the turbocharger.

Press and rotate the turbocharger shaft, then repeat from the opposite side. If either the compressor or the turbine wheel blades contact the housing, the bearings are worn or damaged and a new turbocharger must be installed.

Turbocharger — LH

Material

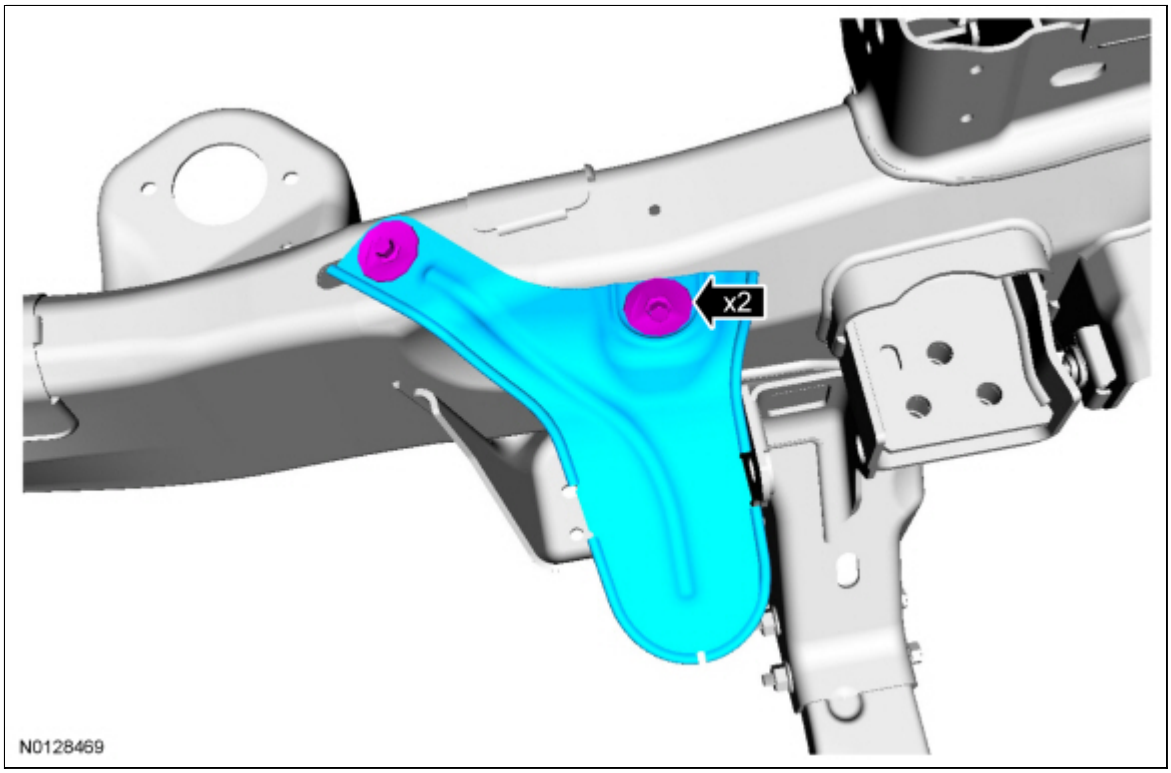
Item	Specification
Motorcraft® High Temperature Nickel Anti-Seize Lubricant XL-2	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

NOTICE: **Whenever turbocharger air intake system components are removed, always cover open ports to protect from debris. It is important that no foreign material enter the system. The turbocharger compressor blades are susceptible to damage from even small particles. All components should be inspected and cleaned, if necessary, prior to installation or reassembly.**

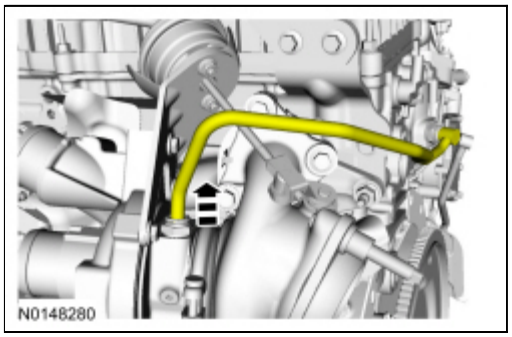
1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. Drain the engine cooling system. Refer to Section 303-03 .
3. Remove the Air Cleaner (ACL) outlet pipe, LH ACL pipe-to-turbocharger pipe, LH turbocharger bypass hose and the LH turbocharger-to-Charge Air Cooler (CAC) pipe. Refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .
4. Remove the LH catalytic converter. Carry out the exhaust Y-pipe - dual catalytic converter procedure. Refer to Section 309-00 .
5. If equipped, remove the 2 exhaust system heat shield bolts and the exhaust system heat shield.

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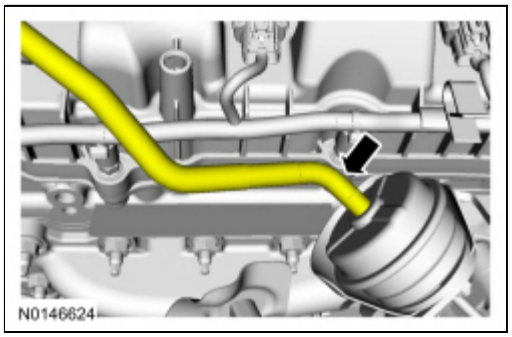


6. **NOTE:** Position a drain pan prior to disconnecting the turbocharger coolant supply tube.

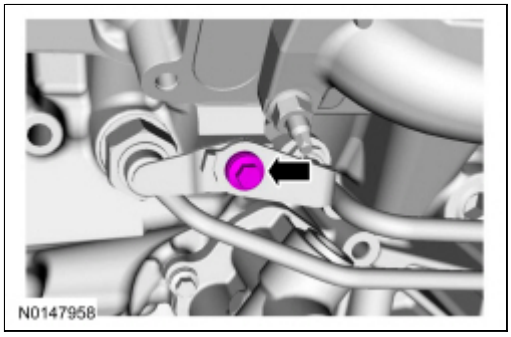
   Using a commercially available quick disconnect tool, disconnect the turbocharger coolant supply tube at the turbocharger.
   - Position the coolant supply tube aside.



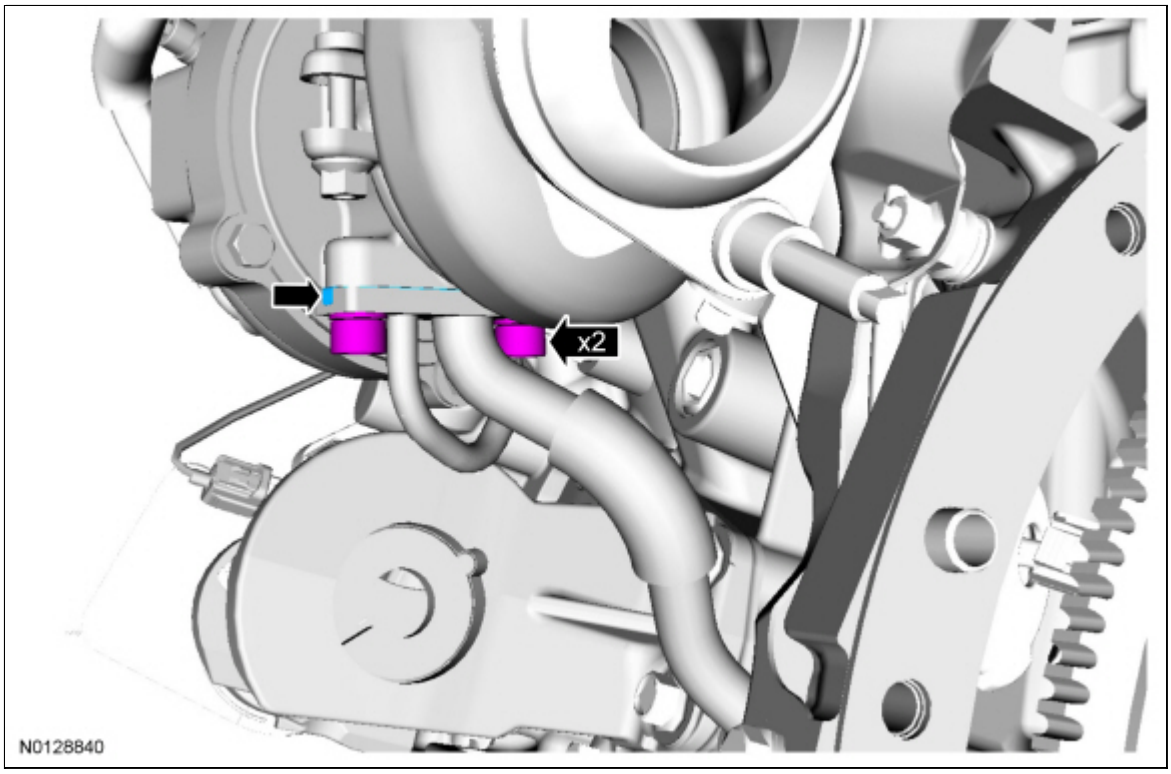
7. Disconnect the wastegate hose.



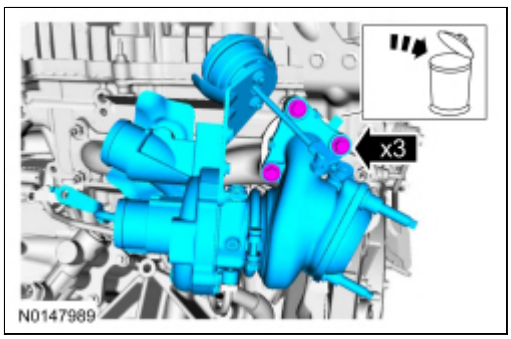
8. Remove the bolt for the LH turbocharger coolant and oil tubes.



9. Remove the 2 bolts at the LH turbocharger oil return tube.
    - Remove and discard the turbocharger oil return tube assembly gasket.

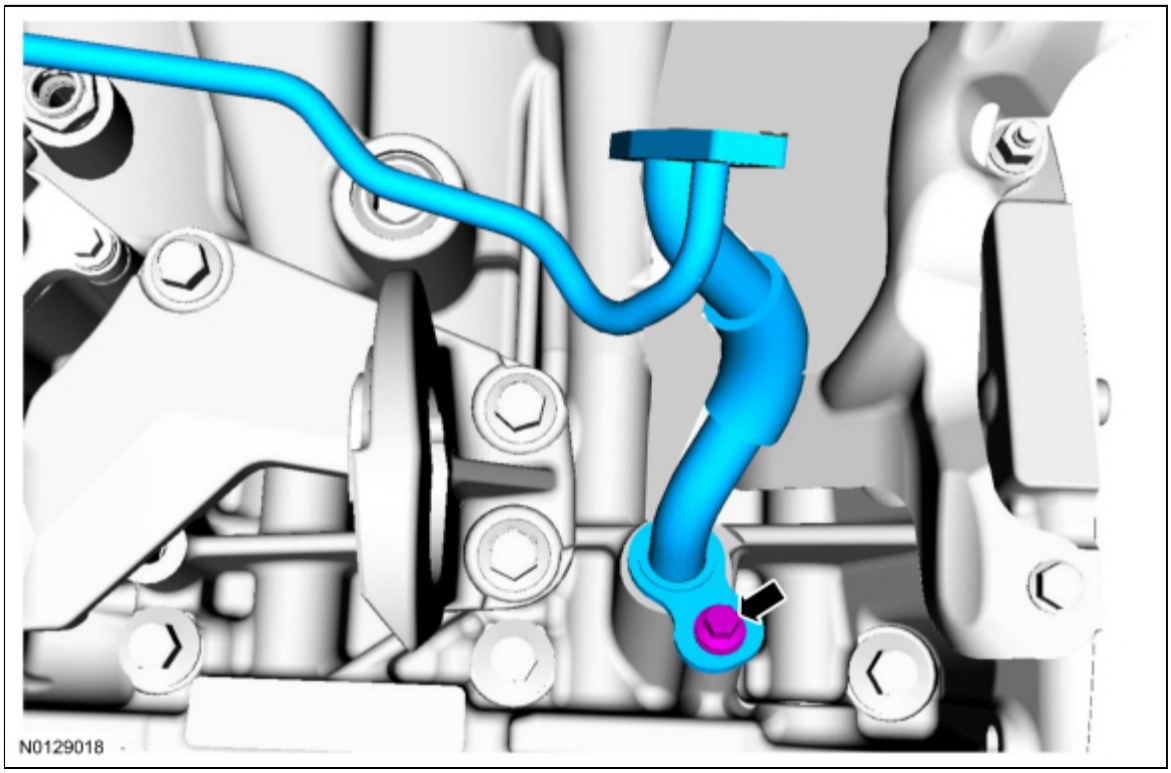


10. Remove the 3 turbocharger mounting bolts and the turbocharger.
    - Discard the turbocharger exhaust manifold gasket.



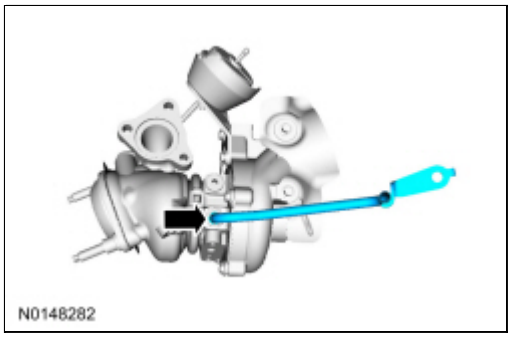
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11. Remove the bolt and the turbocharger oil return tube assembly.
    - Remove and discard the turbocharger oil return tube O-ring seal.

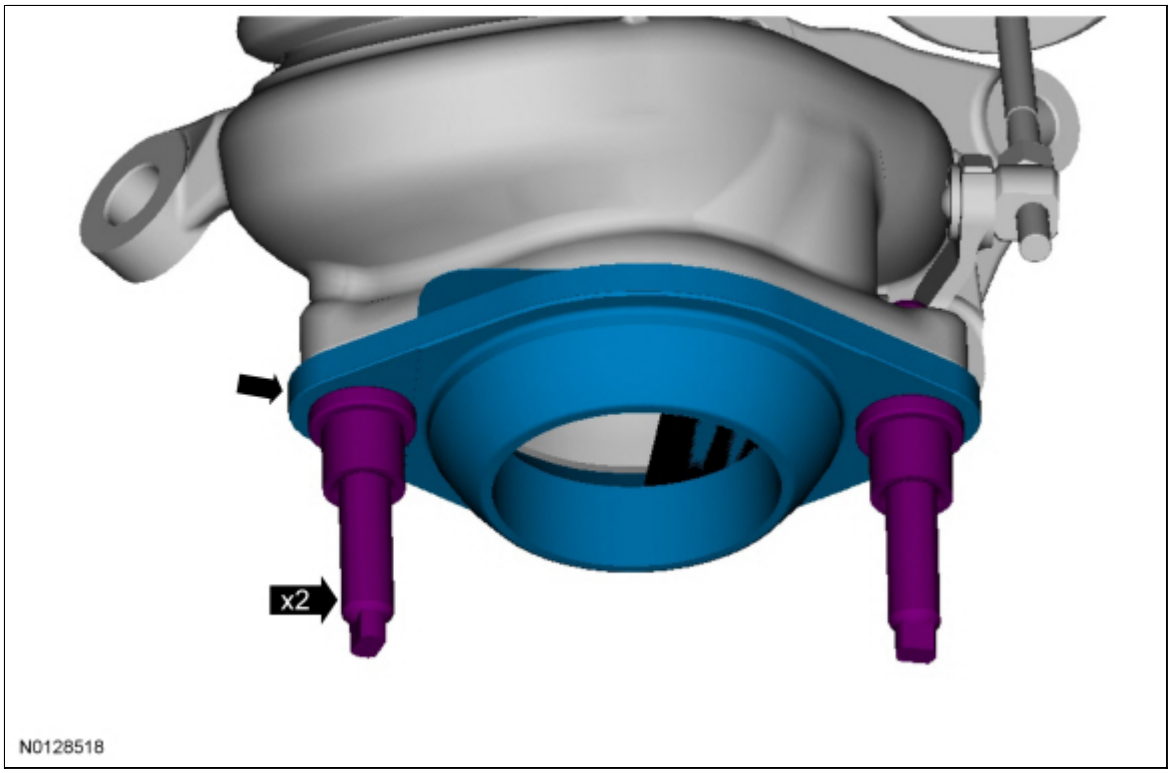


12. **NOTE:** If it is necessary to remove the turbocharger coolant tube, use a commercially available quick disconnect tool to disconnect the turbocharger coolant tube at the turbocharger.

    If necessary, remove the turbocharger coolant tube.



13. If necessary, remove the 2 turbocharger exhaust flange stud bolts and the turbocharger exhaust flange.
    - Discard the 2 turbocharger exhaust flange stud bolts and the turbocharger exhaust flange gasket.

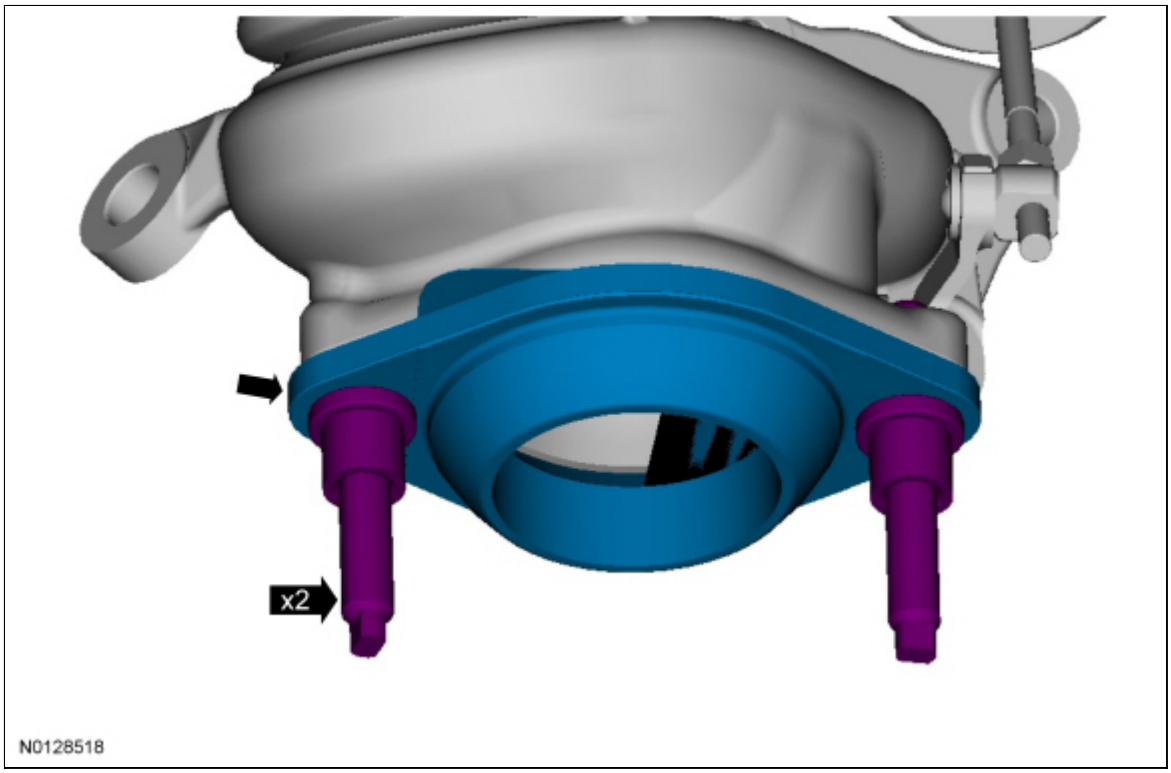


Installation

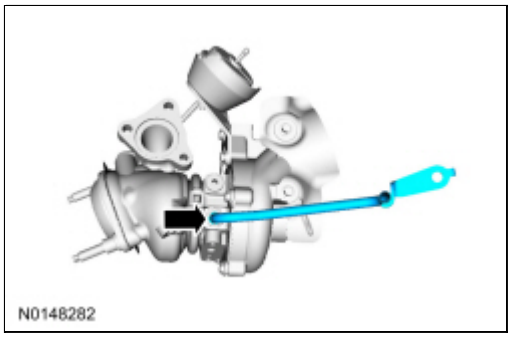
1. **NOTE:** Apply high temperature nickel anti-seize lubricant to the turbocharger exhaust flange stud bolt threads prior to installation of the turbocharger exhaust flange.

   If removed, using a new turbocharger exhaust flange gasket, install the turbocharger exhaust flange and the 2 new turbocharger exhaust flange stud bolts.
   - Tighten to 40 Nm (30 lb-ft).

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2. If removed, install the turbocharger coolant tube.

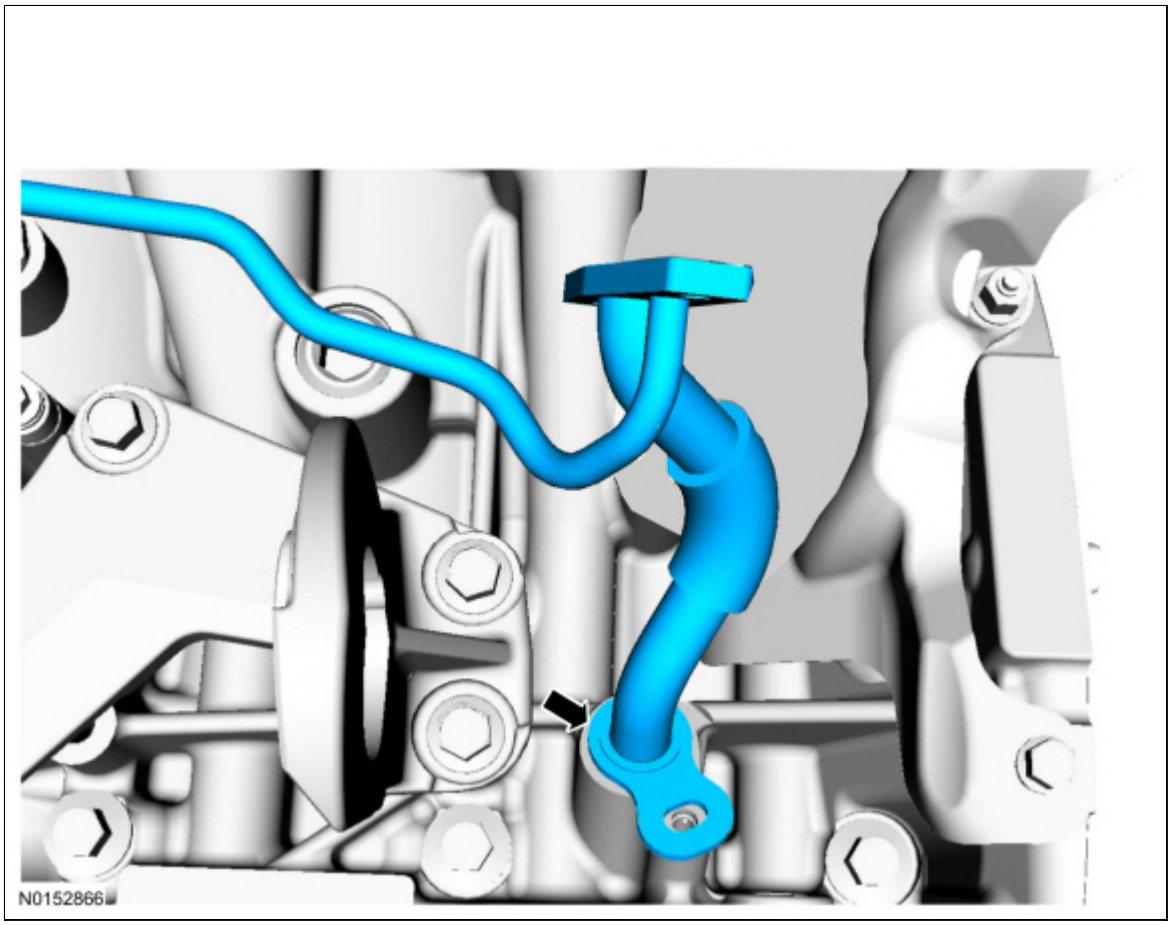


3. **NOTE:** Lubricate the cylinder block bore with clean engine oil.

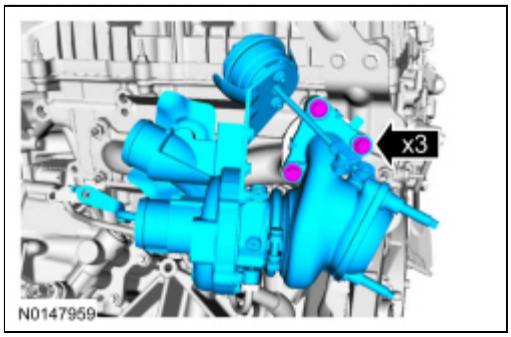
   NOTE: Apply clean engine oil to the turbocharger oil return tube O-ring seal.

   NOTE: Make sure the turbocharger oil supply tube is positioned in the cylinder block during the installation of the turbocharger oil return tube assembly.

   Using a new turbocharger oil return tube O-ring seal, install the turbocharger oil return tube assembly.

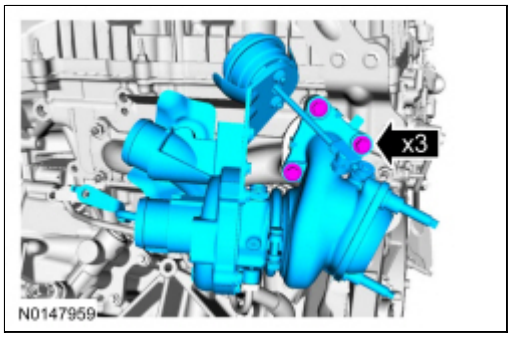


4. Using a new turbocharger exhaust manifold gasket, install the LH turbocharger and the 3 turbocharger mounting bolts.
    - Tighten finger tight.

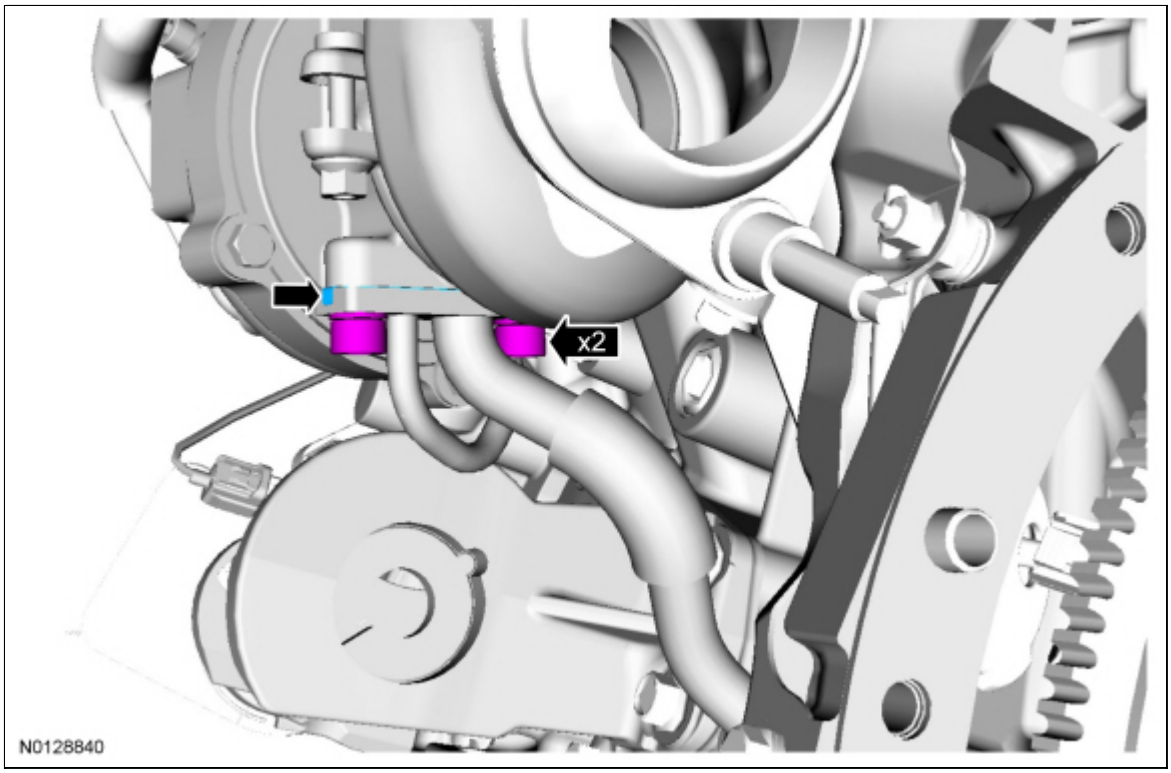


5. Tighten the 3 turbocharger mounting bolts.
    - Tighten to 32 Nm (24 lb-ft).

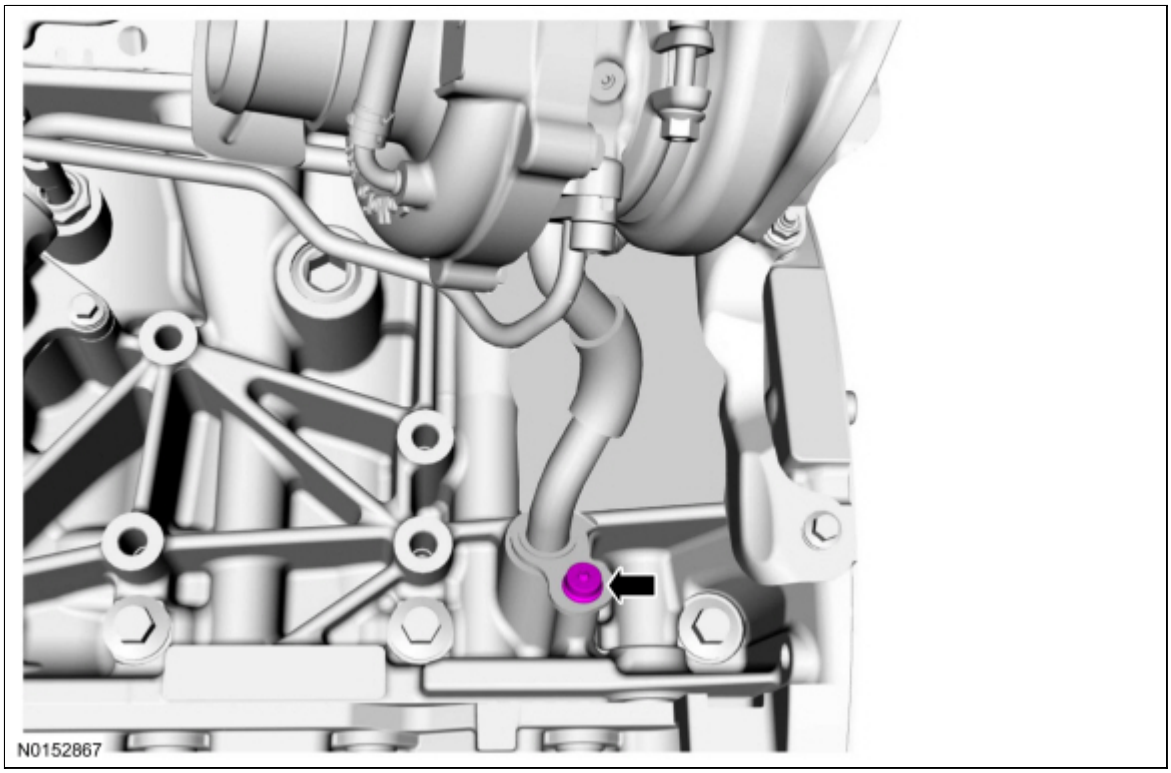
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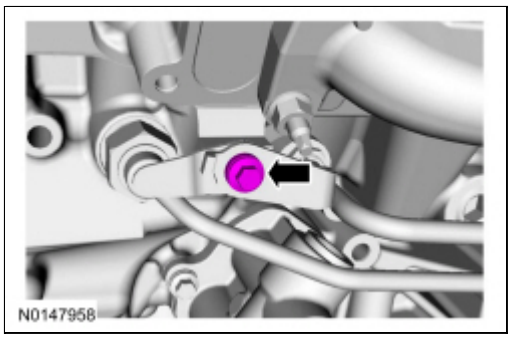
6. Using a new turbocharger oil return tube gasket, install the 2 turbocharger center housing bolts at the turbocharger. Tighten in the following stages:
    - Stage 1: Install the bolt for the oil pressure tube side halfway.
    - Stage 2: Install the bolt for the oil drain tube side and tighten to 10 Nm (89 lb-in).
    - Stage 3: Tighten the bolt for the oil drain tube side an additional 30 degrees.
    - Stage 4: Tighten the bolt for the oil pressure tube side to 10 Nm (89 lb-in).
    - Stage 5: Tighten the bolt for the oil pressure tube side an additional 30 degrees.



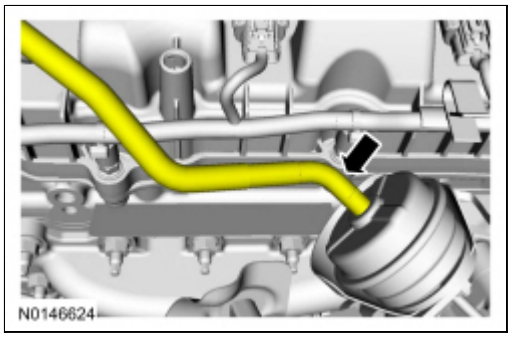
7. Install the turbocharger oil return tube bolt at the cylinder block. Tighten in the following stages:
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.



8. Install the bolt for the LH turbocharger coolant and oil tubes. Tighten in the following stages:
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.

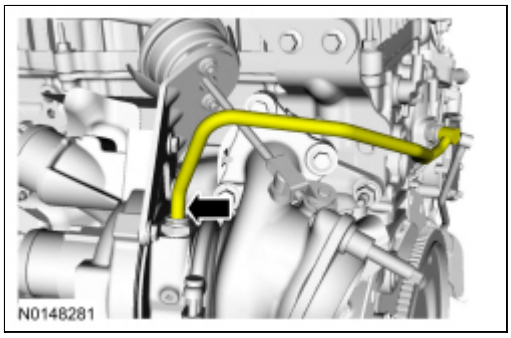


9. Connect the wastegate hose.

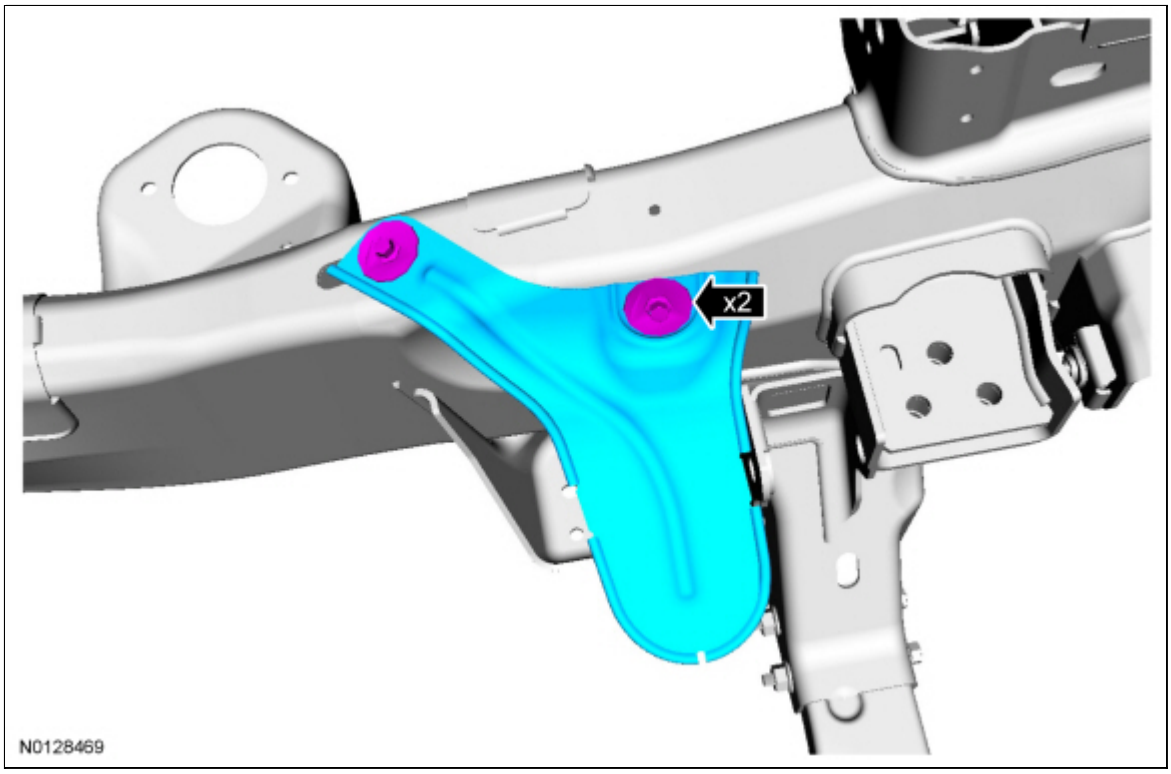


10. Connect the turbocharger coolant supply tube to the turbocharger.

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11. If equipped, install the exhaust system heat shield and the 2 exhaust system heat shield bolts.
    - Tighten to 20 Nm (177 lb-in).



12. Install the LH catalytic converter. Carry out the exhaust Y-pipe - dual catalytic converter procedure. Refer to Section 309-00 .

13. Install the ACL outlet pipe, LH ACL pipe to-turbocharger pipe, LH turbocharger bypass hose and the LH turbocharger-to- CAC pipe. Refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

14. Fill the engine cooling system. Refer to Section 303-03 .

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Turbocharger — RH

Material

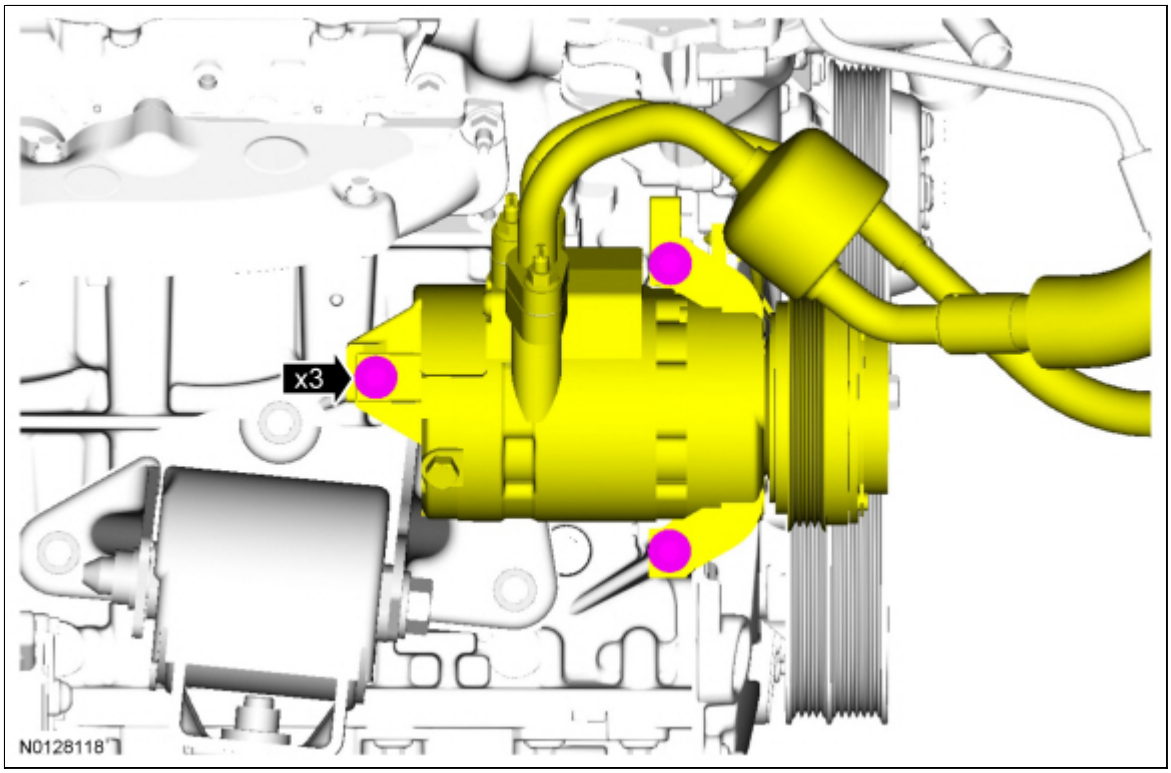
Item	Specification
Motorcraft® High Temperature Nickel Anti-Seize Lubricant XL-2	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil (Canada) XO-5W30-QSP (US); CXO-5W30-LSP12 (Canada)	WSS-M2C946-A

Removal

NOTICE: **Whenever turbocharger air intake system components are removed, always cover open ports to protect from debris. It is important that no foreign material enter the system. The turbocharger compressor blades are susceptible to damage from even small particles. All components should be inspected and cleaned, if necessary, prior to installation or reassembly.**

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. Drain the engine cooling system. Refer to Section 303-03 .
3. Remove the Air Cleaner (ACL) outlet pipe, RH ACL pipe to-turbocharger pipe, RH turbocharger bypass hose and the RH turbocharger-to-Charge Air Cooler (CAC) pipe. Refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .
4. Remove the Air Conditioning (A/C) compressor belt. Refer to Section 303-05 .
5. Remove the 3 A/C compressor bolts and position the A/C compressor aside.

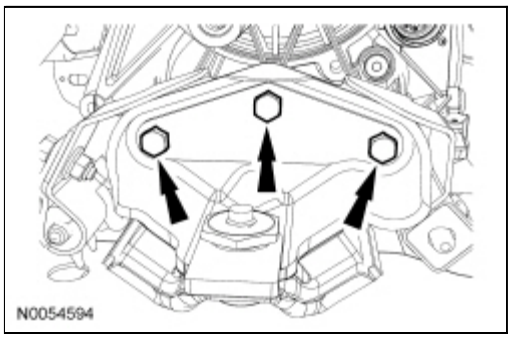


6. Remove the exhaust Y-pipe - dual catalytic converter. Refer to Section 309-00 .

Rear Wheel Drive (RWD) vehicles

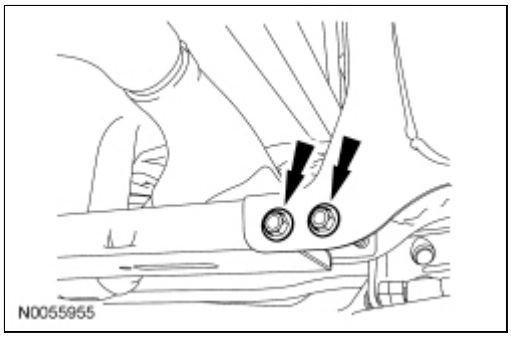
NOTE: The exhaust Y-pipe - dual catalytic converter procedure requires the removal of the transmission insulator and retainer and the transmission crossmember. The transmission insulator and retainer and the transmission crossmember must be installed to continue the procedure.

7. Install the transmission insulator and retainer and the 3 transmission insulator and retainer bolts.
   - Tighten to 90 Nm (66 lb-ft).

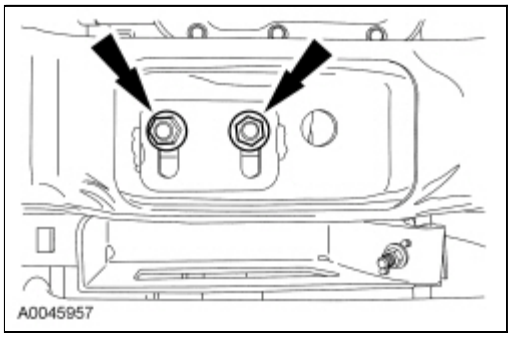


8. Install the transmission crossmember and the 4 transmission crossmember nuts and bolts (2 each side).
   - Tighten to 90 Nm (66 lb-ft).

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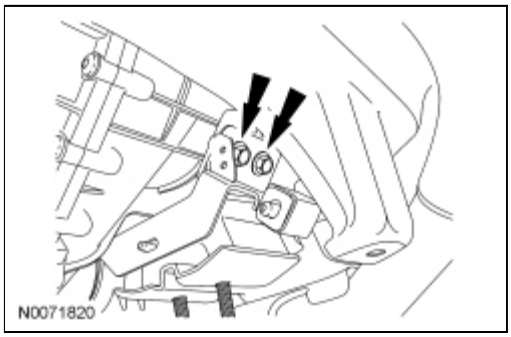
9. Lower the transmission onto the transmission crossmember and install the 2 transmission insulator and retainer nuts.
    - Tighten to 103 Nm (75 lb-ft).



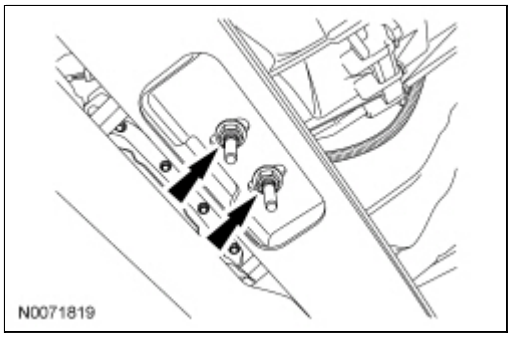
Four-Wheel Drive (4WD)

NOTE: The exhaust Y-pipe - dual catalytic converter procedure requires the removal of the transmission insulator and retainer and the transmission crossmember. The transmission insulator and retainer and the transmission crossmember must be installed to continue the procedure.

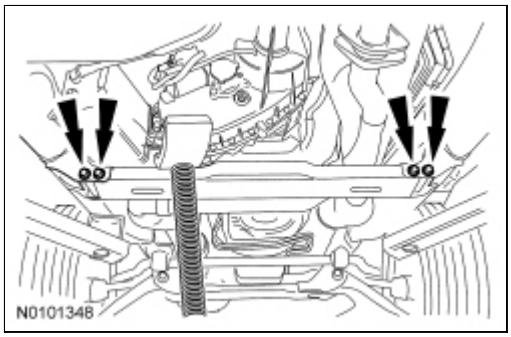
10. Loosely install the transmission insulator and retainer and the 4 transmission insulator and retainer bolts.



11. Position the transmission crossmember and loosely install the 2 transmission insulator and retainer nuts.



12. Install the 4 transmission crossmember bolts and nuts.
    - Tighten the transmission insulator and retainer bolts to 90 Nm (66 lb-ft).
    - Tighten the transmission crossmember bolts and nuts to 90 Nm (66 lb-ft).
    - Tighten the transmission insulator and retainer nuts to 103 Nm (75 lb-ft).

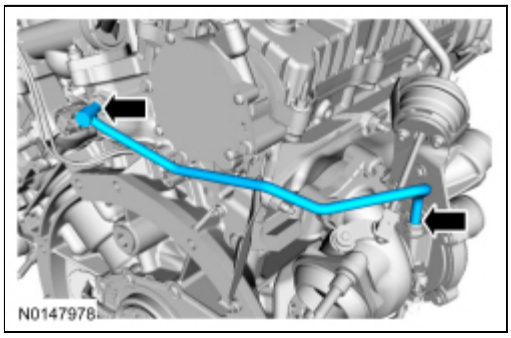


All vehicles

13. Remove the starter. Refer to Section 303-06 .

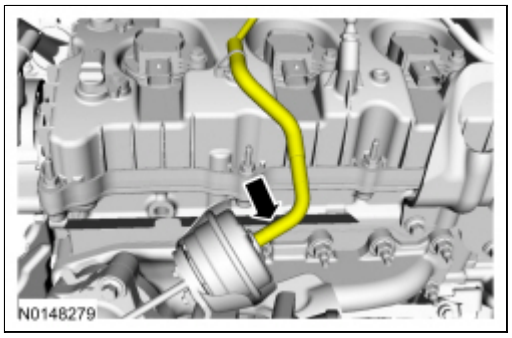
14. **NOTE:** Position a drain pan prior to disconnecting the turbocharger coolant supply tube.

    Using a commercially available quick disconnect tool, remove the turbocharger coolant supply tube.

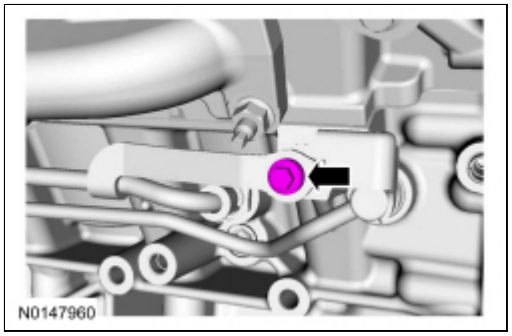


15. Disconnect the wastegate hose.

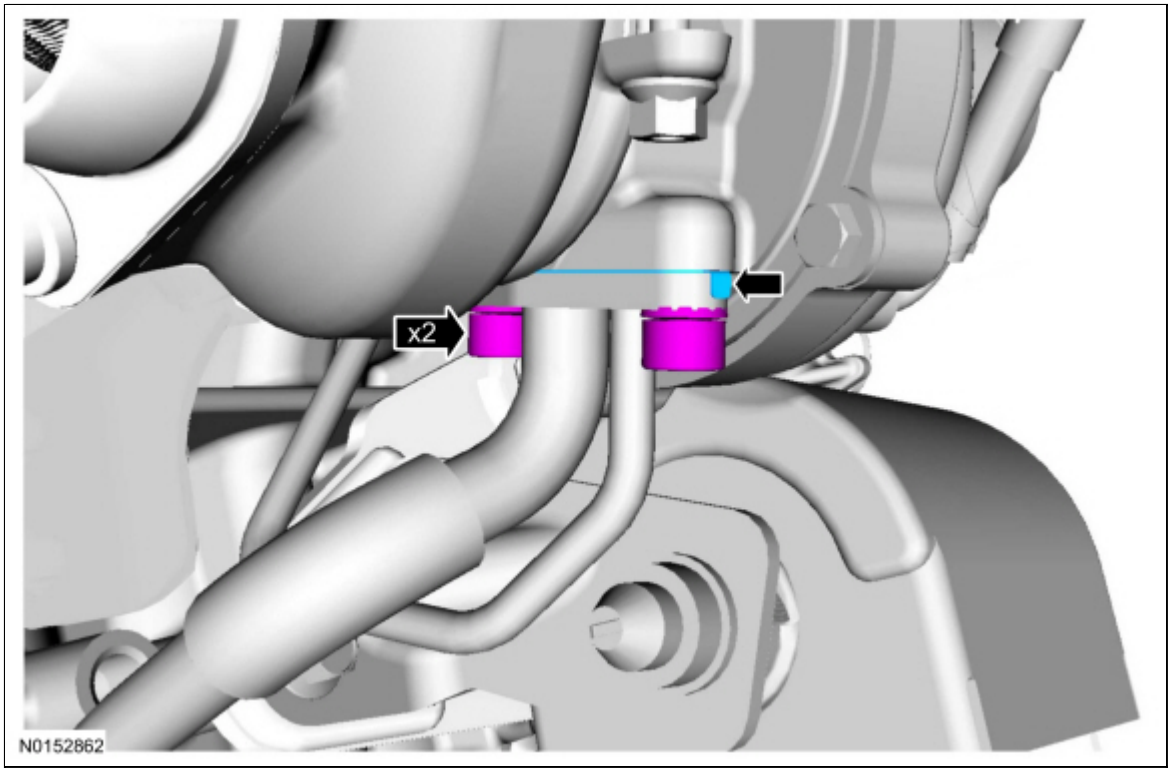
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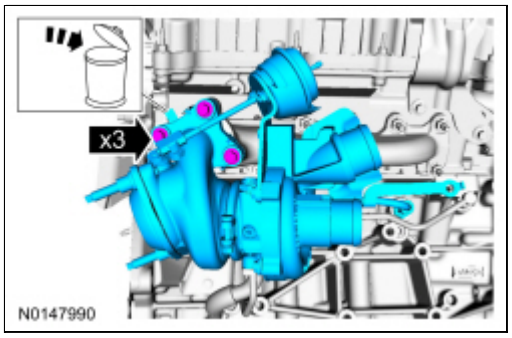
16. Remove the bolt for the RH turbocharger coolant and oil tubes.



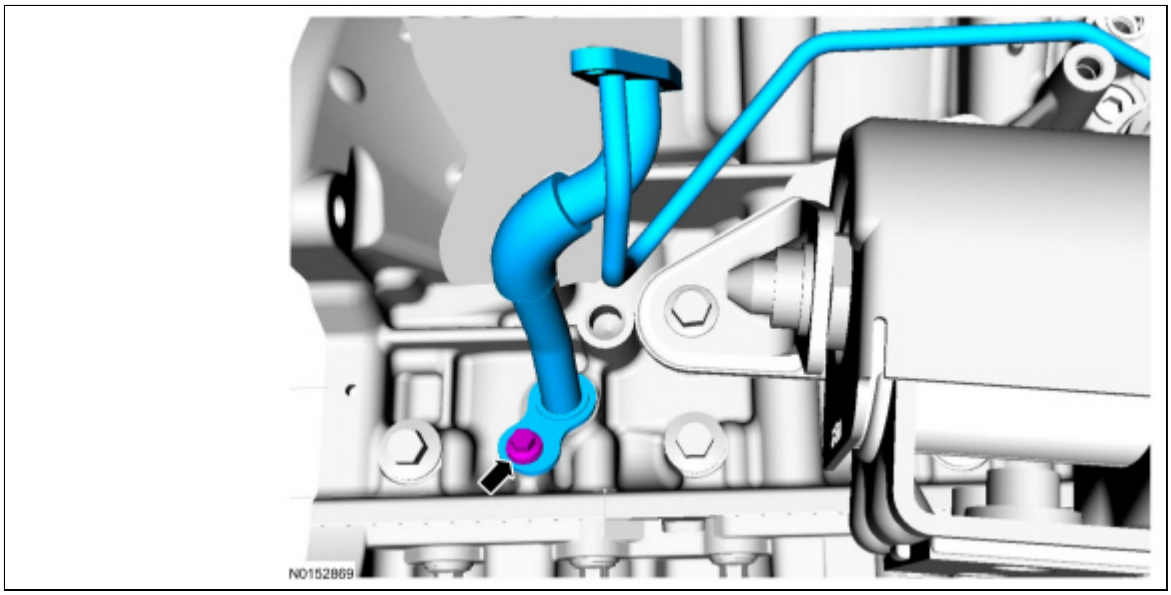
17. Remove the 2 bolts for the turbocharger oil return tube assembly.
    - Remove and discard the turbocharger oil return tube gasket.



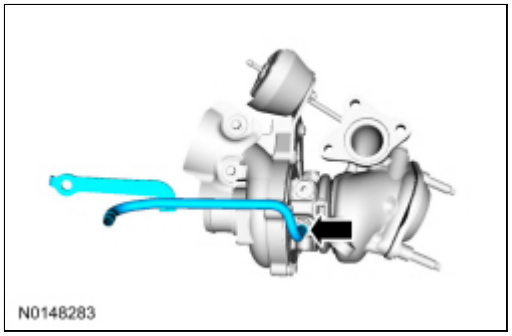
18. Remove the 3 turbocharger mounting bolts and the turbocharger.
    - Discard the turbocharger exhaust manifold gasket.



19. Remove the bolt and the RH turbocharger oil return tube.
    - Remove and discard the turbocharger oil return tube O-ring seal.

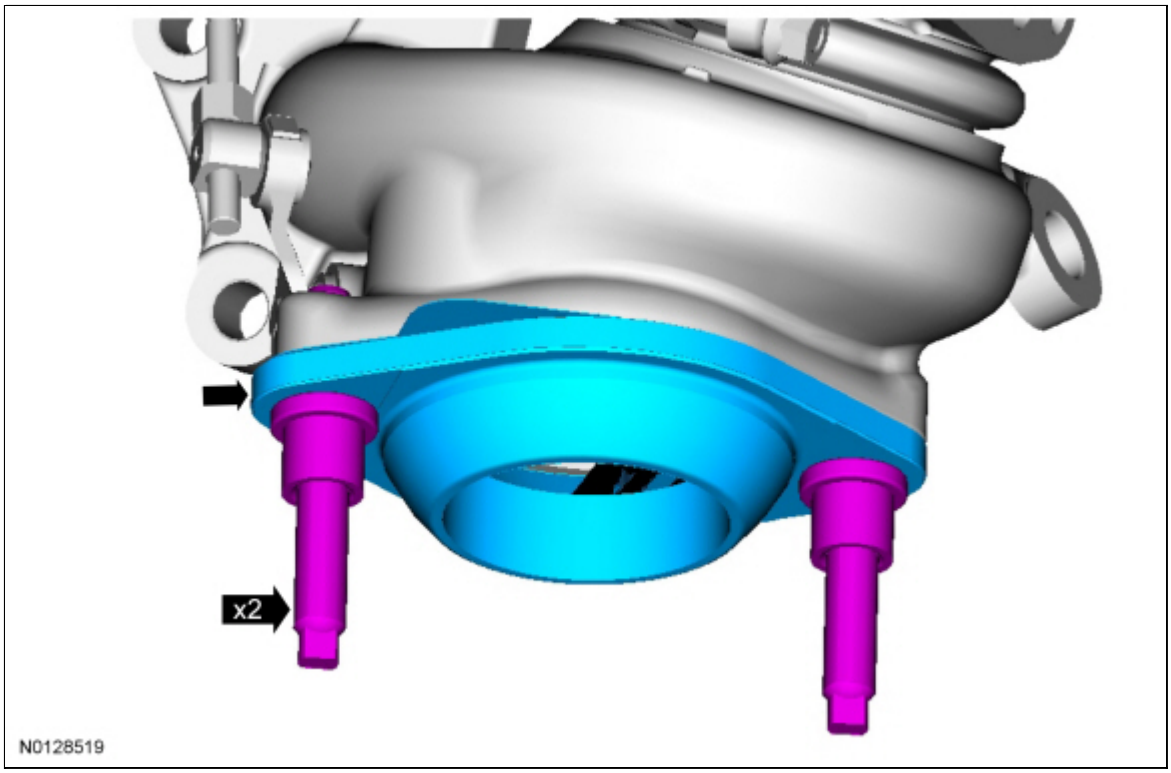


20. If necessary, using a commercially available quick disconnect tool, remove the turbocharger coolant tube.



21. If necessary, remove the 2 turbocharger exhaust flange stud bolts and the turbocharger exhaust flange.
    - Discard the 2 turbocharger exhaust flange stud bolts and the turbocharger exhaust flange gasket.

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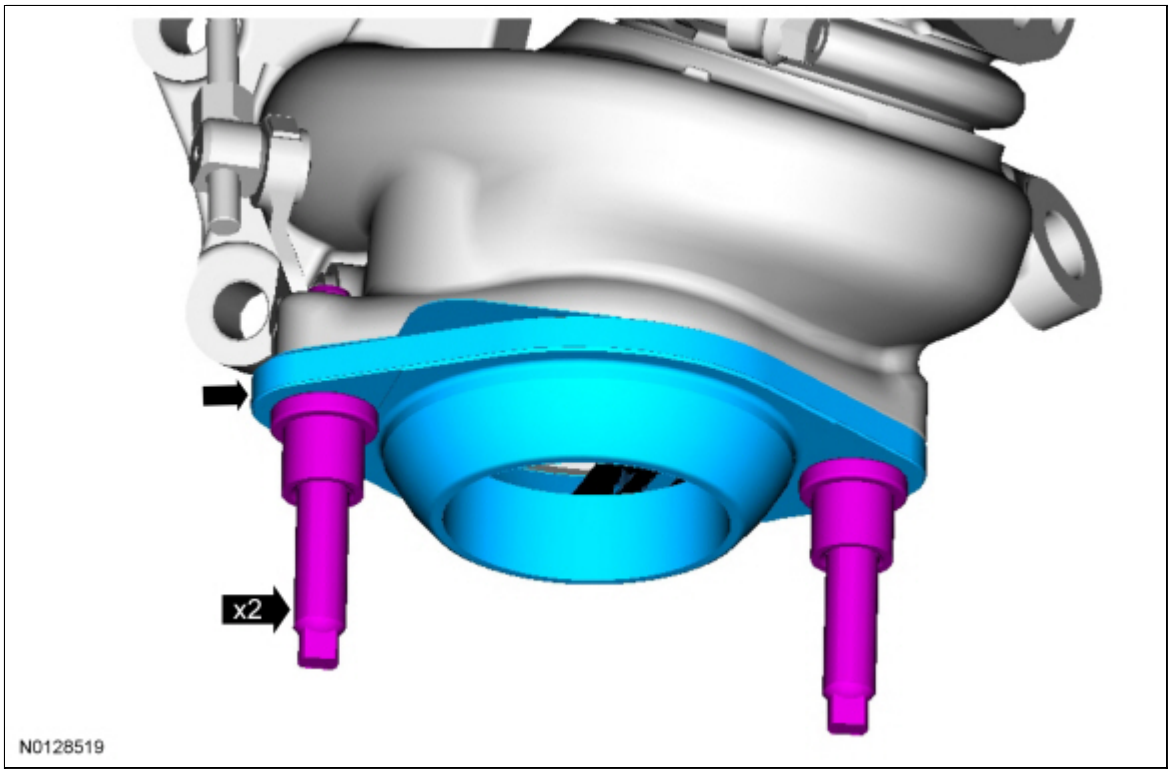


Installation

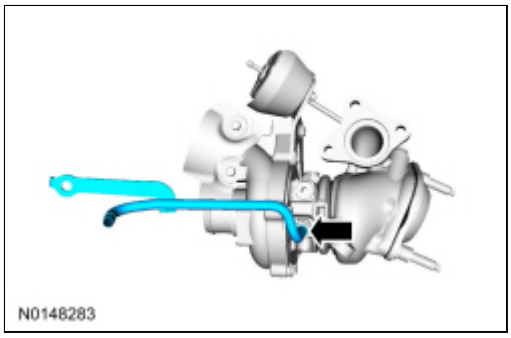
All vehicles

1. **NOTE:** Apply high temperature nickel anti-seize lubricant to the turbocharger exhaust flange stud bolt threads prior to installation of the turbocharger exhaust flange.

   If removed, using a new turbocharger exhaust flange gasket, install the turbocharger exhaust flange and the 2 new turbocharger exhaust flange stud bolts.
   - Tighten to 40 Nm (30 lb-ft).



2. If removed, install the turbocharger coolant tube.



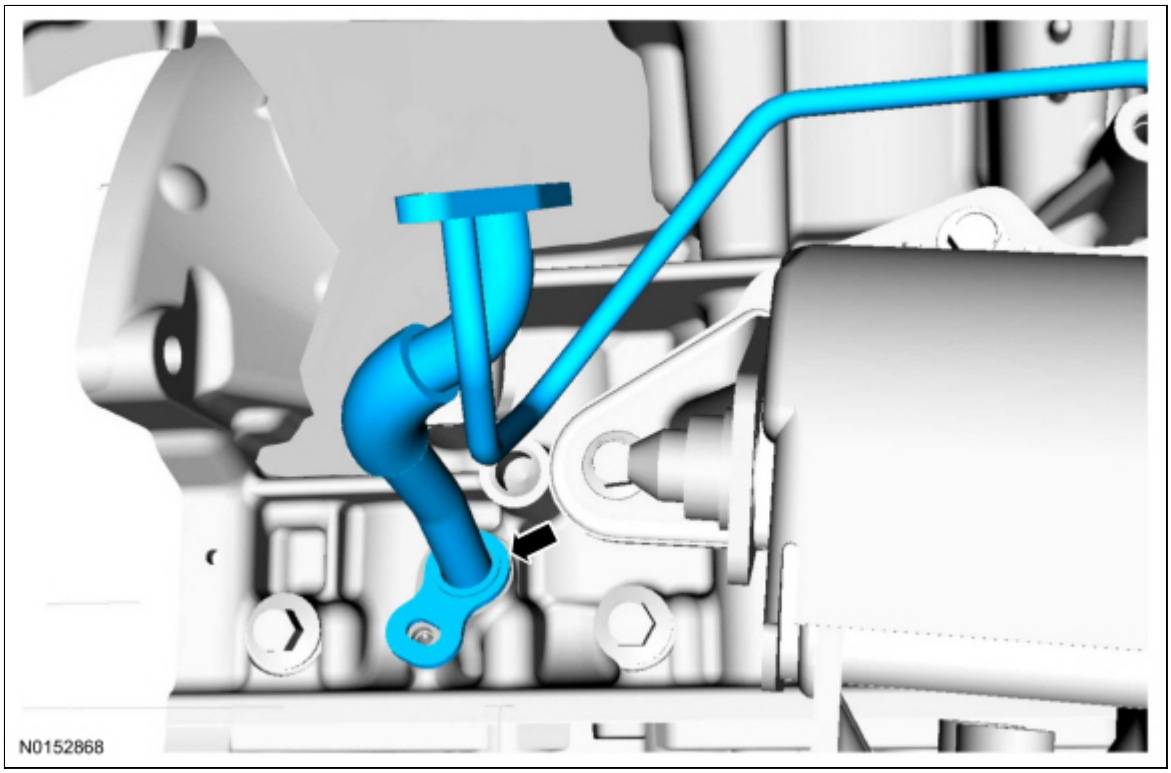
3. **NOTE:** Lubricate the cylinder block bore with clean engine oil.

   NOTE: Apply clean engine oil to the turbocharger oil return tube O-ring seal.

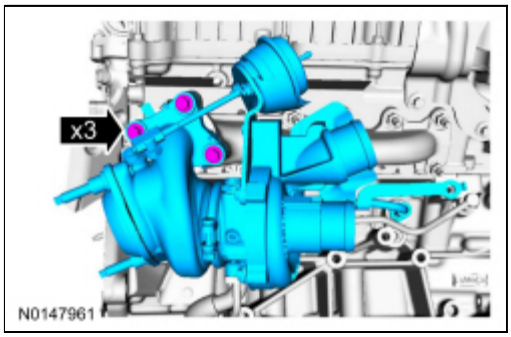
   NOTE: Make sure the turbocharger oil supply tube is positioned in the cylinder block during the installation of the turbocharger oil return tube assembly.

   Using a new turbocharger oil return tube O-ring seal, install the turbocharger oil return tube assembly.

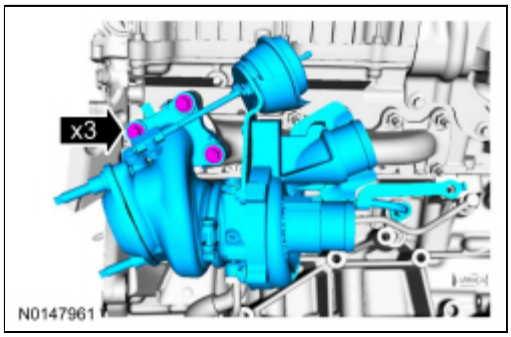
repair4less



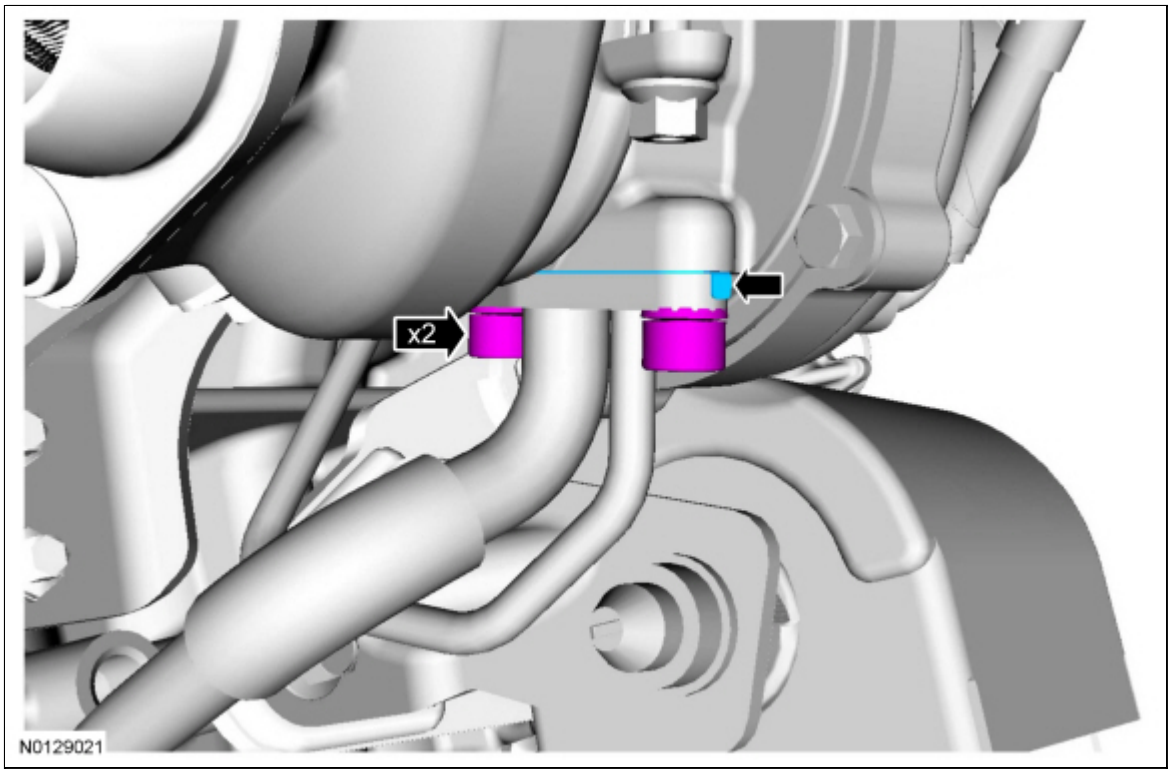
4. Using a new turbocharger exhaust manifold gasket, install the RH turbocharger and the 3 turbocharger mounting bolts.
    - Tighten finger tight.



5. Tighten the 3 turbocharger mounting bolts.
    - Tighten to 32 Nm (24 lb-ft).

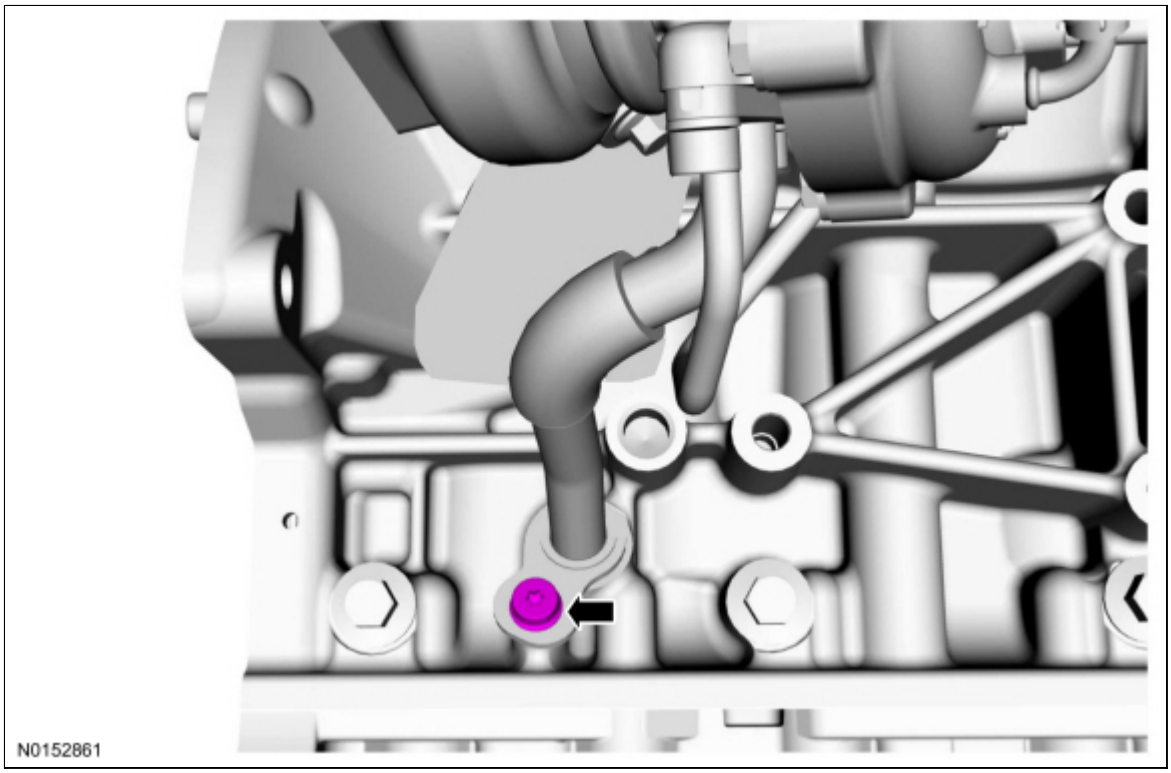


6. Using a new turbocharger oil return tube gasket, install the 2 turbocharger center housing bolts at the turbocharger. Tighten in the following stages:
    - Stage 1: Install the bolt for the oil pressure tube side halfway.
    - Stage 2: Install the bolt for the oil drain tube side and tighten to 10 Nm (89 lb-in).
    - Stage 3: Tighten the bolt for the oil drain tube side an additional 30 degrees.
    - Stage 4: Tighten the bolt for the oil pressure tube side to 10 Nm (89 lb-in).
    - Stage 5: Tighten the bolt for the oil pressure tube side an additional 30 degrees.

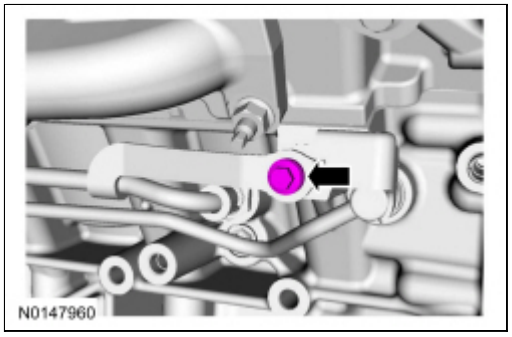


7. Install the turbocharger oil return tube bolt at the cylinder block. Tighten in the following stages:
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.

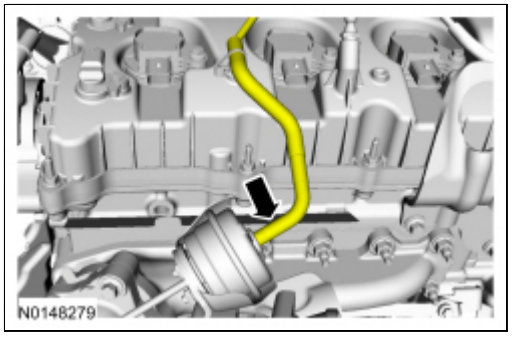
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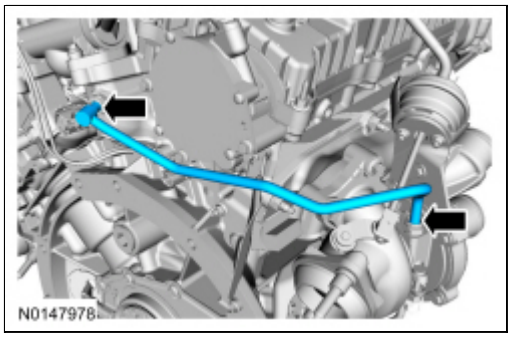
8. Install the bolt for the RH turbocharger coolant and oil tubes. Tighten in the following stages:
    - Stage 1: Tighten to 8 Nm (71 lb-in).
    - Stage 2: Tighten an additional 30 degrees.



9. Connect the wastegate hose.



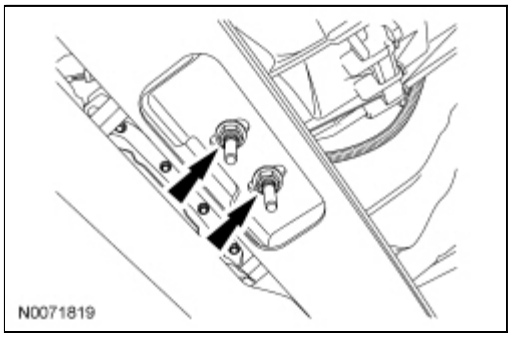
10. Install the turbocharger coolant supply tube.



11. Install the starter. Refer to Section 303-06 .

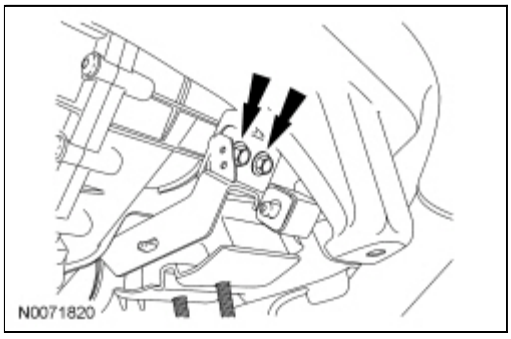
4WD vehicles

12. Remove the 2 transmission insulator and retainer nuts.



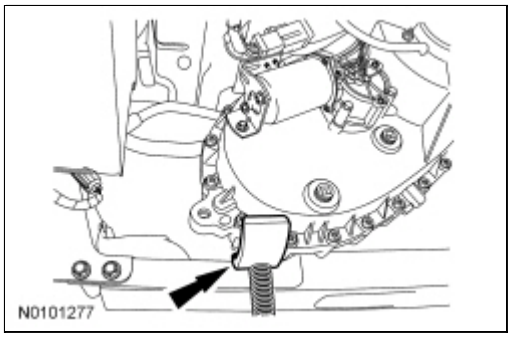
13. **NOTE:** Right side shown, left side similar. Transmission crossmember removed for clarity.

    Remove the 4 transmission insulator and retainer bolts.

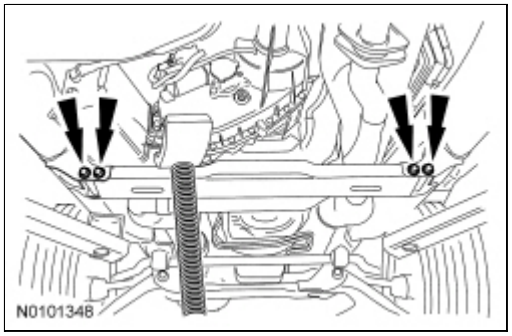


14. Support the transfer case.

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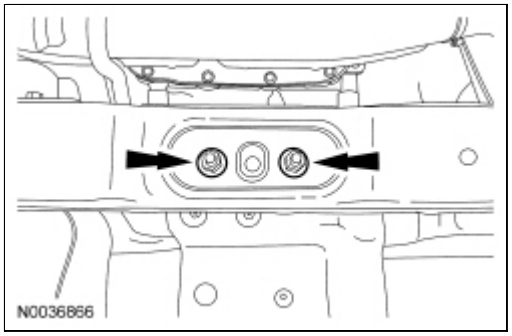
15. Remove the 4 transmission crossmember nuts and bolts.



16. Remove the transmission insulator and retainer.

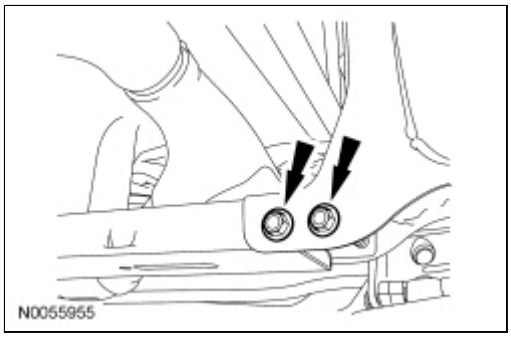
RWD

17. Remove the 2 transmission insulator and retainer nuts.

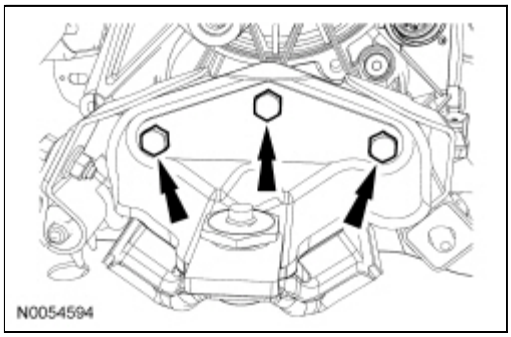


18. Position a suitable high-lift transmission jack under the transmission.

19. Remove the 4 transmission crossmember nuts and bolts (2 each side) and remove the transmission crossmember.



20. Remove the 3 transmission insulator and retainer bolts and remove the transmission insulator and retainer.

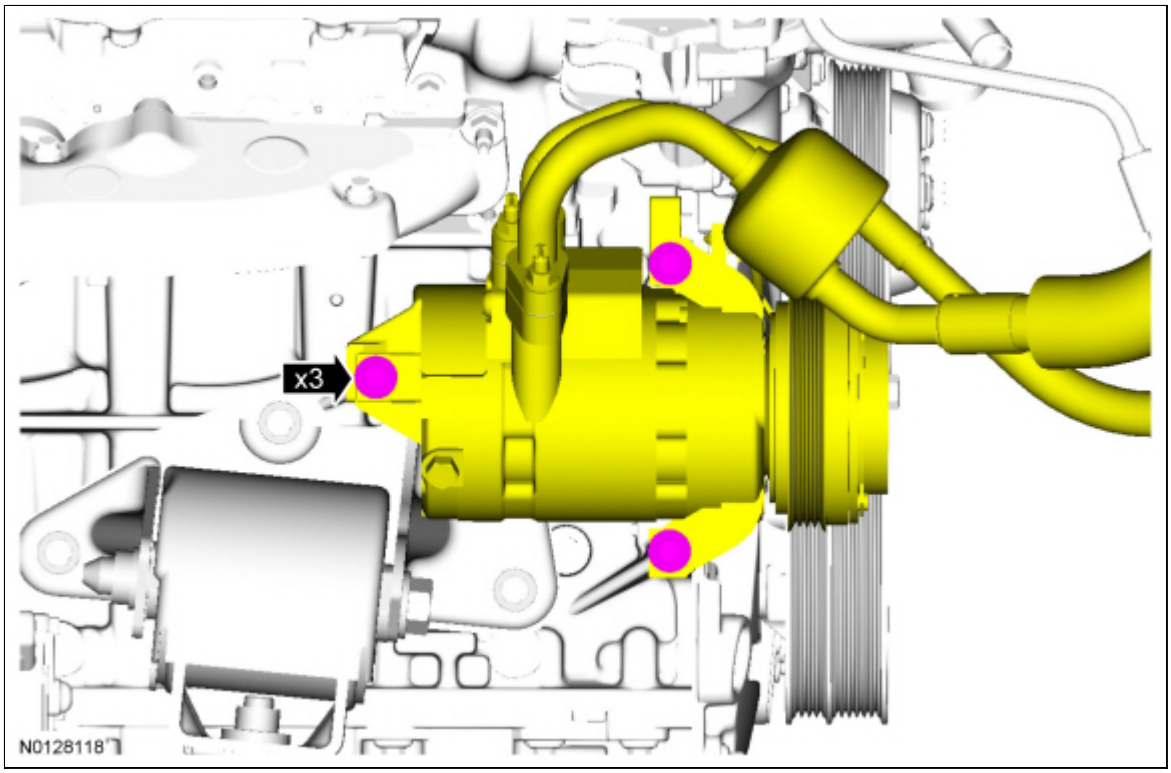


All vehicles

21. Install the exhaust Y-pipe - dual catalytic converter. Refer to Section 309-00 .

22. Position the A/C compressor and install the 3 A/C compressor bolts.
    - Tighten to 25 Nm (18 lb-ft).

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23. Install the A/C compressor belt. Refer to Section 303-05 .

24. Install the ACL outlet pipe, RH ACL pipe to-turbocharger pipe, RH turbocharger bypass hose and the RH turbocharger-to- CAC pipe. Refer to Intake Air System Components — Exploded View, 3.5L GTDI in Section 303-12 .

25. Fill the engine cooling system. Refer to Section 303-03 .

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General Specifications

Item	Specification
A/C compressor drive belt — 3.5L and 3.7L	4 ribs
A/C compressor drive belt — 5.0L	6 ribs
Accessory drive belt	6 ribs

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor drive belt tensioner bolt — 5.0L (4V) late build vehicles only	25	18	—
A/C compressor drive belt idler pully bolt — 5.0L (4V) late build vehicles only	25	18	—
Accessory drive belt tensioner bolts — 3.5L and 3.7L	25	18	—
Accessory drive belt tensioner bolt — 5.0L (4V)	47	35	—
Accessory drive belt tensioner bolts — 6.2L (2V)	25	18	—
Accessory drive belt idler pulley bolt — 6.2L (2V)	25	18	—

Accessory Drive

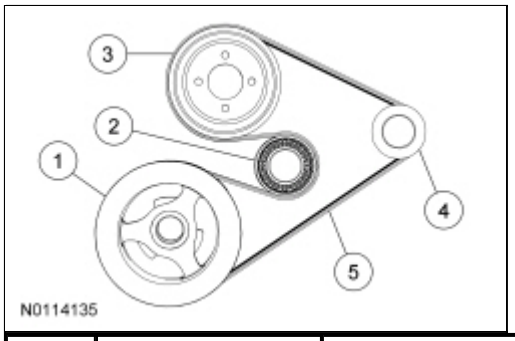
The accessory drive system:

- has a serpentine drive belt with 6 ribs.
- has a A/C compressor drive belt (3.5L, 3.7L and 5.0L only).
- has an automatic drive belt tensioner and idler pulley for the A/C compressor drive belt (5.0L).
- has an automatic drive belt tensioner for the accessory drive belt.
- has 2 or more idler pulleys (6.2L only).
- is not adjustable.

The accessory drive system provides power to operate components which power other systems. These could include components such as the generator, power steering pump and A/C compressor. Each of these components is equipped with a pulley which is driven by the accessory drive belt. The accessory drive belt is driven by the engine crankshaft pulley. One or more idler pulleys may be provided to facilitate belt routing and alignment. The automatic belt tensioner maintains correct belt tension and compensates for component wear and changes in system load. System load changes can be caused by the A/C compressor clutch engaging or disengaging, or demand changes on other systems powered by the accessory drive belt. To maintain correct operation of this system, it is critical that the correct length drive belt be installed. The pulleys must also be correctly aligned and kept clean.

Accessory Drive Belt Routing

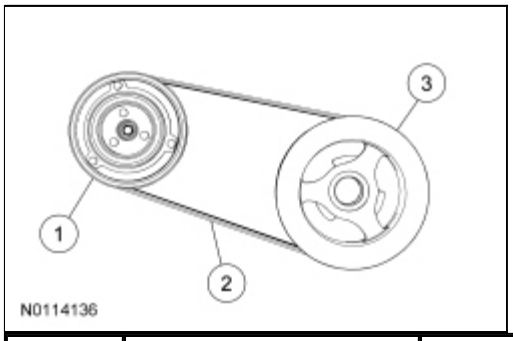
Front End Accessory Drive (FEAD) — 3.5L and 3.7L



Item	Part Number	Description
1	6316	Crankshaft pulley
2	6B209	Accessory drive belt tensioner pulley
3	8A528	Coolant pump pulley
4	10A352	Generator pulley
5	8620	Accessory drive belt

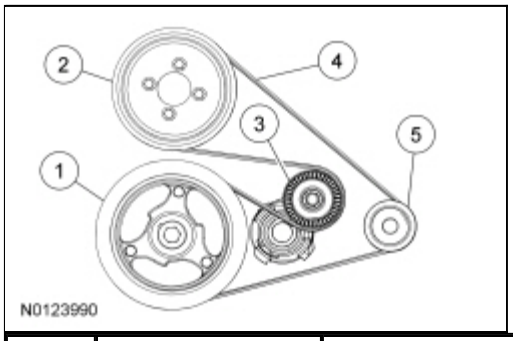
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A/C Compressor Drive Belt — 3.5L and 3.7L



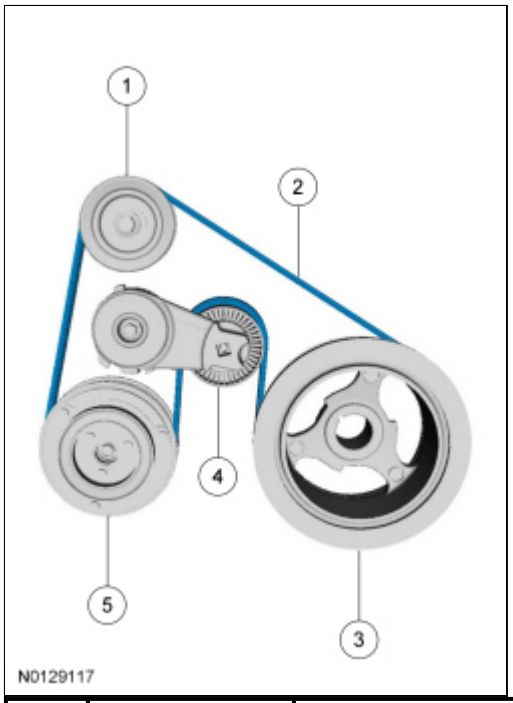
Item	Part Number	Description
1	19D784	A/C compressor pulley
2	6C301	Accessory drive belt
3	6316	Crankshaft pulley

Front End Accessory Drive (FEAD) — 5.0L (4V)



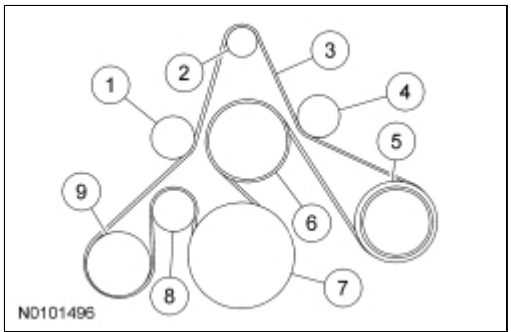
Item	Part Number	Description
1	6316	Crankshaft pulley
2	8A528	Coolant pump pulley
3	6B209	Accessory drive belt tensioner pulley
4	8620	Accessory drive belt
5	10300	Generator pulley

A/C Compressor Drive Belt — 5.0L (4V)



Item	Part Number	Description
1	19A216	A/C compressor drive belt idler pulley
2	6C301	A/C compressor drive belt
3	6316	Crankshaft pulley
4	6A228	A/C compressor drive belt tensioner pulley
5	19D784	A/C compressor pulley

Front End Accessory Drive (FEAD) — 6.2L (2V)



Item	Part Number	Description
1	8678	Belt idler pulley
2	10344	Generator pulley
3	8620	Drive belt
4	8678	Belt idler pulley
5	3A733	Power steering pump pulley

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6	8509	Coolant pump pulley
7	6312	Crankshaft pulley
8	6B209	Drive belt tensioner
9	19D784	A/C compressor pulley

Accessory Drive

Inspection and Verification

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

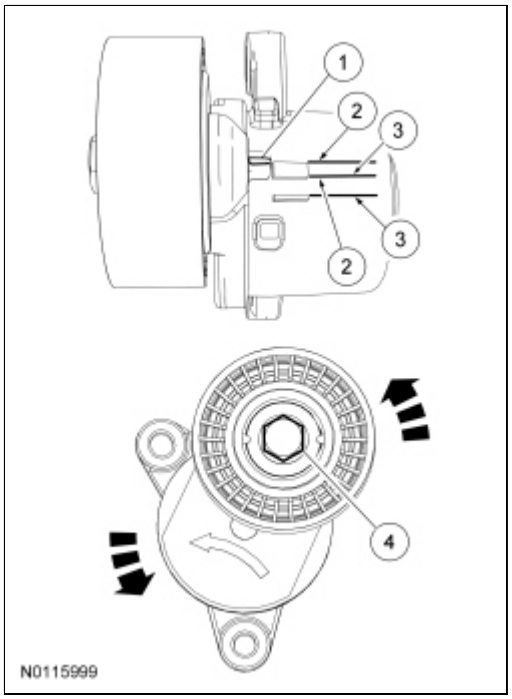
1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
● Drive belt cracking/chunking/wear ● Belt/pulley contamination ● Incorrect accessory drive belt ● Incorrectly routed accessory drive belt ● Pulley misalignment or excessive pulley runout ● Loose or mislocated hardware ● Loose accessory drive belt ● Damaged pulleys ● Tensioner arm misalignment

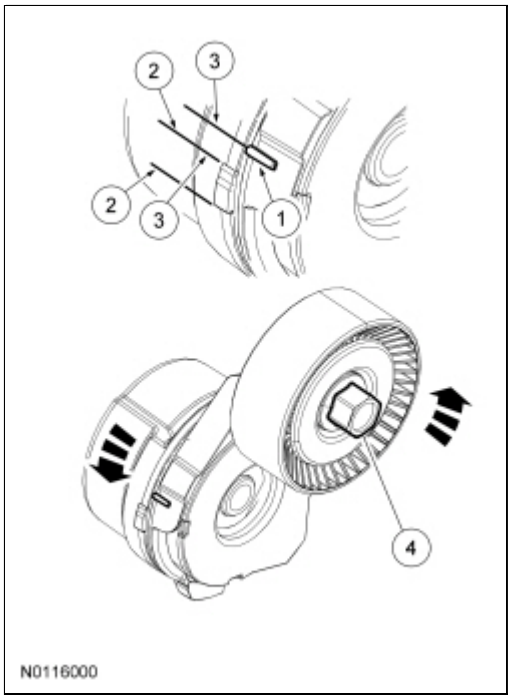
Belt Tensioner With Belt Length Indicator — 3.5L and 3.7L

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Item	Description
1	Belt length indicator
2	Acceptable belt installation and wear range
3	Belt replacement range
4	Belt tension relief point

Belt Tensioner With Belt Length Indicator — 5.0L



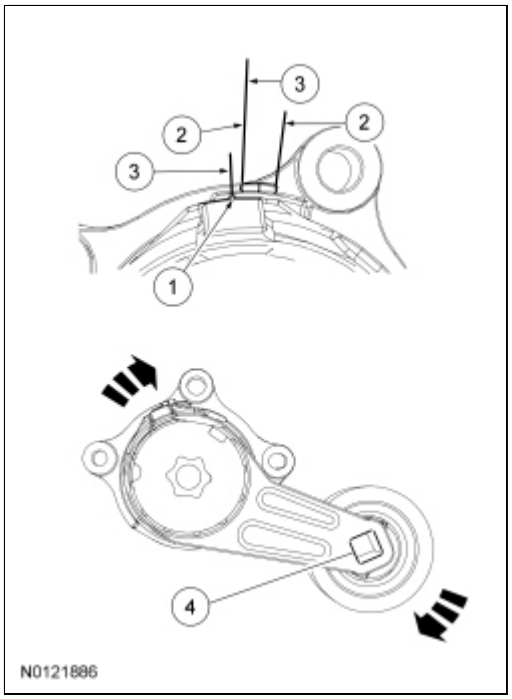
Item	Description
1	Belt length indicator
2	Acceptable belt installation and wear range
3	Belt replacement range
4	Belt tension relief point

Belt Tensioner With Belt Length Indicator — 6.2L

NOTE: 6.2L (2V) accessory drive belt tensioner shown, other accessory drive belt tensioners similar.

NOTE: Belt tensioner is shown in the free-state position against the arm travel stops.

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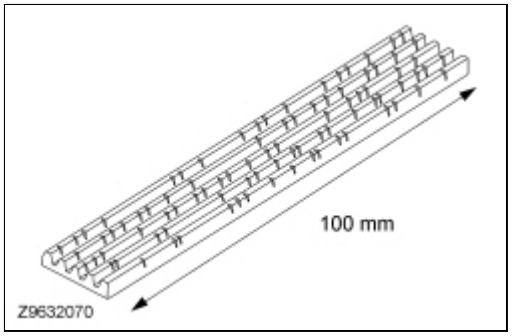
Item	Description
1	Belt length indicator
2	Acceptable belt installation and wear range
3	Belt replacement range
4	Belt tension relief point

3. Check that the belt length indicator, if equipped, on the belt tensioner is in the acceptable belt installation and wear range. If the indicator is in the belt replacement range, either an incorrect belt is installed or the belt is worn beyond the service limit. Install a new belt as necessary.

4. Eliminate all other non-belt related noises that could cause belt misdiagnosis, such as A/C compressor engagement chirp, A/C slugging noise, power steering cavitations at low temperatures, Variable Camshaft Timing (VCT) tick or generator whine.

5. If a concern is found, correct the condition before proceeding to the next step.

V-Ribbed Serpentine Drive Belt With Cracks Across Ribs

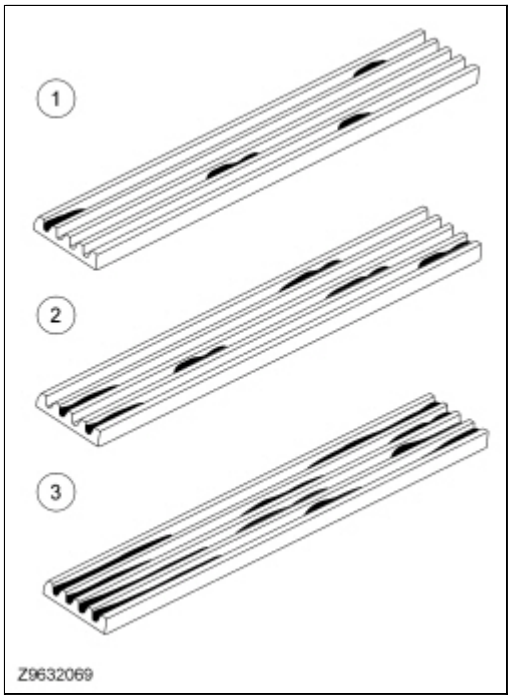


6. Check the belt for cracks. Up to 15 cracks in a rib over a distance of 100 mm (4.0 in) can be

considered acceptable. If cracks exceed this standard, install a new belt.

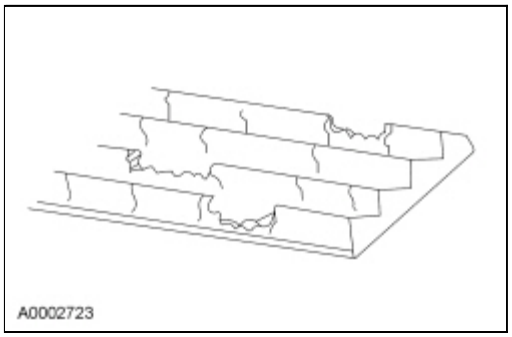
V-Ribbed Serpentine Belt With Piling

NOTE: Piling is an excessive buildup in the V-grooves of the belt.



7. The condition of the V-ribbed drive belt should be compared against the illustration and appropriate action taken.
    1. Small scattered deposits of rubber material. This is not a concern, therefore, installation of a new belt is not required.
    2. Longer deposit areas building up to 50% of the rib height. This is not considered a durability concern, but it can result in excessive noise. If noise is apparent, install a new belt.
    3. Heavy deposits building up along the grooves resulting in a possible noise and belt stability concern. If heavy deposits are apparent, install a new belt.

V-Ribbed Serpentine Belt With Chunks of Rib Missing



8. There should be no chunks missing from the belt ribs. If the belt shows any evidence of this, install a new accessory drive belt.

9. If the concern is not visually evident, verify the symptom and GO to Symptom Chart .

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Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Accessory drive belt cracking (over 15 cracks in a rib over a distance of 100 mm [4.0 in])	• Accessory drive belt	• INSPECT the accessory drive belt. REFER to Inspection and Verification in this section. INSTALL a new accessory drive belt as necessary.
• Accessory drive belt chunking	• Accessory drive belt	• INSPECT the accessory drive belt. REFER to Inspection and Verification in this section. INSTALL a new accessory drive belt as necessary.
	• Damaged pulley grooves	• INSPECT the accessory drive belt pulley grooves for damage. INSTALL a new pulley or component as necessary.
• Accessory drive belt noise, squeal, chirping or flutter	• Defective/worn or incorrect accessory drive belt • Misaligned pulley (s) • Pulley runout • Damaged or worn accessory drive component or idler • Fluid contamination of accessory drive belt or pulleys	• REFER to Component Tests, Drive Belt — Noise/Flutter in this section. REPAIR or INSTALL new parts as necessary.
	• Damaged or worn accessory drive belt tensioner	• REFER to Component Tests, Belt Tensioner — Mechanical and Belt Tensioner — Dynamics in this section. INSTALL a new accessory drive belt tensioner as necessary.
	• Damaged pulley grooves	• INSPECT the accessory drive belt pulley grooves for damage. INSTALL a new pulley or component as necessary.
	• Accessory drive component failure	• CHECK the accessory drive components. INSTALL new components as necessary.
	• Accessory drive belt idler pulley bearing failure	• INSPECT the accessory drive belt idler pulley for freedom of rotation and damage. INSTALL a new accessory drive belt idler pulley as necessary.
• Premature accessory drive belt wear	• Defective or incorrect accessory drive belt	• REFER to Component Tests, Drive Belt — Noise/Flutter and Drive Belt — Incorrect

	• Misaligned pulley (s) • Pulley runout • Damaged accessories • Incorrectly installed drive belt • Fluid contamination	Installation in this section. REPAIR or INSTALL new parts as necessary.
	• Damaged pulley grooves	• INSPECT the accessory drive belt pulley grooves for damage. INSTALL a new pulley or component as necessary.

Component Tests

Drive Belt — Noise/Flutter

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged or incorrectly aligned grooved pulley.

To correct, determine the area where the noise comes from. Check each of the pulleys in that area with a straightedge to the crankshaft pulley. Look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal may be an intermittent or constant noise that occurs when the drive belt slips on an accessory pulley under certain conditions.

A short intermittent squeal may occur during engine start up and shut down or during very rapid engine acceleration and decelerations, such as:

- Wide Open Throttle (WOT) 1-2 and 2-3 shifts or 2-3 and 3-4 back-out shifts on automatic transmissions.
- WOT 1-2 and 2-3 shifts and any combination of rapid downshifting on manual transmissions.

These special short-term transient events are expected, and are due to the higher system inertias required to meet the electrical and cooling demands on today's vehicle systems. Constant or reoccurring drive belt squeal can occur:

- if the A/C discharge pressure goes above specifications:
  - the A/C system is overcharged.
  - the A/C condenser core airflow is blocked.
  - the A/C anti-slugging strategy executes after a long hot heat soak.
- if the A/C off equalized pressure (the common discharged and suction pressure that occurs after several minutes) exceeds specifications.
- if any of the accessories or idler pulley(s) are damaged or have a worn or damaged bearing. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if there is evidence of fluid contamination on the accessory drive belt. When the drive belt has been

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exposed to fluid contamination during vehicle operation, such as leaks from the power steering system, A/C system or cooling system, clean all pulleys with soap and water, rinse with clean water and install a new accessory drive belt. If the drive belt has been exposed to fluids in a localized area during routine vehicle service, such as replacement of hoses or fluids, the drive belt and pulleys should be washed with soap and water immediately (prior to starting the engine), and rinsed with clean water.

- if the accessory drive belt is too long. A drive belt that is too long will allow the accessory drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the accessory drive belt tensioner indicator is outside the normal installation wear range window, install a new accessory drive belt.
- **NOTE:** The accessory drive belt tensioner arm should rotate freely without binding.

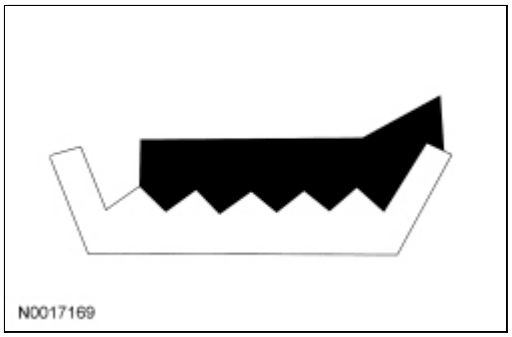
Install a new accessory drive belt tensioner if the drive belt tensioner is worn or damaged.

Drive Belt — Incorrect Installation

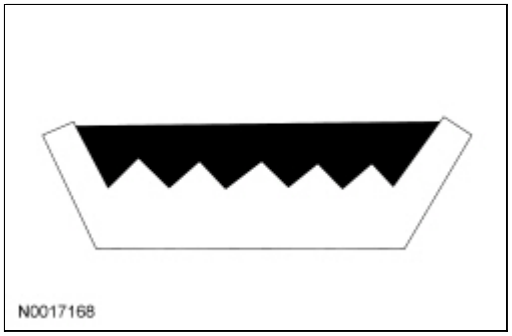
NOTICE: **Incorrect accessory drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the pulleys.**

Non-standard accessory drive belts can track differently or incorrectly. If an accessory drive belt tracks incorrectly, install a new accessory drive belt to avoid performance failure or loss of the drive belt.

Incorrect Installation



Correct Installation



With the engine running, check accessory drive belt tracking on all pulleys. If the edge of the accessory drive belt rides beyond the edge of the pulleys, noise and premature wear will occur. Make sure the accessory drive belt rides correctly on the pulley. If an accessory drive belt tracking condition exists, proceed with the following:

- Visually check the accessory drive belt tensioner for damage and wear, especially the mounting pad surface and arm alignment. If the accessory drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. If the tensioner arm is worn, the arm will be out of alignment. Either of these conditions will result in chirp and squeal noises.
- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
- Check all accessories, mounting brackets and the accessory drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the accessory drive belt tracking.
- Tighten all accessories, mounting brackets and accessory drive belt tensioner retaining hardware to specification. Recheck the accessory drive belt tracking.

Belt Tensioner — Mechanical

The only mechanical check that needs to be made is a check for tensioner stick, grab or bind.

1. With the engine off, check routing of the accessory drive belt. Refer to the illustrations under Accessory Drive in the Description and Operation portion of this section.

2. **NOTE:** The accessory drive belt tensioner spring is very strong and requires substantial force to release.

   Using a suitable, commercially available serpentine belt tensioner release tool, release the tension on the belt and detach the accessory drive belt from the tensioner. Carry out the following tests:
   - Using the release tool, move the tensioner from its relaxed position, through its full stroke and back to the relaxed position to make sure there is no stick, grab or bind, and to make sure that there is tension on the tensioner spring.
   - Rotate the tensioner pulley by hand and check for a binding, contaminated or seized condition.
   - Inspect the area surrounding the accessory drive belt tensioner for oil leaks or contamination and repair any leaks.

3. If the accessory drive belt tensioner does not meet the criteria in the previous step, install a new tensioner. If the accessory drive belt tensioner meets the criteria in the previous step, proceed to testing the tensioner dynamically.

4. If the tensioner is saturated with oil and grease internally, install a new tensioner.

Belt Tensioner — Dynamics

The accessory drive belt tensioner can be checked dynamically as follows:

1. With the engine running, observe the accessory drive belt tensioner movement. The accessory drive tensioner should move (respond) when the A/C clutch cycles (if equipped), or when the engine is accelerated rapidly. If the accessory drive belt tensioner movement is excessive without A/C clutch cycling or engine acceleration, check belt rideout. Excessive belt rideout (uneven depth of grooves in the belt) can cause excessive accessory drive belt tensioner movement. Check rideout condition by installing a new belt. If excessive accessory drive belt tensioner movement still exists, install a new accessory drive belt tensioner.

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Air Conditioning (A/C) Compressor Belt — 3.5L GTDI, 3.7L, 5.0L

Special Tool(s)

 ST3085-A	Remover, Stretchy Belt 303-1419

Removal

NOTICE: **Under no circumstances should the A/C compressor belt, accessory drive belt, tensioner or pulleys be lubricated as potential damage to the belt material and tensioner damping mechanism will occur. Do not apply any fluids or belt dressing to the A/C compressor belt, accessory drive belt or pulleys.**

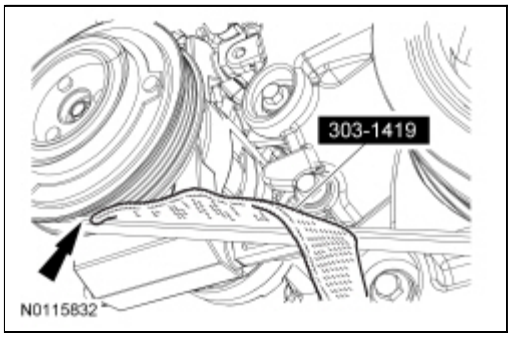
All Engines

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive belt. For additional information, refer to Front End Accessory Drive (FEAD) — Exploded View in this section.

3.5L and 3.7L Engines

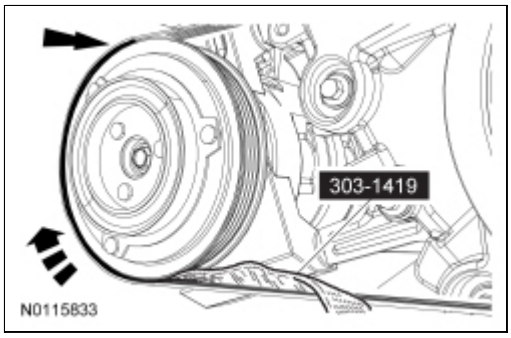
3. Position the Stretchy Belt Remover on the A/C compressor belt as shown.



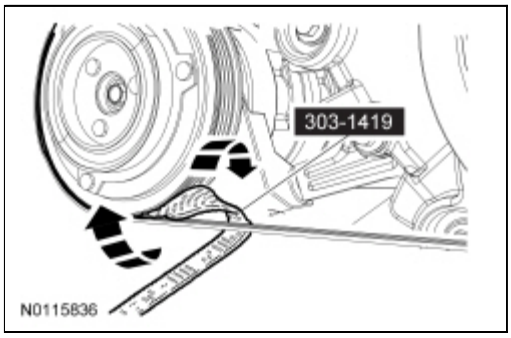
4. **NOTE:** Feed the Stretchy Belt Remover on to the A/C compressor pulley approximately 180 degrees.

   Turn the crankshaft clockwise and feed the Stretchy Belt Remover evenly between the A/C compressor pulley and the A/C compressor belt as shown.

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5. Remove the A/C compressor belt.
    - Fold the Stretchy Belt Remover around the inside of the A/C compressor belt as shown.
    - In one quick motion, firmly pull the Stretchy Belt Remover from below the vehicle and remove the A/C compressor belt.

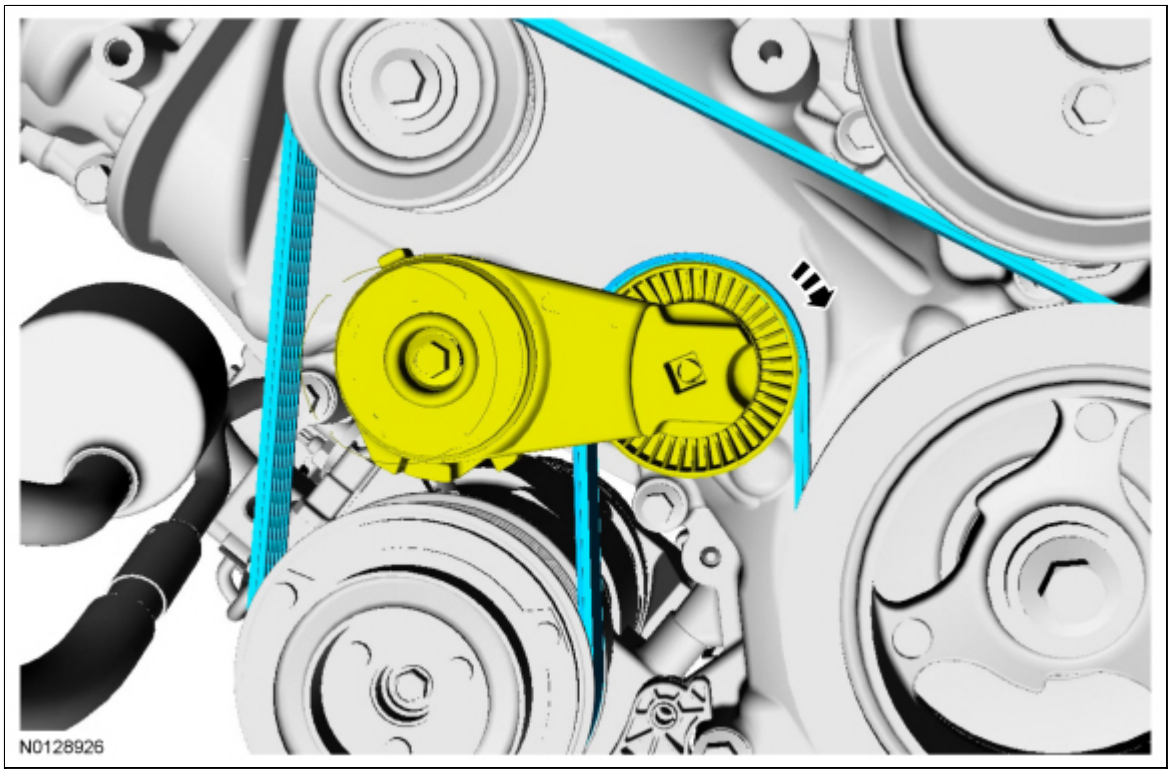


5.0L (4V) Early Build Vehicles

6. Cut the A/C compressor belt and discard the belt.

5.0L (4V) Late Build Vehicles

7. Rotate the drive belt tensioner clockwise and detach the A/C compressor drive belt from the idler pulley and remove the A/C compressor drive belt.



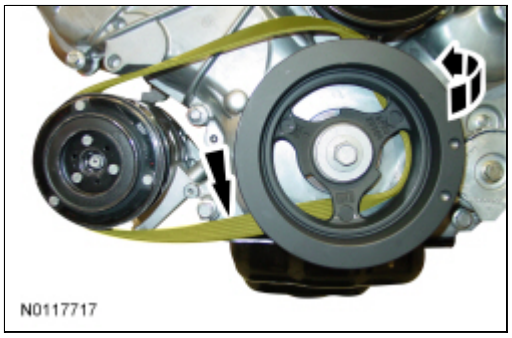
Installation

3.5L GTDI, 3.7L, 5.0L (4V) Early Build Vehicles

1. **NOTE:** 5.0L (4V) engine shown, 3.5L and 3.7L engines similar.

   Position the A/C compressor belt in 2 stages.
   - Stage 1: Slide the A/C compressor belt between the crankshaft pulley and the accessory drive belt tensioner.
   - Stage 2: Position the A/C compressor belt behind the crankshaft pulley with the accessory drive belt ribs facing towards the front of the vehicle.
   - **NOTE:** Make sure the A/C compressor belt is correctly seated on the A/C compressor pulley.

     Stage 3: Position the A/C compressor belt onto the A/C compressor pulley with the lower portion of the accessory drive belt ribs facing towards the front of the vehicle and above the oil pan as shown.

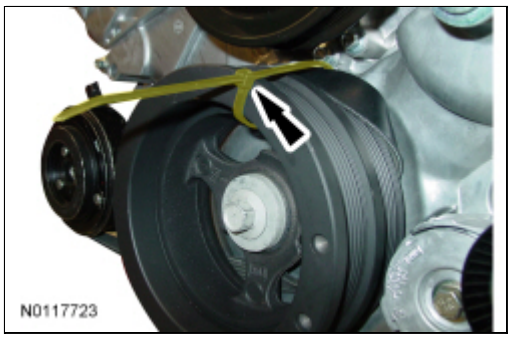


2. **NOTE:** 5.0L (4V) engine shown, 3.5L and 3.7L engines similar.

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NOTE: After installation, make sure the A/C compressor belt is correctly seated on the crankshaft and A/C compressor pulleys.

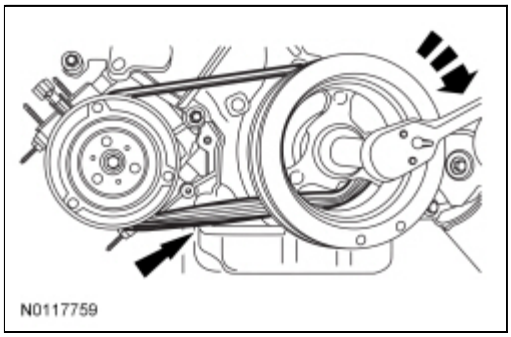
Position the A/C compressor belt onto the top of the crankshaft pulley and feed a tie strap with a minimum width of 3 mm (0.12 in) through the crankshaft pulley spokes, up and over the A/C compressor belt and tighten the tie strap.



3. ***NOTICE:*** **The A/C compressor belt must be above the oil pan flange or damage to the A/C compressor belt and engine can occur.**

   NOTE: 5.0L (4V) engine shown, 3.5L and 3.7L engines similar.

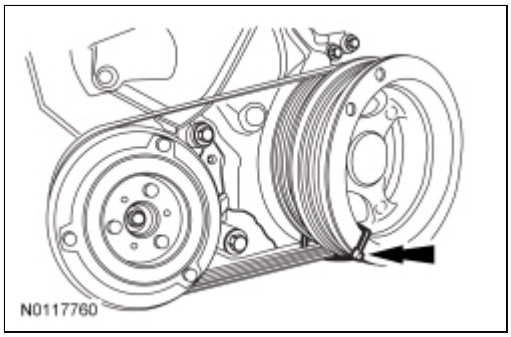
   With the A/C compressor belt positioned above the oil pan flange, rotate the crankshaft by hand clockwise until the tie strap is at the 6 o'clock position.



4. **NOTE:** 5.0L (4V) engine shown, 3.5L and 3.7L engines similar.

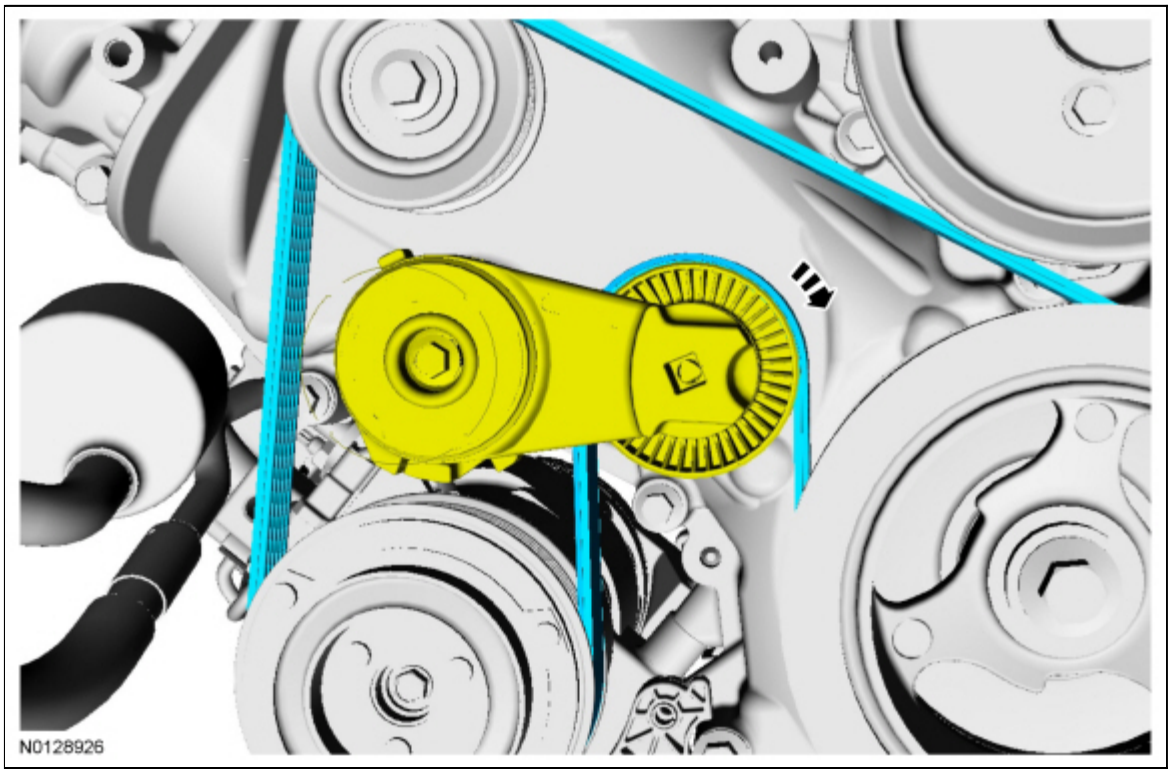
   NOTE: After installation, make sure the A/C compressor belt is correctly seated on the crankshaft and A/C compressor pulleys.

   Remove the tie strap and rotate the crankshaft clockwise 1 full rotation to verify the A/C compressor belt has correctly seated onto the crankshaft and A/C compressor pulleys.



5.0L (4V) Late Build Vehicles

5. Position the A/C drive belt and rotate the drive belt tensioner clockwise and attach the A/C compressor drive belt to the idler pulley.



All Engines

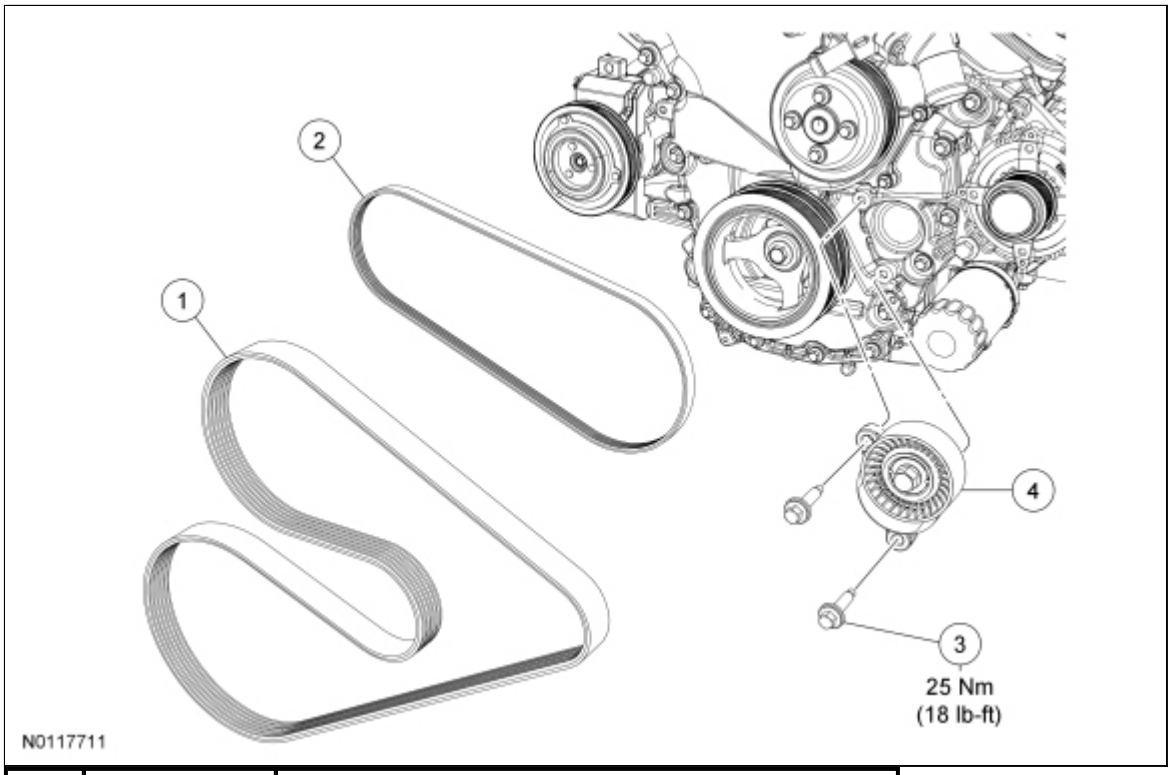
6. Install the accessory drive belt. For additional information, refer to Front End Accessory Drive (FEAD) — Exploded View in this section.

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Front End Accessory Drive (FEAD) — Exploded View

3.5L and 3.7L

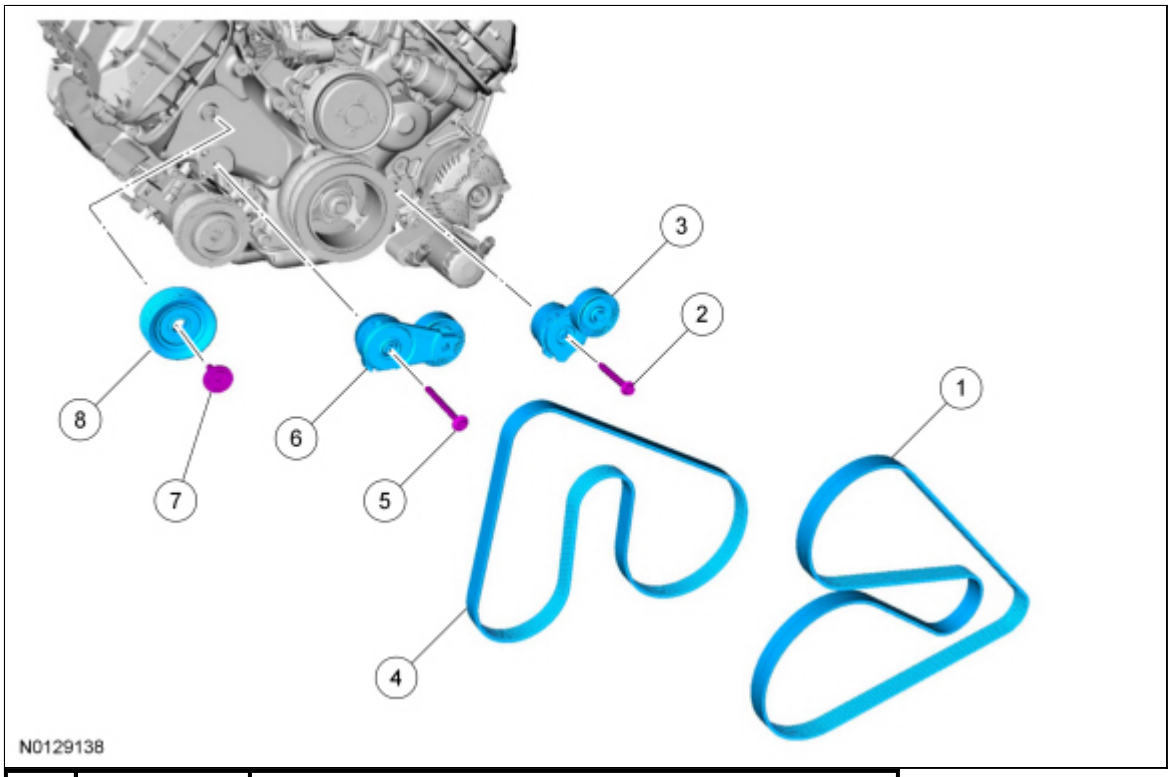
NOTE: 3.7L shown 3.5L similar.



Item	Part Number	Description
1	8620	Accessory drive belt
2	6C301	A/C compressor drive belt
3	W713261	Accessory drive belt tensioner bolt (2 required)
4	6B209	Accessory drive belt tensioner

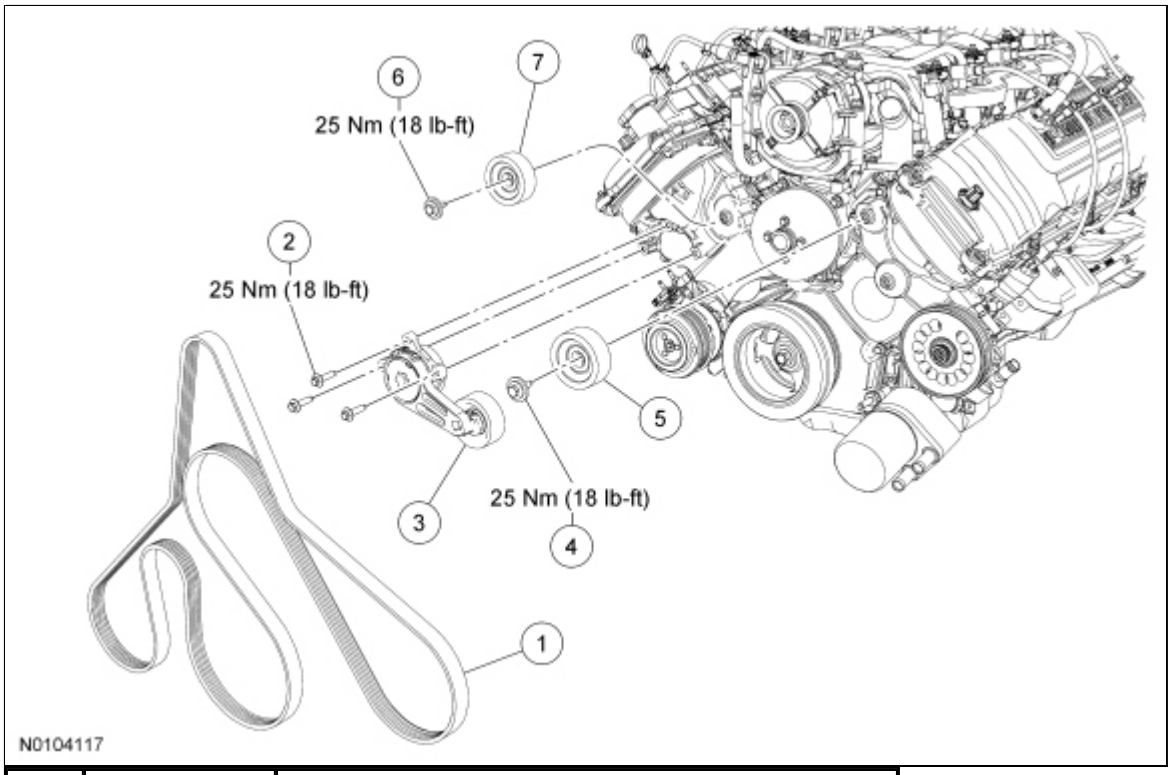
5.0L (4V)

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Item	Part Number	Description
1	8620	Accessory drive belt - 47 Nm (35 lb-ft)
2	W709638	Accessory drive belt tensioner bolt
3	6B209	Accessory drive belt tensioner
4	6C301	A/C compressor drive belt
5	Part of 6A228	A/C compressor drive belt tensioner bolt - 34 Nm (25 lb-ft)
6	6A228	A/C drive compressor belt tensioner
7	W707288	A/C compressor drive belt idler pulley bolt - 25 Nm (18 lb-ft)
8	19A216	A/C compressor drive belt Idler pulley

6.2L (2V)



Item	Part Number	Description
1	8620	Accessory drive belt
2	N808920	Accessory drive belt tensioner bolt (3 required)
3	6B209	Accessory drive belt tensioner
4	N808102	Accessory drive belt idler pulley bolt
5	19A216	Accessory drive belt idler pulley
6	N808102	Accessory drive belt idler pulley bolt
7	19A216	Accessory drive belt idler pulley

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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General Specifications

Item	Specification
Normal engine cranking speed	140-220 rpm
Starter motor maximum load	800 amps [a]
Starter motor maximum voltage drop (engine at normal operating temperature)	0.5 volt
Starter motor minimum stall torque (at 5 volts)	14.7 Nm (10.8 lb-ft)
Starter motor no load current draw	60-84 amps
Starter motor normal load current draw	130-220 amps [b]

[a] Initial "in-rush" current draw.
[b] Continuously running current draw.

Torque Specifications

Description	Nm	lb-ft	lb-in
Starter motor mounting bolts — 3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L	48	35	—
Starter motor mounting bolts — 5.0L (4V) and 6.2L (2V)	25	18	—
Starter motor mounting stud bolts — 5.0L (4V) and 6.2L (2V)	25	18	—
Starter motor ground cable nut — 5.0L (4V) and 6.2L (2V)	25	18	—
Starter solenoid B+ terminal nut	12	—	106
Starter solenoid S-terminal nut	5	—	44

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Starting System

The starting system consists of the following:

- Fuse(s)
- Battery
- Battery cables
- Ignition switch
- Starter motor
- Run/start relay (located in the Battery Junction Box (BJB))
- Starter relay (located in the Battery Junction Box (BJB))
- PCM (located on the RH side of cowl)
- Body Control Module (BCM)
- Transmission Range (TR) sensor (located inside the transmission)
- Integrated Keyhead Transmitter (IKT)
- Tire Pressure Monitor Module (TPM) (TPM is standard equipment, also used for optional remote start feature)
- External antenna (if equipped with remote start)
- Hood switch (hood switch is standard equipment, also used for optional remote start feature)

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Starting System

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

NOTE: This vehicle is equipped with Passive Anti-Theft System (PATS) that disables the engine from cranking and starting if an unprogrammed PATS key is used or an invalid PCM ID is received. PATS is controlled by the Body Control Module (BCM). If there is a PATS concern that causes the engine to disabled, the Instrument Panel Cluster (IPC) displays "STARTING SYSTEM FAULT" in the message center. Refer to Section 419-01B to diagnose a PATS concern.

The starter system controls the cranking of the engine. The starter motor is enabled by the starter relay when the relay is activated by the PCM. The starting system is electronically controlled by the PCM. The PCM requires the following inputs:

- Ignition switch request to start the engine
- Run/start relay voltage
- PATS enable status from the BCM
- Correct transmission PARK or NEUTRAL input from the Transmission Range (TR) sensor

Under normal operation when the ignition is turned to the START position, the BCM generates a key verification message. It sends this message to the PATS transceiver. The transceiver reads the key and sends a key verification message back to the BCM . If the message received does not match the key verified in the BCM memory, the engine is disabled and does not crank and start. Once the BCM determines the correct programmed key is in the ignition, the BCM sends the PCM a valid PATS message. When the PCM receives the message, it generates a response and sends it back to the BCM . If the response from the PCM does not match the response in the BCM memory, PATS is not enabled and the engine does not crank. If

both the key verification and PCM ID pass, PATS is enabled. The PCM recognizes the correct electronically coded passive key and provides voltage and ground to the starter relay coil. The starter relay coil is energized causing the relay contacts to close providing voltage to the starter solenoid, allowing the starter motor to crank and start the engine. The PCM disengages the starter once an engine rpm threshold is reached, a set crank time is exceeded or the ignition is turned OFF. The BCM also enables the Run/start relay which sends voltage to the PCM. If the PCM does not receive this voltage the engine will not crank.

The TR sensor prevents operation of the starter motor unless the transmission is in NEUTRAL or PARK.

Remote Start

The factory remote start system (if equipped) does not operate if the ignition is in the RUN/START position or the hood is not closed.

The remote start system can be enabled or disabled by the customer. When enabled, the customer can set the engine run time for 5, 10 or 15 minutes. For information on setting the engine run time, refer to the Owner's Literature or Section 413-01 .

The remote start system enables the engine to be started from up to 100 m (328 ft) away, by pressing a sequence of buttons on the Integrated Keyhead Transmitter (IKT). The remote start system is activated by pressing the lock button on the IKT , to make sure the doors are locked, followed by 2 presses of the remote start button. The 3 button presses must occur within 3 seconds. The system acknowledges the start request by flashing the exterior lights twice. Once started, the engine runs for 10 minutes (default run time is 10 minutes; the time can be programmed by the customer to 5, 10 or 15 minutes) and the parking lights remain illuminated until the cycle is complete. The remote start duration can also be extended by initiating remote start while the first timer is still running or by initiating a completely independent start cycle when the first has completed. No more than 2 remote start sequences can occur within a one hour period, unless the ignition is set to the RUN/START position between the remote start requests. During the remote start cycle the power windows are inhibited and the radio will not turn on automatically but may be switched on manually from inside the vehicle. If the remote start system fails to start the horn chirps twice.

To transition from remote start mode to drive mode, use a programmed IKT to switch the ignition to the RUN position. If a programmed IKT is not used, the engine shuts off.

To deactivate the remote start system, press the remote start button once. When deactivating the remote start system the parking lights turn off to give a visual indication that the engine and climate control features have turned off. It may be necessary to be closer to the vehicle to deactivate the remote start feature than it was to initiate it due to ground deflections and added noise from the engine running.

The remote start system conditions the cabin temperature during remote start based on the outside temperature. For information on cabin temperature conditioning during remote start, refer to Section 412-00 .

Inspection and Verification

WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

NOTE: Make sure the anti-theft system is functioning correctly before carrying out a logical starting system diagnosis. Address anti-theft system concerns before continuing. Refer to Section 419-01B .

1. Verify the customer concern by operating the starting system.

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2. Check the battery condition and state of charge. Section 414-01 .

3. Remove the accessory drive belt. Refer to Section 303-05 . Verify the crankshaft and each of the components driven by the accessory drive belt rotate and are not seized or damaged.

4. If any aftermarket accessories have been added to the vehicle, make sure they are properly wired.

5. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
• Starter motor • Starter motor bolts	• Battery • Battery cables • Battery Junction Box (BJB) Starter relay • Battery Junction Box (BJB) Run/start relay • Battery Junction Box (BJB) fuse 13 (30A) • Body Control Module (BCM) fuse 28 (15A) • Loose or corroded connections

6. If an obvious cause for an observed or reported concern is found, correct the cause before proceeding to the next step.

7. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

8. **NOTE:** The LED prove out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

9. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no communication with the scan tool.

10. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, proceed with module self-test diagnostics.

11. Carry out the self-test diagnostics for the BCM , PCM and Tire Pressure Monitor Module (TPM) (TPM is standard equipment, also used for optional remote start feature).

12. If the DTCs retrieved are related to the concern, go to DTC Charts.

13. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

PCM DTC Chart

DTC	Description	Action
P0512	Starter Request Circuit — Circuit has Power With the Ignition in the OFF Position	CARRY OUT the Ignition Switch Component Test. Refer to Wiring Diagrams Cell 149 for component testing. If necessary, INSTALL a new ignition switch. If the ignition switch passed the component test, REPAIR circuit CDC35 (BU/WH) for a short to voltage.
P0705	Transmission Range Sensor A Circuit (PRNDL Input): No Sub Type Information	REFER to Section 307-01 to diagnose the Transmission Range (TR) sensor concern.
P0706	Transmission Range Sensor "A" Circuit Range/Performance: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P0707	Transmission Range Sensor "A" Circuit Low: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P0708	Transmission Range Sensor "A" Circuit High: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P0709	Transmission Range Sensor "A" Circuit Intermittent: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P161A	Incorrect Response From Immobilizer Control Module	REFER to Section 419-01B .
P1702	Transmission Range Sensor Circuit Intermittent: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P1705	Transmission Range Circuit Not Indicating Park/Neutral During Self Test: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P1921	Transmission Range Signal: No Sub Type Information	REFER to Section 307-01 to diagnose the TR sensor concern.
P2532	Ignition Switch Run Position Circuit High	GO to Pinpoint Test G .
P2535	Ignition Switch Run/Start Position Circuit High	GO to Pinpoint Test G .
All other PCM DTCs	—	REFER to Section 303-14 .

Body Control Module (BCM) DTC Chart

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DTC	Description	Action
B1305:01	Hood Switch: General Electrical Failure	REFER to Section 419-01A .
C113A:11	Wake up Control: Circuit Short to Ground	GO to Pinpoint Test C .
C113A:15	Wake up Control: Circuit Short to Battery or Open	GO to Pinpoint Test C .
U1000:00	Solid State Driver Protection Activated - Driver Disabled: No Sub Type Information	The Body Control Module (BCM) has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first. After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
All other DTCs	—	REFER to Section 419-10 .

Tire Pressure Monitor (TPM) Module DTC Chart

DTC	Description	Action
B1D55:01	Antenna #2: General Electrical Failure	GO to Pinpoint Test D .
All other DTCs	—	REFER to Section 204-04 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The engine does not crank	• Battery • Battery cables • Fuses • Starter motor • PCM • Starter relay • Run/start relay • Ignition switch • Transmission Range (TR) sensor • Passive Anti-Theft System (PATS) • Body Control Module (BCM) • Wiring, terminals or connectors	• GO to Pinpoint Test A .
• Unusual starter noise	• Starter motor • Starter motor mounting	• GO to Pinpoint Test B .

	• Starter motor engagement • Flexplate ring gear	
• The engine cranks slowly	• Battery • Battery cables • Starter motor • Wiring, terminals or connectors	• CARRY OUT the Starter Motor — Feed Circuit and Starter Motor — Ground Circuit Tests. REFER to Component Tests in this section.
• The engine cranks but does not start.	• Fuses • PCM • Fuel pump • Fuel pump relay	• Powertrain Control/Emissions Diagnosis (PC/ED) manual
• The starter spins but the engine does not crank	• Damaged flexplate • Starter motor	• REFER to Starter Motor Drive Gear and Flywheel Ring Gear Inspection in this section to continue diagnosis.
• The starter does not disengage from the flexplate	• Starter motor • Wiring, terminal or connectors • Starter relay	• REFER to Starter Motor Drive Gear and Flywheel Ring Gear Inspection in this section to continue diagnosis. • REMOVE the starter relay, if the engine stops cranking INSTALL a new relay. If the engine continues to crank, REPAIR circuit CDC25 (BN/GN) for a short to voltage.
• The remote start system operates with reduced range	• Wiring, terminals or connectors • External antenna • Tire Pressure Monitor Module (TPM)	• GO to Pinpoint Test D .
• The remote start is inoperative	• Wiring, terminals or connectors • Remote start feature not enabled • Integrated Keyhead Transmitter (IKT) • Hood switch • PCM	• GO to Pinpoint Test E .
• One-Touch Integrated Start (OTIS) is inoperative	• OTIS not enabled	• Using a scan tool, ENABLE OTIS .

Pinpoint Tests

Pinpoint Test A: The Engine Does Not Crank

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Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Normal Operation

When the ignition switch is turned to the START position, the Body Control Module (BCM) and PCM receive a request to start the engine. When the PCM receives the correct coded key ID messages from the BCM , voltage from the Run/start relay, and the correct input from the Transmission Range (TR) sensor that the gear selector is in PARK or NEUTRAL, voltage and ground is supplied to the starter relay coil. When the starter relay is energized the relay contacts close. Voltage is then supplied from Battery Junction Box (BJB) fuse 13 (30A) to the starter relay contacts which supplies voltage to the starter solenoid. The starter solenoid is grounded at the starter motor. Energizing the starter solenoid engages the starter drive into the ring gear and closes the starter solenoid contacts allowing voltage directly from the battery to the starter motor to crank the engine. The PCM disengages the starter once an RPM threshold is reached, a set crank time is exceeded or the ignition switch is turned to the OFF position.

This pinpoint test is intended to diagnose the following:

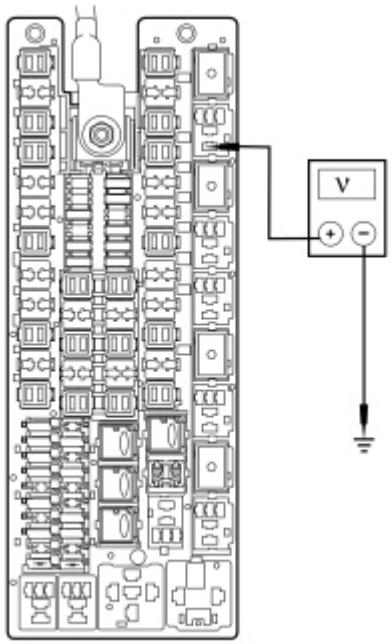
- Battery
- Battery cables
- Fuses
- Ignition switch
- PCM
- Starter motor
- Starter relay
- TR sensor
- Passive Anti-Theft System (PATS)
- BCM
- Wiring, terminals or connectors

PINPOINT TEST A: THE ENGINE DOES NOT CRANK

Test Step	Result / Action to Take
A1 PERFORM INSPECTION AND VERIFICATION	**Yes** Correct the cause as necessary. **No** GO to A2 .
NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test. **NOTE:** If it is necessary to leave the battery charger connected during testing, do not leave it on its highest setting. The highest and boost settings can occasionally exceed 16 volts, resulting in false test results and setting DTCs. • Perform the Inspection and Verification procedure in this section. • **Was an obvious cause for an observed or reported concern found?**	
A2 CHECK FOR ANY MESSAGES IN THE MESSAGE CENTER	**Yes** REFER to Section 419-01B . **No** GO to A3 .
• Ignition ON. • Check the message center with the ignition key in the RUN position. • **Is STARTING SYSTEM FAULT displayed in the message center?**	
A3 VERIFY BCM AND PCM PASS THE NETWORK TEST	

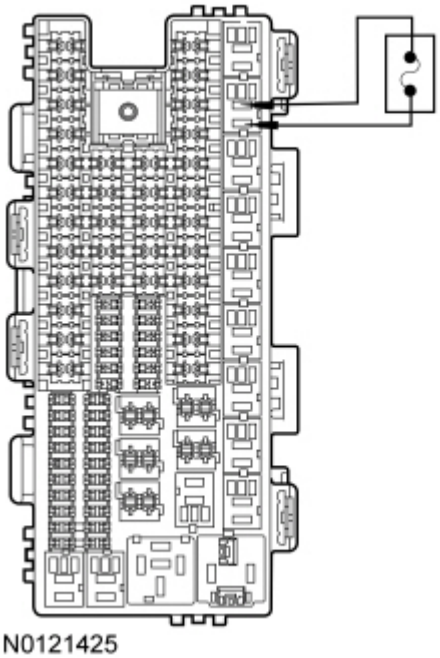
• Ignition ON. • Using a diagnostic scan tool, perform the Network Test. • **Did the BCM and PCM pass the Network Test?**	**Yes** GO to A4 . **No** REFER to Section 418-00 .
A4 RETRIEVE BCM AND PCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM — Self-Test. • Enter the following diagnostic mode on the scan tool: PCM — Self-Test. • **Were DTCs retrieved during the self-test?**	**Yes** REFER to the DTC Charts in this section. **No** GO to A5 .
A5 CHECK THE PCM TRANSMISSION RANGE TR SENSOR PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — PCM. • While observing the TR PID, place the gear selector in PARK and then NEUTRAL. • **Does the PID match the selector lever position?**	**Yes** GO to A6 . **No** REFER to Section 307-01 , to diagnose the TR sensor concern.
A6 CHECK THE BCM IGN_SW_STATE PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — BCM. • While holding the key in the START position, monitor the BCM IGN_SW_STATE PID. • **Does the PID change from OFF to START?**	**Yes** GO to A7 . **No** DIAGNOSE No power in Start. REFER to Section 211-05 .
A7 CHECK THE STARTER MOTOR RELAY	
• Swap the starter relay with a known good relay and attempt to crank the engine. • **Does the engine crank?**	**Yes** INSTALL a new starter relay. **No** GO to A8 .
A8 CHECK THE VOLTAGE TO THE STARTER RELAY	
• Ignition OFF. • Disconnect: Starter Relay. • Measure the voltage between starter relay socket 3, circuit SBB13 (GY/RD) and ground.	**Yes** GO to A9 . **No** VERIFY BJB fuse 13 (30A) is OK. If OK, REPAIR circuit SBB13 (GY/RD) for an open. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.

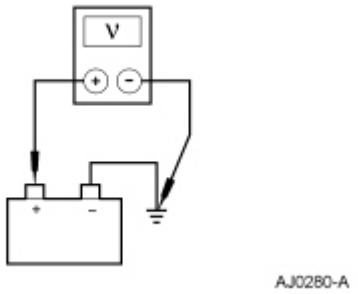
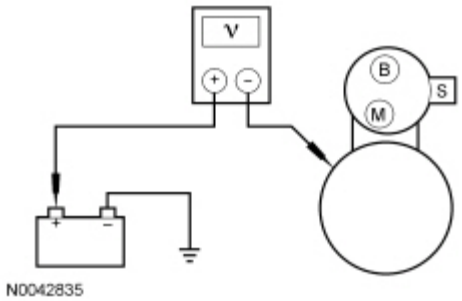
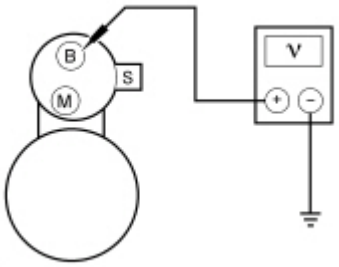
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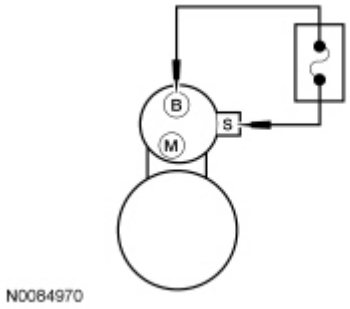
N0121935

- **Is the voltage greater than 11 volts?**

A9 CHECK THE STARTER MOTOR	
• With the transmission in PARK, connect one end of a fused jumper wire to starter relay socket 3, circuit SBB13 (GY/RD) and momentarily connect the other end of the fused jumper wire to starter relay socket 5, circuit CDC25 (BN/GN).  N0121425 • **Did the starter motor engage and the engine crank?**	**Yes** GO to A15 . **No** GO to A10 .
A10 CHECK THE BATTERY GROUND CABLE	
• Measure the voltage between the positive battery post and	**Yes**

the battery ground cable connection at the engine.  AJ0280-A • **Is the voltage greater than 11 volts?**	GO to A11 . **No** INSTALL new battery cables. REFER to Section 414-01 . TEST the system for normal operation.
A11 CHECK THE STARTER MOTOR GROUND	
• Measure the voltage between the positive battery post and the starter motor case.  N0042835 • **Is the voltage greater than 11 volts?**	**Yes** GO to A12 . **No** CLEAN the starter motor mounting flange and make sure the starter motor is correctly mounted. TEST the system for normal operation.
A12 CHECK THE VOLTAGE TO THE STARTER MOTOR	
• Measure the voltage between the starter solenoid C197A-1, circuit SDC02 (RD) and ground.  N0042836 • **Is the voltage greater than 11 volts?**	**Yes** GO to A13 . **No** INSTALL new battery cables. REFER to Section 414-01 . TEST the system for normal operation.
A13 CHECK THE STARTER MOTOR	
• Connect one end of a fused jumper wire to starter solenoid C197A-1, circuit SDC02 (RD) and momentarily connect the other end of the fused jumper wire to starter solenoid C197B-1, circuit CDC25 (BN/GN).	**Yes** GO to A14 . **No** INSTALL a new starter motor. REFER to Starter Motor — 3.5L GTDI, 3.7L or Starter Motor — 5.0L (4V), 6.2L (2V) in this section. TEST the system for

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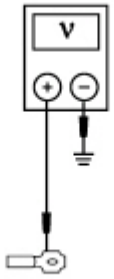
N0084970

- **Did the starter engage and the engine crank?**

normal operation.

A14 CHECK FOR START INPUT AT THE STARTER

- Connect: Starter Relay.
- Disconnect: Starter Solenoid C197B.
- Measure the voltage between the starter solenoid C197B-1, circuit CDC25 (BN/GN) and ground, while holding the key in the START position.



AJ0285-A

- **Is the voltage greater than 11 volts?**

Yes
CLEAN the starter solenoid "S" terminal and C197B. CHECK the wiring and the starter motor for a loose or intermittent connection. TEST the system for normal operation.

No
REPAIR circuit CDC25 (BN/GN) for an open. TEST the system for normal operation.

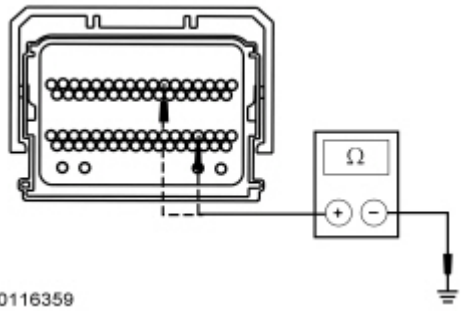
A15 CHECK THE PCM START CIRCUITS FOR A SHORT TO GROUND

- Disconnect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).
- Measure the resistance between the PCM C175B (5.0L and 6.2L) or C1381B (3.7L), harness side and ground, using the following chart:

PCM Connector-Pin	Circuit
C175B-7 (5.0L and 6.2L) or C1381B-7 (3.7L)	CDC12 (YE)
C175B-37 (5.0L and 6.2L) or C1381B-37 (3.7L)	CDC54 (WH/GN)

Yes
GO to A16 .

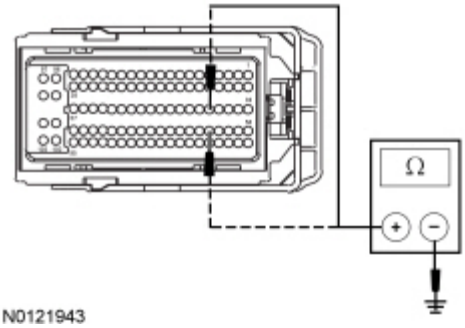
No
REPAIR the affected circuit. TEST the system for normal operation.



N0116359

- Measure the resistance between the PCM C1551B (3.5L), harness side and ground, using the following chart:

PCM Connector-Pin	Circuit
C1551B-43 (3.5L)	CDC12 (YE)
C1551B-62 (3.5L)	CDC54 (WH/GN)



N0121943

- **Are the resistances greater than 10,000 ohms?**

A16 CHECK THE PCM START CIRCUITS FOR AN OPEN

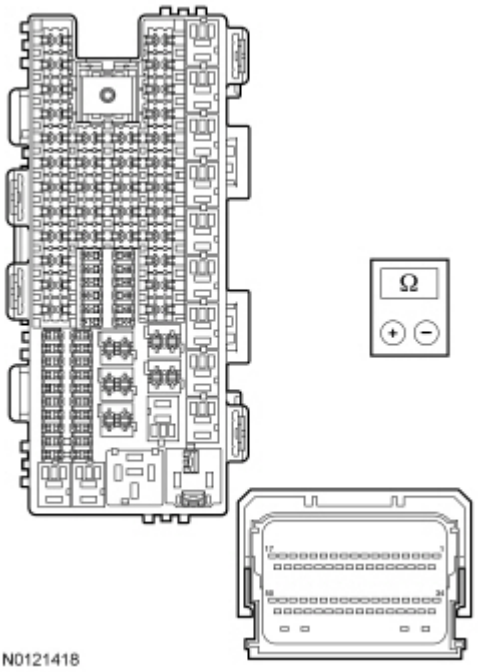
- Measure the resistance between the PCM C175B (5.0L and 6.2L) or C1381B (3.7L), harness side and the starter relay using the following chart:

PCM Connector-Pin	Circuit	Starter Relay Socket
C175B-7 (5.0L and 6.2L) or C1381B-7 (3.7L)	CDC12 (YE)	2
C175B-37 (5.0L and 6.2L) or C1381B-37 (3.7L)	CDC54 (WH/GN)	1

Yes
INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

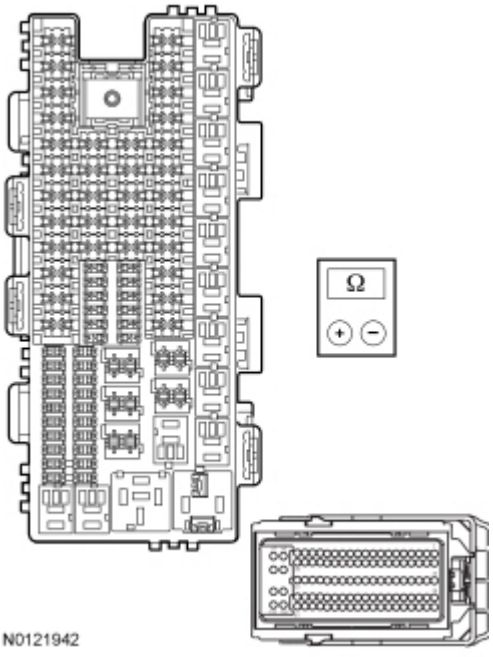
No
REPAIR the affected circuit. TEST the system for normal operation.

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- Measure the resistance between the PCM C1551B (3.5L), harness side and the starter relay using the following chart:

PCM Connector-Pin	Circuit	Starter Relay Socket
C1551B-43 (3.5L)	CDC12 (YE)	2
C1551B-62 (3.5L)	CDC54 (WH/GN)	1



• **Are the resistances less than 5 ohms?**	

Pinpoint Test B: Unusual Starter Noise

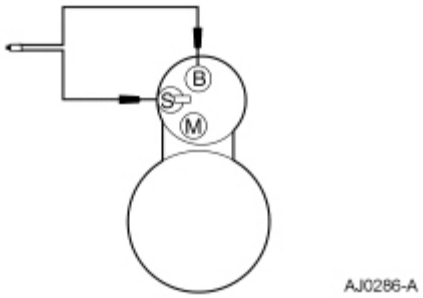
Normal Operation

Correct starter operation relies on correct mounting of the starter to the engine, alignment of the starter ring gear to the flexplate and correct functioning of the starter assembly (internal gears, bearings).

This pinpoint test is intended to diagnose the following:

- Starter motor
- Starter motor mounting
- Starter motor engagement
- Flexplate ring gear

PINPOINT TEST B: UNUSUAL STARTER NOISE

Test Step	Result / Action to Take
B1 CHECK THE STARTER MOUNTING	
• Inspect the starter motor mounting bolts for looseness. • **Is the starter motor mounted correctly?**	**Yes** GO to B2 . **No** INSTALL the starter motor correctly. REFER to Starter Motor — 3.5L GTDI, 3.7L or Starter Motor — 5.0L (4V), 6.2L (2V) in this section. TEST the system for normal operation.
B2 CHECK FOR STARTER NOISE	
• Ignition OFF. • Connect a remote starter switch between the starter solenoid C197A-1 and C197B-1.  • Engage the starter and verify the noise is due to starter operation. • **Is the noise due to the starter engagement?**	**Yes** REFER to Starter Motor Drive Gear and Flywheel Ring Gear Inspection in this section to continue diagnosis. **No** REFER to Section 303-00 , Symptom Chart — Engine NVH to continue diagnosis.

Pinpoint Test C: DTC C113A:11 or C113A:15

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Refer to Wiring Diagrams Cell 112 , Passive Anti-Theft System for schematic and connector information.

Normal Operation

The wake up control circuit is used to wake up the PCM prior to engine cranking. The PCM needs to wake up prior to a crank request so that it has time to go through its own initialization. The wake up control circuit also powers the Passive Anti-Theft System (PATS) transceiver. The wake up control circuit is controlled by the Body Control Module (BCM) and receives voltage from fuse 18 (10A). The BCM uses a Field-Effect Transistor (FET) to control the wake up control circuit. A DTC sets and the wake up control circuit is disabled via the FET if a fault is detected. Once the condition that caused the DTC to set is repaired, the BCM must pass a self-test in order for the DTC to clear and the system to resume normal operation.

The BCM activates the wake up control circuit when:

- the driver door is opened.
- a remote start request is received (if equipped with factory remote start).
- the brake pedal is pressed.
- a key is inserted into the ignition.
- the ignition is in the RUN or START position.

- DTC C113A:11 (Wake up Control: Circuit Short To Ground) — sets when the BCM detects a short to ground on the wake up control circuit.
- DTC C113A:15 (Wake up Control: Circuit Short To Battery or Open) — sets when the BCM detects a short to voltage or an open on the wake up control circuit.

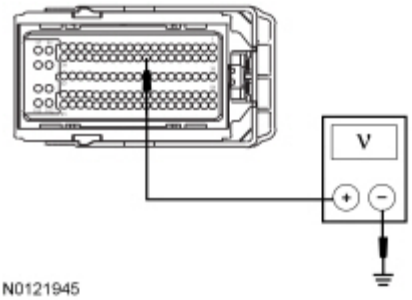
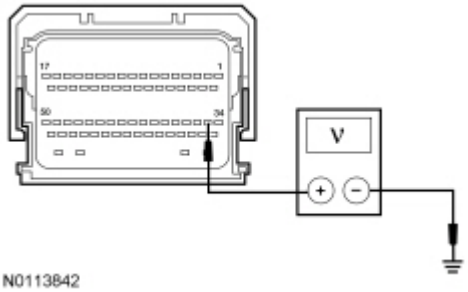
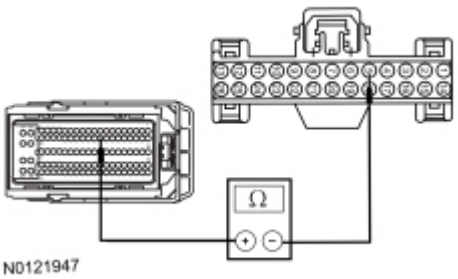
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PATS transceiver
- PCM
- BCM

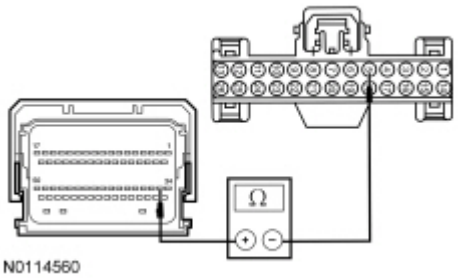
PINPOINT TEST C: DTC C113A:11 OR C113A:15

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

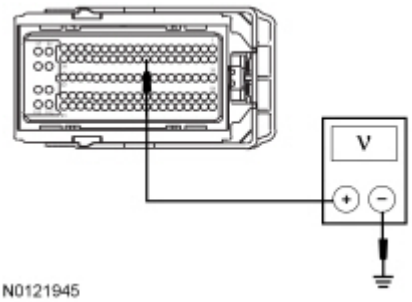
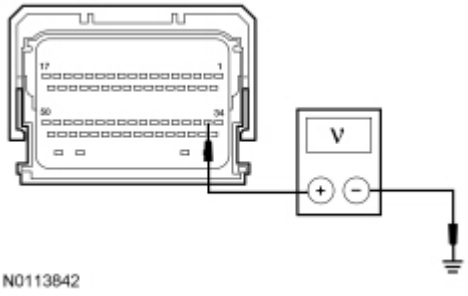
Test Step	Result / Action to Take
C1 RETRIEVE THE BCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM — Self-Test. • **Is DTC C113A:15 on demand during the self-test?**	**Yes** GO to C2 . **No** GO to C5 .
C2 CHECK THE WAKE UP CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280F. • Disconnect: PATS Transceiver C252. • Disconnect: PCM C175B (5.0L and 6.2L), C1381B	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

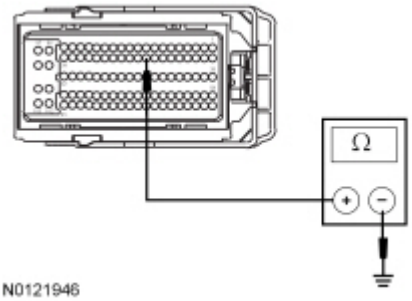
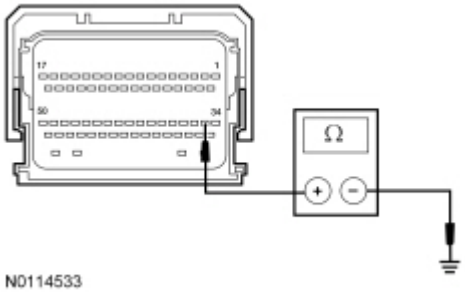
(3.7L) or C1551B (3.5L). • Ignition ON. • Measure the voltage between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.  N0121945 • Measure the voltage between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and ground.  N0113842 • **Is any voltage present?**	**No** GO to C3 .
C3 CHECK THE WAKE UP CONTROL CIRCUIT FOR AN OPEN • Ignition OFF. • Measure the resistance between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and BCM C2280F-5, circuit CE436 (VT/OG), harness side.  N0121947 • Measure the resistance between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and BCM C2280F-5, circuit CE436 (VT/OG), harness side.	**Yes** GO to C4 . **No** REPAIR circuit CE436 (VT/OG) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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- **Is the resistance less than 5 ohms?**

C4 CHECK THE BCM AND PCM FOR CORRECT OPERATION	
• Connect: BCM C2280F. • Ignition ON. • Measure the voltage between PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.  • Measure the voltage between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and ground.  • **Is the voltage greater than 11 volts?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** VERIFY BCM fuse 18 (10A) is OK. If OK, INSTALL a new BCM . REFER to Section 419-10 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C5 CHECK THE WAKE UP CONTROL CIRCUIT DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
• Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs. • Ignition OFF. • Disconnect: PATS Transceiver C252. • Connect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L). • Ignition ON. • Enter the following diagnostic mode on the scan tool:	**Yes** GO to C6 . **No** GO to C7 .

BCM — Self-Test. • **Was DTC C113A:11 retrieved on demand during self-test?**	
C6 CHECK THE WAKE UP CONTROL CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: BCM C2280F. • Measure the resistance between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.  N0121946 • Measure the resistance between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and ground.  N0114533 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new BCM. REFER to Section 419-10. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C7 CHECK THE PCM FOR CORRECT OPERATION • Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs. • Ignition OFF. • Connect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L). • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM — Self-Test. • **Was DTC C113A:11 retrieved on-demand during self-test?**	**Yes** INSTALL a new PCM. REFER to Section 303-14. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new PATS transceiver. REFER to Section 419-01B. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTC B1D55:01

Normal Operation

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An external antenna connected to the Tire Pressure Monitor Module (TPM) receives a signal from the Integrated Keyhead Transmitter (IKT) to enable activation of the remote start function from a distance of up to 100 meters (328 feet). If the external antenna fails, the remote start operates with a reduction in the range of operation.

- DTC B1D55:01 (Antenna #2: General Electrical Failure) — this DTC is set if the vehicle is equipped with remote start but the system feedback circuit does not detect an external antenna.

This pinpoint test is intended to diagnose the following:

- External antenna
- External antenna lead
- TPM

PINPOINT TEST D: DTC B1D55:01

Test Step	Result / Action to Take
D1 CHECK THE EXTERNAL ANTENNA CONNECTION • Check the connections at the external antenna and TPM . • **Are the connections loose or disconnected?**	**Yes** REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D2 .
D2 CHECK THE EXTERNAL ANTENNA • INSTALL a new external antenna. • ATTEMPT to start the vehicle using the IKT from a distance of 100 meters (328 feet) from the vehicle. • **Does the vehicle start from this distance?**	**Yes** System is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D3 .
D3 CHECK THE EXTERNAL ANTENNA CABLE • INSTALL a new external antenna cable. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. • ATTEMPT to start the vehicle using the IKT from a distance of 100 meters (328 feet) from the vehicle • **Does the vehicle start from this distance?**	**Yes** System is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new TPM . REFER to Section 204-04 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint test E: The Remote Start Is Inoperative

Normal Operation

The factory equipped remote start system enables the engine to be started from up to 100 meters (328 feet) away by pressing the Integrated Keyhead Transmitter (IKT) lock button followed by 2 presses of the remote

start button. The 3 button presses must occur within 3 seconds. The IKT signal is received through an external antenna attached to the Tire Pressure Monitor Module (TPM) module and communicated over the Medium Speed Controller Area Network (MS-CAN) to initiate the vehicle start.

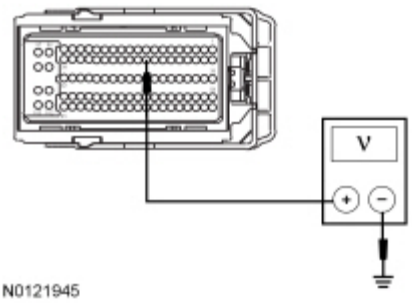
This pinpoint test is intended to diagnose the following:

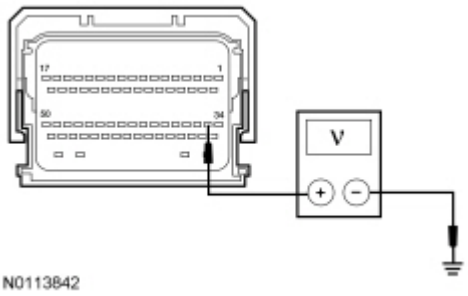
- Wiring, terminals or connectors
- Remote start feature disabled
- IKT
- Hood switch
- PCM

PINPOINT TEST E: THE REMOTE START IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE OPERATION OF THE IKT • Press all buttons on the IKT and check for the correct operation. • **Is the remote start the only function that is inoperative?**	**Yes** GO to E2. **No** REFER to Section 501-14 to DIAGNOSE and REPAIR the Remote Keyless Entry (RKE) system.
E2 CHECK THE VEHICLE STARTING • Attempt to start the vehicle. • **Did the vehicle start?**	**Yes** GO to E3. **No** This is not a remote start issue. GO to Symptom Chart to diagnose the no crank condition.
E3 CHECK FOR ILLUMINATED ENGINE WARNING LAMPS • With the engine running check the instrument cluster for illuminated warning lamps. • **Are any engine warning lamps illuminated?**	**Yes** CARRY OUT a self test of the PCM. DIAGNOSE and REPAIR any present DTCs. REFER to Section 303-14 or Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to E4.
E4 RETRIEVE BCM AND TPM DTCs • Enter the following diagnostic mode on the scan tool: BCM — Self-Test. • Enter the following diagnostic mode on the scan tool: TPM — Self-Test. • **Are any DTCs present?**	**Yes** For BCM DTCs C113A:11 or C113A:15, GO to Pinpoint Test C. For BCM DTC B1305:01, REFER to Section 419-01A. For TPM DTCs U0140:87 or U0422:68, REFER to Section 204-04.

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	For all other DTCs, REFER to Section 419-10 . **No** GO to E5 .
E5 CONFIRM THE REMOTE START FUNCTION IS ENABLED • Ignition ON. • Check the message center and confirm the remote start function is enabled. Refer to the Owner's Literature or Section 413-01 . • **Is the remote start function enabled?**	**Yes** GO to E6 . **No** ENABLE the remote start function. TEST the system for normal operation.
E6 CHECK THE BCM LAST RECEIVED RKE TRANSMITTER BUTTON PRESS (LST_RKE_xMTR) TRANSMITTER PID • Enter the following diagnostic mode on the scan tool: DataLogger — BCM . • Press the remote start button on the IKT and note the PID status. • **Does the selected PID indicate the remote start button was the last button pressed?**	**Yes** GO to E7 . **No** INSTALL and PROGRAM a new IKT . REFER to Section 419-01B . TEST the system for normal operation.
E7 CHECK THE PCM WAKE UP CIRCUIT • Ignition OFF. • Disconnect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L). • Ignition ON. • Measure the voltage between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.  N0121945 • Measure the voltage between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.5L), circuit CE436 (VT/OG), harness side and ground.	**Yes** GO to E8 . **No** VERIFY BCM fuse 18 (10A) is OK. If OK, REPAIR circuit CE436 (VT/OG) for an open. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 • **Is the voltage greater than 11 volts?**	
E8 CHECK THE REMOTE START PRECONDITIONS FOR CORRECT OPERATION	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** CARRY OUT the required precondition as necessary. TEST the system for normal operation.
NOTE: The Body Control Module (BCM) acknowledges the remote start request and that all preconditions have been met by providing 2 short flashes of the turn indicators and a system complete chirp. • Make sure that the following preconditions for remote start have been met: ▪ Hood is closed with no DTC present. ▪ Ignition must be off ▪ Vehicle must be in PARK. ▪ Remote start feature is configured ON. ▪ Number of remote start events does not exceed allowed time (2 events in a 1 hour duration). ▪ Attempt to carry out a remote start. • **Is the remote start system still inoperative?**	

Pinpoint Test G: DTC P2532 And P2535

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Normal Operation

When the ignition key is turned to the RUN or START position, the ignition switch supplies voltage to the PCM logic through the ignition circuit inputs to the BCM . The PCM then provides a ground to the START/RUN relay control circuit to activate the RUN/START relay. When the relay contacts close voltage is supplied to the PCM through Battery Junction Box (BJB) fuse 52 (10A) on the RUN/START bus and circuit.

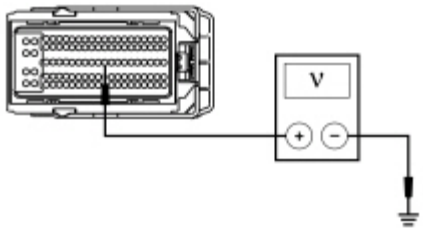
- DTC P2532 (Ignition Switch Run Position Circuit High) — sets when the PCM detects a voltage from the ACC/RUN bus when the ignition key is not in the START or RUN position.
- DTC P2535 (Ignition Switch Run/Start Position Circuit High) — sets when the PCM detects a voltage from the RUN/START bus when the ignition key is not in the START or RUN position.

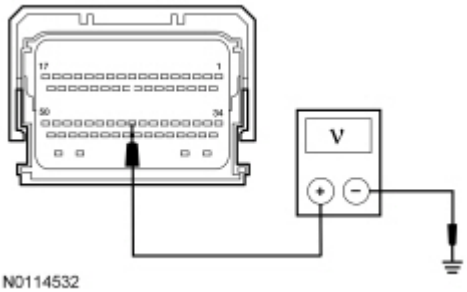
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Starter relay
- BJB
- BCM
- PCM

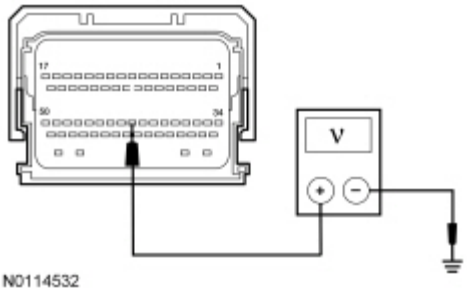
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PINPOINT TEST G: DTC P2532 AND P2535

Test Step	Result / Action to Take
G1 CHECK THE PCM FOR DTCS	
• Ignition ON. • Check the PCM for DTCs. • **Are any DTCs present?**	**Yes** **For DTC P2532** ,GO to G2 . **For DTC P2535** ,GO to G3 . For all other PCM DTCs, REFER to Section 303-14 . **No** The system is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G2 CHECK THE RUN START CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM . • Ignition ON. • **NOTE:** Voltage is present **ONLY** when the ignition switch is in the START or RUN position. • **For 3.5L equipped vehicles** , measure the voltage between the PCM C1551B-48, circuit CBB53 (GY/BN), harness side and ground.  N0146611 • Ignition ON. • **NOTE:** Voltage is present **ONLY** when the ignition switch is in the START or RUN position. • **For 3.7L equipped vehicles** , measure the voltage between PCM C175B-42, circuit CBB53 (GY/BN), harness side and ground	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. ACTIVATE other systems in the same wire harness. REPAIR any concern found. REPEAT the self-test. TEST the system for normal operation. If DTC returns. INSTALL a new PCM. REFER to Section 303-14 .



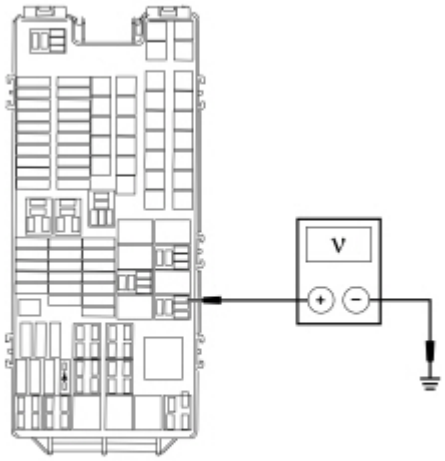
- Ignition ON.
- **NOTE:** Voltage is present **ONLY** when the ignition switch is in the START or RUN position.
- **For 5.0L and 6.2L equipped vehicles** , measure the voltage between PCM C1381B-42, circuit CBB53 (GY/BN), harness side and ground



- **Is any voltage present?**

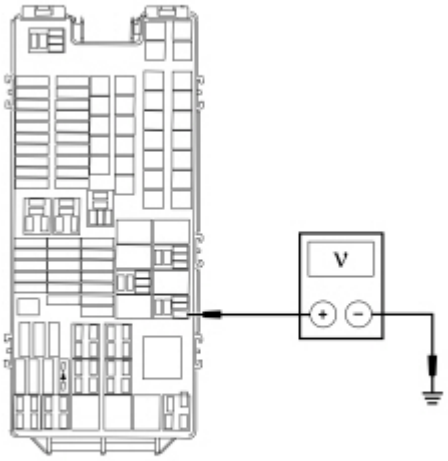
G3 CHECK THE START MOTOR REQUEST CIRCUIT	
• Start the engine. • Disconnect: Starter Motor Relay . • Measure the voltage between BJB starter relay socket pin 2, circuit CDC26 (GY/OG) and ground.	**Yes** GO to G4 . **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

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N0146535

- **Is any voltage present?**

G4 CHECK THE START MOTOR REQUEST CIRCUIT FOR A SHORT VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175B. • Ignition ON. • Measure the voltage between BJB starter relay socket pin 1, circuit CDC12 (YE) and ground.  N0146536 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

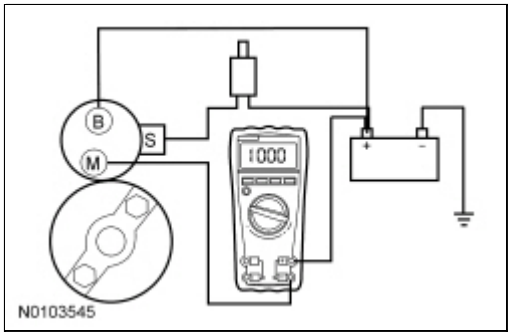
Component Tests

WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

Always make the Digital Multimeter connections at the component terminal rather than at the wiring end of the connector. Making a connection at the wiring end of the connector could result in false readings because the meter will not pick up high resistance between the wiring connector and component.

Starter Motor — Feed Circuit Test

1. Make sure the battery is fully charged; carry out a battery Drain test. Refer to Section 414-01 .
2. Connect a remote starter switch between the starter solenoid C197B and the battery positive terminal.
3. Connect the Digital Multimeter positive lead to the battery positive post. Connect the negative lead to the starter solenoid "M" terminal.



4. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.5 volt or less.
5. If the voltage reading is 0.5 volt or less, go to the starter motor-ground circuit component test.
6. If the voltage reading is greater than 0.5 volt, this is an indication of excessive resistance in the connections, the positive battery cable or in the starter solenoid. Move the Digital Multimeter negative lead to the starter solenoid C197A and repeat the test. If the voltage reading at starter solenoid C197A is lower than 0.5 volt, the concern is either in the connections at the starter solenoid or in the solenoid contacts.
7. Remove the cables from starter solenoid C197A, C197B and "M" terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop reading is still greater than 0.5 volt when checked at the "M" terminal or less than 0.5 volt when checked at C197A, the concern is in the solenoid contacts. Install a new starter motor. Refer to Starter Motor — 3.5L GTDI, 3.7L or Starter Motor — 5.0L (4V), 6.2L (2V) in this section.
8. If the voltage reading taken at starter solenoid C197A is still greater than 0.5 volt after cleaning the cables and connections at the solenoid, the concern is either in the battery cable connection or in the positive battery cable itself.
9. Clean the positive battery cable connection. If this does not solve the problem, install a new battery

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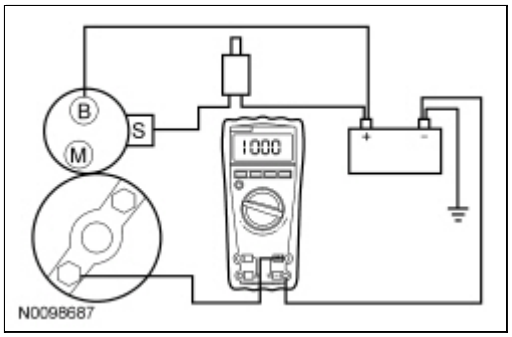
cables. Refer to Section 414-01 .

Starter Motor — Ground Circuit Test

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Connect a remote starter switch between the starter solenoid C197B and the battery positive terminal.

2. Connect the Digital Multimeter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative battery terminal.



3. Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.5 volt or less.

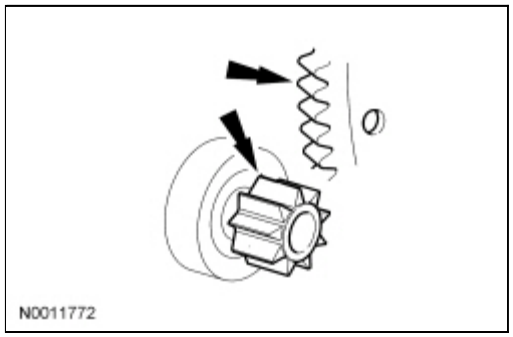
4. If the voltage drop is greater than 0.5 volt, clean the negative cable connections at the battery, the body ground connections and the starter ground connection. Retest.

5. If the voltage drop is greater than 0.5 volt, install new cables. Refer to Section 414-01 . If the voltage reading is less than 0.5 volt and the engine still cranks slowly, install a new starter motor. Refer to Starter Motor — 3.5L GTDI, 3.7L or Starter Motor — 5.0L (4V), 6.2L (2V) in this section.

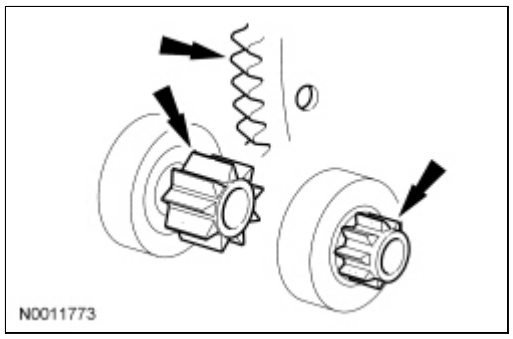
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Starter Motor Drive Gear and Flywheel Ring Gear Inspection

1. Check the wear patterns on the starter drive and the flexplate ring gear. If the wear pattern is not normal, install a new starter motor. For additional information, refer to Starter Motor — 3.5L GTDI, 3.7L or Starter Motor — 5.0L (4V), 6.2L (2V) in this section.

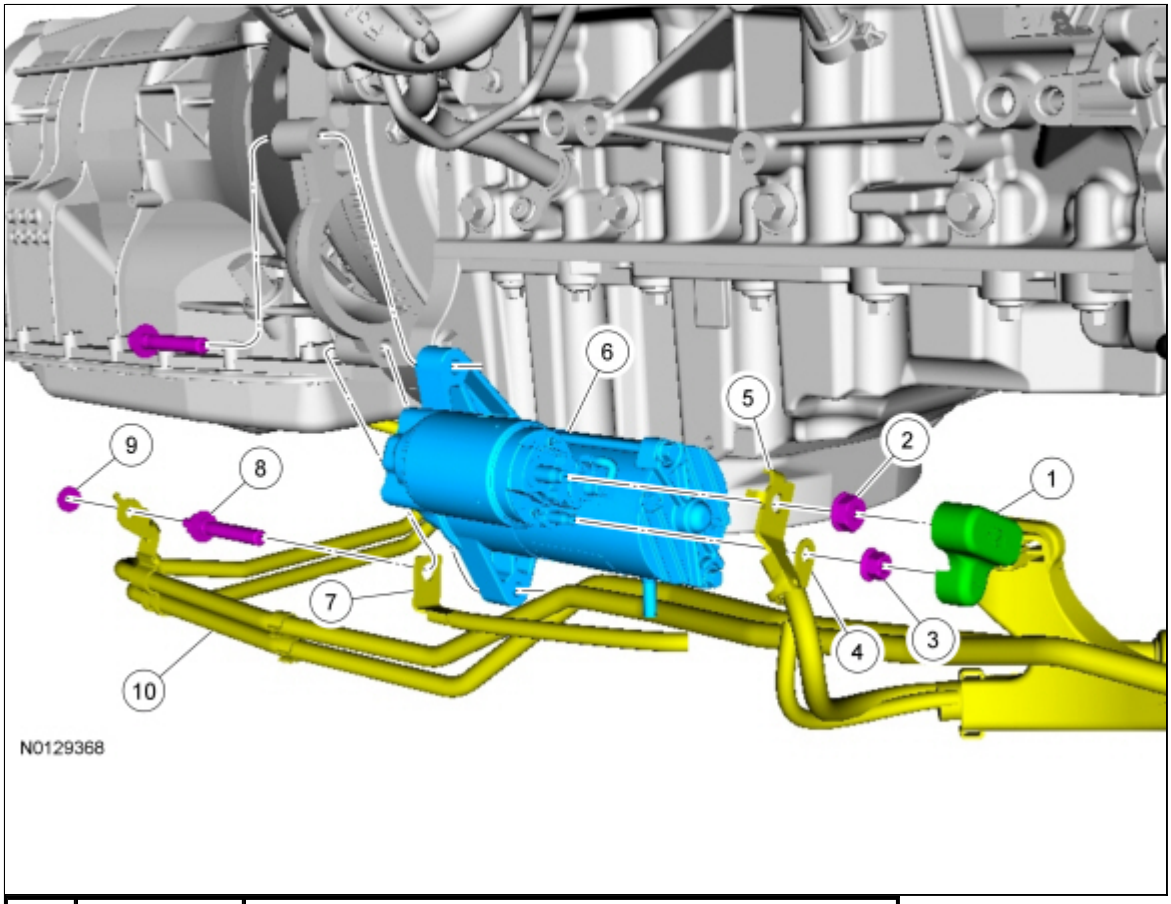


2. If the starter drive gear and the flywheel ring gear are not fully meshing or the gears are milled or damaged, install a new starter motor. For additional information, refer to Starter Motor — 3.5L GTDI, 3.7L or Starter Motor — 5.0L (4V), 6.2L (2V) in this section. Install a new flexplate. For additional information, refer to Section 303-01A , Section 303-01B , Section 303-01C or Section 303-01D .



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Starter Motor — 3.5L GTDI, 3.7L



Item	Part Number	Description
1	11N087	Starter solenoid terminal cover
2	W706414	Starter solenoid B+ terminal nut - 12 Nm (106 lb-in)
3	W705790	Starter solenoid S-terminal nut - 5 Nm (44 lb-in)
4	14463	Starter solenoid S-terminal eyelet
5	14463	Starter solenoid B+ terminal eyelet
6	11002	Starter motor
7	14463	Starter motor ground cable eyelet
8	W714290	Starter motor mounting stud bolts (2 required) - 48 Nm (35 lb-ft)
9	W709450	Transmission fluid cooler tube bracket nut - 12 Nm (106 lb-in)
10	7R081	Transmission fluid cooler inlet and outlet tubes

Removal and Installation

WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the terminal cover.

4. Remove the nut and disconnect the starter solenoid B+ terminal eyelet.
   - To install, tighten to 12 Nm (106 lb-in).

5. Remove the nut and disconnect the starter solenoid S-terminal eyelet.
   - To install, tighten to 5 Nm (44 lb-in).

6. Remove the transmission fluid cooler tube bracket nut and position the transmission cooler inlet and outlet tubes aside.
   - To install, tighten to 12 Nm (106 lb-in).

7. Remove the lower stud bolt and position starter motor ground cable eyelet aside.
   - To install, tighten to 48 Nm (35 lb-ft).

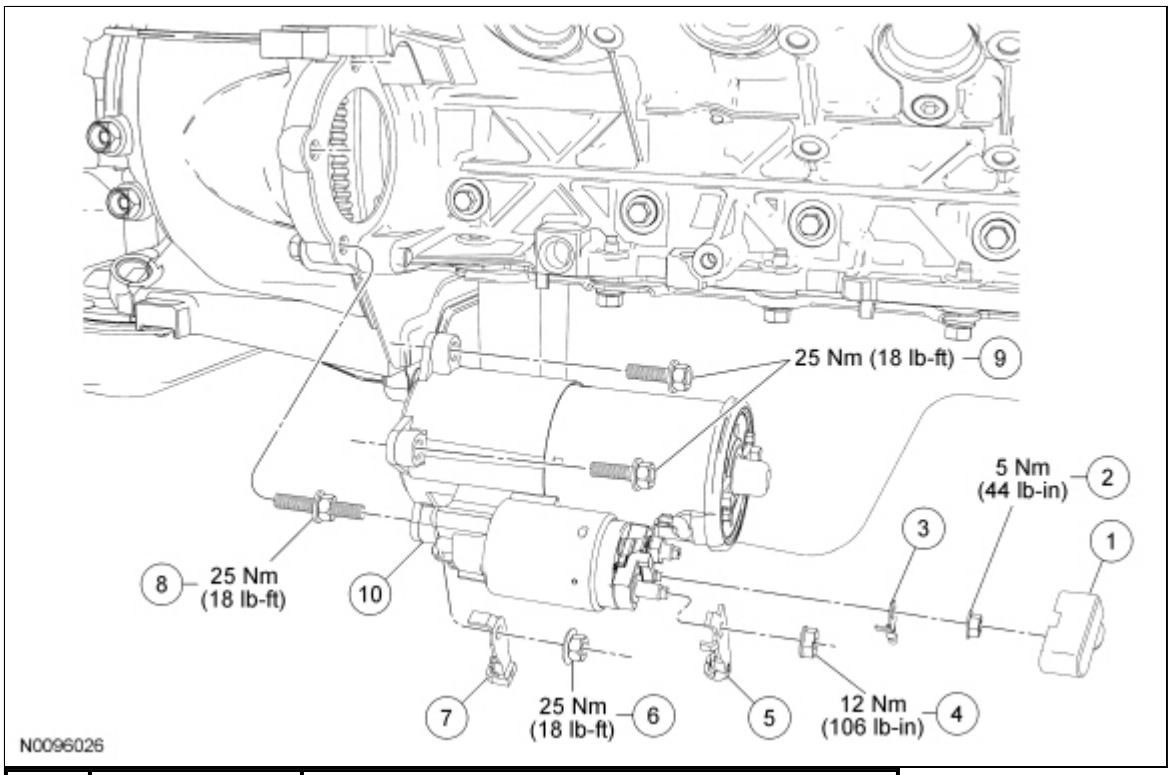
8. **NOTE:** Tighten the upper bolt before tightening the lower fasteners.

   Remove the upper stud bolt and the starter motor.
   - To install, tighten to 48 Nm (35 lb-ft).

9. To install, reverse the removal procedure.

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Starter Motor — 5.0L (4V), 6.2L (2V)



Item	Part Number	Description
1	11N087	Terminal cover
2	W705790	Starter solenoid S-terminal nut
3	14463	Starter solenoid S-terminal eyelet
4	W706414	Starter solenoid B+ terminal nut
5	14463	Starter solenoid B+ terminal eyelet
6	N805024	Starter motor ground cable nut
7	14463	Starter motor ground cable eyelet
8	W704941	Starter motor mounting stud bolt
9	W704942	Starter motor mounting bolts (2 required)
10	11002	Starter motor

Removal and Installation

WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

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1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the terminal cover.

4. Remove the nut and disconnect the starter solenoid S-terminal eyelet.
   - To install, tighten to 5 Nm (44 lb-in).

5. Remove the nut and disconnect the starter solenoid B+ terminal eyelet.
   - To install, tighten to 12 Nm (106 lb-in).

6. Remove the nut and disconnect the starter motor ground cable eyelet.
   - To install, tighten to 25 Nm (18 lb-ft).

7. **NOTE:** Tighten the upper bolt before tightening the lower fasteners.

   Remove the stud bolt, the 2 bolts and the starter motor.
   - To install, tighten to 25 Nm (18 lb-ft).

8. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

General Specifications

Item	Specification
Spark plug	12405
Spark plug gap	0.80 mm (0.031 in)

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	7	62
Spark plugs	15	133

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Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- six ignition coil-on-plugs.
- six spark plugs.

The 6 separate ignition coil-on-plugs:

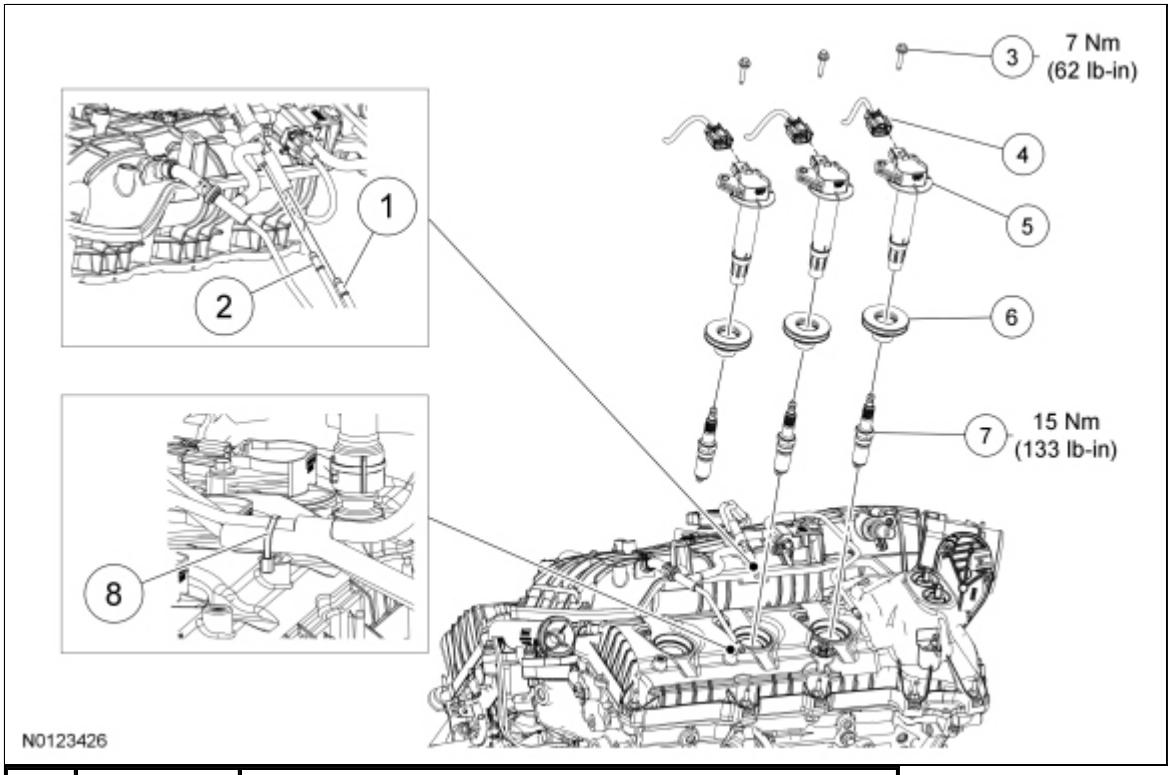
- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to the spark plug.
- have replaceable ignition coil-on-plug seals.

The 6 spark plugs:

- change high voltage pulses into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a iridium-enhanced fine wire electrode for long life.
- gap is not adjustable.

Engine Ignition Components — Exploded View

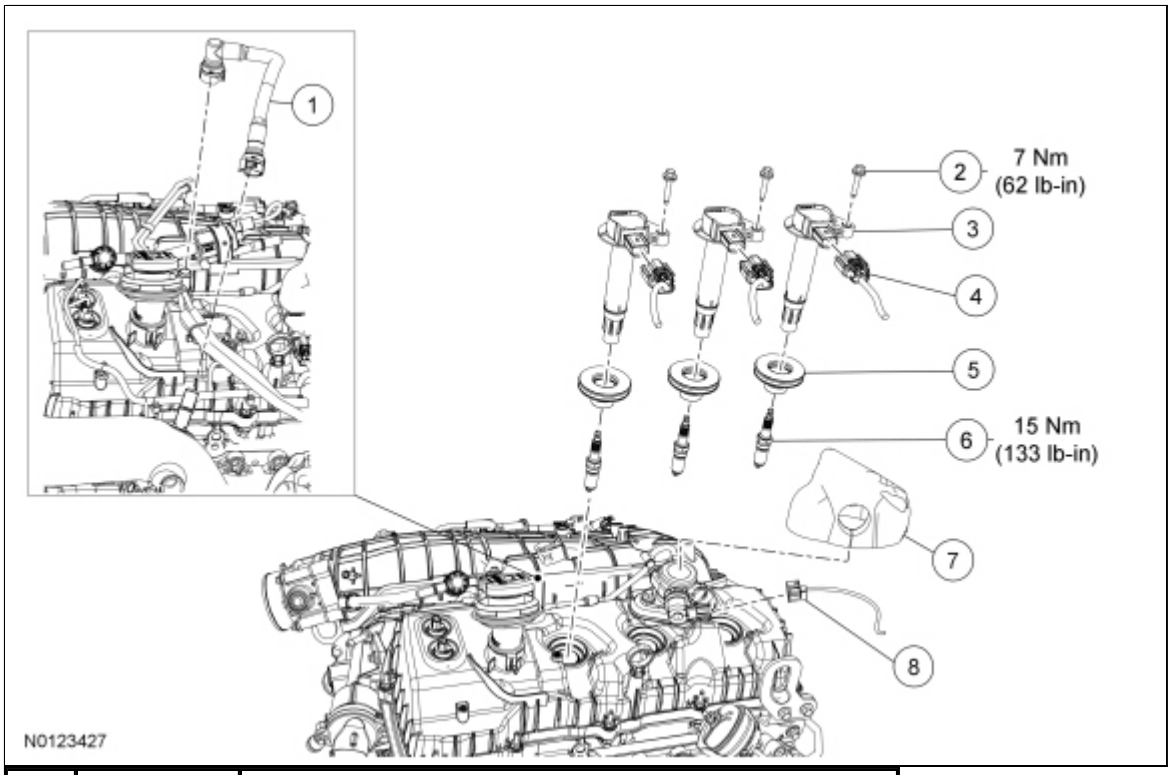
NOTE: Ignition Components RH Side



Item	Part Number	Description
1	—	Turbocharger regulator hose part of (9961)
2	—	Turbocharger regulator hose part of (9961)
3	W714507	Ignition coil-on-plug bolt (3 required)
4	—	Ignition coil-on-plug electrical connector (part of 12A581) (3 required)
5	12029	Ignition coil-on-plug (3 required)
6	12025	Coil-on-plug seal (3 required)
7	12405	Spark plug (3 required)
8	—	Tie strap

NOTE: Ignition Components LH Side

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Item	Part Number	Description
1	6758	Crankcase vent tube assembly
2	W714507	Ignition coil-on-plug bolt (3 required)
3	12029	Ignition coil-on-plug (3 required)
4	—	Ignition coil-on-plug electrical connector (part of 12A581) (3 required)
5	12025	Coil-on-plug seal (3 required)
6	12405	Spark plug (3 required)
7	6N041	Fuel injection pump noise insulator shield
8	—	Fuel injection pump electrical connector (part of 12A581)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

RH side

1. Cut and discard the tie strap from turbocharger regulator hose retainer at the valve cover.

2. Disconnect the 2 turbocharger regulator hoses.

LH side

3. Disconnect the 2 crankcase vent tube quick connect fittings and remove the crankcase vent tube assembly. For additional information, refer to Section 310-00 .

4. Disconnect the fuel injection pump electrical connector.

5. Remove the fuel injection pump noise insulator shield.

Both sides

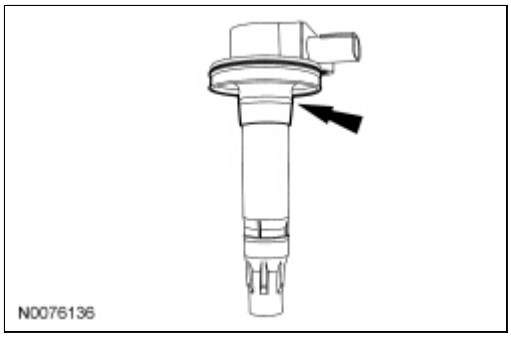
6. **NOTE:** Use compressed air to remove any foreign material from the ignition coil-on-plugs and surrounding area before removing the ignition coil-on-plugs.

   Disconnect the 6 ignition coil-on-plug electrical connectors.

7. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 6 bolts and the 6 ignition coil-on-plugs.
   - To install, tighten to 7 Nm (62 lb-in).

8. Inspect the coil-on-plug seals for rips, nicks or tears. Remove and discard any damaged coil-on-plug seals.
   - To install, slide the new coil-on-plug seal onto the coil until it is fully seated at the top of the coil-on-plug.



9. To install, reverse the removal procedure.
    - Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

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Spark Plugs

Removal and Installation

1. Remove the 6 ignition coil-on-plugs. For additional information, refer to Ignition Coil-On-Plug in this section.

2. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

   NOTICE: **The spark plug procedure must be followed exactly or damage to the cylinder head and spark plug will result.**

   NOTICE: **Do not remove the spark plugs when the engine is hot or cold soaked. Spark plug thread or cylinder head damage can occur. Make sure the engine is warm (hand touch after cooling down) prior to spark plug removal.**

   NOTICE: **The spark plug gap is NOT adjustable. Damage can occur to the iridium tip if the gap is adjusted. Replace the spark plug if the gap is out of specification.**

   NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

   Remove the 6 spark plugs.
   - To install, tighten to 15 Nm (133 lb-in).

3. Inspect the 6 spark plugs. For additional information, refer to Section 303-00 .

4. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

General Specifications

Item	Specification
Spark plug	12405
Spark plug gap	1.25-1.35 mm (0.049-0.053 in)

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	8	71
Spark plugs	15	133

Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- six ignition coil-on-plugs.
- six spark plugs.

The 6 separate ignition coil-on-plugs:

- change low voltage signals from the PCM to high voltage pulses.
- deliver the high voltage pulses to the spark plugs.
- are connected directly to the spark plug.
- have replaceable ignition coil-on-plug seals.

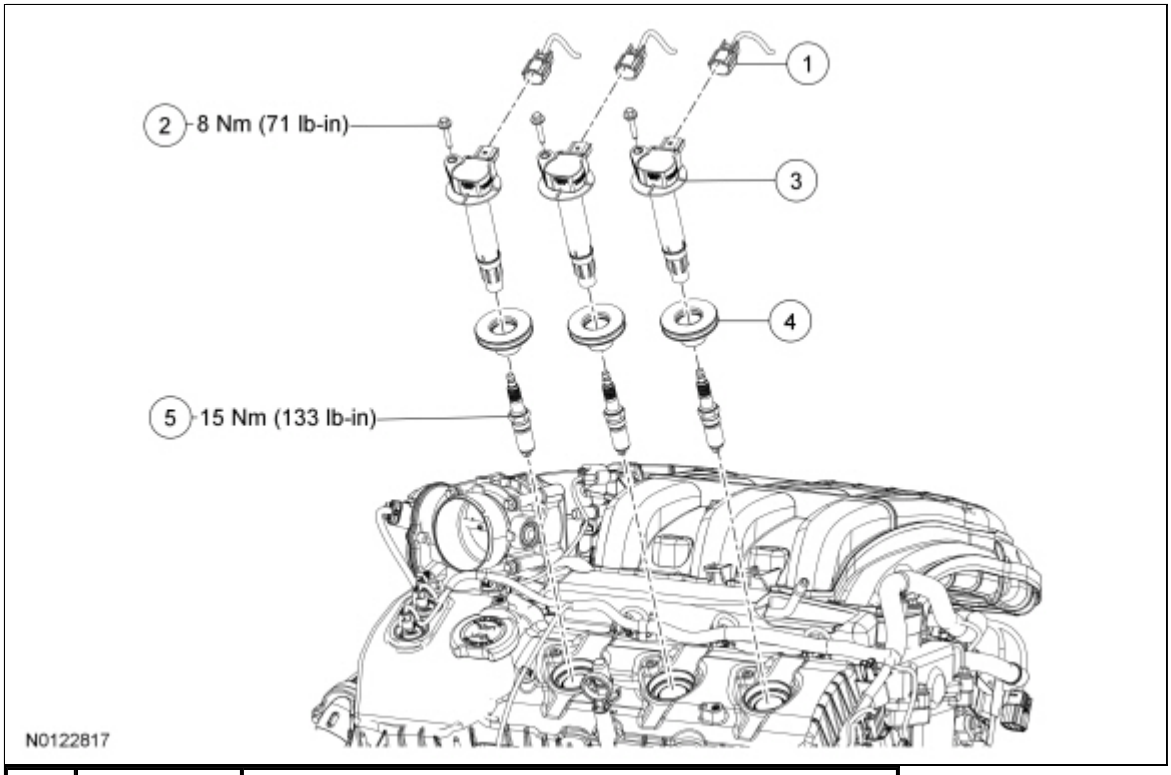
The 6 spark plugs:

- change high voltage pulses into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a platinum-enhanced fine wire electrode for long life.

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Engine Ignition Components — Exploded View

NOTE: LH side shown, RH side similar



Item	Part Number	Description
1	—	Ignition coil-on-plug electrical connector (part of 9D930) (3 required)
2	W714507	Ignition coil-on-plug bolt (3 required)
3	12029	Ignition coil-on-plug (3 required)
4	12025	Ignition coil-on-plug seal (3 required)
5	12405	Spark plug (3 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

RH side

1. **NOTE:** The upper intake manifold must be removed to access the RH ignition coil-on-plugs.

   Remove the upper intake manifold. For additional information, refer to Section 303-01B .

Both sides

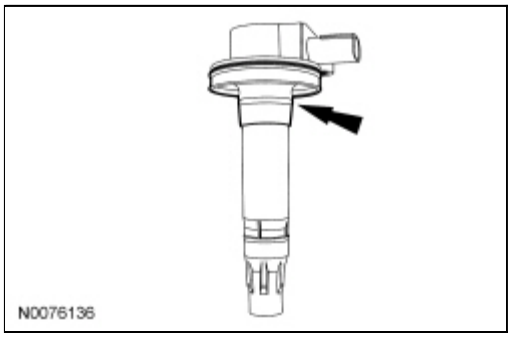
2. **NOTE:** Use compressed air to remove any foreign material from the ignition coil-on-plugs and surrounding area before removing the ignition coil-on-plugs.

   Disconnect the 6 ignition coil-on-plug electrical connectors.

3. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 6 ignition coil-on-plug bolts and the 6 ignition coil-on-plugs.
   - To install, tighten to 8 Nm (71 lb-in).

4. Inspect the ignition coil-on-plug seals for rips, nicks or tears. Remove and discard any damaged ignition coil-on-plug seals.
   - To install, slide the new ignition coil-on-plug seal onto the ignition coil-on-plug until it is fully seated at the top of the ignition coil-on-plug.



5. **NOTE:** Verify that the ignition coil-on-plug spring is correctly located inside the ignition coil-on-plug boot and that there is no damage to the tip of the boot.

To install, reverse the removal procedure.

- Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

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Spark Plugs

Removal and Installation

1. Remove the ignition coil-on-plugs. For additional information, refer to Ignition Coil-On-Plug in this section.

2. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

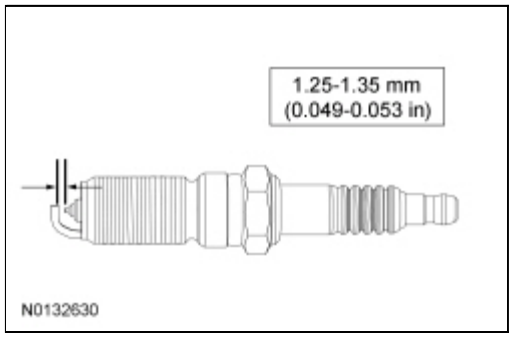
   NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

   NOTE: If an original spark plug is used, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

   Remove the 6 spark plugs.
   - To install, tighten to 15 Nm (133 lb-in).

3. Inspect the spark plugs. Install new spark plugs as necessary. For additional information, refer to Section 303-00 .

4. Adjust the spark plug gap as necessary.



5. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

General Specifications

Item	Specification
Firing order	1-5-4-8-6-3-7-2
Spark plug gap	1.25 - 1.35 mm (0.049 - 0.053 in)
Spark plug type	12405

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	6	53
Spark plugs	14	124

Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- eight ignition coil-on-plugs.
- eight spark plugs.

The 8 separate ignition coil-on-plugs:

- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to the spark plug.
- have replaceable ignition coil-on-plug seals.

The 8 spark plugs:

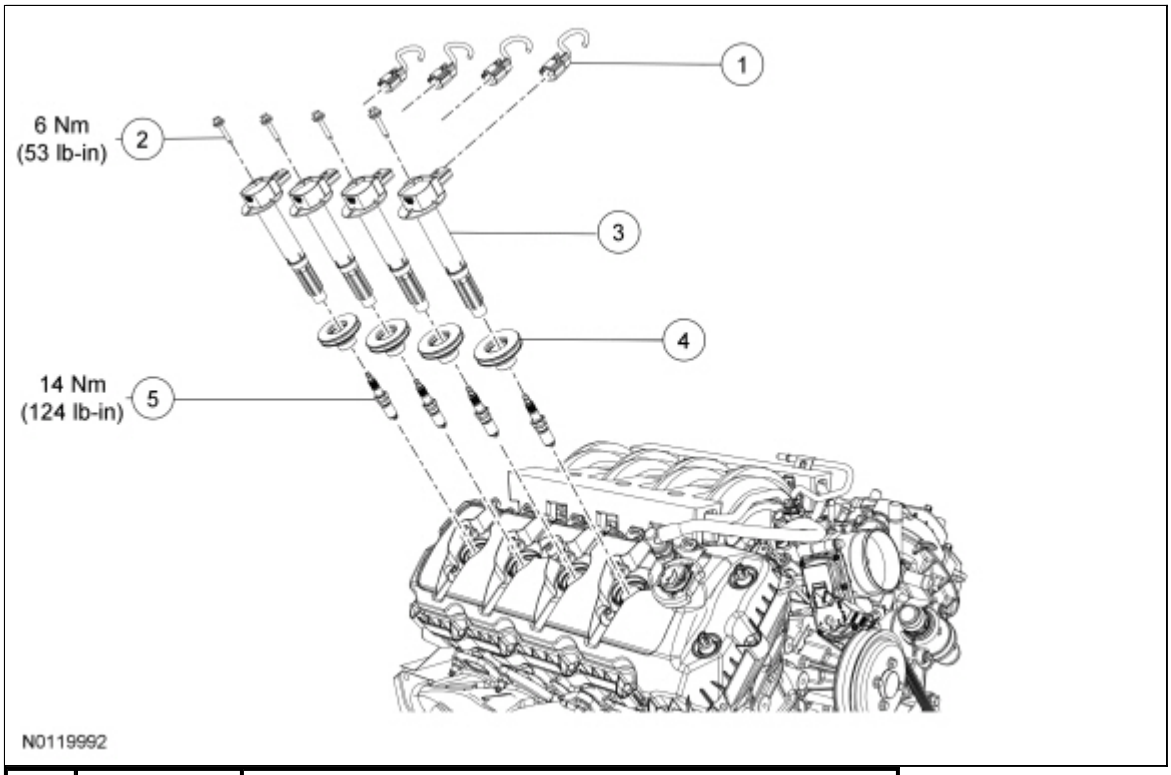
- change high voltage pulses into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a iridium-enhanced fine wire electrode for long life.

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Engine Ignition Components — Exploded View

LH Ignition Components

NOTE: RH side shown, LH side similar



Item	Part Number	Description
1	—	Ignition coil-on-plug electrical connector (part of 9D930) (4 required)
2	W714507	Ignition coil-on-plug bolt (4 required)
3	12029	Ignition coil-on-plug (4 required)
4	12025	Ignition coil-on-plug seal (part of 12029) (4 required)
5	12405	Spark plug (4 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

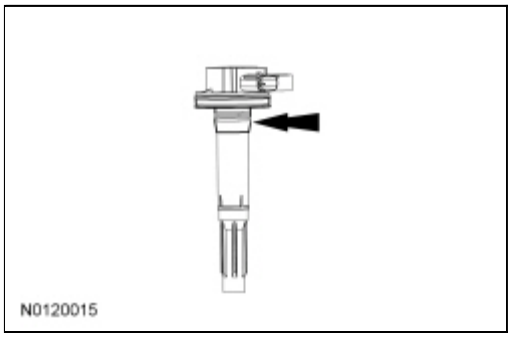
1. **NOTE:** Use compressed air to remove any foreign material from the ignition coil-on-plugs and surrounding area before removing the ignition coil-on-plugs.

   Disconnect the 8 ignition coil-on-plug electrical connectors.

2. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 8 bolts and the 8 ignition coil-on-plugs.
   - To install, tighten to 6 Nm (53 lb-in).

3. Inspect the ignition coil-on-plug seals for rips, nicks or tears. Remove and discard any damaged ignition coil-on-plug seals.
   - To install, slide the new ignition coil-on-plug seal onto the ignition coil-on-plug until it is fully seated at the top of the ignition coil-on-plug .



4. **NOTE:** Verify that the ignition coil-on-plug spring is correctly located inside the ignition coil-on-plug boot and that there is no damage to the tip of the boot.

   To install, reverse the removal procedure.
   - Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

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Spark Plugs

Removal and Installation

1. Remove the ignition coil-on-plugs. For additional information, refer to Ignition Coil-On-Plug in this section.

2. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs, or damage may occur to the cylinder head or spark plug.**

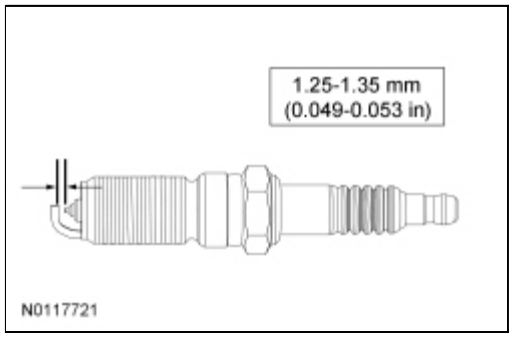
   NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

   NOTE: If an original spark plug is used, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

   Remove the 8 spark plugs.
   - To install, tighten to 14 Nm (124 lb-in).

3. Inspect the spark plugs. Install new spark plugs as necessary. For additional information, refer to Section 303-00 .

4. Adjust the spark plug gap as necessary.



5. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

General Specifications

Item	Specification
Engine Ignition	
Firing order	1-3-7-2-6-5-4-8
Spark plug	12405
Spark plug gap	1.07-1.17 mm (0.042-0.046 in)

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	10	89
Spark plug	18	159

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Engine Ignition

The electronic ignition system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- eight ignition coil-on-plugs.
- eight ignition wires.
- eight upper spark plugs.
- eight lower spark plugs.

The 8 separate ignition coil-on-plugs:

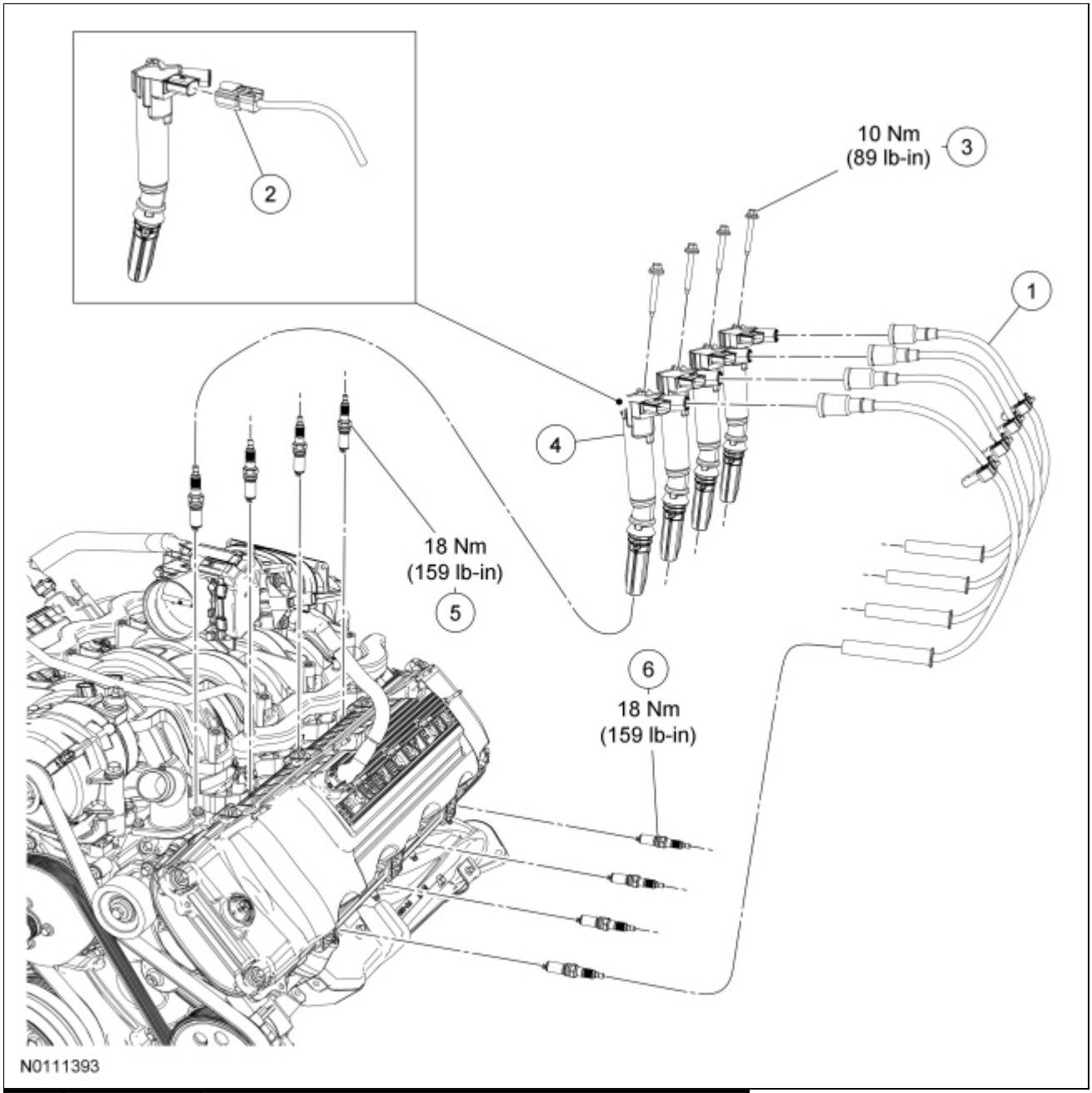
- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to the upper spark plug.
- are connected by an ignition wire to the lower spark plug.

The 16 spark plugs:

- change high voltage pulses into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have platinum-enhanced electrodes for long life.

Engine Ignition Components — Exploded View

NOTE: LH side shown, RH side similar



Item	Part Number	Description
1	12286	LH ignition wire (4 required)
2	—	Ignition coil-on-plug electrical connector (part of 9D930) (4 required)

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3	W503282	LH ignition coil-on-plug bolt (4 required)
4	12029	LH ignition coil-on-plug (4 required)
5	12405	LH upper spark plug (4 required)
6	12405	LH lower spark plug (4 required)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
2. Remove the intake air resonator. For additional information, refer to Section 303-12 .
3. Disconnect the 8 ignition wires.
4. Disconnect the 8 ignition coil-on-plug electrical connectors.
5. Remove the 8 ignition coil-on-plug bolts.
   - To install, tighten to 10 Nm (89 lb-in).
6. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 8 ignition coil-on-plugs.
7. **NOTE:** Verify that the coil-on-plug spring is correctly located inside the ignition coil-on-plug boot and that there is no damage to the tip of the boot.

   To install, reverse the removal procedure.
   - Apply a light coat of dielectric compound to the inside of the coil-on-plug boots.

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Spark Plugs

Removal

NOTICE: **The spark plug procedure must be followed exactly or damage to the cylinder head and spark plug will result.**

NOTICE: **Do not remove the spark plugs when the engine is hot or cold soaked. Spark plug thread or cylinder head damage can occur. Make sure the engine is warm (hand touch after cooling down) prior to spark plug removal.**

Upper spark plugs

1. Remove the ignition coil-on-plug. For additional information, refer to Ignition Coil-On-Plug in this section.

Lower spark plugs

2. Disconnect the ignition wire from the lower spark plug.

All spark plugs

3. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

   NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

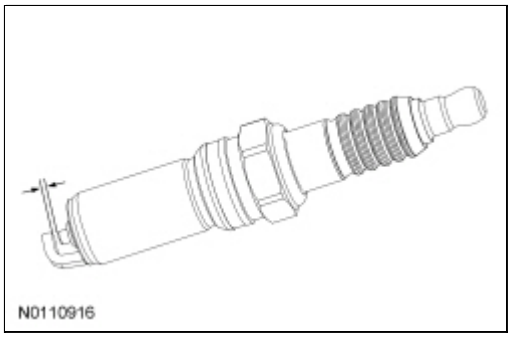
   Remove the spark plug.

4. Inspect the spark plug. For additional information, refer to Section 303-00 .

Installation

All spark plugs

1. Adjust the spark plug gap as necessary. For the correct spark plug gap specification, refer to Specifications in this section.



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2. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

   Install the spark plug.
   - Tighten to 18 Nm (159 lb-in).

Lower spark plugs

3. Connect the ignition wire from the lower spark plug.

Upper spark plugs

4. Install the ignition coil-on-plug. For additional information, refer to Ignition Coil-On-Plug in this section.

Engine Emission Control

NOTE: Do not permanently remove or render inoperative any part of the vehicle emission control system including related hardware. Failure to comply may violate applicable state and federal law.

NOTE: The vehicle emission vacuum routing diagrams are contained in the Description and Operation subsection of the Evaporative Emissions section. Refer to Section 303-13 .

The engine emission control system consists of the:

- PCV system.

PCV System

The PCV system:

- uses intake manifold vacuum to ventilate blow-by gases from the crankcase.
- returns the gases to the intake manifold for combustion.

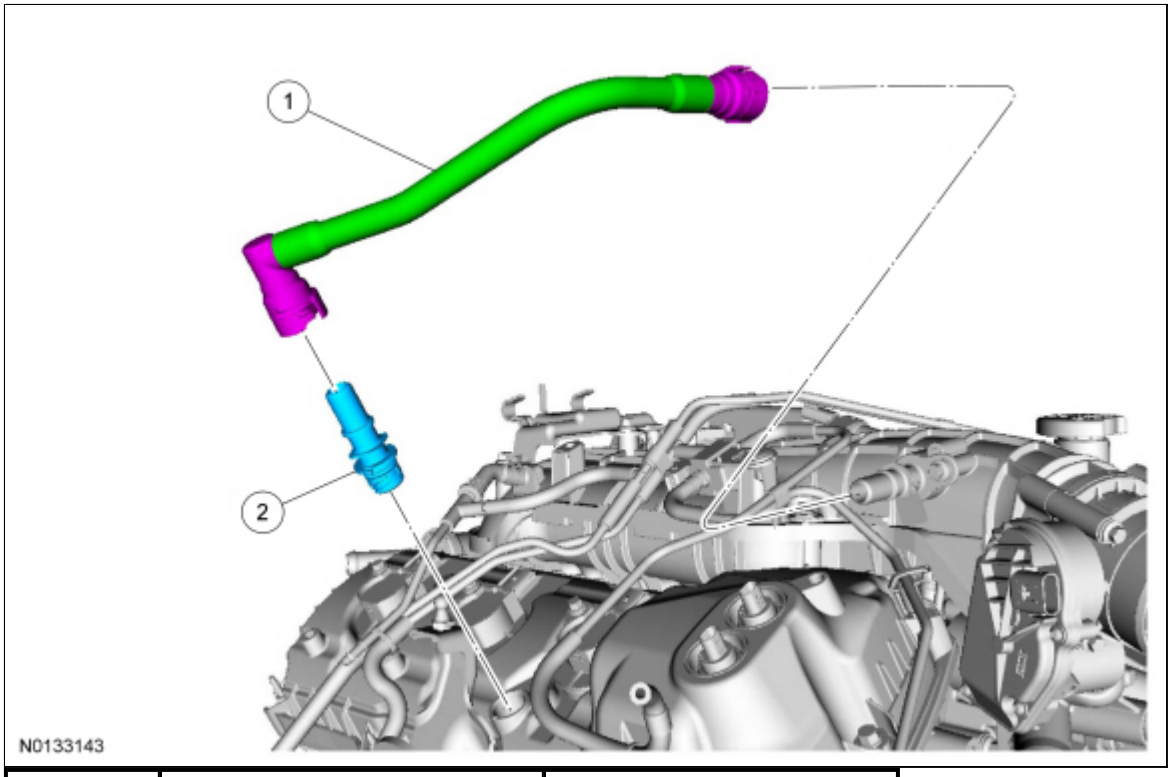
The PCV valve:

- varies the amount of blow-by gases returned to the intake manifold based on available engine vacuum.

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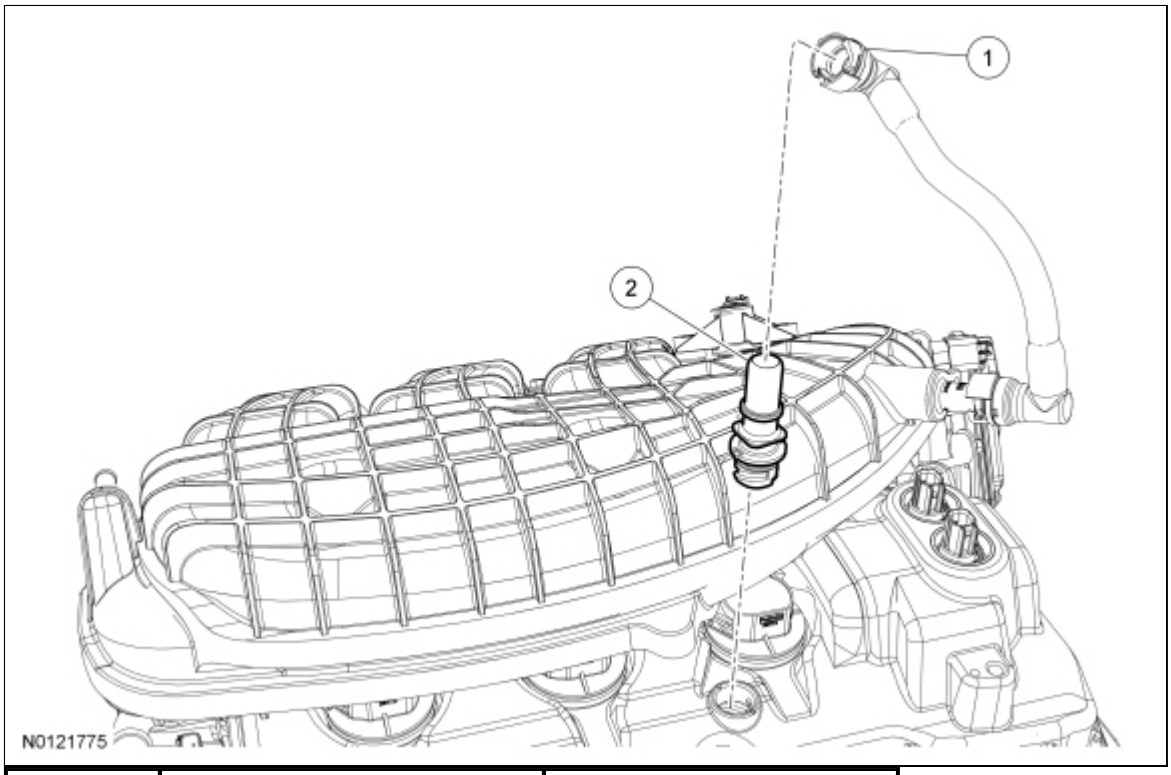
Positive Crankcase Ventilation (PCV) Valve

3.5L GTDI



Item	Part Number	Description
1	6A664	PCV tube
2	6A666	PCV valve

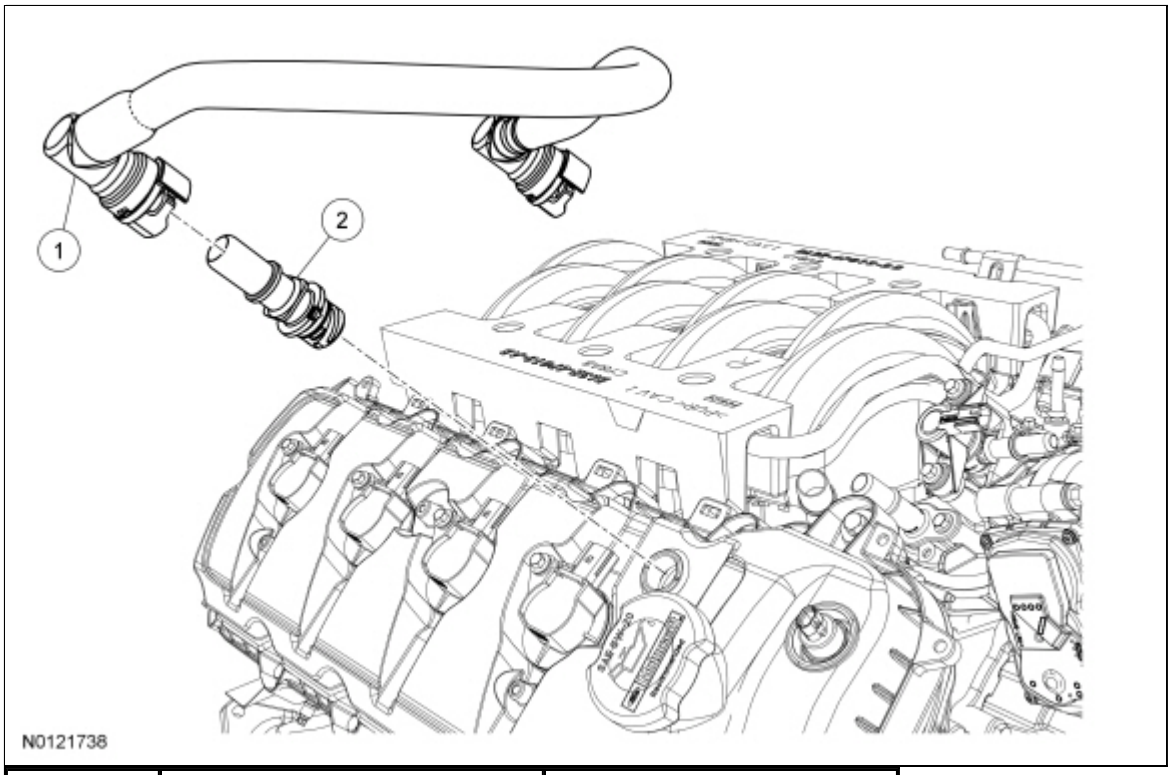
3.7L



Item	Part Number	Description
1	6A664	PCV tube
2	6A666	PCV valve

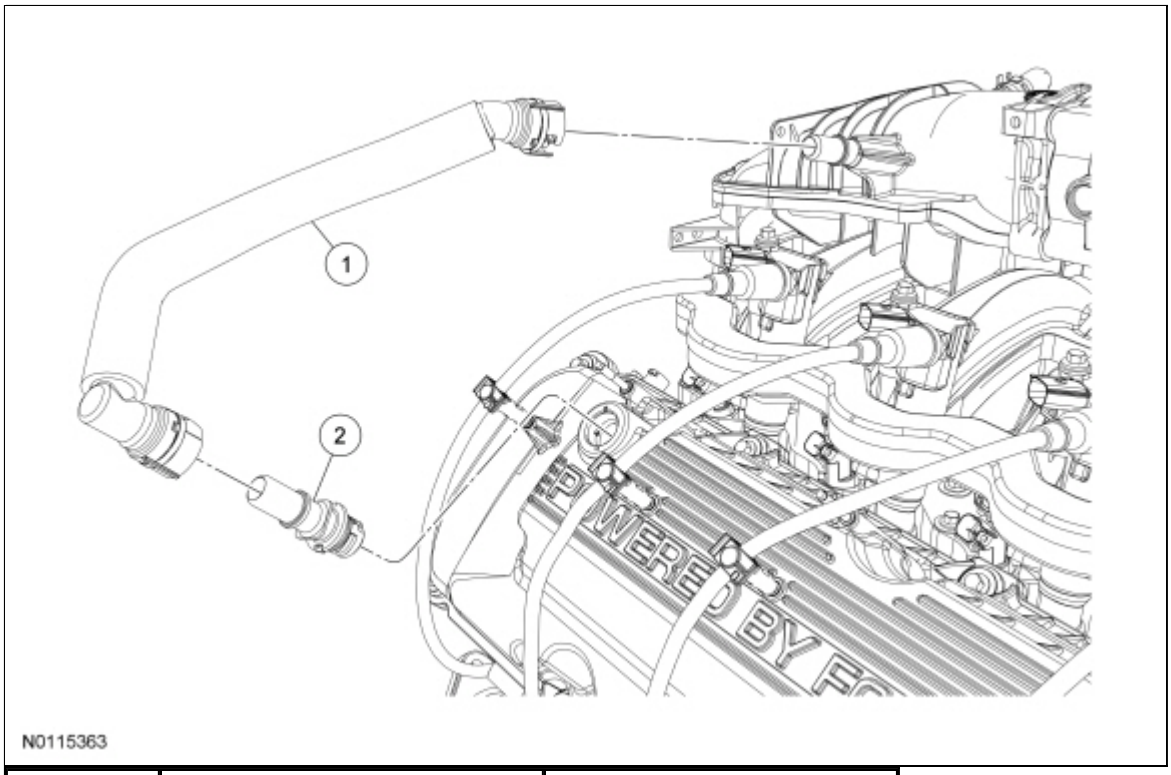
5.0L

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Item	Part Number	Description
1	6A664	PCV tube
2	6A666	PCV valve

6.2L



Item	Part Number	Description
1	6A664	PCV tube
2	6A666	PCV valve

Removal and Installation

1. Disconnect the PCV tube quick connect coupling from the PCV. For additional information, refer to Section 310-00 .

2. ***NOTICE:*** **A new PCV valve must be installed if removed. During removal, the plastic retaining ears of the PCV valve are sheared.**

   Rotate the PCV valve counterclockwise and remove the PCV valve.
   - Discard the PCV valve.

3. To install, reverse the removal procedure.
   - Install a new PCV valve.

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Torque Specifications

Description	Nm	lb-ft	lb-in
Adaptor-Turbocharger exhaust bypass	7	—	62
Air Cleaner (ACL) outlet pipe clamp	4	—	35
Charge Air Cooler (CAC) bracket bolts	40	30	—
CAC and Turbocharger pipe bracket-to-generator stud nut	48	35	—
CAC and Turbocharger pipe bracket-to-valve cover stud nuts	6	—	53
CAC pipe clamps	5	—	44
Mass Air Flow (MAF) sensor screws	2	—	18
Turbocharger pipe clamps	5	—	44
Resonator bolts	10	—	89
Resonator clamp	4	—	35

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Intake Air Distribution and Filtering

The intake air system consists of the:

- Engine Air Cleaner (ACL).
- ACL element.
- ACL outlet pipe.
- Mass Air Flow (MAF) sensor.
- Manifold Absolute Pressure (MAP) sensor.
- Charge Air Cooler (CAC) - 3.5L Gasoline Turbocharged Direct Injection (GTDI).
- CAC pipes and tubes - 3.5L GTDI .
- turbocharger intake pipes - 3.5L GTDI .
- turbocharger intake tubes - 3.5L GTDI .

The intake air system:

- cleans intake air with a replaceable, dry-type ACL element.
- measures airflow and air temperature with a MAF sensor. Refer to Section 303-14 .
- measures manifold vacuum with a MAP sensor (3.5L GTDI engine) and converts it to an electronic signal. This provides the PCM information on the engine load. Refer to Section 303-14 .

The engine ACL contains an ACL element made of treated, pleated paper. A new ACL element must be installed periodically as scheduled. Engine performance and fuel economy are adversely affected when maximum restriction of the ACL element is reached. The ACL housing is an integral part of the degas bottle (3.5L Gasoline Turbocharged Direct Injection (GTDI), 3.7L and 5.0L engines) or the coolant expansion tank (6.2L engines) and cannot be serviced separately. Refer to Section 303-03 .

The CAC subsystem (3.5L GTDI engine) cools and increases the density of the compressed turbocharged air.

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Charge Air Cooler (CAC) Cleaning

Material

Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

Charge Air Cooler (CAC) Cleaning

1. Remove the Charge Air Cooler (CAC). For additional information, refer to Charge Air Cooler in this section.

2. ***NOTICE:*** **Do not use a high-pressure power washer to clean the Charge Air Cooler (CAC) or the CAC may be damaged.**

   NOTE: Drain all contaminates such as coolant, fuel and oil prior to cleaning the Charge Air Cooler (CAC).

   NOTE: Thoroughly clean the joint clamp areas as well as the turbocharger connections and the engine connection using metal brake parts cleaner.

   Lay the CAC flat with the inlet and outlet ports pointing up.

3. **NOTE:** Plug or cap the CAC openings prior to agitating.

   Add an appropriate amount of commercially available detergent cleaner such as Simple Green® Pro HD, or equivalent, to the CAC . Follow the manufacturer's directions for cleaning. Fill the CAC to 40% of its volume with water.

4. Raise one end of the CAC and agitate it by hand for at least 5 minutes.

5. Raise the opposite end of the CAC and agitate it by hand for at least 5 minutes.

6. Drain the CAC .

7. Flush the CAC thoroughly with clean water.

8. Repeat Steps 1 through 6 until no contaminates are found in the flush water.

9. Allow the CAC to air dry.

10. **NOTE:** The following leak test steps must be performed prior to installing the CAC .

    NOTE: Use a commercially available kit, such as the SPX/OTC Charged Air Cooler Tester No. 5039, or equivalent.

Install the commercially available CAC cooler tester on the CAC following the manufacturer's installation instructions.

- Tighten the clamps to 5 Nm (44 lb-in).

11.  **WARNING: Never exceed the specified pressure. Excessive pressure may cause the test adapter to blow off or may damage the charge air cooler (CAC). Failure to follow this instruction may result in serious personal injury.**

    Slowly apply air pressure to 150 kPa (22 psi).

12. Let the CAC stand for a few minutes and note any loss in pressure.
    - Release the air pressure.

13. Repeat Steps 11 and 12 as many times as necessary to verify the readings. The reading is considered verified when 3 consecutive tests show approximately the same pressure drop.
    - If the pressure loss exceeds 20 kPa (3 psi) per minute, install a new CAC . For additional information, refer to Charge Air Cooler in this section.

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Air Cleaner — 3.5L GTDI

Material

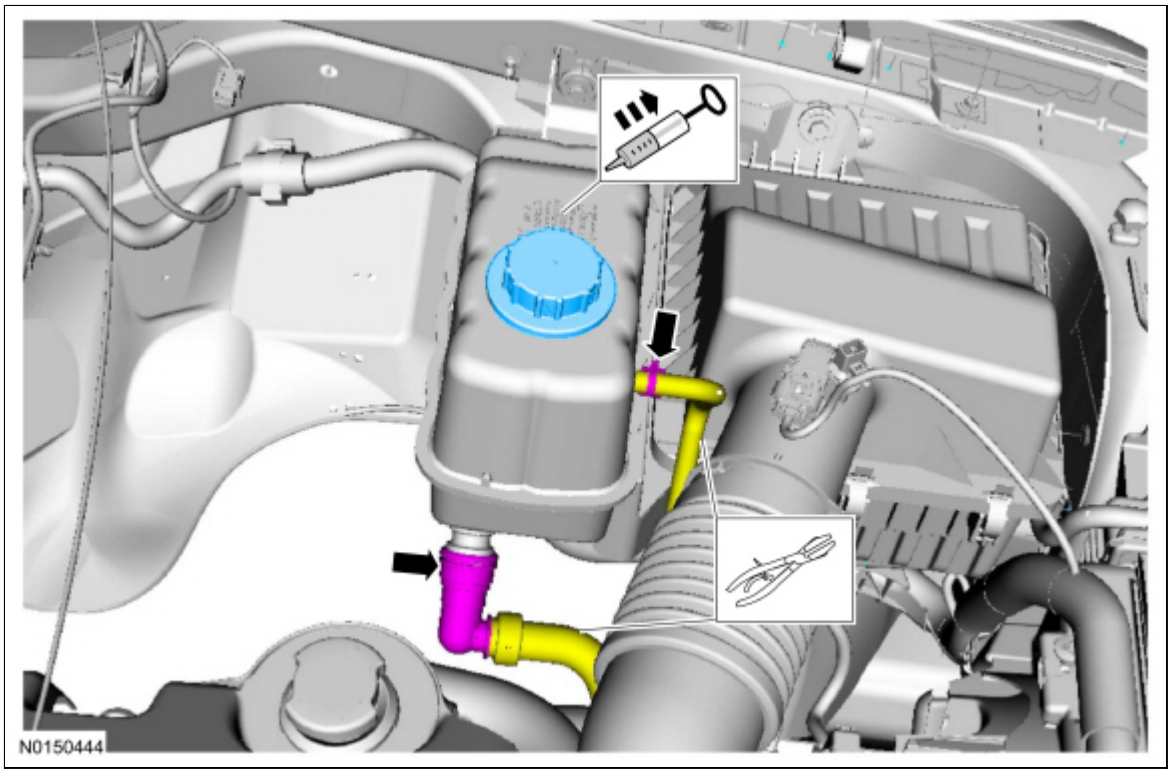
Item	Specification
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D

NOTICE: **Whenever turbocharger air intake system components are removed, always cover open ports to protect from debris. It is important that no foreign material enter the system. The turbocharger compressor vanes are susceptible to damage from even small particles. All components should be inspected and cleaned, if necessary, prior to installation or reassembly.**

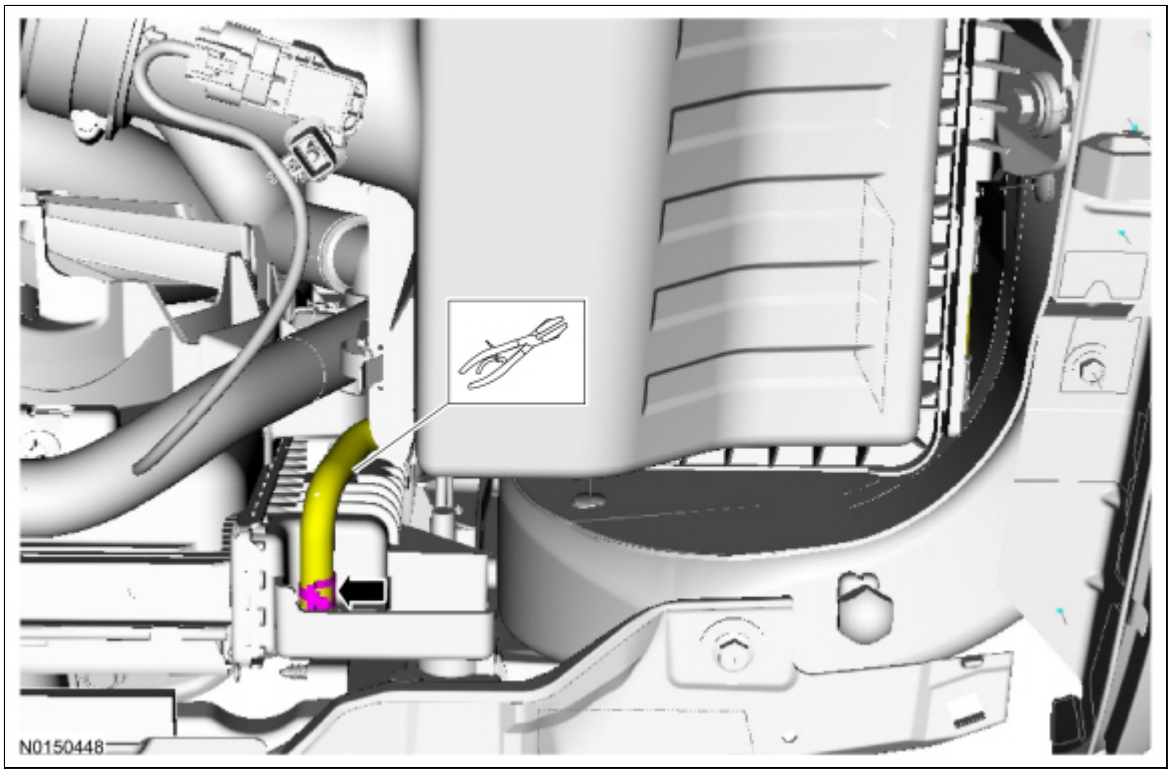
1. **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   NOTE: During normal vehicle operation, Motorcraft Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

2.



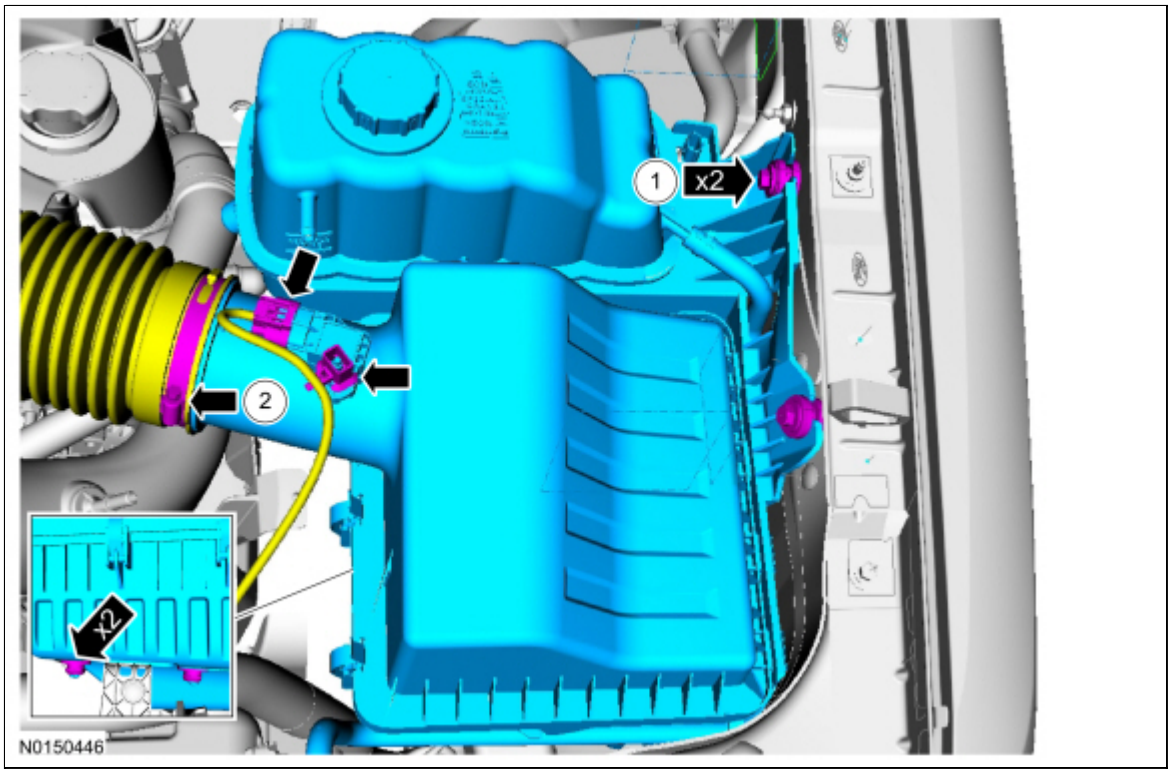
3.



4.

1. Tighten to 17 Nm (150 lb-in).
2. Tighten to 5Nm (44 lb-in).

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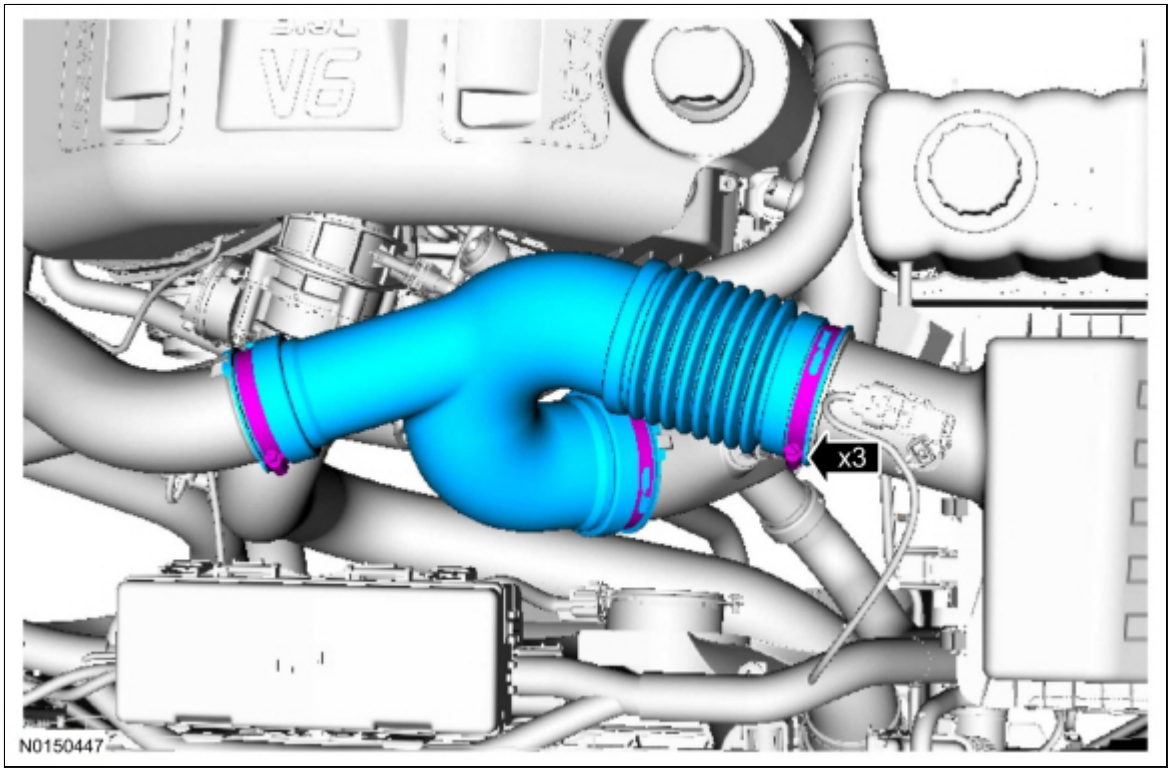


5. To install, reverse the removal procedure.
6. Fill the degas bottle with a 50/50 mixture of coolant and distilled water.

Air Cleaner Outlet Pipe — 3.5L GTDI

NOTICE: **Whenever turbocharger air intake system components are removed, always cover open ports to protect from debris. It is important that no foreign material enter the system. The turbocharger compressor vanes are susceptible to damage from even small particles. All components should be inspected and cleaned, if necessary, prior to installation or reassembly.**

1.
    - Tighten to 5Nm (44 lb-in).



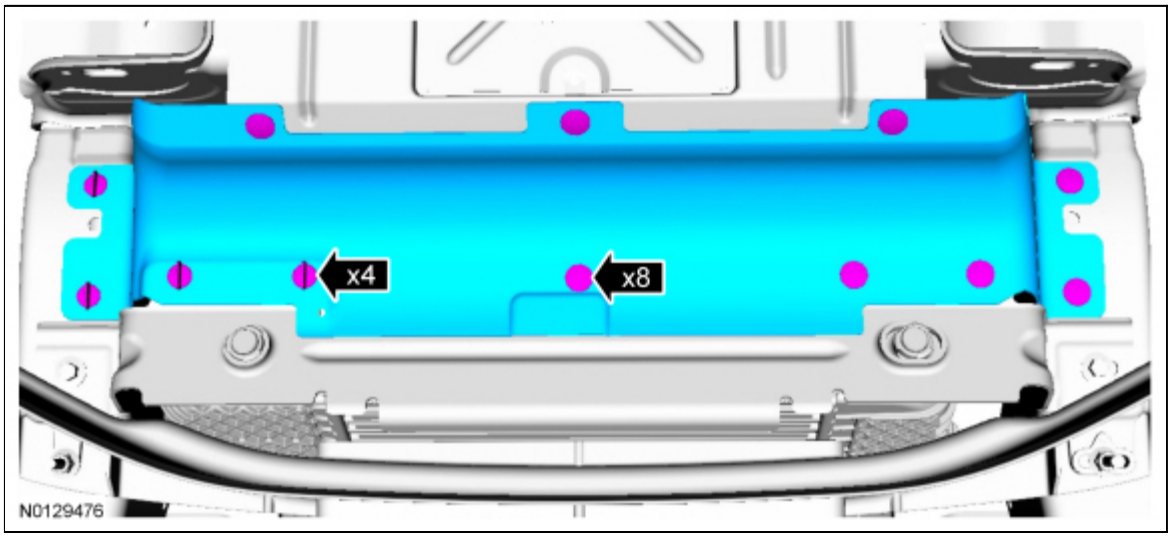
2. To install, reverse the removal procedure.

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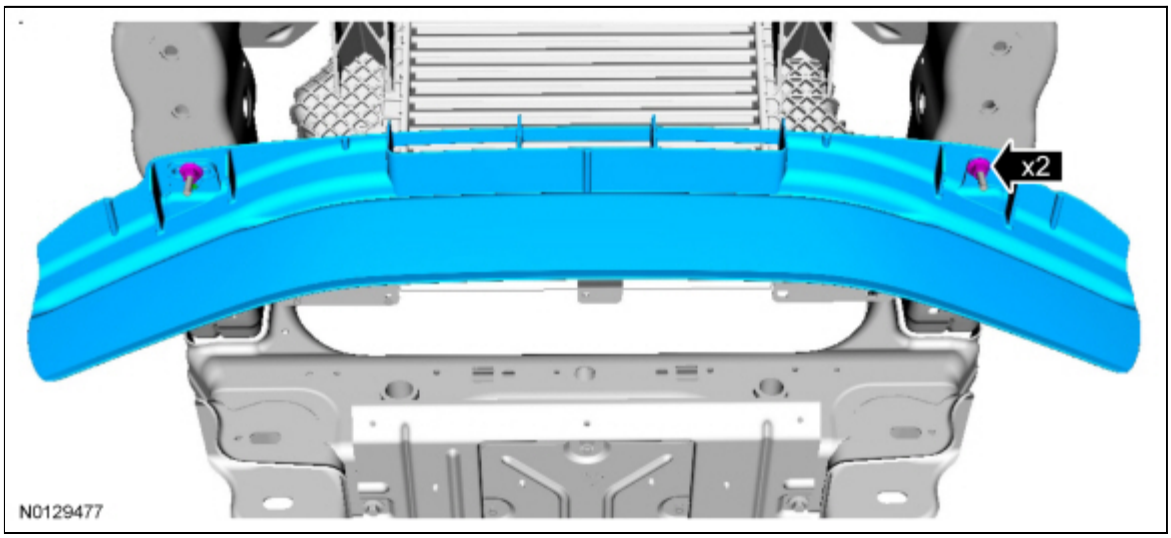
Charge Air Cooler

Removal and Installation

NOTICE: **Whenever turbocharger air intake system components are removed, always cover open ports to protect from debris. It is important that no foreign material enter the system. The turbocharger compressor vanes are susceptible to damage from even small particles. All components should be inspected and cleaned, if necessary, prior to installation or reassembly.**

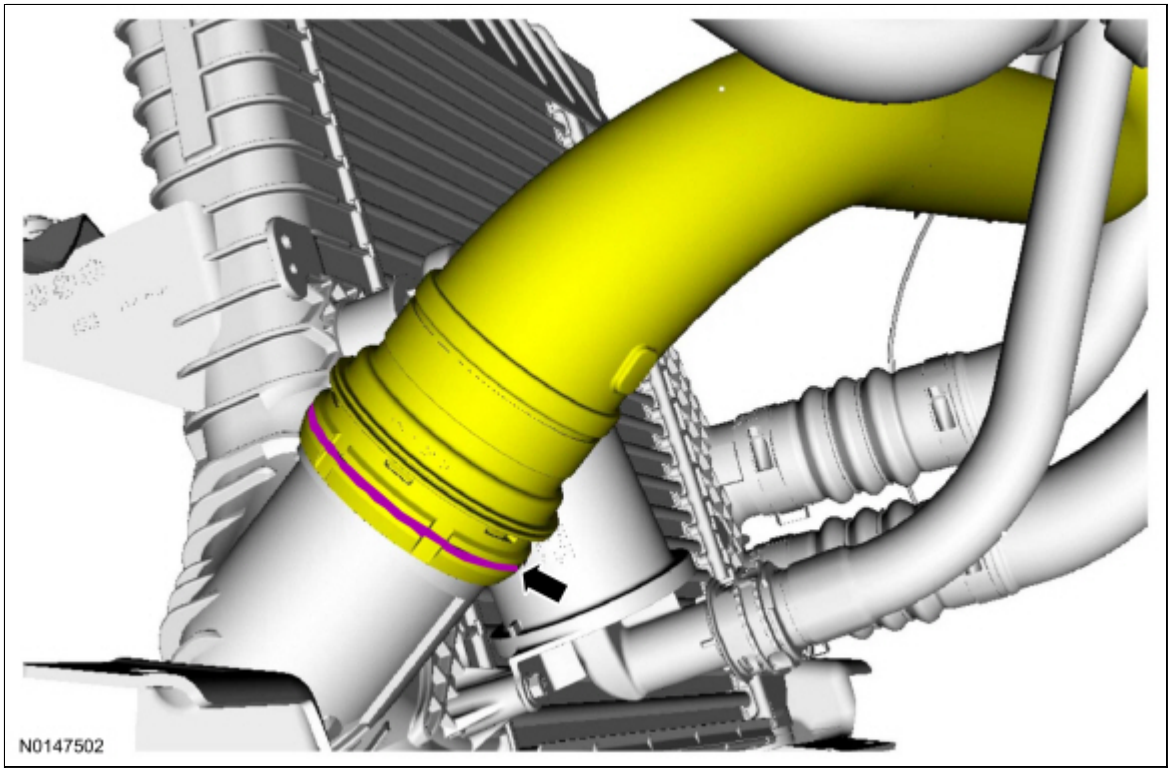
1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. 

3. - Tighten to 20 Nm (15 lb-ft).



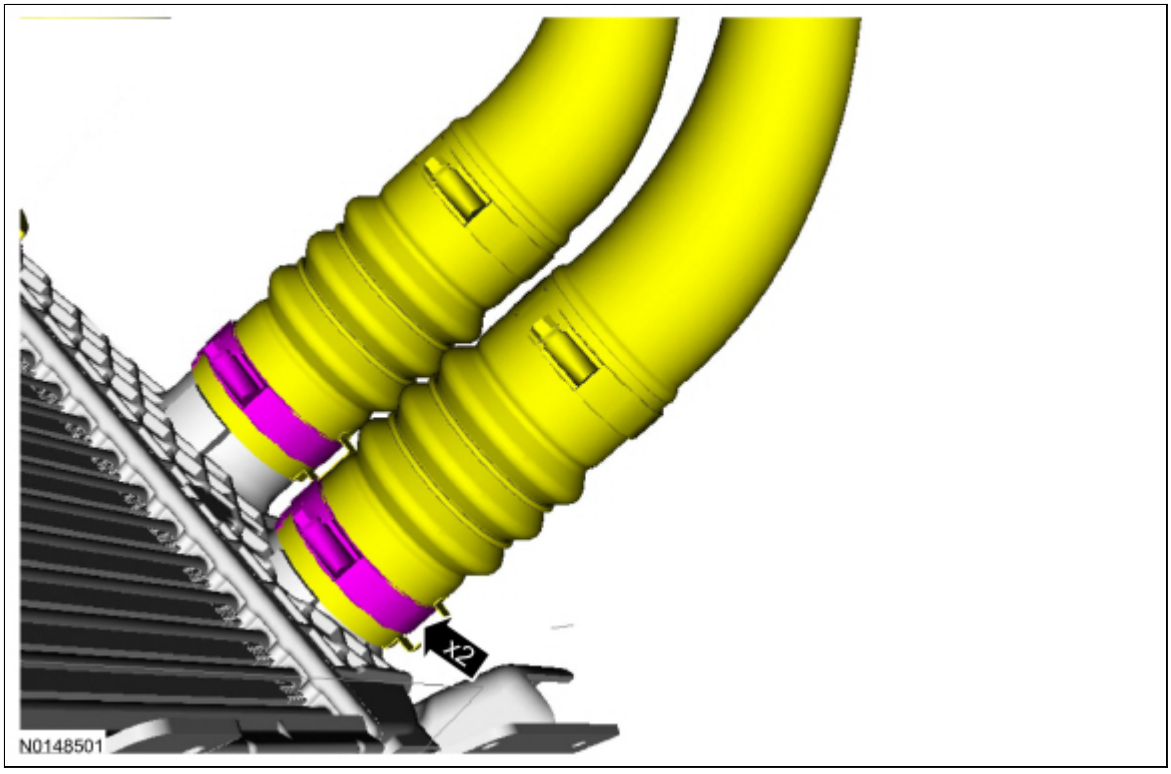
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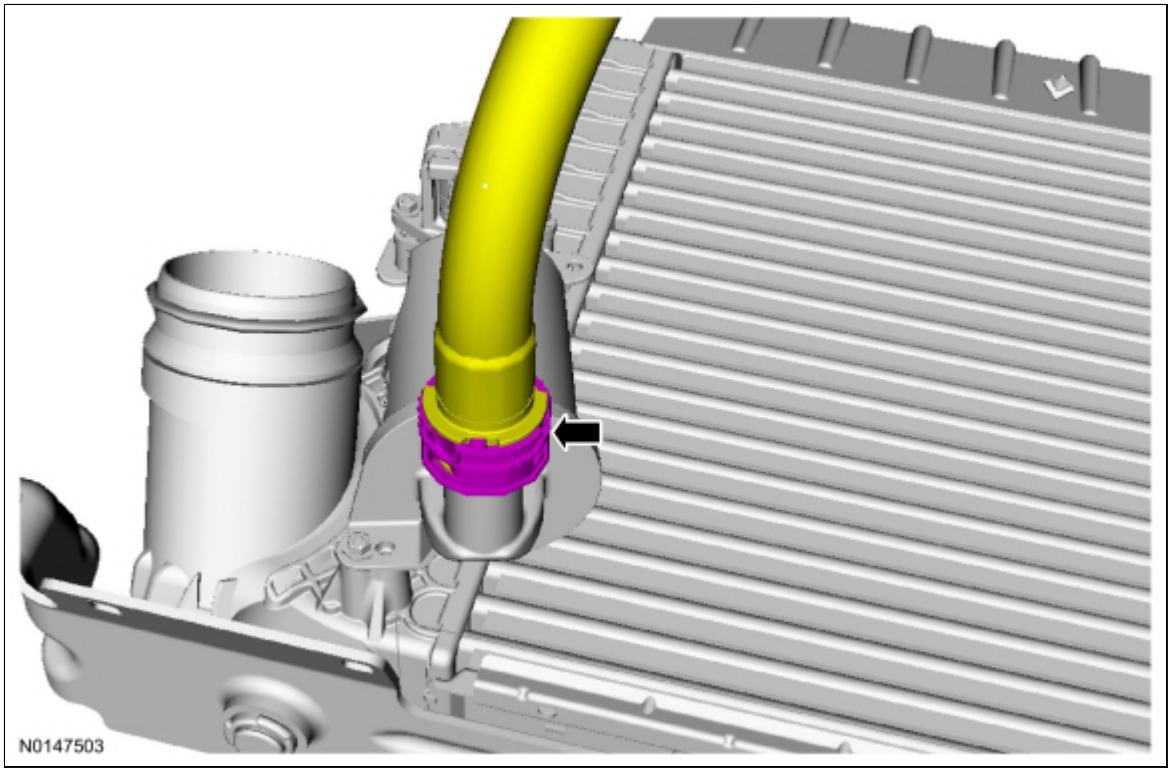


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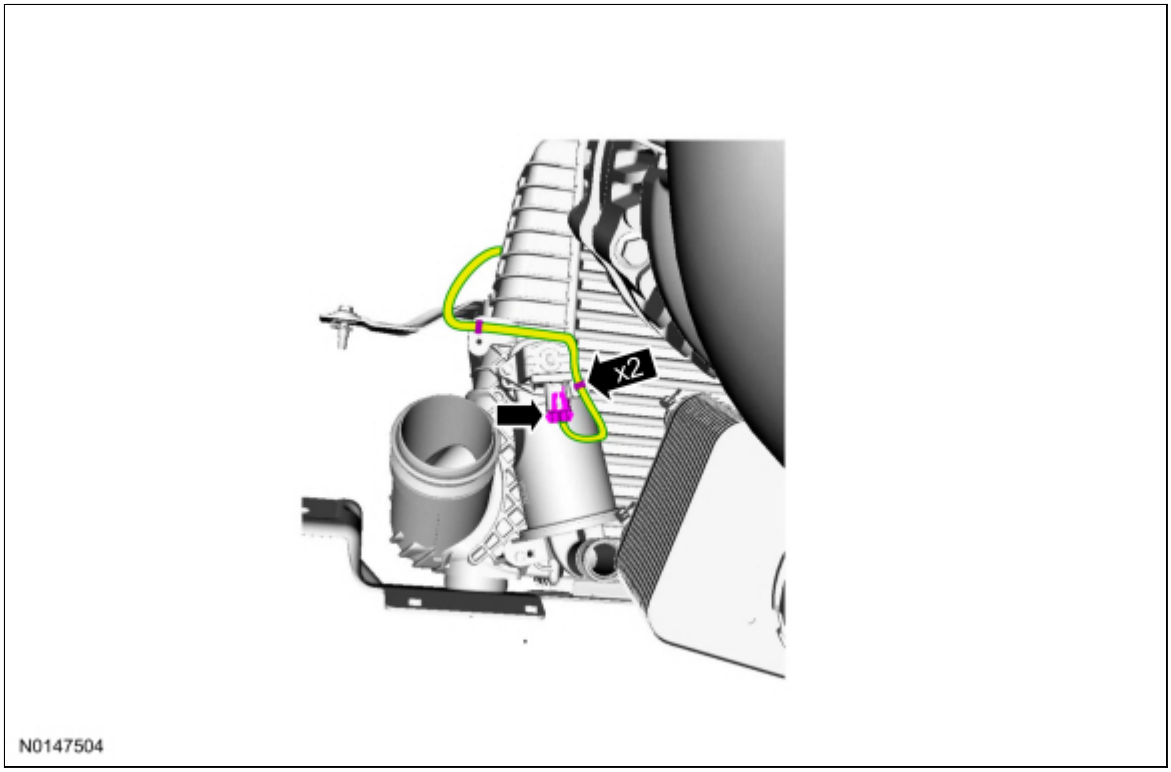
- Tighten to 5 Nm (44 lb-in).



6. Disconnect the quick connect coupling as necessary. Refer to Section 310-00



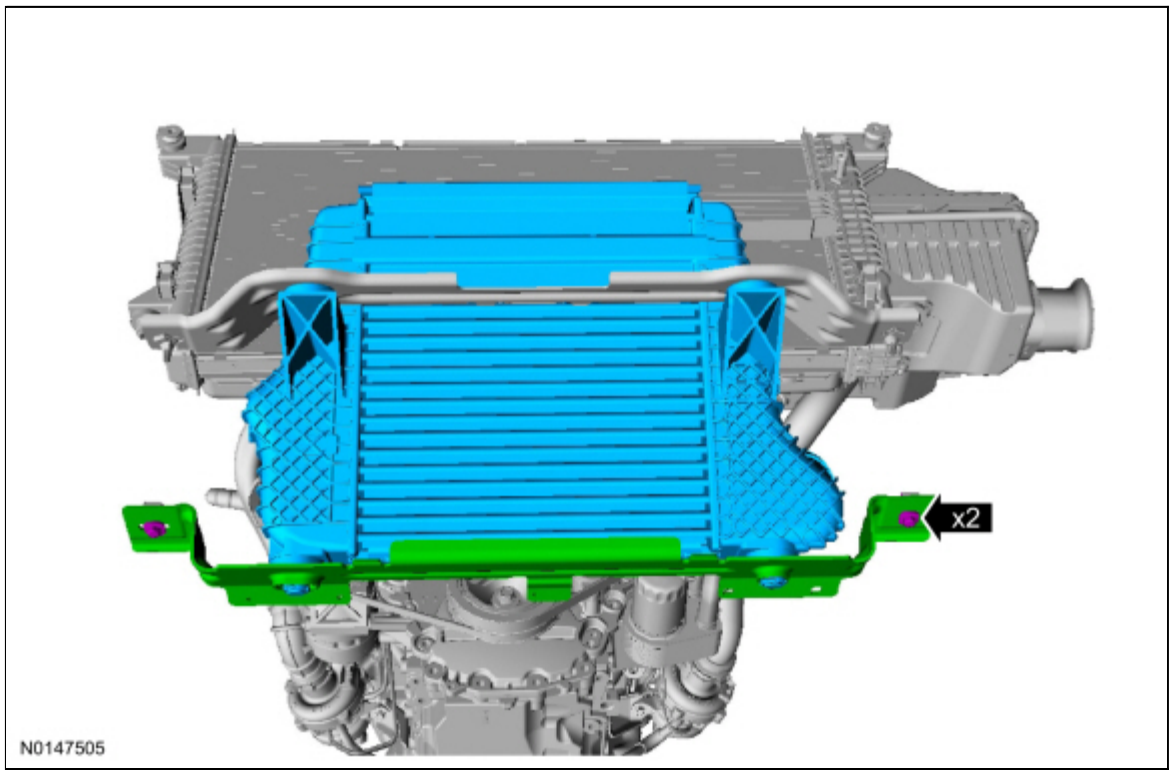
7.



8.

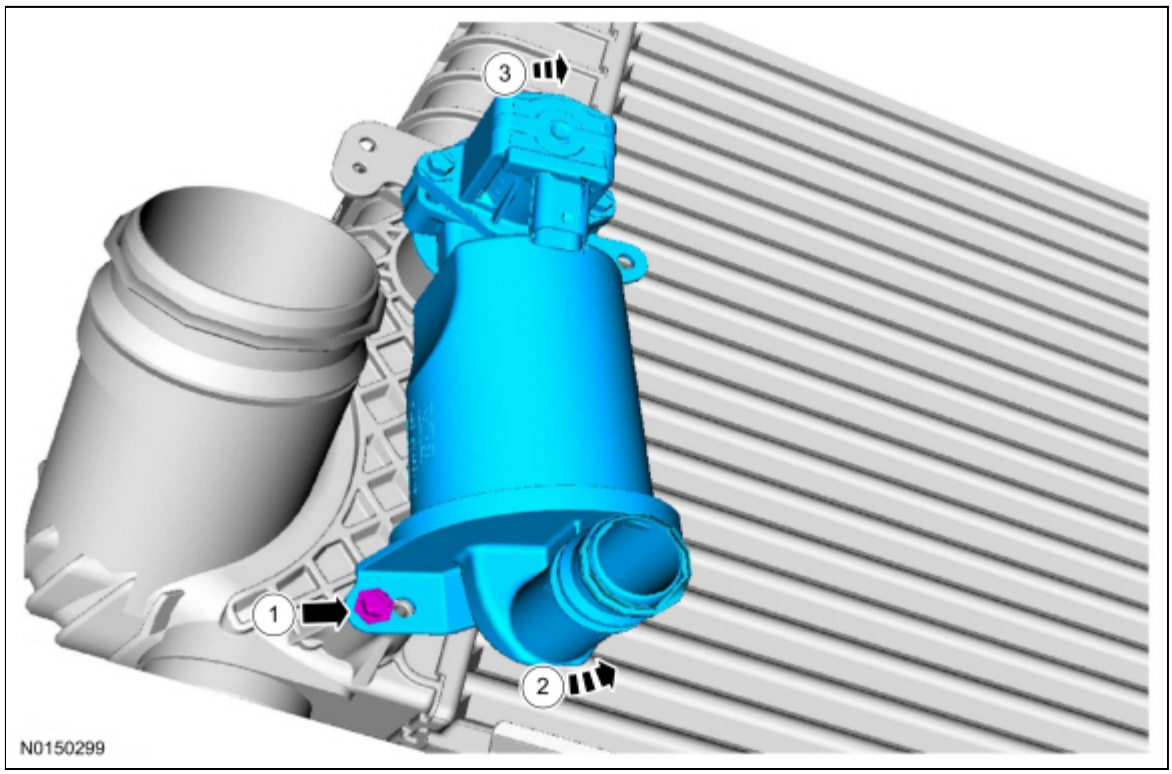
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- Tighten to 40 Nm (30 lb-ft).

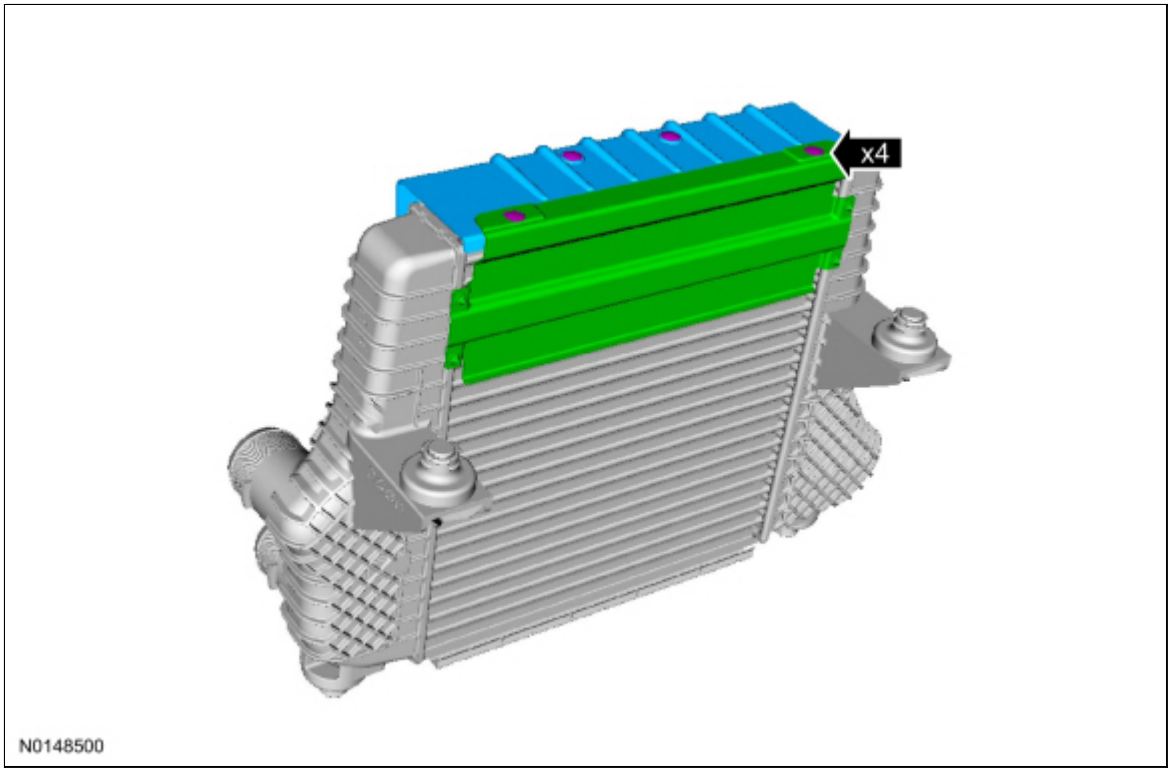


9.

- Tighten to 8 Nm (71 lb-in).



10.



11. To install, reverse the removal procedure.

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Intake Air System Components — Exploded View

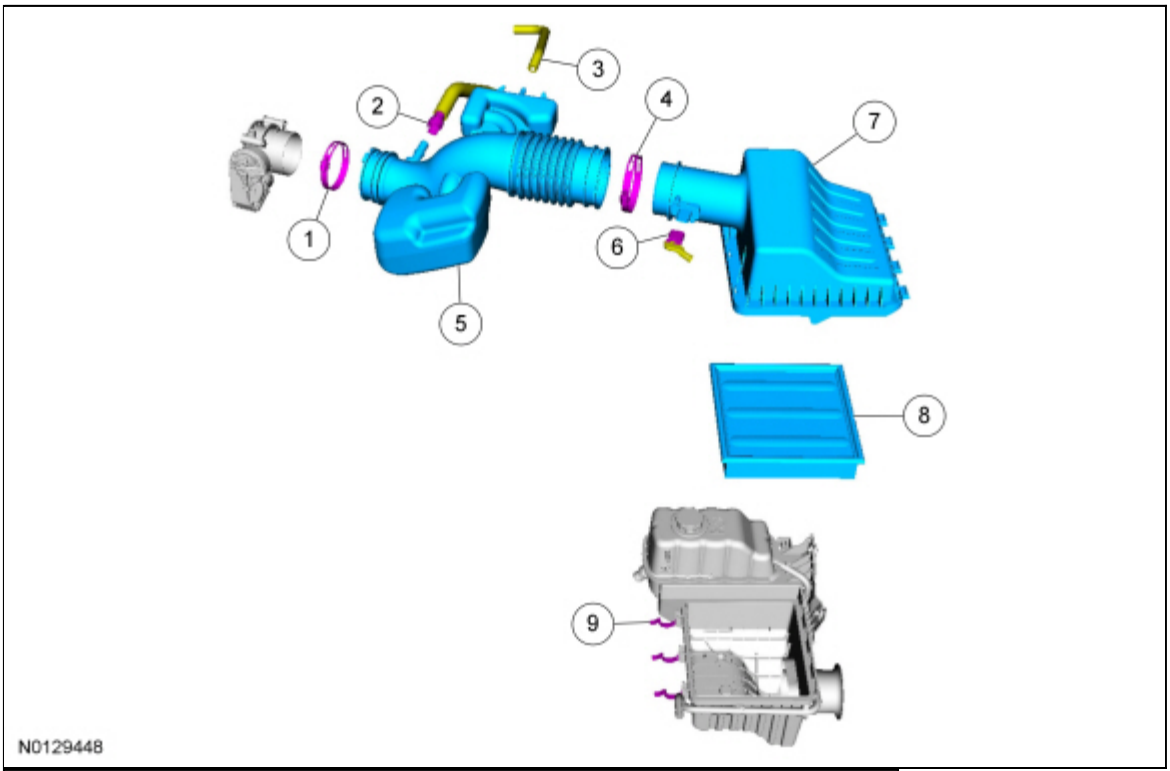
3.7L Air Cleaner (ACL) Assembly

NOTICE: **Fully seat the Air Cleaner (ACL) element into the ACL housing. Failure to do so will result in unusual engine noise.**

NOTE: Disconnect the crankcase vent hose quick connect coupling from the air cleaner outlet pipe as necessary. Refer to Section 310-00 .

NOTE: Securely seal the ACL outlet pipe to prevent unmetered air from entering the engine.

NOTE: The ACL housing is part of the degas bottle assembly. Refer to Section 303-03 .



Item	Part Number	Description
1	—	Air Cleaner (ACL) outlet pipe-toThrottle Body (TB) clamp - 4 Nm (35 lb-in) (part of 9B659)
2	—	Crankcase vent hose quick connect coupling (part of 6758)
3	9C490	Vacuum hose
4	—	ACL -to- ACL outlet pipe clamp - 4 Nm (35 lb-in) (part

		of 9B659)
5	9B659	ACL outlet pipe
6	—	Mass Air Flow (MAF) sensor electrical connector (part of 12A581)
7	9661	ACL upper tray
8	9601	ACL element
9	9628	Air cleaner tray retaining clips (3 required)

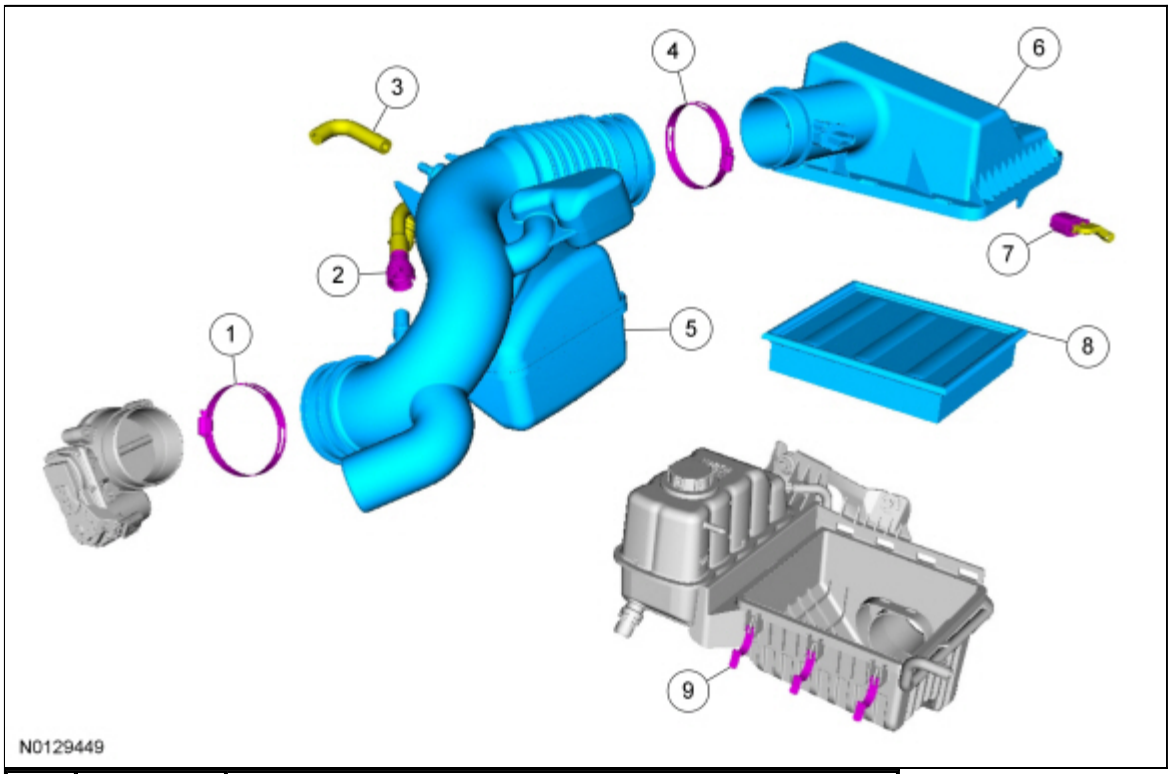
5.0L Air Cleaner (ACL) Assembly

NOTICE: **Fully seat the Air Cleaner (ACL) element into the ACL housing. Failure to do so will result in unusual engine noise.**

NOTE: Disconnect the crankcase vent hose quick connect coupling from the air cleaner outlet pipe as necessary. Refer to Section 310-00 .

NOTE: Securely seal the ACL outlet pipe to prevent unmetered air from entering the engine.

NOTE: The ACL housing is part of the degas bottle assembly. Refer to Section 303-03 .



Item	Part Number	Description
1	—	Air Cleaner (ACL) outlet pipe-to-Throttle Body (TB) clamp - 4 Nm (35 lb-in) (part of 9B659)

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2	6758	Crankcase vent hose
3	9C490	Vacuum hose
4	—	ACL -to- ACL outlet pipe clamp - 4 Nm (35 lb-in) (part of 9B659)
5	9B659	ACL outlet pipe
6	9661	ACL upper tray
7	—	Mass Air Flow (MAF) sensor electrical connector (part of 12A581)
8	9601	ACL element
9	9628	Air cleaner tray retaining clips (3 required)

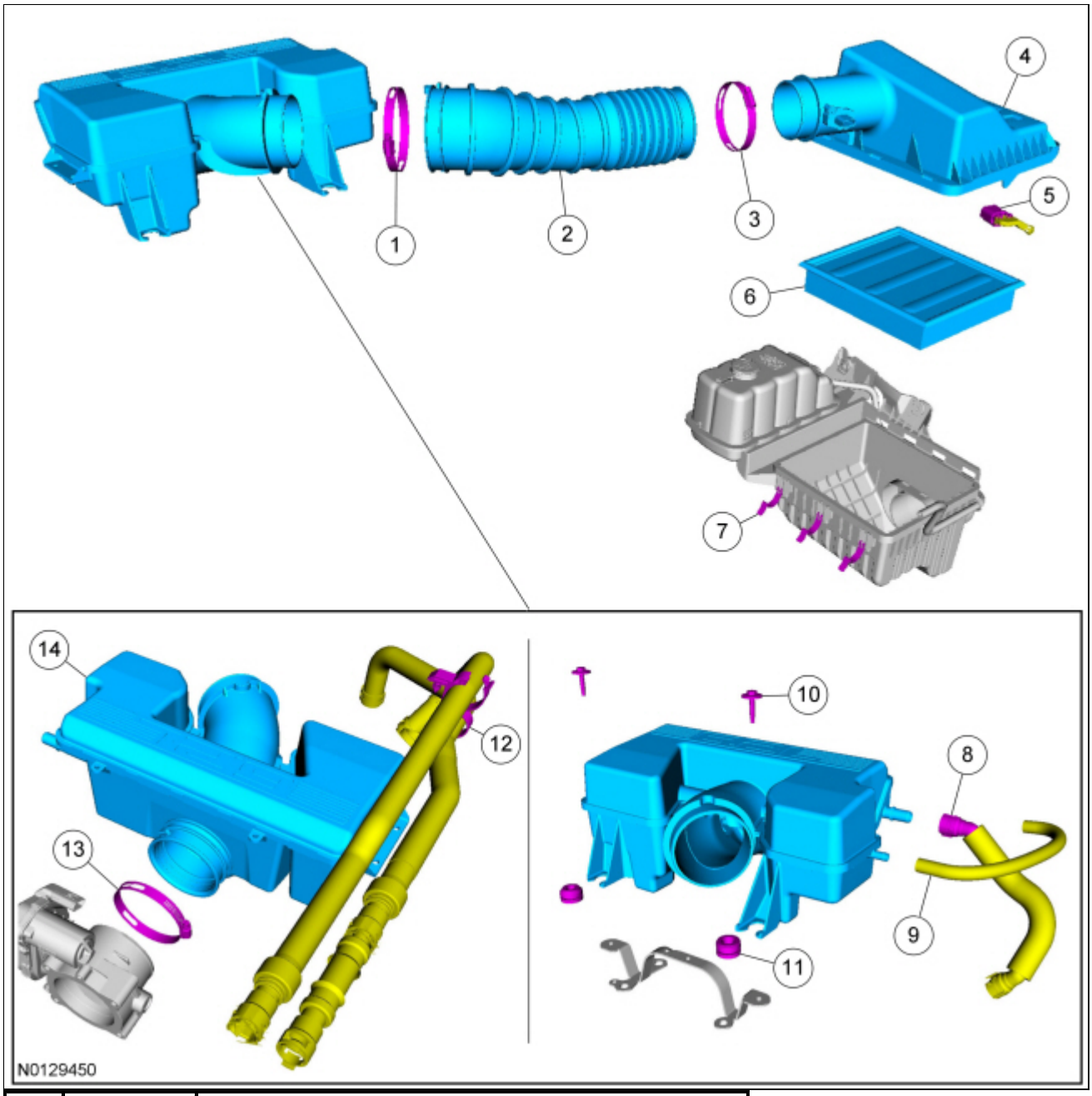
6.2L Air Cleaner (ACL) Assembly

NOTICE: **Fully seat the Air Cleaner (ACL) element into the ACL housing. Failure to do so will result in unusual engine noise.**

NOTE: Disconnect the crankcase vent hose quick connect coupling from the resonator as necessary. Refer to Section 310-00 .

NOTE: Securely seal the ACL outlet pipe to prevent unmetered air from entering the engine.

NOTE: The ACL housing is part of the coolant expansion tank assembly. Refer to Section 303-03 .



Item	Part Number	Description
1	—	Air Cleaner (ACL) outlet pipe-to-resonator clamp - 4 Nm (35 lb-in) (part of 9B659)
2	9B659	ACL outlet pipe
3	—	ACL -to- ACL outlet pipe clamp - 4 Nm (35 lb-in) (part of 9B659)
4	9661	ACL upper tray
5	—	Mass Air Flow (MAF) sensor electrical connector (part of 12A581)
6	9601	ACL element

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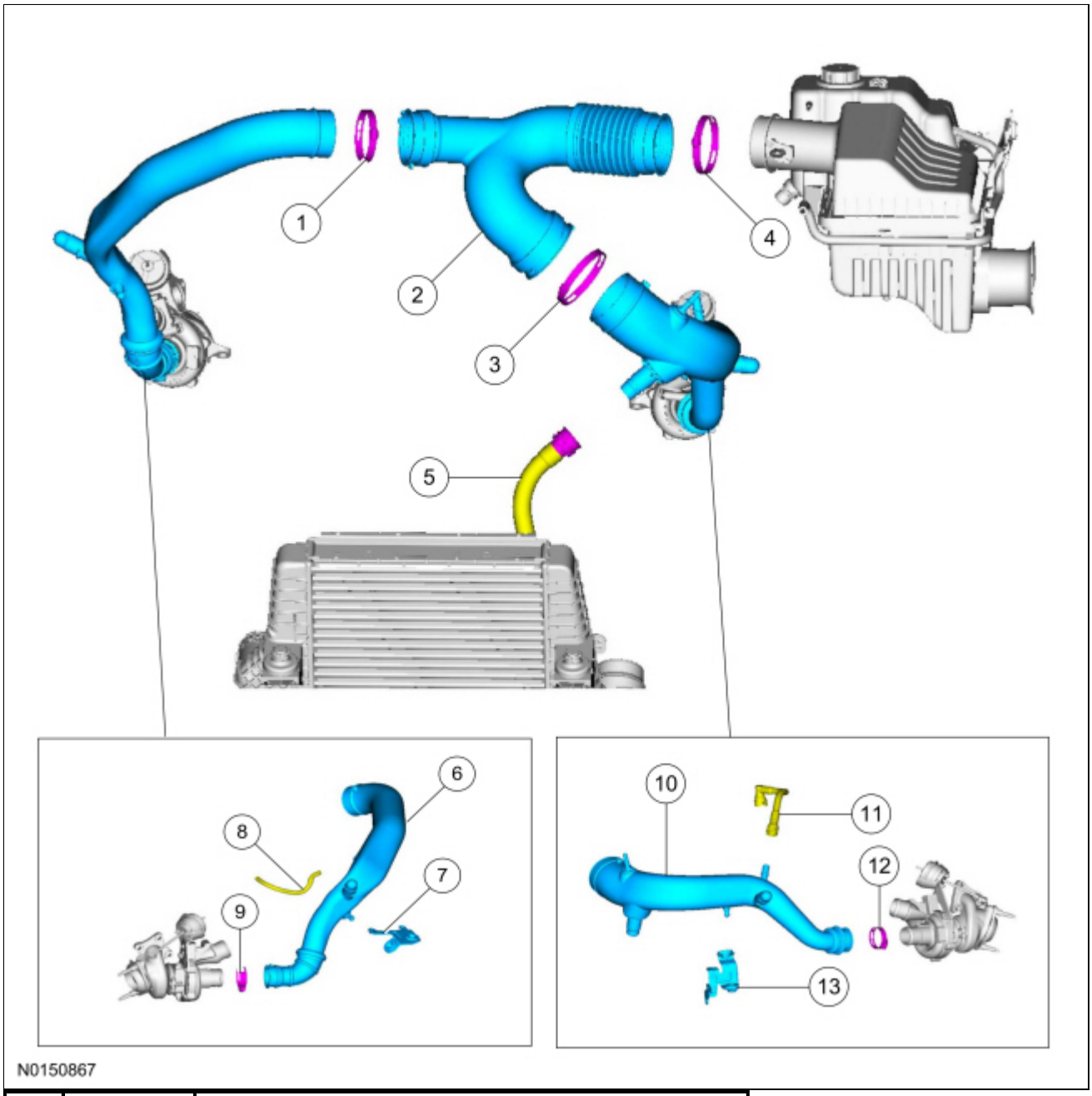
7	9628	Air cleaner tray retaining clips (3 required)
8	—	Crankcase ventilation tube quick connect coupling (part of 6758)
9	9C490	Brake booster vacuum hose
10	W707522	Resonator bolts - 10 Nm (89 lb-in)
11	9P686	Resonator insulator
12	8W278	Heater hose retainer
13	—	Resonator-to-throttle body clamp - 4 Nm (35 lb-in) (part of 9F763)
14	9F763	Resonator

3.5L GTDI Air Cleaner (ACL) Assembly and ACL Outlet Pipes

NOTE: Disconnect the fuel vapor management hose and the crankcase vent hose quick connect couplings from the LH ACL pipe-to-turbocharger pipe as necessary. Refer to Section 310-00 .

NOTE: Securely seal the ACL outlet pipe and the turbocharger pipes to prevent unmetered air from entering the engine.

NOTE: The ACL housing is part of the coolant expansion tank assembly. Refer to Section 303-03 .

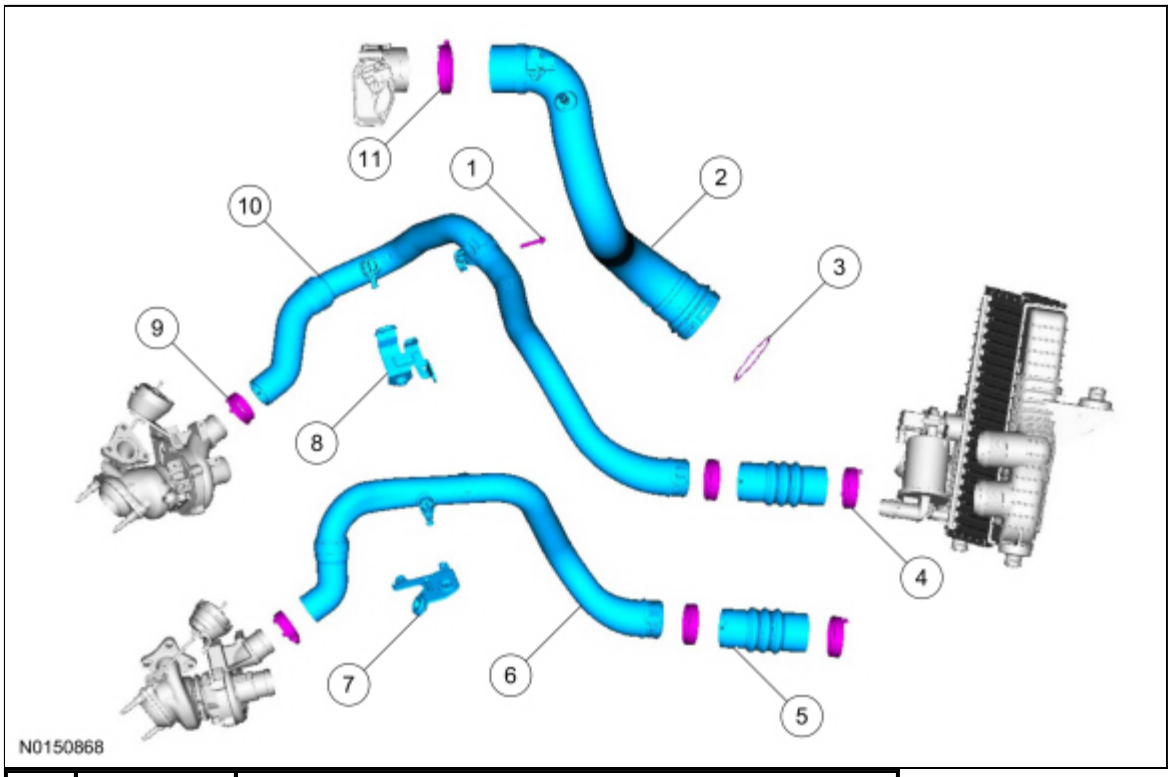


Item	Part Number	Description
1	—	ACL outlet pipe clamp - 5 Nm (44 lb-in) (part of 9C623)
2	9C623	ACL outlet pipe
3	—	ACL outlet pipe clamp - 5 Nm (44 lb-in) (part of 9C623)
4	—	ACL outlet pipe clamp - 5 Nm (44 lb-in) (part of 9C623)
5	9J478	Air bypass hose assembly
6	9B659	RH ACL pipe-to-turbocharger pipe
7	9647	RH ACL and CAC pipe bracket
8	9E499	Vacuum hose

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9	—	RH ACL pipe-to-turbocharger pipe clamp - 5 Nm (44 lb-in) (part of 9B659)
10	—	LH ACL pipe-to-turbocharger pipe (part of 9C623)
11	3E675	Crankcase vent tube assembly
12	—	LH ACL pipe-to-turbocharger pipe - 5 Nm (44 lb-in) (part of 9C623)
13	9647	LH ACL and CAC pipe bracket

3.5L GTDI Charge Air Cooler (CAC) and Tubes



Item	Part Number	Description
1	W503280	LH turbocharger-to- CAC pipe bracket bolt - 6 Nm (53 lb-in)
2	6F073	CAC -to-Throttle Body (TB) pipe
3	—	CAC -to- TB pipe spring clip (part of 6F073)
4	—	CAC pipe clamp - 5 Nm (44 lb-in) (part of 6C646) (4 required)
5	—	CAC tube flex joint (part of 6C646) (4 required)
6	6C646	LH turbocharger-to- CAC pipe
7	9647	RH ACL and CAC pipe bracket
8	9647	LH ACL and CAC pipe bracket

9	—	Turbocharger-to- CAC pipe clamp - 5 Nm (44 lb-in) (part of 9C623) (2 required)
10	6C646	RH turbocharger-to- CAC pipe
11	—	CAC -to- TB pipe clamp - 5 Nm (44 lb-in) (part of 6F073)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Torque Specifications

Description	Nm	lb-in
Evaporative Emission (EVAP) canister assembly bracket-to- EVAP canister assembly bolts	6	53
EVAP canister assembly-to-frame bolts	13	115
EVAP canister purge valve-to-intake manifold bolts	10	89

Evaporative Emissions

The Evaporative Emission (EVAP) system consists of the following components:

- EVAP canister (located in front of the fuel tank)
- EVAP canister purge valve (located on the intake manifold)
- Dual check valve (3.5L Gasoline Turbocharged Direct Injection (GTDI) engine) (part of the canister purge valve)
- Vapor ejector (3.5L GTDI engine) (located in front of the engine)
- EVAP canister vent solenoid and dust separator assembly (located on the front of the EVAP canister)
- Fuel Tank Pressure (FTP) sensor and vapor tube assembly (located on top of the fuel tank)
- Vapor tubes
- Fresh air hose (located on top of the transmission)

The EVAP system:

- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the EVAP canister that are generated during vehicle operation or hot soak, until they can be consumed by the engine during normal engine operation.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the PCM which, using various sensor inputs, calculates the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.

The fuel vapors are routed:

- from the fuel tank through the fill limit valve and fuel vapor vent valve. The fuel vapor vent valves are part of the fuel tank assembly and cannot be serviced separately.
- to the EVAP canisters through a vapor line.
- to the engine when the EVAP canister purge valve is opened by the PCM.

The EVAP canister:

- contains activated carbon.
- stores fuel vapors.

The EVAP canister purge valve:

- is normally closed.
- regulates the purging of the EVAP canister.
- is controlled by the PCM.

The dual check valve (3.5L GTDI engine):

- routes fuel vapors to the intake manifold when the intake manifold is not pressurized.
- routes fuel vapors to the vapor ejector when the intake manifold is pressurized.

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The vapor ejector (3.5L GTDI engine):

- is a venturi valve.
- uses pressurized air from the RH turbocharger-to-Charge Air Cooler (CAC) tube to route fuel vapors to the Air Cleaner (ACL) outlet tube-to-LH turbocharger tube.

The EVAP canister vent solenoid:

- is controlled by the PCM.
- is normally open.
- seals the EVAP system for the inspection and maintenance (I/M 240) test and OBD II leak and pressure tests.

The EVAP dust separator:

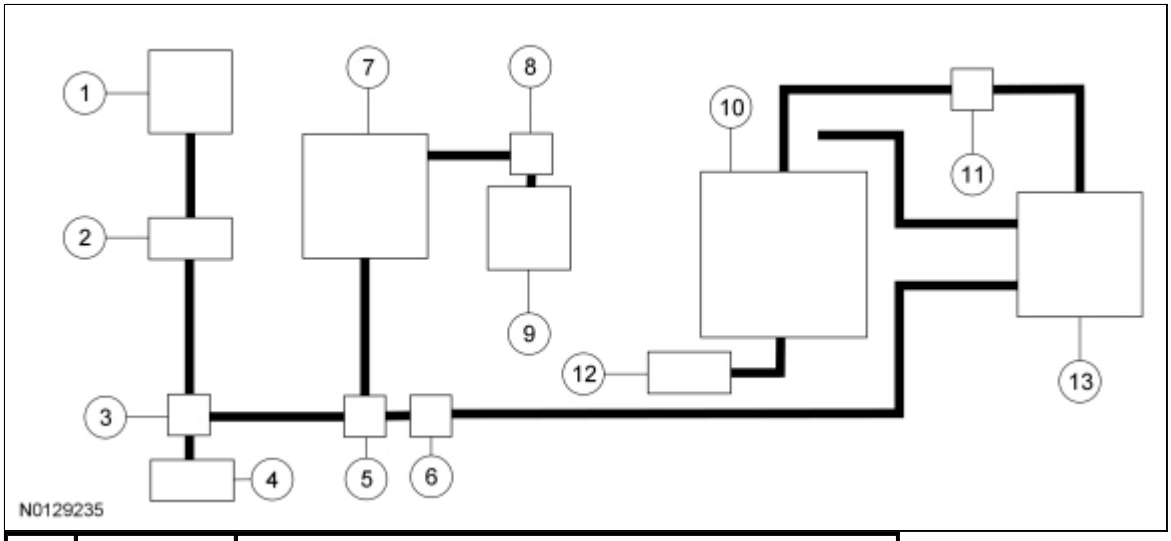
- prevents suspended dust and dirt particles from entering the EVAP system.
- is serviced as a separate item.

The FTP sensor:

- measures the pressure levels in the fuel tank continuously.
- serves as an input to the PCM.

Vehicle Emission Vacuum Routing

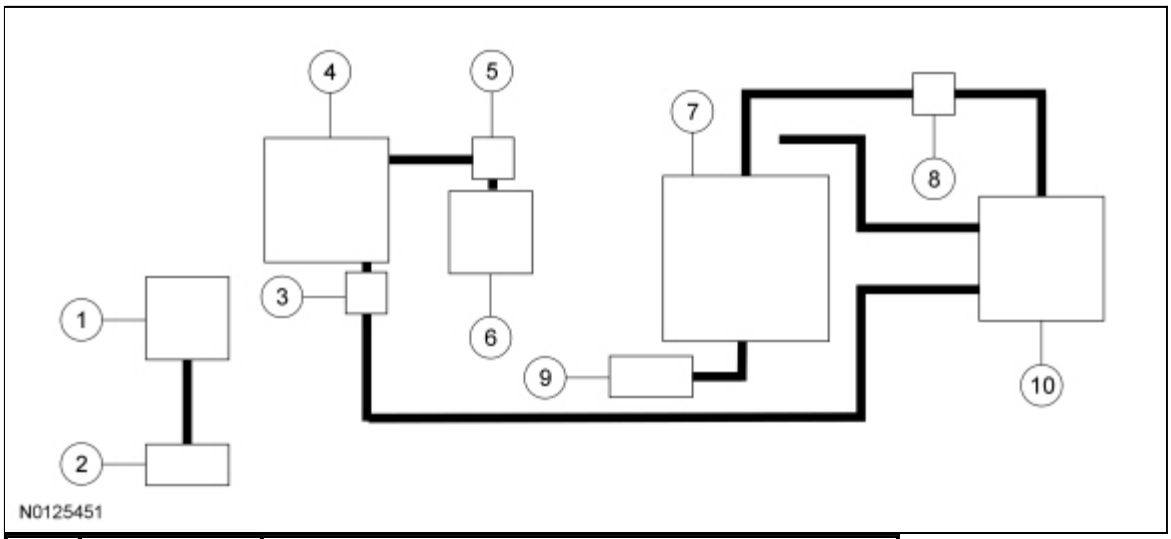
3.5L Gasoline Turbocharged Direct Injection (GTDI)



Item	Part Number	Description
1	6A505	LH valve cover
2	—	Air Cleaner (ACL) outlet tube-to-LH turbocharger tube (part of 9C623)
3	—	Vapor ejector (part of 9C915)

4	9C646	RH turbocharger-to-Charge Air Cooler (CAC) tube
5	—	Dual check valve (part of 9B325)
6	9B325	Evaporative Emission (EVAP) canister purge valve
7	9424	Intake manifold
8	6A666	PCV valve
9	6582	RH valve cover
10	9002	Fuel tank
11	—	Fuel Tank Pressure (FTP) sensor (part of 9E325)
12	9034	Fuel tank filler pipe
13	9E857	EVAP canister

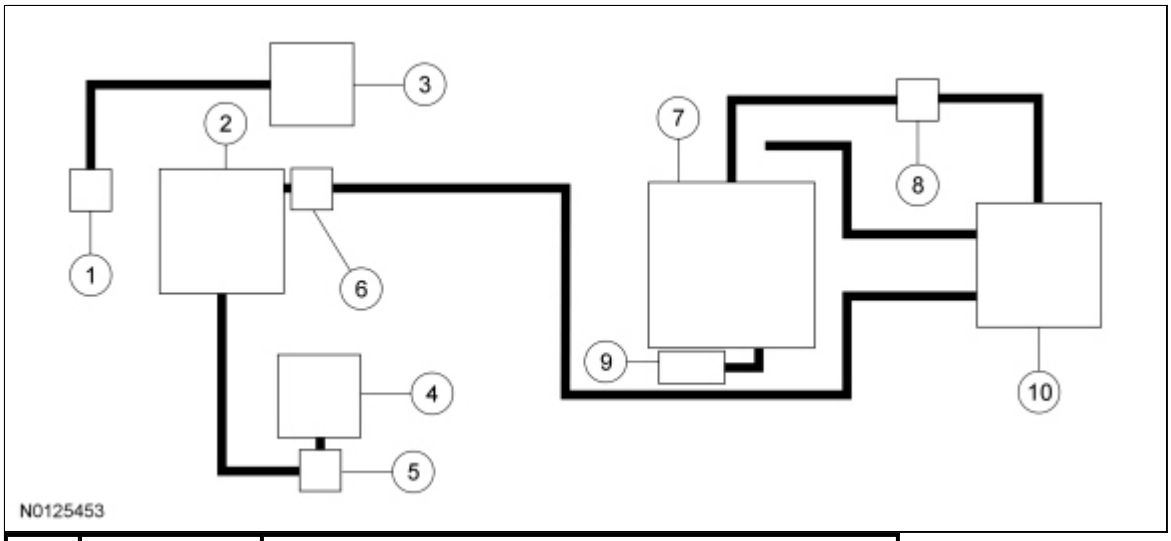
3.7L



Item	Part Number	Description
1	6A505	LH valve cover
2	9R530	Air Cleaner (ACL) outlet tube
3	9G866	Evaporative Emission (EVAP) canister purge valve
4	9424	Intake manifold
5	6A666	PCV valve
6	6582	RH valve cover
7	9002	Fuel tank
8	—	Fuel Tank Pressure (FTP) sensor (part of 9E325)
9	9034	Fuel tank filler pipe
10	9E857	EVAP canister

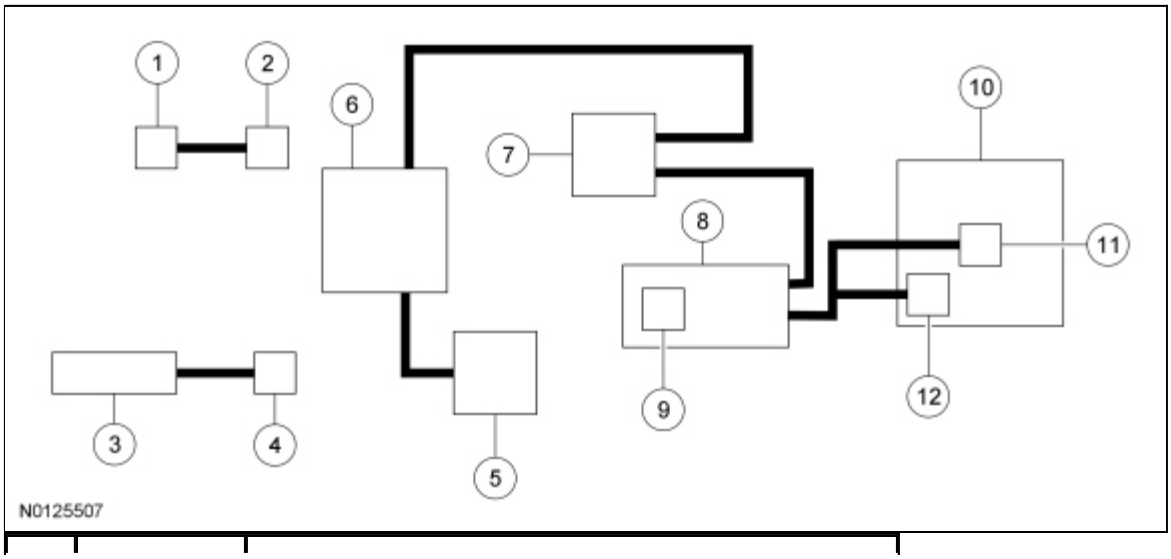
5.0L

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Item	Part Number	Description
1	9B659	Air Cleaner (ACL) outlet pipe
2	9425	Intake manifold
3	6582	RH valve cover
4	6A505	LH valve cover
5	—	PCV valve (part of LH valve cover)
6	9G866	Evaporative Emission (EVAP) canister purge valve
7	9002	Fuel tank
8	—	Fuel Tank Pressure (FTP) sensor (part of 9E325)
9	9034	Fuel tank filler pipe
10	9E857	EVAP canister

6.2L



Item	Part Number	Description
1	6A666	PCV valve
2	9F624	PCV fitting
3	6A505	LH valve cover
4	9A589	Air Cleaner (ACL) outlet pipe-to-Throttle Body (TB) adapter
5	—	Brake booster
6	9S455	Intake manifold
7	9C915	Evaporative Emission (EVAP) canister purge valve
8	9D653	EVAP canister assembly
9	9F675	EVAP canister vent solenoid and dust separator assembly
10	9K007	Fuel tank
11	—	Fuel pump module
12	—	Fuel vent valve

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Evaporative Emission System Leak Test

Special Tool(s)

 ST2817-A	VACUTEC Smoke Machine Fuel Evaporative Emission System Tester 218-0002 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Phase 1 — Leak Verification

1. Run the EVAP Test with the scan tool.

2. **NOTE:** Some small leaks may not be detected using the EVAP Test. If the system has passed the test but a leak is still suspected, then proceed to Phase 2.

   If the Evaporative Emission (EVAP) system failed the EVAP Test, then proceed to Phase 2.

Phase 2 — System Leak Check

1. Disconnect the upper vapor tube-to- EVAP canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .

2. Connect the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester to the upper EVAP canister purge valve fitting. For additional information, refer to the manufacturer's instructions.

3. **NOTE:** The battery ground cable was previously disconnected in the vapor tube quick connect coupling procedure.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

4. **NOTE:** In the scan tool, the EVAP canister purge valve is referred to as the EVAP vapor management valve.

   Open the EVAP canister purge valve with the scan tool.

5. Close the canister vent solenoid with the scan tool.

6. **NOTE:** The supplemental refueling adapter is located with the vehicle jack.

Install the supplemental refueling adapter into the Easy Fuel ^{TM} (capless) fuel tank filler pipe assembly.

7. **NOTE:** If smoke does not exit the fuel tank filler pipe neck area after the system is pressurized, open the canister vent solenoid with the scan tool to allow the air to purge. Once smoke is seen at the canister vent solenoid, close the canister vent solenoid with the scan tool.

   Introduce smoke from the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester into the EVAP system and verify that smoke is exiting the fuel tank filler pipe neck area. For additional information, refer to the manufacturer's instructions.

8. Remove the supplemental refueling adapter once smoke is observed exiting the fuel tank filler pipe neck area.

9. Continue to enter smoke into the system for 60 seconds to obtain pressure.

10. Press and release the remote start button in intervals of 15 seconds ON and 15 seconds OFF while checking for exiting smoke.

11. Use the halogen light provided with the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester to follow the EVAP system path and look for smoke exiting at the source of the leak(s).

12. Repair any leaks as necessary.

13. Repeat the EVAP Leak Test until the system passes.

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Dust Separator

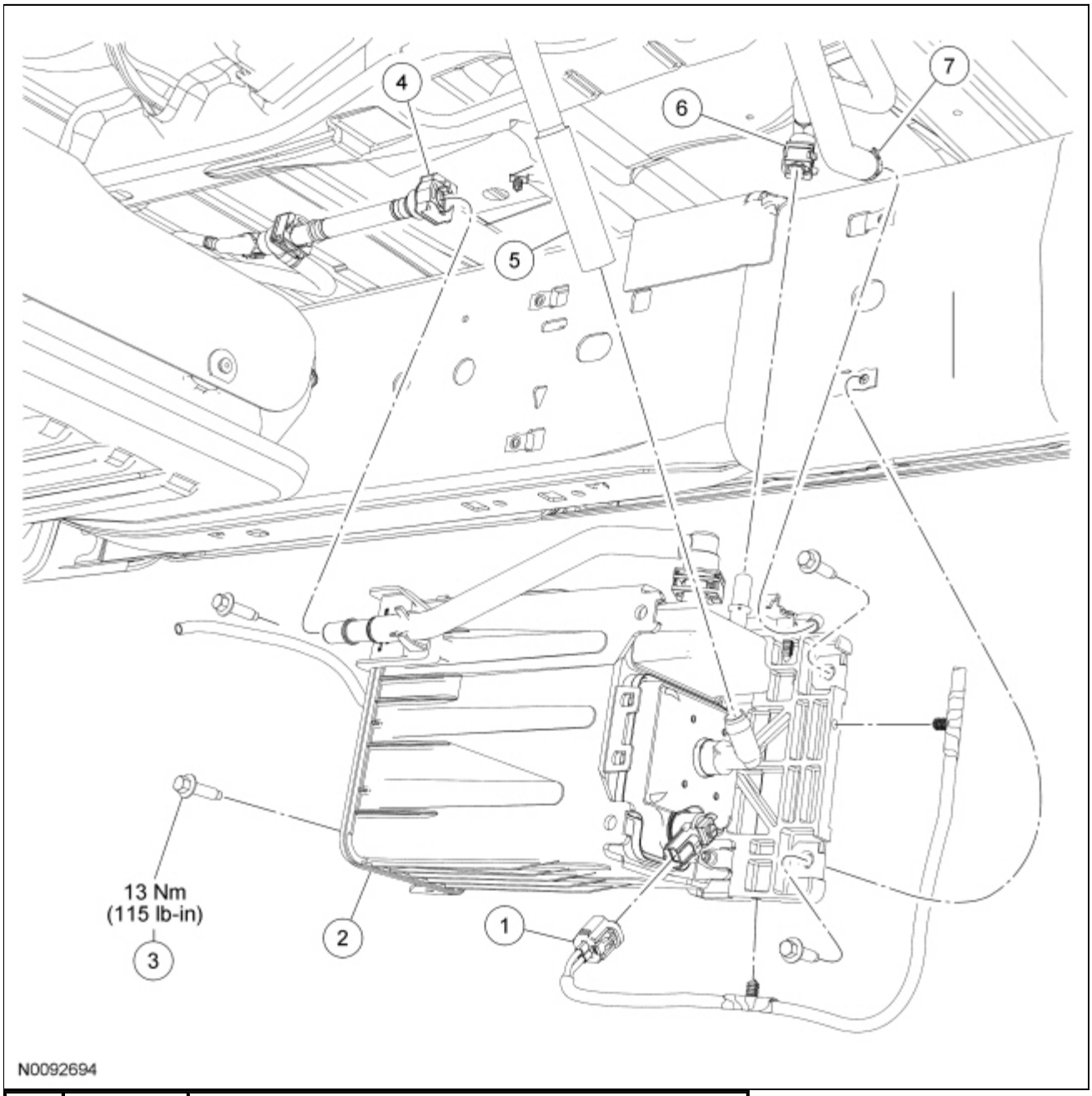
Removal and Installation

1. **NOTE:** The Evaporative Emission (EVAP) canister vent solenoid and dust separator are an assembly. This assembly is removed with the EVAP canister vent solenoid.

   For additional information, refer to Evaporative Emission Canister Vent Solenoid in this section.

Evaporative Emission (EVAP) System Components — Exploded View

Evaporative Emission (EVAP) Canister Assembly — Removal

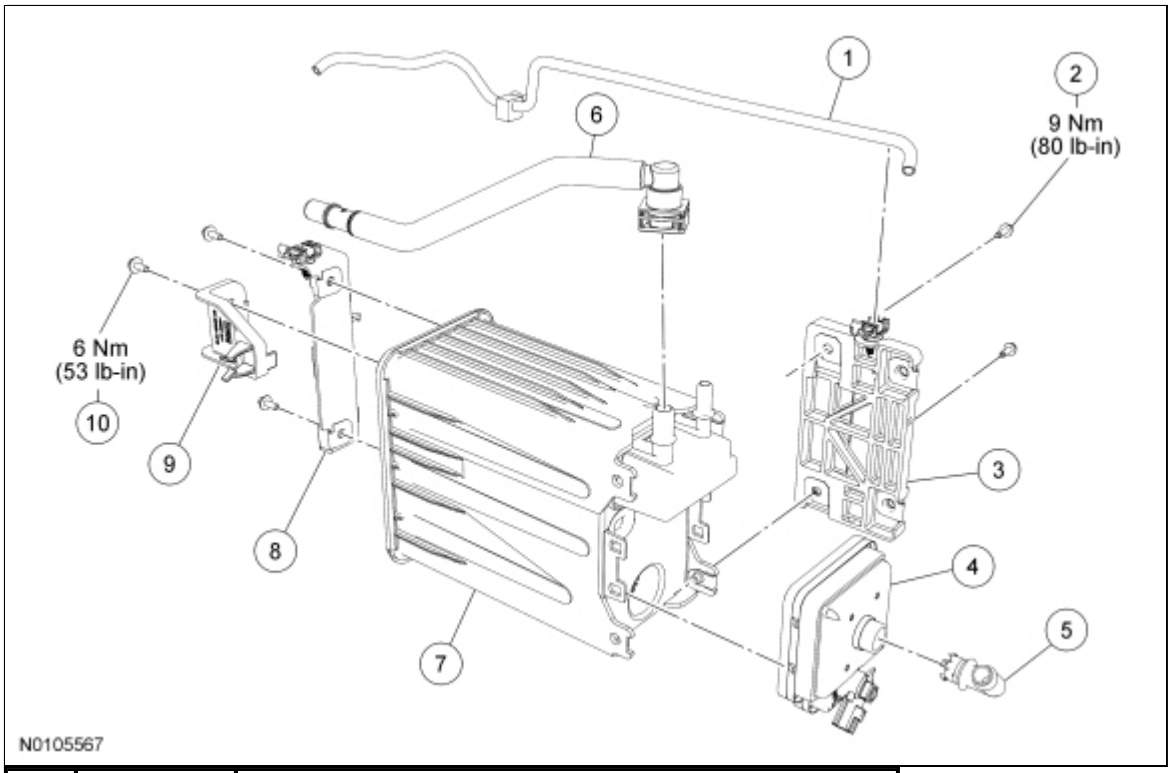


Item	Part Number	Description
1	—	Evaporative Emission (EVAP) canister vent valve

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		electrical connector
2	9C985	EVAP canister assembly
3	W500224	EVAP canister assembly bracket bolt (4 required)
4	9E616	Fuel Tank Pressure (FTP) sensor and vapor tube assembly-to- EVAP canister vapor tube quick connect coupling
5	9S327	Fresh air tube
6	—	Front vapor tube-to- EVAP canister quick connect coupling (part of 9D676)
7	—	Front fuel supply tube-to-center fuel supply tube quick connect coupling (part of 9J280)

EVAP Canister, Brackets, Vent Solenoid and Dust Separator Assembly, Center Fuel Tube and Vapor Tube Disassembly



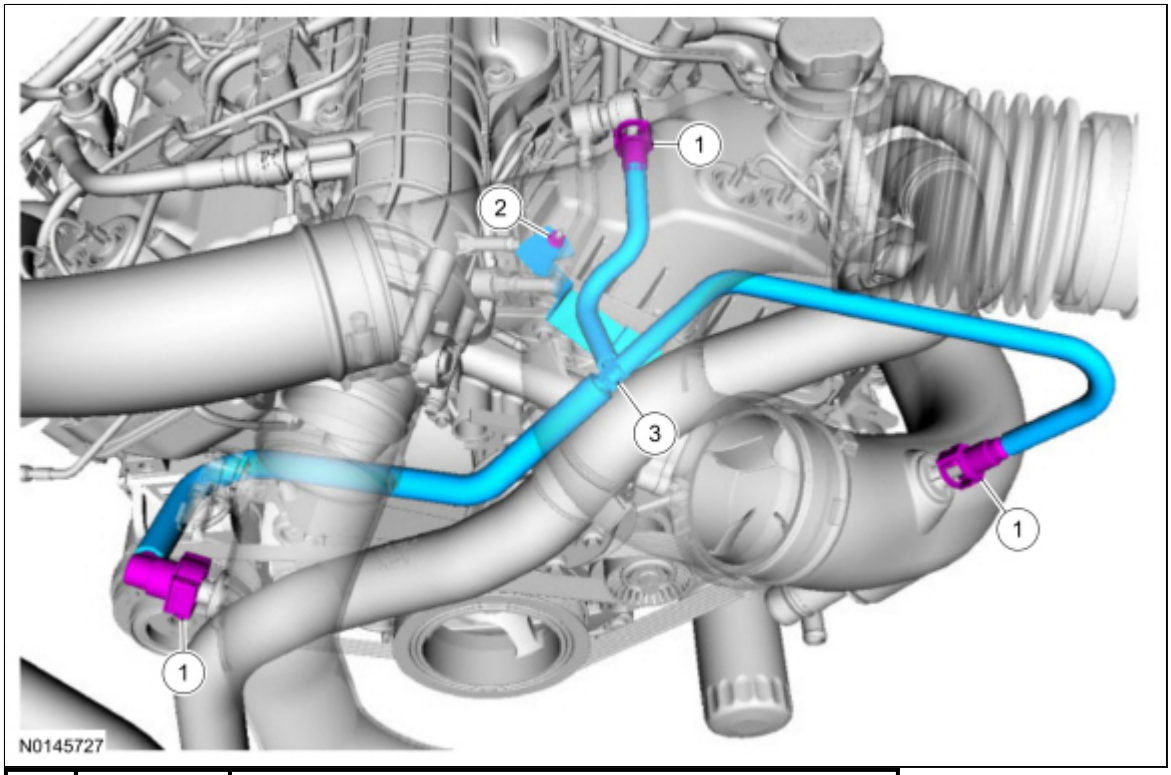
Item	Part Number	Description
1	9A274	Center fuel supply tube
2	W500213	Evaporative Emission (EVAP) canister assembly front bracket bolts (2 required)
3	9E817	EVAP canister assembly front bracket
4	9B328	EVAP canister vent solenoid and dust separator assembly

5	9D925	EVAP canister vent solenoid and dust separator assembly fitting
6	9B050	EVAP canister vapor tube
7	9D653	EVAP canister
8	9E817	EVAP canister rear assembly bracket
9	9D665	EVAP canister assembly vapor tube bracket
10	9R543	EVAP canister assembly bolt (3 required)

1. For additional information, refer to the procedures in this section.

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Evaporative Emission (EVAP) Vapor Ejector



Item	Part Number	Description
1	—	Evaporative Emission (EVAP) vapor ejector quick-connect coupling (part of 9G297) (3 required)
2	W520100	Evaporative Emission (EVAP) vapor ejector and hose assembly bracket nut - 6 Nm (53 lb-in)
3	9G297	Evaporative Emission (EVAP) vapor ejector and hose assembly

Removal and Installation

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an

evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Disconnect the battery ground cable. Refer to Section 414-01 .
2. Remove the Air Cleaner (ACL) outlet pipe. Refer to Section 303-12 .
3. Remove the Charge Air Cooler (CAC)-to-Throttle Body (TB) pipe. Refer to Section 303-12 .
4. Disconnect the 3 Evaporative Emission (EVAP) vapor ejector and hose assembly quick-connect fittings.
5. Remove the nut and the Evaporative Emission (EVAP) vapor ejector and hose assembly.
    - To install, tighten to 6 Nm (53 lb-in).

Installation

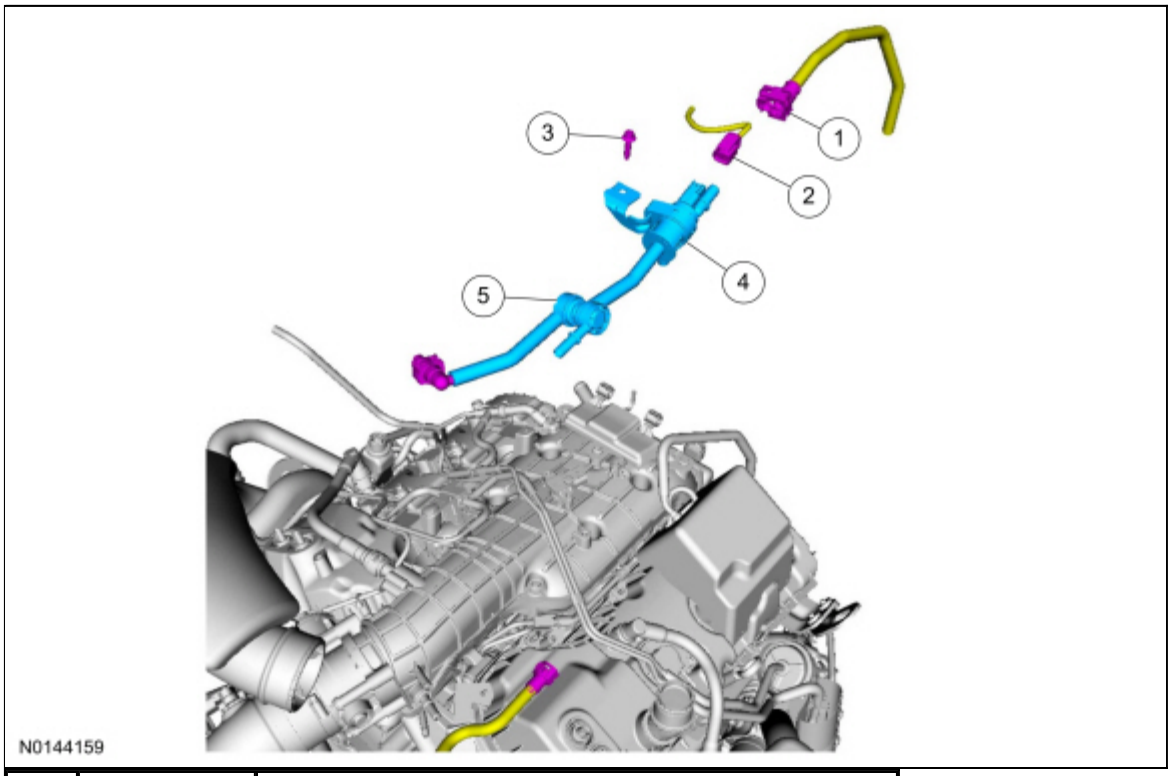
1. To install, reverse the removal steps.
    - Carry out the Evaporative Emission System Leak Test. Refer to Evaporative Emission System Leak Test .

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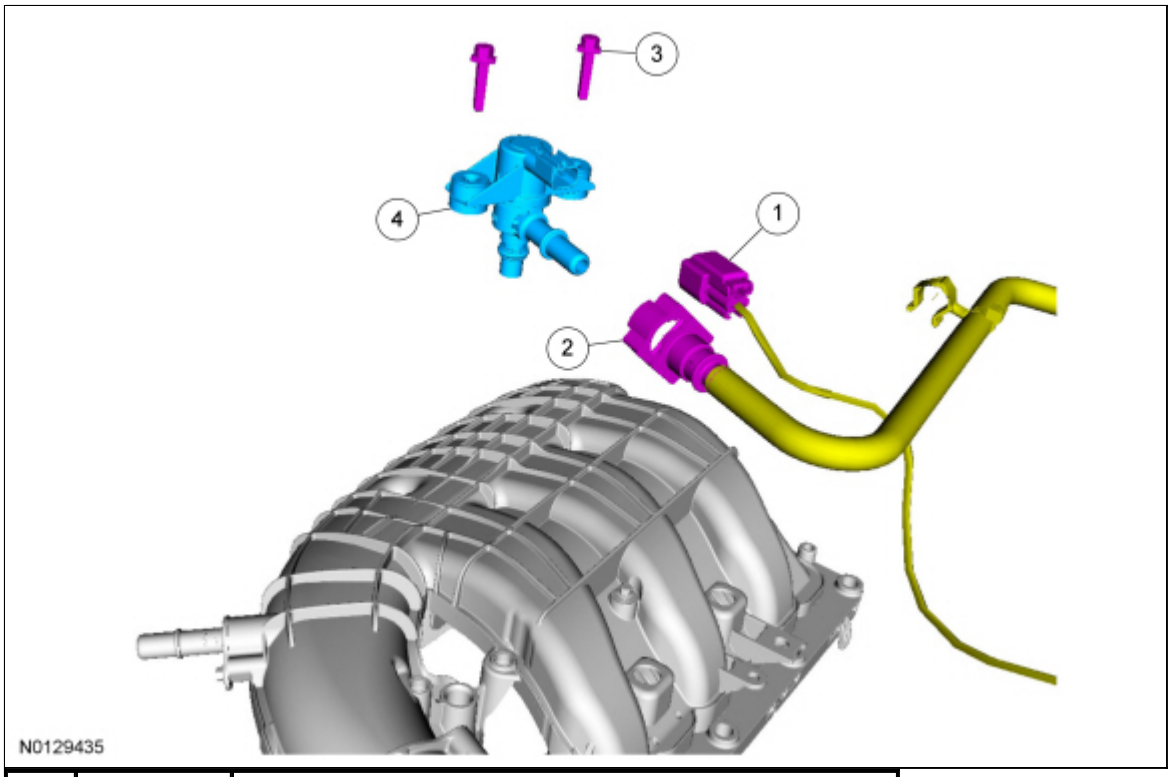
Evaporative Emission Canister Purge Valve

3.5L Gasoline Turbocharged Direct Injection (GTDI) Engine



Item	Part Number	Description
1	—	Fuel vapor hose quick-connect coupling (3 required)
2	—	Purge valve electrical connector (part of 12C508)
3	W500215	Purge valve bracket bolt - 10 Nm (89 lb-in)
4	9B325	Purge valve and hose assembly
5	—	Dual check valve (Part of 9B325)

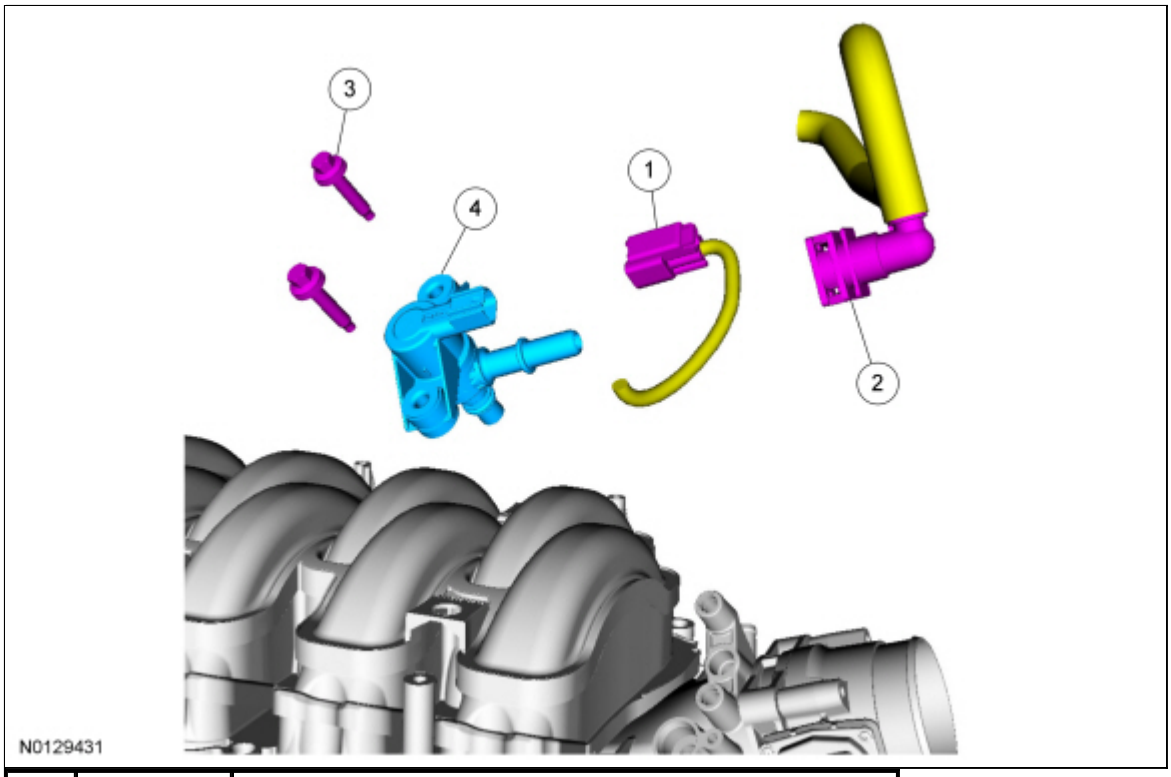
3.7L Engine



Item	Part Number	Description
1	—	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12C508)
2	9J280	EVAP canister-to- EVAP canister purge valve vapor tube
3	W500015	EVAP canister purge valve bolt - 10 Nm (89 lb-in) (2 required)
4	9G866	EVAP canister purge valve

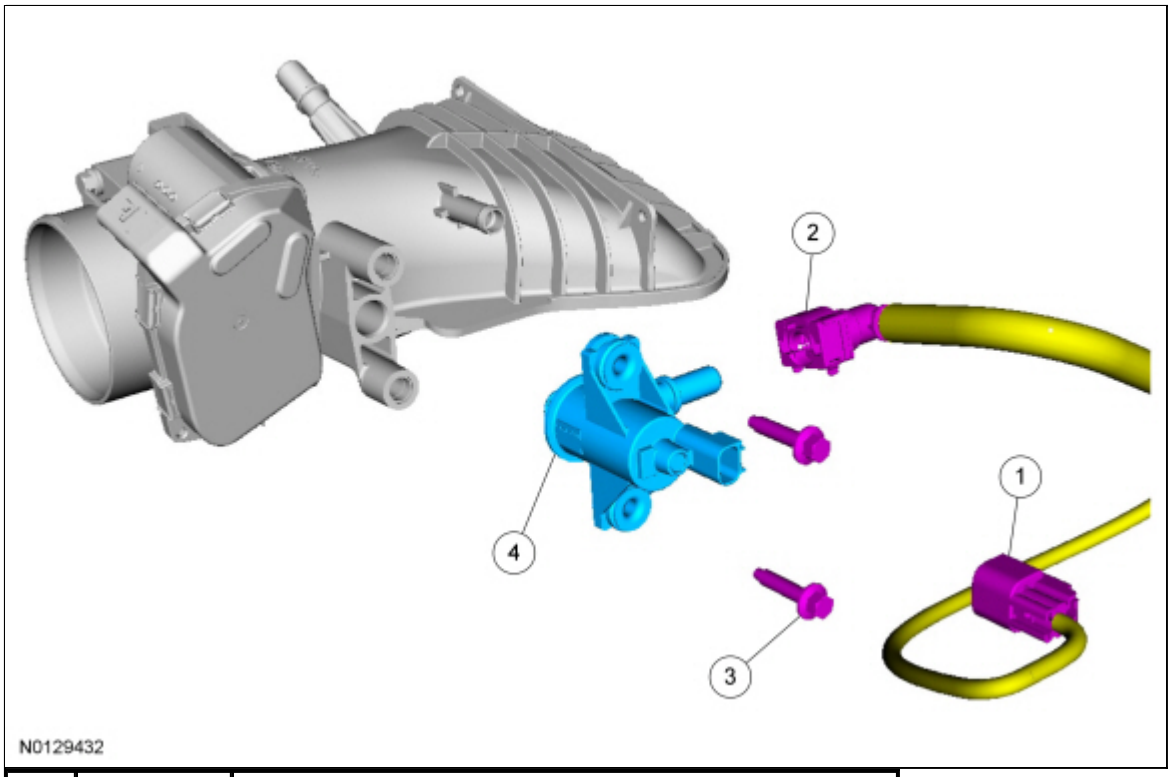
5.0L Engine

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Item	Part Number	Description
1	—	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12C508)
2	9G271	EVAP canister-to- EVAP canister purge valve vapor tube
3	W503278	EVAP canister purge valve bolt - 10 Nm (89 lb-in) (2 required)
4	9G866	EVAP canister purge valve

6.2L Engine



Item	Part Number	Description
1	—	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12C508)
2	9D676	EVAP canister-to- EVAP canister purge valve vapor tube
3	W500215	EVAP canister purge valve bolt - 10 Nm (89 lb-in) (2 required)
4	9G866	EVAP canister purge valve

Removal and Installation

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

All engines

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1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.

3.5L Gasoline Turbocharged Direct Injection (GTDI) engine

3. Disconnect the 3 purge valve and hose assembly vapor hose quick-connect fittings.

4. Remove the bolt and the purge valve and hose assembly.
   - To install, tighten to 10 Nm (89 lb-in).

3.7L, 5.0L and 6.2L engines

5. Disconnect the EVAP canister-to- EVAP canister purge valve vapor tube quick connect coupling from the valve. For additional information, refer to Section 310-00 .

6. Remove the 2 EVAP canister purge valve bolts and remove the valve.
   - To install, tighten to 10 Nm (89 lb-in).

All engines

7. To install, reverse the removal procedure.
   - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

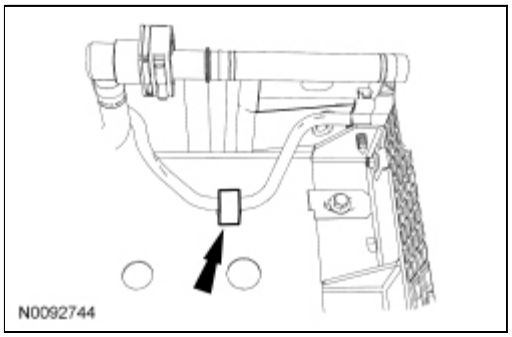
Evaporative Emission Canister Vent Solenoid

Removal and Installation

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

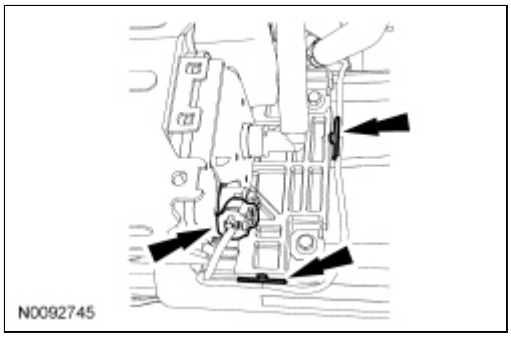
WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Disconnect the Fuel Tank Pressure (FTP) sensor and vapor tube assembly-to-Evaporative Emission (EVAP) canister vapor tube quick connect coupling. For additional information, refer to Section 310-00 .
4. Disconnect the fuel tank supply tube-to-center fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .
5. Disconnect the front fuel supply tube-to-center fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .
6. Disconnect the front vapor tube-to- EVAP canister quick connect coupling. For additional information, refer to Section 310-00 .
7. Remove the vapor hose from the EVAP canister vent solenoid.
8. Disconnect the center fuel supply tube-to-frame pushpin retainer.



9. Disconnect the EVAP canister vent solenoid electrical connector and 2 pushpin retainers.

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10. Remove the 4 EVAP canister assembly bolts and remove the EVAP canister from the vehicle.
    - To install, tighten to 13 Nm (115 lb-in).

11. Place the EVAP canister assembly on a workbench.

12. Open the front retainer and position the center fuel supply tube out of the retainer.

13. **NOTE:** Before tightening the front bracket bolts, extend the front bracket as far forward as possible.

    Remove the 2 bolts and the EVAP canister assembly front bracket from the EVAP canister.
    - To install, tighten to 9 Nm (80 lb-in).

14. Remove the canister vent solenoid and dust box from the EVAP canister.

15. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

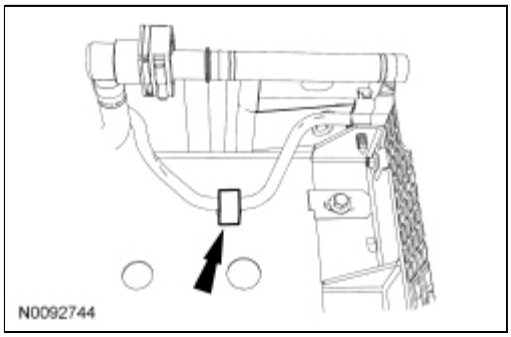
Evaporative Emission Canister

Removal and Installation

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

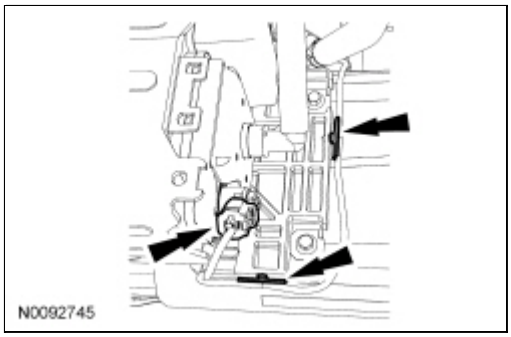
WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Disconnect the Fuel Tank Pressure (FTP) sensor and vapor tube assembly-to-Evaporative Emission (EVAP) canister vapor tube quick connect coupling. For additional information, refer to Section 310-00 .
4. Disconnect the fuel tank supply tube-to-center fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .
5. Disconnect the front fuel supply tube-to-center fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .
6. Disconnect the front vapor tube-to- EVAP canister quick connect coupling. For additional information, refer to Section 310-00 .
7. Remove the vapor hose from the EVAP canister vent solenoid.
8. Disconnect the center fuel supply tube-to-frame pushpin retainer.



9. Disconnect the EVAP canister vent solenoid electrical connector and 2 pushpin retainers.

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10. Remove the 4 EVAP canister assembly bolts and remove the EVAP canister from the vehicle.
    - To install, tighten to 13 Nm (115 lb-in).

11. Place the EVAP canister assembly on a workbench.

12. Disconnect the center vapor tube quick connect coupling from the EVAP canister and remove from the EVAP canister assembly. For additional information, refer to Section 310-00 .

13. Open the 2 center fuel supply tube retainers and remove the center fuel supply tube from the EVAP canister assembly.

14. **NOTE:** Before tightening the front bracket bolts, extend the front bracket as far forward as possible.

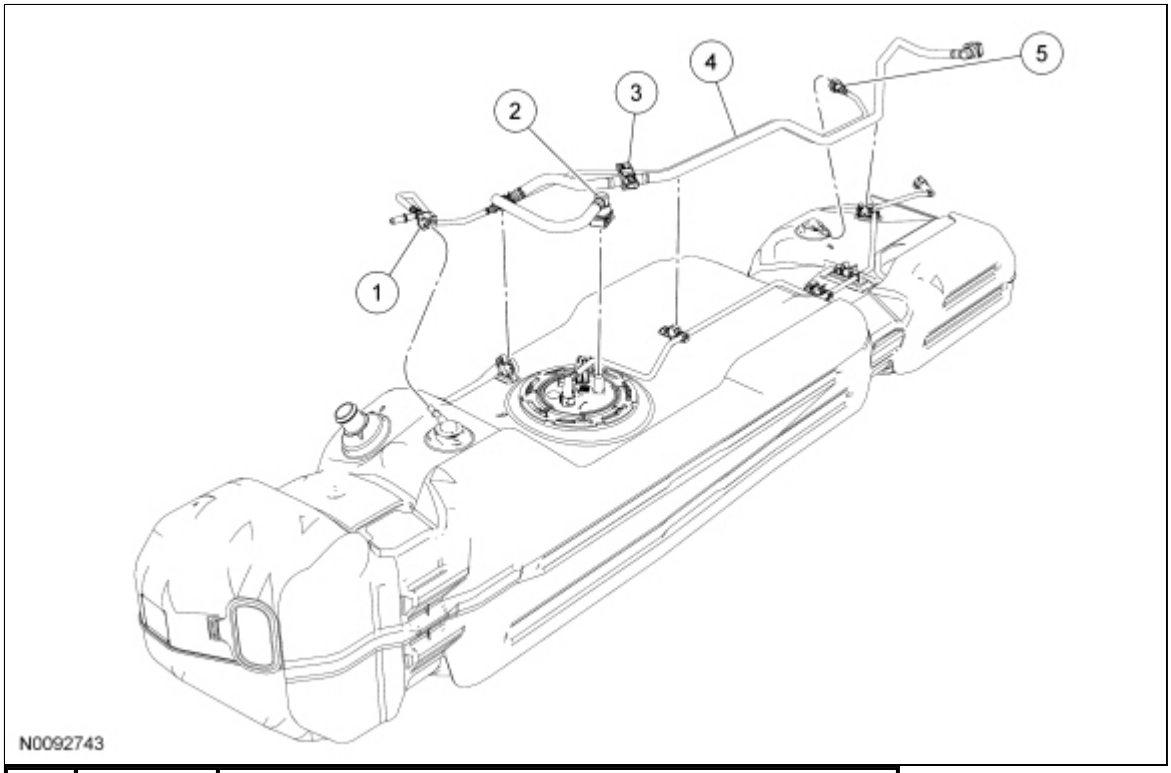
    Remove the 5 bolts and the EVAP canister assembly brackets from the EVAP canister.
    - To install, tighten to 9 Nm (80 lb-in).

15. Remove the canister vent solenoid and dust box from the EVAP canister.

16. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

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Fuel Tank Pressure Sensor



Item	Part Number	Description
1	—	Fuel Tank Pressure (FTP) sensor and vapor tube assembly-to-fuel tank vent valve quick connect coupling (part of 9J279)
2	—	FTP sensor and vapor tube assembly-to-fuel pump module quick connect coupling (part of 9J279)
3	—	FTP sensor (part of 9J279)
4	9J279	FTP sensor and vapor tube assembly
5	—	FTP sensor and vapor tube assembly-to-fuel tank vent valve quick connect coupling (part of 9J279)

Removal and Installation

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and

may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Remove the fuel tank. For additional information, refer to Section 310-01 .

2. Disconnect the 2 Fuel Tank Pressure (FTP) sensor and vapor tube assembly-to-fuel tank vent valve quick connect couplings. For additional information, refer to Section 310-00 .

3. Disconnect the FTP sensor and vapor tube assembly-to-fuel pump module quick connect coupling. For additional information, refer to Section 310-00 .

4. Remove the FTP sensor and vapor tube assembly from the fuel tank.

5. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

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Material

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	—	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	—
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—	—

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	—
Camshaft Position (CMP) sensor bolt	10	—	89
Catalyst Monitor Sensor (CMS) — 3.5L GTDI, 3.7L and 5.0L (4V)	48	35	—
CMS — 6.2L (2V)	46	34	—
Crankshaft Position (CKP) sensor bolt	10	—	89
Cylinder Head Temperature (CHT) sensor — 3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L	10	—	89
CHT sensor — 5.0L (4V) and 6.2L (2V)	11	—	97
Cylinder head heat shield bolts	10	—	89
Cylinder head heat shield nut	10	—	89
Cylinder head heat shield stud bolt	10	—	89
Fuel Rail Pressure (FRP) sensor — 3.5L GTDI	33	24	—
Ground cable nut	9	—	80
Heated Oxygen Sensor (HO2S) — 3.5L GTDI, 3.7L and 5.0L (4V)	48	35	—
HO2S — 6.2L (2V)	46	34	—
Intake Air Temperature (IAT) sensor bolts — 3.5L GTDI	6	—	53
Knock Sensor (KS) bolt	20	—	177
Manifold Absolute Pressure (MAP)/Intake Air Temperature 2 (IAT2) sensor bolt — 3.5L GTDI	6	—	53
Mass Air Flow (MAF) sensor screws — 3.7L, 5.0L (4V) and 6.2L (2V)	2	—	18
Powertrain Control Module (PCM)-to- PCM support bracket bolts — 3.5L GTDI	9	—	80

PCM stud bolts	9	—	80
Turbocharger Boost Pressure (TCBP)/Charge Air Cooler (CAC) Sensor screws — 3.5L GTDI	3	—	27
Variable Camshaft Timing (VCT) solenoid bolt [a]	—	—	—
VCT variable force solenoid bolt [a]	—	—	—

[a] Refer to the procedure in this section.

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Electronic Engine Controls

The electronic engine controls consist of the following:

- Camshaft Position (CMP) Sensor
- Catalyst Monitor Sensor (CMS)
- Crankshaft Position (CKP) Sensor
- Cylinder Head Temperature (CHT) Sensor
- Fuel Rail Pressure (FRP) Sensor — 3.5L Gasoline Turbocharged Direct Injection (GTDI)
- Heated Oxygen Sensor (HO2S)
- Intake Air Temperature (IAT) Sensor — 3.5L GTDI
- Knock Sensor (KS)
- Manifold Absolute Pressure (MAP)/Intake Air Temperature 2 (IAT2) Sensor — 3.5L GTDI
- Mass Air Flow (MAF) Sensor — 3.7L, 5.0L (4V) and 6.2L (2V)
- PCM
- Turbocharger Boost Pressure (TCBP)/Charge Air Cooler (CAC) Sensor — 3.5L GTDI
- Variable Camshaft Timing (VCT) Oil Control Valve — 3.5L GTDI and 3.7L
- VCT Variable Force Solenoid — 5.0L (4V) and 6.2L (2V)

The CHT sensor:

- is mounted to the wall of the cylinder head and is not connected to any coolant passages.
- sends the PCM a signal indicating cylinder head temperature.

The CKP sensor:

- is mounted to the wall of the cylinder block.
- sends the PCM a signal indicating crankshaft position and engine speed.

The CMP sensor:

- is mounted to the cylinder head.
- sends the PCM a signal indicating camshaft position.

The CMS :

- is mounted to the catalytic converter.
- sends the PCM a signal indicating oxygen content in the exhaust after the exhaust leaves the catalytic converter.

The FRP sensor (3.5L GTDI):

- is mounted to the fuel rail.
- measures the pressure of the fuel rail and sends these signals to the PCM .

The HO2S :

- is mounted to the exhaust Y-pipe.
- sends the PCM a signal indicating oxygen content in the exhaust before the exhaust enters the catalytic converter.

The IAT sensor (3.5L GTDI):

- is mounted on the Air Cleaner (ACL).
- sends the PCM a signal indicating the temperature of the air entering the engine.

The KS :

- is mounted to the wall of the cylinder block.
- sends a signal to the PCM indicating engine detonation.

The MAF sensor:

- is mounted on the ACL .
- sends the PCM a signal indicating mass airflow rate of air entering the engine.

The MAP / IAT2 Sensor (3.5L GTDI):

- is mounted on the top of the intake manifold.
- is a combination sensor.
- measures manifold pressure and converts it to an electrical signal. This provides the PCM information on engine load.
- sends the PCM a signal indicating the temperature of the air entering the cylinders after passing through the CAC .

The TCBP / CAC Sensor (3.5L GTDI only):

- is mounted to the CAC outlet tube.
- is a combination sensor.
- measures turbocharger boost pressure and sends this information to the PCM .
- measures the temperature of the charge air exiting the CAC and sends this information to the PCM .

The VCT Oil Control Valve (3.5L GTDI and 3.7L only)

- is mounted to the cylinder head.
- is an electronic solenoid that supplies force to actuate the VCT oil control valve. When the PCM transmits a signal based on the engine speed and load, the solenoid moves the VCT oil control valve activating either the advance circuit, retard circuit or hold position. The camshaft is then repositioned in relation to crankshaft timing to allow for optimum engine performance with lower emissions and reduced fuel consumption.

The VCT Variable Force Solenoid [5.0L (4V) and 6.2L (2V) only]:

- is mounted to the engine front cover.
- is an electronic solenoid that supplies force to actuate the VCT oil control valve. The PCM transmits a

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signal based on the engine speed and load, the solenoid will move the VCT oil control valve activating either the advance circuit, retard circuit or hold position. The camshaft is then repositioned in relation to crankshaft timing to allow for optimum engine performance with lower emissions and reduced fuel consumption.

Electronic Engine Controls

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	REFER to Section 303-03 .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	REFER to Section 303-03 .
P0217	Engine Coolant Overtemperature Condition	REFER to Section 303-03 .
P0504	Brake Switch A/B Correlation	REFER to Section 419-03 .
P0512	Starter Request Circuit	REFER to Section 303-06 .
P0532	A/C Refrigerant Pressure Sensor A Circuit Low	REFER to Section 412-00 .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	REFER to Section 412-00 .
P0562	System Voltage Low	REFER to Section 414-00 .
P0563	System Voltage High	REFER to Section 414-00 .
P0572	Brake Switch A Circuit Low	REFER to Section 419-03 .
P0573	Brake Switch A Circuit High	REFER to Section 419-03 .
P0579	Cruise Control Multifunction Input "A" Circuit Range/Performance	REFER to Section 419-03 .
P0602	Powertrain Control Module Programming Error	REFER to Section 418-01 .
P0605	Internal Control Module Read Only Memory (ROM) Error	REFER to Section 418-01 .
P0620	Generator Control Circuit	REFER to Section 414-00 .
P0625	Generator Field Terminal Circuit Low	REFER to Section 414-00 .
P0626	Generator Field Terminal Circuit High	REFER to Section 414-00 .
P0645	A/C Clutch Relay Control Circuit	REFER to Section 412-00 .
P0657	Actuator Supply Voltage A Circuit/Open	REFER to Section 307-01 .
P065B	Generator Control Circuit Range/Performance	REFER to Section 414-00 .
P0701	Transmission Control System Range/Performance	REFER to Section 307-01 .
P0702	Transmission Control System Electrical	REFER to Section 307-01 .
P0705	Transmission Range Sensor A Circuit (PRNDL Input)	REFER to Section 307-01 .
P0706	Transmission Range Sensor A Circuit Range/Performance	REFER to Section 307-01 .

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P0707	Transmission Range Sensor A Circuit Low	REFER to Section 307-01 .
P0708	Transmission Range Sensor A Circuit High	REFER to Section 307-01 .
P0709	Transmission Range Sensor "A" Circuit Intermittent	REFER to Section 307-01 .
P0710	Transmission Fluid Temperature Sensor A Circuit	REFER to Section 307-01 .
P0711	Transmission Fluid Temperature Sensor A Circuit Range/Performance	REFER to Section 307-01 .
P0712	Transmission Fluid Temperature Sensor A Circuit Low	REFER to Section 307-01 .
P0713	Transmission Fluid Temperature Sensor A Circuit High	REFER to Section 307-01 .
P0715	Turbine/Input Shaft Speed Sensor A Circuit	REFER to Section 307-01 .
P0717	Turbine/Input Shaft Speed Sensor A Circuit No Signal	REFER to Section 307-01 .
P0718	Turbine/Input Shaft Speed Sensor A Circuit Intermittent	REFER to Section 307-01 .
P0720	Output Shaft Speed Sensor Circuit	REFER to Section 307-01 .
P0721	Output Shaft Speed Sensor Circuit Range/Performance	REFER to Section 307-01 .
P0722	Output Shaft Speed Sensor Circuit No Signal	REFER to Section 307-01 .
P0729	Gear 6 Incorrect Ratio	REFER to Section 307-01 .
P0731	Gear 1 Incorrect Ratio	REFER to Section 307-01 .
P0732	Gear 2 Incorrect Ratio	REFER to Section 307-01 .
P0733	Gear 3 Incorrect Ratio	REFER to Section 307-01 .
P0734	Gear 4 Incorrect Ratio	REFER to Section 307-01 .
P0735	Gear 5 Incorrect Ratio	REFER to Section 307-01 .
P0740	Torque Converter Clutch Solenoid Circuit/Open	REFER to Section 307-01 .
P0741	Torque Converter Clutch Solenoid Circuit Performance/Stuck Off	REFER to Section 307-01 .
P0742	Torque Converter Clutch Solenoid Circuit Stuck On	REFER to Section 307-01 .
P0743	Torque Converter Clutch Solenoid Circuit Electrical	REFER to Section 307-01 .
P0744	Torque Converter Clutch Solenoid Circuit Intermittent	REFER to Section 307-01 .
P0748	Pressure Control Solenoid A Electrical	REFER to Section 307-01 .
P0750	Shift Solenoid A	REFER to Section 307-01 .
P0751	Shift Solenoid A Performance/Stuck Off	REFER to Section 307-01 .
P0752	Shift Solenoid A Stuck On	REFER to Section 307-01 .
P0753	Shift Solenoid A Electrical	REFER to Section 307-01 .
P0754	Shift Solenoid "A" Intermittent	REFER to Section 307-01 .
P0755	Shift Solenoid B	REFER to Section 307-01 .

P0756	Shift Solenoid B Performance/Stuck Off	REFER to Section 307-01 .
P0757	Shift Solenoid B Stuck On	REFER to Section 307-01 .
P0758	Shift Solenoid B Electrical	REFER to Section 307-01 .
P0759	Shift Solenoid "B" Intermittent	REFER to Section 307-01 .
P0760	Shift Solenoid C	REFER to Section 307-01 .
P0761	Shift Solenoid C Performance/Stuck Off	REFER to Section 307-01 .
P0762	Shift Solenoid C Stuck On	REFER to Section 307-01 .
P0763	Shift Solenoid C Electrical	REFER to Section 307-01 .
P0764	Shift Solenoid "C" Intermittent	REFER to Section 307-01 .
P0765	Shift Solenoid D	REFER to Section 307-01 .
P0766	Shift Solenoid D Performance/Stuck Off	REFER to Section 307-01 .
P0767	Shift Solenoid D Stuck On	REFER to Section 307-01 .
P0768	Shift Solenoid D Electrical	REFER to Section 307-01 .
P0769	Shift Solenoid "D" Intermittent	REFER to Section 307-01 .
P0770	Shift Solenoid E	REFER to Section 307-01 .
P0771	Shift Solenoid E Performance/Stuck Off	REFER to Section 307-01 .
P0772	Shift Solenoid E Stuck On	REFER to Section 307-01 .
P0773	Shift Solenoid E Electrical	REFER to Section 307-01 .
P0774	Shift Solenoid E Intermittent	REFER to Section 307-01 .
P07A8	Transmission Friction Element "D" Performance/Stuck Off	REFER to Section 307-01 .
P07A9	Transmission Friction Element "D" Stuck On	REFER to Section 307-01 .
P07AA	Transmission Friction Element "E" Performance/Stuck Off	REFER to Section 307-01 .
P0815	Upshift Switch Circuit	REFER to Section 307-05 .
P0816	Downshift Switch Circuit	REFER to Section 307-05 .
P0826	Up and Down Switch Circuit	REFER to Section 307-05 .
P0882	TCM Power Input Signal Low	REFER to Section 307-01 .
P0883	TCM Power Input Signal High	REFER to Section 307-01 .
P0960	Pressure Control Solenoid A Control Circuit/Open	REFER to Section 307-01 .
P0961	Pressure Control Solenoid A Control Circuit Range/Performance	REFER to Section 307-01 .
P0962	Pressure Control Solenoid A Control Circuit Low	REFER to Section 307-01 .
P0963	Pressure Control Solenoid A Control Circuit High	REFER to Section 307-01 .
P0973	Shift Solenoid A Control Circuit Low	REFER to Section 307-01 .
P0974	Shift Solenoid A Control Circuit High	REFER to Section 307-01 .
P0976	Shift Solenoid B Control Circuit Low	REFER to Section 307-01 .
P0977	Shift Solenoid B Control Circuit High	REFER to Section 307-01 .
P0979	Shift Solenoid C Control Circuit Low	REFER to Section 307-01 .

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P0980	Shift Solenoid C Control Circuit High	REFER to Section 307-01 .
P0982	Shift Solenoid D Control Circuit Low	REFER to Section 307-01 .
P0983	Shift Solenoid D Control Circuit High	REFER to Section 307-01 .
P0984	Shift Solenoid "E" Control Circuit Range/Performance	REFER to Section 307-01 .
P0A5A	Generator Current Sensor Circuit Range/Performance	REFER to Section 414-00 .
P0A5B	Generator Current Sensor Circuit Low	REFER to Section 414-00 .
P0A5C	Generator Current Sensor Circuit High	REFER to Section 414-00 .
P1285	Cylinder Head Overtemperature Condition	REFER to Section 303-03 .
P1299	Cylinder Head Overtemperature Protection Active	REFER to Section 303-03 .
P1397	System Voltage Out Of Self Test Range	REFER to Section 414-00 .
P1464	A/C Demand Out Of Self Test Range	REFER to Section 412-00 .
P161A	Incorrect Response from Immobilizer Control Module	REFER to Section 419-01B .
P1636	Inductive Signature Chip Communication Error	REFER to Section 307-01 .
P1639	Vehicle ID Block Corrupted, Not Programmed	REFER to Section 418-01 .
P163E	Transmission Control Module Programming Error	REFER to Section 307-01 .
P163F	Transmission ID Block Corrupted, Not Programmed	REFER to Section 307-01 .
P1700	Transmission Indeterminate Failure (Failed to Neutral)	REFER to Section 307-01 .
P1702	Transmission Range Sensor Circuit Intermittent	REFER to Section 307-01 .
P1703	Brake Switch Out Of Self Test Range	REFER to Section 419-03 .
P1711	Transmission Fluid Temperature Sensor Out Of Self Test Range	REFER to Section 307-01 .
P1744	Torque Converter Clutch Solenoid Circuit Performance	REFER to Section 307-01 .
P1780	Transmission Control Switch (O/D Cancel) Circuit Out Of Self Test Range	REFER to Section 307-01 .
P1783	Transmission Overtemperature Condition	REFER to Section 307-01 .
P1910	Reverse Lamp Control Circuit/Open	REFER to Section 307-01 .
P1921	Transmission Range Signal	REFER to Section 307-01 .
P193D	Cruise Control Multi-Function Input Signal	REFER to Section 419-03 .
P2700	Transmission Friction Element A Apply Time Range/Performance	REFER to Section 307-01 .
P2701	Transmission Friction Element B Apply Time Range/Performance	REFER to Section 307-01 .
P2702	Transmission Friction Element C Apply Time Range/Performance	REFER to Section 307-01 .
P2703	Transmission Friction Element D Apply Time	REFER to Section 307-01 .

	Range/Performance	
P2704	Transmission Friction Element E Apply Time Range/Performance	REFER to Section 307-01 .
P2758	Torque Converter Clutch Pressure Control Solenoid Stuck On	REFER to Section 307-01 .
P2760	Torque Converter Clutch Pressure Control Solenoid Intermittent	REFER to Section 307-01 .
U0300	Internal Control Module Software Incompatibility	REFER to Section 418-01 .
All Other DTCs	—	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

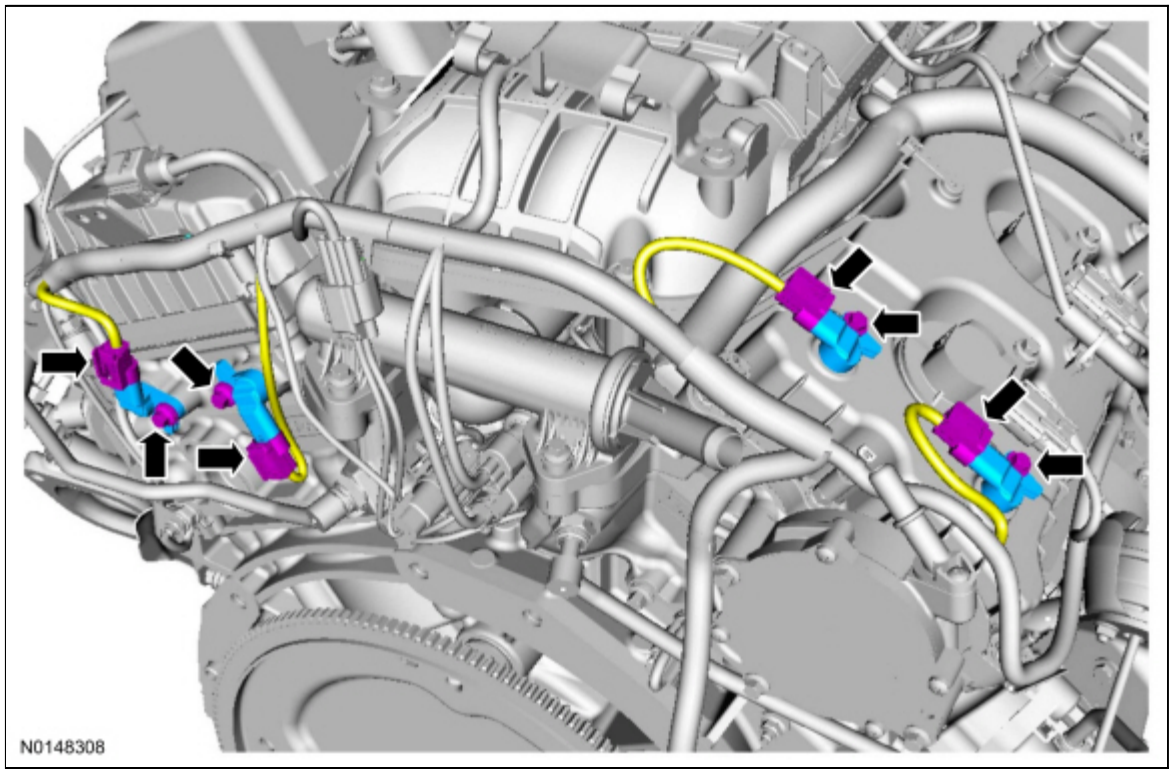
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Camshaft Position (CMP) Sensor — 3.5L GTDI

Removal

NOTE: Removal steps in this procedure may contain installation details.

1.
    - To install, tighten to 10 Nm (89 lb-in).



Installation

1. To install, reverse the removal steps.

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Camshaft Position (CMP) Sensor — 5.0L (4V)

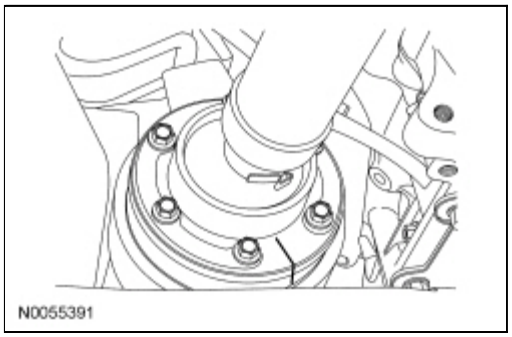
Removal

Both RH and LH intake Camshaft Position (CMP) sensors and RH exhaust CMP sensor

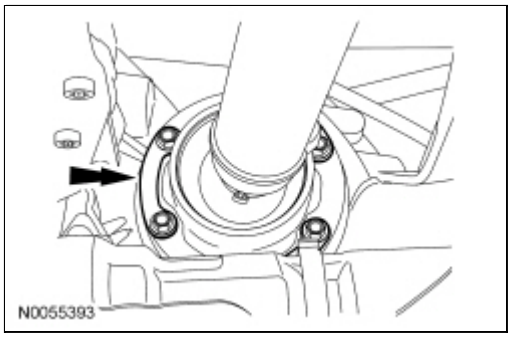
1. Disconnect the Camshaft Position (CMP) sensor electrical connector.
2. Remove the bolt and the CMP sensor.

LH exhaust Camshaft Position (CMP) sensor

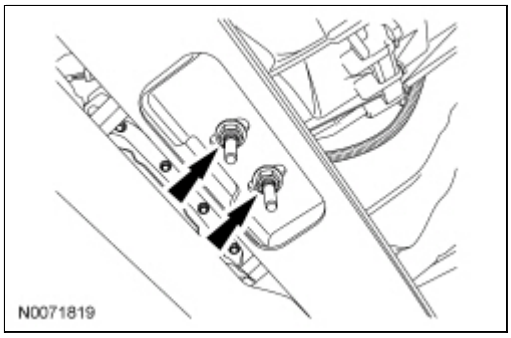
3. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. If equipped with 4 wheel drive, index-mark the front flange to the pinion flange.



5. If equipped with 4 wheel drive, remove the 6 front flange-to-pinion flange bolts and 2 washers and position the driveshaft aside.
   - Discard the 6 bolts and 2 washers



6. Remove the 2 bolts and the LH heat shield from the rear of the LH cylinder head.
7. Disconnect the CMP sensor electrical connector.
8. Remove the 2 transmission support insulator nuts.



9. Remove the CMP bolt.

10. **NOTE:** Make sure the transmission jack contacts the outer ribs of the transmission fluid pan.

    Position a suitable high-lift transmission jack under the transmission. Raise the transmission until the CMP sensor can be removed.
    - Remove the CMP sensor.

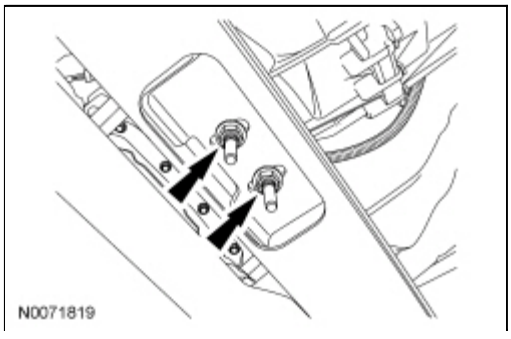
Installation

LH exhaust Camshaft Position (CMP) sensor

1. **NOTE:** The bolt must be torqued while the transmission is raised

   Position the Camshaft Position (CMP) sensor and install the bolt.
   - Tighten to 10 Nm (89 lb-in).

2. Using the suitable high-lift transmission jack, lower the transmission and install the 2 transmission support insulator nuts.
   - Tighten to 103 Nm (75 lb-ft).

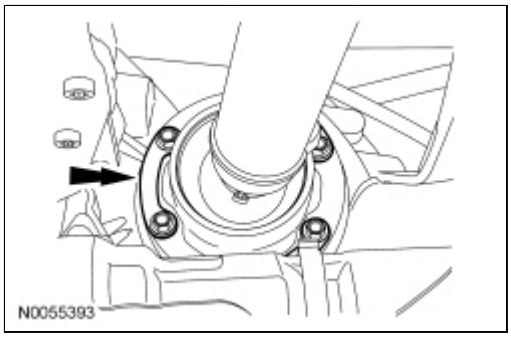


3. Connect the CMP sensor electrical connector.

4. Position the LH heat shield onto the rear of the LH cylinder head and install the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

5. If equipped with 4 wheel drive, position back the driveshaft, align the index mark and install 2 washers and 6 new bolts.
   - Tighten to 55 Nm (41 lb-ft).

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Both RH and LH intake CMP sensors and RH exhaust CMP sensor

6. Position the CMP sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).

7. Connect the CMP sensor electrical connector.

Crankshaft Position (CKP) Sensor — 5.0L (4V)

Removal

1. Remove the intake manifold. For additional information, refer to Section 303-01C .
2. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.
3. Disconnect theCrankshaft Position (CKP) sensor electrical connector.
4. **NOTE:** The Crankshaft Position (CKP) sensor bolt is part of the CKP sensor and cannot be removed.

   Loosen the bolt and remove the CKP sensor.

Installation

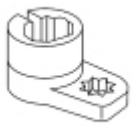
1. **NOTE:** The Crankshaft Position (CKP) sensor bolt is part of the CKP sensor and cannot be removed.

   Position the CKP sensor and tighten the bolt.
   - Tighten to 10 Nm (89 lb-in).
2. Connect the CKP sensor electrical connector.
3. Connect the CHT sensor electrical connector.
4. Install the intake manifold. For additional information, refer to Section 303-01C .

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Engine Control Components — Exploded View, 3.5L GTDI

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

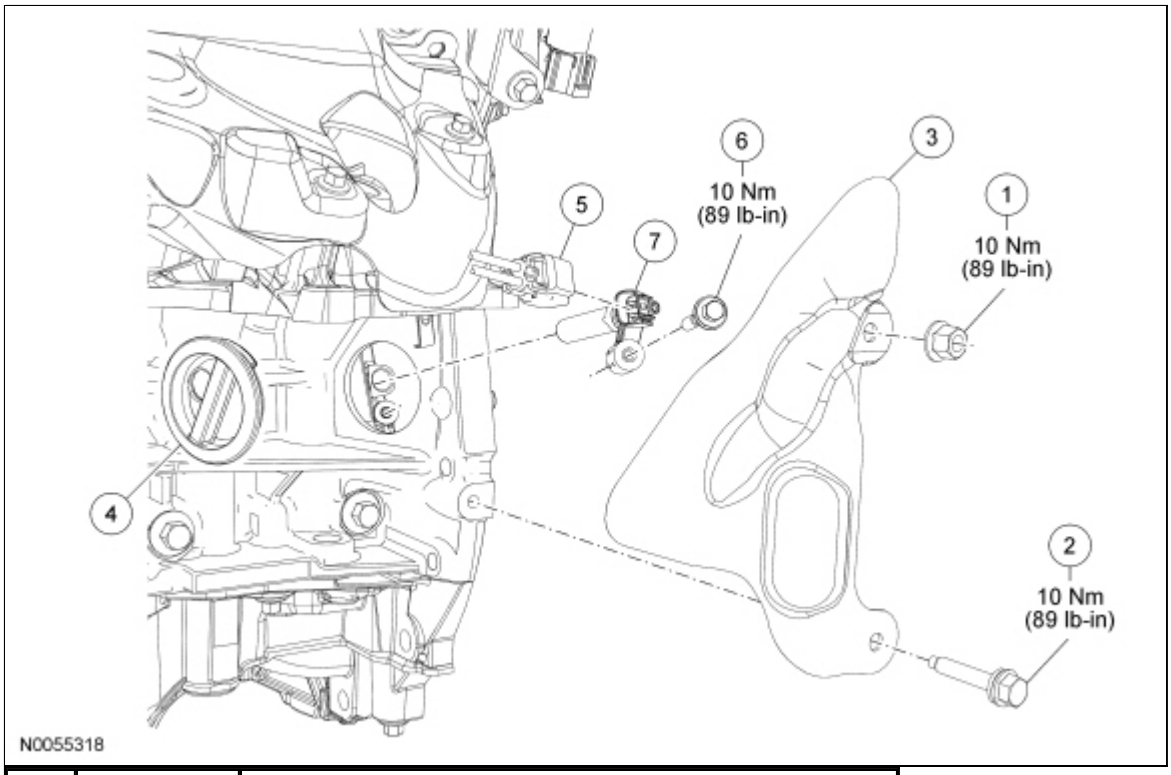
Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	—
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—

Crankshaft Position (CKP) Sensor

NOTE: It is necessary to remove the LH turbo charger to access the Crankshaft Position (CKP) sensor. For additional information, refer to Section 303-04E .

NOTE: After installing the Crankshaft Position (CKP) sensor, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

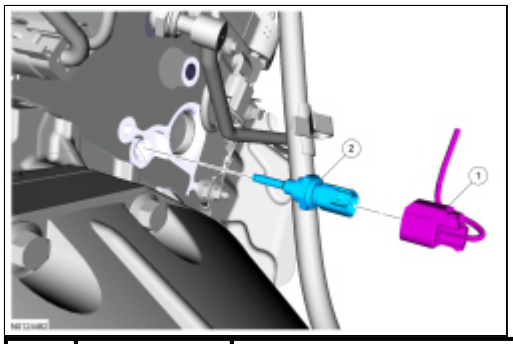
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Item	Part Number	Description
1	W701542	Heat shield nut
2	W701669	Heat shield bolt
3	6K342	Heat shield
4	6C070	Rubber grommet cover
5	—	Crankshaft Position (CKP) sensor electrical connector (part of 12C508)
6	W712315	CKP sensor bolt (part of 6D327)
7	6C315	CKP sensor (part of 6D327)

Cylinder Head Temperature (CHT) Sensor

NOTE: It is necessary to remove the RH fender splash shield to access the Cylinder Head Temperature (CHT) sensor. For additional information, refer to Section 501-02 .



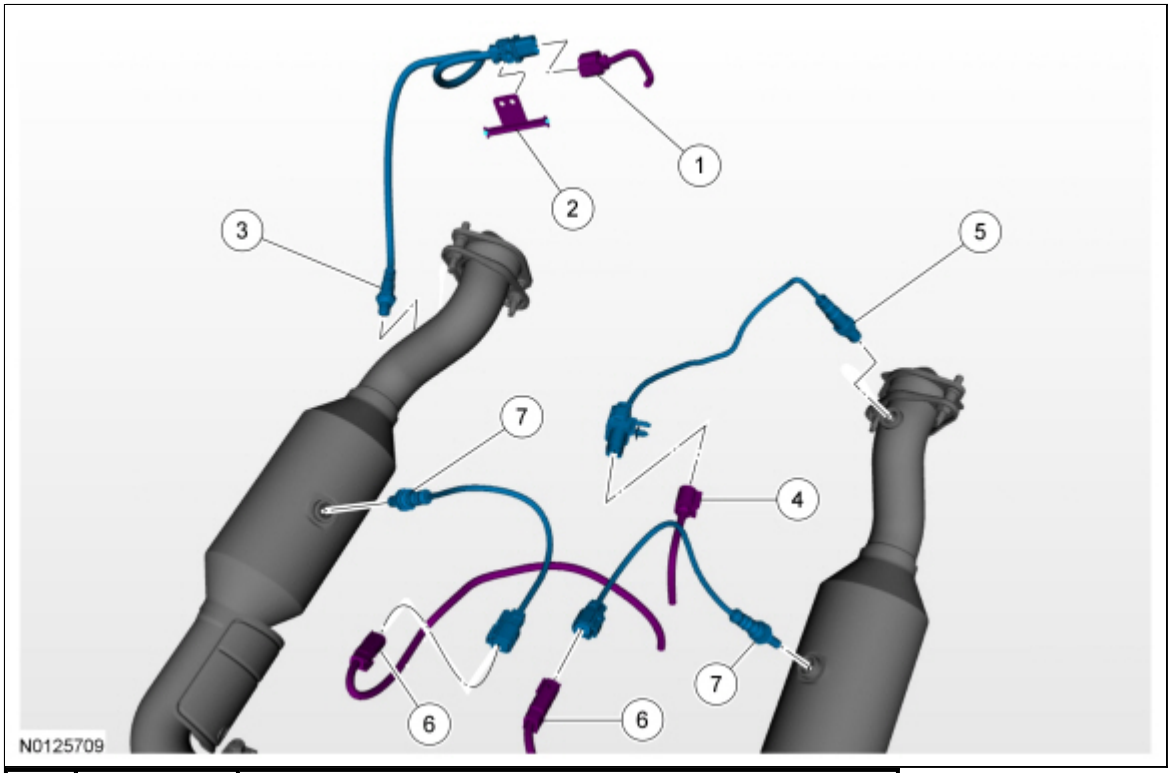
Item	Part Number	Description
1	—	Cylinder Head Temperature (CHT) sensor electrical connector (part of 12C508)
2	6G004	CHT sensor - 10 Nm (89 lb-In)

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor (CMS)

NOTE: If necessary, lubricate the Heated Oxygen Sensor (HO2S) and/or Catalyst Monitor Sensor (CMS) with penetrating and lock lubricant to assist in removal.

NOTE: Apply anti-seize to the threads of the HO2S and/or CMS prior to installing.

NOTE: The correct torque wrench setting must be calculated when using the Exhaust Gas Oxygen Sensor Socket to install the HO2S and/or CMS . Refer to the Torque Wrench Adapter Formulas in the Appendix.



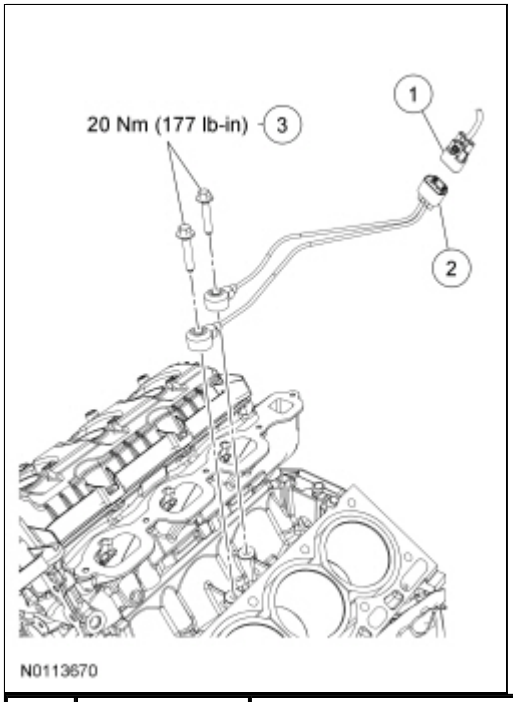
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Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)
2	—	HO2S wiring harness electrical connector retainer (part of 12C508)
3	9F472	HO2S
4	—	HO2S electrical connector (part of 15525)
5	9F472	HO2S
6	—	Catalyst Monitor Sensor (CMS) electrical connectors (part of 15525)
7	9G444	CMS

Knock Sensor (KS)

NOTE: It is necessary to remove the lower intake manifold to access the Knock Sensor (KS). For additional information, refer to Section 303-01A .

NOTE: LH cylinder head removed in graphic for clarity.



Item	Part Number	Description
1	—	Knock Sensor (KS) electrical connector (part of 12C508)
2	12A699	KS

3	W704749	KS bolt (2 required)

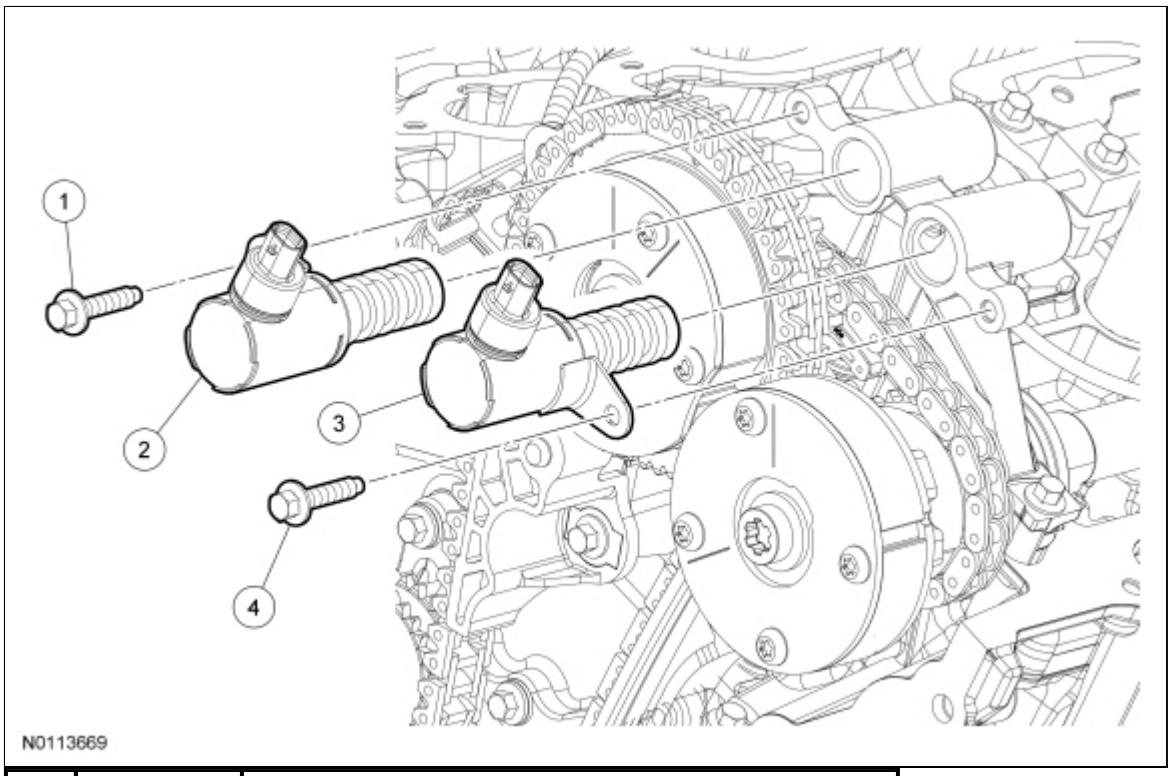
Variable Camshaft Timing (VCT) Oil Control Solenoid

NOTE: It is necessary to remove the RH or LH valve cover to access the Variable Camshaft Timing (VCT) oil control solenoid. For additional information, refer to Section 303-01A .

NOTE: Position the VCT oil control solenoid and tighten the bolts in 2 stages.

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 20 degrees.

NOTE: LH shown, RH similar.



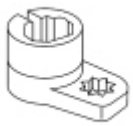
Item	Part Number	Description
1	W500215	LH intake Variable Camshaft Timing (VCT) oil control solenoid bolt
2	6B297	LH intake VCT oil control solenoid
3	6B297	LH exhaust VCT oil control solenoid
4	W500215	LH exhaust VCT oil control solenoid bolt

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Engine Control Components — Exploded View, 3.7L

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

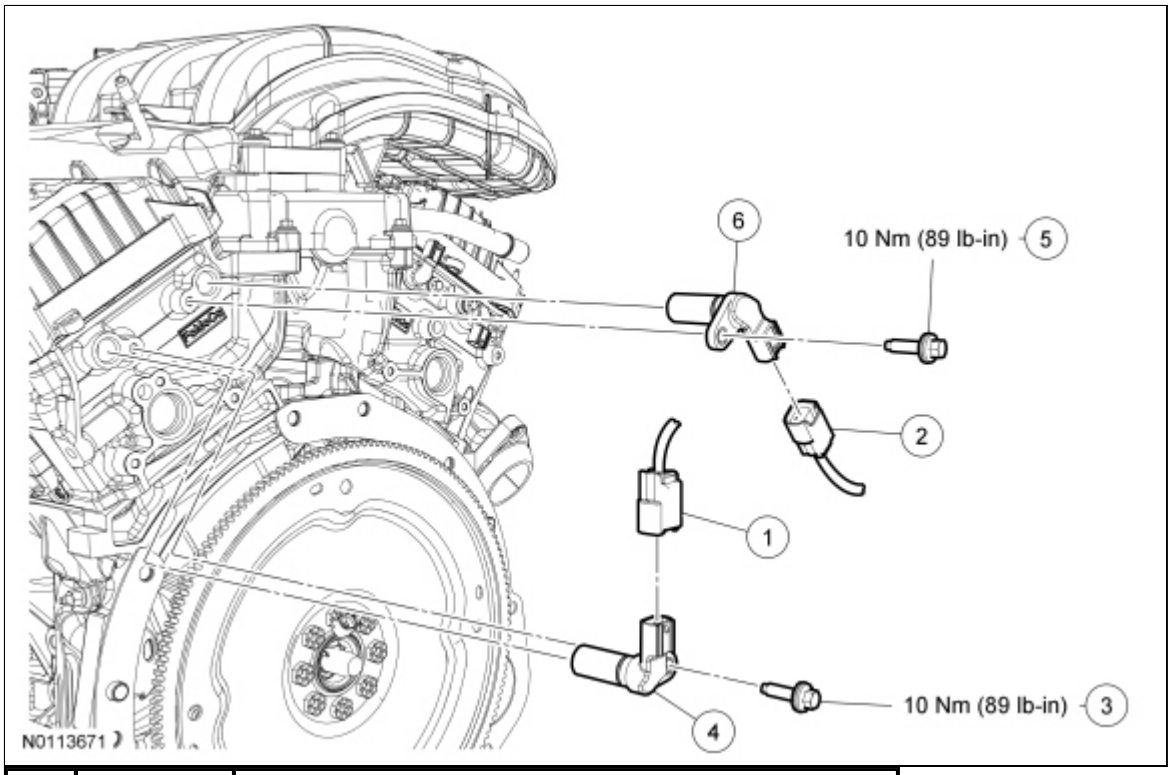
Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	—
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—

Camshaft Position (CMP) Sensor

NOTE: It is necessary to remove the upper intake manifold to access the RH exhaust or intake Camshaft Position (CMP) sensor. For additional information, refer to Section 303-01B .

NOTE: LH shown, RH similar.

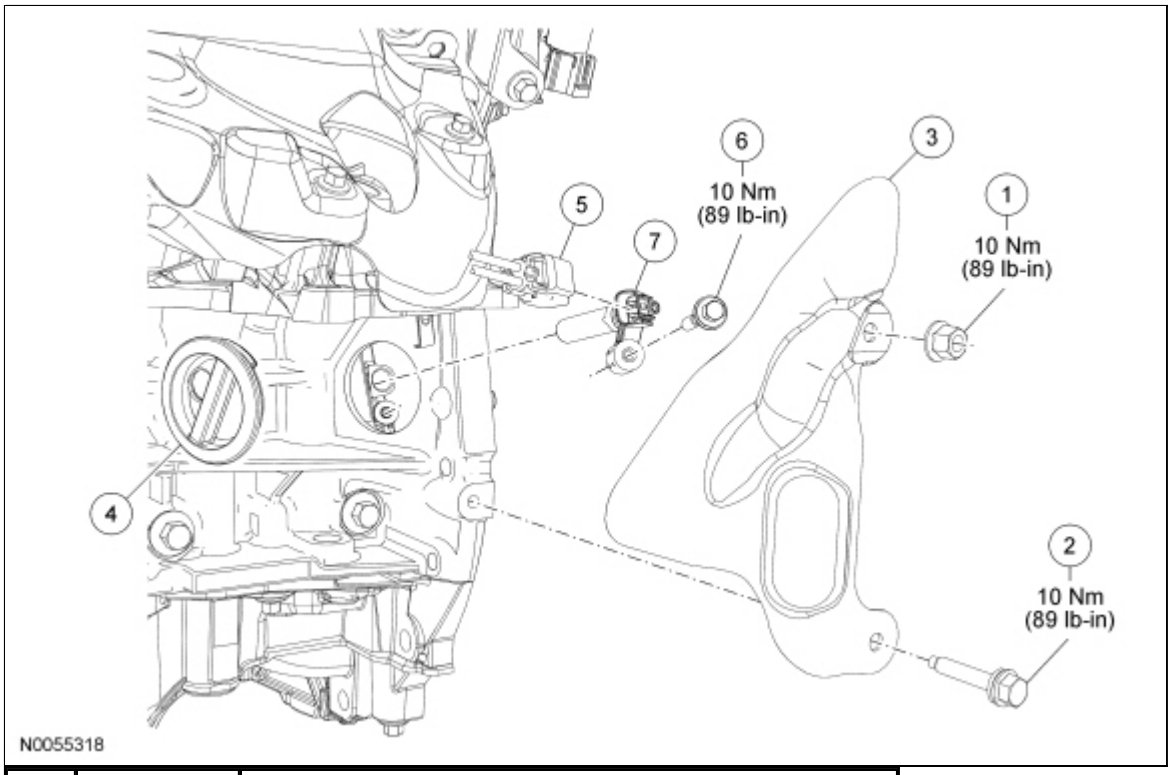
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Item	Part Number	Description
1	—	LH exhaust Camshaft Position (CMP) sensor electrical connector (part of 12A581)
2	—	LH intake CMP sensor electrical connector (part of 12A581)
3	W503275	LH exhaust CMP sensor bolt
4	6B288	LH exhaust CMP sensor
5	W503275	LH intake CMP sensor bolt
6	6B288	LH intake CMP sensor

Crankshaft Position (CKP) Sensor

NOTE: After installing the Crankshaft Position (CKP) sensor, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

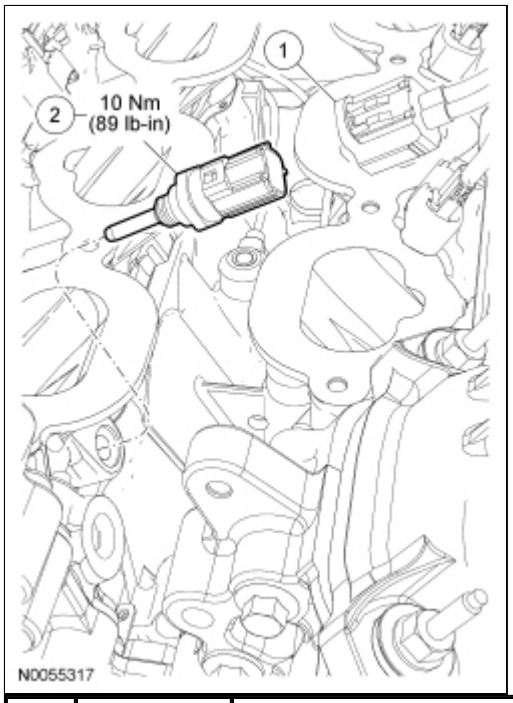


Item	Part Number	Description
1	W520101	Heat shield nut
2	W701669	Heat shield bolt
3	6K342	Heat shield
4	6C070	Rubber grommet cover
5	—	Crankshaft Position (CKP) sensor electrical connector (part of 12A581)
6	W712315	CKP sensor bolt (part of 6C315)
7	6C315	CKP sensor

Cylinder Head Temperature (CHT) Sensor

NOTE: It is necessary to remove the lower intake manifold to access the Cylinder Head Temperature (CHT) sensor. For additional information, refer to Section 303-01B .

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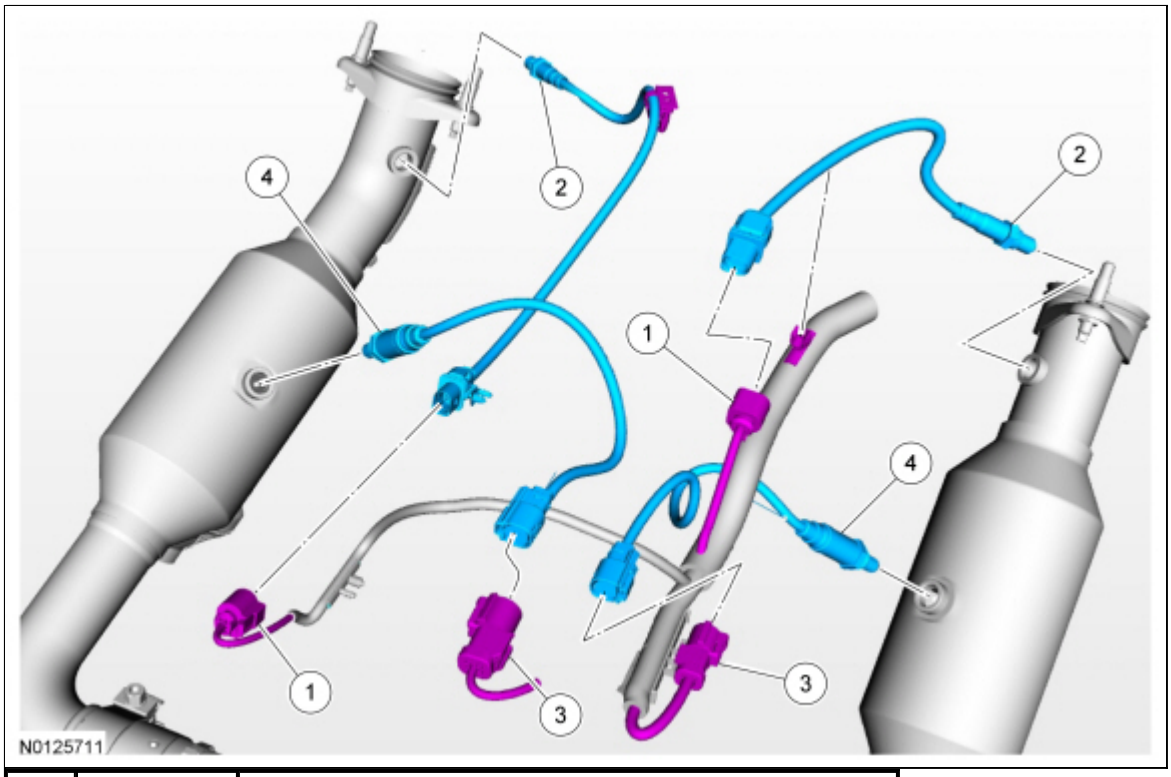
Item	Part Number	Description
1	—	Cylinder Head Temperature (CHT) sensor electrical connector (part of 12A581)
2	6G004	CHT sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor (CMS)

NOTE: If necessary, lubricate the Heated Oxygen Sensor (HO2S) and/or Catalyst Monitor Sensor (CMS) with penetrating and lock lubricant to assist in removal.

NOTE: Apply anti-seize to the threads of the HO2S and/or CMS prior to installing.

NOTE: The correct torque wrench setting must be calculated when using the Exhaust Gas Oxygen Sensor Socket to install the HO2S and/or CMS . Refer to the Torque Wrench Adapter Formulas in the Appendix.



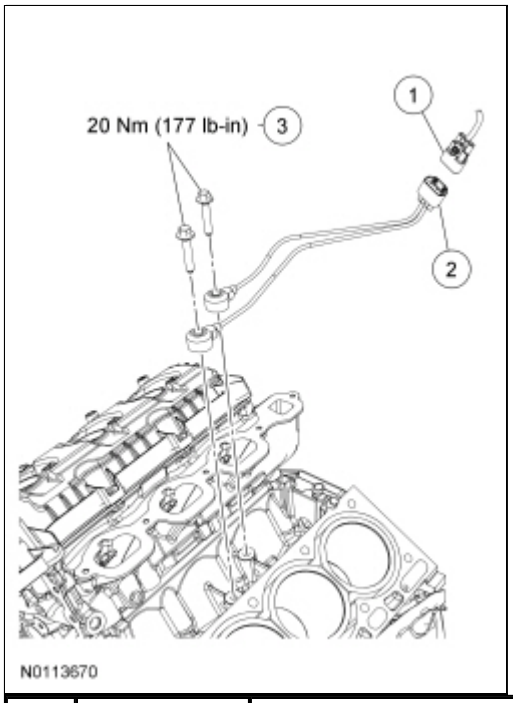
Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connectors (part of 15525)
2	9F472	HO2S
3	—	Catalyst Monitor Sensor (CMS) electrical connectors (part of 15525)
4	9G444	CMS

Knock Sensor (KS)

NOTE: It is necessary to remove the lower intake manifold to access the Cylinder Head Temperature (CHT) sensor. For additional information, refer to Section 303-01B .

NOTE: LH cylinder head removed in graphic for clarity.

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Item	Part Number	Description
1	—	Knock Sensor (KS) electrical connector (part of 12A581)
2	12A699	KS
3	W704749	KS bolt (2 required)

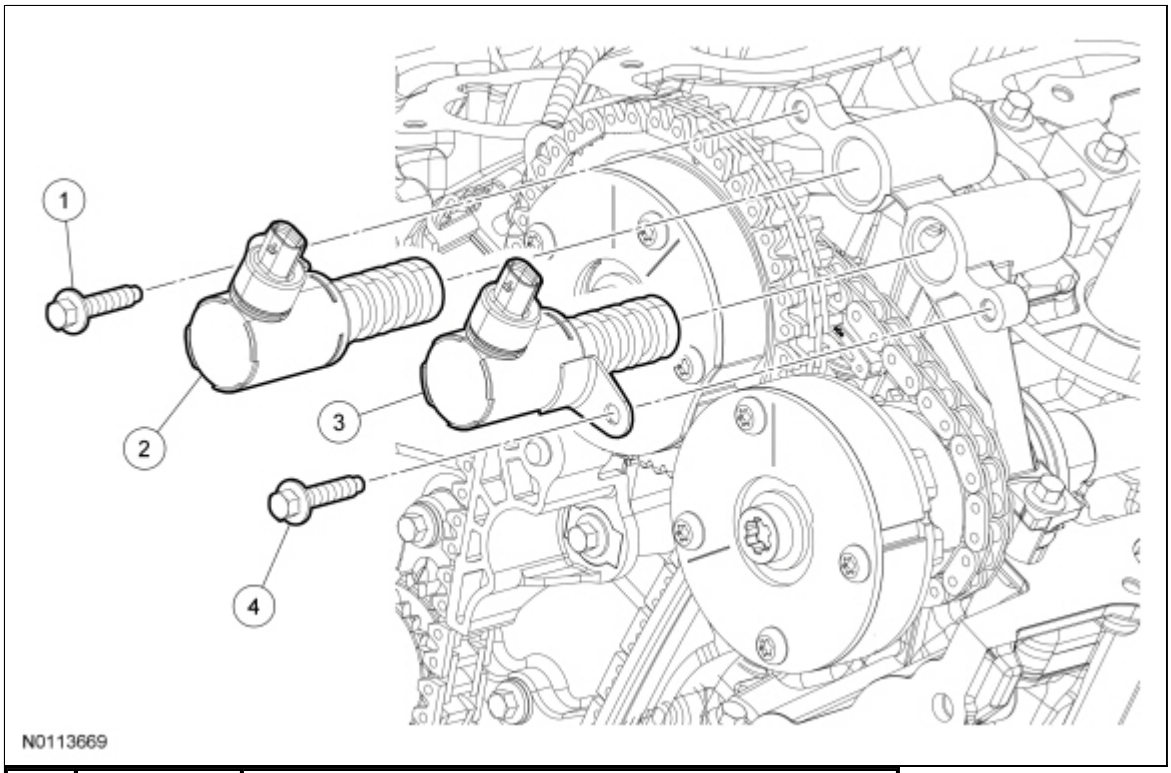
Variable Camshaft Timing (VCT) Oil Control Solenoid

NOTE: It is necessary to remove the RH or LH valve cover to access the Variable Camshaft Timing (VCT) oil control solenoid. For additional information, refer to Section 303-01B .

NOTE: Position the VCT oil control solenoid and tighten the bolts in 2 stages.

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 20 degrees.

NOTE: LH shown, RH similar.



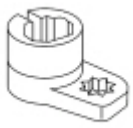
Item	Part Number	Description
1	W500215	LH intake Variable Camshaft Timing (VCT) oil control solenoid bolt
2	6B297	LH intake VCT oil control solenoid
3	6B297	LH exhaust VCT oil control solenoid
4	W500215	LH exhaust VCT oil control solenoid bolt

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Engine Control Components — Exploded View, 5.0L (4V)

Special Tool(s)

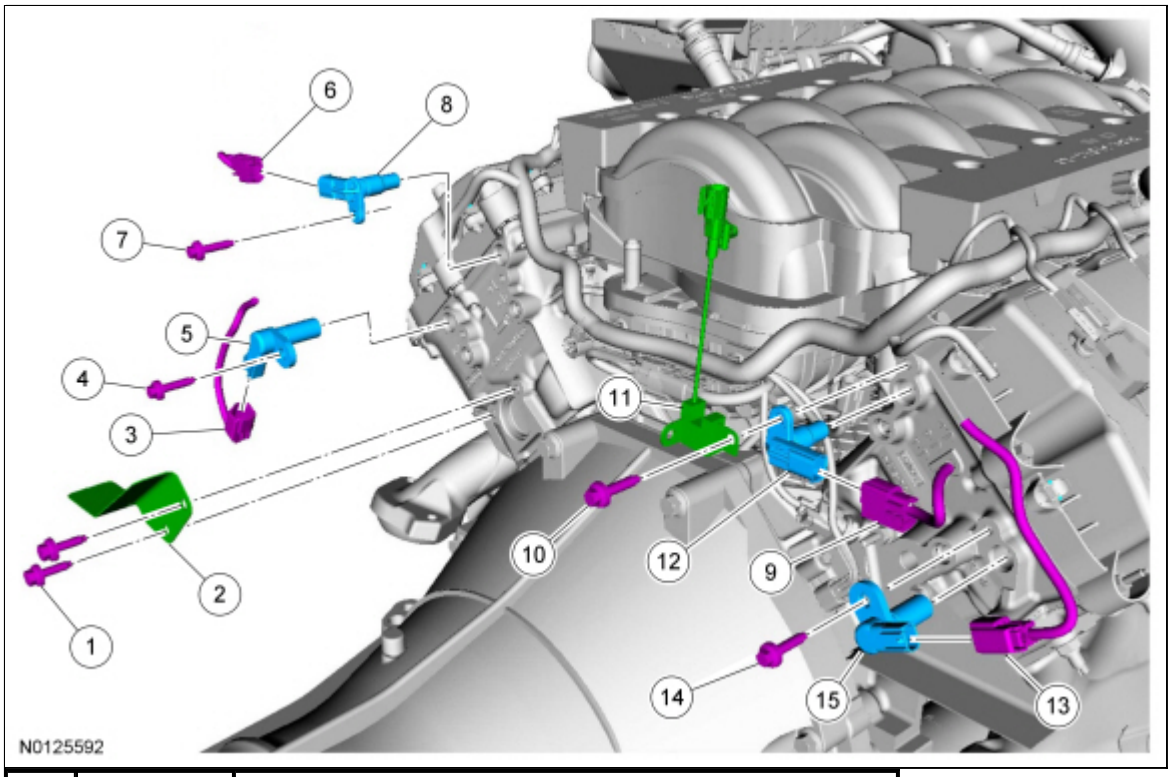
 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	—
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—

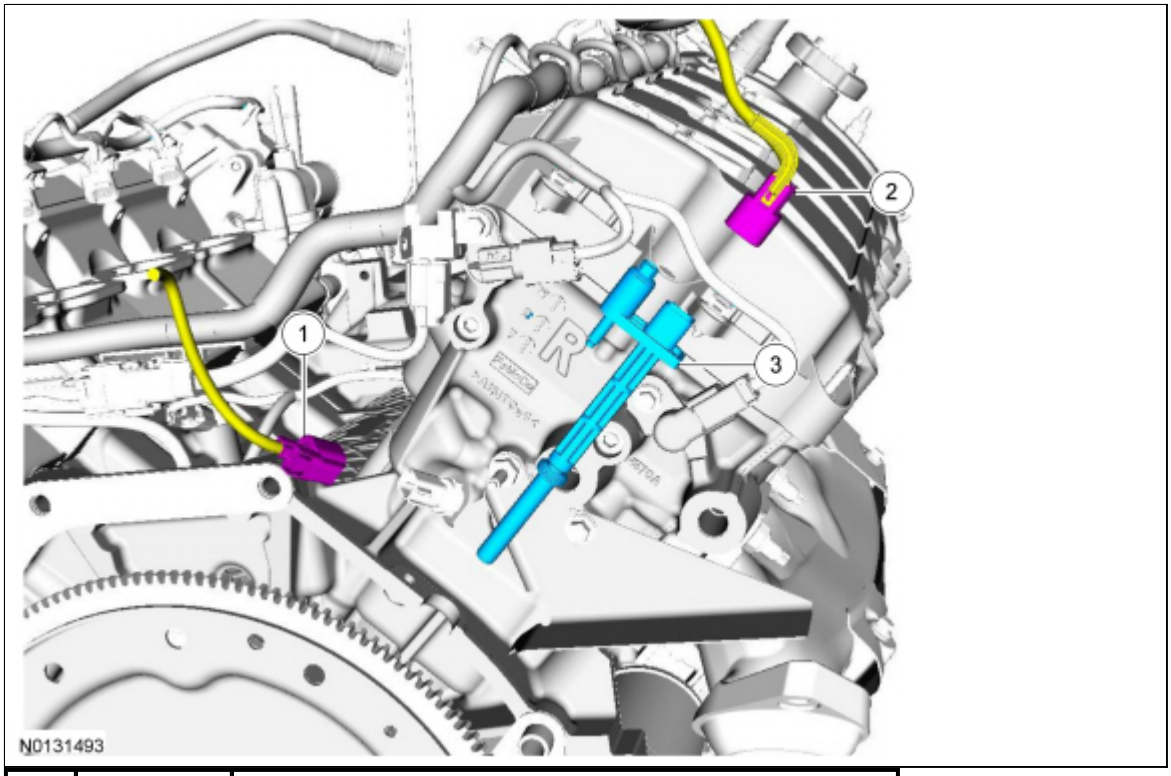
Camshaft Position (CMP) Sensor

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Item	Part Number	Description
1	—	LH heat shield bolt - 10 Nm (89 lb-in) (2 required)
2	39686	LH heat shield
3	—	LH exhaust Camshaft Position (CMP) sensor electrical connector (part of 12A581)
4	W503278	LH exhaust CMP sensor bolt - 10 Nm (89 lb-in)
5	6B288	LH exhaust CMP sensor
6	—	LH intake CMP sensor electrical connector (part of 12A581)
7	W503278	LH intake CMP sensor bolt - 10 Nm (89 lb-in)
8	12K073	LH intake CMP sensor
9	—	RH intake CMP sensor electrical connector (part of 12A581)
10	W503278	RH intake CMP sensor bolt - 10 Nm (89 lb-in)
11	18801	RH radio ignition interference capacitor
12	12K073	RH intake CMP sensor
13	—	RH exhaust CMP sensor electrical connector (part of 12A581)
14	W503278	RH exhaust CMP sensor bolt - 10 Nm (89 lb-in)
15	6B288	RH exhaust CMP sensor

Crankshaft Position (CKP) Sensor

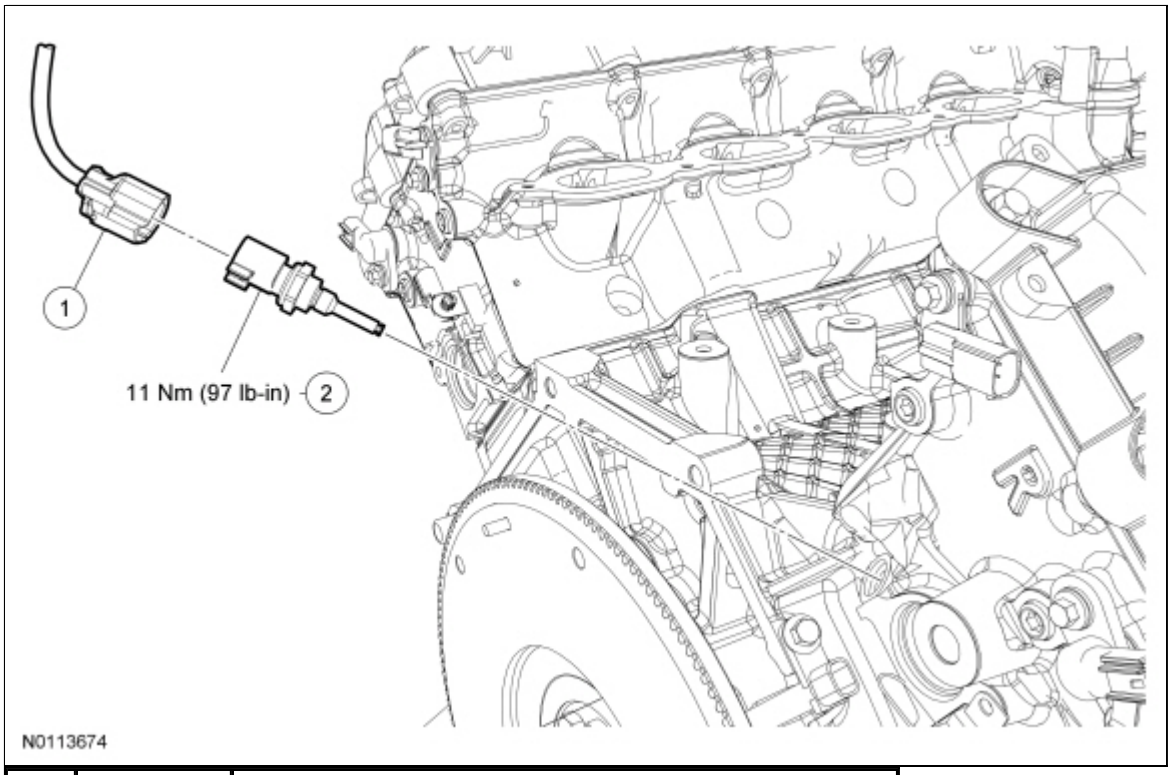


Item	Part Number	Description
1	—	Cylinder Head Temperature (CHT) sensor electrical connector (part of 12A581)
2	—	Crankshaft Position (CKP) sensor electrical connector (part of 12A581)
3	6C315	CKP sensor and bolt assembly - 10 Nm (89 lb-in)

Cylinder Head Temperature (CHT) Sensor

NOTE: It is necessary to remove the intake manifold to perform this procedure. For additional information, refer to Section 303-01C .

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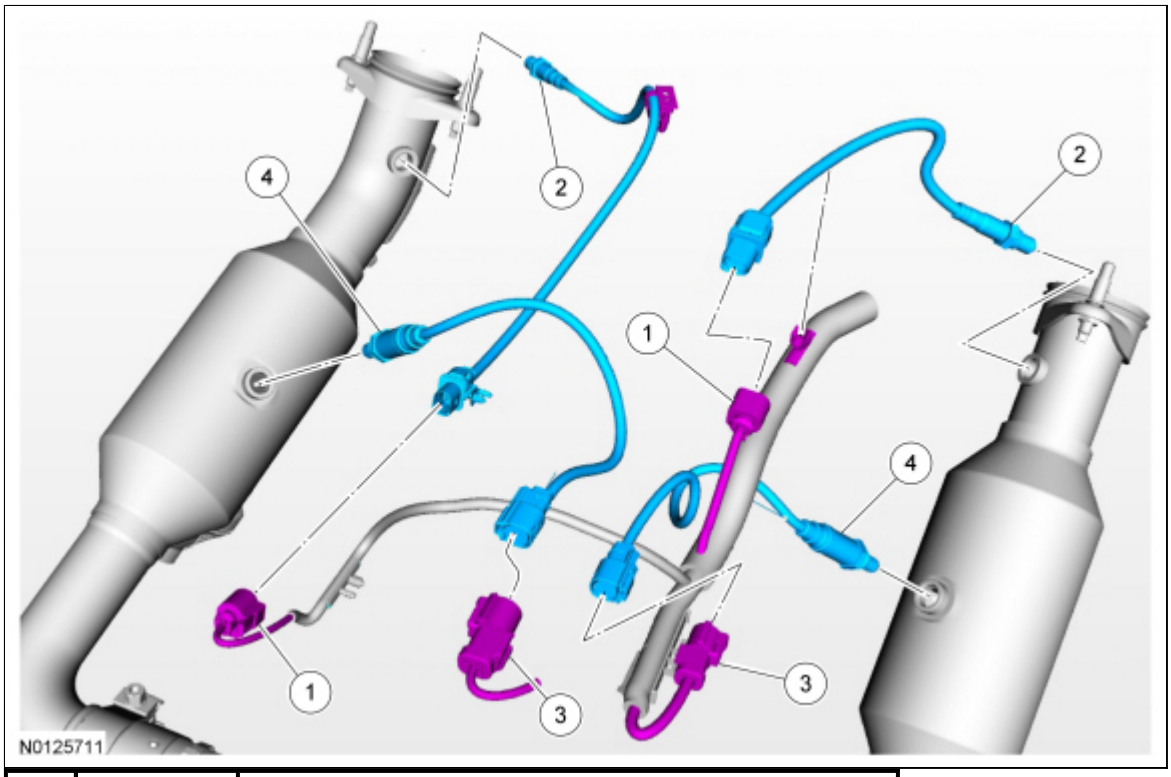
Item	Part Number	Description
1	—	Cylinder Head Temperature (CHT) sensor electrical connector (part of 12A581)
2	6G004	CHT sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor (CMS)

NOTE: If necessary, lubricate the Heated Oxygen Sensor (HO2S) and/or Catalyst Monitor Sensor (CMS) with penetrating and lock lubricant to assist in removal.

NOTE: Apply anti-seize to the threads of the HO2S and/or CMS prior to installing.

NOTE: The correct torque wrench setting must be calculated when using the Exhaust Gas Oxygen Sensor Socket to install the HO2S and/or CMS . Refer to the Torque Wrench Adapter Formulas in the Appendix.

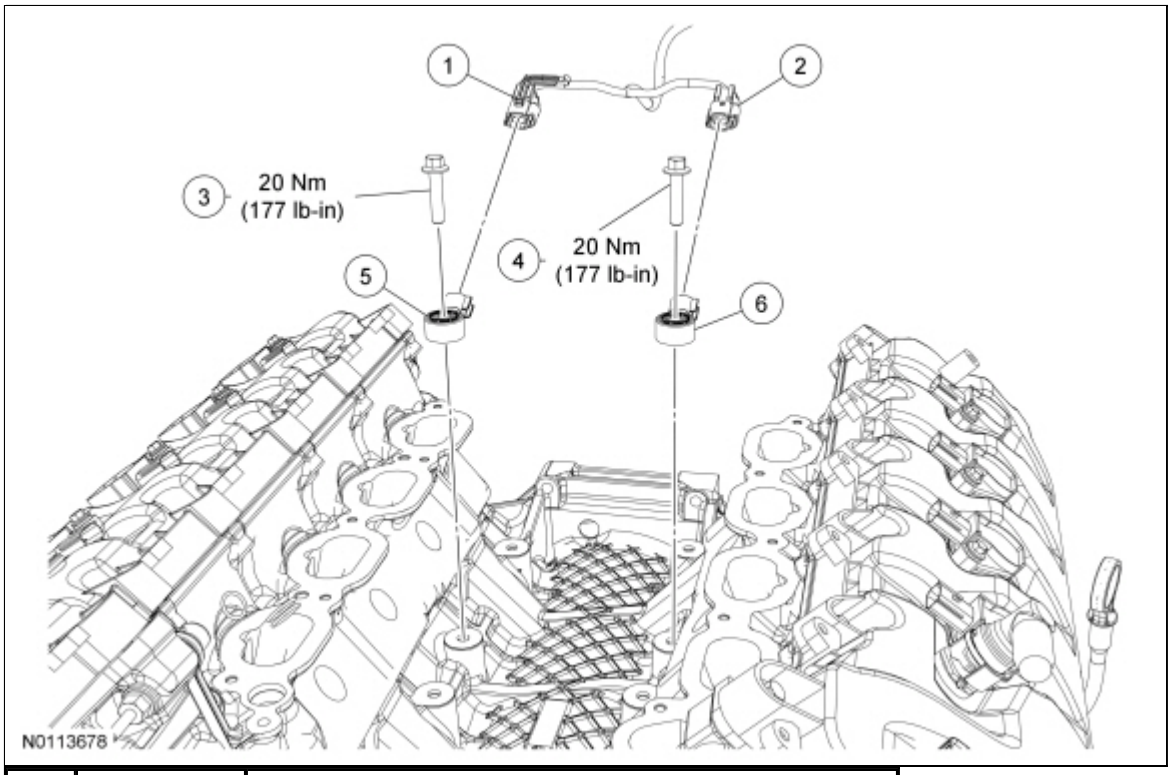


Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connectors (part of 15525)
2	9F472	HO2S
3	—	Catalyst Monitor Sensor (CMS) electrical connectors (part of 15525)
4	9G444	CMS

Knock Sensor (KS)

NOTE: It is necessary to remove the intake manifold to perform this procedure. For additional information, refer to Section 303-01C .

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Item	Part Number	Description
1	—	RH Knock Sensor (KS) electrical connector (part of 14B485)
2	—	LH KS electrical connector (part of 14B485)
3	W500110	RH KS bolt
4	W500110	LH KS bolt
5	12A699	RH KS
6	12A699	LH KS

Variable Camshaft Timing (VCT) Variable Force Solenoid

NOTICE: **The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully depressed to avoid interference with the VCT valve tips when installing the solenoids. Failure to follow these instructions can result in damage to the engine.**

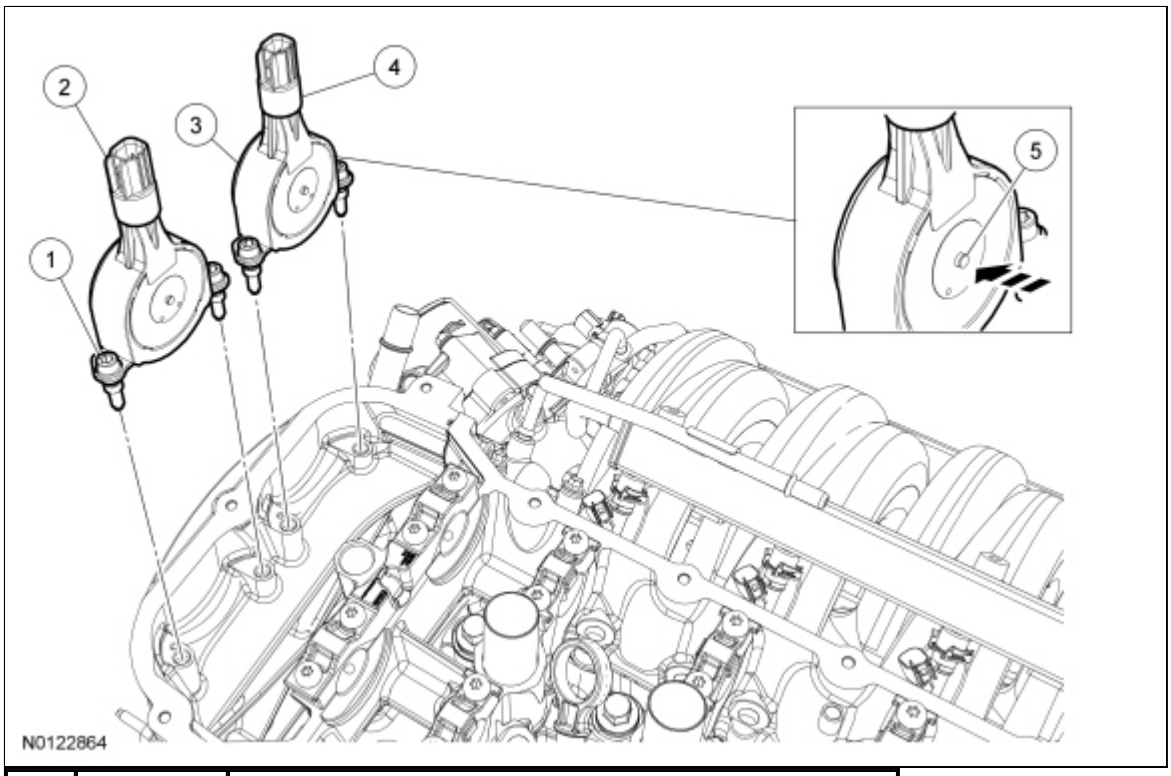
NOTE: The LH or RH valve cover must be removed to perform this procedure. For additional information, refer to Section 303-01C .

NOTE: The bolts are part of the VCT variable force solenoid and cannot be removed.

NOTE: Position the VCT variable force solenoid and tighten the bolts in 2 stages.

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 30 degrees.

NOTE: LH shown, RH similar.



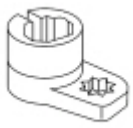
Item	Part Number	Description
1	W700005	LH exhaustVariable Camshaft Timing (VCT) variable force solenoid bolt (part of 6M280) (2 required)
2	6M280	LH exhaust VCT variable force solenoid
3	W700005	LH intake VCT variable force solenoid bolt (part of 6M280) (2 required)
4	6M280	LH intake VCT variable force solenoid
5	—	VCT variable force solenoid pin (part of 6M280) (depress prior to installing solenoid)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Engine Control Components — Exploded View, 6.2L (2V)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

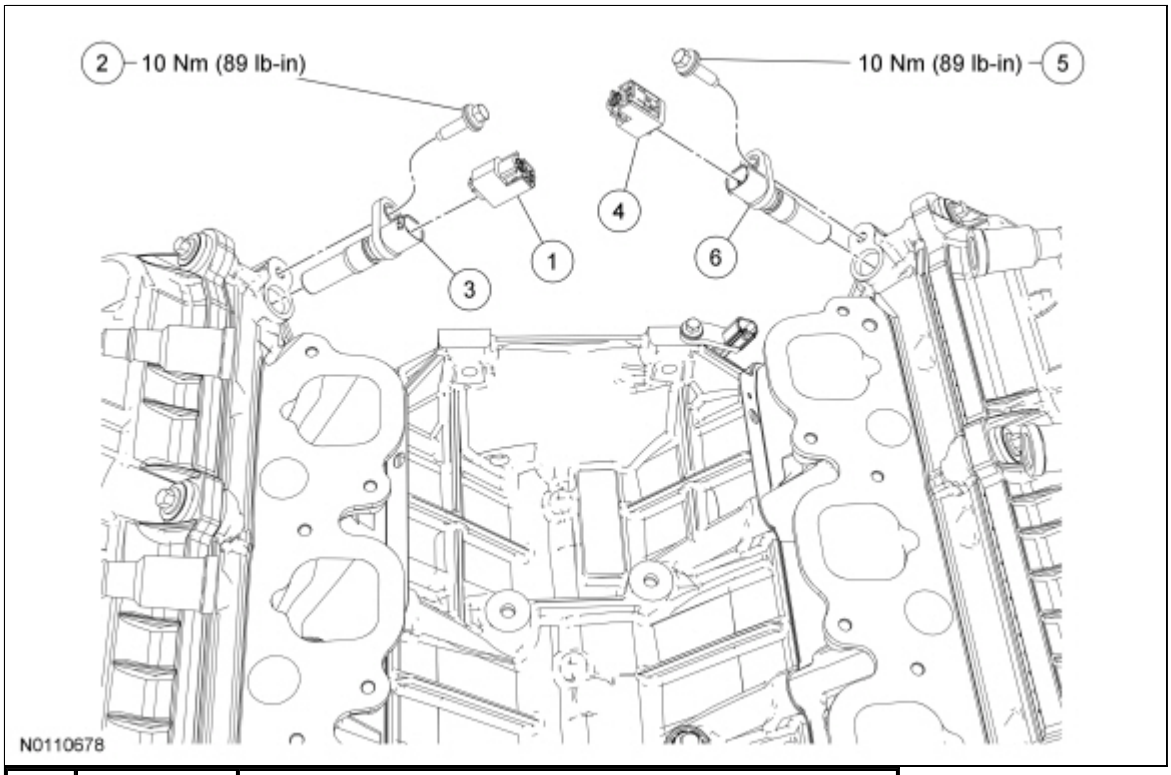
Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—

Camshaft Position (CMP) Sensor

NOTE: Intake manifold removed from graphic for clarity.

NOTE: Lubricate the CMP sensor O-ring seal with clean engine oil prior to installation.

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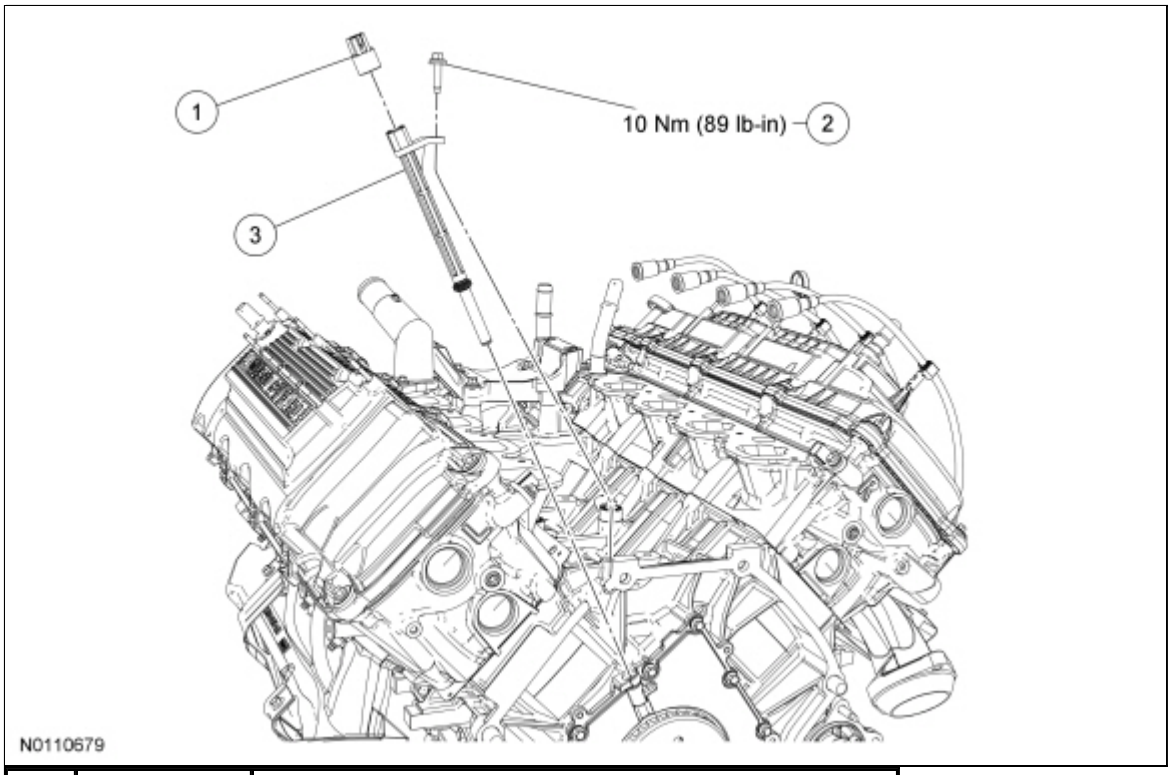
Item	Part Number	Description
1	—	RH Camshaft Position (CMP) sensor electrical connector (part of 12C508)
2	W503276	RH CMP sensor bolt
3	12K073	RH CMP sensor
4	—	LH CMP sensor electrical connector (part of 12C508)
5	W503276	LH CMP sensor bolt
6	12K073	LH CMP sensor

Crankshaft Position (CKP) Sensor

NOTICE: **The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.**

NOTE: The intake manifold must be removed to perform this procedure. For additional information, refer to Section 303-01D .

NOTE: After installing the CKP sensor, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

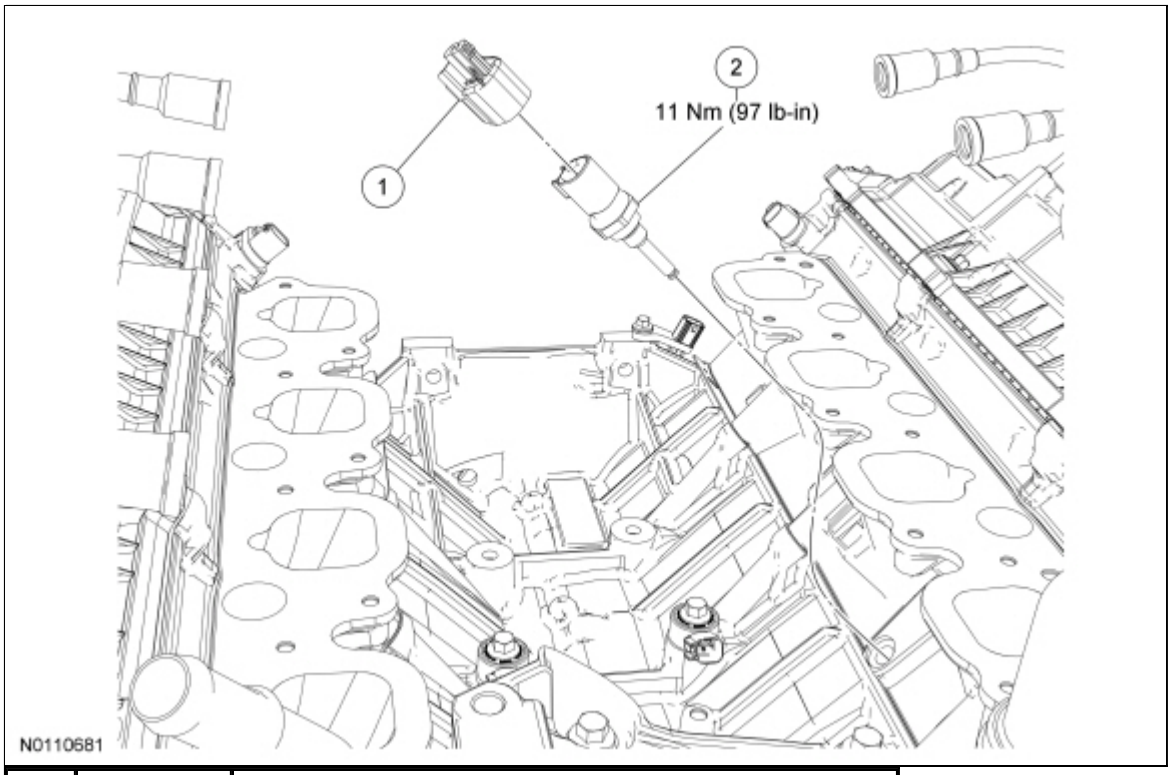


Item	Part Number	Description
1	—	Crankshaft Position (CKP) sensor electrical connector
2	W503276	CKP sensor bolt
3	6C315	CKP sensor

Cylinder Head Temperature (CHT) Sensor

NOTE: The intake manifold must be removed to perform this procedure. For additional information, refer to Section 303-01D .

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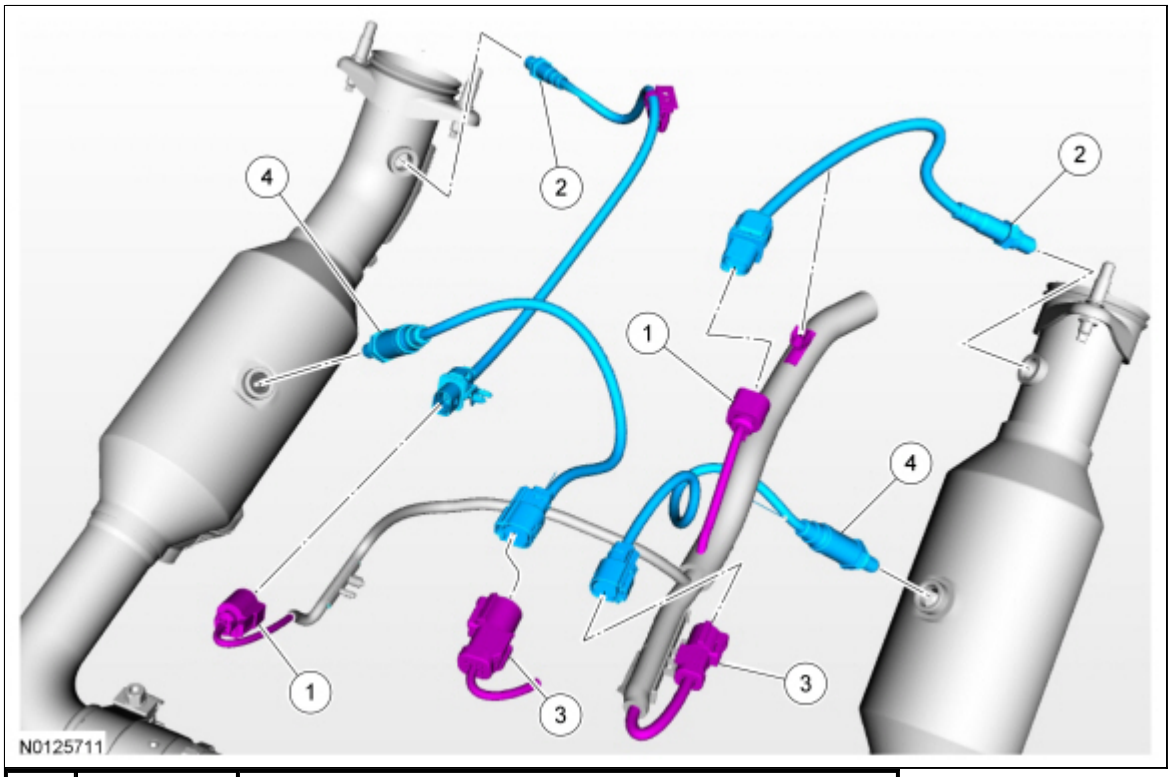
Item	Part Number	Description
1	—	Cylinder Head Temperature (CHT) sensor electrical connector (part of 14B485)
2	6G004	CHT sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor (CMS)

NOTE: If necessary, lubricate the Heated Oxygen Sensor (HO2S) and/or Catalyst Monitor Sensor (CMS) with penetrating and lock lubricant to assist in removal.

NOTE: Apply anti-seize to the threads of the HO2S and/or CMS prior to installing.

NOTE: The correct torque wrench setting must be calculated when using the Exhaust Gas Oxygen Sensor Socket to install the HO2S and/or CMS . Refer to the Torque Wrench Adapter Formulas in the Appendix.

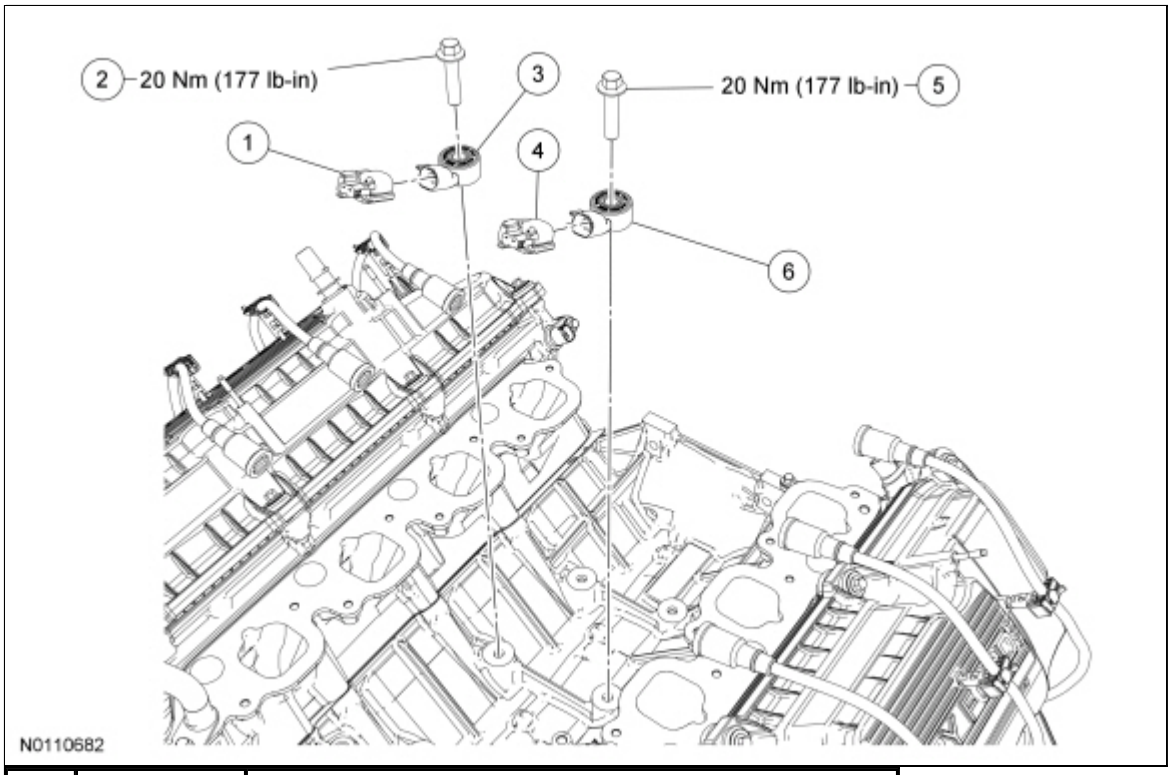


Item	Part Number	Description
1	—	Heated Oxygen Sensor (HO2S) electrical connectors (part of 15525)
2	9F472	HO2S
3	—	Catalyst Monitor Sensor (CMS) electrical connectors (part of 15525)
4	9G444	CMS

Knock Sensor (KS)

NOTE: The intake manifold must be removed to perform this procedure. For additional information, refer to Section 303-01D .

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Item	Part Number	Description
1	—	RH Knock Sensor (KS) electrical connector (part of 14B485)
2	W710119	RH KS bolt
3	12A699	RH KS
4	—	LH KS electrical connector (part of 14B485)
5	W710119	LH KS bolt
6	12A699	LH KS

Variable Camshaft Timing (VCT) Variable Force Solenoid

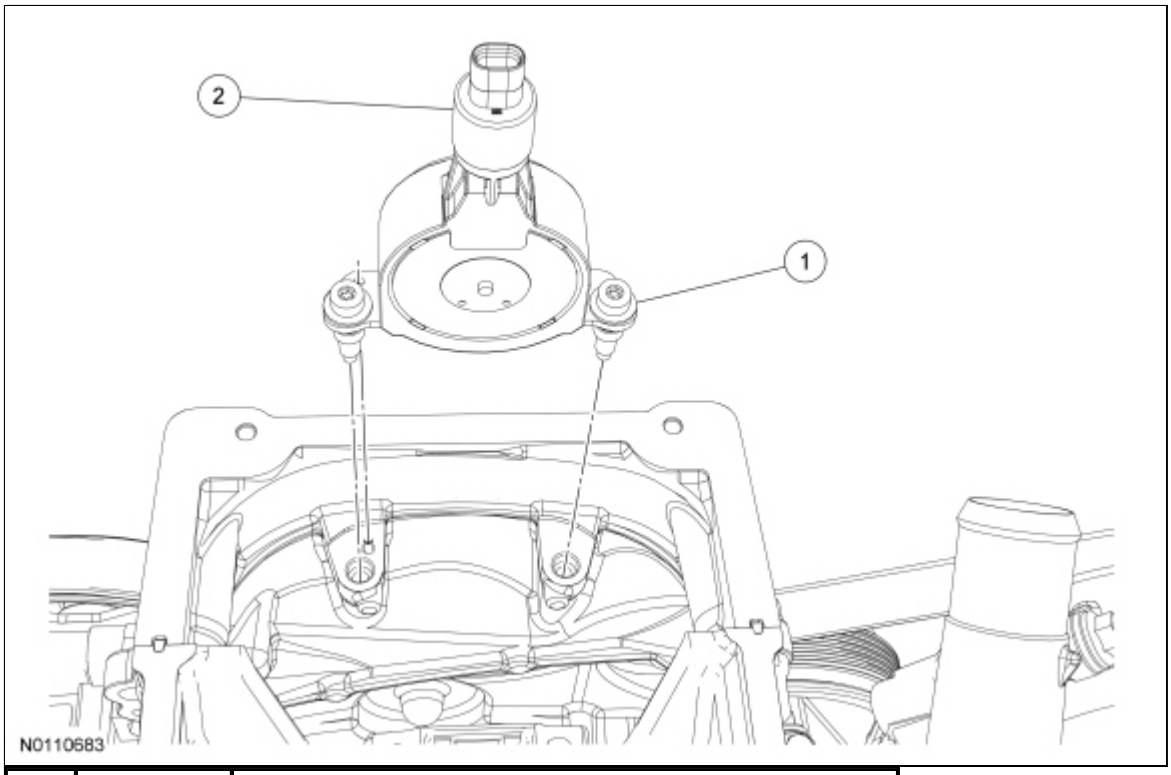
NOTICE: **The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully depressed to avoid interference with the VCT valve tips when installing the solenoids. Failure to follow these instructions can result in damage to the engine.**

NOTE: The LH or RH valve cover must be removed to perform this procedure. For additional information, refer to Section 303-01D .

NOTE: The bolts are part of the VCT variable force solenoid and cannot be removed.

NOTE: Position the VCT variable force solenoid and tighten the bolts in 2 stages.

- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.



Item	Part Number	Description
1	W700005	Variable Camshaft Timing (VCT) variable force solenoid bolt (part of 6B297) (2 required)
2	6M280	VCT variable force solenoid

Removal and Installation

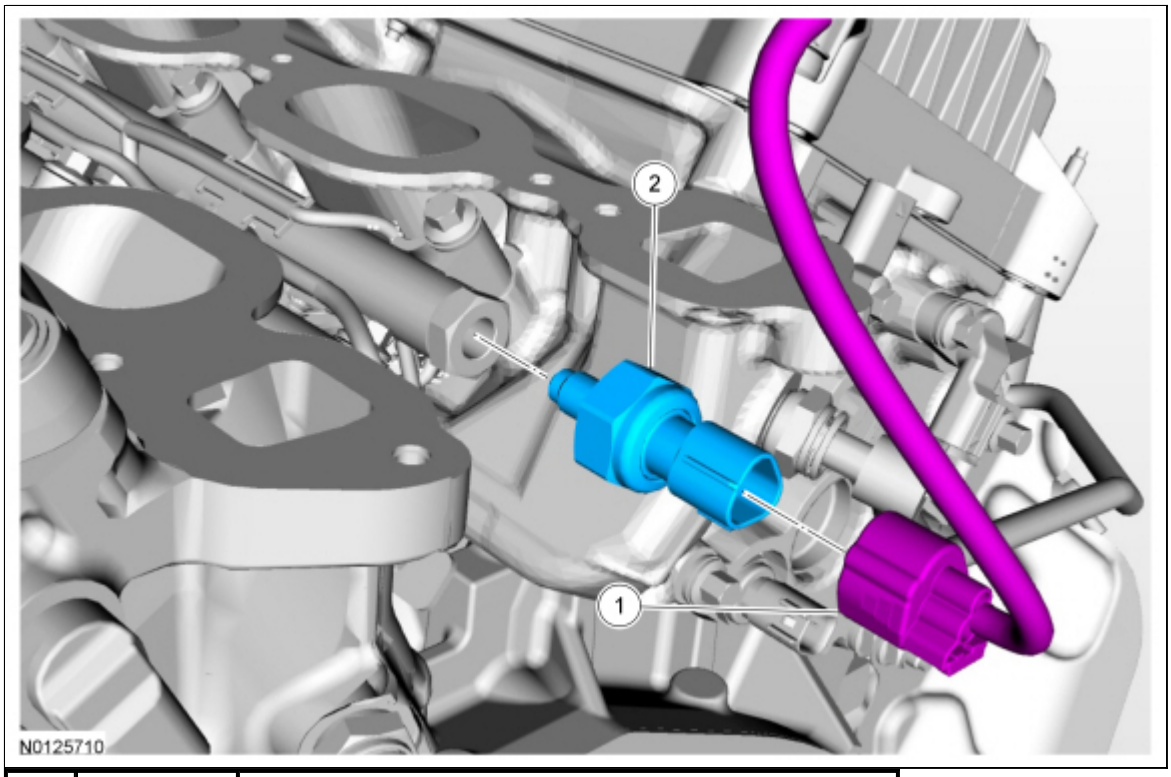
1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Fuel Rail Pressure (FRP) Sensor — 3.5L GTDI

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	—	Fuel Rail Pressure (FRP) sensor electrical connector (part of 12C508)
2	9G756	FRP sensor

Removal

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

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WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

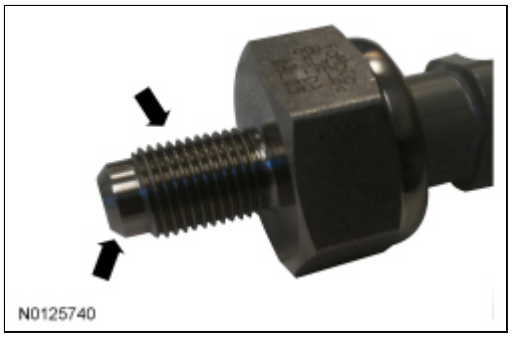
1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the intake manifold. For additional information, refer to Section 303-01A .
4. Disconnect the Fuel Rail Pressure (FRP) sensor electrical connector.
5. ***NOTICE:*** **During repair procedure, cleanliness is extremely important. Any foreign material, including any material created while cleaning or removing components that enters the fuel supply passages may cause engine failure.**

   NOTE: Use compressed air to remove any foreign material from around the FRP sensor area before removal.

   Remove and discard the FRP sensor.

Installation

1. Lubricate the tip and thread area of the new FRP sensor with clean engine oil prior to installation.



2. ***NOTICE:*** **During repair procedure, cleanliness is extremely important. Any foreign material, including any material created while cleaning or removing components that enters the fuel supply passages may cause engine failure.**

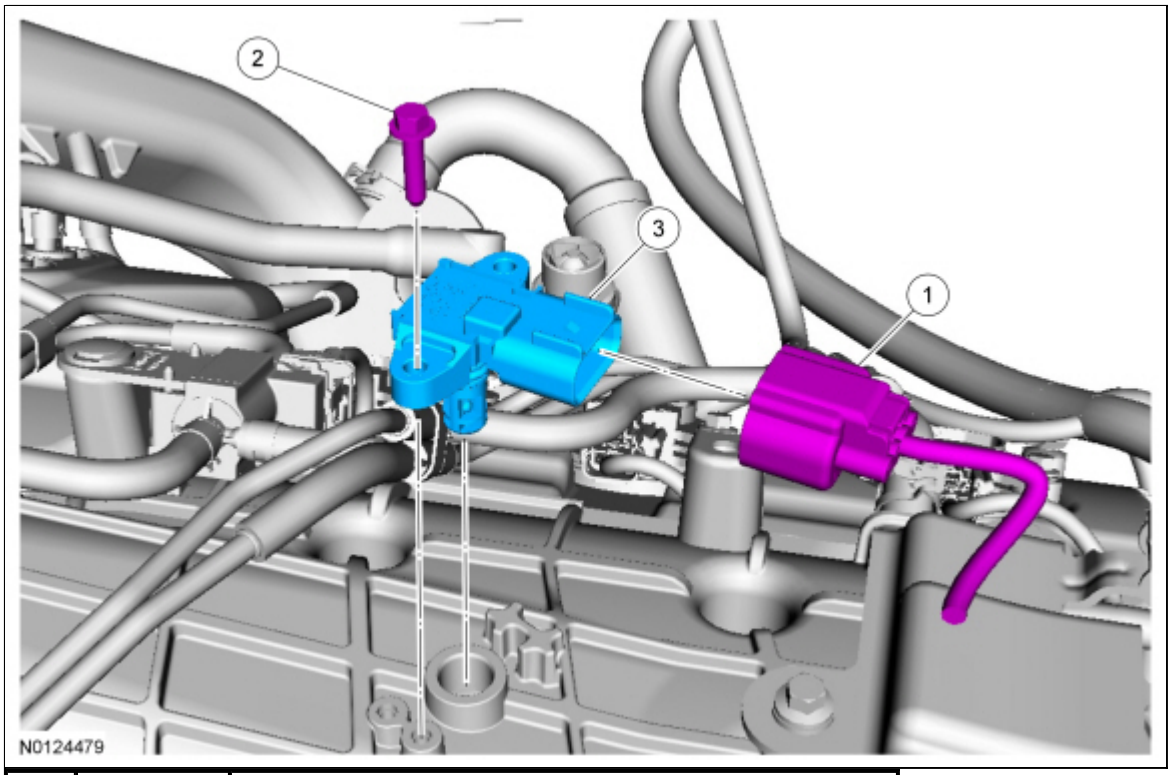
   Install the FRP sensor.
   - To install, tighten to 33 Nm (24 lb-ft).
3. Connect the FRP sensor electrical connector.
4. Install the intake manifold. For additional information, refer to Section 303-01A .
5. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Manifold Absolute Pressure (MAP) / Intake Air Temperature 2 (IAT2) Sensor — 3.5L GTDI

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	—	MAP / IAT2 sensor electrical connector (part of 12A581)
2	W505565	Manifold Absolute Pressure (MAP)/ Intake Air Temperature 2 (IAT2) sensor bolt - 6 Nm (53 lb-in)
3	9F479	MAP / IAT2 sensor

Removal

NOTE: The Turbocharger Boost Pressure (TCBP)/Charge Air Cooler Temperature (CACT) sensor and the

Manifold Absolute Pressure (MAP)/ Intake Air Temperature 2 (IAT2) sensor are not interchangeable.

1. Disconnect the MAP / IAT2 sensor electrical connector.
2. Remove the bolt and the MAP / IAT2 sensor.

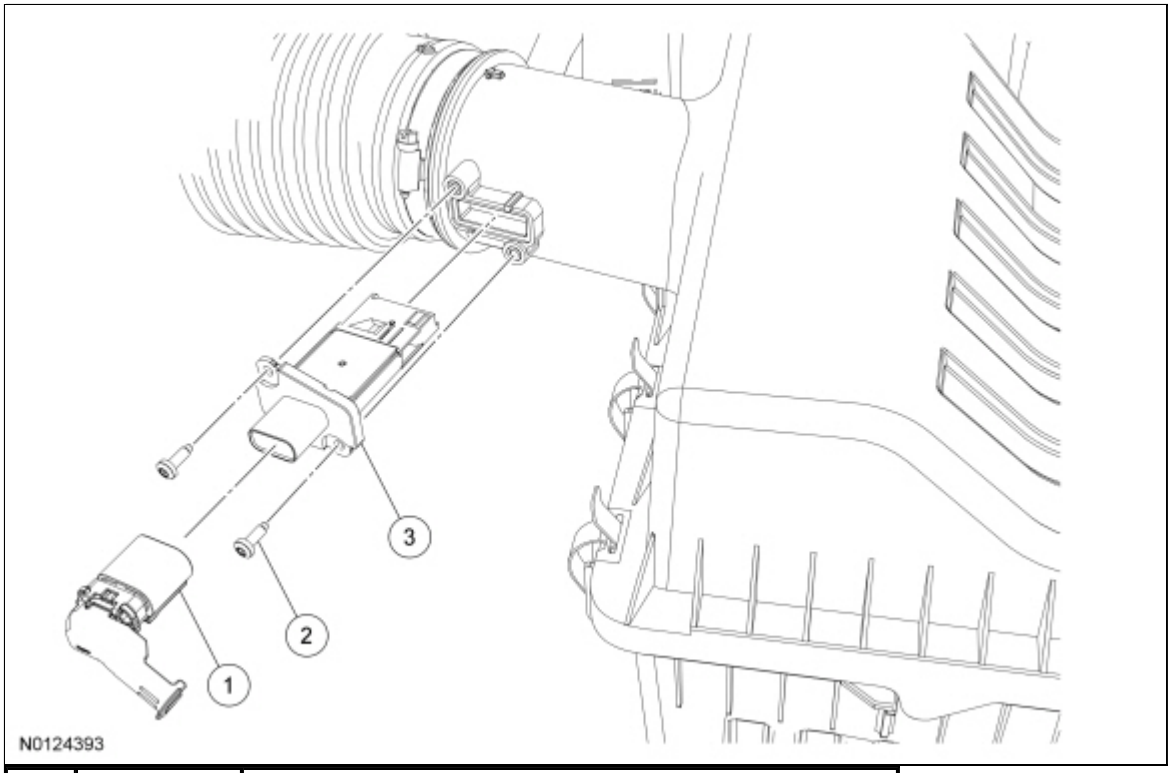
Installation

1. Lubricate the MAP / IAT2 sensor O-ring seal with clean engine oil.
2. Install the MAP / IAT2 sensor and the bolt.
    - Tighten to 6 Nm (53 lb-in).
3. Connect the MAP / IAT2 sensor electrical connector.

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Mass Air Flow (MAF) Sensor — 3.7L, 5.0L (4V), 6.2L (2V)



Item	Part Number	Description
1	—	Mass Air Flow (MAF) sensor electrical connector (part of 12A581)
2	W709287	MAF sensor screw (2 required)
3	12B579	MAF sensor

Removal and Installation

1. Disconnect the Mass Air Flow (MAF) sensor electrical connector.
2. Remove the 2 screws and the MAF sensor.
3. To install, reverse the removal procedure.

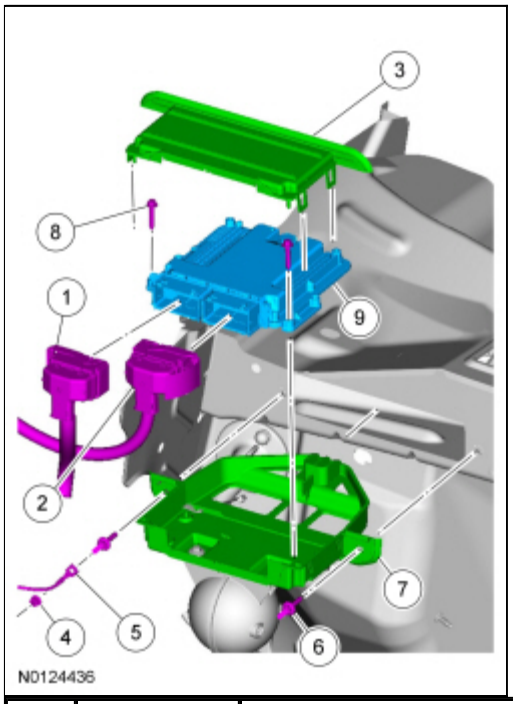
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Powertrain Control Module (PCM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

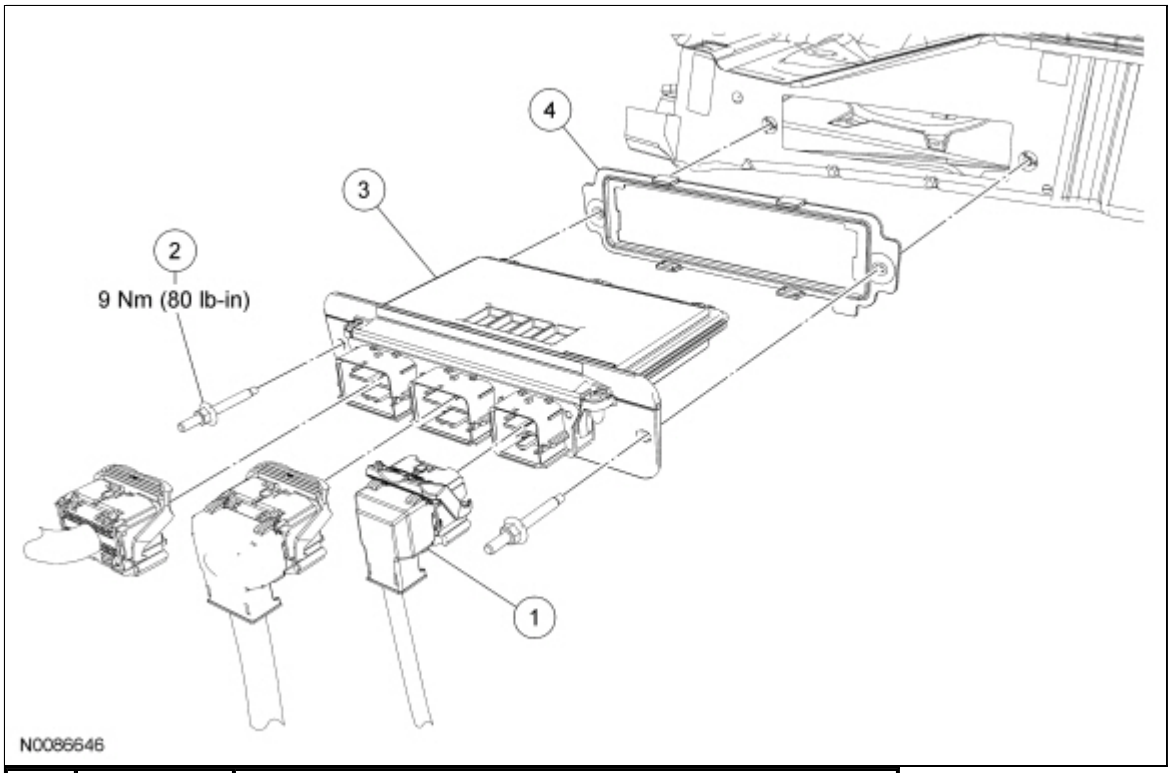
3.5L Gasoline Turbocharged Direct Injection (GTDI) Powertrain Control Module (PCM)



Item	Part Number	Description
1	—	Powertrain Control Module (PCM) electrical connector (part of 14A464)
2	—	PCM electrical connector (part of 12A581)
3	—	PCM cover (part of 12A692)
4	W705790	Ground cable nut - 9 Nm (80 lb-in)
5	—	Ground cable (part of 12A581)
6	W711897	PCM stud bolt (2 required) - 9 Nm (80 lb-in)
7	12A692	PCM support bracket
8	N605894	PCM -to- PCM support bracket bolt - 9 Nm (80 lb-in)

		(2 required)
9	12B684	PCM

3.7L, 5.0L (4V) and 6.2L (2V) Powertrain Control Module (PCM)



Item	Part Number	Description
1	—	Powertrain Control Module (PCM) electrical connectors (part of 14A464 and 12A581)
2	W711897	PCM stud bolt (2 required)
3	12A650	PCM
4	12A696	PCM gasket

Removal

All engines

1. Retrieve the module configuration. Carry out the module configuration retrieval steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

Vehicles equipped with a 3.5L Gasoline Turbocharged Direct Injection (GTDI) engine

2. Disconnect the 2 Powertrain Control Module (PCM) electrical connectors.

3. Disengage and remove the PCM cover.

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4. Remove the 2 PCM -to- PCM support bracket bolts and the PCM .

5. If the PCM support bracket is damaged, remove the nut and position the ground cable aside and remove the 2 PCM stud bolts and slide the PCM support bracket out of the bulkhead.

Vehicles equipped with a 3.7L, 5.0L (4V) or 6.2L (2V) engine

6. Disconnect the Powertrain Control Module (PCM) electrical connectors.

7. Remove the stud bolts, the PCM and the gasket.

Installation

Vehicles equipped with a 3.7L, 5.0L (4V) or 6.2L (2V) engine

1. Install the gasket, the PCM and the 2 stud bolts.
   - Tighten to 9 Nm (80 lb-in).

2. Connect the PCM electrical connectors.

Vehicles equipped with a 3.5L Gasoline Turbocharged Direct Injection (GTDI) engine

3. If the PCM support bracket was removed, position the support bracket assembly into the bulkhead and install the 2 stud bolts.
   - Tighten to 9 Nm (80 lb-in).

4. If the PCM support bracket was removed, position the ground cable and install the nut.
   - Tighten to 9 Nm (80 lb-in).

5. Position the PCM onto the support bracket and install the 2 bolts.
   - Tighten to 9 Nm (80 lb-in).

6. Install the PCM cover.

7. Connect the 2 PCM electrical connectors.

All engines

8. Carry out the transmission solenoid body strategy identification. For additional information, refer to Section 307-01 .

9. **NOTE:** If the Programmable Module Installation (PMI) procedure was not successful in downloading the data from the vehicles original PCM, then the oil life data of the vehicle is lost. If this occurs, and the oil life cannot be determined through service history or customer interview, it is recommended the vehicle engine oil and filter be changed and the oil change minder reset.

   Restore the module configuration. Carry out the module configuration restore steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

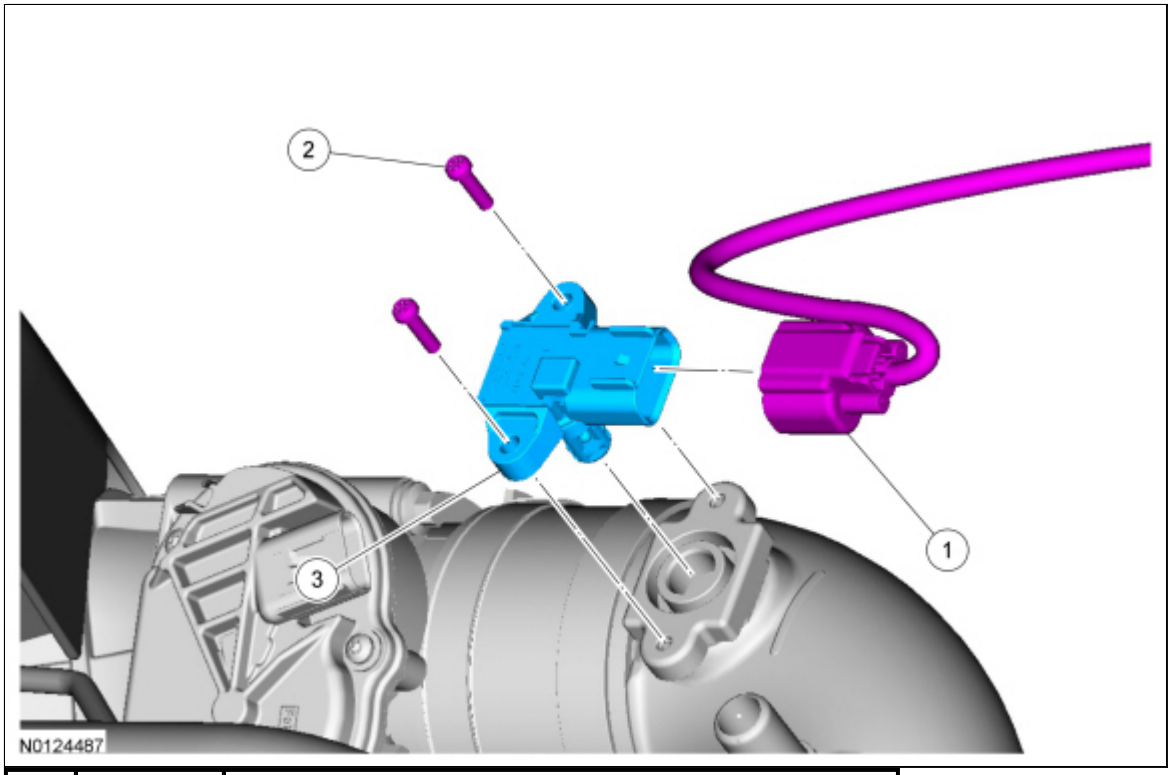
10. Perform the Passive Anti-Theft System (PATS) Parameter Reset procedure. For additional information, refer to Section 419-01B .

11. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the

on-screen instructions.

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Turbocharger Boost Pressure (TCBP) / Charge Air Cooler Temperature (CACT) Sensor — 3.5L GTDI



Item	Part Number	Description
1	—	Turbocharger Boost Pressure (TCBP)/ Charge Air Cooler Temperature (CACT) sensor electrical connector (part of 12A581)
2	W506843	TCBP / CACT sensor screws - 3 Nm (27 lb-in)
3	9F479	TCBP / CACT sensor

Removal

NOTE: Turbocharger Boost Pressure (TCBP)/ Charge Air Cooler Temperature (CACT) sensor and the Manifold Absolute Pressure (MAP)/Intake Air Temperature 2 (IAT2) sensor are not interchangeable.

1. Remove the ACL outlet tube. For additional information, refer to Section 303-12 .
2. Disconnect the Turbocharger Boost Pressure (TCBP)/Charge Air Cooler Temperature (CACT) sensor electrical connector.
3. Remove the 2 screws and the TCBP / CACT sensor.

Installation

1. Install the TCBP / CACT sensor and the 2 screws.
    - Tighten to 3 Nm (27 lb-in).

2. Connect the TCBP / CACT sensor electrical connector.

3. Install the ACL outlet tube. For additional information, refer to Section 303-12 .

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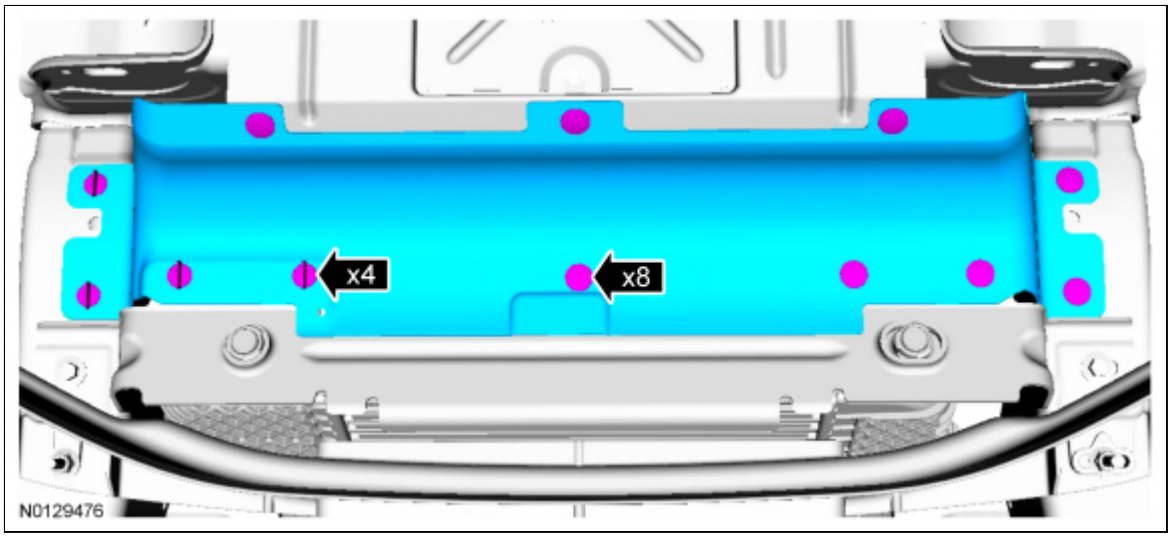
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Turbocharger Bypass Valve

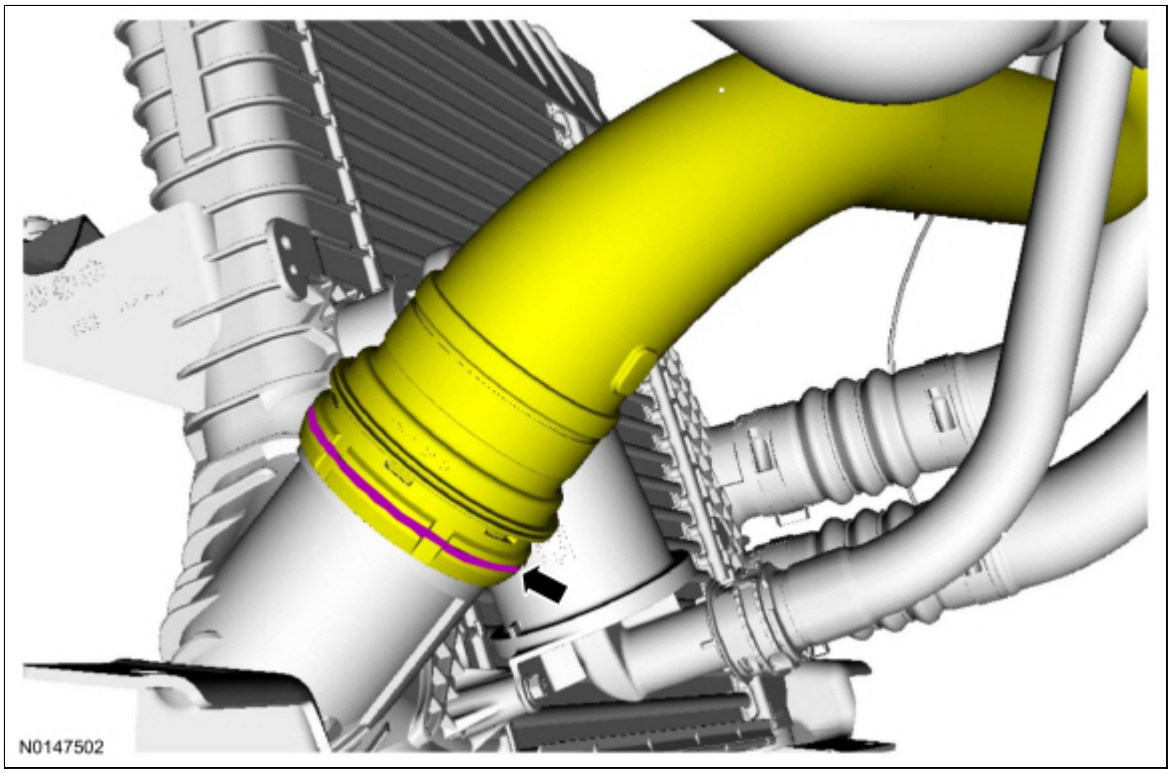
Removal

NOTICE: **Whenever turbocharger air intake system components are removed, always cover open ports to protect from debris. It is important that no foreign material enter the system. The turbocharger compressor vanes are susceptible to damage from even small particles. All components should be inspected and cleaned, if necessary, prior to installation or reassembly.**

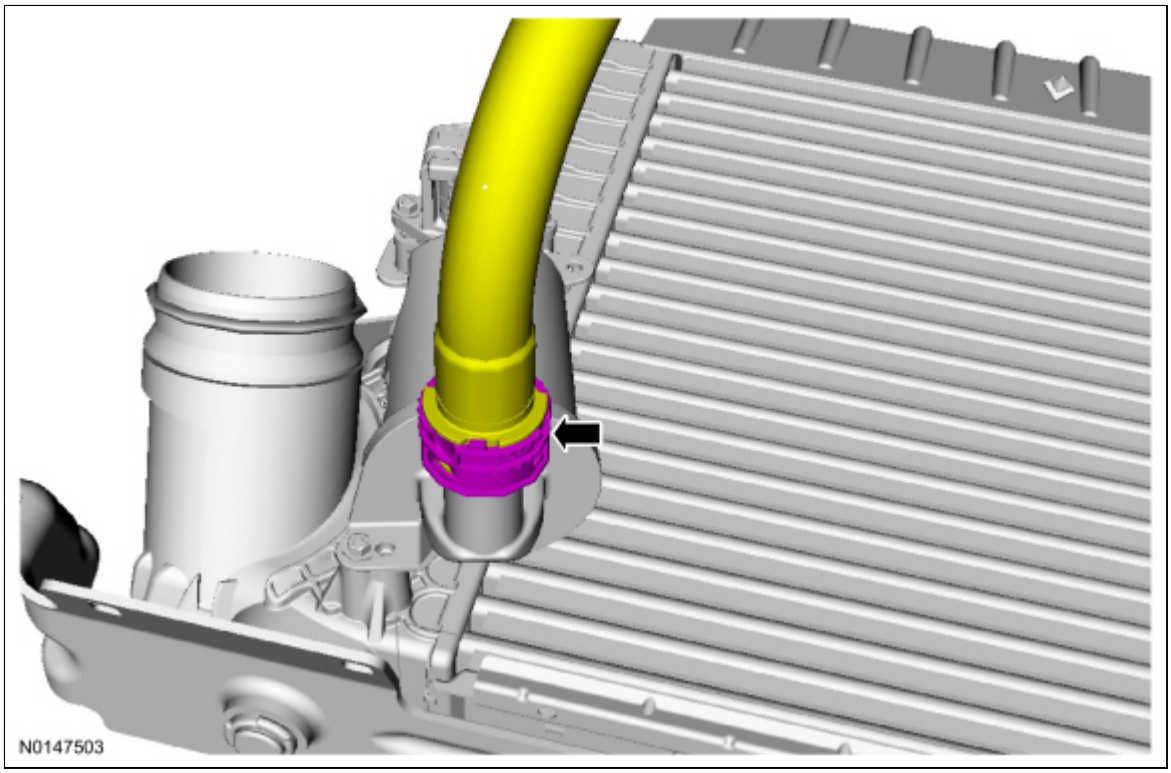
NOTE: Removal steps in this procedure may contain installation details.

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. 

3.

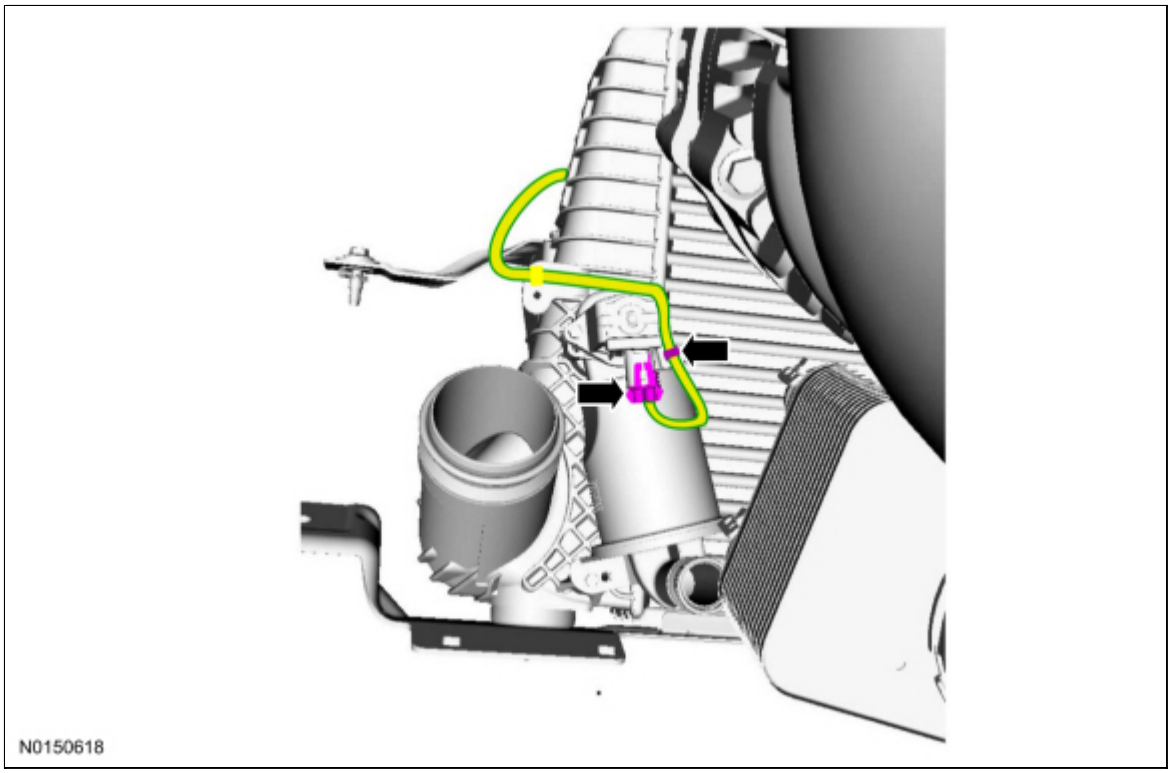


4.



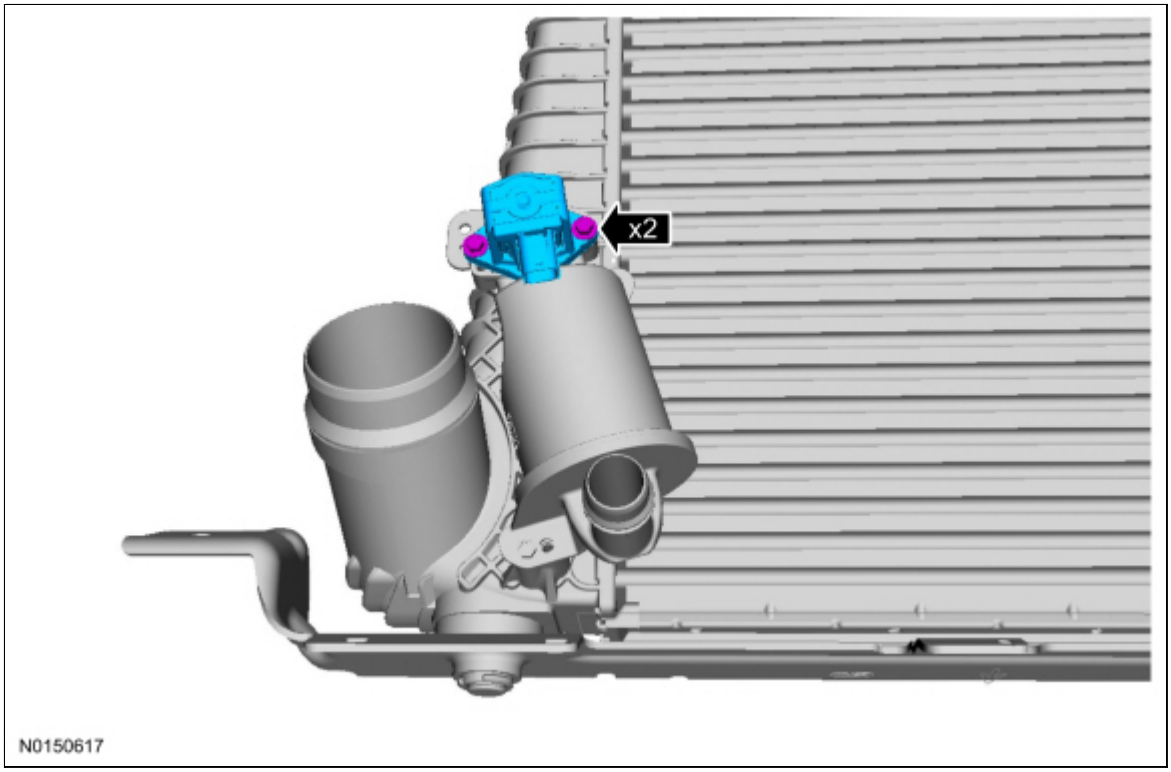
5.

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6.

- To install, tighten to 6 Nm (53 lb-in).



Installation

1. To install, reverse the removal procedure.

---

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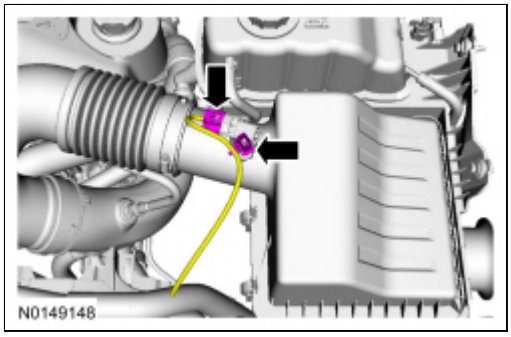
Turbocharger Intake Pressure and Temperature Sensor (TCIPT) — 3.5L GTDI

Removal

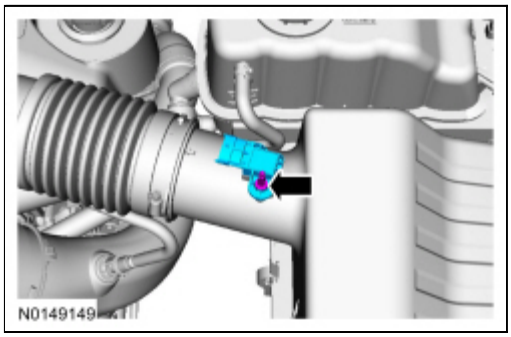
NOTE: Removal steps in this procedure may contain installation details.

1. **WARNING: Before beginning any service procedure in this manual, refer to health and safety warnings in section 100-00 General Information. Failure to follow this instruction may result in serious personal injury.**

   For additional information, refer to Section 100-00 .

2. 

3. - To install, tighten to 3 Nm (27 lb-in).



Installation

1. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV	12.30L (13.0 qt)

General Specifications

Item	Specification
Fluid	
NOTICE: Transmission fluids are not interchangeable. The use of any other fluid or cleaning agents will cause internal transmission damage.	

• Normal maintenance:
  ▪ Transmission fluid change not necessary, filled for life.
• Severe duty maintenance:
  ▪ Change the transmission fluid at 240,000 km (150,000 mi) intervals.	

Fluid Filter	
Internal to the transmission	—

Assembly Weight

Description	Specification
Transmission	84.24 kg (215 lb)

Clutch Application Chart

Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
Park				H		
Reverse		D		H		
Neutral				H		
1st Gear D	D			H [a]		H
2nd Gear D	D		H			O/R
3rd Gear D	D	D				O/R
4th Gear D	D				D	O/R
5th Gear D		D			D	O/R

6th Gear D			H		D	O/R
3rd Gear Manual	D	D				O/R
2nd Gear Manual	D		H			O/R
1st Gear Manual	D			H		H
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

[a] Clutch released when vehicle speed is above 3 mph.

- D = Drive Clutch
- H = Hold Clutch
- O/R = Overrunning

Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L,R/C 4,5,6)	SSE NC	
P	P	Off	On	Off	Off	Off	Off
R	R	Off	Off	Off	Off	Off	Off
N	N	Off	On	Off	Off [a]	Off	Off
D	1	On	On	Off	Off [b]	Off	Off
	2	On	On	On	On	Off	Off
	3	On	Off	Off	On	On	On/Off
	4	On	On	Off	Off	On	On/Off
	5	Off	Off	Off	Off	On	On/Off
	6	Off	On	On	Off	On	On/Off
M [c]	—	—	—	—	—	—	—
2	2	On	On	On	On	Off	Off
1	1	On	On	Off	Off	On	Off

[a] Solenoid state will change if vehicle is moving forward with the selector lever in the NEUTRAL position.
[b] Solenoid is On when vehicle is above 3 mph.
[c] All gears available upon driver request.

CB = Clutch brake

NC = Normally closed

NH = Normally high

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NL = Normally low

Gear Ratio	
1st	4.17 to 1
2nd	2.34 to 1
3rd	1.52 to 1
4th	1.14 to 1
5th	0.87 to 1
6th	0.69 to 1
Reverse	3.40 to 1

Stall Speed

Engine	Min	Max
3.7L	2300	2580
5.0L	2400	2700
3.5L GTDI	2300	2580
6.2L	2,000	2,250

End Play

NOTE: All friction and steel plates use a wave design plate.

Item	Specifications
Forward Clutch (A)	0.71-1.10 mm (0.027-0.043 in)
Direct Clutch (B)	0.50-1.30 mm (0.019-0.051 in)
Intermediate Clutch (C)	0.71-1.10 mm (0.028-0.043 in)
Low/Reverse Clutch (D)	1.0-1.6 mm (0.039-0.063 in)
Overdrive (O/D) Clutch (E)	0.50-0.90 mm (0.019-0.035 in)

Forward Clutch, Direct Clutch and Intermediate Clutch Selective Snap Rings

Part Number	Snap Ring Thickness
6L2Z-7D483-BA	3.0 mm (0.118 in)
6L2Z-7D483-CA	3.2 mm (0.125 in)
6L2Z-7D483-DA	3.4 mm (0.133 in)
6L2Z-7D483-EA	3.6 mm (0.141 in)
6L2Z-7D483-FA	3.8 mm (0.149 in)
6L2Z-7D483-GA	4.0 mm (0.157 in)
6L2Z-7D483-HA	4.2 mm (0.165 in)

Overdrive Clutch Selective Snap Rings

Part Number	Snap Ring Thickness
6L2Z-7D483-M	1.7 mm (0.066 in)
6L2Z-7D483-N	1.9 mm (0.074 in)
6L2Z-7D483-P	2.1 mm (0.082 in)
6L2Z-7D483-Q	2.3 mm (0.09 in)
6L2Z-7D483-R	2.5 mm (0.098 in)
6L2Z-7D483-S	2.7 mm (0.106 in)

Low/Reverse Clutch Selective Pressure Plates

Part Number	Pressure Plate Thickness
6L2Z-7B066-HA	5.1 mm (0.2 in)
6L2Z-7B066-M	5.3 mm (0.208 in)
6L2Z-7B066-JA	5.4 mm (0.212 in)
6L2Z-7B066-N	5.6 mm (0.22 in)
6L2Z-7B066-KA	5.7 mm (0.224 in)
6L2Z-7B066-P	5.9 mm (0.232 in)
6L2Z-7B066-LA	6.0 mm (0.236 in)

Clutch Plate Quantity 3.5L GTDI, 5.0L and 6.2L Engines

Component	Number of Frictions	Number of Separator Plates	Separator Plate Thickness	Number of Pressure Plates	Pressure Plate Thickness
Forward Clutch (A)	5	5	3.0 mm (0.118 in)	1	3.0 mm (0.118 in)
Direct Clutch (B)	5	5	1.75 mm	1	3.9 mm

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			(0.068 in)		(0.153 in)
Intermediate Clutch (C)	5	5	3.0 mm (0.118 in)	1	3.9 mm (0.153 in)
Low/Reverse (D)	5	5	1.75 mm (0.068 in)	Select	5.4 mm (0.212 in)
			1.75 mm (0.068 in)	Select Select	5.7 mm (0.224 in) 6.0 mm (0.236 in)
Overdrive (O/D) Clutch (E)	6	6	3.0 mm (0.118 in)	1	6.15 mm (0.242 in)

Clutch Plate Quantity 3.7L Engine

Component	Number of Frictions	Number of Separator Plates	Separator Plate Thickness	Number of Pressure Plates	Pressure Plate Thickness
Forward Clutch (A)	4	4	3.0 mm (0.118 in)	1	3.0 mm (0.118 in)
Direct Clutch (B)	4	4	1.75 mm (0.068 in)	1	3.9 mm (0.153 in)
Intermediate Clutch (C)	4	4	3.0 mm (0.118 in)	1	3.9 mm (0.153 in)
Low/Reverse (D)	5	5	1.75 mm (0.068 in)	Select	5.4 mm (0.212 in)
			1.75 mm (0.068 in)	Select Select	5.7 mm (0.224 in) 6.0 mm (0.236 in)
Overdrive (O/D) Clutch (E)	6	6	3.0 mm (0.118 in)	1	6.15 mm (0.242 in)

Shift Speeds

Throttle Position	Shift	Km/H	MPH

Light Throttle	1-2	13-21	8-13
TP Voltage	2-3	26-34	16-21
1.25 Volts	3-4	35-43	22-27
	4-5	56-64	35-40
	5-6	71-79	44-49
	5-6 [a]	100-105	62-65
Closed Throttle	6-5	56-64	35-40
	5-4	40-48	25-30
	4-3	13-21	8-13
	3-2	3-11	2-7
	2-1	2-6	1-4
Wide Open Throttle	1-2	45-53	28-33
	2-3	87-95	54-59
	3-4	140-148	87-92

[a] Vehicles equipped with a 4.10:1 FDR

Torque Specifications

Description	Nm	lb-ft	lb-in
Detent spring bolts	12	—	106
EVAP canister bolt	20	—	177
Exhaust heat shield bolts	15	—	133
Flexplate inspection cover bolts	48	35	—
Flexplate-to-torque converter nuts	40	30	—
Front pump bolts [a]	—	—	—
Fuel line bracket bolt	25	18	—
Isolator cap bolt	35	26	—
Main control bolts [a]	—	—	—
Manual control lever nut	15	—	133
Molded leadframe bolts [a]	—	—	—
Output shaft flange nut [a]	—	—	—
Park pawl pin bolt	23	17	—
Park rod actuating plate	12	—	106
Pump plate assembly-to-pump body bolts	15	—	133
Selector lever cable bracket bolts	48	35	—
Skid plate bolts	40	30	—
Solenoid bracket bolts	6	—	53
Transmission fluid cooler tube-to-transmission bolt [a]	—	—	—
Transmission fluid cooler tube bracket nut	12	—	106
Transmission fluid fill plug	35	26	—

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Transmission fluid pan bolts [a]	—	—	—
Transmission insulator and retainer bolts	90	66	—
Transmission insulator and retainer nuts	103	76	—
Transmission-to-engine bolts	48	35	—

[a] Refer to the procedure in this section.

Gear Ratios

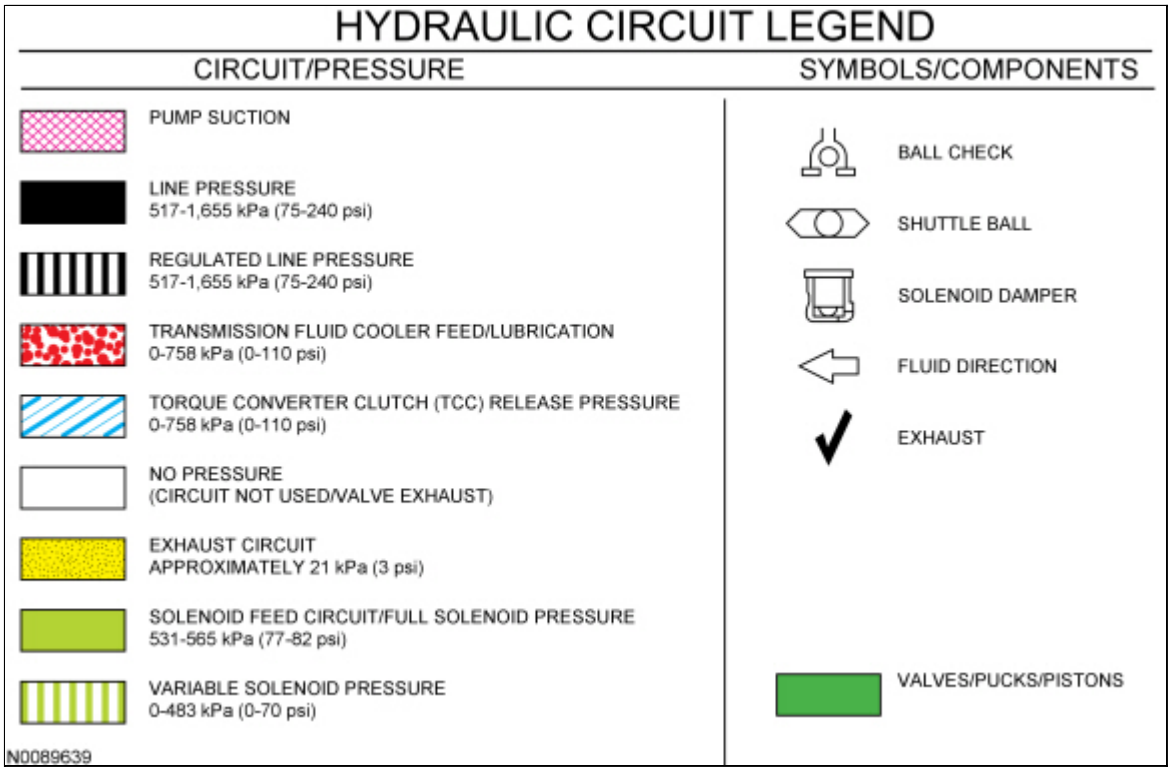
Power is transmitted from the torque converter to the planetary gearsets through the input shaft. Clutches are used to hold and drive certain combinations of gearsets. This results in 6 forward ratios and one reverse ratio which are transmitted to the rear planetary ring gear (output shaft). The planetary gearsets of this transmission provide the following ratios:

- Reverse:
  - Front planetary gearset ratio of 1.52:1
  - Rear planetary gearset ratio of 2.24:1 (reverse direction)
  - Total ratio of 3.40:1 (reverse direction)
- 1st gear:
  - Front planetary gearset ratio of 1.52:1
  - Rear planetary gearset ratio of 2.74:1
  - Total ratio of 4.17:1
- 2nd gear:
  - Front planetary gearset ratio of 1.52:1
  - Rear planetary gearset ratio of 1.54:1
  - Total ratio of 2.34:1
- 3rd gear:
  - Front planetary gearset ratio of 1.52:1
  - Rear planetary gearset ratio of 1:1
  - Total ratio of 1.52:1
- 4th gear:
  - Front planetary gearset provides ratios of 1:1 and 1.52:1 to different rear planetary gearset members
  - Rear planetary gearset ratio of 1.14:1
  - Total ratio of 1.14:1
- 5th gear:
  - Front planetary gearset provides ratios of 1:1 and 1.52:1 to different rear planetary gearset members
  - Rear planetary gearset ratio of 0.87:1
  - Total ratio of 0.87:1
- 6th gear:
  - Front planetary gearset ratio of 1:1
  - Rear planetary gearset ratio of 0.69:1
  - Total ratio of 0.69:1

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Hydraulic Circuits

Hydraulic Circuit Identification and Function



Hydraulic Circuit Identification Chart

Circuit Name	Description
BREVA	BREV5 pressure from the drive enable valve to the clutch A regulator valve.
BREV5	BREV 5F pressure from the clutch A latch valve to the drive enable valve and the No. 2 shuttle ball.
BREV 5F	Regulated line pressure from the CL B circuit directed to the A clutch latch valve by the B clutch latch valve.
BREV5/SS1	BREV5 or SS1 pressure from the No. 2 shuttle ball to the solenoid multiplex valve.
CAPLY	Apply circuit to the torque converter, also the return circuit during Torque Converter Clutch (TCC) release.
CAPLY EX	TCC release pressure from the bypass clutch control regulator valve to the converter release regulator valve.
CAPLY F	Line pressure from the PUMP circuit directed to the bypass clutch control regulator valve by the main regulator valve.
CL A	Regulated line pressure from the clutch A regulator valve to the clutch A latch valve and the

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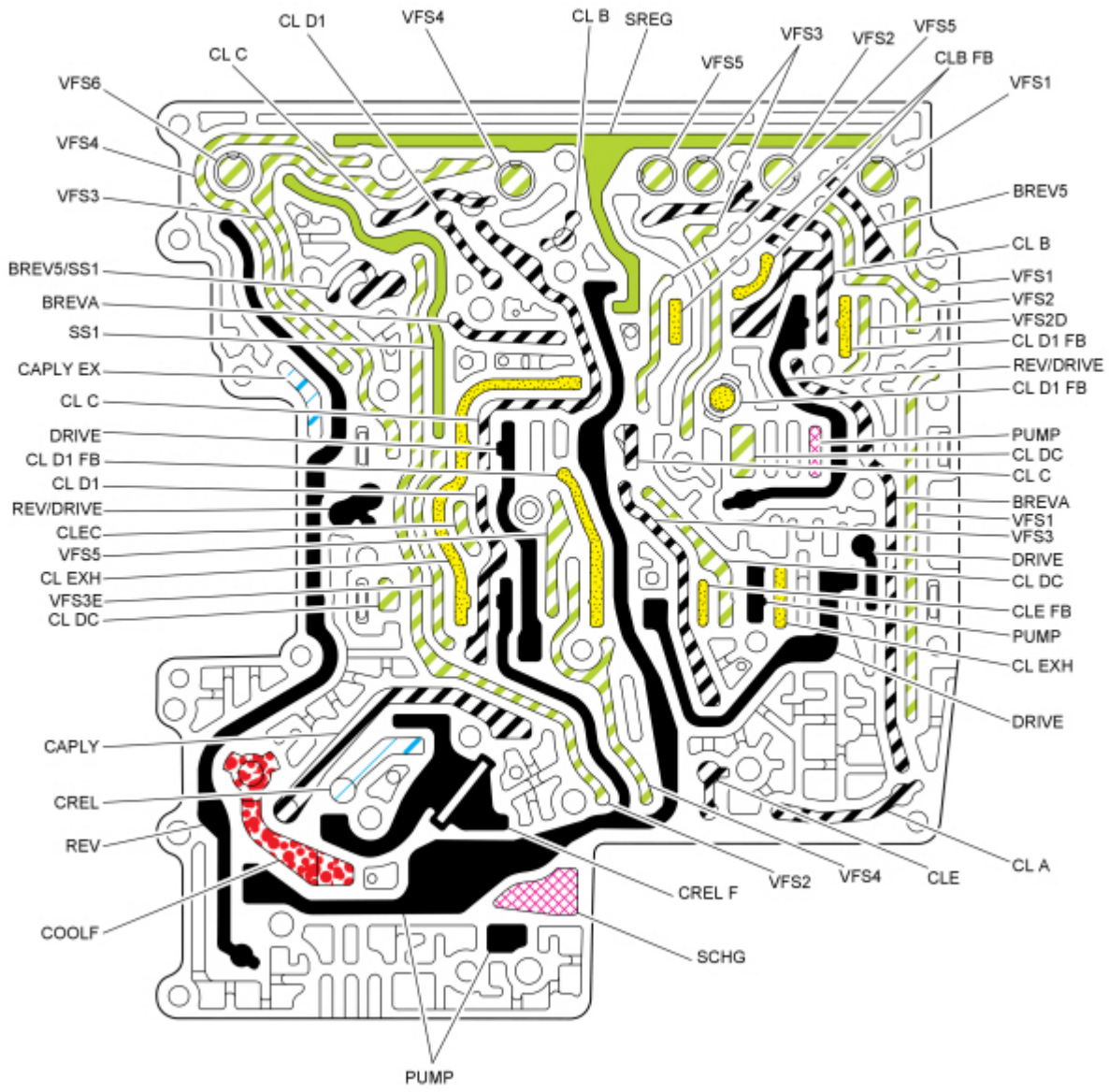
	forward (A) clutch to apply the clutch.
CLA FB	Regulated line pressure from the clutch A latch valve that feeds back to the clutch A regulator valve.
CL B	Regulated line pressure from the clutch B regulator valve to the clutch B latch valve and the direct (B) clutch to apply the clutch.
CLB FB	Regulated line pressure from the clutch B latch valve that feeds back to the clutch B regulator valve.
CL C	Regulated line pressure from the clutch C regulator valve to the intermediate (C) clutch to apply the clutch.
CL D1	Regulated line pressure from the clutch D1 regulator valve to the clutch D1 latch valve and the low/reverse (D) clutch to apply the clutch.
CL D1 FB	Regulated line pressure from the clutch D1 latch valve that feeds back to the clutch D1 regulator valve.
CL DC	Regulated solenoid output pressure from Shift Solenoid D (SSD) directed by the solenoid multiplex valve to the D1 and D2 regulator and latch valves to apply the low/reverse (D) clutch.
CLE	Regulated line pressure from the clutch E regulator valve to the clutch E latch valve and the overdrive (E) clutch to apply the clutch.
CLEC	Regulated solenoid output pressure from the CLEC F circuit directed by the drive enable valve to the clutch E regulator and latch valves to apply the clutch.
CLEC F	Regulated solenoid output pressure from the VFS4 circuit directed to the drive enable valve by the solenoid multiplex valve to move the clutch E regulator and latch valves to apply the overdrive (E) clutch.
CLE FB	Regulated line pressure from the clutch E latch valve that feeds back to the clutch E regulator valve.
CL EXH	Line pressure regulated to approximately 21 kPa (3 psi) by the D2 latch valve that supplies exhaust pressure to the A, B, C, D1 and E clutch when the clutches are released.
COOLF	Pressure from the lubrication control valve to the oil cooler or the thermal bypass valve that feeds the lubrication circuit.
CREL	Pressure supplied to the torque converter by the converter release regulator valve to release the TCC .
CREL F	Line pressure from the main regulator valve that supplies the converter release regulator valve and the lubrication control valve.
DBACK	CAPLY EX pressure directed to the drain back valve by the converter release regulator valve.
DRIVE	Line pressure directed by the manual valve to the A, C and E clutch regulator valves and the No. 1 shuttle ball.
LUBE	Transmission lubrication circuit supplied by the COOLF circuit after the fluid circulates the transmission fluid cooler or is returned by the cooler bypass valve.
PUMP	Line pressure supplied by the pump to the manual valve, solenoid pressure regulator valve, main regulator valve, clutch D1 regulator valve, clutch D2 regulator valve and clutch D2 latch valve.
REV	Line pressure from the manual valve to the No. 1 shuttle ball and the solenoid multiplex valve.
REV/DRIVE	REV or DRIVE pressure from the No. 1 shuttle ball to the clutch B regulator valve.
SCHG	Line pressure from the main regulator valve to the pump suction port.
SREG	Line pressure from the solenoid regulator valve that supplies pressure to the 7 solenoids

	Shift Solenoid A (SSA), Shift Solenoid B (SSB), Shift Solenoid C (SSC), SSD , Shift Solenoid E (SSE), TCC solenoid and Line Pressure Control (LPC) solenoid.
SS1	Solenoid output pressure from SSE to the drive enable valve and to shuttle ball No. 2. to direct SSD output pressure to clutch E regulator and latch valves to apply the overdrive (E) clutch.
VFS1	Solenoid output pressure from SSA to the A clutch regulator and latch valve to apply the forward (A) clutch.
VFS2	Solenoid output pressure from SSB to the B clutch regulator and latch valve to apply the direct (B) clutch and is also routed to the D1 latch valve.
VFS2D	SSB output pressure from the VFS2 circuit directed to the clutch B regulator valve by the D1 latch valve.
VFS3	Solenoid output pressure from SSC to the C clutch regulator valve to apply the intermediate (C) clutch and is also routed to the clutch E latch valve.
VFS3E	SSC output pressure from the VFS3 circuit directed to the clutch C regulator valve by the clutch E latch valve.
VFS4	Solenoid output pressure from SSD to the solenoid multiplex valve to apply either the D or E clutch.
VFS5	Solenoid output pressure from the LPC solenoid to the main regulator valve to control line pressure.
VFS6	Solenoid output pressure from the TCC solenoid to the bypass clutch control regulator valve and the converter release regulator valve to control the TCC .

Main Control Hydraulic Passage Identification

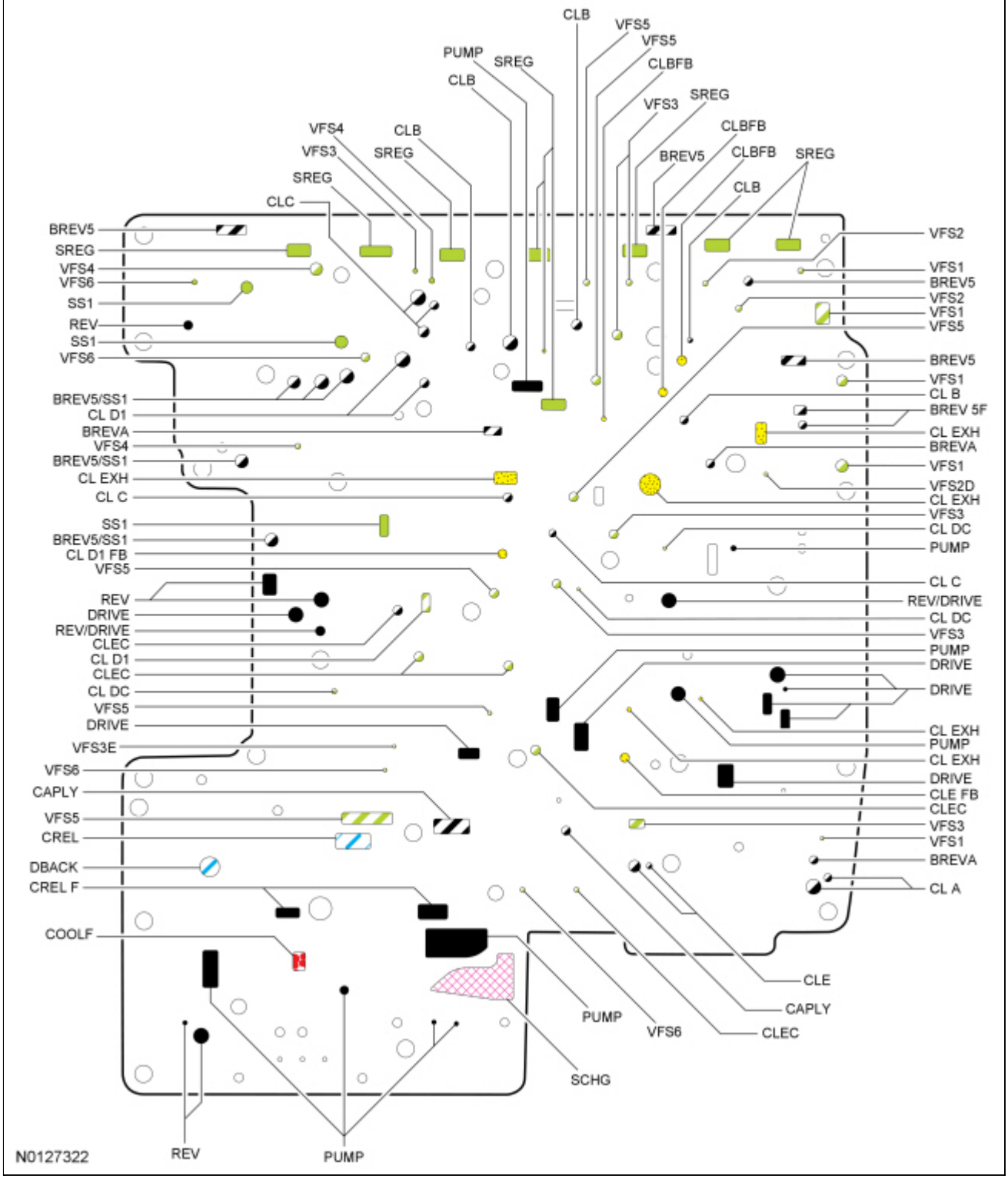
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UPPER VALVE BODY PASSAGES



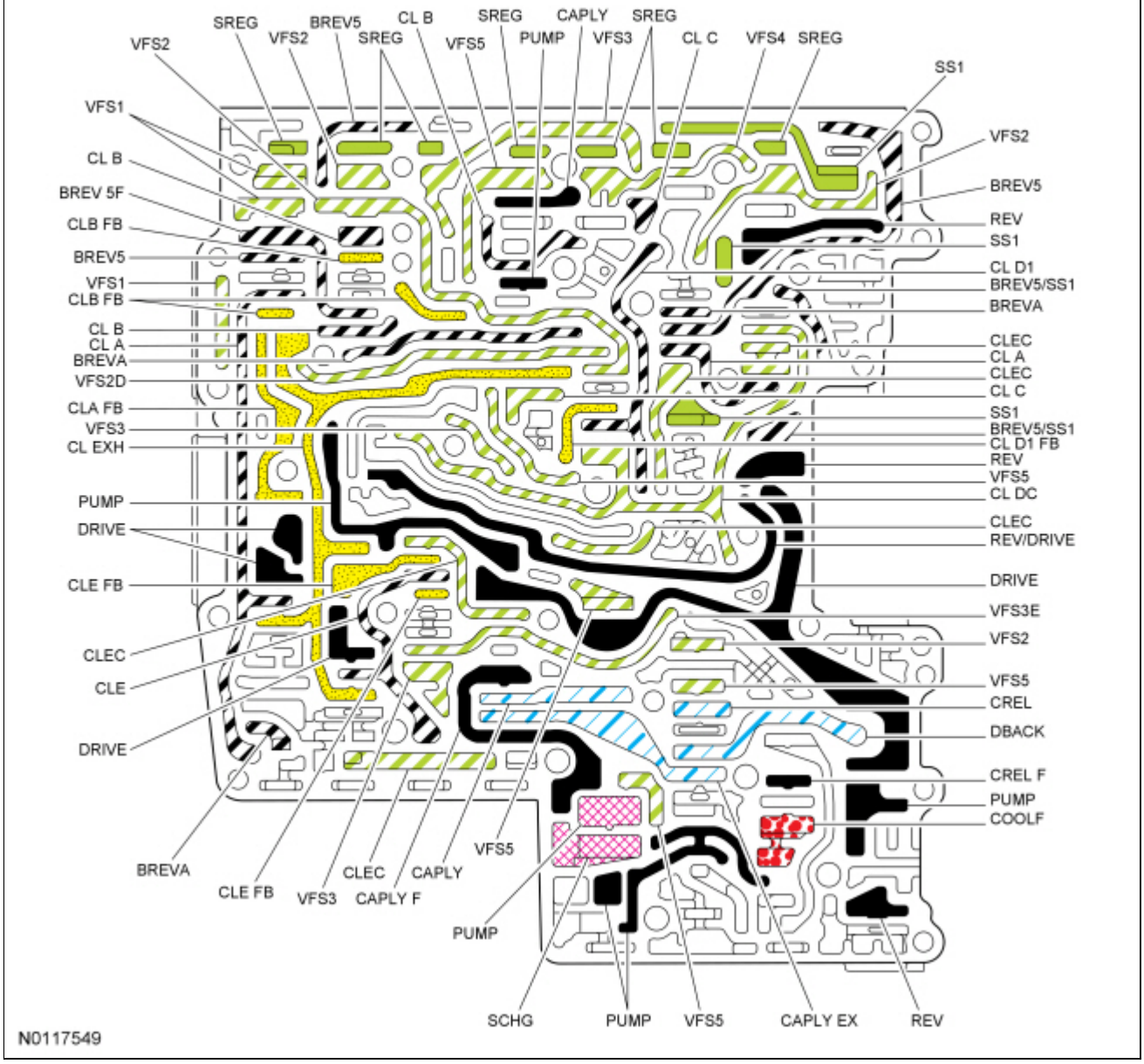
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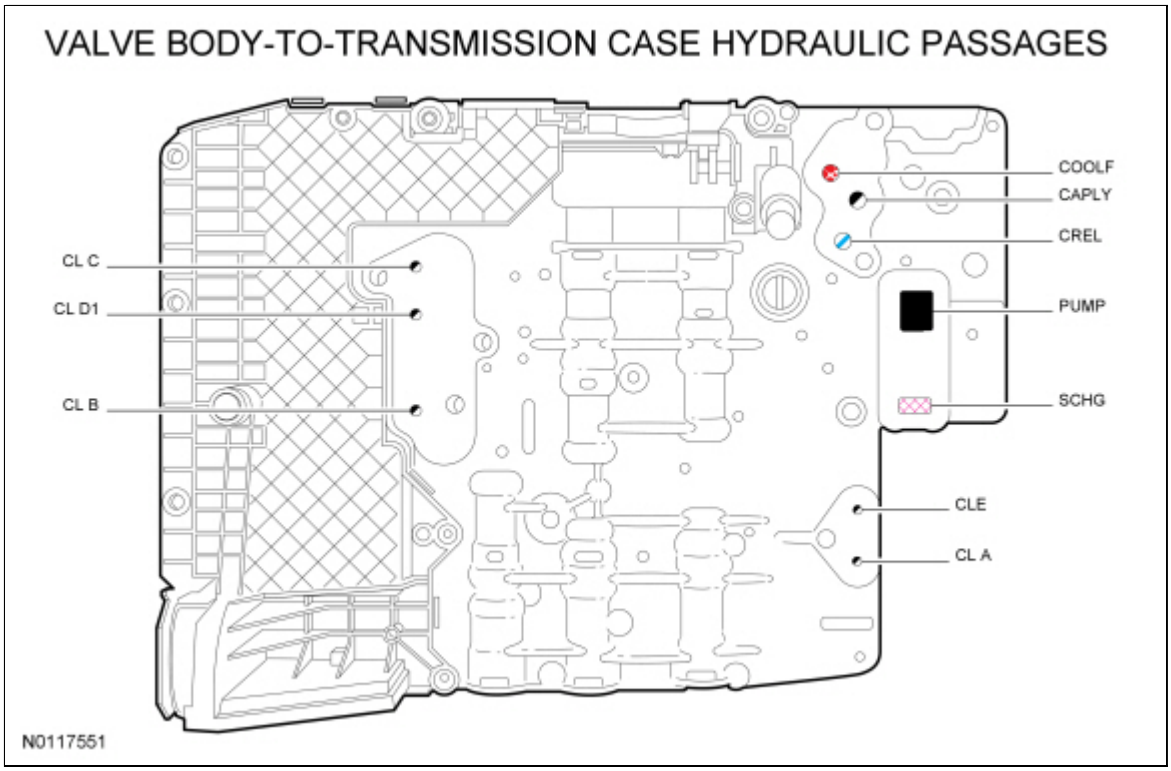
SEPARATOR PLATE PASSAGES
(LOWER VALVE BODY SIDE)



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LOWER VALVE BODY PASSAGES





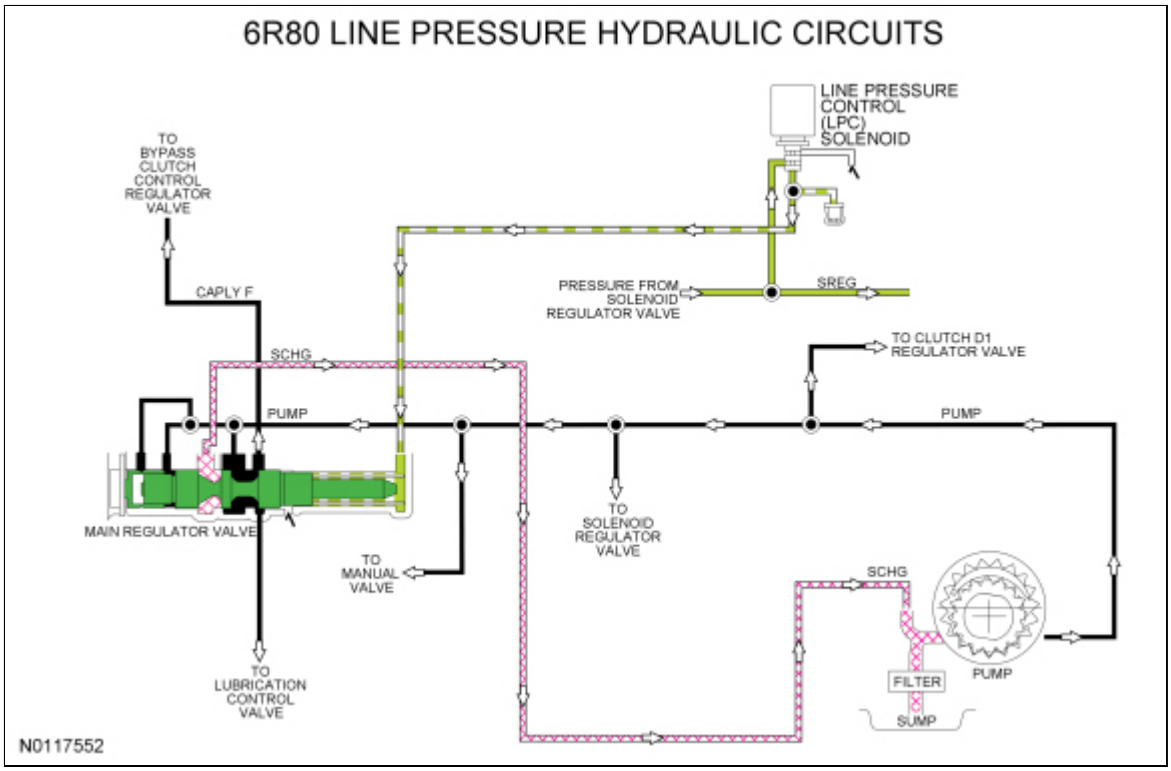
Line Pressure Hydraulic Circuits

The PCM controls line pressure with the Line Pressure Control (LPC) solenoid. Varying pressure from the LPC solenoid effects shift feel while allowing sufficient pressure for clutch application.

When the engine is running, the pump supplies pressure to the main regulator valve through the PUMP circuit. The position of the main regulator valve controls line pressure (in the PUMP circuit). Pressure from the LPC through the VFS5 circuit controls the position of the main regulator valve.

The main regulator valve varies pressure in the SCHG circuit. The higher the pressure in the SCHG circuit, the lower the line pressure (PUMP circuit) is. As SCHG pressure decreases, line pressure (PUMP circuit) increases.

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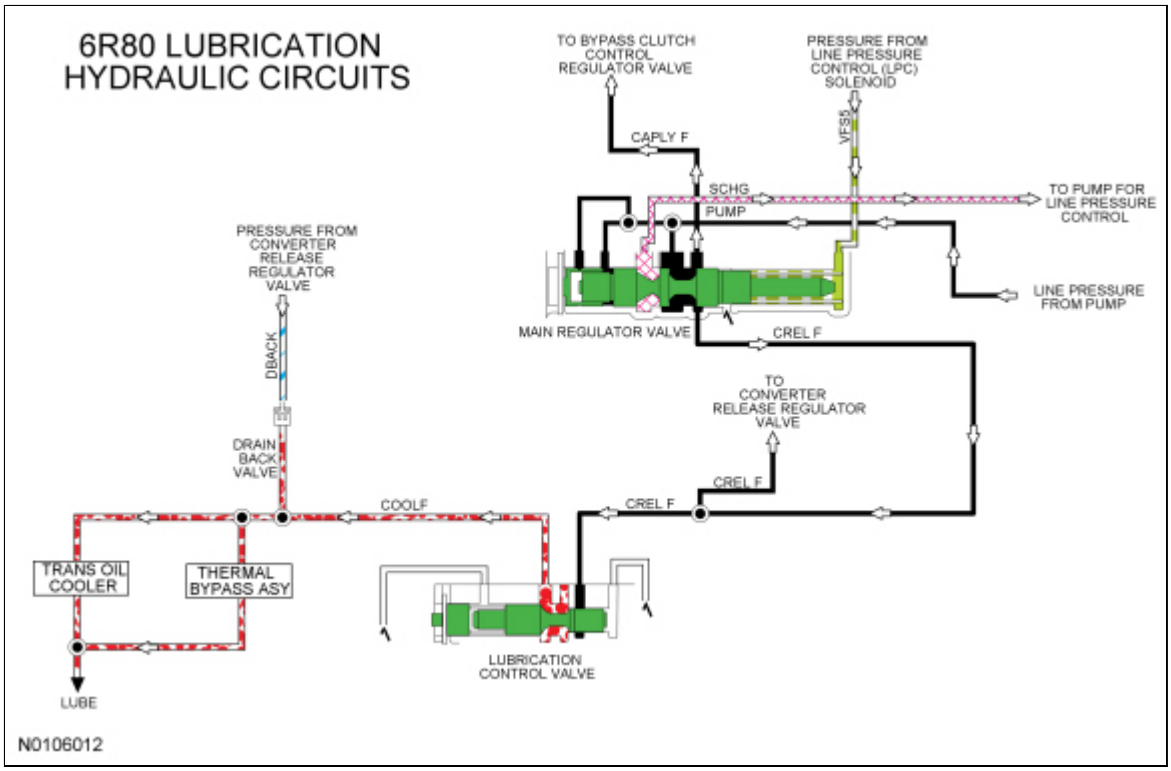


Lubrication Hydraulic Circuits

The main regulator valve supplies pressure to the lubrication control valve through the CREL F circuit. When the Torque Converter Clutch (TCC) is applied, the lubrication control valve supplies the transmission lubrication through the COOLF circuit to the LUBE circuit.

When the TCC is released, return fluid from the torque converter is supplied to the LUBE circuit through the CAPLY, CAPLY EX and DBACK circuits.

Pressure in the LUBE circuit either circulates through the thermal bypass valve when Transmission Fluid Temperature (TFT) is below operating temperature or through the transmission fluid cooler when the transmission fluid is at or above operating temperature. Return fluid from the thermal bypass valve or the transmission fluid cooler enters the input shaft through the pump assembly and flows through passages in the input shaft, intermediate shaft and output shaft to provide lubrication for the transmission.

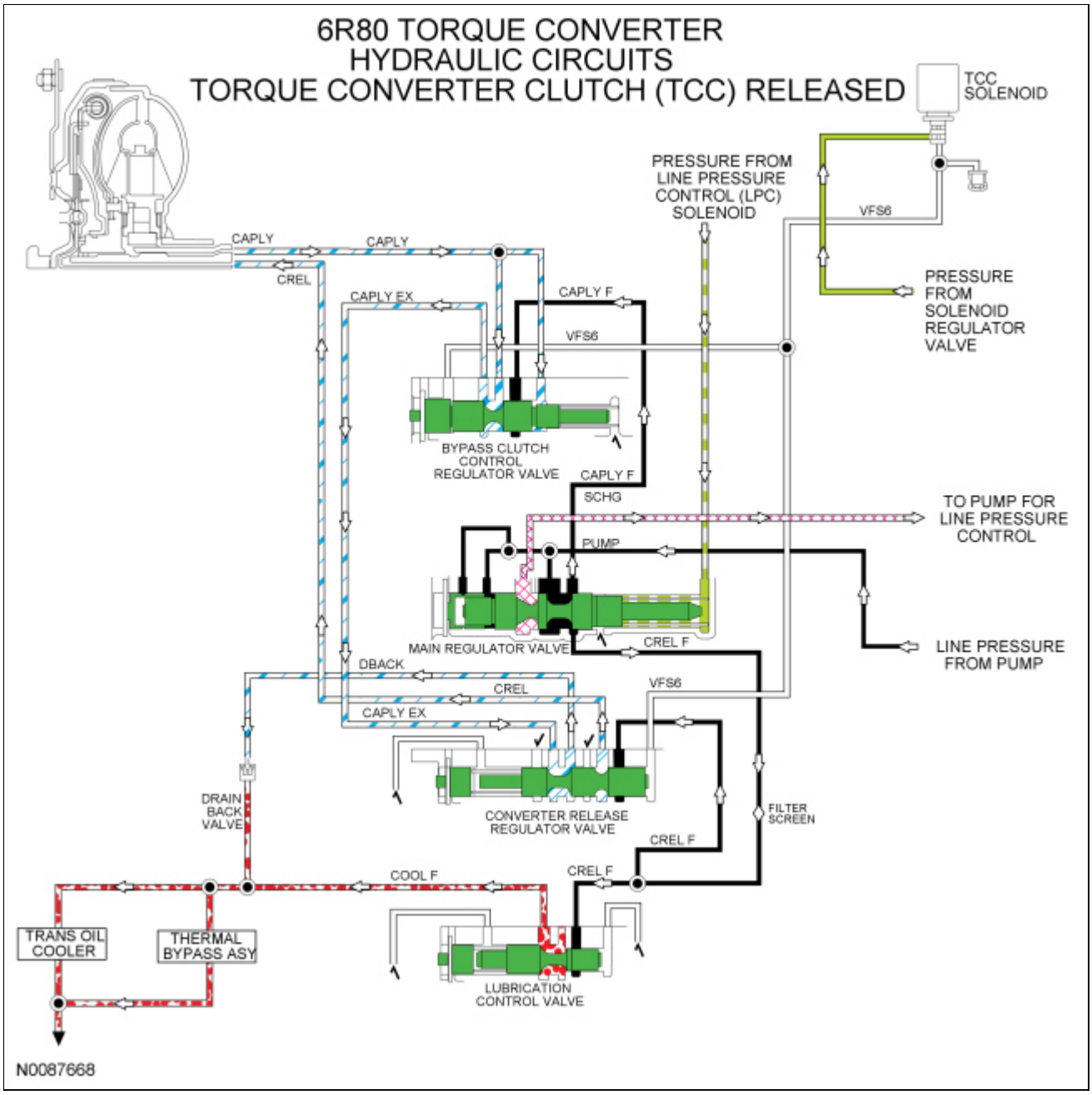


Torque Converter Hydraulic Circuits

When the TCC is released, line pressure is supplied to the converter release regulator valve from the lubrication control valve through the CREL F circuit. The converter release regulator valve supplies pressure to the torque converter through the CREL circuit to release the torque converter.

CREL pressure exits the torque converter through the CAPLY circuit and goes to the bypass clutch control regulator valve. The bypass clutch control regulator valve directs the fluid back to the converter release regulator valve through the CAPLY EX circuit. The converter release regulator valve directs the fluid to the DBACK circuit where it supplies lubrication in the LUBE circuit.

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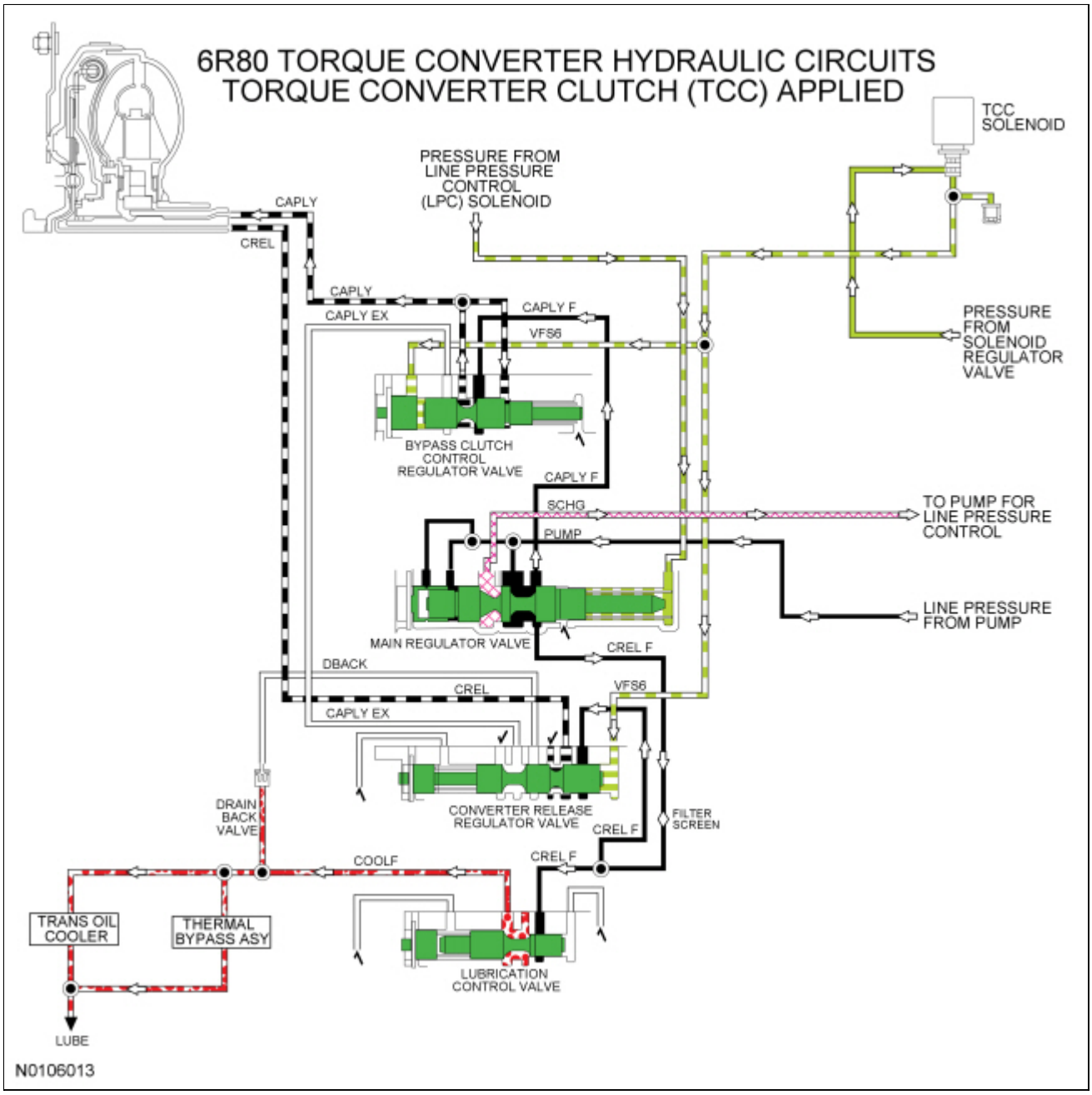


When the TCC is applied, the TCC solenoid applies hydraulic pressure to the bypass clutch control regulator valve and the converter release regulator valve through the VFS6 circuit to position the valves to apply the TCC .

Line pressure is supplied to the bypass clutch control regulator valve from the main regulator valve. The bypass clutch control regulator valve directs regulated line pressure to the TCC through the CAPLY circuit to apply the TCC .

CAPLY pressure exits the torque converter through the CREL circuit and goes to the converter release regulator valve.

For torque converter description and function, refer to Torque Converter in this section.



Solenoid Hydraulic Circuits

LINE pressure from the pump is directed to the individual shift, TCC solenoid and LPC solenoid by the solenoid regulator valve through the SREG circuit. The PCM controlled solenoids, direct full or regulated SREG pressure to the valves that they control.

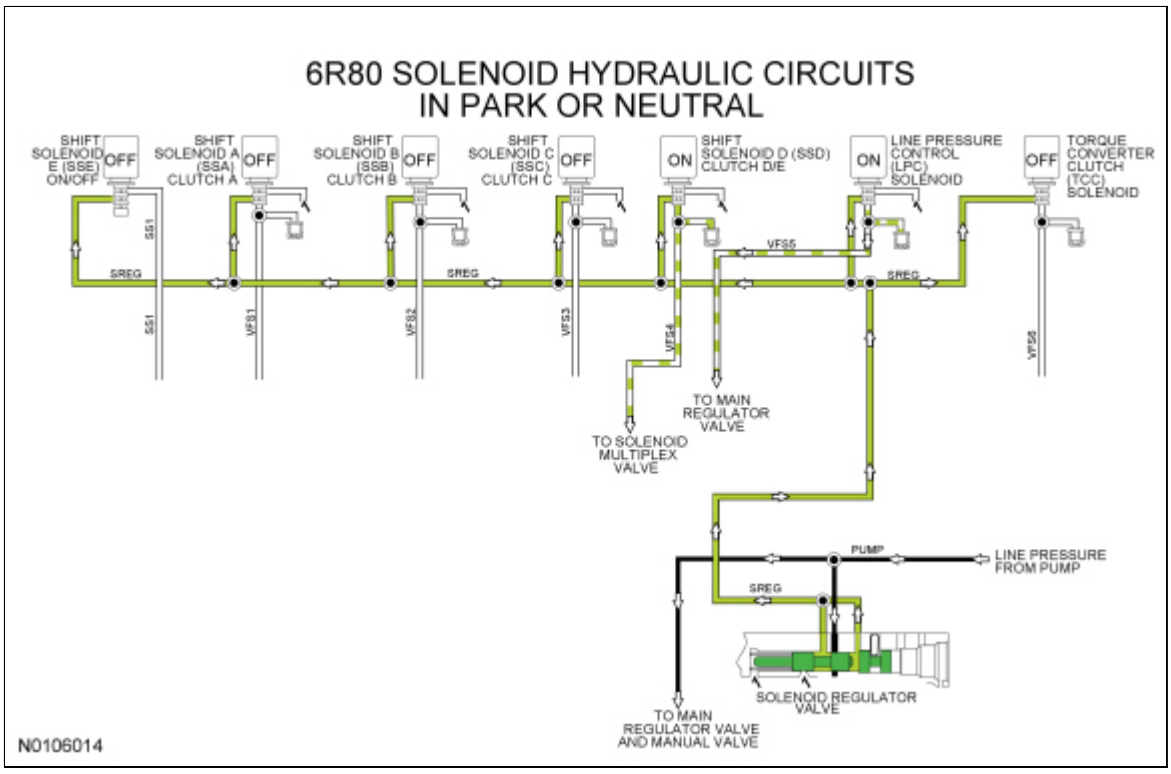
For electrical operation of the solenoids, refer to Transmission Electronic Control System in this section.

The LPC solenoid sends varying pressure to the main regulator valve to control line pressure.

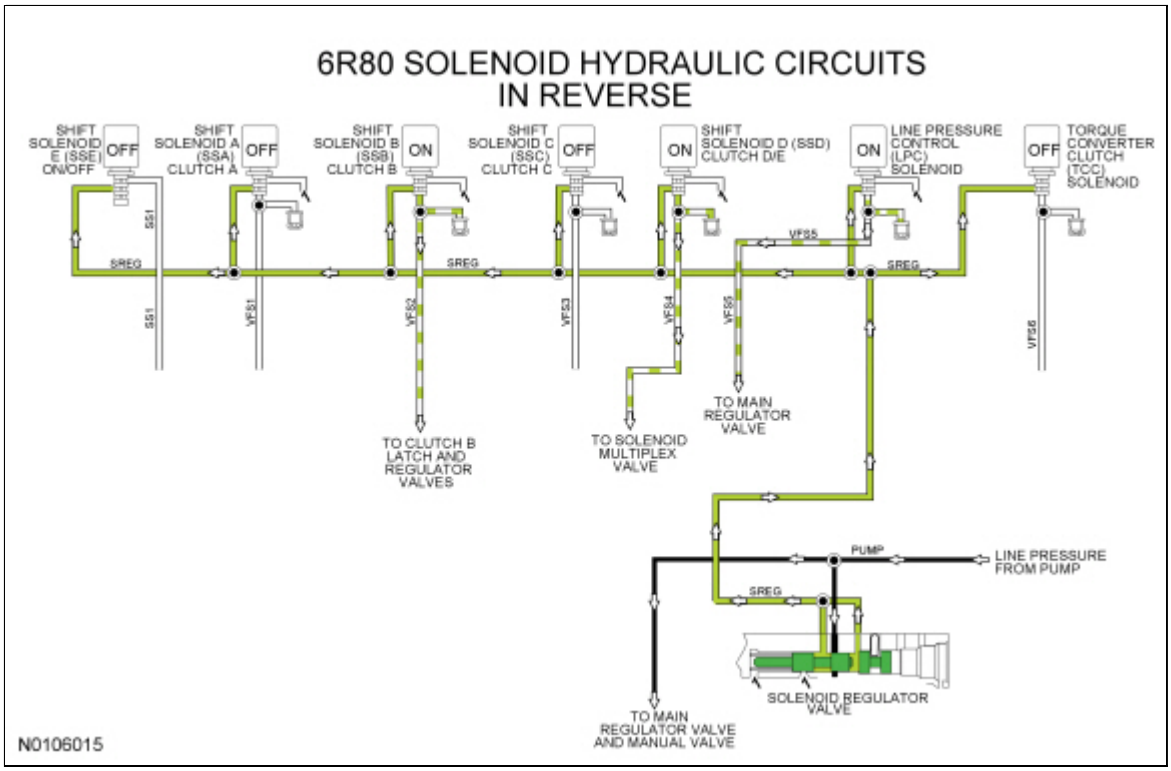
In the PARK and NEUTRAL position, the PCM supplies low current to Shift Solenoid D (SSD) to apply high-regulated pressure to the solenoid multiplex valve which directs the pressure to the D1 regulator and latch

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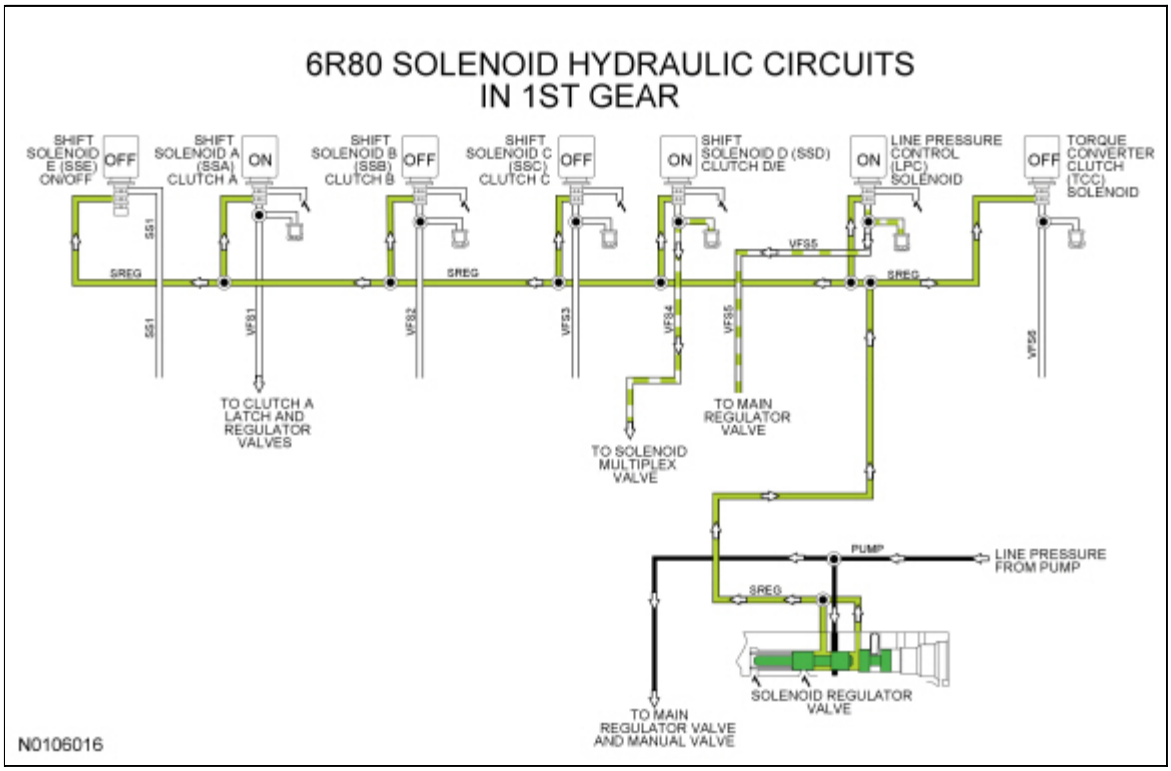
valves to apply the low/reverse clutch (D).



In the REVERSE position, the PCM supplies low current to Shift Solenoid B (SSB) to apply high-regulated pressure to the clutch B regulator and latch valves to apply the direct clutch (B). The PCM also supplies low current to SSD to apply high-regulated pressure to the solenoid multiplex valve which directs the pressure to the D1 regulator and latch valves to apply the low/reverse clutch (D).

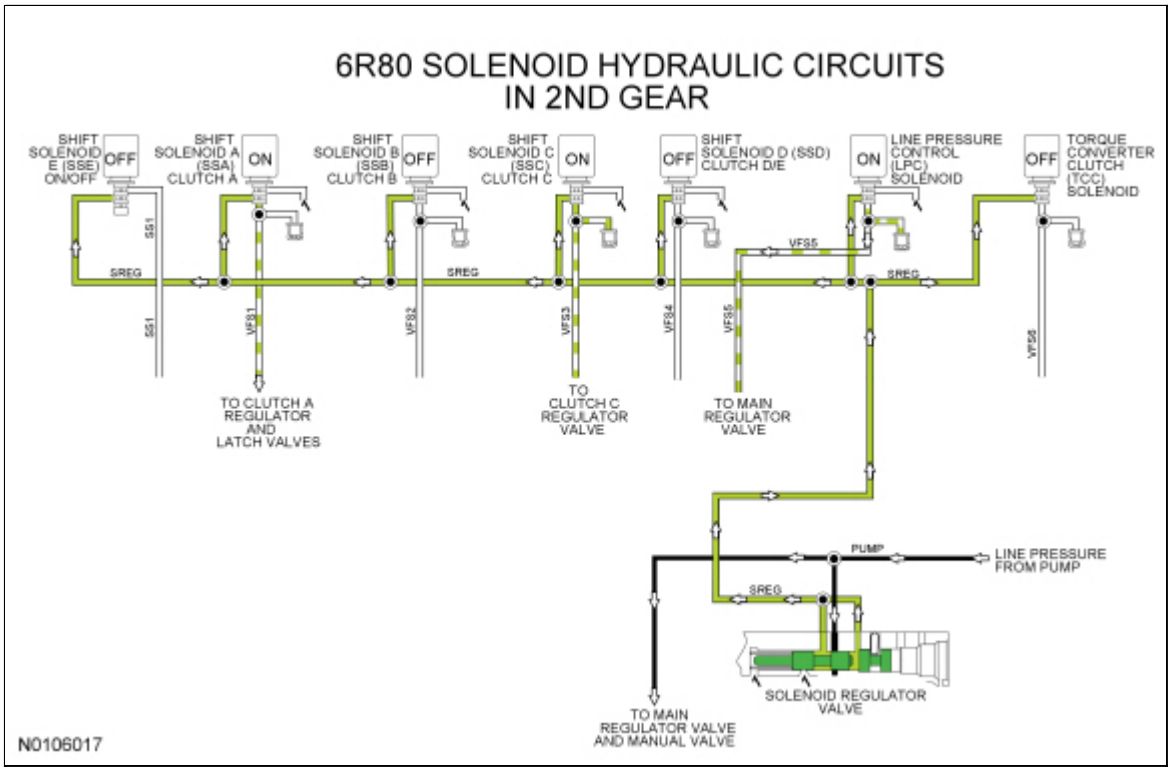


In 1st gear, the PCM supplies high current to Shift Solenoid A (SSA) to apply high-regulated pressure to the clutch A regulator and latch valves to apply the forward clutch (A). The PCM also supplies low current to SSD to apply high-regulated pressure to the solenoid multiplex valve which directs the pressure to the D1 regulator and latch valves to apply the low/reverse clutch (D).

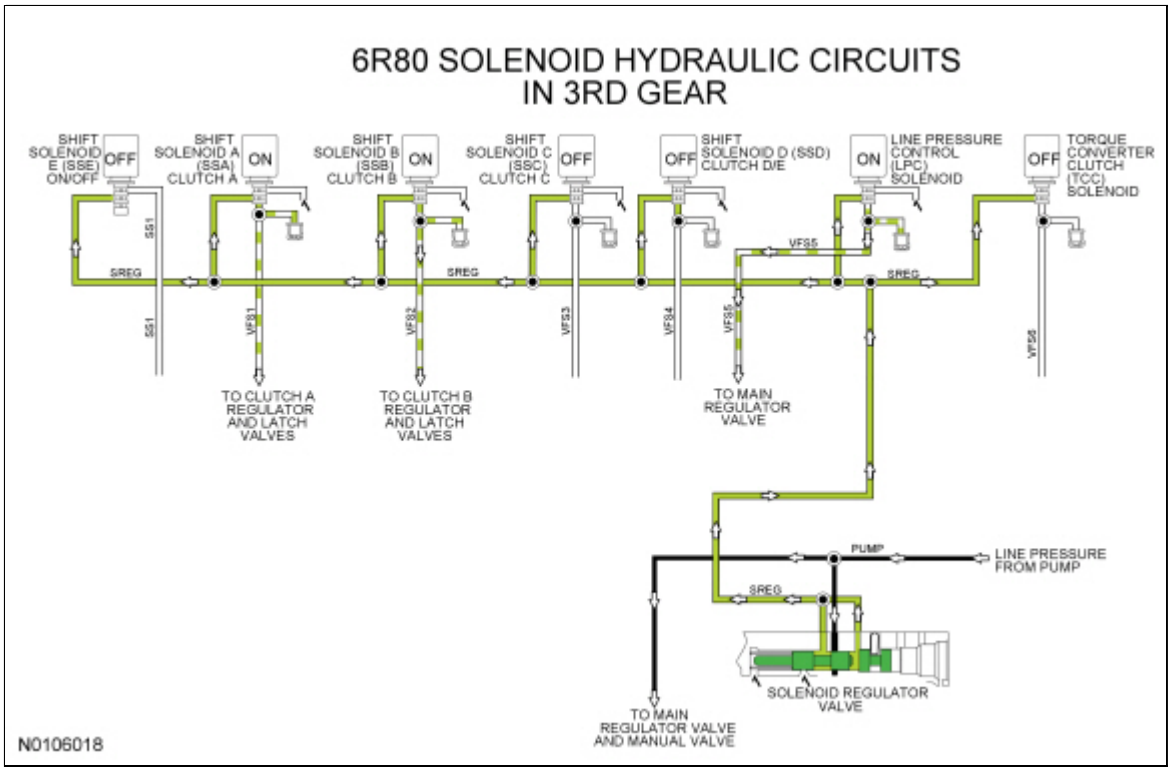


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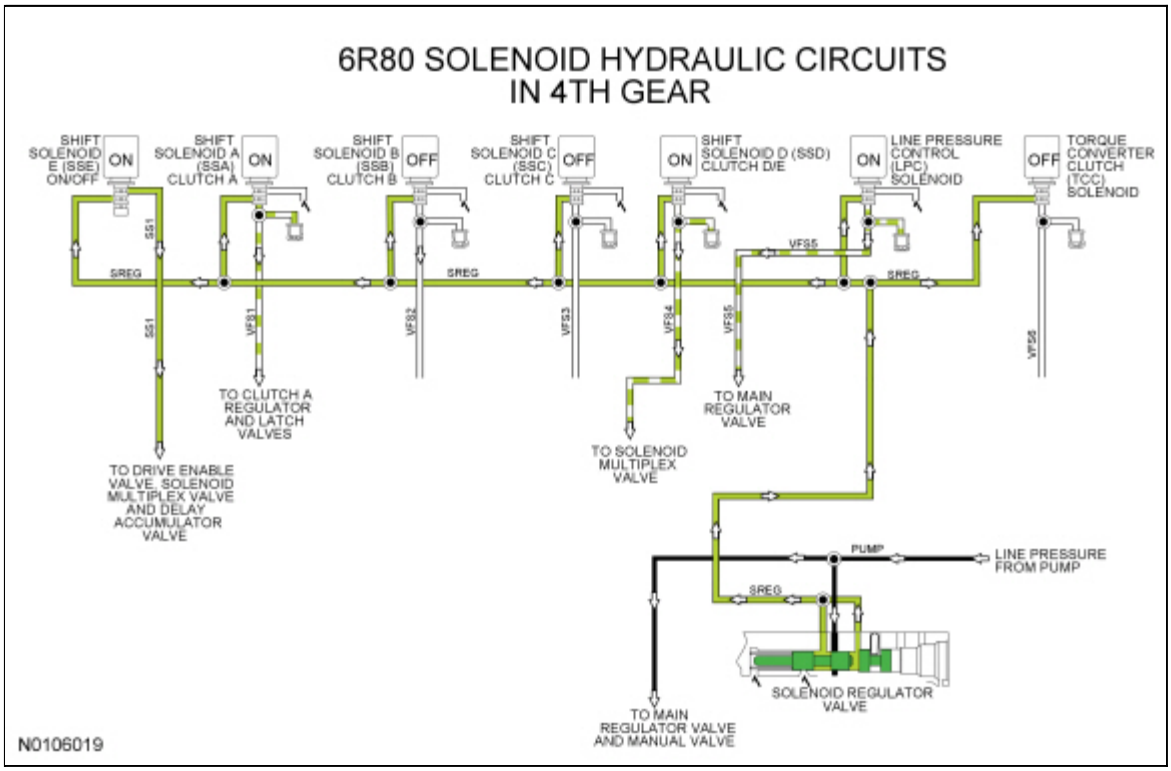
In 2nd gear, the PCM supplies high current to SSA to apply high-regulated pressure to the clutch A regulator and latch valves to apply the forward clutch (A). The PCM also supplies high current to Shift Solenoid C (SSC) to apply high-regulated pressure to the clutch C regulator valve to apply the intermediate clutch (C).



In 3rd gear, the PCM supplies high current to SSA to apply high-regulated pressure to the clutch A regulator and latch valves to apply the forward clutch (A). The PCM also supplies low current to Shift Solenoid B (SSB) to apply high-regulated pressure to the clutch B regulator and latch valves to apply the direct clutch (B).

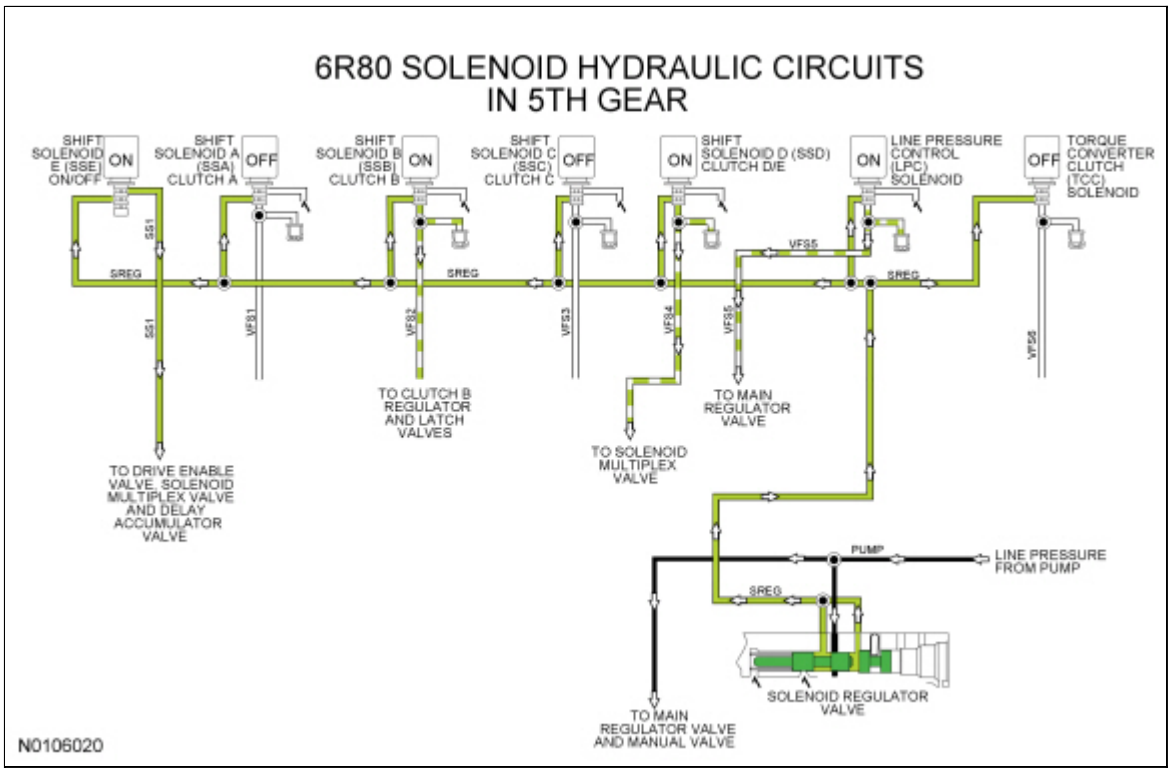


In 4th gear, the PCM supplies high current to SSA to apply high-regulated pressure to the clutch A regulator and latch valves to apply the forward clutch (A). The PCM also supplies low current to SSD to apply high-regulated pressure to the solenoid multiplex valve which directs the pressure to the clutch E regulator and latch valves to apply the overdrive clutch (E). The PCM turns on Shift Solenoid E (SSE) to apply pressure to the solenoid multiplex valve and the drive enable valve to direct SSD pressure to the clutch E regulator and latch valves.

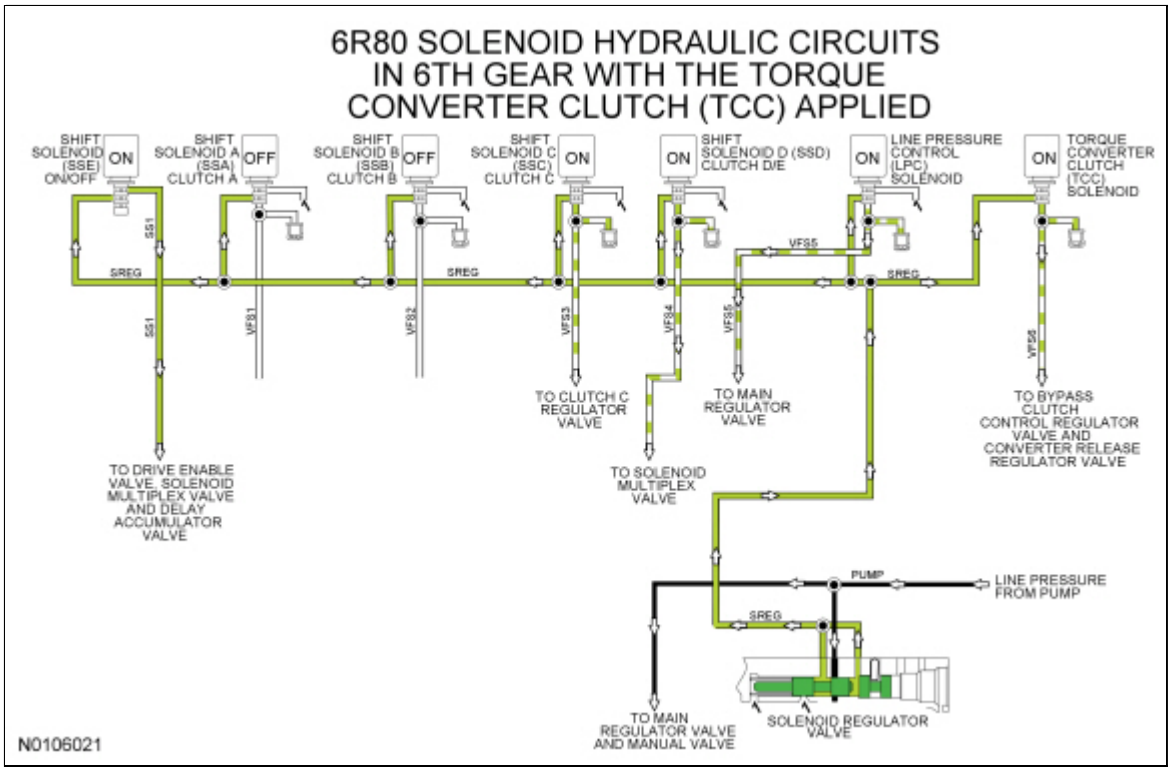


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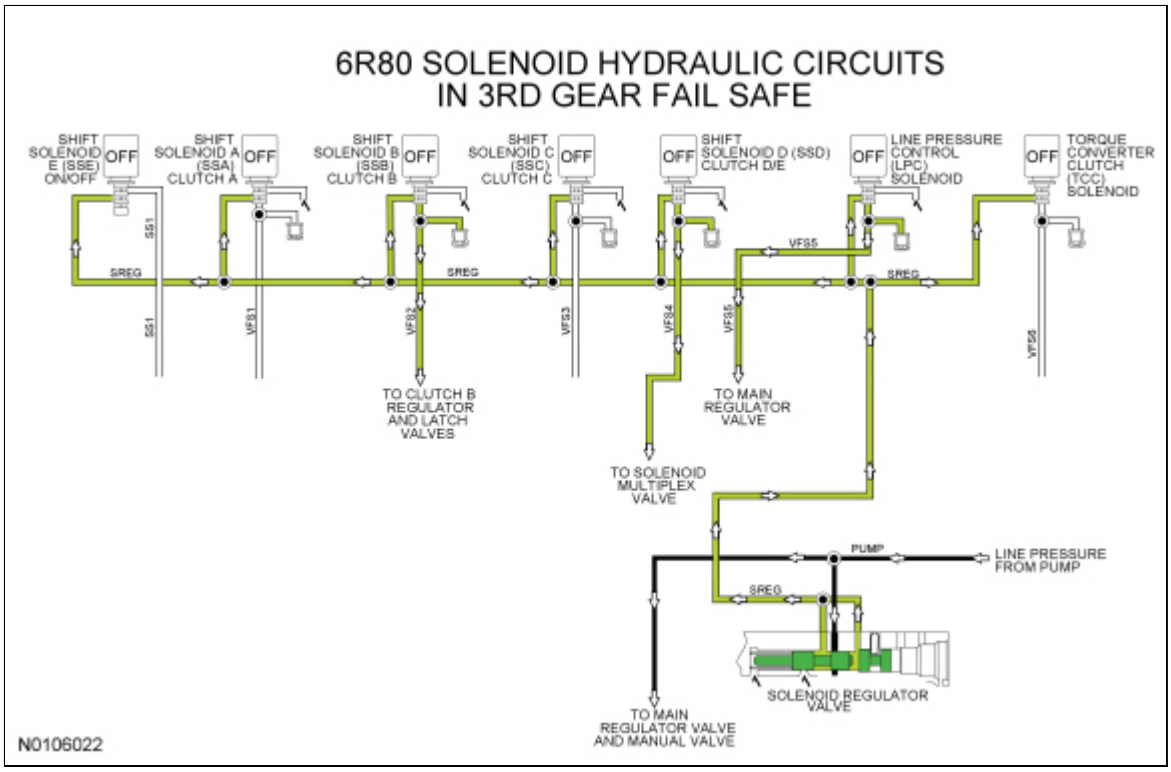
In 5th gear, the PCM supplies low current to SSD to apply high-regulated pressure to the solenoid multiplex valve which directs the pressure to the clutch E regulator and latch valves to apply the overdrive clutch (E). The PCM turns on SSE to apply pressure to the solenoid multiplex valve and the drive enable valve to direct SSD pressure to the clutch E regulator and latch valves. The PCM also supplies low current to SSB to apply high-regulated pressure to the clutch B regulator and latch valves to apply the direct clutch (B).



In 6th gear, the PCM supplies low current to SSD to apply high-regulated pressure to the solenoid multiplex valve which directs the pressure to the clutch E regulator and latch valves to apply the overdrive clutch (E). The PCM turns on SSE to apply pressure to the solenoid multiplex valve and the drive enable valve to direct SSD pressure to the clutch E regulator and latch valves. The PCM also supplies high current to SSC to apply high-regulated pressure to the clutch C regulator valve to apply the intermediate clutch (C). To apply the TCC , the PCM supplies high current to the TCC solenoid to apply high-regulated pressure to the converter release regulator valve and the bypass clutch control regulator valve to apply the TCC .



In 3rd gear fail safe, all solenoids are off. SSB , in the off position, applies high pressure to the clutch B regulator and latch valves to apply the direct clutch (B). The forward clutch (A) is hydraulically applied in 3rd gear fail safe. PCA provides maximum solenoid pressure to the main regulator valve for maximum line pressure. Also, SSD is on which applies high pressure to the solenoid multiplex valve which is directed to the drive enable valve where it is blocked.



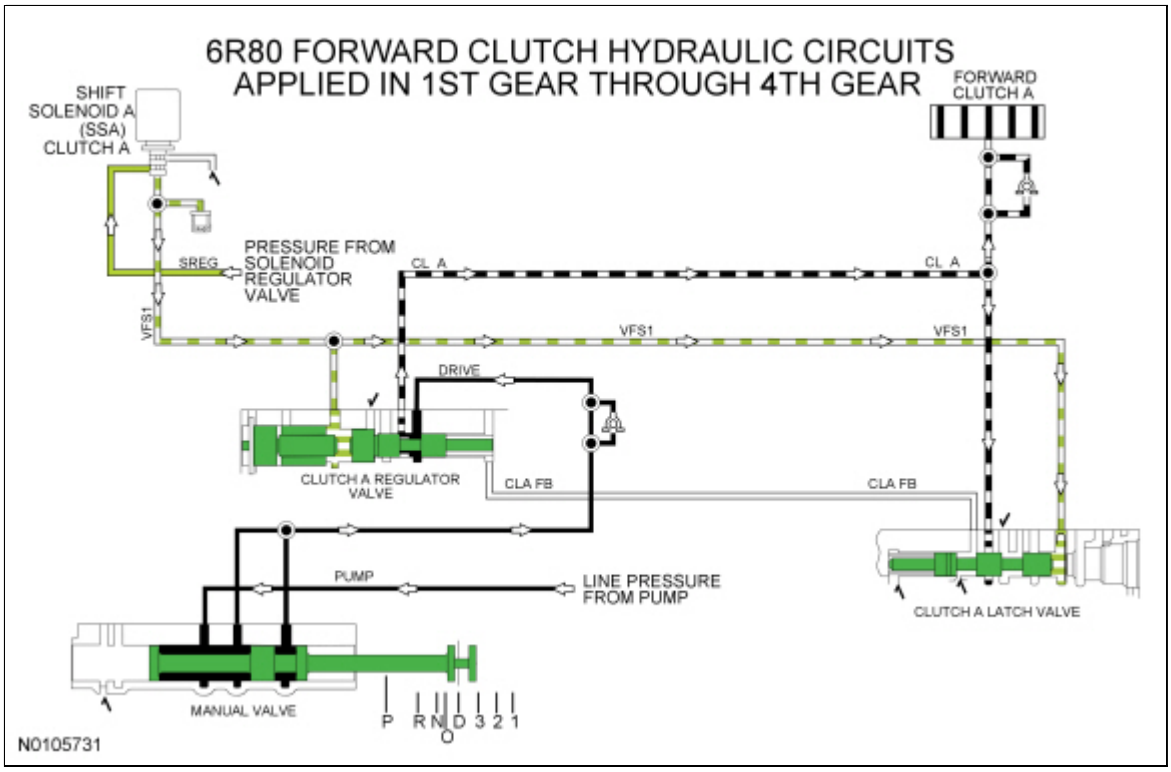
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Forward Clutch (A) Hydraulic Circuits

To apply the forward clutch (A), the manual valve must be in the DRIVE, 3, 2 or 1 position to provide line pressure to the clutch A regulator valve through the DRIVE circuit.

For the forward clutch (A) to apply, SSA provides regulated solenoid pressure from the SREG circuit to the clutch A regulator and latch valves through the VFS1 circuit to position the valves to apply the forward clutch (A). As the forward clutch is applied, SSA increases pressure to the clutch A regulator and latch valves.

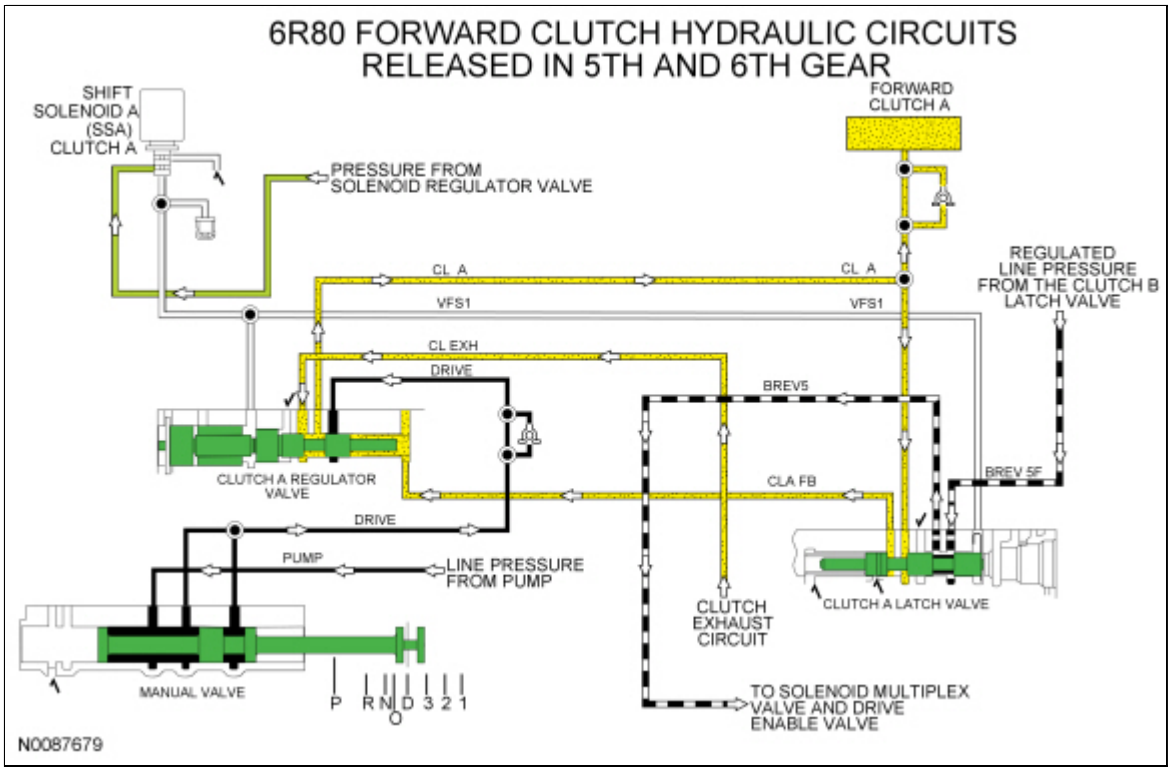
The clutch A regulator valve provides regulated line pressure to the CL A circuit to apply the forward clutch (A).



The forward clutch (A) is released when the manual valve is in the NEUTRAL, REVERSE or PARK position or the when the manual valve is in the DRIVE position with the transmission in 5th or 6th gear.

SSA lowers pressure to the clutch A regulator and latch valve to position the valves to lower the regulated line pressure in the CL A circuit to release the clutch.

When the forward clutch (A) is released, the clutch A regulator valve directs exhaust circuit pressure from the CL EXH circuit to the CL A circuit to fill the circuit and the forward clutch (A) with fluid at low pressure, approximately 21 kPa (3 psi).



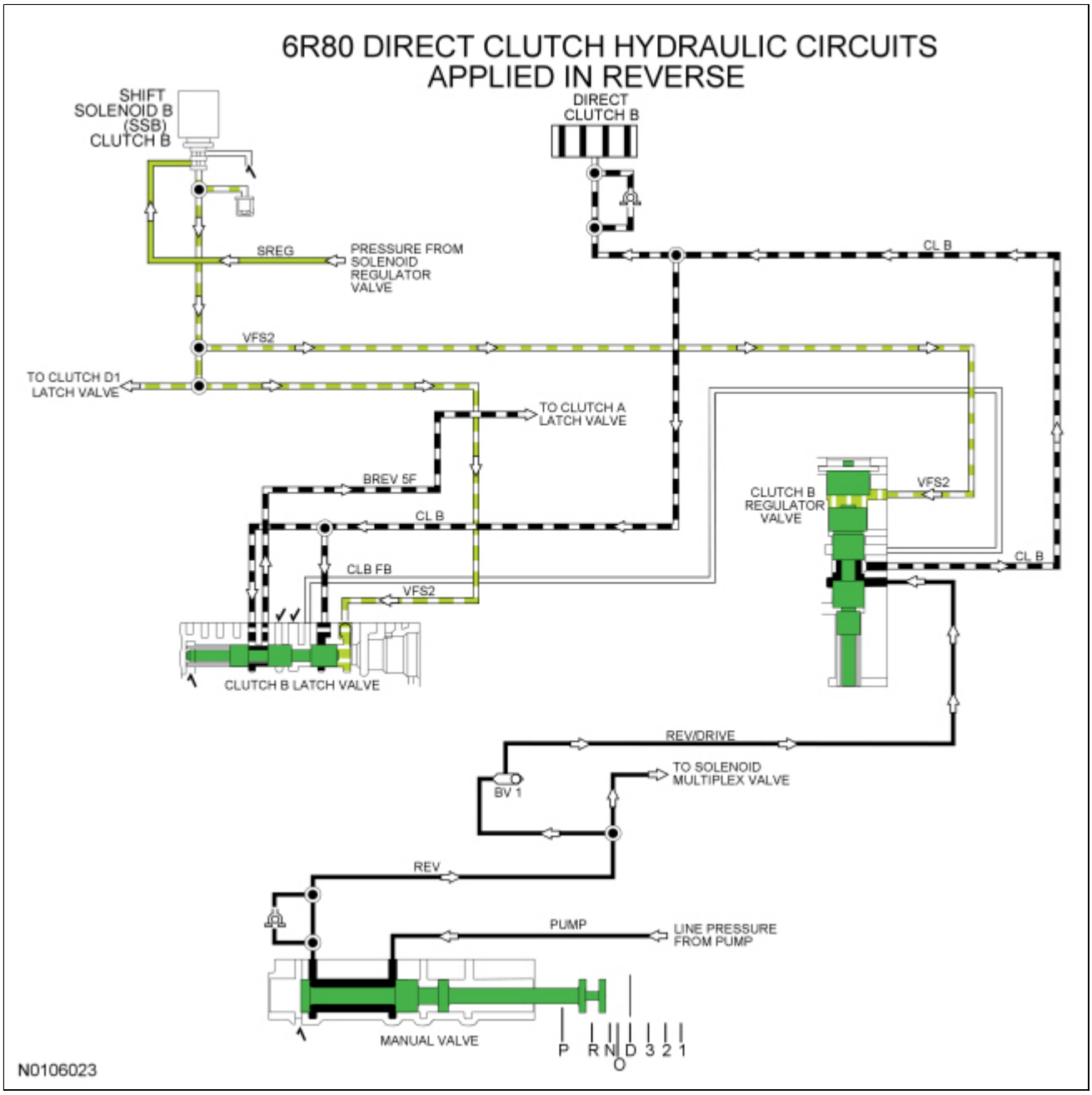
Direct Clutch (B) Hydraulic Circuits

To apply the direct clutch (B), the manual valve can be in the REVERSE, DRIVE, 3, 2 or 1 position to provide line pressure to the clutch B regulator valve through the REV/DRIVE circuit.

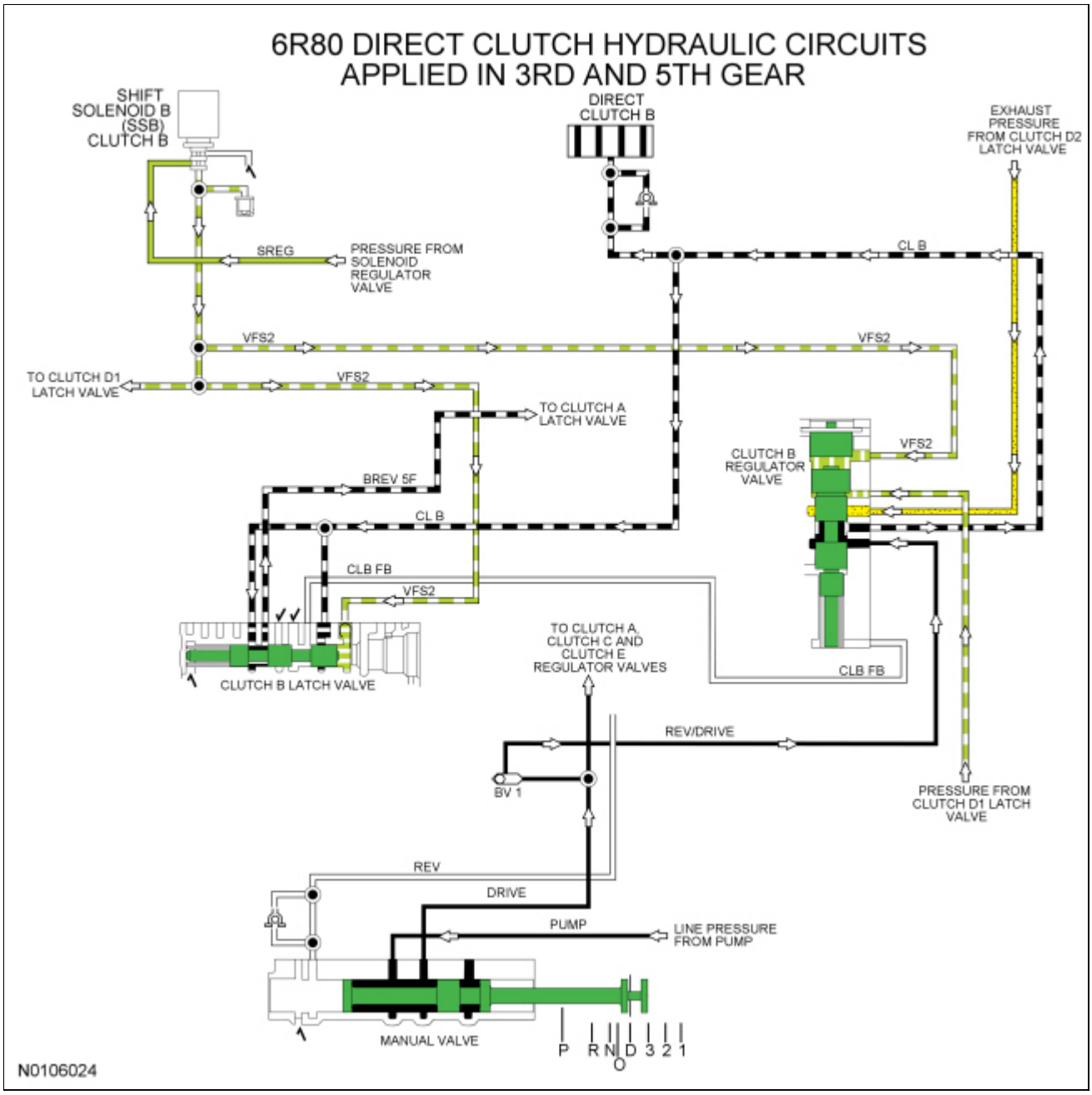
For the direct clutch (B) to apply in reverse, SSB provides regulated solenoid pressure from the SREG circuit to the clutch B regulator and latch valves through the VFS2 circuit to position the valves to apply the direct clutch (B). As the direct clutch is applied, SSB increases pressure to the clutch B regulator and latch valves.

The clutch B regulator valve provides regulated line pressure to the CL B circuit to apply the direct clutch (B).

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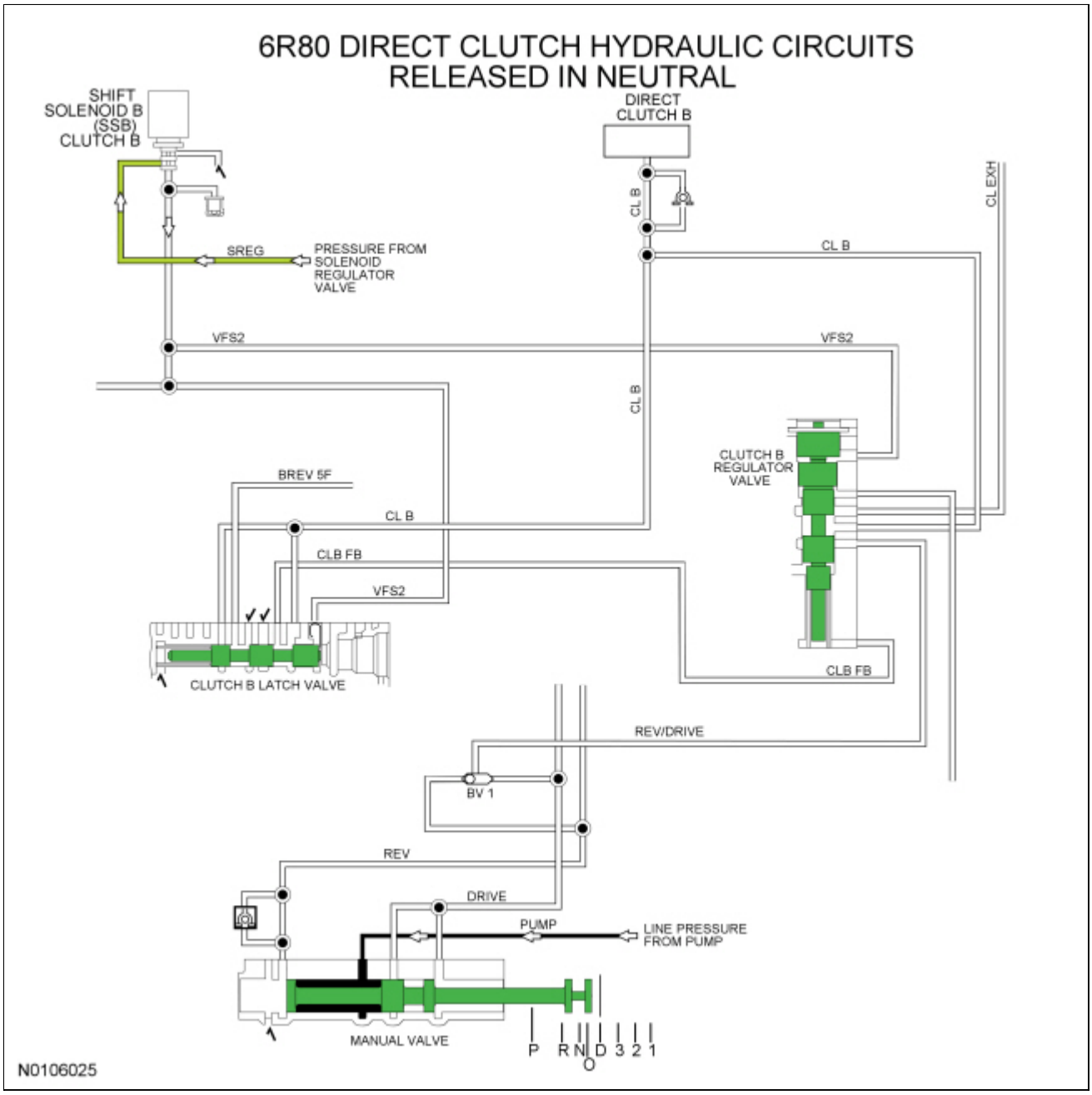
When the direct clutch (B) is applied in 3rd and 5th gear, regulated solenoid pressure from the D1 latch valve is supplied to the clutch B regulator valve through the VFS2D circuit and opposes pressure from the VFS2 circuit for clutch B valve positioning.



The direct clutch (B) is released when the manual valve is in the PARK or NEUTRAL position or when the manual valve is in the DRIVE position with the transmission in 1st, 2nd, 4th or 6th gear.

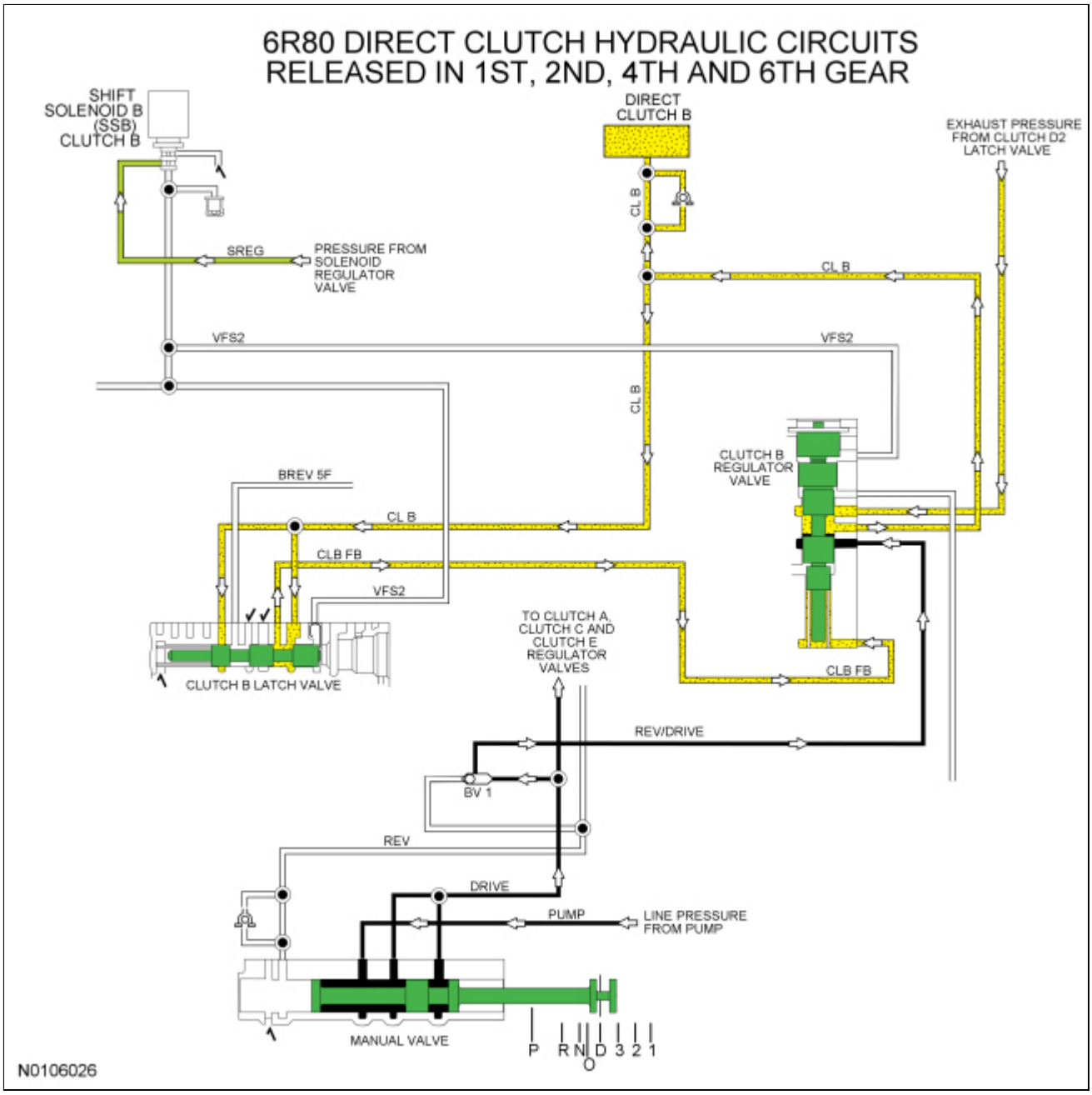
In NEUTRAL or PARK, the manual valve does not supply line pressure to the clutch B regulator valve. SSB lowers pressure to the clutch B regulator and latch valve to position the valves to lower the regulated line pressure in the CL B circuit to release the clutch.

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In 1st, 2nd, 4th or 6th gear, the manual valve supplies line pressure to the clutch B regulator valve. SSB lowers pressure to the clutch B regulator and latch valve to position the valves to lower the regulated line pressure in the CL B circuit to release the clutch.

When the direct clutch (B) is released in 1st, 2nd, 4th or 6th gear, the clutch (B) regulator valve directs exhaust circuit pressure from the CL EXH circuit to the CL B circuit to fill the circuit and the direct clutch (B) with fluid at low pressure, approximately 21 kPa (3 psi).



Intermediate Clutch (C) Hydraulic Circuits

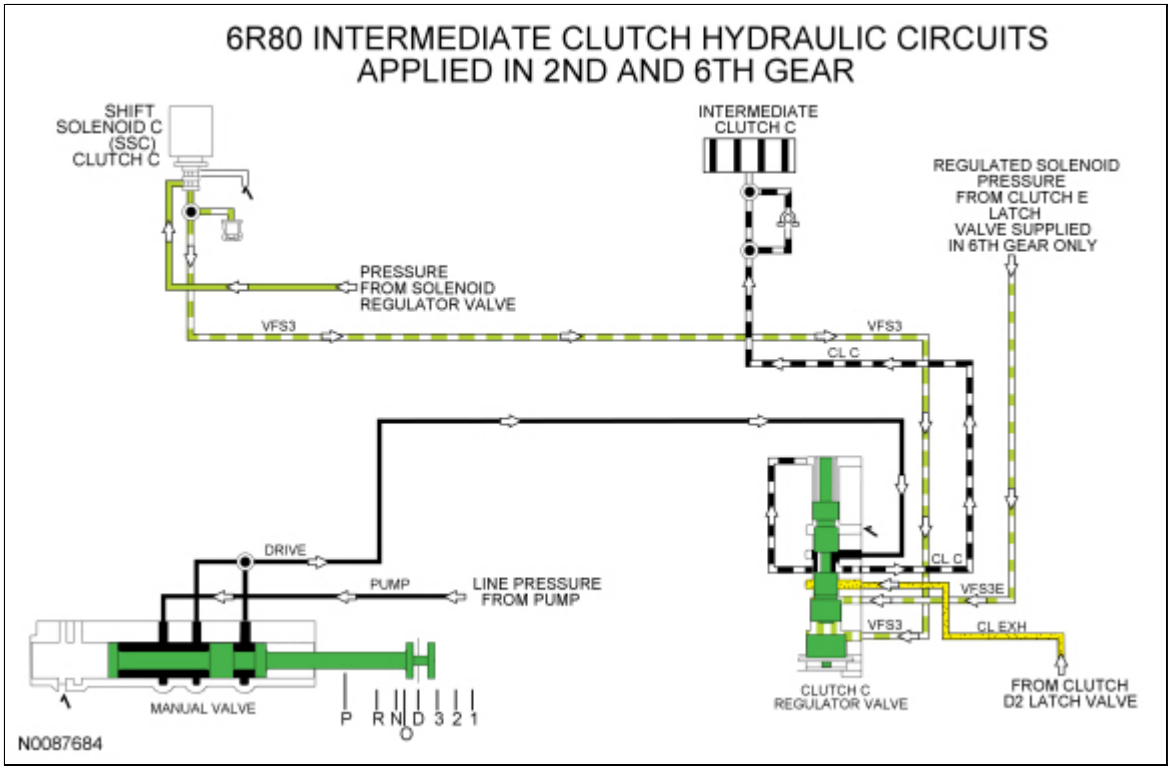
To apply the intermediate clutch (C), the manual valve can be in the DRIVE, 3, 2 or 1 position to provide line pressure to the clutch C regulator valve through the DRIVE circuit.

SSC provides regulated solenoid pressure from the SREG circuit to the clutch C regulator valve through the VFS3 circuit to position the valve to apply the intermediate clutch (C). As the intermediate clutch (C) is applied, SSC increases pressure to the clutch C regulator valve.

The clutch C regulator valve provides regulated line pressure to the CL C circuit to apply the intermediate clutch (C).

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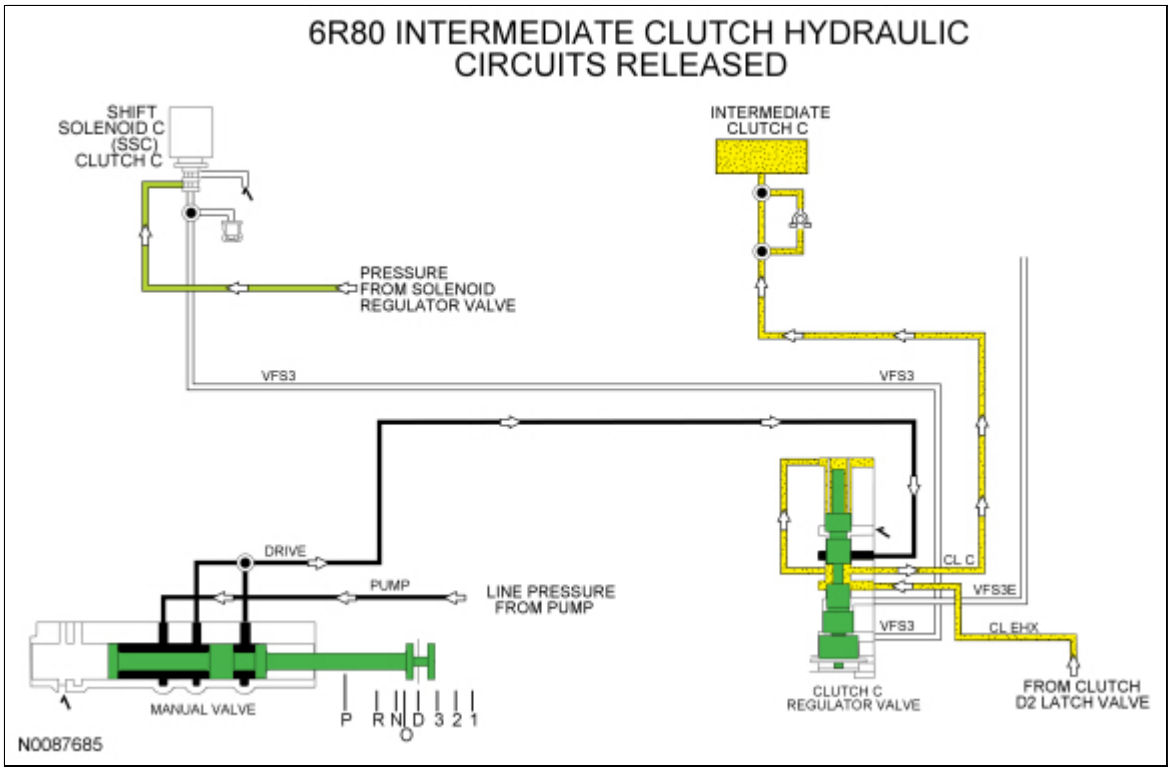
Regulated solenoid pressure from the clutch E latch valve is supplied to the clutch C regulator valve through the VFS3E circuit and opposes VFS3 pressure for clutch C regulator valve positioning in 6th gear only.



To release the intermediate clutch (C) when the manual valve is in the DRIVE, 3, 2 or 1 position SSC lowers pressure to the clutch C regulator valve to position the valve to lower the regulated line pressure in the CL C circuit to release the clutch.

When the intermediate clutch (C) is released, the clutch C regulator valve directs exhaust circuit pressure from the CL EXH circuit to the CL C circuit to fill the CL C circuit and the intermediate clutch (C) with fluid at low pressure, approximately 21 kPa (3 psi).

In PARK, REVERSE or NEUTRAL, the manual valve does not supply line pressure to the clutch C regulator valve.



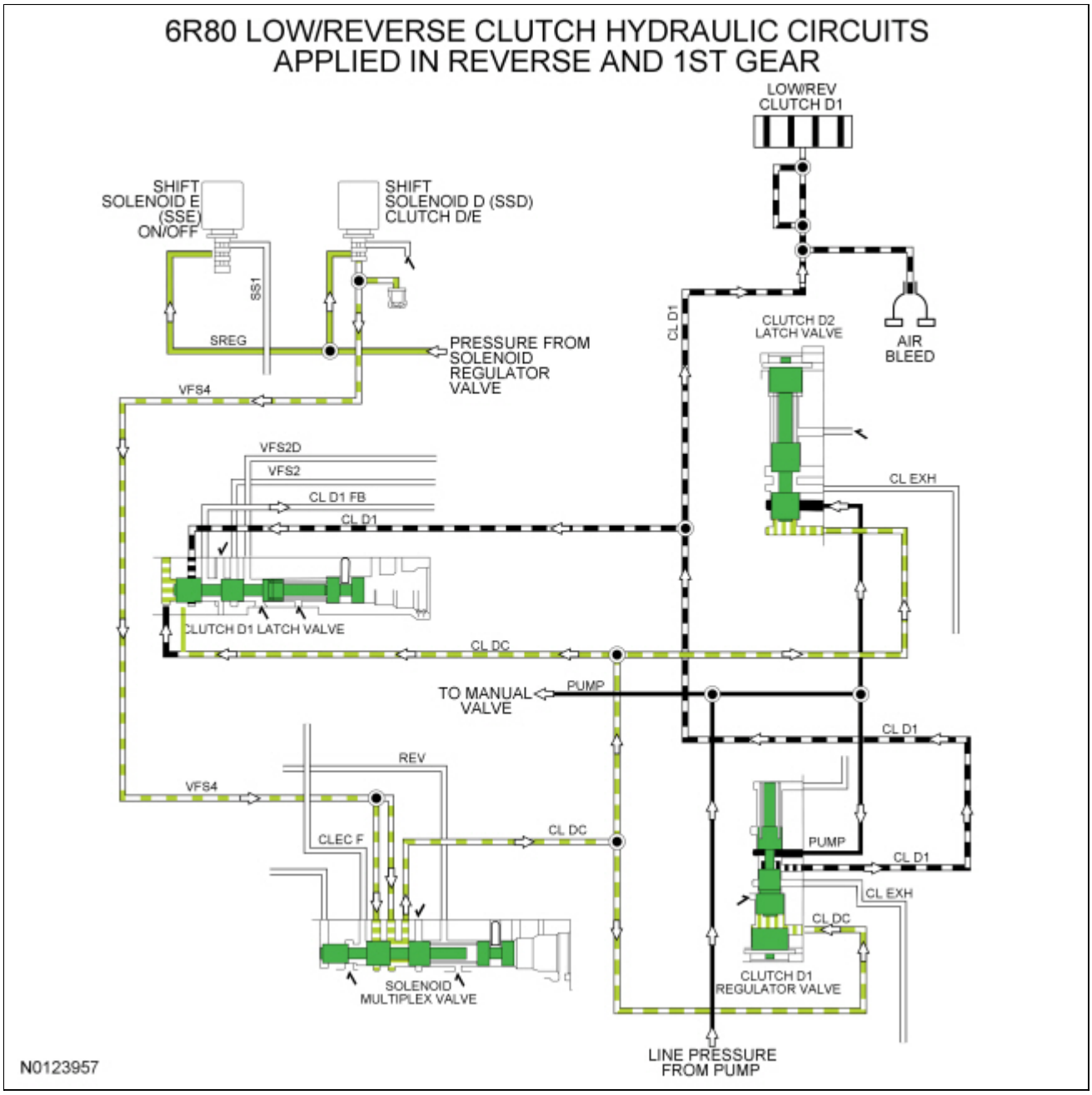
Low/Reverse Clutch (D) Hydraulic Circuits

To apply the low/reverse clutch (D), the manual valve can be in any position. Line pressure is supplied to the D1 regulator and latch valves by the pump through the PUMP circuit.

SSD provides regulated solenoid pressure from the SREG circuit to the solenoid multiplex valve through the VFS4 circuit where it is directed to the D1 regulator and latch valves through the CL DC circuit to position the valves to apply the low/reverse clutch (D). As the low/reverse clutch (D) is applied, SSD increases pressure to the D1 clutch regulator and latch valves.

The clutch D1 regulator valve provides regulated line pressure from the PUMP circuit to the CL D1 circuit to apply the low/reverse clutch (D).

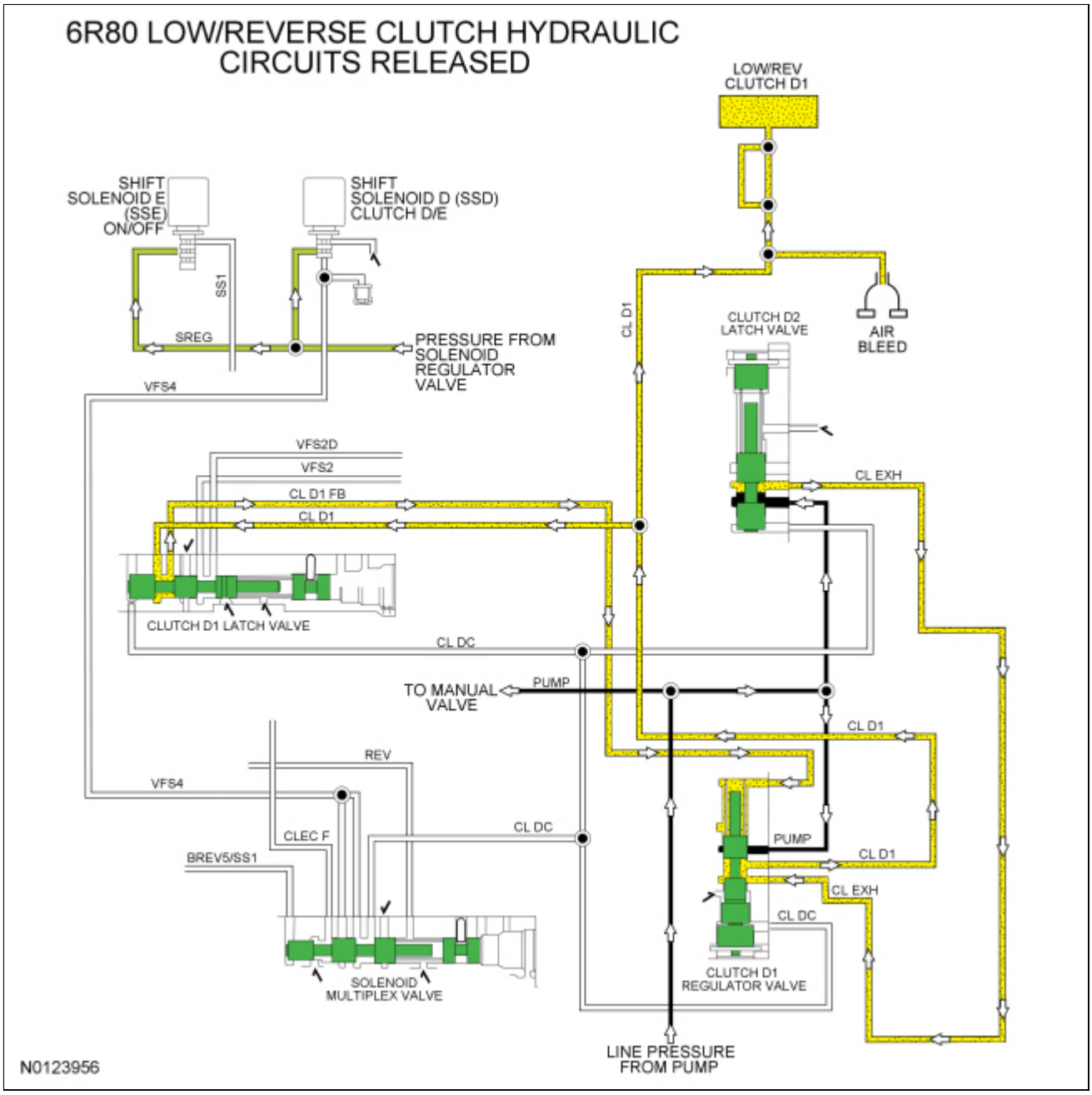
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To release the low/reverse clutch (D), the manual valve can be in the DRIVE, 3 or 2 position. SSD lowers pressure to the VFS4 circuit which lowers pressure in the CL DC circuit to position the D clutch regulator and latch valves to lower pressure in the CL D1 circuit and release the low/reverse clutch (D).

When the low/reverse clutch (D) is released, the clutch D2 latch valve directs line pressure regulated to approximately 21 kPa (3 psi) to the CL EXH circuit which fills the volume of the unused clutches and circuits.

When the low/reverse clutch (D) is released, the CL EXH circuit supplies the D1 regulator valve which fills the CL D1 circuit and the low/reverse (D) clutch.



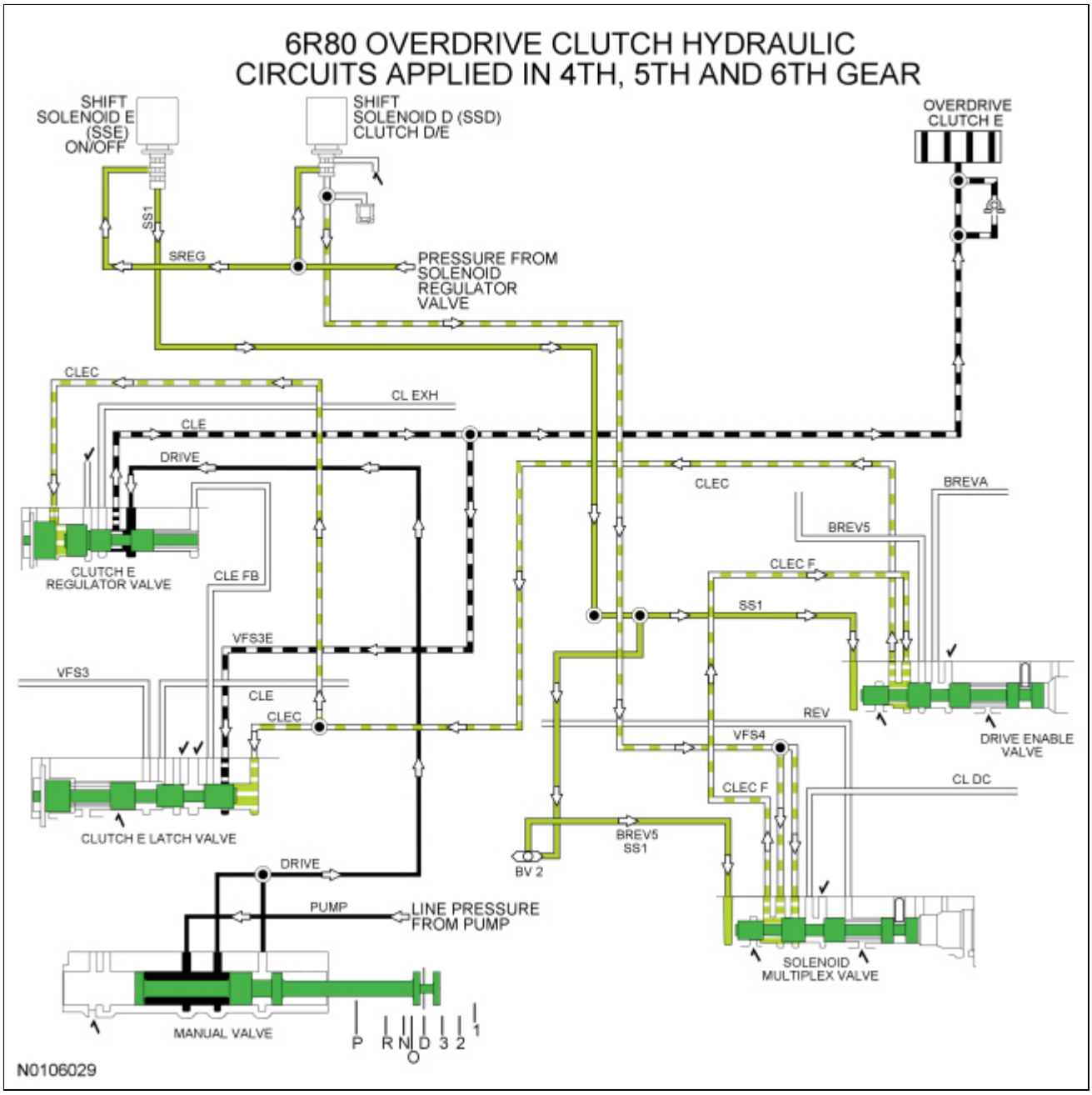
Overdrive Clutch (E) Hydraulic Circuits

To apply the overdrive clutch (E), the manual valve must be in the DRIVE position. Line pressure is supplied to the clutch E regulator valve.

SSD provides regulated solenoid pressure from the SREG circuit to the solenoid multiplex valve through the VFS4 circuit. SSE supplies pressure to the solenoid multiplex valve and the drive enable valve to position the valves to direct pressure from the VFS4 circuit to the CLEC F and CLEC circuits to position the clutch E regulator and latch valves to apply the overdrive clutch (E). As the overdrive clutch (E) is applied, SSD increases pressure to the clutch E regulator and latch valve.

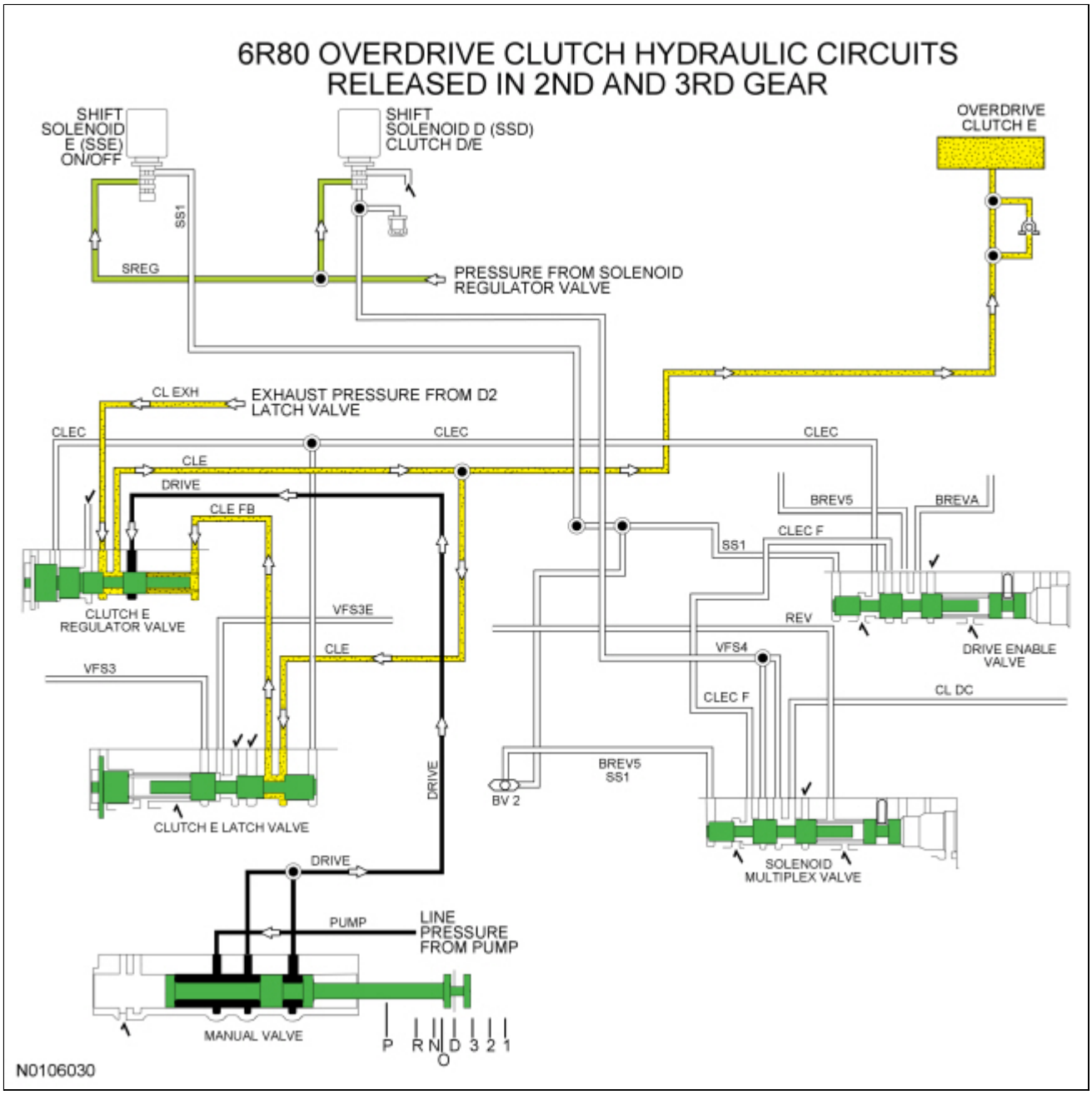
The clutch E regulator valve provides regulated line pressure from the DRIVE circuit to the CLE circuit to apply the overdrive clutch (E).

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To release the overdrive clutch (E), the manual valve can be in any position. SSD lowers pressure to the VFS4 circuit which lowers pressure in the CLEC and CLEC F circuits and releases the overdrive clutch (E). SSE blocks SREG pressure to the solenoid multiplex valve and the drive enable valve to allow SSD to control low/reverse clutch (D) operation.

When the overdrive clutch (E) is released, the clutch E regulator valve directs exhaust circuit pressure from the CL EXH circuit to the CL E circuit to fill the circuit and the clutch with fluid at low pressure, approximately 21 kPa (3 psi).



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Hydraulic System

Pump Assembly and Transmission Fluid Filter

This transmission has a gear type pump that supplies transmission fluid pressure to the hydraulic system.

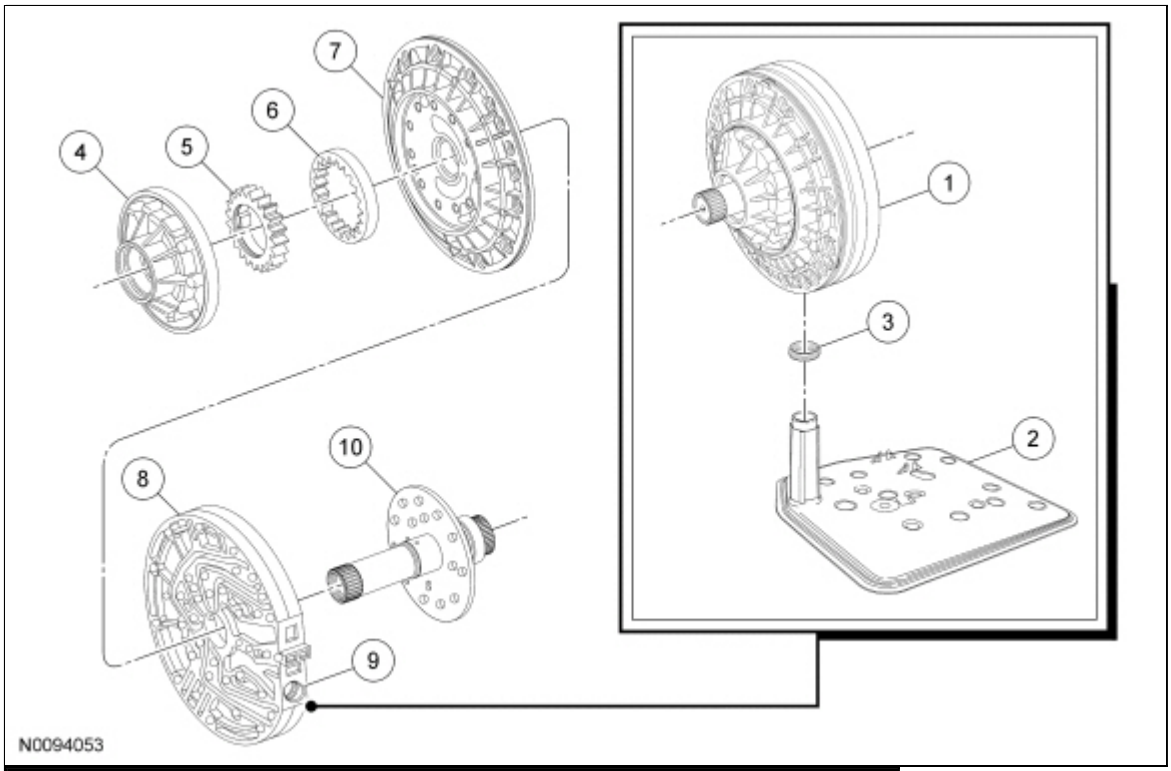
The inner (drive) gear is turned by the torque converter hub.

The transmission fluid pump has the following parts:

- Pump body, with inner (drive) and outer (driven) gears
- Centering plate
- Intermediate plate
- Stator shaft

The transmission fluid pump draws transmission fluid from the sump area, formed by the transmission fluid pan, through the transmission fluid filter, which is installed into the intermediate plate portion of the pump assembly and sealed by a rubber seal. A magnet attached to the transmission fluid pan collects any metallic material in the transmission fluid.

Pump Assembly and Transmission Fluid Filter Components



Item	Part Number	Description

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1	7A103	Transmission fluid pump assembly
2	7A098	Transmission fluid filter
3	—	Transmission fluid filter seal (part of 7A098)
4	—	Transmission fluid pump body (part of 7A103)
5	—	Inner (drive) gear (part of 7A103)
6	—	Outer (driven) gear (part of 7A103)
7	—	Centering plate (part of 7A103)
8	—	Intermediate plate (part of 7A103)
9	—	Filter suction port
10	—	Stator shaft (part of 7A103)

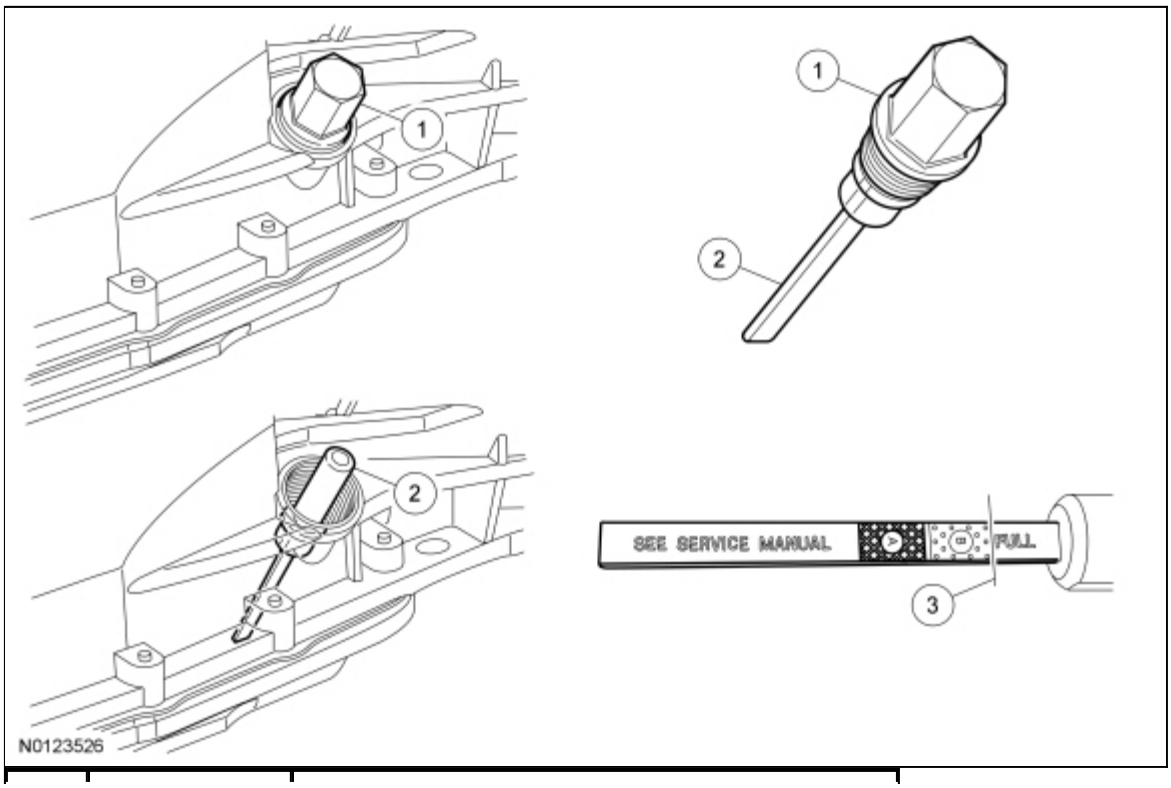
Transmission Fluid Level Indicator

A removable dipstick-type fluid level indicator is located on the right front area of the transmission case. It is held in by an external fluid fill plug. The transmission fluid level indicator is removed with the transmission fluid fill plug. The transmission fluid level indicator is removed from the fill plug to check the transmission fluid level.

The transmission fluid level is correctly checked when the transmission is at normal operating temperature, 89ºC-102ºC (193ºF-215ºF), and the vehicle is on a level surface.

The correct transmission fluid level is at the upper level of the crosshatch marks on the transmission fluid level indicator.

Transmission Fluid Level Indicator



Item	Part Number	Description
1	—	Transmission fluid fill plug
2	7A010	Transmission fluid level indicator
3	—	Transmission fluid level indicator FULL line

Main Control Assembly

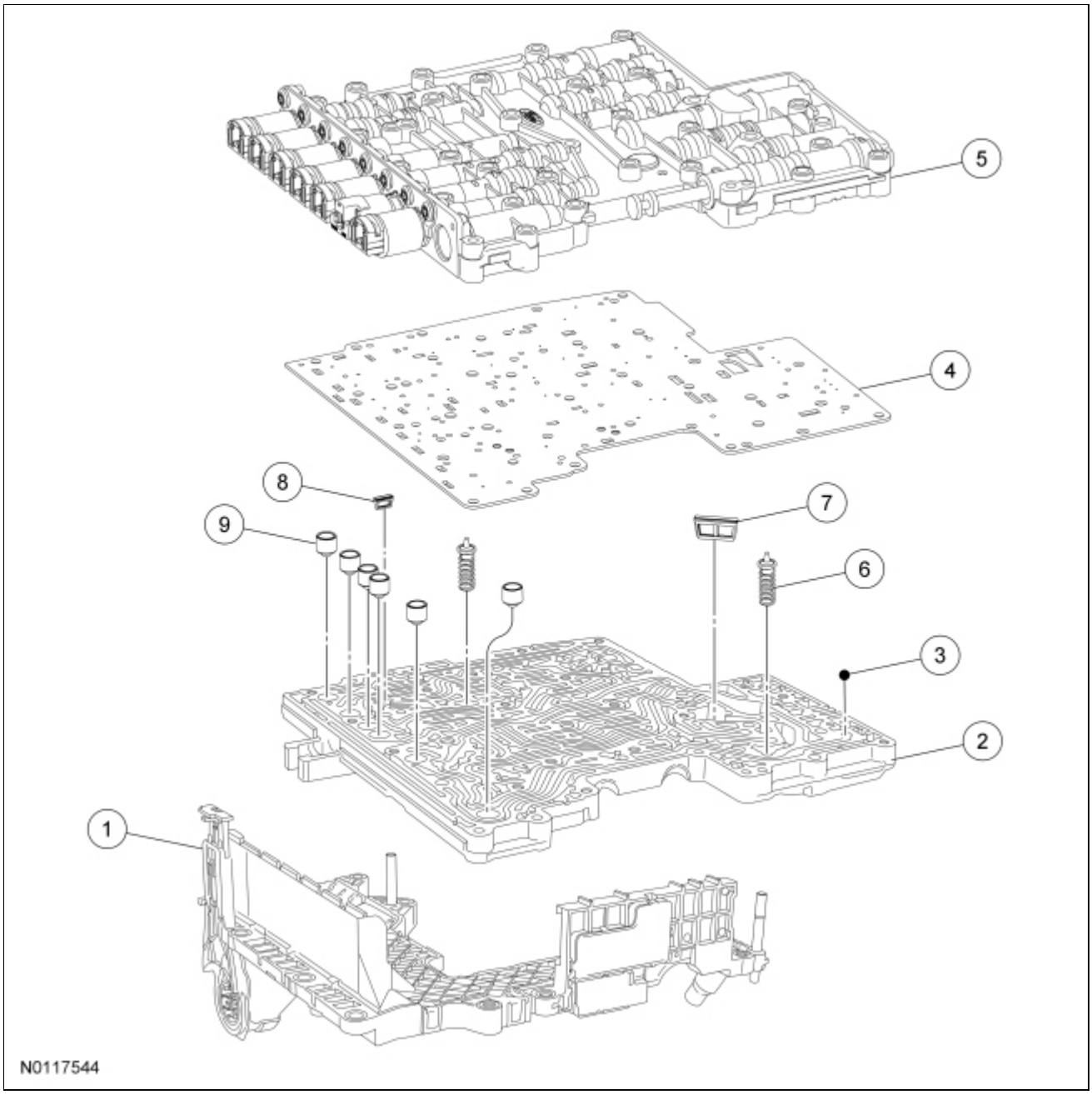
The hydraulic system of this transmission includes the fluid pump, a main control assembly and fluid passages in the transmission case and center support to apply the clutches.

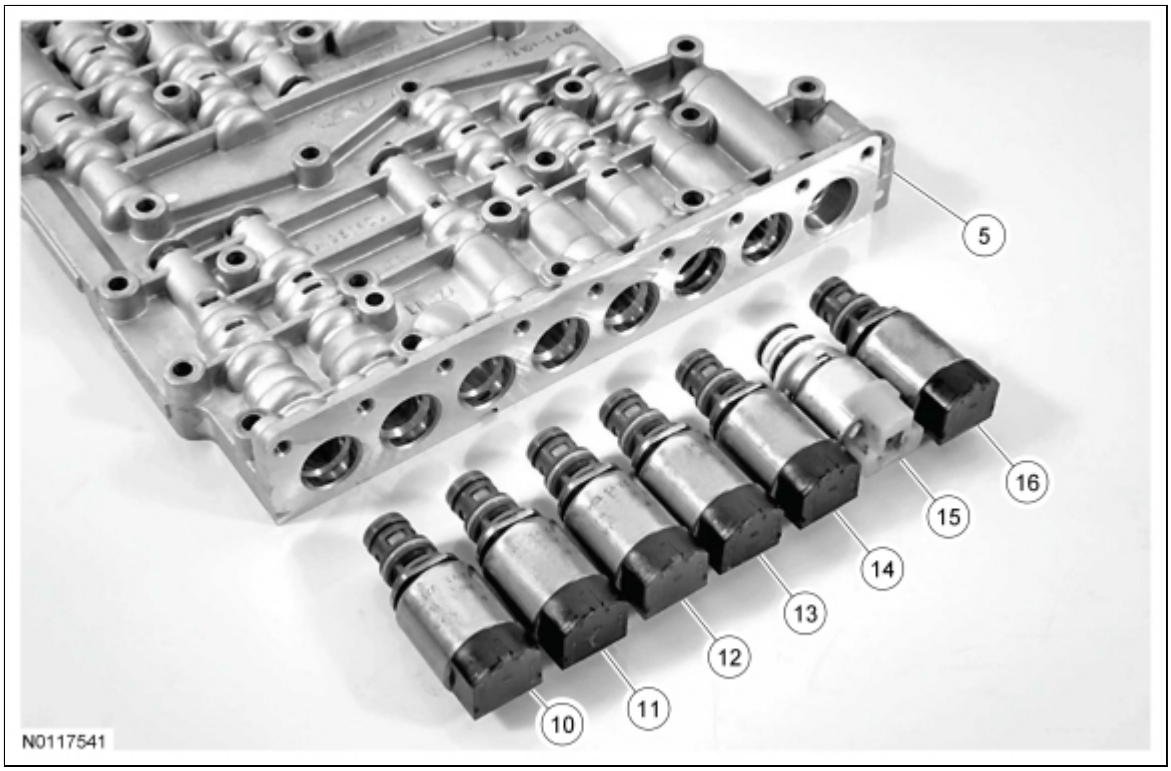
The main control assembly has an upper valve body assembly, a separator plate and a lower valve body assembly. The lower valve body assembly has 7 solenoids to control the valves in the main control.

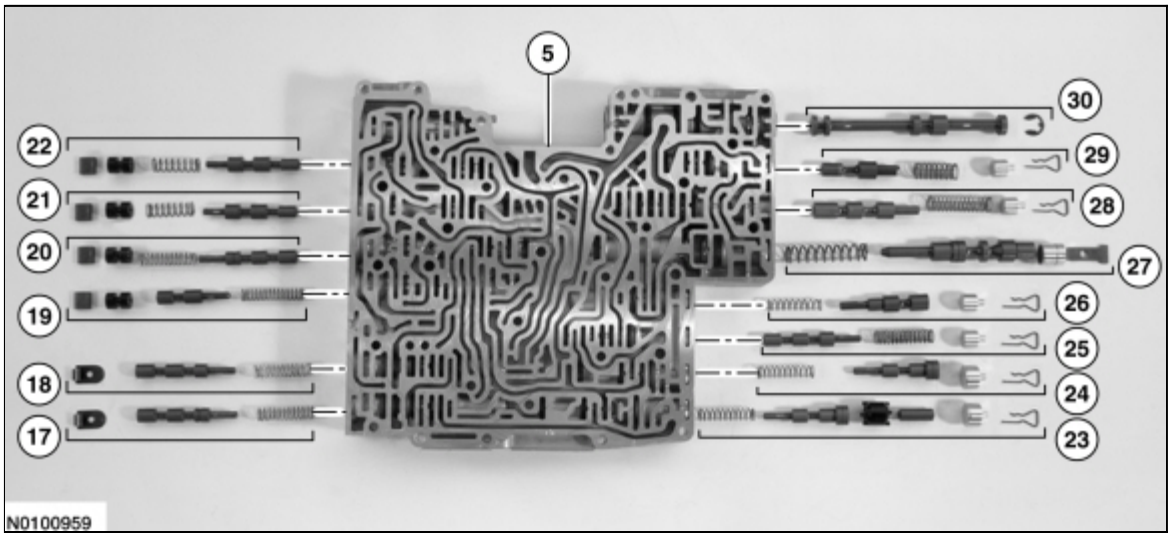
TheTurbine Shaft Speed (TSS), Output Shaft Speed (OSS), Transmission Range (TR) and Transmission Fluid Temperature (TFT) sensors are all part of the main control assembly leadframe.

Main Control Assembly

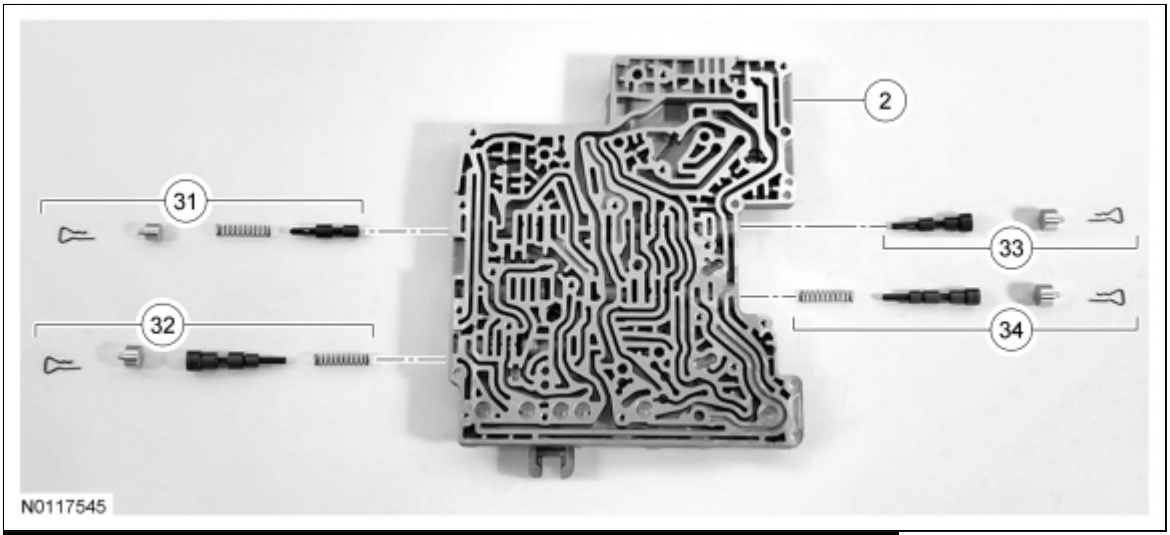
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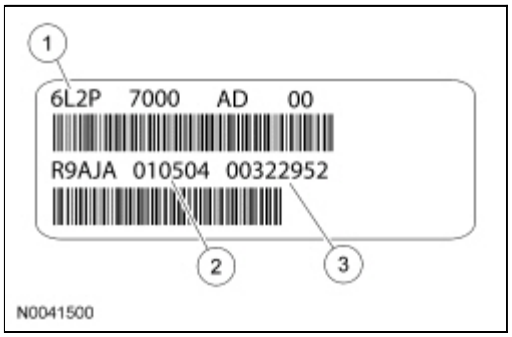
Item	Part Number	Description
1	7A100	Main control
1	7G276	Molded leadframe
2	—	Transmission control valve body (upper)
3	7E195	Transmission control valve check ball (8 required)
4	7Z490	Transmission control valve body separator plate
5	—	Transmission control valve body (lower)
6	—	Transmission control valve assembly
7	7H187	Transmission control filter assembly
8	7B155	Transmission fluid filter
9	—	Transmission solenoid damper valve assembly
10	7G383	Shift Solenoid A (SSA)
11	7G383	Shift Solenoid B (SSB)
12	7G383	Shift Solenoid C (SSC)
13	7G383	Line Pressure Control (LPC) solenoid
14	7G383	Shift Solenoid D (SSD)
15	7G484	Shift Solenoid E (SSE)
16	7G383	Torque Converter Clutch (TCC) solenoid
17	—	Forward (A) clutch latch valve assembly
18	—	Direct (B) clutch latch valve assembly
19	—	Solenoid regulator valve
20	—	Low/reverse (D1) clutch latch valve assembly
21	—	Drive enable valve
22	—	Solenoid multiplex valve
23	—	Forward (A) clutch regulator valve assembly
24	—	Overdrive (E) clutch regulator valve assembly
25	—	Overdrive (E) clutch latch valve assembly

26	—	Bypass clutch control regulator valve assembly
27	—	Main regulator valve assembly
28	—	Converter release regulator valve assembly
29	—	Lubrication control valve assembly
30	—	Manual valve assembly
31	—	Low/reverse (D2) clutch latch valve assembly
32	—	Direct (B) clutch regulator valve assembly
33	—	Low/reverse (D1) clutch regulator valve assembly
34	—	Intermediate (C) clutch regulator valve

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Identification Tags

All vehicles come equipped with a Safety Compliance Certification Label. The location on the label marked TR is reserved for the transmission code. To determine the correct transmission for this vehicle, refer to the Owner's Literature, Transmission Code Designations. All transmissions are equipped with an identification tag located on the transmission case. For transmission part number, serial number and build date, refer to the transmission identification tag located on the transmission case.



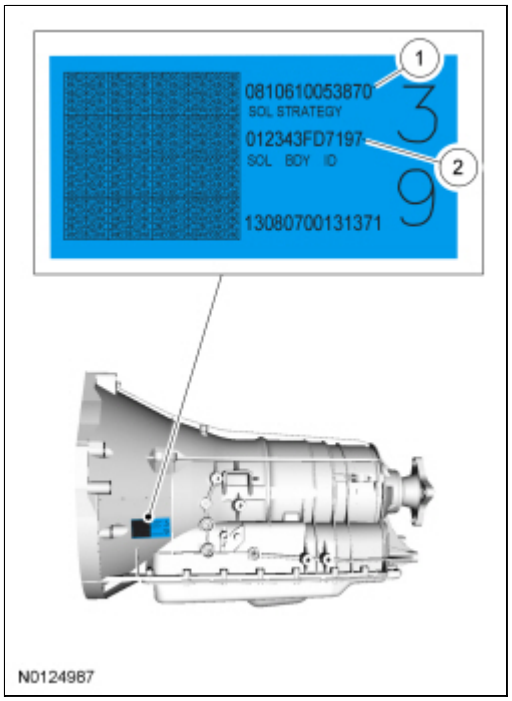
Item	Description
1	Part number
2	Build date
3	Serial number

Solenoid Strategy Identification Tag

NOTE: Letters are not used in the 13 digit solenoid body strategy. The characters consist of all numbers.

PCM controlled transmissions have a solenoid strategy identification tag located on the left side of the transmission case. Compare the 13 digit number on the tag with the 13 digit number displayed on the scan tool to determine the correct solenoid strategy for the transmission. If the scan tool matches the service tag then the solenoid strategy is correct. If the solenoid strategy retrieved from the scan tool does not match the solenoid strategy identification tag, the transmission fluid pan must be removed to compare what the scan tool displays to the solenoid strategy number etched on the main control. Refer to Fluid Pan, Gasket and Filter in this section. If the solenoid strategy identification etched on the main control matches what the scan tool displays, then the solenoid strategy is correct. If the solenoid strategy identification etched on the main control does not match the scan tool, then a Solenoid Strategy Data Download is required. Refer to Solenoid Body Strategy for the download procedure in this section.

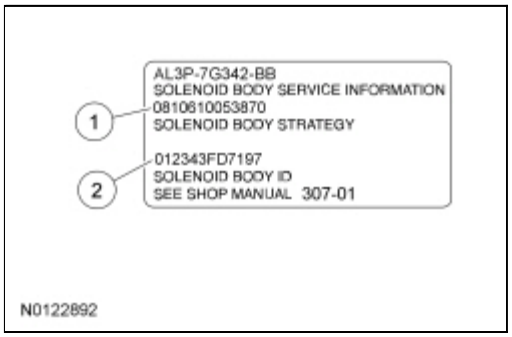
Original Solenoid Body Tag



Item	Description
1	13 digit solenoid strategy
2	12 digit solenoid body identification

A replacement solenoid body tag is provided when the main control is serviced. The replacement solenoid body tag is placed over the original solenoid body tag.

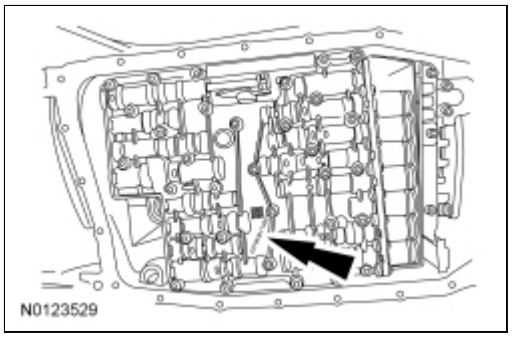
Replacement Solenoid Body Tag



Item	Description
1	13 digit solenoid strategy
2	12 digit solenoid body identification

Main Control Solenoid Body Strategy Identification

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If the solenoid body strategy etched on the main control does not match what the scan tool displays, the solenoid body strategy must be downloaded into the PCM or harsh shifts will result.

Major Components

Major Components

This transmission has the following major components:

- Transmission case with integral torque converter housing
- Torque converter
- Fluid pump
- Three drive clutches:
  - Forward clutch (A)
  - Direct clutch (B)
  - Overdrive clutch (E)
- Three brake clutches:
  - Intermediate clutch (C)
  - Low/reverse clutch (D)
  - One-Way Clutch (OWC)
- Two planetary gearsets:
  - Front single planetary gearset (1 sun gear, 1 carrier, 1 ring gear)
  - Rear ravigneaux planetary gearset (2 sun gears, 1 carrier with 2 sets of pinion gears and 1 ring gear)
- Main control:
  - Upper valve body
  - Lower valve body
  - Transmission Range (TR) sensor
  - Turbine Shaft Speed (TSS) sensor
  - Output Shaft Speed (OSS) sensor
  - Transmission Fluid Temperature (TFT) sensor
  - Line Pressure Control (LPC) solenoid
  - Torque Converter Clutch (TCC) solenoid
  - Five electronically controlled shift solenoids

In addition to the torque converter, the other shift elements are:

- three rotating multi-plate clutches: forward (A), direct (B) and overdrive (E).
- two fixed multi-disc brakes: intermediate (C) and low/reverse (D).

All gear shifts from 1st to 6th or from 6th to 1st are power-on overlapping shifts. That is, during the shift, one of the clutches must continue to transmit the drive at lower main pressure until the other clutch is able to accept the input torque.

The shift elements, clutches or brakes are engaged hydraulically. The transmission fluid pressure builds up between the cylinder and the piston, pressing the clutches together.

The purpose of these shift elements is to carry out in-load shifts with no interruption to traction.

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Multi-plate clutches; forward, direct and overdrive, supply power from the engine to the planetary geartrain. Multi-disc brakes, intermediate and low/reverse, press against the transmission housing in order to achieve a torque reaction effect.

Multi-Plate Clutch

Clutches; overdrive (E), forward (A) and direct (B) are balanced in terms of dynamic pressure. That is, their pistons are exposed to the transmission fluid flow on both sides, in order to prevent pressure buildup in the clutch as speed increases. This equalization process is achieved by a baffle plate and pressure-free transmission fluid supplied by a lubricating passage, through which the space between piston and baffle plate is filled with transmission fluid.

The advantages of this dynamic pressure equalization are:

- reliable clutch engagement and release in all speed ranges.
- improved shift refinement.

Shift Overlap Control

The electro-hydraulic shift action is obtained by means of various valves in the main control valve body, actuated by pressure regulators. They engage or disengage the relevant clutches or brakes at the correct moments.

Hydraulic Systems

Fluid Pump

The torque converter is supported in the fluid pump by a needle roller bearing. The fluid pump is driven directly from the engine by the torque converter shell and supplies transmission fluid to the transmission and the hydraulic control unit.

The fluid pump draws in transmission fluid through a transmission fluid filter and delivers it at high pressure to the main pressure valve in the main control valve body unit. The valve adjusts the pressure and returns excess transmission fluid to the transmission fluid pan.

Fluid Filter

All transmission fluid that is picked up from the transmission fluid pan passes through the transmission fluid filter. The transmission fluid filter and its accompanying seal are part of the transmission fluid path from the pan to the transmission fluid pump.

Single Planetary Gearset

The single planetary gear overdrive carrier is driven by the input shaft. The single planetary gear set consists of the following components:

- One sun gear
- Four planetary gears meshing with the sun gear
- One planetary carrier
- One ring gear

Ravigneaux Planetary Gearset

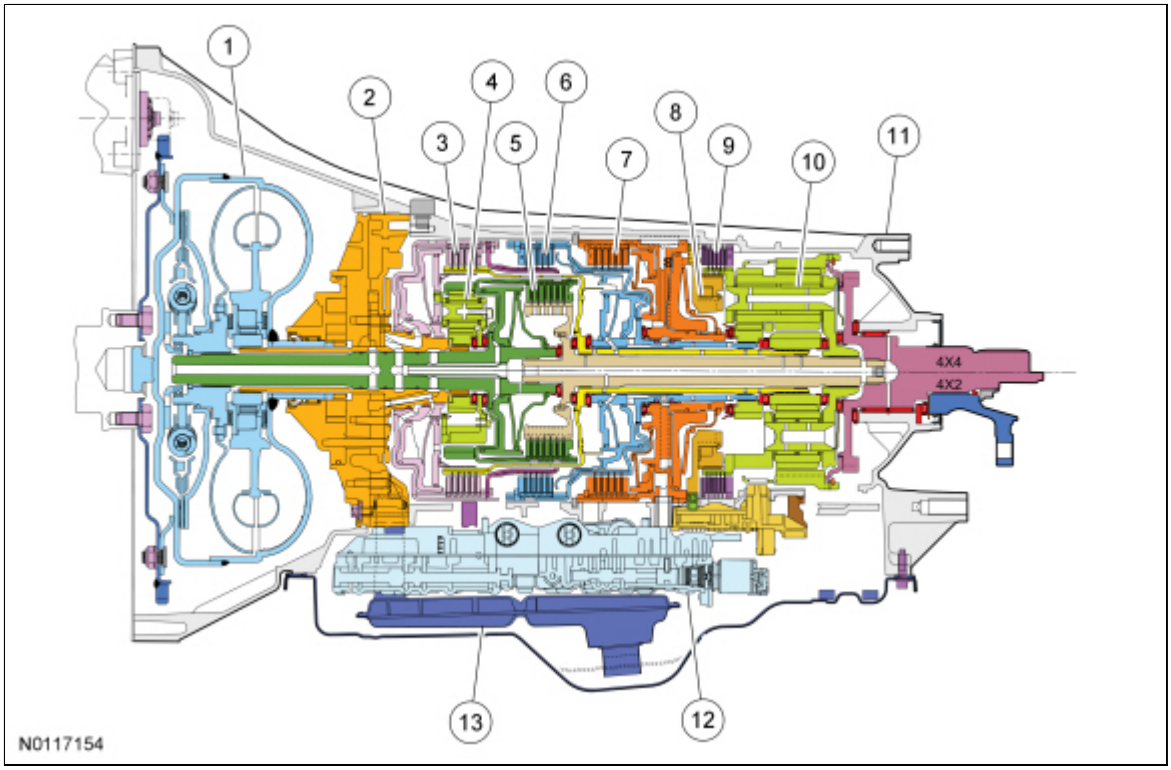
The ravigneaux planetary gearset is splined to the output shaft and consists of the following components:

- Two sun gears of different sizes
- Three long planetary gear pinions meshing with the large sun gear and the ring gear
- Three short planetary gear pinions meshing with the small sun gear and the long pinions
- One planetary carrier
- One ring gear

Output Shaft

The output shaft provides torque to the driveshaft and rear axle assembly. It is splined to the ring gear of the rear/ravigneaux planetary gearset.

Major Components Cutaway View



Item	Description
1	Torque converter

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2	Front pump assembly
3	Forward clutch (A)
4	Front planetary gearset
5	Overdrive clutch (E)
6	Direct clutch (B)
7	Intermediate clutch (C)
8	One-Way Clutch (OWC)
9	Low/reverse clutch (D)
10	Rear planetary gearset
11	Transmission case
12	Main control assembly
13	Transmission fluid filter

Mechanical Components and Functions

Planetary Gearset

This transmission has 2 planetary gearsets (front and rear) to provide operation in reverse and 6 forward speeds.

The front planetary gearset is a single planetary gearset and has the following components:

- Front planetary No. 1 sun gear
- Front planetary carrier
- Front planetary ring gear (part of the input shaft assembly)

The input shaft rotates the front ring gear as a driving member. The front sun gear is connected to the fluid pump and is held stationary. The front ring gear rotates the front planetary carrier assembly with a reduction ratio of 1.52:1.

The front planetary carrier assembly is the only output member of the front planetary gearset in reverse, 1st, 2nd and 3rd gear. The front planetary gearset provides a 1.52:1 gear ratio to the rear planetary gearset.

In 4th and 5th gear, both the front ring gear and front planetary carrier assembly are output members of the front planetary gearset. The front planetary gearset provides both a 1:1 and 1.52:1 gear ratio to different members of the rear planetary gearset.

In 6th gear, the front ring gear is the only output member of the front planetary gearset. The front planetary gearset provides a 1:1 gear ratio to the rear planetary gearset.

The rear planetary gearset is a ravigenaux planetary gearset and has the following components:

- Rear planetary No. 2 sun gear
- Rear planetary No. 3 sun gear
- Rear planetary carrier assembly (2 sets of pinion gears)
- Rear planetary ring gear assembly

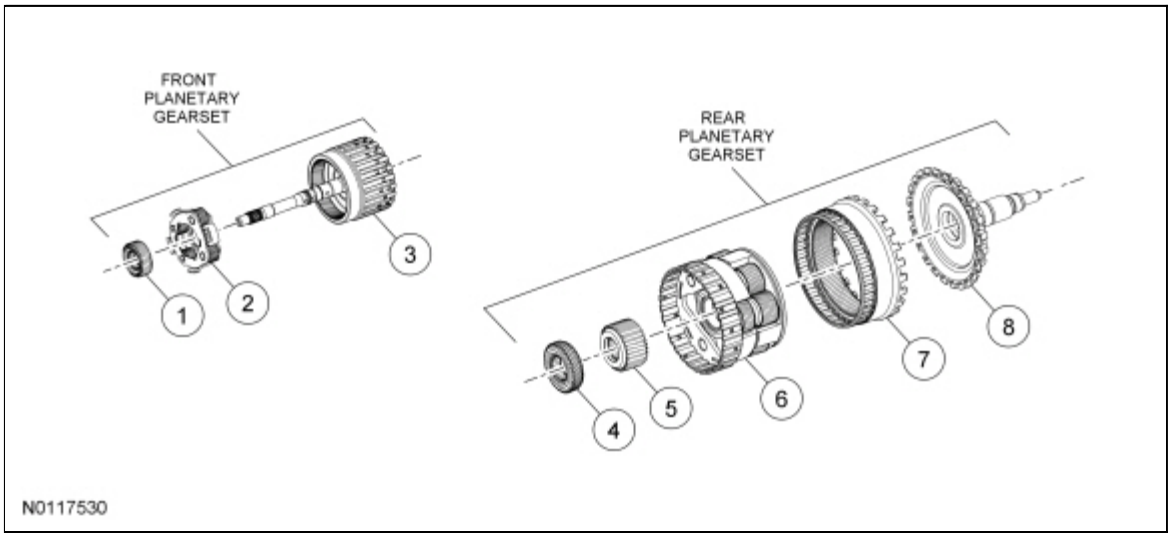
Power flow through the rear planetary gearset is as follows:

- In reverse, rear sun gear No. 2 is driven, the rear planetary carrier is held and the ring gear is the output (2.24:1 with reverse direction)
- In 1st gear, sun gear No. 3 is driven, the rear planetary carrier is held and the ring gear is the output (2.74:1)
- In 2nd gear, sun gear No. 3 is driven, sun gear No. 2 is held and the ring gear is the output (1.54:1)
- In 3rd gear, sun gear No. 3 and sun gear No. 2 are driven and the ring gear is the output (1:1)
- In 4th gear, sun gear No. 3 and the rear planetary carrier are driven and the ring gear is the output (1.14:1)
- In 5th gear, sun gear No. 2 and the rear planetary carrier are driven and the ring gear is the output (0.87:1)
- In 6th gear, the rear planetary carrier is driven, sun gear No. 2 is held and the ring gear is the output

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(0.69:1)

Planetary Gearset Exploded View



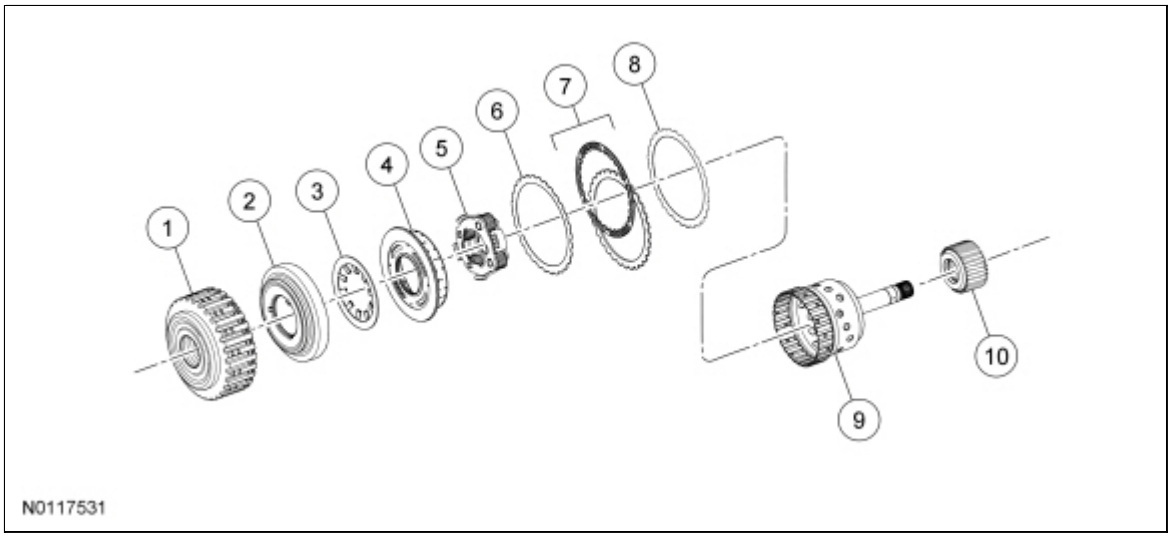
Item	Description
1	Front planetary No. 1 sun gear
2	Front planetary carrier
3	Front planetary ring gear (part of input shaft assembly)
4	Rear planetary No. 2 sun gear
5	Rear planetary No. 3 sun gear
6	Rear planetary carrier
7	Rear planetary ring gear
8	Output shaft

Forward Clutch (A)

The forward clutch (A) connects the front planetary carrier to the rear No. 3 sun gear. This provides a gear reduction ratio of 1.52:1 from the input shaft to rear sun gear No. 3. The forward clutch (A) is applied in 1st, 2nd, 3rd and 4th gears.

Regulated hydraulic pressure from the regulator valve in the valve body pushes the forward clutch (A) piston against the forward clutch (A) pack to apply the clutch. The front planetary carrier and the rear No. 3 sun gear are connected as a result of the clutch being applied.

Forward Clutch (A) Exploded View



Item	Description
1	Forward clutch cylinder
2	Forward clutch piston
3	Forward clutch piston return spring
4	Forward clutch balance piston
5	Front planetary carrier assembly
6	Forward clutch wave spring
7	Forward clutch friction and steel plates
8	Forward clutch pressure plate
9	Rear planetary No. 3 sun gear hub and shaft assembly
10	Rear planetary No. 3 sun gear

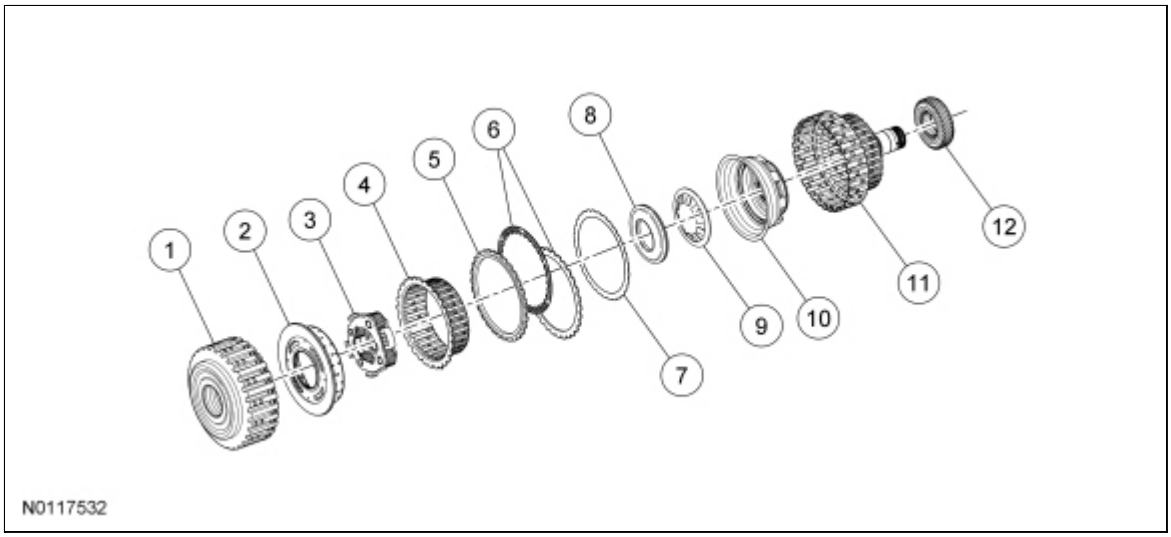
Direct Clutch (B)

The direct clutch (B) connects the front planetary carrier to the rear No. 2 sun gear. This provides a gear reduction ratio of 1.52:1 from the input shaft to rear sun gear No. 2. The direct clutch (B) is applied in reverse, 3rd and 5th gears.

Regulated hydraulic pressure from the regulator valve in the valve body pushes the direct clutch (B) piston against the direct clutch (B) pack to apply the clutch. The front planetary carrier and the rear No. 2 sun gear are connected as a result of the clutch being applied.

Direct Clutch (B) Exploded View

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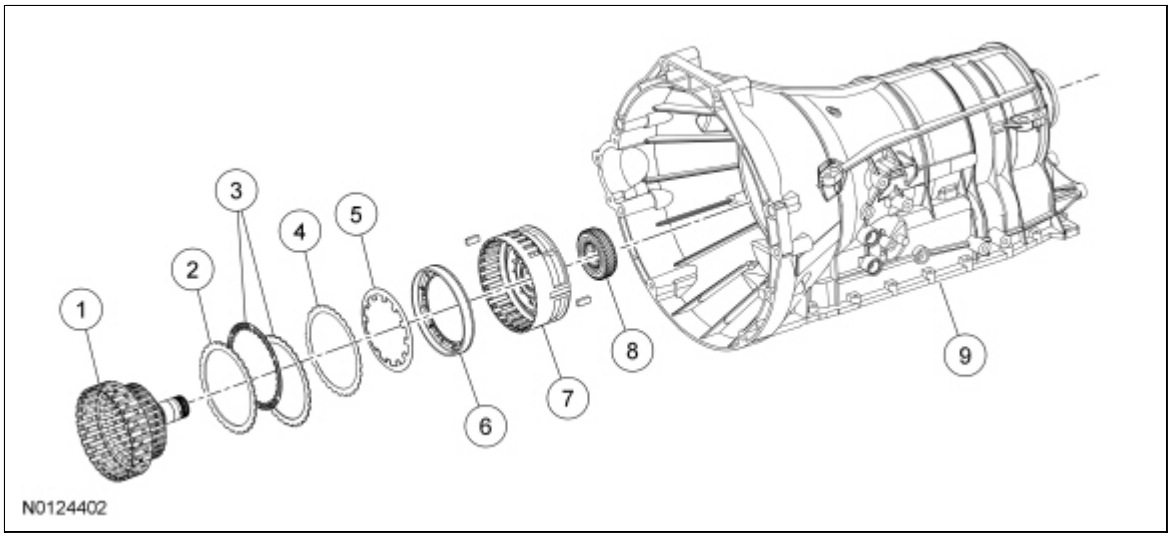
Item	Description
1	Forward clutch cylinder
2	Forward clutch balance piston
3	Front planetary carrier assembly
4	Direct clutch hub
5	Direct clutch pressure plate
6	Direct clutch friction and steel plates
7	Direct clutch wave spring
8	Direct clutch balance piston
9	Direct clutch piston return spring
10	Direct clutch piston
11	Direct clutch cylinder
12	Rear planetary sun gear No. 2

Intermediate Clutch (C)

The intermediate clutch (C) holds the rear planetary No. 2 sun gear stationary to the transmission case. The intermediate clutch (C) is applied in 2nd and 6th gears.

Regulated hydraulic pressure from the regulator valve in the valve body pushes the intermediate clutch (C) piston against the intermediate clutch (C) pack to apply the clutch.

Intermediate Clutch (C) Exploded View



Item	Description
1	Direct clutch cylinder
2	Intermediate clutch pressure plate
3	Intermediate clutch friction and steel plates
4	Intermediate clutch wave spring
5	Intermediate clutch piston return spring
6	Intermediate clutch piston
7	Center support assembly
8	Rear planetary sun gear No. 2
9	Transmission case

Low/Reverse Clutch (D) and Low/One-Way Clutch (OWC)

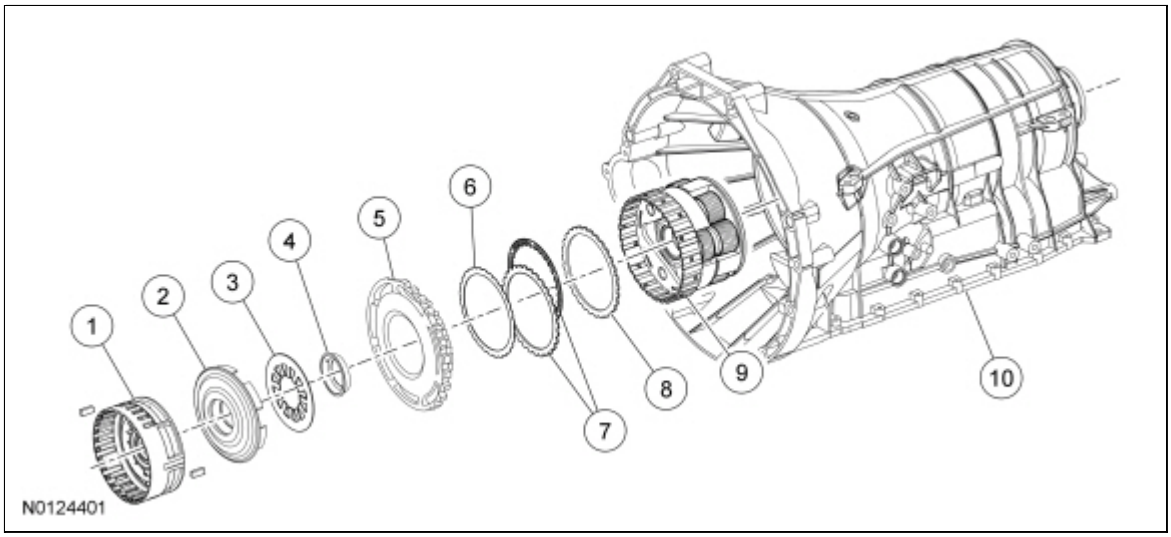
The low/reverse clutch (D) holds the rear planetary carrier stationary to the transmission case. The low/reverse clutch (D) is applied in park, reverse, neutral and 1st gear below 5 kph (3 mph).

Regulated hydraulic pressure from the regulator valve in the valve body pushes the low/reverse clutch (D) piston against the low/reverse clutch (D) pack to apply the clutch.

The low/ OWC is a brake clutch that holds the rear planetary carrier in one direction and allows it to freewheel in the opposite direction eliminating engine braking in 1st gear when the transmission is in drive, above 5 kph (3 mph) only.

Low/Reverse Clutch (D) and Low/One-Way Clutch (OWC) Exploded View

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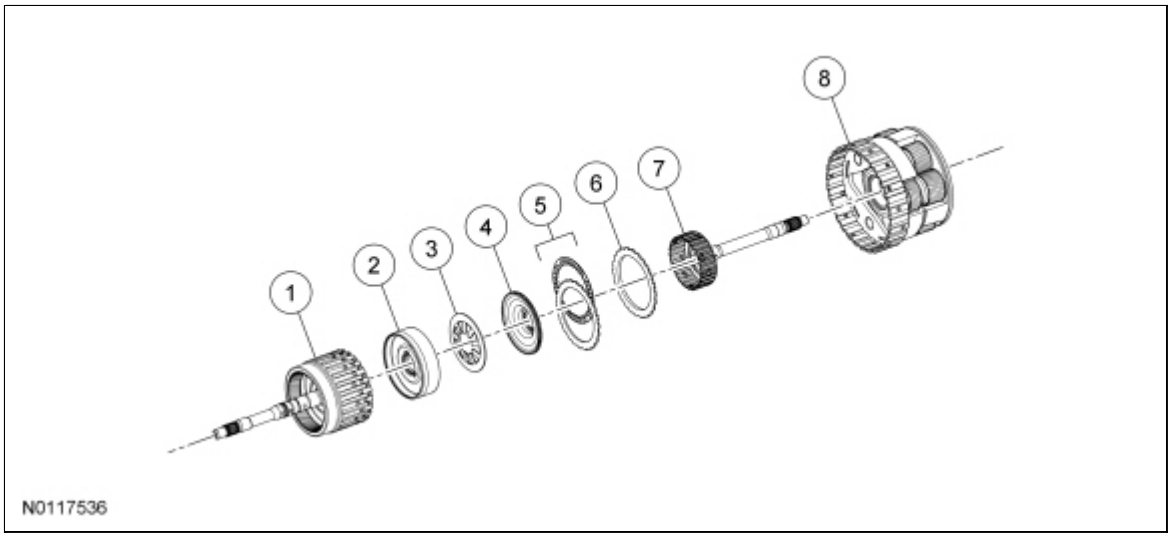
Item	Description
1	Center support assembly
2	Low/reverse clutch piston
3	Low/reverse clutch piston return spring
4	Low/reverse clutch piston retainer
5	Low/ OWC
6	Low/reverse clutch wave spring
7	Low/reverse clutch friction and steel plates
8	Low/reverse clutch pressure plate
9	Rear planetary carrier assembly
10	Transmission case

Overdrive Clutch (E)

The overdrive clutch (E) connects the input shaft with the rear planetary carrier. The overdrive clutch (E) is applied in 4th, 5th and 6th gears.

Regulated hydraulic pressure from the regulator valve in the valve body pushes the overdrive clutch (E) piston against the overdrive clutch (E) pack to apply the clutch.

Overdrive Clutch (E) Exploded View



Item	Description
1	Input shaft assembly
2	Overdrive clutch piston
3	Overdrive clutch piston return spring
4	Overdrive clutch balance piston
5	Overdrive clutch friction and steel plates
6	Overdrive clutch pressure plate
7	Intermediate shaft
8	Rear planetary carrier assembly

External Sealing

The pump assembly has a lip-type seal for the torque converter impeller hub. The pump assembly uses a large O-ring to seal the transmission case. The pump bolts also seal the pump to the transmission case.

The manual control lever shaft has a lip seal for its bore in the transmission case.

The transmission fluid pan uses a reusable gasket.

The output shaft flange has a lip-type seal that seals the flange to the transmission case.

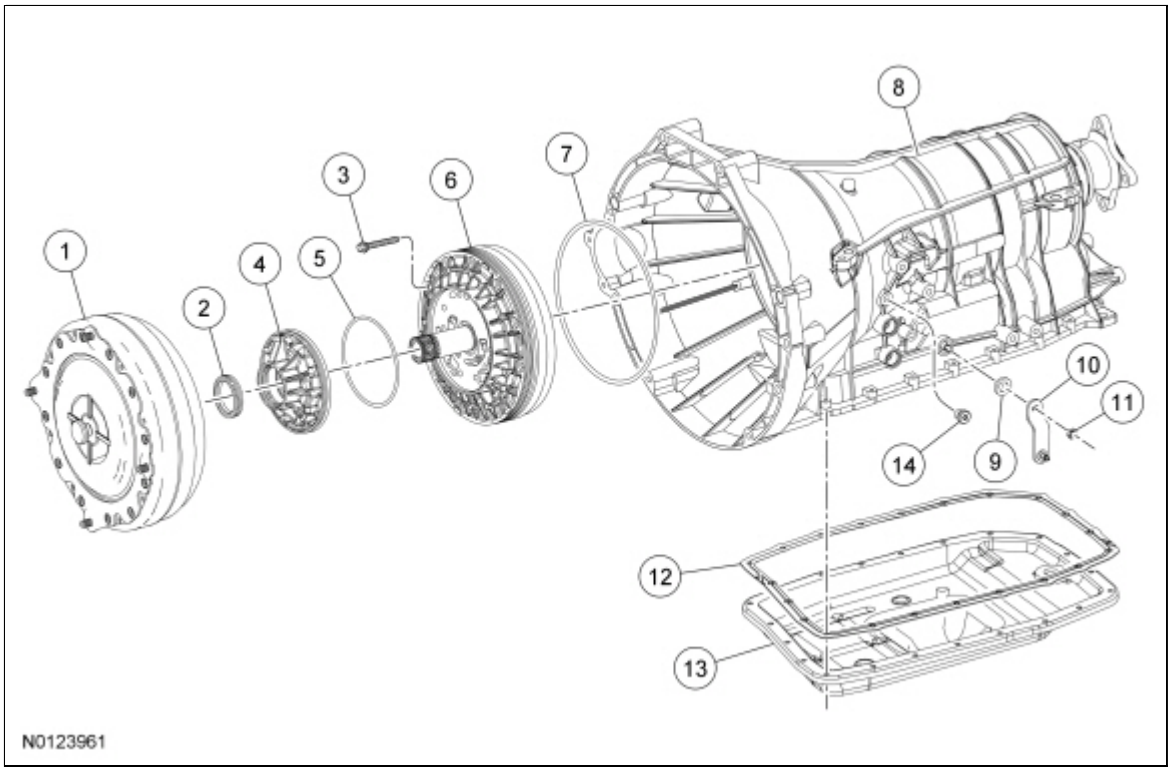
The transmission case plug provides access to the park pawl shaft. The plug has a seal that is serviced as an assembly with the plug.

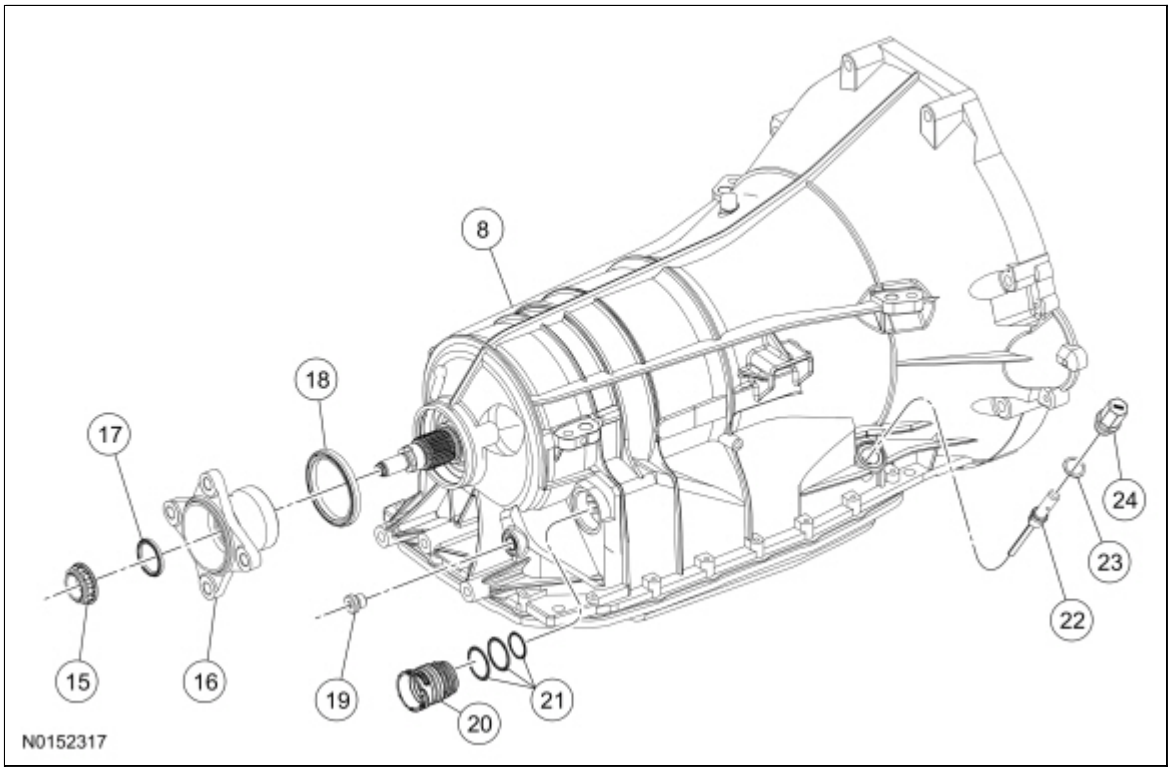
The transmission bulkhead connector sleeve has seals for the transmission case bore.

The plug for the fluid level indicator uses an O-ring seal.

External Sealing (Gaskets, O-rings and Seals)

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Item	Description
1	Torque converter
2	Front pump oil seal
3	Front pump-to-case bolt (13 required)

4	Front pump assembly
5	Pump assembly inner oil seal
6	Front pump assembly
7	Front pump outer oil seal
8	Transmission case
9	Manual control lever shaft seal
10	Manual control lever (Manual control lever installation position is vehicle/model dependent.)
11	Manual control lever nut
12	Transmission fluid pan gasket
13	Transmission fluid pan
14	Line pressure tap plug
15	Output shaft flange retaining nut RWD
16	Output shaft flange RWD
17	Output shaft flange seal RWD
18	Output shaft seal (model dependent)
19	Transmission case plug (park pawl shaft access)
20	Transmission bulkhead connector sleeve
21	Transmission bulkhead connector sleeve seals
22	Transmission fluid level indicator
23	Transmission fluid level indicator plug seal (part of transmission fluid level indicator)
24	Transmission fluid level indicator plug (part of transmission fluid level indicator)

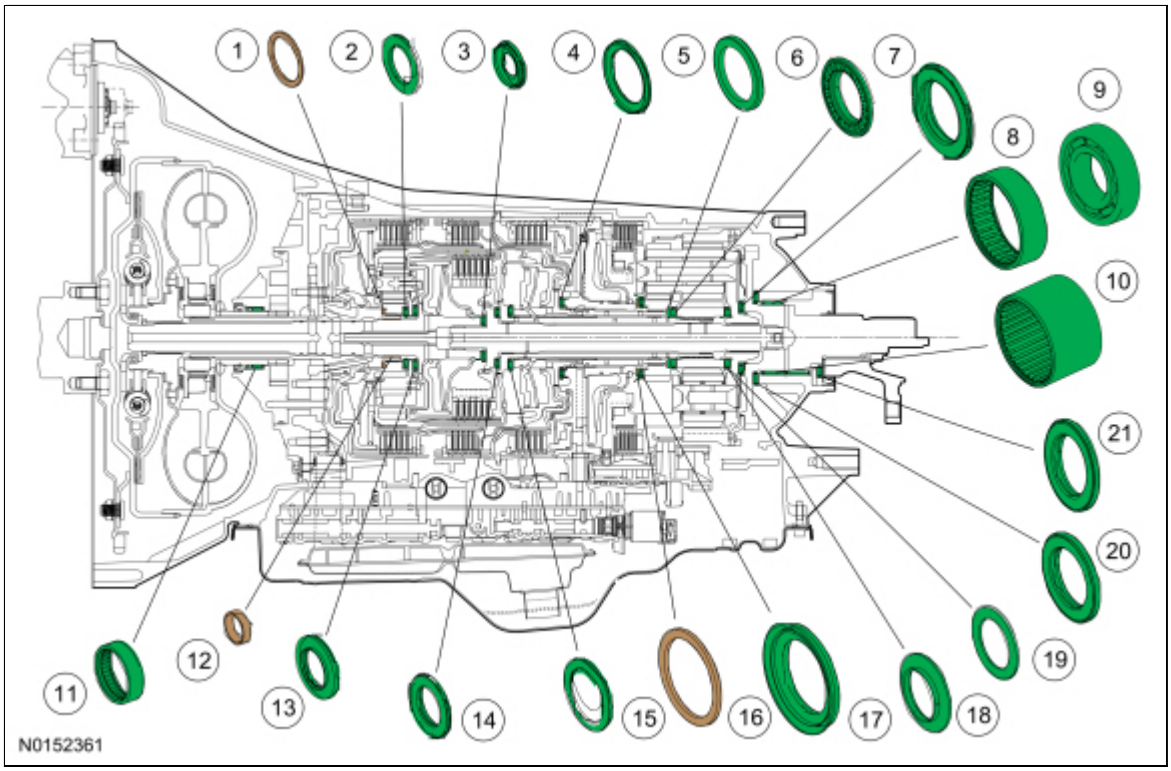
Bushings, Bearings and Thrust Washer Locations

This transmission supports the rotating components of the transmission with bushings, bearings and thrust washers.

The pump assembly support thrust washer controls the amount of end play for components between the pump assembly and the center support (forward/overdrive clutch assembly, direct clutch cylinder).

The T8 thrust bearing outer race controls the amount of end play for components between the center support and the rear of the transmission case (rear planetary gearset assembly, output shaft assembly).

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Item	Description
1	Front pump selective washer
2	Bearing T1
3	Bearing T3
4	Bearing T6
5	Thrust bearing outer race
6	Roller bearing T8
7	Thrust bearing T10
8	Output shaft bearing assembly (4WD vehicles and late build RWD vehicles)
9	Output shaft ball bearing assembly (late build RWD vehicles)
10	Output shaft bearing assembly (early build RWD vehicles)
11	Front oil pump bearing assembly (part of pump assembly)
12	Input shaft bushing (part of pump assembly)
13	Bearing T2
14	Bearing T4
15	Roller bearing T5
16	Rear planetary carrier selective washer
17	Thrust bearing T7
18	Roller bearing T9
19	Outer race bearing T9
20	Bearing T11

21	Thrust bearing T12 (early build RWD)

Lubrication

This transmission provides lubrication for rotating mechanical components through one main hydraulic circuit. The general flow of lubrication moves from the front of the transmission, through the input and intermediate shafts, to the rear of the transmission.

Transmission fluid from the pump assembly and the torque converter exit the transmission case to go to the transmission fluid cooler through the bottom of the transmission fluid cooler tube and returns to the transmission through the top of the transmission fluid cooler tube.

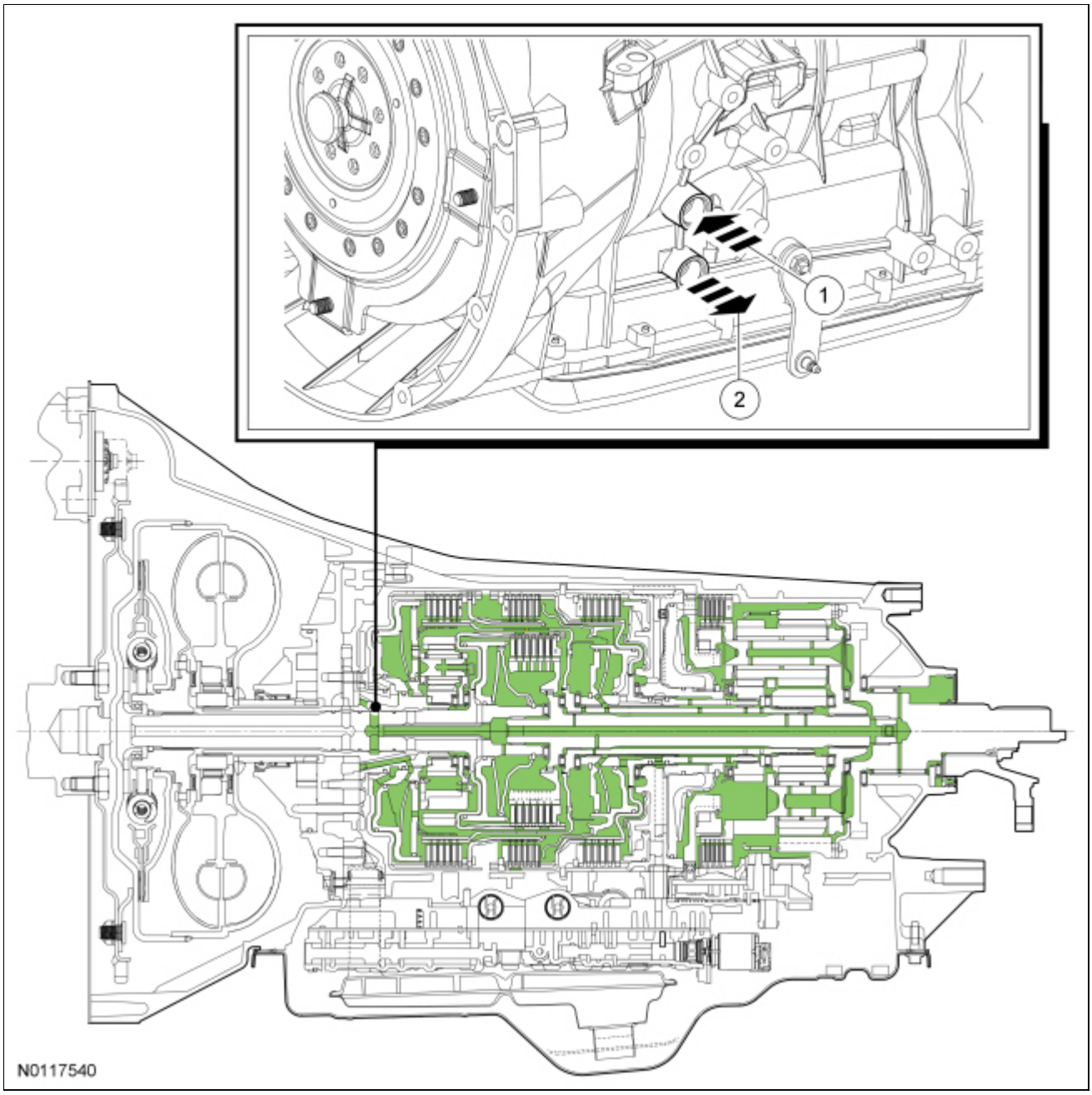
With lower transmission fluid temperatures, the thermal bypass valve in the transmission case bypasses the transmission fluid cooler tubes and redirects the fluid to the lubrication circuit. As transmission fluid temperature increases, the thermal bypass valve directs the fluid to the transmission fluid cooler.

Transmission fluid from the transmission fluid cooler or the thermal bypass valve enters the main lubrication circuit from the top of the transmission fluid cooler tube port.

Transmission fluid in the lubrication circuit flows to each of the balance pistons for the forward (A), direct (B) and overdrive (E) clutches. The balance pistons prevent unwanted clutch application when the clutch cylinder rotates at high speeds and hydraulic controls have released the clutch.

Lubrication Passages

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Item	Description
1	Transmission fluid cooler return (inlet from the transmission fluid cooler)
2	Transmission fluid cooler pressure (outlet to the transmission fluid cooler)

Park

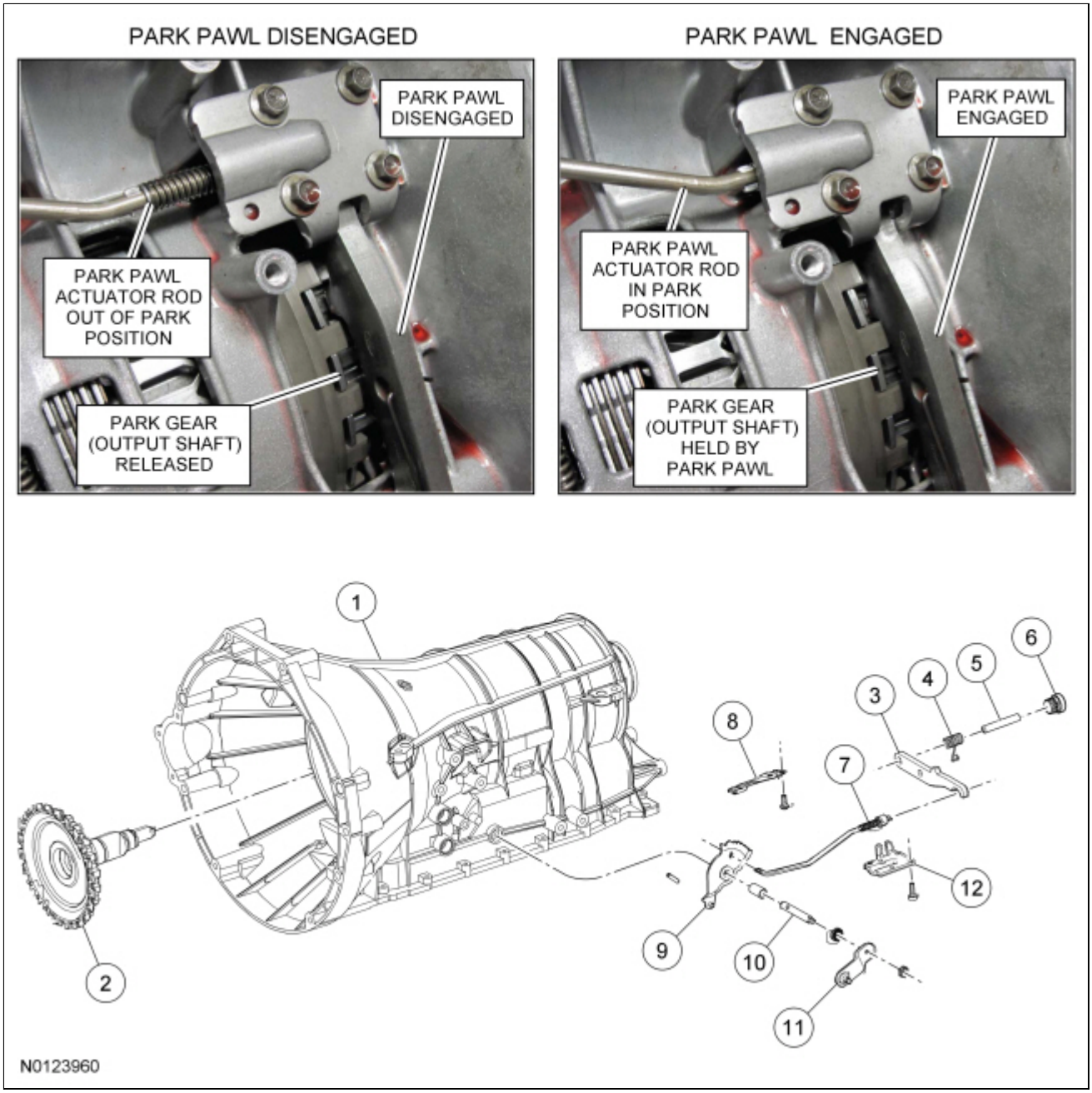
The park gear is part of the output shaft assembly. The park gear has lugs on its overdrive surface that the park pawl engages to lock the output shaft.

The park lock prevents the vehicle wheels from rotating by allowing the transmission case to hold the output

shaft stationary through the park pawl. When the park pawl is engaged in the park gear, the output shaft is held stationary.

When the manual control lever is rotated to the PARK position, the park lock works as follows:

- The detent assembly (connected to the manual control shaft) rotates and pushes the park pawl actuator rod into the park pawl. The actuator rod is spring loaded.
- The actuator rod is guided into the park pawl by the park pawl abutment.
- When the park pawl actuator rod is pushed into the park pawl, the park pawl pivots into the park gear and engages with the lugs.
- The park pawl holds the output shaft to the transmission case.

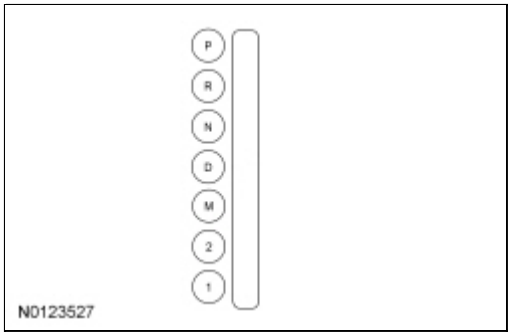


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Item	Description
1	Transmission case
2	Output shaft park gear assembly
3	Park pawl
4	Park pawl return spring
5	Park pawl pin
6	Plug — park pawl pin
7	Park pawl actuator rod
8	Manual valve detent spring
9	Manual valve detent lever assembly
10	Manual control lever shaft
11	Manual control lever (Manual control lever installation position is vehicle/model dependent.)
12	Park rod actuating plate

Range Selection

The transmission has 7 range positions: P, R, N, D, M, 2 and 1.



Park

In the PARK position:

- there is no power flow through the transmission.
- the park pawl locks the output shaft to the case.
- the engine can be started.
- the ignition key can be removed.

Reverse

In the REVERSE position:

- the vehicle can be operated in a rearward direction, at a reduced gear ratio.
- backup lamps are illuminated.

Neutral

In the NEUTRAL position:

- there is no power flow through the transmission.
- the output shaft is not held and is free to turn.
- the engine can be started.

D Position

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The D is the normal position for most forward driving.

The D position provides:

- automatic shifts 1-6 and 6-1.
- apply and release of the torque converter clutch.
- maximum fuel economy during normal operation.
- engine braking in all gears.

Position M — SelectShift™

This position provides:

- manual control of the transmission.
- engine braking.

Position 3— 3rd Gear (column-shift only) (For vehicles without SST)

This position provides:

- manual 3rd gear.

Position 2 — 2nd Gear

This position provides:

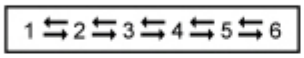
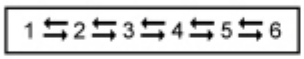
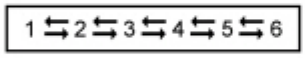
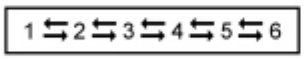
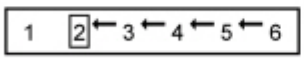
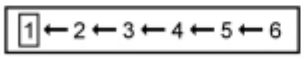
- manual 2nd gear.

Position 1 — 1st Gear

This position provides:

- first gear operation only.
- engine braking for descending steep grades.

Gear Availability

MANUAL LEVER POSITION	TRANSMISSION GEAR OPERATION	DESCRIPTION
P	Park	Forward or reverse gears not available. Output shaft is held to the transmission case.
R	Reverse	Transmission allows reverse only.
N	Neutral	Forward or reverse gears not available. Output shaft moves freely.
D		6 forward gears are available. Gears are dependent on vehicle speed and throttle position with coast braking.
D Tow/Haul		1st through 6th gears are available. The shift scheduling is altered for higher shift speeds for a given throttle position. Transmission provides engine braking.
D Range Select		All gears available. Driver has the option to lockout higher gears by pressing "–" on the selector lever. Driver can also enable higher gears that have been locked out by pressing "+". Transmission automatically shifts through lower gears that have not been locked out.
M SelectShift™		All gears available upon driver request. Driver has the ability to shift the transmission using the "+" "–" switches on the selector lever.
2		2nd gear hold, no upshift. Downshift to 2nd gear when 2 position is selected above a calibrated speed.
1		1st gear hold with engine braking, no upshift. The transmission downshifts to 1st gear when 1 is selected above a calibrated speed under minimum to moderate accelerator pedal position.

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Shift Patterns

Downshifts

Under certain conditions, the transmission will downshift automatically to a lower gear range (without moving the range selector lever). There are 3 categories of automatic downshifts:

- Coastdown
- Torque demand
- Forced or kickdown shifts

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio.

Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

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Torque Converter

The torque converter is a 4-element unit containing a 2-plate clutch. The clutch can be controlled and engaged in any gear, 2nd through 6th. Calibration parameters may be set to allow lockup in a higher gear only. The clutch is applied by removing fluid pressure from one side of the plate. The torque converter transmits and multiplies torque. The torque converter includes the following 4 elements:

- Impeller assembly
- Turbine assembly
- Reactor assembly
- Torque Converter Clutch (TCC)

Rotation of the torque converter housing and impeller set the transmission fluid in motion by driving the impeller blades and pump.

The turbine is driven by the transmission fluid from the impeller and transmits power to the input shaft.

The reactor redirects transmission fluid flow returned from the turbine to the impeller so that it rotates in the same direction as the impeller. This action assists in torque multiplication.

The reactor has a One-Way Clutch (OWC) to hold it stationary during torque multiplication and allows it to rotate at higher vehicle speeds.

Torque Converter Clutch (TCC)

The TCC has a cover assembly with a 2-plate clutch and a turbine and damper assembly that connects to the transmission input shaft.

The TCC connects the cover to the turbine when the TCC is applied.

During TCC release, transmission fluid flows through the torque converter in one direction to release the 2-plate clutch.

During TCC apply, transmission fluid flows through the torque converter in the opposite direction to apply the 2-plate clutch.

The TCC operates in 3 stages:

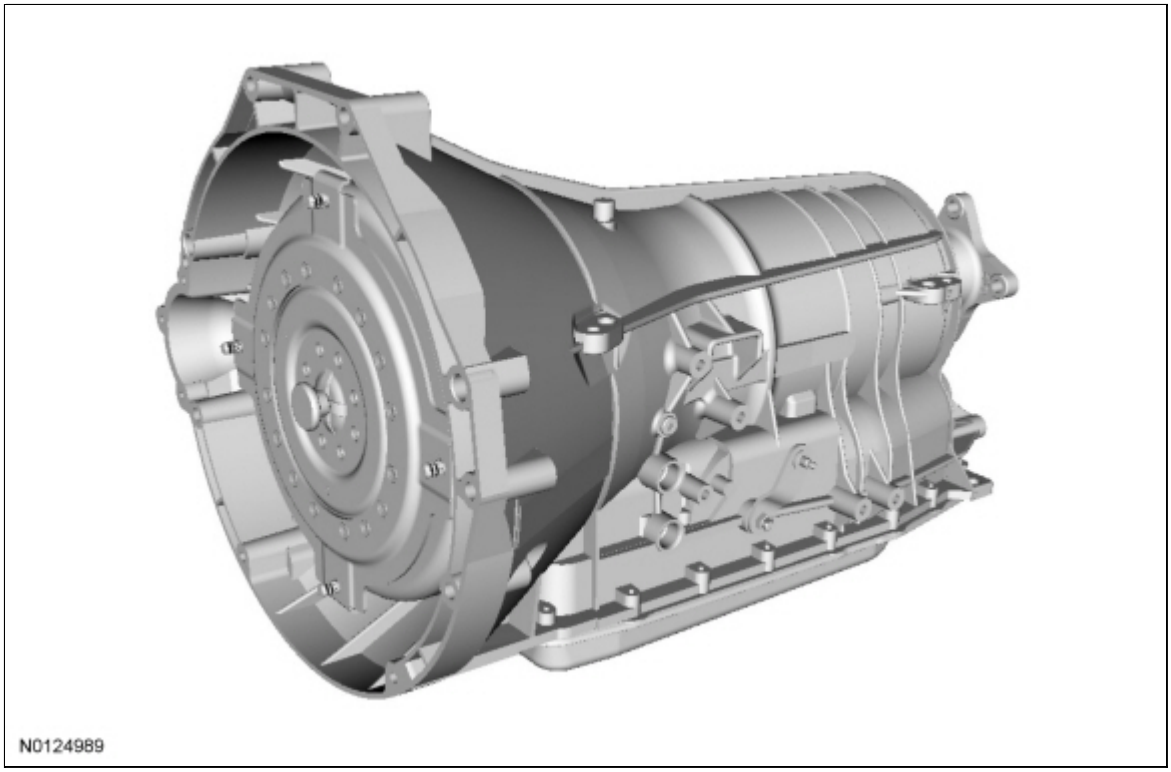
- Full release
- Controlled modulation
- Full apply

The PCM controls TCC operation using the TCC solenoid. TCC solenoid operation provides the modulation of hydraulic pressure to change the position of the bypass clutch control regulator valve. The valve changes the pressure and direction of transmission fluid flow in the torque converter. TCC may be applied in forward gears, 2nd through 6th.

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Transmission Description

6R80 Transmission


N0124989

This transmission has the following features:

- Six forward speeds
- Torque converter with an integral converter clutch
- Electronic shift and pressure controls
- Single planetary gear set
- Double planetary gear set
- Two fixed multi-disc clutches
- Three multi-plate clutches
- One-Way Clutch (OWC)

Hydraulic functions are directed by electronic solenoids to control the following:

- Engagement feel
- Shift feel
- Shift scheduling
- Modulated Torque Converter Clutch (TCC) applications

The 6R80 transmission has a main control assembly which contains:

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- Turbine Shaft Speed (TSS) sensor
- Output Shaft Speed (OSS) sensor
- An internal Transmission Range (TR) sensor
- Transmission Fluid Temperature (TFT) sensor
- Line Pressure Control (LPC)
- TCC solenoid
- Five electronically controlled shift solenoids

Engine power reaches the transmission by a torque converter with an integral converter clutch. The 6 forward gears and one reverse gear are obtained from 2 planetary gearsets.

This 6-speed electronically controlled automatic transmission is comprised of a PCM, main control valve body assembly, torque converter, 1 solenoid valve and 6 pressure regulators. Gear selection is achieved by controlling transmission fluid to operate various internal clutches. The PCM operates the electrical components and provides for the control of gear selection and shift pressure, which increases refinement and torque converter slip.

In the event of a system fault, the PCM also provides for Failure Mode Effect Management to maintain maximum functional operation of the transmission with a minimum power reduction. In the event of a total loss of control or electrical power, the basic transmission functions park, reverse, neutral and drive are retained. Also 3rd or 5th gear is retained by the transmissions hydraulic system. The default gear retained is dependent upon the gear selected at the time of a failure.

Transmission Electronic Control System

Powertrain Control System

The PCM controls the electronic functions of this transmission. A plastic molded leadframe is bolted to the main control assembly. The leadframe contains the Turbine Shaft Speed (TSS), Output Shaft Speed (OSS), Transmission Fluid Temperature (TFT) and Transmission Range (TR) sensors.

The PCM receives input signals from engine and transmission sensors and uses these inputs to control line pressure, shift time, Torque Converter Clutch (TCC), and shift solenoids. The PCM also provides power and ground for the reverse lamp relay coil and provides a PARK/NEUTRAL start enable signal.

The following is a list of direct engine and driver inputs to the PCM along with module information from the vehicle Controller Area Network (CAN):

- Engine speed
- Engine torque
- Engine coolant temperature
- Throttle position
- Accelerator pedal
- Brake pedal
- ABS wheel speed
- Traction control status

The PCM also:

- monitors inputs and outputs for the presence of faults.
- stores DTCs related to detected faults.
- provides outputs on the CAN for transmission range, output shaft speed, turbine shaft speed, transmission fluid temperature, current gear and A/C inhibit.
- provides On-Board Diagnostic (OBD) information using the CAN to illuminate the Malfunction Indicator Lamp (MIL) or Transmission Control Indicator Lamp (TCIL).
- provides diagnostic information to a scan tool through the Data Link Connector (DLC).

If the PCM detects a system or component fault, it substitutes a default value or signal using Failure Mode and Effect Management strategies.

The PCM also uses Failure Mode and Effect Management strategies to compensate for electrical or mechanical shift solenoid and apply component faults that result in alternate shift patterns.

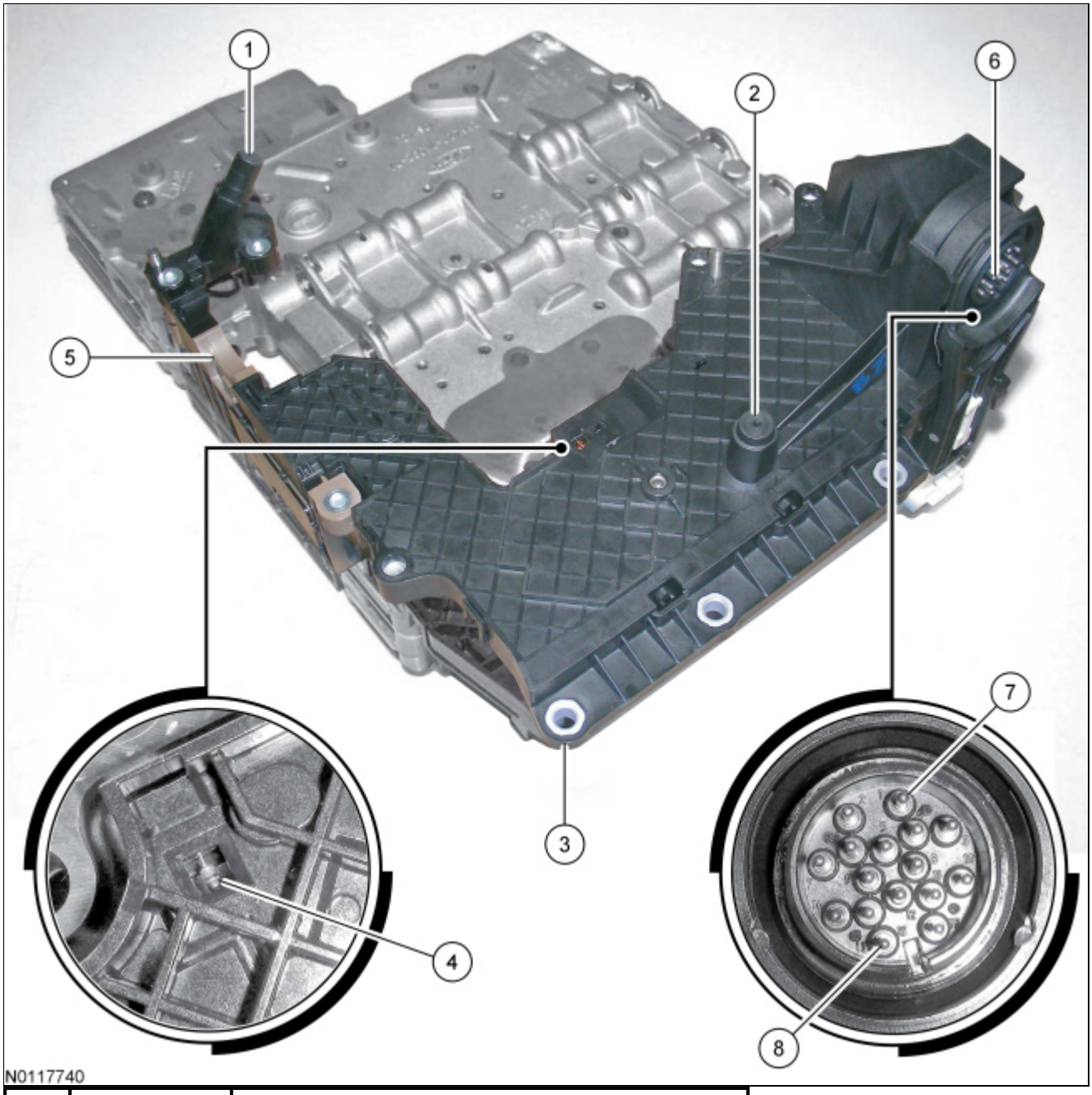
If the transmission loses complete electronic control, it operates in a fail-safe mode with:

- Maximum line pressure in all transmission ranges
- Functional PARK, REVERSE and NEUTRAL positions
- Operation in 3rd or 5th gear (depending on the failure conditions) when the selector lever is in the DRIVE, 3, 2 or 1 position

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- TCC is released in all transmission ranges and gears

Molded Leadframe



Item	Part Number	Description
1	—	Turbine Shaft Speed (TSS) sensor
2	—	Output Shaft Speed (OSS) sensor
3	7G276	Molded leadframe
4	—	Transmission Fluid Temperature (TFT) sensor
5	—	Transmission Range (TR) sensor

6	—	Leadframe connector
7	—	Terminal 1
8	—	Terminal 16

Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L,R/C 4,5,6)	SSE NC	
P	P	Off	On	Off	Off	Off	Off
R	R	Off	Off	Off	Off	Off	Off
N	N	Off	On	Off	Off [a]	Off	Off
D	1	On	On	Off	Off [b]	Off	Off
	2	On	On	On	On	Off	Off
	3	On	Off	Off	On	On	On/Off
	4	On	On	Off	Off	On	On/Off
	5	Off	Off	Off	Off	On	On/Off
	6	Off	On	On	Off	On	On/Off

[a] Solenoid state will change if vehicle is moving forward with the selector lever in the NEUTRAL position.
[b] Solenoid is On when vehicle is above 3 mph.

CB = Clutch brake

NC = Normally closed

NH = Normally high

NL = Normally low

The following are brief descriptions of the sensors and actuators used to control transmission operation.

Line Pressure Control (LPC) Solenoid

The Line Pressure Control (LPC) solenoid, is a Variable Force Solenoid (VFS) that varies hydraulic pressure by actuating a hydraulic valve.

The PCM applies variable current to the LPC solenoid which varies pressure in the VFS5 hydraulic circuit to the main regulator valve. Refer to Hydraulic Circuits in this section.

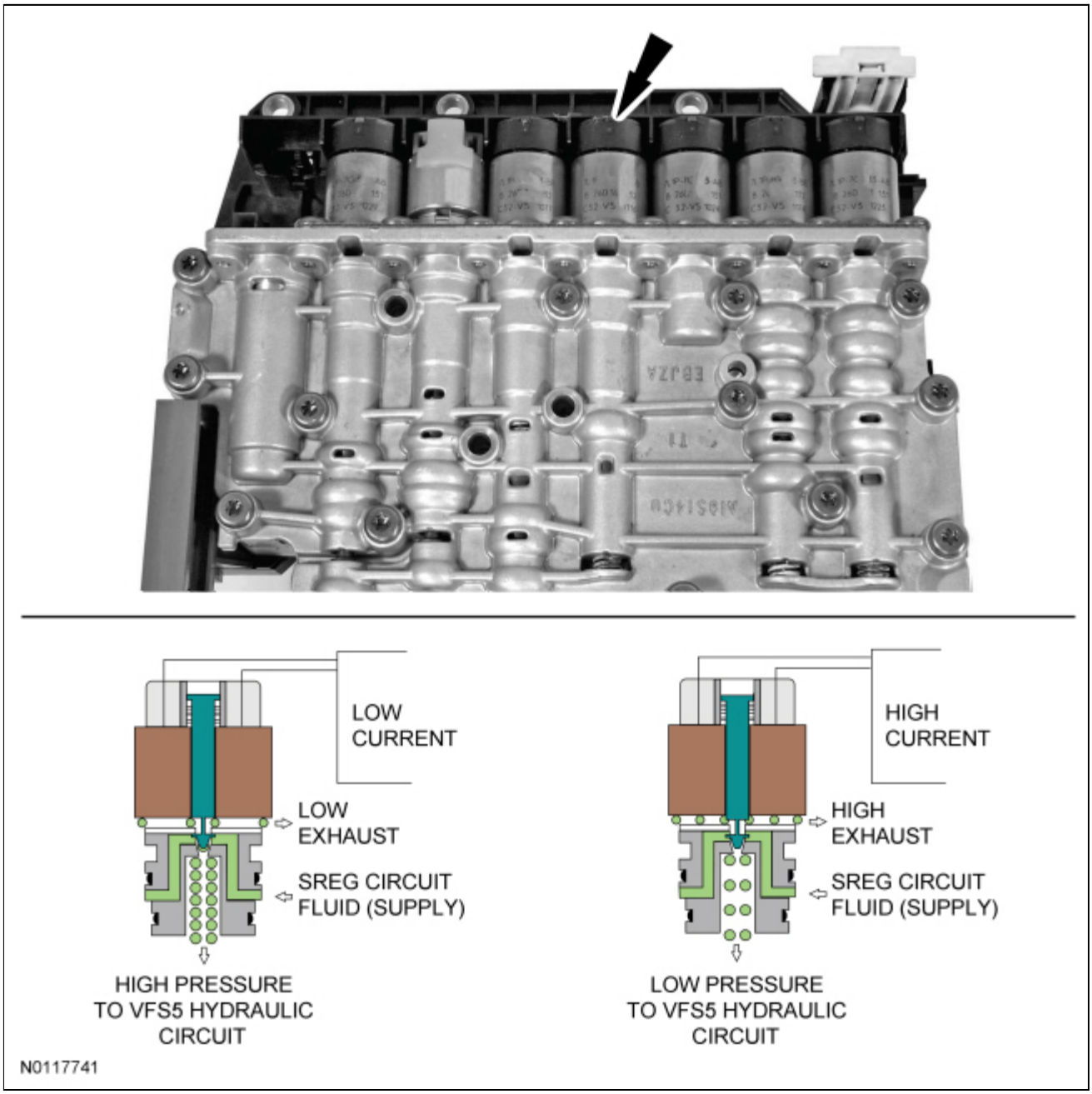
The LPC solenoid uses inversely proportional operation. As the current from the PCM decreases, the pressure from the solenoid increases. As the current from the PCM increases, the pressure from the solenoid decreases. The LPC solenoid is supplied hydraulic pressure from the SREG circuit.

With zero current, the LPC solenoid fully opens the hydraulic valve which applies the maximum amount of hydraulic pressure to the main regulator valve through the VFS5 hydraulic circuit and applies maximum line

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pressure in the PUMP hydraulic circuit. With maximum current to the solenoid, the hydraulic valve fully closes the outlet port for minimum pressure to the VFS5 hydraulic circuit, lowering the line pressure in the PUMP hydraulic circuit.

LPC Inversely Proportional VFS



Torque Converter Clutch (TCC) Solenoid

The TCC solenoid is a VFS that varies hydraulic pressure by actuating a hydraulic valve.

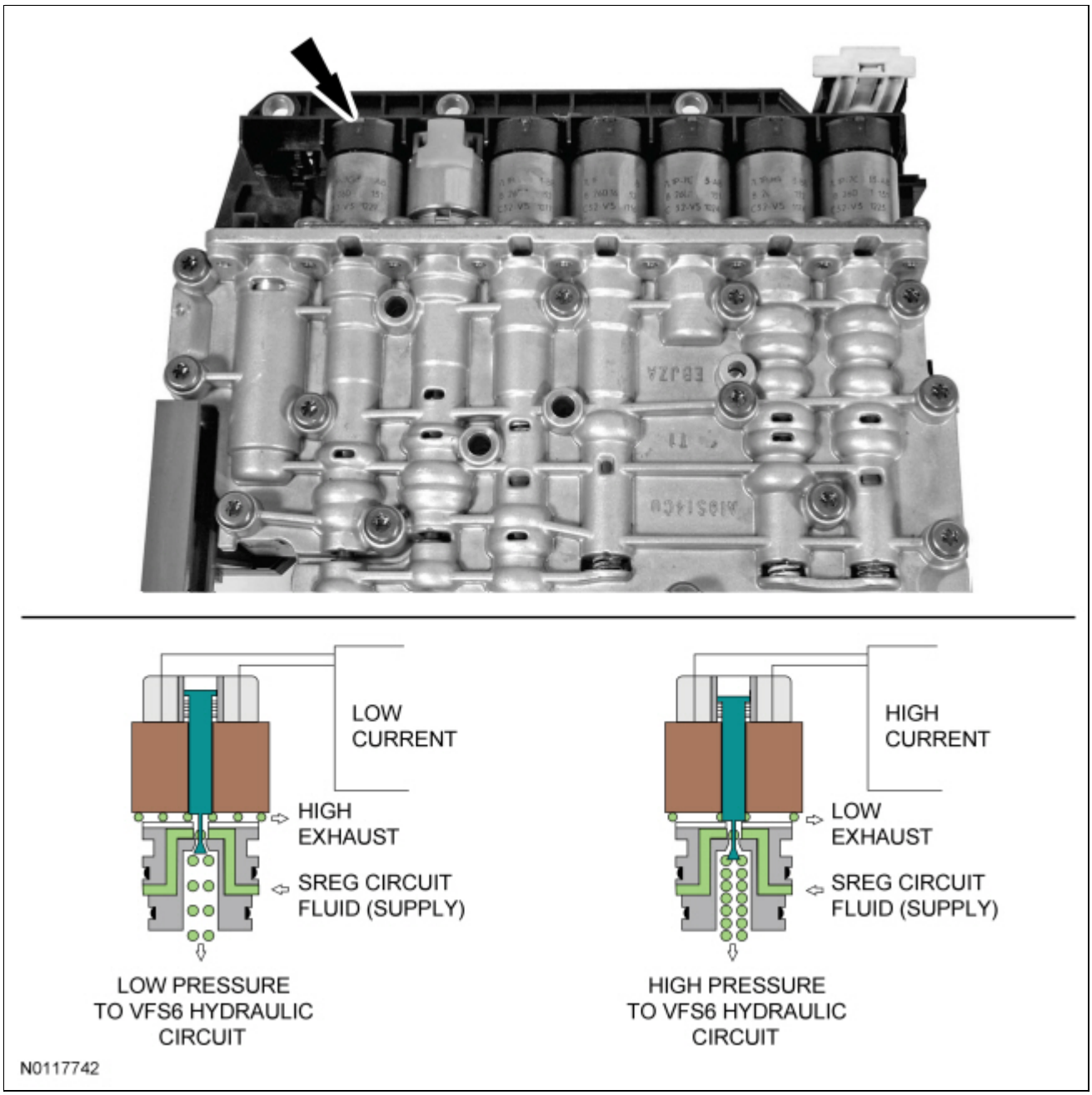
The PCM applies variable current to the TCC solenoid which varies pressure in the VFS6 hydraulic circuit to the converter release regulator valve and the bypass clutch control regulator valve. Refer to Hydraulic

Circuits in this section.

The TCC solenoid uses proportional operation. As the current from the PCM decreases, the pressure from the solenoid decreases. As the current from the PCM increases, the pressure from the solenoid increases. The TCC solenoid is supplied hydraulic pressure from the SREG circuit.

With zero current, the TCC solenoid fully closes the hydraulic valve which applies the minimum amount of hydraulic pressure to the converter release regulator valve and the bypass clutch control regulator valve through the VFS6 hydraulic circuit and releases the TCC . With maximum current to the solenoid, the hydraulic valve fully opens the outlet port for maximum pressure to the VFS6 hydraulic circuit to apply the TCC .

Torque Converter Clutch (TCC) Proportional VFS



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Shift Solenoid A (SSA), Shift Solenoid B (SSB), Shift Solenoid C (SSC) and Shift Solenoid D (SSD)

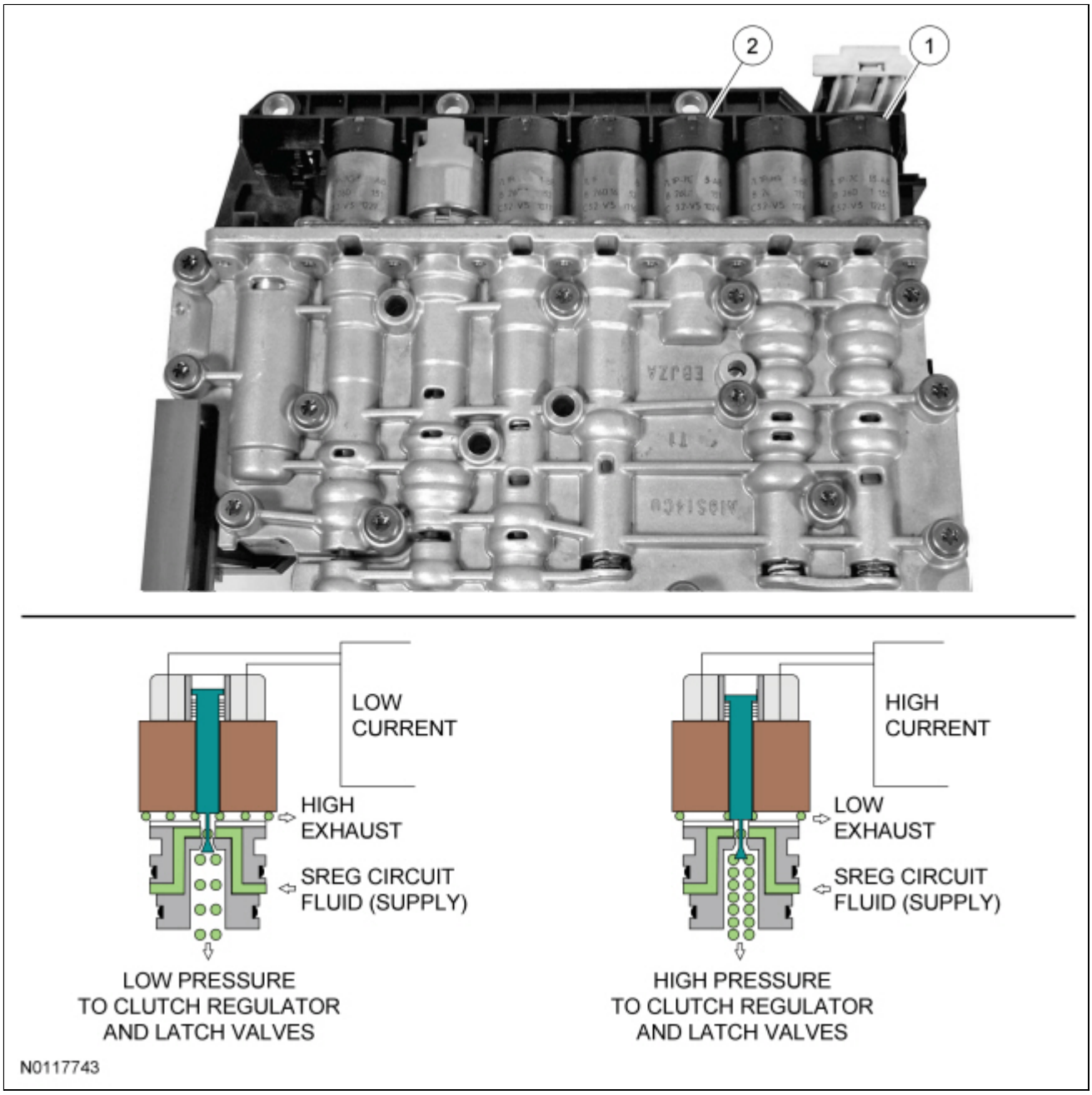
Shift solenoids A through D are VFS that vary hydraulic pressure by actuating a hydraulic valve.

The PCM applies variable current to the shift solenoids which varies pressure in the hydraulic circuit to the regulator and latch valves of the clutch that it controls. Refer to Hydraulic Circuits in this section.

SSA and SSC use proportional operation. As the current from the PCM decreases, the pressure from the solenoid decreases. As the current from the PCM increases, the pressure from the solenoid increases. SSA and SSC are supplied hydraulic pressure from the SREG circuit.

With zero current, SSA and SSC fully close the hydraulic valves which applies zero amount of hydraulic pressure to the regulator and latch valves of the clutch that it controls and releases the clutch. With maximum current to the solenoids, the hydraulic valves fully open for maximum pressure to the regulator and latch valves to apply the clutch.

Shift Solenoid A (SSA) and Shift Solenoid C (SSC) Proportional VFS



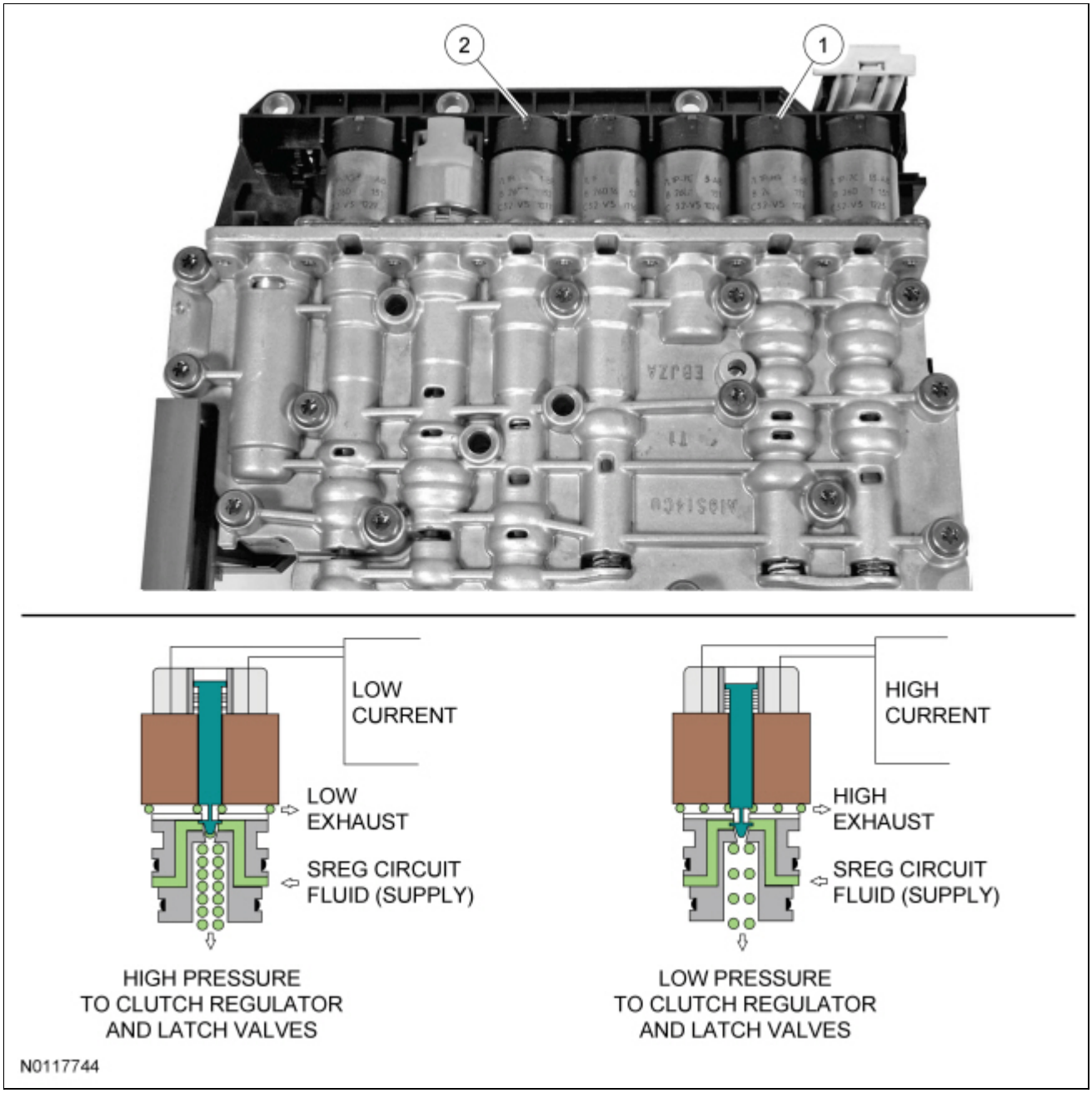
Item	Description
1	Shift Solenoid A (SSA) Variable Force Solenoid (VFS)
2	Shift Solenoid C (SSC) VFS

SSB and SSD use inverse proportional operation. As the current from the PCM decreases, the pressure from the solenoid increases. As the current from the PCM increases, the pressure from the solenoid decreases. SSB and SSD are supplied hydraulic pressure from the SREG circuit.

With zero current, SSB and SSD fully open the hydraulic valves which applies maximum hydraulic pressure to the regulator and latch valves to apply the clutch that it controls. With maximum current to the solenoids, the hydraulic valve fully closes to apply zero amount of hydraulic pressure to the regulator and latch valves of the clutch that it controls and releases the clutch.

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Shift Solenoid B (SSB) and Shift Solenoid D (SSD) Inverse Proportional VFS



Item	Description
1	Shift Solenoid B (SSB) Variable Force Solenoid (VFS)
2	Shift Solenoid D (SSD) VFS

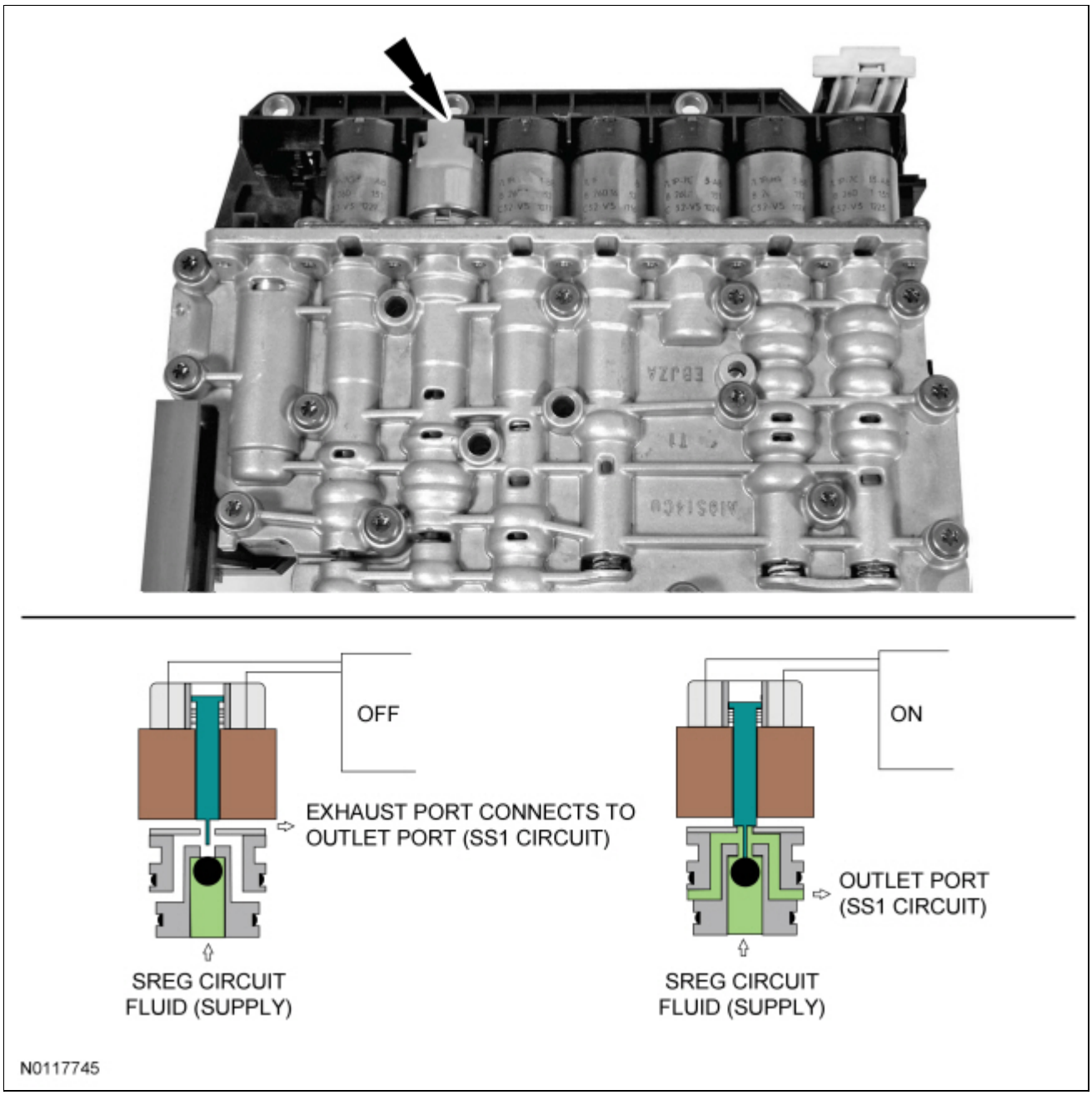
Shift Solenoid E (SSE)

SSE is an ON/OFF solenoid. When SSE is in the OFF position, SSD controls the regulator and latch valves to apply the low/reverse clutch. When SSE is in the ON position, SSD controls the regulator and latch valves

to apply the overdrive (456) clutch. Refer to Hydraulic Circuits in this section.

SSE is supplied hydraulic pressure from the SREG circuit. When SSE is OFF, the solenoid supply is blocked and the outlet port (SS1 circuit) is connected to the exhaust port. When SSE is ON, the exhaust port is blocked and the solenoid supply is connected to the outlet port (SS1 circuit).

Shift Solenoid E (SSE) ON/OFF Solenoid



Turbine Shaft Speed (TSS) Sensor

The TSS sensor is a Hall-effect type sensor that provides a signal to the PCM that changes in frequency as the rotating speed of the forward (1,2,3,4) clutch cylinder varies.

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The PCM compares the TSS sensor signal with the engine speed information to determine the amount of slip occurring in the torque converter.

The PCM also compares the TSS sensor signal with the OSS sensor signal to determine the gear ratio provided by the rear planetary gearset.

The PCM uses the TSS sensor signal as an input for its strategies for shifts and TCC operation. The PCM also uses the TSS sensor signal for transmission fault detection and diagnostics.

Refer to the component illustration at the beginning of this procedure for the location of the TSS sensor.

Output Shaft Speed (OSS) Sensor

The OSS sensor is a Hall-effect type sensor that provides a signal to the PCM that changes in frequency as the rotating speed of the output shaft ring gear varies.

The PCM also compares the OSS sensor signal with the TSS sensor signal to determine the gear ratio provided by the rear planetary gearset.

The PCM uses the OSS sensor signal as an input for its strategies for shifts and TCC operation. The PCM also uses the OSS sensor signal for transmission fault detection and diagnostics.

Refer to the component illustration at the beginning of this procedure for the location of the OSS sensor.

Transmission Fluid Temperature (TFT) Sensor

The TFT sensor is a temperature dependent resistor that is in contact with transmission fluid in the transmission sump area.

The PCM monitors the voltage across the TFT sensor, which changes as transmission fluid temperature varies.

The PCM uses the TFT sensor signal as an input for its strategy for shifting and TCC operation. The PCM also uses the TFT sensor signal for transmission fault detection and diagnostics.

Refer to the component illustration at the beginning of this procedure for the location of the TFT sensor.

Transmission Range (TR) Sensor

The TR sensor has a set of Hall-effect sensors that have a pattern of ON/OFF states which are dependant on the PARK, REVERSE, NEUTRAL, DRIVE, 3, 2 or 1 position of the manual valve.

The TR sensor also provides signals for the starting system and the reverse lights.

The PCM uses the TR sensor signal as an input for its strategy for shifting and TCC operation. The PCM also uses the TR sensor signal for transmission fault detection and diagnostics.

Refer to the component illustration at the beginning of this procedure for the location of the TR sensor.

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Transmission Operation

Transmission Operation Overview

Transmission operation is controlled by the PCM.

Torque Converter

This transmission uses a torque converter with the following elements:

- Impeller
- Turbine
- Reactor
- Torque Converter Clutch (TCC)

For component information, refer to Torque Converter in this section.

Planetary Gearsets

Operation of this transmission involves the use of 2 planetary gearsets that have the following components:

- Front (single planetary gearset)
  - One sun gear
  - One planetary carrier with 4 gears
  - One ring gear
- Rear (ravigneaux planetary gearset)
  - Two sun gears of different sizes
  - Three short planetary gear pinions meshing with the sun gears
  - Three long planetary gear pinions meshing with the sun gears
  - One planetary carrier
  - One ring gear

Apply Clutches

This transmission uses the following clutches to operate the 2 planetary gearsets:

- Forward clutch (A)
- Direct clutch (B)
- Intermediate clutch (C)
- Low/reverse clutch (D)
- Overdrive clutch (E)
- Low One-Way Clutch (OWC)

For information about planetary gearsets or the apply clutches, refer to Mechanical Components and Functions in this section.

Hydraulic System

The hydraulic operation of this transmission includes the following components:

- Main control assembly
- Pump assembly with filter
- Torque converter
- Apply components (clutches)

For component information, refer to Hydraulic System in this section.

Electronic Operation

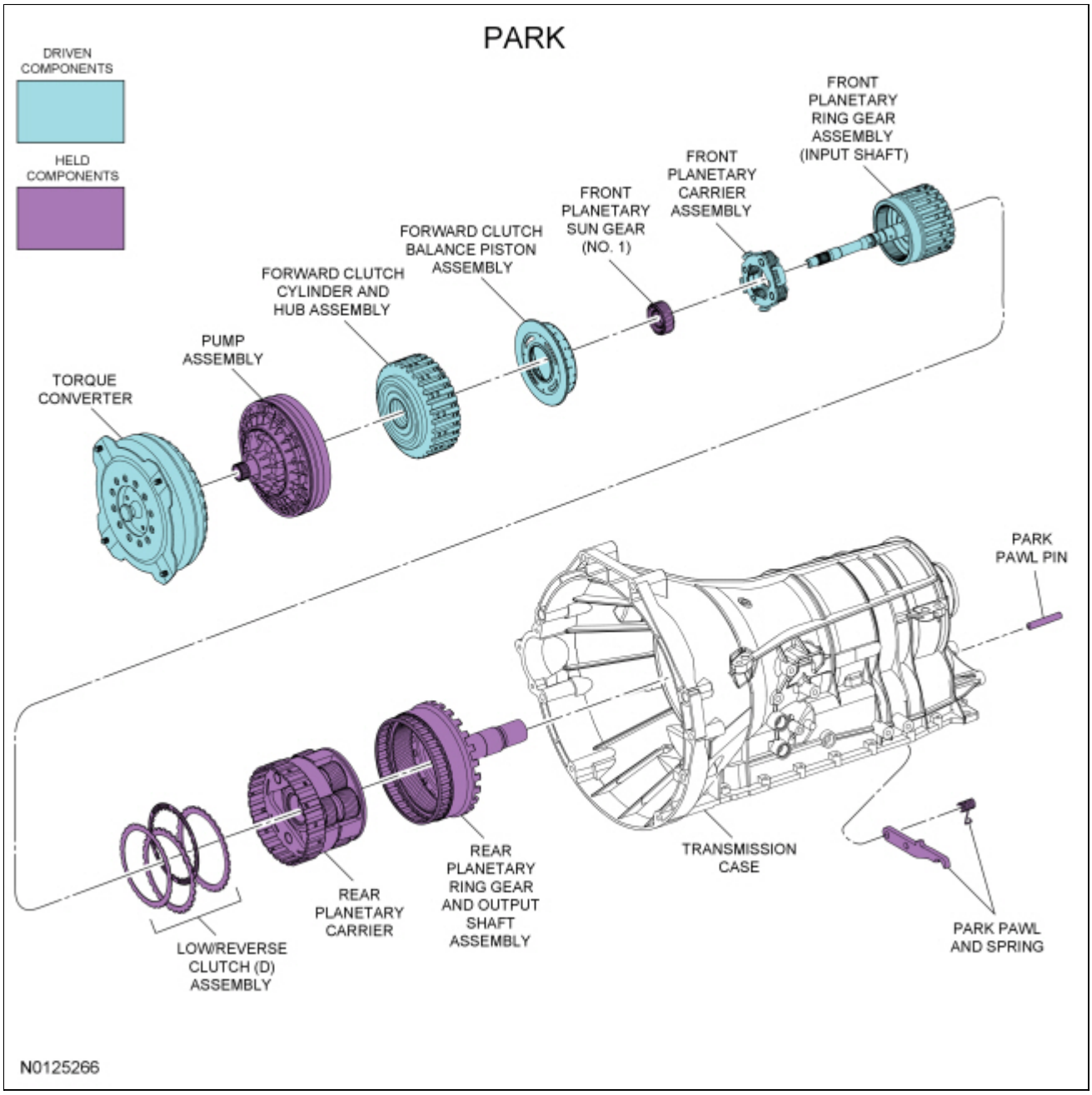
The PCM controls the operation of this transmission with the following solenoids:

- Line Pressure Control (LPC) solenoid
- Shift Solenoid A (SSA)
- Shift Solenoid B (SSB)
- Shift Solenoid C (SSC)
- Shift Solenoid D (SSD)
- Shift Solenoid E (SSE)
- TCC solenoid

For solenoid information, refer to Transmission Electronic Control System in this section.

Park Position

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Mechanical Operation

Apply components:

- Park pawl engaged holding the park gear (output shaft) stationary
- Low/reverse clutch (D) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- None

Rear planetary gearset driven components:

- None

Rear planetary gearset held components:

- Planetary carrier
- Ring gear (output shaft)

Park Position Clutch Application Chart

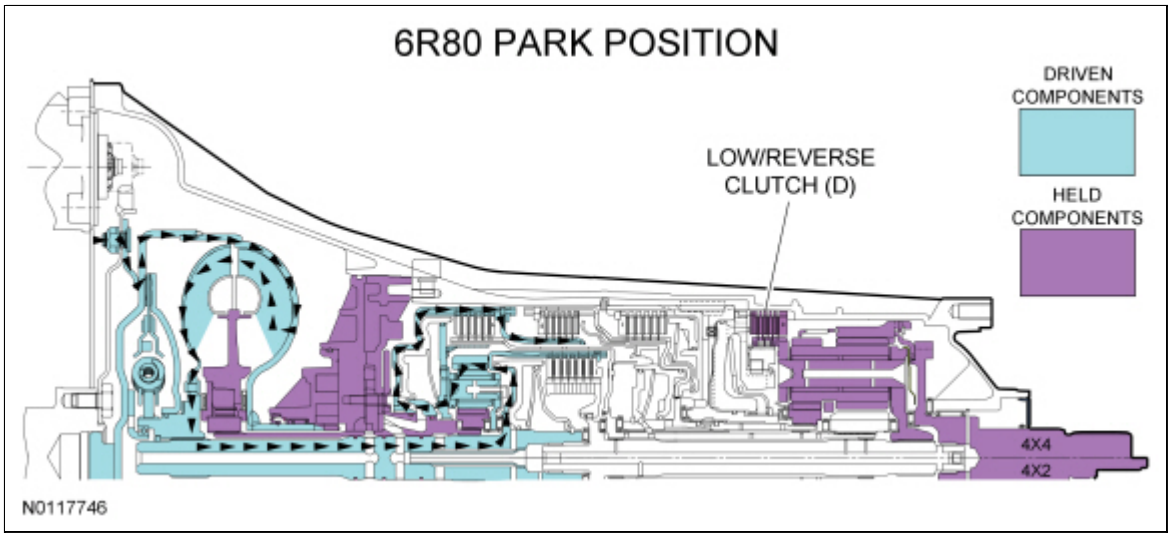
Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
Park				H		
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- H = Hold Clutch

For component information, refer to Mechanical Components and Functions in this section.

Park Position Power Flow

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Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoids through the SREG hydraulic circuit.
- The LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit.
- The position of the solenoid multiplex valve allows pressure from the VFS4 circuit to be directed to the D1 and D2 latch and regulator valves through the CL DC circuit to position the valves for low/reverse clutch (D) application.

Clutch hydraulic circuits:

- Line pressure is supplied by the pump to the D1 latch and regulator valves.
- Regulated line pressure from the D1 regulator valve is supplied to the low/reverse clutch (D) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Park Position Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
P	P	Off	On	Off	On	On	Off

CB = Clutch brake

NC = Normally closed

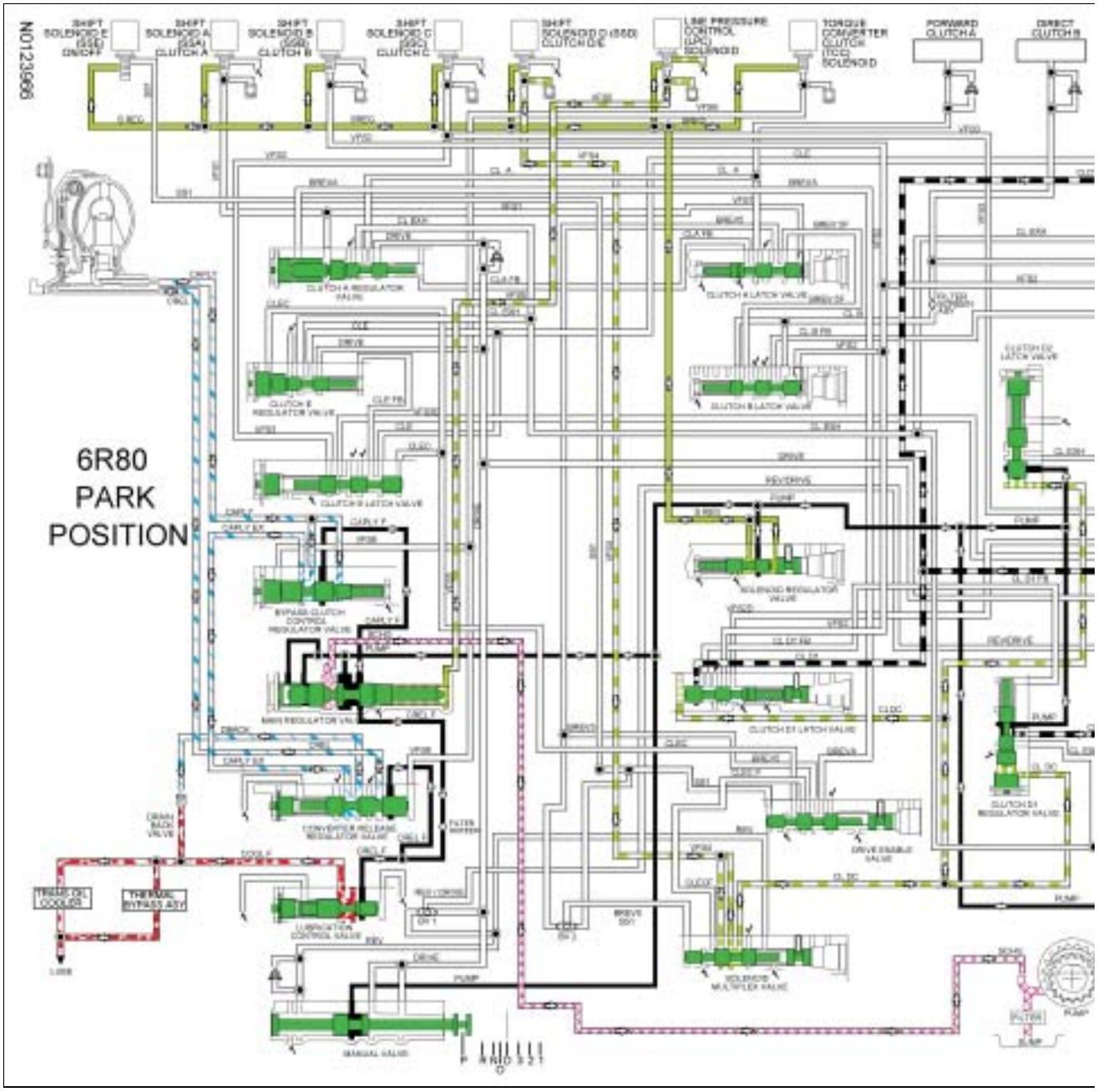
NH = Normally high

NL = Normally low

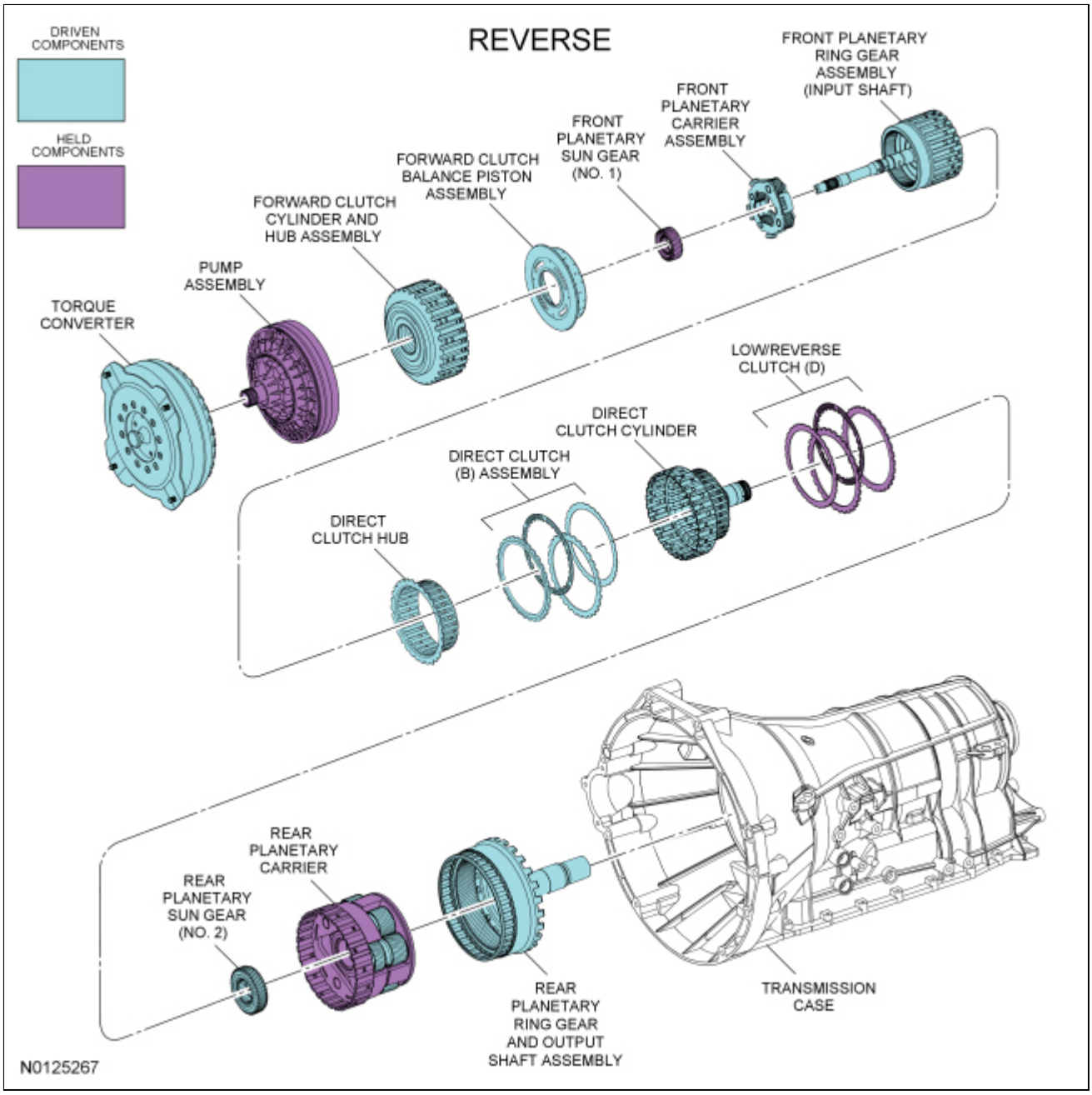
For solenoid information, refer to Transmission Electronic Control System in this section.

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Reverse Position



Mechanical Operation

Apply components:

- Low/reverse clutch (D) applied
- Direct clutch (B) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

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Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- Sun gear No. 2

Rear planetary gearset driven components:

- Ring gear (output shaft)

Rear planetary gearset held components:

- Planetary carrier

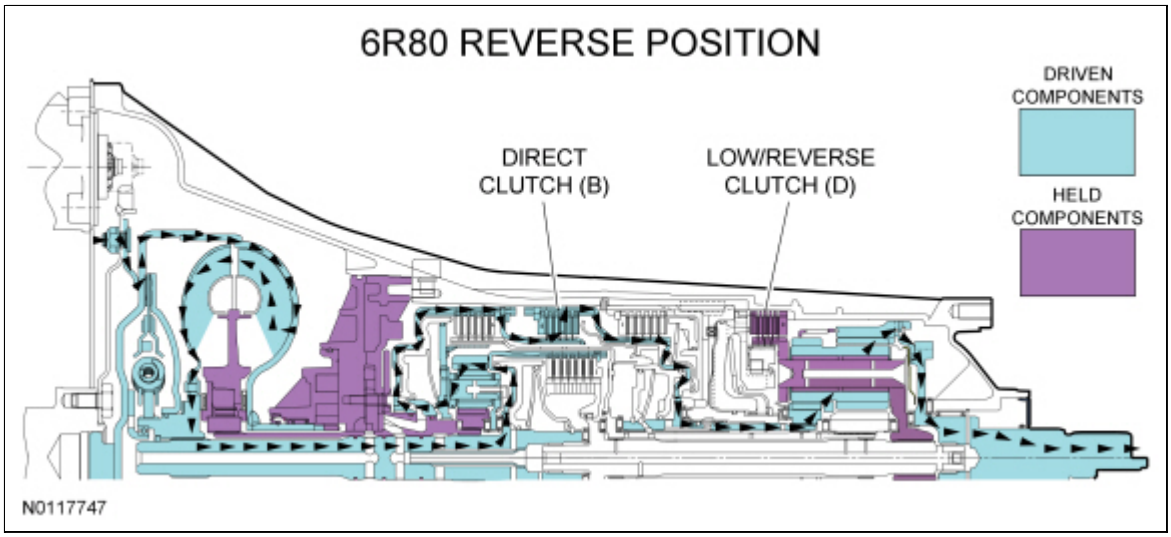
Reverse Position Clutch Application Chart

Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
Reverse		D		H		
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- H = Hold Clutch

For component information, refer to Mechanical Components and Functions in this section.

Reverse Position Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In reverse, the manual valve directs line pressure to the No. 1 shuttle valve and the solenoid multiplex valve through the REV circuit.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

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lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit.
- The position of the solenoid multiplex valve allows pressure from the VFS4 circuit to be directed to the D1 and D2 latch and regulator valves through the CLDC circuit to position the valves for low/reverse clutch (D) application.
- SSB supplies pressure to the clutch B regulator and latch valves to position the valves for direct clutch (B) application.

Clutch hydraulic circuits:

- Line pressure is supplied by the pump to the D1 latch and regulator valves.
- Regulated line pressure from the D1 regulator valve is supplied to the low/reverse clutch (D) to apply the clutch.
- Line pressure is supplied by the manual valve to the clutch B latch and regulator valves.
- Regulated line pressure from the clutch B regulator valve is supplied to the direct clutch (B) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Reverse Position Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
R	R	Off	Off	Off	Off	On	Off

CB = Clutch brake

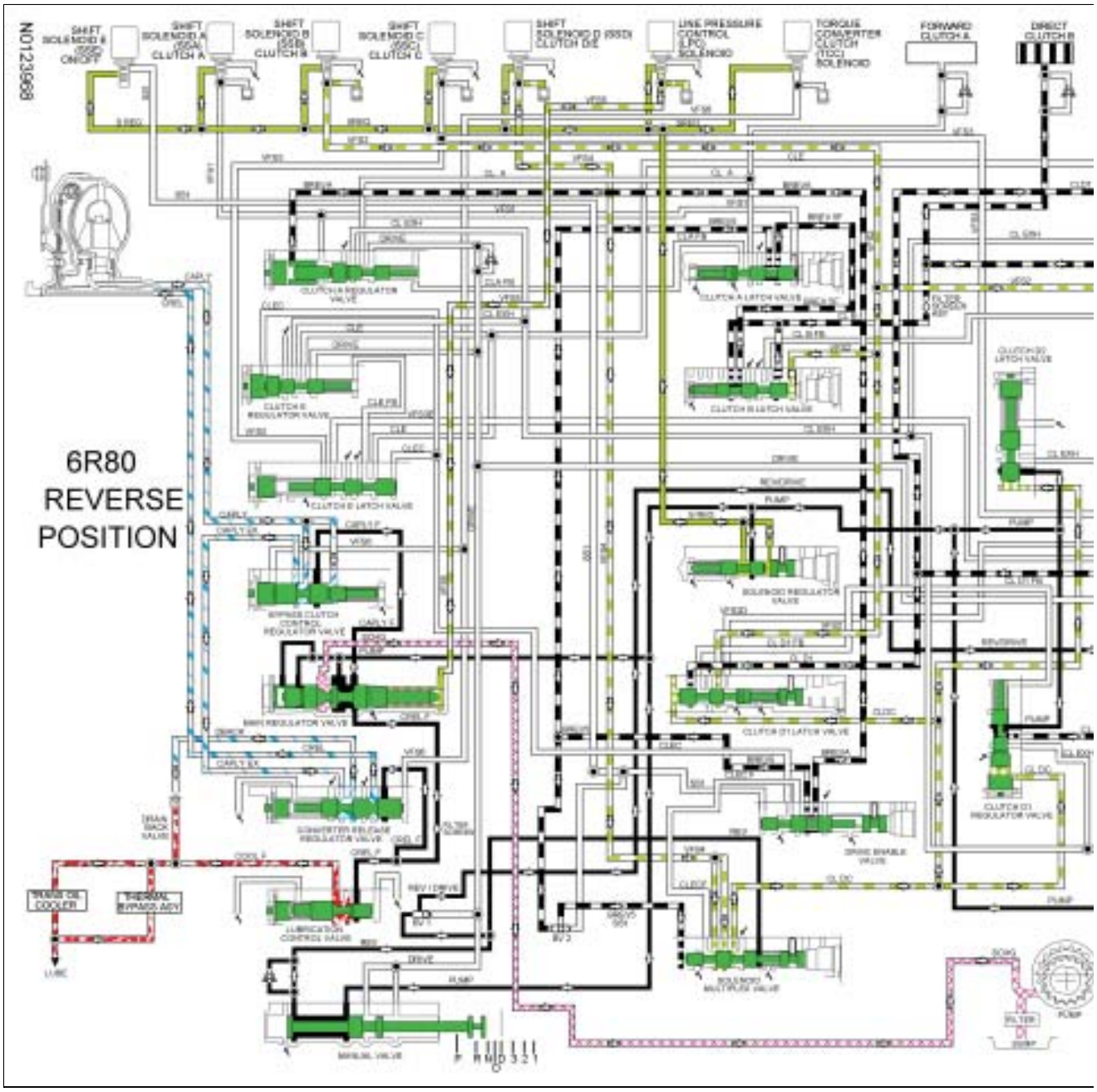
NC = Normally closed

NH = Normally high

NL = Normally low

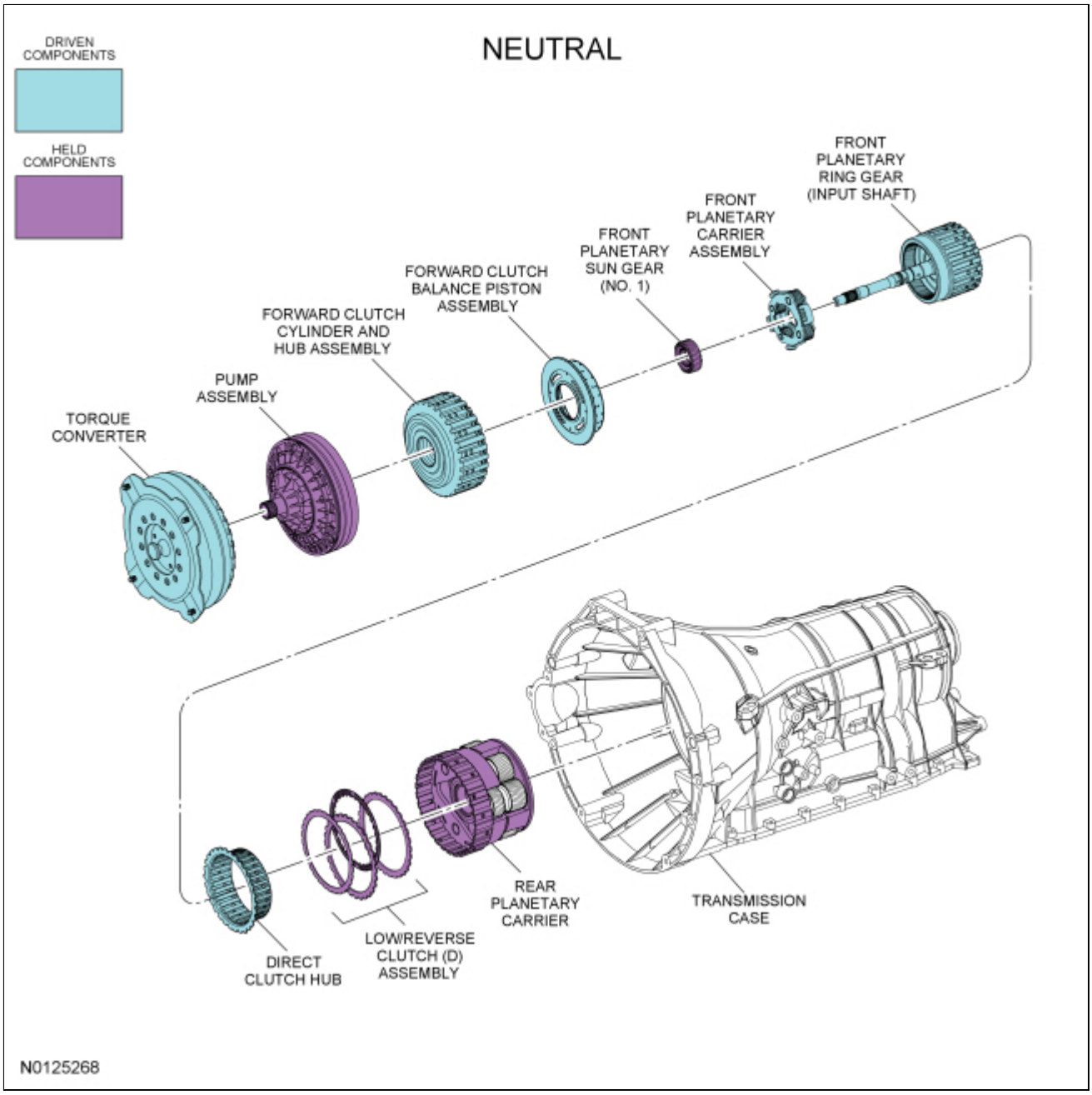
For solenoid information, refer to Transmission Electronic Control System in this section.

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Neutral Position

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Mechanical Operation

Apply components:

- Low/reverse clutch (D) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- None

Rear planetary gearset driven components:

- None

Rear planetary gearset held components:

- Planetary carrier

Neutral Position Clutch Application Chart

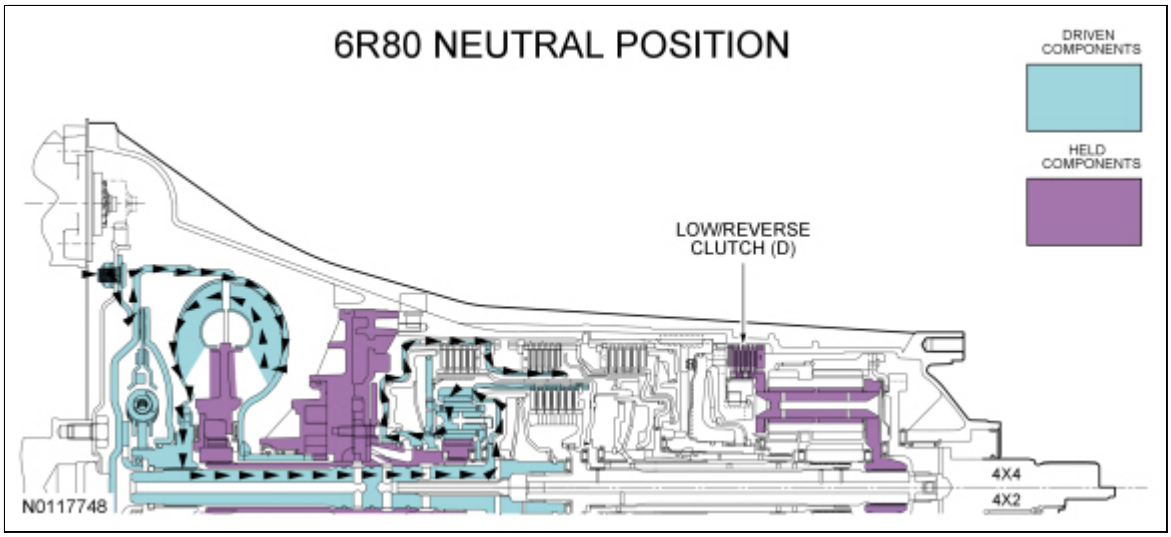
Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
Neutral				H		
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- H = Hold Clutch

For component information, refer to Mechanical Components and Functions in this section.

Neutral Position Power Flow

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Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit.
- The position of the solenoid multiplex valve allows pressure from the VFS4 circuit to be directed to the D1 latch and regulator valves through the CL DC circuit to position the valves for low/reverse clutch (D) application.

Clutch hydraulic circuits:

- Line pressure is supplied by the pump to the D1 latch and regulator valves.
- Regulated line pressure from the D1 regulator valve is supplied to the low/reverse clutch (D) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Neutral Position Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
N	N	Off	On	Off	On [a]	On [a]	Off

[a] Solenoid state changes if vehicle is moving forward with the selector lever in the NEUTRAL position.

CB = Clutch brake

NC = Normally closed

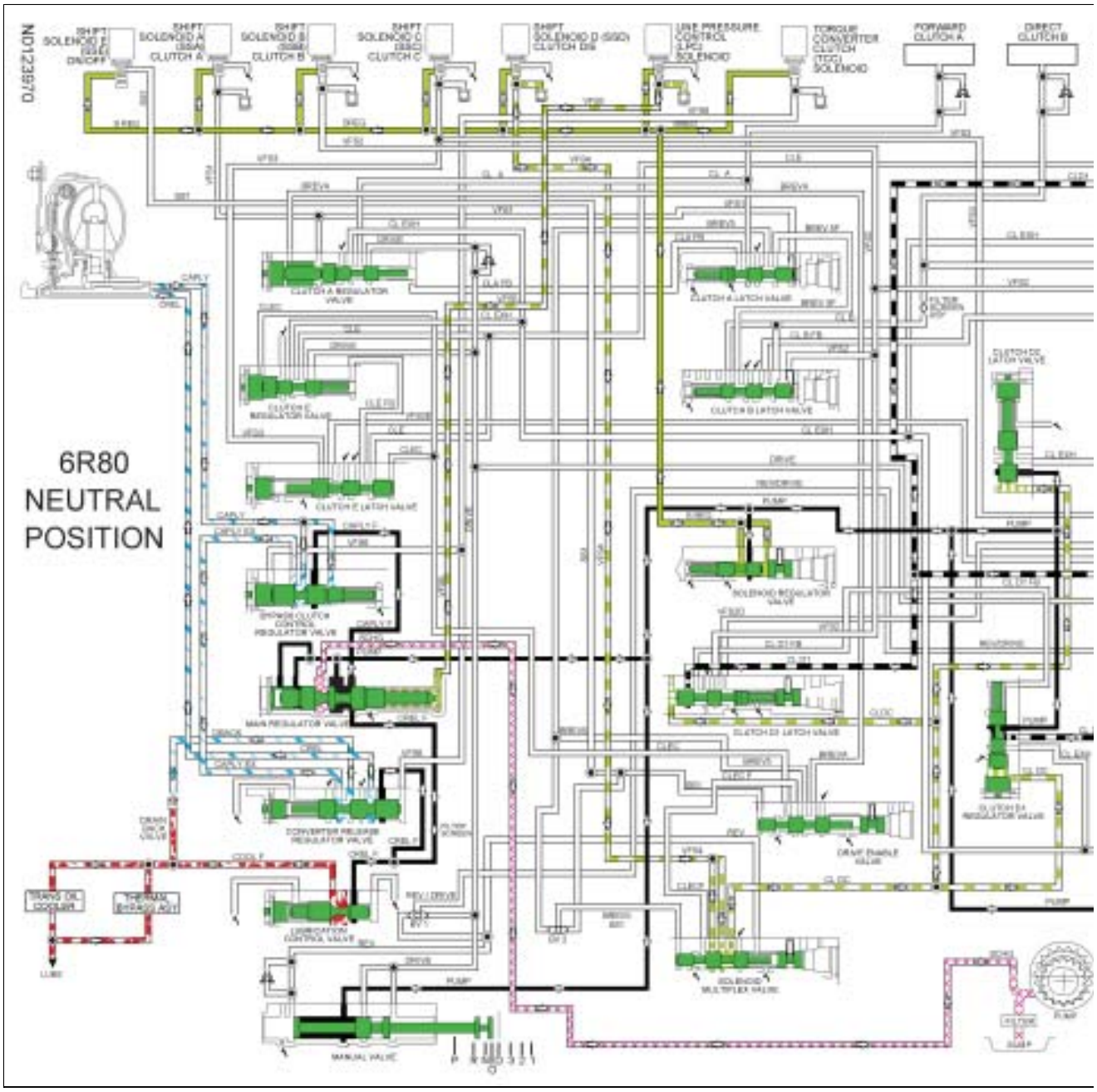
NH = Normally high

NL = Normally low

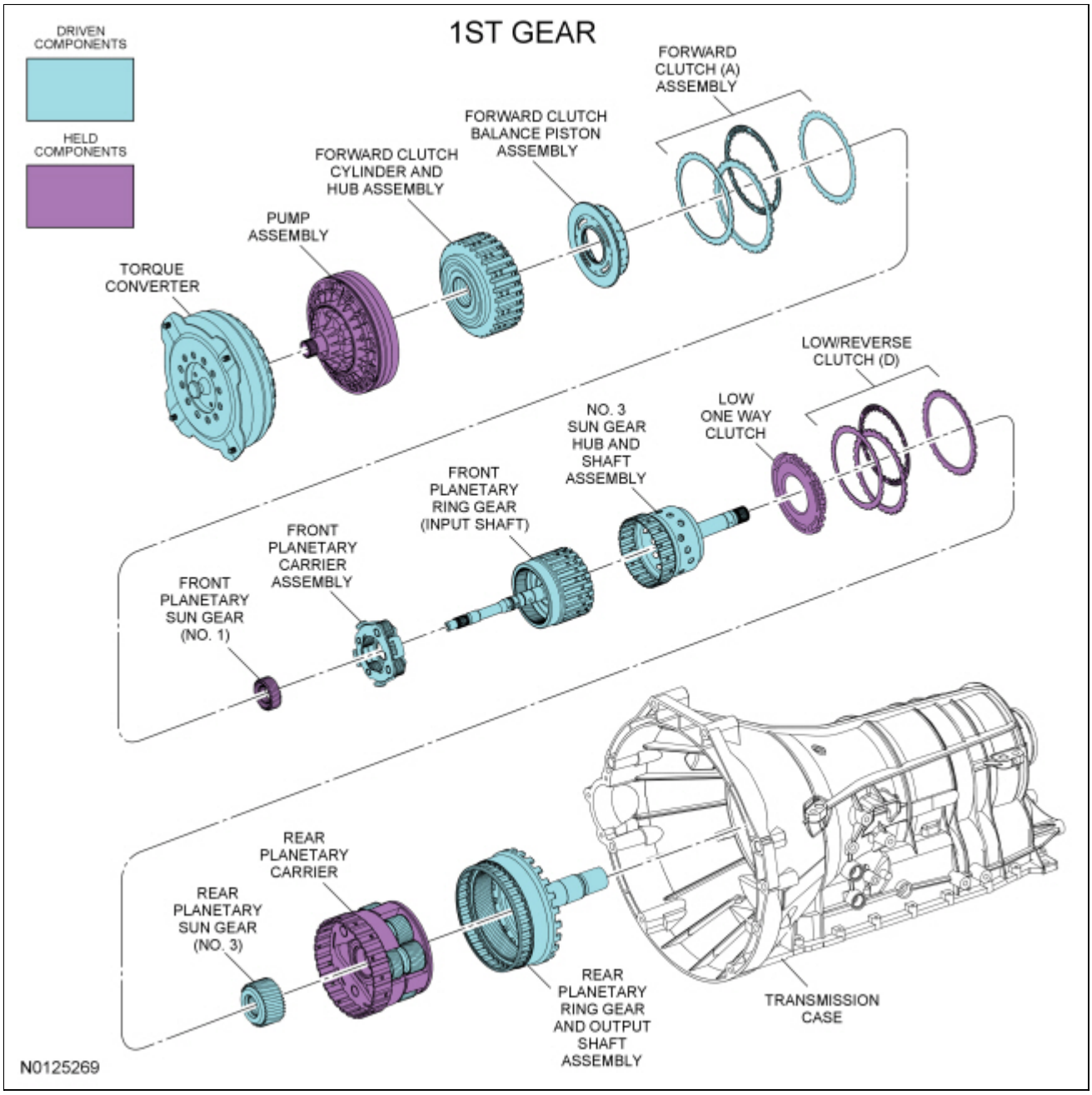
For solenoid information, refer to Transmission Electronic Control System in this section.

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1st Gear



Mechanical Operation

Apply components:

- Low/reverse clutch (D) applied Below 5 kph (3 mph) only
- Low/One-Way Clutch (OWC)
- Forward clutch (A) applied

Planetary Gearset Operation

Front planetary gearset driving components:

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- Ring gear (input shaft)

Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- No. 3 sun gear

Rear planetary gearset driven components:

- Ring gear (output shaft)

Rear planetary gearset held components:

- Planetary carrier

1st Gear Clutch Application Chart

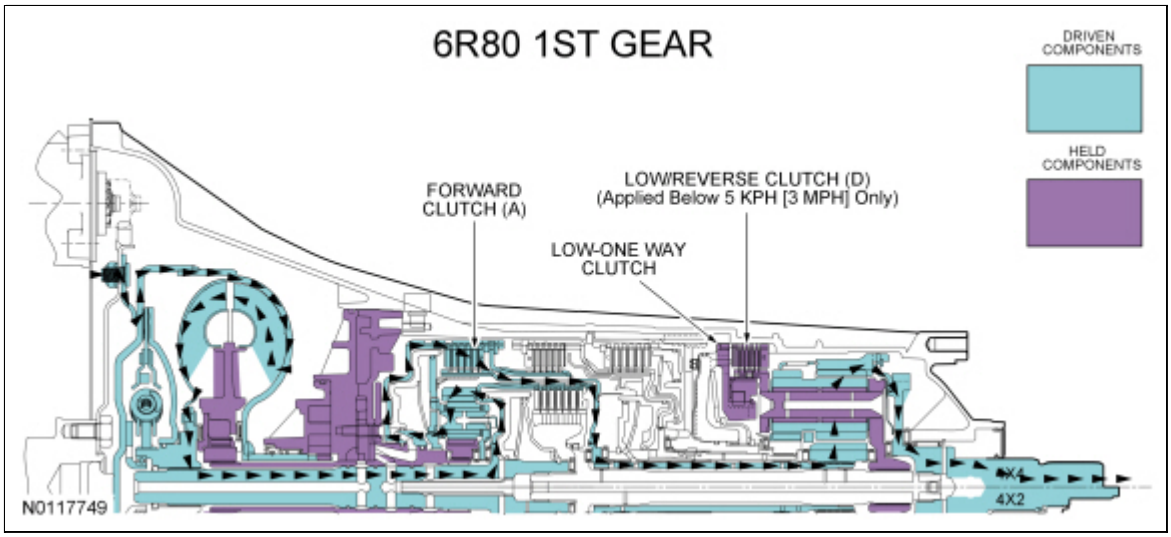
Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
1st Gear D	D			H [a]		H
1st Gear Manual	D			H		H
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

[a] Clutch released when vehicle speed is above 3 mph.

- D = Drive Clutch
- H = Hold Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

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lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- Below 5 kph (3 mph), SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit. Above 5 kph (3 mph), amperage to SSD is increased to decrease pressure to the solenoid multiplex valve and clutch D1 regulator valve to release the low/reverse clutch (D).
- The position of the solenoid multiplex valve allows pressure from the VFS4 circuit to be directed to the D1 latch and regulator valves through the CLDC circuit to position the valves for low/reverse clutch (D) application.
- SSA supplies pressure to the clutch A regulator and latch valves to position the valves for forward clutch (A) application.

Clutch hydraulic circuits:

- Line pressure is supplied by the pump to the D1 latch and regulator valves.
- Below 5 kph (3 mph), regulated line pressure from the D1 regulator valve is supplied to the low/reverse clutch (D) to apply the clutch. Above 5 kph (3 mph) the D1 regulator valve exhausts to release the low/reverse clutch and the Low/ OWC continues to hold the rear planetary carrier with no engine braking.
- Regulated line pressure from the clutch A regulator valve is supplied to the forward clutch (A) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

1st Gear Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
D	1	On	On	Off	Off [b]	On	Off
1	1	On	On	Off	Off	On	Off

[b] Solenoid is On when vehicle is above 3 mph.

CB = Clutch brake

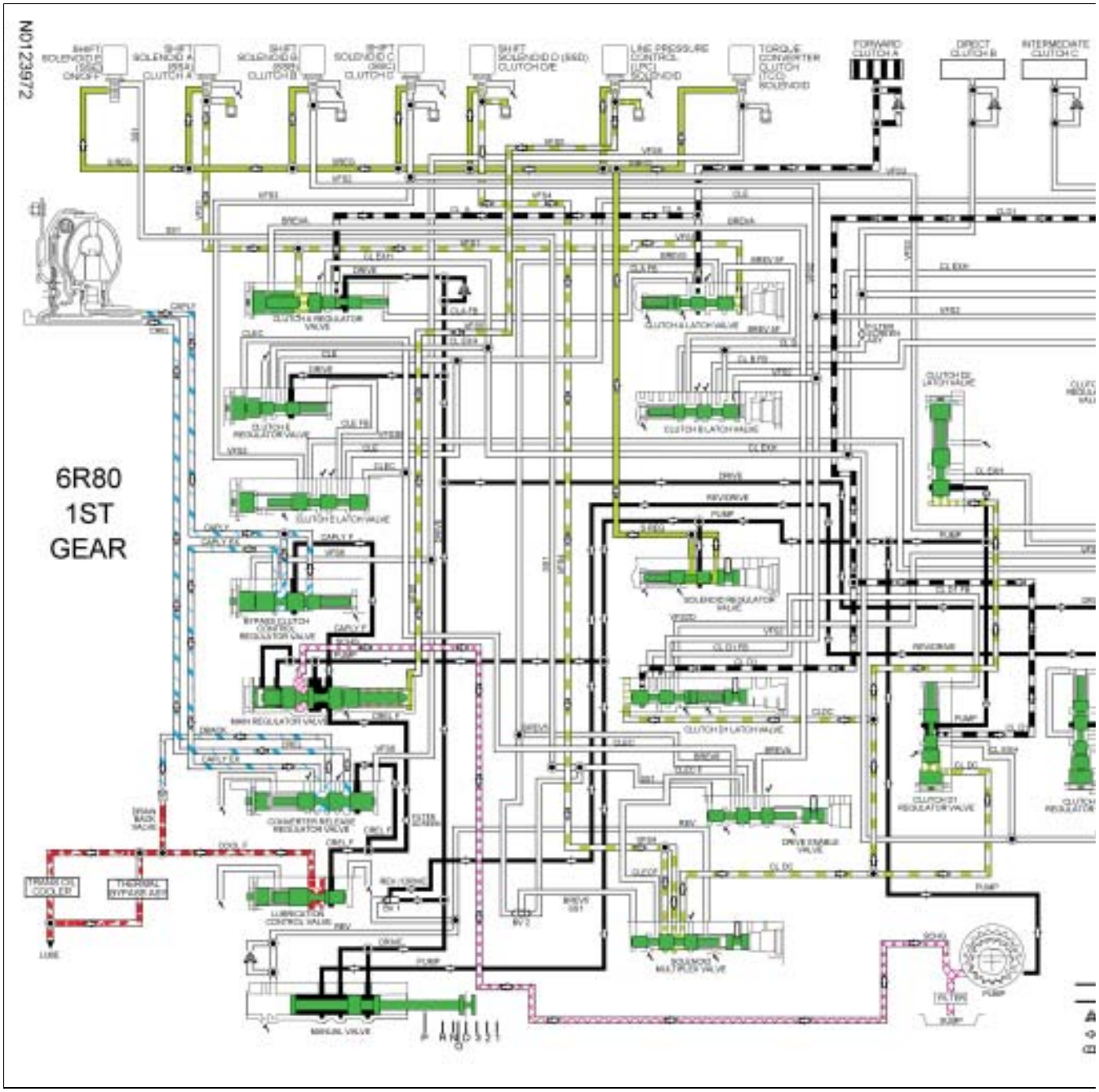
NC = Normally closed

NH = Normally high

NL = Normally low

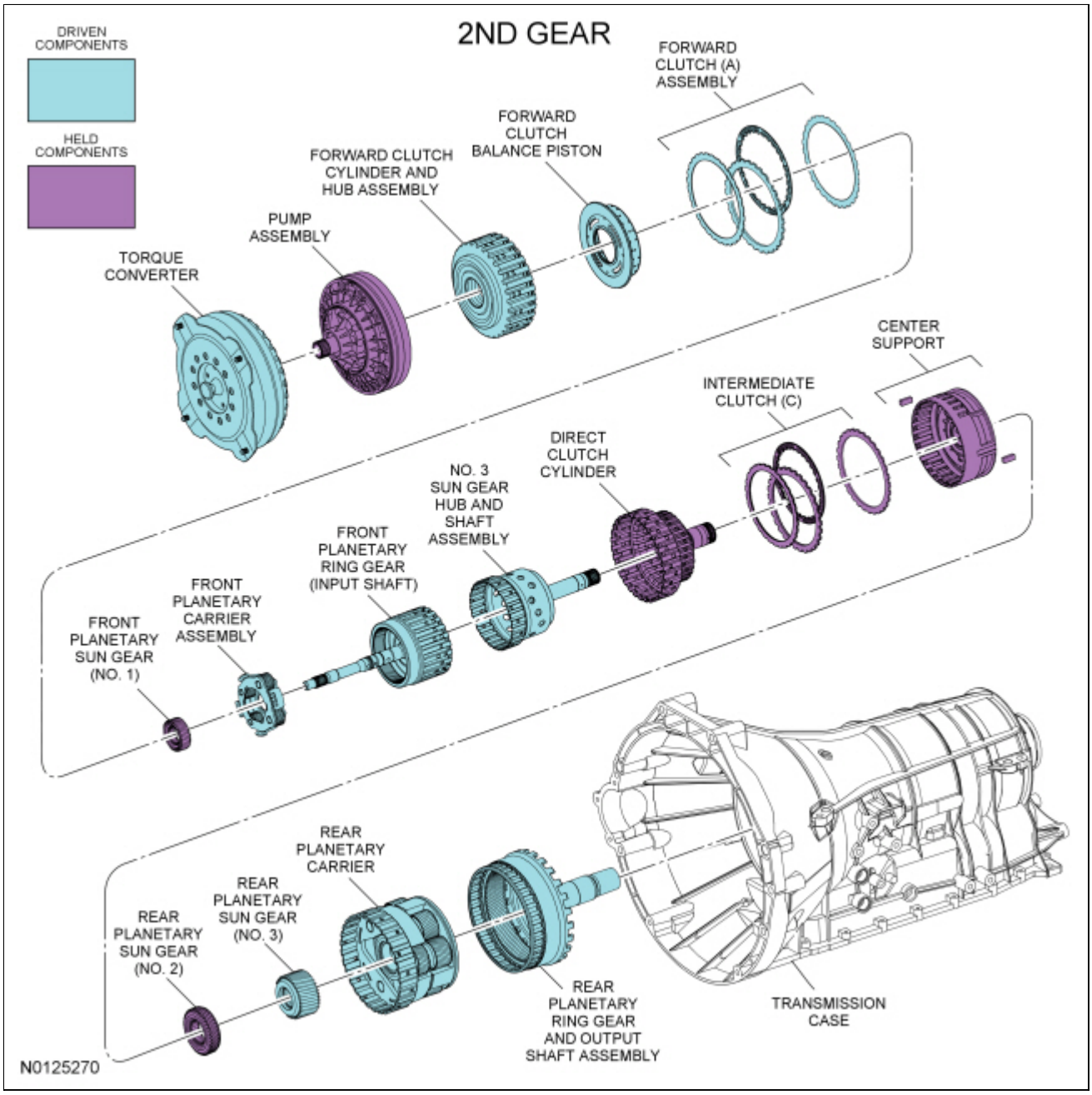
For solenoid information, refer to Transmission Electronic Control System in this section.

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2nd Gear

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Mechanical Operation

Apply components:

- Forward clutch (A) applied
- Intermediate clutch (C) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- No. 3 sun gear

Rear planetary gearset driven components:

- Planetary carrier
- Ring gear (output shaft)

Rear planetary gearset held components:

- No. 2 sun gear

2nd Gear Clutch Application Chart

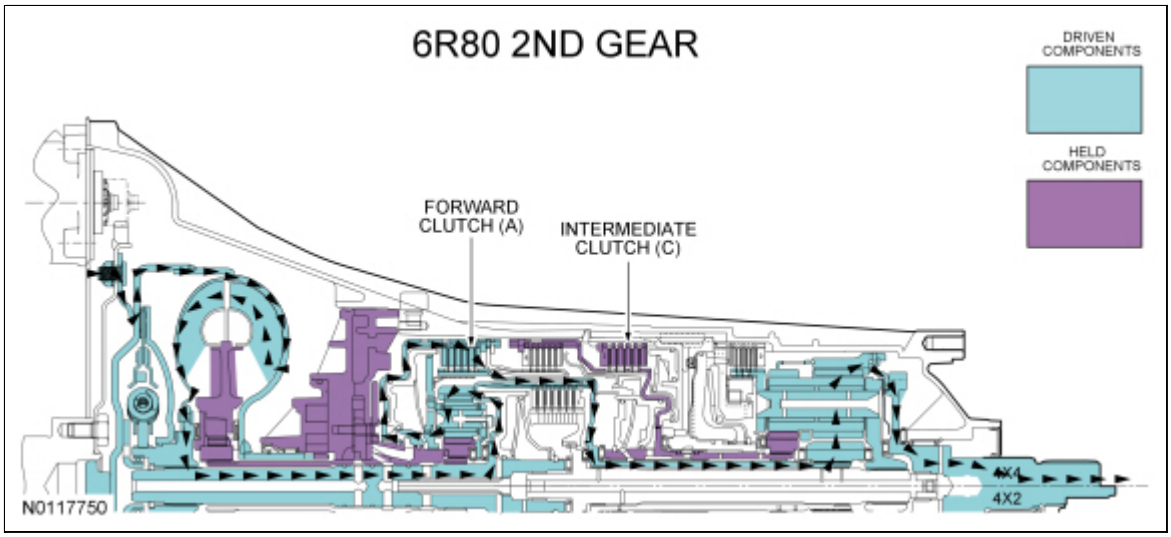
Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
2nd Gear D and Manual 2	D		H			O/R
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- H = Hold Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow

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Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSA supplies pressure to the clutch A regulator and latch valves to position the valves for forward clutch (A) application.
- SSC supplies pressure to the clutch C regulator valve to position the valve for intermediate clutch (C) application.

Clutch hydraulic circuits:

- Regulated line pressure from the clutch A regulator valve is supplied to the forward clutch (A) to apply the clutch.
- Regulated line pressure from the clutch C regulator valve is supplied to the intermediate clutch (C) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

2nd Gear Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
D and 2	2	On	On	On	On	Off	Off

CB = Clutch brake

NC = Normally closed

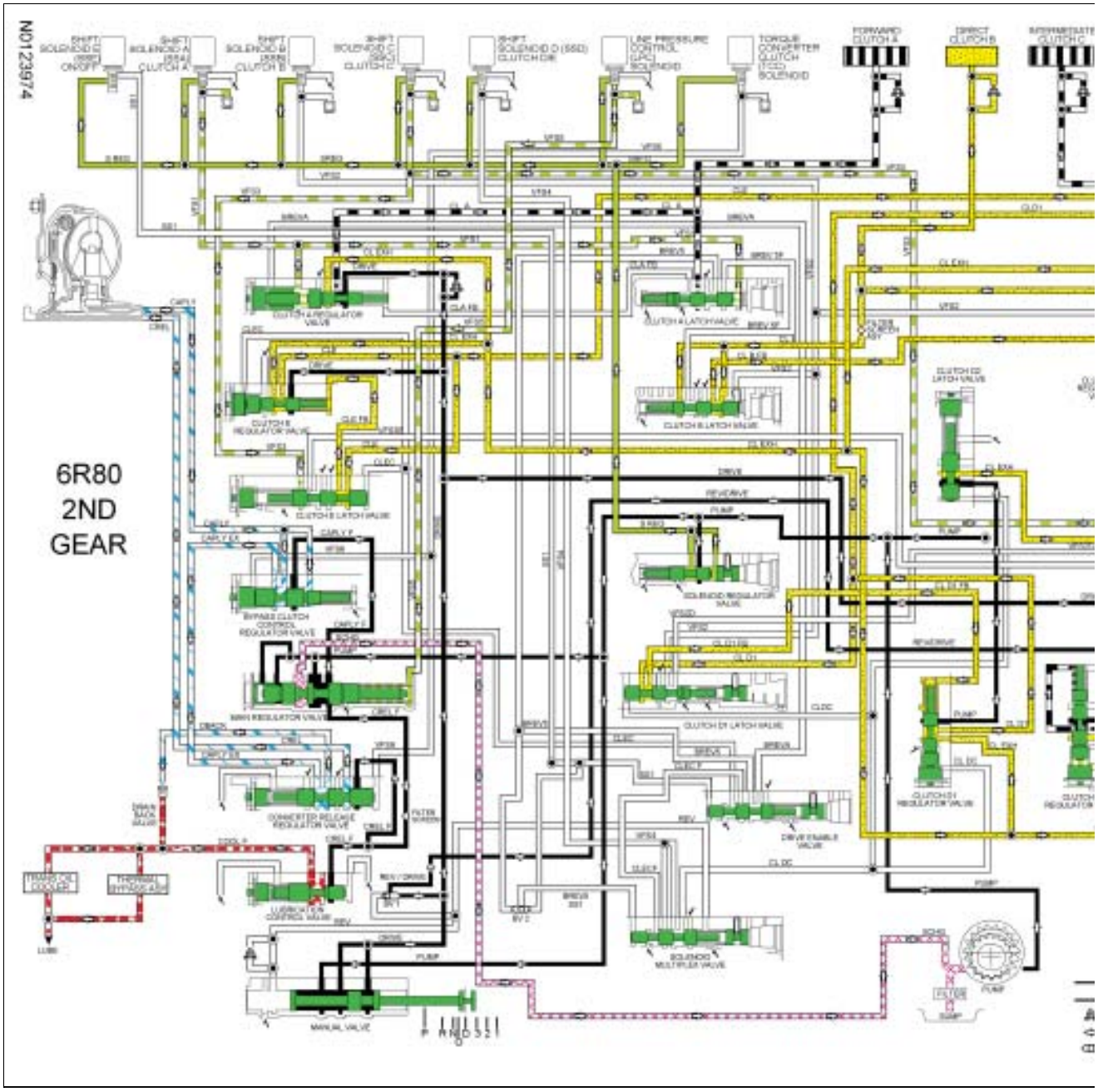
NH = Normally high

NL = Normally low

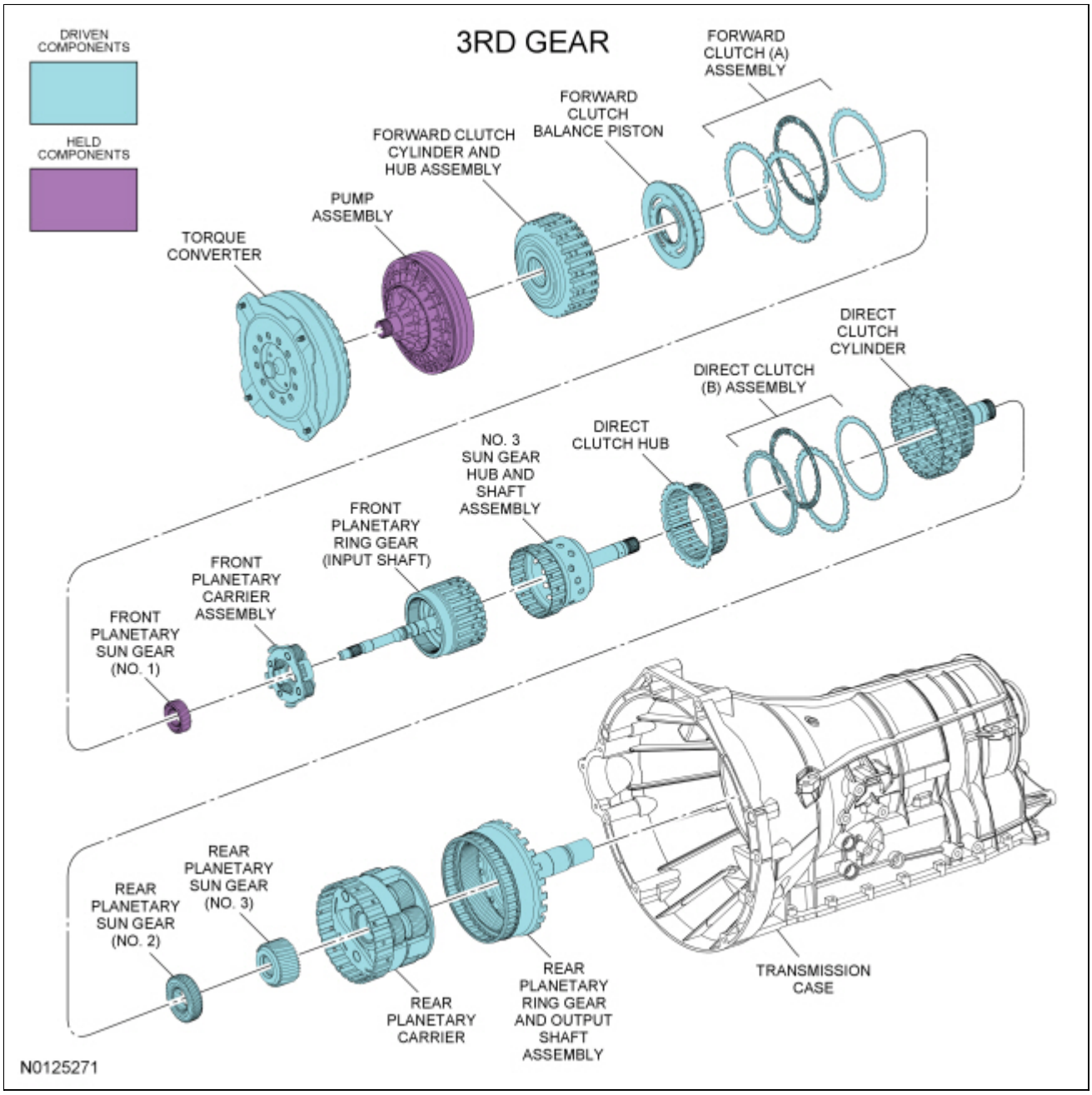
For solenoid information, refer to Transmission Electronic Control System in this section.

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3rd Gear



Mechanical Operation

Apply components:

- Forward clutch (A) applied
- Direct clutch (B) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

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Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- No. 3 sun gear
- No. 2 sun gear

Rear planetary gearset driven components:

- Planetary carrier
- Ring gear (output shaft)

Rear planetary gearset held components:

- None

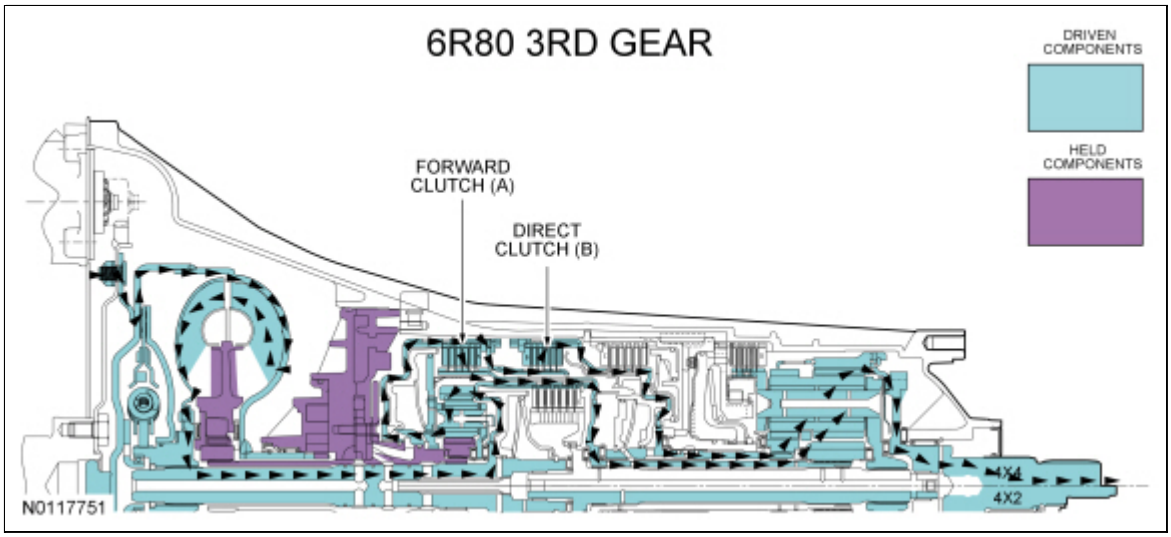
3rd Gear Clutch Application Chart

Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
3rd Gear D and Manual 3	D	D				O/R
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

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lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSA supplies pressure to the clutch A regulator and latch valves to position the valves for forward clutch (A) application.
- SSB supplies pressure to the clutch B regulator valve to position the valve for direct clutch (B) application.

Clutch hydraulic circuits:

- Regulated line pressure from the clutch A regulator valve is supplied to the forward clutch (A) to apply the clutch.
- Regulated line pressure from the clutch B regulator valve is supplied to the direct clutch (B) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

3rd Gear Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
D and 3	3	On	Off	Off	On	Off	Off

CB = Clutch brake

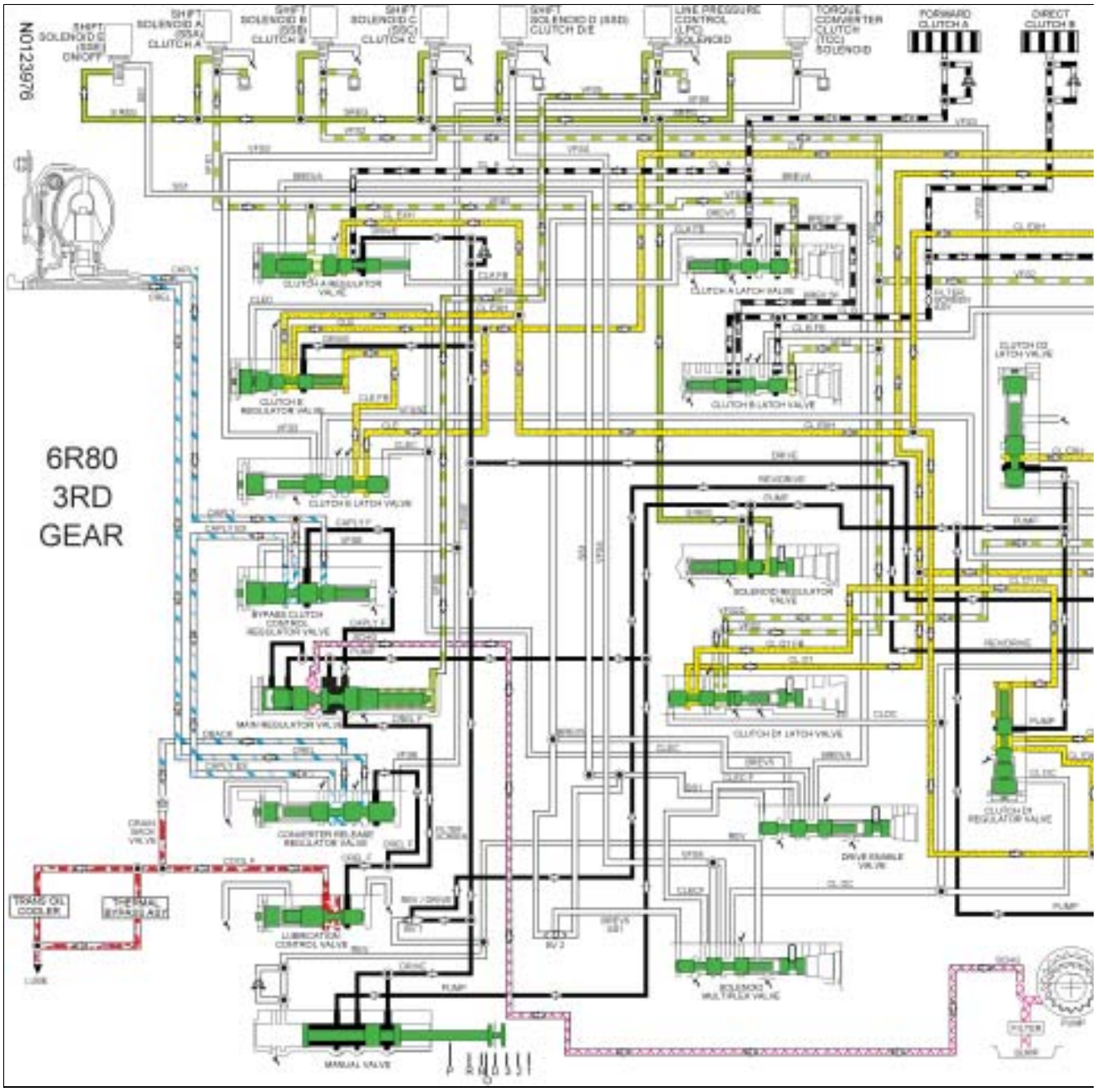
NC = Normally closed

NH = Normally high

NL = Normally low

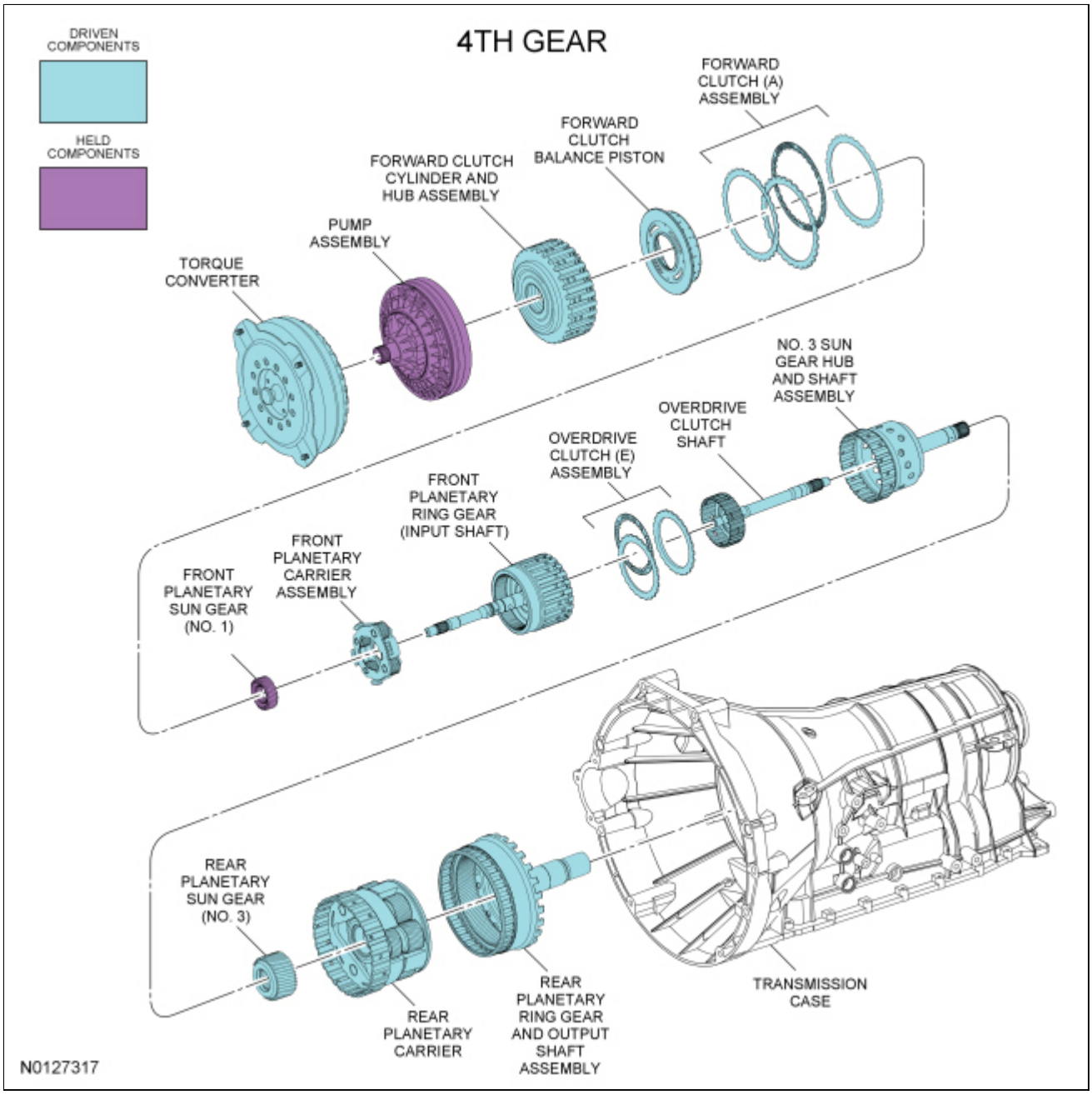
For solenoid information, refer to Transmission Electronic Control System in this section.

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4th Gear

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Mechanical Operation

Apply components:

- Forward clutch (A) applied
- Overdrive clutch (E) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- No. 3 sun gear
- Planetary carrier

Rear planetary gearset driven components:

- Ring gear (output shaft)

Rear planetary gearset held components:

- None

4th Gear Clutch Application Chart

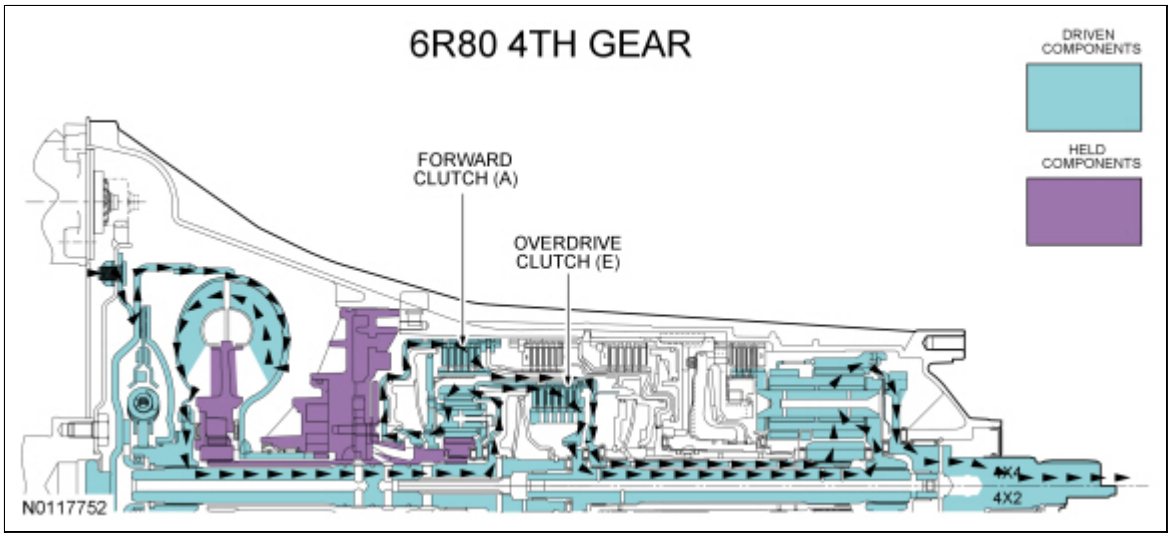
Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
4th Gear D	D				D	O/R
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow

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Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The LPC applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSA supplies pressure to the clutch A regulator and latch valves to position the valves for forward clutch (A) application.
- SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit.
- SSE supplies pressure to the solenoid multiplex valve and the drive enable valve through the SS1 circuit to move the valves.
- The position of the solenoid multiplex valve and the drive enable valve allows pressure from the VFS4 circuit to be directed to the clutch E latch and regulator valves through the CLEC circuit to position the valves for overdrive clutch (E) application.

Clutch hydraulic circuits:

- Regulated line pressure from the clutch A regulator valve is supplied to the forward clutch (A) to apply the clutch.
- Regulated line pressure from the clutch E regulator valve is supplied to the overdrive clutch (E) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

4th Gear Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
D	4	On	On	Off	Off	Off	On/Off

CB = Clutch brake

NC = Normally closed

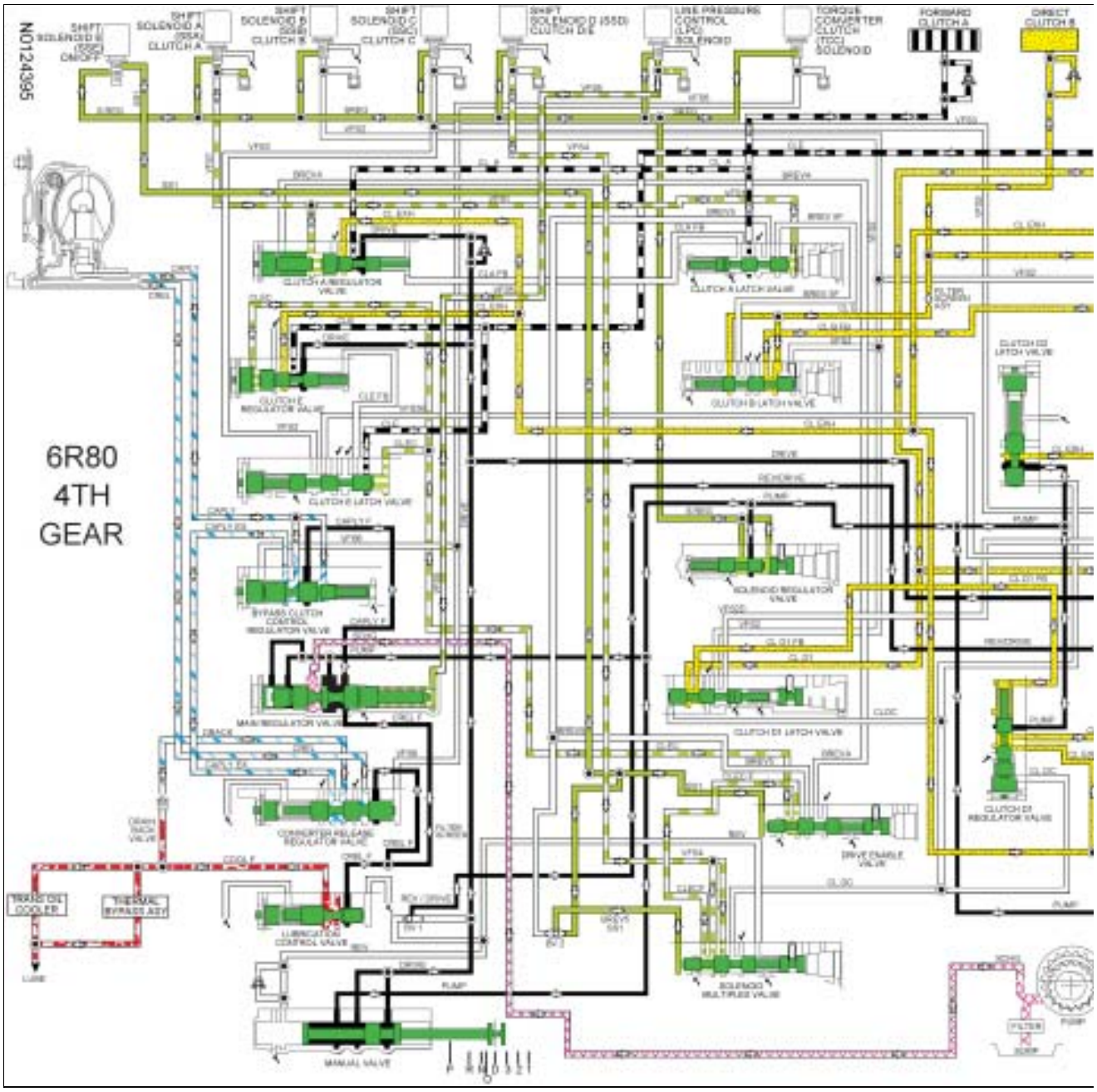
NH = Normally high

NL = Normally low

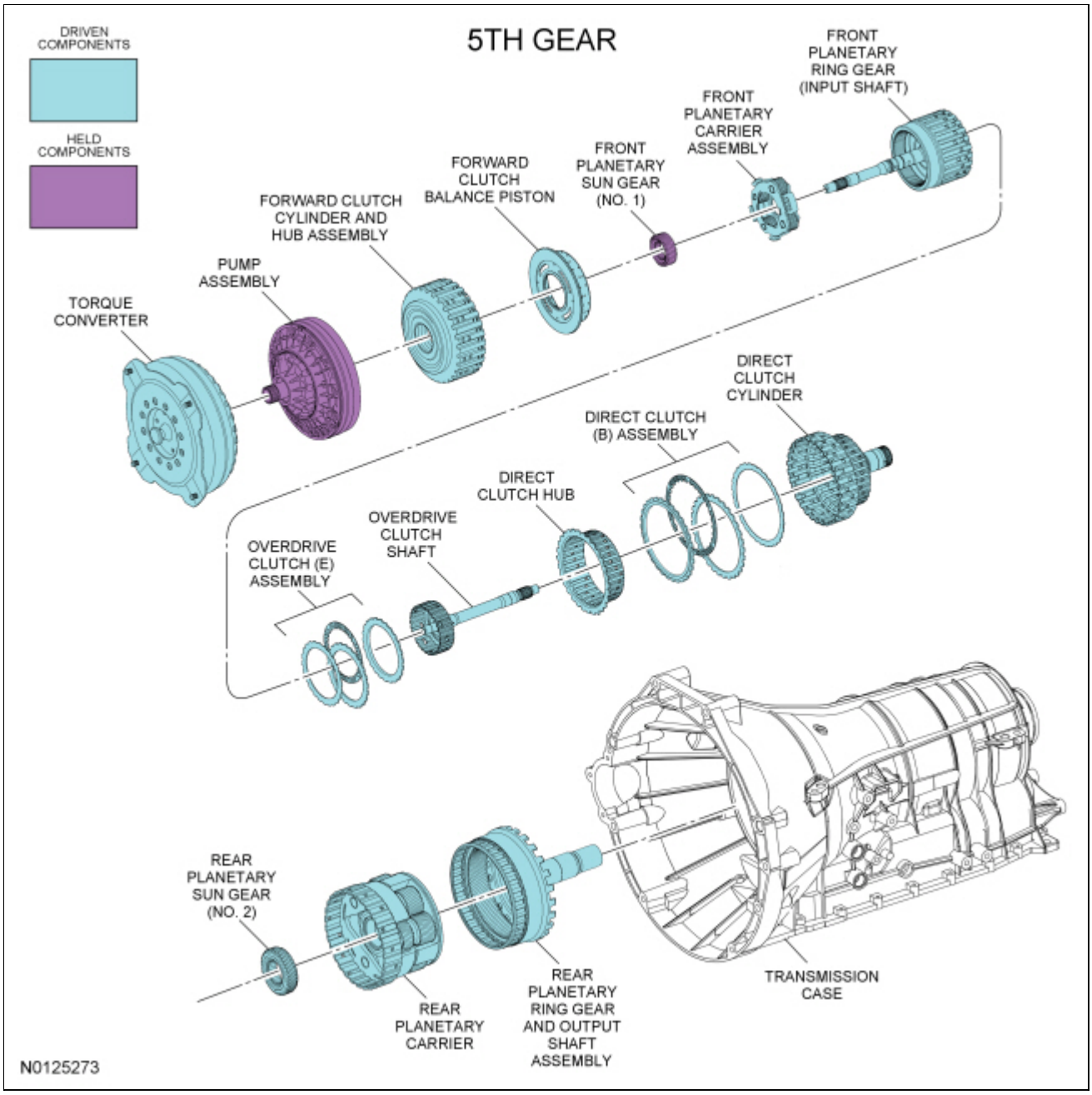
For solenoid information, refer to Transmission Electronic Control System in this section.

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5th Gear



Mechanical Operation

Apply components:

- Overdrive clutch (E) applied
- Direct clutch (B) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

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Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- No. 2 sun gear
- Planetary carrier

Rear planetary gearset driven components:

- Ring gear (output shaft)

Rear planetary gearset held components:

- None

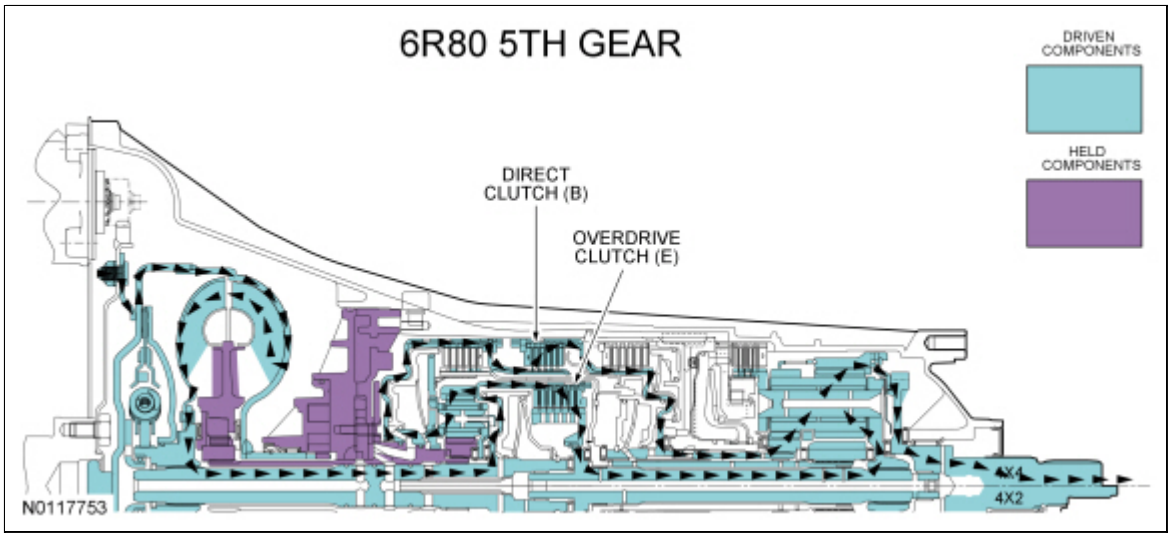
5th Gear Clutch Application Chart

Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
5th Gear D		D			D	O/R
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

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lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The PCA applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- SSB supplies pressure to the clutch B regulator valve to position the valve for direct clutch (B) application.
- SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit.
- SSE supplies pressure to the solenoid multiplex valve and the drive enable valve through the SS1 circuit to move the valves.
- The position of the solenoid multiplex valve and the drive enable valve allows pressure from the VFS4 circuit to be directed to the clutch E latch and regulator valves through the CLEC circuit to position the valves for overdrive clutch (E) application.

Clutch hydraulic circuits:

- Regulated line pressure from the clutch B regulator valve is supplied to the direct clutch (B) to apply the clutch.
- Regulated line pressure from the clutch E regulator valve is supplied to the overdrive clutch (E) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

5th Gear Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
D	5	Off	Off	Off	Off	Off	On/Off

CB = Clutch brake

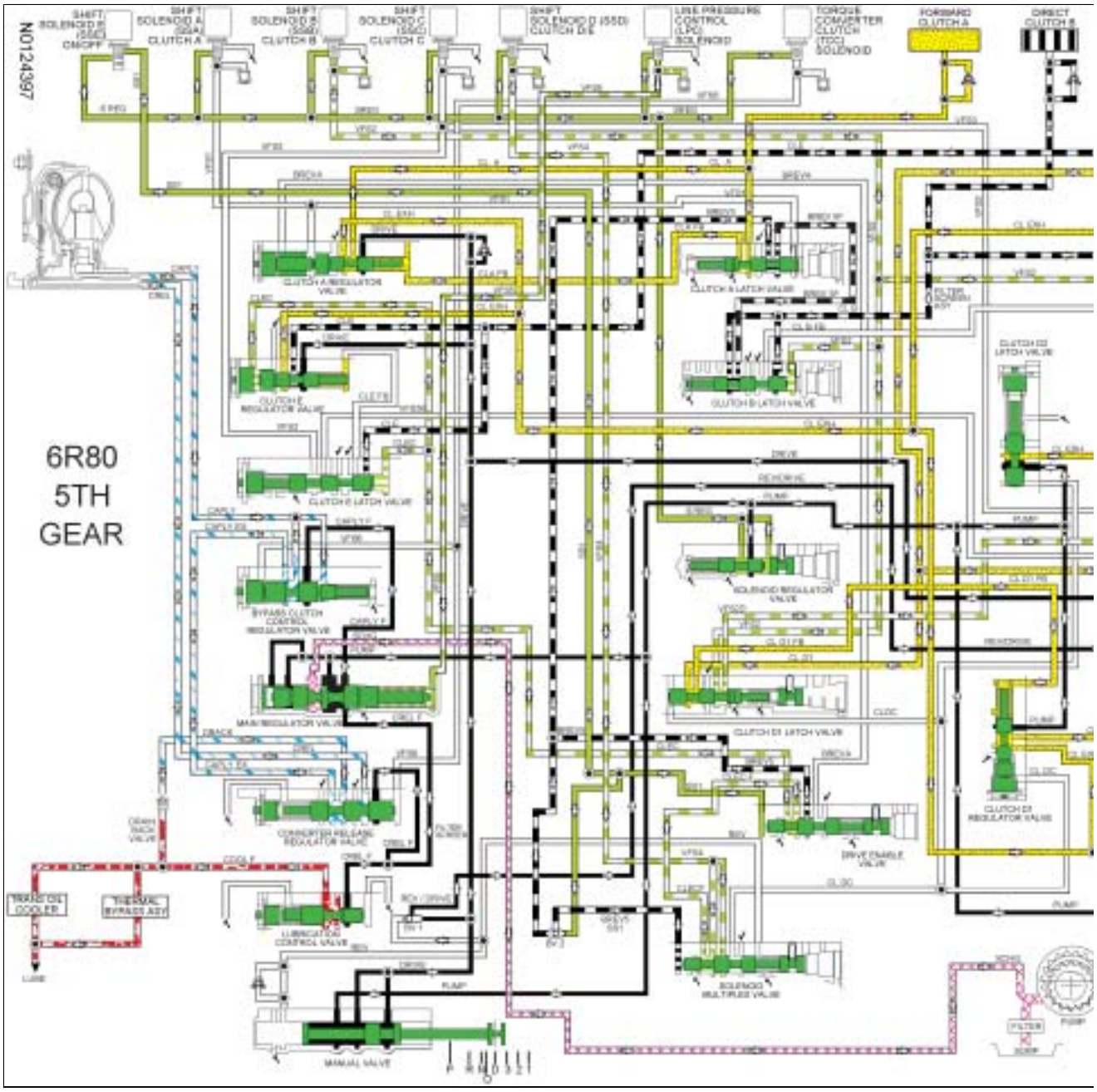
NC = Normally closed

NH = Normally high

NL = Normally low

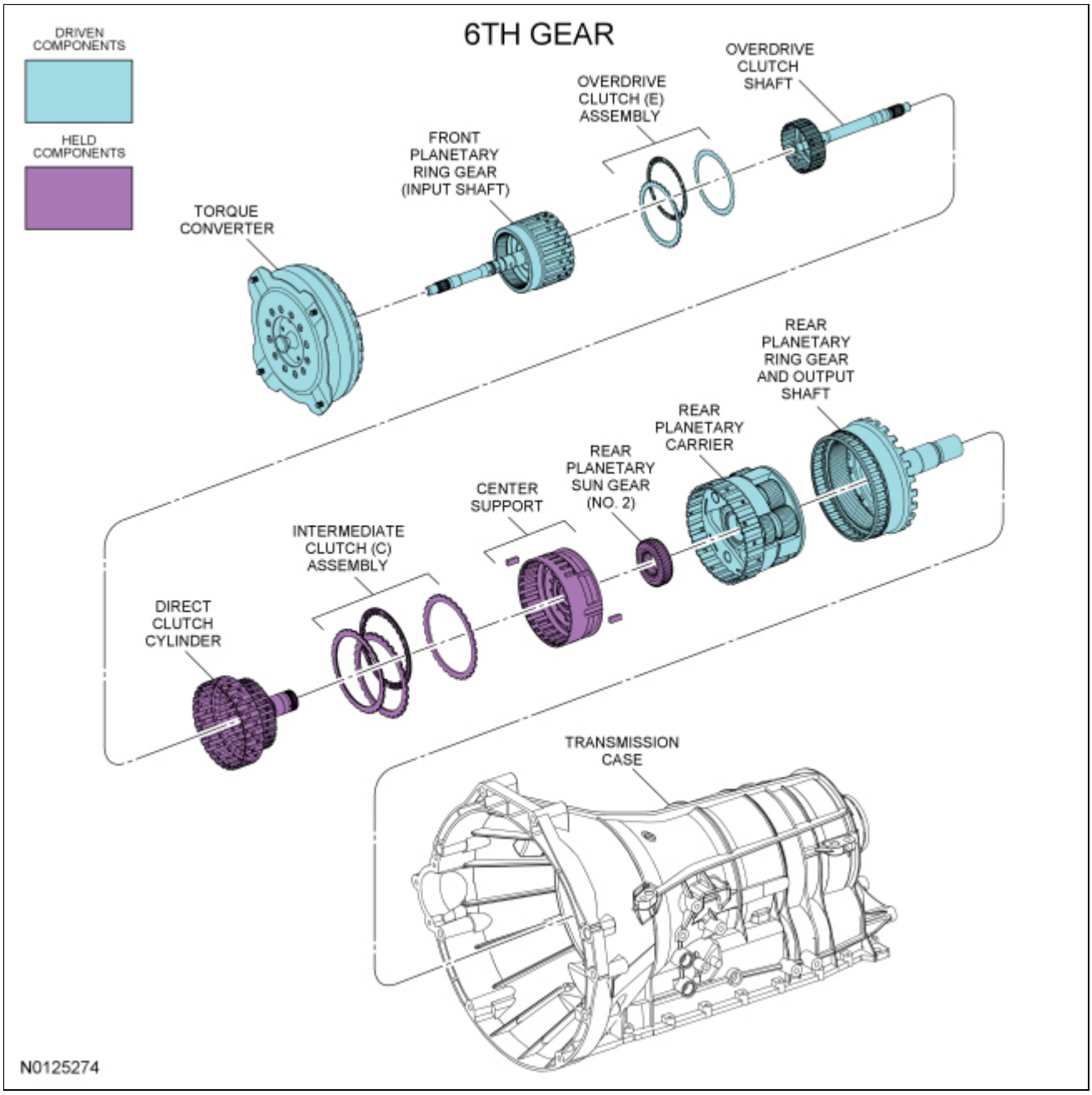
For solenoid information, refer to Transmission Electronic Control System in this section.

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6th Gear Torque Converter Clutch (TCC) Applied

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Mechanical Operation

Apply components:

- Overdrive clutch (E) applied
- Intermediate clutch (C) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

Front planetary gearset driven components:

- Planetary carrier (does not contribute to power flow)

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- Planetary carrier

Rear planetary gearset driven components:

- Ring gear (output shaft)

Rear planetary gearset held components:

- No. 2 sun gear

6th Gear Torque Converter Clutch (TCC) Applied Clutch Application Chart

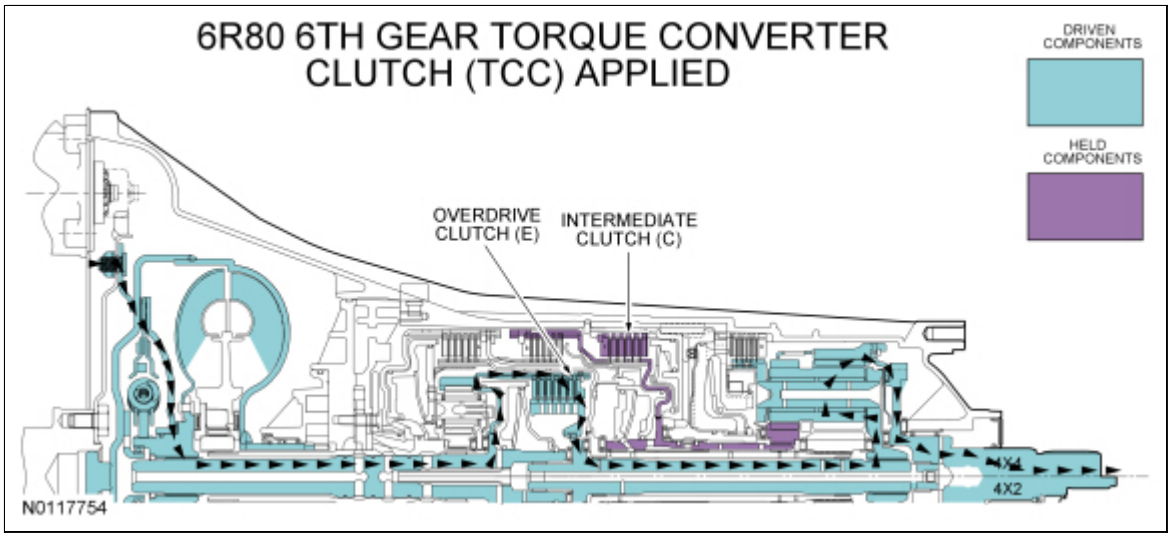
Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
6th Gear D			H		D	O/R
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- H = Hold Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow

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Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is applied, the bypass clutch control regulator valve applies pressure to the torque converter through the CAPLY circuit to apply the TCC.
- CAPLY pressure exits the torque converter through the CREL circuit to the converter release regulator valve.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies regulated line pressure to the shift, LPC and TCC solenoids through the SREG hydraulic circuit.
- The LPC solenoid applies varying pressure to the main regulator valve through the VFS5 hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main regulator valve.
- The TCC solenoid supplies pressure to the converter release regulator valve and the bypass clutch control regulator valve to move the position of the valves for TCC application.
- SSC supplies pressure to the clutch C regulator valve to position the valve for intermediate clutch (C) application.
- SSD supplies pressure to the solenoid multiplex valve through the VFS4 circuit.
- SSE supplies pressure to the solenoid multiplex valve and the drive enable valve through the SS1 circuit to move the valves.
- The position of the solenoid multiplex valve and the drive enable valve allows pressure from the VFS4 circuit to be directed to the clutch E latch and regulator valves through the CLEC circuit to position the valves for overdrive clutch (E) application.

Clutch hydraulic circuits:

- Regulated line pressure from the clutch C regulator valve is supplied to the intermediate clutch (C) to apply the clutch.
- Regulated line pressure from the clutch E regulator valve is supplied to the overdrive clutch (E) to apply the clutch.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

6th Gear Torque Converter Clutch (TCC) Applied Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	
	6	Off	On	On	Off	Off	On/Off

CB = Clutch brake

NC = Normally closed

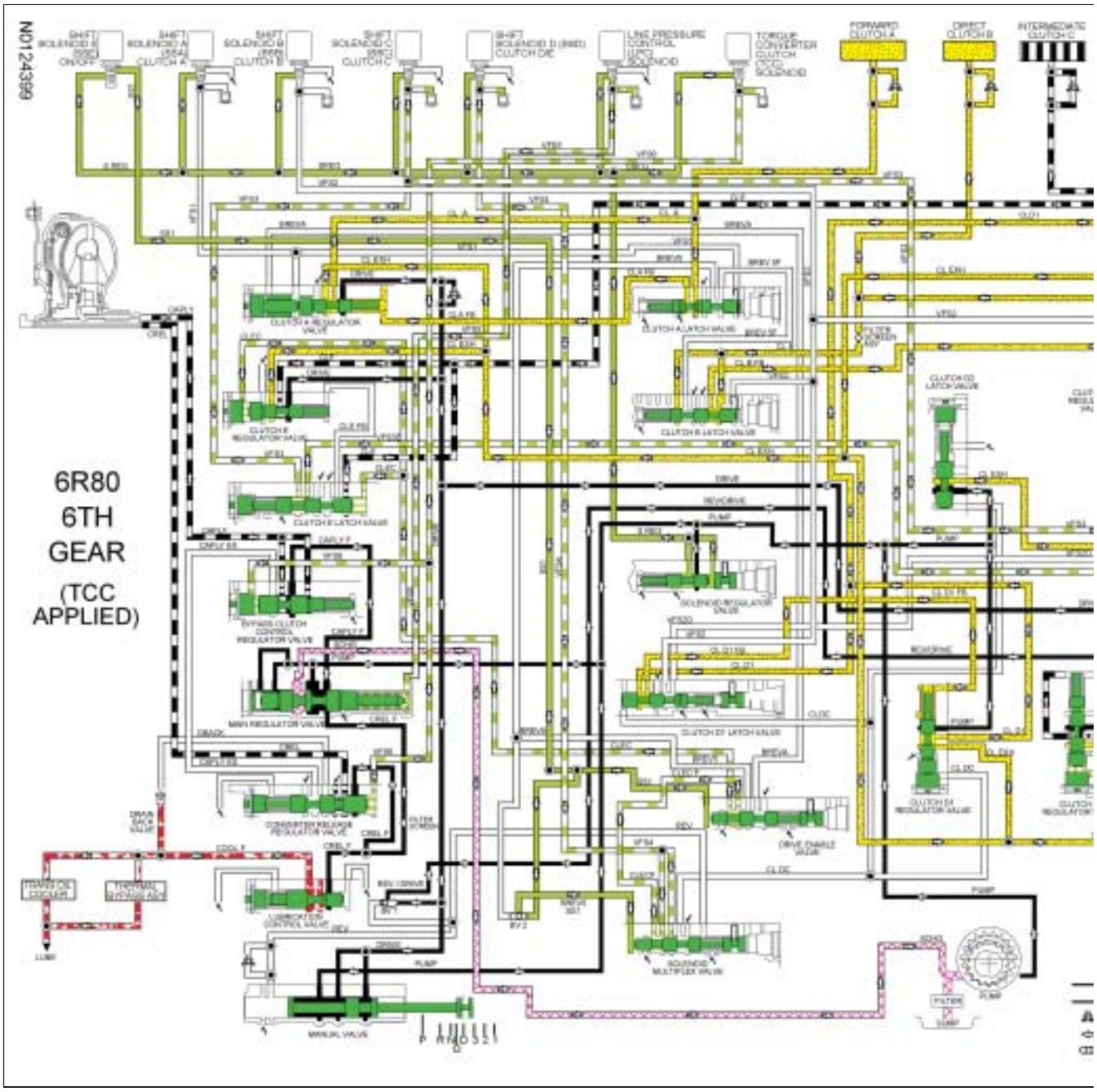
NH = Normally high

NL = Normally low

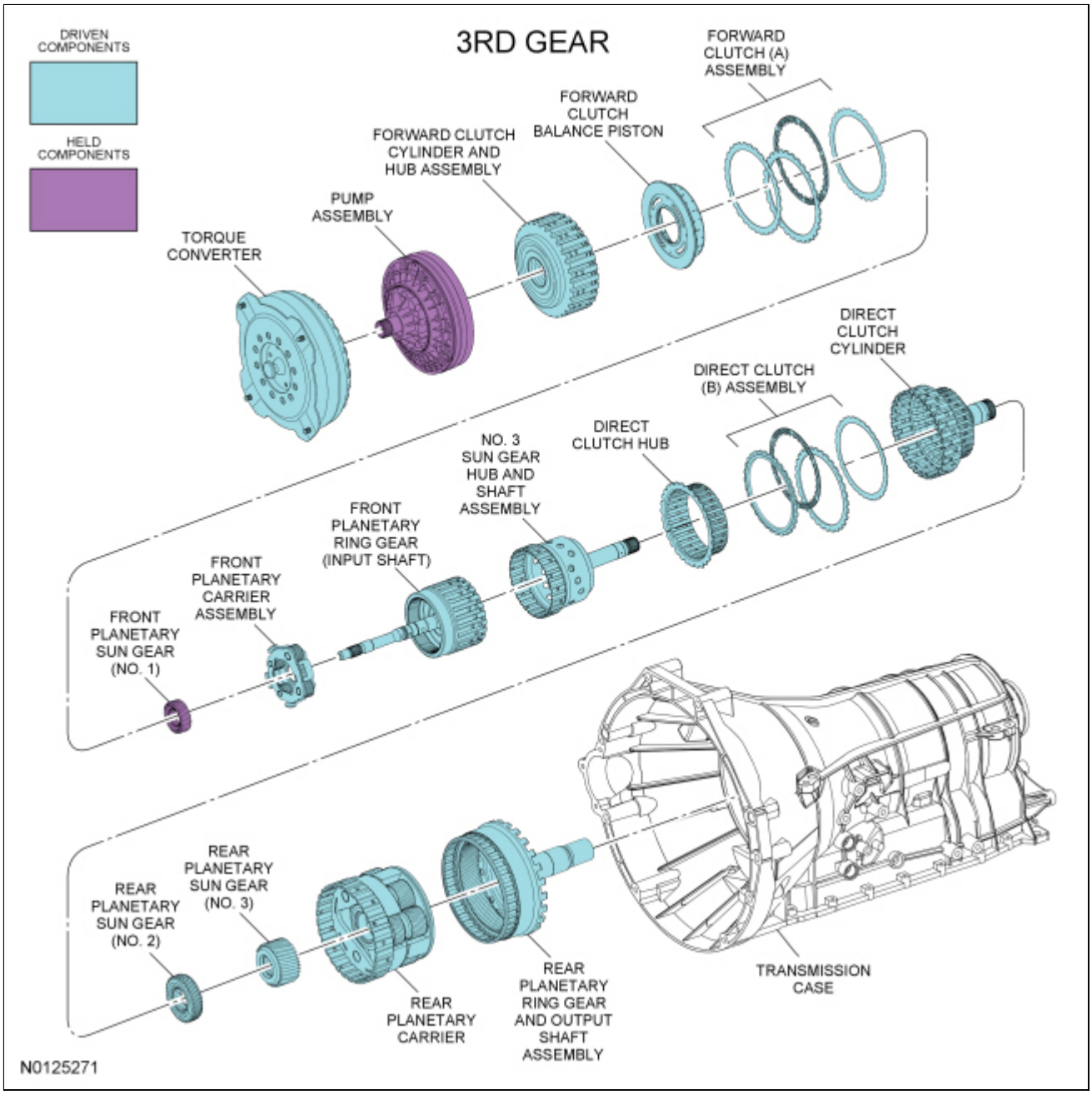
For solenoid information, refer to Transmission Electronic Control System in this section.

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3rd Gear Fail Safe



Mechanical Operation

Apply components:

- Forward clutch (A) applied
- Direct clutch (B) applied

Planetary Gearset Operation

Front planetary gearset driving components:

- Ring gear (input shaft)

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Front planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear (splined to pump assembly)

Rear planetary gearset driving components:

- No. 3 sun gear
- No. 2 sun gear

Rear planetary gearset driven components:

- Planetary carrier
- Ring gear (output shaft)

Rear planetary gearset held components:

- None

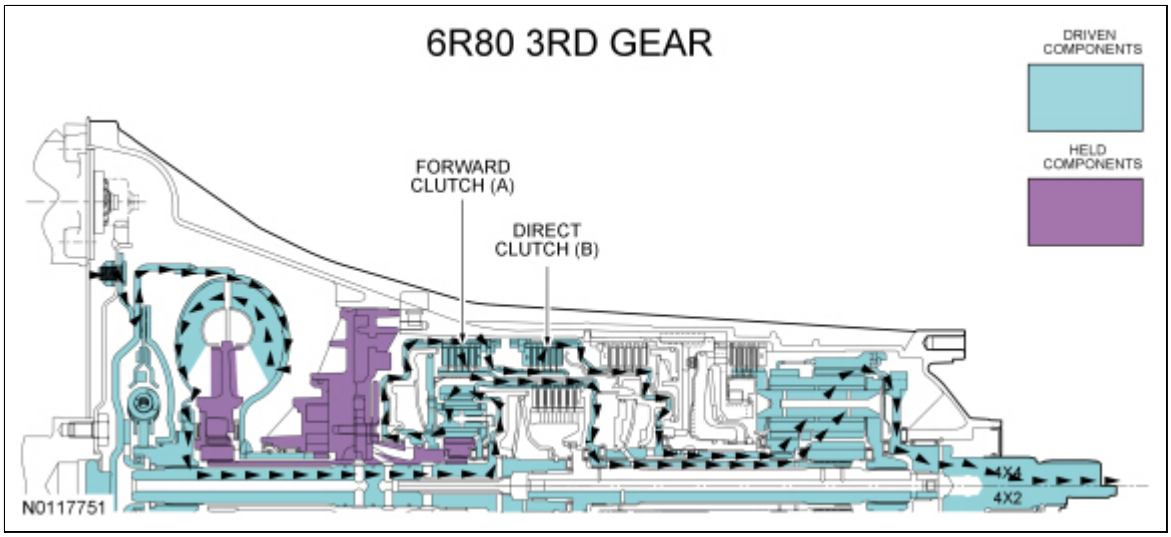
3rd Gear Fail Safe Clutch Application Chart

Gear	Forward A (1,2,3,4)	Direct B (3,5,R)	Inter-mediate C (2,6)	Low/ Reverse D (1,R)	Overdrive E (4,5,6)	Low-OWC
3rd Gear D and Manual 3	D	D				O/R
Planetary Components	Front planetary carrier-to-No. 3 sun gear	Front carrier-to-No. 2 sun gear	No. 2 sun gear	Rear planetary carrier	Input shaft-to-rear planetary carrier	Rear planetary carrier

- D = Drive Clutch
- O/R = Overrunning

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- The position of the main regulator valve controls line pressure. The position of the main regulator valve is dependent on the pressure applied to it by the LPC solenoid through the VFS5 circuit.
- The main regulator valve varies pressure in the PUMP circuit by controlling hydraulic flow from the SCHG circuit into the pump suction circuit.
- Line pressure is supplied to the:
  - manual valve.
  - lubrication control valve.
  - converter release regulator valve.
  - bypass clutch control regulator valve.
  - solenoid pressure regulator valve.
  - D1 latch and regulator valves.
- In drive, the manual valve directs line pressure to the No. 1 shuttle valve and clutch A, C and E regulator valves.
- The No. 1 shuttle ball directs line pressure to the clutch B regulator valve.

Torque converter circuits:

- When the TCC is released, the converter release regulator valve applies pressure to the torque converter through the CREL circuit to release the TCC .
- CREL pressure exits the torque converter through the CAPLY circuit to the bypass clutch control regulator valve.
- The bypass clutch control regulator valve directs the pressure from the CAPLY circuit back to the converter release regulator valve through the CAPLY EX circuit.
- The converter release regulator valve directs the pressure from the CAPLY EX circuit to the drain back valve through the DBACK circuit.

Cooler and lubrication hydraulic circuits:

- The lubrication control valve directs line pressure to the transmission fluid cooler or the thermal bypass valve through the COOLF circuit.
- When the transmission fluid exits the transmission fluid cooler or thermal bypass valve, it provides lubrication to the transmission through the LUBE circuit. For information about transmission

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lubrication, refer to Mechanical Components and Functions in this section.

Solenoid hydraulic circuits:

- The solenoid pressure regulator valve supplies line pressure to the shift, LPC and TCC solenoid through the SREG hydraulic circuit.
- The LPC solenoid applies full solenoid output pressure to the main regulator valve through the VFS5 hydraulic circuit. With full solenoid output pressure, the main regulator valve provides maximum line pressure during fail safe.
- SSB supplies maximum solenoid output pressure to the clutch B regulator valve to position the valve for direct clutch (B) application.

Clutch hydraulic circuits:

- Regulated line pressure from the clutch B regulator valve is supplied to the direct clutch (B) to, apply the clutch. Regulated line pressure from the clutch B regulator valve is also supplied to the clutch A latch valve from the clutch B latch valve through the BREV 5F circuit.
- The clutch A latch valve directs the regulated line pressure to the drive enable valve through the BREV5 circuit.
- The drive enable valve directs the BREV5 pressure to the BREVA circuit which supplies the clutch A regulator valve to position the valve to apply the forward clutch (A) with 81% of line pressure.

For hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation: In failsafe, voltage is removed from all solenoids and the solenoids default to their normal position. If a solenoid is a normally low (NL) solenoid, the solenoid will not supply pressure to the regulator valve, releasing the clutch that it controls. If a solenoid is a normally high (NH) solenoid, the solenoid will provide high pressure to the regulator valve, applying the clutch that it controls.

3rd Gear Fail Safe Solenoid Operation Chart

Gear	SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L/R 4,5,6)	SSE NC	LPC NH	TCC NL
3rd Gear	—	—	—	—	—	—	—

CB = Clutch brake

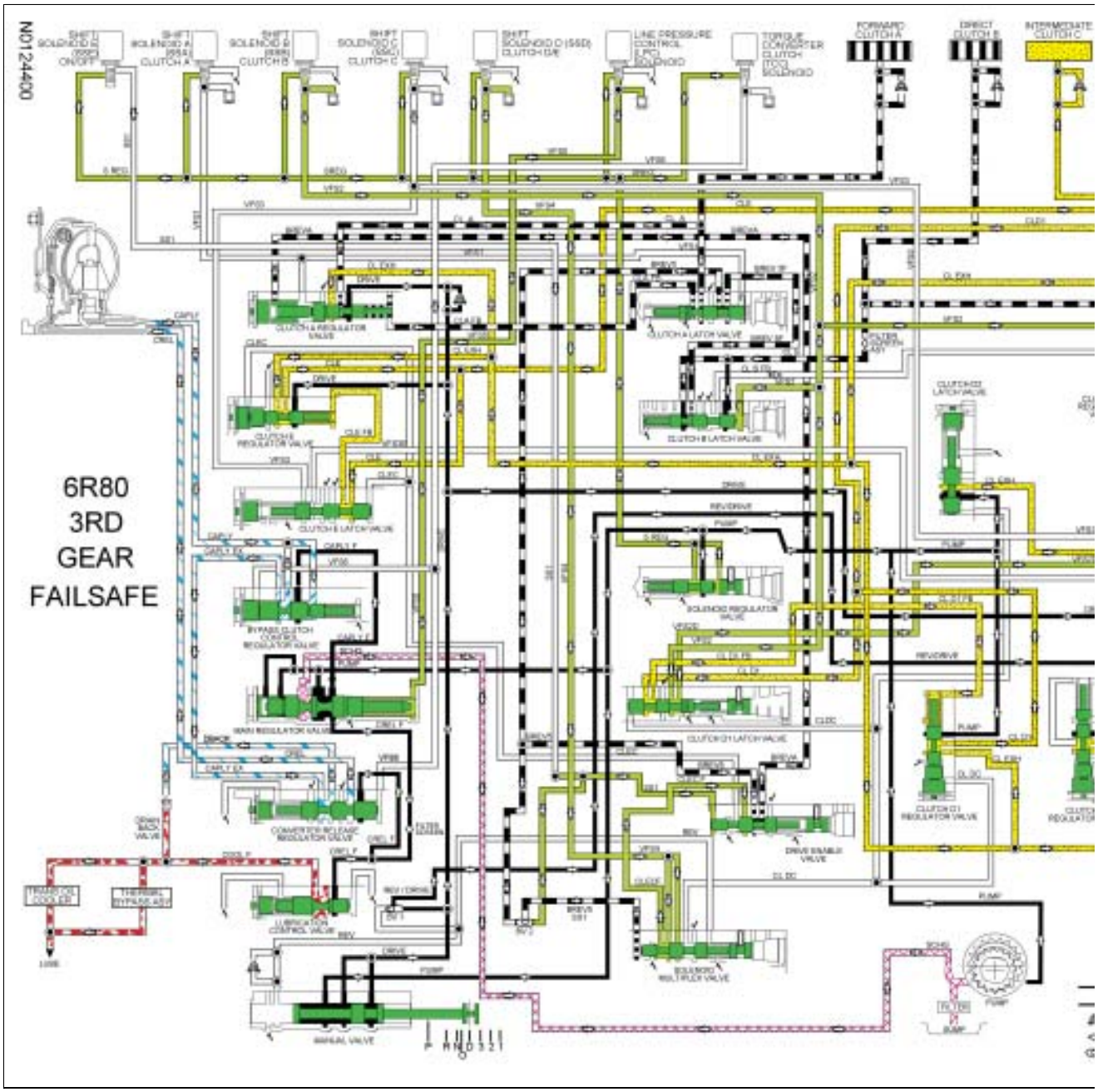
NC = Normally closed

NH = Normally high

NL = Normally low

For solenoid information, refer to Transmission Electronic Control System in this section.

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Diagnosis By Symptom

The Diagnosis by Symptom gives the technician diagnostic information and direction, and suggests possible components using a symptom as a starting point. All routines start out with any potential electrical components that can cause or contribute to the symptom described. The routines then list all possible hydraulic or mechanical components that can cause or contribute the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom, select the condition that best describes the condition.

2. Refer to the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:
    1. preliminary inspections.
    2. verifications of condition.
    3. checking the fluid levels.
    4. carrying out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a DTC. Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

   NOTE: When the battery is disconnected or a new battery is installed, certain transmission operating parameters can be lost. The PCM must relearn these parameters. During this learning process, the vehicle may exhibit slightly firm shifts, delayed or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

   Begin Diagnosis by Symptoms with the Routines, if indicated. Follow the reference or action required statements. Always perform the self-tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, proceed to the Hydraulic/Mechanical Routine listed.

5. The list contains only possible hydraulic or mechanical components that may cause or contribute to the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to make sure that repairs are complete.

Diagnosis by Symptom Index

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Diagnostic Routines

Engagement Concerns: No Forward in D

Possible Component	Reference/Action
201 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section. • INSTALL a new filter assembly.
• Fluid filter and seal assembly — plugged, damaged	
Selector Lever Linkage	
• Selector lever linkage — damage or incorrectly adjusted	• INSPECT and REPAIR as required. VERIFY transmission selector lever cable adjustment. REFER to Section 307-05 . ADJUST transmission selector lever cable as necessary.
Powertrain Control System	
• PCM, external vehicle harness, main control molded leadframe or Shift Solenoid A (SSA).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . INSPECT and CLEAN the SSA terminals on the molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
Main Control	
• Defective manual valve	• INSPECT manual valve linkage.
• Defective clutch (A) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section. • INSTALL a new front pump adapter seal.
• Front pump adapter seal — cracked, leaking or damaged	
Clutch Plates	
• Forward clutch (A) friction and steel plate — failure	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Low One-Way Clutch (OWC) assembly — failure	• INSPECT the OWC assembly for damage. The OWC must rotate counterclockwise and lock clockwise. REPLACE the OWC . REFER to Transmission — Early Build or Transmission — Late Build in this section.
Pump	
• Pump gear — failure	• INSTALL a new pump assembly. REFER to Pump Assembly in this section.

Engagement Concerns: No Reverse

Possible Component	Reference/Action

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202 — ROUTINE	
Transmission Fluid • Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
Powertrain Control System • PCM, external vehicle harness, main control leadframe or Shift Solenoid B (SSB).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . INSPECT and CLEAN the shift solenoid terminals on the molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
Main Control • Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates • Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
Pump • Pump gear — failure	• INSTALL a new pump assembly. REFER to Pump Assembly in this section.

Engagement Concerns: Harsh Reverse

Possible Component	Reference/Action
203 — ROUTINE	
Transmission Fluid • Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
Driveline • Engine driveline looseness in the driveshaft, U-joints or the engine mounts	• REPAIR as required.
Powertrain Control System • PCM, external vehicle harness, main control leadframe or Shift Solenoid B (SSB).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . INSPECT and CLEAN the shift solenoid terminals on the molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
Main Control • Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	

• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.

Engagement Concerns: Harsh Forward

Possible Component	Reference/Action
204 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
Driveline	
• Engine driveline looseness in the driveshaft, U-joints or the engine mounts	• REPAIR as required.
Powertrain Control System	
• PCM, external vehicle harness, main control leadframe or Shift Solenoid A (SSA).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . INSPECT and CLEAN the shift solenoid terminals on the molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
Main Control	
• Defective clutch (A) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (A) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (A) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.

Engagement Concerns: Delayed/Soft Reverse

Possible Component	Reference/Action
205 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Fluid filter and seal assembly — plugged, damaged	• INSTALL a new filter assembly.
Powertrain Control System	
• PCM, external	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine

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vehicle harness, main control leadframe or Shift Solenoid B (SSB).	OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . INSPECT and CLEAN the shift solenoid terminals on the molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
Main Control	
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section. • INSTALL a new front pump adapter seal.
• Front pump adapter seal — cracked, leaking or damaged	
Clutch Plates	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Direct clutch (B) friction and steel plate — failure	

Engagement Concerns: Delayed/Soft Forward

Possible Component	Reference/Action
206 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section. • INSTALL a new filter assembly.
• Fluid filter and seal assembly — plugged, damaged	
Powertrain Control System	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . INSPECT and CLEAN the shift solenoid terminals on the mechatronic leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
• PCM, external vehicle harness, main control leadframe or a defective Shift Solenoid A (SSA).	
Main Control	
• Defective clutch (A) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section. • INSTALL a new front pump adapter seal.
• Front pump adapter seal — cracked, leaking or damaged	
Clutch Plates	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.
• Forward clutch (A) friction and steel plate — failure	

Engagement Concerns: No Forward and No Reverse

Possible Component	Reference/Action
207 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
Selector Lever Linkage (Internal/External)	
• Damaged, out of aadjustment	• INSPECT for damage, repair as required.
Transmission Filter and Seal Assembly	
• Not seated, damaged or plugged	• INSPECT for position, damage and restriction. INSTALL a new filter and seal assembly. .
• Pump adapter Seal	• INSPECT for crack or damage. INSTALL new as required.
Main Controls	
• Manual Valve	• INSPECT for damage. Replace as required.
• Mounting bolt torque	• INSPECT for loose main control to transmission bolts. Tighten to specification.
• Solenoid Pressure Regulator Valve	• INSPECT for valve stuck in spring compressed position or broken spring. CLEAN or REPLACE main control as required. Main Control
Pump Assembly	
• Gear	• INSPECT for damage. REPLACE as required.
• Sun gear hub/splines	• INSPECT for damage. REPLACE as required.
Other Possible Components	
• Turbine shaft	• INSPECT for damage. REPAIR as required.
• Front planetary gear set	• INSPECT for damage. REPAIR as required.
• Forward clutch drum	• INSPECT for damage. REPAIR as required.
• Output shaft/ring gear	• INSPECT for damage. REPAIR as required.

Engagement Concerns: Harsh Forward and Harsh Reverse

Possible Component	Reference/Action
208 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.

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• Fluid filter and seal assembly — plugged, damaged	• INSTALL a new filter assembly.
Powertrain Control System	
• PCM electrical inputs/outputs, external vehicle wiring harnesses, main control molded leadframe, Transmission Range (TR) sensor, Shift Solenoid A (SSA) or Line Pressure Control (LPC)	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . If engine control DTCs return, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Multiple shift missing (more than one gear)	• If some shifts are missing, DETERMINE which shifts do not occur. REFER to Clutch and Solenoid Application Charts in this section. MONITOR appropriate PIDs as listed in Diagnostic Parameters Identification (PID) Chart. REFER to Routine 210.
• Gears 4-6 default to 5th gear and gears 1-3 default to 3rd gear	• RETRIEVE DTCs.

Engagement Concerns: Delayed Forward and Delayed Reverse

Possible Component	Reference/Action
209 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly.
Powertrain Control System	
• PCM, external vehicle wiring harnesses or molded leadframe	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. INSPECT and CLEAN the shift solenoid terminals on the molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
Main Control	
• Front pump adapter seal — cracked, leaking or damaged	• INSTALL a new front pump adapter seal.

Shift Concerns: Some/All Shifts Missing

Possible Component	Reference/Action
210 — ROUTINE	
Transmission Fluid	

• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly. REFER to Fluid Pan, Gasket and Filter in this section.
Selector Lever Linkage Damaged or Incorrectly Adjusted	
• Selector lever cable	• INSPECT and REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05 . ADJUST selector lever cable as necessary.
Powertrain Control System	
• PCM electrical inputs/outputs, external vehicle wiring harnesses, main control molded leadframe, Transmission Range (TR) sensor, Shift Solenoid A (SSA) or Line Pressure Control (LPC)	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A . If engine control DTCs return, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Multiple shift missing (more than one gear)	• If some shifts are missing, DETERMINE which shifts do not occur. REFER to clutch and solenoid application charts in this section. MONITOR appropriate PIDs as listed in Diagnostic Parameters Identification (PID) Chart.
Main Control	
• Leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (A) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (A) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (E) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (E) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Forward clutch (A) friction and steel plate — failure or Low One-Way Clutch (OWC) assembly — failure	• For 1st, 2nd, 3rd or 4th gear concerns, INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section. For the One-Way Clutch (OWC), INSPECT for damage. One-Way Clutch (OWC) must rotate counterclockwise and lock clockwise. REFER to

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	Transmission — Early Build or Transmission — Late Build in this section.
• Direct clutch (B) friction and steel plate — failure	• For 3rd or 5th gear concerns, INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Intermediate clutch (C) friction and steel plate — failure	• For 2nd or 6th gear concerns, INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.
• Overdrive clutch (E) assembly — failure	• For 4th, 5th or 6th gear concerns, INSPECT the overdrive clutch for damage. REPLACE the overdrive clutch. REFER to Overdrive Clutch Assembly in this section.

Shift Concerns: Timing — Early/Late

Possible Component	Reference/Action
211 — ROUTINE	
Powertrain Control System	
• PCM electrical inputs/outputs, external vehicle wiring harnesses or main control molded leadframe	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If engine control DTCs return, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section.
• Engine driveability concerns	• REFER to Section 303-00 .
Main Control	
• Bolts not tightened to specification	• TIGHTEN to specification.
• Main control unit contaminated, solenoid(s) damaged, stuck or bore damaged. Manual valve damaged, stuck or bore damaged	• REFER to Main Control in this section.
Incorrect Pressures	
• Application pressures are incorrect	• Incorrect application pressures may be due to non-transmission components, main control assembly or internal transmission damage. REPAIR all non-transmission components then continue with this routine.
Other	
• Tire size change, axle ratio change	• VERIFY the vehicle has the original equipment. REFER to the certification label. Changes in tire size and axle ratio will affect shift timing.

Shift Concerns: Timing — Erratic/Hunting

Possible Component	Reference/Action
212 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Condition	• CARRY OUT the fluid level check in Transmission Fluid Level Check in this section. • REFER to Routine 257 Transmission Overheating.
• Transmission fluid over temperature condition	
Powertrain Control System	
• PCM electrical inputs/outputs, external vehicle wiring harnesses or main control leadframe	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If engine control DTCs return, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
Torque Converter Concerns	
• Torque converter	• REFER to torque converter operation concern: Cycling/Chatter.

Feel Concerns: Soft/Slipping (Some or All)

Possible Component	Reference/Action
213 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly. REFER to Fluid Pan, Gasket and Filter in this section.
Powertrain Control System	
• PCM electrical inputs/outputs, external vehicle wiring harnesses, main control molded leadframe or Transmission Fluid Temperature (TFT) sensor.	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test B .
Main Control	
• Main control molded leadframe	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Front pump adapter seal — cracked, leaking or damaged	• INSTALL a new front pump adapter seal.
• Bolts not tightened to	• TIGHTEN to specification.

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specification	
• Main control contaminated, solenoid(s) damaged, stuck or bore damaged. Manual valve damaged, stick or bore damaged	• INSPECT for damage. If damaged, INSTALL a new main control assembly. REFER to Main Control in this section.

Feel Concerns: Harsh (Some or All)

Possible Component	Reference/Action
214 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly. REFER to Fluid Pan, Gasket and Filter in this section.
Powertrain Control System	
• PCM electrical inputs/outputs, external vehicle wiring harnesses, main control molded leadframe or solenoid body information does not match PCM information	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If solenoid body and PCM information does not match, REPROGRAM the PCM with the latest calibration. PERFORM the Solenoid Body Strategy Data Download. REFER to Solenoid Body Strategy in this section. PERFORM Road Test — Adaptive Drive Cycle, REFER to Shift Point Road Test in this section. ROAD TEST and CHECK for DTCs.
Main Control	
• Bolts not tightened to specification	• TIGHTEN bolts to specification.
• Main control contaminated, solenoid(s) damaged, solenoids stuck or bore damaged	• INSPECT for damage. If damaged, INSTALL a new main control assembly. REFER to Main Control in this section.
• Manual valve damaged, stuck or bore damaged	• INSPECT for damage. If damaged, INSTALL a new main control assembly. REFER to Main Control in this section.

Feel Concerns: No 1st Gear, Engages in a Higher Gear

Possible Component	Reference/Action
215 — ROUTINE	
Powertrain Control System	
• PCM, external vehicle wiring harnesses or main control molded leadframe	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs.

Clutch Plates	
• Low One-Way Clutch (OWC) assembly — failure	• INSPECT the OWC assembly for damage. The OWC must rotate counterclockwise and lock clockwise. REPLACE the OWC . REFER to Transmission — Early Build or Transmission — Late Build in this section.
Incorrect Gear	
• Transmission failure	• DETERMINE which gear the transmission is in. REFER to the Clutch and Solenoid Application Charts in this section.

Feel Concerns: No Manual 1st Gear

Possible Component	Reference/Action
216 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly. REFER to Fluid Pan, Gasket and Filter in this section.
Selector Lever Linkage	
• Selector lever cable system — damaged, misaligned	• INSPECT and REPAIR as necessary. VERIFY selector lever cable adjustment. REFER to Section 307-05 .
Powertrain Control System	
• PCM, external vehicle harness, main control molded leadframe or Shift Solenoid A (SSA).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and Manual for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination., REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
Clutch Plates	
• Forward clutch (A) friction and steel plate — failure	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.
• Low/reverse clutch (D) friction and steel plate — failure	• INSPECT the low/reverse clutch assembly for damage. REPAIR as required. REFER to Low/Reverse Clutch Assembly in this section.
• Low One-Way Clutch (OWC) assembly — failure	• If no 1st gear above 3 mph, INSPECT the OWC assembly for damage. The OWC must rotate counterclockwise and lock clockwise. REPLACE the OWC . REFER to Transmission — Early Build or Transmission — Late Build in this section.
Pump	

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• Pump gear — failure	• INSTALL a new pump assembly. REFER to Pump Assembly in this section.

Feel Concerns: No Manual 2nd Gear

Possible Component	Reference/Action
217 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly.
Selector Lever Linkage	
• Selector lever cable system — damaged, misaligned	• INSPECT and REPAIR as necessary. VERIFY selector lever cable adjustment. REFER to Section 307-05 .
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe or Shift Solenoid A (SSA)	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
Clutch Plates	
• Forward clutch (A) friction and steel plate — failure	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.
• Intermediate clutch (C) friction and steel plate — failure	• INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.
Pump	
• Pump gear — failure	• INSTALL a new pump assembly. REFER to Pump Assembly in this section.

Feel Concerns: No Manual 3rd Gear

Possible Component	Reference/Action
218 — ROUTINE	

Selector Lever Linkage	
• Selector lever cable system — damaged, misaligned	• INSPECT and REPAIR as necessary. VERIFY selector lever cable adjustment. REFER to Section 307-05 .
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe or Shift Solenoid B (SSB).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
Clutch Plates	
• Forward clutch (A) friction and steel plate — failure	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
Pump	
• Pump gear — failure	• INSTALL a new pump assembly. REFER to Pump Assembly in this section.

Feel Concerns: No 1-2 Shift

Possible Component	Reference/Action
220 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly. REFER to Fluid Pan, Gasket and Filter in this section.
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe, Shift Solenoid C (SSC) or Shift Solenoid D (SSD).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs.

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	ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Intermediate clutch (C) friction and steel plate — failure	• INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.
• Low/reverse clutch (D) friction and steel plate — failure	• INSPECT the low/reverse clutch assembly for damage. REPAIR as required. REFER to Low/Reverse Clutch Assembly in this section.
• Low One-Way Clutch (OWC) assembly — failure	• INSPECT the OWC assembly for damage. The OWC must rotate counterclockwise and lock clockwise. REPLACE the OWC . REFER to Transmission — Early Build or Transmission — Late Build in this section.

Feel Concerns: No 2-3 Shift

Possible Component	Reference/Action
221 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission fluid filter and seal assembly — plugged, damaged	• INSTALL a new transmission fluid filter assembly. REFER to Fluid Pan, Gasket and Filter in this section.
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe, Shift Solenoid B (SSB) or Shift Solenoid C (SSC).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch	• INSPECT main control assembly for stuck valves or

valve	contamination. REFER to Main Control in this section.
• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Intermediate clutch (C) friction and steel plate — failure	• INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.

Feel Concerns: No 3-4 Shift

Possible Component	Reference/Action
222 — ROUTINE	
Powertrain Control System	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
• PCM, external vehicle wiring harnesses, main control molded leadframe, Shift Solenoid B (SSB), Shift Solenoid D (SSD) or Shift Solenoid E (SSE).	
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (E) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective solenoid multiplex valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Overdrive clutch (E) friction and steel plate — failure	• INSPECT the overdrive clutch assembly for damage. REPAIR as required. REFER to Overdrive Clutch Assembly in this section.

Feel Concerns: No 4-3 Shift

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Possible Component	Reference/Action
223 — ROUTINE	
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe, Shift Solenoid B (SSB) or Shift Solenoid D (SSD).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (E) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (E) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Solenoid multiplex valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Drive enable valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Overdrive clutch (E) friction and steel plate — failure	• INSPECT the overdrive clutch assembly for damage. REPAIR as required. REFER to Overdrive Clutch Assembly in this section.

Feel Concerns: No 3-2 Shift

Possible Component	Reference/Action
224 — ROUTINE	
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe, Shift Solenoid B (SSB) or Shift Solenoid C (SSC).	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic

	contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A.
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Intermediate clutch (C) friction and steel plate — failure	• INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.

Feel Concerns: No 2-1 Shift

Possible Component	Reference/Action
225 — ROUTINE	
Powertrain Control System	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A.
• PCM, external vehicle wiring harnesses, main control molded leadframe or Shift Solenoid C (SSC).	
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A.
• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (C) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Low/reverse clutch (D) friction and steel plate — failure	• INSPECT the low/reverse clutch assembly for damage. REPAIR as required. REFER to Low/Reverse Clutch Assembly in this section.
• Low One-Way Clutch (OWC) assembly — failure	• INSPECT the OWC assembly for damage. The OWC must rotate counterclockwise and lock clockwise. REPLACE the OWC. REFER to Transmission — Early Build or Transmission — Late Build in this section.

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Torque Converter Operation Concerns: No Apply

Possible Component	Reference/Action
240 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Fluid condition	• CHECK transmission fluid condition. REFER to Preliminary Inspection in this section.
Powertrain Control System	
• PCM, external vehicle wiring harnesses, main control molded leadframe or Torque Converter Clutch (TCC) solenoid.	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the TCC solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Main control assembly contaminated, solenoid(s) damaged, stuck or bore damaged. Manual valve damaged, stuck or bore damaged	• INSPECT for damage. If damaged, install a new main control assembly. REFER to Main Control in this section.
• Defective torque converter apply regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective torque converter release regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Main control assembly bolts — not tightened to specification	• TIGHTEN to specification.
Torque Converter	
• Torque converter components	• REMOVE the transmission. INSPECT for damage. INSTALL a new or remanufactured torque converter. REFER to Transmission — Four Wheel Drive (4WD) or Transmission — Rear Wheel Drive (RWD) in this section.

Torque Converter Operation Concerns: Cycling/Chatter

Possible Component	Reference/Action
241 — ROUTINE	

Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Fluid condition	• CHECK transmission fluid condition. REFER to Preliminary Inspection in this section.
Powertrain Control System	
• PCM, vehicle wiring harnesses, main control molded leadframe, Torque Converter Clutch (TCC) solenoid or Transmission Fluid Temperature (TFT) sensor	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A for TCC solenoid diagnosis and GO to Pinpoint Test B for TFT sensor diagnosis.
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the TCC solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A to diagnosis the Torque Converter Clutch (TCC) or GO to Pinpoint Test B to diagnosis the Transmission Fluid Temperature (TFT) sensor.
• Main control assembly contaminated, solenoid(s) damaged, stuck or bore damaged. Manual valve damaged, stuck or bore damaged	• INSPECT for damage. If damaged, install a new main control assembly. REFER to Main Control in this section.
• Defective torque converter apply regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Main control assembly bolts — not tightened to specification	• TIGHTEN to specification.
Torque Converter	
• Torque converter components	• REMOVE the transmission. INSPECT for damage. INSTALL a new or remanufactured torque converter. REFER to Transmission — Four Wheel Drive (4WD) or Transmission — Rear Wheel Drive (RWD) in this section.

Torque Converter Operation Concerns: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
242 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.

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• Fluid condition	• CHECK transmission fluid condition. REFER to Preliminary Inspection in this section.
Powertrain Control System	
• PCM, vehicle wiring harnesses, main control molded leadframe, Torque Converter Clutch (TCC) solenoid or Transmission Fluid Temperature (TFT) sensor	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A for TCC solenoid diagnosis and GO to Pinpoint Test B for TFT sensor diagnosis.
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the TCC solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A to diagnosis the Torque Converter Clutch (TCC) or GO to Pinpoint Test B to diagnosis the Transmission Fluid Temperature (TFT) sensor.
• Main control assembly contaminated, solenoid(s) damaged, stuck or bore damaged. Manual valve damaged, stuck or bore damaged	• INSPECT for damage. If damaged, install a new main control assembly. REFER to Main Control in this section.
• Main control assembly bolts — not tightened to specification	• TIGHTEN to specification.
Torque Converter	
• Torque converter components	• REMOVE the transmission. INSPECT for damage. INSTALL a new or remanufactured torque converter. REFER to Transmission — Four Wheel Drive (4WD) or Transmission — Rear Wheel Drive (RWD) in this section.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Transmission case vent — damaged, case porosity	• REPAIR as necessary.
• Leakage at gaskets, seals, electrical connector	• REFER to Leakage Inspection , Fluid Leakage in Torque Converter Area and Leak Check Test with A Black Light in this section. REMOVE all traces of lubricant on exposed surface of the transmission. REPAIR as necessary.

Fluid Cooler Tubes	
• Cooler tube fittings	• LOCATE leak source. REPAIR as required. REFER to Section 307-02 .
• Cooler tube O-rings, cooler tubes	• LOCATE leak source. REPAIR as required. REFER to Section 307-02 .
Torque Converter	
• Torque converter studs	• INSTALL a new torque converter. If a new or remanufactured torque converter is installed, use the scan tool and follow the on-screen instructions and perform the Misfire Monitor Neutral Profile Correction procedure.
• Torque converter hub seal	• INSTALL a new torque converter hub seal.
• Torque converter weld	• INSTALL a new torque converter. If a new or remanufactured torque converter is installed, use the scan tool and follow the on-screen instructions and perform the Misfire Monitor Neutral Profile Correction procedure.
Transmission Case	
• Case — leaking	• INSTALL a new transmission case. REFER to Transmission — Early Build or Transmission — Late Build in this section.
• Transmission vehicle harness connector	• INSTALL a new transmission vehicle harness connector O-ring.
• Transmission fluid fill plug	• INSTALL a new transmission fluid fill plug.
• Output shaft seal	• INSTALL a new seal. REFER to Output Shaft Seal in this section.
• Manual control lever seal	• INSTALL a new seal.
• Transmission fluid pan gasket	• INSTALL a new gasket.
Fluid Pump	
• Fluid pump O-ring	• INSTALL a new O-ring. REFER to Pump Assembly in this section.
• Fluid pump seal ring	• INSTALL a new seal ring. REFER to Pump Assembly in this section.

Other Concerns: Noise/Vibration in Forward or Reverse

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Possible Component	Reference/Action
254 — ROUTINE	
Transmission Fluid	
• Incorrect level (low) pump cavitation	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level

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	Check in this section.
Fluid Cooler Tubes • Cooler tubes grounding out	• ADJUST or REPOSITION cooler tubes.
Torque Converter • Check the torque converter components/balance weight	• LOCATE source of disturbance. REPAIR as required. If a new or remanufactured torque converter is installed, use the scan tool and follow the on-screen instructions and perform the Misfire Monitor Neutral Profile Correction procedure.
Engine Driveline • Engine drive accessories	• REFER to Section 303-00 .

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ROUTINE	
Selector Lever Cable System • Selector lever cable system — damaged, misaligned	• INSPECT and REPAIR as necessary. REFER to Section 307-05 .
Powertrain Control System • PCM, vehicle wiring harnesses, engine starting and charging system, main control molded leadframe or Transmission Range (TR) sensor	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test C .
Torque Converter • Flexplate — damaged	• REPAIR as necessary.
Vehicle Starter • Starter system concerns	• INSPECT and REPAIR as necessary. REFER to Section 303-06 .
Transmission Range (TR) Sensor Assembly • TR sensor assembly — damaged	• INSPECT and REPAIR as necessary.
Fluid Pump Assembly • Internal parts seized	• REPAIR as necessary.

Other Concerns: No Park (P) Range

Possible Component	Reference/Action
256 — ROUTINE	
Selector Lever Cable	
• Selector lever cable system — damaged, misaligned	• INSPECT and REPAIR as necessary. REFER to Section 307-05 for additional information.

• Manual control lever assembly damaged, manual valve inner lever pin bent, manual valve inner lever damaged, spring rod damaged, park pawl pin loose or damaged, park rod actuating plate loose, damaged or missing	• INSPECT for damage. REPAIR as necessary.
• Transmission case	• INSPECT for damage. If damaged, REPAIR as necessary.
• Park gear, park pawl, park pawl return spring, part or guide, park actuating rod, park pawl shaft, manual lever	• INSPECT for damage. If damaged, REPAIR as necessary.
• External linkages/brackets — damaged	• INSPECT for damage. REPAIR as necessary.
Powertrain Control System	
• PCM, vehicle wiring harnesses, main control molded leadframe or Transmission Range (TR) sensor	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test C .
Transmission Range (TR) Sensor Assembly Damaged	
• Manual lever detent spring	INSPECT for damage. REPAIR as necessary.
• TR sensor assembly	• INSTALL a new main control assembly. REFER to Main Control in this section.

Other Concerns: Transmission Overheating

Possible Component	Reference/Action
257 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
• Fluid condition	• CHECK transmission fluid condition. REFER to Preliminary Inspection in this section.
Powertrain Control System	
• PCM, vehicle wiring harnesses, main control molded leadframe, Torque Converter Clutch (TCC) solenoid or Transmission Fluid Temperature (TFT) sensor	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A for TCC solenoid diagnosis and GO to Pinpoint Test B for TFT sensor diagnosis.
Torque Converter Not Engaging	
• Torque converter	• INSTALL a new torque converter. If a new or remanufactured torque converter is installed, use the scan tool and follow the on-screen instructions and perform the Misfire Monitor Neutral Profile Correction procedure.

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Case Vent Damaged	
• Transmission case	• INSPECT for damage. If damaged, REPAIR as necessary.
Other	
• Restriction in transmission cooling system	• CHECK transmission cooling system efficiency. REFER to Section 307-02 for automatic transmission cooling system diagnostic procedures.
• Excessive trailer tow load	• REFER to the Owner's Literature for specifications on trailer towing.
• Vehicle heat shield — missing or damaged	• INSPECT for damage. REPAIR as necessary.
• Vehicle airflow is restricted	• INSPECT for damage. REPAIR as necessary.
• Thermal bypass valve — missing or damaged	• INSPECT for damage. REPAIR as necessary. REFER to Main Control in this section.

Other Concerns: Fluid Venting/Foaming

Possible Component	Reference/Action
261 — ROUTINE	
Transmission Fluid	
• Incorrect level	• CHECK the transmission fluid level. ADJUST transmission fluid to correct level. REFER to Transmission Fluid Level Check in this section.
Case Vent Damaged	
• Transmission case	• INSPECT for damage. If damaged, REPAIR as necessary.

Feel Concerns: Shift Concerns: No 4-5 Shift

Possible Component	Reference/Action
270 — ROUTINE	
Powertrain Control System	
• PCM, vehicle wiring harnesses, main control molded leadframe, Shift Solenoid A (SSA) solenoid or Shift Solenoid B (SSB) sensor	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .

• Defective clutch (A) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (A) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Forward clutch (A) friction and steel plate — failure	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.

Feel Concerns: No 5-4 Shift (Automatic)

Possible Component	Reference/Action
271 — ROUTINE	
Powertrain Control System	
• PCM, vehicle wiring harnesses, main control molded leadframe or Shift Solenoid B (SSB)	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A.
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A.
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (A) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Forward clutch (A) friction and steel plate — failure	• INSPECT the forward clutch assembly for damage. REPAIR as required. REFER to Forward Clutch Assembly in this section.

Feel Concerns: No 5-6 Shift (Automatic)

Possible Component	Reference/Action

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272 — ROUTINE	
Powertrain Control System	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
• PCM, vehicle wiring harnesses, main control molded leadframe, Shift Solenoid B (SSB) or Shift Solenoid C (SSC)	
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Intermediate clutch (C) friction and steel plate — failure	• INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.

Feel Concerns: No 6-5 Shift (Automatic)

Possible Component	Reference/Action
273 — ROUTINE	
Powertrain Control System	• If DTCs are set, CLEAR the DTCs. CARRY OUT the Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER) self-test. ROAD TEST the vehicle and CHECK for DTCs. If the DTCs return, GO to Pinpoint Test A .
• PCM, vehicle wiring harnesses, main control leadframe or Shift Solenoid C (SSC)	
Main Control	
• Molded leadframe — contamination	• REMOVE the main control assembly, REFER to Main Control in this section. INSPECT and CLEAN the shift solenoid terminals on the main control molded leadframe for metallic contamination, REFER to Shift Solenoids (SS) in this section. INSTALL the main control assembly. CLEAR the DTCs. ROAD TEST the vehicle. If the symptom returns, GO to Pinpoint Test A .
• Defective clutch (B) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
• Defective clutch (B) latch valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.

• Defective clutch (C) regulator valve	• INSPECT main control assembly for stuck valves or contamination. REFER to Main Control in this section.
Clutch Plates	
• Direct clutch (B) friction and steel plate — failure	• INSPECT the direct clutch assembly for damage. REPAIR as required. REFER to Direct Clutch Assembly in this section.
• Intermediate clutch (C) friction and steel plate — failure	• INSPECT the intermediate clutch assembly for damage. REPAIR as required. REFER to Intermediate Clutch Assembly in this section.

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Diagnostic Parameters Identification (PID) Chart

The following is a list of output state control parameters and their corresponding PIDs:

Diagnostic PID Chart

PID Name	PID Description	Units
AXLE	Axle Ratio	Ratio
BOO1	Brake ON/OFF Switch	On/Off
BOO2	Brake ON/OFF Switch	On/Off
CHT	Cylinder Head Temperature	Temperature
DTCCNT	Continuous Codes	Number
GEAR	Gear Commanded by Module	Mode
GEAR_OSC#	Gear Commanded by Output State Control	Mode
GEAR_RAT	Gear Ratio Commanded	Ratio
HRSH_SHFT#	Firm Shift	On/Off
IN_GEAR	In Gear-Transmission is Applying a Load to Engine	In Gear
ISS_F	Input Shaft Speed Sensor Fault	No Fault/Yes Fault
ISS_SRC	Input Shaft Speed Sensor	rpm
LINEDSD#	Line Pressure Control Desired	Pressure
LOAD	Engine Load	Percentage
OSS_F	Output Shaft Speed Reliable	No Fault/Yes Fault
OSS_SRC	Unfiltered Output Shaft Speed	rpm
PARK_BRK	Park Brake Switch	On/Off
LPC	Line Pressure Control (LPC) solenoid	Pressure
LPC_AMP#	LPC solenoid current	Current
LPC_F	LPC solenoid fault status	No Fault/Yes Fault
RLC_F	Reverse Control Lamp Status	No Fault/Yes Fault
RPM#	Engine Revolutions Per Minute	rpm
SHIFT_DROP	Shift rpm Drop in Input Shaft Speed Below Expected	rpm
SHIFT_FLRE	Shift rpm Rise in Input Shaft Speed Above Expected	rpm
SHIFT_ID	Shift Identification of Shift PIDs Lag, Time, Flair and Drop	rpm
SHIFT_LAG	Shift Time Elapsed From 1% to 9% Complete	Time
SHIFT_TIME	Shift Time From Commanded to 10% Complete	Time
SHIFT_TYPE	Shift Type	Type
SSA_AMP#	Shift Solenoid Pressure Control A (SSPCA)	Current

SSB_AMP#	Shift Solenoid Pressure Control B (SSPCB)	Current
SSC_AMP#	Shift Solenoid Pressure Control C (SSPCC)	Current
SSD_AMP#	Shift Solenoid Pressure Control D (SSPCD)	Current
SSE_AMP#	Shift Solenoid Pressure Control E (SSPCE)	Current
SSPCA	SSPCA	Pressure
SSPCA_F	SSPCA Status	No Fault/Yes Fault
SSPCB	SSPCB	Pressure
SSPCB_F	SSPCB Status	No Fault/Yes Fault
SSPCC	SSPCC	Pressure
SSPCC_F	SSPCC Status	No Fault/Yes Fault
SSPCD	SSPCD	Pressure
SSPCD_F	SSPCD Status	No Fault/Yes Fault
SSPCE_F	SSPCE Status	No Fault/Yes Fault
TCC	Torque Converter Clutch (TCC) Solenoid	Pressure
TCC AMP#	Converter Pressure Control	Current
TCC_F	TCC Fault	No Fault/Yes Fault
TCC_OSC#	Output State Control of Torque Converter	Locked/Unlocked
TCC_RAT	Transmission Slip Ratio	Ratio
TCIL	Transmission Control Indicator Lamp (TCIL)	On/Off
TCS_DEPRES	Transmission Control Switch (TCS) Pressed	Yes/No
TCS_STATE	TCS Requested State	On/Off
TC_SLIPACT	Torque Converter Slip Actual	rpm
TC_SLIPDSD	Torque Converter Slip Desired	rpm
TFT	Transmission Fluid Temperature (TFT)	Temperature
TFTV	TFT Volts	Volts
TFT_F	TFT Status	No Fault/Yes Fault
TIRESIZE	Tire Size	Rev Per Mile
TP	Throttle Position (TP) Sensor	Percentage
TP1	TP Sensor 1	Volts
TP2	TP Sensor 2	Volts
TR	Transmission Range (TR)	Mode
TRANS_VOLT_A	Transmission Supply Voltage Control State	On/Off
TRAN_RAT	Transmission Gear ratio	Ratio
TRN_N_F	Neutral Output Status	On/Off
TRN_P_F	Park Output Status	On/Off
TR_CRANK	TR Input Allowing Input Start	Yes/No
TR_DC	TR Duty Cycle	Percentage
TR_F	TR Status	No Fault/Yes Fault
TR_FREQ	TR Frequency	Frequency

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	Turbine Shaft Speed (TSS) Reliable	No Fault/Yes Fault
TSS_SRC	Unfiltered Turbine Shaft Speed	rpm
VPWR	Module Supply Voltage	Volts
VREF	Reference Voltage	Volts
VSOUT_F	Vehicle Speed Output Status	No Fault/Yes Fault
VSS	Vehicle Speed Sensor (VSS)	Speed

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To correctly diagnose a concern, have the following publications available:

- Powertrain Control/Emissions Diagnosis (PC/ED) manual
- On-Line Automotive Service Information System (OASIS)
- TSBs
- Wiring Diagrams manual

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer concern.
- Verify the concern by operating the vehicle.
- Check the transmission fluid level and condition.
- Check for non-factory add-on items.
- Check selector lever cable for correct adjustment.
- Check TSBs regarding the concern.

Diagnostics

- Carry out On-Board Diagnostic (OBD) procedures, Key ON Engine OFF (KOEO) and Key ON Engine Running (KOER).
- Record all DTCs.
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Clear all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only codes that have passed are obtained, refer to Diagnosis By Symptom in this section for additional information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

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Diagnostic Trouble Code (DTC) Charts

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Using a scan tool to retrieve DTCs, begin with and repair all non-transmission related DTCs. Start with the U-DTCs (communication link codes) then repair transmission related DTCs.

The PCM will command a default gear to protect the engine and transmission when certain faults occur. Default or (limp-home mode) depends on the actual gear the vehicle was in when the fault occurred.

- For gears 1-3, the default will be 3rd gear.
- For gears 4-6, the default will be 5th gear.

The default gear is held until the vehicle is placed in reverse, park or the vehicle is restarted. After these action(s) the vehicle will default to 3rd gear.

DTC Chart

DTC	Component	Description	Condition	Symptom	Action
B2572	Brake Shift Interlock Actuator (BSIA)	BSIA open or shorted circuit	The BSIA system a malfunction.	• BSIA inoperative	REFER to Section 307-05 .
P0657	PCM	Actuator supply voltage A circuit open	The Transmission Solenoid Power Control (TSPC) relay failed open.	• Malfunction Indicator Lamp (MIL) ON • Maximum line pressure • Default to 5th gear	Power is routed through the transmission solenoid power control (TSPC) relay (inside the PCM) to all solenoids. If the power circuit to the transmission solenoids or the TSPC relay fails open, then all solenoids are failed electrically off. CHECK for open, short to ground or the transmission

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					connector disconnected. The TSPC relay also disables power to the transmission solenoids when certain transmission DTCs are set. REPAIR as required. CLEAR the DTC. GO to Pinpoint Test A .
P0701	PCM	Transmission control system range/performance	The PCM detected an intermittent clutch ON fault.	• Vehicle decelerates during upshift or hangs in gear • DTCs P2700 (A) clutch, P2701 (B) clutch, P2702 (C) clutch, P2703 (D) clutch and/or P2704 (E) clutch may set	CLEAR the DTCs. TEST the system for normal operation. If the DTCs return, REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P0702	Battery	Battery voltage out of range	The PCM detected a voltage level above or below the accepted voltage range.	• Wrench light illuminated • Maximum line pressure • DTCs P0882 and/or P0883 may set	REPAIR the more specific DTC first. CLEAR the DTCs. TEST the system for normal operation. REFER to Section 414-00 .
P0705	Transmission Range (TR) sensor	TR sensor failure	The PCM detected a TR sensor signal duty cycle is within range but does not match the calibrated bit pattern.	• MIL ON • Engine will not crank • Default to 3rd or 5th gear if DTC sets after engine running • Maximum line pressure • DTC P1702 may set	REPAIR the more specific DTC first. CLEAR the DTCs. GO to Pinpoint Test C .
P0706	TR sensor	TR sensor A circuit range/performance	The PCM detected a TR sensor signal duty cycle is out of range.	• MIL ON • Engine will not crank • Default to 3rd or 5th gear if DTC sets after engine running • Maximum line pressure • DTC P1705	The TR sensor outputs a duty cycle indicating manual lever position. This DTC sets when the duty cycle is greater or less than commanded by 50Hz. GO to Pinpoint Test C .

				may set	
P0707	TR sensor	TR sensor A circuit low	The PCM detected a TR sensor signal duty cycle is out of range.	• MIL ON • Engine will not crank • Default to 5th gear if DTC sets after engine is running • Maximum line pressure • DTC P1702 may set	The TR sensor outputs a duty cycle indicating manual lever position. This DTC sets when the duty cycle is 8% less than commanded. GO to Pinpoint Test C .
P0708	TR sensor	TR sensor A circuit high	The PCM detected a TR sensor signal duty cycle is out of range.	• MIL ON • Engine will not crank • Default to 5th gear if DTC sets after engine running • Maximum line pressure • DTC P1702 may set	The TR sensor outputs a duty cycle indicating manual lever position. This DTC sets when the duty cycle is 92% greater than commanded. GO to Pinpoint Test C .
P0709	TR sensor	TR sensor A circuit intermittent	The PCM detected a TR sensor signal duty cycle is not out of range but is invalid.	• Wrench light illuminated • Engine may not crank • Default to 5th gear if DTC sets after engine running • Maximum line pressure • DTC P1702 may set	The TR sensor outputs a duty cycle indicating manual lever position. This DTC sets when the duty cycle is within range but is in the dead band between the design position, an in-range but invalid duty cycle. GO to Pinpoint Test C .
P0710	Transmission Fluid Temperature (TFT) sensor	TFT sensor A circuit	The PCM detected a voltage drop across the TFT sensor exceeds scale.	• Wrench light illuminated • DTC P0712 and/or P0713 may set	REPAIR the more specific DTC first. GO to Pinpoint Test B .
P0711	TFT sensor	TFT sensor A circuit range/performance	The PCM detected no TFT sensor change during operation. The TFT sensor is stuck below 21° C (70°F) or above 107°C (225°F) or the temperature did not change by 8°F during a drive cycle.	• MIL ON • Default to 1st or 3rd gear	CLEAR the DTC. If the DTC returns, GO to Pinpoint Test B .

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P0712	TFT sensor	TFT sensor A circuit low	The PCM detected a temperature greater than 171° C (340°F) for at least 2.5 seconds (grounded circuit).	• MIL ON • Default to 1st gear • DTC P0710 may set	REPAIR the more specific DTC first. CLEAR the DTCs. If the DTC returns, GO to Pinpoint Test B.
P0713	TFT sensor	TFT sensor A circuit high	The PCM detected a temperature less than -45°C (-50° F) for at least 2.5 seconds (open circuit).	• MIL ON • Default to 1st gear • DTC P0710 may set	REPAIR the more specific DTC first. CLEAR the DTCs. If the DTC returns, GO to Pinpoint Test B.
P0715	Turbine Shaft Speed (TSS) sensor	TSS sensor A circuit	The PCM indicated no rpm input from the TSS sensor when the Output Shaft Speed (OSS) sensor indicated rpm greater than 0.	• MIL ON • Default to 5th gear • Maximum line pressure • DTC P0717 may set	REPAIR the more specific DTC first. CLEAR the DTCs. If the DTC returns, GO to Pinpoint Test D.
P0717	TSS sensor	TSS sensor A circuit no signal	The PCM has not detected a TSS sensor signal during operation.	• Wrench light illuminated • Default to 5th gear • Maximum line pressure • DTC P0715 may set	This DTC sets when DTC P0715 is set. REFER to DTC P0715.
P0718	TSS sensor	TSS sensor A circuit intermittent	The PCM has detected an intermittent (noise) in the TSS sensor signal during operation.	• Wrench light illuminated • Poor shift quality	CLEAR the DTC. If the DTC returns, GO to Pinpoint Test D.
P0720	OSS sensor	OSS sensor circuit	The PCM indicated no rpm input from the OSS sensor when the TSS sensor indicated rpm greater than 0.	• MIL ON • Default to 5th gear • Maximum line pressure • DTC P0722 may set	REPAIR the more specific DTC first. CLEAR the DTCs. If the DTC returns, GO to Pinpoint Test E.
P0721	OSS sensor	OSS sensor circuit intermittent	The PCM has detected and unrealistic rpm change in the OSS sensor.	• Wrench light illuminated • Poor shift quality	CLEAR the DTC. If the DTC returns, GO to Pinpoint Test E.
P0722	OSS sensor	OSS sensor no signal	The PCM indicated no rpm input from the OSS sensor when the TSS sensor indicated rpm	• Wrench light illuminated • Default to 5th gear • Maximum line pressure	This DTC sets when DTC P0720 is set. REFER to DTC P0720.

			greater than 0.	• DTC P0720 may set	
P0729	Transmission	Gear 6 incorrect ratio	The PCM did not detect a 6th gear ratio when commanded.	• Wrench light illuminated • No 6th gear • Flair or neutral condition • Hangs in gear	Intermediate clutch (C) or overdrive clutch (E) failed to apply. REFER to the Clutch Application Chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0731	Transmission	Gear 1 incorrect ratio	The PCM did not detect a 1st gear ratio when commanded.	• Wrench light illuminated • No 1st gear • Flair or neutral condition • Hangs in gear	Forward clutch (A) or low/reverse clutch (D) slip of clutch (D) failed to apply or OWC failed to hold. REFER to the Clutch Application Chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0732	Transmission	Gear 2 incorrect ratio	The PCM did not detect a 2nd gear ratio when commanded.	• Wrench light illuminated • No 2nd gear • Flair or neutral condition • Hangs in gear	Forward clutch (A) or intermediate clutch (C) slip or clutch (C) failed to apply. REFER to the Clutch Application Chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0733	Transmission	Gear 3 incorrect ratio	The PCM did not detect a 3rd gear ratio when commanded.	• Wrench light illuminated • No 3rd gear • Flair or neutral condition • Hangs in gear	Forward clutch (A) or direct clutch (B) slip or clutch (B) failed to apply. REFER to the Clutch Application Chart located in

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					Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0734	Transmission	Gear 4 incorrect ratio	The PCM did not detect a 4th gear ratio when commanded.	• Wrench light illuminated • No 4th gear • Flair or neutral condition • Hangs in gear	Forward clutch (A) or overdrive clutch (E) slip or clutch (A) or (E) failed to apply. REFER to the Clutch Application Chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0735	Transmission	Gear 5 incorrect ratio	The PCM did not detect a 5th gear ratio when commanded.	• Wrench light illuminated • No 5th gear • Flair or neutral condition • Hangs in gear	Direct clutch (B) or overdrive clutch (E) slip or clutch (B) or (E) failed to apply. REFER to the Clutch Application Chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0740	Torque Converter Clutch (TCC) solenoid	TCC solenoid circuit/open	The PCM detected that the TCC solenoid control circuit failed open.	• MIL ON • TCC is disabled • DTC P0743 may set	GO to Pinpoint Test A .
P0741	TCC solenoid	TCC solenoid circuit performance/stuck OFF	The TCC failed to apply after 3 consecutive commands from the PCM.	• MIL ON • TCC is disabled • TCC regulator apply valve stuck in the release position • TCC control valve stuck in the release	DTC P0741 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Torque Converter Operation Concerns, No Apply in Diagnosis By Symptom in this

				position • DTC P0751 may set	section.
P0742	TCC solenoid	TCC solenoid circuit stuck ON	The PCM detected the TCC solenoid control circuit is shorted to ground.	• MIL ON • TCC is disabled • Poor launch performance • Default to 3rd or 5th gear • DTC P0743 may set	GO to Pinpoint Test A .
P0743	TCC solenoid	TCC solenoid circuit electrical	The PCM detected that the TCC solenoid circuit is open, shorted to ground or an intermittent.	• Wrench light illuminated • TCC is disabled • Poor launch performance • Default to 5th gear • DTCs P0740, P0742 and/or P0744 may set	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0744	TCC solenoid	TCC solenoid circuit intermittent	The PCM detected that the TCC solenoid control circuit is shorted to power.	• MIL ON • TCC is disabled • DTC P0743 may set	GO to Pinpoint Test A .
P0748	Line Pressure Control (LPC)	LPC electrical	The PCM sets this DTC along with one or more specific electrical DTCs.	• Wrench light illuminated • Maximum line pressure • May default to 5th gear • DTCs P0960, P0962 and/or P0963 may set	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0750	Shift Solenoid A (SSA)	SSA	The PCM detected that the SSA circuit failed open or shorted to power.	• MIL ON • 5th and 6th gear only • DTC P0753 may set	GO to Pinpoint Test A .
P0751	SSA	SSA performance/stuck OFF	The PCM commanded SSA ON but detected a ratio error. Forward clutch (A) failed OFF.	• MIL ON • 5th and 6th gear only • Harsh reverse engagement • Neutral or flair condition • Clutch A regulator valve stuck in default position	DTC P0751 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Hydraulic Circuits in this section.

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				• Clutch A latch valve stuck in default position • DTC P2700 may set	
P0752	SSA	SSA stuck ON	The PCM commanded SSA OFF but detected a ratio error. Forward clutch (A) stuck ON.	• MIL ON • Disable 5th and 6th gear • Erratic shifts • Stuck in 4th gear • Clutch A regulator valve stuck in spring compressed position • DTC P2700 may set	DTC P0752 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Forward Clutch Assembly in this section.
P0753	SSA	SSA electrical	The PCM sets this DTC along with one or more specific electrical DTCs.	• Wrench light illuminated • 5th and 6th gear only • DTCs P0750, P0973 and/or P0974 may set	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0754	SSA	SSA intermittent	The PCM sets this DTC when an intermittent condition (open, short to power or ground) occurs 3 times for less than 5 seconds with each occurrence.	• Unexpected upshifts, downshifts, flairs or neutral conditions	CLEAR the DTC. TEST the system for normal operation. If the DTC returns, GO to Pinpoint Test A .
P0755	Shift Solenoid B (SSB)	SSB	The PCM detected that the SSB circuit failed open or shorted to power.	• MIL ON • Default to 3rd or 5th gear • Harsh 1-3 shift • DTC P0756 may set	GO to Pinpoint Test A .
P0756	SSB	SSB performance/stuck OFF	The PCM commanded SSB ON but detected a ratio error. Direct clutch (B) failed OFF.	• MIL ON • Default to 3rd or 5th gear • Neutral or flair condition • Transmission hangs in 2nd gear on acceleration • Clutch B regulator	DTC P0756 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Hydraulic Circuits in this section.

				valve stuck in default position • Clutch B latch valve stuck in default position • DTC P0757 may set	
P0757	SSB	SSB stuck ON	The PCM commanded SSB OFF but detected a ratio error. Direct clutch (B) stuck ON.	• MIL ON • Default to 3rd or 5th gear • Harsh 1-3 shift • Erratic shifts • Clutch B regulator valve stuck in spring compressed position • DTC P0758 may set	DTC P0757 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Direct Clutch Assembly in this section.
P0758	SSB	SSB electrical	The PCM sets this DTC along with one or more specific electrical DTCs.	• Wrench light illuminated • Default to 3rd or 5th gear • Maximum line pressure • DTCs P0755, P0976 and/or P0977 may set	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0759	SSB	SSB intermittent	The PCM sets this DTC when an intermittent condition (open, short to power or ground) occurs 3 times for less than 5 seconds with each occurrence.	• Unexpected upshifts, downshifts, flairs or neutral conditions	CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, GO to Pinpoint Test A .
P0760	Shift Solenoid C (SSC)	SSC	The PCM detected the SSC circuit has failed open.	• MIL ON • Disable 2nd and 6th gear • Erratic or harsh 1-3 shift • DTC P0763 may set	GO to Pinpoint Test A .
P0761	SSC	SSC performance/stuck OFF	The PCM commanded SSC ON but detected a ratio error. Intermediate	• MIL ON • Disable 2nd and 6th gear • Neutral or flair condition	DTC P0761 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If

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			clutch (C) failed OFF.	• Clutch C regulator valve stuck in default position • DTC P2702 may set	the DTC returns, REFER to Intermediate Clutch Assembly in this section.
P0762	SSC	SSC stuck ON	The PCM commanded SSC OFF but detected a ratio error. Intermediate clutch (C) stuck ON.	• MIL ON • 2nd and 6th upshift only • Harsh reverse engagement • Erratic shift or stuck in 6th • Clutch C regulator valve stuck in spring compressed position • DTC P2702 may set	DTC P0762 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Intermediate Clutch Assembly in this section.
P0763	SSC	SSC electrical	The PCM sets this DTC along with one or more specific electrical DTCs.	• Wrench light illuminated • Disable 2nd and 6th gear • DTCs P0760, P0979 and/or P0980 may set	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0764	SSC	SSC intermittent	The PCM sets this DTC when an intermittent condition (open, short to power or ground) occurs 3 times for less than 5 seconds with each occurrence.	• Unexpected upshifts, downshifts, flairs or neutral conditions	CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, GO to Pinpoint Test A .
P0765	Shift Solenoid D (SSD)	SSD	The PCM detected that SSD circuit has failed open.	• MIL ON • Disable 1st, 2nd and 3rd gears • Poor launch performance • DTC P0768 may set	GO to Pinpoint Test A .
P0766	SSD	SSD performance/stuck OFF	The PCM commanded SSD ON but detected a ratio error. The low/reverse clutch (D) and overdrive clutch (E) have both failed OFF.	• MIL ON • 3rd gear only • Delayed or no reverse engagement • Neutral or flair condition • DTCs P2703	REPAIR the more specific DTC first. DTC P0766 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns,

				and/or P2704 may set	REFER to Hydraulic Circuits in this section.
P0767	SSD	SSD stuck ON	The PCM commanded SSD OFF but detected a ratio error. Overdrive clutch (E) failed to release.	• MIL ON • 4th, 5th and 6th gear only • Early upshifts • Stuck in 4th • DTC P2704 may set	DTC P0767 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0768	SSD	SSD electrical	The PCM sets this DTC along with one or more specific electrical DTCs.	• Wrench light illuminated • Default to 3rd gear • DTCs P0765, P0982 and/or P0983 may set	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0769	SSD	SSD intermittent	The PCM sets this DTC when an intermittent condition (open, short to power or ground) occurs 3 times for less than 5 seconds with each occurrence.	• Unexpected upshifts, downshifts, flairs or neutral conditions	CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, GO to Pinpoint Test A .
P0770	Shift Solenoid E (SSE)	SSE	The PCM detected that the SSE circuit failed open, shorted to ground or shorted to power.	• MIL ON • No TCC • If 1st, 2nd and 3rd gears are achieved than circuit is open or shorted to power (no pressure) • If 5th gear launch than circuit is shorted to ground (pressure) • DTC P0773 may set	GO to Pinpoint Test A .
P0771	SSE	SSE performance/stuck OFF	The PCM commanded SSE ON but detected a ratio error (mechanical failure).	• MIL ON • 1st, 2nd and 3rd gear only • Solenoid multiplex valve stuck in default position	DTC P0771 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this

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				• DTC P0984 may set	section.
P0772	SSE	SSE stuck ON	The PCM commanded SSE OFF but detected a ratio error (mechanical failure).	• MIL ON • No 1st gear • 4th gear launch • Solenoid multiplex valve stuck in spring compressed position • DTC P0984 may set	DTC P0772 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0773	SSE	SSE electrical	The PCM sets this DTC along with one other specific electrical DTC. SSE circuit may be open, short to power or ground.	• Wrench light illuminated • If 1st, 2nd and 3rd gears are achieved than circuit is open or shorted to power (no pressure) • If 5th gear launch than circuit is shorted to ground (pressure) • DTC P0770 may set	REFER to DTC P0770.
P0774	SSE	SSE intermittent	The PCM sets this DTC when an intermittent condition (open, short to power or ground) occurs but does not set DTC P0770.	• Wrench light illuminated • Transmission hangs in 1st gear or may be stuck in 3rd gear	CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, GO to Pinpoint Test A .
P07A8	Transmission	Transmission friction element D performance/stuck OFF	The low/reverse clutch failed OFF.	• Wrench light illuminated • Delay or no reverse engagement • Disable 1st gear • Erratic shifts	DTC P07A8 is a non-electrical DTC. CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REFER to Low/Reverse Clutch Assembly in this section.
P07A9	Transmission	Transmission friction element D stuck ON	The low/reverse One-Way Clutch (OWC) is failed ON.	• Wrench light illuminated • No TCC • 1st gear only • High engine rpm	DTC P07A9 is a non-electrical DTC. CLEAR the DTC. TEST the system for normal operation. If the DTC returns,

					REFER to Low/Reverse Clutch Assembly in this section.
P07AA	Transmission	Transmission friction element E performance/stuck off	The PCM detected a ratio error. Overdrive clutch (E) failed OFF.	• Wrench light illuminated • 1st, 2nd and 3rd gears only • Neutral or flair condition • High engine rpm • Erratic shifts	DTC P07AA is a non-electrical DTC. CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REFER to Overdrive Clutch Assembly in this section.
P0815	SelectShift™ switch	Upshift switch circuit	The upshift and downshift switches are open in PARK, REVERSE and NEUTRAL. The PCM sets this DTC when it detects an upshift switch is closed (short to ground).	• Wrench light illuminated • Disable SelectShift™ scheduling to automatic shift scheduling • Upshifts request ignored • Unexpected upshifts	REFER to Section 307-05 .
P0816	SelectShift™ switch	Downshift switch circuit	The upshift and downshift switches are open in PARK, REVERSE and NEUTRAL. The PCM sets this DTC when it detects a downshift switch is closed (short to ground).	• Wrench light illuminated • Disable SelectShift™ scheduling to automatic shift scheduling • Upshifts request ignored • Unexpected downshifts	REFER to Section 307-05 .
P0826	SelectShift™ switch	Up and Down switch circuit	The upshift and downshift switches are open in PARK, REVERSE and NEUTRAL. The PCM sets this DTC when it detects the select switch inputs do not match the selector lever position.	• Wrench light illuminated • Default to automatic shift scheduling • Upshifts and downshift request ignored	REFER to Section 307-05 .
P0882	Battery	PCM power input signal low	The battery voltage is out of range low. At low	• MIL ON • Default to 3rd or 5th gear	CLEAR the DTC. TEST the system for normal operation. If

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			volts the solenoid drivers may no longer be able to achieve desired current so the transmission solenoid power control relay will be turned OFF.	depending vehicle speed and gear • Battery voltage below 9 volts • Maximum line pressure	the DTC returns, REFER to Section 414-00 .
P0883	Battery	PCM power input signal high	The battery voltage is out of range high. Greater than 21 volts.	• MIL ON • Default to 3rd or 5th gear depending vehicle speed and gear • Battery voltage above 21 volts • Maximum line pressure • May set DTC P0702	CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REFER to Section 414-00 .
P0960	LPC	LPC control circuit/open	The PCM detected 0 volts on the LPC circuit.	• MIL ON • Maximum line pressure • May default to 5th gear • DTC P0748 may set	GO to Pinpoint Test A .
P0961	LPC	LPC control circuit range/performance	The PCM detected that the LPC control circuit is shorted to ground but not long enough to set DTC P0962.	• Intermittent condition • Minimum line pressure	GO to Pinpoint Test A .
P0962	LPC	LPC control circuit low	The PCM detected 0 volts on the LPC circuit. Short to ground detected.	• MIL ON • Default to 5th gear • Maximum line pressure • DTC P0748 may set	GO to Pinpoint Test A .
P0963	LPC	LPC control circuit high	The PCM detected voltage on the LPC circuit. Short to power detected.	• MIL ON • Maximum line pressure • DTC P0748 may set	GO to Pinpoint Test A .
P0973	SSA	SSA control circuit low	The PCM detected 0 volts on the SSA circuit. Short to ground detected.	• MIL ON • Default to 5th gear • Default to 3rd only, when the selector lever is shifted into	GO to Pinpoint Test A .

				Reverse then back into Drive • Maximum line pressure • DTC P0753 may set	
P0974	SSA	SSA control circuit high	The PCM detected voltage on the SSA circuit. Short to power or open circuit detected.	• MIL ON • 5th and 6th gear only • DTC P0753 may set	GO to Pinpoint Test A .
P0976	SSB	SSB control circuit low	The PCM detected 0 volts on the SSB circuit. Short to ground detected.	• MIL ON • Default to 5th gear • Default to 3rd only, when the selector lever is shifted into REVERSE then back into DRIVE • Maximum line pressure • DTC P0753 may set	GO to Pinpoint Test A .
P0977	SSB	SSB control circuit high	The PCM detected voltage on the SSB circuit. Short to power or open circuit.	• MIL ON • Default to 3rd and 5th gear • Harsh 1st to 3rd shift • Maximum line pressure • DTC P0758 may set	GO to Pinpoint Test A .
P0979	SSC	SSC control circuit low	The PCM detected 0 volts on the SSC circuit. Short to ground detected.	• MIL ON • Default to 5th gear • Maximum line pressure • DTC P0763 may set	GO to Pinpoint Test A .
P0980	SSC	SSC control circuit high	The PCM detected voltage on the SSC circuit. Short to power detected.	• MIL ON • 2nd and 6th gears disabled • Harsh 1st to 3rd shift • Maximum line pressure • DTC P0763 may set	GO to Pinpoint Test A .
P0982	SSD	SSD control circuit low	The PCM detected 0 volts	• MIL ON • Default to 5th	GO to Pinpoint Test A .

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			on the SSD circuit. Short to ground detected.	gear • Default to 3rd only, when the selector lever is shifted into REVERSE then back into DRIVE • Maximum line pressure • DTC P0768 may set	
P0983	SSD	SSD control circuit high	The PCM detected voltage on the SSD circuit. Short to power detected.	• MIL ON • Disable 1st, 2nd and 3rd gear • Poor launch performance • Maximum line pressure • DTC P0768 may set	GO to Pinpoint Test A .
P0984	SSE	SSE control circuit range/performance	The PCM commanded SSE ON or OFF but detected a ratio error (mechanical failure).	• Wrench light illuminated • DTC P0771 and/or P0772 will set	DTC P0984 is a non-electrical DTC. CLEAR the DTCs. REPAIR the more specific DTC first. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P1001	PCM	Key ON Engine Running (KOER) not able to complete, KOER aborted	The KOER self-test was unable to complete and aborted.	• —	REFER to, Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1397	PCM	System voltage out of self-test range	The PCM detected that system voltage is out of self-test range of 11 to 18 volts, during the Key ON Engine OFF (KOEO) or KOER .	• —	CLEAR the DTC. RERUN the KOEO and KOER self test. If the DTC returns, REFER to Section 414-00 .
P1501	PCM	Vehicle Speed Sensor (VSS) out of self-test range	The PCM detected a VSS signal during the self-test.	• Self-test aborted	CLEAR the DTC. With the selector lever in the Park position, RERUN the self-test. If the DTC returns, REFER to Powertrain

					Control/Emissions Diagnosis (PC/ED) manual.
P1502	PCM	VSS intermittent	Intermittent VSS fault keeps disabling engine monitors.	• Can not complete engine monitors	REFER to, Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1635	PCM	Tire/Axle out of acceptable range	The tire, axle or the combination of tire and axle are out of the certified range. Calibration was not updated.	• MIL ON • PCM will use a default tire and axle calibration	REFER to, Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1636	PCM	Inductive signature chip communication error	The PCM lost communication with an internal chip that controls the solenoid states and fault reporting.	• MIL ON • Default to 3rd or 5th gear • Maximum line pressure • Poor launch performance	REPLACE the PCM, REFER to Section 303-14 . After installing the new PCM, PROGRAM it with the latest calibration and PERFORM the Solenoid Body Strategy Data Download. REFER to Solenoid Body Strategy in this section. ROAD TEST the vehicle and PERFORM the Adaptive Drive Cycle, REFER to Shift Point Road Test in this section.
P163E	PCM	PCM programming error	The PCM has detected an invalid checksum.	• MIL ON • Default to 1st or 3rd gear • Maximum line pressure	REPROGRAM the original PCM with the latest calibration. CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REPLACE the PCM. REFER to Section 303-14 . After installing the new PCM, PROGRAM it with the latest calibration and PERFORM the Solenoid Body Strategy Data Download. REFER to Solenoid Body Strategy in this section. ROAD TEST the vehicle

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					and PERFORM the Adaptive Drive Cycle, REFER to Shift Point Road Test in this section.
P163F	PCM	Transmission ID block corrupted, not programmed	The PCM has detected an invalid transmission identification.	• MIL ON • Default to 1st or 3rd gear • Maximum line pressure	REPROGRAM the original PCM with the latest calibration. CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REPLACE the PCM. REFER to Section 303-14 . After installing the new PCM, PROGRAM it with the latest calibration and PERFORM the Solenoid Body Strategy Data Download. REFER to Solenoid Body Strategy in this section. ROAD TEST the vehicle and PERFORM the Adaptive Drive Cycle, REFER to Shift Point Road Test in this section.
P1700	Transmission	Transmission intermittent failure (failed to neutral)	Main control body issue where the multiplex valve reverse pressure bleeds off to slow and causes the multiplex valve to get stuck in the wrong state.	• Wrench light illuminated • Neutral condition when 1st gear commanded	DTC P1700 is a non-electrical DTC. CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P1702	TR sensor	TR sensor circuit intermittent	The PCM detected a TR sensor signal duty cycle is not out of range but is invalid.	• Wrench light illuminated • DTC P0705, P0706, P0707, P0708 and/or P0709 may set	REPAIR the more specific DTC first. GO to Pinpoint Test C .
P1705	TR sensor	TR sensor circuit did not indicate PARK/NEUTRAL during the self-test.	The TR sensor circuit did not indicate PARK/NEUTRAL during KOEO or KOER self-test.	• —	CLEAR the DTC. RERUN the KOEO and KOER self test. If DTC returns. GO to Pinpoint Test C .
P1711	TFT sensor	TFT sensor out of	The PCM did not	• —	CLEAR the DTC.

		self-test range	receive a TFT sensor input during the KOEO or KOER self-test that was within -1.11°C to 104°C (30°F to 220°F) during the self-test.		RERUN the KOEO and KOER self-test. If DTC returns GO to Pinpoint Test B .
P1744	TCC	TCC solenoid circuit	The PCM detected that the TCC solenoid is stuck ON or stuck OFF.	• Wrench light illuminated • DTC P0741 and/or P2758 may set	DTC P1744 is a non-electrical DTC. REPAIR the more specific DTC first. CLEAR the DTCs. TEST the system for normal operation. If the DTCs return, REFER to Diagnosis By Symptom in this section.
P1780	Transmission Control Switch (TCS)	TCS (Tow/Haul) circuit out of self-test range	The PCM did not receive a TCS input during the KOER self-test.	• Disable Tow/Haul function	CLEAR the DTC. RERUN KOER self-test. If DTC returns, REFER to Section 307-05 .
P1783	Transmission	Transmission overtemperature condition	The PCM detected a transmission temperature greater than 135° C (275°F) for more than 5 seconds.	• Wrench light illuminated • TCC commanded on early	CLEAR the DTC. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P1921	TR sensor	TR signal	The PCM detected a TR sensor signal duty cycle out of range.	• Engine will not crank • DTCs P1705, P0706, P0707, P0708 and/or P0709 may set	REPAIR the more specific DTC first. GO to Pinpoint Test C .
P2700	Transmission	Transmission friction element A apply time range/performance	The PCM commanded SSA ON or OFF but detected a ratio error (mechanical failure).	• Wrench light illuminated • DTC P0751 and/or P0752 will set	DTC P2700 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2701	Transmission	Transmission friction element B apply time range/performance	The PCM commanded SSB ON or OFF but detected a ratio error (mechanical failure).	• Wrench light illuminated • DTC P0756 and/or P0757 will set	DTC P2701 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.

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P2702	Transmission	Transmission friction element C apply time range/performance	The PCM commanded SSC ON or OFF but detected a ratio error (mechanical failure).	• Wrench light illuminated • DTC P0761 and/or P0762 will set	DTC P2702 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2703	Transmission	Transmission friction element D apply time range/performance	The PCM commanded SSD ON or OFF but detected a ratio error (mechanical failure).	• Wrench light illuminated • DTC P0766 and/or P2704 will set	DTC P2703 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2704	Transmission	Transmission friction element E apply time range/performance	The PCM commanded SSE ON or OFF but detected a ratio error (mechanical failure).	• Wrench light illuminated • DTC P0766 and/or P0767 will set	DTC P2704 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2705	Transmission	Transmission friction element F apply time range/performance	The One-Way Clutch (OWC) failed OFF (OWC failure).	• Wrench light illuminated • Neutral condition when 1st gear is commanded • Poor launch performance • Harsh engagements	DTC P2704 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2758	TCC	TCC pressure control solenoid stuck ON	The PCM commanded the TCC solenoid OFF but the TCC did not release (mechanical error).	• Wrench light illuminated • Engine stalls or is lugging • DTC P1744 may set	DTC P2758 is a non-electrical DTC. REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2760	TCC	TCC pressure control solenoid intermittent	The TCC solenoid control circuit shorted to ground 3 times without setting DTC P0742.	• TCC disabled • Poor launch performance • Default to 5th gear	CLEAR the DTC. TEST the system for normal operation. If the DTC returns, GO to Pinpoint Test A .

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Diagnostics

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Diagnosing an electronically controlled automatic transmission is simplified by using the following procedures. The most important things to remember is there is a definite procedure to follow. Do not take shortcuts or assume that critical checks or adjustments have already been made. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostic (OBD) with Scan Tool

These self-tests should be used to diagnose the PCM and should be carried out in order.

NOTE: Make sure the latest software version is loaded on the scan tool.

1. If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

NOTE: The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC to the VCM .

2. If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No power to the scan tool.

3. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the RUN position.
   - verify scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM does not respond to the scan tool.

4. Carry out the network test:

- If the scan tool responds with no communication from one or more modules, refer to Section 418-00 , No High Speed Controller Area Network (CAN) communication, all modules are not responding.
- If the network test passes, retrieve and record the continuous memory DTCs.

5. Clear the continuous DTCs and carry out the PCM self-test.

6. If DTCs retrieved are related to the concern, GO to the DTC Chart.

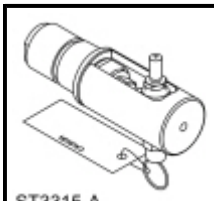
7. If no DTCs related to the concern are retrieved, REFER to Diagnosis By Symptom in this section.

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Leakage Inspection

Special Tool(s)

 ST3315-A	Leak Tester, Torque Converter 307-691

Material

Item	Specification
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	—

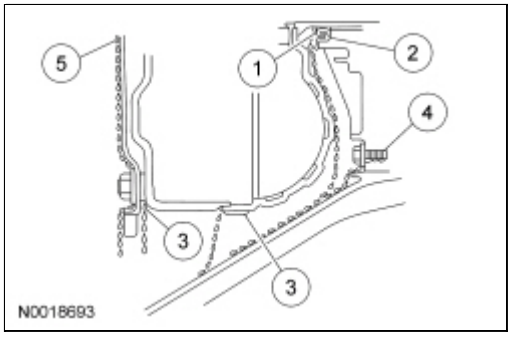
Leak Check Test

NOTE: When diagnosing transmission leaks, the source of the leak must be positively identified prior to repair. If the vehicle is driven extensively between adding the fluorescent additive and performing the leak test, the leaking oil can spread and make identifying the location of the leak difficult.

1. Clean off any transmission fluid from the top and bottom of the torque converter housing, the front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a nonflammable solvent and blow dry with compressed air.

2. Add Dye-Lite® ATF Power Steering Fluid Leak Detection Dye to the transmission fluid. Use one 30 ml (1 fl. oz) of dye solution for every 3.8 L (4 qt) of transmission fluid.

3. Start and run the engine until the transmission reaches its normal operating temperature. Raise the vehicle on a hoist and run the engine occasionally shifting to the DRIVE and REVERSE ranges to increase pressure within the transmission. Using a black light, observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Run the engine until transmission fluid leakage is evident and the probable source of leakage can be determined.



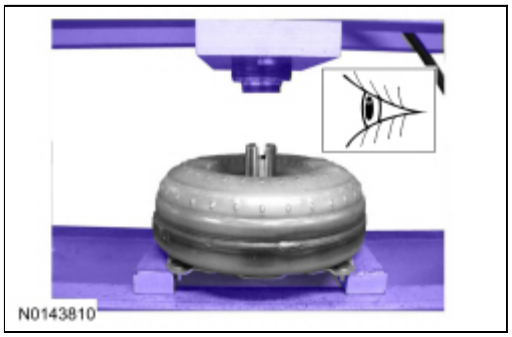
4. If the source of the leak is obvious, repair as required. Leaks from the torque converter housing can originate from several locations. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The 5 steps following correspond with the numbers in the illustration.
    1. Transmission fluid leaking by the converter hub seal lip will tend to move along the drive hub and onto the back of the torque converter. Except in the case of a total seal failure, transmission fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.
    2. Transmission fluid leakage by the outside diameter of the converter impeller hub seal and the case will follow the same path that leaks by the ID of the converter hub seal follow.
    3. Transmission fluid leakage from the converter cover weld or the converter-to-flexplate stud weld will appear at outside diameter of torque converter on the back face of the flexplate and in the converter housing only near the flexplate. If a converter-to-flexplate lug, lug weld or converter cover weld leak is suspected, remove the converter and pressure check.
    4. Transmission fluid leakage from the bolts inside the converter housing will flow down the back of the torque converter housing. Leakage may be from loose or missing bolts.
    5. Engine oil leaks from the rear main oil.

5. Remove the torque converter.

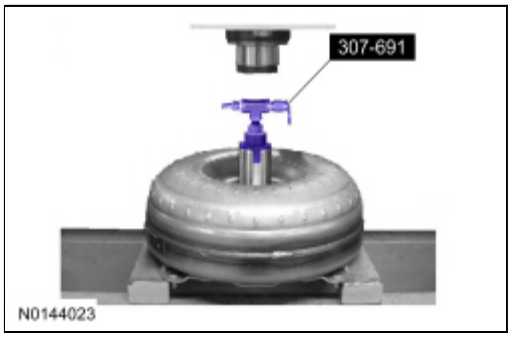
6. Using a black light, observe the torque converter housing. Inspect for evidence of dye from the pump bolts, pump seal, and torque converter hub seal. Repair as required.

7. If the source of the leak is not evident, continue with this procedure to leak test the torque converter.

8. Install the torque converter in the arbor press. Support the torque converter on the mounting pads.

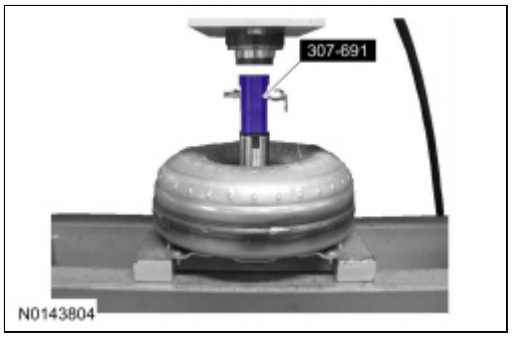


9. Install the Leak Tester, Torque Converter 307-691 into the torque converter hub. Tighten to 25 Nm.

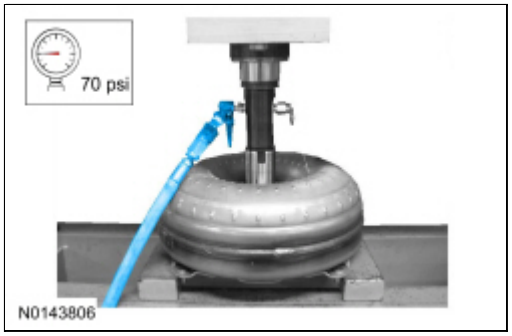


10. Secure the press. Only apply enough force from the press to seal the Leak Tester, Torque Converter 307-691 into the torque converter hub.

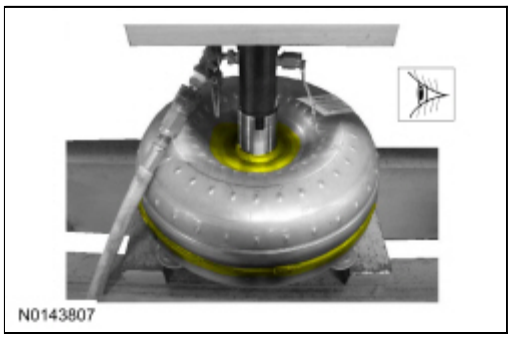
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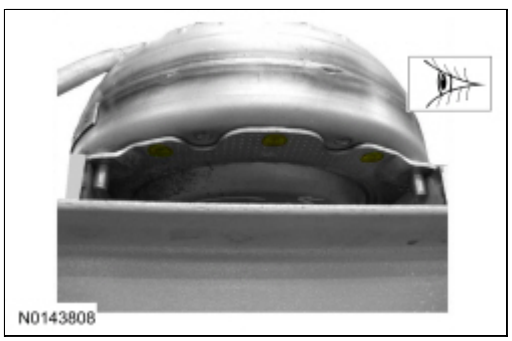
11. Connect a compressed air supply to the Leak Tester, Torque Converter 307-691.



12. With air pressure applied to valve, inspect for leaks at the converter hub weld and seams. A soap bubble solution can be applied around those areas to aid in the diagnosis. If any leaks are present, install a new torque converter.



13. With air pressure applied to valve, inspect for leaks at the stud or mounting pad and balance weight welds. A soap bubble solution can be applied around those areas to aid in the diagnosis. If any leaks are present, install a new torque converter.



14. After leaks are repaired, clean the remaining transmission fluid dye from serviced areas.

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Output State Control (OSC) Mode

On-Board Diagnostic (OBD)

Output state control allows the technician to take control of certain parameters to function the transmission.

Output state control allows the technician to shift the transmission when commanding a gear change.

Another example of the output state control features is, the technician can command the torque converter ON or OFF to check operation.

This transmission output state control has one mode of operation; DRIVE. This mode has a unique set of operating requirements that the technician must meet before allowed to operate the torque converter or select gears.

Pinpoint Tests — OSC Equipped Vehicle

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

When the electrical connector or solenoid body is disconnected, inspect the connector for terminal condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install new components as required.

Power is routed through the Transmission Solenoid Power Control (TSPC) relay (inside the PCM) to all transmission solenoids. If the power circuit to the transmission solenoids or the TSPC relay fails open, then all solenoids are failed electrically OFF. CHECK for open, short to ground or the transmission connector disconnected. The TSPC relay will disable power to the transmission solenoids when certain transmission DTCs are set.

Shift Solenoid Pre-Diagnosis

Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC NL
		SSA NL (1,2,3,4)	SSB NH (3,5,R)	SSC NL (CB 2,6)	SSD NH (CB L,R/C 4,5,6)	SSE NC	
P	P	Off	On	Off	Off	Off	Off
R	R	Off	Off	Off	Off	Off	Off
N	N	Off	On	Off	Off [a]	Off	Off
D	1	On	On	Off	Off [b]	Off	Off
	2	On	On	On	On	Off	Off
	3	On	Off	Off	On	On	On/Off
	4	On	On	Off	Off	On	On/Off
	5	Off	Off	Off	Off	On	On/Off

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	6	Off	On	On	Off	On	On/Off
M [c]	—	—	—	—	—	—	—
2	2	On	On	On	On	Off	Off
1	1	On	On	Off	Off	On	Off

[a] Solenoid state will change if vehicle is moving forward with the selector lever in the NEUTRAL position.
[b] Solenoid is On when vehicle is above 3 mph.
[c] All gears available upon driver request.

CB = Clutch brake

NC = Normally closed

NH = Normally high

NL = Normally low

Pinpoint Tests

Refer to Wiring Diagrams Cell 30 for schematic and connector information.

NOTE: Refer to all TSBs and On-Line Automotive Service Information System (OASIS) messages that pertain to the transmission concern and follow the procedure as described.

NOTE: Vehicles equipped with a 3.7L engine use PCM C175T.

NOTE: Vehicles equipped with a 5.0L or 6.2L engine use PCM C1381T.

NOTE: Vehicles equipped with a 3.5L engine use PCM C1551E.

PINPOINT TEST A: TRANSMISSION CONTROL SOLENOIDS

NOTE: Refer to the Transmission Vehicle Harness Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: Refer to the Transmission Leadframe Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: If the scan tool is unable to access the transmission PIDs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: Read and record all DTCs.

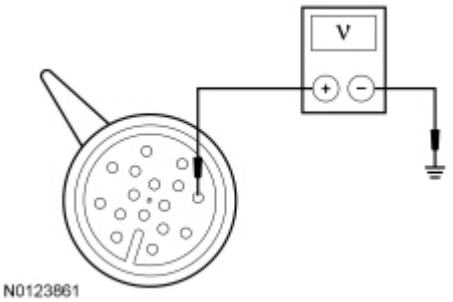
NOTE: Without a voltage signal return to the PCM, the Transmission Solenoid Power Control (TSPC) relay is commanded OFF. By using a fused jumper between a transmission solenoid control circuit and the signal return circuit, the TSPC relay circuit will supply power to the transmission solenoids when the ignition is cycled from OFF to ON. Do not use a solenoid control circuit that may be at fault, refer to Diagnostic Trouble Code (DTC) Charts in this section for a fault listing.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>A1 CHECK THE SOLENOID POWER CIRCUIT FOR VOLTAGE</td><td></td></tr>
<tr><td>

Ignition OFF.
Disconnect: Transmission C1575 .
Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals.
NOTICE: Do not use a solenoid control circuit that may be at fault. Failure to jump pin 5 to a known good solenoid control circuit can cause incorrect diagnostic results. For additional information, refer to Diagnostic Trouble Code (DTC) Charts in this section for a fault listing.
Using the chart, connect a fused jumper between one of the 7 solenoid control circuit pins on transmission vehicle harness C1575 and C1575-5.

<table>
<tr><th>Transmission Vehicle Harness C1575</th><th>Solenoid Control Circuit</th></tr>
<tr><td>C1575-9</td><td>Shift Solenoid A (SSA) CET05 (BU/GN)</td></tr>
<tr><td>C1575-14</td><td>Shift Solenoid B (SSB) CET06 (GN/BN)</td></tr>
<tr><td>C1575-13</td><td>Shift Solenoid C (SSC) CET07 (GY/OG)</td></tr>
<tr><td>C1575-10</td><td>Shift Solenoid D (SSD) CET08 (BN/WH)</td></tr>
<tr><td>C1575-8</td><td>Shift Solenoid E (SSE) CET18 (GY/YE)</td></tr>
<tr><td>C1575-16</td><td>Line Pressure Control (LPC) solenoid CET09 (YE/VT)</td></tr>
<tr><td>C1575-3</td><td>Torque Converter Clutch (TCC) solenoid CET10 (BU/GY)</td></tr>
</table>

Ignition ON.
Measure the voltage from the transmission vehicle harness C1575-7 circuit CET25 (BU/GN) harness side to ground.



Is the voltage greater than 10 volts?

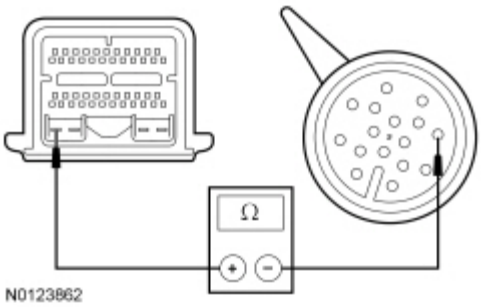
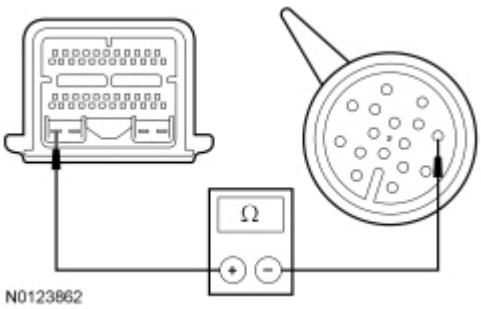
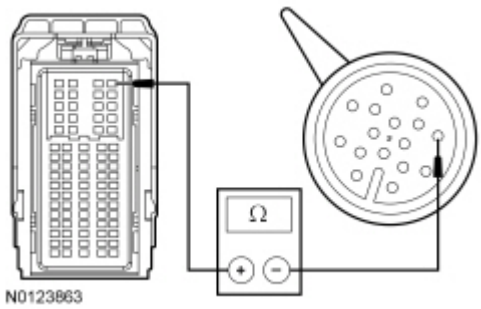
</td><td>Yes
GO to A4 .

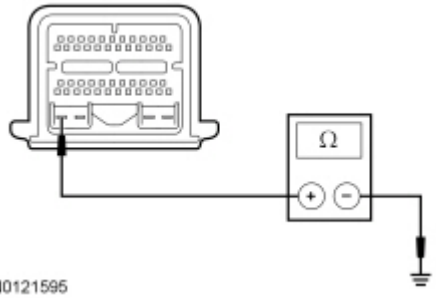
No
GO to A2 .</td></tr>
<tr><td>A2 CHECK THE SOLENOID POWER CIRCUIT FOR AN OPEN</td><td></td></tr>
<tr><td>

Ignition OFF.
Disconnect: PCM C175T (3.7L Engine) .
Disconnect: PCM C1381T (5.0L and 6.2L Engines) .

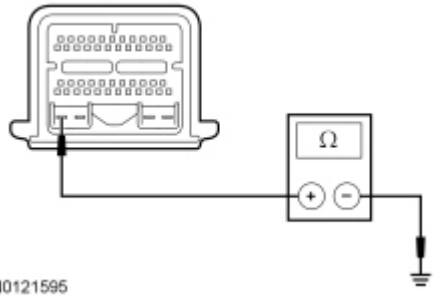
</td><td>Yes
GO to A3 .</td></tr>
</table>

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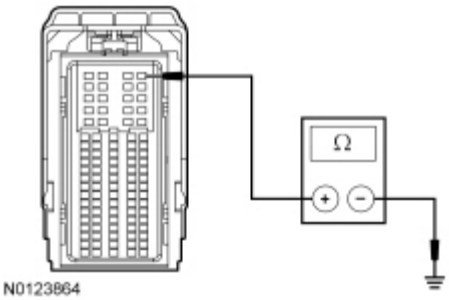
• Disconnect: PCM C1551E (3.5L Gasoline Turbocharged Direct Injection (GTDI) Engine) . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Vehicle equipped with 3.7L engine, measure the resistance from the PCM C175T-50 to the transmission vehicle harness C1575-7, circuit CET25 (BU/GN).  • Vehicle equipped with 5.0L or 6.2L engine, measure the resistance from the PCM C1381T-50 to the transmission vehicle harness C1575-7, circuit CET25 (BU/GN).  • Vehicle equipped with 3.5L engine, measure the resistance from the PCM C1551E-80 to the transmission vehicle harness C1575-7, circuit CET25 (BU/GN).  • **Is the resistance less than 5 ohms?**	**No** REPAIR transmission vehicle harness circuit CET25 (BU/GN) for an open. CLEAR the DTC's. TEST the system for normal operation. If DTC P0657 returns, REPLACE the PCM. REFER to Section 303-14 . PROGRAM the PCM with the latest calibration level. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.
A3 CHECK THE SOLENOID POWER CIRCUIT FOR A SHORT TO GROUND	
• Vehicle equipped with 3.7L engine, measure the resistance from the PCM C175T-50, circuit CET25 (BU/GN) of the transmission vehicle harness to ground.	**Yes** GO to A4 . **No** REPAIR transmission vehicle harness circuit CET25 (BU/GN)



- Vehicle equipped with 5.0L or 6.2L engine, measure the resistance from the PCM C1381T-50, circuit CET25 (BU/GN) of the transmission vehicle harness to ground.



- Vehicle equipped with 3.5L engine, measure the resistance from the PCM C1551E-80, circuit CET25 (BU/GN) of the transmission vehicle harness to ground.



- **Is the resistance greater than 10,000 ohms?**

for a short to ground. CLEAR the DTC's. TEST the system for normal operation. If DTC P0657 returns, REPLACE the PCM, REFER to Section 303-14 . PROGRAM the PCM with the latest calibration level. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for moral operation.

A4 CHECK SOLENOID CONTROL CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect: PCM C175T (3.7L Engine) .
- Disconnect: PCM C1381T (5.0L and 6.2L Engines) .
- Disconnect: PCM C1551E (3.5L GTDI Engine) .
- Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals.
- Vehicles equipped with a 3.7L engine, measure the resistance of the solenoid control circuits using the following chart.

PCM	Circuit	Transmission
C175T-45	SSA CET05 (BU/GN)	C1575-9
C175T-43	SSB CET06 (GN/BN)	C1575-14

Yes
GO to A5 .

No
REPAIR the transmission vehicle harness circuit which measured greater than 5 ohms. CLEAR the DTCs. TEST the system for normal operation.

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C175T-44	SSC CET07 (GY/OG)	C1575-13
C175T-10	SSD CET08 (BN/WH)	C1575-10
C175T-11	SSE CET18 (GY/YE)	C1575-8
C175T-34	LPC solenoid CET09 (YE/VT)	C1575-16
C175T-46	TCC solenoid CET10 (BU/GY)	C1575-3

- Vehicles equipped with a 5.0L or 6.2L engine, measure the resistance of the solenoid control circuits using the following chart.

PCM	Circuit	Transmission
C1381T-43	SSA CET05 (BU/GN)	C1575-9
C1381T-44	SSB CET06 (GN/BN)	C1575-14
C1381T-45	SSC CET07 (GY/OG)	C1575-13
C1381T-10	SSD CET08 (BN/WH)	C1575-10
C1381T-11	SSE CET18 (GY/YE)	C1575-8
C1381T-34	LPC CET09 (YE/VT)	C1575-16
C1381T-46	TCC CET10 (BU/GY)	C1575-3

- Vehicles equipped with a 3.5L engine, measure the resistance of the solenoid control circuits using the following chart.

PCM	Circuit	Transmission
C1551E-60	SSA CET05 (BU/GN)	C1575-9
C1551E-45	SSB CET06 (GN/BN)	C1575-14
C1551E-75	SSC CET07 (GY/OG)	C1575-13
C1551E-30	SSD CET08 (BN/WH)	C1575-10
C1551E-2	SSE CET16 (WH/BU)	C1575-8
C1551E-59	LPC solenoid CET09 (YE/VT)	C1575-16
C1551E-44	TCC solenoid CET10 (BU/GY)	C1575-3

- **Is the resistance less than 5 ohms on each circuit?**

A5 CHECK SOLENOID CONTROL CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between the transmission vehicle harness C1575, harness side and ground using the following chart.

Transmission	Control Circuit	Ground
C1575-7	Solenoid Power CET25 (BU/GN)	Ground
C1575-9	SSA CET05 (BU/GN)	Ground
C1575-14	SSB CET06 (GN/BN)	Ground
C1575-13	SSC CET07 (GY/OG)	Ground

Yes
GO to A6 .

No
REPAIR the transmission vehicle harness circuit which measured less than 10,000 ohms. CLEAR the DTCs. TEST the system for normal operation.

C1575-10	SSD CET08 (BN/WH)	Ground
C1575-8	SSE CET18 (GY/YE) (CET16 (WH/BU) 3.5L only)	Ground
C1575-16	LPC solenoid CET09 (YE/VT)	Ground
C1575-3	TCC solenoid CET10 (BU/GY)	Ground

- **Is the resistance greater than 10,000 ohms?**

A6 CHECK SOLENOID CONTROL CIRCUITS FOR A SHORT TO POWER

- Connect: PCM C175T (3.7L Engine) .
- Connect: PCM C1381T (5.0L and 6.2L Engines) .
- Connect: PCM C1551E (3.5L GTDI Engine) .
- Ignition ON.
- Measure for voltage between the transmission vehicle harness C1575, harness side and ground using the following chart.

Transmission	Control Circuit	Ground
C1575-9	SSA CET05 (BU/GN)	Ground
C1575-14	SSB CET06 (GN/BN)	Ground
C1575-13	SSC CET07 (GY/OG)	Ground
C1575-10	SSD CET08 (BN/WH)	Ground
C1575-8	SSE CET18 (GY/YE) (CET16 (WH/BU) 3.5L only)	Ground
C1575-16	LPC solenoid CET09 (YE/VT)	Ground
C1575-3	TCC solenoid CET10 (BU/GY)	Ground

- **Is voltage greater that 4 volts?**

Yes
REPAIR the transmission vehicle harness circuit shorted to power. CLEAR the DTCs. TEST the system for normal operation.

No
GO to A7 .

A7 CHECK COMPONENT RESISTANCE

- Measure resistance of the solenoid between the transmission molded leadframe C1575, component side using the following chart.

Transmission	Solenoid	Transmission	Ohms
C1575-7	SSA	C1575-9	4.8 to 5.6
C1575-7	SSB	C1575-14	4.8 to 5.6
C1575-7	SSC	C1575-13	4.8 to 5.6
C1575-7	SSD	C1575-10	4.8 to 5.6
C1575-7	SSE	C1575-8	17.5 to 18.6
C1575-7	LPC solenoid	C1575-16	4.8 to 5.6
C1575-7	TCC solenoid	C1575-3	4.8 to 5.6

- **Is the resistance within specifications?**

Yes
REFER to Main Control to inspect for stuck valves or debris. If no problems are found, INSTALL suspected solonoid. REFER to Shift Solenoids (SS) . CLEAR the DTCs. TEST the system for normal operation.

No
REPLACE the suspected solenoid which failed the resistance check. REFER to Shift Solenoids (SS) in this section. CLEAR the transmission adaptive tables and perform the adaptive drive cycle. REFER to Shift Point Road Test in this section. TEST the system for normal

repair4less

<table>
<tr><td></td><td>operation.</td></tr>
<tr><td>A8 CHECK SOLENOID RESISTANCE

• Remove the molded leadframe from the main control. Refer to Shift Solenoids (SS) in this section. Inspect for metallic contamination and clean the solenoid and molded leadframe terminals.
• Measure and record the resistance of the suspected solenoid. For solenoid location, refer to Shift Solenoids (SS) in this section. Compare the recorded value with the chart below.

<table><tr><th>Solenoid</th><th>Ohms</th></tr><tr><td>SSA</td><td>4.8 to 5.6</td></tr><tr><td>SSB</td><td>4.8 to 5.6</td></tr><tr><td>SSC</td><td>4.8 to 5.6</td></tr><tr><td>SSD</td><td>4.8 to 5.6</td></tr><tr><td>SSE</td><td>17.5 to 18.6</td></tr><tr><td>LPC solenoid</td><td>4.8 to 5.6</td></tr><tr><td>TCC solenoid</td><td>4.8 to 5.6</td></tr></table>
• Is the solenoid resistance within specification?</td><td>Yes
INSTALL a new molded leadframe, REFER to Shift Solenoids (SS) in this section. CLEAR the DTCs. TEST the system for normal operation.

No
REPLACE the suspected solenoid which failed the resistance check. REFER to Shift Solenoids (SS) in this section. CLEAR the transmission adaptive tables and perform the adaptive drive cycle. REFER to Shift Point Road Test in this section. TEST the system for normal operation.</td></tr>
</table>

PINPOINT TEST B: TFT SENSOR

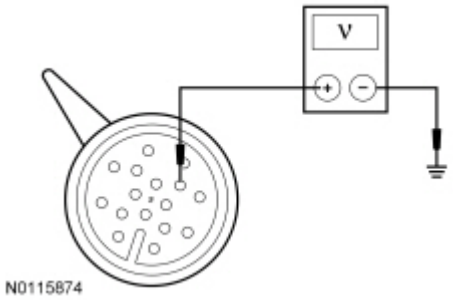
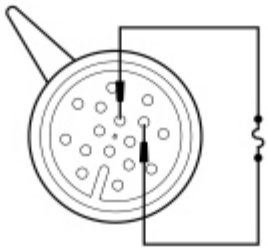
NOTE: Refer to the Transmission Vehicle Harness Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: Refer to the Transmission Leadframe Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: If the scan tool is unable to access the transmission PIDs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

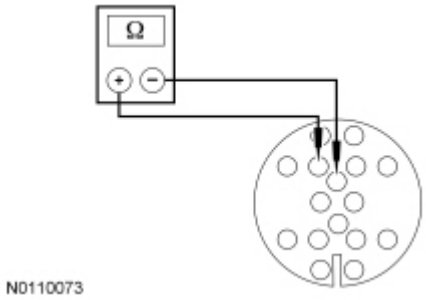
NOTE: Read and record all DTCs.

Test Step	Result / Action to Take
B1 CHECK TFT INPUT SIGNAL • Ignition OFF. • Disconnect: Transmission Vehicle Harness C1575 . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: TFT PIDs: TFT and TFTV . • **Does the TFT PID display -40°C (-40°F) and the TFTV PID display 4.96 to 5.10 volts?**	**Yes** GO to B2 . **No** REPAIR vehicle harness circuit VET27 (BN/YE) for a short to ground. CLEAR the DTCs. TEST the system for normal operation.
B2 CHECK TFT SIGNAL INPUT CIRCUIT FOR	

VOLTAGE	
• Measure the voltage between the transmission vehicle harness C1575-6, circuit VET27 (BN/YE), harness side and ground.  N0115874 • **Is the voltage between 4.8 and 5.1 volts?**	**Yes** GO to B3 . **No** INSPECT and REPAIR transmission vehicle harness circuit VET27 (BN/YE) for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PROGRAM the PCM with the latest calibration level. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.
B3 CHECK TFT SIGNAL RETURN CIRCUIT	
• Connect a fused jumper between the transmission vehicle harness C1575-5 and C1575-6, harness side.  N0115873 • **Does the TFT PID display 190°-195°C (374°-383°F) and the TFTV PID display 0 volts?**	**Yes** GO to B4 . **No** INSPECT and REPAIR the transmission vehicle harness signal return circuit for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PROGRAM the PCM with the latest calibration level. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.
B4 CHECK TFT SENSOR RESISTANCE	
• Measure the resistance between the transmission molded leadframe C1575-5 and C1575-6, component side using the following chart. **TRANSMISSION FLUID TEMPERATURE (TFT)** **°C** / **°F** / **Resistance** -40 to -20 / -40 to -4 / 967K-284K -19 to -1 / -3 to 31 / 284K-100K 0-20 / 32-68 / 100K-37K 21-40 / 69-104 / 37K-16K 41-70 / 105-158 / 16K-5K 71-90 / 159-194 / 5K-2.7K 91-110 / 195-230 / 2.7K-1.5K 111-130 / 231-266 / 1.5K-0.8K	**Yes** REFER to Diagnosis By Symptom in this section to diagnose an overheating concern. **No** INSPECT and CLEAN the TFT sensor on the molded leadframe for metallic contamination. INSTALL a new molded leadframe if no debris was found, REFER to Shift Solenoids (SS) in this section. CLEAR the DTCs. TEST the system for normal operation.

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131-150	267-302	0.8K-0.54K



- **Does the temperature to resistance specifications match?**

PINPOINT TEST C: TR SENSOR

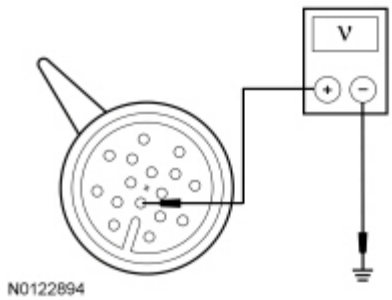
NOTE: Refer to the Transmission Vehicle Harness Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: Refer to the Transmission Leadframe Connector illustration within the Transmission Connector Layouts procedure in this section.

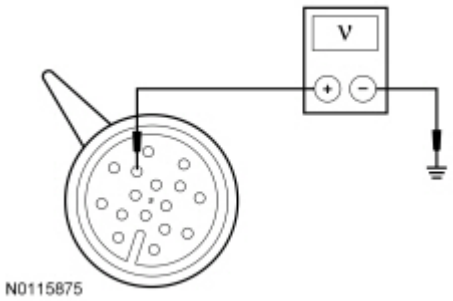
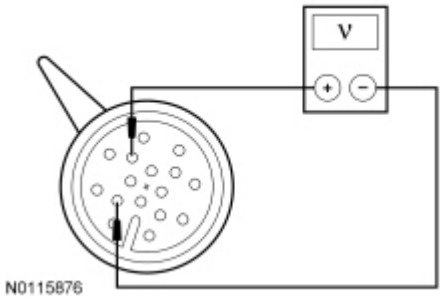
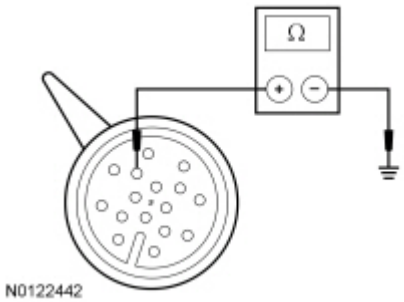
NOTE: If the scan tool is unable to access the transmission PIDs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

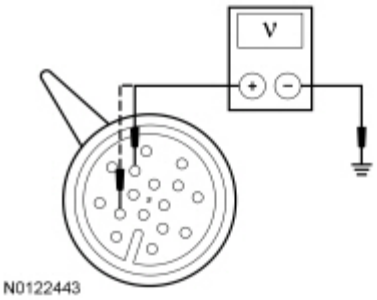
NOTE: Read and record all DTCs.

Test Step	Result / Action to Take
C1 VERIFY DTCs	
• Ignition OFF. • Select PARK. • Connect the scan tool. • Carry out the Key ON Engine OFF (KOEO) then the Key ON Engine Running (KOER) test. DTCs P0705, P0706, P0707, P0708, P0709, P1702, P1705 and P1921 cannot be set by an incorrectly adjusted selector lever cable. • **Are Transmission Range (TR) sensor DTCs present?**	**Yes** GO to C3. **No** GO to C2.
C2 VERIFY SELECTOR LEVER CABLE/LINKAGE ADJUSTMENT	
• Verify the selector lever cable is correctly adjusted. Refer to Section 307-05. • **Is the selector lever cable correctly adjusted?**	**Yes** GO to C3. **No** ADJUST the selector lever cable. REFER to Section 307-05.
C3 CHECK TR SENSOR ELECTRICAL OPERATION	

• Ignition ON. • Enter the following diagnostic mode on the scan tool: TR PIDs: TR_DC and TR_FREQ . • Move the selector lever into each range and stop. • Observe the following PIDs: TR_DC and TR_FREQ while wiggling the harness or driving the vehicle. • Compare the PID: TR_DC to the selector lever position duty cycle, using the following chart. **Selector Lever Position / Range (% Duty Cycle)** P: 8.0 — 25.8 R: 30.50 — 39.31 N: 40.54 — 52.49 D: 54.35 — 71.15 M: 65.15 — 82 2: 70.55 — 85.61 1: 75.25 — 88.91 • **Is the TR_FREQ between 100 to 150 Hz?** **Is the TR_DC within range?** **Does the TR_DC and TR_FREQ remain steady when the harness is wiggled or the vehicle driven?**	**Yes** The problem is not in the TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis. **No** GO to C4 .
C4 CHECK TR SENSOR VPWR CIRCUIT FOR POWER • Ignition OFF. • Disconnect: Transmission Vehicle Harness C1575 . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Ignition ON. • Measure the voltage between the transmission vehicle harness C1575-12, circuit LE111 (VT/GN) harness side and ground.  • **Is the voltage less than 9.5 volts?**	**Yes** INSPECT and REPAIR the transmission vehicle harness circuit LE111 (VT/GN) for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. CLEAR the DTCs. TEST the system for normal operation. **No** GO to C5 .
C5 CHECK TR SENSOR SIGNAL CIRCUIT • Measure the voltage between the transmission vehicle harness C1575-4, circuit VET32 (VT) harness side and ground.	**Yes** GO to C6 . **No**

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 N0115875 • **Is the voltage greater than 4.8 volts?**	INSPECT and REPAIR vehicle harness circuit VET32 (VT) for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. CLEAR the DTCs. TEST the system for normal operation.
C6 CHECK TR SENSOR GROUND CIRCUIT	
• Measure the voltage between the transmission vehicle harness C1575-4 circuit VET32 (VT) and C1575-11 circuit RET24 (BN/BU).  N0115876 • **Is the voltage greater than 4.8 volts?**	**Yes** GO to C7 . **No** INSPECT and REPAIR transmission vehicle harness circuit RET24 (BN/BU) for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. CLEAR the DTCs. TEST the system for normal operation.
C7 CHECK TR SENSOR POWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: PCM C175T . • Disconnect: PCM C1381T . • Disconnect: PCM C1551E . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Measure the resistance between the transmission vehicle harness C1575-4 circuit VET32 (VT) and ground.  N0122442 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C8 . **No** REPAIR transmission vehicle harness circuit VET32 (VT) for a short to ground. CLEAR the DTCs. TEST the system for normal operation.
C8 CHECK TR SENSOR CIRCUITS FOR A SHORT TO POWER	

• Connect: PCM C175T . • Connect: PCM C1381T . • Connect: PCM C1551E . • Ignition ON. • Measure the voltage between the transmission vehicle harness C1575-4, circuit VET32 (VT) and C1575-11, circuit RET24 (BN/BU) to ground.  • **Is voltage greater than 9.8 volts?**	**Yes** REPAIR the transmission vehicle harness circuit which measured greater than 9.8 volts. CLEAR the DTCs. TEST the system for normal operation. **No** GO to C9 .
C9 CHECK TR SENSOR TO MANUAL VALVE	
• Drain the transmission fluid and remove the transmission fluid pan. Refer to Fluid Pan, Gasket and Filter in this section. • Check the connection between the TR sensor and the manual control valve. Refer to Transmission — Early Build or Transmission — Late Build in this section. • Inspect the molded leadframe for metallic contamination, refer to Shift Solenoids (SS) . • **Is the TR sensor connected to the manual control valve shaft?**	**Yes** REPLACE molded leadframe. REFER to Shift Solenoids in this section. **No** CONNECT the TR sensor to the manual control valve, REFER to Transmission — Early Build or Transmission — Late Build in this section. CLEAN any debris from the molded leadframe. RUN the Key ON Engine OFF (KOEO) self-test. If DTCs return, REPLACE the molded leadframe, REFER to Shift Solenoids (SS) in this section.

PINPOINT TEST D: TSS SENSOR

NOTE: Refer to the Transmission Vehicle Harness Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: Refer to the Transmission Leadframe Connector illustration within the Transmission Connector Layouts procedure in this section.

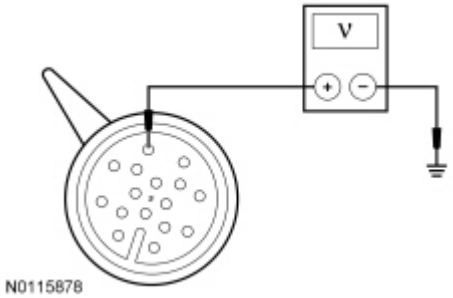
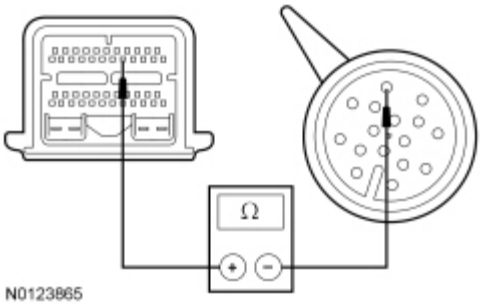
NOTE: If the scan tool is unable to access the transmission PIDs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

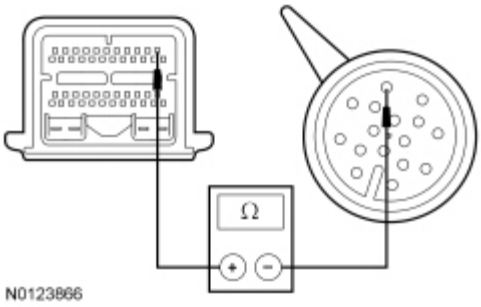
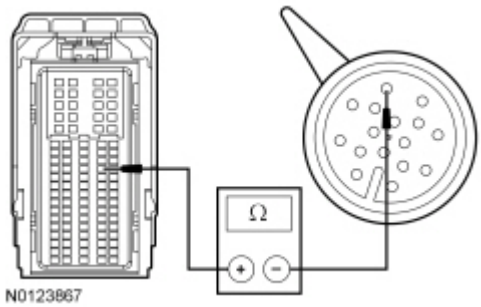
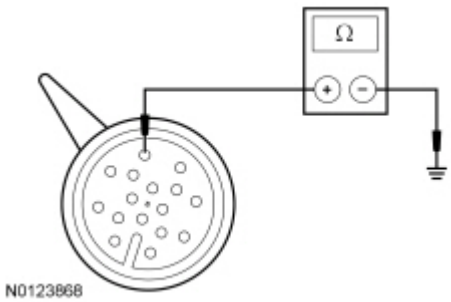
NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: Read and record all DTCs.

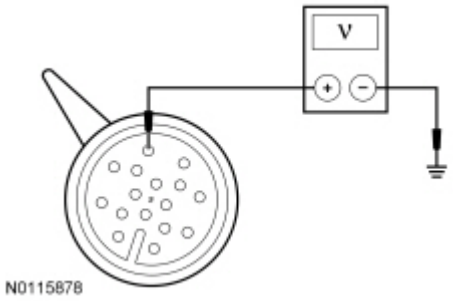
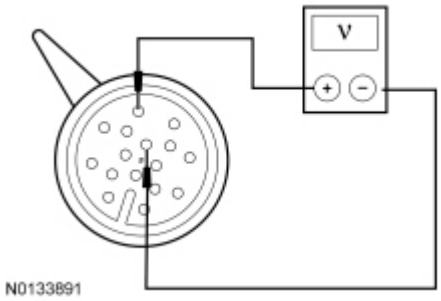
NOTE: If DTCs P0705, P0706, P0707, P0708, P0709, P1702, P1705 and/or P1921 are set, diagnose those DTCs first.

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Test Step	Result / Action to Take
D1 DRIVE CYCLE TEST	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: TSS PID: TSS_SRC . • Monitor the TSS_SRC PID while road testing the vehicle. Drive the vehicle so the transmission upshifts and downshifts through all the gears. • **Does the TSS sensor rpm increase and decrease with engine rpm and vehicle speed?**	**Yes** REFER to Shift Point Road Test in this section for further diagnosis. **No** GO to D2 .
D2 CHECK TSS SENSOR SIGNAL CIRCUIT FOR POWER	
• Ignition OFF. • Disconnect: Transmission Vehicle Harness C1575 . • Ignition ON. • Measure the voltage between the transmission vehicle harness C1575-1 and ground.  • **Is the voltage less than 4.8 volts?**	**Yes** GO to D3 . **No** GO to D6 .
D3 CHECK THE TSS SENSOR SIGNAL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175T . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Vehicles equipped with a 3.7L engine, measure the resistance between the transmission vehicle harness C1575-1 circuit VET33 (WH/OG) and PCM C175T-16.  • Disconnect: PCM C1381T . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or	**Yes** GO to D4 . **No** INSPECT and REPAIR transmission vehicle harness TSS signal circuit for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.

damaged seals. • Vehicles equipped with a 5.0L or 6.2L engine, measure the resistance between the transmission vehicle harness C1575-1 circuit VET33 (WH/OG) and PCM C1381T-1.  • Disconnect: PCM C1551E . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Vehicles equipped with a 3.5L engine, measure the resistance between the transmission vehicle harness C1575-1 circuit RET33 (WH/VT) and PCM C1551E-27.  • **Is the resistance less than 5 ohms?**	
D4 CHECK THE TSS SENSOR SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between the transmission vehicle harness C1575-1 and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D5 . **No** INSPECT and REPAIR transmission vehicle harness TSS signal circuit for a short to ground. If a short to ground is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.
D5 CHECK THE TSS SENSOR SIGNAL CIRCUIT FOR A SHORT TO POWER	

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• Connect: PCM C175T . • Connect: PCM C1381T . • Connect: PCM C1551E . • Ignition ON. • Measure for voltage between the transmission vehicle harness C1575-1, and ground.  • **Is voltage greater than 5.1 volts?**	**Yes** INSPECT and REPAIR transmission vehicle harness TSS signal circuit for a short to power. If a short to power is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation. **No** GO to D6 .
D6 CHECK THE TSS SENSOR GROUND CIRCUIT	
• Measure the voltage between the transmission vehicle harness C1575-1 and C1575-5.  • **Is voltage less than 4.8 volts?**	**Yes** REPAIR the transmission vehicle harness signal return circuit for an open. If an open is not found, REPLACE the PCM, REFER to Section 303-14 . PROGRAM the PCM with the latest calibration level. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation. **No** REPLACE the molded leadframe, REFER to Shift Solenoids (SS) in this section. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST E: OSS SENSOR

NOTE: Refer to the Transmission Vehicle Harness Connector illustration within the Transmission Connector Layouts procedure in this section.

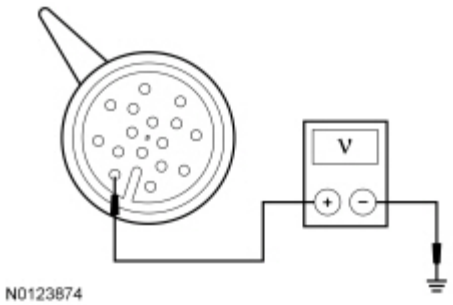
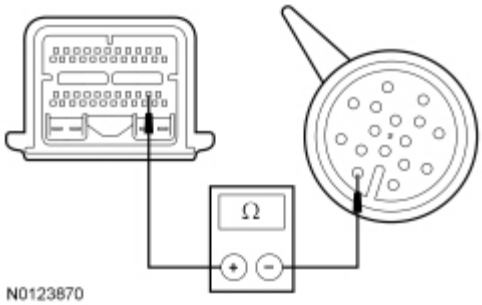
NOTE: Refer to the Transmission Leadframe Connector illustration within the Transmission Connector Layouts procedure in this section.

NOTE: If the scan tool is unable to access the transmission PIDs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

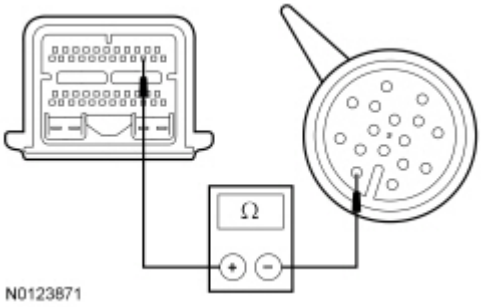
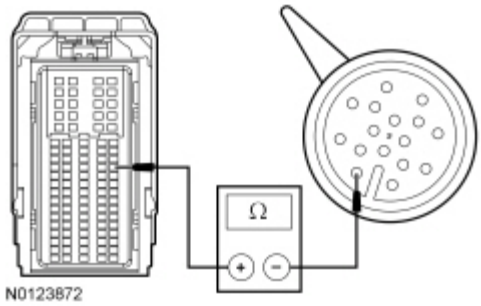
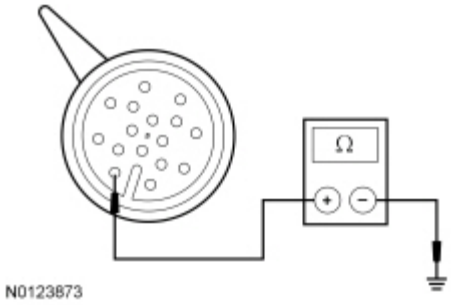
NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

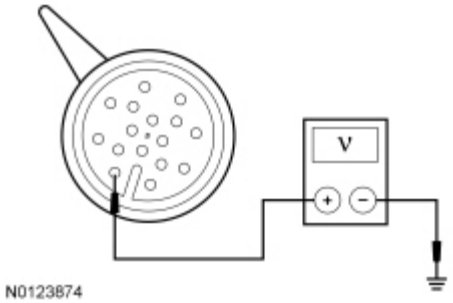
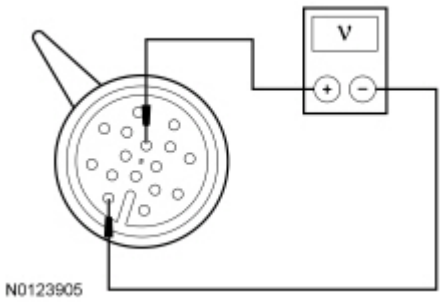
NOTE: Read and record all DTCs.

NOTE: If DTCs P0705, P0706, P0707, P0708, P0709, P1702, P1705 and/or P1921 are set, diagnose those DTCs first.

Test Step	Result / Action to Take
E1 DRIVE CYCLE TEST	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: OSS PID: OSS_SRC . • Monitor the Output Shaft Speed (OSS) sensor PID while road testing the vehicle. Drive the vehicle so the transmission upshifts and downshifts through all the gears. • **Does the OSS sensor rpm increase and decrease with engine rpm and vehicle speed?**	**Yes** REFER to Shift Point Road Test in this section for further diagnosis. **No** GO to E2 .
E2 CHECK OSS SENSOR SIGNAL CIRCUIT FOR POWER	
• Ignition OFF. • Disconnect: Transmission Vehicle Harness C1575 . • Ignition ON. • Measure the voltage between the transmission vehicle harness C1575-15 and ground.  N0123874 • **Is the voltage less than 4.8 volts?**	**Yes** GO to E3 . **No** GO to E6 .
E3 CHECK THE OSS SENSOR SIGNAL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175T . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Vehicles equipped with a 3.7L engine, measure the resistance between the transmission vehicle harness C1575-15 circuit VET26 (BN/GN) and PCM C175T-25.  N0123870 • Disconnect: PCM C1381T . • Inspect the connector for damaged or pushed out	**Yes** GO to E4 . **No** INSPECT and REPAIR transmission vehicle harness OSS signal circuit for an open. If an open circuit is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.

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terminals, corrosion, loose wires and missing or damaged seals. • Vehicles equipped with a 5.0L or 6.2L engine, measure the resistance between the transmission vehicle harness C1575-15 circuit VET26 (BN/GN) and PCM C1381T-14.  • Disconnect: PCM C1551E . • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Vehicles equipped with a 3.5L engine, measure the resistance between the transmission vehicle harness C1575-15 circuit RET04 (YE/OG) and PCM C1551E-12.  • **Is the resistance less than 5 ohms?**	
E4 CHECK THE OSS SENSOR SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between the transmission vehicle harness C1575-15 and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E5 . **No** INSPECT and REPAIR transmission vehicle harness OSS signal circuit for a short to ground. If a short to ground is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation.
E5 CHECK THE OSS SENSOR SIGNAL CIRCUIT FOR	

A SHORT TO POWER	
• Connect: PCM C175T . • Connect: PCM C1381T . • Connect: PCM C1551E . • Ignition ON. • Measure for voltage between the transmission vehicle harness C1575-15, and ground.  • **Is voltage greater than 5.1 volts?**	**Yes** INSPECT and REPAIR transmission vehicle harness OSS signal circuit for a short to power. If a short to power is not found, REPLACE the PCM, REFER to Section 303-14 . PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation. **No** GO to E6 .
E6 CHECK THE OSS SENSOR GROUND CIRCUIT	
• Measure the voltage between the transmission vehicle harness C1575-15 and C1575-5.  • **Is voltage less than 4.8 volts?**	**Yes** REPAIR the transmission vehicle harness signal return circuit for an open. If an open is not found, REPLACE the PCM, REFER to Section 303-14 . PROGRAM the PCM with the latest calibration level. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Solenoid Body Strategy in this section. TEST the system for normal operation. **No** REPLACE the molded leadframe, REFER to Main Control in this section. CLEAR the DTCs. TEST the system for normal operation.

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Preliminary Inspection

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Check the following items prior to beginning the diagnostic procedures:

Know and Understand the Concern

To correctly diagnose a concern, first understand the customer concern or condition. Customer contact may be required to understand the conditions, including when the concern occurs. For example:

- Hot or cold vehicle temperature
- Hot or cold ambient temperature
- Vehicle driving conditions
- Vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to Verification of Condition.

Verification of Condition

This section provides information that must be used in determining the actual cause of customer concerns and carrying out the appropriate procedures.

Use the following procedures when verifying customer concerns for the transmission.

Determine Customer Concern

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Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperature
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshifting
- Downshifting
- Coasting
- Engagement
- Noise/vibration — check for engine rpm, vehicle speed, shift, gear, range or temperature dependencies.

Check Transmission Fluid Level and Condition

Transmission Fluid Level Check

NOTICE: **The vehicle should not be driven if the transmission fluid level is low. Internal transmission failure could result.**

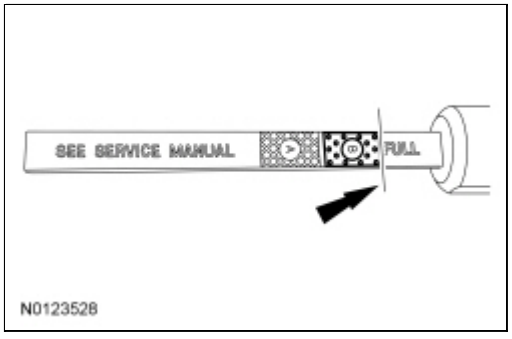
NOTICE: **The transmission fluid fill plug is located near the exhaust system. The exhaust will be extremely hot during this procedure.**

NOTE: If the vehicle is operated for an extended period at high highway speeds, in city traffic, during hot weather, or while pulling a trailer, allow the transmission fluid to cool down to obtain an accurate reading.

NOTE: If the transmission starts to slip, shifts slowly, or shows signs of transmission fluid leaking, check the transmission fluid level.

This transmission is equipped with an internal thermal bypass located in the case. This internal thermal bypass valve shuts off transmission fluid flowing to the transmission fluid cooler if the transmission fluid temperature falls below normal operating temperature. Refer to Transmission Fluid Level Check in this section.

The transmission fluid level indicator has 2 areas for the fluid level, a crosshatched area (labeled A) and a dotted area (labeled B). Use the dotted (labeled B) area when checking the transmission fluid level. The correct transmission fluid level is at the upper level of the dotted marks on the transmission fluid level indicator.



High Transmission Fluid Level

NOTICE: **Transmission fluid level that is too high can cause the transmission fluid to become aerated due to the churning action of the rotating internal parts. This may cause erratic control pressure, foaming, loss of transmission fluid through the vent tube, and possible transmission failure.**

If an overfill reading is indicated on the transmission fluid level indicator, remove the excess transmission fluid. Refer to Transmission Fluid Level Check in this section.

Low Transmission Fluid Level

Low transmission fluid level can result in poor transmission engagement, slipping, or failure. This may also indicate a leak in one of the transmission seals or gaskets.

Adding Transmission Fluid

NOTICE: **The use of any type of transmission fluid other than specified can result in transmission failure.**

NOTICE: **The transmission fluid fill plug is located near the exhaust system. The exhaust will be extremely hot during this procedure.**

NOTICE: **The vehicle should not be driven if the transmission fluid level is low. Internal failure could result.**

Add transmission fluid using the refill procedure. Refer to Transmission Fluid Drain and Refill in this section.

Transmission Fluid Condition Check

1. Check the transmission fluid level.
2. Remove the transmission fluid fill plug and transmission fluid level indicator, allowing the transmission fluid to drip onto a facial tissue. Examine the stain.
3. Observe the color and the odor.
4. If evidence of solid material is found, remove the transmission fluid pan for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant in the transmission. Inspect the engine cooling system at this time.
6. If transmission fluid contamination or transmission failure is confirmed by the sediment in the bottom of the transmission fluid pan, disassemble and completely clean the transmission. This includes the torque converter and transmission fluid cooler tubes. Refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

Water in Transmission Fluid

To correctly repair an automatic transmission that has had water or coolant introduced into the system, completely disassemble, clean, and replace the following parts:

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- All internal and external seals
- All friction material
- Torque converter
- All parts with bonded seals
- All solenoids
- All transmission fluid filters

Prior to installing the transmission, flush and clean the transmission fluid cooler(s) and the transmission fluid cooler tubes and hoses. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

Shift Point Road Test

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

This test verifies the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.
2. Operate vehicle with the selector lever in the D position.
3. Apply minimum throttle and observe speeds when an upshift occurs. Refer to the Shift Speeds chart in this section.
4. With the selector lever in the D position and speed above 80 km/h (50 mph) and less than half throttle, move the selector lever from the D position to manual 2 position and release the accelerator pedal. The transmission should downshift into 2nd gear. With the transmission remaining in the manual 2 position, move the selector lever into the manual 1 position and release the accelerator pedal. The transmission should downshift into 1st gear at speeds below approximately 45-56 km/h (28-35 mph).
5. If the transmission fails to upshift/downshift, refer to Diagnosis By Symptom in this section.

Shift Speeds

Throttle Position	Shift	Km/H	MPH
Light Throttle	1-2	13-21	8-13
Throttle Position (TP) Sensor	2-3	26-34	16-21
Voltage @ 1.25 Volts	3-4	35-43	22-27
	4-5	56-64	35-40
	5-6	71-79	44-49
Closed Throttle	6-5	56-64	35-40
	5-4	40-48	25-30
	4-3	13-21	8-13
	3-2	3-11	2-7
	2-1	2-6	1-4
Wide Open Throttle (WOT)	1-2	45-53	28-33

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	2-3	87-95	54-59
	3-4	140-148	87-92

Road Test — Adaptive Drive Cycle

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

1. Connect the scan tool to the Data Link Connector (DLC).

2. **NOTE:** Disconnecting the battery will not clear the Keep Alive Memory (KAM).

   NOTE: Do not clear the PCM KAM .

   Using the scan tool, clear the adaptive table before conducting an adaptive drive cycle test.

3. Verify the transmission fluid is at normal operating temperature, between 91°-102°C (195°-215°F). If the transmission fluid is not at operating temperature, drive the vehicle until the operating temperature is reached.

4. **NOTE:** The transmission fluid must be at operating temperature before proceeding to this step.

   Drive the vehicle on a level road surface performing the adaptive drive cycle.
   1. Accelerate from a stop with light throttle to 24 km/h (15 mph) then release the accelerator pedal.
   2. Gently brake and bring the vehicle to a stop and hold the brake for 6 seconds.
   3. Repeat substeps 1 and 2 an additional 5 times.
   4. Accelerate from a stop with light throttle so the 1-2, 2-3 and 3-4 shifts occur with engine rpm between 1,700-2,000.
   5. Continue accelerating until the vehicle speed reaches 80 km/h (50 mph) or the 5-6 upshift is reached.
   6. Gently brake and bring the vehicle to a stop and hold the brake for 10 seconds.
   7. Repeat substeps 4, 5 and 6 an additional 3 times.

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Solenoid Body Strategy

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

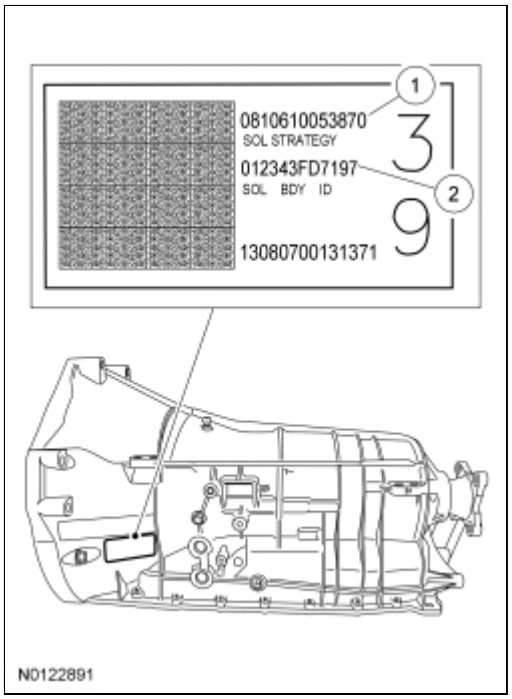
Solenoid Body Identification Procedure

1. Using the scan tool, select Powertrain, Transmission and Transmission Solenoid Body Identification from the toolbox icon and follow the instructions displayed on the scan tool.
   The solenoid body identification screen displays solenoid body identification information:
   - Solenoid body strategy 13-digits
   - Solenoid body identification 12-digits
     The next screen displays the current solenoid body identification and strategy data file stored in the PCM. If the solenoid body strategy field is blank, the module contains a partial transmission solenoid body strategy. This is due to a corrupt or missing file at the time the programmable parameters were completed.

NOTE: The 13-digit solenoid body strategy number consists of only numbers. Letters are not used.

2. Compare the solenoid body identification and strategy to the solenoid body identification tag located on the left side of the transmission case.

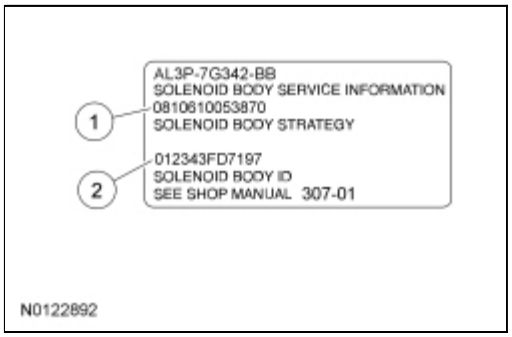
Solenoid Strategy Identification Tag



Item	Description
1	13-digit solenoid body strategy
2	12-digit solenoid body identification

3. If the solenoid body identification and strategy displayed on the scan tool match the solenoid body identification tag or replacement tag, then the solenoid body identification and strategy are correct for this transmission and a solenoid body strategy data download is not required. If the solenoid body identification tag or replacement tag is missing or damaged so it is not readable or does not match the identification or strategy displayed on the scan tool, remove the transmission fluid pan and filter and locate the 13-digit solenoid body strategy etched on the main control casting. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

Replacement Solenoid Strategy Identification Tag



Item	Description
1	13-digit solenoid body strategy
2	12-digit solenoid body identification

4. ***NOTICE:*** **The 13-digit solenoid body strategy number displayed on the scan tool must match**

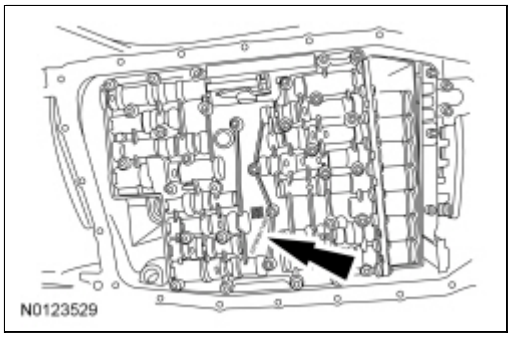
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the solenoid body strategy number etched on the main control. If the numbers do not match, damage to the transmission or driveability concerns can occur.

NOTICE: **If the new main control was not supplied with a replacement solenoid strategy identification tag, DO NOT INSTALL the main control as all required programming information will be missing.**

Compare the solenoid body strategy identification etched on the main control to the solenoid strategy identification tag on the transmission case. If the solenoid body strategy identification etched on the main control does not match the solenoid strategy identification tag then a solenoid body strategy data download is required. If the solenoid body strategy etched on the main control does match the solenoid strategy identification tag on the transmission case but does not match the solenoid body identification and strategy displayed on the scan tool, then a solenoid body strategy data download is also required.

Main Control Solenoid Body Strategy



Solenoid Body Strategy Data Download

1. Using the scan tool, select Module Programming and Programmable Parameters under the toolbox icon then select transmission. Follow the instructions displayed on the scan tool.
   There are fields to enter the 12-digit solenoid body identification and 13-digit solenoid body strategy recorded from the solenoid body.

2. ***NOTICE:*** **If the solenoid body information is not correct, transmission damage or driveability concerns can occur.**

   Enter the solenoid body identification and strategy.
   The scan tool verifies the numbers entered are valid and displays a message if the information is not valid.
   The scan tool checks to see if the file is present on the scan tool. If the file is present, the technician may proceed with downloading the file to the PCM. If the file is not present, the scan tool will need to be connected to the Professional Technician Society (PTS) server to download the file onto the scan tool.

3. Verify the file is present on the scan tool. If the file is present, go to Step 8. If the file is not present, continue with this procedure.

4. Connect the scan tool to the PTS server.

5. Follow the instructions on the network to download the strategy file to the scan tool.

6. If the scan tool cannot connect to the PTS server, download the file from www.motorcraft.com.

If the scan tool cannot download a strategy from the web site, a partial strategy will automatically be downloaded.

7. Reconnect the scan tool to the vehicle.

8. Follow the instructions displayed on the scan tool.

9. If a new solenoid body was installed, compare the 12-digit identification and the 13-digit strategy fields from the solenoid body to the replacement solenoid body tag provided with the solenoid body service kit and place it over the existing identification tag.
The scan tool automatically downloads the strategy file or partial strategy file to the PCM. The scan tool displays a message when it is finished downloading the data that states that the file was downloaded successfully.

10. ***NOTICE:*** **The customer may feel erratic shifts and driveability concerns if the adaptive drive cycle has not been performed.**

    Road test the vehicle following the Adaptive Drive Cycle. For additional information, refer to Shift Point Road Test in this section.

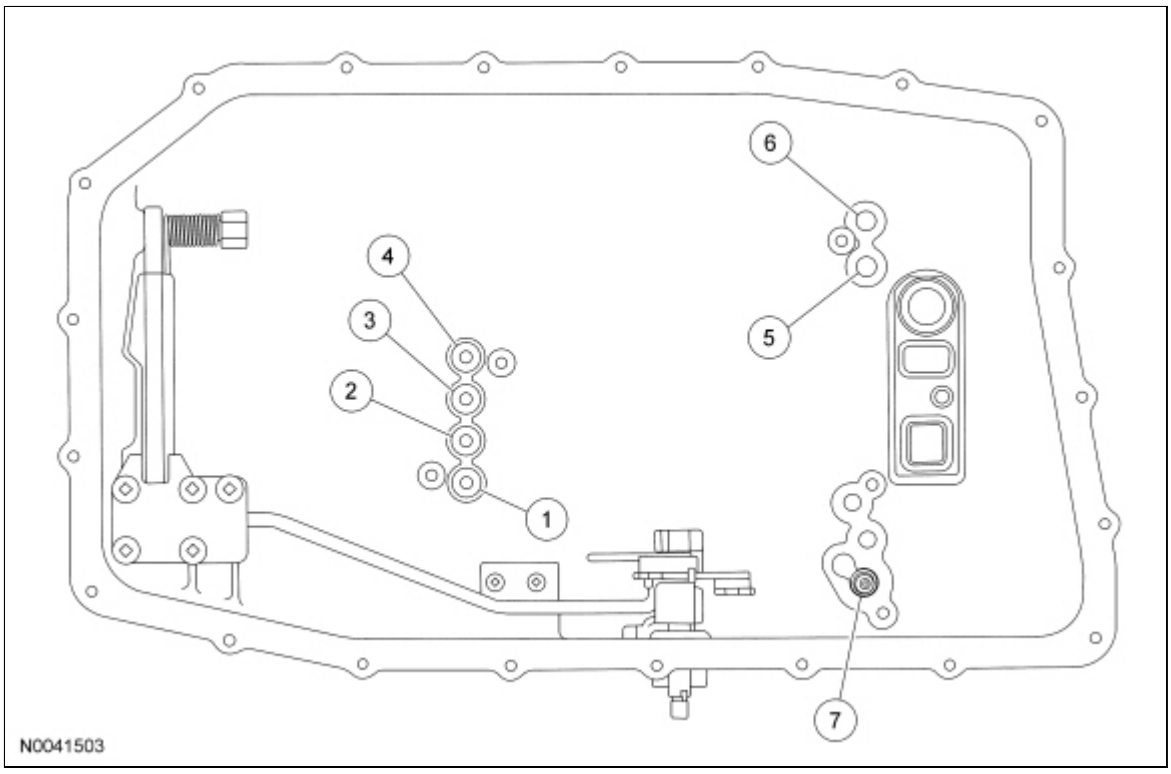
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Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portions of the transmission.

Air Pressure Test



Item	Description
1	Intermediate clutch (C) port
2	Low/reverse clutch (D1) port
3	Not used
4	Direct clutch (B) port
5	Overdrive clutch (E) port
6	Forward clutch (A) port
7	Thermal bypass valve

A no-drive condition can exist with correct transmission fluid pressure because of inoperative clutches. Refer to the Clutch Application Chart to determine the appropriate elements. A clutch concern can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the concern.

Example: When the selector lever is in a forward gear range, a no-drive condition may be caused by an inoperative clutch.

1. Drain the transmission fluid. Remove the transmission fluid pan.

2. Remove the transmission fluid filter, seal assembly and mechatronic unit.

3. Locate the inoperative clutches by applying air pressure into the appropriate clutch port.

4. Apply air pressure to the appropriate clutch port. A dull thud may be heard or movement felt when a clutch piston is applied. If the clutch seals or check ball are leaking, a hissing sound may be heard.

5. If the clutches fail to operate during the air check:
    - the piston seals are not seated, damaged or installed incorrectly.
    - plugged feed holes for clutch apply in the case and/or clutch cylinder.
    - damaged piston and/or clutch cylinder.

6. Service as required and recheck.

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Torque Converter Diagnosis

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: If the torque converter is replaced, use the scan tool and follow the on-screen instructions and perform the Misfire Monitor Neutral Profile Correction procedure.

Perform all diagnostic procedures prior to torque converter installation. This prevents the unnecessary installation of new or remanufactured torque converters. Only after a complete diagnostic evaluation can the decision be made to install a new torque converter.

Torque Converter Operation Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

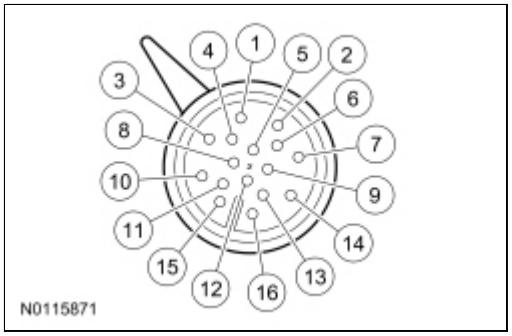
The Torque Converter Operation Test verifies the Torque Converter Clutch (TCC) control system and the torque converter are operating correctly.

1. Connect a scan tool to the vehicle.
2. Perform a self-test and check for DTCs.
3. Bring the engine to normal operating temperature by driving the vehicle at highway speeds in the D position.
4. After normal operating temperature is reached, maintain a constant speed of about 56 km/h (35 mph) in 5th gear for 10 seconds.
5. Release the accelerator pedal and monitor the scan tool TP1 PID voltage to approximately 1.25 volts or 25% throttle.
6. Monitor the TCC_OSC# and RPM# PID. The torque converter should release and engine rpm should increase before the 5-4 shift occurs.

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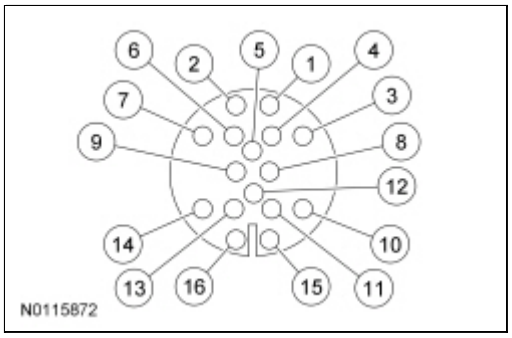
Transmission Connector Layouts

Transmission Vehicle Harness



Item	Description
1	Turbine Shaft Speed (TSS) sensor
2	NOT USED
3	TCC control
4	Transmission Range (TR) sensor
5	Signal return
6	Transmission Fluid Temperature (TFT) sensor power
7	Ignition voltage
8	Shift Solenoid E (SSE) control
9	Shift Solenoid A (SSA) control
10	Shift Solenoid D (SSD) control
11	TR sensor signal return
12	Battery voltage
13	Shift Solenoid C (SSC) control
14	Shift Solenoid B (SSB) control
15	Output Shaft Speed (OSS) sensor
16	LPC solenoid control

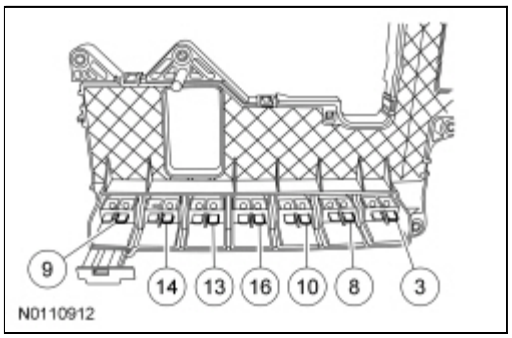
Transmission Leadframe Connector



Item	Description
1	Turbine Shaft Speed (TSS) sensor
2	NOT USED
3	TCC control
4	Transmission Range (TR) sensor
5	Signal return
6	Transmission Fluid Temperature (TFT) sensor power
7	Ignition voltage
8	Shift Solenoid E (SSE) control
9	Shift Solenoid A (SSA) control
10	Shift Solenoid D (SSD) control
11	TR sensor signal return
12	Battery voltage
13	Shift Solenoid C (SSC) control
14	Shift Solenoid B (SSB) control
15	Output Shaft Speed (OSS) sensor
16	LPC solenoid control

Molded Leadframe

NOTE: Terminal 7 of the transmission leadframe connector is the common power feed to the solenoids listed in the following chart.



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Item	Description
3	Torque Converter Clutch (TCC) control
8	Shift Solenoid E (SSE) control
10	Shift Solenoid D (SSD) control
16	LPC solenoid control
13	Shift Solenoid C (SSC) control
14	Shift Solenoid B (SSB) control
9	Shift Solenoid A (SSA) control

Transmission Drive Cycle Test

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur 4 times consecutively for a shift error DTC to set, and 5 times consecutively for continuous Torque Converter Clutch (TCC) DTCs to set.

NOTE: Refer to the Solenoid Application Chart for solenoid operation while performing the Transmission Drive Cycle Test.

After performing the self-test, follow the transmission drive cycle test for checking codes.

1. Record then clear the DTCs.
2. Warm the engine to normal operating temperature.
3. Make sure the transmission fluid level is correct.
4. With the selector lever in Overdrive (O/D), moderately accelerate from stop to 80 km/h (50 mph) allowing the transmission to shift into 6th gear. Keep vehicle speed and throttle steady for a minimum of 15 seconds.
5. With the transmission in 6th gear and maintaining steady speed and throttle, lightly apply and release the brake pedal to operate the stop lamps. Then, hold vehicle speed and throttle steady for a minimum of 5 seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least 5 times.
8. Perform a self-test and record DTCs.

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- If DTCs are present, refer to the DTC Chart. Repair all non-transmission DTCs first as they can directly affect the operation of the transmission. Repeat the self-test and the road test to verify the correction. Clear the DTCs. Perform the transmission drive cycle test and repeat the self-test after completing the repair.
- If the tests pass and a concern is present, refer to Diagnosis By Symptom in this section, OASIS messages and TSBs for concerns.

After On-Board Diagnostic (OBD)

NOTE: The vehicle wiring harness, PCM and non-transmission sensors may affect transmission operations. Repair these concerns first.

Repair all DTCs after the On-Board Diagnostic (OBD) test procedures are completed.

Begin with non-transmission related DTCs, then repair transmission related DTCs. Use the DTC Chart for information on condition and symptoms. This chart will be helpful in referring to the correct manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Diagnosis the vehicle wiring harness and the PCM as well. The Powertrain Control/Emissions Diagnosis (PC/ED) manual aids in diagnosing non-transmission electronic components.

Visual Inspection

A visual inspection identifies modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- Electronic add-on items
- Vehicle modification

PCM or transmission function is affected if add on devices, wiring splices, abnormal tire size or axle ratio changes are made.

- If leaks are present; refer to Leakage Inspection in this section.
- Correct selector lever adjustments; refer to Section 307-05 .

Selector Lever Check

Check for misadjustment in the selector lever by matching the detents in the selector lever with those of the manual control lever in the transmission. Refer to Section 307-05 for selector lever cable adjustment.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05 for selector lever cable adjustment.

Check TSBs and On-Line Automotive Service Information System (OASIS)

Refer to all TSB and On-Line Automotive Service Information System (OASIS) messages that pertain to the transmission concern and follow the procedure as described.

Carry Out On-Board Diagnostic (OBD) Key ON Engine OFF (KOEO), Key ON Engine Running (KOER)

After a road test, with the engine and transmission warm and before disconnecting any connectors, use the scan tool and perform a self-test.

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Torque Converter Contamination Inspection

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
    - A torque converter malfunction has been determined based on complete diagnostic procedures.
    - The torque converter stud or studs, impeller hub or bushing are damaged.
    - The torque converter exhibits external discoloration (due to overheating).
    - There is evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes.
        - Major metallic failure
        - Multiple clutch plates or band failures
        - Sufficient component wear which results in metallic contamination
        - Water or antifreeze contamination

2. If none of the above conditions are present, continue with the following fluid inspection.

3. Pour a small amount of transmission fluid from the torque converter onto an absorbent white tissue or through a paper filter.

4. Examine the fluid for contaminants. The fluid must be free of metallic contaminants.

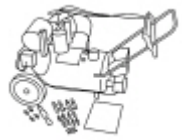
5. ***NOTICE:*** **Do not use water-based cleaners or mineral spirits to clean or flush the torque converter or transmission damage will occur.**

   If the fluid passed inspection:
    - drain the remaining fluid from the torque converter.
    - using only the recommended transmission fluid, add 1.9L (2 qt) of clean fluid into the converter and agitate by hand.
    - thoroughly drain the fluid.

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Transmission Fluid Cooler Backflushing and Cleaning

Special Tool(s)

 ST2971-A	Transmission Heated Cooler Line Flusher 222-00007, 222-00004 or equivalent

NOTICE: **Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will affect the operation of the transmission.**

NOTE: Transmission fluid cooler backflushing and cleaning will be performed using the Transmission Heated Cooler Line Flusher or equivalent. Follow the manufacturer's instructions included with the machine. Test the equipment to make sure that a vigorous fluid flow is present before proceeding.

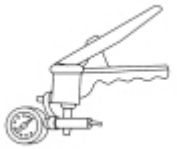
NOTE: If the Transmission Heated Cooler Line Flusher or equivalent is not available, install a new transmission fluid cooler and/or an auxiliary transmission fluid cooler.

1. Check and top off the fluid level of the cooler line flusher with transmission fluid.
2. Allow the transmission fluid in the cooler line flusher 15-30 minutes to heat up to 60°C (140°F) before using.
3. Install the line adapters into the transmission fluid cooler tubes.
4. Attach the cooler line flusher red line to the transmission fluid cooler pressure tube quick connect fitting.
5. Attach the cooler line flusher blue line to the transmission fluid cooler return tube quick connect fitting.
6. Follow the equipment instructions to purge the transmission fluid cooler tubes and cooler prior to starting the flushing procedure.
7. Allow the transmission fluid cooling system to backflush for 10-15 minutes, then flush the transmission fluid cooler in a normal flow direction for an additional 10-15 minutes.

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Transmission Fluid Drain and Refill

Special Tool(s)

 ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST2933-A	Transmission Fluid Fill Tube 307-570
 ST2715-A	Transporter Fluid Evacuator/Injector 307-D465 or equivalent
 ST1269-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

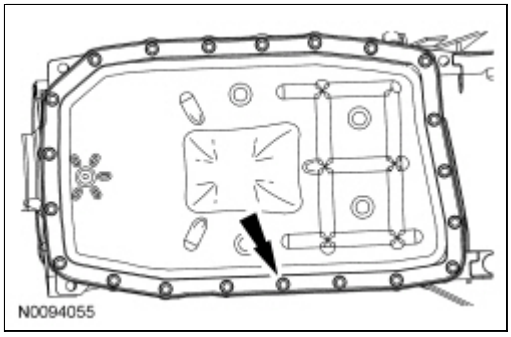
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Drain

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

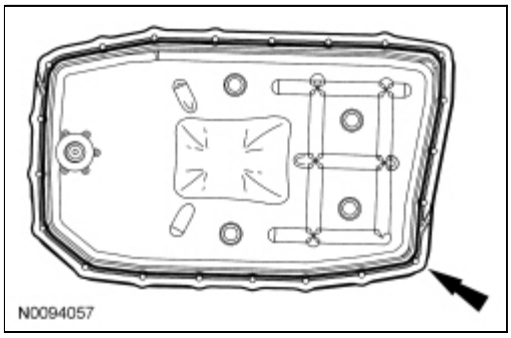
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2. Remove the transmission fluid pan and allow the transmission fluid to drain.

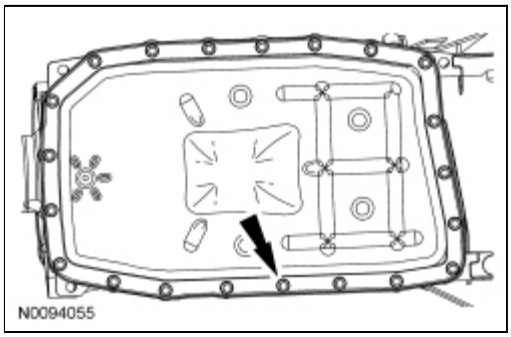


3. **NOTE:** The transmission fluid pan gasket can be reused if not damaged.

   Install a new transmission fluid pan gasket, if required.



4. Install the transmission fluid pan and tighten the bolts in a crisscross pattern.
   - Tighten to 9 Nm (80 lb-in).



Refill

NOTICE: **This procedure contains the air purge steps required to purge air from the transmission fluid cooling system. This procedure is NOT intended for use with the Transmission Fluid Level Check.**

NOTICE: **The vehicle should not be driven if the transmission fluid level is low as internal failure could result.**

NOTICE: **The transmission fluid fill plug is located near the exhaust system. The exhaust will be**

extremely hot during this procedure.

NOTICE: **The use of any other transmission fluid than specified can result in the transmission failing to operate in a normal manner or transmission failure.**

NOTE: If the transmission starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

NOTE: Here is an overview of the Transmission Fluid Drain and Refill procedure.

- Adding 3.3L (3.5 qt) of transmission fluid to the transmission is an initial fill enabling the engine to be started.
- The cold level range shown in the procedure allows the vehicle to be driven.
- The vehicle should be driven to allow the TFT to reach 91ºC-102ºC (195ºF-215ºF) in order to purge the air from the transmission fluid cooling system.
- Fill the transmission fluid to the fill range on the transmission fluid level indicator at the normal operating range 91ºC-102ºC (195ºF-215ºF).

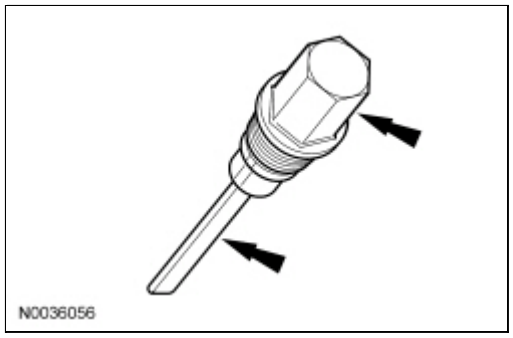
1. **NOTE:** The transmission will need 3.3L (3.5 qt) of transmission fluid added to the transmission as an initial fill if:
   - a new mechatronic assembly has been installed.
   - the transmission fluid pan or transmission fluid filter have been removed.

   NOTE: The transmission will need 11.35L (12 qt) of transmission fluid added to the transmission as an initial fill if the transmission has been overhauled.

   Using the Transmission Fluid Fill Tube, add the transmission fluid to the transmission through the transmission fluid fill hole. For additional information, refer to Adding Additional Transmission Fluid in this procedure.

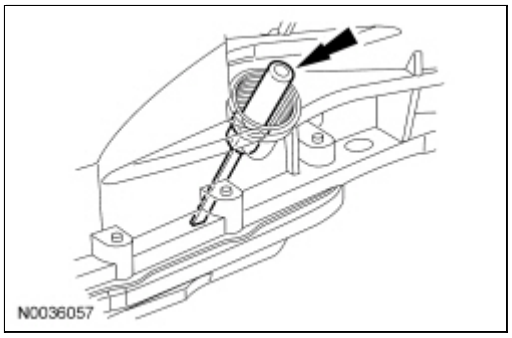
2. Check the transmission fluid level cold.
   - The vehicle is safe to drive if the transmission fluid is in the cold level range 32°C-43°C (90°F-110°F).
   - Using the scan tool and with the engine running, place the selector lever in each gear position and hold approximately 5 seconds. Place the selector lever in PARK, with the engine at idle (600-750 rpm).

3. Separate the transmission fluid level indicator from the transmission fluid fill plug.



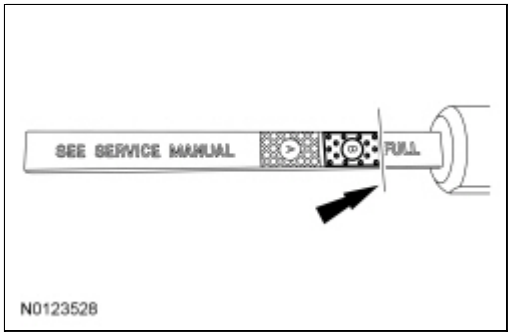
4. Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.

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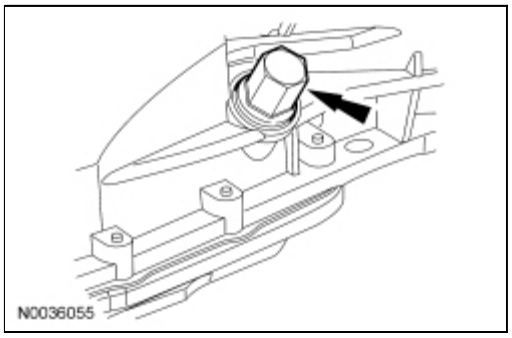


5. **NOTE:** The transmission fluid level indicator has 2 areas for the fluid level, a crosshatched (labeled A) area and a dotted (labeled B) area. Use the dotted area to check the transmission fluid level.

   Using the scan tool, verify that the TFT is between 91ºC-102ºC (195ºF-215ºF). Do not overfill the transmission. The transmission fluid level must be at the upper level of the dotted (B) marked area on the transmission fluid level indicator.

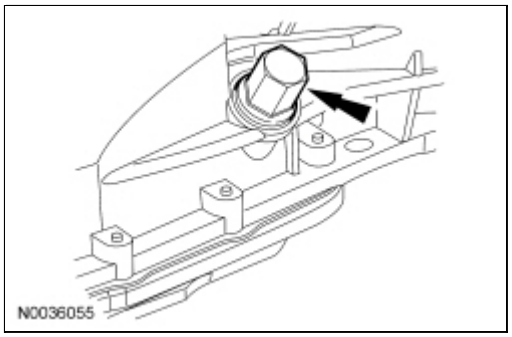


6. Install the transmission fluid fill plug.
   - Tighten to 35 Nm (26 lb-ft).

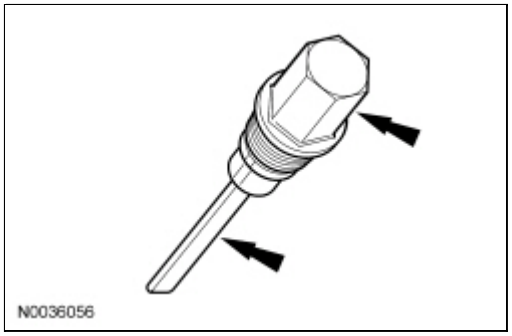


7. While driving the vehicle, use the scan tool to verify that the TFT has reached a temperature of 91°C (195°F). This will circulate the transmission fluid through the torque converter and the transmission fluid cooling system, eliminating any trapped air in the transmission fluid cooling system.
   - With the engine idling (600-750 rpm) in PARK, verify that the TFT is between 91ºC-102ºC (195ºF-215ºF).

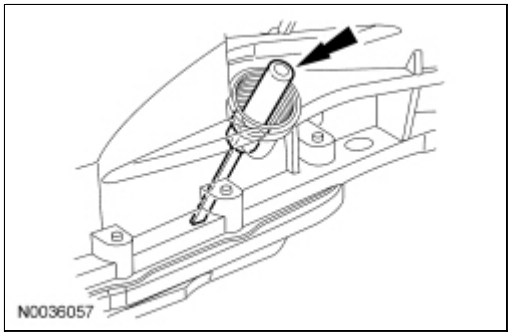
8. Remove the transmission fluid fill plug transmission fluid level indicator assembly located on the passenger side front portion of the transmission case.



9. Separate the transmission fluid level indicator from the transmission fluid fill plug.



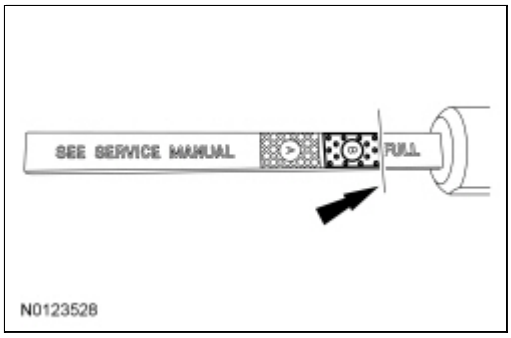
10. Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.



11. **NOTE:** The transmission fluid level indicator has 2 areas for the fluid level, a crosshatched (labeled A) area and a dotted (labeled B) area. Use the dotted (labeled B) area when checking the transmission fluid level. The correct transmission fluid level is at the upper level of the dotted marks on the transmission fluid level indicator.

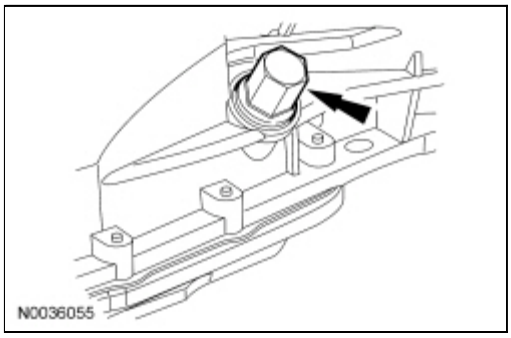
    Using the scan tool verify that the TFT is between 91ºC-102ºC (195ºF-215ºF). The transmission fluid level must be at the upper level of the dotted (B) mark.

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12. **NOTE:** If the transmission fluid is not at the correct level, follow the steps for Adding Additional Transmission Fluid or Removing Transmission Fluid in this procedure.

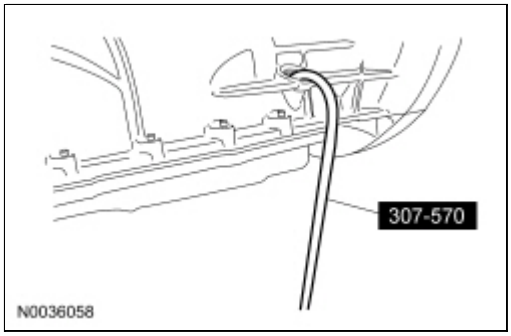
    Install the transmission fluid fill plug.
    - Tighten to 35 Nm (26 lb-ft).



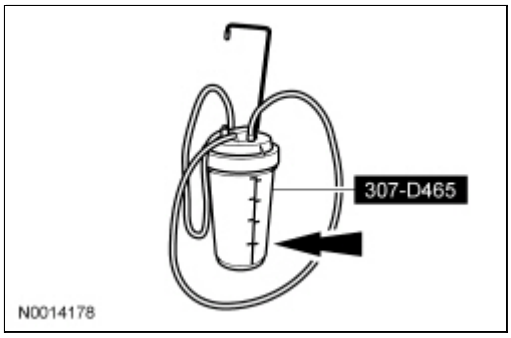
Adding Additional Transmission Fluid

NOTE: To get an accurate transmission fluid level reading the engine should be idling (600-750 rpm) in PARK.

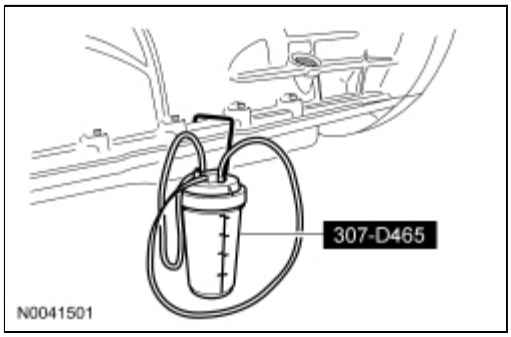
1. Install the Transmission Fluid Fill Tube into the transmission fluid fill hole.



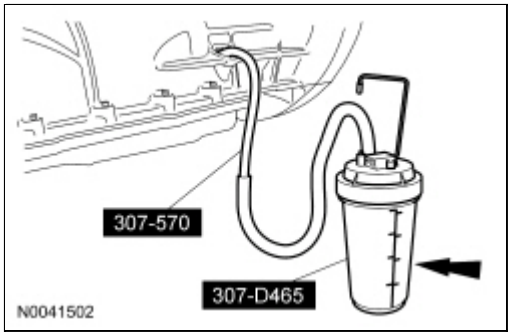
2. Fill the Transporter Fluid Evacuator/Injector with approximately 0.47L (1 pt) of transmission fluid.



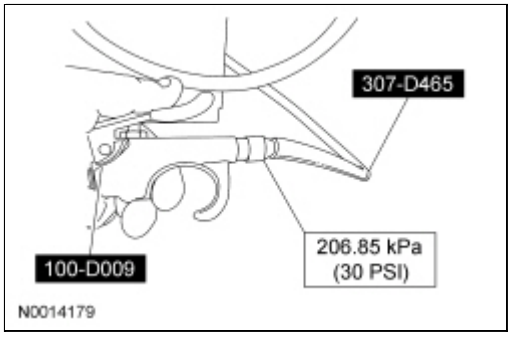
3. Hang the Transporter Fluid Evacuator/Injector under the vehicle, upright and close to the transmission.



4. Connect the Transporter Fluid Evacuator/Injector and Transmission Fluid Fill Tube.
    - Connect the open end of the fluid hose from the Transporter Fluid Evacuator/Injector onto the Transmission Fluid Fill Tube from the transmission case.



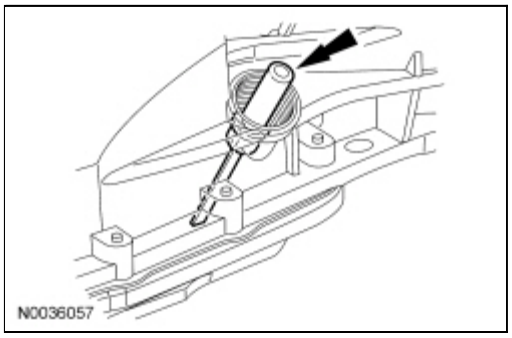
5. Use a Rubber Tip Air Nozzle to apply a maximum of 206.85 kPa (30 psi) to the open end of the vacuum/pressure hose from the Transporter Fluid Evacuator/Injector. Transmission fluid will immediately start flowing out of the Transporter Fluid Evacuator/Injector into the transmission.



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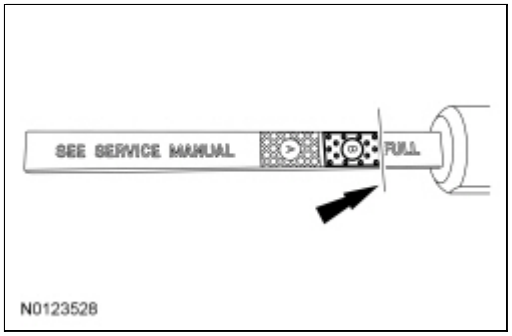
6. **NOTE:** Do not overfill the transmission. The transmission fluid level must be at the upper level of the dotted mark.

   Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.



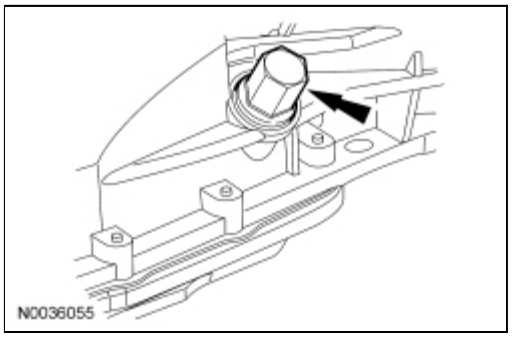
7. **NOTE:** The transmission fluid level indicator has 2 areas for the fluid level, a crosshatched (labeled A) area and a dotted (labeled B) area. Use the dotted (labeled B) area when checking the transmission fluid level. The correct transmission fluid level is at the upper level of the dotted marks on the transmission fluid level indicator.

   Using the scan tool, verify that the TFT is between 91ºC-102ºC (195ºF-215ºF). The transmission fluid level must be at the upper level of the dotted (B) mark.



8. **NOTE:** If the transmission fluid is over full, follow the steps for Removing Transmission Fluid in this procedure.

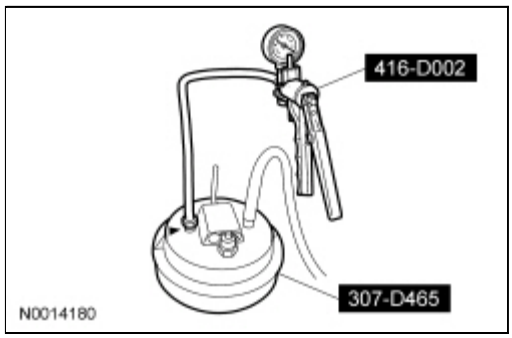
   Install the transmission fluid fill plug.
   - Tighten to 35 Nm (26 lb-ft).



Removing Transmission Fluid

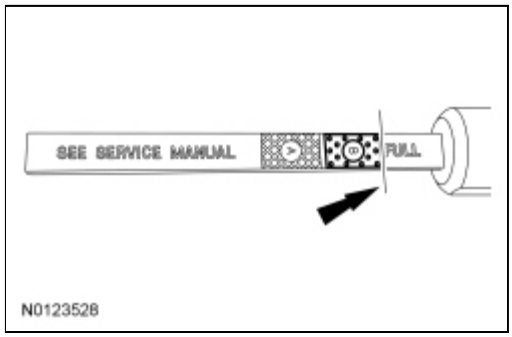
NOTE: To get an accurate transmission fluid level reading the engine should be idling (600-750 rpm) in PARK.

1. If the transmission is overfilled, transmission fluid must be removed to the correct level. Use the Transporter Fluid Evacuator/Injector and the Vacuum Pump Kit to extract any excessive transmission fluid.

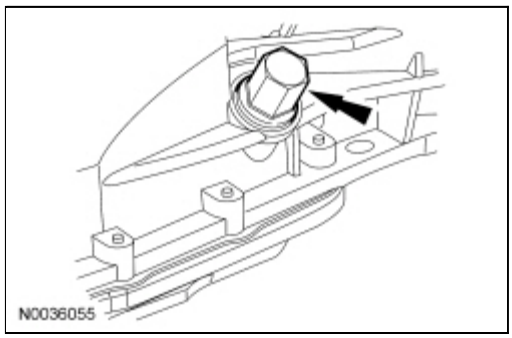


2. **NOTE:** The transmission fluid level indicator has 2 areas for the fluid level, a crosshatched (labeled A) area and a dotted (labeled B) area. Use the dotted (labeled B) area when checking the transmission fluid level. The correct transmission fluid level is at the upper level of the dotted marks on the transmission fluid level indicator.

   Using the scan tool, verify that the TFT is between 91ºC-102ºC (195ºF-215ºF). The transmission fluid level must be at the upper level of the dotted (B) mark.



3. Install the transmission fluid fill plug.
   - Tighten to 35 Nm (26 lb-ft).



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Transmission Fluid Exchange

Special Tool(s)

 ST3088-A	ATF Fluid Exchanger W/Power Steering Fluid Exchanger 199-00059 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

NOTICE: **Use transmission fluid specific for this transmission. Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products can cause internal transmission components to fail, which will affect the operation of the transmission.**

NOTE: For best results, perform the transmission cooler backflush and cleaning procedure before exchanging the fluid.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Connect the ATF Fluid Exchanger W/Power Steering Fluid Exchanger to the transmission fluid cooler tube after the transmission fluid cooler on the return tube. This will help remove any foreign material trapped in the transmission fluid coolers.
3. Perform the transmission fluid exchange using the ATF Fluid Exchanger W/Power Steering Fluid Exchanger. Follow the manufacturer's instructions included with the machine.
4. Once the transmission fluid exchange is completed, disconnect the ATF Fluid Exchanger W/Power Steering Fluid Exchanger. Reconnect any disconnected transmission fluid cooler tubes.
5. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 91ºC-102ºC (195ºF-215ºF). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

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Transmission Fluid Level Check

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

NOTICE: **The vehicle should not be driven if the transmission fluid level is low as internal failure could result.**

NOTICE: **The transmission fluid fill plug is located near the exhaust system. The exhaust will be extremely hot during this procedure.**

NOTE: If the vehicle has been operated for an extended period at high highway speeds, in city traffic, during hot weather or while pulling a trailer, the transmission fluid must cool down to obtain an accurate reading.

NOTE: If the transmission starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

NOTE: Do not overfill the transmission. The transmission fluid level must be at the upper level of the crosshatch mark.

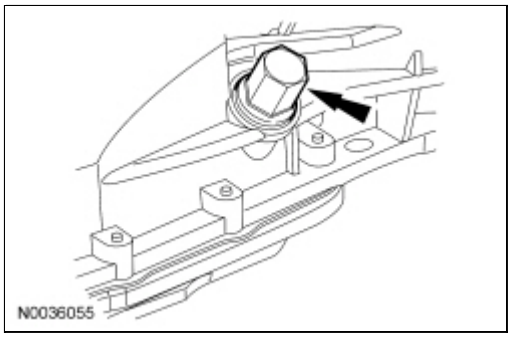
NOTE: If the installation of a new transmission fluid cooler or transmission fluid cooler tubes has been carried out, the vehicle must be driven to get the transmission fluid to a temperature of 89°C (193°F) in order to purge the air from the transmission fluid cooling system.

1. With the engine running, place the transmission selector lever in each gear position and hold approximately 5 seconds. Place the transmission selector lever in PARK.

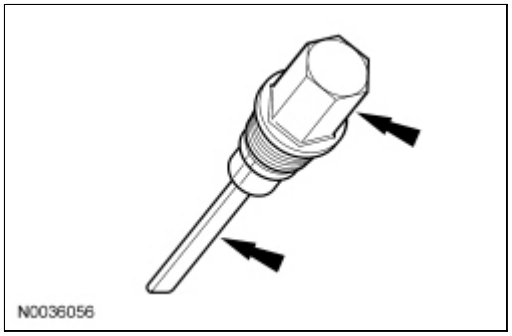
2. With the engine idling (600-750 rpm) in PARK, position it on a hoist. For additional information, refer to Section 100-02.

3. Remove the transmission fluid fill plug transmission fluid level indicator assembly, located on the passenger side front portion of the transmission case.

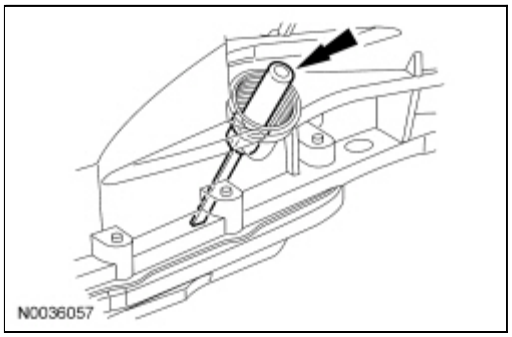
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4. Separate the transmission fluid level indicator from the transmission fluid fill plug.

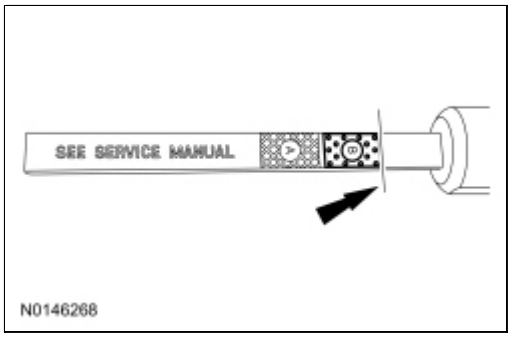


5. Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level.



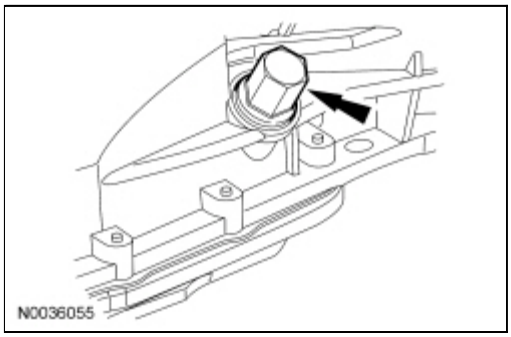
6. **NOTE:** The transmission fluid level indicator has 2 areas for the fluid level, a crosshatched (labeled A) area and a dotted (labeled B) area. Use the dotted (labeled B) area when checking the transmission fluid level. The correct transmission fluid level is at the upper level of the dotted marks on the transmission fluid level indicator.

   Using the scan tool verify that the TFT is between 89ºC-102ºC (193ºF-215ºF). The transmission fluid level must be at the upper level of the dotted (B) mark.



7. **NOTE:** If the transmission fluid is not at the correct level, follow the steps for Adding Additional Transmission Fluid or Removing Transmission Fluid. For additional information, refer to Transmission Fluid Drain and Refill in this section.

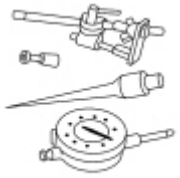
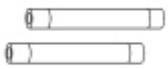
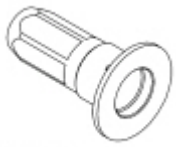
   Install the transmission fluid fill plug.
   - Tighten to 35 Nm (26 lb-ft).



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Transmission — Early Build

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1360-A	Drawbar (Heavy Duty Threaded) 204-029 (T77F-1176)
 ST2883-A	End Play Gauge, Transmission 307-534
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST3059-A	Installer, 6R80 Rear Seal 4X4 307-637
 ST3060-A	Installer, 6R80 Rear Seal 4X2 307-638
	Installer, Fluid Pump Seal 307-556

 ST2887-A	
	Installer, Front Wheel Hub Oil Seal 205-276 (T88T-1175-AH)
 ST2890-A	Installer, Shifter Fluid Seal 307-559
 ST2894-A	Output Shaft Bearing Installer 307-647
 ST3061-A	Remover/Installer, 6R80 Rear Bearing 307-639
 ST2891-A	Remover, Transmission Fluid Pump 307-553
 ST1104-B	Retaining Ring Pliers 307-343 (T95P-77001-AHR)

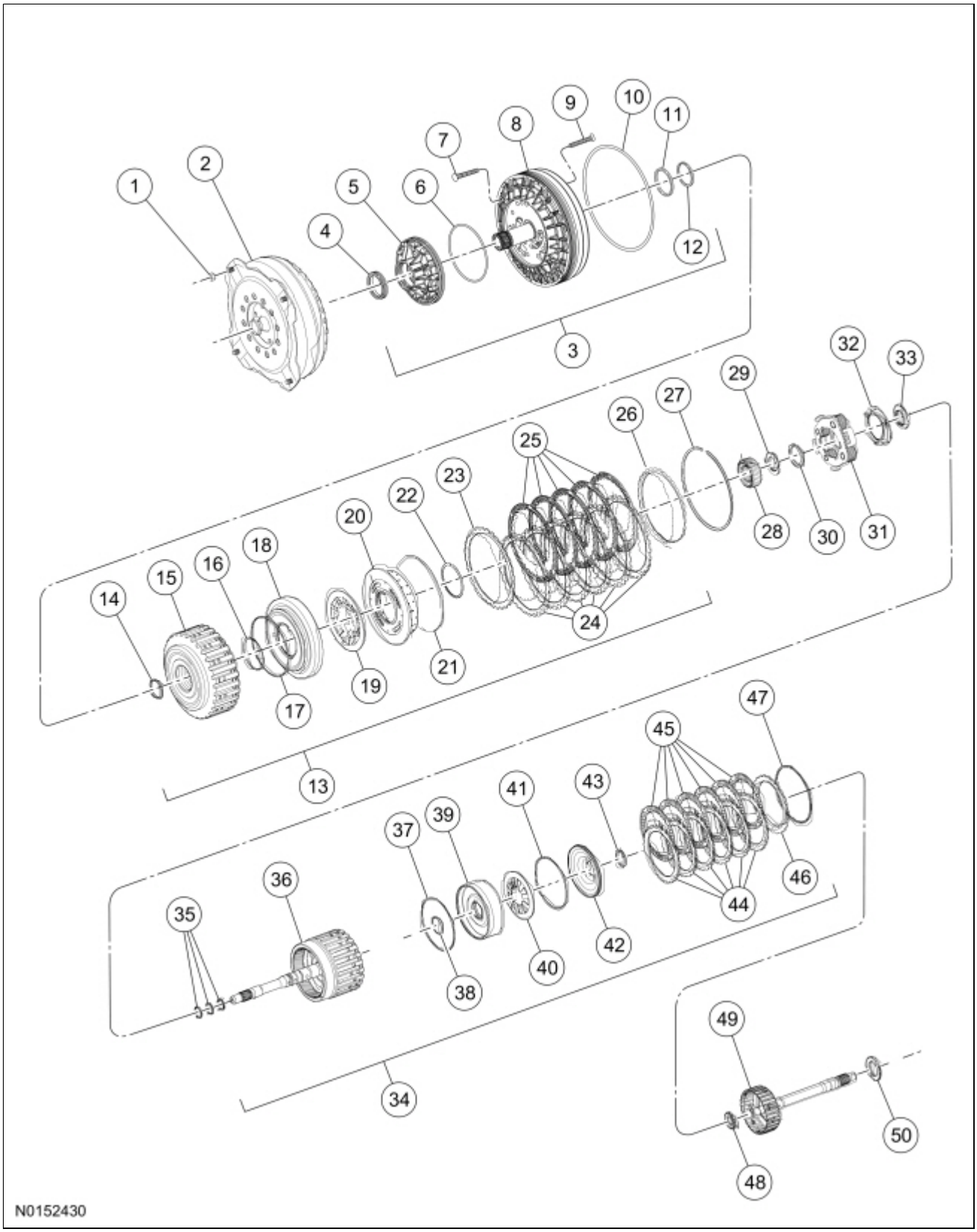
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

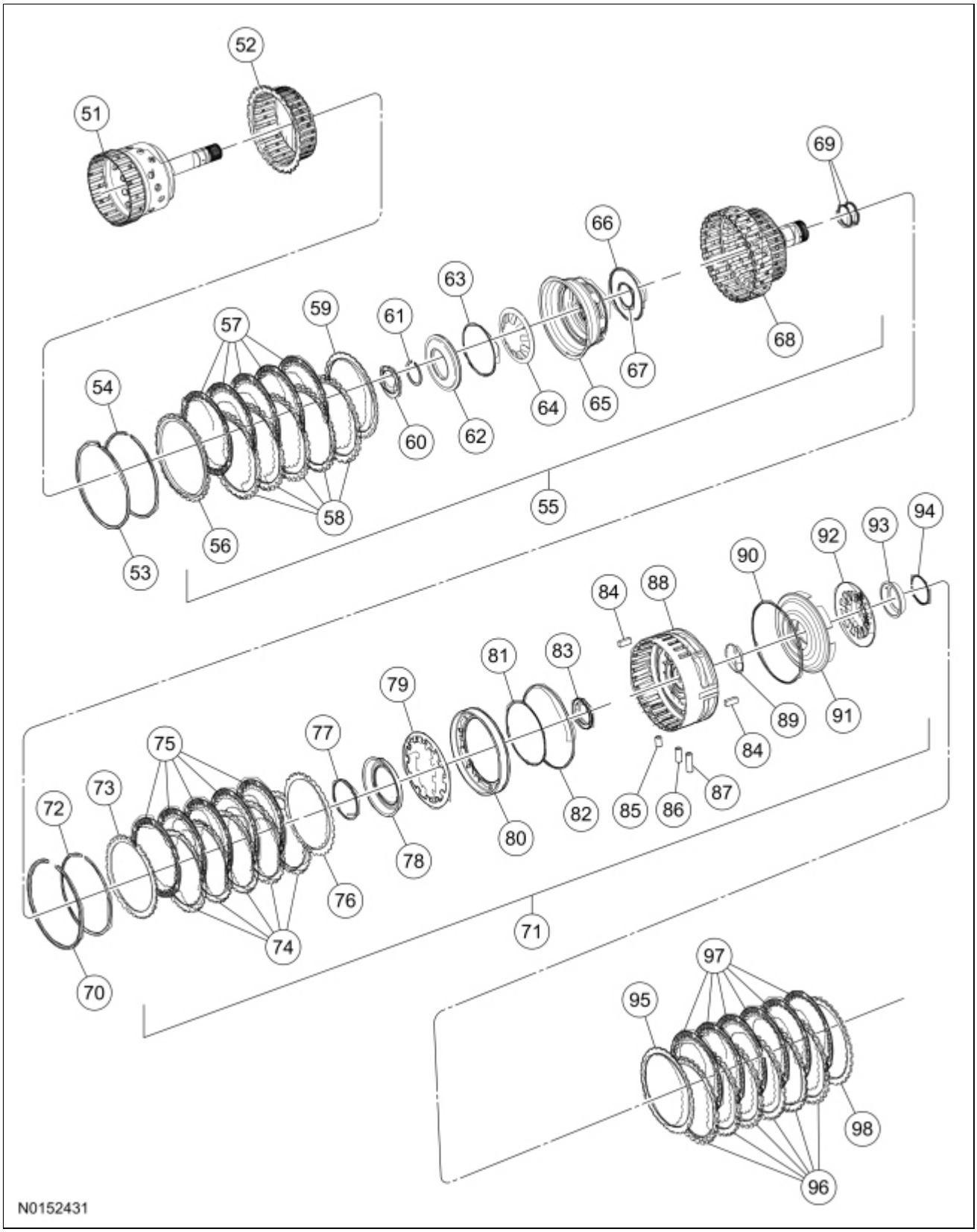
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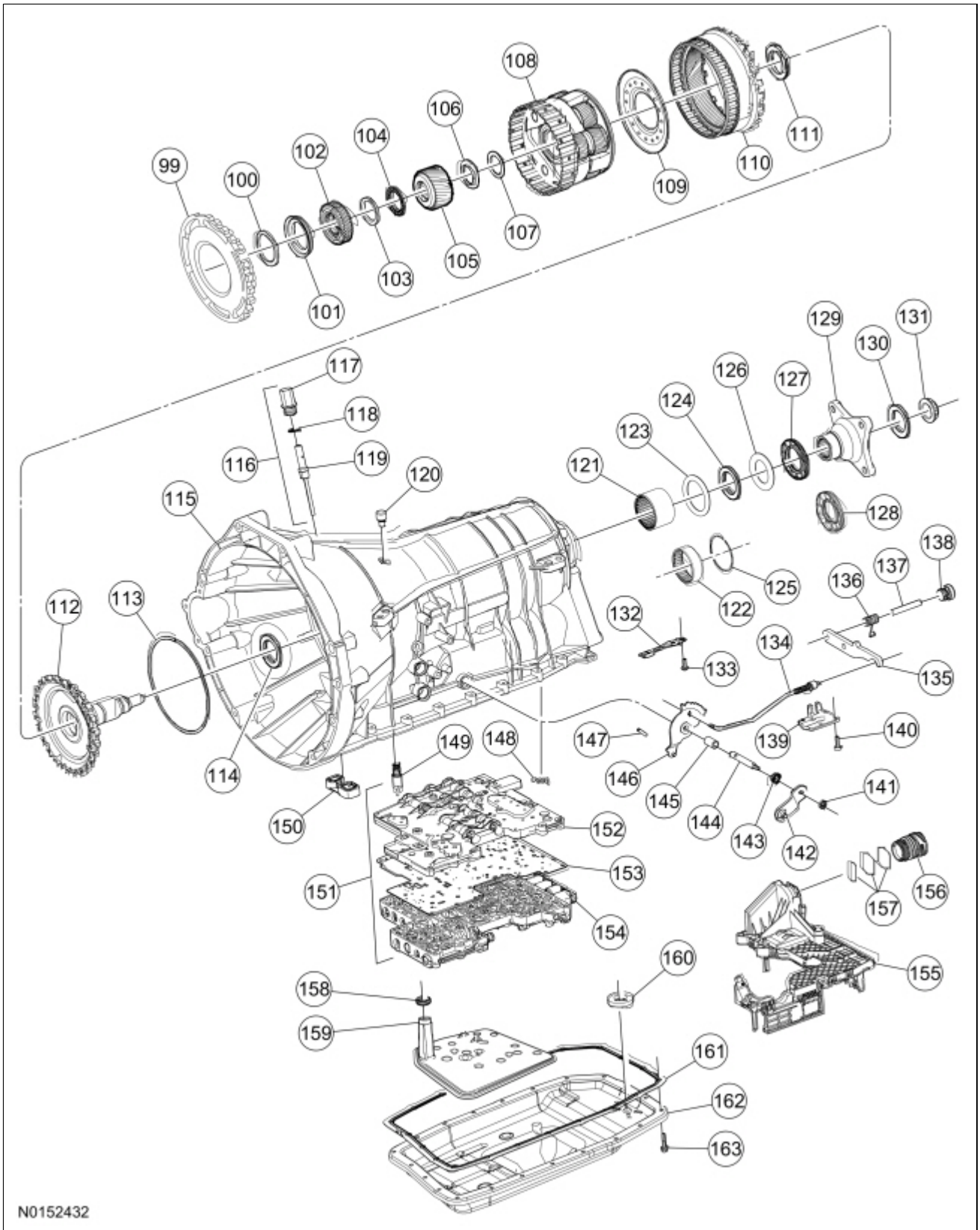
Motorcraft® 6R ATF Additive Kit XL-16	—

Disassembled Views



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Item	Part Number	Description
1	N800750-	Flexplate-to-torque converter nut (4 required)

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	S437	
2	7902	Torque converter
3	7A103	Pump assembly
4	7A248	Front pump oil seal
5	—	Pump body (part of 7A103)
6	7A248	Front pump inner oil seal
7	7N134	Front pump-to-case bolt (13 required)
8	7A103	Front pump assembly
9	W707871-S300	Bolt — attaches pump to pump adapter assembly (11 required)
10	7A248	Front pump outer oil seal
11	7D019	Clutch support fluid seal
12	7L323	Front pump support seal
13	—	Forward (A) clutch assembly
14	7D014	Front pump selective washer
15	7A360	Forward (A) clutch cylinder and hub assembly
16	7A548	Forward (A) clutch inner piston seal
17	7A548	Forward (A) clutch outer piston seal
18	7A262	Forward (A) clutch piston
19	7A480	Forward (A) clutch piston retaining spring
20	7H360	Forward (A) clutch balance piston assembly
21	7A548	Forward (A) clutch balance piston outer seal
22	7H365	Forward (A) clutch balance piston snap ring
23	7E085	Forward (A) clutch cushion spring
24	7E314	Forward (A) clutch steel plates (externally splined) (quantity model dependent)
25	7B164	Forward (A) clutch friction plates (internally splined) (quantity model dependent)
26	7B066	Forward (A) clutch pressure plate
27	7D483	Pressure plate retaining snap ring
28	7D063	Front planetary sun gear (No. 1)
29	7H375	Bearing (T1)
30	—	Front planetary carrier assembly snap ring (part of 7A398)
31	7A398	Front planetary carrier assembly
32	7L339	Plate transmission fluid collector
33	7L495	Bearing (T2)
34	—	Overdrive (E) clutch assembly
35	7G091	Turbine shaft seals (3 required)
36	7F207	Input shaft

37	7A548	Overdrive (E) clutch piston outer seal
38	7A548	Overdrive (E) clutch piston inner seal
39	7A262	Overdrive (E) clutch piston
40	7B070	Overdrive clutch piston spring
41	7A548	Balance piston outer seal
42	7H360	Overdrive (E) balance piston
43	7C122	Balance piston snap ring
44	7B442	Overdrive (E) clutch steel plates (externally splined)
45	7B164	Overdrive (E) clutch friction plates (internally splined)
46	7B066	Overdrive (E) pressure plate
47	7D483	Overdrive (E) clutch retaining ring
48	7C096	Bearing (T3)
49	7F351	Intermediate (C) clutch shaft
50	7H375	Bearing (T4)
51	7B067	Sun gear hub and shaft assembly
52	7F236	Direct (B) clutch hub
53	7C122	Direct (B) clutch cylinder retaining ring
54	7D483	Direct (B) clutch pressure plate retaining ring
55	—	Direct (B) clutch assembly (clutch B)
56	7B066	Direct (B) clutch pressure plate
57	7B164	Direct (B) clutch friction plates (internally splined) (quantity model dependent)
58	7B442	Direct (B) clutch steel plates (externally splined) (quantity model dependent)
59	7E085	Direct (B) clutch cushion plate
60	7C096	Roller bearing (T5)
61	7A577	Direct (B) clutch piston retaining ring
62	7A262	Direct (B) clutch balance piston
63	7A548	Direct (B) clutch balance seal
64	7B488	Direct (B) clutch piston return spring
65	—	Direct (B) clutch piston
66	7A548	Direct (B) clutch piston outer seal
67	7C099	Direct (B) clutch piston inner seal
68	7F283	Direct (B) clutch cylinder
69	7D020	Shell cylinder seals (2 required)
70	7D483	Center support retaining ring
71	—	Intermediate (C) clutch assembly
72	7D483	Intermediate (C) clutch pressure plate retaining ring
73	7B066	Intermediate (C) clutch pressure plate

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74	7B442	Intermediate (C) clutch steel plates (externally splined) (quantity model dependent)
75	7B164	Intermediate (C) clutch friction plates (internally splined) (quantity model dependent)
76	7E085	Intermediate (C) clutch pressure plate spring
77	7A577	Intermediate (C) clutch retaining ring
78	7B043	Intermediate (C) clutch ring
79	7A480	Intermediate (C) clutch piston spring
80	7E005	Intermediate (C) clutch piston
81	7F225	Intermediate (C) clutch piston inner seal
82	7F224	Intermediate (C) clutch piston outer seal
83	7F373	Bearing (T6)
84	7B220	Center support keys (2 required)
85	7G199	Center support feed tube seal (black)
86	7G087	Center support feed tube seal (green)
87	7G084	Center support feed tube seal (blue)
88	7G033	Center support assembly
89	7D404	Low/reverse clutch piston center seal
90	7D403	Low/reverse clutch piston outer seal
91	7A262	Low/reverse clutch piston
92	7B070	Low/reverse clutch piston return spring
93	7H318	Low/reverse clutch piston retainer
94	7D483	Retainer transmission-snap ring
95	7E085	Clutch disc cushion plate
96	7B442	Low/reverse clutch steel plates (externally splined)
97	7B164	Low/reverse clutch friction plates (internally splined)
98	7B066	Low/reverse clutch pressure plate (select fit)
99	7A089	OWC
100	7F405	Thrust gear shim (select fit)
101	7C041	Thrust bearing (T7)
102	7D063	Sun gear No. 2
103	7D235	Thrust bearing outer race
104	7D234	Roller bearing (T8)
105	7D063	Sun gear No. 3
106	7D234	Roller bearing (T9)
107	—	Roller bearing race (T9)
108	7D006	Rear planetary carrier assembly
109	—	Fluid collar rear planetary plate (part of 7D006)
110	7A153	Output shaft ring gear assembly

111	7G178	Thrust Bearing (T10)
112	7060	Output shaft park gear assembly
113	7N194	Output shaft retaining ring
114	7B368	Bearing (T11)
115	7005	Transmission case assembly (model dependent)
116	7A010	Transmission case fluid fill plug assembly
117	7H398	Transmission case fluid fill plug
118	7A010	Transmission case fluid fill seal
119	7A010	Transmission oil level indicator
120	7034	Transmission case vent assembly (model dependent)
121	7A415	Output shaft bearing assembly (RWD)
122	7A415	Output shaft bearing assembly (4WD)
123	7A433	Washer (RWD)
124	7B368	Thrust bearing (T12) (RWD)
125	7030	Output shaft bearing snap ring (4WD)
126	7N357	Slip plane washer (RWD)
127	7052	Output shaft seal (RWD)
128	7052	Output shaft seal (4WD)
129	7089	Output shaft flange (RWD)
130	7052	Output shaft flange seal (RWD)
131	7045	Output shaft flange retaining nut (RWD)
132	7E332	Manual valve detent spring
133	W711235-S300	Manual valve detent spring retaining screw and washer
134	7A232	Park pawl actuator rod
135	7A441	Park pawl
136	7D070	Park pawl return spring
137	7D071	Park pawl shaft
138	7H398	Plug assembly transmission case housing
139	7G101	Park rod actuating plate
140	W711235-S300	Park pawl abutment retaining screw and washer
141	W708455-S441	Manual control lever nut
142	7A256	Manual control lever
143	7B498	Manual control lever shaft seal
144	7C493	Manual control lever shaft
145	7A209	Manual control lever shaft spacer
146	7A115	Manual valve detent lever assembly

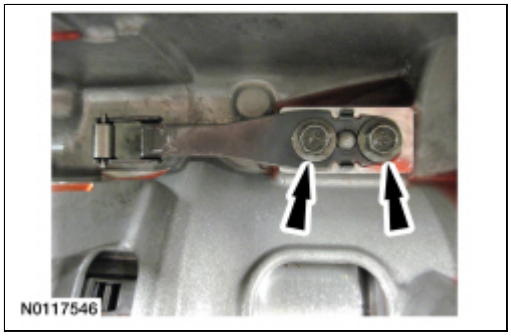
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147	7G100	Manual valve detent lever retaining pin
148	7F277	OWC bias spring
149	7H322	Thermal bypass valve
150	7F401	Front pump adapter seal
151	7A100	Main control assembly
152	—	Main control valve body assembly (part of 7A100)
153	7Z490	Main control valve body separator plate
154	—	Lower main control valve body (part of 7A100)
155	7G276	Molded leadframe
156	7G276	Bulkhead connector sleeve
157	7A248	Bulkhead connector sleeve seals
158	—	Transmission fluid filter seal (part of 7A098)
159	7A098	Transmission fluid filter
160	—	Transmission fluid pan magnet
161	7A191	Transmission fluid pan gasket
162	7A194	Transmission fluid pan
163	W500214-S437	Transmission fluid pan bolt

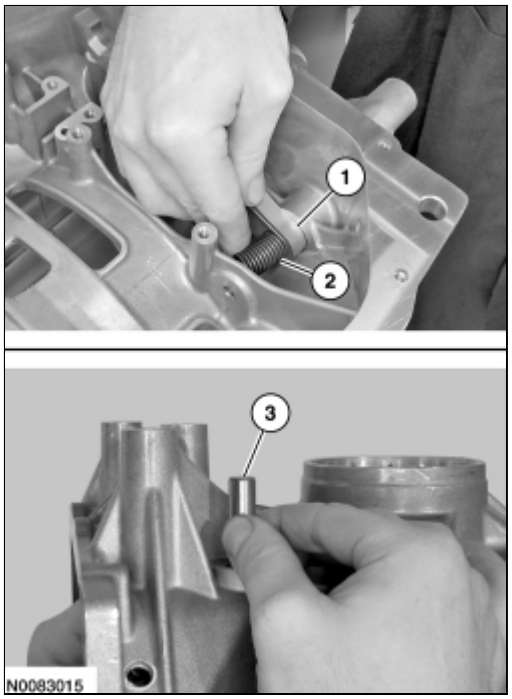
NOTE: Clutch plate quantity is model dependant based on engine displacement. Refer to Clutch Plate Quantity chart in the Specifications portion of this section.

All vehicles

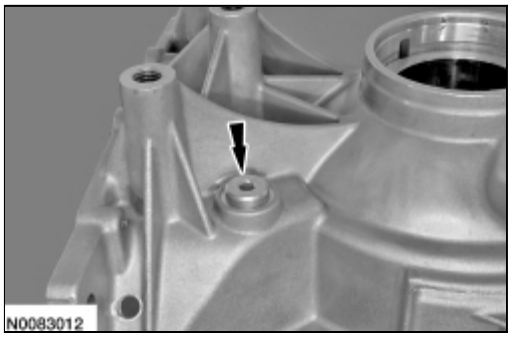
1. Install the park detent spring and the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).



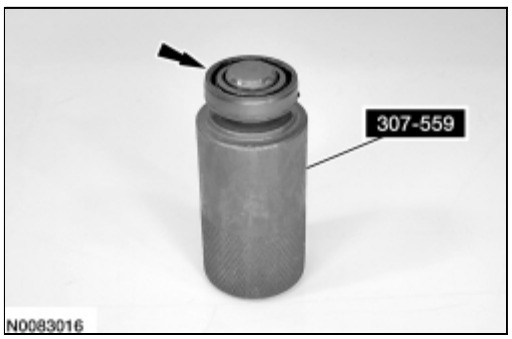
2. Position the park pawl and spring into the case and install the park pawl pin.
    1. Park pawl
    2. Park pawl return spring
    3. Park pawl pin



3. Install the park pawl pin bolt.
    - Tighten to 23 Nm (17 lb-ft).

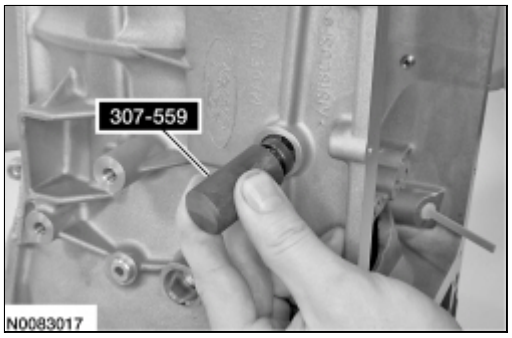


4. Install a new manual control lever shaft seal on the Shifter Fluid Seal Installer.



5. Using the Shifter Fluid Seal Installer, install the manual control lever shaft seal.

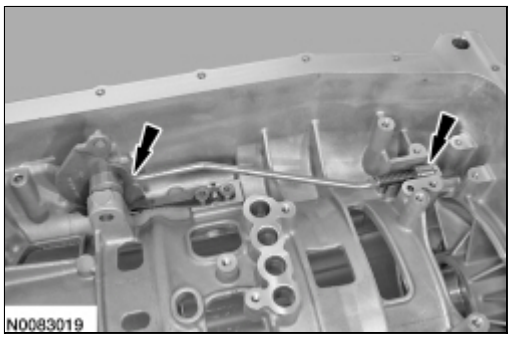
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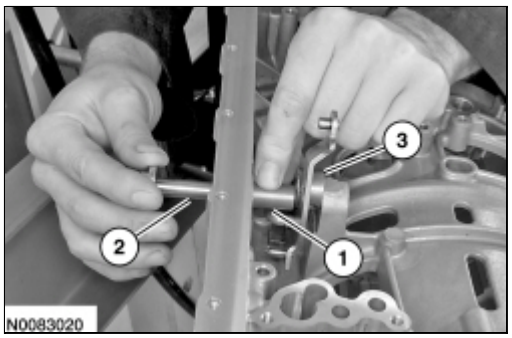
6. Assemble the manual control lever detent plate assembly and park pawl actuator rod.



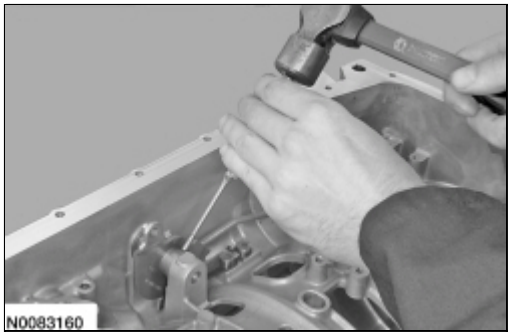
7. Position the manual valve detent lever and park pawl actuator rod assembly in the transmission case.



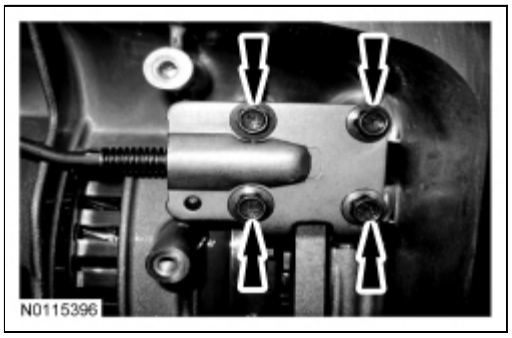
8. Position the manual control lever spacer in place and slide the manual control lever shaft into the case and the manual lever detent plate.
    1. Manual control lever spacer
    2. Manual control lever shaft
    3. Manual control lever detent plate



9. Align the roll pin hole in the manual control lever detent plate with the roll pin hole in the manual control lever shaft and install a new roll pin.

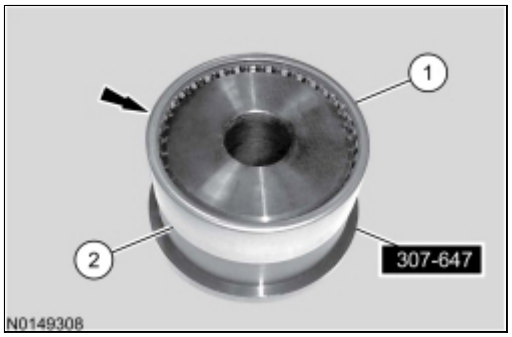


10. Install the park rod actuating plate and the 4 bolts.
    - Tighten to 12 Nm (106 lb-in).



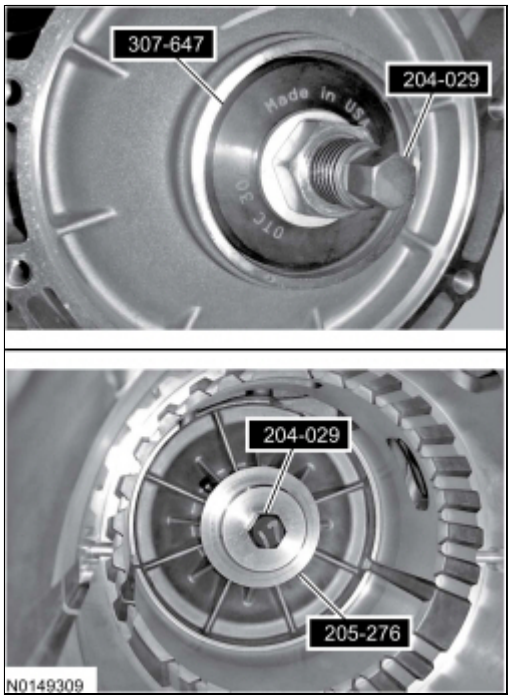
Four-Wheel Drive (4WD) vehicles

11. If removed, position a new bearing on the Output Shaft Bearing Installer. Install the bearing with the flat bearing surface facing down and the rounded bearing surface facing up so that when installed, the flat surface is on the snap ring side and the rounded surface is on the transmission case side.
    1. Rounded bearing surface facing up
    2. Flat bearing surface facing down

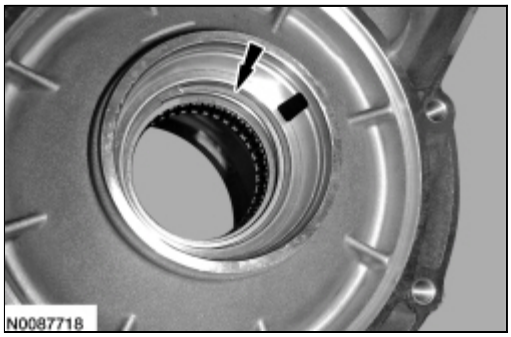


12. Using the Output Shaft Bearing Installer, the Drawbar and the Front Wheel Hub Oil Seal Installer, install the bearing in the transmission case.

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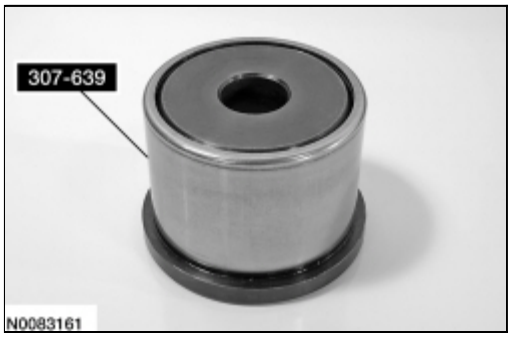


13. Install the snap ring.

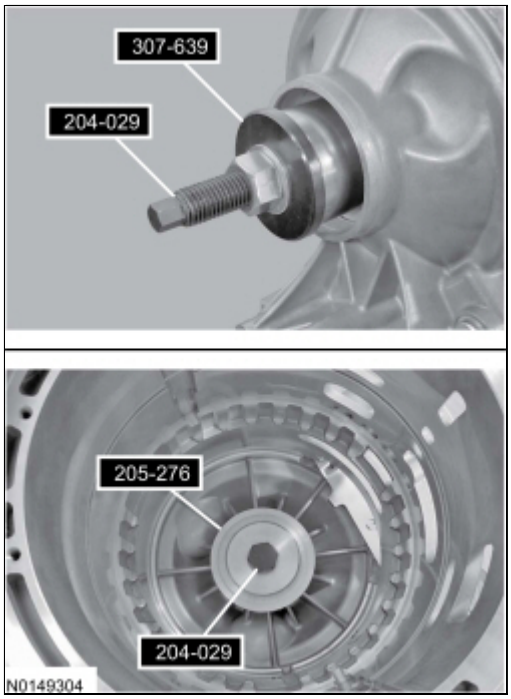


Rear Wheel Drive (RWD) vehicles

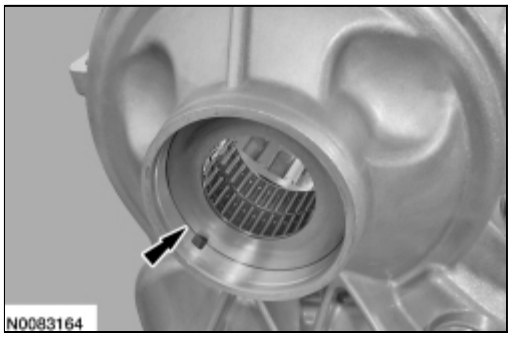
14. Install the bearing on the 6R80 Rear Bearing Remover/Installer.



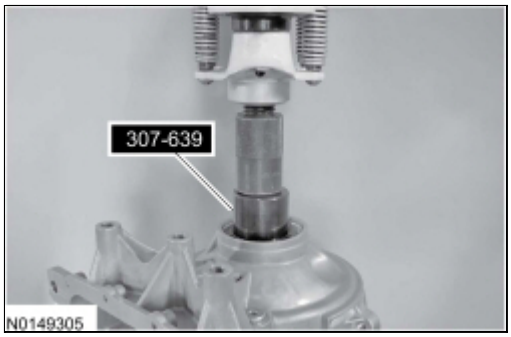
15. Assemble the Front Wheel Hub Oil Seal Installer and the 6R80 Rear Bearing Remover/Installer on the Drawbar and install the bearing in the transmission case.



16. Position the thrust bearing spacer.

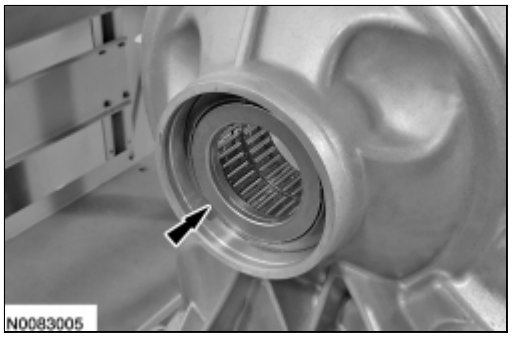


17. Using the 6R80 Rear Bearing Remover/Installer and a press, press the thrust bearing spacer in place.



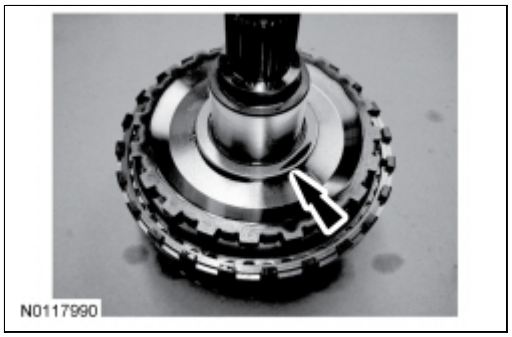
18. Install the T12 thrust bearing.

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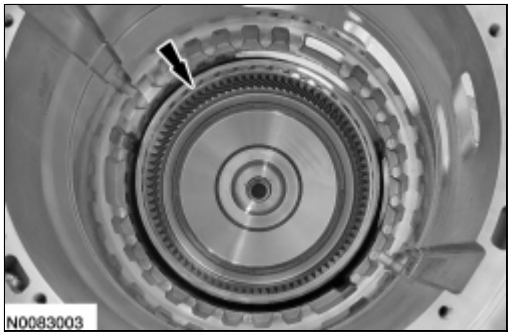


All vehicles

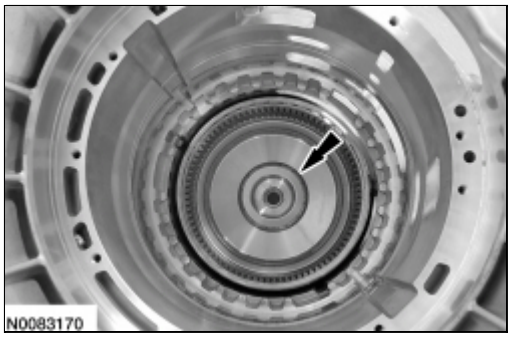
19. Install the T11 bearing, on the planetary ring gear and output shaft assembly.



20. Install the rear planetary ring gear and output shaft assembly.



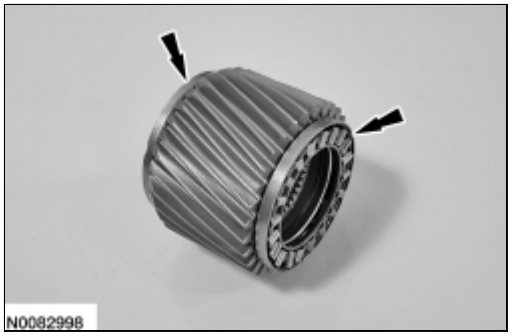
21. Install the T10 thrust bearing on the output shaft assembly.



22. Install the T9 roller bearing race into the bottom of the carrier.

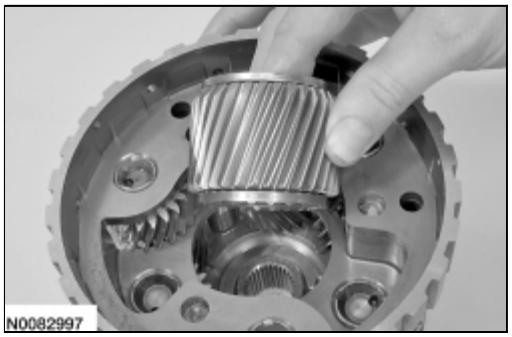


23. Install the top T8 and the bottom T9 roller bearings onto the sun gear.



24. **NOTE:** When installing the sun gear, make sure that the TAPERED EDGE is facing UP toward the torque converter housing.

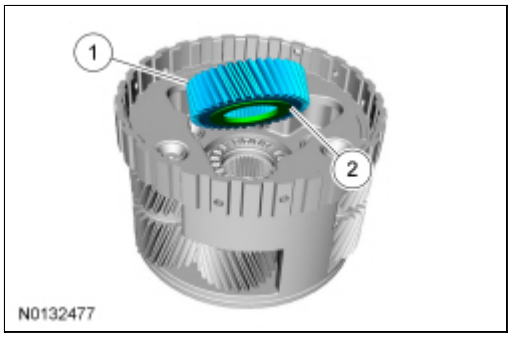
    Install the sun gear into the planetary assembly.



25. **NOTE:** Be sure the bearing race is installed in the sun gear.

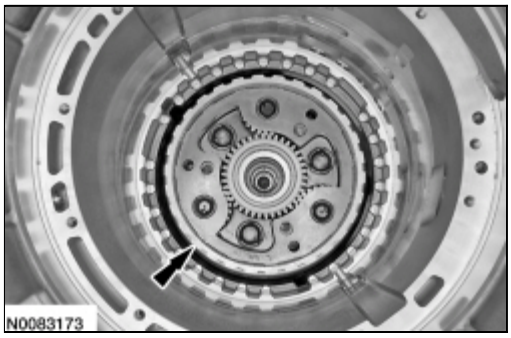
    Install the low/reverse sun gear and bearing race into the planetary carrier with the race side facing down.
    1. Low/reverse sun gear
    2. Bearing race

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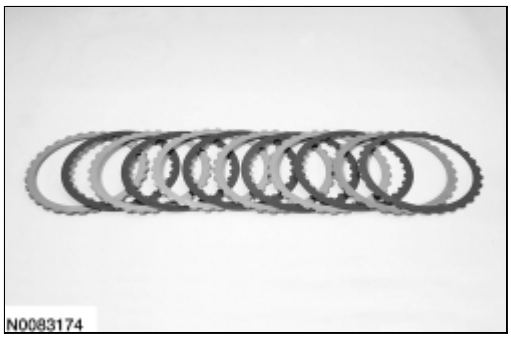
26. **NOTE:** Place the manual control lever in PARK when installing the rear planetary gearset to hold the rear ring gear stationary.

    Install the planetary carrier.

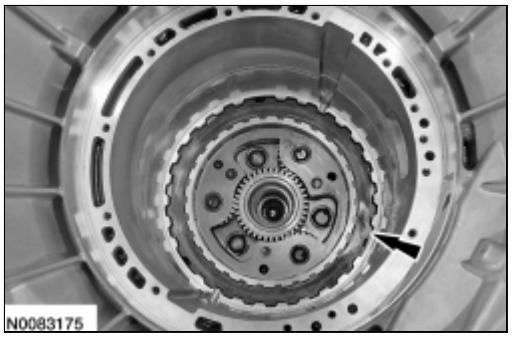


27. **NOTE:** Friction and steel plate quantity are model dependent and vary based on engine displacement. For additional information, refer to the Clutch Plate Quantity Chart in the Specifications portion of this section.

    Soak the low/reverse clutch plates in clean automatic transmission fluid.

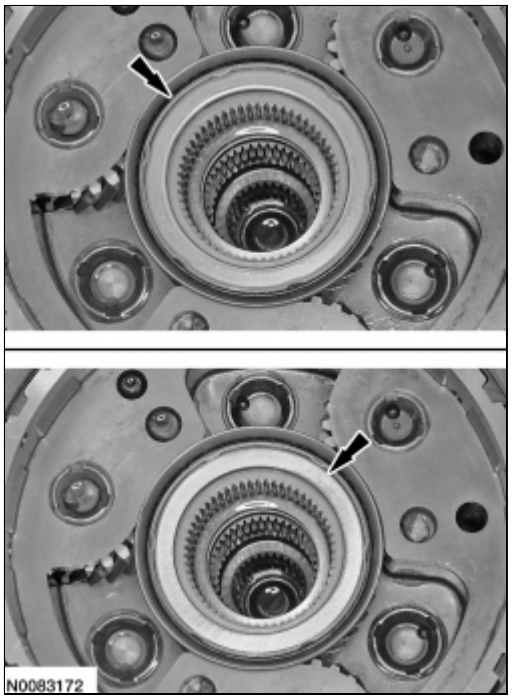


28. Install the low/reverse clutch plates, starting with the pressure plate and alternating between the friction and steel plates and ending with the wave spring plate on the top.



29. **NOTE:** Inspect the T7 thrust bearing and selective shim for damage or scoring.

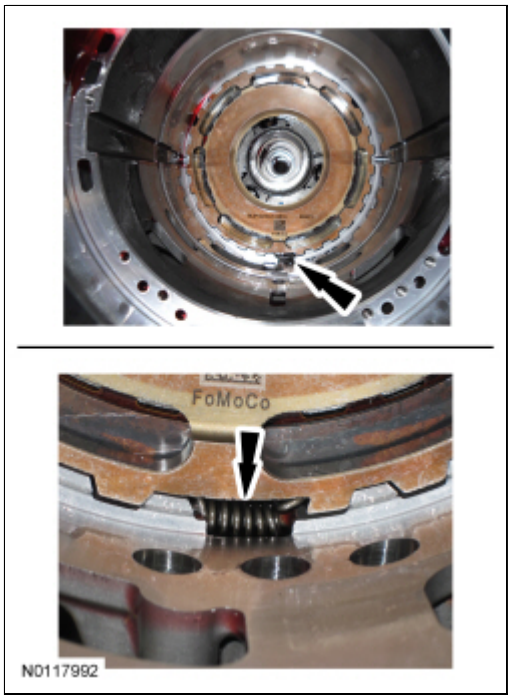
    Install the T7 thrust bearing and the selective shim.



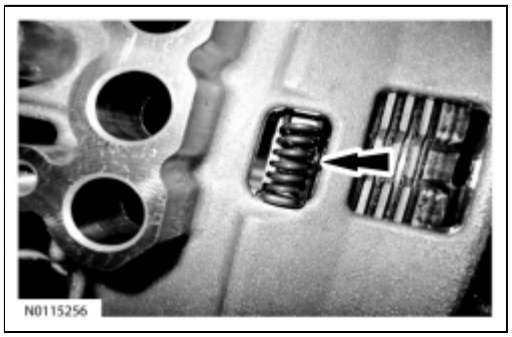
30. **NOTE:** Align the OWC in the transmission case so the bias spring fits into the transmission case.

    Install the OWC as shown so the bias spring can be installed as shown.

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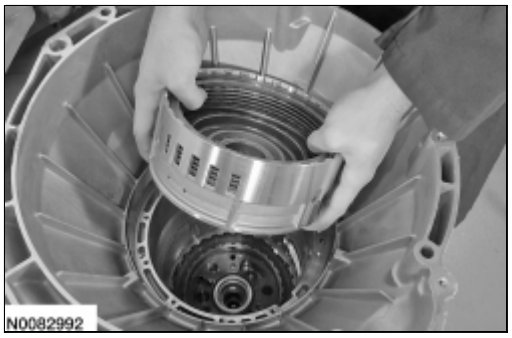


31. Install the bias spring.



32. **NOTE:** Make sure that when installing the center support the feed holes on the center support are lined up with the feed holes in the case.

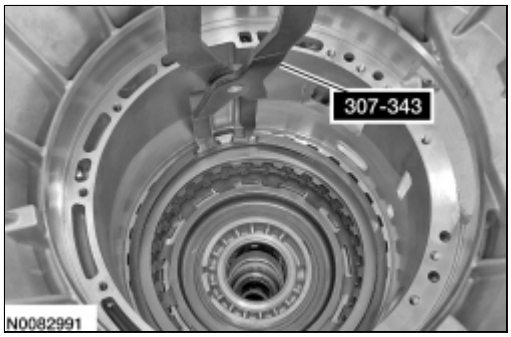
    Install the center support into the case.



33. ***NOTICE:*** **Install the snap ring with the beveled surface facing up and the snap ring gap in the 3 o'clock or the 9 o'clock position.**

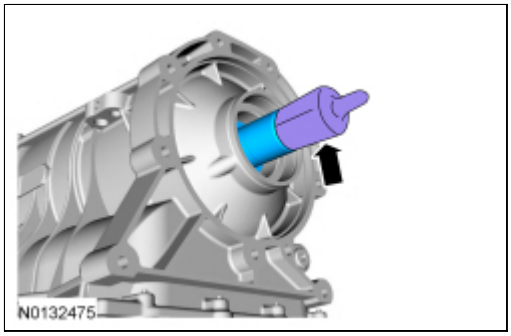
NOTE: Rotate the case to a horizontal position.

Using the Retaining Ring Pliers, install the center support snap ring. Make sure the snap ring is fully seated.

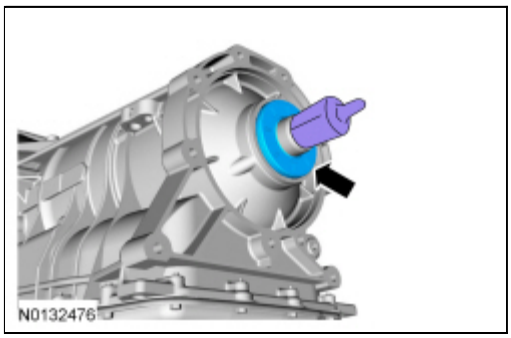


Four-Wheel Drive (4WD) vehicles

34. Install the seal protector provided with the new output shaft seal on the output shaft.

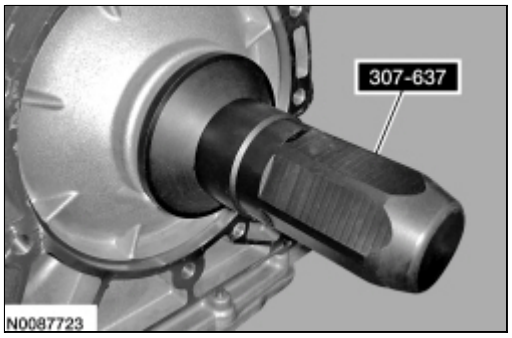


35. Slide the output shaft seal over the output shaft seal protector onto the output shaft. Remove the output shaft seal protector.



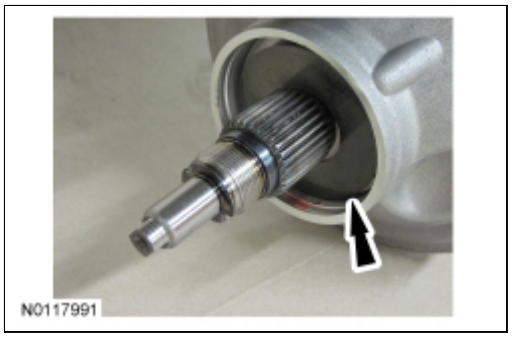
36. Using the 6R80 Rear Seal 4X4 Installer, install the output shaft seal.

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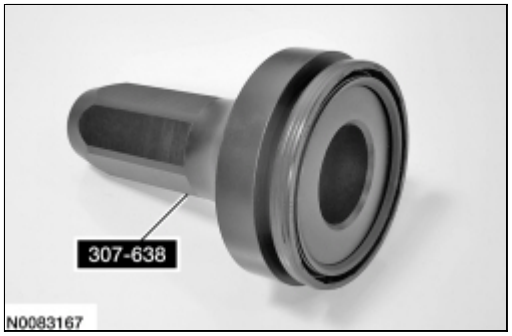


Rear Wheel Drive (RWD) vehicles

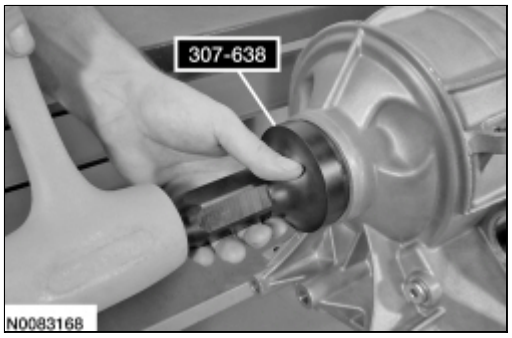
37. Rotate the transmission to the vertical position and install the slip plane washer.



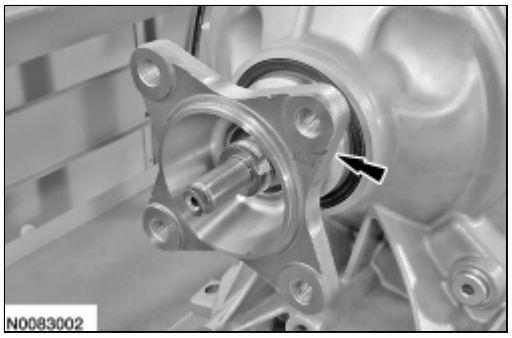
38. Position a new output shaft seal on the 6R80 4X2 Rear Seal Installer.



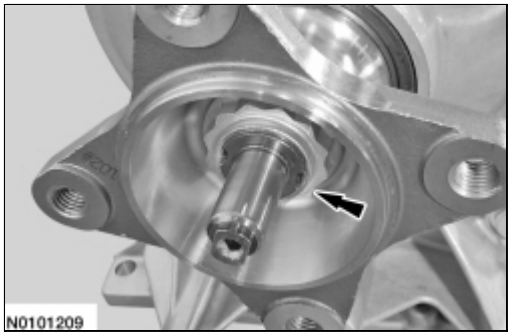
39. Using the 6R80 Rear Seal 4X2 Installer, install the output shaft seal.



40. Install the output shaft flange and the output shaft flange seal.

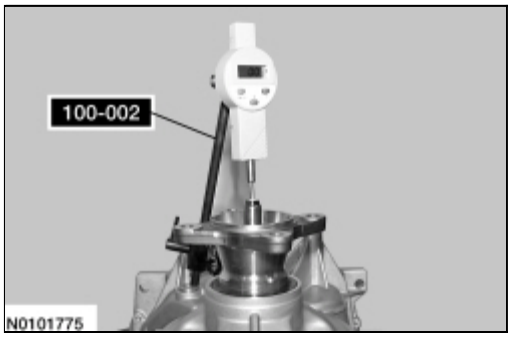


41. Loosely install a new output shaft flange retaining nut.



Rear Wheel Drive (RWD) vehicles

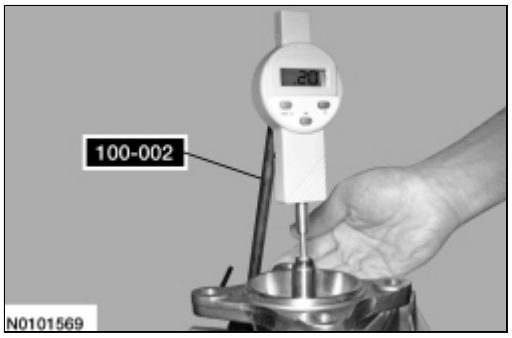
42. Install the Dial Indicator Gauge with Holding Fixture on the transmission case and position the plunger on the output shaft flange.



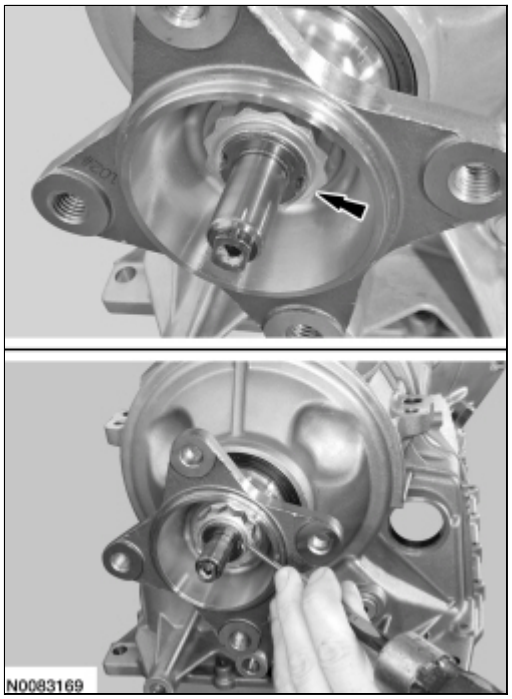
43. **NOTE:** Loosely install the flange nut or an inaccurate reading may be recorded.

    Using the Dial Indicator Gauge with Holding Fixture, lift up on the output shaft flange and record the reading. The reading should be within 0.6-0.9 mm (0.024-0.035 in).
    - If the reading is not within specification, install a different (either thinner or thicker) selective shim.

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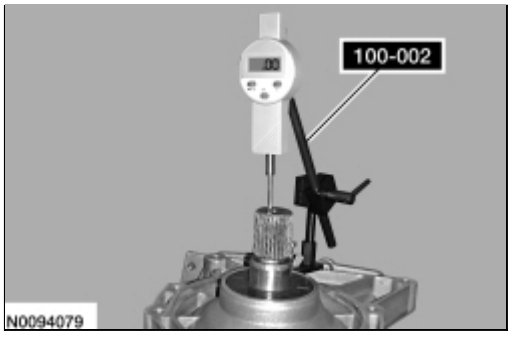


44. Tighten the output shaft flange retaining nut.
    - Tighten to 80 Nm (59 lb-ft).
    - After installing the new output shaft flange retaining nut, stake the slots to prevent it from coming loose.

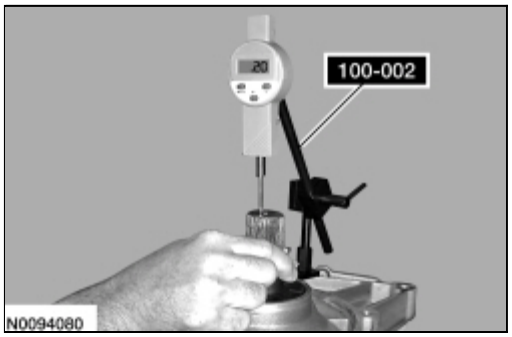


Four-Wheel Drive (4WD) vehicles

45. Install the Dial Indicator Gauge with Holding Fixture on the transmission case and position the plunger on the output shaft.

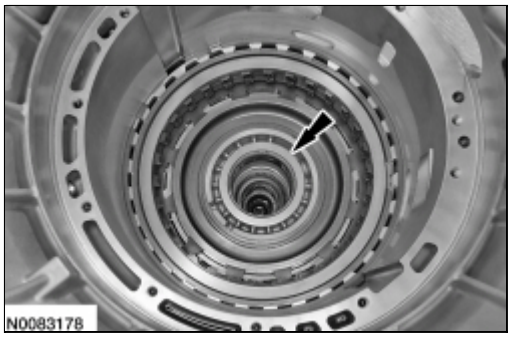


46. Using the Dial Indicator Gauge with Holding Fixture, lift up on the output shaft and record the reading. The reading should be within 0.15-0.35 mm (0.005-0.013 in).
    - If the reading is not within the specification, install a different (either thinner or thicker) select fit thrust gear shim.

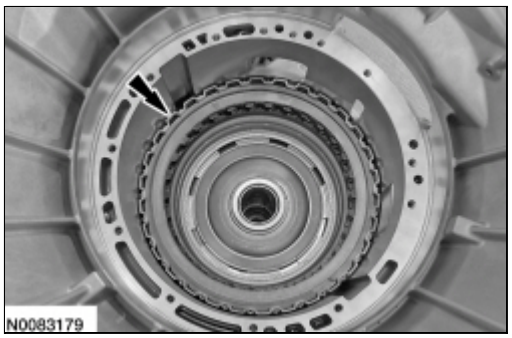


All vehicles

47. Rotate the transmission in the vertical position with the torque converter housing facing up and install the T6 bearing.

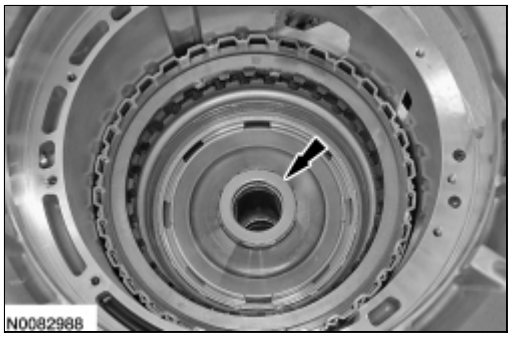


48. Install the direct (B) clutch assembly.

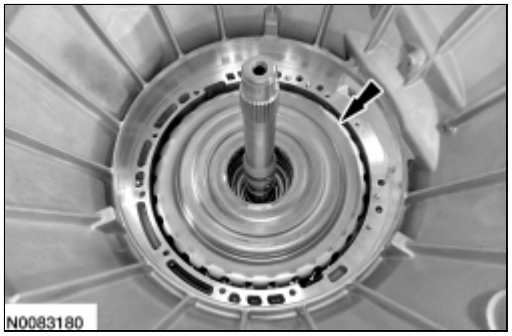


49. Install the T5 roller bearing on the direct (B) clutch assembly.

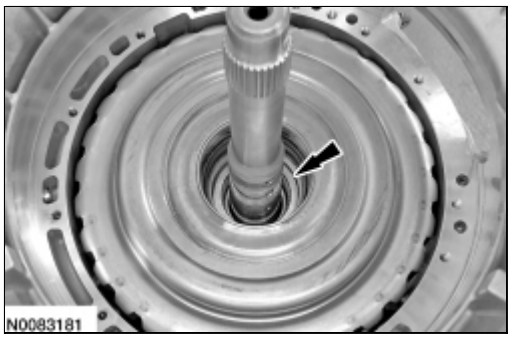
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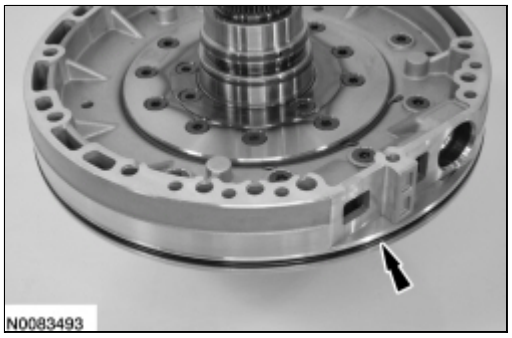
50. Install the forward (A)/overdrive (E) clutch assembly.



51. Install the selective shim.



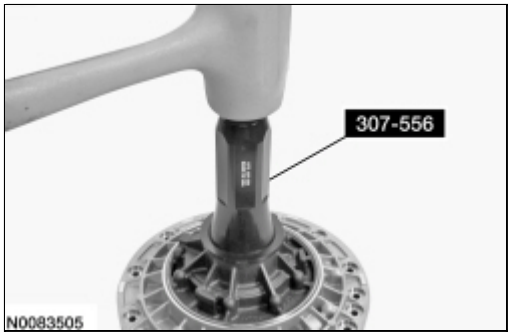
52. If the front pump was not disassembled and assembled, install a new front pump O-ring seal and lubricate it with petroleum jelly.



53. Install a new front pump seal on the Fluid Pump Seal Installer.



54. Using the Fluid Pump Seal Installer, install the front pump seal.

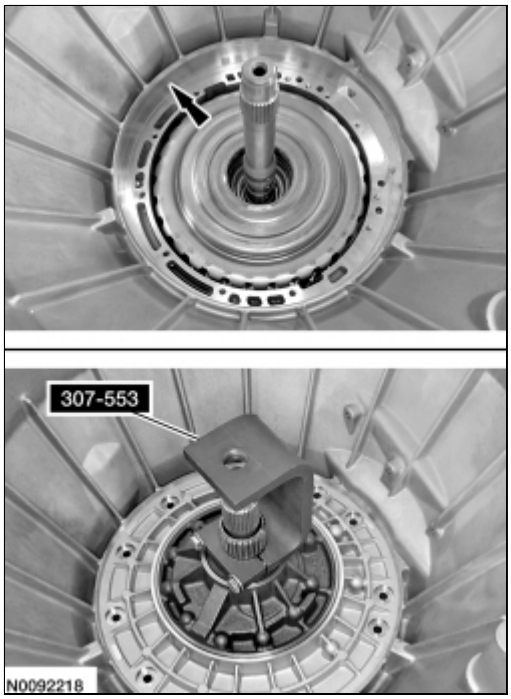


55. Install the Transmission Fluid Pump Remover on the front pump.



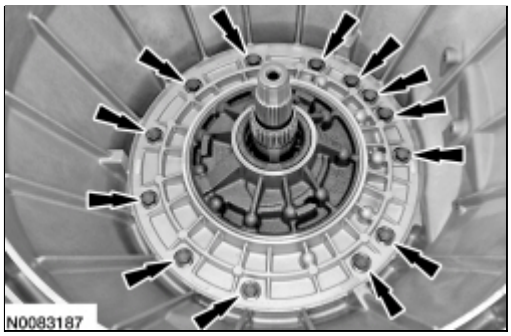
56. Lubricate the transmission case pump bore with petroleum jelly. Using the Transmission Fluid Pump Remover, position the pump assembly in the case and rotate the pump to insert the pump splines into the front planetary sun gear. Rotate the pump to align the pump-to-case bolts and push the pump into the case.

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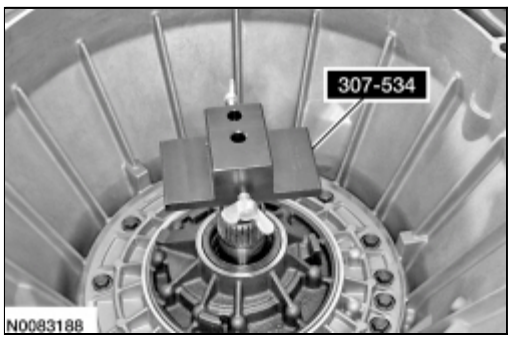


57. **NOTE:** Failure to replace the fasteners will result in transmission fluid leakage.

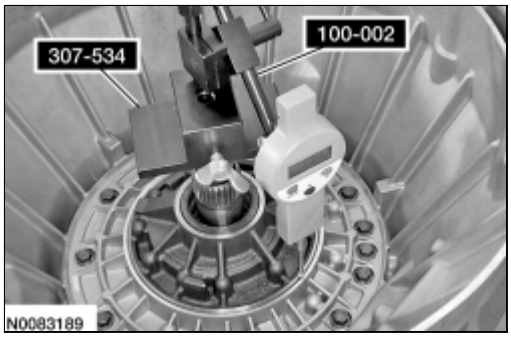
    Install 13 new front pump-to-case bolts and washers. Tighten in a crisscross pattern.
    - Tighten pump fasteners with washers to 10 Nm (89 lb-in).
    - Tighten fasteners without washers to 10 Nm (89 lb-in).



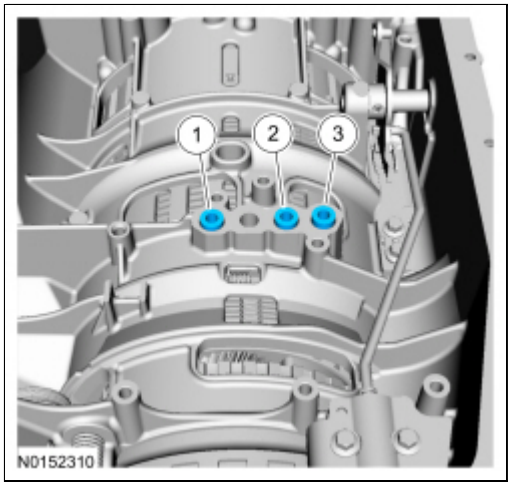
58. Install the Transmission End Play Gauge on the input shaft to measure the end play.
    - Tighten the wing nut.



59. Install the Dial Indicator Gauge with Holding Fixture on the Transmission End Play Gauge.
    - Push down on the Transmission End Play Gauge and zero the Dial Indicator Gauge.
    - Lift up on the Transmission End Play Gauge and record the measurement on the Dial Indicator Gauge. The measurement should be between 0.2-0.4 mm (0.008-0.015 in). If the measurement is not within specification, install a new selective front pump shim.
    - Measure the original shim, install a thinner or a thicker shim to achieve the correct measurement.



60. Rotate the transmission in the horizontal position with the main control area facing up and install 3 new center support feed tube seals.
    1. Center support feed tube seal (7G199 Black)
    2. Center support feed tube seal (7G087 Green)
    3. Center support feed tube seal (7G084 Blue)

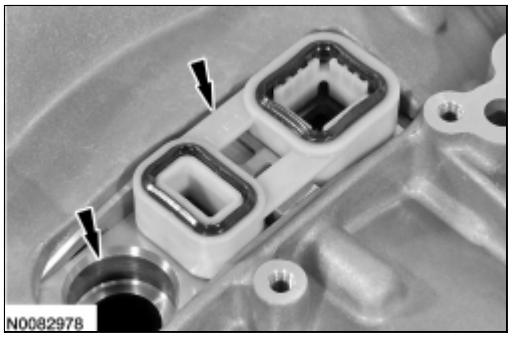


61. **NOTE:** Make sure the transmission fluid filter seal has been removed. If it has not, use a suitable pick and remove the seal.

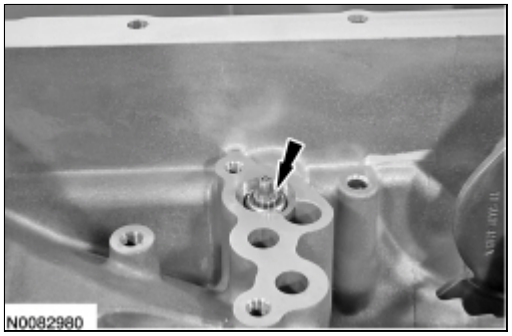
    NOTE: Add 0.118L (4 oz) of clean transmission fluid to prime the pump.

    Install the front pump adapter seal and prime the fluid pump.

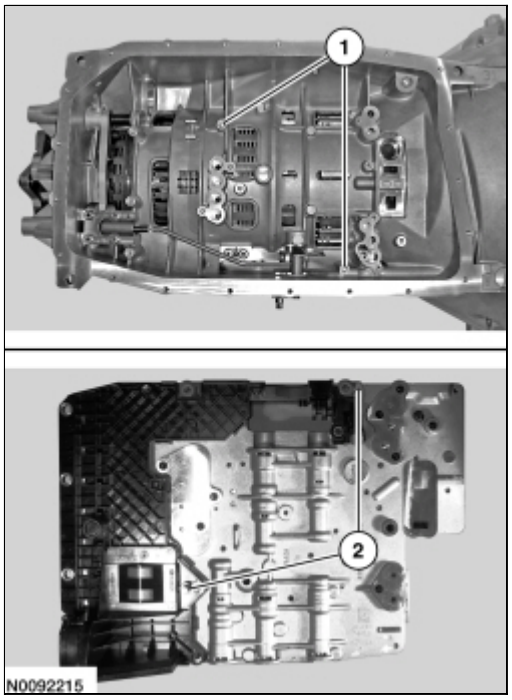
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62. Install the thermal bypass valve into the case.

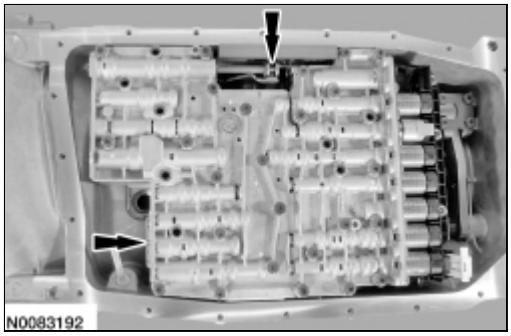


63. Align the guide pins in the alignment holes in the transmission case and position the mechatronic assembly in place.
    1. Alignment holes
    2. Guide pins

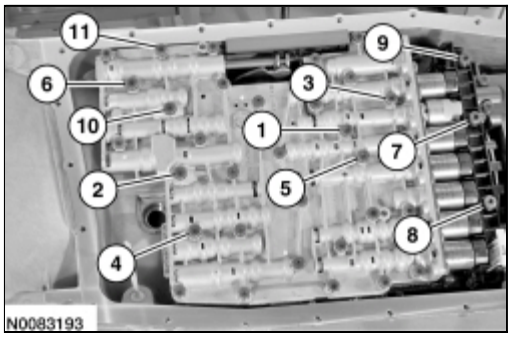


64. **NOTE:** The mechatronic assembly will not lay flush on the case, this is a normal condition with the rubber feed tubes, the bolts will pull the mechatronic assembly down.

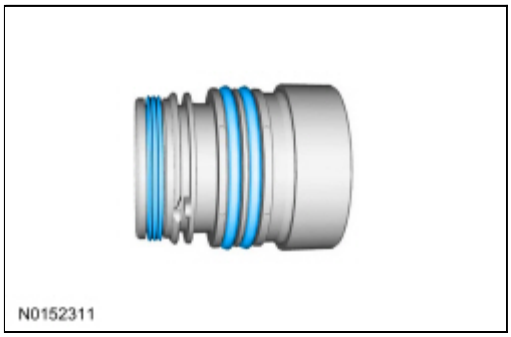
Slightly lift the mechatronic assembly and align the manual valve in the manual valve linkage and position the mechatronic in place.



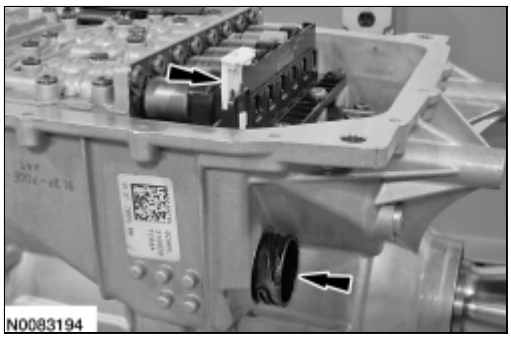
65. Install the 11 mechatronic assembly bolts and tighten in the sequence shown.
    - Tighten to 8 Nm (71 lb-in).



66. If removed, install the bulkhead connector sleeve seals.

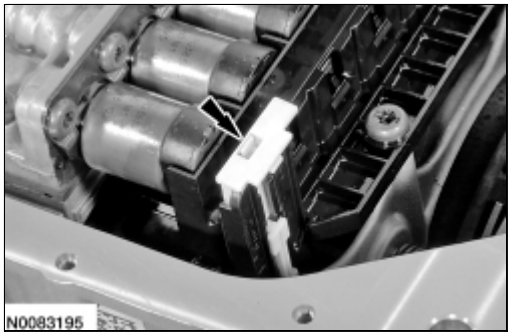


67. With the release tab up and unlocked, push the outer shell of the bulkhead connector sleeve into the transmission. Make sure the bulkhead connector sleeve is fully seated into the molded leadframe.

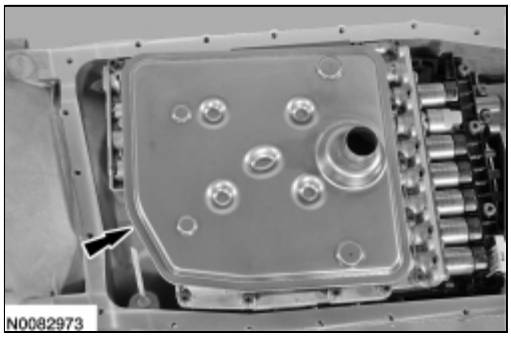


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68. Press down on the tab and lock the outer shell of the bulkhead connector sleeve in place. Make sure the locking tab is securely locked.

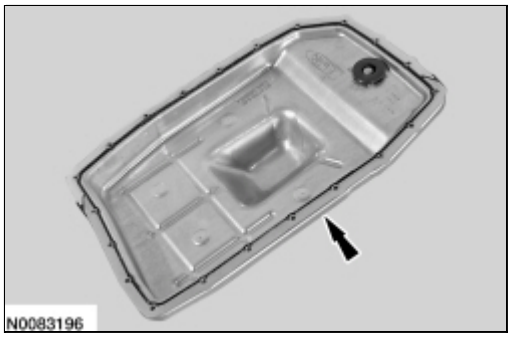


69. Install a new transmission fluid filter.

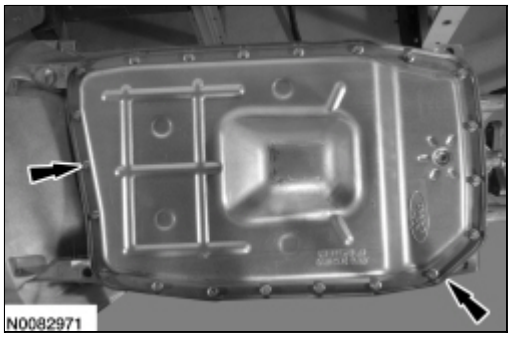


70. **NOTE:** The fluid pan gasket can be reused if not damaged.

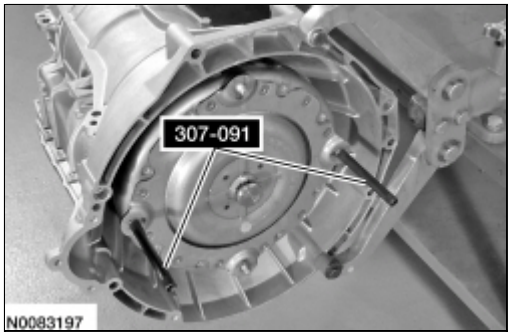
    Install a new transmission fluid pan gasket if required.



71. Install the transmission fluid pan and transmission fluid pan bolts. Tighten in a crisscross pattern.
    - Tighten to 9 Nm (80 lb-in).



72. Using the Torque Converter Handle, install the torque converter.



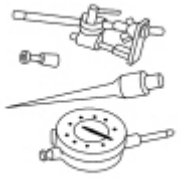
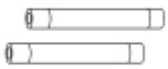
73. If the Overdrive clutch FRICTIONS were replaced, install 1 6R ATF Additive Kit XL-16.

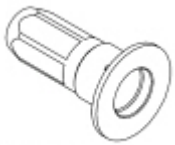
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Transmission — Late Build

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1360-A	Drawbar (Heavy Duty Threaded) 204-029 (T77F-1176)
 ST2883-A	End Play Gauge, Transmission 307-534
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST2887-A	Installer, Fluid Pump Seal 307-556
	Installer, Front Wheel Hub Oil Seal 205-276 (T88T-1175-AH)
	Installer, Needle Bearing 307-714

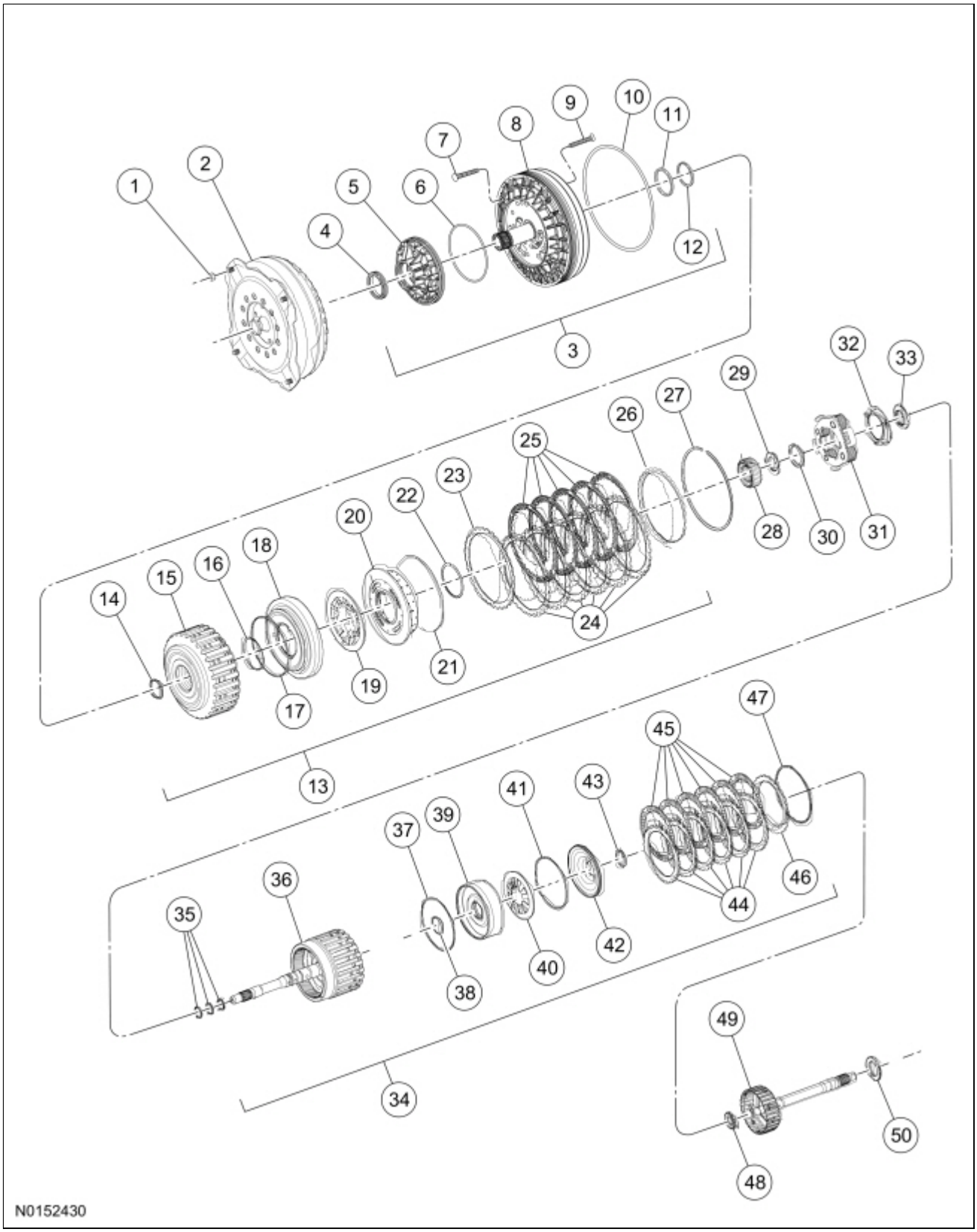
 E173277	
 E173278	Installer, Output Seal (4X2) 307-715
 ST3059-A	Installer, 6R80 Rear Seal 4X4 307-637
 E173276	Installer, Roller Bearing 307-713
 ST2890-A	Installer, Shifter Fluid Seal 307-559
 ST2216-A	Installer, Spindle/Axle Shaft 205-199 (T83T-3132-A1)
 ST2891-A	Remover, Transmission Fluid Pump 307-553
 ST1104-B	Retaining Ring Pliers 307-343 (T95P-77001-AHR)

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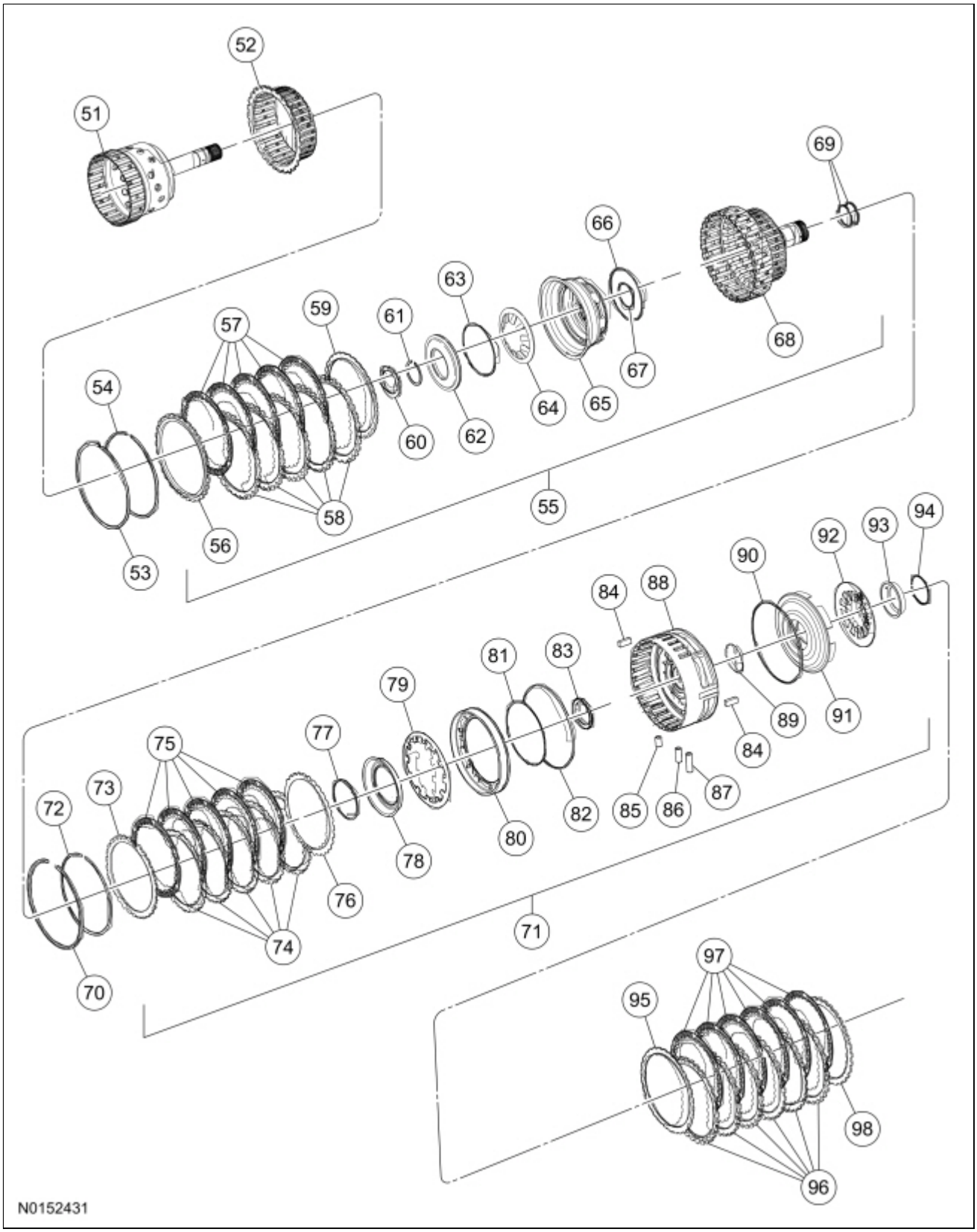
Material

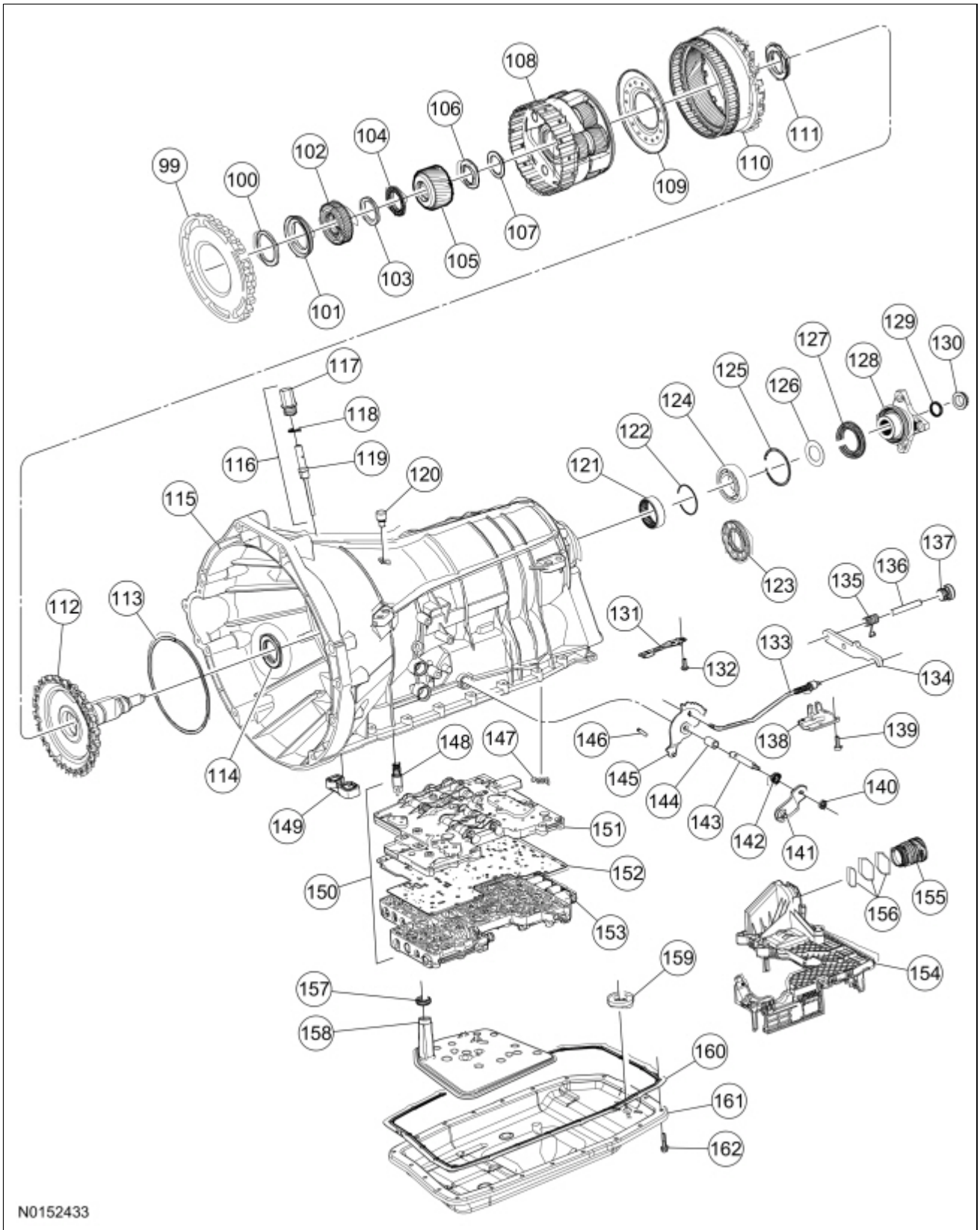
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV
Motorcraft® 6R ATF Additive Kit XL-16	—

Disassembled Views



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Item	Part Number	Description
1	N800750-	Flexplate-to-torque converter nut (4 required)

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	S437	
2	7902	Torque converter
3	7A103	Pump assembly
4	7A248	Front pump oil seal
5	—	Pump body (part of 7A103)
6	7A248	Front pump inner oil seal
7	7N134	Front pump-to-case bolt (13 required)
8	7A103	Front pump assembly
9	W707871-S300	Bolt — attaches pump to pump adapter assembly (11 required)
10	7A248	Front pump outer oil seal
11	7D019	Clutch support fluid seal
12	7L323	Front pump support seal
13	—	Forward (A) clutch assembly
14	7D014	Front pump selective washer
15	7A360	Forward (A) clutch cylinder and hub assembly
16	7A548	Forward (A) clutch inner piston seal
17	7A548	Forward (A) clutch outer piston seal
18	7A262	Forward (A) clutch piston
19	7A480	Forward (A) clutch piston retaining spring
20	7H360	Forward (A) clutch balance piston assembly
21	7A548	Forward (A) clutch balance piston outer seal
22	7H365	Forward (A) clutch balance piston snap ring
23	7E085	Forward (A) clutch cushion spring
24	7E314	Forward (A) clutch steel plates (externally splined) (quantity model dependent)
25	7B164	Forward (A) clutch friction plates (internally splined) (quantity model dependent)
26	7B066	Forward (A) clutch pressure plate
27	7D483	Pressure plate retaining snap ring
28	7D063	Front planetary sun gear (No. 1)
29	7H375	Bearing (T1)
30	—	Front planetary carrier assembly snap ring (part of 7A398)
31	7A398	Front planetary carrier assembly
32	7L339	Plate transmission fluid collector
33	7L495	Bearing (T2)
34	—	Overdrive (E) clutch assembly
35	7G091	Turbine shaft seals (3 required)
36	7F207	Input shaft

37	7A548	Overdrive (E) clutch piston outer seal
38	7A548	Overdrive (E) clutch piston inner seal
39	7A262	Overdrive (E) clutch piston
40	7B070	Overdrive clutch piston spring
41	7A548	Balance piston outer seal
42	7H360	Overdrive (E) balance piston
43	7C122	Balance piston snap ring
44	7B442	Overdrive (E) clutch steel plates (externally splined)
45	7B164	Overdrive (E) clutch friction plates (internally splined)
46	7B066	Overdrive (E) pressure plate
47	7D483	Overdrive (E) clutch retaining ring
48	7C096	Bearing (T3)
49	7F351	Intermediate (C) clutch shaft
50	7H375	Bearing (T4)
51	7B067	Sun gear hub and shaft assembly
52	7F236	Direct (B) clutch hub
53	7C122	Direct (B) clutch cylinder retaining ring
54	7D483	Direct (B) clutch pressure plate retaining ring
55	—	Direct (B) clutch assembly (clutch B)
56	7B066	Direct (B) clutch pressure plate
57	7B164	Direct (B) clutch friction plates (internally splined) (quantity model dependent)
58	7B442	Direct (B) clutch steel plates (externally splined) (quantity model dependent)
59	7E085	Direct (B) clutch cushion plate
60	7C096	Roller bearing (T5)
61	7A577	Direct (B) clutch piston retaining ring
62	7A262	Direct (B) clutch balance piston
63	7A548	Direct (B) clutch balance seal
64	7B488	Direct (B) clutch piston return spring
65	—	Direct (B) clutch piston
66	7A548	Direct (B) clutch piston outer seal
67	7C099	Direct (B) clutch piston inner seal
68	7F283	Direct (B) clutch cylinder
69	7D020	Shell cylinder seals (2 required)
70	7D483	Center support retaining ring
71	—	Intermediate (C) clutch assembly
72	7D483	Intermediate (C) clutch pressure plate retaining ring
73	7B066	Intermediate (C) clutch pressure plate

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74	7B442	Intermediate (C) clutch steel plates (externally splined) (quantity model dependent)
75	7B164	Intermediate (C) clutch friction plates (internally splined) (quantity model dependent)
76	7E085	Intermediate (C) clutch pressure plate spring
77	7A577	Intermediate (C) clutch retaining ring
78	7B043	Intermediate (C) clutch ring
79	7A480	Intermediate (C) clutch piston spring
80	7E005	Intermediate (C) clutch piston
81	7F225	Intermediate (C) clutch piston inner seal
82	7F224	Intermediate (C) clutch piston outer seal
83	7F373	Bearing (T6)
84	7B220	Center support keys (2 required)
85	7G199	Center support feed tube seal (black)
86	7G087	Center support feed tube seal (green)
87	7G084	Center support feed tube seal (blue)
88	7G033	Center support assembly
89	7D404	Low/reverse clutch piston center seal
90	7D403	Low/reverse clutch piston outer seal
91	7A262	Low/reverse clutch piston
92	7B070	Low/reverse clutch piston return spring
93	7H318	Low/reverse clutch piston retainer
94	7D483	Retainer transmission-snap ring
95	7E085	Clutch disc cushion plate
96	7B442	Low/reverse clutch steel plates (externally splined)
97	7B164	Low/reverse clutch friction plates (internally splined)
98	7B066	Low/reverse clutch pressure plate (select fit)
99	7A089	OWC
100	7F405	Thrust gear shim (select fit)
101	7C041	Thrust bearing (T7)
102	7D063	Sun gear No. 2
103	7D235	Thrust bearing outer race
104	7D234	Roller bearing (T8)
105	7D063	Sun gear No. 3
106	7D234	Roller bearing (T9)
107	—	Roller bearing race (T9)
108	7D006	Rear planetary carrier assembly
109	—	Fluid collar rear planetary plate (part of 7D006)
110	7A153	Output shaft ring gear assembly

111	7G178	Thrust Bearing (T10)
112	7060	Output shaft park gear assembly
113	7N194	Output shaft retaining ring
114	7B368	Bearing (T11)
115	7005	Transmission case assembly (model dependent)
116	7A010	Transmission case fluid fill plug assembly
117	7H398	Transmission case fluid fill plug
118	7A010	Transmission case fluid fill seal
119	7A010	Transmission oil level indicator
120	7034	Transmission case vent assembly (model dependent)
121	7A415	Output shaft bearing assembly (all models)
122	7030	Output shaft bearing snap ring (all models)
123	7052	Output shaft seal (4WD)
124	7R205	Output shaft ball bearing (RWD)
125	7030	Output shaft ball bearing snap ring (RWD)
126	7N135	Slip plane washer (RWD)
127	7052	Output shaft seal (RWD)
128	7A021	Output shaft flange (RWD)
129	7052	Output shaft flange seal (RWD)
130	7045	Output shaft flange retaining nut (RWD)
131	7E332	Manual valve detent spring
132	W711235-S300	Manual valve detent spring retaining screw and washer
133	7A232	Park pawl actuator rod
134	7A441	Park pawl
135	7D070	Park pawl return spring
136	7D071	Park pawl shaft
137	7H398	Plug assembly transmission case housing
138	7G101	Park rod actuating plate
139	W711235-S300	Park pawl abutment retaining screw and washer
140	W708455-S441	Manual control lever nut
141	7A256	Manual control lever
142	7B498	Manual control lever shaft seal
143	7C493	Manual control lever shaft
144	7A209	Manual control lever shaft spacer
145	7A115	Manual valve detent lever assembly
146	7G100	Manual valve detent lever retaining pin

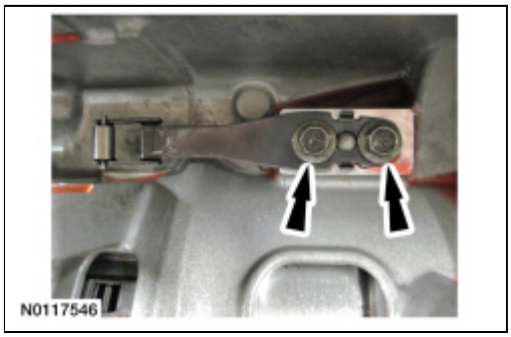
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147	7F277	OWC bias spring
148	7H322	Thermal bypass valve
149	7F401	Front pump adapter seal
150	7A100	Main control assembly
151	—	Main control valve body assembly (part of 7A100)
152	7Z490	Main control valve body separator plate
153	—	Lower main control valve body (part of 7A100)
154	7G276	Molded leadframe
155	7G276	Bulkhead connector sleeve
156	7A248	Bulkhead connector sleeve seals
157	—	Transmission fluid filter seal (part of 7A098)
158	7A098	Transmission fluid filter
159	—	Transmission fluid pan magnet
160	7A191	Transmission fluid pan gasket
161	7A194	Transmission fluid pan
162	W500214-S437	Transmission fluid pan bolt

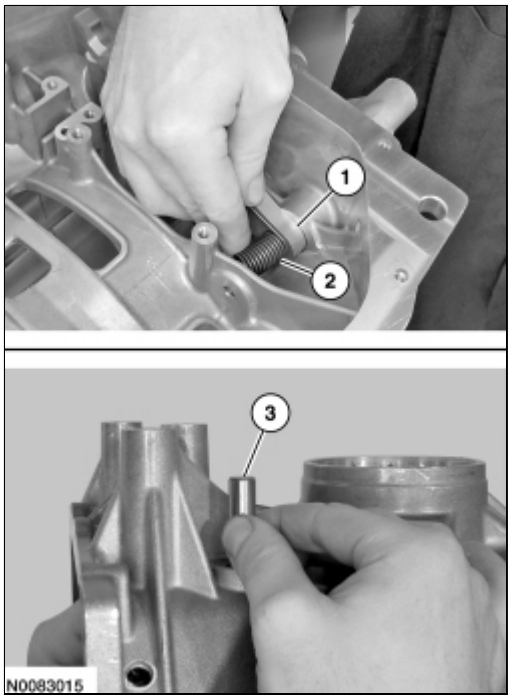
NOTE: Clutch plate quantity is model dependant based on engine displacement. Refer to Clutch Plate Quantity chart in the Specifications portion of this section.

All vehicles

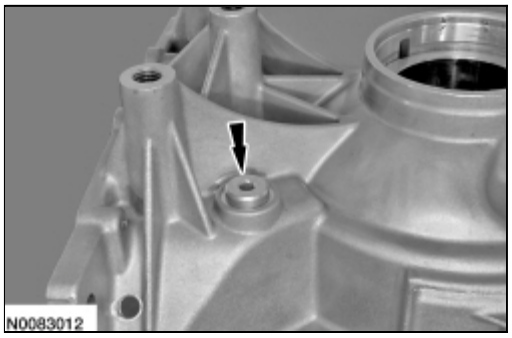
1. Install the park detent spring and the 2 bolts.
   - Tighten to 12 Nm (106 lb-in).



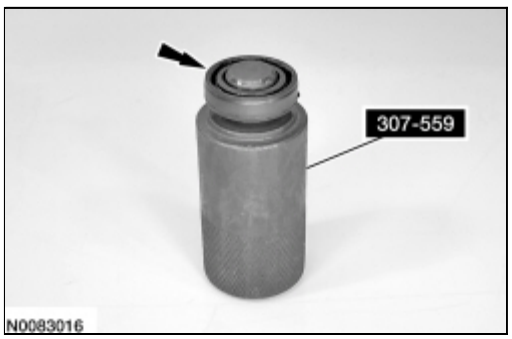
2. Position the park pawl and spring into the case and install the park pawl pin.
   1. Park pawl
   2. Park pawl return spring
   3. Park pawl pin



3. Install the park pawl pin bolt.
    - Tighten to 23 Nm (17 lb-ft).

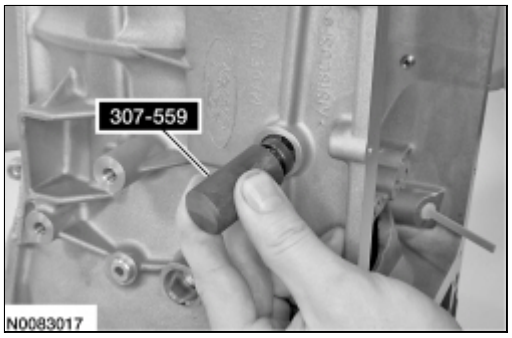


4. Install a new manual control lever shaft seal on the Shifter Fluid Seal Installer.



5. Using the Shifter Fluid Seal Installer, install the manual control lever shaft seal.

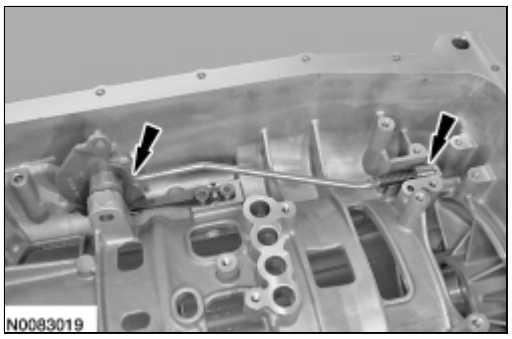
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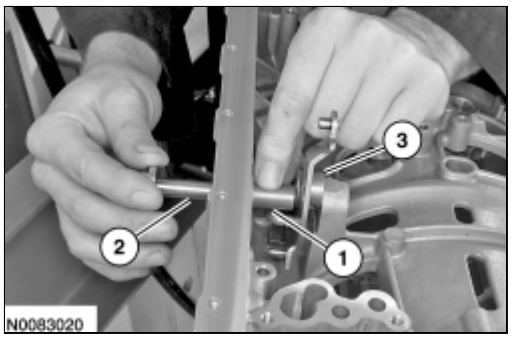
6. Assemble the manual control lever detent plate assembly and park pawl actuator rod.



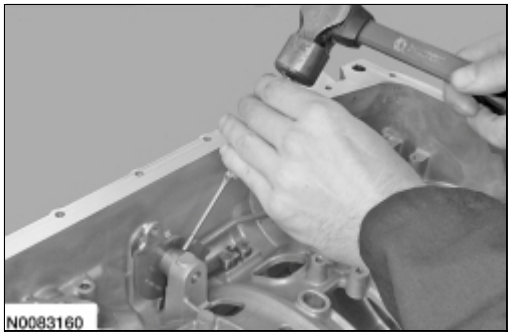
7. Position the manual valve detent lever and park pawl actuator rod assembly in the transmission case.



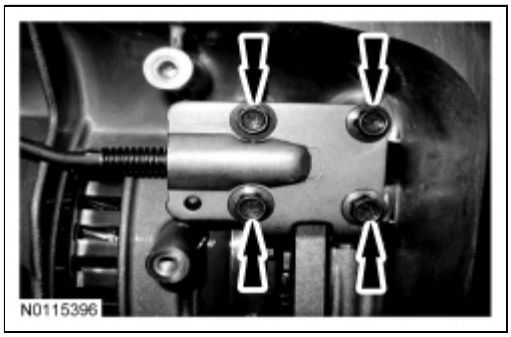
8. Position the manual control lever spacer in place and slide the manual control lever shaft into the case and the manual lever detent plate.
    1. Manual control lever spacer
    2. Manual control lever shaft
    3. Manual control lever detent plate



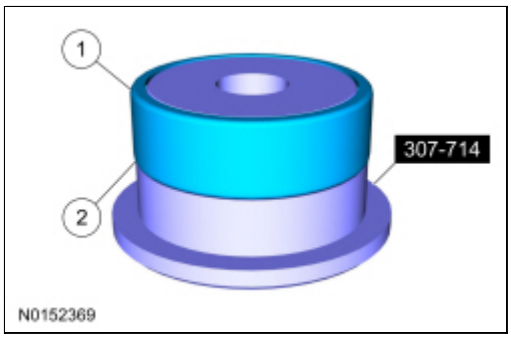
9. Align the roll pin hole in the manual control lever detent plate with the roll pin hole in the manual control lever shaft and install a new roll pin.



10. Install the park rod actuating plate and the 4 bolts.
    - Tighten to 12 Nm (106 lb-in).



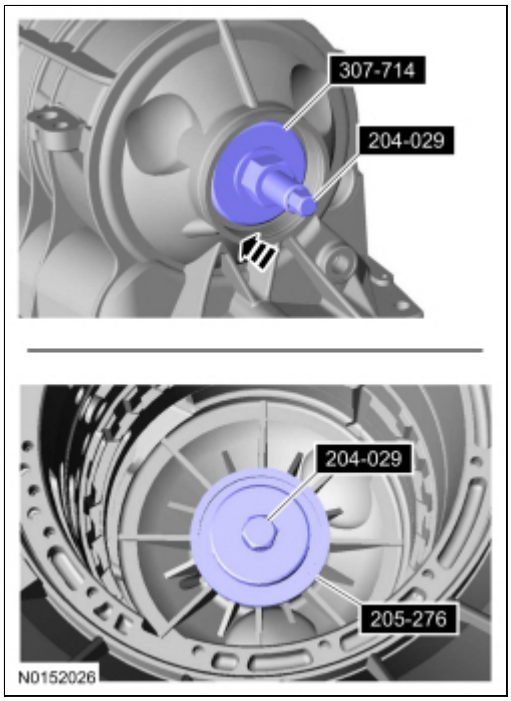
11. If removed, position a new bearing on the Needle Bearing Installer. Install the bearing with the flat bearing surface facing down and the rounded bearing surface facing up so that when installed, the flat surface is on the snap ring side and the rounded surface is on the transmission case side.
    1. Rounded bearing surface facing up
    2. Flat bearing surface facing down



12. **NOTE:** RWD case shown, 4WD case similar.

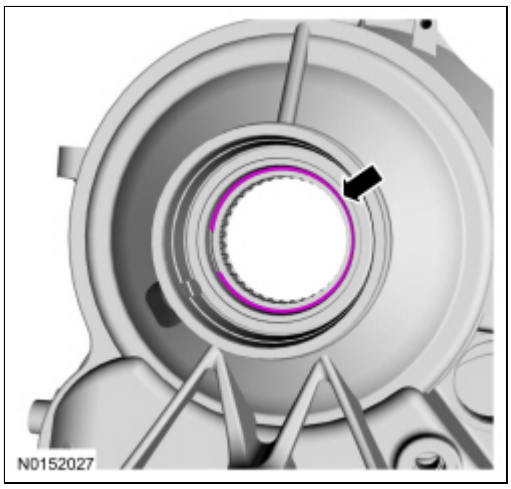
    Assemble the Front Wheel Hub Oil Seal Installer and the Needle Bearing Installer on the Drawbar and install the bearing in the transmission case.

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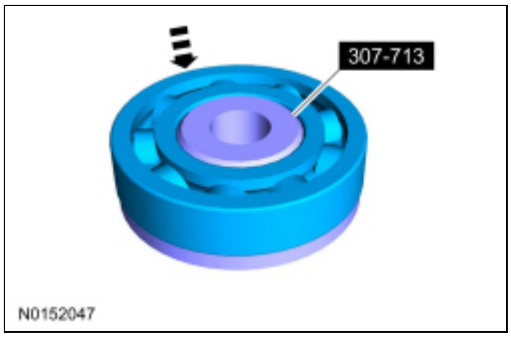
13. **NOTE:** RWD case shown, 4WD case similar.

    Install the snap ring.

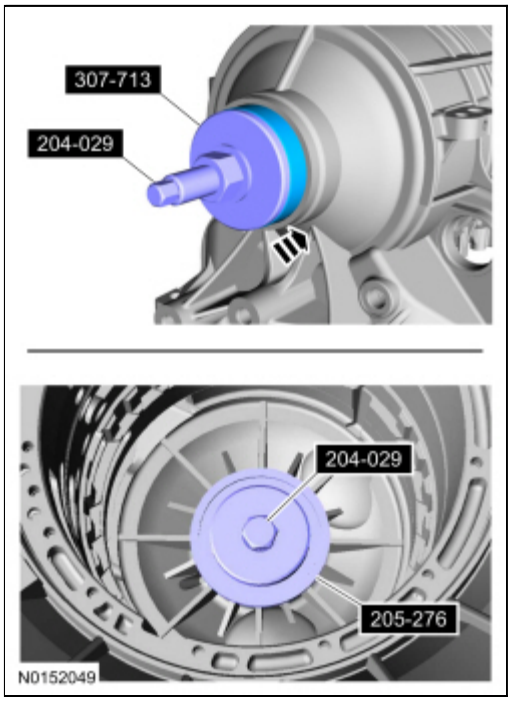


Rear Wheel Drive (RWD) vehicles

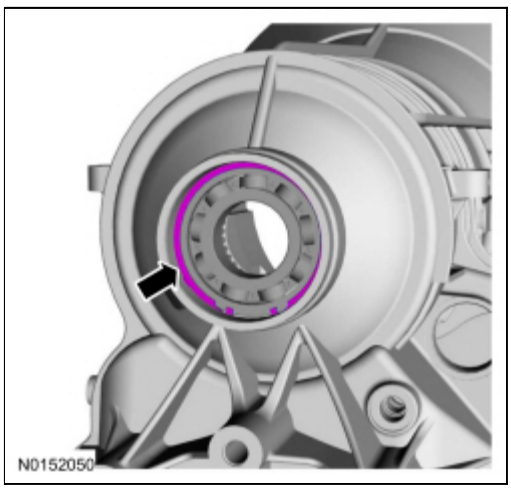
14. Install the bearing on the Roller Bearing Installer.



15. Assemble the Front Wheel Hub Oil Seal Installer and the Roller Bearing Installer on the Drawbar and install the bearing in the transmission case.



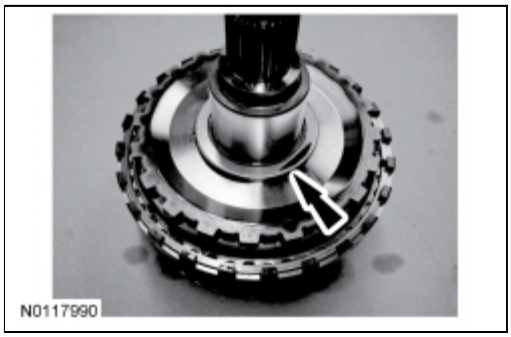
16. Install the snap ring.



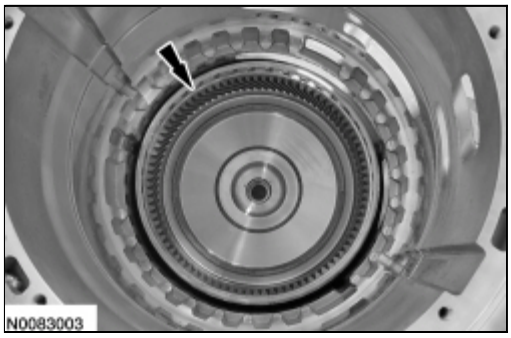
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All vehicles

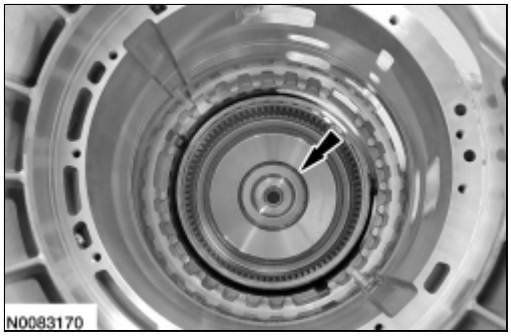
17. Install the T11 bearing, on the planetary ring gear and output shaft assembly.



18. Install the rear planetary ring gear and output shaft assembly.



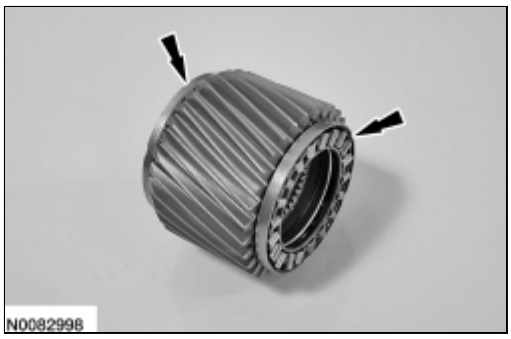
19. Install the T10 thrust bearing on the output shaft assembly.



20. Install the T9 roller bearing race into the bottom of the carrier.

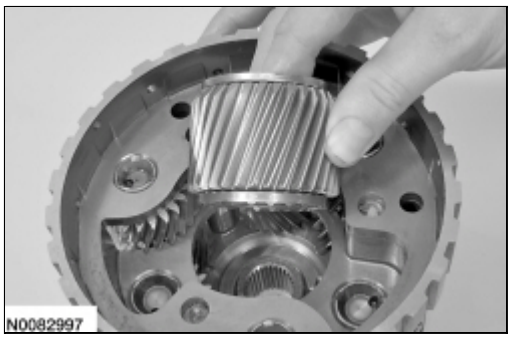


21. Install the top T8 and the bottom T9 roller bearings onto the sun gear.



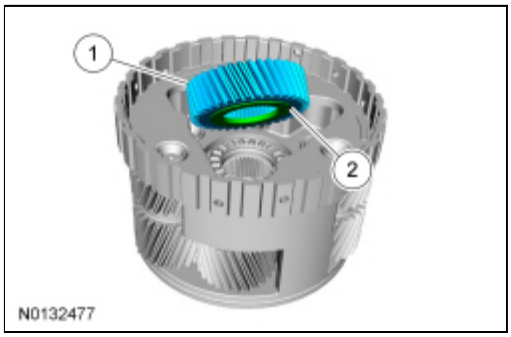
22. **NOTE:** When installing the sun gear, make sure that the TAPERED EDGE is facing UP toward the torque converter housing.

    Install the sun gear into the planetary assembly.



23. **NOTE:** Be sure the bearing race is installed in the sun gear.

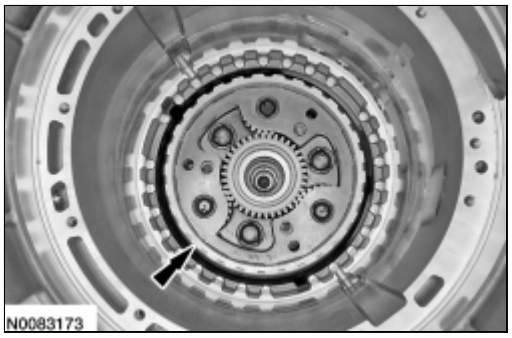
    Install the low/reverse sun gear and bearing race into the planetary carrier with the race side facing down.
    1. Low/reverse sun gear
    2. Bearing race



24. **NOTE:** Place the manual control lever in PARK when installing the rear planetary gearset to hold the rear ring gear stationary.

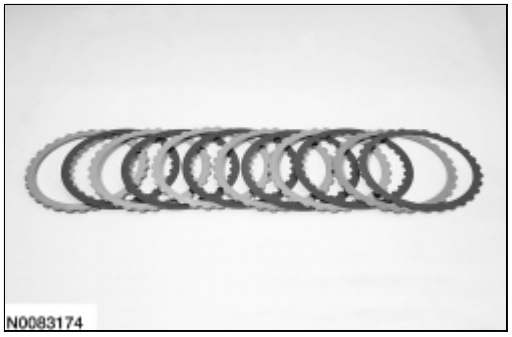
    Install the planetary carrier.

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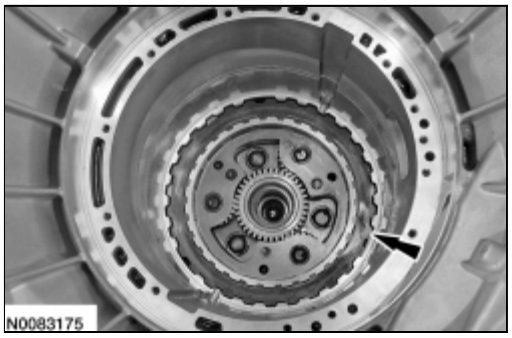


25. **NOTE:** Friction and steel plate quantity are model dependent and vary based on engine displacement. For additional information, refer to the Clutch Plate Quantity Chart in the Specifications portion of this section.

    Soak the low/reverse clutch plates in clean automatic transmission fluid.

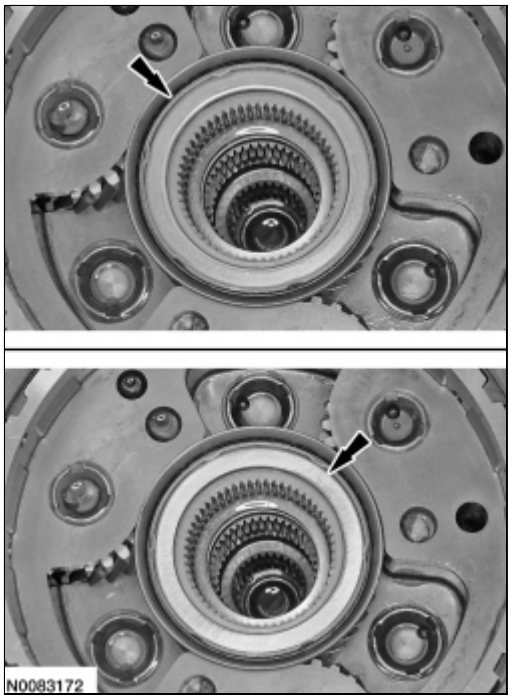


26. Install the low/reverse clutch plates, starting with the pressure plate and alternating between the friction and steel plates and ending with the wave spring plate on the top.



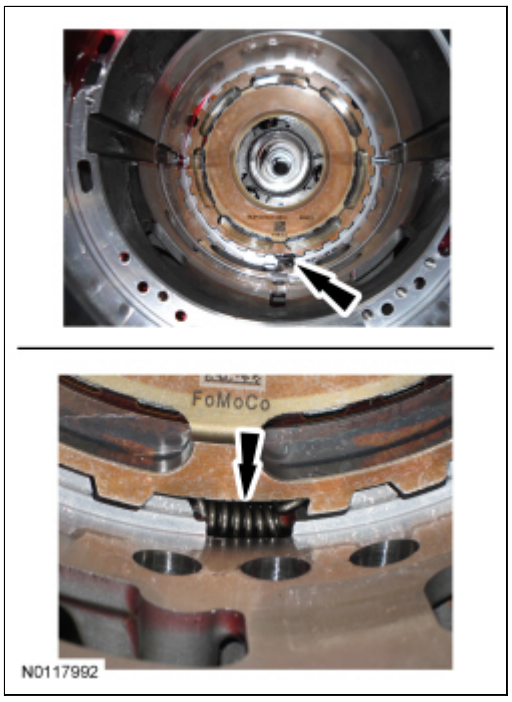
27. **NOTE:** Inspect the T7 thrust bearing and selective shim for damage or scoring.

    Install the T7 thrust bearing and the selective shim.



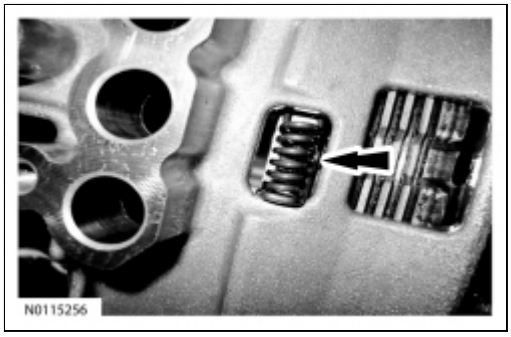
28. **NOTE:** Align the OWC in the transmission case so the bias spring fits into the transmission case.

    Install the OWC as shown so the bias spring can be installed as shown.



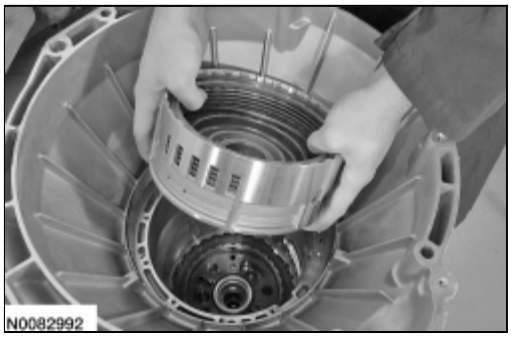
29. Install the bias spring.

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30. **NOTE:** Make sure that when installing the center support the feed holes on the center support are lined up with the feed holes in the case.

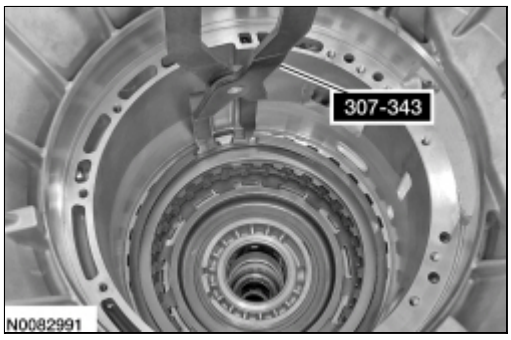
    Install the center support into the case.



31. ***NOTICE:*** **Install the snap ring with the beveled surface facing up and the snap ring gap in the 3 o'clock or the 9 o'clock position.**

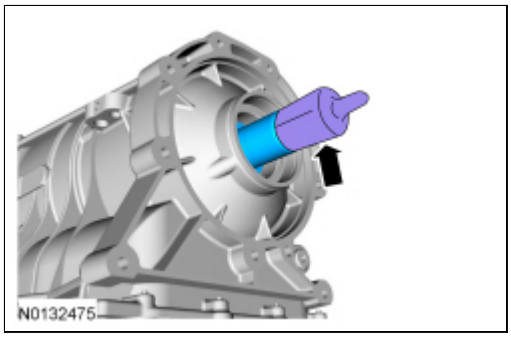
    NOTE: Rotate the case to a horizontal position.

    Using the Retaining Ring Pliers, install the center support snap ring. Make sure the snap ring is fully seated.

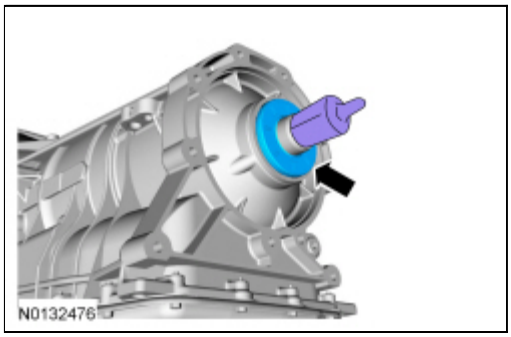


Four-Wheel Drive (4WD) vehicles

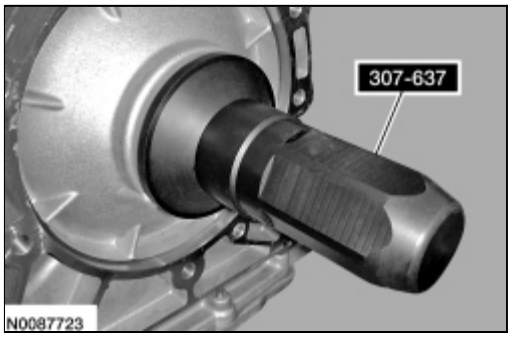
32. Install the seal protector provided with the new output shaft seal on the output shaft.



33. Slide the output shaft seal over the output shaft seal protector onto the output shaft. Remove the output shaft seal protector.



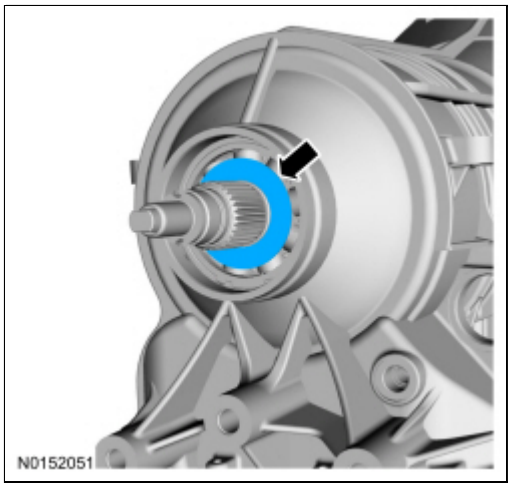
34. Using the 6R80 Rear Seal 4X4 Installer, install the output shaft seal.



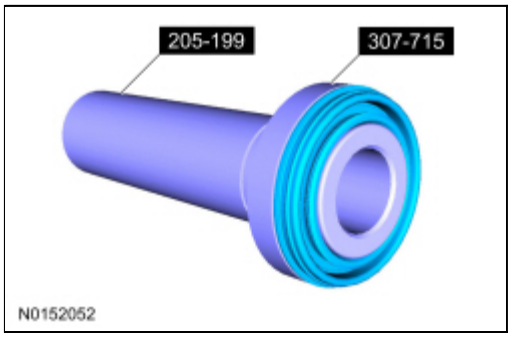
Rear Wheel Drive (RWD) vehicles

35. Rotate the transmission to the vertical position and install the slip plane washer.

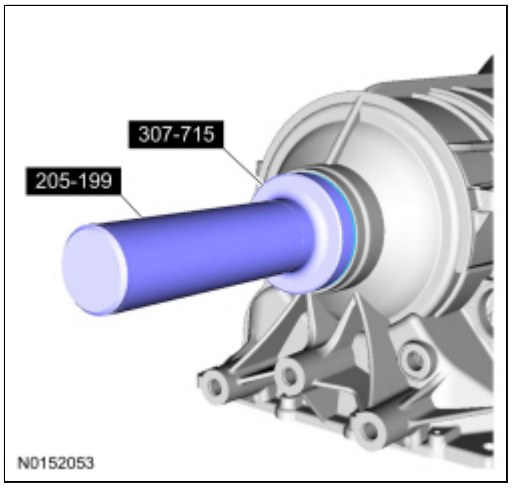
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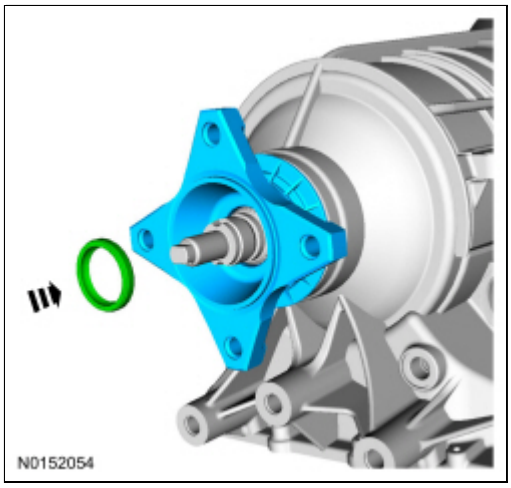
36. Position a new output shaft seal on the Output Seal (4X2) Installer and Spindle/Axle Shaft Installer.



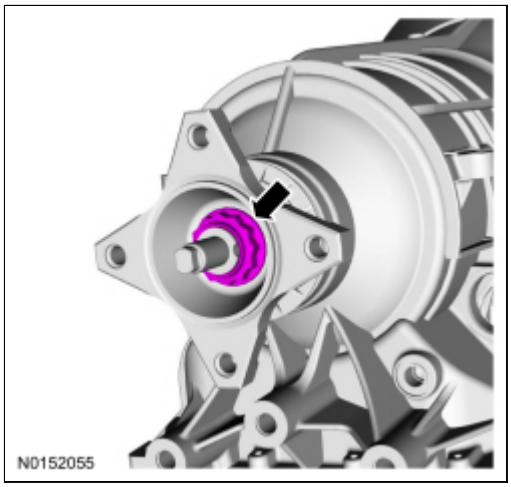
37. Using the Output Seal (4X2) Installer and Spindle/Axle Shaft Installer, install the output shaft seal.



38. Install the output shaft flange and the output shaft flange seal.

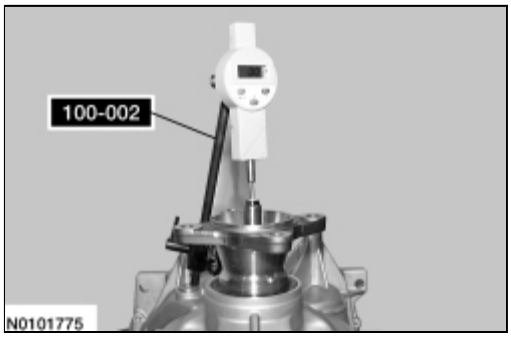


39. Loosely install a new output shaft flange retaining nut.



Rear Wheel Drive (RWD) vehicles

40. Install the Dial Indicator Gauge with Holding Fixture on the transmission case and position the plunger on the output shaft flange.

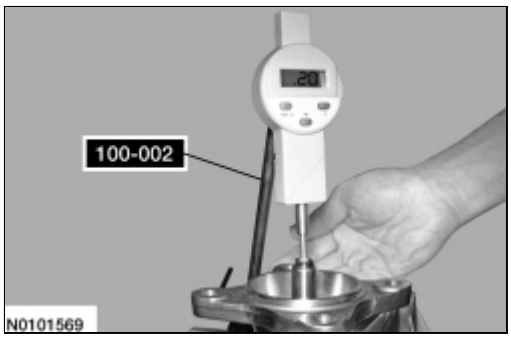


41. **NOTE:** Loosely install the flange nut or an inaccurate reading may be recorded.

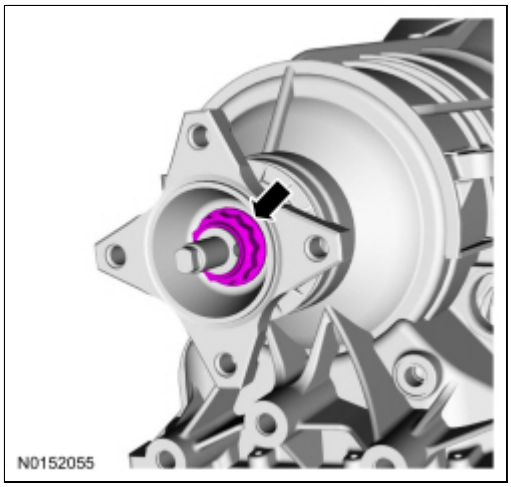
    Using the Dial Indicator Gauge with Holding Fixture, lift up on the output shaft flange and record the reading. The reading should be within 0.6-0.9 mm (0.024-0.035 in).
    - If the reading is not within specification, install a different (either thinner or thicker) selective

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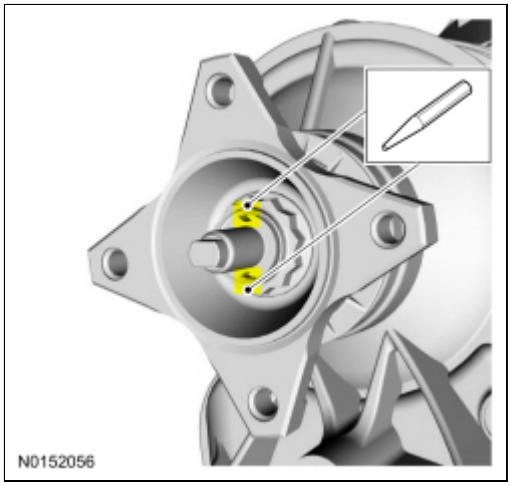
shim.



42. Tighten the output shaft flange retaining nut.
    - Tighten to 80 Nm (59 lb-ft).

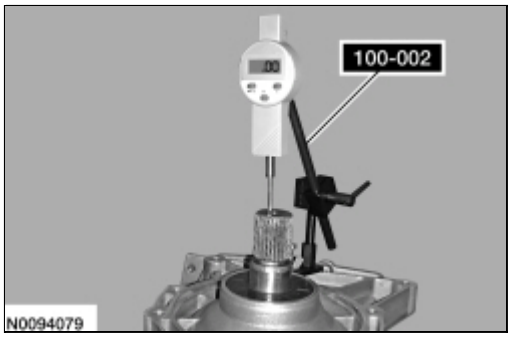


43. After installing the new output shaft flange retaining nut, stake the slots to prevent it from coming loose.

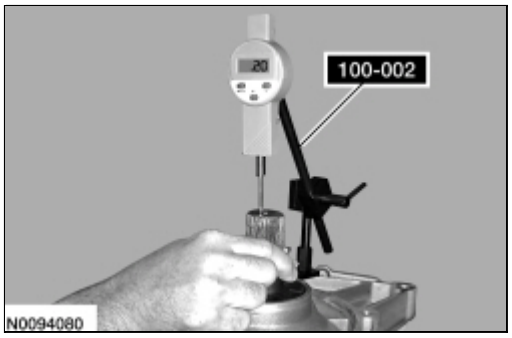


Four-Wheel Drive (4WD) vehicles

44. Install the Dial Indicator Gauge with Holding Fixture on the transmission case and position the plunger on the output shaft.

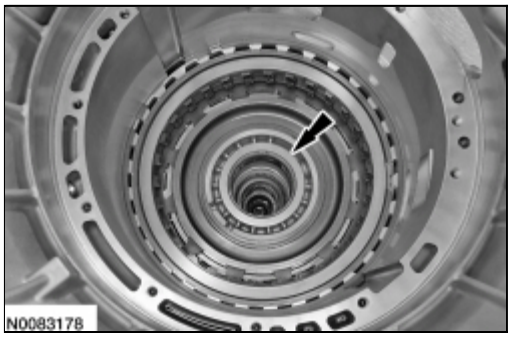


45. Using the Dial Indicator Gauge with Holding Fixture, lift up on the output shaft and record the reading. The reading should be within 0.15-0.35 mm (0.005-0.013 in).
    - If the reading is not within the specification, install a different (either thinner or thicker) select fit thrust gear shim.



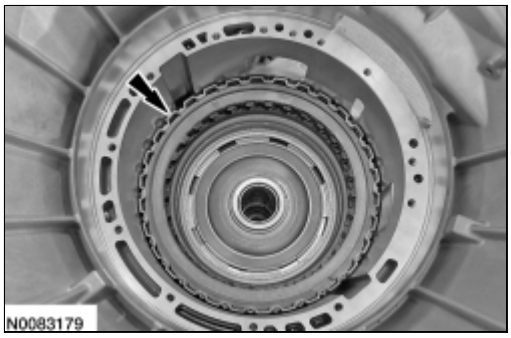
All vehicles

46. Rotate the transmission in the vertical position with the torque converter housing facing up and install the T6 bearing.

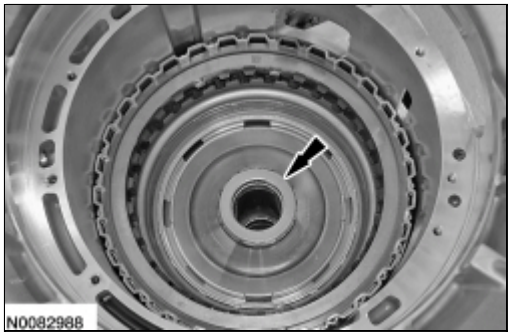


47. Install the direct (B) clutch assembly.

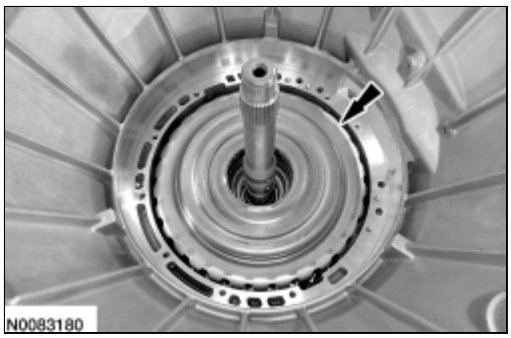
repair4less



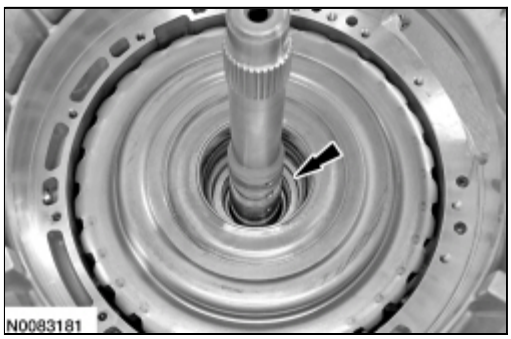
48. Install the T5 roller bearing on the direct (B) clutch assembly.



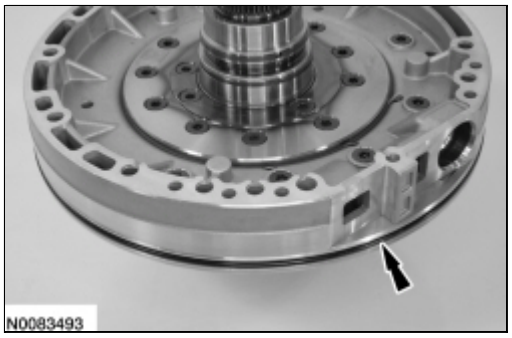
49. Install the forward (A)/overdrive (E) clutch assembly.



50. Install the selective shim.



51. If the front pump was not disassembled and assembled, install a new front pump O-ring seal and lubricate it with petroleum jelly.



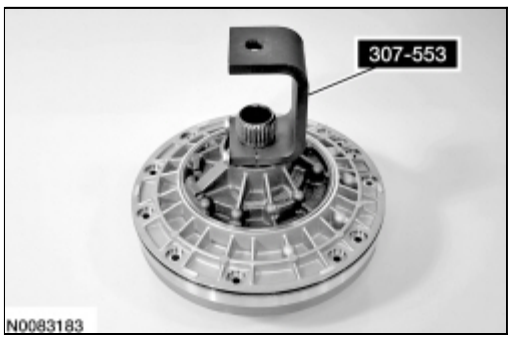
52. Install a new front pump seal on the Fluid Pump Seal Installer.



53. Using the Fluid Pump Seal Installer, install the front pump seal.

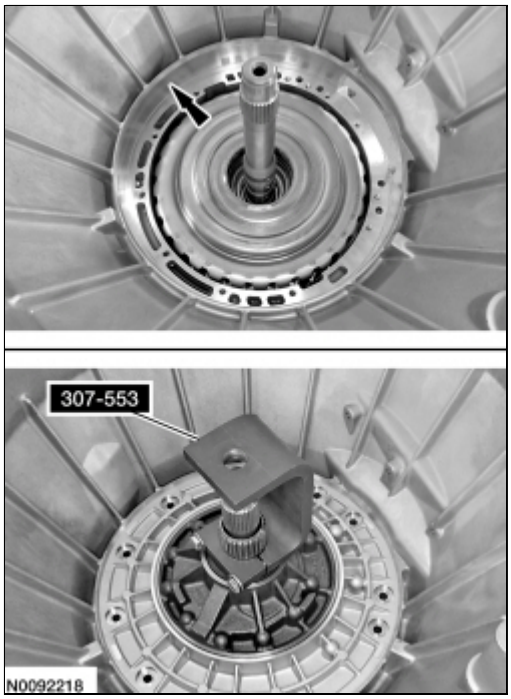


54. Install the Transmission Fluid Pump Remover on the front pump.



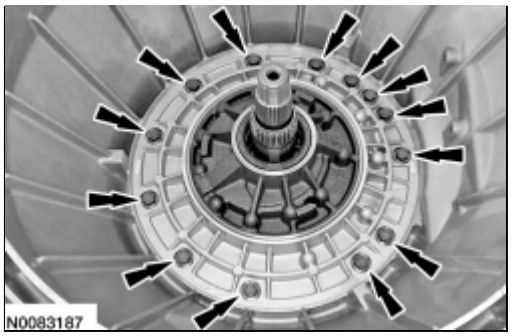
55. Lubricate the transmission case pump bore with petroleum jelly. Using the Transmission Fluid Pump Remover, position the pump assembly in the case and rotate the pump to insert the pump splines into the front planetary sun gear. Rotate the pump to align the pump-to-case bolts and push the pump into the case.

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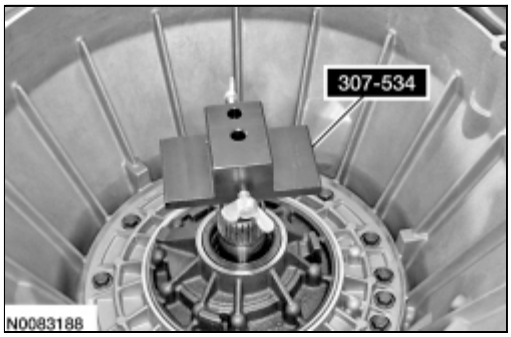


56. **NOTE:** Failure to replace the fasteners will result in transmission fluid leakage.

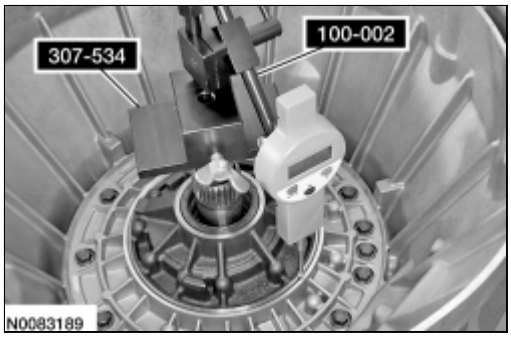
    Install 13 new front pump-to-case bolts and washers. Tighten in a crisscross pattern.
    - Tighten pump fasteners with washers to 10 Nm (89 lb-in).
    - Tighten fasteners without washers to 10 Nm (89 lb-in).



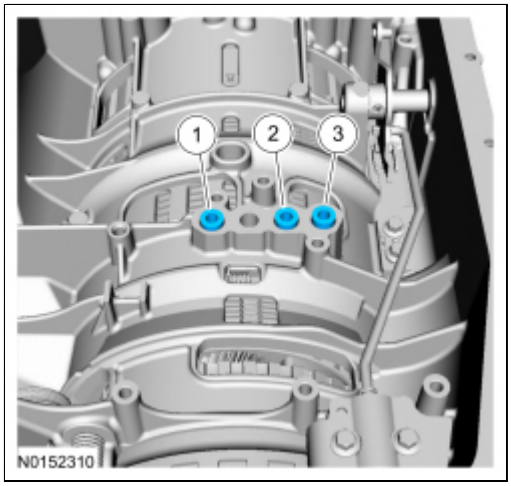
57. Install the Transmission End Play Gauge on the input shaft to measure the end play.
    - Tighten the wing nut.



58. Install the Dial Indicator Gauge with Holding Fixture on the Transmission End Play Gauge.
    - Push down on the Transmission End Play Gauge and zero the Dial Indicator Gauge.
    - Lift up on the Transmission End Play Gauge and record the measurement on the Dial Indicator Gauge. The measurement should be between 0.2-0.4 mm (0.008-0.015 in). If the measurement is not within specification, install a new selective front pump shim.
    - Measure the original shim, install a thinner or a thicker shim to achieve the correct measurement.



59. Rotate the transmission in the horizontal position with the main control area facing up and install 3 new center support feed tube seals.
    1. Center support feed tube seal (7G199 Black)
    2. Center support feed tube seal (7G087 Green)
    3. Center support feed tube seal (7G084 Blue)

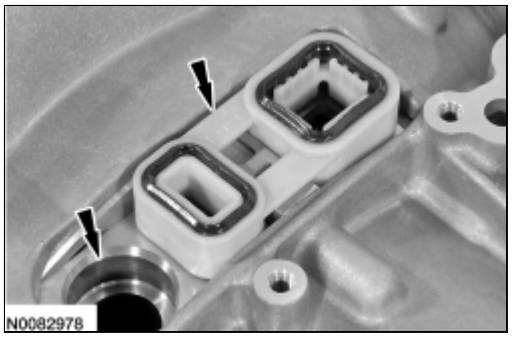


60. **NOTE:** Make sure the transmission fluid filter seal has been removed. If it has not, use a pick and remove the seal.

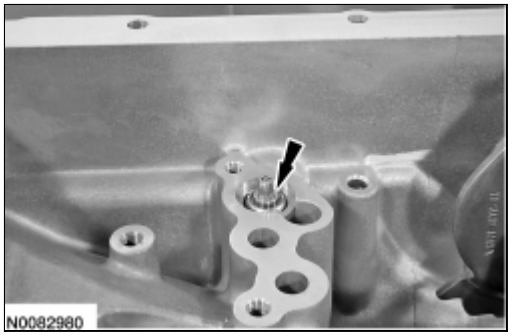
    NOTE: Add 0.118L (4 oz) of clean transmission fluid to prime the pump.

    Install the front pump adapter seal and prime the fluid pump.

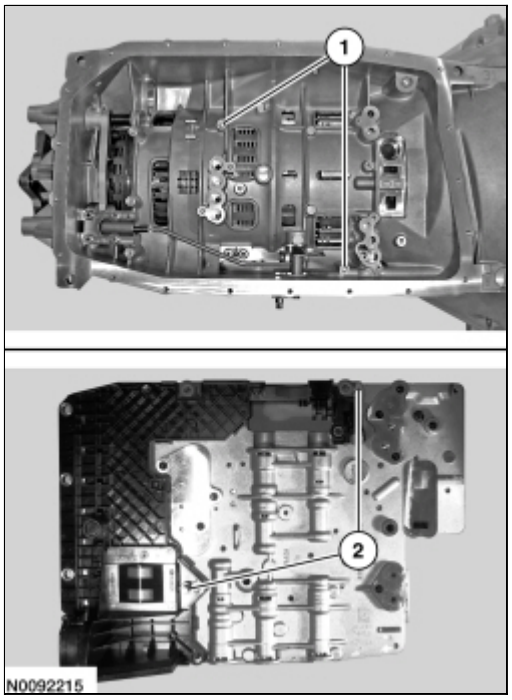
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61. Install the thermal bypass valve into the case.

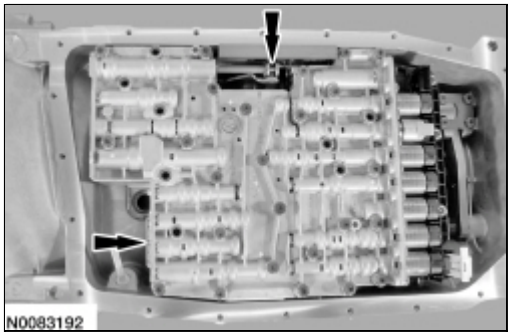


62. Align the guide pins in the alignment holes in the transmission case and position the mechatronic assembly in place.
    1. Alignment holes
    2. Guide pins

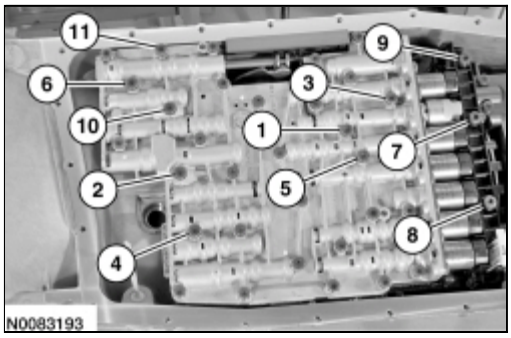


63. **NOTE:** The mechatronic assembly will not lay flush on the case, this is a normal condition with the rubber feed tubes, the bolts will pull the mechatronic assembly down.

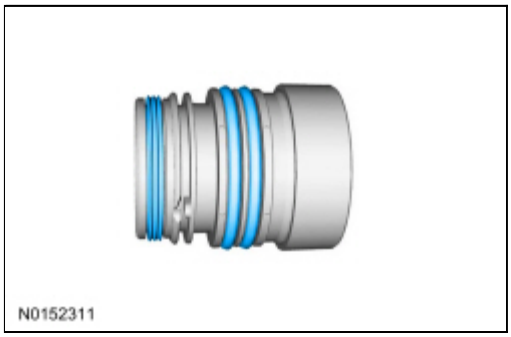
Slightly lift the mechatronic assembly and align the manual valve in the manual valve linkage and position the mechatronic in place.



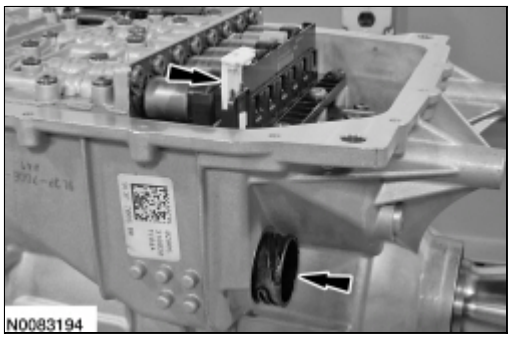
64. Install the 11 mechatronic assembly bolts and tighten in the sequence shown.
    - Tighten to 8 Nm (71 lb-in).



65. If removed, install the bulkhead connector sleeve seals.

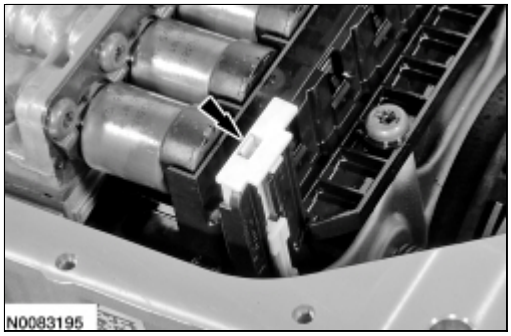


66. With the release tab up and unlocked, push the outer shell of the bulkhead connector sleeve into the transmission. Make sure the bulkhead connector sleeve is fully seated into the molded leadframe.

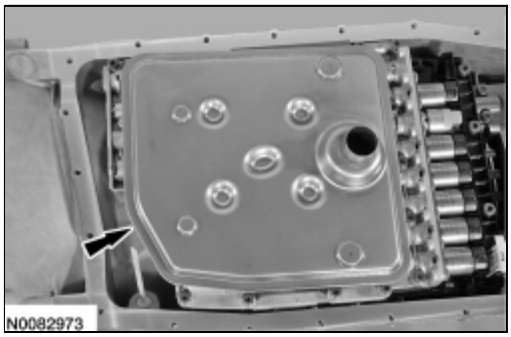


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67. Press down on the tab and lock the outer shell of the bulkhead connector sleeve in place. Make sure the locking tab is securely locked.

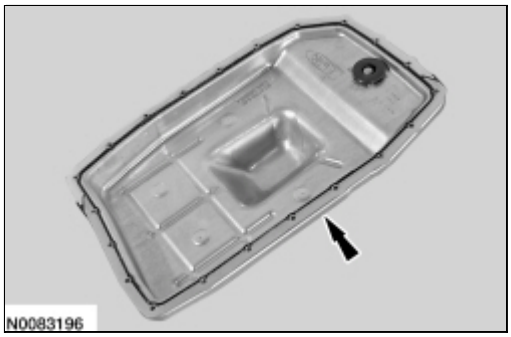


68. Install a new transmission fluid filter.

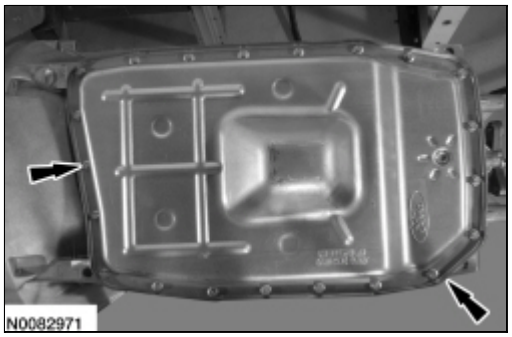


69. **NOTE:** The fluid pan gasket can be reused if not damaged.

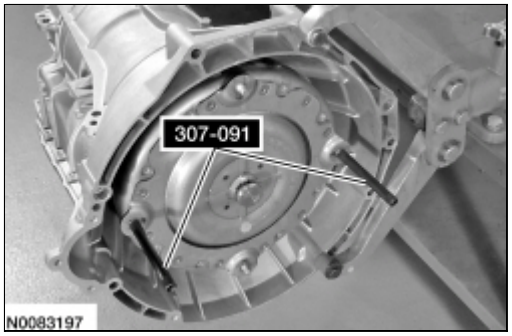
    Install a new transmission fluid pan gasket if required.



70. Install the transmission fluid pan and transmission fluid pan bolts. Tighten in a crisscross pattern.
    - Tighten to 9 Nm (80 lb-in).



71. Using the Torque Converter Handle, install the torque converter.



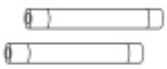
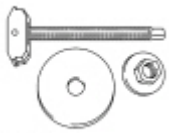
72. If the Overdrive clutch FRICTIONS were replaced, install 1 6R ATF Additive Kit XL-16.

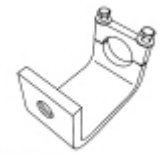
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Transmission — Early Build

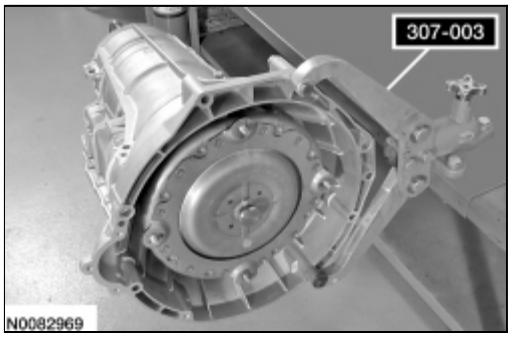
Special Tool(s)

 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1433-B	Installer, Front Wheel Hub Oil Seal 205-256
 ST2381-A	Remover, Input Shaft Oil Seal 308-375
 E173280	Remover, Koastal Sleeve 307-717
 ST2932-A	Remover, Needle Bearing 307-562 (includes 307-562/1 and 307-562/2)
	Remover, Pilot Bearing 308-001 (T58L-101-B)

 ST1282-A	
 ST2891-A	Remover, Transmission Fluid Pump 307-553
 ST1104-B	Retaining Ring Pliers 307-343 (T95P-77001-AHR)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

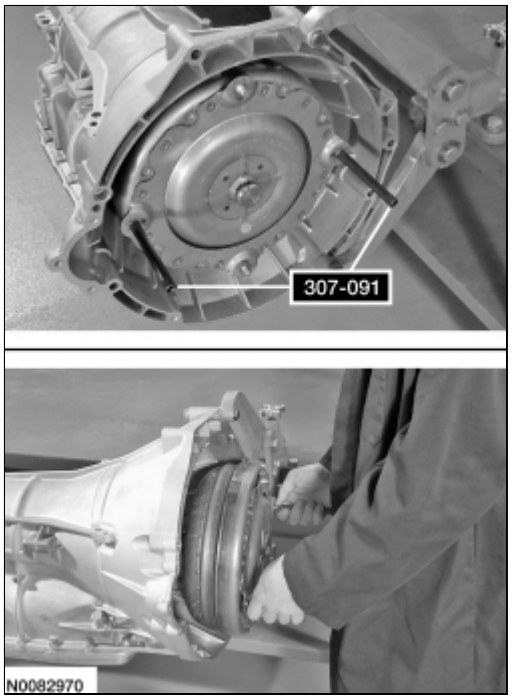
All vehicles

1. Install the Transmission Holding Fixture on the torque converter housing and install the transmission on a bench.

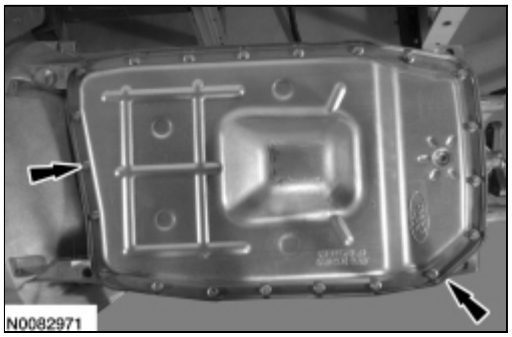


2. Using the Torque Converter Handle, remove the torque converter.

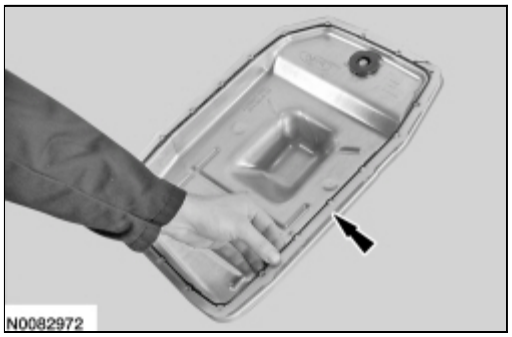
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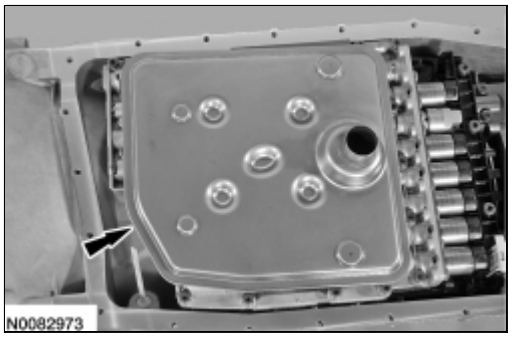
3. Remove the transmission fluid pan bolts and the transmission fluid pan.



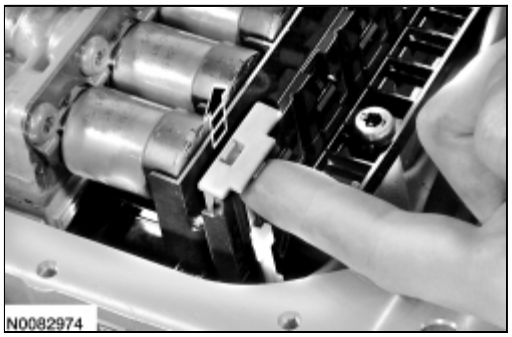
4. Remove the transmission fluid pan gasket.



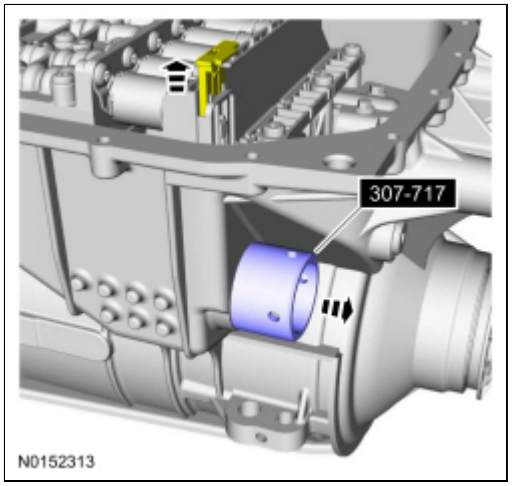
5. Remove and discard the transmission fluid filter.



6. Press the release tab and lift up on the bulkhead connector sleeve retainer to release the bulkhead connector sleeve shell.

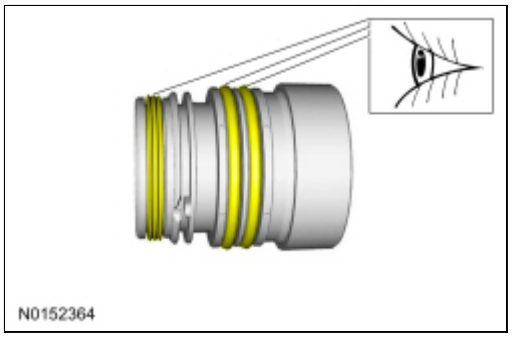


7. With the transmission bulkhead connector sleeve retainer released, use the Koastal Sleeve Remover to pull the outer shell of the bulkhead connector sleeve out of the transmission.

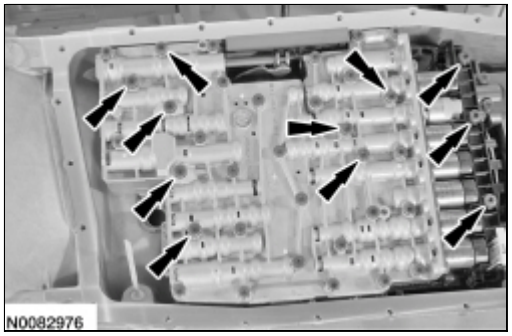


8. Inspect the bulkhead connector sleeve seals.
    - If necessary, replace the seals.

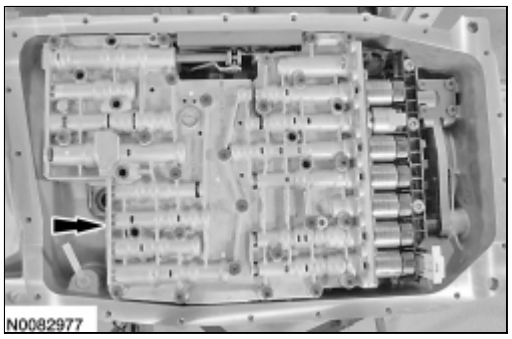
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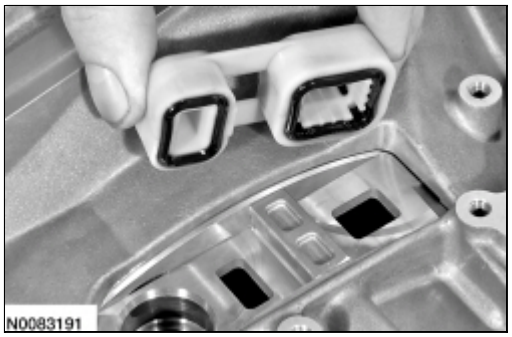
9. Remove the 11 bolts from the main control assembly.



10. Remove the main control assembly.



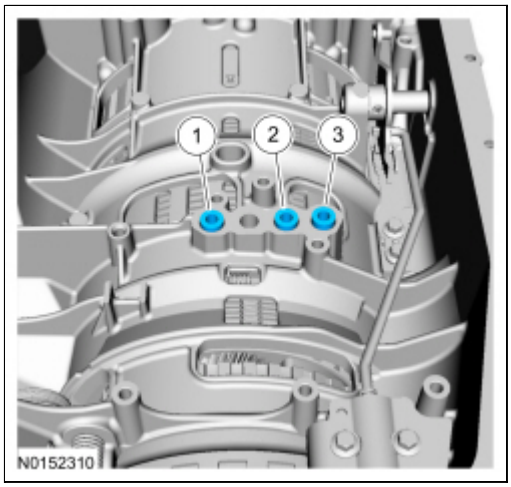
11. Remove the front pump adapter seal and the transmission fluid filter seal. Inspect for cracks or damage.



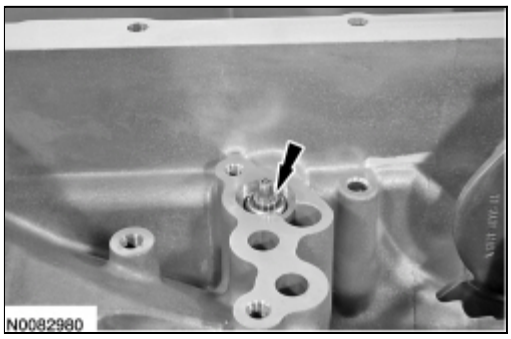
12. **NOTE:** Note the color, size and location while removing for correct assembly.

    Remove and discard the 3 center support feed tube seals.

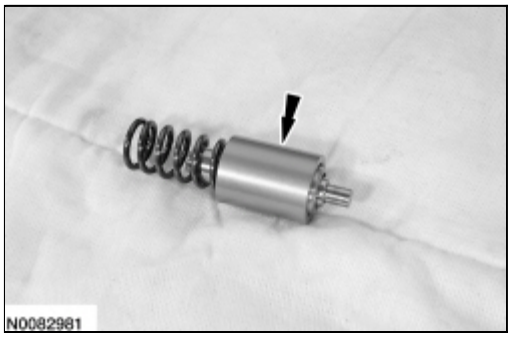
1. Center support feed tube seal (7G199 Black)
2. Center support feed tube seal (7G087 Green)
3. Center support feed tube seal (7G084 Blue)



13. Remove the thermal bypass valve from the case.

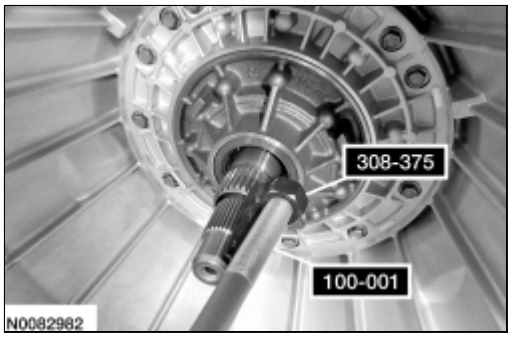


14. Inspect the thermal bypass valve for damage and install a new valve if damaged.

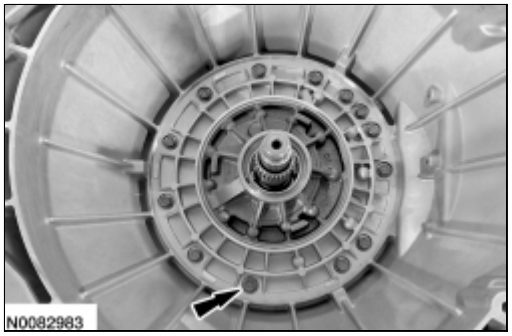


15. Using the Input Shaft Oil Seal Remover and Slide Hammer, remove and discard the front pump seal.

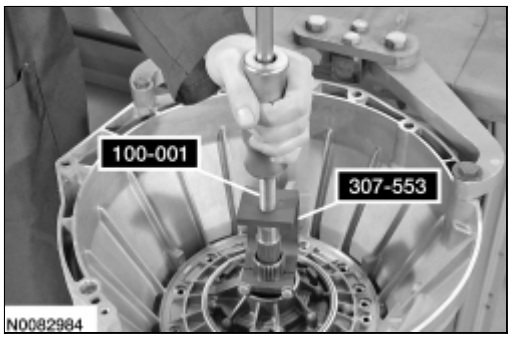
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16. Remove and discard the 13 front pump-to-case bolts and washers.

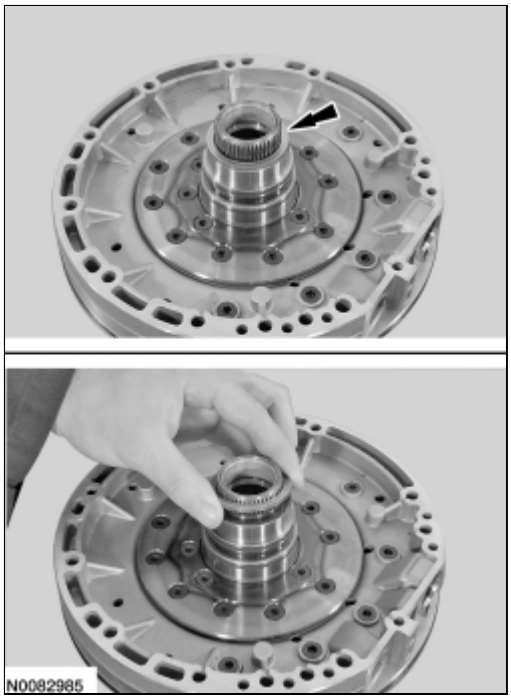


17. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the front pump support.

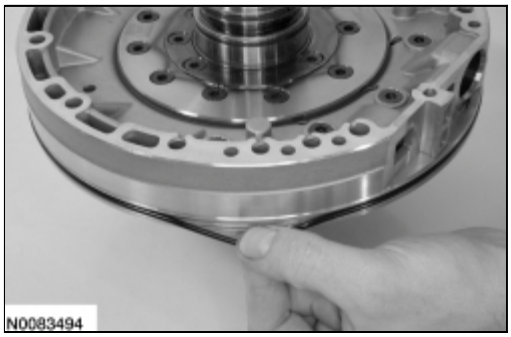


18. **NOTE:** The selective shim may come out while removing the front pump.

    Inspect the back of the front pump for the selective shim and remove If necessary.

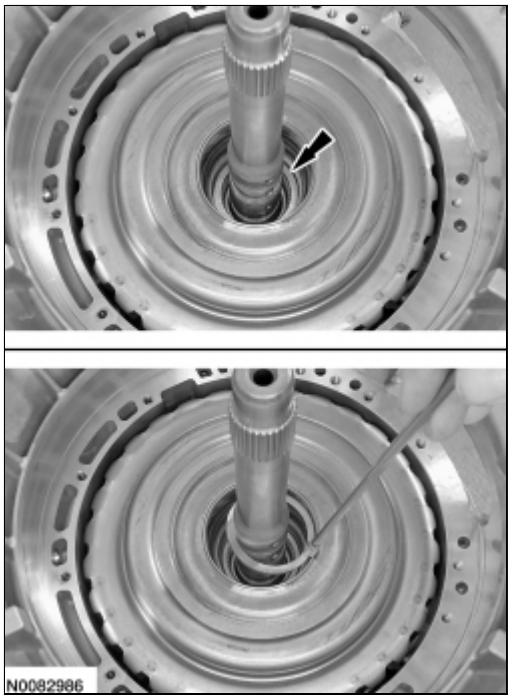


19. Remove and discard the front pump O-ring seal.

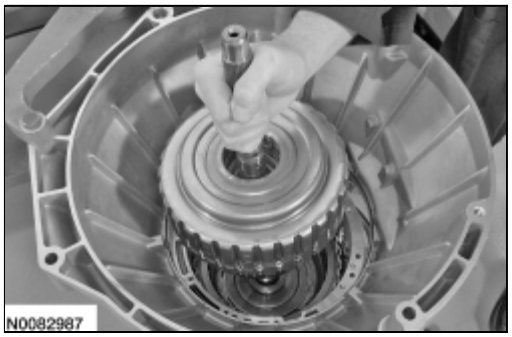


20. If the selective shim is not on the pump, using a magnet, remove it from the forward (A)/overdrive (E) clutch assembly.

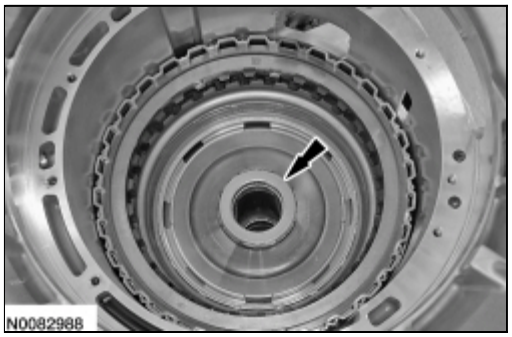
repair4less



21. Remove the forward (A)/overdrive (E) clutch assembly.



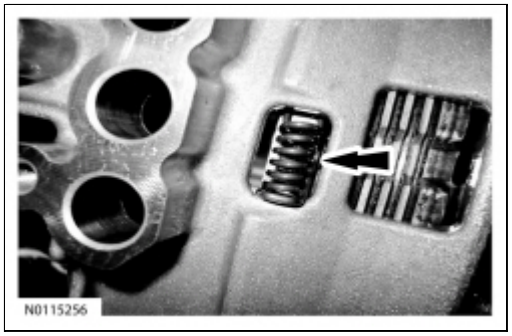
22. Remove the caged T5 roller bearing from the direct (B) clutch assembly.



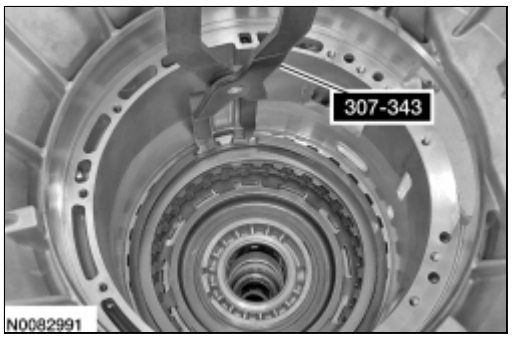
23. Remove the direct (B) clutch assembly.



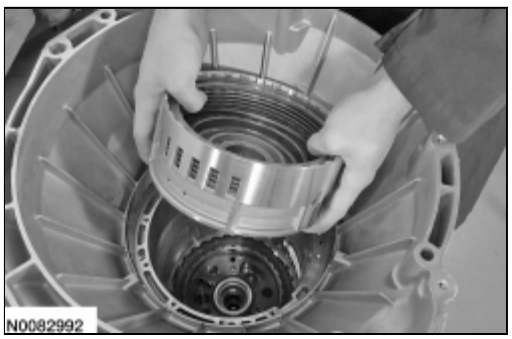
24. Remove the bias spring.



25. Using the Retaining Ring Pliers, remove the center support snap ring.



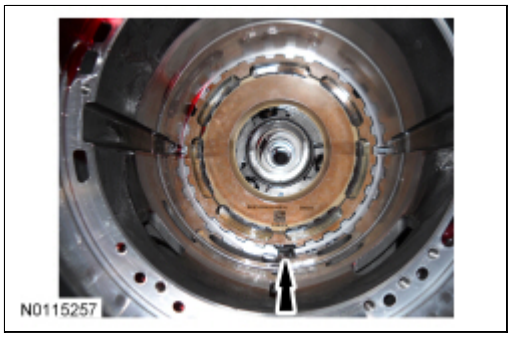
26. Remove the center support and T6 bearing.



27. **NOTE:** When removing the OWC , note the position for assembly.

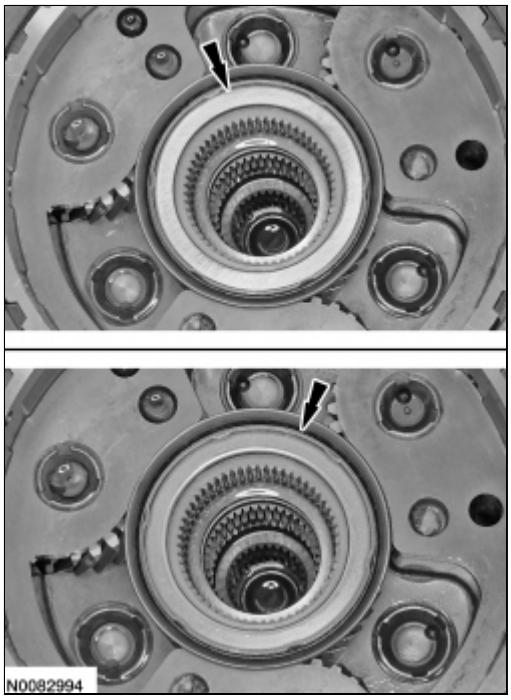
    Remove the OWC .

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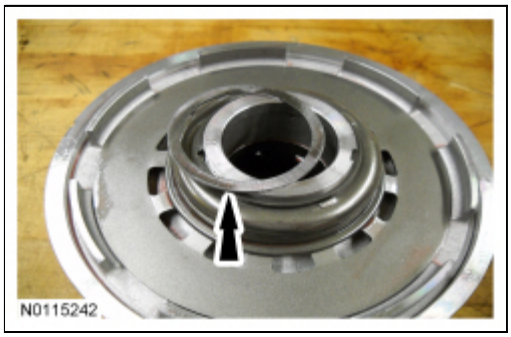
28. **NOTE:** The selective shim might stick to the T7 thrust bearing during removal of the center support.

    Remove the selective shim and the T7 thrust bearing.



29. **NOTE:** The selective shim might stick to the back of the center support assembly during removal.

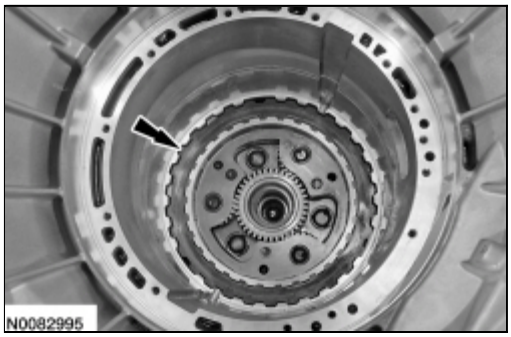
    Remove the selective shim from the center support assembly.



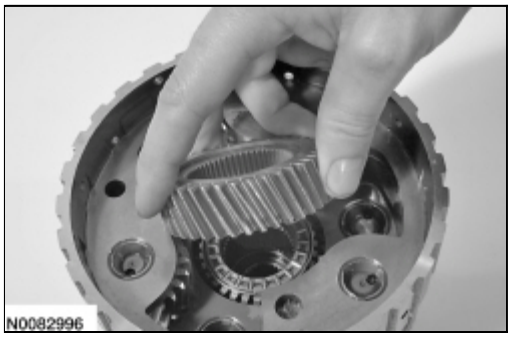
30. **NOTE:** Some of the clutch plates may stay in the case when removing the planetary carrier and the low/reverse clutch pack. Remove any clutch plates from the transmission that were not removed with

the carrier and keep the clutch plates together.

Remove the planetary carrier and the low/reverse clutch pack as an assembly.



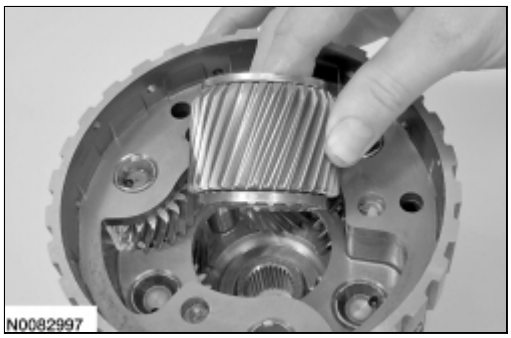
31. Remove the No. 2 sun gear and race.



32. **NOTE:** Remove the bearings with the sun gear.

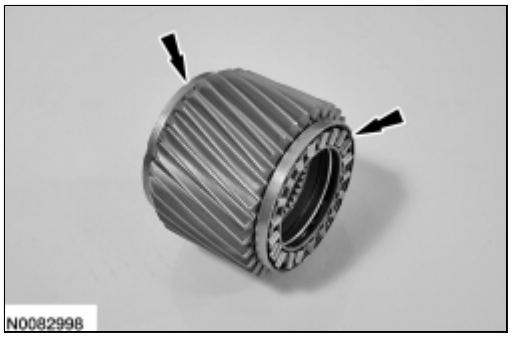
    NOTE: When removing the sun gear, note that the tapered edge is facing up toward the torque converter housing.

    Remove the No. 3 sun gear from the planetary assembly.



33. Remove the top T8 and the bottom T9 roller bearings from the sun gear.

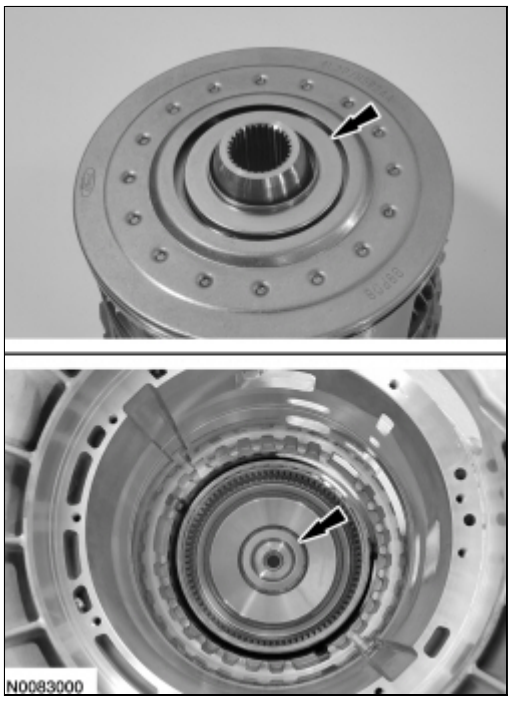
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34. Remove the T9 roller bearing race from the bottom of the carrier.



35. Remove the T10 thrust bearing from either the rear planetary carrier or the output shaft assembly.

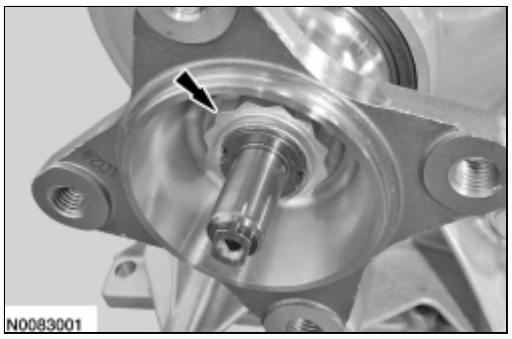


Rear Wheel Drive (RWD) vehicles

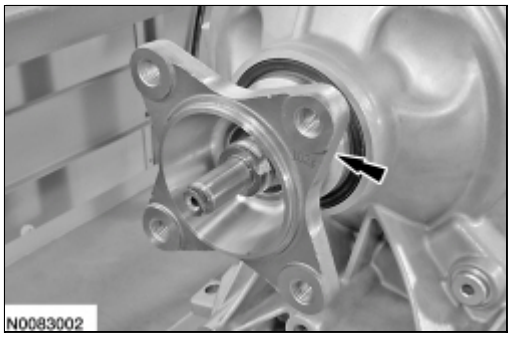
36. ***NOTICE:*** **The output shaft flange retaining nut has been staked to prevent it from coming loose. Prior to removing the nut, remove the stake to prevent damage to the output shaft.**

    Place the manual control lever in the PARK position and remove and discard the output shaft flange

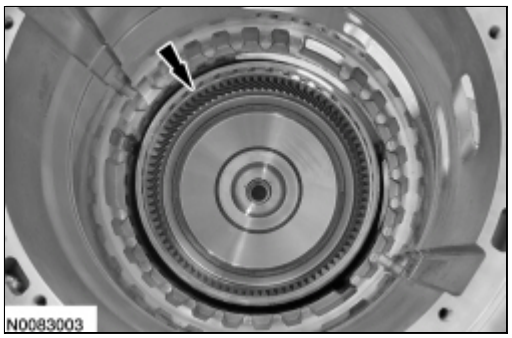
retaining nut.



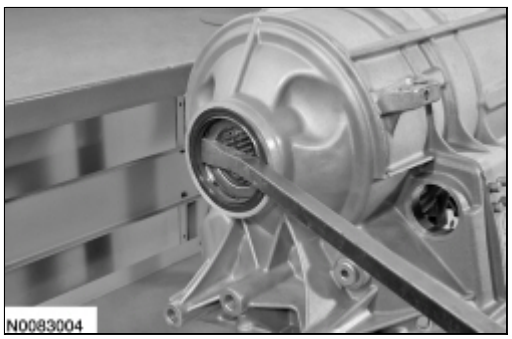
37. Remove the output shaft flange seal and the output shaft flange.



38. Remove the planetary carrier hub, output shaft assembly and T11 bearing.

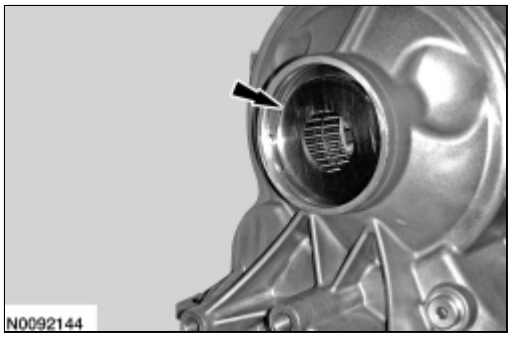


39. Remove and discard the output shaft seal.

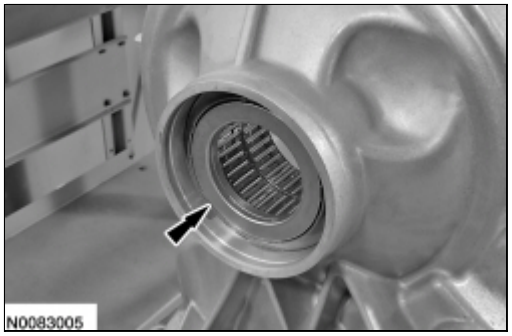


40. Remove the slip plane washer.

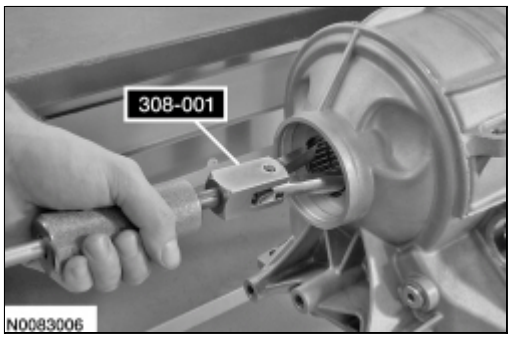
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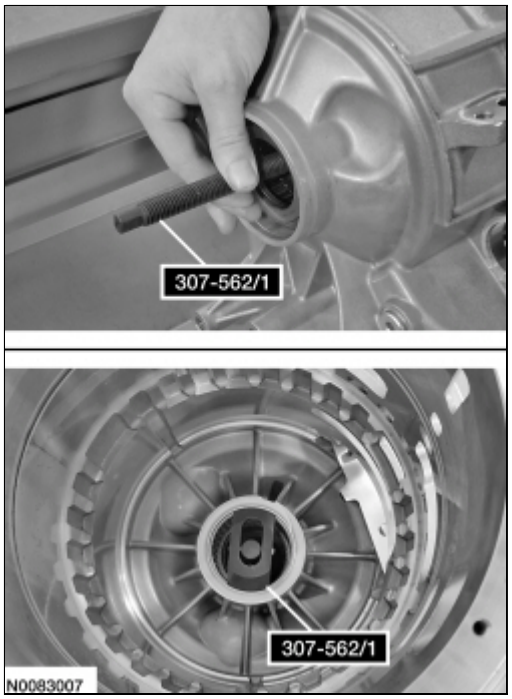
41. Remove the T12 thrust bearing.



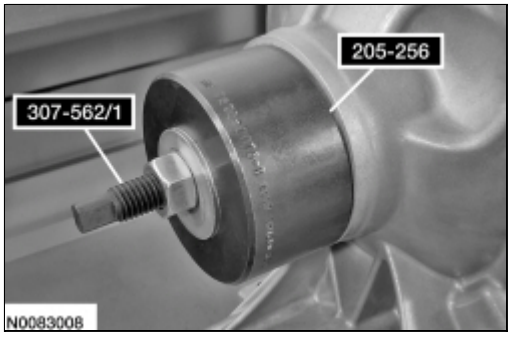
42. Using the Pilot Bearing Remover, remove the thrust bearing spacer.



43. Install the Needle Bearing Remover on the bearing.

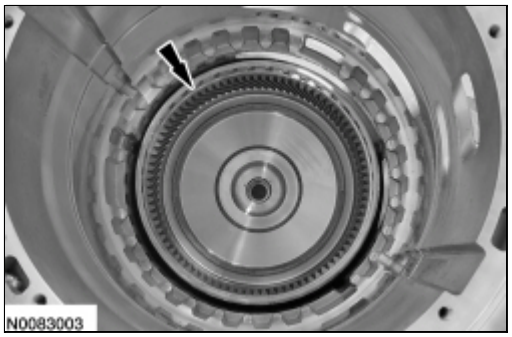


44. Install the Front Wheel Hub Oil Seal Installer on the Needle Bearing Remover and remove the bearing.



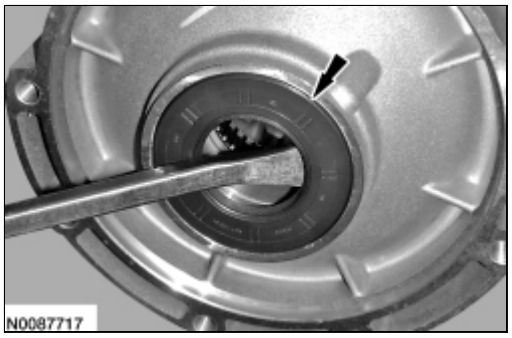
Four-Wheel Drive (4WD) vehicles

45. Remove the planet carrier hub, output shaft assembly and T11 bearing.

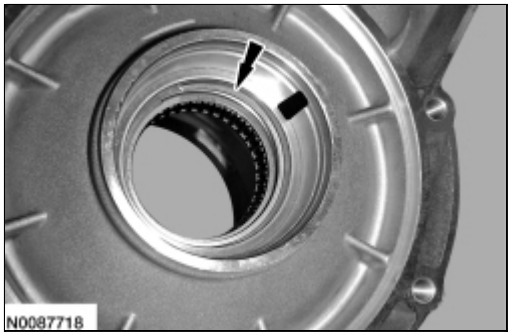


46. Remove and discard the output shaft seal.

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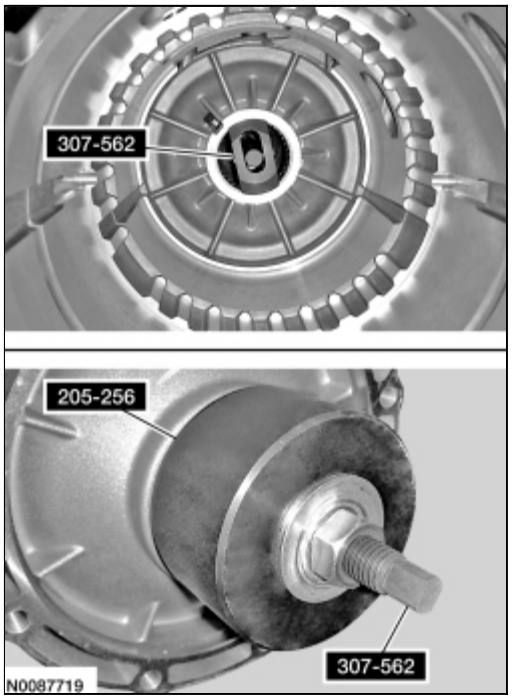


47. Remove the snap ring from the case.



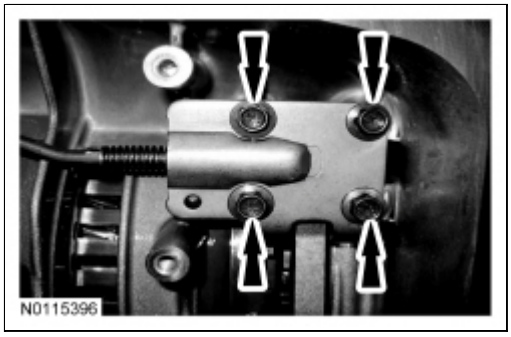
48. ***NOTICE:*** **Use care when installing the Needle Bearing Remover. Look inside the transmission case to make sure that the Needle Bearing Remover contacts the bearing only and not the lip of the case, or damage to the case will occur.**

    Using the Needle Bearing Remover and the Front Wheel Hub Oil Seal Installer, remove the bearing assembly.

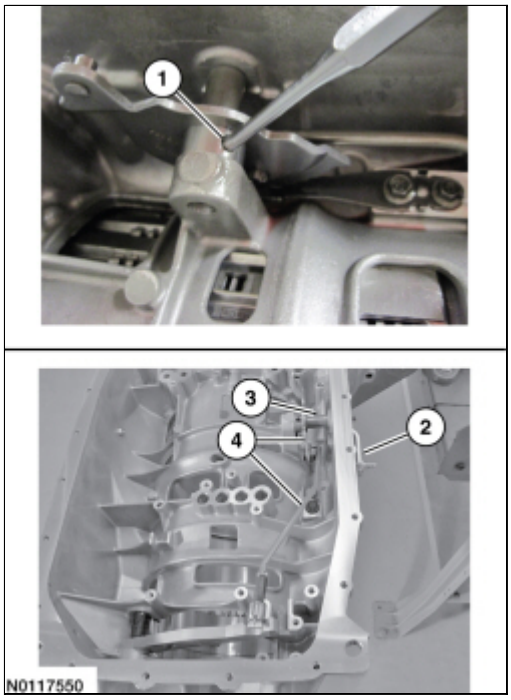


All vehicles

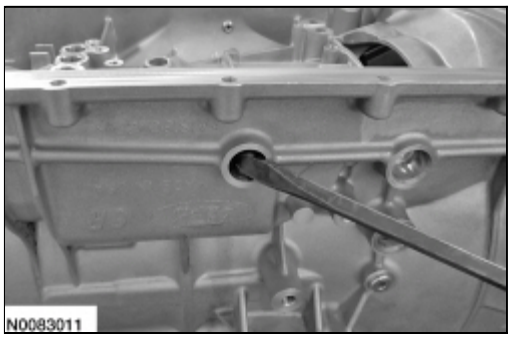
49. Remove and discard the 4 park rod actuating plate bolts and the park rod actuating plate.



50. Remove the manual control lever detent plate and park pawl actuator rod from the transmission case.
    1. Remove and discard the roll pin.
    2. Slide the manual control lever shaft out of the case.
    3. Hold the manual control lever spacer to keep it from falling into the case.
    4. Remove the manual valve detent lever and park pawl actuator rod as an assembly.

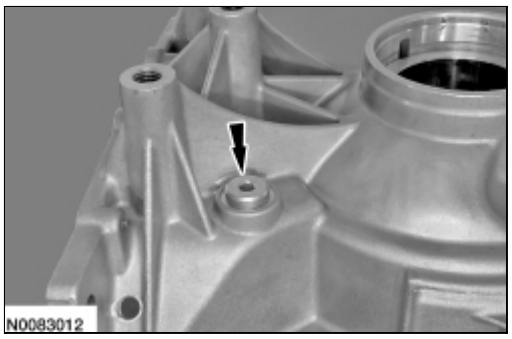


51. Remove and discard the manual control lever shaft seal.

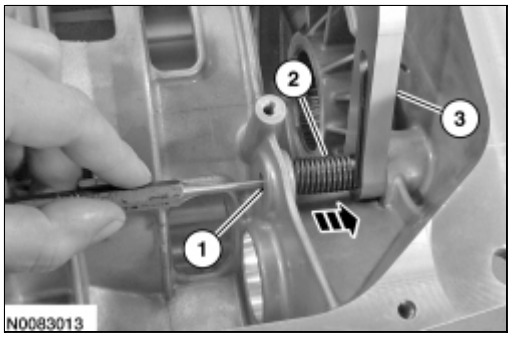


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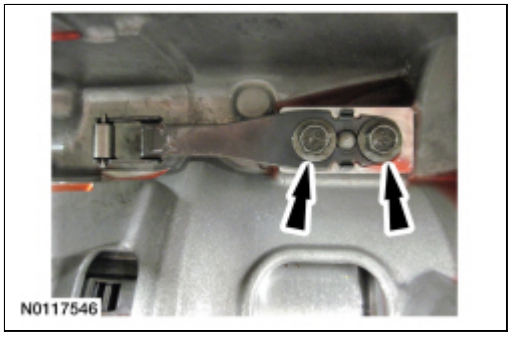
52. Remove the bolt from the back of the case to gain access to the park pawl pin.



53. From the inside of the case, push the park pawl pin out toward the back side of the case while holding the park pawl return spring and the park pawl. Remove the park pawl pin then remove the park pawl and spring.
    1. Park pawl pin
    2. Park pawl return spring
    3. Park pawl



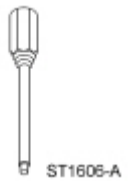
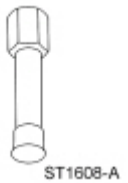
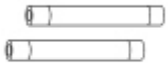
54. Remove and discard the 2 bolts and the park detent spring.

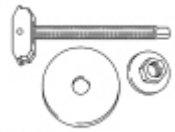


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Transmission — Late Build

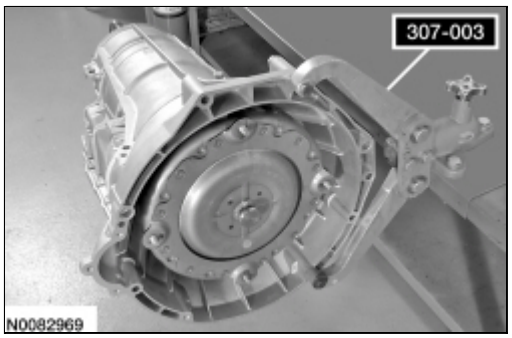
Special Tool(s)

 ST1606-A	Actuator Pin 303-D012 (D80L-100-H)
 ST1608-A	Collet, 1 1/4 Inch to 1 1/2 Inch 303-D022 (D80L-100-T)
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 **ST1433-B**	Installer, Front Wheel Hub Oil Seal 205-256
 ST2381-A	Remover, Input Shaft Oil Seal 308-375
	Remover, Koastal Sleeve 307-717

 E173280	
 ST2932-A	Remover, Needle Bearing 307-562 (includes 307-562/1 and 307-562/2)
 ST2891-A	Remover, Transmission Fluid Pump 307-553
 ST1104-B	Retaining Ring Pliers 307-343 (T95P-77001-AHR)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

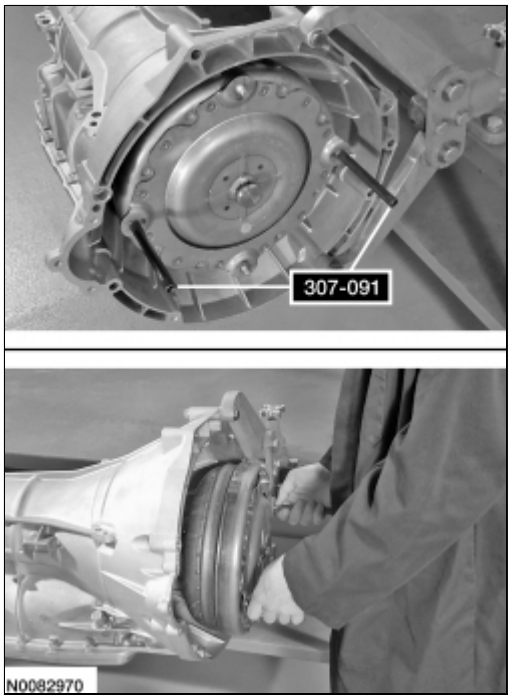
All vehicles

1. Install the Transmission Holding Fixture on the torque converter housing and install the transmission on a bench.

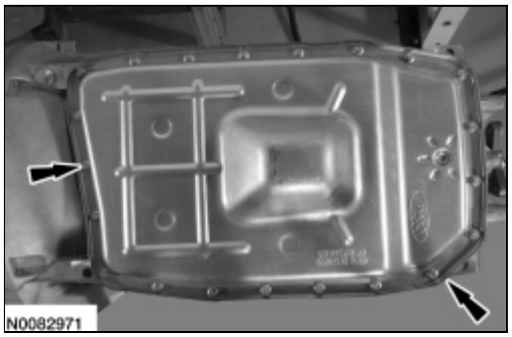


2. Using the Torque Converter Handle, remove the torque converter.

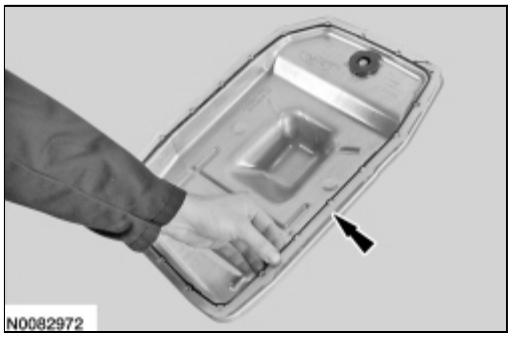
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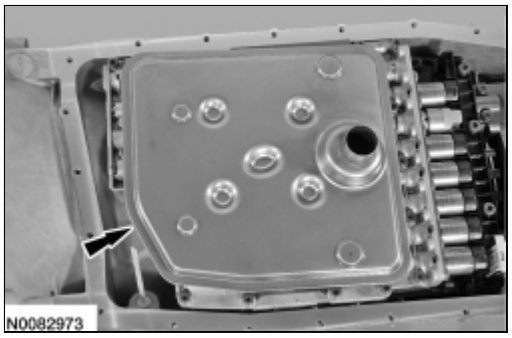
3. Remove the transmission fluid pan bolts and the transmission fluid pan.



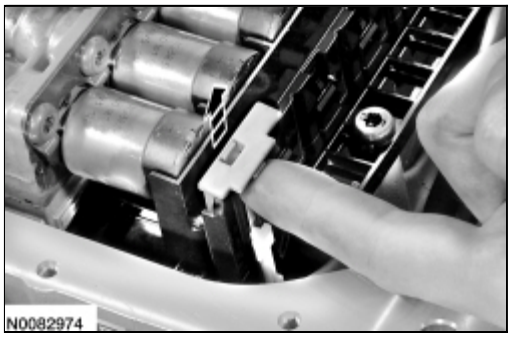
4. Remove the transmission fluid pan gasket.



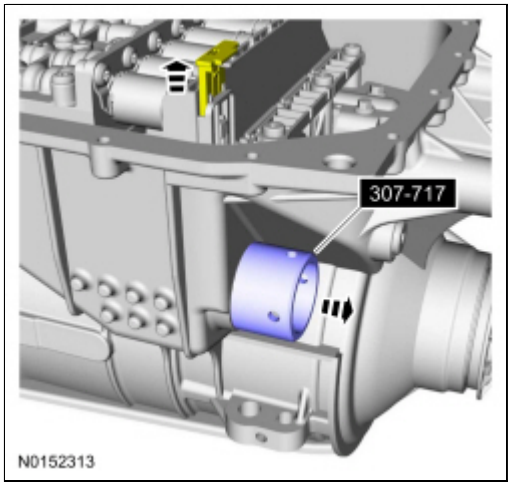
5. Remove and discard the transmission fluid filter.



6. Press the release tab and lift up on the bulkhead connector sleeve retainer to release the bulkhead connector sleeve shell.

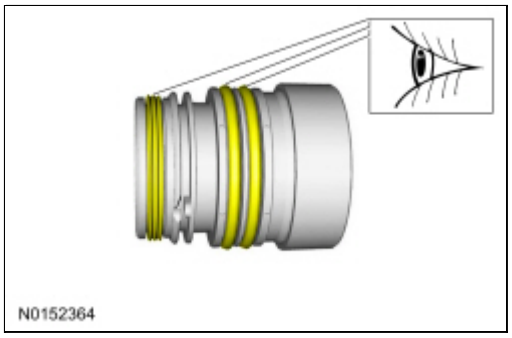


7. With the transmission bulkhead connector sleeve retainer released, use the Koastal Sleeve Remover to pull the outer shell of the bulkhead connector sleeve out of the transmission.

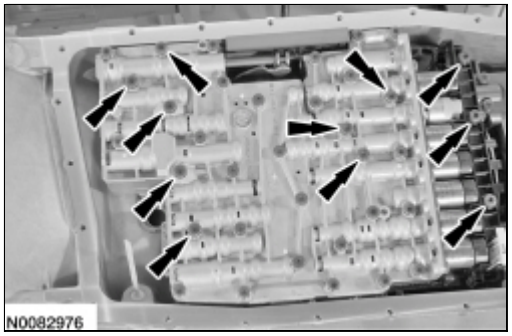


8. Inspect the bulkhead connector sleeve seals.
    - If necessary, replace the seals.

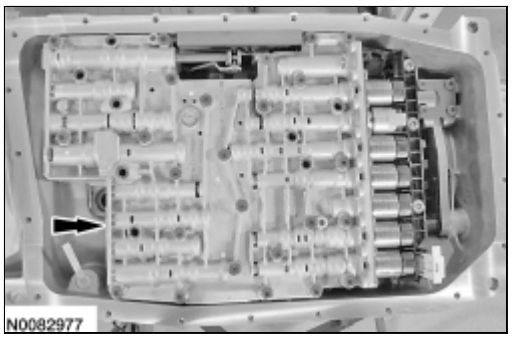
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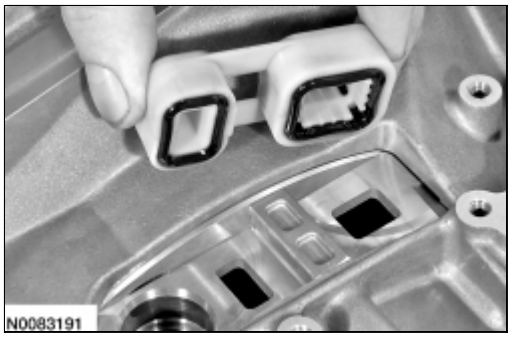
9. Remove the 11 bolts from the main control assembly.



10. Remove the main control assembly.



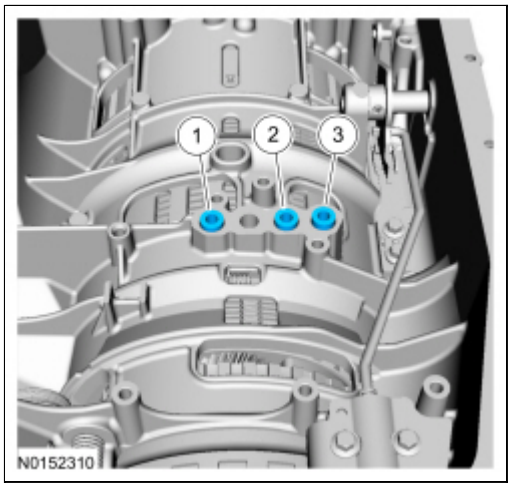
11. Remove the front pump adapter seal and the transmission fluid filter seal. Inspect for cracks or damage.



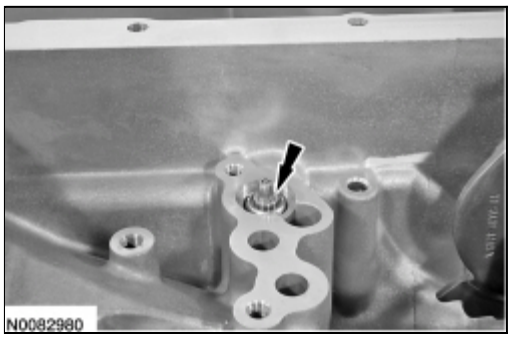
12. **NOTE:** Note the color, size and location while removing for correct assembly.

    Remove and discard the 3 center support feed tube seals.

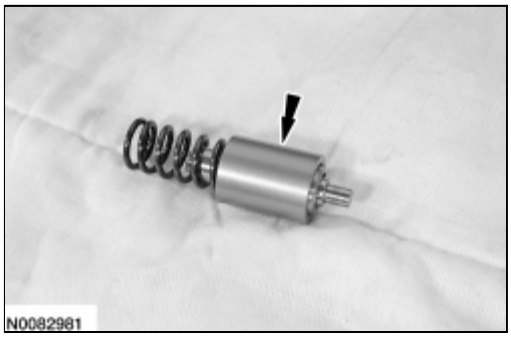
1. Center support feed tube seal (7G199 Black)
2. Center support feed tube seal (7G087 Green)
3. Center support feed tube seal (7G084 Blue)



13. Remove the thermal bypass valve from the case.

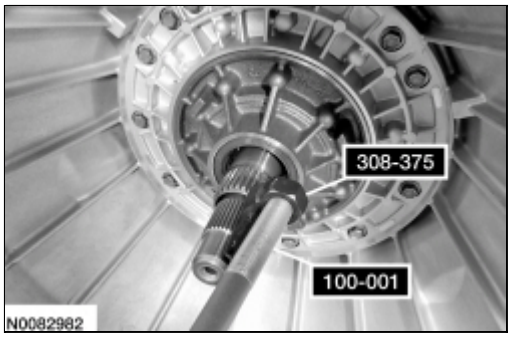


14. Inspect the thermal bypass valve for damage and install a new valve if damaged.

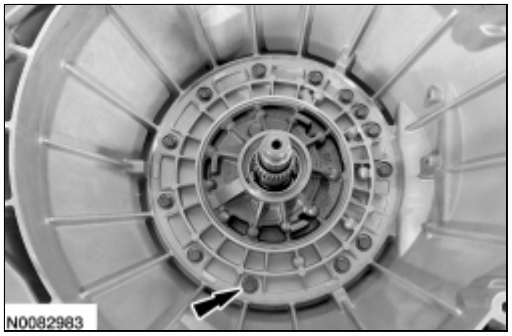


15. Using the Input Shaft Oil Seal Remover and Slide Hammer, remove and discard the front pump seal.

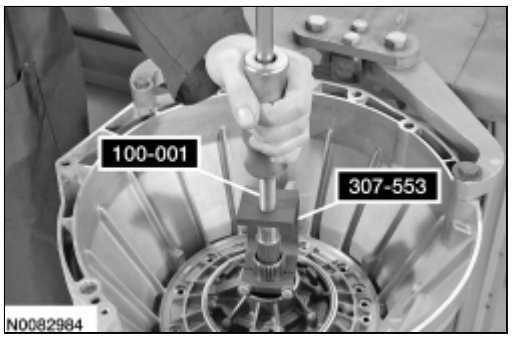
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16. Remove and discard the 13 front pump-to-case bolts and washers.

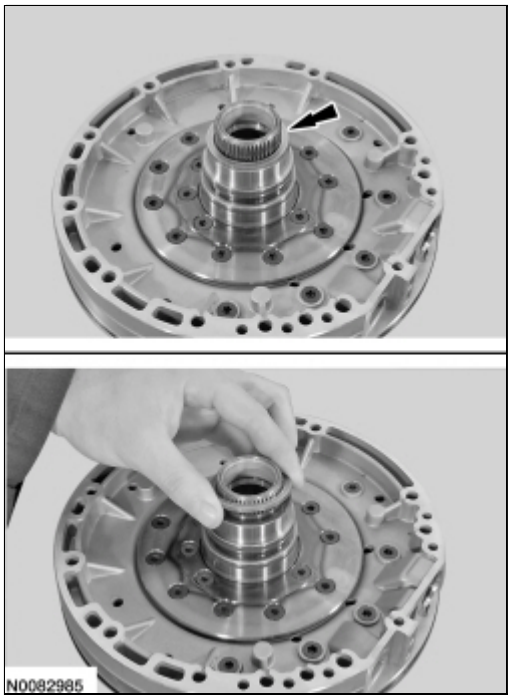


17. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the front pump support.

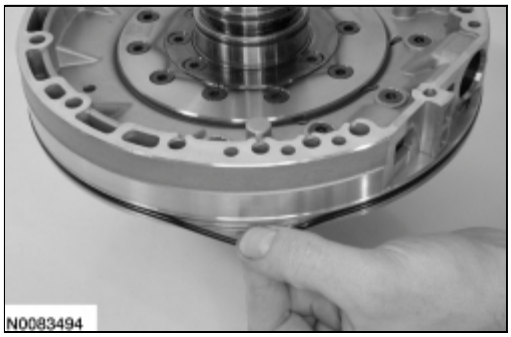


18. **NOTE:** The selective shim may come out while removing the front pump.

    Inspect the back of the front pump for the selective shim and remove If necessary.

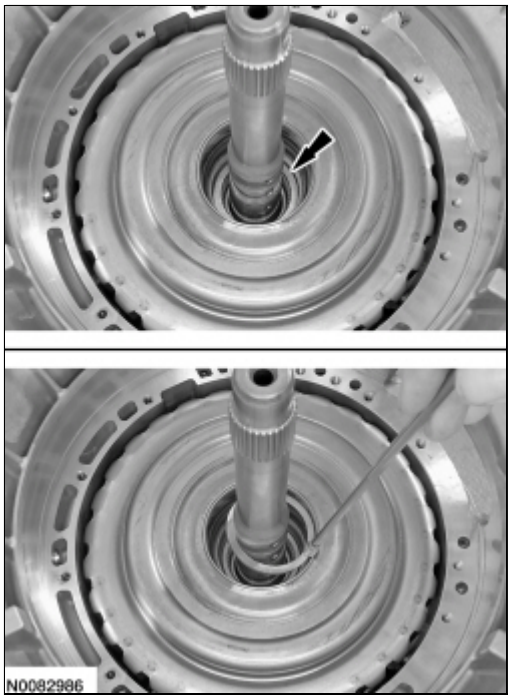


19. Remove and discard the front pump O-ring seal.

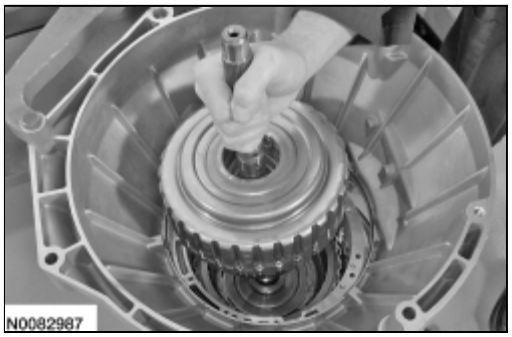


20. If the selective shim is not on the pump, using a magnet, remove it from the forward (A)/overdrive (E) clutch assembly.

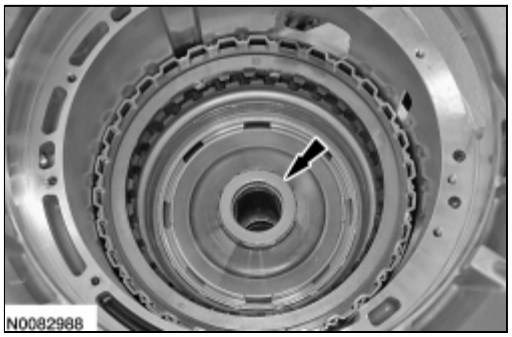
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21. Remove the forward (A)/overdrive (E) clutch assembly.



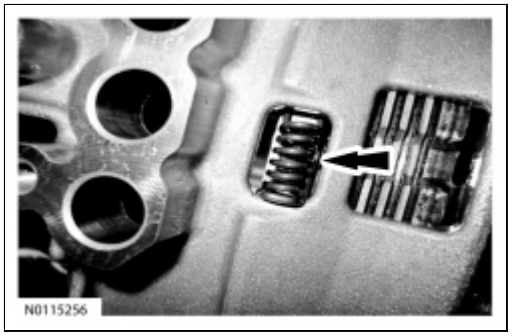
22. Remove the caged T5 roller bearing from the direct (B) clutch assembly.



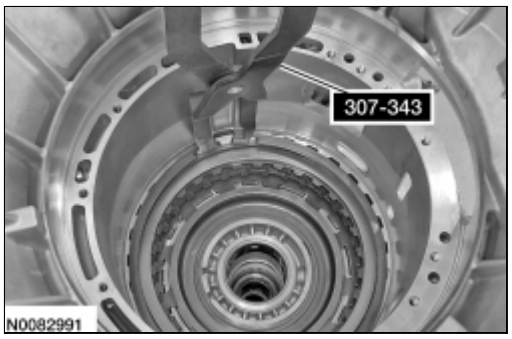
23. Remove the direct (B) clutch assembly.



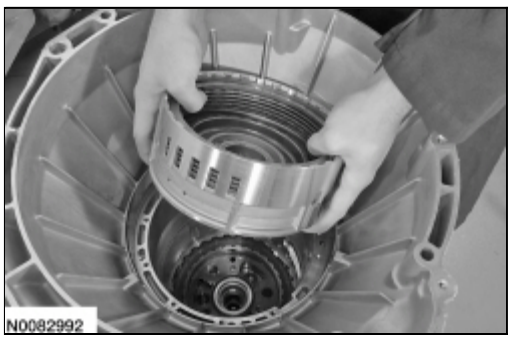
24. Remove the bias spring.



25. Using the Retaining Ring Pliers, remove the center support snap ring.



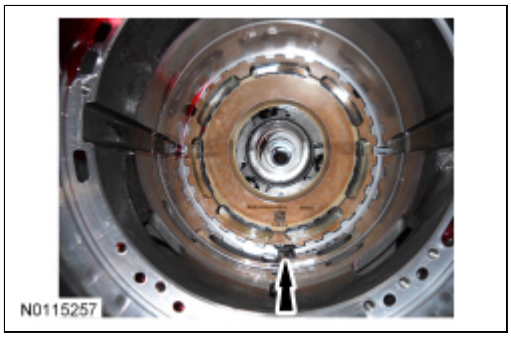
26. Remove the center support and T6 bearing.



27. **NOTE:** When removing the OWC , note the position for assembly.

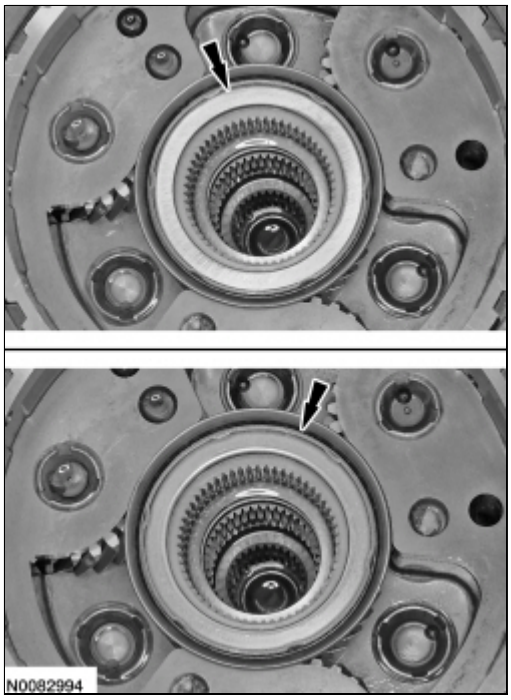
    Remove the OWC .

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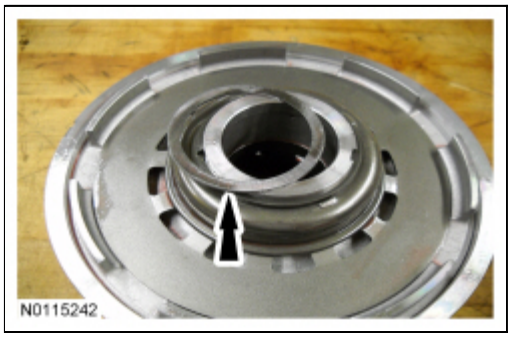
28. **NOTE:** The selective shim might stick to the T7 thrust bearing during removal of the center support.

    Remove the selective shim and the T7 thrust bearing.



29. **NOTE:** The selective shim might stick to the back of the center support assembly during removal.

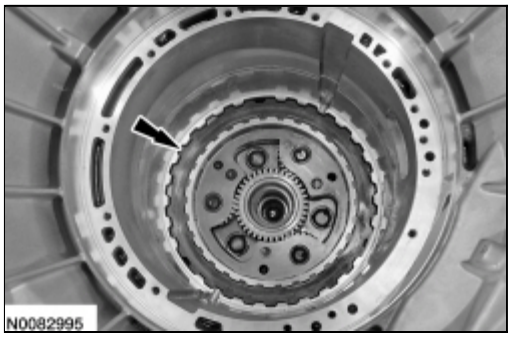
    Remove the selective shim from the center support assembly.



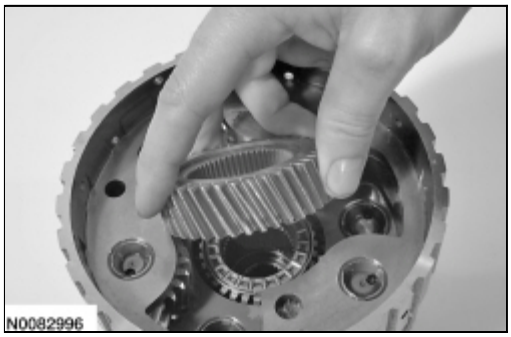
30. **NOTE:** Some of the clutch plates may stay in the case when removing the planetary carrier and the low/reverse clutch pack. Remove any clutch plates from the transmission that were not removed with

the carrier and keep the clutch plates together.

Remove the planetary carrier and the low/reverse clutch pack as an assembly.



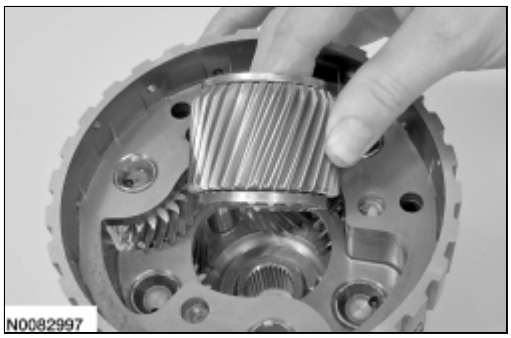
31. Remove the No. 2 sun gear and race.



32. **NOTE:** Remove the bearings with the sun gear.

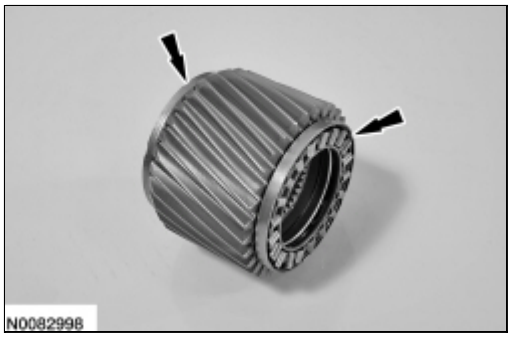
    NOTE: When removing the sun gear, note that the tapered edge is facing up toward the torque converter housing.

    Remove the No. 3 sun gear from the planetary assembly.



33. Remove the top T8 and the bottom T9 roller bearings from the sun gear.

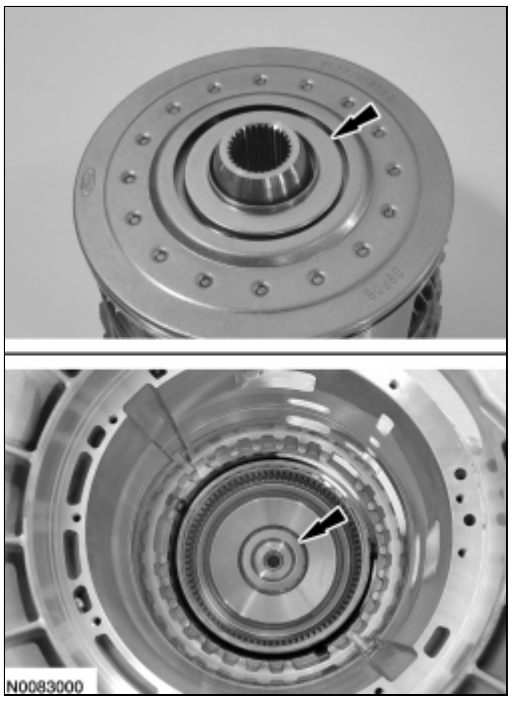
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34. Remove the T9 roller bearing race from the bottom of the carrier.

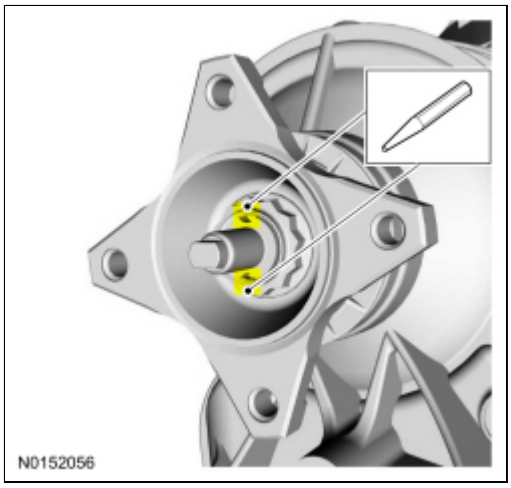


35. Remove the T10 thrust bearing from either the rear planetary carrier or the output shaft assembly.



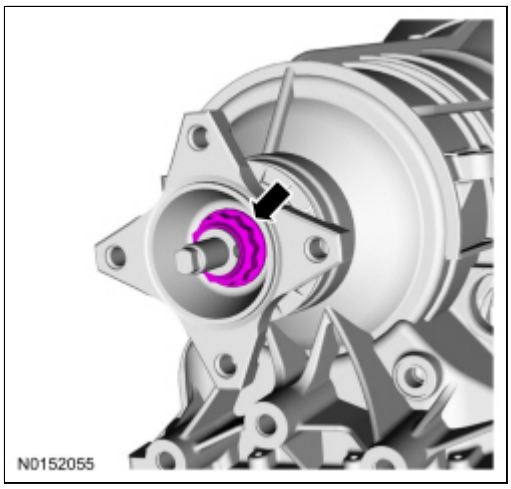
Rear Wheel Drive (RWD) vehicles

36. Remove the stakes from the output shaft flange retaining nut.

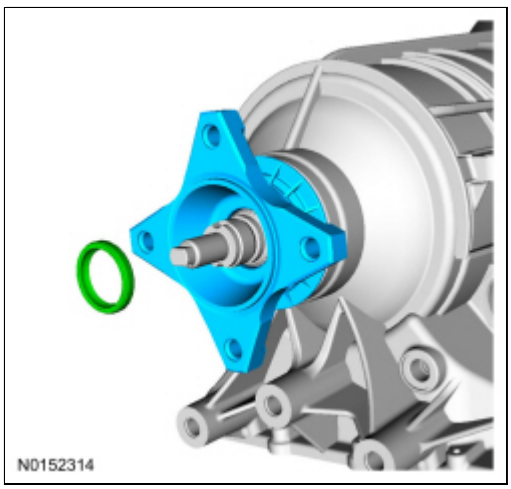


37. ***NOTICE:*** **The output shaft flange retaining nut has been staked to prevent it from coming loose. Prior to removing the nut, remove the stake to prevent damage to the output shaft.**

    Place the manual control lever in the PARK position and remove and discard the output shaft flange retaining nut.

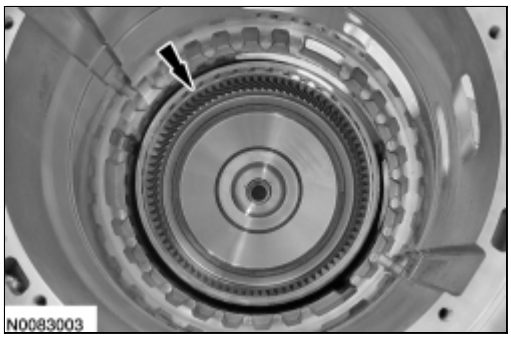


38. Remove the output shaft flange and the output shaft flange seal.

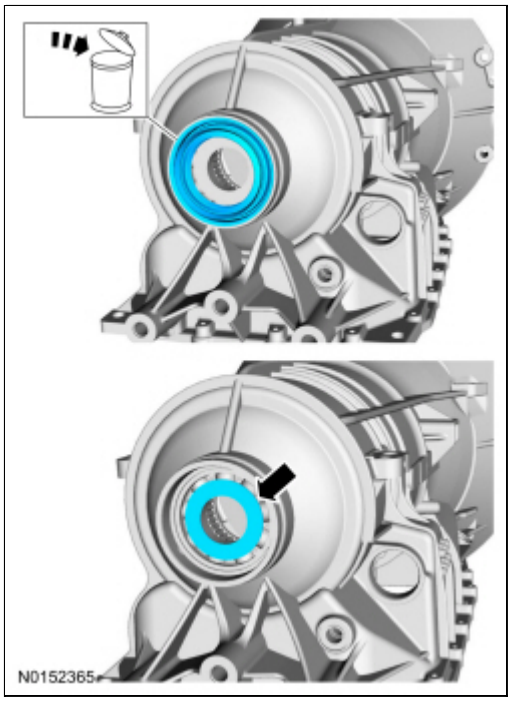


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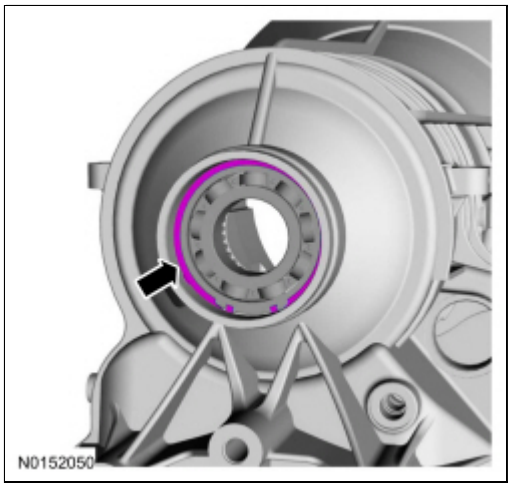
39. Remove the planetary carrier hub, output shaft assembly and T11 bearing.



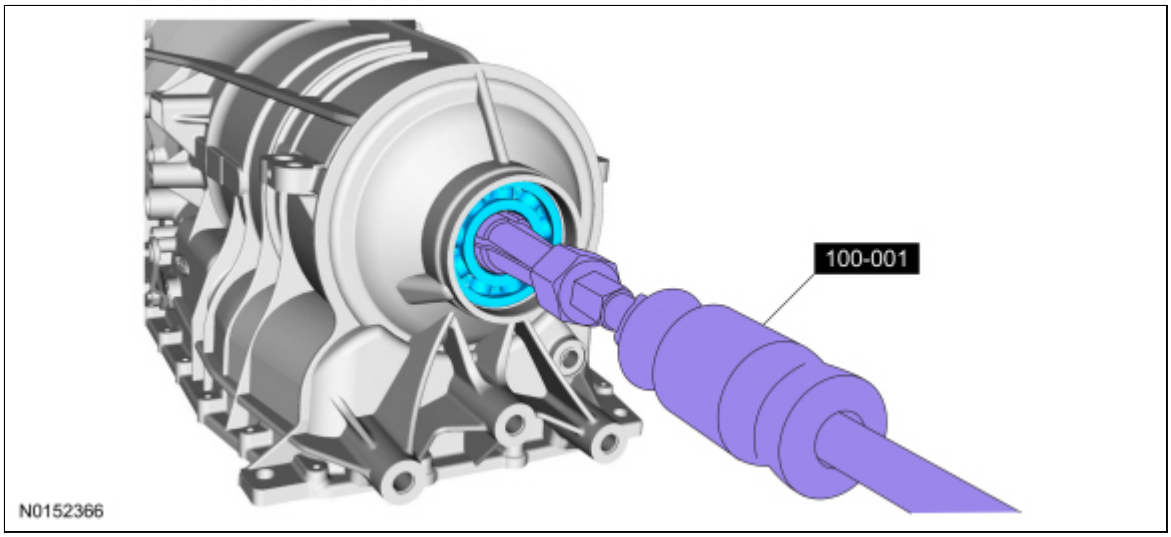
40. Remove the output shaft seal and the slip plane washer.
    - Discard the output shaft seal.



41. Remove the output shaft ball bearing snap ring.

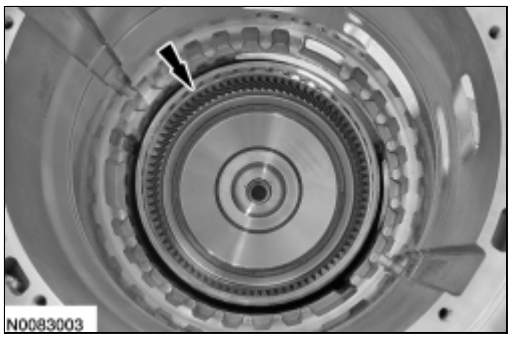


42. Using the Slide Hammer, Actuator Pin 303-D012, Collet, 1 1/4 Inch to 1 1/2 Inch 303-D022, remove the output shaft ball bearing.



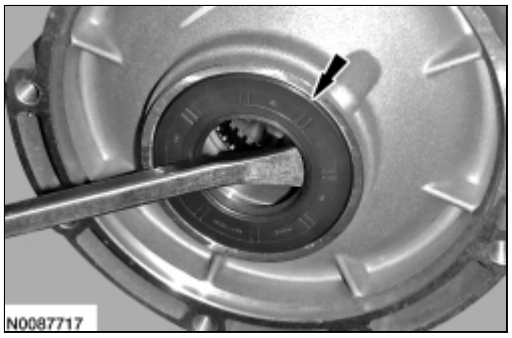
Four-Wheel Drive (4WD) vehicles

43. Remove the planet carrier hub, output shaft assembly and T11 bearing.



44. Remove and discard the output shaft seal.

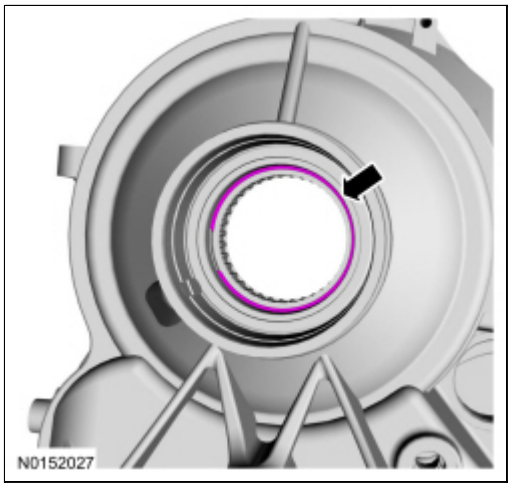
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All vehicles

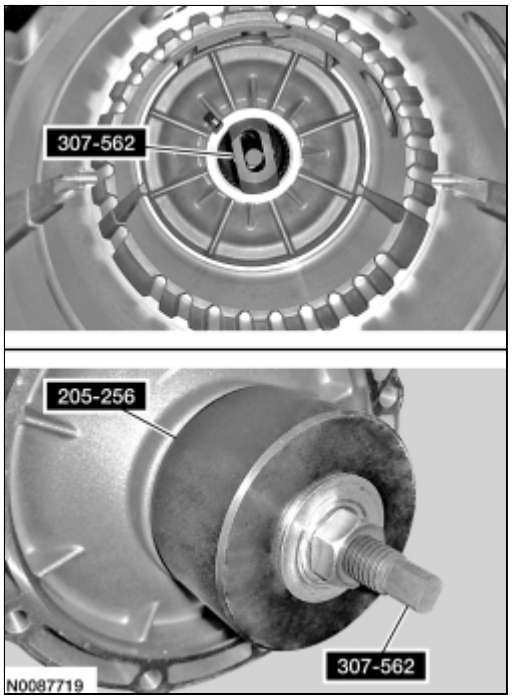
45. **NOTE:** RWD case shown, 4WD case similar.

    Remove the snap ring.

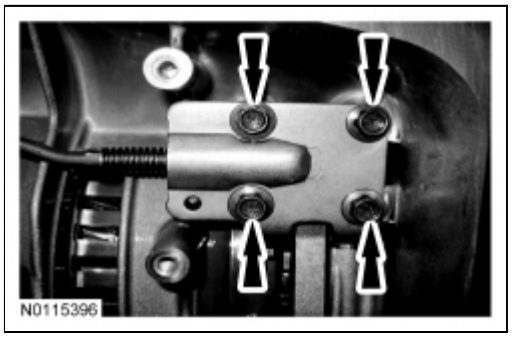


46. ***NOTICE:*** **Use care when installing the Needle Bearing Remover. Look inside the transmission case to make sure that the Needle Bearing Remover contacts the bearing only and not the lip of the case, or damage to the case will occur.**

    Using the Needle Bearing Remover and the Front Wheel Hub Oil Seal Installer, remove the bearing assembly.

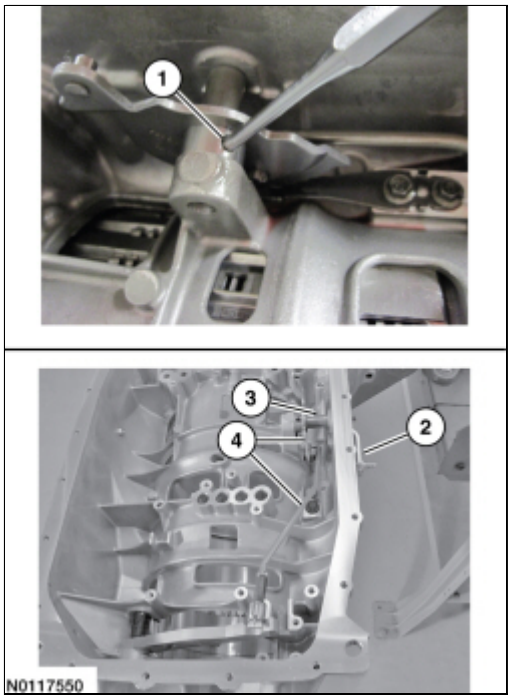


47. Remove and discard the 4 park rod actuating plate bolts and the park rod actuating plate.

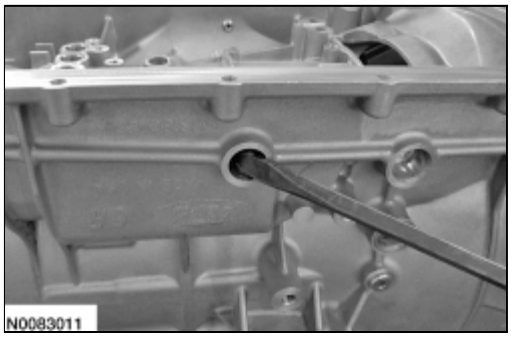


48. Remove the manual control lever detent plate and park pawl actuator rod from the transmission case.
    1. Remove and discard the roll pin.
    2. Slide the manual control lever shaft out of the case.
    3. Hold the manual control lever spacer to keep it from falling into the case.
    4. Remove the manual valve detent lever and park pawl actuator rod as an assembly.

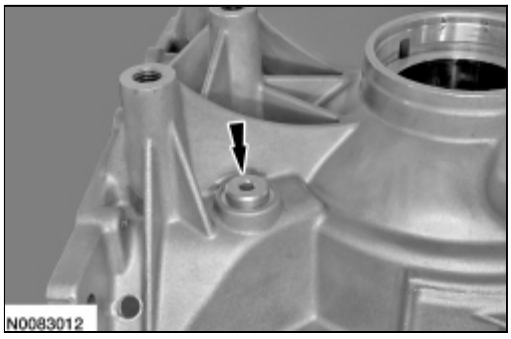
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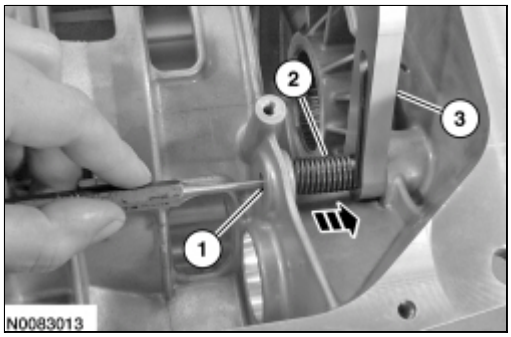
49. Remove and discard the manual control lever shaft seal.



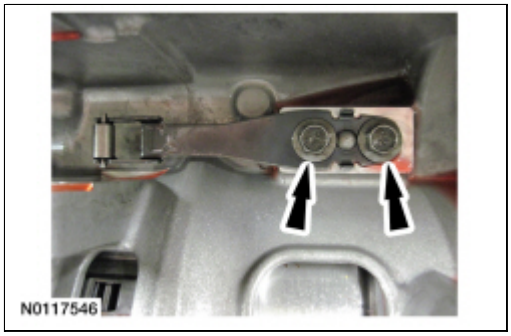
50. Remove the bolt from the back of the case to gain access to the park pawl pin.



51. From the inside of the case, push the park pawl pin out toward the back side of the case while holding the park pawl return spring and the park pawl. Remove the park pawl pin then remove the park pawl and spring.
    1. Park pawl pin
    2. Park pawl return spring
    3. Park pawl



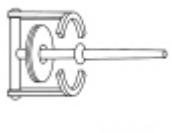
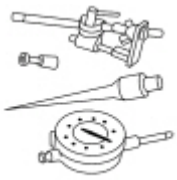
52. Remove and discard the 2 bolts and the park detent spring.



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Direct Clutch Assembly

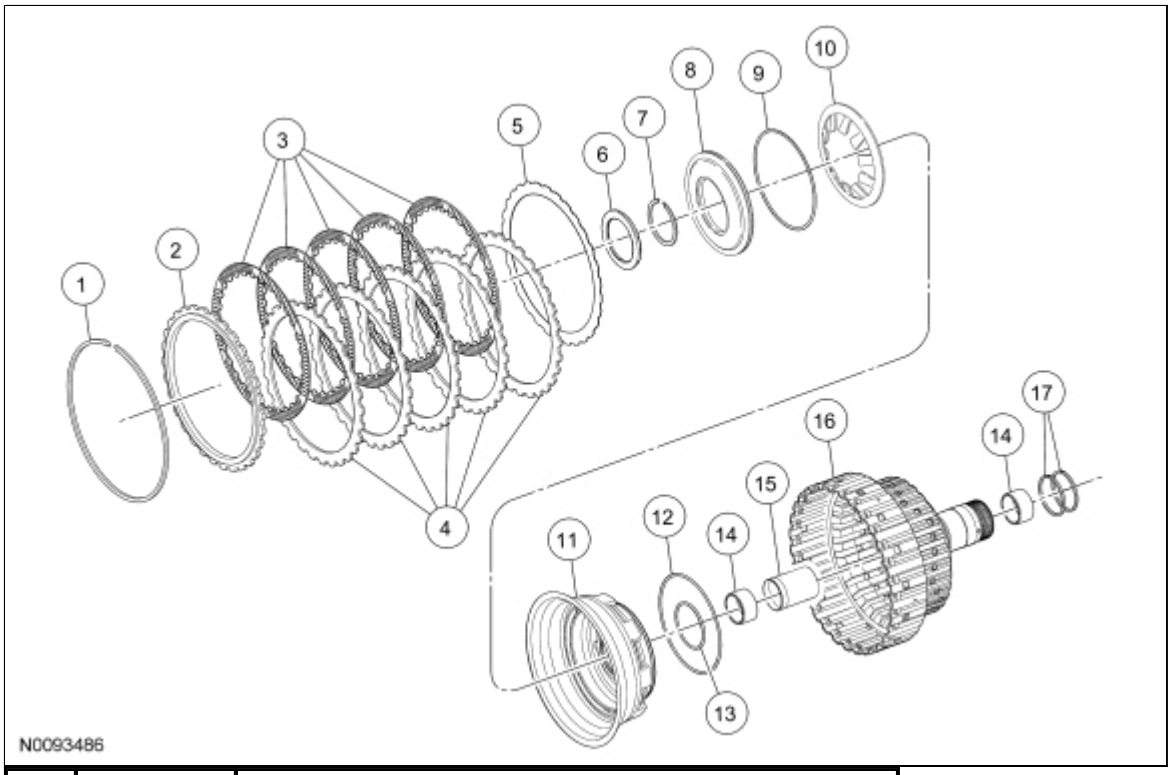
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST2893-A	Compressor, Clutch Spring 307-552
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2892-A	End Play Gauge, Clutch 307-555

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Direct Clutch Assembly

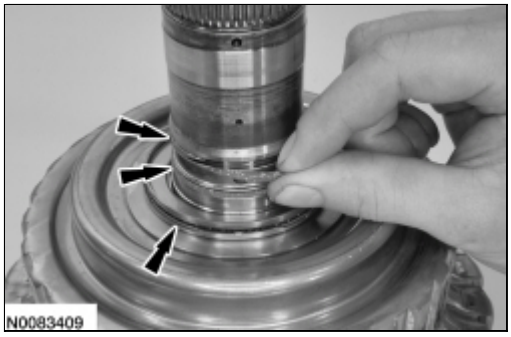


Item	Part Number	Description
1	7D483	Direct clutch pressure plate retaining ring
2	7B066	Direct clutch pressure plate (thickness model dependant)
3	7B164	Direct clutch internal splined friction plates (quantity model dependant)
4	7B442	Direct clutch external splined steel plates (quantity model dependant)
5	—	Direct clutch cushion plate (wave spring)
6	7C096	Bearing (T5)
7	7A577	Piston retaining ring
8	7A262	Direct clutch balance piston
9	7A548	Direct clutch balance piston seal
10	7B488	Return spring
11	7A262	Direct clutch apply piston
12	7A548	Direct clutch apply piston outer seal
13	7C099	Direct clutch apply piston inner seal
14	—	Direct clutch bushing hubs (part of 7F283) (2 required)
15	—	Gear shaft tube sleeve (part of 7F283)
16	7F283	Direct clutch cylinder
17	7D020	Seal shell cylinders

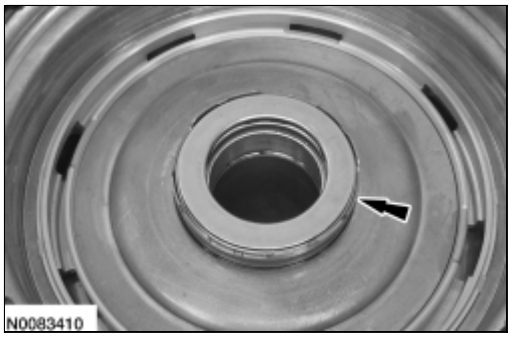
Disassembly

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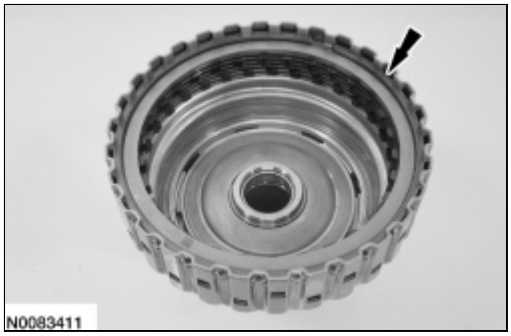
1. Remove and discard the 2 scarf cut seals and the roller bearing.



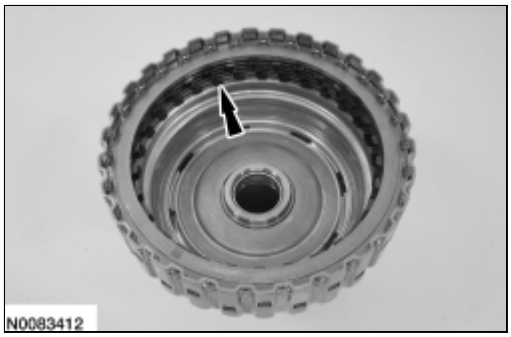
2. Remove the T5 thrust bearing.



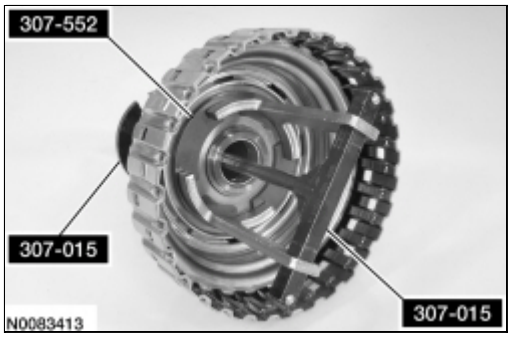
3. Remove the direct clutch snap ring.



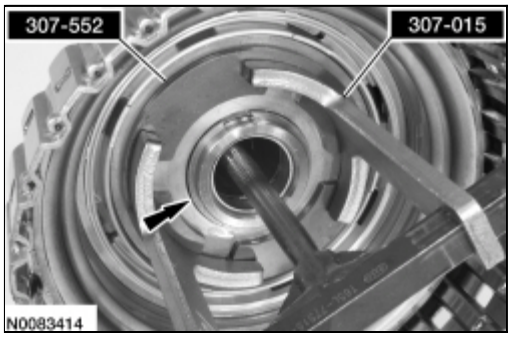
4. Remove the direct clutch steel and friction plates.



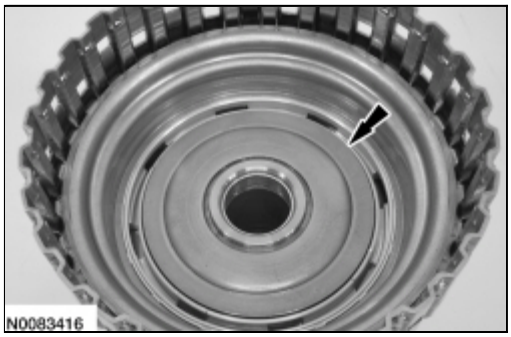
5. Install the Clutch Spring Compressors onto the direct clutch assembly.



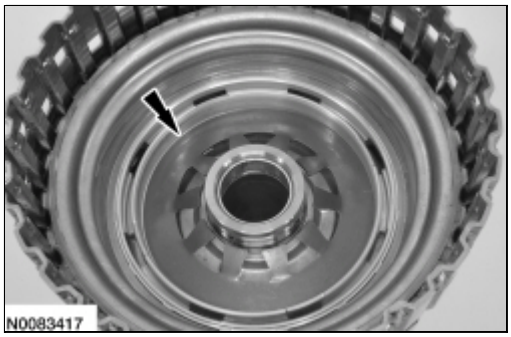
6. Using the Clutch Spring Compressors, compress the direct clutch return spring and remove the direct clutch return spring retainer.



7. Remove the balance piston.

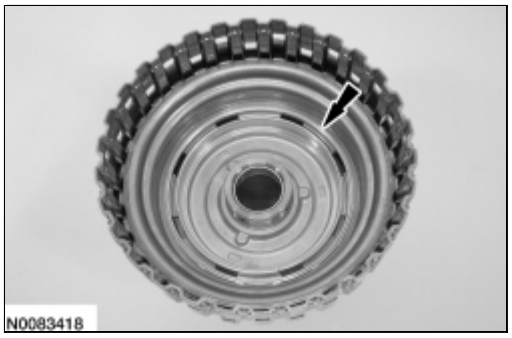


8. Remove the direct clutch return spring.



9. Remove the direct clutch piston.

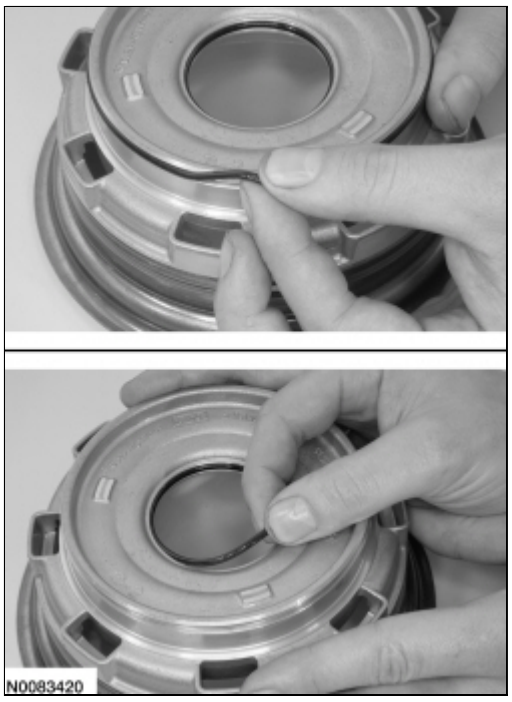
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10. Remove and discard the outer O-ring seal from the balance piston.



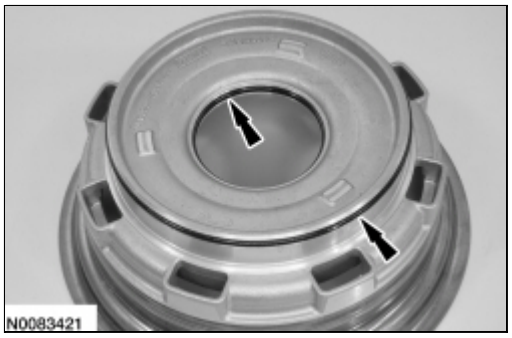
11. Remove and discard the outer and inner O-ring seals from the apply piston.



12. Inspect the components of the direct clutch for damage. If damage is indicated, install new components as necessary.

Assembly

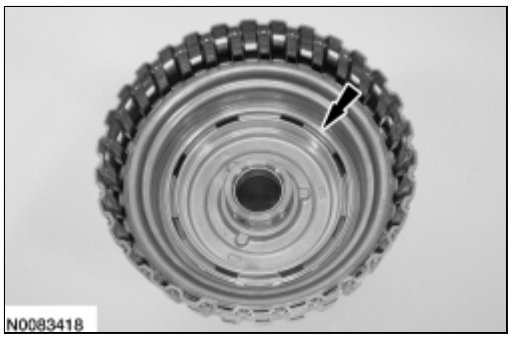
1. Install a new inner and outer O-ring seal on the apply piston.



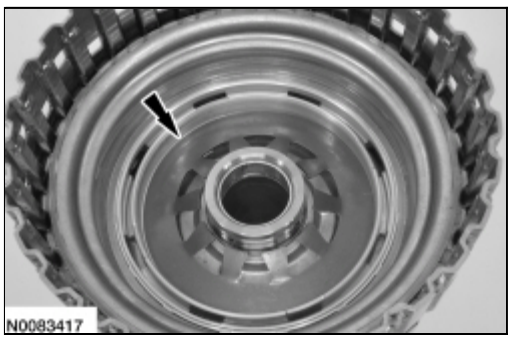
2. Install a new outer O-ring seal on the balance piston.



3. Lightly coat the O-ring seals in clean transmission fluid and install the direct clutch piston.

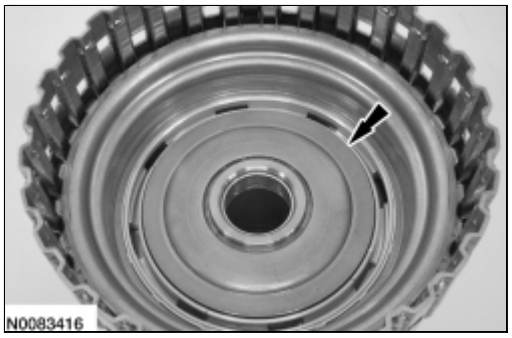


4. Install the direct clutch return spring.

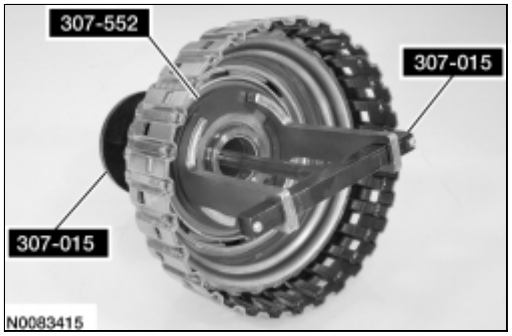


5. Install the balance piston.

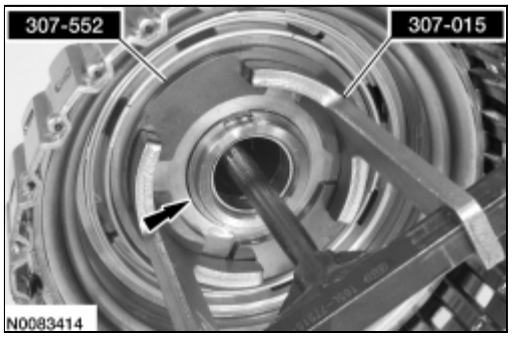
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6. Install the Clutch Spring Compressors onto the direct clutch assembly.

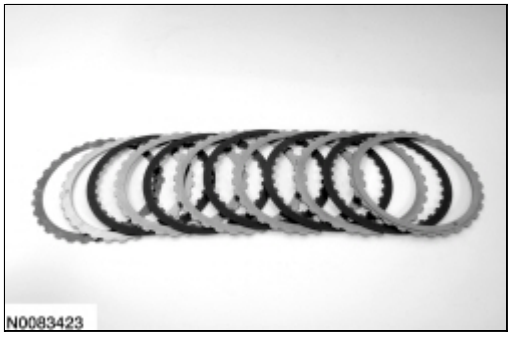


7. Using the Clutch Spring Compressors, compress the direct clutch return spring and install the direct clutch return spring retainer.

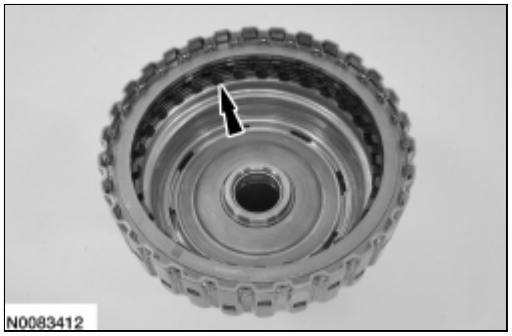


8. **NOTE:** Friction and steel plate quantity will vary based on engine displacement. For additional information, refer to the Clutch Plate Quantity Chart in the Specifications portion of this section.

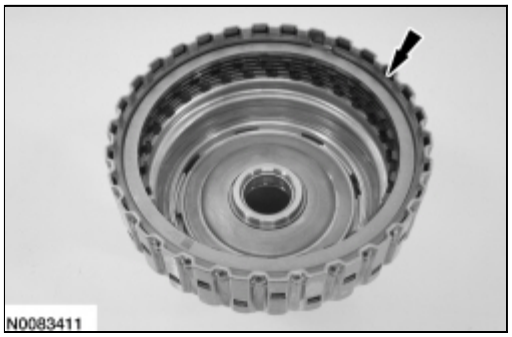
   Soak the new direct clutch in clean transmission fluid.



9. Install the new direct clutch plates, starting with the wave spring then a steel plate and alternating between steel and friction plates, and ending with the pressure plate on the top.

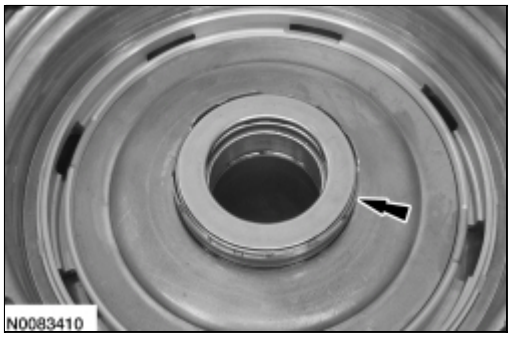


10. Install the direct clutch snap ring.



11. **NOTE:** Inspect and install a new thrust bearing as required.

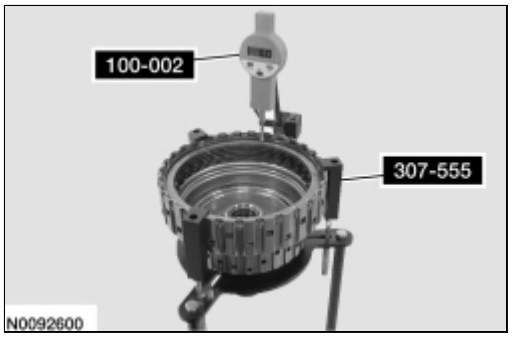
    Install the T5 thrust bearing.



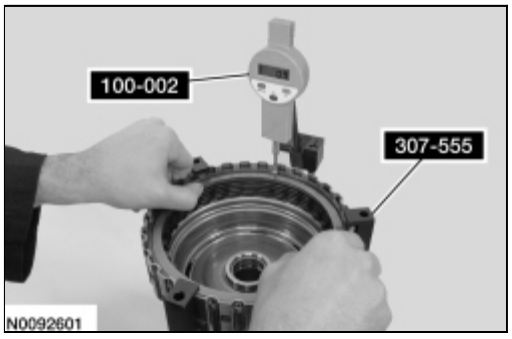
12. **NOTE:** All direct clutch plates, friction and steel are of a wave-type design.

    Install the direct clutch assembly into the Clutch End Play Gauge and install the Dial Indicator Gauge with Holding Fixture and position the plunger so it fits into the opening of the snap ring.

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13. With the Dial Indicator Gauge set at zero, lift up on the steel pressure plate so it is against the select fit snap ring. Record this reading as reading A.



14. Rotate the direct clutch assembly 180 degrees from the opening of the snap ring, take a second reading and record this reading as reading B.

Description	Reading
Reading A	
Reading B	
Add reading A to reading B for a total end clearance	
Divide the total reading by 2 for an average end clearance	

15. **NOTE:** If the final measurement is not within specification, install a new snap ring until the correct specification is achieved.
    - 0.5-1.3 mm (0.019-0.051 in).

    If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is high, remeasure using a thicker select fit snap ring. If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is low, remeasure using a thinner select fit snap ring.

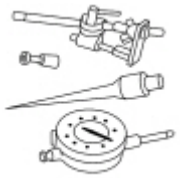
16. Install 2 new scarf cut seals and the roller bearing.



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Forward Clutch Assembly

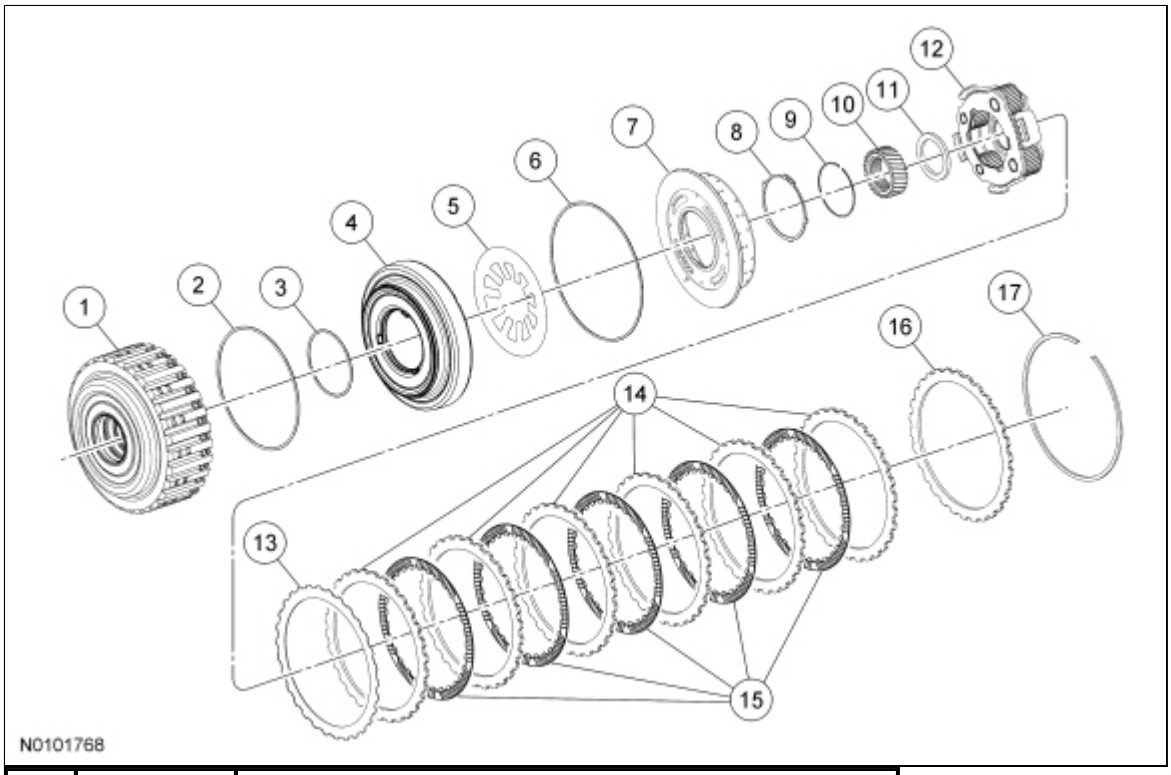
Special Tool(s)

 ST2881-A	Compressor, Clutch Spring 307-525
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2892-A	End Play Gauge, Clutch 307-555

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Forward Clutch Assembly (A Clutch)

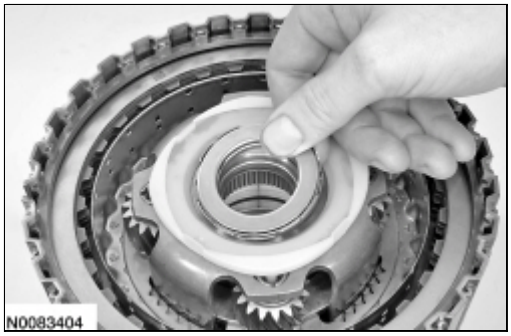


Item	Part Number	Description
1	7A360	Forward clutch drum
2	7A548	Forward clutch piston outer O-ring seal
3	7A548	Forward clutch piston inner O-ring seal
4	7A262	Forward clutch piston
5	7A480	Forward clutch piston return spring
6	7A548	Forward clutch balance dam O-ring seal
7	7H360	Forward clutch balance dam
8	7H365	Forward clutch balance dam retaining ring
9	7H579	Sun gear retaining ring
10	7D063	Sun gear
11	7H375	Bearing (T1)
12	7A398	Planetary gear
13	7E085	Forward clutch cushion spring
14	7E314	Forward clutch external splined steel plates (quantity model dependent)
15	7B164	Forward clutch internal splined friction plates (quantity model dependent)
16	7B066	Forward clutch pressure plate
17	7D483	Forward clutch plate retaining ring

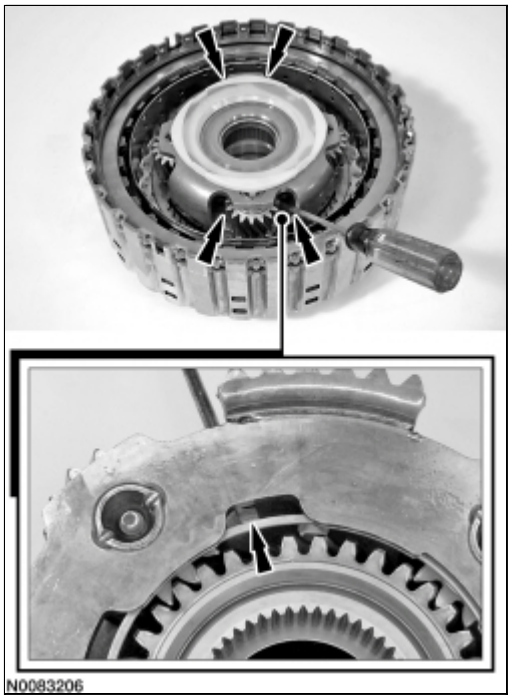
Disassembly

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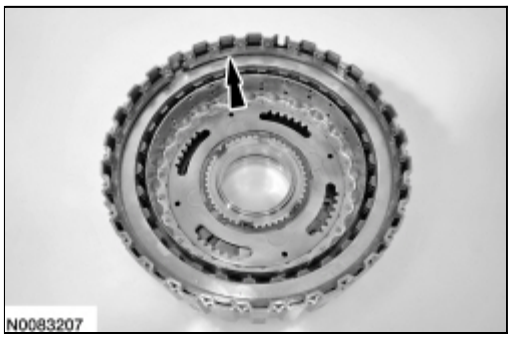
1. If the T2 thrust bearing is on the forward clutch assembly, remove it from the forward clutch assembly.



2. Remove the front planetary carrier and sun gear from the forward clutch assembly.
    - With a small screwdriver or a suitable pick inserted into the front planetary assembly, push on the retaining ring in 4 places while lifting up on the front planetary assembly.



3. Remove the forward clutch pack snap ring.

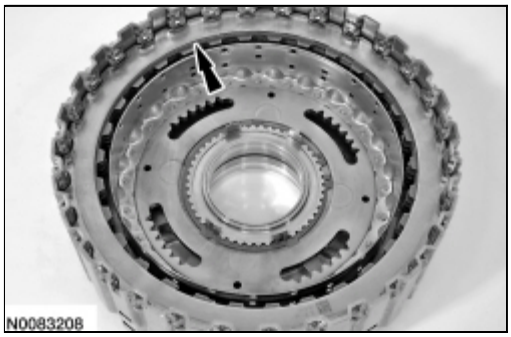


4. **NOTE:** Inspect the forward clutch drum and the friction and steel plates for damage. Install new

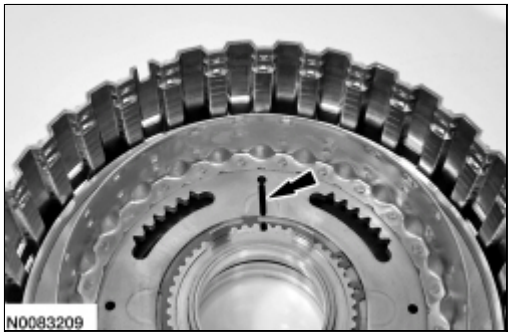
components as necessary.

Remove and inspect the forward clutch steel and friction plates.

- If the plates are damaged, install a new forward clutch assembly.
- If no damage is indicated, the forward clutch may be reassembled.



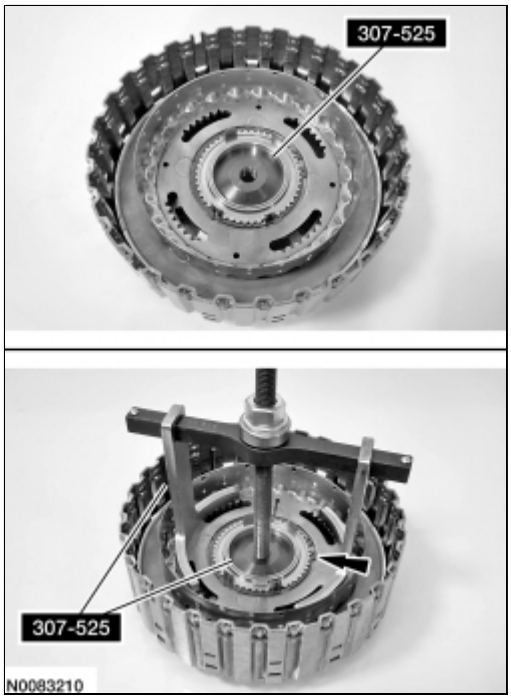
5. For correct alignment during assembly, make an identifying mark on the balance dam and the center part of the housing.



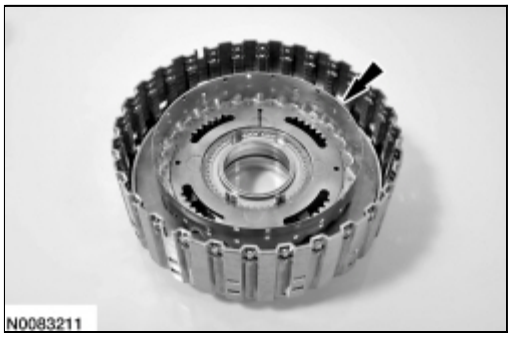
6. **NOTE:** The bottom of the Clutch Spring Compressor will need to be installed from the back side of the forward clutch assembly.

   Using the Clutch Spring Compressor, slightly collapse the balance dam to gain access to the retaining ring and remove the retaining ring.

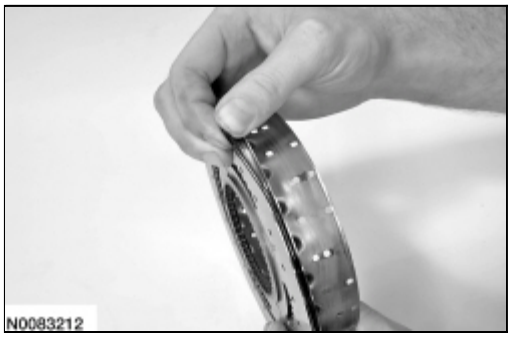
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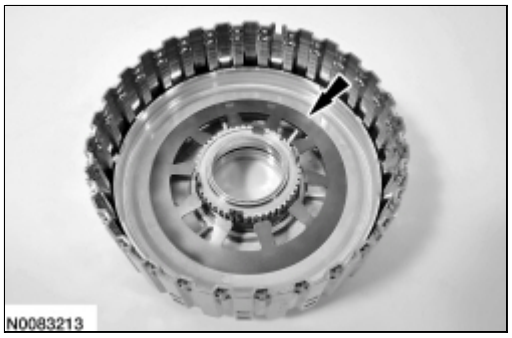
7. Remove the balance dam.



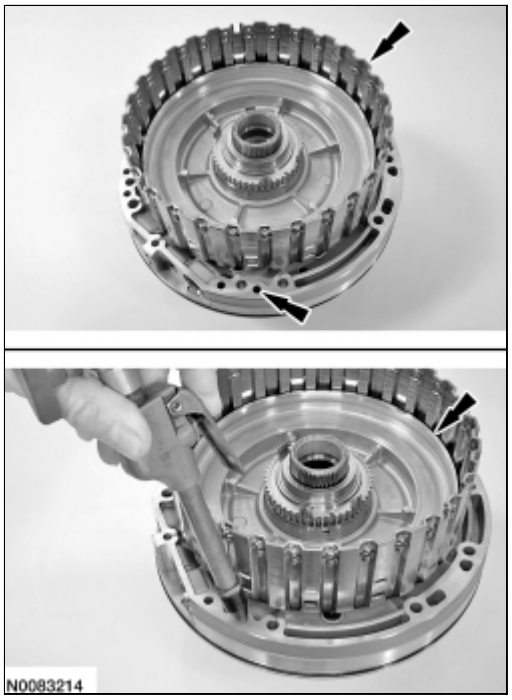
8. Remove and discard the O-ring seal from the balance dam.



9. Remove the forward clutch return spring.



10. Install the forward clutch on the front pump to remove the forward clutch piston. Apply a small amount of shop air to remove the piston.

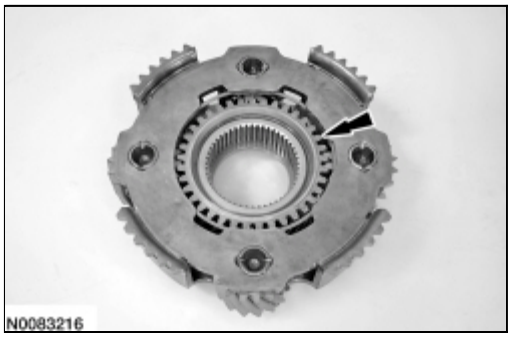


11. Remove and discard the inner and outer piston O-ring seals.

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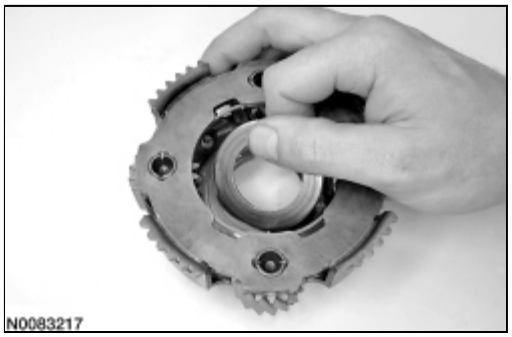


12. Remove the sun gear from the planet assembly.

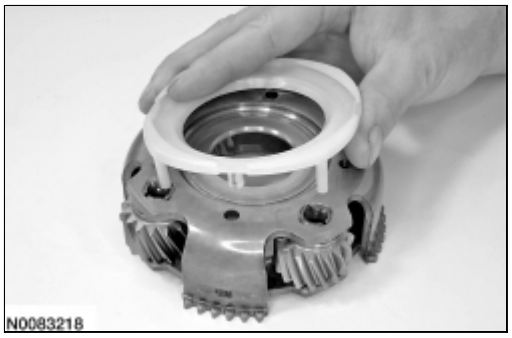


13. **NOTE:** The T1 thrust bearing may have stuck to the sun gear when it was removed.

    Remove the T1 bearing from the planetary carrier.



14. Remove the transmission fluid collector plate from the front planetary carrier.

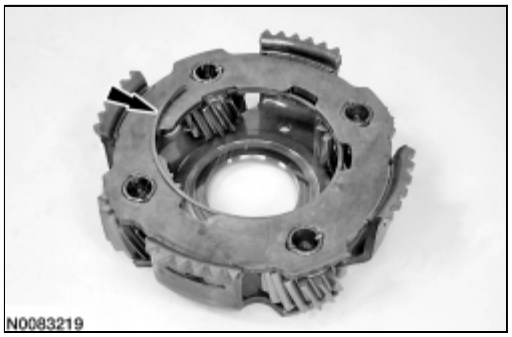


15. Clean and inspect the components of the forward clutch assembly for damage and install new components as necessary.

Assembly

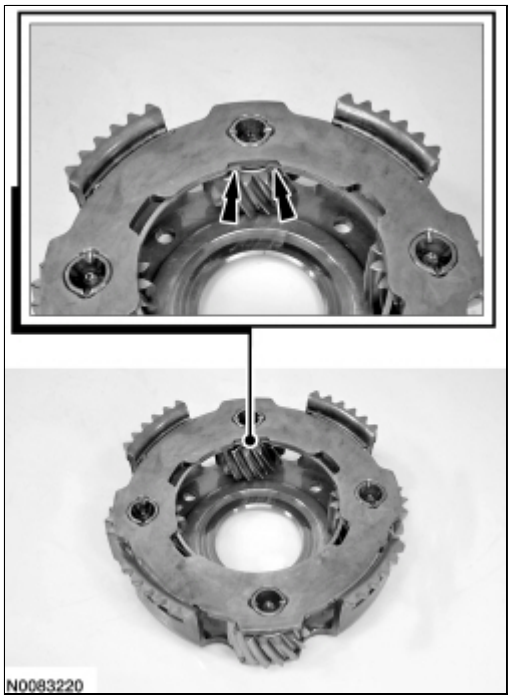
1. **NOTE:** If a new planetary assembly is being installed, the new planetary assembly may not come with the snap ring installed.

   Install the planetary assembly snap ring, if necessary.

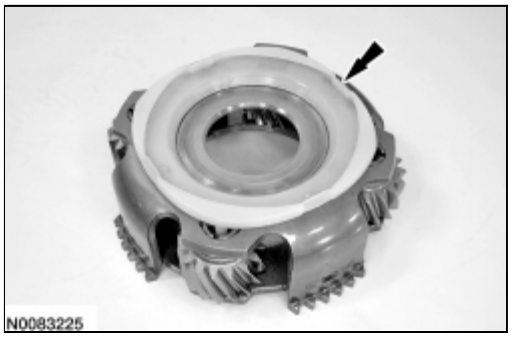


2. Make sure the planetary snap ring is oriented as shown.

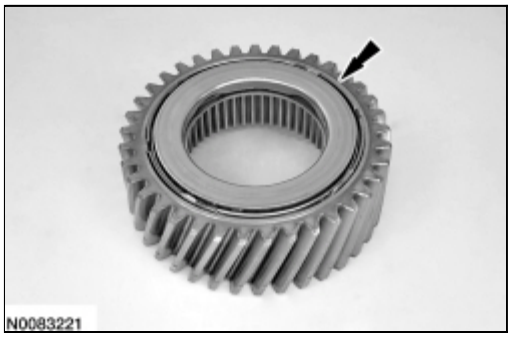
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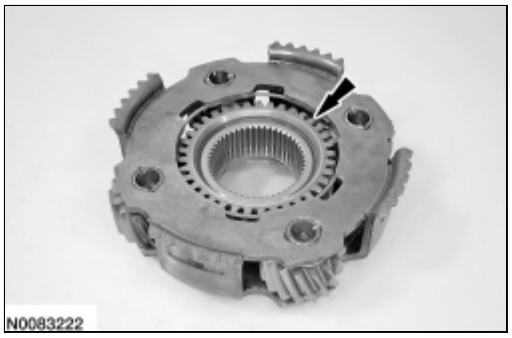
3. Install the transmission fluid collector plate on the front planetary carrier.



4. Install the T1 bearing onto the sun gear.



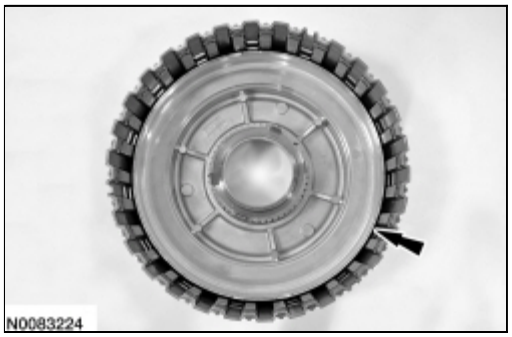
5. Install the sun gear into the planet assembly with the T1 bearing facing down and the recessed part of the gear up.



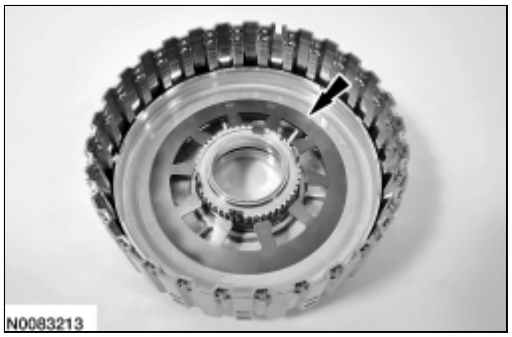
6. Install new O-ring seals onto the forward clutch piston.



7. Lightly coat the O-ring seals with clean transmission fluid and install the forward clutch piston into the forward clutch drum.



8. Install the forward clutch return spring.

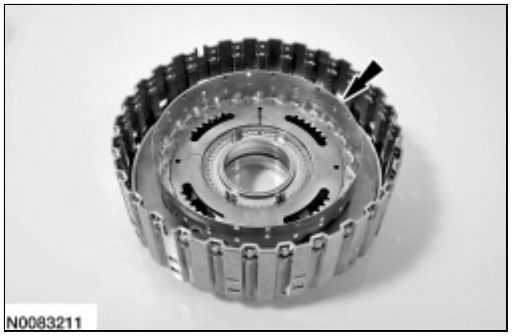


9. Install a new O-ring seal onto the forward clutch balance dam. Lightly coat the O-ring seal with clean transmission fluid.

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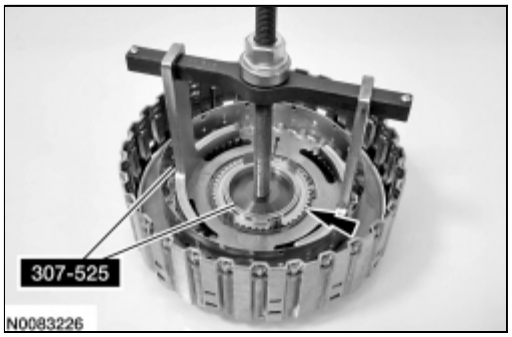


10. Align the marks made during disassembly and install the balance dam into the forward clutch drum.



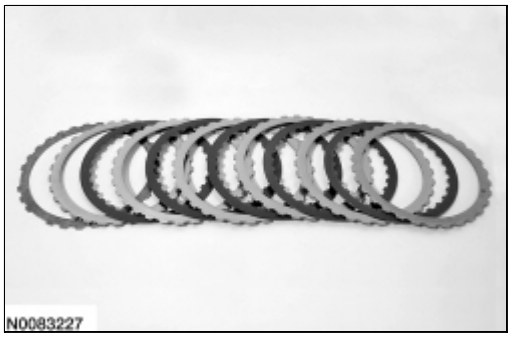
11. **NOTE:** Prior to releasing the Clutch Spring Compressor, make sure that the snap ring is fully seated.

    Using the Clutch Spring Compressor, slightly collapse the balance dam to install the retaining ring. Install the retaining ring.

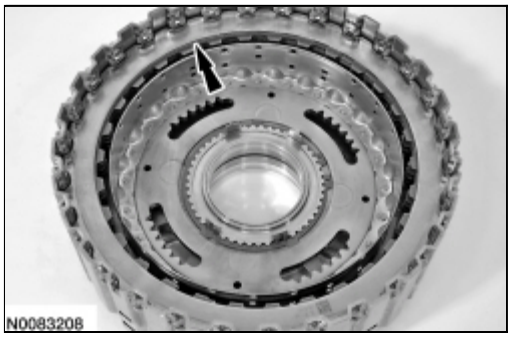


12. **NOTE:** Friction and steel plate quantity will vary based on engine displacement. For additional information, refer to the Clutch Plate Quantity chart in the Specifications portion of this section.

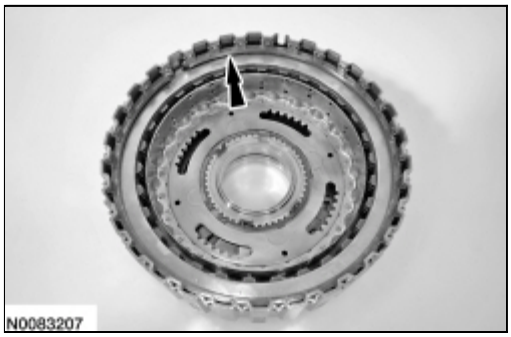
    Soak the new forward clutch plates in clean transmission fluid.



13. Install the new forward clutch plates, starting with the wave spring then a steel plate and alternating between friction and steel plates and install the pressure plate.

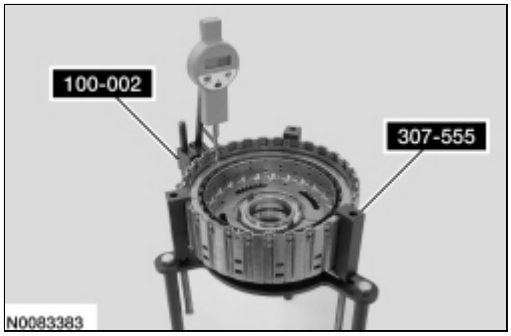


14. Install the forward clutch plate snap ring.



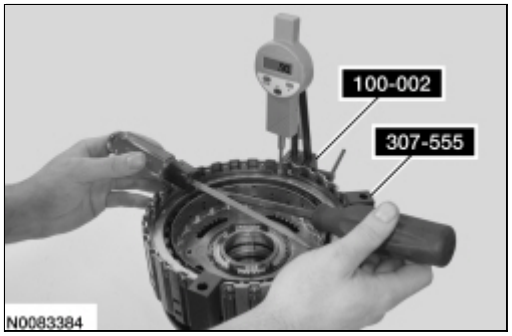
15. **NOTE:** All forward clutch plates, friction and steel are of a wave-type design.

    Install the forward clutch assembly into the Clutch End Play Gauge and install the Dial Indicator Gauge with Holding Fixture and position the plunger so it fits into the opening of the snap ring.



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16. With the Dial Indicator Gauge set at zero, lift up on the steel pressure plate so it is against the select fit snap ring. Record this reading as reading A.



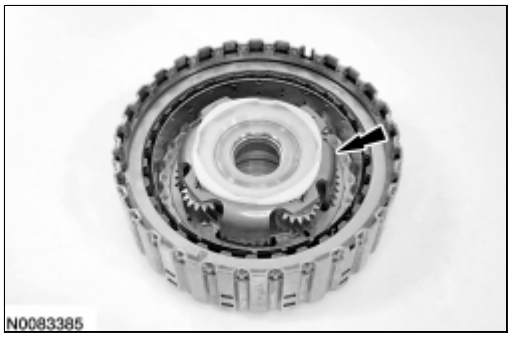
17. Rotate the forward clutch assembly 180 degrees from the opening of the snap ring, take a second reading and record this reading as reading B.

Description	Reading
Reading A	
Reading B	
Add reading A to reading B for a total end clearance	
Divide the total reading by 2 for an average end clearance	

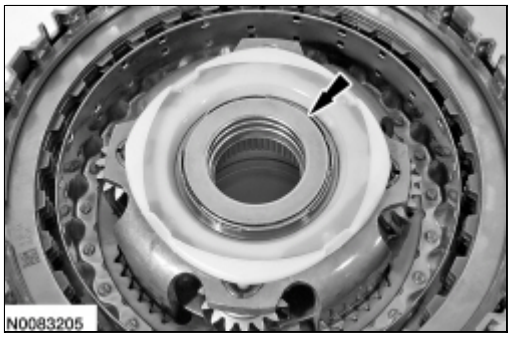
18. **NOTE:** If the final measurement is not within specification, install a new snap ring until the correct specification is achieved.
    - 0.71-1.10 mm (0.028-0.043 in)

    If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is high, remeasure using a thicker select fit snap ring. If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is low, remeasure using a thinner select fit snap ring.

19. Install the sun gear and planetary gearset into the forward clutch drum. Make sure it snaps and locks in place.



20. Install the T2 thrust bearing.



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Forward/Overdrive Clutch Assembly — Assembly

Special Tool(s)

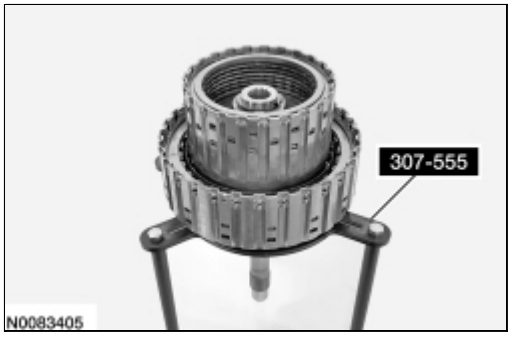
 ST2892-A	End Play Gauge, Clutch 307-555

Material

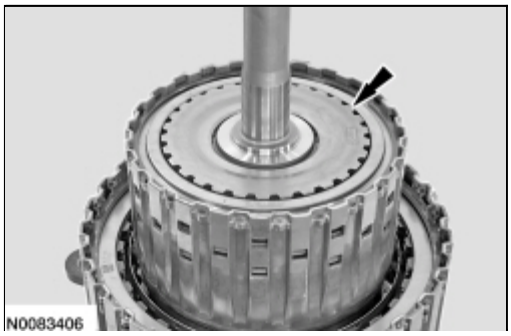
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Assembly

1. Position the forward clutch assembly in the Clutch End Play Gauge and install the overdrive clutch pack onto the forward clutch and planetary gear set.

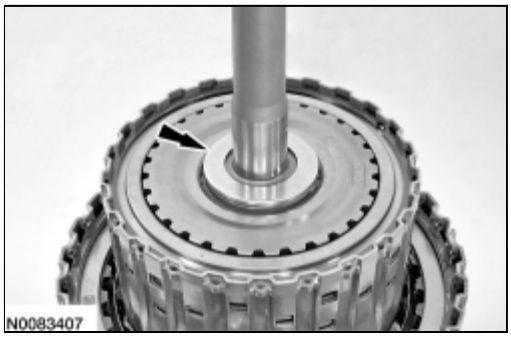


2. Install the intermediate shaft assembly.

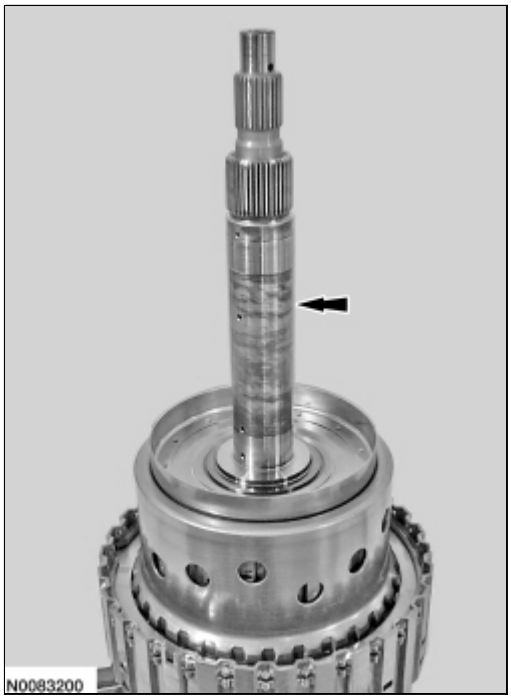


3. **NOTE:** Inspect and install new thrust bearings as required.

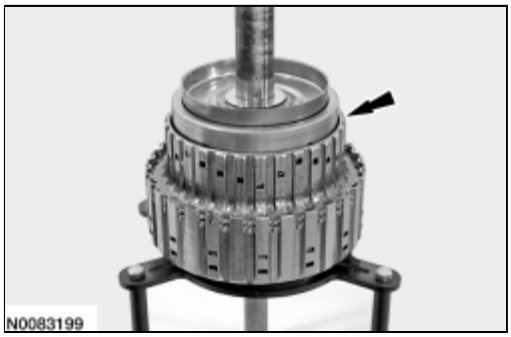
   Install the T4 intermediate shaft bearing.



4. Install the forward clutch hub and sun shaft assembly.



5. Install a new the direct clutch hub.

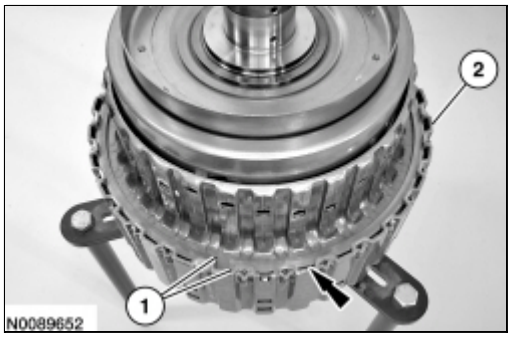


6. ***NOTICE:*** **Do not install the snap ring on the forward clutch hub with the snap ring gap in the same position as the original snap ring or damage to the transmission can occur.**

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Install a new direct clutch outer shell retaining ring with the snap ring gap positioned approximately 120 degrees from the index mark made on the forward clutch hub during disassembly.

1. New snap ring gap
2. Index mark from original snap ring gap



Forward/Overdrive Clutch Assembly — Disassembly

Special Tool(s)

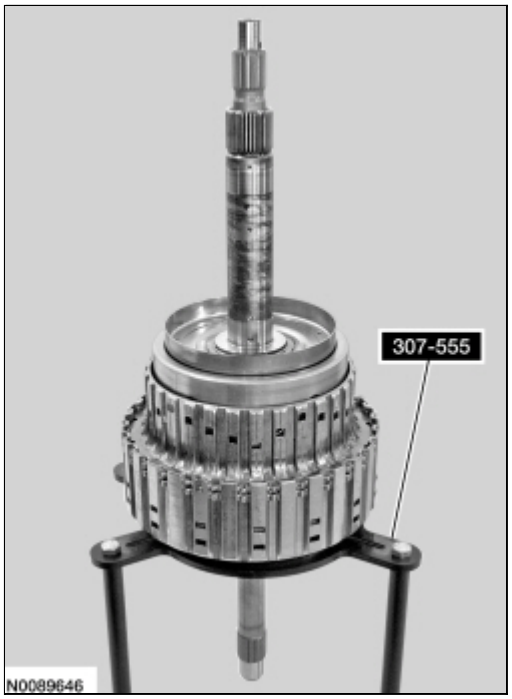
 ST2892-A	End Play Gauge, Clutch 307-555

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

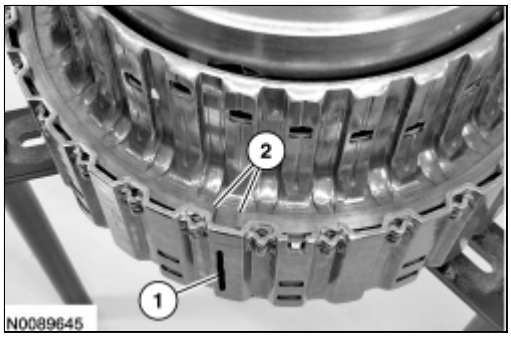
Disassembly

1. Position the forward/overdrive clutch assembly in the Clutch End Play Gauge 307-555.



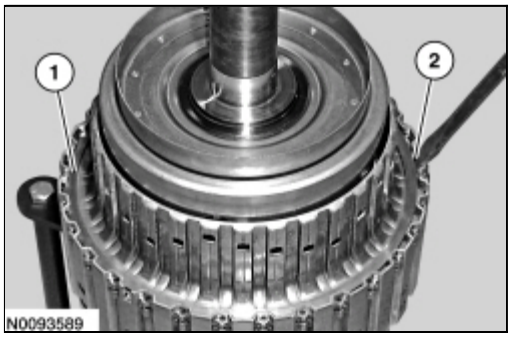
2. Index-mark the direct clutch outer shell snap ring gap location to the side of the forward clutch hub using a suitable paint marker.
    1. Index mark
    2. Snap ring gap

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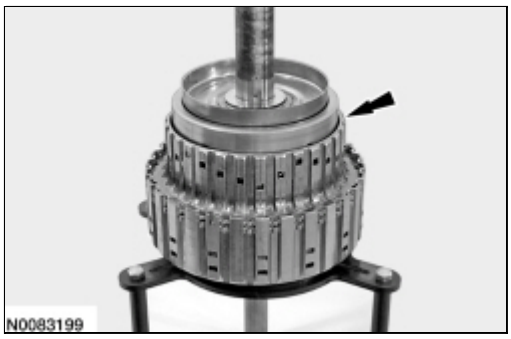


3. ***NOTICE:*** **Compress the snap ring out of the groove 180 degrees from the snap ring gap or damage to the forward clutch hub can occur.**

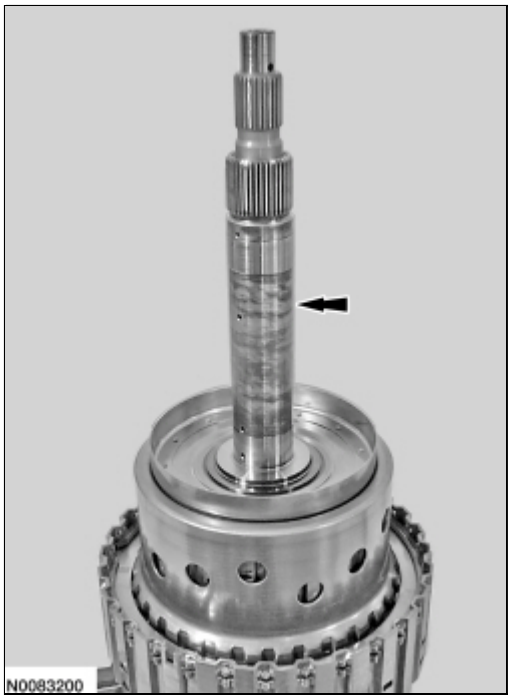
   Using a suitable tool, remove and discard the direct clutch outer shell retaining ring by compressing the snap ring 180 degrees from the snap ring gap.
   1. Snap ring gap
   2. 180 degrees from the snap ring gap



4. Remove and discard the direct clutch hub.

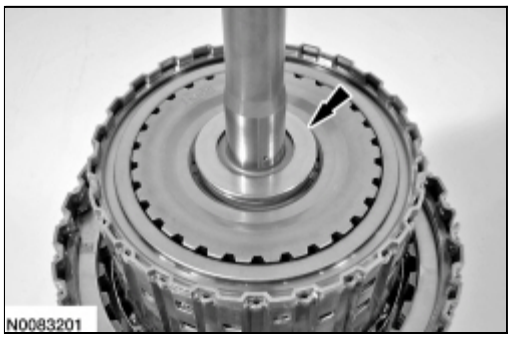


5. Remove the forward clutch and sun shaft assembly.



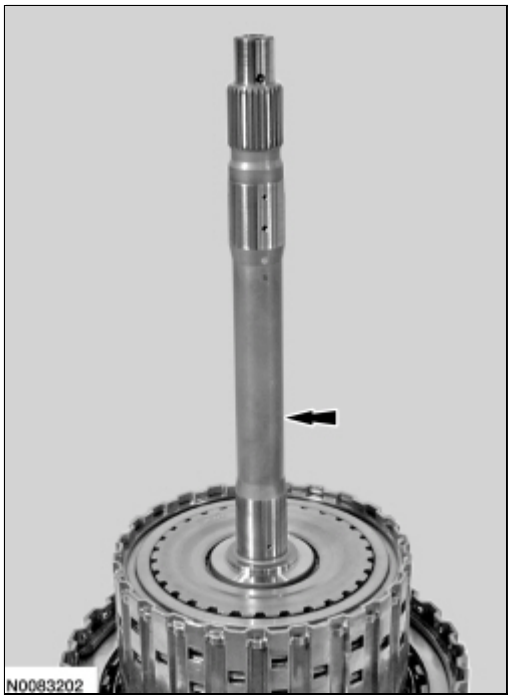
6. **NOTE:** The bearing may stick in the forward clutch drum.

   Remove the intermediate shaft bearing.

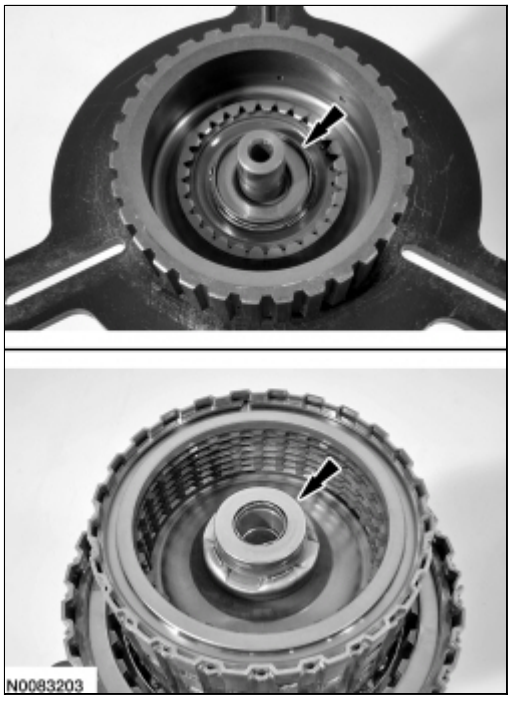


7. Remove the intermediate shaft assembly.

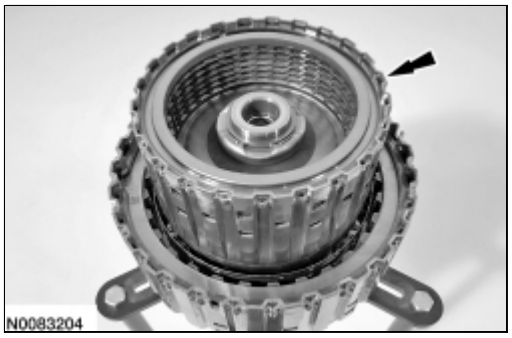
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8. If the T3 thrust bearing stuck to the intermediate shaft assembly, remove it from the intermediate shaft assembly. If the T3 thrust bearing is on the overdrive clutch, remove it from the overdrive clutch assembly.



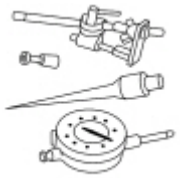
9. Remove the overdrive clutch pack from the forward clutch pack.



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Intermediate Clutch Assembly

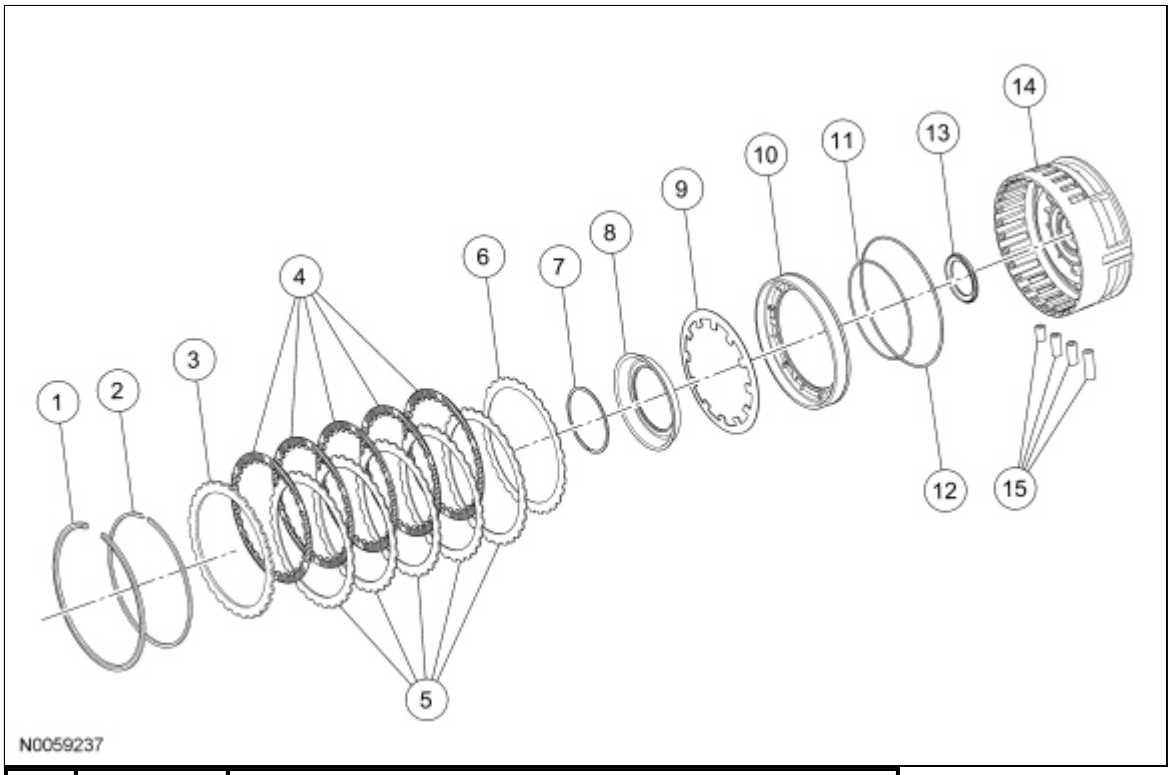
Special Tool(s)

 ST2881-A	Compressor, Clutch Spring 307-525
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2892-A	End Play Gauge, Clutch 307-555

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Intermediate Clutch Assembly



Item	Part Number	Description
1	7D483	Center support retaining ring
2	7D483	Intermediate clutch pack retaining ring
3	7B066	Intermediate clutch pressure plate
4	7B164	Intermediate clutch internal splined friction plates (quantity model dependent)
5	7B442	Intermediate clutch external splined steel plates (quantity model dependent)
6	7E085	Intermediate clutch cushion spring
7	7A577	Intermediate clutch snap ring
8	7B043	Intermediate clutch return spring retaining ring
9	7A480	Intermediate clutch piston return spring
10	7E005	Intermediate clutch piston (model dependant)
11	7F225	Intermediate clutch piston inner seal
12	7F224	Intermediate clutch piston outer seal
13	7F373	Bearing (T6)
14	7A130	Intermediate/low/reverse clutch center support
15	7G199	Center support seals (2 — 7G199, 1 — 7G087, 1 — 7G484)

Disassembly

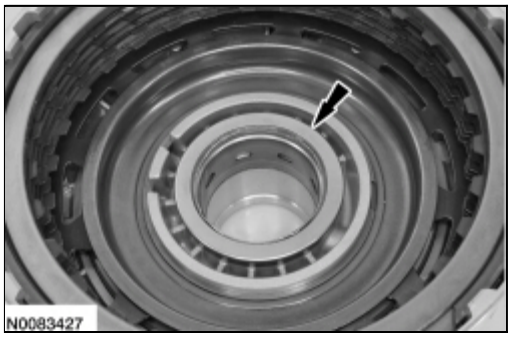
NOTICE: **The intermediate clutch plate quantity is model dependent on engine size. Check the clutch plate quantity charts in specifications for the correct clutch plate quantity. Failure to install the**

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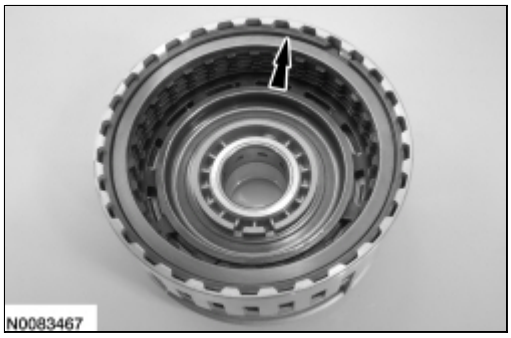
correct clutch plate quantity will result in transmission failure.

NOTICE: **The intermediate clutch piston is model dependent on engine size due to the different quantity of intermediate clutch plates. If installing a new intermediate clutch piston, check to make sure the height of the new piston is the same as the original piston. Failure to install the correct piston will result in transmission failure.**

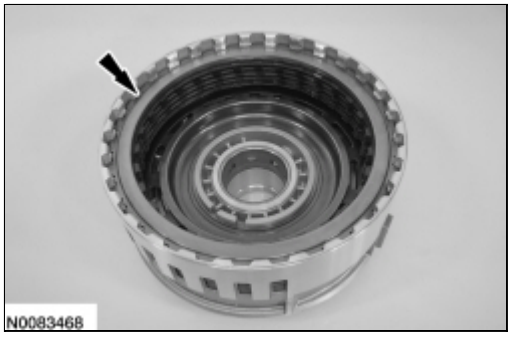
1. Remove the T6 thrust bearing.



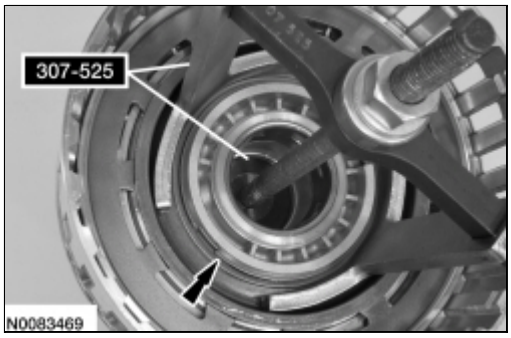
2. Remove the intermediate clutch plate snap ring.



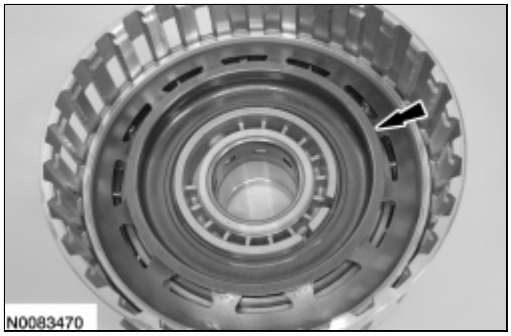
3. Remove the intermediate clutch plates.



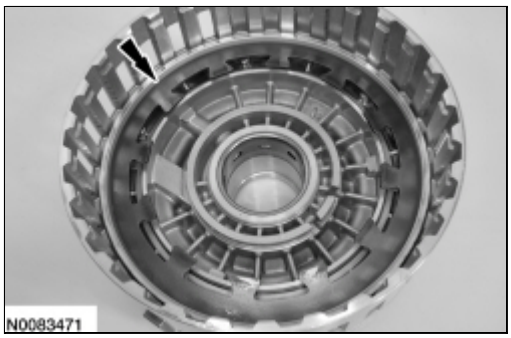
4. Using the Clutch Spring Compressor, remove and discard the intermediate clutch return spring retainer.



5. Remove the intermediate clutch return spring top plate.

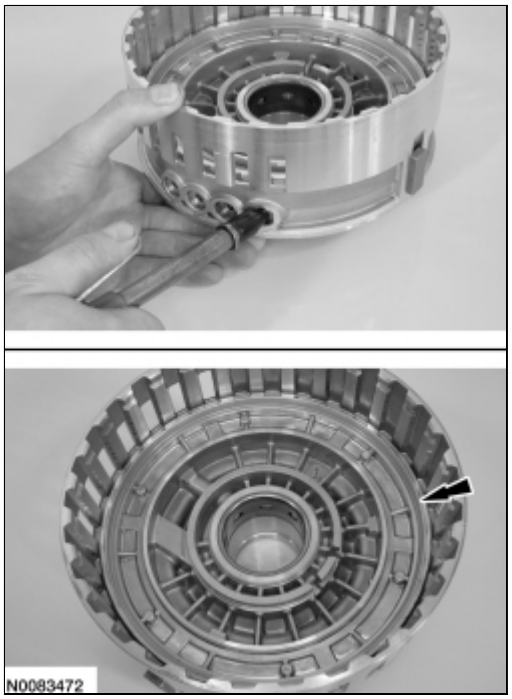


6. Remove the intermediate clutch return spring.

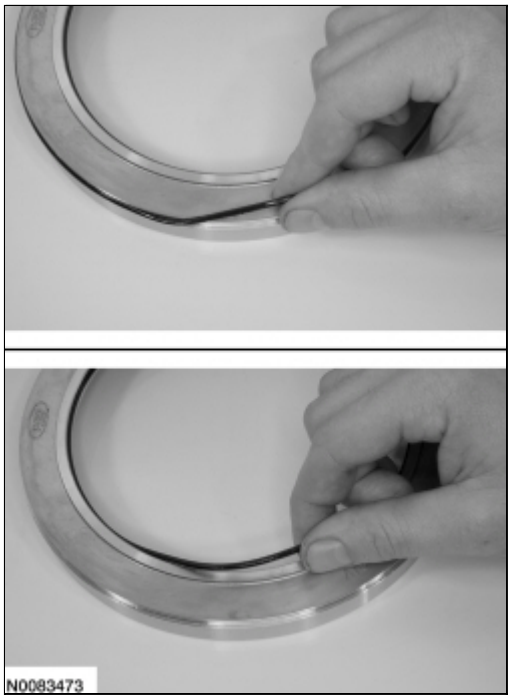


7. Applying a slight amount of air to the port, remove the intermediate clutch piston.

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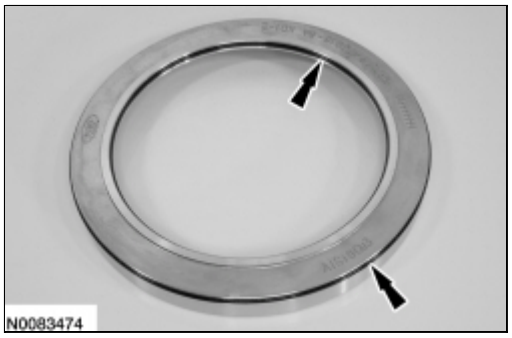


8. Remove and discard the inner and outer intermediate clutch piston O-ring seals.

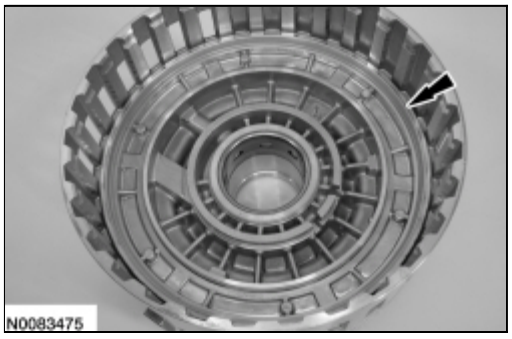


Assembly

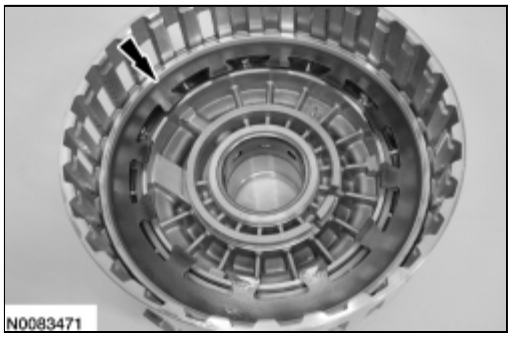
1. Install new inner and outer intermediate clutch piston O-ring seals.



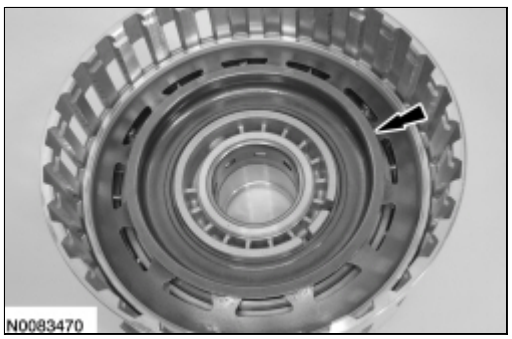
2. Lightly coat the O-ring seals in clean automatic transmission fluid and install the intermediate clutch piston.



3. Install the intermediate clutch return spring.

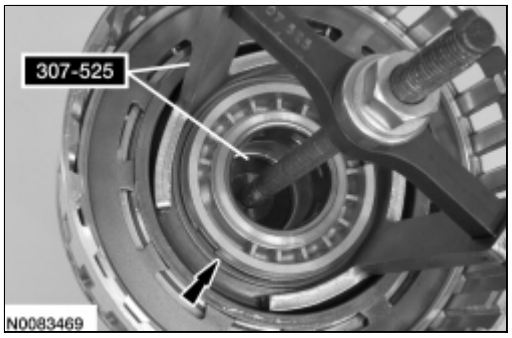


4. Install the intermediate clutch return spring top plate.



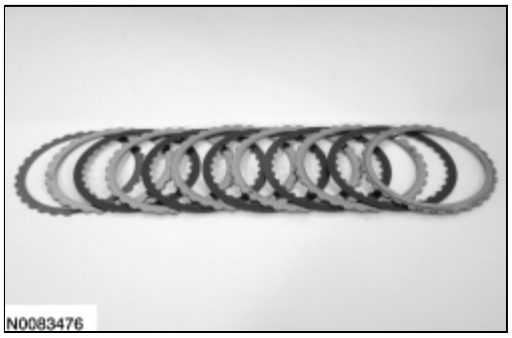
5. Using the Clutch Spring Compressor, install a new intermediate clutch return spring retainer.

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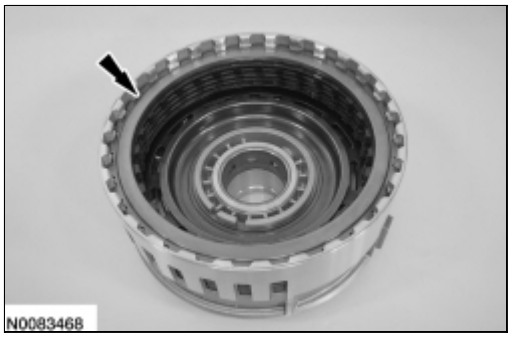


6. **NOTE:** Friction and steel plate quantity will vary based on engine displacement. For additional information, refer to the Clutch Plate Quantity Chart in the Specifications portion of this section.

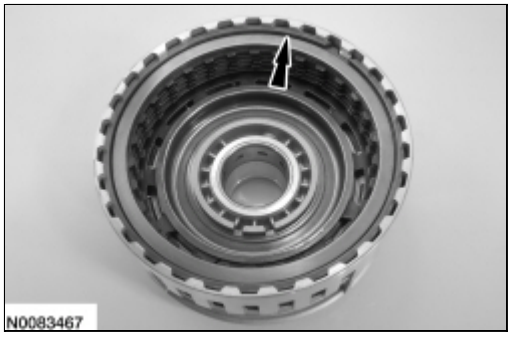
   Soak the new intermediate clutch plates in clean automatic transmission fluid.



7. Install the new intermediate clutch plates, starting with the wave spring then a steel plate and alternating between friction and steel plates, and ending with the pressure plate.

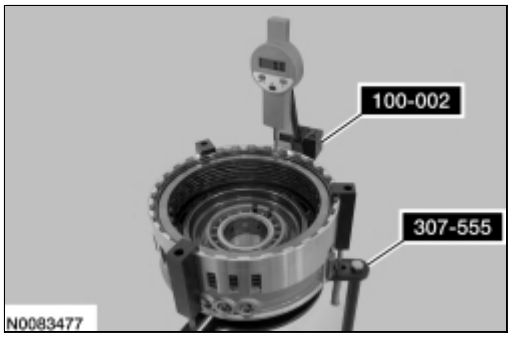


8. Install the intermediate clutch plate snap ring.

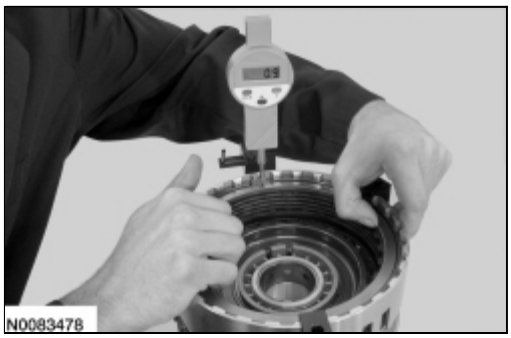


9. **NOTE:** All intermediate clutch plates, friction and steel are of a wave-type design.

   Install the intermediate clutch assembly into the Clutch End Play Gauge and install the Dial Indicator Gauge with Holding Fixture and position the plunger so it fits into the opening of the snap ring.



10. With the Dial Indicator Gauge set at zero, lift up on the steel pressure plate so it is against the select fit snap ring. Record this reading as reading A.



11. Rotate the intermediate clutch assembly 180 degrees from the opening of the snap ring, take a second reading and record this reading as reading B.

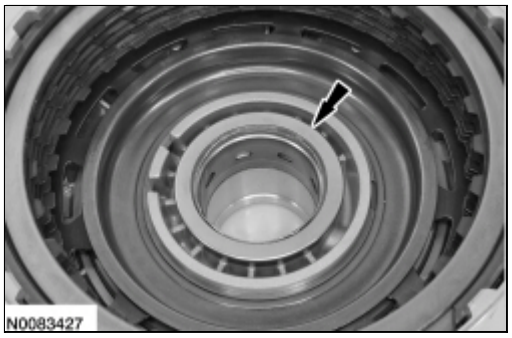
Description	Reading
Reading A	
Reading B	
Add reading A to reading B for a total end clearance	
Divide the total reading by 2 for an average end clearance	

12. **NOTE:** If the final measurement is not within specification, install a new snap ring until the correct specification is achieved.
    - 0.7-1.1 mm (0.027-0.043 in).

    If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is high, remeasure using a thicker select fit snap ring. If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is low, remeasure using a thinner select fit snap ring.

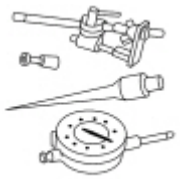
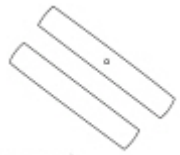
13. Install the T6 thrust bearing.

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Low/Reverse Clutch Assembly

Special Tool(s)

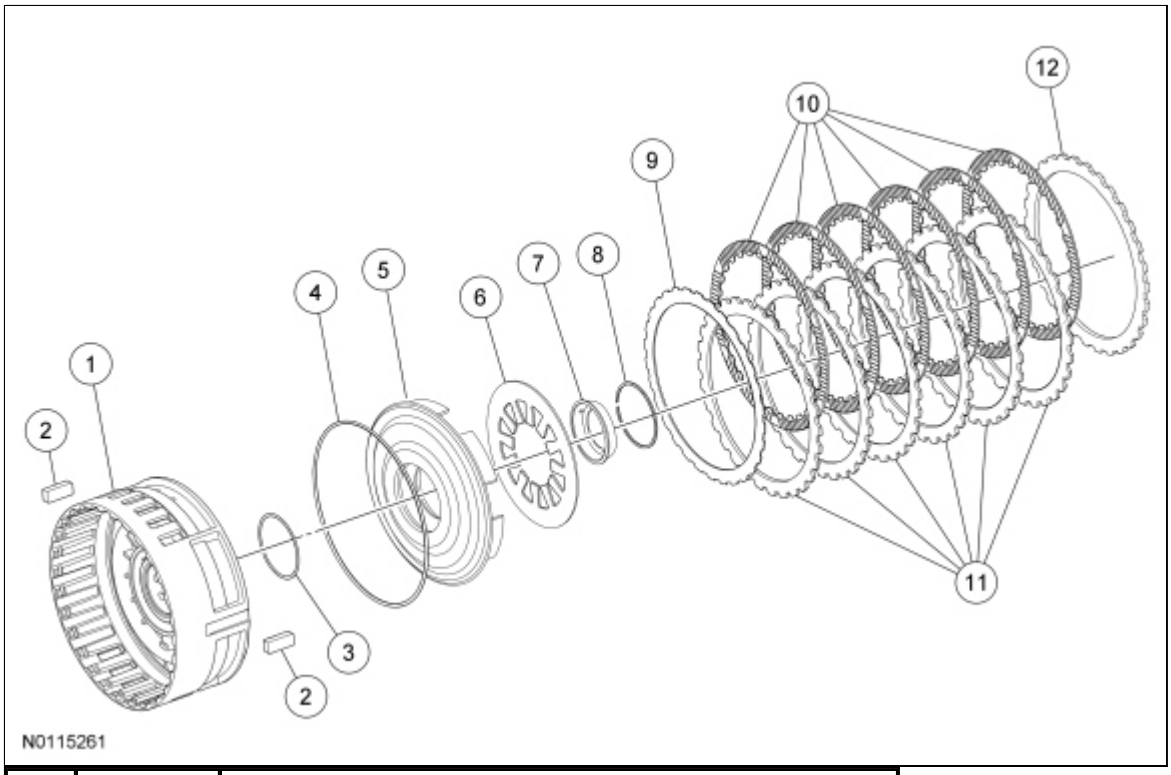
 ST2881-A	Compressor, Clutch Spring 307-525
 ST1274-A	Depth Micrometer 303-D075 (D92P-4201-A) or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2892-A	End Play Gauge, Clutch 307-555
 ST2896-A	Gauge, D-Clutch Measurement 307-554

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Low/Reverse Clutch Assembly

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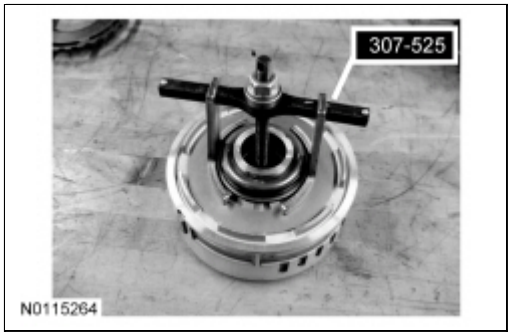
Item	Part Number	Description
1	7A130	Intermediate/low/reverse clutch center support
2	7B220	Center support keys (2 required)
3	7F225	Low/reverse clutch piston center seal
4	7D403	Low/reverse clutch cylinder outer seal
5	7A262	Low/reverse clutch piston
6	7B070	Low/reverse clutch return spring
7	7H318	Low/reverse clutch return spring retainer
8	7D483	Low/reverse clutch return spring snap ring
9	7E085	Low/reverse clutch cushion spring
10	7B164	Low/reverse clutch internal splined friction plates (internally splined to the rear planetary carrier)
11	7B442	Low/reverse clutch external splined steel plates (externally splined to the case)
12	7B066	Low/reverse clutch pressure plate (externally splined to the case) (select fit)

Disassembly

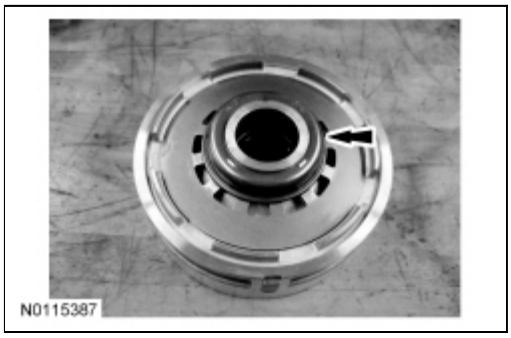
NOTICE: **The low/reverse clutch plate quantity is model dependent on engine size. Check the clutch plate quantity charts in specifications for the correct clutch plate quantity. Failure to install the correct clutch plate quantity will result in transmission failure.**

NOTE: The low/reverse clutch plates are installed in the case during the transmission assembly procedure.

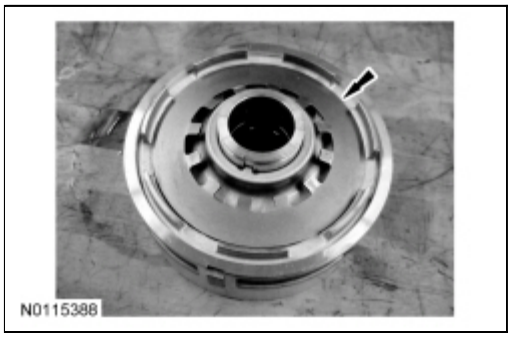
1. Using the Clutch Spring Compressor, remove and discard the low/reverse clutch return spring retainer.



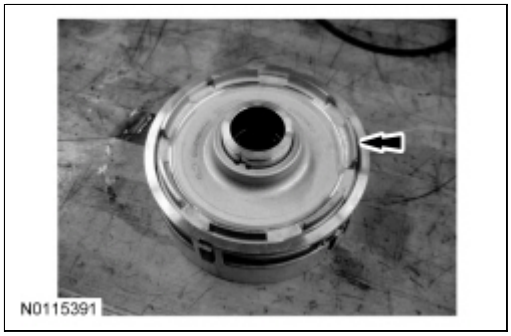
2. Remove and discard the low/reverse clutch return spring retainer.



3. Remove the low/reverse clutch return spring.

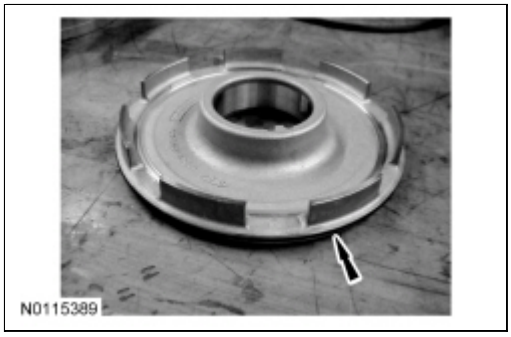


4. Apply a slight amount of air to the port, remove the low/reverse clutch piston from the low/reverse clutch drum.



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5. Remove and discard the low/reverse outer piston O-ring seal.



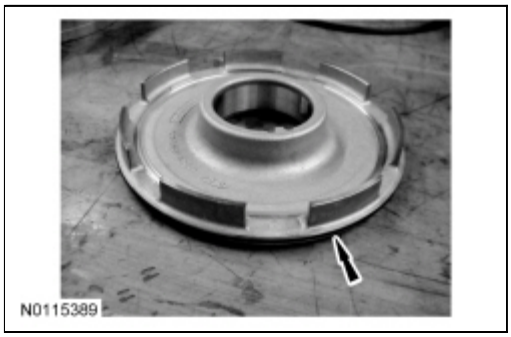
6. Remove and discard the low/reverse drum O-ring seal.



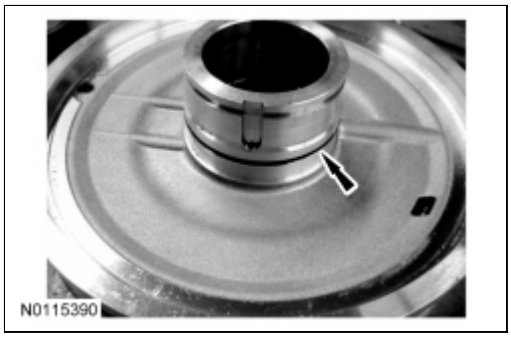
Assembly

Low/reverse piston

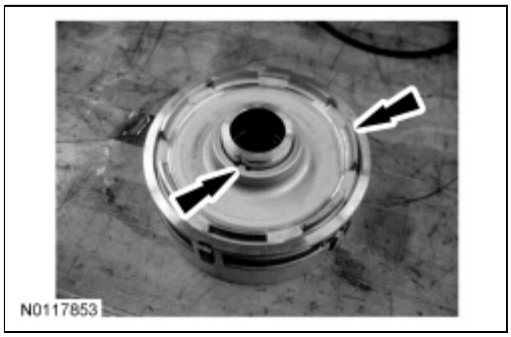
1. Install new low/reverse outer piston O-ring seal.



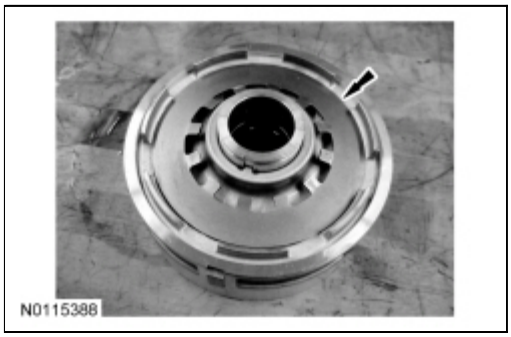
2. Install new low/reverse drum O-ring seal.



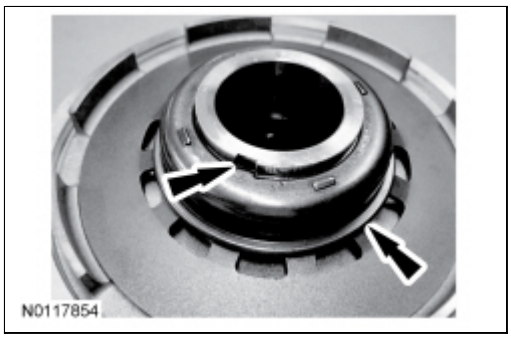
3. Lubricate the O-ring seal with clean transmission fluid. Align the alignment tab on the piston with the groove in the center support and install the low/reverse piston.



4. Install the low/reverse clutch return spring.

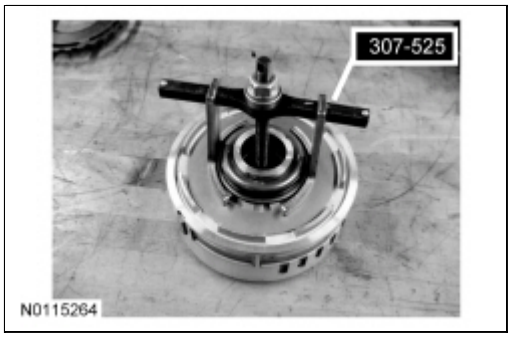


5. Install a new low/reverse clutch return spring retainer. Align the alignment tab on the retainer with the groove in the center support and install the low/reverse piston return spring retainer.



6. Using the Clutch Spring Compressor, compress the low/reverse clutch return spring and install the retaining ring.

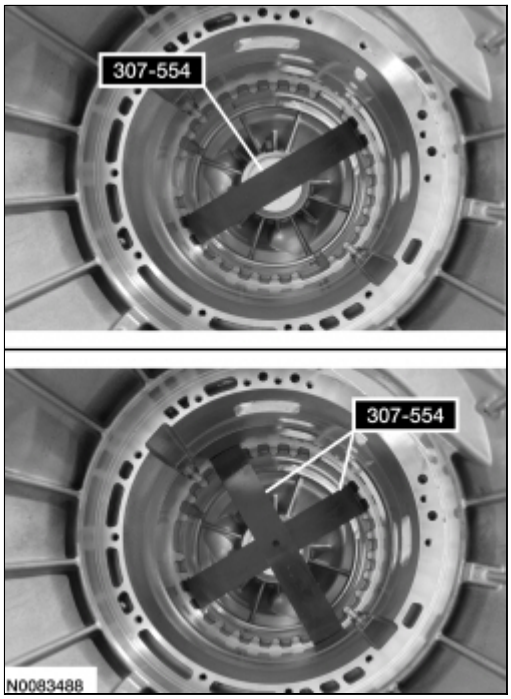
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Low/reverse clutch stackup

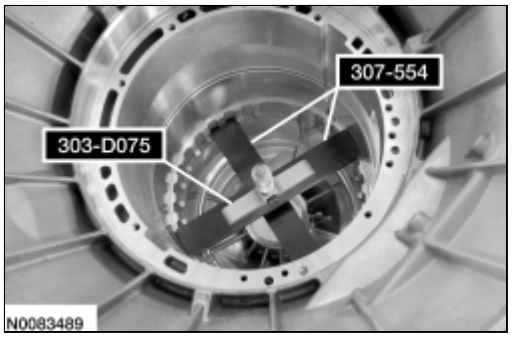
7. **NOTE:** All low/reverse clutch plates, friction and steel are of a wave-type design.

   Install the D-Clutch Measurement Gauge into the case.



8. With the D-Clutch Measurement Gauge positioned in the case, use the Depth Micrometer to measure the case stop depth.

Description	Reading
Measure the distance from the top of the upper gauge bar to the top of the lower gauge bar. Record this reading as the case measurement. Record as reading A.	



9. Measure the clutch pack height.

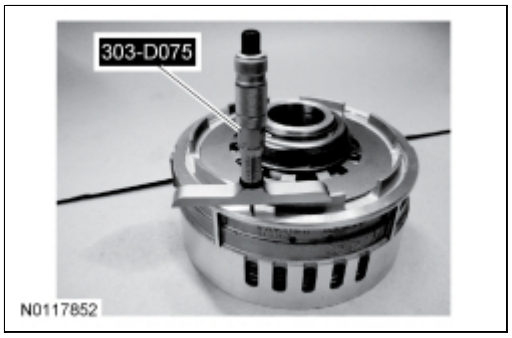
	Description	Reading
A.	Place the low/reverse clutch pack on the Clutch End Play Gauge with the wave spring down and the pressure plate on top. Using the Dial Indicator Gauge with Holding Fixture, place the plunger on the pressure plate. Slide the clutch to the side so the plunger of the Dial Indicator is touching the gauge plate of the Clutch End Play Gauge. Zero out the Dial Indicator Gauge.	
B.	Carefully lift the plunger enough to slide the clutch pack under the plunger to take a reading. Record this reading. Rotate the clutch pack 180 degrees and take a second reading. Add the first and second readings together and divide the total by 2. Record this reading as B.	



10. Using the Depth Micrometer, measure the piston to center support shoulder height.

Description	Reading
Measure the piston to center support shoulder height. Record this measurement. Rotate the center support 180 degrees and record this measurement. Add the first and the second measurements, then divide by 2. Record this as reading C.	

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11. Calculate the end clearance.

Description	Reading
Subtract B and C from A to determine end clearance	
Total C measurement	
End clearance specification	1.0-1.6 mm (0.039-0.062 in)

Compare the end clearance to the specification. If the end clearance is out of specification, select the next thinner or thicker plate as required and repeat Steps 10, 11 and 12.

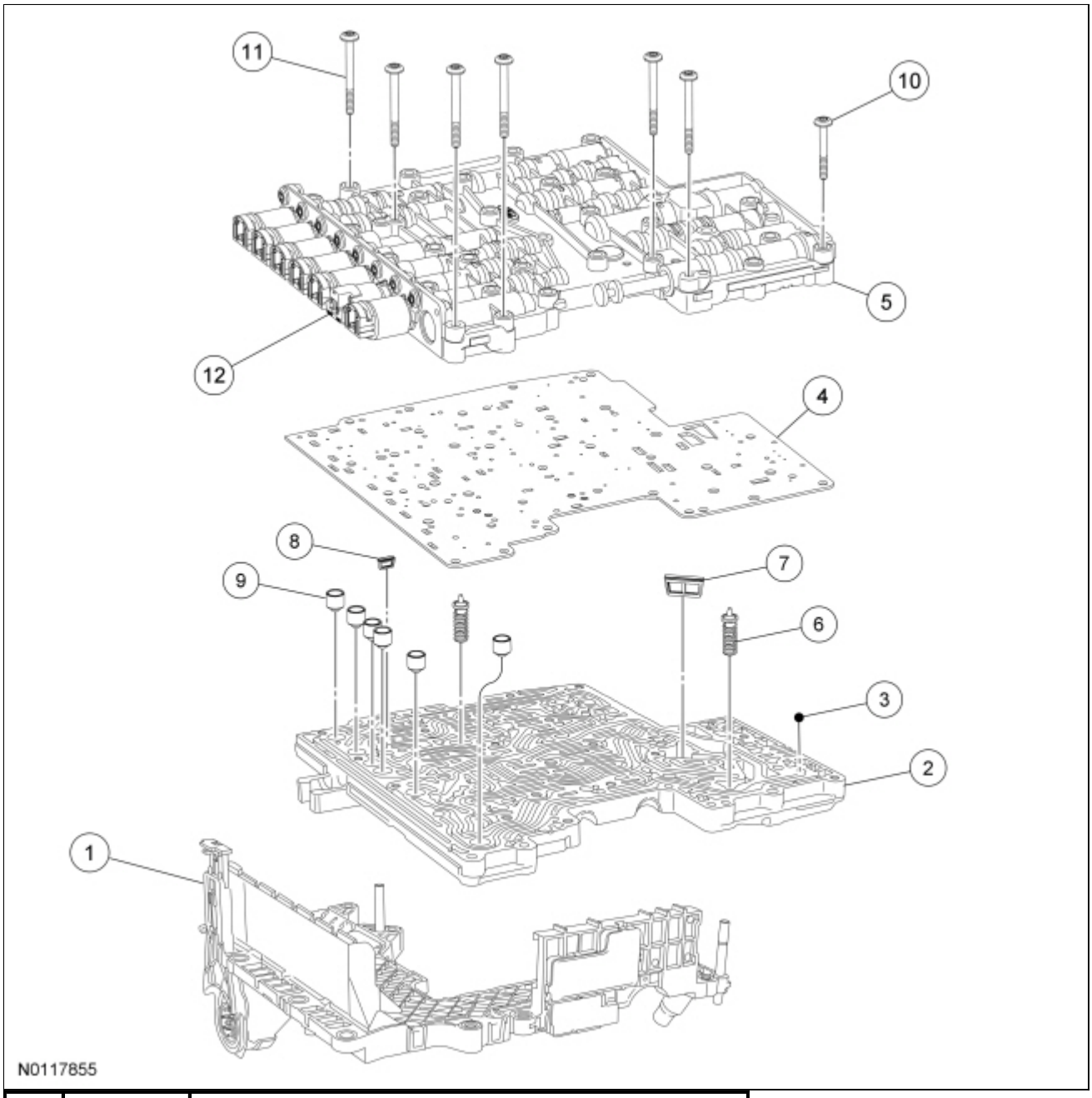
Main Control

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

Main Control Assembly

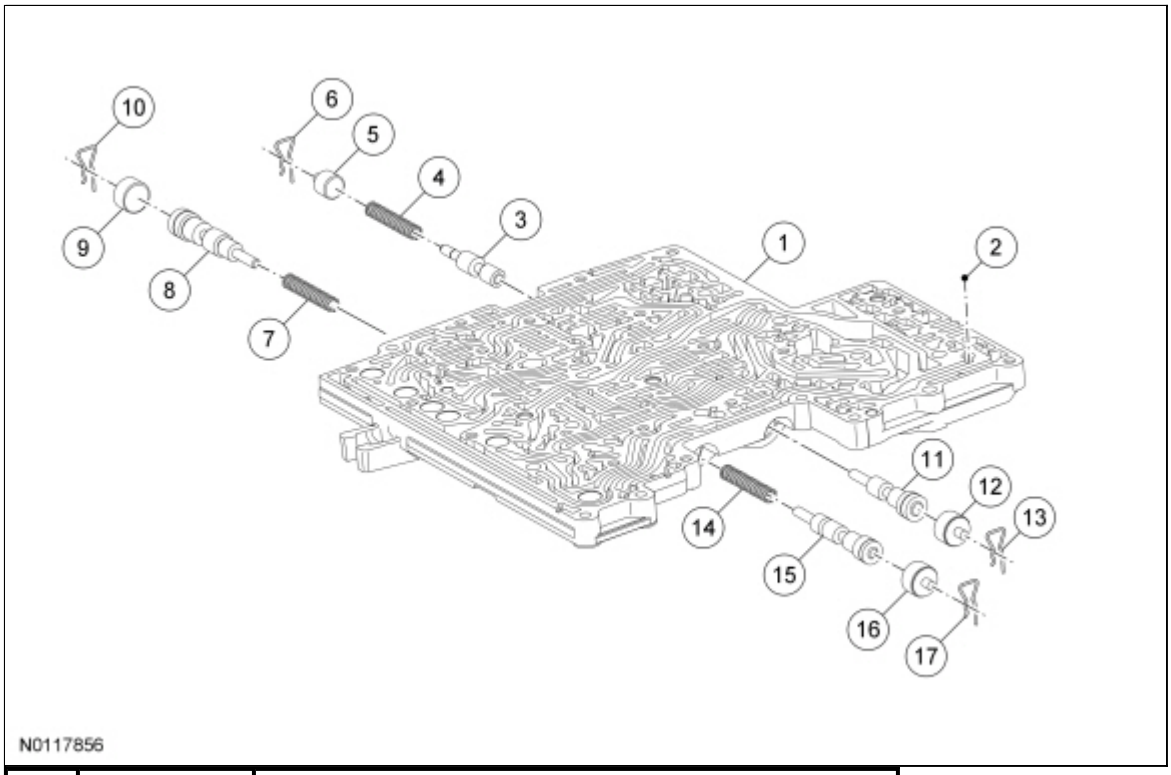
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Item	Part Number	Description
1	7G276	Molded leadframe
2	—	Main control valve body (upper)
3	7E195	Main control valve check ball (8 required)
4	7Z490	Main control valve body separator plate
5	—	Main control valve body (lower)
6	—	Main control valve
7	7H187	Main control filter
8	7B155	Transmission fluid filter

9	7J191	Transmission solenoid damper valve assembly
10	W707886	Main control assembly short bolt — connects upper and lower half together (19 required)
11	W707884	Main control assembly long bolt — connects molded leadframe to main control valve assembly (6 required)
12	—	Transmission shift control solenoids

Main Control Upper Half

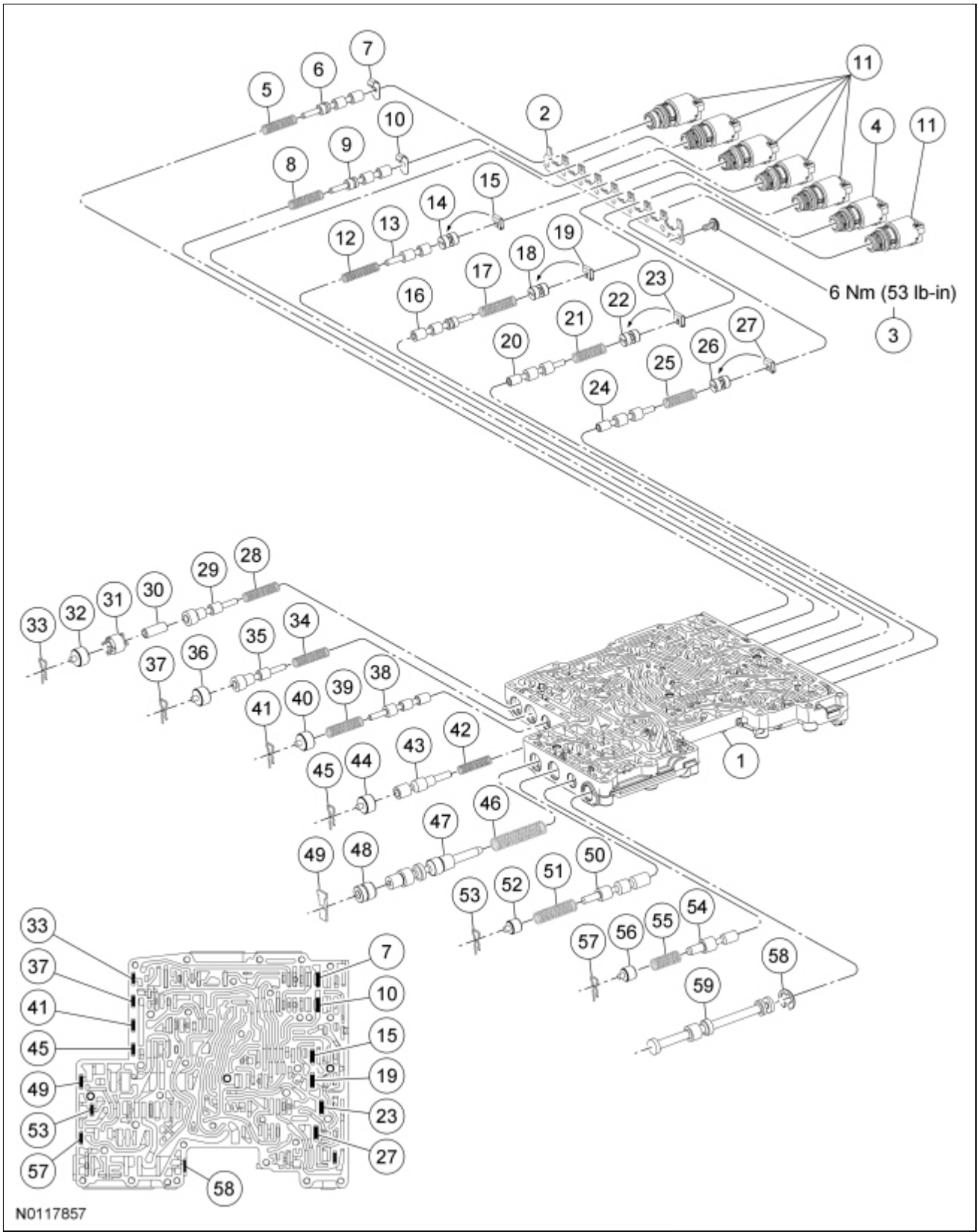


Item	Part Number	Description
1	7A092	Main control valve assembly (ditch plate) (upper half)
2	7E195	Main control valve check ball (8 required)
3	—	Transmission clutch D2 latch valve
4	—	Transmission clutch valve spring
5	—	Transmission clutch valve spring plug
6	7G007	Transmission clutch valve spring plug retaining clip
7	—	Transmission clutch valve spring
8	—	Transmission clutch B regulator valve
9	—	Transmission clutch valve spring plug
10	7G007	Transmission clutch valve spring plug retaining clip
11	—	Transmission clutch valve
12	—	Transmission clutch valve spring plug

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13	7G007	Transmission clutch valve spring plug retaining clip
14	—	Transmission clutch valve spring
15	—	Transmission clutch valve
16	—	Transmission clutch valve spring plug
17	7G007	Transmission clutch valve spring plug retaining clip

Main Control Lower Half



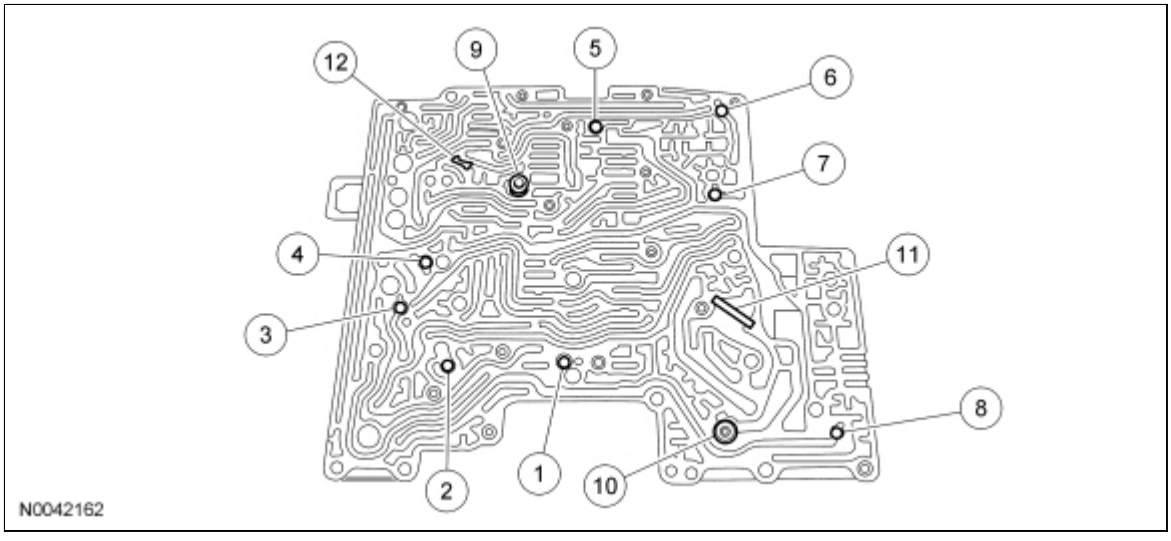
Item	Part Number	Description
1	—	Main control valve assembly (lower half)

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2	—	Transmission shift control solenoid hold-down bracket
3	—	Transmission shift control solenoid hold-down bracket bolt M5 x 0.80 x 12 (8 required)
4	7G484	Transmission ON/OFF shift solenoid
5	—	Transmission clutch valve spring
6	—	Transmission clutch A latch valve
7	—	Transmission spring retainer plate
8	—	Transmission clutch valve spring
9	—	Transmission clutch B latch valve
10	7F194	Transmission spring retainer plate
11	7G383	Transmission VFS (6 required)
12	—	Transmission solenoid regulator valve spring
13	—	Transmission solenoid pressure regulator valve
14	—	Transmission solenoid plug
15	7G007	Transmission valve plug retainer
16	—	Transmission clutch D1 latch valve
17	—	Transmission clutch valve spring
18	—	Transmission solenoid plug
19	7G007	Transmission valve plug retainer
20	—	Transmission drive enable valve
21	—	Transmission solenoid valve spring
22	—	Transmission solenoid plug
23	7G007	Transmission valve plug retainer
24	—	Transmission solenoid multiplex valve
25	—	Transmission solenoid valve spring
26	—	Transmission solenoid plug
27	7G007	Transmission valve plug retainer
28	—	Transmission clutch valve spring
29	—	Transmission clutch A pressure regulator valve
30	—	Transmission clutch regulator valve sleeve
31	—	Transmission valve return plug
32	—	Transmission valve return plug
33	7G077	Transmission valve plug return clip
34	—	Transmission clutch valve spring
35	—	Transmission clutch E pressure regulator valve
36	—	Transmission valve return plug
37	7G007	Transmission valve plug return clip
38	—	Transmission clutch E latch valve
39	—	Transmission clutch control valve spring

40	—	Transmission valve return plug
41	7G007	Transmission valve plug return clip
42	—	Transmission bypass clutch control valve spring
43	—	Transmission bypass clutch control valve
44	—	Transmission valve return plug
45	7G007	Transmission valve plug return clip
46	—	Transmission manual oil pressure regulator valve spring
47	—	Transmission main oil pressure regulator valve
48	—	Transmission manual oil pressure regulator valve sleeve
49	7G007	Transmission valve plug return clip
50	—	Transmission converter regulator valve
51	—	Transmission converter regulator valve spring
52	—	Transmission valve return plug
53	7G007	Transmission valve plug return clip
54	—	Transmission lube control valve
55	—	Transmission lube control valve spring
56	—	Transmission valve return plug
57	7G007	Transmission valve plug return clip
58	W527007-S	Retaining ring
59	—	Transmission control manual valve

Check Ball Location

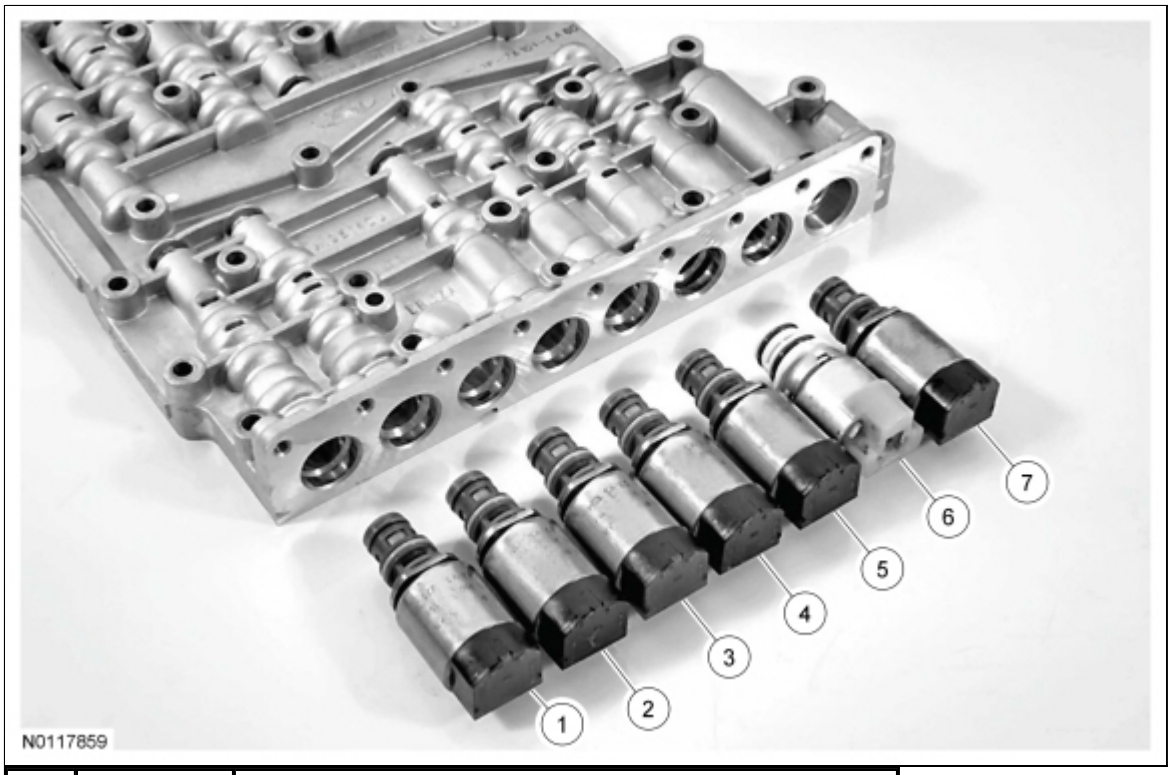


Item	Description
1	Reverse/drive control check ball

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2	Shift solenoid control check ball
3	Intermediate clutch exhaust control check ball
4	Direct clutch exhaust control check ball
5	Low/reverse clutch exhaust control check ball
6	Forward clutch exhaust control check ball
7	Overdrive clutch exhaust control check ball
8	Reverse exhaust control check ball
9	Clutch exhaust valve
10	Converter drain back valve
11	Large filter screen
12	Small filter screen

Shift Solenoid Location



Item	Part Number	Description
1	7G383	SSA , Forward (1,2,3,4) clutch, normally low VFS (brown nozzle).
2	7G383	SSB , Direct (3,5,R) clutch, normally high VFS (black nozzle).
3	7G383	SSC , Intermediate (2,6) clutch, normally low VFS (brown nozzle).

4	7G383	LPC solenoid, normally high VFS (black nozzle).
5	7G383	SSD , low/reverse/overdrive clutch, normally high VFS (black nozzle).
6	7G484	SSE , normally off ON/OFF solenoid.
7	7G383	TCC solenoid, normally low VFS (brown nozzle).

Disassembly

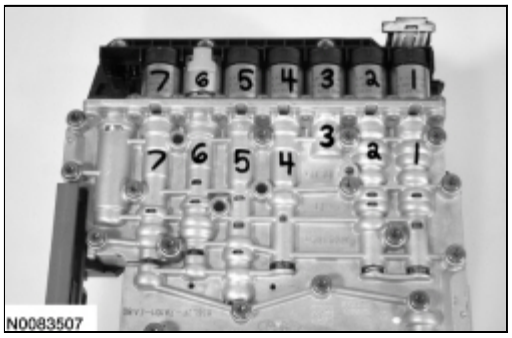
NOTE: Make an identifying mark on each solenoid and the corresponding bore for correct assembly.

NOTE: Solenoids may visually appear the same but their designs/functions are different. Use care not to assemble the main control assembly incorrectly. Incorrect solenoid installation results in poor transmission shift quality.

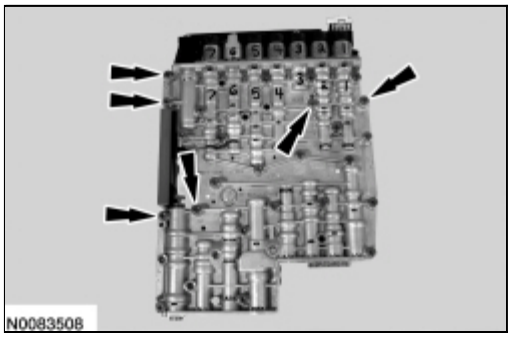
NOTE: Note the location of the 8 check balls, 6 solenoid dampers, 2 internal valves and springs and 2 filter screens for reassembly.

Main Control Upper Half

1. Make an identifying mark on each solenoid and the corresponding bore for correct assembly.

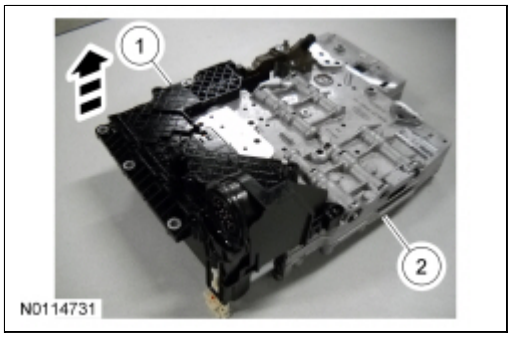


2. Remove the 6 long molded leadframe-to-valve body bolts from the molded leadframe.

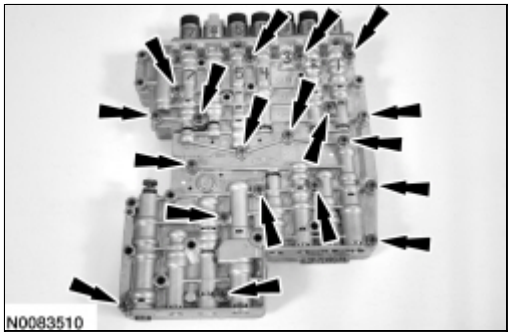


3. Carefully separate the molded leadframe from the main control assembly.
    1. Molded leadframe
    2. Main control assembly

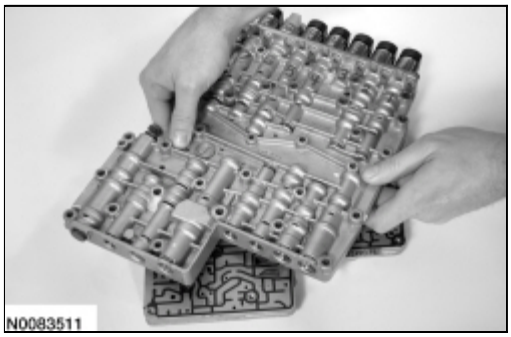
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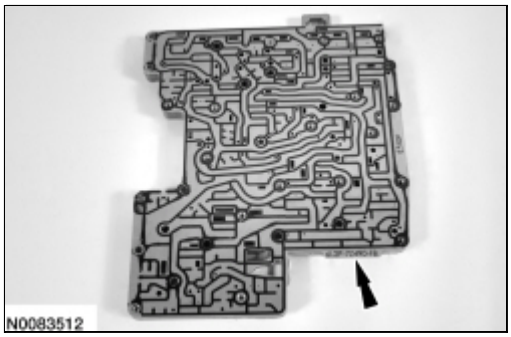
4. Remove 19 short molded leadframe-to-valve body bolts from the main control assembly.



5. Separate the lower half of the main control assembly from the upper half of the main control assembly.

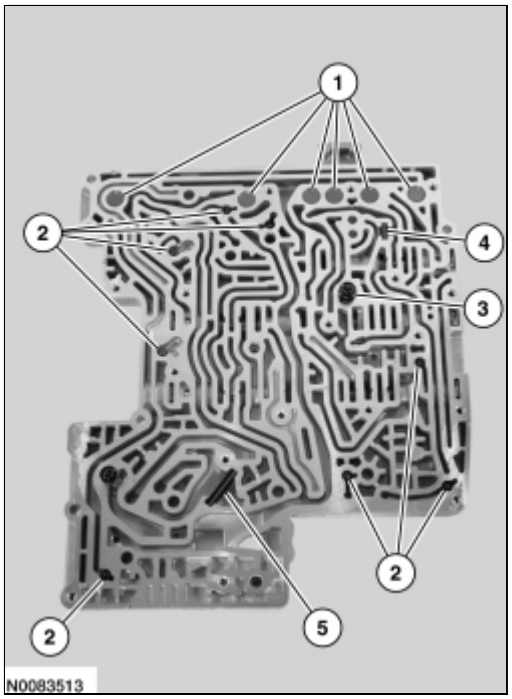


6. Remove and discard the main control valve body separator plate.

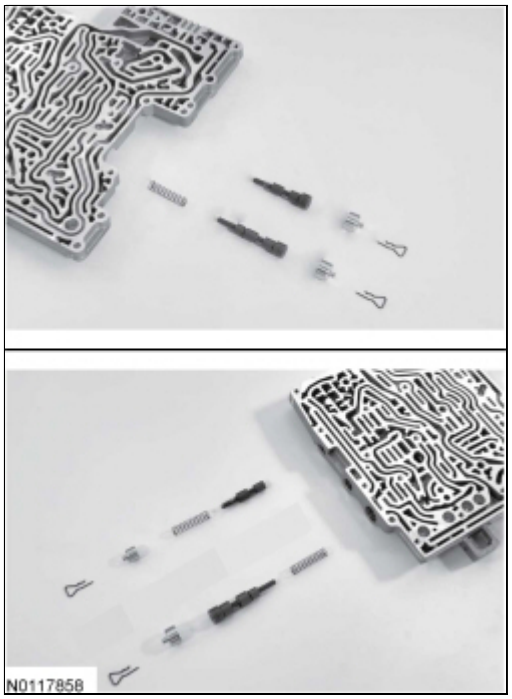


7. Remove the solenoid dampers, check balls, converter drain back valve and filter screens from the main control assembly. Note the location for assembly.
    1. Solenoid dampers

2. Check balls
3. Converter drain back valve
4. Small filter screen
5. Large filter screen



8. Remove the retaining clips, caps, valves and valve springs from each bore of the main control assembly. Note the location and order for assembly.



9. Using clean mineral spirits, clean the upper half of the main control assembly.

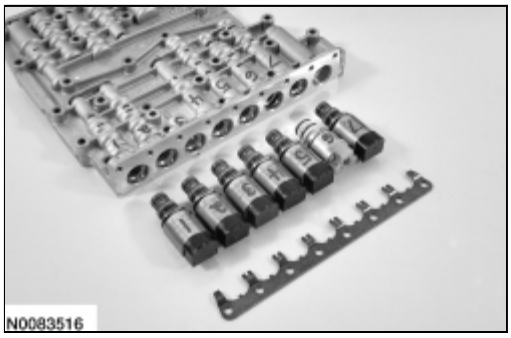
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Main Control Lower Half

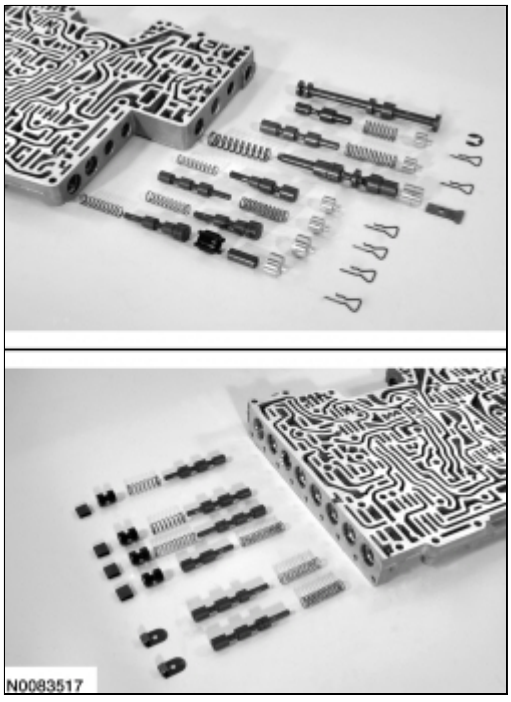
10. Remove the 8 solenoid hold down bracket bolts and the solenoid hold down bracket.



11. Remove the solenoids.



12. Remove the retaining clips, caps, valves and valve springs from each bore of the main control assembly. Note the location and order for assembly.



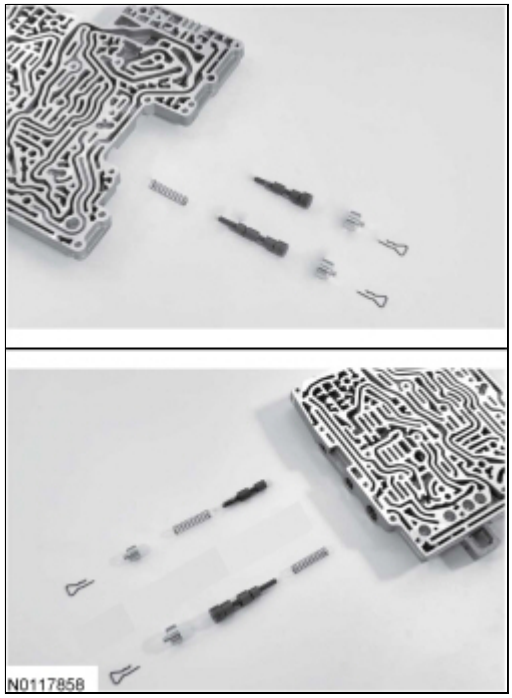
13. Using clean mineral spirits, clean the lower half of the main control assembly.

Assembly

Main Control Upper Half

1. **NOTE:** Many components and surfaces in the main control valve body are precision machined. Careful handling during disassembly, cleaning, inspection and assembly prevents unnecessary damage to machined surfaces.

   Install the retaining clips, caps, valves and valve spring into each bore.

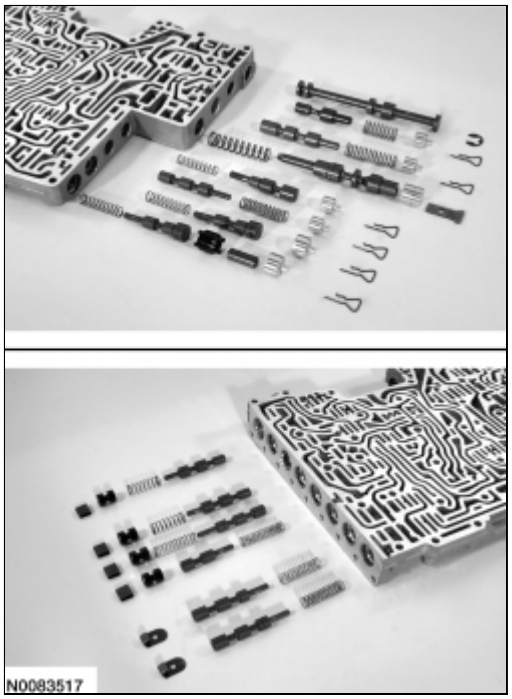


Main Control Lower Half

2. **NOTE:** Many components and surfaces in the main control valve body are precision machined. Careful handling during disassembly, cleaning, inspection and assembly prevents unnecessary damage to machined surfaces.

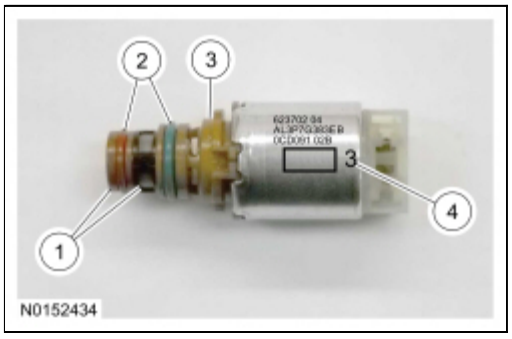
   Install the retaining clips, caps, valves and valve spring into each bore.

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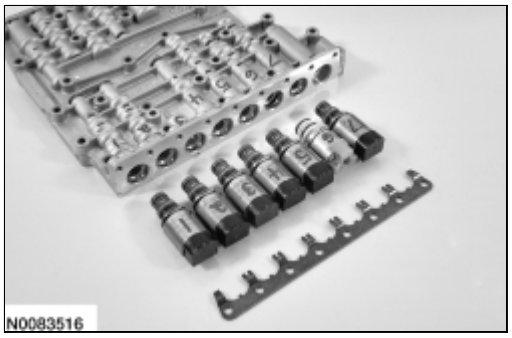


3. ***NOTICE:*** **A VFS is calibrated from the factory and are not all the same. To replace a VFS , match the replacement solenoid nozzle color and the band number with the original solenoid or harsh/erratic shifts, harsh/soft engagement or damage to the transmission can occur.**

   Inspect the solenoid screens for contamination and install new solenoids if needed. Lubricate the solenoid O-rings with clean transmission fluid.
   If replacing a solenoid, use the solenoid exploded view at the beginning of this procedure to identify what type of solenoid is being replaced. The solenoid can be a normally high VFS with a black nozzle, normally low VFS with a brown nozzle or an ON/OFF solenoid.
   If replacing a VFS , record the band number and the solenoid nozzle color to get the correct part number for the solenoid.
   1. Screens
   2. O-rings
   3. Solenoid nozzle
   4. Solenoid band number



4. Install the solenoids into their correct bores as indicated during disassembly.



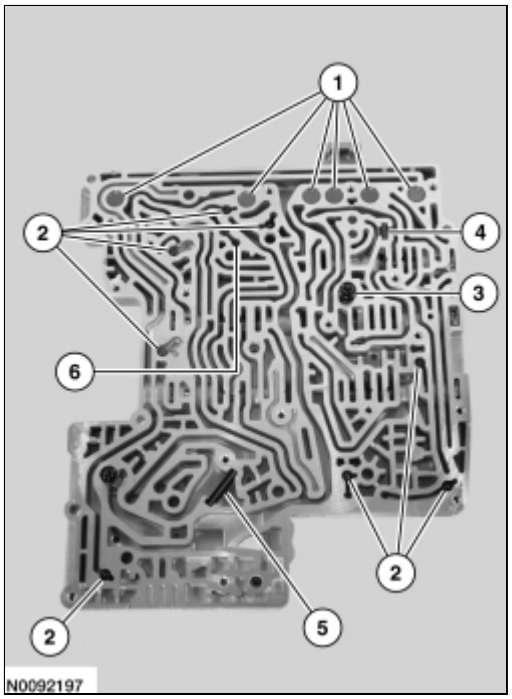
5. Install the shift control solenoid hold down bracket and the 8 hold down bracket bolts.
    - Tighten to 6 Nm (53 lb-in).



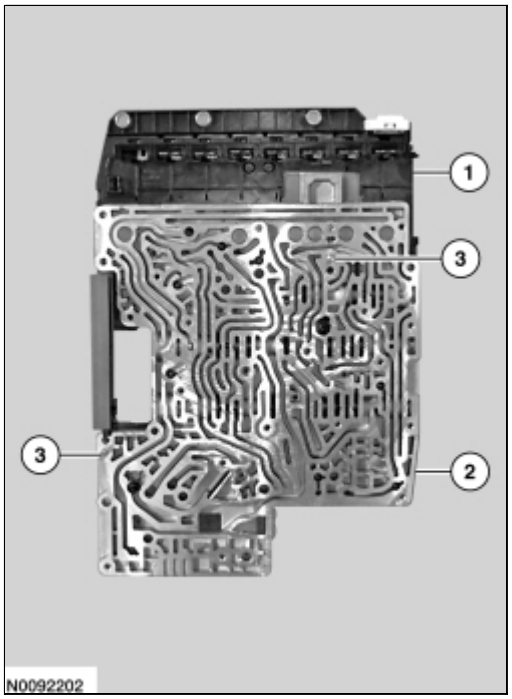
6. ***NOTICE:*** **Toward the back of the upper valve body there is a hydraulic passage that is shaped as though it receives a check ball. This passage does not require a check ball. Be sure not to mistake this hydraulic passage for a passage that does require a check ball or damage to the transmission can occur.**

    Install the solenoid dampers, check balls, converter drain back valve and filter screens.
    1. Solenoid dampers
    2. Check balls
    3. Converter drain back valve
    4. Small filter screen
    5. Large filter screen
    6. Empty hydraulic passage (no check ball)

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7. Align the guide pins on the molded leadframe with the holes in the main control upper valve body and install the valve body onto the molded leadframe.
    1. Molded leadframe
    2. Main control upper valve body
    3. Guide pins

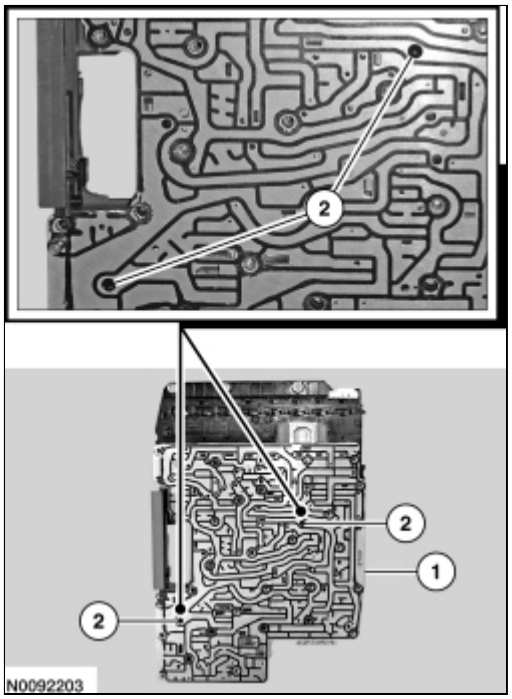


8. ***NOTICE:*** **If the drain back valves are not installed correctly in the separator plate, damage to the transmission can occur.**

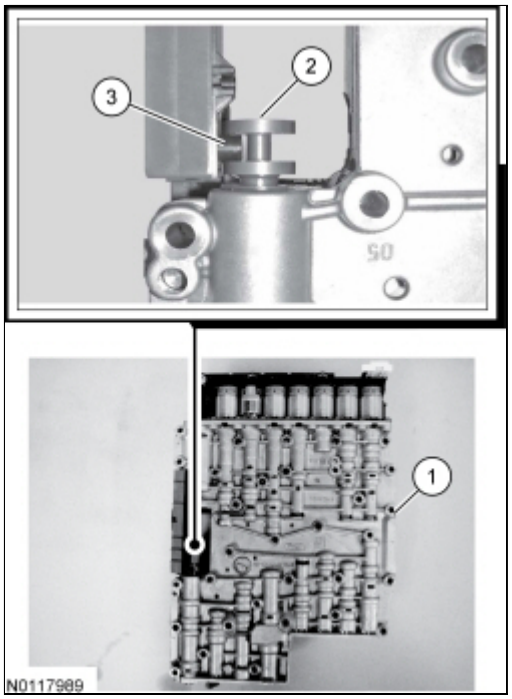
    Position the new main control separator plate on the main control upper valve body.

Check the 2 drain back valves to be sure they are correctly positioned in the separator plate when the separator plate is pressed flush against the main control upper valve body.

1. Main control separator plate
2. Drain back valves

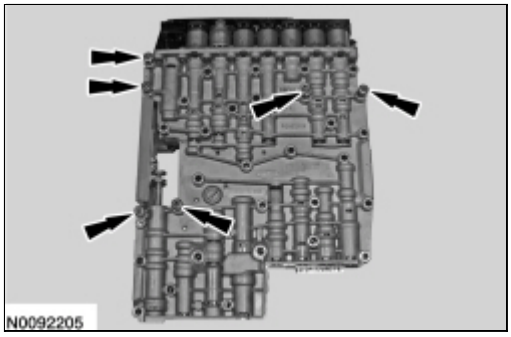


9. Position the main control lower valve body on the 2 molded leadframe alignment studs, align the manual valve with the TR sensor on the molded leadframe and install the main control lower valve body.
    1. Main control lower valve body
    2. Manual valve
    3. TR sensor

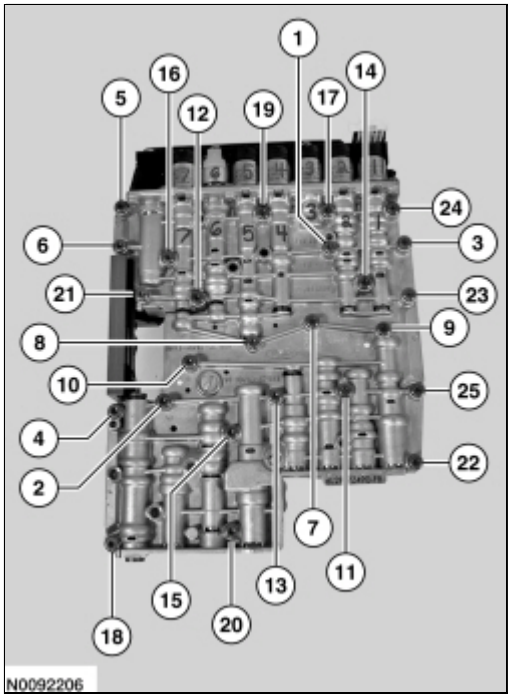


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10. Install the 6 long molded leadframe-to-valve body bolts hand-tight.



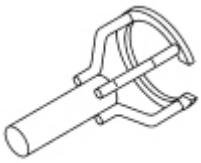
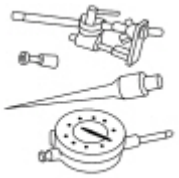
11. Install the 19 short main control assembly lower-to-upper valve body bolts. Tighten the bolts in the sequence shown.
    - Tighten bolts 1 through 6 to 6 Nm (53 lb-in).
    - Tighten bolts 7 through 25 to 7 Nm (62 lb-in).



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Overdrive Clutch Assembly

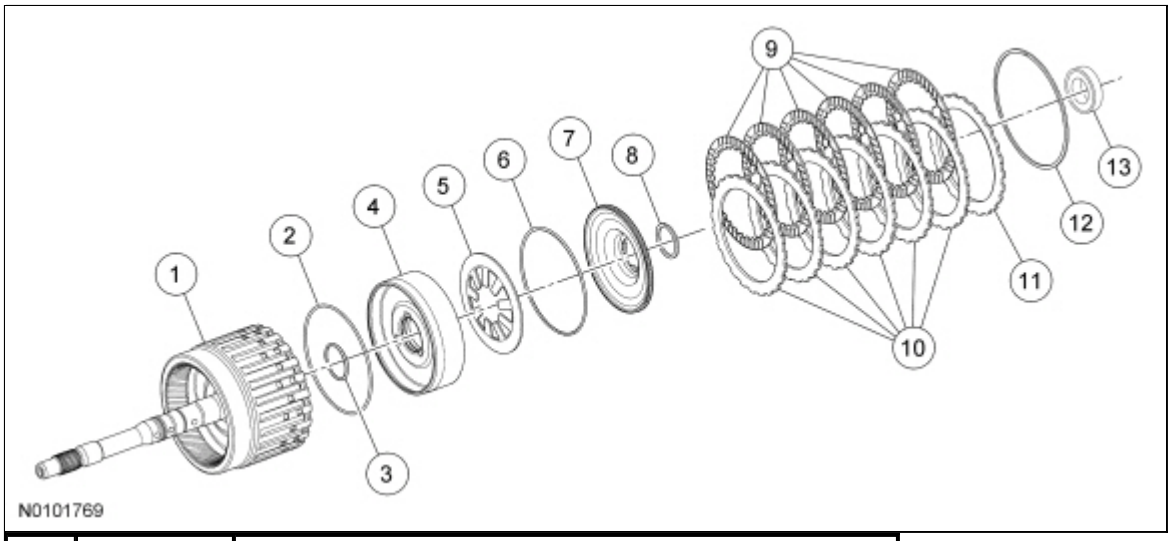
Special Tool(s)

 ST2497-A	Compressor, Spring Washer 307-209
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2892-A	End Play Gauge, Clutch 307-555

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

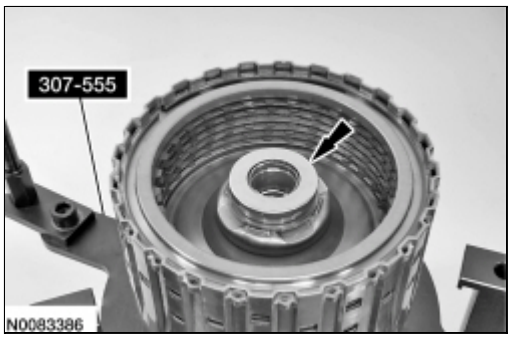
Overdrive (O/D) Clutch Assembly



Item	Part Number	Description
1	7F207	Input shaft
2	7A548	Overdrive (O/D) clutch piston outer seal
3	7A548	O/D clutch piston inner seal
4	7A262	O/D clutch piston
5	7B070	O/D clutch piston spring
6	7A548	O/D balance piston outer seal
7	7H360	O/D balance piston
8	7C122	O/D balance piston snap ring
9	7B164	O/D clutch internal splined clutch friction plates (quantity model dependent)
10	7B442	O/D clutch external splined clutch steel plates (quantity model dependent)
11	7B066	O/D pressure plate
12	7D483	O/D clutch retaining ring
13	7C096	Bearing T3

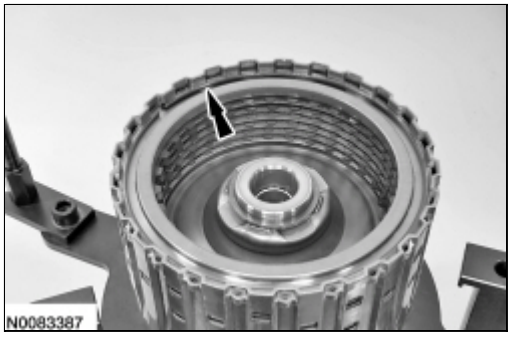
Disassembly

1. Position the Overdrive (O/D) clutch assembly in the Clutch End Play Gauge and remove the T3 thrust bearing.

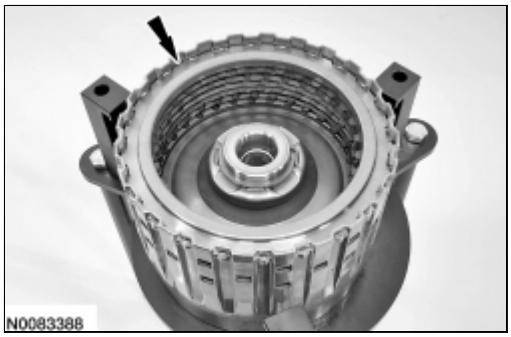


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2. Remove the O/D clutch pack snap ring.



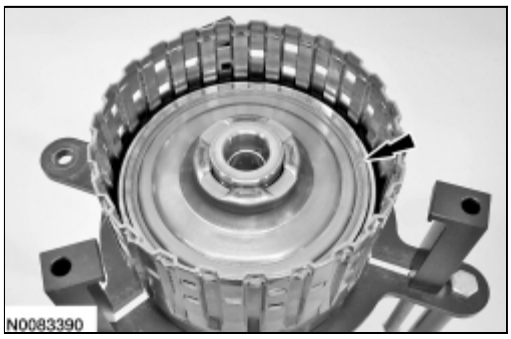
3. Remove the O/D clutch pack.



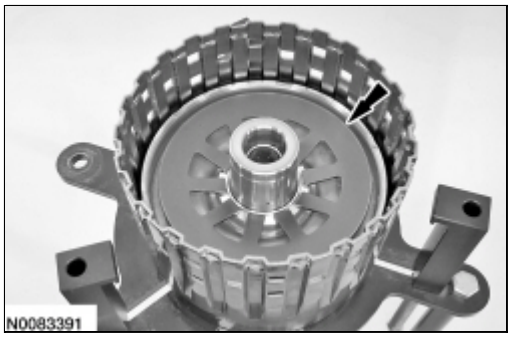
4. Using the Spring Washer Compressor and a press, remove and discard the O/D clutch balance piston retaining ring.



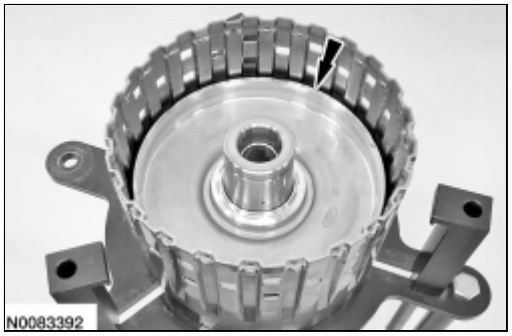
5. Remove the O/D clutch balance piston.



6. Remove the O/D clutch return spring.



7. Remove the O/D clutch apply piston.

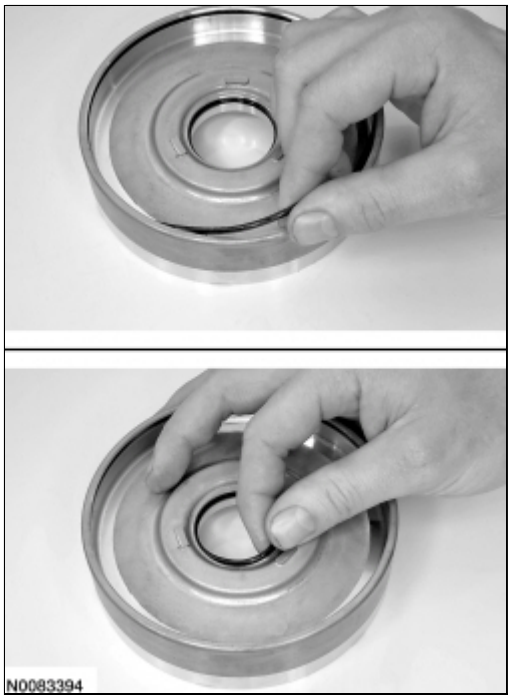


8. Remove and discard the outer O-ring seal on the O/D clutch balance piston.



9. Remove and discard both the inner (one large and one small) O-ring seals on the O/D clutch apply piston.

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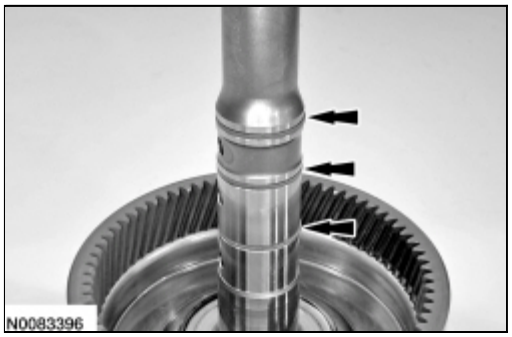


10. Remove and discard the 3 scarf cut seals.

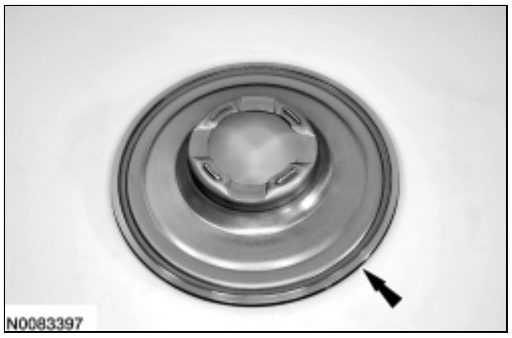


Assembly

1. Install the 3 new scarf cut seals and the roller bearing.



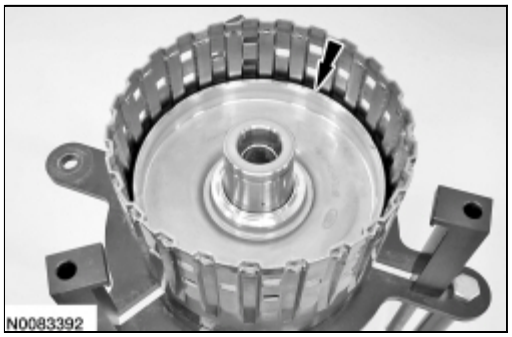
2. Install a new outer O-ring seal on the O/D clutch balance piston.



3. Install 2 new inner O-ring seals on the O/D clutch apply piston.

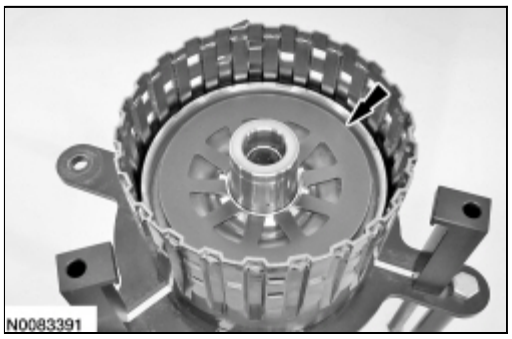


4. Lubricate all the O-ring seals with clean transmission fluid. Install the O/D clutch apply piston into the drum with the O-ring seals and the 3 pads facing down toward the drum.



5. **NOTE:** The fingers on the return spring are facing down toward the piston.

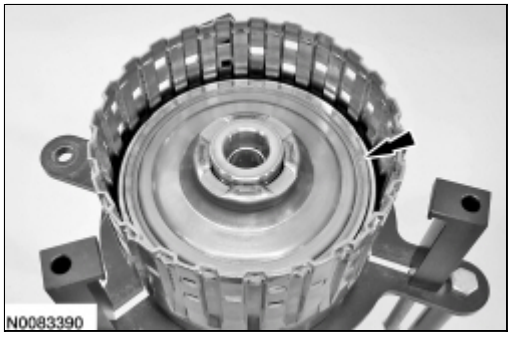
   Install the O/D clutch return spring.



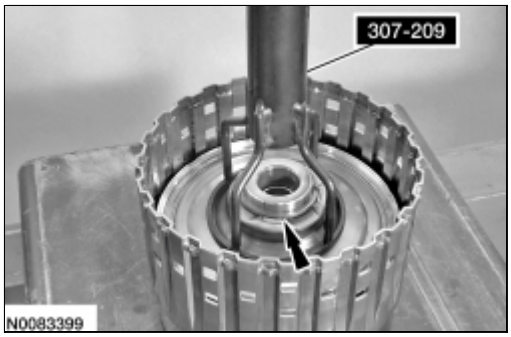
6. **NOTE:** The cone shape of the balance piston must face up when installed correctly.

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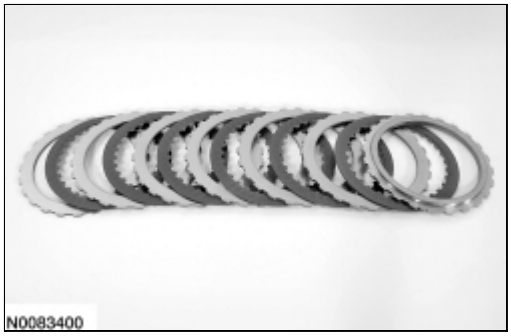
Lubricate all the O-ring seals with clean transmission fluid. Install the O/D clutch balance piston.



7. Using the Spring Washer Compressor, install a new O/D clutch balance piston retaining ring.

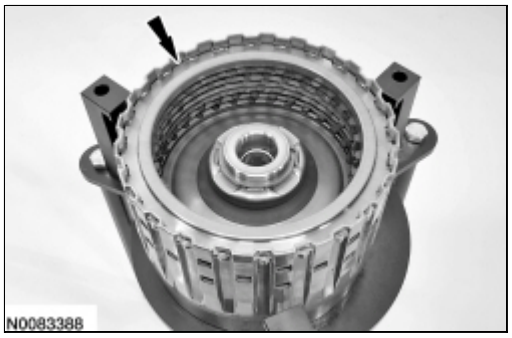


8. Soak the new O/D clutch plates in clean transmission fluid.

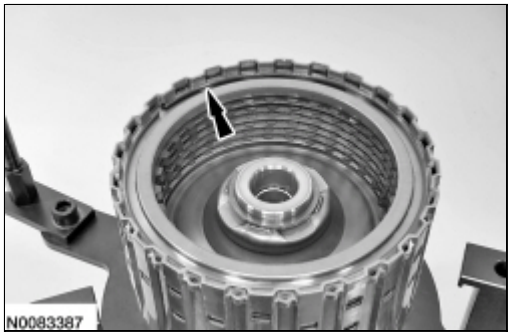


9. **NOTE:** Friction and steel plate quantity will vary based on engine displacement. For additional information, refer to the Clutch Plate Quantity chart in the Specifications portion of this section.

   Install the new O/D clutch plates, starting with a steel plate and alternating between friction and steel plates, and ending with the pressure plate on the top.

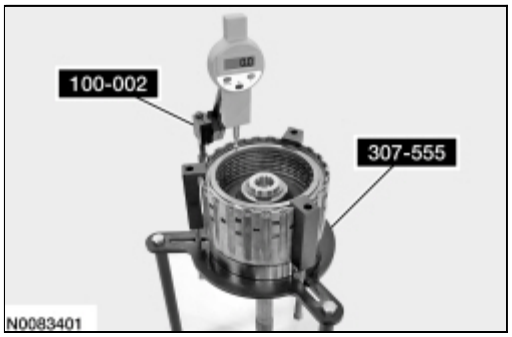


10. Install the O/D clutch pack snap ring.



11. **NOTE:** All O/D clutch plates, friction and steel are of a wave-type design.

    Install the O/D clutch assembly into the Clutch End Play Gauge and install the Dial Indicator Gauge with Holding Fixture and position the plunger so it fits into the opening of the snap ring.



12. With the Dial Indicator Gauge set at zero, lift up on the steel pressure plate so it is against the select fit snap ring. Record this reading as reading A.



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13. Rotate the O/D clutch assembly 180 degrees from the opening of the snap ring, take a second reading and record this reading as reading B.

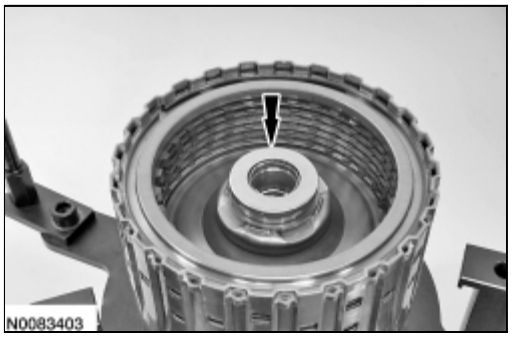
Description	Reading
Reading A	
Reading B	
Add reading A to reading B for a total end clearance	
Divide the total reading by 2 for an average end clearance	

14. **NOTE:** If the final measurement is not within specification, install a new snap ring until the correct specification is achieved.
    - 0.5-0.9 mm (0.019-0.035 in)

    If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is high, remeasure using a thicker select fit snap ring. If the free pack end clearance between the bottom of the snap ring and the top of the pressure plate is low, remeasure using a thinner select fit snap ring.

15. **NOTE:** Inspect and install new thrust bearings as required.

    Install the T3 thrust bearing.



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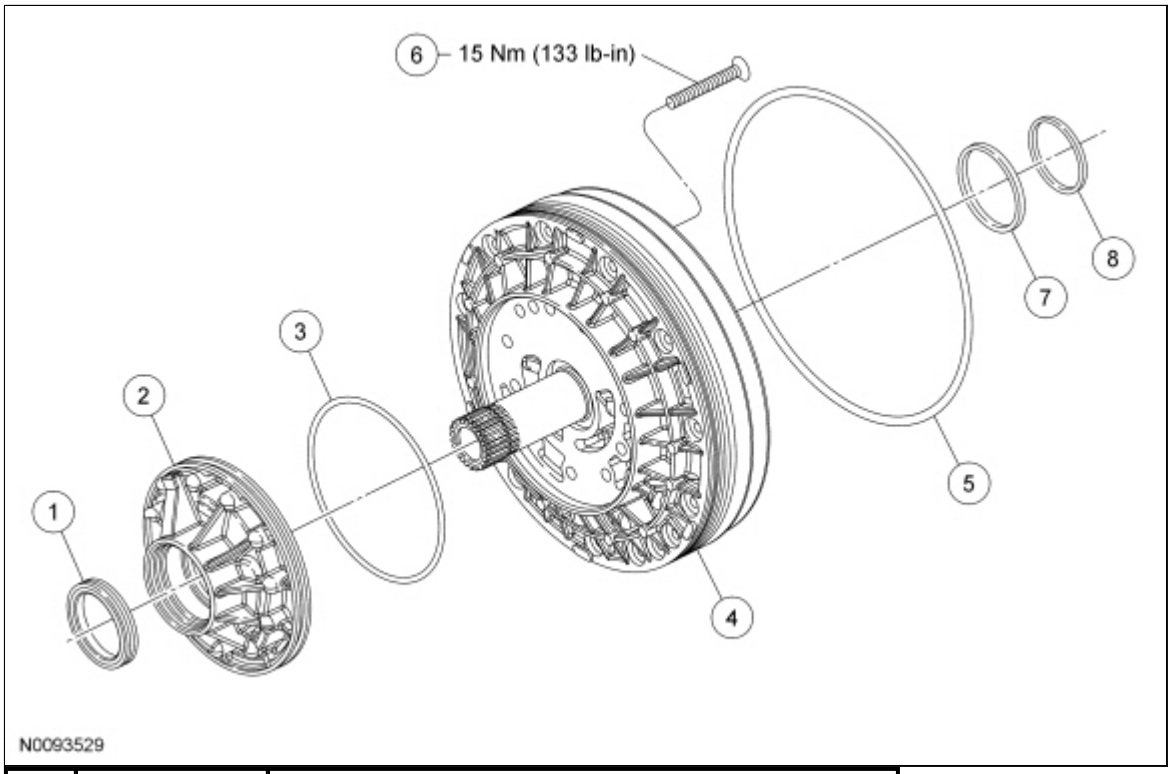
Pump Assembly

Special Tool(s)

 ST2887-A	Installer, Fluid Pump Seal 307-556

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

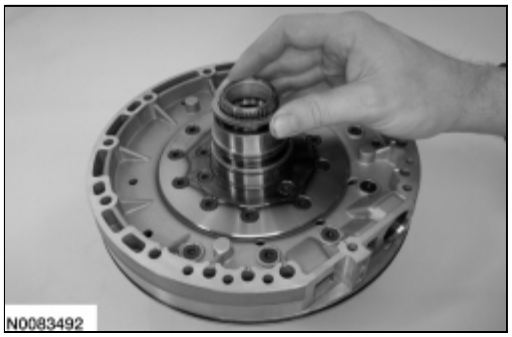


Item	Part Number	Description
1	7A248	Front pump oil seal
2	—	Pump body (part of 7A103)
3	7A248C	Pump body seal

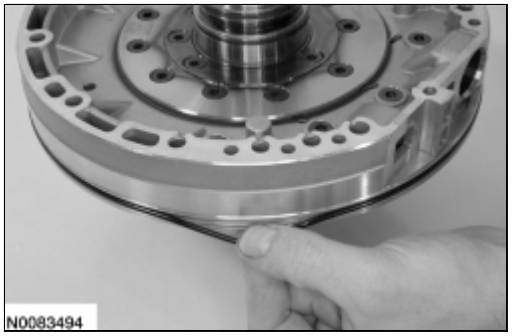
4	7A103	Pump plate assembly
5	7A248A	Pump plate assembly seal
6	W707871-S300	Pump plate assembly-to-front pump body bolt (11 required)
7	7D019	Clutch support fluid seal
8	7L323	Front pump support seal

Disassembly

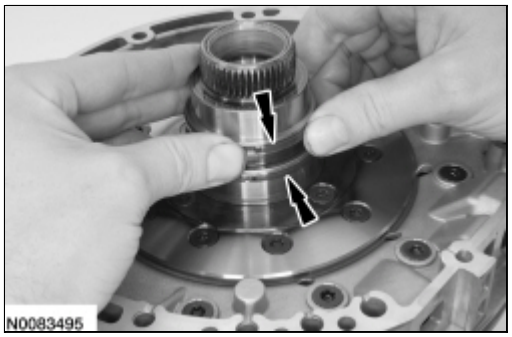
1. Remove the front pump washer.



2. If the O-ring seal was not removed during disassembly, remove and discard the front pump O-ring seal from the pump assembly.



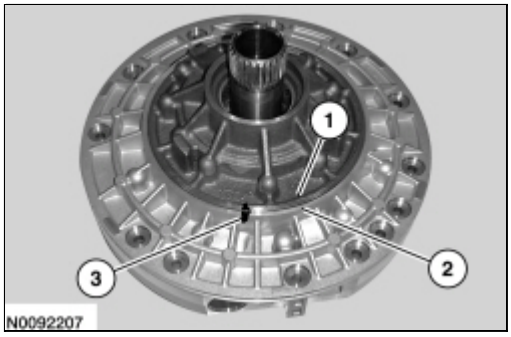
3. Remove and discard the front pump seal rings from the stator support.



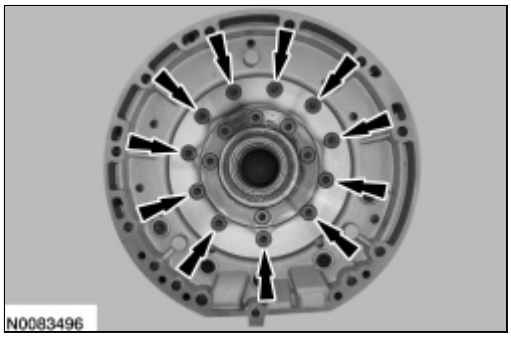
4. Index-mark the pump body to the pump plate assembly.
    1. Pump body
    2. Pump plate assembly

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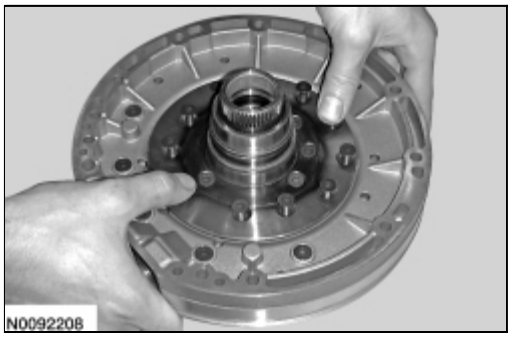
3. Index mark



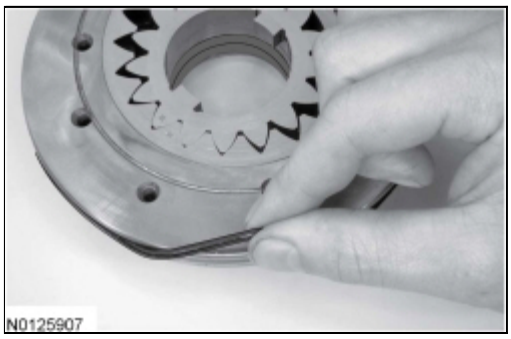
5. Remove the 11 pump plate assembly-to-pump body bolts.



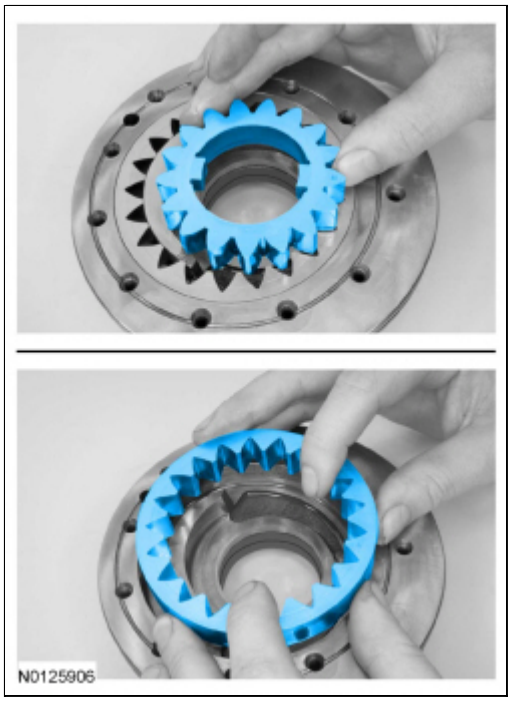
6. Push down on the loose pump plate assembly-to-pump body bolts to remove the pump body from the pump plate assembly and remove the 11 bolts.



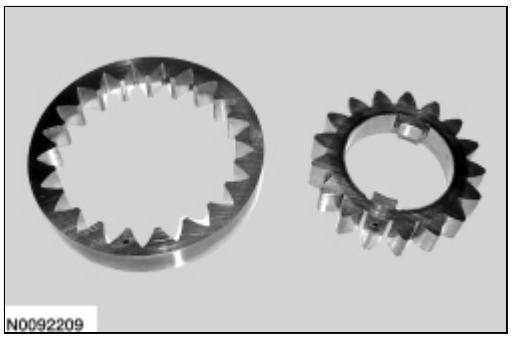
7. Remove and discard the pump body outer seal.



8. Remove the fluid pump gears.

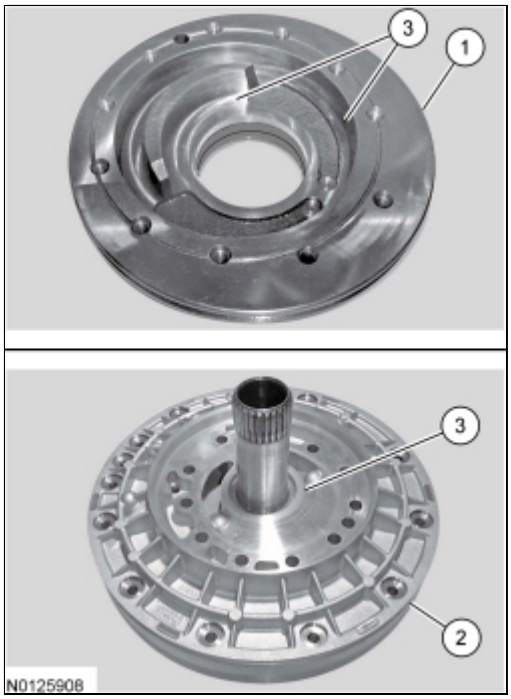


9. Inspect the inner and the outer pump gears for damage.
    - Clean all pump components in solvent.
    - Dry the parts with compressed air.
    - Inspect the pump gears, faces, gear teeth and mating surfaces for damage or scoring.
    - Install a new pump as necessary.



10. Inspect the pump body and pump plate thrust surfaces for damage or scoring.
    1. Pump body
    2. Pump plate assembly
    3. Pump gear thrust surfaces

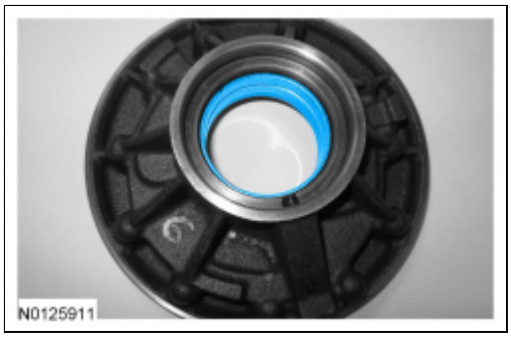
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11. Inspect the input shaft bushing for damage or scoring. If the bushing is damaged, install a new pump.



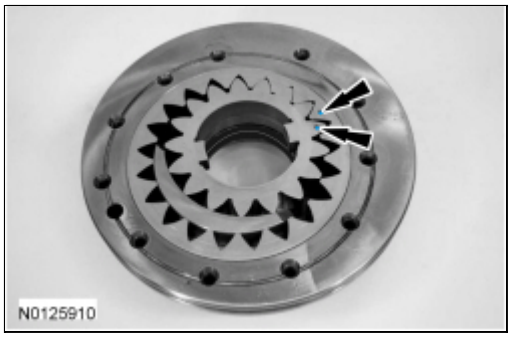
12. Inspect the torque converter hub bushing for damage or scoring. If the bushing is damaged, install a new pump.



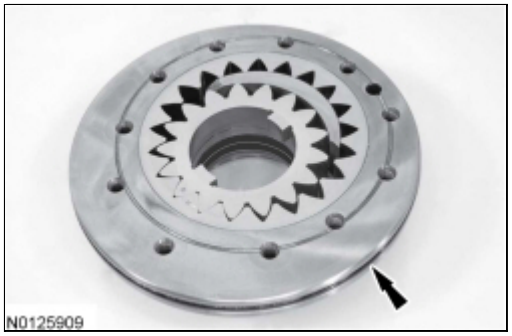
Assembly

1. **NOTE:** Prior to installation, lightly lubricate the pump gears with clean automatic transmission fluid.

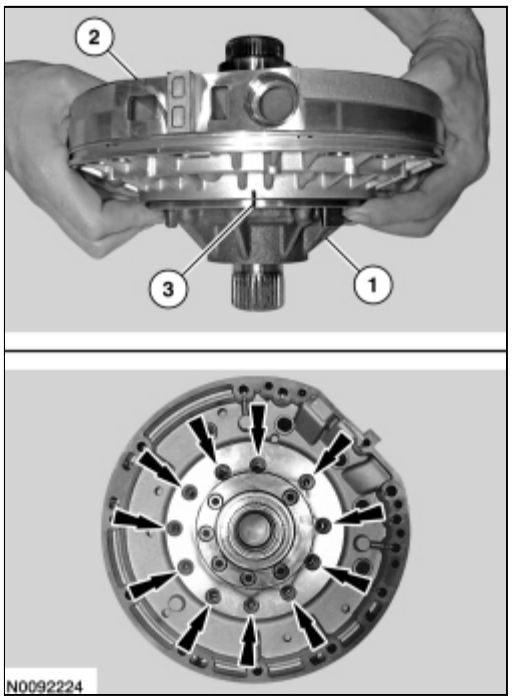
   Install the pump gears with the dot facing the pump plate assembly.



2. Install a new pump body outer seal.



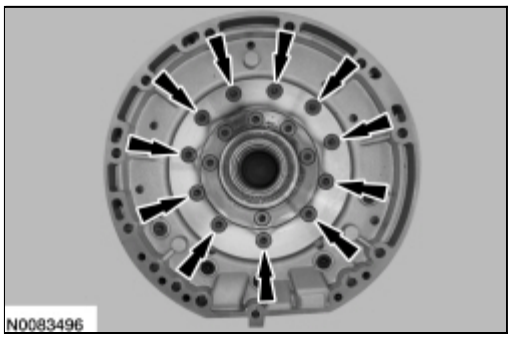
3. Align the marks made during disassembly to correctly assemble the pump. Press the pump body into the pump plate assembly. Visually inspect the pump body-to-pump plate assembly bolt holes to be sure that the pump body and pump plate are correctly aligned.
    1. Pump body
    2. Pump plate assembly
    3. Pump gear thrust surfaces



4. Install the pump plate assembly-to-front pump body bolts.

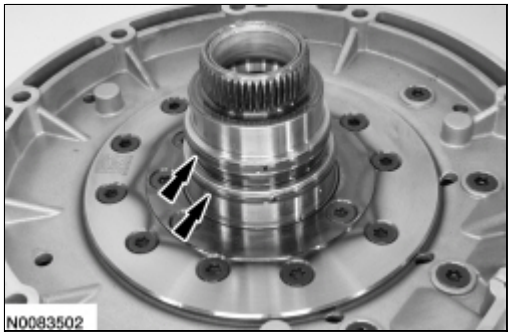
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- Tighten to 15 Nm (133 lb-in).

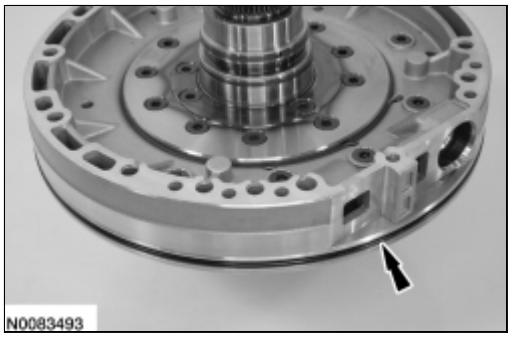


5. ***NOTICE:*** **Make sure that the seal ends of each seal ring are hooked together or fluid leakage can occur.**

   Install the 2 front pump seal rings onto the stator support. Make sure the seals are fully seated in the stator support seal grooves and the seal ends are oriented 180 degrees apart.



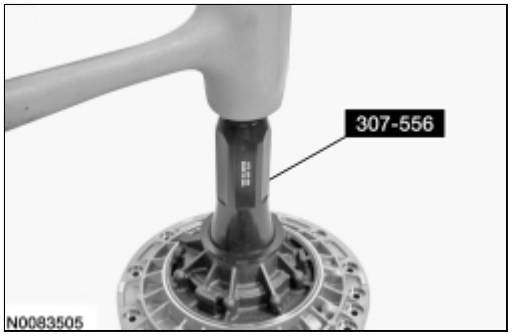
6. Install the pump outer diameter front pump O-ring seal.



7. Install a new front pump seal on the Fluid Pump Seal Installer 307-556.

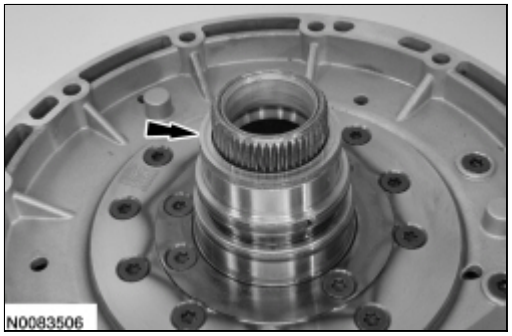


8. Using the Fluid Pump Seal Installer 307-556, install the front pump seal.



9. **NOTE:** Lightly lubricate the thrust washer with petroleum jelly to hold it in place during assembly.

   Install the pump thrust washer.



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Fluid Pan, Gasket and Filter

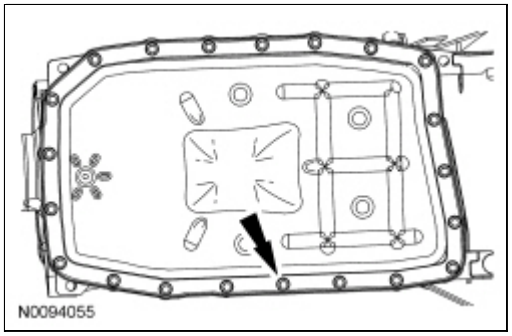
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

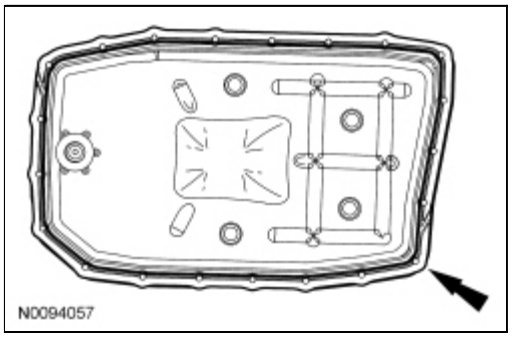
Removal

NOTICE: **The use of any transmission fluid other than specified can result in the transmission failing to operate in a normal manner or transmission failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. Remove the transmission fluid pan and allow the transmission fluid to drain.



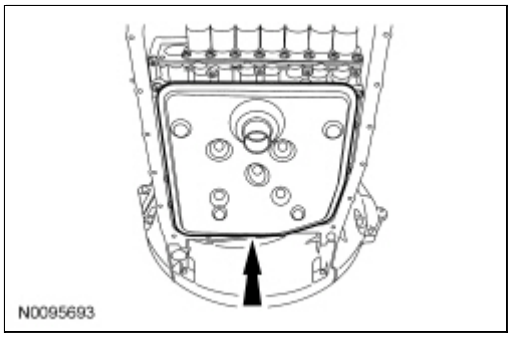
3. Remove the transmission fluid pan gasket.



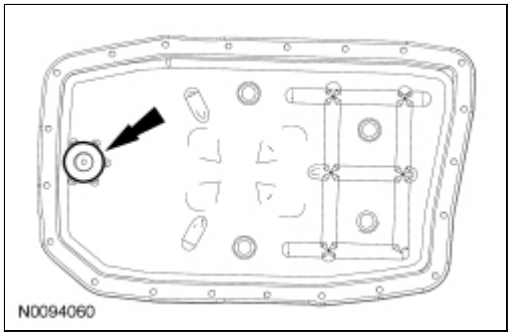
4. **NOTE:** The transmission fluid filter may be reused if no excessive contamination is indicated.

   Remove and discard the transmission fluid filter.

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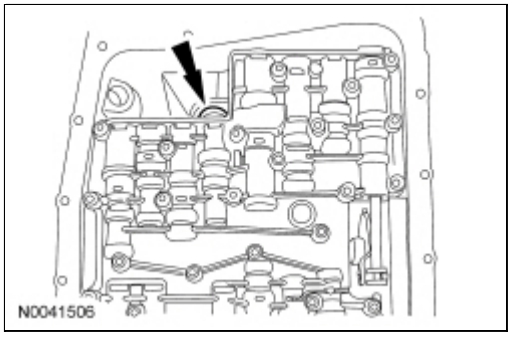
5. Clean and inspect the transmission fluid pan and magnet.



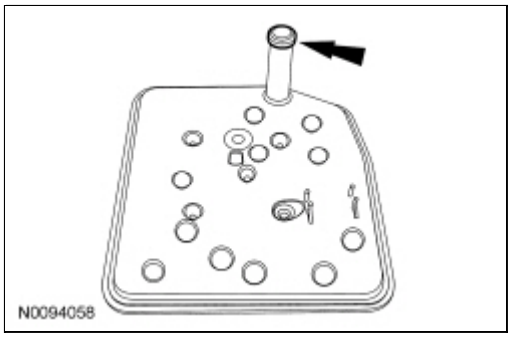
Installation

NOTE: If the transmission is being repaired for a contamination-related failure, install a new transmission fluid filter and seal assembly. The transmission fluid filter may be reused if no excessive contamination is indicated.

1. Inspect the transmission case for the transmission fluid filter seal. If the seal is in the case, carefully remove the seal without scratching the case.

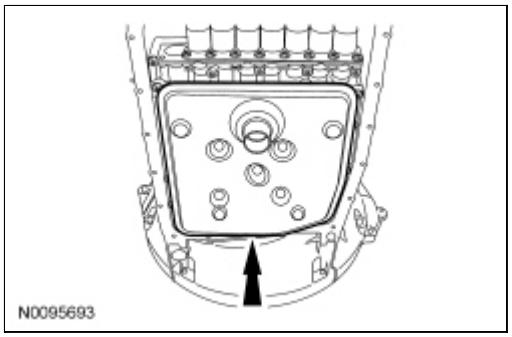


2. Make sure that the seal is on the transmission fluid filter and lubricate the seal with automatic transmission fluid.

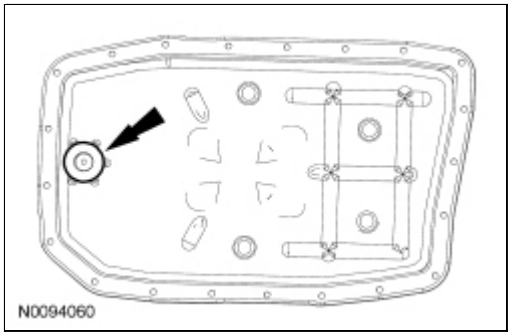


3. **NOTE:** The transmission fluid filter may be reused if no excessive contamination is indicated.

   If required, install a new transmission fluid filter.

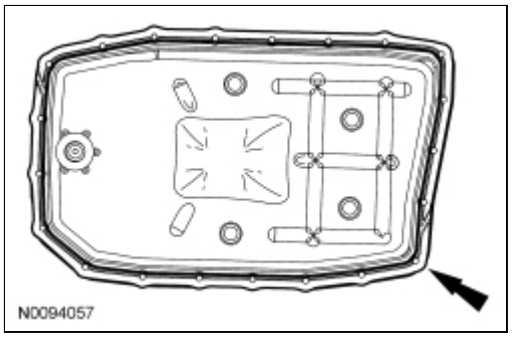


4. Position the magnet in the transmission fluid pan.



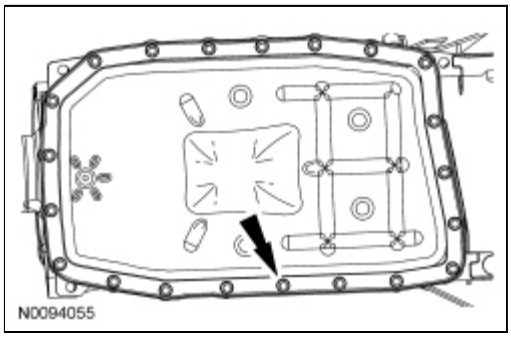
5. **NOTE:** The transmission fluid pan gasket can be reused if not damaged.

   Install a new transmission fluid pan gasket if required.



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6. Install the transmission fluid pan and tighten the bolts in a crisscross pattern.
    - Tighten to 9 Nm (80 lb-in).



7. Using the Adding Additional Transmission Fluid procedure, fill and check the transmission fluid. Refer to Transmission Fluid Drain and Refill .

Main Control

Special Tool(s)

 E173280	Remover, Koastal Sleeve 307-717

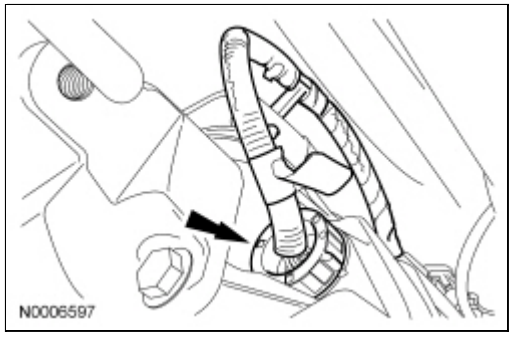
Removal

NOTE: The Solenoid Body Strategy Data Download procedure must be performed if a new main control assembly is installed.

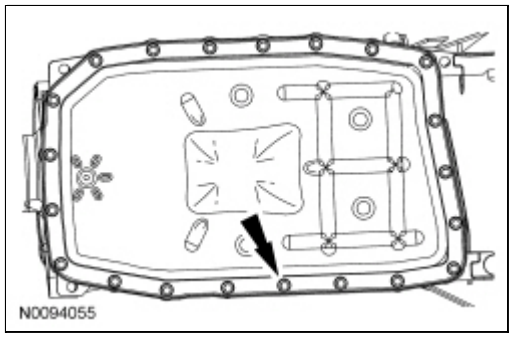
1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

2. ***NOTICE:*** **Do not pull on the wire harness to disconnect the connector or damage to the connector will occur.**

   Disconnect the transmission vehicle harness connector by twisting the outer shell and pulling back on the connector.

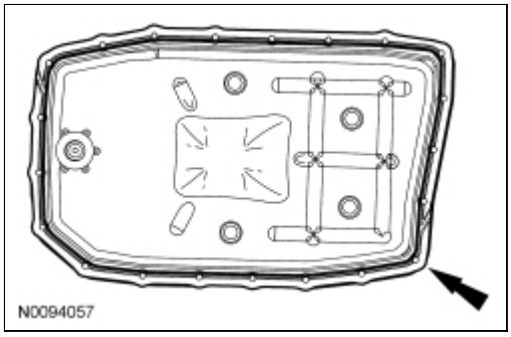

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3. Remove the transmission fluid pan and allow the transmission fluid to drain.


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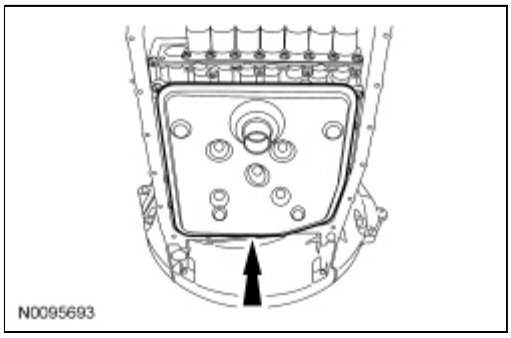
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4. Remove the transmission fluid pan gasket.

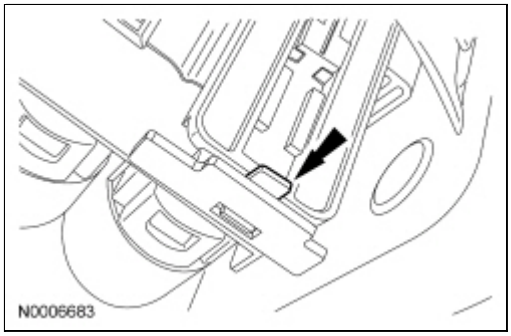


5. **NOTE:** The transmission fluid filter may be reused if no excessive contamination is indicated.

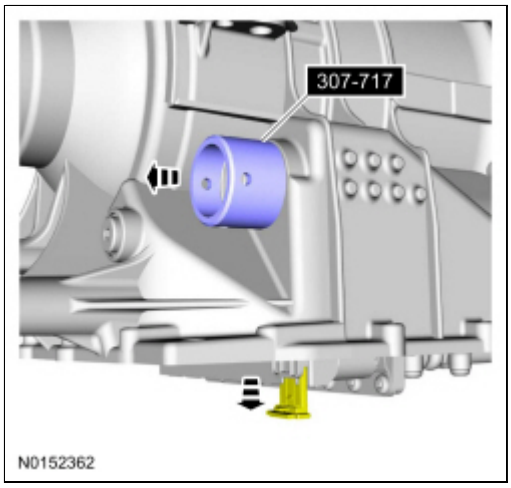
   Remove and discard the transmission fluid filter.



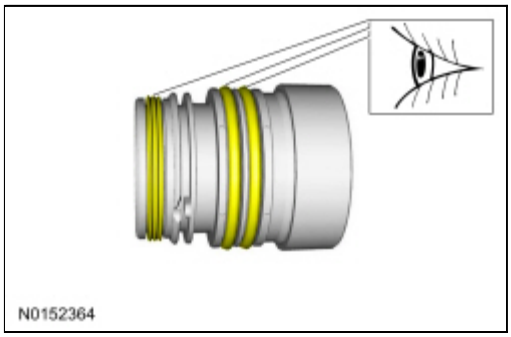
6. Pull the release tab and pull down on the bulkhead connector sleeve retainer.



7. With the transmission bulkhead connector sleeve retainer released, use the Koastal Sleeve Remover to pull the outer shell of the bulkhead connector sleeve out of the transmission.



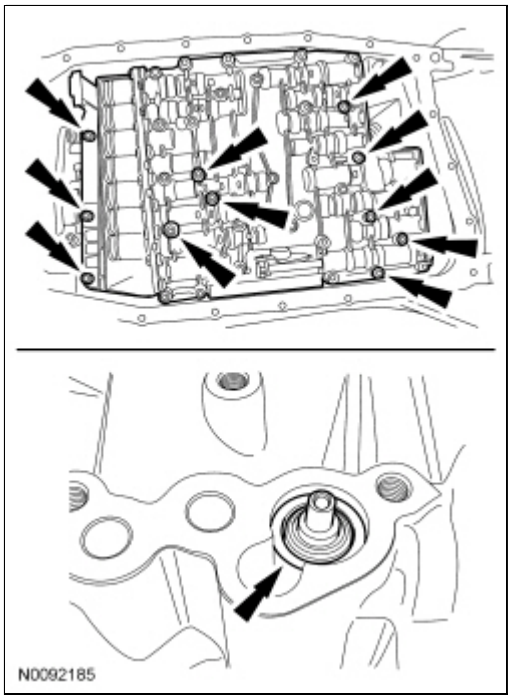
8. Inspect the bulkhead connector sleeve seals.
    - If necessary, replace the seals.



9. ***NOTICE:*** **During removal of the main control assembly, the thermal bypass valve may fall out of the transmission case. Damage to the valve may occur if the valve falls out.**

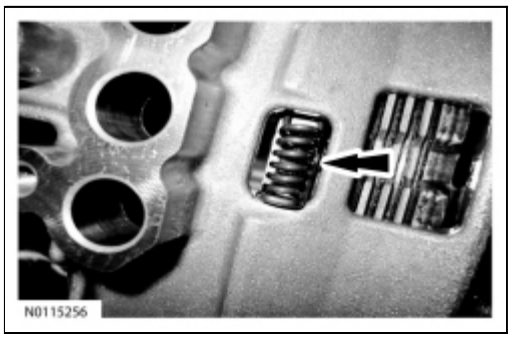
   Remove the 11 bolts from the main control assembly and remove the main control assembly and the bypass valve.

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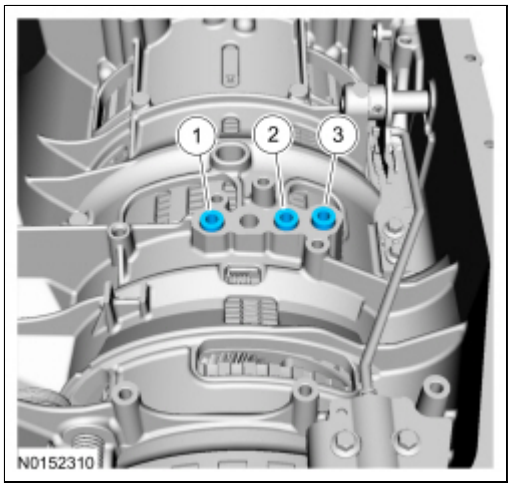
Installation

1. Inspect the bias spring to make sure it is positioned correctly in the transmission case.

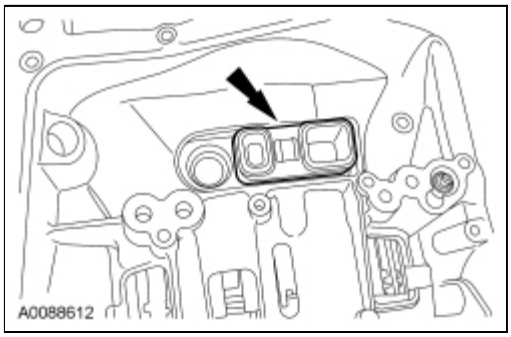


2. **NOTE:** Before installing the main control assembly into the transmission case, verify the presence and orientation of the thermal bypass valve, pump adapter seal and center support feed tube seals. Also note that one or more of the center support feed tube seals may have remained in the main control assembly during removal and should be installed into the transmission case at this time.

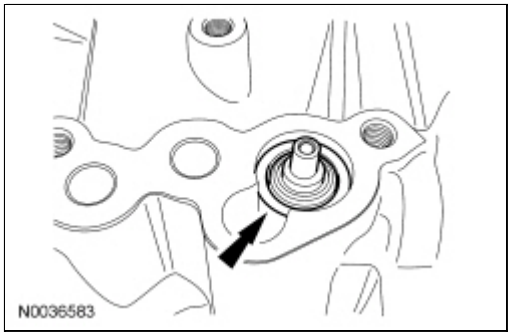
   Verify the 3 center support feed tube seals are in place.
   1. Center support feed tube seal (7G199 Black)
   2. Center support feed tube seal (7G087 Green)
   3. Center support feed tube seal (7G084 Blue)



3. Verify the rubber adapter is in place.

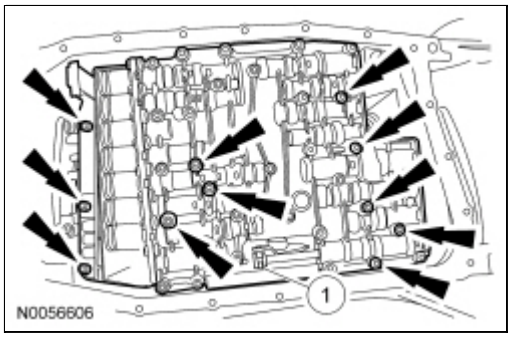


4. Coat the thermal bypass valve with petroleum jelly to hold it in place and install the thermal bypass valve into the transmission case.

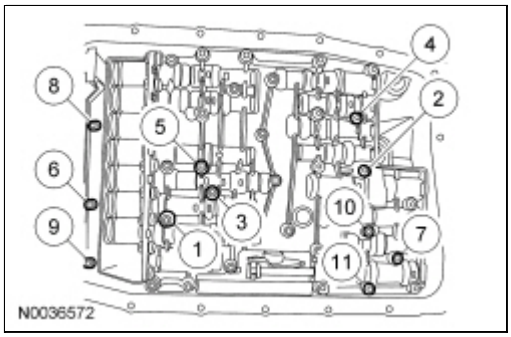


5. Position the main control assembly in place and loosely install the 11 bolts.
    1. Align the manual valve and control lever linkage.

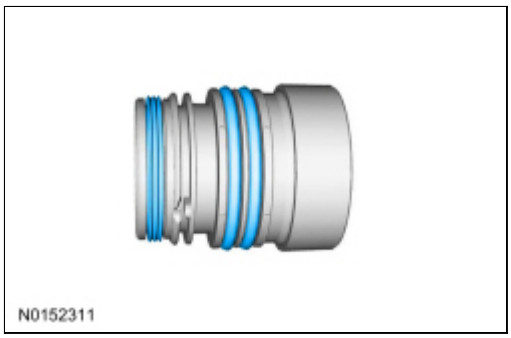
repair4less



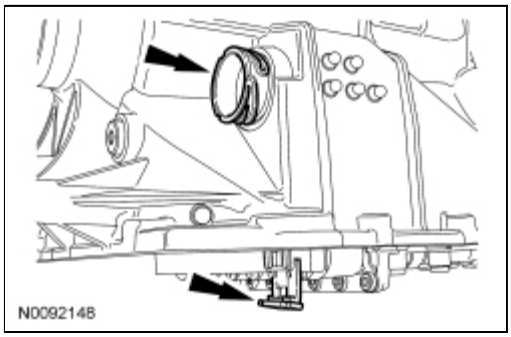
6. Tighten the main control bolts in the sequence shown.
    - Tighten to 8 Nm (71 lb-in).



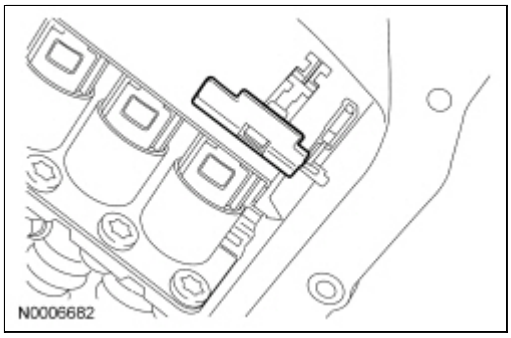
7. If removed, install the bulkhead connector sleeve seals.



8. With the release tab down and unlocked, push the outer shell of the bulkhead connector sleeve into the transmission. Make sure the bulkhead connector sleeve is fully seated into the molded leadframe.

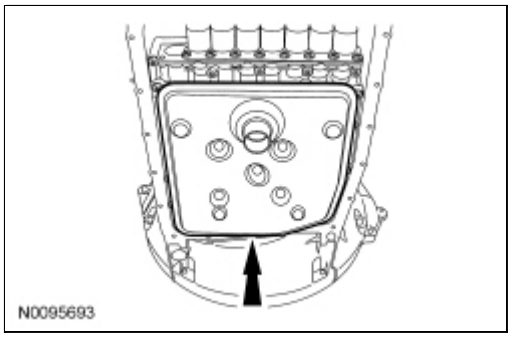


9. Press up on the tab and lock the outer shell of the bulkhead connector sleeve in place. Make sure that the locking tab is securely locked.



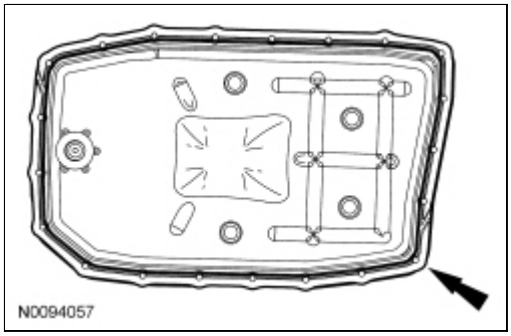
10. **NOTE:** The transmission fluid filter may be reused if no excessive contamination is indicated.

    If required, install a new transmission fluid filter.



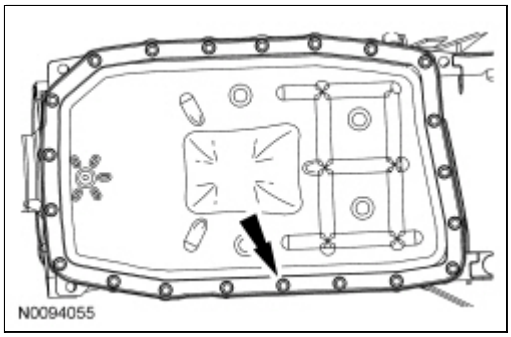
11. **NOTE:** The transmission fluid pan gasket can be reused if not damaged.

    Install a new transmission fluid pan gasket, if required.

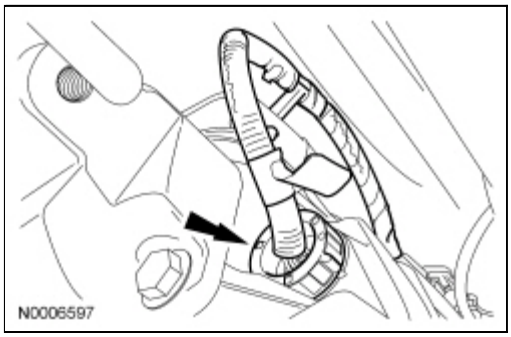


12. Install the transmission fluid pan and tighten the transmission fluid pan bolts in a crisscross pattern.
    - Tighten to 9 Nm (80 lb-in).

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13. Connect the transmission vehicle harness connector by pushing it in and twisting the outer shell to lock it in place.



14. Make sure the transmission fluid is at the correct level. Refer to Transmission Fluid Drain and Refill .

15. **NOTE:** If an individual solenoid was replaced clear the adaptive strategy.

    Perform a Road Test — Adaptive Drive Cycle after the adaptive strategy is cleared. Refer to Shift Point Road Test .

16. **NOTE:** If the main control assembly was replaced, perform the Solenoid Body Strategy Data Download. Refer to Solenoid Body Strategy .

    Perform a Road Test — Adaptive Drive Cycle after the Solenoid Body Strategy Data Download. Refer to Shift Point Road Test .

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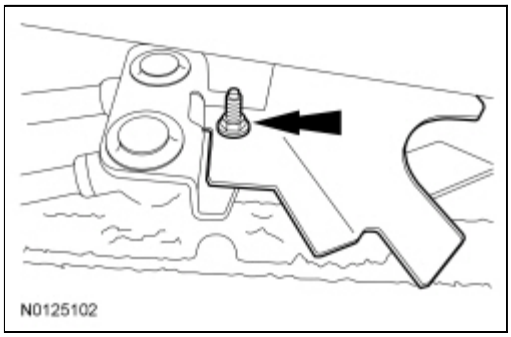
Manual Control Lever Shaft and Seal

Special Tool(s)

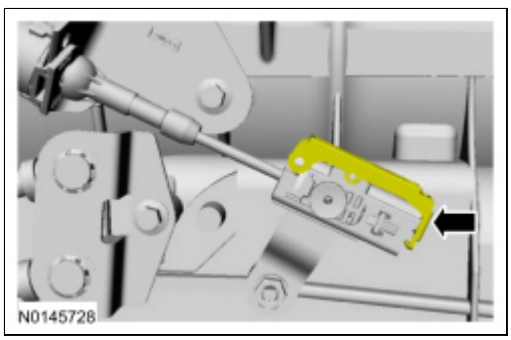
 ST2890-A	Installer, Shifter Fluid Seal 307-559
 E173280	Remover, Koastal Sleeve 307-717

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. If equipped, remove the nut and the selector lever cable splash shield.


N0125102

3. Clean the cable adjustment lock of any debris.

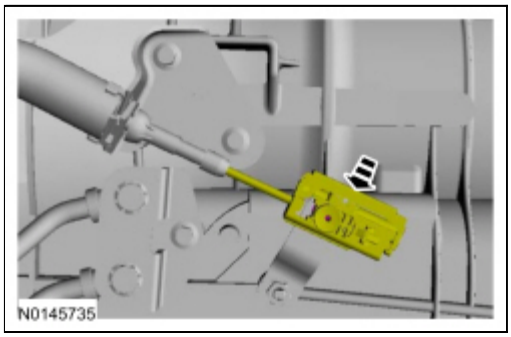

N0145728

4. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable**

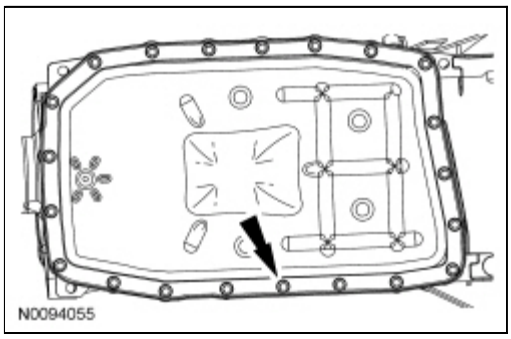
between the manual control lever and the selector lever cable bracket.

NOTE: The column shift is shown, the floor shift is similar.

Disconnect the transmission selector lever cable end from the manual control lever.

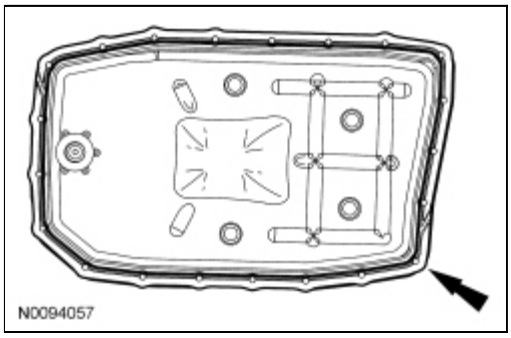


5. Remove the transmission fluid pan and allow the transmission fluid to drain.



6. **NOTE:** The transmission fluid pan gasket can be reused if not damaged.

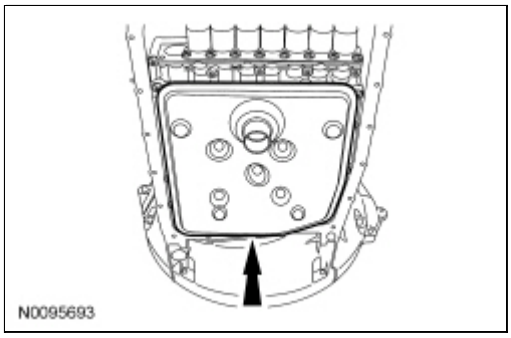
   Remove the transmission fluid pan gasket.



7. **NOTE:** The transmission fluid filter may be reused if no excessive contamination is indicated.

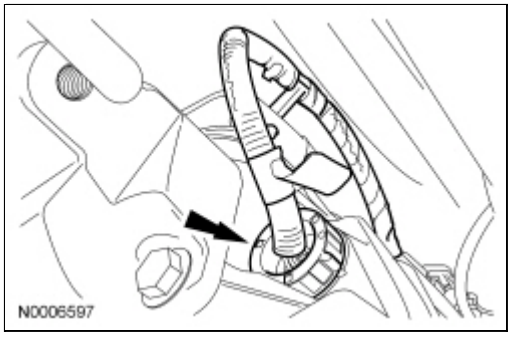
   Remove and discard the transmission fluid filter.

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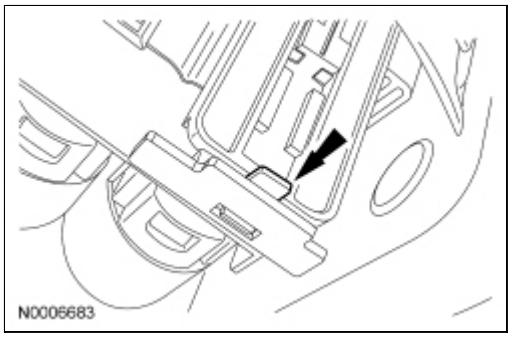


8. ***NOTICE:*** **Do not pull on the wire harness to disconnect the connector or damage to the connector will occur.**

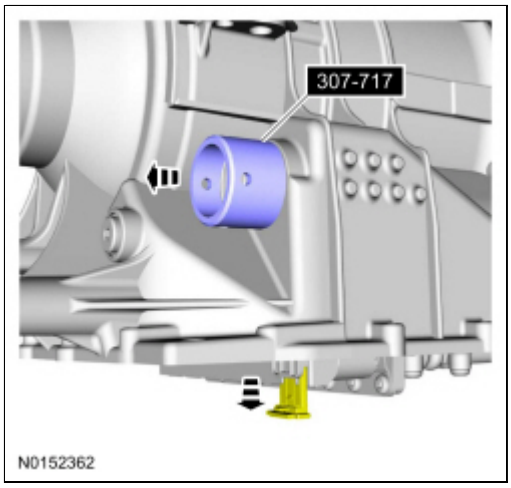
   Disconnect the transmission vehicle harness connector by twisting the outer shell and pulling back on the connector.



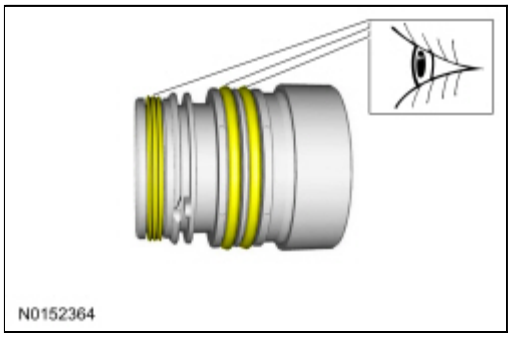
9. Pull the release tab and pull down on the bulkhead connector sleeve retainer.



10. With the transmission bulkhead connector sleeve retainer released, use the Koastal Sleeve Remover to pull the outer shell of the bulkhead connector sleeve out of the transmission.



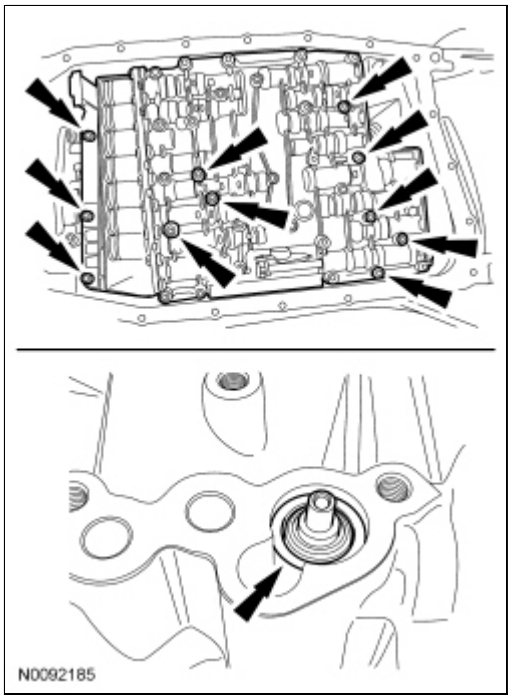
11. Inspect the bulkhead connector sleeve seals.
    - If necessary, replace the seals.



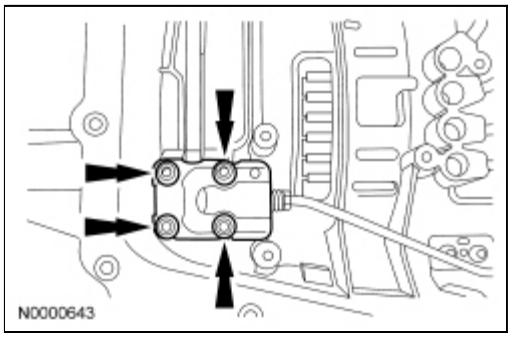
12. ***NOTICE:*** **During removal of the main control, the thermal bypass valve will fall out of the transmission case. Damage to the valve will occur if the valve falls out.**

    Remove the 11 bolts from the main control and remove the main control assembly and the bypass valve.

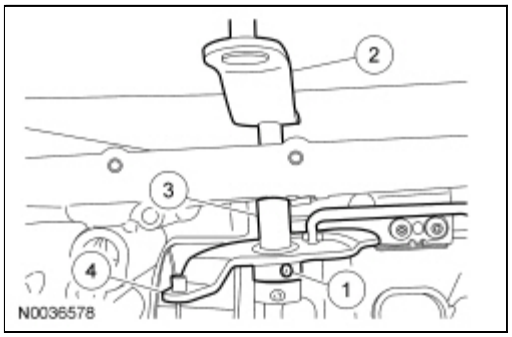
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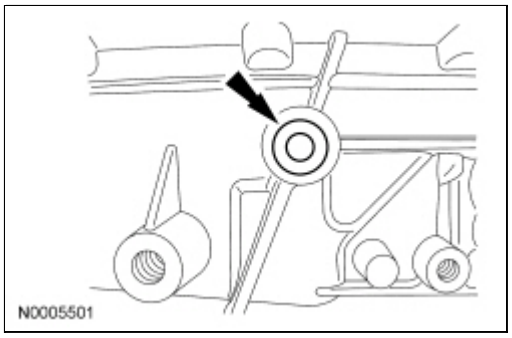
13. Remove the park rod actuating plate.



14. Remove the manual control lever.
    1. Remove the roll pin.
    2. Slide the manual control lever shaft out of the case.
    3. Hold the spacer to keep it from falling out of the case.
    4. Remove the manual valve inner lever and the park rod as an assembly.

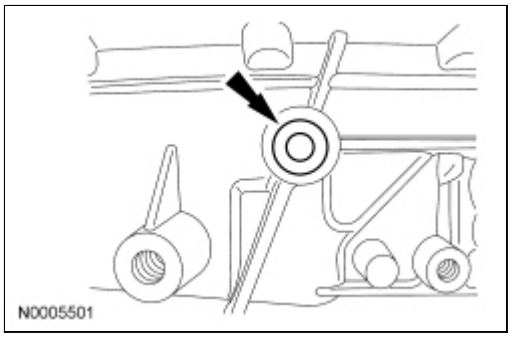


15. Remove and discard the manual control lever seal.

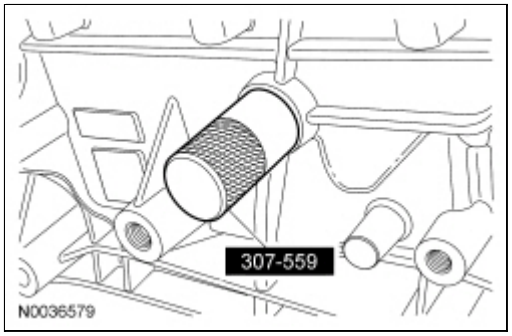


Installation

1. Position a new manual control lever seal in place.

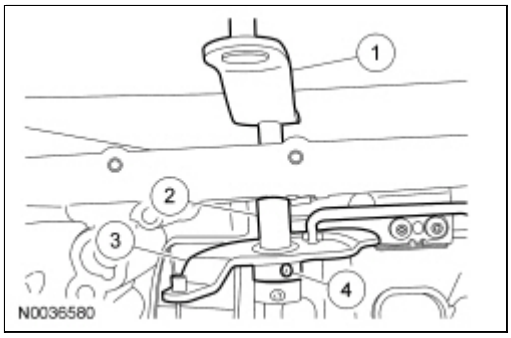


2. Using the Shifter Fluid Seal Installer, install a new manual control lever shaft seal.



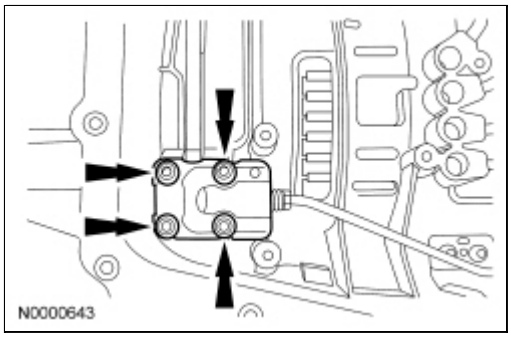
3. Install the manual control lever in the case.
    1. Slide the manual control lever in the case.
    2. Position the spacer in place while sliding the manual control lever into the spacer.
    3. Position the manual valve inner lever while sliding the manual control lever and lining up the roll pin hole.
    4. Install the roll pin.

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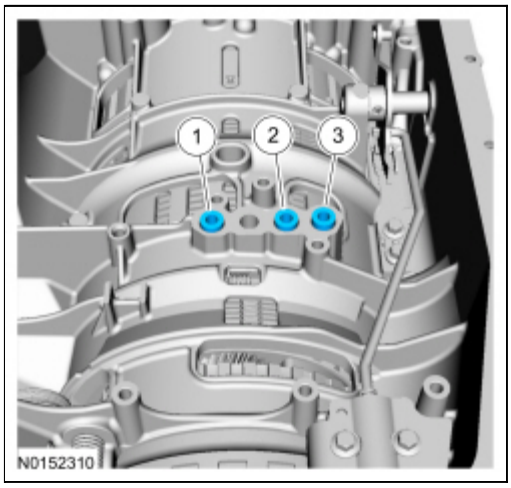
4. Position the park rod in place. Push down on the park pawl and position the park rod in place.

5. While holding the park rod down, install the park rod actuating plate.
   - Tighten to 12 Nm (106 lb-in).

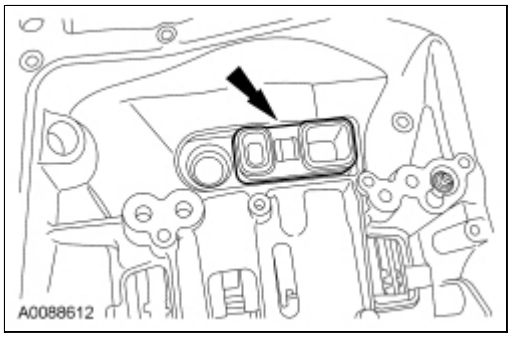


6. **NOTE:** Before installing the main control assembly into the transmission case, verify the presence and orientation of the thermal bypass valve, pump adapter seal and center support feed tube seals. Also note that one or more of the center support feed tube seals may have remained in the main control assembly during removal and should be installed into the transmission case at this time.

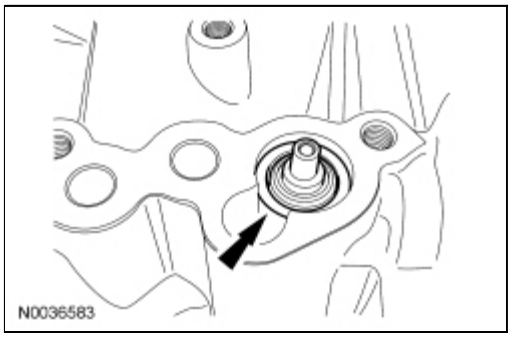
   Verify the 3 center support feed tube seals are in place.
   1. Center support feed tube seal (7G199 Black)
   2. Center support feed tube seal (7G087 Green)
   3. Center support feed tube seal (7G084 Blue)



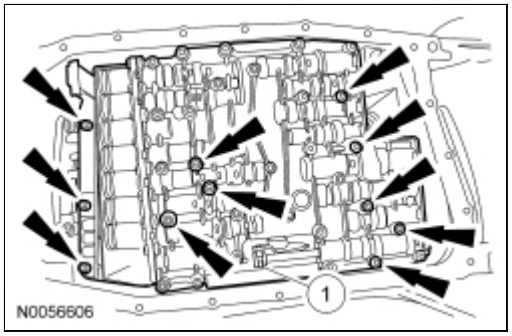
7. Verify the rubber adapter is in place.



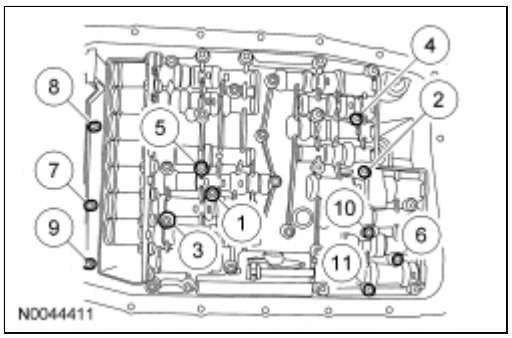
8. Coat the thermal bypass valve with petroleum jelly to hold it in place and install the thermal bypass valve in the transmission case.



9. Position the main control in place and loosely install the 11 bolts.
    1. Align the manual valve and control lever linkage.

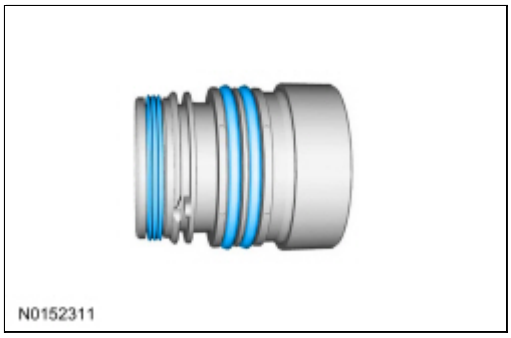


10. Tighten the main control bolts in the sequence shown.
    - Tighten to 8 Nm (71 lb-in).

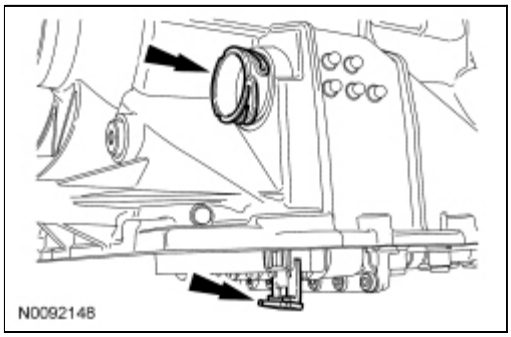


11. If removed, install the bulkhead connector sleeve seals.

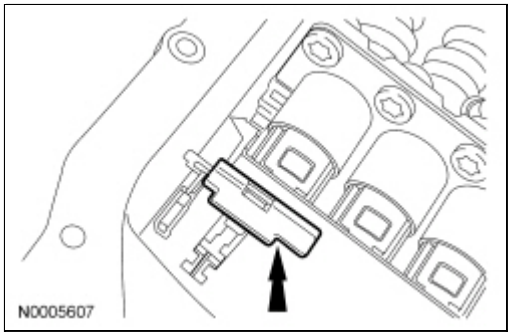
repair4less



12. With the release tab down and unlocked, push the outer shell of the bulkhead connector sleeve into the transmission. Make sure the bulkhead connector sleeve is fully seated into the molded leadframe.

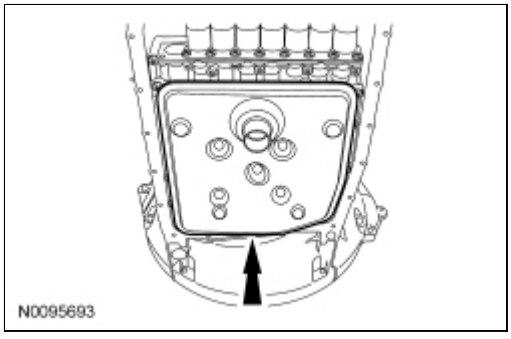


13. Press up on the tab and lock the outer shell of the bulkhead connector sleeve in place. Make sure that the locking tab is securely locked.



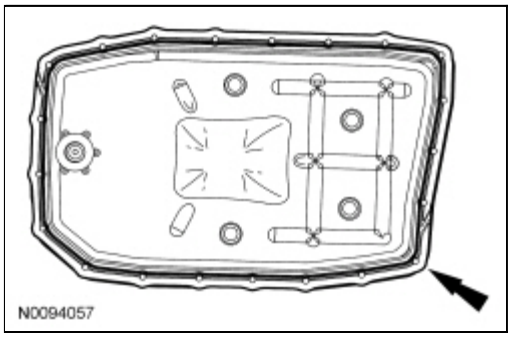
14. **NOTE:** The transmission fluid filter may be reused if no excessive contamination is indicated.

    If required, install a new transmission fluid filter.

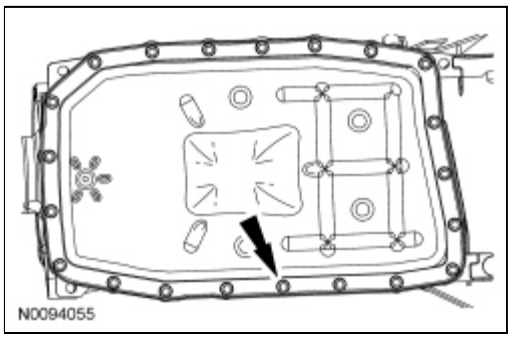


15. **NOTE:** The transmission fluid pan gasket can be reused if not damaged.

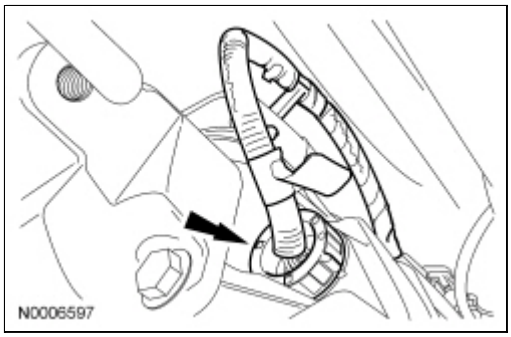
    If necessary, install a new transmission fluid pan gasket.



16. Install the transmission fluid pan and tighten the transmission fluid pan bolts in a crisscross pattern.
    - Tighten to 9 Nm (80 lb-in).



17. Connect the transmission vehicle harness connector by pushing it in and twisting the outer shell to lock it in place.

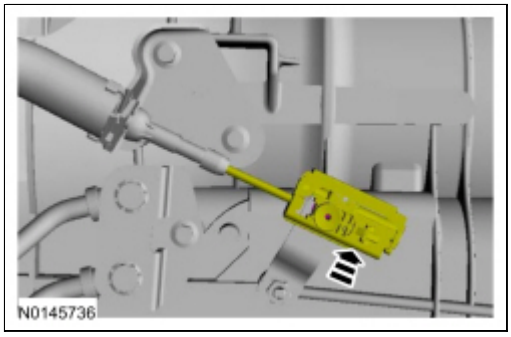


18. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

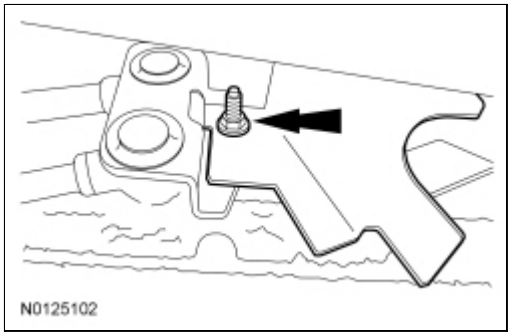
    NOTE: The column shift is shown, the floor shift is similar.

    Install the selector lever cable end on the manual control lever.

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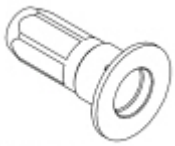
19. If equipped, install the selector lever cable splash shield and the nut.



20. Fill the transmission with clean transmission fluid. Refer to Transmission Fluid Drain and Refill .

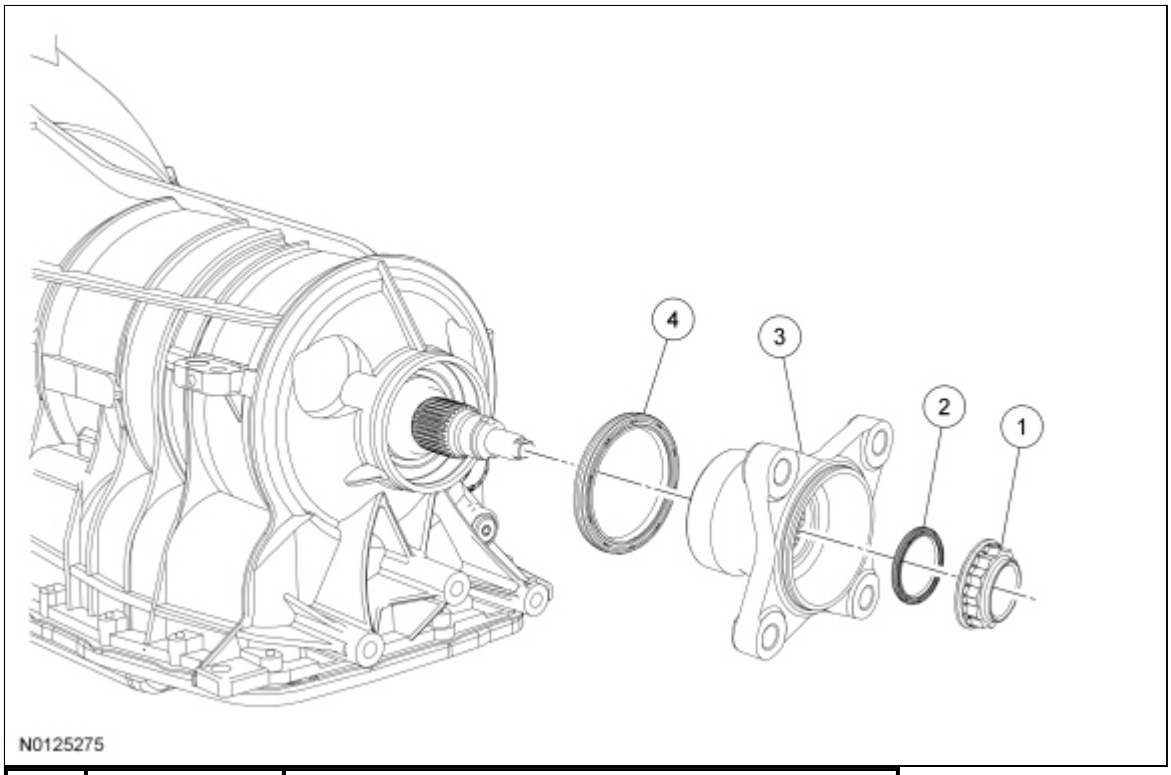
Output Shaft Seal

Special Tool(s)

 E173278	Installer, Output Seal (4X2) 307-715
 ST2216-A	Installer, Spindle/Axle Shaft 205-199 (T83T-3132-A1)
 ST3059-A	Installer, 6R80 Rear Seal 4X4 307-637
 ST3060-A	Installer, 6R80 Rear Seal 4X2 307-638
 ST2381-A	Remover, Input Shaft Oil Seal 308-375
 ST1187-A	Slide Hammer 100-001 (T50T-100-A)

NOTE: Early build RWD shown, late build RWD and 4WD similar.

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Item	Part Number	Description
1	7045	Output shaft flange retaining nut RWD
2	7052	Output shaft flange seal RWD
3	—	Output shaft flange (model dependent) RWD
4	7052	Output shaft seal (model dependent)

Removal

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

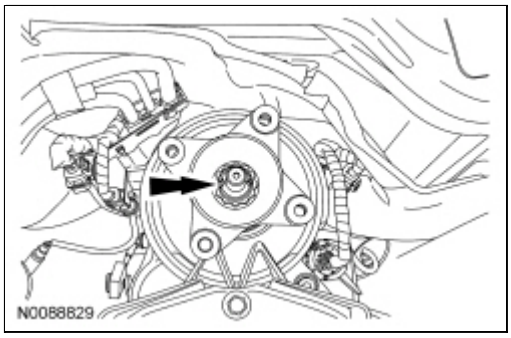
All Rear Wheel Drive (RWD) vehicles

2. Remove the rear driveshaft. Refer to Section 205-01 .

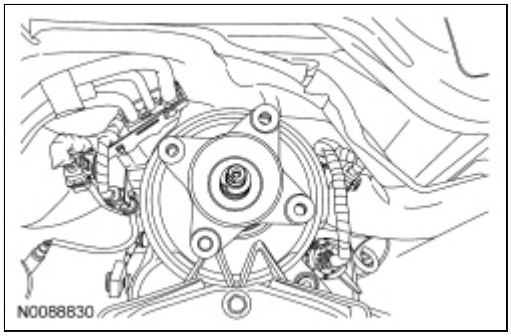
Early Build Rear Wheel Drive (RWD) vehicles

3. **NOTE:** The output shaft flange reatining nut has been staked to prevent it from coming loose. Prior to removing the nut, remove the stake to prevent damage to the output shaft.

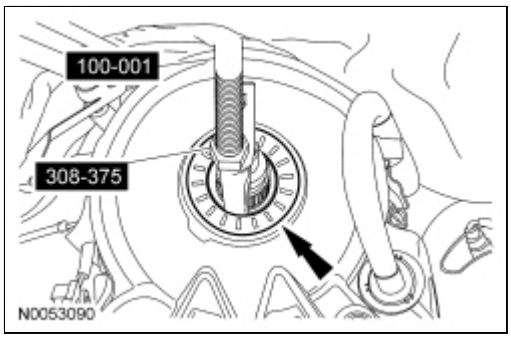
   Remove and discard the output shaft flange retaining nut.



4. Remove the output shaft flange seal and the output shaft flange.



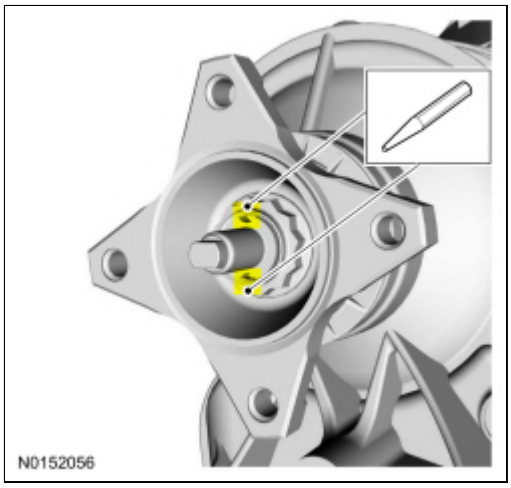
5. Using the Input Shaft Oil Seal Remover and Slide Hammer, remove the output shaft seal.



Late Build Rear Wheel Drive (RWD) vehicles

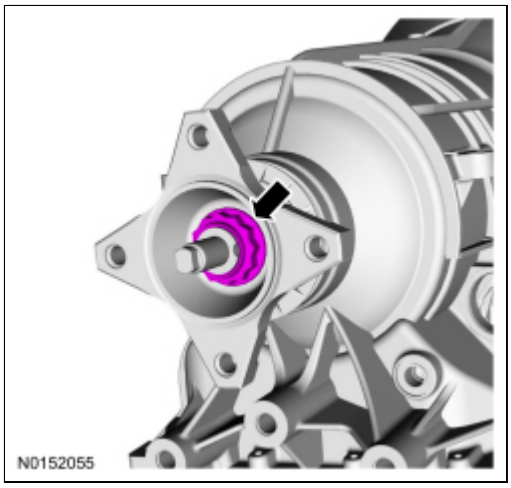
6. Remove the stakes from the output shaft flange retaining nut.

repair4less

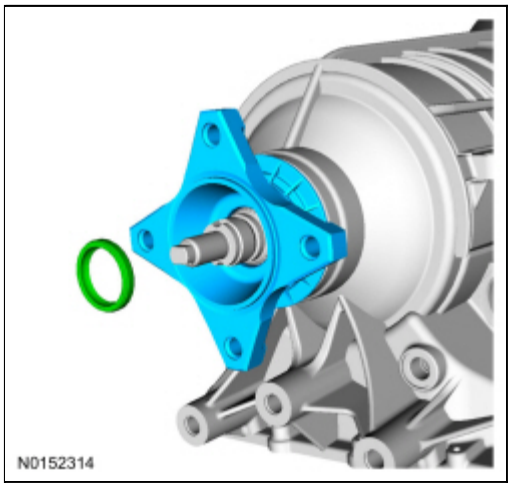


7. ***NOTICE:*** **The output shaft flange retaining nut has been staked to prevent it from coming loose. Prior to removing the nut, remove the stake to prevent damage to the output shaft.**

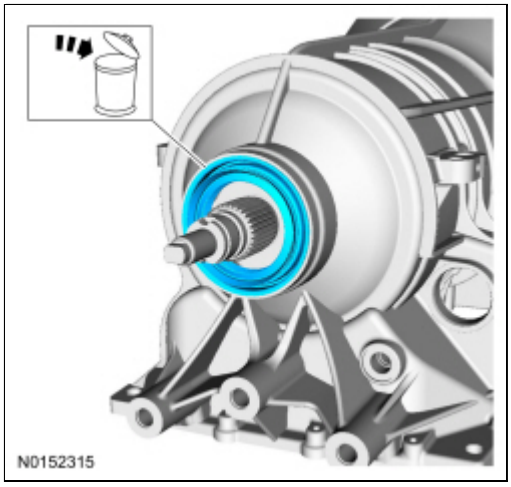
   Remove and discard the output shaft flange retaining nut.



8. Remove the output shaft flange seal and the output shaft flange.



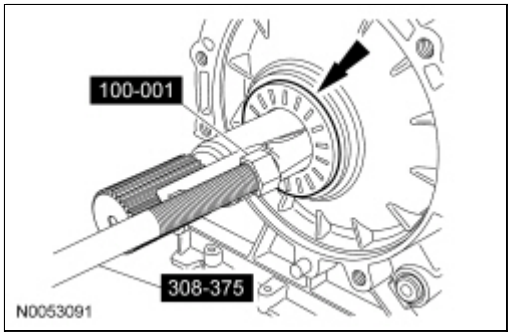
9. Remove and discard the output shaft seal.



Four-Wheel Drive (4WD) vehicles

10. Remove the transfer case. Refer to Section 308-07B .

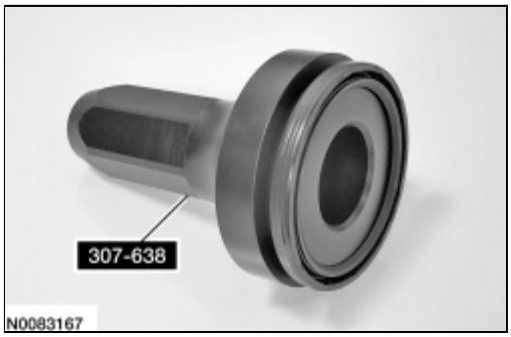
11. Using the Input Shaft Oil Seal Remover and Slide Hammer, remove the output shaft seal.



Installation

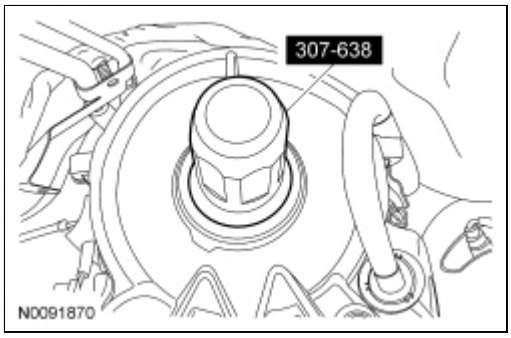
Early Build Rear Wheel Drive (RWD) vehicles

1. Position a new output shaft seal on the 6R80 Rear Seal 4X2 Installer.

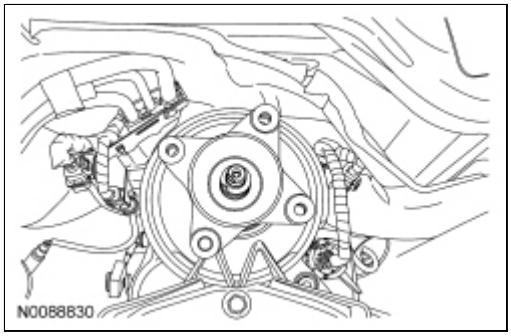


2. Using the 6R80 Rear Seal 4X2 Installer, install the output shaft seal.

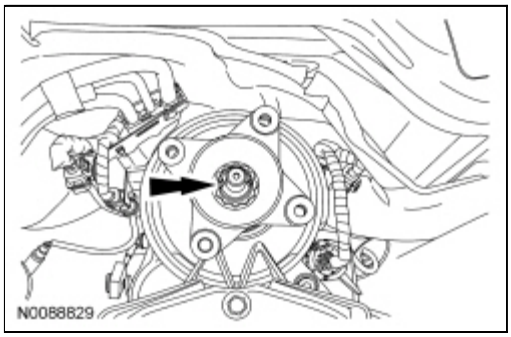
repair4less



3. Install the output shaft flange.

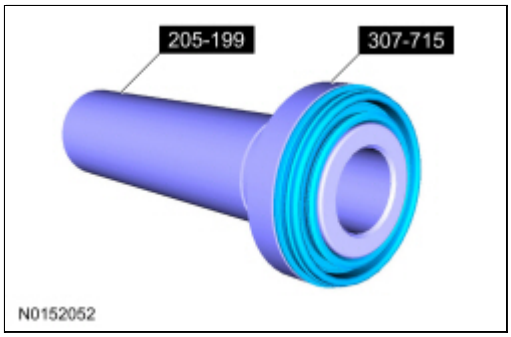


4. Install the output shaft flange seal and a new output shaft flange nut.
    - Tighten to 80 Nm (59 lb-ft).
    - After installing the new output shaft flange nut, it must be staked at the slots to prevent it from coming loose.

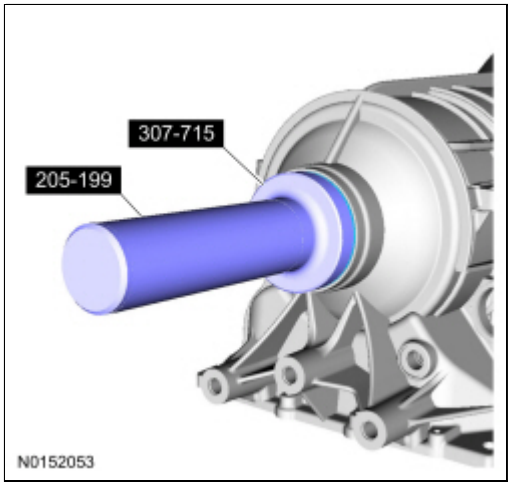


Late Build Rear Wheel Drive (RWD) vehicles

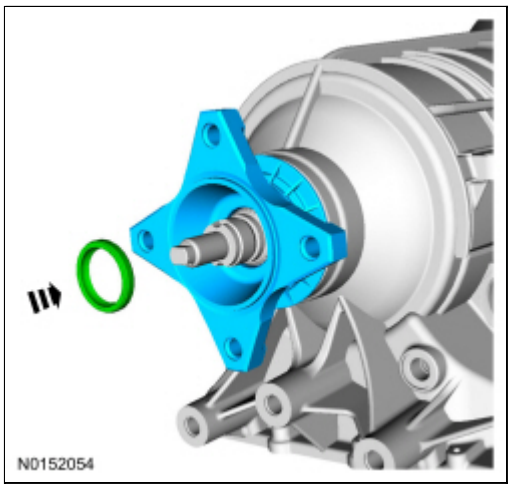
5. Position a new output shaft seal on the Output Seal (4X2) Installer and Spindle/Axle Shaft Installer.



6. Using the Output Seal (4X2) Installer and Spindle/Axle Shaft Installer, install the output shaft seal.

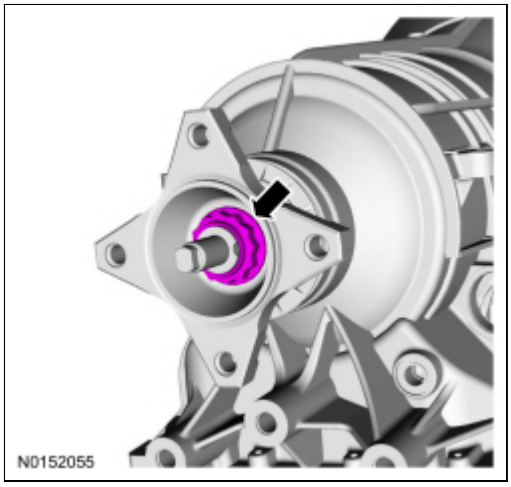


7. Install the output shaft flange and the output shaft flange seal.

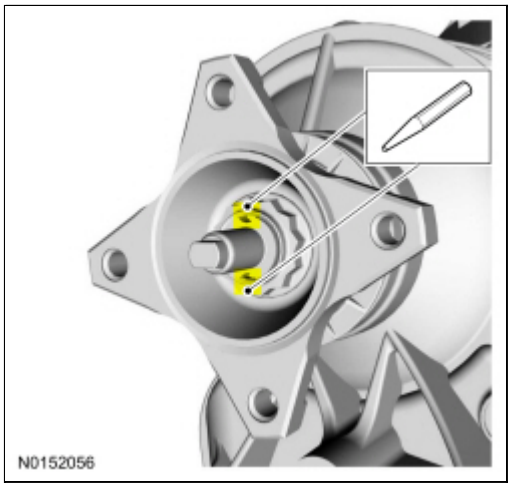


8. Install the new output shaft flange retaining nut.
    - Tighten to 80 Nm (59 lb-ft).

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9. After installing the output shaft flange retaining nut, stake the slots to prevent it from coming loose.

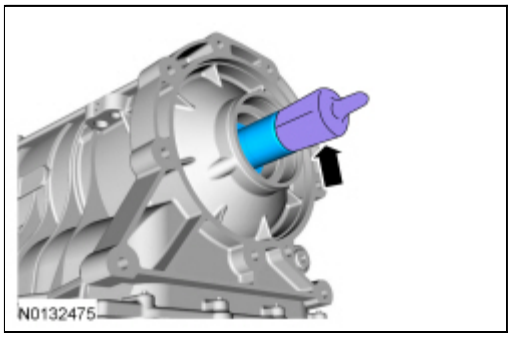


All Rear Wheel Drive (RWD) vehicles

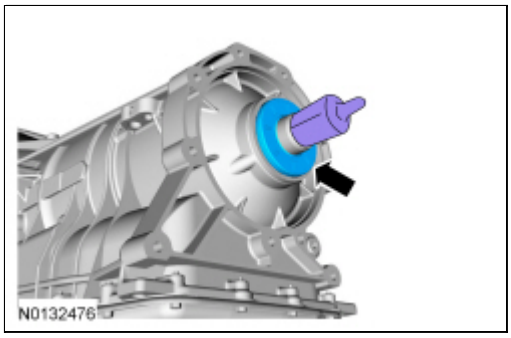
10. Install the rear driveshaft. Refer to Section 205-01 .

Four-Wheel Drive (4WD) vehicles

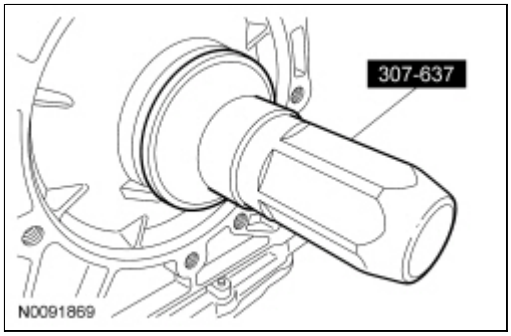
11. Install the seal protector provided with the new output shaft seal on the output shaft.



12. Slide the output shaft seal over the output shaft seal protector onto the output shaft. Remove the output shaft seal protector.



13. Using the 6R80 Rear Seal 4X4 Installer, install a new output shaft seal.



14. Install the transfer case. Refer to Section 308-07B .

All vehicles

15. Fill and check the transmission fluid. Refer to Transmission Fluid Level Check .

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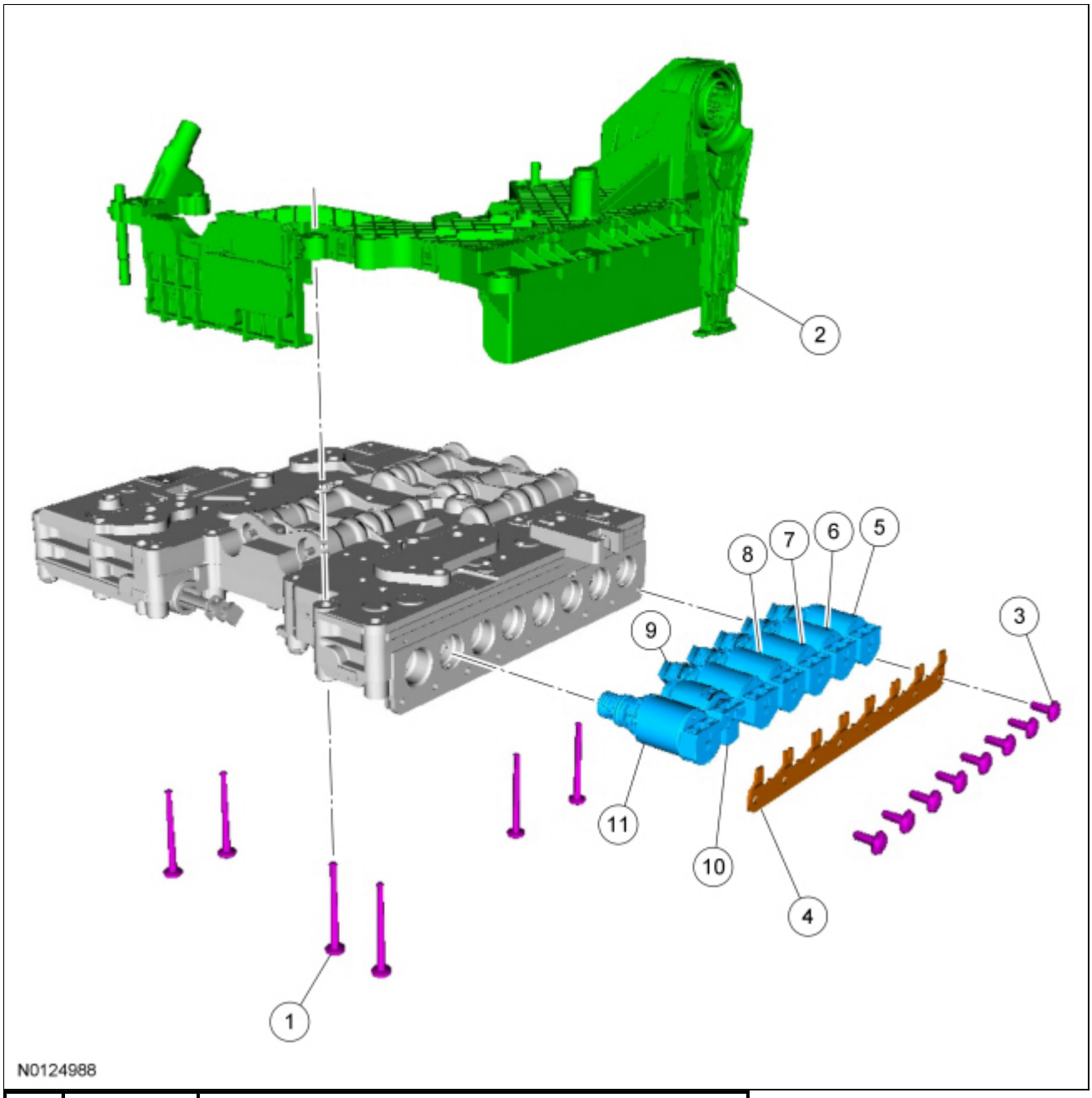
Shift Solenoids (SS)

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



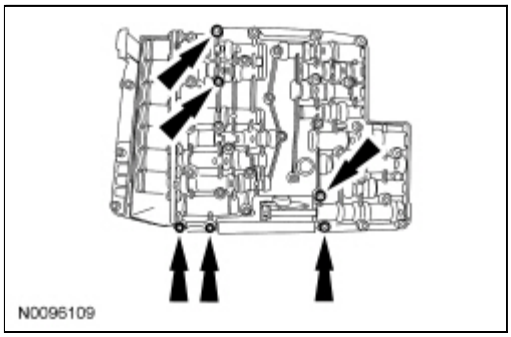
Item	Part Number	Description
1	W707884	Main control-to-molded leadframe bolts
2	7G267	Molded leadframe
3	W707885	Solenoid hold-down bracket bolt (8 required)
4	7Z369	Solenoid hold-down bracket
5	7G383	SSA , Forward (1,2,3,4) clutch, normally low VFS (brown nozzle).
6	7G383	SSB , Direct (3,5,R) clutch, normally high VFS (black nozzle).
7	7G383	SSC , Intermediate (2,6) clutch, normally low VFS

repair4less

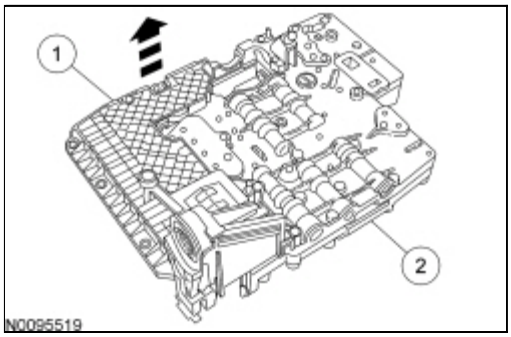
		(brown nozzle).
8	7G383	LPC solenoid, normally high VFS (black nozzle).
9	7G383	SSD , low/reverse/overdrive clutch, normally high VFS (black nozzle).
10	7G484	SSE , normally off ON/OFF solenoid.
11	7G383	TCC solenoid, normally low VFS (brown nozzle).

Removal

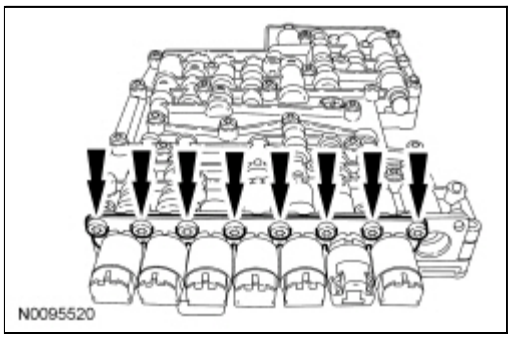
1. Remove the main control. Refer to Main Control .
2. Remove the 6 long bolts from the molded leadframe.



3. Carefully separate the molded leadframe from the main control assembly.
   1. Molded leadframe.
   2. Main control.

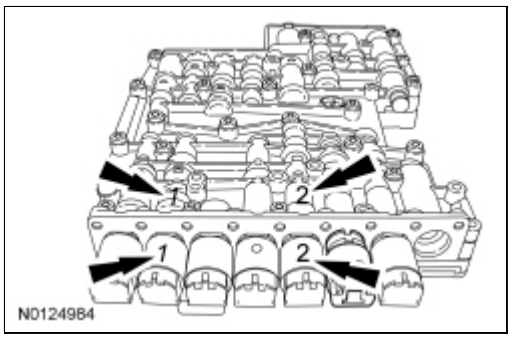


4. Remove the 8 solenoid bracket bolts and the solenoid bracket.



5. ***NOTICE:*** **A VFS is calibrated from the factory and are not all the same. To replace a VFS , match the replacement solenoid nozzle color and the band number with the original solenoid or harsh/erratic shifts, harsh/soft engagement or damage to the transmission can occur.**

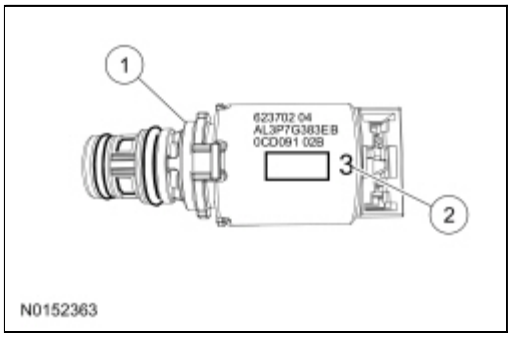
   If replacing more then 1 solenoid, number the solenoids and number the main control solenoid ports to correspond to the solenoid. Pull the solenoid(s) out of the main control valve body.



Installation

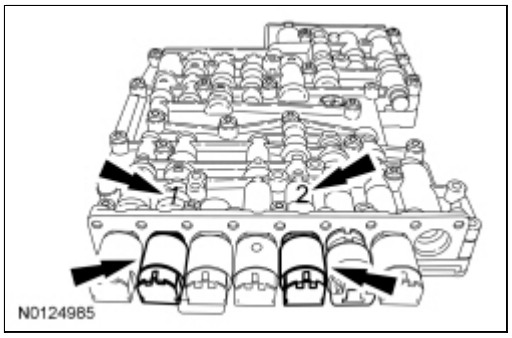
1. ***NOTICE:*** **A VFS is calibrated from the factory and are not all the same. To replace a VFS , match the replacement solenoid nozzle color and the band number with the original solenoid or harsh/erratic shifts, harsh/soft engagement or damage to the transmission can occur.**

   Use the solenoid exploded view at the beginning of this procedure to identify what type of solenoid is being replaced. The solenoid can be a normally high VFS with a black nozzle, normally low VFS with a brown nozzle or an ON/OFF solenoid.
   If replacing a VFS , record the band number and the solenoid nozzle color to get the correct part number for the solenoid.
   Lubricate the solenoid O-rings with clean transmission fluid.
   1. Solenoid Nozzle
   2. Solenoid band number

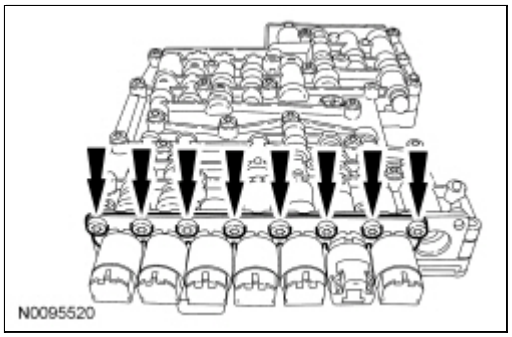


2. Position the solenoid(s) in the main control in the correct port(s) as marked during removal.

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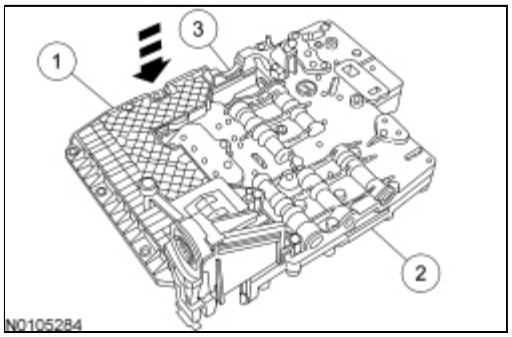


3. Position the solenoid bracket in place and install the 8 bolts.
    - Tighten to 6 Nm (53 lb-in).

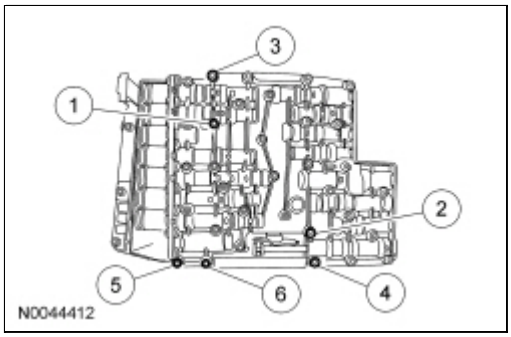


4. **NOTE:** The TR sensor pin must be aligned with the manual control valve during installation.

    Position the molded leadframe on the main control.
    1. Molded leadframe.
    2. Main control.
    3. TR sensor pin.



5. Install the 6 long bolts into the molded leadframe. Tighten the bolts in the sequence shown.
    - Tighten to 6 Nm (53 lb-in).

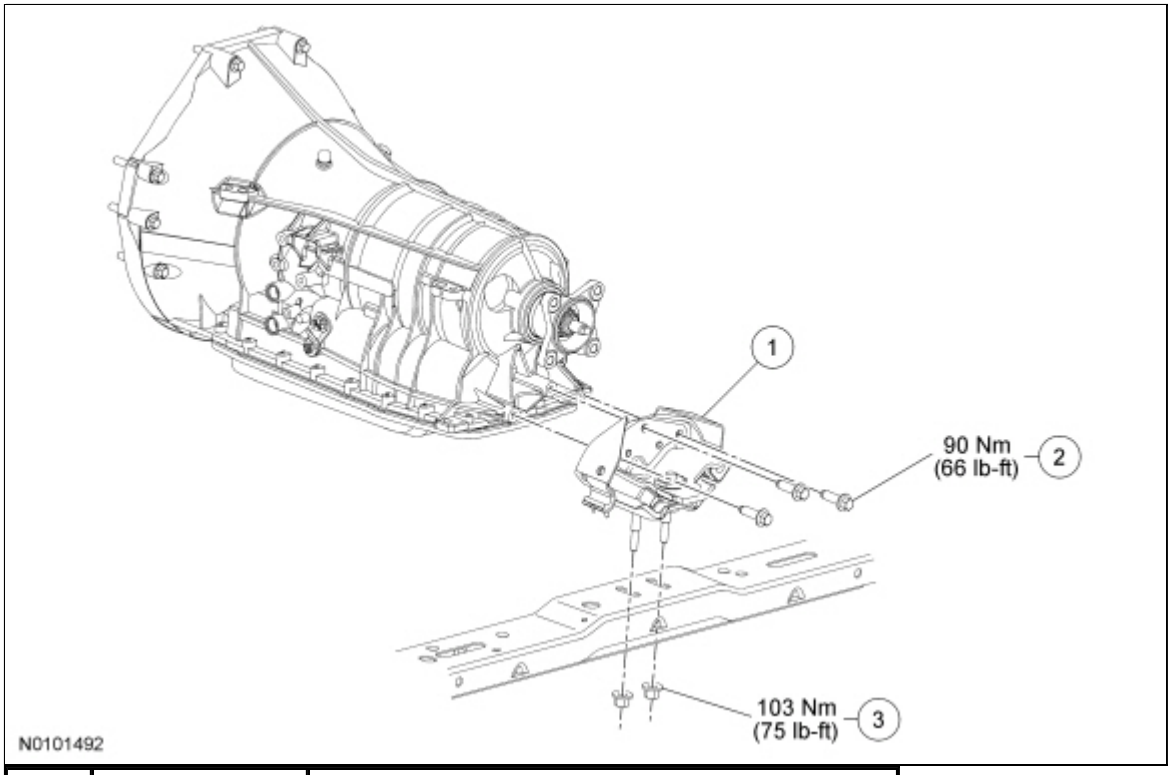


6. Install the main control. Refer to Main Control .

repair4less

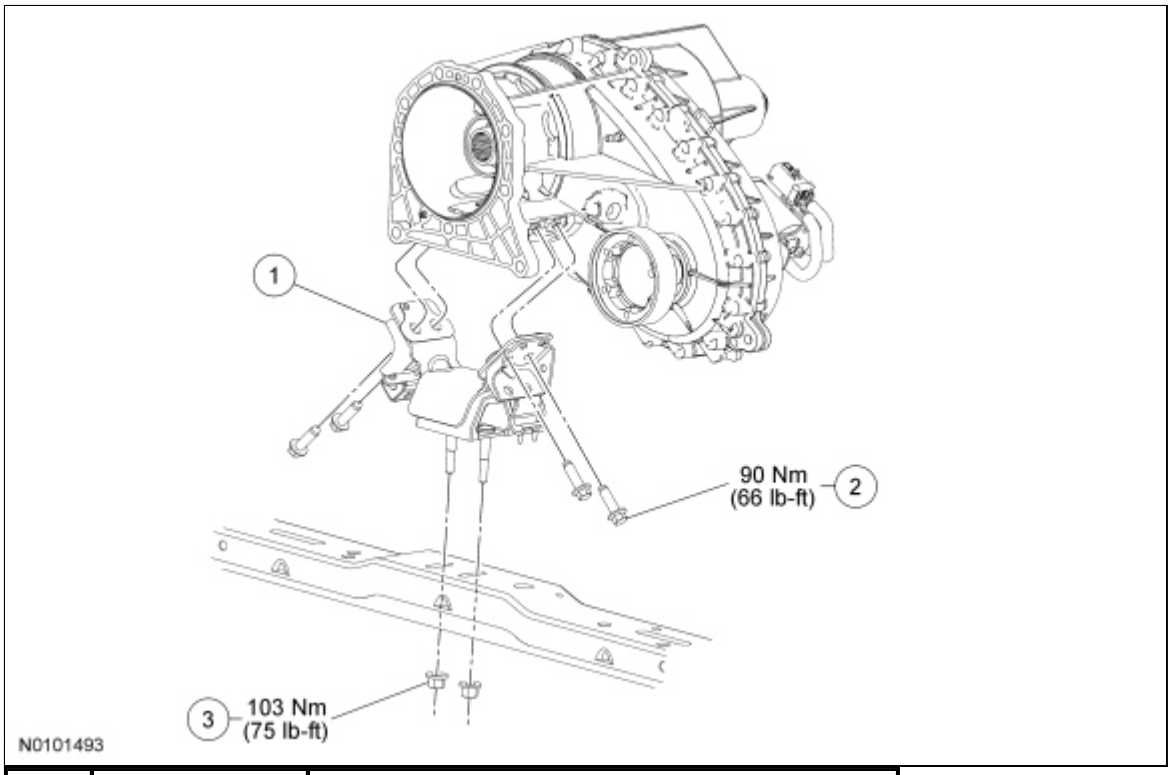
Transmission Insulator and Retainer

Transmission Insulator and Retainer Rear Wheel Drive (RWD)



Item	Part Number	Description
1	6068	Transmission insulator and retainer
2	W713728	Transmission insulator and retainer bolt
3	N621945	Transmission insulator and retainer nut

Transmission Insulator and Retainer 4WD

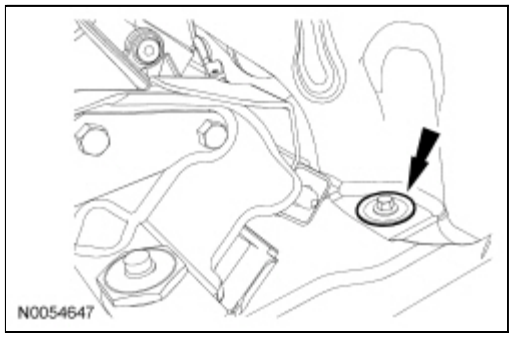


Item	Part Number	Description
1	6068	Transmission insulator and retainer
2	W713728	Transmission insulator and retainer bolt
3	N621945	Transmission insulator and retainer nut

Removal

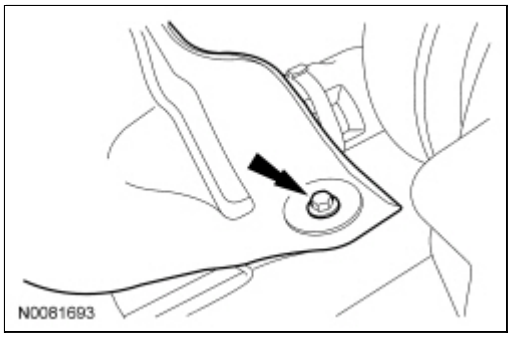
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. Remove the RH exhaust heat shield bolt from the transmission support crossmember.



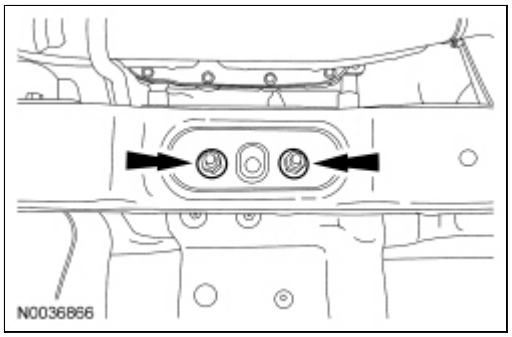
3. Remove the LH exhaust heat shield bolt from the transmission support crossmember.

repair4less

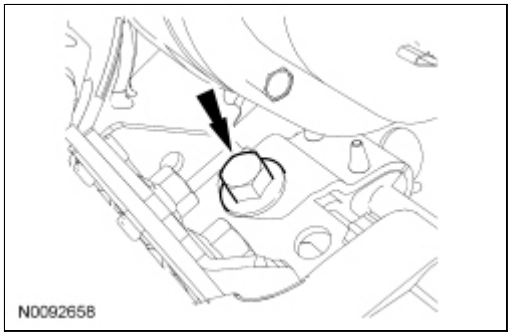


RWD vehicles

4. Remove the 2 transmission insulator and retainer nuts.

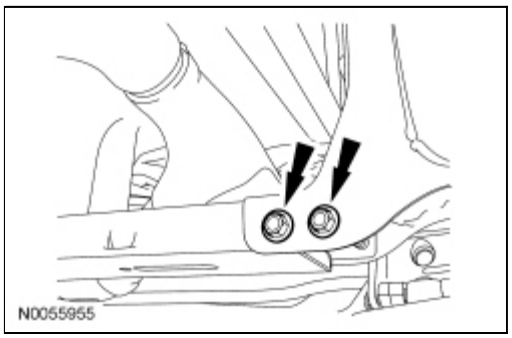


5. Remove the LH isolator cap bolt.

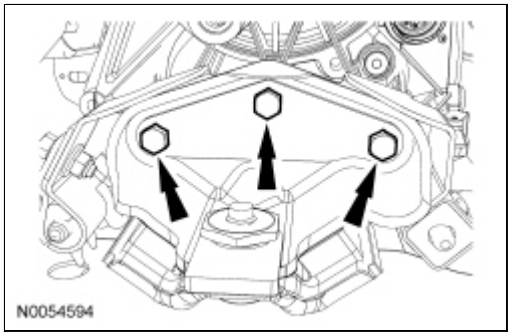


6. Position a high-lift transmission jack under the transmission.

7. Remove and discard the 4 transmission support crossmember nuts and bolts (2 each side) and remove the transmission support crossmember.

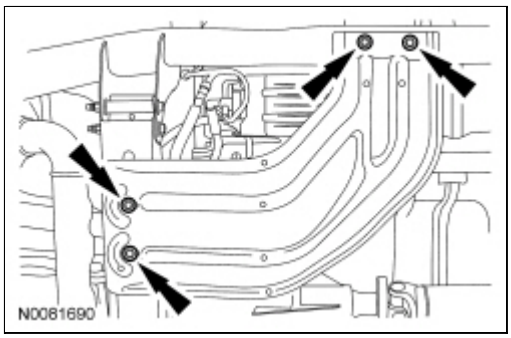


8. Remove the 3 transmission insulator and retainer bolts and remove the transmission insulator and retainer.

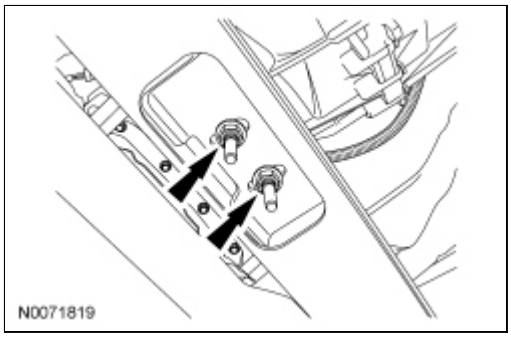


4WD vehicles

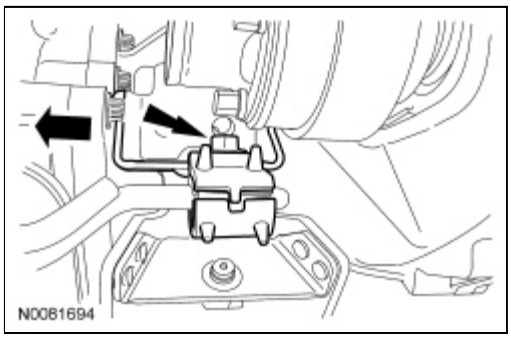
9. If equipped, remove the 4 skid plate bolts and remove the skid plate.



10. Remove the 2 transmission insulator and retainer nuts.



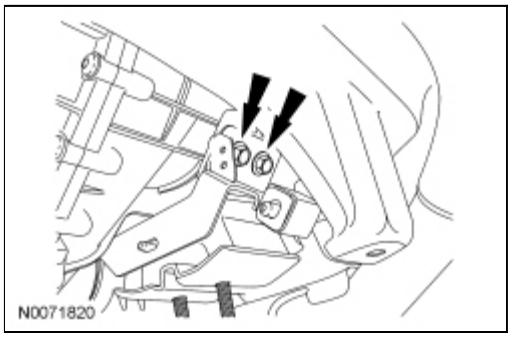
11. Remove the LH insolator cap bolt.



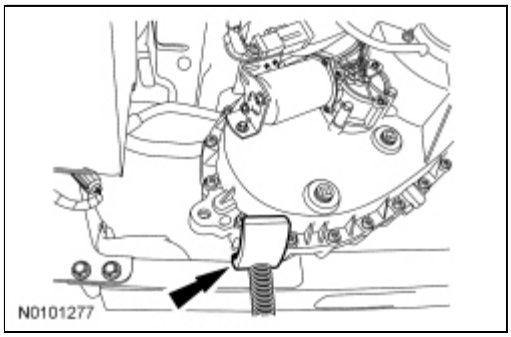
repair4less

12. **NOTE:** Right side shown, left side similar. Transmission crossmember removed for clarity.

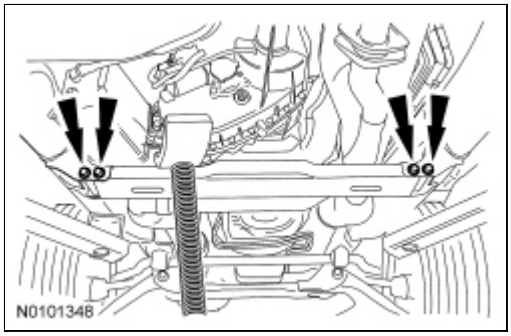
    Remove the 4 transmission insulator and retainer bolts.



13. Support the transfer case.



14. Remove and discard the 4 transmission support crossmember nuts and bolts.

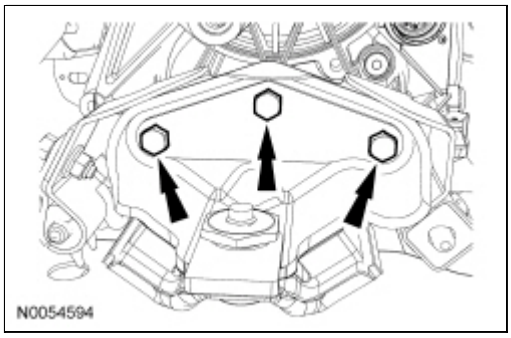


15. Remove the transmission insulator and retainer.

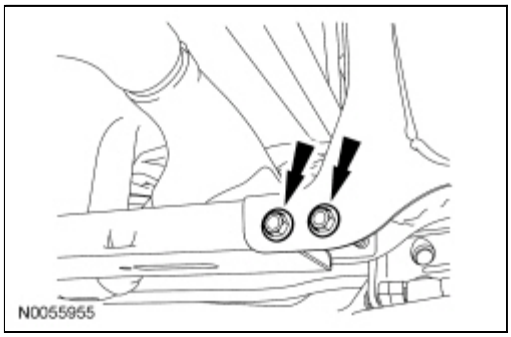
Installation

RWD vehicles

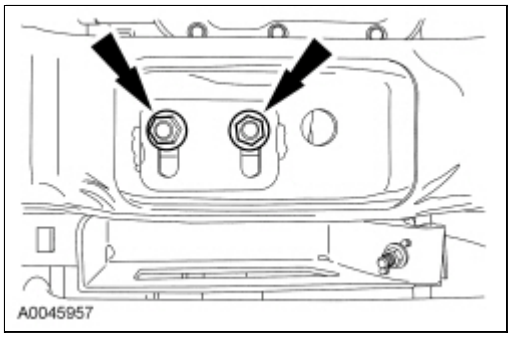
1. Install the transmission insulator and retainer and the 3 bolts.
    - Tighten to 90 Nm (66 lb-ft).



2. Install the transmission support crossmember and the 4 new transmission support crossmember nuts and bolts (2 each side).
    - Tighten to 90 Nm (66 lb-ft).

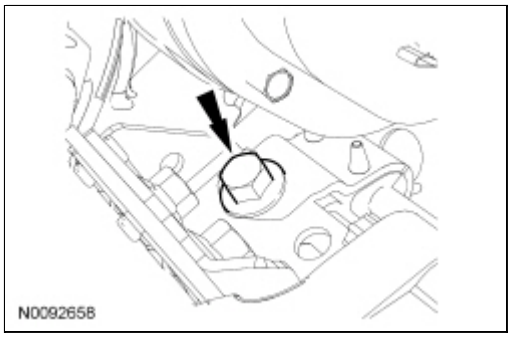


3. Lower the transmission onto the transmission support crossmember and install the 2 transmission insulator and retainer nuts.
    - Tighten to 103 Nm (75 lb-ft).



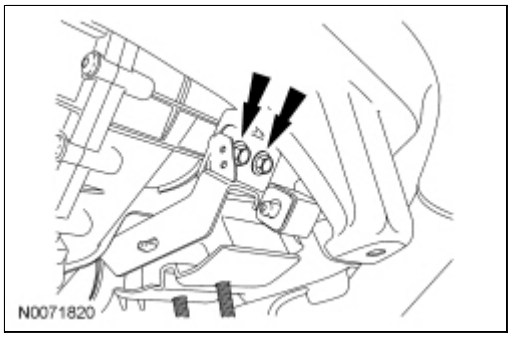
4. Install the LH isolator cap bolt.
    - Tighten to 35 Nm (26 lb-ft).

repair4less

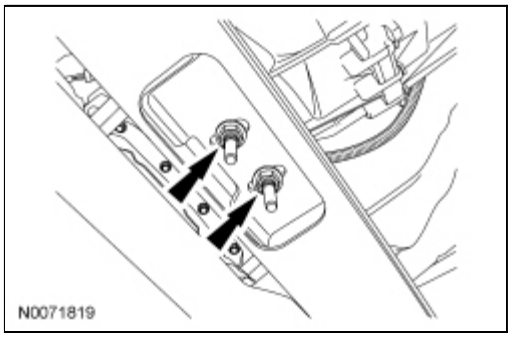


4WD vehicles

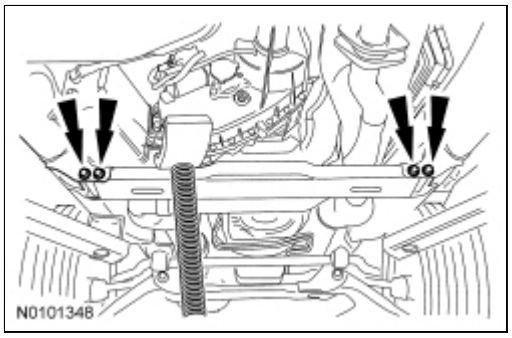
5. Loosely install the transmission insulator and retainer and the 4 bolts.



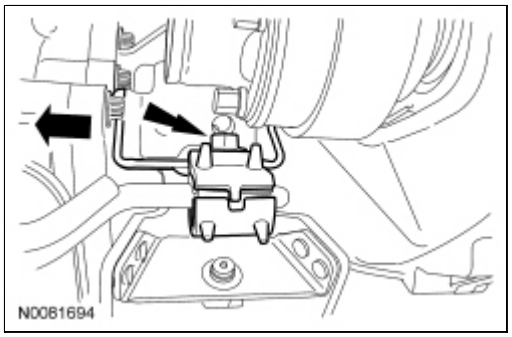
6. Position the transmission support crossmember and loosely install the 2 transmission insulator and retainer nuts.



7. Install the 4 new transmission support crossmember bolts and nuts.
    - Tighten the transmission insulator and retainer bolts to 90 Nm (66 lb-ft).
    - Tighten the transmission support crossmember bolts and nuts to 90 Nm (66 lb-ft).
    - Tighten the transmission insulator and retainer nuts to 103 Nm (75 lb-ft).

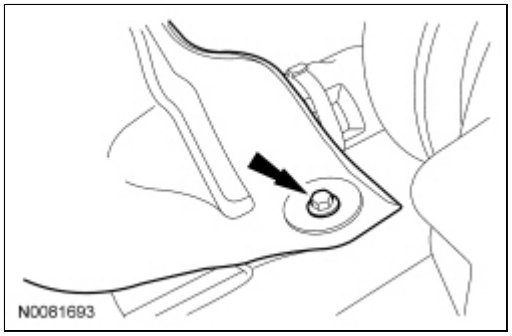


8. Install the bolt for the LH isolator cap bolt.
    - Tighten to 35 Nm (26 lb-ft).



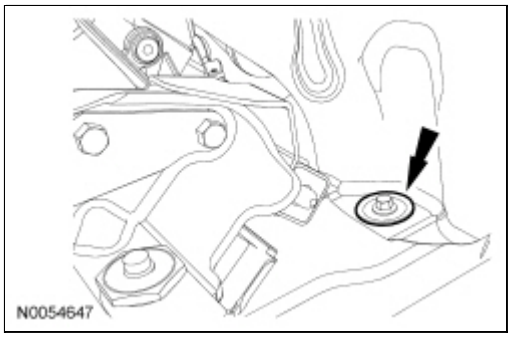
All vehicles

9. Install the LH exhaust heat shield bolt to the transmission support crossmember.
    - Tighten to 15 Nm (133 lb-in).



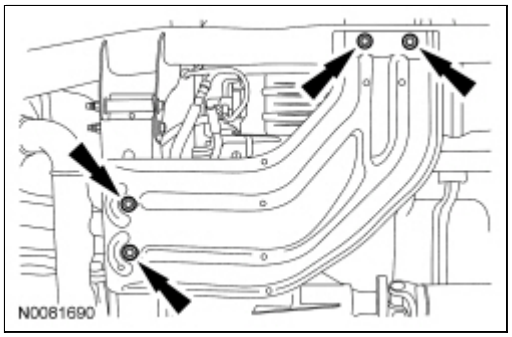
10. Install the RH exhaust heat shield bolt to the transmission support crossmember.
    - Tighten to 15 Nm (133 lb-in).

repair4less



4WD vehicles

11. If equipped, install the skid plate and the 4 skid plate bolts.
    - Tighten to 40 Nm (30 lb-ft).



Transmission — Four Wheel Drive (4WD)

Special Tool(s)

 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B

Installation

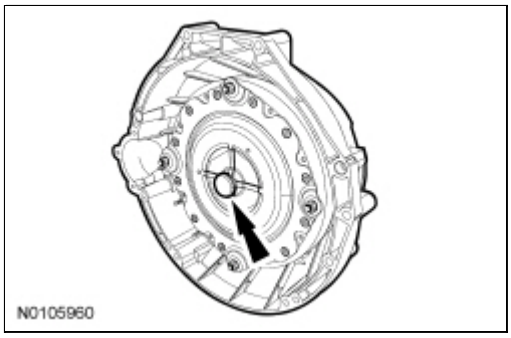
All vehicles

NOTE: Prior to installing a new transmission or an overhauled transmission with a new main control, record the solenoid strategy identification tag. If a new main control was installed, install the replacement solenoid body tag over the original identification tag. REFER to Solenoid Body Strategy .

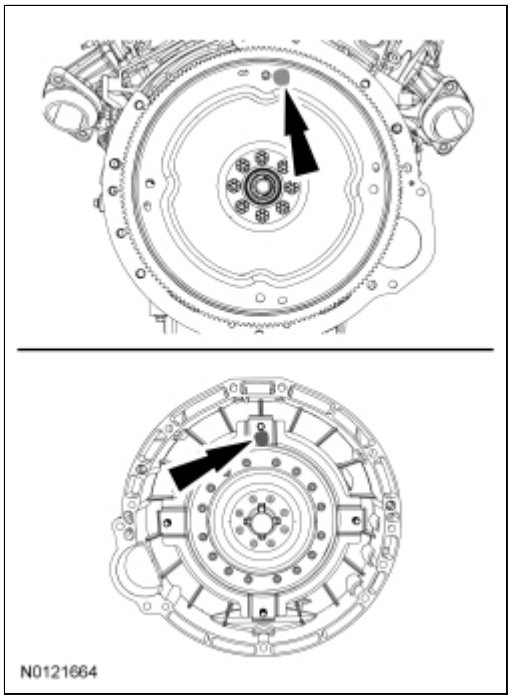
1. ***NOTICE:*** **Prior to installation of the transmission, lubricate the torque converter pilot hub with multi-purpose grease or damage to the torque converter or engine crankshaft can occur.**

   Lubricate the torque converter pilot hub with multi-purpose grease.

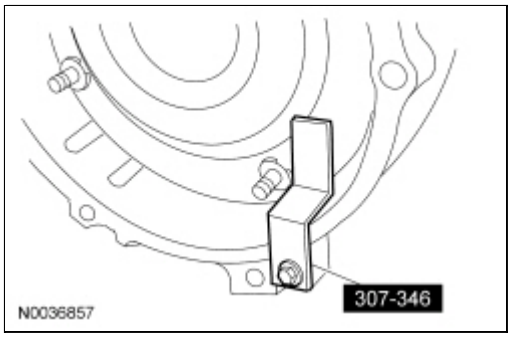
repair4less



2. If equipped, align the torque converter stud and flexplate hole near the paint marks at the 12 o'clock position.



3. Install the Torque Converter Retainer.



4. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

NOTICE: **The torque converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates the torque converter pilot is not binding in the engine crankshaft.**

NOTE: Make sure the transmission jack contacts the outer ribs of the transmission fluid pan.

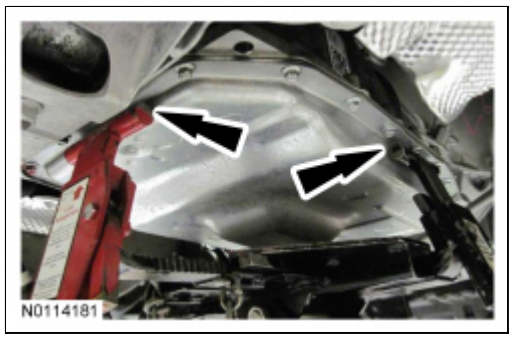
NOTE: If transmission was disassembled, follow the add transmission fluid to the transmission steps. If transmission is being replaced, remove the transmission fluid fill plug and verify transmission is filled with transmission fluid.

Add transmission fluid to the transmission.

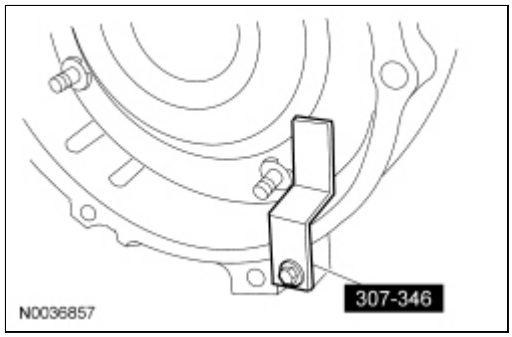
- Slightly tilt the transmission rearward.
- Remove the transmission fluid fill plug transmission fluid level indicator assembly.
- Add 11.35L (12 qt) of transmission fluid to the transmission through the transmission fluid fill hole.
- Install the transmission fluid fill plug.
    - Tighten to 26 Nm (19 lb-ft).

5. ***NOTICE:*** **The torque converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates the torque converter pilot is not binding in the engine crankshaft.**

   Position and secure the transmission on the high-lift transmission jack. Raise and position the transmission into the vehicle behind the engine.



6. Remove the Torque Converter Retainer.



7. ***NOTICE:*** **Make sure the transmission wiring harness is not between the engine block and transmission prior to moving the transmission toward the engine or damage can occur.**

   NOTE: Make sure the torque converter is fully seated in the transmission before aligning the transmission to the engine.

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With the transmission in a horizontal position, move it toward the engine and position it on the dowel pins.

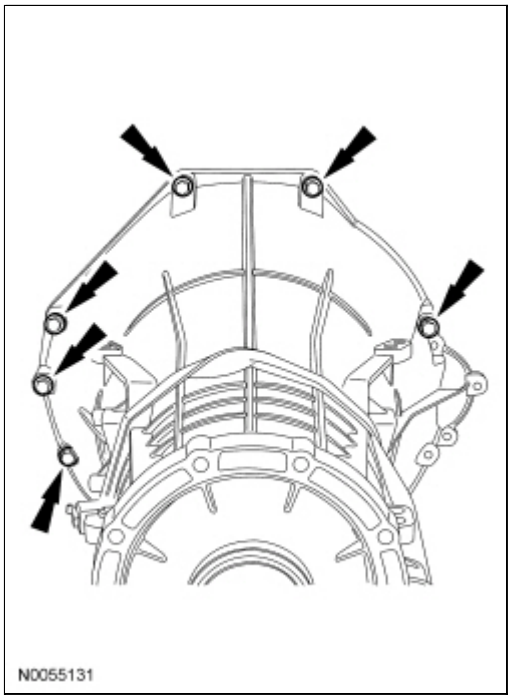
Vehicles equipped with a 5.0L or 6.2L engine

8. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

   NOTE: Install the top 2 transmission-to-engine bolts before installing the rest of the bolts.

   NOTE: Install the top left transmission-to-engine bolt through the fuel line bracket first, then through the transmission case.

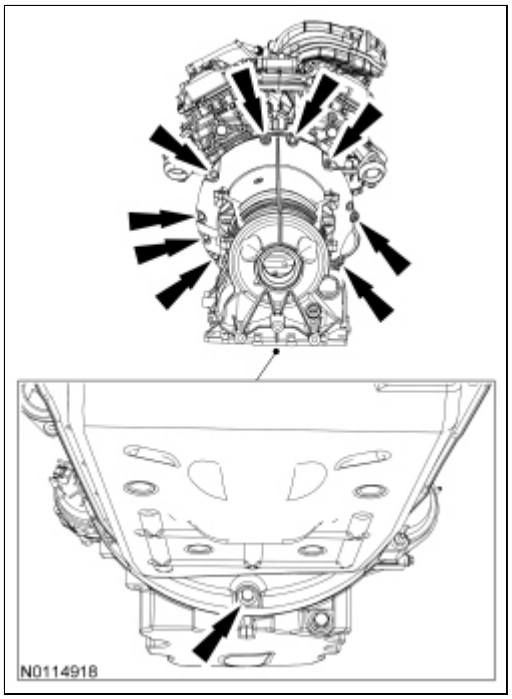
   Install 6 of the 7 transmission-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).



Vehicles equipped with a 3.5L or 3.7L engine

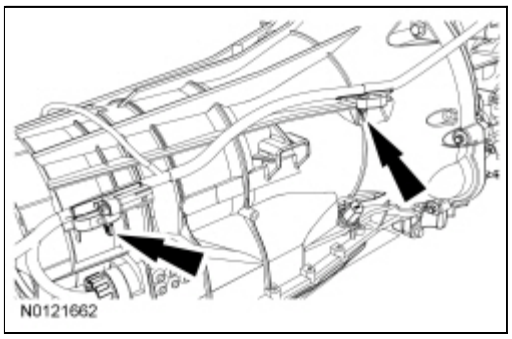
9. **NOTE:** Install the top 2 transmission-to-engine bolts through the fuel line bracket first, then through the transmission case.

   Install the 10 transmission-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).

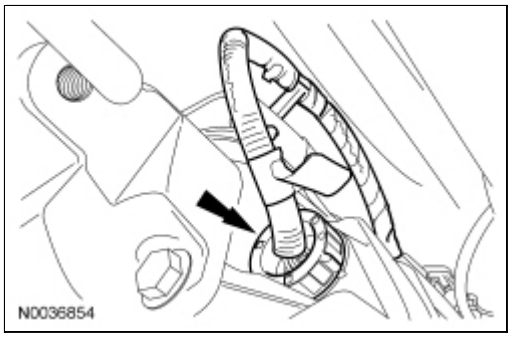


All vehicles

10. Connect the wiring harness retainers to the top of the transmission.



11. Connect the transmission electrical connector by pushing it in and twisting the outer shell to lock it in place.

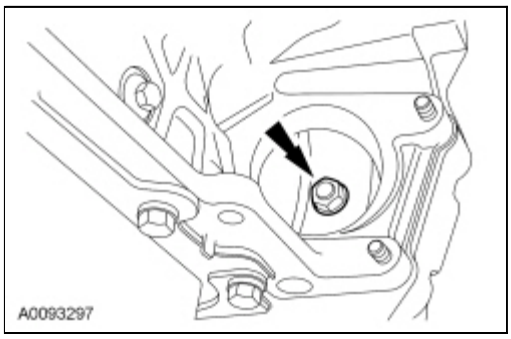


Vehicles equipped with a 5.0L or 6.2L engine

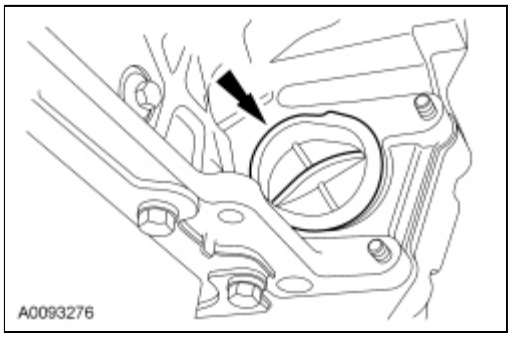
12. Install 4 new flexplate-to-torque converter nuts.

repair4less

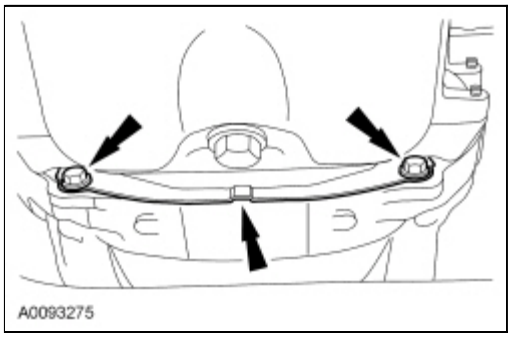
- Tighten to 40 Nm (30 lb-ft).



13. Install the rubber torque converter nut access cover.

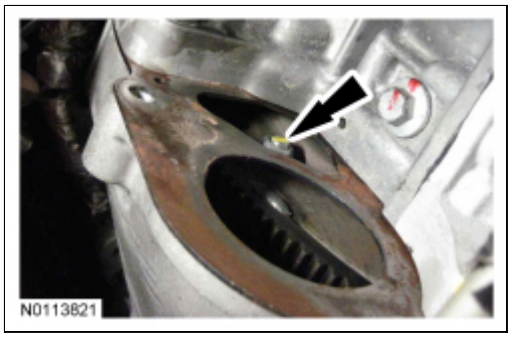


14. Install the flexplate inspection cover and the flexplate inspection cover bolts.
    - Tighten to 48 Nm (35 lb-ft).

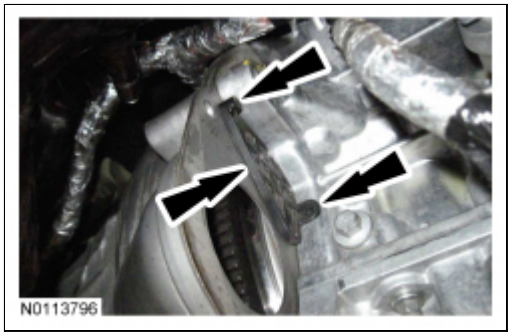


Vehicles equipped with a 3.5L or 3.7L engine

15. Install 4 new flexplate-to-torque converter nuts.
    - Tighten to 40 Nm (30 lb-ft).



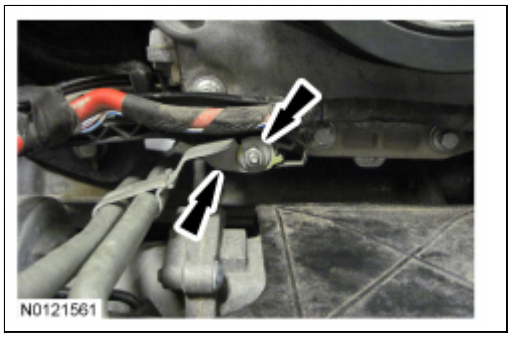
16. Install the access cover and the 2 pin-type retainers.



All vehicles

17. Install the starter motor. REFER to Section 303-06 .

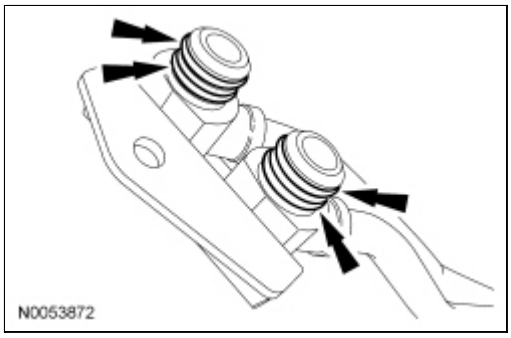
18. Reposition the transmission fluid cooler tubes and bracket and install the transmission fluid cooler tube bracket nut.
    - Tighten to 12 Nm (106 lb-in).



19. **NOTE:** Inspect the case to make sure the old transmission fluid cooler tube O-rings are not stuck in the case.

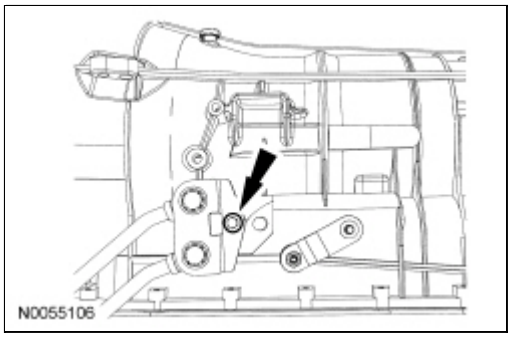
    Install new transmission fluid cooler tube O-rings on the transmission fluid cooler tubes.

repair4less



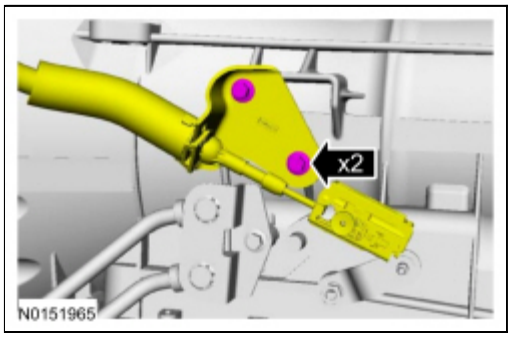
20. ***NOTICE:*** **Install a new transmission fluid cooler tube bracket bolt.**

    Install the transmission fluid cooler tubes and a new transmission fluid cooler tube bracket bolt.
    - Tighten to 30 Nm (22 lb-ft).



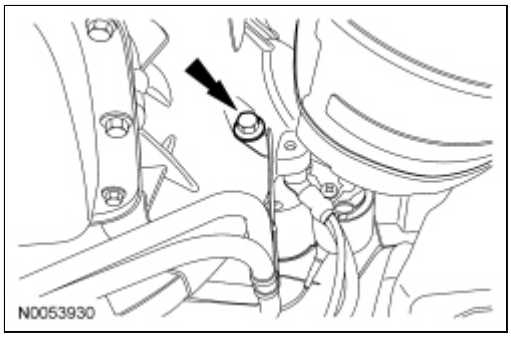
21. **NOTE:** The column shift is shown, the floor shift similar.

    Install the selector lever cable bracket and selector lever cable bracket bolts.
    - Tighten to 25 Nm (18 lb-ft).



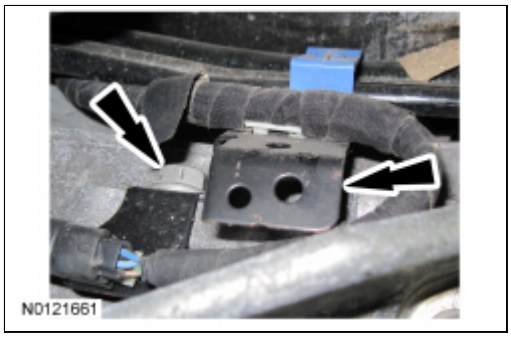
Vehicles equipped with a 5.0L or 6.2L engine

22. Align the transmission fluid cooler tube bracket and install the remaining transmission-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).

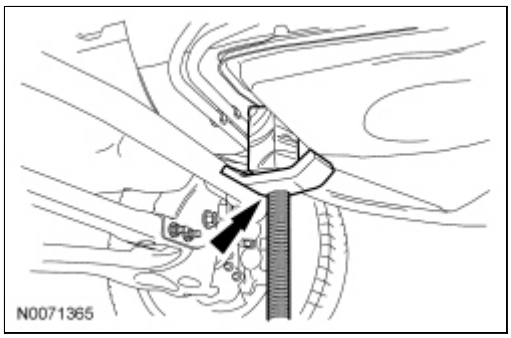


All vehicles

23. Install the fuel line bracket and the fuel line bracket bolt.
    - Tighten to 25 Nm (18 lb-ft).



24. Position a jack stand under the transmission, and remove the high-lift transmission jack.

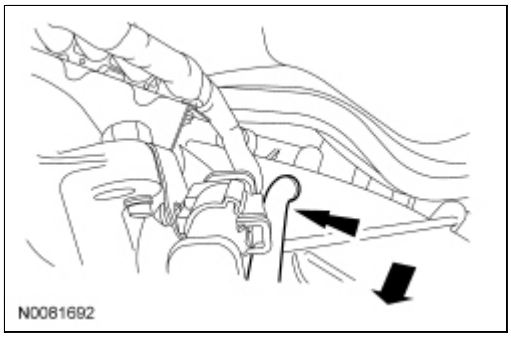


25. **NOTE:** Do not reuse the old transfer case-to-transmission bolts.

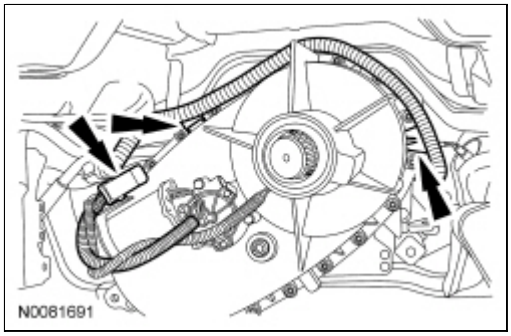
    If the transfer case was removed from the transmission during removal, install the transfer case using a high-lift transmission jack. Install 9 new transfer case-to-transmission bolts.
    - Tighten the bolts evenly in a cross pattern to 17 Nm (150 lb-in).

26. Connect the vent hose to the transfer case.

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27. Connect the electrical connector and attach the 2 harness retainer clips to the transfer case.



28. Install the shift cable mounting bracket and the 2 nuts.
    - Tighten to 28 Nm (21 lb-ft).

29. Connect the cable end to the shift lever.

30. Install the front and rear driveshafts. REFER to Section 205-01 .

31. Install the exhaust Y-pipe. REFER to Section 309-00 .

32. Connect the battery ground cable. REFER to Section 414-01 .

33. Adjust the selector lever cable and install the selector lever cable end on the manual control lever. Verify the selector lever cable is correctly adjusted. REFER to Section 307-05 .

34. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

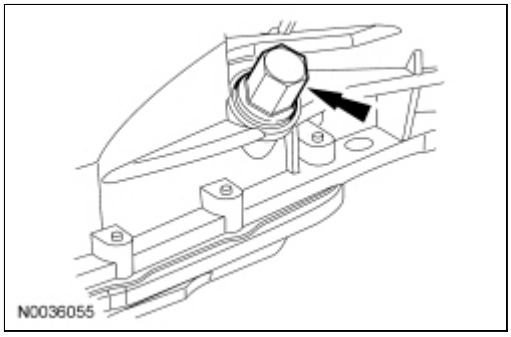
35. If a new transmission or a new main control was installed, the solenoid body strategy must be updated. REFER to Solenoid Body Strategy .

36. If the transmission was overhauled, the adaptive drive cycle must be updated. REFER to Shift Point Road Test .

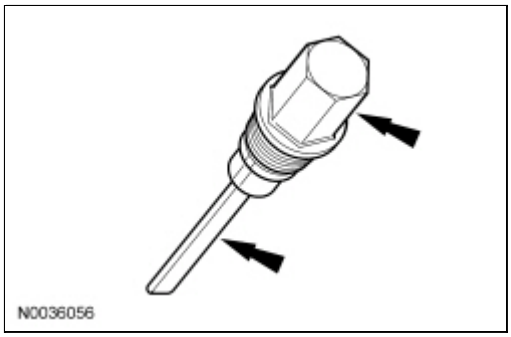
37. While driving the vehicle, use the scan tool to verify that the TFT has reached a temperature of 91°C (195°F). This will circulate the transmission fluid through the torque converter and the transmission fluid cooling system, eliminating any trapped air in the transmission fluid cooling system.
    - With the engine idling (600-750 rpm) in PARK, verify that the TFT is between 91ºC-102ºC (195ºF-215ºF).

38. Remove the transmission fluid fill plug transmission fluid level indicator assembly located on the

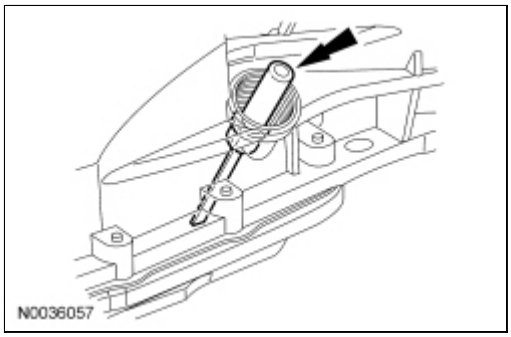
passenger side front portion of the transmission case.



39. Separate the transmission fluid level indicator from the transmission fluid fill plug.



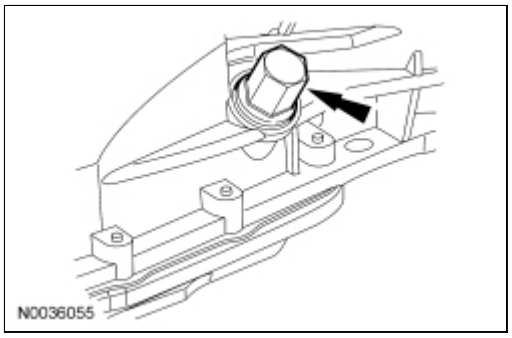
40. Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.



41. **NOTE:** If the transmission fluid is not at the correct level, follow the steps for Adding Additional Transmission Fluid or Removing Transmission Fluid. REFER to Transmission Fluid Drain and Refill .

    Install the transmission fluid fill plug.
    - Tighten to 35 Nm (26 lb-ft).

repair4less


N0036055

Transmission — Rear Wheel Drive (RWD)

Special Tool(s)

 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B

Installation

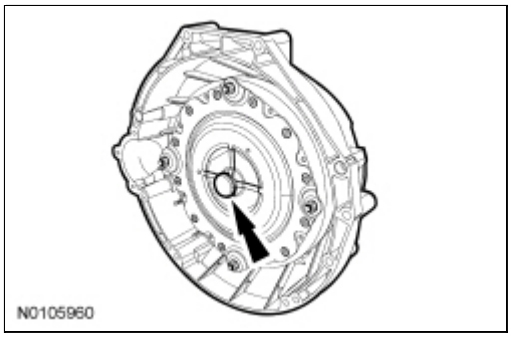
All vehicles

NOTE: Prior to installing a new transmission or an overhauled transmission with a new main control, record the solenoid strategy identification tag. If a new main control was installed, install the replacement solenoid body tag over the original identification tag. REFER to Solenoid Body Strategy .

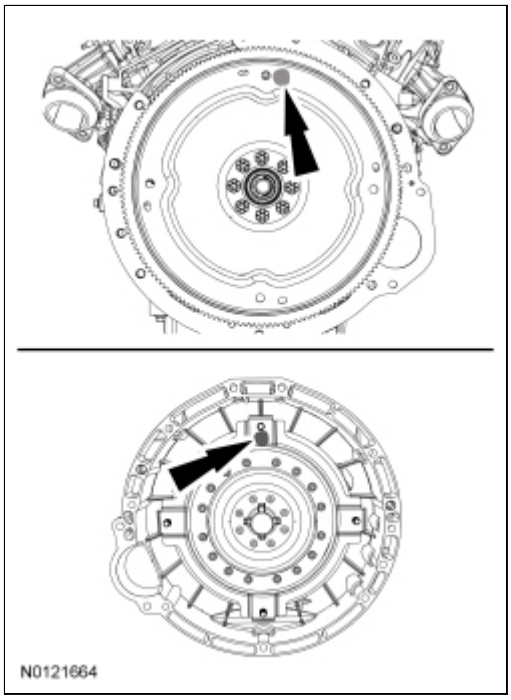
1. ***NOTICE:*** **Prior to installation of the transmission, lubricate the torque converter pilot hub with multi-purpose grease or damage to the torque converter or engine crankshaft can occur.**

   Lubricate the torque converter pilot hub with multi-purpose grease.

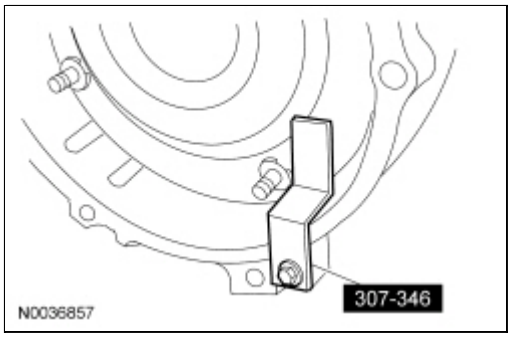
repair4less



2. If equipped, align the torque converter stud and flexplate hole near the paint marks at the 12 o'clock position.



3. Install the Torque Converter Retainer.



4. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

NOTICE: **The torque converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates the torque converter pilot is not binding in the engine crankshaft.**

NOTE: Make sure the transmission jack contacts the outer ribs of the transmission fluid pan.

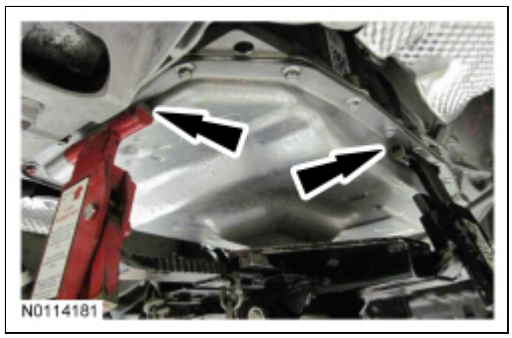
NOTE: If transmission was disassembled, follow the add transmission fluid to the transmission steps. If transmission is being replaced, remove the transmission fluid fill plug and verify transmission is filled with transmission fluid.

Add transmission fluid to the transmission.

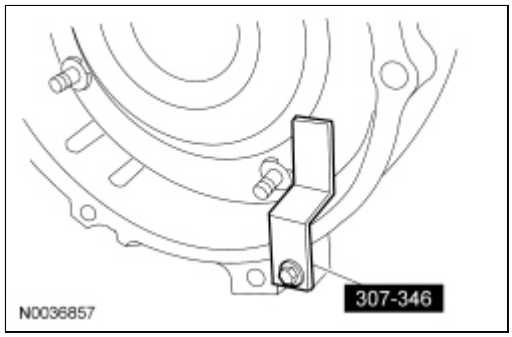
- Slightly tilt the transmission rearward.
- Remove the transmission fluid fill plug transmission fluid level indicator assembly.
- Add 11.35L (12 qt) of transmission fluid to the transmission through the transmission fluid fill hole.
- Install the transmission fluid fill plug.
    - Tighten to 26 Nm (19 lb-ft).

5. ***NOTICE:*** **The torque converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates the torque converter pilot is not binding in the engine crankshaft.**

   Position and secure the transmission on the high-lift transmission jack. Raise and position the transmission into the vehicle behind the engine.



6. Remove the Torque Converter Retainer.



7. ***NOTICE:*** **Make sure the transmission wiring harness is not between the engine block and transmission prior to moving the transmission toward the engine or damage can occur.**

   NOTE: Make sure the torque converter is fully seated in the transmission before aligning the transmission to the engine.

repair4less

With the transmission in a horizontal position, move it toward the engine and position it on the dowel pins.

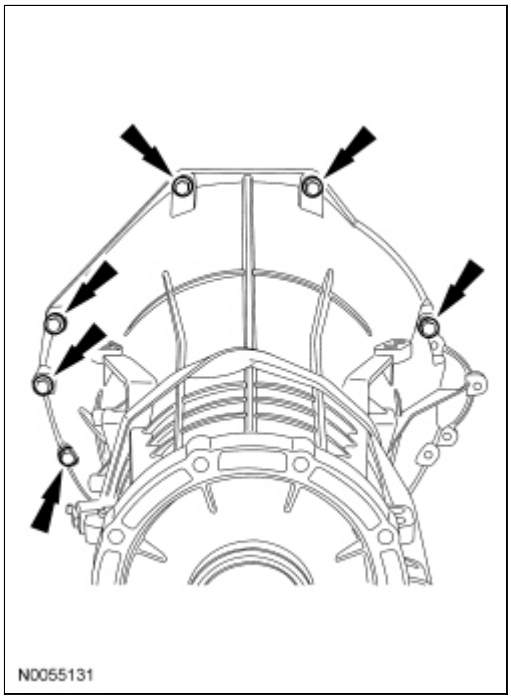
Vehicles equipped with a 5.0L or 6.2L engine

8. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

   NOTE: Install the top 2 transmission-to-engine bolts before installing the rest of the bolts.

   NOTE: Install the top left transmission-to-engine bolt through the fuel line bracket first, then through the transmission case.

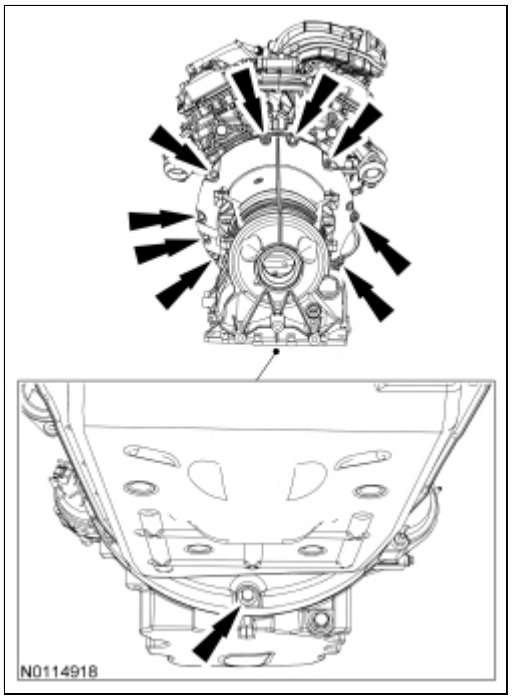
   Install 6 of the 7 transmission-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).



Vehicles equipped with a 3.5L or 3.7L engine

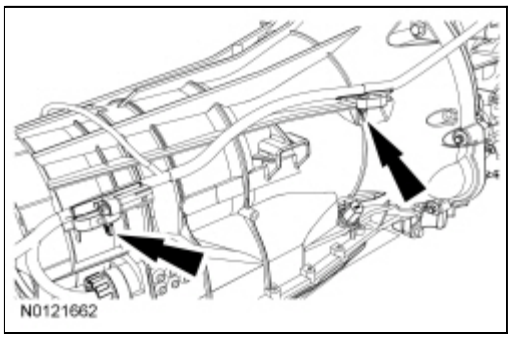
9. **NOTE:** Install the top 2 transmission-to-engine bolts through the fuel line bracket first, then through the transmission case.

   Install the 10 transmission-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).

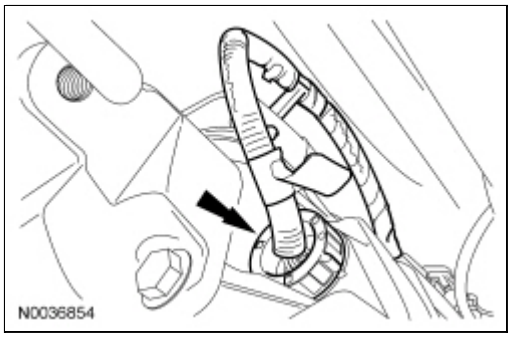


All vehicles

10. Connect the wiring harness retainers to the top of the transmission.



11. Connect the transmission electrical connector by pushing it in and twisting the outer shell to lock it in place.

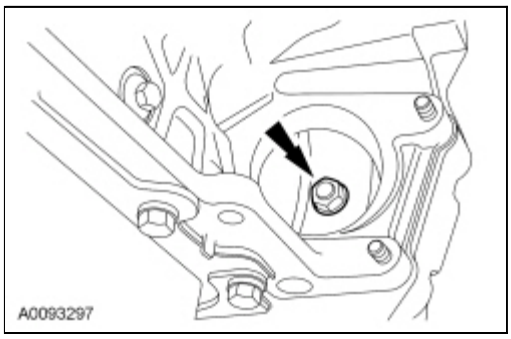


Vehicles equipped with a 5.0L or 6.2L engine

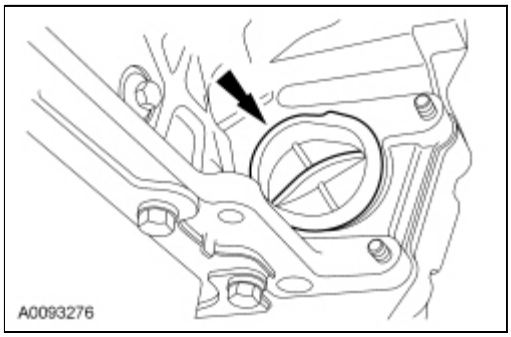
12. Install 4 new flexplate-to-torque converter nuts.

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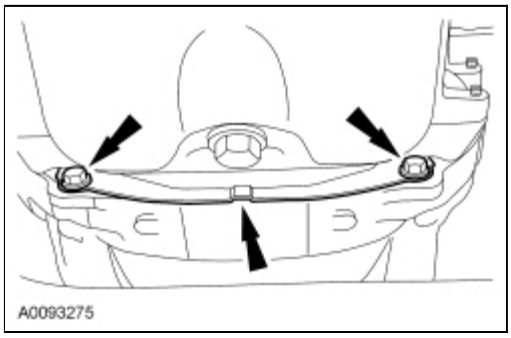
- Tighten to 40 Nm (30 lb-ft).



13. Install the rubber torque converter nut access cover.

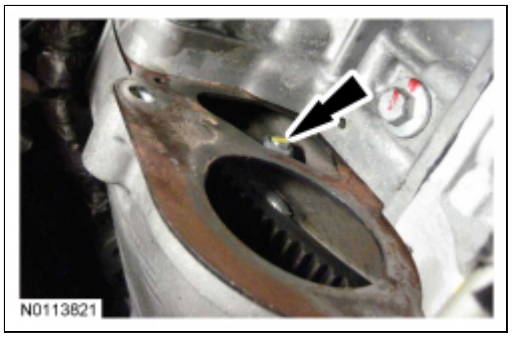


14. Install the flexplate inspection cover and the flexplate inspection cover bolts.
    - Tighten to 48 Nm (35 lb-ft).

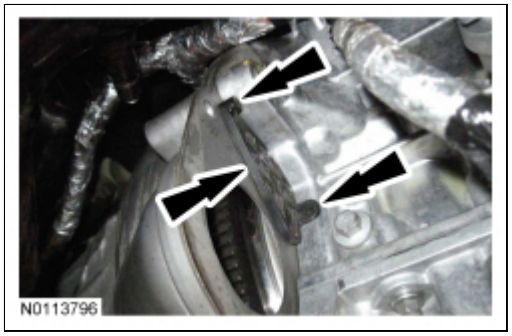


Vehicles equipped with a 3.5L or 3.7L engine

15. Install 4 new flexplate-to-torque converter nuts.
    - Tighten to 40 Nm (30 lb-ft).



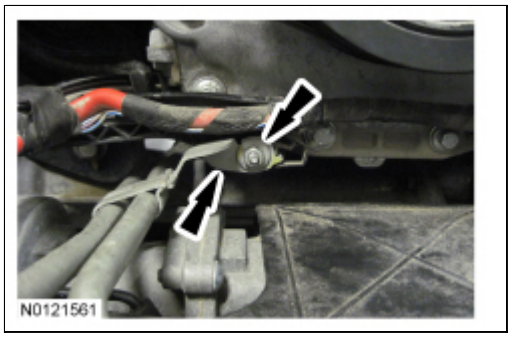
16. Install the access cover and the 2 pin-type retainers.



All vehicles

17. Install the starter motor. REFER to Section 303-06 .

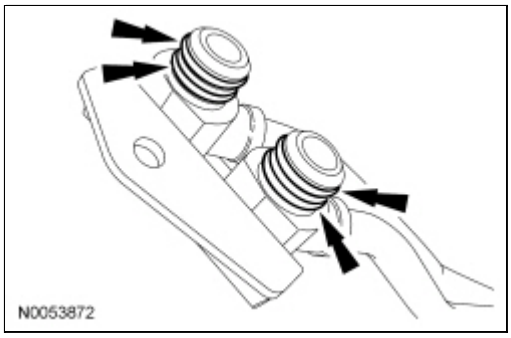
18. Reposition the transmission fluid cooler tubes and bracket and install the transmission fluid cooler tube bracket nut.
    - Tighten to 12 Nm (106 lb-in).



19. **NOTE:** Inspect the case to make sure the old transmission fluid cooler tube O-rings are not stuck in the case.

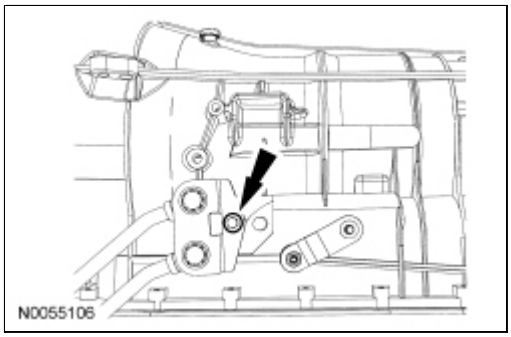
    Install new transmission fluid cooler tube O-rings on the transmission fluid cooler tubes.

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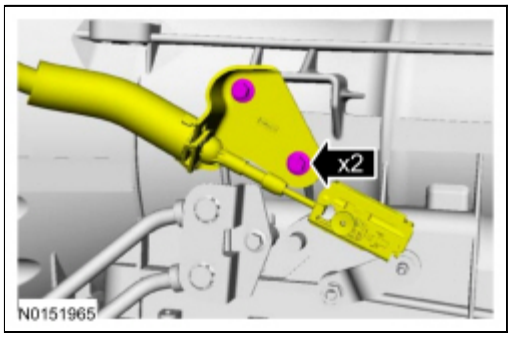
20. ***NOTICE:*** **Install a new transmission fluid cooler tube bracket bolt.**

    Install the transmission fluid cooler tubes and a new transmission fluid cooler tube bracket bolt.
    - Tighten to 30 Nm (22 lb-ft).



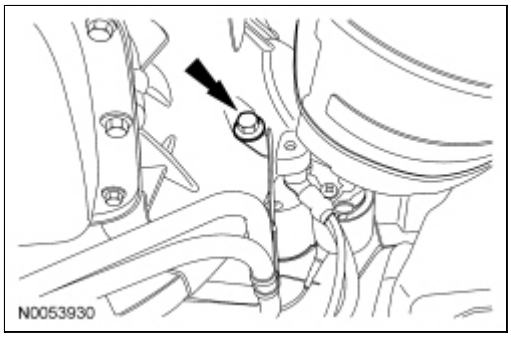
21. **NOTE:** The column shift is shown, the floor shift similar.

    Install the selector lever cable bracket and selector lever cable bracket bolts.
    - Tighten to 25 Nm (18 lb-ft).



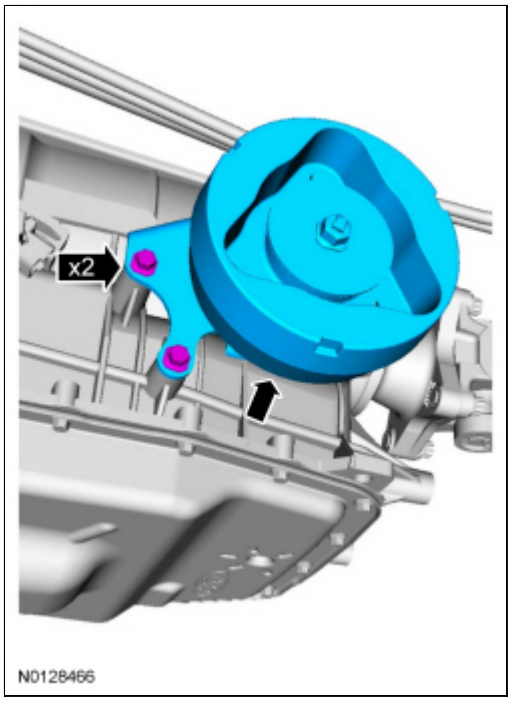
Vehicles equipped with a 5.0L or 6.2L engine

22. Align the transmission fluid cooler tube bracket and install the remaining transmission-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



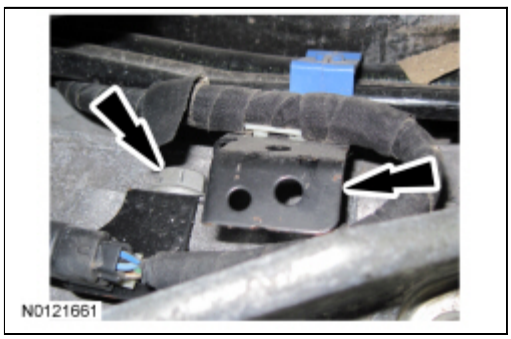
Vehicles equipped with 3.7L engine

23. Install the transmission damper and the 2 transmission damper bolts.
    - Tighten to 25 Nm (18 lb-ft).



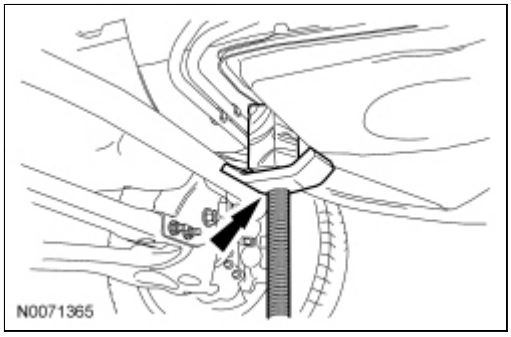
All vehicles

24. Install the fuel line bracket and the fuel line bracket bolt.
    - Tighten to 25 Nm (18 lb-ft).



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25. Position a jack stand under the transmission, and remove the high-lift transmission jack.



26. Install the driveshaft. REFER to Section 205-01 .

27. Install the exhaust Y-pipe. REFER to Section 309-00 .

28. Connect the battery ground cable. REFER to Section 414-01 .

29. Adjust the selector lever cable and install the selector lever cable end on the manual control lever. Verify the selector lever cable is correctly adjusted. REFER to Section 307-05 .

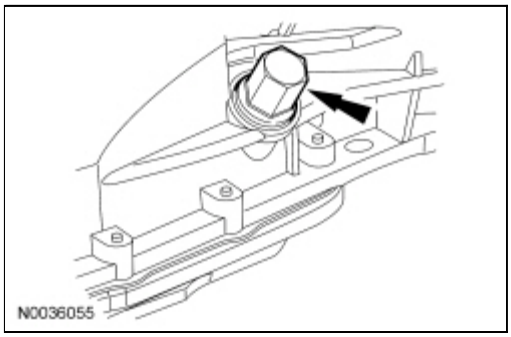
30. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

31. If a new transmission or a new main control was installed, the solenoid body strategy must be updated. REFER to Solenoid Body Strategy .

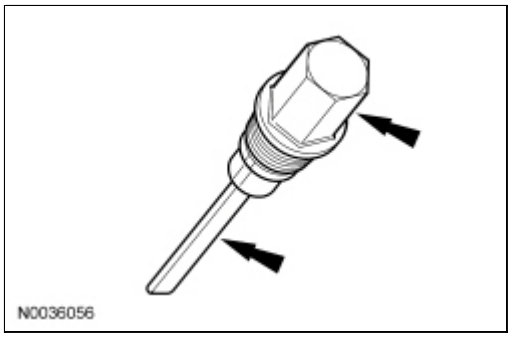
32. If the transmission was overhauled, the adaptive drive cycle must be updated. REFER to Shift Point Road Test .

33. While driving the vehicle, use the scan tool to verify that the TFT has reached a temperature of 91°C (195°F). This will circulate the transmission fluid through the torque converter and the transmission fluid cooling system, eliminating any trapped air in the transmission fluid cooling system.
    - With the engine idling (600-750 rpm) in PARK, verify that the TFT is between 91ºC-102ºC (195ºF-215ºF).

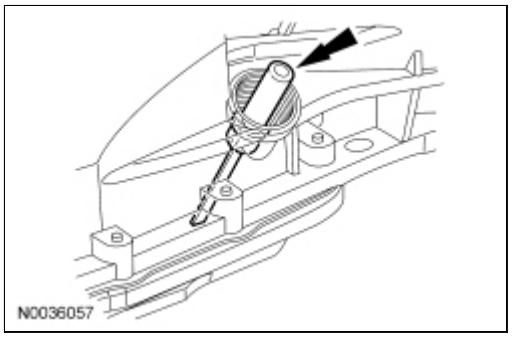
34. Remove the transmission fluid fill plug transmission fluid level indicator assembly located on the passenger side front portion of the transmission case.



35. Separate the transmission fluid level indicator from the transmission fluid fill plug.

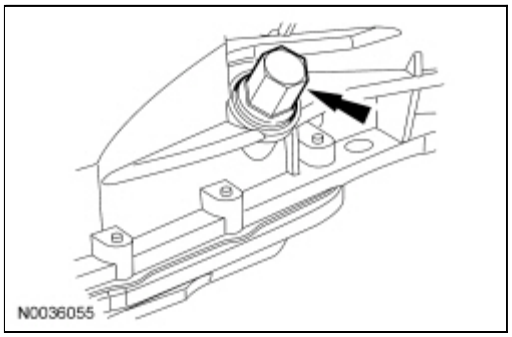


36. Wipe the transmission fluid level indicator clean. Reinstall the transmission fluid level indicator only back into the transmission fluid fill plug hole to check the transmission fluid level. Repeat this until a consistent reading is established.



37. **NOTE:** If the transmission fluid is not at the correct level, follow the steps for Adding Additional Transmission Fluid or Removing Transmission Fluid. REFER to Transmission Fluid Drain and Refill .

    Install the transmission fluid fill plug.
    - Tighten to 35 Nm (26 lb-ft).



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Transmission — Four Wheel Drive (4WD)

Special Tool(s)

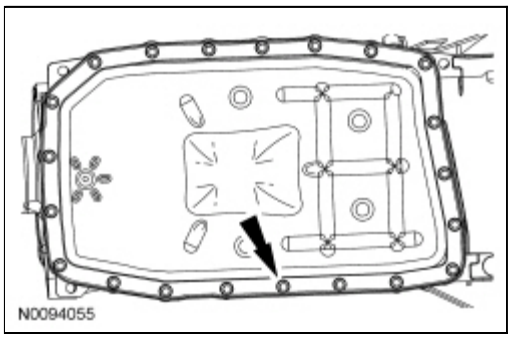
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Removal

NOTE: Refer to the Transmission Cooler Flushing Job Aid on the FMCDealer website.

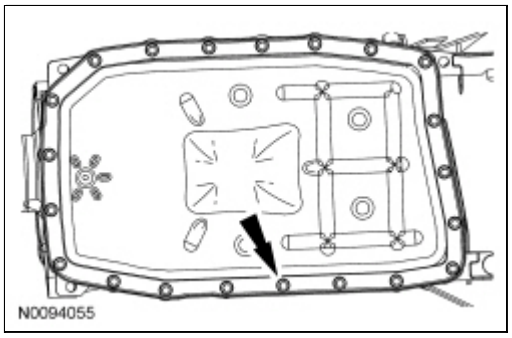
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to Section 100-02 .
2. Disconnect the battery ground cable. REFER to Section 414-01 .
3. If transmission disassembly or installation of a new transmission is necessary, remove the 21 transmission fluid pan bolts and remove the transmission fluid pan. Drain the transmission fluid into a container.


N0094055

4. Install the transmission fluid pan and the 21 transmission fluid pan bolts. Tighten transmission fluid pan bolts in a crisscross pattern.
   - Tighten to 9 Nm (80 lb-in).

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5. Remove the exhaust Y-pipe. REFER to Section 309-00 .

6. **NOTE:** It is only necessary to remove the transfer case from the transmission if a new transmission is being installed or if the transmission is going to be disassembled for a transmission related repair.

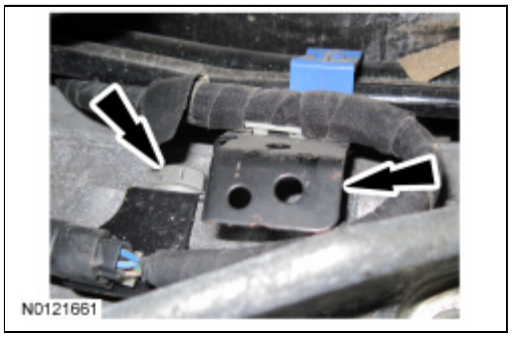
   Remove the transfer case. REFER to Section 308-07B .

7. **NOTE:** Make sure the transmission jack contacts the outer ribs of the transmission fluid pan.

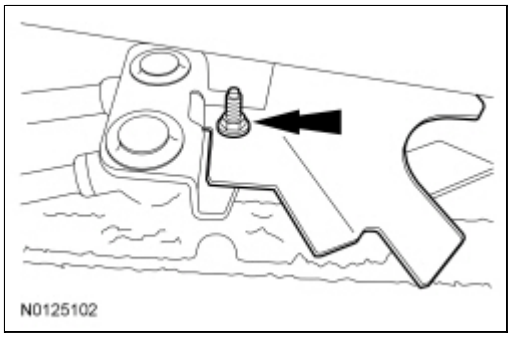
   NOTE: Make sure the transmission is securely fastened to the transmission jack.

   Using a high-lift transmission jack, support the transmission and remove the jack stand.

8. Remove the fuel line bracket bolt from the left side of the transmission and position the fuel line bracket aside.

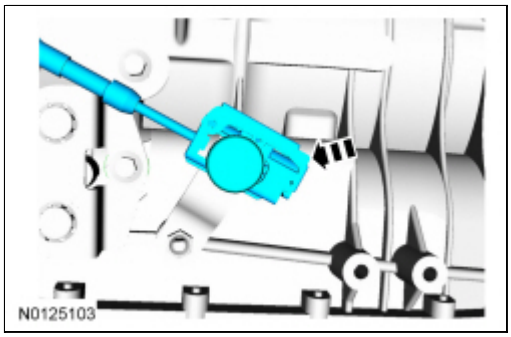


9. If equipped, remove the nut and the selector lever cable splash shield.



Vehicles equipped with a floor shift

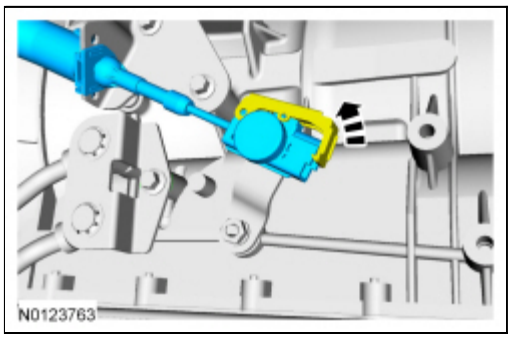
10. Clean the cable adjustment lock of any debris.



11. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

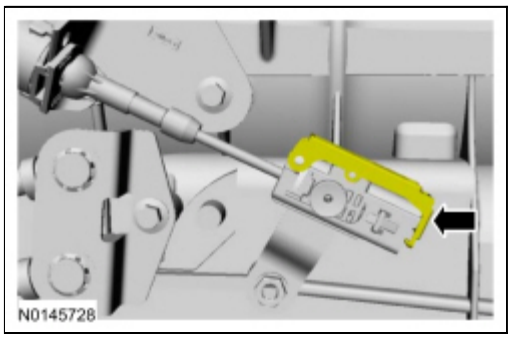
    NOTE: The 3.5L engine is shown, the 3.7L, 5.0L and 6.2L engines are similar.

    Rotate the cable adjustment lock upward and remove the selector lever cable from the manual control lever.



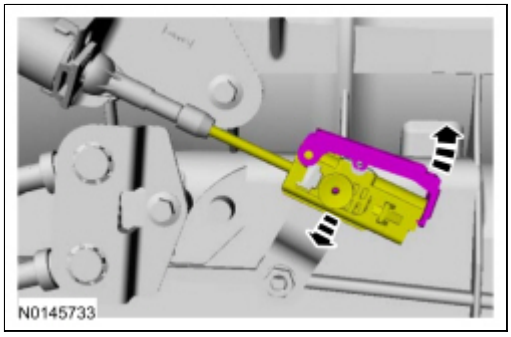
Vehicles equipped with a column shift

12. Clean the cable adjustment lock of any debris.



13. Rotate the cable adjustment lock upward and remove the selector lever cable from the manual control lever.

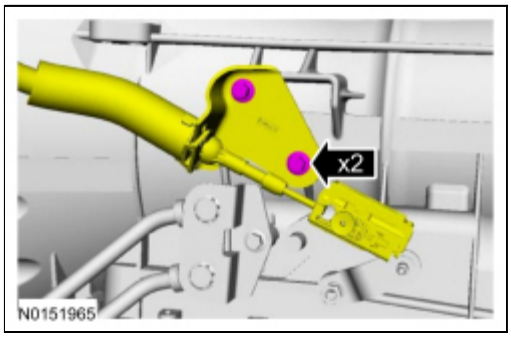
repair4less



All vehicles

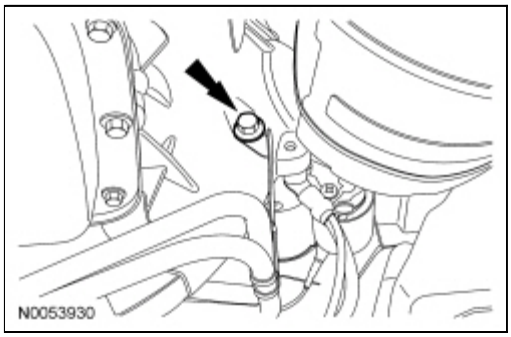
14. **NOTE:** The column shift is shown, the floor shift is similar.

    Remove the selector lever cable bracket bolts and remove the selector lever cable bracket.



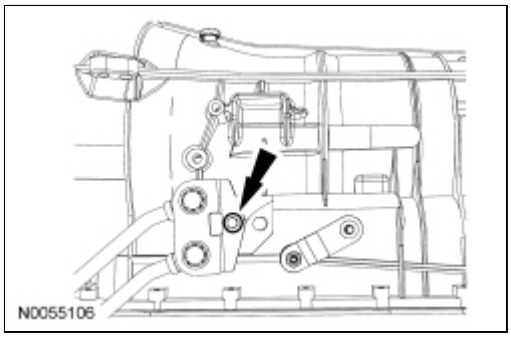
Vehicles equipped with a 5.0L or 6.2L engine

15. Remove the transmission-to-engine bolt.



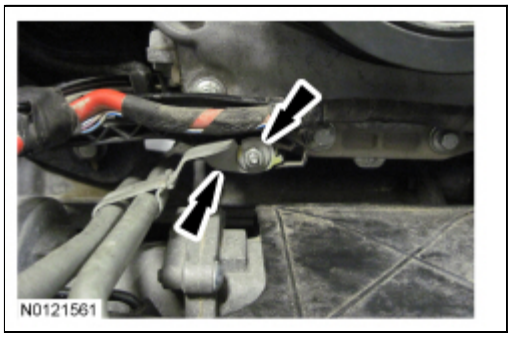
All vehicles

16. Remove and discard the transmission fluid cooler tube bracket bolt.



17. **NOTE:** The 3.5L and 3.7L engine is shown, the 5.0L and the 6.2L engines are similar.

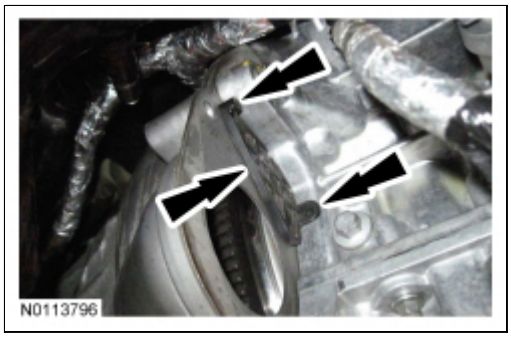
    Remove the transmission fluid cooler tube bracket nut and position the transmission fluid cooler tube bracket and tubes aside.



18. Remove the starter motor. REFER to Section 303-06 .

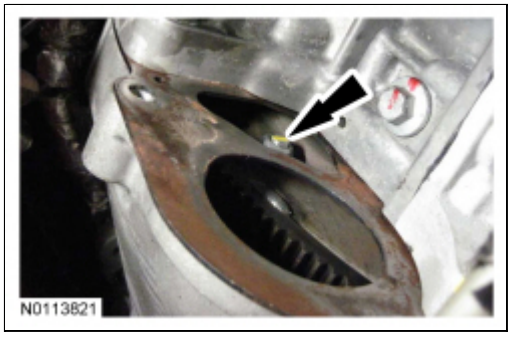
Vehicles equipped with a 3.5L or 3.7L engine

19. Remove the 2 pin-type retainers and the access cover.



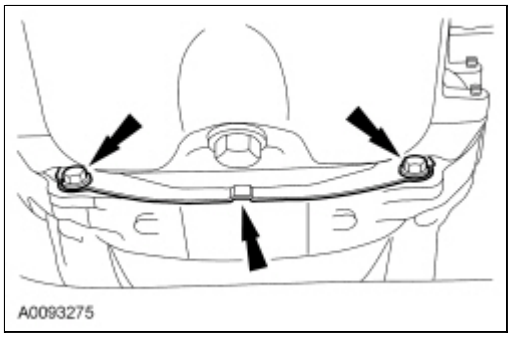
20. Remove and discard the 4 flexplate-to-torque converter nuts.

repair4less

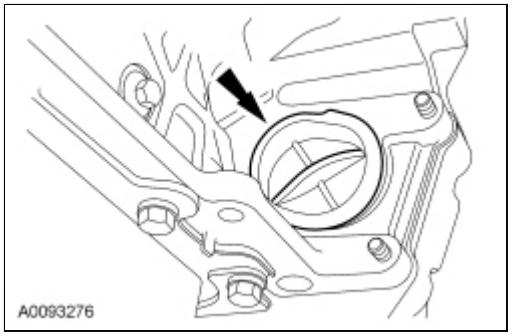


Vehicles equipped with a 5.0L or 6.2L engine

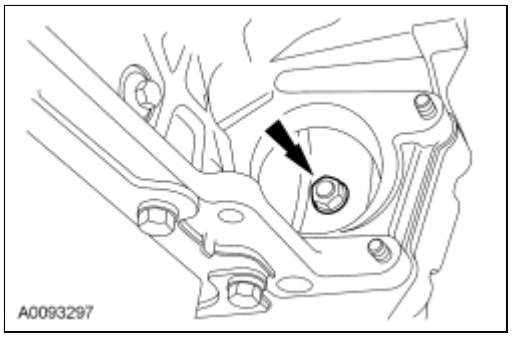
21. Remove the flexplate inspection cover bolts and the flexplate inspection cover.



22. Remove the rubber torque converter nut access cover.



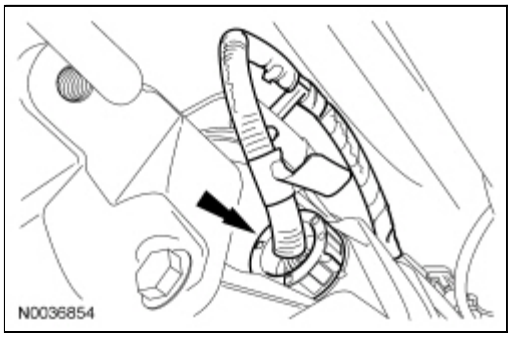
23. Remove and discard the 4 flexplate-to-torque converter nuts.



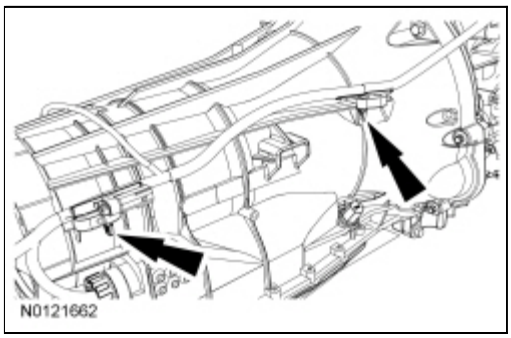
All vehicles

24. ***NOTICE:*** **Do not pull on the wiring harness to disconnect the electrical connector or damage to the electrical connector will occur.**

    Disconnect the electrical connector by twisting the outer shell and pulling back on the electrical connector.



25. Disconnect the wiring harness retainers from the top of the transmission.



Vehicles equipped with a 3.5L or 3.7L engine

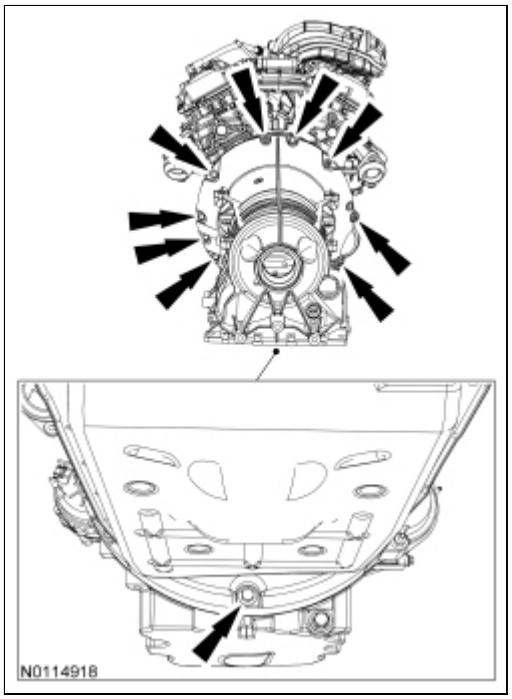
26. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

    NOTICE: **Make sure to not pinch the transmission wiring harness between the transmission and the body or damage can occur.**

    NOTE: The top 2 transmission-to-engine bolts secure the fuel line bracket to the transmission case.

    Remove the 10 transmission-to-engine bolts.

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Vehicles equipped with a 5.0L or 6.2L engine

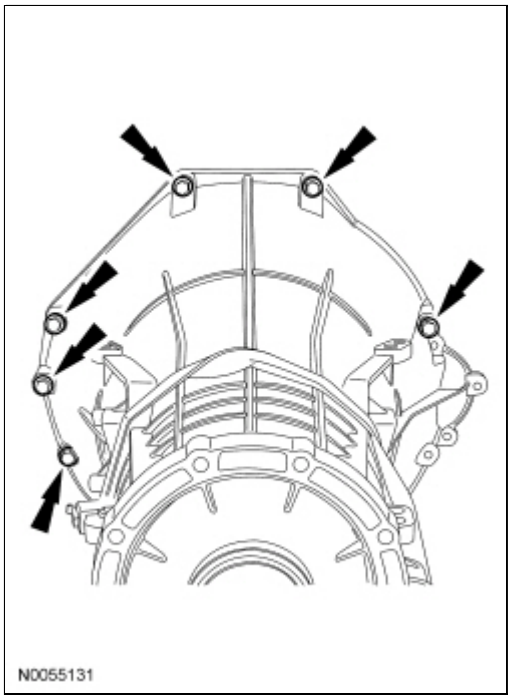
27. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

    NOTICE: **Make sure to not pinch the transmission wiring harness between the transmission and the body or damage can occur.**

    NOTE: Remove the top 2 transmission-to-engine bolts before removing the rest of the bolts.

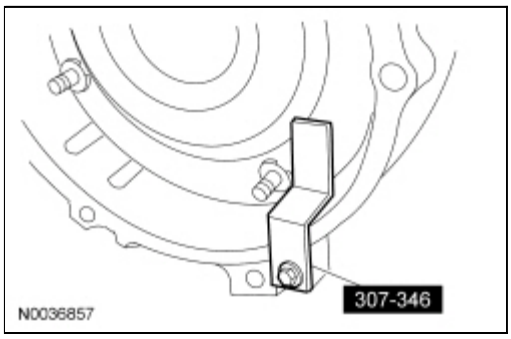
    NOTE: The top left transmission-to-engine bolt secures the fuel line bracket to the transmission case.

    Remove the 6 remaining transmission-to-engine bolts.



All vehicles

28. Slide the transmission back enough to install the Torque Converter Retainer.



29. Remove the transmission from the vehicle.

30. If the transmission is being disassembled to install new parts, or if a new or remanufactured transmission is being installed, clean and backflush the transmission fluid cooler, the auxiliary transmission fluid cooler (if equipped) and the transmission fluid cooler tubes to prevent contaminants from entering the transmission. REFER to Transmission Fluid Cooler Backflushing and Cleaning .

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Transmission — Rear Wheel Drive (RWD)

Special Tool(s)

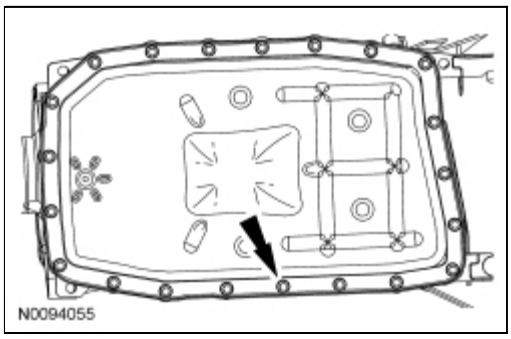
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Removal

NOTE: Refer to the Transmission Cooler Flushing Job Aid on the FMCDealer website.

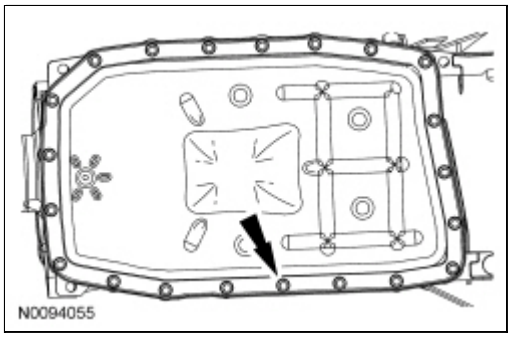
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to Section 100-02 .
2. Disconnect the battery ground cable. REFER to Section 414-01 .
3. If transmission disassembly or installation of a new transmission is necessary, remove the 21 transmission fluid pan bolts and remove the transmission fluid pan. Drain the transmission fluid into a container.


N0094055

4. Install the transmission fluid pan and the 21 transmission fluid pan bolts. Tighten transmission fluid pan bolts in a crisscross pattern.
   - Tighten to 9 Nm (80 lb-in).

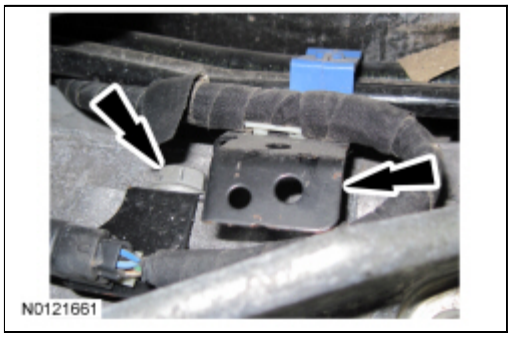
repair4less



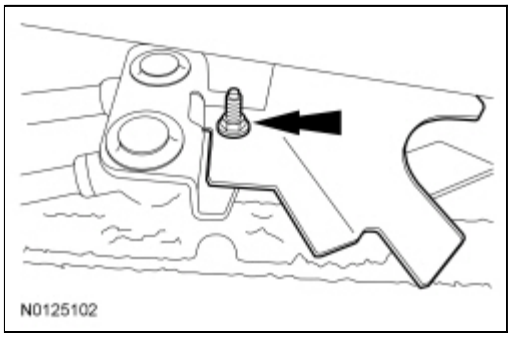
5. Remove the exhaust Y-pipe. REFER to Section 309-00 .
6. Remove the driveshaft. REFER to Section 205-01 .
7. **NOTE:** Make sure the transmission jack contacts the outer ribs of the transmission fluid pan.

   NOTE: Make sure the transmission is securely fastened to the transmission jack.

   Using a high-lift transmission jack, support the transmission and remove the jack stand.
8. Remove the fuel line bracket bolt from the left side of the transmission and position the fuel line bracket aside.

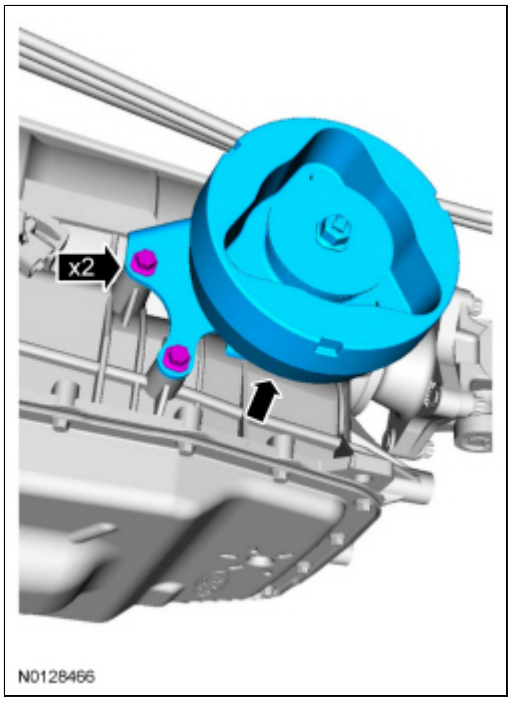


9. If equipped, remove the nut and the selector lever cable splash shield.



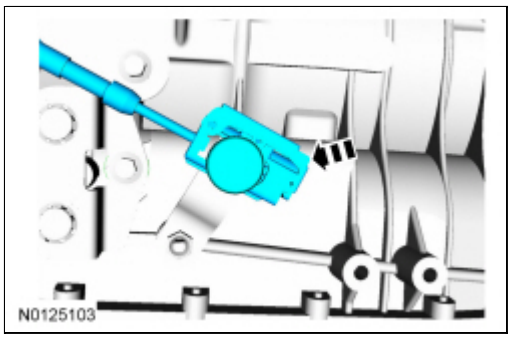
Vehicles equipped with 3.7L engine Rear Wheel Drive (RWD)

10. Remove the 2 transmission damper bolts and remove the transmission damper.



Vehicles equipped with a floor shift

11. Clean the cable adjustment lock of any debris.

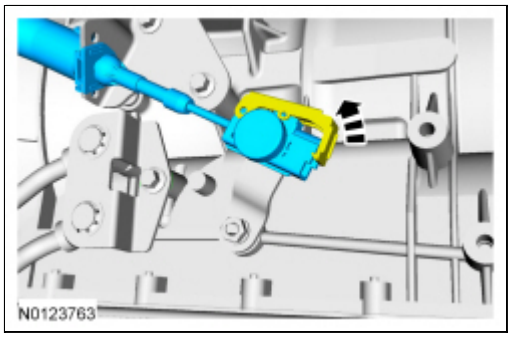


12. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

    NOTE: The 3.5L engine is shown, the 3.7L, 5.0L and 6.2L engines are similar.

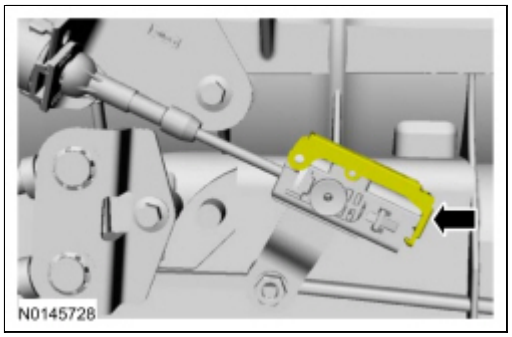
    Rotate the cable adjustment lock upward and remove the selector lever cable from the manual control lever.

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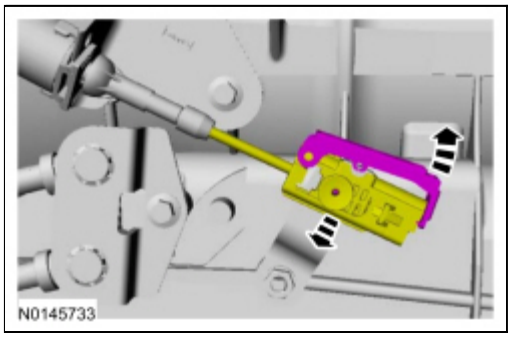


Vehicles equipped with a column shift

13. Clean the cable adjustment lock of any debris.



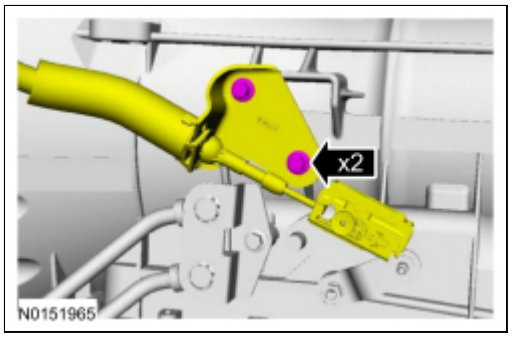
14. Rotate the cable adjustment lock upward and remove the selector lever cable from the manual control lever.



All vehicles

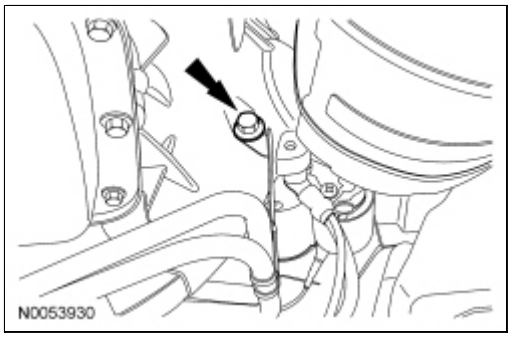
15. **NOTE:** The column shift is shown, the floor shift is similar.

    Remove the selector lever cable bracket bolts and remove the selector lever cable bracket.



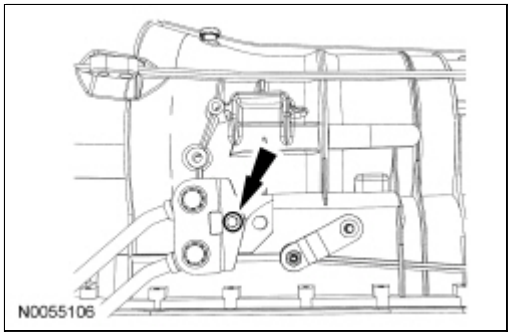
Vehicles equipped with a 5.0L or 6.2L engine

16. Remove the transmission-to-engine bolt.



All vehicles

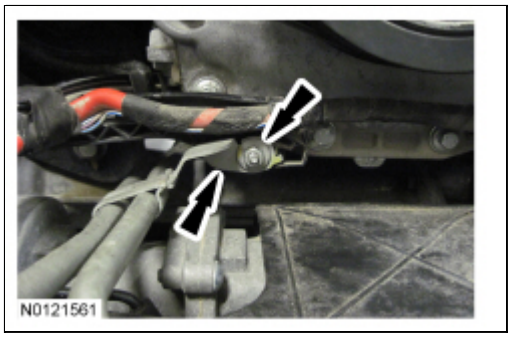
17. Remove and discard the transmission fluid cooler tube bracket bolt.



18. **NOTE:** The 3.5L and 3.7L engine is shown, the 5.0L and the 6.2L engines are similar.

    Remove the transmission fluid cooler tube bracket nut and position the transmission fluid cooler tube bracket and tubes aside.

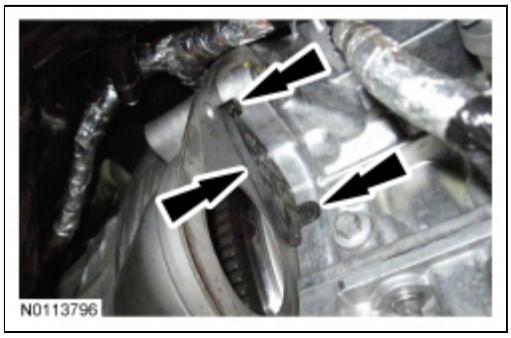
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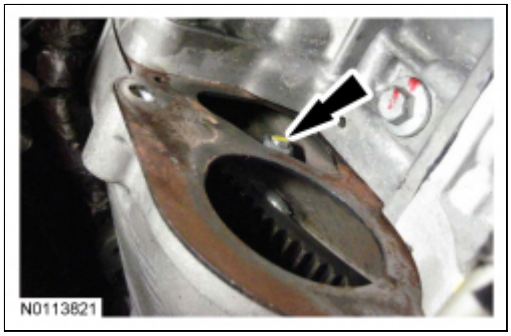
19. Remove the starter motor. REFER to Section 303-06 .

Vehicles equipped with a 3.5L or 3.7L engine

20. Remove the 2 pin-type retainers and the access cover.

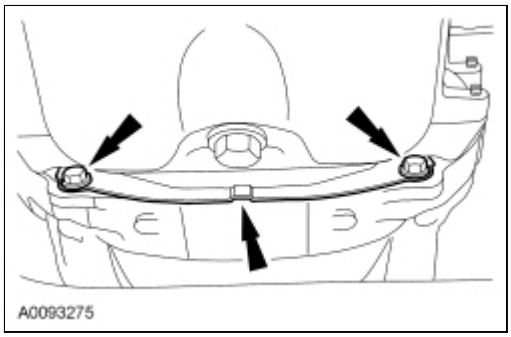


21. Remove and discard the 4 flexplate-to-torque converter nuts.

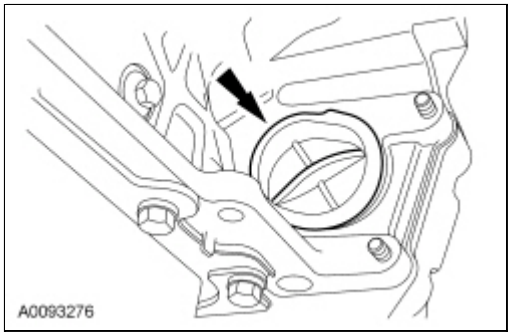


Vehicles equipped with a 5.0L or 6.2L engine

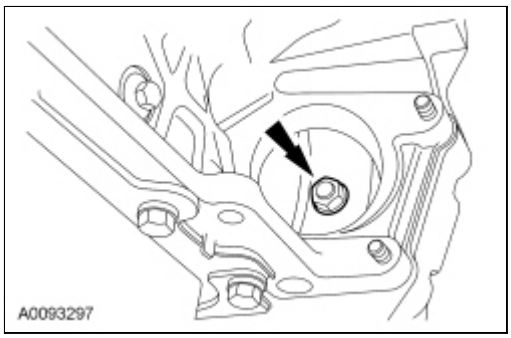
22. Remove the flexplate inspection cover bolts and the flexplate inspection cover.



23. Remove the rubber torque converter nut access cover.



24. Remove and discard the 4 flexplate-to-torque converter nuts.

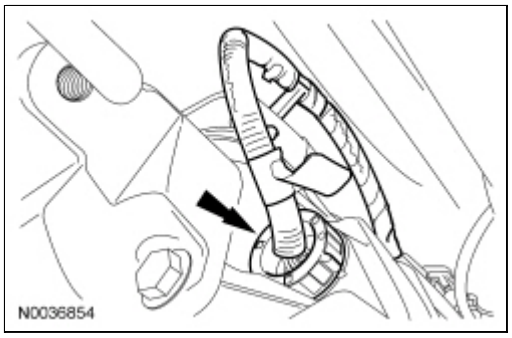


All vehicles

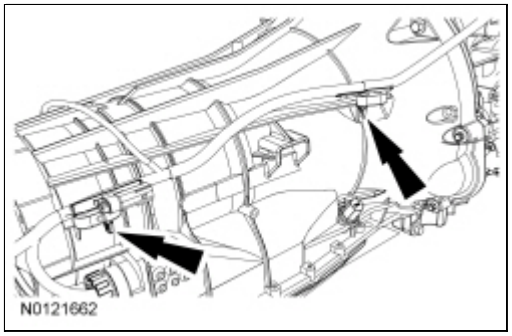
25. ***NOTICE:*** **Do not pull on the wiring harness to disconnect the electrical connector or damage to the electrical connector will occur.**

    Disconnect the transmission electrical connector by twisting the outer shell and pulling back on the electrical connector.

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26. Disconnect the wiring harness retainers from the top of the transmission.

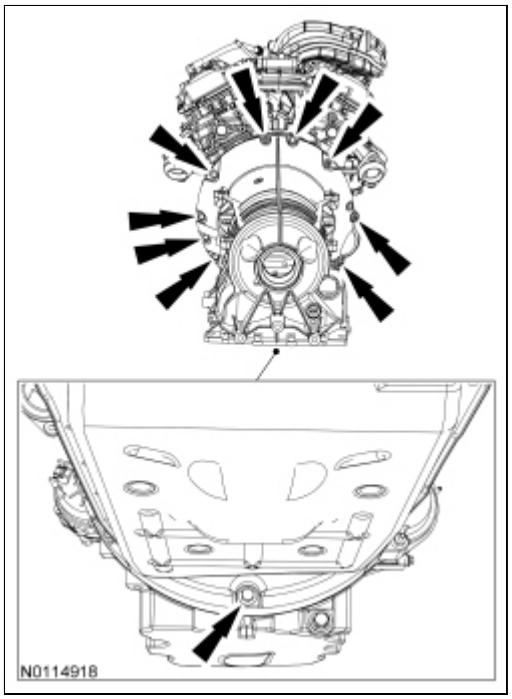


Vehicles equipped with a 3.5L or 3.7L engine

27. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

    NOTE: The top 2 transmission-to-engine bolts secure the fuel line bracket to the transmission case.

    Remove the 10 transmission-to-engine bolts.



Vehicles equipped with a 5.0L or 6.2L engine

28. **WARNING: Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.**

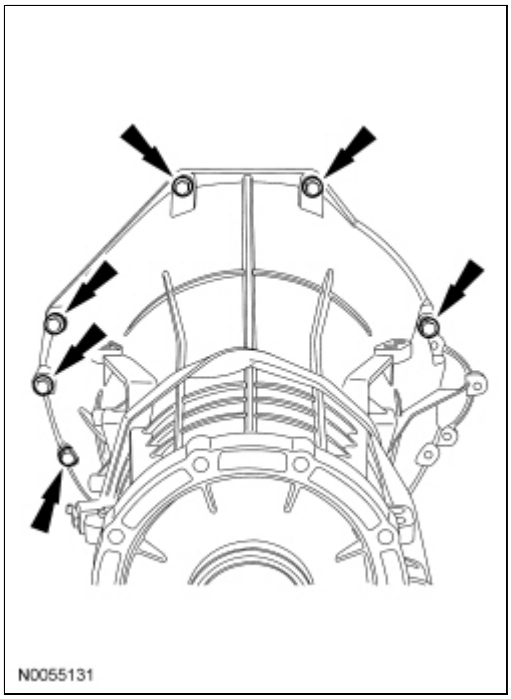
    NOTICE: **Make sure to not pinch the transmission wiring harness between the transmission and the body or damage can occur.**

    NOTE: Remove the top 2 transmission-to-engine bolts before removing the rest of the bolts.

    NOTE: The top left transmission-to-engine bolt secures the fuel line bracket to the transmission case.

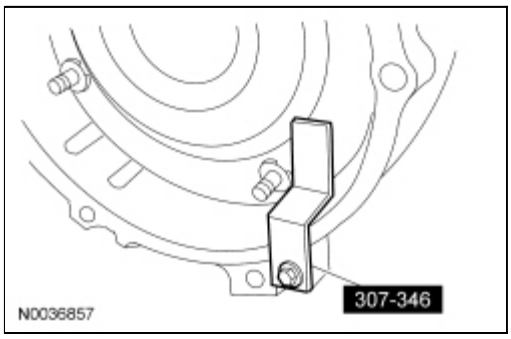
    Remove the 6 remaining transmission-to-engine bolts.

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All vehicles

29. Slide the transmission back enough to install the Torque Converter Retainer.



30. Remove the transmission from the vehicle.

31. If the transmission is being disassembled to install new parts, or if a new or remanufactured transmission is being installed, clean and backflush the transmission fluid cooler, the auxiliary transmission fluid cooler (if equipped) and the transmission fluid cooler tubes to prevent contaminants from entering the transmission. REFER to Transmission Fluid Cooler Backflushing and Cleaning .

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Material

Item	Specification	Fill Capacity
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV	12.30L (13.0 qt)

General Specifications

Item	Specification
Transmission Fluid	
This transmission fluid is not interchangeable with any other transmission fluids. Check the transmission fluid level indicator to determine the correct transmission fluid.	

Torque Specifications

Description	Nm	lb-ft	lb-in
Axle carrier mounting bushing bolt	115	85	—
Axle shaft housing carrier bushing bolt	115	85	—
Forward skid plate (6 required)	48	35	—
Heat shield nut—Raptor	48	35	—
Heat shield nut—Raptor	23	17	—
Rearward skid plate (4 required)	48	35	—
Selector lever cable splash shield nut	12	—	106
Starter motor ground cable eyelet nut	25	18	—
Starter solenoid B-terminal eyelet nut	12	—	106
Starter solenoid S-terminal eyelet	5	—	44
Sway bar nut (4 required) [a]	—	—	—
Transmission fluid cooler tube bracket bolt	12	—	106
Transmission fluid cooler tube bracket-to-front of the engine nut—3.5L GTDI and 3.7L	12	—	106
Transmission fluid cooler tube bracket-to-front of the engine nut—5.0L (4V)	12	—	106
Transmission fluid cooler tube bracket-to-front of the engine nut—6.2L (2V)	40	30	—
Transmission fluid cooler tube bracket-to-starter motor stud nut—3.5L GTDI and 3.7L	12	—	106
Transmission fluid cooler tubes-to-transmission bolt [a]	—	—	—
Transmission-to-engine bolt—6.2L (2V) and 5.0L (4V)	48	35	—

[a] Refer to the procedure in this section.

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Transmission Cooling

The transmission fluid cooling system without an auxiliary transmission fluid cooler consists of the following:

- An in-tank transmission fluid cooler inlet tube
- A non-repairable in-tank transmission fluid cooler
- An in-tank transmission fluid cooler outlet tube

The transmission fluid cooling system with an auxiliary transmission fluid cooler consists of the following:

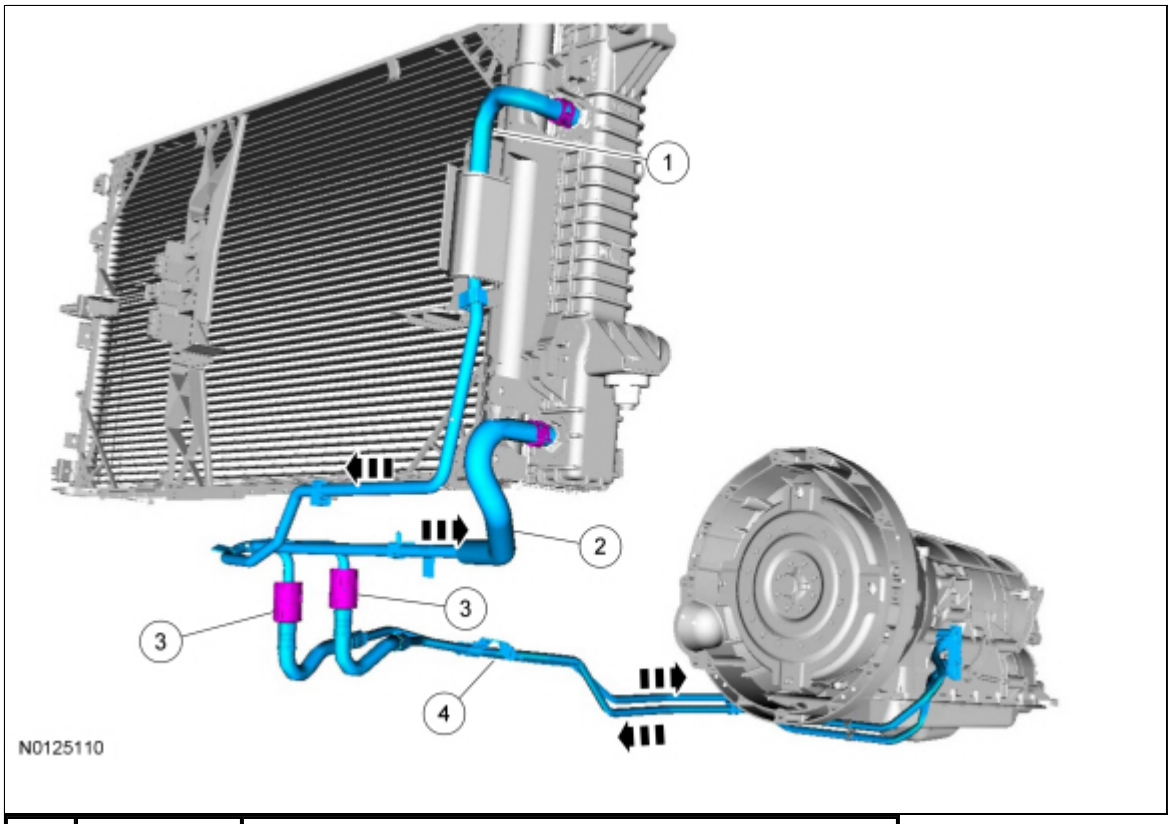
- An in-tank transmission fluid cooler inlet tube
- A non-repairable in-tank transmission fluid cooler
- An auxiliary transmission fluid cooler inlet tube
- An auxiliary transmission fluid cooler
- An auxiliary transmission fluid cooler outlet tube

Located inside the transmission case is a thermal bypass valve. The thermal bypass is used to route fluid to the cooler when operating temperatures increase, or to return fluid directly to the transmission lube circuit. When the transmission fluid temperature is below 185°F (85°C) no fluid is routed to the cooler. It is essential that the transmission fluid level be checked and adjusted only when the fluid temperature is verified with a scan tool.

The transmission fluid flows from the transmission bottom fitting, to the in-tank transmission fluid cooler, to the auxiliary transmission fluid cooler, if so equipped, and returns to the transmission top fitting.

For the transmission fluid cooler backflushing and cleaning procedure, refer to Section 307-01.

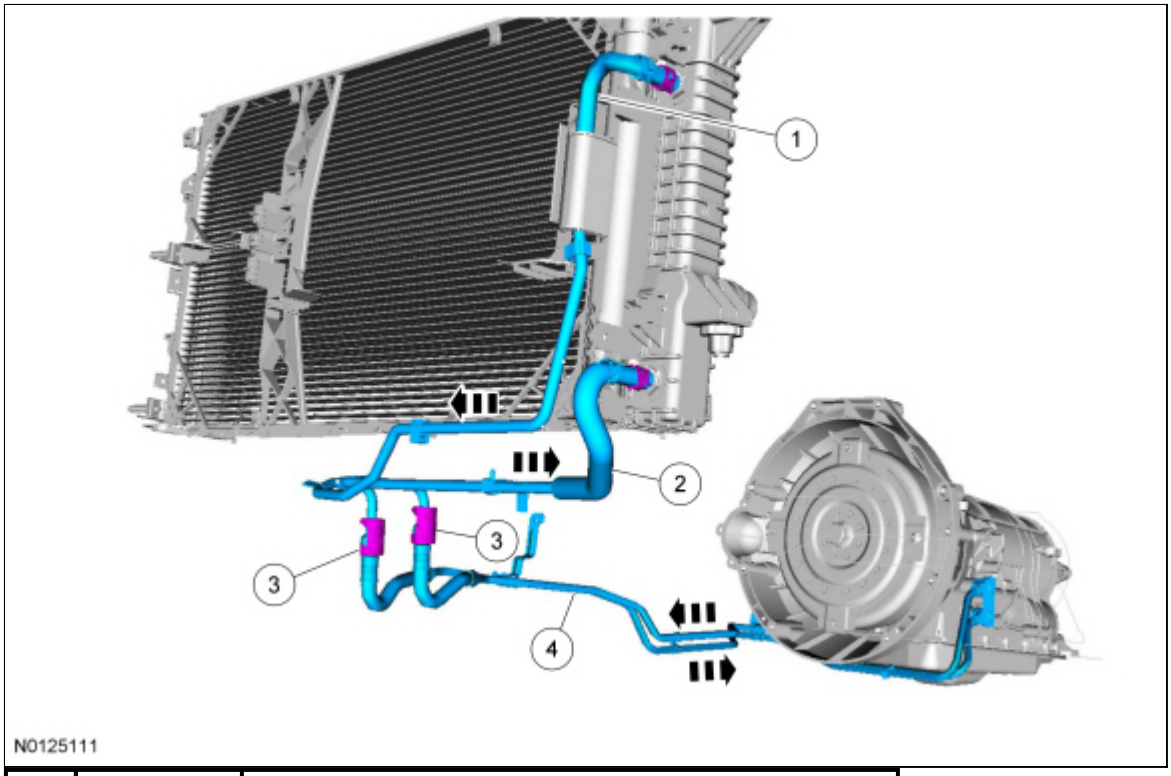
3.5L GTDI and 3.7L Engines Without an Auxiliary Transmission Fluid Cooler



Item	Part Number	Description
1	7B028	In-tank transmission fluid cooler outlet tube
2	7B028	Transmission fluid cooler tube radiator inlet
3	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
4	7R081	Transmission fluid cooler tubes

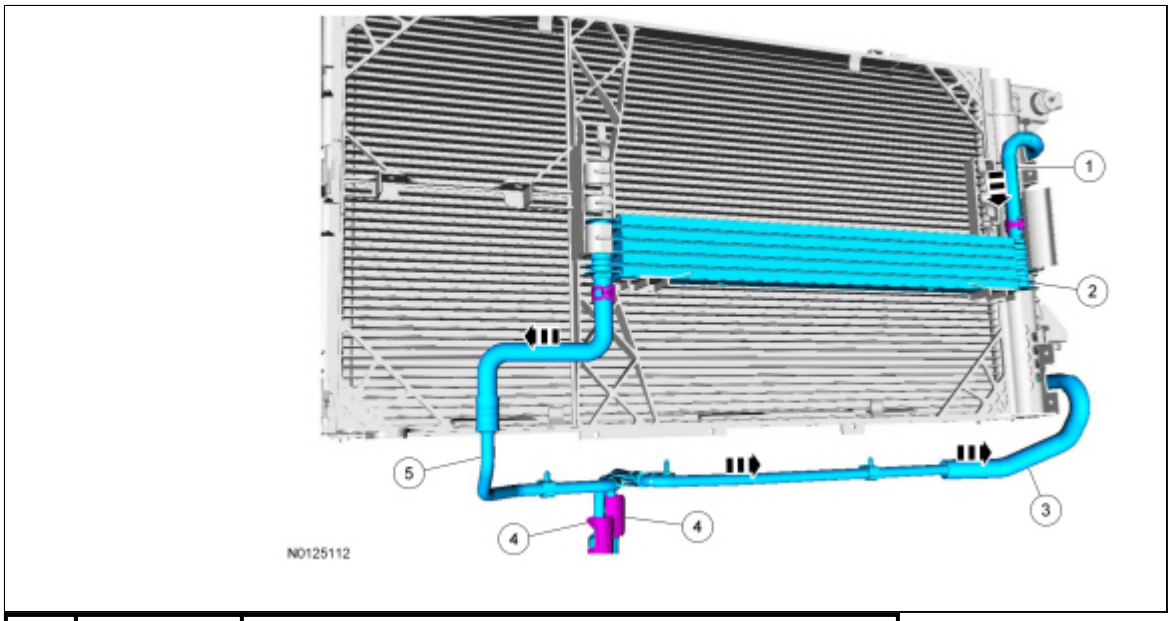
5.0L (4V) Engine Without an Auxiliary Transmission Fluid Cooler

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Item	Part Number	Description
1	7B028	In-tank transmission fluid cooler outlet tube
2	7B028	Transmission fluid cooler tube radiator inlet
3	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
4	7R081	Transmission fluid cooler tubes

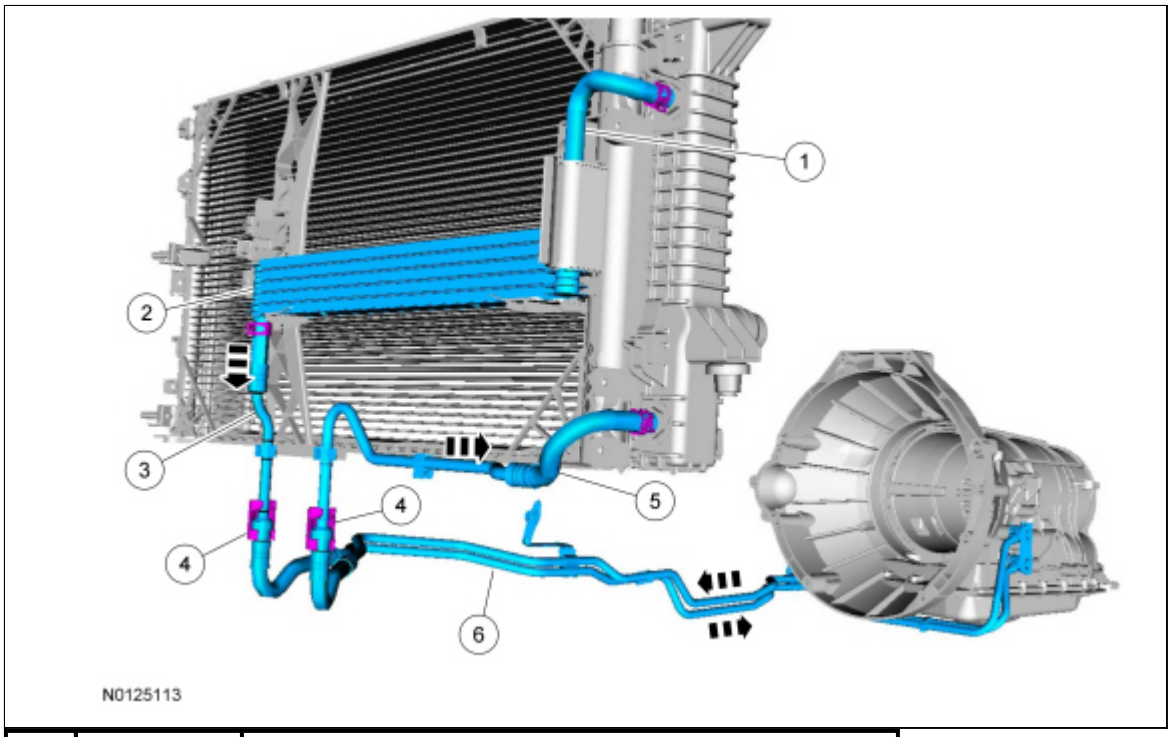
3.5L GTDI, 3.7L and 5.0L Engines With an Auxiliary Transmission Fluid Cooler



Item	Part Number	Description
1	7C410	Auxiliary transmission fluid cooler inlet hose
2	7A095	Auxiliary transmission fluid cooler
3	7B028	In-tank transmission fluid cooler inlet tube
4	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
5	7B028	Auxiliary transmission fluid cooler outlet hose

6.2L (2V) Engine With an Auxiliary Transmission Fluid Cooler

repair4less



Item	Part Number	Description
1	7C410	Auxiliary transmission fluid cooler inlet hose
2	7A095	Auxiliary transmission fluid cooler
3	7B028	Auxiliary transmission fluid cooler outlet hose
4	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
5	7B028	In-tank transmission fluid cooler inlet tube
6	7R081	Transmission fluid cooler inlet and outlet tubes

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Transmission Cooling

Inspection and Verification

NOTICE: **When internal wear/damage occurs in the transmission, metal particles, clutch plate material and band material can travel into the torque converter, the transmission fluid cooler tubes, the in-tank transmission fluid cooler and the auxiliary transmission fluid cooler, if so equipped. These contaminants are a major cause of recurring transmission concerns. To prevent future concerns, remove these contaminants from the cooling system before placing the transmission back into use.**

1. Visually inspect for obvious signs of mechanical damage, incorrect component installation and system leaks. Repair as necessary.
    - Install a new or remanufactured radiator when transmission fluid is found leaking from the in-tank transmission fluid cooler. Refer to Section 303-03 .
    - Install a new auxiliary transmission fluid cooler if there is leakage from the auxiliary transmission fluid cooler.

2. If the fault is not visually evident, GO to Symptom Chart - Transmission Cooling or GO to Symptom Chart - NVH .

Symptom Chart — Transmission Cooling

Symptom Chart — Transmission Cooling

Condition	Possible Sources	Action
• Transmission overheating	• Excessive vehicle or towing loads, severe vehicle use	• REFER to the Vehicle Specification Manual for load and GVW information. REFER to the Owner's Literature.
	• Incorrect transmission fluid level	• CHECK and if necessary, ADJUST the transmission fluid to the correct level.
	• Transmission fluid condition	• CHECK transmission fluid condition.
	• Incorrect transmission fluid type	• REFER to Specifications in this section.
	• Transmission cooling system damaged, blocked, restricted or installed incorrectly	• CARRY OUT the Transmission Fluid Cooler Backflushing and Cleaning. REFER to Section 307-01 .
	• System leaks	• INSPECT for leakage.
	• Engine overheating	• REFER to Section 303-03 .

	• Powertrain control system electrical inputs/outputs, vehicle wiring harnesses, PCM, Torque Converter Clutch (TCC) solenoid • Internal transmission concerns	• CARRY OUT On-Board Diagnostic (OBD) test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. • REPAIR as necessary.
• Transmission fluid leak at radiator in-tank cooler	• Transmission fluid cooler tubes-to-transmission fluid cooler fitting	• REFER to the Component Test in this section.

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Vibration — a high frequency (20-80 Hz) that is felt through the seat or selector lever. Changes with engine speed	• Transmission fluid cooler tubes grounded out	• CHECK the transmission fluid cooler tubes. REPAIR as necessary.

Component Test

Transmission Fluid Cooler Leaks at Radiator

Transmission fluid may leak between the radiator transmission fluid cooler and the transmission fluid cooler fitting (not the transmission fluid cooler tube into the transmission fluid cooler fitting), which may result in a residue of transmission fluid on the radiator tank around the transmission fluid cooler fitting. Insufficient thread sealer on the transmission fluid cooler fitting may cause this.

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Transmission Fluid Cooler Tubes — 3.5L GTDI, 3.7L

Special Tool(s)

 ST2935A	Disconnect Tool, Transmission Cooler Line 307-569

Material

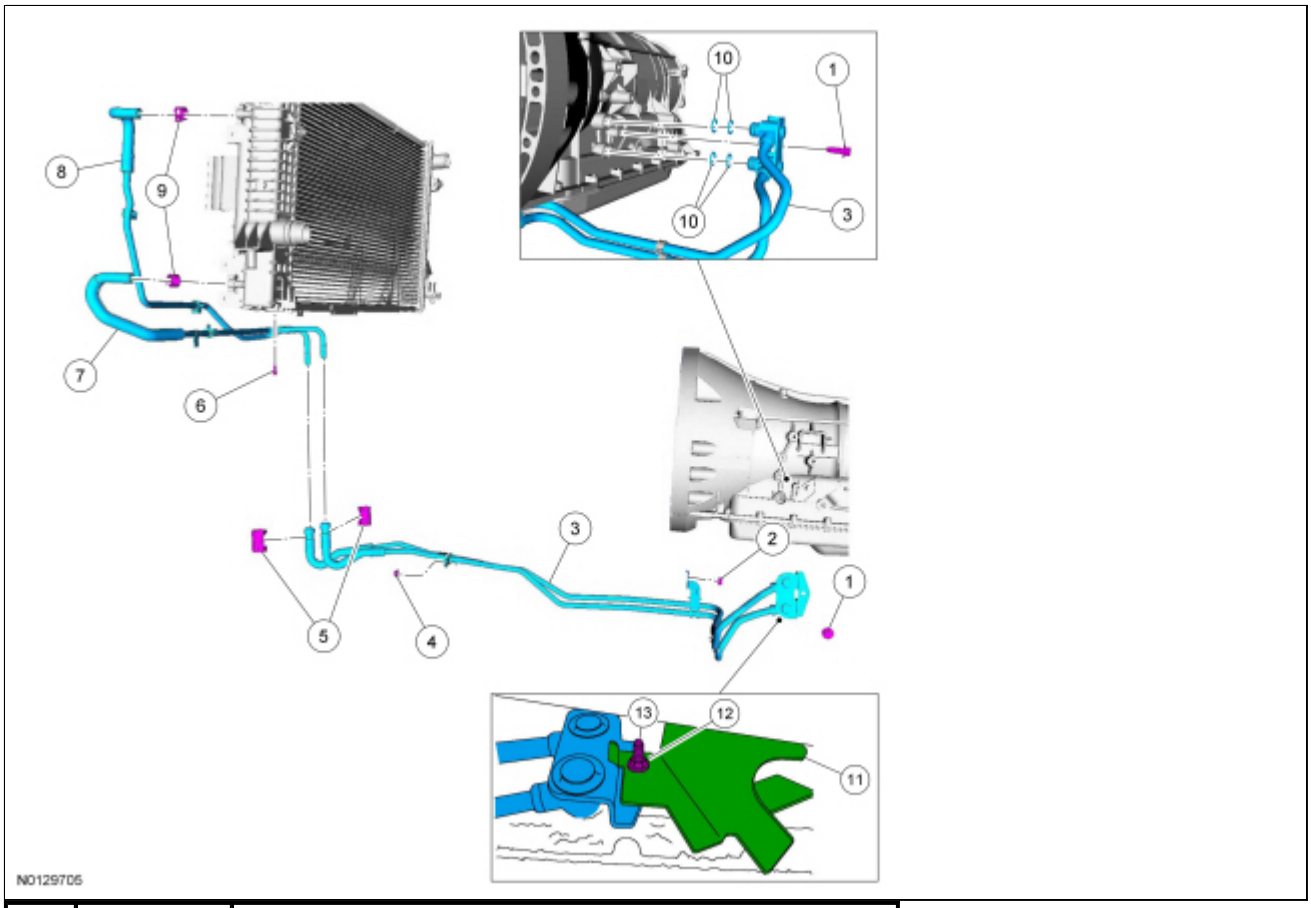
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

3.5L GTDI and 3.7L Transmission Fluid Cooler Tubes

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.

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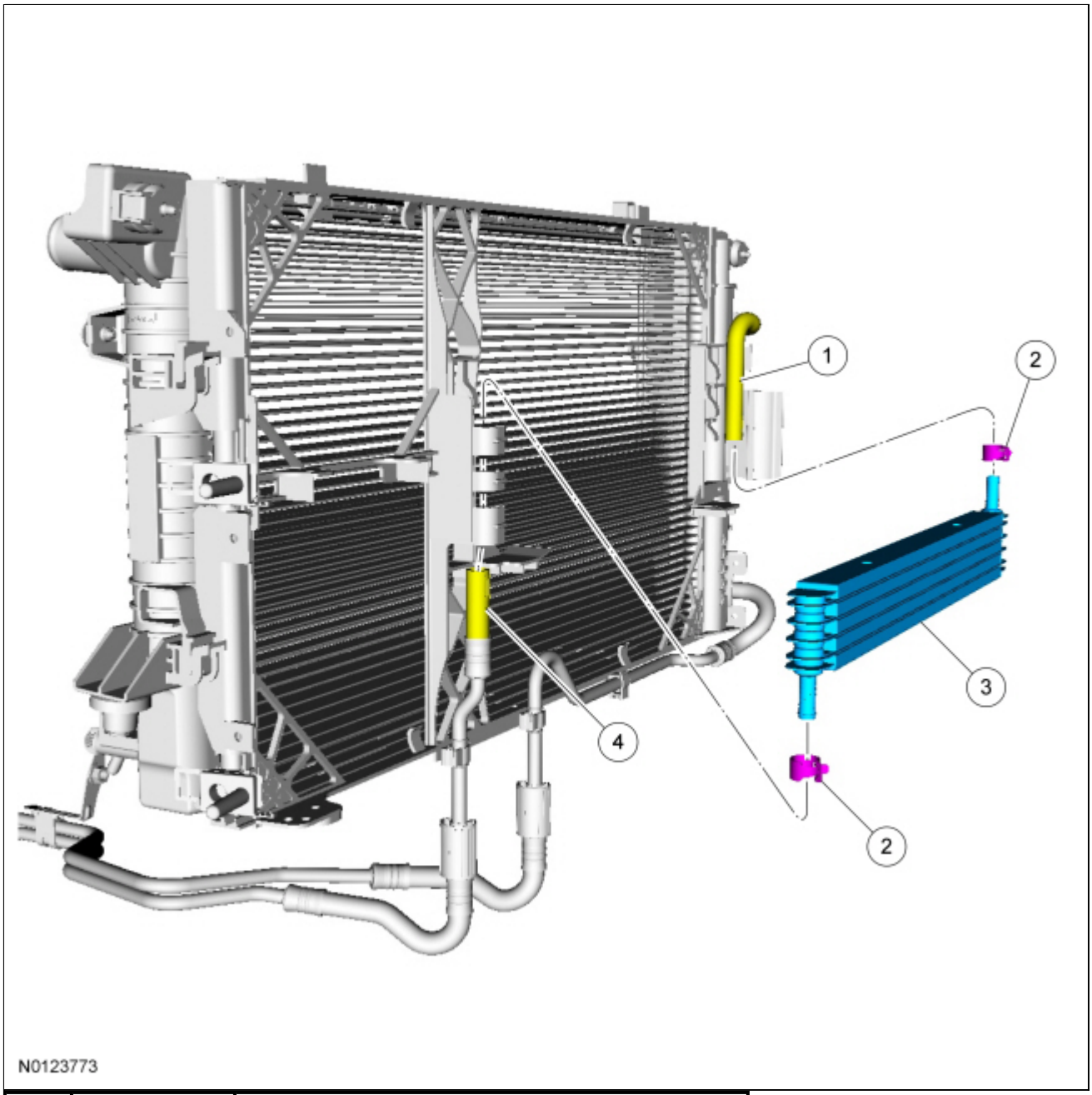


Item	Part Number	Description
1	W715131	Transmission fluid cooler tubes-to-transmission bolt
2	W709450	Transmission fluid cooler tube bracket nut
3	7R081	Transmission fluid cooler inlet and outlet tubes
4	W709450	Transmission fluid cooler tube bracket-to-front of engine nut
5	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
6	W500212	Transmission fluid cooler tube bracket bolt
7	7B028	In-tank transmission fluid cooler inlet tube
8	7B028	In-tank transmission fluid cooler outlet tube
9	7C107	Transmission fluid cooler hose clamps
10	7J227	Transmission fluid cooler tube O-rings (4 required)
11	7B147	Selector lever cable splash shield (if equipped)
12	W520111	Selector lever cable splash shield nut
13	W715798	Transmission fluid cooler tubes-to-transmission bolt (with selector lever cable splash shield)

3.5L GTDI and 3.7L With Auxiliary Transmission Fluid Cooler

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view. requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



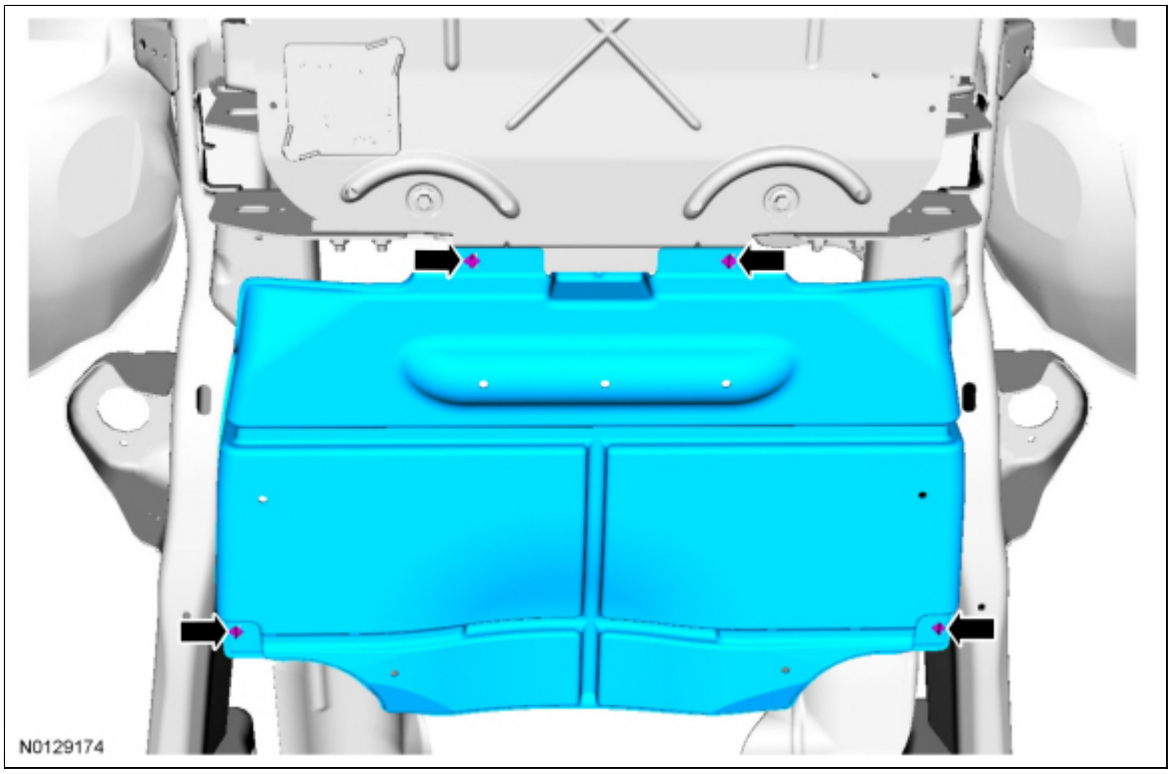
Item	Part Number	Description
1	7C410	Auxiliary transmission fluid cooler inlet hose
2	7C107	Transmission fluid cooler hose clamps
3	7A095	Auxiliary transmission fluid cooler
4	7B028	Auxiliary transmission fluid cooler outlet hose

Removal

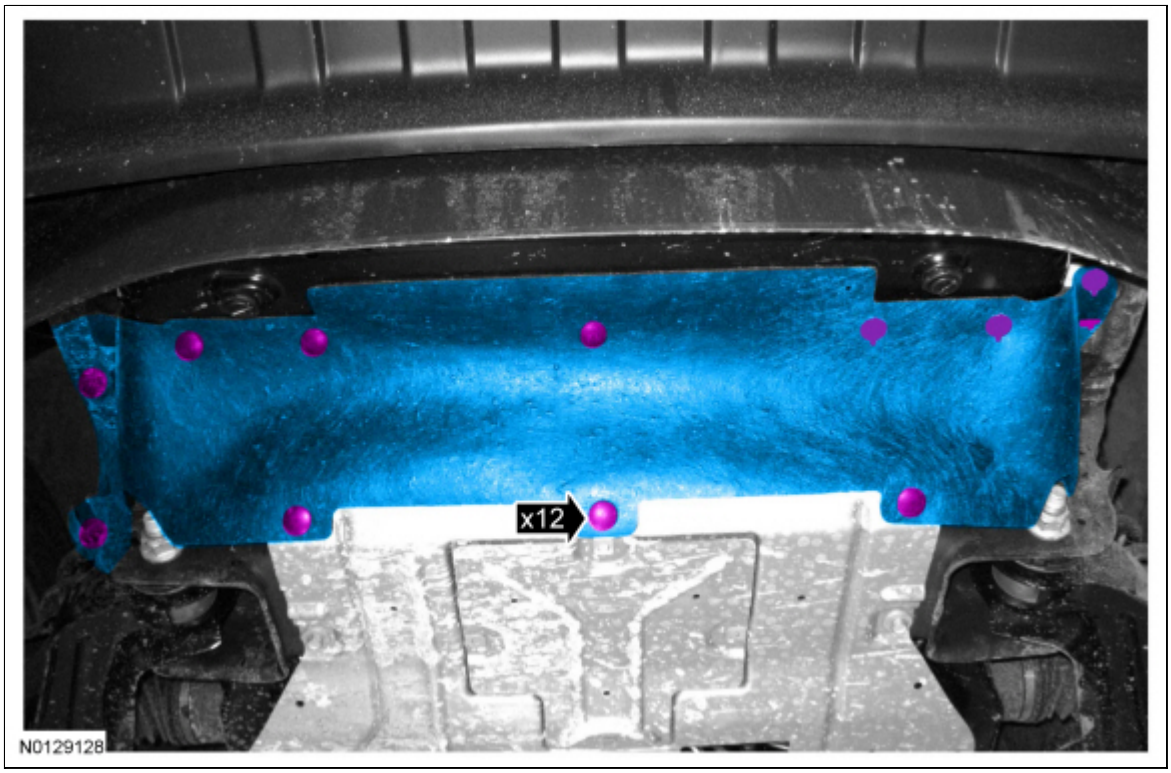
repair4less

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

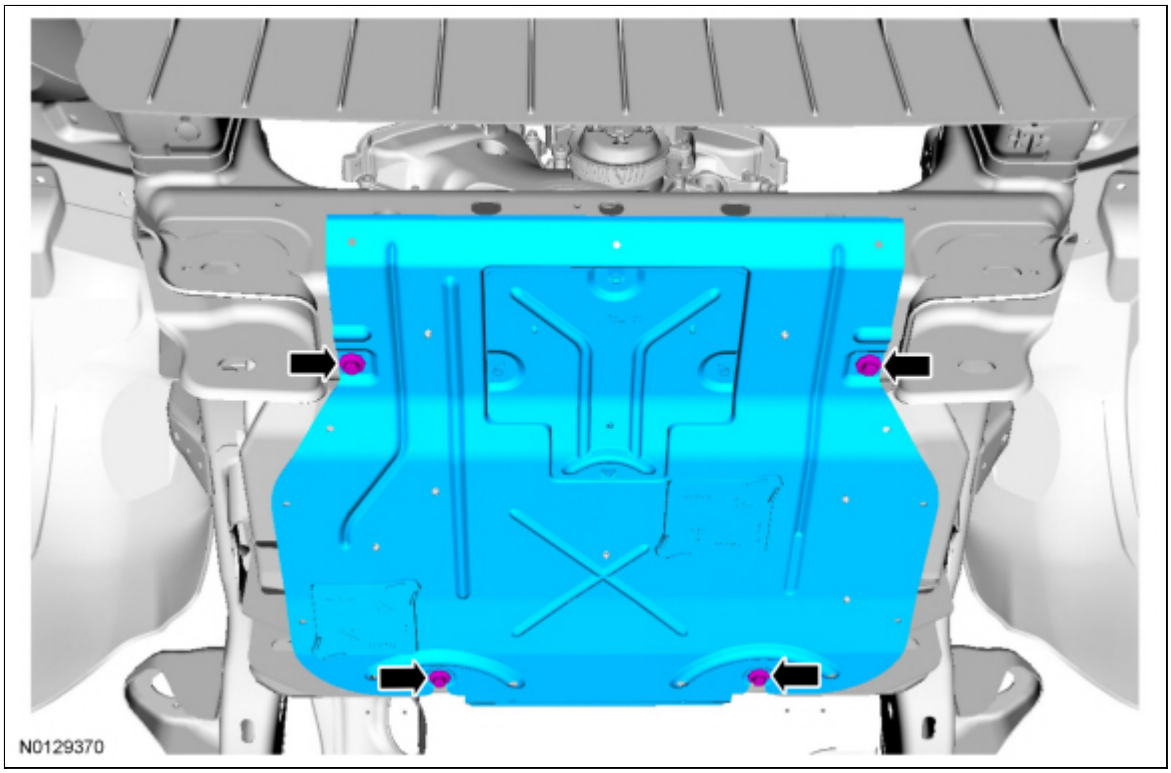
2. If equipped, remove the 4 fasteners and the splash shield.



3. If equipped, remove the 12 pushpins and the air deflector.

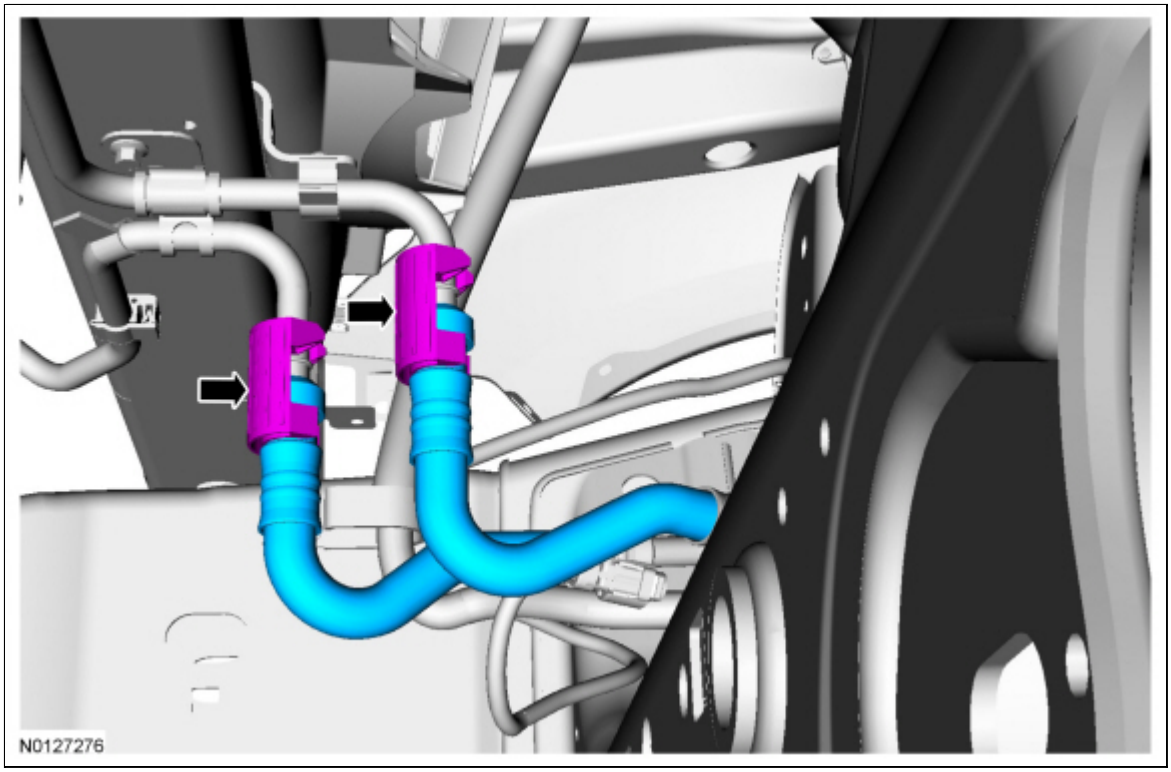


4. If equipped, remove the 4 bolts and the skid plate.

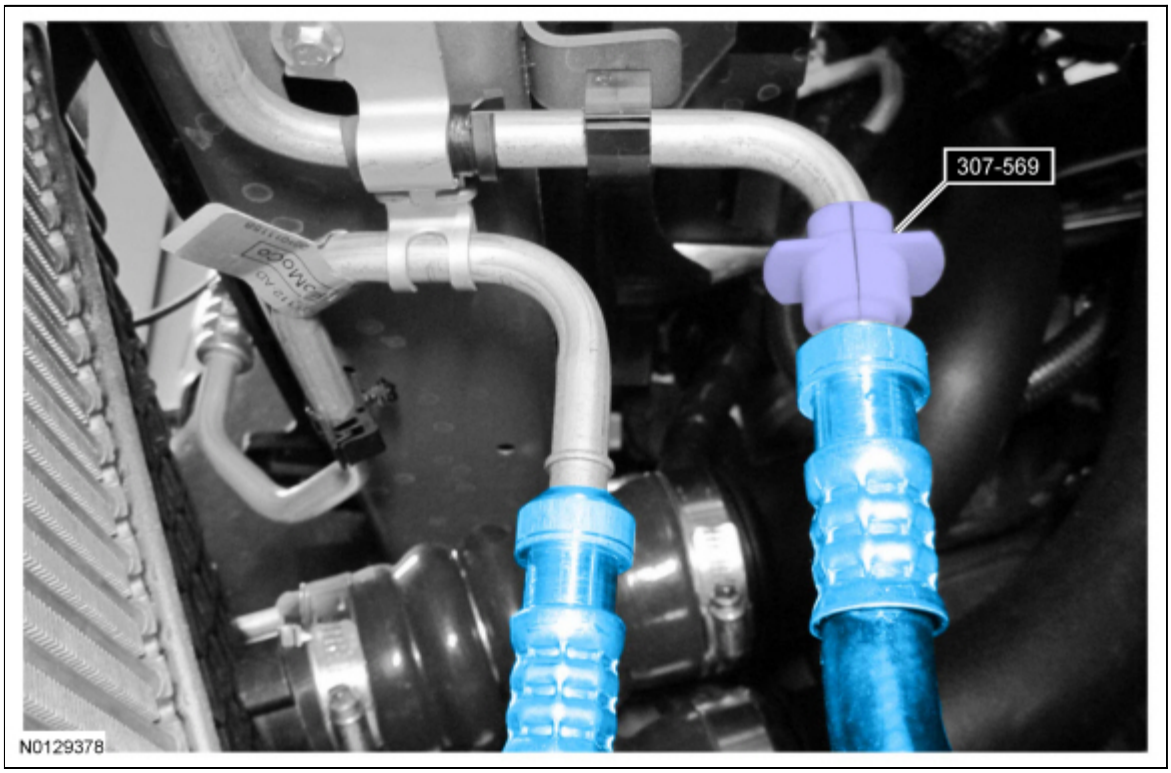


5. Remove the transmission fluid cooler tube secondary latches.

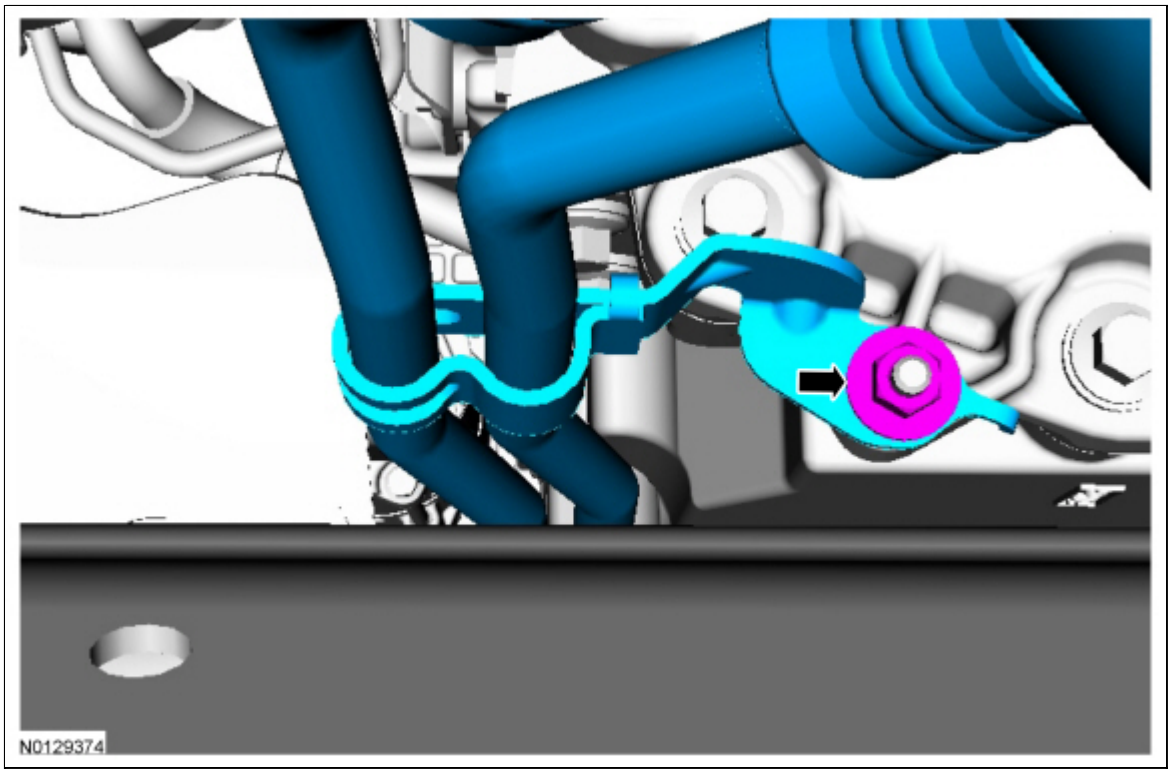
repair4less



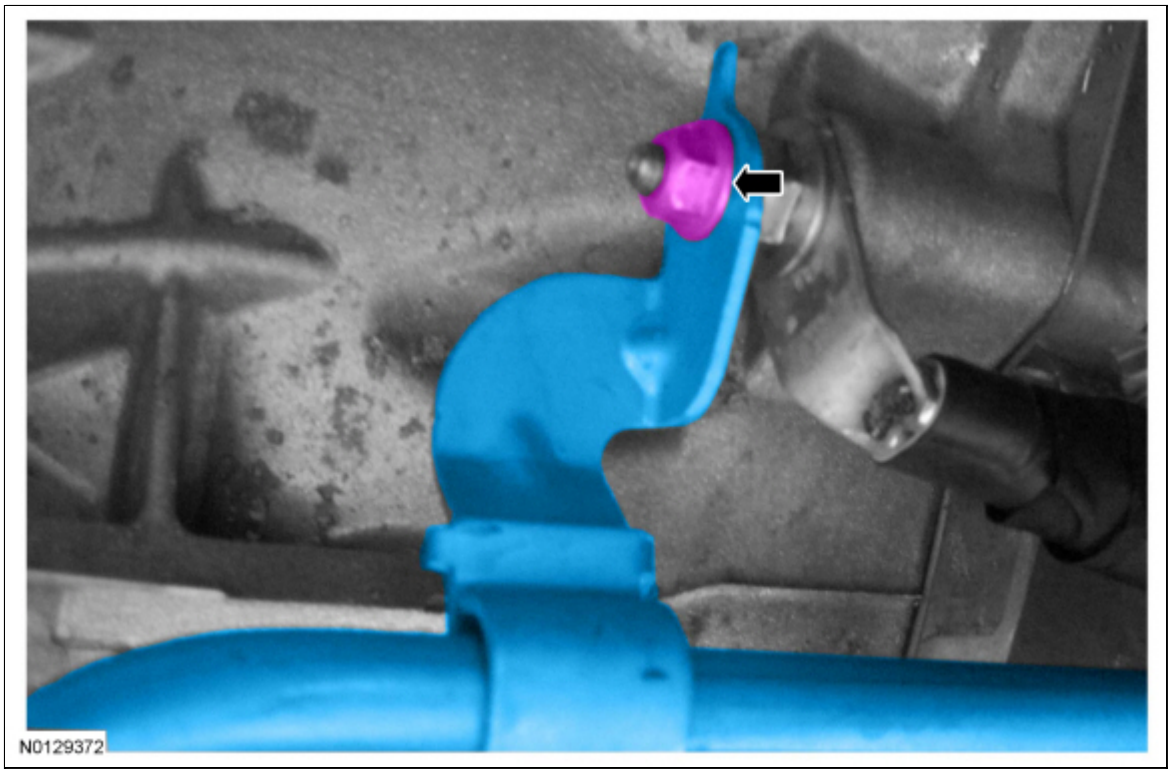
6. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes from the transmission fluid cooler hoses.



7. Remove the transmission fluid cooler tube bracket nut from the front of the engine.

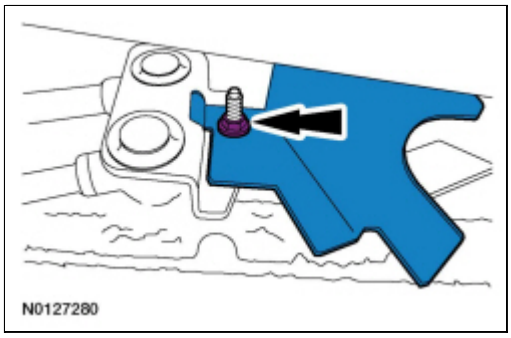


8. Remove the transmission fluid cooler tube bracket nut from the starter motor stud bolt.



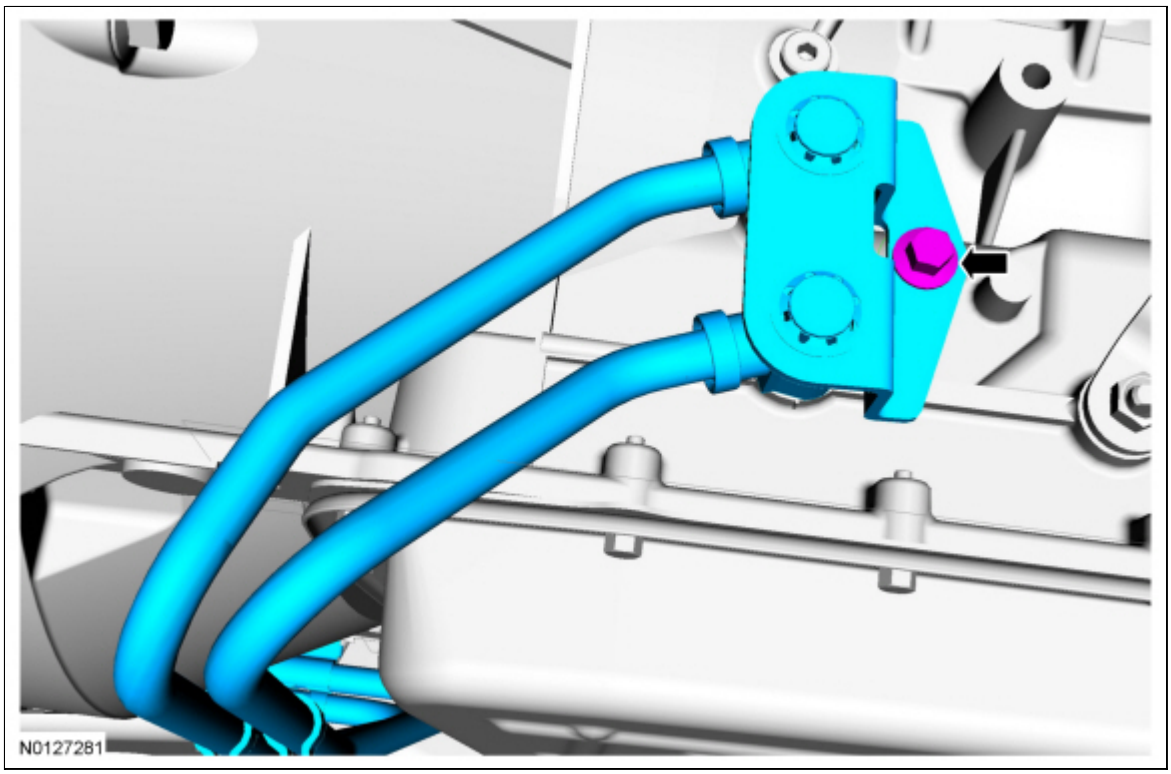
9. If equipped, remove the selector lever cable splash shield nut and the selector lever cable splash shield.

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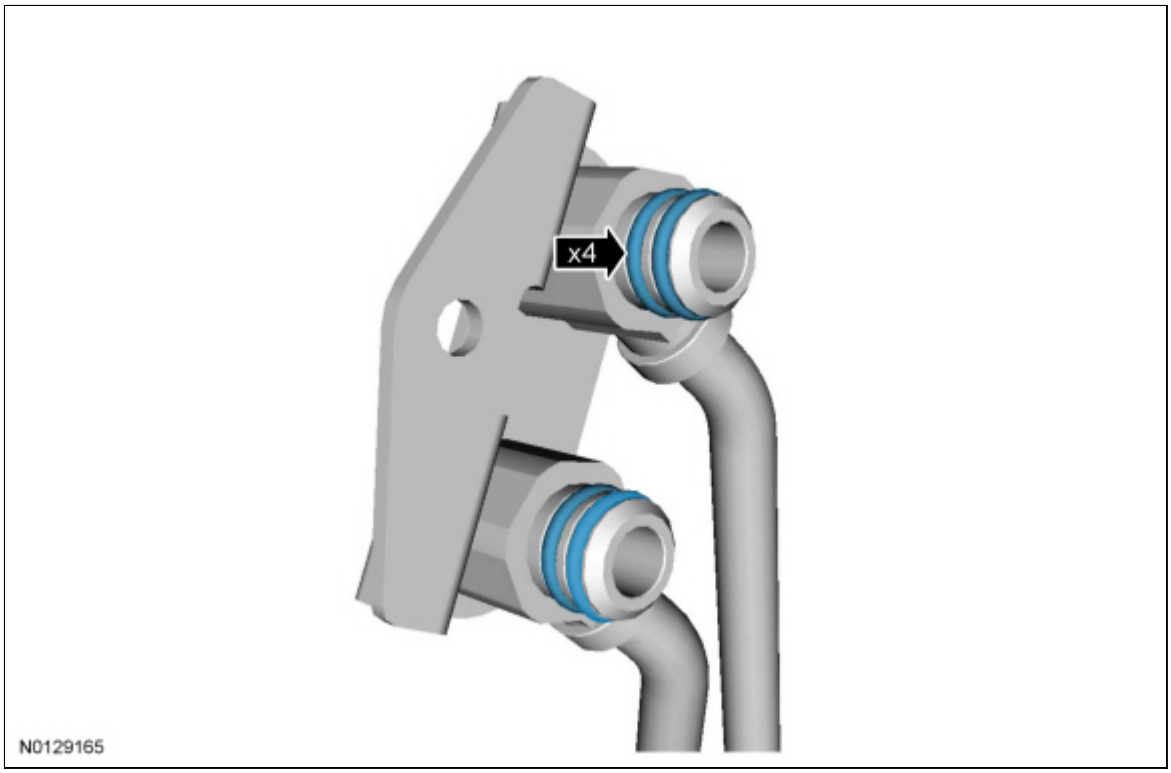


10. **NOTE:** The transmission fluid cooler tube O-rings may remain in the transmission case. Carefully remove them from the case if retained.

    Remove and discard the transmission fluid cooler tubes-to-transmission bolt and separate the transmission fluid cooler tubes from the transmission.



11. Remove and discard the 4 O-rings on the transmission fluid cooler tubes.



12. Remove the transmission fluid cooler tubes from the transmission.

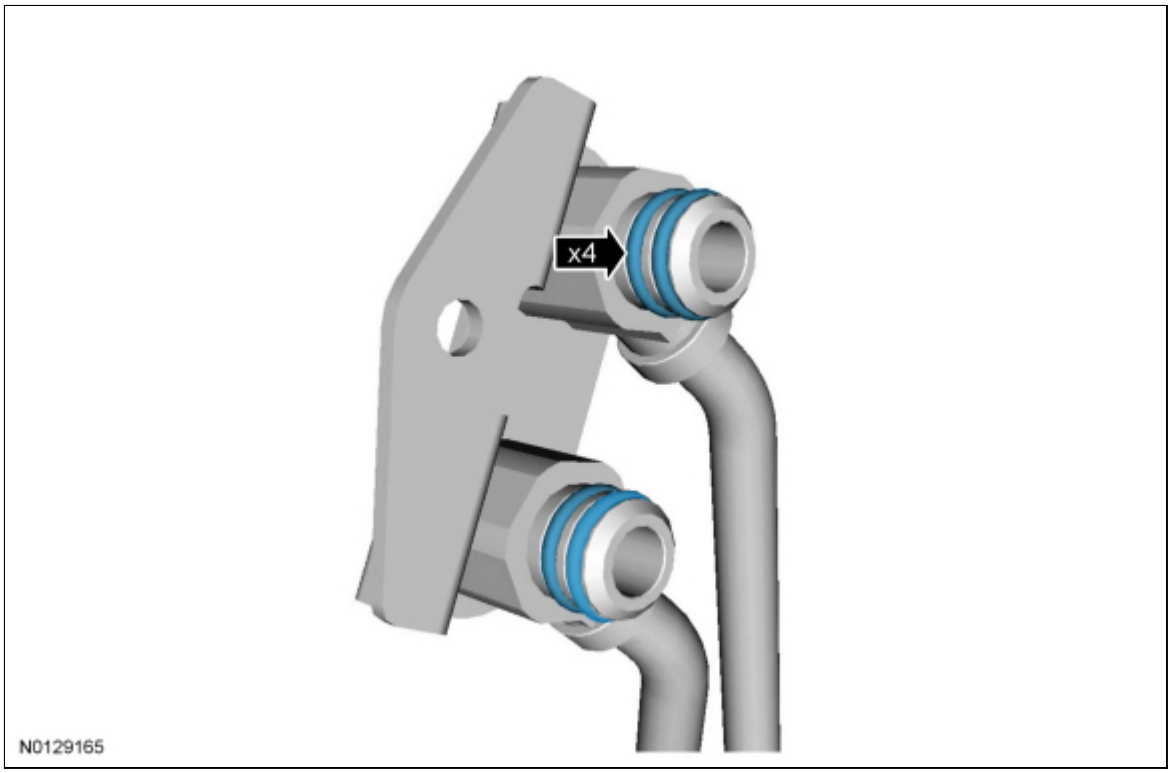
Installation

1. Route the transmission fluid cooler tubes and position them in place.

2. **NOTE:** Inspect the transmission case to make sure that the transmission fluid cooler tube O-rings did not remain in the transmission case. Carefully remove and discard them from the case if retained.

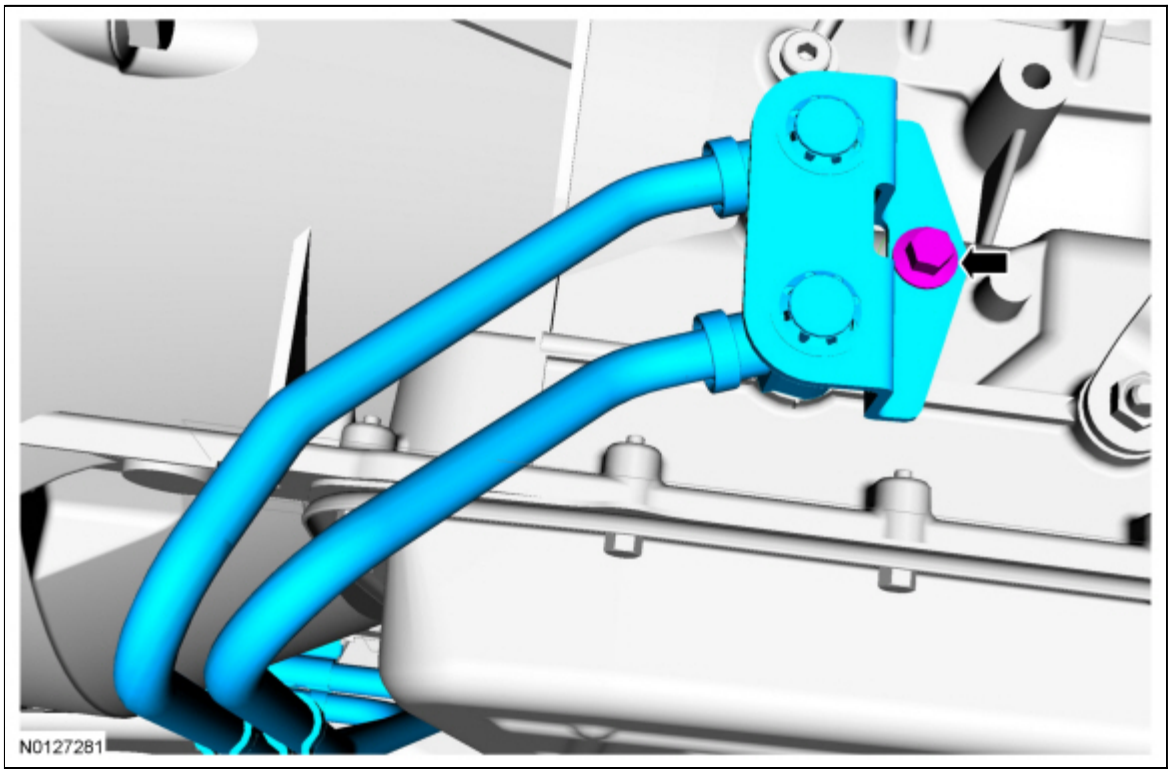
   Install 4 new O-rings on the transmission fluid cooler tubes.

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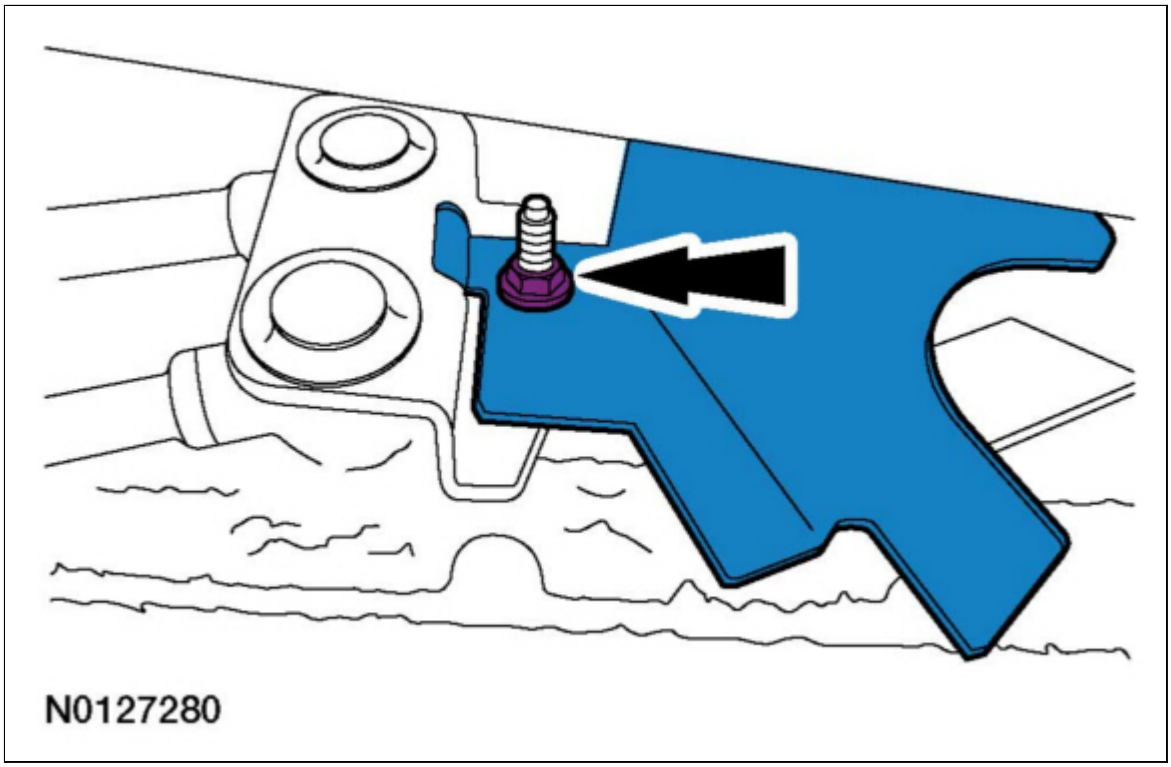


3. ***NOTICE:*** **Install a new transmission fluid cooler tubes-to-transmission bolt.**

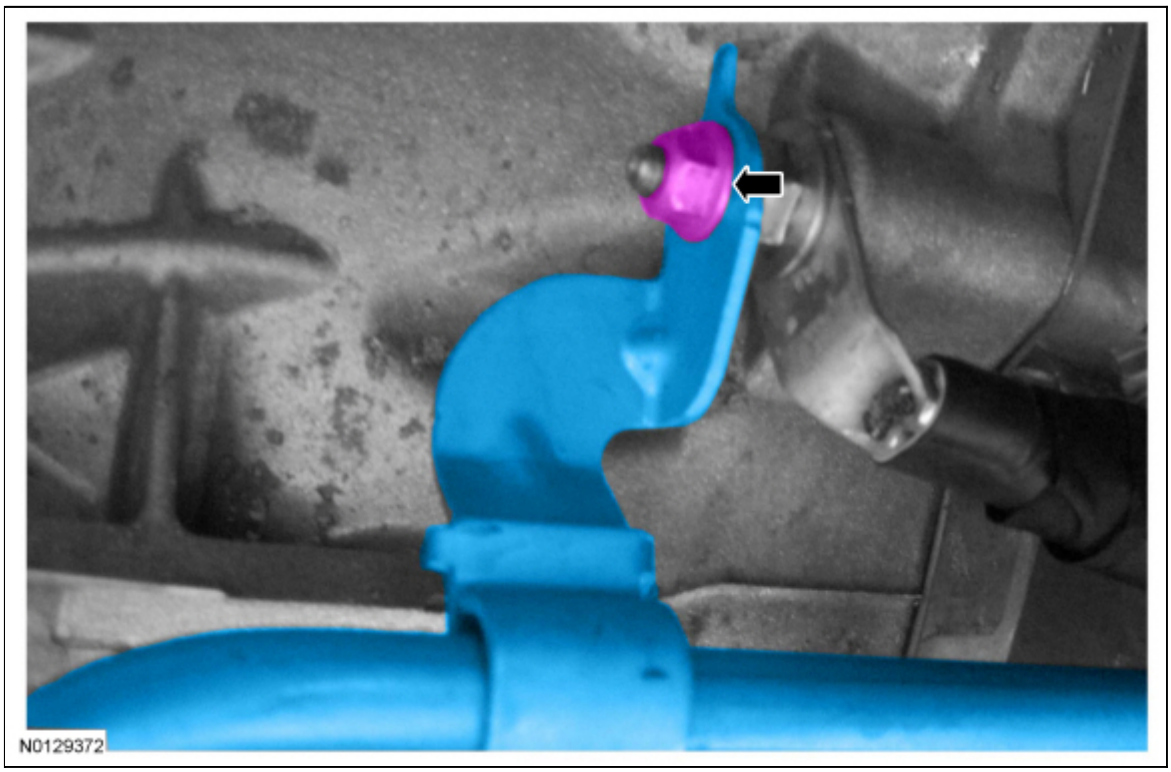
   Install the transmission fluid cooler tubes and a new transmission fluid cooler tubes-to-transmission bolt.
   - Tighten to 30 Nm (22 lb-ft).



4. If equipped, install the selector lever cable splash shield and the splash shield nut.
    - Tighten to 12 Nm (106 lb-in).

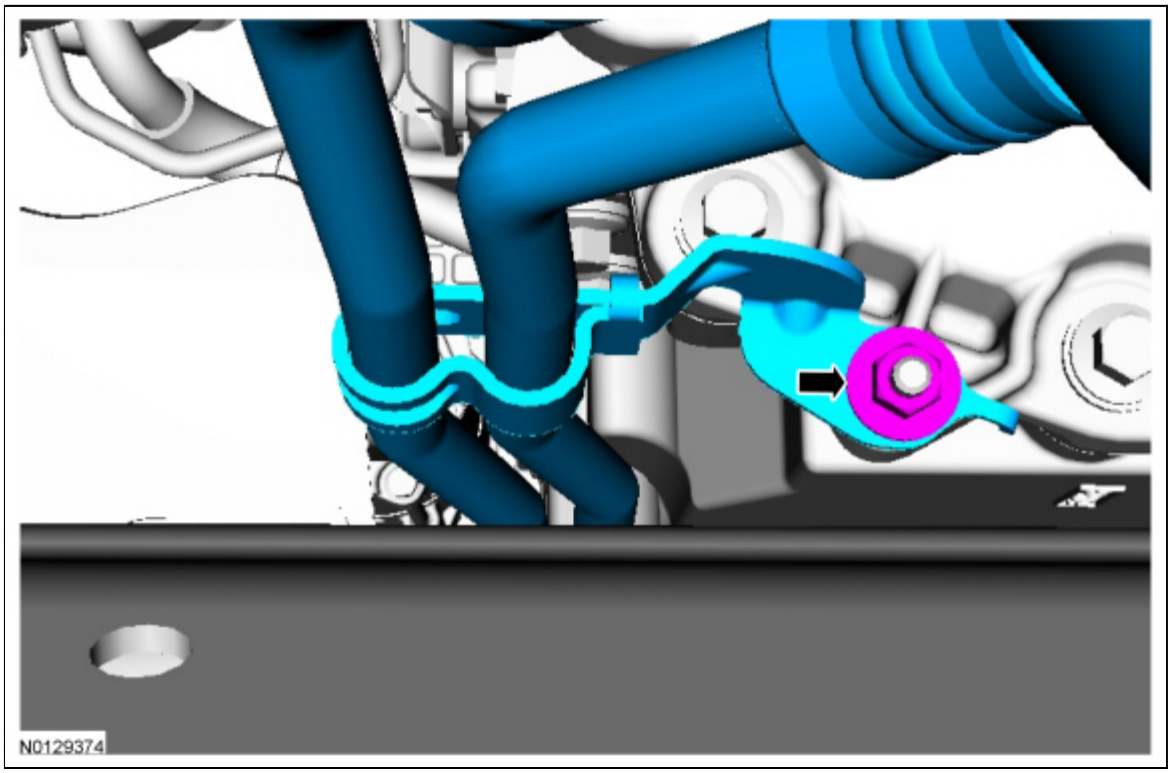


5. Install the transmission fluid cooler tube bracket nut to the starter motor stud bolt.
    - Tighten to 12 Nm (106 lb-in).

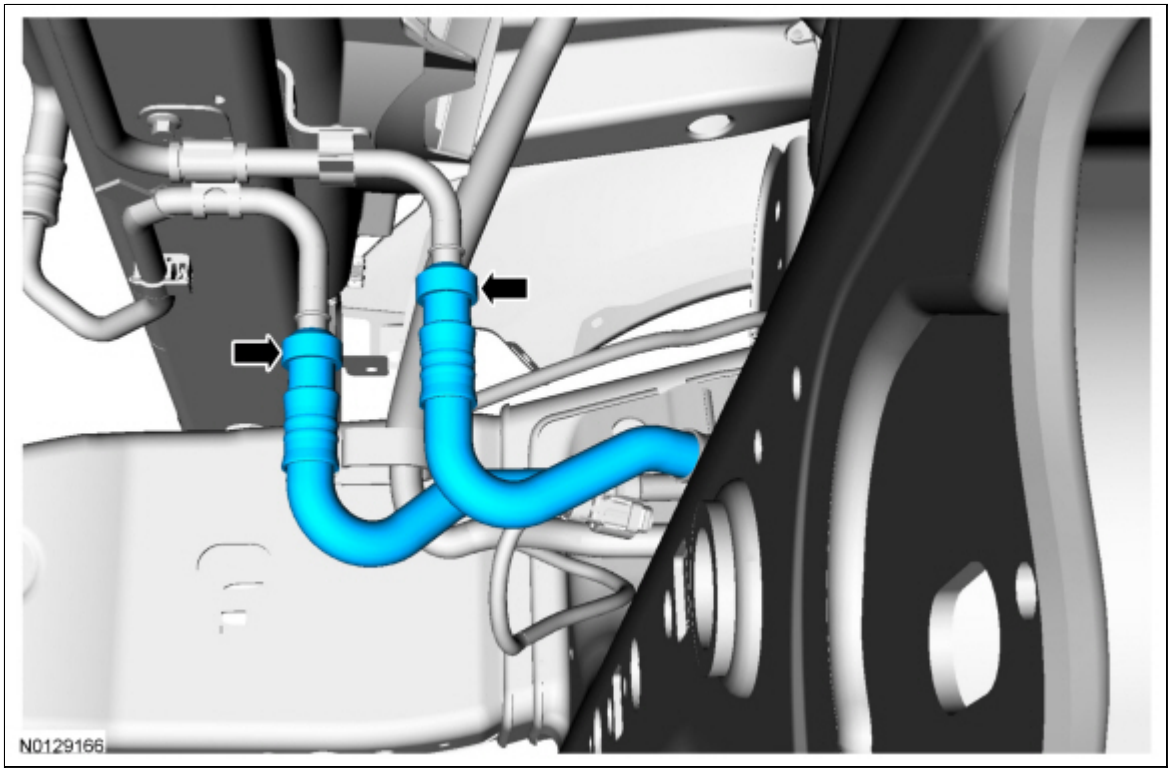


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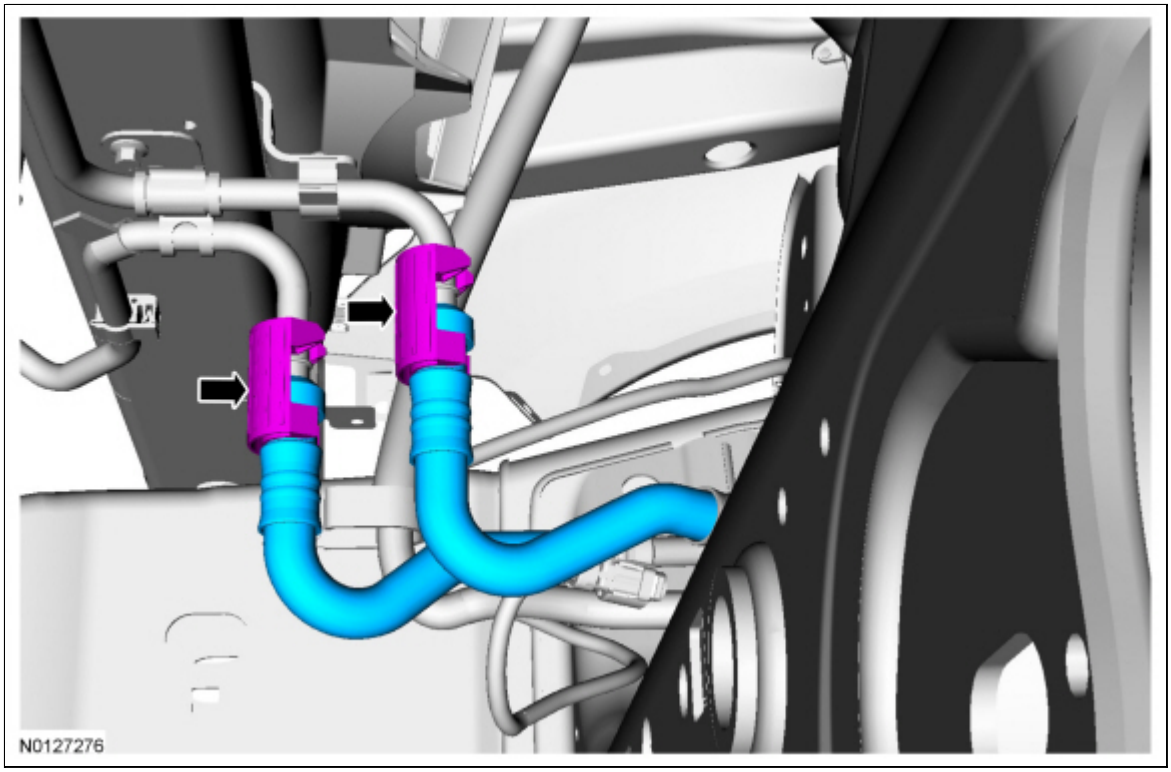
6. Install the transmission fluid cooler tube bracket nut to the front of the engine.
    - Tighten to 12 Nm (106 lb-in).



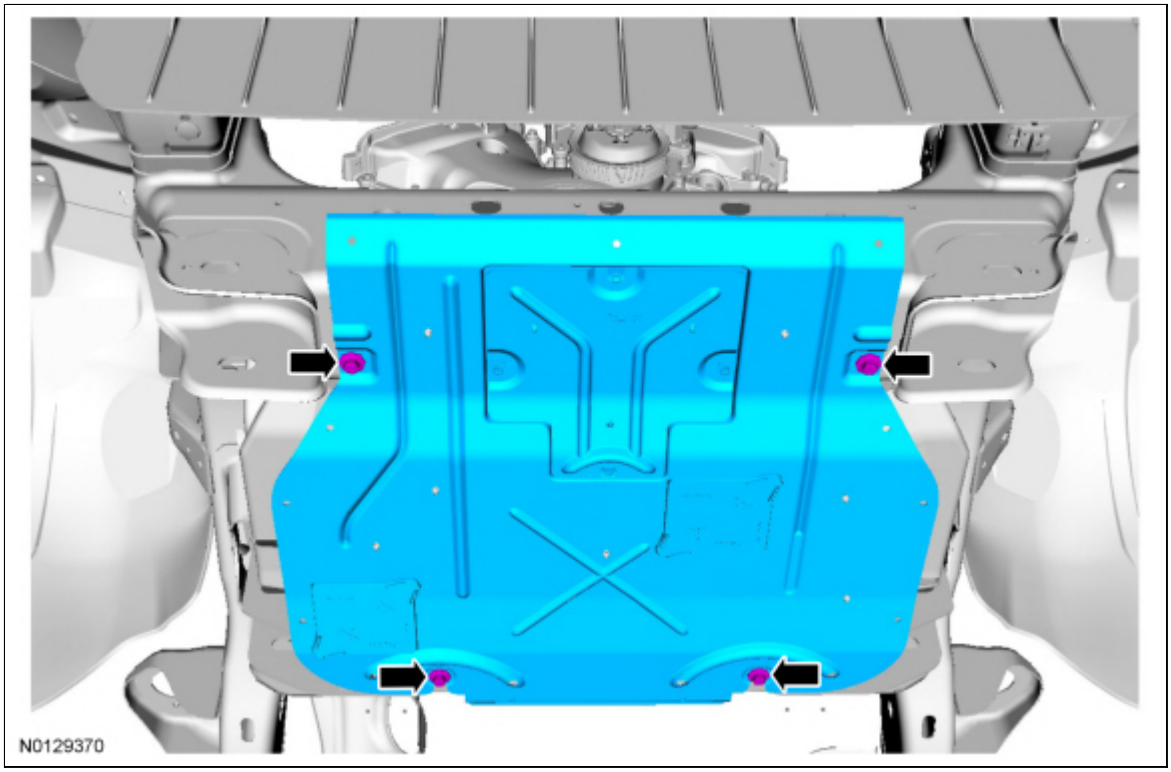
7. Connect the transmission fluid cooler tubes to the transmission fluid cooler hoses.



8. Install the transmission fluid cooler tube secondary latches.

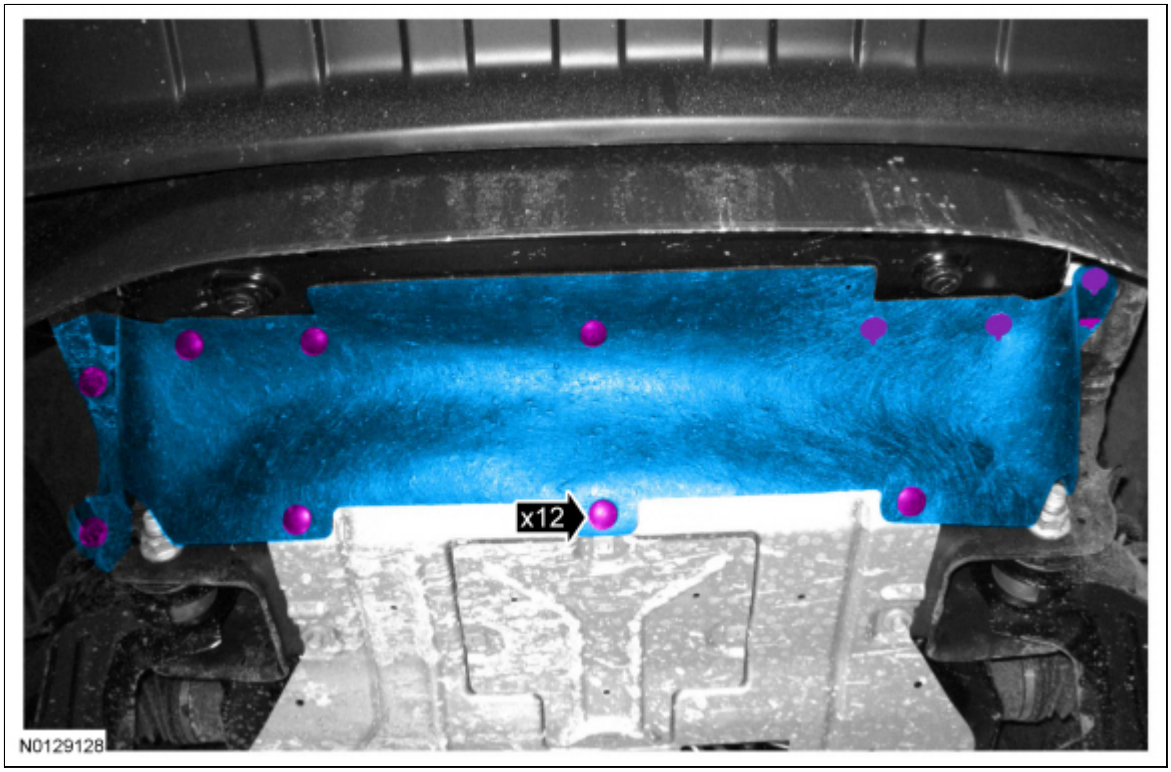


9. If equipped, install the skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).

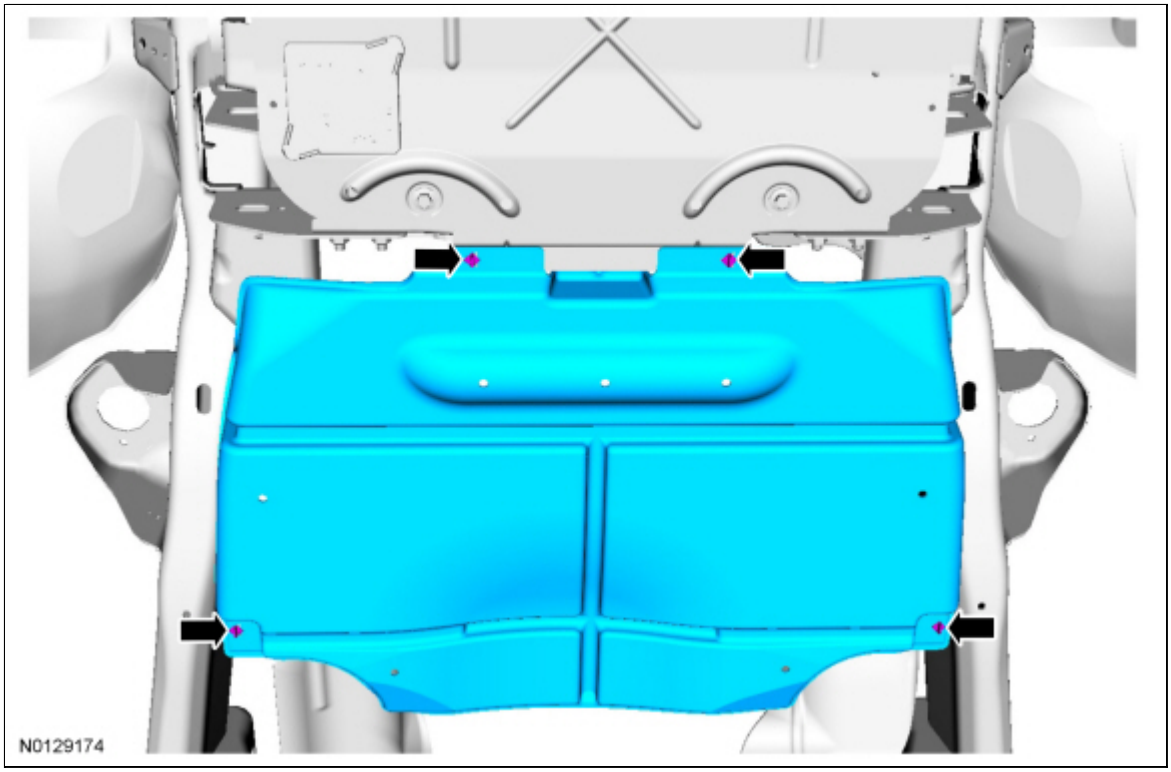


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10. If equipped, install the air deflector and the 12 pushpins.



11. If equipped, install the splash shield and the 4 fasteners.



12. Fill the transmission with fluid and verify correct operation. For additional information, refer to

Transmission Fluid Level Check in Section 307-01 .

13. Check for leaks.

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Transmission Fluid Cooler Tubes — 5.0L (4V), 6.2L (2V)

Special Tool(s)

 ST2935A	Disconnect Tool, Transmission Cooler Line 307-569

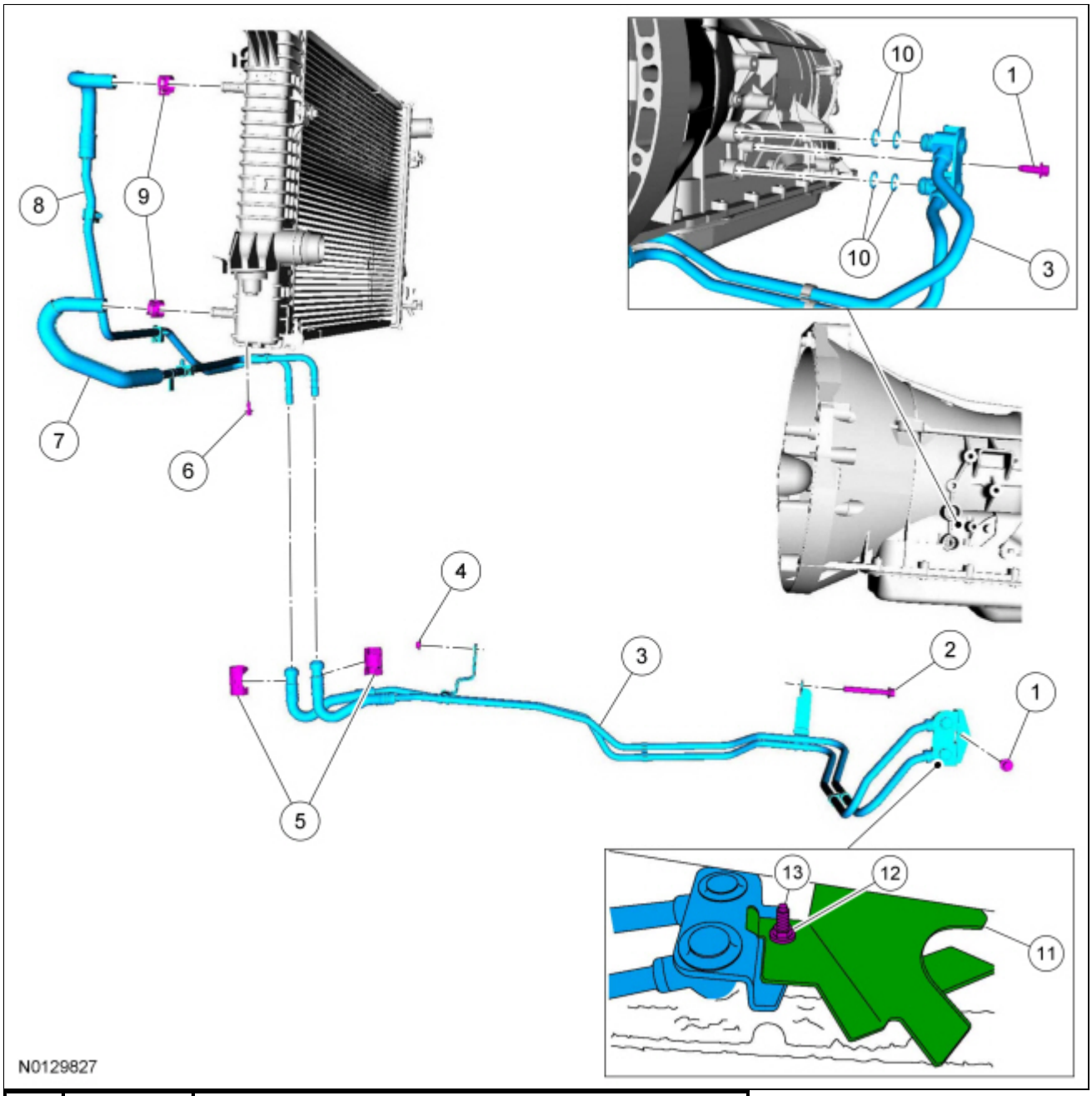
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

5.0L (4V) Transmission Fluid Cooler Tubes

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	W715131	Transmission fluid cooler tubes-to-transmission bolt
2	W714012	Transmission-to-engine bolt
3	7R081	Transmission fluid cooler inlet and outlet tubes
4	W520822	Transmission fluid cooler tube bracket-to-front of engine nut
5	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
6	W500212	Transmission fluid cooler tube bracket bolt
7	7B028	In-tank transmission fluid cooler inlet tube

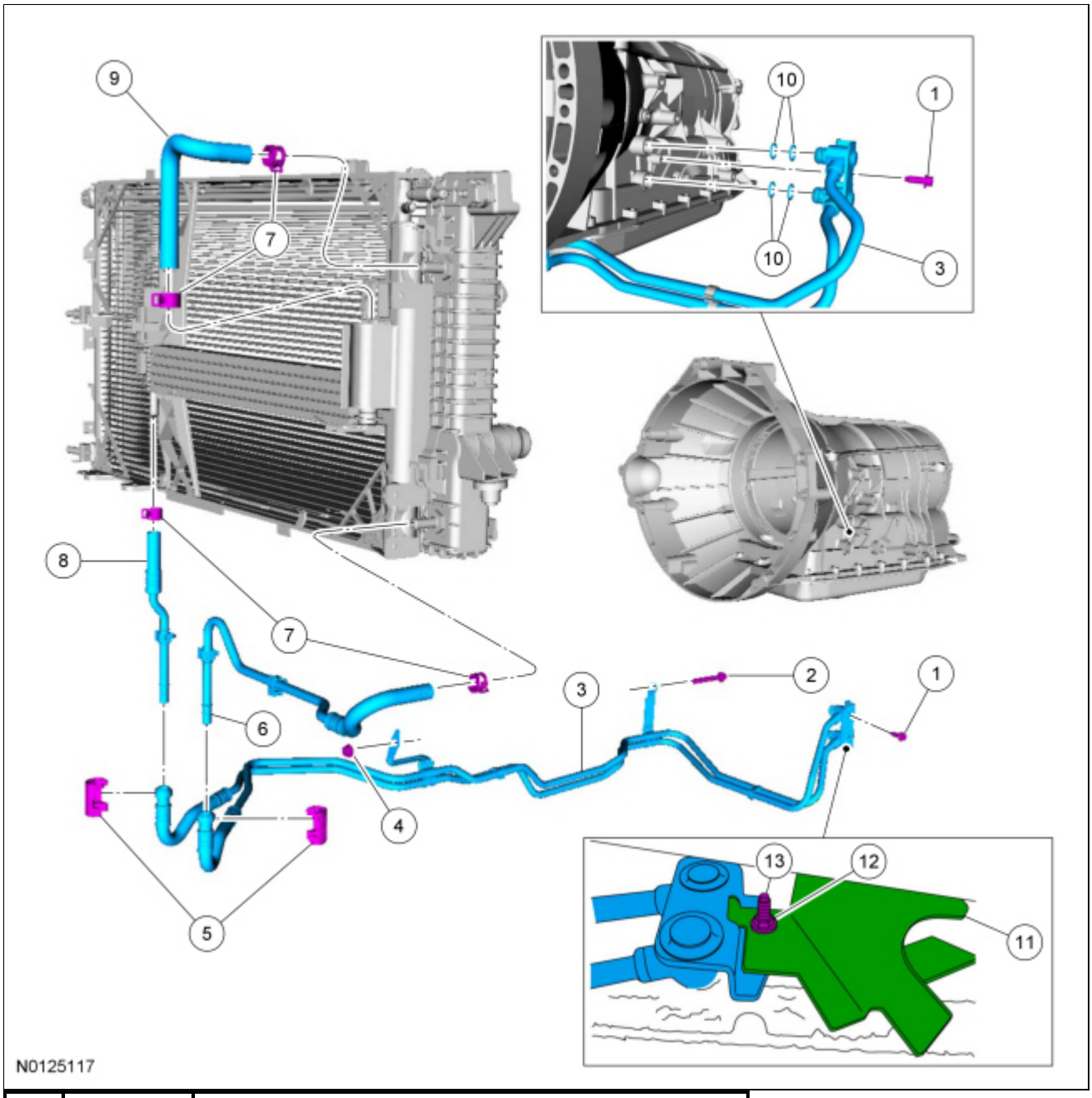
repair4less

8	7B028	In-tank transmission fluid cooler outlet tube
9	7C107	Transmission fluid cooler hose clamps
10	7J227	Transmission fluid cooler tube O-rings (4 required)
11	7B147	Selector lever cable splash shield (if equipped)
12	W520111	Selector lever cable splash shield nut
13	W715798	Transmission fluid cooler tubes-to-transmission bolt (with selector lever cable splash shield)

6.2L (2V) Transmission Fluid Cooler Tubes

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	W715131	Transmission fluid cooler tubes-to-transmission bolt
2	W714012	Transmission-to-engine bolt
3	7R081	Transmission fluid cooler inlet and outlet tubes
4	W707014	Transmission fluid cooler tube bracket-to-front of engine nut
5	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches
6	7B028	In-tank transmission fluid cooler inlet tube
7	7C107	Transmission fluid cooler hose clamps

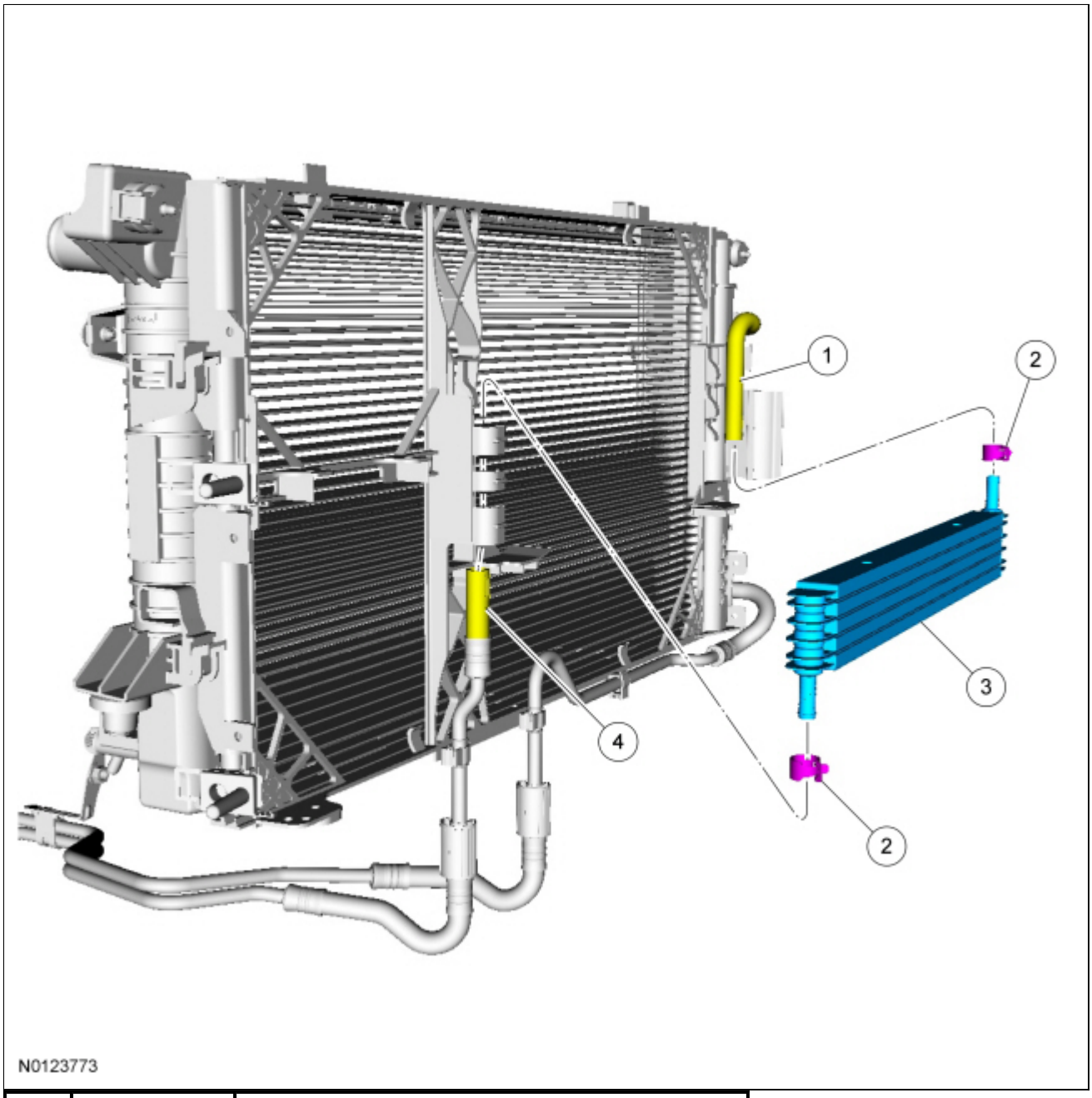
repair4less

8	7B028	Auxiliary transmission fluid cooler outlet hose
9	7C410	Auxiliary transmission fluid cooler inlet hose
10	7J227	Transmission fluid cooler tube O-rings (4 required)
11	7B147	Selector lever cable splash shield (if equipped)
12	W520111	Selector lever cable splash shield nut
13	W715798	Transmission fluid cooler tubes-to-transmission bolt (with selector lever cable splash shield)

5.0L (4V) With Auxiliary Transmission Fluid Cooler

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	7C410	Auxiliary transmission fluid cooler inlet hose
2	7C107	Transmission fluid cooler hose clamps
3	7A095	Auxiliary transmission fluid cooler
4	7B028	Auxiliary transmission fluid cooler outlet hose

Removal

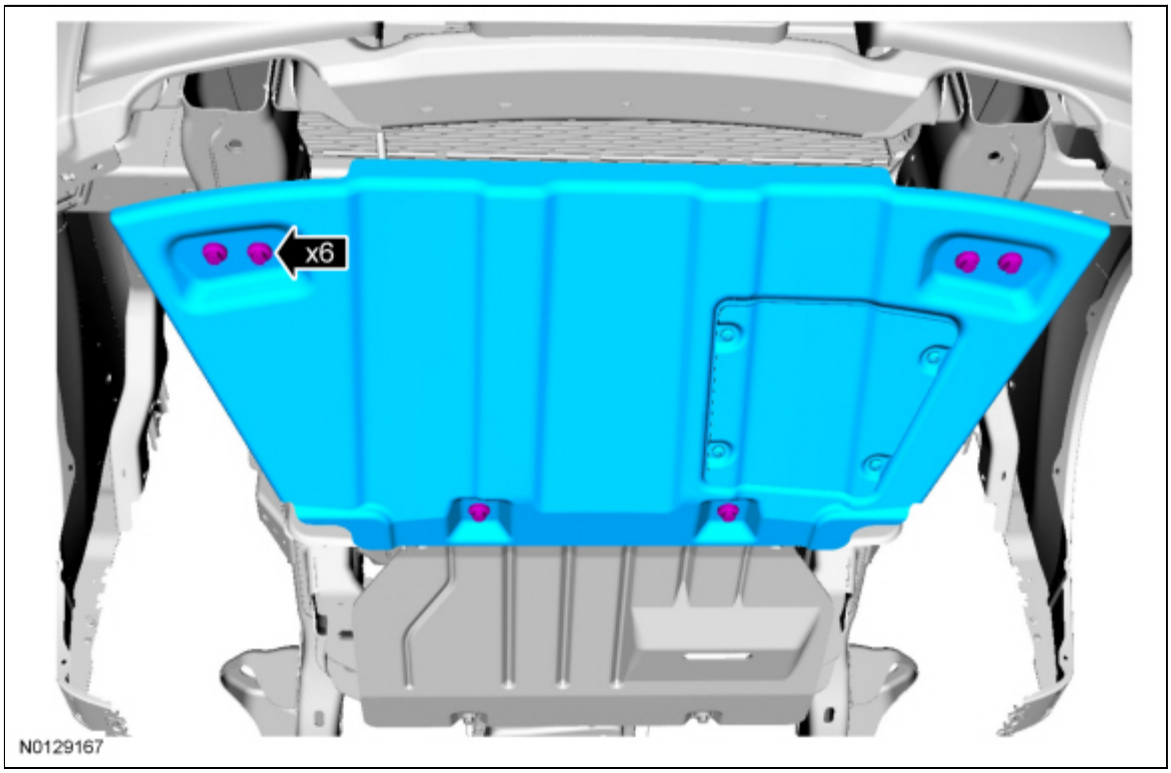
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

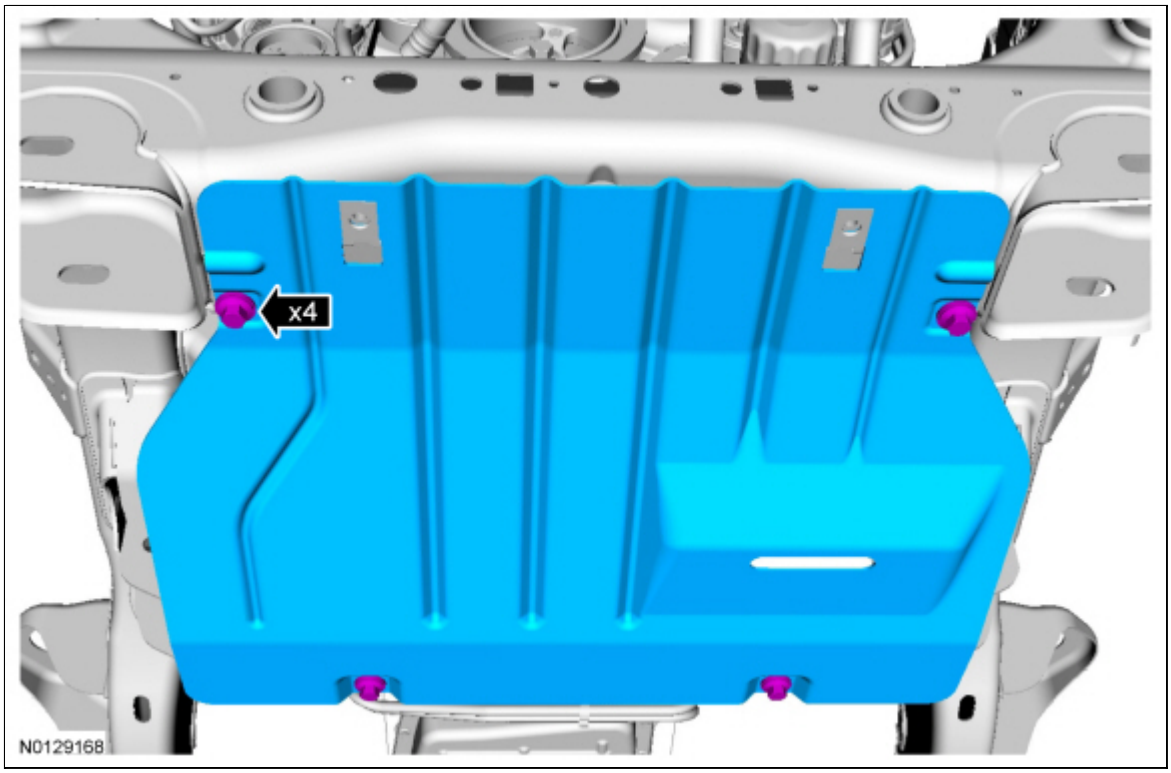
repair4less

4WD

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. If equipped, remove the 6 bolts and the forward skid plate.



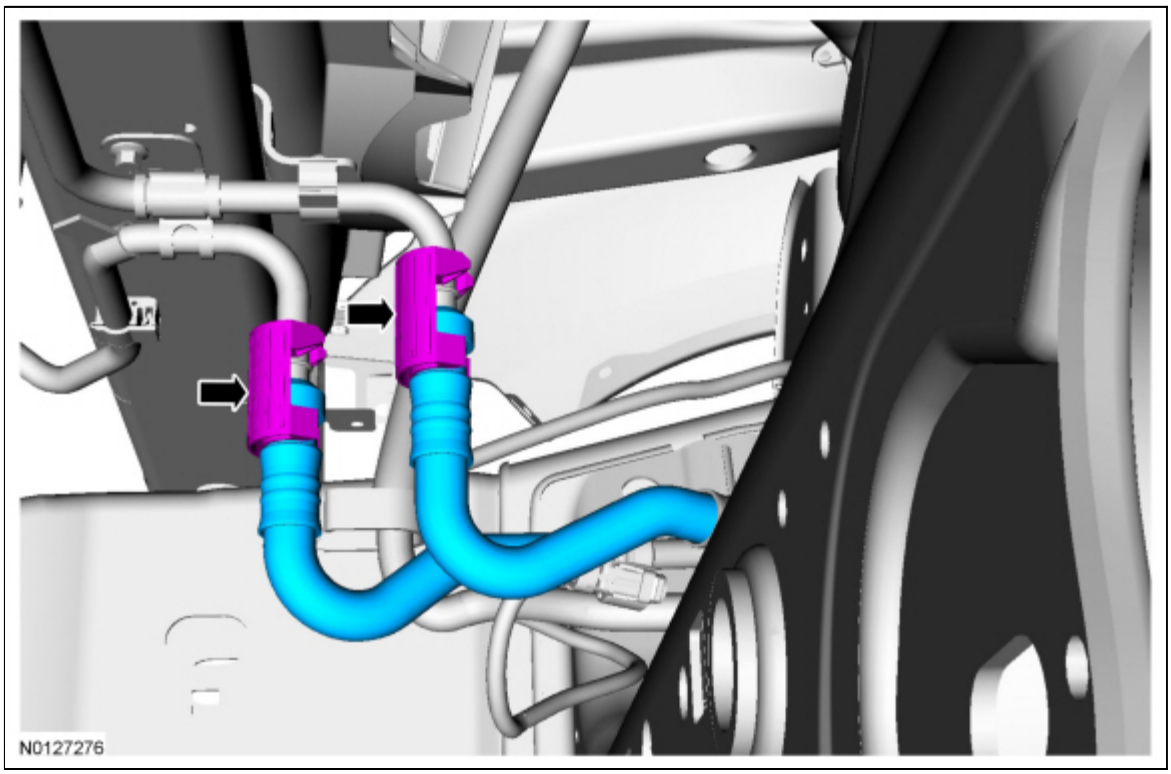
4. Remove the 4 bolts and the rearward skid plate.



All vehicles

NOTE: 5.0L (4V) Shown, 6.2L (2V) similar.

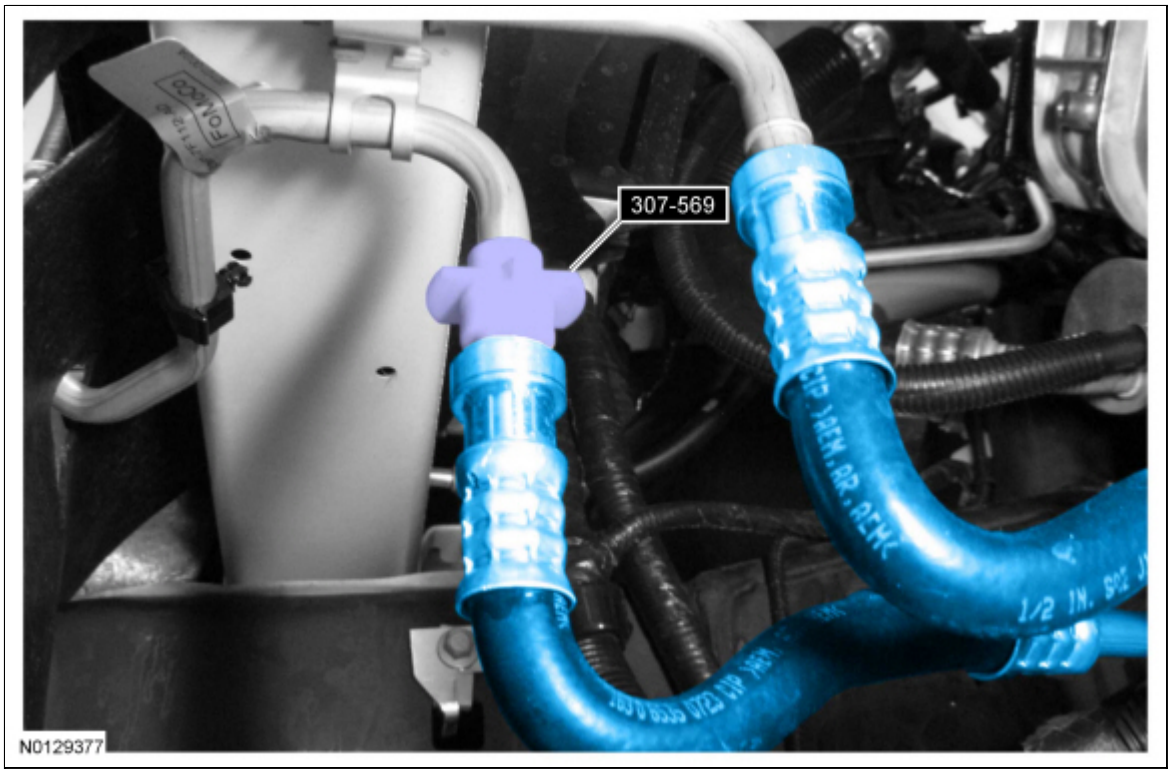
5. Remove the transmission fluid cooler tube secondary latches.



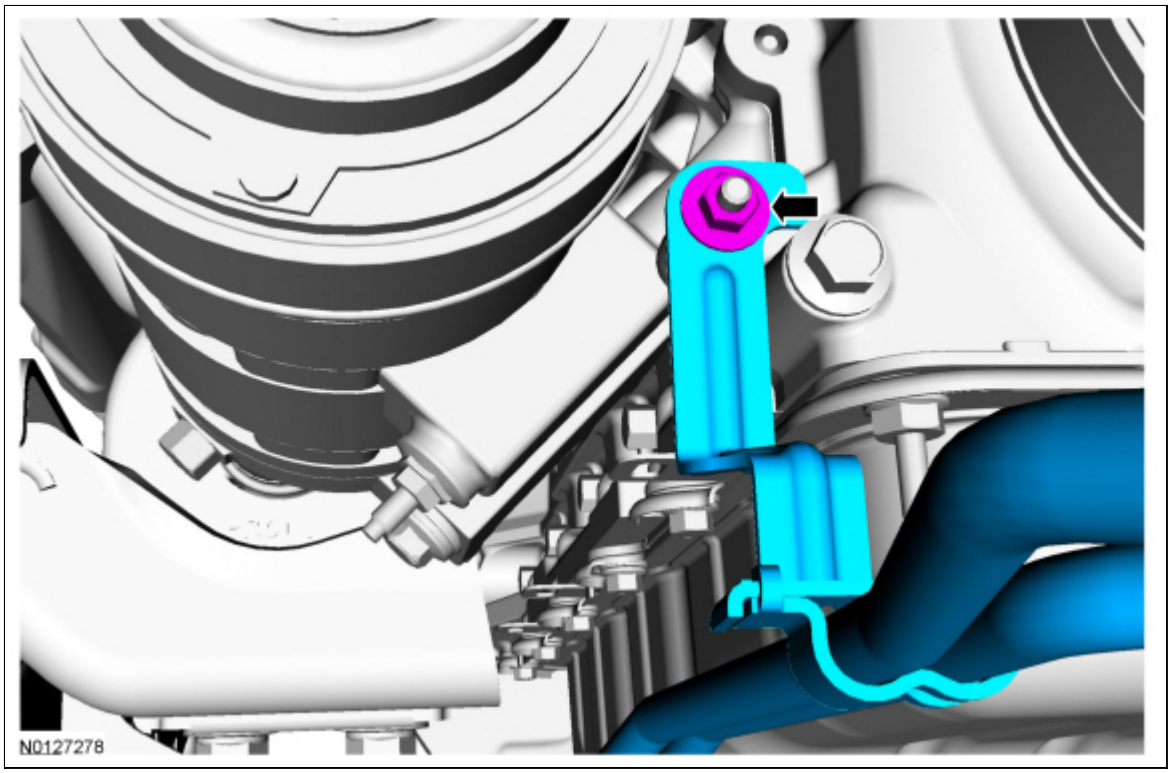
repair4less

NOTE: 5.0L (4V) Shown, 6.2L (2V) similar.

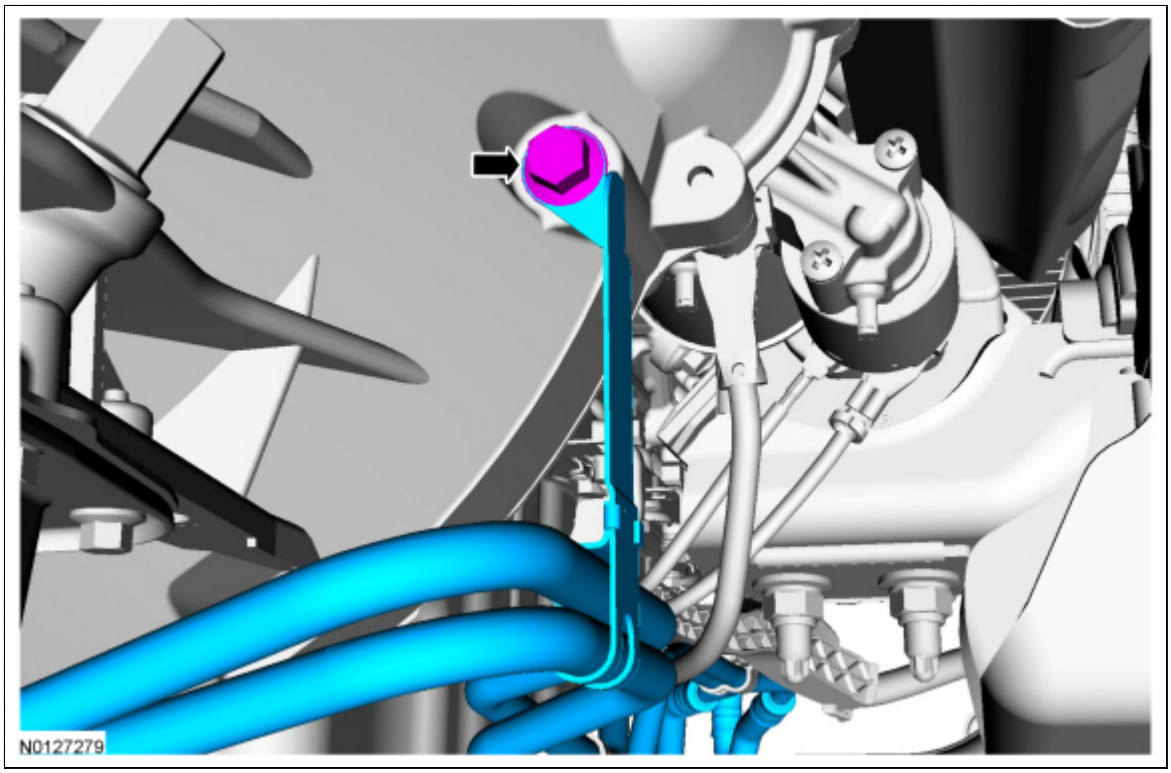
6. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes from the transmission fluid cooler hoses.



7. Remove the transmission fluid cooler tube bracket nut from the front of the engine.

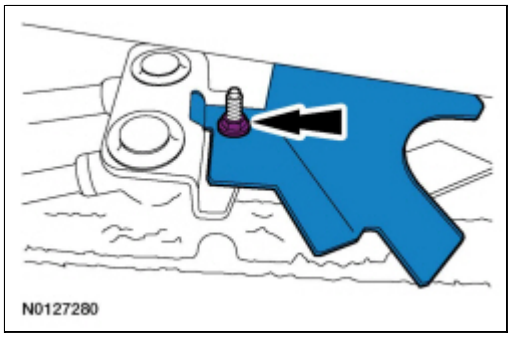


8. Remove the transmission-to-engine bolt and transmission fluid cooler tube bracket from the engine.



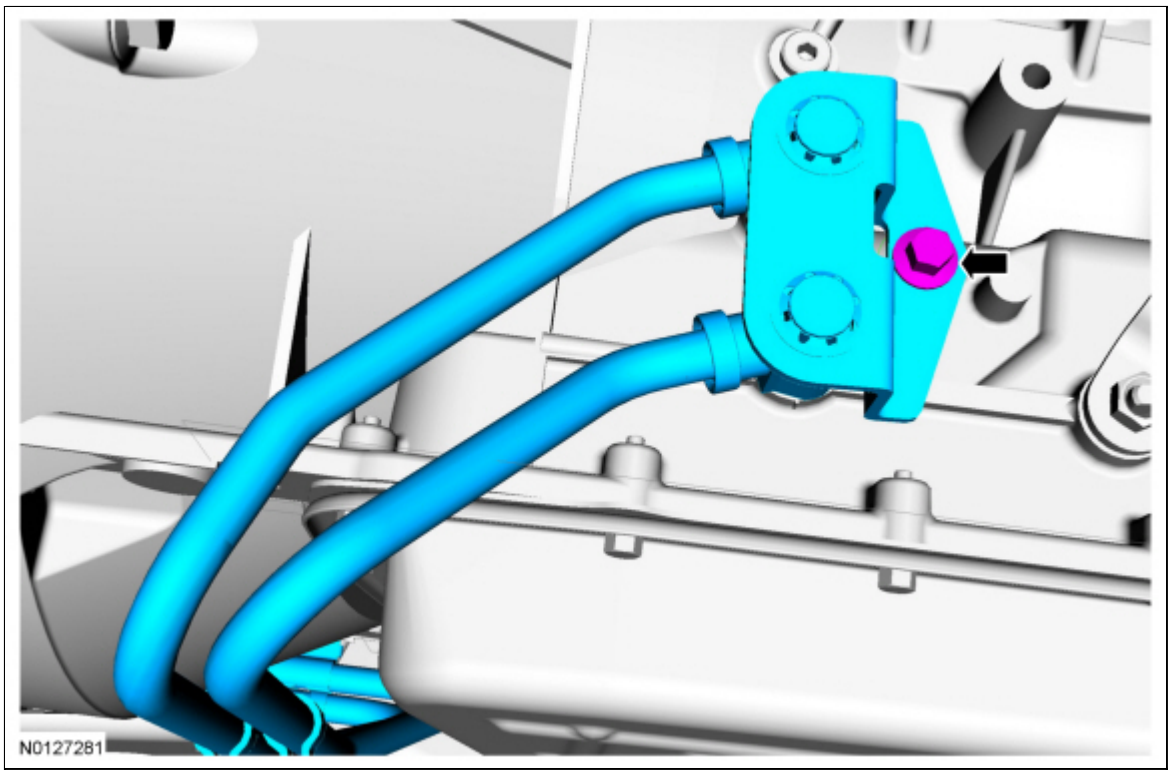
9. If equipped, remove the nut and the selector lever cable splash shield.

repair4less

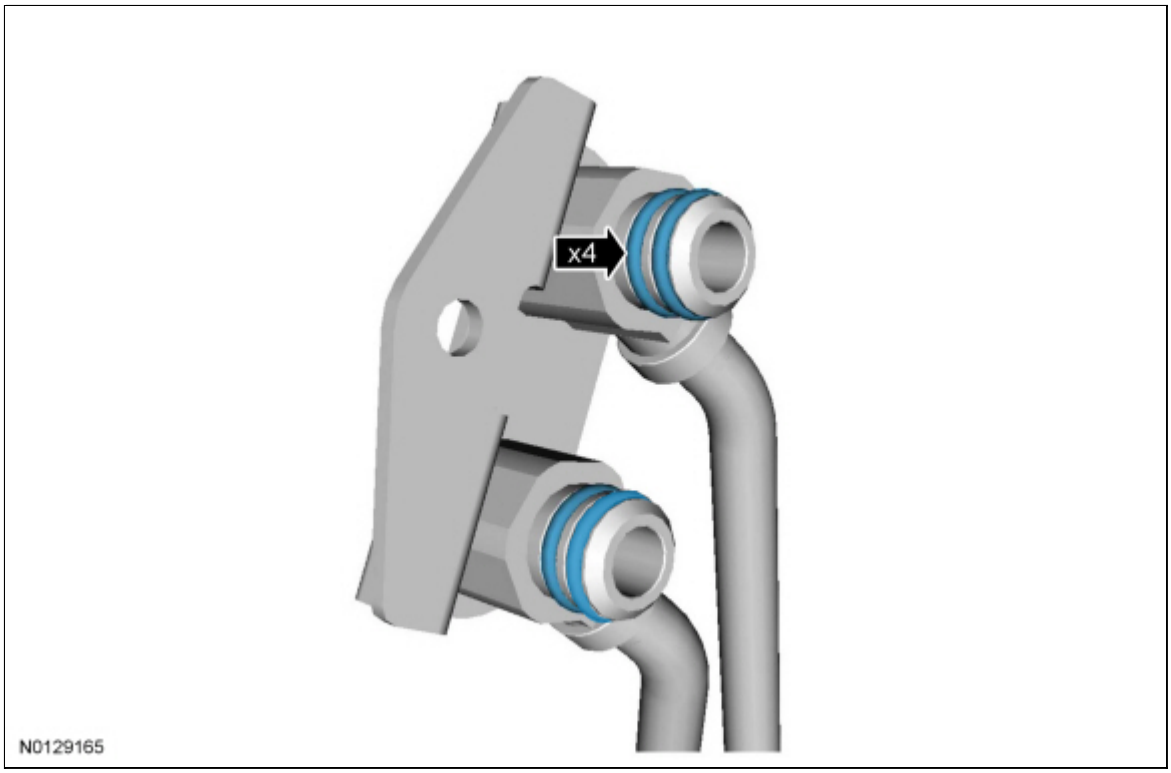


10. **NOTE:** The transmission fluid cooler tube O-rings may remain in the transmission case. Carefully remove them from the case if retained.

    Remove and discard the transmission fluid cooler tubes-to-transmission bolt and separate the transmission fluid cooler tubes from the transmission.

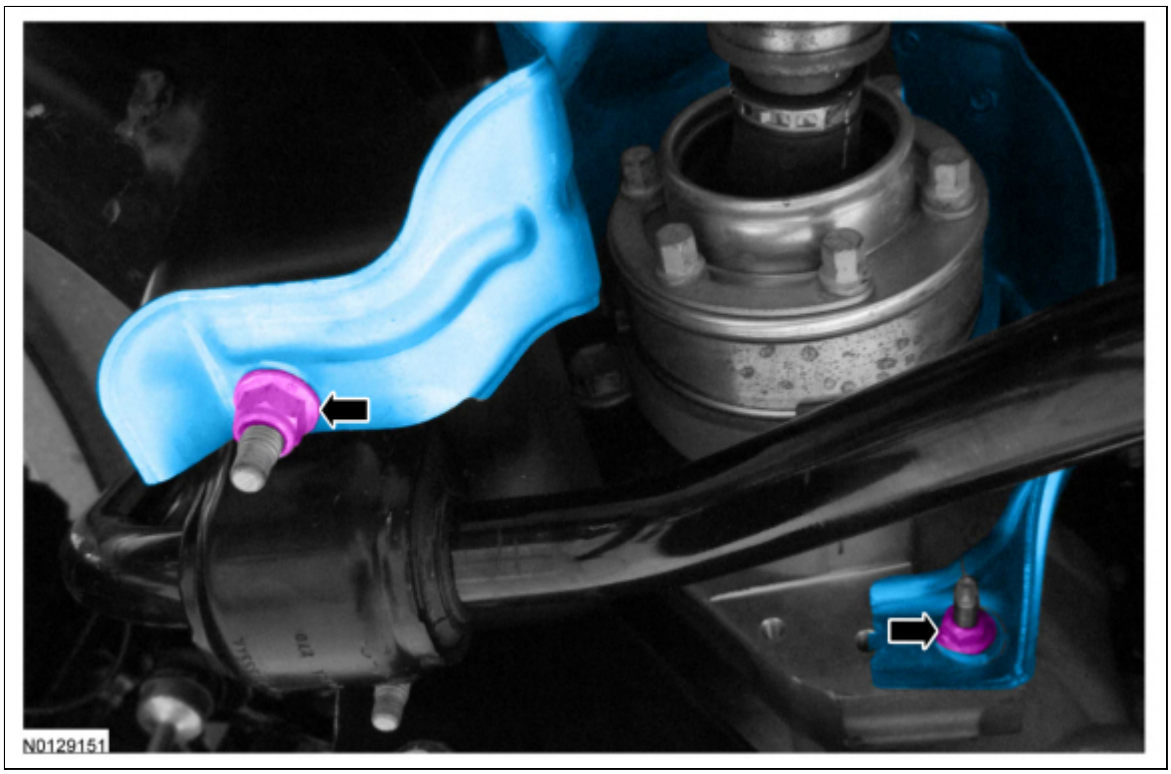


11. Remove and discard the 4 O-rings on the transmission fluid cooler tubes.



Raptor

12. Remove the 2 nuts and the heat shield.

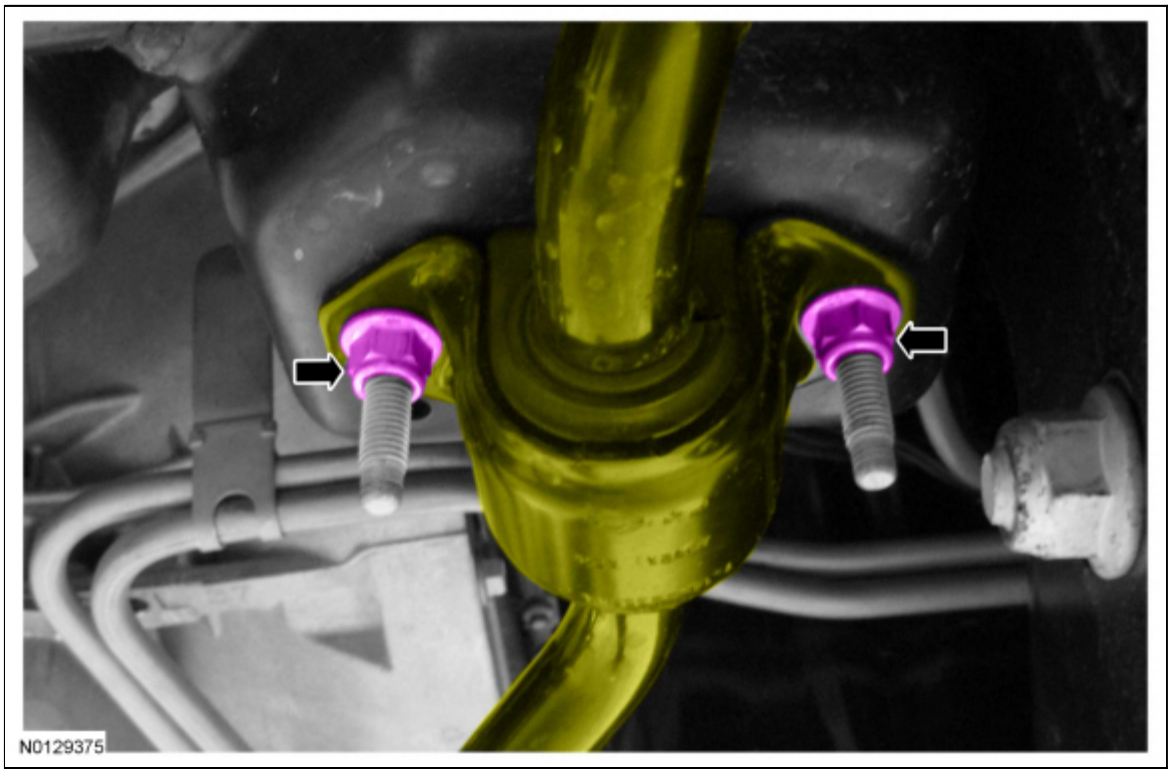


All vehicles

repair4less

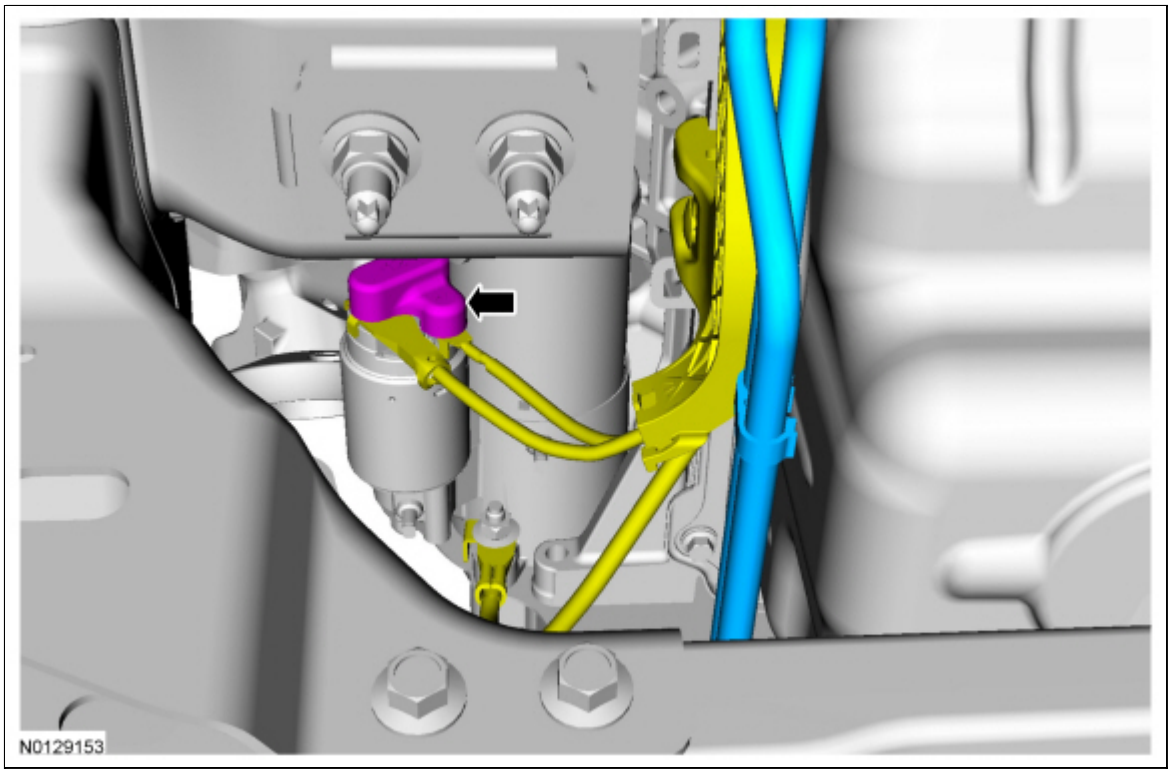
13. **NOTE:** Right side shown, left side similar.

    Remove and discard the 4 nuts and lower the front sway bar.

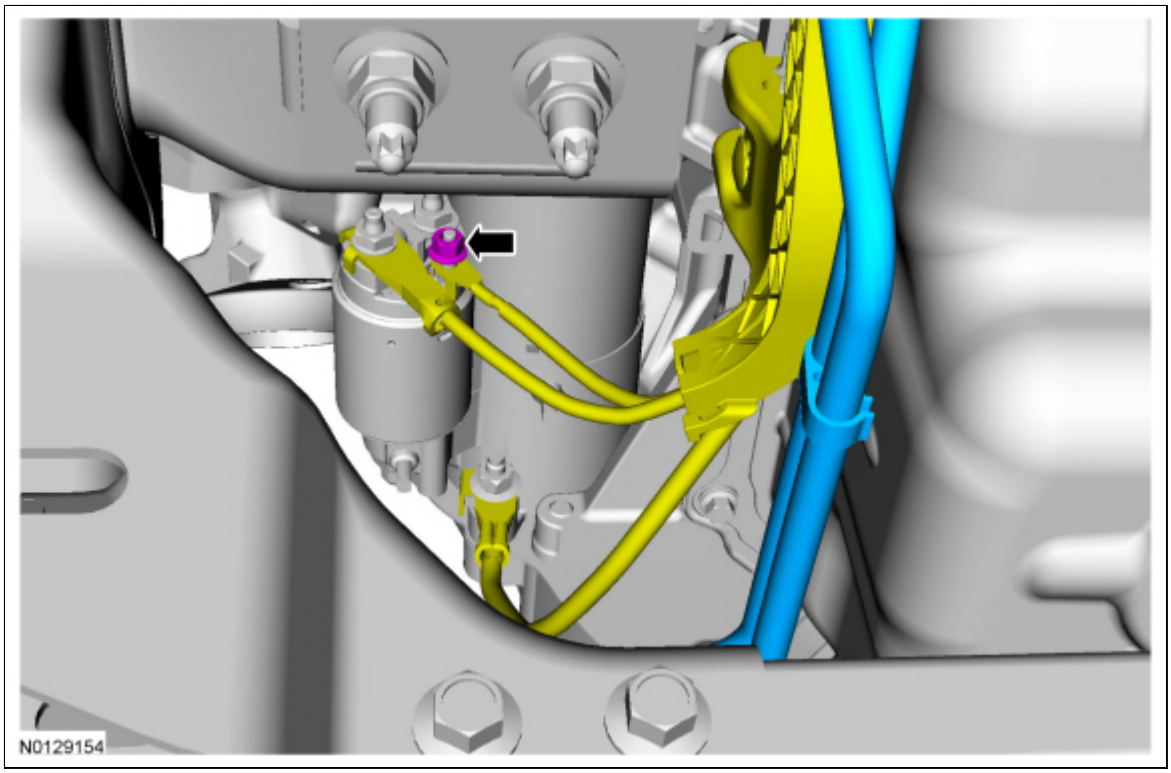


4WD

14. Remove the starter terminal cover.

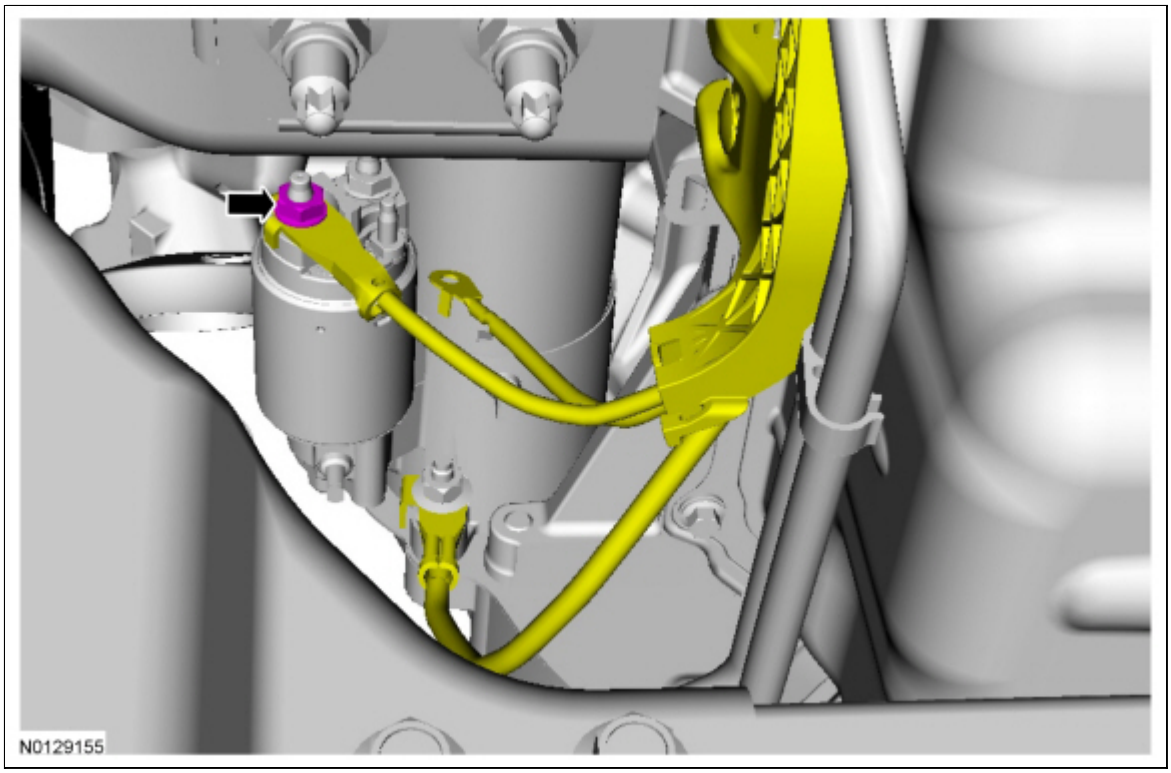


15. Remove the nut and disconnect the starter solenoid S-terminal eyelet.

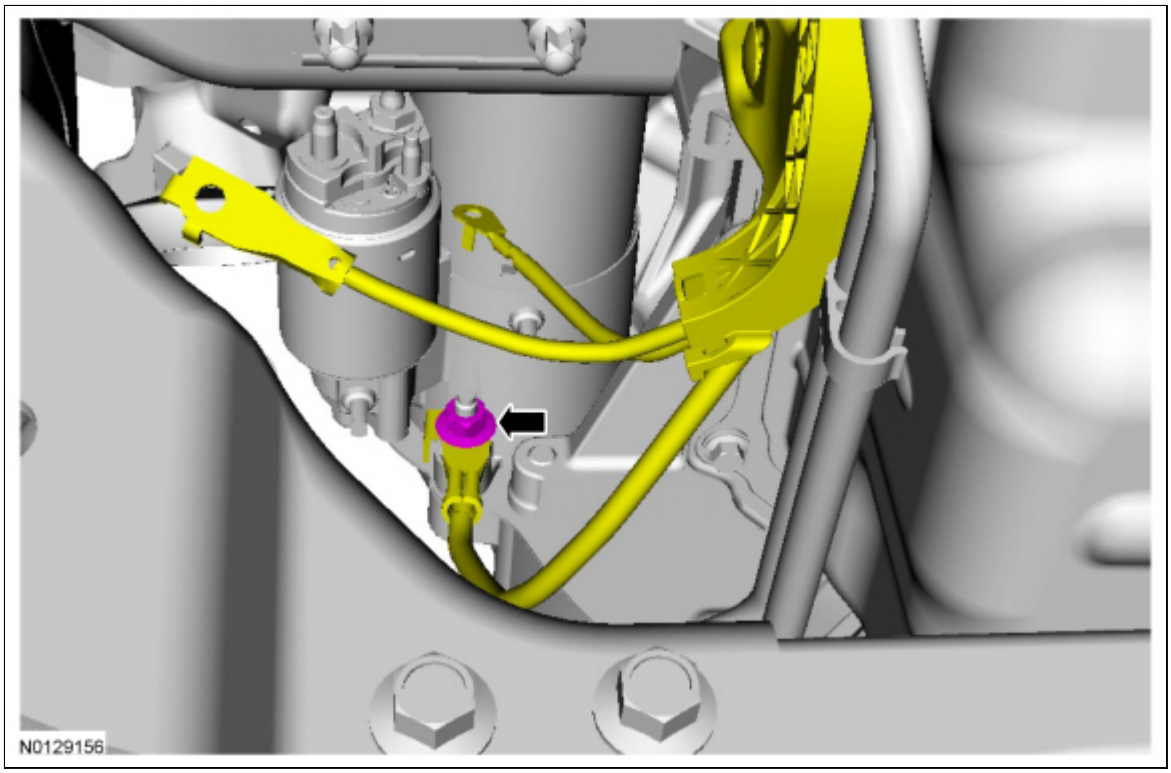


16. Remove the nut and disconnect the starter solenoid B-terminal eyelet.

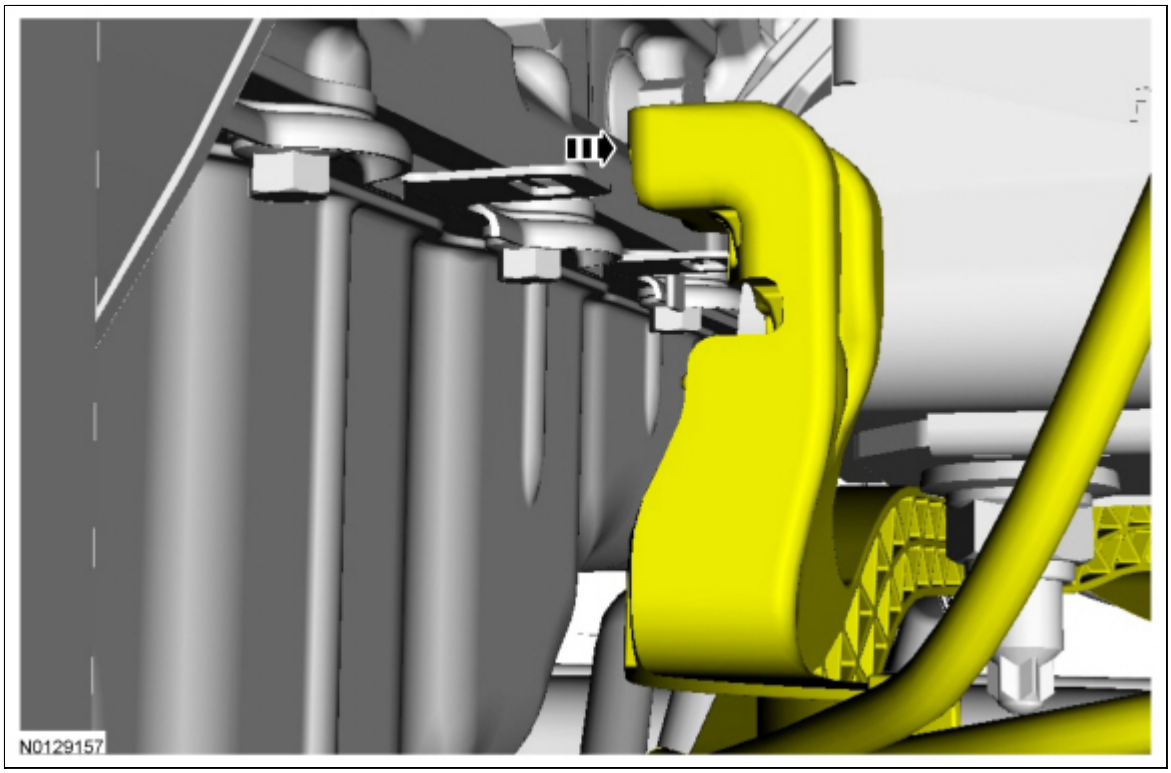
repair4less



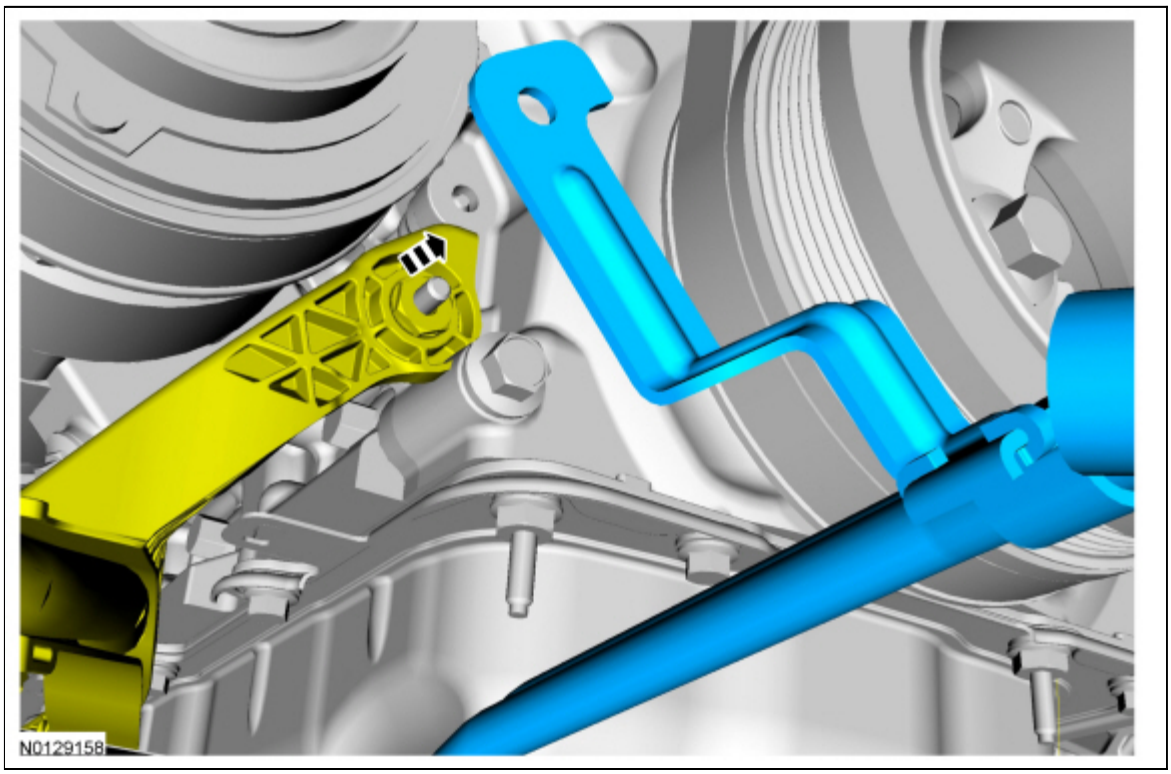
17. Remove the nut and disconnect the starter motor ground cable eyelet.



18. Detach the starter wiring harness from the oil pan.



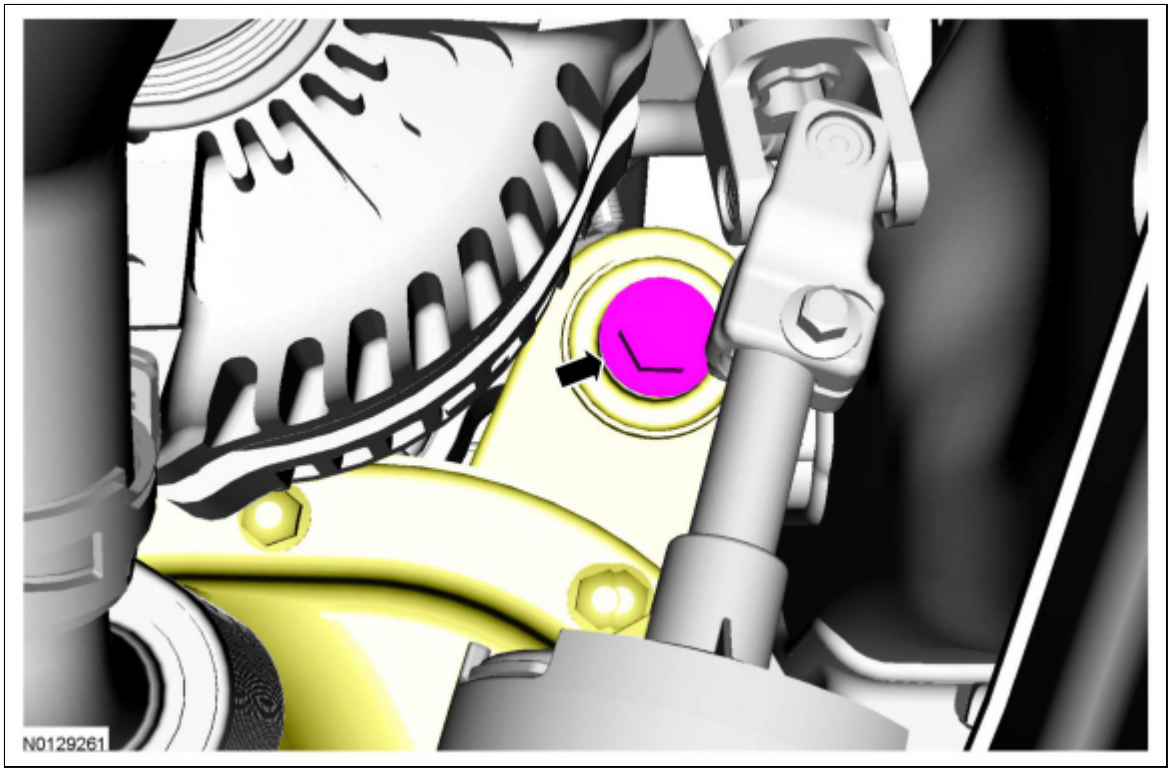
19. Remove the starter wiring harness form the front engine cover stud and position the starter wiring harness aside.



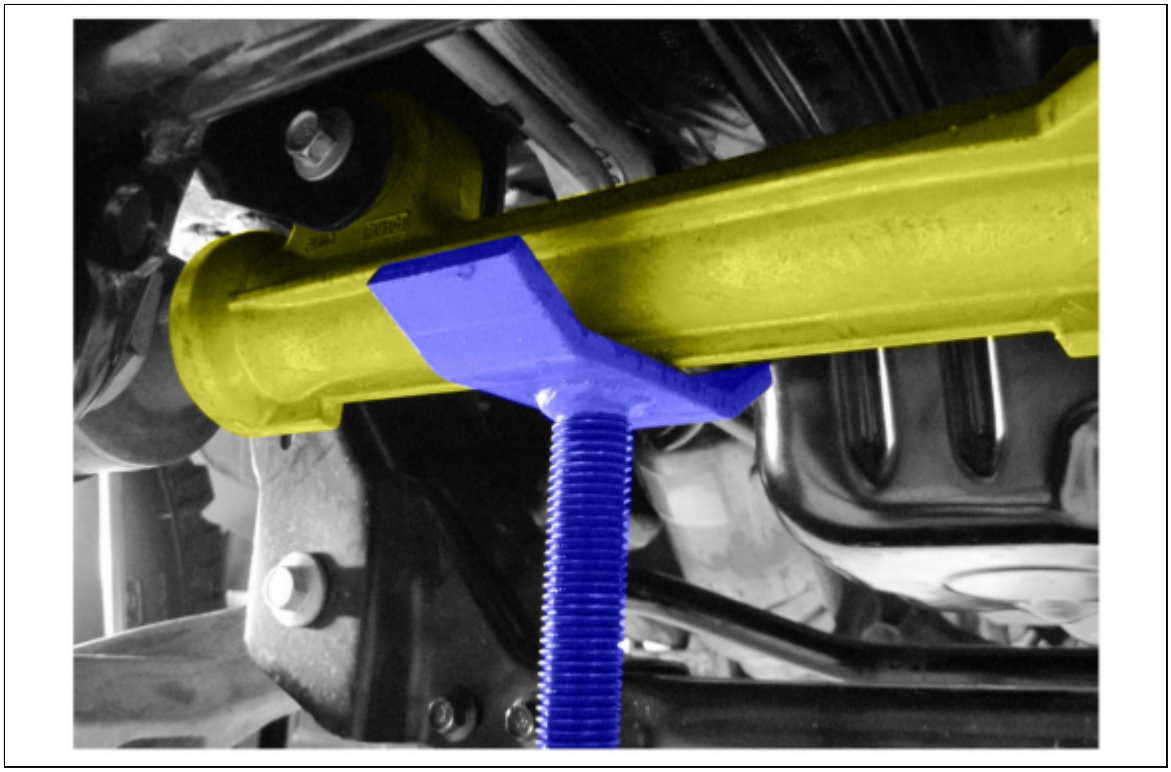
20. **NOTE:** Rotate the steering column so that the pinch bolt for the steering column coupler allows clearance for the upper front axle carrier mounting bushing bolt.

repair4less

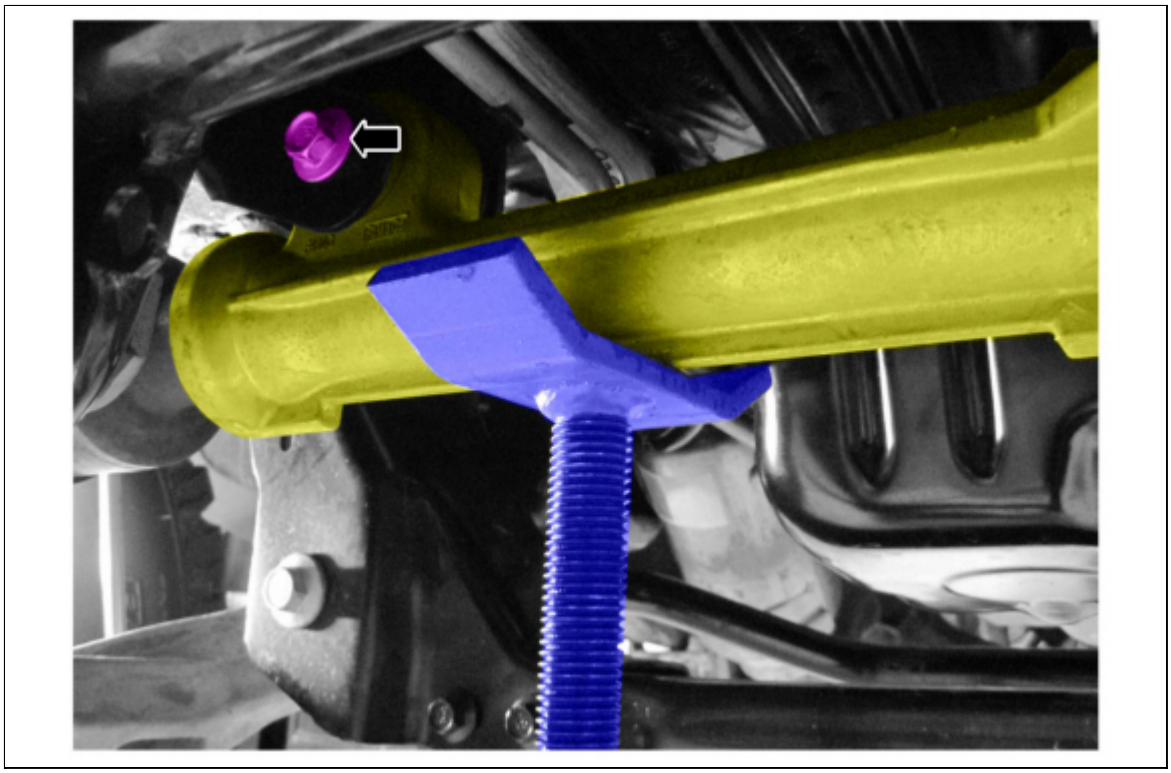
Remove the upper front axle carrier mounting bushing bolt.



21. Position a jack stand under the right side of the front axle.



22. Remove the axle shaft housing carrier bushing bolt.



23. Lower the right side of the front axle.

All vehicles

24. Remove the transmission fluid cooler tubes.

Installation

All vehicles

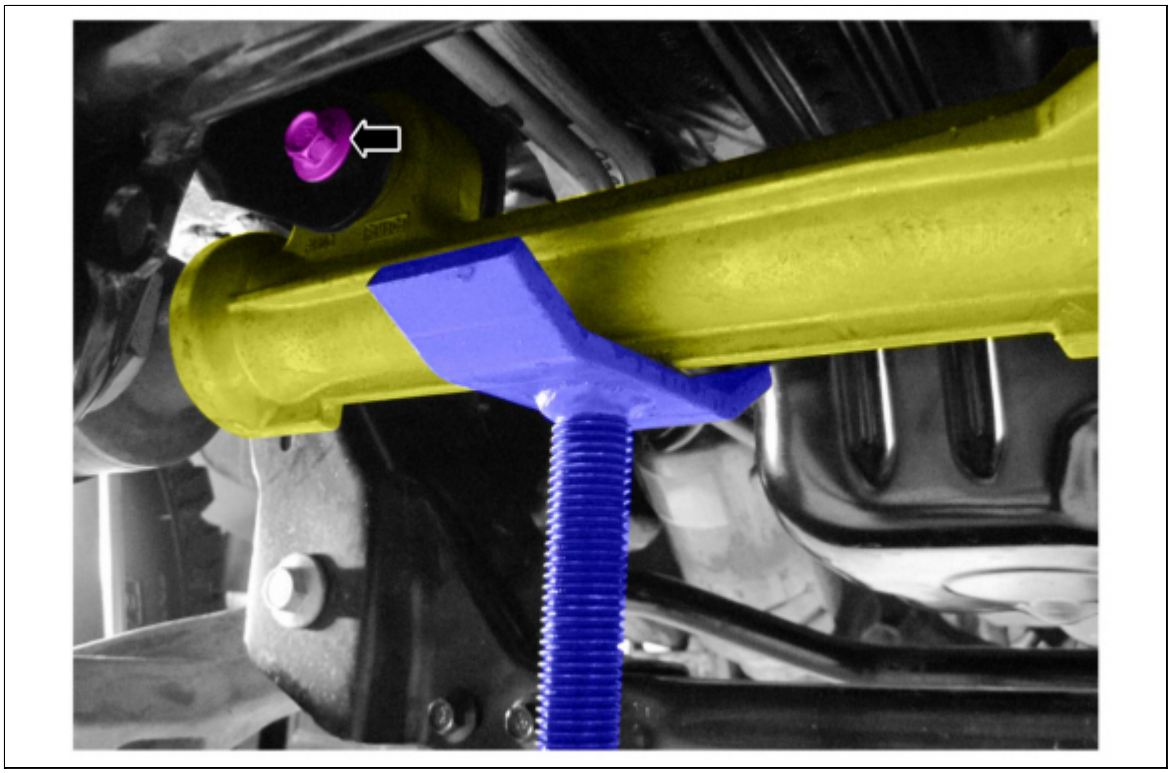
1. Route the transmission fluid cooler tubes and position them in place.

4WD

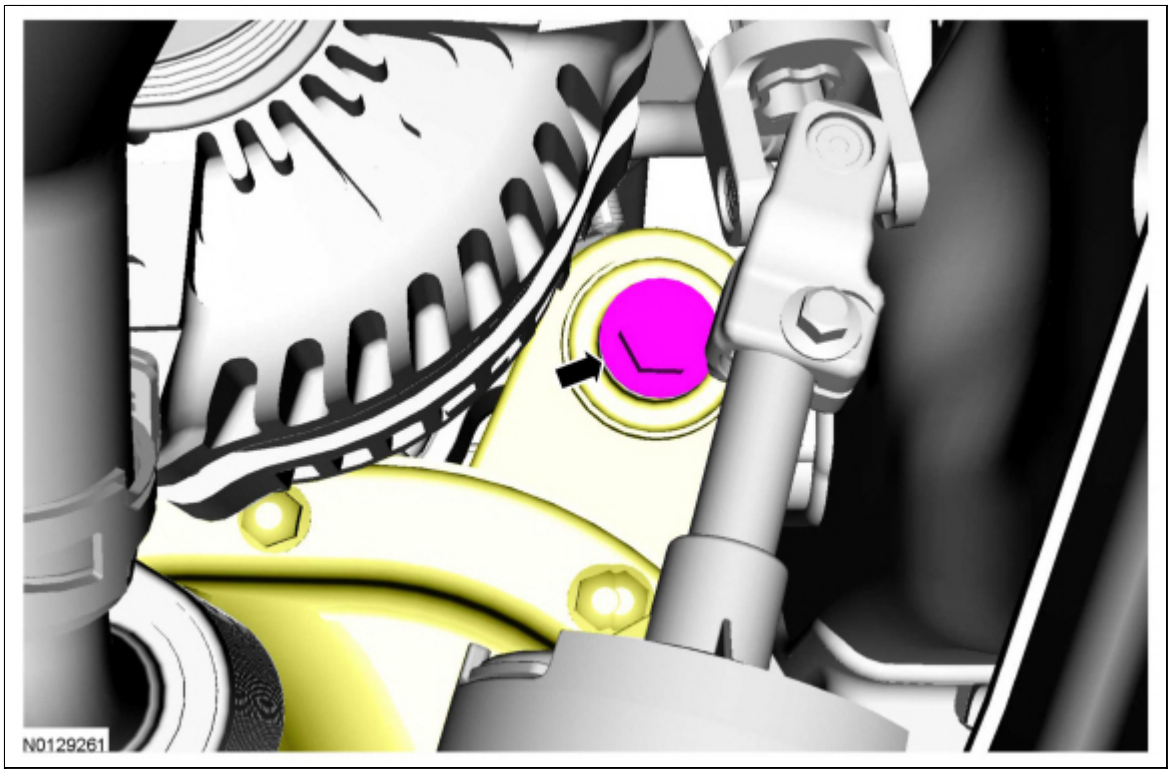
2. Raise the right side of the front axle.

3. Install the axle shaft housing carrier bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).

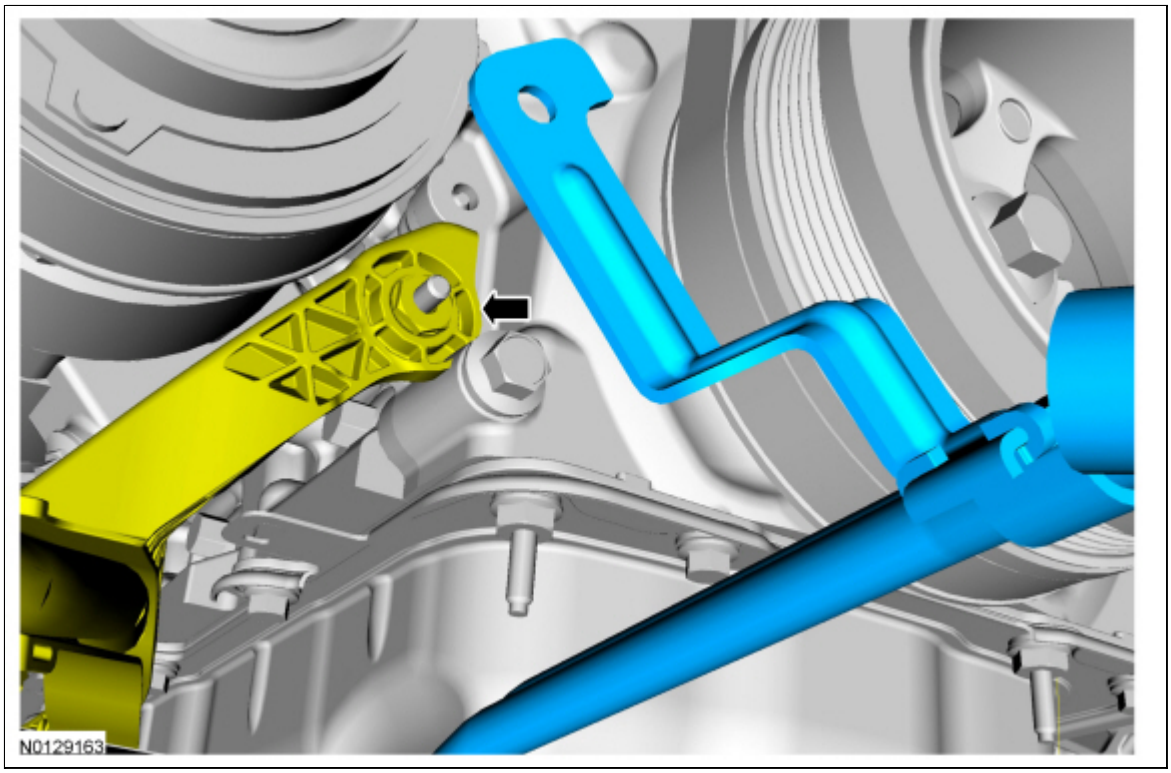
repair4less



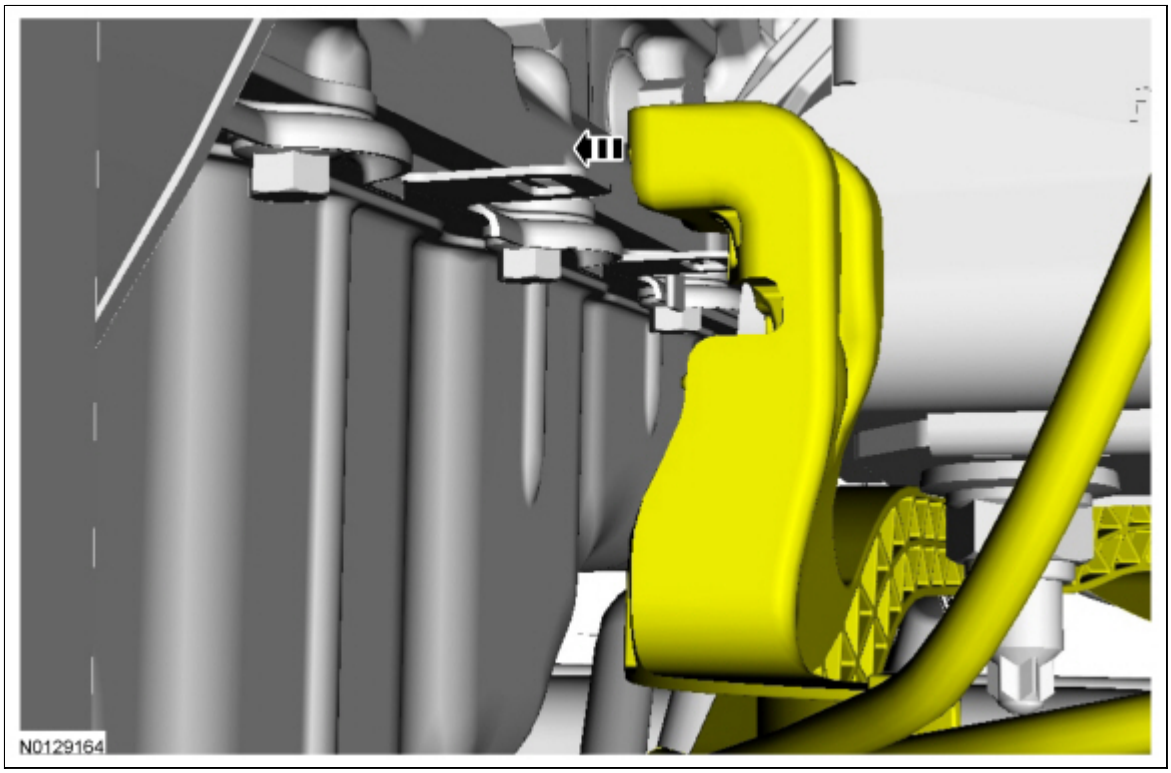
4. Install the upper front axle carrier mounting bushing bolt.
    - Tighten to 115 Nm (85 lb-ft).



5. Position the starter wiring harness to the front of the engine cover stud.

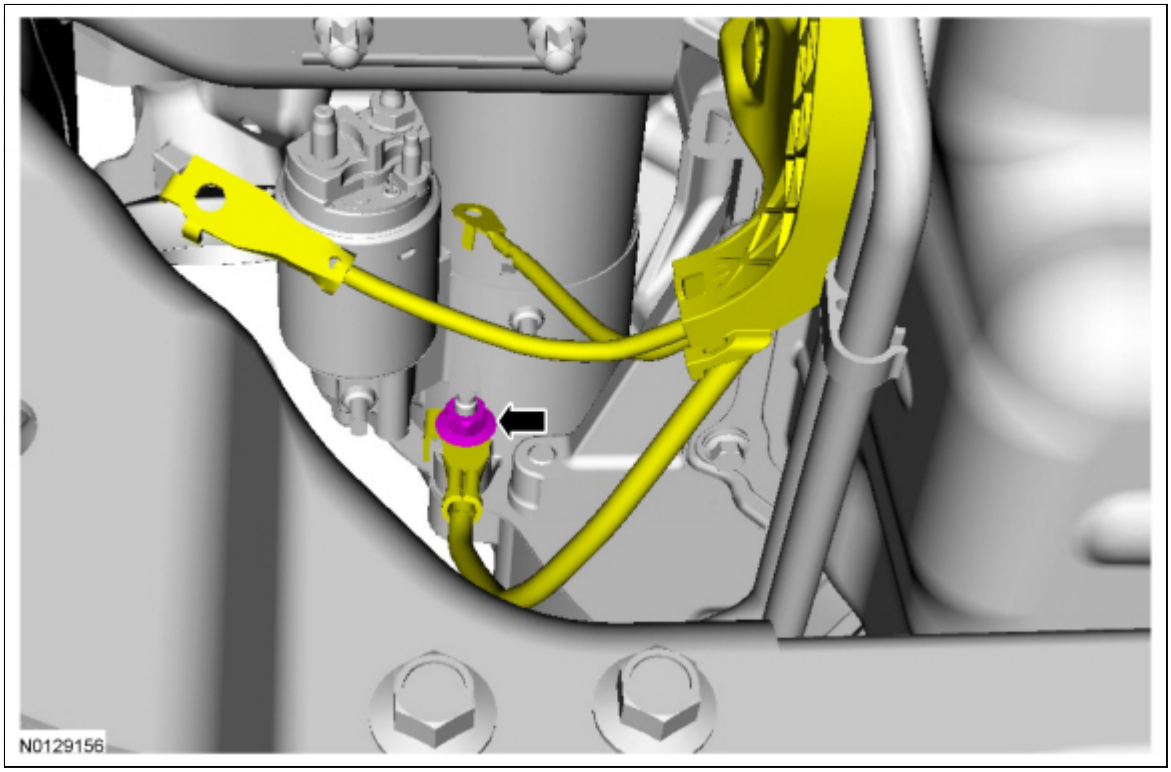


6. Attach the starter wiring harness to the oil pan.

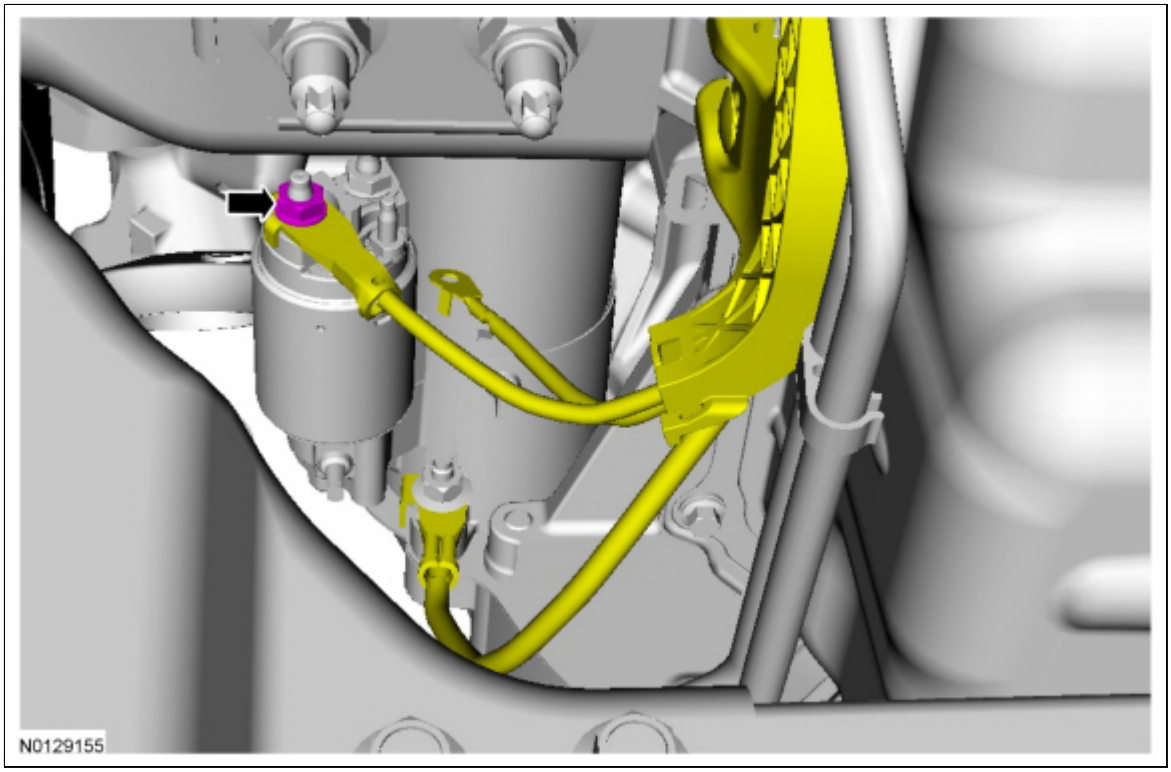


7. Connect the starter motor ground cable eyelet and install the nut.
   - Tighten to 25 Nm (18 lb-ft).

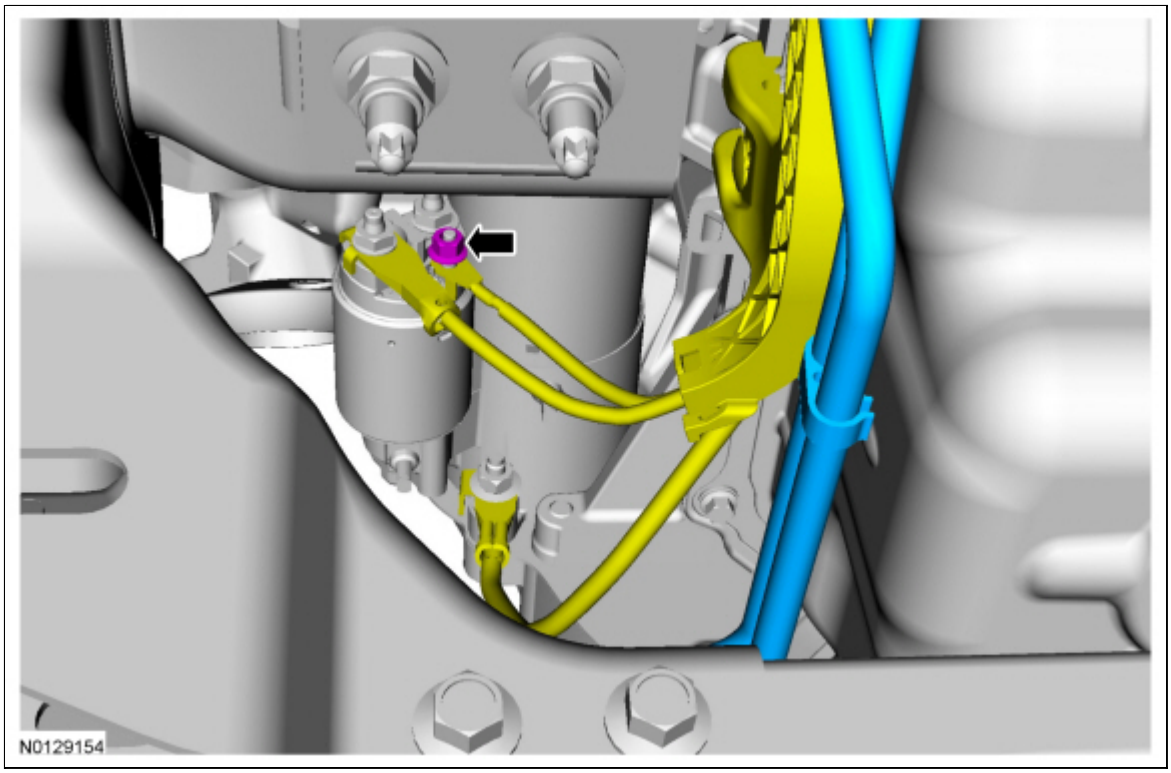
repair4less



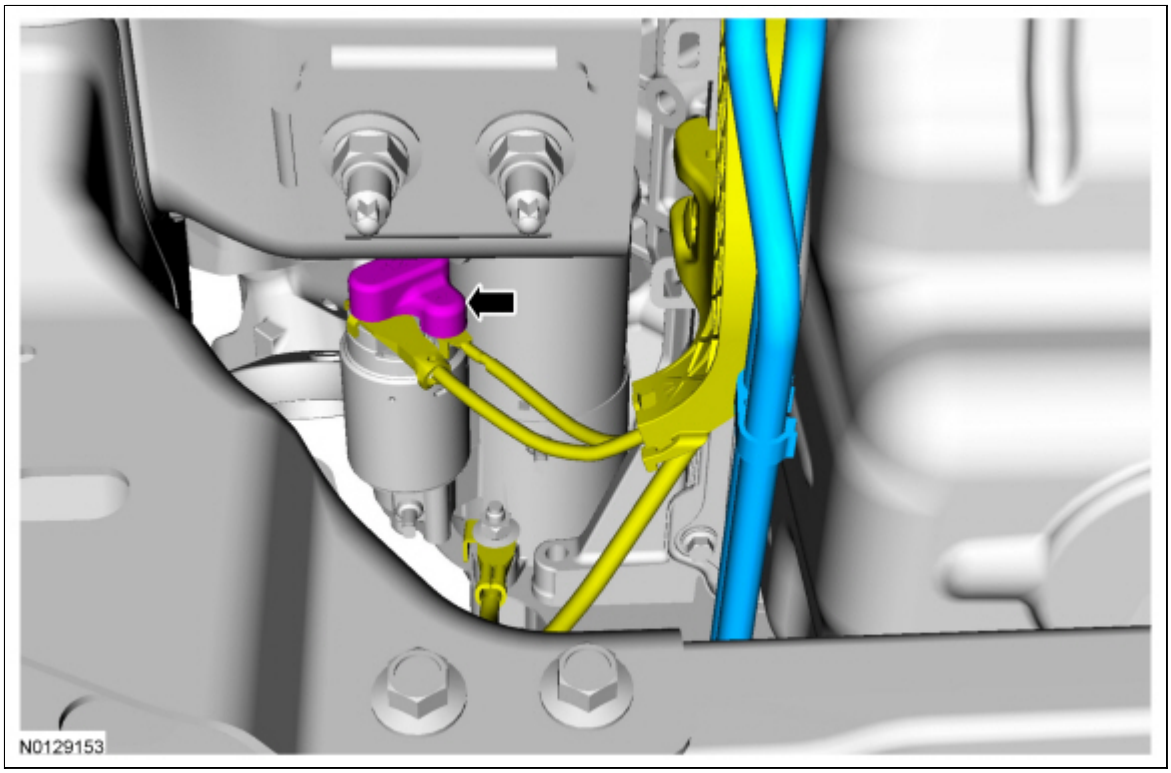
8. Connect the starter solenoid B-terminal eyelet and install the nut.
    - Tighten to 12 Nm (106 lb-in).



9. Connect the starter solenoid S-terminal eyelet and install the nut.
    - Tighten to 5 Nm (44 lb-in).



10. Install the terminal cover.

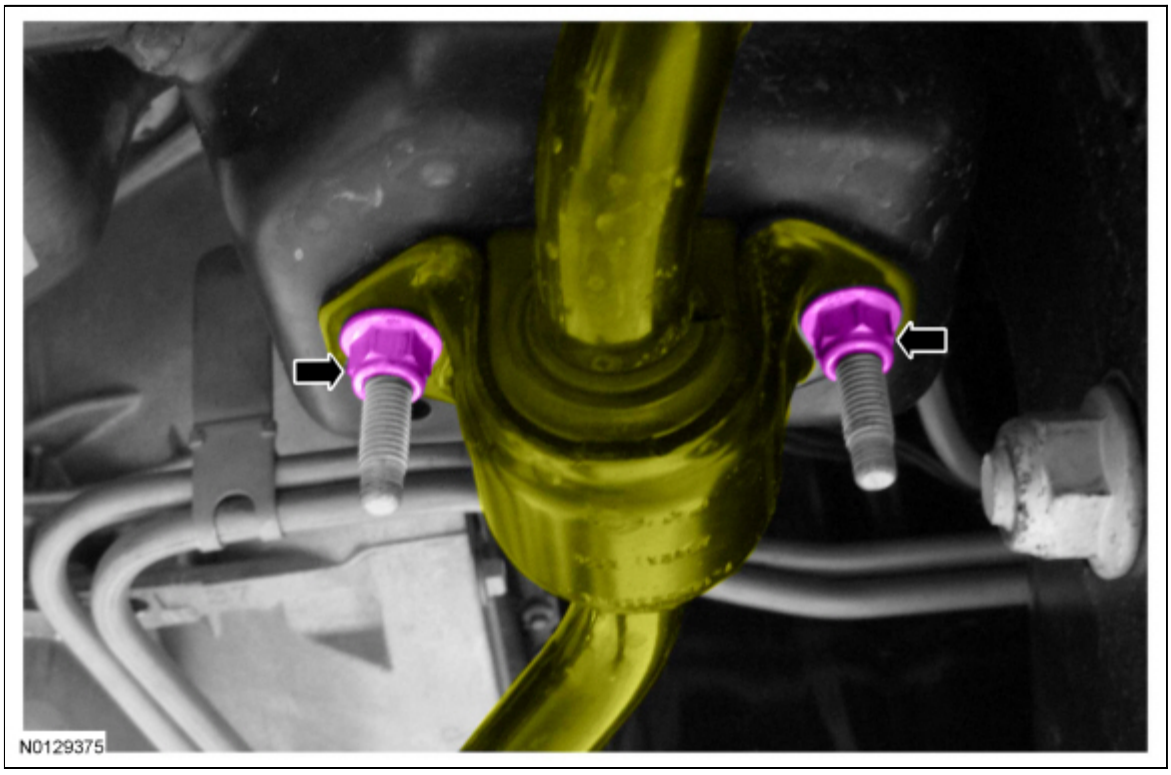


All vehicles

NOTE: Right side shown, left side similar.

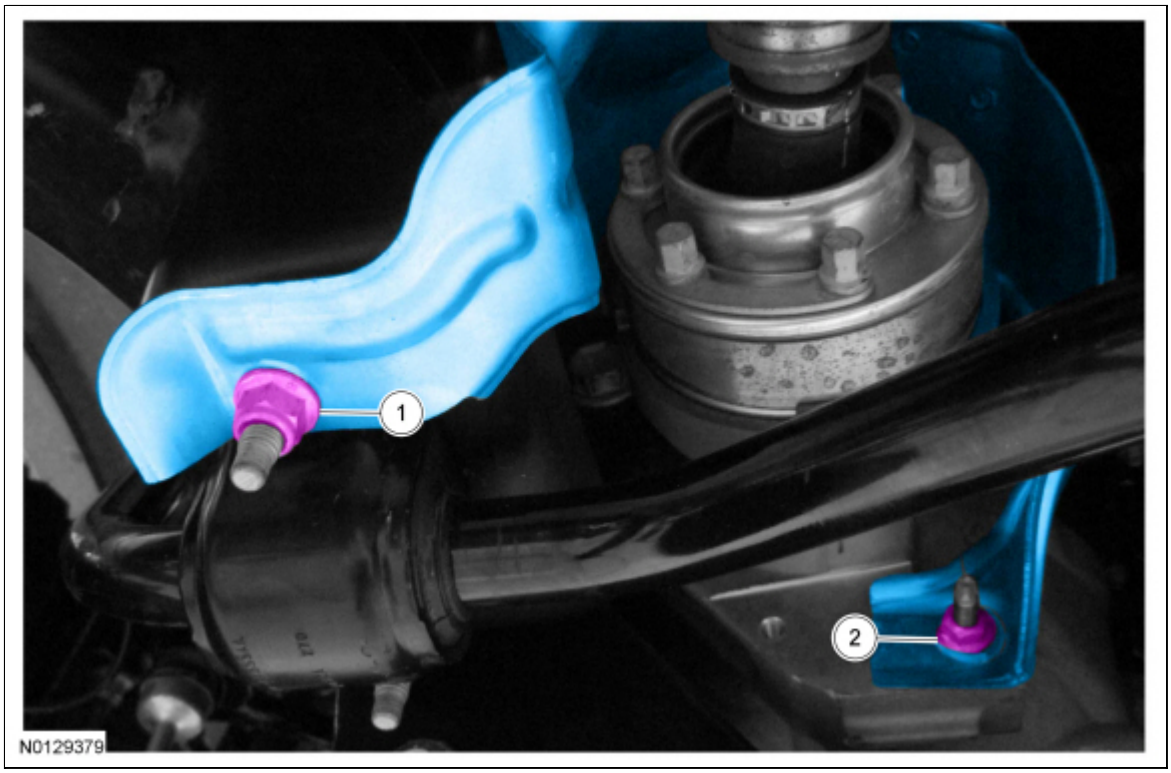
repair4less

11. Position the sway bar in place and install 4 new nuts.
    - Tighten to 55 Nm (41 lb-ft).



Raptor

12. Install the heat shield and the 2 nuts.
    1. Tighten to 48 Nm (35 lb-ft).
    2. Tighten to 23 Nm (17 lb-ft).

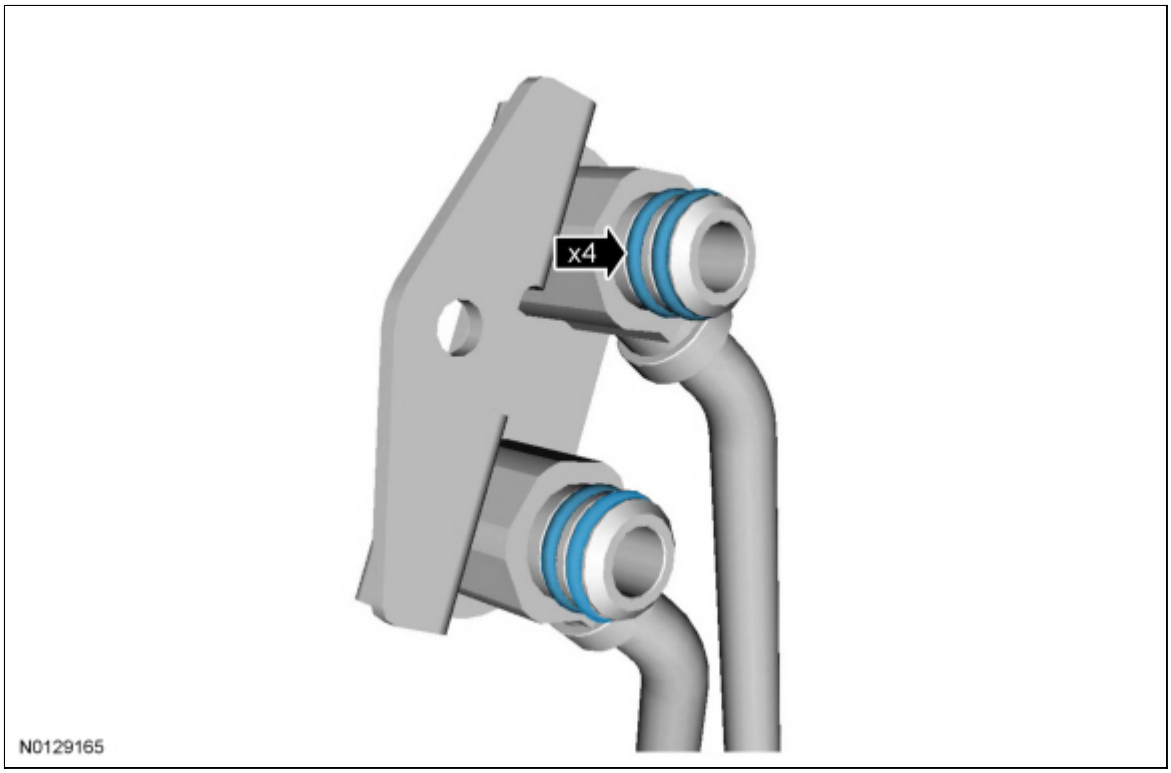


All vehicles

13. **NOTE:** Inspect the transmission case to make sure that the transmission fluid cooler tube O-rings did not remain in the transmission case. Carefully remove and discard them from the case if retained.

    Install 4 new O-rings on the transmission fluid cooler tubes.

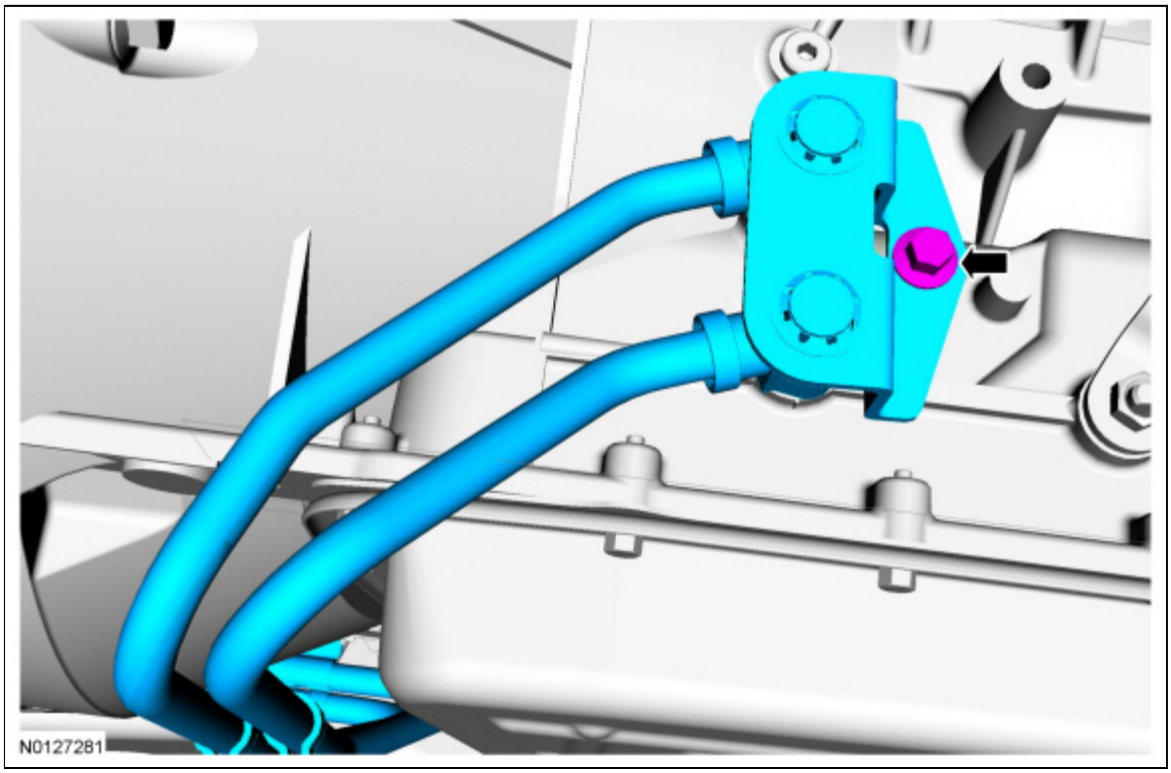
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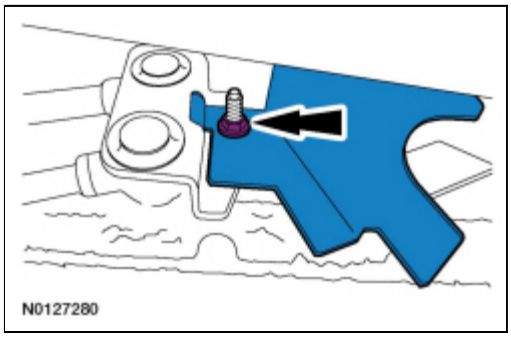
14. ***NOTICE:*** **Install a new transmission fluid cooler tubes-to-transmission bolt.**

    Install the transmission fluid cooler tubes and a new transmission fluid cooler tubes-to-transmission bolt.

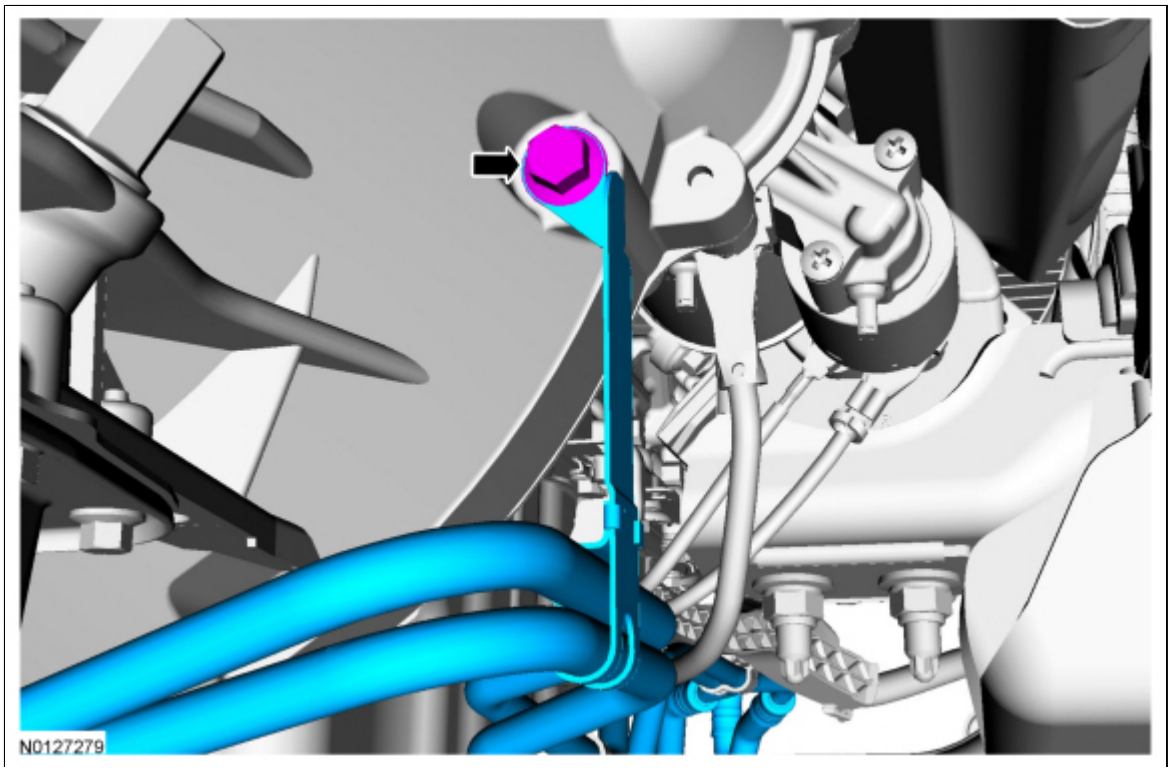
    - Tighten to 30 Nm (22 lb-ft).



15. If equipped, install the selector lever cable splash shield and the nut.
    - Tighten to 12 Nm (106 lb-in).



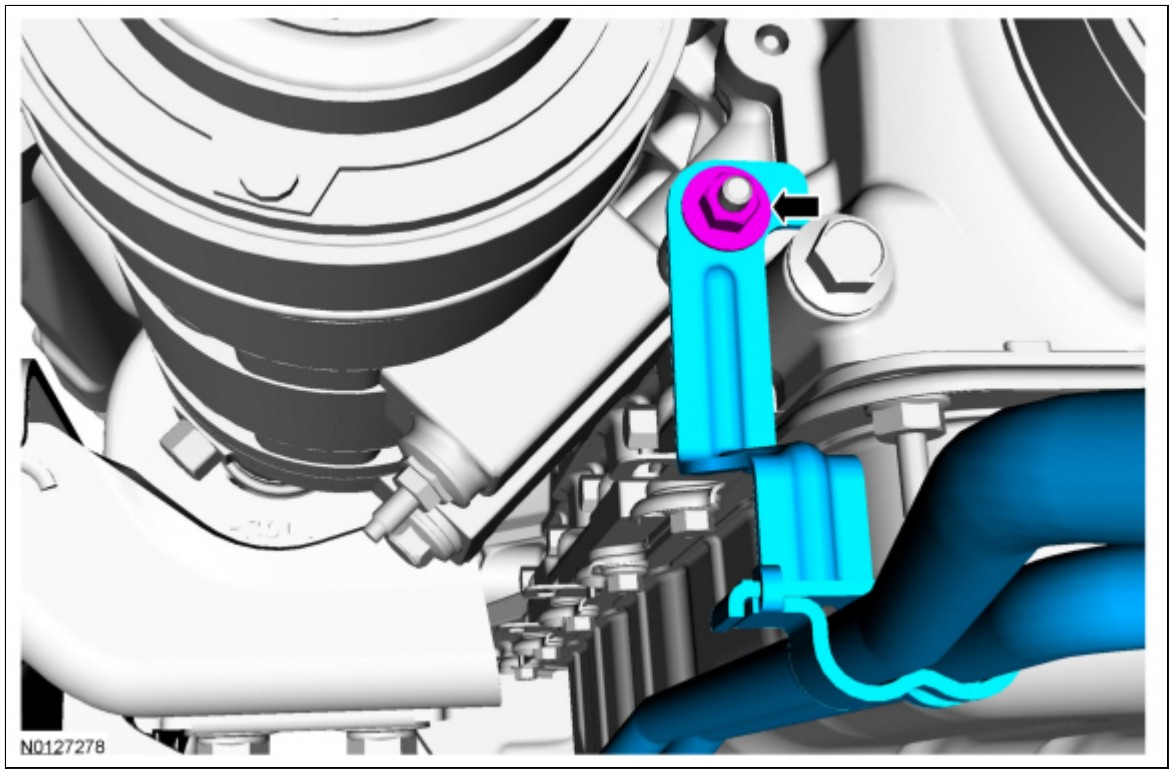
16. Install the transmission fluid cooler tube bracket and the transmission-to-engine bolt.
    - Tighten to 48 Nm (35 lb-ft).



5.0L (4V)

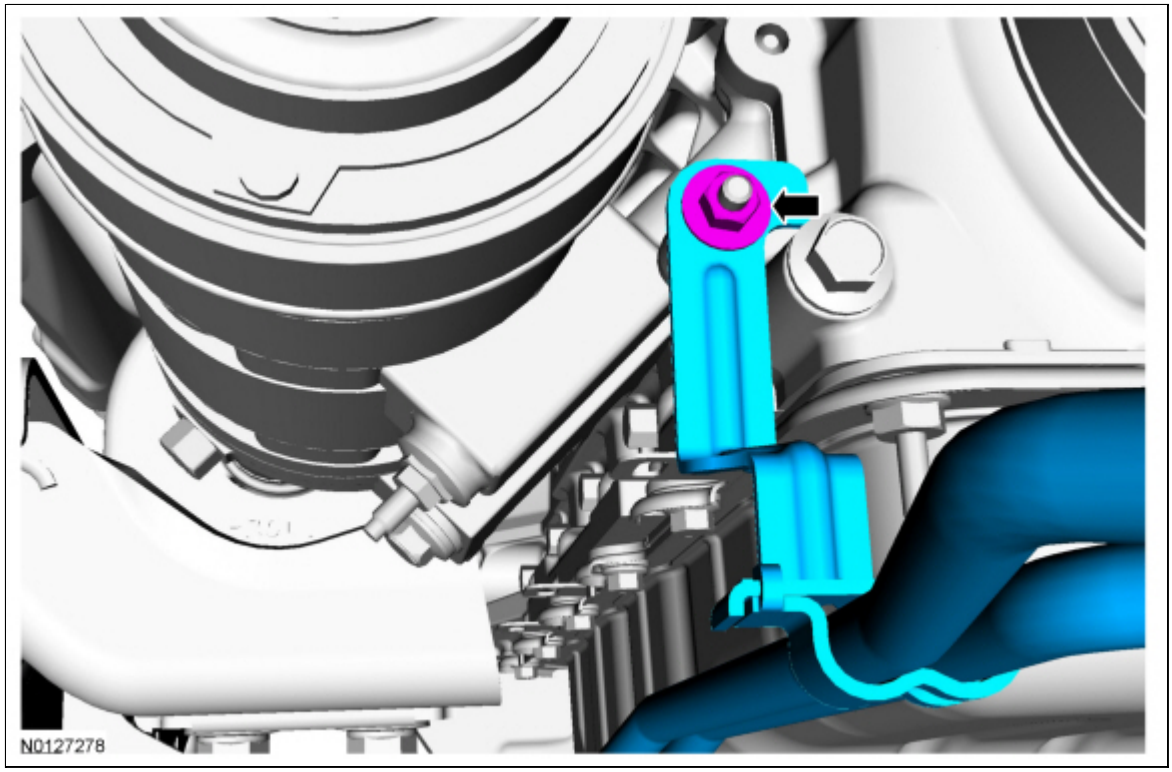
17. Install the transmission fluid cooler tube bracket and the nut to the front of the engine.
    - Tighten to 12 Nm (106 lb-in).

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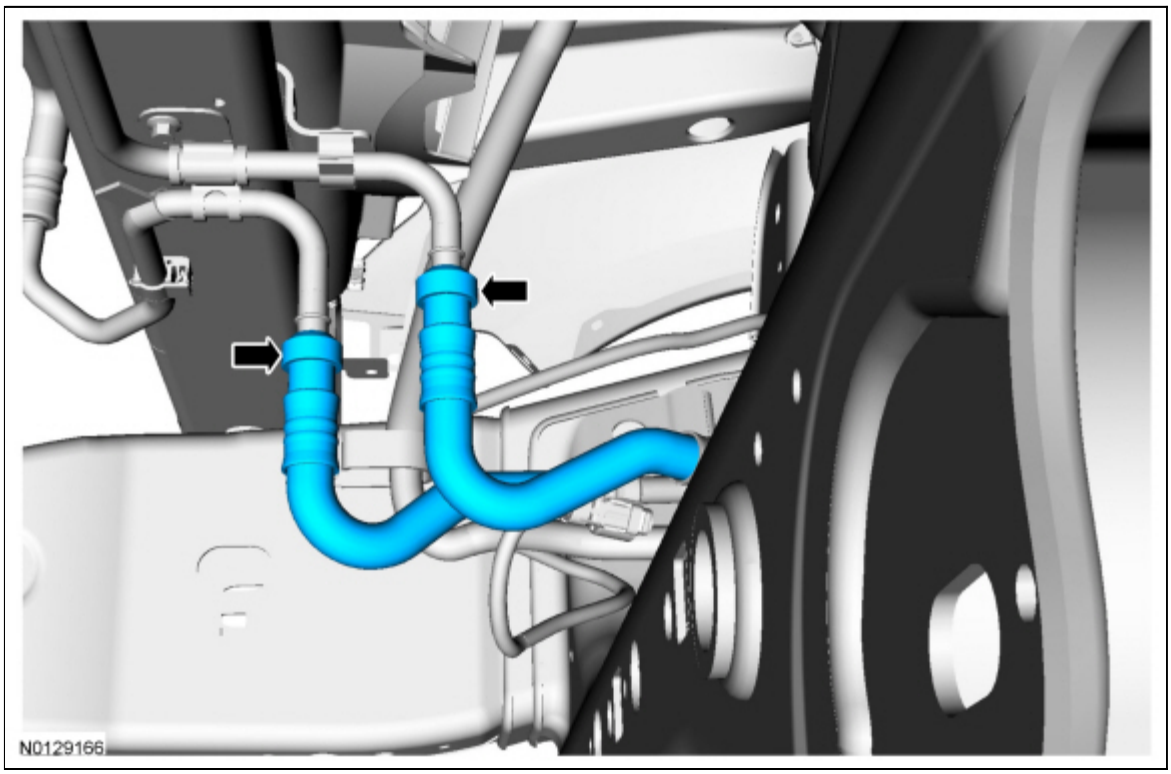
6.2L (2V)

18. Install the transmission fluid cooler tube bracket and the nut to the front of the engine.
    - Tighten to 40 Nm (30 lb-ft).

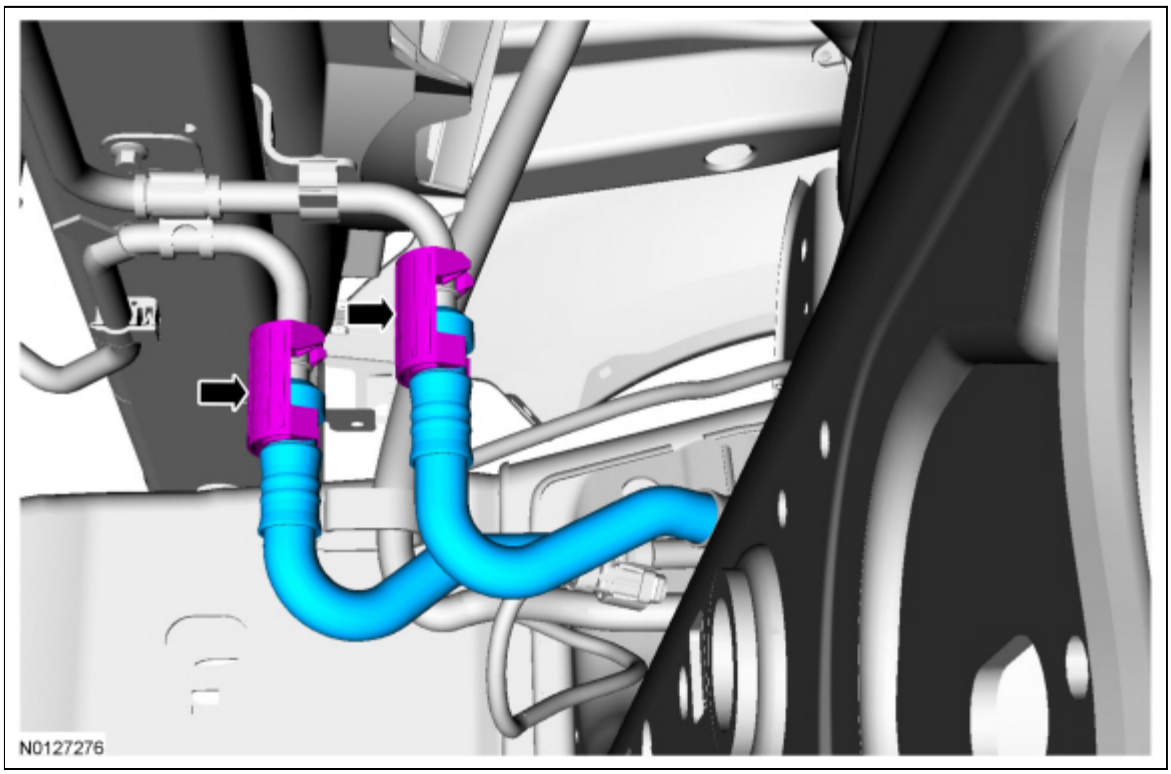


All vehicles

19. Connect the transmission fluid cooler tubes to the transmission fluid cooler hoses.



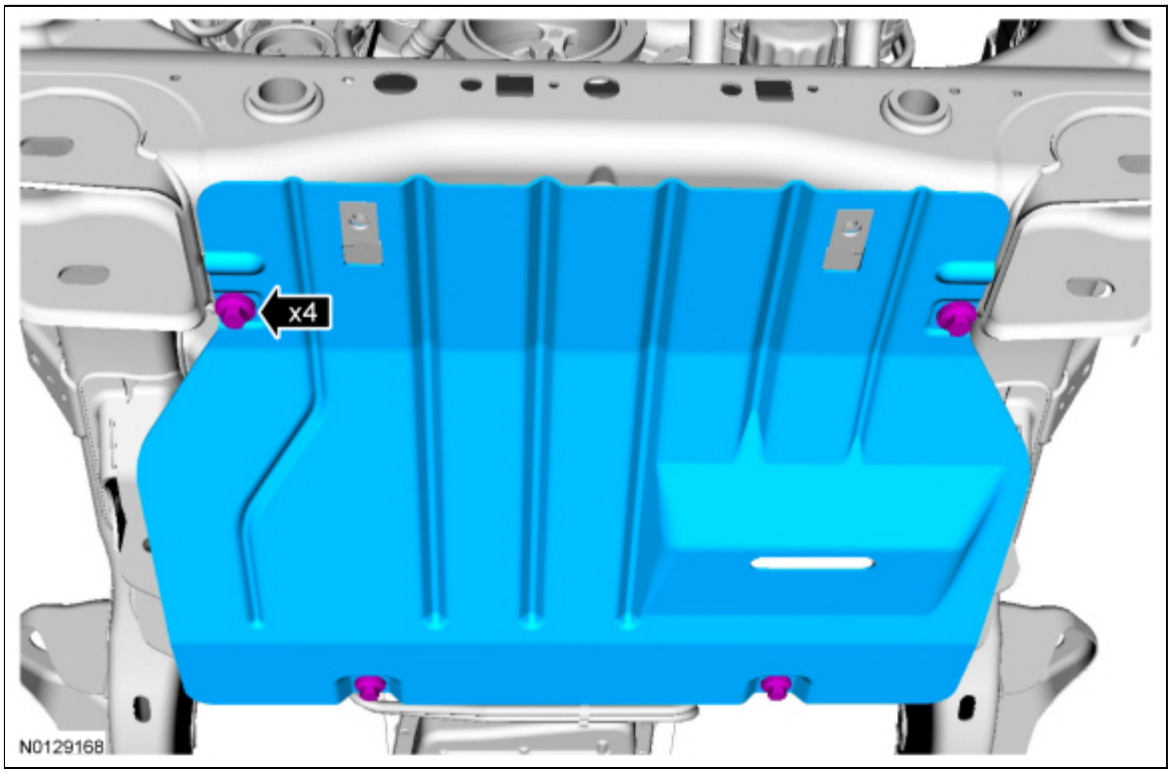
20. Install the transmission fluid cooler tube secondary latches.



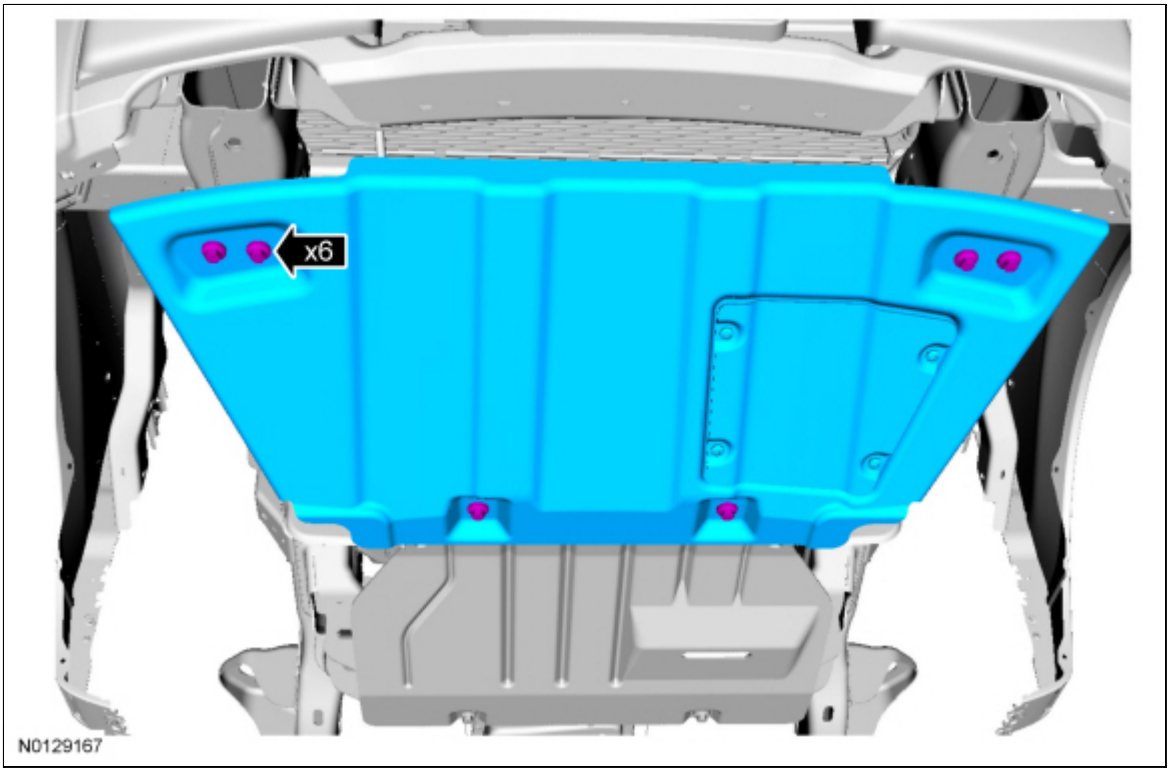
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4WD

21. Install the rearward skid plate and the 4 bolts.
    - Tighten to 48 Nm (35 lb-ft).



22. If equipped, install the forward skid plate and the 6 bolts.
    - Tighten to 48 Nm (35 lb-ft).



23. Connect the battery ground cable. For additional information, refer to Section 414-01 .

All vehicles

24. Fill the transmission with fluid and verify correct operation. For additional information, refer to Transmission Fluid Level Check in Section 307-01 .

25. Check for leaks.

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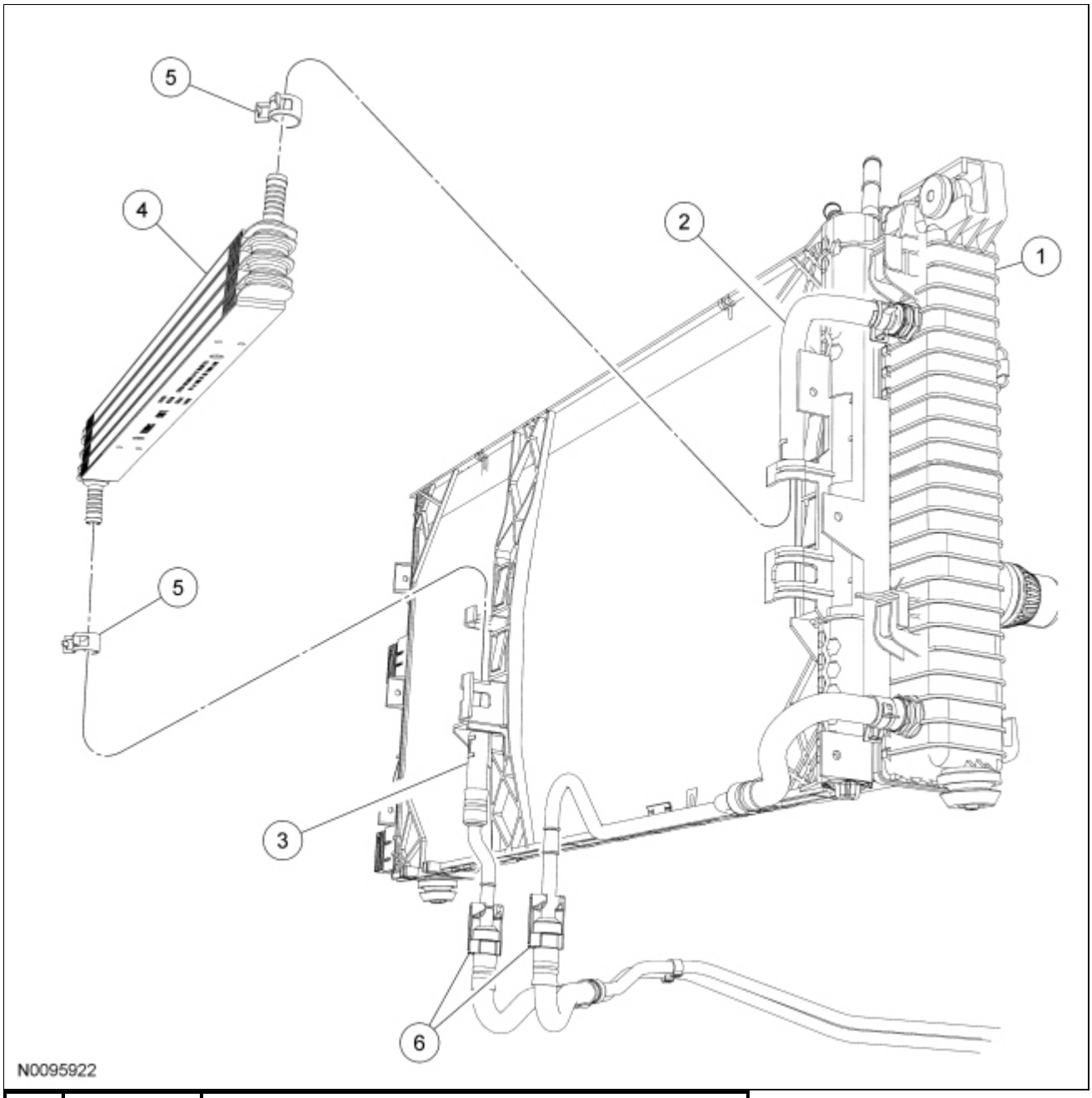
Transmission Fluid Cooler

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

Transmission Cooling

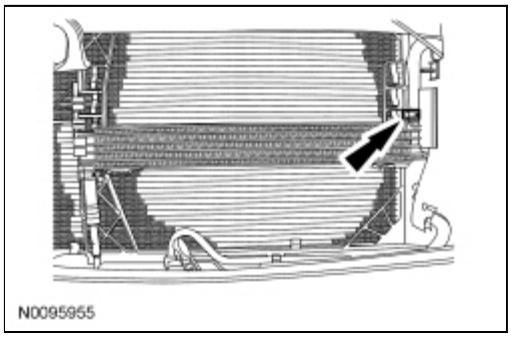
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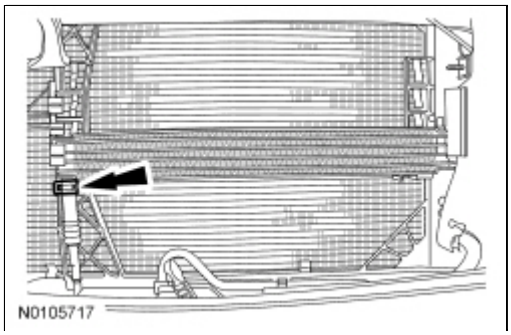
Item	Part Number	Description
1	8005	Radiator
2	7C410	In-tank transmission fluid cooler outlet hose
3	7B028	Auxiliary transmission fluid cooler outlet hose
4	7A095	Auxiliary transmission fluid cooler
5	7C107	Clamps
6	7Z465	Transmission fluid cooler inlet and outlet tube secondary latches

Removal

1. Remove the transmission fluid cooler inlet hose from the transmission fluid cooler.
    - Discard the clamp.



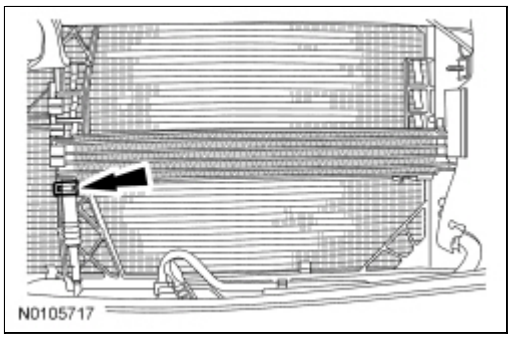
2. Remove the transmission fluid cooler outlet hose from the transmission fluid cooler.
    - Discard the clamp.



3. Remove the transmission fluid cooler.

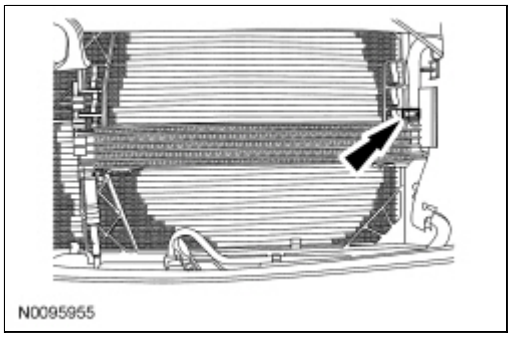
Installation

1. Install the transmission fluid cooler.
2. Install a new transmission fluid cooler outlet hose clamp.
3. Install the transmission fluid cooler outlet hose to the transmission fluid cooler.



4. Install a new transmission fluid cooler inlet hose clamp.
5. Install the transmission fluid cooler inlet hose to the transmission fluid cooler.

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6. Fill the transmission with transmission fluid. For additional information, refer to Transmission Fluid Level Check in Section 307-01 .

7. Check for leaks.

Torque Specifications

Description	Nm	lb-ft	lb-in
Selector lever bolt (column shift)	18	—	159
Selector lever mechanism (column shift)	10	—	89
Selector lever cable bracket bolts	25	18	—
Selector lever assembly bolts (floor shift)	8	—	71

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External Controls — Column Shift

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical

• Damaged Brake Shift Interlock Actuator (BSIA)
• Damaged Tow/Haul switch
• Damaged SelectShift™ switch
	• Failed fuse(s):
	  ▪ Body Control Module (BCM) 18 (10A)
	  ▪ BCM 42 (5A)
	• PCM
	• Loose or damaged connections
	• Damaged wiring harness
	• Corroded or damaged terminals

3. If the fault is not visually evident, determine the symptom. GO to Symptom Chart - External Controls, Column Shift or GO to Symptom Chart - NVH Column Shift .

DTC Chart

DTC Chart

DTC	Component	Description	Condition	Symptom	Action
B1319:11	Brake Shift Interlock	Shift Interlock (BSI) Output Circuit: Circuit	BSIA system malfunction	BSIA inoperative.	GO to Pinpoint

	Actuator (BSIA), BCM	short to ground			Test A .
B1319:15	Brake Shift Interlock Actuator (BSIA), BCM	Shift Interlock (BSI) Output Circuit: Circuit short to voltage or open	BSIA system malfunction	BSIA inoperative.	GO to Pinpoint Test A .
P0815	Upshift Switch Circuit	Upshift switch concerns, open or shorted circuit	The PCM signal input voltage status is out of range	Upshift switch inoperative.	GO to Pinpoint Test D .
P0816	Downshift Switch Circuit	Downshift switch concerns, open or shorted circuit	The PCM signal input voltage status is out of range	Downshift switch inoperative.	GO to Pinpoint Test D .
P1780	Tow/Haul Switch	Transmission Control Switch (TCS) (Overdrive (O/D) cancel) circuit out of self-test range	The PCM did not receive a Tow/Haul switch input during the Key ON Engine Running (KOER) self-test	Tow/Haul is inoperative or does not operate correctly.	GO to Pinpoint Test C .

Symptom Chart — External Controls, Column Shift

Symptom Chart — External Controls, Column Shift

Condition	Possible Sources	Action
• The Brake Shift Interlock Actuator (BSIA) system does not release/lock correctly	• Circuitry • Fuse(s): ▪ Body Control Module (BCM) 18 (10A) • BSIA	• GO to Pinpoint Test A .
	• Selector lever cable	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Column Shift in this section.
• Transmission Range (TR) indicator (PRNDL) does not correspond to the selected gear	• Selector lever cable bracket	• TIGHTEN bolts holding the selector lever cable bracket. REFER to Selector Lever Cable Adjustment — Column Shift in this section.
	• Instrument Panel Cluster (IPC) malfunction	• REFER to Section 413-01 .
	• Selector lever cable loose in the selector lever cable bracket	• VERIFY cable is fully seated in the selector lever cable bracket. REFER to Selector Lever Cable — Column Shift in this section.
	• Selector lever cable	• VERIFY selector lever cable

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		adjustment. REFER to Selector Lever Cable Adjustment — Column Shift in this section.
	• Clip securing the selector lever cable to the steering column bracket	• INSTALL clip correctly. REFER to Selector Lever Cable — Column Shift in this section.
• TR indicator (PRNDL) does not illuminate	• IPC malfunction	• REFER to Section 413-00 .
	• TR sensor	• CHECK for TR sensor DTCs. REFER to Section 307-01 .
• The Tow/Haul switch does not operate correctly	• Tow/Haul switch • Tow/Haul switch not cycled during self-test • Circuitry	• GO to Pinpoint Test C
• The Tow/Haul indicator lamp is not operating correctly	• IPC • PCM • Circuitry	• REFER to Section 413-01 .
• The SelectShift™ switch is not operating correctly	• SelectShift™ switch • PCM • Circuitry	• GO to Pinpoint Test D .
• Water enters inside the vehicle	• Cable assembly grommet	• SECURE grommet to floor panel. REFER to Selector Lever Cable — Column Shift in this section.
	• Torn selector lever cable assembly grommet	• INSTALL a new selector lever cable. REFER to Selector Lever Cable — Column Shift in this section.
• Excessive shift effort	• Selector lever cable	• INSTALL a new selector lever cable. REFER to Selector Lever Cable — Column Shift in this section.
	• Cable bracket	• ADJUST cable. REFER to Selector Lever Cable Adjustment — Column Shift in this section. TIGHTEN cable bracket screws. REFER to Specifications in this section.
• Selector lever will not shift from PARK	• Selector lever cable	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Column Shift in this section.
	• Column bracket clip	• INSTALL a new bracket clip. REFER to Selector Lever Cable — Column Shift in this section.
	• Broken selector lever cable	• INSTALL a new selector lever cable. REFER to Selector

		Lever Cable — Column Shift in this section. • Brake Shift Interlock Actuator (BSIA) system failure • GO to Pinpoint Test A .
• Vehicle will not crank/start in park but will crank/start in neutral	• Selector lever cable • TR sensor	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Column Shift in this section. • CHECK for TR sensor DTCs. REFER to Section 307-01 .

Symptom Chart — NVH Column Shift

Symptom Chart — NVH Column Shift

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Vibration — a high frequency (20-80 Hz) that is felt through the seat or selector lever. Changes with engine speed	• Selector lever cable incorrectly routed, grounded out or loose	• CHECK the selector lever cable. REPAIR as necessary. REFER to Selector Lever Cable — Column Shift in this section.
• Rattle, buzz or other noise	• Selector lever loose • Selector lever • Cable assembly grommet	• TIGHTEN the selector lever bolts. REFER to Selector Lever — Column Shift in this section. • INSTALL a new selector lever. REFER to Selector Lever — Column Shift in this section. • SECURE the grommet to the floor panel. REFER to Selector Lever Cable — Column Shift in this section.

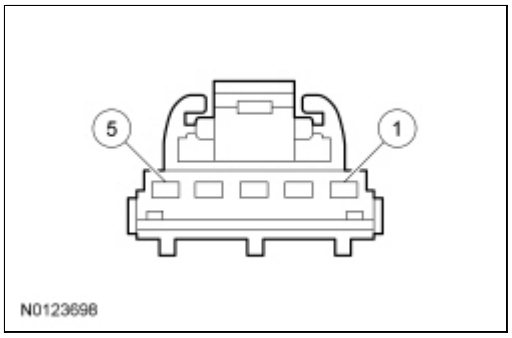
Pinpoint Tests

Refer to Wiring Diagrams Cell 30 , Transmission Controls for schematic and connector information.

Refer to Wiring Diagrams Cell 37 , Shift Interlock for schematic and connector information.

Tow/Haul Connector — C2399

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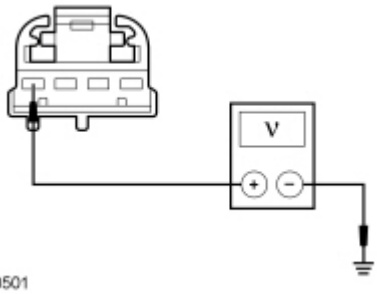
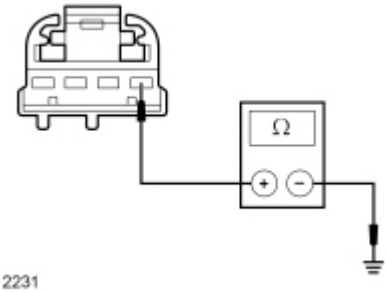
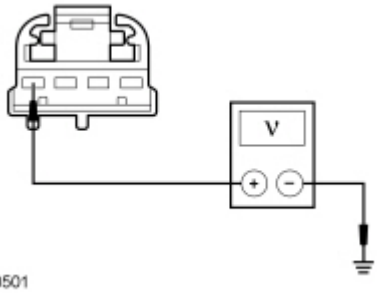


Pin Number	Circuit Function
1	Tow/Haul Power
2	Tow/Haul Signal
3	SelectShift™ Upshift
4	SelectShift™ Ground
5	SelectShift™ Downshift

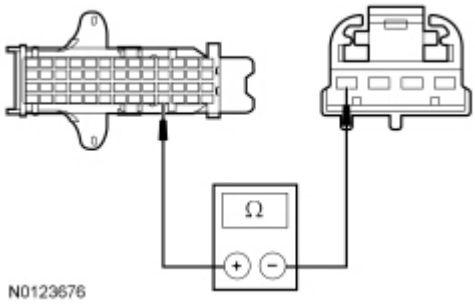
PINPOINT TEST A: THE BSIA SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

NOTE: Inspect the selector lever cable before proceeding with this pinpoint test.

Test Step	Result / Action to Take
A1 CHECK THE STOPLAMPS	
• Apply the brake pedal and observe the stoplamps. • **Do the stoplamps illuminate?**	**Yes** VERIFY the BCM fuse 18 (10A) is OK, If OK GO to A2. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. **No** REFER to Section 417-01.
A2 CHECK THE BSIA OUTPUT CIRCUIT	
• Disconnect: Brake Shift Interlock Actuator (BSIA) C2008. • Ignition ON. • Measure the voltage between the BSIA C2008-4, circuit CET53 (BU/OG), harness side and ground.	**Yes** GO to A3. **No** If the voltage was greater than 10 volts with the brake pedal applied or not applied, GO to A4. Otherwise, GO to A5.

 N0130501 • Depress the brake pedal. • With the brake pedal depressed, measure the voltage between the BSIA C2008-4, circuit CET53 (BU/OG), harness side and ground. • **Is the voltage greater than 10 volts with the brake pedal applied and 0 volts with the brake pedal not applied?**	
A3 CHECK THE BSIA GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Measure the resistance between the BSIA C2008-1, circuit GD133 (BK), harness side and ground.  N0112231 • **Is the resistance less than 5 ohms?**	**Yes** REPLACE the BSIA . REFER to Brake Shift Interlock Actuator — Column Shift in this section. CLEAR the DTC. TEST the system for normal operation. **No** REPAIR circuit GD133 (BK) for an open. CLEAR the DTC. TEST the system for normal operation.
A4 CHECK THE BSIA OUTPUT CIRCUIT FOR A SHORT TO POWER • Ignition OFF. • Disconnect: BCM C2280B. • Inspect C2008 and C2280B for damaged, pushed-out terminals or loose wires. • Ignition ON. • Measure the voltage between the BSIA C2008-4, circuit CET53 (BU/OG), harness side and ground.  N0130501 • **Is any voltage present?**	**Yes** REPAIR circuit CET53 (BU/OG) for a short to power. CLEAR the DTC. TEST the system for normal operation. **No** GO to A5 .

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A5 CHECK THE BSIA POWER CIRCUIT FOR AN OPEN	
• Measure the resistance between the BSIA C2008-4, circuit CET53 (BU/OG) and BCM C2280B-49, CET53 (BU/OG) harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A6 . **No** REPAIR circuit CET53 (BU/OG) for an open. CLEAR the DTC. TEST the system for normal operation.
A6 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	REPLACE the BCM . REFER to Section 418-00 . CLEAR the DTC. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

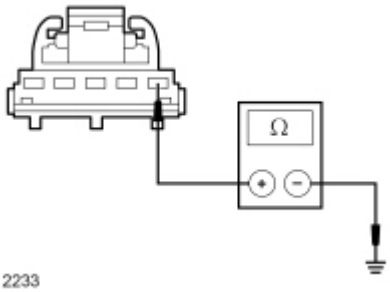
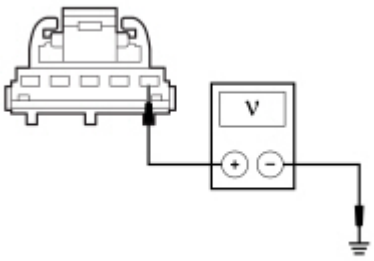
PINPOINT TEST C: THE TOW/HAUL SWITCH DOES NOT OPERATE CORRECTLY

NOTE: Vehicles equipped with a 3.7L engine use PCM C175T.

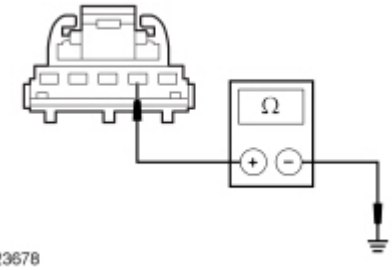
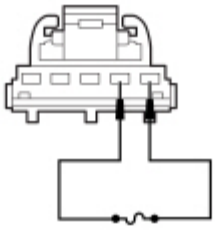
NOTE: Vehicles equipped with a 5.0L or 6.2L engine use PCM C1381T.

NOTE: Vehicles equipped with a 3.5L engine use PCM C1551B.

Test Step	Result / Action to Take
C1 CHECK DTCs	
• Ignition ON. • Connect the scan tool. • Start the engine and RUN the Key ON Engine Running (KOER) self-test. • **Is DTC P1780 set?**	**Yes** GO to C2 . **No** No trouble found with the Tow/Haul system. REFER to Section 413-01 if the Tow/Haul lamp does not illuminate.
C2 CHECK THE BCM FUSE 42 (5A)	
• Ignition OFF. • Remove Body Control Module (BCM) fuse 42 (5A). • Check fuse: BCM 42 (5A).	**Yes** GO to C4 . **No**

• **Is the resistance less than 5 ohms?**	GO to C3 .
C3 CHECK THE TOW/HAUL POWER CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: Tow/Haul C2399. • Disconnect: BCM C2280B. • Inspect C2399 and C2280B for damaged, pushed-out terminals or loose wires. • Measure the resistance between the Tow/Haul C2399-1, circuit CBP42 (GN), harness side and ground.  N0112233 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C4 . **No** REPAIR circuit CBP42 (GN) for a short to ground. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation.
C4 CHECK THE TOW/HAUL POWER CIRCUIT FOR VOLTAGE	
• Disconnect: Tow/Haul C2399. • Inspect C2399 for damaged, pushed-out terminals or loose wires. • Ignition ON. • Measure the voltage between the Tow/Haul switch C2399-1, circuit CBP42 (GN), harness side and ground.  N0123677 • **Is the voltage greater than 10 volts?**	**Yes** GO to C5 . **No** REPAIR circuit CBP42 (GN) for an open. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation.
C5 CHECK THE TOW/HAUL INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: PCM C175T. • Disconnect: PCM C1381T. • Disconnect: PCM C1551B. • Inspect the connector for damaged, pushed-out terminals, corrosion or loose wires. • Measure the resistance between Tow/Haul switch C2399-2, circuit CET34 (BN/GN) and ground.	**Yes** GO to C6 . **No** REPAIR circuit CET34 (BN/GN) for a short to ground. REPLACE the BCM 42 (5A). CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation.

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 N0123678 • **Is the resistance greater than 10,000 ohms?**	
C6 CHECK THE TOW/HAUL INPUT CIRCUIT FOR AN OPEN	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: TCS_DEPRES. • Connect a fused jumper from Tow/Haul switch, C2399-1 to C2399-2, harness side.  N0123679 • **Does the TCS_DEPRES PID display YES?**	**Yes** REPLACE the selector lever. REFER to Selector Lever — Column Shift in this section. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation. **No** INSPECT and REPAIR circuit CET34 (BN/GN) for an open. If an open circuit is not found, REPLACE the PCM. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Section 307-01 . RERUN the KOER self-test and test the system for normal operation.

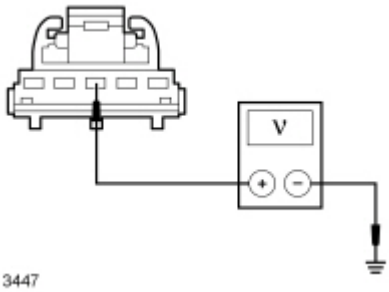
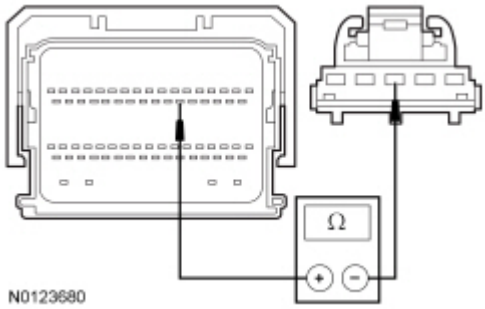
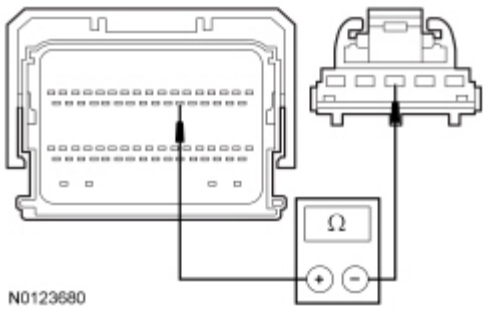
PINPOINT TEST D: THE SELECTSHIFT™ SWITCH IS NOT OPERATING CORRECTLY

NOTE: Vehicles equipped with a 3.7L engine use PCM C175B.

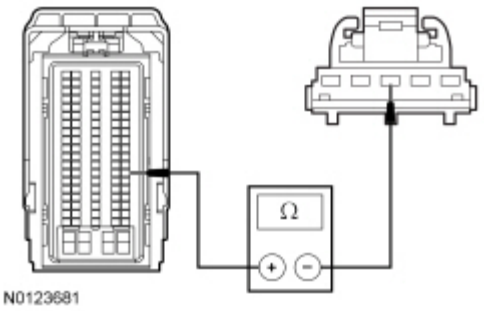
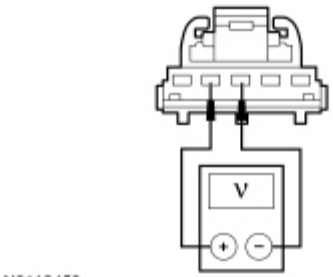
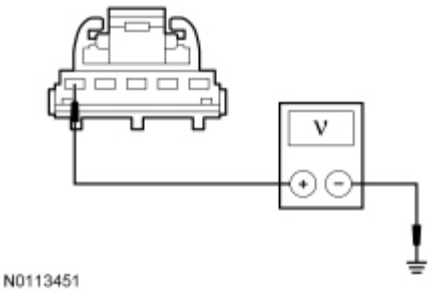
NOTE: Vehicles equipped with a 5.0L or 6.2L engine use PCM C1381B.

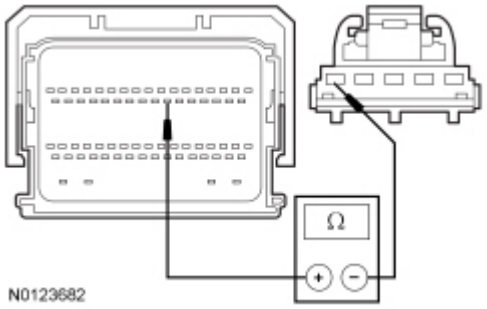
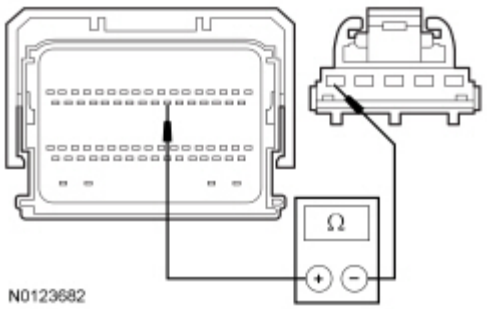
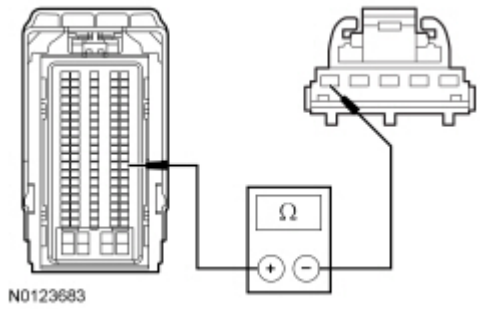
NOTE: Vehicles equipped with a 3.5L engine use PCM C1551B.

Test Step	Result / Action to Take
D1 CHECK DTCs	
• Ignition ON. • Connect the scan tool. • Start the engine and RUN the Key ON Engine Running (KOER) self-test. • **Is DTC P0815 set?**	**Yes** GO to D2 . **No** GO to D5 .
D2 CHECK THE UPSHIFT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: Tow/Haul C2399. • Inspect C2399 for damaged, pushed-out terminals, corrosion or loose wires.	**Yes** GO to D4 . **No**

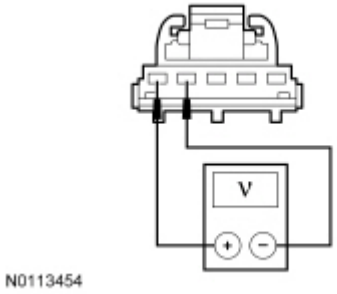
• Ignition ON. • Measure the voltage between the Tow/Haul switch C2399-3, circuit CET43 (GY), harness side and ground.  N0113447 • **Is the voltage greater than 10 volts?**	GO to D3 .
D3 CHECK THE UPSHIFT CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: PCM C175B. • Disconnect: PCM C1381B. • Disconnect: PCM C1551B. • Inspect the connector for damaged, pushed-out terminals, corrosion or loose wires. • For 3.7L engine vehicles, measure the resistance between the Tow/Haul switch C2399-3, circuit CET43 (GY) and PCM C175B-23, harness side.  N0123680 • For 5.0L or 6.2L engine vehicles, measure the resistance between the Tow/Haul switch C2399-3, circuit CET43 (GY) and PCM C1381B-23, harness side.  N0123680 • For 3.5L engine vehicles, measure the resistance between the Tow/Haul switch C2399-3, circuit CET43 (GY) and PCM C1551B-89, harness side.	**Yes** GO to D4 . **No** REPAIR circuit CET43 (GY) for an open. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation.

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 N0123681 • **Is the resistance less than 5 ohms?**	
D4 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	
• Connect: PCM C175B. • Connect: PCM C1381B. • Connect: PCM C1551B. • Ignition ON. • Measure the voltage between Tow/Haul switch C2399-3 and C2399-4 harness side.  N0113450 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new selector lever, REFER to Selector Lever — Column Shift in this section. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation. **No** INSPECT and REPAIR the signal return circuit RE407 (YE/VT) for an open. If an open circuit is not found, REPLACE the PCM. PROGRAM the PCM with the latest calibration level. PERFORM the solenoid strategy download procedure, REFER to solenoid body strategy in Section 307-01. RERUN the KOER self-test and test the system for normal operation.
D5 CHECK THE DOWNSHIFT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: Tow/Haul C2399. • Inspect C2399 for damaged, pushed-out terminals, corrosion or loose wires. • Ignition ON. • Measure the voltage between the Tow/Haul switch C2399-5, circuit CET42 (GN/VT), harness side and ground.  N0113451 • **Is the voltage greater than 10 volts?**	**Yes** GO to D7. **No** GO to D6.

D6 CHECK THE DOWNSHIFT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175B. • Disconnect: PCM C1381B. • Disconnect: PCM C1551B. • Inspect the connector for damaged, pushed-out terminals, corrosion or loose wires. • For 3.7L engine vehicles, measure the resistance between the Tow/Haul switch C2399-5, circuit CET42 (GN/VT) and PCM C175B-24, harness side.  • For 5.0L or 6.2L engine vehicles, measure the resistance between the Tow/Haul switch C2399-5, circuit CET42 (GN/VT) and PCM C1381B-24, harness side.  • For 3.5L engine vehicles, measure the resistance between the Tow/Haul switch C2399-5, circuit CET42 (GN/VT) and PCM C1551B-88, harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to D7 . **No** REPAIR circuit CET42 (GN/VT) for an open. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation.
D7 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	

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• Connect: PCM C175B. • Connect: PCM C1381B. • Connect: PCM C1551B. • Ignition ON. • Measure the voltage between tow/haul switch C2399-5 and C2399-4 harness side.  N0113454 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new selector lever, REFER to Selector Lever — Column Shift in this section. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation. **No** INSPECT and REPAIR the signal return circuit RE407 (YE/VT) for an open. If an open circuit is not found, REPLACE the PCM. PROGRAM the PCM with the latest calibration level. PERFORM the solenoid strategy download procedure, REFER to solenoid body strategy in Section 307-01 . RERUN the KOER self-test and test the system for normal operation.

External Controls — Floor Shift

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical

• Damaged Brake Shift Interlock Actuator (BSIA)
• Damaged Tow/Haul switch
• Damaged SelectShift™ switch
	• Failed fuse(s):
	  ▪ Body Control Module (BCM) 18 (10A)
	  ▪ BCM 42 (5A)
	• PCM
	• Loose or damaged connections
	• Damaged wiring harness
	• Corroded or damaged terminals

3. If the fault is not visually evident, determine the symptom. GO to Symptom Chart - External Controls, Floor Shift or GO to Symptom Chart - NVH Floor Shift .

DTC Chart

DTC Chart

DTC	Component	Description	Condition	Symptom	Action
B1319:11	Brake Shift Interlock	Shift Interlock (BSI) Output Circuit: Circuit	BSIA system malfunction	BSIA inoperative.	GO to Pinpoint

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	Actuator (BSIA), BCM	short to ground			Test e .
B1319:15	Brake Shift Interlock Actuator (BSIA), BCM	Shift Interlock (BSI) Output Circuit: Circuit short to voltage or open	BSIA system malfunction	BSIA inoperative.	GO to Pinpoint Test e .
P0815	Upshift Switch Circuit	Upshift switch concerns, open or shorted circuit	The PCM signal input voltage status is out of range	Upshift switch inoperative.	GO to Pinpoint Test H .
P0816	Downshift Switch Circuit	Downshift switch concerns, open or shorted circuit	The PCM signal input voltage status is out of range	Downshift switch inoperative.	GO to Pinpoint Test H .
P1780	Tow/Haul Switch	Transmission Control Switch (TCS) (Overdrive (O/D) cancel) circuit out of self-test range	The PCM did not receive a Tow/Haul switch input during the Key ON Engine Running (KOER) self-test	Tow/Haul is inoperative or does not operate correctly.	GO to Pinpoint Test G .

Symptom Chart — External Controls, Floor Shift

Symptom Chart — External Controls, Floor Shift

Condition	Possible Sources	Action
• The Brake Shift Interlock Actuator (BSIA) system does not release/lock correctly	• Circuitry • Fuse(s): ▪ Body Control Module (BCM) 18 (10A) • BSIA	• GO to Pinpoint Test E .
	• Selector lever cable	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Floor Shift in this section.
• The shift control is out of correct gear relationship	• Selector lever cable and bracket • Selector lever linkage	• GO to Pinpoint Test F .
• Transmission Range (TR) indicator (PRNDL) does not correspond to the selected gear	• Selector lever cable bracket	• TIGHTEN bolts holding selector lever cable bracket. REFER to Selector Lever Cable Adjustment — Floor Shift in this section.
	• Selector lever cable loose at the selector lever	• SECURE selector lever cable. REFER to Selector Lever Cable Adjustment — Floor Shift in this section.

	• Selector lever cable	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Floor Shift in this section.
• TR indicator (PRNDL) does not illuminate	• Instrument Panel Cluster (IPC) malfunction • Circuitry • TR sensor	• REFER to Section 413-00 . • CHECK for TR sensor DTCs. REFER to Section 307-01 .
• The ignition key cannot be returned to the OFF position or the ignition key can be turned to the OFF position when the selector lever is not in PARK	• Wiring, terminals or connectors • Ignition lock cylinder • Key removal inhibit solenoid (part of the ignition switch) • Park detect switch (part of the selector lever) • Selector lever cable • Mechanical damage to the selector lever, selector lever cable or selector lever knob	• REFER to Section 211-05 .
• The PRNDL indicator does not illuminate P	• Wiring, terminals or connectors • PCM concern • IPC • Park detect switch (part of the selector lever)	• REFER to Section 413-01 .
• The Tow/Haul switch does not operate correctly	• Tow/Haul switch • Tow/Haul switch not cycled during self-test • Circuitry	• GO to Pinpoint Test G .
• The Tow/Haul lamp is not operating correctly	• IPC • PCM • Circuitry	• REFER to Section 413-01 .
• The SelectShift™ switch is not operating correctly	• SelectShift™ switch • PCM • Circuitry	• GO to Pinpoint Test H .
• Water enters inside the vehicle	• Cable assembly grommet • Torn selector lever cable assembly grommet	• SECURE grommet to floor panel. REFER to Selector Lever Cable — Floor Shift in this section. • INSTALL a new selector lever cable. REFER to Selector

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		Lever Cable — Floor Shift in this section.
• Excessive shift effort	• Selector lever cable • Cable bracket	• INSTALL a new selector lever cable. REFER to Selector Lever Cable — Floor Shift in this section. • ADJUST cable. TIGHTEN cable bracket screws. REFER to Selector Lever Cable — Floor Shift in this section.
• Selector lever will not shift from PARK	• Selector lever cable • Selector lever knob • Broken selector lever cable • Brake Shift Interlock Actuator (BSIA) system failure	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Floor Shift in this section. • INSTALL a new selector lever knob. REFER to Selector Lever Knob in this section. • INSTALL a new selector lever cable. REFER to Selector Lever Cable — Floor Shift in this section. • GO to Pinpoint Test E .
• Vehicle will not crank/start in park but will crank/start in neutral	• Selector lever cable • TR sensor	• VERIFY selector lever cable adjustment. REFER to Selector Lever Cable Adjustment — Floor Shift in this section. • CHECK for TR sensor DTCs. REFER to Section 307-01 .

Symptom Chart — NVH Floor Shift

Symptom Chart — NVH Floor Shift

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

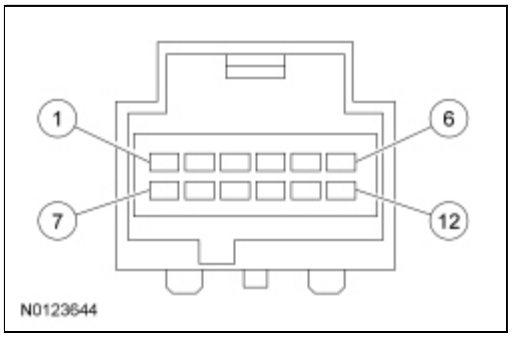
Condition	Possible Sources	Action
• Vibration — a high frequency (20-80 Hz) that is felt through the seat or selector lever. Changes with engine speed	• Selector lever cable incorrectly routed, grounded out or loose	• CHECK the selector lever cable. REPAIR as necessary. REFER to Selector Lever Cable — Floor Shift in this section.
• Rattle, buzz or other noise	• Selector lever loose	• TIGHTEN the selector lever bolts. REFER to Selector Lever — Floor Shift in this section.
	• Selector lever knob	• INSTALL a new selector lever knob. REFER to Selector Lever Knob in this section.
	• Selector lever	• INSTALL a new selector lever. REFER to Selector Lever — Floor Shift in this section.
	• Cable assembly grommet	• SECURE the grommet to the floor panel. REFER to Selector Lever Cable — Floor Shift in this section.

Pinpoint Tests

Refer to Wiring Diagrams Cell 30 , Transmission Controls for schematic and connector information.

Refer to Wiring Diagrams Cell 37 , Shift Interlock for schematic and connector information.

Selector Lever Connector — C3245



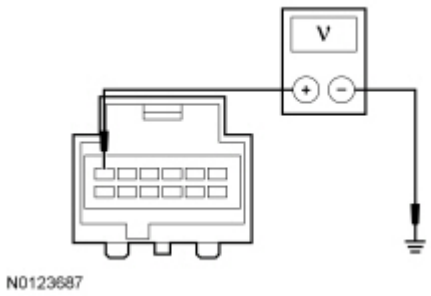
Pin Number	Circuit Function
1	BSIA Power
2	Key Lock Solenoid (inhibit removal)
3	Transmission Park Detect
4	Illumination
5	Ground
6	Tow/Haul Power

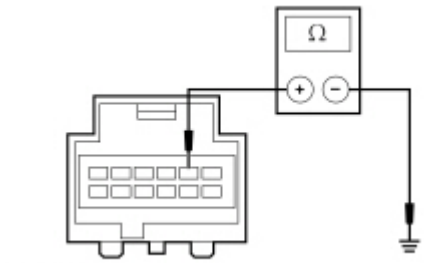
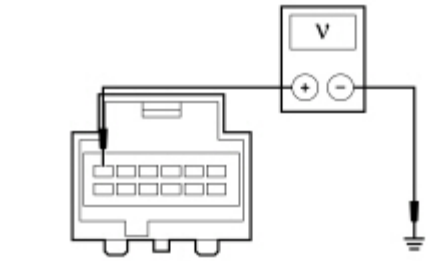
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7	Tow/Haul Signal
8	Not Used
9	SelectShift™ Upshift
10	SelectShift™ Downshift
11	SelectShift™ Ground
12	Not Used

PINPOINT TEST E: THE BSIA SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

NOTE: Inspect the selector lever cable before proceeding with this pinpoint test.

Test Step	Result / Action to Take
E1 CHECK THE STOPLAMPS	
• Apply the brake pedal and observe the stoplamps. • **Do the stoplamps operate correctly?**	**Yes** GO to E2. **No** REFER to Section 417-01.
E2 CHECK THE BSIA POWER CIRCUIT FOR VOLTAGE	
• Disconnect: Floor Shifter C3245. • Ignition ON. • Measure the voltage between the BSIA C3245-1, circuit CET53 (BU/OG), harness side and ground.  N0123687 • Apply the brake pedal. • With the brake pedal applied, measure the voltage between the BSIA C3245-1, circuit CET53 (BU/OG), harness side and ground. • **Is the voltage greater than 10 volts with the brake pedal applied and 0 volts with the brake pedal not applied?**	**Yes** GO to E3. **No** VERIFY the BCM fuse 18 (10A) is OK, If OK REPAIR circuit CET53 (BU/OG) for an open. CLEAR the DTC. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. If voltage was present with the brake pedal not applied, GO to E4.
E3 CHECK THE BSIA GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the selector lever C3245-5, circuit GD138 (BK/WH), harness side and ground.	**Yes** INSTALL a new selector lever. REFER to Selector Lever — Floor Shift in this section. CLEAR the DTC. TEST the system for normal operation.

 N0123686 • **Is the resistance less than 5 ohms?**	**No** REPAIR circuit GD138 (BK/WH) for an open. CLEAR the DTC. TEST the system for normal operation.
E4 CHECK THE BSIA OUTPUT CIRCUIT FOR A SHORT TO POWER	
• Disconnect: BCM C2280B. • Inspect C3245 and C2280B for damaged, pushed-out terminals or loose wires. • Ignition ON. • Measure the voltage between the selector lever C3245-1, circuit CET53 (BU/OG), harness side and ground.  N0123687 • **Is any voltage present?**	**Yes** REPAIR circuit CET53 (BU/OG) for a short to power. CLEAR the DTC. TEST the system for normal operation. **No** GO to E5.
E5 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	Install a new BCM. REFER to Section 418-00. CLEAR the DTC. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

PINPOINT TEST F: THE SHIFT CONTROL IS OUT OF CORRECT GEAR RELATIONSHIP

Test Step	Result / Action to Take
F1 CHECK THE SHIFT CONTROL LINKAGE	
• Ignition ON. • Apply the brake pedal.	**Yes** INSTALL a new selector lever. REFER to Selector Lever — Floor Shift in this section. TEST the system for normal

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• Gain access to the selector lever linkage. • Position the selector lever in all ranges. • Observe all selector lever linkage during operation. • **Is the selector lever linkage damaged?**	operation. **No** GO to F2 .
F2 CHECK THE SELECTOR LEVER CABLE	
• Check the selector lever cable and bracket installation and tightness. • **Is the selector lever cable correctly installed and adjusted?**	**Yes** VERIFY the selector lever cable adjustment. ADJUST the selector lever cable if necessary. REFER to Selector Lever Cable Adjustment — Floor Shift in this section. GO to F3 . **No** REPAIR as necessary. TEST the system for normal operation.
F3 CHECK THE LINKAGE/CABLE FOR CORRECT GEAR RELATIONSHIP	
• Apply the brake pedal. • Position the selector lever in all ranges. • **Does the indicator match the gear selection?**	**Yes** System OK. TEST the system for normal operation. **No** REFER to Selector Lever Cable — Floor Shift in this section. TEST the system for normal operation.

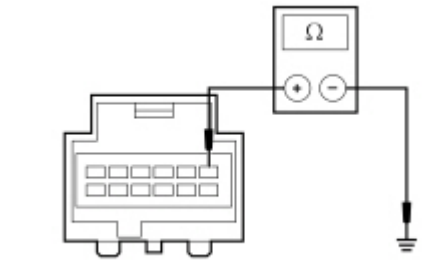
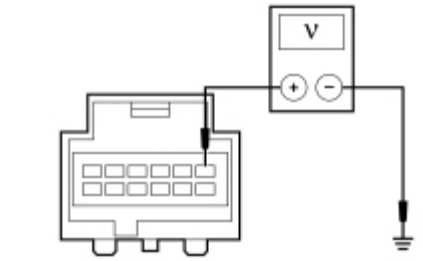
PINPOINT TEST G: THE TOW/HAUL SWITCH DOES NOT OPERATE CORRECTLY

NOTE: Vehicles equipped with a 3.7L engine use PCM C175T.

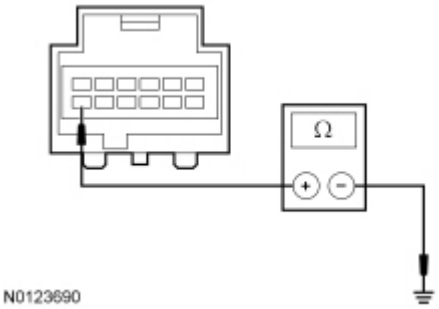
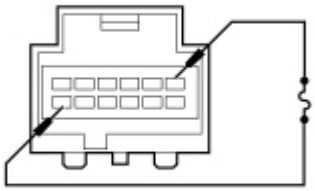
NOTE: Vehicles equipped with a 5.0L or 6.2L engine use PCM C1381T.

NOTE: Vehicles equipped with a 3.5L engine use PCM C1551B.

Test Step	Result / Action to Take
G1 CHECK DTCs	
• Ignition ON. • Connect the scan tool. • Start the engine and RUN the Key ON Engine Running (KOER) self-test. • **Is DTC P1780 set?**	**Yes** GO to G2 . **No** No trouble found with the Tow/Haul system. REFER to Section 413-01 if Tow/Haul lamp does not illuminate.
G2 CHECK THE BCM FUSE 42 (5A)	
• Ignition OFF. • Remove Body Control Module (BCM) fuse 42 (5A). • Check fuse: BCM 42 (5A). • **Is the resistance less than 5 ohms?**	**Yes** GO to G4 . **No** GO to G3 .
G3 CHECK THE TOW/HAUL POWER CIRCUIT FOR A	

SHORT TO GROUND	
• Disconnect: Selector Lever C3245. • Disconnect: BCM C2280B. • Inspect C3245 and C2280B for damaged, pushed-out terminals or loose wires. • Measure the resistance between the selector lever C3245-6, circuit CBP42 (GN), harness side and ground.  N0123688 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G4 . **No** REPAIR circuit CBP42 (GN) for a short to ground. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation.
G4 CHECK THE TOW/HAUL POWER CIRCUIT FOR VOLTAGE	
• Disconnect: Selector Lever C3245. • Inspect C3245 for damaged, pushed-out terminals or loose wires. • Ignition ON. • Measure the voltage between the selector lever C3245-6, circuit CBP42 (GN), harness side and ground.  N0123689 • **Is the voltage greater than 10 volts?**	**Yes** GO to G5 . **No** REPAIR circuit CBP42 (GN) for an open. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation.
G5 CHECK THE TOW/HAUL INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: PCM C175T. • Disconnect: PCM C1381T. • Disconnect: PCM C1551B. • Inspect the connector for damaged, pushed-out terminals, corrosion or loose wires. • Measure the resistance between the selector lever C3245-7, circuit CET34 (BN/GN) and ground.	**Yes** GO to G6 . **No** REPAIR circuit CET34 (BN/GN) for a short to ground. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation.

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 N0123690 • **Is the resistance greater than 10,000 ohms?**	
G6 CHECK THE TOW/HAUL INPUT CIRCUIT FOR AN OPEN	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: TCS_DEPRES. • Connect a fused jumper from the selector lever switch, C3245-6 circuit CBP42 (GN) to C3245-7 circuit CET34 (BN/GN) harness side.  N0123691 • **Does the TCS_DEPRES PID display YES?**	**Yes** REPLACE the selector lever. REFER to Selector Lever — Floor Shift in this section. CLEAR the DTC. RERUN the KOER self-test and test the system for normal operation. **No** INSPECT and REPAIR circuit CET34 (BN/GN) for an open. If an open circuit is not found, REPLACE the PCM. PERFORM the Solenoid Body Strategy Data Download procedure. REFER to Section 307-01 . RERUN the KOER self-test and test the system for normal operation.

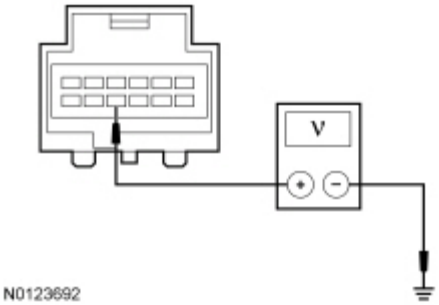
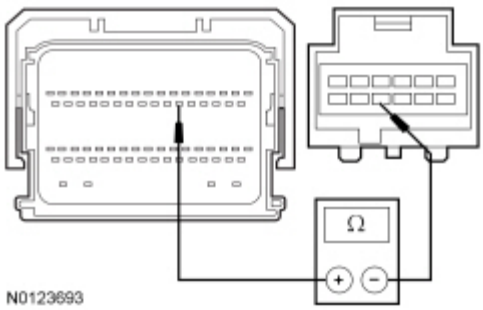
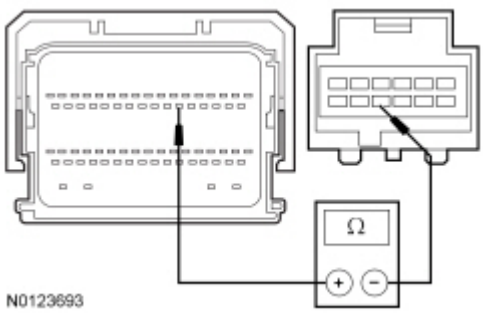
PINPOINT TEST H: THE SELECTSHIFT™ SWITCH IS NOT OPERATING CORRECTLY

NOTE: Vehicles equipped with a 3.7L engine use PCM C175B.

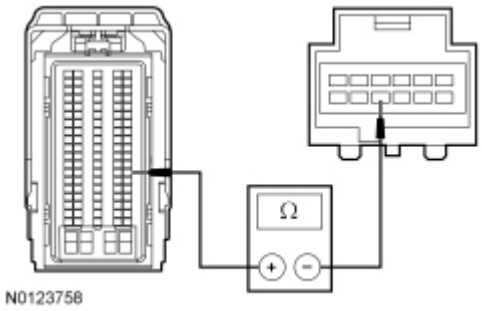
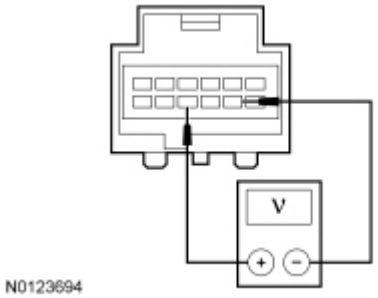
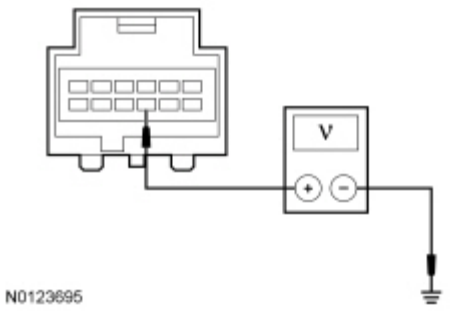
NOTE: Vehicles equipped with a 5.0L or 6.2L engine use PCM C1381B.

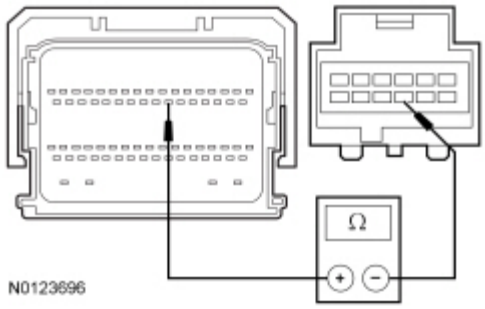
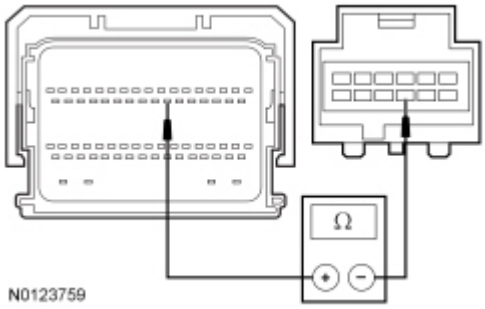
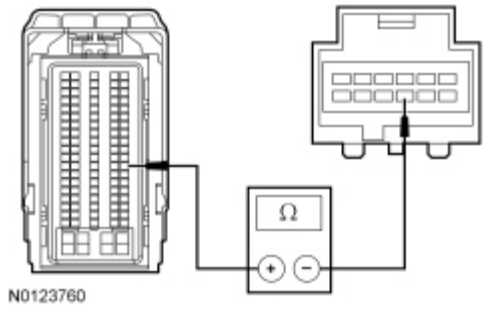
NOTE: Vehicles equipped with a 3.5L engine use PCM C1551B.

Test Step	Result / Action to Take
H1 CHECK DTCs	
• Ignition ON. • Connect the scan tool. • Start the engine and RUN the Key ON Engine Running (KOER) self-test. • **Is DTC P0815 set?**	**Yes** GO to H2 . **No** GO to H5 .
H2 CHECK THE UPSHIFT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: Selector Lever C3245. • Inspect C3245 for damaged, pushed-out terminals,	**Yes** GO to H4 .

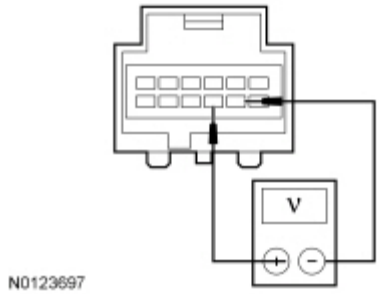
corrosion or loose wires. • Ignition ON. • Measure the voltage between the selector lever C3245-9, circuit CET43 (GY), harness side and ground.  N0123692 • **Is the voltage greater than 10 volts?**	**No** GO to H3 .
H3 CHECK THE UPSHIFT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175B. • Disconnect: PCM C1381B. • Disconnect: PCM C1551B. • Inspect the connector for damaged, pushed-out terminals, corrosion or loose wires. • For 3.7L engine vehicles, measure the resistance between the Tow/Haul switch C3245-9, circuit CET43 (GY) and PCM C175B-23, harness side.  N0123693 • For 5.0L or 6.2L engine vehicles, measure the resistance between the Tow/Haul switch C3245-9, circuit CET43 (GY) and PCM C1381B-23, harness side.  N0123693 • For 3.5L engine vehicles, measure the resistance between the Tow/Haul switch C3245-9, circuit	**Yes** GO to H4 . **No** REPAIR circuit CET43 (GY) for an open. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation.

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CET43 (GY) and PCM C1551B-89, harness side.  N0123758 • **Is the resistance less than 5 ohms?**	
H4 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	
• Connect: PCM C175B. • Connect: PCM C1381B. • Connect: PCM C1551B. • Ignition ON. • Measure the voltage between the selector lever C3245-9, circuit CET43 (GY) and C3245-11, circuit RE407 (YE/VT) harness side.  N0123694 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new selector lever, REFER to Selector Lever — Floor Shift in this section. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation. **No** REPAIR the signal return circuit RE407 (YE/VT) for an open. If an open circuit is not found, REPLACE the PCM. PROGRAM the PCM with the latest calibration level. PERFORM the solenoid strategy download procedure, REFER to solenoid body strategy in Section 307-01 . RERUN the KOER self-test and test the system for normal operation.
H5 CHECK THE DOWNSHIFT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: Selector Lever C3245. • Inspect C3245 for damaged, pushed-out terminals, corrosion or loose wires. • Ignition ON. • Measure the voltage between the selector lever C3245-10, circuit CET42 (GN/VT), harness side and ground.  N0123695	**Yes** GO to H7 . **No** GO to H6 .

• **Is the voltage greater than 10 volts?**	
H6 CHECK THE DOWNSHIFT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175B. • Disconnect: PCM C1381B. • Disconnect: PCM C1551B. • Inspect the connector for damaged, pushed-out terminals, corrosion or loose wires. • For 3.7L engine vehicles, measure the resistance between the selector lever C3245-10, circuit CET42 (GN/VT) and PCM C175B-24, harness side.  • For 5.0L or 6.2L engine vehicles, measure the resistance between the Tow/Haul switch C3245-10, circuit CET42 (GN/VT) and PCM C1381B-24, harness side.  • For 3.5L engine vehicles, measure the resistance between the Tow/Haul switch C3245-10, circuit CET42 (GN/VT) and PCM C1551B-88, harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to H7 . **No** REPAIR circuit CET42 (GN/VT) for an open. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation.
H7 CHECK THE SIGNAL RETURN CIRCUIT FOR AN	

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OPEN	
• Connect: PCM C175B. • Connect: PCM C1381B. • Connect: PCM C1551B. • Measure the voltage between the selector lever C3245-10, circuit CET42 (GN/VT) and C3245-11, circuit RE407 (YE/VT) harness side.  N0123697 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new selector lever, REFER to Selector Lever — Floor Shift in this section. CLEAR the DTCs. RERUN the KOER self-test and test the system for normal operation. **No** INSPECT and REPAIR the signal return circuit RE407 (YE/VT) for an open. If an open circuit is not found, REPLACE the PCM. PROGRAM the PCM with the latest calibration level. PERFORM the solenoid strategy download procedure, REFER to solenoid body strategy in Section 307-01 . RERUN the KOER self-test and test the system for normal operation.

Brake Shift Interlock Override — Column Shift

NOTE: If it is necessary to use the override procedure to move the selector lever out of the PARK position, it is possible that a fuse has blown. GO to Pinpoint Test A .

This vehicle is equipped with a brake shift interlock feature that prevents the selector lever from being moved out of PARK when the ignition is in the ON position until the brake pedal is applied.

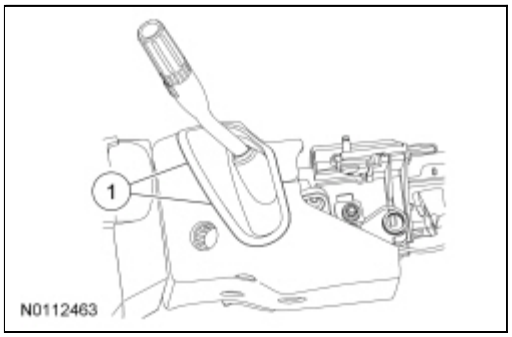
If the selector lever cannot be moved out of the PARK position when the ignition is in the ON position and the brake pedal is applied:

1. Apply the parking brake. Turn the ignition key to the off position and remove the key.

2. Tilt and telescope the steering column to the full downward and rearward position.

3. ***NOTICE:*** **Make sure to use extra care when detaching the selector lever boot clips from steering column shrouds or damage to the selector lever boot may occur causing replacement of the selector lever assembly. The selector lever boot is not serviceable separately.**

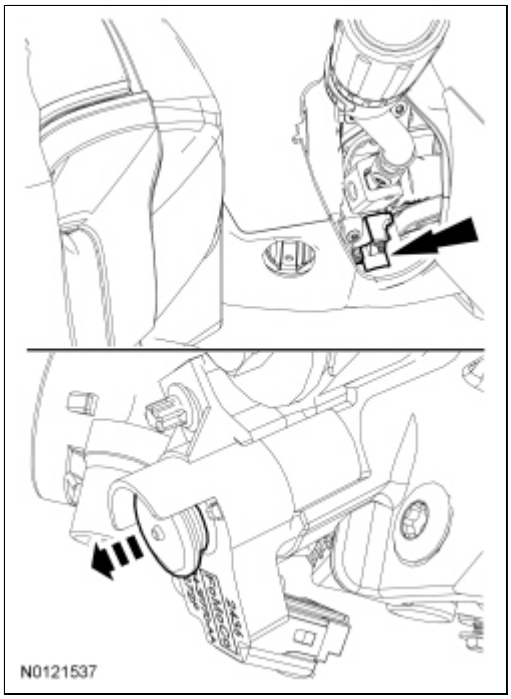
   Position the selector lever boot aside.
   1. Push forward on the selector lever boot at the area indicated and remove the boot from the upper and lower steering column shrouds.



4. **NOTE:** The BSIA spindle can be accessed through the selector lever boot opening.

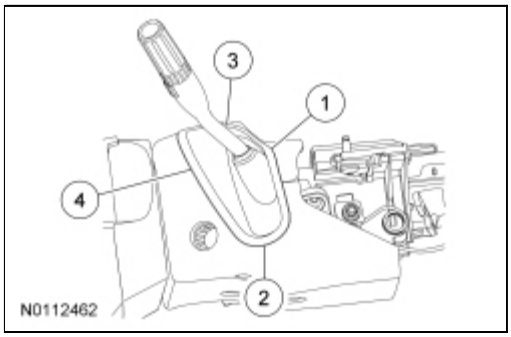
   Move the BSIA spindle outward, apply the brake pedal and position the selector lever into NEUTRAL.

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5. ***NOTICE:*** **Make sure to use extra care and follow the installation sequence when installing the selector lever boot to the steering column shrouds or damage to the boot may occur causing replacement of the selector lever assembly. the selector lever boot is not serviceable separately.**

   Install the selector lever boot in the sequence shown.
   1. Install the front of the selector lever boot.
   2. Install the bottom of the selector lever boot.
   3. Install the top of the selector lever boot.
   4. Install the back of the selector lever boot.



6. Start the vehicle.

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Brake Shift Interlock Override — Floor Shift

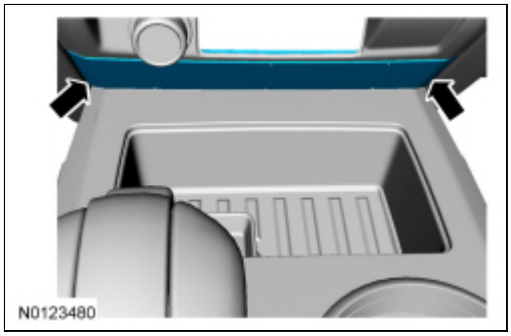
NOTE: If it is necessary to use the override procedure to move the selector lever out of the PARK position, it is possible that a fuse has blown. GO to Pinpoint Test A .

This vehicle is equipped with a brake shift interlock feature that prevents the selector lever from being moved out of PARK when the ignition is in the ON position, until the brake pedal is applied.

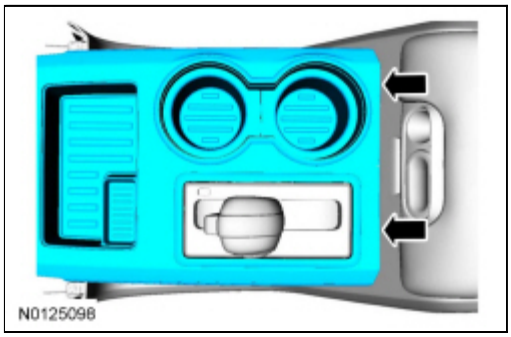
If the selector lever cannot be moved out of the PARK position when the ignition is in the ON position and the brake pedal is applied:

1. Apply the park brake and remove the ignition key.

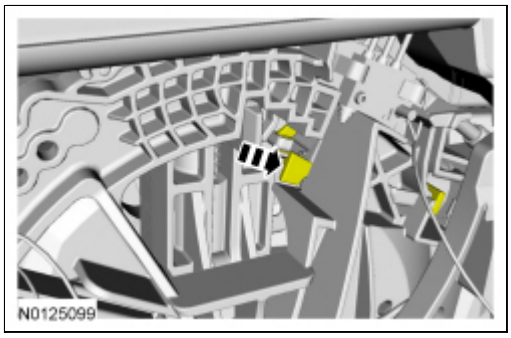
2. Remove the instrument panel to floor console finish panel.



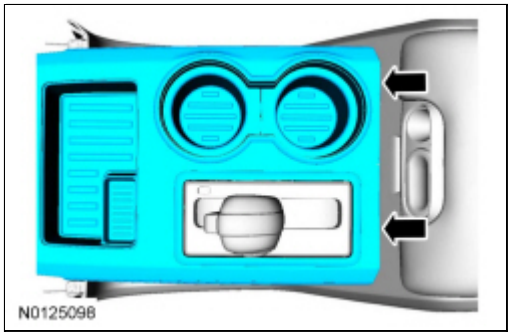
3. Remove the floor console upper finish panel.
    - Starting at the rear of the upper finish panel, carefully pry up the upper finish panel and disconnect the electrical connectors.



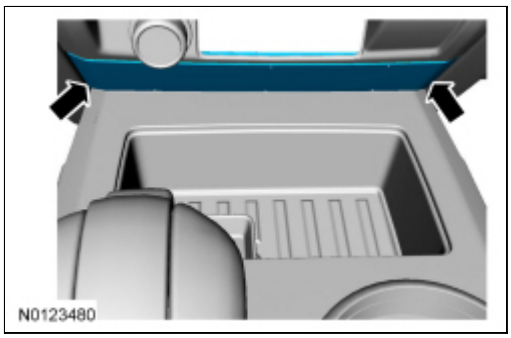
4. Apply the brake pedal. Press and hold the Brake Shift Interlock Actuator (BSIA) lever while moving the selector lever into NEUTRAL.



5. Connect and install the floor console upper finish panel.



6. Install the instrument panel to floor console finish panel.

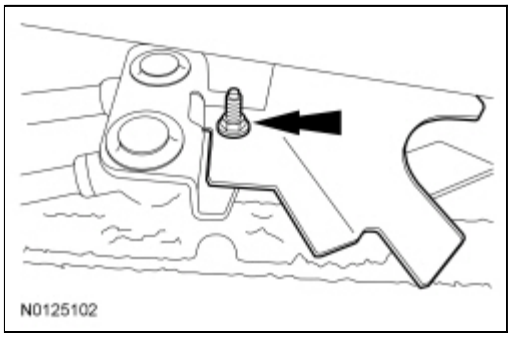


7. Start the vehicle.

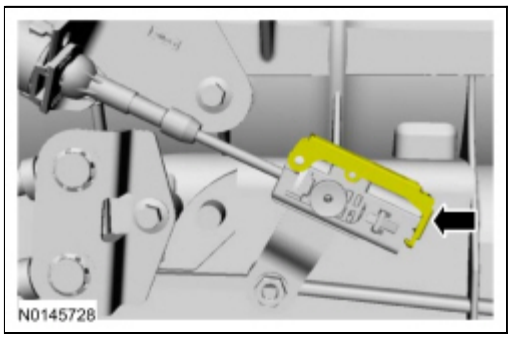
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Selector Lever Cable Adjustment — Column Shift

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to Section 100-02 .
2. Place the selector lever in DRIVE.
3. If equipped, remove the nut and the selector lever cable splash shield.

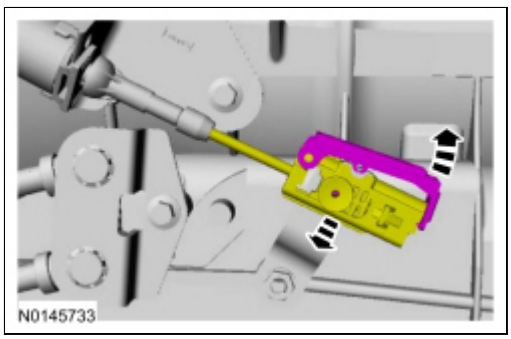


4. Clean the cable adjustment lock of any debris.



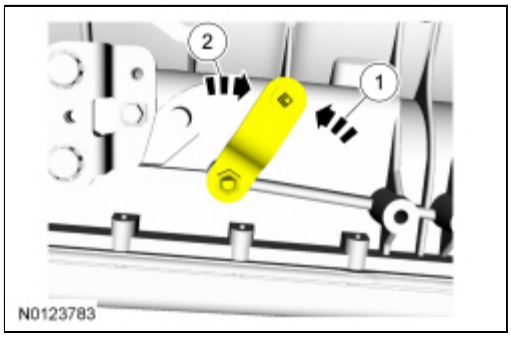
5. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

   Rotate the cable adjustment lock upward and remove the selector lever cable from the manual control lever.

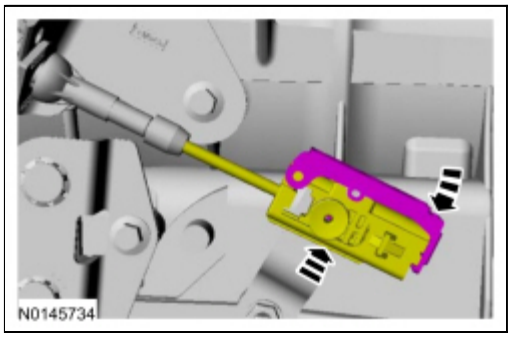


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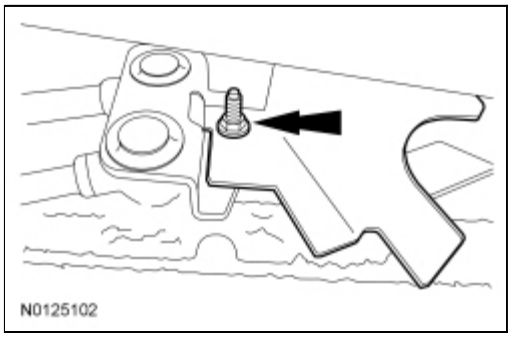
6. Place the manual control lever in the (D) position.
    1. Rotate the manual control lever counterclockwise 3 detents into the manual 1st position.
    2. Rotate the manual control lever clockwise 3 detents into the (D) position.



7. Connect the selector lever cable onto the manual control lever and move the locking tab down.
    - Listen for the audible click, then push back on the locking tab to verify it is locked.
    - Pull back on the selector lever cable to verify it is installed correctly to the manual lever.



8. If equipped, install the selector lever cable splash shield and the nut.
    - Tighten to 12 Nm (106 lb-in).



9. Verify the vehicle will start in PARK or NEUTRAL and the backup lamps illuminate in REVERSE.

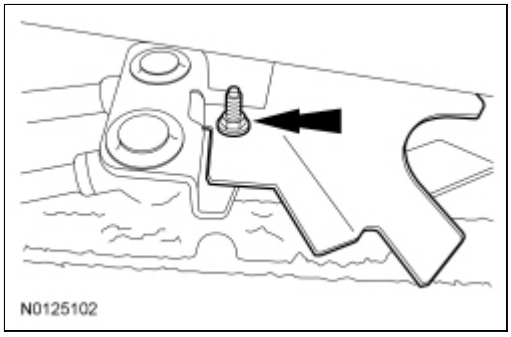
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Selector Lever Cable Adjustment — Floor Shift

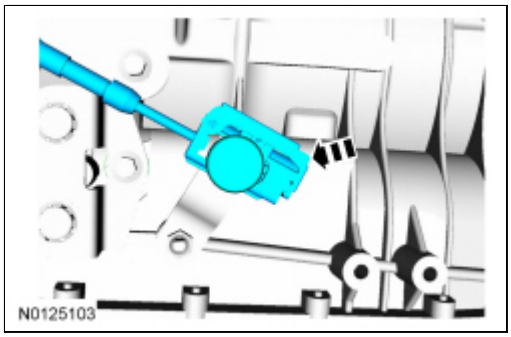
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Place the selector lever in DRIVE.

3. If equipped, remove the nut and the selector lever cable splash shield.

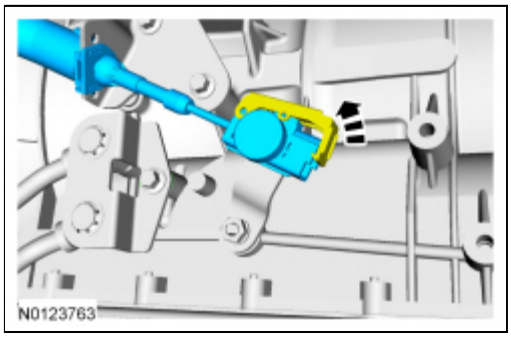


4. Clean the cable adjustment lock of any debris.

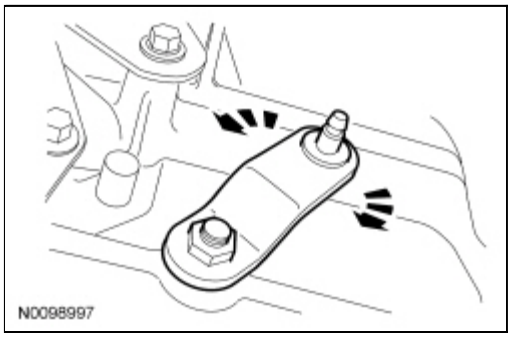


5. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

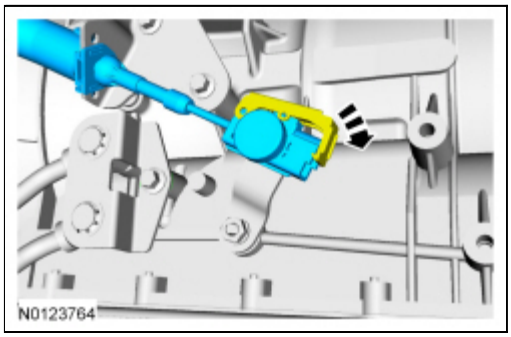
   Rotate the cable adjustment lock upward and remove the selector lever cable from the manual control lever.



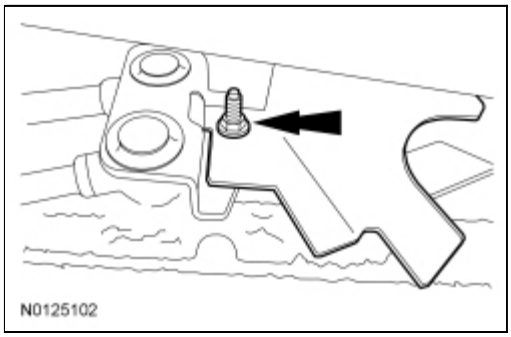
6. Place the manual control lever in the (D) position.
    - Rotate the manual control lever counterclockwise 3 detents into the manual 1st position.
    - Rotate the manual control lever clockwise 3 detents into the (D) position.



7. Connect the selector lever cable onto the manual control lever and move the locking tab down.
    - Listen for the audible click, then push back on the locking tab to verify it is locked.
    - Pull back on the selector lever cable to verify it is installed correctly to the manual lever.



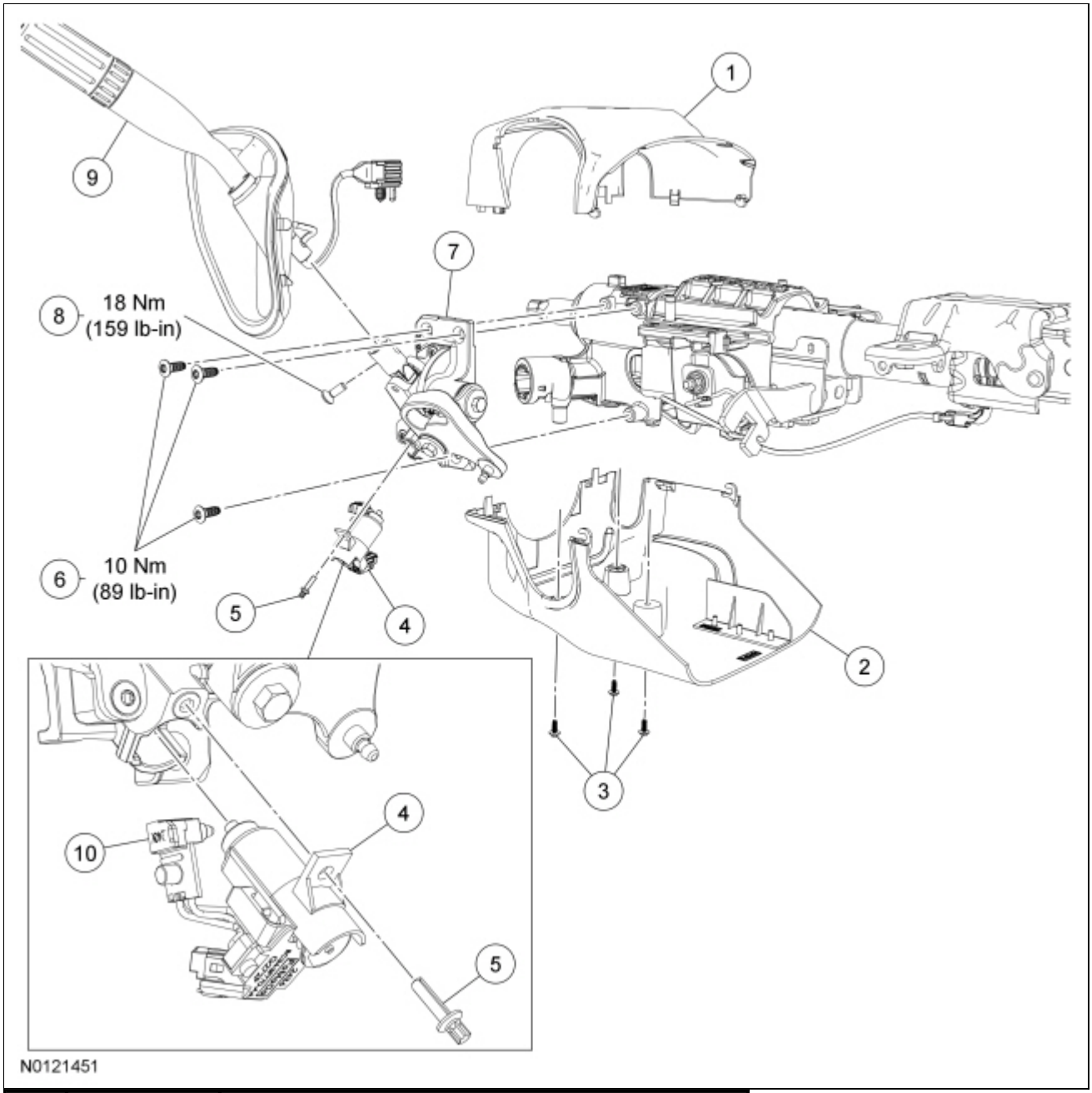
8. If equipped, install the selector lever cable splash shield and the nut.
    - Tighten to 12 Nm (106 lb-in).



9. Verify the vehicle will start in PARK or NEUTRAL and the backup lamps illuminate in REVERSE.

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Brake Shift Interlock Actuator — Column Shift



Item	Part Number	Description
1	3530	Upper steering column shroud
2	3530	Lower steering column shroud
3	W710485	Lower steering column shroud screws (3 required)
4	3Z719	Brake Shift Interlock Actuator (BSIA)

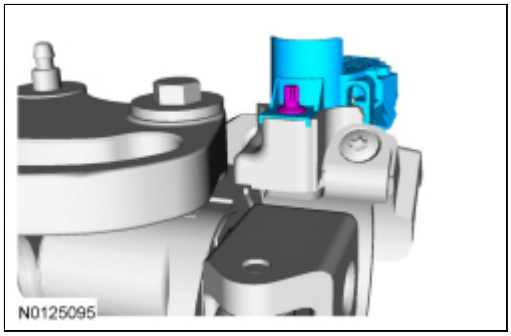
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5	3F907	BSIA screw
6	W790181	Selector lever mechanism bolts (3 required)
7	7210B	Selector lever mechanism
8	W712000	Selector lever bolt
9	7210A	Selector lever
10	—	Park position switch (part of 3Z719)

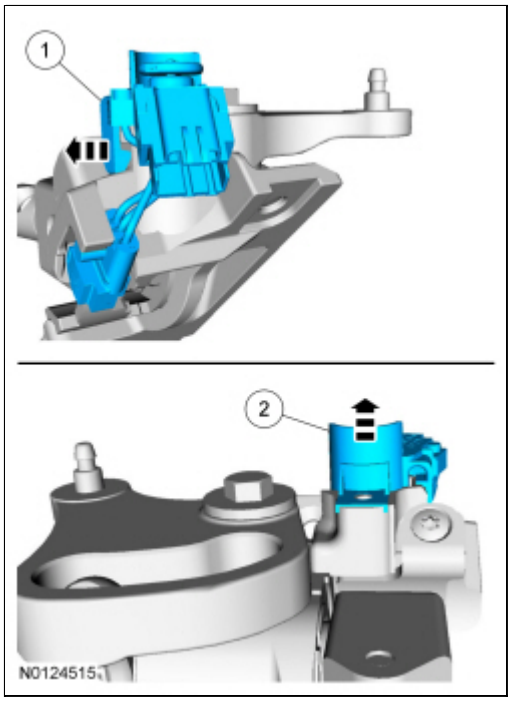
Removal and Installation

1. Remove the selector lever mechanism. For additional information, refer to Selector Lever Mechanism — Column Shift in this section.

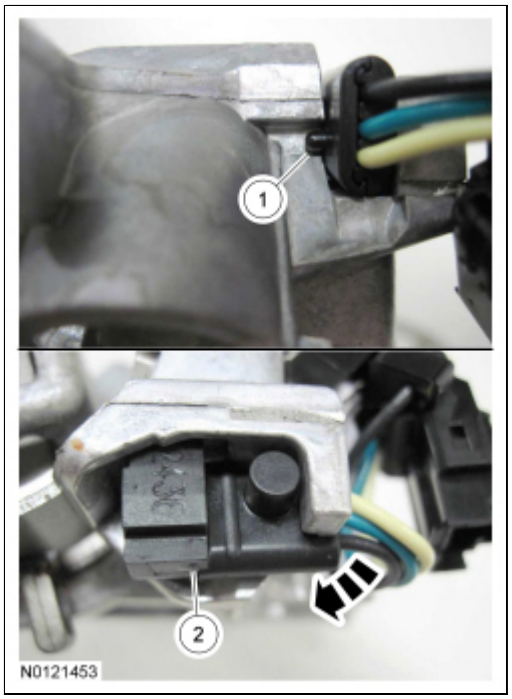
2. Remove the Brake Shift Interlock Actuator (BSIA) screw.



3. Remove the BSIA .
    1. Gently pry out the clip.
    2. While prying out the clip, simultaneously remove the BSIA from the selector lever mechanism housing.



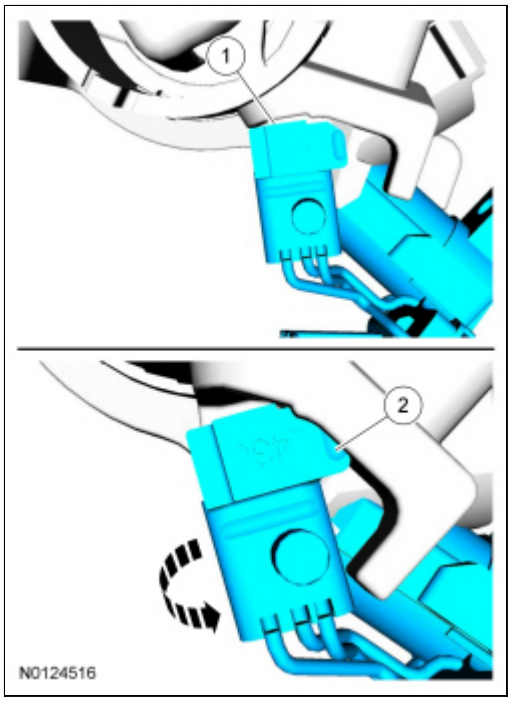
4. Remove the park position switch.
    1. Press the spring loaded pin.
    2. While pressing in on the spring loaded pin, rotate the park position switch clockwise and remove it from the selector lever mechanism.



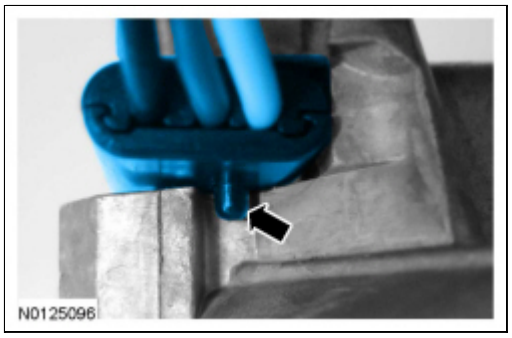
Installation

1. Install the park position switch.
    1. Place the large plunger on the park position switch in the locating hole and position the switch as shown.
    2. Rotate the park position switch counterclockwise making sure the tab locks under the housing lip.

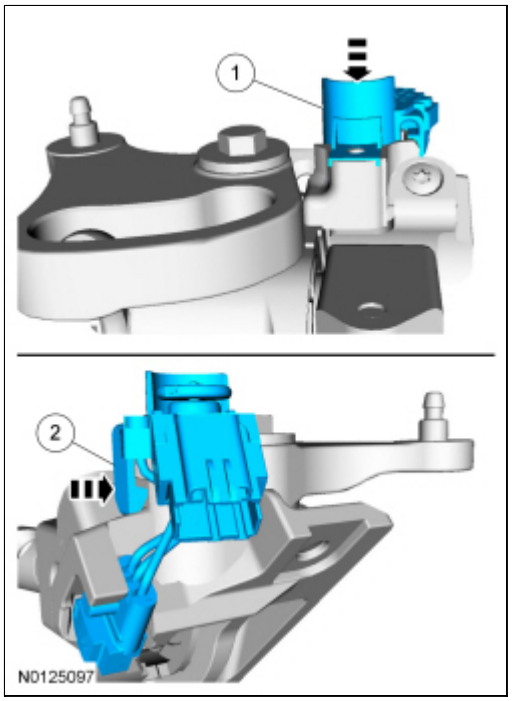
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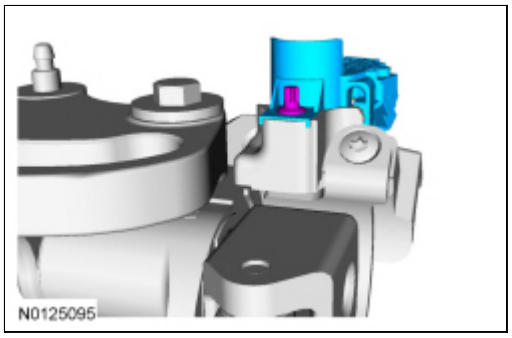
2. Verify small plunger is fully extended.



3. Install the BSIA .
    1. Insert the BSIA into the selector lever mechanism housing.
    2. Gently push the snap lock clip in place.



4. Install the BSIA screw.
    - Tighten to 2 Nm (18 lb-in).



5. Install the selector lever mechanism. For additional information, refer to Selector Lever Mechanism — Column Shift in this section.

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Brake Shift Interlock Actuator — Floor Shift

Removal and Installation

NOTE: The Brake Shift Interlock Actuator (BSIA) is not serviced separately. If a new BSIA is required, install a new floor shift selector lever assembly.

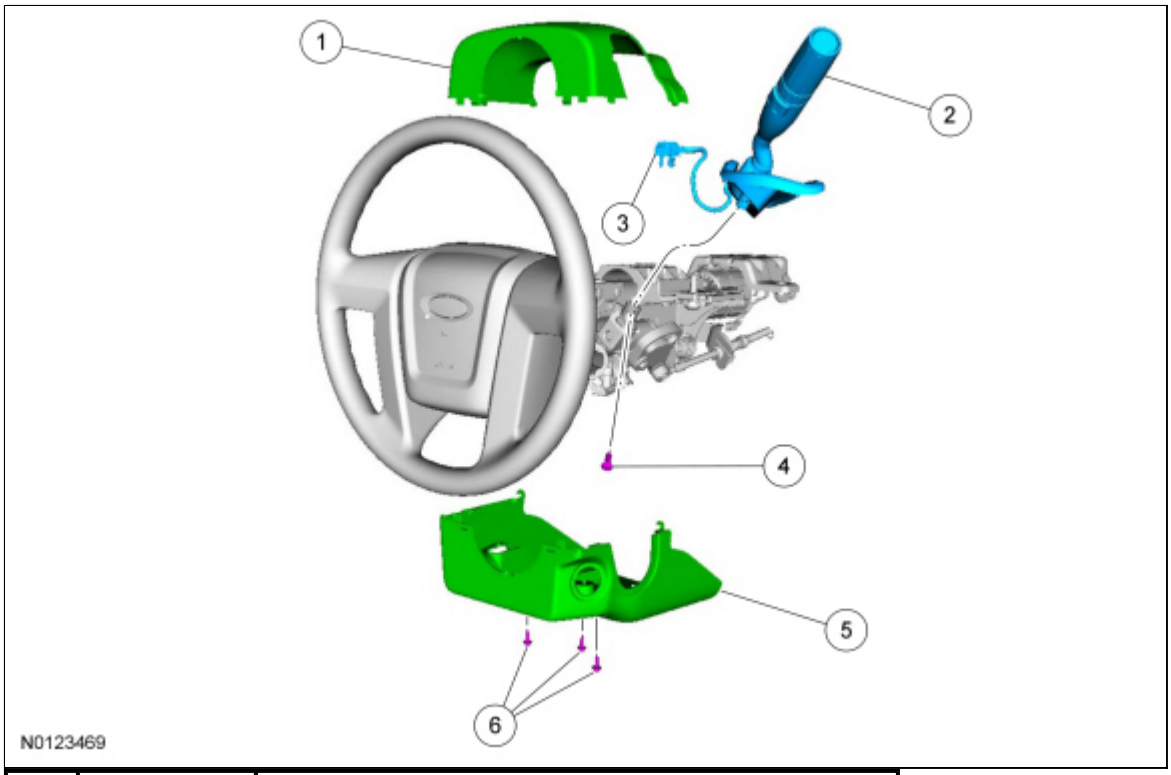
1. For additional information, refer to Selector Lever — Floor Shift in this section.

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Selector Lever — Column Shift

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

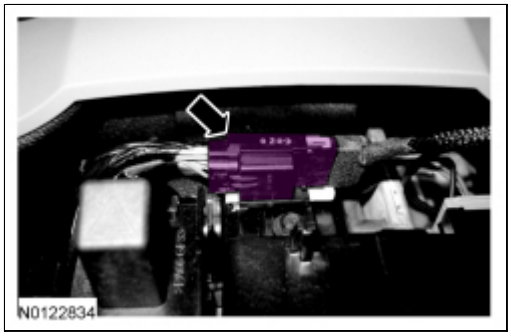
NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



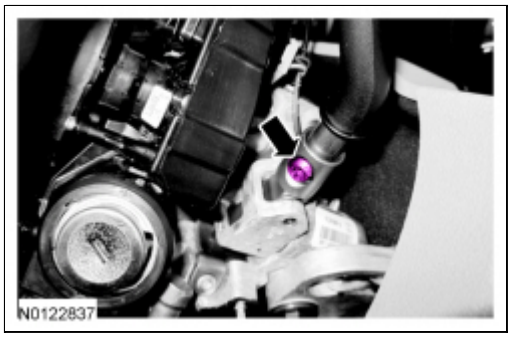
Item	Part Number	Description
1	3530	Upper steering column shroud
2	7210A	Selector lever
3	—	Tow/Haul switch electrical connector (part of 7210A)
4	W712000	Selector lever bolt
5	3530	Lower steering column shroud
6	W710485	Lower steering column shroud screws (3 required)

Removal and Installation

1. Remove the steering column shrouds. For additional information, refer to Section 211-04 .
2. Disconnect the Tow/Haul switch electrical connector.



3. Remove and discard the selector lever bolt.
    - To install, tighten to 18 Nm (159 lb-in).



4. Remove the selector lever.

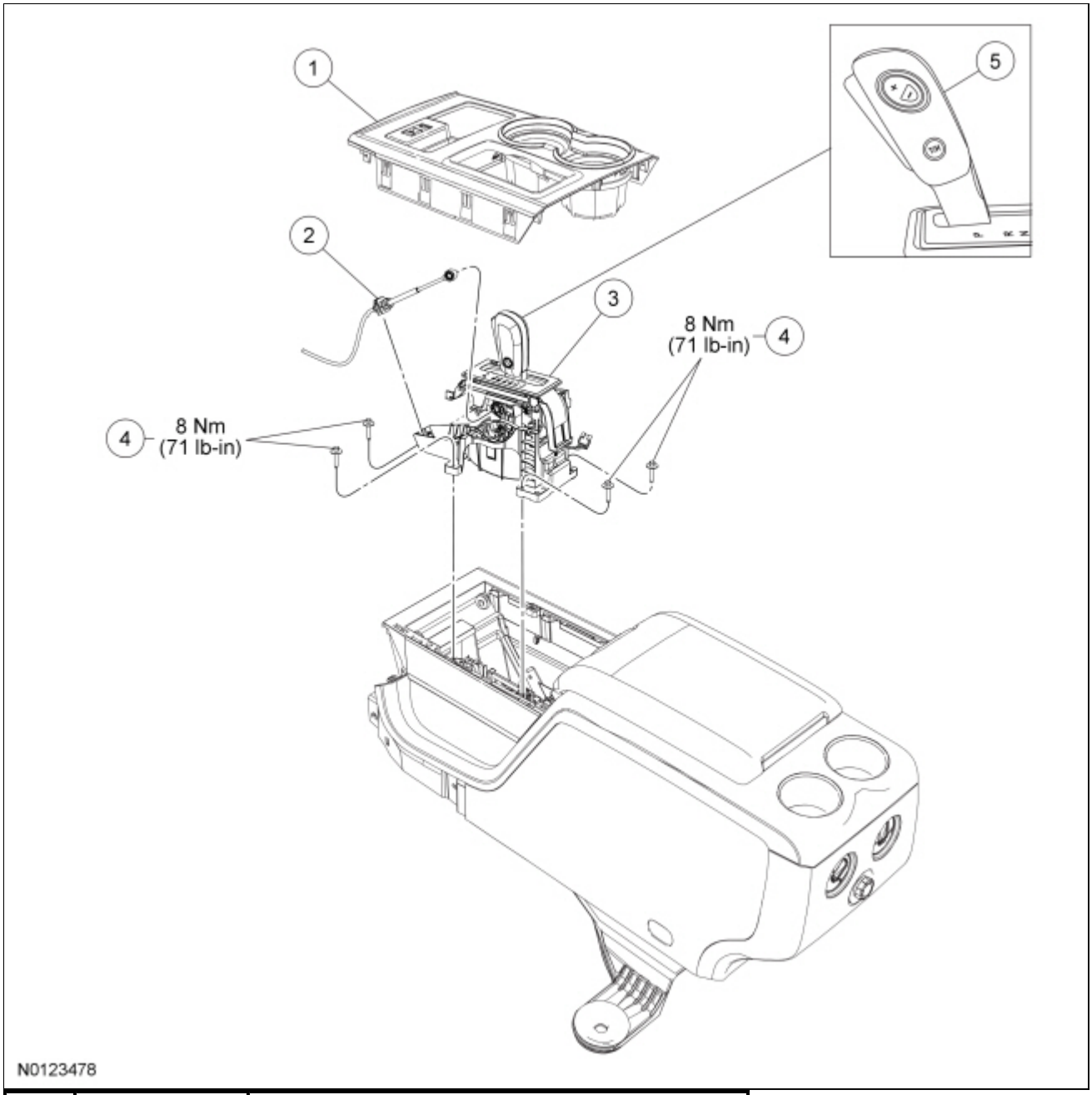
5. To install, reverse the removal procedure.

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Selector Lever — Floor Shift

Selector Lever — Floor Shift

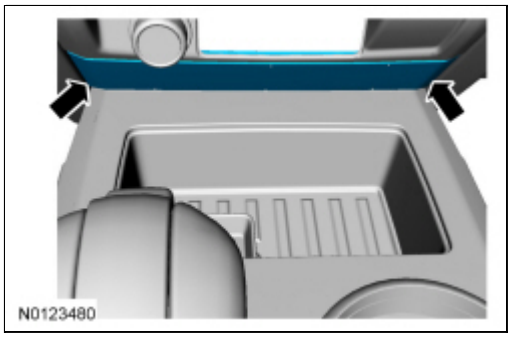


Item	Part Number	Description
1	—	Console upper trim panel
2	7E395	Selector lever cable
3	7210	Selector lever assembly

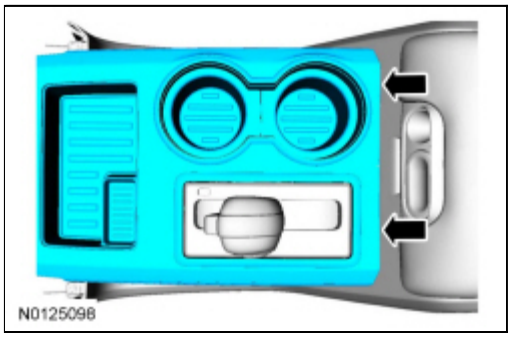
4	N606678-S	Selector lever assembly bolts (4 required)
5	7213	Selector lever knob

Removal

1. Remove the instrument panel to floor console finish panel.

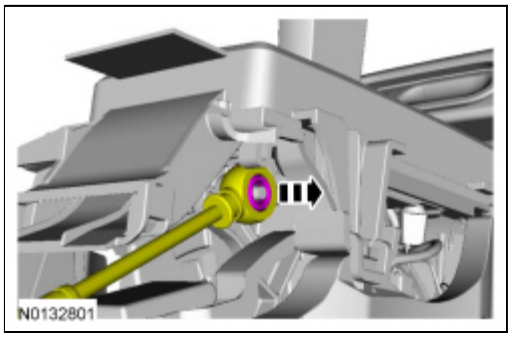


2. Remove the floor console upper finish panel.
   - Starting at the rear of the upper finish panel, carefully pry up the upper finish panel and disconnect the electrical connectors.



3. ***NOTICE:*** **Do not pry on selector lever cable or the selector lever pin may be damaged.**

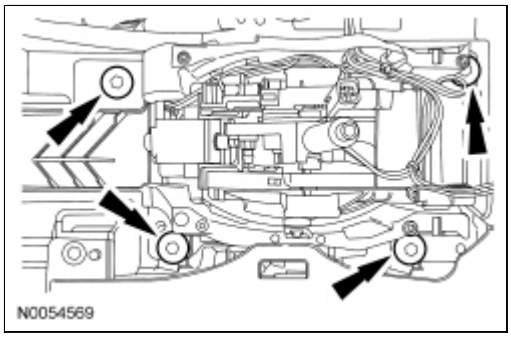
   Disconnect the selector lever cable end from the selector lever pin by gently pulling the selector lever cable end straight off the selector lever arm.



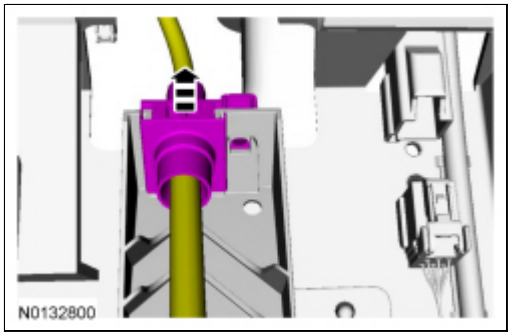
4. **NOTE:** The selector lever bezel has been removed for clarity. Do not remove the selector lever bezel.

   Remove the 4 selector lever assembly bolts.

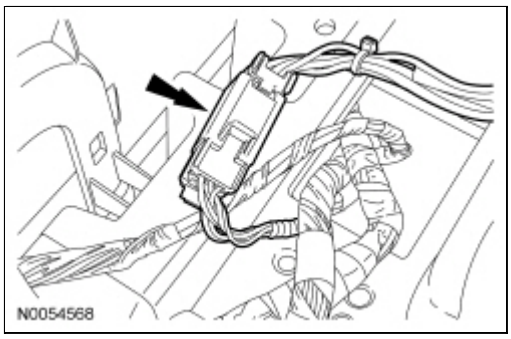
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5. Disconnect the selector lever cable from the selector lever cable bracket.



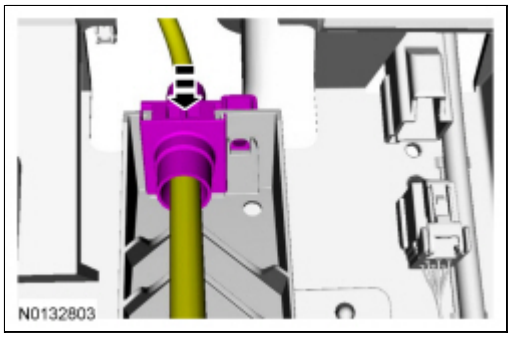
6. Disconnect the selector lever harness connector and remove the selector lever from the vehicle.



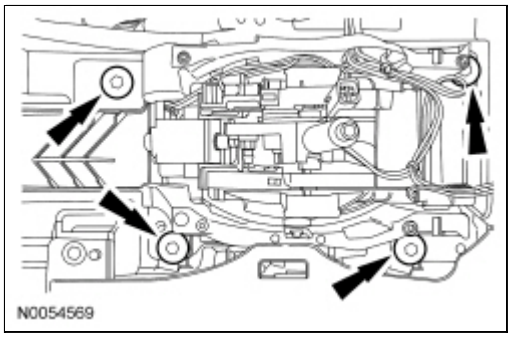
Installation

1. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place. Press the selector lever cable into the bracket and listen for the selector lever cable to click in place. Pull back on the selector lever cable to make sure that it is locked into the bracket.

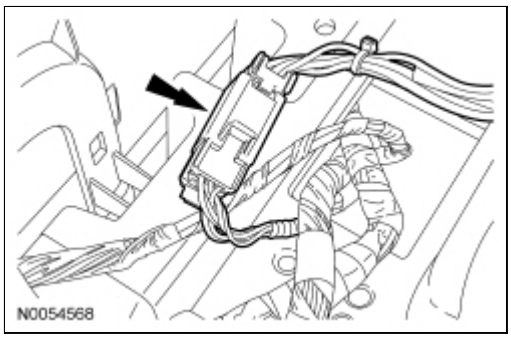
   Install the selector lever cable in the selector lever cable bracket.



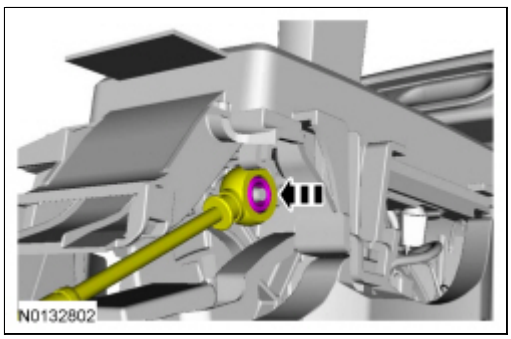
2. Position the selector lever assembly in the console and install the 4 bolts.
    - Tighten to 8 Nm (71 lb-in).



3. Connect the selector lever harness connector.

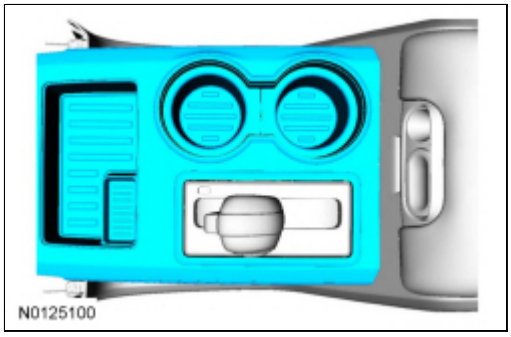


4. Connect the selector lever cable onto the selector lever arm.
    - Listen for the audible click.
    - Pull back on the selector lever cable to make sure that it is installed correctly.

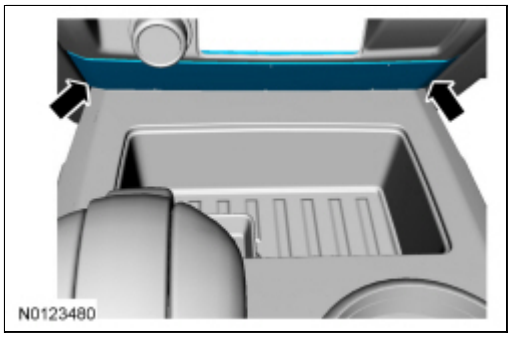


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5. Connect and install the floor console upper finish panel.



6. Install the instrument panel to floor console finish panel.

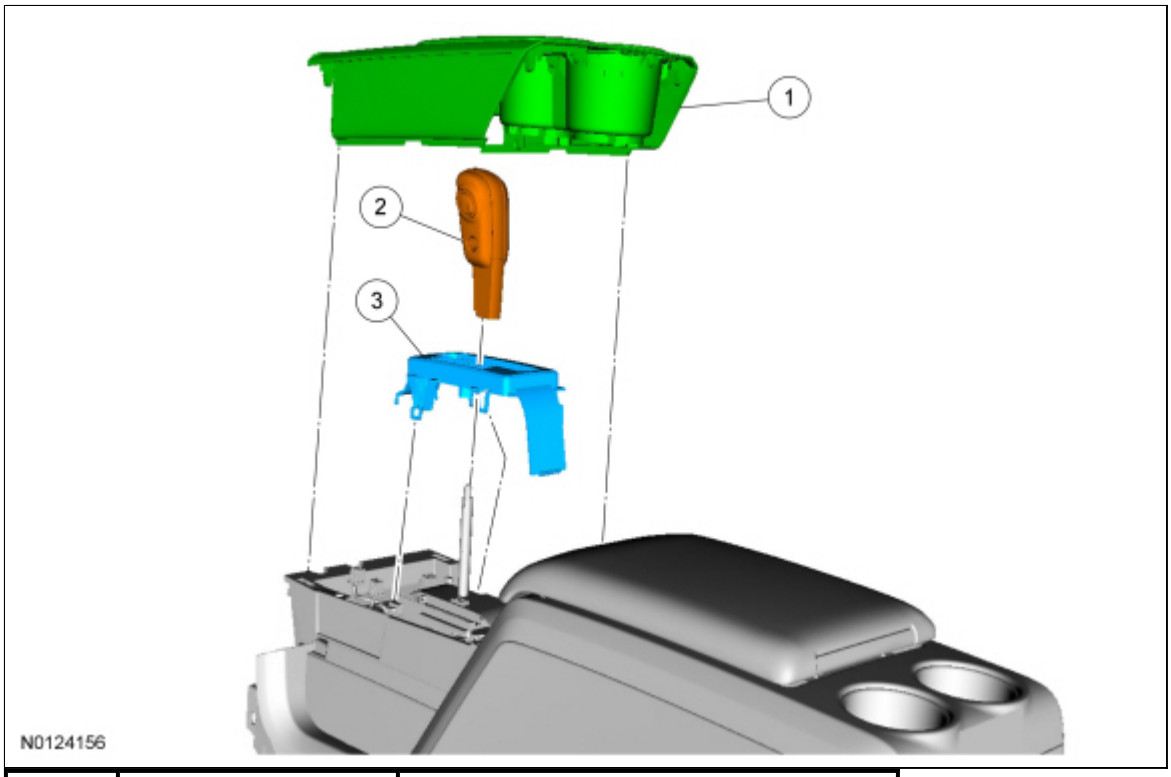


7. Adjust the selector lever cable. For additional information, refer to Selector Lever Cable Adjustment — Floor Shift in this section.

Selector Lever Bezel

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.

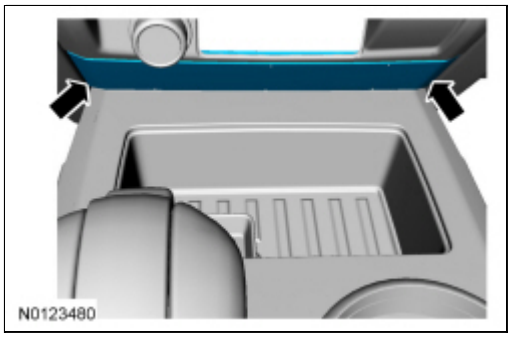


Item	Part Number	Description
1	045A76	Console upper trim panel
2	7213	Selector lever knob
3	7D443	Selector lever bezel

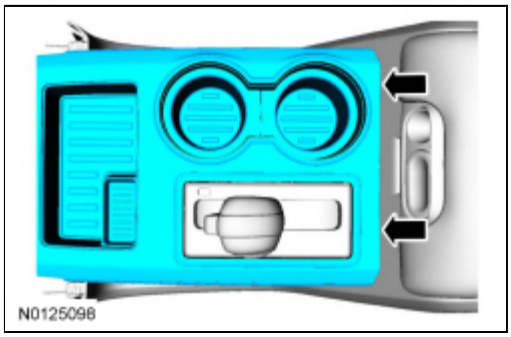
Removal

1. Remove the instrument panel to floor console finish panel.

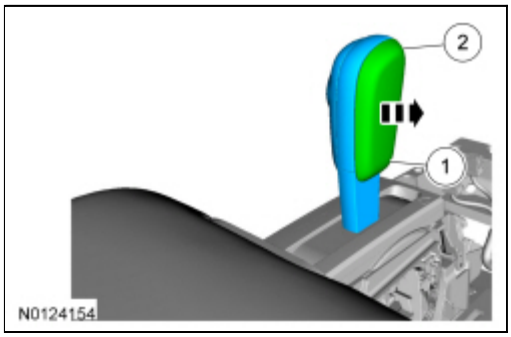
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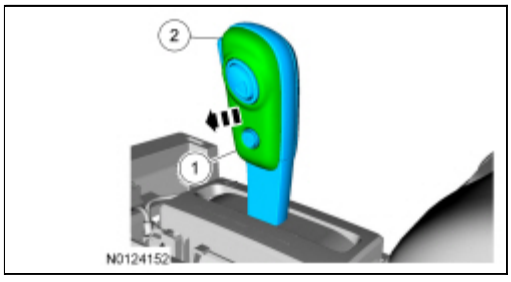
2. Remove the floor console upper finish panel.
    - Starting at the rear of the upper finish panel, carefully pry up the upper finish panel and disconnect the electrical connectors.



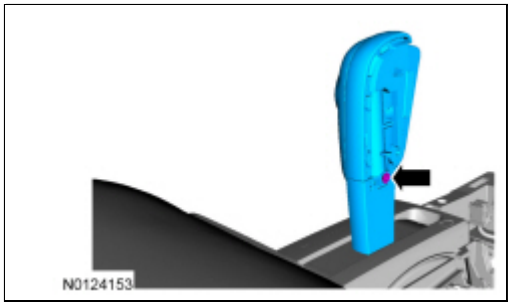
3. Remove and discard the RH selector lever knob cover.
    1. Start at the bottom front.
    2. Move towards the top front and remove the cover.



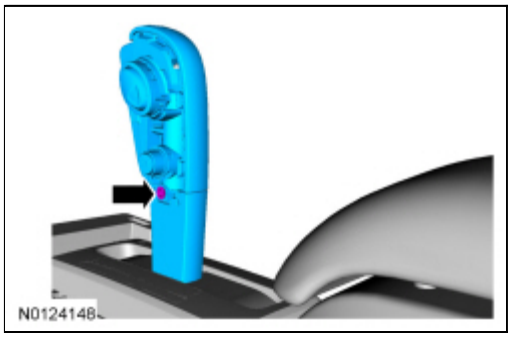
4. Remove and discard the LH selector lever knob cover.
    1. Start at the bottom front.
    2. Move towards the top front and remove the cover.



5. Remove and discard the RH selector lever knob screw.

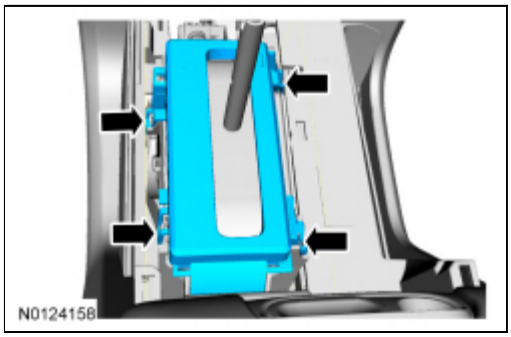


6. Remove and discard the LH selector lever knob screw.

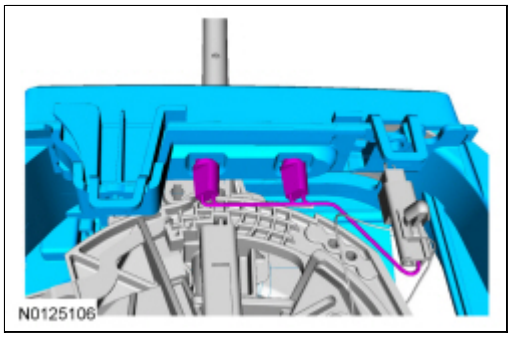


7. Disconnect the select shift and the Tow/Haul electrical connectors and remove the selector lever knob.

8. Lift the tabs on the selector lever bezel and lift the bezel.



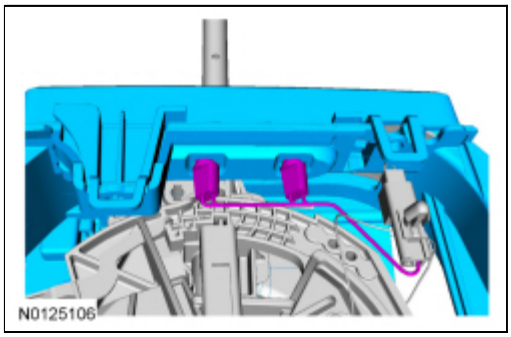
9. Disconnect the electrical harness from the bezel and remove the selector lever bezel.



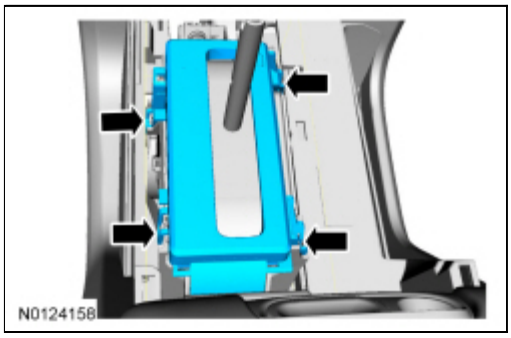
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Installation

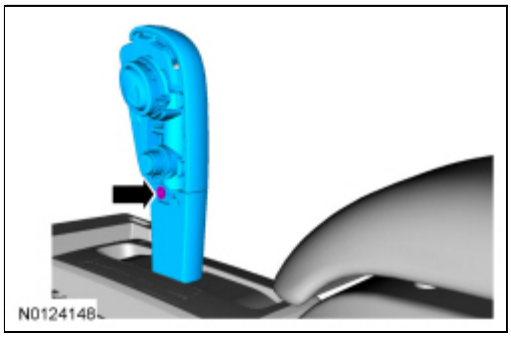
1. Connect the electrical harness to the selector lever bezel.



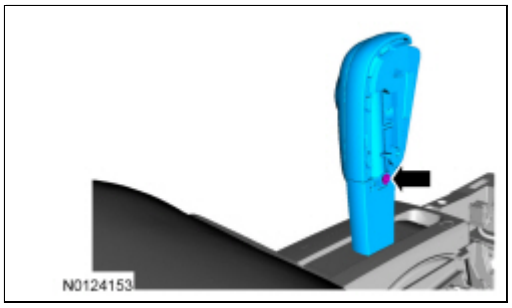
2. Install the selector lever bezel onto the selector lever housing.



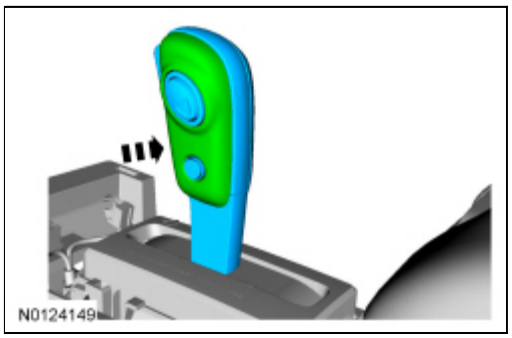
3. Connect the select shift and the Tow/Haul electrical connectors and install the selector lever knob.
4. Install a new LH selector lever knob screw.



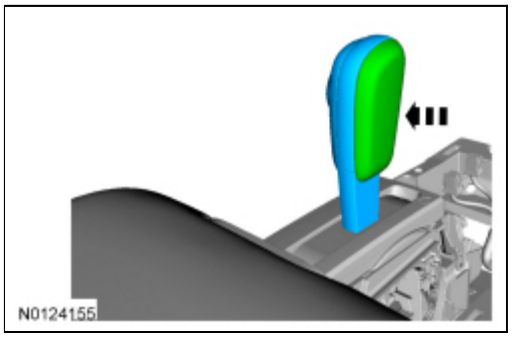
5. Install a new RH selector lever knob screw.



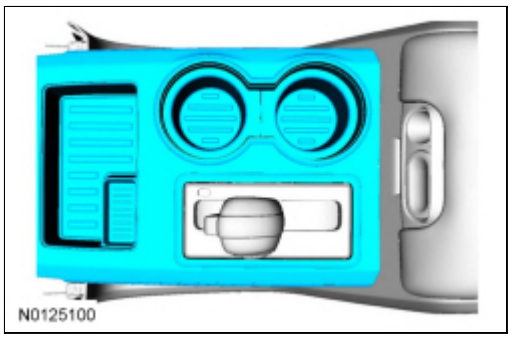
6. Install a new LH selector lever knob cover.



7. Install a new RH selector lever knob cover.

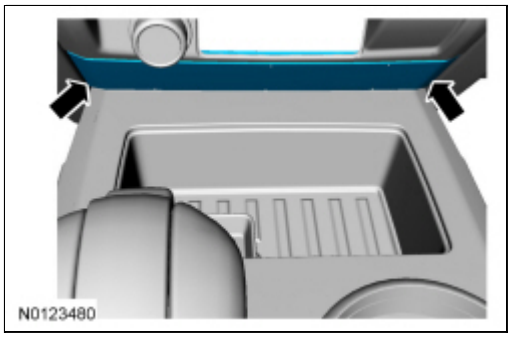


8. Connect and install the floor console upper finish panel.



9. Install the instrument panel to floor console finish panel.

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Selector Lever Button

NOTE: The selector lever button is part of the selector lever knob.

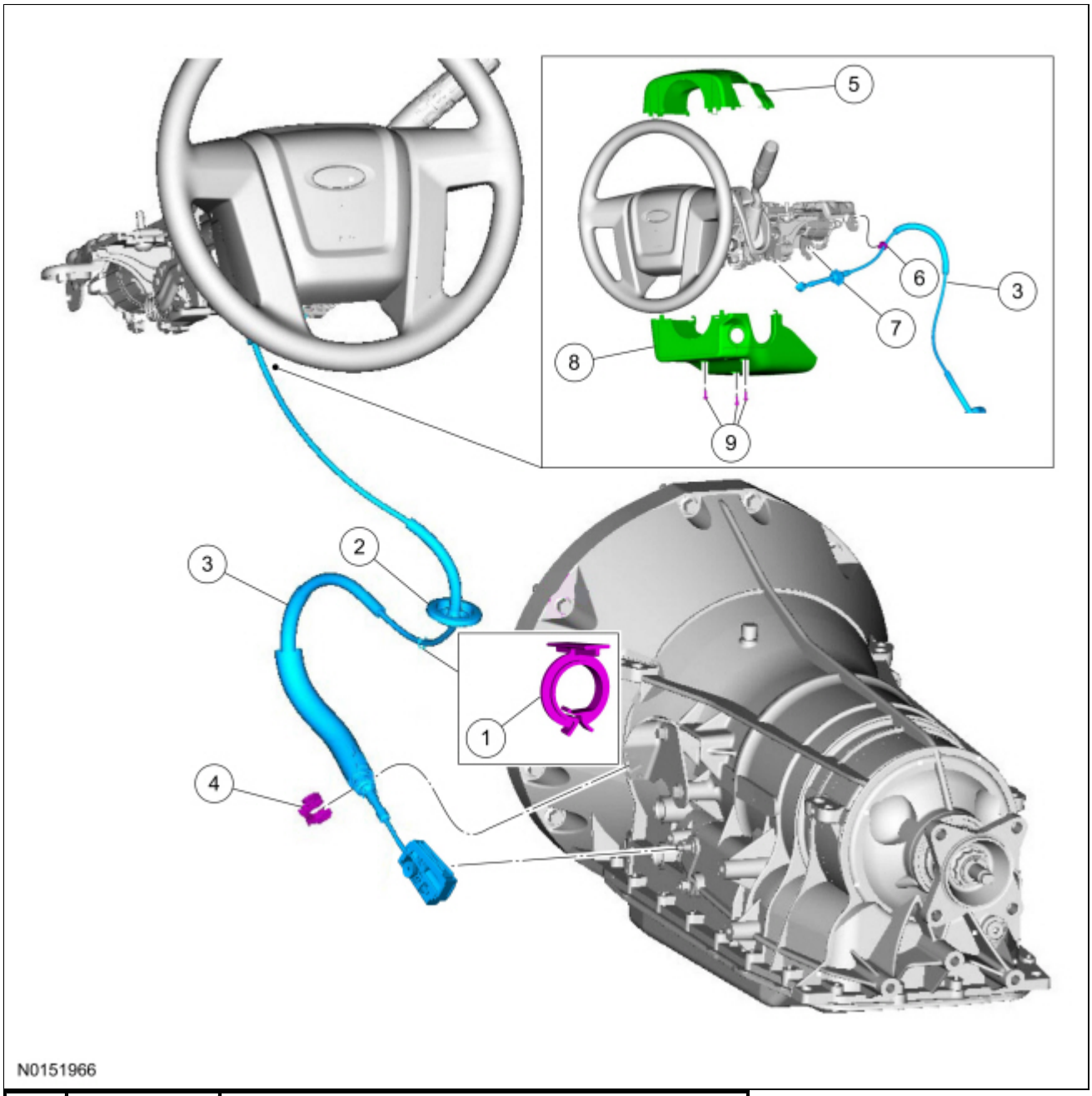
1. To install a new selector button, a new selector lever knob must be installed. For additional information, refer to Selector Lever Knob in this section.

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Selector Lever Cable — Column Shift

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	W708211	Selector lever cable routing clip

2	—	Grommet (part of 7E395)
3	7E395	Selector lever cable
4	7H181	Retaining clip
5	3530	Upper steering column shroud
6	—	Retaining pushpin (part of 7E395)
7	—	Retainer (part of 7E395)
8	3530	Lower steering column shroud
9	W710485	Lower steering column shroud screws (3 required)

Removal

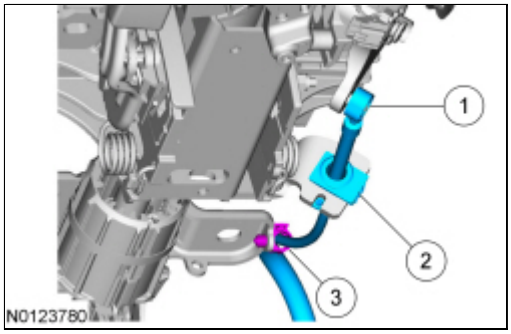
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to Section 100-02 .

2. Remove the steering column shrouds. REFER to Section 211-04 .

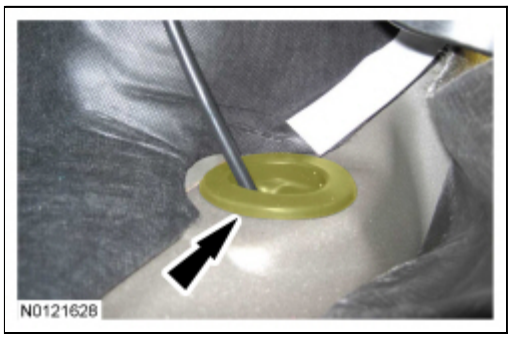
3. Position the selector lever into the D position.

4. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable assembly between the selector lever mechanism and the steering column bracket.**

   Disconnect the selector lever cable from the steering column.
   1. Disconnect the selector lever cable from the selector lever mechanism.
   2. Carefully lift the locking tab and disconnect the selector lever cable from the steering column bracket.
   3. Disconnect the selector lever cable retainer.

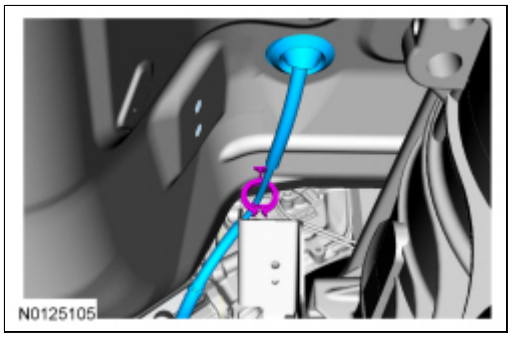


5. Push the rubber grommet and selector lever cable through the floor pan.

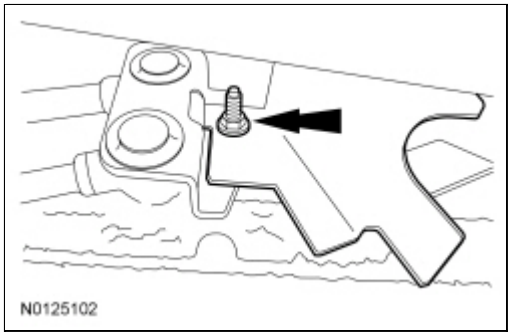


6. Detach the selector lever cable from the routing clip.

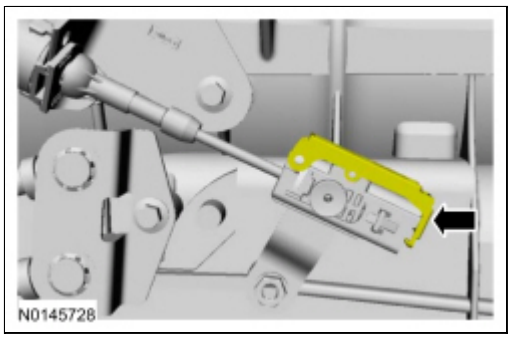
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7. If equipped, remove the nut and the selector lever cable splash shield.

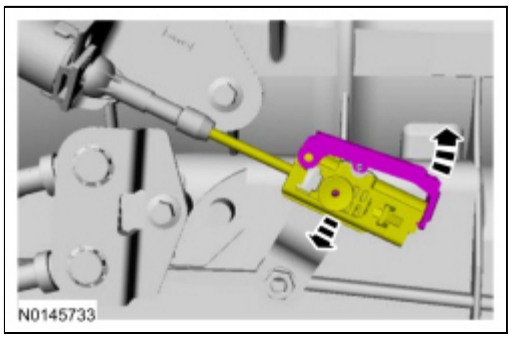


8. Clean cable adjustment lock of any debris.

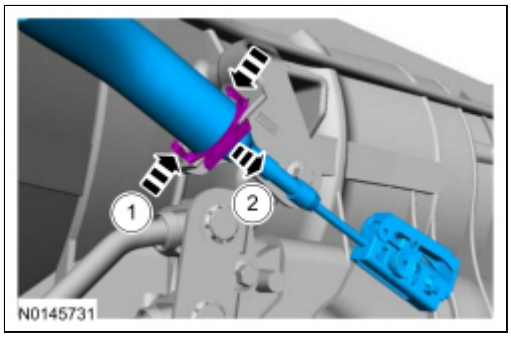


9. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable assembly between the manual control lever and the selector lever cable bracket.**

   Move the locking tab up and disconnect the selector lever cable from the manual control lever.

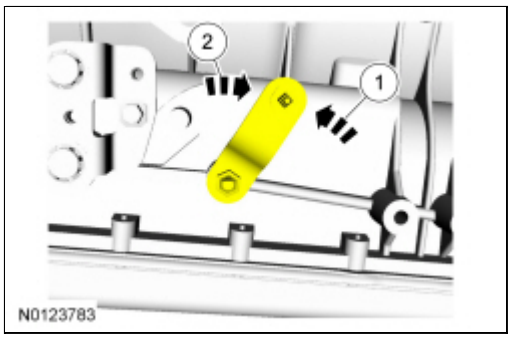


10. Remove the selector lever cable from the selector lever cable bracket.



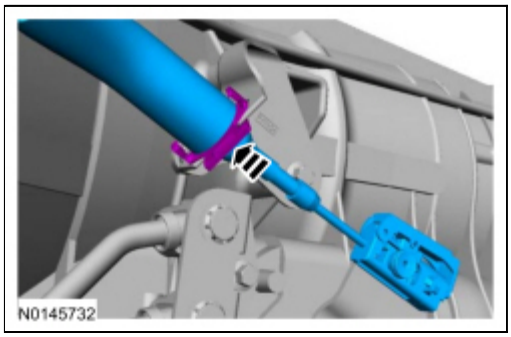
Installation

1. Place the manual control lever in DRIVE.
    1. Rotate the manual lever counterclockwise 3 detents into the manual 1st position.
    2. Rotate the manual lever clockwise 3 detents into Drive.



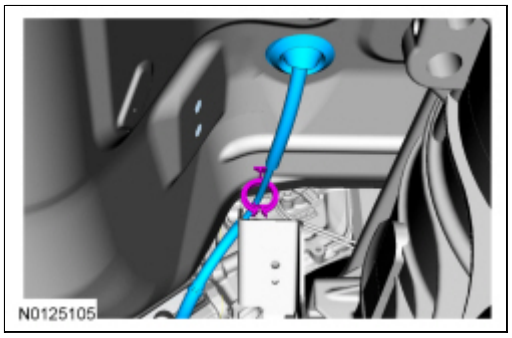
2. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place. Press the selector lever cable into the bracket and listen for the cable to click in place. Pull back on the selector lever cable to make sure that it is locked into the bracket.

   Install the selector lever cable into the selector lever cable bracket.

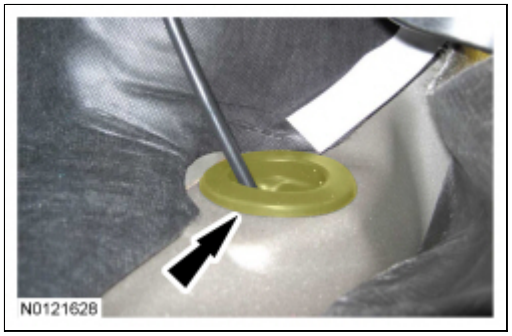


3. Attach the selector lever cable to the routing clip.

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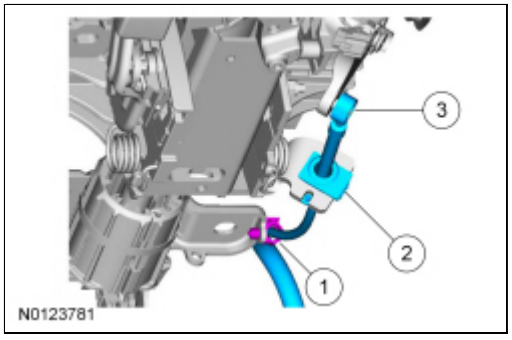


4. Push the rubber grommet and selector lever cable up through the floor pan.



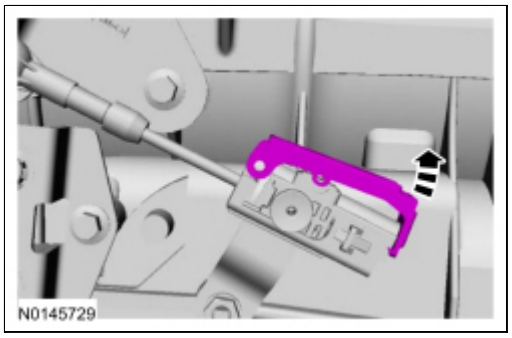
5. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place. Press the selector lever cable into the bracket and listen for the cable to click in place. Pull back on the selector lever cable to make sure that it is locked into the bracket.

   Connect the selector lever cable onto the steering column.
   1. Connect the selector lever cable retainer.
   2. Connect the selector lever cable onto the steering column bracket.
   3. Connect the selector lever cable onto the selector lever mechanism.
      - Listen for the audible click.
      - Pull back on the selector lever cable to make sure that it is correctly installed.

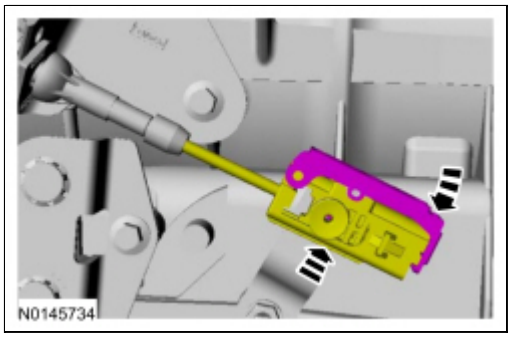


6. Install the steering column shrouds. REFER to Section 211-04 .

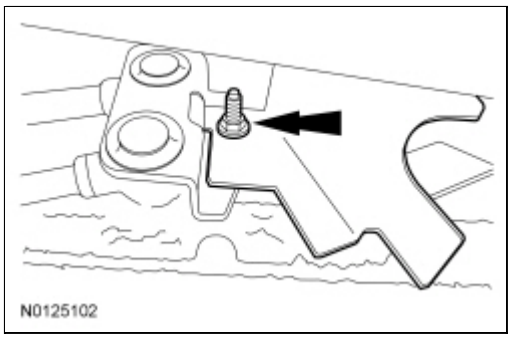
7. Unlock the lock tab on the selector lever cable by sliding it up.



8. Connect the selector lever cable onto the manual control lever and move the locking tab down.
    - Listen for the audible click, then push back on the locking tab to verify it is locked.
    - Pull back on the selector lever cable to verify it is installed correctly to the manual lever.



9. If equipped, install the selector lever cable splash shield and the nut.
    - Tighten to 12 Nm (106 lb-in).



10. Verify the vehicle will start in PARK or NEUTRAL and the backup lamps illuminate in REVERSE.

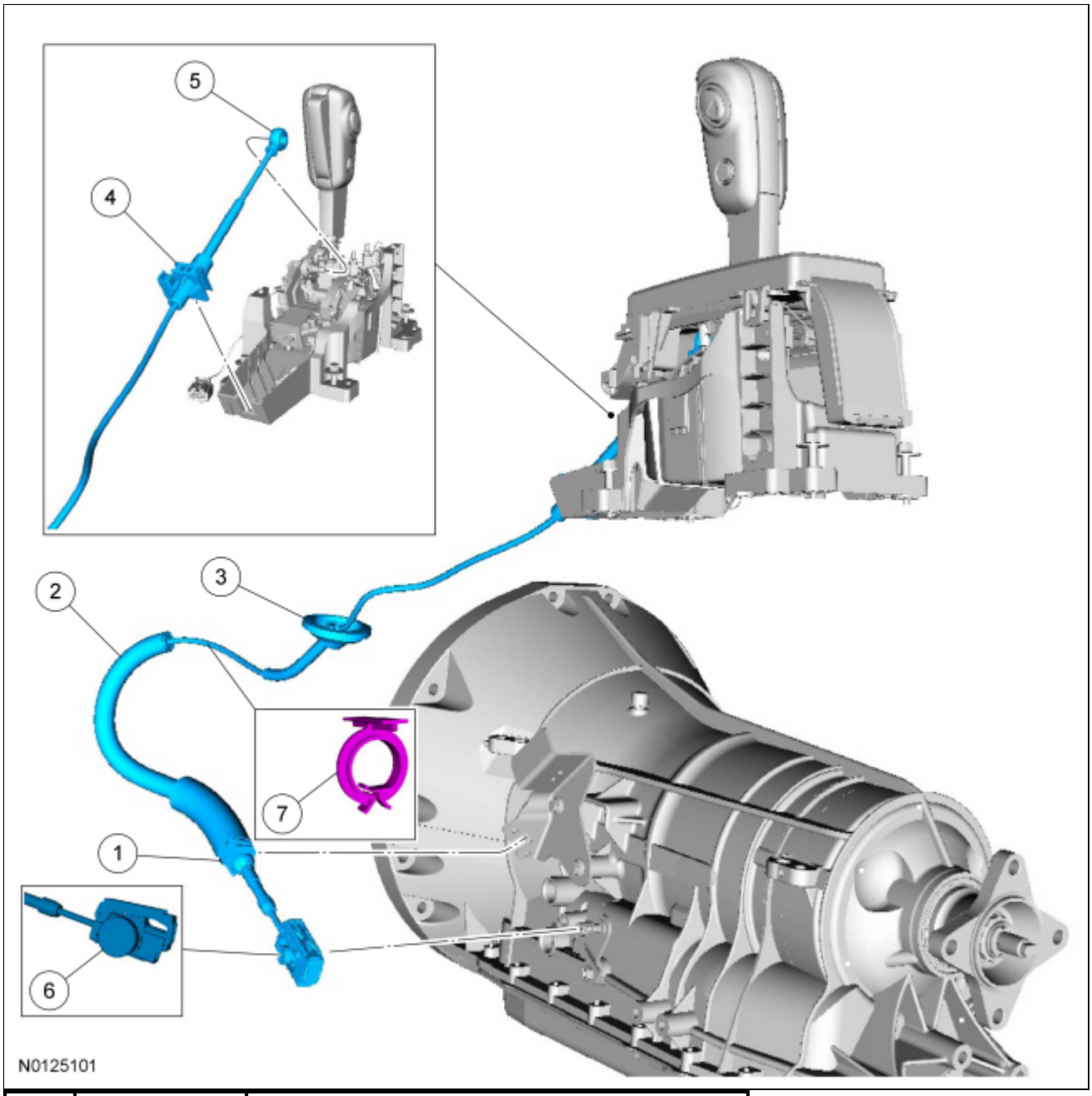
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Selector Lever Cable — Floor Shift

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.



Item	Part Number	Description
1	—	Selector lever cable clip

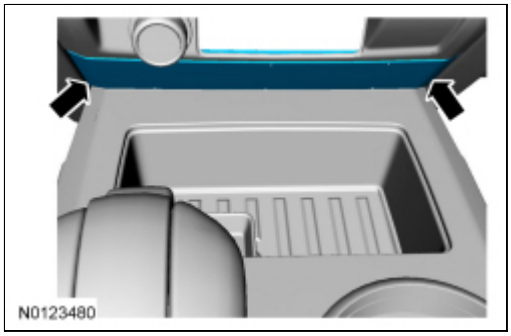
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2	7E395	Selector lever cable
3	—	Rubber grommet (part of 7E395)
4	—	Selector lever cable clip (part of 7E395)
5	—	Selector lever cable eyelet (part of 7E395)
6	—	Heat shield (part of 7E395) (3.5L GTDI)
7	W708211	Selector lever cable routing clip

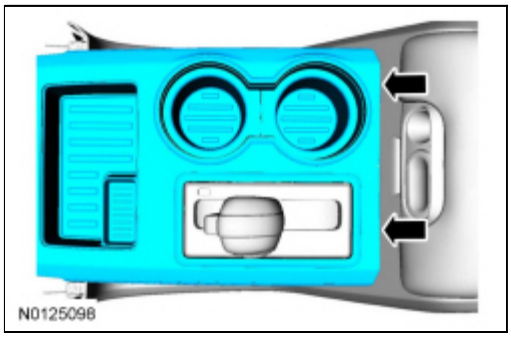
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the instrument panel to floor console finish panel.

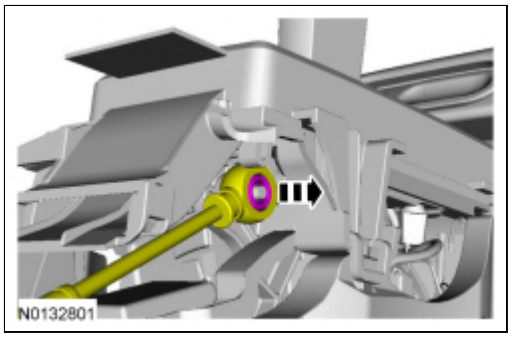


3. Remove the floor console upper finish panel.
   - Starting at the rear of the upper finish panel, carefully pry up the upper finish panel and disconnect the electrical connectors.

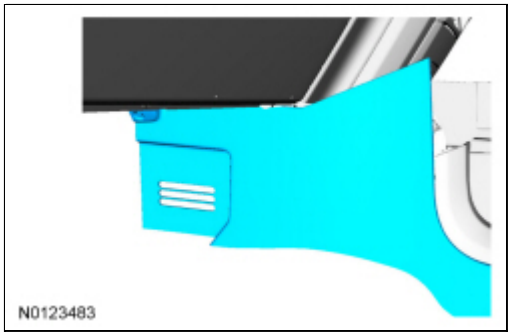


4. ***NOTICE:*** **Do not pry on selector lever cable or the selector lever pin may be damaged.**

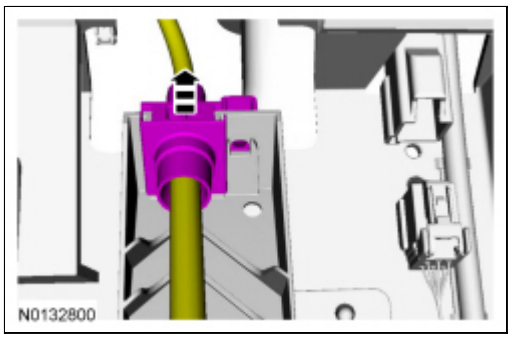
   Disconnect the selector lever cable end from the selector lever pin by gently pulling the selector lever cable end straight off the selector lever arm.



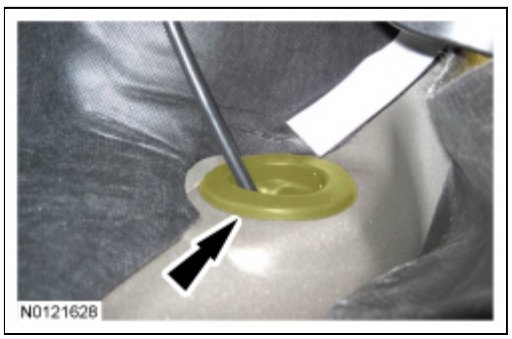
5. Remove the center console LH kick panel.



6. Disconnect the selector lever cable from the selector lever cable bracket.

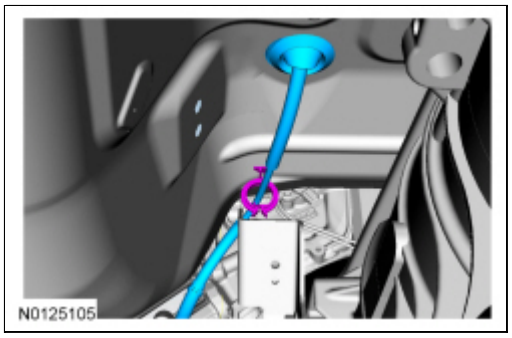


7. Push the rubber grommet and selector lever cable through the floor panel.

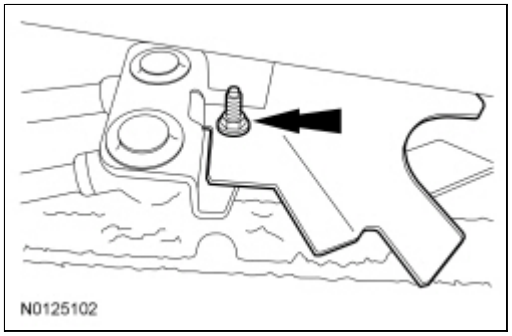


8. Detach the selector lever cable from the routing clip.

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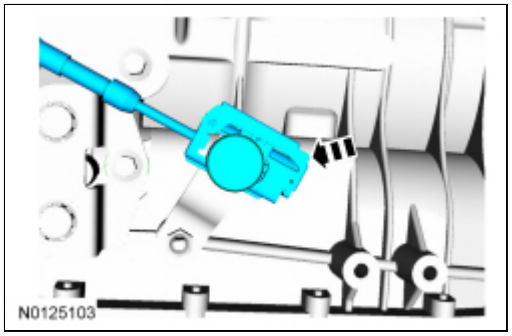


9. If equipped, remove the nut and the selector lever cable splash shield.



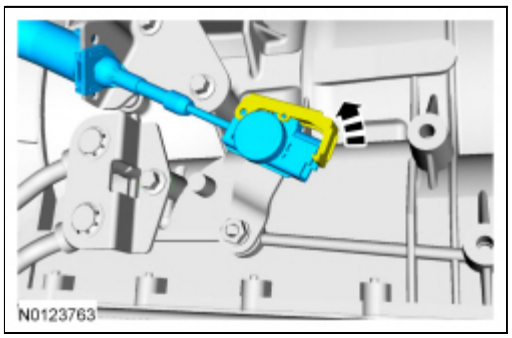
10. **NOTE:** The 3.5L is shown. The 3.7L, 5.0L and 6.2L do not have a heat shield.

    Clean cable adjustment lock of any debris.

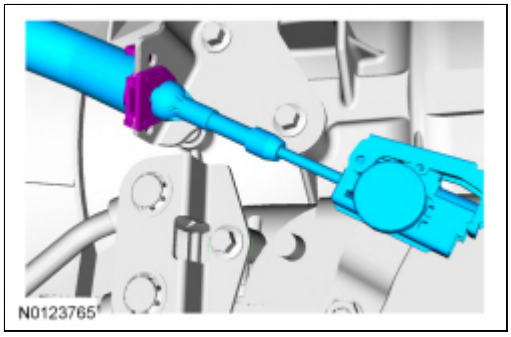


11. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

    Move the locking tab up and disconnect the selector lever cable from the manual control lever.



12. Remove the selector lever cable from the selector lever cable bracket.

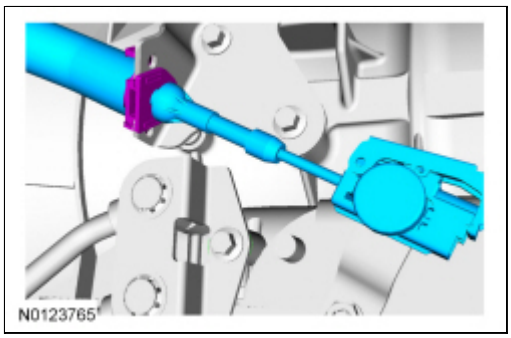


Installation

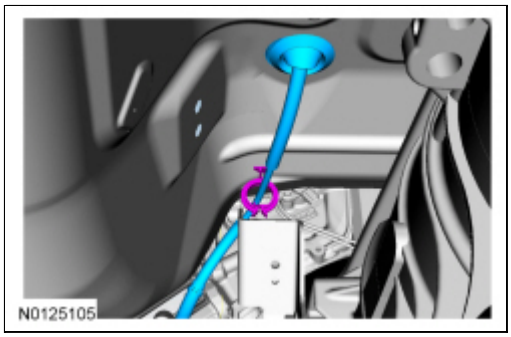
1. ***NOTICE:*** **To prevent selector lever cable damage, do not apply force to the selector lever cable between the manual control lever and the selector lever cable bracket.**

   NOTE: When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place. Press the selector lever cable into the selector lever cable bracket and listen for the selector lever cable to click into place. Pull back on the selector lever cable to make sure that it is locked into the selector lever cable bracket.

   Attach the selector lever cable to the selector lever cable bracket.

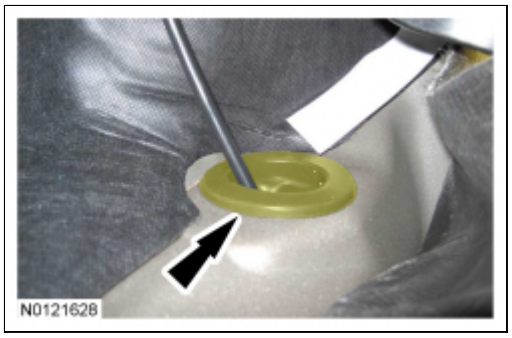


2. Attach the selector lever cable to the routing clip.



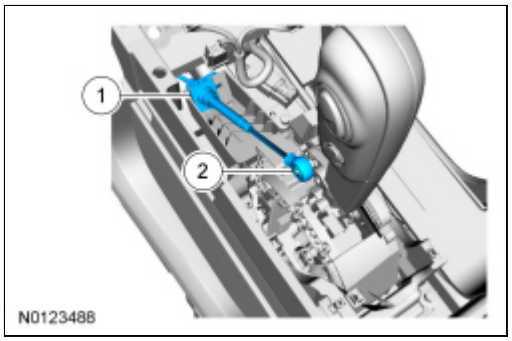
3. Install the rubber grommet and selector lever cable through the floor panel.

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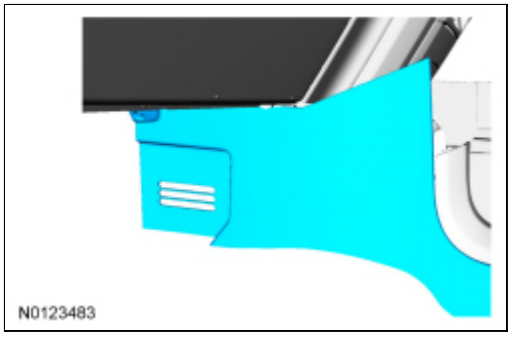


4. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place. Press the selector lever cable into the selector lever cable bracket and listen for the selector lever cable to click into place. Pull back on the selector lever cable to make sure that it is locked into the selector lever cable bracket.

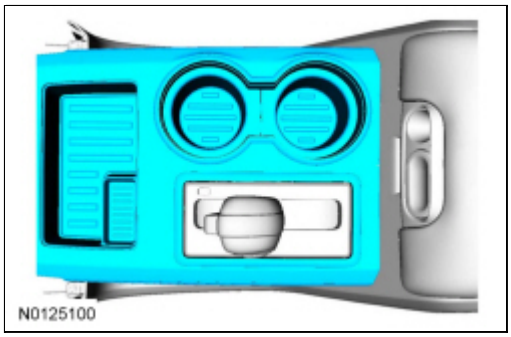
   Connect the selector lever cable onto the selector lever.
   1. Connect the selector lever cable onto the selector lever cable bracket.
   2. Connect the selector lever cable onto the selector lever arm.
      - Listen for the audible click.
      - Pull back on the selector lever cable to make sure that it is installed correctly.



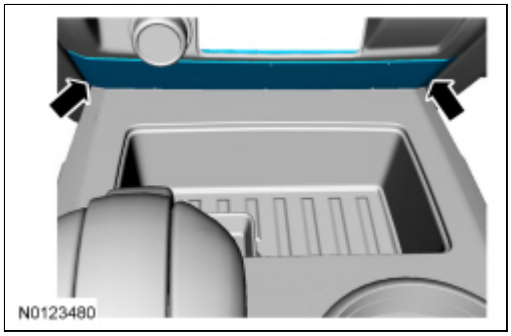
5. Install the center console LH kick panel.



6. Connect and install the floor console upper finish panel.

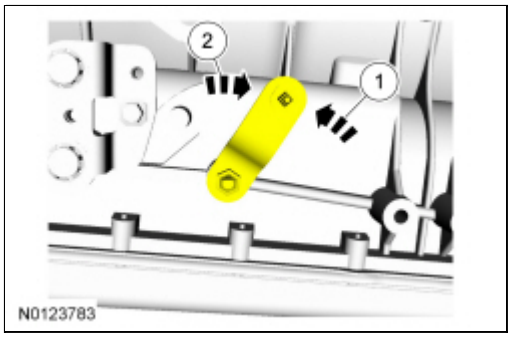


7. Install the instrument panel to floor console finish panel.



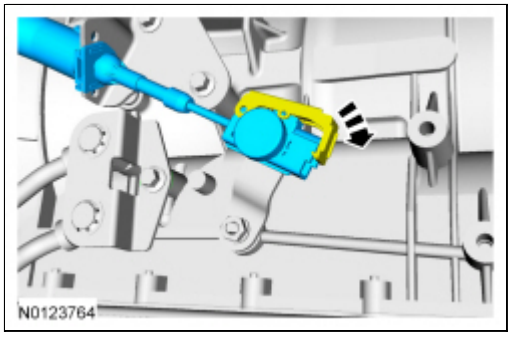
8. Place the selector lever in DRIVE.

9. Place the manual control lever in DRIVE.
    1. Rotate the manual lever counterclockwise 3 detents into the manual 1st position.
    2. Rotate the manual lever clockwise 3 detents into Drive.

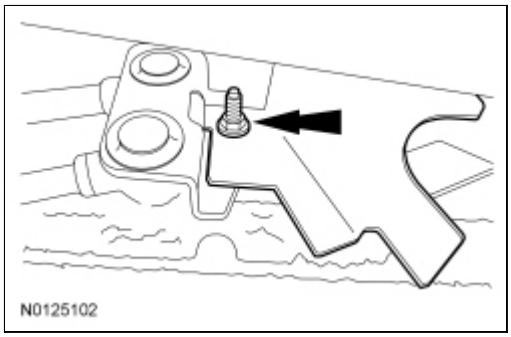


10. Connect the selector lever cable onto the manual control lever and move the locking tab down.
    - Listen for the audible click, then push back on the locking tab to verify it is locked.
    - Pull back on the selector lever cable to verify it is installed correctly to the manual lever.

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11. If equipped, install the selector lever cable splash shield and the nut.
    - Tighten to 12 Nm (106 lb-in).

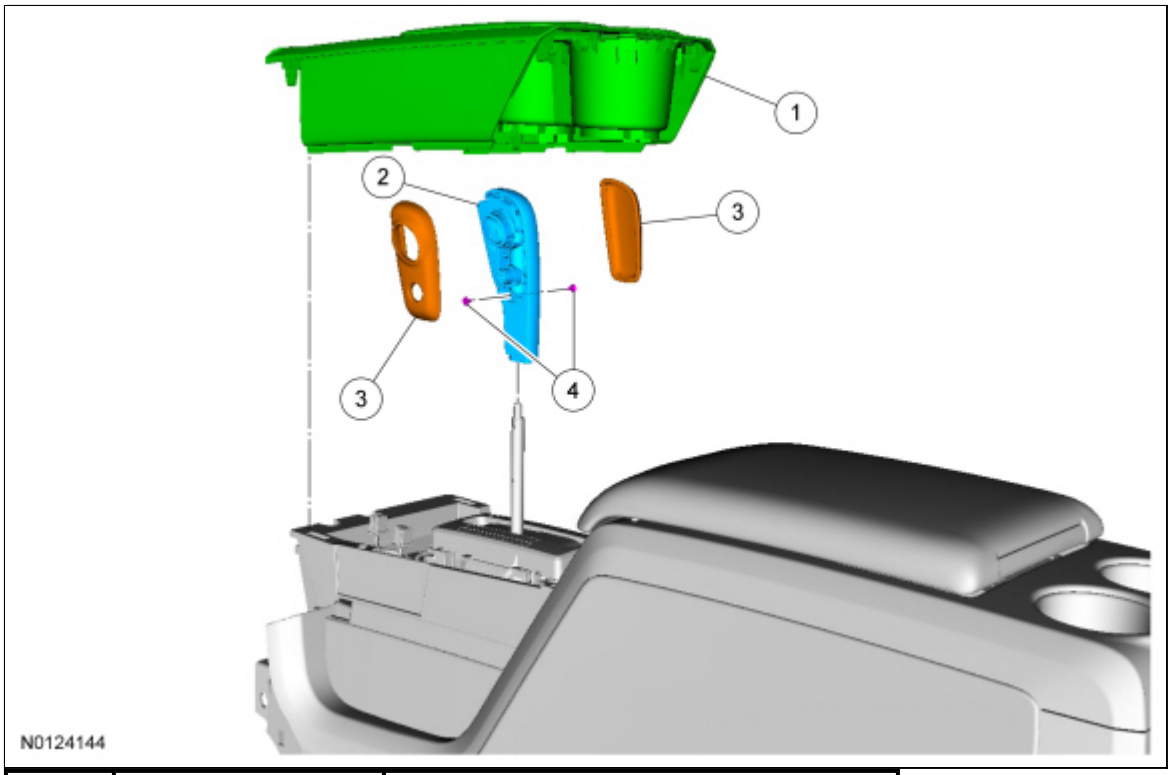


12. Verify the vehicle will start in PARK or NEUTRAL and the backup lamps illuminate in REVERSE.

Selector Lever Knob

NOTE: Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.

NOTE: Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.

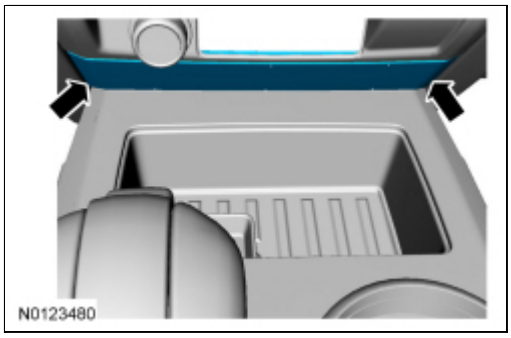


Item	Part Number	Description
1	—	Console upper trim panel
2	7213	Selector lever knob
3	7L468	Selector lever knob covers
4	W790088	Selector lever knob screws

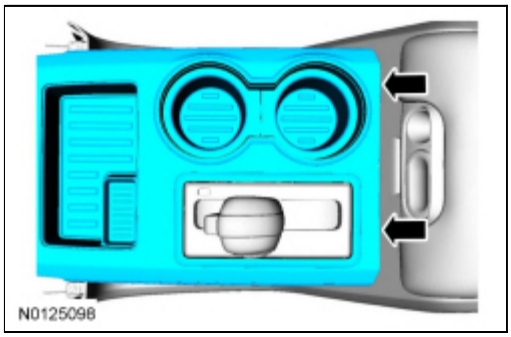
Removal

1. Remove the instrument panel to floor console finish panel.

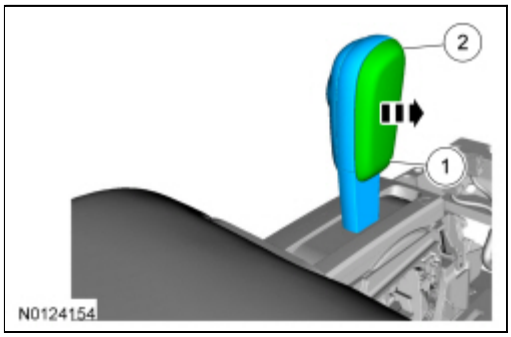
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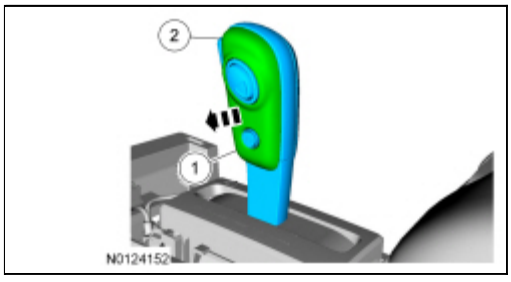
2. Remove the floor console upper finish panel.
    - Starting at the rear of the upper finish panel, carefully pry up the upper finish panel and disconnect the electrical connectors.



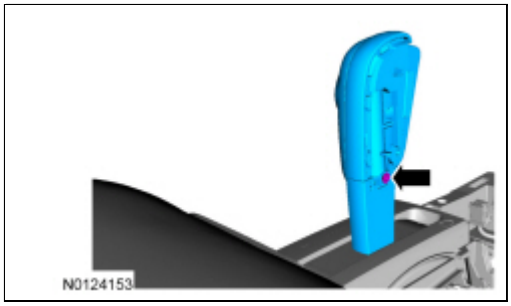
3. Remove and discard the RH selector lever knob cover.
    1. Start at the bottom front.
    2. Move towards the top front and remove the cover.



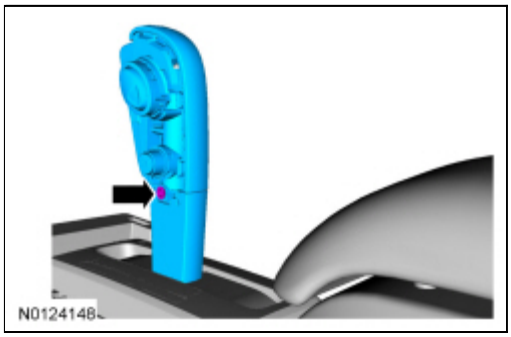
4. Remove and discard the LH selector lever knob cover.
    1. Start at the bottom front.
    2. Move towards the top front and remove the cover.



5. Remove and discard the RH selector lever knob screw.



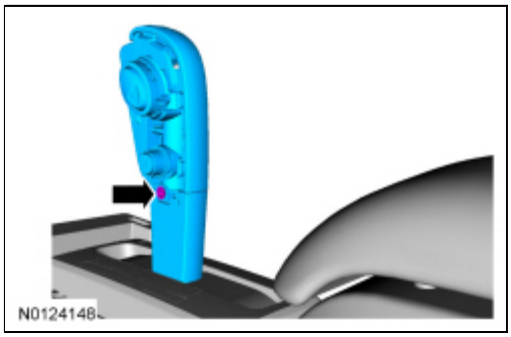
6. Remove and discard the LH selector lever knob screw.



7. Disconnect the SelectShift™ and the Tow/Haul electrical connectors and remove the selector lever knob.

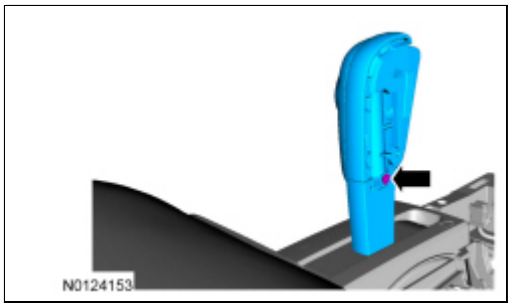
Installation

1. Connect the SelectShift™ and the Tow/Haul electrical connectors and install the selector lever knob.
2. Install a new LH selector lever knob screw.

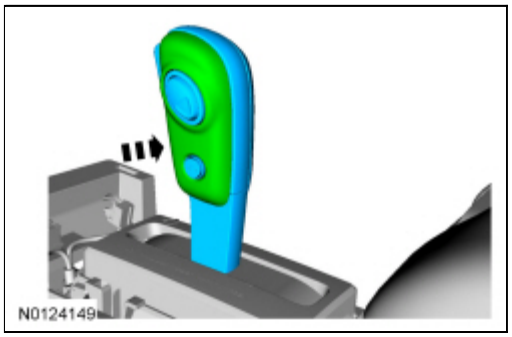


3. Install a new RH selector lever knob screw.

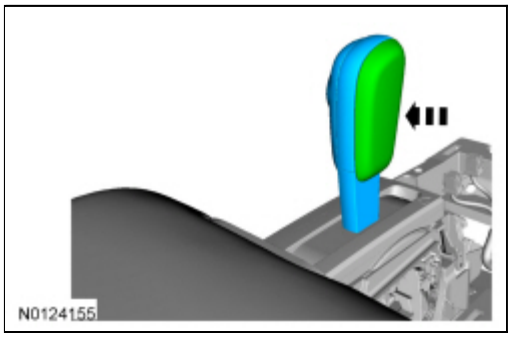
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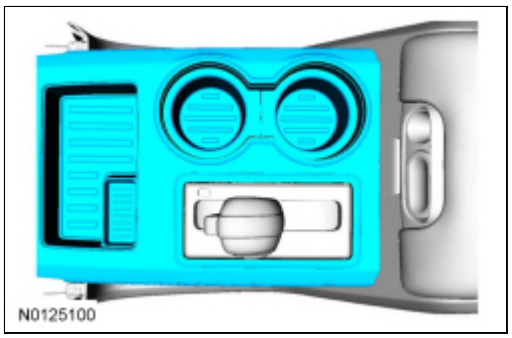
4. Install a new LH selector lever knob cover.



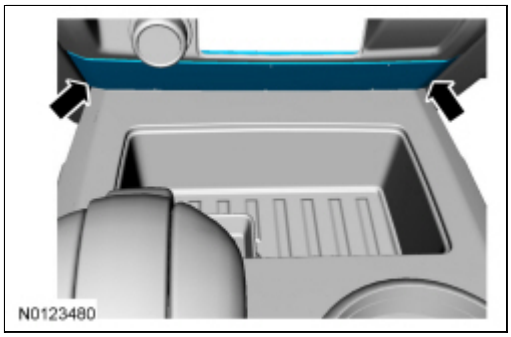
5. Install a new RH selector lever knob cover.



6. Connect and install the floor console upper finish panel.

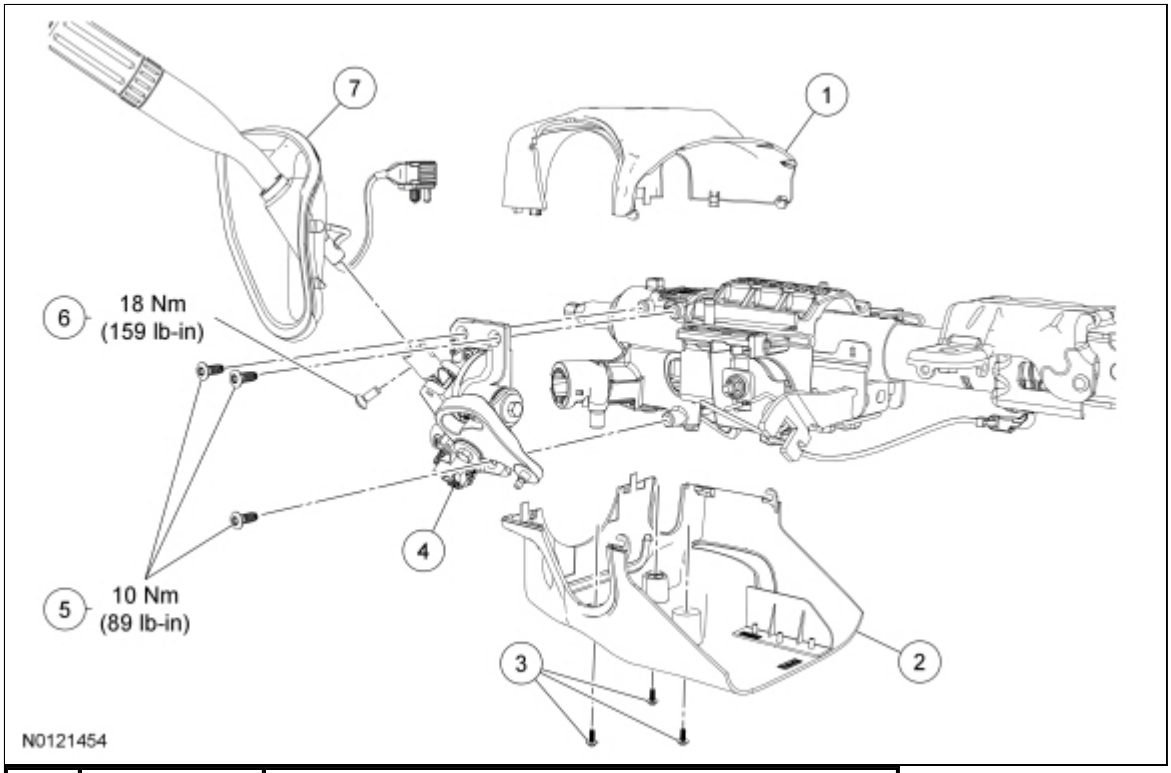


7. Install the instrument panel to floor console finish panel.



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Selector Lever Mechanism — Column Shift



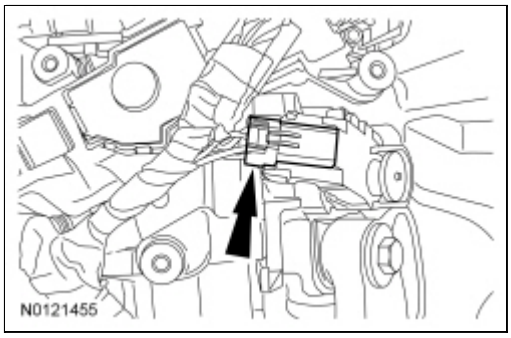
Item	Part Number	Description
1	3530	Upper steering column shroud
2	3530	Lower steering column shroud
3	W710485	Lower steering column shroud screws (3 required)
4	7210B	Selector lever mechanism
5	W790181	Selector lever mechanism bolts (3 required)
6	—	Selector lever bolt (part of 7210A)
7	7210A	Selector lever

Removal and Installation

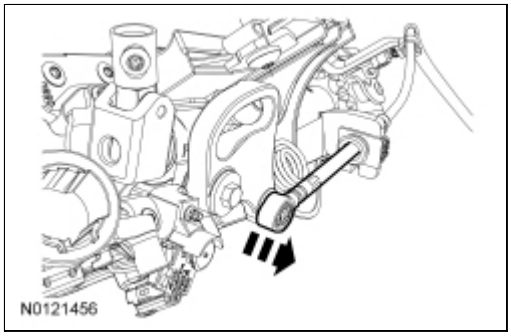
1. **NOTE:** To access the top selector lever mechanism bolts, position the selector lever in NEUTRAL before removing the selector lever.

   Remove the selector lever. For additional information, refer to Selector Lever — Column Shift in this section.

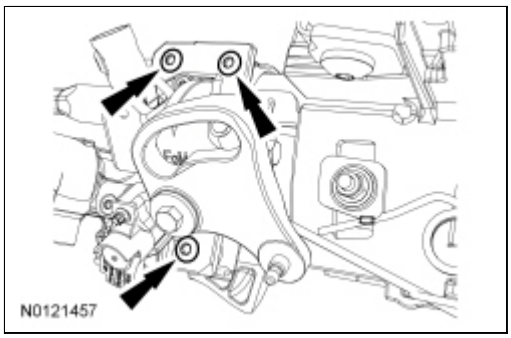
2. Disconnect the Brake Shift Interlock Actuator (BSIA) electrical connector.



3. Disconnect the selector lever cable.



4. Remove and discard the 3 bolts and remove the selector lever mechanism.
    - To install, tighten to 10 Nm (89 lb-in).



5. To install, reverse the removal procedure.

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SelectShift™ Switch — Column Shift

Removal and Installation

NOTE: The SelectShift™ switch is part of the selector lever.

1. To install a new SelectShift™ switch, a new selector lever must be installed. For additional information, refer to Selector Lever — Column Shift in this section.

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SelectShift™ Switch — Floor Shift

NOTE: The SelectShift™ switch is part of the selector lever knob.

1. To install a new SelectShift™ switch, a new selector lever knob must be installed. For additional information, refer to Selector Lever Knob in this section.

Tow/Haul Switch — Column Shift

Removal and Installation

NOTE: The Tow/Haul switch is part of the selector lever.

1. To install a new Tow/Haul switch, a new selector lever must be installed. For additional information, refer to Selector Lever — Column Shift in this section.

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Tow/Haul Switch — Floor Shift

NOTE: The Tow/Haul switch is part of the selector lever knob.

1. To install a new Tow/Haul switch, a new selector lever knob must be installed. For additional information, refer to Selector Lever Knob in this section.

Material

Item	Specification	Fill Capacity
Ultra Silicone Sealant TA-29	—	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Axle nut	40	30	—
Front brake flexible hose bracket bolt	12	—	106
Integrated Wheel End (IWE) bolts	12	—	106
Shift lever assembly-to-floorpan bolt	24	18	—
Tie-rod nut	115	85	—
Transfer Case Control Module (TCCM) screws	7	—	62
Transfer case shift motor bolts	10	—	89
Transfer case shift motor bracket bolt	10	—	89
Transfer case shift motor bracket nut	3	—	27
Upper ball joint nut	115	85	—
Wheel speed sensor harness bracket bolt	12	—	106

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Four Wheel Drive (4WD) Systems

Electronic Shift-On-The-Fly (ESOF) System

The Electronic Shift-On-The-Fly (ESOF) system consists of the following components:

- Mode Select Switch (MSS), located on the instrument panel
- Transfer Case Control Module (TCCM), located near the passenger kick panel
- Integrated Wheel End (IWE) solenoid, located in left rear of the engine compartment
- Integrated Wheel Ends (IWEs), located at each front wheel hub
- Transfer case assembly (includes shift motor and synchronization clutch)

Vehicles equipped with an ESOF system allow the operator to choose between 2-Wheel Drive (2WD) (2H) and 2 different Four-Wheel Drive (4WD) modes. The transfer case is shifted electronically based on the MSS position. Under normal driving conditions, the transfer case is in 2WD (2H), but when desired, the operator may shift into 4WD high (4H) or 4WD low (4L). The operator can shift between 2WD (2H) and 4WD high (4H) at any speed. When shifting into or out of 4WD low (4L) range, the TCCM requires that the vehicle speed is less than 5 km/h (3 mph) and the transmission in NEUTRAL.

The transfer case is equipped with an electronically controlled clutch which is located inside the case. This clutch is used to synchronize the speed of the front driveline with the rear driveline during 2WD (2H) to 4WD high (4H) shifts.

2-Speed Torque-On-Demand

The 2-speed torque-on-demand system consists of the following components:

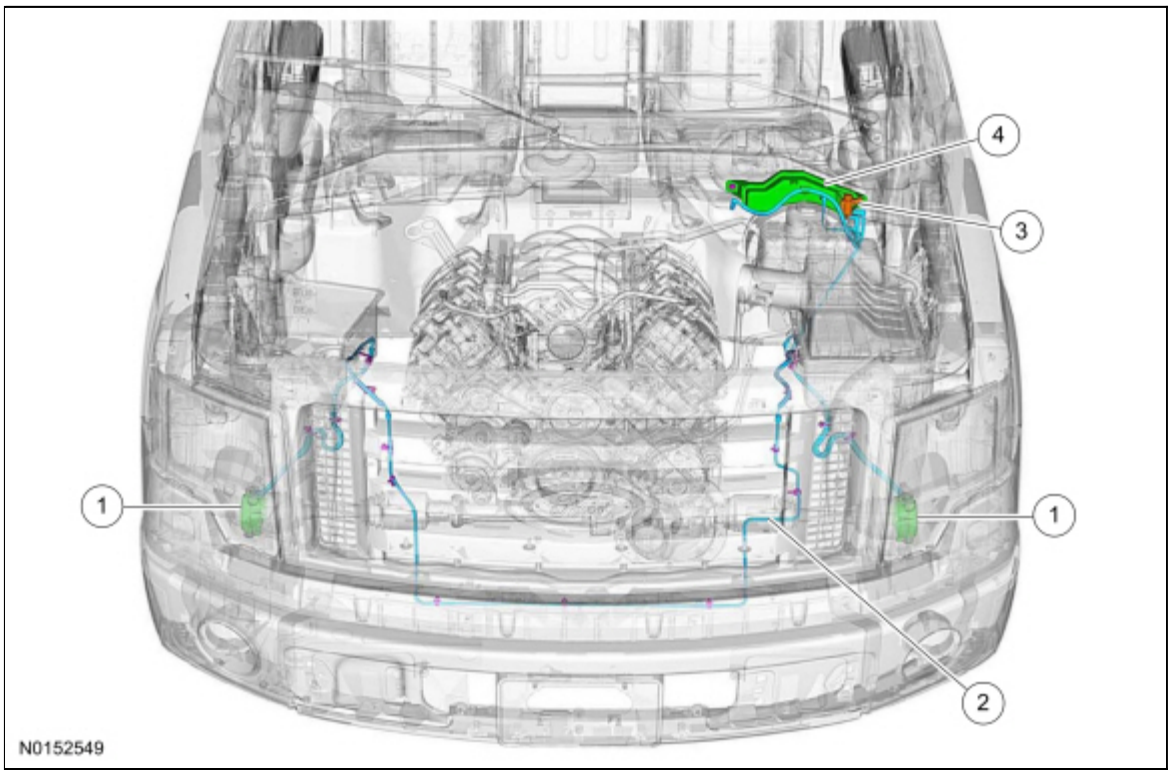
- MSS , located on the instrument panel
- TCCM , located near the passenger kick panel
- IWE solenoid, located in left rear of the engine compartment
- IWEs , located at each front wheel hub
- Transfer case assembly (includes shift motor and synchronization clutch)

Vehicles equipped with the 2-speed torque-on-demand system allow the operator to choose between 2WD and 3 different 4WD modes. The transfer case is shifted electronically based on the MSS position. Under normal driving conditions, the unit is in 2WD (2H), but when desired, the operator may shift into 4WD AUTO (4A), 4WD high (4H), or 4WD low (4L). When shifting into or out of 4WD (4L) range, the TCCM requires that the vehicle speed is less than 5 km/h (3 mph) and the transmission is in NEUTRAL.

The transfer case is equipped with an electronically controlled clutch which is located inside the case. This clutch is used to synchronize the speed of the front driveline with the rear driveline during 2WD (2H) to 4WD high (4H) or 4WD AUTO (4A) shifts. The clutch also provides torque to the front driveline in all 4WD modes.

Integrated Wheel End (IWE) System

The IWE system consists of the following components:



1	IWEs (spring-loaded vacuum hubs)
2	Vacuum hoses
3	IWE solenoid
4	Vacuum reservoir

The IWE system, used on ESOF and 2-speed torque-on-demand equipped vehicles, uses vacuum hubs that engage or disengage the front wheel hubs from the front halfshafts.

The IWE solenoid receives engine vacuum from the vacuum reservoir. When the 4WD system is in 2H mode, the TCCM supplies a ground path to the IWE solenoid to apply vacuum to the IWEs (disengaging the front hubs from the front halfshafts). When operating in any 4x4 mode, the TCCM does not supply the ground path to the IWE solenoid, vacuum is not applied to the IWEs and an internal spring keeps the front hubs engaged to the front halfshafts. Vehicles equipped with a 3.5L engine are also equipped with an electrically-driven brake booster vacuum pump located behind the LH headlamp assembly. For additional information, refer to Section 206-07 . As a first step in service, eliminate obvious items such as loose wiring connections, loose vacuum connections or damaged vacuum lines.

Electronic Locking Differential (ELD) System

The Electronic Locking Differential (ELD) system consists of the following components:

- ELD field coil, located at the rear differential

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- Rear differential
- MSS (unique for ELD equipped vehicles, the ELD switch is integrated with the MSS), located on instrument panel

The optional ELD system, allows the operator to lock the rear differential side gears on slippery and/or off road surfaces. ELD operation is requested by pulling out on the MSS on 4X4 equipped vehicles, and by rotating the switch from OFF to ON on 4x2 vehicles.

Off-Road Mode

NOTE: Off-road mode is specifically calibrated for off-road driving conditions and should never be used on pavement.

The SVT Raptor comes equipped with a special off-road function. An off-road button is located on the floor console. A light on the button illuminates when this feature is activated.

The off-road function consists of the following components:

- Off-road mode switch
- TCCM

Off-road mode affects 4 vehicle functions:

- It allows unique transmission shifting that optimizes off-road performance.
- Off-road mode provides optimized throttle response tailored for off-road performance driving.
- When off-road mode is engaged, the standard vehicle speed thresholds for the ELD are lifted.
- When off-road mode is engaged, the AdvanceTrac settings are altered for optimized off-road performance.

Neutral Flat Tow

***NOTICE:* 2WD vehicles cannot be towed with any wheels on the ground as vehicle or transmission damage may occur.**

***NOTICE:* Failing to put the transfer case in the NEUTRAL position will damage vehicle components.**

Vehicles equipped with a Four-Wheel Drive (4WD) system have neutral flat tow software in the TCCM . Following the neutral flat tow activation procedure commands the transfer case shift motor into a neutral position. Locking the transfer case in neutral will prevent damage to the transmission while towing a 4WD vehicle on all 4 wheels (such as when being towed behind a motorhome).

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Neutral Flat Tow Activation and Deactivation

Activation

WARNING: Shifting the transfer case to its neutral position for neutral flat towing may allow the vehicle to be able to roll even if the transmission is in park (P). Make sure the foot brake is depressed and the vehicle is in a secure and safe position while the transfer case is being shifted to its neutral position. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not disconnect the battery during neutral flat towing. Doing so will prevent the transfer case from shifting properly and may allow the vehicle to roll even if the transmission is in park (P). Failure to follow this instruction may result in serious personal injury.

***NOTICE:* 2-Wheel Drive (2WD) vehicles cannot be flat towed with any of the wheels on the ground. Vehicle or transmission damage will occur.**

***NOTICE:* Failure to put the transfer case in its NEUTRAL position will damage vehicle components.**

NOTE: Four-Wheel Drive (4WD) vehicles can be flat towed by placing the transfer case in its NEUTRAL position.

NOTE: Neutral flat tow status can be checked at any time by opening the driver door or turning the ignition to the ACC or ON position and checking the display in the IPC .

1. Turn the ignition to the ON position. Do not start the engine.
2. Press and hold the brake pedal.
3. Shift the Mode Select Switch (MSS) to 2H.
4. Shift the transmission to NEUTRAL.
5. Rotate the MSS from 2H to 4L and back to 2H 5 times within 7 seconds.
   - If completed successfully, the Instrument Panel Cluster (IPC) displays "NEUTRAL TOW LEAVE IN N" or "NEUTRAL TOW ENABLED LEAVE TRANSMISSION IN NEUTRAL", indicating that the vehicle is safe to tow with all wheels on the ground.
   - If the message is not shown in the display, the entire procedure must be performed again.
   - An audible noise may be heard as the transfer case shifts into neutral position, this is normal operation.
6. Leave the transmission in NEUTRAL and turn the ignition as far as it will go toward the OFF position (it will not turn fully off when the transmission is in NEUTRAL). The key must be left in the ignition while towing. To lock and unlock your vehicle, use the keyless entry keypad or extra set of keys.
7. Release the brake pedal.

Deactivation

WARNING: Shifting the transfer case to its neutral position for neutral flat towing may allow the vehicle to be able to roll even if the transmission is in park (P). Make sure the foot brake is depressed and the vehicle is in a secure and safe position while the transfer case is being shifted to its neutral position. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not disconnect the battery during neutral flat towing. Doing so will prevent the transfer case from shifting properly and may allow the vehicle to roll even if the transmission is in park (P). Failure to follow this instruction may result in serious personal injury.

NOTE: Neutral flat tow status can be checked at any time by opening the driver door or turning the ignition to the ACC or ON position and checking the display in the IPC .

1. Press and hold the brake pedal.
2. Turn the ignition to the ON position. Do not start the engine.
3. Shift the transmission out of NEUTRAL and into any gear.
4. Release the brake pedal.
    - If completed successfully, the IPC displays 4X2, then "NEUTRAL TOW DISABLED".
    - If the indicator light and message do not display, the entire procedure must be performed again.
    - An audible noise may be heard as the transfer case shifts out of NEUTRAL position, this is normal operation.

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Electronic Locking Differential (ELD) System

Special Tool(s)

 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Electronic Locking Differential (ELD) System

The ELD system allows the operator to lock the rear differential side gears. When the ELD is engaged both rear wheels turn at the same speed, providing added traction on slippery and/or off road surfaces. The operator can engage the ELD per the charts below:

ELD Engagement Speeds — 4WD Vehicles

Switch Position	Engage	Disengage	Re-engage
2H/4A/4H	31 km/h (19 mph) [a]	42 km/h (25 mph)	31 km/h (19 mph) [a]
4L	90 km/h (56 mph) [a]	100 km/h (62 mph)	90 km/h (56 mph) [a]

[a] The ELD system engages/re-engages at or below the speed noted.

ELD Engagement Speeds — 2WD Vehicles

Switch Position	Engage	Disengage	Re-engage
Off	N/A	N/A	N/A

On	31 km/h (19 mph) [a]	42 km/h (25 mph)	31 km/h (19 mph) [a]

[a] The ELD system engages/re-engages at or below the speed noted.

When the operator activates the ELD , the ELD icon displays in the IPC message center. If the vehicle is driven above the disengage speed, the IPC message center no longer displays the ELD icon, alerting the operator that the ELD is disengaged. Once the vehicle drops below the re-engage speed, the IPC message center displays the ELD icon again. If there is a malfunction with the ELD system, a "CHECK LOCKING DIFFERENTIAL" message is displayed in the IPC message center, letting the operator know the ELD is not engaged.

The differential locks when a PWM controlled magnetic field coil located inside the differential energizes. A collar within the differential moves toward a differential side gear and engages a dog clutch within the differential. This locks the differential side gears and creates the locked differential.

The TCCM activates the ELD . When the ELD is engaged, the TCCM sends PWM voltage to the ELD field coil located in the differential. This voltage is initially 98% duty cycle, and then tapers off to 40% duty cycle after 30 seconds. In order for the TCCM to activate the ELD , certain conditions must be met.

TCCM Input Conditions

- MSS set to ELD position
- Average rear wheel speed versus average front wheel speed must be less than 7 km/h (4.3 mph) (via HS-CAN communication from ABS module)
- Operating range (voltage between 9-16 volts)
- DTC setting range (voltage between 10-15 volts)
- Ignition in the ON position
- Throttle Position (TP) less than 50%

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

• Rear axle assembly
• Matching tire sizes
	• Battery Junction Box (BJB) fuses:
	  ▪ 20 (20A)
	  ▪ 29 (10A)
	  ▪ 54 (5A)
	  ▪ 68 (25A)
	• Body Control Module (BCM) fuse 34 (10A) (vehicles with ELD only)
	• Wiring, terminals or connectors
	• Mode Select Switch (MSS)
	• Electronic Locking Differential (ELD) field coil
	• Transfer Case Control Module (TCCM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

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4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the DLC .

5. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record CMDTCs .

8. Carry out the self-test diagnostics for the TCCM .

9. If the DTCs retrieved are related to the concern, go to the TCCM DTC Chart in this section. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Electronic Locking Differential (ELD) System in this section.

DTC Charts

Transfer Case Control Module (TCCM) DTC Chart — ELD System

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Network DTCs (U-codes) are often a result of intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set network DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. To prevent repeat network DTC concerns, inspect all network wiring, especially connectors. Test the vehicle battery, refer to Section 414-01 .

DTC	Description	Action
P0562:00	System Voltage Low: No Sub Type Information	GO to Pinpoint Test M .
P0563:00	System Voltage High: No Sub Type Information	GO to Pinpoint Test M .
P185A:00	Differential Lock-Up Input Switch Circuit High: No	GO to Pinpoint Test Y .

	Sub Type Information	
P185B:00	Differential Lock-Up Indicator Circuit Low: No Sub Type Information	GO to Pinpoint Test Z .
P185C:00	Differential Lock-Up Indicator Circuit High: No Sub Type Information	GO to Pinpoint Test AA .
P185D:00	Differential Lock-Up Control Circuit Performance: No Sub Type Information	GO to Pinpoint Test AB .
P187C:00	Differential Lock-Up Control Circuit/Open: No Sub Type Information	GO to Pinpoint Test AC .
P187D:00	Differential Lock-Up Control Circuit Low: No Sub Type Information	GO to Pinpoint Test AC .
P187E:00	Differential Lock-Up Control Circuit High: No Sub Type Information	GO to Pinpoint Test AD .
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	GO to Pinpoint Test AE .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0140:00	Lost Communication With Body Control Module (BCM): No Sub Type Information	GO to Pinpoint Test AG .
U0418:00	Invalid Data Received From Brake System Control Module: No Sub Type Information	REFER to Section 206-09 to diagnose the wheel speed sensor concern.
U2300:54	Central Configuration: Missing Calibration	This DTC can set if one or more expected configuration data identifications is missing (gearbox type, tire circumference) from the BCM . CARRY OUT a self-test of the BCM . If DTCs are present, REFER to Section 419-10 . If no DTCs are present, CLEAR the DTCs. CARRY OUT a self-test. If U2300:54 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U2300:55	Central Configuration: Not Configured	This DTC can set upon power up only until all expected configuration data parameters (gearbox type, axle ratio, tire circumference) is received from the BCM . CARRY OUT a self-test of the BCM . If DTCs are present, REFER to Section 419-10 . If no DTCs are present, CLEAR the DTCs. CARRY OUT self-test. If U2300:55 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U2300:56	Central Configuration: Invalid / Incompatible Configuration	This DTC can set if one expected configuration data parameter is out of range (gearbox type, axle ratio, tire circumference) from the BCM . CARRY OUT a self-test of the BCM . If DTCs are present,

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		REFER to Section 419-10 . If no DTCs are present, CLEAR the DTCs. CARRY OUT a self-test. If U2300:56 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U2300:64	Central Configuration: Signal Plausibility Failure	This DTC can set if the expected axle ratio or tire circumference is out of range from the BCM . CARRY OUT a self-test of the BCM . If DTCs are present, REFER to Section 419-10 . If no DTCs are present, CLEAR the DTCs. CARRY OUT a self-test. If U2300:64 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:41	Control Module: General Checksum Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:41 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:46 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:49	Control Module: Internal Electronic Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:49 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U300D:11	Ignition Input On/Start: Circuit Short To Ground	GO to Pinpoint Test L .
All other TCCM DTCs	—	REFER to the TCCM DTC Chart in of this section.

Symptom Chart — Electronic Locking Differential (ELD) System

Symptom Chart

Condition	Possible Sources	Action
• No communication with the TCCM	• Wiring, terminals or connectors • Scan tool • DLC • TCCM	• CHECK the module communications network. REFER to Section 418-00 .
• Rear wheels binding when turning corners with the MSS in 2WD or OFF	• Wiring, terminals or connectors • ELD field coil • TCCM • Rear differential	• GO to Pinpoint Test AD .

Pinpoint Tests

Pinpoint Test Y: DTC P185A:00

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the MSS is engaged to lock the rear differential, a PWM signal is sent to the ELD field coil by the TCCM through the differential lock control circuit. This PWM signal is initially 98% duty cycle to lock the differential and decreases to 40% duty cycle once the differential is locked. If the differential does not lock, the TCCM continues to send the signal for a set amount of time. Once the differential is locked, the indicator will illuminate steady.

- DTC P185A:00 (Differential Lock-Up Input Switch Circuit High: No Sub Type Information) — When not in locking mode, the TCCM C2371A pin 15 senses whether the ELD mode switch circuit has high voltage and if the differential is always engaged. This DTC will not set unless the MSS is set to 2H or OFF. If the ELD is functioning normally, the differential will immediately lock when the MSS is activated and the ELD operating conditions are qualified. This DTC will only display during the self-test function.

This pinpoint test is intended to diagnose the following:

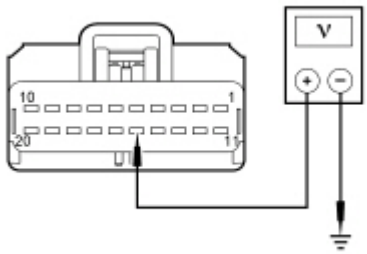
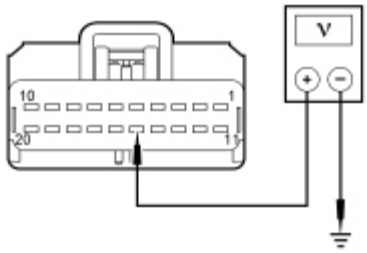
- Wiring, terminals or connectors
- TCCM

PINPOINT TEST Y: DTC P185A:00

NOTE: Make sure the battery is fully charged before carrying out this pinpoint test.

Test Step	Result / Action to Take
Y1 CHECK FOR TCCM DTCs	
NOTE: Failure to place the MSS in 2H or OFF prior to carrying out a self-test of the TCCM (to disable the ELD field coil) results in inaccurate self-test. • Ignition ON. • Set the MSS in 2H (ESOF or 2 speed-torque-on-demand). • Set the MSS in OFF (2WD). • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** If only DTC P185A:00 is retrieved, GO to Y2 . For any other DTCs, REFER to the TCCM DTC Chart in this section. **No** IDENTIFY the customer concern and GO to Symptom Chart - Electronic Locking Differential (ELD) System in this section.
Y2 CHECK FOR A SHORT TO VOLTAGE ON THE LOCKER MODE SWITCH CIRCUIT	
• Ignition OFF. • Disconnect: TCCM C2371A. • Ignition ON. • With the MSS in 2H or OFF (depending upon vehicle option content), measure the voltage between TCCM C2371A-15, circuit CCF32 (WH/GN), harness side and ground.	**Yes** GO to Y3 . **No** GO to Y4 .

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 N0090953 • **Is any voltage present?**	
Y3 CHECK FOR A SHORT TO VOLTAGE ON THE LOCKER MODE SWITCH CIRCUIT WITH THE MSS DISCONNECTED	
• Ignition OFF. • Disconnect: MSS . • Ignition ON. • Measure the voltage at TCCM C2371A-15, circuit CCF32 (WH/GN), harness side and ground.  N0090953 • **Is any voltage present?**	**Yes** REPAIR circuit CCF32 (WH/GN). CLEAR the DTCs. TEST the system for normal operation. **No** INSTALL a new MSS . REFER to Mode Select Switch (MSS) in this section. TEST the system for normal operation.
Y4 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test Z: DTC P185B:00

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the MSS is engaged to lock the rear differential, a PWM signal is sent to the ELD field coil by the TCCM through the differential lock control circuit. This PWM signal is initially 98% duty cycle to lock the

differential and decreases to 40% duty cycle once the differential is locked. If the differential does not lock, the TCCM continues to send the signal for a set amount of time. Once the differential is locked, the indicator will illuminate steady.

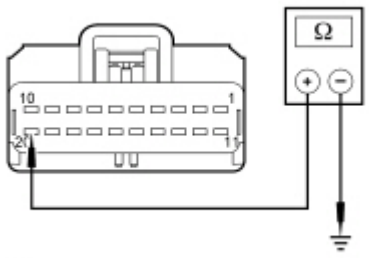
- DTC P185B:00 (Differential Lock-Up Indicator Circuit Low: No Sub Type Information) — When not in locking mode, the TCCM C2371A-20 senses the indicator circuit is shorted to ground and the indicator is always illuminated. This DTC should not set for an open circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TCCM

PINPOINT TEST Z: DTC P185B:00

NOTE: Make sure the battery is fully charged before performing this pinpoint test.

Test Step	Result / Action to Take
Z1 CHECK THE TCCM 4WD SWITCH STATUS (4X4_SW) PID • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Set the MSS to 4H and pull the knob to lock the rear differential. • Monitor the 4X4_SW PID. • **Does the 4X4_SW PID indicate 4H mode?**	**Yes** GO to Z2 . **No** INSTALL a new MSS . REFER to Mode Select Switch (MSS) in this section. CLEAR the DTCs. TEST the system for normal operation.
Z2 CHECK THE REAR ELD INDICATOR CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: TCCM C2371A. • Disconnect: MSS . • Measure the resistance between TCCM C2371A-20, circuit CCF33 (GY/YE), harness side and ground.  N0090963 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to Z3 . **No** REPAIR circuit CCF33 (GY/YE). CLEAR the DTCs. TEST the system for normal operation.
Z3 CHECK FOR CORRECT TCCM OPERATION • Ignition OFF. • Disconnect and inspect all TCCM connectors. • Repair: ▪ corrosion (install new connector or terminals -	**Yes** INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for

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clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect all TCCM connectors. Make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test AA: DTC P185C:00

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the MSS is engaged to lock the rear differential, a PWM signal is sent to the ELD field coil by the TCCM through the differential lock control circuit. This PWM signal is initially 98% duty cycle to lock the differential and decreases to 40% duty cycle once the differential is locked. When the differential is fully locked, the indicator will illuminate steady.

- DTC P185C:00 (Differential Lock-Up Indicator Circuit High: No Sub Type Information) — When the driver engages the ELD the TCCM C2371A-20 senses the indicator circuit has high voltage and is not illuminated.

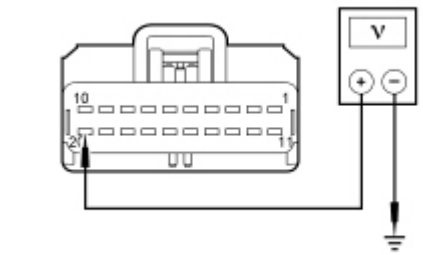
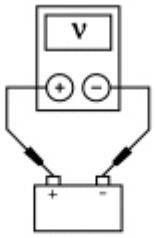
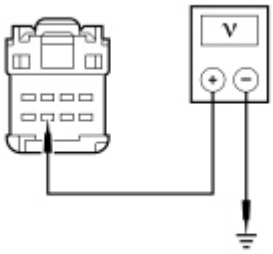
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TCCM

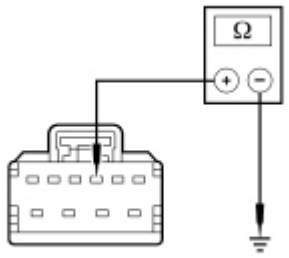
PINPOINT TEST AA: DTC P185C:00

NOTE: Make sure the battery is fully charged before performing this pinpoint test.

Test Step	Result / Action to Take
AA1 OPERATE THE ELD INDICATOR USING THE TCCM REAR LOCKING DIFF LAMP OUTPUT CONTROL OPTIONAL (DIFF_LAMP_OS) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Command the DIFF_LAMP_OS PID on. • **Does the ELD indicator in the MSS illuminate?**	**Yes** GO to AA5 . **No** GO to AA2 .
AA2 CHECK THE ELD INDICATOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: TCCM C2371A. • Disconnect: MSS . • Ignition ON. • Measure the voltage between TCCM C2371A-20,	**Yes** REPAIR circuit CCF33 (GY/YE). CLEAR the DTCs. TEST the system for normal operation.

circuit CCF33 (GY/YE), harness side and ground.  N0090961 • **Is any voltage present?**	**No** GO to AA3 .
AA3 CHECK FOR VOLTAGE TO THE MSS	
• Measure and record the battery voltage at the battery.  AJ0210-A • Measure the voltage between MSS C284-7, circuit CBP34 (VT/BN), harness side and ground.  N0090958 • **Does the voltage equal the recorded battery voltage?**	**Yes** GO to AA4 . **No** VERIFY BCM fuse 34 (10A) is OK. If OK, REPAIR circuit CBP34 (VT/BN). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. TEST the system for normal operation.
AA4 CHECK THE TCCM GROUND CIRCUIT	
• Ignition OFF. • Disconnect: TCCM C2371B. • Measure the resistance between C2371B-3, circuit GD123 (BK/GY), harness side and ground.	**Yes** GO to AA5 . **No** REPAIR circuit GD123 (BK/GY). CLEAR the DTCs. TEST the system for normal operation.

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 N0090962 • **Is the resistance less than 3 ohms?**	

AA5 CHECK FOR CORRECT TCCM OPERATION
• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test AB: DTC P185D:00

Refer to Wiring Diagrams Cell 34, Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the MSS is engaged to lock the rear differential, a PWM signal is sent to the ELD field coil by the TCCM through the differential lock control circuit. This PWM signal is initially 98% duty cycle to lock the differential and decreases to 40% duty cycle once the differential is locked. If the differential does not lock, the TCCM continues to send the signal for a set amount of time. Once the differential is locked, the indicator will illuminate steady.

- DTC P185D:00 (Differential Lock-up Control Circuit Performance: No Sub Type Information) — The TCCM sends a signal to the lock up solenoid to lock the differential. After several unsuccessful attempts, the TCCM sets this DTC alerting the driver the ELD is inoperative. Fault may be due to a wheel speed condition or due to a mechanical failure within the driveline/axle subsystem.

This pinpoint test is intended to diagnose the following:

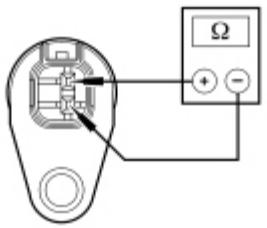
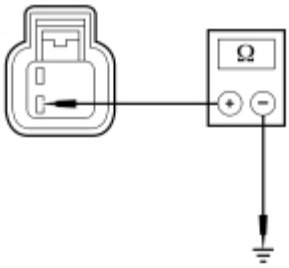
- Wiring, terminals or connectors
- ELD field coil

PINPOINT TEST AB: DTC P185D:00

NOTE: Make sure the battery is fully charged before carrying out this pinpoint test.

Test Step	Result / Action to Take

AB1 CHECK THE ABS MODULE WHEEL SPEED SENSOR PIDs
• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module.
• While driving the vehicle at 30 km/h (18 mph), monitor the following wheel speed sensor PIDs:
  ▪ Left Front Wheel Speed Sensor (LF_WSPD)
  ▪ Left Rear Wheel Speed Sensor (LR_WSPD)
  ▪ Right Front Wheel Speed Sensor (RF_WSPD)
  ▪ Right Rear Wheel Speed Sensor (RR_WSPD)
• Compare the speedometer reading to the wheel speed sensor PIDs.
• **Do the wheel speed sensor PIDs and speedometer speeds match within 1.5 km/h (1 mph)?**
	Yes
	GO to AB2.
	
	No
	VERIFY that the 4 road wheels are the same size and have similar tread depth. CHECK the ABS for faults. REFER to Section 206-09. TEST the system for normal operation.

AB2 CHECK RESISTANCE OF THE ELD FIELD COIL • Ignition OFF. • Disconnect: ELD Field Coil. • **NOTE:** If the temperatures are exceptionally high, a higher than normal resistance reading could result. A lower temperature could result in a lower resistance reading. • Measure the resistance between ELD field coil C4359 pins 1 and 2, component side.  N0091387 • **Is the resistance between 2-4 ohms?**	**Yes** GO to AB3. **No** INSTALL a new ELD field coil. REFER to Section 205-02B. CLEAR the DTCs. TEST the system for normal operation.
AB3 CHECK THE ELD FIELD COIL GROUND • Measure the resistance between ELD field coil C4359-2, circuit GD123 (BK/GY), harness side and ground.  N0090955 • **Is the resistance less than 3 ohms?**	**Yes** REFER to Section 205-02B to repair the rear differential. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR circuit GD123 (BK/GY). CLEAR the DTCs. TEST the system for normal operation.

Pinpoint Test AC: DTC P187C:00 and P187D:00

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Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the MSS is engaged to lock the rear differential, a PWM signal is sent to the ELD field coil by the TCCM through the differential lock control circuit. This PWM signal is initially 98% duty cycle to lock the differential and decreases to 40% duty cycle once the differential is locked. If the differential lock control circuit is open or shorted to ground, the TCCM senses a signal is not reaching the differential and sets a DTC.

- DTC P187C:00 (Differential Lock-Up Control Circuit/Open: No Sub Type Information) — The TCCM sends a signal to the differential to lock the differential. The TCCM C2371B pin 9 senses that the differential lock control circuit is open. The ELD differential is not engaged.
- DTC P187D:00 (Differential Lock-Up Control Circuit Low: No Sub Type Information) — The TCCM sends a signal to lock the differential. The TCCM C2371B pin 9 senses that the differential lock control circuit is shorted to ground. The ELD differential is not engaged.

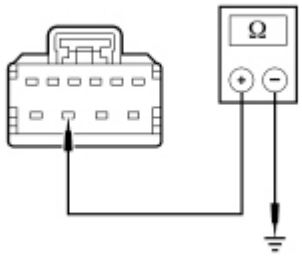
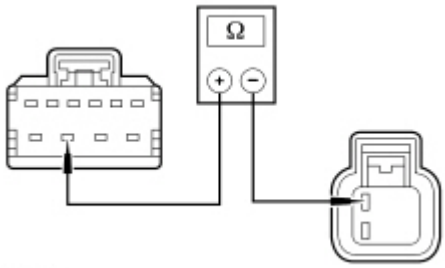
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TCCM

PINPOINT TEST AC: DTC P187C:00 AND P187D:00

NOTE: Make sure the battery is fully charged before carrying out this pinpoint test.

Test Step	Result / Action to Take
AC1 CHECK FOR TCCM DTCs	**Yes** For DTC P187C:00, GO to AC4 . For DTC P187D:00, GO to AC2 . For all other DTCs, REFER to the TCCM DTC Chart in this section. **No** IDENTIFY the customer concern and GO to Symptom Chart - Electronic Locking Differential (ELD) System in this section.
NOTE: Failure to place the MSS in 2H or OFF prior to carrying out a self-test of the TCCM (to disable the ELD field coil) results in inaccurate self-test. • Ignition ON. • Set the MSS in 2H (ESOF or 2 speed-torque-on-demand). • Set the MSS in OFF (2WD). • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	
AC2 CHECK FOR TCCM DTCs WITH THE ELD FIELD COIL DISCONNECTED	**Yes** GO to AC3 . **No** INSTALL a new field coil. REFER to Section 205-02B . CLEAR the DTCs. TEST the system for normal operation.
• Ignition OFF. • Disconnect: ELD Field Coil. • Ignition ON. • Set the MSS in 2H (ESOF or 2 speed-torque-on-demand). • Set the MSS in OFF (2WD). • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **CLEAR the DTCs. REPEAT the self-test. Does DTC P187D:00 return?**	

AC3 CHECK THE ELD DIFFERENTIAL LOCK CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: TCCM C2371B. • Measure the resistance between TCCM C2371B-9, circuit CCF31 (BN/VT), harness side and ground.  N0090960 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AC4 . **No** REPAIR circuit CCF31 (BN/VT). CLEAR the DTCs. TEST the system for normal operation.
AC4 CHECK THE ELD DIFFERENTIAL LOCK CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: TCCM C2371B. • Disconnect: ELD Field Coil. • Measure the resistance between TCCM C2371B-9, circuit CCF31 (BN/VT), harness side and ELD field coil C4359-1, circuit CCF31 (BN/VT), harness side.  N0090956 • **Is the resistance less than 3 ohms?**	**Yes** GO to AC5 . **No** REPAIR circuit CCF31 (BN/VT). CLEAR the DTCs. TEST the system for normal operation.
AC5 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

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Pinpoint Test AD: Rear Wheels Binding When Turning Corners With the ELD OFF

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the MSS is engaged to lock the rear differential, a PWM signal is sent to the ELD field coil by the TCCM through the differential lock control circuit. This PWM signal is initially 98% duty cycle to lock the differential and decreases to 40% duty cycle once the differential is locked. If the differential does not lock, the TCCM continues to send the signal for a set amount of time. Once the differential is locked, the indicator will illuminate steady.

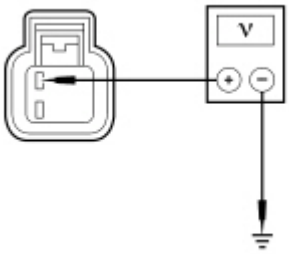
- DTC P187E:00 (Differential Lock-Up Control Circuit High: No Sub Type Information) — The TCCM sends a signal to lock the differential. This DTC sets when the TCCM C2371B-9 senses that the differential lock control circuit is shorted to battery voltage. The differential is constantly engaged.

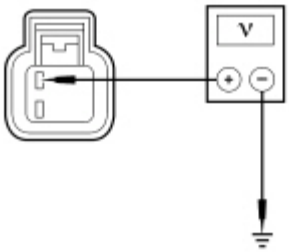
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- ELD field coil
- TCCM

PINPOINT TEST AD: REAR WHEELS BINDING WHEN TURNING CORNERS WITH THE ELD OFF

NOTE: Make sure the battery is fully charged before carrying out this pinpoint test.

Test Step	Result / Action to Take
AD1 CHECK FOR VOLTAGE TO THE ELD FIELD COIL	
• Ignition OFF. • Disconnect: ELD Field Coil. • Ignition ON. • Set the MSS in 2H (ESOF or 2 speed-torque-on-demand). • Set the MSS in OFF (2WD). • Measure the voltage between ELD field coil C4359-1, circuit CCF31 (BN/VT), harness side and ground.  N0090954 • **Is any voltage present?**	**Yes** GO to AD2 . **No** REFER to Section 205-02B to repair the rear differential. CLEAR the DTCs. TEST the system for normal operation.
AD2 CHECK THE ELD FIELD COIL CIRCUIT FOR A SHORT TO VOLTAGE	
	Yes

• Ignition OFF. • Disconnect: TCCM C2371B. • Ignition ON. • Measure the voltage between field coil C4359-1, circuit CCF31 (BN/VT), harness side and ground.  N0090954 • **Is any voltage present?**	REPAIR circuit CCF31 (BN/VT). CLEAR the DTCs. TEST the system for normal operation. **No** GO to AD3 .
AD3 CHECK THE TCCM REAR LOCKING DIFFERENTIAL PWM OUTPUT CONTROL (DIFF_PWM_OS) PID	
• Ignition OFF. • Connect: ELD Field Coil. • Connect: TCCM C2371B. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • With the MSS in 2H or OFF (depending upon vehicle option content), monitor the DIFF_PWM_OS PID. • **Does the DIFF_PWM_OS PID read OFF?**	**Yes** GO to AD4 . **No** INSTALL a new MSS . REFER to Mode Select Switch (MSS) in this section. CLEAR the DTCs. TEST the system for normal operation.
AD4 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test AE: DTC U0100:00

Normal Operation

- DTC U0100:00 (Lost Communication With ECM/PCM "A": No Sub-Type Information) — sets in continuous memory in the TCCM if data messages received from the PCM over the HS-CAN are missing for 5 seconds or longer with ignition in RUN and battery voltage in range. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

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- PCM
- TCCM

PINPOINT TEST AE: DTC U0100:00

Test Step	Result / Action to Take
AE1 CHECK THE TCCM CONTINUOUS MEMORY DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: TCCM Self-Test. • Clear the DTCs. • Wait 10 seconds. • Repeat the TCCM self-test. • **Is DTC U0100:00 retrieved again?**	**Yes** GO to AE2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded DTCs from the PCM KOEO self-test. • **Is DTC P0562:00 or P0563:00 recorded?**	**Yes** REFER to Section 414-00 . **No** GO to AE3 .
AE3 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST	
• Check for recorded DTCs from the TCCM self-test. • **Is DTC P0562:00 or P0563:00 recorded?**	**Yes** REFER to GO to Pinpoint Test M . **No** GO to AE4 .
AE4 CHECK FOR DTC U0100:00 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — All CMDTCs . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0100:00 in the RCM , or DTC U0100:87 in the BCM ?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.

Pinpoint Test AF: DTC U0121:00

Normal Operation

- DTC U0121:00 (Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub-Type Information) — sets in continuous memory in the TCCM if data messages received from the ABS module over the HS-CAN are missing for 5 seconds or longer with ignition in RUN and battery voltage in range. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- ABS module
- TCCM

PINPOINT TEST AF: DTC U0121:00

Test Step	Result / Action to Take
AF1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AF2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the ABS module pass the network test?**	**Yes** GO to AF3 . **No** REFER to Section 418-00 .
AF3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST • Check for recorded DTCs from the ABS module self-test. • **Is DTC B11E8:16 (B1318) or DTC B11E8:17 (B1317) recorded?**	**Yes** REFER to Section 206-09 . **No** GO to AF4 .
AF4 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST • Check for recorded DTCs from the TCCM self-test. • **Is DTC P0562:00 or P0563:00 recorded?**	**Yes** GO to Pinpoint Test M . **No** GO to AF5 .
AF5 RECHECK THE TCCM DTCs **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the PMI or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the TCCM self-test. • **Is DTC U0121:00 still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the TCCM self-test. If DTC U0121:00 is still present, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

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Pinpoint Test AG: DTC U0140:00

Normal Operation

- DTC U0140:00 (Lost Communication With Body Control Module: No Sub-Type Information) — sets in continuous memory in the TCCM if data messages received from the BCM over the HS-CAN are missing for 5 seconds or longer with ignition in RUN and battery voltage in range. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- BCM
- TCCM

PINPOINT TEST AG: DTC U0140:00

Test Step	Result / Action to Take
AG1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AG2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the pass the network test?**	**Yes** GO to AG3 . **No** REFER to Section 418-00 .
AG3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded DTCs from the BCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** Section 419-10 . **No** GO to AG4 .
AG4 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST	
• Check for recorded DTCs from the TCCM self-test. • **Is DTC P0562:00 or P0563:00 recorded?**	**Yes** GO to Pinpoint Test M . **No** GO to AG5 .
AG5 RECHECK THE TCCM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the or the may not have been	**Yes** GO to AG6 . **No**

carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the TCCM self-test. • **Is DTC U0140:00 still present?**	The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG6 CHECK FOR DTC U0140 OR DTC U0140:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test — All CMDTCs . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140 or U0140:00 set in more than one module?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No** INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.

Pinpoint Test AH: Neutral Flat Tow Functional Test

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive System for schematic and connector information.

Normal Operation

Neutral flat tow operates by shifting the transfer case shift motor into the NEUTRAL position, locking the transfer case in NEUTRAL. The TCCM sends the transfer case shift motor NEUTRAL position status to the IPC over the HS-CAN .

This pinpoint test is intended to diagnose the following:

- IPC
- TCCM
- TR sensor from PCM
- Ignition switch

PINPOINT TEST AH: NEUTRAL FLAT TOW FUNCTIONAL TEST

WARNING: Shifting the transfer case to its neutral position for neutral flat towing may allow the vehicle to be able to roll even if the transmission is in park (P). Make sure the foot brake is depressed and the vehicle is in a secure and safe position while the transfer case is being shifted to its neutral position. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not disconnect the battery during neutral flat towing. Doing so will prevent the transfer case from shifting properly and may allow the vehicle to roll even if the transmission is in park (P). Failure to follow this instruction may result in serious personal injury.

***NOTICE:* 2WD vehicles cannot be towed with any wheels on the ground as vehicle or transmission damage may occur.**

***NOTICE:* Failing to put the transfer case in its NEUTRAL position will damage vehicle components.**

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NOTE: 4WD vehicles can only be flat towed with all wheels on the ground by placing the transfer case in its NEUTRAL position.

Test Step	Result / Action to Take
AH1 CHECK NEUTRAL FLAT TOW ACTIVATION AND DEACTIVATION	
• Activate neutral flat tow. Refer to Neutral Flat Tow Activation and Deactivation in this section. • **Does the IPC indicate neutral flat tow is activated?**	**Yes** RETURN the vehicle to the customer. ADVISE the customer about the correct Neutral Flat Tow Activation and Deactivation procedure. **No** GO to AH2.
AH2 CHECK NEUTRAL FLAT TOW ACTIVATION WHILE MONITORING THE TCCM 4WD MODES (4WD_MODES) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the 4WD_MODES PID. • **Does the PID indicate NEUTRAL?**	**Yes** REFER to Section 413-01 to diagnose IPC faults. After the repair is complete, CLEAR the DTCs. TEST the system for normal operation. **No** GO to AH3.
AH3 CHECK FOR TCCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. After the repair is complete, CLEAR the DTCs. TEST the system for normal operation. **No** GO to AH4.
AH4 CHECK TCCM BRAKE ON/OFF (4X4_BOO) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the 4X4_BOO PID while pressing the brake pedal. • **Does the PID agree with the brake pedal position?**	**Yes** GO to AH5. **No** REFER to Section 417-01 to diagnose stoplamp system faults. After the repair is complete, CLEAR the DTCs. TEST the system for normal operation.
AH5 CHECK THE TCCM IGNITION POSITION (KEY_POS_4X4) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the KEY_POS_4X4 PID with the ignition in the ON position. • **Does the PID indicate Ignition On?**	**Yes** GO to AH6. **No** REFER to Section 211-05 for further diagnosis of the ignition switch.
AH6 CHECK THE TCCM NEUTRAL INDICATOR (NEUTRAL) PID	
• Enter the following diagnostic mode	**Yes** For vehicles equipped with the ESOF system, GO to

on the scan tool: DataLogger — TCCM . • Monitor the NEUTRAL PID with the gear selector in neutral position. • **Does the PID indicate TRUE?**	Pinpoint Test B to diagnose the transfer case shift motor. For vehicles equipped with the 2-speed torque-on-demand system, GO to Pinpoint Test P to diagnose the transfer case shift motor. **No** REFER to Section 307-01 for diagnosis of the TR sensor.

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Four Wheel Drive (4WD) Systems — 2-Speed Torque-On-Demand

Special Tool(s)

 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The 2-speed torque-on-demand system is an automatic electronic-shift system that allows the operator to choose between 2-Wheel Drive (2WD) and 3 different Four-Wheel Drive (4WD) modes. The operator can switch between 2WD (2H) mode, 4X4 AUTO (4A) mode or 4X4 (4H) mode at any speed or at a stop. To engage or disengage 4X4 LOW (4L) mode, the vehicle speed must be less than 5 km/h (3 mph) and the transmission must be in NEUTRAL.

Wheel slip is sensed by monitoring the average front and rear wheel speeds. Based on steering wheel angle, Accelerator Pedal Position (APP) and wheel slip, a Pulse-Width Modulation (PWM) signal is transmitted to the transfer case as torque is required.

The Transfer Case Control Module (TCCM) will provide the ABS with current clutch duty cycle and whether or not ABS may command the clutch duty cycle.

The brake subsystem sends the following information signals to the 4WD system over the High Speed Controller Area Network (HS-CAN):

- Occurrences of brake events and failures. Refer to Section 206-09 .
- Steering wheel angle status. Refer to Section 206-09 .
- Wheel speeds. Refer to Section 206-09 .

A concern with any of the above listed brake system signals HS-CAN will affect operation of the 4WD system.

The APP output signal is provided to the TCCM from the PCM. This signal is used by the TCCM in controlling the transfer case clutch.

The shift motor sense plate, an integral part of the shift motor assembly, informs the TCCM of the transfer case position.

The electric shift motor is mounted externally to the transfer case. It drives a rotary cam which moves the range fork within the transfer case between the HIGH range (2H, 4A and 4H) and LOW range (4L) positions. **The shift motor only moves during a shift to/from 4L on the 2 speed torque on demand system; it does not move during any other mode shift.**

The TCCM sends a duty cycle command to the clutch coil which activates the clutch within the transfer case.

The TCCM varies the torque sent to the front driveline by controlling the transfer case clutch. At rest and under cruising conditions, the TCCM activates the transfer case clutch a minimum duty cycle (percentage of time the clutch is turned on), which allows for the slight difference between the front and rear driveshafts which normally occurs when negotiating a corner on dry pavement. Under any of the following conditions, the TCCM will increase the duty cycle in order to prevent or control slip:

- Slip is detected
- Heavy acceleration (throttle position)
- Straight-ahead steering wheel angle

Feature inputs:

- MSS
- Steering wheel angle (from the ABS module)
- TR position (from the PCM)
- Transmission output torque (from the PCM)
- Wheel speed signal (transmitted from the ABS module)
- APP (from the PCM)
- Transfer case shift motor contact plate position inputs A, B, C, D

Feature outputs:

- PWM signal to the transfer case clutch
- 4WD message center indicators
- Transfer case shift motor outputs

Shifts between 4X4 AUTO (4A) and 4X4 (4H) modes can be made at any speed. Listed below are the inputs and outputs needed by the to execute a change between any of these modes.

Feature inputs:

- Wheel speed signal
- APP (from the PCM)
- MSS

Feature outputs:

- Transfer case shift motor outputs
- PWM signal to the transfer case clutch

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- 4WD message center indicators

When shifting into or out of 4X4 LOW (4L) mode, TCCM the requires that the vehicle speed is less than 5 km/h (3 mph) and the transmission is in NEUTRAL.

Feature inputs:

- APP (from the PCM)
- MSS
- Transfer case shift motor encoder contact plate position inputs A, B, C, D
- Wheel speed signal (transmitted from ABS module)

Feature outputs:

- Transfer case shift motor outputs
- 4WD message center indicators
- PWM signal to the transfer case clutch

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Mechanical	Electrical

• Halfshafts
• IWEs
• Driveshaft and U-joints
• Vacuum leaks
• Fluid leaks
• Matching tire sizes
• Transfer case
	• BJB fuses:
	  ▪ 20 (20A)
	  ▪ 29 (10A)
	  ▪ 54 (5A)
	  ▪ 68 (25A)
	• BCM fuse 34 (10A) (vehicles with ELD only)
	• Wiring, terminals or connectors
	• MSS
	• Synchronization clutch
	• IWE solenoid
	• Transfer case shift motor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM .

If the scan tool does not communicate with the VCM :
- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Carry out the self-test diagnostics for the TCCM .

9. If the DTCs retrieved are related to the concern, go to the TCCM DTC Chart in this section. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Four-Wheel Drive System or GO to Symptom Chart - NVH .

DTC Charts

Transfer Case Control Module (TCCM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
C1979:11	IWE Solenoid Circuit Failure: Circuit Short To Ground	GO to Pinpoint Test N .
C1979:12	IWE Solenoid Circuit Failure: Circuit Short To Battery	GO to Pinpoint Test N .
C1979:13	IWE Solenoid Circuit Failure: Circuit Open	GO to Pinpoint Test N .
P0562:00	System Voltage Low: No Sub Type Information	GO to Pinpoint Test M .
P0563:00	System Voltage High: No Sub Type Information	GO to Pinpoint Test M .
P1812:00	4-Wheel Drive Mode Select Circuit Failure: No Sub Type Information	GO to Pinpoint Test X .
P1815:00	4-Wheel Drive Mode Select Short To Ground: No Sub Type Information	GO to Pinpoint Test X .
P1825:00	4-Wheel Drive Clutch Relay Open	GO to Pinpoint Test Q .

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	Circuit: No Sub Type Information	
P1826:00	4-Wheel Drive Low Clutch Relay Circuit To Battery: No Sub Type Information	GO to Pinpoint Test Q .
P1827:00	4-Wheel Drive Low Clutch Relay Circuit To Ground: No Sub Type Information	GO to Pinpoint Test Q .
P1839:00	Transfer Case Shift Motor Open Circuit: No Sub Type Information	GO to Pinpoint Test P .
P1840:00	Transfer Case Shift Motor Short Circuit To Battery: No Sub Type Information	GO to Pinpoint Test P .
P1841:00	Transfer Case Shift Motor Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test P .
P1849:00	Transfer Case Contact Plate 'A' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test P .
P184B:00	Transfer Case Unable To Transition Between 4H and 4L: No Sub Type Information	GO to Pinpoint Test P .
P1853:00	Transfer Case Contact Plate 'B' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test P .
P1857:00	Transfer Case Contact Plate 'C' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test P .
P185A:00	Differential Lock-Up Input Switch Circuit High: No Sub Type Information	Go to Pinpoint Test Y in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P185B:00	Differential Lock-Up Indicator Circuit Low: No Sub Type Information	Go to Pinpoint Test Z in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P185C:00	Differential Lock-Up Indicator Circuit High: No Sub Type Information	Go to Pinpoint Test AA in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P185D:00	Differential Lock-Up Control Circuit Performance: No Sub Type Information	Go to Pinpoint Test AB in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P1861:00	Transfer Case Contact Plate 'D' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test P .
P1867:00	Transfer Case Contact Plate General Circuit Failure: No Sub Type Information	GO to Pinpoint Test P .
P187C:00	Differential Lock-Up Control Circuit/Open: No Sub Type Information	Go to Pinpoint Test AC in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P187D:00	Differential Lock-Up Control Circuit Low: No Sub Type Information	Go to Pinpoint Test AC in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P187E:00	Differential Lock-Up Control Circuit High: No Sub Type Information	Go to Pinpoint Test AD in Electronic Locking Differential (ELD) System, Diagnosis and Testing,

		Section 308-07A .
P1886:00	4X4 Initialization Failure: No Sub Type Information	CLEAR the DTC. REPEAT the self-test. If the DTC still reports, CONFIRM the TCCM part number is correct for the vehicle.
P1891:00	Transfer Case Contact Plate Ground Return Open Circuit: No Sub Type Information	GO to Pinpoint Test P .
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	Go to Pinpoint Test AB in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub Type Information	Go to Pinpoint Test AF in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
U0418:00	Invalid Data Received From Brake System Control Module: No Sub Type Information	REFER to Section 206-09 to diagnose the wheel speed sensor concern.
U3000:04	Control Module: System Internal Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:04 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:41	Control Module: General Checksum Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:41 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:46 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:49	Control Module: Internal Electronic Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:49 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U300D:11	Ignition Input On/Start: Circuit Short To Ground	GO to Pinpoint Test L .

Symptom Chart — Four-Wheel Drive System

Symptom Chart —

Condition	Possible Sources	Action
• No communication with the TCCM	• Scan tool • DLC • TCCM • Wiring, terminals or connectors	• REFER to Section 418-00 .
• The 4X4 mode indicators do not operate correctly/do not operate	• Instrument Panel Cluster (IPC) • 4WD system fault • HS-CAN	• GO to Pinpoint Test V .

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	• TCCM	
• The vehicle does not shift between 2H (2WD) and 4X4 modes correctly	• Wiring, terminals or connectors • MSS • Transfer case • TCCM	• GO to Pinpoint Test X .
• The vehicle does not shift between 4A (4X4 AUTO) and 4H (4X4) modes correctly	• MSS • IWEs • IWE solenoid • Transfer case • Vacuum leaks • Front axle assembly • TCCM • Wiring, terminals or connectors	• GO to Pinpoint Test O .
• Vehicle has no torque or inadequate torque at front wheels in 4A (4X4 AUTO) mode	• Transfer case and related components • IWEs and related components • Wheel/tire assemblies	• CARRY OUT the 4WD System Functional Test. GO to Pinpoint Test U .
• The vehicle does not shift between 4H (4X4) and 4L (4X4 LOW) modes correctly	• Wiring, terminals or connectors • Transfer case • TR • ABS wheel speed inputs • IWEs • TCCM • Transmission drag torque	• GO to Pinpoint Test P .
• 4WD does not engage at speed correctly	• Transfer case synchronization clutch • Transfer case • TCCM • Front axle assembly • Wiring, terminals or connectors	• GO to Pinpoint Test Q .
• The front axle does not engage/disengage correctly	• MSS • IWEs • IWE solenoid • Transfer case • Vacuum leaks • Front axle assembly • TCCM • Wiring, terminals or connectors • Fuses	• GO to Pinpoint Test N .
• The 4WD system jumps out of gear	• IWE vent line(s) • MSS	• GO to Pinpoint Test R .

	• Transfer case	
• Unable to duplicate customer concern	• 4WD system and/or related components	• CARRY OUT the 4WD System Functional Test. GO to Pinpoint Test U .
• Unable to achieve flat tow (neutral tow) mode	• Wiring, terminals or connectors • HS-CAN • IPC • TCCM • Door ajar switch • Ignition switch	• Go to Pinpoint Test AH in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Symptom Chart — NVH

Condition	Possible Sources	Action
• Grinding noise during 4WD system engagement, especially at high speeds	• Front halfshaft speeds not turning at the same speed • Synchronization clutch	• GO to Pinpoint Test N .
• Vehicle Pulsates or Shudders in a Straight Line (Straightline Driveline Wind-up)	• Unequal tire inflation pressures • Unmatched tire and wheel size • Unequal amounts of tire wear • Unmatched front and rear axle ratios	• GO to Pinpoint Test S .
• The front axle makes noise in 2H mode only and generally under heavy throttle	• Vacuum leaks • Vacuum check valve • Vacuum reservoir • IWE solenoid • IWEs	• GO to Pinpoint Test T .
• The transfer case makes noise	• Tire inflation pressure • Tire and wheel size • Tire tread wear	• MAKE SURE that all tires and wheels are the same size and that the inflation pressures are correct. • CHECK tire tread wear to see if there is more than 0.15 mm (0.06 in) difference in tread wear between front and rear. INTERCHANGE one front wheel

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		and one rear wheel. ROAD TEST again.
	• Internal components	• OPERATE the vehicle in all transmission gears. If there is noise in the transmission in NEUTRAL, or in some gears and not in others, REMOVE and REPAIR the transmission. REFER to Section 307-01 . If there is noise in all gears, DISASSEMBLE the transfer case. REFER to Section 308-07B . CHECK the planetary gears, the bearings, the upper and lower drive sprockets and drive chain for damage. INSTALL new parts as necessary.
	• Fluid level	• FILL with automatic transmission fluid. REFER to Section 308-07B .
• Transfer case whine — noise at all ranges	• Incorrect fluid level or fluid quality • Worn oil pump • Under-inflated or oversized tires	• CHECK that the transfer case is filled to the correct level and with the specified fluid. REFER to Section 308-07B . • DISASSEMBLE the transfer case. CHECK the oil pump for wear or damage. REPAIR as necessary. REFER to Section 308-07B . • CONFIRM that the tires and wheels are correct for the vehicle. CHECK that the tire inflation pressures are correct.
• Transfer case growl/rumble — noise at all ranges	• Damaged or worn bearings or planetary gear	• DISASSEMBLE the transfer case. CHECK the bearings or planetary gear for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case scraping/grating — noise at all ranges	• Excessively stretched drive chain hitting the case	• DISASSEMBLE the transfer case. CHECK the drive chain for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum — noise at all ranges or 4H only	• Worn or damaged sun (input) gear, clutch pack (intermediate) gear or output shaft gear	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Vehicle binds in a turn/resists turning/pulsates in a straightline in 4WD mode	• Unmatched tire sizes • Unequal amounts of tire wear • Unequal tire inflation pressures • Throttle position failure • Transfer case • TCCM	• GO to Pinpoint Test W .

Pinpoint Tests

Pinpoint Test L: DTC U300D:11

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

The TCCM receives ignition switch position status from the hardwired run/start input circuit and the ignition switch position status message communicated by the BCM over the HS-CAN .

- DTC U300D:11 (Ignition Input On/Start: Circuit Short To Ground) — Fault sets when short to ground is sensed by TCCM C2371A pin 7. If the ignition switch is not in RUN for the self-test, this code will set.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Ignition switch
- HS-CAN

PINPOINT TEST L: U300D:11

Test Step	Result / Action to Take
L1 CHECK THE TCCM IGNITION POSITION (KEY_POS_4X4) AND IGNITION STATUS (KEY_STATUS_4X4) PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the KEY_POS_4X4 and KEY_STATUS_4X4 PIDs. • **Do the ignition PIDs match the ignition switch positions?**	**Yes** The system is functioning correctly at this time. CLEAR the DTCs. TEST the system for normal operation. **No** If the KEY_STATUS_4X4 PID did not match, CHECK BJB fuse 54 (5A). If the fuse is OK, REPAIR circuit CBB54 (VT/OG). If the fuse is not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the fault is repaired, CLEAR the DTCs. TEST the system for normal operation. If the KEY_POS_4X4 PID did not match, REFER to Section 211-05 to diagnose the ignition switch. After the fault is repaired, CLEAR the DTCs. TEST the system for normal operation.

Pinpoint Test M: DTC P0562:00 or P0563:00

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

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Normal Operation

If the TCCM observes an overpower or underpower voltage condition, a DTC is set and all TCCM outputs are turned off (IWEs engaged).

- DTC P0562:00 (Battery Voltage Low: No Sub Type Information) — Fault sets when the TCCM detects battery voltage less than 9 volts for 5 seconds or more at TCCM C2371B pin 7.
- DTC P0563:00 (Battery Voltage High: No Sub Type Information) — Fault sets when the TCCM detects battery voltage greater than 16 volts for 5 seconds or more at TCCM C2371B pin 7.

This pinpoint test is intended to diagnose the following:

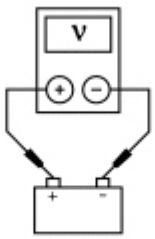
- Fuses
- Wiring, terminals or connectors
- TCCM

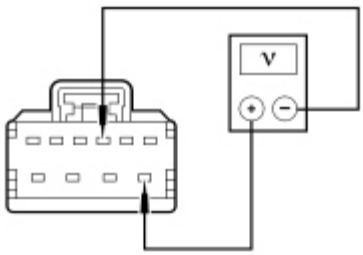
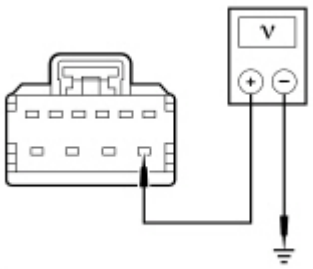
PINPOINT TEST M: DTC P0562:00 OR P0563:00

NOTE: DTC P0562:00 or P0563:00 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
M1 RETRIEVE ALL CMDTCs IN ALL MODULES • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — All CMDTCs . • **Is P0562:00 or P0563:00 present in one or more modules AND P0563, P0620, P0625, P0626 or P065B present in the PCM?**	**Yes** REFER to Section 414-00 for diagnosis of the battery and charging system. **No** GO to M2 .
M2 CHECK BATTERY CONDITION • Ignition OFF. • Refer to Section 414-01 and carry out the Battery — Condition Test. • **Does the battery pass the condition test?**	**Yes** GO to M3 . **No** CHARGE or INSTALL a new battery. REFER to Section 414-01 . CLEAR all CMDTCs . TEST the system for normal operation.
M3 CHECK THE CHARGING SYSTEM VOLTAGE **NOTE:** Do not allow the engine rpm to increase above 2,000 rpm while performing this step or the generator may self excite and result in default charging system output voltage. If engine rpm has gone above 2,000 rpm, shut the vehicle OFF and restart the engine before performing this step.	**Yes** For DTC P0562:00, GO to M4 . For DTC P0563:00, GO to M6 .

• Start the engine.
• Measure the voltage of the battery:
  ■ For DTC P0562:00, turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes.
  ■ For DTC P0563:00, turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes.

AJ0210-A
• **Is the battery voltage between 13-15.2 volts?**
	No
	REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.

M4 CHECK VOLTAGE AND GROUND TO THE TCCM	
• Ignition OFF. • Disconnect: TCCM C2371B . • Ignition ON. • Measure the voltage between TCCM C2371B-3, circuit GD123 (BK/GY), harness side and TCCM C2371B-7, circuit SBB68 (GN/RD), harness side.  N0091388 • **Is the voltage greater than 11 volts?**	**Yes** GO to M6 . **No** GO to M5 .
M5 CHECK VOLTAGE TO THE TCCM	
• Measure the voltage between TCCM C2371B-7, circuit SBB68 (GN/RD), harness side and ground.  N0091389 • **Is the voltage greater than 11 volts?**	**Yes** REPAIR circuit GD123 (BK/GY). CLEAR all CMDTCs . TEST the system for normal operation. **No** VERIFY BJB fuse 68 (20A) is OK. If OK, REPAIR circuit SBB68 (GN/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR all CMDTCs. TEST the system for normal

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	operation.

M6 CHECK FOR CORRECT TCCM OPERATION
• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test N: The Front Axle Does Not Engage/Disengage Correctly

Refer to Wiring Diagrams Cell 34, Four-Wheel Drive Systems for schematic and connector information.

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A.

Normal Operation

In 2H mode, the TCCM supplies a ground path to the IWE solenoid to apply vacuum to the IWEs (disengaging the front hubs from the front axle). In 4H or 4L modes, the TCCM does not supply the ground path to the IWE solenoid, vacuum is not applied to IWEs the and an internal spring in the IWEs keeps the hubs engaged.

- DTC C1979:11 (IWE Solenoid Circuit Failure: Short Circuit To Ground) — Fault sets when TCCM C2371A pin 6 detects a short to ground. Fault results in IWEs hubs disengaged all the time.
- DTC C1979:12 (IWE Solenoid Circuit Failure: Short Circuit To Battery) — Fault sets when TCCM C2371A pin 6 detects a short to voltage. Fault results in IWEs hubs engaged all the time.
- DTC C1979:13 (IWE Solenoid Circuit Failure: Circuit Open) — Fault sets when TCCM C2371A pin 6 detects an open circuit. Fault results in IWEs hubs engaged all the time.

This pinpoint test is intended to diagnose the following:

- MSS
- IWEs
- IWE solenoid
- Transfer case
- Vacuum leaks
- Front axle assembly
- TCCM
- Wiring, terminals or connectors
- Fuses

PINPOINT TEST N: THE FRONT AXLE DOES NOT ENGAGE/DISENGAGE CORRECTLY

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

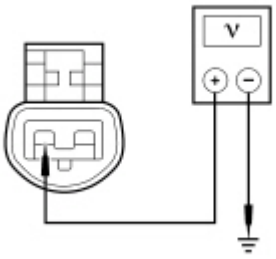
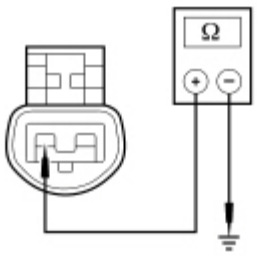
Test Step	Result / Action to Take
N1 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** For DTC C1979:11, GO to N19. For DTC C1979:12, GO to N18. For DTC C1979:13, GO to N20. For all other DTCs, REFER to the TCCM - DTC Chart. **No** GO to N2.
N2 CHECK FOR GRINDING NOISES AT HIGH SPEEDS	
• With the vehicle warm and the MSS in 2H mode, drive the vehicle at sustained WOT for 5 seconds. • **Is there a grinding noise from the axle system during WOT?**	**Yes** GO to Pinpoint Test T. **No** GO to N3.
N3 CHECK TCCM OPERATION	
• Ignition ON. • Monitor the 4X4 indicator on the IPC while moving the MSS between 2H and 4H modes. • **Does the 4X4 indicator illuminate when the MSS is in the 4H position and turn off when the MSS is in the 2H position?**	**Yes** GO to N4. **No** GO to Pinpoint Test X.
N4 CHECK THE IWE DISENGAGEMENT	
NOTE: The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02. • Place the MSS in 2H. • Start the engine. • Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft. • Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft. • **Did either front halfshaft rotate?**	**Yes** GO to N8. **No** GO to N5.
N5 CHECK THE IWE ENGAGEMENT	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02. • Place the MSS in 4H. • Start the engine. • Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft. • Rotate the RH front tire one revolution forward and one	**Yes** The front axle is operating properly at this time. CARRY OUT the 4WD Functional Test. GO to Pinpoint Test U. **No**

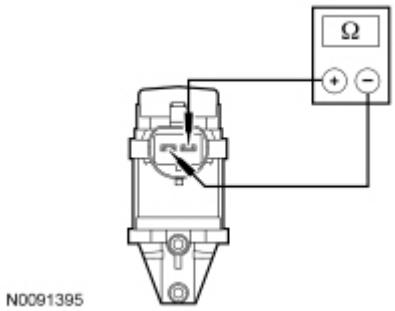
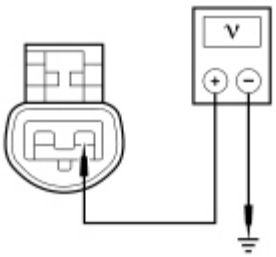
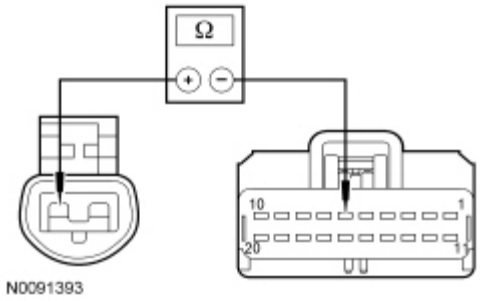
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revolution backward while observing the RH front halfshaft. • **Did both front halfshafts rotate?**	GO to N6.
N6 CHECK THE IWE SOLENOID OUTPUT IN 4H • Disconnect the output vacuum line at the IWE solenoid. • Switch the MSS to 4H. • With the engine running, measure the vacuum at the output port of the IWE solenoid. • **Is the vacuum less than 25 mm (1 in) Hg?**	**Yes** The IWE is mechanically stuck in the disengaged position. INSTALL a new IWE on the halfshaft(s) that did not rotate. REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation. **No** GO to N7.
N7 CHECK THE IWE SOLENOID • Ignition OFF. • Disconnect: IWE Solenoid . • Start the engine. • Measure the vacuum at the output port of the IWE solenoid. • **Is the vacuum less than 25 mm (1 in) Hg?**	**Yes** GO to N20. **No** INSTALL a new IWE solenoid. TEST the system for normal operation.
N8 CHECK THE IWE SOLENOID OUTPUT VACUUM IN 2H • Disconnect the output vacuum line at the IWE solenoid. • With the engine running and the MSS in 2H, measure the vacuum at the output port of the IWE solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to N11. **No** GO to N9.
N9 CHECK THE IWE SOLENOID INPUT VACUUM • Disconnect the supply vacuum line at the IWE solenoid. • With the engine running, measure the supply line vacuum to the IWE solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to N20. **No** GO to N10.
N10 CHECK THE VACUUM RESERVOIR • Ignition OFF. • With the source vacuum line still disconnected, connect a vacuum pump to the vacuum port on the vacuum reservoir and apply 508 mm (20 in) Hg of vacuum. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** REPAIR or INSTALL new vacuum lines or INSTALL a check valve. TEST the system for normal operation. **No** INSTALL a new vacuum reservoir. TEST the system for normal operation.
N11 CHECK THE IWE VACUUM LINES • Ignition OFF. • Disconnect the output vacuum line from the IWE solenoid. • Disconnect and plug the LH and RH IWE vacuum lines at the IWEs. • Connect a vacuum pump to the IWE output vacuum circuit at the IWE solenoid connection. Apply 508 mm (20 in) Hg of vacuum and observe the vacuum reading.	**Yes** GO to N14. **No** GO to N12.

• **Does the vacuum drop more than 25 mm (1 in) Hg per minute?**	
N12 CHECK THE LH IWE VACUUM LINE FOR AN OBSTRUCTION	
• REMOVE the plug from the vacuum line at the LH IWE . • Connect a hand vacuum pump to the LH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the vacuum pump draw a vacuum on the LH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. CLEAR the DTCs. TEST the system for normal operation. **No** GO to N13 .
N13 CHECK THE RH IWE VACUUM LINE FOR AN OBSTRUCTION	
• REMOVE the plug from the vacuum line at the RH IWE . • Connect a vacuum pump to the RH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the vacuum pump draw a vacuum on the RH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. CLEAR the DTCs. TEST the system for normal operation. **No** GO to N14 .
N14 CHECK THE RH IWE LEAK RATE	
• Apply 508 mm (20 in) Hg of vacuum to the RH IWE port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to N15 . **No** INSTALL a new RH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
N15 CHECK THE RH IWE OPERATION	
• Connect a vacuum pump with gauge to the larger port of the RH IWE . • Observe the RH halfshaft while rotating the RH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum and release the vacuum to manually disengage and engage the RH IWE . • **Did the RH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**Yes** CONNECT the vacuum line to the RH IWE . GO to N16 . **No** INSTALL a new RH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
N16 CHECK THE LH IWE LEAK RATE	
• Disconnect the vacuum line from the larger port at the LH IWE . • Apply 508 mm (20 in) Hg of vacuum to the LH IWE port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to N17 . **No** INSTALL a new LH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
N17 CHECK THE LH IWE OPERATION	
• Connect a vacuum pump with gauge to the larger port of the LH IWE . • Observe the LH halfshaft while rotating the LH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum	**Yes** CONNECT the vacuum line to the LH IWE . GO to N18 .

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and release the vacuum to manually disengage and engage the LH IWE . • **Did the LH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**No** INSTALL a new LH IWE . REFER to Integrated Wheel End (IWE) in this section. CLEAR the DTCs. TEST the system for normal operation.
N18 CHECK THE IWE SOLENOID CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IWE Solenoid . • Disconnect: TCCM C2371A . • Ignition ON. • Measure the voltage between IWE solenoid C1291-2, circuit CCF05 (BN/BU), harness side and ground.  N0091392 • **Is any voltage present?**	**Yes** REPAIR circuit CCF05 (BN/BU). CLEAR the DTCs. TEST the system for normal operation. **No** GO to N19 .
N19 CHECK THE IWE SOLENOID CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IWE Solenoid . • Disconnect: TCCM C2371A . • Measure the resistance between solenoid C1291-2, circuit CCF05 (BN/BU), harness side and ground.  N0091394 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to N20 . **No** REPAIR circuit CCF05 (BN/BU). CLEAR the DTCs. TEST the system for normal operation.
N20 CHECK THE IWE SOLENOID RESISTANCE	
NOTE: If the temperatures (either ambient or in the engine compartment) are exceptionally high, a higher than normal resistance reading could result. A lower temperature could result in a lower resistance reading. • Measure the resistance between IWE solenoid C1291 pins 1 and 2, component side.	**Yes** GO to N21 . **No** INSTALL a new IWE solenoid. CLEAR the DTCs. TEST the system for normal operation.

 N0091395 • **Is the resistance between 44 and 70 ohms?**	
N21 CHECK FOR VOLTAGE TO THE IWE SOLENOID	
• Measure the voltage between IWE solenoid C1291-1, circuit SBB29 (GY/RD), harness side and ground.  N0091391 • **Is the voltage greater than 11 volts?**	**Yes** GO to N22 . **No** CHECK BJB fuse 29 (10A). If OK, REPAIR circuit SBB29 (GY/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR the DTCs. TEST the system for normal operation.
N22 CHECK THE IWE SOLENOID CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: IWE Solenoid . • Disconnect: TCCM C2371A . • Measure the resistance between IWE solenoid C1291-2, circuit CCF05 (BN/BU), harness side and TCCM C2371A-6, circuit CCF05 (BN/BU), harness side.  N0091393 • **Is the resistance less than 3 ohms?**	**Yes** GO to N23 . **No** REPAIR circuit CCF05 (BN/BU). CLEAR the DTCs. TEST the system for normal operation.
N23 CHECK FOR CORRECT TCCM OPERATION	
• Ignition OFF. • Disconnect and inspect all TCCM connectors. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins	**Yes** INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.

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▪ pushed-out pins - install new pins as necessary • Connect all TCCM connectors. Make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test O: The Vehicle Does Not Shift Between 4A (4X4 AUTO) and 4H (4X4) Modes Correctly

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

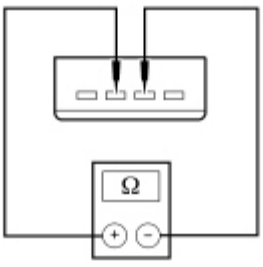
In 2H mode, the TCCM supplies a ground path to the IWE solenoid to apply vacuum to the IWEs (disengaging the front hubs from the front axle). In AUTO, 4H and 4L modes, the TCCM does not supply the ground path to the IWE solenoid, vacuum is not applied to the IWEs and an internal spring keeps the hubs engaged. Systematically check the necessary inputs and outputs at the TCCM , internal components of the transfer case, MSS , IWE components and drive axles.

This pinpoint test is intended to diagnose the following:

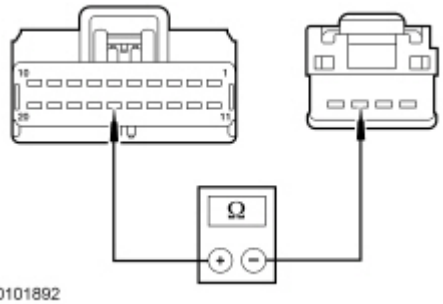
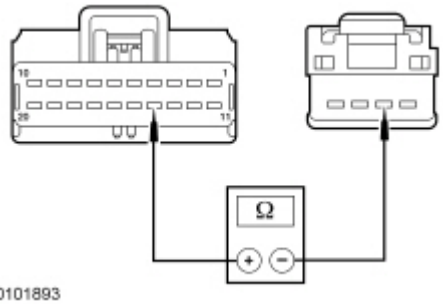
- MSS
- IWEs
- IWE solenoid
- Transfer case
- Vacuum leaks
- Front axle assembly
- TCCM
- Wiring, terminals or connectors

PINPOINT TEST O: THE VEHICLE DOES NOT SHIFT BETWEEN 4A (4X4 AUTO) AND 4H (4X4) MODES CORRECTLY

Test Step	Result / Action to Take
O1 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs retrieved?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** GO to O2 .
O2 CHECK THE 4H INDICATOR	
• Select 4H mode and observe the IPC . • **Does the IPC indicator lamp indicate 4H (4X4) mode?**	**Yes** GO to O8 . **No** GO to O3 .
O3 CHECK THE TCCM IGNITION POSITION (KEY_POS_4X4) PID	
• Enter the following diagnostic mode on the scan tool:	**Yes**

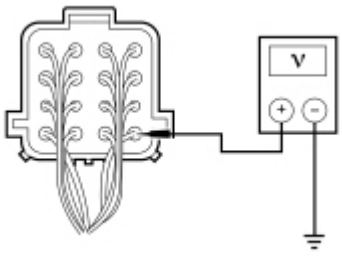
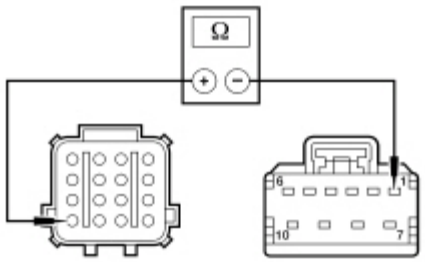
DataLogger — TCCM . • Monitor the KEY_POS_4X4 PID while cycling through each position: • **Does the ignition position PID match the ignition switch positions?**	GO to O4 . **No** REFER to Section 211-05 to diagnose the ignition switch concern.
O4 CHECK THE TCCM 4WD SWITCH STATUS (4X4_SW) PID • Monitor 4X4_SW PID while cycling the MSS through each position. **MSS Position** / **PID Status**: 2H — 2-W Drive; 4A — A4WD; 4H — 4W Auto/Hi; 4L — 4W Low • **Does each PID status agree with each MSS position?**	**Yes** GO to O7 . **No** GO to O5 .
O5 CHECK THE MSS RESISTANCE VALUES • Ignition OFF. • Disconnect: MSS . • Measure the resistance between C284 pin 2 and pin 3, component side. Refer to the following chart: **MSS Position** / **Resistance (±1%)**: 2H — 619 ohms; 4A — 270 ohms; 4H — 130 ohms; 4L — 62 ohms  N0063005 • **Are the resistance values within specification?**	**Yes** GO to O6 . **No** INSTALL a new MSS . REFER to Mode Select Switch (MSS) in this section. CLEAR the DTCs. TEST the system for normal operation.
O6 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR AN OPEN • Disconnect: TCCM C2371A . • Measure the resistance between MSS C284-2, circuit CCF13 (WH/BU), harness side and TCCM C2371A-16, circuit CCF13 (WH/BU), harness side.	**Yes** GO to O19 . **No** REPAIR the affected circuit

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 N0101892 • Measure the resistance between MSS C284-3, circuit RCF13 (WH/BN), harness side and TCCM C2371A-14, circuit RCF13 (WH/BN), harness side.  N0101893 • **Are the resistances less than 3 ohms?**	(s). CLEAR the DTCs. TEST the system for normal operation.
O7 CHECK THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID IN 4H • Switch the MSS to 4H mode. • Monitor the 4WD_CLTCH_OUT PID. • **Does the PID read 2 to 10% at closed throttle?**	**Yes** GO to O19 . **No** DIAGNOSE the PCM. REFER to PC/ED manual and the HS-CAN . REFER to Section 418-00 . CLEAR the DTCs. TEST the system for normal operation.
O8 CHECK FOR WIND-UP IN 4H MODE • Switch the MSS to 4H mode. • Drive the vehicle on a dry, hard surface in turns while applying the throttle. • **Is wind-up present in turns?**	**Yes** GO to O13 . **No** GO to O9 .
O9 CHECK THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID AT WOT • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the 4WD_CLTCH_OUT PID at WOT , KOEO . • **Does the 4WD_CLTCH_OUT PID read 98% at WOT ?**	**Yes** GO to O11 . **No** GO to O10 .
O10 CHECK THE TCCM ABSOLUTE THROTTLE POSITION (TP_TCCM) PID • **NOTE:** The TP_TCCM PID is APP as communicated by the	**Yes**

PCM via HS-CAN . • Slowly move the accelerator pedal from closed throttle to WOT and observe the TP_TCCM PID. • **Does the TP_TCCM PID vary between 0% at closed throttle and 100% at WOT ?**	GO to O11 . **No** DIAGNOSE the PCM. REFER to PC/ED manual and the HS-CAN . REFER to Section 418-00 . CLEAR the DTCs. TEST the system for normal operation.
O11 CHECK FOR TRANSFER CASE CLUTCH ENGAGEMENT WITH THE TCCM 4WD PWM CLUTCH STATUS COMMAND (4WD_CLTCH_OUT) ACTIVE COMMAND AND 4WD CLUTCH STATUS (4WD_CLTCH_OUT) PIDs	
• Using the 4WD_CLTCH_OUT active command, engage the transfer case clutch to 100% while monitoring the 4WD_CLTCH_OUT PID. • **Does the 4WD_CLTCH_OUT PID read 100%?**	**Yes** END the active command. CHECK the transfer case. REFER to Section 308-07B . **No** END the active command. GO to O12 .
O12 CHECK THE IPC INDICATOR IN AUTO MODE	
• Select 4A mode and observe the IPC . • **Does the message center indicate 4A (4X4 AUTO) mode?**	**Yes** GO to O13 . **No** GO to Pinpoint Test V .
O13 CHECK FOR WIND-UP IN AUTO MODE	
• Drive the vehicle on a dry, hard surface in turns while applying the throttle. • **Is wind-up present in turns?**	**Yes** GO to O14 . **No** The system is operating correctly.
O14 CHECK THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID AT CLOSED THROTTLE	
• Monitor the 4WD_CLTCH_OUT PID at closed throttle, KOEO . • **Does the 4WD_CLTCH_OUT PID indicate 2 to 10% clutch application at closed throttle?**	**Yes** GO to O15 . **No** GO to O17 .
O15 CHECK VOLTAGE ON THE CLUTCH CONTROL CIRCUIT USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) ACTIVE COMMAND	
• Using the 4WD_CLTCH_OUT active command, command the transfer case clutch to 4%. • Measure the voltage by carefully back-probing transfer case C350-16, circuit CCF03 (GY/BN), component side and ground.	**Yes** END the active command. CHECK the transfer case. REFER to Section 308-07B . **No** GO to O16 .

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 N0133480 • **Is the voltage approximately 0.2 to 0.4 volt?**	
O16 CHECK THE CLUTCH CONTROL CIRCUIT FOR AN OPEN	**Yes** GO to O17 . **No** REPAIR circuit CCF03 (GY/BN). CLEAR the DTCs. TEST the system for normal operation.
• Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371B . • Measure the resistance between transfer case C350-16, circuit CCF03 (GY/BN), harness side and TCCM C2371B-1, circuit CCF03 (GY/BN), harness side.  N0093126 • **Are the resistances less than 3 ohms?**	
O17 CHECK THE ABS MODULE WHEEL SPEED SENSOR PIDs	**Yes** GO to O18 . **No** CHECK the ABS for faults. REFER to Section 206-09 .
• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module . • While driving the vehicle at 30 km/h (18 mph), monitor the following wheel speed sensor PIDs: ▪ Left Front Wheel Speed Sensor (LF_WSPD) ▪ Left Rear Wheel Speed Sensor (LR_WSPD) ▪ Right Front Wheel Speed Sensor (RF_WSPD) ▪ Right Rear Wheel Speed Sensor (RR_WSPD) • Compare the speedometer reading to the wheel speed sensor PIDs. • **Do the wheel speed sensor PIDs and speedometer speeds match within 1.5 km/h (1 mph)?**	
O18 CHECK THE TCCM ABSOLUTE THROTTLE POSITION (TP_TCCM) PID	**Yes** GO to O19 . **No** DIAGNOSE the PCM. REFER to PC/ED manual and the HS-CAN . REFER to Section 418-00 . CLEAR the DTCs. TEST the system for normal
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • **NOTE:** The TP_TCCM PID is APP as communicated by the PCM via HS-CAN . • Slowly move the accelerator pedal from closed throttle to and observe the TP_TCCM PID. • **Does the TP_TCCM PID vary between 0% at closed throttle and 100% at WOT ?**	

	operation.

O19 CHECK FOR CORRECT TCCM OPERATION
• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test P: The Vehicle Does Not Shift Between 4H (4X4) and 4L (4X4 Low) Modes Correctly

Refer to Wiring Diagrams Cell 34, Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

The high-low shift occurs when the reduction shift fork moves the high-low collar to lock the planetary gear set to the output shaft. The torque transmitted through the sun gear from the input shaft turns the front planetary gear set assembly. The front planetary gear set assembly, now engaged, provides transfer case speed reduction. Certain criteria, such as vehicle speed and TR selection must be met before this shift can occur. Systematically check the necessary inputs and outputs of the TCCM, components of the transfer case, IWE components and halfshafts.

DTC Description	Fault Trigger Condition
• P1839:00 — Transfer Case Shift Motor Open Circuit: No Sub Type Information	Fault sets when TCCM C2371B pin 4 or 5 detects an open circuit. Shift motor moves are prevented when this DTC is set.
• P1840:00 — Transfer Case Shift Motor Short Circuit To Battery: No Sub Type Information	Fault sets when TCCM C2371B pin 4 or 5 detects a short to voltage. Shift motor moves are prevented when this DTC is set.
• P1841:00 — Transfer Case Shift Motor Short Circuit To Ground: No Sub Type Information	Fault sets when TCCM C2371B pin 4 or 5 detects a short to ground. Shift motor moves are prevented when this DTC is set.
• P1849:00 — Transfer Case Contact Plate 'A' Short Circuit To Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 1 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P184B:00 — Transfer Case Unable to Transition Between 4H and 4L: No Sub Type Information	Fault sets when target shift motor position is not reached after the maximum number of allowed blocked shift retries for 4H to 4L. Requested shift motor position is not reached.

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• P1853:00 — Transfer Case Contact Plate 'B' Short Circuit to Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 2 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P1857:00 — Transfer Case Contact Plate 'C' Short Circuit to Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 3 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P1861:00 — Transfer Case Contact Plate 'D' Short Circuit to Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 4 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P1867:00 — Transfer Case Contact Plate General Circuit Failure: No Sub Type Information	Fault sets when an invalid shift motor position is detected during selection of a new 4WD mode or during a motor movement. If the shift motor is not moving, shift motor movement will be prevented. If the shift motor is moving when this DTC sets, the shift motor will move to the high-side mechanical stop.
• P1891:00 — Transfer Case Contact Plate Ground Return Open Circuit: No Sub Type Information	Fault sets when TCCM C2371A pin 5 detects a short to ground, a short to voltage or open circuit. The TCCM will not complete mode change if a change in shift motor position is required.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Transfer case
- TR
- ABS wheel speed inputs
- IWEs
- TCCM
- Transmission drag torque

PINPOINT TEST P: THE VEHICLE DOES NOT SHIFT BETWEEN 4H (4X4) AND 4L (4X4 LOW) MODES CORRECTLY

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

Test Step	Result / Action to Take
P1 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** For DTC P184B:00, GO to P2. For DTC P1839:00, GO to P22. For DTC P1840:00, GO to P23.

	For DTC P1841:00, GO to P24 . For DTC P1849:00, P1853:00, P1857:00, P1861:00, GO to P17 . For DTC P1867:00, GO to P7 . For DTC P1891:00, GO to P15 . For all other DTCs, REFER to the TCCM DTC Chart in this section. **No** GO to P2 .
P2 CHECK THE 2H TO 4H SHIFT	
• Drive the vehicle and shift MSS from 2H to 4H. • **Does the vehicle shift between 2H and 4H correctly?**	**Yes** GO to P3 . **No** GO to Pinpoint Test O .
P3 CHECK THE 4H TO 4L SHIFT	
• **NOTE:** When switching in or out of 4L, the transmission must be in NEUTRAL and the vehicle stopped or moving less than 5 km/h (3 mph). • Drive the vehicle and shift MSS from 4H to 4L. • **Does the transfer case shift from 4H to 4L correctly and the complaint is related to a clunk noise during the shift?**	**Yes** Transmission neutral drag is excessive. REFER to Section 307-01 for transmission diagnosis. **No** GO to P4 .
P4 CHECK THE NEUTRAL INDICATOR (NEUTRAL) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the NEUTRAL TCCM PID while shifting the transmission through gear ranges. • **Does the NEUTRAL PID indicate True when the transmission is shifted to NEUTRAL?**	**Yes** GO to P5 . **No** REFER to Section 307-01 for further diagnosis of the TR sensor.
P5 CHECK THE TCCM AVERAGE FRONT WHEEL SPEED (FRT_WHL_SPD) AND AVERAGE REAR WHEEL SPEED (REAR_WHL_SPD) PIDs	
• Ignition OFF. • Connect: TCCM C2371A . • Connect: MSS . • Ignition ON. • Switch the MSS to 2H. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM .	**Yes** GO to P6 . **No** REFER to Section 206-09 to diagnose the wheel speed concern.

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• Monitor the FRT_WHL_SPD and REAR_WHL_SPD PIDs with the vehicle stopped and while driving. • **Do the FRT_WHL_SPD and REAR_WHL_SPD PIDs match with the vehicle stopped and at all speeds?**	After the repair is complete, CLEAR the DTCs. TEST the system for normal operation.
P6 CHECK THE ABS MODULE WHEEL SPEED PIDs	

• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module .
• Monitor the wheel speed PIDs:
  ▪ Left Front Wheel Speed Sensor (LF_WSPD)
  ▪ Left Rear Wheel Speed Sensor (LR_WSPD)
  ▪ Right Front Wheel Speed Sensor (RF_WSPD)
  ▪ Right Rear Wheel Speed Sensor (RR_WSPD)
• **Do the wheel speed PIDs indicate 0 km/h (0 mph)?**
	Yes
	GO to P7 .
	
	No
	REFER to Section 206-09 for further diagnosis of the ABS system.

P7 CHECK THE TCCM 4WD MODES (4WD_MODES) PID WITH THE MSS IN 4H	
• Start the engine. • Switch the MSS to 4H. • Monitor the 4WD_MODES PID. • **Does the 4WD_MODES PID indicate 4WD High?**	**Yes** GO to P10 . **No** GO to P8 .
P8 CHECK FOR 4H WIND-UP	
• Switch the MSS to 4H. • Drive the vehicle on a dry, hard surface in turns. • **Is wind-up present in turns?**	**Yes** GO to P11 . **No** GO to P9 .
P9 CHECK FOR TRANSFER CASE ENGAGEMENT	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Rotate the rear driveshaft. • Observe the front driveshaft. • **Did the front driveshaft rotate?**	**Yes** GO to P10 . **No** GO to P14 .
P10 CHECK FOR IWE ENGAGEMENT	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Switch the MSS to 4H. • Start the engine. • **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft and U-joint. • Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft and U-joint. • **Did both front halfshafts rotate?**	**Yes** GO to P12 . **No** GO to Pinpoint Test N .
P11 CHECK THE TRANSFER CASE SHIFT TO 2H	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Command the Transfer Case Contact Plate Power (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly. • Monitor the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE_C) and D (PLATE_D) PIDs for the contact	**Yes** GO to P12 . **No** GO to P15 .

plate position with the MSS in the 2H position.

MSS Position	Contact Plate Position			
	PLATE_A	PLATE_B	PLATE_C	PLATE_D
2H/4A/4H Mode	CLOSED	OPEN	CLOSED	CLOSED
4L Mode	OPEN	CLOSED	OPEN	CLOSED

- **Do the PIDs and message center indicate that vehicle shifted into 2H (4X2 displayed in message center for approximately 4 seconds)?**

P12 CHECK FOR IWE DISENGAGEMENT

- With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
- Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft and U-joint.
- Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft and U-joint.
- **Did either of the front halfshafts rotate?**

Yes
GO to Pinpoint Test N .

No
GO to P13 .

P13 CHECK FOR TRANSFER CASE DISENGAGEMENT

- Rotate the rear driveshaft while observing the front driveshaft.
- **Does the front driveshaft rotate?**

Yes
The system is functioning correctly. CARRY OUT the Functional Test. GO to Pinpoint Test u .

No
GO to P14 .

P14 CHECK THE TCCM TRANSFER CASE CONTACT PLATE POSITION PIDs

- Enter the following diagnostic mode on the scan tool: DataLogger — TCCM .
- Command the Transfer Case Contact Plate Power (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly.
- Monitor the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE C) and D (PLATE_D) PIDs for the contact plate position with the MSS in the 4H position.

MSS Position	Contact Plate Position			
	PLATE_A	PLATE_B	PLATE_C	PLATE_D
2H/4A/4H Mode	CLOSED	OPEN	CLOSED	CLOSED
4L Mode	OPEN	CLOSED	OPEN	CLOSED

- **Did the PIDs and message center indicate that the vehicle shifted into 4H (4X4 HIGH)?**

Yes
GO to P25 .

No
GO to P15 .

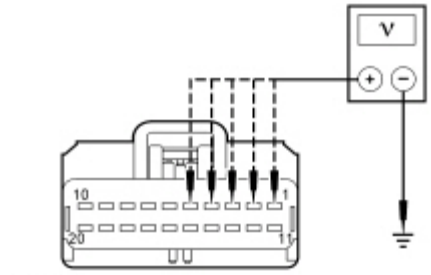
P15 CHECK THE TRANSFER CASE SHIFT MOTOR OPERATION

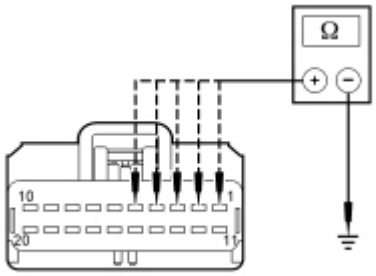
- Remove the transfer case shift motor from the transfer case, leaving the wiring connector connected.
- Observe the transfer case shift motor while switching the MSS from 2H to 4H.

Yes
GO to P25 .

No

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• **Does the transfer case shift motor rotate from the 2H position to the 4H position?**	GO to P16 .
P16 CHECK TRANSFER PLATE CONTACT PLATE CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between the following circuits at C2371A, harness side and ground: **Circuit** / **C2371A Pin** CCF14 (WH) / 1 CCF15 (BN/YE) / 2 CCF16 (VT/GN) / 3 CCF17 (WH/OG) / 4 RCF09 (BN/WH) / 5  N0091402 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to P17 .
P17 CHECK TRANSFER PLATE CONTACT PLATE CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Transfer Case (if not previously disconnected) . • Disconnect: TCCM C2371A (if not previously disconnected) . • Measure the resistance between the following circuits at C2371A, harness side and ground: **Circuit** / **C2371A Pin** CCF14 (WH) / 1 CCF15 (BN/YE) / 2 CCF16 (VT/GN) / 3 CCF17 (WH/OG) / 4 RCF09 (BN/WH) / 5	**Yes** GO to P18 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation.

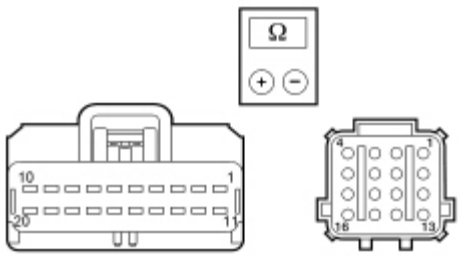


N0091403

- **Are the resistances greater than 10,000 ohms?**

P18 CHECK THE TRANSFER PLATE CONTACT PLATE CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371A . • Measure the resistance of the following circuits between TCCM C2371A, harness side and transfer case C350, harness side:	**Yes** GO to P19 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation.

Circuit	C2371A Pin	C350 Pin
CCF14 (GN/OG)	1	5
CCF15 (BN/YE)	2	1
CCF16 (VT/GN)	3	9
CCF17 (WH/OG)	4	13
RCF09 (BN/WH)	5	10

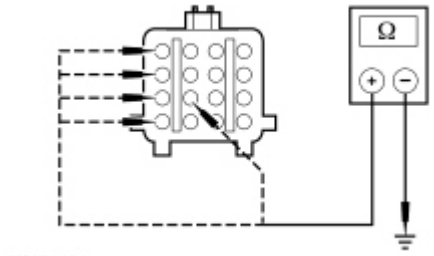
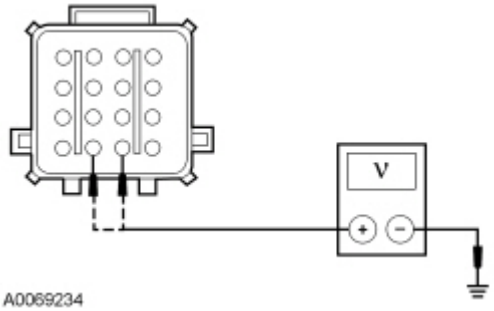
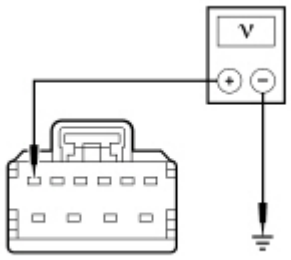


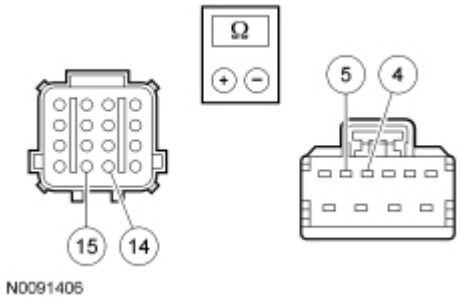
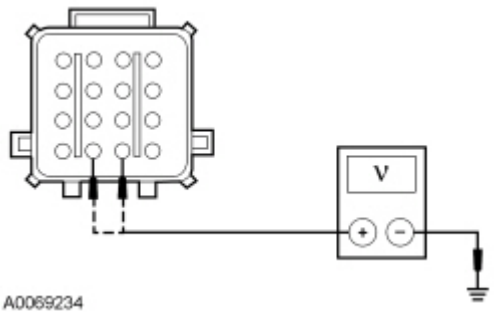
N0091401

- **Are the resistances less than 3 ohms?**

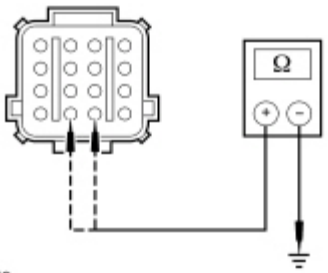
P19 CHECK THE SHIFT MOTOR FOR AN INTERNAL SHORT TO GROUND	
• Measure the resistance between transfer case C350 pins 1, 5, 9, 10 and 13, component side and ground.	**Yes** GO to P20 . **No** INSTALL a new transfer case shift motor. REFER to Transfer Case Shift Motor in this section. CLEAR the DTCs.

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 N0091404 • **Are the resistances greater than 10,000 ohms?**	REPEAT the self-test. If the concern is still present, GO to P26 .
P20 CHECK THE SHIFT MOTOR CIRCUITS FOR POWER WHILE COMMANDING THE TCCM CW RELAY (CW_SMD_OS) AND CCW RELAY (CCW_SMD_OS) PIDs ON	
• Connect: TCCM C2371A . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Command the CW_SMD_OS PID ON and OFF while measuring the voltage between transfer case C350-14, circuit CCF08 (GY/OG), harness side and ground. Then command the CCW_SMD_OS PID ON and OFF while measuring the voltage between transfer case C350-15, circuit CCF07 (BN/GN), harness side and ground.  A0069234 • **Are the voltages 10 volts or greater on the circuits when commanding the PIDs ON?**	**Yes** GO to P25 . **No** GO to P21 .
P21 CHECK THE TCCM VOLTAGE CIRCUIT	
• Ignition OFF. • Disconnect: TCCM C2371B . • Measure the voltage between TCCM C2371B-6, circuit SBB20 (GN/RD), harness side and ground.  N0091405 • **Is the voltage greater than 11 volts?**	**Yes** GO to P22 . **No** VERIFY BJB fuse 20 (20A) is OK. If OK, REPAIR circuit SBB20 (GN/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR the DTCs. TEST the system for normal operation.

P22 CHECK THE TRANSFER CASE SHIFT MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: TCCM C2371B . • Disconnect: Transfer Case . • Measure the resistance between transfer case C350, harness side and TCCM C2371B, harness side. Refer to the following chart. **Transfer Case / Circuit / TCCM** C350-14 / CCF08 (GY/OG) / C2371B-5 C350-15 / CCF07 (BN/GN) / C2371B-4  N0091405 • **Are the resistances less than 3 ohms?**	**Yes** GO to P23 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation.
P23 CHECK THE TRANSFER CASE SHIFT MOTOR CIRCUITS FOR SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: TCCM C2371B (if not previously disconnected) . • Disconnect: Transfer Case (if not previously disconnected) . • Measure the voltage between transfer case C350-14, circuit CCF08 (GY/OG), harness side and ground; and between transfer case C350-15, circuit CCF07 (BN/GN), harness side and ground.  A0069234 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to P24 .
P24 CHECK THE TRANSFER CASE SHIFT MOTOR CIRCUITS FOR SHORT TO GROUND	
• Ignition OFF. • Disconnect: TCCM C2371B (if not previously disconnected) . • Disconnect: Transfer Case (if not previously disconnected) . • Measure the resistance between transfer case C350-14, circuit CCF08 (GY/OG), harness side and ground; and between the transfer case C350-15, circuit CCF07 (BN/GN), harness side and ground.	**Yes** GO to P25 . **No** REPAIR the affected circuit(s). CLEAR the

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 • **Are the resistances greater than 10,000 ohms?**	DTCs. TEST the system for normal operation.

P25 CHECK FOR CORRECT TCCM OPERATION
• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

P26 SHIFT THE TRANSFER CASE TO 4H MANUALLY • Remove the transfer case shift motor from the transfer case. • Using a wrench, rotate the shift cam to the 4H position. • Rotate the rear driveshaft and watch the front driveshaft. • **Does the transfer case shift to 4H and the front driveshaft rotates?**	**Yes** GO to P27. **No** REPAIR the transfer case. REFER to Section 308-07B.
P27 CHECK THE TORQUE REQUIRED TO SHIFT THE TRANSFER CASE • Rotate the shift cam by hand through 4L, 4H and 2H positions. • Measure the torque required to perform the shift. • **Is the torque required to shift 45 Nm (33 lb-ft) or less?**	**Yes** GO to P28. **No** REPAIR the transfer case. REFER to Section 308-07B.
P28 SHIFT THE TRANSFER CASE TO 2H MANUALLY • Rotate the shift cam to the 2H position. • Rotate the rear driveshaft and watch the front driveshaft. • **Does the transfer case shift to 2H and the front driveshaft does not rotate?**	**Yes** GO to P29. **No**

	REPAIR the transfer case. REFER to Section 308-07B .
P29 SHIFT THE TRANSFER CASE TO 4L MANUALLY • Rotate the shift cam by hand to the 4L position. • Rotate the rear driveshaft and watch the front driveshaft. • **Does the transfer case shift to 4L and the front driveshaft rotates?**	**Yes** INSTALL a new transfer case shift motor. REFER to Transfer Case Shift Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the transfer case. REFER to Section 308-07B .

Pinpoint Test Q: Four-Wheel Drive (4WD) Does Not Engage at Speed Correctly

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive System for schematic and connector information.

Normal Operation

When the operator selects a transfer case mode from 2H mode, the TCCM engages a clutch for approximately 5 seconds to synchronize the front and rear driveshafts allowing a mechanical engagement of the transfer case. The TCCM also removes the ground path from the IWE solenoid, which removes vacuum from the IWEs , allowing them to engage the front axle shaft. Systematically check the necessary inputs and outputs at the TCCM , internal components of the transfer case, IWE components and drive axles.

- DTC P1825:00 (4-Wheel Drive Clutch Relay Open Circuit: No Sub Type Information) — Fault sets when TCCM C2371B pin 1 detects an open circuit. The TCCM disables transfer case synchronization clutch operation.
- DTC P1826:00 (4-Wheel Drive Low Clutch Relay Circuit To Battery: No Sub Type Information) — Fault sets when TCCM C2371B pin 1 detects a short to voltage. Transfer case synchronization clutch operation, though disabled by the TCCM , is fully engaged when this DTC is present.
- DTC P1827:00 (4-Wheel Drive Low Clutch Relay Circuit To Ground) — Fault sets when TCCM C2371B pin 1 detects a short to ground. The TCCM disables transfer case synchronization clutch operation.

This pinpoint test is intended to diagnose the following:

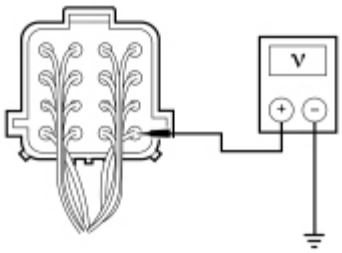
- Transfer case synchronization clutch
- Transfer case
- TCCM
- Front axle assembly
- Wiring, terminals or connectors

PINPOINT TEST Q: 4WD DOES NOT ENGAGE AT SPEED CORRECTLY

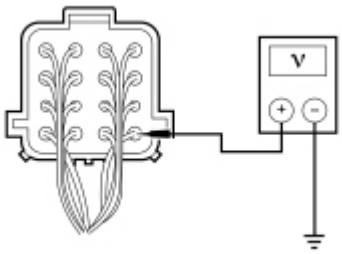
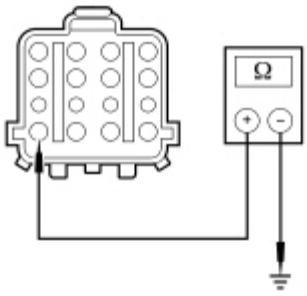
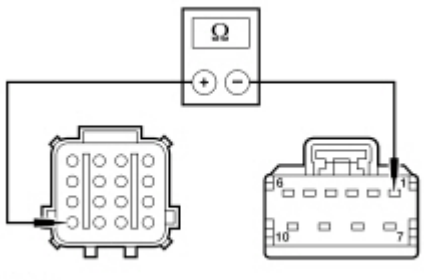
Test Step	Result / Action to Take

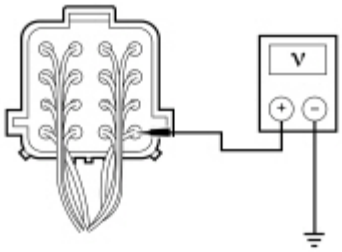
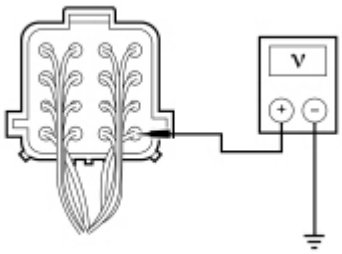
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Q1 RETRIEVE TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs retrieved?**	**Yes** For DTC P1825:00, GO to Q11. For DTC P1826:00, GO to Q13. For DTC P1827:00, GO to Q10. For all other DTCs, GO to the TCCM DTC Chart in this section. **No** GO to Q2.
Q2 CHECK 4X4 MODE ENGAGEMENT AT REST	
• Switch the Mode Select Switch (MSS) from 4X2 mode to 4X4 mode. • **Does 4X4 mode engage at rest correctly?**	**Yes** GO to Q3. **No** GO to Pinpoint Test N.
Q3 CHECK 4X2 MODE TO 4X4 MODE SHIFT AT SPEED	
• Switch the MSS to 4X2 mode. • Drive the vehicle and carry out a 4X2 mode to 4X4 mode shift while driving at approximately 16 km/h (10 mph). • Stop the vehicle, shift to 4X2 mode, drive the vehicle and carry out a 4X2 mode to 4X4 mode shift while driving at approximately 64 km/h (40 mph). • **Does 4X4 mode engage correctly at 16 km/h (10 mph) and at 64 km/h (40 mph)?**	**Yes** GO to Pinpoint Test U. **No** GO to Q4.
Q4 CHECK THE TCCM AVERAGE FRONT WHEEL SPEED (FRT_WHL_SPD) AND AVERAGE REAR WHEEL SPEED (REAR_WHL_SPD)	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the FRT_WHL_SPD and REAR_WHL_SPD PIDs while driving in a straight line. • **Do the FRT_WHL_SPD and REAR_WHL_SPD PIDs match?**	**Yes** GO to Q5. **No** REFER to Section 206-09 to diagnose the wheel speed sensor concern.
Q5 CHECK THE TRANSFER CASE CLUTCH LOCKUP USING TCCM 4WD PWM CLUTCH STATUS (4WD CLTCH_OUT) PID ACTIVE COMMAND	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Switch the MSS to AUTO mode. • Using the 4WD CLTCH_OUT active command, command the PID to 98%. • Rotate the rear driveshaft while observing the front driveshaft. • **Does the front driveshaft rotate when the rear driveshaft is rotated?**	**Yes** GO to Q6. **No** GO to Q9.
Q6 CHECK THE TRANSFER CASE CLUTCH RELEASE USING TCCM 4WD PWM CLUTCH STATUS (4WD	

CLTCH_OUT) PID ACTIVE COMMAND	
• With the vehicle still in NEUTRAL and on a hoist, using the 4WD_CLTCH_OUT active command, command the transfer case clutch to 0%. • Rotate the rear driveshaft while observing the front driveshaft. • **Does the front driveshaft rotate when the rear driveshaft is rotated?**	**Yes** GO to Q15 . **No** End the active command. GO to Q7 .
Q7 CHECK THE TRANSFER CASE ENGAGEMENT (ON A HOIST)	
• Start the engine, switch the MSS to 4X2 mode. • Place the transmission in DRIVE and increase speed to between 16 km/h (10 mph) and 24 km/h (15 mph). • While observing the front driveshaft, switch the MSS to 4X4 mode. • **Did the front driveshaft start to spin?**	**Yes** GO to Q8 . **No** GO to Q15 .
Q8 CHECK THE TRANSFER CASE DISENGAGEMENT	
• Switch the MSS to 4X2 mode while observing the front driveshaft. • **Does the front driveshaft rotate?**	**Yes** GO to Q15 . **No** GO to Pinpoint Test N .
Q9 CHECK CLUTCH CONTROL CIRCUIT FOR VOLTAGE USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) ACTIVE COMMAND	
• Using the 4WD_CLTCH_OUT active command, command the transfer case clutch to 98%. • Measure the voltage by carefully back-probing transfer case C350-16, circuit CCF03 (GY/BN), component side and the transfer case housing.  N0133480 • **Is the voltage greater than 9 volts?**	**Yes** END the active command. INSTALL a new transfer case synchronization clutch. REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation. **No** GO to Q10 .
Q10 CHECK THE TRANSFER CASE-TO-CHASSIS GROUND USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) ACTIVE COMMAND	
• Using the 4WD_CLTCH_OUT active command, command the transfer case clutch to 98%. • Measure the voltage by carefully back-probing transfer case C350-16, circuit CCF03 (GY/BN), component side and chassis ground.	**Yes** END the active command. REPAIR the transfer case ground connection between the transfer case and the chassis. CLEAR the DTCs. TEST the system for normal operation. **No**

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 N0133480 • **Is the voltage greater than 9 volts?**	GO to Q11 .
Q11 CHECK CLUTCH CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371B . • Measure the resistance between transfer case C350-16, circuit CCF03 (GY/BN), harness side and ground.  N0057998 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to Q12 . **No** REPAIR circuit CCF03 (GY/BN). CLEAR the DTCs. TEST the system for normal operation.
Q12 CHECK CLUTCH CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Transfer Case (if not previously disconnected) . • Disconnect: TCCM C2371B (if not previously disconnected) . • Measure the resistance between transfer case C350-16, circuit CCF03 (GY/BN), harness side and TCCM C2371B-1, circuit CCF03 (GY/BN), harness side.  N0093126 • **Is the resistance less than 3 ohms?**	**Yes** GO to Q13 . **No** REPAIR circuit CCF03 (GY/BN). CLEAR the DTCs. TEST the system for normal operation.
Q13 CHECK CLUTCH CONTROL CIRCUIT FOR VOLTAGE USING THE TCCM 4WD PWM CLUTCH STATUS	

(4WD_CLTCH_OUT) PID ACTIVE COMMAND	
• Connect: Transfer Case . • Connect: TCCM C2371B . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Using the 4WD_CLTCH_OUT active command, command the transfer case clutch to greater than 10%. • Measure the voltage by carefully back-probing transfer case C350-16, circuit CCF03 (GY/BN), component side and ground.  N0133480 • **Is any voltage present?**	**Yes** END the active command. GO to Q14 . **No** END the active command. INSTALL a new transfer case synchronization clutch. REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation.
Q14 CHECK CLUTCH CONTROL CIRCUIT FOR A SHORT TO VOLTAGE USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) ACTIVE COMMAND	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Using the 4WD_CLTCH_OUT active command, command the transfer case clutch to 0%. • Measure the voltage by carefully back-probing transfer case C350-16, circuit CCF03 (GY/BN), component side and ground.  N0133480 • **Is any voltage present?**	**Yes** REPAIR circuit CCF03 (GY/BN). CLEAR the DTCs. TEST the system for normal operation. **No** GO to Q15 .
Q15 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at

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correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of connector or pin issue.

Pinpoint Test R: The Four-Wheel Drive (4WD) System Jumps Out of Gear

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A .

Normal Operation

When the 4WD system engages the user selected mode, that mode should be maintained. If the 4WD system does not stay in the selected mode, systematically check the 4WD system components.

This pinpoint test is intended to diagnose the following:

- IWE vent line(s)
- MSS
- Transfer case

PINPOINT TEST R: THE 4WD SYSTEM JUMPS OUT OF GEAR

Test Step	Result / Action to Take
R1 CHECK FOR OBSTRUCTED IWE VENT LINES • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • **NOTE:** The IWE vent port is the smaller of the 2 vacuum ports. • Disconnect the LH IWE line from the vent port. • Attach a hand vacuum pump to the IWE vent line. • Attempt to draw and hold a vacuum. • Connect the LH IWE line. • Disconnect the RH IWE line from the vent port. • Attempt to draw and hold a vacuum. • **Can a vacuum be held on either IWE vent line?**	**Yes** INSTALL new IWE vent lines as necessary. TEST the system for normal operation. **No** GO to R2 .
R2 CHECK THE TCCM 4WD SWITCH STATUS (4X4_SW) PID • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Drive the vehicle. • Monitor the 4X4_SW PID while driving the vehicle in each MSS position. **MSS Position** | **PID Status**	**Yes** GO to R3 . **No** GO to Pinpoint Test N .

2H	2-W Drive
4A	A4WD
4H	4W Auto/Hi
4L	4W Low

- **Does the PID always agree with the MSS position?**

R3 CHECK THE 4WD INDICATORS	
• Stop the vehicle. • Shift the transmission into the NEUTRAL position. • **NOTE:** 2H is indicated by the absence of 4X4 AUTO, 4H or 4L mode indicators in the IPC message center. • Observe the 4WD indicators in the IPC while cycling through each MSS position. • **Do the 4WD indicators match MSS switch positions?**	**Yes** GO to Pinpoint Test N . **No** GO to R4 .
R4 CHECK FOR TCCM DTCs	
• Shift the transmission into the PARK position. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** CHECK the transfer case fluid level. REFER to Section 308-07B . If the fluid level is OK, CHECK for internal transfer case faults. REFER to Section 308-07B . TEST the system for normal operation.

Pinpoint Test S: Vehicle Pulsates or Shudders in a Straight Line (Straightline Driveline Wind-up)

Normal Operation

In order for the 4WD system to function correctly, tires and wheels must be the same size, be in good condition and the front and rear axle ratios must match.

This pinpoint test is intended to diagnose the following:

- Unmatched tire sizes
- Unequal amounts of tire wear
- Unequal tire inflation pressures
- Unmatched front and rear axle ratios

PINPOINT TEST S: VEHICLE PULSATES OR SHUDDERS IN A STRAIGHT LINE (STRAIGHTLINE DRIVELINE WIND-UP)

NOTE: 4X4 is not intended for driving on hard/dry surfaces; using 4X4 mode while driving on these surfaces may produce noises like intermittent clunking, but will not damage driveline components.

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Test Step	Result / Action to Take
S1 VERIFY THE CONCERN • Drive the vehicle and shift from 2H mode to 4H mode. There should be minimal wind-up in 4H mode during straightline maneuvers (wind-up in turns is normal; 4H/4L is not intended for driving on hard/dry surfaces). • **Is excessive wind-up present?**	**Yes** GO to S2. **No** RETURN the vehicle to the customer. ADVISE about correct 4WD system operation and normal vehicle behavior.
S2 CHECK FOR MATCHING WHEEL AND TIRE SIZES • Check the wheel and tire sizes. • **Do the 4 wheels and tire sizes match?**	**Yes** GO to S3. **No** ADVISE the customer that 4WD systems require 4 matched, correctly inflated, correctly maintained tires to operate correctly.
S3 CHECK TIRE WEAR • Check each of the 4 tires for wear. • **Are the 4 tires worn evenly?**	**Yes** GO to S4. **No** ADVISE the customer that 4WD systems require 4 matched, correctly inflated, correctly rotated tires to operate correctly.
S4 CHECK TIRE INFLATION PRESSURE • Check the inflation pressure in each tire. Refer to the Safety Certification Label on driver door or door pillar. • **Are the tire inflation pressures correct?**	**Yes** GO to S5. **No** ADJUST the tire pressure as necessary. TEST the vehicle for normal operation. ADVISE the customer that 4WD systems require 4 matched, correctly inflated, correctly maintained tires to operate correctly.
S5 CHECK THE FRONT AND REAR AXLE RATIOS • Check that front and rear axle ratios match. Refer to Section 205-00. • **Do the front and rear axle ratios match?**	**Yes** RETURN the vehicle to the customer and ADVISE about correct 4WD system usage and normal vehicle behavior. **No** CHECK the VC label. INSTALL the correct axle(s). REFER to Section 205-02A or Section 205-02B or Section 205-03. TEST the system for normal operation.

Pinpoint Test T: The Front Axle Makes Noise in 2H Mode Only and Generally Under Heavy Throttle

Refer to Wiring Diagrams Cell 34, Four-Wheel Drive Systems for schematic and connector information.

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A .

Normal Operation

In 2H mode, the TCCM provides a ground path to the IWE solenoid to supply vacuum to each IWE (disengaging the front hubs from the front axle). During certain conditions such as WOT maneuvers, manifold vacuum is lower than desired. To maintain uninterrupted IWE function in 2H, stored engine vacuum is sourced from the vacuum reservoir. A one-way check valve is implemented between the vacuum reservoir and the IWE solenoid to prevent the stored vacuum from escaping into the manifold during low engine vacuum conditions. For noise-free IWE operation under all conditions, the check valve must be operating correctly.

This pinpoint test is intended to diagnose the following:

- Vacuum leaks
- Vacuum check valve
- Vacuum reservoir
- IWE solenoid
- IWE

PINPOINT TEST T: THE FRONT AXLE MAKES NOISE IN 2H MODE ONLY AND GENERALLY UNDER HEAVY THROTTLE

Test Step	Result / Action to Take
T1 CHECK FOR GRINDING NOISES AT HIGH SPEEDS	**Yes** GO to T2 . **No** IDENTIFY the customer concern and GO to the Symptom Charts in this section.
WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury. • With the vehicle warm and the MSS in 2H mode, drive the vehicle at sustained WOT for 5 seconds. • **Is there a grinding noise from the axle system during WOT ?**	
T2 CHECK THE IWE SOLENOID OUTPUT VACUUM IN 2H	**Yes** GO to T7 . **No** GO to T3 .
• **NOTE:** The engine must be idling during the following steps to supply vacuum to the IWE solenoid. • Start the engine. • Disconnect the output vacuum line at the IWE solenoid while having the vacuum supply attached to the solenoid. • With the engine running and the in 2H mode, measure the vacuum at the output port of the solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	
T3 CHECK THE IWE SOLENOID INPUT VACUUM	**Yes** INSTALL a new IWE solenoid. TEST the system for normal operation. **No** GO to T4 .
• Disconnect the supply vacuum line at the IWE solenoid. • With the engine still running, measure the supply line vacuum to the IWE solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	

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T4 CHECK SOURCE VACUUM TO THE VACUUM RESERVOIR	
• Disconnect the source vacuum line from the vacuum reservoir. • With the engine still running, measure the source vacuum being supplied to the vacuum reservoir. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to T5 . **No** REPAIR or INSTALL a new source vacuum line. TEST the system for normal operation.
T5 CHECK THE VACUUM RESERVOIR	
• Ignition OFF. • Disconnect the vacuum line from the vacuum reservoir. • Connect a hand vacuum pump to the source vacuum port on the vacuum reservoir and apply 508 mm (20 in) Hg of vacuum. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to T6 . **No** INSTALL a new vacuum reservoir. TEST the system for normal operation.
T6 CHECK THE ONE-WAY VACUUM CHECK VALVE	
• **NOTE:** The check valve is between the IWE solenoid and the vacuum reservoir. • Connect the vacuum lines to the IWE solenoid. • Connect a hand vacuum pump to the IWE solenoid vacuum line at the vacuum reservoir and apply 508 mm (20 in) Hg of vacuum. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** Concern not present at this time. CARRY OUT the Four-Wheel Drive (4WD) System Functional Test. GO to Pinpoint Test u . **No** REPAIR or INSTALL new vacuum lines or INSTALL a new one-way check valve. TEST the system for normal operation.
T7 CHECK THE IWE VACUUM SYSTEM	
• Ignition OFF. • Disconnect both vacuum lines from the IWE solenoid. • Using a hand vacuum pump, apply 508 mm (20 in) Hg of vacuum to the IWE system through the apply vacuum circuit. • Observe the vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** CONNECT the vacuum lines to the solenoid. GO to T11 . **No** GO to T8 .
T8 CHECK THE RH IWE LEAK RATE	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Disconnect the vacuum line from the larger port on the RH IWE . • Apply 508 mm (20 in) Hg of vacuum to the RH port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to T9 . **No** INSTALL a new RH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
T9 CHECK THE LH IWE LEAK RATE	
• Disconnect the vacuum line from the larger port at the LH IWE . • Apply 508 mm (20 in) Hg of vacuum to the LH port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to T10 . **No** INSTALL a new LH IWE . REFER to Integrated Wheel End (IWE) in

	this section. TEST the system for normal operation.
T10 CHECK THE IWE VACUUM SUPPLY TUBE • Disconnect both vacuum lines from the IWE solenoid. • Plug both LH and RH IWE vacuum lines. Apply 508 mm (20 in) Hg of vacuum to the IWE apply vacuum circuit and observe the vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to T11 . **No** INSTALL new vacuum lines as necessary. TEST the system for normal operation.
T11 CHECK THE IWE VACUUM SUPPLY AT EACH IWE IN 2H • Connect a hand-held vacuum gauge to the LH vacuum supply tube. • **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWE to engage and disengage. • Start the engine. • Switch the to 2H mode while observing the vacuum gauge. • Repeat these steps for the RH IWE . • **Are the vacuum readings greater than 254 mm (10 in) Hg?**	**Yes** GO to T12 . **No** INSTALL new vacuum lines as necessary. TEST the system for normal operation.
T12 CHECK THE LH IWE VACUUM LINE FOR AN OBSTRUCTION • Ignition OFF. • Disconnect both vacuum lines from the IWE solenoid. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Disconnect the vacuum line at the LH IWE . • Connect a hand vacuum pump to the LH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the hand vacuum pump draw a vacuum on the LH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. TEST the system for normal operation. **No** CONNECT the vacuum line to the LH IWE . GO to T13 .
T13 CHECK THE RH IWE VACUUM LINE FOR AN OBSTRUCTION • Disconnect the larger vacuum line at the RH IWE . • Connect a hand vacuum pump to the RH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the hand vacuum pump draw a vacuum on the RH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. TEST the system for normal operation. **No** CONNECT the vacuum line to the RH IWE . GO to T14 .
T14 CHECK THE LH IWE OPERATION • Ignition OFF. • Connect a hand vacuum pump with gauge to the larger port of the LH IWE . • Observe the LH halfshaft while rotating the LH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum and release the vacuum to manually disengage and engage the LH IWE . • **Did the LH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**Yes** GO to T15 . **No** INSTALL a new LH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
T15 CHECK THE RH IWE OPERATION	

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• Connect a hand vacuum pump with gauge to the larger port of the RH IWE . • Observe the RH halfshaft while rotating the RH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum and release the vacuum to manually disengage and engage the RH IWE . • **Did the RH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**Yes** GO to Pinpoint Test U . **No** INSTALL a new RH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.

Pinpoint Test U: Four-Wheel Drive (4WD) System Functional Test

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A .

Normal Operation

When operating in 4WD modes, the transfer case clutch is energized and both IWEs are locked. When in 4L mode, the transfer case low range gear set provides an additional 2.64 gear reduction. When operating in 2H mode, the transfer case clutch is de-energized and both IWEs are unlocked.

This pinpoint test is intended to diagnose the following:

- Transfer case and related components
- IWEs and related components
- Wheel/tire assemblies

PINPOINT TEST U: FOUR-WHEEL DRIVE (4WD) SYSTEM FUNCTIONAL TEST

NOTE: 4X4 High and 4X4 Low are not intended for driving on hard/dry surfaces; using these modes while driving on these surfaces may produce noises like intermittent clunking, but will not damage driveline components.

Test Step	Result / Action to Take
U1 CHECK 2H MODE OPERATION	
• Shift the transmission into the NEUTRAL position. • Switch the MSS to 2H mode. • **Are there any 4WD mode indicators present in the IPC message center?**	**Yes** GO to U2 . **No** GO to U4 .
U2 CHECK FOR TCCM DTCs	
• Shift the transmission into the PARK position. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs retrieved?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to U3 .
U3 CHECK FOR WIND-UP IN 2H MODE	
• Drive the vehicle on a dry, hard surface while	**Yes**

executing turns. • **Is wind-up present in turns?**	GO to Pinpoint Test P . **No** GO to Pinpoint Test V .
U4 CHECK AUTO MODE OPERATION	
• Switch the MSS to 4A mode. • **Is the 4X4 auto (4A) mode indicator on in the IPC message center?**	**Yes** GO to U7 . **No** GO to U5 .
U5 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to U6 .
U6 CHECK FOR WIND-UP IN 4A MODE	
• Drive the vehicle on a dry, hard surface, executing turns while applying the throttle. • **Is wind-up present in turns?**	**Yes** GO to U7 . **No** GO to U8 .
U7 CHECK THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the 4WD_CLTCH_OUT PID. • **Does the PID indicate 2 to 10% clutch application at closed throttle?**	**Yes** GO to U8 . **No** GO to U9 .
U8 CHECK FOR WIND-UP IN 4A MODE WITH 100% CLUTCH USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) ACTIVE COMMAND	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Command the 4WD_CLTCH_OUT to 100%. • Drive the vehicle on a dry, hard surface, executing turns. • **Is wind-up present in turns?**	**Yes** GO to U9 . **No** CHECK the transfer case. REFER to Section 308-07B .
U9 CHECK THE TCCM AVERAGE FRONT WHEEL SPEED (FRT_WHL_SPD) AND AVERAGE REAR WHEEL SPEED (REAR_WHL_SPD) PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the FRT_WHL_SPD and REAR_WHL_SPD PIDs. • Drive the vehicle 30 km/h (18 mph). • Record and compare the FRT_WHL_SPD and REAR_WHL_SPD PIDs. • **Do the FRT_WHL_SPD and REAR_WHL_SPD PID values match within 1.5 km/h (1 mph)?**	**Yes** GO to U10 . **No** VERIFY all 4 tires are the same size and brand. INSTALL new tires as necessary. If the tires are OK, CHECK the ABS. REFER to Section 206-09 and VERIFY that the 4 road tire sizes match. TEST the system for normal operation.

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U10 CHECK THE TCCM ABSOLUTE THROTTLE POSITION (TP_TCCM) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Ignition ON. • Monitor the TP_TCCM PID. • **NOTE:** The TP_TCCM PID is APP as communicated by the PCM via HS-CAN . • Slowly move throttle from closed throttle to WOT and observe the TP_TCCM PID. • **Does the TP_TCCM PID value vary between 0% at closed throttle and 100% at WOT ?**	**Yes** GO to U11 . **No** CHECK the APP sensor and/or the PCM. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U11 CHECK 4H MODE OPERATION	
• Switch the MSS to 4H mode. • **Does the 4X4 (4H) indicator illuminate in the IPC message center correctly?**	**Yes** GO to U14 . **No** GO to U12 .
U12 CHECK FOR TCCM DTCs	
• Shift the transmission into the PARK position. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs retrieved?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to U13 .
U13 CHECK FOR WIND-UP IN 4H MODE	
• Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present in turns?**	**Yes** GO to Pinpoint Test Q . **No** GO to Pinpoint Test O .
U14 CHECK FOR STRAIGHTLINE WIND-UP IN 4H MODE	
• Drive the vehicle on a dry, hard surface. • **Is straightline wind-up present?**	**Yes** GO to Pinpoint Test S . **No** GO to U15 .
U15 CHECK WIND-UP IN TURNS IN 4H MODE	
• Drive the vehicle in 4H mode while turning. • **Is wind-up present in turns?**	**Yes** GO to U16 . **No** GO to Pinpoint Test O .
U16 CHECK 4L MODE OPERATION	
• Bring the vehicle to a stop with the transmission in NEUTRAL, switch the MSS to 4L mode. • **Does the 4WD LOW (4L) indicator in the IPC message center illuminate correctly?**	**Yes** GO to U19 . **No** GO to U17 .
U17 CHECK FOR TCCM DTCs	

• Shift the transmission into the PARK position. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs retrieved?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to U18 .
U18 CHECK FOR WIND-UP IN 4L MODE	
• Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present in turns?**	**Yes** GO to Pinpoint Test V . **No** GO to Pinpoint Test P .
U19 CHECK FOR WIND-UP IN TURNS IN 4L MODE	
• Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present and 4L mode functioning?**	**Yes** GO to U20 . **No** CHECK for DTCs. REFER to the Inspection and Verification procedure in this section. If no DTCs are present, GO to Pinpoint Test P .
U20 CHECK 4L MODE TO 2H MODE SHIFT	
• With the vehicle at a stop and transmission in NEUTRAL, switch the MSS from 4L mode to 2H mode. • **Are there any 4WD mode indicators present in the message center?**	**Yes** GO to U21 . **No** GO to U23 .
U21 CHECK FOR TCCM DTCs	
• Shift the transmission into the PARK position. • Release the brake pedal. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs retrieved?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to U22 .
U22 CHECK FOR WIND-UP IN 2H MODE	
• Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present in turns?**	**Yes** GO to Pinpoint Test P . **No** GO to Pinpoint Test V .
U23 CHECK FOR TRANSFER CASE DISENGAGEMENT	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Rotate the rear driveshaft while observing the front driveshaft. • **Does the front driveshaft rotate?**	**Yes** REFER to Section 308-07B . **No** GO to U24 .
U24 CHECK FOR LH AND RH DISENGAGEMENT	
NOTE: The engine must be at idle during the following steps to supply vacuum for IWE engagement/disengagement.	**Yes** GO to Pinpoint Test N . **No**

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• Start the engine and allow to idle. • Rotate the LF tire one revolution forward and one revolution backward while observing the LF halfshaft and U-joint. • Rotate the RF tire one revolution forward and one revolution backward while observing the RF halfshaft and U-joint. • **Does the LH or RH front halfshaft rotate?**	GO to U25.
U25 CHECK FOR VACUUM LEAKS	
• Ignition OFF. • Disconnect both vacuum lines from the IWE solenoid. • Using a hand vacuum pump, apply 508 mm (20 in) Hg of vacuum to the IWE apply vacuum circuit. • Observe the vacuum reading. • **Did the vacuum drop more than 25 mm (1 in) Hg per minute?**	**Yes** CHECK the IWE and related components for leaks. GO to Pinpoint Test N. **No** GO to U26.
U26 CHECK 2H MODE TO 4H MODE SHIFT AT SPEED ABOVE 32 KM/H (20 MPH)	
• Switch the MSS to 2H mode. • Drive the vehicle on the road and shift from 2H mode to 4H mode while driving above 32 km/h (20 mph). • **Does the transfer case shift to 4H mode satisfactorily?**	**Yes** The 4WD system is functioning correctly. **No** GO to Pinpoint Test Q.

Pinpoint Test V: The 4X4 Mode Indicators Do Not Operate Correctly/Do Not Operate

Refer to Wiring Diagrams Cell 34, Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

The 4WD system status is transmitted to the IPC from the TCCM through the HS-CAN to the 4WD indicator. A steady indicator displays if the vehicle is in 4X4 auto (4A), 4X4 (4H) or 4X4 low (4L). When in 2WD, the message center will display 4X2 for approximately 4 seconds, then the message center will no longer provide 4WD system indication until another shift mode is attained. A system fault condition will illuminate the powertrain malfunction indicator. The powertrain malfunction indicator includes other general powertrain system failures. For information about HS-CAN, refer to Section 418-00.

This pinpoint test is intended to diagnose the following:

- IPC
- 4WD system fault
- HS-CAN circuits
- TCCM

PINPOINT TEST V: THE 4X4 MODE INDICATORS DO NOT OPERATE CORRECTLY/DO NOT OPERATE

Test Step	Result / Action to Take
V1 CHECK FOR TCCM DTCs	

• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to V2 .
V2 CHECK FOR IPC DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — IPC . • **Are DTCs present?**	**Yes** REFER to Section 413-01 . **No** GO to V3 .
V3 CHECK 4WD SYSTEM OPERATION	
• Test drive the vehicle and operate the 4WD system. • **Does the 4WD system operate correctly?**	**Yes** REFER to Section 413-01 . **No** GO to Symptom Chart - Four Wheel Drive (4WD) in this section.

Pinpoint Test W: Vehicle Binds in a Turn/Resists Turning/Pulsates in a Straightline in 4WD Mode

Normal Operation

When the vehicle is operating in 4WD modes, all 4 wheels receive the same amount of torque and rotate at the same speed. The amount of traction the vehicle can achieve depends on the amount of traction each tire can establish with the road surface. In order for the 4WD system to function correctly, each tire must be in good condition and the front and rear axle ratios must match.

This pinpoint test is intended to diagnose the following:

- Unmatched tire sizes
- Unequal amounts of tire wear
- Unequal tire inflation pressures
- Throttle position failure
- Transfer case
- TCCM

PINPOINT TEST W: VEHICLE BINDS IN A TURN/RESISTS TURNING/PULSATES IN A STRAIGHTLINE IN 4WD MODE

NOTE: 4X4 is not intended for driving on hard/dry surfaces; using 4X4 mode while driving on these surfaces may produce noises like intermittent clunking, but will not damage driveline components.

Test Step	Result / Action to Take
W1 VERIFY THE CONCERN	
• Test drive the vehicle on a straight stretch of road in 4A mode. • Drive the vehicle through turns and parking lot maneuvers.	**Yes** If the problem occurs in 4A mode, GO to W2 ; If 4H mode or 4L mode, binding is a normal condition.

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• **Does the vehicle bind, pulsate or shudder?**	**No** GO to Pinpoint Test S .
W2 CHECK THE 4H AND 4L INDICATORS • Review the test drive notes. • **Did the 4X4 (4H) or 4X4 LOW (4L) or powertrain malfunction indicator (wrench light) illuminate in the IPC message center?**	**Yes** If the powertrain malfunction indicator (wrench light) illuminated, GO to W4 . If the 4H mode or 4L mode indicators illuminated, GO to W3 . **No** GO to W5 .
W3 VERIFY THE FAULT • Review the test drive notes. • **Was 4H mode or 4L mode selected when the 4H or 4L indicators were illuminated in the IPC message center?**	**Yes** The system is functioning correctly. **No** The fault may have been caused by an intermittent, uncommanded or autolock shift. TEST the system for normal operation. GO to Pinpoint Test S .
W4 CHECK FOR TCCM DTCs • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are DTCs retrieved?**	**Yes** REFER to the TCCM DTC Chart for diagnosis. **No** GO to W5 .
W5 VERIFY THE CONCERN WITH TRANSFER CASE CONNECTOR DISCONNECTED • Disconnect: Transfer Case . • Test drive the vehicle on a straight stretch of road and in turns, and shift the transfer case through each mode. Record any fault conditions. • **Is the concern present?**	**Yes** INSPECT the driveline components for damage or wear. REFER to Inspection and Verification in this section. TEST the system for normal operation. **No** GO to W6 .
W6 CHECK THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID • Connect: Transfer Case . • Using the scan tool, clear the DTCs. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the 4WD_CLTCH_OUT PID at closed throttle, KOEO . • Select 4H mode. • **Does the PID indicate 2 to 10% clutch application at closed throttle?**	**Yes** GO to W7 . **No** CHECK the transfer case. REFER to Section 308-07B . TEST the system for normal operation.
W7 CHECK THE ABS MODULE WHEEL SPEED SENSOR PIDs • Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module .	**Yes** GO to W8 .

• While driving the vehicle at 30 km/h (18 mph), monitor the following wheel speed sensor PIDs:
  ▪ Left Front Wheel Speed Sensor (LF_WSPD)
  ▪ Left Rear Wheel Speed Sensor (LR_WSPD)
  ▪ Right Front Wheel Speed Sensor (RF_WSPD)
  ▪ Right Rear Wheel Speed Sensor (RR_WSPD)
• Compare the speedometer reading to the wheel speed sensor PIDs.
• **Do the wheel speed sensor PIDs and speedometer speeds match within 1.5 km/h (1 mph)?**
	No
	VERIFY that the 4 road wheels are the same size and have similar tread depth. CHECK the ABS for faults. REFER to Section 206-09 . TEST the system for normal operation.

W8 CHECK THE TCCM ABSOLUTE THROTTLE POSITION (TP_TCCM) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • **NOTE:** The TP_TCCM PID is APP as communicated by the PCM via HS-CAN . • Slowly move accelerator pedal from closed throttle to and observe the TP_TCCM PID. • **Does the TP_TCCM PID value vary between 0% at closed throttle and 100% at WOT ?**	**Yes** GO to W9 . **No** DIAGNOSE the PCM. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. TEST the system for normal operation.
W9 CHECK THE TRANSFER CASE FRONT DRIVESHAFT OUTPUT	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Rotate the front driveshaft by hand. • **Does the front driveshaft rotate freely (does it require less than 45 Nm [33 lb-ft] to rotate)?**	**Yes** GO to W10 . **No** CHECK the transfer case. REFER to Section 308-07B . TEST the system for normal operation.
W10 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test X: The Vehicle Does Not Shift Between 2H (2WD) and 4X4 Modes Correctly

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Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

The MSS communicates the operator's choice to the TCCM . The TCCM then controls the transfer case synchronization clutch, transfer case motor and IWEs as necessary. If the vehicle is not responding as intended, systematically check the necessary inputs and outputs of the TCCM , components of the transfer case, IWE components and halfshafts. Check all circuits for opens and shorts to power or ground.

DTC Description	Fault Trigger Condition
• P1812:00 — 4-Wheel Drive Mode Select Circuit Failure: No Sub Type Information	Fault sets when TCCM C2371A pin 16 senses an open circuit. 4WD system mode cannot be changed.
• P1815:00 — 4-Wheel Drive Mode Select Short To Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 16 detects a short to ground. 4WD system mode cannot be changed.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- MSS
- Transfer case
- TCCM

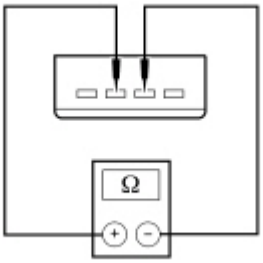
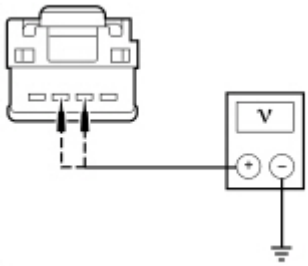
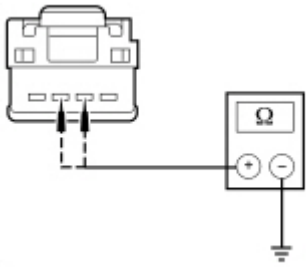
PINPOINT TEST X: THE VEHICLE DOES NOT SHIFT BETWEEN 2H (2WD) AND 4X4 MODES CORRECTLY

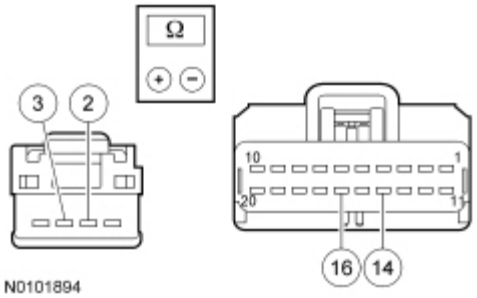
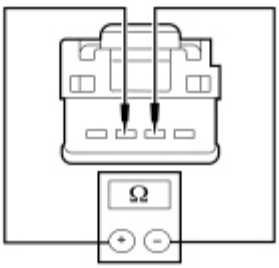
WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

Test Step	Result / Action to Take
X1 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** For DTC P1812:00, GO to X5 . For DTC P1815:00, GO to X7 . For all other DTCs, REFER to the DTC Chart in this section. **No** GO to X2 .
X2 CHECK THE TCCM IGNITION POSITION (KEY_POS_4X4) AND IGNITION STATUS (KEY_STATUS_4X4) PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the KEY_POS_4X4 and	**Yes** GO to X3 .

KEY_STATUS_4X4 PIDs while cycling through each position. • **Do the ignition PIDs match the ignition switch positions?**	**No** If the KEY_STATUS_4X4 PID did not match, CHECK BJB fuse 54 (5A). If the fuse is OK, REPAIR circuit CBB54 (VT/OG). If the fuse is not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the fault is repaired, CLEAR the DTCs. TEST the system for normal operation. If the KEY_POS_4X4 PID did not match, REFER to Section 211-05 to diagnose the ignition switch. After the fault is repaired, CLEAR the DTCs. TEST the system for normal operation.
X3 CHECK THE TCCM MODULE SUPPLY VOLTAGE (VBAT_4X4) PID • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the VBAT_4X4 PID. • **Is the VBAT_4X4 PID greater than 12 volts?**	**Yes** GO to X4. **No** REFER to Section 414-00 to DIAGNOSE the low battery voltage and/or charging system concern. CLEAR the DTCs. TEST the system for normal operation.
X4 CHECK THE MSS POSITION MONITORING THE TCCM 4WD SWITCH STATUS (4X4_SW) PID • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the 4X4_SW PID while switching to each MSS position. • **Does the PID match the MSS position?**	**Yes** GO to X10. **No** GO to X5.
X5 CHECK THE MSS RESISTANCE VALUES • Ignition OFF. • Disconnect: MSS. • Measure the resistance between MSS C284 pins 2 and 3, component side, while rotating the MSS through all positions. Refer to the following chart. **MSS Position** / **Resistance (±1%)** 2H — 619 ohms 4A — 270 ohms 4H — 130 ohms 4L — 62 ohms	**Yes** GO to X6. **No** INSTALL a new MSS. REFER to Mode Select Switch (MSS) in this section. CLEAR the DTCs. TEST the system for normal operation.

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 N0063005 • **Are the resistance values within specification?**	
X6 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR SHORT TO VOLTAGE	
• Disconnect: TCCM C2371A . • Ignition ON. • Measure the voltage between MSS C284-3, circuit RCF13 (WH/BN), harness side and ground; and between MSS C284-2, circuit CCF13 (WH/BU), harness side and ground.  A0092316 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to X7 .
X7 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR SHORT TO GROUND	
• Ignition OFF. • Disconnect: TCCM C2371A . • Disconnect: MSS . • Measure the resistance between MSS C284-3, circuit RCF13 (WH/BN), harness side and ground; and between MSS C284-2, circuit CCF13 (WH/BU), harness side and ground.  A0092317 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X8 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation.
X8 CHECK THE MSS CONTROL AND RETURN	

CIRCUITS FOR AN OPEN	
• Disconnect: TCCM C2371A . • Measure the resistance between MSS C284, and TCCM C2371A, harness side. Refer to the following chart. **MSS** / **Circuit** / **TCCM** C284-3 / RCF13 (WH/BN) / C2371A-14 C284-2 / CCF13 (WH/BU) / C2371A-16  N0101894 • **Are the resistances less than 3 ohms?**	**Yes** GO to X9 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. TEST the system for normal operation.
X9 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Measure the resistance between MSS C284-3, circuit RCF13 (WH/BN), harness side and MSS C284-2, circuit CCF13 (WH/BU), harness side.  N0132538 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X10 . **No** REPAIR the affected circuit(s). CLEAR the DTCs.
X10 CHECK FOR CORRECT TCCM OPERATION	
• Ignition OFF. • Disconnect and inspect all TCCM connectors. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect all TCCM connectors. Make sure they are	**Yes** INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

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seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	ADDRESS the root cause of the connector or pin issues.

Four Wheel Drive (4WD) Systems — Electronic Shift

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-300 mA incandescent bulb test light
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The Electronic Shift-On-The-Fly (ESOF) system has 3 modes of operation: 2H (4X2), 4H (4X4 HIGH) and 4L (4X4 LOW). Integrated Wheel Ends (IWEs) are used at each front wheel to reduce rolling resistance when 2H is selected. The Transfer Case Control Module (TCCM) sends a duty cycle command to the synchronization coil which activates the clutch within the transfer case. Refer to Section 308-07B .

Engagement and disengagement of the front wheels is done by the IWEs . The IWEs are normally engaged (no vacuum). Vacuum is supplied to the IWEs by actuation of the IWE solenoid when commanded by the TCCM . When actuated, the IWE solenoid allows manifold vacuum to pass through to each IWE . The IWEs disengage and allow the front wheel hubs to be turned freely from the front axle.

The electric shift motor is mounted externally to the transfer case. It drives a rotary cam which moves the 2 shift forks in the transfer case to change between the 2H and 4H modes and between the 4H and 4L modes. For information on transfer case mechanical operation, refer to Section 308-07B . The TCCM directly controls the electric shift motor and can reverse motor polarity to reverse rotary cam/shift fork direction. The shift motor sense plate, an integral part of the shift motor assembly, informs the TCCM of the transfer case position.

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The transfer case is equipped with an electronically controlled clutch which is located inside the case. This clutch is used to synchronize the speed of the front driveline with the rear driveline during 2H to 4H shifts. When the Mode Select Switch (MSS) is switched between 2H and 4H modes, the TCCM energizes the synchronization clutch. When the transfer case front and rear output shafts are synchronized, the spring-loaded lockup collar mechanically engages (4H) or disengages (2H) the mainshaft hub to the drive sprocket. Finally, the front axle IWEs are engaged (4H) or disengaged (2H) and the synchronization clutch is deactivated.

Shifts from 2H mode to 4H mode can be made at any speed. The synchronization clutch is applied to equalize output shaft speeds before 4H mode is engaged. The following are the inputs and outputs needed by the TCCM to execute a change between these modes.

Feature inputs:

- Ambient air temperature from the PCM
- MSS
- Wheel speed signal from ABS module
- APP from PCM
- Transfer case shift motor contact plate position inputs A, B, C and D

Feature outputs:

- Transfer case electric shift motor outputs
- PWM signal to transfer case clutch
- 4WD message center and indicators

When shifting into or out of 4L mode, the TCCM requires the vehicle speed to be less than 5 km/h (3 mph) and the transmission in NEUTRAL. The following are the inputs and outputs needed by the TCCM to execute a change into or out of 4L mode.

Feature inputs:

- MSS
- Wheel speed signal from ABS module
- TR position from PCM
- Transfer case shift motor contact plate position inputs A, B, C and D

Feature outputs:

- Transfer case electric shift motor outputs
- PWM signal to transfer case clutch
- 4WD message center and indicators

Off-Road Mode

NOTE: Off-road mode is specifically calibrated for off-road driving conditions and should never be used on pavement.

The SVT Raptor comes equipped with a special off-road function. An off-road button is located on the floor console. A light on the button will illuminate when this feature is activated.

Off-road mode affects 4 vehicle functions:

- It allows unique transmission shifting that optimizes off-road performance. Off-road mode shifting differs from standard on-road shifting in several ways:
  - Transmission upshifts are delayed and occur less frequently. This ensures the best possible vehicle response and acceleration if the driver needs to briefly lift off the throttle to negotiate an obstacle or corner.
  - Transmission downshifts occur more quickly improving vehicle response.
  - Sixth gear (overdrive) will not engage. This prevents engine lugging (6.2L equipped vehicles only).
- Off-road mode provides optimized throttle response tailored for off-road performance driving.
- When off-road mode is engaged, the standard vehicle speed thresholds for the ELD are lifted and the ELD will remain locked until the operator manually disengages it with the control knob. If the operator disengages off-road mode and exceeds the standard ELD speed thresholds, the ELD will disengage.
- When off-road mode is engaged, the AdvanceTrac settings are altered for optimized off-road performance.

To engage off-road mode, slow the vehicle to a speed of 5 km/h (3 mph) or less. Release the accelerator pedal then press and release the off-road mode button. The message center will display OFF ROAD MODE ENABLED once off-road mode has been enabled. If any of the above conditions are not met, off-road mode will not enable and the message center will display information guiding the driver through the proper off-road mode enabling procedures. To disable off-road mode, press and release the off-road mode button. The message center will display EXITING OFF ROAD MODE.

The operator can engage the ELD per the following table:

Switch Position	Engage	Disengage	Re-engage
2H (off-road off) [a]	31 km/h (19 mph)	42 km/h (25 mph)	31 km/h (19 mph) [a]
2H (off-road on)	unlimited	unlimited	unlimited
4H (off-road on)	unlimited	unlimited	unlimited
4L (off-road on)	unlimited	unlimited	unlimited

[a] The 4WD system engages/re-engages at or below the speed noted.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

• Halfshafts
• IWEs
• Driveshaft and U-joints
• Vacuum leaks
• Fluid leaks
	• BJB fuses:
	  ▪ 20 (20A)
	  ▪ 29 (10A)
	  ▪ 54 (5A)
	  ▪ 68 (25A)

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• Matching tire sizes • Transfer case	• BCM fuse 34 (10A) (vehicles with ELD only) • Wiring, terminals or connectors • MSS • Synchronization clutch • IWE solenoid • Transfer case shift motor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record CMDTCs.

8. Carry out the self-test diagnostics for the TCCM.

9. If the DTCs retrieved are related to the concern, go to the TCCM DTC Chart in this section. For all other DTCs, refer to Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Four-Wheel Drive (4WD) System or GO to Symptom Chart - NVH.

DTC Charts

Transfer Case Control Module (TCCM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B12E0:11	Off Road Indicator: Circuit	GO to Pinpoint Test J.

	Short To Ground	
B12E0:12	Off Road Indicator: Circuit Short To Battery	GO to Pinpoint Test J .
B12E0:13	Off Road Indicator: Circuit Open	GO to Pinpoint Test J .
B12E5:00	Off Road Mode Select Switch: No Sub Type Information	GO to Pinpoint Test K .
B12E5:11	Off Road Mode Select Switch: Circuit Short To Ground	GO to Pinpoint Test K .
C1979:11	IWE Solenoid Circuit Failure: Circuit Short To Ground	GO to Pinpoint Test D .
C1979:12	IWE Solenoid Circuit Failure: Circuit Short To Battery	GO to Pinpoint Test D .
C1979:13	IWE Solenoid Circuit Failure: Circuit Open	GO to Pinpoint Test D .
P0562:00	System Voltage Low: No Sub Type Information	Go to Pinpoint Test M in 2-Speed Torque-On-Demand, Diagnosis and Testing, Section 308-07A .
P0563:00	System Voltage High: No Sub Type Information	Go to Pinpoint Test M in 2-Speed Torque-On-Demand, Diagnosis and Testing, Section 308-07A .
P1812:00	4-Wheel Drive Mode Select Circuit Failure: No Sub Type Information	GO to Pinpoint Test B .
P1815:00	4-Wheel Drive Mode Select Short To Ground: No Sub Type Information	GO to Pinpoint Test B .
P1825:00	4-Wheel Drive Clutch Relay Open Circuit: No Sub Type Information	GO to Pinpoint Test G .
P1826:00	4-Wheel Drive Low Clutch Relay Circuit To Battery: No Sub Type Information	GO to Pinpoint Test G .
P1827:00	4-Wheel Drive Low Clutch Relay Circuit To Ground: No Sub Type Information	GO to Pinpoint Test G .
P1839:00	Transfer Case Shift Motor Open Circuit: No Sub Type Information	GO to Pinpoint Test B .
P1840:00	Transfer Case Shift Motor Short Circuit To Battery: No Sub Type Information	GO to Pinpoint Test B .
P1841:00	Transfer Case Shift Motor Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test B .
P1849:00	Transfer Case Contact Plate 'A' Short Circuit To	GO to Pinpoint Test B .

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	Ground: No Sub Type Information	
P184A:00	Transfer Case Unable To Transition Between 4x2 and 4x4 Mode: No Sub Type Information	GO to Pinpoint Test B .
P184B:00	Transfer Case Unable To Transition Between 4x4 High and 4x4 Low Range: No Sub Type Information	GO to Pinpoint Test C .
P1853:00	Transfer Case Contact Plate 'B' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test B .
P1857:00	Transfer Case Contact Plate 'C' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test B .
P185A:00	Differential Lock-Up Input Switch Circuit High: No Sub Type Information	Go to Pinpoint Test Y in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P185B:00	Differential Lock-Up Indicator Circuit Low: No Sub Type Information	Go to Pinpoint Test Z in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P185C:00	Differential Lock-Up Indicator Circuit High: No Sub Type Information	Go to Pinpoint Test AA in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P185D:00	Differential Lock-Up Control Circuit Performance: No Sub Type Information	Go to Pinpoint Test AB in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P1861:00	Transfer Case Contact Plate 'D' Short Circuit To Ground: No Sub Type Information	GO to Pinpoint Test B .
P1867:00	Transfer Case Contact Plate General Circuit Failure: No Sub Type Information	GO to Pinpoint Test B .
P187C:00	Differential Lock-Up Control Circuit/Open: No Sub Type Information	Go to Pinpoint Test AC in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P187D:00	Differential Lock-Up Control Circuit Low: No Sub Type Information	Go to Pinpoint Test AC in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P187E:00	Differential Lock-Up Control Circuit High: No Sub Type Information	Go to Pinpoint Test AD in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
P1891:00	Transfer Case Contact Plate Ground Return Open Circuit: No Sub	GO to Pinpoint Test B .

	Type Information	
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	Go to Pinpoint Test AE in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub Type Information	Go to Pinpoint Test AF in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
U0140:00	Lost Communication With Body Control Module (BCM): No Sub Type Information	Go to Pinpoint Test AG in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
U0418:00	Invalid Data Received From Brake System Control Module: No Sub Type Information	REFER to Section 206-09 to diagnose the wheel speed sensor concern.
U2300:54	Central Configuration: Missing Calibration	This DTC can set if one or more expected configuration data identifications is missing (gearbox type, axle ratio, tire circumference) from the BCM . CARRY OUT a self-test of the BCM . If BCM DTCs are present, REFER to Section 419-10 . If no BCM DTCs are present, CLEAR the DTCs. CARRY OUT a TCCM self-test. If U2300:54 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U2300:55	Central Configuration: Not Configured	This DTC can set upon TCCM power up only until all expected configuration data parameters (gearbox type, axle ratio, tire circumference) is received from the BCM . CARRY OUT a self-test of the BCM . If BCM DTCs are present, REFER to Section 419-10 . If no BCM DTCs are present, CLEAR the DTCs. CARRY OUT TCCM self-test. If U2300:55 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U2300:56	Central Configuration: Invalid / Incompatible Configuration	This DTC can set if one expected configuration data parameter is out of range (gearbox type, axle ratio, tire circumference) from the BCM . CARRY OUT a self-test of the BCM . If DTCs are present, REFER to Section 419-10 . If no BCM DTCs are present, CLEAR the DTCs. CARRY OUT a TCCM self-test. If U2300:56 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U2300:64	Central Configuration: Signal Plausibility Failure	This DTC can set if the expected axle ratio or tire circumference is out of range from the BCM . CARRY OUT a self-test of the BCM . If BCM DTCs are present, REFER to Section 419-10 . If no BCM DTCs are present, CLEAR the DTCs. CARRY OUT a TCCM self-test. If U2300:64 returns, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:04	Control Module: System Internal Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:04 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:41	Control Module: General Checksum Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:41 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	CLEAR the DTC. REPEAT the self-test. If DTC U3000:46 is retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U3000:49	Control Module: Internal	CLEAR the DTC. REPEAT the self-test. If DTC U3000:49 is

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	Electronic Failure	retrieved, INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section.
U300D:11	Ignition Input On/Start: Circuit Short To Ground	GO to Pinpoint Test B .

Symptom Chart — Four-Wheel Drive (4WD) System

Symptom Chart — System

Condition	Possible Sources	Action
• No communication with the TCCM	• Scan tool • DLC • TCCM • Wiring, terminals or connectors	• REFER to Section 418-00 .
• The 4WD indicators do not operate correctly	• Wiring, terminals or connectors • 4WD system fault • IPC • TCCM	• GO to Pinpoint Test A .
• The vehicle does not shift between 2H and 4H modes correctly	• Wiring, terminals or connectors • MSS • Transfer case • Transfer case synchronization clutch • IWEs • IWE solenoid • TCCM • Front axle assembly	• GO to Pinpoint Test B .
• The vehicle does not shift between 4H and 4L modes correctly	• TR • Transmission drag torque • ABS wheel speed inputs • HS-CAN	• GO to Pinpoint Test C .
• The 4WD does not engage at speed correctly	• Transfer case synchronization clutch • Transfer case • TCCM • Front axle assembly • Wiring, terminals or connectors	• GO to Pinpoint Test G .
• The front axle does not engage/disengage correctly	• MSS • IWEs • IWE solenoid • Transfer case • Vacuum leaks	• GO to Pinpoint Test D .

	• Front axle assembly • TCCM • Wiring, terminals or connectors • Fuses	
• The transfer case jumps out of gear	• IWE vent line(s) • MSS • Transfer case	• GO to Pinpoint Test E .
• Unable to duplicate customer concern	• 4WD system and/or related components	• CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I .
• Rear wheels binding when turning corners with the MSS in 2WD or OFF	• Wiring, terminals or connectors • ELD field coil • Differential	• Go to Pinpoint Test AD in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
• Off-road mode is inoperative	• Wiring, terminals or connectors • Off-road mode switch • TCCM	• GO to Pinpoint Test K .
• Off-road mode switch indicator is inoperative	• Wiring, terminals or connectors • Off-road mode switch • TCCM	• GO to Pinpoint Test J .
• Unable to achieve flat tow (neutral tow) mode	• Wiring, terminals or connectors • HS-CAN • IPC • TCCM • Door ajar switch • Ignition switch	• Go to Pinpoint Test AH in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Grinding noise during 4WD engagement, especially at high speeds	• Front halfshaft speeds not turning at the same speed • Synchronization clutch	• GO to Pinpoint Test B .

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• Vehicle pulsates or shudders in a straight line (straightline driveline wind-up)	• Unequal tire inflation pressures • Unmatched tire and wheel size • Unequal amounts of tire wear • Unmatched front and rear axle ratios	• GO to Pinpoint Test H .
• The front axle makes noise in 2H mode only and generally under heavy throttle	• Vacuum leaks • Vacuum check valve • Vacuum reservoir • IWE solenoid • IWEs	• GO to Pinpoint Test F .
• The transfer case makes noise	• Tire inflation pressure • Tire and wheel size	• MAKE SURE that all tires and wheels are the same size and that the inflation pressures are correct.
	• Tire tread wear	• CHECK tire tread wear to see if there is more than 0.15 mm (0.06 in) difference in tread wear between front and rear. INTERCHANGE one front wheel and one rear wheel. ROAD TEST again.
	• Internal components	• OPERATE the vehicle in all transmission gears. If there is noise in the transmission in NEUTRAL, or in some gears and not in others, REMOVE and REPAIR the transmission. REFER to Section 307-01 . If there is noise in all gears, DISASSEMBLE the transfer case. REFER to Section 308-07B . CHECK the planetary gears, the bearings, the upper and lower drive sprockets and drive chain for damage. INSTALL new parts as necessary.
	• Fluid level	• FILL with transfer case fluid. REFER to Section 308-07B .
• Transfer case whine — noise at all ranges	• Incorrect fluid level or fluid quality • Worn oil pump • Under-inflated or oversized tires	• CHECK that the transfer case is filled to the correct level and with the specified fluid. REFER to Section 308-07B . • DISASSEMBLE the transfer case. CHECK the oil pump for wear or damage. REPAIR as necessary. REFER to Section 308-07B . • CONFIRM that the tires and wheels are correct for the vehicle. CHECK that the tire inflation pressures are correct.
• Transfer case growl/rumble —	• Damaged or worn bearings or	• DISASSEMBLE the transfer case. CHECK the bearings or planetary

noise at all ranges	planetary gear	gear for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case scraping/grating — noise at all ranges	• Excessively stretched drive chain hitting the case	• DISASSEMBLE the transfer case. CHECK the drive chain for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum — noise at all ranges or 4WD only	• Worn or damaged sun (input) gear, clutch pack (intermediate) gear or output shaft gear	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .

Pinpoint Tests

Pinpoint Test A: The 4WD Indicators Do Not Operate Correctly

Refer to Wiring Diagrams Cell 34 , Four Wheel Drive System for schematic and connector information.

Normal Operation

Indicator status of the 4WD system is transmitted to the Instrument Panel Cluster (IPC) from the TCCM through the HS-CAN then displayed in the message center of the IPC . The message center displays 4X4 HIGH when in 4H and 4X4 LOW in 4L. When in 2H, the message center will display 4X2 for approximately 4 seconds then no longer provides 4WD system indication until another shift mode is attained. For information about HS-CAN , refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- 4WD system fault
- IPC
- TCCM

PINPOINT TEST A: THE 4WD INDICATORS DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
A1 CHECK FOR IPC DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — IPC . • **Are any DTCs present?**	**Yes** If DTC U0102:00 is retrieved, REFER to Section 418-00 to diagnose lost communication with TCCM . For all other IPC DTCs, REFER to Section 413-01 . **No** GO to A2 .

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A2 CHECK FOR TCCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section for diagnosis. **No** GO to A3 .
A3 CHECK THE TCCM IGNITION POSITION (KEY_POS_4X4) AND IGNITION STATUS (KEY_STATUS_4X4) PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the KEY_POS_4X4 and KEY_STATUS_4X4 PIDs while cycling through each position. • **Do the ignition PIDs match the ignition switch positions?**	**Yes** GO to A4 . **No** If the KEY_STATUS_4X4 PID did not match, CHECK BJB fuse 54 (5A). If the fuse is OK, REPAIR circuit CBB54 (VT/OG). If the fuse is not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. If the KEY_POS_4X4 PID did not match, REFER to Section 211-05 to diagnose the ignition switch.
A4 CHECK THE 4WD SYSTEM INDICATION IN 2H	
• Switch the MSS to 2H while monitoring the message center. • **Does 4X2 display in the message center for approximately 4 seconds?**	**Yes** GO to A5 . **No** GO to A6 .
A5 CHECK THE 4WD SYSTEM INDICATION IN 4H	
• Switch the MSS to 4H while monitoring the message center. • **Does 4X4 HIGH display in the message center?**	**Yes** GO to A8 . **No** GO to A9 .
A6 CHECK THE MSS USING THE TCCM 4WD SWITCH STATUS (4X4_SW) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the 4X4_SW PID while switching to each MSS position. • **Does the 4X4_SW PID match the MSS position?**	**Yes** GO to A7 . **No** INSTALL a new MSS . REFER to Mode Select Switch (MSS) in this section. TEST the system for normal operation.
A7 CHECK THE TCCM PIDs IN 2H	
• Enter the following diagnostic mode on the scan tool:	**Yes**

DataLogger — TCCM .
- Command the Transfer Case Shift Motor Position Sense Contact Plate Power Circuit Status (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly.
- Monitor the Integrated Wheel Ends Output Control (IWE_OS) PID and the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE_C) and D (PLATE_D) PIDs with the MSS in the 2H position.

MSS Position	Contact Plate Position			
	PLATE_A	PLATE_B	PLATE_C	PLATE_D
2H Mode	CLOSED	OPEN	CLOSED	CLOSED
4H Mode	OPEN	CLOSED	CLOSED	OPEN
4L Mode	OPEN	CLOSED	OPEN	CLOSED

- **Do the PIDs indicate the IWE solenoid is energized (PID status No) and that the shift motor is in 2H position?**

END the active command.
CHECK the IPC for faults.
REFER to Section 413-01 .

No
END the active command.
GO to Pinpoint Test B .

A8 CHECK THE 4WD SYSTEM INDICATION IN 4L

- **NOTE:** When shifting in or out of 4L, the transmission must be in NEUTRAL and the vehicle stopped or moving less than 5 km/h (3 mph).
- With the vehicle at a stop and transmission in NEUTRAL, switch the MSS to 4L while monitoring the message center.
- **Does the message center display 4X4 LOW ?**

Yes
The 4WD indicators are operating correctly. CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I .

No
GO to A10 .

A9 CHECK THE TCCM PIDs IN 4H

- Switch the MSS to 4H.
- Enter the following diagnostic mode on the scan tool: DataLogger — TCCM .
- Command the Transfer Case Shift Motor Position Sense Contact Plate Power Circuit Status (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly.
- Monitor the Integrated Wheel Ends Output Control (IWE_OS) PID and the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE_C) and D (PLATE_D) PIDs with the MSS in the 4H position.

MSS Position	Contact Plate Position			
	PLATE_A	PLATE_B	PLATE_C	PLATE_D
2H Mode	CLOSED	OPEN	CLOSED	CLOSED
4H Mode	OPEN	CLOSED	CLOSED	OPEN
4L Mode	OPEN	CLOSED	OPEN	CLOSED

- **Do the PIDs indicate the IWE solenoid is de-energized (PID status Yes) and that the shift motor is in 4H position?**

Yes
END the active command.
CHECK the IPC for faults.
REFER to Section 413-01 .

No
END the active command.
GO to Pinpoint Test B .

A10 CHECK THE TCCM PIDs IN 4L

- Enter the following diagnostic mode on the scan tool: DataLogger — TCCM .
- Command the Transfer Case Shift Motor Position Sense

Yes
CHECK the IPC for faults.
REFER to Section 413-01 .

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Contact Plate Power Circuit Status (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly. • Monitor the Integrated Wheel Ends Output Control (IWE_OS) PID and the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE_C) and D (PLATE_D) PIDs with the MSS in the 4L position. **Contact Plate Position** **MSS Position** / **PLATE_A** / **PLATE_B** / **PLATE_C** / **PLATE_D** 2H Mode / CLOSED / OPEN / CLOSED / CLOSED 4H Mode / OPEN / CLOSED / CLOSED / OPEN 4L Mode / OPEN / CLOSED / OPEN / CLOSED • **Do the PIDs indicate the IWE solenoid is de-energized (PID status Yes) and that the shift motor is in 4L position?**	**No** END the active command. GO to Pinpoint Test C .

Pinpoint Test B: The Vehicle Does Not Shift Between 2H and 4H Correctly and/or Grinding Noise Heard During 4WD Engagement at High Speeds

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

The MSS communicates the operator's choice to the TCCM . The TCCM then controls the transfer case synchronization clutch, transfer case motor and IWEs as necessary. If the vehicle is not responding to the operator's intentions, systematically check the necessary inputs and outputs of the TCCM , components of the transfer case, IWE components and halfshafts. Check all circuits for opens and shorts to power or ground.

DTC Description	Fault Trigger Condition
• P1812:00 — 4-Wheel Drive Mode Select Circuit Failure: No Sub Type Information	Fault sets when TCCM C2371A pin 16 detects an open circuit or short to battery. Four-Wheel Drive (4WD) system mode cannot be changed.
• P1815:00 — 4-Wheel Drive Mode Select Short Circuit To Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 16 detects a short to ground. 4WD system mode cannot be changed.
• P1839:00 — Transfer Case Shift Motor Open Circuit: No Sub Type Information	Fault sets when TCCM C2371B pin 4 or 5 detects an open circuit. Shift motor moves are prevented when this DTC is set.
• P1840:00 — Transfer Case Shift Motor Short Circuit To Battery: No Sub Type Information	Fault sets when TCCM C2371B pin 4 or 5 detects a short to voltage. Shift motor moves are prevented when this DTC is set.
• P1841:00 — Transfer Case Shift Motor Short Circuit To Ground: No Sub Type Information	Fault sets when TCCM C2371B pin 4 or 5 detects a short to ground. Shift motor moves are prevented when this DTC is set.

• P1849:00 — Transfer Case Contact Plate 'A' Short Circuit To Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 1 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P184A:00 — Transfer Case Unable To Transition Between 4x2 and 4x4 Mode: No Sub Type Information	Fault sets when target shift motor position is not reached after the maximum number of allowed blocked shift retries for 2H to 4H or 4H to 2H. Requested shift motor position is not reached.
• P1853:00 — Transfer Case Contact Plate 'B' Short Circuit to Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 2 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P1857:00 — Transfer Case Contact Plate 'C' Short Circuit to Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 3 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P1861:00 — Transfer Case Contact Plate 'D' Short Circuit to Ground: No Sub Type Information	Fault sets when TCCM C2371A pin 4 detects a short to ground. Shift motor moves are prevented when this DTC is set. The TCCM will not complete mode change if a change in shift motor position is required.
• P1867:00 — Transfer Case Contact Plate General Circuit Failure: No Sub Type Information	Fault sets when an invalid shift motor position is detected during selection of a new 4WD mode or during a motor movement. If the shift motor is not moving, shift motor movement will be prevented. If the shift motor is moving when this DTC sets, the shift motor will move to the high-side or low-side mechanical stop position.
• P1891:00 — Transfer Case Contact Plate Ground Return Open Circuit: No Sub Type Information	Fault sets when TCCM C2371A pin 5 detects a short to ground, a short to voltage or open circuit. The TCCM will not complete mode change if a change in shift motor position is required.
• U300D:11 — Ignition Input On/Start: Circuit Short To Ground	Fault sets when TCCM C2371A pin 7 detects a short to ground.

This pinpoint test is intended to diagnose the following:

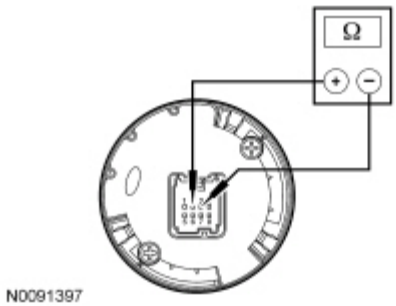
- Wiring, terminals or connectors
- MSS
- Transfer case
- Transfer case synchronization clutch
- IWEs
- IWE solenoid
- TCCM
- Front axle assembly

PINPOINT TEST B: THE VEHICLE DOES NOT SHIFT BETWEEN 2H AND 4H CORRECTLY AND/OR GRINDING NOISE HEARD DURING 4WD ENGAGEMENT AT HIGH SPEEDS

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

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Test Step	Result / Action to Take
B1 CHECK FOR TCCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** For DTC P184A:00, GO to B19. For DTC P1812:00, GO to B5. For DTC P1815:00, GO to B7. For DTC P1839:00, GO to B28. For DTC P1840:00, GO to B26. For DTC P1841:00, GO to B27. For DTC P1849:00, DTC P1853:00, DTC P1857:00, DTC P1861:00, GO to B21. For DTC P1867:00, GO to B4. For DTC P1891:00, GO to B20. For DTC U300D:11, GO to B2. For all other DTCs, REFER to the DTC Chart in this section. **No** GO to B2.
B2 CHECK THE TCCM IGNITION POSITION (KEY_POS_4X4) AND IGNITION STATUS (KEY_STATUS_4X4) PIDs • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the KEY_POS_4X4 and KEY_STATUS_4X4 PIDs while cycling through each ignition switch position. • **Do the ignition PIDs match the ignition switch positions?**	**Yes** GO to B3. **No** If the KEY_STATUS_4X4 PID did not match, CHECK BJB fuse 54 (5A). If the fuse is OK, REPAIR circuit CBB54 (VT/OG). If the fuse is not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the fault is repaired, CLEAR the DTCs. TEST the system for

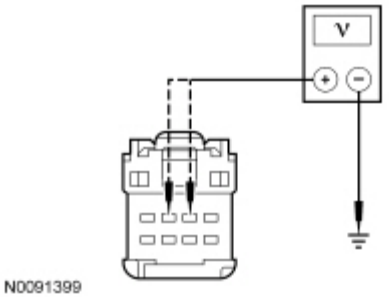
	normal operation. If the KEY_POS_4X4 PID did not match, REFER to Section 211-05 to diagnose the ignition switch. After the fault is repaired, CLEAR the DTCs. TEST the system for normal operation.
B3 CHECK THE TCCM MODULE SUPPLY VOLTAGE (VBAT_4X4) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Start the engine and monitor the VBAT_4X4 PID. • **Is the VBAT_4X4 PID greater than 12 volts?**	**Yes** GO to B4 . **No** REFER to Section 414-00 to DIAGNOSE the low battery voltage and/or charging system concern. After the repair is complete, CLEAR the DTCs. TEST the system for normal operation.
B4 CHECK THE MSS POSITION MONITORING THE TCCM 4WD SWITCH STATUS (4X4_SW) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the 4X4_SW PID while switching to each MSS position. • **Does the 4X4_SW PID match the MSS position?**	**Yes** GO to B11 . **No** GO to B5 .
B5 CHECK THE MSS RESISTANCE VALUES	
• Ignition OFF. • Disconnect: MSS . • Measure the resistance between MSS C284 pins 2 and 3, component side, while rotating the MSS through all positions. Refer to the following chart. **MSS Position** / **Resistance** 2H — 606 - 632 ohms 4H — 265 - 275 ohms 4L — 127 - 133 ohms  N0091397	**Yes** GO to B6 . **No** INSTALL a new MSS . REFER to Mode Select Switch (MSS) in this section. CLEAR the DTCs. TEST the system for normal operation.

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- **Are the resistance values within specification?**

B6 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: TCCM C2371A .
- Ignition ON.
- Measure the voltage between MSS C284-2, circuit RCF13 (WH/BN), harness side and ground; and between MSS C284-3, circuit CCF13 (WH/BU), harness side and ground.



N0091399

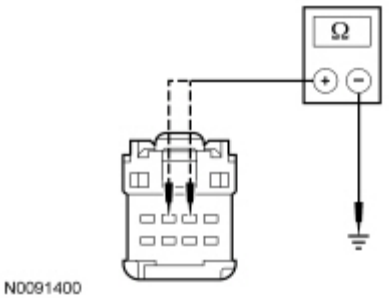
- **Is any voltage present?**

Yes
REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation.

No
GO to B7 .

B7 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between MSS C284-2, circuit RCF13 (WH/BN), harness side and ground; and between MSS C284-3, circuit CCF13 (WH/BU), harness side and ground.



N0091400

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B8 .

No
REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation.

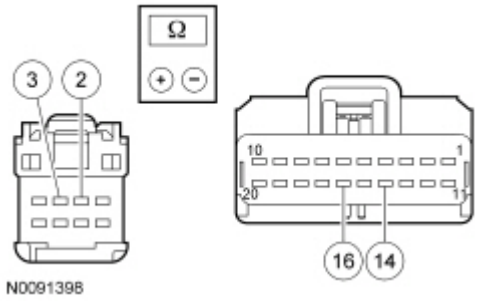
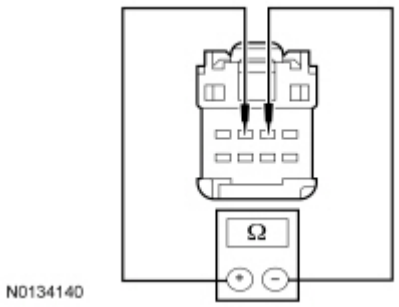
B8 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR AN OPEN

- Measure the resistance between MSS C284 and TCCM C2371A as shown below:

MSS	Circuit	TCCM
C284-2	RCF13 (WH/BN)	C2371A-14
C284-3	CCF13 (WH/BU)	C2371A-16

Yes
GO to B9 .

No
REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation.

 N0091398 • **Are the resistances less than 3 ohms?**	
B9 CHECK THE MSS CONTROL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Measure the resistance between MSS C284-2, circuit RCF13 (WH/BN), harness side and MSS C284-3, circuit CCF13 (WH/BU), harness side.  N0134140 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B10 . **No** REPAIR the affected circuit (s). CLEAR the DTCs.
B10 CHECK THE TCCM AVERAGE FRONT WHEEL SPEED (FRT_WHL_SPD) AND AVERAGE REAR WHEEL SPEED (REAR_WHL_SPD) PIDs	
• Connect: TCCM C2371A . • Connect: MSS . • Ignition ON. • Set the MSS to 2H. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the FRT_WHL_SPD and REAR_WHL_SPD PIDs with the vehicle stopped and while driving. • **Do the FRT_WHL_SPD and REAR_WHL_SPD PIDs match with the vehicle stopped and at all speeds?**	**Yes** GO to B11 . **No** REFER to Section 206-09 to diagnose the wheel speed concern. After the repair is complete, CLEAR the DTCs. TEST the system for normal operation.
B11 CHECK THE TCCM 4WD MODES (4WD_MODES) PID WITH THE MSS IN 4H	
• Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Set the MSS to 4H. • Monitor the 4WD_MODES PID. • **Does the 4WD_MODES PID indicate 4WD High?**	**Yes** GO to B14 . **No** GO to B12 .
B12 CHECK FOR 4H WIND-UP	
• Switch the MSS to 4H. • Drive the vehicle on a dry, hard surface in turns.	**Yes** GO to B15 .

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- **Is wind-up present in turns?**

</td><td>

No
GO to B13 .

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B13 CHECK FOR TRANSFER CASE ENGAGEMENT

- With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
- Rotate the rear driveshaft.
- Observe the front driveshaft.
- **Did the front driveshaft rotate?**

</td><td>

Yes
GO to B14 .

No
GO to B18 .

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B14 CHECK FOR IWE ENGAGEMENT

- **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage.
- Start the engine.
- Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft and U-joint.
- Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft and U-joint.
- **Did both front halfshafts rotate?**

</td><td>

Yes
CHECK that all driveline fasteners are present and tightened to specification. REFER to Section 205-00 for further diagnosis of the front axle.

No
GO to Pinpoint Test D .

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B15 CHECK THE TRANSFER CASE SHIFT TO 2H

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: DataLogger — TCCM .
- Command the Transfer Case Contact Plate Power (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly.
- Monitor the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE_C) and D (PLATE_D) PIDs for the contact plate position with the MSS in the 2H position.

MSS Position	Contact Plate Position			
	PLATE_A	PLATE_B	PLATE_C	PLATE_D
2H Mode	CLOSED	OPEN	CLOSED	CLOSED
4H Mode	OPEN	CLOSED	CLOSED	OPEN
4L Mode	OPEN	CLOSED	OPEN	CLOSED

- **Do the PIDs and message center indicate that vehicle shifted into 2H (4X2) displayed in message center for approximately 4 seconds)?**

</td><td>

Yes
GO to B16 .

No
GO to B20 .

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B16 CHECK FOR IWE DISENGAGEMENT

- With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
- Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft and U-joint.
- Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft and U-joint.
- **Did either of the front halfshafts rotate?**

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Yes
GO to Pinpoint Test D .

No
GO to B17 .

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B17 CHECK FOR TRANSFER CASE DISENGAGEMENT

- Rotate the rear driveshaft while observing the front driveshaft.

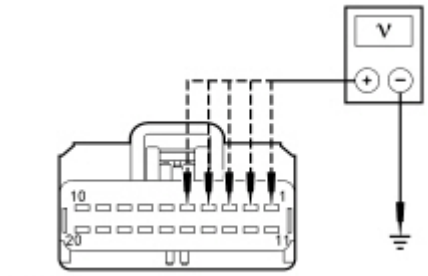
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Yes

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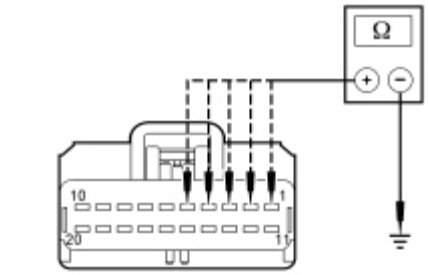
• **Does the front driveshaft rotate?**	The system is functioning correctly. CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I . **No** GO to B18 .
B18 CHECK THE TRANSFER CASE CONTACT PLATE POSITION PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Command the Transfer Case Contact Plate Power (PLATE_PWR_OS) PID to energize the transfer case gearmotor encoder assembly. • Monitor the Transfer Case Contact Plate Switch A (PLATE_A), B (PLATE_B), C (PLATE C) and D (PLATE_D) PIDs for the contact plate position with the MSS in the 4H position. **MSS Position** / **Contact Plate Position**: **PLATE_A** / **PLATE_B** / **PLATE_C** / **PLATE_D** 2H Mode: CLOSED / OPEN / CLOSED / CLOSED 4H Mode: OPEN / CLOSED / CLOSED / OPEN 4L Mode: OPEN / CLOSED / OPEN / CLOSED • **Do the transfer case contact plate PIDs indicate 4H?**	**Yes** GO to B29 . **No** GO to B19 .
B19 CHECK THE TRANSFER CASE SHIFT MOTOR OPERATION	
• Remove the transfer case shift motor from the transfer case, leaving the wiring connector connected. • Observe the transfer case shift motor while switching the MSS from 2H to 4H. • **Does the transfer case shift motor rotate from the 2H position to the 4H position?**	**Yes** GO to B29 . **No** GO to B20 .
B20 CHECK TRANSFER CASE CONTACT PLATE CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371A . • Ignition ON. • Measure the voltage between the following circuits at TCCM C2371A, harness side and ground: **Circuit** / **C2371A Pin** CCF14 (GN/OG) / 1 CCF15 (BN/YE) / 2 CCF16 (VT/GN) / 3 CCF17 (WH/OG) / 4 RCF09 (BN/WH) / 5	**Yes** REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to B21 .

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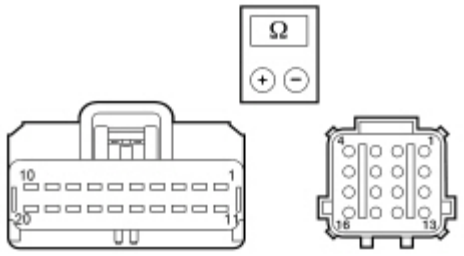
N0091402

- **Is any voltage present?**

B21 CHECK TRANSFER CASE CONTACT PLATE CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371A . • Measure the resistance between the following circuits at TCCM C2371A, harness side and ground: **Circuit** / **C2371A Pin** CCF14 (GN/OG) — 1 CCF15 (BN/YE) — 2 CCF16 (VT/GN) — 3 CCF17 (WH/OG) — 4 RCF09 (BN/WH) — 5  N0091403 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to B22 . **No** REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation.

B22 CHECK THE TRANSFER CASE CONTACT PLATE CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371A . • Measure the resistance of the following circuits between TCCM C2371A, harness side and transfer case C350, harness side: **C2371A Pin** / **Circuit** / **C350 Pin** 1 — CCF14 (GN/OG) — 5 2 — CCF15 (BN/YE) — 1	**Yes** GO to B23 . **No** REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation.

3	CCF16 (VT/GN)	9
4	CCF17 (WH/OG)	13
5	RCF09 (BN/WH)	10

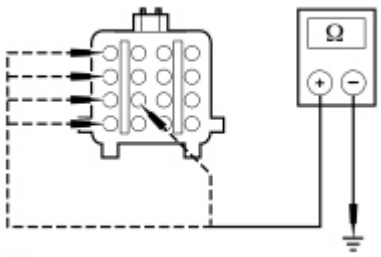


N0091401

- **Are the resistances less than 3 ohms?**

B23 CHECK THE SHIFT MOTOR FOR AN INTERNAL SHORT TO GROUND

- Measure the resistance between transfer case C350 pins 1, 5, 9, 10 and 13, component side and ground.



N0091404

- **Are the resistances greater than 10,000 ohms?**

Yes
GO to B24 .

No
INSTALL a new transfer case shift motor. REFER to Transfer Case Shift Motor in this section. CLEAR the DTCs. REPEAT the self-test, if the concern is still present, GO to B30 .

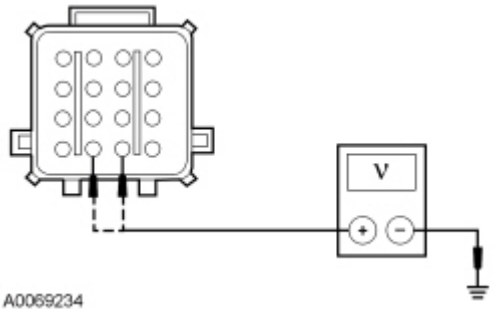
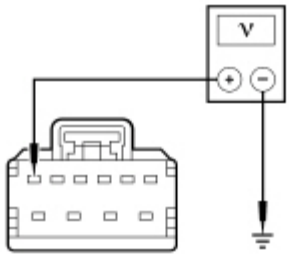
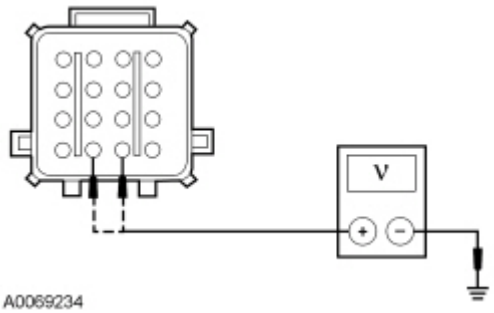
B24 CHECK THE SHIFT MOTOR CIRCUITS FOR POWER WHILE COMMANDING THE TCCM CW RELAY (CW_SMD_OS) AND CCW RELAY (CCW_SMD_OS) PIDs ON

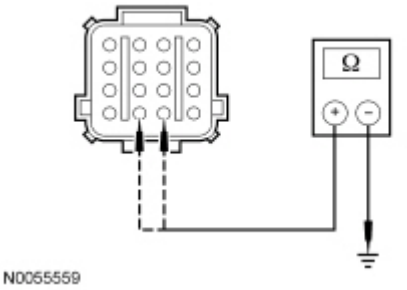
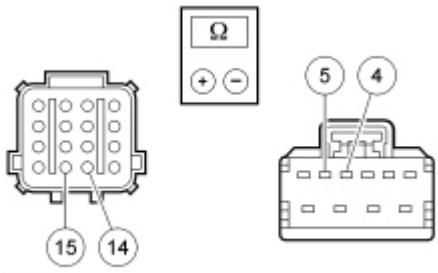
- Ignition ON.
- Connect: TCCM C2371A .
- Enter the following diagnostic mode on the scan tool: DataLogger — TCCM .
- Command the CW_SMD_OS PID ON and OFF while measuring the voltage between transfer case C350-14, circuit CCF08 (GY/OG), harness side and ground. Then command the CCW_SMD_OS PID ON and OFF while measuring the voltage between transfer case C350-15, circuit CCF07 (BN/GN), harness side and ground.

Yes
GO to B29 .

No
GO to B25 .

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 A0069234 • **Are the voltages 9 volts or greater on the circuits when commanding the PIDs ON?**	
B25 CHECK THE TCCM VOLTAGE CIRCUIT	
• Ignition OFF. • Disconnect: TCCM C2371B . • Measure the voltage between TCCM C2371B-6, circuit SBB20 (GN/RD), harness side and ground.  N0091405 • **Is the voltage greater than 11 volts?**	**Yes** GO to B26 . **No** VERIFY BJB fuse 20 (20A) is OK. If OK, REPAIR circuit SBB20 (GN/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR the DTCs. TEST the system for normal operation.
B26 CHECK THE TRANSFER CASE SHIFT MOTOR CIRCUITS FOR SHORT TO VOLTAGE	
• Ignition ON. • Disconnect: TCCM C2371B . • Disconnect: Transfer Case . • Measure the voltage between transfer case C350-14, circuit CCF08 (GY/OG), harness side and ground; and between transfer case C350-15, circuit CCF07 (BN/GN), harness side and ground.  A0069234 • **Is any voltage present?**	**Yes** REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to B27 .
B27 CHECK THE TRANSFER CASE SHIFT MOTOR CIRCUITS FOR SHORT TO GROUND	
• Ignition OFF.	**Yes**

• Disconnect: TCCM C2371B . • Disconnect: Transfer Case . • Measure the resistance between transfer case C350-14, circuit CCF08 (GY/OG), harness side and ground; and between the transfer case C350-15, circuit CCF07 (BN/GN), harness side and ground.  N0055559 • **Are the resistances greater than 10,000 ohms?**	GO to B28 . **No** REPAIR the affected circuit (s). CLEAR the DTCs. TEST the system for normal operation.
B28 CHECK THE TRANSFER CASE SHIFT MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: TCCM C2371B . • Disconnect: Transfer Case . • Measure the resistance between transfer case C350 and TCCM C2371B as shown below: **Transfer Case** / **Circuit** / **TCCM** C350-14 / CCF08 (GY/OG) / C2371B-5 C350-15 / CCF07 (BN/GN) / C2371B-4  N0091406 • **Are the resistances less than 3 ohms?**	**Yes** GO to B29 . **No** REPAIR the affected circuit. CLEAR the DTCs. TEST the system for normal operation.
B29 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
	Yes
	INSTALL a new TCCM .
	REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No

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• Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.
B30 SHIFT THE TRANSFER CASE TO 4H MANUALLY	
• Remove the transfer case shift motor from the transfer case. • Using a wrench, rotate the shift cam to the 4H position. • Rotate the rear driveshaft and watch the front driveshaft. • **Does the transfer case shift to 4H and the front driveshaft rotates?**	**Yes** GO to B31 . **No** REPAIR the transfer case. REFER to Section 308-07B .
B31 CHECK THE TORQUE REQUIRED TO SHIFT THE TRANSFER CASE	
• Rotate the shift cam by hand through 4L, 4H and 2H positions. • Measure the torque required to perform the shift. • **Is the torque required to shift 45 Nm (33 lb-ft) or less?**	**Yes** GO to B32 . **No** REPAIR the transfer case. REFER to Section 308-07B .
B32 SHIFT THE TRANSFER CASE TO 2H MANUALLY	
• Rotate the shift cam to the 2H position. • Rotate the rear driveshaft and watch the front driveshaft. • **Does the transfer case shift to 2H and the front driveshaft does not rotate?**	**Yes** GO to B33 . **No** REPAIR the transfer case. REFER to Section 308-07B .
B33 SHIFT THE TRANSFER CASE TO 4L MANUALLY	
• Rotate the shift cam by hand to the 4L position. • Rotate the rear driveshaft and watch the front driveshaft. • **Does the transfer case shift to 4L and the front driveshaft rotates?**	**Yes** INSTALL a new transfer case shift motor. REFER to Transfer Case Shift Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the transfer case. REFER to Section 308-07B .

Pinpoint Test C: The Vehicle Does Not Shift Between 4H and 4L Modes Correctly

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

The high-low shift occurs when the reduction shift fork moves the high-low collar to lock the planetary gear set to the output shaft. The torque transmitted through the sun gear from the input shaft turns the front planetary gear set assembly. The front planetary gear set assembly, now engaged, provides transfer case speed reduction. Certain criteria, such as vehicle speed and TR selection must be met before this shift can occur. Systematically check the necessary inputs and outputs of the TCCM , components of the transfer

case, IWE components and halfshafts.

- DTC P184B:00 (Transfer Case Unable To Transition Between 4x4 High and 4x4 Low Range) — Fault sets when target shift motor position is not reached after the maximum number of allowed blocked shift retries for 4H to 4L. Requested shift motor position is not reached.

This pinpoint test is intended to diagnose the following:

- TR
- Transmission drag torque
- ABS wheel speed inputs
- HS-CAN

PINPOINT TEST C: THE VEHICLE DOES NOT SHIFT BETWEEN 4H AND 4L MODES CORRECTLY

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

Test Step	Result / Action to Take
C1 CHECK FOR TCCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** For DTC P184B:00, GO to C2. For all other DTCs, REFER to the TCCM DTC Chart in this section. **No** GO to Pinpoint Test B.
C2 CHECK THE 2H TO 4H SHIFT • Drive the vehicle and shift MSS from 2H to 4H. • **Does the vehicle shift between 2H and 4H correctly?**	**Yes** GO to C3. **No** GO to Pinpoint Test B.
C3 CHECK THE 4H TO 4L SHIFT • **NOTE:** When shifting in or out of 4L, the transmission must be in NEUTRAL and the vehicle stopped or moving less than 5 km/h (3 mph). • Drive the vehicle and shift MSS from 4H to 4L. • **Does the transfer case shift from 4H to 4L correctly and the complaint is related to a clunk noise during the shift?**	**Yes** Transmission neutral drag is excessive. REFER to Section 307-01 for transmission diagnosis. **No** GO to C4.
C4 CHECK THE TCCM NEUTRAL INDICATOR (NEUTRAL) AND ABS MODULE WHEEL SPEED PIDs • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • A. Monitor the NEUTRAL PID while shifting the transmission through gear ranges. • Enter the following diagnostic mode on the scan tool:	**Yes** If all 5 PIDs are accurate, GO to Pinpoint Test B. **No** **A.** REFER to Section 307-01 for

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DataLogger — ABS Module .
• B. Monitor the wheel speed PIDs:
  ▪ Left Front Wheel Speed Sensor (LF_WSPD)
  ▪ Left Rear Wheel Speed Sensor (LR_WSPD)
  ▪ Right Front Wheel Speed Sensor (RF_WSPD)
  ▪ Right Rear Wheel Speed Sensor (RR_WSPD)
• **A. Does the NEUTRAL PID indicate True when the transmission is shifted to NEUTRAL?**
 	
B. Do the wheel speed PIDs indicate 0 km/h (0 mph)?
	further diagnosis of the TR sensor.
	
	B. REFER to Section 206-09 for further diagnosis of the ABS system.

Pinpoint Test D: The Front Axle Does Not Engage/Disengage Correctly

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A .

Normal Operation

In 2H mode, the TCCM supplies a ground path to the IWE solenoid to apply vacuum to the IWEs (disengaging the front hubs from the front axle). In 4H or 4L modes, the TCCM does not supply the ground path to the IWE solenoid, vacuum is not applied to IWEs the and an internal spring in the IWEs keeps the hubs engaged.

- DTC C1979:11 (IWE Solenoid Circuit Failure: Short Circuit To Ground) — Fault sets when TCCM C2371A pin 6 detects a short to ground. Fault results in IWEs hubs disengaged all the time.
- DTC C1979:12 (IWE Solenoid Circuit Failure: Short Circuit To Battery) — Fault sets when TCCM C2371A pin 6 detects a short to voltage. Fault results in IWEs hubs engaged all the time.
- DTC C1979:13 (IWE Solenoid Circuit Failure: Circuit Open) — Fault sets when TCCM C2371A pin 6 detects an open circuit. Fault results in IWEs hubs engaged all the time.

This pinpoint test is intended to diagnose the following:

- MSS
- IWEs
- IWE solenoid
- Transfer case
- Vacuum leaks
- Front axle assembly
- TCCM
- Wiring, terminals or connectors
- Fuses

PINPOINT TEST D: THE FRONT AXLE DOES NOT ENGAGE/DISENGAGE CORRECTLY

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

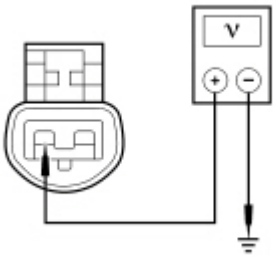
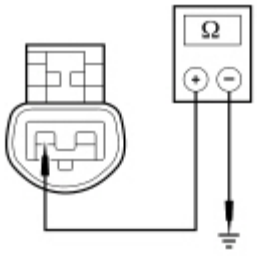
Test Step	Result / Action to Take
D1 CHECK FOR TCCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** For DTC C1979:11, GO to D19 . For DTC C1979:12, GO to D18 . For DTC C1979:13, GO to D20 . For all other DTCs, REFER to the TCCM DTC Chart in this section. **No** GO to D2 .
D2 CHECK FOR GRINDING NOISES AT HIGH SPEEDS • With the vehicle warm and the MSS in 2H mode, drive the vehicle at sustained WOT for 5 seconds. • **Is there a grinding noise from the axle system during WOT ?**	**Yes** GO to Pinpoint Test F . **No** GO to D3 .
D3 CHECK TCCM OPERATION • Ignition ON. • Monitor the 4X4 indicator on the IPC while moving the MSS between 2H and 4H modes. • **Does the 4X4 indicator illuminate when the MSS is in the 4H position and turn off when the MSS is in the 2H position?**	**Yes** GO to D4 . **No** GO to Pinpoint Test B .
D4 CHECK THE IWE DISENGAGEMENT **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Place the MSS in 2H. • Start the engine. • Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft. • Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft. • **Did either front halfshaft rotate?**	**Yes** GO to D8 . **No** GO to D5 .
D5 CHECK THE IWE ENGAGEMENT • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • With the engine running, place the MSS in 4H. • Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft. • Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft. • **Did both front halfshafts rotate?**	**Yes** The front axle is operating properly at this time. CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I . **No** GO to D6 .
D6 CHECK THE IWE SOLENOID OUTPUT IN 4H • Disconnect the output vacuum line at the IWE solenoid. • With the engine running and the MSS In 4H, measure the	**Yes** The IWE is mechanically stuck in

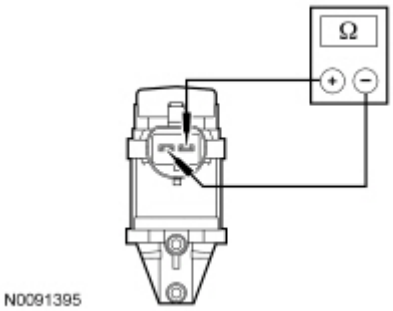
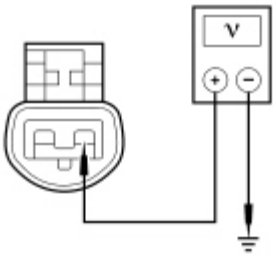
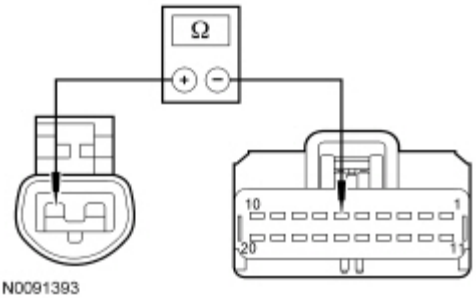
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vacuum at the output port of the IWE solenoid. • **Is the vacuum less than 25 mm (1 in) Hg?**	the disengaged position. INSTALL a new IWE on the halfshaft(s) that did not rotate. REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation. **No** GO to D7.
D7 CHECK THE IWE SOLENOID	
• Ignition OFF. • Disconnect: IWE Solenoid . • Start the engine. • Measure the vacuum at the output port of the IWE solenoid. • **Is the vacuum less than 25 mm (1 in) Hg?**	**Yes** GO to D20. **No** INSTALL a new IWE solenoid. TEST the system for normal operation.
D8 CHECK THE IWE SOLENOID OUTPUT VACUUM IN 2H	
• Disconnect the output vacuum line at the IWE solenoid. • With the engine running and the MSS in 2H, measure the vacuum at the output port of the IWE solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to D11. **No** GO to D9.
D9 CHECK THE IWE SOLENOID INPUT VACUUM	
• Disconnect the supply vacuum line at the IWE solenoid. • With the engine running, measure the supply line vacuum to the IWE solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to D20. **No** GO to D10.
D10 CHECK THE VACUUM RESERVOIR	
• Ignition OFF. • With the source vacuum line still disconnected, connect a vacuum pump to the vacuum port on the vacuum reservoir and apply 508 mm (20 in) Hg of vacuum. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** REPAIR or INSTALL new vacuum lines or INSTALL a check valve. TEST the system for normal operation. **No** INSTALL a new vacuum reservoir. TEST the system for normal operation.
D11 CHECK THE IWE VACUUM LINES	
• Ignition OFF. • Disconnect the output vacuum line from the IWE solenoid. • Disconnect and plug the LH and RH IWE vacuum lines at the IWEs. • Connect a vacuum pump to the IWE output vacuum circuit at the IWE solenoid connection. Apply 508 mm (20 in) Hg of vacuum and observe the vacuum reading. • **Does the vacuum drop more than 25 mm (1 in) Hg per minute?**	**Yes** GO to D14. **No** GO to D12.
D12 CHECK THE LH IWE VACUUM LINE FOR AN OBSTRUCTION	
• REMOVE the plug from the vacuum line at the LH IWE.	**Yes**

• Connect a hand vacuum pump to the LH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the vacuum pump draw a vacuum on the LH IWE vacuum line?**	INSTALL a new vacuum line. CLEAR the DTCs. TEST the system for normal operation. **No** GO to D13.
D13 CHECK THE RH IWE VACUUM LINE FOR AN OBSTRUCTION	
• REMOVE the plug from the vacuum line at the RH IWE. • Connect a vacuum pump to the RH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the vacuum pump draw a vacuum on the RH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. CLEAR the DTCs. TEST the system for normal operation. **No** GO to D14.
D14 CHECK THE RH IWE LEAK RATE	
• Apply 508 mm (20 in) Hg of vacuum to the RH IWE port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to D15. **No** INSTALL a new RH IWE. REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
D15 CHECK THE RH IWE OPERATION	
• Connect a vacuum pump with gauge to the larger port of the RH IWE. • Observe the RH halfshaft while rotating the RH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum and release the vacuum to manually disengage and engage the RH IWE. • **Did the RH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**Yes** CONNECT the vacuum line to the RH IWE. GO to D16. **No** INSTALL a new RH IWE. REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
D16 CHECK THE LH IWE LEAK RATE	
• Disconnect the vacuum line from the larger port at the LH IWE. • Apply 508 mm (20 in) Hg of vacuum to the LH IWE port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to D17. **No** INSTALL a new LH IWE. REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
D17 CHECK THE LH IWE OPERATION	
• Connect a vacuum pump with gauge to the larger port of the LH IWE. • Observe the LH halfshaft while rotating the LH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum and release the vacuum to manually disengage and engage the LH IWE. • **Did the LH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**Yes** CONNECT the vacuum line to the LH IWE. GO to D18. **No** INSTALL a new LH IWE. REFER to Integrated Wheel End (IWE) in this section. CLEAR the DTCs. TEST the system for normal operation.

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D18 CHECK THE IWE SOLENOID CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IWE Solenoid . • Disconnect: TCCM C2371A . • Ignition ON. • Measure the voltage between IWE solenoid C1291-2, circuit CCF05 (BN/BU), harness side and ground.  N0091392 • **Is any voltage present?**	**Yes** REPAIR circuit CCF05 (BN/BU). CLEAR the DTCs. TEST the system for normal operation. **No** GO to D19 .
D19 CHECK THE IWE SOLENOID CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IWE Solenoid C1291 . • Disconnect: TCCM C2371A . • Measure the resistance between solenoid C1291-2, circuit CCF05 (BN/BU), harness side and ground.  N0091394 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D20 . **No** REPAIR circuit CCF05 (BN/BU). CLEAR the DTCs. TEST the system for normal operation.
D20 CHECK THE IWE SOLENOID RESISTANCE	
NOTE: If the temperatures (either ambient or in the engine compartment) are exceptionally high, a higher than normal resistance reading could result. A lower temperature could result in a lower resistance reading. • Measure the resistance between IWE solenoid C1291 pins 1 and 2, component side.	**Yes** GO to D21 . **No** INSTALL a new IWE solenoid. CLEAR the DTCs. TEST the system for normal operation.

 N0091395 • **Is the resistance between 44 and 70 ohms?**	
D21 CHECK FOR VOLTAGE TO THE IWE SOLENOID	
• Ignition OFF. • Disconnect: IWE Solenoid . • Measure the voltage between IWE solenoid C1291-1, circuit SBB29 (GY/RD), harness side and ground.  N0091391 • **Is the voltage greater than 11 volts?**	**Yes** GO to D22 . **No** CHECK BJB fuse 29 (10A). If OK, REPAIR circuit SBB29 (GY/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR the DTCs. TEST the system for normal operation.
D22 CHECK THE IWE SOLENOID CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: IWE Solenoid . • Disconnect: TCCM C2371A . • Measure the resistance between IWE solenoid C1291-2, circuit CCF05 (BN/BU), harness side and TCCM C2371A-6, circuit CCF05 (BN/BU), harness side.  N0091393 • **Is the resistance less than 3 ohms?**	**Yes** GO to D23 . **No** REPAIR circuit CCF05 (BN/BU). CLEAR the DTCs. TEST the system for normal operation.
D23 CHECK FOR CORRECT TCCM OPERATION	
• Ignition OFF. • Disconnect and inspect all TCCM connectors. • Repair: ▪ corrosion (install new connector or terminals - clean	**Yes** INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the

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module pins) ■ damaged or bent pins - install new terminals/pins ■ pushed-out pins - install new pins as necessary • Connect all TCCM connectors. Make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test E: The Transfer Case Jumps Out of Gear

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A .

Normal Operation

Once the 4WD system engages the user selected mode, that mode should be maintained. If the 4WD system does not stay in the selected position systematically check the 4WD system components.

This pinpoint test is intended to diagnose the following:

- Integrated Wheel Ends (IWEs) vent line(s)
- MSS
- Transfer case

PINPOINT TEST E: THE TRANSFER CASE JUMPS OUT OF GEAR

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

Test Step	Result / Action to Take
E1 CHECK FOR OBSTRUCTED IWE VENT LINES	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • **NOTE:** The IWE vent port is the smaller of the 2 vacuum ports. • Disconnect the LH IWE line from the vent port. • Attach a vacuum pump to the IWE vent line and attempt to hold a vacuum. • Disconnect the RH IWE line from the vent port. • Attach a vacuum pump to the IWE vent line and attempt to hold a vacuum. • **Can a vacuum be held on either IWE vent line?**	**Yes** INSTALL new IWE vent lines as necessary. TEST the system for normal operation. **No** GO to E2 .
E2 VERIFY THE CONCERN	
	Yes

• Drive the vehicle and attempt to duplicate the concern. • **Is the concern an uncommanded range shift (in or out of low range)?**	GO to E5. **No** GO to E3.
E3 CHECK THE MSS POSITION MONITORING THE TCCM 4WD SWITCH STATUS (4X4_SW) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Drive the vehicle. • Dynamically monitor the 4X4_SW PID while driving the vehicle in each shift position. • **Does the 4X4_SW PID always agree with the switch position?**	**Yes** GO to E4. **No** GO to Pinpoint Test B.
E4 CHECK FOR TCCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I.
E5 CHECK THE 4WD INDICATORS	
• Stop the vehicle. • Transmission in NEUTRAL. • Depress the brake pedal. • Observe the 4WD indication in the message center while cycling through each MSS position. • **Does the 4WD indicator(s) match the MSS?**	**Yes** GO to E6. **No** GO to Pinpoint Test A.
E6 CHECK FOR TCCM DTCs	
• Transmission in PARK. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** CHECK the transfer case fluid level. REFER to Section 308-07B. If the fluid level is OK, CHECK for internal transfer case faults. REFER to Section 308-07B.

Pinpoint Test F: The Front Axle Makes Noise in 2H Mode Only and Generally Under Heavy Throttle

Refer to Wiring Diagrams Cell 34, Four-Wheel Drive Systems for schematic and connector information.

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A.

Normal Operation

In 2H mode, the TCCM provides a ground path to the IWE solenoid to supply vacuum to each IWE (disengaging the front hubs from the front axle). During certain conditions such as WOT maneuvers,

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manifold vacuum is lower than desired. To maintain uninterrupted IWE function in 2H mode, stored engine vacuum is sourced from the vacuum reservoir. A one-way check valve is implemented between the manifold and IWE solenoid/vacuum reservoir to prevent the stored vacuum from escaping into the manifold during low engine vacuum conditions. For noise-free IWE operation under all conditions, the check valve must be operating correctly.

This pinpoint test is intended to diagnose the following:

- Vacuum leaks
- Vacuum check valve
- Vacuum reservoir
- IWE solenoid
- IWEs

PINPOINT TEST F: THE FRONT AXLE MAKES NOISE IN 2H MODE ONLY AND GENERALLY UNDER HEAVY THROTTLE

 **WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.**

Test Step	Result / Action to Take
F1 CHECK FOR GRINDING NOISES AT HIGH SPEEDS	
• With the vehicle warm and the MSS in 2H mode, drive the vehicle at sustained WOT for 5 seconds. • **Is there a grinding noise from the axle system during WOT ?**	**Yes** GO to F2 . **No** IDENTIFY the customer concern and GO to Symptom Chart - Four-Wheel Drive (4WD) System or GO to Symptom Chart - NVH in this section.
F2 CHECK THE IWE SOLENOID OUTPUT VACUUM IN 2H	
• **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • Start the engine. • Disconnect the output vacuum line at the IWE solenoid while having the vacuum supply attached to the solenoid. • With the engine running and the transfer case in 2H mode, measure the vacuum at the output port of the IWE solenoid. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to F7 . **No** GO to F3 .
F3 CHECK THE IWE SOLENOID INPUT VACUUM	
• Disconnect the supply vacuum line at the IWE solenoid. • **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • With the engine still running, measure the supply line vacuum to the IWE solenoid.	**Yes** INSTALL a new IWE solenoid. TEST the system for normal operation. **No** GO to F4 .

• **Is the vacuum greater than 254 mm (10 in) Hg?**	
F4 CHECK SOURCE VACUUM TO THE VACUUM RESERVOIR	
• Disconnect the source vacuum line from the vacuum reservoir. • **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • With the engine still running, measure the source vacuum being supplied to the vacuum reservoir. • **Is the vacuum greater than 254 mm (10 in) Hg?**	**Yes** GO to F5 . **No** REPAIR or INSTALL a new source vacuum line. TEST the system for normal operation.
F5 CHECK THE VACUUM RESERVOIR	
• Ignition OFF. • Disconnect the vacuum line from the vacuum reservoir. • Connect a vacuum pump to the source vacuum port on the vacuum reservoir and apply 508 mm (20 in) Hg of vacuum. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to F6 . **No** INSTALL a new vacuum reservoir. TEST the system for normal operation.
F6 CHECK THE VACUUM CHECK VALVE	
• **NOTE:** The check valve is between the vacuum source and the IWE solenoid and vacuum reservoir. • Connect the vacuum lines to the IWE solenoid. • Connect a vacuum pump to the IWE solenoid vacuum line at the vacuum reservoir and apply 508 mm (20 in) Hg of vacuum. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** Concern not present at this time. CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I . **No** REPAIR or INSTALL new vacuum lines or INSTALL a new check valve. TEST the system for normal operation.
F7 CHECK THE IWE VACUUM SYSTEM	
• Ignition OFF. • Disconnect both vacuum lines from the IWE solenoid. • Using a vacuum pump, apply 508 mm (20 in) Hg of vacuum to the IWE system through the apply vacuum circuit. • Observe the vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** CONNECT the vacuum lines to the IWE solenoid. GO to F11 . **No** GO to F8 .
F8 CHECK THE RH IWE LEAK RATE	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Disconnect the vacuum line from the larger port on the RH IWE . • Apply 508 mm (20 in) Hg of vacuum to the RH IWE port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to F9 . **No** INSTALL a new RH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
F9 CHECK THE LH IWE LEAK RATE	
• Disconnect the vacuum line from the larger port at the LH IWE . • Apply 508 mm (20 in) Hg of vacuum to the LH IWE	**Yes** GO to F10 .

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port and observe vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**No** INSTALL a new LH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
F10 CHECK THE IWE VACUUM SUPPLY TUBE	
• Disconnect both vacuum lines from the IWE solenoid. • Plug both LH and RH IWE vacuum lines. Apply 508 mm (20 in) Hg of vacuum to the IWE apply vacuum circuit and observe the vacuum reading. • **Does the vacuum maintain or drop less than 25 mm (1 in) Hg per minute?**	**Yes** GO to F11 . **No** INSTALL new vacuum lines as necessary. TEST the system for normal operation.
F11 CHECK THE IWE VACUUM SUPPLY AT EACH IWE IN 2H	
• Connect the vacuum lines to the IWE solenoid. • Connect a hand-held vacuum gauge to the LH IWE vacuum supply tube. • **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • Start the engine. • Switch the MSS to 2H mode while observing the vacuum gauge. • Repeat these steps for the RH IWE . • **Are the vacuum readings greater than 254 mm (10 in) Hg?**	**Yes** GO to F12 . **No** INSTALL new vacuum lines as necessary. TEST the system for normal operation.
F12 CHECK THE LH IWE VACUUM LINE FOR AN OBSTRUCTION	
• Ignition OFF. • Disconnect both vacuum lines from the IWE solenoid. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Disconnect the vacuum line at the LH IWE . • Connect a hand vacuum pump to the LH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the vacuum pump draw a vacuum on the LH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. TEST the system for normal operation. **No** CONNECT the vacuum line to the LH IWE . GO to F13 .
F13 CHECK THE RH IWE VACUUM LINE FOR AN OBSTRUCTION	
• Disconnect the larger vacuum line at the RH IWE . • Connect a vacuum pump to the RH IWE vacuum line and attempt to draw a vacuum on the line. • **Did the vacuum pump draw a vacuum on the RH IWE vacuum line?**	**Yes** INSTALL a new vacuum line. TEST the system for normal operation. **No** CONNECT the vacuum line to the RH IWE . GO to F14 .
F14 CHECK THE LH IWE OPERATION	
• Connect a vacuum pump with gauge to the larger port of the LH IWE . • Observe the LH halfshaft while rotating the LH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg	**Yes** GO to F15 . **No**

of vacuum and release the vacuum to manually disengage and engage the LH IWE . • **Did the LH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	INSTALL a new LH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.
F15 CHECK THE RH IWE OPERATION	
• Connect a vacuum pump with gauge to the larger port of the RH IWE . • Observe the RH halfshaft while rotating the RH front tire. Apply between 152 and 203 mm (6 to 8 in) Hg of vacuum and release the vacuum to manually disengage and engage the RH IWE . • **Did the RH IWE disengage between 152 and 203 mm (6 to 8 in) Hg and engage when the vacuum is released?**	**Yes** CARRY OUT the ESOF Functional Test. GO to Pinpoint Test I . **No** INSTALL a new RH IWE . REFER to Integrated Wheel End (IWE) in this section. TEST the system for normal operation.

Pinpoint Test G: The 4WD Does Not Engage at Speed Correctly

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the operator selects a transfer case mode from 2H mode, the Transfer Case Control Module (TCCM) engages the synchronization clutch for approximately 5 seconds to synchronize the front and rear driveshafts allowing a further mechanical engagement of the transfer case. The TCCM also removes the ground path from the IWE solenoid, which removes vacuum from the IWEs , allowing them to engage. Systematically check the necessary inputs and outputs at the TCCM , internal components of the transfer case, IWE components and drive axles.

- DTC P1825:00 (4-Wheel Drive Clutch Relay Open Circuit: No Sub Type Information) — Fault sets when TCCM C2371B pin 1 detects an open circuit. The TCCM disables transfer case synchronization clutch operation.
- DTC P1826:00 (4-Wheel Drive Low Clutch Relay Circuit To Battery: No Sub Type Information) — Fault sets when TCCM C2371B pin 1 detects a short to voltage. Transfer case synchronization clutch operation, though disabled by the TCCM , is fully engaged when this DTC is present.
- DTC P1827:00 (4-Wheel Drive Low Clutch Relay Circuit To Ground) — Fault sets when TCCM C2371B pin 1 detects a short to ground. The TCCM disables transfer case synchronization clutch operation.

This pinpoint test is intended to diagnose the following:

- Transfer case synchronization clutch
- Transfer case
- TCCM
- Front axle assembly
- Wiring, terminals or connectors

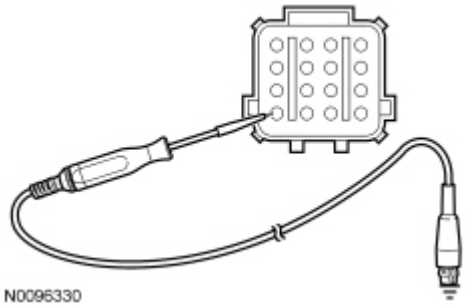
PINPOINT TEST G: THE 4WD DOES NOT ENGAGE AT SPEED CORRECTLY

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in

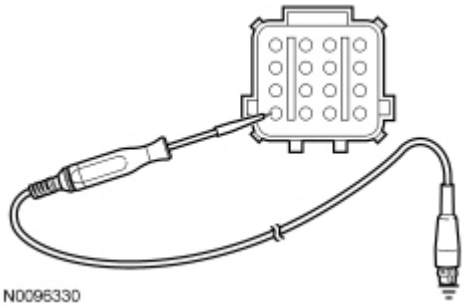
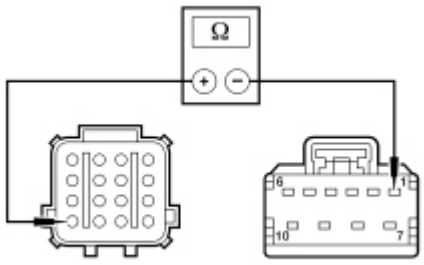
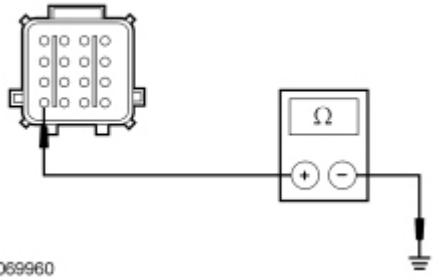
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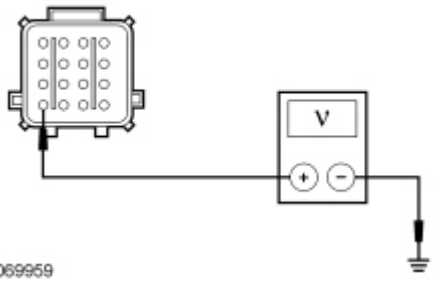
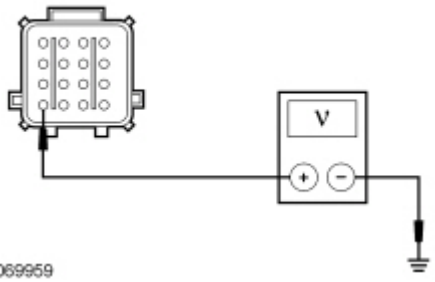
personal injury.

Test Step	Result / Action to Take
G1 CHECK FOR TCCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** For DTC P1825:00, GO to G7. For DTC P1826:00, GO to G12. For DTC P1827:00, GO to G10. For all other DTCs, REFER to the TCCM DTC Chart for diagnosis. **No** GO to G2.
G2 CHECK 4H ENGAGEMENT AT REST • Switch the MSS from 2H to 4H. • Confirm 4H engagement by driving the vehicle and check for wind-up in turns. • **Does 4H engage at rest correctly?**	**Yes** GO to G3. **No** GO to Pinpoint Test B.
G3 CHECK 2H TO 4H SHIFT AT SPEED • Switch the MSS to 2H. • Drive the vehicle and carry out a 2H to 4H shift while driving approximately at 16 km/h (10 mph). • Stop the vehicle, shift to 2H, drive the vehicle and carry out a 2H to 4H shift while driving at approximately 64 km/h (40 mph). • **Does 4H engage correctly (or much better) at 16 km/h (10 mph) than at 64 km/h (40 mph)?**	**Yes** GO to Pinpoint Test D. **No** GO to G4.
G4 CHECK THE TCCM AVERAGE FRONT WHEEL SPEED (FRT_WHL_SPD) AND AVERAGE REAR WHEEL SPEED (REAR_WHL_SPD) PIDs • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM. • Monitor the FRT_WHL_SPD and REAR_WHL_SPD PIDs while driving in a straight line. • **Do the FRT_WHL_SPD and REAR_WHL_SPD PIDs match?**	**Yes** GO to G5. **No** REFER to Section 206-09 to diagnose the wheel speed sensor concern.
G5 CHECK THE TRANSFER CASE SYNCHRONIZATION CLUTCH LOCK-UP USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID • Ignition ON. • Switch the MSS to 4H. • Active command the 4WD_CLTCH_OUT PID to 98%. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02. • Remove the transfer case shift motor from the transfer case, leaving the electrical connector connected.	**Yes** GO to G6. **No** GO to G7.

• Using a wrench, shift the transfer case shift cam to 2H. • Rotate the rear driveshaft while observing the front driveshaft. • **Does the front driveshaft rotate when the rear driveshaft is rotated?**	
G6 CHECK THE TRANSFER CASE SYNCHRONIZATION CLUTCH RELEASE USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID • Active command the 4WD_CLTCH_OUT PID to 0%. • Rotate the rear driveshaft while observing the front driveshaft. • **Does the front driveshaft rotate when the rear driveshaft is rotated?**	**Yes** GO to G11 . **No** END the active command. GO to G7 .
G7 CHECK FOR VOLTAGE TO THE TRANSFER CASE SYNCHRONIZATION CLUTCH USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID ***NOTICE:* The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition OFF. • Disconnect: Transfer Case . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Active command the 4WD_CLTCH_OUT PID at 98%.  N0096330 • Connect a 12-volt incandescent test light between transfer case C350-16, circuit CCF03 (GY/BN), harness side and the transfer case housing. • **Does the test light illuminate?**	**Yes** END the active command. INSTALL a new transfer case synchronization clutch. REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation. **No** GO to G8 .
G8 CHECK THE TRANSFER CASE CHASSIS GROUND USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID ***NOTICE:* The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Active command the 4WD_CLTCH_OUT PID at 98%.	**Yes** END the active command. REPAIR the transfer case ground connection between the transfer case and the chassis. CLEAR the DTCs. TEST the system for normal operation.

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 N0096330 • Connect a 12-volt incandescent test light between transfer case C350-16, circuit CCF03 (GY/BN), harness side and chassis ground. • **Does the test light illuminate?**	**No** END the active command. GO to G9 .
G9 CHECK THE TRANSFER CASE SYNCHRONIZATION CLUTCH CONTROL CIRCUIT FOR AN OPEN	
• Measure the resistance between transfer case C350-16, circuit CCF03 (GY/BN), harness side and TCCM C2371B-1, circuit CCF03 (GY/BN), harness side.  N0093126 • **Is the resistance less than 3 ohms?**	**Yes** GO to G10 . **No** REPAIR circuit CCF03 (GY/BN). CLEAR the DTCs. TEST the system for normal operation.
G10 CHECK THE TRANSFER CASE SYNCHRONIZATION CLUTCH CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: TCCM C2371B . • Disconnect: Transfer Case . • Measure the resistance between transfer case C350-16, circuit CCF03 (GY/BN), harness side and ground.  A0069960 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G13 . **No** REPAIR circuit CCF03 (GY/BN) for a short to ground. CLEAR the DTCs. TEST the system for normal operation.
G11 CHECK THE TRANSFER CASE SYNCHRONIZATION CLUTCH CONTROL CIRCUIT FOR VOLTAGE USING THE TCCM 4WD PWM CLUTCH STATUS (4WD_CLTCH_OUT) PID	

• Ignition OFF. • Disconnect: Transfer Case . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Active command the 4WD_CLTCH_OUT PID 98%.  A0069959 • Measure the voltage between transfer case C350-16, circuit CCF03 (GY/BN), harness side and ground. • **Is any voltage present?**	**Yes** END the active command. GO to G12 . **No** END the active command. INSTALL a new transfer case synchronization clutch. REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation.
G12 CHECK THE TRANSFER CASE SYNCHRONIZATION CLUTCH CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Transfer Case . • Disconnect: TCCM C2371B . • Ignition ON. • Measure the voltage between transfer case C350-16, circuit CCF03 (GY/BN), harness side and ground.  A0069959 • **Is any voltage present?**	**Yes** REPAIR circuit CCF03 (GY/BN). CLEAR the DTCs. TEST the system for normal operation. **No** GO to G13 .
G13 CHECK TRANSFER CASE SYNCHRONIZATION CLUTCH • Ignition OFF. • Measure the resistance between transfer case C350-16, component side and the transfer case housing. • **Is the resistance between 1-3 ohms?**	**Yes** GO to G14 . **No** INSTALL a new transfer case synchronization clutch. REFER to Transfer Case Disassembly and Assembly in Section 308-07B . CLEAR the DTCs. TEST the system for normal operation.
G14 CHECK FOR CORRECT TCCM OPERATION	

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• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test H: Vehicle Pulsates or Shudders in a Straight Line (Straightline Driveline Wind-up)

Normal Operation

In order for the 4WD system to function correctly, tires and wheels must be the same size, be in good condition and the front and rear axle ratios must match.

This pinpoint test is intended to diagnose the following:

- Unequal tire inflation pressures
- Unmatched and wheel size
- Unequal amounts of tire wear
- Unmatched front and rear axle ratios

PINPOINT TEST H: VEHICLE PULSATES OR SHUDDERS IN A STRAIGHT LINE (STRAIGHTLINE DRIVELINE WIND-UP)

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

NOTE: 4X4 high/low (4H/4L) is not intended for driving on hard/dry surfaces.

Test Step	Result / Action to Take
H1 VERIFY THE CONCERN	
• Drive the vehicle and shift from 2H to 4H. There should be minimal wind-up in 4H mode during straight line maneuvers (wind-up in turns is normal; 4X4 high/low is not intended for driving on hard/dry surfaces). • **Is excessive wind-up present?**	**Yes** GO to H2. **No** RETURN the vehicle to the customer. ADVISE about correct system operation and normal vehicle behavior.
H2 CHECK FOR MATCHING WHEEL AND TIRE	

SIZES	
• Check the wheel and tire sizes. • **Do the 4 wheel and tire sizes match?**	**Yes** GO to H3 . **No** ADVISE the customer that 4WD systems require 4 matched, correctly inflated, correctly maintained tires to operate correctly.
H3 CHECK TIRE WEAR	
• Check each of the 4 tires for wear. • **Are the 4 tires worn evenly?**	**Yes** GO to H4 . **No** ADVISE the customer that Four-Wheel Drive (4WD) systems require 4 matched, correctly inflated, correctly maintained tires to operate correctly.
H4 CHECK TIRE INFLATION PRESSURE	
• Check the inflation pressure in each tire. Refer to VC label. • **Are the tire inflation pressures correct?**	**Yes** GO to H5 . **No** ADJUST the tire pressure as necessary. TEST the vehicle for normal operation. ADVISE the customer that 4WD systems require 4 matched, correctly inflated, correctly maintained tires to operate correctly.
H5 CHECK THE FRONT AND REAR AXLE RATIOS	
• Check that front and rear axle ratios match. Refer to Section 205-00 . • **Do the front and rear axle ratios match?**	**Yes** RETURN the vehicle to the customer and ADVISE about correct 4WD usage and normal vehicle behavior. **No** CHECK the vehicle VC label. INSTALL the correct axle(s). REFER to Section 205-00 .

Pinpoint Test I: Electronic Shift-On-The-Fly (ESOF) Functional Test

Locator views for the vacuum lines and vacuum reservoir are located in Description and Operation. Refer to Section 308-07A .

Normal Operation

When operating in 4H or 4L mode, the transfer case and both IWEs are locked. When in 4L mode, the transfer case low range gear set provides an additional 2.64 gear reduction. When operating in 2H mode, the transfer case and both IWEs are unlocked.

This pinpoint test is intended to diagnose the following:

- 4WD system and/or related components

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PINPOINT TEST I: ESOF FUNCTIONAL TEST

WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

NOTE: 4X4 high/low (4H/4L) is not intended for driving on hard/dry surfaces.

Test Step	Result / Action to Take
I1 CHECK FOR IPC DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — IPC. • **Are any DTCs present?**	**Yes** If DTC U0102:00 is retrieved, REFER to Section 418-00 to diagnose lost communication with TCCM. For all other DTCs, REFER to Section 413-01. **No** GO to I2.
I2 CHECK 2H OPERATION • Switch the MSS to 2H while monitoring the message center. • **Does the message center display 4X2 for approximately 4 seconds?**	**Yes** GO to I5. **No** GO to I3.
I3 CHECK FOR TCCM DTCs • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** GO to I4.
I4 CHECK FOR WIND-UP IN 2H • Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present in turns?**	**Yes** GO to Pinpoint Test B. **No** GO to I5.
I5 CHECK 4H OPERATION • Switch the MSS to 4H while monitoring the message center. • **Does the message center display 4X4 HIGH?**	**Yes** GO to I8. **No** GO to I6.
I6 CHECK FOR TCCM DTCs • Transmission in PARK. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM. • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** GO to I7.
I7 CHECK FOR WIND-UP IN 4H • Drive the vehicle on a dry, hard surface	**Yes**

while executing turns. • **Is wind-up present in turns?**	Go to Pinpoint Test AB in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A . **No** Go to Pinpoint Test AC in Electronic Locking Differential (ELD) System, Diagnosis and Testing, Section 308-07A .
I8 CHECK FOR STRAIGHT LINE 4H WIND-UP	
• Drive the vehicle on a dry, hard surface. • **Is straightline wind-up present?**	**Yes** GO to Pinpoint Test H . **No** GO to I9 .
I9 CHECK 4H WIND-UP IN TURNS	
• Drive the vehicle in 4H while turning. • **Is wind-up present in turns?**	**Yes** GO to I10 . **No** GO to Pinpoint Test B .
I10 CHECK 4L OPERATION	
• Bring the vehicle to a stop with the transmission in NEUTRAL and switch the MSS to 4L. • **Does the 4X4 LOW indicator illuminate correctly?**	**Yes** GO to I13 . **No** GO to I11 .
I11 CHECK FOR TCCM DTCs	
• Transmission in PARK. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** GO to I12 .
I12 CHECK FOR WIND-UP IN 4L	
• Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present in turns?**	**Yes** GO to Pinpoint Test A . **No** GO to Pinpoint Test C .
I13 CHECK FOR 4L WIND-UP IN TURNS	
• Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present and 4L functioning?**	**Yes** GO to I14 . **No** CHECK for TCCM DTCs. REFER to the TCCM DTC Chart in this section. If no DTCs are present, GO to Pinpoint Test C .
I14 CHECK 4L TO 2H SHIFT	
• With the vehicle at a stop and transmission in NEUTRAL, switch the MSS from 4L to 2H. • **Does the message center display 4X2 for approximately 4 seconds?**	**Yes** GO to I17 . **No** GO to I15 .

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I15 CHECK FOR TCCM DTCs • Transmission in PARK. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** REFER to the TCCM DTC Chart in this section. **No** GO to I16 .
I16 CHECK FOR WIND-UP IN 2H • Switch the MSS to 2H. • Drive the vehicle on a dry, hard surface while executing turns. • **Is wind-up present in turns?**	**Yes** GO to Pinpoint Test C . **No** GO to Pinpoint Test A .
I17 CHECK FOR TRANSFER CASE DISENGAGEMENT • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Rotate the rear driveshaft while observing the front driveshaft. • **Does the front driveshaft rotate?**	**Yes** REFER to Section 308-07B . **No** GO to I18 .
I18 CHECK FOR LH AND RH IWE DISENGAGEMENT **NOTE:** The engine must be idling during the following steps to supply the vacuum required for the IWEs to engage and disengage. • Start the engine. • Rotate the LH front tire one revolution forward and one revolution backward while observing the LH front halfshaft and U-joint. • Rotate the RH front tire one revolution forward and one revolution backward while observing the RH front halfshaft and U-joint. • **Does the LH or RH front halfshaft rotate?**	**Yes** GO to Pinpoint Test D . **No** GO to I19 .
I19 CHECK FOR IWE VACUUM LEAKS • Ignition OFF. • Disconnect both vacuum lines from the IWE solenoid. • Using a vacuum pump, apply 508 mm (20 in) Hg of vacuum to the IWE apply vacuum circuit. • Observe the vacuum reading. • **Did the vacuum drop more than 25 mm (1 in) Hg per minute?**	**Yes** CHECK the IWE and related components for leaks. GO to Pinpoint Test D . **No** GO to I20 .
I20 CHECK 2H TO 4H SHIFT AT SPEED ABOVE 32 KM/H (20 MPH) • Switch the MSS to 2H. • Drive the vehicle on the road and shift from 2H to 4H while driving above 32 km/h (20 mph). • **Does the transfer case shift to 4H satisfactorily?**	**Yes** The 4WD system is functioning correctly. **No** GO to Pinpoint Test G .

Pinpoint Test J: Off-Road Mode Switch Indicator Is Inoperative

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the off-road switch is depressed, a signal is sent to the TCCM which alerts other modules along the HS-CAN that off-road mode is being requested. Other vehicle functions change to accommodate off-road mode and an indicator illuminates on the off-road mode switch confirming off-road mode.

- DTC B12E0:11 (Off Road Indicator: Circuit Short to Ground) — When in off-road mode, the TCCM senses the indicator circuit has low voltage and is always illuminated.
- DTC B12E0:12 (Off Road Indicator: Circuit Short to Battery) — When in off-road mode, the TCCM senses the indicator circuit has high voltage and never illuminates.
- DTC B12E0:13 (Off Road Indicator: Circuit Open) — When in off-road mode, the TCCM senses the indicator lamp circuit is open and never illuminates.

This pinpoint test is intended to diagnose the following:

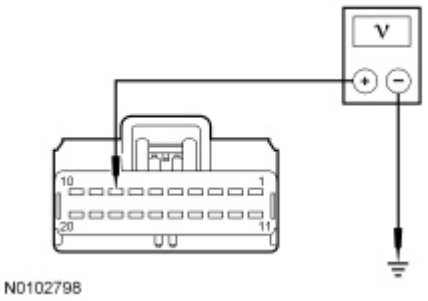
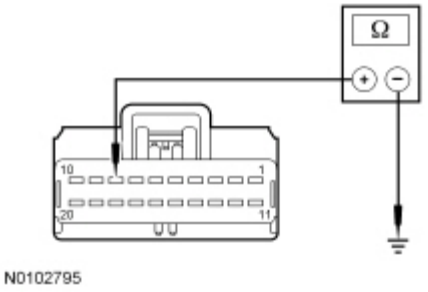
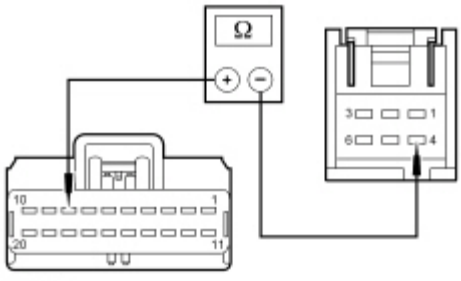
- Wiring, terminals or connectors
- Off-road mode switch
- TCCM

PINPOINT TEST J: OFF-ROAD MODE SWITCH INDICATOR IS INOPERATIVE

NOTE: Make sure the battery is fully charged before performing this pinpoint test.

Test Step	Result / Action to Take
J1 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** For DTC B12E0:11, GO to J3 . For DTC B12E0:12, GO to J2 . For DTC B12E0:13, GO to J4 For all other DTCs, REFER to the TCCM DTC Chart in this section. **No** IDENTIFY the customer concern and GO to Symptom Chart - Four-Wheel Drive (4WD) System in this section.
J2 CHECK THE OFF-ROAD MODE INDICATOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: TCCM C2371A . • Disconnect: Off-Road Mode Switch . • Ignition ON. • Measure the voltage between TCCM C2371A-8, circuit CCF01 (BN), harness side and ground.	**Yes** REPAIR circuit CCF01 (BN). CLEAR the DTCs. TEST the system for normal operation. **No** GO to J3 .

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 N0102798 • **Is any voltage present?**	
J3 CHECK THE OFF-ROAD MODE INDICATOR CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: TCCM C2371A . • Disconnect: Off-Road Mode Switch . • Measure the resistance between TCCM C2371A-8, circuit CCF01 (BN), harness side and ground.  N0102795 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J4 . **No** REPAIR circuit CCF01 (BN). CLEAR the DTCs. TEST the system for normal operation.
J4 CHECK THE OFF-ROAD MODE INDICATOR CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: TCCM C2371A . • Disconnect: Off-Road Mode Switch . • Measure the resistance between TCCM C2371A-8, circuit CCF01 (BN), harness side and off-road mode switch C3393-4, circuit CCF01 (BN), harness side.  N0102796 • **Is the resistance less than 3 ohms?**	**Yes** GO to J5 . **No** REPAIR circuit CCF01 (BN). CLEAR the DTCs. TEST the system for normal operation.
J5 CHECK THE TCCM OFF-ROAD INPUT SWITCH STATUS (OFF_RD_SW) PID	
• Connect: TCCM C2371A .	**Yes**

• Connect: Off-Road Mode Switch . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Monitor the OFF_RD_SW PID. • **Does the OFF_RD_SW PID status indicate Not Pressed?**	GO to J6 . **No** INSTALL a new off-road mode switch. REFER to the Console — Floor exploded view in Section 501-12 . PRESS the tab on each side of the switch to remove it from the bezel. CLEAR the DTCs. TEST the system for normal operation.
J6 CHECK THE TCCM OFF-ROAD STATUS (OFF_RD_STAT) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — TCCM . • Press the off-road mode switch button. • Monitor the OFF_RD_STAT PID. • **Does the PID status indicate Off-Road Mode?**	**Yes** GO to J7 . **No** INSTALL a new off-road mode switch. REFER to the Console — Floor exploded view in Section 501-12 . PRESS the tab on each side of the switch to remove it from the bezel. CLEAR the DTCs. TEST the system for normal operation.
J7 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

Pinpoint Test K: Off-Road Mode Is Inoperative

Refer to Wiring Diagrams Cell 34 , Four-Wheel Drive Systems for schematic and connector information.

Normal Operation

When the off-road switch is depressed, a signal is sent to the TCCM which alerts other modules along the HS-CAN that off-road mode is being requested. Other vehicle functions change to accommodate off-road mode and an indicator illuminates on the off-road mode switch confirming off-road mode.

- DTC B12E5:00 (Off Road Mode Select Switch: No Sub Type Information) — When in off-road mode, the TCCM C2371A-12 senses if the switch is pressed for more than 30 seconds or if a short to ground on the switch circuit has occurred.
- DTC B12E5:11 (Off Road Mode Select Switch: Circuit Short To Ground) — The TCCM C2371A-12 senses a short to ground on the switch control circuit.

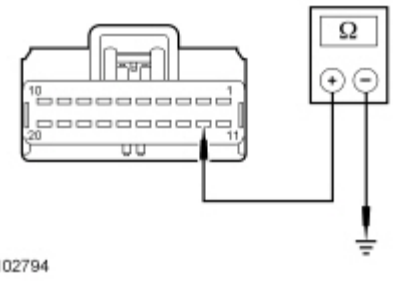
This pinpoint test is intended to diagnose the following:

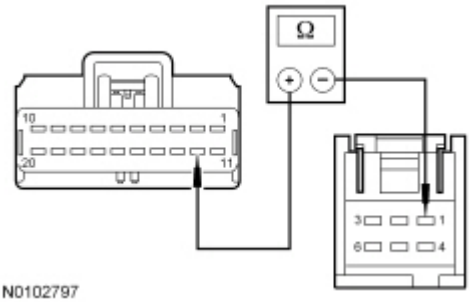
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- Wiring, terminals or connectors
- Off-road mode switch
- TCCM

PINPOINT TEST K: OFF-ROAD MODE IS INOPERATIVE

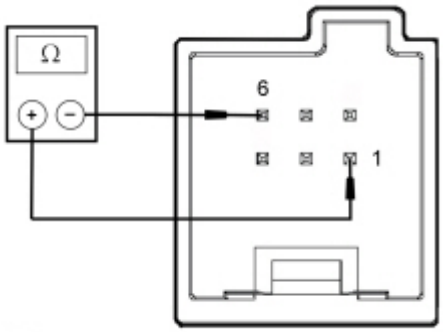
NOTE: Make sure the battery is fully charged before performing this pinpoint test.

Test Step	Result / Action to Take
K1 CHECK FOR TCCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — TCCM . • **Are any DTCs present?**	**Yes** If DTCs B12E5:00 or B12E5:11 are retrieved, GO to K2 . For all other DTCs, REFER to the TCCM DTC Chart in this section. **No** IDENTIFY the customer concern and GO to Symptom Chart - Four-Wheel Drive (4WD) System in this section.
K2 CHECK THE OFF-ROAD MODE SWITCH CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: TCCM C2371A . • Disconnect: Off-Road Mode Switch . • Measure the resistance between TCCM C2371A-12, circuit CCF11 (YE/VT), harness side and ground.  N0102794 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K3 . **No** REPAIR circuit CCF11 (YE/VT). CLEAR the DTCs. TEST the system for normal operation.
K3 CHECK THE OFF-ROAD MODE SWITCH CIRCUIT FOR AN OPEN	
• Measure the resistance between TCCM C2371A-12, circuit CCF11 (YE/VT), harness side and off-road mode switch C3393-1, circuit CCF11 (YE/VT), harness side.	**Yes** GO to K4 . **No** REPAIR circuit CCF11 (YE/VT). CLEAR the DTCs. TEST the system for normal operation.



N0102797

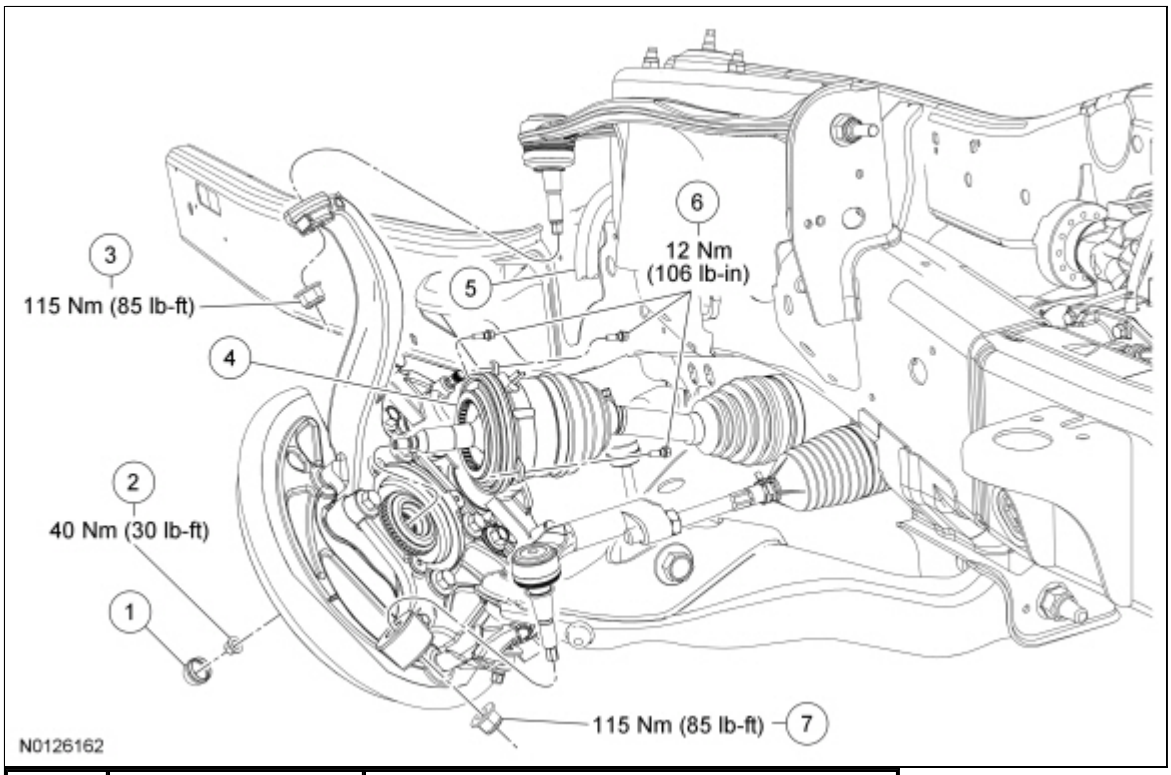
- **Is the resistance less than 3 ohms?**

K4 CHECK THE OFF-ROAD MODE SWITCH	
• Measure the resistance between off-road mode switch C3393-6, circuit CCF11, component side and off-road mode switch C3393-1, circuit CCF11, component side.  N0133483 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K5 . **No** INSTALL a new off-road mode switch. REFER to the Console — Floor exploded view in Section 501-12 . PRESS the tab on each side of the switch to remove it from the bezel. CLEAR the DTCs. TEST the system for normal operation.
K5 CHECK FOR CORRECT TCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all TCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all TCCM connectors. Make sure they are seated correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM . REFER to Transfer Case Control Module (TCCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. ADDRESS the root cause of the connector or pin issues.

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Integrated Wheel End (IWE)



Item	Part Number	Description
1	1131	Dust cap
2	N802827-S	Axle nut
3	W520215-S	Upper ball joint nut
4	3C247	Integrated Wheel End (IWE)
5	—	Vacuum vent and supply tube
6	W710279-S	IWE bolts (3 required)
7	W520215-S	Tie-rod nut

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
2. Remove the front wheel and tire. Refer to Section 204-04 .
3. Remove the dust cap.
4. Remove and discard the axle nut.
5. Disconnect the vacuum tubes from the Integrated Wheel End (IWE).

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6. Remove the 3 IWE -to-wheel knuckle retaining bolts.

7. Remove the tie-rod nut and separate the tie rod from the wheel knuckle.
    - Discard the tie-rod nut.

8. Remove the wheel speed sensor harness bracket bolt and position the harness aside.

9. Remove the front brake flexible hose bracket bolt and position the brake hose aside.

10. Remove the upper ball joint nut and separate the upper ball joint from the wheel knuckle.
    - Discard the upper ball joint nut.

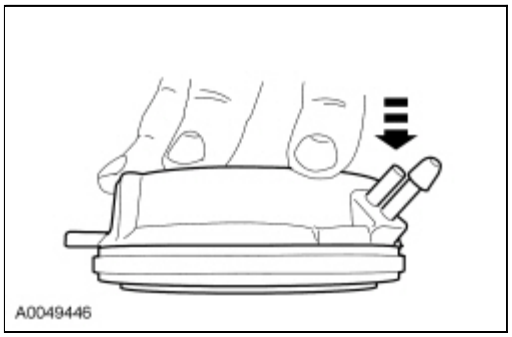
11. **NOTE:** Allow the wheel knuckle to swing outward while keeping the halfshaft pushed inward.

    Once clearance is available, remove the halfshaft outboard end from the wheel knuckle hub bearing.

12. Remove the IWE from the halfshaft outboard end.

Installation

1. Compress the IWE and install a vacuum cap on the vacuum port.



2. ***NOTICE:*** **Do not dislodge the Integrated Wheel End (IWE) seal spring when installing the IWE on halfshaft outboard end or component damage may occur.**

    Install the IWE onto the halfshaft outboard end.

3. **NOTE:** Allow the wheel knuckle to swing outward while keeping the halfshaft pushed inward.

    Once clearance is available, install the halfshaft outboard end into the wheel knuckle hub bearing.

4. Connect the upper ball joint and install a new nut.
    - Tighten to 115 Nm (85 lb-ft).

5. Connect the tie rod and install a new nut.
    - Tighten to 115 Nm (85 lb-ft).

6. Position the front brake flexible hose bracket and install the bolt.
    - Tighten to 12 Nm (106 lb-in).

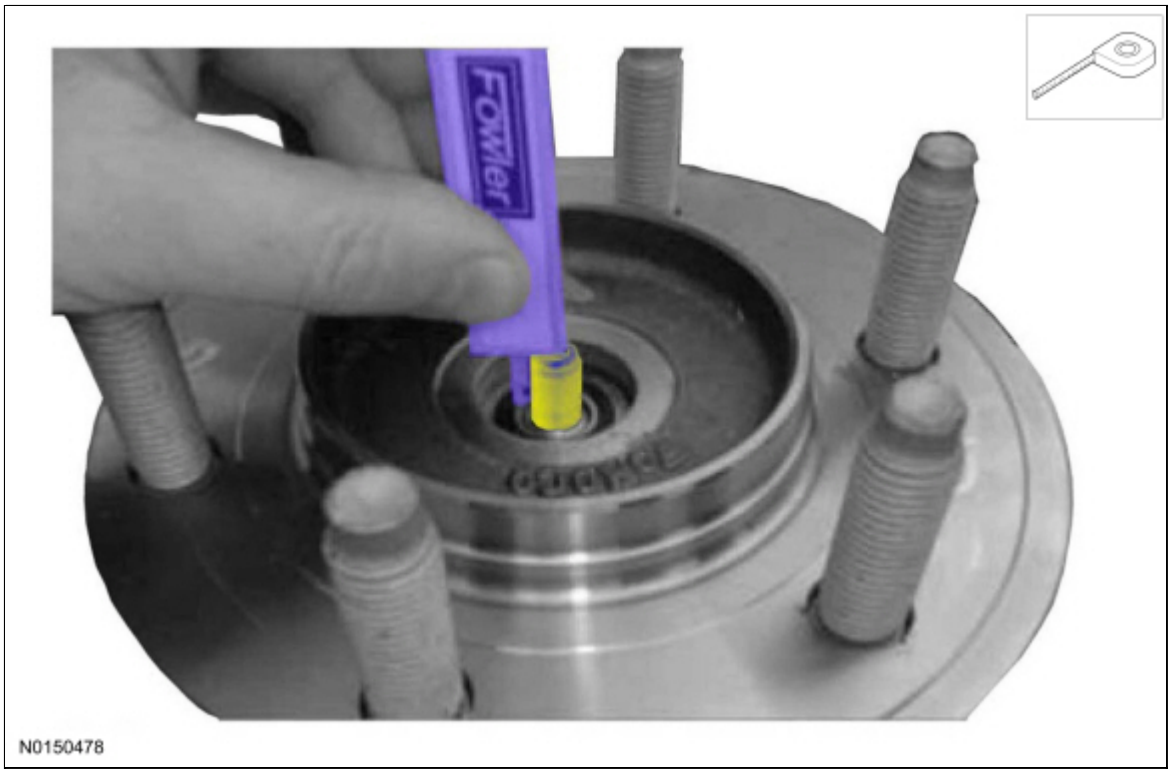
7. Position the wheel speed sensor harness bracket and install the bolt.
    - Tighten to 12 Nm (106 lb-in).

8. Install the 3 IWE -to-wheel knuckle retaining bolts.
    - Tighten to 12 Nm (106 lb-in).

9. Remove the IWE vacuum cap and connect the vacuum tubes.

10. ***NOTICE:*** **Measure the depth of the CV Shaft threaded end to the inner bearing race (shown in illustration). The minimum depth is 15.5 mm (0.61 in). If the depth is less than 15.5 mm (0.61 in) rotate the CV shaft to clear a binding condition between the IWE and CV splines. Installing the axle nut and tightening without the proper depth of protrusion will result in damage to the IWE .**

    Measure the CV shaft threaded end to the inner bearing race.



11. ***NOTICE:*** **Verify the spline engagement by checking for spline lash before installing the axle nut or component damage may occur.**

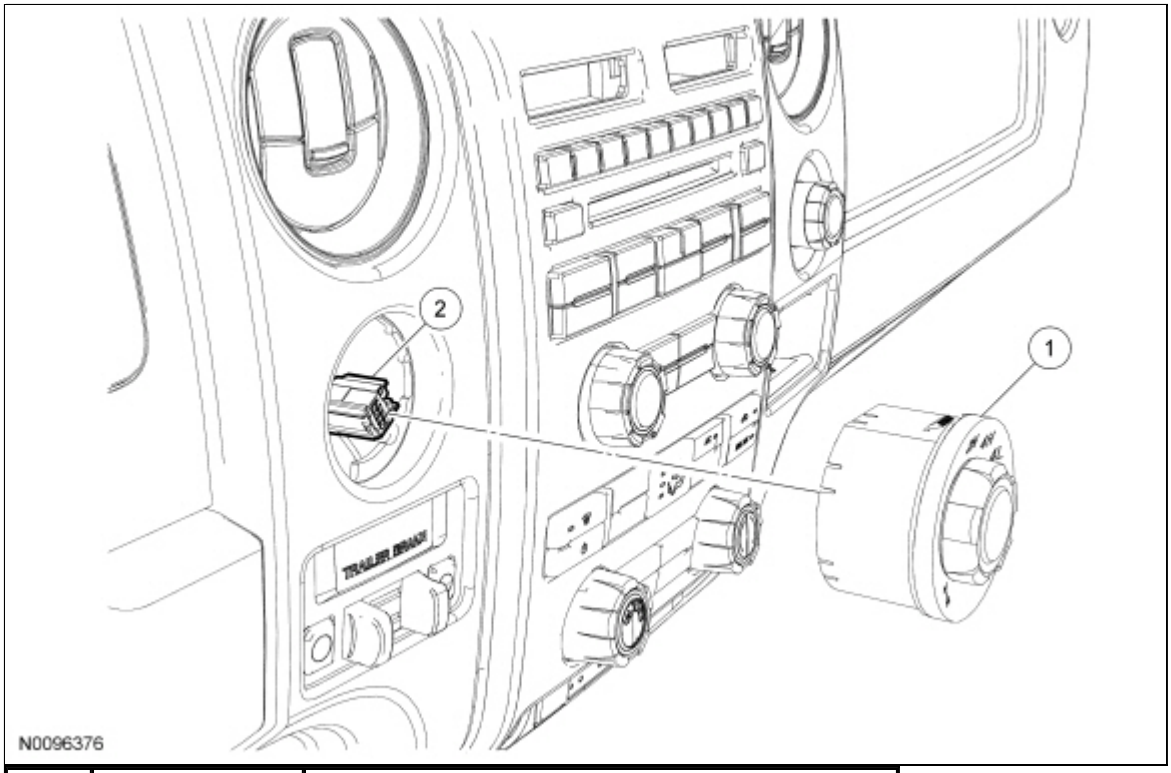
    Install the new axle nut.
    - Tighten to 40 Nm (30 lb-ft).

12. Install the dust cap.

13. Install the front wheel and tire. Refer to Section 204-04 .

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Mode Select Switch (MSS)



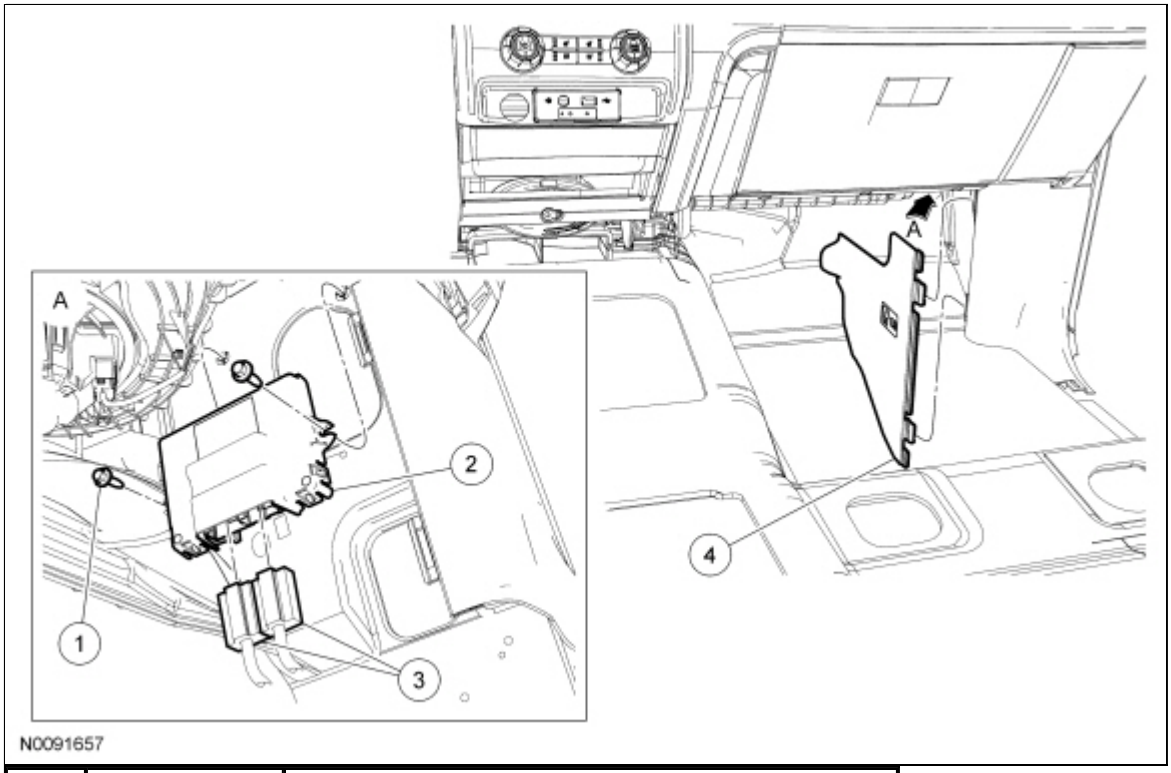
Item	Part Number	Description
1	14B166	Mode Select Switch (MSS)
2	—	MSS electrical connector (part of 14401)

1. Carefully pry the Mode Select Switch (MSS) from the instrument panel.
2. Disconnect the MSS harness connector and remove the switch.
3. To install, reverse the removal procedure.

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Transfer Case Control Module (TCCM)

Removal and Installation



Item	Part Number	Description
1	W706287	Screw (2 required)
2	7E453	Transfer Case Control Module (TCCM)
3	—	TCCM electrical connectors (part of 12A581)
4	023A98	Central Junction Box (CJB) cover

1. Remove the Central Junction Box (CJB) cover to gain access to the Transfer Case Control Module (TCCM).

NOTE: The TCCM has slotted mounting holes. It is not necessary to remove the LH TCCM screw when removing the TCCM .

2. Loosen the LH TCCM screw and remove the RH TCCM screw.
   - To install, tighten to 7 Nm (62 lb-in).

3. Disconnect the 2 electrical connectors.

4. Remove the TCCM .

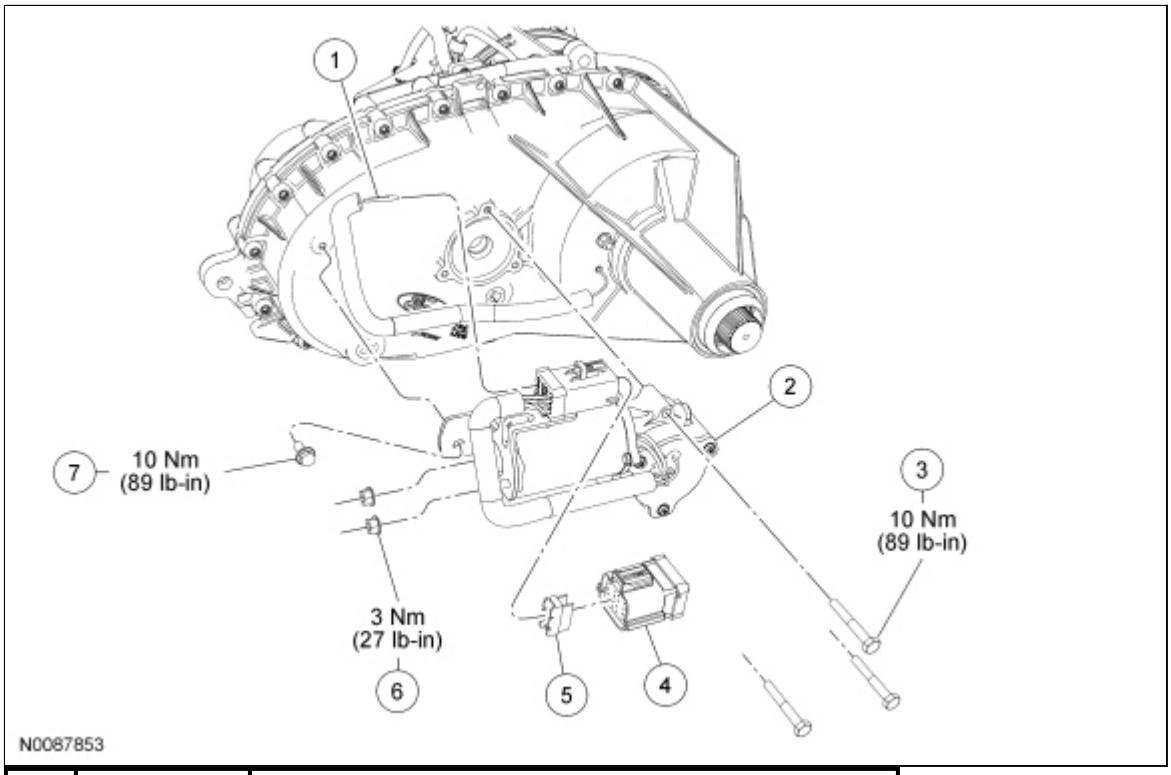
5. To install, reverse the removal procedure.

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Transfer Case Shift Motor

Material

Item	Specification
Ultra Silicone Sealant TA-29	—



Item	Part Number	Description
1	—	Coil wire (part of 7G361)
2	7G360	Transfer case shift motor
3	N800670-S	Transfer case shift motor bolt (3 required)
4	15525	Connector
5	—	Connector inner retainer (part of 15525)
6	—	Transfer case shift motor nut (part of 7G360) (2 required)
7	7A443	Transfer case shift motor bolt

Removal

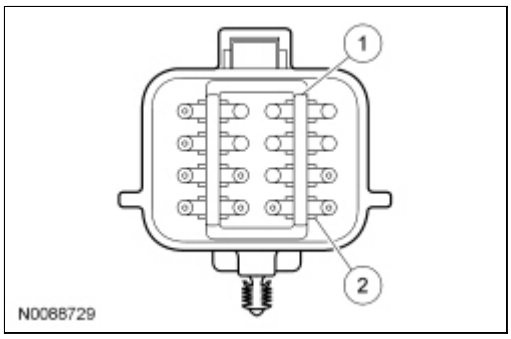
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-

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02 .

2. Disconnect the harness connector.

3. Remove the coil wire pin from the electrical connector.
    1. Remove the inner retainer from the wire connector.
    2. Press the release tab and remove the coil wire pin.



4. Remove the transfer case shift motor bracket bolt and the 3 mounting bolts, then remove the transfer case shift motor.

Installation

1. Apply a small bead of silicone sealant to the transfer case shift motor mating surface.

NOTICE: **New shift motor bracket nuts are loose and are tightened last. Failure to follow the steps in the correct order may result in damage to the component.**

2. Install the transfer case shift motor and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

3. Install the transfer case shift motor bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

4. Secure the transfer case shift motor bracket nuts.
    - Tighten to 3 Nm (27 lb-in).

5. **NOTE:** After the wire is inserted into the connector, gently pull the wire back to verify the pin is locked inside the connector.

    Insert the coil wire pin in the electrical connector and install the inner connector retainer.

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Material

Item	Specification	Fill Capacity
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV	1.4L (2.9 pt) [a]
Motorcraft® Transfer Case Fluid XL-12	ESP-M2C166-H	1.4L (2.9 pt) [b]
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	—
Ultra Silicone Sealant TA-29	—	—

[a] 2-speed torque-on-demand
[b] Electronic Shift-On-The-Fly (ESOF)

Torque Specifications

Description	Nm	lb-ft	lb-in
Crossmember bolts	90	66	—
Drain plug	15	—	133
Exhaust heat shield bolts	15	—	133
Exhaust support bracket bolt	35	26	—
Fill plug	15	—	133
Mode Indication Switch (MIS)	41	30	—
Shift motor bolts	10	—	89
Shift motor nuts	3	—	27
Skid plate bolts	40	30	—
Transfer case bolts [a]	—	—	—
Transfer case field coil nuts	10	—	89
Transfer case-to-transmission bolts [a]	—	—	—
Transmission mount bolts	90	66	—
Transmission mount nuts	103	76	—

[a] Refer to the procedure in this section.

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Transfer Case

Electronic Shift-On-The-Fly (ESOF) System

The ESOF transfer case system consists of the following components:

- Mode Select Switch (MSS), located on the instrument panel
- Transfer case assembly (includes shift motor and synchronization clutch)
- Transfer Case Control Module (TCCM)

The Borg-Warner 4419 electronic shift transfer case is a 2-piece magnesium design. The unit transfers engine power from the transmission to the front and rear axles. Vehicles equipped with an ESOF system allow the operator to choose between 2-Wheel Drive (2WD) (2H) and 2 different 4WD modes. The transfer case is shifted electronically based on the MSS position. Under normal driving conditions, the transfer case is in 2WD (2H), but when desired, the operator may shift into 4WD high (4H) or 4WD low (4L). The operator can shift between 2WD (2H) and 4WD high (4H) at any speed. When shifting into or out of 4WD low (4L) range, the TCCM requires that the vehicle speed is less than 5 km/h (3 mph) and the transmission in NEUTRAL.

The transfer case is equipped with an electronically controlled high torque capacity clutch which is located inside the case. This clutch is used to synchronize the speed of the front driveline with the rear driveline during 2WD (2H) to 4WD high (4H) shifts. The transfer case is lubricated by a positive displacement fluid pump that channels fluid flow through holes in the rear output shaft.

2-Speed Torque-On-Demand

The 2-speed torque-on-demand transfer case system consists of the following components:

- MSS , located on the instrument panel
- Transfer case assembly (includes shift motor and synchronization clutch)
- TCCM

The Borg-Warner 2-speed torque-on-demand transfer case is a 2-piece magnesium design. The transfer case transfers engine power from the transmission to the front and rear axles. Vehicles equipped with the 2-speed torque-on-demand system allow the operator to choose between 2WD and 3 different 4WD modes. The transfer case is shifted electronically based on the MSS position. Under normal driving conditions, the unit is in 2WD (2H), but when desired, the operator may shift into 4WD high (4H), 4WD low (4L) or 4WD AUTO (4A). When shifting into or out of 4WD (4L) range, the TCCM requires that the vehicle speed is less than 5 km/h (3 mph) and the transmission is in NEUTRAL.

The transfer case is equipped with an electronically controlled high torque capacity clutch which is located inside the case. This clutch is used to synchronize the speed of the front driveline with the rear driveline during 2WD (2H) to 4WD high (4H) or 4WD AUTO (4A) shifts. The clutch also provides torque to the front driveline in all 4WD modes. The transfer case is lubricated by a positive displacement fluid pump that channels fluid flow through holes in the rear output shaft.

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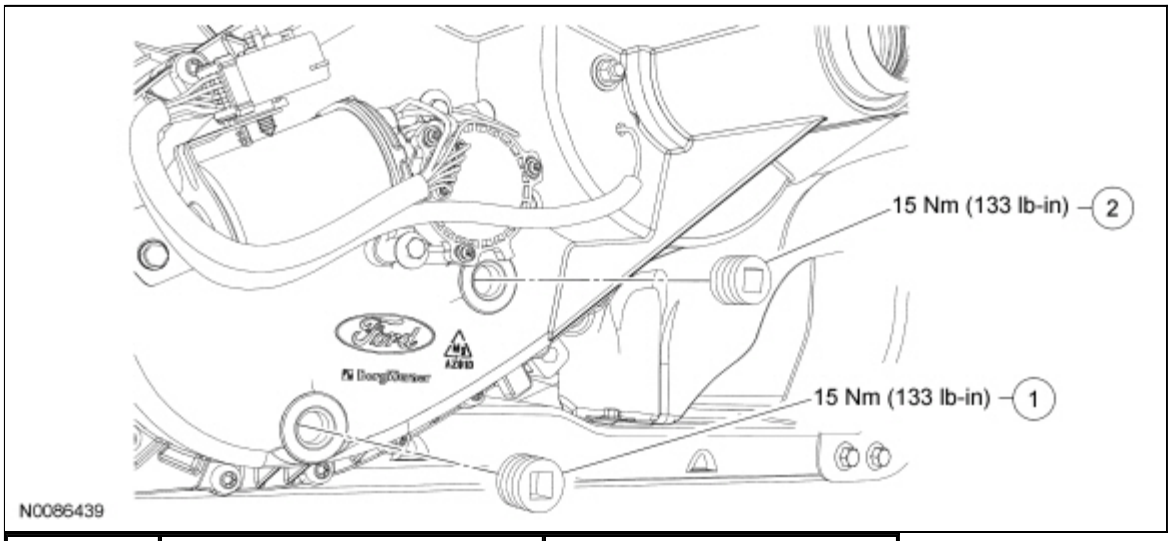
Transfer Case Draining and Filling

Special Tool(s)

 ST2323-A	Oil Suction Gun 303-D104 (D94T-9000-A)

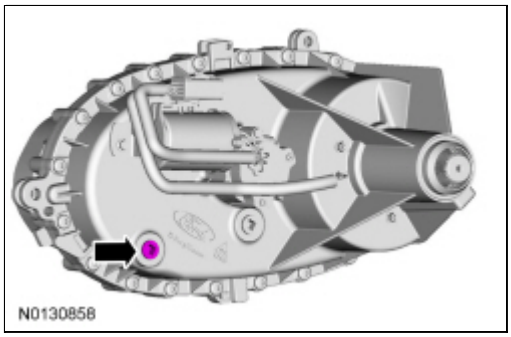
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC (US); CXT-10-LV12 (Canada)	MERCON® LV
Motorcraft® Transfer Case Fluid XL-12	ESP-M2C166-H
Thread Sealant with PTFE TA-24	WSK-M2G350-A2



Item	Part Number	Description
1	7A110	Drain plug
2	7A110	Fill plug

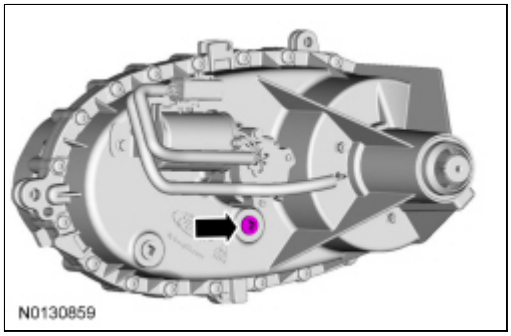
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the drain plug and drain the fluid.



3. Clean the drain plug and the drain plug area. Apply thread sealant to the drain plug threads and install the drain plug.
    - To install, tighten to 15 Nm (133 lb-in).

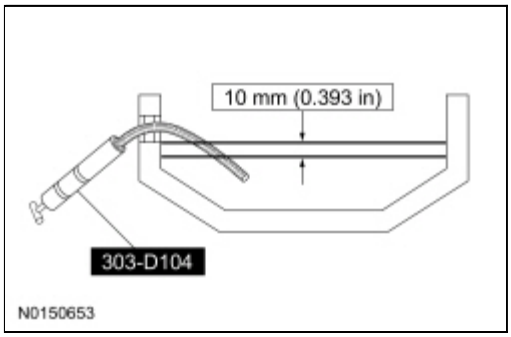
4. **NOTE:** Prior to removal, clean the area around the fill plug.

   Remove the fill plug.



5. ***NOTICE:*** **In the Electronic Shift-On-The-Fly (ESOF) transfer case use Motorcraft® Transfer Case Fluid and in the 2-speed torque-on-demand transfer case use Motorcraft® MERCON® LV Automatic Transmission Fluid. Incorrect fluid fill will result in transfer case failure.**

   Using the Oil Suction Gun, fill the transfer case with the recommended fluid, to specification.
    - Transfer case capacity is 1.4L (2.9 pt).
    - The fluid must be 10 mm (0.393 in) below the fill plug hole.



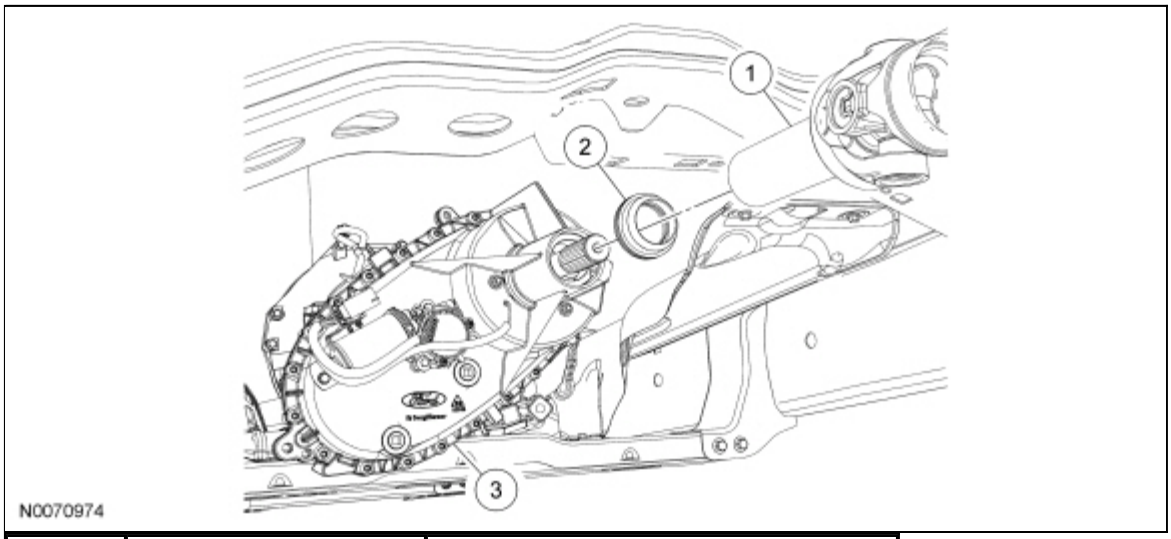
6. Apply thread sealant to the fill plug threads and install the fill plug.
    - Tighten to 15 Nm (133 lb-in).

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Transfer Case Rear Output Shaft Seal

Special Tool(s)

 ST2261-A	Installer, Input Shaft Oil Seal 308-249 (T96T-7127-A)

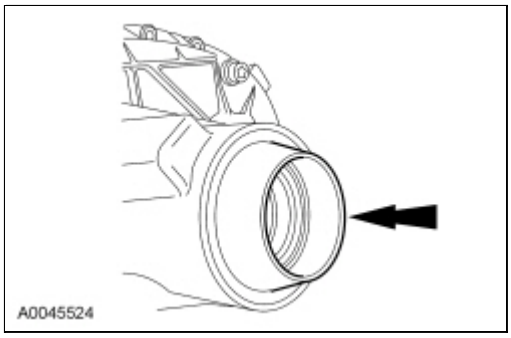


Item	Part Number	Description
1	4602	Driveshaft
2	7B215	Rear output shaft seal
3	7A195	Transfer case

Removal

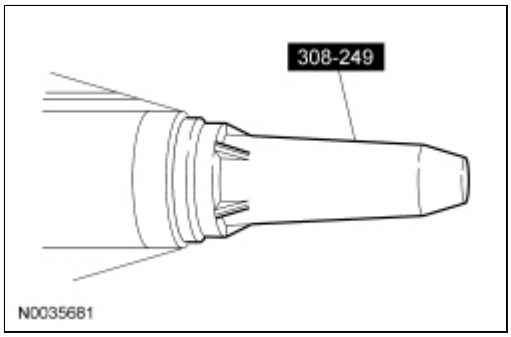
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the rear driveshaft. For additional information, refer to Section 205-01 .
3. Using a suitable seal puller, remove the rear output shaft seal.

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Installation

1. Using the Input Shaft Oil Seal Installer, install the rear output shaft seal.



2. Install the rear driveshaft. For additional information, refer to Section 205-01 .

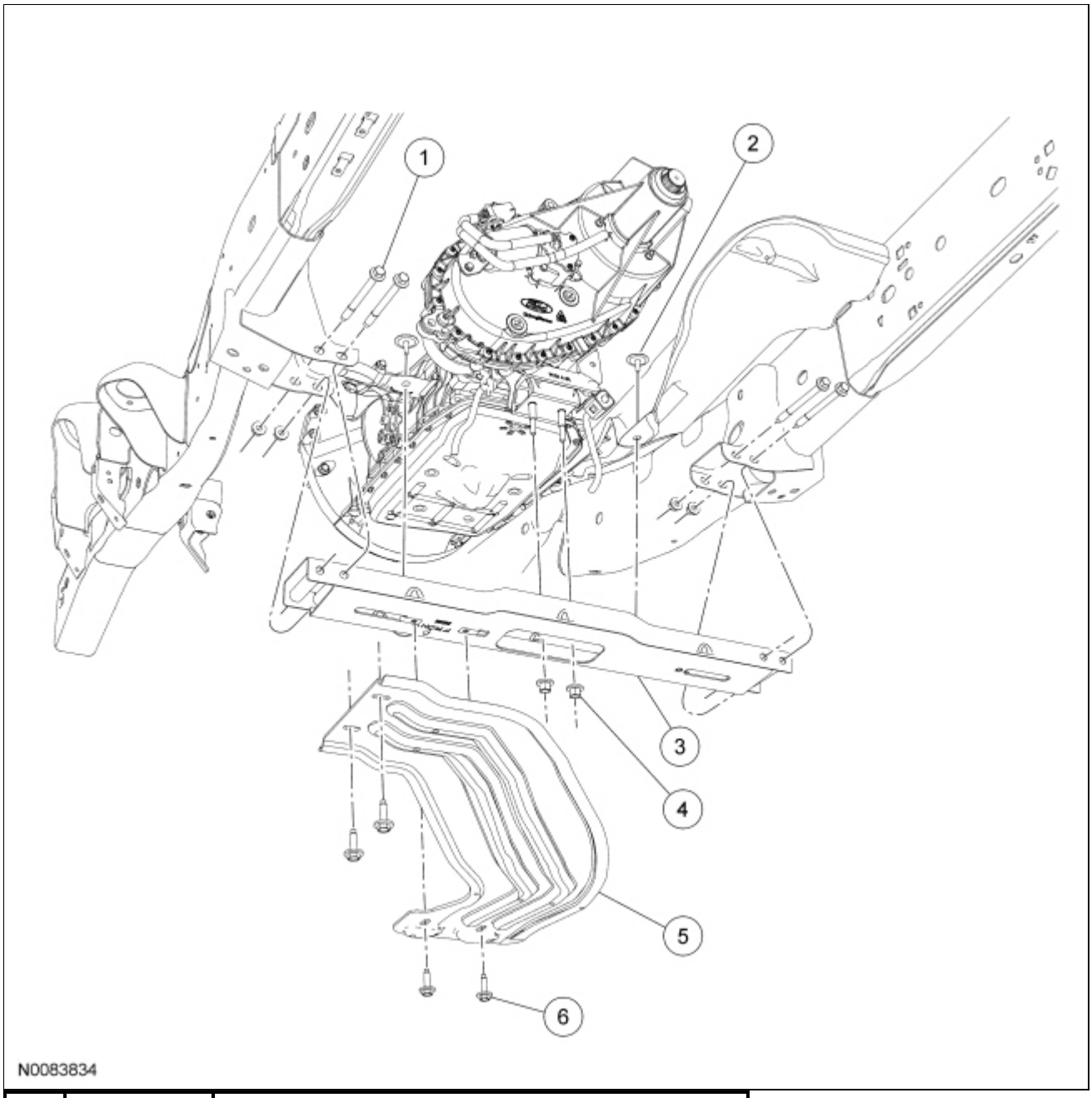
Transfer Case

Material

Item	Specification
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

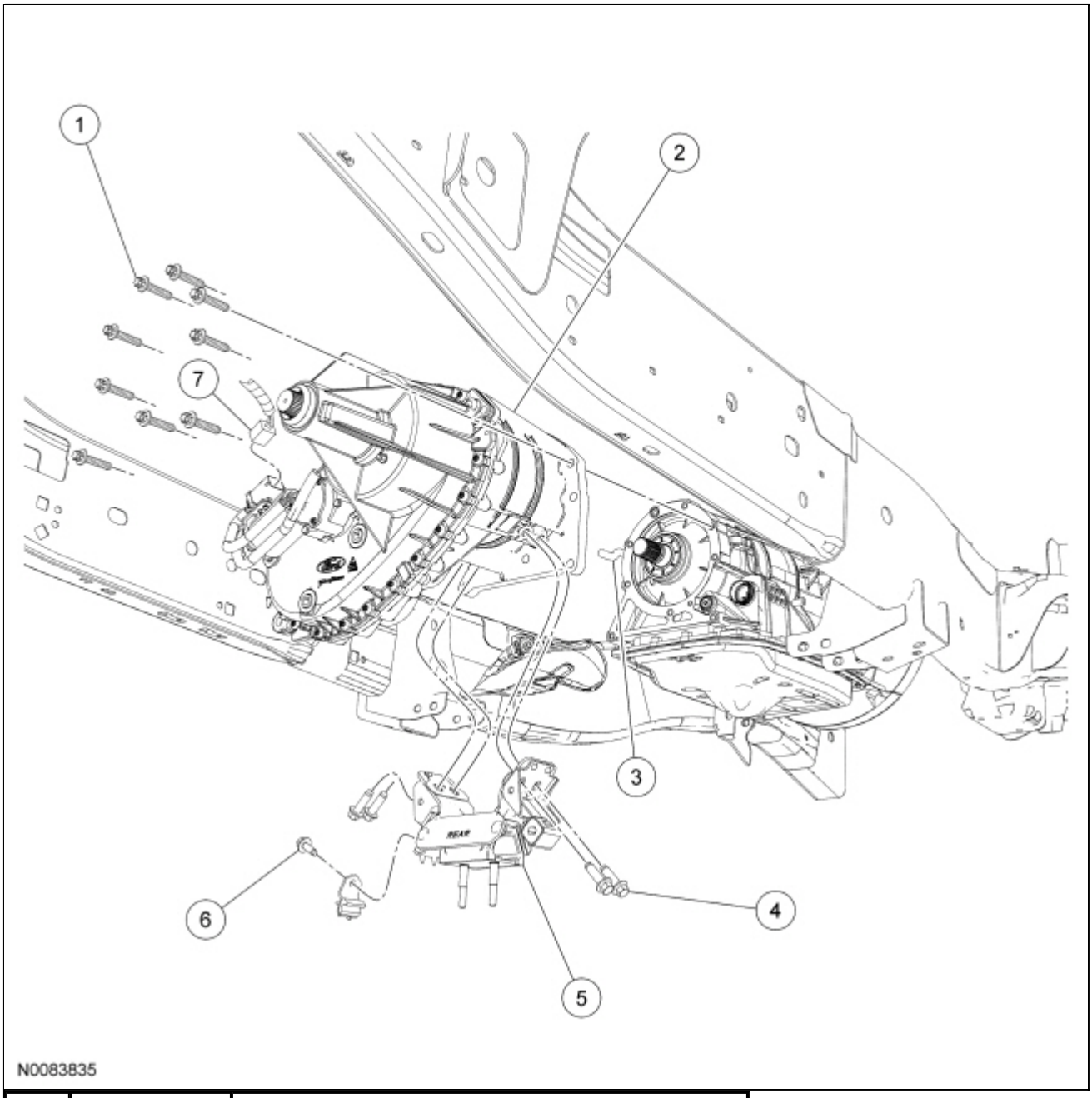
Transfer Case — Left Side

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Item	Part Number	Description
1	637077	Transmission support crossmember bolt (4 required)
2	W707959-S	Heat shield bolt (2 required)
3	9740124	Transmission support crossmember
4	N621945-S	Transmission mount nut (2 required)
5	7E063	Skid plate
6	W503932-S	Skid plate-to-frame bolt (4 required)

Transfer Case — Right Side

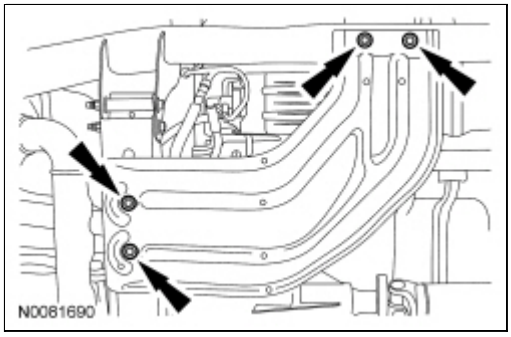


Item	Part Number	Description
1	7A443	Transfer case-to-transmission bolt (9 required)
2	7A195	Transfer case
3	7D494	Vent tube
4	W713728-S	Transmission mount bolt (4 required)
5	6D091	Transmission mount
6	W709341-S	Exhaust support bracket bolt
7	14489	Shift motor electrical connector — ESOF

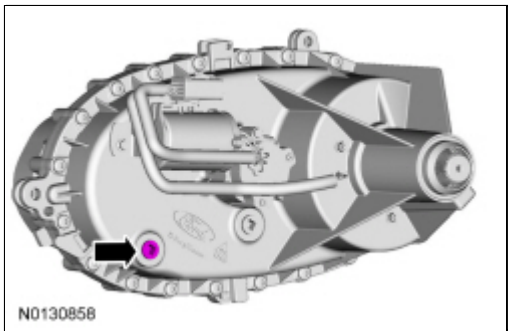
1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .

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2. If equipped, remove the 4 skid plate bolts and remove the skid plate.



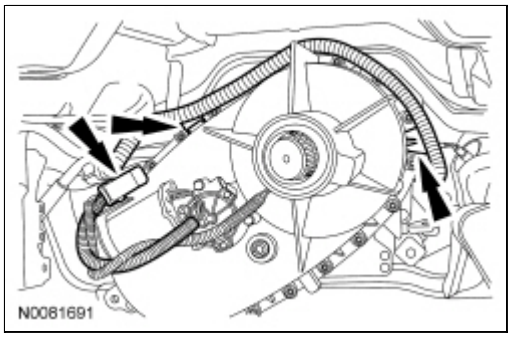
3. Drain the fluid if the transfer case is to be disassembled.
    - Apply thread sealant to the drain plug threads and install the drain plug when finished draining.
        - Tighten to 15 Nm (133 lb-in).



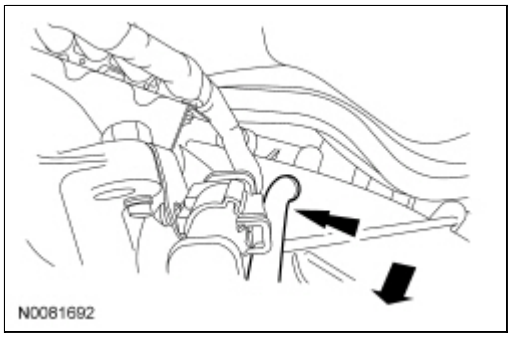
4. Remove the front driveshaft. Refer to Section 205-01 .

5. Remove the rear driveshaft. Refer to Section 205-01 .

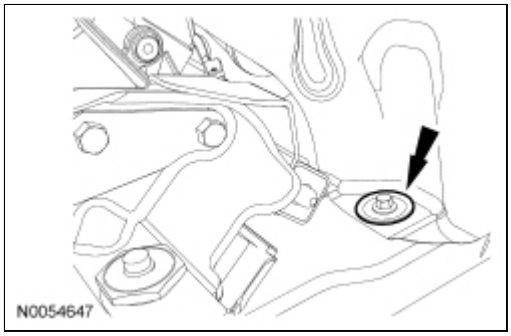
6. Disconnect the shift motor electrical connector and detach the 2 harness retainer clips from the transfer case.



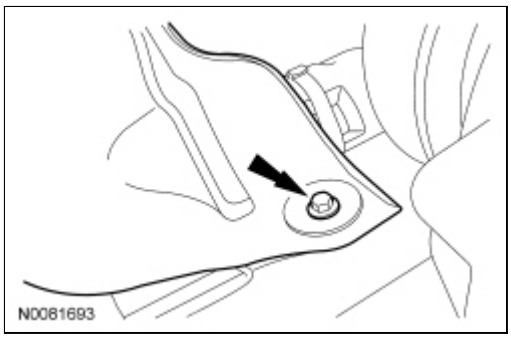
7. Disconnect the vent hose from the transfer case.



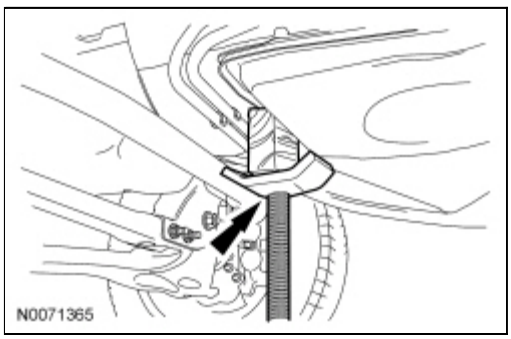
8. Remove the RH exhaust heat shield bolt from the transmission support crossmember.



9. Remove the LH exhaust heat shield bolt from the transmission support crossmember.

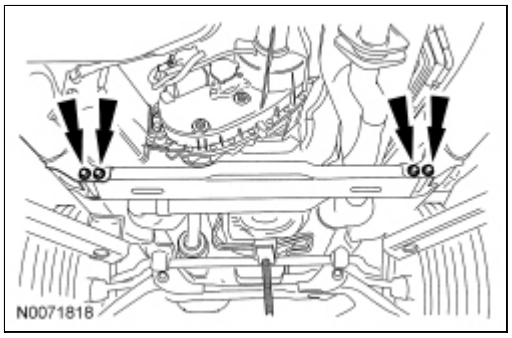


10. Support the front of the transmission.

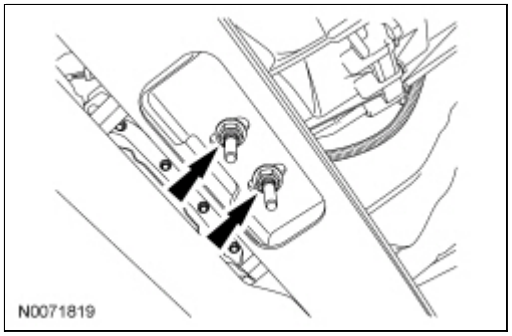


11. Remove and discard the 4 transmission support crossmember nuts and bolts.

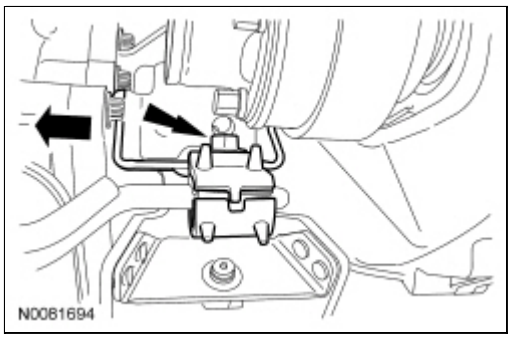
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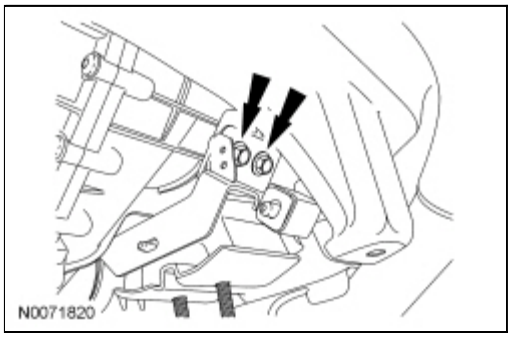
12. Remove the 2 transmission mount nuts and the transmission support crossmember.



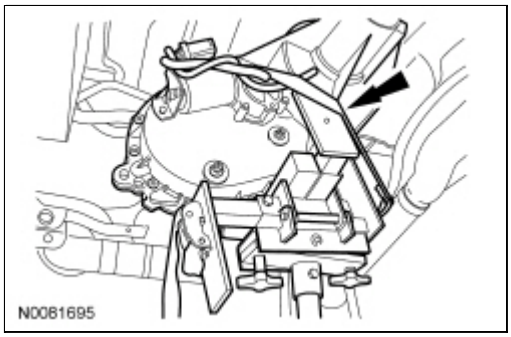
13. Remove the bolt from the LH exhaust support bracket.



14. Remove the 4 transmission mount bolts and the transmission mount.

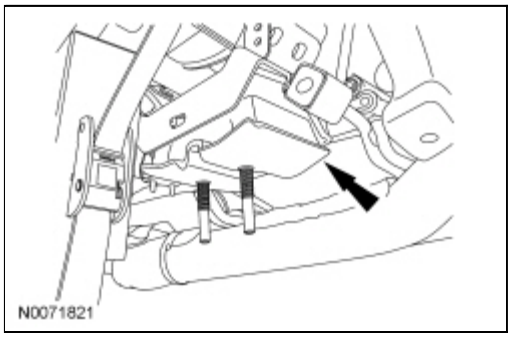


15. Using a transmission jack, position it to the transfer case. Secure the transfer case to the jack with a safety strap.



16. Remove and discard the 9 transfer case-to-transmission bolts.

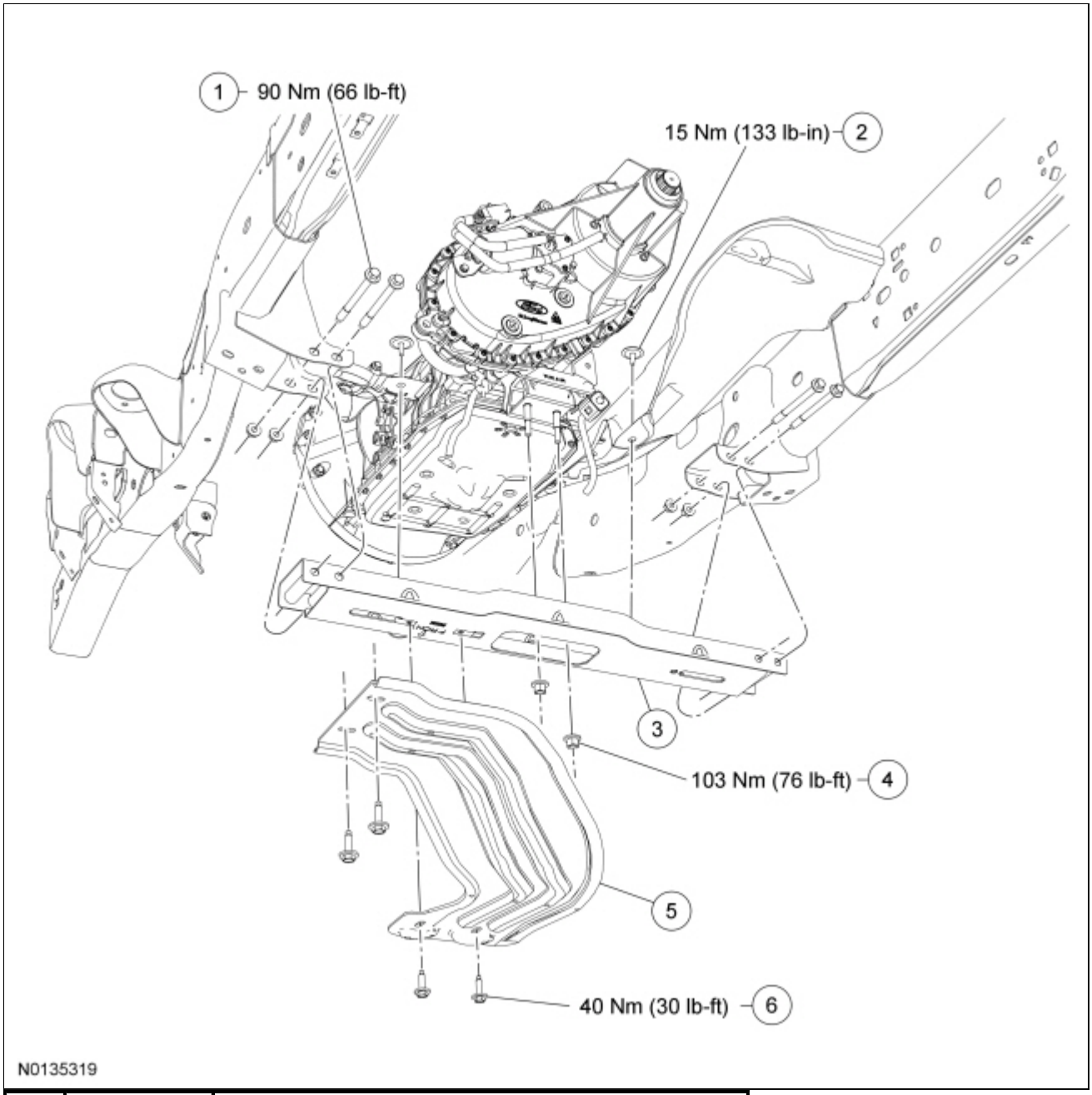
17. Separate the transfer case from the transmission and move the transfer case rearward 25.4 mm (1 in). Move the transfer case rearward off the output shaft and lower it from the vehicle.



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Transfer Case

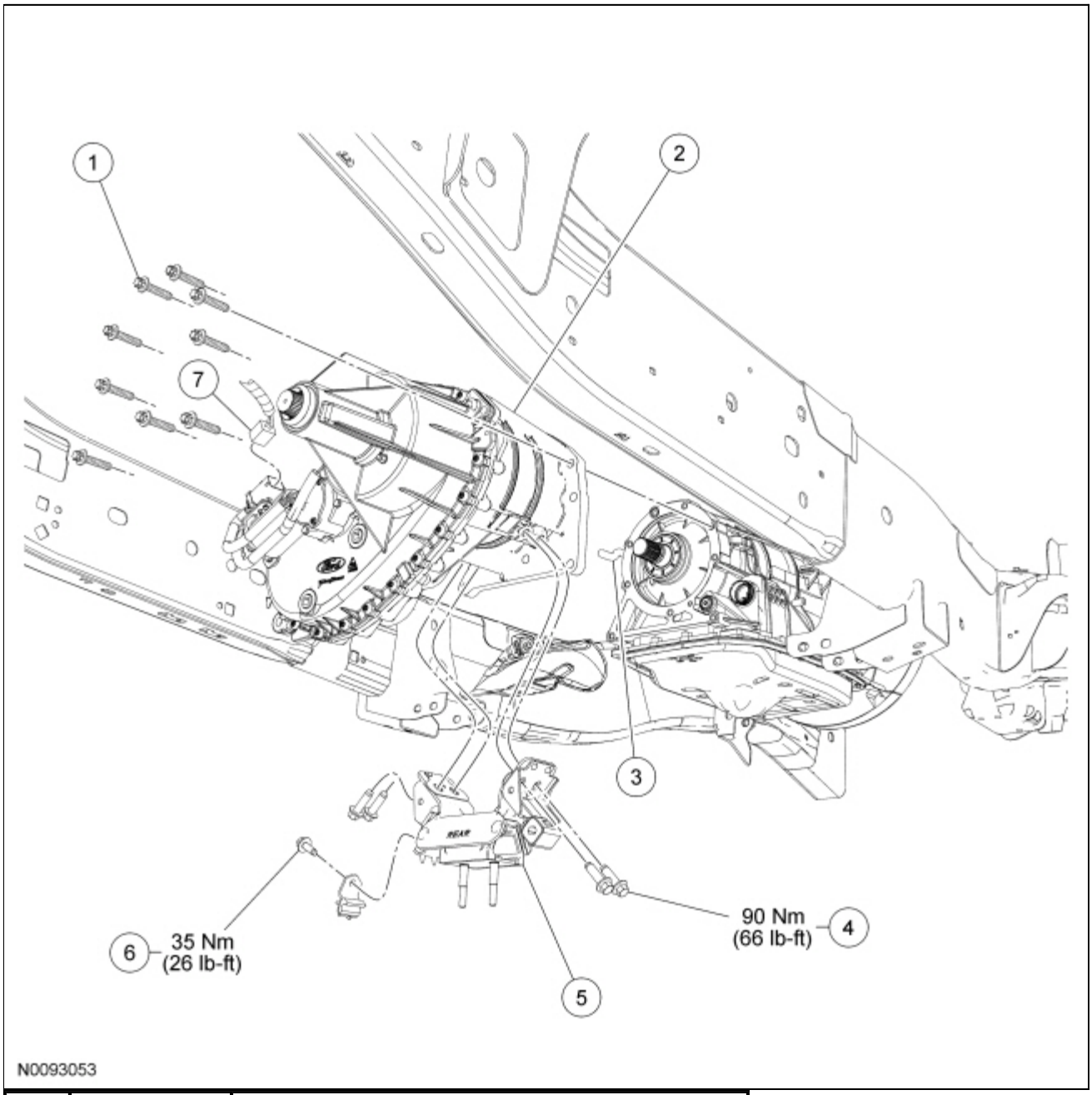
Transfer Case — Left Side



Item	Part Number	Description
1	637077	Transmission support crossmember bolt (4 required)
2	W707959-S	Heat shield bolt (2 required)
3	9740124	Transmission support crossmember

4	N621945-S	Transmission mount nut (2 required)
5	7E063	Skid plate
6	W503932-S	Skid plate bolt (4 required)

Transfer Case — Right Side



Item	Part Number	Description
1	7A443	Transfer case-to-transmission bolt (9 required)
2	7A195	Transfer case
3	7D494	Vent tube

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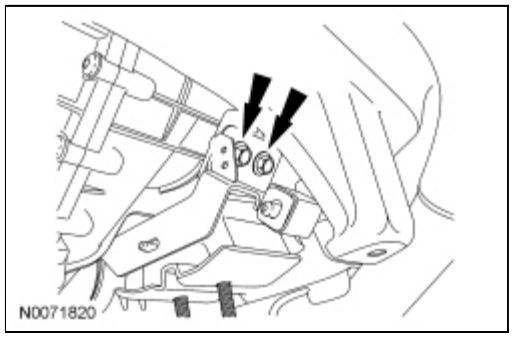
4	W713728-S	Transmission mount bolt (4 required)
5	6D091	Transmission mount
6	W709341-S	Exhaust support bracket bolt
7	14489	Shift motor electrical connector

1. Position the transfer case to the transmission and onto the output shaft. With the transfer case 25.4 mm (1 in) from the transmission, push the transfer case to the transmission.

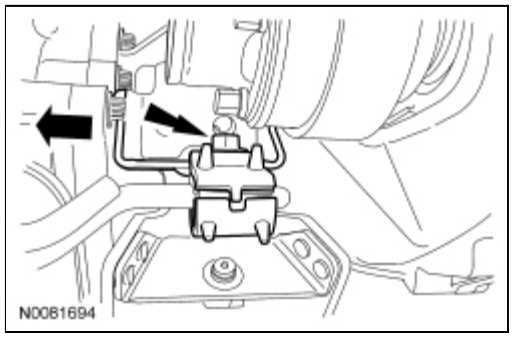
2. **NOTE:** Do not reuse the old transfer case-to-transmission bolts.

   Install 9 new transfer case-to-transmission bolts.
   - Tighten the bolts evenly in a cross pattern to 17 Nm (150 lb-in).

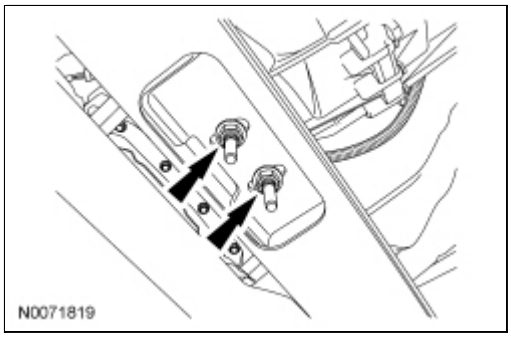
3. Install the transmission mount and the 4 transmission mount bolts.
   - Tighten to 90 Nm (66 lb-ft).



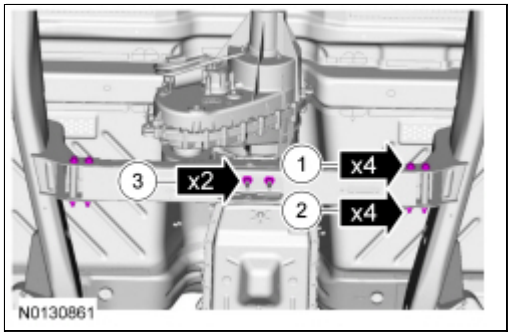
4. Install the LH exhaust support bracket and bolt.
   - Tighten to 35 Nm (26 lb-ft).



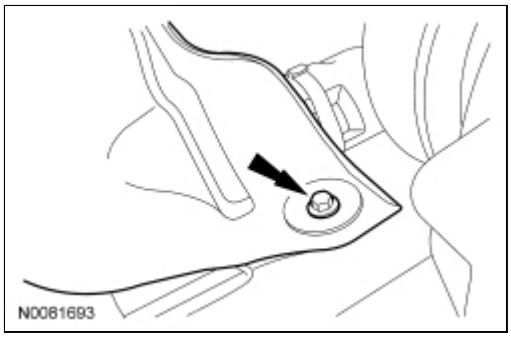
5. Position the transmission support crossmember and the 2 transmission mount nuts.
   - Do not tighten at this time.



6. Install the 4 new transmission support crossmember bolts and nuts, then tighten the transmission support crossmember and transmission mount nuts.
    1. Install the transmission support crossmember bolts.
        - Remove the transmission jack from under the transmission pan rail.
    2. Install the transmission support crossmember nuts and tighten to 90 Nm (66 lb-ft).
    3. Tighten the transmission mount nuts to 103 Nm (76 lb-ft).

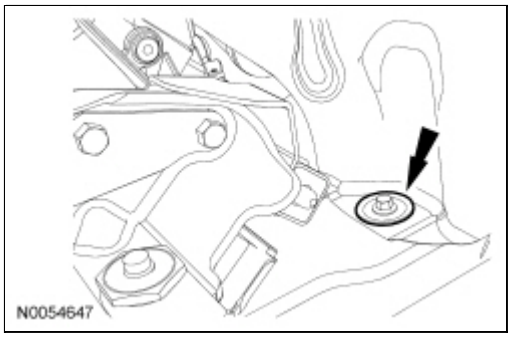


7. Install the LH exhaust heat shield bolt to the transmission support crossmember.
    - Tighten to 15 Nm (133 lb-in).

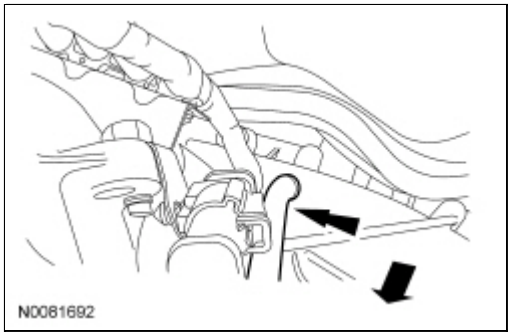


8. Install the RH exhaust heat shield bolt to the transmission support crossmember.
    - Tighten to 15 Nm (133 lb-in).

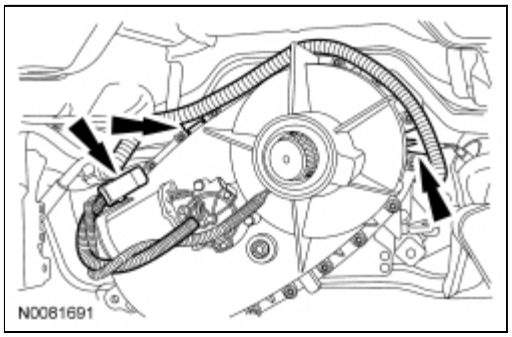
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9. Connect the vent hose to the transfer case.



10. Connect the shift motor electrical connector and attach the 2 harness retainer clips to the transfer case.



11. **NOTE:** Align the index marks made during removal.

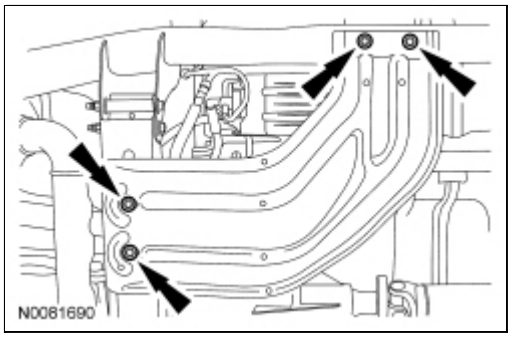
    Install the rear driveshaft. Refer to Section 205-01 .

12. **NOTE:** Align the index marks made during removal.

    Install the front driveshaft. Refer to Section 205-01 .

13. Fill the transfer case. Refer to Transfer Case Draining and Filling .

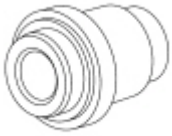
14. If equipped, position the skid plate and install the 4 skid plate bolts.
    - Tighten to 40 Nm (30 lb-ft).

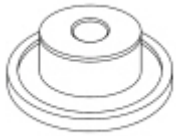
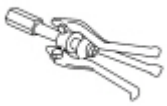


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Transfer Case — 2-Speed Torque-On-Demand

Special Tool(s)

 ST1255-A	Handle 205-D055 (D81L-4000-A) or equivalent
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1786-A	Installer, Front Axle Oil Seal 205-350 (T95T-3010-A)
 ST1789-A	Installer, Input Shaft Bearing 308-085 (T83T-7025-C)
 ST2305-A	Installer, Input Shaft Oil Seal 308-186 (T90T-7127-B)
 ST2261-A	Installer, Input Shaft Oil Seal 308-249 (T96T-7127-A)
	Installer, Mainshaft Bearing 308-060 (T77J-7025-K)

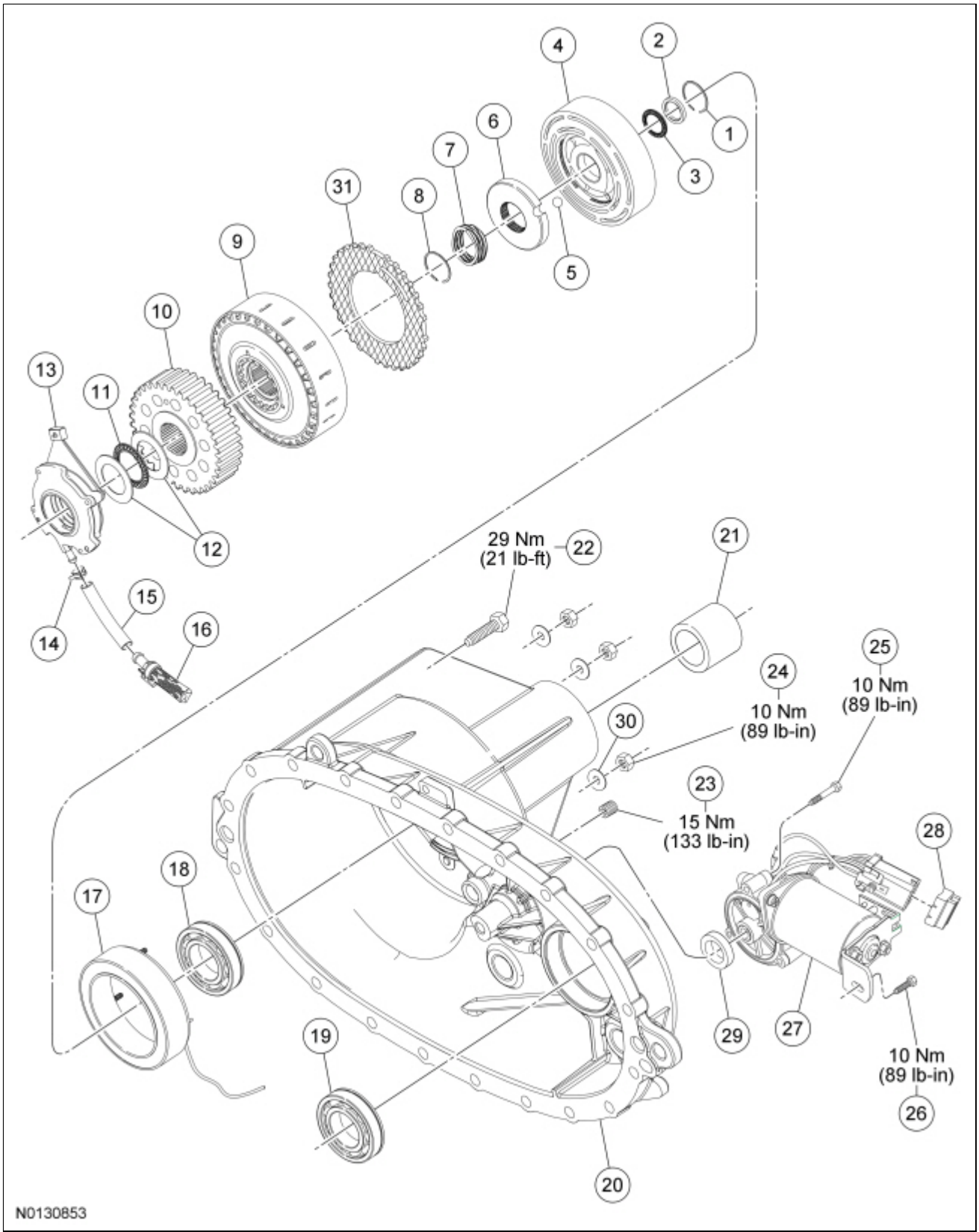
 ST1788-A	
 ST2239-A	Installer, Output Shaft Front Bearing 308-410
 ST1466-A	Installer, Valve Stem Oil Seal 303-367 (T90P-6510-AH)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	—

2-Speed Transfer Case — Rear Half

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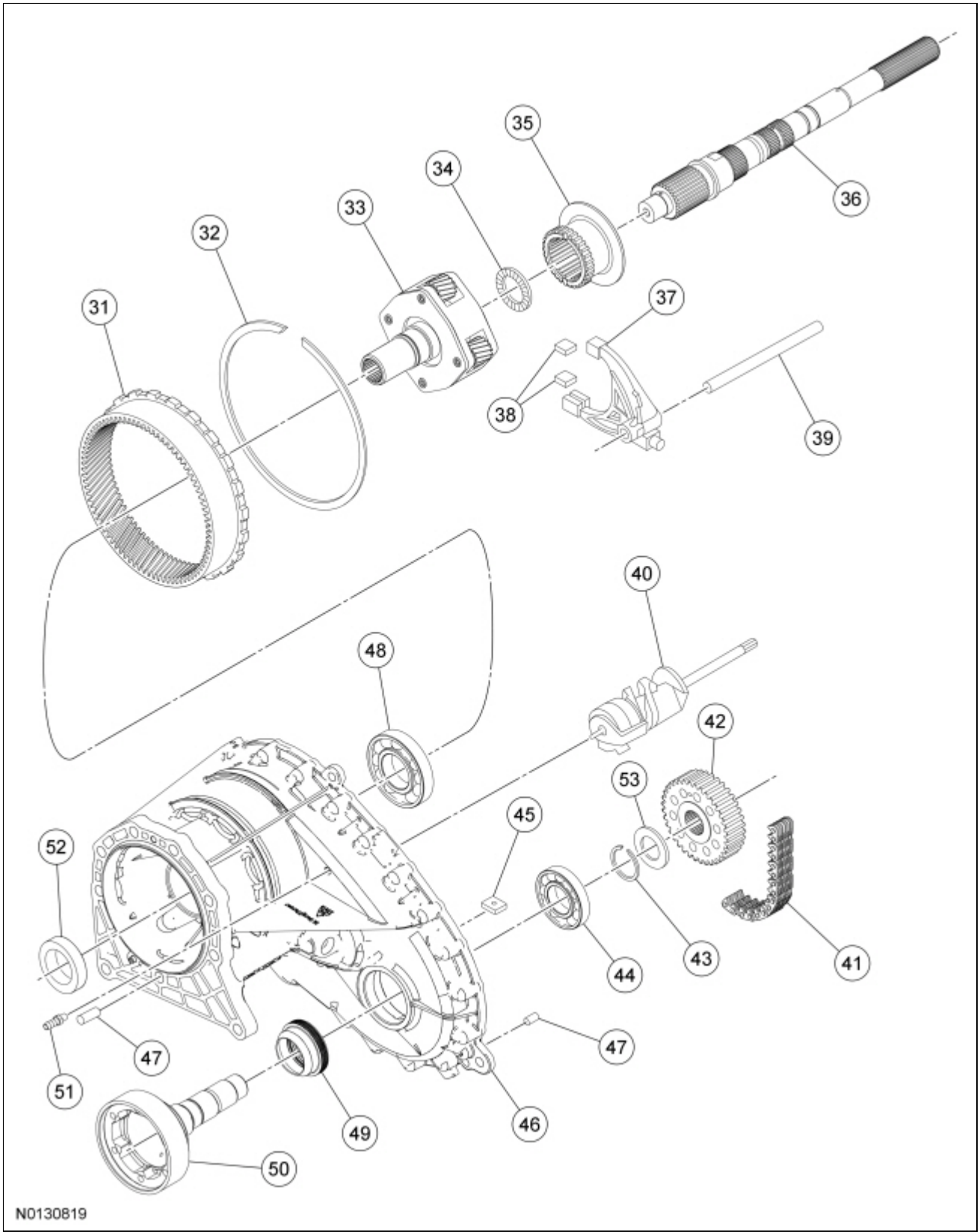


Item	Part Number	Description
1	7917	Snap ring
2	7N063	Spacer

3	7D221	Caged thrust bearing
4	7G362	Hub and coil housing
5	7A534	Ball (3 required)
6	7R428	Cam
7	7D126	Wave spring
8	7917	Snap ring
9	7C108	Clutch assembly
10	7177	Drive sprocket
11	7D221	Caged thrust bearing
12	7C341	Thrust washer (2 required)
13	7A149	Oil pump assembly
14	7H298	Hose clamp
15	4090	Oil pump pickup hose
16	7A098	Oil pickup and filter
17	7G361	Transfer case field coil
18	7025	Rear output shaft support bearing
19	7025	Front output shaft rear bearing
20	7005	Case
21	—	Output shaft bushing (part of 7005)
22	7A443	Transfer case bolts (20 required)
23	7A010	Fill plug
24	7045	Coil nut (3 required)
25	N800670-S	Shift motor bolt (3 required)
26	7A443C	Shift motor bracket bolt
27	7G360	Transfer case shift motor
28	7H298	Inner connector retainer
29	7B215	Shift motor seal
30	7B368	Washer (3 required)
31	7H150	Armature

2-Speed Transfer Case — Front Half

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Item	Part Number	Description
31	7A153	Ring gear
32	7064	Snap ring

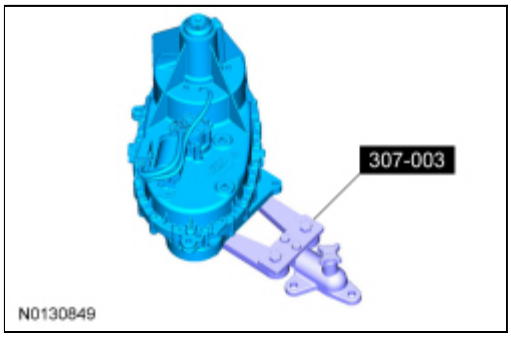
33	7A398	Front planet carrier
34	7D221	Front planet needle bearing
35	7D164	Reduction hub
36	7061	Output shaft
37	7389	Shift fork
38	7C430	Shift fork pad (2 required)
39	7240	Shift fork shaft
40	7F063	Shift cam assembly
41	7A029	Drive chain
42	7177	Driven sprocket
43	7917	Snap ring
44	7025	Front output shaft support bearing
45	7E290	Magnet
46	7005	Case
47	7B362	Dowel
48	7025	Front input shaft support bearing
49	7B215	Front output shaft oil seal
50	7061	Front output shaft
51	7034	Vent tube
52	7B215	Front input shaft seal
53	7N063	Driven sprocket spacer

Disassembly

1. ***NOTICE:*** **Seal all openings before cleaning the transfer case exterior. This will prevent entry of dirt and water, which may cause damage to internal components.**

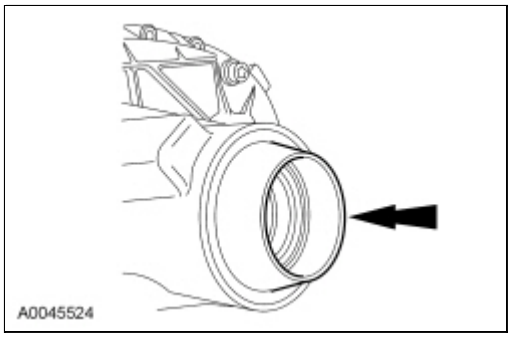
   Clean the transfer case exterior with solvent and dry with compressed air.

2. Using the Transmission Holding Fixture, secure the transfer case to a work bench. Rotate the transfer case so that the output shaft is pointing upward.

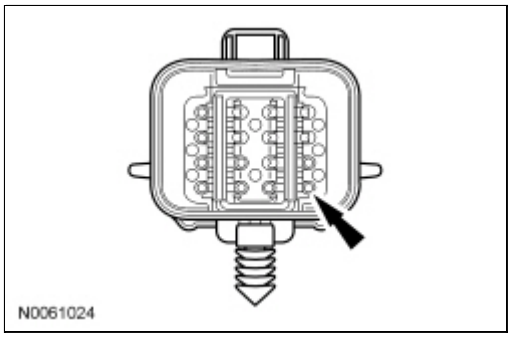


3. Remove and discard the rear output shaft seal.

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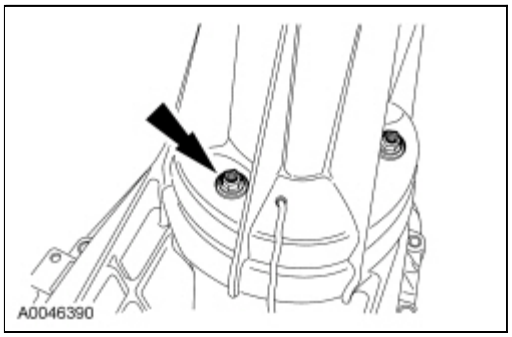
4. Remove the coil wire pin from the electrical connector.
    - Remove the wire connector inner retainer.
    - Press the release tab and remove the coil wire pin (tan wire).



5. Loosen the 2 transfer case shift motor bracket nuts and remove the bracket bolt.

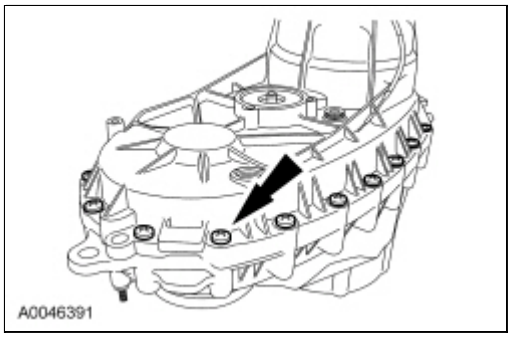
6. Remove the 3 transfer case shift motor bolts and transfer case shift motor.

7. Remove the 3 coil nuts and washers.

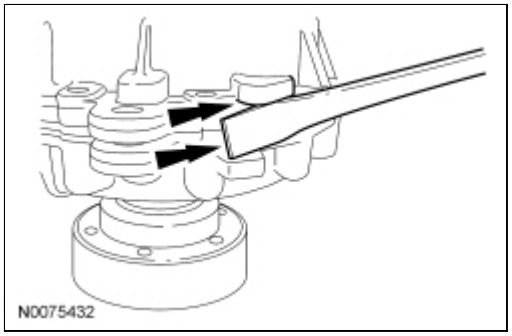


8. **NOTE:** It is normal to find metal shavings after removing the self-tapping transfer case bolts.

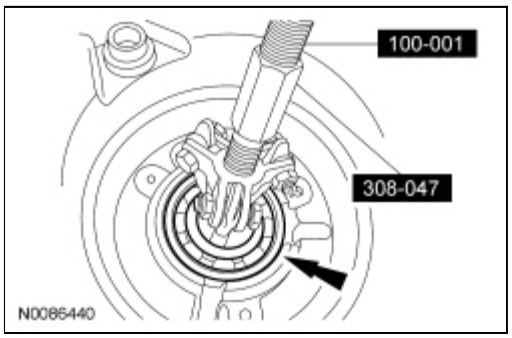
   Remove the 20 transfer case cover bolts.



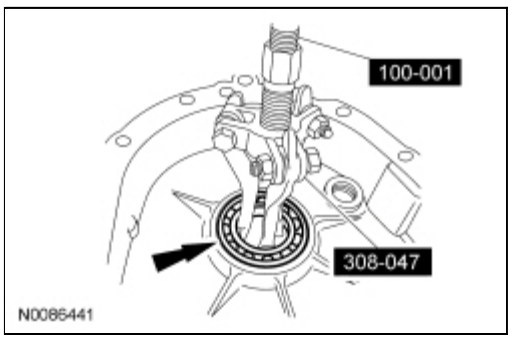
9. Using the pry bosses, separate the transfer case halves.



10. Using the Bearing Cup Remover and the Slide Hammer, remove the rear output shaft support bearing.
    - Inspect the bearing for wear or damage. Install a new bearing as necessary.



11. Using the Bearing Cup Remover and the Slide Hammer, remove the front output shaft rear bearing.
    - Inspect the bearing for wear or damage. Install a new bearing as necessary.

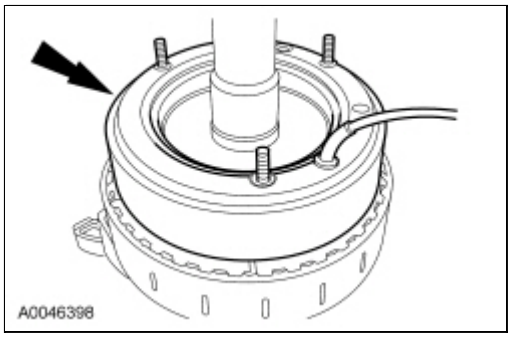


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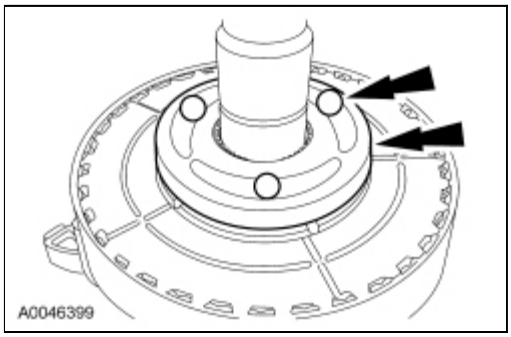
12. Remove the snap ring.
    - Inspect the snap ring for wear or damage. Install a new snap ring as necessary.

13. Remove the caged thrust bearing assembly.
    - Inspect the bearing for wear or damage. Install a new bearing as necessary.

14. Remove the cam/coil housing.

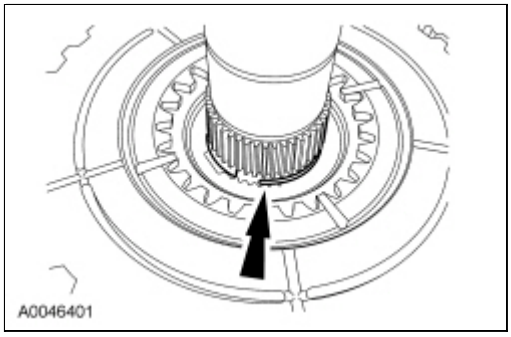


15. Remove the steel balls and the cam.



16. Remove the wave spring.

17. Remove and discard the snap ring.

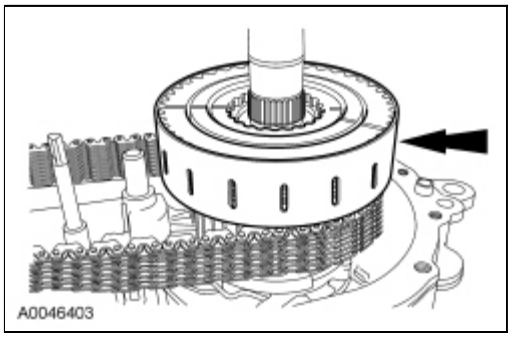


18. ***NOTICE:*** **When removing the clutch pack assembly, do not separate the clutch pack assembly. Keep tension on the clutch pack during removal. Set the clutch pack assembly on the bench in the same position as located in the transfer case. The thrust washer in the lower clutch pack uses tabs to hold it in place. If the thrust washer is not in place, a transfer case clearance problem will occur.**

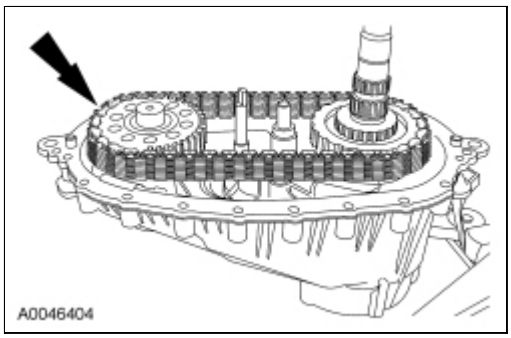
    NOTICE: **If the clutch pack is disassembled, a new clutch pack must be installed and the**

armature transferred. Failure to install a new clutch pack can result in component failure.

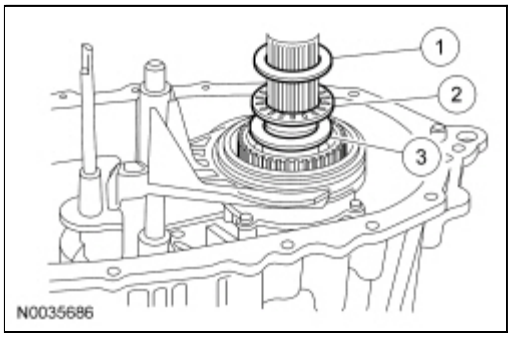
Remove the clutch pack assembly with the armature.



19. Remove the drive chain and the sprockets as an assembly.
    - Inspect the drive chain for wear or damage. Inspect the sprockets for broken or cracked teeth. Install new components as necessary.

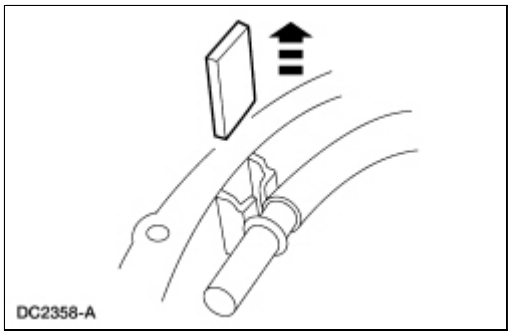


20. Remove the thrust bearing assembly.
    1. Remove the thrust washer.
        - The upper thrust washer may be attached to the sprocket.
    2. Remove the thrust bearing.
    3. Remove the thrust washer.
    - Inspect the washers and bearing for wear or damage. Install new components as necessary.

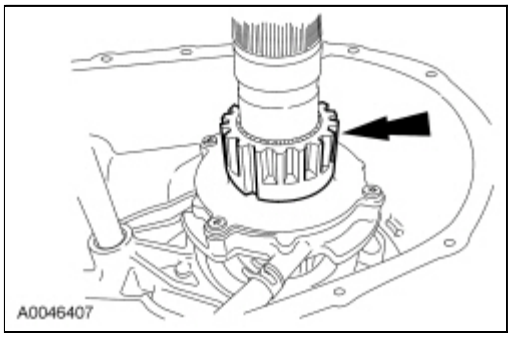


21. Remove and clean the oil pan magnet.

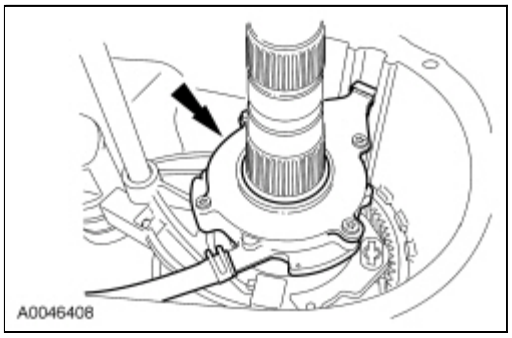
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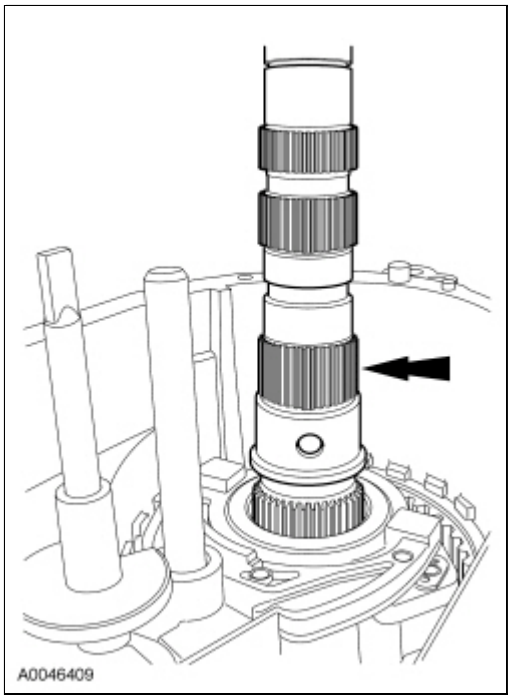
22. Remove the output shaft sprocket.



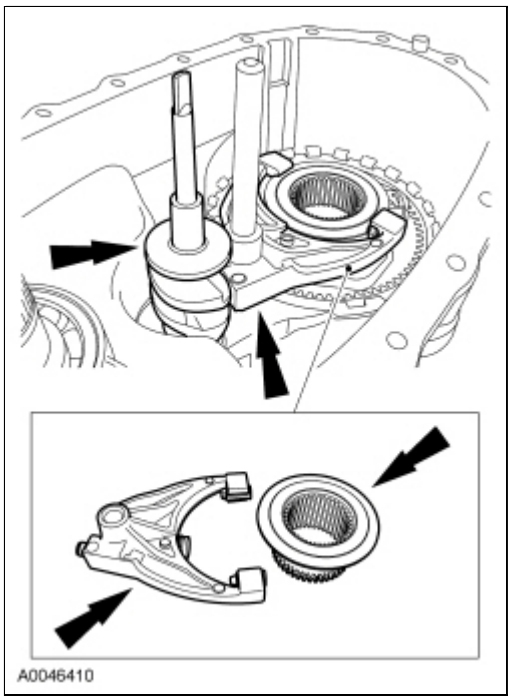
23. Remove the oil pump assembly.



24. Remove the output shaft.

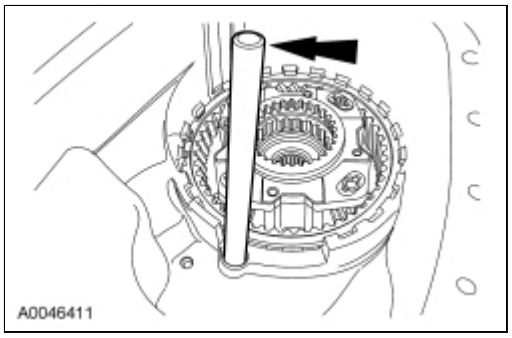


25. Remove the reduction shift fork, the reduction hub and the shift cam as an assembly.
    - Separate and inspect the reduction hub and the reduction shift fork for wear or damage. Do not disassemble the shift cam assembly.

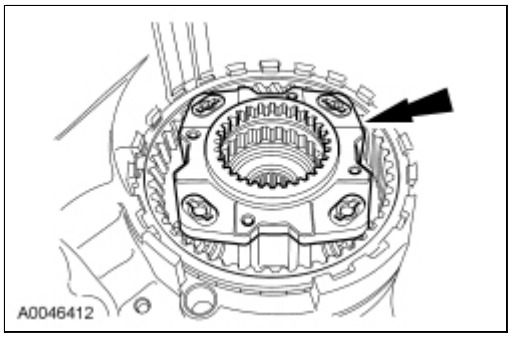


26. Remove the shift fork shaft.

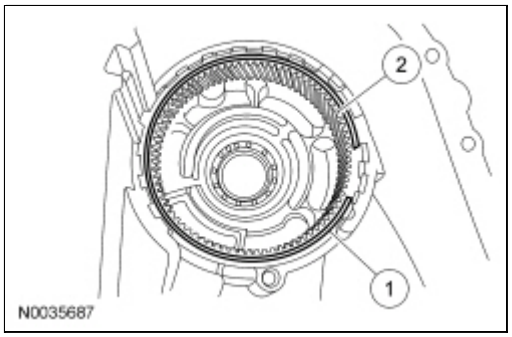
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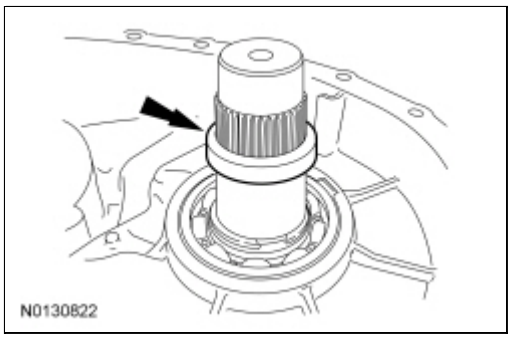
27. Remove the front planet.
    - Remove the front planet needle bearing, if necessary.



28. Remove the ring gear.
    1. Remove the snap ring.
        - Inspect the snap ring for wear or damage. Install a new snap ring as necessary.
    2. Remove the ring gear.

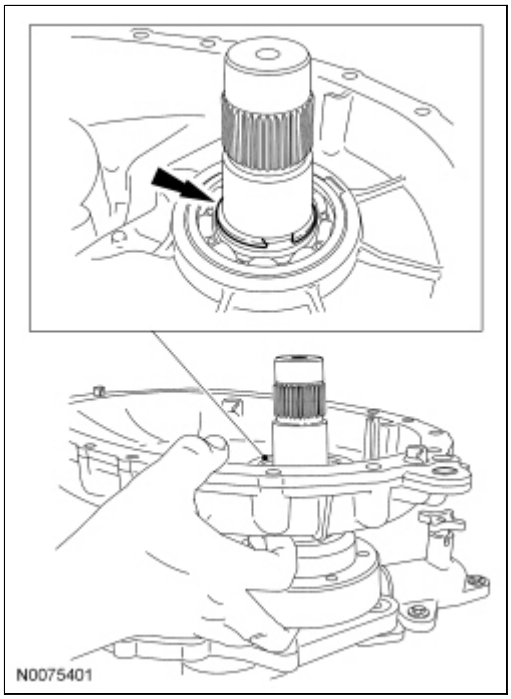


29. Remove the driven sprocket spacer.



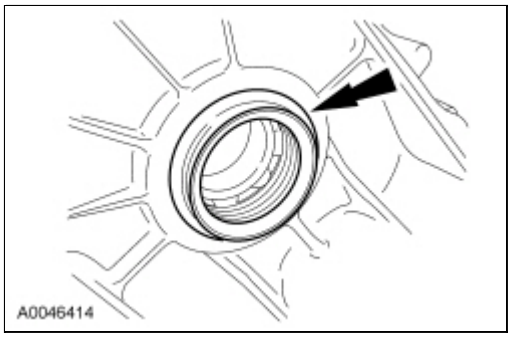
30. **NOTE:** Do not let the front output shaft fall when removing the snap ring.

    Remove the snap ring and the front output shaft.
    - Inspect the snap ring for wear or damage. Install a new snap ring as necessary.



31. ***NOTICE:*** **Carefully remove the seal, do not damage the seal bore.**

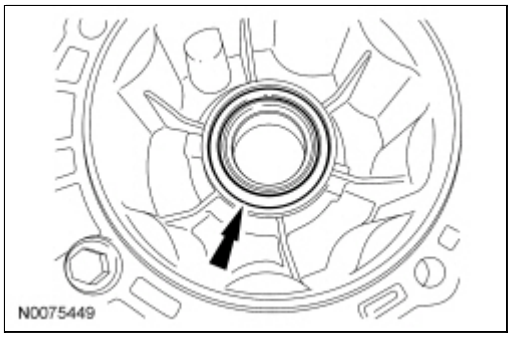
    Remove and discard the front output shaft oil seal.



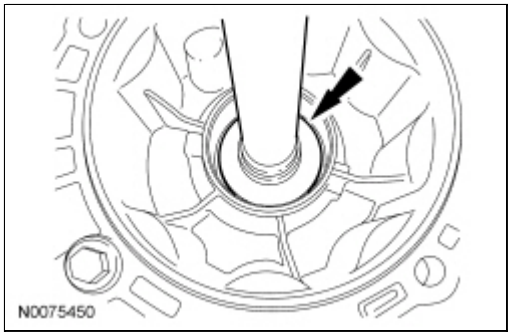
32. ***NOTICE:*** **Carefully remove the seal, do not damage the seal bore.**

    Remove and discard the front input shaft seal.

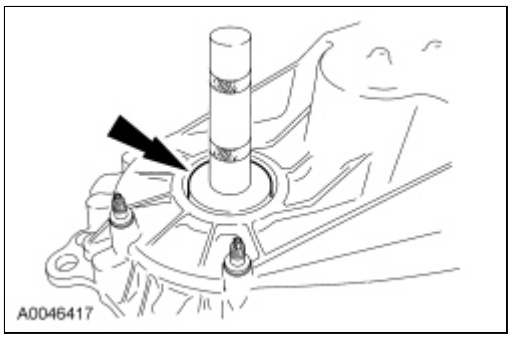
repair4less



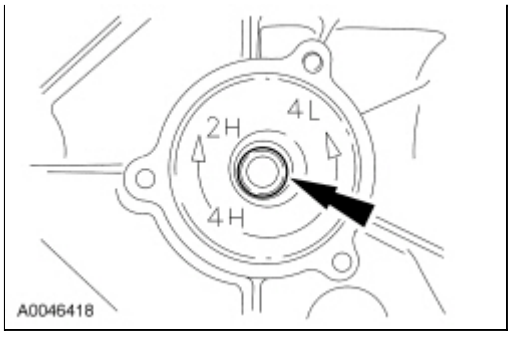
33. Remove the front planet support bearing.



34. Remove the front output shaft support bearing.
    - Inspect the bearing for wear or damage. Install a new bearing as necessary.



35. Remove and discard the shift shaft seal.

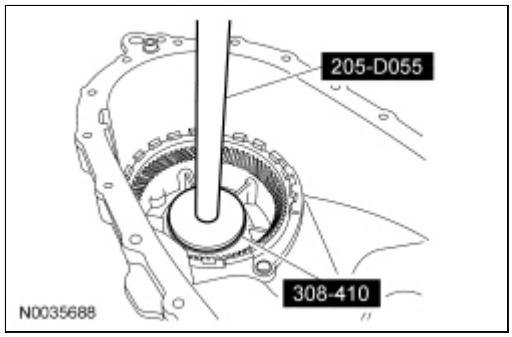


Assembly

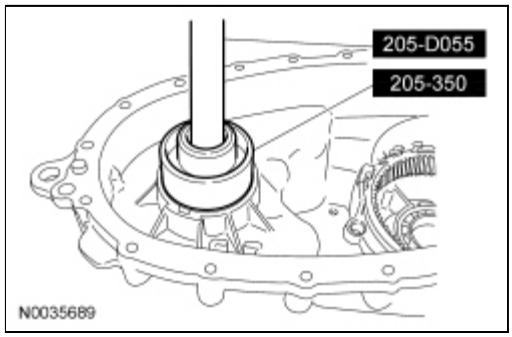
1. Lubricate all internal components with the recommended transfer case lubricant during reassembly.

2. Clean the mating surfaces of the cases.

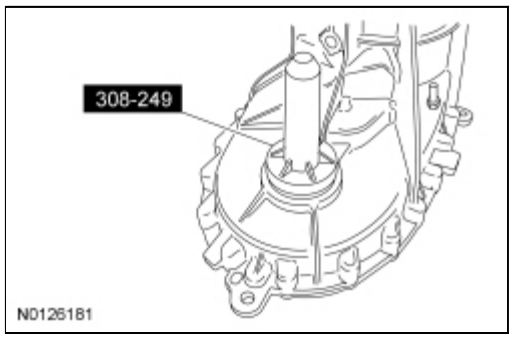
3. Using a press and the Output Shaft Front Bearing Installer with the Handle, install the front planet support bearing.



4. Using a press and the Front Axle Oil Seal Installer with the Handle, install the front output shaft support bearing.

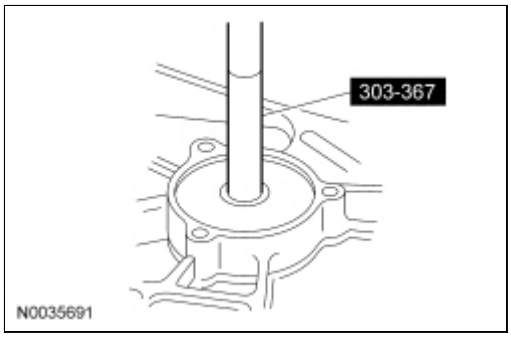


5. Using the Input Shaft Oil Seal Installer, install a new front output shaft seal.

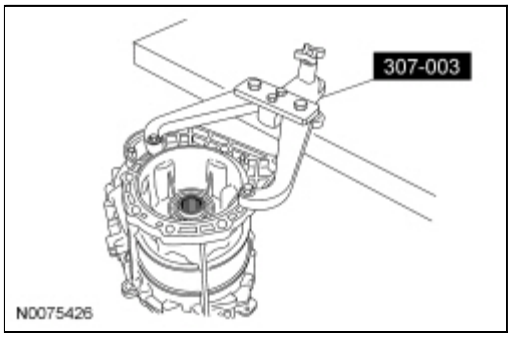


6. Using the Valve Stem Oil Seal Installer, install a new shift shaft seal.

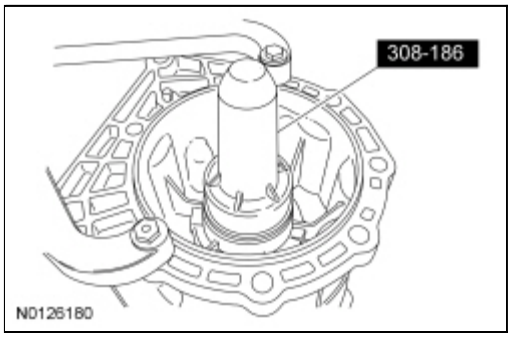
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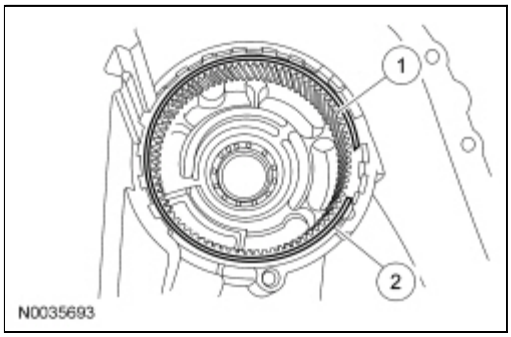
7. Install the case to the Transmission Holding Fixture. Secure the case and the Transmission Holding Fixture to the work bench.



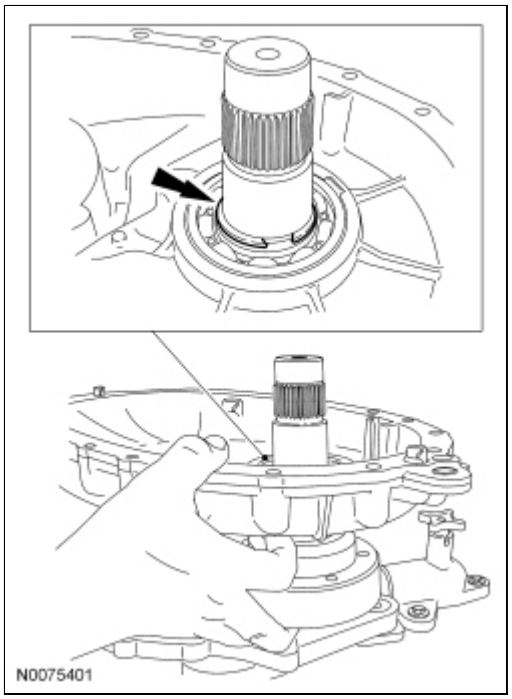
8. Using Input Shaft Oil Seal Installer, install a new front input shaft seal.



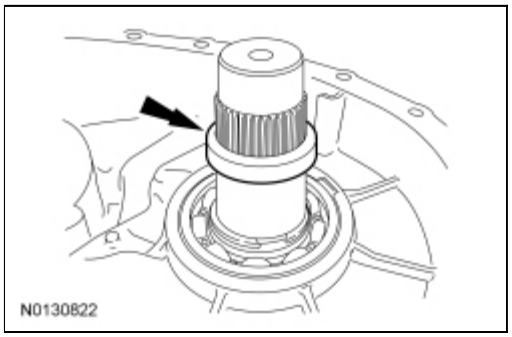
9. Install the ring gear.
    1. Position the ring gear in the case.
    2. Install the snap ring.



10. Install the front output shaft and the snap ring.

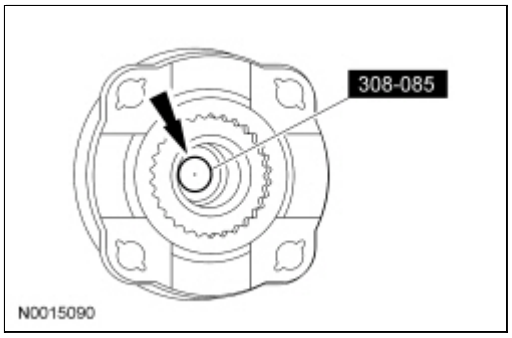


11. Install the driven sprocket spacer.



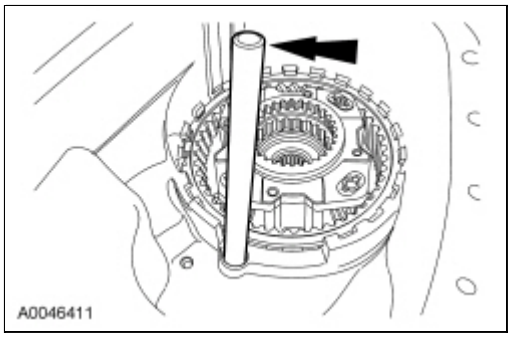
12. ***NOTICE:*** **If removed, using a press and the Input Shaft Bearing Installer, install the needle bearing into the front planet. Be careful not to damage the bearing cage.**

    Install the front planet.

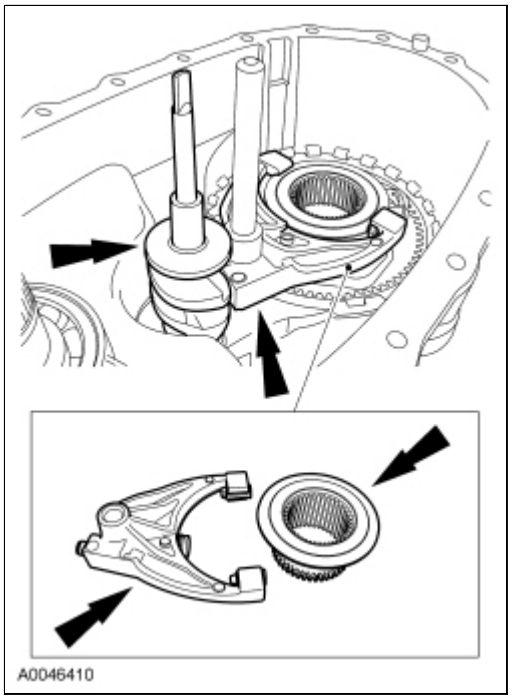


13. Install the shift fork shaft.

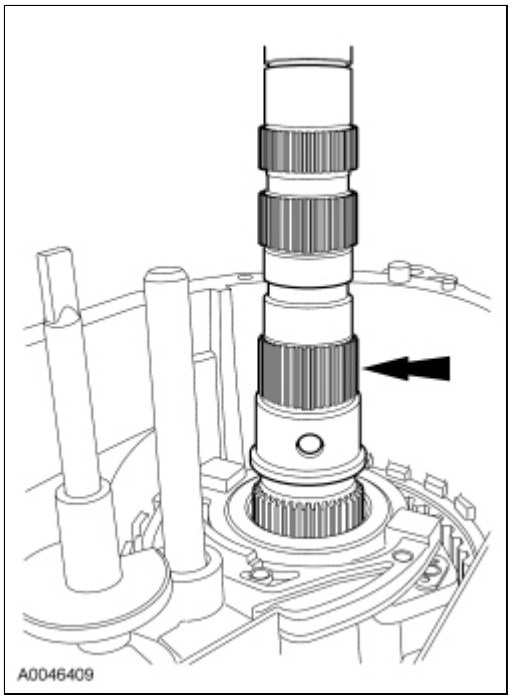
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14. Assemble the reduction hub and the reduction shift fork. Install the reduction shift fork, the reduction hub and the shift cam as an assembly.

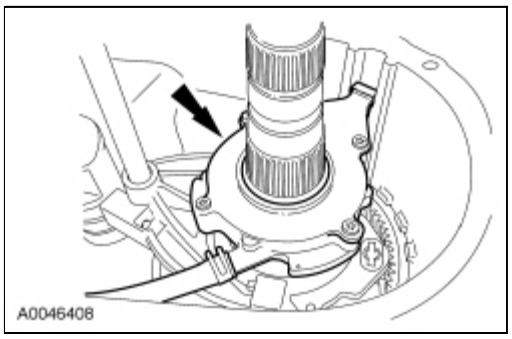


15. Install the output shaft.

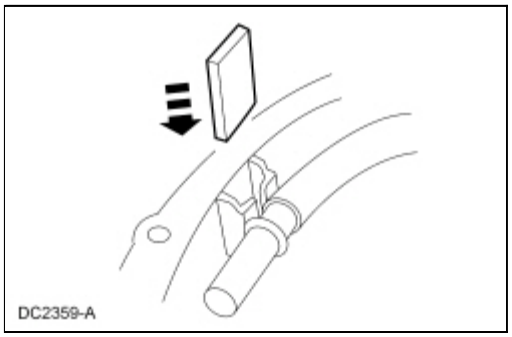


16. **NOTE:** Make sure the oil pump finger is in the slot in the case.

    Install the oil pump assembly.

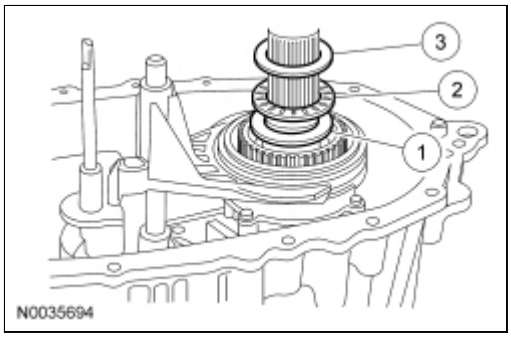


17. Install the oil pan magnet into the slot in the case.

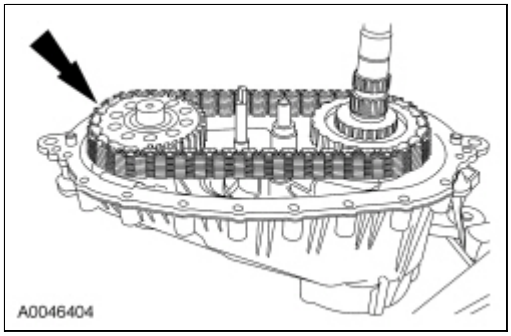


18. Install the 3-piece thrust bearing assembly.
    1. Install the thrust washer.
    2. Install the thrust bearing.
    3. Install the thrust washer.

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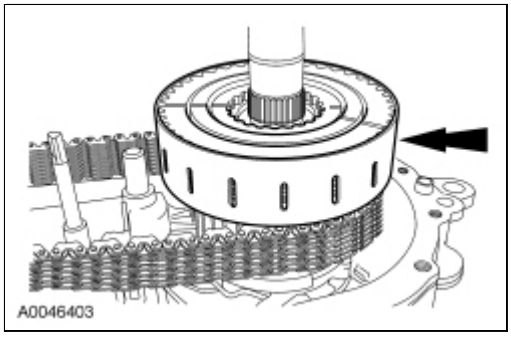
19. Install the drive chain and the sprockets as an assembly.



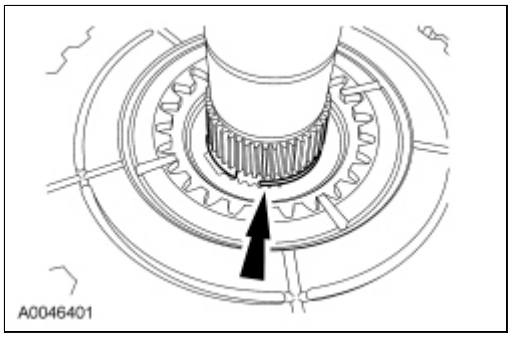
20. ***NOTICE:*** **When installing the clutch assembly, do not separate the clutch pack assembly. The thrust washer in the lower clutch pack uses tabs to hold it in place. If the thrust washer is not in place, a transfer case clearance problem will occur.**

    NOTICE: **If the clutch pack is disassembled, a new clutch pack must be installed and the armature transferred. Failure to install a new clutch pack can result in component failure.**

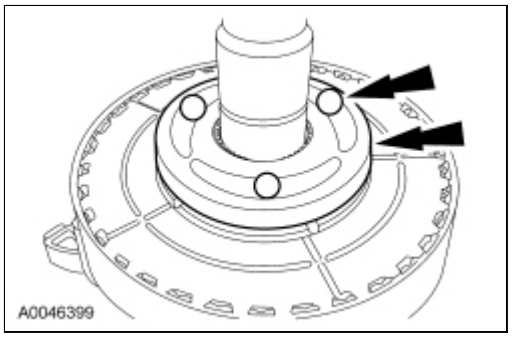
    Install the clutch pack assembly with the armature.



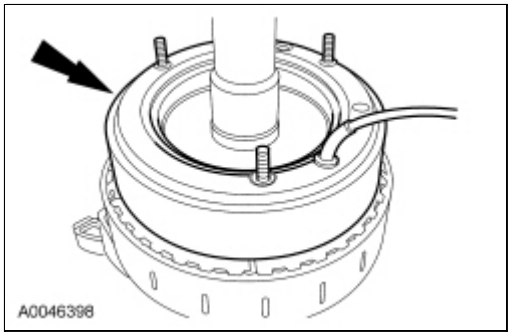
21. Install a new snap ring.



22. Install the wave spring.
23. Install the cam and the steel balls.

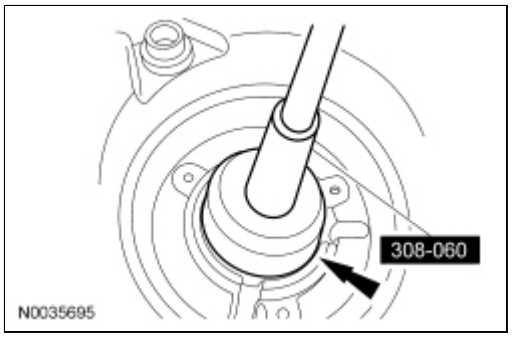


24. Install the cam/coil housing.

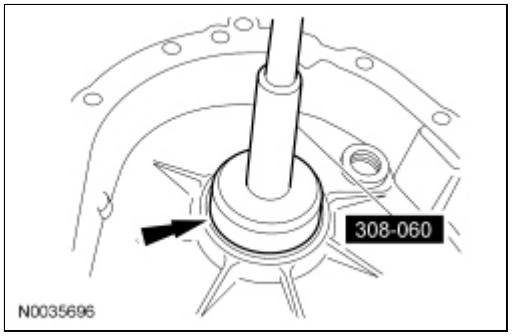


25. Install the thrust bearing assembly.
26. Install the snap ring.
27. Using a press and the Mainshaft Bearing Installer, install the rear output shaft support bearing.

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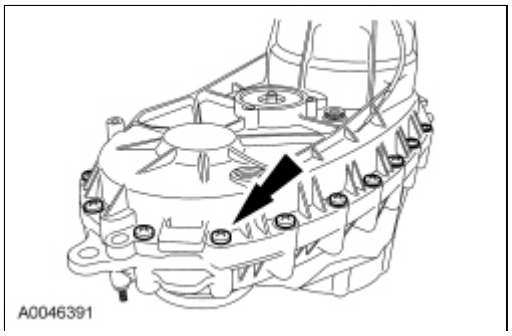


28. Using a press and the Mainshaft Bearing Installer, install the front output shaft rear bearing.



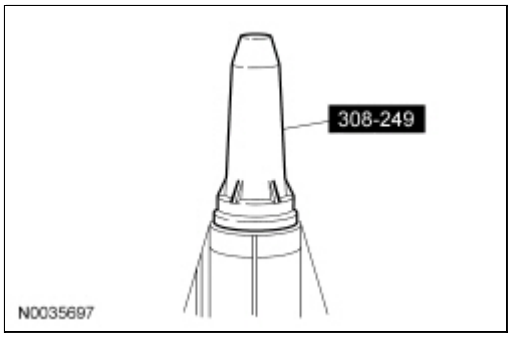
29. **NOTE:** Only apply enough silicone sealant to seal the transfer case halves together.

    Apply a bead of silicone sealant to the transfer case mating surface, then position the 2 transfer case halves together. Tighten the 20 transfer case bolts evenly in a star pattern.
    - Position the coil studs through the case holes, making sure the shift cam shaft is aligned with its case bore and the lockup shift fork spring is in position.
    - Tighten to 29 Nm (21 lb-ft).



30. Install the 3 coil washers and nuts.
    - Tighten to 10 Nm (89 lb-in).

31. Using the Input Shaft Oil Seal Installer, install the rear output shaft seal.



32. Apply a small bead of silicone sealant to the transfer case shift motor mating surface.

NOTICE: **When installing the shift motor, tighten the bracket nuts last. Failure to follow the steps in the correct order may result in damage to the component.**

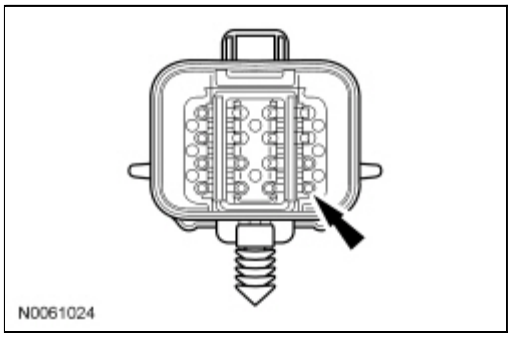
33. Install the transfer case shift motor and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

34. Install the transfer case shift motor bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

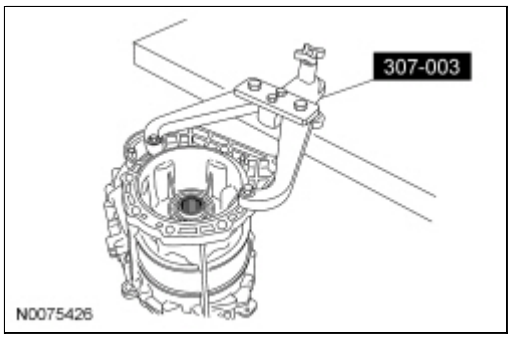
35. Secure the transfer case shift motor bracket nuts.

36. **NOTE:** After the wire is inserted into the connector, gently pull the wire back to verify the pin is locked inside the connector.

    Insert the coil wire pin in the electrical connector and install the inner connector retainer.



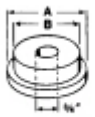
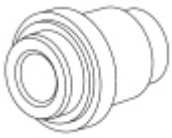
37. Secure the transfer case to a transmission jack and remove the transfer case from the Transmission Holding Fixture.



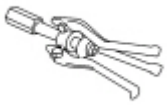
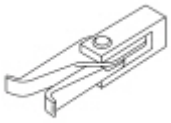
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Transfer Case — Electronic Shift

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1471-A	Installer, Bearing Cup 308-017 (T73T-4222-B)
 ST1789-A	Installer, Input Shaft Bearing 308-085 (T83T-7025-C)
 ST2305-A	Installer, Input Shaft Oil Seal 308-186 (T90T-7127-B)
 ST2261-A	Installer, Input Shaft Oil Seal 308-249 (T96T-7127-A)
	Installer, Mainshaft Bearing 308-060 (T77J-7025-K)

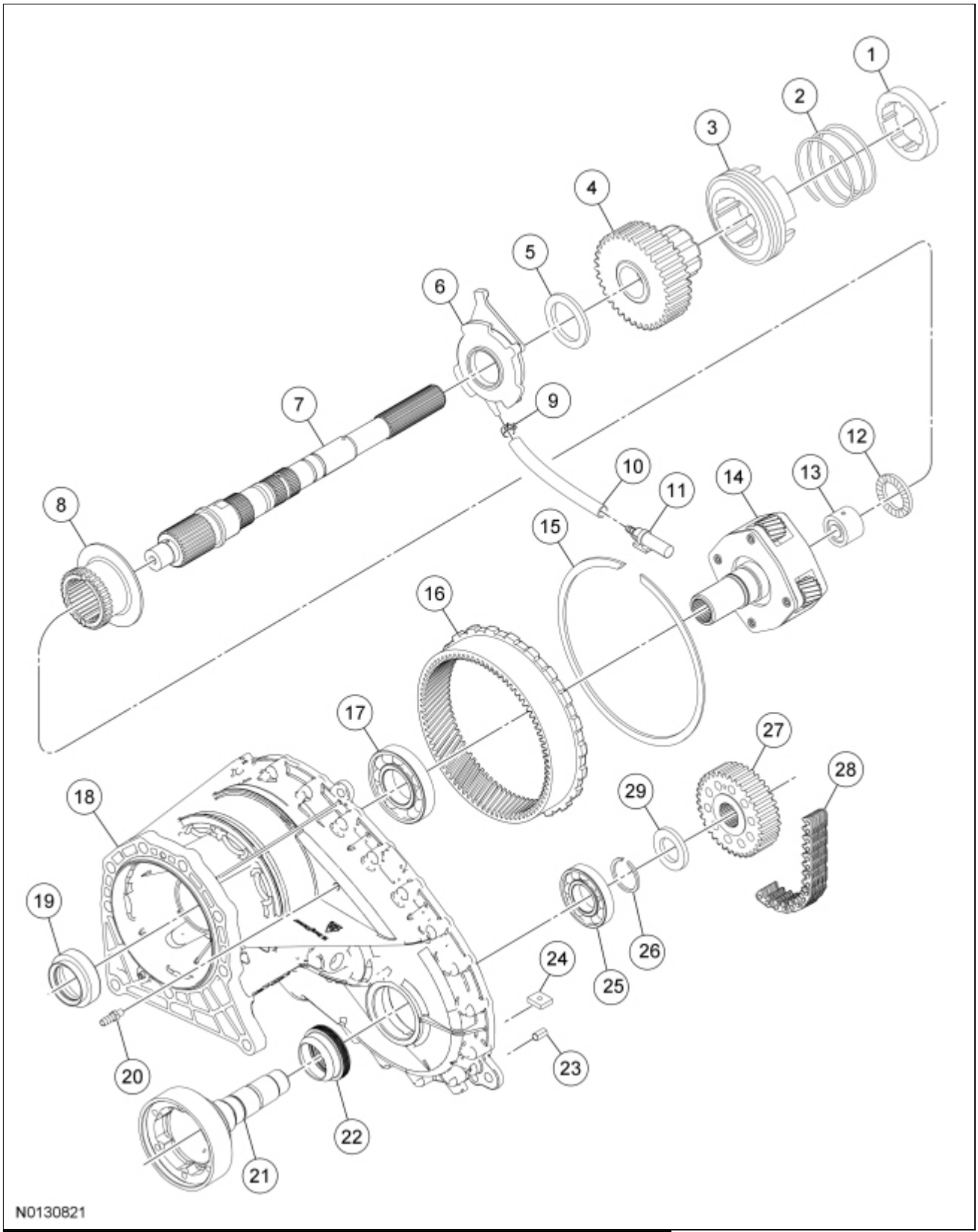
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 ST1788-A	
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST1362-A	Remover, Stator Bearing 307-318 (T94P-77001-KH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Ultra Silicone Sealant TA-29	—

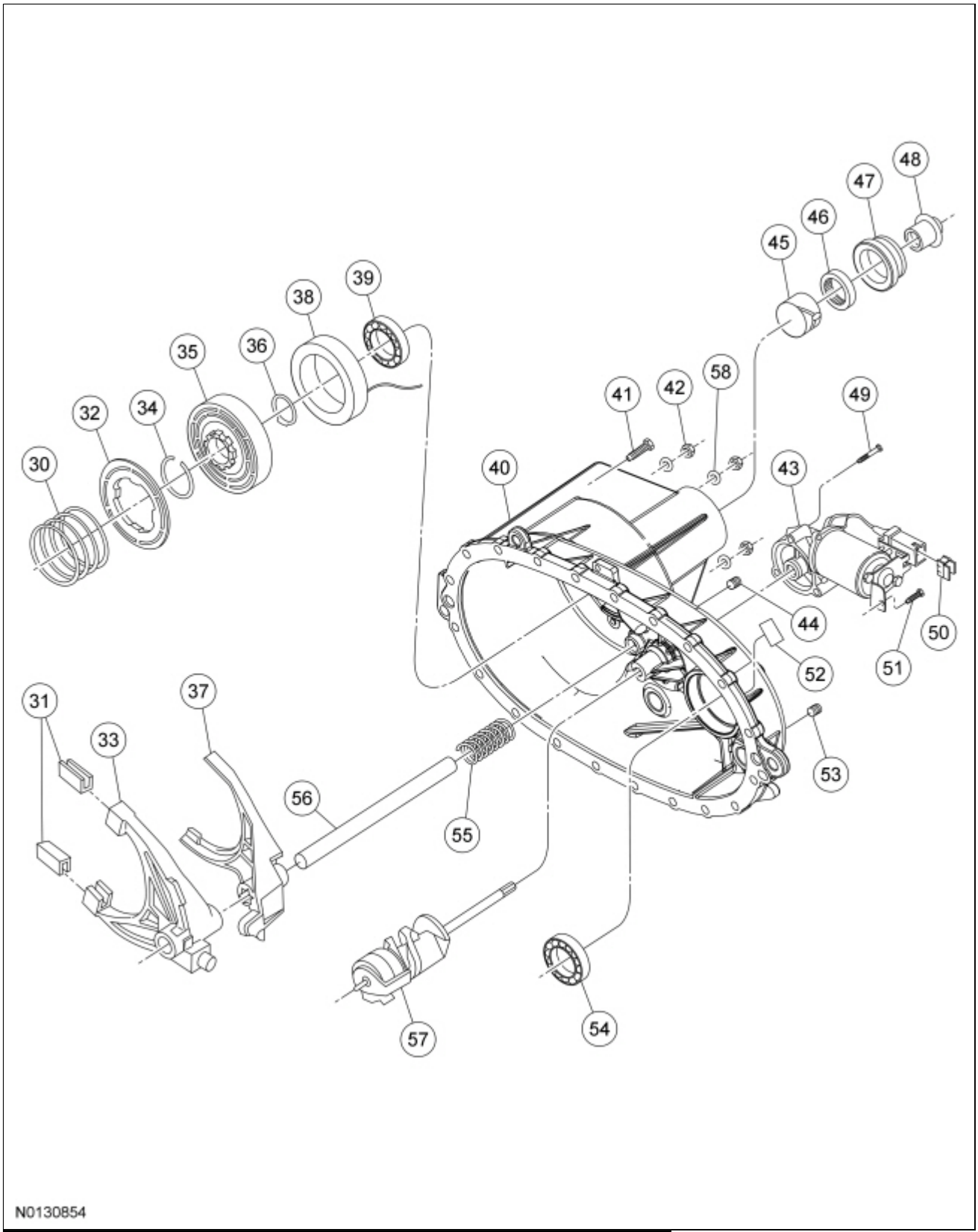
Transfer Case Exploded View — Electronic Shift



Item	Part Number	Description
1	7D164	Lockup hub
2	7D126	Spring

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3	7106	Lockup collar
4	7177	Drive sprocket
5	7Z112	Thrust washer
6	7A149	Oil pump assembly
7	7061	Output shaft
8	7100	Reduction hub
9	—	Hose clamp
10	9324	Hose
11	7A098	Lube pickup and filter
12	7D221	Thrust bearing
13	7120	Needle bearing
14	7A398	Front planet carrier
15	7064	Snap ring
16	7A153	Ring gear
17	7025	Bearing
18	7005	Case
19	7B215	Input flange seal
20	7034	Vent tube
21	7061	Front output shaft
22	7B215	Front output shaft seal
23	—	Dowel (part of 7005)
24	7E290	Magnet
25	7025	Bearing
26	7917	Snap ring
27	7177	Driven sprocket
28	7A029	Drive chain assembly
29	7N063	Driven sprocket spacer



Item	Part Number	Description
30	7F135	Spring
31	7C430	Shift fork pads

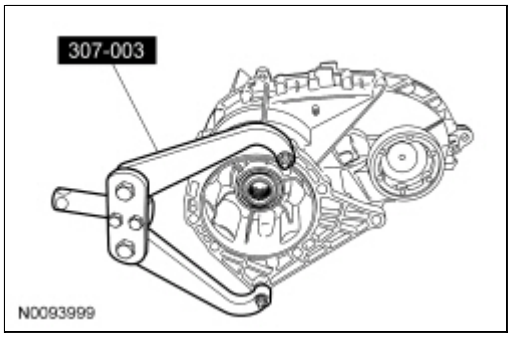
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32	7H150	Armature
33	7289	Reduction shift fork assembly
34	7917	Snap ring
35	7G362	Hub and coil housing
36	7917	Snap ring
37	7289	Lockup fork
38	7G361	Transfer case field coil
39	7025	Bearing
40	7005	Case
41	7A443	Bolt
42	N62048C-S2	Nut
43	7G360	Transfer case shift motor
44	7A010	Case plug
45	—	Bushing (part of 7005)
46	—	Sealing ring (part of 7005)
47	7B215	Rear output shaft seal
48	7F293	Shipping plug
49	N800670-S	Bolt
50	—	Wire connector spacer (part of 7G360)
51	7A443	Bolt
52	—	Bar code label (part of 7005)
53	7A010	Case plug
54	7025	Bearing
55	7219	Lockup fork spring
56	7240	Shift rail
57	7F063	Shift cam assembly
58	7B368	Coil nut washer

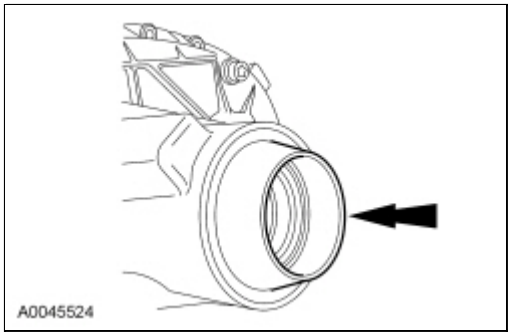
Disassembly

NOTE: Discard all seals after removing them.

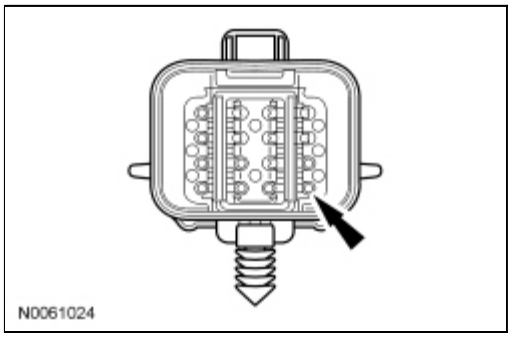
1. Clean the transfer case with solvent and dry with compressed air.
2. Using the Transmission Holding Fixture, secure the transfer case to the bench.



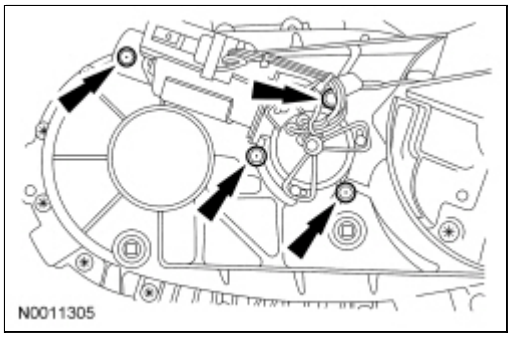
3. Remove the rear output shaft seal.



4. Remove the inner connector retainer. Press the release tab and remove the coil wire from the electric shift motor electrical connector.



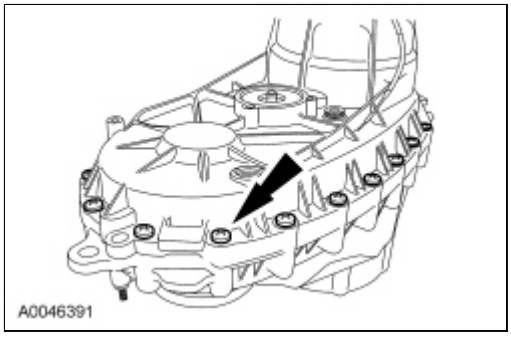
5. Remove the 3 transfer case shift motor bolts, bracket bolt and loosen the 2 bracket nuts.



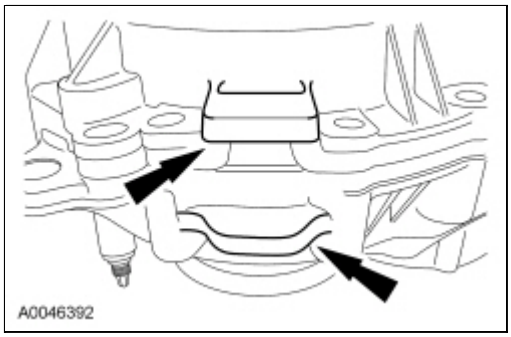
6. **NOTE:** The transfer case bolts are self tapping, and it is normal to find metal shavings while removing the cover.

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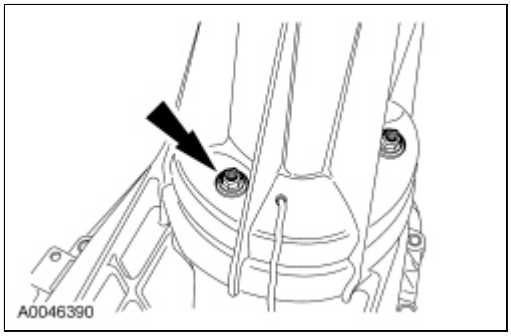
Remove the 20 transfer case bolts.



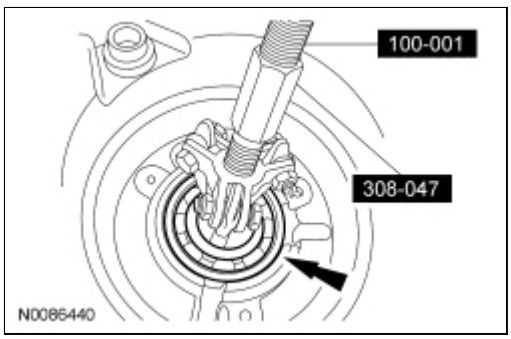
7. Using the pry bosses, separate the transfer case covers.



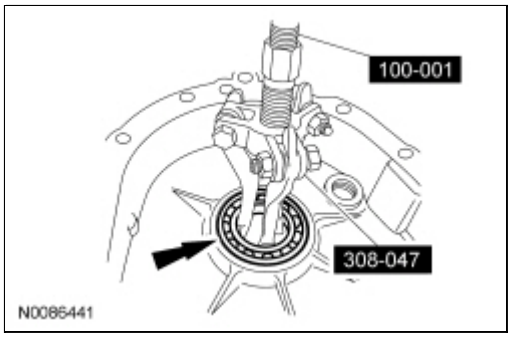
8. Remove the 3 transfer case field coil nuts, washers and transfer case field coil.



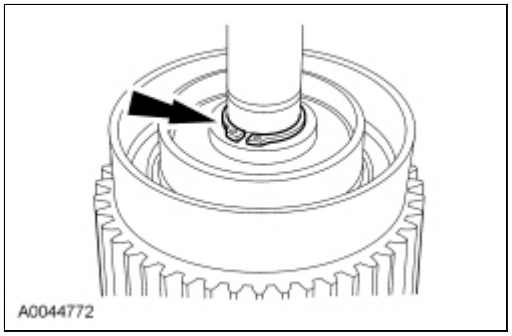
9. Using the Bearing Cup Remover with the Slide Hammer, remove the rear output shaft bearing.



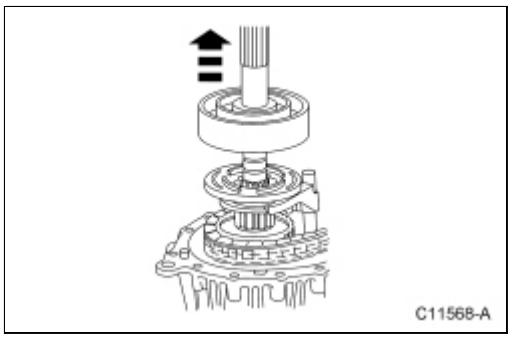
10. Using the Bearing Cup Remover with the Slide Hammer, remove the front output shaft bearing.



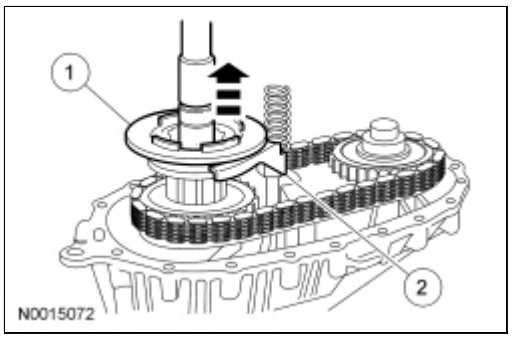
11. Remove the shift collar hub snap ring.



12. Remove the coil housing.



13. Remove the shift fork.
    1. Remove the lockup hub.
    2. Remove the shift fork and spring.

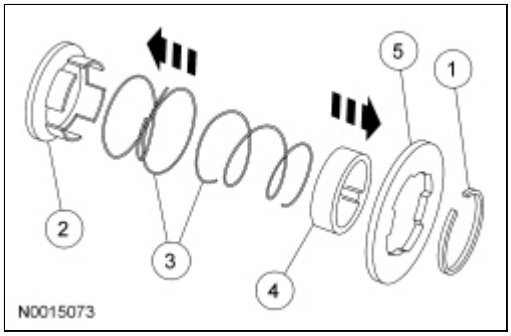


14. **NOTE:** Remove the lockup hub assembly as a single unit. If disassembly is required, proceed with the following.

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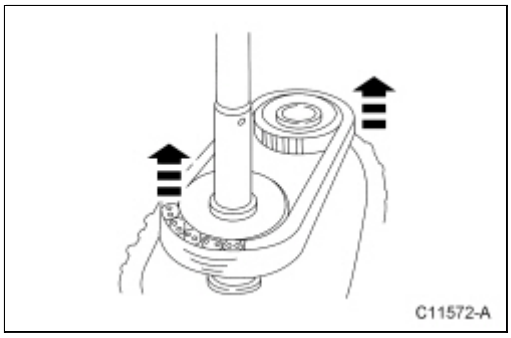
Disassemble the lockup hub assembly.

1. Remove the lockup hub snap ring.
2. Separate the lockup collar.
3. Separate the 2 lockup springs.
4. Separate the lockup hub.
5. Remove the armature.

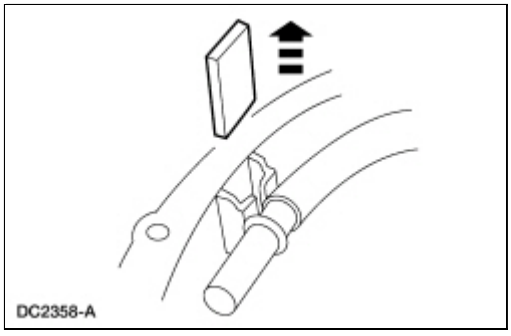


15. **NOTE:** Remove the drive chain and sprockets as an assembly.

    Remove the drive chain, sprockets and the thrust washer.

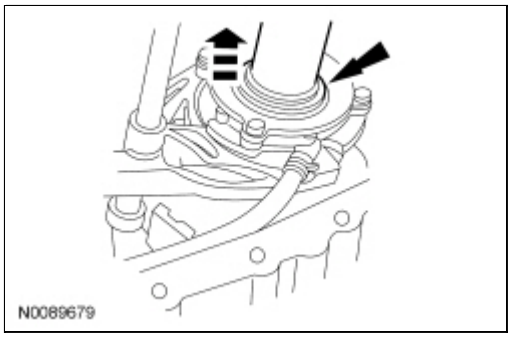


16. Remove the magnet from its slot in the case.

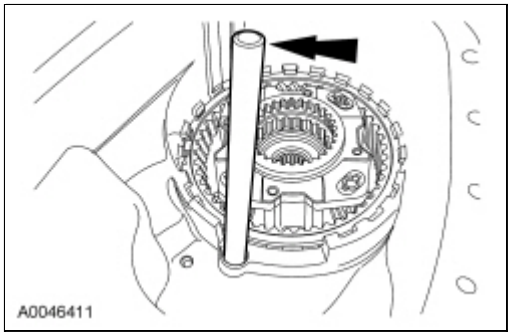


17. **NOTE:** The pump assembly is not repairable.

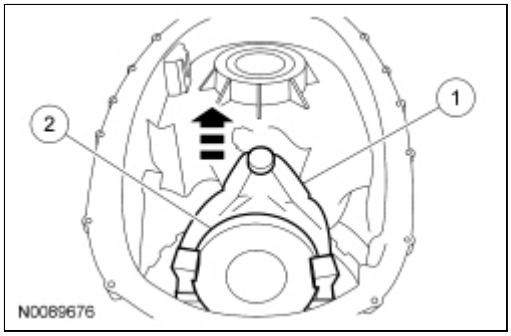
    Remove the oil pump and the output shaft as an assembly. Remove the oil pump from the output shaft.



18. Remove the shift rail.

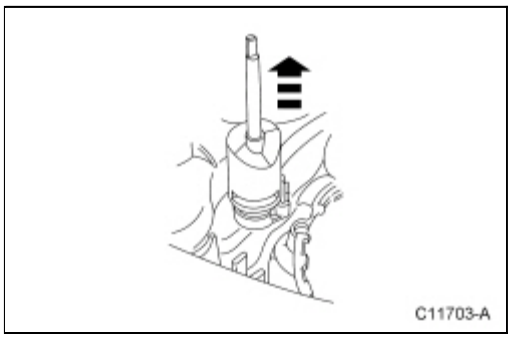


19. Remove the shift fork and the reduction hub.
    1. Remove the shift fork.
    2. Remove the reduction hub.



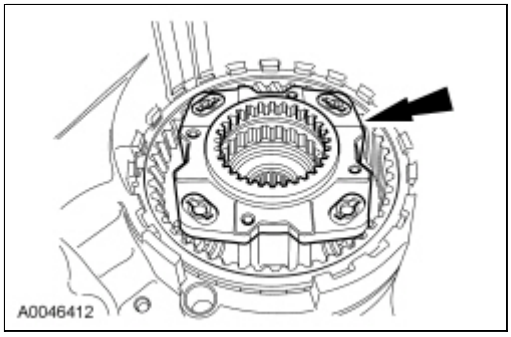
20. **NOTE:** The electric shift cam is serviced as an assembly. Do not disassemble the shift cam assembly.

    Remove the electric shift cam assembly.

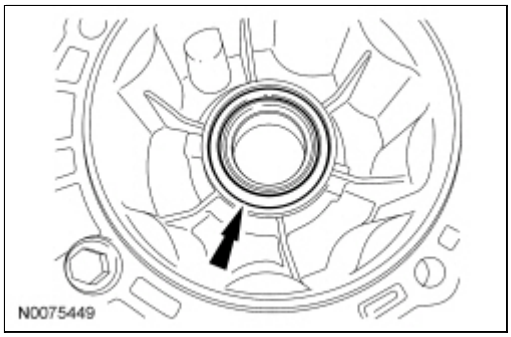


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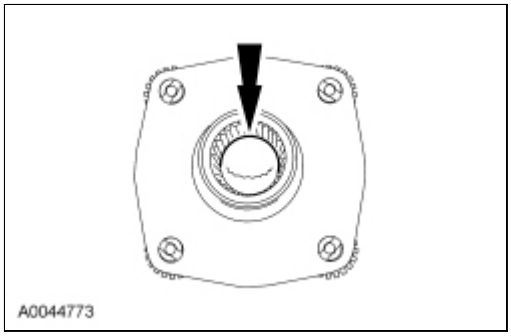
21. Remove the front planet carrier.



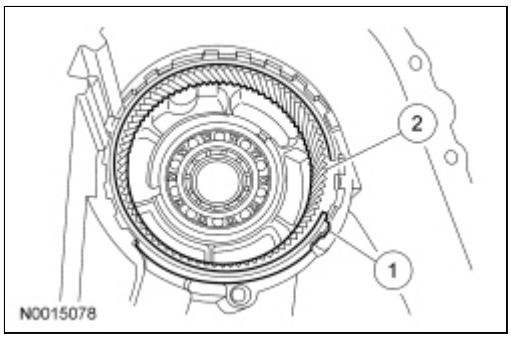
22. Remove and discard the front input shaft seal.



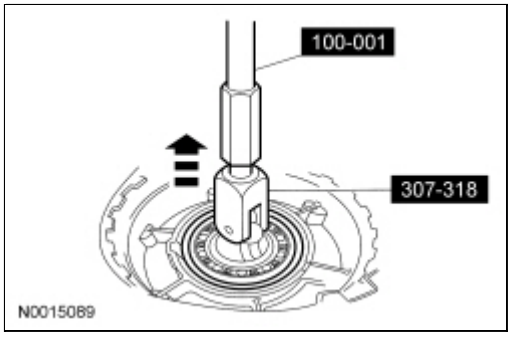
23. Remove the thrust bearing.
    - Remove the needle bearing, if necessary.



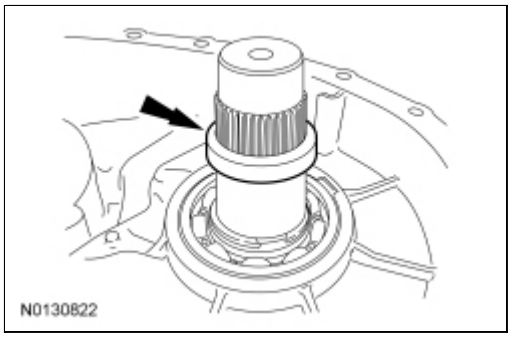
24. Remove the ring gear.
    1. Remove the ring gear snap ring.
    2. Remove the ring gear.



25. Using the Stator Bearing Remover with the Slide Hammer, remove the front planet carrier bearing.

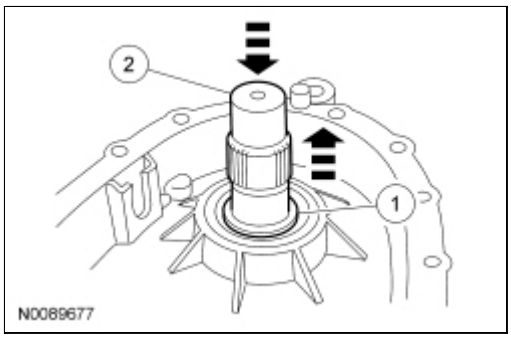


26. Remove the driven sprocket spacer.



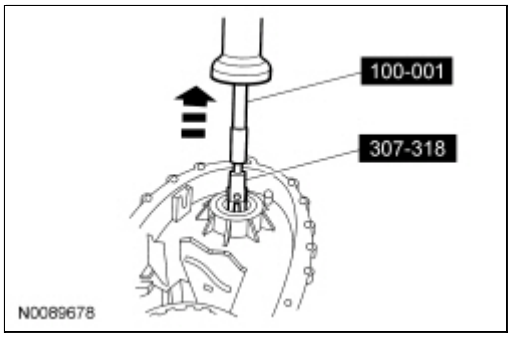
27. ***NOTICE:*** **Do not let the front output shaft fall while removing the snap ring or damage to the component may occur.**

    Remove the front output shaft.
    1. Remove the front output shaft snap ring.
    2. Remove the front output shaft.

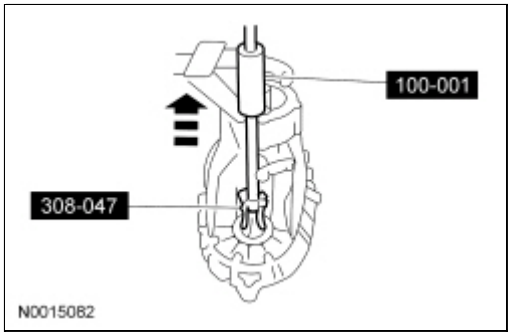


28. Using the Stator Bearing Remover with the Slide Hammer, remove the front output shaft bearing.

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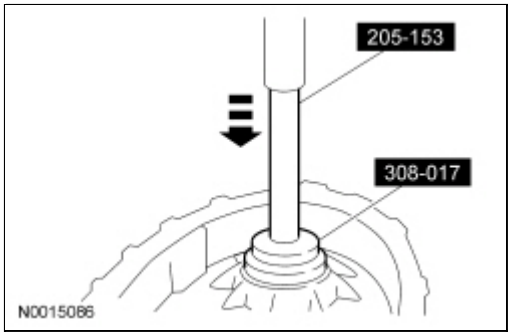


29. Using the Bearing Cup Remover with the Slide Hammer, remove the front output shaft seal.

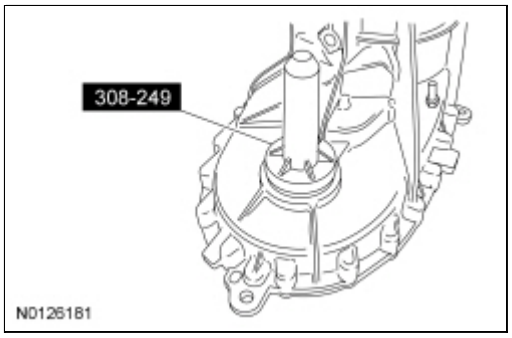


Assembly

1. Using a press and the Bearing Cup Installer with the Handle, install the front output shaft bearing.

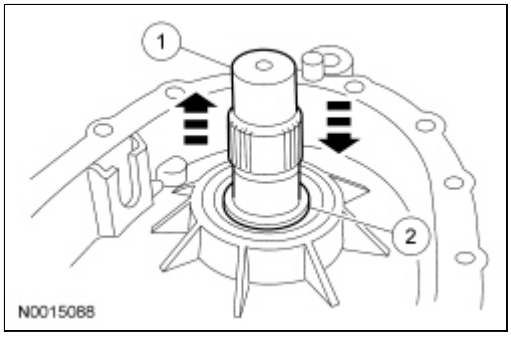


2. Using the Input Shaft Oil Seal Installer, install the front output shaft seal.

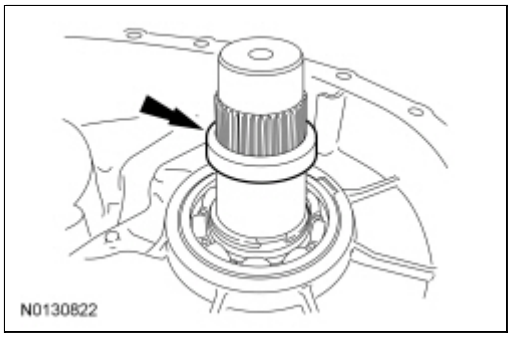


3. Install the front output shaft.
    1. Position the front output shaft.

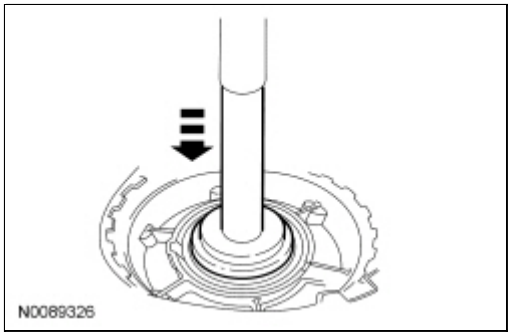
2. Install the front output shaft snap ring.



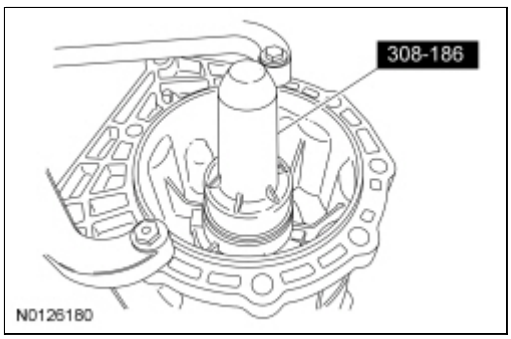
4. Install the driven sprocket spacer.



5. Install the front planet carrier bearing.



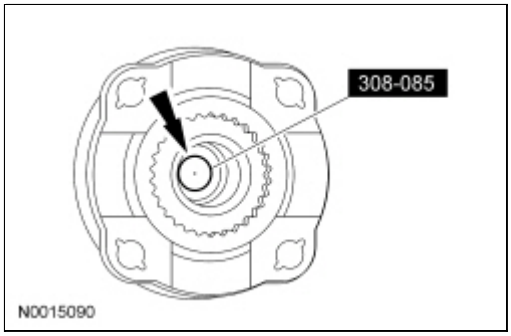
6. Using the Input Shaft Oil Seal Installer, install the front input seal.



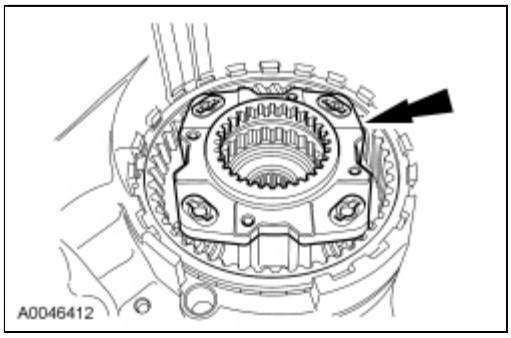
7. Position the ring gear in the case. Install the ring gear snap ring.

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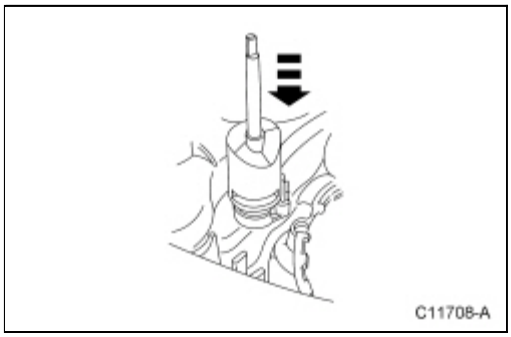
8. If removed, using a press and the Input Shaft Bearing Installer, install the needle bearing into the front planet carrier.



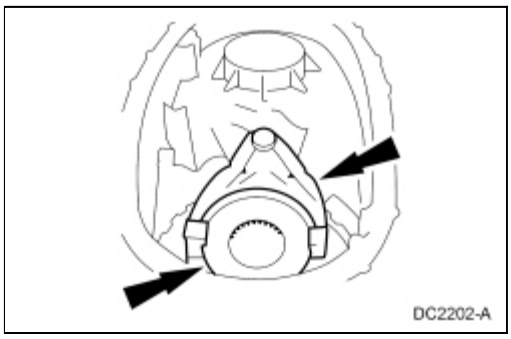
9. Install the front planet carrier and the thrust bearing.



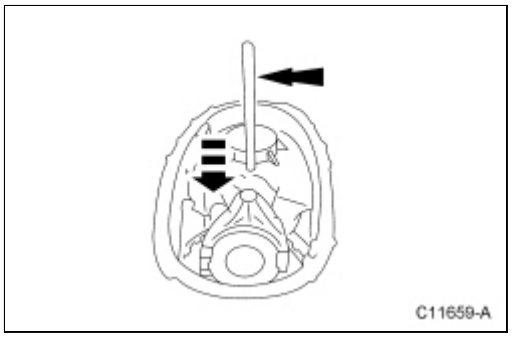
10. Install the electric shift cam assembly.



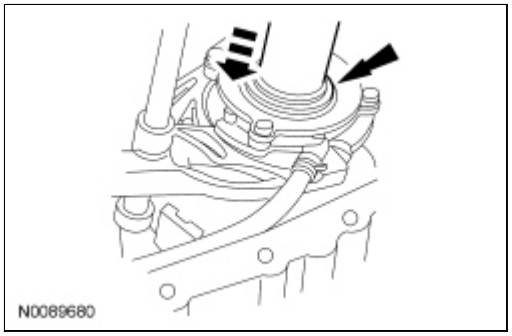
11. Install the shift fork and the reduction hub.



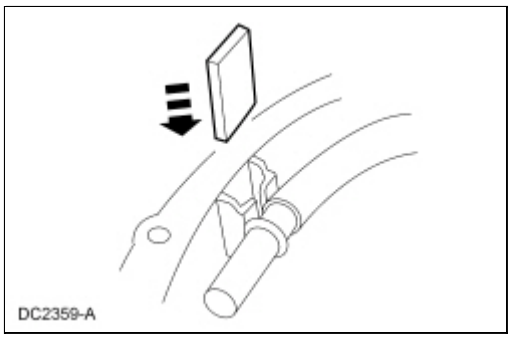
12. Install the shift rail.



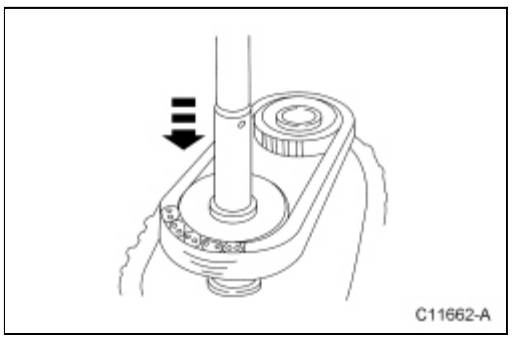
13. Install the oil pump, output shaft and the thrust washer.



14. Install the magnet into its slot in the case.



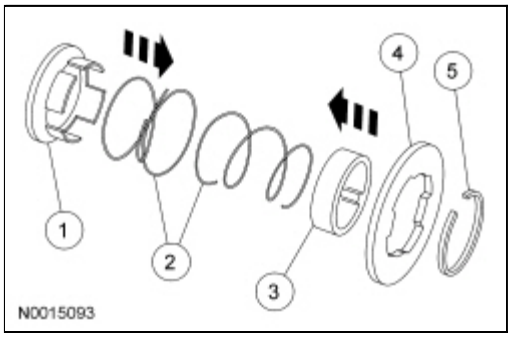
15. Install the drive chain and the sprockets as an assembly.



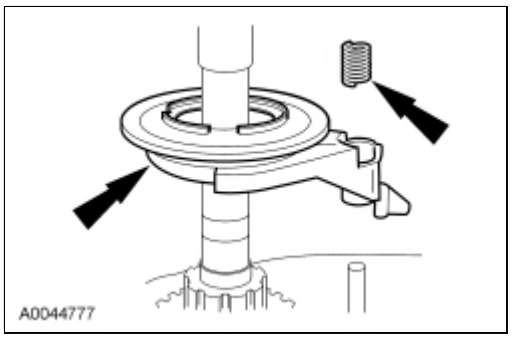
16. Install the lockup hub assembly. If the lockup hub assembly was disassembled, carry out the following steps.
    1. Position the lockup collar.
    2. Install the lockup collar springs.

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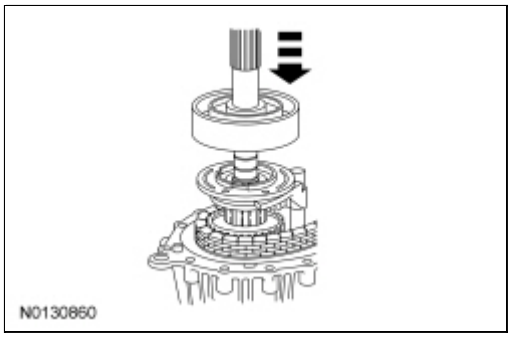
3. Install the lockup hub.
4. Install the armature.
5. Install the lockup hub snap ring.



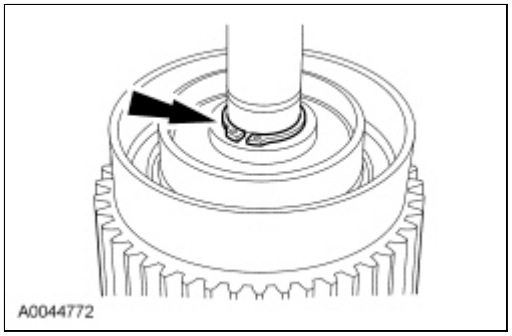
17. Install the lockup hub and the shift fork and spring.



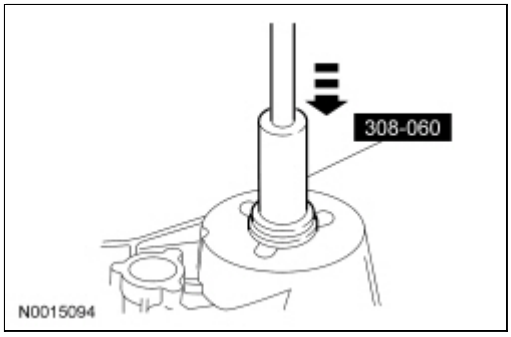
18. Install the coil housing.



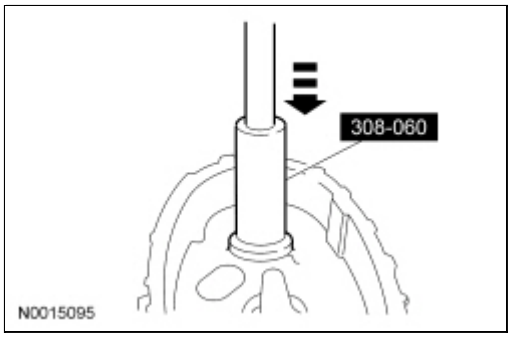
19. Install the snap ring.



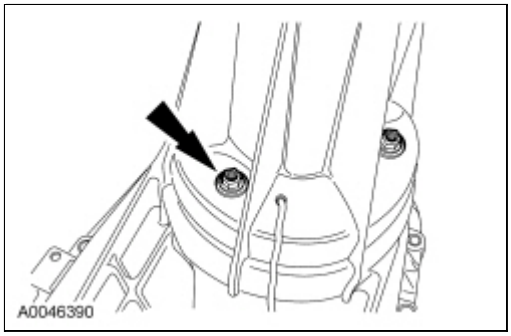
20. Using the Mainshaft Bearing Installer, install the rear output shaft bearing.



21. Using the Mainshaft Bearing Installer, install the front output shaft bearing.



22. Install the transfer case field coil, washers and the 3 nuts.
    - Tighten to 10 Nm (89 lb-in).

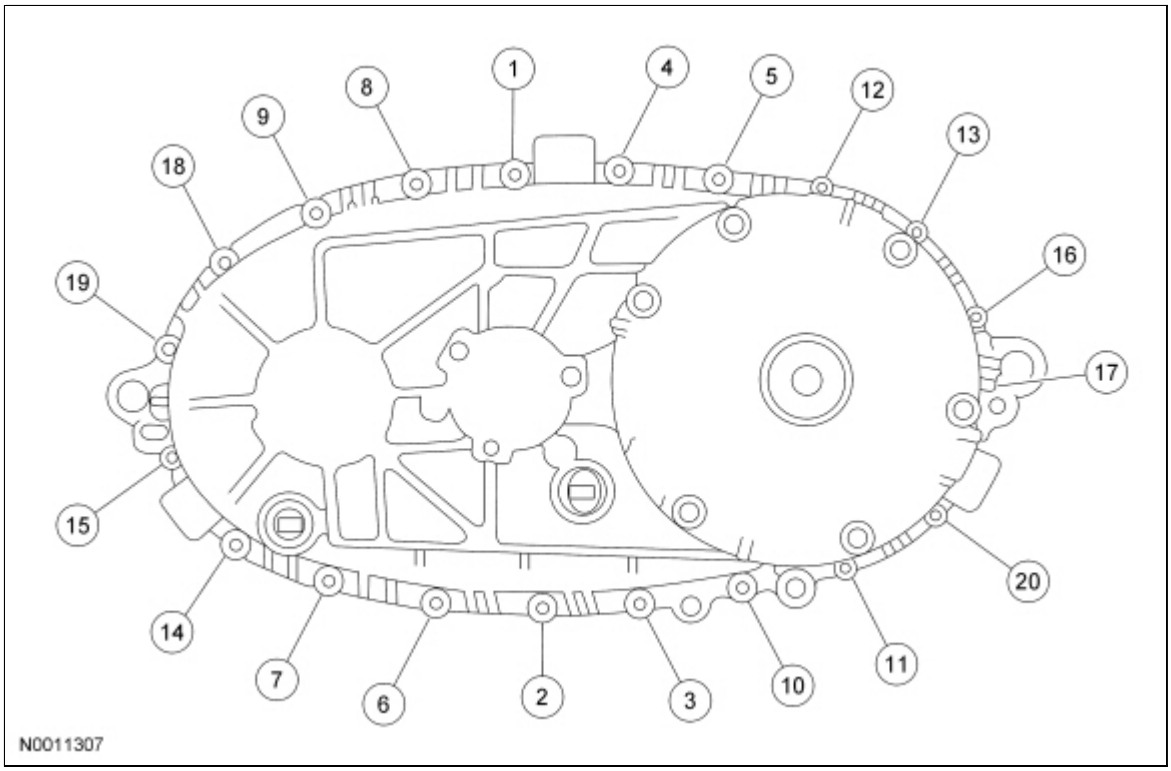


23. **NOTE:** Only apply enough silicone sealant to seal the transfer case halves together.

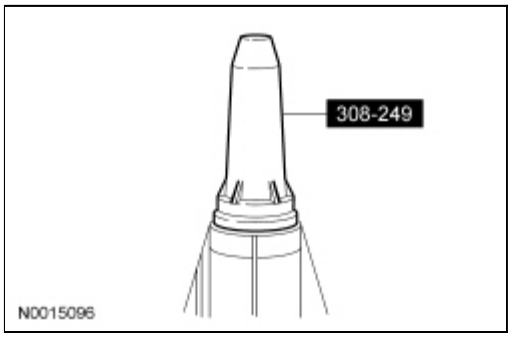
    Apply a small bead of silicone sealant to the mating surface of the case and cover.

24. Position the 2 transfer case halves and tighten the 20 bolts in the sequence shown.
    - Tighten to 24 Nm (18 lb-ft).

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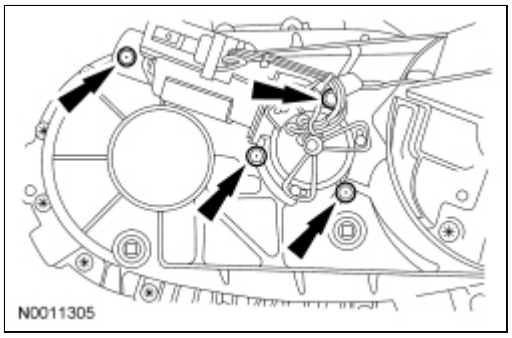
25. Using the Input Shaft Oil Seal Installer, install the rear output shaft seal.



26. Apply a small bead of silicone sealant to the transfer case shift motor mating surface.

NOTICE: **The following steps need to be performed in the correct order when installing the transfer case shift motor. Failure to follow the steps in the correct order may result in damage to the component.**

27. Install the transfer case shift motor and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

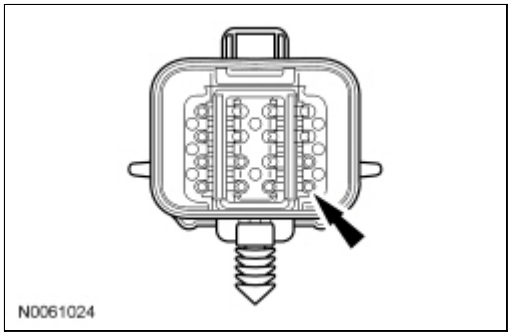


28. Install the transfer case shift motor bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

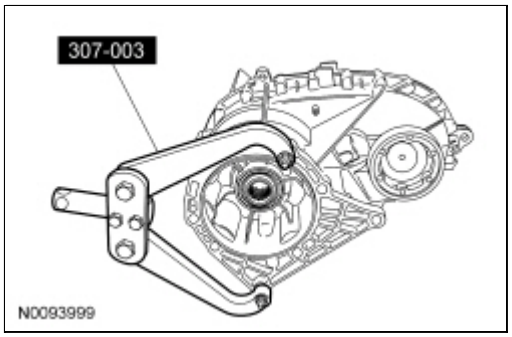
29. Secure the 2 transfer case shift motor bracket nuts.
    - Tighten to 3 Nm (27 lb-in).

30. **NOTE:** After the coil wire is inserted into the connector, gently pull the wire back to verify the pin is locked inside the connector.

    Insert the coil wire pin in the electrical connector and install the inner connector retainer.



31. Remove the transfer case from the Transmission Holding Fixture.



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Torque Specifications

Description	Nm	lb-ft	lb-in
Exhaust heat shield bolts	15	—	133
Exhaust intermediate pipe-to-muffler and tail pipe assembly Torca® clamp	47	35	—
Exhaust tip assembly Torca® clamp	47	35	—
Exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts [a]	—	—	—
Exhaust Y-pipe dual catalytic converter-to-exhaust manifold or turbocharger nuts [a]	—	—	—
Front muffler isolator and bracket assembly bolts	30	22	—
LH isolator cap bolt	55	41	—
Muffler inlet pipe bracket support isolator bolts (3.5L Gasoline Turbocharged Direct Injection (GTDI) vehicles only)	30	22	—
Rear tailpipe hanger isolator bolts	30	22	—
Rear muffler isolator and bracket assembly bolt	30	22	—
RH catalytic converter-to-LH catalytic converter Torca® clamp	55	41	—
Transfer case skid plate bolts	24	18	—
Transmission crossmember bolts and nuts	90	18	—
Transmission insulator and retainer/exhaust bracket assembly bolts (Four-Wheel Drive (4WD) vehicles only)	90	66	—
Transmission insulator and retainer/exhaust bracket assembly bolts	90	66	—
Transmission insulator and retainer/exhaust support bracket assembly nuts	103	76	—
Worm gear clamp	7	—	62

[a] Refer to the procedure in this section.

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Exhaust System

NOTICE: **When repairing exhaust system or removing exhaust components, disconnect all Heated Oxygen Sensor (HO2S) and all Catalyst Monitor Sensor (CMS) at the wiring connectors to prevent damage to the HO2S and CMS wiring harnesses. Refer to Section 303-14 for location of the HO2S and CMS .**

NOTICE: **Oil or grease-based lubricants on the isolators may cause the exhaust hanger isolator to separate from the exhaust hanger bracket during vehicle operation.**

NOTE: Exhaust fasteners are of a torque-prevailing design. Use only new fasteners with the same part number as the original. Torque values must be used as specified during reassembly to make sure of correct retention of exhaust components.

The exhaust system:

- has an exhaust Y-pipe dual catalytic converter that is a 2-piece assembly. The RH and LH converters can be serviced separately as needed.
- has 2 upstream Heated Oxygen Sensor (HO2S) mounted before the catalytic converters.
- has 2 Catalyst Monitor Sensor (CMS) mounted on catalytic converters.
- has an intermediate pipe.
- has muffler brackets with isolators at the front and rear of the muffler, bolted to the body.
- production muffler and tail pipe assembly is a one-piece design.

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Exhaust System

Inspection and Verification

1. Verify the concern by running the engine (with the vehicle on the ground) or road testing the vehicle to duplicate the condition.

2. Visually inspect the components of the exhaust system and related controls that may affect exhaust gas quality or loss of power.

3. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
• Exhaust pipe pinched or crushed • Damaged muffler and tail pipe assembly • Broken or damaged exhaust hanger brackets • Damaged catalytic converter • Cracked exhaust manifold • Loose or damaged heat shields

4. Verify that the exhaust system is installed correctly, with Torca® clamps correctly located and tightened to specification.

5. If the fault is not visually evident, determine the symptom. GO to Symptom Chart - Exhaust System or GO to Symptom Chart - NVH .

Symptom Chart — Exhaust System

Symptom Chart — Exhaust System

Condition	Possible Sources	Action
• Vehicle has low or no power — vehicle performance complaint	• Exhaust pipe pinched or crushed • Damaged catalytic converter • Loose obstruction in exhaust	• INSPECT the exhaust components for damage. REPAIR or INSTALL new components as necessary. TEST the system for normal operation. If the concern is still present, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for restricted exhaust.
	• Restricted exhaust	• CHECK drain holes for foreign

	(possible frozen condensate in muffler)	material. PARK the vehicle inside to thaw. TEST vehicle for normal operation. If concern is still present, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Burning smell — usually occurs at idle with possible traces of smoke	• Foreign material caught in exhaust system • Missing heat shields • Fluid leak on exhaust	• INSPECT the exhaust system for foreign material or missing heat shields. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.
• Odor — described as a sulfur or rotten egg smell	• Catalytic converter	• At times, a slight sulfur smell is normal for catalytic converters. The cause is the sulfur content in the gasoline being used. ADVISE customer, no repair required.
	• Rich fuel conditions • Misfire conditions • Excessive sulfur content in fuel	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Visible rust on surface of exhaust pipes	• Catalytic converter/exhaust system	• Surface rust is a characteristic of materials used on exhaust systems. Exposure to heat or road salt may result in surface rust. INSPECT for perforations. If there are no perforations, condition is normal.

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Rattle, squeaks or buzz-type noise — from the bottom of vehicle	• Loose or damaged heat shield	• INSPECT the exhaust system for loose or missing heat shields or foreign material trapped between the heat shields and the exhaust system components. If any heat shields are loose, INSTALL worm gear clamp 7L5Z-5A231-AA and tighten to 7 Nm (62 lb-in). If the heat shields are missing, INSTALL new heat shields or exhaust system components as necessary. If a rattle, noise or buzz condition persists, INSTALL a new heat

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		shield or component as necessary. TEST the system for normal operation after the repair.
	• Loose or damaged exhaust isolators	• CHECK that the exhaust isolators are correctly installed. INSPECT the exhaust isolators for wear or damage. INSTALL new isolators as necessary. TEST the system for normal operation after the repair.
	• Damaged exhaust isolator hanger bracket	• INSPECT the exhaust system components for damage or broken hangers. INSTALL new components as necessary. CHECK for loose or damaged exhaust hanger brackets or fasteners. TIGHTEN bolts to specification or INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Catalytic converter • Muffler	• MOVE the exhaust system to simulate the bouncing action of the vehicle, checking for exhaust-to-body contact while moving the exhaust system. Using a rubber mallet, lightly TAP on the exhaust components one at a time to duplicate the noise concern. DETERMINE if there are any loose or broken baffles or element. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Exhaust grounded to chassis	• INSPECT for signs of exhaust components-to-body contact. If necessary, CARRY OUT the Exhaust System Alignment in this section.
• Drone or clunk type noise — from bottom of vehicle	• Loose or damaged exhaust isolators	• INSPECT exhaust isolators for wear or damage. INSTALL new isolators as necessary. TEST the system for normal operation after the repair.
	• Exhaust grounded to chassis	• INSPECT for signs of exhaust components-to-body contact. If necessary, CARRY OUT the Exhaust System Alignment in this section.
• Whistles, boom, hum or ticking-type noise — noise tends to change as engine warms. Noises are often	• Exhaust system leak	• INSPECT the entire exhaust system for leaks. CHECK for punctures, loose or damaged Torca® clamps/fasteners, sensors or broken welds. EXAMINE the chassis for grayish-white or black exhaust soot, which would indicate

accompanied by exhaust fumes		exhaust leakage at that point. To magnify a small leak, have an assistant hold a shop towel over the tail pipe outlet, while listening for a leak. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Catalytic converter • Muffler	• MOVE the exhaust system to simulate the bouncing action of the vehicle, checking for exhaust-to-body contact while moving the exhaust system. Using a rubber mallet, lightly TAP on the exhaust components one at a time to duplicate the noise concern. DETERMINE if there are any loose or broken baffles or element. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Exhaust muffler drain hole enlarged due to corrosion	• **NOTE:** Check with vehicle on the ground, not on a hoist. CONFIRM drain holes are the noise source. INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Thermal expansion of exhaust versus heat shields	• This is a normal condition.
• Hissing or rushing noise — high frequency sound. Vehicle performance is unaffected	• Exhaust system. Exhaust flow through pipes	• MOVE the exhaust system to simulate the bouncing action of the vehicle, checking for exhaust-to-body contact while moving the exhaust system. Using a rubber mallet, lightly TAP on the exhaust components one at a time to duplicate the noise concern. DETERMINE if there are any loose or broken baffles or element. CHECK for missing or leaking Torca® clamps or couplings. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.
• Pinging noise — occurs when exhaust system is hot, engine turned off	• Catalytic converter/exhaust system • Thermal expansion of exhaust system	• Cool down pinging is the exhaust system expanding and contracting during heating and cooling. This is a normal condition.
• Vibration — occurs at idle	• Loose or damaged exhaust isolators	• INSPECT the exhaust isolators for wear or damage. INSTALL new

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and at low speeds. Also accompanied by clunk or buzz type noise		isolators as necessary. TEST the system for normal operation after the repair.
	• Loose or damaged exhaust isolator hanger brackets	• INSPECT the exhaust isolator hanger brackets for wear or damage. INSTALL or REPAIR as necessary. TEST the system for normal operation after the repair.
	• Damper missing or damaged, if equipped	• INSPECT for missing or damaged damper. INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Exhaust system grounded to chassis	• CARRY OUT the Exhaust System Alignment in this section.
• Engine drumming noise — normally accompanied by vibration	• Damaged or misaligned exhaust system	• INSPECT the exhaust system for loose or damaged fasteners, Torca® clamps, couplings or isolators. CARRY OUT the Exhaust System Alignment in this section. TEST the system for normal operation after the repair.
• Sputter type noise — noise worse when cold, lessens or disappears when the vehicle is at operating temperature	• Damaged or worn exhaust system	• INSPECT the exhaust system for leaks or damage. REPAIR as necessary. TEST the system for normal operation after the repair.
• Thumping noise — from the bottom of the vehicle, worse at acceleration	• Misaligned exhaust system	• CHECK the exhaust system-to-chassis clearance. CHECK the exhaust system isolators for damage. REPAIR as necessary. TEST the system for normal operation after the repair.
• Engine vibration — is felt with increases and decreases in engine rpm	• Strain on exhaust system isolators	• CARRY OUT the Exhaust System Alignment in this section. REPAIR as necessary. TEST the system for normal operation after the repair.
• Drumming noise — occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent	• Exhaust system vibration excites the body resonances inducing interior noise	• GO to Pinpoint Test A .

Pinpoint Test

Pinpoint Test A: Drumming Noise

This pinpoint test is intended to diagnose the following:

- Exhaust system

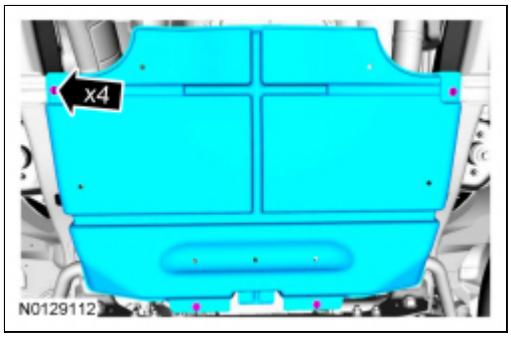
PINPOINT TEST A: DRUMMING NOISE

Test Step	Result / Action to Take
A1 CHECK THE EXHAUST SYSTEM • Start the engine. • Increase the engine rpm until the noise is the loudest. Note the engine rpm. • Ignition OFF. • Add approximately 9 kg (20 lb) of weight to the exhaust system. First place the weight at the tail pipe and test, then at the front pipe. • Start the engine. • Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs. • Ignition OFF. • Determine the amount of vibration that occurs with the drumming noise. • **Is the noise/vibration reduced or eliminated, or does the noise/vibration occur at a different rpm?**	**Yes** REFER to Exhaust System Alignment in this section. TEST the system for normal operation. **No** CONDUCT a diagnosis on other suspect systems. REFER to Section 100-04 .

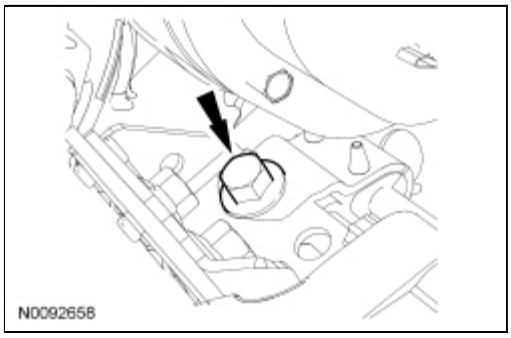
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Exhaust System Alignment

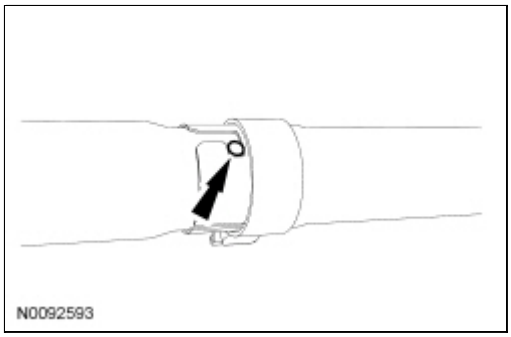
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. If equipped, release the 4 fasteners and remove the splash shield.



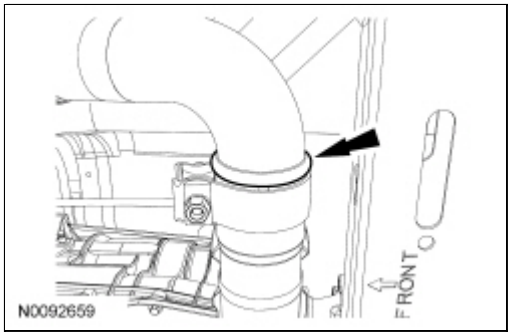
3. Loosen all exhaust system component fasteners adjoining the exhaust system.
4. Loosen the 2 front muffler isolator and bracket assembly bolts.
5. Loosen the LH isolator cap bolt.



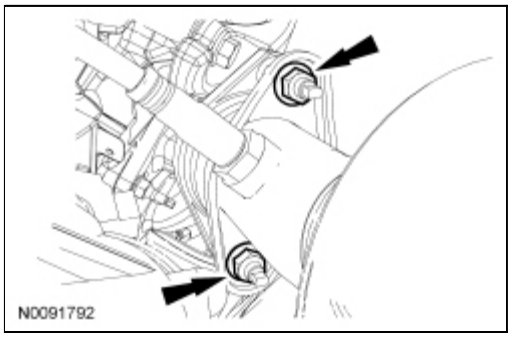
6. Make sure the button on the exhaust intermediate pipe is fully inserted into the L-notch on the muffler and tail pipe assembly inlet pipe.



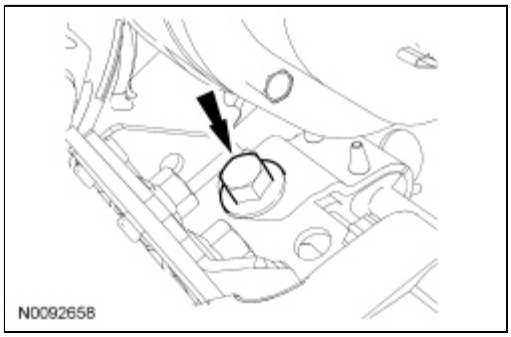
7. Make sure the LH catalytic converter is fully seated into the RH catalytic converter up to the stop on the LH catalytic converter.



8. Tighten the RH catalytic converter-to-exhaust manifold or turbocharger nuts in the following sequence.
    1. Tighten the RH lower catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).
    2. Tighten the RH upper catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).

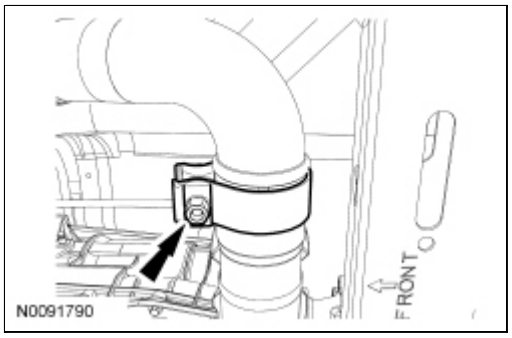


9. Tighten the LH isolator cap bolt.
    - Tighten to 55 Nm (41 lb-ft).

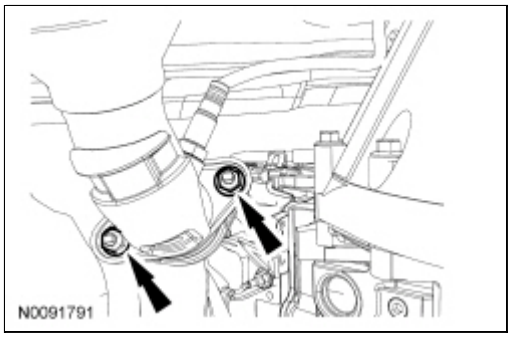


10. Tighten the RH catalytic converter-to-LH catalytic converter Torca® clamp.
    - Tighten to 55 Nm (41 lb-ft).

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11. Tighten the LH catalytic converter-to-exhaust manifold or turbocharger nuts in the following sequence.
    1. Snug the LH inner catalytic converter-to-exhaust manifold or turbocharger nut.
    2. Tighten the LH outer catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).
    3. Tighten the LH inner catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).

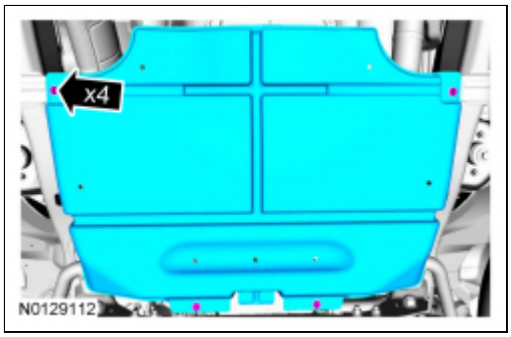


12. Tighten the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts in the following sequence.
    1. Snug the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt.
    2. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    3. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

13. Tighten the exhaust intermediate pipe-to-muffler and tail pipe assembly exhaust Torca® clamp.
    - Tighten to 47 Nm (35 lb-ft).

14. Tighten the 2 front muffler isolator and bracket assembly bolts.
    - Tighten to 30 Nm (22 lb-ft).

15. If equipped, install the splash shield and the 4 fasteners.



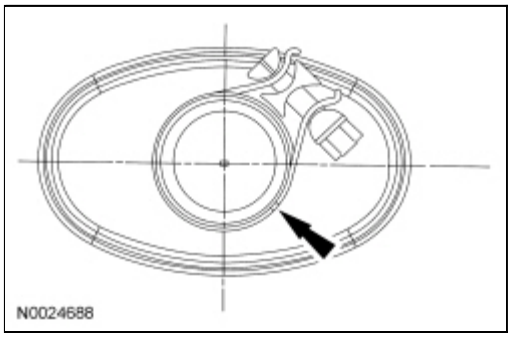
16. Start the engine and check the exhaust system for leaks.

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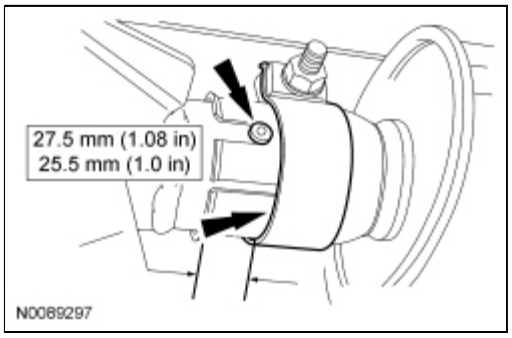
Torca® Clamp

1. Remove the nut from the Torca® clamp.
2. Grind the spot weld and the tac weld from the Torca® clamp and remove the clamp.
3. Clean the uneven surface area and position the Torca® clamp.



4. **NOTE:** Make sure the clamp position is no more than 27.5 mm (1.08 in) or less than 25.5 mm (1 in) from the inlet of the resonator pipe.

   Make sure the back of the slot is covered by the clamp and the button is fully seated inside the notch.



5. **NOTE:** Do not tighten the clamp until the exhaust system has been aligned.

   Tighten the Torca® clamp.
   - Tighten to 55 Nm (41 lb-ft).

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Exhaust Intermediate Pipe

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

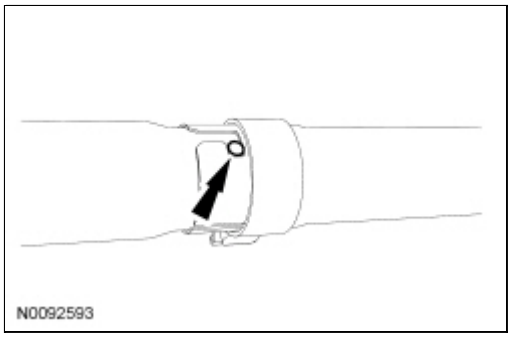
2. Remove the muffler and tail pipe. For additional information, refer to Muffler and Tailpipe in this section.

3. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and remove the exhaust intermediate pipe from the vehicle.

Installation

1. **NOTE:** Make sure the exhaust intermediate pipe is installed so the rear L-notch nub is at the 1 o'clock position.

   Position the exhaust intermediate pipe into the vehicle and install the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and tighten in the following sequence.
   1. Snug the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt.
   2. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
   3. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



2. Install the muffler and tail pipe. For additional information, refer to Muffler and Tailpipe in this section.

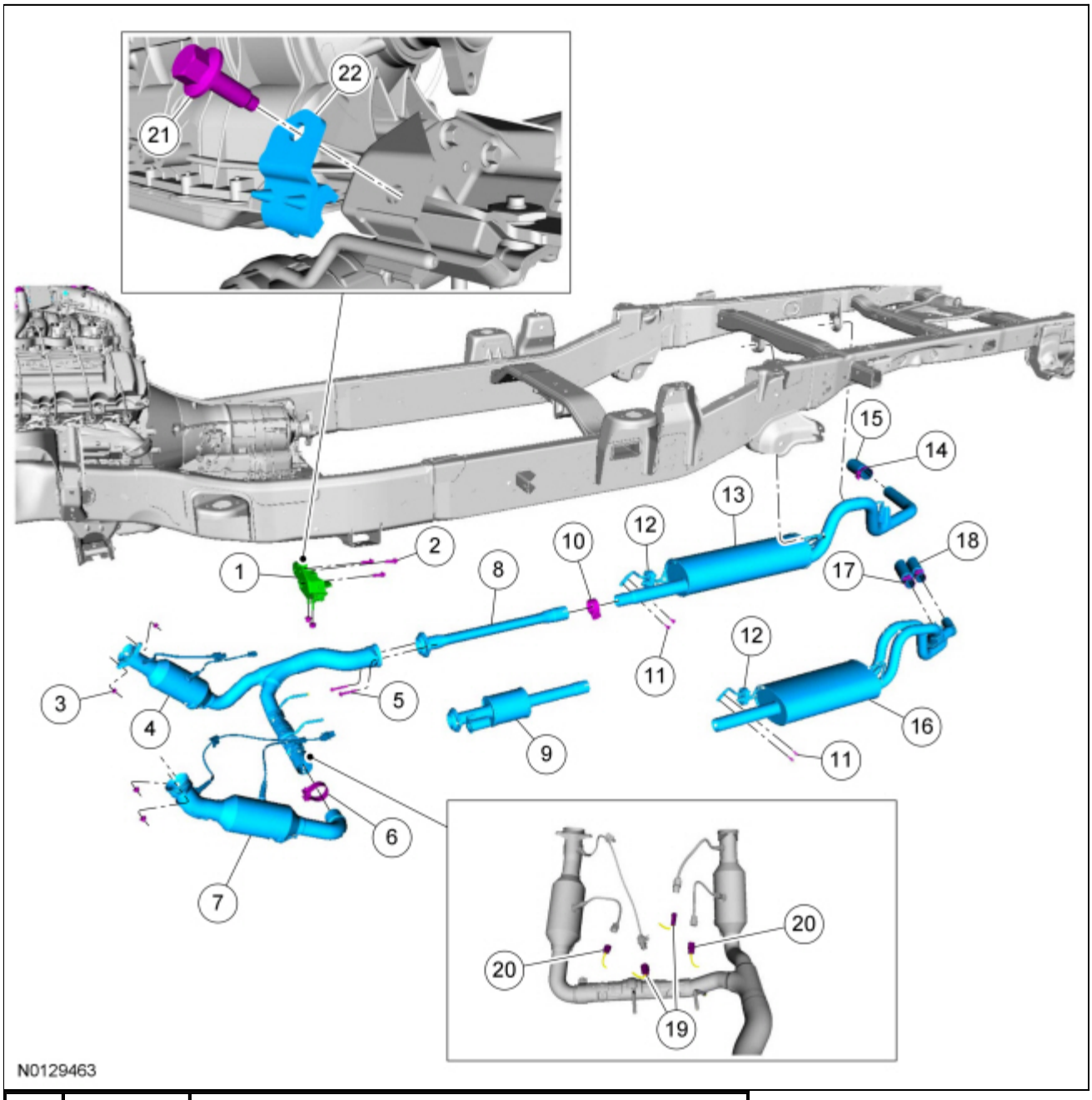
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Exhaust System — Exploded View

NOTE: 2-Wheel Drive (2WD) shown, Four-Wheel Drive (4WD) similar.

NOTE: Exhaust system may vary by engine and wheelbase.

NOTE: Vehicle body removed from art for clarity.



	Part	

Item	Number	Description
1	6068	Transmission insulator and retainer/exhaust support bracket assembly
2	W711140	Transmission insulator and retainer/exhaust support bracket assembly bolt (3 required) - 90 Nm (66 lb-ft)
3	W520514	Exhaust Y-pipe dual catalytic converter-to-exhaust manifold or turbocharger nut (4 required)
4	5E212	RH catalytic converter
5	W714717	Exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt (2 required)
6	5A231	RH catalytic converter-to-LH catalytic converter Torca® clamp - 55 Nm (41 lb-ft)
7	5E212	LH catalytic converter
8	5A212	Exhaust intermediate pipe
9	5A212	Exhaust intermediate pipe with resonator (if equipped)
10	—	Exhaust intermediate pipe Torca® clamp (part of 5A212) - 47 Nm (35 lb-ft)
11	W712773	Front muffler isolator and bracket assembly bolt (2 required) - 30 Nm (22 lb-ft)
12	5B245	Front muffler isolator and bracket assembly
13	5230	Muffler
14	—	Exhaust tip assembly Torca® clamp (part of 5C262) - 47 Nm (35 lb-ft)
15	—	Exhaust tip (part of 5C262)
16	5K214	Muffler (SVT Raptor and Harley Davidson® models only)
17	—	Exhaust tip assembly Torca® clamp (part of 5C262) (2 required) - 47 Nm (35 lb-ft)
18	—	Duel exhaust tip assembly (part of 5C262) (SVT Raptor and Harley Davidson® Models only)
19	—	Heated Oxygen Sensor (HO2S) electrical connectors (part of 12B637) (2 required)
20	—	Catalyst Monitor Sensor (CMS) electrical connectors (part of 15525) (2 required)
21	W713314	LH isolator cap bolt - 55 Nm (41 lb-ft)
22	5A262	LH isolator cap

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

repair4less

Exhaust Y-Pipe — Dual Catalytic Converter

Removal

All vehicles

NOTICE: **Do not use oil or grease-based lubricants on the isolators. These lubricants may cause deterioration of the rubber. This can lead to separation of the isolator from the exhaust hanger bracket during vehicle operation.**

NOTE: The exhaust Y-pipe dual catalytic converter is a 2-piece assembly. The RH and LH converters can be serviced separately as needed.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

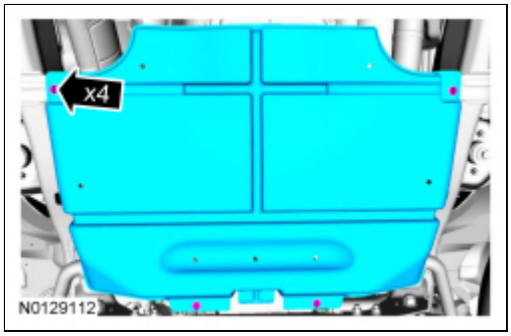
3.5L Gasoline Turbocharged Direct Injection (GTDI)

2. Disconnect the LH Heated Oxygen Sensor (HO2S) pushpin and electrical connector.

All vehicles

3. **NOTE:** Inspect and replace this splash shield if it is damaged or will not re-secure properly to the vehicle.

   If equipped, release the 4 fasteners and remove the splash shield.



3.5L GTDI

4. Disconnect the RH HO2S pushpin and electrical connector.

3.7L, 5.0L and 6.2L

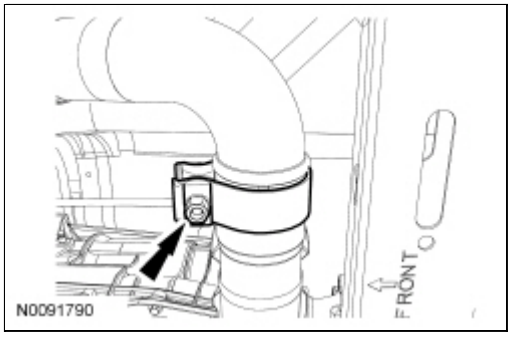
5. Disconnect the 2 HO2S pushpins and electrical connectors.

All vehicles

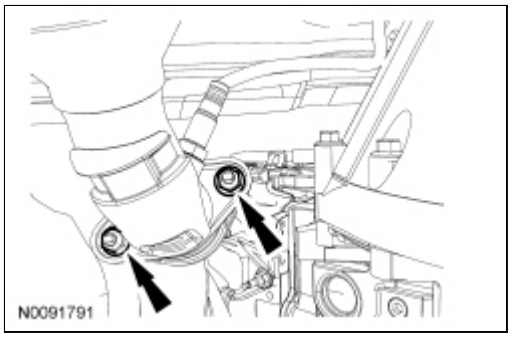
6. Disconnect the 2 Catalyst Monitor Sensor (CMS) electrical connectors.

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7. Loosen the RH catalytic converter-to-LH catalytic converter Torca® clamp.



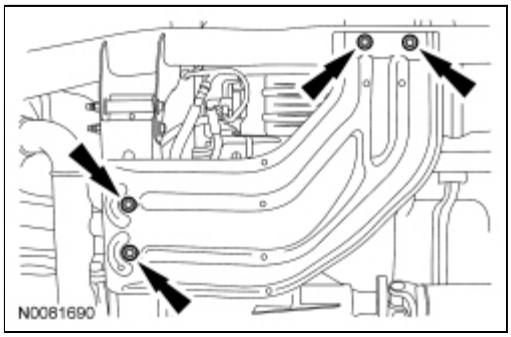
8. Remove and discard the 2 LH catalytic converter-to-exhaust manifold or turbocharger nuts.



9. Remove the LH catalytic converter from the vehicle.

Four-Wheel Drive (4WD) vehicles

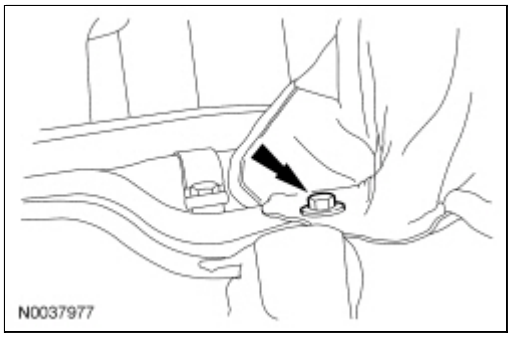
10. If equipped, remove the 4 bolts and the transfer case skid plate.



All vehicles

11. Using an appropriate tool, support the transmission.
12. **NOTE:** LH side shown, RH similar.

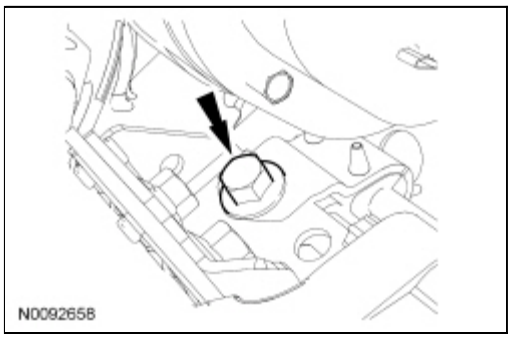
    Remove the 2 heat shield bolts from the transmission crossmember.



13. Remove the 2 transmission insulator and retainer/exhaust support bracket assembly nuts.

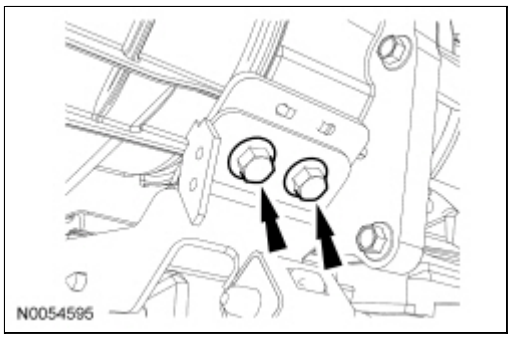
14. Remove the 4 transmission crossmember nuts, the 4 bolts and remove the transmission crossmember from the vehicle.

15. Remove the LH isolator cap from the transmission insulator and retainer/exhaust support bracket assembly.



4WD vehicles

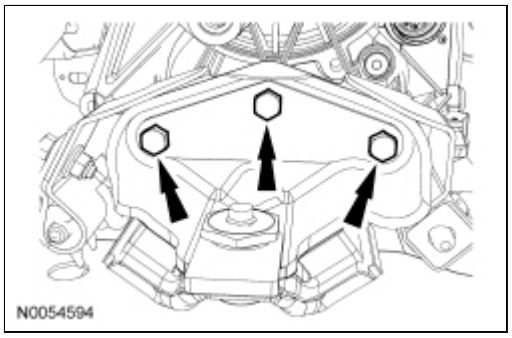
16. Remove the 4 transmission insulator and retainer/exhaust support bracket assembly bolts and remove the transmission insulator and retainer/exhaust support bracket assembly from the vehicle.



2-Wheel Drive (2WD) vehicles

17. Remove the 3 transmission insulator and retainer/exhaust support bracket assembly bolts and remove the transmission insulator and retainer/exhaust support bracket assembly from the vehicle.

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3.5L GTDI and 3.7L vehicles

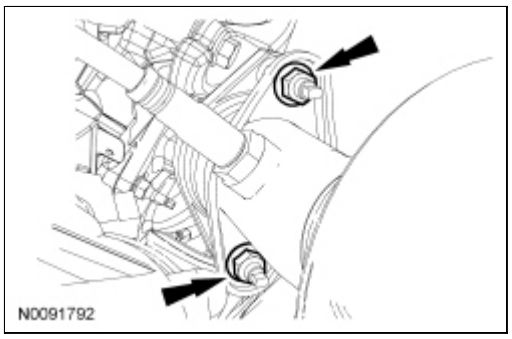
18. ***NOTICE:*** **Do not excessively bend, twist or allow the exhaust intermediate pipe to hang from the flexible pipe or damage to the muffler and tailpipe may occur.**

    Support the exhaust intermediate pipe with a jackstand.

All vehicles

19. Remove the 2 RH catalytic converter-to-exhaust intermediate pipe bolts.

20. With help of an assistant, remove the 2 nuts on the RH catalytic converter-to-exhaust manifold or turbocharger joint and remove the RH catalytic converter from the vehicle.
    - Discard the nuts.

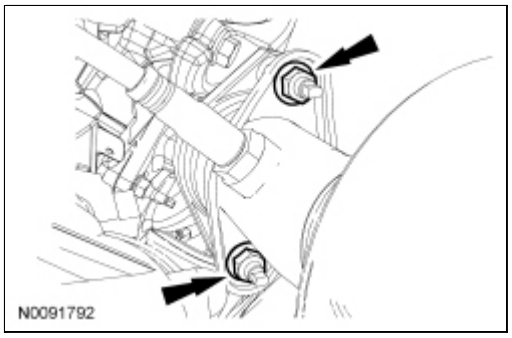


Installation

NOTE: Clean the mating surfaces of the exhaust manifold outlet or turbocharger flares and the catalytic converter inlet flares.

All vehicles

1. With the help of an assistant, position the RH catalytic converter into the vehicle and loosely install 2 new RH catalytic converter-to-exhaust manifold or turbocharger nuts.

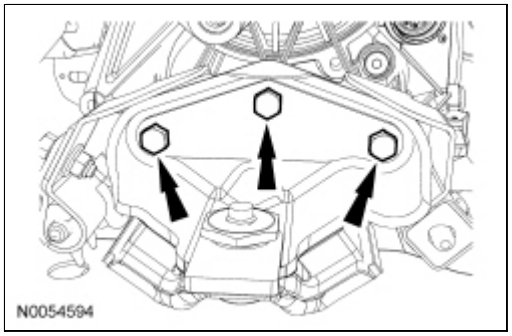


2. ***NOTICE:*** **If equipped, do not excessively bend, twist or allow the exhaust to hang from the flexible pipe or damage to the muffler and tailpipe may occur.**

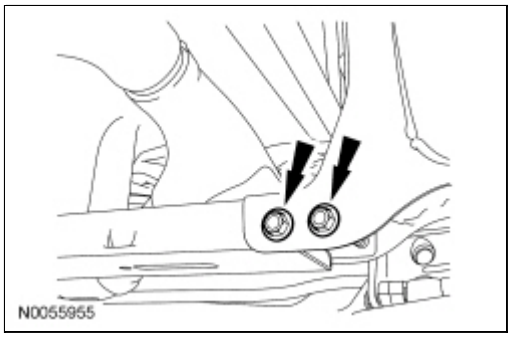
   Loosely install the 2 RH catalytic converter-to-intermediate pipe bolts.

2WD vehicles

3. Install the transmission insulator and retainer/exhaust bracket assembly and 3 bolts.
   - Tighten to 90 Nm (66 lb-ft).

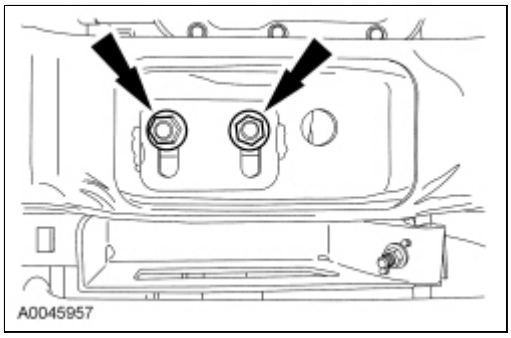


4. Install the transmission crossmember, 4 bolts and 4 nuts.
   - Tighten to 90 Nm (66 lb-ft).



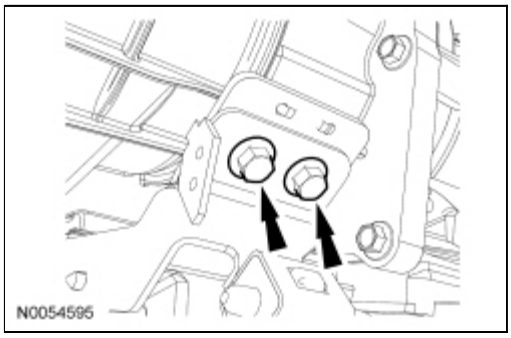
5. Lower the transmission onto the transmission crossmember and install the 2 transmission insulator and retainer/exhaust support bracket assembly nuts.
   - Tighten to 103 Nm (76 lb-ft).

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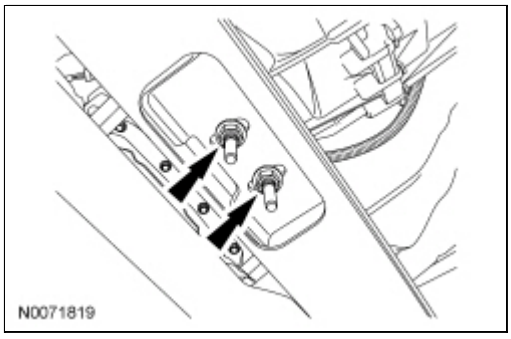


4WD vehicles

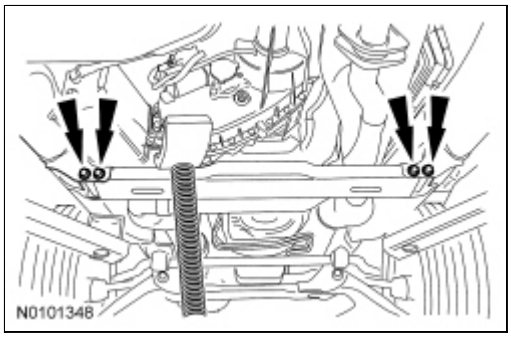
6. Loosely install the transmission insulator and retainer/exhaust support bracket assembly and the 4 bolts.



7. Position the transmission crossmember and loosely install the 2 transmission insulator and retainer/exhaust support bracket assembly nuts.

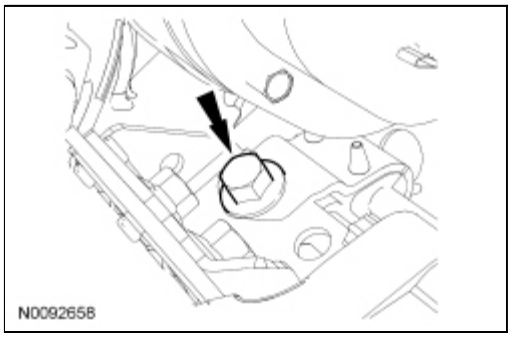


8. Install the 4 transmission crossmember bolts and nuts.
    - Tighten the transmission insulator and retainer/exhaust support bracket assembly and 4 bolts to 90 Nm (66 lb-ft).
    - Tighten the transmission crossmember bolts and nuts to 90 Nm (66 lb-ft).
    - Tighten the 2 transmission insulator and retainer/exhaust support bracket assembly nuts to 103 Nm (75 lb-ft).



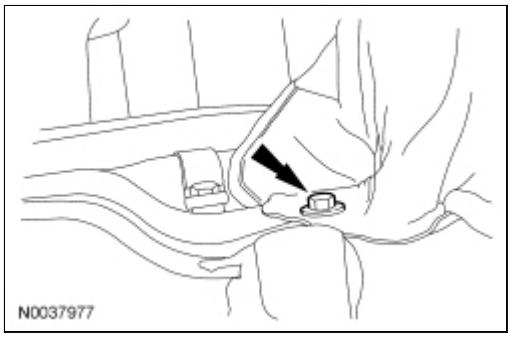
All vehicles

9. Loosely install the LH isolator cap and bolt onto the transmission insulator and retainer/exhaust support bracket assembly.



10. **NOTE:** LH side shown, RH similar.

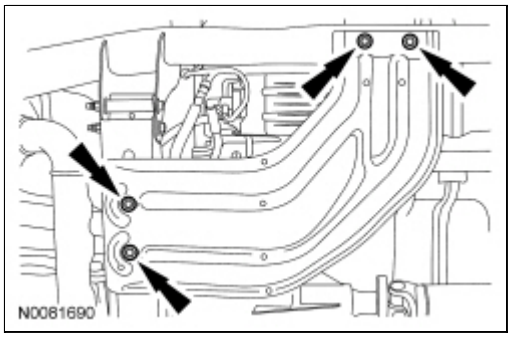
    Install the 2 heat shield bolts into the transmission crossmember.
    - Tighten to 15 Nm (133 lb-in).



4WD vehicles

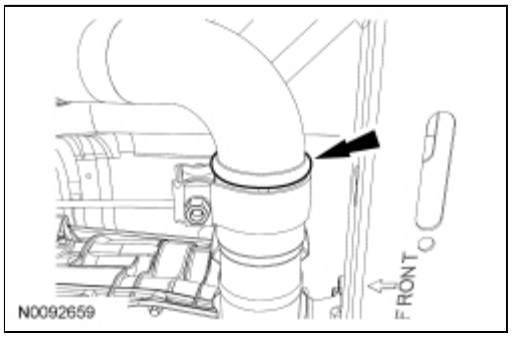
11. If equipped, install the transfer case skid plate and 4 bolts.
    - Tighten to 24 Nm (18 lb-ft).

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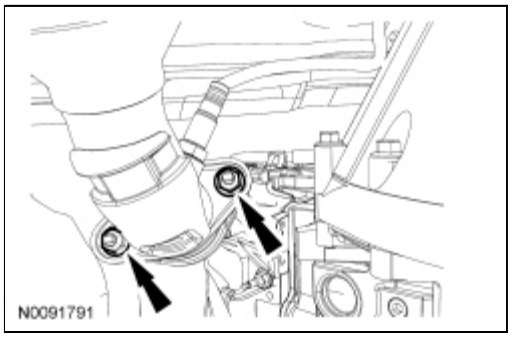


All vehicles

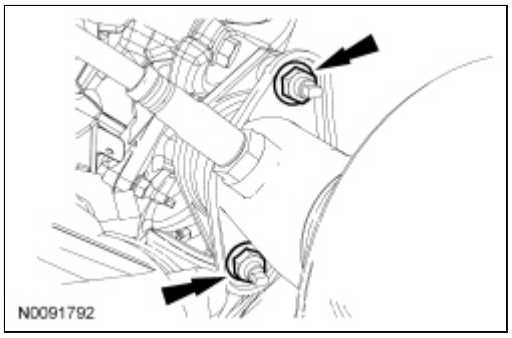
12. Slide the LH catalytic converter into the RH catalytic converter up to the stop on the LH catalytic converter and position the LH catalytic converter into place.



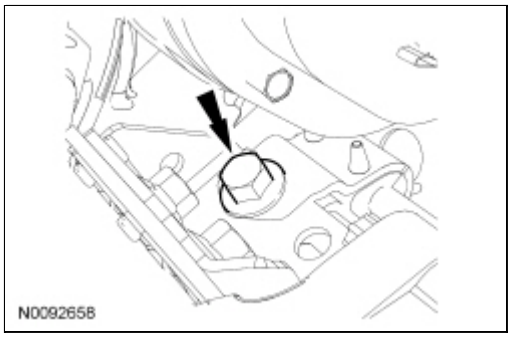
13. Loosely install the 2 new LH catalytic converter-to-exhaust manifold or turbocharger nuts.



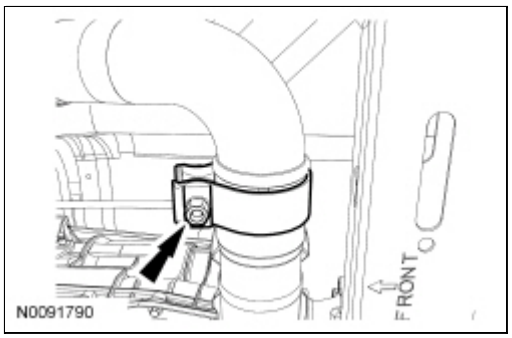
14. Tighten the 2 new RH catalytic converter-to-exhaust manifold or turbocharger nuts in the following sequence.
    1. Tighten the RH lower catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).
    2. Tighten the RH upper catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).



15. Tighten the LH isolator cap bolt.
    - Tighten to 55 Nm (41 lb-ft).

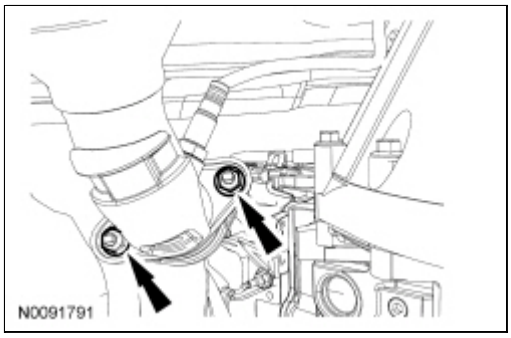


16. Tighten the RH catalytic converter-to-LH catalytic converter Torca® clamp.
    - Tighten to 55 Nm (41 lb-ft).



17. Tighten the 2 new LH catalytic converter-to-exhaust manifold or turbocharger nuts in the following sequence.
    1. Snug the LH inner catalytic converter-to-exhaust manifold or turbocharger nut.
    2. Tighten the LH outer catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).
    3. Tighten the LH inner catalytic converter-to-exhaust manifold or turbocharger nut to 40 Nm (30 lb-ft).

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18. ***NOTICE:*** **If equipped, do not excessively bend, twist or allow the exhaust to hang from the flexible pipe or damage to the muffler and tailpipe may occur.**

    Tighten the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts in the following sequence.
    1. Snug the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt.
    2. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
    3. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

19. Connect the 2 CMS electrical connectors.

3.7L, 5.0L and 6.2L

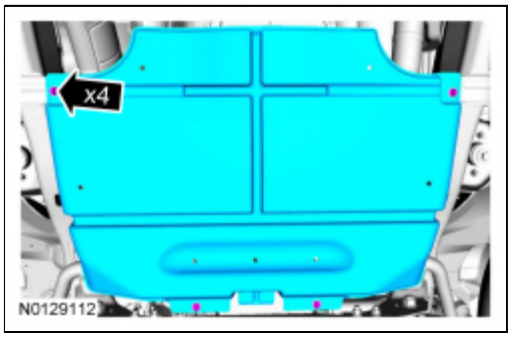
20. Connect the 2 HO2S pushpins and electrical connectors.

3.5L GTDI

21. Connect the RH HO2S pushpin and electrical connector.

All vehicles

22. If equipped, install the splash shield and the 4 fasteners.



3.5L GTDI

23. Connect the LH HO2S pushpin and electrical connector.

All vehicles

24. Start engine and check for exhaust leaks.

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Muffler and Tailpipe

Removal

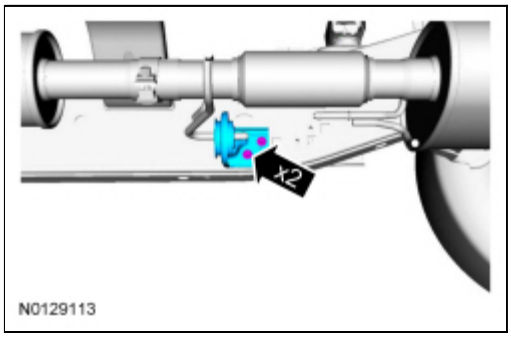
All vehicles

NOTICE: **Do not use oil or grease-based lubricants on the isolators. These lubricants may cause deterioration of the rubber. This can lead to separation of the isolator from the exhaust hanger bracket during vehicle operation.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Support the muffler and tailpipe with a jackstand.
3. Loosen the exhaust intermediate pipe-to-muffler and tail pipe assembly Torca® clamp.
4. Remove the 2 bolts and the front muffler isolator and bracket assembly from the frame.

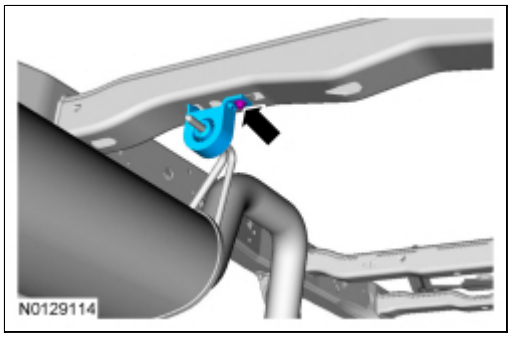
3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L vehicles

5. Remove the 2 bolts and the muffler inlet pipe bracket support isolator from the frame.

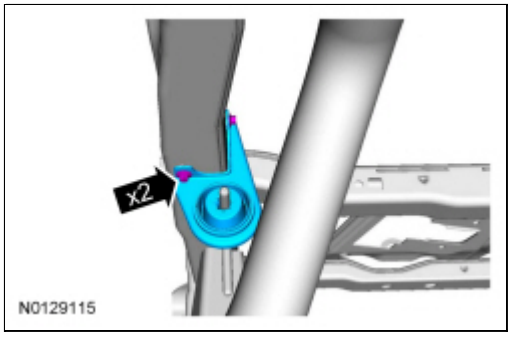


All vehicles

6. Remove the bolt and the rear muffler isolator and bracket assembly from the frame.



7. Remove the 2 bolts and the rear tailpipe hanger isolator from the frame.



8. ***NOTICE:*** **If equipped, do not excessively bend, twist or allow the exhaust to hang from the flexible pipe or damage to the muffler and tailpipe may occur.**

   Release the exhaust intermediate pipe alignment nub from the muffler and tailpipe.
   - Remove the muffler and tail pipe assembly from the vehicle.

Installation

All vehicles

1. **NOTE:** Using an abrasive pad, clean the exhaust Torca® clamp surface area of any surface rust.

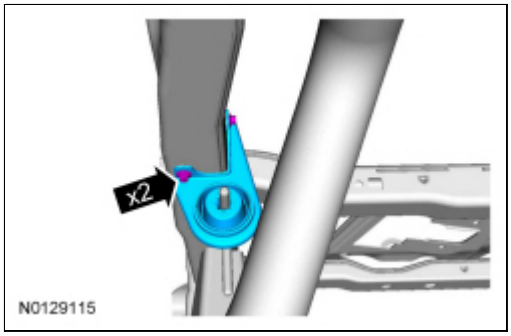
   Position the muffler and tail pipe assembly.

2. ***NOTICE:*** **If equipped, do not excessively bend, twist or allow the exhaust to hang from the flexible pipe or damage to the muffler and tailpipe may occur.**

   Slide the muffler and tail pipe assembly into the exhaust intermediate pipe until the alignment nub on the exhaust intermediate pipe is properly positioned into the L-notch on the muffler and tail pipe.

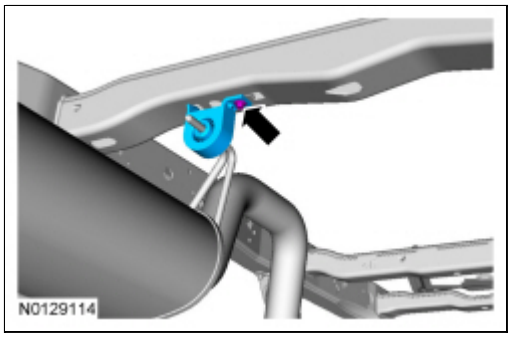
3. Support the muffler and tailpipe with a jackstand.

4. Position the rear tailpipe hanger isolator on the frame and install the 2 bolts.
   - Tighten to 30 Nm (22 lb-ft).



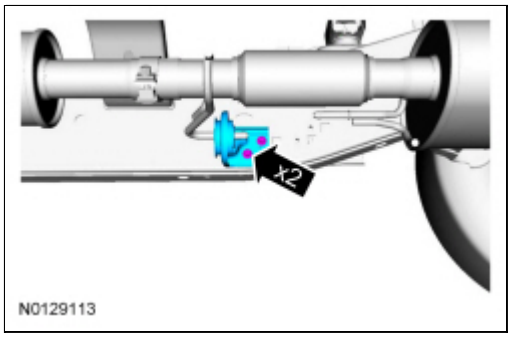
5. Position the rear muffler isolator and bracket assembly on the frame and install the bolt.
   - Tighten to 30 Nm (22 lb-ft).

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3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L vehicles

6. Position the muffler inlet pipe bracket support isolator on the frame and install the 2 bolts.
    - Tighten to 30 Nm (22 lb-ft).



All vehicles

7. Position the front muffler isolator and bracket assembly and install the 2 bolts.
    - Tighten to 30 Nm (22 lb-ft).

8. Tighten the exhaust intermediate pipe-to-muffler and tail pipe assembly Torca® clamp.
    - Tighten to 47 Nm (35 lb-ft).

repair4less

General Specifications

Item	Specification
Fuel Pressure	
Engine running - 3.5L Gasoline Turbocharged Direct Injection (GTDI)	430-500 kPa (62-73 psi)
Engine running - 3.7L	350-430 kPa (51-62 psi)
Engine running - 5.0L (4V)	350-430 kPa (51-62 psi)
Engine running - 6.2L (2V)	350-430 kPa (51-62 psi)
Fuel Tank Capacity	
Standard fuel tank	98.4L (26 gal)
Optional long wheelbase fuel tank	136.3L (36 gal)

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel tank filler pipe hose clamp	4	—	44
High pressure fuel tube-to-fuel injection pump	30	22	—

Fuel System

3.5L Gasoline Turbocharged Direct Injection (GTDI)

The fuel system consists of the following:

- Fuel supply tubes
- Fuel vapor tubes
- Fuel Pump (FP) module (located in the fuel tank)
- High pressure Fuel Pump (FP) (located in the left valve cover)
- Lifetime fuel filter (serviced as part of the FP module)
- Fuel tank filler pipe assembly
- Fuel tank
- Fuel rail
- Fuel injectors
- Fresh air tube (located on top of the transmission)
- Easy Fuel ^{TM} (capless) fuel tank filler pipe assembly (which cannot be modified in any way)
- Supplement refueling adapter (located with the vehicle jack)
- Two-speed Mechanical Returnless Fuel System (MRFS)

The vehicle is equipped with a Gasoline Turbocharged Direct Injection (GTDI) system.

Fuel delivery is accomplished through a MRFS .

- The FP module supplies pressurized fuel to the high pressure FP .
- The high pressure FP supplies high pressure low volume fuel pressure to the fuel rails.
- The fuel injectors are separately controlled and mounted to the intake manifold for each cylinder.
- The fuel tubes route the fuel from the FP to the fuel rail.
- The fuel filter cleans the fuel delivered from the FP to the fuel rail.

3.7L, 5.0L (4V), 6.2L (2V)

The fuel system consists of the following:

- Fuel supply tubes
- Fuel vapor tubes
- Fuel Pump (FP) module (located in the fuel tank)
- Lifetime fuel filter (serviced as part of the FP module)
- Fuel tank filler pipe assembly
- Fuel tank
- Fuel rail
- Fuel injectors

repair4less

- Fresh air tube (located on top of the transmission)
- Easy Fuel TM (capless) fuel tank filler pipe assembly (which cannot be modified in any way)
- Supplement refueling adapter (located with the vehicle jack)
- Two-speed Mechanical Returnless Fuel System (MRFS)

The vehicle is equipped with a Multi-Port Fuel Injection (MFI) system.

Fuel delivery is accomplished through a MRFS .

- The FP supplies the fuel injectors with pressurized fuel through the fuel rail.
- The fuel injectors are separately controlled and mounted to the intake manifold for each cylinder.
- The fuel tubes route the fuel from the FP to the fuel rail.
- The fuel filter cleans the fuel delivered from the FP to the fuel rail.

Fuel Pump (FP) Shut-off Feature

In the event of a moderate to severe collision, the vehicle is equipped with a Fuel Pump (FP) shut-off feature that is initiated by the event notification signal.

The event notification signal is a signal provided by the Restraints Control Module (RCM) to the FP control module. Signal communication between the RCM and the FP control module allows the PCM to shut-off the FP .

Should the vehicle shut off after a collision due to this feature, the vehicle may be restarted by first turning the ignition switch to the OFF position and then turn the ignition switch to the ON position. In some instances the vehicle may not start the first time and may take one additional key cycle.

For exploded view information of the fuel system, refer to Fuel Tank and Filter Pipe — Exploded View or Fuel Lines and Fuel Filter — Exploded View in Section 310-01 .

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Fuel System

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

NOTE: The following procedure diagnoses a slow-to-fill concern only. For all other concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

The fuel tank filler pipe assembly is used to refuel the vehicle. The fuel tank inlet check valve prevents spitback of fuel during and after refueling. The fuel tank stores the fuel. The fuel tank contains a Fuel Pump (FP) module. The FP module consists of a fuel level sender and a FP . The fuel level sender sends a signal to the fuel gauge informing the driver of how much fuel is in the fuel tank. The FP provides fuel to the fuel tubes which supply the fuel rail.

During refueling, the fuel tank vents to the atmosphere through the vent and filler pipes, on vehicles without On-Board Refueling Vapor Recovery (ORVR) systems. In vehicles equipped with ORVR , the fuel tank and filler pipe are designed so that when the vehicle is being refueled, fuel vapors in the fuel tank travel to the Evaporative Emission (EVAP) canister, which absorbs the fuel vapors and vents the pressure from the fuel tank during refueling.

Inspection and Verification

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: Do not use incandescent lights when inspecting the fuel system. Use only flourescent or LED lighting.

1. Verify the customer concern by refueling the vehicle and observe the fuel fill rate.

2. Inspect to determine if any of the following mechanical concerns apply.

Visual Inspection Chart

Mechanical
• Bent, kinked or damaged fuel tank filler pipe • Bent, kinked or damaged fuel tank filler pipe vent tube (if equipped) • Incorrect routing of the fuel tank filler pipe • Incorrect routing of the fuel tank filler pipe vent tube (if equipped) • Incorrect position of fuel tank filler pipe clamps • Incorrect position of fuel tank filler pipe vent tube clamps (if equipped) • Fuel tank mounted vapor tubes bent or damaged • Evaporative Emission (EVAP) system tubes or hoses bent or damaged • Accident damage to the fuel tank • Accident damage to the vehicle affecting the fuel tank filler pipe-to-body connection • Unauthorized modifications and/or alterations to the vehicle • EVAP system fresh air hose plugged (dirt, spider webbing)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.

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- If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the continuous DTCs and carry out the self-test diagnostics for the EVAP system using the scan tool.

9. If the DTCs retrieved are related to the concern, go to Evaporative Emission (EVAP) System DTC Chart. For PCM-related DTCs, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Chart

Evaporative Emission (EVAP) System DTC Chart

DTC	Description	Action
P0446	Evaporative Emission System Vent Control Circuit	GO to Pinpoint Test A .
P0451	Evaporative Emission System Pressure Sensor/Switch Range/Performance	GO to Pinpoint Test A .
P0452	Evaporative Emission System Pressure Sensor/Switch Low	GO to Pinpoint Test A .
P0453	Evaporative Emission System Pressure Sensor/Switch High	GO to Pinpoint Test A .
P0454	Evaporative Emission System Pressure Sensor/Switch Intermittent	GO to Pinpoint Test A .
P1450	Unable to Bleed up Fuel Tank Vacuum	GO to Pinpoint Test A .
P1451	Evaporative Emission System Vent Control Circuit	GO to Pinpoint Test A .
P260F	Emission System Monitoring Processor Performance	GO to Pinpoint Test A .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Slow to fill	• Fuel tank filler pipe • Fuel tank filler pipe vent tube, if equipped • Evaporative Emission (EVAP) system • Fuel tank inlet check valve (part of the fuel tank) • Fuel level vent valve, if	• GO to Pinpoint Test A .

	equipped (part of the Fuel Pump (FP) module)	
• All other fuel system concerns	• Fuel system components	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Pinpoint Test

Pinpoint Test A: Slow to Fill

Normal Operation

Under normal operation, fuel should flow at a steady rate through the fuel tank filler pipe into the fuel tank. As fuel enters the fuel tank, air is vented through the filler pipe or the On-Board Refueling Vapor Recovery (ORVR) system.

This pinpoint test is intended to diagnose the following:

- Fuel tank filler pipe vent tube, if equipped
- Fuel tank filler pipe
- Evaporative Emission (EVAP) system
- Fuel tank inlet check valve (part of the fuel tank)
- Fuel level vent valve, if equipped

PINPOINT TEST A: SLOW TO FILL

Test Step	Result / Action to Take
A1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out Inspection and Verification. • **Was the cause of the concern found?**	**Yes** REPAIR or INSTALL new components to correct the concern. **No** GO to A2.
A2 CHECK THE SYSTEM FOR ANY EVAP DTCs	
• Connect the scan tool. • Check the system for any of the following EVAP DTCs: P0446, P0451, P0452, P0453, P0454, P1450, P1451 and P260F. • **Are any of these DTCs present?**	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnosis the EVAP system. **No** GO to A3.
A3 MONITOR THE FTP WHILE FILLING THE FUEL TANK	
• Monitor the Fuel Tank Pressure (FTP) reference value while filling the fuel tank.	**Yes** GO to A5.

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Refer to the Reference Values in the Powertrain Control/Emissions Diagnosis (PC/ED) manual. • **Is FTP within specification?**	**No** GO to A4.
A4 MONITOR THE FTP WHILE FILLING THE FUEL TANK WITH THE EVAP SYSTEM DISCONNECTED	
• Disconnect the fuel tank-to- EVAP canister quick connect coupling at the EVAP canister. • Monitor the FTP reference value while filling the fuel tank. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. • **Is FTP within specification?**	**Yes** INSPECT the EVAP system for blockage or restrictions. REPAIR the blockage or restriction. If the blockage or restriction cannot be repaired, INSTALL new EVAP system components. **No** GO to A5.
A5 CHECK THE FUEL TANK FILLER PIPE ASSEMBLY FOR BLOCKAGE OR RESTRICTION	
• Remove the fuel tank filler pipe assembly. Refer to Section 310-01. • Inspect the fuel tank filler pipe and fuel tank filler pipe vent tube (if equipped) for a blockage or restriction. • **Is the fuel tank filler pipe or fuel tank filler pipe vent tube (if equipped) blocked or restricted?**	**Yes** If possible, REPAIR the blockage or restriction. If the blockage or restriction cannot be repaired, INSTALL a new fuel tank filler pipe or fuel tank filler pipe vent tube. **No** GO to A6.
A6 CHECK THE FUEL TANK INLET CHECK VALVE	
• Inspect the fuel tank inlet check valve for restriction or sticking. • **Is the fuel tank inlet check valve restricted or sticking?**	**Yes** If possible, REPAIR the restrictions. If the restriction cannot be repaired, INSTALL a new fuel tank. REFER to Section 310-01. **No** GO to A7.
A7 CHECK TO MAKE SURE THAT THE FUEL LEVEL VENT VALVE IS FUNCTIONING CORRECTLY	
• **NOTE:** The fuel level vent valve, if equipped, is part of the FP module. • Remove the FP module. Refer to Section 310-01. • Inspect the fuel level vent valve for foreign material at the bottom drain hole. • Invert the FP. Watch for a movement and a click noise. • **Was a movement/click noise witnessed?**	**Yes** Fuel level vent valve is OK. RETEST the system for normal operation. **No** INSTALL a new FP module. REFER to Section 310-01.

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Fuel System Pressure Release

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

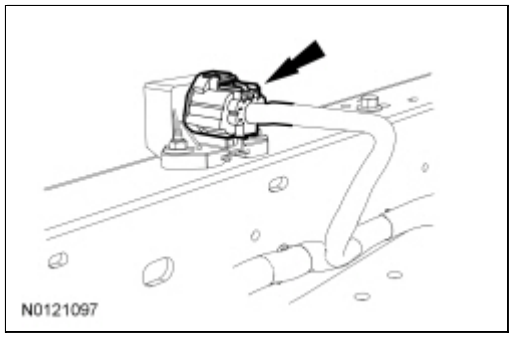
WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** The Fuel Pump Control Module (FPCM) is located on the frame rail above the spare tire.

   Disconnect the Fuel Pump Control Module (FPCM) electrical connector.



3. Start the engine and allow it to idle until it stalls.

4. After the engine stalls, crank the engine for approximately 5 seconds to make sure the fuel rail pressure has been released.

5. Turn the ignition switch to the OFF position.

6. Disconnect battery ground cable.

Gasoline Turbocharged Direct Injection (GTDI) equipped vehicles

7. Remove and discard the nut for the high pressure fuel tube bracket.

8. **NOTE:** On vehicles equipped with Gasoline Turbocharged Direct Injection (GTDI), it is necessary to release the high pressure fuel system prior to disconnecting a low pressure fuel tube quick connect coupling.

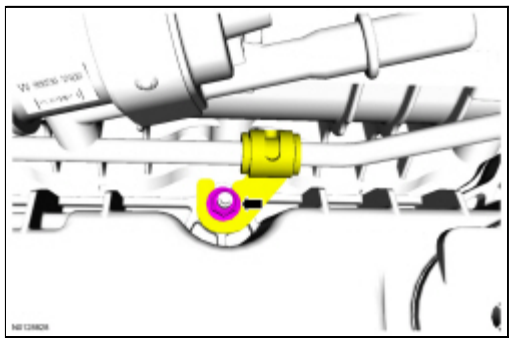
   NOTE: To release the fuel pressure in the high pressure fuel tube, wrap the flare nut with a shop towel to absorb any residual fuel pressure during the loosening of the flare nut.

   Disconnect the high pressure fuel tube-to-fuel injection pump flare nut to release the fuel pressure.

9. Connect the high pressure fuel tube-to-fuel injection pump flare nut.
   1. Tighten to 15 Nm (133 lb-in).
   2. Tighten an additional 30 degrees.
   3. Tighten to 32 Nm (24 lb-ft).

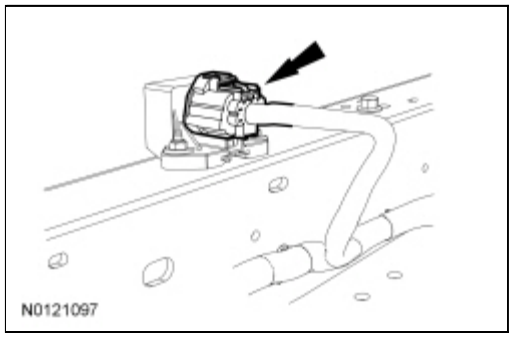
All vehicles

10. Install new nut for the high pressure fuel tube bracket.
    - Tighten to 8 Nm (71 lb-in).



11. Reconnect battery ground cable.

12. When fuel system service is complete, reconnect the FPCM electrical connector.



13. **NOTE:** It may take more than one key cycle to pressurize the fuel system.

    Cycle the ignition key and wait 3 seconds to pressurize the fuel system. Check for leaks before

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starting the engine.

14. Start the vehicle and check the fuel system for leaks.

Fuel System Pressure Test

Special Tool(s)

 ST3038-A	Fuel Pressure Test Kit 310-D009 (D95L-7211-A) or equivalent
 ST3284-A	Fuel Pressure T-Adapter 3/8" 310-D252 or equivalent

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

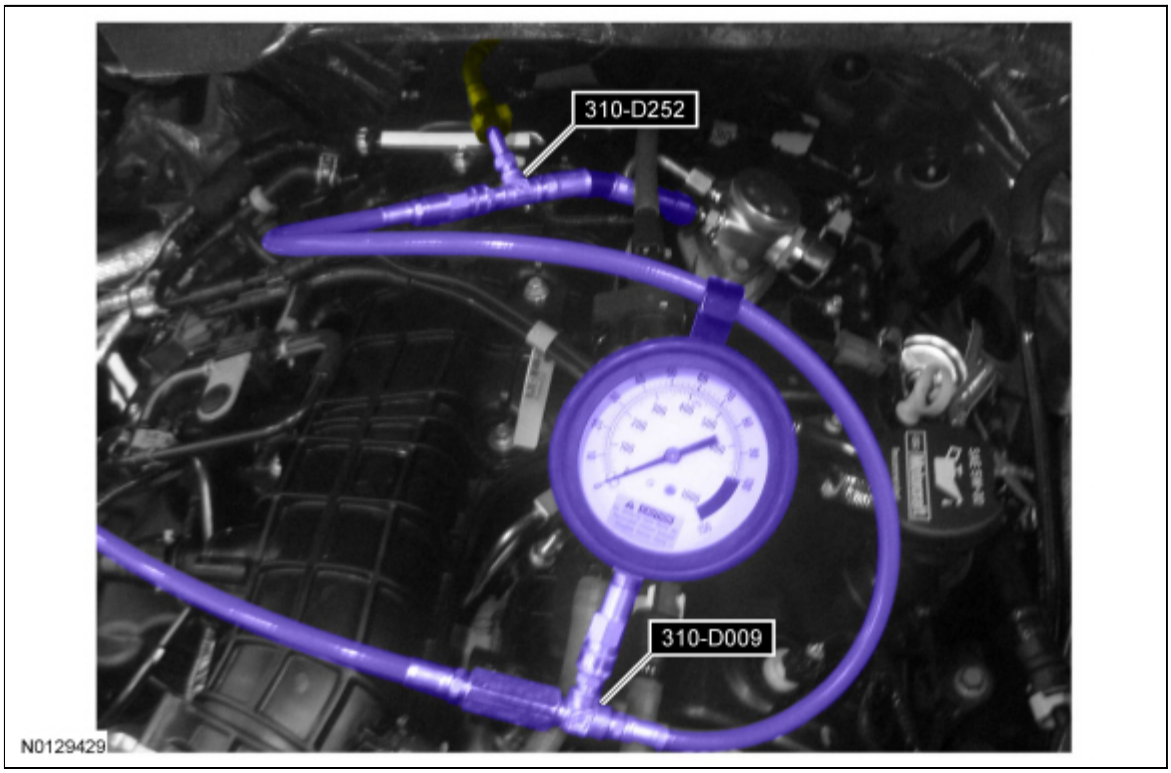
3.5L Gasoline Turbocharged Direct Injection (GTDI)

3. Remove the fuel injection pump noise insulator shield.

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4. Disconnect the front fuel supply tube-to-fuel injection pump quick connect coupling. For additional information, refer to Quick Connect Coupling in this section.

5. Install the Fuel Pressure T-Adapter 3/8" and Fuel Pressure Test Kit between the fuel tube and the fuel injection pump.



3.7L, 5.0L (4V), 6.2L (2V) engines

6. Disconnect the front fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to Quick Connect Coupling in this section.

7. Install the Fuel Pressure T-Adapter 3/8" and Fuel Pressure Test Kit in line between the fuel supply line and fuel rail.

All vehicles

8. **NOTE:** The Fuel Pump (FP) control module electrical connector was previously disconnected to release the fuel system pressure and must be reconnected to test the fuel system pressure.

   Connect the FP control module electrical connector.

9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

10. **NOTE:** It may take more than one key cycle to pressurize the fuel system.

    Cycle the ignition key and wait 3 seconds to pressurize the fuel system. Check for leaks before starting the engine.

11. **NOTE:** After completing the fuel system pressure test, open the drain valve on the Fuel Pressure Test Kit and release any residual fuel into a suitable container prior to removing the tool.

Test the fuel system pressure to make sure it is within the specified range. For additional information, refer to Specifications in this section.

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Fuel Tank Draining

Special Tool(s)

 ST1134A	100 Gallon Gasoline Hand Pump Storage Tanker 292-00007 or equivalent

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

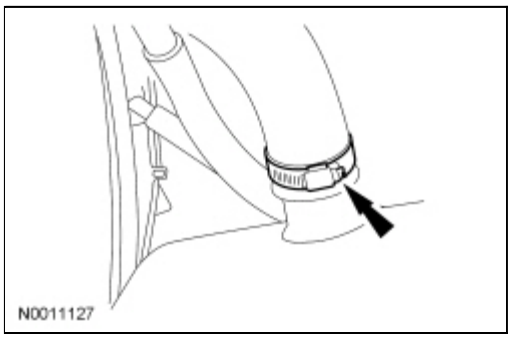
WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

WARNING: Remove the fuel filler cap slowly. The fuel system may be under pressure. If the fuel filler cap is venting vapor or if you hear a hissing sound, wait until it stops before completely removing the fuel filler cap. Otherwise, fuel may spray out. Failure to follow these instructions may result in serious personal injury.

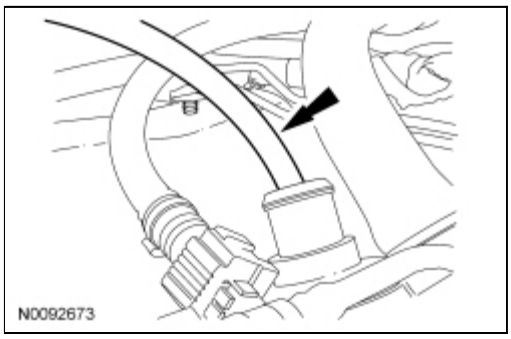
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Relieve the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
4. Remove the driveshaft. For additional information, refer to Section 205-01 .
5. Disconnect the fuel tank filler pipe from the fuel tank.

- To install, tighten to 4 Nm (35 lb-in).



6. **NOTE:** Follow the operating instructions supplied by the equipment manufacturer.

   Insert the hose from the 100 Gallon Manual Fuel Tanker and siphon the fuel through the fuel tank inlet spout.



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Quick Connect Coupling

Disconnect — Type I

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

***NOTICE:* Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage may occur. Always install plugs to any open orifices or tubes.**

***NOTICE:* When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip may occur.**

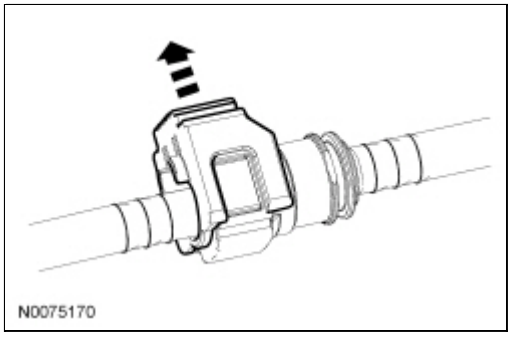
NOTE: During the repair or replacement of fuel-related components, all fuel liquid and fuel vapor openings must be capped, taped or otherwise appropriately protected to prevent the ingress of dirt or other contamination. All caps, tape and other protective materials must be removed prior to installation.

1. If servicing a liquid fuel tube, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

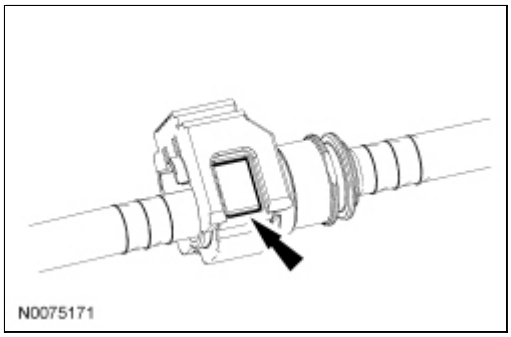
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. ***NOTICE:* Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

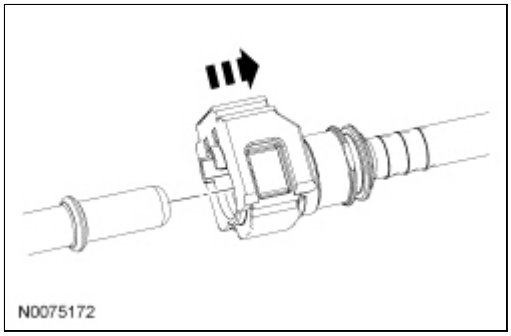
Position the secondary latch outward.



4. Squeeze both of the release tabs.

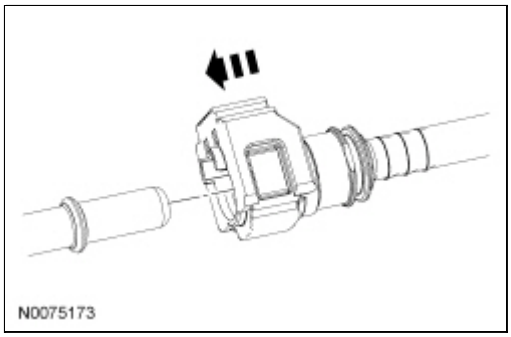


5. Remove the quick connect coupling from the tube.



Connect — Type I

1. Install the quick connect coupling onto the tube until completely seated.

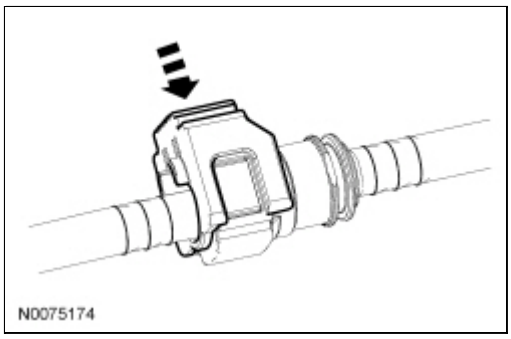


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2. ***NOTICE:*** **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

   NOTE: Make sure the coupling is completely seated and locked onto the tube by pulling on the quick connect coupling.

   Apply the secondary latch into the locked position.



3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect — Type II

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage may occur. Always install plugs to any open orifices or tubes.**

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove**

any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip may occur.

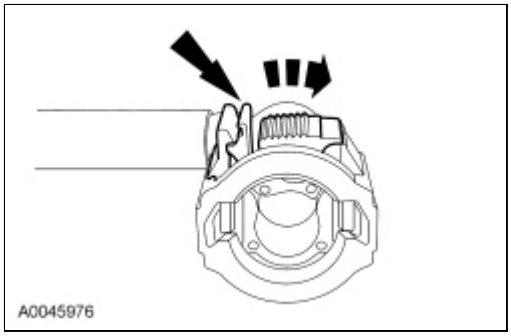
NOTE: During the repair or replacement of fuel-related components, all fuel liquid and fuel vapor openings must be capped, taped or otherwise appropriately protected to prevent the ingress of dirt or other contamination. All caps, tape and other protective materials must be removed prior to installation.

1. If servicing a liquid fuel tube, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

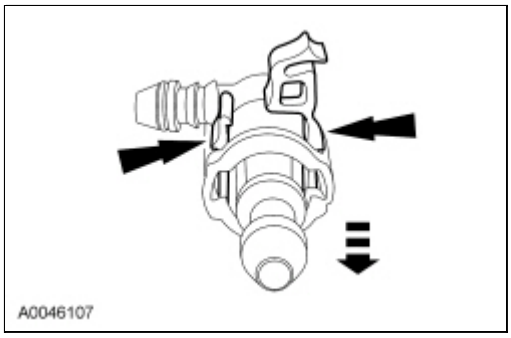
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. ***NOTICE:*** **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

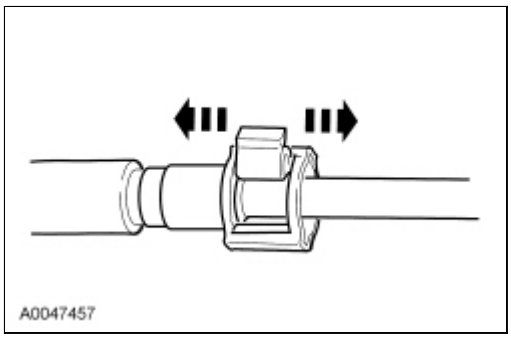
   Unclip the locking tab.



4. Depress the tabs and press the clip downward.



5. Separate the quick connect coupling.

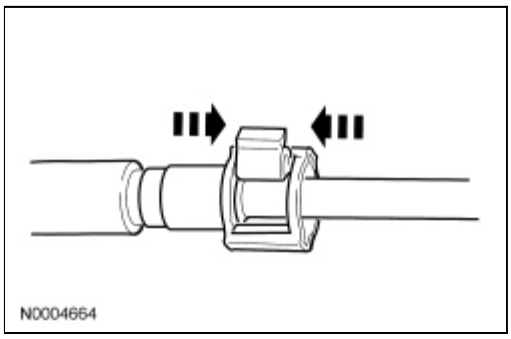


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Connect — Type II

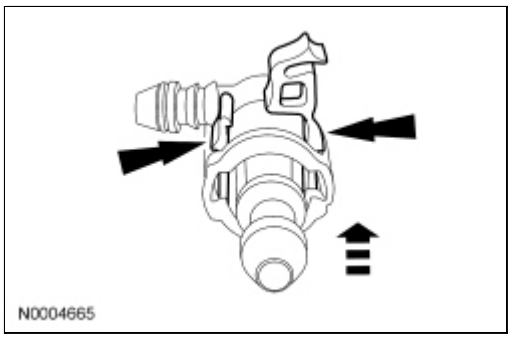
1. Inspect and clean both quick connect coupling ends.
2. **NOTE:** Make sure the fuel tube clicks into place when installing the tube. To make sure that the fuel tube is fully seated, pull on the tube.

   Connect the tube into the quick connect coupling.

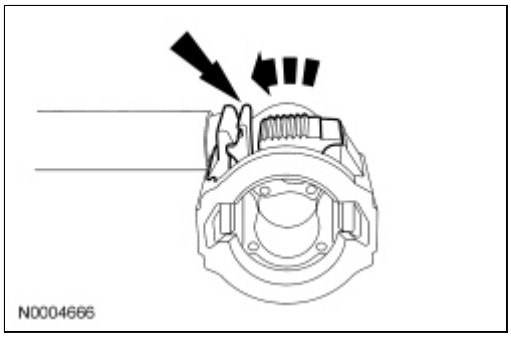


3. ***NOTICE:*** **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

   Push the clip up into the quick connect coupling. Pull on the tube to make sure it is seated correctly.



4. Clip the locking tab into place.



5. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect — Type III

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

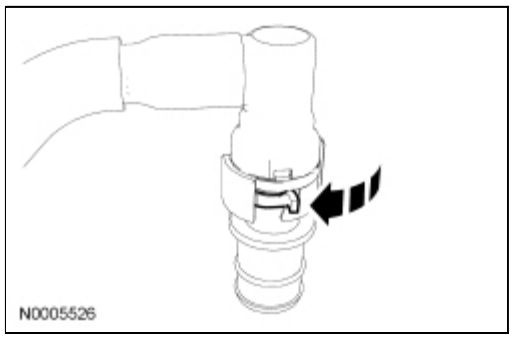
WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

***NOTICE:* When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip may occur.**

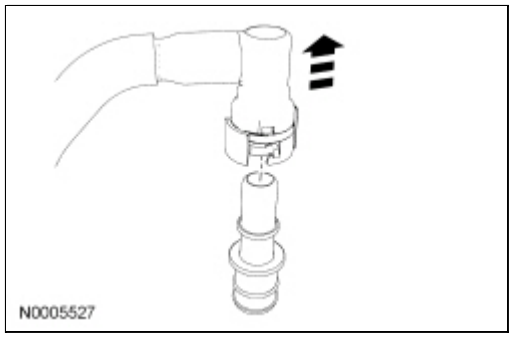
NOTE: During the repair or replacement of fuel-related components, all fuel liquid and fuel vapor openings must be capped, taped or otherwise appropriately protected to prevent the ingress of dirt or other contamination. All caps, tape and other protective materials must be removed prior to installation.

1. ***NOTICE:* Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

   Release the locking tab on the quick connect coupling.



2. Separate the quick connect coupling from the fitting.



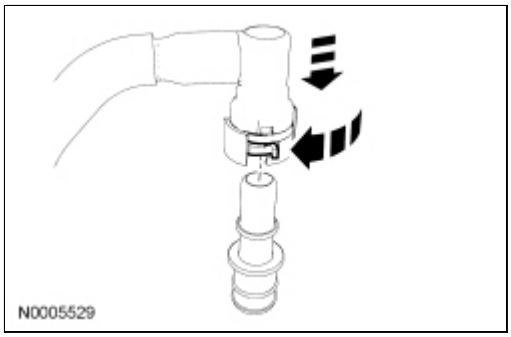
Connect — Type III

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1. Inspect the quick connect coupling and the tube for damage. Remove any dirt or obstructions.

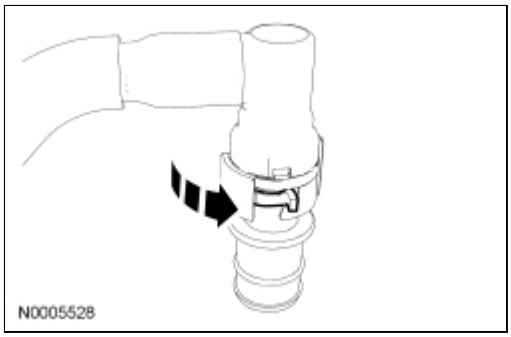
2. ***NOTICE:*** **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

   Release the locking tab and install the quick connect coupling onto the fitting.



3. **NOTE:** Make sure the fuel tube clicks into place when installing the tube. To make sure that the fuel tube is fully seated, pull on the tube.

   Position the locking tab into the latched position.



Disconnect — Type IV

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in

the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

***NOTICE:* When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur.**

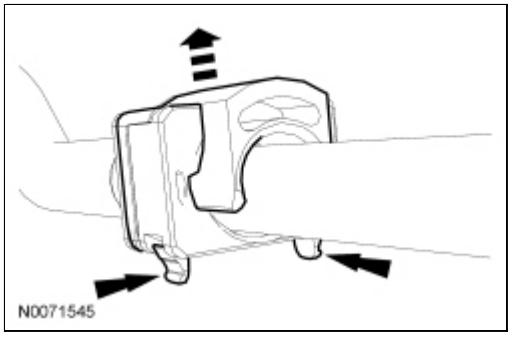
***NOTICE:* Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install blanking plugs to any open orifices or tubes.**

1. If servicing a liquid fuel tube, release the fuel system pressure. For additional information refer to Fuel System Pressure Release in this section.

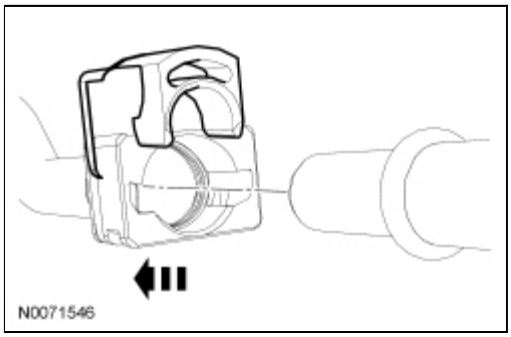
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. ***NOTICE:* Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

   Depress the legs of the retainer clip and position the clip to the outward position.



4. Disconnect the quick connect coupling from the fuel tube.

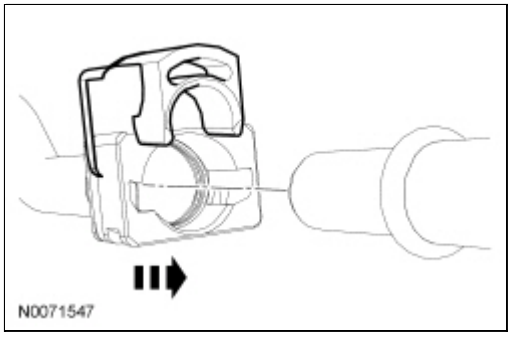


Connect — Type IV

1. Inspect and clean both quick connect coupling ends.

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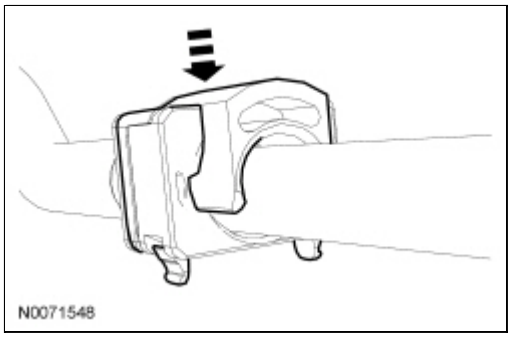
2. Install the quick connect coupling onto the fuel tube until fully seated.



3. ***NOTICE:*** **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

   NOTE: Make sure the retainer clip is fully seated and locked onto the fuel tube by pulling on the quick connect coupling.

   Press the retainer clip into the quick connect coupling body until flush and the legs are locked in place.



4. Connect the battery ground cable. For additional information, refer to Section 414-01 .

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Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Front fuel supply tube, vapor tube and fresh air tube rear bracket bolt	35	26	—
Fuel pump module cover nuts	9	—	80
Fuel tank skid plate nuts	20	—	177
Fuel tank support strap bolts	47	35	—
Selector lever cable bracket bolts (6R80 automatic transmission)	25	18	—

Fuel Tank and Lines

3.5L Gasoline Turbocharged Direct Injection (GTDI)

The fuel system contains the following:

- Fuel tank assembly
- Easy Fill ™ (capless) fuel tank filler pipe assembly (which cannot be modified in any way)
- Lifetime fuel filter (serviced as part of the Fuel Pump (FP) module)
- Fuel tube(s)
- Fuel vapor tubes
- Fresh air tube (located on top of the transmission)
- FP module containing:
  - the electric FP , which provides pressurized fuel to the high pressure FP .
  - the fuel level sensor.
  - an inlet filter.
  - a check valve which maintains system pressure after the pump is shut off.
  - a pressure regulator.

The FP is controlled by the PCM which energizes the FP control module. Electrical power to the pump is provided through the FP control module.

3.7L, 5.0L (4V), 6.2L (2V)

The fuel system contains the following:

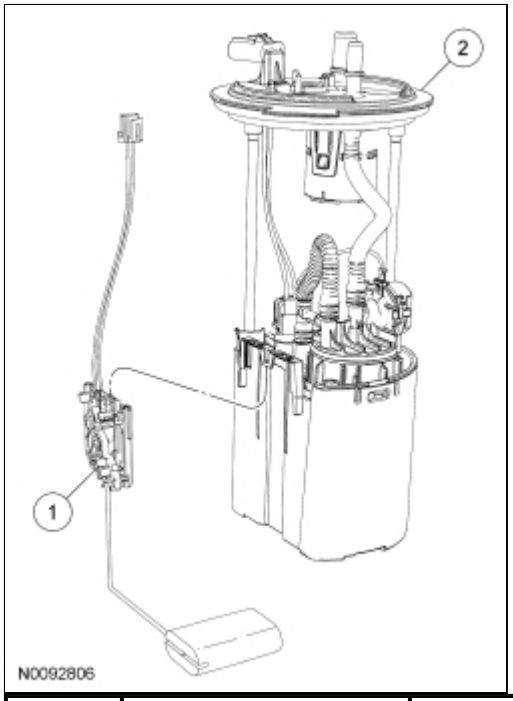
- Fuel tank assembly
- Easy Fill ™ (capless) fuel tank filler pipe assembly (which cannot be modified in any way)
- Lifetime fuel filter (serviced as part of the Fuel Pump (FP) module)
- Fuel tube(s)
- Fuel vapor tubes
- Fresh air tube (located on top of the transmission)
- FP module containing:
  - the electric FP , which provides pressurized fuel to the engine.
  - the fuel level sensor.
  - an inlet filter.
  - a check valve which maintains system pressure after the pump is shut off.
  - a pressure regulator.

The FP is controlled by the PCM which energizes the FP control module. Electrical power to the pump is provided through the FP control module.

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Fuel Level Sender

Removal and Installation



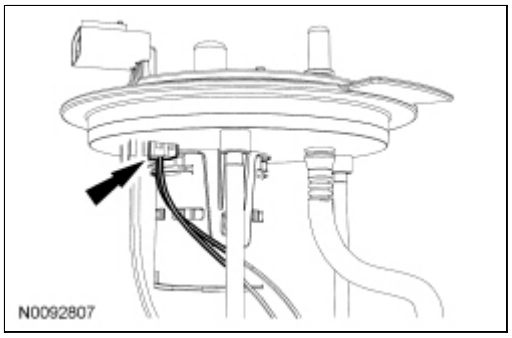
Item	Part Number	Description
1	9A299	Fuel level sender
2	9H307	Fuel Pump (FP) module

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

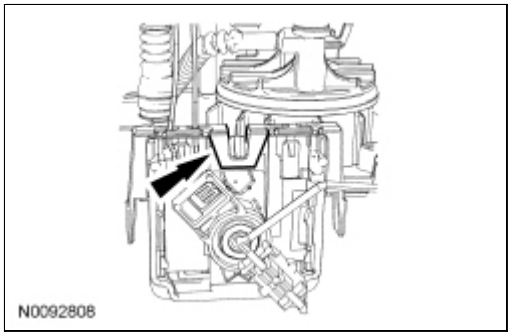
1. Remove the Fuel Pump (FP) module. For additional information, refer to Fuel Pump Module in this section.

2. Disconnect the fuel level sender-to- FP module electrical connector.

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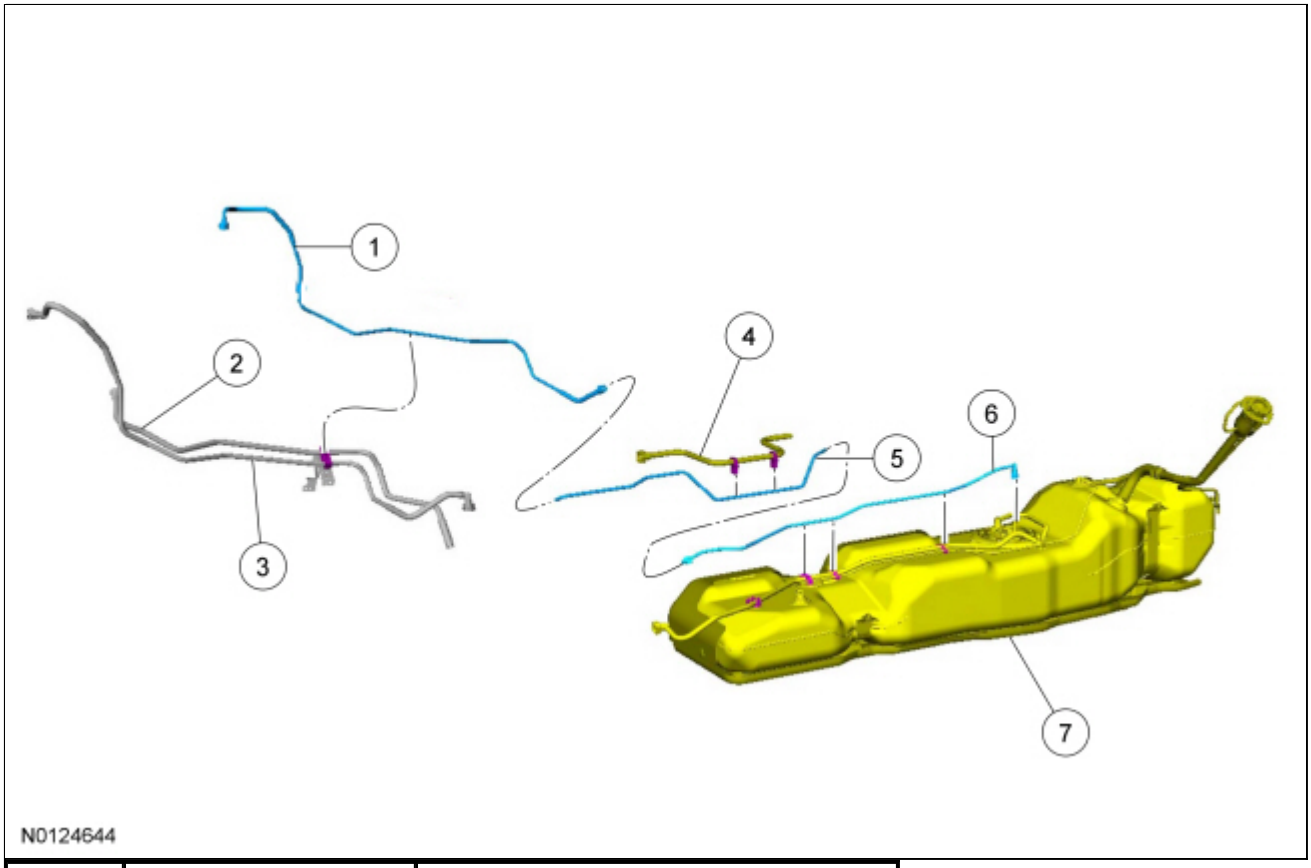
3. Disconnect the FP module retainer clip and slide the fuel level sender off of the FP module.



4. To install, reverse the removal procedure.

Fuel Lines — Exploded View

NOTE: 5.0L (4V) shown, others similar.



Item	Part Number	Description
1	9J280	Front fuel supply tube
2	9S327	Fresh air tube
3	9D676	Fuel vapor tube
4	—	Fuel vapor tube
5	—	Center fuel supply tube
6	9S278	Rear supply tube
7	9002	Fuel tank

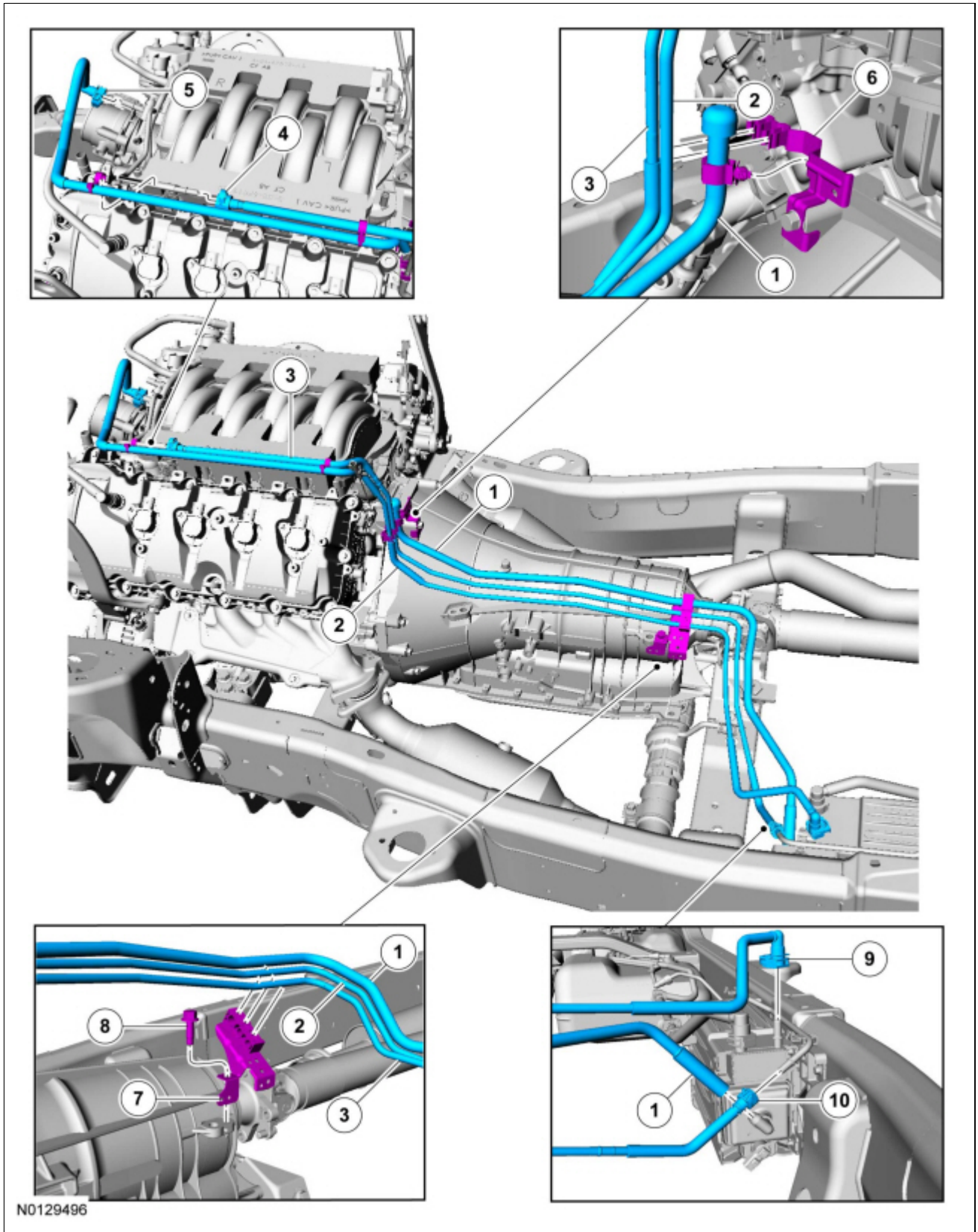
1. For additional information, refer to the procedures in this section.

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Fuel Lines

NOTE: 5.0L (4V) automatic transmission with Rear Wheel Drive (RWD) shown, others similar.

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Item	Part Number	Description
1	9J338	Fresh air tube

2	9D676	Fuel vapor tube
3	9J280	Front fuel supply tube
4	—	Fuel vapor tube-to-Evaporative Emission (EVAP) canister purge valve quick connect coupling (part of 9D676)
5	—	Front fuel supply tube-to-fuel rail quick connect coupling (part of 9J280)
6	2S284	Front fuel supply tube, vapor tube and fresh air tube transmission bellhousing bracket
7	9D319	Front fuel supply tube, vapor tube and fresh air tube rear bracket
8	W715531	Front fuel supply tube, vapor tube and fresh air tube rear bracket bolt
9	—	Fuel vapor tube-to- EVAP canister quick connect coupling (part of 9D676)
10	—	Front fuel supply tube-to-center fuel supply tube quick connect coupling (part of 9J280)

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: Remove the fuel filler cap slowly. The fuel system may be under pressure. If the fuel filler cap is venting vapor or if you hear a hissing sound, wait until it stops before completely removing the fuel filler cap. Otherwise, fuel may spray out. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3.5L Gasoline Turbocharged Direct Injection (GTDI)

4. Remove the fuel injection pump noise insulator shield.

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5. Disconnect the front fuel supply tube-to-fuel injection pump quick connect coupling. For additional information, refer to Section 310-00 .

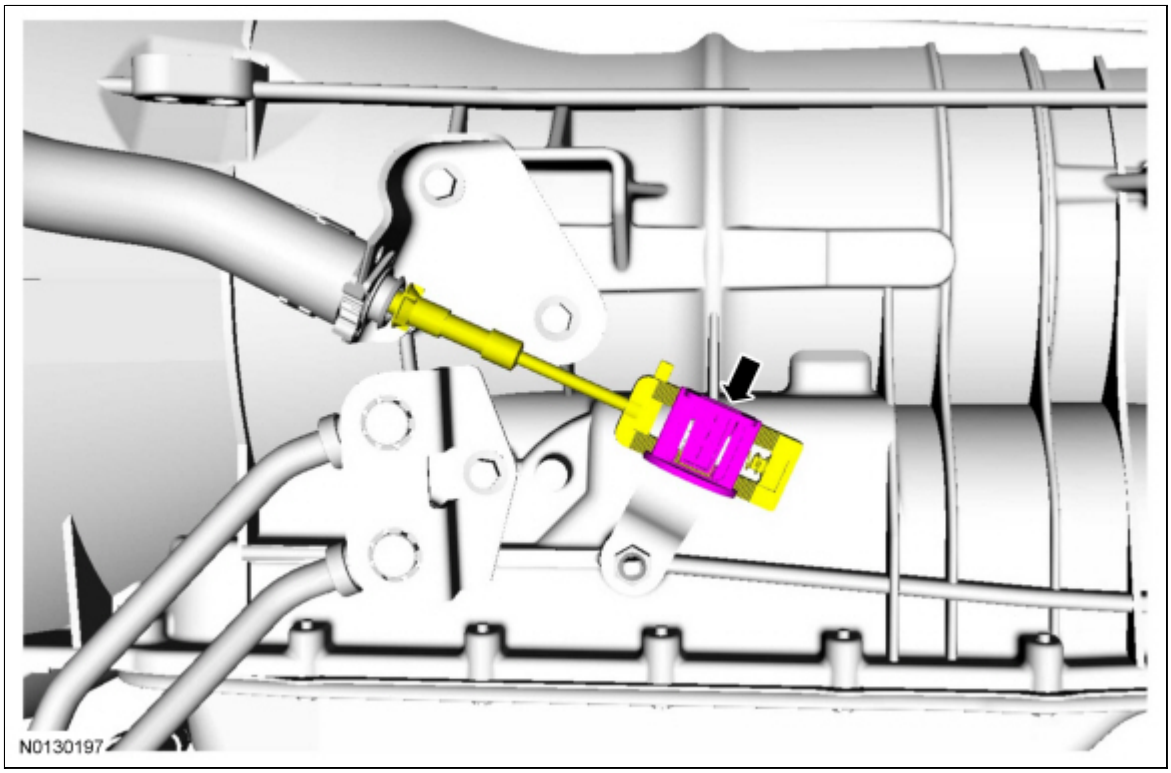
3.7L, 5.0L (4V), 6.2L (2V) engines

6. Disconnect the front fuel supply tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

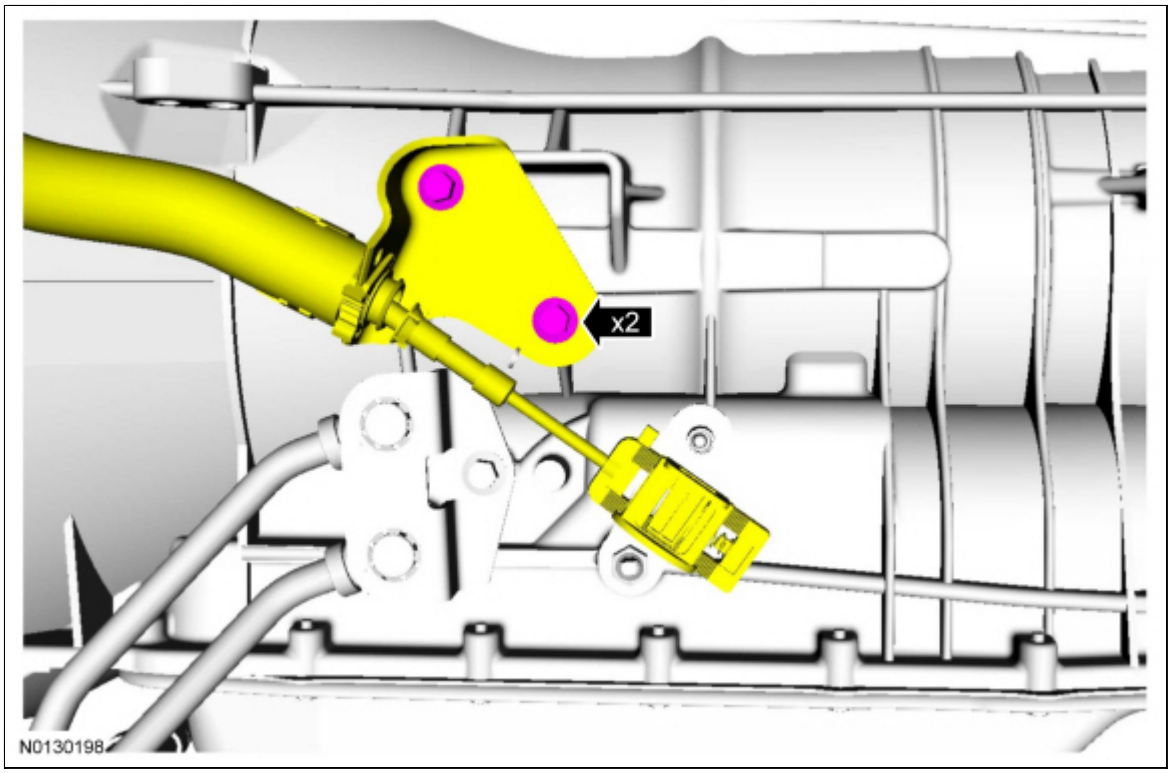
All vehicles

7. Disconnect the fuel vapor tube-to-Evaporative Emission (EVAP) canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .

8. Move the locking tab up and disconnect the selector lever cable from the manual lever ball stud.



9. Remove the selector lever cable bracket and 2 bolts.
    - To install, tighten to 48 Nm (35 lb-ft).



10. If equipped, remove the transfer case shift lever. For additional information, refer to Section 308-07B .

11. Disconnect the vapor tube-to- EVAP canister quick connect coupling. For additional information, refer to Section 310-00 .

12. Disconnect the fresh air tube from the EVAP canister vent solenoid and dust separator assembly.

13. Disconnect the front fuel supply tube-to-center fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .

14. If necessary, remove the front fuel supply tube, vapor tube and fresh air tube bracket bolt at the rear of the transmission.
    - To install, tighten to 35 Nm (26 lb-ft).

15. Unclip the front fuel supply tube, vapor tube and fresh air tube from the bracket at the rear of the transmission.

16. Unclip the front fuel supply tube and vapor tube from the bracket at the transmission bellhousing.

17. Remove the front fuel supply tube from the vehicle.

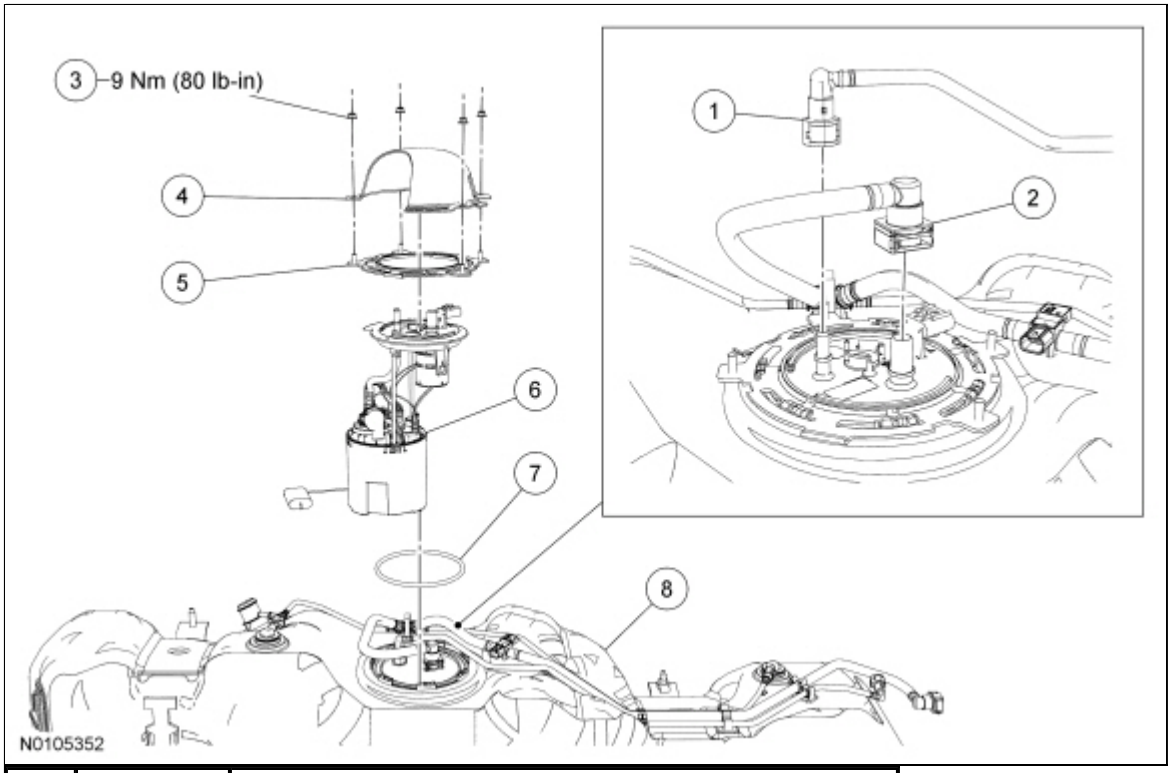
18. Remove the vapor tube from the vehicle.

19. Unclip the fresh air tube retainer from the bracket at the transmission bellhousing and remove from the vehicle.

20. To install, reverse the removal procedure.

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Fuel Pump Module — Exploded View



Item	Part Number	Description
1	—	Fuel supply tube quick connect coupling (part of 9J279)
2	—	Fuel Tank Pressure (FTP) sensor and vapor tube assembly quick connect coupling (part of 9J279)
3	W520101	Fuel pump module cover nuts (4 required) (if equipped)
4	9B007	Fuel pump module cover (if equipped)
5	9B077	Fuel pump module locking ring
6	9H307	Fuel pump module
7	9276	Fuel pump module O-ring seal
8	9002	Fuel tank

1. For additional information, refer to the procedures in this section.

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Fuel Pump Module

Special Tool(s)

 ST2803-A	Wrench, Fuel Tank Sending Unit 310-123

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal and Installation

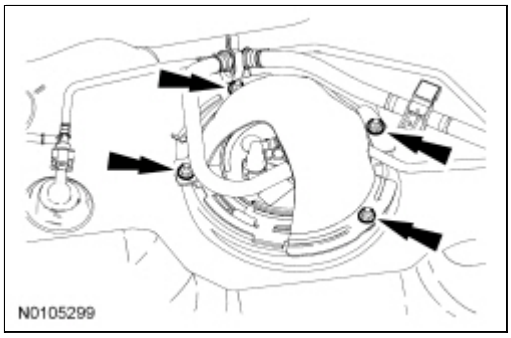
WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

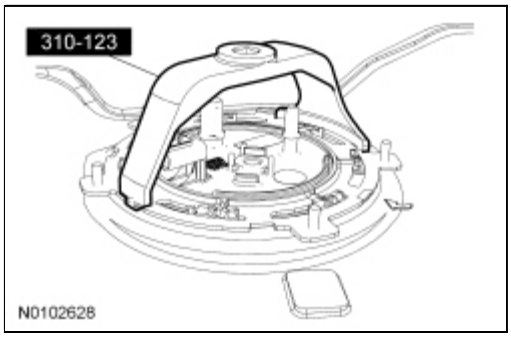
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the fuel tank. For additional information, refer to Fuel Tank in this section.
3. Using soapy water, clean a minimum of 76 mm (3 in) surface area around the Fuel Pump (FP) module.
4. If equipped, remove the 4 fuel pump module cover nuts and remove the fuel pump module cover.
   - To install, tighten to 9 Nm (80 lb-in).

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5. Disconnect the fuel supply tube and Fuel Tank Pressure (FTP) sensor and vapor tube assembly quick connect couplings at the FP module. For additional information, refer to Section 310-00 .

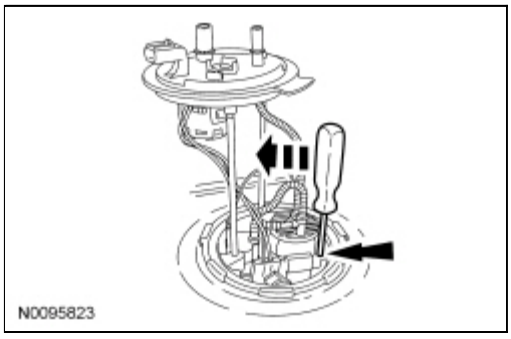
6. Using the Fuel Tank Sending Unit Wrench, remove the FP module locking ring.



7. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm and the filter.**

   NOTE: If the FP does not clear the FP mounting flange on the fuel tank, the use of a screwdriver may be necessary.

   Remove the FP module.
   - If necessary, insert a screwdriver into the empty FP rod hole and slightly pull the screwdriver inboard until the base of the FP clears the FP mounting flange.

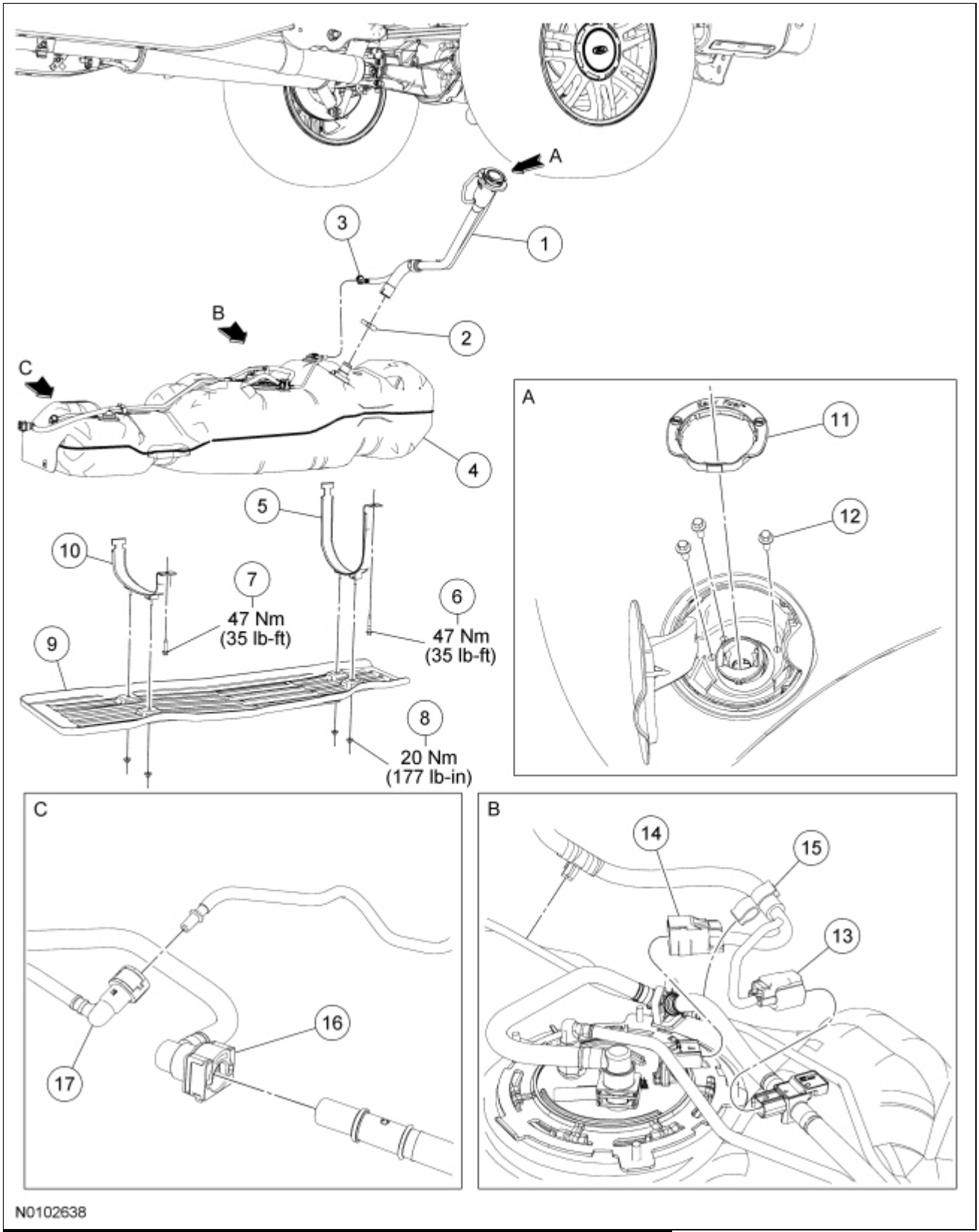


8. Remove and discard the FP module O-ring seal.

9. To install, reverse the removal procedure.
   - Install a new FP module O-ring seal and lubricate with clean engine oil.

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Fuel Tank and Filler Pipe — Exploded View



Item	Part Number	Description
1	9034	Fuel tank filler pipe assembly

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2	W525937	Fuel tank filler pipe hose clamp
3	—	Fuel tank filler pipe vent tube quick connect coupling (part of 9034)
4	9002	Fuel tank assembly
5	9057	Rear fuel tank support strap
6	W709593	Fuel tank support strap bolt
7	W710428	Fuel tank support strap bolt
8	W705047	Fuel tank skid plate nut (4 required) (if equipped)
9	9A147	Fuel tank skid plate (if equipped)
10	9054	Front fuel tank support strap
11	9K072	Information bezel
12	W505253	Fuel tank filler pipe screw (3 required)
13	—	Fuel Tank Pressure (FTP) and vapor tube assembly electrical connector (part of 14405)
14	—	Fuel pump module electrical connector (part of 14405)
15	—	Wiring harness retainer (part of 14405)
16	—	FTP and vapor tube assembly-to-Evaporative Emission (EVAP) canister vapor tube quick connect coupling (part of 9J279)
17	—	Fuel tank fuel supply tube-to-center fuel supply tube quick connect coupling (part of 9J279)

1. For additional information, refer to the procedures in this section.

Fuel Tank Filler Pipe

Removal and Installation

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

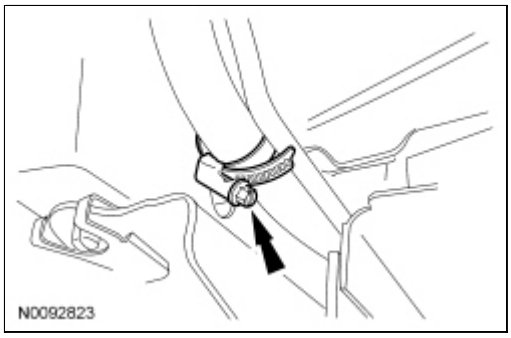
WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

WARNING: Remove the fuel filler cap slowly. The fuel system may be under pressure. If the fuel filler cap is venting vapor or if you hear a hissing sound, wait until it stops before completely removing the fuel filler cap. Otherwise, fuel may spray out. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the driveshaft. For additional information, refer to Section 205-01 .
4. Loosen the worm gear clamp and disconnect the fuel tank filler pipe from the fuel tank.
    - To install, tighten to 4 Nm (35 lb-in).
5. Disconnect the fuel tank filler pipe-to-Fuel Tank Pressure (FTP) sensor and vapor tube assembly quick connect coupling. For additional information, refer to Section 310-00 .
6. Loosen the fuel tank filler pipe-to-body worm gear clamp.
    - To install, tighten to 5 Nm (44 lb-in).

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7. Remove the fuel tank filler pipe information bezel.

8. Remove the 3 screws from the fuel tank filler pipe and remove the fuel tank filler pipe.
    - To install, tighten to 3 Nm (27 lb-in).

9. To install, reverse the removal procedure.

Fuel Tank

Removal and Installation

WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. Drain the fuel tank. For additional information, refer to Section 310-00 .
2. Disconnect the fuel tank fuel supply tube-to-center fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .
3. Disconnect the Fuel Tank Pressure (FTP) sensor and vapor tube assembly-to-Evaporative Emission (EVAP) canister assembly vapor tube quick connect coupling. For additional information, refer to Section 310-00 .
4. Disconnect the FTP sensor and Fuel Pump (FP) module electrical connectors, and if equipped, retainer(s).
5. Disconnect the fuel tank filler pipe-to- FTP sensor and vapor tube assembly quick connect coupling. For additional information, refer to Section 310-00 .
6. If equipped, remove the 4 fuel tank skid plate nuts and the skid plate.
   - To install, tighten to 20 Nm (177 lb-in).
7. Use a suitable jack to support the fuel tank.
8. Remove the 2 fuel tank support strap-to-frame bolts and remove the fuel tank support straps.
   - To install, tighten to 47 Nm (35 lb-ft).
9. Lower the fuel tank out of the vehicle.
10. To install, reverse the removal procedure.

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Torque Specifications

Description	Nm	lb-ft
Adjustable accelerator pedal bolts	25	18
Fixed accelerator pedal bolts	25	18

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Acceleration Control

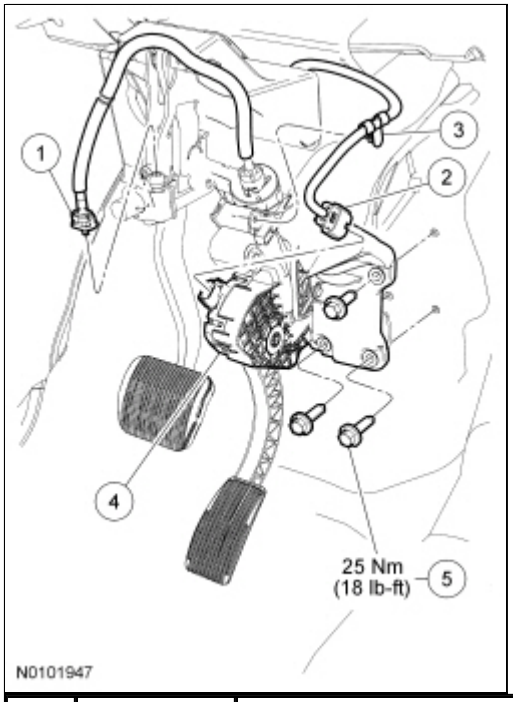
The acceleration control consists of one of the following:

- A fixed accelerator pedal and position sensor assembly
- An adjustable accelerator pedal and position sensor assembly

The throttle is controlled by an Accelerator Pedal Position (APP) sensor on the accelerator pedal assembly. The APP sensor sends a signal to the PCM in response to throttle pedal movements initiated by the driver. The PCM sends a signal to the electronic throttle control which increases and decreases throttle position.

Some vehicles are equipped with adjustable pedals. This allows both the accelerator and brake pedals to be adjusted simultaneously forward or rearward. A rocker switch on the instrument panel provides adjustment on the pedal assembly when it is activated. On vehicles with the memory seat option, the pedal position can be controlled by the memory selection, as well as the rocker switch. The components in the acceleration control system cannot be repaired, new components must be installed if damaged or worn. When servicing the adjustable accelerator pedal, always disconnect the cable at the brake pedal.

Accelerator Pedal — Adjustable



Item	Part Number	Description
1	—	Accelerator pedal-to-brake pedal cable (part of 9F836)
2	—	Accelerator Pedal Position (APP) sensor electrical connector (part of 12A581)
3	—	APP sensor electrical connector wiring harness retainer (part of 12A581)
4	9F836	Accelerator pedal assembly
5	W713384	Accelerator pedal assembly bolts (3 required)

Removal

1. If possible, adjust the pedals to the full forward (away from driver) position.
2. **NOTE:** To prevent setting DTCs, make sure the ignition switch is in the OFF position prior to disconnecting the accelerator pedal electrical connector.

   Disconnect the Accelerator Pedal Position (APP) sensor electrical connector.
3. Disconnect the accelerator pedal-to-brake pedal cable from the brake pedal.
4. Remove the 3 bolts and the accelerator pedal assembly.

Installation

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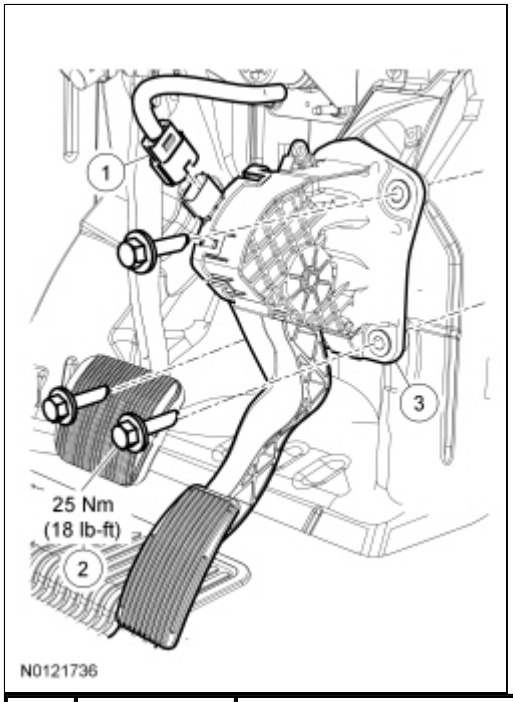
1. Install the accelerator pedal assembly and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

2. Connect the accelerator pedal-to-brake pedal cable to the brake pedal.

3. Connect the APP sensor electrical connector.

4. Carry out the adjustable pedal indexing procedure. For additional information, refer to Section 206-06 .

Accelerator Pedal — Fixed



Item	Part Number	Description
1	—	Accelerator Pedal Position (APP) sensor electrical connector (part of 12A581)
2	W713384	Accelerator pedal assembly bolts (3 required)
3	9F836	Accelerator pedal assembly

Removal and Installation

1. **NOTE:** To prevent setting DTCs, make sure the ignition switch is in the OFF position prior to disconnecting the accelerator pedal electrical connector.

   Disconnect the Accelerator Pedal Position (APP) sensor electrical connector.

2. Remove the 3 bolts and the accelerator pedal assembly.
   - To install, tighten to 25 Nm (18 lb-ft).

3. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Motorcraft® A/C Cooling Coil Coating YN-29	—	—
Motorcraft® A/C System Flushing Solvent YN-23	—	—
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B	6.2L (2v) Only 177 ml (6 fl oz) 3.5L GTDI, 3.7L or 5.0L (4v) 100 ml (3.4 fl oz)
Motorcraft® R-134a Refrigerant YN-19 (US); CYN-16-R (Canada)	WSH-M17B19-A	0.68 kg (24 oz) (1.5 lb)
Stay-Brite® R-134a Leak Detection Dye 164-R6060 (Rotunda)	—	—

General Specifications

Item	Specification
A/C Compressor Magnetic Clutch	
Air gap clearance	0.3 - 0.6 mm (0.011 - 0.023 in)
A/C Pressure Relief Valve [a]	
Open pressures	3,792-4,137 kPa (550-600 psi)
Evaporator Temperature Sensor	
On/off temperatures	2.2-3.3°C (36-38°F)
Refrigerant System Dye	
R-134a Leak Detection Dye 164-R6060	—

[a] Manifold gauge set pressures may vary slightly depending on the distance between the service gauge port valve and the A/C pressure relief valve, low charge protection and pressure cutoff switch locations.

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Climate Control System

WARNING: Air conditioning R-134a liquid refrigerant is capable of harming eyes or freezing skin. Always wear safety goggles and avoid contact with liquid refrigerant. Failure to follow these instructions may result in serious personal injury.

WARNING: Air conditioning R-134a refrigerant gas is capable of displacing the air necessary for breathing in a confined space and can produce toxic gasses if burned at high temperatures. Do not release a large quantity of R-134a gas within a confined space or allow it to be exposed to a high temperature flame (such as a torch). Consult the Material Safety Data Sheet for further information. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **To avoid damaging the vehicle or A/C components, the following precautions must be observed.**

- **The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to do so can contaminate the shop bulk refrigerant and other vehicles.**
- **Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These 2 types of refrigerant must never be mixed. Doing so can damage the A/C system.**
- **Charge the A/C system with R-134a refrigerant gas while the engine is running only at the low-pressure side to prevent refrigerant slugging from damaging the A/C compressor.**
- **Use only R-134a refrigerant. Due to environmental concerns, when the A/C system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal, State/Provincial and/or local laws REQUIRE that R-134a be recovered into appropriate recovery equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as ASE or MACS . Use of a recovery machine dedicated to R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the A/C system.**
- **Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and higher pressures.**
- **A number of manufacturers are producing refrigerant products that are described as direct substitutes for refrigerant R-134a. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled refrigerant R-134a.**

NOTICE: **To avoid contamination of the A/C system, the following precautions must be observed.**

- **Never open or loosen a connection before recovering the refrigerant.**
- **When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.**
- **Evacuate a system that has been opened to install a new component or one that has discharged through leakage before charging.**
- **Seal open fittings with a cap or plug immediately after disconnecting a component from the system.**
- **Clean the outside of the fittings thoroughly before disconnecting a component from the system.**

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- **Do not remove the sealing caps from a new component until ready to install.**
- **Refrigerant oil absorbs moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use and install the cap immediately after using. Store the oil in a clean, moisture-free container.**
- **Install a new O-ring seal before connecting an open fitting. Coat the fitting and O-ring seal with PAG oil before connecting.**
- **When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.**
- **Tighten threaded fittings only to specifications. The steel and aluminum fittings used in the refrigerant system does not tolerate overtightening.**
- **When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.**
- **Do not open a refrigerant system or uncap a new component unless it is as close as possible to room temperature. This prevents condensation from forming inside a component that is cooler than the surrounding air.**

The system consists of the following components:

- A/C compressor
- A/C compressor clutch assembly
- A/C condenser core
- A/C evaporator core
- Receiver/drier
- Connecting refrigerant lines
- TXV
- A/C pressure transducer
- Heater core and evaporator core housing
- HVAC module
- FCIM
- FCDIM (non touchscreen only)
- FDIM (touchscreen only)
- Air inlet mode door actuator
- Defrost/panel/floor mode door actuator
- Temperature blend door actuator(s)
- Blower motor resistor (EMTC base systems only)
- Blower motor speed control (remote HVAC control module systems only)
- Blower motor
- In-vehicle temperature and humidity sensor (remote HVAC control module systems only)
- Sunload sensor (EATC dual zone systems only)
- Evaporator temperature sensor (serviced only with the heater core and evaporator core housing)

External Temperature Display

The ambient air temperature sensor is monitored by the PCM. The PCM sends the raw value through the HS-CAN to the BCM . The BCM sends the data through the MS-CAN to the HVAC module. The HVAC module filters and stabilizes the value and sends it back to the BCM . The BCM sends the filtered ambient temperature data to the IPC over the I-CAN . The IPC sends the data over the I-CAN to the FDIM to display the temperature.

While the actual external temperature can vary continuously, the value that is displayed updates at a specific

rate depending on whether or not the engine is "hot" and whether or not the vehicle is moving.

When the external temperature is rising, the display updates slowly.

Updates (when the actual external temperature is higher than currently displayed value) is limited to 0.6°C (1°F) every 20 seconds while the vehicle is moving at greater than 32 km/h (20 mph) for more than 60 seconds or 0.6°C (1°F) every 20 minutes if the vehicle is not moving at this speed. This is to prevent the heat from the engine compartment from affecting the accuracy of the display.

When the external temperature is dropping, the display updates quickly.

Updates (when the actual external temperature is lower than currently displayed value) are limited to 0.6°C (1°F) every 2 seconds (regardless of vehicle speed). Consequently the display essentially follows the drop experienced by the external temperature thermistor.

EMTC — Base System

System Operation

The EMTC base system heats or cools the vehicle depending on the HVAC module control panel selection. The EMTC base system has 4 blower motor speed positions.

- The control panel selection determines heating or cooling, air distribution and enables blower motor operation.
- The temperature control setting determines the outlet air temperature.
- The blower motor switch varies the blower motor speed (4 speed positions).
- During A/C operation, the system reduces the relative humidity of the air inside the vehicle.

Remote Start System Behavior — Message Center Set to Auto

Remote start is an available feature on this vehicle. In addition to being able to start the vehicle remotely, the remote start feature also utilizes other vehicle systems to increase the level of comfort to the vehicle occupants upon entering the vehicle. For additional information on the remote start feature and the other vehicle systems it utilizes, refer to Section 303-06 .

When the remote start feature is used, the climate control system automatically sets certain parameters in an attempt to achieve a comfortable cabin temperature. These parameters are set based on outside air temperature. During remote start, the outside air temperature is continually evaluated and HVAC system behavior can change if the outside air changes between cold, moderate and warm temperatures.

For cold ambient air temperatures (below 4.4°C (40°F)):

- the airflow mode is set to FLOOR/DEFROST if Front Defrost is set to Off in the message center.
- the airflow mode is set to DEFROST if Front Defrost is set to Auto in the message center.
- the temperature is set to full HOT.
- the blower speed is set to HIGH.
- the air inlet mode is set to fresh air.
- A/C is set to OFF.

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For moderate ambient air temperatures (between 4.4°C (40°F) and 23.9°C (75°F)):

- the airflow mode is set to the last user setting.
- the temperature is set to the last user setting.
- the blower speed is set to the last user setting.
- the air inlet mode is set to the last user setting.
- A/C is set to the last user setting.

For warm ambient air temperatures (above 23.9°C (75°F)):

- the airflow mode is set to MAX A/C.
- the temperature is set to full COOL.
- the blower speed is set to HIGH.
- the air inlet mode is set to RECIRC.
- A/C is set to ON.

Remote Start System Behavior — Message Center Set to Last User Settings

Remote start is an available feature on this vehicle. In addition to being able to start the vehicle remotely, the remote start feature also utilizes other vehicle systems to increase the level of comfort to the vehicle occupants upon entering the vehicle. For additional information on the remote start feature and the other vehicle systems it utilizes, refer to Section 303-06.

When the remote start feature is used, the climate control system automatically sets certain parameters in an attempt to achieve a comfortable cabin temperature. These parameters are set based on outside air temperature. During remote start, the outside air temperature is continually evaluated and HVAC system behavior can change if the outside air changes between cold, moderate and warm temperatures.

For additional information regarding the message center, refer to Section 413-01.

When Heater — A/C is set to Last User Settings in the message center, the remote start sets the climate control system to the following settings.

- For cold ambient air temperatures as determined by the HVAC module:
  - the airflow mode is set to the last user setting if Front Defrost is set to Off in the message center.
  - the airflow mode is set to DEFROST if Front Defrost is set to Auto in the message center.
  - the temperature is set to the last user setting.
  - the blower speed is set to the last user setting.
  - the air inlet mode is set to the last user setting.
  - A/C is set to the last user setting.
- For moderate and warm ambient air temperatures as determined by the HVAC module:
  - the airflow mode is set to the last user setting.
  - the temperature is set to the last user setting.
  - the blower speed is set to the last user setting.
  - the air inlet mode is set to the last user setting.
  - A/C is set to the last user setting.

System Airflow and Mode Description

Max A/C

When MAX A/C is selected:

- the air inlet door closes, preventing outside air and admits only recirculated air.
- the RECIRC indicator is illuminated (RECIRC forced on).
- the mode doors direct airflow to the instrument panel A/C registers.
- blended air temperature is available.
- the A/C request button is illuminated.
- the A/C compressor operates if the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

PANEL

When PANEL is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment.
- the mode doors direct airflow to the instrument panel A/C registers.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on) can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor operates and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment.
- the mode doors direct airflow to the floor duct and the instrument panel A/C registers. A small amount of airflow from the side window demisters and defrost duct is present.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on) can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor operates and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

OFF

When OFF is selected:

- the air inlet door closes, preventing outside air and allowing only recirculated air.
- the blower motor is off.

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FLOOR

When FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment. In this mode, the RECIRC request times-out after 5 minutes and return to fresh air mode. RECIRC mode can be selected again after the time-out.
- the mode doors direct airflow to the floor duct. A small amount of airflow from the defroster duct and side window demisters is present.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on) can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor operates and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

FLOOR/DEFROST

When FLOOR/DEFROST is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment. In this mode, the RECIRC request times-out after 5 minutes and return to fresh air mode. RECIRC mode can be selected again after the time-out.
- the mode doors direct airflow to the floor duct, the defroster duct and the side window demisters.
- blended air temperature is available.
- the A/C request button toggles the indicator on and off. To reduce fogging, the A/C compressor operates automatically, regardless of indicator status, if the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

DEFROST

When DEFROST is selected:

- the RECIRC request button is disabled. The air inlet door opens, allowing only outside air into the passenger compartment.
- the mode doors direct airflow to the defroster duct and side window demisters. A small amount of airflow from the floor duct is present.
- blended air temperature is available.
- the A/C request button toggles the indicator on and off. To reduce fogging, the A/C compressor operates automatically, regardless of indicator status, if the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

HVAC Module — Remote Mount

The EATC dual zone and the EMTC 4.2 inch display systems use a remote HVAC module that is separate from the control interface. The EMTC with 4.2 inch display system has 7 blower motor speed positions.

System Operation

The system maintains the selected vehicle interior temperature by heating and/or cooling the air.

- During A/C operation, the system reduces the relative humidity of the air inside the vehicle.
- The driver may override the automatic mode of operation.
- The temperature control setting is the desired cabin air temperature.
- The blower motor control override buttons vary the blower motor speed.
- The driver side and passenger side temperature settings can be individually controlled (dual zone systems only).

When the system is set to AUTO the air distribution direction, blower motor speed and A/C compressor operation and air inlet door mode are automatically controlled based on the temperature(s) selected.

The system manual override settings:

- allow the air distribution direction to be manually selected.
- allow the blower motor speed to be manually selected.
- allow recirculation mode to be manually selected in all modes except DEFROST. The A/C request can be manually selected by pressing the A/C request switch.
- allow A/C compressor operation to be manually selected except in DEFROST and FLOOR/DEFROST.

Load Shed Behavior

Under certain circumstances, the vehicle can enter an engine running load shed mode. When this condition occurs, the blower motor in the EATC system behaves in the following manor:

- If the blower motor speed setting is greater than 50%, the speed automatically is reduced to 50% of the maximum setting.
- If the blower motor speed setting is equal to or less than 50%, the speed automatically is reduced to the next lowest level.
- If the blower motor speed setting is set to it's lowest setting, it remains in the lowest setting.

For information on when the vehicle can enter an engine running load shed mode, refer to Section 414-00 .

Remote Start System Behavior — Message Center Set to Auto

Remote start is an available feature on this vehicle. In addition to being able to start the vehicle remotely, the remote start feature also utilizes other vehicle systems to increase the level of comfort to the vehicle occupants upon entering the vehicle. For additional information on the remote start feature and the other vehicle systems it utilizes, refer to Section 303-06 .

When the remote start feature is used, the climate control system automatically sets certain parameters in an attempt to achieve a comfortable cabin temperature. These parameters are set based on outside air temperature. During remote start, the outside air temperature is continually evaluated and HVAC system behavior can change if the outside air changes between cold, moderate and warm temperatures.

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For additional information regarding the message center, refer to Section 413-01 .

When Heater — A/C is set to Auto in the message center, the remote start sets the climate control system to the following settings:

- For cold ambient air temperatures as determined by the HVAC module AUTO mode to request heat:
  - the airflow mode is set to AUTO if Front Defrost is set to Off in the message center. (if the HVAC module requests FLOOR in AUTO mode, FLOOR/DEFROST is used in remote start mode).
  - the airflow mode is set to DEFROST if Front Defrost is set to Auto in the message center.
  - the temperature is set to 22°C (72°F).
  - the blower speed is set to AUTO.
  - the air inlet mode is set to AUTO.
  - A/C is set to AUTO.
- For moderate and warm ambient air temperatures as determined by the HVAC module AUTO mode to request heat or cooling:
  - the airflow mode is set to AUTO.
  - the temperature is set to 22°C (72°F).
  - the blower speed is set to AUTO.
  - the air inlet mode is set to AUTO.
  - A/C is set to AUTO.

Remote Start System Behavior — Message Center Set to Last User Settings

Remote start is an available feature on this vehicle. In addition to being able to start the vehicle remotely, the remote start feature also utilizes other vehicle systems to increase the level of comfort to the vehicle occupants upon entering the vehicle. For additional information on the remote start feature and the other vehicle systems it utilizes, refer to Section 303-06 .

When the remote start feature is used, the climate control system automatically sets certain parameters in an attempt to achieve a comfortable cabin temperature. These parameters are set based on outside air temperature. During remote start, the outside air temperature is continually evaluated and HVAC system behavior can change if the outside air changes between cold, moderate and warm temperatures.

For additional information regarding the message center, refer to Section 413-01 .

When Heater — A/C is set to Last User Settings in the message center, the remote start sets the climate control system to the following settings:

- For cold ambient air temperatures as determined by the HVAC module:
  - the airflow mode is set to the last user setting if Front Defrost is set to Off in the message center.
  - the airflow mode is set to DEFROST if Front Defrost is set to Auto in the message center.
  - the temperature is set to the last user setting.
  - the blower speed is set to the last user setting.
  - the air inlet mode is set to the last user setting.
  - A/C is set to the last user setting.
- For moderate and warm ambient air temperatures as determined by the HVAC module AUTO mode to request heating or cooling:
  - the airflow mode is set to the last user setting.
  - the temperature is set to the last user setting.

- the blower speed is set to the last user setting.
- the air inlet mode is set to the last user setting.
- A/C is set to the last user setting.

System Airflow and Mode Description

AUTO

When AUTO is selected:

- the temperature control setting is manually set to the desired setting.
- the air inlet door is automatically controlled by the HVAC module based on the temperature setting.
- the mode door is automatically controlled by the HVAC module based on the temperature setting.
- the temperature blend doors are automatically controlled by the HVAC module, based on the temperature setting.
- the A/C compressor is automatically controlled by the HVAC module, based on the temperature setting. The A/C compressor cannot operate if the outside temperature is below approximately 0°C (32°F).
- the blower motor is on. The blower motor speed is automatically controlled by the HVAC module based on the temperature setting, but can be manually overridden.

OFF

When OFF is selected:

- the air inlet door closes, preventing outside air and allowing only recirculated air.
- the blower motor is off.

Max A/C

When MAX A/C is selected:

- the air inlet door closes, preventing outside air and allows only recirculated air.
- the RECIRC button is disabled and the indicator is illuminated (RECIRC forced on).
- the mode doors direct airflow to the instrument panel A/C registers.
- blended air temperature is available.
- the A/C request button is illuminated and is disabled.
- the A/C compressor operates if the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

PANEL

When PANEL is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment.
- the mode doors direct airflow to the instrument panel A/C registers.
- blended air temperature is available. Only when A/C compressor operation has been selected by

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pressing the A/C request button (indicator on) can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor operates and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment.
- the mode doors direct airflow to the floor duct and the instrument panel A/C registers. A small amount of airflow from the side window demisters and defrost duct is present.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on) can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor operates and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

FLOOR

When FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment. In this mode, the RECIRC request times-out after 5 minutes and return to fresh air mode. RECIRC mode can be selected again after the time-out.
- the mode doors direct airflow to the floor duct. A small amount of airflow from the defroster duct and side window demisters is present.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on) can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor operates and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

FLOOR/DEFROST

When FLOOR/DEFROST is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator on), the air inlet door closes, preventing outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator off), the air inlet door opens, allowing only outside air into the passenger compartment. In this mode, the RECIRC request times-out after 5 minutes and return to fresh air mode. RECIRC mode can be selected again after the time-out.
- the mode doors direct airflow to the floor duct, the defroster duct and the side window demisters.
- blended air temperature is available.
- the A/C request button is enabled. The A/C compressor operates automatically and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately

0°C (32°F).
- the blower motor is on.

DEFROST

When DEFROST is selected:

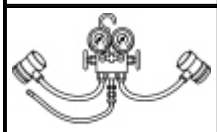
- the RECIRC request button and indicator is disabled. Regardless of button and indicator status, the air inlet door opens, allowing only outside air into the passenger compartment.
- the mode doors direct airflow to the defroster duct and side window demisters. A small amount of airflow from the floor duct is present.
- blended air temperature is available.
- the A/C request button is enabled. The A/C compressor operates automatically and the indicator illuminates if the A/C request button is selected and the outside temperature is above approximately 0°C (32°F).
- the blower motor is on.

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Climate Control System

Special Tool(s)

 ST2985-A	A/C Flush Adapter Kit 219-00074 or equivalent
 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST1474-A	Pressure Test Kit 014-R1072 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST3317A	Infrared Refrigerant Leak Detector (SAE J-2791 Compliant) 023-22791 or equivalent
 ST3316A	Dual Mode Refrigerant Gas and UV Dye Leak Detector (SAE J-2791 Compliant) 339-D440A-UV or equivalent
	Test Light SGT27000 or equivalent 250-300 mA incandescent bulb test lamp

 ST3094-A	

Principles of Operation

For additional refrigerant system and component information, refer to Section 412-01 .

The Refrigerant Cycle

During stabilized conditions (A/C system shutdown), the refrigerant pressures are equal throughout the system. When the A/C compressor is in operation, it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core.

The A/C condenser, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser and enters the inlet side of the A/C receiver/drier. The receiver/drier is designed to remove moisture from the refrigerant.

The outlet of the receiver/drier is connected to the TXV . The TXV provides the orifice which is the restriction in the refrigerant system and separates the high and low pressure sides of the A/C system. As the liquid refrigerant passes across this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator, it absorbs heat from the airflow passing over the plate/fin sections of the A/C evaporator. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

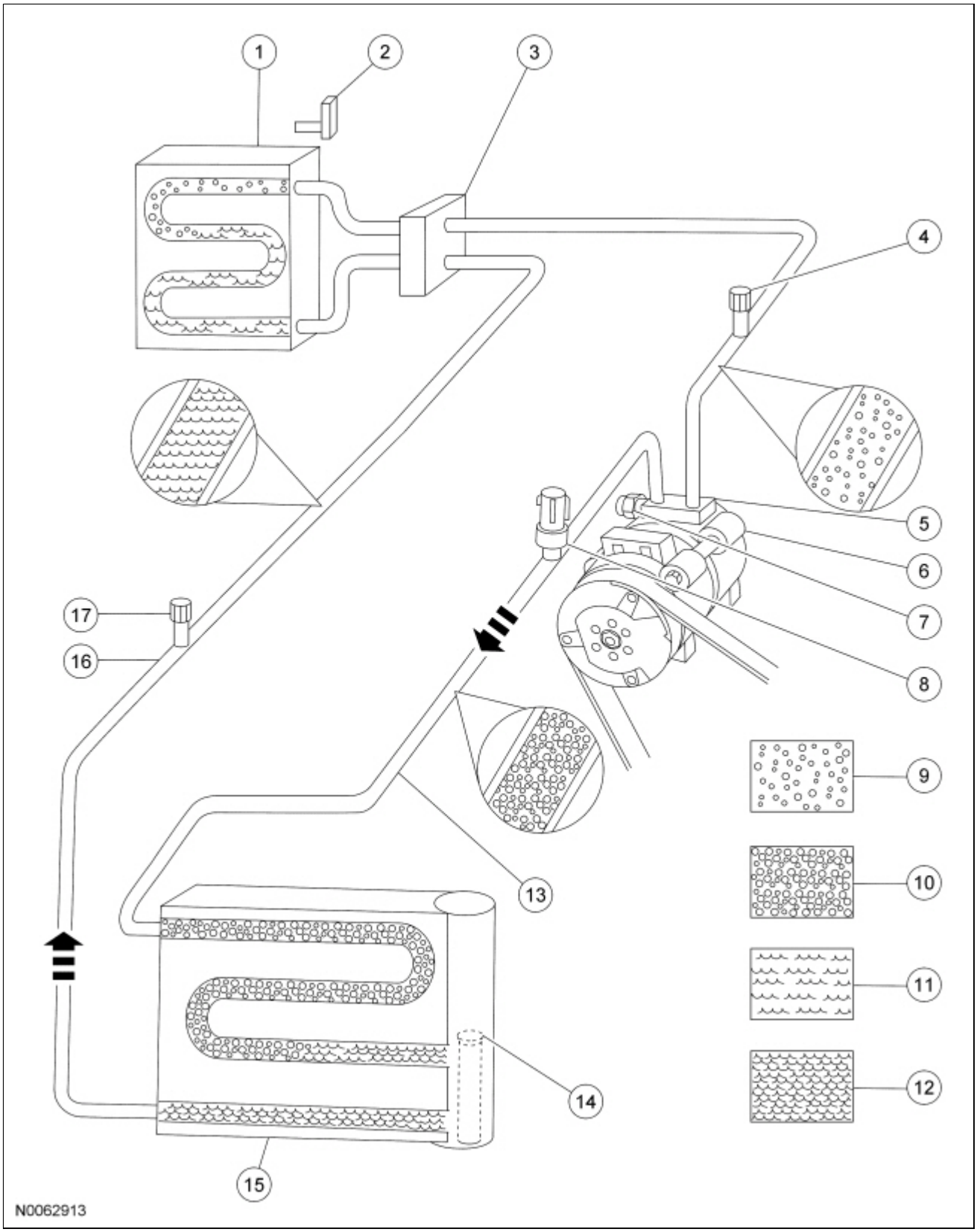
The PCM controls the A/C clutch relay. The evaporator temperature sensor monitors the temperature of the air that has passed through the evaporator core and sends a signal to the PCM. If the temperature of the evaporator core discharge air is low enough to cause the condensed water vapor to freeze, the A/C clutch is disengaged by the PCM.

The line pressure is monitored so that A/C compressor operation is interrupted if the system pressure becomes too high or too low.

The A/C compressor relief valve opens and vents refrigerant to relieve unusually high system pressure.

TXV Type Refrigerant System

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Item	Description
1	A/C evaporator core

2	A/C evaporator core outlet temperature thermistor
3	TXV
4	A/C charge valve port (low side)
5	A/C suction line
6	A/C compressor
7	A/C pressure relief valve
8	A/C pressure transducer
9	Low-pressure vapor
10	High-pressure vapor
11	Low-pressure liquid
12	High-pressure liquid
13	Compressor discharge line
14	A/C desiccant cartridge
15	A/C condenser core with A/C receiver/drier
16	Condenser-to-evaporator line
17	A/C charge valve port (high side)

Inspection and Verification

1. Verify the customer's concern by operating the climate control system to duplicate the condition.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

   Visual Inspection Chart

Mechanical	Electrical

• Loose, missing or damaged A/C compressor drive belt
• Loose or disconnected A/C clutch
• Broken or binding door/actuator
• Broken or leaking refrigerant lines
• Obstructed in-vehicle temperature and humidity sensor
• Disconnected in-vehicle temperature aspirator hose
	• BJB fuses:
	  ▪ 30 (10A)
	  ▪ 51 (40A)
	  ▪ 52 (5A)
	  ▪ 77 (10A)
	• BCM fuse 46 (10A)
	• Blower motor inoperative
	• A/C compressor inoperative
	• Circuitry open/shorted
	• Disconnected electrical connectors
	• Cooling fan inoperative

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the DLC .
5. **NOTE:** The VCM LED prove-out confirms power and ground from the DLC are provided to the VCM .

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If the scan tool does not communicate with the VCM :

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the VCM .

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM, HVAC module.

7. Carry out the network test.
   - If the scan tool responds with no communication from one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the CMDTCs .

8. Clear the continuous DTCs and carry out the self-test diagnostics from the PCM or HVAC module.

9. **NOTE:** Some PCM DTCs can inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

   If the HVAC DTCs retrieved are related to the concern, go to the HVAC Module DTC Chart. If the PCM DTCs retrieved are related to the concern, go to the PCM DTC Chart. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Climate Control Systems or GO to Symptom Chart - NVH .

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0532	A/C Refrigerant Pressure Sensor A Circuit Low	GO to Pinpoint Test A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	GO to Pinpoint Test A .
P0645	A/C Clutch Relay Control Circuit	GO to Pinpoint Test B .
P1464	A/C Demand Out Of Self Test Range	If the HVAC selector was not powered off, POWER the HVAC off, CLEAR the DTCs and REPEAT the self-test. If the DTC does not return, IGNORE the DTC and continue diagnosing other DTCs or symptoms. If the DTC returns, GO to Pinpoint Test Q .
All Other DTCs	—	REFER to Section 303-14 .

HVAC Module DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. CMDTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Network DTCs (U-codes) are often a result of intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set network DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. To prevent repeat network DTC concerns, inspect all network wiring, especially connectors. Test the vehicle battery, refer to Section 414-01 .

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

DTC	Description	Action to Take
B1034:11	Left Front Seat Heater Element: Circuit Short to Ground	REFER to Section 501-10 .
B1034:13	Left Front Seat Heater Element: Circuit Open	REFER to Section 501-10 .
B1036:11	Right Front Seat Heater Element: Circuit Short to Ground	REFER to Section 501-10 .
B1036:13	Right Front Seat Heater Element: Circuit Open	REFER to Section 501-10 .
B1038:11	Left Front Seat Heater Sensor: Circuit Short to Ground	REFER to Section 501-10 .
B1038:12	Left Front Seat Heater Sensor: Circuit Short to Battery	REFER to Section 501-10 .
B103A:11	Right Front Seat Heater Sensor: Circuit Short to Ground	REFER to Section 501-10 .
B103A:12	Right Front Seat Heater Sensor: Circuit Short to Battery	REFER to Section 501-10 .
B1081:00	Left Temperature Damper Motor: No Sub Type Information	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R . For EMTC with 4.2 inch display which has 7 blower motor speed positions, GO to Pinpoint Test S . For Dual Zone EATC , GO to Pinpoint Test U .
B1081:07	Left Temperature Damper Motor: Mechanical Failure	INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new Driver Side temperature blend door actuator. REFER to Section 412-01
B1081:11	Left Temperature Damper Motor: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R .

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		For EMTC with 4.2 inch display which has 7 blower motor speed positions, GO to Pinpoint Test S . For Dual Zone EATC , GO to Pinpoint Test U .
B1081:12	Left Temperature Damper Motor: Circuit Short to Battery	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R . For EMTC with 4.2 inch display which has 7 blower motor speed positions, GO to Pinpoint Test S . For Dual Zone EATC , GO to Pinpoint Test U .
B1081:13	Left Temperature Damper Motor: Circuit Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R . For EMTC with 4.2 inch display which has 7 blower motor speed positions, GO to Pinpoint Test S . For Dual Zone EATC , GO to Pinpoint Test U .
B1082:00	Right Temperature Damper Motor: No Sub Type Information	GO to Pinpoint Test V .
B1082:07	Right Temperature Damper Motor: Mechanical Failure	INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new Passenger Side temperature blend door actuator. REFER to Section 412-01
B1082:11	Right Temperature Damper Motor: Circuit Short to Ground	GO to Pinpoint Test V .
B1082:12	Right Temperature Damper Motor: Circuit Short to Battery	GO to Pinpoint Test V .
B1082:13	Right Temperature Damper Motor: Circuit Open	GO to Pinpoint Test V .
B1083:00	Recirculation Damper Motor: No Sub Type Information	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .
B1083:07	Recirculation Damper Motor: Mechanical Failure	INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new air inlet door actuator. REFER to Section 412-01
B1083:11	Recirculation Damper Motor: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .
B1083:12	Recirculation Damper Motor: Circuit Short to Battery	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .
B1083:13	Recirculation Damper Motor: Circuit Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .
B1086:00	Air Distribution Damper	For EMTC base with 4 blower motor speed positions, GO to

	Motor: No Sub Type Information	Pinpoint Test L . For other systems, GO to Pinpoint Test M .
B1086:07	Air Distribution Damper Motor: Mechanical Failure	INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new defrost/panel/floor door actuator. REFER to Section 412-01
B1086:11	Air Distribution Damper Motor: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test L . For other systems, GO to Pinpoint Test M .
B1086:12	Air Distribution Damper Motor: Circuit Short to Battery	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test L . For other systems, GO to Pinpoint Test M .
B1086:13	Air Distribution Damper Motor: Circuit Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test L . For other systems, GO to Pinpoint Test M .
B10AF:11	Blower Fan Relay: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test X . For other systems, GO to Pinpoint Test Z .
B10AF:12	Blower Fan Relay: Circuit Short to Battery	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test W . For other systems, GO to Pinpoint Test Y .
B10AF:13	Blower Fan Relay: Circuit Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test W . For other systems, GO to Pinpoint Test Y .
B10B8:00	Push Buttons: No Sub Type Information	A button held too long can set DTC. ATTEMPT to clean buttons. CLEAR the DTCs. REPEAT the self-test. If code returns, INSTALL a new HVAC module. REFER to Section 412-01
B10B9:12	Blower Control: Circuit Short to Battery	GO to Pinpoint Test Z .
B10B9:14	Blower Control: Circuit Short to Ground or Open	If the blower motor is inoperative, GO to Pinpoint Test Y . If the blower motor is always on HIGH, GO to Pinpoint Test Z .
B11E5:11	Left HVAC Damper Position Sensor: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R . For EMTC with 4.2 inch display with 7 blower motor speed positions, GO to Pinpoint Test S . For Dual Zone EATC , GO to Pinpoint Test U .
B11E5:15	Left HVAC Damper Position Sensor: Circuit Short to Battery or Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R . For EMTC with 4.2 inch display with 7 blower motor speed positions, GO to Pinpoint Test S . For Dual Zone EATC , GO to Pinpoint Test U .

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B11E6:11	Right HVAC Damper Position Sensor: Circuit Short to Ground	GO to Pinpoint Test V .
B11E6:15	Right HVAC Damper Position Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test V .
B11E7:11	Air Distribution Damper Position Sensor: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test L . For other systems, GO to Pinpoint Test M .
B11E7:15	Air Distribution Damper Position Sensor: Circuit Short to Battery or Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test L . For other systems, GO to Pinpoint Test M .
B11F0:11	Air Intake Damper Position Sensor: Circuit Short to Ground	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .
B11F0:15	Air Intake Damper Position Sensor: Circuit Short to Battery or Open	For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .
B1A61:11	Cabin Temperature Sensor: Circuit Short to Ground	GO to Pinpoint Test D .
B1A61:15	Cabin Temperature Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test D .
B1A63:11	Right Solar Sensor: Circuit Short to Ground	GO to Pinpoint Test F .
B1A63:15	Right Solar Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test F .
B1A64:11	Left Solar Sensor: Circuit Short to Ground	GO to Pinpoint Test F .
B1A64:15	Left Solar Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test F .
B1A69:11	Humidity Sensor: Circuit Short to Ground	GO to Pinpoint Test E .
B1A69:15	Humidity Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test E .
B1B71:11	Evaporator Temperature Sensor: Circuit Short to Ground	GO to Pinpoint Test G .
B1B71:15	Evaporator Temperature Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test G .
B1C83:11	Rear Defog Relay: Circuit Short to Ground	REFER to Section 501-09 .
B1C83:13	Rear Defog Relay: Circuit Open	REFER to Section 501-09 .

C1B14:11	Sensor Supply Voltage A: Circuit Short to Ground	GO to Pinpoint Test C .
C1B14:12	Sensor Supply Voltage A: Circuit Short to Battery	GO to Pinpoint Test C .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AA .
U0256:00	Lost Communication With FCIM "A": No Sub Type Information	GO to Pinpoint Test AC .
U0401:09	Invalid Data Received From ECM/PCM A: Component Failure	This DTC can set due to a fault in the PCM. CARRY OUT a self-test of the PCM and DIAGNOSE any PCM DTCs present, REFER to Section 303-14 .
U0401:68	Invalid Data Received From ECM/PCM A: Event Information	This DTC can set due to a fault in the PCM. CARRY OUT a self-test of the PCM and DIAGNOSE any PCM DTCs present, REFER to Section 303-14 .
U0401:81	Invalid Data Received From ECM/PCM A: Invalid Serial Data Received	This DTC can set due to a fault in the PCM. CARRY OUT a self-test of the PCM and DIAGNOSE any PCM DTCs present, REFER to Section 303-14 .
U0401:82	Invalid Data Received From ECM/PCM A: Alive/Sequence Counter Incorrect/Not Updated	This DTC can set due to a fault in the PCM. CARRY OUT a self-test of the PCM and DIAGNOSE any PCM DTCs present, REFER to Section 303-14 .
U0422:68	Invalid Data Received From Body Control Module: Event Information	This DTC can set due to a fault in the BCM . CARRY OUT a self-test of the BCM and DIAGNOSE any BCM DTCs present, REFER to Section 419-10 .
U0422:81	Invalid Data Received From Body Control Module: Invalid Serial Data Received	This DTC can set due to a fault in the BCM . CARRY OUT a self-test of the BCM and DIAGNOSE any BCM DTCs present, REFER to Section 419-10 .
U0423:82	Invalid Data Received from Instrument Panel Cluster Control Module: Alive/Sequence Counter Incorrect/Not Updated	This DTC can set due to a fault in the IPC . CARRY OUT a self-test of the IPC and DIAGNOSE any IPC DTCs present, REFER to Section 413-01 .
U0554:82	Invalid Data Received From Accessory Protocol Interface Module: Alive / Sequence Counter Incorrect / Not Updated	This DTC can set due to a fault in the APIM . CARRY OUT a self-test of the APIM and DIAGNOSE any APIM DTCs present, Refer to the appropriate section in Group 415 for the procedure.
U1000:00	Solid State Driver Protection Actived - Driver Disabled:	The HVAC module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The HVAC module cannot enable the output until the cause of the short is corrected. ADDRESS all other Diagnostic Trouble Codes (DTCs) first. After the cause of the concern is corrected, CLEAR the Diagnostic Trouble Codes (DTCs). REPEAT the self-test.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CARRY OUT PMI on the HVAC module. REFER to Section 418-01 . REPEAT the self-test. If PMI is successful, the DTC will not be present. If the DTC returns, INSTALL a new HVAC module. REFER to Section 412-01 .
U3000:49	Control Module: Internal	ADDRESS all other DTCs first. CLEAR the DTCs. REPEAT the

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	Electronic Failure	self-test. If DTC U3000:49 is retrieved again, INSTALL a new HVAC module. REFER to Section 412-01 .
U3002:62	Vehicle Identification Number: Signal Compare Failure	CARRY OUT PMI on the HVAC module. REFER to Section 418-01 . REPEAT the self-test. If PMI is successful, the DTC will not be present. If the DTC returns, INSTALL a new HVAC module. REFER to Section 412-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test H .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test H .
All other DTCs	—	REFER to the Master DTC Chart in Section 419-10 .

Symptom Chart — Climate Control Systems

Symptom Chart — Climate Control Systems

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

Condition	Possible Sources	Action
• No communication with the HVAC module	• HVAC module • Communication network	• REFER to Section 418-00 .
• Unable to duplicate the customer concern and no DTCs present	• HVAC system and/or related components	• GO to Pinpoint Test I .
• Reduced outlet airflow	• Wiring, terminals or connectors • A/C compressor clutch air gap • A/C evaporator temperature sensor • A/C clutch relay • Blower motor control • Blower motor resistor • PCM • HVAC module • FCIM	• If the A/C compressor does not cycle, GO to Pinpoint Test P . • For EMTC base with 4 blower motor speed positions, if the A/C compressor cycles normally, GO to Pinpoint Test X . • For other systems, if the A/C compressor cycles normally, GO to Pinpoint Test Z .
• The air inlet door is inoperative	• Wiring, terminals or connectors • Air inlet mode door actuator • Stuck or bound linkage or door • HVAC module • FCIM	• For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . • For other systems, GO to Pinpoint Test K .
• Incorrect/erratic	• Wiring, terminals or	• For EMTC base with 4

direction of airflow from outlets	connectors • Defrost/panel/floor mode door actuator • Stuck or bound linkage or door • HVAC module • FCIM	blower motor speed positions, GO to Pinpoint Test L . • For other systems, GO to Pinpoint Test M .
• Insufficient, erratic or no heat	• Low engine coolant level • Plugged or partially plugged heater core • Temperature blend door(s) binding or stuck • Temperature blend door actuator(s)	• GO to Pinpoint Test n .
• Insufficient A/C cooling	• Improper refrigerant level • Temperature blend door(s) binding or stuck • Temperature blend door actuator(s)	• CARRY OUT the refrigerant system tests. Refrigerant System Tests If OK, DIAGNOSE for a temperature blend door actuator not operating correctly. • For inadequate temperature out of the EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R . • For inadequate temperature out of the EMTC with 4.2 inch display with 7 blower motor speed positions, GO to Pinpoint Test S . • For inadequate temperature out of the EATC , dual zone driver side, GO to Pinpoint Test U . • For inadequate temperature out of the EATC , dual zone passenger side, GO to Pinpoint Test V .
• The air conditioning (A/C) is inoperative	• Fuse(s) • Wiring, terminals or connectors • A/C system discharged/low charge • PCM • HVAC module • FCIM • A/C clutch relay • A/C compressor clutch air gap • A/C pressure transducer • Evaporator temperature sensor	• GO to Pinpoint Test O .

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	• A/C compressor clutch field coil	
• The air conditioning (A/C) is always on — A/C compressor does not cycle	• Wiring, terminals or connectors • PCM • Evaporator temperature sensor • A/C clutch relay • A/C compressor clutch air gap	• GO to Pinpoint Test P .
• The air conditioning (A/C) is always on — A/C mode always commanded ON	• Wiring, terminals or connectors • PCM • FCIM • HVAC module	• GO to Pinpoint Test Q .
• Temperature control is inoperative/does not operate correctly — EMTC base with 4 blower motor speed positions	• Wiring, terminals or connectors • HVAC module • Stuck or bound linkage or door • Temperature blend door actuator	• GO to Pinpoint Test R .
• Temperature control is inoperative/does not operate correctly — EMTC with 4.2 inch display with 7 blower motor speed positions	• Wiring, terminals or connectors • HVAC module • Stuck or bound linkage or door • Temperature blend door actuator	• GO to Pinpoint Test S .
• Temperature control is inoperative/does not operate correctly — EATC , dual zone driver side	• Wiring, terminals or connectors • HVAC module • Stuck or bound linkage or door • Temperature blend door actuator • FCIM	• GO to Pinpoint Test U .
• Temperature control is inoperative/does not operate correctly — EATC , dual zone passenger side	• Wiring, terminals or connectors • HVAC module • Stuck or bound linkage or door • Temperature blend door actuator • FCIM	• GO to Pinpoint Test V .
• The blower motor is inoperative — EMTC base with 4 blower motor speed positions	• Fuse(s) • Wiring, terminals or connectors • Blower motor relay • Blower motor • HVAC module	• GO to Pinpoint Test W .
• The blower motor does not operate correctly — EMTC base with 4 blower motor speed	• Wiring, terminals or connectors • Blower motor resistor	• GO to Pinpoint Test X .

positions	• HVAC module	
• The blower motor is inoperative — EATC dual zone and EMTC with 4.2 inch display with 7 blower motor speed positions	• Fuse(s) • Wiring, terminals or connectors • Blower motor relay • Blower motor • HVAC module • Blower motor speed control	• GO to Pinpoint Test Y .
• The blower motor does not operate correctly — EATC dual zone and EMTC with 4.2 inch display with 7 blower motor speed positions	• Wiring, terminals or connectors • Blower motor speed control • HVAC module • FCIM	• GO to Pinpoint Test Z .
• A/C pressure relief valve discharging	• High system pressure • A/C pressure relief valve	• CHECK the high side system pressure. If the pressure is below the A/C pressure relief valve open pressure, REPLACE the A/C pressure relief valve. If the system pressure is above the A/C pressure relief valve open pressure, REPAIR the system for a restriction.

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms will be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Noisy A/C compressor	• A/C compressor clutch air gap out of specification	• CHECK and ADJUST the A/C compressor clutch gap if necessary. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation. • If the A/C compressor clutch gap is OK, INSTALL an A/C compressor clutch. REFER to Section 412-01 . TEST the system for normal operation.
	• A/C compressor pulley bearing worn	• INSPECT the A/C compressor pulley bearing for roughness. If bearing roughness is found, INSTALL an A/C compressor pulley. REFER to Section 412-01 . TEST the system for normal operation.

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	• A/C compressor bearing worn	• INSPECT the A/C compressor bearing for roughness. If bearing roughness is found, INSTALL an A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.

Pinpoint Tests

Pinpoint Test A: DTC P0532 or P0533

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

The A/C pressure transducer receives a ground from the PCM. A 5-volt reference voltage is supplied to the A/C pressure transducer from the PCM. The A/C pressure transducer then sends a voltage to the PCM to indicate the A/C pressure.

DTC Fault Trigger Conditions

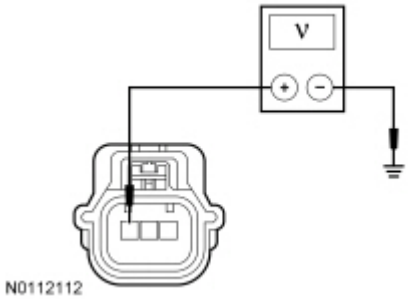
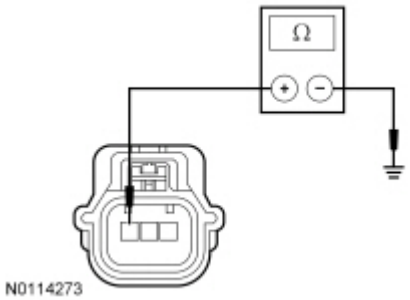
DTC	Description	Fault Trigger Conditions
P0532	A/C Refrigerant Pressure Sensor A Circuit Low: No Sub Type Information	The A/C pressure transducer inputs a feedback voltage to the PCM. This DTC sets if the feedback voltage is less than 0.26 volts for at least 2 seconds and the ambient air temperature is greater than 0°C (32°F).
P0533	A/C Refrigerant Pressure Sensor A Circuit High: No Sub Type Information	The A/C pressure transducer inputs a feedback voltage to the PCM. This DTC sets if the feedback voltage is greater than 4.95 volts for at least 2 seconds and the ambient air temperature is greater than 0°C (32°F).

This pinpoint test is intended to diagnose the following:

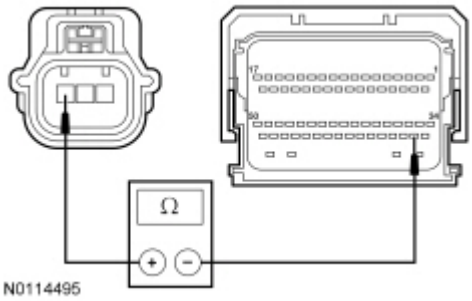
- Wiring, terminals or connectors
- A/C pressure transducer
- PCM

PINPOINT TEST A: DTC P0532 OR P0533

Test Step	Result / Action to Take
A1 COMPARE THE A/C PRESSURE SENSOR (ACP_PRESS) PCM PARAMETER IDENTIFICATION (PID) WITH THE MANIFOLD GAUGE SET READINGS	
• Allow the A/C system to stabilize to the outside ambient	**Yes**

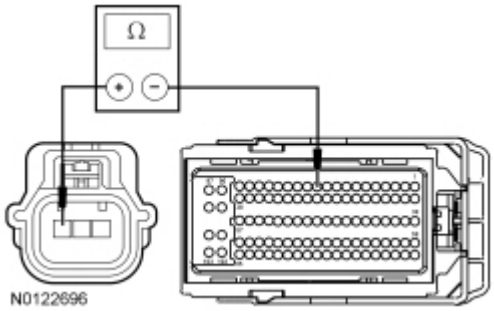
temperature. • Ignition ON. • Enter the following diagnostic mode on the scan tool: PCM DataLogger . • With the R-134a manifold gauge set connected, compare the pressure readings of the manifold gauge set and the ACP_PRESS PCM PID. • **Are the pressure values of the manifold gauge set and the Parameter Identification (PID) within +/-15 psi?**	IGNORE the Diagnostic Trouble Codes (DTCs). REFER to the Symptom Chart in this section. **No** GO to A2 .
A2 CHECK THE PCM REFERENCE VOLTAGE CIRCUIT	
• Ignition OFF. • Disconnect: A/C Pressure Transducer C1260 . • Ignition ON. • Measure the voltage between ground and A/C pressure transducer C1260-3, circuit LE424 (YE/GN), harness side.  • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to A5 . **No** If the voltage is below 4.7 volts, GO to A3 . If the voltage is greater than 5.1 volts, REPAIR the circuit for a short to voltage.
A3 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: PCM C1381B (5.0L, 6.2L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1551B (3.5L) . • Measure the resistance between ground and A/C pressure transducer C1260-3, circuit LE424 (YE/GN), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A4 . **No** REPAIR the circuit.
A4 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
For 3.7L, 5.0L and 6.2L	**Yes** GO to A14 . **No** REPAIR the circuit.

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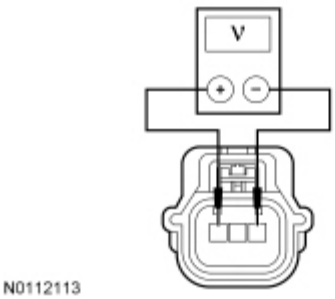


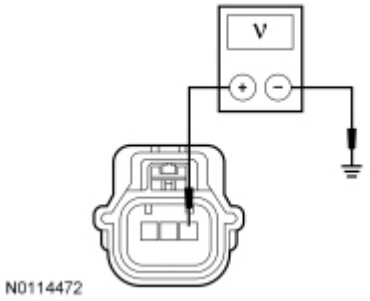
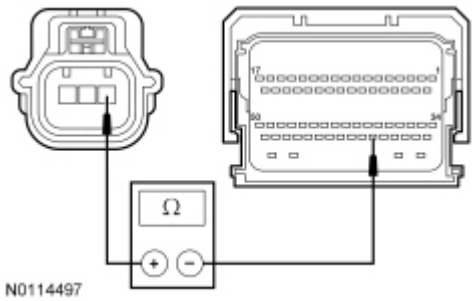
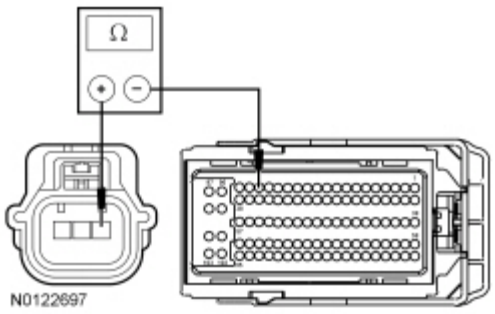
- Measure the resistance between A/C pressure transducer C1260-3, circuit LE424 (YE/GN), harness side and:
  - For 3.7L, PCM C175B-52, circuit LE424 (YE/GN), harness side.
  - For 5.0L and 6.2L, PCM C1381B-52, circuit LE424 (YE/GN), harness side.

For 3.5L

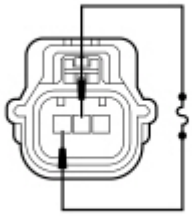
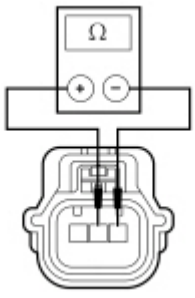


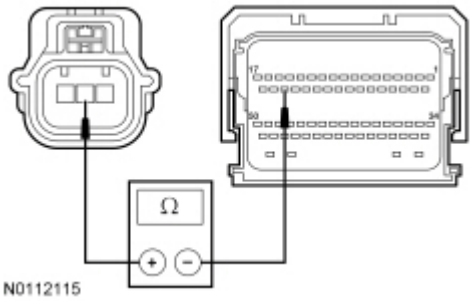
- For 3.5L, measure the resistance between A/C pressure transducer C1260-3, circuit LE424 (YE/GN), harness side and PCM C1551B-11, circuit LE424 (YE/GN), harness side.
- **Is the resistance less than 3 ohms?**

A5 CHECK THE PCM SENSOR GROUND	
• Measure the voltage between A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side and A/C pressure transducer C1260-3, circuit LE424 (YE/GN), harness side.  • **Is the voltage greater than 4.7 volts?**	**Yes** If diagnosing DTC P0532, GO to A8 . If diagnosing DTC P0533, GO to A11 . **No** GO to A6 .
A6 CHECK THE SIGNAL RETURN CIRCUIT FOR VOLTAGE	
• Measure the voltage between ground and A/C pressure	**Yes**

transducer C1260-1, circuit RE407 (YE/VT), harness side.  • **Is any voltage present?**	If the voltage is 5.1 volts or less, REPAIR circuit RE407 (YE/VT) for a short to circuit LE424 (YE/GN). If the voltage is greater than 5.1 volts, REPAIR circuit RE407 (YE/VT) for a short to voltage. **No** GO to A7 .
A7 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: PCM C1381B (5.0L, 6.2L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1551B (3.5L) . **For 3.7L, 5.0L and 6.2L**  • Measure the resistance between A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side and: ▪ For 3.7L, PCM C175B-56, circuit RE407 (YE/VT), harness side. ▪ For 5.0L and 6.2L, PCM C1381B-56, circuit RE407 (YE/VT), harness side. **For 3.5L**  • For 3.5L, measure the resistance between A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side and PCM C1551B-17, circuit RE407 (YE/VT), harness side. • **Is the resistance less than 3 ohms?**	**Yes** GO to A14 . **No** REPAIR the circuit.

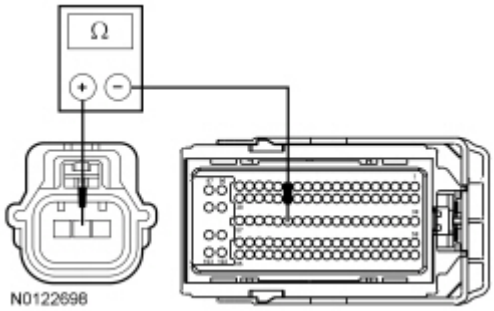
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A8 CHECK THE A/C PRESSURE SENSOR (ACP_V) PCM PID WITH THE A/C PRESSURE TRANSDUCER SHORTED	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • While observing the ACP_V PCM PID, connect a fused jumper between A/C pressure transducer C1260-3, circuit LE424 (YE/GN), harness side and A/C pressure transducer C1260-2, circuit VH433 (VT/OG), harness side.  N0114498 • **Does the ACP_V PCM PID voltage read between 4.7 and 5.1 volts?**	**Yes** INSTALL a new A/C pressure transducer. **No** GO to A9 .
A9 CHECK THE A/C PRESSURE TRANSDUCER FEEDBACK CIRCUIT FOR A SHORT TO THE SIGNAL RETURN CIRCUIT	
• Ignition OFF. • Disconnect: PCM C1381B (5.0L, 6.2L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1551B (3.5L) . • Measure the resistance between A/C pressure transducer C1260-2, circuit VH433 (VT/OG), harness side and A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side.  N0112118 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A10 . **No** REPAIR circuit VH433 (VT/OG) for a short to circuit RE407 (YE/VT).
A10 CHECK THE A/C PRESSURE TRANSDUCER FEEDBACK CIRCUIT FOR AN OPEN	
For 3.7L, 5.0L and 6.2L	**Yes** GO to A14 . **No** REPAIR the circuit.



- Measure the resistance between A/C pressure transducer C1260-2, circuit VH433 (VT/OG), harness side and:
  - For 3.7L, PCM C175B-31, circuit VH433 (VT/OG), harness side.
  - For 5.0L and 6.2L, PCM C1381B-31, circuit VH433 (VT/OG), harness side.

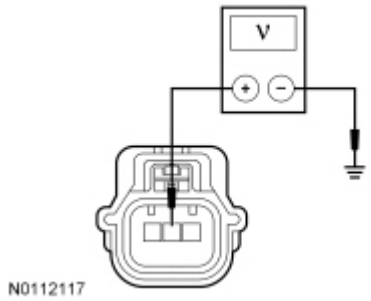
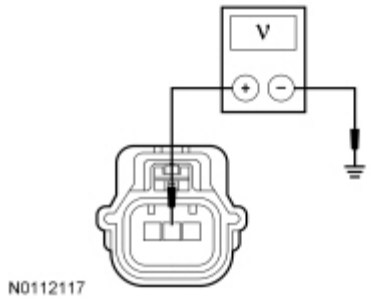
For 3.5L



- For 3.5L, measure the resistance between A/C pressure transducer C1260-2, circuit VH433 (VT/OG), harness side and PCM C1551B-52, circuit VH433 (VT/OG), harness side.
- **Is the resistance less than 3 ohms?**

A11 CHECK THE A/C PRESSURE SENSOR (ACP_V) PCM PID WITH THE A/C PRESSURE TRANSDUCER DISCONNECTED	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Observe the ACP_V PCM PID voltage. • **Does the ACP_V PCM PID voltage read 0 volts?**	**Yes** INSTALL a new A/C pressure transducer. **No** GO to A12 .
A12 CHECK THE A/C PRESSURE TRANSDUCER FEEDBACK CIRCUIT FOR VOLTAGE	
• Measure the voltage between ground and A/C pressure transducer C1260-2, circuit VH433 (VT/OG), harness side.	**Yes** GO to A13 . **No** GO to A14 .

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 • **Is any voltage present?**	
A13 CHECK THE A/C PRESSURE TRANSDUCER FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C1381B (5.0L, 6.2L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1551B (3.5L) . • Ignition ON. • Measure the voltage between ground and A/C pressure transducer C1260-2, circuit VH433 (VT/OG), harness side.  • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** REPAIR circuit VH433 (VT/OG) for a short to circuit LE424 (YE/GN).
A14 CHECK FOR CORRECT PCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all PCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all PCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new PCM. REFER to Section 303-14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test B: DTC P0645

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

Voltage is provided to the A/C clutch relay coil from Battery Junction Box (BJB) fuse 77 (10A). When A/C is requested and A/C line pressures allow, a ground is provided to the A/C clutch relay coil from the PCM, energizing the A/C clutch relay.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
P0645	A/C Clutch Relay Control Circuit: No Sub Type Information	The DTC sets when the PCM grounds the relay circuit and more voltage than expected is detected on the relay circuit. The DTC also sets when the relay circuit is off and no voltage is detected on the relay circuit.

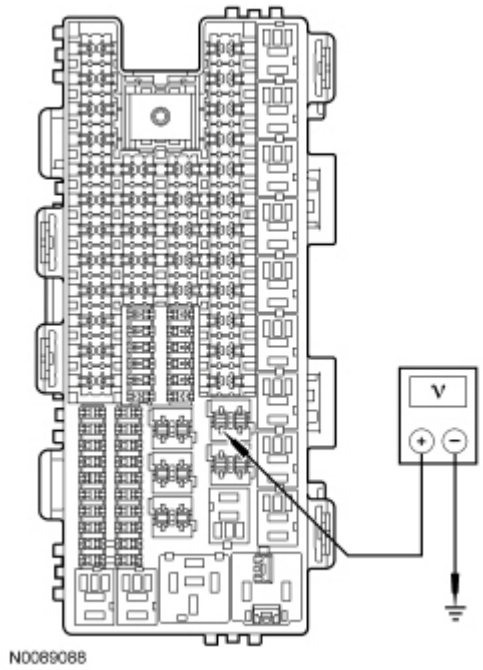
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- A/C clutch relay
- PCM

PINPOINT TEST B: DTC P0645

Test Step	Result / Action to Take
B1 CHECK THE VOLTAGE TO THE A/C CLUTCH RELAY	
• Ignition OFF. • Disconnect: A/C Clutch Relay . • Ignition ON. • Measure the voltage between ground and the A/C clutch relay socket, circuit CBB77 (WH).	**Yes** GO to B2 . **No** VERIFY BJB fuse 77 (10A) is OK. If OK, REPAIR circuit CBB77 (WH) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

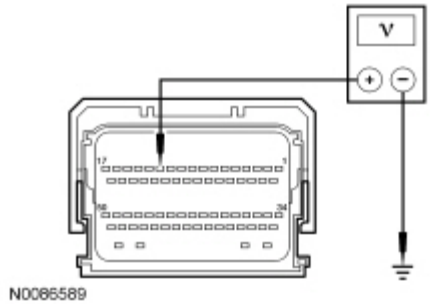
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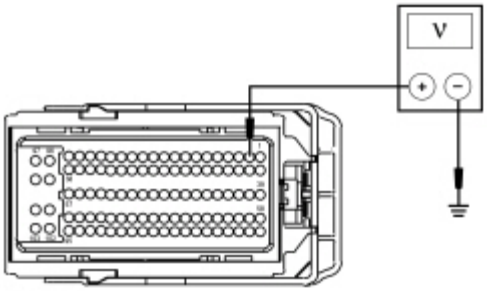
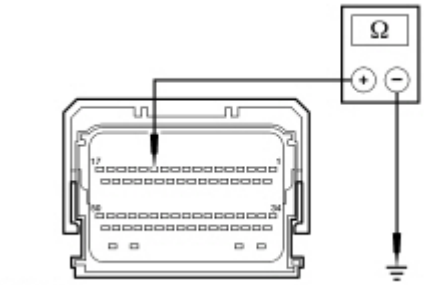
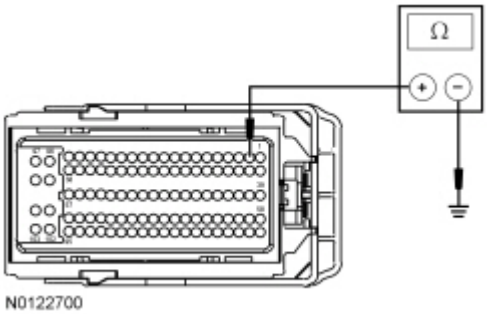
- **Is the voltage greater than 11 volts?**

B2 CHECK THE A/C CLUTCH RELAY	
• Carry out the A/C clutch relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the relay pass the component test?**	**Yes** GO to B3 . **No** INSTALL a new A/C clutch relay. TEST the system for normal operation.
B3 CHECK THE A/C CLUTCH RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C1381B (5.0L, 6.2L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1551B (3.5L) . • Ignition ON. **For 3.7L, 5.0L and 6.2L**	**Yes** REPAIR the circuit. **No** GO to B4 .

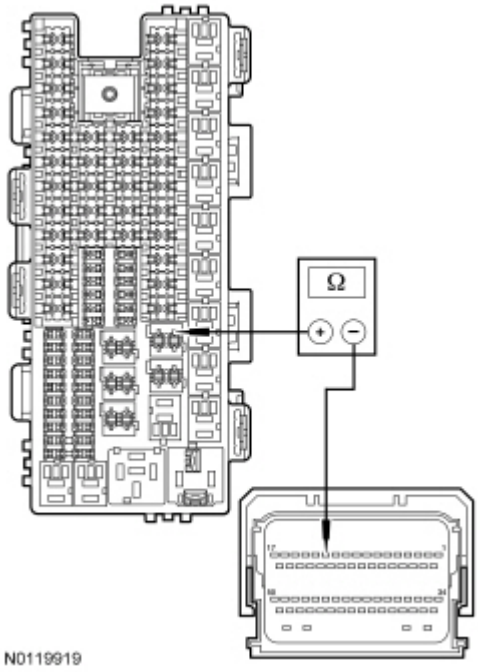


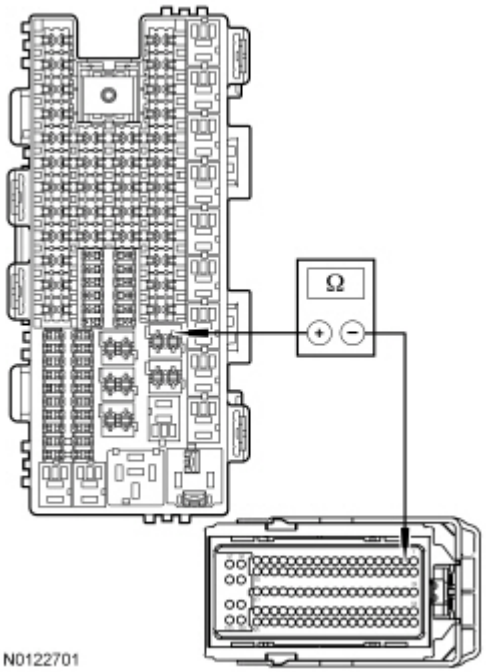
N0086589

- Measure the voltage between ground and:
  - For 3.7L, PCM C175B-12, circuit CH302 (WH/BN), harness side.
  - For 5.0L and 6.2L, PCM C1381B-12, circuit

CH302 (WH/BN), harness side. **For 3.5L**  N0122699 • For 3.5L, measure the voltage between ground and PCM C1551B-2, circuit CH302 (WH/BN), harness side. • **Is any voltage present?**	
B4 CHECK THE A/C CLUTCH RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. **For 3.7L, 5.0L and 6.2L**  N0086590 • Measure the resistance between ground and: ▪ For 3.7L, PCM C175B-12, circuit CH302 (WH/BN), harness side. ▪ For 5.0L and 6.2L, PCM C1381B-12, circuit CH302 (WH/BN), harness side. **For 3.5L**  N0122700 • For 3.5L, measure the resistance between ground and	**Yes** GO to B5 . **No** REPAIR the circuit.

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PCM C1551B-2, circuit CH302 (WH/BN), harness side. • **Is the resistance greater than 10,000 ohms?**	
B5 CHECK THE A/C CLUTCH RELAY COIL SWITCHED GROUND CIRCUIT FOR AN OPEN	
For 3.7L, 5.0L and 6.2L  N0119919 • Measure the resistance between A/C clutch relay socket, circuit CH302 (WH/BN) and: ▪ For 3.7L, PCM C175B-12, circuit CH302 (WH/BN), harness side. ▪ For 5.0L and 6.2L, PCM C1381B-12, circuit CH302 (WH/BN), harness side. **For 3.5L**	**Yes** GO to B6 . **No** REPAIR the circuit.

 • For 3.5L, measure the resistance between A/C clutch relay socket, circuit CH302 (WH/BN) and PCM C1551B-2, circuit CH302 (WH/BN), harness side. • **Is the resistance less than 3 ohms?**	
B6 CHECK FOR CORRECT PCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all PCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all PCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new PCM. REFER to Section 303-14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test C: DTC C1B14:11 or C1B14:12

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

A 5-volt reference voltage is supplied to the sensors and actuators from the HVAC module.

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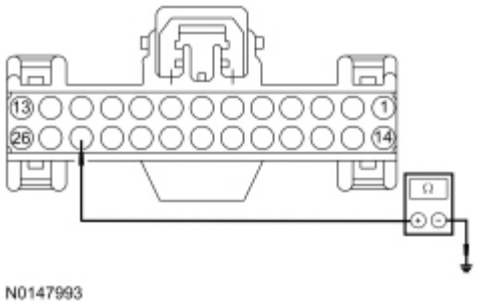
DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
C1B14:11	Sensor Supply Voltage A: Circuit Short to Ground	The HVAC module senses less than 5 volts on the sensor reference voltage circuit, indicating a short to ground.
C1B14:12	Sensor Supply Voltage A: Circuit Short to Battery	The HVAC module senses greater than 5 volts on the sensor reference voltage circuit, indicating a short to voltage.

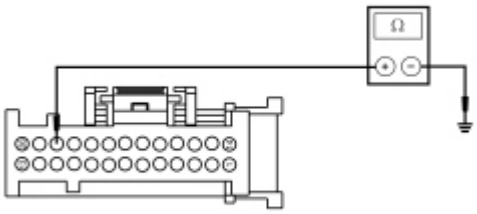
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- HVAC module

PINPOINT TEST C: DTC C1B14:11 OR C1B14:12

Test Step	Result / Action to Take
C1 CHECK THE SENSOR RESISTANCE	
• Check for HVAC DTCs. • **Is DTC C1B14:11 present?**	**Yes** GO to C2 . **No** GO to C5 .
C2 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . **For vehicles with Base EMTC**  N0147993 • Measure the resistance between ground and HVAC module — Base EMTC C294A-24, circuit LH111 (BN/WH), harness side.	**Yes** GO to C3 . **No** REPAIR the circuit.

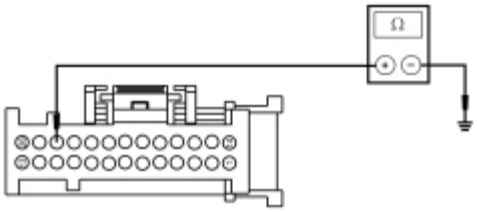
For vehicles with Remote Mount EMTC



N0114401

- Measure the resistance between ground and HVAC module — Remote Mount EMTC C2357A-24, circuit LH111 (BN/WH), harness side.

For vehicles with EATC

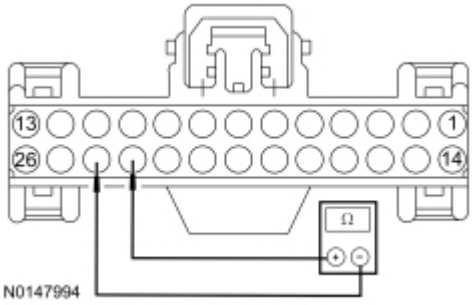


N0114401

- Measure the resistance between ground and HVAC module — EATC C228A-24, circuit LH111 (BN/WH), harness side.
- **Is the resistance greater than 10,000 ohms?**

C3 CHECK THE REFERENCE VOLTAGE CIRCUIT AND THE SIGNAL RETURN CIRCUIT FOR A SHORT TOGETHER

For vehicles with Base EMTC



N0147994

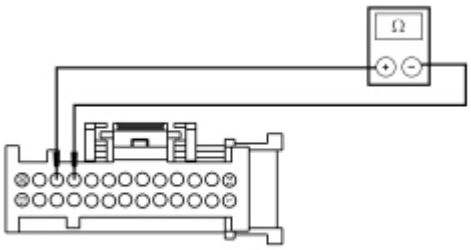
- Measure the resistance between HVAC module — Base EMTC C294A-24, circuit LH111 (BN/WH), harness side and HVAC module — EMTC C294A-23, circuit RH111 (GY/BU), harness side.

For vehicles with Remote Mount EMTC

Yes
GO to C6 .

No
GO to C4 .

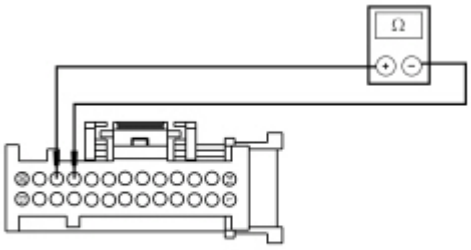
repair4less



N0114402

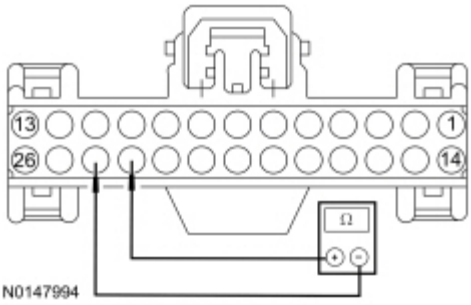
- Measure the resistance between HVAC module — Remote Mount EMTC C2357A-24, circuit LH111 (BN/WH), harness side and HVAC module — Remote Mount EMTC C2357A-23, circuit RH111 (GY/BU), harness side.

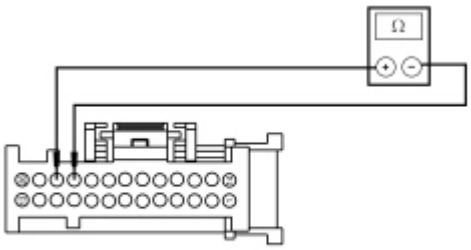
For vehicles with EATC



N0114402

- Measure the resistance between HVAC module — EATC C228A-24, circuit LH111 (BN/WH), harness side and HVAC module — EATC C228A-23, circuit RH111 (GY/BU), harness side.
- **Is the resistance greater than 200 ohms?**

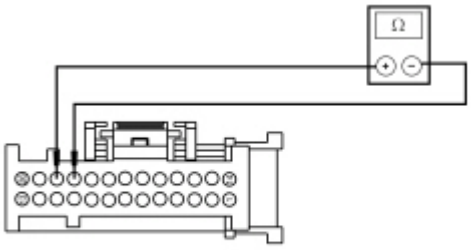
C4 CHECK THE ACTUATORS	
For vehicles with Base EMTC  N0147994 • Measure the resistance between HVAC module — Base EMTC C294A-24, circuit LH111 (BN/WH), harness side and HVAC module — Base EMTC C294A-23, circuit RH111 (GY/BU), harness side. **For vehicles with Remote Mount EMTC**	**Yes** INSTALL a new actuator or sensor (the last one to be disconnected). REFER to Section 412-01 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected. TEST the system for normal operation. **No** REPAIR the circuits.



N0114402

- Measure the resistance between HVAC module — Remote Mount EMTC C2357A-24, circuit LH111 (BN/WH), harness side and HVAC module Remote Mount EMTC C2357A-23, circuit RH111 (GY/BU), harness side.

  For vehicles with EATC



N0114402

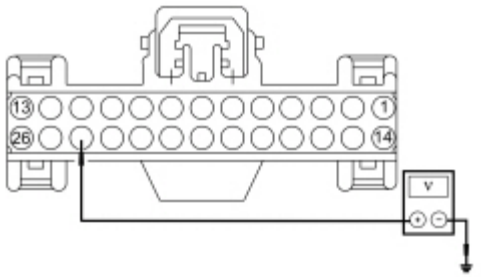
- Measure the resistance between HVAC module — EATC C228A-24, circuit LH111 (BN/WH), harness side and HVAC module C228A-23, circuit RH111 (GY/BU), harness side.
- While measuring the resistance, disconnect the following components one at a time, in order. Stop disconnecting components if the measured resistance rises above 200 ohms.
  - In-vehicle temperature and humidity sensor C2247
  - Air inlet mode door actuator C289
  - Defrost/panel/floor mode door actuator C236
  - Temperature blend door actuator C2381 (EMTC only)
  - Driver side temperature blend door actuator C2091 (EATC only)
  - Passenger side temperature blend door actuator C2092 (EATC only)
- **Did the resistance rise above 200 ohms?**

C5 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC	**Yes** REPAIR the circuit. **No** GO to C6 .

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C2357B .
- Disconnect: HVAC Module — EATC C228A .
- Disconnect: HVAC Module — EATC C228B .

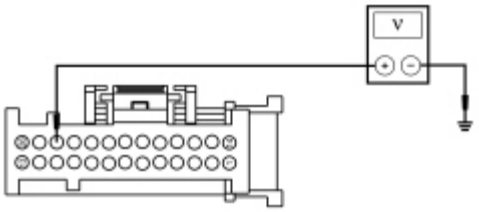
For vehicles with Base EMTC



N0147995

- Measure the voltage between ground and HVAC module — EMTC C294A-24, circuit LH111 (BN/WH), harness side.

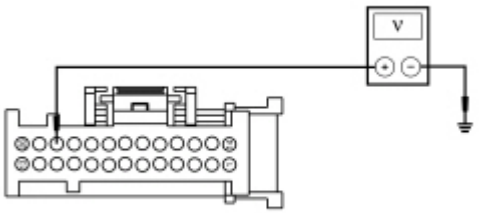
For vehicles with Remote Mount EMTC



N0114403

- Measure the voltage between ground and HVAC module — Remote Mount EMTC C2357A-24, circuit LH111 (BN/WH), harness side.

For vehicles with EATC



N0114403

- Measure the voltage between ground and HVAC module — EATC C228A-24, circuit LH111 (BN/WH), harness side.
- **Is any voltage present?**

C6 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: DTC B1A61:11 or B1A61:15

Refer to Wiring Diagrams Cell 54, Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55, Automatic Climate Control System for schematic and connector information.

Normal Operation

The in-vehicle temperature and humidity sensor receives a ground from the HVAC module. The sensor varies its resistance with the temperature. As the temperature rises, the resistance falls. As the temperature falls the resistance rises. The HVAC module measures this resistance to determine the temperature at the sensor.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A61:11	Cabin Temperature Sensor: Circuit Short to Ground	This CMDTC and on demand DTC sets when the HVAC module senses lower than expected voltage on the sensor feedback circuit, indicating a short to ground.
B1A61:15	Cabin Temperature Sensor: Circuit Short to Battery or Open	This CMDTC and on demand DTC sets when the HVAC module senses greater than expected voltage on the sensor feedback circuit, indicating a short to voltage or an open circuit or sensor.

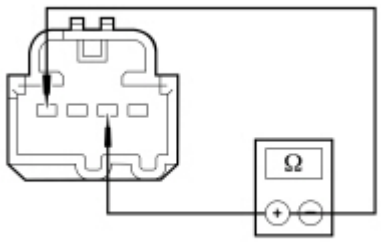
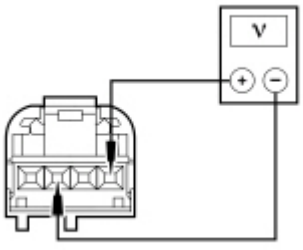
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- In-vehicle temperature and humidity sensor
- HVAC module

PINPOINT TEST D: DTC B1A61:11 OR B1A61:15

Test Step	Result / Action to Take
D1 CHECK THE IN-VEHICLE TEMPERATURE SENSOR	

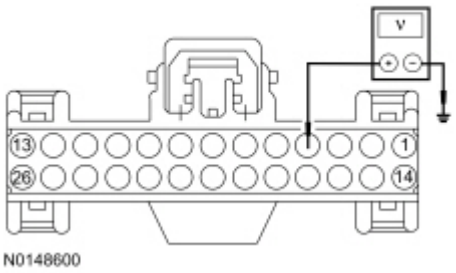
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RESISTANCE • Ignition OFF. • Disconnect: In-Vehicle Temperature and Humidity Sensor C2247 . • Measure the resistance between the in-vehicle temperature and humidity sensor C2247-1, component side and C2247-3, component side and compare to the table below. **Ambient Temperature** / **Resistance (Ohms)** 0-10°C (32-50°F) / 57,950-97,640 10-20°C (50-68°F) / 36,880-59,920 20-25°C (68-77°F) / 29,700-37,790 25-30°C (77-86°F) / 23,960-30,300 30-35°C (86-95°F) / 19,440-24,550 35-40°C (95-104°F) / 15,860-20,000 40-50°C (104-122°F) / 10,740-16,390  N0119920 • **Is the resistance within the specified values for the temperatures?**	**Yes** GO to D2 . **No** INSTALL a new in-vehicle temperature and humidity sensor. REFER to Section 412-01 .
D2 CHECK THE HVAC MODULE OUTPUT VOLTAGE • Ignition ON. • Measure the voltage between in-vehicle temperature and humidity sensor C2247-1, circuit VH414 (GN/BU), harness side and C2247-3, circuit RH111 (GY/BU), harness side.  N0119921 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new in-vehicle temperature and humidity sensor. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. If the DTC returns, GO to D8 . **No** For DTC B1A61:15, GO to D3 . For DTC B1A61:11, GO to D6 .
D3 CHECK THE IN-VEHICLE TEMPERATURE SENSOR	

FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: HVAC Module — Base EMTC C294A .
- Disconnect: HVAC Module — Base EMTC C294B .
- Disconnect: HVAC Module — Remote Mount EMTC C2357A .
- Disconnect: HVAC Module — Remote Mount EMTC C2357B .
- Disconnect: HVAC Module — EATC C228A .
- Disconnect: HVAC Module — EATC C228B .
- Ignition ON.

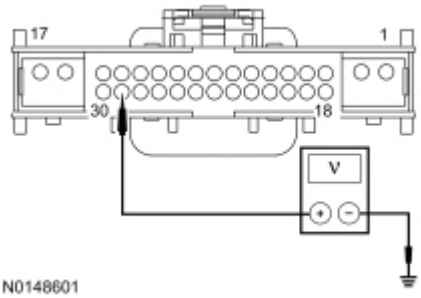
For Base EMTC vehicles



N0148600

- Measure the voltage between ground and HVAC module — Base EMTC C294A-4, circuit VH414 (GN/BU), harness side.

For Remote Mount EMTC vehicles



N0148601

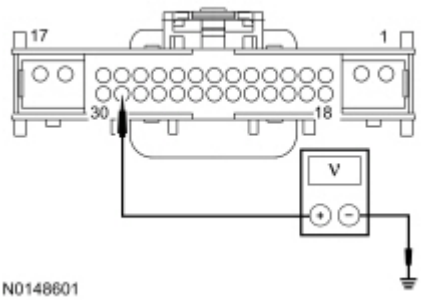
- Measure the voltage between ground and HVAC module — Remote Mount EMTC C2357A-29, circuit VH414 (GN/BU), harness side.

For EATC vehicles

Yes
REPAIR the circuit.

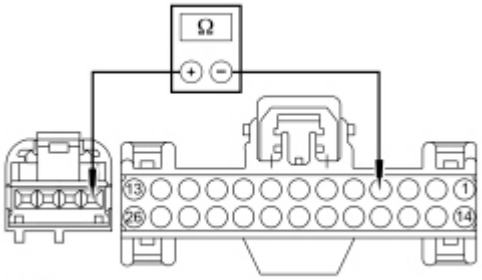
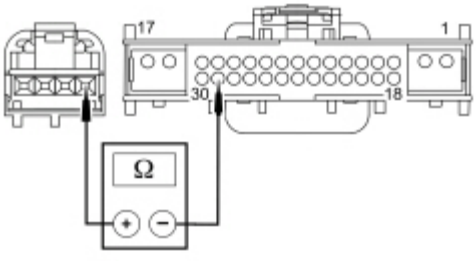
No
GO to D4 .

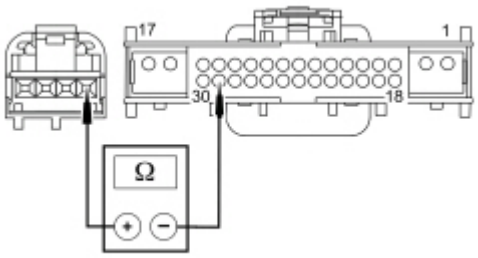
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N0148601

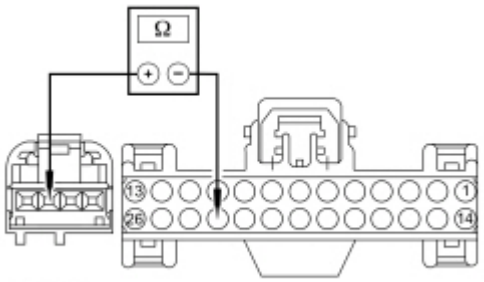
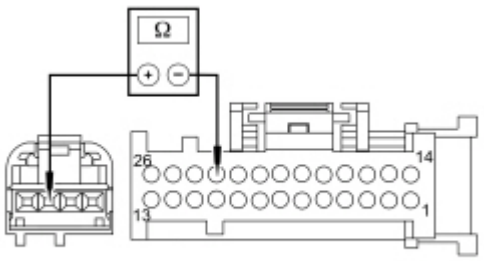
- Measure the voltage between ground and HVAC module — EATC C228B-29, circuit VH414 (GN/BU), harness side.
- **Is any voltage present?**

D4 CHECK THE IN-VEHICLE TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR AN OPEN	
• Ignition OFF. **For Base EMTC vehicles**  N0148602 • Measure the resistance between HVAC module — Base EMTC C294A-4, circuit VH414 (GN/BU), harness side and in-vehicle temperature and humidity sensor C2247-1, circuit VH414 (GN/BU), harness side. **For Remote Mount EMTC vehicles**  N0148603 • Measure the resistance between HVAC module — Remote Mount EMTC C2357A-29, circuit VH414 (GN/BU), harness side and in-vehicle temperature and humidity sensor C2247-1, circuit VH414 (GN/BU), harness side. **For EATC vehicles**	**Yes** GO to D5 . **No** REPAIR the circuit.

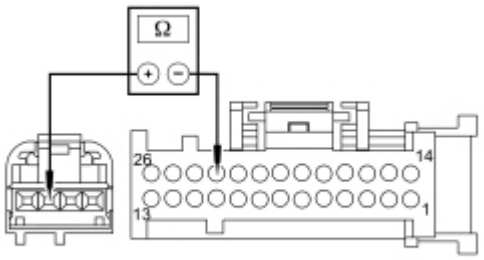


N0148603

- Measure the resistance between HVAC module — EATC C228B-29, circuit VH414 (GN/BU), harness side and in-vehicle temperature and humidity sensor C2247-1, circuit VH414 (GN/BU), harness side.
- **Is the resistance less than 3 ohms?**

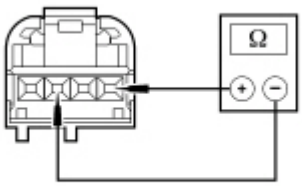
D5 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	
For Base EMTC vehicles  N0148604 • Measure the resistance between HVAC module — Base EMTC C294A-23, circuit RH111 (GY/BU), harness side and in-vehicle temperature and humidity sensor C2247-3, circuit RH111 (GY/BU), harness side. **For Remote Mount EMTC vehicles**  N0148608 • Measure the resistance between HVAC module — Remote Mount EMTC C2357A-23, circuit RH111 (GY/BU), harness side and in-vehicle temperature and humidity sensor C2247-3, circuit RH111 (GY/BU), harness side. **For EATC vehicles**	**Yes** GO to D8 . **No** REPAIR the circuit.

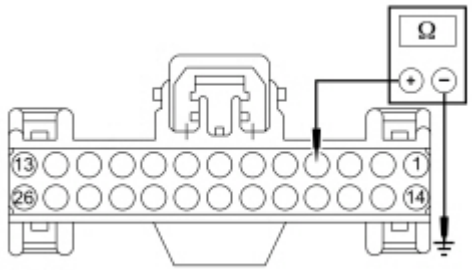
repair4less



N0148608

- Measure the resistance between HVAC module — EATC C228A-23, circuit RH111 (GY/BU), harness side and in-vehicle temperature and humidity sensor C2247-3, circuit RH111 (GY/BU), harness side.
- **Is the resistance less than 3 ohms?**

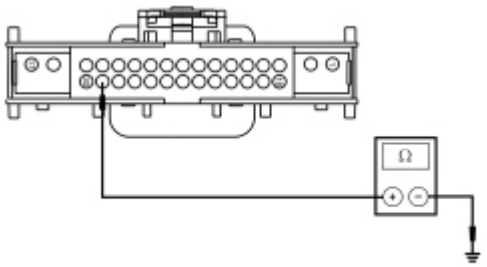
D6 CHECK THE IN-VEHICLE TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR A SHORT TO THE SIGNAL RETURN CIRCUIT	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Measure the resistance between in-vehicle temperature and humidity sensor C2247-1, circuit VH414 (GN/BU), harness side and C2247-3, circuit RH111 (GY/BU), harness side.  N0098162 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D7 . **No** REPAIR the circuits.
D7 CHECK THE IN-VEHICLE TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
For Base EMTC vehicles	**Yes** GO to D8 . **No** REPAIR the circuit.



N0148612

- Measure the resistance between HVAC module — Base EMTC C294A-4, circuit VH414 (GN/BU), harness side and ground.

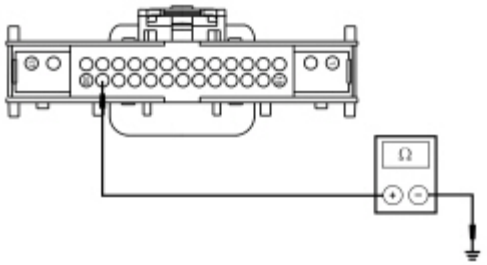
For Remote Mount EMTC vehicles



N0114407

- Measure the resistance between HVAC module — Remote Mount EMTC C2357A-29, circuit VH414 (GN/BU), harness side and ground.

For EATC vehicles



N0114407

- Measure the resistance between HVAC module — EATC C228B-29, circuit VH414 (GN/BU), harness side and ground.
- **Is the resistance greater than 10,000 ohms?**

D8 CHECK FOR CORRECT HVAC MODULE OPERATION
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module.

repair4less

• Connect all HVAC module connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	REFER to Section 412-01 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test E: DTC B1A69:11 or B1A69:15

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

The in-vehicle temperature and humidity sensor receives a ground from the HVAC module. The sensor varies its resistance with the humidity inside the vehicle. As the humidity rises, the resistance falls. As the humidity falls the resistance rises. The HVAC module measures this resistance to determine the humidity at the sensor.

DTC Fault Trigger Conditions

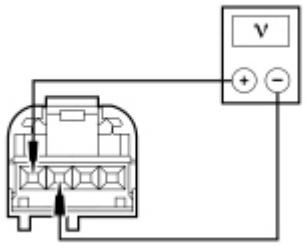
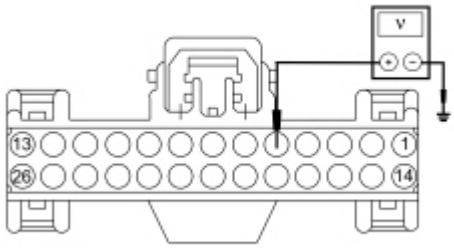
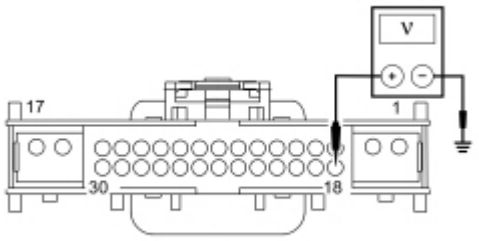
DTC	Description	Fault Trigger Conditions
B1A69:11	Humidity Sensor: Circuit Short to Ground	This DTC sets when the HVAC module senses lower than expected voltage on the sensor feedback circuit, indicating a short to ground.
B1A69:15	Humidity Sensor: Circuit Short to Battery or Open	This DTC sets when the HVAC module senses greater than expected voltage on the sensor feedback circuit, indicating a short to voltage or an open circuit or sensor.

This pinpoint test is intended to diagnose the following:

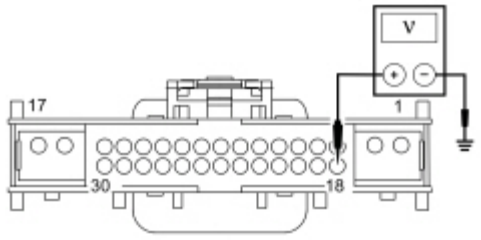
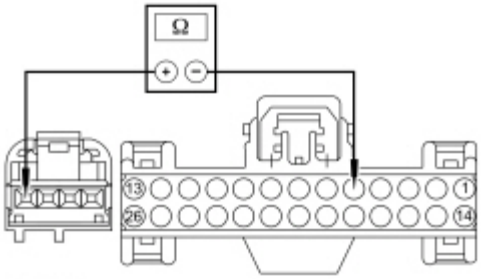
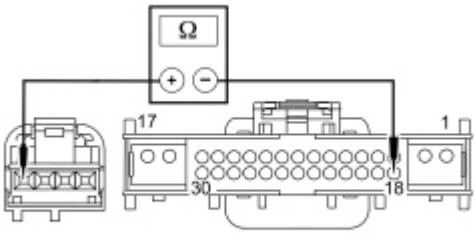
- Wiring, terminals or connectors
- In-vehicle temperature and humidity sensor
- HVAC module

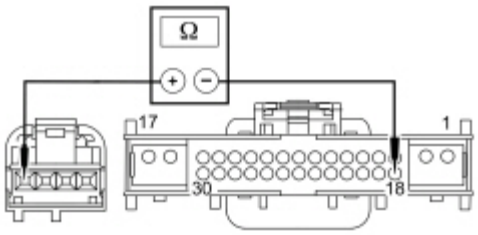
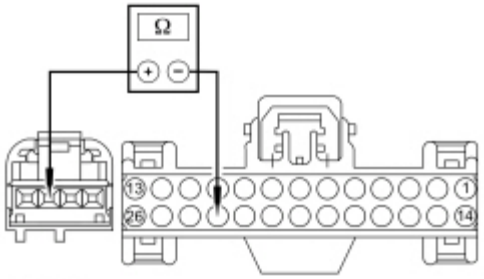
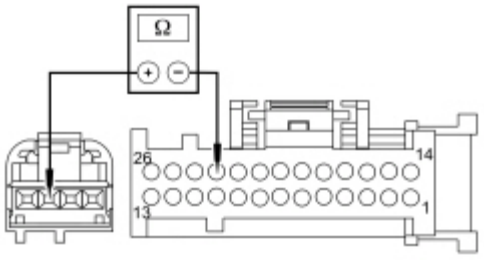
PINPOINT TEST E: DTC B1A69:11 OR B1A69:15

Test Step	Result / Action to Take
E1 CHECK THE HVAC MODULE OUTPUT VOLTAGE	
• Ignition OFF. • Disconnect: In-Vehicle Temperature and Humidity Sensor C2247 . • Ignition ON. • Measure the voltage between in-vehicle temperature and humidity sensor C2247-4, circuit VH413 (WH/BU), harness	**Yes** INSTALL a new in-vehicle temperature and humidity sensor. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. If the DTC returns, GO to

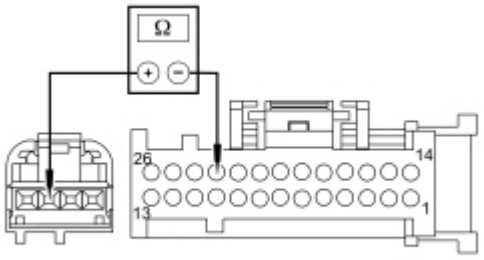
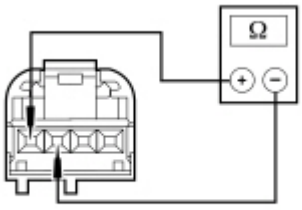
side and C2247-3, circuit RH111 (GY/BU), harness side.  N0119929 • **Is the voltage between 4.7 and 5.1 volts?**	E7 . **No** For DTC B1A69:15, GO to E2 . For DTC B1A69:11, GO to E5 .
E2 CHECK THE HUMIDITY SENSOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Ignition ON. **For Base EMTC vehicles**  N0148613 • Measure the voltage between ground and HVAC module — Base EMTC C294A-5, circuit VH413 (WH/BU), harness side. **For Remote Mount EMTC vehicles**  N0148614	**Yes** REPAIR the circuit. **No** GO to E3 .

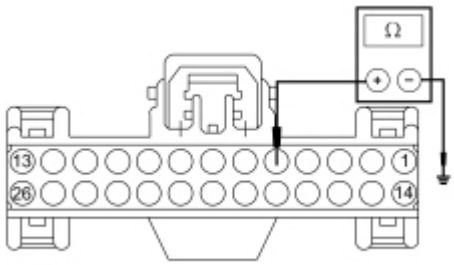
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• Measure the voltage between ground and HVAC module — Remote Mount EMTC C2357A-18, circuit VH413 (WH/BU), harness side. **For EATC vehicles**  N0148614 • Measure the voltage between ground and HVAC module — EATC C228B-18, circuit VH413 (WH/BU), harness side. • **Is any voltage present?**	
E3 CHECK THE HUMIDITY SENSOR FEEDBACK CIRCUIT FOR AN OPEN	
• Ignition OFF. **For Base EMTC vehicles**  N0148615 • Measure the resistance between HVAC module — Base EMTC C294A-5, circuit VH413 (WH/BU), harness side and in-vehicle temperature and humidity sensor C2247-4, circuit VH413 (WH/BU), harness side. **For Remote Mount EMTC vehicles**  N0148616 • Measure the resistance between HVAC module — Remote	**Yes** GO to E4 . **No** REPAIR the circuit.

Mount EMTC C2357A-18, circuit VH413 (WH/BU), harness side and in-vehicle temperature and humidity sensor C2247-4, circuit VH413 (WH/BU), harness side. **For EATC vehicles**  N0148616 • Measure the resistance between HVAC module — EATC C228B-18, circuit VH413 (WH/BU), harness side and in-vehicle temperature and humidity sensor C2247-4, circuit VH413 (WH/BU), harness side. • **Is the resistance less than 3 ohms?**	
E4 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	
For Base EMTC vehicles  N0148604 • Measure the resistance between HVAC module — Base EMTC C294A-23, circuit RH111 (GY/BU), harness side and in-vehicle temperature and humidity sensor C2247-3, circuit RH111 (GY/BU), harness side. **For Remote Mount EMTC vehicles**  N0148608 • Measure the resistance between HVAC module — For Remote Mount EMTC C2357A-23, circuit RH111 (GY/BU),	**Yes** GO to E7 . **No** REPAIR the circuit.

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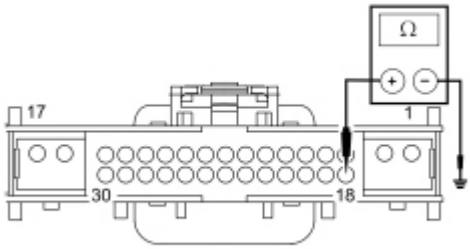
harness side and in-vehicle temperature and humidity sensor C2247-3, circuit RH111 (GY/BU), harness side. **For EATC vehicles**  N0148608 • Measure the resistance between HVAC module — EATC C228A-23, circuit RH111 (GY/BU), harness side and in-vehicle temperature and humidity sensor C2247-3, circuit RH111 (GY/BU), harness side. • **Is the resistance less than 3 ohms?**	
E5 CHECK THE HUMIDITY SENSOR FEEDBACK CIRCUIT FOR A SHORT TO THE SIGNAL RETURN CIRCUIT	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Measure the resistance between in-vehicle temperature and humidity sensor C2247-4, circuit VH413 (WH/BU), harness side and C2247-3, circuit RH111 (GY/BU), harness side.  N0119936 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E6 . **No** REPAIR the circuits.
E6 CHECK THE HUMIDITY SENSOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
For Base EMTC vehicles	**Yes** GO to E7 . **No** REPAIR the circuit.



N0148635

- Measure the resistance between HVAC module — Base EMTC C294A-5, circuit VH413 (WH/BU), harness side and ground.

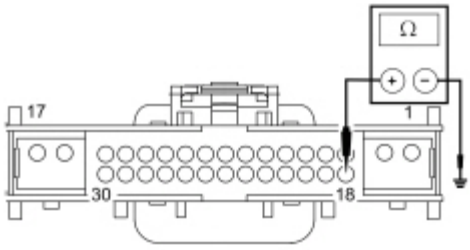
For Remote Mount EMTC vehicles



N0148636

- Measure the resistance between HVAC module — Remote Mount EMTC C2357B-18, circuit VH413 (WH/BU), harness side and ground.

For EATC vehicles



N0148636

- Measure the resistance between HVAC module — EATC C228B-18, circuit VH413 (WH/BU), harness side and ground.
- **Is the resistance greater than 10,000 ohms?**

E7 CHECK FOR CORRECT HVAC MODULE OPERATION
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module.

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• Connect all HVAC module connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	REFER to Section 412-01 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test F: DTC B1A63:11, B1A63:15, B1A64:11 or DTC B1A64:15

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

The autolamp/autolamp/sunload sensor is grounded. As the light applied to the sensor changes, the HVAC module detects the change through the passenger side and driver side feedback circuits.

DTC Fault Trigger Conditions

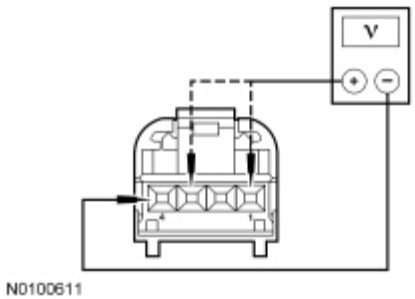
DTC	Description	Fault Trigger Conditions
B1A63:11	Right Solar Sensor: Circuit Short to Ground	This DTC sets when the HVAC module senses lower than expected voltage on the passenger side sensor feedback circuit, indicating a short to ground.
B1A63:15	Right Solar Sensor: Circuit Short to Battery or Open	This DTC sets when the HVAC module senses greater than expected voltage on the passenger side sensor feedback circuit, indicating a short to voltage or an open circuit or sensor.
B1A64:11	Left Solar Sensor: Circuit Short to Ground	This DTC sets when the HVAC module senses lower than expected voltage on the driver side sensor feedback circuit, indicating a short to ground.
B1A64:15	Left Solar Sensor: Circuit Short to Battery or Open	This DTC sets when the HVAC module senses greater than expected voltage on the driver side sensor feedback circuit, indicating a short to voltage or an open circuit or sensor.

This pinpoint test is intended to diagnose the following:

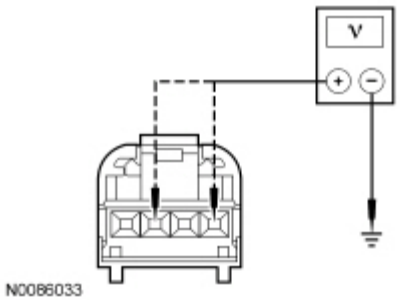
- Wiring, terminals or connectors
- Autolamp/autolamp/sunload sensor
- HVAC module

PINPOINT TEST F: DTC B1A63:11, B1A63:15, B1A64:11 OR DTC B1A64:15

Test Step	Result / Action to Take
F1 CHECK THE AUTOLAMP/SUNLOAD SENSOR REFERENCE VOLTAGE	
• Ignition OFF.	**Yes**

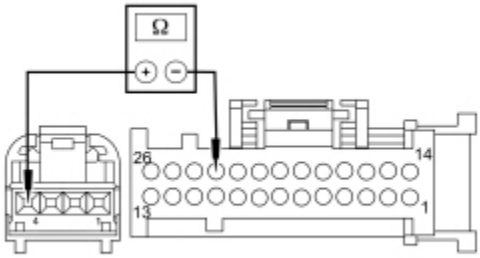
• Disconnect: Autolamp/Sunload Sensor C286 .
• Ignition ON.
• Press the AUTO button.
• Measure the voltage between autolamp/sunload sensor C286-4, circuit RH111 (GY/BU), harness side and autolamp/sunload sensor:
  ▪ For DTC B1A63:11 or B1A63:15, C286-1, circuit VH417 (YE/OG), harness side.
  ▪ For DTC B1A64:11 or B1A64:15, C286-3, circuit VH416 (VT), harness side.

 	
N0100611
• **Is the voltage between 4.7 and 5.1 volts?**
	INSTALL a new autolamp/sunload sensor. REFER to Section 417-01 . CLEAR the DTCs. REPEAT the self-test. If the code returns, GO to F7 .
	
	No
	If diagnosing DTC B1A63:15 or DTC B1A64:15, GO to F2 .
	
	If diagnosing DTC B1A63:11 or DTC B1A64:11, GO to F5 .

F2 CHECK THE AUTOLAMP/SUNLOAD SENSOR FEEDBACK CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Ignition ON.
• Measure the voltage between ground and autolamp/sunload sensor:
  ▪ For DTC B1A64:15, C286-3, circuit VH416 (VT), harness side.
  ▪ For DTC B1A63:15, C286-1, circuit VH417 (YE/OG), harness side.

 	
N0086033
• **Is any voltage present?**
	Yes
	REPAIR the circuit in question.
	
	No
	GO to F3 .

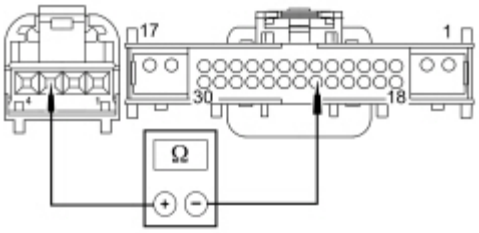
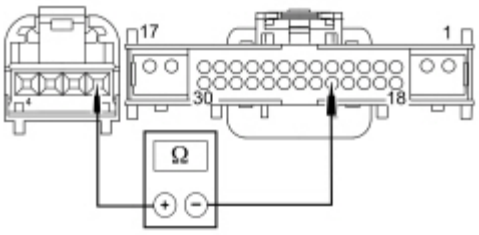
F3 CHECK THE AUTOLAMP/SUNLOAD SENSOR GROUND CIRCUIT FOR AN OPEN	
	Yes GO to F4 . **No** REPAIR the circuit.

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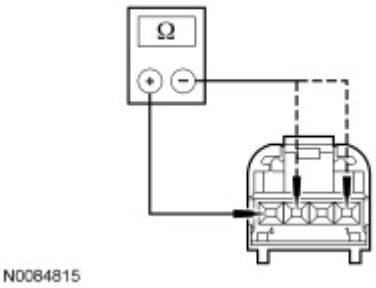


N0148637

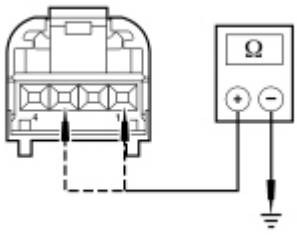
- Ignition OFF.
- Measure the resistance between autolamp/sunload sensor C286-4, circuit RH111 (GY/BU), harness side and HVAC module — EATC C228A-23, circuit RH111 (GY/BU), harness side.
- **Is the resistance less than 3 ohms?**

F4 CHECK THE AUTOLAMP/SUNLOAD SENSOR FEEDBACK CIRCUITS FOR AN OPEN	
For DTC B1A64:15  N0148638 • Measure the resistance between HVAC module — EATC C228B-23, circuit VH416 (VT), harness side and autolamp/sunload sensor C286-3, circuit VH416 (VT), harness side. **For DTC B1A63:15**  N0148639 • Measure the resistance between HVAC module — EATC C228B-22, circuit VH417 (YE/OG), harness side and autolamp/sunload sensor C286-1, circuit VH417 (YE/OG), harness side. • **Is the resistance less than 3 ohms?**	**Yes** GO to F7 . **No** REPAIR the circuit.
F5 CHECK THE AUTOLAMP/SUNLOAD SENSOR FEEDBACK CIRCUITS FOR A SHORT TO THE	

AUTOLAMP/SUNLOAD SENSOR GROUND CIRCUIT	

• Ignition OFF.
• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Measure the resistance between autolamp/sunload sensor C286-4, circuit RH111 (GY/BU), harness side and autolamp/sunload sensor:
  ▪ For DTC B1A64:11, C286-3, circuit VH416 (VT), harness side.
  ▪ For DTC B1A63:11, C286-1, circuit VH417 (YE/OG), harness side.

 	
N0084815
• **Is the resistance greater than 10,000 ohms?**
	Yes
	GO to F6 .
	
	No
	REPAIR the circuit in question.

F6 CHECK THE AUTOLAMP/SUNLOAD SENSOR FEEDBACK CIRCUITS FOR A SHORT TO GROUND	

• Measure the resistance between ground and autolamp/sunload sensor:
  ▪ For DTC B1A64:11, C286-3, circuit VH416 (VT), harness side.
  ▪ For DTC B1A63:11, C286-1, circuit VH417 (YE/OG), harness side.

 	
N0083696
• **Is the resistance greater than 10,000 ohms?**
	Yes
	GO to F7 .
	
	No
	REPAIR the circuit in question.

F7 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .

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seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test G: DTC B1B71:11 or B1B71:15

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

The evaporator temperature sensor receives a ground from the HVAC module. The sensor varies its resistance with the temperature. As the temperature rises, the resistance falls. As the temperature falls the resistance rises. The HVAC module measures this resistance to determine the temperature at the sensor.

An accurate evaporator temperature is critical to prevent evaporator icing. The HVAC module uses the temperature measurement to turn off the A/C compressor before the evaporator temperatures are cold enough to freeze the condensation. This prevents ice blockage of airflow over the evaporator core.

DTC Fault Trigger Conditions

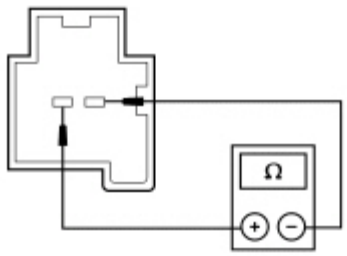
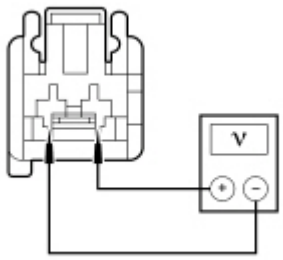
DTC	Description	Fault Trigger Conditions
B1B71:11	Evaporator Temperature Sensor: Circuit Short to Ground	This CMDTC and on demand DTC sets when the HVAC module senses lower than expected voltage on the sensor feedback circuit, indicating a short to ground.
B1B71:15	Evaporator Temperature Sensor: Circuit Short to Battery or Open	This CMDTC and on demand DTC sets when the HVAC module senses greater than expected voltage on the sensor feedback circuit, indicating a short to voltage or an open circuit or sensor.

This pinpoint test is intended to diagnose the following:

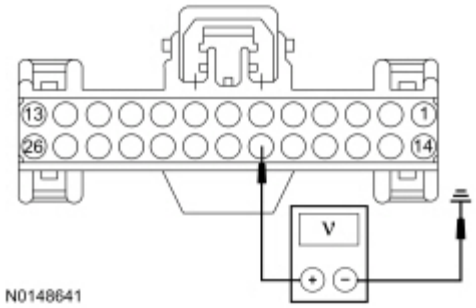
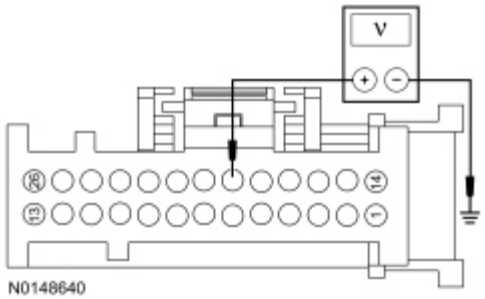
- Wiring, terminals or connectors
- Evaporator temperature sensor
- HVAC module

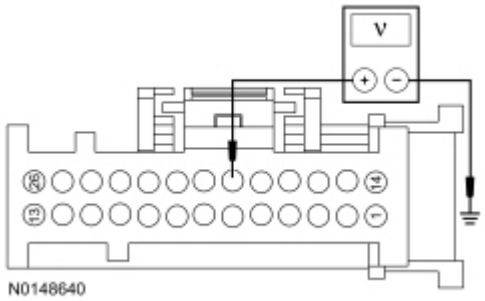
PINPOINT TEST G: DTC B1B71:11 OR B1B71:15

Test Step	Result / Action to Take
G1 CHECK THE EVAPORATOR TEMPERATURE SENSOR RESISTANCE	
• Ignition OFF. • Disconnect: Evaporator Temperature Sensor C296 .	**Yes** GO to G2 .

• Measure the resistance between the evaporator temperature sensor C296-1, component side and evaporator temperature sensor C296-2, component side and compare to the table below. **Ambient Temperature / Resistance (Ohms)** -40°C (-40°F) 1,005,00-1,104,000 -20°C (-4°F) 287,811-307,800 0°C (32°F) 96,890-101,300 20°C (68°F) 37,080-38,000 25°C (77°F) 29,700-30,300 30°C (86°F) 23,840-24,430 35°C (95°F) 19,260-19,820 40°C (104°F) 15,660-16,180 60°C (140°F) 7,239-7,594 100°C (212°F) 1,943-2,091  A0004761 • **Is the resistance within the specified values for the temperatures?**	**No** INSTALL a new heater core and evaporator core housing. REFER to Section 412-01 .
G2 CHECK THE HVAC MODULE OUTPUT VOLTAGE	
• Ignition ON. • Select PANEL on the HVAC controls. • Measure the voltage between evaporator temperature sensor C296-1, circuit VH406 (VT/BN), harness side and C296-2, circuit RH111 (GY/BU), harness side.  N0054664 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to G8 . **No** For DTC B1B71:11, GO to G6 . For DTC B1B71:15, GO to G3 .

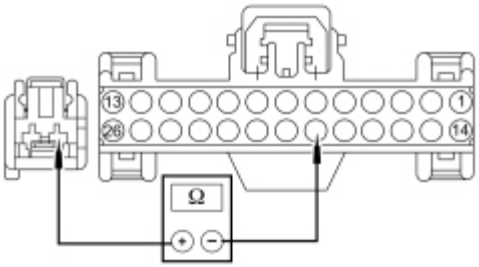
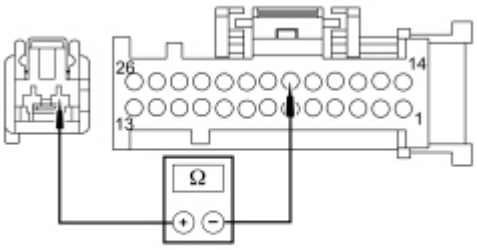
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G3 CHECK THE EVAPORATOR TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Ignition ON. **For Base EMTC vehicles**  N0148641 • Measure the voltage between ground and HVAC module — Base EMTC C294A-19, circuit VH406 (VT), harness side and ground. **For Remote Mount EMTC vehicles**  N0148640 • Measure the voltage between ground and HVAC module — Remote Mount EMTC C2357A-19, circuit VH406 (VT/BN), harness side and ground. **For EATC vehicles**	**Yes** REPAIR the circuit. **No** GO to G4 .

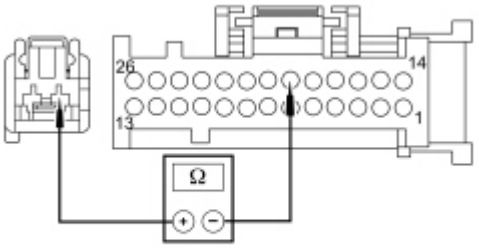


N0148640

- Measure the voltage between ground and HVAC module — EATC C228A-19, circuit VH406 (VT/BN), harness side and ground.
- **Is any voltage present?**

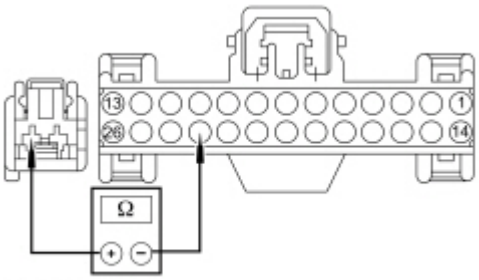
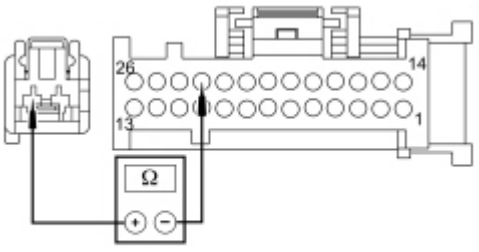
G4 CHECK THE EVAPORATOR TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR AN OPEN	
• Ignition OFF. **For Base EMTC vehicles**  N0148642 • Measure the resistance between HVAC module — Base EMTC C294A-19, circuit VH406 (VT), harness side and evaporator temperature sensor C296-1, circuit VH406 (VT/BN), harness side. **For Remote Mount EMTC vehicles**  N0148649 • Measure the resistance between HVAC module — Remote Mount EMTC C2357A-19, circuit VH406 (VT/BN), harness side and evaporator temperature sensor C296-1, circuit VH406 (VT/BN), harness side. **For EATC vehicles**	**Yes** GO to G5 . **No** REPAIR the circuit.

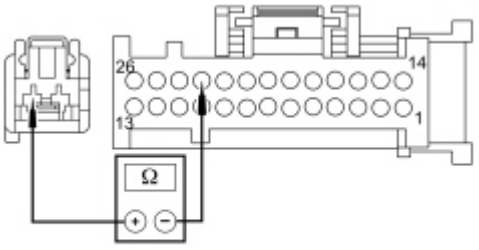
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N0148649

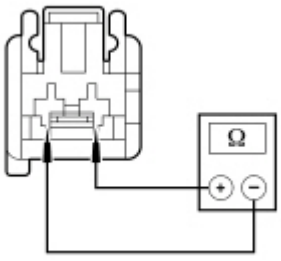
- Measure the resistance between HVAC module — EATC C228A-19, circuit VH406 (VT/BN), harness side and evaporator temperature sensor C296-1, circuit VH406 (VT/BN), harness side.
- **Is the resistance less than 3 ohms?**

G5 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	
For Base EMTC vehicles  N0148644 • Measure the resistance between HVAC module — Base EMTC C294A-23, circuit RH111 (GY/BU), harness side and evaporator temperature sensor C296-2, circuit RH111 (GY/BU), harness side. **For Remote Mount EMTC vehicles**  N0148645 • Measure the resistance between HVAC module — Remote Mount EMTC C2357A-23, circuit RH111 (GY/BU), harness side and evaporator temperature sensor C296-2, circuit RH111 (GY/BU), harness side. **For EATC vehicles**	**Yes** GO to G8 . **No** REPAIR the circuit.

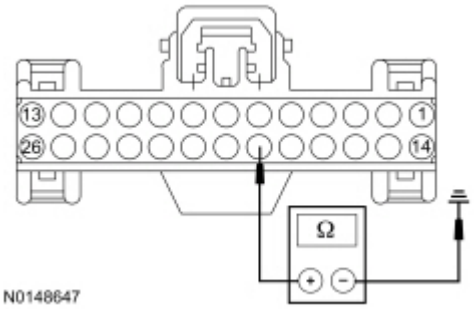


N0148645

- Measure the resistance between HVAC module — EATC C228A-23, circuit RH111 (GY/BU), harness side and evaporator temperature sensor C296-2, circuit RH111 (GY/BU), harness side.
- **Is the resistance less than 3 ohms?**

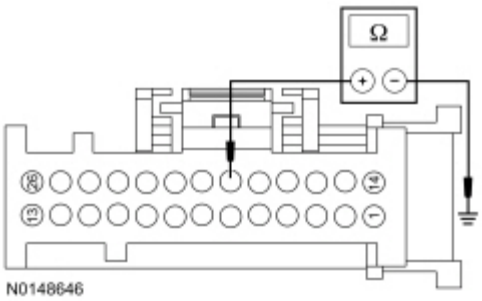
G6 CHECK THE EVAPORATOR TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR A SHORT TO THE SIGNAL RETURN CIRCUIT	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Measure the resistance between evaporator temperature sensor C296-1, circuit VH406 (VT/BN), harness side and C296-2, circuit RH111 (GY/BU), harness side.  N0089503 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G7 . **No** REPAIR the circuits.
G7 CHECK THE EVAPORATOR TEMPERATURE SENSOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
For Base EMTC vehicles	**Yes** GO to G8 . **No** REPAIR the circuit.

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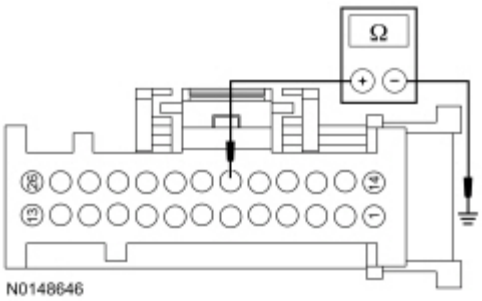
- Measure the resistance between HVAC module — EMTC C294A-19, circuit VH406 (VT), harness side and ground.

For Remote Mount EMTC vehicles



- Measure the resistance between HVAC module — Remote Mount EMTC C2357A-19, circuit VH406 (VT/BN), harness side and ground.

For EATC vehicles



- Measure the resistance between HVAC module — EATC C228A-19, circuit VH406 (VT/BN), harness side and ground.
- **Is the resistance greater than 10,000 ohms?**

G8 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01.

seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test H: DTC U3003:16 or U3003:17

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

NOTE: DTC U3003 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Normal Operation

The HVAC module is supplied constant battery voltage and ground.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	This CMDTC sets when the HVAC module senses battery voltage is less than 8 volts for more than 10 seconds.
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	This CMDTC sets when the HVAC module senses battery voltage is greater than 16 volts for more than 10 seconds.

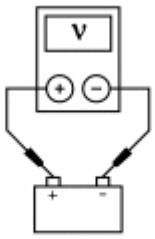
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- HVAC module

PINPOINT TEST H: U3003:16 OR U3003:17

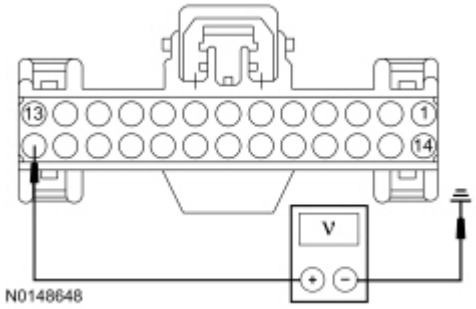
Test Step	Result / Action to Take
H1 RETRIEVE PCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — PCM .	**Yes** REFER to Section 414-00 for diagnosis of the battery and

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• **Are any charging system DTCs present in the PCM?**	charging system. **No** GO to H2 .
H2 CHECK BATTERY CONDITION • Ignition OFF. • Refer to Section 414-01 and carry out the Battery — Condition Test • **Does the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to H3 . **No** INSTALL a new battery. REFER to Section 414-01 .
H3 CHECK THE CHARGING SYSTEM VOLTAGE **NOTE:** Do not allow the engine rpm to exceed 2,000 rpm while performing this step or the generator may self-excite, resulting in default charging system output voltage. If engine rpm has exceeded 2,000 rpm, shut the vehicle off and restart the engine before performing this step. • Start the engine. • Measure the voltage of the battery: ▪ For DTC U3003:17, turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes. ▪ For DTC U3003:16, turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes.  AJ0210-A • **Is the battery voltage between 13-15.2 volts?**	**Yes** For DTC U3003:16, GO to H4 . For DTC U3003:17, GO to H6 . **No** REFER to Section 414-00 to diagnose the charging system.
H4 CHECK THE HVAC MODULE VOLTAGE SUPPLY CIRCUIT FOR HIGH RESISTANCE • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC	**Yes** GO to H5 . **No**

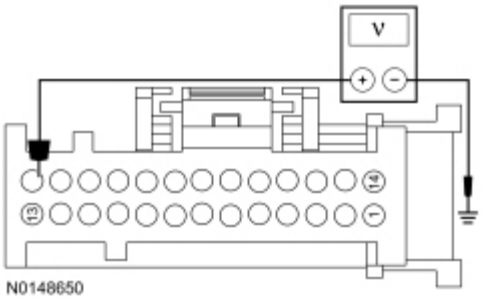
C2357A .
- Disconnect: HVAC Module — Remote Mount EMTC C2357B .
- Disconnect: HVAC Module — EATC C228A .
- Disconnect: HVAC Module — EATC C228B .
- Ignition ON.

For Base EMTC vehicles



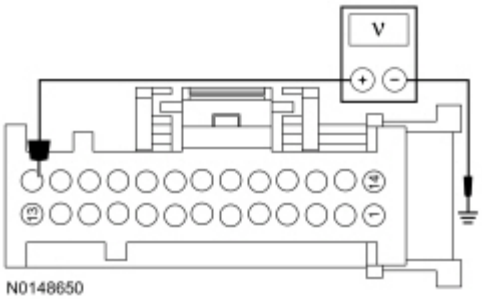
- Measure the voltage between ground and HVAC module — EMTC C294A-19, circuit VH406 (VT), harness side and ground.

For Remote Mount EMTC vehicles



- Measure the voltage between ground and HVAC module — Remote Mount EMTC C2357A-19, circuit VH406 (VT/BN), harness side and ground.

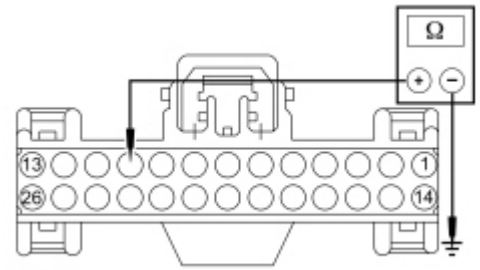
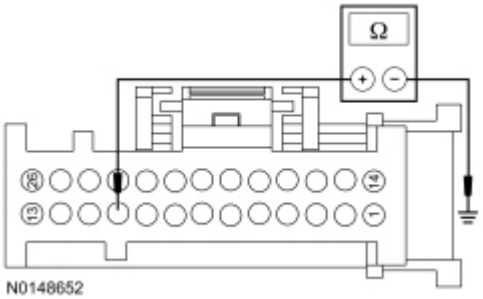
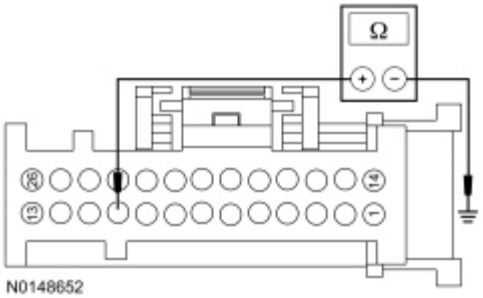
For EATC vehicles



- Measure the voltage between ground and HVAC module — EATC C228A-19, circuit VH406 (VT/BN), harness side and ground.

REPAIR the circuit.

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• **Is the voltage greater than 11 volts?**	
H5 CHECK THE HVAC MODULE GROUND CIRCUIT FOR HIGH RESISTANCE	
• Ignition OFF. **For Base EMTC vehicles**  N0148651 • Measure the resistance between HVAC module — Base EMTC C294A-10, circuit GD133 (BK), harness side and ground. ▪ Repeat this measurement while wiggling the harness. **For For Remote Mount EMTC vehicles**  N0148652 • Measure the resistance between HVAC module — For Remote Mount EMTC C2357A-10, circuit GD133 (BK), harness side and ground. ▪ Repeat this measurement while wiggling the harness. **For EATC vehicles**  N0148652 • Measure the resistance between HVAC module — EATC C228A-10, circuit GD133 (BK), harness side and ground.	**Yes** GO to H6 . **No** REPAIR the circuit.

▪ Repeat this measurement while wiggling the harness. • **Is the resistance less than 3 ohms?**	
H6 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Ignition OFF. • Disconnect and inspect all HVAC module connectors. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect all HVAC module connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test I: Unable to Duplicate the Customer Concern and No DTCs Present

Normal Operation

This pinpoint test tests the functions of the HVAC system and identifies the correct HVAC symptom pinpoint test.

This pinpoint test is intended to diagnose the following:

- HVAC system and/or related components

PINPOINT TEST I: UNABLE TO DUPLICATE THE CUSTOMER CONCERN AND NO DTCs PRESENT

NOTE: Before carrying out the following test, diagnose any HVAC or PCM DTCs.

Test Step	Result / Action to Take
I1 CHECK THE BLOWER MOTOR OPERATION	
• Ignition ON. • Select PANEL mode. • Observe blower motor operation and select each blower motor speed. • **Does the blower motor operate in all selections and change speed in each?**	**Yes** GO to I2 . **No** For EMTC base with 4 blower motor speed positions, if the blower motor does not operate in any setting, GO to Pinpoint Test W . For EATC dual zone or EMTC with 4.2 inch display with 7 blower motor speed positions, if the blower motor does not operate in any setting, GO to Pinpoint Test Y .

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	For EMTC base with 4 blower motor speed positions, if the blower motor does not properly change speeds or shut OFF, GO to Pinpoint Test X. For EATC dual zone or EMTC with 4.2 inch display with 7 blower motor speed positions, if the blower motor does not properly change speeds or shut OFF, GO to Pinpoint Test Z.
I2 CHECK AIRFLOW OPERATION • Select the highest blower motor setting. • **NOTE:** Refer to Description and Operation in this section for proper airflow descriptions. • While observing the airflow, select each of the airflow positions (PANEL, PANEL/FLOOR, FLOOR, FLOOR/DEFROST, DEFROST). • **Is the airflow directed to the proper outlets?**	**Yes** GO to I3. **No** EMTC base, GO to Pinpoint Test L. For other systems, GO to Pinpoint Test M.
I3 VERIFY TEMPERATURE CONTROL OPERATION • Start the vehicle and allow it to reach normal operating temperature. • With the A/C OFF, select PANEL mode. • Change the temperature setting from the coldest to the warmest and back to the coldest. • **Does the temperature change between very warm to cool?**	**Yes** GO to I4. **No** If the temperature does not get very warm, GO to Pinpoint Test N. For EMTC base with 4 blower motor speed positions, if the temperature does not change at all, GO to Pinpoint Test R. For EMTC with 4.2 inch display with 7 blower motor speed positions, if the temperature does not change at all, GO to Pinpoint Test S. For EATC dual zone, if the driver side temperature does not change at all, GO to Pinpoint Test U. For EATC dual zone, if the passenger side temperature does not change at all, GO to Pinpoint Test V.
I4 VERIFY THE A/C CLUTCH DOES NOT ENGAGE WITH A/C OFF • With the engine running and the A/C off, select PANEL mode. • Select the coldest temperature setting. • **Is the outlet temperature close to ambient temperature?**	**Yes** GO to I5. **No** For EMTC base with 4 blower motor speed positions, if the temperature is warmer than ambient temperature, GO to Pinpoint Test R and diagnose for inoperative blend door.

	For EMTC with 4.2 inch display with 7 blower motor speed positions, if the temperature is warmer than ambient temperature, GO to Pinpoint Test S and diagnose for inoperative blend door. For EATC dual zone, if the driver side temperature is warmer than ambient temperature, GO to Pinpoint Test U and diagnose for an inoperative blend door. For EATC dual zone, if the passenger side temperature is warmer than ambient temperature, GO to Pinpoint Test V and diagnose for an inoperative blend door. If the outlet temperature is significantly colder than ambient temperature and the A/C compressor clutch cycles normally, GO to Pinpoint Test Q . If the outlet temperature is significantly colder than ambient temperature and the A/C compressor clutch does not cycle, GO to Pinpoint Test P .
I5 VERIFY A/C CLUTCH ENGAGEMENT IN THE A/C MODE • Make sure the ambient air temperature is above 2°C (35°F). • With the engine running, select PANEL mode. • Press the A/C button (indicator ON). • **Does the A/C clutch engage when the PANEL and A/C button (indicator ON) is pressed?**	**Yes** GO to I6 . **No** GO to Pinpoint Test O .
I6 CHECK THE RECIRC OPERATION • Press the RECIRC button (indicator OFF). • Select PANEL mode. • Select the highest blower motor setting. • Observe airflow noise. • Press the RECIRC button (indicator ON). • **Does the airflow noise increase when the RECIRC mode is selected (indicator ON)?**	**Yes** The system is operating normally. **No** EMTC base with 4 blower motor speed positions, GO to Pinpoint Test J . For other systems, GO to Pinpoint Test K .

Pinpoint Test J: The Air Inlet Door Is Inoperative — EMTC Base With 4 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Normal Operation

To rotate the air inlet door actuator, the HVAC module supplies voltage and ground to the air inlet door actuator through the door actuator motor circuits. To reverse the air inlet door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The air inlet door actuator feedback resistors are supplied a ground from the HVAC module by the air inlet door actuator return circuits and a 5-volt reference voltage on the air inlet door actuator reference circuits. The HVAC module reads the voltage on the air inlet door actuator feedback circuits to determine the air inlet

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door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the air inlet door until the door reaches both internal stops in the HVAC case. If the air inlet door is temporarily obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to its end of travel, the air intake may not be from the expected source.

In FLOOR and FLOOR/DEFROST modes, the RECIRC request will time-out after 5 minutes and return to fresh air mode. RECIRC mode can be selected again after the time-out.

DTC Fault Trigger Conditions

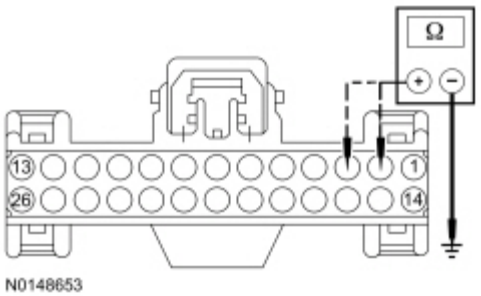
DTC	Description	Fault Trigger Conditions
B1083:00	Recirculation Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1083:11	Recirculation Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1083:12	Recirculation Damper Motor: Circuit Short to Battery	The HVAC module senses higher than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1083:13	Recirculation Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11F0:11	Air Intake Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11F0:15	Air Intake Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Air inlet mode door actuator
- HVAC module
- Stuck or bound linkage or door

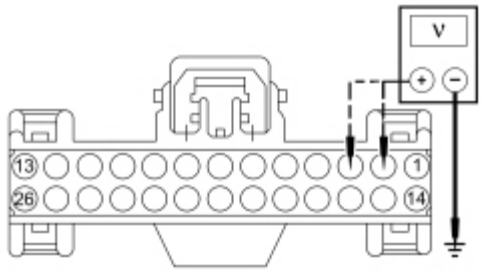
PINPOINT TEST J: THE AIR INLET DOOR IS INOPERATIVE — EMTC BASE WITH 4 BLOWER MOTOR SPEED POSITIONS

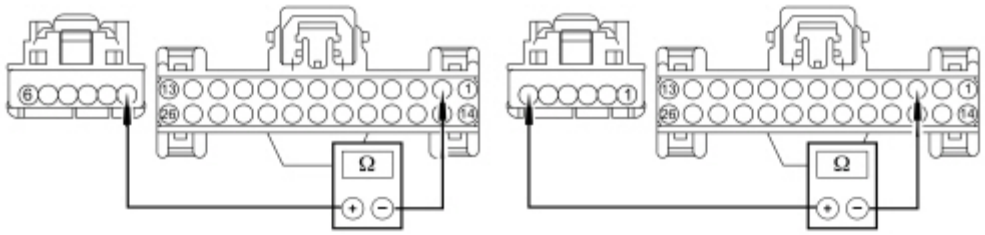
Test Step	Result / Action to Take
J1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1083:00,

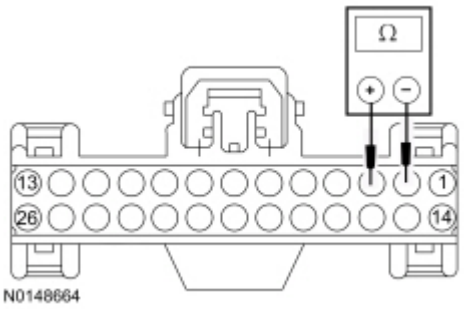
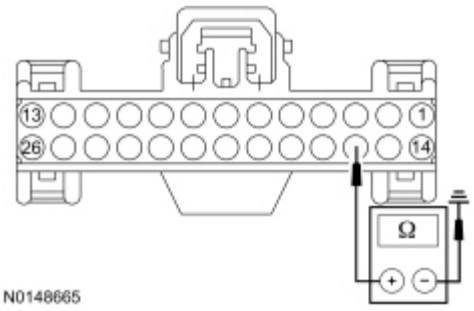
	INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to J4 . For DTC B1083:11, GO to J2 . For DTC B1083:12, GO to J3 . For DTC B1083:13, GO to J4 . For DTC B11F0:11, GO to J6 . For DTC B11F0:15, GO to J9 . **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to J13 .
J2 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Measure the resistance between ground and: ▪ HVAC module — EMTC C294A-2, circuit CH207 (BU), harness side. ▪ HVAC module — EMTC C294A-3, circuit CH208 (GN), harness side.  N0148653	**Yes** GO to J5 . **No** REPAIR the circuit in question.

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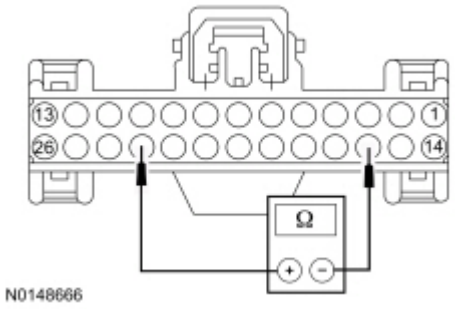
• **Are the resistances greater than 10,000 ohms?**	
J3 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Disconnect: HVAC Module — Base EMTC C294A .
• Disconnect: HVAC Module — Base EMTC C294B .
• Ignition ON.
• Measure the voltage between ground and:
  ▪ HVAC module — EMTC C294A-2, circuit CH207 (BU), harness side.
  ▪ HVAC module — EMTC C294A-3, circuit CH208 (GN), harness side.

 	
N0148654
• **Is any voltage present?**
	Yes
	REPAIR the circuit in question.
	
	No
	GO to J5 .

J4 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: Air Inlet Mode Door Actuator C289 . • Measure the resistance between HVAC module — EMTC C294A-2, circuit CH207 (BU), harness side and air inlet mode door actuator C289-1, circuit CH207 (BU/GY), harness side.  N0148655 N0148663 • Measure the resistance between HVAC module — EMTC C294A-3, circuit CH208 (GN), harness side and air inlet mode door actuator C289-6, circuit CH208 (GN/OG), harness side. • **Are the resistances less than 3 ohms?**	**Yes** GO to J13 . **No** REPAIR the circuit in question.
J5 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER	
NOTE: Access to the connector in the following step is difficult. Before performing	**Yes**

this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Air Inlet Mode Door Actuator C289 . • Measure the resistance between HVAC module — EMTC C294A-2, circuit CH207 (BU), harness side and HVAC module — EMTC C294A-3 , circuit CH208 (GN), harness side.  N0148664 • **Is the resistance greater than 10,000 ohms?**	GO to J13 . **No** REPAIR the circuits.
J6 CHECK THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Measure the resistance between ground and HVAC Module — EMTC C294A-16, circuit VH438 (GN), harness side.  N0148665 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J7 . **No** REPAIR the circuit.
J7 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Air Inlet Mode Door Actuator C289 . • Measure the resistance between HVAC Module — EMTC C294A-16, circuit VH438 (GN), harness side and HVAC module — EMTC C294A-23, circuit RH111 (GY/BU), harness side.	**Yes** GO to J8 . **No** REPAIR the circuits.

repair4less

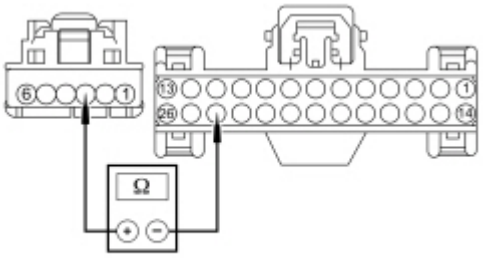


N0148666

- **Is the resistance greater than 10,000 ohms?**

J8 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN

- Measure the resistance between HVAC Module — EMTC C294A-24, circuit LH111 (BN/WH), harness side and air inlet door actuator C289-3, circuit LH111 (BN/WH), harness side.



N0148667

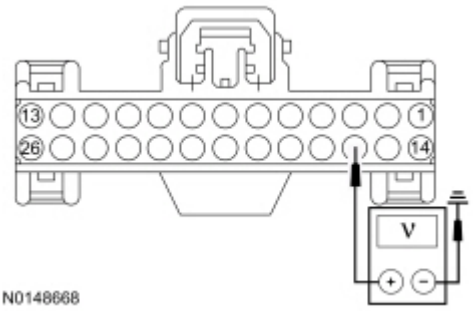
- **Is the resistance less than 3 ohms?**

Yes
GO to J13 .

No
REPAIR the circuit.

J9 CHECK THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: HVAC Module — Base EMTC C294A .
- Disconnect: HVAC Module — Base EMTC C294B .
- Ignition ON.
- Measure the voltage between ground and HVAC Module — EMTC C294A-16, circuit VH438 (GN), harness side.



N0148668

- **Is any voltage present?**

Yes
REPAIR the circuit.

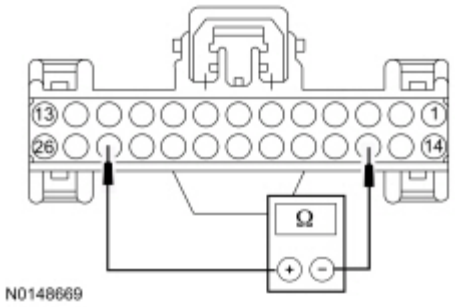
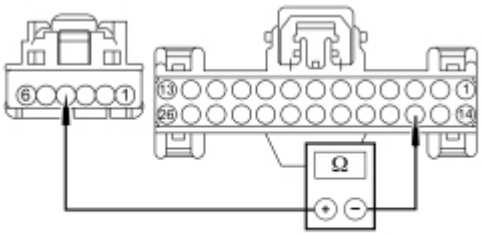
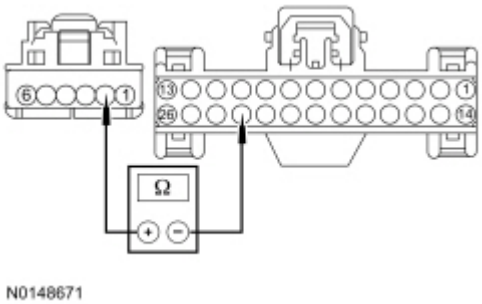
No
GO to J10 .

J10 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT

NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.

Yes
GO to J11 .

No

• Ignition OFF. • Disconnect: Air Inlet Mode Door Actuator C289 . • Measure the resistance between HVAC Module — EMTC C294A-16, circuit VH438 (GN), harness side and HVAC module — EMTC C294A-24, circuit LH111 (BN/WH), harness side.  N0148669 • **Is the resistance greater than 10,000 ohms?**	REPAIR the circuits.
J11 CHECK THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC Module — EMTC C294A-16, circuit VH438 (GN), harness side and air inlet door actuator C289-4, circuit VH438 (GN/VT), harness side.  N0148670 • **Is the resistance less than 3 ohms?**	**Yes** GO to J12 . **No** REPAIR the circuit.
J12 CHECK THE AIR INLET MODE DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC Module — EMTC C294A-23, circuit RH111 (GY/BU), harness side and air inlet door actuator C289-2, circuit RH111 (GY/BU), harness side.  N0148671 • **Is the resistance less than 3 ohms?**	**Yes** GO to J13 . **No** REPAIR the circuit.
J13 CHECK THE AIR INLET MODE DOOR ACTUATOR CONNECTION	
• Ignition OFF.	**Yes**

repair4less

• Disconnect and inspect the air inlet mode door actuator connector.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Reconnect the air inlet mode door actuator connector. Make sure it seats and latches correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	CARRY OUT the Air Inlet Mode Door Actuator component test in this section. If the actuator tests OK, GO to J14 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

J14 MODULE ACTUATOR POSITION CALIBRATION
 	
NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below.
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Select any position except OFF.
• **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators takes approximately 30 seconds.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No

	The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

Pinpoint Test K: The Air Inlet Door Is Inoperative — EATC Dual Zone And EMTC With 4.2 Inch Display System With 7 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Automatic Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

To rotate the air inlet door actuator, the HVAC module supplies voltage and ground to the air inlet door actuator through the door actuator motor circuits. To reverse the air inlet door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The air inlet door actuator feedback resistors are supplied a ground from the HVAC module by the air inlet door actuator return circuits and a 5-volt reference voltage on the air inlet door actuator reference circuits. The HVAC module reads the voltage on the air inlet door actuator feedback circuits to determine the air inlet door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the air inlet door until the door reaches both internal stops in the HVAC case. If the air inlet door is temporarily obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to its end of travel, the air intake may not be from the expected source.

In FLOOR and FLOOR/DEFROST modes, the RECIRC request will time-out after 5 minutes and return to fresh air mode. RECIRC mode can be selected again after the time-out.

repair4less

DTC Fault Trigger Conditions

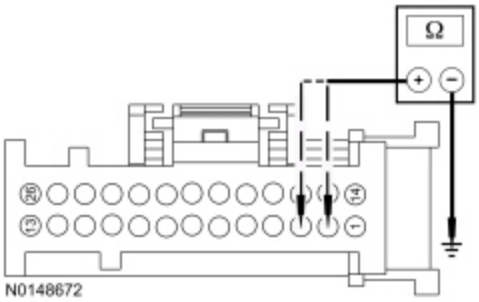
DTC	Description	Fault Trigger Conditions
B1083:00	Recirculation Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1083:11	Recirculation Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1083:12	Recirculation Damper Motor: Circuit Short to Battery	The HVAC module senses higher than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1083:13	Recirculation Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11F0:11	Air Intake Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11F0:15	Air Intake Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

This pinpoint test is intended to diagnose the following:

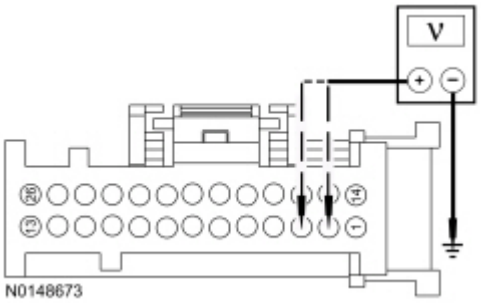
- Wiring, terminals or connectors
- Air inlet mode door actuator
- HVAC module
- FCIM
- Stuck or bound linkage or door

PINPOINT TEST K: THE AIR INLET DOOR IS INOPERATIVE — EATC DUAL ZONE AND EMTC WITH 4.2 INCH DISPLAY SYSTEM WITH 7 BLOWER MOTOR SPEED POSITIONS

Test Step	Result / Action to Take
K1 CHECK THE HVAC MODULE FOR DTCs • Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1083:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to K5. For DTC B1083:11, GO to K3. For DTC B1083:12, GO to K4. For DTC B1083:13, GO to K5. For DTC B11F0:11, GO to K7. For DTC B11F0:15, GO to K10.

	No INSPECT for broken/binding linkage or door. REPAIR as necessary. If no condition is found, GO to K2 .
K2 CHECK THE AIR INLET MODE DOOR ACTUATOR OPERATION USING THE HVAC A/C RECIRCULATING SERVO POSITION (RECIRC_DPOS) ACTIVE COMMAND	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: HVAC Module DataLogger . • Select PANEL mode on the HVAC controls. • Select the highest blower motor setting. • Observe airflow noise while using the scan tool to operate the HVAC module active command RECIRC_DPOS between Fresh Air and RECIRC. • **Does the airflow noise change when the active command is changed?**	**Yes** INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure.. **No** INSPECT for broken/binding linkage or door. REPAIR as necessary. If no condition is found, GO to K14 .
K3 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module Remote Mount EMTC C2357A . • Disconnect: HVAC Module Remote Mount EMTC C2357B .  • Measure the resistance between ground and: ▪ HVAC module EATC C228A-3, circuit CH208 (GN), harness side. ▪ HVAC module EATC C228A-2, circuit CH207 (BU), harness side. ▪ HVAC module EMTC C2357A-3, circuit CH208 (GN), harness side. ▪ HVAC module EMTC C2357A-2, circuit CH207 (BU), harness side. • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to K6 . **No** REPAIR the circuit in question.
K4 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module Remote Mount EMTC C2357A . • Disconnect: HVAC Module Remote Mount EMTC C2357B . • Ignition ON.	**Yes** REPAIR the circuit in question. **No** GO to K6 .

repair4less

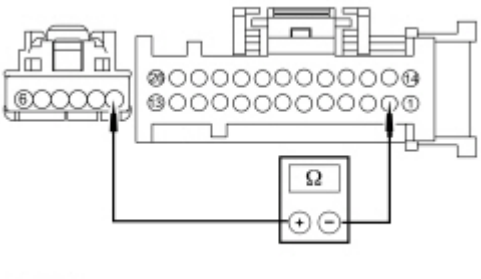


- Measure the voltage between ground and:
  - HVAC module EATC C228A-3, circuit CH208 (GN), harness side.
  - HVAC module EATC C228A-2, circuit CH207 (BU), harness side.
  - HVAC module EMTC C2357A-3, circuit CH208 (GN), harness side.
  - HVAC module EMTC C2357A-2, circuit CH207 (BU), harness side.
- **Is any voltage present?**

K5 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN

NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.

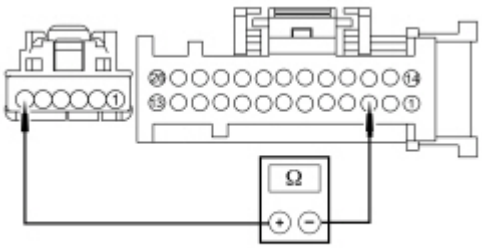
- Ignition OFF.
- Disconnect: HVAC Module — EATC C228A .
- Disconnect: HVAC Module — EATC C228B .
- Disconnect: HVAC Module Remote Mount EMTC C2357A .
- Disconnect: HVAC Module Remote Mount EMTC C2357B .
- Disconnect: Air Inlet Mode Door Actuator C289 .



- Measure the resistance between:
  - HVAC module EATC C228A-2, circuit CH207 (BU), harness side and air inlet mode door actuator C289-1, circuit CH207 (BU/GY), harness side.
  - HVAC module EMTC C2357A-2, circuit CH207 (BU), harness side and air inlet mode door actuator C289-1, circuit CH207 (BU/GY), harness side.

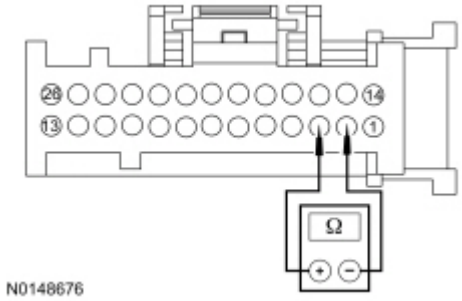
Yes
GO to K14 .

No
REPAIR the circuit in question.



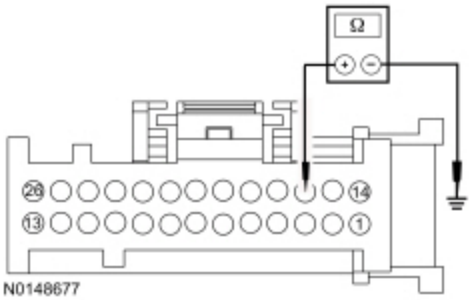
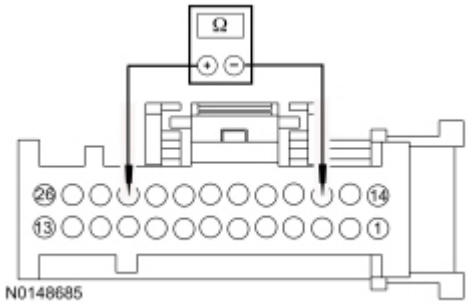
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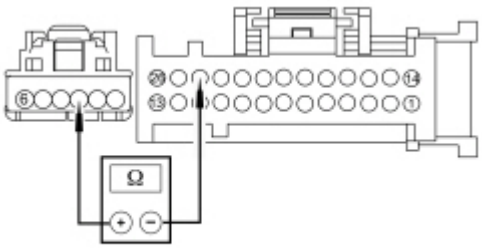
- Measure the resistance between:
  - HVAC module EATC C228A-3, circuit CH208 (GN), harness side and air inlet mode door actuator C289-6, circuit CH208 (GN/OG), harness side.
  - HVAC module EMTC C2357A-3, circuit CH208 (GN), harness side and air inlet mode door actuator C289-6, circuit CH208 (GN/OG), harness side.
- **Are the resistances less than 3 ohms?**

K6 CHECK THE AIR INLET MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Air Inlet Mode Door Actuator C289 .  N0148676 • Measure the resistance between: ▪ HVAC module EATC C228A-2, circuit CH207 (BU), harness side and HVAC module C228A-3, circuit CH208 (GN), harness side. ▪ HVAC module EMTC C2357A-2, circuit CH207 (BU), harness side and HVAC module C228A-3, circuit CH208 (GN), harness side. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K14 . **No** REPAIR the circuits.

K7 CHECK THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module Remote Mount EMTC C2357A .	**Yes** GO to K8 . **No** REPAIR the circuit.

repair4less

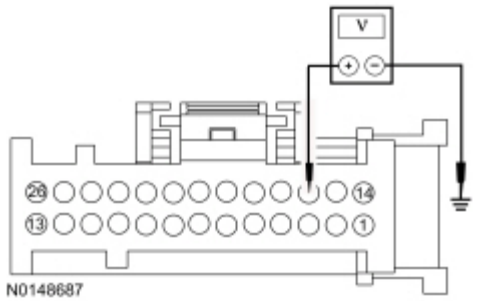
• Disconnect: HVAC Module Remote Mount EMTC C2357B .  N0148677 • Measure the resistance between ground and: ▪ HVAC module EATC C228A-16, circuit VH438 (GN), harness side. ▪ HVAC module EMTC C2357A-16, circuit VH438 (GN), harness side. • **Is the resistance greater than 10,000 ohms?**	
K8 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Air Inlet Mode Door Actuator C289 .  N0148685 • Measure the resistance between: ▪ HVAC module EATC C228A-16, circuit VH438 (GN), harness side and HVAC module C228A-23, circuit RH111 (GY/BU), harness side. ▪ HVAC module C2357A-16, circuit VH438 (GN), harness side and HVAC module C228A-23, circuit RH111 (GY/BU), harness side. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K9 . **No** REPAIR the circuits.
K9 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
	Yes GO to K14 . **No** REPAIR the circuit.



N0148686

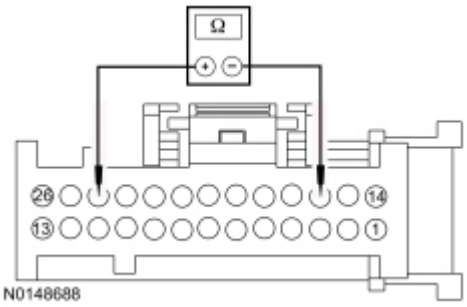
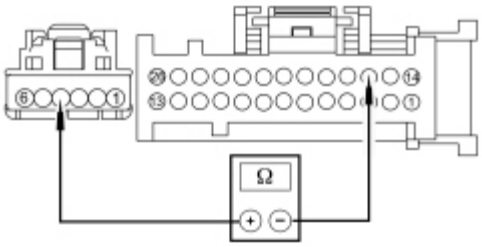
- Measure the resistance between:
  - HVAC module EATC C228A-24, circuit LH111 (BN/WH), harness side and air inlet door actuator C289-3, circuit LH111 (BN/WH), harness side.
  - HVAC module EMTC C2357A-24, circuit LH111 (BN/WH), harness side and air inlet door actuator C289-3, circuit LH111 (BN/WH), harness side.
- **Is the resistance less than 3 ohms?**

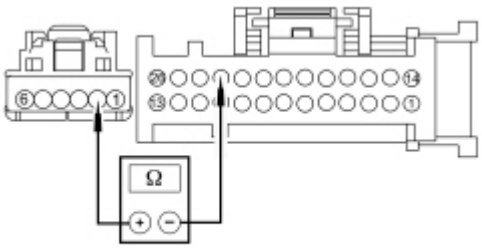
K10 CHECK THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Disconnect: HVAC Module Remote Mount EMTC C2357A .
• Disconnect: HVAC Module Remote Mount EMTC C2357B .
• Ignition ON.

 	
N0148687
• Measure the voltage between ground and:
  ▪ HVAC module EATC C228A-16, circuit VH438 (GN), harness side.
  ▪ HVAC module EMTC C2357A-16, circuit VH438 (GN), harness side.
• **Is any voltage present?**
	Yes
	REPAIR the circuit.
	
	No
	GO to K11 .

K11 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.	**Yes** GO to K12 . **No** REPAIR the circuits.

repair4less

• Ignition OFF. • Disconnect: Air Inlet Mode Door Actuator C289 .  N0148688 • Measure the resistance between: ▪ HVAC module EATC C228A-24, circuit LH111 (BN/WH), harness side and HVAC module C228A-16, circuit VH438 (GN), harness side. ▪ HVAC module EMTC C2357A-24, circuit LH111 (BN/WH), harness side and HVAC module C2357A-16, circuit VH438 (GN), harness side. • **Is the resistance greater than 10,000 ohms?**	
K12 CHECK THE AIR INLET MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
 N0148689 • Measure the resistance between: ▪ HVAC module EATC C228A-16, circuit VH438 (GN), harness side and air inlet mode door actuator C289-4, circuit VH438 (GN/VT), harness side. ▪ HVAC module EMTC C2357A-16, circuit VH438 (GN), harness side and air inlet mode door actuator C289-4, circuit VH438 (GN/VT), harness side. • **Is the resistance less than 3 ohms?**	**Yes** GO to K13 . **No** REPAIR the circuit.
K13 CHECK THE AIR INLET MODE DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
	Yes GO to K14 . **No** REPAIR the circuit.

 N0148692 • Measure the resistance between: ▪ HVAC module EATC C228A-23, circuit RH111 (GY/BU), harness side and inlet door mode door actuator C289-2, circuit RH111 (GY/BU), harness side. ▪ HVAC module EMTC C2357A-23, circuit RH111 (GY/BU), harness side and inlet door mode door actuator C289-2, circuit RH111 (GY/BU), harness side. • **Is the resistance less than 3 ohms?**	
K14 CHECK THE AIR INLET MODE DOOR ACTUATOR CONNECTION	
• Disconnect and inspect the air inlet mode door actuator connector. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect the air inlet mode door actuator connector. Make sure they seat and latch correctly. • Clear the DTCs. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module . • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CARRY OUT the Air Inlet Mode Door Actuator component test in this section. If the actuator tests OK, GO to K15 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected. **No** The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects. ADDRESS the root cause of any connector or pin issues.
K15 MODULE ACTUATOR POSITION CALIBRATION	
NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below. • Ignition OFF. • Disconnect and inspect all HVAC module connectors. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new	**Yes** CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded

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terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect all HVAC module connectors. Make sure they seat and latch correctly. • Ignition ON. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module . • Select any position except OFF. • **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators takes approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test L: Incorrect/Erratic Direction of Airflow From Outlets — EMTC Base

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Normal Operation

To rotate the defrost/panel/floor mode door actuator, the HVAC module supplies voltage and ground to the defrost/panel/floor mode door actuator motor through the actuator motor circuits. To reverse the defrost/panel/floor mode door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The defrost/panel/floor mode door actuator feedback resistor is supplied a 5-volt reference voltage and ground from the HVAC module. The HVAC module measures the resistance on the defrost/panel/floor mode door actuator feedback circuit to determine the defrost/panel/floor mode door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the defrost/panel/floor mode door until the door reaches both internal stops in the HVAC case. If the defrost/panel/floor mode door is temporally obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to it's end of travel, the airflow may not be from the expected outlets.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1086:00	Air Distribution Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1086:11	Air Distribution Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1086:12	Air Distribution Damper Motor: Circuit Short to Battery	The HVAC module senses greater than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1086:13	Air Distribution Damper	The HVAC module senses no voltage on the actuator motor circuit

	Motor: Circuit Open	when ground is applied to drive the motor, indicating an open circuit.
B11E7:11	Air Distribution Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11E7:15	Air Distribution Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4.88 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

This pinpoint test is intended to diagnose the following:

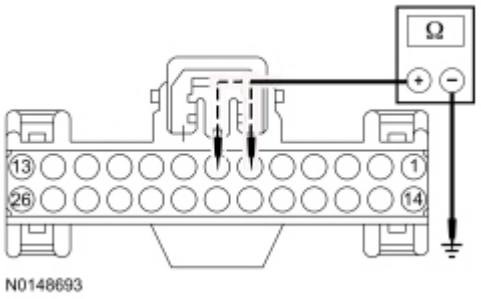
- Wiring, terminals or connectors
- Defrost/panel/floor mode door actuator
- HVAC module
- Stuck or bound linkage or door

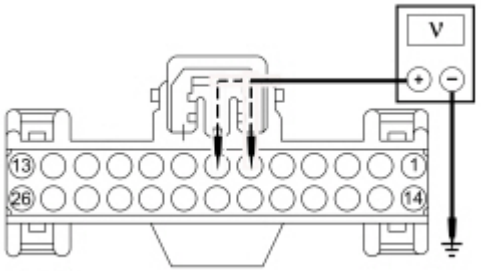
PINPOINT TEST L: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLETS — EMTC BASE

Test Step	Result / Action to Take
L1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1086:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to L4 . For DTC B1086:11, GO to L2 . For DTC B1086:12, GO to L3 . For DTC B1086:13, GO to L4 . For DTC B11E7:11, GO to L6 . For DTC B11E7:15, GO to L9 . **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to L13 .
L2 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND	

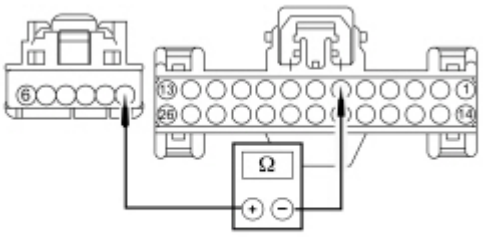
• Ignition OFF.
• Disconnect: HVAC Module — Base EMTC C294A .
• Disconnect: HVAC Module — Base EMTC C294B .
• Measure the resistance between ground and:
  ▪ HVAC module — EMTC C294A-6, circuit CH229 (WH), harness side.
  ▪ HVAC module — EMTC C294A-7, circuit CH228 (YE), harness side.
	Yes
	GO to L5 .
	
	No
	REPAIR the circuit in question.

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 N0148693 • **Are the resistances greater than 10,000 ohms?**	
L3 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

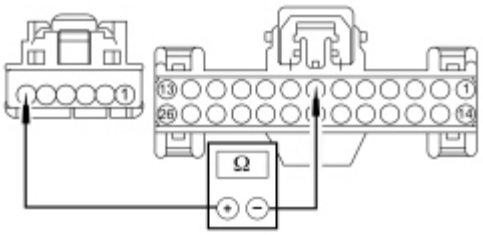
• Ignition OFF.
• Disconnect: HVAC Module — Base EMTC C294A .
• Disconnect: HVAC Module — Base EMTC C294B .
• Ignition ON.
• Measure the voltage between ground and:
  ▪ HVAC module — EMTC C294A-6, circuit CH229 (WH), harness side.
  ▪ HVAC module — EMTC C294A-7, circuit CH228 (YE), harness side.

 	
N0148694
• **Is any voltage present?**
	Yes
	REPAIR the circuit in question.
	
	No
	GO to L5 .

L4 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: Defrost/Panel/Floor Mode Door Actuator C236 . • Measure the resistance between HVAC module — EMTC C294A-6, circuit CH229 (WH), harness side and defrost/panel/floor mode door actuator C236-1, circuit CH229 (WH/BU), harness side.	**Yes** GO to L13 . **No** REPAIR the circuit in question.



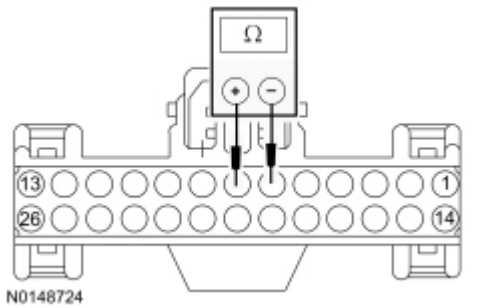
N0148695

- Measure the resistance between HVAC module — EMTC C294A-7, circuit CH228 (YE), harness side and defrost/panel/floor mode door actuator C236-6, circuit CH228 (YE/GY), harness side.

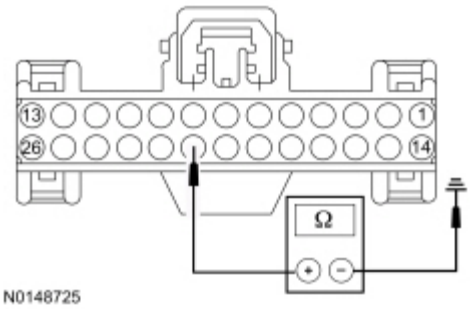
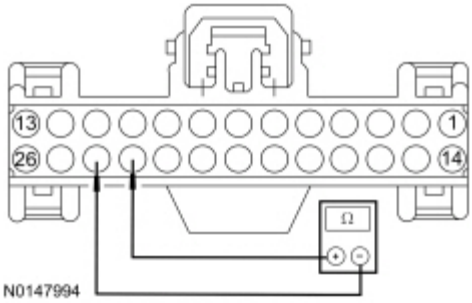


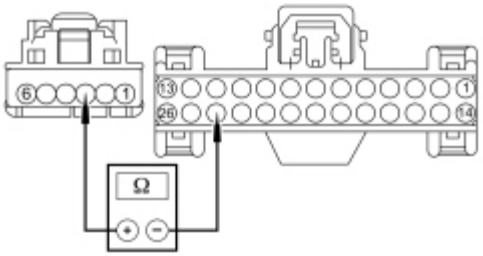
N0148696

- **Are the resistances less than 3 ohms?**

L5 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C236 . • Measure the resistance between HVAC module — EMTC C294A-7, circuit CH228 (YE), harness side and HVAC module — EMTC C294A-6, circuit CH229 (WH), harness side.  N0148724 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to L13 . **No** REPAIR the circuits.

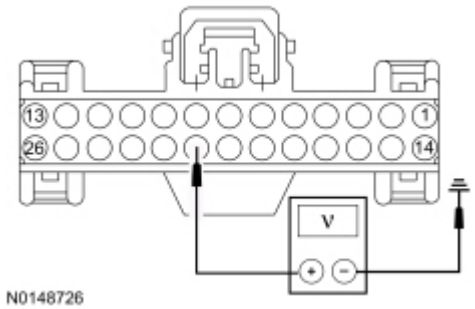
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L6 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Measure the resistance between ground and HVAC module — EMTC C294A-21, circuit VH436 (YE), harness side.  N0148725 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to L7 . **No** REPAIR the circuit.
L7 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C236 . • Measure the resistance between HVAC module — EMTC C294A-23, circuit RH111 (GY/BU), harness side and HVAC module — EMTC C294A-21, circuit VH436 (YE), harness side.  N0147994 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to L8 . **No** REPAIR the circuits.
L8 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EMTC C294A-24, circuit LH111 (BN/WH), harness side and defrost/panel/floor mode door actuator C236-3, circuit LH111 (BN/WH), harness side.	**Yes** GO to L13 . **No** REPAIR the circuit.

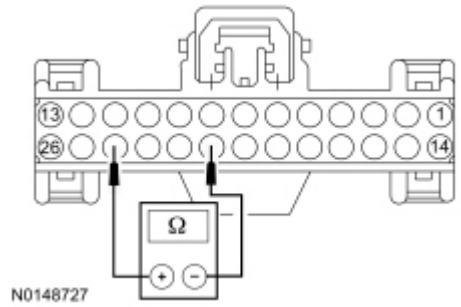
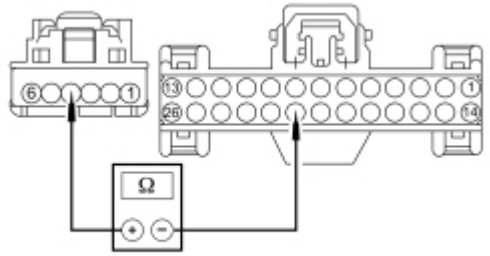
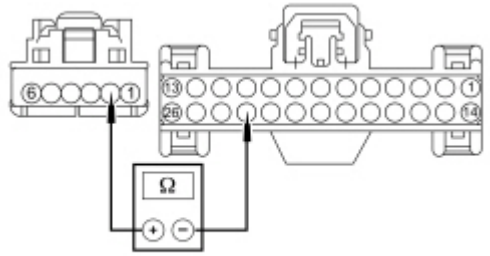


N0148667

- **Is the resistance less than 3 ohms?**

L9 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Ignition ON. • Measure the voltage between ground and HVAC module — EMTC C294A-21, circuit VH436 (YE), harness side.  N0148726 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to L10 .
L10 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C236 . • Measure the resistance between HVAC module — EMTC C294A-24, circuit LH111 (BN/WH), harness side and HVAC module — EMTC C294A-21, circuit VH436 (YE), harness side.	**Yes** GO to L11 . **No** REPAIR the circuits.

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 N0148727 • **Is the resistance greater than 10,000 ohms?**	
L11 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EMTC C294A-21, circuit VH436 (YE), harness side and defrost/panel/floor mode door actuator C236-4, circuit VH436 (YE/VT), harness side.  N0148728 • **Is the resistance less than 3 ohms?**	**Yes** GO to L12 . **No** REPAIR the circuit.
L12 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EMTC C294A-23, circuit RH111 (GY/BU), harness side and defrost/panel/floor mode door actuator C236-2, circuit RH111 (GY/BU), harness side.  N0148671 • **Is the resistance less than 3 ohms?**	**Yes** GO to L13 . **No** REPAIR the circuit.
L13 CHECK FOR CORRECT DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR OPERATION	
• Disconnect and inspect the defrost/panel/floor mode door actuator connector. • Repair: ▪ corrosion (install new connector or terminals -	**Yes** CARRY OUT the Defrost/Panel/Floor Mode Door Actuator component test in this section. If the actuator tests OK, GO

clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Reconnect the defrost/panel/floor mode door actuator connector. Make sure it seats and latches correctly. • Connect all HVAC module connectors. Make sure they seat and latch correctly. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module . • Operate the system and verify the concern is still present. • **Is the concern still present?**	to L14 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.
L14 MODULE ACTUATOR POSITION CALIBRATION **NOTE:** The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below. • Ignition OFF. • Disconnect and inspect all HVAC module connectors. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect all HVAC module connectors. Make sure they seat and latch correctly. • Ignition ON. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module . • Select any position except OFF. • **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators takes approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 . **No** The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

Pinpoint Test M: Incorrect/Erratic Direction of Airflow From Outlets — EATC Dual Zone and EMTC With 4.2 Inch Display System With 7 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Automatic Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

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To rotate the defrost/panel/floor mode door actuator, the HVAC module supplies voltage and ground to the defrost/panel/floor mode door actuator motor through the actuator motor circuits. To reverse the defrost/panel/floor mode door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The defrost/panel/floor mode door actuator feedback resistor is supplied a 5-volt reference voltage and ground from the HVAC module. The HVAC module measures the resistance on the defrost/panel/floor mode door actuator feedback circuit to determine the defrost/panel/floor mode door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the defrost/panel/floor mode door until the door reaches both internal stops in the HVAC case. If the defrost/panel/floor mode door is temporally obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to it's end of travel, the airflow may not be from the expected outlets.

DTC Fault Trigger Conditions

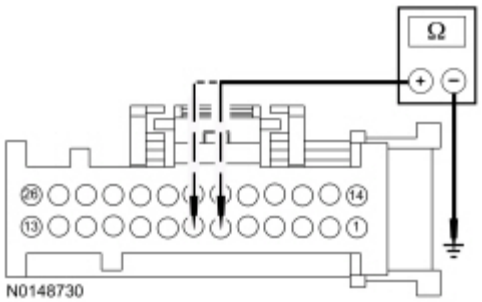
DTC	Description	Fault Trigger Conditions
B1086:00	Air Distribution Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1086:11	Air Distribution Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1086:12	Air Distribution Damper Motor: Circuit Short to Battery	The HVAC module senses greater than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1086:13	Air Distribution Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11E7:11	Air Distribution Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11E7:15	Air Distribution Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4.88 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

This pinpoint test is intended to diagnose the following:

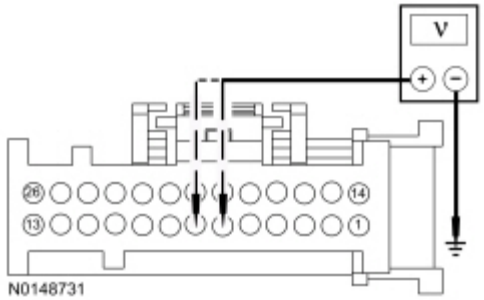
- Wiring, terminals or connectors
- Defrost/panel/floor mode door actuator
- HVAC module
- Front Controls Interface Module (FCIM)
- Stuck or bound linkage or door

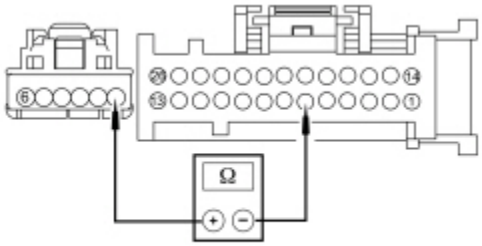
PINPOINT TEST M: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLETS — EATC DUAL ZONE AND EMTC WITH 4.2 INCH DISPLAY SYSTEM WITH 7 BLOWER MOTOR SPEED POSITIONS

Test Step	Result / Action to Take

M1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1086:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to M5 . For DTC B1086:11, GO to M3 . For DTC B1086:12, GO to M4 . For DTC B1086:13, GO to M5 . For DTC B11E7:11, GO to M7 . For DTC B11E7:15, GO to M10 . **No** GO to M2 .
M2 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR OPERATION USING THE HVAC AIR MODE ACTUATOR (AIR_MODE_DPOS) ACTIVE COMMAND	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: HVAC Module DataLogger . • Select PANEL mode on the HVAC controls. • Select the highest blower motor setting. • Observe airflow while using the scan tool to operate the HVAC module active command AIR_MODE_DPOS, increasing and decreasing the percentage value. • **Does the airflow change between the defrost, panel and floor outlets when the active command is changed?**	**Yes** INSTALL a new Front Controls Interface Module (FCIM). Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation. **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to M14 .
M3 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module — EMTC C2357A . • Disconnect: HVAC Module — EMTC C2357B .  • Measure the resistance between ground and: ▪ HVAC module EATC C228A-6, circuit CH229	**Yes** GO to M6 . **No** REPAIR the circuit in question.

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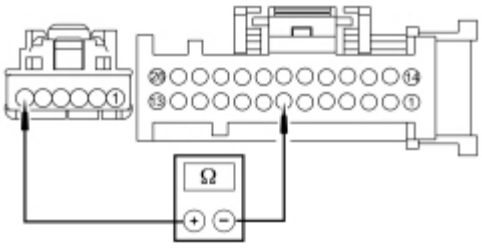
(WH/BU), harness side. ■ HVAC module EATC C228A-7, circuit CH228 (YE/GY), harness side. ■ HVAC module EMTC C2357A-6, circuit CH229 (WH/BU), harness side. ■ HVAC module EMTC C2357A-7, circuit CH228 (YE/GY), harness side. • **Are the resistances greater than 10,000 ohms?**	
M4 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Ignition ON.  • Measure the voltage between ground and: ■ HVAC module EATC C228A-6, circuit CH229 (WH/BU), harness side. ■ HVAC module EATC C228A-7, circuit CH228 (YE/GY), harness side. ■ HVAC module EMTC C2357A-6, circuit CH229 (WH/BU), harness side. ■ HVAC module EMTC C2357A-7, circuit CH228 (YE/GY), harness side. • **Is any voltage present?**	**Yes** REPAIR the circuit in question. **No** GO to M6 .
M5 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: Defrost/Panel/Floor Mode Door Actuator	**Yes** GO to M14 . **No** REPAIR the circuit in question.



N0148732

C236 .

- Measure the resistance between:
  - HVAC module EATC C228A-6, circuit CH229 (WH), harness side and defrost/panel/floor mode door actuator C236-1, circuit CH229 (WH/BU), harness side.
  - HVAC module EMTC C2357A-6, circuit CH229 (WH), harness side and defrost/panel/floor mode door actuator C236-1, circuit CH229 (WH/BU), harness side.

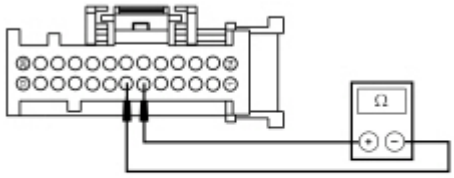
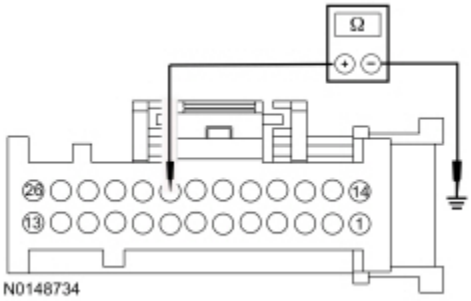


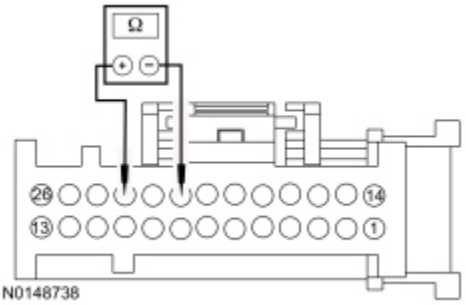
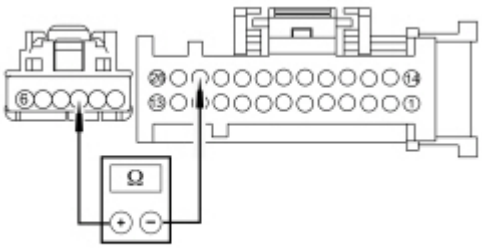
N0148733

- Measure the resistance between:
  - HVAC module EATC C228A-7, circuit CH228 (YE), harness side and defrost/panel/floor mode door actuator C236-6, circuit CH228 (YE/GY), harness side.
  - HVAC module EMTC C2357A-7, circuit CH228 (YE), harness side and defrost/panel/floor mode door actuator C236-6, circuit CH228 (YE/GY), harness side.
- **Are the resistances less than 3 ohms?**

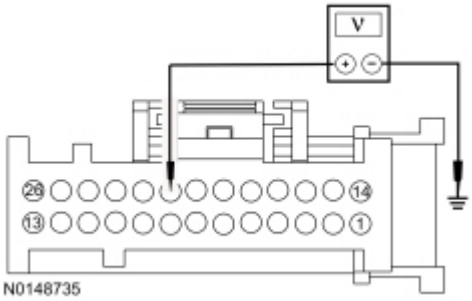
M6 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C236 . • Ignition OFF.	**Yes** GO to M14 . **No** REPAIR the circuits.

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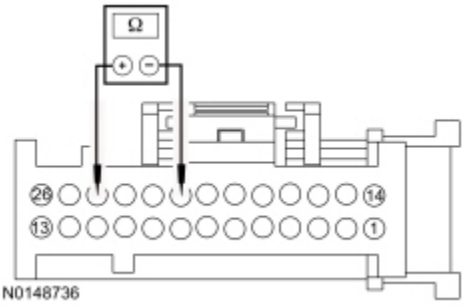
 N0114426 • Measure the resistance between: ▪ HVAC module EATC C228A-7, circuit CH228 (YE), harness side and HVAC module C228A-6, circuit CH229 (WH), harness side. ▪ HVAC module EMTC C2357A-7, circuit CH228 (YE), harness side and HVAC module C228A-6, circuit CH229 (WH), harness side. • **Is the resistance greater than 10,000 ohms?**	
M7 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B .  N0148734 • Measure the resistance between ground and: ▪ HVAC module EATC C228A-21, circuit VH436 (YE/VT), harness side. ▪ HVAC module EMTC C2357A-21, circuit VH436 (YE/VT), harness side. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M8 . **No** REPAIR the circuit.
M8 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Defrost/Panel/Floor Mode Door Actuator	**Yes** GO to M9 . **No** REPAIR the circuits.

 N0148738 C236 . • Measure the resistance between: ▪ HVAC module EATC C228A-23, circuit RH111 (GY/BU), harness side and HVAC module C228A-21, circuit VH436 (YE/VT), harness side. ▪ HVAC module EMTC C2357A-23, circuit RH111 (GY/BU), harness side and HVAC module C2357A-21, circuit VH436 (YE/VT), harness side. • **Is the resistance greater than 10,000 ohms?**	
M9 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
 N0148686 • Measure the resistance between: ▪ HVAC module EATC C228A-24, circuit LH111 (BN/WH), harness side and defrost/panel/floor mode door actuator C236-3, circuit LH111 (BN/WH), harness side. ▪ HVAC module EMTC C2357A-24, circuit LH111 (BN/WH), harness side and defrost/panel/floor mode door actuator C236-3, circuit LH111 (BN/WH), harness side. • **Is the resistance less than 3 ohms?**	**Yes** GO to M14 . **No** REPAIR the circuit.
M10 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Ignition ON.	**Yes** REPAIR the circuit. **No** GO to M11 .

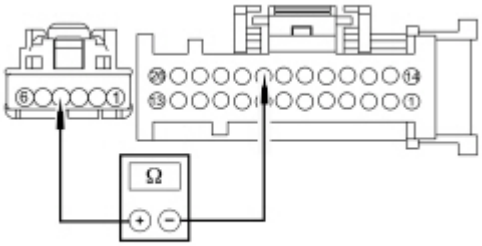
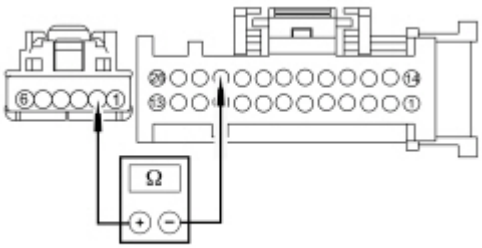
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• Measure the voltage between ground and:
  ▪ HVAC module EATC C228A-21, circuit VH436 (YE/VT), harness side.
  ▪ HVAC module EMTC C2357A-21, circuit VH436 (YE/VT), harness side.
• **Is any voltage present?**	

M11 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT	

NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.
• Ignition OFF.
• Disconnect: Defrost/Panel/Floor Mode Door Actuator C236 .

 	
• Measure the resistance between:
  ▪ HVAC module EATC C228A-24, circuit LH111 (BN/WH), harness side and HVAC module C228A-21, circuit VH436 (YE/VT), harness side.
  ▪ HVAC module EMTC C2357A-21, circuit LH111 (BN/WH), harness side and HVAC module C2357A-21, circuit VH436 (YE/VT), harness side.
• **Is the resistance greater than 10,000 ohms?**
	Yes
	GO to M12 .
	
	No
	REPAIR the circuits.

M12 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
	Yes GO to M13 . **No** REPAIR the circuit.

 N0148737 • Measure the resistance between: ▪ HVAC module EATC C228A-21, circuit VH436 (YE/VT), harness side and defrost/panel/floor mode door actuator C236-4, circuit VH436 (YE/VT), harness side. ▪ HVAC module EMTC C2357A-21, circuit VH436 (YE/VT), harness side and defrost/panel/floor mode door actuator C236-4, circuit VH436 (YE/VT), harness side. • **Is the resistance less than 3 ohms?**	
M13 CHECK THE DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	**Yes** GO to M14 . **No** REPAIR the circuit.
 N0148692 • Measure the resistance between: ▪ HVAC module EATC C228A-23, circuit RH111 (GY/BU), harness side and defrost/panel/floor mode door actuator C236-2, circuit RH111 (GY/BU), harness side. ▪ HVAC module EMTC C2357A-23, circuit RH111 (GY/BU), harness side and defrost/panel/floor mode door actuator C236-2, circuit RH111 (GY/BU), harness side. • **Is the resistance less than 3 ohms?**	
M14 CHECK FOR CORRECT DEFROST/PANEL/FLOOR MODE DOOR ACTUATOR OPERATION	**Yes** CARRY OUT the Defrost/Panel/Floor Mode Door Actuator component test in this section. If the actuator tests OK, GO to M15 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected.
• Disconnect and inspect the defrost/panel/floor mode door actuator connector. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Reconnect the defrost/panel/floor mode door actuator connector. Make sure it seats and latches	

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correctly. • Connect all HVAC module connectors. Make sure they seat and latch correctly. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module . • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

M15 MODULE ACTUATOR POSITION CALIBRATION
 	
NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below.
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Select any position except OFF.
• **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators takes approximately 30 seconds.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

Pinpoint Test N: Insufficient, Erratic or No Heat

Normal Operation

Warm coolant flows from the engine through the heater core and back to the engine. Proper coolant temperatures are critical for good heater performance.

This pinpoint test is intended to diagnose the following:

- Plugged or partially plugged heater core
- Low engine coolant level
- Temperature blend door actuator(s)
- Temperature blend door(s) binding or stuck

PINPOINT TEST N: INSUFFICIENT, ERRATIC OR NO HEAT

Test Step	Result / Action to Take
N1 CHECK FOR CORRECT ENGINE COOLANT LEVEL • Ignition OFF. • Check the engine coolant level when hot and cold. • **Is the engine coolant at the correct level (hot/cold) as indicated on the engine coolant recovery reservoir?**	**Yes** GO to N3. **No** GO to N2.
N2 CHECK THE ENGINE COOLING SYSTEM FOR LEAKS • Pressure test the cooling system for leaks. Refer to Section 303-03. • **Does the engine cooling system leak?**	**Yes** REPAIR the engine coolant leak. TEST the system for normal operation. **No** FILL and BLEED the cooling system. REFER to Section 303-03. After filling and bleeding the cooling system, GO to N3.
N3 CHECK FOR COOLANT FLOW TO THE HEATER CORE • Run the engine until it reaches normal operation temperature. Select the FLOOR position on the control assembly. Set the temperature control to full warm and the blower to the lowest setting. • Using a suitable temperature measuring device, check the heater core inlet hose to see if it is hot. • **Is the heater core inlet hose temperature above 65.5°C (150°F)?**	**Yes** GO to N4. **No** REFER to Section 303-03 to check cooling system function.
N4 CHECK FOR A PLUGGED OR RESTRICTED HEATER CORE • Using a suitable temperature measuring device, measure the heater core outlet hose temperature. • **Is the heater core outlet hose temperature similar to the inlet hose temperature (within approximately 6-17°C [10-30°F])?**	**Yes** For EMTC base with 4 blower motor speed positions, GO to Pinpoint Test R. For EMTC with 4.2 inch display with 7 blower motor speed positions, GO to Pinpoint Test S. For EATC dual zone, if the driver side temperature is not hot, GO to Pinpoint Test U. For EATC dual zone, if the passenger side temperature is not hot, GO to Pinpoint Test V. **No** INSTALL a new heater core. REFER to Section 412-01. TEST the system for normal operation.

Pinpoint Test O: The Air Conditioning (A/C) is Inoperative

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Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

For vehicles equipped with EMTC base system with 4 blower motor speed positions, when A/C button is pressed, a message is sent from the HVAC module over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with EMTC with non touch 4.2" display (FCDIM) system with 7 blower motor speed positions, when A/C is requested, the A/C request message is sent over I-CAN to the FCIM . The FCIM sends a message over the MS-CAN bus to the HVAC module that A/C has been selected. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with 8" touchscreen, when A/C is requested by touching the FDIM , a message is sent from the APIM over the MS-CAN bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

Voltage is provided to the A/C clutch relay coil from BJB fuse 77 (10A) and switch contacts from BJB fuse 30 (10A). When A/C is requested and A/C line pressures allow, a ground is provided to the A/C clutch relay coil from the PCM, energizing the A/C clutch relay. When the PCM energizes the relay, voltage is supplied to the A/C compressor clutch field coil from the relay. Ground is supplied for the A/C compressor clutch field coil.

An accurate evaporator temperature is critical for compressor engagement. The PCM uses the temperature measurement to turn the A/C compressor off before the evaporator temperatures are cold enough to freeze the condensation on the evaporator core.

When an A/C request is received by the PCM, the A/C compressor clutch will only be engaged through the A/C clutch relay if all of the following conditions are met:

- The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer.
- The PCM does not detect excessively high engine coolant temperature.
- The PCM does not detect an ambient air temperature below -1°C (30°F).
- The PCM has not detected a WOT condition.
- The HVAC module does not detect an evaporator discharge air temperature below 2°C (36°F).

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- A/C system discharged/low charge
- PCM
- HVAC module
- FCIM
- Evaporator temperature sensor
- A/C pressure transducer
- A/C compressor clutch field coil
- A/C clutch relay
- A/C compressor clutch air gap

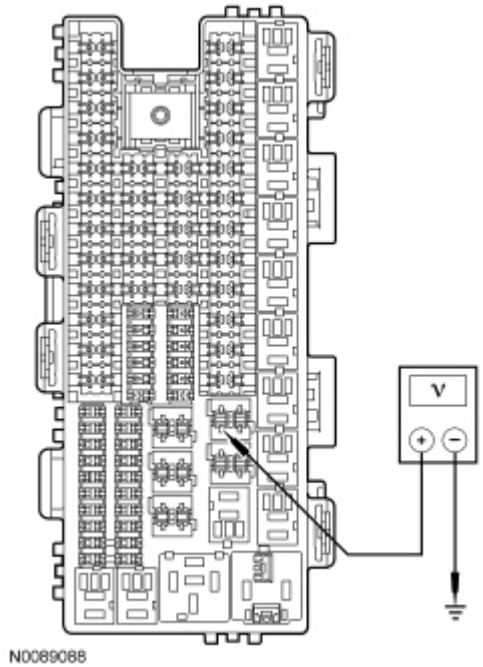
PINPOINT TEST O: THE AIR CONDITIONING (A/C) IS INOPERATIVE

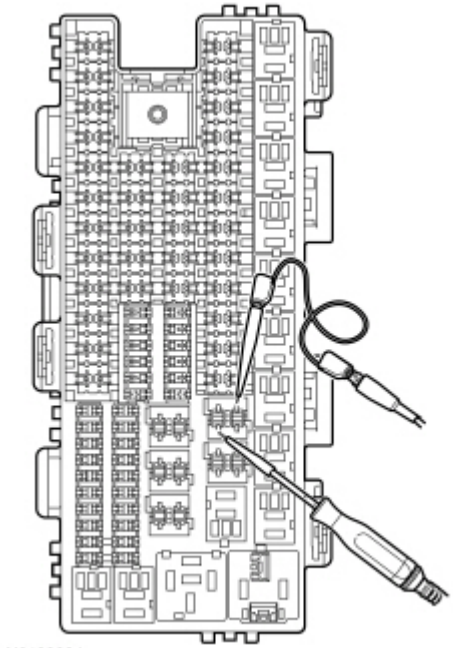
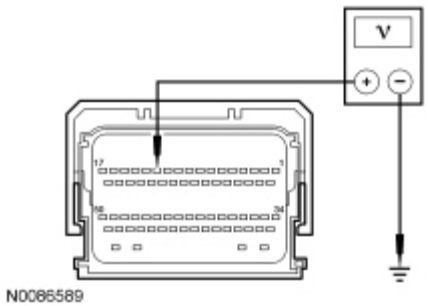
NOTE: Before carrying out the following test, diagnose any HVAC or PCM DTCs.

NOTE: Before carrying out the following test, check that the A/C system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), refer to Fluorescent Dye Leak Detection in this section.

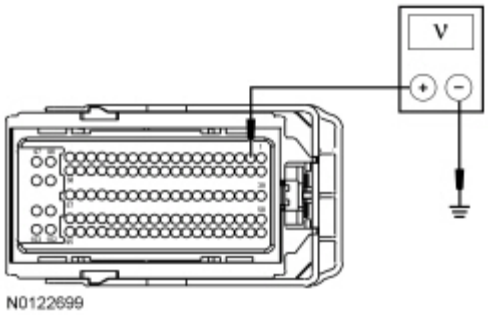
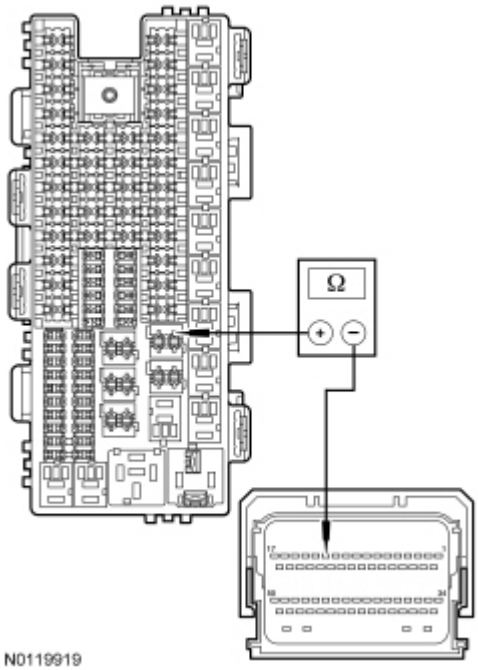
Test Step	Result / Action to Take
O1 CHECK THE A/C SYSTEM PRESSURE • Ignition OFF. • With the R-134a manifold gauge set connected, check the A/C system pressure. • **Is the A/C system pressure above 290 kPa (42 psi) ?**	**Yes** GO to O2 . **No** CHECK the A/C system for leaks. REFER to Fluorescent Dye Leak Detection or Electronic Leak Detection in this section. RECHARGE the A/C system. REFER to Air Conditioning (A/C) System Recovery, Evacuation and Charging . TEST the system for normal operation.
O2 CHECK THE A/C PRESSURE SENSOR (ACP_PRESS) PCM PID • Ignition ON. • Enter the following diagnostic mode on the scan tool: PCM DataLogger . • With the R-134a manifold gauge set connected, compare the pressure readings of the manifold gauge set and the ACP_PRESS PCM PID. • **Are the pressure values of the manifold gauge set and the ACP_PRESS PID similar?**	**Yes** GO to O3 . **No** INSTALL a new A/C pressure transducer. TEST the system for normal operation.
O3 CHECK THE A/C EVAPORATOR TEMPERATURE (EVAP_TEMP) HVAC PID • Allow the vehicle exterior and interior to stabilize to the ambient temperature. • Enter the following diagnostic mode on the scan tool: HVAC DataLogger . • Monitor the EVAP_TEMP HVAC PID • **Does the EVAP_TEMP HVAC PID read similar to the ambient temperature?**	**Yes** GO to O4 . **No** GO to Pinpoint Test g .
O4 CHECK THE AC_DEMAND HVAC PID WITH THE A/C ON • Enter the following diagnostic mode on the scan tool: HVAC DataLogger . • Select PANEL press the A/C button (indicator on) on the HVAC controls and monitor the AC_DEMAND HVAC PID. • **Does the AC_DEMAND HVAC PID read Active?**	**Yes** GO to O5 . **No** GO to O17 .
O5 CHECK THE (A/C) SWITCH (CC_SW_AC) FCIM PID WITH THE A/C ON • Enter the following diagnostic mode on the scan tool:	**Yes**

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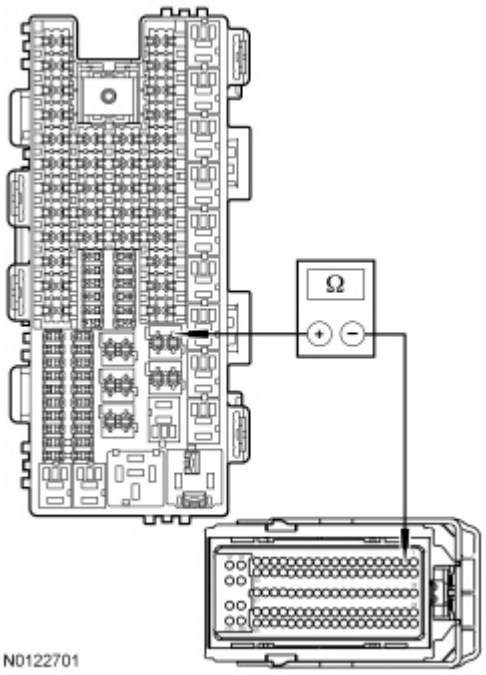
FCIM DataLogger . • Select PANEL press the A/C button (indicator on) on the HVAC controls and monitor the CC_SW_AC FCIM PID. • **Does the CC_SW_AC FCIM PID read Active?**	GO to O6 . **No** INSTALL a new Front Controls Interface Module (FCIM). Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation.
O6 CHECK THE AIR CONDITIONING REQUEST SIGNAL (AC_REQ) PCM PID WITH THE A/C ON	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Select PANEL press the A/C button (indicator on) on the HVAC controls and monitor the AC_REQ PCM PID. • **Does the AC_REQ PCM PID read YES?**	**Yes** GO to O7 . **No** GO to O17 .
O7 CHECK THE AIR CONDITIONING COMPRESSOR COMMANDED STATE (ACC_CMD) PCM PID WITH THE A/C ON	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Select PANEL press the A/C button (indicator on) on the HVAC controls and monitor the ACC_CMD PCM PID. • **Does the ACC_CMD PCM PID read ON?**	**Yes** GO to O8 . **No** GO to O18 .
O8 CHECK THE VOLTAGE TO THE A/C CLUTCH RELAY COIL	
• Ignition OFF. • Disconnect: A/C Clutch Relay . • Ignition ON. • Measure the voltage between ground and the A/C clutch relay socket, circuit CBB77 (WH).  N0089088	**Yes** GO to O9 . **No** VERIFY Battery Junction Box (BJB) fuse 77 (10A) is OK. If OK, REPAIR circuit CBB77 (WH) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

• **Is the voltage greater than 11 volts?**	
O9 CHECK THE A/C CLUTCH RELAY • Start the engine. • Select PANEL and press the A/C button (indicator on) on the HVAC controls. • With the engine running, connect a 12-volt test light between A/C clutch relay socket, circuit CBB77 (WH) and A/C clutch relay socket, circuit CH302 (WH/BN).  N0122684 • **Does the test light illuminate?**	**Yes** GO to O12 . **No** GO to O10 .
O10 CHECK THE A/C CLUTCH RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: PCM C1381B (5.0L, 6.2L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1551B (3.5L) . • Ignition ON. **For 3.7L, 5.0L and 6.2L**  N0086589 • Measure the voltage between ground and: ▪ For 3.7L, PCM C175B-12, circuit CH302	**Yes** REPAIR the circuit. **No** GO to O11 .

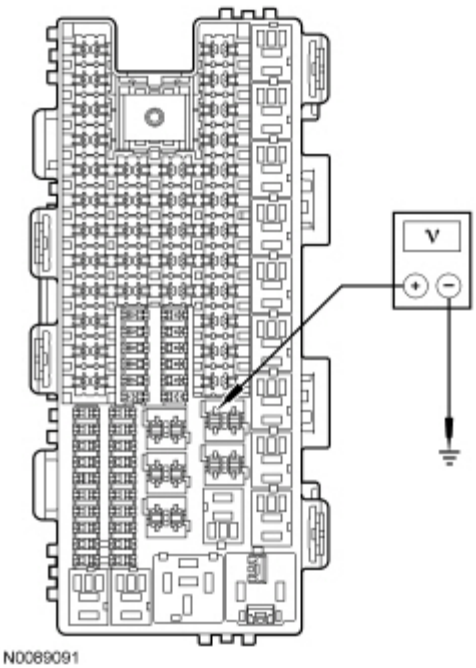
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(WH/BN), harness side. ■ For 5.0L and 6.2L, PCM C1381B-12, circuit CH302 (WH/BN), harness side. **For 3.5L**  N0122699 ● For 3.5L, measure the voltage between ground and PCM C1551B-2, circuit CH302 (WH/BN), harness side. ● **Is any voltage present?**	
O11 CHECK THE A/C CLUTCH RELAY COIL SWITCHED GROUND CIRCUIT FOR AN OPEN	
● Ignition OFF. **For 3.7L, 5.0L and 6.2L**  N0119919 ● Measure the resistance between A/C clutch relay socket, circuit CH302 (WH/BN) and: ■ For 3.7L, PCM C175B-12, circuit CH302 (WH/BN), harness side. ■ For 5.0L and 6.2L, PCM C1381B-12, circuit CH302 (WH/BN), harness side.	**Yes** GO to O18 . **No** REPAIR the circuit.

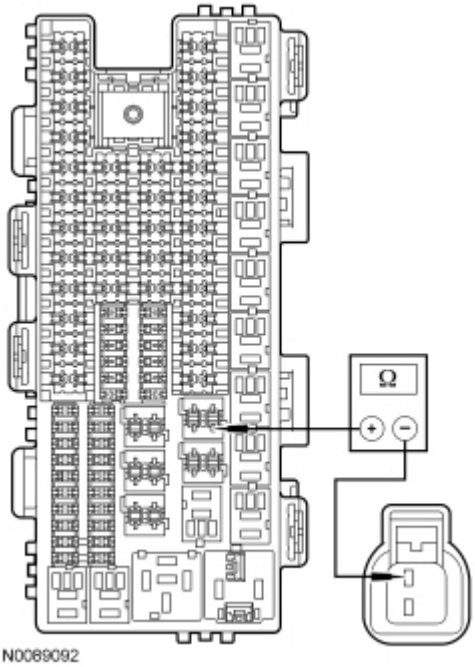
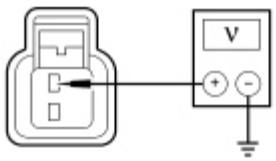
For 3.5L

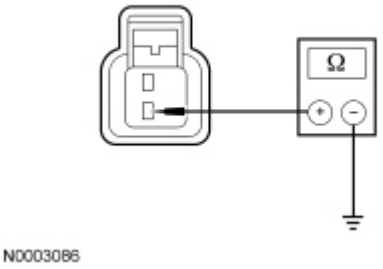
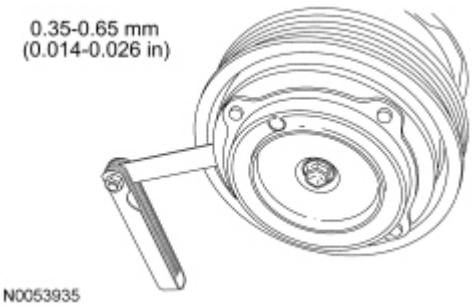


- For 3.5L, measure the resistance between A/C clutch relay socket, circuit CH302 (WH/BN) and PCM C1551B-2, circuit CH302 (WH/BN), harness side.
- **Is the resistance less than 3 ohms?**

O12 CHECK THE VOLTAGE TO THE A/C CLUTCH RELAY SWITCH CONTACTS	
• Measure the voltage between the A/C clutch relay socket, circuit SBB30 (BN/RD) and ground.  	**Yes** GO to O13 . **No** VERIFY Battery Junction Box (BJB) fuse 30 (10A) is OK. If OK, REPAIR circuit SBB30 (BN/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

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• **Is the voltage greater than 11 volts?**	
O13 CHECK THE A/C COMPRESSOR CLUTCH FIELD COIL VOLTAGE CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: A/C Compressor Clutch Field Coil C100 . • Measure the resistance between the A/C clutch relay socket, circuit CH401 (VT/WH) and A/C compressor clutch field coil C100-1, circuit CH401 (VT/WH), harness side.  N0089092 • **Is the resistance less than 3 ohms?**	**Yes** GO to O14 . **No** REPAIR the circuit.
O14 CHECK THE VOLTAGE AT THE A/C COMPRESSOR CLUTCH FIELD COIL • Connect: A/C Clutch Relay . • Ignition ON. • Select PANEL and press the A/C button (indicator on) on the HVAC controls. • Measure the voltage between A/C compressor clutch field coil C100-1, circuit CH401 (VT/WH), harness side and ground.  A0048576 • **Is the voltage greater than 11 volts?**	**Yes** GO to O15 . **No** INSTALL a new A/C clutch relay. TEST the system for normal operation.

O15 CHECK THE GROUND AT THE A/C COMPRESSOR CLUTCH FIELD COIL	
• Ignition OFF. • Measure the resistance between A/C compressor clutch field coil C100-2, circuit GD123 (BK/GY), harness side and ground.  N0003086 • **Is the resistance less than 3 ohms?**	**Yes** GO to O16 . **No** REPAIR the circuit.
O16 CHECK THE A/C COMPRESSOR CLUTCH AIR GAP	
• Measure the A/C compressor clutch air gap at 3 equally spaced locations between the clutch hub and the A/C compressor clutch pulley.  N0053935 • **Is the A/C compressor clutch air gap average greater than 0.65 mm (0.026 in)?**	**Yes** ADJUST the A/C compressor clutch gap. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new A/C compressor clutch field coil. REFER to Section 412-01 . TEST the system for normal operation.
O17 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

O18 CHECK FOR CORRECT PCM OPERATION	

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• Ignition OFF.
• Disconnect and inspect all the PCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all PCM connectors. Make sure they seat and latch correctly.
• Operate the system and verify the concern is still present.
• Connect and correctly seat all the PCM connectors.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — PCM .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new PCM. REFER to Section 303-14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test P: The Air Conditioning (A/C) is Always On — A/C Compressor Does Not Cycle

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

For vehicles equipped with EMTC base system with 4 blower motor speed positions, when A/C button is pressed, a message is sent from the HVAC module over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with EMTC with non touch 4.2" display (FCDIM) system with 7 blower motor speed positions, when A/C is requested, the A/C request message is sent over I-CAN to the FCIM . The FCIM sends a message over the MS-CAN bus to the HVAC module that A/C has been selected. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with 8" touchscreen, when A/C is requested by touching the FDIM , a message is sent from the APIM over the MS-CAN bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

Voltage is provided to the A/C clutch relay coil from Battery Junction Box (BJB) fuse 77 (10A) and switch contacts from Battery Junction Box (BJB) fuse 30 (10A). When A/C is requested and A/C line pressures allow, a ground is provided to the A/C clutch relay coil from the PCM, energizing the A/C clutch relay. When the PCM energizes the relay, voltage is supplied to the A/C compressor clutch field coil from the relay. Ground is supplied for the A/C compressor clutch field coil.

The evaporator temperature sensor is used for A/C compressor cycling. An accurate evaporator temperature is critical for compressor engagement. The PCM uses the temperature measurement to turn the A/C compressor off before the evaporator temperatures are cold enough to freeze the condensation on the evaporator core.

This pinpoint test is intended to diagnose the following:

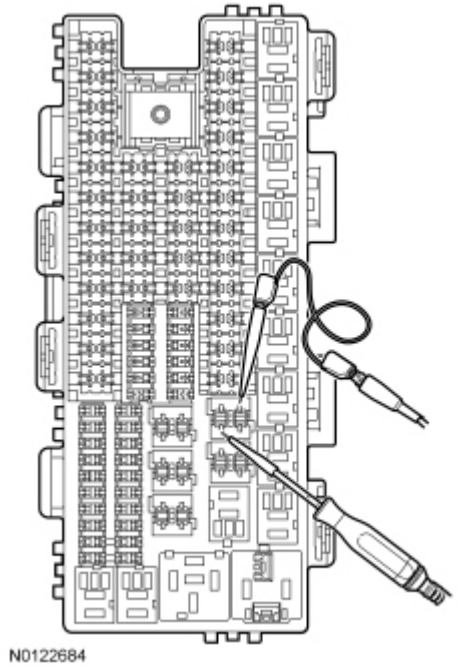
- Wiring, terminals or connectors
- PCM
- Evaporator temperature sensor
- A/C clutch relay
- A/C compressor clutch air gap

PINPOINT TEST P: THE AIR CONDITIONING (A/C) IS ALWAYS ON — A/C COMPRESSOR DOES NOT CYCLE

NOTE: Before carrying out the following test, diagnose any HVAC or PCM or DTCs.

Test Step	Result / Action to Take
P1 CHECK THE A/C EVAPORATOR TEMPERATURE (EVAP_TEMP) HVAC PID	
• Ignition ON. • Allow the vehicle exterior and interior to stabilize to the ambient temperature. • Enter the following diagnostic mode on the scan tool: HVAC DataLogger . • Monitor the EVAP_TEMP HVAC PID • **Does the EVAP_TEMP HVAC PID read similar to the ambient temperature?**	**Yes** GO to P2 . **No** GO to Pinpoint Test g .
P2 CHECK THE AIR CONDITIONING COMPRESSOR COMMANDED STATE (ACC_CMD) PCM PID WITH THE A/C OFF	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Monitor the ACC_CMD PCM PID • Select PANEL press the A/C button (indicator off) on the HVAC controls. • **Does the ACC_CMD PCM PID read OFF?**	**Yes** GO to P3 . **No** GO to P7 .
P3 CHECK THE A/C COMPRESSOR CLUTCH ENGAGEMENT WITH RELAY DISCONNECTED	
• Ignition OFF. • Disconnect: A/C Clutch Relay . • Start the engine. • With the engine running, observe the A/C compressor clutch. • **Is the compressor clutch disengaged?**	**Yes** GO to P4 . **No** GO to P6 .
P4 CHECK THE A/C CLUTCH RELAY	
• Select PANEL and press the A/C button (indicator off) on the HVAC controls. • With the engine running, connect a 12-volt test light between A/C clutch relay socket, circuit CBB77 (WH) and A/C clutch relay socket, circuit CH302 (WH/BN).	**Yes** GO to P5 . **No** INSTALL a new A/C clutch relay. TEST the system for normal operation.

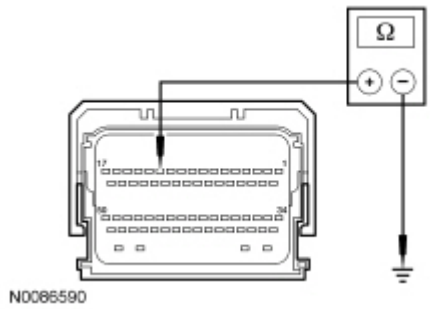
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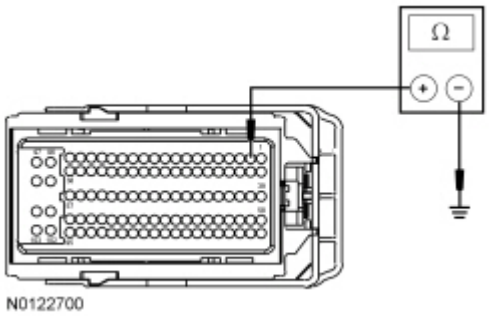
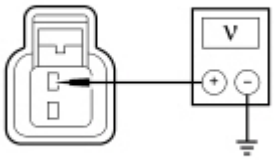


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- **Does the test light illuminate?**

P5 CHECK THE A/C CLUTCH RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF.
• Disconnect: PCM C1381B (5.0L, 6.2L) .
• Disconnect: PCM C175B (3.7L) .
• Disconnect: PCM C1551B (3.5L) .
 	
For 3.7L, 5.0L and 6.2L
 	

 	
N0086590
 	
• Measure the resistance between ground and:
  ▪ For 3.7L, PCM C175B-12, circuit CH302 (WH/BN), harness side.
  ▪ For 5.0L and 6.2L, PCM C1381B-12, circuit CH302 (WH/BN), harness side.
 	
For 3.5L
	Yes
	GO to P7 .
	
	No
	REPAIR the circuit.

 N0122700 • For 3.5L, measure the resistance between ground and PCM C1551B-2, circuit CH302 (WH/BN), harness side. • **Is the resistance greater than 10,000 ohms?**	
P6 CHECK FOR VOLTAGE TO THE A/C COMPRESSOR CLUTCH FIELD COIL	
• Ignition OFF. • Disconnect: A/C Compressor Clutch Field Coil C100 . • Ignition ON. • Select the OFF position on the HVAC module. • Measure the voltage between A/C compressor clutch field coil C100-1, circuit CH401 (VT/WH), harness side and ground.  A0048576 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** ADJUST the A/C compressor clutch gap. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation.
P7 CHECK FOR CORRECT PCM OPERATION	
• Disconnect and inspect all PCM connectors. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect all PCM connectors. Make sure they seat and latch correctly. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — PCM . • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new PCM. REFER to Section 303-14 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Q: The Air Conditioning (A/C) is Always On — A/C Mode Always Commanded ON

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Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

For vehicles equipped with EMTC base system with 4 blower motor speed positions, when A/C button is pressed, a message is sent from the HVAC module over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with EMTC with non touch 4.2" display (FCDIM) system with 7 blower motor speed positions, when A/C is requested, the A/C request message is sent over I-CAN to the FCIM . The FCIM sends a message over the MS-CAN bus to the HVAC module that A/C has been selected. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with 8" touchscreen, when A/C is requested by touching the FDIM , a message is sent from the APIM over the MS-CAN bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Front Controls Interface Module (FCIM)
- PCM
- HVAC module

PINPOINT TEST Q: THE AIR CONDITIONING (A/C) IS ALWAYS ON — A/C MODE ALWAYS COMMANDED ON

NOTE: Before carrying out the following test, diagnose any HVAC or PCM DTCs.

Test Step	Result / Action to Take
Q1 CHECK THE AIR CONDITIONING REQUEST SIGNAL (AC_REQ) PCM PID WITH THE A/C OFF	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Select PANEL press the A/C button (indicator off) on the HVAC controls and monitor the AC_REQ PCM PID. • **Does the AC_REQ PCM PID read NO?**	**Yes** GO to Q6 . **No** GO to Q2 .
Q2 CHECK THE AIR CONDITIONING SWITCH STATUS (CC_SW_AC) HVAC PID WITH THE A/C OFF	
• Enter the following diagnostic mode on the scan tool: HVAC DataLogger . • Select PANEL on the HVAC controls and monitor the CC_SW_AC HVAC PID.	**Yes** GO to Q3 . **No** GO to Q5 .

• **Does the CC_SW_AC HVAC PID read Inactive?**	
Q3 CHECK THE AIR CONDITIONING SWITCH STATUS (CC_SW_AC) FCIM PID WITH THE A/C OFF	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Front Controls Interface Module (FCIM) DataLogger . • Monitor the CC_SW_AC FCIM PID • Select PANEL on the HVAC controls and monitor the CC_SW_AC FCIM PID. • **Does the CC_SW_AC FCIM PID read Inactive?**	**Yes** GO to Q4 . **No** INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation.
Q4 CHECK THE AIR CONDITIONING REQUEST SIGNAL (AC_REQ) PCM PID WITH HVAC MODULE DISCONNECTED	
• Disconnect: HVAC Module — Base EMTC C294A . • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Monitor the AC_REQ PCM PID • **Does the AC_REQ PCM PID read NO?**	**Yes** GO to Q5 . **No** GO to Q6 .
Q5 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

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• Operate the system and verify the concern is still present. • **Is the concern still present?**	

Q6 CHECK FOR CORRECT PCM OPERATION
• Disconnect and inspect all PCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all PCM connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — PCM .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new PCM. REFER to Section 303-14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test R: Temperature Control Is Inoperative/Does Not Operate Correctly — EMTC Base With 4 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Normal Operation

To rotate the temperature blend door actuator, the HVAC module supplies voltage and ground to the temperature blend door actuators through the door actuator motor circuits. To reverse the temperature blend door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The temperature blend door actuator feedback resistor is supplied a ground from the HVAC module and a 5-volt reference voltage on the temperature blend door actuator reference circuits. The HVAC module reads the voltage on the temperature blend door actuator feedback circuits to determine the temperature blend door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the temperature blend door until the door reaches both internal stops in the HVAC case. If the temperature blend door is temporally obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to it's end of travel, the airflow temperature may not be as warm or cold as expected.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1081:00	Left Temperature Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit,

		an actuator internal failure or a binding or stuck linkage or door.
B1081:11	Left Temperature Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1081:12	Left Temperature Damper Motor: Circuit Short to Battery	The HVAC module senses greater than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1081:13	Left Temperature Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11E5:11	Left Temperature Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11E5:15	Left Temperature Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4.88 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

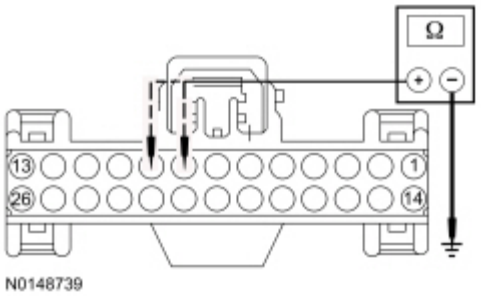
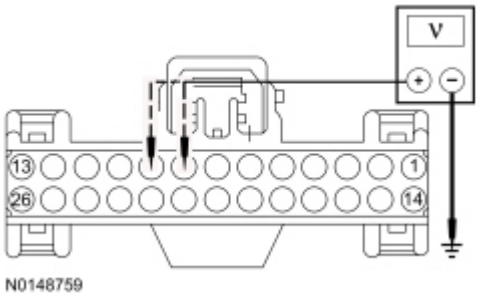
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Temperature blend door actuator
- HVAC module
- Stuck or bound linkage or door

PINPOINT TEST R: TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — EMTC BASE WITH 4 BLOWER MOTOR SPEED POSITIONS

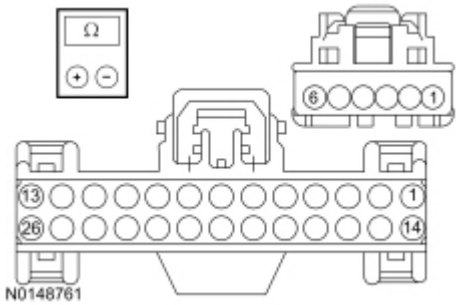
Test Step	Result / Action to Take
R1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1081:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to R4. For DTC B1081:11, GO to R2. For DTC B1081:12, GO to R3. For DTC B1081:13, GO to R4. For DTC B11E5:11, GO to R6. For DTC B11E5:15, GO to R9. **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to R13.
R2 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO	

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GROUND • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Measure the resistance between ground and: ▪ HVAC module — EMTC C294A-9, circuit CH238 (YE/OG), harness side. ▪ HVAC module — EMTC C294A-8, circuit CH239 (BU), harness side.  N0148739 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to R5 . **No** REPAIR the circuit in question.
R3 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Ignition ON. • Measure the voltage between ground and: ▪ HVAC module — EMTC C294A-8, circuit CH239 (BU), harness side. ▪ HVAC module — EMTC C294A-9, circuit CH238 (YE/OG), harness side.  N0148759 • **Are any voltages present?**	**Yes** REPAIR the circuit in question. **No** GO to R5 .
R4 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN **NOTE:** Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF.	**Yes** GO to R13 . **No** REPAIR the circuit in question.

- Disconnect: HVAC Module — Base EMTC C294A .
- Disconnect: Temperature Blend Door Actuator C2381 .
- Measure the resistance between HVAC module — EMTC C294A, harness side and temperature blend door actuator C2381, harness side using the following chart:

HVAC Module — EMTC	Circuit	Temperature Blend Door Actuator
C294A-9	CH238 (YE/OG)	C2381-6
C294A-8	CH239 (BU) (BU/WH)	C2381-5



- **Are the resistances less than 3 ohms?**

R5 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER

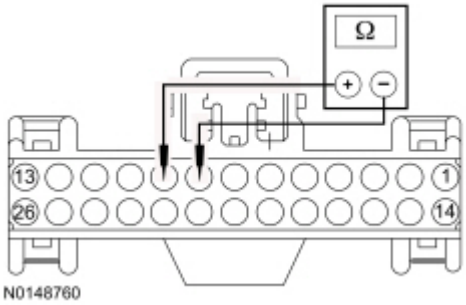
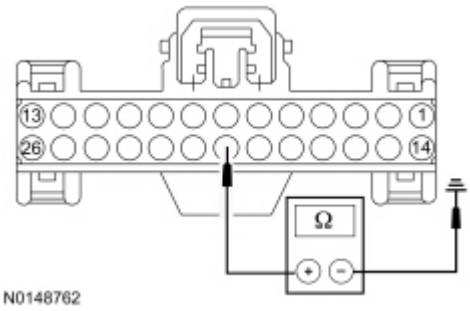
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.

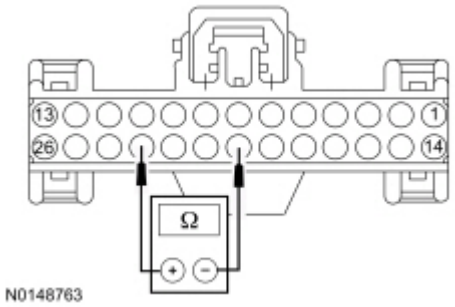
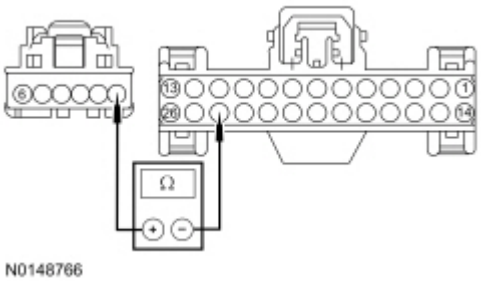
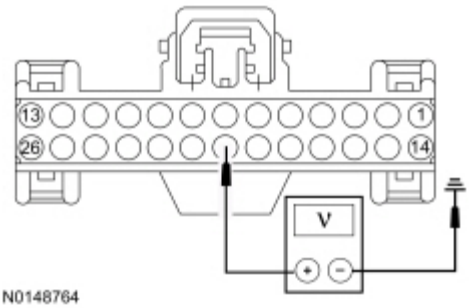
- Ignition OFF.
- Disconnect: Temperature Blend Door Actuator C2381 .
- Measure the resistance between HVAC module — EMTC C294A-8, circuit CH239 (BU), harness side and HVAC module — EMTC C294A-9, circuit CH238 (YE/OG), harness side.

Yes
GO to R13 .

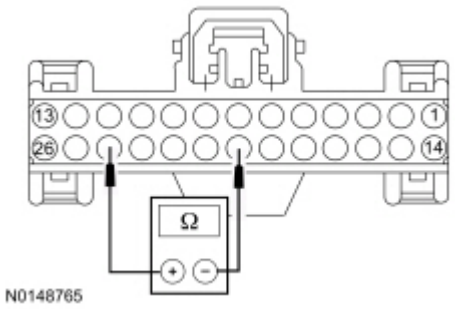
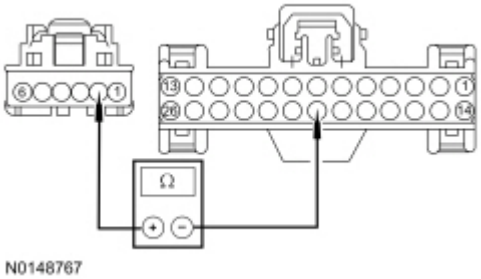
No
REPAIR the circuits.

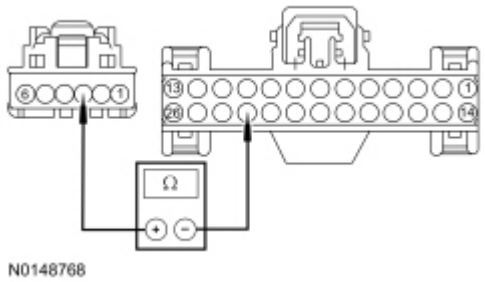
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 N0148760 • **Is the resistance greater than 10,000 ohms?**	
R6 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Measure the resistance between ground and HVAC module — EMTC C294A-20, circuit VH440 (BU), harness side.  N0148762 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R7 . **No** REPAIR the circuit.
R7 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between HVAC module — EMTC C294A-23, circuit RH111 (GY/BU) and HVAC module — EMTC C294A-20, circuit VH440 (BU), harness side.	**Yes** GO to R8 . **No** REPAIR the circuits.

 N0148763 • **Is the resistance greater than 10,000 ohms?**	
R8 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EMTC C294A-24, circuit LH111 (BN/WH) and temperature blend door actuator C2381-1, circuit LH111 (BN/WH), harness side.  N0148766 • **Is the resistance less than 3 ohms?**	**Yes** GO to R13 . **No** REPAIR the circuit.
R9 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Ignition ON. • Measure the voltage between ground and HVAC module — EMTC C294A-20, circuit VH440 (BU), harness side.  N0148764 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to R10 .
R10 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT	

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NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between HVAC module — EMTC C294A-24, circuit LH111 (BN/WH) and HVAC module — EMTC C294A-20, circuit VH440 (BU), harness side.  N0148765 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R11 . **No** REPAIR the circuits.
R11 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EMTC C294A-20, circuit VH440 (BU), harness side and driver side blend door actuator C2381-2, circuit VH440 (BU/BN), harness side.  N0148767 • **Is the resistance less than 3 ohms?**	**Yes** GO to R12 . **No** REPAIR the circuit.
R12 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EMTC C294A-23, circuit RH111 (GY/BU) and temperature blend door actuator C2381-3, circuit RH111 (GY/BU), harness side.	**Yes** GO to R13 . **No** REPAIR the circuit.

 N0148768 • **Is the resistance less than 3 ohms?**	
R13 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR CONNECTION	

• Disconnect and inspect the temperature blend door actuator connector.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Reconnect the temperature blend door actuator connector. Make sure it seats and latches correctly.
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CARRY OUT the Temperature Blend Door Actuator component test in this section. If the actuator tests OK, GO to R14 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

R14 MODULE ACTUATOR POSITION CALIBRATION	

NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below.
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Select any position except OFF.
• **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

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takes approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test S: Temperature Control Is Inoperative/Does Not Operate Correctly — EMTC With 4.2 Inch Display With 7 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Automatic Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

To rotate the temperature blend door actuator, the HVAC module supplies voltage and ground to the temperature blend door actuators through the door actuator motor circuits. To reverse the temperature blend door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The temperature blend door actuator feedback resistor is supplied a ground from the HVAC module and a 5-volt reference voltage on the temperature blend door actuator reference circuits. The HVAC module reads the voltage on the temperature blend door actuator feedback circuits to determine the temperature blend door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the temperature blend door until the door reaches both internal stops in the HVAC case. If the temperature blend door is temporally obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to it's end of travel, the airflow temperature may not be as warm or cold as expected.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1081:00	Left Temperature Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1081:11	Left Temperature Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1081:12	Left Temperature Damper Motor: Circuit Short to Battery	The HVAC module senses greater than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1081:13	Left Temperature Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11E5:11	Left Temperature Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.

B11E5:15	Left Temperature Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4.88 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

This pinpoint test is intended to diagnose the following:

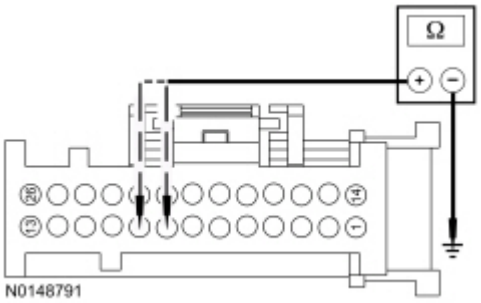
- Wiring, terminals or connectors
- Temperature blend door actuator
- HVAC module
- Front Controls Interface Module (FCIM)
- Stuck or bound linkage or door

PINPOINT TEST S: TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — EMTC WITH 4.2 INCH DISPLAY WITH 7 BLOWER MOTOR SPEED POSITIONS

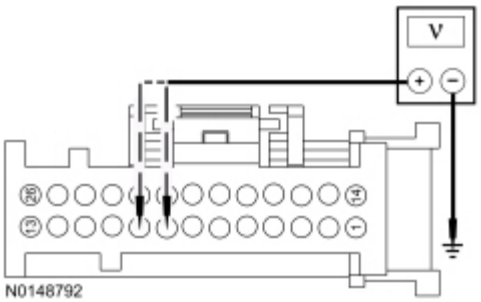
Test Step	Result / Action to Take
S1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1081:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to S5 . For DTC B1081:11, GO to S3 . For DTC B1081:12, GO to S4 . For DTC B1081:13, GO to S5 . For DTC B11E5:11, GO to S7 . For DTC B11E5:15, GO to S10 . **No** GO to S2 .
S2 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR OPERATION USING THE HVAC LEFT BLEND DOOR POSITION (LEFT_BLEND) ACTIVE COMMAND	
• Start the engine. • Run the engine until it reaches normal operating temperature. • Enter the following diagnostic mode on the scan tool: HVAC Module DataLogger . • Select PANEL mode on the HVAC controls. • Select the highest blower motor setting. • Observe airflow while using the scan tool to operate the HVAC module active command LEFT_BLEND, increasing and decreasing the percentage value. • **Does the airflow temperature change between warm and cold when the active command is changed?**	**Yes** INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation. **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to S14 .
S3 CHECK THE TEMPERATURE BLEND DOOR	

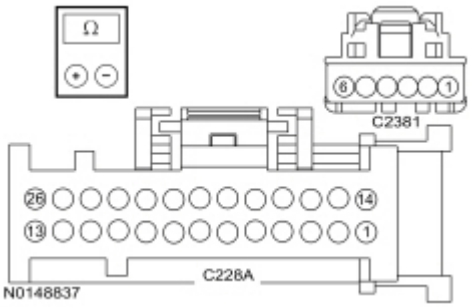
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ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND	

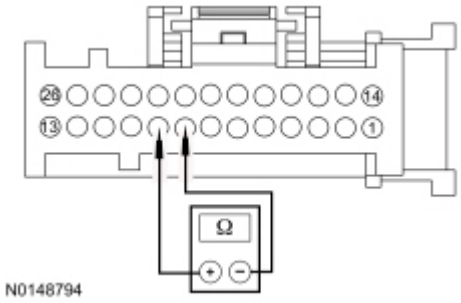
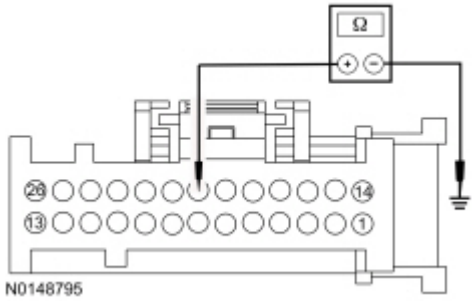
• Ignition OFF.
• Disconnect: HVAC Module — Remote Mount EMTC C2357A .
• Disconnect: HVAC Module — Remote Mount EMTC C2357B .
• Disconnect: Temperature Blend Door Actuator C2381 .
• Measure the resistance between ground and:
  ▪ HVAC module C2357A-8, circuit CH239 (BU), harness side.
  ▪ HVAC module C2357A-9, circuit CH238 (YE/OG), harness side.

 	
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to S6 .
	
	No
	REPAIR the circuit in question.

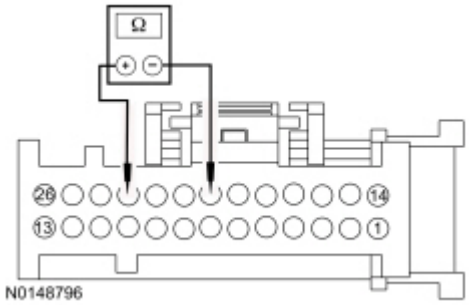
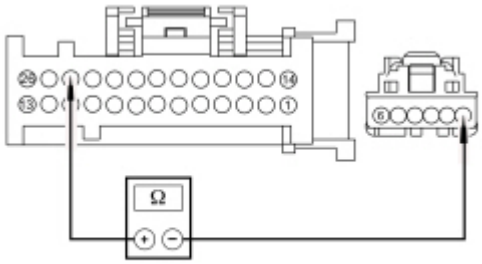
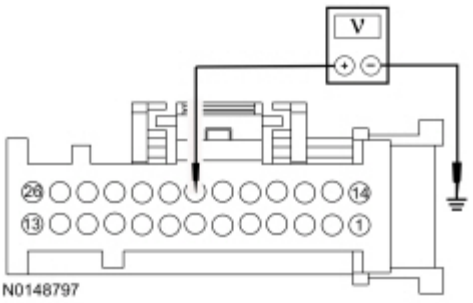
S4 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

• Disconnect: HVAC Module — Remote Mount EMTC C2357A .
• Disconnect: HVAC Module — Remote Mount EMTC C2357B .
• Disconnect: Temperature Blend Door Actuator C2381 .
• Ignition ON.
• Measure the voltage between ground and:
  ▪ HVAC module C2357A-8, circuit CH239 (BU), harness side.
  ▪ HVAC module C2357A-9, circuit CH238 (YE/OG), harness side.

 	
• **Are any voltages present?**
	Yes
	REPAIR the circuit in question.
	
	No
	GO to S6 .

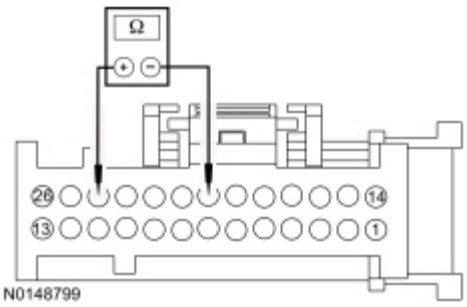
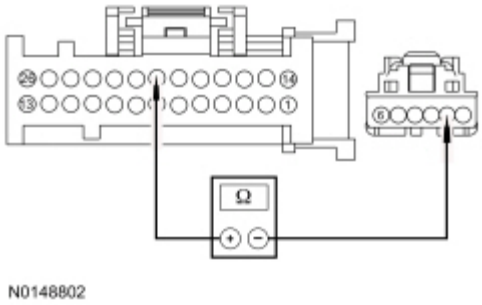
S5 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between HVAC module C228A, harness side and driver side temperature blend door actuator C2381, harness side using the following chart: **HVAC Module** / **Circuit** / **Temperature Blend Door Actuator** C2357A-9 / CH238 (YE) (YE/OG) / C2381-6 C2357A-8 / CH239 (BU) (BU/WH) / C2381-5  • **Are the resistances less than 3 ohms?**	**Yes** GO to S14 . **No** REPAIR the circuit in question.
S6 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between HVAC module C2357A-8, circuit CH239 (BU), harness side and HVAC module C2357A-9, circuit CH238 (YE),	**Yes** GO to S14 . **No** REPAIR the circuits.

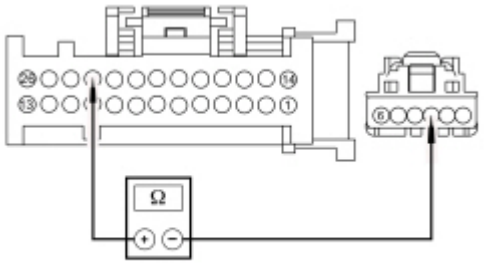
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harness side.  • **Is the resistance greater than 10,000 ohms?**	
S7 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between ground and HVAC module C2357A-20, circuit VH440 (BU), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to S8 . **No** REPAIR the circuit.
S8 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between HVAC module C2357A-23, circuit RH111 (GY/BU) and HVAC module C2357A-20, circuit VH440 (BU), harness side.	**Yes** GO to S9 . **No** REPAIR the circuits.

 N0148796 • **Is the resistance greater than 10,000 ohms?**	
S9 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module C2357A-24, circuit LH111 (BN/WH) and temperature blend door actuator C2381-1, circuit LH111 (BN/WH), harness side.  N0148798 • **Is the resistance less than 3 ohms?**	**Yes** GO to S14 . **No** REPAIR the circuit.
S10 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Disconnect: HVAC Module — Remote Mount EMTC C2357B . • Ignition ON. • Measure the voltage between ground and HVAC module C2357A-20, circuit VH440 (BU), harness side.  N0148797 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to S11 .

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S11 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Temperature Blend Door Actuator C2381 . • Measure the resistance between HVAC module C2357A-24, circuit LH111 (BN/WH) and HVAC module C2357A-20, circuit VH440 (BU), harness side.  N0148799 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to S12 . **No** REPAIR the circuits.
S12 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module C2357A-20, circuit VH440 (BU), harness side and temperature blend door actuator C2381-2, circuit VH440 (BU/BN), harness side.  N0148802 • **Is the resistance less than 3 ohms?**	**Yes** GO to S13 . **No** REPAIR the circuit.
S13 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module C2357A-23, circuit RH111 (GY/BU) and temperature blend door actuator C2381-3, circuit RH111 (GY/BU), harness side.	**Yes** GO to S14 . **No** REPAIR the circuit.

 N0148801 • **Is the resistance less than 3 ohms?**	

S14 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR CONNECTION
• Disconnect and inspect the temperature blend door actuator connector.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Reconnect the temperature blend door actuator connector. Make sure it seats and latches correctly.
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CARRY OUT the Temperature Blend Door Actuator component test in this section. If the actuator tests OK, GO to S15 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

S15 MODULE ACTUATOR POSITION CALIBRATION
NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below.
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Select any position except OFF.
• **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

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takes approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test U: Temperature Control Is Inoperative/Does Not Operate Correctly — EATC , Dual Zone Driver Side

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

To rotate the temperature blend door actuator, the HVAC module supplies voltage and ground to the temperature blend door actuators through the door actuator motor circuits. To reverse the temperature blend door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The temperature blend door actuator feedback resistor is supplied a ground from the HVAC module and a 5-volt reference voltage on the temperature blend door actuator reference circuits. The HVAC module reads the voltage on the temperature blend door actuator feedback circuits to determine the temperature blend door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the temperature blend door until the door reaches both internal stops in the HVAC case. If the temperature blend door is temporally obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to it's end of travel, the airflow temperature may not be as warm or cold as expected.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1081:00	Left Temperature Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1081:11	Left Temperature Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1081:12	Left Temperature Damper Motor: Circuit Short to Battery	The HVAC module senses greater than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1081:13	Left Temperature Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11E5:11	Left Temperature Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11E5:15	Left Temperature Damper Position Sensor: Circuit Short to Battery or Open	The HVAC module senses greater than 4.88 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

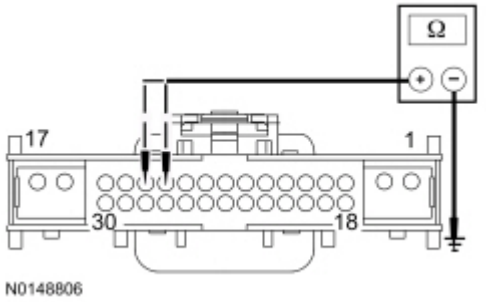
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Temperature blend door actuator
- HVAC module
- Front Controls Interface Module (FCIM)
- Stuck or bound linkage or door

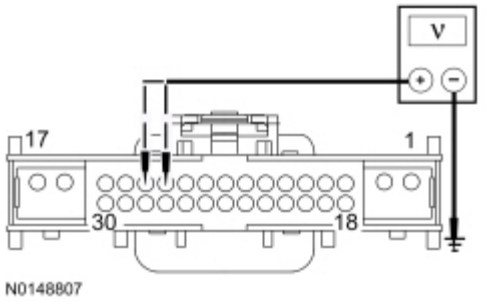
PINPOINT TEST U: TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — EATC , DUAL ZONE DRIVER SIDE

Test Step	Result / Action to Take
U1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1081:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to U5 . For DTC B1081:11, GO to U3 . For DTC B1081:12, GO to U4 . For DTC B1081:13, GO to U5 . For DTC B11E5:11, GO to U7 . For DTC B11E5:15, GO to U10 . **No** GO to U2 .
U2 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR OPERATION USING THE HVAC LEFT BLEND DOOR POSITION (LEFT_BLEND) ACTIVE COMMAND	
• Start the engine. • Run the engine until it reaches normal operating temperature. • Enter the following diagnostic mode on the scan tool: HVAC Module DataLogger . • Select PANEL mode on the HVAC controls. • Select the highest blower motor setting. • Observe airflow while using the scan tool to operate the HVAC module active command LEFT_BLEND, increasing and decreasing the percentage value. • **Does the airflow temperature change between warm and cold when the active command is changed?**	**Yes** INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation. **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to U14 .
U3 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF.	**Yes**

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• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Disconnect: Driver Side Temperature Blend Door Actuator C2091 .
• Measure the resistance between ground and:
  ▪ HVAC module — EATC C228B-12, circuit CH239 (BU), harness side.
  ▪ HVAC module — EATC C228B-13, circuit CH238 (YE), harness side.

 	
N0148806
• **Are the resistances greater than 10,000 ohms?**
	GO to U6 .
	
	No
	REPAIR the circuit in question.

U4 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

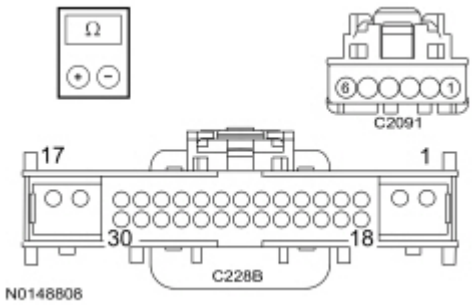
• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Disconnect: Driver Side Temperature Blend Door Actuator C2091 .
• Ignition ON.
• Measure the voltage between ground and:
  ▪ HVAC module — EATC C228B-12, circuit CH239 (BU), harness side.
  ▪ HVAC module — EATC C228B-13, circuit CH238 (YE), harness side.

 	
N0148807
• **Are any voltages present?**
	Yes
	REPAIR the circuit in question.
	
	No
	GO to U6 .

U5 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the	**Yes** GO to U14 . **No** REPAIR the circuit in question.

test.

- Ignition OFF.
- Disconnect: HVAC Module — EATC C228A .
- Disconnect: HVAC Module — EATC C228B .
- Disconnect: Driver Side Temperature Blend Door Actuator C2091 .
- Measure the resistance between HVAC module — EATC C228B, harness side and driver side temperature blend door actuator C2091, harness side using the following chart:

HVAC Module — EATC	Circuit	Driver side Temperature Blend Door Actuator
C228B-13	CH238 (YE) (YE/OG)	C2091-6
C228B-12	CH239 (BU) (BU/WH)	C2091-5



- **Are the resistances less than 3 ohms?**

U6 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER

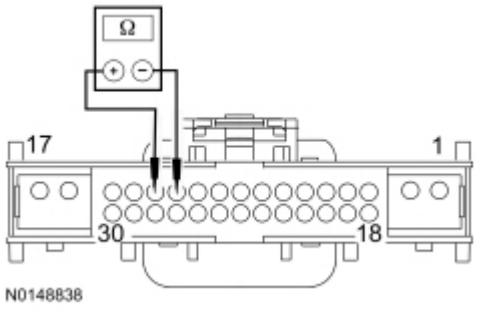
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.

- Ignition OFF.
- Disconnect: Driver side Temperature Blend Door Actuator C2091 .
- Measure the resistance between HVAC module — EATC C228B-12, circuit CH239 (BU), harness side and HVAC module — EATC C228B-13, circuit CH238 (YE), harness side.

Yes
GO to U14 .

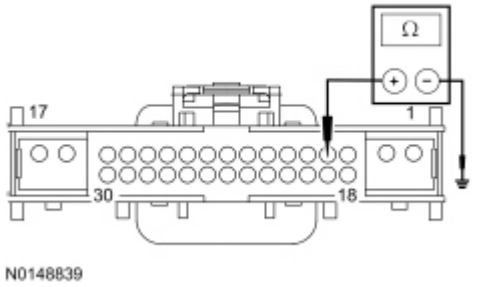
No
REPAIR the circuits.

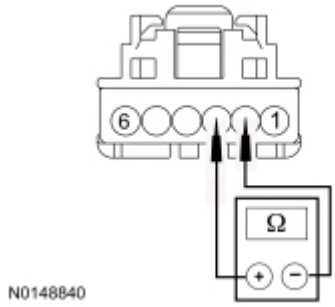
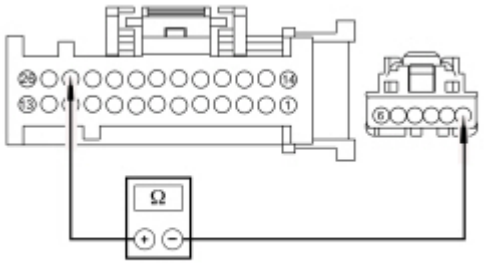
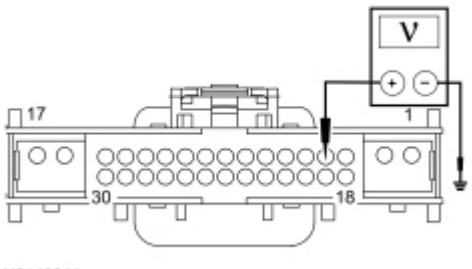
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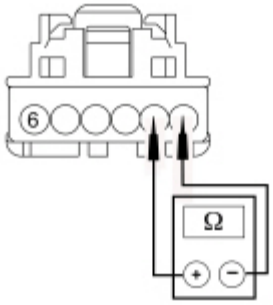
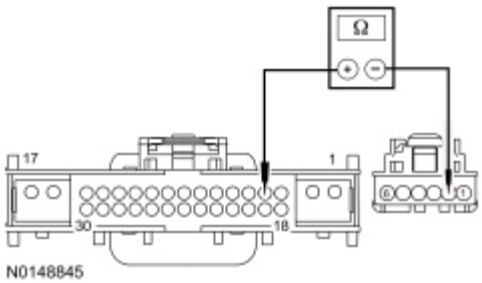
N0148838

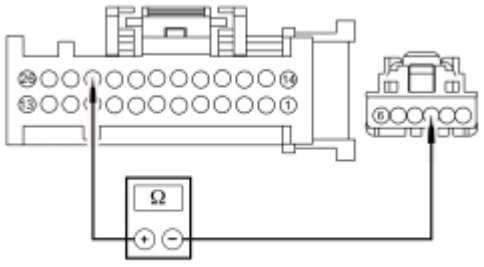
- **Is the resistance greater than 10,000 ohms?**

U7 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Disconnect: Driver Side Temperature Blend Door Actuator C2091 . • Measure the resistance between ground and HVAC module — EATC C228B-4, circuit VH440 (BU), harness side.  N0148839 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to U8 . **No** REPAIR the circuit.
U8 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Driver Side Temperature Blend Door Actuator C2091 . • Measure the resistance between EATC C2091-3, circuit RH111 (GY/BU) and EATC C2091-2, circuit VH440 (BU/BN), harness side.	**Yes** GO to U9 . **No** REPAIR the circuits.

 N0148840 • **Is the resistance greater than 10,000 ohms?**	
U9 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EATC C228A-24, circuit LH111 (BN/WH) and driver side temperature blend door actuator C2091-1, circuit LH111 (BN/WH), harness side.  N0148798 • **Is the resistance less than 3 ohms?**	**Yes** GO to U14 . **No** REPAIR the circuit.
U10 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Ignition ON. • Measure the voltage between ground and HVAC module — EATC C228B-4, circuit VH440 (BU/BN), harness side.  N0148841 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to U11 .
U11 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR	

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ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Driver side Temperature Blend Door Actuator C2091 . • Measure the resistance between HVAC module C2091-1, circuit LH111 (BN/WH) and HVAC module — EATC C2091-2, circuit VH440 (BU/BN), harness side.  N0148844 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to U12 . **No** REPAIR the circuits.
U12 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EATC C228B-4, circuit VH440 (BU), harness side and driver side temperature blend door actuator C2091-2, circuit VH440 (BU/BN), harness side.  N0148845 • **Is the resistance less than 3 ohms?**	**Yes** GO to U13 . **No** REPAIR the circuit.
U13 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EATC C228A-23, circuit RH111 (GY/BU) and driver side temperature blend door actuator C2091-3, circuit RH111 (GY/BU), harness side.	**Yes** GO to U14 . **No** REPAIR the circuit.

 N0148801 • **Is the resistance less than 3 ohms?**	
U14 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR CONNECTION	

• Disconnect and inspect the temperature blend door actuator connector.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Reconnect the temperature blend door actuator connector. Make sure it seats and latches correctly.
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CARRY OUT the Temperature Blend Door Actuator component test in this section. If the actuator tests OK, GO to U15 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

U15 MODULE ACTUATOR POSITION CALIBRATION	

NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below.
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Select any position except OFF.
• **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

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takes approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test V: Temperature Control is Inoperative/Does Not Operate Correctly — EATC , Dual Zone Passenger Side

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

To rotate the temperature blend door actuator, the HVAC module supplies voltage and ground to the temperature blend door actuators through the door actuator motor circuits. To reverse the temperature blend door actuator rotation, the HVAC module reverses the voltage and ground circuits.

The temperature blend door actuator feedback resistor is supplied a ground from the HVAC module and a 5-volt reference voltage on the temperature blend door actuator reference circuits. The HVAC module reads the voltage on the temperature blend door actuator feedback circuits to determine the temperature blend door actuator position by the position of the actuator feedback resistor wiper arm.

During an actuator calibration cycle, the HVAC module drives the temperature blend door until the door reaches both internal stops in the HVAC case. If the temperature blend door is temporally obstructed or binding during a calibration cycle, the HVAC module may interpret this as the actual end of travel for the door. When this condition occurs and the HVAC module commands the actuator to it's end of travel, the airflow temperature may not be as warm or cold as expected.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1082:00	Right Temperature Damper Motor: No Sub Type Information	The HVAC module senses no changes in the feedback circuit when motor movement is commanded and no motor electrical DTCs are present. This indicates either an open in an actuator motor circuit, an actuator internal failure or a binding or stuck linkage or door.
B1082:11	Right Temperature Damper Motor: Circuit Short to Ground	The HVAC module senses lower than expected voltage on an actuator motor circuit when voltage is applied to drive the motor, indicating a short to ground.
B1082:12	Right Temperature Damper Motor: Circuit Short to Battery	The HVAC module senses greater than expected voltage on the actuator motor circuit when ground is applied to drive the motor, indicating a short to voltage.
B1082:13	Right Temperature Damper Motor: Circuit Open	The HVAC module senses no voltage on the actuator motor circuit when ground is applied to drive the motor, indicating an open circuit.
B11E6:11	Right Temperature Damper Position Sensor: Circuit Short to Ground	The HVAC module senses less than 1 volt on the actuator feedback circuit, indicating a short to ground.
B11E6:15	Right Temperature Damper Position Sensor: Circuit Short to Battery or	The HVAC module senses greater than 4.88 volts on the actuator feedback circuit, indicating an open circuit or a short to voltage.

	Open	

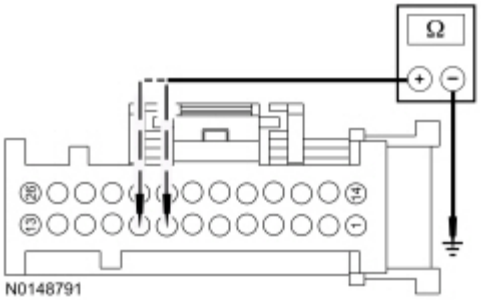
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Temperature blend door actuator
- HVAC module
- Front Controls Interface Module (FCIM)
- Stuck or bound linkage or door

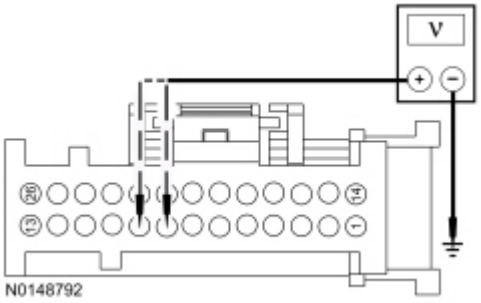
PINPOINT TEST V: TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — EATC , PASSENGER SIDE

Test Step	Result / Action to Take
V1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B1082:00, INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, GO to V5 . For DTC B1082:11, GO to V3 . For DTC B1082:12, GO to V4 . For DTC B1082:13, GO to V5 . For DTC B11E6:11, GO to V7 . For DTC B11E6:15, GO to V10 . **No** GO to V2 .
V2 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR OPERATION USING THE HVAC RIGHT BLEND DOOR POSITION (RIGHT_BLEND) ACTIVE COMMAND	
• Start the engine. • Run the engine until it reaches normal operating temperature. • Enter the following diagnostic mode on the scan tool: HVAC Module DataLogger . • Select PANEL mode on the HVAC controls. • Select the highest blower motor setting. • Observe airflow while using the scan tool to operate the HVAC module active command RIGHT_BLEND, increasing and decreasing the percentage value. • **Does the airflow temperature change between warm and cold when the active command is changed?**	**Yes** INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation. **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to V14 .
V3 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO GROUND	

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• Ignition OFF.
• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Measure the resistance between ground and:
  ▪ HVAC module — EATC C228A-8, circuit CH213 (BN/GN), harness side.
  ▪ HVAC module — EATC C228A-9, circuit CH212 (BU/OG), harness side.

 	
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to V6 .
	
	No
	REPAIR the circuit in question.

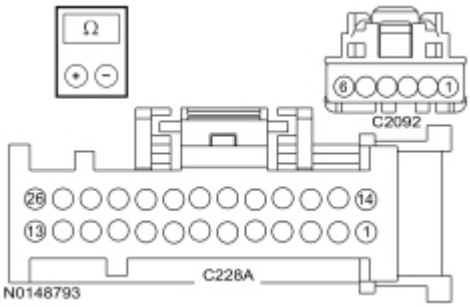
V4 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

• Disconnect: HVAC Module — EATC C228A .
• Disconnect: HVAC Module — EATC C228B .
• Ignition ON.
• Measure the voltage between ground and:
  ▪ HVAC module — EATC C228A-8, circuit CH213 (BN/GN), harness side.
  ▪ HVAC module — EATC C228A-9, circuit CH212 (BU/OG), harness side.

 	
• **Are any voltages present?**
	Yes
	REPAIR the circuit in question.
	
	No
	GO to V6 .

V5 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR AN OPEN	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module — EATC C228A .	**Yes** GO to V14 . **No** REPAIR the circuit in question.

- Disconnect: HVAC Module — EATC C228B .
- Disconnect: Passenger side Temperature Blend Door Actuator C2092 .
- Measure the resistance between HVAC module — EATC C228A, harness side and passenger side temperature blend door actuator C2092, harness side using the following chart:

HVAC Module — EATC	Circuit	Passenger side Temperature Blend Door Actuator
C228A-9	CH212 (BU/OG)	C2092-6
C228A-8	CH213 (BN/GN)	C2092-5



- **Are the resistances less than 3 ohms?**

V6 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR MOTOR CIRCUITS FOR A SHORT TOGETHER

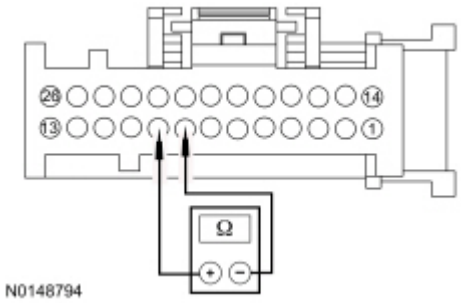
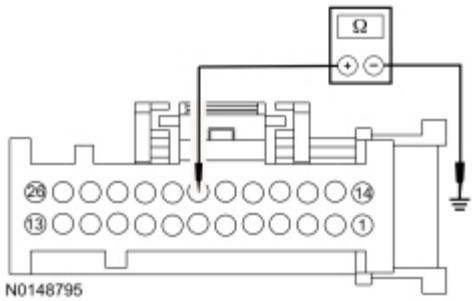
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test.

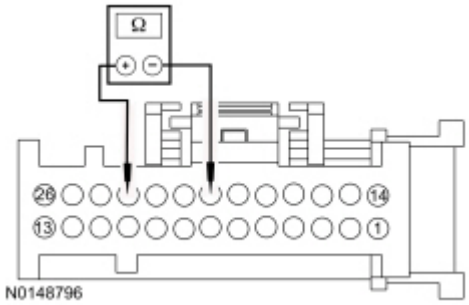
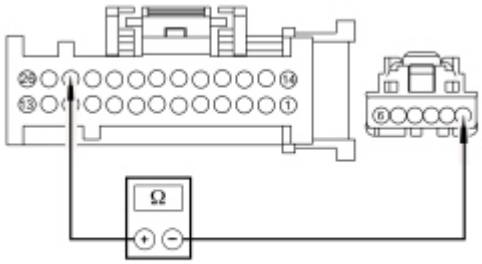
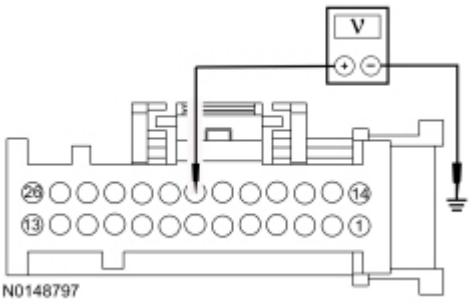
- Ignition OFF.
- Disconnect: Passenger side Temperature Blend Door Actuator C2092 .
- Measure the resistance between HVAC module — EATC C228A-8, circuit CH213 (BN/GN), harness side and HVAC module — EATC C228A-9, circuit CH212 (BU/OG), harness side.

Yes
GO to V14 .

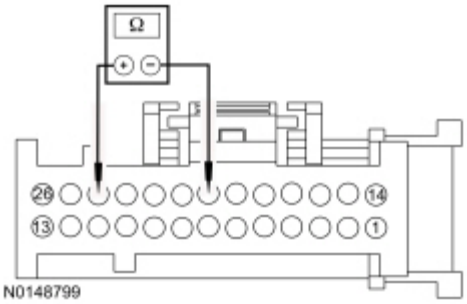
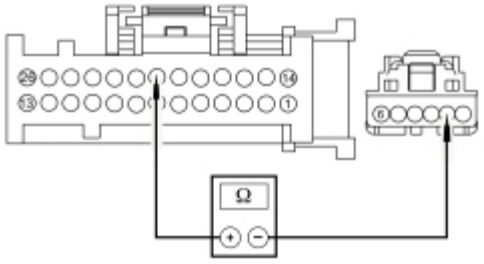
No
REPAIR the circuits.

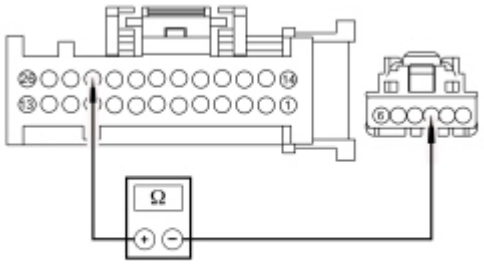
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 • **Is the resistance greater than 10,000 ohms?**	
V7 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Measure the resistance between ground and HVAC module — EATC C228A-20, circuit VH441 (WH), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to V8 . **No** REPAIR the circuit.
V8 CHECK THE SIGNAL RETURN CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Disconnect: Passenger side Temperature Blend Door Actuator C2092 . • Measure the resistance between HVAC module — EATC C228A-23, circuit RH111 (GY/BU) and HVAC module — EATC C228A-20, circuit VH441 (WH), harness side.	**Yes** GO to V9 . **No** REPAIR the circuits.

 N0148796 • **Is the resistance greater than 10,000 ohms?**	
V9 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EATC C228A-24, circuit LH111 (BN/WH) and passenger side temperature blend door actuator C2092-1, circuit LH111 (BN/WH), harness side.  N0148798 • **Are the resistances less than 3 ohms?**	**Yes** GO to V14 . **No** REPAIR the circuit.
V10 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — EATC C228B . • Ignition ON. • Measure the voltage between ground and HVAC module — EATC C228A-20, circuit VH441 (WH), harness side.  N0148797 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to V11 .
V11 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO THE TEMPERATURE BLEND DOOR	

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ACTUATOR FEEDBACK CIRCUIT	
NOTE: Access to the connector in the following step is difficult. Before performing this step, visually inspect the actuator and its harness for obvious damage. If no damage is evident, proceed with the test. • Ignition OFF. • Disconnect: Passenger side Temperature Blend Door Actuator C2092 . • Measure the resistance between HVAC module — C228A-24, circuit LH111 (BN/WH) and HVAC module — EATC C228A-20, circuit VH441 (WH), harness side.  N0148799 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to V12 . **No** REPAIR the circuits.
V12 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR FEEDBACK CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EATC C228A-20, circuit VH441 (WH), harness side and passenger side temperature blend door actuator C2092-2, circuit VH441 (WH), harness side.  N0148802 • **Is the resistance less than 3 ohms?**	**Yes** GO to V13 . **No** REPAIR the circuit.
V13 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between HVAC module — EATC C228A-23, circuit RH111 (GY/BU) and passenger side temperature blend door actuator C2092-3, circuit RH111 (GY/BU), harness side.	**Yes** GO to V14 . **No** REPAIR the circuit.



N0148801

- **Is the resistance less than 3 ohms?**

V14 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR CONNECTION	

• Disconnect and inspect the temperature blend door actuator connector.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Reconnect the temperature blend door actuator connector. Make sure it seats and latches correctly.
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CARRY OUT the Temperature Blend Door Actuator component test in this section. If the actuator tests OK, GO to V15 . When installing an actuator, CONNECT the actuator electrical connector before the HVAC module connector(s). This allows the actuator to be calibrated when the HVAC module is reconnected.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

V15 MODULE ACTUATOR POSITION CALIBRATION	

NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below.
• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Select any position except OFF.
• **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

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takes approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test W: The Blower Motor Is Inoperative — EMTC Base With 4 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Normal Operation

Voltage is supplied to the relay coil and relay switch contacts from BJB . The coil receives ground from the HVAC module if any function selector position but OFF is selected. When the relay coil is grounded by the HVAC module, the relay is energized and voltage is delivered to the blower motor. Ground for the blower motor is provided from the blower resistor or the blower switch (in HI only). The blower resistor and blower switch are grounded.

DTC Fault Trigger Conditions

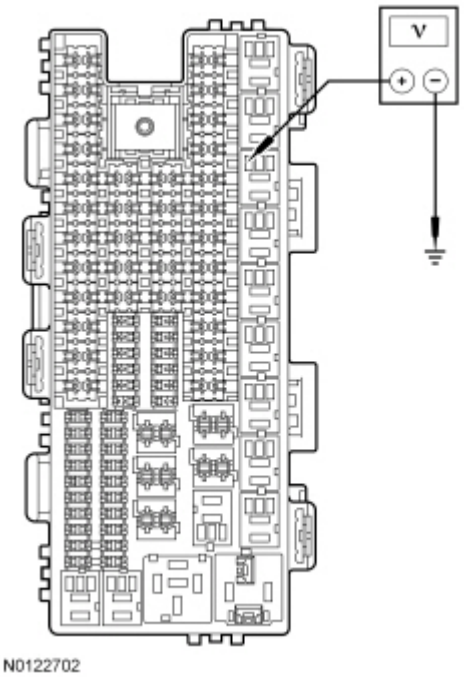
DTC	Description	Fault Trigger Conditions
B10AF:12	Blower Fan Relay: Circuit Short to Battery	This DTC sets when the HVAC module senses voltage on the relay coil ground circuit when the relay is grounded by the HVAC module, indicating a short directly to voltage.
B10AF:13	Blower Fan Relay: Circuit Open	This CMDTC sets when the HVAC module senses no voltage on the relay coil ground circuit when the relay is not grounded by the HVAC module, indicating an open.

This pinpoint test is intended to diagnose the following:

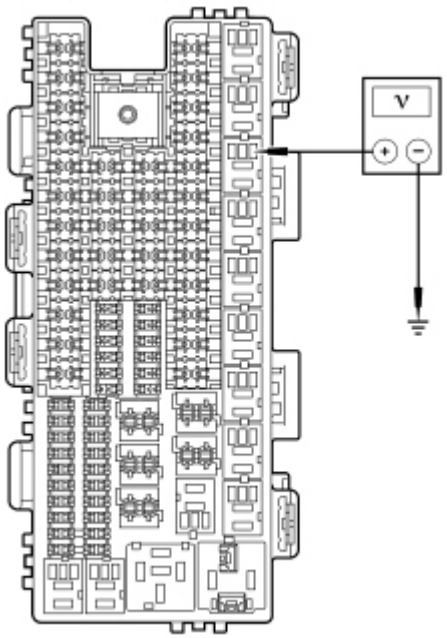
- Battery Junction Box (BJB) fuse 51 (40A) and fuse 52 (5A)
- Wiring, terminals or connectors
- Blower motor
- Blower motor relay
- HVAC module

PINPOINT TEST W: THE BLOWER MOTOR IS INOPERATIVE — EMTC BASE WITH 4 BLOWER MOTOR SPEED POSITIONS

Test Step	Result / Action to Take
W1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For B10AF:12, GO to W2 . For B10AF:13, CARRY OUT the blower motor relay component test.

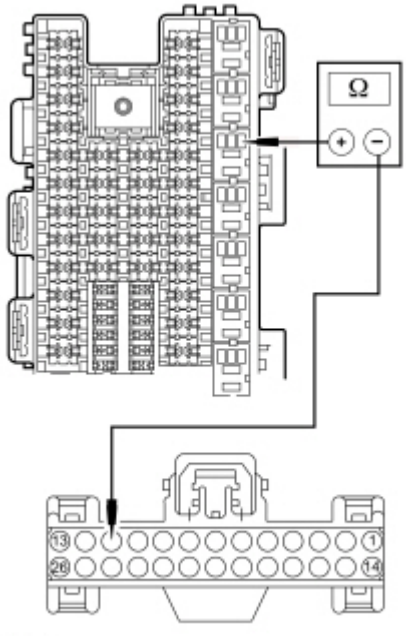
	Refer to Wiring Diagrams Cell 149 for component testing. If the relay tests OK, GO to W3 . **No** GO to W5 .
W2 CHECK THE BLOWER MOTOR RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Blower Motor Relay . • Disconnect: HVAC Module — Base EMTC C294A . • Ignition ON. • Measure the voltage between blower motor relay socket pin 2, circuit CH123 (VT/GN) and ground.  N0122702 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to W11 .
W3 CHECK THE BLOWER MOTOR RELAY COIL SUPPLY VOLTAGE • Ignition OFF. • Disconnect: Blower Motor Relay . • Ignition ON. • Measure the voltage between blower motor relay socket pin 1, circuit CBB52 (GN/WH) and ground.	**Yes** GO to W4 . **No** VERIFY Battery Junction Box (BJB) fuse 52 (5A) is OK. If OK, REPAIR circuit CBB52 (GN/WH) for an open. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

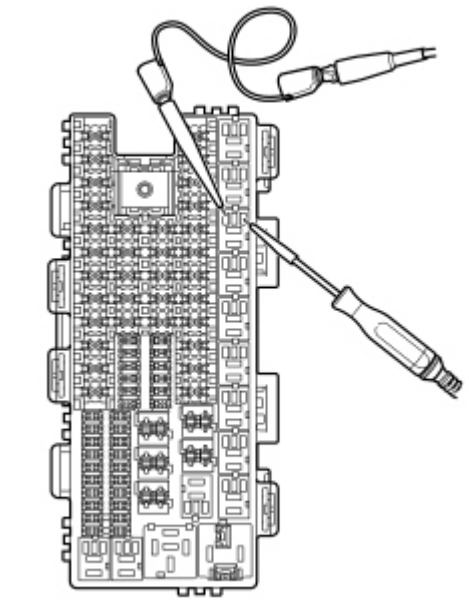
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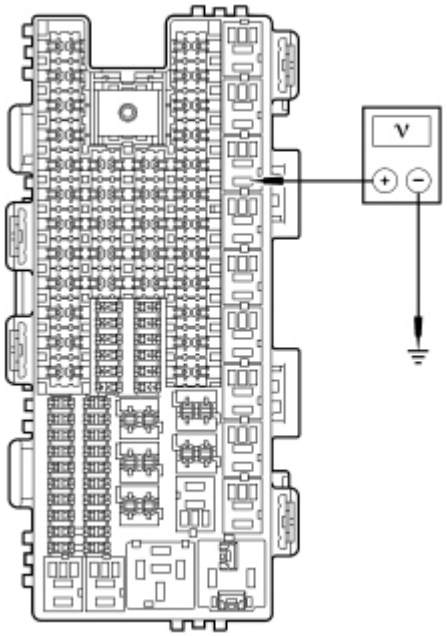
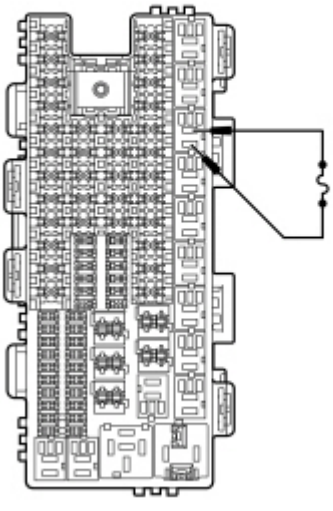
N0096368

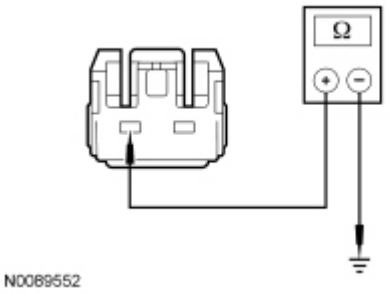
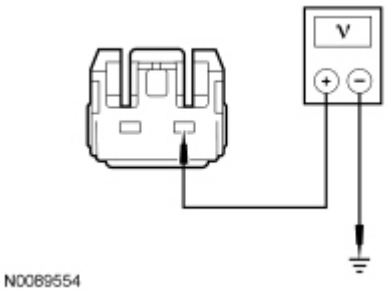
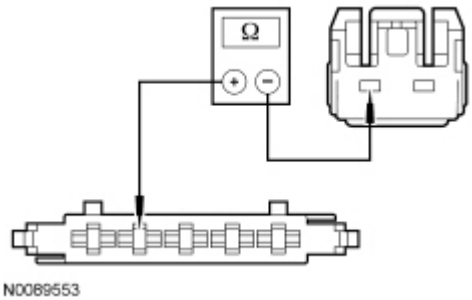
- **Is the voltage greater than 11 volts?**

W4 CHECK THE BLOWER MOTOR RELAY COIL SWITCHED GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294A . • Measure the resistance between blower motor relay socket pin 2, circuit CH123 (VT/GN) and HVAC module — EMTC C294A-11, circuit CH123 (VT), harness side.  N0148803 • **Is the resistance less than 3 ohms?**	**Yes** GO to W11 . **No** REPAIR the circuit.
W5 CHECK THE HVAC MODULE BLOWER MOTOR RELAY	

OUTPUT	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition OFF. • Disconnect: Blower Motor Relay . • Ignition ON. • Connect the 12-volt test light between blower motor relay socket pin 1, circuit CBB52 (GN/WH) and socket pin 2, circuit CH123 (VT/GN).  N0095371 • Select PANEL on the HVAC controls. • **Does the test light illuminate?**	**Yes** GO to W6 . **No** GO to W11 .
W6 CHECK THE BLOWER MOTOR RELAY SWITCH CONTACT VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the voltage between blower motor relay socket pin 3, circuit SBB51 (BU/RD) and ground.	**Yes** GO to W7 . **No** VERIFY Battery Junction Box (BJB) fuse 51 (40A) is OK. If OK, REPAIR circuit SBB51 (BU/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

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 N0096369 • **Is the voltage greater than 11 volts?**	
W7 CHECK THE BLOWER MOTOR RELAY	
• Connect fused jumper lead between blower motor relay socket pin 3, circuit SBB51 (BU/RD) and socket pin 5, circuit CH402 (YE/GN).  N0122704 • **Does the blower motor operate?**	**Yes** INSTALL a new blower motor relay. TEST the system for normal operation. **No** GO to W8 .
W8 CHECK FOR GROUND TO THE BLOWER MOTOR	
• Ignition OFF. • Disconnect: Blower Motor C2004 .	**Yes** GO to W9 .

• Turn the blower motor switch to the HI position. • Measure the resistance between blower motor connector C2004-2, circuit CH426 (YE/OG), harness side and ground.  N0089552 • **Is the resistance less than 3 ohms?**	**No** GO to W10 .
W9 CHECK FOR VOLTAGE TO THE BLOWER MOTOR	
• Connect: Blower Motor Relay . • Ignition ON. • Select PANEL on the HVAC controls. • Measure the voltage between blower motor C2004-1, circuit CH402 (YE/GN), harness side and ground.  N0089554 • **Is the voltage greater than 11 volts?**	**Yes** INSTALL a new blower motor. REFER to Section 412-01 . TEST the system for normal operation. **No** REPAIR the circuit.
W10 CHECK THE BLOWER MOTOR GROUND CIRCUIT FOR AN OPEN	
• Disconnect: HVAC Module — Base EMTC C294B . • Measure the resistance between HVAC module — EMTC C294B-2, circuit CH426 (YE/OG), harness side and blower motor C2004-2, circuit CH426 (YE/OG), harness side.  N0089553 • **Is the resistance less than 3 ohms?**	**Yes** REPAIR circuit GD138 (BK/WH) for an open. TEST the system for normal operation. **No** REPAIR circuit CH426 (YE/OG) for an open. TEST the system for normal operation.
W11 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Ignition OFF.	**Yes**

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• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test X: The Blower Motor Does Not Operate Correctly — EMTC Base With 4 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Normal Operation

The blower motor is provided a ground through the entire blower resistor in the lowest blower setting. In MED-LO and MED-HI the resistor gets a ground from the blower motor switch. In HI, the blower motor is grounded directly through the blower motor switch. The blower switch is provided a ground.

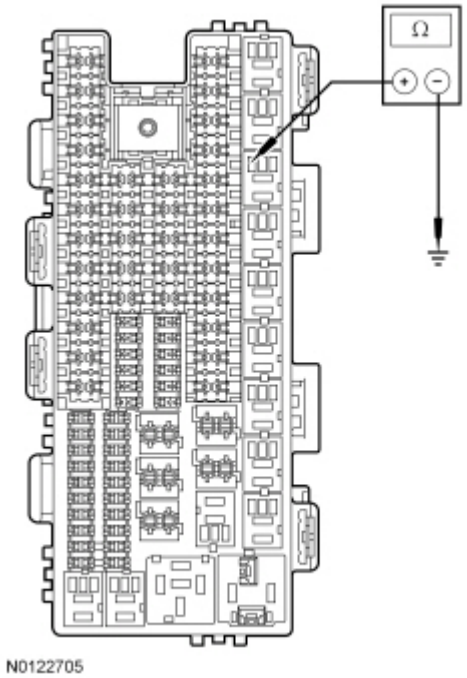
- DTC B10AF:11 (Blower Fan Relay: Circuit Short to Ground) — the module senses no voltage on the relay coil ground circuit when the module is not grounding the circuit for more than 2 seconds.

This pinpoint test is intended to diagnose the following:

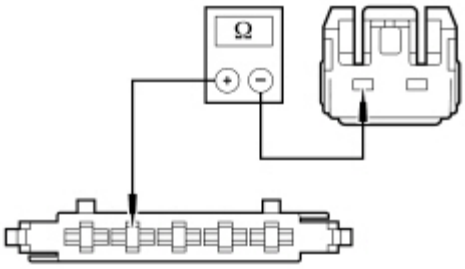
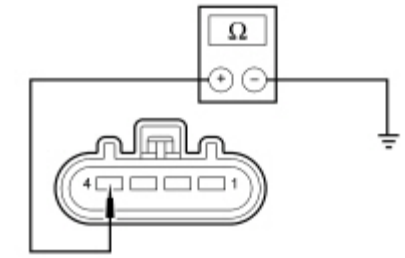
- Wiring, terminals or connectors
- Blower motor resistor
- HVAC module

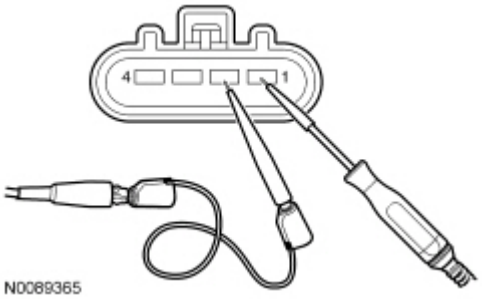
PINPOINT TEST X: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY — EMTC BASE WITH 4 BLOWER MOTOR SPEED POSITIONS

Test Step	Result / Action to Take
X1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Is DTC B10AF:11 present?**	**Yes** GO to X2 . **No** GO to X3 .
X2 CHECK THE BLOWER MOTOR RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF. • Disconnect: Blower Motor Relay . • Disconnect: HVAC Module — Base EMTC C294B . • Measure the resistance between blower motor relay socket pin 2, circuit CH123 (VT/GN) and ground.  N0122705 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X12 . **No** REPAIR the circuit.
X3 CHECK THE BLOWER MOTOR OPERATION	
• Ignition ON. • Select PANEL on the HVAC controls. • Select all blower speed positions. • **Does the blower motor operate in any position?**	**Yes** If the blower motor does not operate in HI setting only, GO to X4 . If the blower motor does not operate in LO setting only, GO to X5 . If the blower motor does not operate in MED-LO or MED-HI setting only, GO to X6 . If the blower motor operates in HI setting only, GO to X8 . If the blower motor operates in LO setting only, GO to X9 . For all other symptoms, GO to X10 . **No** GO to Pinpoint Test W .
X4 CHECK THE BLOWER MOTOR GROUND CIRCUIT FOR AN	

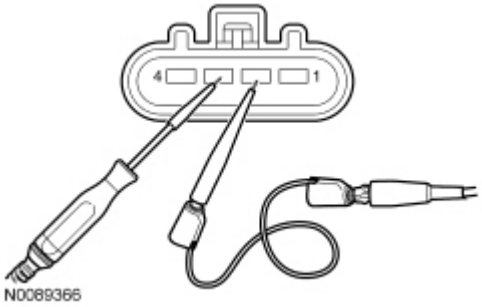
repair4less

OPEN • Ignition OFF. • Disconnect: HVAC Module — Base EMTC C294B . • Disconnect: Blower Motor C2004 . • Measure the resistance between HVAC module — EMTC C294B-2, circuit CH426 (YE/OG), harness side and blower motor C2004-2, circuit CH426 (YE/OG), harness side.  N0089553 • **Is the resistance less than 3 ohms?**	**Yes** GO to X12 . **No** REPAIR the circuit.
X5 CHECK BLOWER MOTOR RESISTOR GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Blower Motor Resistor C2185 . • Measure the resistance between blower motor resistor C2185-4, circuit GD138 (BK/WH), harness side and ground.  A0035320 • **Is the resistance less than 3 ohms?**	**Yes** INSTALL a new blower motor resistor. REFER to Section 412-01 . TEST the system for normal operation. **No** REPAIR the circuit.
X6 CHECK THE BLOWER MOTOR SWITCH ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition OFF. • Disconnect: Blower Motor Resistor C2185 . • Ignition ON. **For MED-LO inoperative**	**Yes** INSTALL a new blower motor resistor. REFER to Section 412-01 . TEST the system for normal operation. **No** GO to X7 .



- For MED-LO inoperative: With the blower motor switch in the MED-LO speed position, connect the 12-volt test light between blower motor resistor C2185-2, circuit CH426 (YE/OG), harness side and blower motor resistor C2185-1, circuit CH428 (GN/WH), harness side.

For MED-HI inoperative

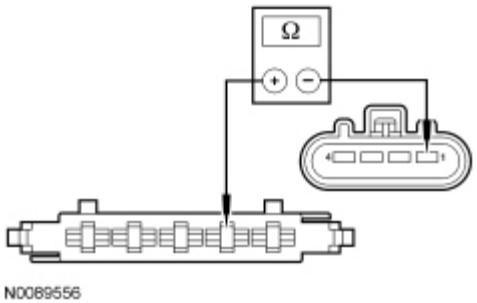


- For MED-HI inoperative: With the blower motor switch in the MED-HI speed position, connect the 12-volt test light between blower motor resistor C2185-2, circuit CH426 (YE/OG), harness side and blower motor resistor C2185-3, circuit CH429 (GY/BN), harness side.
- **Does the test light illuminate?**

X7 CHECK THE BLOWER MOTOR SWITCH TO BLOWER MOTOR RESISTOR CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect: HVAC Module — Base EMTC C294B .

For MED-LO inoperative

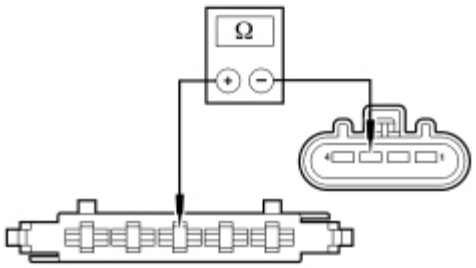
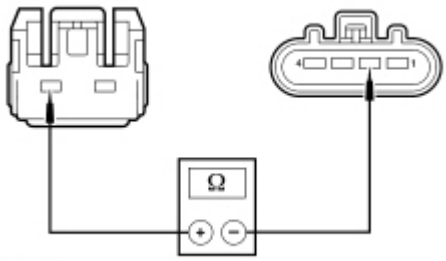


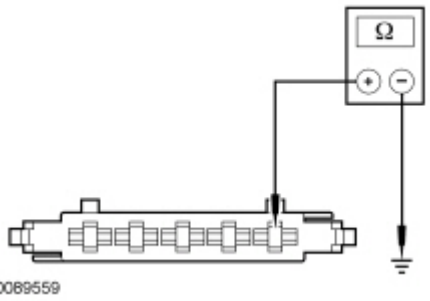
- For MED-LO inoperative, measure the resistance between HVAC module — EMTC C294B-4, circuit CH428 (GN/WH), harness side and blower motor resistor C2185-1, circuit CH428

Yes
GO to X12 .

No
REPAIR the circuit in question.

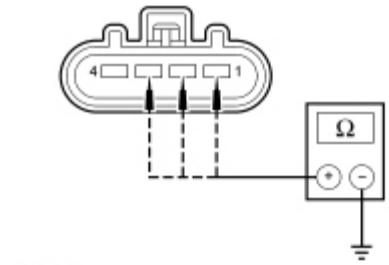
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(GN/WH), harness side. **For MED-HI inoperative**  N0089557 • For MED-HI inoperative, measure the resistance between HVAC module — EMTC C294B-3, circuit CH429 (GY/BN), harness side and blower motor resistor C2185-3, circuit CH429 (GY/BN), harness side. • **Is the resistance less than 3 ohms?**	
X8 CHECK THE BLOWER MOTOR GROUND CIRCUIT TO THE BLOWER MOTOR RESISTOR FOR AN OPEN • Ignition OFF. • Disconnect: Blower Motor Resistor C2185 . • Disconnect: Blower Motor C2004 . • Measure the resistance between blower motor resister C2185-2, circuit CH426 (YE/OG), harness side and blower motor C2004-2, circuit CH426 (YE/OG), harness side.  N0089558 • **Is the resistance less than 3 ohms?**	**Yes** INSTALL a new blower motor resistor. REFER to Section 412-01 . TEST the system for normal operation. **No** REPAIR the circuit.
X9 CHECK THE BLOWER MOTOR SWITCH GROUND CIRCUIT FOR AN OPEN • Disconnect: HVAC Module — Base EMTC C294B . • Measure the resistance between HVAC module — EMTC C294B-5, circuit GD138 (BK/WH), harness side and ground.	**Yes** GO to X12 . **No** REPAIR the circuit.



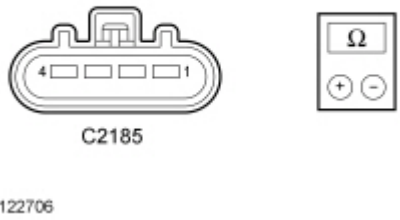
- **Is the resistance less than 3 ohms?**

X10 CHECK THE BLOWER MOTOR RESISTOR CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Disconnect: Blower Motor C2004 .
• Disconnect: Blower Motor Resistor C2185 .
• Disconnect: HVAC Module — Base EMTC C294B .
• Measure the resistance between ground and blower motor resistor:
  ▪ C2185-1, circuit CH428 (GN/WH), harness side.
  ▪ C2185-2, circuit CH426 (YE/OG), harness side.
  ▪ C2185-3, circuit CH429 (GY/BN), harness side.

 	
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to X11 .
	
	No
	REPAIR the circuit in question.

X11 CHECK THE BLOWER MOTOR RESISTOR CIRCUITS FOR SHORTS TOGETHER	
• Measure the resistance between blower motor resistor C2185, harness side using the following chart: **Blower Motor Resistor** / **Circuit** / **Blower Motor Resistor** / **Circuit** C2185-1 / CH428 (GN/WH) / C2185-2 / CH426 (YE/OG) C2185-1 / CH428 (GN/WH) / C2185-3 / CH429 (GY/BN) C2185-2 / CH426 (YE/OG) / C2185-3 / CH429 (GY/BN)	**Yes** CARRY OUT the Blower Motor Resistor component test in this section. If the resistor tests OK, GO to X12 . **No** REPAIR the circuit in question.

repair4less

 • **Are the resistances greater than 10,000 ohms?**	
X12 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Y: The Blower Motor is Inoperative — EATC Dual Zone and EMTC With 4.2 Inch Display System With 7 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Automatic Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

Voltage is supplied to the relay coil and relay switch contacts from BJB . When the blower motor relay coil receives a ground from the HVAC module, the relay coil is energized and voltage is delivered to the blower motor and the blower motor speed control from the relay. Ground for the motor is provided from the blower motor speed control. Ground is provided for the blower control module. The HVAC module sends a Pulse Width Modulated (PWM) signal to the blower motor speed control to control the blower speed.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions

B10AF:12	Blower Fan Relay: Circuit Short to Battery	This DTC sets when the HVAC module senses voltage on the relay coil ground circuit when the relay is grounded by the HVAC module, indicating a short directly to voltage.
B10AF:13	Blower Fan Relay: Circuit Open	This DTC sets when the HVAC module senses no voltage on the relay coil ground circuit when the relay is not grounded by the HVAC module, indicating an open.
B10B9:14	Blower Control: Circuit Short to Ground or Open	This DTC sets when the HVAC module senses no voltage on the blower motor control target speed signal circuit, indicating an open or a short directly to ground.

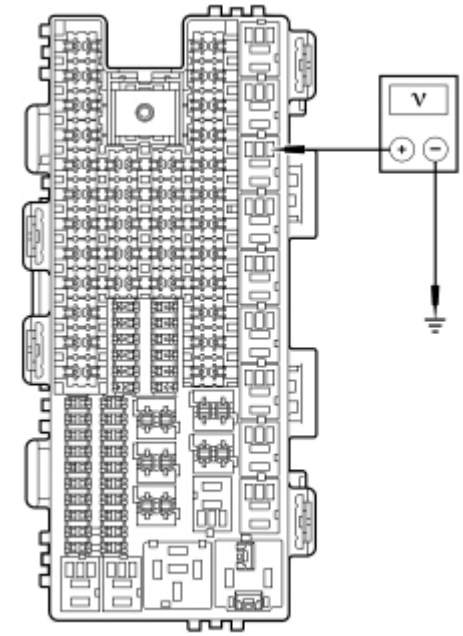
This pinpoint test is intended to diagnose the following:

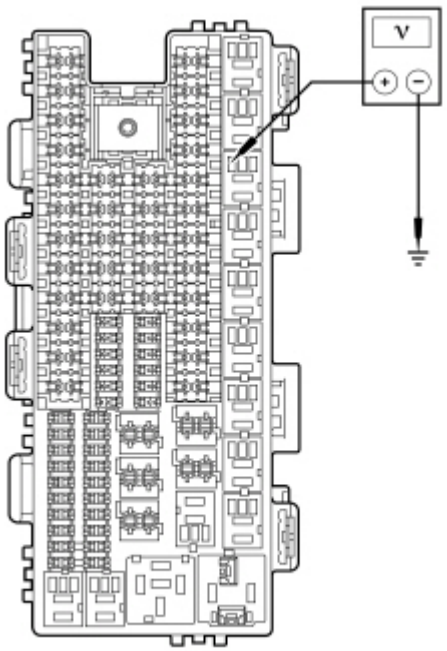
- Battery Junction Box (BJB) fuse 51 (40A) and fuse 52 (5A)
- Wiring, terminals or connectors
- Blower motor relay
- Blower motor speed control
- HVAC module
- Blower motor

PINPOINT TEST Y: THE BLOWER MOTOR IS INOPERATIVE — EATC DUAL ZONE AND EMTC WITH 4.2 INCH DISPLAY SYSTEM WITH 7 BLOWER MOTOR SPEED POSITIONS

Test Step	Result / Action to Take
Y1 CHECK THE BLOWER MOTOR RELAY FUNCTIONALITY	
• Ignition OFF. • Install a known good blower motor relay. • Ignition ON. • Operate the system and verify the concern is still present. • **Does the blower motor function correctly?**	**Yes** INSTALL a new blower motor relay. **No** GO to Y2.
Y2 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B10AF:12 and B10AF:13, GO to Y3. For DTC B10B9:14, GO to Y6. **No** GO to Y6.
Y3 CHECK THE BLOWER MOTOR RELAY COIL SUPPLY VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Relay . • Ignition ON. • Measure the voltage between ground and BJB blower motor relay socket, pin 1, circuit CBB52 (GN/WH).	**Yes** GO to Y4. **No** VERIFY Battery Junction Box (BJB) fuse 52 (5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit

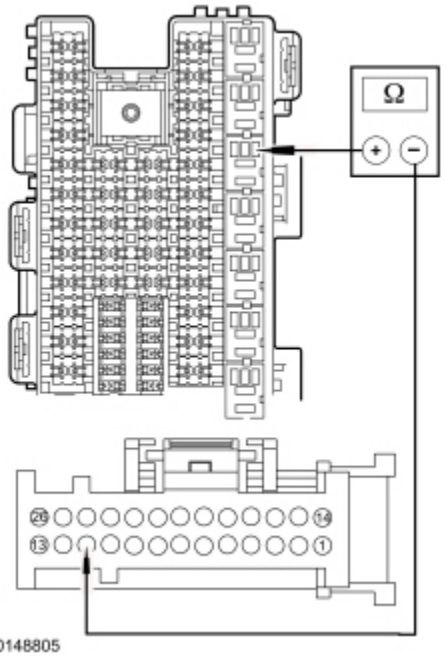
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 N0096368 • **Is the voltage greater than 11 volts?**	short.
Y4 CHECK THE BLOWER MOTOR RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Ignition ON. • Measure the voltage between ground and BJB blower motor relay socket, pin 2, circuit CH123 (VY/GN).	**Yes** REPAIR the circuit. CLEAR the DTCs. RETEST the system. If the blower motor is still inoperative, GO to Y6 . **No** GO to Y5 .

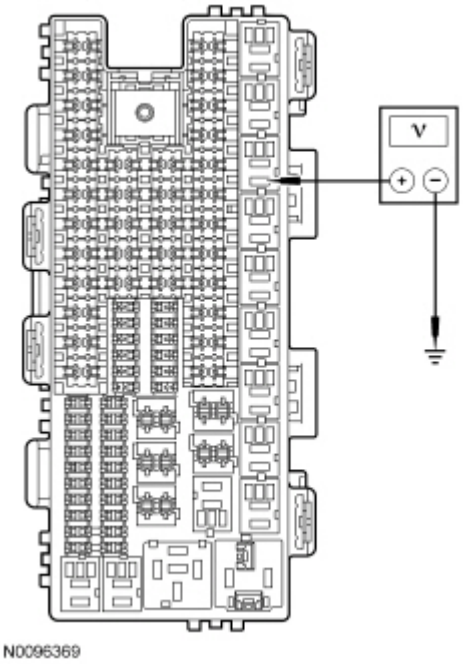
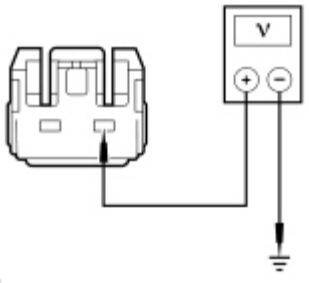


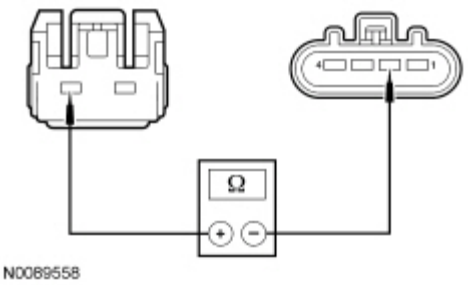
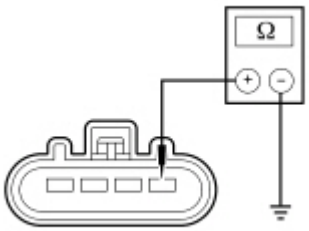
N0122702

- **Is any voltage present?**

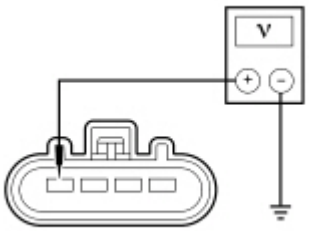
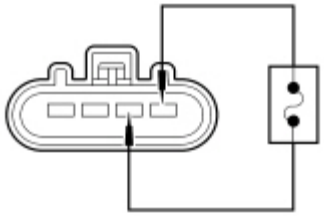
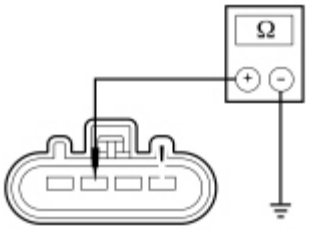
Y5 CHECK THE BLOWER MOTOR RELAY COIL SWITCHED GROUND CIRCUIT FOR AN OPEN	
 N0148805 • Ignition OFF. • Measure resistance between BJB blower motor relay socket pin 2, circuit CH123 (VT/GN) and: ▪ HVAC module — EATC C228A-11, circuit CH123 (VT/GN), harness side. ▪ HVAC module — EMTC C2357A-11, circuit CH123 (VT/GN), harness side. • **Is the resistance less than 3 ohms?**	**Yes** GO to Y14 . **No** REPAIR the circuit. CLEAR the DTCs. RETEST the system. If the blower motor is still inoperative, GO to Y6 .
Y6 CHECK THE BLOWER MOTOR RELAY SWITCH	

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SUPPLY VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Relay . • Ignition ON. • Measure the voltage between ground and BJB blower motor relay socket, pin 3, circuit SBB51 (/BU/RD).  N0096369 • **Is the voltage greater than 11 volts?**	**Yes** GO to Y7 . **No** VERIFY BJB fuse 51 (40A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
Y7 CHECK FOR VOLTAGE TO THE BLOWER MOTOR	
• Ignition OFF. • Connect: Blower Motor Relay . • Disconnect: Blower Motor C2004 . • Ignition ON. • Select PANEL on the HVAC controls. • Measure the voltage between blower motor C2004-1, circuit CH402 (YE/GN), harness side and ground.  N0089554 • **Is the voltage greater than 11 volts?**	**Yes** GO to Y8 . **No** REPAIR the circuit.
Y8 CHECK THE GROUND CIRCUIT BETWEEN THE BLOWER MOTOR AND BLOWER MOTOR SPEED CONTROL FOR AN OPEN	
• Ignition OFF.	**Yes**

• Disconnect: Blower Motor Speed Control C271 . • Measure the resistance between blower motor C2004-2, circuit VH301 (YE/BU), harness side and blower motor speed control C271-2, circuit VH301 (YE/BU), harness side.  N0089558 • **Is the resistance less than 3 ohms?**	GO to Y9 . **No** REPAIR the circuit.
Y9 CHECK THE BLOWER MOTOR SPEED CONTROL GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between blower motor speed control C271-1, circuit GD138 (BK/WH), harness side and ground.  N0001799 • **Is the resistance less than 3 ohms?**	**Yes** GO to Y10 . **No** REPAIR the circuit.
Y10 CHECK FOR VOLTAGE TO THE BLOWER MOTOR SPEED CONTROL	
• Connect: HVAC Module — EATC C228A . • Connect: HVAC Module — Remote Mount EMTC C2357A . • Ignition ON. • Select PANEL on the HVAC controls. • Measure the voltage between blower motor speed control C271-4, circuit CH402 (YE/GN), harness side and ground.	**Yes** GO to Y11 . **No** REPAIR the circuit.

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 N0001798 • **Is the voltage greater than 11 volts?**	
Y11 CHECK THE BLOWER MOTOR	**Yes** GO to Y12 . **No** INSTALL a new blower motor. REFER to Section 412-01 . TEST the system for normal operation.
• Ignition OFF. • Connect: Blower Motor C2004 . • Connect a fused jumper lead between blower motor speed control C271-2, circuit VH301 (YE/BU), harness side and C271-1, circuit GD138 (BK/WH), harness side.  N0001800 • Ignition ON. • Select PANEL on the HVAC controls. • **Does the blower motor operate?**	
Y12 CHECK THE BLOWER MOTOR SPEED CONTROL PULSE WIDTH CIRCUIT FOR A SHORT TO GROUND	**Yes** GO to Y13 . **No** REPAIR the circuit.
• Ignition OFF. • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Measure the resistance between blower motor speed control C271-3, circuit VH101 (WH/VT), harness side and ground.  N0148253 • **Is the resistance greater than 10,000 ohms?**	

Y13 CHECK THE BLOWER MOTOR SPEED CONTROL CONNECTION	

• Disconnect and inspect the blower motor speed control connector.
  ▪ Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect the blower motor speed control connector. Make sure it seats and latches correctly.
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new blower motor speed control. REFER to Section 412-01 .
	
	RETEST the system. If concern Is still present, GO to Y14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Y14 CHECK THE HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Clear the DTCs.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Z: The Blower Motor Does Not Operate Correctly — EATC Dual Zone and EMTC With 4.2 Inch Display System With 7 Blower Motor Speed Positions

Refer to Wiring Diagrams Cell 54 , Automatic Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

Voltage is supplied to the relay coil from Battery Junction Box (BJB) fuse 52 (5A) and relay switch contacts from BJB fuse 51 (40A). When the blower motor relay coil receives a ground from the HVAC module, the relay coil is energized and voltage is delivered to the blower motor and the blower motor speed control from the relay. Ground for the motor is provided from the blower motor speed control. Ground is provided for the blower control module. The HVAC module sends a Pulse Width Modulated (PWM) signal to the blower motor speed control to control the blower speed.

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DTC Fault Trigger Conditions

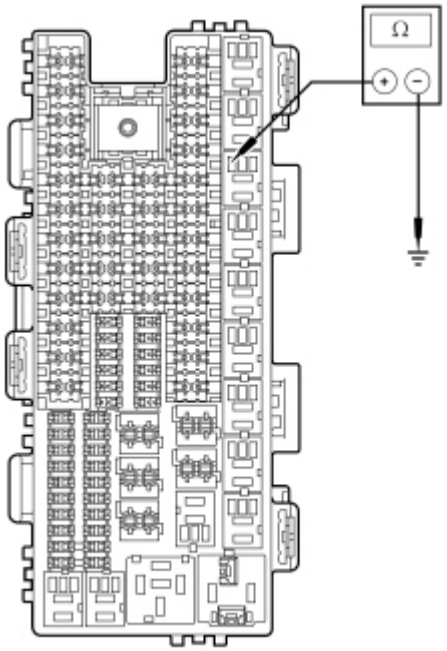
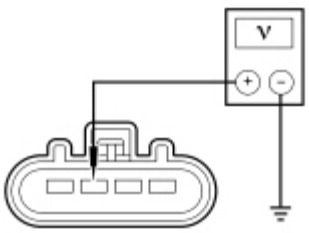
DTC	Description	Fault Trigger Conditions
B10AF:11	Blower Fan Relay: Circuit Short to Battery	This DTC sets when the HVAC module senses no voltage on the relay coil ground circuit when the HVAC module is not grounding the circuit, indicating a short directly to voltage.
B10B9:12	Blower Control: Circuit Short to Battery	This DTC sets when the HVAC module senses excessive voltage on the blower motor control PWM circuit for more than 1 second, indicating a short to voltage.
B10B9:14	Blower Control: Circuit Short to Ground or Open	This DTC sets when the HVAC module senses no voltage on the blower motor control blower motor control PWM circuit for more than 1 second, indicating an open or a short directly to ground.

This pinpoint test is intended to diagnose the following:

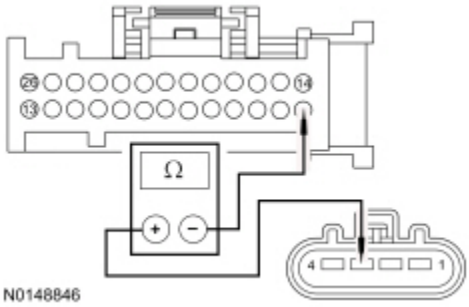
- Wiring, terminals or connectors
- Blower motor speed control
- HVAC module
- Front Controls Interface Module (FCIM)

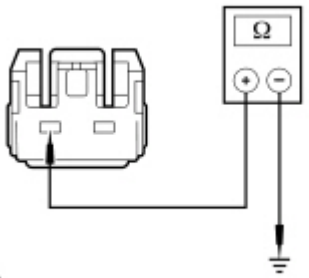
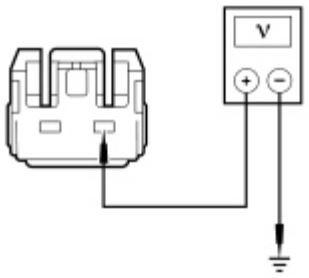
PINPOINT TEST Z: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY — EATC DUAL ZONE AND EMTC WITH 4.2 INCH DISPLAY SYSTEM WITH 7 BLOWER MOTOR SPEED POSITIONS

Test Step	Result / Action to Take
Z1 CHECK THE HVAC MODULE FOR DTCs • Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** For DTC B10AF:11, GO to Z2 . For DTC B10B9:12, GO to Z3 . For DTC B10B9:14, GO to Z4 . **No** GO to Z5 .
Z2 CHECK THE BLOWER MOTOR RELAY COIL SWITCHED GROUND CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: Blower Motor Relay . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Ignition ON. • Measure the voltage between blower motor relay socket pin 2, circuit CH123 (VT/GN) and ground.	**Yes** GO to Z11 . **No** REPAIR the circuit.

 N0122705 • **Is the resistance greater than 10,000 ohms?**	
Z3 CHECK THE BLOWER MOTOR CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Speed Control C271 . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — Remote Mount EMTC C2357A . • Ignition ON. • Measure the voltage between blower motor speed control C271-3, circuit VH101 (WH/VT), harness side and ground.  N0001804 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to Z10 .
Z4 CHECK THE BLOWER MOTOR CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Blower Motor Speed Control C271 . • Disconnect: HVAC Module — EATC C228A . • Disconnect: HVAC Module — Remote Mount EMTC	**Yes** GO to Z10 . **No** REPAIR the circuit.

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 C2357A . • Measure the resistance between HVAC module — EATC C228A-1, circuit VH101 (WH/VT), harness side and blower motor speed control C271-3, circuit VH101 (WH/VT), harness side. • **Is the resistance less than 3 ohms?**	
Z5 CHECK THE BLOWER MOTOR OPERATION USING THE BLOWER MOTOR SPEED (BLOWRSPD) ACTIVE COMMAND	
• Enter the following diagnostic mode on the scan tool: HVAC Module DataLogger . • Select PANEL mode on the HVAC controls. • Select the lowest blower motor setting. • Observe blower motor speed while using the scan tool to operate the HVAC module active command BLOWRSPD, increasing and decreasing the percentage value. • **Does the blower motor speed change between low and high when the active command is changed?**	**Yes** INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure.. TEST the system for normal operation. **No** GO to Z6 .
Z6 VERIFY THE BLOWER MOTOR OPERATION	
• Select PANEL on the HVAC controls. Adjust the blower motor setting to LO and then to HI then press the POWER button on the HVAC module (OFF). • **Does the blower motor operate at any setting and/or turn OFF?**	**Yes** If the blower motor operates always in HI, GO to Z7 . If the blower motor is always ON, GO to Z8 . All other symptoms, INSTALL a new blower motor speed control. REFER to Section 412-01 . TEST the system for normal operation. If the blower motor still does not operate correctly, GO to Z11 . **No** GO to Pinpoint Test Y .
Z7 CHECK THE BLOWER MOTOR PWM GROUND CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Blower Motor Speed Control C271 . • Disconnect: Blower Motor C2004 . • Measure the resistance between blower motor connector C2004-2, circuit VH301 (YE/BU), harness side and ground.	**Yes** GO to Z10 . **No** REPAIR the circuit.

 N0089552 • **Is the resistance greater than 10,000 ohms?**	
Z8 CHECK THE BLOWER MOTOR RELAY • Ignition OFF. • Disconnect: Blower Motor Relay . • Turn OFF the HVAC system. • **Does the blower motor operate?**	**Yes** GO to Z9 . **No** INSTALL a new blower motor relay. TEST the system for normal operation.
Z9 CHECK THE BLOWER MOTOR VOLTAGE CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Blower Motor C2004 . • Disconnect: Blower Motor Speed Control C271 . • Ignition ON. • Measure the voltage between blower motor C2004-1, circuit CH402 (YE/GN), harness side and ground.  N0089554 • **Is any voltage present?**	**Yes** REPAIR the circuit. **No** GO to Z10 .
Z10 CHECK THE BLOWER MOTOR SPEED CONTROL CONNECTION • Disconnect and inspect the blower motor speed control connector. • Repair: ▪ corrosion (install new connector or terminals - clean module pins) ▪ damaged or bent pins - install new terminals/pins ▪ pushed-out pins - install new pins as necessary • Connect the blower motor speed control connector. Make sure it seats and latches correctly. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — HVAC Module . • Operate the system and verify the concern is still	**Yes** INSTALL a new blower motor speed control. REFER to Section 412-01 . TEST the system for normal operation. If the blower motor is still inoperative, GO to Z11 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

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present. • **Is the concern still present?**	
Z11 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all HVAC module connectors.
• Repair:
  ▪ corrosion (install new connector or terminals - clean module pins)
  ▪ damaged or bent pins - install new terminals/pins
  ▪ pushed-out pins - install new pins as necessary
• Connect all HVAC module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSB addresses this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AA: DTC U0140:00

Normal Operation

- DTC U0140:00 (Lost Communication With Body Control Module: No Sub-Type Information) — sets in continuous memory in the HVAC module if data messages received from the Body Control Module (BCM) over the Medium Speed Controller Area Network (MS-CAN) are missing for 3 seconds or more. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- BCM
- HVAC module

PINPOINT TEST AA: DTC U0140:00

Test Step	Result / Action to Take
AA1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AA2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the BCM pass the network test?**	**Yes** GO to AA3 . **No** REFER to Section 418-00 .

AA3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded DTCs from the BCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** Section 419-10 . **No** GO to AA4 .
AA4 RETRIEVE THE RECORDED DTCs FROM THE HVAC MODULE SELF-TEST	
• Check for recorded DTCs from the HVAC module self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test H . **No** GO to AA5 .
AA5 RECHECK THE HVAC MODULE DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the HVAC module self-test. • **Is DTC U0140:00 still present?**	**Yes** GO to AA6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA6 CHECK FOR DTC U0140:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140:00 set in the Driver Seat Module (DSM)?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.

Pinpoint Test AB: DTC U0163:00

Normal Operation

- DTC U0163:00 (Lost Communication With navigation Control Module: No Sub-Type Information) — sets in continuous memory in the HVAC module if data messages received from the Accessory Protocol Interface Module (APIM) over the Medium Speed Controller Area Network (MS-CAN) are missing for 3 seconds or more. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- APIM
- HVAC module

PINPOINT TEST AB: DTC U0163:00

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Test Step	Result / Action to Take
AB1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AB2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the APIM pass the network test?**	**Yes** GO to AB3 . **No** REFER to Section 418-00 .
AB3 RETRIEVE THE RECORDED DTCs FROM THE APIM SELF-TEST • Check for recorded DTCs from the APIM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** Refer to the appropriate section in Group 415 for the procedure.. **No** GO to AB4 .
AB4 RETRIEVE THE RECORDED DTCs FROM THE HVAC MODULE SELF-TEST • Check for recorded DTCs from the HVAC module self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test H . **No** GO to AB5 .
AB5 RECHECK THE HVAC MODULE DTCs **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the HVAC module self-test. • **Is DTC U0163:00 still present?**	**Yes** INSTALL a new APIM . Refer to the appropriate section in Group 415 for the procedure.. CLEAR the DTCs. REPEAT the HVAC module self-test. If HVAC DTC U0163:00 returns, INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AC: DTC U0256:00

Normal Operation

- DTC U0256:00 (Lost Communication With FCIM "A") — sets in continuous memory in the HVAC module if data messages received from the FCIM over the MS-CAN are missing for 3 seconds or more. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- FCIM
- HVAC module

PINPOINT TEST AC: DTC U0256:00

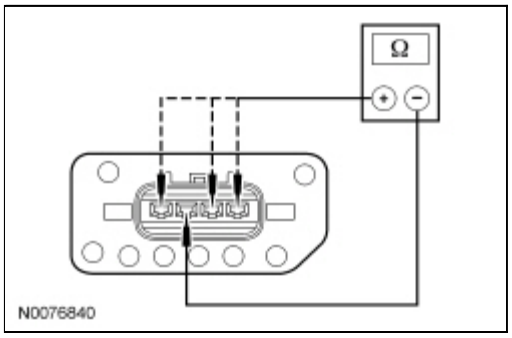
Test Step	Result / Action to Take
AC1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AC2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the FCIM pass the network test?**	**Yes** GO to AC3 . **No** REFER to Section 418-00 .
AC3 RETRIEVE THE RECORDED DTCs FROM THE FCIM SELF-TEST • Check for recorded DTCs from the FCIM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** Refer to the appropriate section in Group 415 for the procedure.. **No** GO to AC4 .
AC4 RETRIEVE THE RECORDED DTCs FROM THE HVAC MODULE SELF-TEST • Check for recorded DTCs from the HVAC module self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test H . **No** GO to AC5 .
AC5 RECHECK THE HVAC MODULE DTCs **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the PMI or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the HVAC module self-test. • **Is DTC U0256:00 still present?**	**Yes** GO to AC6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC6 CHECK FOR DTC U0256:00 SET IN OTHER MODULES	

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• Clear all DTCs. • Ignition OFF. • Wait 10 seconds. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0256:00 set in the APIM ?**	**Yes** INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure.. **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.

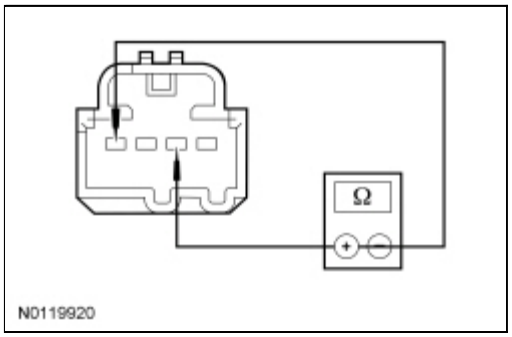
Component Tests

Blower Motor Resistor



Blower Motor Resistor Pins	Resistance (Ohms)
4 and 2	2.0-2.6
2 and 3	0.2-0.4
2 and 1	0.8-1.1

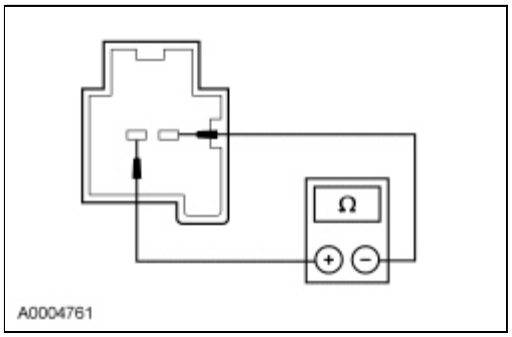
Temperature Sensor — In-Vehicle



Ambient Temperature	Resistance (Ohms)
0-10°C (32-50°F)	57,950-97,640
10-20°C (50-68°F)	36,880-59,920
20-25°C (68-77°F)	29,700-37,790

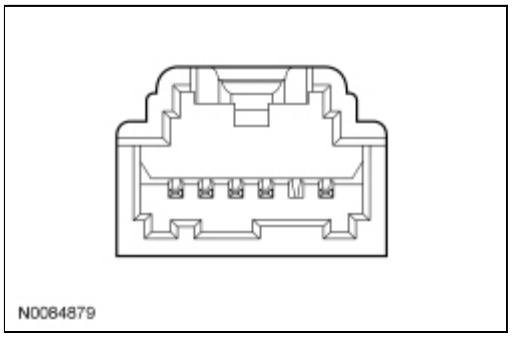
25-30°C (77-86°F)	23,960-30,300
30-35°C (86-95°F)	19,440-24,550
35-40°C (95-104°F)	15,860-20,000
40-50°C (104-122°F)	10,740-16,390

Temperature Sensor — Evaporator Discharge



Ambient Temperature	Resistance (Ohms)
-40°C (-40°F)	1,005,00-1,104,000
-20°C (-4°F)	287,811-307,800
0°C (32°F)	96,890-101,300
20°C (68°F)	37,080-38,000
25°C (77°F)	29,700-30,300
30°C (86°F)	23,840-24,430
35°C (95°F)	19,260-19,820
40°C (104°F)	15,660-16,180
60°C (140°F)	7,239-7,594
100°C (212°F)	1,943-2,091

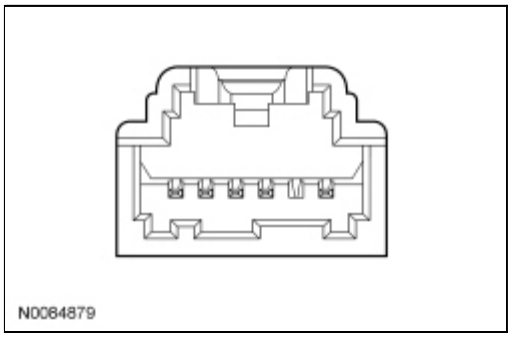
Air Inlet Mode Door Actuator



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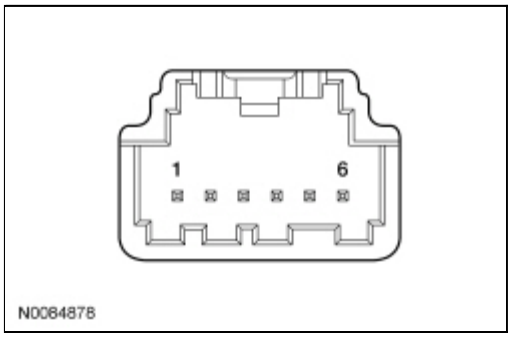
Actuator Pins	Approx. Resistance (Ohms)
2 and 3	2,775-4,625
2 and 4	187-4,313
3 and 4	187-4,313
1 and 6	43-53

Defrost/Panel/Floor Door Actuator



Actuator Pins	Approx. Resistance (Ohms)
2 and 3	2,775-4,625
2 and 4	187-4,313
3 and 4	187-4,313
1 and 6	43-53

Temperature Blend Door Actuator



Actuator Pins	Approx. Resistance (Ohms)
1 and 3	2,850-4,750
1 and 2	113-4,563
2 and 3	113-4,563
5 and 6	32-44

Heater Core

1. **NOTE:** If a heater core leak is suspected, the heater core must be tested by following the Plugged Heater Core Component Test before the heater core pressure test. Carry out a system inspection by checking the heater system thoroughly as follows:

   Inspect for evidence of coolant leakage at the heater hose to heater core attachments. A coolant leak in the heater hose could follow the heater core tube to the heater core and appear as a leak in the heater core.

2. **NOTE:** Spring-type clamps are installed as original equipment. Installation and overtightening of non-specified clamps can cause leakage at the heater hose connection and damage the heater core.

   Check the integrity of the heater hose clamps.

Heater Core — Plugged

1. Check to see that the engine coolant is at the correct level.

2. Start the engine and turn on the heater.

3. When the engine coolant reaches operating temperature, using a suitable temperature measuring device, check the core inlet and outlet hoses to see if they are hot.

4. If the outlet only is not hot:
   - the heater core may have an air pocket.
   - the heater core may be plugged.

5. If the inlet only is not hot:
   - the thermostat may not be working correctly.

Heater Core — Pressure Test

 **WARNING: Before disconnecting any heater water hoses, shut OFF the engine and wait until engine is fully cool. Failure to comply with this warning may result in serious injury or burns from hot liquid escaping from the engine cooling system.**

Use the Pressure Test Kit to carry out the pressure test.

1. **NOTE:** Due to space limitations, a bench test may be necessary for pressure testing.

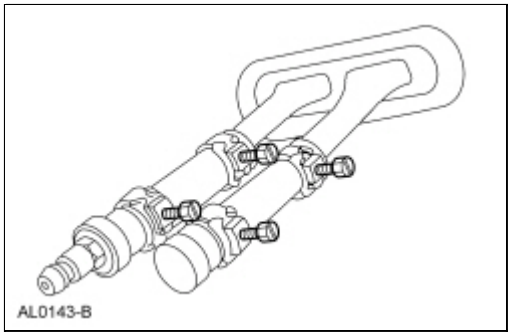
   Drain the coolant from the cooling system.

2. Disconnect the heater hoses from the heater core.

3. Install a short piece of heater hose, approximately 101 mm (4 in) long on each heater core tube.

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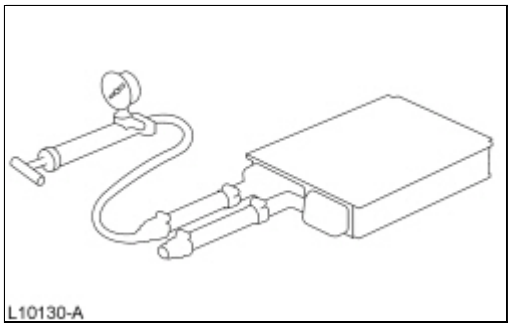
4. Fill the heater core and heater hoses with water and install the plug BT-7422-B and the adapter BT-7422-A from the Pressure Test Kit. Secure the heater hoses, plug and adapter with hose clamps.



5. Attach the pump and gauge assembly from the Pressure Test Kit to the adapter.
6. Close the bleed valve at the base of the gauge. Pump 138 kPa (20 psi) of air pressure into the heater core.
7. Observe the pressure gauge for a minimum of 3 minutes.
8. If the pressure drops, check the heater hose connections to the core tubes for leaks. If the heater hoses do not leak, remove the heater core from the vehicle and carry out the bench test.

Heater Core — Bench Test

1. Remove the heater core from the vehicle.
2. Drain all of the coolant from the heater core.
3. Connect the 101 mm (4 in) test heater hoses with plug and adapter to the core tubes. Then connect the Pressure Test Kit to the adapter.
4. Apply 138 kPa (20 psi) of air pressure to the heater core. Submerge the heater core in water.
5. If a leak is observed, install a new heater core.



Evaporator/Condenser Core — On-Vehicle Leak Test

1. Discharge and recover the refrigerant. Refer to Air Conditioning (A/C) System Recovery, Evacuation

and Charging in this section.

2. Disconnect the suspect evaporator core or condenser core from the A/C system.

3. Clean the manifold fittings.

4. Connect the appropriate test fittings from the A/C Flush Adapter Kit to the condenser or evaporator core tube connections.

5. **NOTE:** The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without shut-off valves. If hoses with shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter that will activate the valve. The test is not valid if the shut-off valve does not open.

   Connect the red and blue hoses from the R-134a Manifold Gauge Set to the test fittings on the evaporator core or condenser core. Connect the yellow hose to a known good vacuum pump.

6. Open both gauge set valves and start the vacuum pump. Allow the vacuum pump to operate for a minimum of 45 minutes after the gauge set low-pressure gauge indicates 101 kPa (30 in-Hg). The 45-minute evacuation is necessary to remove any refrigerant from oil left in the evaporator core or condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the vacuum and appear as a refrigerant leak.

7. If the low-pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves on the gauge and manifold set are open and the vacuum pump is operating, close the gauge set valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and gauge set connections before installing a new evaporator core or condenser core.

8. After evacuating for 45 minutes, close the gauge set valves and stop the vacuum pump. Observe the low-pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.
   - If the low-pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
   - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
   - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the evaporator core or condenser core. Then recheck for loss of vacuum.
   - If a very small leak is suspected, allow the system to sit overnight with vacuum applied and check for vacuum loss.

9. If the evaporator core or condenser core does leak, as verified by the above procedure, install a new evaporator core or condenser core.

A/C Compressor — External Leak Test

1. Install the appropriate adapter from the A/C Flush Adapter Kit on the port of the A/C compressor, using the existing manifold retaining bolt.

2. Connect the high- and low-pressure lines of a manifold gauge set or a refrigerant recovery/recycling station to the corresponding fittings on the adapter.

3. Attach the center hose of a manifold gauge set to a refrigerant container standing in an upright position.

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4. Open the low-pressure gauge valve, the high-pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the A/C compressor.

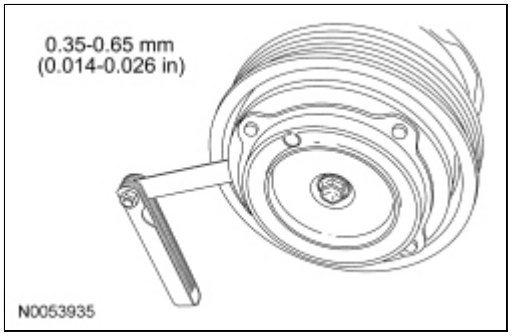
5. Using the Refrigerant Leak Detector, check for leaks at the compressor shaft.

6. If a shaft seal leak is found, install a new compressor shaft seal. If an external leak is found, install a new A/C compressor.

7. When the leak test is complete, recover the refrigerant from the compressor.

Air Conditioning (A/C) Clutch Air Gap Adjustment

1. Check the A/C clutch air gap at 3 equally spaced places between the clutch plate and the A/C clutch pulley.



2. Remove the clutch plate. Add or remove spacers between the clutch plate hub and the compressor shaft until the clearance is within specification.

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Air Conditioning (A/C) Odor Treatment

Special Tool(s)

 ST2940-A	Flexible Applicator Tool 258-62644

Material

Item	Specification
Motorcraft® A/C Cooling Coil Coating YN-29	—

WARNING: Carry out this procedure in a well-ventilated area with all vehicle windows and doors opened. Carefully read cautionary information on product label. For emergency medical information, seek medical advice. On Ford/Motorcraft products in the USA or Canada call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS), if available. Failure to follow these instructions may result in serious personal injury.

NOTE: There are typically 4 types of objectionable odors found in a vehicle:

- Chemical odors
- Environmental odors
- Human and other interior-generated odors
- Microbiological odors

Before determining that A/C odor treatment is required, the source and the circumstances under which the odor occurs must be determined.

NOTE: Chemical odors are usually constant regardless of the climate control system setting although they may be enhanced by A/C operation. Most chemical odors are caused by fluid leaks or incorrectly cured adhesives. Chemical odors can be eliminated by repairing the leaking component and removing any residue.

NOTE: Environmental odors usually occur for a short time and diminish after the vehicle passes through the affected area. These odors are typically only detected when the vehicle windows are open, or when the climate control system is operating in a mode that allows for fresh air. Environmental odors cannot be eliminated because they are external in source, but they may be minimized by switching to a climate control setting that uses recirculated air.

NOTE: Human and other interior-generated odors occur while the source is present and may linger for a short time after. These odors may be more noticeable during A/C operation. Human odors may be

eliminated by removing the source and cleaning the affected area.

NOTE: Microbiological odors, if in the A/C system, usually last for about 30 seconds after the system is turned on. They will be detected while the A/C is turned on and using either outside or recirculated air. Microbiological odors that occur in areas other than the A/C system (for example, water in doors or wet carpeting) may last indefinitely and will be more intense when recirculated air is used. Microbiological odors will not be present at temperatures at or below 10°C (50°F).

Microbiological odors can be eliminated by removing the source and treating the affected area. Standing water must be allowed to drain and dry out. A/C systems may be treated by using Motorcraft® A/C Cooling Coil Coating as described in the service procedure below.

Microbiological odors result from microbial growth supported by warm temperatures and moisture. Microbiological odors are described as musty/mildew type smells and may occur on/in:

- foam seals
- rubber seals
- adhesives
- standing water
- water soaked carpet/trim

1. Identify the type of odor present in the vehicle. Do not proceed with A/C odor treatment if the odor source is found to be outside of the A/C system. Refer to the following chart for examples.

Odor Source	Odor Description
Chemical Odors	
Coolant	Sweet smell
Fuel	Gasoline or diesel fuel smell
Oil	Oil type or burning smell
Power Steering Fluid	Oil type or burning smell
Transmission Fluid	Oil type or burning smell
Washer Fluid	Alcohol type smell
Gear Lube	Garlic/sulfur smell
Refrigerant Oil	Ether type smell
Carpet/trim Adhesives	Fishy, urine or sweet smell
Evaporator Core Coating	Wet cement type smell
Environmental Odors	
Exhaust	Exhaust, fuel or burning type smell
Industrial Pollutants	Various smells
Dust	Musty, mildew or wet cement type smell
Pollen	Sweet smell
Tobacco	Burning, tar smell
Human and Other Interior Generated Odors	
Body Secretions	Body odor
Perfuming Agents	Sweet or fragrance smell

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Clothing	Musty, mildew or body odors
Food/Beverage	Sweet, musty, mildew or fishy smell
Microbiological Odors	
Microbiological Odors Occurring Inside of A/C System	Musty, mildew smell lasting about 30 seconds after A/C is turned on
Microbiological Odors Occurring Outside of A/C System	Musty, mildew smell lasting indefinitely and possibly more pronounced when using recirculated air

2. Identify the source of the odor.
   - Check the evaporator core drain tube for restriction.
   - Check the passenger and driver side carpet for moisture. If moisture is found, A/C odor treatment is not necessary. Diagnose for a water leak as needed.
   - Check the blower motor and blower motor cover (if equipped) for moisture resulting from water bypassing the cowl baffling system. If moisture is found, A/C odor treatment is not necessary. Diagnose for a water leak as needed.
   - Check the cowl top panel and air inlet screen for standing water or foreign material. If possible, remove any standing water and clean the air inlet screen using a wet/dry vacuum.

3. Open all vehicle windows and doors.

4. Make sure that the A/C is off.

5. Set the following.
   - Select PANEL mode (A/C off).
   - Adjust the temperature setting to full warm.
   - Adjust the blower motor speed to HI.

6. Run the engine for 25 minutes to dry out the A/C system.

7. Turn the ignition OFF.

8. Remove the blower motor.

9. **NOTE:** Blower motor speed controls that are mounted outside of the evaporator core housing and not exposed to the blower motor airflow do not need to be removed.

   Remove the blower motor resistor (if equipped) or blower motor speed control (if equipped and exposed to the inside of the evaporator core housing).

10. ***NOTICE:*** **To avoid damage to the vehicle interior, do not spill or spray this product on any interior surface.**

    Add one full bottle of Motorcraft® A/C Cooling Coil Coating to the Flexible Applicator Tool.

11. Insert the nozzle into the evaporator housing and direct the spray toward the evaporator core face. Spray the entire evaporator core face until empty.

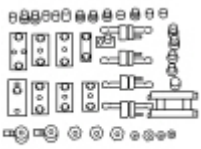
12. Install the blower motor and blower motor resistor (if equipped) or blower motor speed control (if equipped).

13. Repeat Steps 4 through 6 to cure the evaporator core coating.

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Air Conditioning (A/C) System Flushing

Special Tool(s)

 ST2985-A	A/C Flush Adapter Kit 219-CL-00732 or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00082 or equivalent
 ST3313-A	A/C Flush and Purge Machine 357-405 80001 00 or equivalent

Material

Item	Specification
Motorcraft® A/C System Flushing Solvent YN-23	—
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

WARNING: Take the following precautions when repairing an air conditioning system containing R-134a:

- **Always wear safety goggles.**
- **Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and will freeze skin tissue.**
- **Never allow refrigerant R-134a gas to escape in quantity in an occupied space. It will displace the oxygen needed to support life.**
- **Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but it decomposes when exposed to high temperatures such as a torch flame. During decomposition it releases irritating and toxic gasses (as described in the Material Safety Data Sheet from the manufacturer). Decomposition products are hydrofluoric acid,**

carbon dioxide and water.

Failure to follow these instructions may result in serious personal injury.

NOTICE: **An Air Conditioning (A/C) refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer procedures and instructions.**

NOTICE: **Receiver/drier cartridge, front Thermostatic Expansion Valve (TXV), rear TXV (if equipped) and hoses with mufflers should be removed when flushing the Air Conditioning (A/C) system. Internal plumbing of these devices makes it impossible to correctly remove any residual-flushing agent. These components are typically discarded after A/C system contamination. Hoses without mufflers can normally be reused unless they are clogged with foreign material. The 3.78L (1 gal) of Motorcraft® A/C System Flushing Solvent YN-23 and FL1-A filter used in A/C Flush and Purge Machine 357-405 80001 00 are intended for use on one vehicle only. They may be used to flush both the A/C condenser core and the A/C evaporator core on an individual vehicle, but under no circumstances should they be used on more than one vehicle.**

NOTICE: **Only the A/C Flush and Purge Machine 357-405 80001 00 and Motorcraft® A/C System Flushing Solvent is approved for use on Ford vehicles. No other flushing device or solvent is approved for flushing heat exchangers (Air Conditioning (A/C) condenser, A/C evaporator). Use of any other flusher or solvent may cause damage to the A/C system and the flushing unit.**

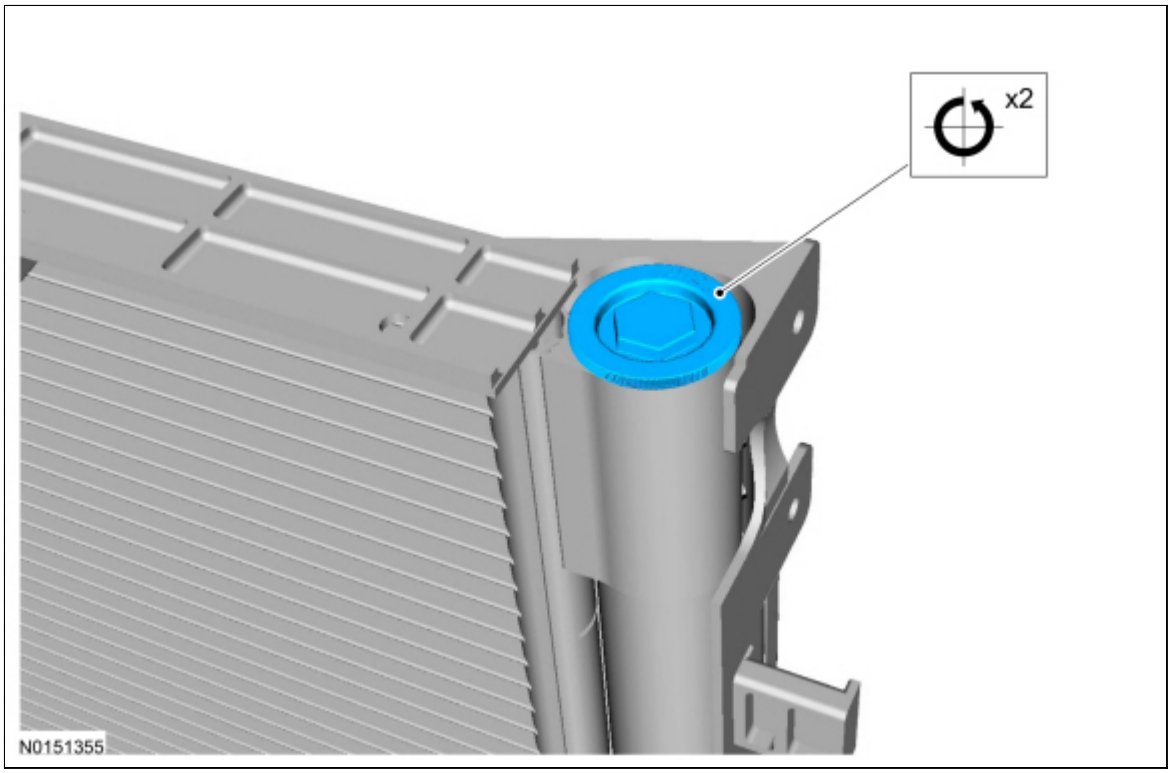
NOTE: Prior to using the A/C Flush and Purge Machine 357-405 80001 00 for the first time, review the operating instructions.

NOTE: Ford Motor Company has approved a procedure to provide technicians with a non-CFC method of flushing contaminated A/C system heat exchangers. The procedure allows the specific components to be cleaned and flushed. The types of contamination flushed include particle matter that results from A/C compressor or desiccant failure and gummy residue that can form when refrigerant oil is overheated during A/C compressor seizure. The flushing process is a 2-step procedure that involves the use of an A/C Flush and Purge Machine 357-405 80001 00 to:

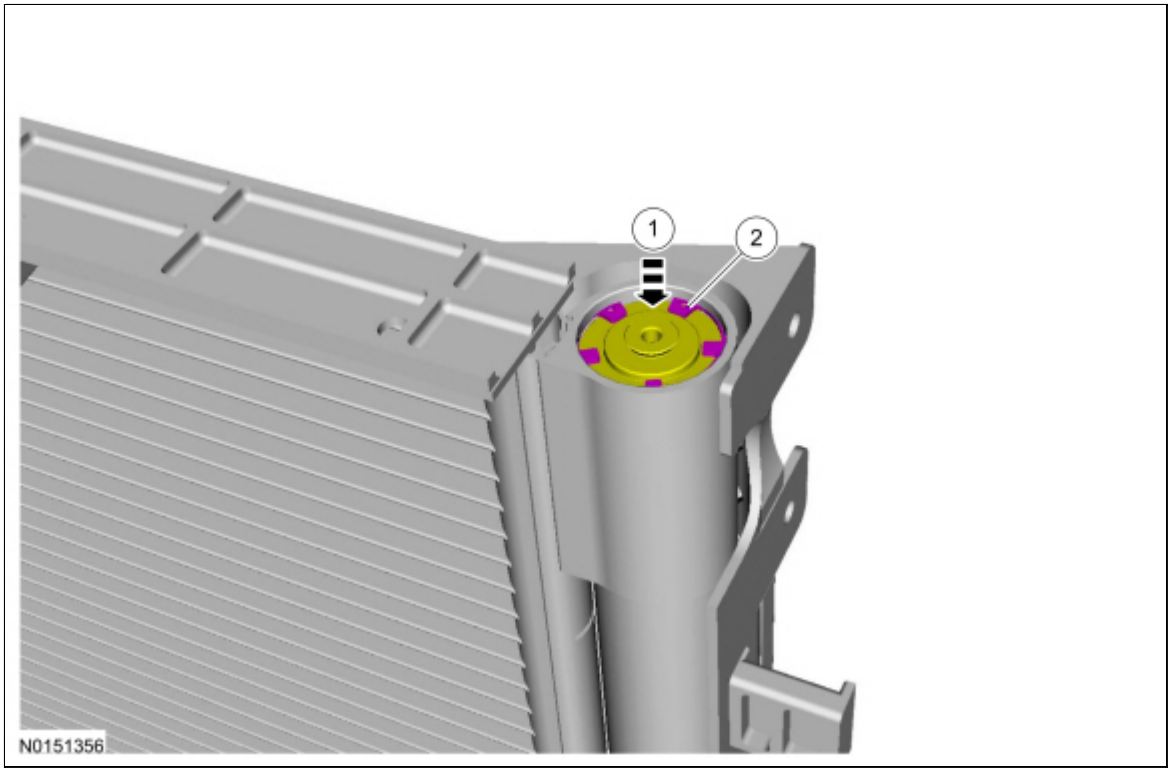
- circulate the flushing solvent through the heat exchanger in the reverse direction of normal refrigerant flow (back-flushing). Particulate matter picked up during flushing is filtered from the returning solvent before the solvent is returned to the reservoir for continued circulation.
- remove the flushing solvent from the heat exchanger. In this step of the procedure, pressurized air 621-862 kPa (90-125 psi) is used to push and evaporate any remaining flush solvent from the heat exchanger.

1. Remove the condenser core. For additional information, refer to Section 412-01 .
2. Remove the plastic receiver/drier cap.

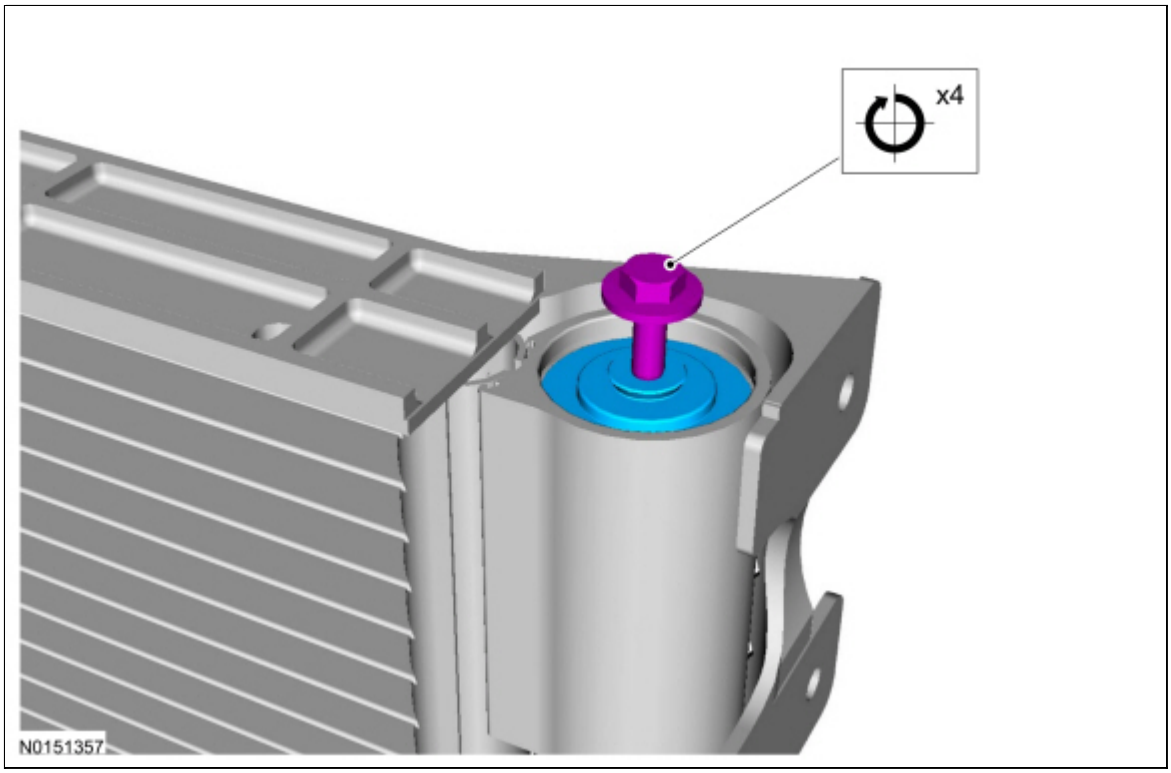
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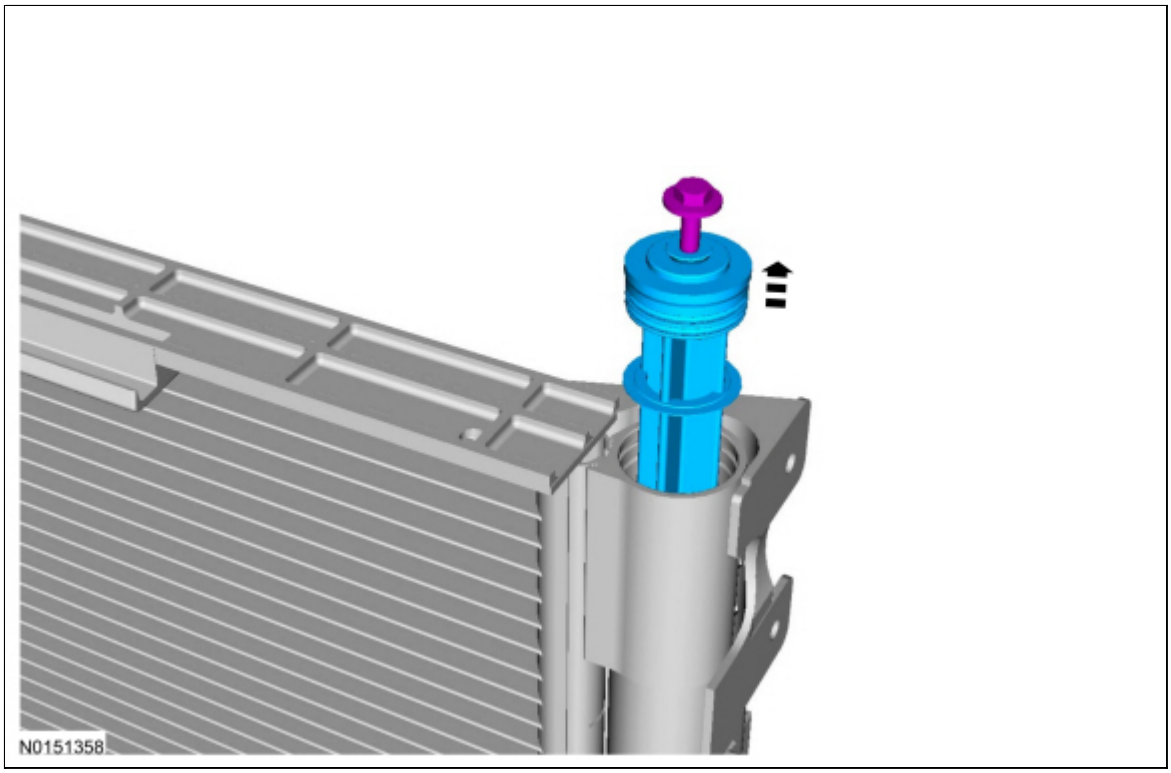
3. Remove the receiver/drier plug.
    1. Push the receiver/drier plug towards the top of the condenser.
    2. Remove the receiver/drier plug snap ring.



4. Install a M5 bolt in the center of the receiver/drier plug.



5. Remove the receiver/drier plug and the desiccant bag.



6. **NOTE:** Do not install a new receiver/drier at this time.

   With the receiver/drier removed, reinstall the receiver/drier plug and snap ring into the condenser

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core.

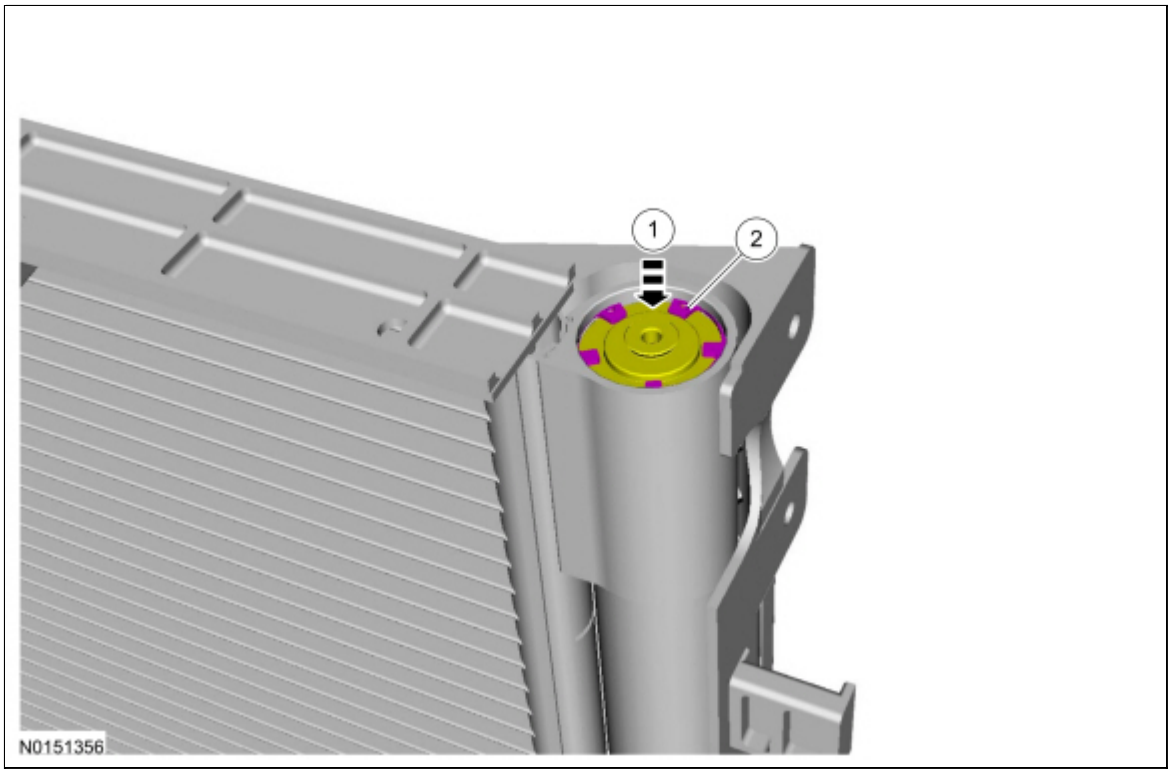
7. Connect the A/C Flush and Purge Machine to the condenser inlet and outlet fittings using the correct adapters from the A/C Flush Adapter Kit.

8. Flush the condenser core for a minimum of 15 minutes.

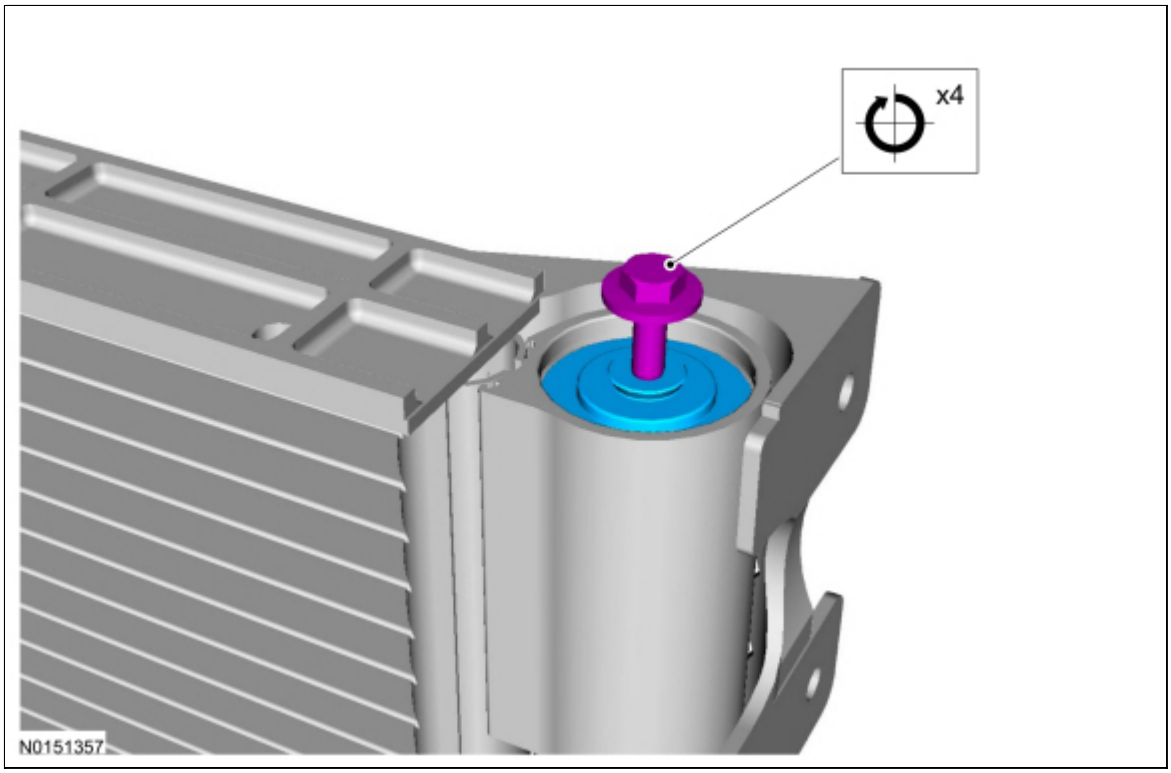
9. Turn the A/C Flush and Purge machine to the PURGE mode and run for a minimum of 30 minutes.

10. Disconnect the A/C Flush and Purge machine and adapters from the condenser core.

11. Remove the receiver/drier plug.
    1. Push the receiver/drier plug towards the top of the condenser.
    2. Remove the receiver/drier plug snap ring.



12. Install a M5 bolt in the center of the receiver/drier plug.



13. Install a new receiver/drier desiccant bag.

14. Install the new receiver/drier plug, snap ring and cap included in the receiver/drier cartridge service kit.

15. **NOTE:** Do not charge the refrigerant system after the condenser core is installed.

    Install the condenser core. For additional information, refer to Section 412-01 .

16. Remove the Thermostatic Expansion Valve (TXV). For additional information, refer to Section 412-01 .

17. Disconnect the evaporator inlet and outlet fittings.
    - Discard the O-ring seals.

18. Connect the A/C Flush and Purge Machine to the evaporator inlet and outlet fittings using the correct adapters from the A/C Flush and Purge Fitting Kit.

19. Flush the evaporator core for a minimum of 15 minutes.

20. Turn the A/C Flush and Purge Machine to the PURGE mode and run for a minimum of 30 minutes.

21. Disconnect the A/C Flush and Purge Machine and adapters from the evaporator core.

22. Install new O-ring seals and connect the front evaporator inlet and outlet fittings.

23. Install a new front TXV and new TXV gaskets. For additional information, refer to Section 412-01 .

24. **NOTE:** It is necessary to evacuate the refrigerant system for a minimum of one hour to evaporate any traces of flush solvent that may remain in the system.

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Evacuate the refrigerant system for one hour. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

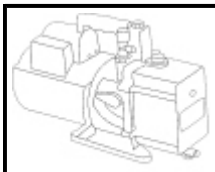
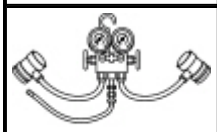
25. If a new A/C compressor is to be installed, install the new A/C compressor. For additional information, refer to Section 412-01 .

26. If a new A/C compressor is not to be installed, add the correct amount of refrigerant oil to the A/C compressor in the following sequence.
    1. Remove the A/C compressor. For additional information, refer to Section 412-01 .
    2. Drain the PAG oil and refill following the Refrigerant Oil Adding in this section.
    3. Reinstall the A/C compressor. For additional information, refer to Section 412-01 .

27. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Air Conditioning (A/C) System Recovery, Evacuation and Charging

Special Tool(s)

 ST1686-A	6.0 CFM Vacuum Pump 300-MSC90066-AE or equivalent
 ST2742-A	Automatic Refrigerant Charging Meter 265-68803 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 265-41339 or equivalent
 ST3079A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 023-34788-H or equivalent
 ST3081-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 199-CCST388 or equivalent
 ST3080-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 265-37830 or equivalent

Material

Item	Specification
Motorcraft® PAG Refrigerant	WSH-M1C231-

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Compressor Oil YN-12-D	B

Refrigerant System Recovery

NOTICE: **An Air Conditioning (A/C) refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer procedures and instructions.**

NOTE: Ford Motor Company recommends the use of R-134a refrigerant management equipment that meets the requirements of the SAE J2788 standard.

1. Prior to recovering, the purity of the refrigerant must be verified. For additional information, refer to Refrigerant Identification Testing in this section.
2. Connect a R-134a Refrigerant Management Machine to the low- and high-pressure service gauge port valves following the operating instructions provided by the equipment manufacturer.
3. Recover the refrigerant from the system following the operating instructions provided by the equipment manufacturer. Note the amount of oil removed during the refrigerant recovery (if any). Add that same amount back into the system once repairs are complete.
4. Once the R-134a Refrigerant Management Machine has recovered the refrigerant, switch OFF the power supply.
5. Allow the system to set for about 2 minutes, and observe the system vacuum reading. If the vacuum is not lost, disconnect the recovery equipment.
6. If the system does lose vacuum, repeat Steps 3 through 5 until the vacuum level remains stable for 2 minutes.
7. Carry out the required repairs.

Refrigerant System Evacuation Using a R-134a Refrigerant Management Machine

1. Connect a R-134a Refrigerant Management Machine to the low- and high-pressure service gauge port valves following the operating instructions provided by the equipment manufacturer.
2. Evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the Vacuum Pump for a minimum of 45 minutes.
3. Turn OFF the Vacuum Pump. Observe the low-pressure gauge for 5 minutes to make sure that the system vacuum is held.

Refrigerant System Evacuation Using a R-134a Manifold Gauge Set and Vacuum Pump

NOTE: Leaks in refrigerant system service equipment, hoses or gauges can cause a leak in vacuum that may be misinterpreted as a problem with the vehicle's refrigerant system. It is necessary to leak-test all refrigerant system service equipment, hoses and gauges on a weekly basis to verify that no leaks are present.

1. Connect the R-134a Manifold Gauge Set to the low-side and high-side service gauge port valves.
2. Connect the center (yellow) hose from the R-134a Manifold Gauge Set to the suction port on the Vacuum Pump.
3. Open all valves on the R-134a Manifold Gauge Set and both service gauge port valves.
4. Turn on the Vacuum Pump and evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the Vacuum Pump for a minimum of 45 minutes.
5. Close the high-side and low-side valves on the R-134a Manifold Gauge Set (not the service gauge port valves) and turn OFF the Vacuum Pump.
6. Observe the low-pressure gauge for 5 minutes to make sure that the system vacuum is held. If vacuum is not held for 5 minutes, leak test the system, repair the leak and evacuate the system again.

Refrigerant System Charging Using a R-134a Refrigerant Management Machine

1. Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Refrigerant Oil Adding in this section.
2. Connect a R-134a Refrigerant Management Machine to the low-side and high-side service gauge port valves following the operating instructions provided by the equipment manufacturer.
3. Set the refrigerant charge amount, and charge the refrigerant system following the instructions provided by the equipment manufacturer.

Refrigerant System Charging Using a R-134a Manifold Gauge Set and Automatic Refrigerant Charging Meter

NOTE: Ford Motor Company recommends use of a R-134a Refrigerant Management Machine to carry out charging of the refrigerant system. If a R-134a Refrigerant Management Machine is not available, refrigerant system charging may be accomplished using a separate Automatic Refrigerant Charging Meter and R-134a Manifold Gauge Set.

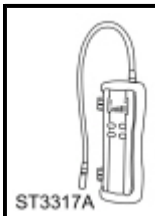
1. Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Refrigerant Oil Adding in this section.
2. Assemble the R-134a Manifold Gauge Set, Automatic Refrigerant Charging Meter and R-134a supply tank following the Automatic Refrigerant Charging Meter operating instructions.
3. Charge the refrigerant system following the Automatic Refrigerant Charging Meter operating instructions.

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4. If the refrigerant flow stops before the refrigerant charge is complete, start the engine, select MAX A/C operation and allow the refrigerant charge to complete.

Electronic Leak Detection

Special Tool(s)

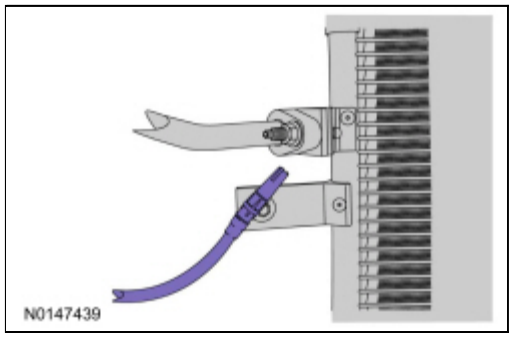
 ST3317A	Infrared Refrigerant Leak Detector (SAE J-2791 Compliant) 023-22791 or equivalent
 ST3316A	Dual Mode Refrigerant Gas and UV Dye Leak Detector (SAE J-2791 Compliant) 339-D440A-UV or equivalent

NOTE: Good ventilation is necessary in the area where electronic A/C leak testing is to be carried out. If the surrounding air is contaminated with refrigerant gas, the Heated Pentode Halogen Leak Detector will indicate this gas all the time. Odors from other chemicals such as antifreeze, diesel fuel, disc brake cleaner or other cleaning solvents can cause the same problem. Using a fan to ventilate the area to be tested before proceeding with the leak detection procedure is helpful in removing small traces of contamination from the air, but the fan should be turned off during actual testing.

NOTE: R-134a is heavier than air, and will tend to move downward from the source of the leak if present. It is possible that a leak may not be detected if the leak detector tip is held above the leaking fitting, line or component. Always be sure to thoroughly leak test below the fitting, line or component for the presence of R-134a as well as leak testing above and around.

1. **NOTE:** The system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off and cool. The pressure reading may be higher if the engine is hot.

   Leak test the refrigerant system using the Heated Pentode Halogen Leak Detector. Follow the instructions included with the Heated Pentode Halogen Leak Detector for handling and operation techniques.


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Fluorescent Dye Leak Detection

Special Tool(s)

 ST3073-A	Cordless/Rechargeable True UV LED Light ES 023-16345 or equivalent
 ST3057-A	R-134a Loop/Add On Injector Kit-Set 219-703710 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 265-41339 or equivalent
 ST3079A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 023-34788-H or equivalent
 ST3081-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 199-CCST388 or equivalent
 ST3080-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 265-37830 or equivalent

Material

Item	Specification
Stay-Brite® R-134a Leak Detection	—

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Dye 164-R6060 (Rotunda)	

Fluorescent Dye Injection Using a R-134a Refrigerant Management Machine and Dye Injector — Vehicles Requiring R-134a Addition

NOTE: This method of fluorescent dye injection requires the addition of R-134a from a R-134a Refrigerant Management Machine or R-134a Manifold Gauge Set hooked to an external tank to charge the dye into the refrigerant system. If adding fluorescent dye to a refrigerant system that is already fully charged, the R-134a Loop/Add On Injector Kit-Set method should be used.

NOTE: Fluorescent refrigerant system dye is added to the refrigerant system at the factory to assist in refrigerant system leak diagnosis using a Rotunda-approved UV blacklight. It is not necessary to add additional dye to the refrigerant system before diagnosing leaks, even if a significant amount of refrigerant has been removed from the system. Replacement suction accumulators and receiver/driers are shipped with a fluorescent dye "wafer" included in the desiccant bag which will dissolve after approximately 30 minutes of continued A/C operation. It is not necessary to add dye after flushing or filtering the refrigerant system because a new suction accumulator or receiver/drier is installed as part of the flushing or filtering procedure. Additional refrigerant system dye should only be added if more than 50% of the refrigerant system lubricant capacity has been lost due to a fitting separation, hose rupture or other damage.

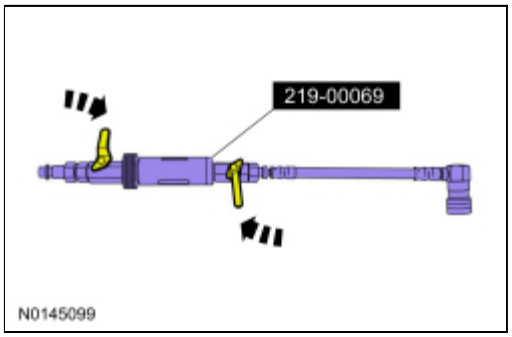
NOTE: Before using the R-134a Loop/Add On Injector Kit-Set for the first time, refer to the manufacturer's instructions on evacuation of any non-condensable gases from the hoses.

NOTE: Only connect the dye/lubricant injector from the R-134a Loop/Add On Injector Kit-Set when fluorescent dye is to be injected. The dye/lubricant injector has a one-way check valve that will prevent refrigerant system recovery and evacuation.

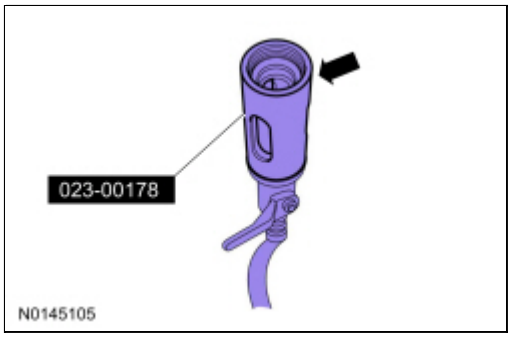
1. **NOTE:** If no R-134a pressure is present in the refrigerant system, the system should be evacuated before carrying out the injection procedure. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

   Connect a R-134a Refrigerant Management Machine or a R-134a Manifold Gauge Set to the refrigerant system service port valves.

2. Verify that the valves on the dye/lubricant injector from the R-134a Loop/Add On Injector Kit-Set are closed.



3. Fill the R-134a fluorescent dye injector reservoir with 7.4 ml (0.25 fl. oz.) of fluorescent dye.



4. Install the dye/lubricant injector between the low-pressure service gauge port valve and the R-134a Refrigerant Management Machine or R-134a Manifold Gauge Set.

5. **NOTE:** Following fluorescent dye injection, the refrigerant system should be fully charged to make sure of correct movement of the dye.

   Open all valves and inject the fluorescent dye into the refrigerant system by charging the refrigerant system with the required amount of R-134a.

6. When fluorescent dye injection is complete, close all valves.

7. Recover the refrigerant from the dye/lubricant injector.

8. Remove the dye/lubricant injector from the low-pressure service gauge port valve and the R-134a Refrigerant Management Machine or R-134a Manifold Gauge Set.

Fluorescent Dye Injection Using a R-134a Loop/Add On Injector Kit-Set — Vehicles Not Requiring R-134a Addition

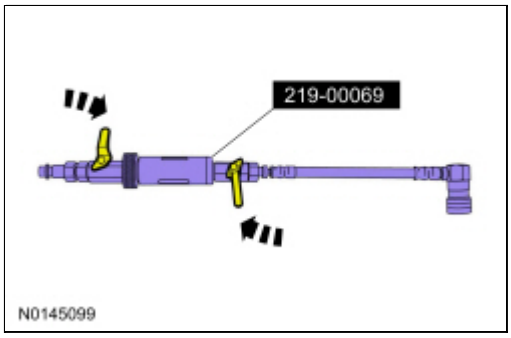
NOTE: Fluorescent refrigerant system dye is added to the refrigerant system at the factory to assist in refrigerant system leak diagnosis using a Rotunda-approved UV blacklight. It is not necessary to add additional dye to the refrigerant system before diagnosing leaks, even if a significant amount of refrigerant has been removed from the system. Replacement suction accumulators and receiver/driers are shipped with a fluorescent dye "wafer" included in the desiccant bag which will dissolve after approximately 30 minutes of continued A/C operation. It is not necessary to add dye after flushing or filtering the refrigerant system because a new suction accumulator or receiver/drier is installed as part of the flushing or filtering procedure. Additional refrigerant system dye should only be added if more than 50% of the refrigerant system lubricant capacity has been lost due to a fitting separation, hose rupture or other damage.

NOTE: Before using the R-134a Loop/Add On Injector Kit-Set for the first time, refer to the equipment manufacturer's instructions on evacuation of non-condensable gases from the hoses.

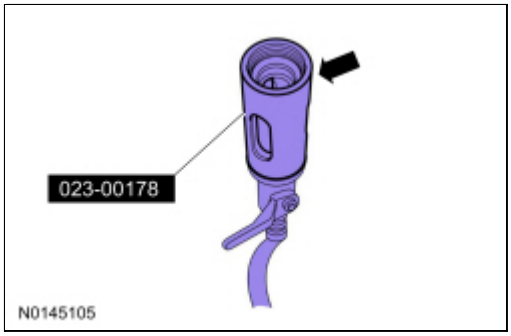
NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off and cool.

1. Verify that the valves on the R-134a Loop/Add On Injector Kit-Set are closed.

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2. Fill the R-134a Loop/Add On Injector Kit-Set reservoir with 7.4 ml (0.25 fl. oz.) of fluorescent dye.



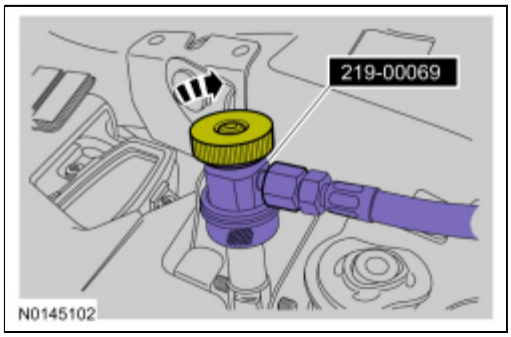
3. Install the R-134a Loop/Add On Injector Kit-Set between the high-pressure and low-pressure service gauge port valves.

4. ***NOTICE:*** **Make sure all tools and hoses are clear of the engine cooling fan and drive belt before starting the engine. Failure to keep tools and hoses clear from the engine cooling fan and drive belt will result in damage to the tools and/or vehicle.**

   With the A/C off, start the engine. Allow engine speed to stabilize below 1,000 rpm.

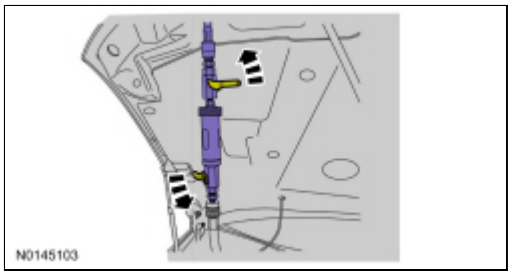
5. Set the A/C to the ON position.

6. Open the high-pressure service valve.

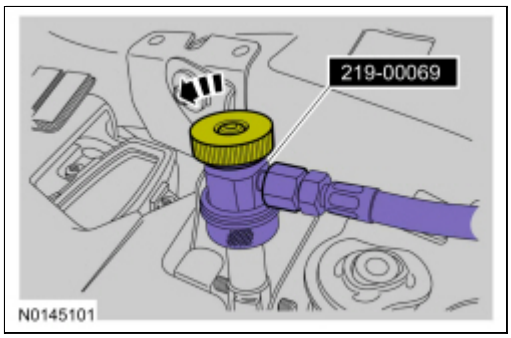


7. **NOTE:** To prevent pressure spike/liquid slug, crack the R-134a Loop/Add On Injector Kit-Set valves and slowly open to inject the fluorescent dye into the refrigerant system.

   Open the R-134a Loop/Add On Injector Kit-Set valves and inject the fluorescent dye into the refrigerant system.

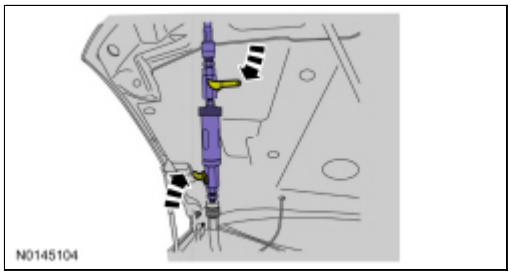


8. Close the high-pressure service valve to allow the pressure inside the R-134a Loop/Add On Injector Kit-Set to equalize with the suction side of the refrigerant system.



9. **NOTE:** Close the valves on the R-134a Loop/Add On Injector Kit-Set while the A/C compressor is operating.

   Close the valves on the R-134a Loop/Add On Injector Kit-Set.



10. **NOTE:** Leave all valves on the R-134a Loop/Add On Injector Kit-Set closed when not in use.

    Disconnect the high-pressure and low-pressure service valves and remove the R-134a Loop/Add On Injector Kit-Set from the vehicle.

Fluorescent Dye Detection

NOTE: Ford Motor Company vehicles are produced with R-134a fluorescent dye installed in the refrigerant system from the factory. The location of leaks can be pinpointed by the bright yellow-green glow of the fluorescent dye under a UV lamp. Since more than one leak can exist, make sure to inspect each component, line and fitting in the refrigerant system for a leak.

NOTE: Use of dye-enhancing glasses or goggles greatly improves the detection of the dye under the UV lamp.

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NOTE: Not all UV lamps will fluoresce the dye used in Ford vehicles. All Rotunda UV lamps are optimized to fluoresce the dye.

1. Check for leaks using a Rotunda-approved UV lamp and dye enhancing glasses.
    - Inspect all components, lines and fittings of the refrigerant system.

2. After the leak(s) is repaired, remove any traces of fluorescent dye with a general purpose oil solvent.

3. Verify the repair by running the vehicle for a short period of time and rechecking the area of the leak with a Rotunda-approved UV lamp.

Refrigerant Identification Testing

Special Tool(s)

 ST3090-A	Refrigerant Blend Identifier with Printer 023-16910 or equivalent

Refrigerant Identification

1. **NOTE:** A Refrigerant Blend Identifier with Printer must be used to identify gas samples taken directly from the refrigeration system or storage containers prior to recovering or charging the refrigerant system.

   Follow the instructions included with the Refrigerant Blend Identifier with Printer to obtain the sample for testing.

2. The Refrigerant Blend Identifier with Printer will display one of the following:
   - If the purity level of R-134a is 98% or greater by weight, the green PASS LED will light. The weight concentrations of R-134a, R-12, R-22, hydrocarbons and air will be displayed on the digital display.
   - If refrigerant R-134a does not meet the 98% purity level, the red FAIL LED will light and an alarm will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22 and hydrocarbons will be displayed on the digital display.
   - If hydrocarbon concentrations are 2% or greater by weight, the red FAIL LED will light, "Hydrocarbon High" will be displayed on the digital display, and an alarm will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22 and hydrocarbons will also be displayed on the digital display.

3. The percentage of air contained in the sample will be displayed if the R-134a content is 98% or greater. The Refrigerant Blend Identifier with Printer eliminates the effect of air when determining the refrigerant sample content because air is not considered a contaminant, although air can affect A/C system performance. When the Refrigerant Blend Identifier with Printer has determined that a refrigerant source is pure (R-134a is 98% or greater by weight) and air concentration levels are 2% or greater by weight, it will prompt the user if an air purge is desired.

4. If contaminated refrigerant is detected, repeat the refrigerant identification test to verify that the refrigerant is indeed contaminated.

Contaminated Refrigerant Handling

NOTICE: **If contaminated refrigerant is detected, DO NOT recover the refrigerant into R-134a**

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recovery/recycling equipment. Recovery of contaminated refrigerant will contaminate the recovered refrigerant supply and may damage the recovery/recycling equipment.

NOTE: A new suction accumulator or receiver/drier must be installed as directed by the A/C system flushing procedure.

1. Recover the contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant only.
    - If this equipment is not available, contact an A/C service facility in the area with the correct equipment to carry out this service.

2. Determine and correct the cause of the customer's initial concern.

3. Flush the A/C system.

4. Dispose of the contaminated refrigerant in accordance with all federal, state and local regulations.

Refrigerant Oil Adding

Special Tool(s)

 ST3057-A	R-134a Loop/Add On Injector Kit-Set 219-703710 or equivalent

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

Refrigerant Oil Adding

NOTICE: **During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.**

1. Refer to the chart below for refrigerant oil adding amounts when new components are installed.

Component	PAG (polyalkylene glycol) Refrigerant Compressor Oil (YN-12-D) Oil Amount (fl oz (ml))	Method of Adding
After installing the A/C Compressor.	Service compressor contains full system charge of oil. Oil matching required plus amount collected during recovery.	Add directly to A/C compressor before installation
After installing the receiver/drier.	2 fl oz (60 ml) plus the amount collected during refrigerant recovery.	Inject to low-side service port during system charging.
After installing the receiver/drier element.	1 fl oz (30 ml) plus the amount collected during refrigerant recovery.	Inject to low-side service port during system charging.
After installing the condenser core.	1.5 fl oz (45 ml) plus the amount collected during refrigerant recovery.	Add directly to inlet port or inject to low-side service port during system charging.
After installing the condenser	2 fl oz (60 ml) plus the amount	Add directly to inlet port or

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core, and the receiver/drier element	collected during refrigerant recovery.	inject to low-side service port during system charging.
After installing the evaporator core.	1.5 fl oz (45 ml) plus the amount collected during refrigerant recovery.	Add directly to inlet port or inject to low-side service port during system charging.
After installing/reassembling the thermostatic expansion valve.	Amount collected during refrigerant recovery.	Inject to low-side service port during system charging.
After installing a refrigerant Hose/Line.	2 fl oz (60 ml) plus the amount collected during refrigerant recovery [a]	Inject to low-side service port during system charging.
After an O-ring Leak Repair.	1 fl oz (30 ml) plus the amount collected during refrigerant recovery [b]	Inject to low-side service port during system charging.
After a service port leak repair.	Amount collected during refrigerant recovery.	Inject to low-side service port during system charging.

[a] If an excessive amount of PAG (polyalkylene glycol) Refrigerant Compressor Oil YN-12-D is lost due to a hose rupture/separation or other damage, the total system PAG (polyalkylene glycol) Refrigerant Compressor Oil YN-12-D capacity must be added. Also, it is necessary to replace the receiver/drier.

[b] The amount specified may be used for one or multiple O-ring leak repairs. Do not multiply the PAG (polyalkylene glycol) Refrigerant Compressor Oil YN-12-D amount by the number of O-ring leaks being repaired.

Compressor Type(s)

NOTICE: **An A/C refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. Dispose of all contaminated A/C refrigerant as hazardous waste. For all equipment, follow the manufacturer's instructions.**

NOTICE: **Motorcraft® PAG A/C Compressor Oil YN-12-D only must be used as a refrigerant system lubricant. Addition of any oil other than Motorcraft® PAG A/C Compressor Oil YN-12-D to the refrigerant system will damage the A/C compressor and contaminate the refrigerant system.**

NOTICE: **During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.**

NOTICE: **Oil balance must be performed when replacing a compressor where system flush will not be performed.**

NOTE: The purpose of oil balance is to ensure that the amount of oil in the system is not increased or decreased as a result of the replacement component(s).

NOTE: New compressors come fully charged with Motorcraft® PAG A/C Compressor Oil YN-12-D. The old

compressor is only partially charged because some of the oil is elsewhere in the A/C system.

1. Verify location of the drain plug by compressor type. Once compressor type has been identified, procedure to appropriate compressor type below for compressor oil matching steps.

2. ***NOTICE:*** **Make sure the equipment is clean and free of foreign material.**

   NOTE: During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the PAG (polyalkylene glycol) oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

   Fill the system with the calculated quantity of new refrigerant oil in accordance with the A/C service unit manufacturer instructions.

Type 1: (IVDC) Internal Variable Displacement Air Conditioning (A/C) Compressor

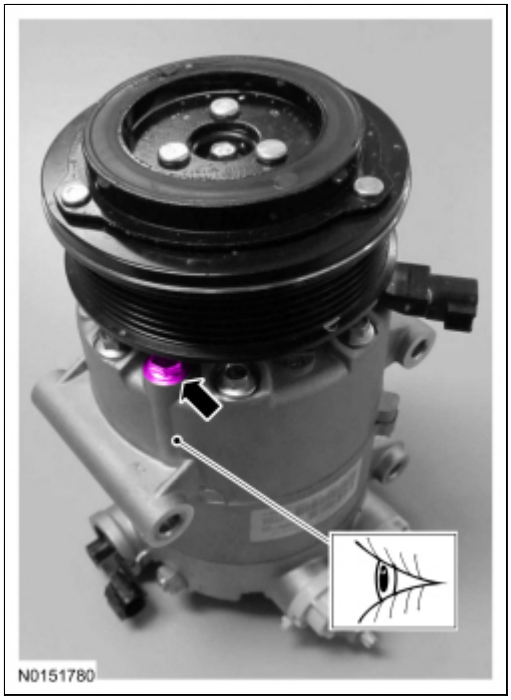
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Type 2: (EVDC) External Variable Displacement Air Conditioning (A/C) Compressor

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Type 3: (EVDC) External Variable Displacement Air Conditioning (A/C) Compressor

1.



Type 4: Fixed Air Conditioning (A/C) Compressor

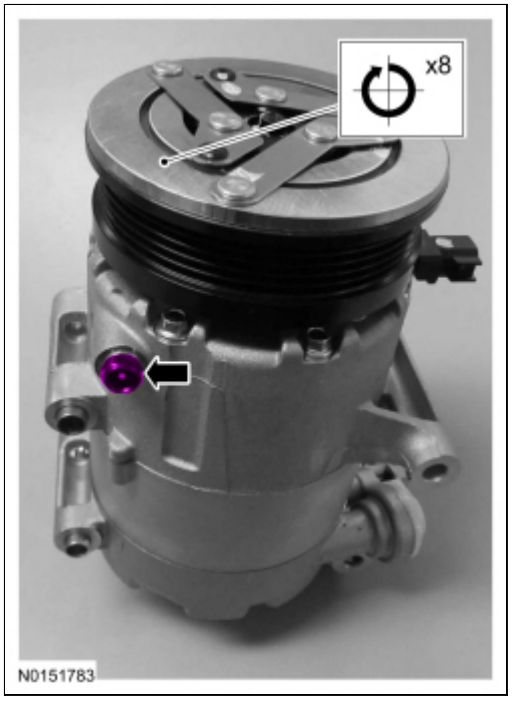
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Type 1

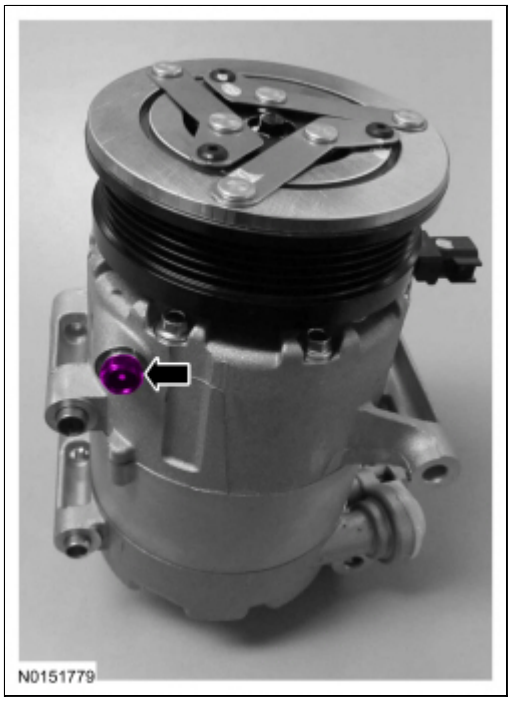
NOTICE: **Make sure the old A/C compressor shaft is rotating and not just the A/C pulley.**

1. Remove the oil drain bolt and rotate the old A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device.



2. Install the oil drain bolt in the old A/C compressor.
    - To install, tighten to 20 Nm (177 lb-in).

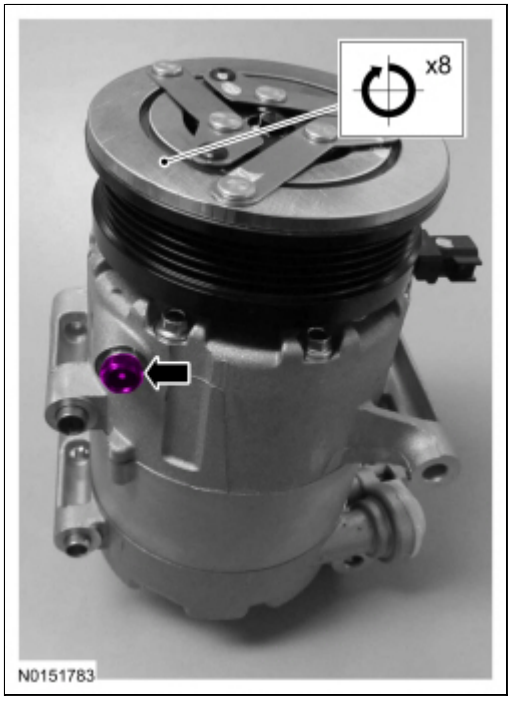
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3. Remove the suction and discharge port seal cap from the new A/C compressor.

4. ***NOTICE:*** **Make sure the new A/C compressor shaft is rotating and not just the A/C pulley.**

   Remove the drain bolt and rotate the new A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device.



5. Measure the amount of oil drained for the old A/C compressor and add the same amount of new oil to the new A/C compressor.

6. Install the oil drain bolt in the new A/C compressor.
    - To install, tighten to 20 Nm (177 lb-in).



7. Install the suction and discharge port seal cap from the new A/C compressor.

Type 2

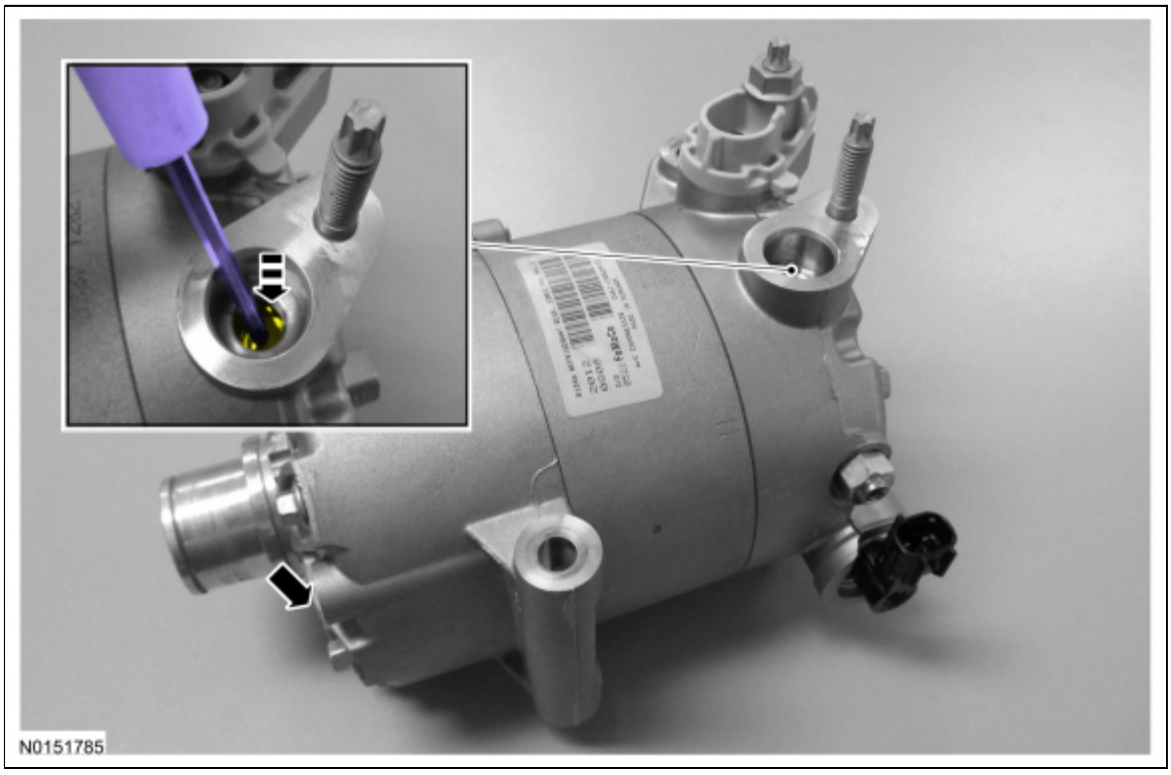
1. Remove the A/C Clutch and A/C Clutch Field Coil from the old A/C compressor. For additional Information, refer to Section 412-01 .

2. Remove the oil drain bolt from the old A/C compressor.

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3. Depress the suction damper to allow proper ventilation while draining oil from the old A/C compressor.



4. Drain as much oil from the old A/C compressor.

5. Install the oil drain bolt in the old A/C compressor.
    - To install, tighten to 9 Nm (80 lb-in).



6. Remove the A/C Clutch and A/C Clutch Field Coil from the new A/C compressor. For additional information, refer to Section 412-01 .

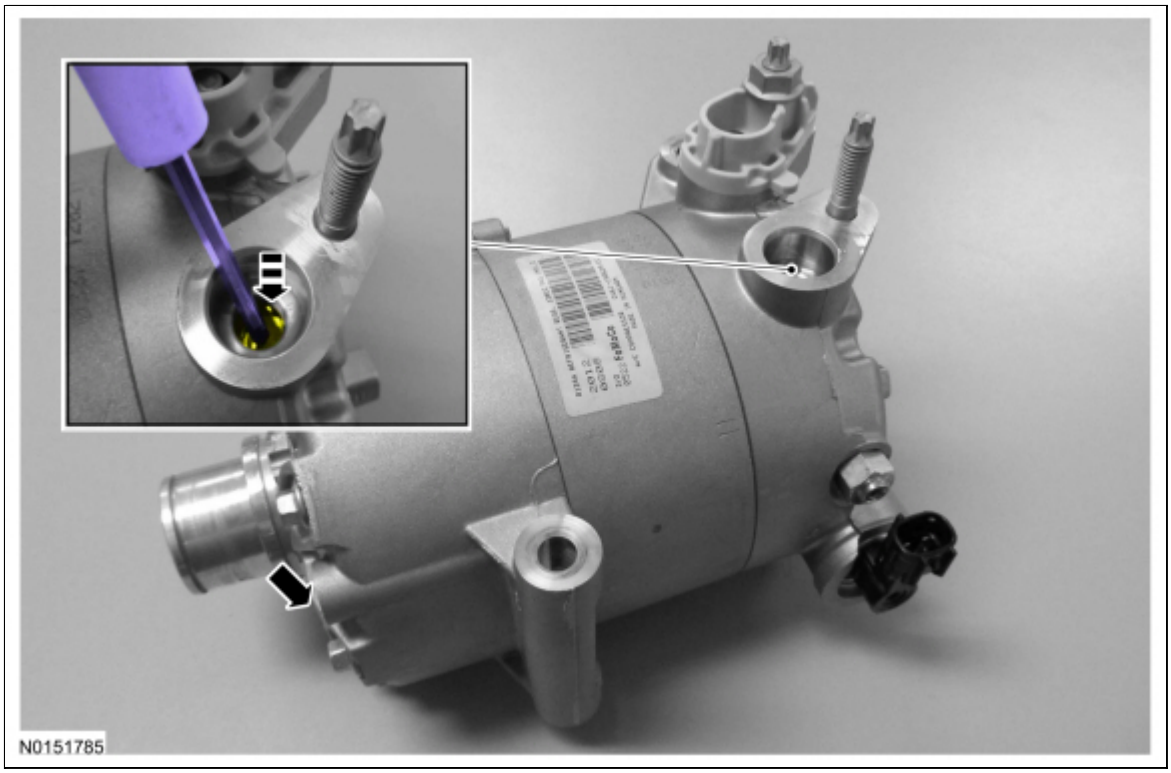
7. Remove the oil drain bolt from the new A/C compressor.



8. Remove the suction port seal cap.

9. Depress the suction damper to allow proper ventilation while draining oil from the old A/C compressor.

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10. Drain as much oil from the new A/C compressor.

11. Measure the amount of oil drained for the old A/C compressor and add the same amount of new oil to the new A/C compressor.

12. Install the oil drain bolt in the new A/C compressor.
    - To install, tighten to 9 Nm (80 lb-in).



13. Install the suction port seal cap.

14. Install the A/C Clutch and A/C Clutch Field Coil on the new A/C compressor. For additional information, refer to Section 412-01 .

Type 3

NOTICE: **Make sure the old A/C compressor shaft is rotating and not just the A/C pulley.**

1. Remove the oil drain bolt and rotate the old A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device.



2. Install the oil drain bolt in the old A/C compressor.
    - To install, tighten to 30 Nm (22 lb-ft).

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3. Remove the suction and discharge port seal cap from the new A/C compressor.

4. ***NOTICE:*** **Make sure the new A/C compressor shaft is rotating and not just the A/C pulley.**

   Remove the drain bolt and rotate the new A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device.



5. Install the oil drain bolt in the old A/C compressor.
   - To install, tighten to 30 Nm (22 lb-ft).



6. Remove the suction and discharge port seal cap from the new A/C compressor

7. ***NOTICE:*** **Make sure the new A/C compressor shaft is rotating and not just the A/C pulley.**

   Remove the drain bolt and rotate the new A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device



8. Measure the amount of oil drained for the old A/C compressor and add the same amount of new oil to the new A/C compressor.

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9. Install the oil drain bolt in the new A/C compressor.
    - To install, tighten to 30 Nm (22 lb-ft).



10. Install the suction and discharge port seal cap on the new A/C compressor.

Type 4

NOTICE: **Make sure the old A/C compressor shaft is rotating and not just the A/C pulley.**

1. Rotate the old A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device from the A/C compressor discharge port.



2. Remove the suction and discharge port seal cap from the new A/C compressor.

3. ***NOTICE:*** **Make sure the new A/C compressor shaft is rotating and not just the A/C pulley.**

   Rotate the new A/C compressor clutch 6 to 8 revolutions while collecting oil in a clean measuring device from the A/C compressor discharge port.



4. Measure the amount of oil drained for the old A/C compressor and add the same amount of new oil to the new A/C compressor.

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5. Install the suction and discharge port seal cap on the new A/C compressor.

Oil Injection Using a Dye/Lubricant Injector

NOTE: Fluorescent refrigerant system dye is added to the refrigerant system at the factory to assist in refrigerant system leak diagnosis using a Rotunda-approved UV black light. It is not necessary to add additional dye to the refrigerant system before diagnosing leaks, even if a significant amount of refrigerant has been removed from the system. Replacement suction accumulators and receiver/driers are shipped with a fluorescent dye wafer included in the desiccant bag which dissolves after approximately 30 minutes of continuous A/C operation. It is not necessary to add dye after flushing the refrigerant system because a new suction accumulator or receiver/drier is installed as part of the flushing procedure. Replace hose/accumulator, receiver/drier or receiver/drier element.

NOTE: The dye/lubricant injector is included as part of the 219-00069 R-134a Loop/Add On Injector Kit-Set.

NOTE: Before using the R-134a Loop/Add On Injector Kit-Set for the first time, refer to the equipment manufacturer's instructions on evacuation of non-condensable gases from the hoses.

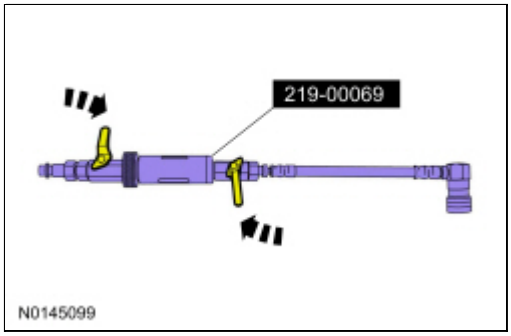
NOTE: If fluorescent leak detection dye is also to be added during A/C charging, the dye may be added to the dye/lubricant injector along with the refrigerant oil.

NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24° C (75° F) with the engine off and cool.

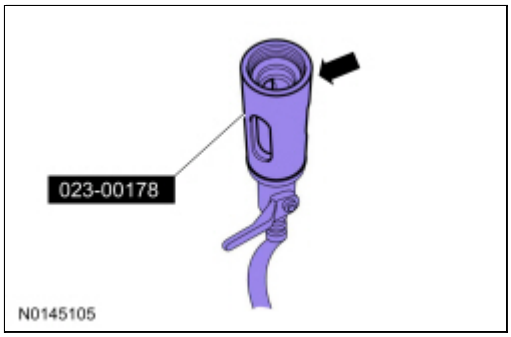
1. Evacuate the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

2. Assemble the dye/lubricant injector using the correct adapters to match the amount of refrigerant compressor oil to be injected.

3. Verify that all the valves on the dye/lubricant injector are closed.



4. Fill the dye/lubricant injector with the correct amount of clean, new PAG (polyalkylene glycol) oil.



5. Install the dye/lubricant injector between the low-side service gauge port valve and the refrigerant service station or manifold gauge set.

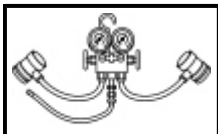
6. **NOTE:** Make sure all tools and hoses are clear of the engine cooling fan and drive belt before starting the engine. Failure to keep tools and hoses clear from the engine cooling fan and drive belt results in damage to the tools and/or vehicle.

   Open all valves and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

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Refrigerant System Tests

Special Tool(s)

 ST1928-A	R-134a Manifold Gauge Set 265-41339 or equivalent
 ST3079A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 023-34788-H or equivalent
 ST3081-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 199-CCST388 or equivalent
 ST3080-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 265-37830 or equivalent

Procedure 1 — Ambient Temperature at or Below 38°C (100°F)

NOTE: The system performance can be evaluated and diagnosed by analysis of the compressor suction and discharge pressures. The following procedure is used to determine if the system is operating at normal pressures.

NOTE: The procedure varies depending on the ambient (shop) temperature. If the ambient temperature is 38°C (100°F) or lower, follow Procedure 1. If the ambient temperature is over 38°C (100°F), follow Procedure 2.

NOTE: If the A/C compressor cycles at any time during this test, refer to the diagnostic table.

1. Drive the vehicle or run the engine until it reaches normal operating temperature.

2. Connect a R-134a Manifold Gauge Set or R-134a Refrigerant Management Machine with high-pressure and low-pressure gauges to the refrigerant system.

3. Set the climate controls.
    - If equipped with manual climate control, set the A/C controls for normal A/C-PANEL mode, full COOL temperature, FRESH air, HI blower. If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.
    - If equipped with Electronic Automatic Temperature Control (EATC), set temperature to 15°C (60°F) (lowest possible temperature setting) with the dual function disabled (if equipped). Manually set blower on HI. If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.
    - If the vehicle is equipped with auxiliary climate control, set the auxiliary controls to full COOL in the PANEL mode at HI blower speed.

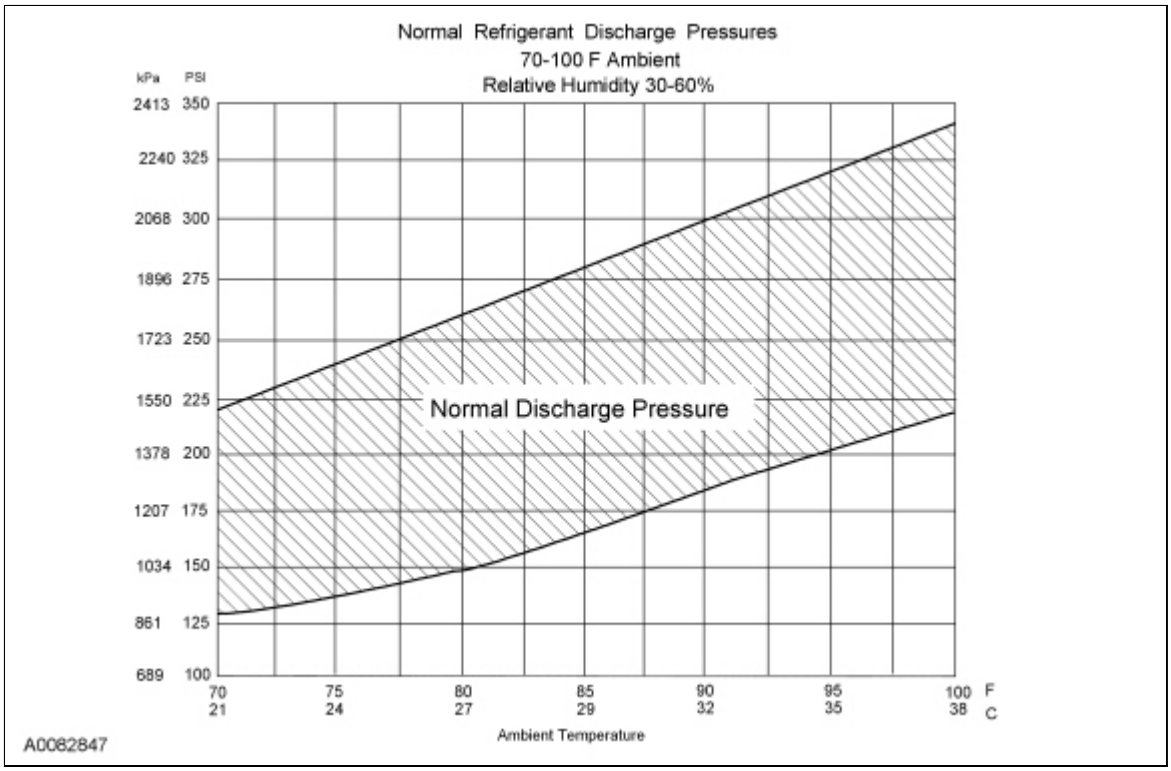
4. Open all vehicle windows and leave the hood open for the test. Open the rear hatch and/or rear doors (if equipped).

5. Confirm the compressor clutch is engaged and the engine cooling fan(s) are operating or engaged. Allow the vehicle to idle until the suction (low-side) and discharge (high-side) pressures are stable or fluctuate in a range that repeats.

6. Record the ambient (shop) temperature.

7. Record the discharge pressure. If the pressure is fluctuating, record the average value.

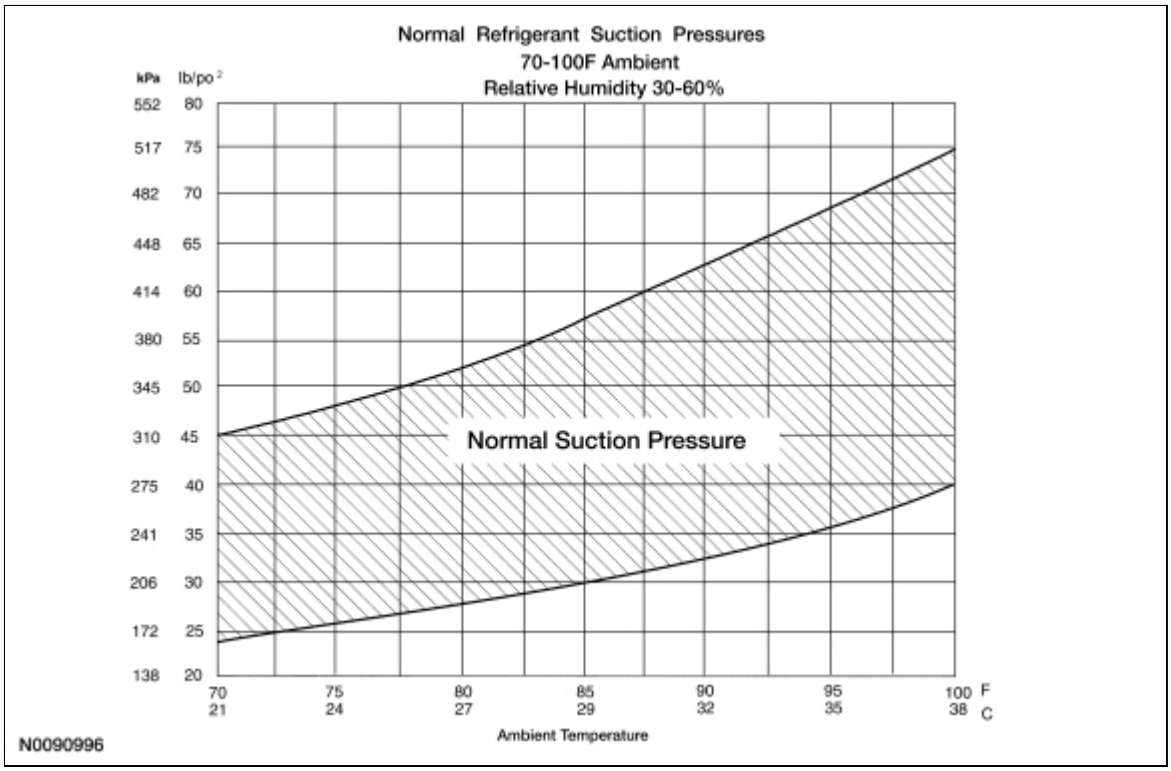
8. Determine if the discharge pressure falls within the normal operating limits using the Normal Refrigerant Discharge Pressures chart.



9. Record the suction pressure. If the pressure is fluctuating, record the average value.

10. Determine if the suction pressure falls between normal operating limits using the Normal Refrigerant Suction Pressures chart.

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11. Proceed to the Diagnostic Table.

Procedure 2 — Ambient Temperature Above 38°C (100°F)

NOTE: The system performance can be evaluated and diagnosed by analysis of the compressor suction and discharge pressures. The following procedure is used to determine if the system is operating at normal pressures.

NOTE: The procedure varies depending on the ambient (shop) temperature. If the ambient temperature is 38°C (100°F) or lower, follow Procedure 1. If the ambient temperature is over 38°C (100°F), follow Procedure 2.

1. Drive the vehicle or run the engine until it reaches normal operating temperature.

2. Connect a R-134a Manifold Gauge Set or R-134a Refrigerant Management Machine with high-pressure and low-pressure gauges to the refrigerant system.

3. Set the climate controls.
   - If equipped with manual climate control, set the A/C controls for normal A/C-PANEL mode, full COOL temperature, FRESH air, MED-LO blower. If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.
   - If equipped with EATC , set temperature to 15°C (60°F) (lowest possible temperature setting). Manually set blower to MED-LO (3 to 4 bars). If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.
   - If the vehicle is equipped with auxiliary climate control, set the auxiliary controls to full COOL in the PANEL mode at MED-LO blower speed.

4. Open all vehicle windows and leave the hood open for the test. Open the rear hatch and/or rear doors

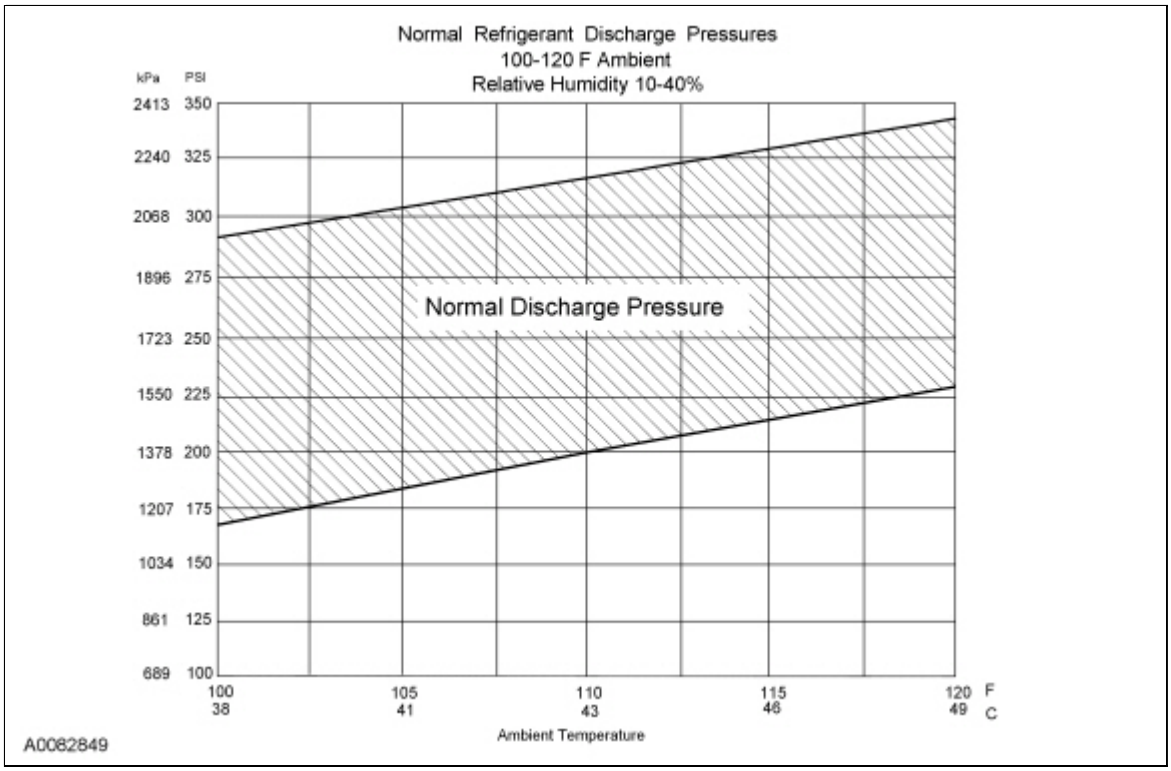
(if equipped).

5. Confirm the compressor clutch is engaged and the engine cooling fan(s) are operating or engaged. Allow the vehicle to idle until the suction (low-side) and discharge (high-side) pressures are stable or fluctuate in a range that repeats.

6. Record the ambient (shop) temperature.

7. Record the discharge pressure. If the pressure is fluctuating, record the average value.

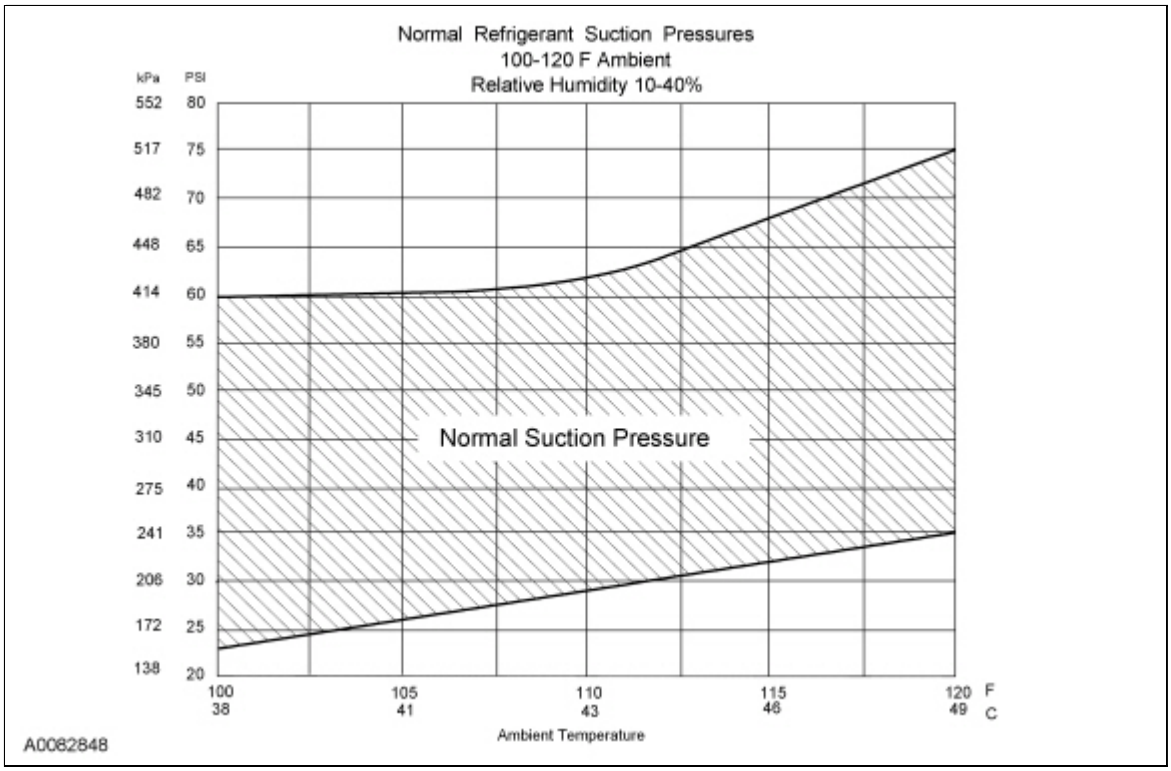
8. Determine if the discharge pressure falls within the normal operating limits using the Normal Refrigerant Discharge Pressures chart.



9. Record the suction pressure. If the pressure is fluctuating, record the average value.

10. Determine if the suction pressure falls between normal operating limits using the Normal Refrigerant Suction Pressures chart.

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11. Proceed to the diagnostic table.

Diagnostic Table

1. **NOTE:** The following table is used to guide diagnosis of the refrigerant system if operating pressures are outside normal limits.

   Refer to the chart below.

High (Discharge) Pressure	Low (Suction) Pressure	Component — Causes
High or Clutch Cycling	High	Condenser — inadequate airflow.
High	Normal to High	Engine — overheating.
Normal to High	Normal	Refrigerant overcharge — air in refrigerant.
Normal to Low	High	TXV not operating correctly.
Normal to Low	Normal to High	A/C suction line — partially restricted or plugged. [a]
Normal to Low	Low or Clutch Cycling	Low refrigerant charge, A/C suction line — partially restricted or plugged A/C cycling switch — sticking closed (if equipped). [b]
Erratic Operation or Compressor Not Running		A/C cycling switch — poor connection at A/C clutch connector or clutch cycling switch connector. A/C electrical circuit erratic — see A/C Electrical Circuit Wiring Diagram.
Normal to Low	High	Compressor — low performance.

Additional Possible Cause Components Associated With Inadequate Compressor Operation
• Compressor Drive Belt — loose • Compressor Clutch — slipping • Clutch Coil Open — shorted, or loose mounting • Control Assembly Switch — dirty contacts or sticking open • Clutch Wiring Circuit — high resistance, open or blown fuse • Compressor Operation Interrupted by Engine Computer
Additional Possible Cause Components Associated With a Damaged Compressor
• Incorrect Clutch Air-gap • Suction Accumulator — refrigerant oil bleed hose plugged • Refrigerant Leaks

[a] Low pressure reading will be normal to high if pressure is taken at accumulator and if restriction is downstream of service access valve.

[b] Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.

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Material

Item	Specification	Fill Capacity
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B	6.2L (2v) Only 177 ml (6 fl oz) 3.5L GTDI, 3.7L or 5.0L (4v) 100 ml (3.4 fl oz)
Motorcraft® R-134a Refrigerant YN-19 (US); CYN-16-R (Canada)	WSH-M17B19-A	0.68 kg (24 oz) (1.5 lb)

General Specifications

Item	Specification
Magnetic Clutch	
Clutch air gap clearance	0.35-0.65 mm (0.014-0.026 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C clutch disc and hub bolt	14	—	124
A/C compressor discharge fitting nut	15	—	133
A/C compressor bolts	25	18	—
A/C compressor suction fitting nut	15	—	133
Air inlet duct bracket nut	7	—	62
Condenser inlet fitting bolt	20	—	177
Condenser outlet fitting nut	15	—	133
Evaporator-to-compressor suction line fitting nut	15	—	133
Fan shroud bolts	15	—	133
Ground cable nut	9	—	80
Heater core and evaporator core housing nuts	7	—	62
High-pressure Schrader-type valve	2.5	—	22
High-pressure service gauge port valve cap	0.8	—	7
Horn assembly bolt	10	—	89
Junction box bracket bolts	10	—	89
Low-pressure Schrader-type valve	1.8	—	16

Low-pressure service gauge port valve cap	0.8	—	7
Plenum chamber nut	7	—	62
Radiator bolts	15	—	133
Steering column cover reinforcement bolts	9	—	80
Thermostatic Expansion Valve (TXV) bolts	8	—	71
TXV manifold and tube bracket bolt	8	—	71
TXV fitting nut	15	—	133

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Air Conditioning

The A/C refrigerant system is a clutch cycling TXV type. The system components are the following:

- A/C compressor
- A/C condenser core
- A/C evaporator core
- Connecting refrigerant lines

The refrigeration system operation is controlled by the following:

- TXV
- Evaporator temperature sensor
- A/C compressor pressure relief valve
- A/C pressure transducer

The refrigerant system incorporates an A/C compressor controlled by the PCM through an A/C clutch relay. The HVAC module sends an A/C request signal over the MS-CAN to the BCM which relays the request over the HS-CAN to the PCM . An evaporator temperature sensor is used to disengage the A/C compressor clutch when the evaporator core temperature is slightly above the freezing point of water.

The PCM commands the A/C clutch relay to turn on the A/C compressor clutch if all of the following conditions are met:

- The HVAC module is set to a mode which provides an A/C request to the PCM via the IPC .
- The evaporator temperature sensor is reading an acceptable temperature.
- The A/C pressure transducer is not reading a pressure above 2,841 kPa (412 psi) in the high side of the refrigerant system.
- The A/C pressure transducer is not reading a pressure that is too low (indicating a low charge condition) in the high-pressure side of the refrigerant system.
- The engine coolant temperature is not excessively high.
- The PCM has not detected a WOT condition.

An A/C compressor pressure relief valve is installed in the A/C compressor to protect the refrigerant system against excessively high refrigerant pressures as a redundant backup to the A/C pressure transducer.

A/C Compressor and Clutch Assembly

NOTE: Internal A/C compressor components are not serviced separately. The A/C compressor is serviced only as an assembly. The clutch disc and hub, A/C compressor pulley and bearing and the clutch field coil are serviceable.

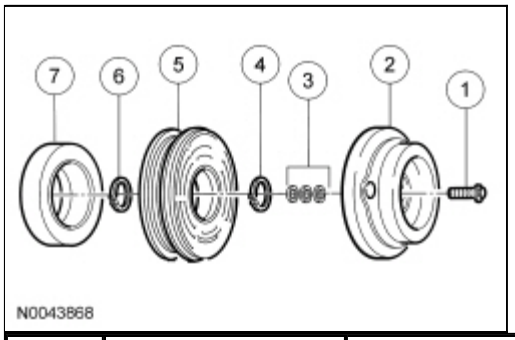
The A/C compressor uses the following:

- A non-serviceable shaft seal
- A pressure relief valve installed in the rear of the compressor to protect the refrigerant system against

excessively high refrigerant pressures as a redundant backup to the A/C pressure transducer
- PAG oil or equivalent. This oil contains special additives required for the A/C compressor

Use the refrigerant oil adding procedure specified for this vehicle when installing a new A/C compressor. Refer to Section 412-00 .

A/C Compressor Clutch Assembly



Item	Part Number	Description
1	W711887	A/C clutch disc and hub bolt
2	19D786	A/C clutch disc and hub
3	19N689	A/C clutch disc and hub spacer
4	N805338	A/C compressor pulley snap ring
5	19D784	A/C compressor pulley
6	W711883	A/C clutch field coil snap ring
7	19D798	A/C clutch field coil

The magnetic A/C clutch has the following characteristics:

- The A/C clutch drives the compressor shaft
- When battery positive voltage (B+) is applied to the A/C clutch field coil, the clutch disc and hub assembly is drawn toward the A/C clutch pulley
- The magnetic force locks the clutch disc and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate
- When B+ is removed from the A/C clutch field coil, springs in the clutch disc and hub assembly move the clutch disc away from the A/C clutch pulley

A/C Pressure Relief Valve

NOTE: If the A/C compressor is operating within limits and the A/C pressure relief valve is venting, or if the A/C pressure relief valve is leaking around the threads, replace the A/C pressure relief valve and O-ring seal. If the A/C pressure relief valve still vents after it is replaced, diagnose the refrigerant system for a restriction between the A/C compressor and A/C pressure transducer.

An A/C pressure relief valve is incorporated in the A/C compressor, as a redundant backup to the A/C pressure transducer, to prevent damage to the A/C compressor and other system components by relieving unusually high system discharge pressure buildups. Under normal conditions the A/C pressure relief valve will never vent. Only a failure of the A/C pressure transducer, a failure of the A/C clutch control system (clutch stuck on), overheating of the refrigerant system, or a restriction in the refrigerant system between the

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A/C compressor and A/C pressure transducer will cause the A/C pressure relief valve to vent.

The A/C pressure relief valve is a separate component and can be replaced separately from the A/C compressor. It is necessary to recover the refrigerant before removing the A/C pressure relief valve.

A/C Condenser/Power Steering Combo Cooler

The A/C condenser/power steering combo cooler is an aluminum fin-and-tube design heat exchanger located in front of the vehicle radiator. It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and by condensing gas to liquid refrigerant as it is cooled.

The receiver/drier is incorporated onto the LH side of the condenser core. The receiver/drier cartridge is a separate component and can be removed and installed separately from the condenser core.

The top portion of the condenser/power steering combo cooler is partitioned from the refrigerant system and is used for power steering fluid cooling.

Evaporator Core

The evaporator core is an aluminum plate/fin type and is located in the heater core and evaporator core housing. A mixture of refrigerant and oil enters the bottom of the evaporator core through the evaporator core inlet tube and continues out of the evaporator core through the evaporator core outlet tube as a vapor. During A/C operation, all airflow from the blower motor is cooled and dehumidified as it flows through the evaporator core fins.

TXV

The TXV is located between the evaporator core and the TXV manifold and tube assembly at the rear of the engine compartment. The TXV provides a restriction to the flow of refrigerant from the high-pressure side of the refrigerant system and separates the low-pressure and high-pressure sides of the refrigerant system. Refrigerant entering and exiting the evaporator core passes through the TXV through 2 separate flow paths. An internal temperature sensing bulb senses the temperature of the refrigerant flowing out of the evaporator core and adjusts an internal pin-type valve to meter the refrigerant flow into the evaporator core. The internal pin-type valve decreases the amount of refrigerant entering the evaporator core at lower temperatures and increases the amount of refrigerant entering the evaporator core at higher temperatures.

Desiccant Bag

NOTE: Installation of a new desiccant bag is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier desiccant bag. Damage to the receiver/drier desiccant bag includes physical damage to the receiver/drier desiccant bag or moisture contamination. Moisture contamination results only from a complete loss of refrigerant and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the system before repairs are carried out, the receiver/drier desiccant bag should not be replaced.

The desiccant bag is integral to the A/C condenser/power steering combo cooler. It stores high-pressure liquid after it leaves the condenser core. The desiccant bag removes any moisture from the refrigerant. The

desiccant bag is a separate component and can be removed and installed separately from the A/C condenser/power steering combo cooler.

Evaporator Temperature Sensor

The evaporator temperature sensor contains a thermistor. The resistance of this thermistor varies by a specific amount based on the evaporator temperature. The HVAC module measures a voltage ratio between the reference voltage it supplies to the sensor and the sensor voltage to determine this resistance and the associated evaporator temperature.

The HVAC module maintains evaporator core temperature and prevents the evaporator core from icing. This is accomplished by switching the A/C request signal off when the evaporator temperature sensor reading falls below acceptable levels (slightly above the freezing point of water), and by switching the A/C request signal on when the evaporator temperature rises above acceptable levels.

The evaporator temperature sensor electrical connector is located outside of the heater core and evaporator core housing behind the glove compartment, with the sensor pigtail leading into the housing to the sensor probe which is inserted between the evaporator core fins.

The evaporator temperature sensor is not available as a separate component. To install a new evaporator temperature sensor, a new heater core and evaporator core housing must be installed.

A/C Pressure Transducer

The A/C pressure transducer monitors the compressor discharge pressure and sends a variable voltage signal representing the pressure to the PCM . The PCM will interrupt A/C compressor operation in the event that the A/C pressure transducer indicates high system discharge pressures. It is also used to sense low charge conditions. If the pressure is below a predetermined value for a given ambient temperature, the PCM will not allow the clutch to engage.

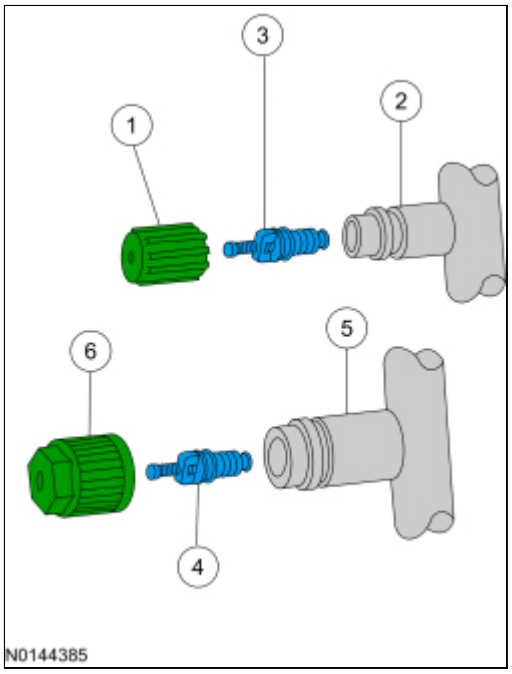
The A/C pressure transducer is located on the compressor-to-condenser discharge line near the condenser inlet fitting. It is not necessary to recover the refrigerant before removing the A/C pressure transducer.

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the condenser-to-evaporator line.

The low-pressure service gauge port valve is located on the evaporator outlet portion of the TXV manifold and tube assembly.

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Item	Torque	Description
1	0.8 Nm (7 lb-in)	Low-pressure service gauge port valve cap
2	—	Low-pressure service gauge port valve
3	2.26 Nm (20 lb-in)	Low-pressure Schrader-type valve
4	3.4 Nm (30 lb-in)	High-pressure Schrader-type valve
5	—	High-pressure service gauge port valve
6	0.8 Nm (7 lb-in)	High-pressure service gauge port valve cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are required for both the high-side and low-side service gauge ports.
- A very small amount of leakage around the Schrader-type valve with the service gauge port valve cap removed is considered normal. Install a new Schrader-type valve core if the seal leaks excessively.
- The A/C service gauge port valve caps are used as primary seals in the refrigerant system to prevent leakage through the Schrader-type valves from reaching the atmosphere. Always install and tighten the A/C service gauge port valve caps to the correct torque after they are removed.

Refrigerant System Dye

A fluorescent refrigerant system dye wafer is added to the receiver/drier desiccant bag to assist in refrigerant system leak diagnosis using a Rotunda-approved UV blacklight. This fluorescent dye wafer dissolves after about 30 minutes of continuous A/C operation. It is not necessary to add additional dye to the refrigerant system before diagnosing leaks, even if a significant amount of refrigerant has been removed from the system.

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Air Distribution and Filtering

NOTE: The air distribution system of this vehicle cannot be equipped with a cabin air filter.

There are 2 sources of air available to the air distribution system:

- Outside air
- Recirculated air

Air enters the passenger compartment from the:

- instrument panel registers.
- floor duct.
- windshield defroster.
- side window demisters.
- rear footwell duct (if equipped).

Passenger compartment air is exhausted from the vehicle through open windows or body air vents on the back panel of the cab.

EMTC

Recirculated air is always used when the HVAC module is set to the MAX A/C mode and can be selected in any mode except DEFROST.

Air distribution within the vehicle is determined by the airflow mode selected. Airflow mode doors are used to direct airflow within the heater core and evaporator core housing. Electric mode door actuators are used to position these airflow mode doors.

Dual-Zone EATC

Vehicles equipped with dual-zone EATC use recirculated air only when the RECIRC mode is selected in any airflow mode other than DEFROST, or when required by the HVAC module in the AUTOMATIC mode during maximum cooling demands. The HVAC module will drive the air inlet mode door to the full RECIRC position, the full fresh air inlet position, or may stop at a mid-position based on the HVAC module cooling/heating requirements.

Air distribution within the vehicle is determined by the airflow mode selected, or by the EATC system in the AUTOMATIC mode. The air distribution mode on vehicles equipped with EATC can be overridden by the driver if desired. Airflow mode doors are used to direct airflow within the heater core and evaporator core housing. Electric mode door actuators are used to position these airflow mode doors.

Vehicles equipped with dual-zone EATC use 2 separate temperature blend doors. This allows individual temperature settings to be selected for the RH and LH air outlets. The airflow mode doors are not partitioned for separate RH and LH airflow positions. Therefore, the airflow mode will always remain similar for the RH

and LH sides of the vehicle regardless of the temperatures selected.

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Control Components

Control System Logic

A/C Request

For vehicles equipped with EMTC base system with 4 blower motor speed positions, when A/C button is pressed, a message is sent from the HVAC module over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with EMTC non touch 4.2" display (FCDIM) system (with 7 blower motor speed positions), when A/C is requested by pressing the A/C button on the FCIM , the A/C request message is sent over the MS-CAN bus to the HVAC module that A/C has been selected. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

For vehicles equipped with 8" touchscreen, when A/C is requested by touching the FDIM , a message is sent from the APIM over the MS-CAN bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the BCM , then from the BCM through the HS-CAN bus to the PCM.

Voltage is provided to the A/C clutch relay coil and switch contacts from BJB . When A/C is requested and A/C line pressures allow, a ground is provided to the A/C clutch relay coil from the PCM, energizing the A/C clutch relay. When the PCM energizes the relay, voltage is supplied to the A/C compressor clutch field coil from the relay. Ground is supplied for the A/C compressor clutch field coil.

An accurate evaporator temperature is critical for compressor engagement. The PCM uses the temperature measurement to turn the A/C compressor off before the evaporator temperatures are cold enough to freeze the condensation on the evaporator core.

When an A/C request is received by the PCM, the A/C compressor clutch will only be engaged through the A/C clutch relay if all of the following conditions are met:

- The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer.
- The PCM does not detect excessively high engine coolant temperature.
- The PCM does not detect an ambient air temperature below -1°C (30°F).
- The PCM has not detected a WOT condition.
- The HVAC module does not detect an evaporator discharge air temperature below 2°C (36°F).

EMTC — Base

All customer commands for the EMTC base climate control system come through the HVAC control head. The EMTC base system heats or cools the vehicle depending on the HVAC control panel selection. The EMTC base system has 4 blower motor speed positions.

- During A/C operation, the system reduces the relative humidity of the air inside the vehicle.
- The control panel selection determines heating or cooling, air distribution and enables blower motor operation.
- The temperature control setting determines the outlet air temperature.
- The blower motor switch varies the blower motor speed.
- A/C compressor operation.

The HVAC module is mounted to the center instrument panel finish panel below the ACM .

Control System Inputs

The temperature control selector setting determines air temperature. Movement of the temperature display from COOL (blue) to WARM (red) causes a corresponding movement of the temperature blend door and determines the discharge air temperature that the air distribution system will maintain. The temperature control selector is an integral part of the HVAC module and cannot be installed separately.

The airflow mode setting determines air discharge location. Pressing each airflow mode selector button causes a corresponding movement of the airflow mode doors and determines the air discharge location. The airflow mode selector buttons are an integral part of the HVAC module and cannot be installed separately.

The A/C request button determines A/C compressor operation, except when the airflow mode selector is in the OFF, MAX A/C or DEFROST mode. The A/C request button is an integral part of the HVAC module and cannot be installed separately.

The recirculated air request button can select recirculated air in any mode except DEFROST, and fresh air in any mode except MAX A/C or OFF. The recirculated air request button is an integral part of the HVAC module and cannot be installed separately.

The rear defog button signals activation of the heated backlight. The rear defog button is an integral part of the HVAC module and cannot be installed separately.

The blower motor speed setting controls blower motor speed by adding or bypassing resistors in the blower motor resistor in all modes except OFF. The blower motor speed selector is an integral part of the HVAC module and cannot be installed separately.

Control System Outputs

The EMTC base system has 4 control system outputs.

Blower Motor Speed

The HVAC module blower motor speed selector varies the blower motor ground circuit resistance by adding or bypassing series resistance in the blower motor resistor. Increased resistance lowers the blower motor speed, and lowered resistance increases blower motor speed. When the blower motor is in the HI (4) position, the blower motor resistor is bypassed.

The blower motor resistor is located on the heater core and evaporator core housing behind the glove compartment.

Temperature Blend Door Position

The temperature blend door actuator moves the temperature blend door on command from the HVAC module.

The temperature blend door actuator contains a reversible electric motor and a potentiometer. The

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potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the temperature blend door. The HVAC module powers the actuator motor to move the temperature blend door to the desired position. The vehicle occupants use the temperature selector knob to set the desired position.

On the EMTC system, the temperature blend door actuator is located on the top of the heater core and evaporator core housing.

Airflow Mode Door Position

The airflow mode door actuator uses a cam and lever assembly to position the defrost/panel/floor airflow mode doors on command from the HVAC module. The airflow mode door actuator contains a reversible electric motor and potentiometer. The potentiometer allows the HVAC module to monitor the position of the airflow mode doors. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the airflow mode doors. The HVAC module powers the actuator motor to move the airflow mode doors to the desired position. The vehicle occupants use the mode selector buttons to set the desired position.

The airflow mode door actuator is located on the heater core and evaporator core housing to the right of the steering column. The HVAC module powers the actuator motor to move the airflow mode doors to the desired position. The desired position is set by the vehicle occupants using the mode selector buttons.

Air Inlet Mode Door Position

The air inlet mode door actuator moves the air inlet door between the fresh and RECIRC positions on command from the HVAC module. The air inlet mode door actuator contains a reversible electric motor and potentiometer. The potentiometer allows the HVAC module to monitor the position of the air inlet door. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the air inlet door.

The air inlet mode door actuator is located on the air inlet duct behind the glove compartment. The HVAC module powers the actuator motor to move the air inlet door to the desired position. Under certain conditions, the air inlet door may stop at intermediate positions to provide a mix of fresh and recirculated air to meet cooling/heating requirements. The air inlet mode door actuator will automatically engage when ambient temperature is above 75°F, once per ignition cycle when in Panel or Panel/Floor modes.

HVAC Module — Remote Mount

The EATC dual zone and the EMTC 4.2 inch display systems use a remote HVAC module that is separate from the control interface. For details on the HVAC module communication, REFER to Control System Logic. The HVAC module also controls the outputs for the rear window defrost and heated seats. The HVAC module utilizes Field-Effect Transistor (FET) protective circuit strategy for its actuator outputs. Output load (current level) is monitored for excessive current (typically short circuits) and is shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started. When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit is still shorted, the FET protection shuts off the circuit again and the cumulative counter advances. When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out.

The FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET. If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events. When each tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by a command to clear the DTCs. The module does not allow the DTC to be cleared or the circuit to be restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns. When each level is reached, the DTC associated with the short circuit sets along with DTC U1000:00. These DTCs can be cleared using the module self-test, then the Clear DTC operation on the scan tool. The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur. If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and a new module must be installed after the repair. The HVAC requires PMI when it is replaced.

The EATC dual zone and the EMTC 4.2 inch display systems use a remote HVAC module that is separate from the control interface. The EMTC with 4.2 inch display system has 7 blower motor speed positions.

The HVAC module analyzes input from the following sources:

- Temperature, airflow direction, blower, A/C and RECIRC selection (made by the vehicle occupants)
- In-vehicle temperature and humidity sensor
- AAT sensor
- Autolamp/Sunload sensor (solar radiation sensor, only on dual zone system)
- Vehicle speed
- Engine coolant temperature

Using these inputs, the HVAC module determines the correct conditions for the following outputs:

- A/C compressor operation
- Blower speed
- Driver side and passenger side (if equipped) temperature blend door positions
- Defrost/panel/floor airflow mode door position
- Air inlet door position

Control System Inputs

Both EATC dual zone system and the EMTC 4.2 inch display without touchscreen system have remote mounted HVAC modules.

HVAC Module — Without Touchscreen System

Vehicles equipped with the non touchscreen 4.2 inch display use a remote HVAC module that is separate from the control interface. This EMTC system has 7 blower motor speed positions. The FCIM provides the interface for the vehicle occupants to control the climate control system. When selections are made, the FCIM communicates the selections to the HVAC module through the MS-CAN . The remote HVAC module controls the climate control system based on the FCIM selections.

HVAC Module — With Touchscreen System

Vehicles equipped with the touchscreen EATC dual zone system use a remote HVAC module that is separate from the control interface. The FDIM provides the touchscreen interface for the vehicle occupants to control the climate control system. When selections are made, the FCIM communicates the selections to the HVAC module over the MS-CAN . The remote HVAC module controls the climate control system based

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on the FDIM selections, or automatically controls the climate control system in the AUTO mode.

The remote HVAC module is located at the top center of the instrument panel and can be accessed through the upper instrument panel storage tray opening with the tray removed.

In-Vehicle Temperature and Humidity Sensor

The in-vehicle temperature and humidity sensor contains 2 thermistors, which separately measure the in-vehicle air temperature and humidity and send those readings to the HVAC module. An aspirator hose and elbow is connected between the heater core and evaporator core housing and the in-vehicle temperature and humidity sensor. The aspirator hose uses airflow from the heater core and evaporator core housing air stream to create a venturi-type suction to draw in-vehicle air through the in-vehicle temperature and humidity sensor and across the thermistors.

The in-vehicle temperature and humidity sensor is mounted to the instrument panel to the right of the steering column.

Autolamp/Sunload Sensor (Solar Radiation Sensor)

The autolamp/sunload sensor supplies information to the dual-zone HVAC module indicating sunload. When sunload is detected, the information from the sensor is used to lower the A/C temperature output to compensate for radiant heat warming the vehicle interior and occupants.

The sunload sensor is located on the center of the instrument panel at the base of the windshield.

AAT Sensor

The AAT sensor signal is hard wired to the PCM and is sent over the vehicle communication network. The AAT sensor is located in front of the radiator to the right of the hood latch. For information regarding the external air temperature display, Section 412-00 .

Control System Outputs

NOTE: Each of the 4 control system outputs may be overridden by the passenger if desired.

When operating in AUTO mode (if equipped), the control system outputs will be automatically adjusted by the HVAC module.

Blower Motor Speed

The blower motor speed control controls the blower motor speed by converting low power signals from the HVAC module to a high-current, variable ground feed for the blower motor. The HVAC module adjusts blower motor speed based on the difference between the in-vehicle temperature sensor signal and set temperature. A delay function is used to provide a gradual increase or decrease in blower motor speed under all conditions.

The blower motor speed control is located on the heater core and evaporator core housing near the blower motor.

Single Zone Temperature Blend Door Position

The single zone temperature blend door actuator moves the temperature blend door on command from the HVAC module.

The single zone temperature blend door actuator contains a reversible electric motor and a potentiometer.

The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the temperature blend door. The HVAC module powers the actuator motor to move the temperature blend door to the desired position. The desired temperature blend door positions are calculated by the HVAC module based on the set temperature, in-vehicle temperature and humidity, and ambient air temperature.

On the single zone system, the temperature blend door actuator is located on the top of the heater core and evaporator core housing.

Dual Zone Temperature Blend Door Position

The dual-zone EATC system uses 2 temperature blend door actuators to control 2 separate temperature blend doors. The temperature blend doors independently vary the driver side and passenger side temperature settings, as desired. The temperature blend door actuators each contain a reversible electric motor and a potentiometer. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the temperature blend door. The HVAC module powers the actuator motors to move the temperature blend doors to the desired positions. The desired temperature blend door positions are calculated by the HVAC module based on the set temperature, in-vehicle temperature and humidity, ambient air temperature and sunload.

On the dual-zone EATC system, the temperature blend door-driver side actuator is located on the bottom of the heater core and evaporator core housing. The temperature blend door-passenger side actuator is located on the top of the heater core and evaporator core housing.

Airflow Mode Door Position

The airflow mode door actuator uses a cam and lever assembly to position the defrost/panel/floor airflow mode doors on command from the HVAC module. The airflow mode door actuator contains a reversible electric motor and potentiometer. The potentiometer allows the HVAC module to monitor the position of the airflow mode doors. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the airflow mode doors. The HVAC module powers the actuator motor to move the airflow mode doors to the desired position. The HVAC module determines the desired airflow mode door position based on the calculated outlet temperature.

The airflow mode door actuator is located on the heater core and evaporator core housing to the right of the steering column.

Air Inlet Mode Door Position

The air inlet mode door actuator moves the air inlet door between the fresh and RECIRC positions on command from the HVAC module. The air inlet mode door actuator contains a reversible electric motor and potentiometer. The potentiometer allows the HVAC module to monitor the position of the air inlet door. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the air inlet door.

The air inlet mode door actuator is located on the air inlet duct behind the glove compartment. The HVAC module powers the actuator motor to move the air inlet door to the desired position. Under certain conditions, the air inlet door may stop at intermediate positions to provide a mix of fresh and recirculated air to meet cooling/heating requirements. The air inlet mode door actuator will automatically engage when

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ambient temperature is above 75°F, once per ignition cycle when in Panel or Panel/Floor modes.

Heating and Ventilation

The heating and ventilation system:

- controls the temperature and, during A/C operation, reduces the relative humidity of the air inside the vehicle.
- delivers heated or cooled air to maintain the vehicle interior temperature and comfort level.

Heater Core

The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer it to air passing through the heater core.

Blower Motor

The blower motor pulls air from the air inlet and forces it into the heater core and evaporator core housing and the plenum chamber where it is mixed and distributed.

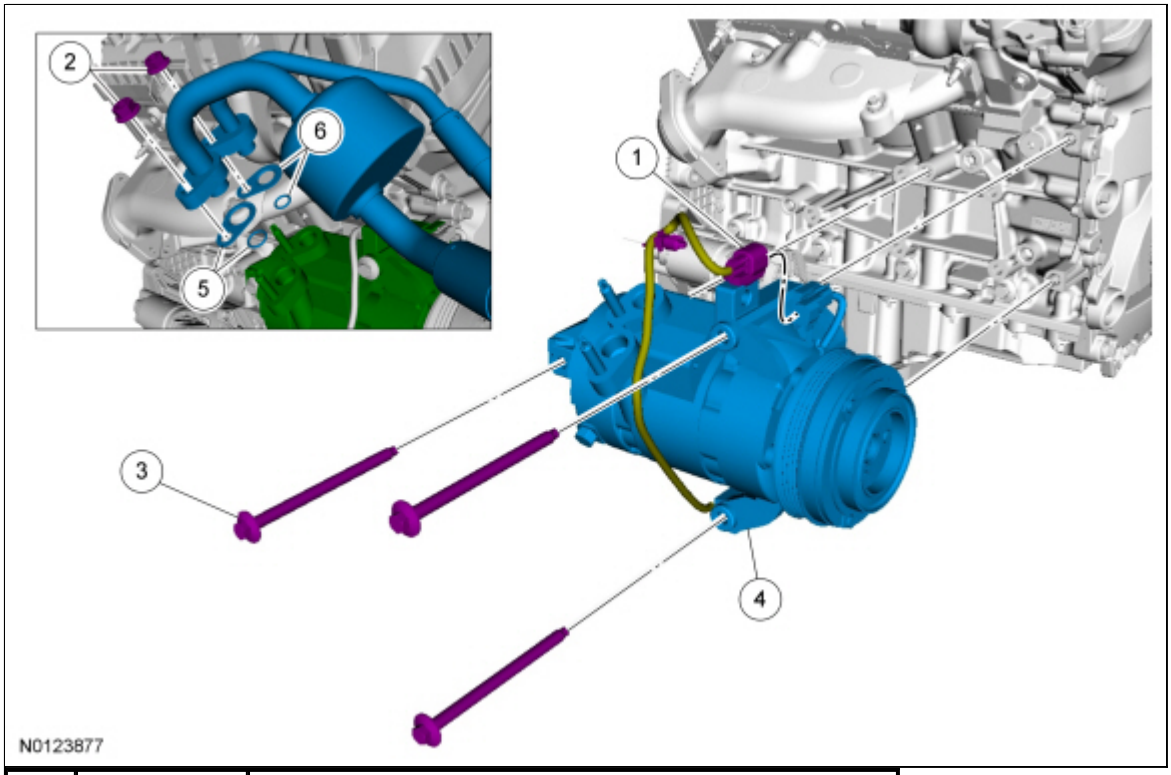
Heater Core and Evaporator Core Housing

The heater core and evaporator core housing directs airflow from the blower motor through the evaporator core and heater core. All airflow from the blower motor passes through the evaporator core. The airflow is then directed through or around the heater core by the temperature blend door. After passing through the heater core, the airflow is distributed to the selected outlet by the airflow mode doors.

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Air Conditioning — Exploded View

A/C Compressor — 3.5L GTDI, 3.7L

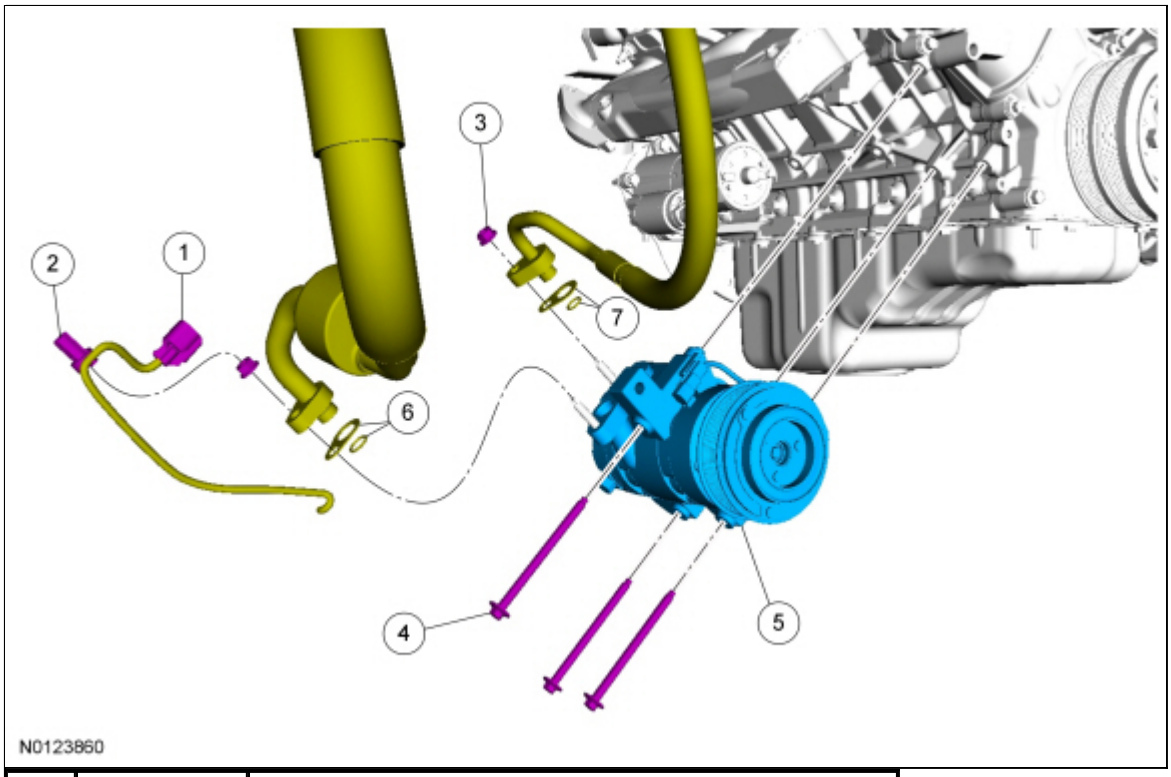


Item	Part Number	Description
1	—	A/C compressor electrical connector (part of 14300)
2	W520413	A/C compressor fitting nut (2 required) - 15 Nm (133 lb-in)
3	W704750	A/C compressor bolt (3 required) - 25 Nm (18 lb-ft)
4	19703	A/C compressor
5	19B596	O-ring seal and gasket seal kit
6	19B596	O-ring seal and gasket seal kit

A/C Compressor 5.0L (4V), 6.2L (2V)

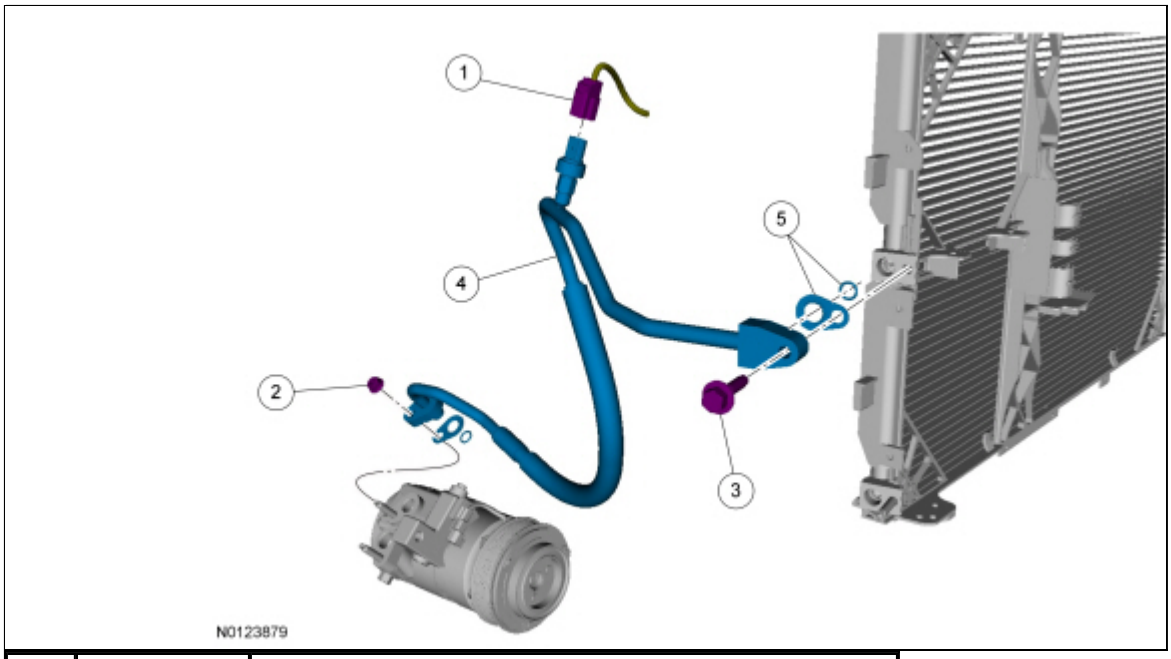
NOTE: 5.0L (4V) shown, 6.2L (2V) similar.

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Item	Part Number	Description
1	—	A/C compressor electrical connector (part of 14300)
2	—	Wire harness retainer (part of 14300)
3	W520413	A/C compressor fitting nut (2 required) - 15 Nm (133 lb-in)
4	W704750	A/C compressor bolt (3 required) - 25 Nm (18 lb-ft)
5	19703	A/C compressor
6	19B596	O-ring seal and gasket seal kit
7	19B596	O-ring seal and gasket seal kit

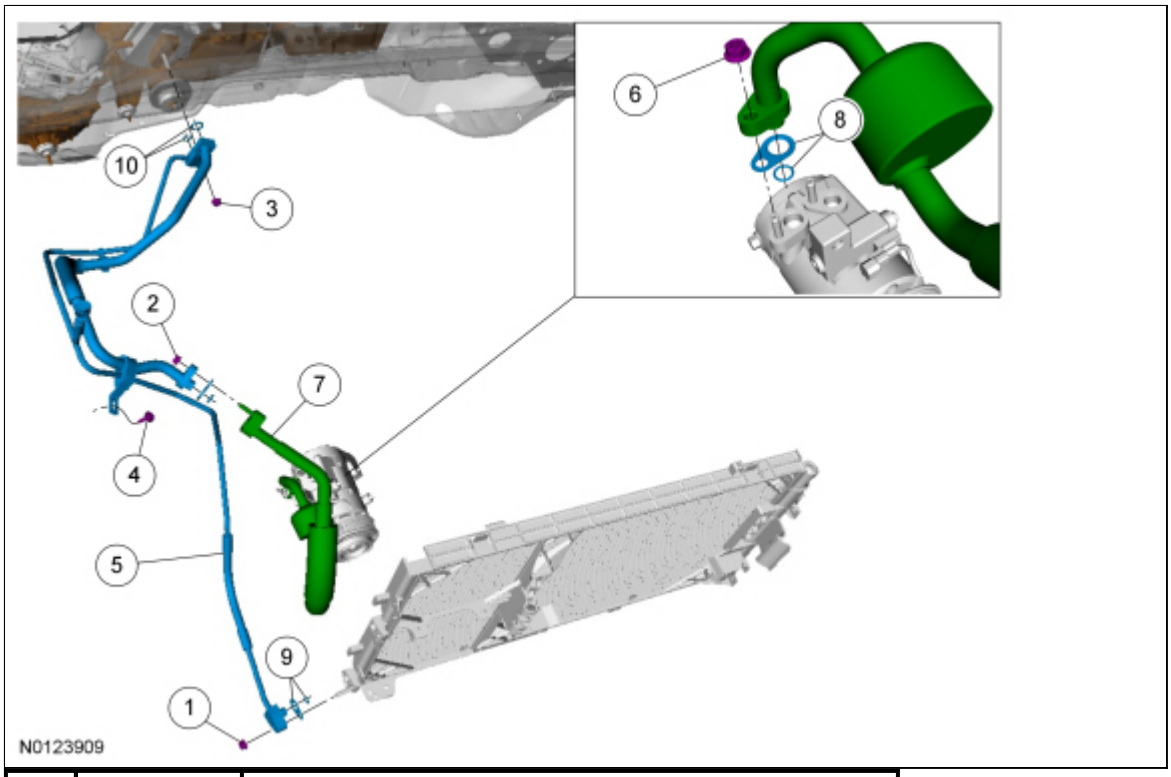
Compressor-to-Condenser Discharge Line



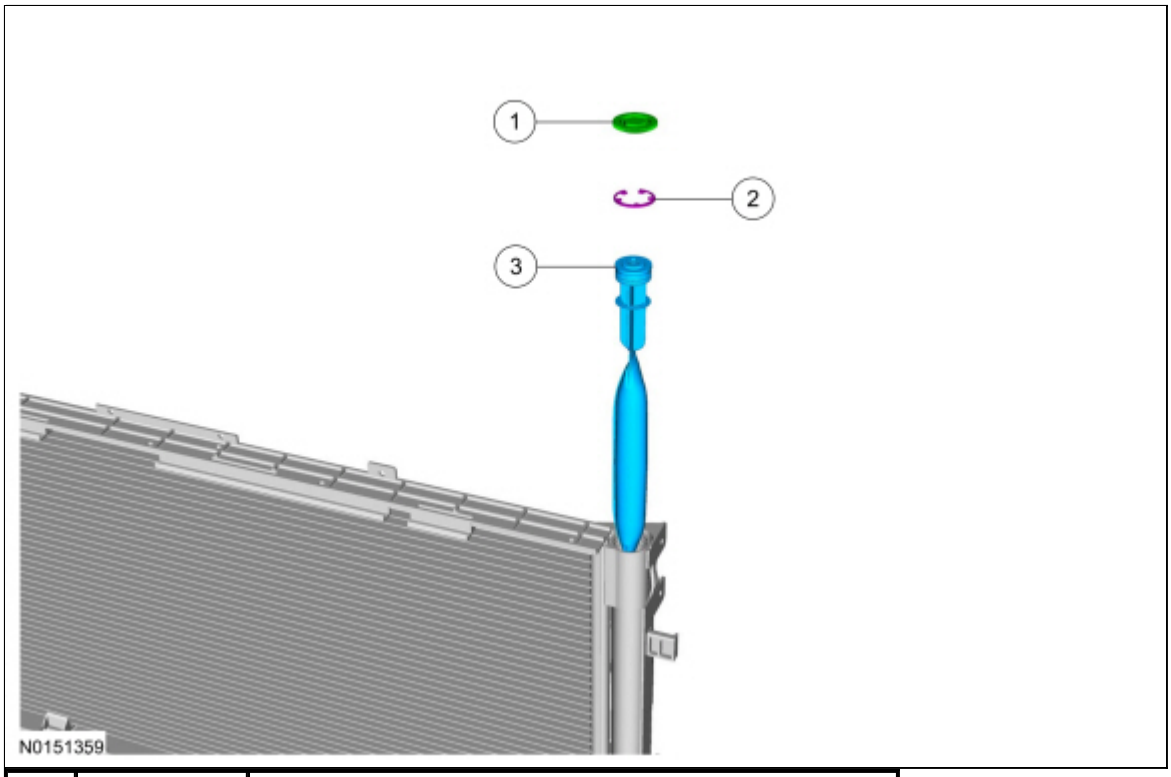
Item	Part Number	Description
1	—	A/C pressure transducer electrical connector
2	W520413	A/C compressor discharge fitting nut - 15 Nm (133 lb-in)
3	W715219	A/C condenser inlet fitting bolt - 20 Nm (177 lb-in)
4	19972	Compressor-to-condenser discharge line
5	19B596	O-ring seal and gasket seal kit (2 required)

Thermostatic Expansion Valve (TXV) Manifold-and-Tube and Evaporator-to-Compressor Suction Line

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Item	Part Number	Description
1	W520413	A/C condenser outlet fitting nut - 15 Nm (133 lb-in)
2	W520413	Evaporator-to-compressor suction line fitting nut - 15 Nm (133 lb-in)
3	W520413	Thermostatic Expansion Valve (TXV) fitting nut 15 Nm (133 lb-in)
4	W505424	TXV manifold and tube assembly bracket bolt
5	19A834	TXV manifold and tube assembly
6	W520413	A/C compressor suction fitting nut - 15 Nm (133 lb-in)
7	19972	Evaporator-to-compressor suction line
8	19B596	O-ring seal and gasket seal kit (2 required)
9	19B596	O-ring seal and gasket seal kit
10	19B596	Gasket seals (2 pieces from kit required)



Item	Part Number	Description
1	—	Plastic receiver/drier cap (part of 19C836 kit)
2	—	Snap ring (part of 19C836 kit)
3	—	Receiver/drier plug and desiccant bag (part of 19C836 kit)

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Air Conditioning (A/C) Compressor

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

Removal and Installation

NOTICE: **If installing a new Air Conditioning (A/C) compressor due to an internal failure of the old unit, the following procedures must be carried out to remove contamination from the A/C system. Failure to remove contamination from the A/C system, if present, will result in poor A/C performance and/or damage to the new A/C compressor and other components.**

- **Carry out flushing of the A/C system prior to installing a new A/C compressor. For additional information, refer to Section 412-00 .**
- **Install a new Thermostatic Expansion Valve (TXV), as directed by the A/C flushing procedure.**
- **Install a new receiver/drier as directed by the A/C flushing procedure.**

NOTE: Installation of a new receiver/drier is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier. Damage to the receiver/drier includes leaks in the receiver/drier, physical damage to the receiver/drier shell or desiccant, or moisture contamination. Moisture contamination results only from a complete loss of refrigerant and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the system before repairs are carried out, the receiver/drier should not be replaced.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If flushing of the A/C system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00 .

3.5L GTDI vehicles

3. Remove the Air Cleaner (ACL) outlet pipe, RH ACL pipe to-turbocharger pipe, RH turbocharger bypass hose and the RH turbocharger-to-Charge Air Cooler (CAC) pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .

All vehicles

4. Disconnect the clutch field coil electrical connector.

5. Detach the wire harness retainer from the A/C compressor and position the wire harness aside.

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6. Remove the 2 A/C compressor fitting nuts and disconnect the fittings.
    - Discard the O-ring seals and gasket seals.
    - To install, tighten to 15 Nm (133 lb-in).

7. If equipped, remove the front skid-plate.

8. Remove the drive belt from the A/C compressor pulley. For additional information, refer to Section 303-05 .

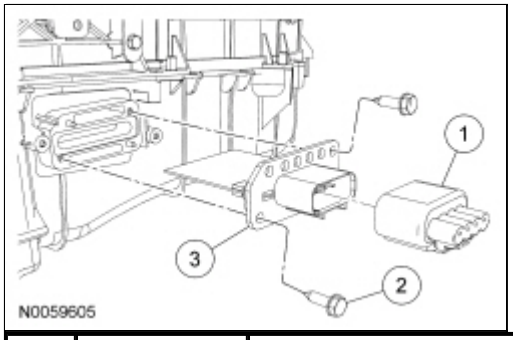
9. Remove the 3 A/C compressor bolts.
    - To install, tighten to 25 Nm (18 lb-ft).

10. Remove the A/C compressor.

11. To install, reverse the removal procedure.
    - If a new A/C compressor is to be installed, the clutch assembly may need to be transferred from the old unit to the new unit. For additional information, refer to Clutch and Clutch Field Coil in this section.
    - Install new gasket seals and O-ring seals.
    - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00 .

12. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Blower Motor Resistor



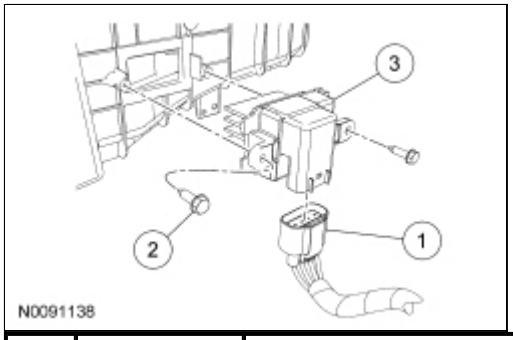
Item	Part Number	Description
1	—	Blower motor resistor electrical connector (part of 18B518)
2	W701696	Blower motor resistor screw (2 required)
3	18591	Blower motor resistor

Removal and Installation

1. Disconnect the blower motor resistor electrical connector.
2. Remove the 2 blower motor resistor screws.
3. Remove the blower motor resistor.
4. To install, reverse the removal procedure.

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Blower Motor Speed Control



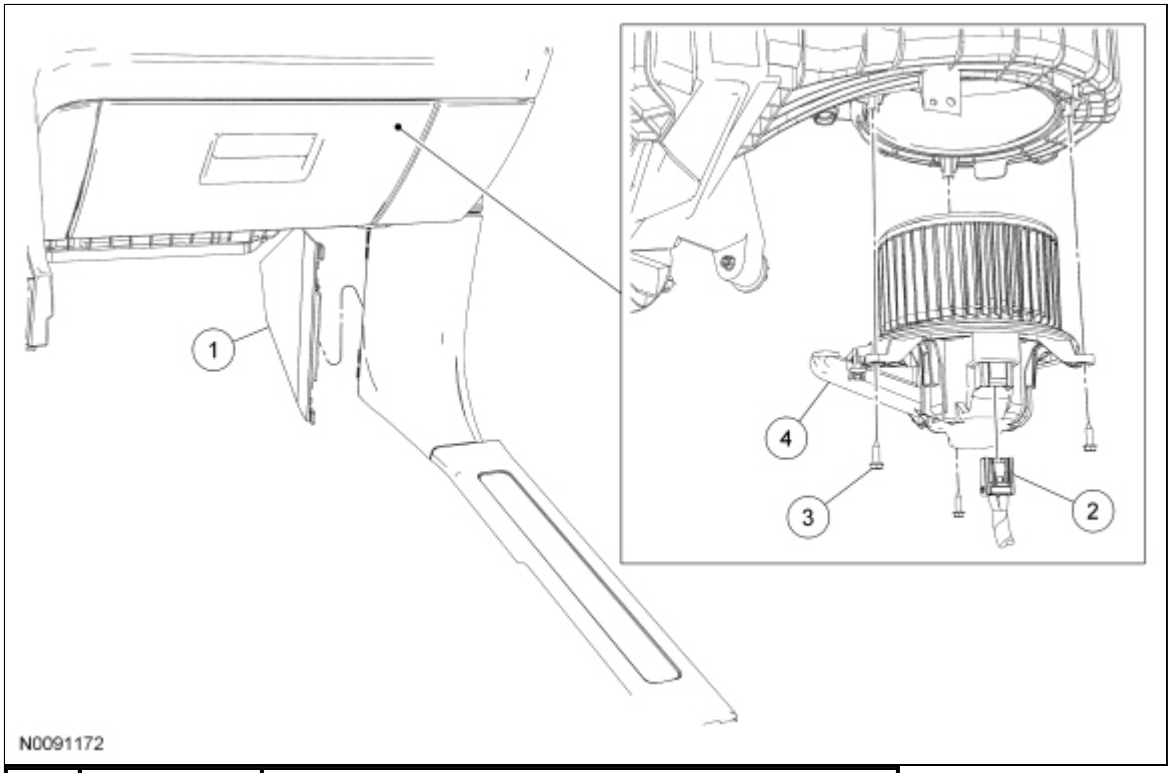
Item	Part Number	Description
1	—	Blower motor speed control electrical connector (part of 18B518)
2	W701696	Blower motor speed control screw (2 required)
3	19E624	Blower motor speed control

Removal and Installation

1. Disconnect the blower motor speed control electrical connector.
2. Remove the 2 blower motor speed control screws.
3. Remove the blower motor speed control.
4. To install, reverse the removal procedure.

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Blower Motor



Item	Part Number	Description
1	02348	Junction box cover
2	—	Blower motor electrical connector (part of 18B574)
3	W701696	Blower motor screw (3 required)
4	19805	Blower motor and wheel assembly

Removal and Installation

NOTICE: **The blower motors for vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) and vehicles equipped with Electronic Manual Temperature Control (EMTC) are not interchangeable. If the wrong blower motor is installed for the specific vehicle application, the blower motor circuit components will be damaged. Use only the correct blower motor listed for the specific vehicle application in the Ford Catalog Advantage™ or equivalent.**

1. Remove the junction box cover.
2. Remove the 2 push pins and the lower access panel.
3. Disconnect the blower motor electrical connector.
4. Remove the 3 blower motor screws.

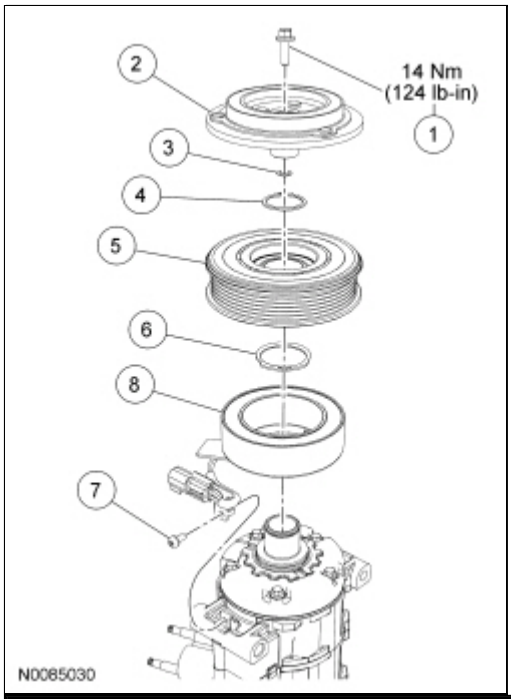
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5. Remove the blower motor.
6. To install, reverse the removal procedure.

Clutch and Clutch Field Coil

Special Tool(s)

 ST2946-A	Holding Tool, A/C Clutch 412-150
 ST2382-A	Remover, Compressor Pulley 412-001 (T71P-19703-B)



Item	Part Number	Description
1	W711887	A/C clutch disc and hub bolt
2	19D786	A/C clutch disc and hub
3	19N689	A/C clutch hub disc and hub spacer
4	N805338	A/C compressor pulley snap ring
5	19D784	A/C compressor pulley
6	W711883	A/C clutch field coil snap ring

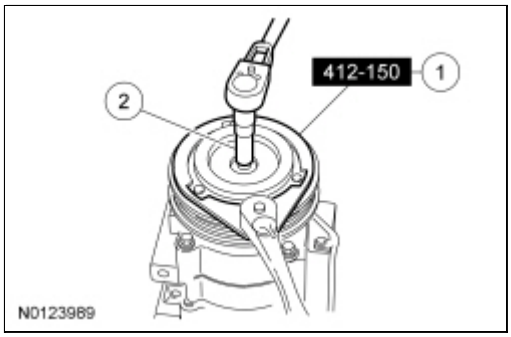
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7	W710797	A/C clutch field coil electrical connector screw
8	19D798	A/C clutch field coil

Removal

1. Remove the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor in this section.

2. Remove the A/C clutch disc and hub bolt.
   1. Using the A/C Clutch Holding Tool, hold the A/C clutch disc and hub.
   2. Remove the A/C clutch disc and hub bolt.

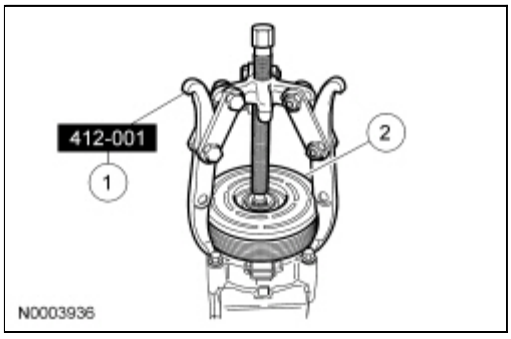


3. Remove the A/C clutch disc and hub.

4. Remove the A/C compressor pulley snap ring.

5. ***NOTICE:*** **Do not use air tools. Damage to the Air Conditioning (A/C) clutch pulley or A/C compressor may result.**

   Using the Compressor Pulley Remover, remove the A/C compressor pulley.
   1. Install the Compressor Pulley Remover.
   2. Remove the A/C compressor pulley.



6. Remove the A/C clutch field coil snap ring.

7. Remove the A/C clutch field coil electrical connector screw.

8. Remove the A/C clutch field coil.

Installation

NOTE: A new A/C compressor may come equipped with a clutch and pulley. If not, the A/C clutch components should be reused unless obvious signs of damage are found. If excessive grooving is found on the friction surface, a new A/C clutch disc and hub and a new A/C compressor pulley must be installed together. Otherwise, each component can be installed individually where needed.

1. Visually inspect the A/C clutch disc and hub, A/C compressor pulley and A/C clutch field coil for damage.
    - Inspect for physical damage, including cracked or melted components or discoloration due to excessive heat.
    - Inspect for excessive wear, including grooving in the A/C clutch disc and hub or A/C compressor pulley that is more than fingernail depth.
    - Inspect for roughness in the A/C compressor pulley bearing.

2. Clean the A/C clutch field coil and pulley mounting surfaces.

3. Install the A/C clutch field coil.

4. Install the A/C clutch field coil electrical connector screw.

5. Install the A/C clutch field coil snap ring.

6. **NOTE:** The A/C compressor pulley is a tight fit on the A/C compressor. It must be correctly aligned during installation.

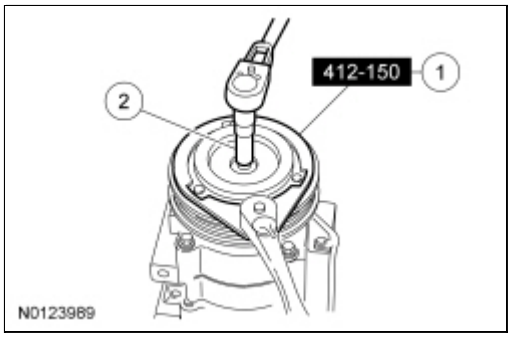
   Install the A/C compressor pulley.

7. Install the A/C compressor pulley snap ring with the bevel side out.

8. Place one nominal thickness A/C clutch disc and hub spacer inside the clutch hub spline opening.

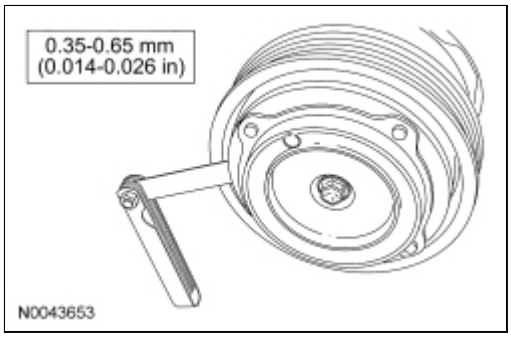
9. Install the A/C clutch disc and hub.

10. Using the A/C Clutch Holding Tool, install the A/C compressor clutch disc and hub bolt.
    1. Hold the A/C clutch disc and hub with the A/C Clutch Holding Tool.
    2. Tighten the bolt to 14 Nm (124 lb-in).



11. Measure and adjust the clutch air gap at 3 spaces by removing or adding A/C clutch disc and hub spacers.

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12. Install the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor in this section.

Compressor to Condenser Discharge Line

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

Removal and Installation

All vehicles

1. Recover the refrigerant. For additional information, refer to Section 412-00 .

3.5L GTDI vehicles

2. Remove the Air Cleaner (ACL) outlet pipe, RH ACL pipe to-turbocharger pipe, RH turbocharger bypass hose and the RH turbocharger-to-Charge Air Cooler (CAC) pipe. For additional information, refer to Intake Air System Components — Exploded View, 3.5L Gasoline Turbocharged Direct Injection (GTDI) in Section 303-12 .

All vehicles

3. Remove the A/C compressor discharge fitting nut and disconnect the fitting.
   - Discard the O-ring seal and gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

4. Remove the RH radiator air deflector upper pin-type retainer and position the air deflector aside.

5. Disconnect the A/C pressure transducer electrical connector.

6. Remove the condenser inlet fitting bolt and disconnect the fitting.
   - Discard the O-ring seal and gasket seal.
   - To install, tighten to 20 Nm (177 lb-in).

7. Remove the compressor-to-condenser discharge line.

8. To install, reverse the removal procedure.
   - Install new gasket seals and O-ring seals.
   - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00 .

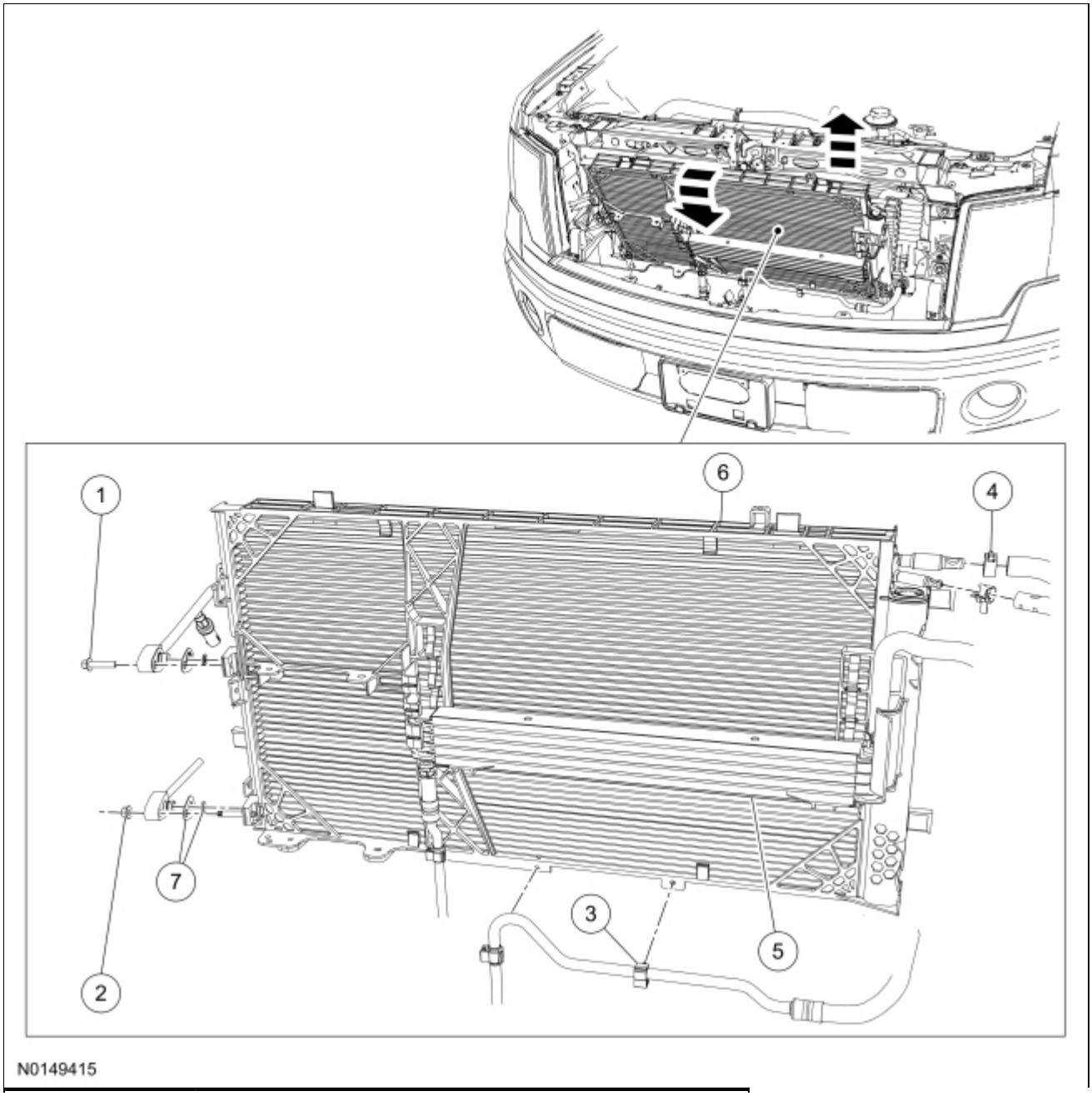
9. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

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Condenser Core

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



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Item	Part Number	Description
1	W715219	Condenser inlet fitting bolt - 20Nm (177 lb-in)
2	W520413	Condenser outlet fitting nut - 15Nm (133 lb-in)
3	7N291	Transmission cooler line pin-type retainer (3 required)
4	—	Power steering fluid cooler hose clamp (6.2L [2V] only) (part of 3A713) (2 required)
5	7A095	Auxiliary transmission fluid cooler
6	19712	Condenser core
7	19B596	O-ring seal and gasket seal kit (2 required)

Removal and Installation

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Recover the refrigerant. For additional information, refer to Section 412-00 .

3. Remove the 6 upper radiator sight shield pin-type retainers and remove the upper radiator sight shield.

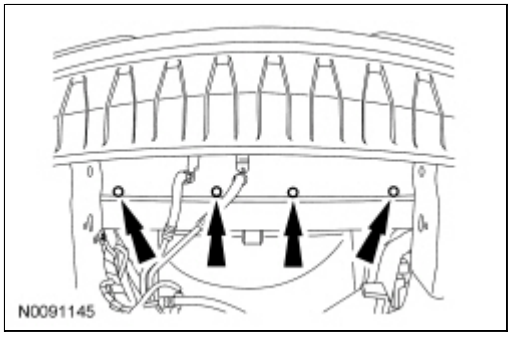
4. Remove the RH and LH radiator side air deflector-to-headlamp pin-type retainers.

5. Remove the 5 radiator side air deflector pin-type retainers from the condenser bracket and position the side air deflectors aside.

6. Remove the horn assembly bolt and position the horn assembly aside.
   - To install, tighten to 10 Nm (89 lb-in).

7. Remove the 4 junction box bracket bolts and position the junction box aside.
   - To install, tighten to 10 Nm (89 lb-in).

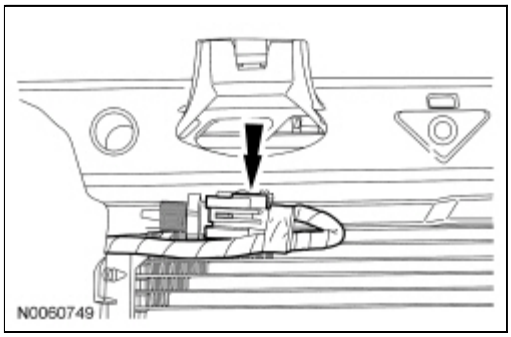
8. Remove the 4 lower radiator air deflector pin-type retainers from the condenser bracket.



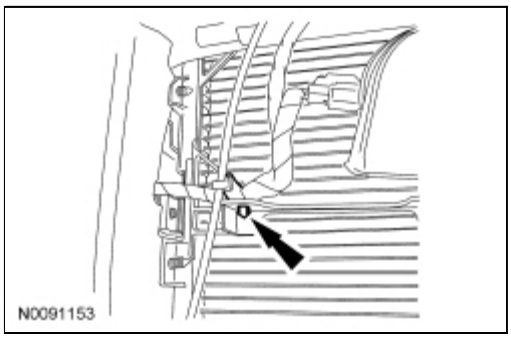
9. Remove the condenser inlet fitting bolt and disconnect the fitting.
   - Discard the O-ring seal and gasket seal.
   - To install, tighten to 20 Nm (177 lb-in).

10. Remove the condenser outlet fitting nut and disconnect the fitting.
    - Discard the O-ring seal and gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

11. Detach the ambient temperature sensor pin-type retainer from the core support.



12. Detach the hood latch cable pin-type retainer from the condenser core bracket.

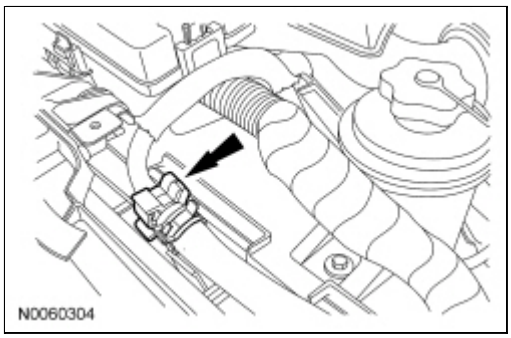


3.5L Gasoline Turbocharged Direct Injection (GTDI)

13. Remove the charge air cooler. For additional information, refer to Section 303-12 .

6.2L (2V) vehicles

14. Detach the power steering cooler line clip from the top of the condenser core bracket.



15. Detach the 3 transmission cooler line pin-type retainers from the condenser bracket.

Vehicles with auxiliary transmission fluid cooler

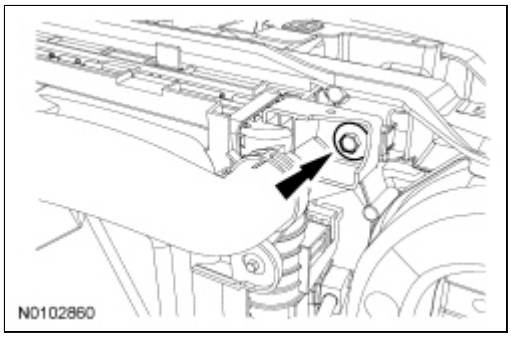
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16. Release the auxiliary transmission fluid cooler from the condenser core bracket and position aside.

All vehicles

17. **NOTE:** RH bolt shown, LH similar.

    Remove the 2 radiator bolts.
    - To install, tighten to 15 Nm (133 lb-in).



6.2L (2V) vehicles

18. Using a suitable suction device, remove the power steering fluid from the fluid reservoir.

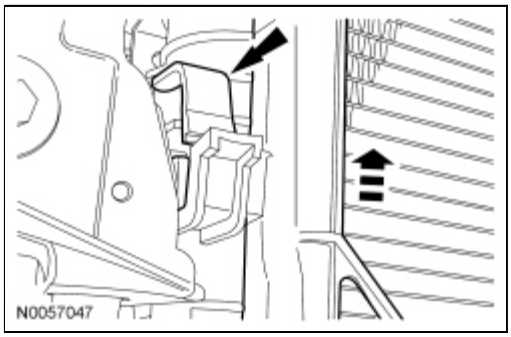
19. Release the 2 power steering fluid cooler hose clamps and disconnect the power steering cooler hoses from the condenser core.

All vehicles

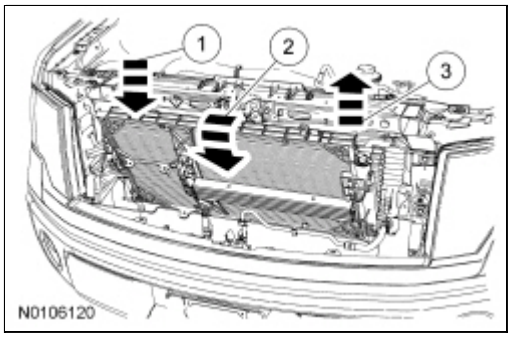
20. **NOTE:** The cooling module must be positioned rearward to detach the condenser from the radiator.

    NOTE: RH condenser retaining clip shown, LH similar.

    Release the 2 condenser core retaining clips, lift the condenser core upward and detach it from the radiator.



21. Remove the condenser core and bracket assembly.
    1. Lower the condenser core and bracket assembly to allow the top of the assembly to be tilted forward.
    2. Tilt the top of the condenser core and bracket assembly forward to allow it to clear the upper radiator support.
    3. Lift the condenser core and bracket assembly out of the vehicle.



22. To install, reverse the removal procedure.
    - Install new gasket seals and O-ring seals.
    - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00 .

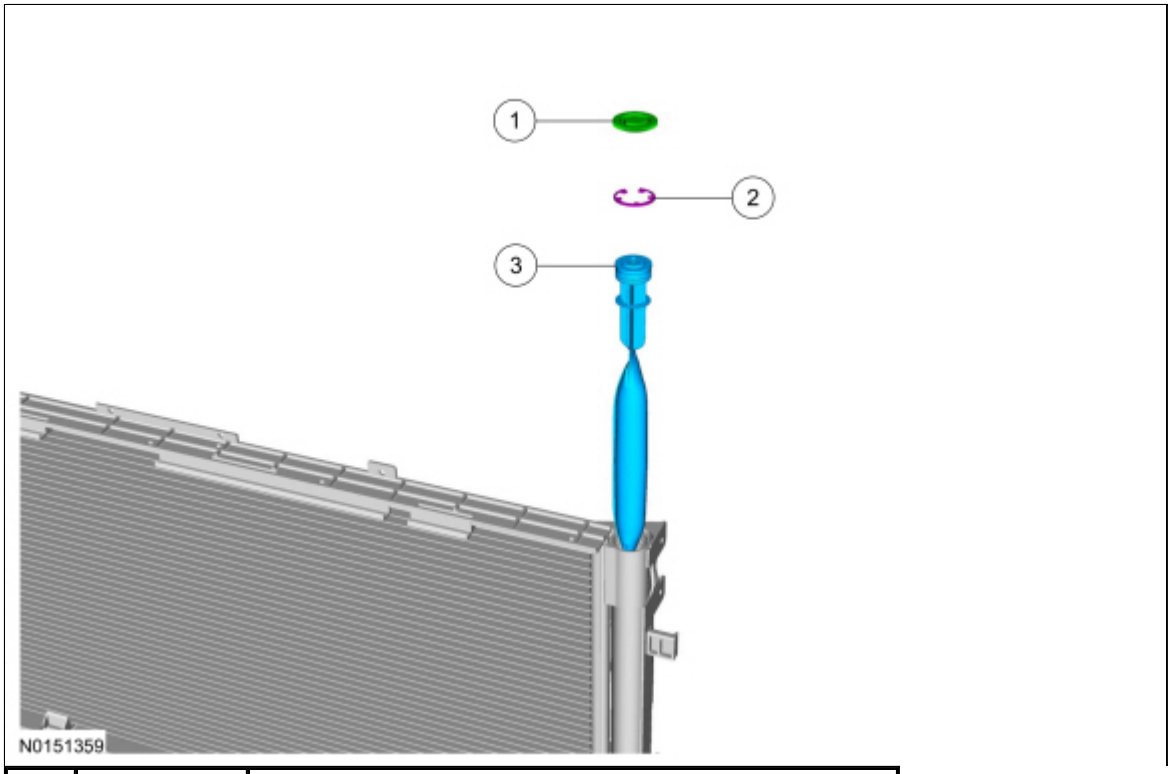
23. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

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Desiccant Bag

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	—	Plastic receiver/drier cap (part of 19C836 kit)
2	—	Snap ring (part of 19C836 kit)
3	—	Receiver/drier plug and desiccant bag (part of 19C836 kit)

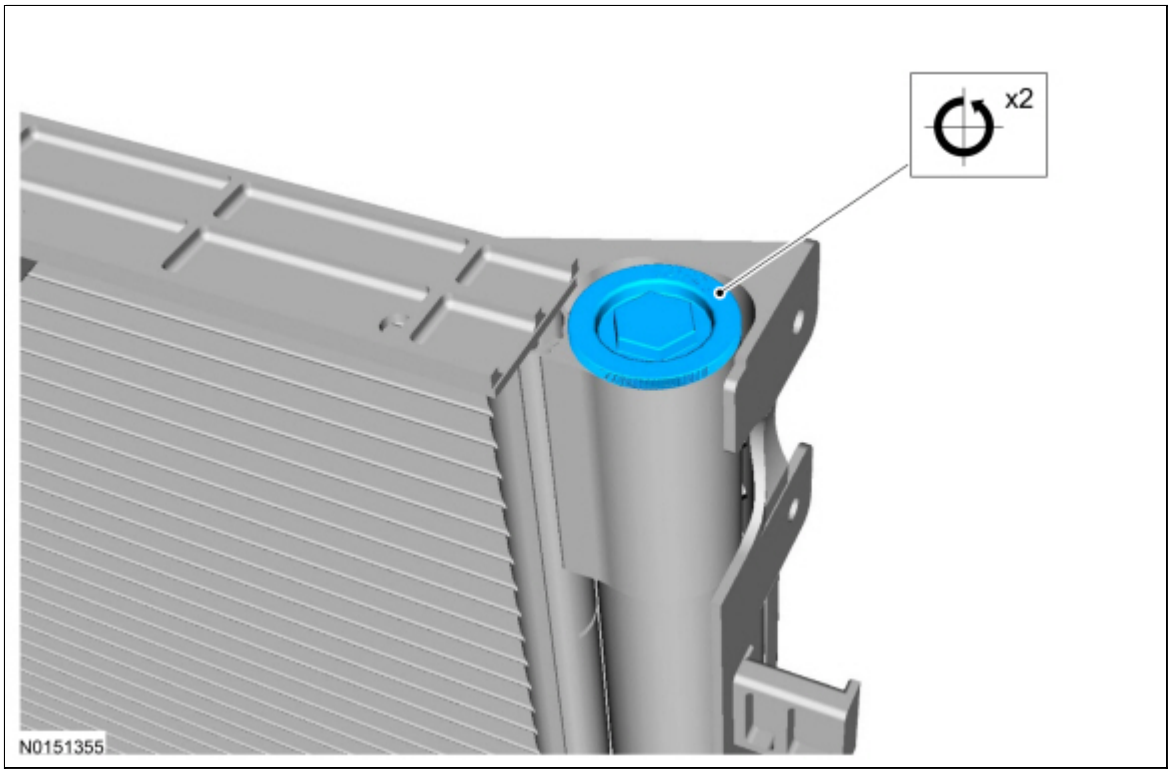
Removal and Installation

NOTE: Installation of a new desiccant bag is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier desiccant bag. It is not necessary to add additional dye to the refrigerant system, the new receiver/drier desiccant bag comes with a new dye pellet. Damage to the receiver/drier desiccant bag includes physical damage to the receiver/drier desiccant bag or moisture contamination. Moisture contamination results only from a complete loss of refrigerant and equalization of the refrigerant system pressure with atmospheric

pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the system before repairs are carried out, the receiver/drier desiccant bag should not be replaced.

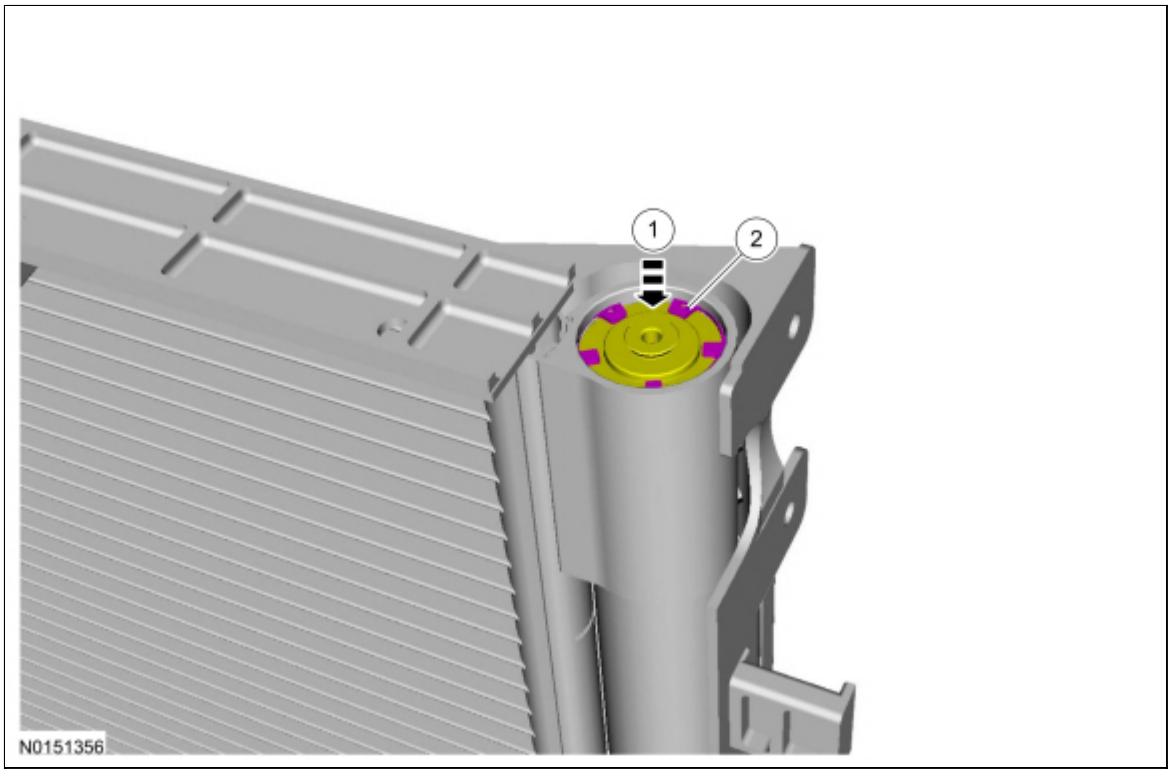
1. Remove the condenser core. For additional information, refer to Condenser Core .

2. Remove the receiver/drier cap.

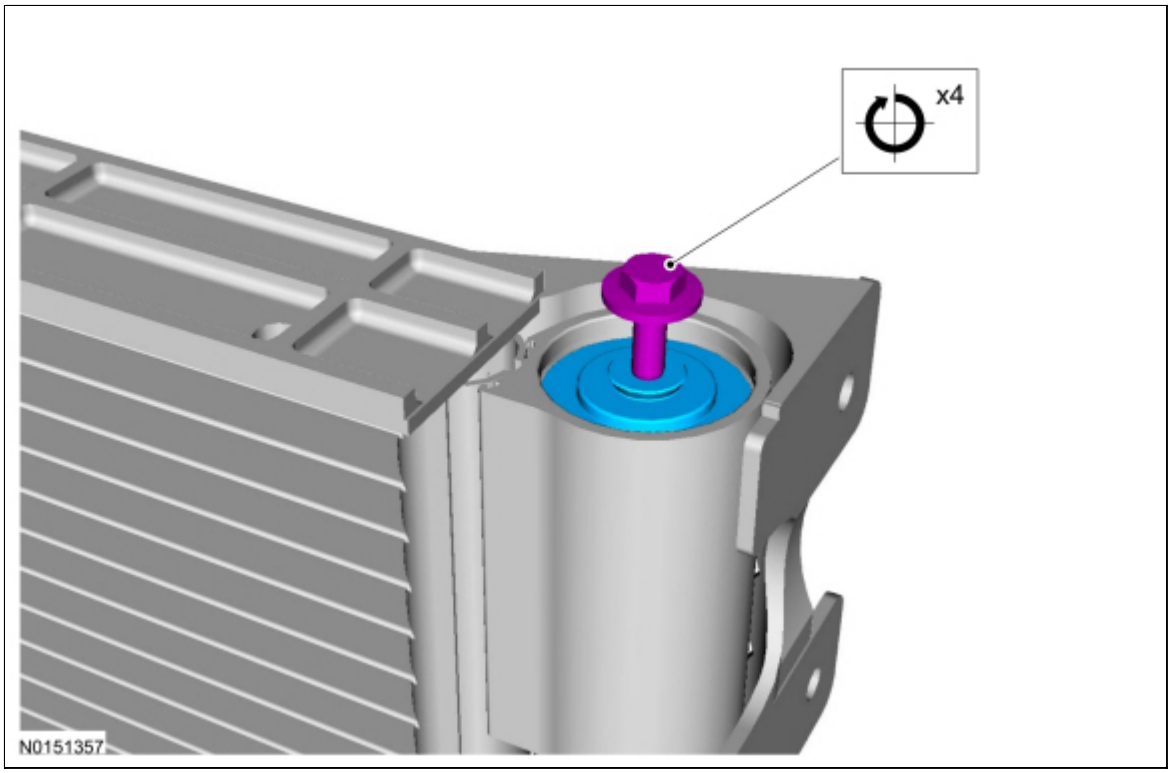


3. Remove the receiver/drier plug snap ring.
    1. Push the receiver/drier plug towards the top of the condenser.
    2. Remove the receiver/drier plug snap ring.

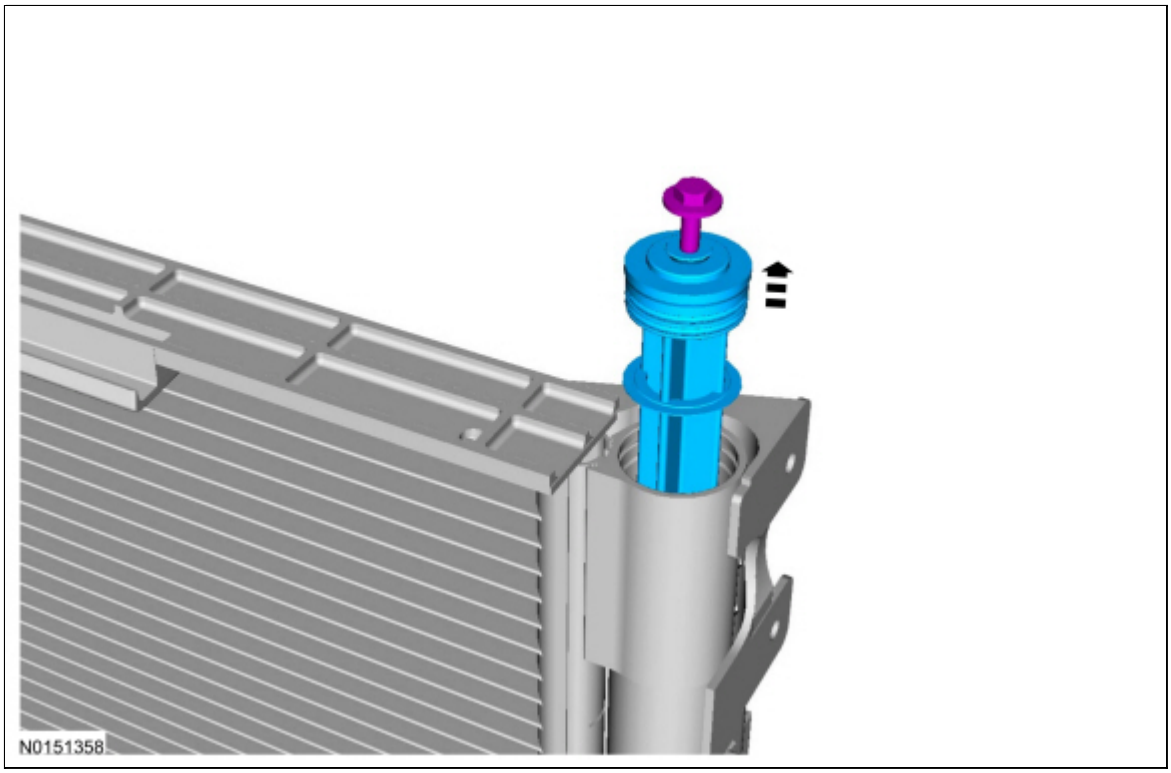
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4. Install an M5 bolt in the center of the receiver/drier plug.



5. Remove the receiver/drier plug and the desiccant bag.



6. To install, reverse the removal procedure.
    - Lubricate the receiver/drier plug O-ring seals using residual refrigerant oil from inside the receiver/drier.

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Evaporator Core

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

Removal and Installation

NOTE: The evaporator core is available only as part of the heater core and evaporator core housing assembly.

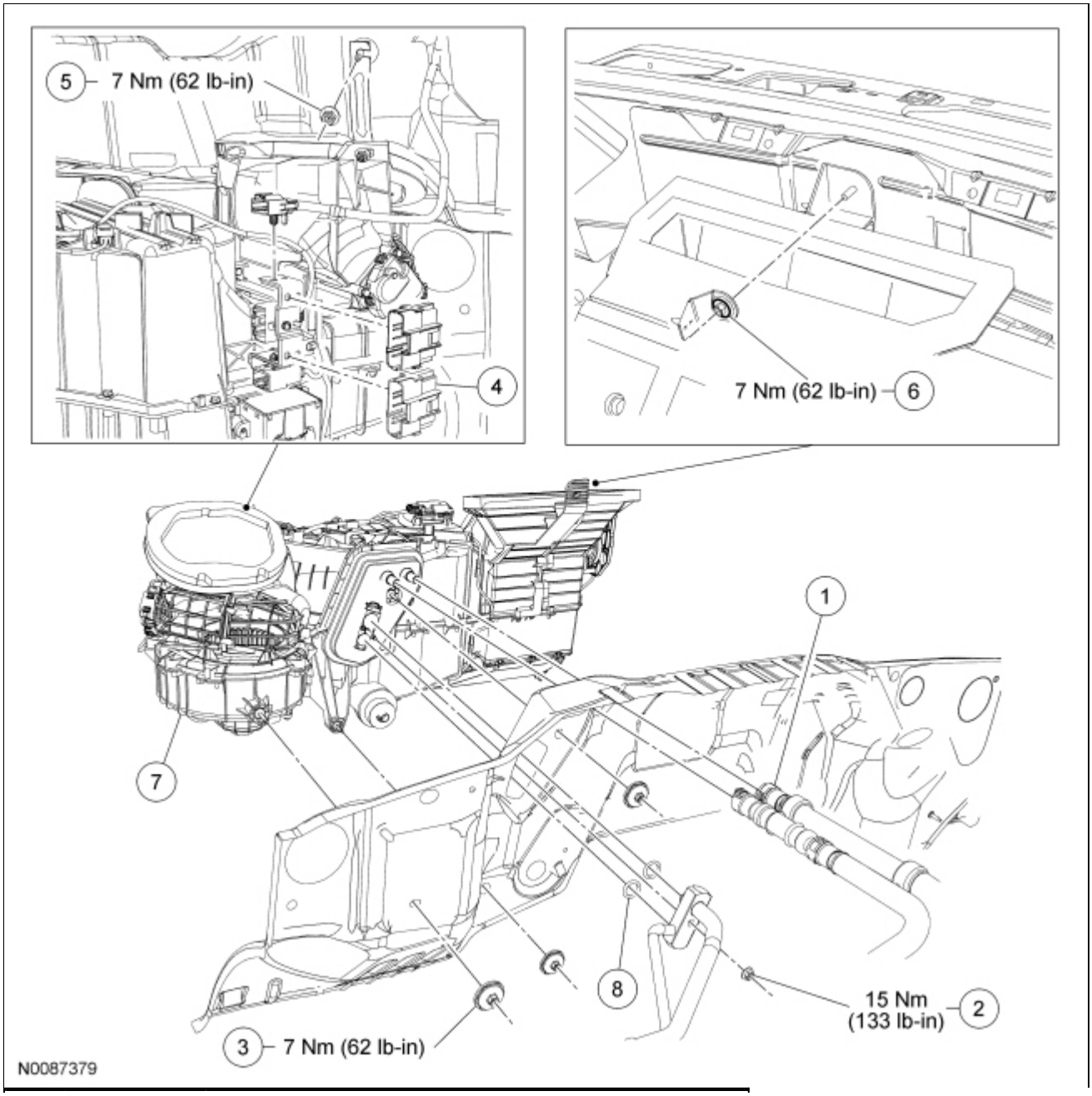
NOTE: If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed from the vehicle.

1. Remove the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.
2. Transfer the components from the old housing to the new housing as needed.
3. Install the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.

Heater Core And Evaporator Core Housing

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



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Item	Part Number	Description
1	18472	Heater hose quick disconnect fitting (2 required)
2	W520413	Thermostatic Expansion Valve (TXV) fitting nut
3	W708206	Heater core and evaporator core housing nut (3 required)
4	—	Body harness electrical connector (part of 14401) (3 required)
5	N806543	Air inlet duct bracket nut
6	—	Plenum chamber nut (part of 18471)
7	19B555	Heater core and evaporator core housing
8	19B596	Gasket seal (2 pieces from kit required)

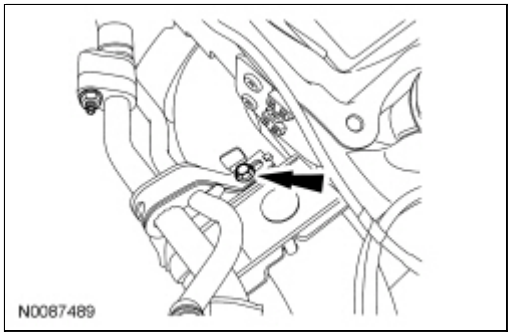
Removal and Installation

NOTE: If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed from the vehicle.

NOTE: If a heater core leak is suspected, the heater core must be leak tested before it is removed from the vehicle.

NOTE: Failure to correctly install the evaporator core seal when installing the evaporator core will result in decreased A/C cooling efficiency due to airflow bypassing the evaporator core.

1. Drain the engine coolant. For additional information, refer to Section 303-03 .
2. Recover the refrigerant. For additional information, refer to Section 412-00 .
3. Remove the instrument panel. For additional information, refer to Section 501-12 .
4. Disconnect the 2 heater core quick disconnect fittings at the heater core.
5. Remove the Thermostatic Expansion Valve (TXV) manifold and tube bracket bolt.
   - To install, tighten to 8 Nm (71 lb-in).



6. Remove the TXV fitting nut and disconnect the fitting.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

7. Remove the 3 heater core and evaporator core housing nuts.
    - To install, tighten to 7 Nm (62 lb-in).

8. Detach the 3 harness electrical connectors from the heater core and evaporator core housing bracket.

9. If equipped, detach the 2 antenna cable retainers from the heater core and evaporator core housing.

10. Remove the air inlet duct bracket nut.
    - To install, tighten to 7 Nm (62 lb-in).

11. Completely loosen the plenum chamber nut.
    - To install, tighten to 7 Nm (62 lb-in).

12. If equipped, detach the floor console duct from the heater core and evaporator core housing.

13. **NOTE:** For vehicles equipped with a rear footwell duct, the heater core and evaporator core housing must be carefully detached from the dash panel and then tilted toward the rear of the vehicle to detach it from the rear footwell duct connection.

    Remove the heater core and evaporator core housing.

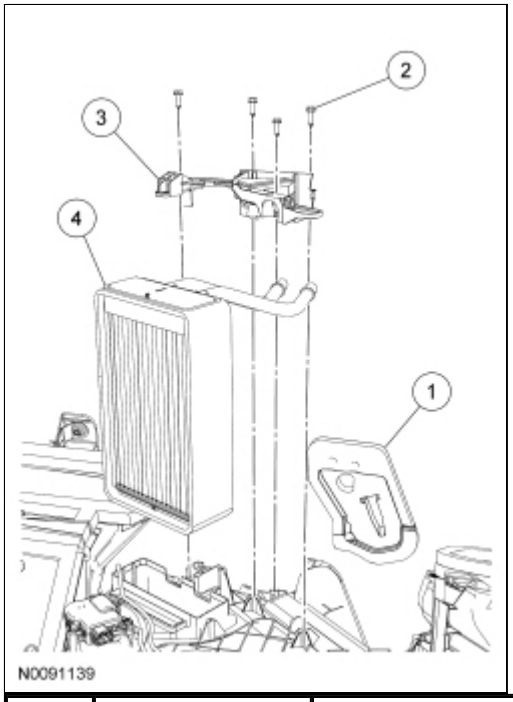
14. To install, reverse the removal procedure.
    - Install new O-ring seals.
    - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00 .

15. Fill the engine cooling system. For additional information, refer to Section 303-03 .

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Heater Core



Item	Part Number	Description
1	19C593	Heater tube dash panel seal
2	W701696	Heater core bracket screw (4 required)
3	18B689	Heater core bracket
4	18476	Heater core

Removal and Installation

NOTE: If a heater core leak is suspected, the heater core must be leak tested before it is removed from the vehicle.

1. Remove the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.
2. Remove the heater hose quick disconnect clips from the heater core.
3. Remove the heater tube dash panel seal.
4. Remove the 4 heater core bracket screws and the bracket.
5. Remove the heater core.
6. **NOTE:** The heater core seal must be correctly installed to prevent airflow from bypassing the heater core.

To install, reverse the removal procedure.

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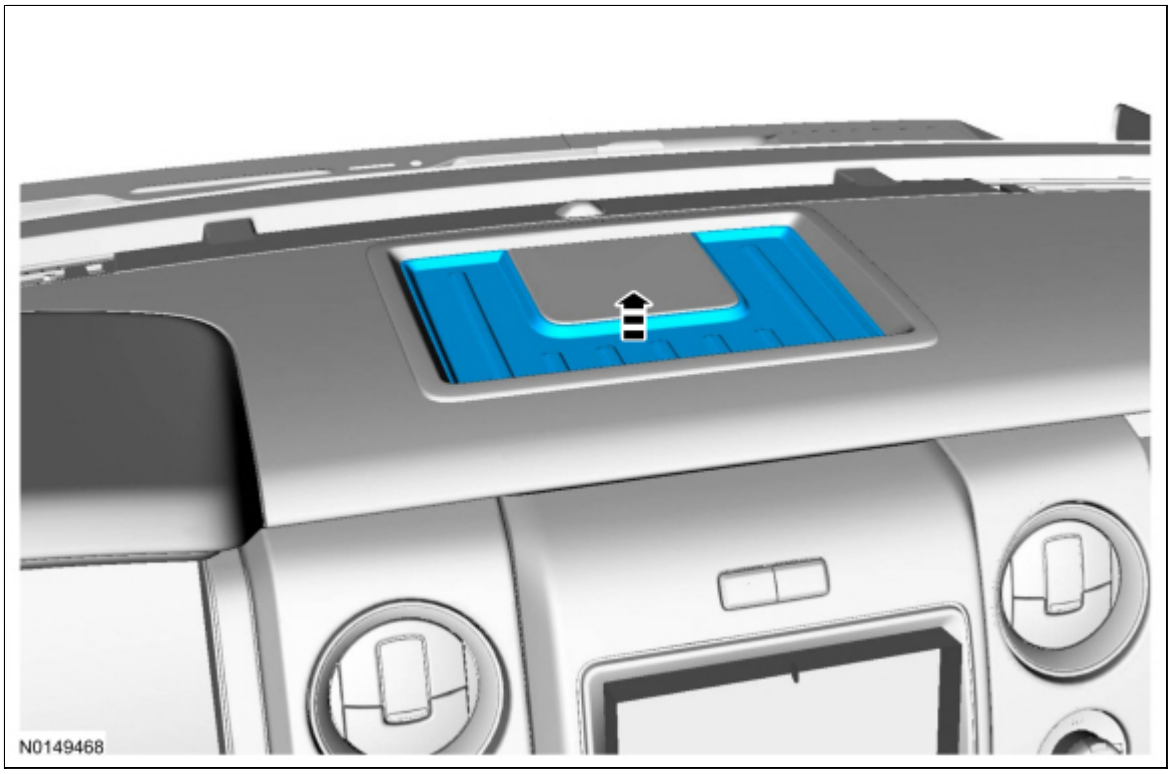
Heating Ventilation Air Conditioning (HVAC) Module

Removal and Installation

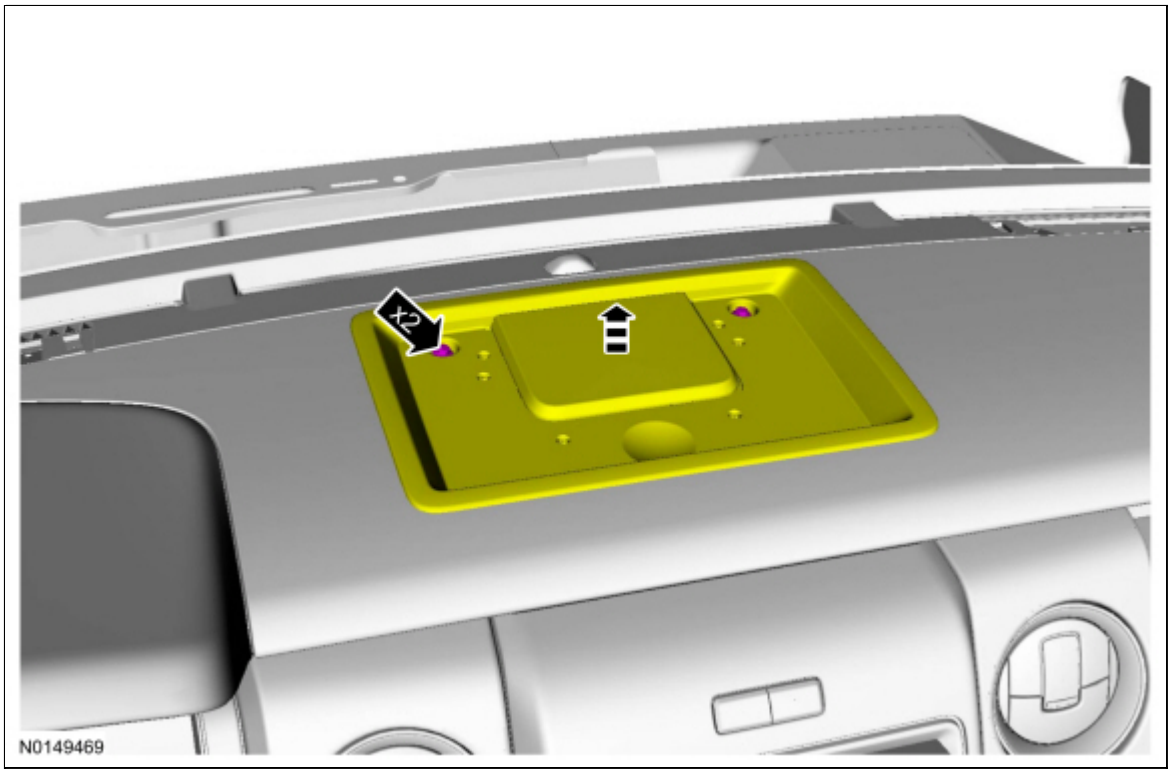
NOTE: If installing a new HVAC module, the new module must be configured for the vehicle. For additional information, refer to Section 418-01 .

With Electronic Automatic Temperature Control or Electronic Manual Temperature Control Remote Mount

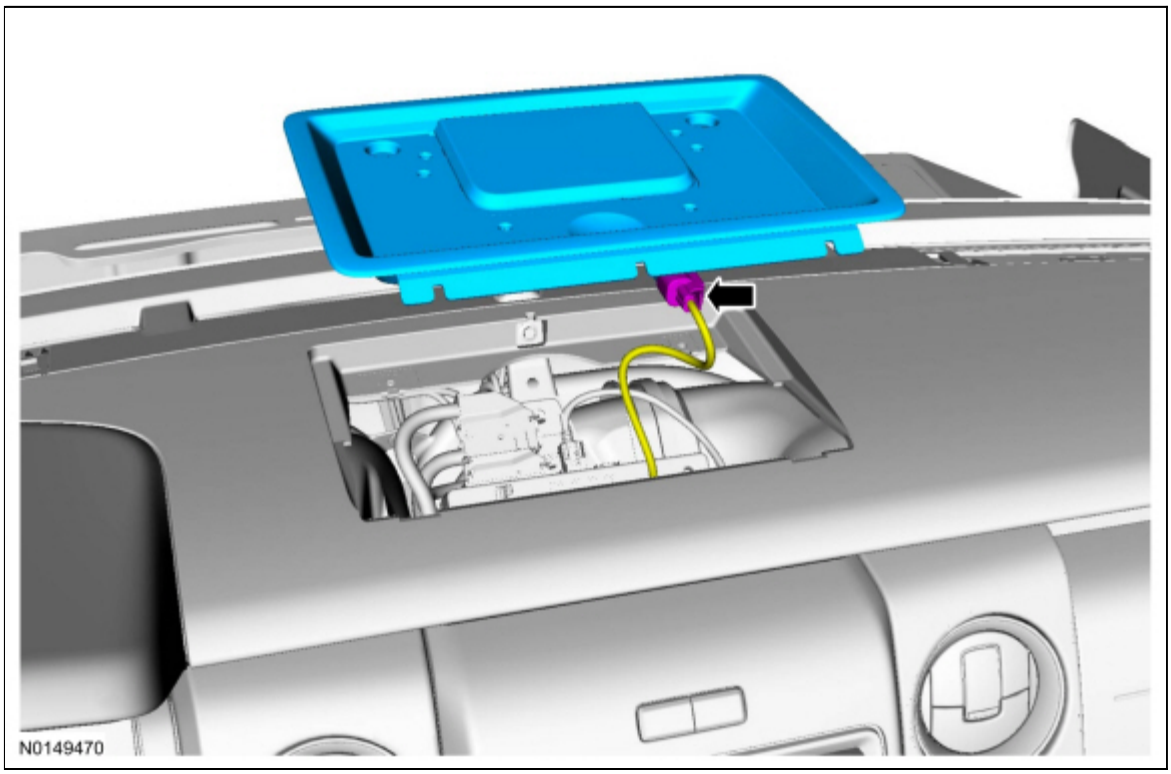
1. Remove the upper instrument panel storage tray mat.



2. Remove the 2 upper instrument panel storage tray screws.



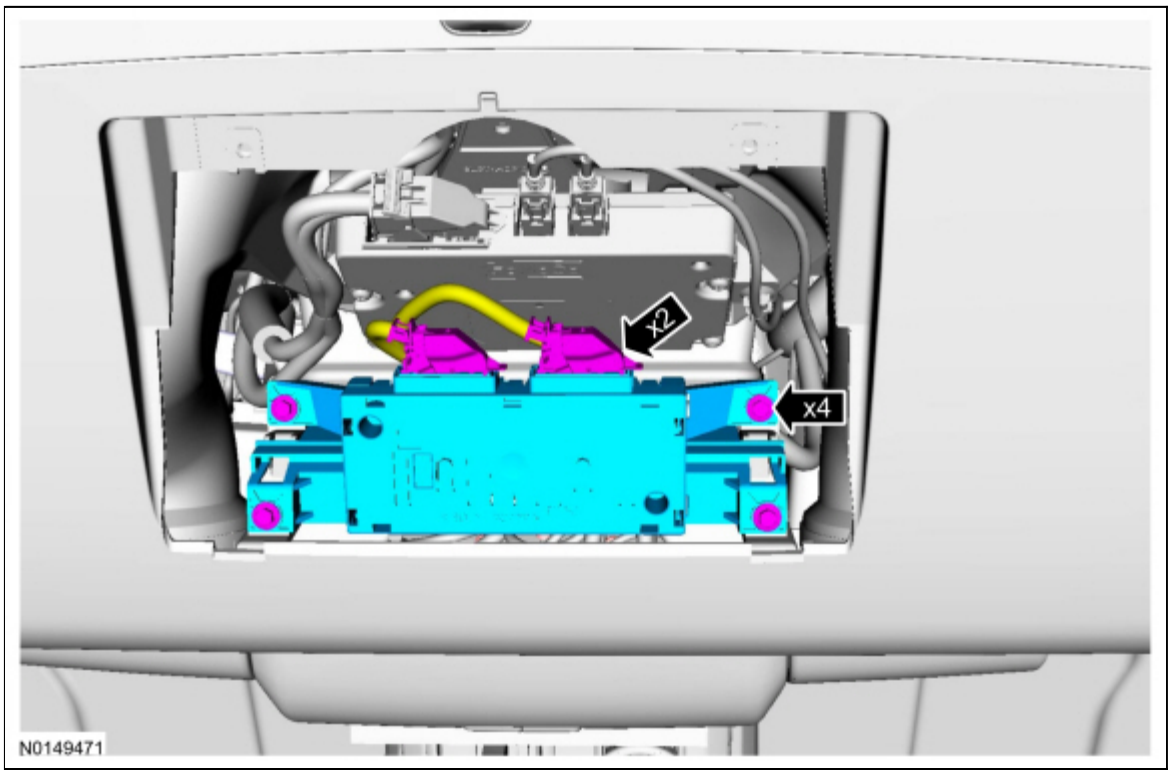
3. Disconnect the speaker electrical connector (if equipped), and remove the upper instrument panel storage tray.



4. Remove the HVAC module.
    - Disconnect the HVAC module electrical connectors.

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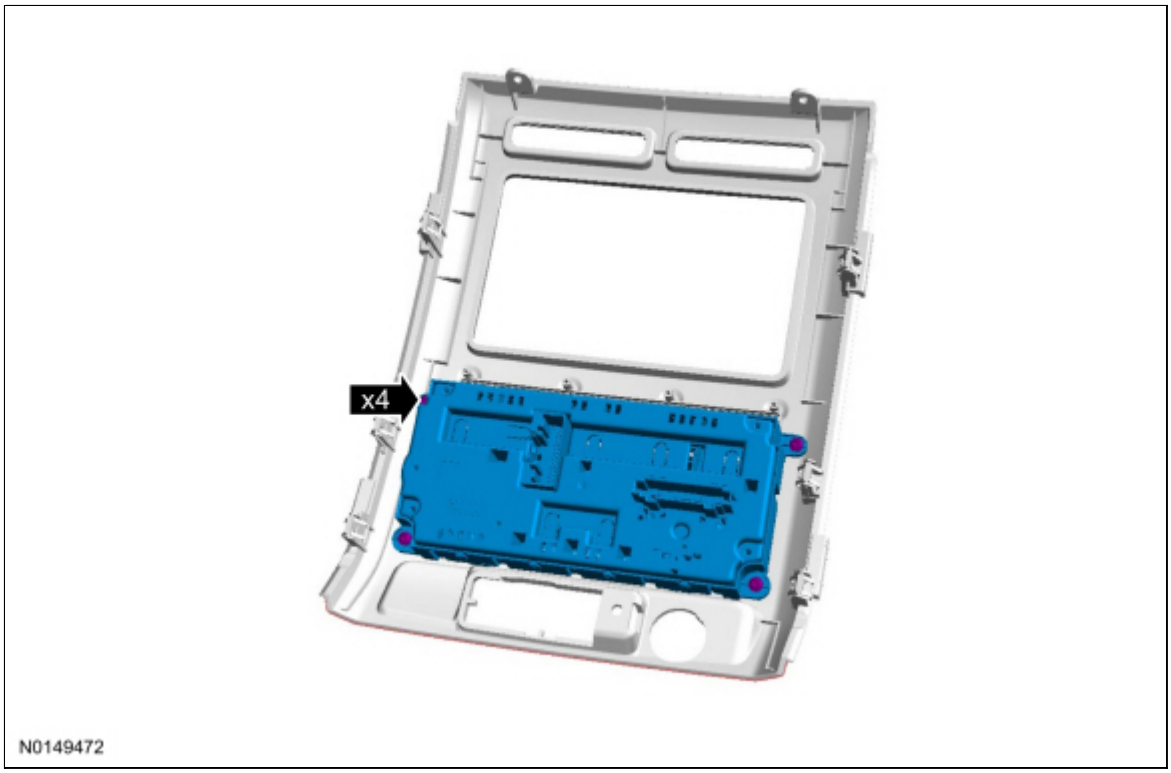
- Remove the 4 HVAC module screws.



Vehicles with Electronic Manual Temperature Control Base

5. Remove the instrument panel finish panel – center, lower. For additional information, refer to Section 501-12 .

6. Remove the HVAC module.
   - Remove the 4 HVAC module screws.



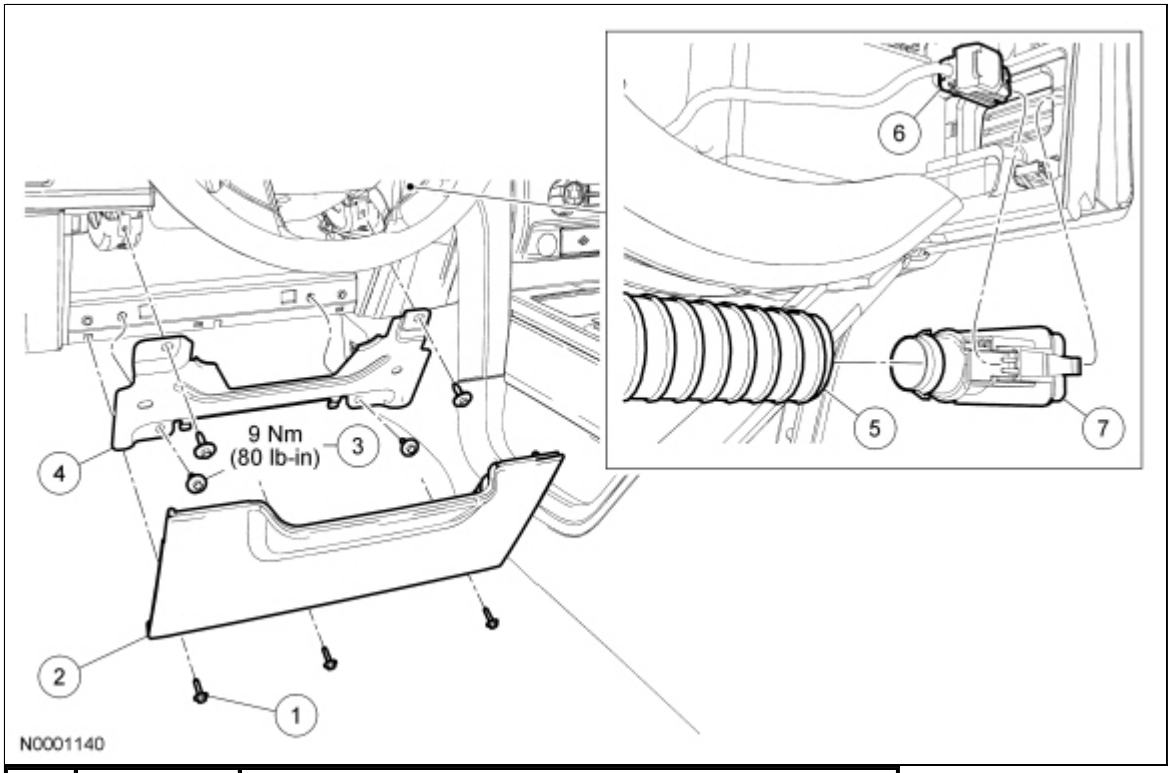
All vehicles

7. To install, reverse the removal procedure.

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In-Vehicle Temperature and Humidity Sensor



Item	Part Number	Description
1	W707628	Steering column cover screw (3 required)
2	1504459	Steering column cover
3	N706599	Steering column cover reinforcement bolt (4 required)
4	15017A26	Steering column cover reinforcement
5	—	In-vehicle temperature and humidity sensor aspirator hose (part of 19C734)
6	14401	In-vehicle temperature and humidity sensor electrical connector
7	19C734	In-vehicle temperature and humidity sensor

Removal and Installation

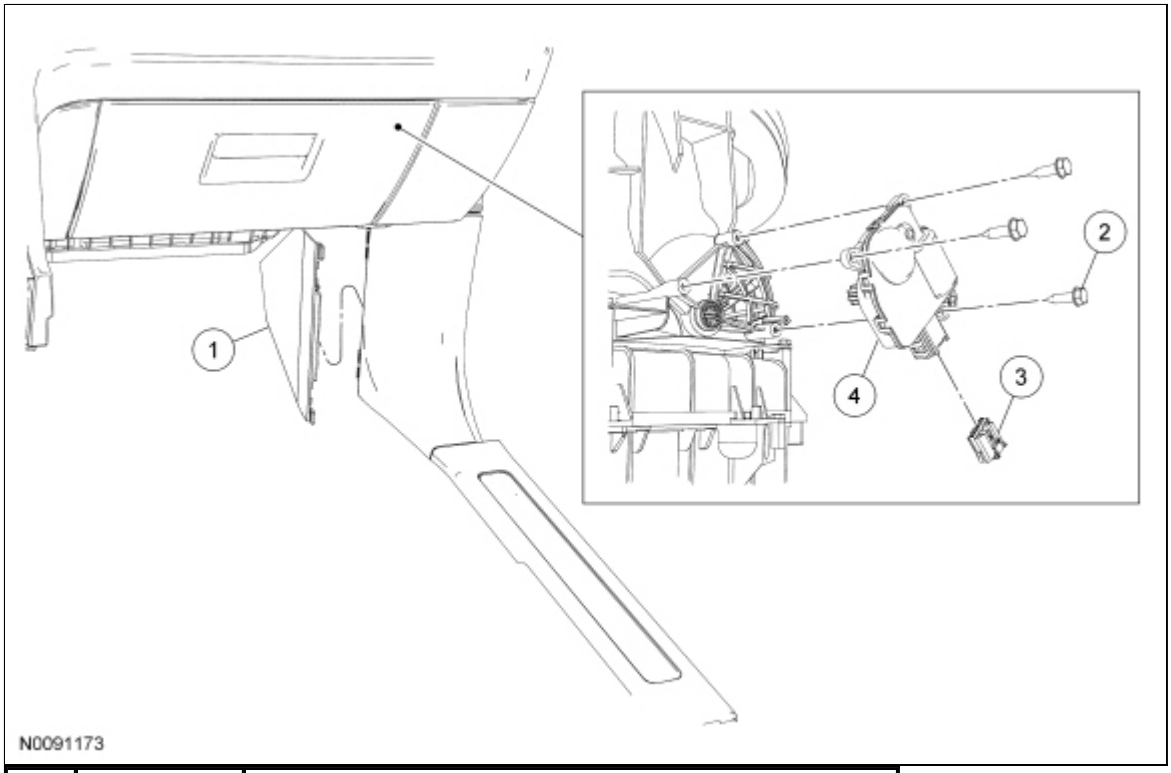
1. Remove the 3 steering column cover screws and the steering column cover.
2. Remove the 4 steering column cover reinforcement bolts.
3. Detach the in-vehicle temperature and humidity sensor aspirator hose.
4. Disconnect the in-vehicle temperature and humidity sensor electrical connector.

5. Remove the in-vehicle temperature and humidity sensor.
6. To install, reverse the removal procedure.

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Mode Door Actuator — Air Inlet Door



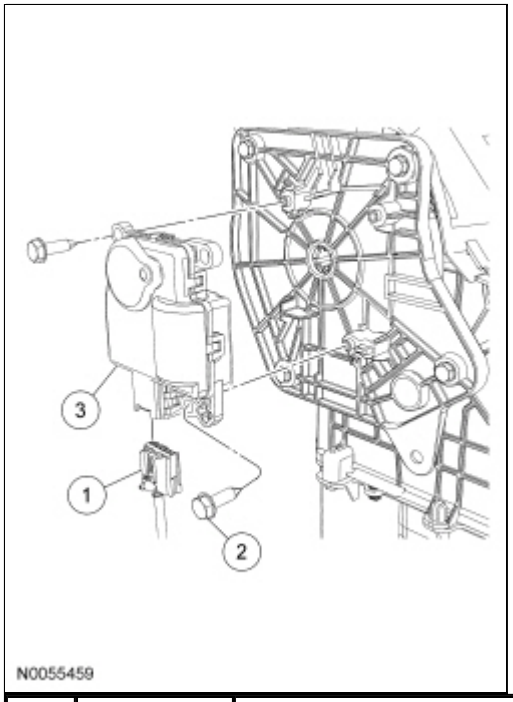
Item	Part Number	Description
1	023A98	Junction box cover
2	W701696	Air inlet mode door actuator screw (3 required)
3	—	Air inlet mode door actuator electrical connector (part of 18B574)
4	19E616	Air inlet mode door actuator

Removal and Installation

1. Remove the junction box cover.
2. Disconnect the air inlet mode door actuator electrical connector.
3. Remove the 3 air inlet mode door actuator screws.
4. Remove the air inlet door mode door actuator.
5. To install, reverse the removal procedure.

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Mode Door Actuator — Defrost/Panel/Floor Door



Item	Part Number	Description
1	—	Defrost/panel/floor door mode door actuator electrical connector (part of 18B518)
2	W701696	Defrost/panel/floor door mode door actuator screw (2 required)
3	19E616	Defrost/panel/floor door mode door actuator

Removal and Installation

NOTE: The defrost/panel/floor mode door actuator can be accessed from underneath the LH side of the instrument panel.

1. Disconnect the defrost/panel/floor door mode door actuator electrical connector.
2. Remove the 2 defrost/panel/floor door mode door actuator screws.
3. Remove the defrost/panel/floor door mode door actuator.
4. ***NOTICE:*** **The ignition key must be off when replacing the actuator. Energizing the actuator before installation will cause the part to become positioned incorrectly and proper orientation will be lost. Incorrect actuator operation will result.**

   To install, reverse the removal procedure.

5. Remove the passenger side cowl trim panel. For additional information, refer to Section 501-12 .

6. **NOTE:** The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out calibration, carry out the following steps.

   Remove Body Control Module BCM fuse 46 for at least one minute.

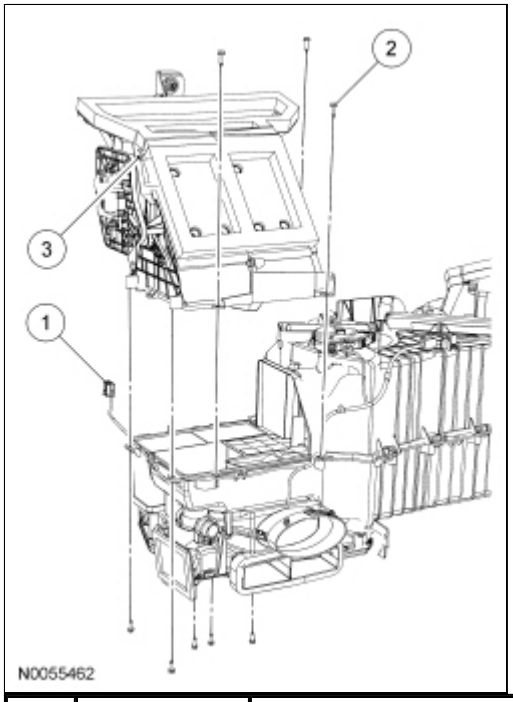
7. **NOTE:** When the ignition switch is switched to the ON position, the HVAC module will initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds.

   Reinstall BCM fuse 46. Turn the ignition switch to the ON position and wait 30 seconds before verifying correct mode door actuator operation.

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Plenum Chamber



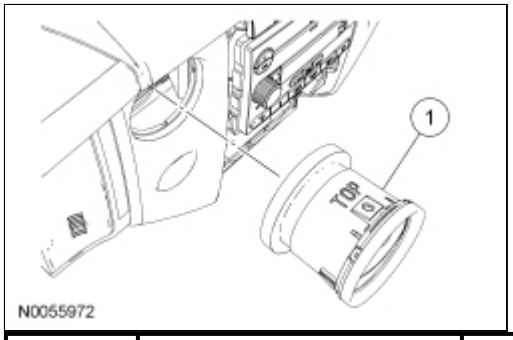
Item	Part Number	Description
1	18B518	Mode door actuator electrical connector (part of 18B518)
2	W701696	Plenum chamber screw (8 required)
3	18471	Plenum chamber

Removal and Installation

1. Remove the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.
2. Disconnect the mode door actuator electrical connector and position the wire harness aside.
3. Remove the 8 plenum chamber screws and remove the plenum chamber.
4. To install, reverse the removal procedure.

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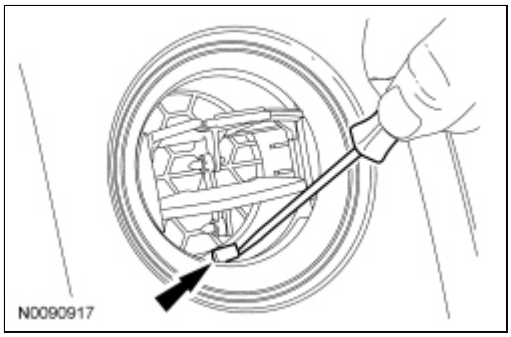
Register



Item	Part Number	Description
1	19893	Register assembly

Removal

1. Using a suitable 90 degree pick-type tool, individually release the 4 clips while gently pulling the register outward to keep the clips from reengaging.



2. Remove the register.

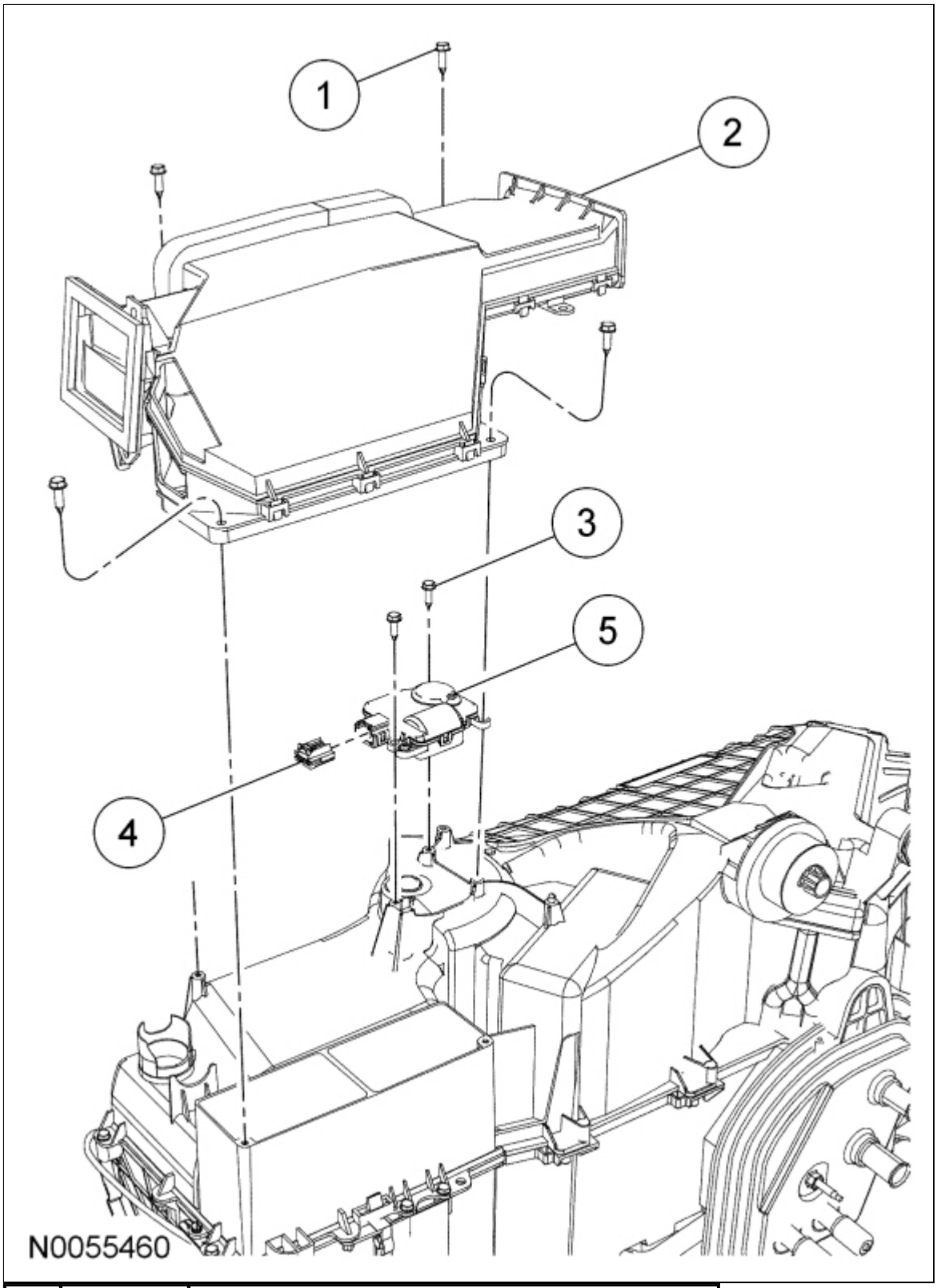
Installation

1. Install the register by aligning it with the opening in the instrument panel and carefully pushing it into the opening until the retaining clips engage.

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Temperature Blend Door Actuator — Driver Side

NOTE: The heater box is shown upside down in the illustration for clarity purposes.



Item	Part Number	Description
1	W701696	Floor duct screw (4 required)
2	18C433	Floor duct

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3	W701696	Driver side temperature blend door actuator screw (2 required)
4	—	Driver side temperature blend door actuator electrical connector (part of 18B574)
5	19E616	Driver side temperature blend door actuator

Removal and Installation

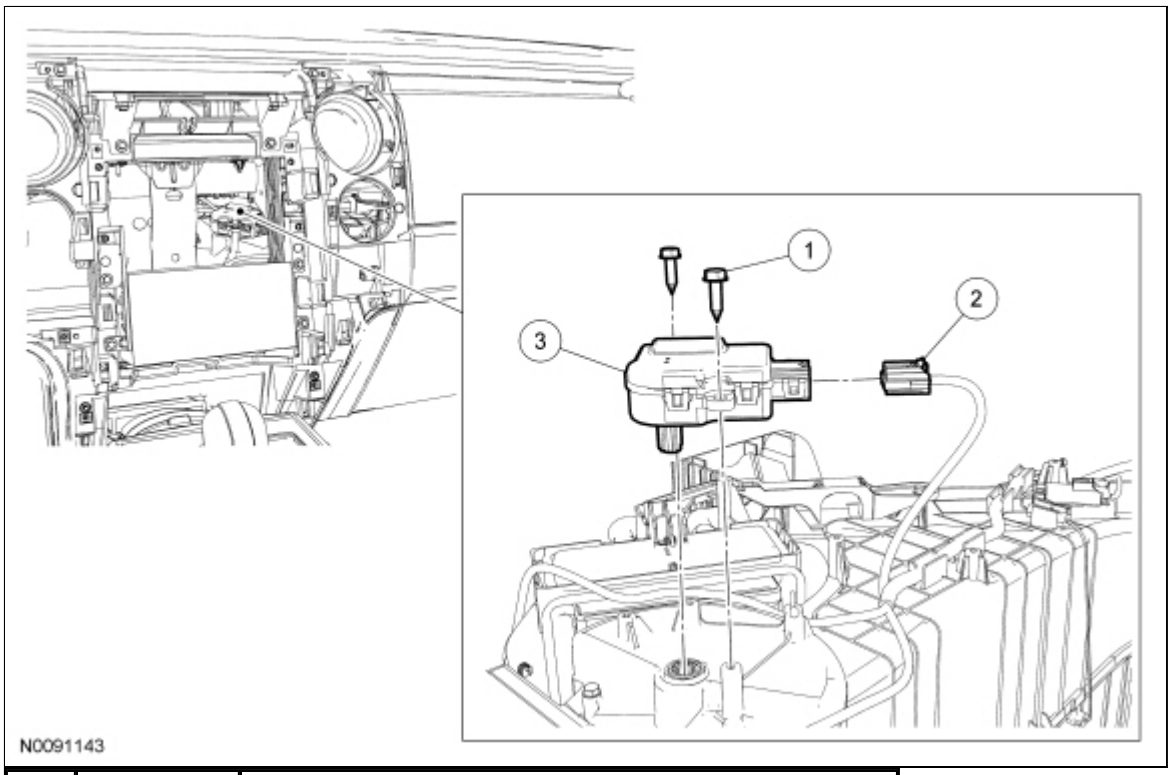
NOTE: The driver side temperature blend door actuator is present on dual-zone Electronic Automatic Temperature Control (EATC) vehicles to control the driver side temperature blend door only. Vehicles equipped with Electronic Manual Temperature Control (EMTC) are not equipped with this actuator. For EMTC vehicles, refer to Temperature Blend Door Actuator — Passenger Side in this section.

1. Remove the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.
2. Remove the 4 floor duct screws and remove the floor duct.
3. Disconnect the driver side temperature blend door actuator electrical connector.
4. Remove the 2 driver side temperature blend door actuator screws.
5. Remove the driver side temperature blend door actuator.
6. To install, reverse the removal procedure.
7. **NOTE:** Because the battery has been disconnected as part of the removal procedure, the HVAC module will initialize and calibrate the actuators when the ignition switch is switched to the ON position. The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. Calibration of the actuators will take approximately 30 seconds.

   Turn the ignition switch to the ON position and wait 30 seconds before verifying correct temperature blend door actuator operation.

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Temperature Blend Door Actuator — Passenger Side

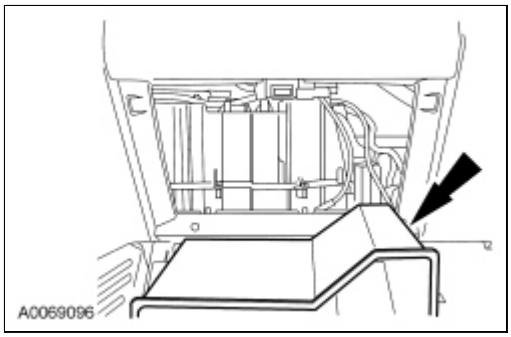


Item	Part Number	Description
1	W701696	Temperature blend door actuator screw (2 required)
2	—	Temperature blend door actuator electrical connector (part of 18B574)
3	19E616	Temperature blend door actuator

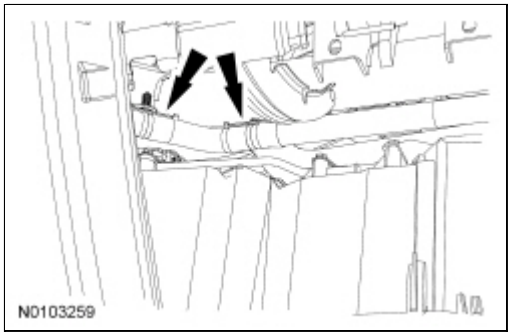
Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, Refer to the appropriate section in Group 415 for the procedure.

2. While pushing the glove compartment door tab, position the glove compartment downward.



3. Detach the 2 wire harness pin-type retainers and position the wire harness aside.



4. **NOTE:** The forward temperature blend door actuator screw can be removed with a combination wrench. With one hand working through the ACM opening, hold the top end of the combination wrench. With the other end of the combination wrench pointing away (toward the right front corner of the vehicle), and with the other hand working through the glove compartment opening, the combination wrench can be manipulated.

   Remove the 2 temperature blend door actuator screws.

5. Detach the temperature blend door actuator.

6. Disconnect the temperature blend door actuator electrical connector.

7. Remove the temperature blend door actuator.

8. ***NOTICE:*** **The ignition key must be off when replacing the actuator. Energizing the actuator before installation will cause the part to become positioned incorrectly and proper orientation will be lost. Incorrect actuator operation will result.**

   To install, reverse the removal procedure.

9. **NOTE:** The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out calibration, carry out the following steps.

   Remove BCM fuse 46 for at least one minute.

10. **NOTE:** When the ignition switch is switched to the ON position, the HVAC module will initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds.

    Reinstall BCM fuse 46. Turn the ignition switch to the ON position and wait 30 seconds before

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verifying correct mode door actuator operation.

Thermostatic Expansion Valve Manifold and Tube Assembly

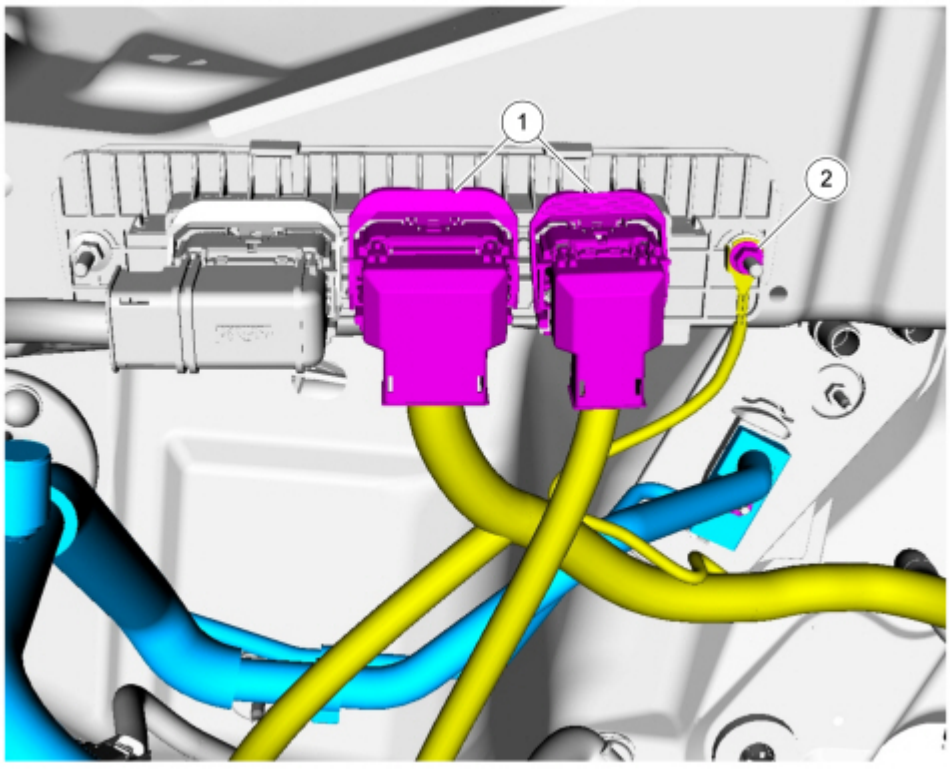
Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

Removal and Installation

1. Recover the refrigerant. For additional information, refer to Section 412-00 .

2. Disconnect the 2 PCM electrical connectors and the ground cable.
    1. Disconnect the 2 PCM electrical connectors.
    2. If equipped with a 5.0L engine, remove the nut and disconnect the ground cable.
    - To install, tighten to 9 Nm (80 lb-in).



3. Remove the condenser outlet fitting nut and disconnect the fitting.
    - Discard the O-ring seal and gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

4. Remove the Thermostatic Expansion Valve (TXV) manifold and tube bracket bolt.

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- To install, tighten to 8 Nm (71 lb-in).

5. Remove the evaporator-to-compressor suction line fitting nut and disconnect the fitting.
   - Discard the O-ring seal and gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

6. Remove the TXV fitting nut and disconnect the fitting.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

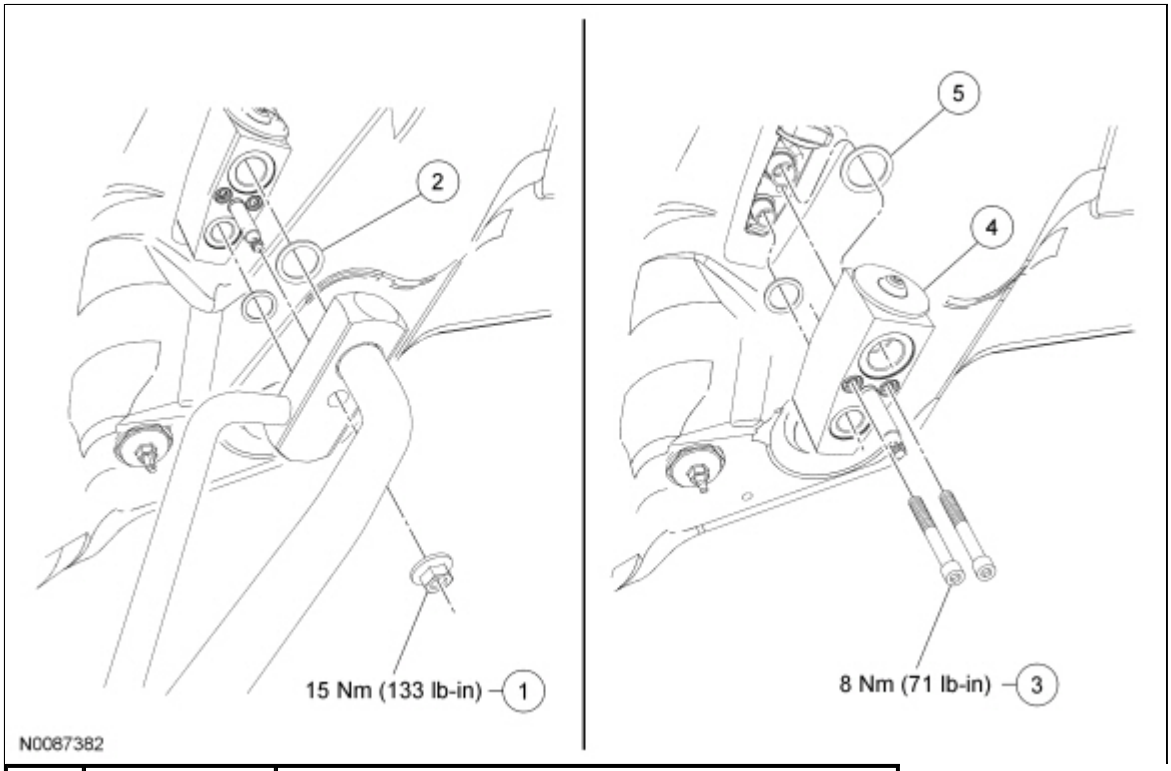
7. To install, reverse the removal procedure.
   - Install new gasket seals and O-ring seals.
   - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00 .

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Thermostatic Expansion Valve

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



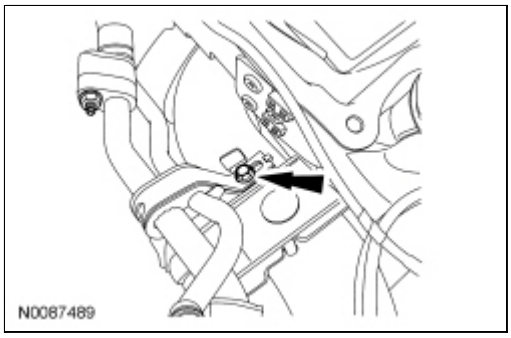
Item	Part Number	Description
1	W505424	Thermostatic Expansion Valve (TXV) fitting nut
2	19B596	Gasket seal kit (2 pieces from kit required)
3	—	TXV bolt (part of 19849 kit) (2 required)
4	19849	TXV
5	19B596	Gasket seal kit (2 pieces from kit required)

Removal and Installation

1. Recover the refrigerant. For additional information, refer to Section 412-00 .

2. Remove the Thermostatic Expansion Valve (TXV) manifold and tube bracket bolt.
   - To install, tighten to 8 Nm (71 lb-in).

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3. Remove the TXV fitting nut and disconnect the fitting.
    - Discard the gasket seals.
    - To install, tighten to 15 Nm (133 lb-in).

4. Remove the 2 TXV bolts.
    - To install, tighten to 8 Nm (71 lb-in).

5. Remove the TXV .
    - Discard the gasket seals.

6. To install, reverse the removal procedure.
    - Install new gasket seals.
    - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00 .

7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Instrument Cluster and Panel Illumination

Dimmable Backlighting

The dimmable backlighting system consists of the following components:

- Floor console lamp
- Floor shifter
- Hazard switch/Passenger Air Bag Deactivation (PAD) indicator/Traction control switch (without 4.2- inch [107mm] or 8- inch [203mm] display)
- Stability/traction control switch (with 4.2- inch [107mm] or 8- inch [203mm] display)
- Headlamp switch
- Hill descent control switch
- Instrument panel dimmer switch
- Mode select switch
- Off-road mode switch (Raptor only)
- Overhead console
- Steering wheel switches
- Upfitter switch (Raptor only)
- Audio Front Control Module (ACM) (base audio only)
- Front Controls Interface Module (FCIM)
- Front Display Interface Module (FDIM) (with 8- inch [203mm] touch screen or non-touch screen)
- FCDIM
- HVAC module (without 4.2- inch [107mm] or 8- inch [203mm] display)
- Instrument Panel Cluster (IPC)
- Trailer Brake Control (TBC) module

The dimmable switches and components are illuminated when the parking lamps are on. The instrument panel dimmer switch is a double detent rocker switch used to control all dimmable interior illuminated components and the courtesy lamps. The first up detent increases dimmable backlighting intensity. The first down detent decreases dimmable backlighting intensity. The second up detent turns the courtesy lamps on. The second down detent turns the courtesy lamps off (allowing other features to control the courtesy lamps).

On vehicles equipped with autolamps, if the exterior lamps are activated during the daytime, the message center illumination remains at full intensity and does not dim from the instrument panel dimmer switch during this condition. If the vehicle travels under a bridge or a tunnel, the low level of ambient light causes the illumination level of the message center to change to the level set by the instrument panel dimmer switch. The message center illumination changes back to full intensity when the intense ambient light is restored.

Non-Dimmable Backlighting

The non-dimmable backlighting system consists of the following components:

- Door lock control switches
- Rear heated seat switches
- Window control switches

Non-dimmable illumination provides backlighting with the ignition on or ignition off while the accessory delay

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relay is energized.

Instrument Cluster and Panel Illumination

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

Dimmable Backlighting

When the parking lamps are on, the Steering Column Control Module (SCCM) monitors the input from the instrument panel dimmer switch. The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN) relaying the instrument panel dimmer switch input. Based on the input from the instrument panel dimmer switch, the BCM sends voltage to the dimmable switches. The BCM sends a message to the HVAC module and to the ACM (except base AM/FM) on the MS-CAN and a message to the Trailer Brake Control (TBC) module and Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) to indicate the backlighting intensity level. The IPC sends a message to indicate the backlighting intensity level to the APIM, FCIM, and FCDIM over the Infotainment Controller Area Network (I-CAN).

If the receiving module receives invalid backlighting data from the BCM or from the IPC for 5 seconds or less, the receiving module defaults the backlighting to the last setting. If the receiving module does not receive the backlighting status message from the BCM or from the IPC or if the data received is deemed invalid for more than 5 seconds, the receiving module sets a missing message related DTC in continuous memory and defaults the backlighting to full nighttime intensity.

Non-Dimmable Backlighting

When the accessory delay relay is energized, switched voltage is supplied to the rear heated seat switches, window control and door lock control switches.

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Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

The BCM utilizes an FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit is still shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by the clear the continuous DTCs command. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When each level is reached, the DTC associated with the short circuit sets along with DTC U1000:00. These DTCs are cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuit for the instrument cluster and panel illumination system is the dimmable switch output circuit.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical

• Body Control Module (BCM) fuse(s):
  ▪ 12 (15A)
  ▪ 32 (15A)
• Wiring, terminals or connectors
• Illuminated components

- BCM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool release software.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication with one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM.

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.
   If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1124:09	Lamp Fade Control: Component Failure	GO to Pinpoint Test A.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1315:11	Backlighting (Non	GO to Pinpoint Test B.

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	Reflective Controls) Illumination Output: Circuit Short To Ground	
B1315:15	Backlighting (Non Reflective Controls) Illumination Output: Circuit Short To Battery or Open	If the backlighting components are inoperative, GO to Pinpoint Test B . If the backlighting components are always on, GO to Pinpoint Test C .
U1000:00	Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first. After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
U3000:49	Control Module: Internal Electrical Failure	The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. CORRECT the cause of the excessive current draw before installing a new BCM . ADDRESS all other DTCs first. After the cause of the concern is corrected, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

FCIM DTC Chart

DTC	Description	Action
B113C:11	Hazard Switch Illumination: Circuit Short To Ground	CLEAR the DTC. WAIT at least 10 seconds. REPEAT the self-test. If DTC B113C:11 is retrieved again, INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure. TEST the system for normal operation.
All other DTCs	—	Refer to the appropriate section in Group 415 for the procedure.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All dimmable illumination does not dim	• Wiring, terminals or connectors • Instrument panel dimmer switch • Steering Column Control Module	• GO to Pinpoint Test A .

	(SCCM)	
• All dimmable non-networked illumination is inoperative	• Fuse • Wiring, terminals or connectors • Body Control Module (BCM)	• GO to Pinpoint Test B .
• All dimmable non-networked illumination is always on	• Wiring, terminals or connectors • BCM	• GO to Pinpoint Test C .
• The steering wheel switch(es) illumination is inoperative	• Wiring, terminals or connectors • Steering wheel switch (es) • Steering wheel harness • Clockspring	• GO to Pinpoint Test D .
• One or more illumination source is inoperative	• Wiring, terminals or connectors • Door lock control switch • Illuminated switch	• GO to Pinpoint Test E .
• The window control switch illumination is inoperative	• Window control switch	• CHECK the operation of the power windows. ▪ If the power windows operate correctly, INSTALL a new window control switch. REFER to Section 501-11 . TEST the system for normal operation. ▪ If the power windows do not operate correctly, REFER to Section 501-11 .
• All network controlled illumination does not dim	• Controller Area Network (CAN) concern • BCM	• CARRY OUT the network test. ▪ If the scan tool responds with no communication to any module on the CAN , REFER to Section 418-00 . ▪ If the scan tool communicates with the modules on the CAN , INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
• The Instrument Panel Cluster (IPC) illumination is inoperative	• High Speed Controller Area Network (HS-CAN) • IPC	• CARRY OUT the network test. ▪ If the scan tool responds with no communication with the IPC , REFER to Section 418-00 . ▪ If the scan tool communicates

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		with the IPC , INSTALL a new IPC . REFER to Section 413-01 . TEST the system for normal operation.
• The HVAC module illumination is inoperative (without 4.2- inch [107mm] or 8-inch [203mm] display)	• Medium Speed Controller Area Network (MS-CAN) • HVAC module	• CARRY OUT the network test. ▪ If the scan tool responds with no communication with the HVAC module, REFER to Section 418-00 . ▪ If the scan tool communicates with the HVAC module, INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.
• The Audio Front Control Module (ACM) illumination is inoperative (base AM/FM radio)	• Wiring, terminals or connectors • ACM	• GO to Pinpoint Test E .
• The Front Controls Interface Module (FCIM) illumination is inoperative/does not dim	• Medium Speed Controller Area Network (MS-CAN) (without 4.2-inch [107mm] display or 8-inch [203mm] touch screen) • Infotainment Controller Area Network (I-CAN) (with 4.2- inch [107mm] display or 8-inch [203mm] touch screen) • FCIM	• CARRY OUT the network test. ▪ If the scan tool responds with no communication with the FCIM , REFER to Section 418-00 . ▪ If the scan tool communicates with the FCIM , INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure.
• The Front Display Interface Module (FDIM) illumination is inoperative/does not dim (non-touchscreen)	• MS-CAN • FDIM	• CARRY OUT the network test. ▪ If the scan tool responds with no communication with the FDIM , REFER to Section 418-00 . ▪ If the scan tool communicates with the FDIM , INSTALL a new FDIM . REFER to Section 415-00B . TEST the system for normal operation.
• The FDIM illumination is inoperative/does not dim (with 8-inch [203mm] touchscreen)	• APIM • FDIM	• VERIFY that the audio system can be operated from the FDIM . ▪ If the audio system operates correctly from the FDIM inputs, For diagnosing and testing please refer to the on-line

		Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. If the APIM replacement does not resolve the condition, replace the FDIM. REFER to Section 415-00D or Section 415-00E. TEST the system for normal operation. ■ If the audio system does not operate correctly from the FDIM inputs, REFER to Section 415-00D or Section 415-00E.
• The FCDIM illumination is inoperative/does not dim (with 4.2-inch [107mm] display)	• Infotainment Controller Area Network (I-CAN) • FCDIM	• CARRY OUT the network test. ■ If the scan tool communicates with the FCDIM, INSTALL a new FCDIM. REFFER to: Section 415-00C. TEST the system for normal operation. ■ If the scan tool does not communicate with the FCDIM, REFER to Section 418-00.
• The hazard switch/ PAD indicator illumination is inoperative/does not dim (with 4.2-inch [107mm] and 8- inch [203mm] display only)	• FCIM	• INSTALL a new FCIM. Refer to the appropriate section in Group 415 for the procedure. TEST the system for normal operation.
• The hazard switch/ PAD indicator/traction control switch illumination is inoperative/does not dim (without 4.2- inch [107mm] or 8- inch [203mm] display)	• Wiring, terminals or connectors • Illuminated switch	• GO to Pinpoint Test E.
• Stability/traction control switch illumination is inoperative/does not dim (with 4.2-inch [107mm] or 8- inch [203mm] display)	• Wiring, terminals or connectors • Illuminated switch	• GO to Pinpoint Test E.
• The Trailer Brake Control (TBC) module illumination is inoperative	• HS-CAN • TBC module	• CARRY OUT the network test. ■ If the scan tool responds with no communication with the TBC module, REFER to Section 418-00. ■ If the scan tool communicates with the TBC module, INSTALL a

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		new TBC module, REFER to Section 206-10 . TEST the system for normal operation.

Pinpoint Tests

Pinpoint Test A: All Dimmable Illumination Does Not Dim

Refer to Wiring Diagrams Cell 71 , Cluster and Panel Illumination for schematic and connector information.

Normal Operation

When the parking lamps are on, the dimmable backlighting intensity can be changed by pressing the instrument panel dimmer switch to the first detent up or first detent down. The instrument panel dimmer switch is a momentary contact switch. When the instrument panel dimmer switch is placed in the first detent up or down, the corresponding input signal is routed back to the SCCM to an internal ground indicating a request to turn the dimmable lighting up or down. The SCCM retains the last brightness setting between uses.

Based on the input received from the instrument panel dimmer switch, the SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The BCM sends a network message to the backlit modules indicating the backlighting intensity level and a voltage to the hardwired dimmable illumination sources.

When the instrument panel dimmer switch is pressed to the second detent, the dome lamp request input circuit is routed to ground in addition to the instrument panel dimmer switch input circuit. The SCCM needs both an instrument panel dimmer switch up/down input circuit and the dome lamp request input circuit to turn the courtesy lamps on or off from the instrument panel dimmer switch.

If the SCCM detects a concern with the instrument panel dimmer switch up/down input circuit or the dome lamp request input circuit, the backlighting defaults to full nighttime brightness.

- DTC B1124:09 (Lamp Fade Control: Component Failure) — a continuous and on-demand DTC that sets when the SCCM detects a short to ground from the instrument panel dimmer switch up/down input or dome lamp request input circuits.

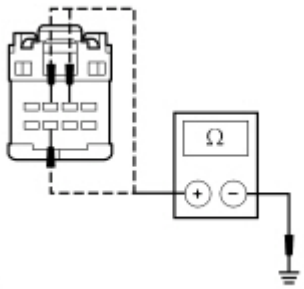
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Instrument panel dimmer switch
- SCCM

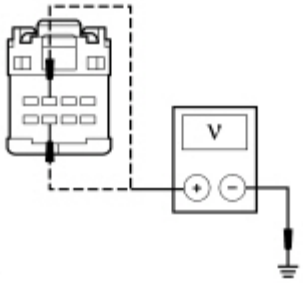
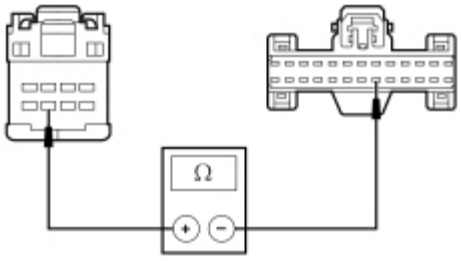
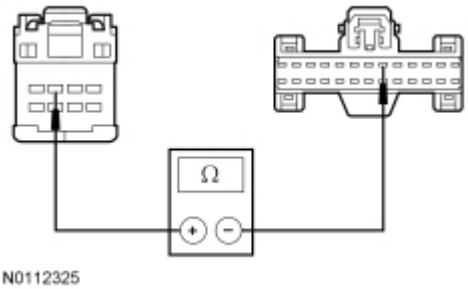
PINPOINT TEST A: ALL DIMMABLE ILLUMINATION DOES NOT DIM

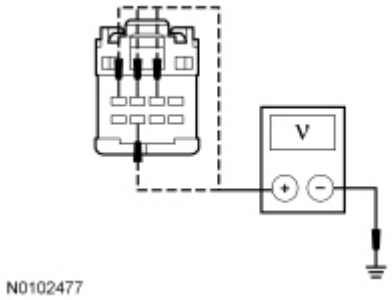
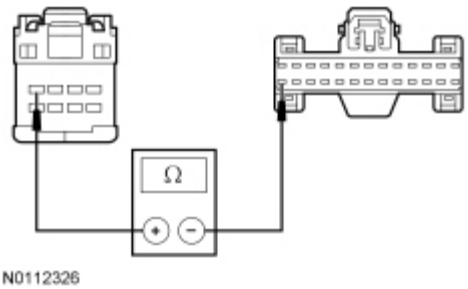
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

A1 CHECK THE RECORDED RESULTS FROM THE SCCM ON-DEMAND SELF-TEST	
• Ignition OFF. • Review the recorded results from the SCCM on-demand self-test. • **Is DTC B1124:09 present?**	**Yes** GO to A2 . **No** GO to A4 .
A2 CHECK THE INSTRUMENT PANEL DIMMER SWITCH	
• Disconnect: Instrument Panel Dimmer Switch C2298 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: SCCM Self-Test . • Clear the DTCs and repeat the SCCM self-test. • **Is DTC B1124:09 still present?**	**Yes** GO to A3 . **No** INSTALL a new instrument panel dimmer switch. REFER to Instrument Panel Dimmer Switch in this section. TEST the system for normal operation.
A3 CHECK THE INSTRUMENT PANEL DIMMER SWITCH INPUT CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SCCM C2414A . • Measure the resistance between the instrument panel dimmer switch, harness side and ground as follows: Connector-Pin / Circuit: C2298-2 — VLN36 (GY/OG) C2298-3 — CLN55 (YE/VT) C2298-7 — CLN56 (BN/VT)  N0102475 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to A9 . **No** REPAIR the circuit in question for a short to ground. CLEAR the DTCs. REPEAT the self-test.
A4 CHECK THE INSTRUMENT PANEL DIMMER SWITCH	
• Disconnect: Instrument Panel Dimmer Switch C2298 . • Carry out the instrument panel dimmer switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the instrument panel dimmer switch OK?**	**Yes** GO to A5 . **No** INSTALL a new instrument panel dimmer switch. REFER to Instrument Panel Dimmer Switch in this section. TEST the system for normal operation.

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A5 CHECK THE INSTRUMENT PANEL DIMMER SWITCH UP AND DOWN INPUT CIRCUITS FOR VOLTAGE	
• Ignition ON. • Measure the voltage between the instrument panel dimmer switch C2298-7, circuit CLN56 (BN/VT), harness side and ground; and between the instrument panel dimmer switch C2298-3, circuit CLN55 (YE/VT), harness side and ground.  N0102476 • **Are the voltages greater than 5 volts?**	**Yes** GO to A7 . **No** GO to A6 .
A6 CHECK THE INSTRUMENT PANEL DIMMER SWITCH UP AND DOWN INPUT CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: SCCM C2414A . • Measure the resistance between the instrument panel dimmer switch C2298-7, circuit CLN56 (BN/VT), harness side and the SCCM C2414A-19, circuit CLN56 (BN/VT), harness side.  N0112324 • Measure the resistance between the instrument panel dimmer switch C2298-3, circuit CLN55 (YE/VT), harness side and the SCCM C2414A-6, circuit CLN55 (YE/VT), harness side.  N0112325 • **Are the resistances less than 5 ohms?**	**Yes** GO to A9 . **No** REPAIR the circuit in question for an open. TEST the system for normal operation.

A7 CHECK THE INSTRUMENT PANEL DIMMER SWITCH INPUT AND RETURN CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SCCM C2414A . • Ignition ON. • Measure the voltage between the instrument panel dimmer switch, harness side and ground as follows: **Connector-Pin / Circuit** C2298-2 — VLN36 (GY/OG) C2298-3 — CLN55 (YE/VT) C2298-4 — RLN29 (WH/OG) C2298-7 — CLN56 (BN/VT)  N0102477 • **Is any voltage present?**	**Yes** REPAIR the circuit in question for a short to voltage. TEST the system for normal operation. **No** GO to A8 .
A8 CHECK THE INSTRUMENT PANEL DIMMER SWITCH RETURN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the instrument panel dimmer switch C2298-4, circuit RLN29 (WH/OG), harness side and the SCCM C2414A-26, circuit RLN29 (WH/OG), harness side.  N0112326 • **Is the resistance less than 5 ohms?**	**Yes** GO to A9 . **No** REPAIR the circuit for an open. TEST the system for normal operation.
A9 CHECK FOR CORRECT SCCM OPERATION	
• Connect all disconnected connectors. • Disconnect all the SCCM connectors. • Check for: ▪ corrosion	**Yes** INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.

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▪ damaged pins ▪ pushed-out pins • Connect all the SCCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. RUN the on-demand self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.

Pinpoint Test B: All Dimmable Non-Networked Illumination Is Inoperative

Refer to Wiring Diagrams Cell 71 , Cluster and Panel Illumination for schematic and connector information.

Normal Operation

When the parking lamps are on, the Body Control Module (BCM) provides voltage to the hardwired dimmable illumination sources based on the Steering Column Control Module (SCCM) illumination messages sent to the BCM over the network.

DTC Description	Fault Trigger Conditions
• B1315:11 — Backlighting (Non Reflective Controls) Illumination Output: Circuit Short To Ground	A continuous and on-demand DTC that sets when the BCM detects a short to ground from the backlighting output circuit. This DTC also sets when fuse 12 (15A) has failed or is removed.
• B1315:15 — Backlighting (Non Reflective Controls) Illumination Output: Circuit Short To Battery or Open	An on-demand DTC that sets when the BCM detects an open from the backlighting output circuit.
• U1000:00 — Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	A continuous DTC that sets when the BCM has temporarily shut down the output driver. The module has temporarily disabled the backlighting output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the backlighting output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.
• U3000:49 — Control Module: Internal Electrical Failure	A continuous DTC that sets when the BCM has permanently shut down the output driver. The module has permanently disabled the backlighting output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. Correct the cause of the excessive current draw before installing a new BCM .

This pinpoint test is intended to diagnose the following:

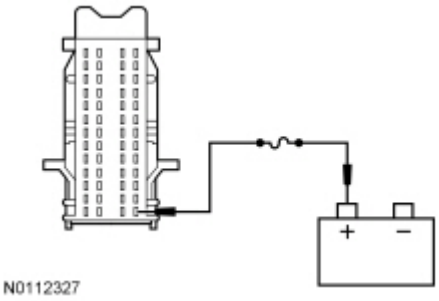
- Fuse
- Wiring, terminals or connectors
- BCM

PINPOINT TEST B: ALL DIMMABLE NON-NETWORKED ILLUMINATION IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK FOR RECORDED BCM DTCs FROM THE ON-DEMAND SELF-TEST	
• Use the recorded results from the BCM self-test. • **Is DTC B1315:11 present?**	**Yes** VERIFY the BCM fuse 12 (15A) is OK. If OK, GO to B2. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the backlighting output driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation. **No** GO to B2.
B2 BYPASS THE BCM	
• Ignition OFF. • Disconnect: BCM C2280B. • **NOTE:** If the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC U1000:00 is present, clear the DTCs **and** repeat the self-test **(required to enable the courtesy lamp output driver if DTC U1000:00 is present).** Test the system for normal operation. If DTC U3000:49 is present, install a new BCM. Refer to Section 419-10. Test the system for normal operation. • Connect a fused jumper wire between the BCM C2280B-	**Yes** REMOVE the jumper wire. GO to B3. **No** REMOVE the jumper wire. REPAIR circuit VLN04 (VT/GY) for an open. TEST the system for normal operation.

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40, circuit VLN04 (VT/GY) and battery positive.  • **Do the backlighting components illuminate?**	

B3 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: All Dimmable Non-Networked Illumination Is Always On

Refer to Wiring Diagrams Cell 71, Cluster and Panel Illumination for schematic and connector information.

Normal Operation

When the parking lamps are on, the Body Control Module (BCM) provides voltage to the hardwired dimmable illumination sources based on the Steering Column Control Module (SCCM) illumination messages sent to the BCM over the network.

- B1315:15 (Backlighting (Non Reflective Controls) Illumination Output: Circuit Short To Battery or Open) — an on-demand DTC that sets when the BCM detects a short to voltage from the backlighting output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BCM

PINPOINT TEST C: ALL DIMMABLE NON-NETWORKED ILLUMINATION IS ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

C1 CHECK THE EXTERIOR LIGHTING	
• Place the headlamp switch in the OFF position. • Observe the parking lights. • **Are the parking lights illuminated?**	**Yes** REFER to Section 417-01 . **No** GO to C2 .
C2 CHECK THE BCM BACKLIGHTING OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280B . • Ignition ON. • **Do the dimmable backlighted components continue to illuminate?**	**Yes** REPAIR circuit VLN04 (VT/GY) for a short to voltage. TEST the system for normal operation. **No** GO to C3 .
C3 CHECK FOR CORRECT BCM OPERATION	

• Ignition OFF.
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: The Steering Wheel Switch(es) Illumination Is Inoperative

Refer to Wiring Diagrams Cell 71 , Cluster and Panel Illumination for schematic and connector information.

Normal Operation

When the parking lamps are on, the Body Control Module (BCM) sends voltage to the clockspring. The voltage passes through the clockspring to the steering wheel switches.

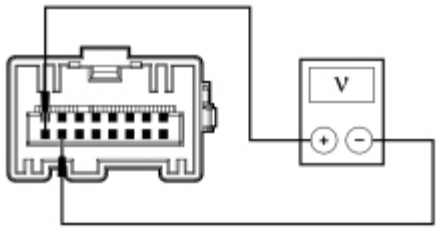
This pinpoint test is intended to diagnose the following:

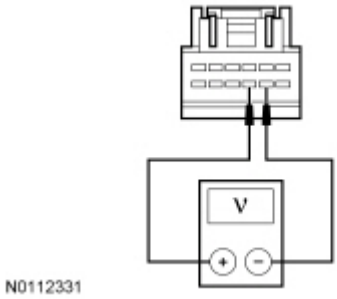
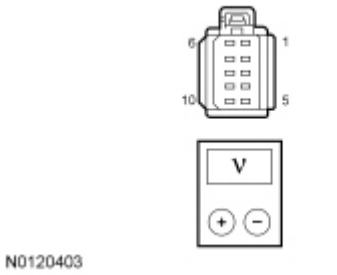
- Wiring, terminals or connectors
- Steering wheel switch(es)
- Steering wheel harness
- Clockspring

PINPOINT TEST D: THE STEERING WHEEL SWITCH(ES) ILLUMINATION IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

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Test Step	Result / Action to Take
D1 CHECK THE OTHER DIMMABLE LIGHTING SWITCHES • Ignition ON. • Place the headlamp switch in the PARKING LAMPS ON position. • Press and hold the instrument panel dimmer switch up to the full illumination position and observe other dimmable switches. • **Are all the dimmable steering wheel switches inoperative?**	**Yes** GO to Pinpoint Test A . **No** If all the steering wheel switches illumination is inoperative, GO to D2 . If only one steering wheel switch illumination is inoperative, GO to D5 .
D2 CHECK THE HORN OPERATION • Press the driver air bag module against the steering wheel. • **Does the horn sound?**	**Yes** GO to D3 . **No** REFER to Section 413-06 to diagnose the horn is inoperative.
D3 CHECK FOR VOLTAGE TO THE STEERING WHEEL SWITCHES • Place the headlamp switch in the OFF position. • Remove the driver air bag module. Refer to Section 501-20B . • Disconnect: Clockspring C218B . • Ignition ON. • Place the headlamp switch in the PARKING LAMPS ON position. • Press and hold the instrument panel dimmer switch up to the full illumination position. • Measure the voltage between the clockspring C218B-9, component side and the clockspring C218B-10, component side.  N0116238 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new steering wheel. REFER to Section 211-04 . TEST the system for normal operation. **No** GO to D4 .
D4 CHECK FOR VOLTAGE TO THE CLOCKSPRING • Disconnect: Clockspring C218A . • Measure the voltage between the clockspring C218A-9, circuit VLN04 (VT/GY), harness side and the clockspring C218A-8, circuit GD133 (BK), harness side.	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation. **No**

 • **Is the voltage greater than 10 volts?**	REPAIR circuit VLN04 (VT/GY) for an open. TEST the system for normal operation.
D5 CHECK THE SUSPECT STEERING WHEEL SWITCH FOR VOLTAGE • Disconnect: Suspect Steering Wheel Switch . • Press and hold the instrument panel dimmer switch up to the full illumination position. • Measure the voltage between the inoperative illumination source, harness side as follows: **Component** / **Connector-Pin** / **Connector-Pin** Steering wheel switch — LH / C2998-2 / C2998-4 Steering wheel switch — RH / C2999-1 / C2999-3  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new component for the one in question. TEST the system for normal operation. **No** INSTALL a new steering wheel. REFER to Section 211-04 . TEST the system for normal operation.

Pinpoint Test E: One Or More Illumination Source Is Inoperative

Refer to Wiring Diagrams Cell 71 , Cluster and Panel Illumination for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends voltage to the dimmable components.

For the base Audio Front Control Module (ACM) (AM/FM only), the BCM supplies voltage to the ACM illumination based on the Steering Column Control Module (SCCM) illumination messages sent to the BCM over the network.

When the accessory delay relay energizes, voltage is provided to the non-dimmable switches.

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This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- ACM
- Door lock control switch
- Illuminated switch
- Illuminated component

PINPOINT TEST E: ONE OR MORE ILLUMINATION SOURCE IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>E1 CHECK THE VOLTAGE TO THE SINGLE ILLUMINATION</td><td rowspan="2">Yes
For a door lock control switch, INSTALL a new door lock control switch. REFER to Section 501-14 . TEST the system for normal operation.

For rear heated seat switch, INSTALL a new rear heated seat switch. REFER to Section 501-10 .

For an instrument panel dimmer switch, INSTALL a new instrument panel dimmer switch. REFER to Instrument Panel Dimmer Switch in this section. TEST the system for normal operation.

For all other components, GO to E2 .

No
REPAIR circuit VLN04 (VT/GY) or circuit CBP32 (GN/VT) for an open. TEST the system for normal operation.</td></tr>
<tr><td>NOTE: If the instrument panel dimmer switch illumination is the inoperative source, increase the backlighting brightness to the highest setting before unplugging the instrument panel dimmer switch connector.
• Ignition OFF.
• Disconnect: Inoperative Illumination Source .
• Ignition ON.
• NOTE: If the headlamp switch illumination is the inoperative source, unplugging the headlamp switch connector causes the BCM to turn the exterior lights on by default, so there is no need to turn the parking lamps on.
• Place the headlamp switch to the PARKING LAMPS ON position.
• Increase the backlighting brightness to the highest setting.
• Measure the voltage between the inoperative illumination source, harness side and ground as follows:
<table>
<tr><th>Component</th><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>ACM (base AM/FM radio only)</td><td>C290A-3</td><td>VLN04 (VT/GY)</td></tr>
<tr><td>Floor console lamp</td><td>C3555-1</td><td>VLN04 (VT/GY)</td></tr>
<tr><td>Floor shifter</td><td>C3245-4</td><td>VLN04 (VT/GY)</td></tr>
<tr><td>Hazard switch/ PAD indicator/traction control switch (without 4.2- inch [107mm] or 8-inch [203mm] display)</td><td>C2355-6</td><td>VLN04 (VT/GY)</td></tr>
<tr><td>Stability/traction control switch (with 4.2- inch [107mm] or 8- inch [203mm] display)</td><td>C2114-5</td><td>VLN04 (VT/GY)</td></tr>
<tr><td>Headlamp switch</td><td>C205-1</td><td>VLN04 (VT/GY)</td></tr>
</table>
</td></tr>
</table>

Hill descent control switch	C3394-3	VLN04 (VT/GY)
Instrument panel dimmer switch	C2298-1	VLN04 (VT/GY)
Mode select switch	C284-4	VLN04 (VT/GY)
Off-road mode switch (Raptor only)	C3393-3	VLN04 (VT/GY)
Overhead console (roof opening panel/power sliding window)	C912-2	VLN04 (VT/GY)
Upfitter switch	C3389-2	VLN04 (VT/GY)
LH rear heated seat switch	C731-2	CBP32 (GN/VT)
RH rear heated seat switch	C831-2	CBP32 (GN/VT)
LH door lock control switch	C505-1	CBP32 (GN/VT)
RH door lock control switch	C605-1	CBP32 (GN/VT)

- **Is the voltage greater than 10 volts?**

E2 CHECK THE GROUND CIRCUIT TO THE ILLUMINATION SOURCE FOR CONTINUITY

- Measure the voltage between the inoperative illumination source pins, harness side as follows:

Component	Connector-Pin/ Circuit	Connector-Pin/ Circuit
ACM (base radio only)	C290A-3 VLN04 (VT/GY)	C290A-4 GD114 (BK/BU)
Floor console lamp	C3555-1 VLN04 (VT/GY)	C3555-3 GD138 (BK/WH)
Floor shifter	C3245-4 VLN04 (VT/GY)	C3245-5 GD138 (BK/WH)
Hazard switch/ PAD indicator/traction control switch (without 4.2- inch [107mm] or 8- inch [203mm] display)	C2355-6 VLN04 (VT/GY)	C2355-1 GD133 (BK)
Stability/traction control switch (with 4.2- inch [107mm] or 8- inch [203mm] display)	C2114-5 VLN04	C2114-3 GD133 (BK)

Yes
INSTALL a new component in question. TEST the system for normal operation.

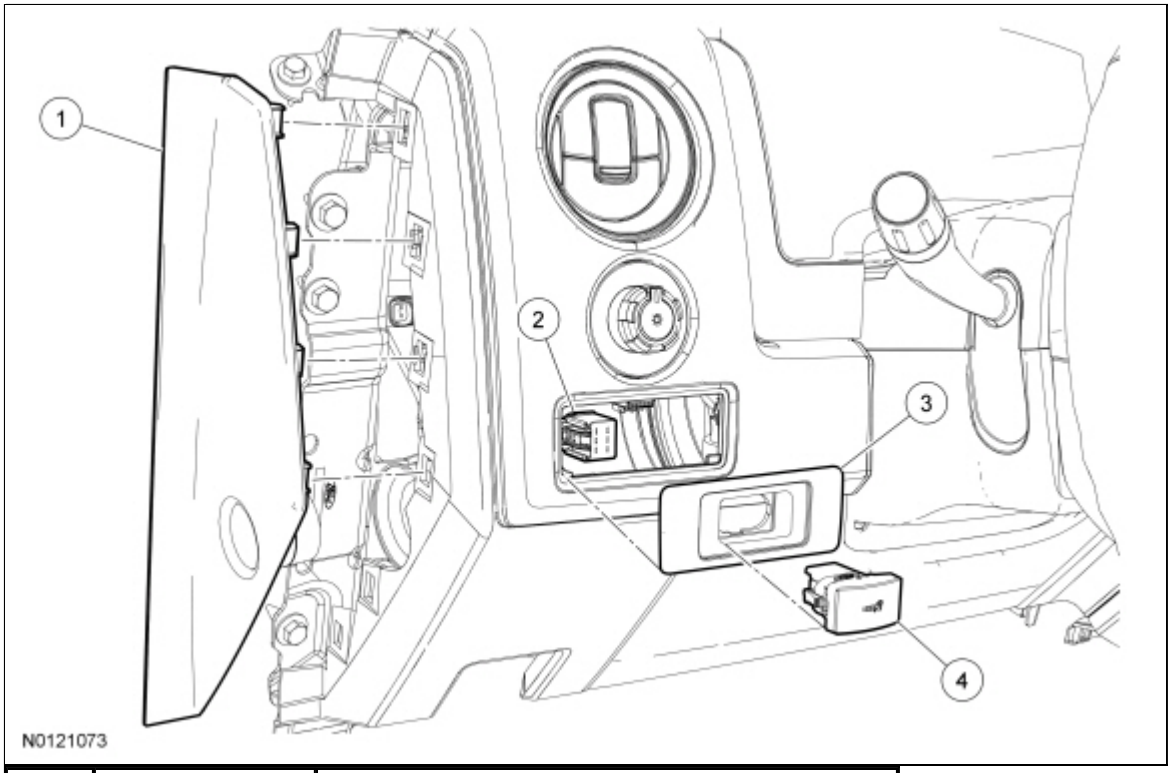
No
REPAIR the ground circuit in question for an open. TEST the system for normal operation.

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	(VT/GY)	
Headlamp switch	C205-1 VLN04 (VT/GY)	C205-8 GD133 (BK)
Hill descent control switch	C3394-3 VLN04 (VT/GY)	C3394-2 GD138 (BK/WH)
Mode select switch	C284-4 VLN04 (VT/GY)	C284-1 GD133 (BK)
Off-road mode switch (Raptor only)	C3393-3 VLN04 (VT/GY)	C3393-2 GD138 (BK/WH)
Overhead console (roof opening panel/power sliding window)	C912-2 VLN04 (VT/GY)	C912-12 CPR39 (VT/WH)
Upfitter switch	C3389-2 VLN04 (VT/GY)	C3389-3 GD138 (BK/WH)

- **Is the voltage greater than 10 volts?**

Instrument Panel Dimmer Switch



Item	Part Number	Description
1	1504481	Instrument panel side finish panel
3	—	Electrical connector (part of 14401)
2	15042D82	Instrument panel dimmer switch bezel
4	11691	Instrument panel dimmer switch

Removal and Installation

1. Remove the instrument panel side finish panel.
2. **NOTE:** The instrument panel dimmer switch is removed by pushing from behind.

   Remove the instrument panel dimmer switch and bezel assembly from the instrument panel.
   - Disconnect the electrical connectors.
3. Release the tabs and separate the instrument panel dimmer switch from the bezel.
4. To install, reverse the removal procedure.

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Information And Message Center

There are 2 types of message center configurations available. The base message center is a fixed format, 2-line display integrated into the center of the Instrument Panel Cluster (IPC). The optional message center is a 4.2 inch display located in the center of the IPC . The base message center is controlled by a 3-button message center switch located in the LH steering wheel switch assembly. The optional message center is controlled by a 5-button message center switch, also located in the LH steering wheel switch assembly.

Oil Change Minder

The message center provides an oil change minder to inform the driver that an oil change is required. The duration of the interval between oil changes is calculated in the PCM and varies due to driving conditions. The PCM assumes a base mileage of 16,093 km (10,000 miles) or 1 year for normal driving. However, this number will be adjusted down due to high engine temperature, high engine rpms, use of flex fuel and possibly low oil level. The PCM calculates and provides an oil life status message to the IPC . The IPC further converts the remaining oil life using the driver's configured oil life start value and displays the oil life percentage, indicating the remaining oil life. The oil change minder can be reset at any time by the driver. For additional information, refer to Message Center Configuration in this section.

Oil Life and Oil Life Start Value

The oil life is displayed in percentages. The oil life start value is used to increase or decrease the starting point of the oil life. The oil life start value can be lowered in 10% increments down to 10% or adjusted up to the maximum of approximately 16,093 km (10,000 miles) if the value was previously changed. Each 10% reduction lowers the oil life in both mileage and time (days).

For example, if the oil life start value is lowered to 50%, the maximum mileage is 8,047 km (5,000 miles) or 6 months. The oil life remains at the selected setting (50% in this example) until the driver changes the oil life start value. When the oil life (not oil life start value) is reset back to 100% following an oil change, the oil life resets to 8,047 km (5,000 miles). For configuration of the oil life and oil life start value, refer to Message Center Configuration in this section.

Message Center Indicators

The message center displays message center indicators in the RH side of the message center display area (base IPC) or in the lower RH section of the message center (optional IPC). Message center indicators replace indicators that have typically been displayed in the IPC using the same iconic representation (for example; the low oil pressure message center warning indicator is represented by the oil can symbol that has been traditionally used as the low oil pressure warning indicator in other IPC configurations). Message center indicators are generally displayed along with warning messages in the message center display area of the IPC .

Base Message Center

The base IPC message center functions and menus listed below can be selected through the INFO and SETUP buttons. The information items (trip A, trip B and average fuel economy) and setup items (language, system configurable items such as autolamps or autolock) can be reset with the RESET button. Refer to the Owner's Literature for complete operating instructions for both the full function message center and the base IPC message center.

Message Center Configuration

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On configurable items such as autolock, auto-unlock or parking aid, the message center indicates the appropriate selection (ON/OFF) by bracketing the selection. For example, if the driver selects the autolock feature on, the message displays: AUTOLOCK OFF. If the driver selects the autolock off, the message displays: AUTOLOCK ON .

Message Center Functions

The message center provides the following functions:

- Information displays (INFO)
- Setup displays (SETUP)
- Reset (RESET)
- System check messages
- System warning messages

Information Displays

The information displays are non-timed modes. The selected mode remains on until the driver presses a message center button to change the mode or it is overridden by another mode.

The information display modes (INFO button) are:

- Odometer
- Trip odometer A and B
- MyKey® miles
- Distance To Empty (DTE)
- Average fuel economy
- Drive time (elapsed travel timer)
- Trailer brake gain and output (displays only when the gain is changed)
- Blank display

Setup Displays

The setup displays are timed modes and terminate after a fixed interval. As part of the setup menu, the message center has the capability to configure items such as units (English or metric), autolamp delay or to enable/disable options such as autolock. The message center setup display modes (SETUP button) are:

- System check
- Oil life
- Units English/metric
- Autolamp (delay in seconds)
- Autolock (on/off) (if equipped)
- Auto unlock
- Running boards (if equipped)
- Easy entry/easy exit
- Parking aid
- Trailer sway control
- Create MyKey®
- MyKey® setup
- Clear MyKey®
- Remote start
- Language

System Check Displays

The system check provides a check of all the monitored systems on the vehicle. The system check scrolls through each of the monitored systems and provides a visual indication to report out the status of each system. If the system check does not detect a fault in the system, the message center displays OK for approximately 2 seconds. If a fault is reported in the system, the message center displays a warning message for approximately 2 seconds. To manually scroll through the system check displays, press the RESET button repeatedly.

The system check display modes are:

- Oil life
- Door ajar status
- Brake system status
- Fuel level/ DTE
- Trailer brake control
- MyKey® distance
- MyKey® programmed keys
- Administrator keys programmed

Optional Message Center Features

The optional message center is different in the way the information is presented. The IPC uses a 4.2 inch Liquid Crystal Display (LCD) for all message center displays. The optional message center provides the following main displays/functions:

- Gauge mode
- Trip A/B
- Fuel economy
- Truck applications
- Settings
- Information

Gauge Mode Displays

- Transmission temperature (in text format)
- ControlTrac 4WD
- Blank display

Trip A/B Displays

- Elapsed time
- Trip distance
- Fuel consumed
- Average fuel economy
- Odometer

Fuel Economy Displays

- Instantaneous fuel economy
- Distance To Empty (DTE)
- Fuel economy history

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- Fuel duration (interval used to calculate the fuel economy history)

Truck Application Displays

- Off road feature settings
  - Electronic Locking Differential (ELD)
  - Four-Wheel Drive (4WD) system
  - Traction control
  - Hill descent control
  - Off road mode (SVT only)
  - AdvanceTrac® (SVT only)
  - Off road camera (SVT only)
- **NOTE:** The trailer naming, trailer connection and trailer mileage displays are only displayed when a trailer is connected.

  Trailer feature settings
  - Active trailer name
  - Accumulated trailer distance
  - Trailer gain/output
  - Trailer disconnected status

Setting Displays

- Driver assist
  - Rear parking aid
  - Rear view camera
  - Trailer brake mode
  - Trailer sway control
- Vehicle
  - Autolamp delay
  - DTE calculation
  - Easy entry/exit
  - Locks
  - Menu control
  - Oil life reset
  - Power running boards
  - Remote start
  - Wiper
- MyKey®
  - Create MyKey®
  - AdvanceTrac®
  - Maximum mph (km/h)
  - Speed warning
  - Volume limiter
  - Clear MyKeys
- Language
  - English
  - Spanish
  - French
- Units

    - English
    - Metric
- System reset

Information Displays

- MyKey®
    - MyKeys programmed
    - Administrator keys
    - MyKey® miles
- System Check
    - Display of any active warnings
    - Oil life
    - Doors
    - Brakes
    - Trailer brake control
    - Fuel level

System Warning Messages

The system warning messages alert the driver to possible problems or malfunctions in the vehicle operating systems. The message center displays the last selected feature if there are no additional warning messages. Once a warning message has been displayed, the message must be acknowledged to allow full functionality of the message center. Press the RESET button (base message center) or the OK button (optional message center) to acknowledge and clear the warning message.

The warning messages are divided into 3 basic categories:

- Cannot be cleared until the condition is corrected.
- Reappears 10 minutes after pressing the select/reset button.
- Reappears if the condition clears then reoccurs within the same ignition on-off cycle.

When the IPC receives a request to display an informational warning message or a fault condition warning message, the message center may display one of the following warning messages:

Body

- COULD NOT PROGRAM INTEGRATED KEY (optional IPC)
- DRIVER DOOR AJAR
- INTKEY COULD NOT PROGRAM (base IPC)
- KEY COULD NOT PROGRAM
- PASSENGER DOOR AJAR
- REAR LEFT DOOR AJAR
- REAR RIGHT DOOR AJAR
- STARTING SYSTEM FAULT
- TO STOP ALARM START VEHICLE

Chassis

- FUEL LEVEL LOW
- ADVANCETRAC SPORT MODE (SVT only)

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- BRAKE FLUID LEVEL LOW
- CHECK BRAKE SYSTEM
- CHECK REAR PARK AID
- LOW TIRE PRESSURE
- PARK BRAKE ENGAGED
- POWER STEERING ASSIST FAULT
- REDUCE ACCELERATOR TO PREVENT WHEEL SLIP (optional IPC)
- REAR PARK AID ON/OFF
- SERVICE ADVANCETRAC
- SERVICE POWER STEERING
- SERVICE POWER STEERING NOW
- TRACTION CONTROL ON/OFF
- TIRE PRESSURE SENSOR FAULT
- TIRE PRESSURE MONITOR FAULT

Electronic Locking Differential (ELD)

- SLOW VEHICLE TO XX MPH or XX KM/H FOR ELD
- CHECK LOCKING DIFFERENTIAL

MyKey®

- ADVANCE TRAC ALWAYS ON/SELECTABLE — MYKEY SETTING
- BUCKLE UP TO UNMUTE AUDIO
- CHECK SPEED DRIVE SAFELY
- ESC ALWAYS ON - MYKEY SETTING
- MYKEY ACTIVE DRIVE SAFELY
- SPEED LIMITED TO 130 KM/H (80 MPH)
- TOP SPEED MYKEY SETTING
- VEHICLE NEAR TOP SPEED
- VEHICLE AT TOP SPEED - MYKEY SETTING

Powertrain

- CHECK CHARGING SYSTEM (late build)
- CHECK FUEL FILL INLET
- ENGINE OIL CHANGE SOON
- LOW BATTERY FEATURES TURNED OFF
- OIL CHANGE REQUIRED
- POWER REDUCED TO LOWER TEMP
- TURN POWER OFF TO SAVE BATT

Electronic Locking Differential (ELD)

- CHECK LOCKING DIFFERENTIAL
- ELD DISENGAGED
- ELD ENGAGED
- TO ENGAGE ELD RELEASE PEDAL
- TO ENGAGE ELD SLOW TO 20 MPH/30KM/H
- TO ENGAGE ELD SLOW TO 55 MPH/90KM/H

Neutral Tow Feature

- NEUTRAL TOW DISABLED
- NEUTRAL TOW ENABLED
- NEUTRAL TOW LEAVE IN N

Trailer

- TRAILER BRAKE GAIN = XX.X
- TRAILER BRAKE MODULE FAULT
- TRAILER CONNECTED/DISCONNECTED
- TBC GAIN = XX.X NO TRAILER
- TBC GAIN = XX.X OUTPUT = (bar display)
- TRAILER SWAY REDUCE SPEED
- WIRING FAULT ON TRAILER

Four-Wheel Drive (4WD) Mode

- 4X4 SHIFT IN PROGRESS
- CHECK 4X4
- FOR 4X4 LOW APPLY BRAKE
- FOR 4X4 LOW SHIFT TO N
- FOR 4X4 LOW SLOW TO 3 MPH
- SHIFT DELAYED PULL FORWARD
- TO EXIT 4X4 LOW APPLY BRAKE
- TO EXIT 4X4 LOW SHIFT TO N
- TO EXIT 4X4 LOW SLOW TO 3 MPH

Hill Descent Mode

- FOR HILL DESCENT REDUCE SPEED
- FOR HILL DESCENT SELECT GEAR
- HILL DESCENT CONTROL FAULT
- HILL DESCENT CONTROL OFF
- HILL DESCENT CONTROL OFF SYSTEM COOLING
- HILL DESCENT CONTROL READY
- HILL DESCENT - DRIVER RESUME CONTROL

Off Road Mode (SVT Only)

- FOR OFF ROAD SLOW TO 5 MPH
- OFF ROAD MODE ENABLED
- EXITING OFF ROAD MODE

Off Road Camera (SVT Only)

- CAMERA MALFUNCTION

Service Procedure Displays

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In addition to the warning messages, the message center provides messages that are displayed during repair procedures to indicate certain states of a procedure. The following are the service repair procedures displayed in the message center:

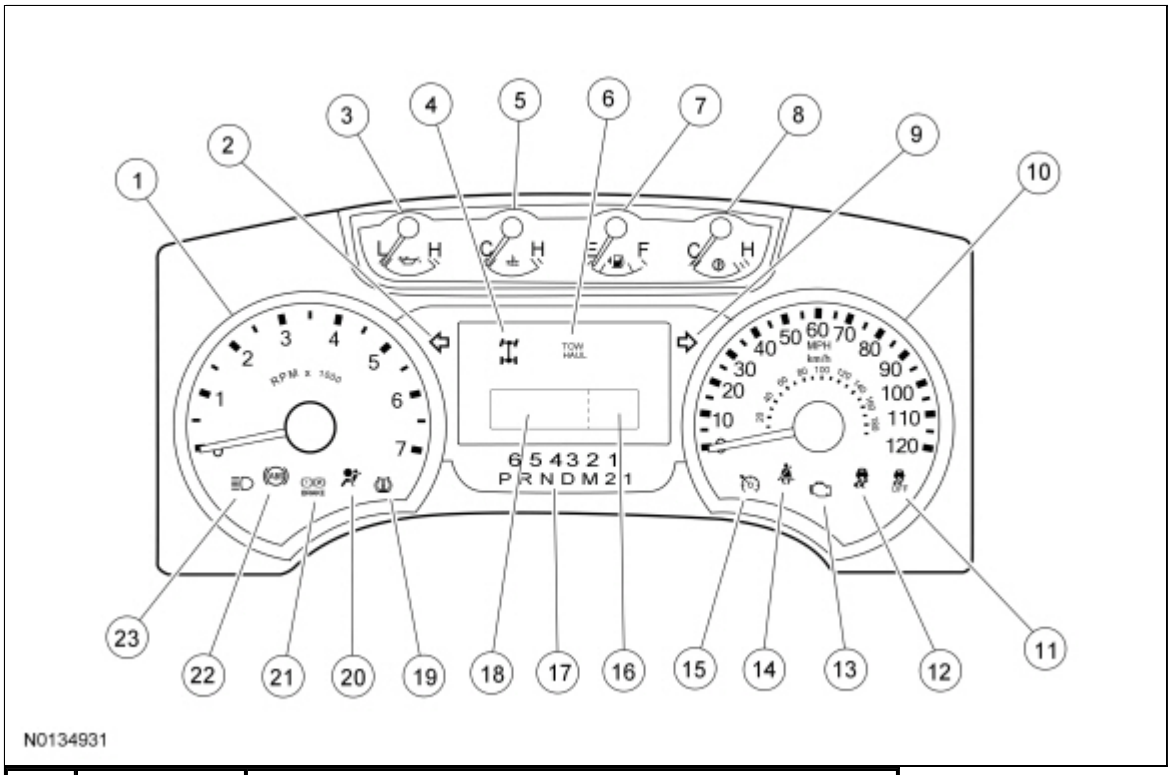
Tire Pressure Monitoring System (TPMS) Tire Training

- TRAINING COMPLETE
- TRAIN LEFT FRONT TIRE
- TRAIN RIGHT FRONT TIRE
- TRAIN RIGHT REAR TIRE
- TRAIN LEFT REAR TIRE
- TIRES NOT TRAINED-REPEAT

Instrument Panel Cluster (IPC)

Base Instrument Panel Cluster (IPC)

NOTE: Additional warning indicators, which are displayed in the message center, are listed below under " IPC Message Center Indicators".



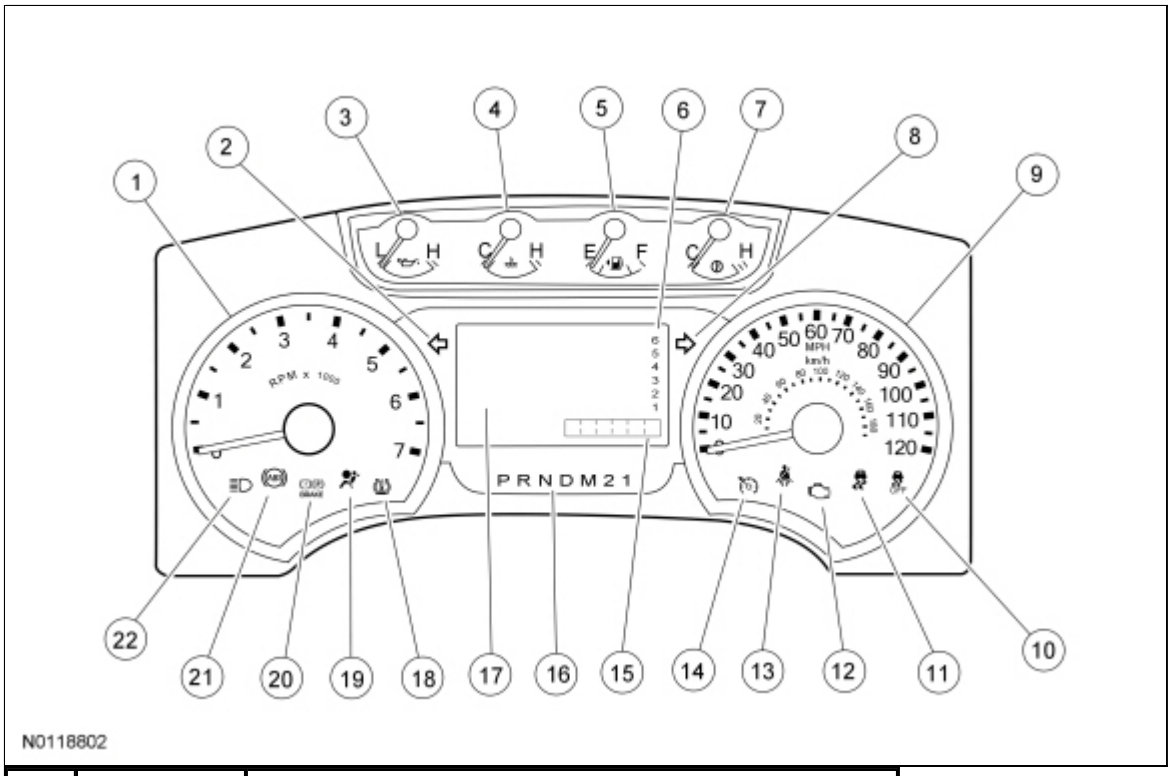
Item	Part Number	Description
1	—	Tachometer
2	—	LH turn indicator
3	—	Oil pressure gauge
4	—	Electronic locking differential indicator
5	—	Engine temperature gauge
6	—	Tow haul indicator
7	—	Fuel gauge
8	—	Transmission temperature gauge
9	—	RH turn indicator
10	—	Speedometer
11	—	Stability/traction control disabled indicator
12	—	Stability/traction control indicator

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13	—	Malfunction Indicator Lamp (MIL)
14	—	Safety belt warning indicator
15	—	Cruise control indicator
16	—	Message center indicator display area
17	—	PRNDL with select shift display (if equipped)
18	—	Message center display area
19	—	Tire Pressure Monitoring System (TPMS) warning indicator
20	—	Air bag warning indicator
21	—	Brake warning indicator
22	—	ABS warning indicator
23	—	High beam indicator

Optional IPC

NOTE: Base F-150 Instrument Panel Cluster (IPC) shown, SVT Raptor IPC similar. Additional warning indicators, which are displayed in the message center, are listed below under " IPC Message Center Indicators".



Item	Part Number	Description
1	—	Tachometer
2	—	LH turn indicator
3	—	Oil pressure gauge

4	—	Engine temperature gauge
5	—	Fuel gauge
6	—	Select shift display
7	—	Transmission temperature gauge
8	—	RH turn indicator
9	—	Speedometer
10	—	Stability/traction control disabled indicator
11	—	Stability/traction control indicator
12	—	Malfunction Indicator Lamp (MIL)
13	—	Safety belt warning indicator
14	—	Cruise control indicator
15	—	Message center indicator display area
16	—	PRNDL display
17	—	Message center display area
18	—	Tire Pressure Monitoring System (TPMS) warning indicator
19	—	Air bag warning indicator
20	—	Brake warning indicator
21	—	ABS warning indicator
22	—	High beam indicator

Instrument Panel Cluster (IPC)

The Instrument Panel Cluster (IPC) is available either with a base message center (identified by the 3-button message center switch) or with the optional message center (identified by the 5-button message center switch). The IPC contains gauges, informational indicators, warning indicators and message center indicators that are designed to provide the driver with system status and to alert the driver that certain conditions exist in the vehicle.

The IPC uses part of the message center as a display area for basic informational items such as the odometer and trip odometer and for the message center display information.

All indicator lamps and warning indicator lamps are LEDs, which are not replaceable.

Compass Display

The electronic compass system consists of:

- Compass module (without navigation)
- Global Positioning System (GPS) antenna (with navigation)
- Front Display Interface Module (FDIM)

Vehicles Without Navigation

The compass signal originates with the compass module and is displayed in the FDIM . The vehicle heading is displayed as a 1 or 2-character display and indicates the current direction of the vehicle (N, NE, E, SE, S,

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SW, W, or NW).

Compass Accuracy

Driving near power lines, or driving in the area of large iron or steel structures on vehicles without navigation can temporarily alter the compass heading. If the compass remains inaccurate after driving near such objects, calibrate the compass. For additional information, refer to Compass Calibration in this section. Most geographic areas (zones) have a magnetic north compass point that varies slightly from the northerly direction on maps. This variation is 4 degrees between the adjacent zones and becomes noticeable as the vehicle crosses multiple zones. A correct zone setting eliminates the error. For additional information, refer to Compass Zone Adjustment in this section.

Vehicles With Navigation

The compass signal originates with the GPS antenna. No calibration or zone adjustment is available, as the compass heading is based on the GPS signal. Refer to the appropriate section in Group 415 for the procedure.

Transport Mode

The vehicle is placed in a transport mode at the completion of production to reduce the drain on the battery. Various systems may be altered in how they operate or are disabled when in the transport mode. The vehicle automatically reverts to normal operation after 201 km (125 miles). To disable or turn off the transport mode, carry out the following within 10 seconds:

- Verify the battery is fully charged.
- With ignition in RUN, press brake pedal 5 times.
- Press hazard switch 4 times (on, off, on, off).

Factory Mode

During vehicle assembly, the vehicle defaults to factory mode. Factory mode sets the function timers such as PRNDL display to further reduce the drain on the battery during assembly. The vehicle is placed into transport mode at the end of vehicle assembly. The vehicle remains in factory mode for 60 ignition cycles or until it is manually changed to transport mode.

Informational Indicators/Warning Indicators

Informational indicators provide information to the driver of conditions that exist in the vehicle. Warning indicators provide information to the driver of conditions that could potentially cause personal injury or alter vehicle performance.

Instrument Panel Cluster (IPC) Message Center Indicators

Message center indicators illuminate in the message center and replace the typical informational or warning indicator using the same iconic representation. When multiple warnings exist, the message center indicators cycle through each display until the condition has been corrected. The message center indicators include:

- 4X4 auto
- Charging system
- Door ajar
- Electronic Locking Differential (ELD)
- Engine oil pressure
- Engine over-temperature

- Low fuel
- 4X2
- 4X4 low
- 4X4 high
- Powertrain malfunction (wrench)
- Tow haul

Hardwired Inputs

The hardwired inputs are provided from the following systems or components:

- Fuel level
- Hill descent control
- Message center switch
- Park detect
- Traction control switch

Messaged Inputs

Module messaging is the standard for sending and receiving information required to operate the IPC . All messages required for the IPC to operate are received over the High Speed Controller Area Network (HS-CAN). For a list of module messages with the message origination sources, refer to Section 418-00 .

Listed below is a partial list of status and information messages that the IPC requires from other vehicle inputs:

- ABS
  - ABS braking
  - Roll Stability Control (RSC®)
  - Traction control
- Base brake system
  - Brake fluid level status
  - Parking brake status
- Body
  - Door ajar
  - Supplemental Restraint System (SRS)
  - Tire Pressure Monitoring System (TPMS)
- Lighting system
  - LH/RH turn
  - High beam
- Powertrain
  - Charging system
  - ELD
  - Engine emission system
  - Engine oil pressure
  - Engine rpm
  - Engine temperature
  - Four-Wheel Drive (4WD)
  - Tow haul status
  - Transmission range
  - Vehicle speed

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Welcome/Farewell Mode

The IPC provides a startup/shutdown mode also known as a welcome/farewell mode. When the vehicle receives a Remote Keyless Entry (RKE) request or a door ajar (open) message, the IPC gradually increases illumination of the gauge trim rings and powers up the message center (the optional IPC provides a welcome graphic). When the key is inserted into the ignition switch (key off), the IPC illuminates the gauge points. When the ignition is placed into the RUN or START position, the IPC begins a prove-out stage. During the prove-out stage, the IPC provides message center information (replaces the welcome screen with vehicle specific information on the optional IPC) while illuminating all LED indicators for a predetermined time. For the shutdown, the IPC reverses the startup process.

MyKey®

NOTE: All MyKey® displayed messages listed below are base IPC (3-button message center switch) displays. The optional IPC (5-button message center switch) message displays are similar.

The MyKey® feature allows the customer to program a restricted driving mode that is tied to one or more keys known as a MyKey®. When MyKey® is in use, the IPC provides the following functions:

- At the beginning of vehicle start up, as part of the welcome strategy, the message center greets the MyKey® driver with MYKEY ACTIVE DRIVE SAFELY displayed in the message center. If the MyKey® speed limiter feature is turned on, the message center also displays SPEED LIMITED TO 80 MPH (or 130 km/h).
- The IPC continuously provides a periodic Belt-Minder® warning chime until the driver and passenger safety belts are buckled. When the Belt-Minder® is issued, the Audio Front Control Module (ACM) is muted and the message center displays BUCKLE UP TO UNMUTE AUDIO.
- If the MyKey® speed limiter feature is turned on and the vehicle speed approaches 120 km/h (75 mph), the message center displays VEHICLE NEAR TOP SPEED along with a chime.
- If the MyKey® speed limiter feature is turned on and the vehicle speed reaches 130 km/h (80 mph), the message center displays VEHICLE AT TOP SPEED DRIVE SAFELY along with a chime.
- If the speed warning is selected at one of the preset values (75, 90, 105 km/h [45, 55, 65 mph]) and the vehicle approaches the preset speed, the message center displays CHECK SPEED DRIVE SAFELY along with a chime.
- If the traction control always on feature is turned on and the MyKey® driver presses the traction control switch to disable traction control, the message center displays ADVTRAC ON MYKEY SETTING.
- At 1/8 tank of remaining fuel, the IPC turns on the low fuel warning with the appropriate Distance To Empty (DTE) message along with a chime.
- MyKey® miles driven by the MyKey® user can be found in the information display and in the system check function of the message center on the base IPC and in the information display only on the optional IPC .
- The number of MyKey® programmed and administrator keys can be found in the system check function of the message center (base IPC) or information function (optional IPC).
- The parking aid warning menu is disabled in the message center to force these features always on.

When an administrator key is in use, the IPC provides the following functions:

- The message center provides a menu guiding the user to create a MyKey®. When the maximum MyKey® limit is reached, the MyKey® creation menu is no longer available.
- The message center provides menus for setting 4 optional MyKey® features:
    - MyKey® 80 MPH speed limiter
    - MyKey® pre-selected speed warning
    - MyKey® radio volume limiter
    - AdvanceTrac® on/off

- The message center provides a menu to clear all MyKey® programmed keys at once.
- MyKey® miles driven by the MyKey® user can be found in the information display and in the system check function of the message center on the base IPC and in the information display only on the optional IPC .
- The number of MyKey® programmed and administrator keys can be found in the system check function of the message center (base IPC) or information function (optional IPC).

For additional information on the MyKey® features, refer to Section 419-01B .

Neutral Tow Feature

The neutral tow feature provides informational messages to inform the driver that neutral tow is enabled or disabled and powers down or turns off IPC functions such as welcome/farewell (starrtup-shut down) and PRNDL indication. The neutral tow feature allows the vehicle to be towed in NEUTRAL (N) without excessive battery drain.

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Warning Chimes

The warning chimes provide the driver with an audible warning that acts as a supplemental alert. The only deviation from this strategy is the air bag chime which alerts the driver that the primary alerting system (air bag warning indicator) does not operate. The Instrument Panel Cluster (IPC) controls all warning chimes based on messages received from external modules.

The warning device system consists of the following:

- IPC
- Key-in-ignition warning switch (part of the ignition switch)
- Parking brake warning indicator switch
- ABS module
- Body Control Module (BCM)
- PCM
- Restraints Control Module (RCM)

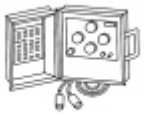
The following chimes are controlled by the IPC :

- Air bag warning
- Belt-Minder®
- Door ajar
- Headlamps on
- Key-in-ignition
- Memory feedback
- Message center
- Parking brake applied
- Perimeter alarm
- Safety belt warning
- Service AdvanceTrac®
- Turn signal left on
- Turn signal/hazard on

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Instrumentation, Message Center and Warning Chimes

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST1473-A	Instrument Gauge System Tester 014-R1063 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Instrument Panel Cluster (IPC) utilizes a microprocessor to control the gauge, indicator, message center and warning chime functions. Data is sent to the IPC over the High Speed Controller Area Network (HS-CAN) and through hardwired circuitry from individual components. The IPC uses each input to output an action to the gauges, indicators, message center or chime arbitrator.

When diagnosing an IPC concern, it is very important to understand:

- where the input originates.
- all of the information necessary for a feature to operate.
- which module(s) receive(s) the input or command message.
- which module controls the output of the feature.
- whether the module that receives the input controls the output of the feature, or whether it outputs a message over the communication network to another module.

Instrument Panel Cluster (IPC)

IPC Network Messages

The IPC uses input messages from other modules to control the gauges, informational indicators, warning indicators and message center indicators over the HS-CAN . Messages that originate within or are sent to other modules on the Medium Speed Controller Area Network (MS-CAN) are sent to the Body Control Module (BCM) and converted to an HS-CAN message. For additional information on the communication networks or the BCM gateway function, refer to Section 418-00 . If a required message is missing or invalid for less than 5 seconds, the gauge or indicator that requires the message remains at the last commanded state based upon the last message received. For example, if the brake status message is missing for less than 5 seconds and the brake warning indicator was illuminated, the indicator remains in the ON state until the next message is received. If the message remains missing or invalid for greater than 5 seconds, the IPC sets a network U-code DTC and the IPC output becomes a default action for the indicator or gauge. Each indicator or gauge utilizes a different default strategy depending on the nature of the indication. Refer to the normal operation descriptions located in the individual pinpoint test for further description of the default action specific to each indicator or gauge. If the missing messaged input to the cluster returns at any time, the normal function of the gauge or indicator resumes.

NOTE: Whenever a message is suspected as missing and confirmed by a missing message DTC, it is important to look for other symptoms that may also be present in the IPC and throughout the vehicle. Once a DTC sets in the IPC , it may be helpful to review the complete message list available in Section 418-00 to see what other modules also rely on the same message and run the self-test for those modules. If the message is missing from other modules, the same DTC may also be set in those modules. Confirmation of missing messages common to multiple modules may indicate that the originating module is the source of the concern or the communication network may be experiencing some problems.

IPC Configuration

The IPC contains items that are configurable. Configurable items include customer preference items, which can also be set with a scan tool. The remaining configurable items can only be set by the Programmable Module Installation (PMI) procedure or by using As-Built data. Refer to Section 418-01 .

The configurable IPC items are as follows:

IPC Configuration Parameters

As-Built Parameter	State Description
ABS	ABS No ABS
Traction control/interactive vehicle dynamics/Roll Stability Control (RSC®)	No traction control/interactive vehicle dynamics/ RSC® Traction control Interactive vehicle dynamics RSC®
Tire Pressure Monitoring System (TPMS)	Off On
Oil pressure input	Hardwired

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	High Speed Controller Area Network (HS-CAN)
Belt-Minder®	Off On
Oil life	Off On
RSC® warning chime	Enabled Disabled
Compass	Enabled Disabled
Rear park aid	Rear park aid No rear park aid
Front park aid	Front park aid No front park aid
MyKey®	Enabled Disabled
Autolamp	Enabled Disabled
Auto lock	Enabled Disabled
Auto unlock	Enabled Disabled
Easy entry/easy exit	Enabled Disabled
Rain sensing wipers	Yes No
Trailer Brake Control (TBC) gain	TBC and gain warnings No TBC and gain warnings
Trailer sway	Enabled Disabled
Default language	English French Spanish

Speedometer bias	European and gulf coast countries North American
Number of fuel senders	One sender Two sender
Number of fuel tanks	One fuel tank Two fuel tanks
Overspeed warning chime	Gulf coast countries Non-gulf coast countries
Reverse warning chime	Japan Non-Japan
Key-in-ignition chime	Enabled Disabled
Electronic Power Assist Steering (EPAS)	Enabled Disabled
Two-wheel drive/Four-Wheel Drive (4WD)/All-Wheel Drive (AWD)	Two-wheel drive 4WD AWD Undefined
Power Running Board (PRB)	PRB No PRB
Electronic Locking Differential (ELD)	ELD No ELD
Welcome	Yes No
Tank configuration	Single tank Dual tanks Saddle tank
Tank selection	Tank 1 (26 gallon) Tank 2 (36 gallon)
Fuel capacity	Fuel tank capacity in tenths of a liter (0-409.5)
Flex-fuel	Flex fuel vehicle Not a flex-fuel vehicle
Fuel economy metric display	L/100km

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	km/L
Fuel economy gallon display	US gallon UK gallon
Welcome start	Blank in start Not blank in start
Rear camera feature	Yes No
Rear camera delay	Yes No
Rear camera visual park aid and auto-zoom	Yes No
Rear camera active guidelines	Yes No
Courtesy wipe after wash	Yes No
One/two stage unlocking	Yes No
Remote start feature	Yes No
Remote start — climate settings	Yes No
Remote start — driver seat temperature control	Yes No
Remote start — passenger seat temperature control	Yes No
Remote start — rear defrost	Yes No
Splash screen	Built Ford Concrete Lincoln Built Ford Desert
Background	No background F150 Lincoln

Mexico	Mexico a IPC Not a Mexico IPC
Rear camera auto zoom	Yes No
Front camera	Yes No
Neutral tow	Yes No
Steering gear ratio	Low 17 to 1 High 20 to 1
ControlTrac 4WD display	Yes No

IPC Prove-Out

The IPC and other vehicle modules carry out a display prove-out to verify all module controlled warning/indicator lamps and monitored systems are functioning correctly within the IPC . When the ignition is cycled to ON with the engine off, the indicators illuminate to prove-out according to the following table:

Indicator	Indicator Type	Prove-Out Duration
ABS	Warning	3 seconds
Air bag	Warning	6 seconds
Brake	Warning	3 seconds
Cruise control	Informational	No prove-out
High beam	Informational	No prove-out
Malfunction Indicator Lamp (MIL)	Warning	Engine startup
RH/LH turn signals	Informational	No prove-out
Safety belt	Warning	65 seconds if the safety belt is unbuckled, turns off when the safety belt is buckled
Tire Pressure Monitoring System (TPMS)	Warning	3 seconds
Stability/traction control	Informational	3 seconds
Stability/traction control disabled	Informational	3 seconds

Information And Message Center

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The message center is an integral part of the IPC that receives and acts upon much of the same information that is input and used to operate the IPC gauges, indicators, warning indicators and message center indicators.

Whenever conditions are present that require a warning message, the message center replaces the last selected display with the new warning display. Once the message is reset or cleared, the message center returns to the last selected display. If multiple warnings are present, the message center displays each warning for approximately 4 seconds. Warning messages are also generally associated with other observable IPC indications. For example, when the LH front door is opened, the message center displays the message DRIVER DOOR AJAR along with the door ajar message center warning indicator. This allows the message center to be a more informative supplement to the IPC gauges and indicators.

Another function of the message center is to display message center warning indicators. The message center often displays a warning message and the message center warning indictor at the same time. For example, if the PCM detects low engine oil pressure, the PCM sends a request to the IPC to illuminate the low oil pressure message center indicator and to display LOW OIL PRESSURE in the message center. If multiple warnings are present requiring multiple message center warning indicator displays, the message center cycles or rotates through the displays in the same manner the message center cycles the text messages.

Warning Chimes

Each warning chime has unique characteristics. The warning chimes use volume, chime frequency, length of time the chime sounds and the number of chime tones to identify which chime is sounding. The IPC prioritizes the chimes according to a preset hierarchy programmed into the IPC software. When more than one chime request is received by the IPC , the highest priority chime sounds. If a lower priority chime is currently sounding, the higher priority request takes over and replaces the lower priority chime.

There are 3 different chimes as listed below:

- Repetitive
- Single tone
- Tick-tock

The following table provides a summary of the chimes:

IPC Chime Characteristics

Chime Name	Chime Type	Condition Description
Air bag	Repetitive	Five sequences of 1 second on and 1 second off (10 seconds total)
Belt-Minder® A and B	Repetitive	The chime sounds 6 chime tones/safety belt warning indicator flash sequences for as long as the IPC receives the Belt-Minder® chime request.
Door ajar	Single tone	The chime sounds a single 1.6 second chime tone when any door changes from the closed to the open state.
Headlamps on	Repetitive	On for as long as the headlamps are on and the IPC receives the chime on command. Shuts off when battery saver has expired (approximately 30 minutes).
Key-in-ignition	Repetitive	On for as long as the key is in the ignition with the driver door ajar and the IPC receives the chime on command. Shuts off when battery saver has

		expired (approximately 30 minutes).
Memory feedback	Single tone	The chime sounds for 0.1 second when the IPC receives a memory state change message.
Message center	Single tone	The chime is a single 0.1 second tone chime that sounds once per ignition cycle whenever the IPC receives a new message commanding on one of the message center warnings.
Parking brake on	Repetitive	On for as long as the parking brake is applied and the IPC receives the chime on command.
Perimeter alarm	Repetitive	On for 12 seconds when the driver door is opened using a key and the alarm is armed. The chime sounds 2 chime tones for the first 6 seconds followed by 3 chime tones for the next 4 seconds and finally 4 chime tones for the last 3 seconds.
Safety belt	Repetitive	Six cycles of 0.5 second on/0.5 second off for as long as the safety belt is unbuckled and the IPC receives the chime on command.
Service AdvanceTrac®	Repetitive	The chime sounds three 1.0 second chime tones for as long as the IPC receives the chime request on command.
Turn signal/hazard on	Tick-tock	On for as long as the RH or LH turn signal or hazards are on and the IPC receives the chime on command.
Turn signal left on	Repetitive	On for as long as the RH or LH turn signal is on and the IPC receives the chime on command (approximately 3.2 km [2 miles]).

Air Bag Secondary Warning Chime

The air bag secondary warning chime warns that the air bag warning indicator light does not work correctly. The IPC monitors the air bag warning indicator status internally and provides an air bag indication status report to the RCM . When a fault is present in the Supplemental Restraint System (SRS) with the RCM sending the IPC an air bag warning indicator on request and a fault is detected in the air bag warning indicator, the RCM sends the IPC a secondary request to sound the air bag warning chime.

The air bag secondary warning chime inputs are:

- Ignition state
- Air bag warning indicator request communicated by the RCM to the IPC
- Air bag warning indicator chime request communicated by the RCM to the IPC

Message Center Warning Chime

The message center warning chime feature draws the driver's attention to the message center display to view each new warning message. The IPC provides a single one second tone whenever a new warning message is displayed in the message center. If multiple warning messages are present, the IPC sounds a chime for each of the warning messages that are present.

Perimeter Alarm Warning Chime

The perimeter alarm warning chime alerts the driver that the perimeter alarm is armed when the driver door is unlocked with a key. The warning chime is only functional when a key is used to unlock the driver door. If the key fob or keypad (if equipped) is used to unlock the door, the perimeter alarm is disarmed and the warning chime does not sound. The warning chime sounds for 12 seconds when the driver door is opened and turns off when the perimeter alarm is disarmed (either by using the key fob, keypad or turning the key on). After the 12 second warning chime duration, the warning chime stops sounding and the perimeter alarm activates, sounding the horn and flashing the turn signal lamps.

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Turn/Hazard On Chime

The turn/hazard on chime provides an audible sound to indicate the RH/LH turn or hazard lamps are on. When the LH turn lamps, RH turn lamps or hazard lamps are on, the IPC provides a tick-tock tone along with the visual turn signal indicators.

The turn/hazard on tone inputs are:

- Left and right turn indicator signal from the BCM to the IPC through the HS-CAN
- Hazard signal from the BCM to the IPC through the HS-CAN

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Accessory drive belt
• Brake fluid level
• Correct tire size
• Courtesy lamps
• Engine coolant level
• Engine oil level
• Fuel tank
• Fuel evaporative system
• Tire pressure
	• Body Control Module (BCM) fuse(s):
	  ▪ 11 (10A)
	  ▪ 32 (15A)
	• Wiring, terminals or connectors
	• Auto-dimming interior mirror
	• Message center switch (part of the LH steering wheel switch)
	• Instrument Panel Cluster (IPC)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the IPC , PCM, Restraints Control Module (RCM), ABS module, Trailer Brake Control (TBC) module, Parking Aid Module (PAM) and the BCM .

9. If the DTCs retrieved are related to the concern, go to DTC Charts in this section.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Instrument Panel Cluster (IPC) , GO to Symptom Chart - Information And Message Center or GO to Symptom Chart - Warning Chimes .

Instrument Panel Cluster (IPC) Dealer Test Mode — Base IPC

To enter the IPC dealer test mode, press and hold the message center RESET button. Place the ignition in RUN and continue to hold the RESET button until the display indicates ENGINEERING TEST MODE, usually within 3 to 5 seconds. Press the RESET button once to advance through each stage of the self-test.

To exit the IPC dealer test mode, press and hold the RESET button for more than 3 seconds or simply turn the ignition off.

NOTE: The displays listed in the table below use xxx's to represent a numeric or alpha-numeric value or a text display. The value may display the same amount of characters represented by the xxx's or there may be more/less depending on the type of display. For example, VEHICLE SPEED xxx.x mph may display VEHICLE SPEED 45 mph.

First Line Display	Second Line Display	Description
ENGINEERING	TEST MODE	Initial entry display into dealer test mode.
GAUGE	TEST	Carries out a gauge sweep of all the gauges, then displays the present gauge values.
All segments illuminated	—	Illuminates all odometer segments.
TELLTALE	TEST	Illuminates all the micro-controlled lamps and LEDs.
PART NUMBER	xxxx-xxx	Displays the alpha-numeric part number prefix and suffix.
ROM LEVEL	$xxxx	Returns all IPC controlled lamps/LEDs to the normal operation and displays the Read-Only Memory (ROM) level stored in hexadecimal format.
EEPROM LEVEL	$xx	Displays the EE level in hexadecimal format.
MANUFACTURE	DATE $xxxx	Displays final manufacturing test date in hexadecimal format.
AUTOCONFIG	BYTE 1 $xx	Displays all bytes of the IPC configuration settings in hexadecimal format.
B&A CONFIG	BYTE 1-2 $xx	Displays all bytes of the IPC configuration settings in hexadecimal format.
MANU CONFIG	BYTE 1 $xx	Displays the Non-Volatile Memory (NVM) As-Built configuration in

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		hexadecimal format.
CONTINUOUS	DTC $xxxx	Displays a 16-bit DTC in hexadecimal format. DTCs displayed are those detected in continuous operation not during self-test.
VEHICLE SPEED	xxx.x mph	Displays the messaged English speed value received. The speedometer indicates the present speed. If the vehicle speed message is missing, MISSING DATA is displayed.
VEHICLE SPEED	xxx.x km/h	Displays the messaged metric speed value received. The speedometer indicates the present speed.
TACHOMETER	xxxx rpm	Displays the messaged engine speed signal value received. The tachometer indicates present rpm.
FUEL LEVEL	xxx INSTANT	Displays the present instantaneous unfiltered fuel level. The fuel gauge indicates the filtered level.
FUEL LEVEL%	STATUS xxx	Displays the present fuel level percent status in decimal input from the secondary fuel level sensor in decimal. The fuel gauge indicates the present level.
INSTANT DTE	xxx MILES	Provides the current Distance To Empty (DTE).
RAFE DTE	xx.x MPG	Displays the running average fuel economy in decimal.
FUEL ON/OFF/SZ	xxx xxx xxx	Displays the key on initialization (left xxx), key off reference (middle xxx), and zero speed reference (right xxx) fuel level values in fuel level percent status.
F#S ON/OFF/SZ	xxx xxx xxx	Displays the number of valid fuel samples taken at key on initialization (left xxx), key off convergence (middle xxx), and zero speed convergence (right xxx) in decimal counts, no leading zeros.
COOLANT TEMP	xxx DEG C	Displays the last messaged engine coolant temperature value message received. The temperature gauge indicates the present temperature.
ODOMETER	xxx COUNTS	Displays the messaged odometer rolling count input received in decimal.
TRIP ODOMETER	xxx.x mi	Displays the trip odometer value stored in Random Access Memory (RAM) in miles.
BATTERY	xx.x VOLTS	Displays the present battery voltage in 10th of volts.
DIMMING CMD	xxx	Displays the messaged dimming value input from the Body Control Module (BCM).
DIMMING STEP	xx	Displays the messaged dimming level step (0 thru 21) received in decimal from the BCM .
MC SWITCH	xxx A/D COUNTS	Displays the present message center switch input analog/digital counts in decimal.
LWF OPS OAT	x x xxx	Displays the low washer fluid switch input (left x), oil pressure switch input (middle x) and the outside air temperature sensor input (right xxx).
COMPASS	xxx	Displays the present compass input in decimal.
LAST CHIME	SOUNDED xx	Displays the last chime that sounded.
GAUGE	TEST	Repeats the sweep of all gauges and then displays present gauge values.

Instrument Panel Cluster (IPC) Dealer Test Mode — Optional IPC

To enter the IPC dealer test mode, press and hold the message center OK button. Place the ignition in RUN and continue to hold the OK button until the display indicates ENGINEERING TEST MODE, usually within 3 to 5 seconds. Press the OK button once to advance through each stage of the self-test.

To exit the IPC dealer test mode, press and hold the OK button for more than 3 seconds or simply turn the ignition off.

NOTE: The displays listed in the table below use xxx's to represent a numeric or alpha-numeric value or a text display. The value may display the same amount of characters represented by the xxx's or there may be more/less depending on the type of display. For example, VEHICLE SPEED xxx.x mph may display VEHICLE SPEED 45 mph.

First Line Display	Second Line Display	Description
ENGINEERING	TEST MODE	Initial entry display into dealer test mode.
GAUGE	TEST	Carries out a gauge sweep of all the gauges, then displays the present gauge values.
All segments illuminated	—	Illuminates all message center LEDs in the different colors.
ALL MICRO CONT	BULBS ON	Illuminates all the micro-controlled lamps and LEDs.
PART NUMBER	xxxx-xxx	Displays the alpha-numeric part number prefix and suffix.
ROM LEVEL	$xxxx	Returns all IPC controlled lamps/LEDs to normal operation and displays the Read-Only Memory (ROM) level in hexadecimal format.
NVM ROM LEVEL	$xxxx	Displays the Non-Volatile Memory (NVM) level in hexadecimal format.
EEPROM LEVEL	$xx	Displays the EE level in hexadecimal format.
MANUFACTURE	DATE $xxxx	Displays final manufacturing test date in hexadecimal format.
MANU CONFIG	BYTE 1-2 $xx	Displays the Non-Volatile Memory (NVM) As-Built configuration in hexadecimal format.
VOPS CONFIG	BYTE 1-5 $xx	Displays all bytes of the IPC configuration settings in hexadecimal format.
VOPS CONFIG	TANK CAP xx.x	Displays all bytes of the IPC configuration settings in hexadecimal format.
VOPS CONFIG	BYTE 7-8 LN $xx	Displays all bytes of the IPC configuration settings in hexadecimal format.
CONTINUOUS	DTC $xxxx	Displays a 16-bit DTC in hexadecimal format. DTCs displayed are those detected in continuous operation not during self-test.
VEHICLE SPEED	xxx.x mph	Displays the messaged English speed value received. The speedometer indicates the present speed. If the vehicle speed message is missing, MISSING DATA is displayed.
VEHICLE SPEED	xxx.x km/h	Displays the messaged metric speed value received. The speedometer indicates the present speed.
SPEEDOMETER	DC xxxx	Displays corresponding gauge driver counts output for present

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		vehicle speed value.
TACHOMETER	xxxx rpm	Displays the messaged engine speed signal value received. The tachometer indicates present rpm.
TACHOMETER	DC xxxx	Displays corresponding gauge driver counts output for present rpm value.
FUEL LEVEL	A/D INPUT xxxx	Displays the present ratio'd analog/digital fuel level input in decimal.
FUEL LEVEL	FLPS IN xxxx	Displays the present input for fuel level percent status in decimal.
FUEL LVL FILT	FLPS IN xxxx	Displays the present filtered fuel level percent status in decimal (used by gauge).
FUEL FILT	% STATUS xxxx	Displays the present fuel filter percent status in decimal.
FUEL FILT HYST	% STATUS xxxx	Displays the present fuel filter delay percent status in decimal.
FUEL GAUGE	DC xxxx	Displays the corresponding fuel gauge driver counts output for filtered fuel level percent status value.
FUEL LEVEL	INIT REF $xxxx	Displays the fuel initial reference type used at key on initiation in hexadecimal followed by the fuel level percent status value of the initial reference in hexadecimal.
FUEL RAFE	xx.x MPG	Displays the running average fuel economy in decimal in miles.
FUEL RAFE	xx.x L/100km	Displays the running average fuel economy in decimal in kilometers.
INSTANT DTE	xxx MILES	Displays the instantaneous Distance To Empty (DTE) in miles.
INSTANT DTE	xxx km	Displays the instantaneous Distance To Empty (DTE) in kilometers.
FUEL ON/OFF/SZ	xxx xxx xxx	Displays the key on initialization (left xxx), key off reference (middle xxx), and zero speed reference (right xxx) fuel level values in fuel level percent status.
F#S ON/OFF/SZ	xxx xxx xxx	Displays the number of valid fuel samples taken at key on initialization (left xxx), key off convergence (middle xxx), and zero speed convergence (right xxx) in decimal counts, no leading zeros.
COOLANT TEMP	xxx C	Displays the last messaged engine coolant temperature value message received. The temperature gauge indicates the present temperature.
TEMP GAUGE	DC xxxx	Displays corresponding gauge driver counts output for present engine temperature value.
FAIL SAFE	COOL MODE xx	Displays the fail safe mode in hexadecimal.
OIL PRESSURE	LAMP xxx	Displays the low oil pressure indicator status.
OIL PRS GAUGE	DC xxxx	Displays corresponding gauge driver counts output for present oil pressure gauge value.
TRANS TEMP	xxx C	Displays the transmission temperature input in degrees Celsius.
TRANS TEMP	DC xxxx	Displays corresponding gauge driver counts output for present transmission temperature gauge value.
BATTERY	xx.x VOLTS	Displays the present battery voltage in 10th of volts.
BATTERY A/D	COUNTS xxxx	Displays the present battery analog/digital counts in decimal.
ODOMETER	xxx COUNTS	Displays the messaged odometer rolling count input received in decimal.

TRIP ODOMETER	A xxx.x mi	Displays the trip odometer value stored in Random Access Memory (RAM) in miles.
TRIP ODOMETER	B xxx.x mi	Displays the trip odometer value stored in Random Access Memory (RAM) in miles.
PDS IN	SENSE x	Displays the current state of the park detect switch input.
MC SW IN	SENSE x	Displays the current state of the message center switch input.
HDC SW IN	SENSE x	Displays the current state of the hill descent switch input.
HDC LED OUT	CMD xx	Displays the current state of the hill descent indicator.
DIMMING CMD	xxxx	Displays the messaged dimming value input from the Body Control Module (BCM).
DIMMING STEP	D xx	Displays the messaged dimming level step (0 thru 21) received in decimal from the BCM .
MCSW IN	xxxx A/D COUNTS	Displays the present message center switch analog/digital counts in decimal.
MC SWITCH	xxx A/D COUNTS	Displays the present message center switch input analog/digital counts in decimal.
LAST CHIME	SOUNDED xx	Displays the last chime that sounded.
A/D PORT 2-9	$ xxxx	Displays 10 bit hexadecimal value of the analog port readings.
DIGITAL INPUTS	PORT A, C, A/D $xx	Displays 8 bit hexadecimal value of the digital port readings.
DIGITAL INPUTS	PORT A/D $xxxx	Displays 8 bit hexadecimal value of the digital port readings.
DIGITAL INPUTS	HET1 $xxxxxxxx	Displays 8 bit hexadecimal value of the digital port readings.
GAUGE	TEST	Repeats the sweep of all gauges and then displays present gauge values.

DTC Charts

Instrument Panel Cluster (IPC) DTC Chart

DTC	Description	Action
B1A82:11	External Trip Switch: Circuit Short To Ground	GO to Pinpoint Test AF .
B1A82:13	External Trip Switch: Circuit Open	GO to Pinpoint Test AF .
B1A82:23	External Trip Switch: Signal Stuck Low	INSTALL a new LH steering wheel switch. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test.
P0460:11	Fuel Level Sensor A Circuit: Circuit Short to Ground	GO to Pinpoint Test B .
P0460:13	Fuel Level Sensor A Circuit: Circuit Open	GO to Pinpoint Test B .
P062F:46	Internal Control Module EEPROM Error: Calibration/Parameter Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC P062F:46 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal

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		operation.
P1534:01	Restraint Deployment Indicator Circuit: General Electrical Failure	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
P1706:00	High Vehicle Speed Observed in Park: No Sub Type Information	GO to Pinpoint Test X .
U0100:00	Lost Communication With ECM /PCM "A": No Sub-Type Information	GO to Pinpoint Test AT .
U0102:00	Lost Communication With Transfer Case Control Module: No Sub-Type Information	GO to Pinpoint Test AU .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub-Type Information	GO to Pinpoint Test AV .
U0131:00	Lost Communication With Power Steering Control Module: No Sub-Type Information	GO to Pinpoint Test AW .
U0137:00	Lost Communication With Trailer Brake Control Module: No Sub-Type Information	GO to Pinpoint Test AX .
U0140:00	Lost Communication With Body Control Module: No Sub-Type Information	GO to Pinpoint Test AY .
U0151:00	Lost Communication With Restraints Control Module: No Sub-Type Information	GO to Pinpoint Test AZ .
U0154:00	Lost Communication With Restraints Occupant Classification System Module: No Sub-Type Information	GO to Pinpoint Test BA .
U0159:00	Lost Communication With Parking Assist Control Module "A": No Sub-Type Information	GO to Pinpoint Test BB .
U0212:00	Lost Communication With Steering Column Control Module: No Sub-Type Information	GO to Pinpoint Test BC .
U0401:00	Invalid Data Received from ECM /PCM A: No Sub-Type Information	This DTC sets when the IPC receives invalid network data from the PCM for the vehicle speed input. RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to Section 419-10 for the correct navigation of all DTCs. TEST the system for normal operation.
U0401:55	Invalid Data Received from ECM /PCM A: Not Configured	This DTC sets when the IPC receives invalid network data from the PCM for Trailer Brake Control (TBC) when the IPC is not configured for TBC . CARRY OUT the Programmable Module Installation (PMI) (when the original module is not available) for the IPC . REFER to Section 418-01 . TEST the system for normal operation.
U0401:81	Invalid Data Received from ECM /PCM A: Invalid Serial Data	This DTC sets when the IPC receives invalid network data from the PCM for the engine temperature data. RETRIEVE

	Received	and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to Section 419-10 for the correct navigation of all DTCs. TEST the system for normal operation.
U0401:86	Invalid Data Received from ECM /PCM A: Signal Invalid	This DTC sets when the IPC receives invalid network data from the PCM for the odometer data. RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to Section 419-10 for the correct navigation of all DTCs. TEST the system for normal operation.
U0415:56	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module: Invalid/Incompatible Configuration	This DTC sets when the IPC receives invalid data from the ABS module. DETERMINE which module (IPC or ABS module) has been replaced. CARRY OUT the Programmable Module Installation (PMI) (when the original module is not available) for the module in question. REFER to Section 418-01 . TEST the system for normal operation.
U0422:00	Invalid Data Received from Body Control Module: No Sub-Type Information	This DTC sets when the IPC receives invalid Body Control Module (BCM) data for the Tire Pressure Monitoring System (TPMS) function. RETRIEVE and REPAIR all non-network DTCs in the BCM . REFER to Section 419-10 for the correct navigation of all DTCs. TEST the system for normal operation.
U0422:56	Invalid Data Received from Body Control Module: Invalid/Incompatible Configuration	This DTC sets when the IPC receives BCM data for the autolamp function and the IPC is not configured for autolamps. DETERMINE which module (IPC or BCM) has been replaced. CARRY OUT the Programmable Module Installation (PMI) (when the original module is not available) for the module in question. REFER to Section 418-01 . TEST the system for normal operation.
U045A:55	Invalid Data Received From Parking Assist Control Module "A": Not Configured	This DTC sets when the IPC receives rear parking aid data when the IPC is not configured for parking aid. CARRY OUT the PMI (when the original module is not available) for the IPC . REFER to Section 418-01 . TEST the system for normal operation.
U045A:68	Invalid Data Received From Parking Assist Control Module "A": Event Information	This DTC sets when the IPC receives invalid rear parking aid data. RETRIEVE and REPAIR all non-network DTCs in the Parking Aid Module (PAM). REFER to Section 413-13 for a list of all DTCs. If there are no DTCs present, INSTALL a new PAM . REFER to Section 413-13 . TEST the system for normal operation.
U0462:82	Invalid Data Received from Compass Module: Alive/Sequence Counter Incorrect/Not Updated	If equipped with a 4.2" message center and a 4.2" FCDIM , GO to Pinpoint Test AG . For all other configurations, Refer to the appropriate section in Group 415 for the procedure.

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U0545:56	Invalid Data Received From Running Board Control Module: Invalid/Incompatible Configuration	This DTC sets when the IPC receives Power Running Board (PRB) data when the IPC is not configured for PRB s. CARRY OUT the PMI (when the original module is not available) for the IPC . REFER to Section 418-01 . TEST the system for normal operation.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CARRY OUT the PMI (when the original module is not available) for the IPC . REFER to Section 418-01 . TEST the system for normal operation. After the PMI , CLEAR the DTC. REPEAT the self-test.
U3000:04	Control Module: System Internal Failure	CLEAR the DTCs. REPEAT the self-test. If the DTC returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test BD .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test BE .
U300A:64	Ignition Switch: Signal Plausibility Failure	This DTC sets on-demand and in continuous memory when the IPC detects a messaged START input for 15 seconds or longer. Once the fault condition is detected, the IPC operates with limited functionality for 15 seconds then returns to full functionality. REFER to Section 211-05 to diagnose the ignition start circuit to the BCM .

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1048:7B	Brake Fluid Level Switch: Low Fluid Level	GO to Pinpoint Test N .
B10F1:14	Key In Switch: Circuit Short To Ground or Open	If the chime sounds with the door ajar and no key in the ignition, GO to Pinpoint Test AM . If the key-in-ignition chime is inoperative, GO to Pinpoint Test AO .
C1D00:11	Park Brake Apply Switch: Circuit Short to Ground	GO to Pinpoint Test N .
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

PCM DTC Chart

DTC	Description	Action

P0457	Evaporative Emission System Leak Detected (Fuel Cap Loose/Off)	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0460	Fuel Level Sensor A Circuit	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B .
P0461	Fuel Level Sensor A Circuit Range/Performance	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B .
P0462	Fuel Level Sensor A Circuit Low	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B .
P0463	Fuel Level Sensor A Circuit High	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B .
All other DTCs	—	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Charts

Symptom Chart — Instrument Panel Cluster (IPC)

Condition	Possible Sources	Action
• No communication with the Instrument Panel Cluster (IPC)	• Fuse • Wiring, terminals or connectors • IPC	• REFER to Section 418-00 .
• The Instrument Panel Cluster (IPC) is inoperative	• Communication concern • IPC	• GO to Pinpoint Test A .
• Incorrect fuel gauge indication	• Wiring, terminals or connectors • Fuel tank • Fuel level sender (float and resistance card) • Fuel pump module • IPC	• GO to Pinpoint Test B .
• Incorrect oil pressure gauge indication	• Communication network concern • Wiring, terminals or connectors	• GO to Pinpoint Test C .

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	• Engine oil pressure switch • Base engine oil pressure concern • PCM • IPC	
• The temperature gauge is inoperative	• PCM • IPC	• GO to Pinpoint Test D .
• Incorrect temperature gauge indication	• PCM concern • IPC	• GO to Pinpoint Test E .
• The speedometer is inoperative	• PCM • IPC	• GO to Pinpoint Test F .
• Incorrect speedometer indication	• Tire size configuration • Axle ratio configuration • PCM concern • IPC	• GO to Pinpoint Test G .
• The odometer is inoperative	• PCM • IPC	• GO to Pinpoint Test H .
• The tachometer is inoperative	• PCM • IPC	• GO to Pinpoint Test I .
• Incorrect tachometer indication	• PCM concern • IPC	• GO to Pinpoint Test J .
• The transmission temperature gauge is inoperative	• PCM • IPC	• GO to Pinpoint Test K .
• Incorrect transmission temperature gauge indication	• Transmission concern • IPC	• GO to Pinpoint Test L .
• The ControlTrac 4WD gauge is inoperative	• 4WD concern • IPC	• GO to Pinpoint Test BG .
• The brake warning indicator is never on	• Wiring, terminals or connectors • Brake fluid level switch • Parking brake warning indicator switch • Body Control Module (BCM) • IPC	• GO to Pinpoint Test M .
• The brake warning indicator is always on	• Wiring, terminals or connectors • Parking brake warning indicator switch • Brake fluid level switch • ABS concern • BCM	• GO to Pinpoint Test N .

	• IPC	
• The ABS warning indicator is never/always on	• ABS module • IPC	• GO to Pinpoint Test O .
• The stability/traction control indicator is never/always on	• Stability/traction control concern • ABS module • IPC	• GO to Pinpoint Test P .
• The stability/traction control disabled indicator is never/always on	• A MyKey® programmed key is in use • Stability/traction control cannot be disabled • ABS module • IPC	• GO to Pinpoint Test Q .
• The LH/RH turn or high beam indicator is never/always on	• Turn signal concern • High beam concern • BCM • IPC	• GO to Pinpoint Test R .
• The Tire Pressure Monitoring System (TPMS) warning indicator is never/always on	• Tire pressure • TPMS concern • BCM • IPC	• GO to Pinpoint Test S .
• The air bag warning indicator is never/always on	• SRS concern • Restraints Control Module (RCM) • IPC	• GO to Pinpoint Test T .
• The safety belt warning indicator is never/always on	• Safety belt buckle concern • RCM • IPC	• GO to Pinpoint Test U .
• The Malfunction Indicator Lamp (MIL) is never/always on	• PCM • IPC	• GO to Pinpoint Test V .
• The cruise control indicator is never/always on	• PCM • IPC	• GO to Pinpoint Test W .
• The PRNDL indicator is never on/always displays P	• Wiring, terminals or connectors • Brake shift interlock actuator • PCM concern • IPC	• GO to Pinpoint Test X .
• The powertrain malfunction (wrench) message center indicator is always on	• Message center concern • Electronic Throttle Control (ETC) concern • 4WD concern (if	• GO to Pinpoint Test Y .

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	equipped) • Transmission concern	
• The engine over-temperature message center warning indicator is never/always on	• PCM concern • IPC	• OPEN then CLOSE the driver door and VERIFY the door ajar message center warning indicator functions correctly. ▪ If the door ajar message center warning indicator does not function correctly, INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. ▪ If the door ajar message center warning indicator functions correctly, GO to Pinpoint Test D to diagnose the temperature gauge.
• The charging system message center warning indicator is never/always on	• Message center concern • Charging system concern • PCM	• GO to Pinpoint Test Z.
• The low oil pressure message center warning indicator is never/always on	• Wiring, terminals or connectors • Message center concern • Communication concern • Tachometer concern • Engine oil pressure switch • Base engine oil pressure concern • PCM	• GO to Pinpoint Test AA.
• The 4X4 auto, 4X4 low, 4X4 high or 4X2 message center indicator is never/always on (if equipped)	• Message center concern • Four-Wheel Drive (4WD) concern • Transfer Case Control Module (TCCM)	• GO to Pinpoint Test AB.
• The tow haul message center indicator is never/always on	• Message center concern • PCM	• GO to Pinpoint Test AC.
• The Electronic Locking Differential (ELD) message center indicator is	• Message center concern • ELD concern • TCCM	• GO to Pinpoint Test AD.

never/always on		
• The door ajar message center warning indicator is never/always on	• Message center concern • Interior lighting concern • BCM	• GO to Pinpoint Test AE .
• The low fuel message center indicator is never/always on	• Fuel gauge indication concern • IPC	• GO to Pinpoint Test BF .

Symptom Chart — Information And Message Center

Condition	Possible Sources	Action
• The message center display is blank	• Message center set to blank display mode • IPC	• On the base IPC , PRESS the INFO button to make sure the message center is not set to a blank display mode. On the optional IPC , PRESS the message center button left several times to navigate from the blank message center display. ▪ If the message center display turns on, the system is operating normally at this time. The message center display was set to a blank display mode. ▪ If the message center display is still blank, GO to Pinpoint Test A .
• Not all segments of the display illuminate — base IPC only	• IPC	• INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• Not all display pixels illuminate — optional IPC only	• IPC	• **NOTE:** In order to condemn the IPC , the display failure must meet all of the following criteria: • There must be 3 or more pixels inoperative. • The inoperative pixels must be within 5 mm (0.196 in) or less from each other. • The inoperative pixels must be inside of the area that is 19 mm (0.748 in) from each outside border. VERIFY the number of pixels

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		are inoperative and the location of the inoperative pixels in the display screen. ■ If the does not meet the above criteria, the display is operating within design specifications. ■ If display meets the above criteria, INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The message center is not operating correctly	• Wiring, terminals or connectors • Message center switch (part of the LH steering wheel switch) • Clockspring • IPC	• GO to Pinpoint Test AF.
• The compass is inoperative (with 4.2" message center and 4.2" FCDIM)	• Communication concern • GPSM	• GO to Pinpoint Test AG.
• The compass is inoperative (without 4.2" message center and 4.2" FCDIM)	• Fuse • Wiring, terminals or connectors • Communication concern • GPSM	• Refer to the appropriate section in Group 415 for the procedure.
• The compass is inaccurate	• Zone setting • Calibration • Compass module • Auto-dimming interior mirror	• Refer to the appropriate section in Group 415 for the procedure.
• The factory mode message is always on	• Vehicle still in factory mode	• **NOTE:** This vehicle automatically defaults to normal operation mode after 60 ignition cycles. CARRY OUT the procedure to place the vehicle in normal operation mode. REFER to Disable Transport or Factory Mode in Section 419-10.
• The transport mode message is always on	• Vehicle still in transport mode	• **NOTE:** The vehicle automatically defaults to normal operation mode when the mileage reaches 125

		miles (200 km). CARRY OUT the procedure to place the vehicle in normal operation mode. REFER to Disable Transport or Factory Mode in Section 419-10 .
• The ENGINE OIL CHANGE SOON, OIL CHANGE REQUIRED message is inoperative	• Odometer • IPC	• Using the system check in the message center, VERIFY the oil life is between 1% and 5% for the ENGINE OIL CHANGE SOON message or at 0% for the OIL CHANGE REQUIRED message. ▪ If the oil life is between 1% and 5%, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. ▪ If the oil life is above 5%, the message center is operating correctly. INFORM the customer how the message center functions and how the oil life messages are set.
• The Distance To Empty (DTE)/average fuel economy display is inoperative	• IPC	• CHECK the operation of the fuel gauge, the speedometer and the odometer. ▪ If the speedometer, the fuel gauge or the odometer do not operate correctly, GO to Pinpoint Test B (fuel gauge), GO to Pinpoint Test F (speedometer) or GO to Pinpoint Test H (odometer). ▪ If the speedometer, the fuel gauge and the odometer operate correctly, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The outside air temperature display is inoperative/incorrect	• Communication concern • PCM concern	• GO to Pinpoint Test AI .

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• A hill descent message is inoperative/always on	• Message center concern • ABS module	• GO to Pinpoint Test AJ .
• The CHECK FUEL FILL INLET message is inoperative/always on	• Evaporative fuel system concern • PCM • IPC	• GO to Pinpoint Test AK .
• The CHECK BRAKE SYSTEM, PARK BRAKE ENGAGED or BRAKE FLUID LEVEL LOW warning is inoperative/always on	• Brake warning indication concern • IPC	• OPEN then CLOSE the driver door and VERIFY the DRIVER DOOR AJAR warning functions correctly. ▪ If the DRIVER DOOR AJAR warning does not function correctly, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. ▪ If the DRIVER DOOR AJAR warning functions correctly, GO to Pinpoint Test M (never on) or GO to Pinpoint Test N (always on) to diagnose the brake warning indicator.
• The DRIVER, PASSENGER, REAR LEFT or REAR RIGHT DOOR AJAR warning is inoperative/always on	• Interior lighting concern • IPC	• DISCONNECT the brake fluid level switch and VERIFY the message center displays CHECK BRAKE SYSTEM. ▪ If the CHECK BRAKE SYSTEM warning turns on, GO to Pinpoint Test AE to diagnose the door ajar message center warning indicator. ▪ If the CHECK BRAKE SYSTEM warning does not turn on, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The TIRE PRESSURE SENSOR FAULT, LOW TIRE PRESSURE or TIRE PRESSURE MONITOR FAULT warning is inoperative/always on	• BCM • IPC	• OPEN then CLOSE the driver door and VERIFY the DRIVER DOOR AJAR warning functions correctly. ▪ If the DRIVER DOOR AJAR warning does not function correctly,

		INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. ■ If the DRIVER DOOR AJAR warning functions correctly, GO to Pinpoint Test S to diagnose the TPMS warning indicator.
• The TRAIN LEFT FRONT, RIGHT FRONT, RIGHT REAR or LEFT REAR message is inoperative/always on	• TPMS warning indicator concern • TPMS sensor training	• **NOTE:** These messages only appear during the TPMS sensor training procedure. REFER to Section 204-04 . VERIFY the TPMS warning indicator functions. ■ If the TPMS warning indicator does not operate, GO to Pinpoint Test S . ■ If the TPMS warning indicator operates, CARRY OUT the TPMS sensor training. REFER to Section 204-04 .
• The TIRES NOT TRAINED-REPEAT message is always on	• TPMS sensor training	• CARRY OUT the TPMS sensor training. REFER to Section 204-04 .
• The TRAINING COMPLETE message is inoperative	• TPMS sensor training	• CARRY OUT the TPMS sensor training. REFER to Section 204-04 .
• A MyKey® menu is not available or incorrect	• MyKey® programmed key in use • Number of keys set to unlimited mode • Non-Ford approved remote start system installed	• REFER to Section 419-01B to diagnose the MyKey® system.
• The WIRING FAULT ON TRAILER, TRAILER BRAKE MODULE FAULT or TRAILER DISCONNECTED warning is inoperative/always on	• IPC configuration • Trailer brake control system	• VERIFY the vehicle is equipped with the trailer brake control system. ■ If the trailer brake warning is inoperative, VERIFY the IPC is correctly configured for trailer brake using the PMI (when the original

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		module is not available). REFER to Section 418-01 . ■ If the trailer brake warning is always on, REFER to Section 206-10 .
• A 4X4 system message is inoperative/always on	• Message center concern • 4WD system concern • TCCM	• OPEN then CLOSE the driver door and VERIFY the DRIVER DOOR AJAR warning functions correctly. ■ If the DRIVER DOOR AJAR warning does not function correctly, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. ■ If the DRIVER DOOR AJAR warning functions correctly, GO to Pinpoint Test AB to diagnose the 4X4 auto, 4X4 low, 4X4 high or 4X2 message center warning indicator.
• An off road mode message is inoperative/always on (Raptor only)	• Message center concern • 4WD concern • TCCM	• GO to Pinpoint Test AL .

Symptom Chart — Warning Chimes

Condition	Possible Sources	Action
• All the chimes are inoperative	• Instrument Panel Cluster (IPC)	• VERIFY the IPC gauges and indicators are functioning correctly. ■ If the IPC gauges and indicators do not function correctly, GO to Pinpoint Test A . ■ If the IPC gauges and indicators function correctly, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The air bag secondary warning chime is inoperative	• IPC	• RETRIEVE the recorded IPC DTCs from the self-test. ■ If the IPC DTC P1534:01 is not present, the system is operating correctly. The air bag secondary warning chime sounds only when a fault in the air bag warning indicator is present and DTC P1534:01 is

		recorded. ■ If the IPC DTC P1534:01 is present, INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The air bag secondary warning chime has activated	• IPC	• INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The Belt-Minder® feature does not operate correctly	• Safety belt warning indication concern • Belt-Minder® deactivated • Speedometer concern • RCM • IPC	• GO to Pinpoint Test AR.
• The chime always sounds	• Exterior lighting concern • Interior lighting concern • Wiring, terminals or connectors • Key-in-ignition warning switch (part of the ignition switch) • Ignition lock cylinder • Body Control Module (BCM)	• GO to Pinpoint Test AM.
• The door ajar warning chime is inoperative	• Interior lighting concern • BCM • IPC	• VERIFY the key-in-ignition warning chime functions correctly. ■ If the key-in-ignition warning chime does not function correctly, GO to Pinpoint Test AO. ■ If the key-in-ignition warning chimes functions correctly, GO to Pinpoint Test AE to diagnose the door ajar message center warning indicator.
• The headlamps on warning chime is inoperative	• Interior lighting concern • BCM • IPC	• GO to Pinpoint Test AN.
• The key-in-ignition warning chime is inoperative	• Interior lighting concern • Wiring, terminals or	• GO to Pinpoint Test AO.

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	connectors • Key-in-ignition warning switch (part of the ignition switch) • Ignition lock cylinder • BCM • IPC	
• The message center warning chime is inoperative	• IPC	• DISCONNECT the brake fluid level switch and VERIFY the message center warning chime sounds when the message center displays CHECK BRAKE SYSTEM. ▪ If the message center warning chime sounds when the CHECK BRAKE SYSTEM warning appears, the system is operating correctly at this time. The message center warning chime only sounds when the message center displays a new warning message. ▪ If the message center warning chime does not sound when the CHECK BRAKE SYSTEM warning appears, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The memory feedback warning chime is inoperative	• Driver Seat Module (DSM) • IPC	• GO to Pinpoint Test AP .
• The parking brake warning chime is inoperative	• Brake warning indication concern • BCM • IPC	• GO to Pinpoint Test AQ .
• The perimeter alarm warning chime is inoperative	• Perimeter alarm concern • IPC	• VERIFY the key-in-ignition warning chime functions correctly. ▪ If the key-in-ignition warning chime does not function correctly, GO to Pinpoint Test AO . ▪ If the key-in-ignition warning chimes functions correctly, REFER to Section 419-01A to diagnose the perimeter alarm.
• The safety belt warning chime is inoperative	• Safety belt warning indication concern • IPC	• GO to Pinpoint Test AR .

• The service AdvanceTrac® warning chime is inoperative	• Message center traction control warning concern • IPC	• VERIFY the SERVICE ADVANCETRAC message is displayed in the message center and the stability/traction control indicator operates correctly. ▪ If the SERVICE ADVANCETRAC message is not displayed in the message center and the stability/traction control indicator is not illuminated, the system is operating correctly. ▪ If the SERVICE ADVANCETRAC message is displayed and the stability/traction control indicator is illuminated, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
• The turn/hazard on chime (tick-tock) is inoperative	• RH/LH turn indicator • IPC	• VERIFY the RH/LH turn indicators operate correctly. ▪ If the RH/LH turn indicators do not operate correctly, GO to Pinpoint Test R . ▪ If the RH/LH turn indicators operate correctly, INSTALL a new IPC . TEST the system for normal operation.
• The turn signal on warning chime is inoperative	• Turn signal indication concern • Odometer operation • BCM • IPC	• GO to Pinpoint Test AS .

Pinpoint Tests

Pinpoint Test A: The Instrument Panel Cluster (IPC) Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives a hot at all times voltage from the Body Control Module (BCM) fuse 11 (10A). The IPC uses a run/start input messaged from the BCM over the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

- Communication concern
- IPC

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PINPOINT TEST A: THE IPC IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 VERIFY THE IPC PASSES THE NETWORK TEST	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • In the LH pane of theIntegrated Diagnostic System (IDS) network test display screen, verify whether the IPC passed the network test. • **Did the IPC pass the network test?**	**Yes** GO to A2 . **No** REFER to Section 418-00 to diagnose the IPC does not respond to the scan tool.
A2 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded BCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** GO to A3 .
A3 CHECK FOR CORRECT IPC OPERATION	

• Disconnect the IPC connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: Incorrect Fuel Gauge Indication

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The fuel level sender (part of the fuel pump module) is hardwired to the Instrument Panel Cluster (IPC) between the signal and return circuits. The fuel level sender is a variable resistor that ranges from 10 ohms ± 2 ohms at full (F) and 180 ohms ± 4 ohms at empty (E). The IPC provides a reference voltage to the fuel pump module. As the fuel level changes, a float actuates a variable resistor on the fuel pump sender and raises or lowers the fuel level signal voltage depending on the resistance of the fuel level sender. The IPC monitors the changes in voltage and commands the fuel gauge with a corresponding movement of the pointer.

The IPC uses 4 different operating modes to calculate the fuel level:

- Anti-slosh (default mode)

- Key off fueling
- Key on fueling
- Recovery

After a fuel fill up, the time for the fuel gauge to move from empty (E) to full (F) ranges from 2 seconds to 55 minutes depending on which operating mode the fuel gauge is in.

Anti-Slosh Mode

The default fuel gauge mode is called the anti-slosh mode. To prevent fuel gauge changes from fuel slosh (gauge instability due to changes in fuel sender readings caused by fuel moving around in the tank), the fuel gauge takes approximately 55 minutes to go from empty (E) to full (F).

Key Off Fueling Mode

The key off fueling mode (2 seconds to read empty [E] to full [F]) requires the following conditions be met:

- The ignition must be off when refueling the vehicle.
- At least 15% of the vehicle's fuel capacity must be added to the fuel tank.
- The IPC must receive a valid key on fuel sender reading within 1 second of the ignition being put into run. The key on sample readings are considered valid if the fuel sender reading is between 10 ohms ± 2 ohms and 180 ohms ± 4 ohms.

If these conditions are not met, the fuel gauge stays in the default anti-slosh mode, which results in a slow to read full (F) event.

Key On Fueling Mode

The key on fueling mode (approximately 60 seconds to read empty [E] to full [F]) requires the following conditions be met:

- Engine speed input greater than 0 rpm.
- The transmission is in park.
- The ignition is in run.
- At least 15% of the vehicle's fuel capacity must be added to the fuel tank.

In key on fueling mode, a 30 second timer activates after the transmission is put into the PARK position. When the 30 second time has elapsed and at least 15% of the vehicle's fuel capacity has been added, the fuel gauge response time is 60 seconds to read from empty (E) to full (F). When the transmission is shifted out of park, the fuel gauge strategy reverts to the anti-slosh mode. The key on fueling mode prevents slow to read full events from happening if the customer refuels the vehicle with the ignition in RUN.

Recovery Mode

Recovery mode is incorporated into the IPC strategy to recover from a missing fuel level input after a refueling event. Missing fuel level inputs result from intermittent opens in the fuel sender or its circuits. Recovery mode (empty [E] to full [F] approximately 20 minutes) is initiated when the following 2 conditions are met:

- The IPC is in the anti-slosh (default) mode.
- The actual fuel level in the tank is greater than what is being displayed by the fuel gauge.

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Instrument Panel Cluster (IPC) DTCs

DTC Description	Fault Trigger Conditions
• P0460:11 — Fuel Level Sensor A Circuit: Circuit Short to Ground	A continuous and on-demand DTC that sets in the IPC if the IPC detects the fuel sender is out of range on the fuel level input circuit with a short to ground for more than 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault and sets DTC P0460:11.
• P0460:13 — Fuel Level Sensor A Circuit: Circuit Open	A continuous and on-demand DTC that sets in the IPC if the IPC detects the fuel sender is out of range on the fuel level input circuit with an open or short to voltage for more than 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault and sets DTC P0460:13.

PCM DTCs

DTC Description	Fault Trigger Condition
• P0460 — Fuel Level Sensor A Circuit	This DTC sets when the PCM determines the value of the fuel level input signal is stuck, the fuel level input signal does not change or does not correspond with the calculated fuel usage.
• P0461 — Fuel Level Sensor A Circuit Range/Performance	This DTC sets when the PCM determines the fuel level input signal repeatedly moves in and out of range, exceeding the minimum or maximum allowable calibrated parameters for a specified fuel fill percentage in the fuel tank.
• P0462 — Fuel Level Sensor A Circuit Low	This DTC sets in the PCM when the PCM detects a short to ground on the fuel pump module signal circuit based on the messaged input received from the IPC .
• P0463 — Fuel Level Sensor A Circuit High	This DTC sets in the PCM when the PCM detects an open or a short to voltage on the fuel pump module signal circuit based on the messaged input received from the IPC .

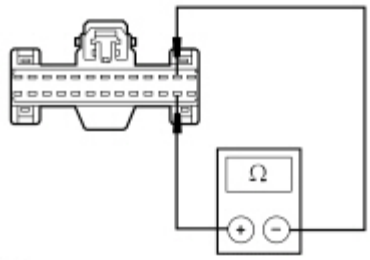
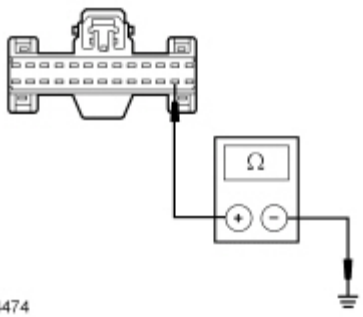
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Fuel tank
- Fuel level sender (float and resistance card)
- Fuel pump module
- IPC

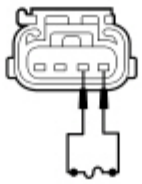
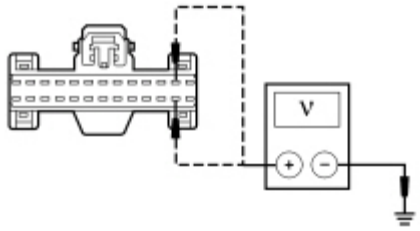
PINPOINT TEST B: INCORRECT FUEL GAUGE INDICATION

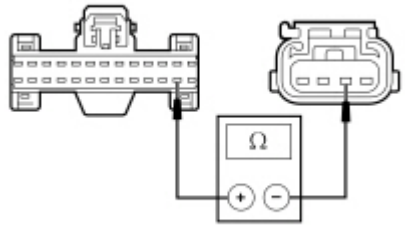
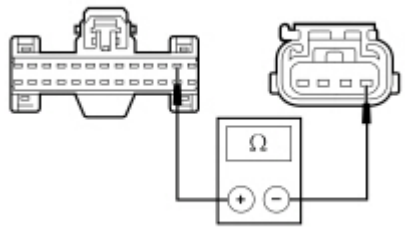
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Ignition OFF.	**Yes**

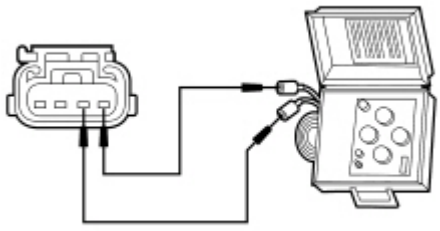
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	For DTC P0460:11, GO to B2 . For DTC P0460:13, GO to B5 . For all other DTCs, REFER to DTC Charts in this section. **No** GO to B9 .
B2 CHECK THE FUEL PUMP MODULE FOR A SHORT TO GROUND	
• Disconnect: Fuel Pump Module C4330 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • Wait 1 minute. • **NOTE:** DTC P0460:11 may also be present when carrying out this test step and should be ignored. • Clear the IPC DTCs. Repeat the IPC self-test. • **Is DTC P0460:13 retrieved?**	**Yes** GO to B13 . **No** GO to B3 .
B3 CHECK THE FUEL PUMP MODULE SIGNAL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: IPC C220 . • Measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and the IPC C220-2, circuit RMC32 (GN/BU), harness side.  N0094472 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B4 . **No** REPAIR the circuits for a short together. CLEAR the DTCs. REPEAT the self-test.
B4 CHECK THE FUEL LEVEL SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and ground.  N0094474 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B15 . **No** REPAIR circuit VMC11 (YE/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test.

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B5 CHECK THE FUEL PUMP MODULE FOR AN OPEN	
• Disconnect: Fuel Pump Module C4330 . • Connect a fused jumper wire between the fuel pump module C4330-2, circuit VMC11 (YE/VT), harness side and the fuel pump module C4330-1, circuit RMC32 (GN/BU), harness side.  N0057125 • Ignition ON. • Wait 1 minute. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **NOTE:** DTC P0460:13 may also be present when carrying out this test step and should be ignored. • Clear the IPC DTCs. Repeat the IPC self-test. • **Is DTC P0460:11 retrieved?**	**Yes** REMOVE the jumper wire. GO to B13 . **No** REMOVE the jumper wire. GO to B6 .
B6 CHECK THE FUEL LEVEL SIGNAL AND RETURN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IPC C220 . • Ignition ON. • Measure the voltage between the IPC C220-15, circuit VMC11 (YE/VT), harness side and ground; and between the IPC C220-2, circuit RMC32 (GN/BU), harness side and ground.  N0094467 • **Is any voltage present?**	**Yes** REPAIR the circuit in question for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to B7 .
B7 CHECK THE FUEL LEVEL SIGNAL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and the fuel pump module C4330-2, circuit VMC11 (YE/VT), harness side:	**Yes** GO to B8 . **No** REPAIR circuit VMC11 (YE/VT) for an open. CLEAR the DTCs. REPEAT the self-test.

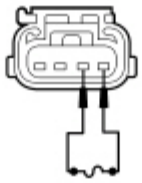
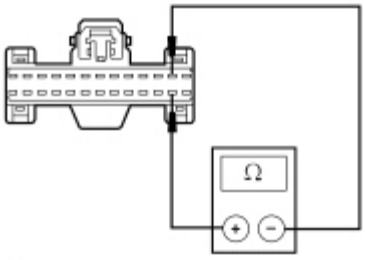
 N0120192 • **Is the resistance less than 5 ohms?**	
B8 CHECK THE FUEL LEVEL RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between the IPC C220-2, circuit RMC32 (GN/BU), harness side and the fuel pump module C4330-1, circuit RMC32 (GN/BU), harness side.  N0120193 • **Is the resistance less than 5 ohms?**	**Yes** GO to B15 . **No** REPAIR circuit RMC32 (GN/BU) for an open. CLEAR the DTCs. REPEAT the self-test.
B9 CARRY OUT THE IPC FUEL GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC fuel gauge (FUELLEVEL) active command. Monitor the fuel gauge while scrolling the fuel level at 0%, 50%, and 100%. • **Does the fuel gauge display below E with 0%, half with 50%, and full stop with 100%?**	**Yes** GO to B10 . **No** GO to B15 .
B10 CHECK THE FUEL LEVEL INPUT TO THE IPC	
NOTE: Since the IPC may be in anti-slosh mode, the PID values may not match the fuel gauge readings. Disregard the actual gauge indication during this test step. • Ignition OFF. • Disconnect: Fuel Pump Module C4330 . • Connect one lead of the instrument gauge system tester to the fuel pump module C4330-2, circuit VMC11 (YE/VT), harness side and the other lead to the fuel pump module assembly C4330-1, circuit RMC32 (GN/BU), harness side.	**Yes** DISCONNECT the instrument gauge system tester. GO to B12 . **No** DISCONNECT the instrument gauge system tester. GO to B11 .

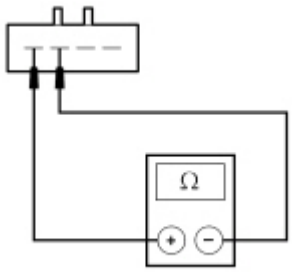
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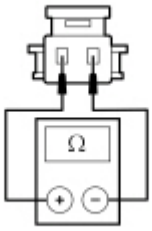
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- Ignition ON.
- Enter the following diagnostic mode on the scan tool: IPC DataLogger .
- **NOTE:** It is important to confirm the gauge tester settings with an ohmmeter to make sure the gauge tester is in the correct position. Failure to follow this check may result in inaccurate test results.
- Monitor the IPC fuel level PID (FUELLEVEL) with the instrument gauge system tester set at 180 ohms, 90 ohms, 55 ohms, 30 ohms, and 10 ohms.
- **Does the PID begin at approximately 0%, move to 25%, 50%, 75% then 100%?**

B11 CHECK THE FUEL PUMP MODULE SIGNAL AND RETURN CIRCUITS FOR A HIGH RESISTANCE	
- Ignition OFF. - Disconnect: IPC C220 . - Connect a fused jumper wire between the fuel pump module C4330-2, circuit VMC11 (YE/VT), harness side and the fuel pump module C4330-1, circuit RMC32 (GN/BU), harness side.  N0057125 - Measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and the IPC C220-2, circuit RMC32 (GN/BU), harness side.  N0094472 - **Is the resistance less than 5 ohms?**	**Yes** GO to B15 . **No** REPAIR the circuits for high resistance. TEST the system for normal operation.

B12 CHECK THE FUEL TANK	
• Check the fuel tank for any damage or deformation. • **Is the fuel tank OK?**	**Yes** GO to B13 . **No** VERIFY the fuel level sensor and fuel pump module are OK. INSTALL a new fuel tank. REFER to Section 310-01 . CLEAR the DTCs. REPEAT the self-test.
B13 CHECK THE FUEL PUMP MODULE	
NOTE: The fuel pump module resistance measures between 10 ohms ± 2 ohms at the upper stop position and 180 ohms ± 4 ohms at the lower stop position. • Remove the fuel pump module. Refer to Section 310-01 . • Measure the resistance between the fuel pump module pin 1, component side, and the fuel pump module pin 2, component side, while moving the float arm from the lower stop position to the upper stop position.  N0027636 • **Does the resistance slowly decrease from approximately 180 ohms to 10 ohms?**	**Yes** CHECK the fuel pump module connector for corrosion, damaged or pushed out pins and REPAIR as necessary. **No** GO to B14 .
B14 CHECK THE FUEL LEVEL SENDER	
NOTE: The fuel level sender resistance measures between 10 ohms ± 2 ohms at the upper stop position and 180 ohms ± 4 ohms at the lower stop position. • Disconnect the fuel level sender input wire from the fuel pump module. • Measure the resistance between the fuel level sender connector pin 1, harness side and the fuel level sender connector pin 2, harness side while slowly moving the float arm between the lower and upper stop position.	**Yes** INSTALL a new fuel pump module. REFER to Section 310-01 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new fuel level sender (float and card). CLEAR the DTCs. REPEAT the self-test.

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 N0112563 • **Does the resistance slowly decrease from approximately 180 ohms to 10 ohms?**	
B15 CHECK FOR CORRECT IPC OPERATION	

• Disconnect the IPC connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: Incorrect Oil Pressure Gauge Indication

Normal Operation

The engine oil pressure switch is hardwired to the PCM. The Instrument Panel Cluster (IPC) receives the engine oil pressure status from the PCM over the High Speed Controller Area Network (HS-CAN).

The PCM provides a reference voltage to the engine oil pressure switch when the ignition key is in RUN. When there is low or no oil pressure, the engine oil pressure switch remains open. The PCM detects no change in the reference voltage and provides engine oil pressure status to IPC to keep the oil pressure gauge in the low oil pressure area of the gauge. With the engine running and sufficient oil pressure, the engine oil pressure switch closes, pulling the reference voltage low. The PCM detects the low reference voltage and provides engine oil pressure status to the IPC to command the oil pressure gauge to the normal oil pressure range.

If the IPC fails to receive the oil pressure status from the PCM for 5 seconds or less, the IPC defaults the oil pressure gauge to the last setting, based upon the last known good oil pressure status message. If the IPC fails to receive the oil pressure status from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the oil pressure gauge to low (L).

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Wiring, terminals or connectors

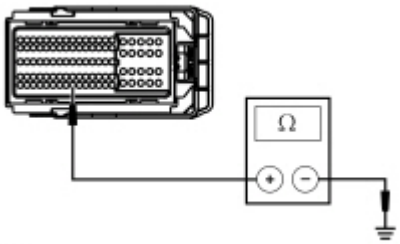
- Engine oil pressure switch
- Base engine oil pressure concern
- PCM
- IPC

PINPOINT TEST C: INCORRECT OIL PRESSURE GAUGE INDICATION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

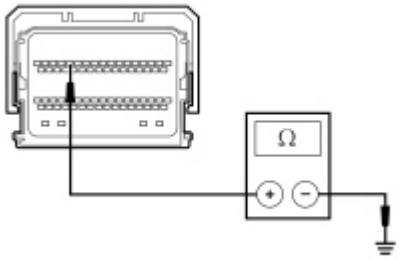
Test Step	Result / Action to Take
C1 CARRY OUT THE IPC OIL PRESSURE GAUGE ACTIVE COMMAND USING THE SCAN TOOL • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC oil pressure gauge active command (OIL_PRESS) on and off to sweep the gauge. • **Does the engine oil pressure gauge sweep to the normal range when commanded on and return to low (L) when commanded off?**	**Yes** If the oil pressure gauge always reads in the normal range, GO to C2 . If the oil pressure gauge always reads low (L) (does not register any oil pressure), GO to C4 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
C2 CHECK FOR A STUCK CLOSED ENGINE OIL PRESSURE SWITCH • Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Ignition ON. • Observe the engine oil pressure gauge. • **Does the engine oil pressure gauge indicate low (L) oil pressure?**	**Yes** INSTALL a new engine oil pressure switch. Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation. **No** GO to C3 .
C3 CHECK THE OIL PRESSURE INPUT CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: PCM C175E (3.7L), C1381E (5.0L and 6.2L), or C1551E (3.5L) . • For 3.5L, measure the resistance between the PCM C1551E-9, circuit CMC24 (GY), harness side and ground.	**Yes** GO to C8 . **No** REPAIR circuit CMC24 (GY) for a short to ground. TEST the system for normal operation.

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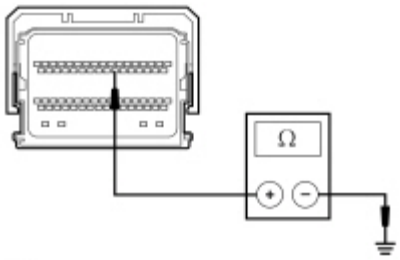
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- For 3.7L, measure the resistance between the PCM C175E-13, circuit CMC24 (GY), harness side and ground.



N0120194

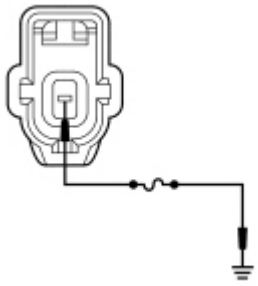
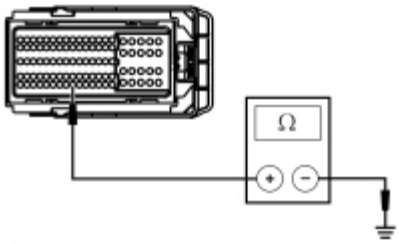
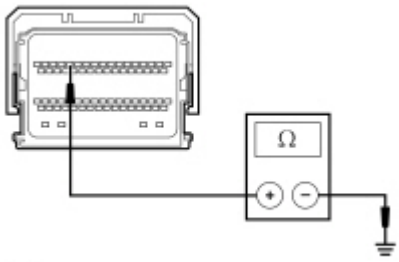
- For 5.0L and 6.2L, measure the resistance between the PCM C1381E-24, circuit CMC24 (GY), harness side and ground.



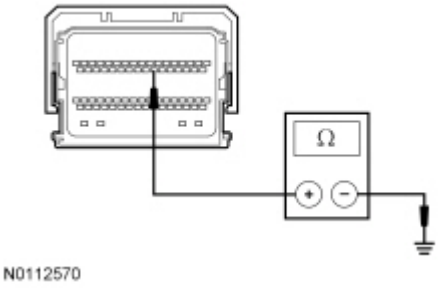
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- **Is the resistance greater than 10,000 ohms?**

C4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test AT . **No** GO to C5 .
C5 CHECK FOR A STUCK OPEN ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Connect a fused jumper wire between the engine oil pressure switch C103-1, circuit CMC24 (GY), harness side and ground.	**Yes** REMOVE the jumper wire. GO to C7 . **No** LEAVE the jumper wire connected.

 N0002760 • Ignition ON. • Observe the engine oil pressure gauge. • **Does the engine oil pressure gauge indicate normal oil pressure?**	GO to C6 .
C6 CHECK THE ENGINE OIL PRESSURE INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175E (3.7L), C1381E (5.0L and 6.2L), or C1551E (3.5L) . • For 3.5L, measure the resistance between the PCM C1551E-9, circuit CMC24 (GY), harness side and ground.  N0122305 • For 3.7L, measure the resistance between the PCM C175E-13, circuit CMC24 (GY), harness side and ground.  N0120194 • For 5.0L and 6.2L, measure the resistance between the PCM C1381E-24, circuit CMC24 (GY), harness side and ground.	**Yes** REMOVE the jumper wire. GO to C8 . **No** REMOVE the jumper wire. REPAIR circuit CMC24 (GY) for an open. TEST the system for normal operation.

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 N0112570 • **Is the resistance less than 5 ohms?**	
C7 CHECK THE ENGINE OIL PRESSURE	
• Carry out the engine oil pressure test. Refer to Section 303-00 . • **Is the engine oil pressure within specification?**	**Yes** INSTALL a new engine oil pressure switch. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation. **No** REFER to Section 303-00 to continue diagnosis of the engine oil pressure.
C8 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Connect: Engine Oil Pressure Switch C103 . • Connect: PCM C175E (3.7L), C1381E (5.0L and 6.2L) or C1551E (3.5L) . • Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to C9 .
C9 CHECK FOR CORRECT PCM OPERATION	

• Disconnect the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: The Temperature Gauge Is Inoperative

Normal Operation

The PCM uses the Cylinder Head Temperature (CHT) sensor to measure the engine temperature. The Instrument Panel Cluster (IPC) receives the engine temperature data from the PCM over the High Speed Controller Area Network (HS-CAN). The IPC monitors the engine temperature data received from the PCM and commands the temperature gauge indication with a corresponding movement of the pointer.

If the IPC receives invalid engine temperature data from the PCM for 5 seconds or less, the IPC defaults the

temperature gauge to the last setting, based upon the last known good engine temperature status message. If the IPC does not receive the engine temperature status message from the PCM or if the data received is deemed invalid for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the temperature gauge to cold (C). If the engine temperature data is deemed invalid by the IPC , the IPC sets DTC U0401:00 and defaults the temperature gauge to cold (C).

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST D: THE TEMPERATURE GAUGE IS INOPERATIVE

Test Step	Result / Action to Take
D1 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to D2 .
D2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** GO to D3 .
D3 CARRY OUT THE TEMPERATURE GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • **NOTE:** Make sure the temperature gauge is commanded to full cold before beginning this step. • Select the IPC temperature gauge (ENGCOOLNT) active command. Command the temperature gauge on and off while monitoring the gauge. • **Does the temperature gauge start at cold (C), move to full hot (H) and return to cold (C)?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test E: Incorrect Temperature Gauge Indication

Normal Operation

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The PCM uses the Cylinder Head Temperature (CHT) sensor to measure the engine temperature. The Instrument Panel Cluster (IPC) receives the engine temperature data from the PCM over the High Speed Controller Area Network (HS-CAN). The IPC monitors the engine temperature data received from the PCM and commands the temperature gauge indication with a corresponding movement of the pointer.

If the IPC receives invalid engine temperature data from the PCM for 5 seconds or less, the IPC defaults the temperature gauge to the last setting, based upon the last known good engine temperature status message. If the IPC does not receive the engine temperature status message from the PCM or if the data received is deemed invalid for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the temperature gauge to cold (C). If the engine temperature data is deemed invalid by the IPC , the IPC sets DTC U0401:00 and defaults the temperature gauge to cold (C).

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM concern
- IPC

PINPOINT TEST E: INCORRECT TEMPERATURE GAUGE INDICATION

Test Step	Result / Action to Take
E1 CHECK FOR CORRECT OPERATION OF THE COOLING SYSTEM	
• Verify the engine cooling system and thermostat are functioning correctly. • **Do the engine cooling system and thermostat operate correctly?**	**Yes** GO to E2 . **No** REFER to Section 303-03 .
E2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the KOEO self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to E3 .
E3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** GO to E4 .
E4 CARRY OUT THE TEMPERATURE GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
	Yes

NOTE: The coolant temperature should range between 0-59°C (32-138°F) with the gauge in the cold (C) range, between 60-120°C (140-248°F) with the gauge in the normal or mid-range and above 121°C (250°F) with the gauge in the hot (H) range. • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • **NOTE:** Make sure the temperature gauge is commanded to full cold before beginning this step. • Select the IPC temperature gauge (ENGCOOLNT) active command. Command the temperature gauge according to the following table: **Temperature Command** / **Gauge Position** 20% / Beginning of the normal band 50% / Center of the gauge (mid-range) 90% / End of the normal band • **Does the temperature gauge operate according to the above specifications?**	GO to E5 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
E5 CHECK THE PCM TEMPERATURE PID	
NOTE: The coolant temperature should range between 0-59°C (32-138°F) with the gauge in the cold (C) range, between 60-120°C (140-248°F) with the gauge in the normal or mid-range and above 121°C (250°F) with the gauge in the hot (H) range. • Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Ignition ON. • Select the PCM temperature PID (CHT). With the engine running, monitor the PCM temperature PID. • **Does the PCM PID agree with the position of the temperature gauge indication?**	**Yes** The temperature gauge is operating correctly at this time. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test F: The Speedometer Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the vehicle speed signal from the PCM over the High Speed Controller Area Network (HS-CAN). The PCM receives the vehicle speed signal input from the transmission Output Shaft Speed (OSS) sensor. The IPC monitors the vehicle speed signal input from the PCM and commands the speedometer with a corresponding movement of the pointer.

If the IPC receives invalid vehicle speed data from the PCM for 5 seconds or less, the IPC defaults the speedometer to the last setting, based upon the last known good vehicle speed message. If the IPC does not receive the vehicle speed data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the speedometer to 0 km/h (0 mph). If the vehicle speed data received is deemed invalid by the IPC , the IPC sets DTC U0401:00 and defaults the speedometer to 0 km/h (0 mph).

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

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- PCM
- IPC

PINPOINT TEST F: THE SPEEDOMETER IS INOPERATIVE

Test Step	Result / Action to Take
F1 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to F2 .
F2 CARRY OUT THE SPEEDOMETER ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC speedometer (SPDOMETER) active command. Command the speedometer on and off while monitoring the speedometer. • **Does the speed begin at 0 km/h (0 mph) move to 193 km/h (120 mph) and return to 0 km/h (0 mph)?**	**Yes** GO to F3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
F3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test G: Incorrect Speedometer Indication

Normal Operation

The Instrument Panel Cluster (IPC) receives the vehicle speed signal from the PCM over the High Speed Controller Area Network (HS-CAN). The PCM receives the vehicle speed signal input from the transmission Output Shaft Speed (OSS) sensor. The IPC monitors the vehicle speed signal input from the PCM and commands the speedometer with a corresponding movement of the pointer.

The IPC provides a tolerance which allows the gauge to display between 3% lower and 7% higher than the actual vehicle speed. This means that with an actual vehicle speed of 96.6 km/h (60 mph), the speedometer may indicate between 93.7-103.3 km/h (58.2-64.1 mph). Factors that could potentially affect the speedometer accuracy are incorrect tire size configuration and axle ratio configuration.

If the IPC receives invalid vehicle speed data from the PCM for 5 seconds or less, the IPC defaults the speedometer to the last setting, based upon the last known good vehicle speed message. If the IPC does not receive the vehicle speed data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the speedometer to 0 km/h (0 mph). If the vehicle speed data received is deemed invalid by the IPC , the IPC sets DTC U0401:00 and defaults the speedometer to 0 km/h (0 mph).

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- Tire size configuration
- Axle ratio configuration
- PCM concern
- IPC

PINPOINT TEST G: INCORRECT SPEEDOMETER INDICATION

Test Step	Result / Action to Take
G1 CHECK THE TIRE SIZE CONFIGURATION	
• Enter the following diagnostic mode on the scan tool: Module Programming . • **NOTE:** The correct tire size can be found on the Vehicle Certification (VC) label on the LH B-pillar. Refer to Section 100-01 . • Verify the size of the tires installed on the vehicle matches the VC label. • Verify the tire size configuration matches the VC label. • **Is the tire size correct and is tire size correctly configured?**	**Yes** GO to G2 . **No** INSTALL the correct size tires or CONFIGURE the correct tire size as required. TEST the system for normal operation.
G2 CHECK THE AXLE RATIO CONFIGURATION	
• Enter the following diagnostic mode on the scan tool: Module Programming . • **NOTE:** The correct axle ratio can be found on the Vehicle Certification (VC) label on the LH B-pillar. Refer to Section 100-01 . • Verify the axle ratio configuration matches the VC label. • **Is the axle ratio correctly configured?**	**Yes** GO to G3 . **No** CONFIGURE the correct axle ratio. TEST the system for normal operation.
G3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to G4 .
G4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test.	**Yes** For DTC U0100:00, GO to

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- **Are any DTCs recorded?**

Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section.

No
GO to G5 .

G5 CARRY OUT THE SPEEDOMETER ACTIVE COMMAND USING THE SCAN TOOL

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: IPC DataLogger .
- Select the IPC speedometer (SPDOMETER) active command. Command the speedometer in 10% increments while monitoring the speedometer. The speed indicated should increase in increments of approximately 19 km/h (12 mph) for each 10% change.

Command	Indication Range
10% (19 km/h [12 mph])	19-21 km/h (12-13 mph)
20% 39 km/h [24 mph])	37-42 km/h (23-26 mph)
30% (58 km/h [36 mph])	56-63 km/h (35-39 mph)
40% (77 km/h [48 mph])	76-82 km/h (47-51 mph)
50% (97 km/h [60 mph])	93-103 km/h (58-64 mph)
60% (116 km/h [72 mph])	113-124 km/h (70-77 mph)
70% (135 km/h [84 mph])	130-145 km/h (81-90 mph)
80% (154 km/h [96 mph])	150-166 km/h (93-103 mph)
90% (174 km/h [108 mph])	169-187 km/h (105-116 mph)
100% (193 km/h [120 mph])	116-206 km/h (116-128 mph)

- **Does the speed indicated increase according to the above specifications?**

Yes
GO to G6 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

G6 CHECK THE PCM VSS PIDs

- Enter the following diagnostic mode on the scan tool: PCM DataLogger .
- Select the PCM vehicle speed (VSS) PID and monitor the PID while driving the vehicle at 32 km/h (20 mph), 64 km/h (40 mph) and 97 km/h (60 mph).
- **Does the speedometer indicate between 31-34 km/h (19-21 mph), 63-69 km/h (39-43 mph) and 93-103 km/h (58-64 mph) at the 3 PCM PID values?**

Yes
GO to G7 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

G7 OBSERVE THE SPEEDOMETER OPERATION

- Ignition ON.
- Observe the speedometer while driving the vehicle at various speeds and stopping frequently.
- **Does the speedometer begin at 0 km/h (0 mph) and fully return to the 0 km/h (0 mph) position when the vehicle is stopped?**

Yes
The speedometer is operating correctly at this time.

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test H: The Odometer Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the odometer rolling count data from the PCM over the High Speed Controller Area Network (HS-CAN). The IPC monitors the odometer rolling count input from the PCM and commands the odometer with a display in the message center display.

If the IPC does not receive the odometer rolling count data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the odometer display to all dashes (-----). If the odometer rolling count data is deemed invalid by the IPC , the IPC sets DTC U0401:86 and defaults the odometer display to all dashes (-----).

If the Non-Volatile Memory (NVM) becomes corrupted or if any NVM failure occurs, the IPC sets DTC U3000:04 and displays ERROR in the message center display.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer, temperature gauge.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST H: THE ODOMETER IS INOPERATIVE

Test Step	Result / Action to Take
H1 CHECK FOR CORRUPTED NVM	
• Ignition ON. • Observe the message center display area. • **Does the odometer display ERROR?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** GO to H2 .
H2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to H3 .
H3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test.	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For DTC U3000:04,

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• **Are any DTCs recorded?**	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test I: The Tachometer Is Inoperative

Normal Operation

The PCM uses the Crankshaft Position (CKP) sensor to measure the engine rpm. The PCM sends the rpm data to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) to command the tachometer according to the data.

If the IPC does not receive the engine rpm data from the PCM for 5 seconds or less, the IPC defaults the tachometer to the last setting, based upon the last known good rpm message. If the IPC does not receive the engine rpm data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the tachometer to 0 rpm.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST I: THE TACHOMETER IS INOPERATIVE

Test Step	Result / Action to Take
I1 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to I2 .
I2 CARRY OUT THE TACHOMETER ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC tachometer (TACH_IND) active command. Command the tachometer on and off while monitoring the tachometer. • **Does the tachometer begin at 0 rpm, increase to 7,000 rpm then return to 0 rpm?**	**Yes** GO to I3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

I3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test J: Incorrect Tachometer Indication

Normal Operation

The PCM uses the Crankshaft Position (CKP) sensor to measure the engine rpm. The PCM sends the rpm data to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) to command the tachometer gauge according to the data.

If the IPC does not receive the engine rpm data from the PCM for 5 seconds or less, the IPC defaults the tachometer to the last setting, based upon the last known good rpm message. If the IPC does not receive the engine rpm data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the tachometer to 0 rpm.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- PCM concern
- IPC

PINPOINT TEST J: INCORRECT TACHOMETER INDICATION

Test Step	Result / Action to Take
J1 RETRIEVE THE RECORDED DTCs FROM PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to J2 .
J2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this

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<table>
<tr><td></td><td>section.

No
GO to J3 .</td></tr>
<tr><td>J3 CARRY OUT THE TACHOMETER ACTIVE COMMAND USING THE SCAN TOOL

• Ignition ON.
• Enter the following diagnostic mode on the scan tool: IPC DataLogger .
• Select the IPC tachometer (TACH_IND) active command. Command the tachometer in 10% increments while monitoring the tachometer.
• Does the tachometer indication increase by 700 rpm at each 10% increment?</td><td>Yes
GO to J4 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.</td></tr>
<tr><td>J4 CHECK THE PCM RPM PIDs

• Enter the following diagnostic mode on the scan tool: PCM DataLogger .
• Select the PCM engine rpm (RPM) PID and monitor the tachometer while operating the engine at 1,000, 1,500, 2,000 and 2,500 rpm using the PCM PID to set the vehicle speed.

<table><tr><th>Command</th><th>Indication Range</th></tr><tr><td>1,000 rpm</td><td>922-1,078 rpm</td></tr><tr><td>1,500 rpm</td><td>1,422-1,578 rpm</td></tr><tr><td>2,000 rpm</td><td>1,922-2,078 rpm</td></tr><tr><td>2,500 rpm</td><td>2,422-2,578 rpm</td></tr></table>
• Does the tachometer indication increase according to the above specifications?</td><td>Yes
The tachometer is operating correctly at this time.

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.</td></tr>
</table>

Pinpoint Test K: The Transmission Temperature Gauge Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the transmission temperature data from the PCM over the High Speed Controller Area Network (HS-CAN). The PCM filters the transmission temperature input and sends the filtered data to the IPC . The IPC then further dampens the temperature data to eliminate minor fluctuations in the gauge indication.

If the transmission temperature data is missing or invalid from the PCM for 5 seconds or less, the IPC defaults the transmission temperature gauge to the last setting, based upon the last known good message received. If the IPC does not receive the transmission temperature data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the transmission temperature gauge to the cold (C) stop position. If the transmission temperature data is deemed invalid by the IPC for more than 5 seconds, the IPC sets DTC U0401:00 and defaults the transmission temperature gauge to the cold (C) stop position.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be the powertrain malfunction (wrench) warning indicator always on.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST K: THE TRANSMISSION TEMPERATURE GAUGE IS INOPERATIVE

Test Step	Result / Action to Take
K1 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the self-test. • **Are any transmission temperature DTCs recorded?**	**Yes** REFER to Section 307-01 . For all other DTCs, REFER to Section 303-14 . TEST the system for normal operation. **No** GO to K2 .
K2 CHECK THE TRANSMISSION TEMPERATURE GAUGE	
• Enter the dealer test mode. Refer to Dealer Test Mode in Inspection and Verification in this section. • Scroll through the displays until GAUGE TEST is displayed while monitoring the transmission temperature gauge. • **Does the transmission temperature gauge sweep from cold (C) to hot (H) then return to cold (C)?**	**Yes** GO to K3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
K3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test L: Incorrect Transmission Temperature Gauge Indication

Normal Operation

The Instrument Panel Cluster (IPC) receives the transmission temperature data from the PCM over the High Speed Controller Area Network (HS-CAN). The PCM filters the transmission temperature input and sends the filtered data to the IPC . The IPC then further dampens the temperature data to eliminate minor fluctuations in the gauge indication.

If the transmission temperature data is missing or invalid from the PCM for 5 seconds or less, the IPC defaults the transmission temperature gauge to the last setting, based upon the last known good message received. If the IPC does not receive the transmission temperature data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the transmission temperature gauge to the cold (C) stop position. If the transmission temperature data is deemed invalid by the IPC for

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more than 5 seconds, the IPC sets DTC U0401:00 and defaults the transmission temperature gauge to the cold (C) stop position.

This pinpoint test is intended to diagnose the following:

- Transmission concern
- IPC

PINPOINT TEST L: INCORRECT TRANSMISSION TEMPERATURE GAUGE INDICATION

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>L1 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST
• Check the recorded PCM DTCs from the self-test.
• Are any transmission temperature DTCs recorded?</td><td>Yes
REFER to Section 307-01 . For all other DTCs, REFER to Section 303-14 .

No
GO to L2 .</td></tr>
<tr><td>L2 CARRY OUT THE TRANSMISSION TEMPERATURE GAUGE ACTIVE COMMAND USING THE SCAN TOOL
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: IPC DataLogger .
• NOTE: Make sure the gauge begins at full cold (C). If necessary, adjust the scan tool to command the gauge to full cold (C) before beginning this step.
• Select the IPC transmission temperature gauge (TRANS_TEMP) active command. Command the transmission temperature gauge as follows:
<table><tr><th>Scan Tool Setting</th><th>Gauge Indication</th><th>Temperature</th></tr><tr><td>18%</td><td>Beginning of normal range</td><td>27°C (81°F)</td></tr><tr><td>45 and 54%</td><td>Center of normal range (just below or above center respectively)</td><td>28-106°C (82-223°F)</td></tr><tr><td>81%</td><td>End of normal range</td><td>107°C (225°F)</td></tr></table>• Does the transmission temperature gauge indication match the temperature specification?</td><td>Yes
GO to L3 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.</td></tr>
<tr><td>L3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST
• Check for recorded IPC DTCs from the self-test.
• Are any DTCs recorded?</td><td>Yes
For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section.</td></tr>
</table>

	No GO to L4 .
L4 CHECK THE PCM TEMPERATURE PID **NOTE:** This step may require the use of an assistant to monitor the transmission temperature PID and the transmission temperature gauge indication. • Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Ignition ON. • **NOTE:** The transmission temperature should range below 10°C (50°F) with the gauge in the cold (C) range, between 27 to 107° C (81 to 225°F) with the gauge in the normal or mid-range and above 135°C (275°F) with the gauge in the hot (H) range. • Select the PCM transmission temperature gauge PID (TFT). • Beginning with a cold transmission, drive the vehicle while monitoring the PCM transmission temperature PID. • **Does the PID agree with the position of the transmission temperature gauge indication at different temperature ranges?**	**Yes** The transmission temperature gauge is operating correctly at this time. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. TEST the system for normal operation.

Pinpoint Test M: The Brake Warning Indicator is Never On

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) uses 3 basic messaged inputs to control the brake warning indicator. The first two are the parking brake warning indicator switch and the brake fluid level switch. The third is for the Electronic Brake Distribution (EBD) function controlled by the ABS module. The parking brake warning indicator switch and the brake fluid level switch status are sent from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The EBD message is sent from the ABS module over the HS-CAN .

The parking brake warning indicator switch is hardwired to the BCM through a single signal circuit while using a separate ground to control the input. The brake fluid level switch is hardwired to the BCM through separate signal and return circuits while using a separate ground to control the input.

The BCM provides a reference voltage to both the parking brake warning indicator switch and the brake fluid level switch. When the parking brake is applied, the parking brake warning indicator switch closes to ground, pulling the parking brake signal circuit low. When a low brake fluid level condition exists, the brake fluid level switch closes to ground, pulling the signal and return circuits low. If the brake fluid level switch is disconnected, the BCM reference voltage sent to the brake fluid level switch is sent high and the BCM sets DTC B1048:7B. When the BCM detects either the brake fluid level signal or the parking brake signal circuits low, or the brake fluid level signal and return circuit high, the BCM sends the IPC a brake warning indicator on request.

When the ABS module detects a base brake system concern or other ABS related concerns that affect the EBD function, the ABS module sends a brake warning indicator on request to the IPC to illuminate the brake warning indicator and the ABS warning indicator.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Brake fluid level switch

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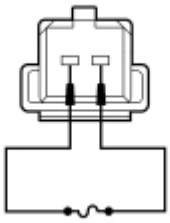
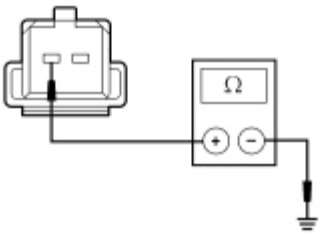
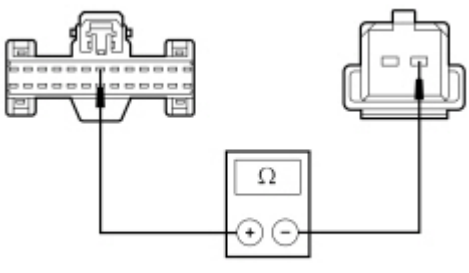
- Parking brake warning indicator switch
- BCM
- IPC

PINPOINT TEST M: THE BRAKE WARNING INDICATOR IS NEVER ON

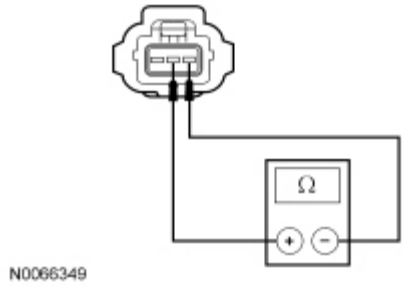
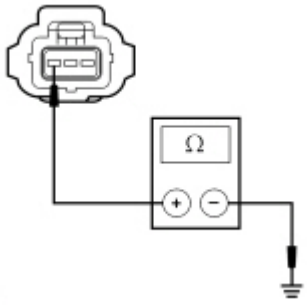
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

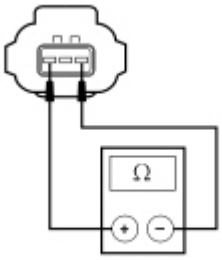
NOTE: Failure to disconnect the battery when instructed, results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
M1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** GO to M2 .
M2 DETERMINE IF THE BRAKE WARNING INDICATOR OPERATES WITH THE PARKING BRAKE	
• Ignition ON. • Apply the parking brake while monitoring the brake warning indicator. • **Does the brake warning indicator illuminate with the parking brake applied?**	**Yes** RELEASE the parking brake. GO to M8 . **No** RELEASE the parking brake. GO to M3 .
M3 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC brake warning indicator (PBA_LMP) active command. Command the brake warning indicator on and observe the brake warning indicator. • **Does the brake warning indicator illuminate when commanded on?**	**Yes** GO to M4 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
M4 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH PID	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Select the BCM parking brake (PARK_BRK_SW) PID. Monitor the parking brake PID while applying the parking brake. • **Does the PID agree with the parking brake position?**	**Yes** GO to M12 . **No** GO to M5 .
M5 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH	
• Disconnect: Parking Brake Warning Indicator Switch C2015 . • Connect a fused jumper wire between the parking brake warning	**Yes** REMOVE the jumper

indicator switch C2015-2, circuit GD120 (BK/GN), harness side and the parking brake warning indicator switch C2015-1, circuit CMC25 (WH/VT), harness side.  N0002774 • **Does the brake warning indicator illuminate?**	wire. INSTALL a new parking brake warning indicator switch. TEST the system for normal operation. **No** REMOVE the jumper wire. GO to M6 .
M6 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the parking brake warning indicator switch C2015-2, circuit GD120 (BK/GN), harness side and ground.  N0057133 • **Is the resistance less than 5 ohms?**	**Yes** GO to M7 . **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.
M7 CHECK THE PARKING BRAKE WARNING INDICATOR SIGNAL CIRCUIT FOR AN OPEN	
• Disconnect: BCM C2280C . • Measure the resistance between the BCM C2280C-7, circuit CMC25 (WH/VT), harness side and the parking brake warning indicator switch C2015-1, circuit CMC25 (WH/VT), harness side and ground.  N0112572 • **Is the resistance less than 5 ohms?**	**Yes** GO to M12 . **No** REPAIR circuit CMC25 (WH/VT) for an open. TEST the system for normal operation.

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M8 CHECK THE BRAKE FLUID LEVEL SWITCH OPERATION	
• Ignition OFF. • Disconnect: Brake Fluid Level Switch C124 . • Ignition ON. • **Does the brake warning indicator illuminate?**	**Yes** GO to M10 . **No** GO to M9 .
M9 CHECK THE BRAKE FLUID LEVEL SIGNAL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: BCM C2280F . • Measure the resistance between the brake fluid level switch C124-2, circuit CMC19 (GY/VT), harness side and the brake fluid level switch C124-3, circuit RMC19 (YE/GY), harness side.  N0066349 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M12 . **No** REPAIR the circuits. TEST the system for normal operation.
M10 CHECK THE BRAKE FLUID LEVEL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the brake fluid level switch C124-1, circuit GD120 (BK/GN), harness side and ground.  N0027596 • **Is the resistance less than 5 ohms?**	**Yes** GO to M11 . **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.
M11 CHECK THE BRAKE FLUID LEVEL SWITCH	
• Ignition ON. • ***NOTICE:*** **Do not spill brake fluid onto painted or plastic surfaces. If spilled, wipe up immediately before damage to the painted or plastic surface occurs.** • Remove the brake fluid from the reservoir to allow the brake fluid level switch to fall to the bottom of the reservoir. • Measure the resistance between the brake fluid level switch pin 3, component side and the brake fluid level switch pin 1, component side.	**Yes** GO to M12 . **No** INSTALL a new brake fluid level switch. TEST the system for normal operation.

 N0057135 • **Is the resistance less than 5 ohms?**	
M12 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test N: The Brake Warning Indicator is Always On

Normal Operation

The Instrument Panel Cluster (IPC) uses 3 basic messaged inputs to control the brake warning indicator. The first two are the parking brake warning indicator switch and the brake fluid level switch. The third is for the Electronic Brake Distribution (EBD) function controlled by the ABS module. The parking brake warning indicator switch and the brake fluid level switch status are sent from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The EBD message is sent from the ABS module over the HS-CAN.

The parking brake warning indicator switch is hardwired to the BCM through a single signal circuit while using a separate ground to control the input. The brake fluid level switch is hardwired to the BCM through separate signal and return circuits while using a separate ground to control the input.

The BCM provides a reference voltage to both the parking brake warning indicator switch and the brake fluid level switch. When the parking brake is applied, the parking brake warning indicator switch closes to ground, pulling the parking brake signal circuit low. When a low brake fluid level condition exists, the brake fluid level switch closes to ground, pulling the signal and return circuits low. If the brake fluid level switch is disconnected, the BCM reference voltage sent to the brake fluid level switch is sent high and the BCM sets DTC B1048:7B. When the BCM detects either the brake fluid level signal or the parking brake signal circuits low, or the brake fluid level signal and return circuit high, the BCM sends the IPC a brake warning indicator on request.

When the ABS module detects a base brake system concern or other ABS related concerns that affect the EBD function, the ABS module sends a brake warning indicator on request to the IPC to illuminate the brake warning indicator and the ABS warning indicator.

If the brake fluid level or parking brake status messages are missing for less than 5 seconds, the IPC

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defaults the brake warning indicator to its last state (on or off) based upon the last known good message received. If the brake fluid level or parking brake status messages are missing for more than 5 seconds, the IPC sets DTC U0140:00 and defaults the brake warning indicator on. If the IPC does not receive the ABS status message or the EBD message from the ABS module for more than 5 seconds, the IPC sets DTC U0121:00 and defaults the ABS warning indicator on.

DTC Description	Fault Trigger Conditions
• DTC B1048:7B — Brake Fluid Level Switch: Low Fluid Level	A continuous DTC that sets when the BCM detects an open or short to ground on the brake fluid level switch input.
• DTC C1D00:11 — Park Brake Apply Switch: Circuit Short to Ground	A continuous DTC that sets in the BCM if the BCM detects a short to ground on the parking brake input circuit.

NOTE: If DTC U0140:00 sets in the IPC, other symptoms may also be present such as Tire Pressure Monitoring System (TPMS), instrument panel backlighting, and door ajar indication. If DTC U0121:00 is set, other symptoms may also be present such as ABS warning indicator and stability/traction control or stability/traction control off indicators always on.

NOTE: Both the ABS warning indicator and the brake warning indicator illuminate if the input to illuminate the brake warning indicator is received from the ABS module.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Parking brake warning indicator switch
- Brake fluid level switch
- ABS concern
- BCM
- IPC

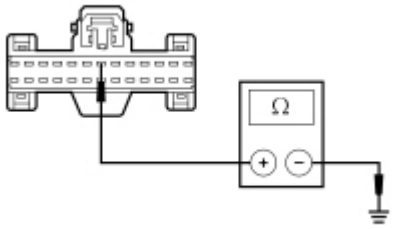
PINPOINT TEST N: THE BRAKE WARNING INDICATOR IS ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
N1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC brake warning indicator (PBA_LMP) active command. Command the brake warning indicator on and off. Observe the brake warning indicator. • **Does the brake warning indicator turn off when commanded off?**	**Yes** GO to N2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
N2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	

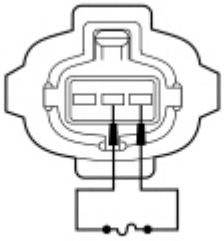
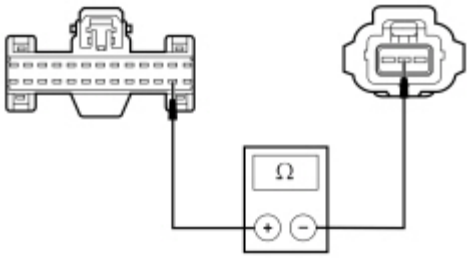
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0121:00, GO to Pinpoint Test AV . For DTC U0140:00, GO to Pinpoint Test AY . For all other DTCs, REFER to DTC Charts in this section. **No** GO to N3 .
N3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded BCM DTCs from the self-test. • **Is DTC B1048:7B recorded?**	**Yes** GO to N8 . **No** GO to N4 .
N4 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded ABS module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** GO to N5 .
N5 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH PID	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Select the BCM parking brake (PARK_BRK_SW) PID. • Monitor the parking brake PID while applying and releasing the parking brake. • **Does the PID agree with the parking brake position?**	**Yes** GO to N12 . **No** GO to N6 .
N6 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH	
• Disconnect: Parking Brake Warning Indicator Switch C2015 . • Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Select the BCM parking brake (PARK_BRK_SW) PID. • Monitor the parking brake PID. • **Does the PID indicate the parking brake is released or off?**	**Yes** INSTALL a new parking brake warning indicator switch. CLEAR the DTCs. REPEAT the self-test. **No** GO to N7 .
N7 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: BCM C2280C . • Measure the resistance between the BCM C2280C-7, circuit CMC25 (WH/VT), harness side and ground.	**Yes** GO to N12 . **No** REPAIR circuit CMC25 (WH/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test.

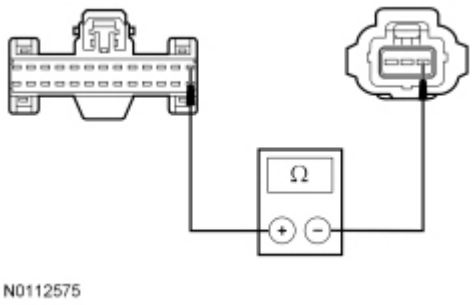
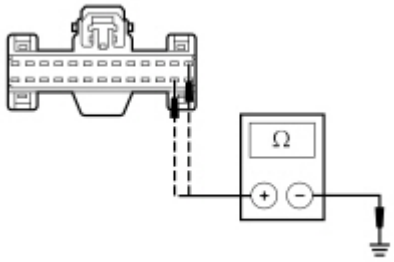
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- **Is the resistance greater than 10,000 ohms?**

N8 CHECK THE BRAKE WARNING INDICATOR USING THE FLUID LEVEL SWITCH	
• Ignition OFF. • Disconnect: Brake Fluid Level Switch C124 . • Connect a fused jumper wire between the brake fluid level switch C124-2, circuit CMC19 (GY/VT), harness side and the brake fluid level switch C124-3, circuit RMC19 (YE/GY), harness side.  N0002771 • Ignition ON. • **Does the brake warning indicator turn off?**	**Yes** REMOVE the jumper wire. INSTALL a new brake fluid level switch. CLEAR the DTCs. REPEAT the self-test. **No** REMOVE the jumper wire. GO to N9 .
N9 CHECK THE BRAKE FLUID LEVEL SWITCH INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280F . • Measure the resistance between the BCM C2280F-15, circuit CMC19 (GY/VT), harness side and the brake fluid level switch C124-2, circuit CMC19 (GY/VT), harness side.  N0112574 • **Is the resistance less than 5 ohms?**	**Yes** GO to N10 . **No** REPAIR circuit CMC19 (GY/VT) for an open. TEST the system for normal operation.
N10 CHECK THE BRAKE FLUID LEVEL SWITCH RETURN CIRCUIT FOR AN OPEN	

• Measure the resistance between the BCM C2280F-1, circuit RMC19 (YE/GY), harness side and the brake fluid level switch C124-3, circuit RMC19 (YE/GY), harness side.  N0112575 • **Is the resistance less than 5 ohms?**	**Yes** GO to N11 . **No** REPAIR circuit RMC19 (YE/GY) for an open. TEST the system for normal operation.
N11 CHECK THE BRAKE FLUID LEVEL SWITCH INPUT AND RETURN CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the BCM C2280F-15, circuit CMC19 (GY/VT), harness side and ground; and between the BCM C2280F-1, circuit RMC19 (YE/GY), harness side and ground.  N0112576 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to N12 . **No** REPAIR the circuit in question. TEST the system for normal operation.
N12 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM .
	REFER to Section 419-10 .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test O: The ABS Warning Indicator Is Never/Always On

Normal Operation

The ABS module provides the ABS warning indicator request to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN). If a fault condition exists in the ABS, the ABS module sends

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the IPC a request to illuminate the ABS warning indicator.

If the ABS warning indicator status message is missing for less than 5 seconds, the IPC defaults the ABS warning indicator to its last state (on or off) based upon the last known good message received. If the ABS warning indicator request message is missing for more than 5 seconds, the IPC sets DTC U0121:00 and defaults the ABS warning indicator on.

This pinpoint test is intended to diagnose the following:

- ABS module
- IPC

PINPOINT TEST O: THE ABS WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
O1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC ABS warning indicator (ABS_LAMP) active command. Command the ABS warning indicator on then off. Observe the ABS warning indicator. • **Does the ABS warning indicator turn on when commanded on and turn off when commanded off?**	**Yes** GO to O2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
O2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0121:00, GO to Pinpoint Test AV . For all other DTCs, REFER to DTC Charts in this section. **No** GO to O3 .
O3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded ABS module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** If the ABS warning indicator is always on, INSTALL a new ABS module. REFER to Section 206-09 . TEST the system for normal operation. If the ABS warning indicator is never on after the bulb prove-out, the system is operating correctly at this time.

Pinpoint Test P: The Stability/Traction Control Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the stability/traction control indicator request from the ABS module over the High Speed Controller Area Network (HS-CAN). The stability/traction control indicator operates according to the following chart:

Indication Mode	Condition
Flashes rapidly	The vehicle stability/traction control is in active mode or is being controlled by the ABS module
Flashes slowly	A configuration conflict or concern is present in the ABS module
On steady	A fault condition exists in the stability/traction control system

The IPC monitors the stability/traction control message from the ABS module and either flashes the stability/traction control indicator or turns it on steady depending on the condition. The stability/traction control indicator is also used to indicate a trailer sway condition (if equipped).

If the stability/traction control indicator status message is missing for less than 5 seconds, the IPC defaults the stability/traction control indicator to its last state (on or off) based upon the last known good message received. If the stability/traction control indicator status message is missing for more than 5 seconds, the IPC sets DTC U0121:00 in continuous memory and defaults the stability/traction control indicator on.

This pinpoint test is intended to diagnose the following:

- Stability/traction control concern
- ABS module
- IPC

PINPOINT TEST P: THE STABILITY/TRACTION CONTROL INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
P1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC stability/traction control indicator (TC/IVD/RSCLMP) active command. Command the stability/traction control active indicator on and off while observing the stability/traction control indicator. • **Does the stability/traction control indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to P2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
P2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	

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• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0121:00, GO to Pinpoint Test AV . For all other DTCs, REFER to DTC Charts in this section. **No** GO to P3 .
P3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS module self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** If the stability/traction control indicator is never on after the bulb prove-out, the system is operating correctly at this time. If the stability/traction control indicator is always on, INSTALL a new ABS module. REFER to Section 206-09 . TEST the system for normal operation.

Pinpoint Test Q: The Stability/Traction Control Disabled Indicator Is Never/Always On

Normal Operation

The traction control switch is hardwired to the Instrument Panel Cluster (IPC). When the traction control switch is pressed, the IPC sends a message to the ABS module over the High Speed Controller Area Network (HS-CAN) indicating the traction control switch has been pressed. The ABS module either disables or enables the stability/traction control system and sends a stability/traction control disabled indicator request back to the IPC to illuminate or turn off the stability/traction control disabled indicator based upon the system state.

When a MyKey® programmed key is in use and the AdvanceTrac® on feature is configured always on, the stability/traction control system cannot be disabled and the stability/traction control indicator does not illuminate when the traction control disable button is pressed. The stability/traction control indicator still functions normally to indicate a stability/traction control system fault and a stability/traction control active event.

If the stability/traction control disabled indicator request message is missing for less than 5 seconds, the stability/traction control disabled indicator remains in the last state (on or off) based upon the last known good message received. If the stability/traction control disabled indicator request message is missing for more than 5 seconds, the IPC sets DTC U0121:00 in continuous memory and defaults the stability/traction control disabled indicator off.

This pinpoint test is intended to diagnose the following:

- A MyKey® programmed key is in use
- Stability/traction control cannot be disabled
- ABS module
- IPC

PINPOINT TEST Q: THE STABILITY/TRACTION CONTROL DISABLED INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
Q1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC stability/traction control disabled indicator (STAB_TC_LMP) active command. Command the stability/traction control disabled indicator on and off while observing the stability/traction control disabled indicator. • **Does the stability/traction control disabled indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to Q2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
Q2 CHECK FOR THE KEY TYPE	
• Check if the key is a MyKey® programmed key or an administrator key. Refer to Section 419-01B . • **Is the key an administrator key?**	**Yes** GO to Q3 . **No** If the MyKey® AdvanceTrac® on feature is configured always on, the system is normal. The stability/traction control system cannot be disabled when the AdvanceTrac® on feature is configured always on. If the MyKey® AdvanceTrac® on feature is not configured always on, GO to Q3 .
Q3 CHECK THE TRACTION CONTROL INPUT TO THE IPC	
• Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC traction control switch PID (STAB_CTRL_SW). • Monitor the traction control PID while pressing and releasing the traction control disable switch. • **Does the traction control PID read RELEASED when the button is released and DEPRESSED when the button is pressed?**	**Yes** GO to Q4 . **No** REFER to Section 206-09 to diagnose the stability/traction control system cannot be disabled.
Q4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0121:00, GO to Pinpoint Test AV . For all other DTCs, REFER to DTC Charts in this section. **No** GO to Q5 .
Q5 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS	**Yes**

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module self-test. • **Are any DTCs recorded?**	REFER to Section 206-09 . **No** INSTALL a new ABS module. REFER to Section 206-09 . TEST the system for normal operation.

Pinpoint Test R: The LH/RH Turn Or High Beam Indicator Is Never/Always On

Normal Operation

When the multifunction switch is in the LH or RH TURN position, a turn signal on/off request is sent to the Instrument Panel Cluster (IPC) from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). Upon receipt of the applicable turn signal on/off request, the IPC flashes the turn signal indicator on and off.

When the high beams are turned on, the BCM sends a high beam indicator on request to the IPC through the HS-CAN to illuminate the high beam indicator.

If the high beam indicator request status message is missing for less than 5 seconds, the IPC defaults the high beam indicator to its last state (on or off) based upon the last known good message received. If the high beam indicator request status message is missing for more than 5 seconds, the IPC sets DTC U0140:00 in continuous memory and defaults the high beam indicator off.

This pinpoint test is intended to diagnose the following:

- Turn signal concern
- High beam concern
- BCM
- IPC

PINPOINT TEST R: THE LH/RH TURN OR HIGH BEAM INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
R1 DETERMINE THE FAULT CONDITION	
• Turn the high beams on then off again. • Ignition ON. • Observe the high beam indicator. • **Does the high beam indicator illuminate when the high beams are on and turn off when the high beams are off?**	**Yes** GO to R4 . **No** LEAVE the headlamp switch in the HIGH BEAM position. GO to R2 .
R2 CHECK THE HIGH BEAM HEADLAMPS OPERATION	
• Observe the high beam headlamps. • **Do the high beam headlamps operate correctly?**	**Yes** GO to R3 . **No** REFER to Section 417-01 .
R3 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON.	**Yes**

• Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC high beam indicator (HIGH_BEAM). • Command the high beam indicator on and off. Observe the high beam indicator. • **Does the high beam indicator illuminate when commanded on and turn off when commanded off?**	GO to R6 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
R4 CHECK THE LH OR RH TURN SIGNAL LAMPS OPERATION	
• Ignition ON. • Operate the LH or RH turn signal. Observe the exterior LH or RH turn signal lamps. • **Do the exterior turn signal lamps operate correctly?**	**Yes** GO to R5 . **No** REFER to Section 417-01 .
R5 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC RH or LH turn signal indicator (RH_TURN_L) or (LH_TURN_L) active command. Command the RH or LH turn signal indicator on and off. Observe the LH or RH turn signal indicator. • **Does the LH or RH turn signal indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to R6 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
R6 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0140:00 recorded?**	**Yes** GO to Pinpoint Test AY . **No** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test S: The Tire Pressure Monitoring System (TPMS) Warning Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the Tire Pressure Monitoring System (TPMS) warning indicator request from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). If the BCM determines the tire pressure has exceeded the low tire pressure limits, a request is sent to the IPC to illuminate the TPMS warning indicator. If a TPMS fault condition exists, the BCM sends a request to the IPC to flash the TPMS warning indicator.

If the TPMS status message is missing for more than 5 seconds, the IPC sets DTC U0140:00 and flashes the TPMS indicator for approximately 75 seconds then turns the TPMS indicator on.

NOTE: If DTC U0140:00 sets in the BCM , other symptoms may also be present such as high beam indicator, RH/LH turn indicators, instrument panel backlighting, and door ajar indication inoperative.

This pinpoint test is intended to diagnose the following:

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- Tire pressure
- TPMS concern
- BCM
- IPC

PINPOINT TEST S: THE TPMS WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
S1 CHECK THE TIRE PRESSURE • Verify the tire pressure in all tires meets the recommended tire pressures on the Vehicle Certification (VC) label. Refer to Section 100-01 . • **Do all the tires meet the recommended tire pressures?**	**Yes** GO to S2 . **No** CORRECT the tire pressures. TEST the system for normal operation.
S2 RETRIEVE THE RECORDED DTCs FROM IPC SELF-TEST • Check for recorded IPC DTC from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0140:00, GO to Pinpoint Test AY . For all other DTCs, REFER to DTC Charts in this section. **No** GO to S3 .
S3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST • Check for recorded BCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to the Body Control Module (BCM) DTC Chart in Section 419-10 . **No** GO to S4 .
S4 RETRIEVE THE RECORDED DTCs FROM THE TPM MODULE SELF-TEST • Check for recorded Tire Pressure Monitor (TPM) module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 204-04 . **No** GO to S5 .
S5 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC TPMS warning indicator (TPMWARN_LMP) active command. Command the TPMS warning indicator on and off. Observe the TPMS warning indicator.	**Yes** If the TPMS warning indicator is never on after the bulb prove-out, the system is operating correctly at this time. If the TPMS warning indicator is always on, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No**

• **Does the TPMS warning indicator illuminate when commanded on and turn off when commanded off?**	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test T: The Air Bag Warning Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the Supplemental Restraint System (SRS) warning indicator request from the Restraints Control Module (RCM) over the High Speed Controller Area Network (HS-CAN). If an SRS concern is detected, the RCM sets a DTC and sends a request to the IPC to illuminate the air bag warning indicator.

If the SRS status message is missing for less than 5 seconds, the IPC defaults the air bag warning indicator to its last state (on or off) based upon the last known good message received. If the SRS status message is missing or is deemed invalid for more than 5 seconds, the IPC sets DTC U0151:00 in continuous memory and defaults the air bag warning indicator on.

This pinpoint test is intended to diagnose the following:

- SRS concern
- RCM
- IPC

PINPOINT TEST T: THE AIR BAG WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
T1 CARRY OUT THE IPC RESTRAINTS OUTPUT CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC air bag warning indicator (AIRBAG_LMP) active command. Command the air bag warning indicator on and off. Observe the air bag warning indicator. • **Does the air bag warning indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to T2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
T2 RETRIEVE THE RECORDED DTCs FROM THE RCM SELF-TEST	
• Check for recorded RCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 501-20B . **No** GO to T3 .
T3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	

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• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0151:00, GO to Pinpoint Test AZ . For all other DTCs, REFER to DTC Charts in this section. **No** If the air bag warning indicator is never on after the bulb prove-out, the system is operating correctly at this time. If the air bag warning indicator is always on, INSTALL a new RCM . REFER to Section 501-20B . TEST the system for normal operation.

Pinpoint Test U: The Safety Belt Warning Indicator Is Never/Always On

Normal Operation

The Restraints Control Module (RCM) monitors the safety belt position through the safety belt buckle switch. The RCM provides the safety belt buckle status to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN).

If the safety belt buckle status message is missing or invalid for less than 5 seconds, the IPC defaults the safety belt warning indicator to its last state (on or off) based upon the last known good message received. If the IPC does not receive the safety belt buckle switch status message from the RCM or the message is deemed invalid by the IPC for greater than 5 seconds, the IPC sets DTC U0151:00 and defaults the safety belt warning indicator off.

This pinpoint test is intended to diagnose the following:

- Safety belt buckle concern
- RCM
- IPC

PINPOINT TEST U: THE SAFETY BELT WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
U1 RETRIEVE THE RECORDED RCM DTCs FROM THE SELF-TEST	
• Check for recorded RCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 501-20B . **No** GO to U2 .
U2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0151:00, GO to Pinpoint Test AZ . For all other DTCs, REFER to DTC Charts in this section. **No** GO to U3 .
U3 CARRY OUT THE IPC INDICATOR	

LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC all warning indicators (SBLT_LAMP) active command. Command all the warning indicators on and off. Observe the safety belt warning indicator. • **Does the safety belt warning indicator illuminate when commanded on and turn off when commanded off?**	**Yes** If the safety belt warning indicator is never on after the bulb prove-out, the system is operating correctly at this time. If the safety belt warning indicator is always on, INSTALL a new RCM . REFER to Section 501-20B . TEST the system for normal operation. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test V: The Malfunction Indicator Lamp (MIL) Is Never/Always On

Normal Operation

The Malfunction Indicator Lamp (MIL) is controlled by the Instrument Panel Cluster (IPC) using data sent from the PCM over the High Speed Controller Area Network (HS-CAN).

If the MIL status message is missing or invalid for less than 5 seconds, the IPC defaults the MIL to its last state (on or off) based upon the last known good message received. If the MIL status message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the MIL on.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST V: THE MIL IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
V1 CARRY OUT THE IPC MIL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC MIL active command (MIL). Command the MIL on and off. Observe the MIL . • **Does the MIL illuminate when selected on and turn off when selected off?**	**Yes** GO to V2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

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V2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the KOEO self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to V3 .
V3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test AT . **No** If the MIL is never on with the KOEO , the system is operating correctly at this time. If the MIL is always on, INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test W: The Cruise Control Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the cruise control indicator on request from the PCM over the High Speed Controller Area Network (HS-CAN). When the cruise control switch is placed in the ON position, the PCM sends the IPC a standby mode request and the IPC illuminates the cruise control indicator to amber. When the cruise control is engaged, the PCM sends a cruise control on request message to the IPC and the IPC changes the cruise control indicator illumination from amber to green.

If the cruise control message is missing or if the data is deemed invalid by the IPC for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the cruise control off.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST W: THE CRUISE CONTROL INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
W1 CHECK THE CRUISE CONTROL OPERATION	
• Operate the cruise control. • **Does the cruise control operate correctly?**	**Yes** GO to W2 . **No** REFER to Section 419-03 .

W2 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC cruise control indicator (CRUISE) active command. Command the cruise control indicator on and off. Observe the cruise control indicator. • **Does the cruise control indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to W3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
W3 RETRIEVE AND RECORD THE DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to W4 .
W4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test X: The PRNDL Indicator is Never On/Always Displays P

Normal Operation

The Instrument Panel Cluster (IPC) receives the transmission range status and the select shift status from the PCM over the High Speed Controller Area Network (HS-CAN). The IPC also uses a park detect switch (part of the brake shift interlock actuator) to signal the IPC the shift lever is fully seated in the PARK (P) position. The IPC compares the park detect switch input with the transmission range status sent from the PCM and looks for vehicle speed above 16 km/h (10 mph). The IPC provides a reference voltage to the brake shift interlock. When the selector lever is in PARK (P), the brake shift indicator routes the reference voltage to ground pulling the circuit low to the IPC . When the selector lever is moved out of PARK (P), the brake shift interlock opens the ground, sending the reference voltage high.

When in select shift mode, the select shift indication is illuminated along with the PRNDM21 display. For example, when M is selected and select shift is selected, the PRNM21 illuminates the M and the select shift display illuminates 1-6 (base IPC) or M1-M6 (optional IPC) simultaneously.

If the transmission range information is missing from the PCM, the IPC sets DTC U0100:00.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer, temperature gauge or odometer. If DTC U0101:00 sets in the IPC , other observable symptoms may be the powertrain malfunction (wrench) warning indicator always on.

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- DTC P1706:00 (High Vehicle Speed Observed In Park: No Sub Type Information) — a continuous memory DTC that sets if the IPC receives a short to ground on the park detect switch input circuit, pulling the circuit low with a Vehicle Speed Sensor (VSS) input over 16 km/h (10 mph) for greater than 5 seconds (indicating the vehicle is in park and in motion).

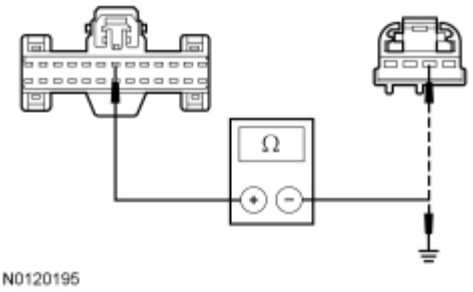
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Brake shift interlock actuator
- PCM concern
- IPC

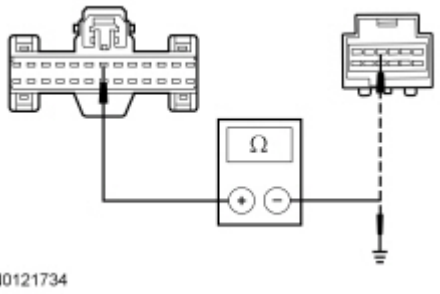
PINPOINT TEST X: THE PRNDL INDICATOR IS NEVER ON/ALWAYS DISPLAYS P

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
X1 CHECK THE PRNDL DISPLAY PARK OPERATION	
• Ignition ON. • Shift the selector lever through the different gear positions while observing the PRNDL display. • Place the selector lever in the PARK (P) position. • Ignition OFF. • Observe the PRNDL display immediately after turning the key off. • **Does the PRNDL display the different ranges according to the selector lever position then display P for approximately 5 seconds when the key is turned off?**	**Yes** The system is functioning correctly at this time. **No** GO to X2.
X2 RETRIEVE AND RECORD THE IPC DTCs FROM THE SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC P1706:00, GO to X3. For DTC U0100:00, GO to Pinpoint Test AT. For all other DTCs, REFER to DTC Charts in this section. **No** GO to X4.
X3 CONFIRM DTC P1706:00 IS STILL PRESENT	
• CLEAR the DTCs. DRIVE the vehicle above 16 km/h (10 mph) for more than 5 seconds. REPEAT the self-test. • **Is DTC P1706:00 present?**	**Yes** GO to X5. **No** The PRNDL is operating correctly at this time. The fault may be caused by an intermittent concern with the park detect input to the IPC.
X4 RETRIEVE AND RECORD THE DTCs FROM THE PCM KOEO	

SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
X5 CHECK THE BRAKE SHIFT INTERLOCK OPERATION	
• Apply the park brake and shift the transmission into NEUTRAL (N). • Ignition OFF. • Disconnect: Brake Shift Interlock C2008 (Column Shift) . • Disconnect: Brake Shift Interlock C3245 (Floor Shift) . • Clear the DTCs. • Disengage the park brake and drive the vehicle above 16 km/h (10 mph) for more than 5 seconds. • Retrieve the IPC continuous memory DTCs. • **Is DTC P1706:00 still present?**	**Yes** GO to X6 . **No** INSTALL a new brake shift interlock actuator. REFER to Section 307-05 . TEST the system for normal operation.
X6 CHECK THE PARK DETECT INPUT CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220 . • For column shift, measure the resistance between the IPC C220-7, circuit CET52 (GN), harness side and the brake shift interlock C2008-2, circuit CET52 (GN), harness side; and between the IPC C220-7, circuit CET52 (GN), harness side and ground.  N0120195 • For floor shift, measure the resistance between the IPC C220-7, circuit CET52 (GN), harness side and the selector lever C3245-3, circuit CET52 (GN), harness side; and between the IPC C220-7, circuit CET52 (GN), harness side and ground.	**Yes** GO to X7 . **No** REPAIR circuit CET52 (GN) for an open or short to ground. REPEAT the self-test. CLEAR the DTCs.

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 N0121734 • **Is the resistance less than 5 ohms between the IPC and the brake shift interlock or selector lever, and greater than 10,000 ohms between the IPC and ground?**	

X7 CHECK FOR CORRECT IPC OPERATION
• Disconnect the IPC connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test Y: The Powertrain Malfunction (Wrench) Message Center Indicator Is Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives requests from the PCM and Transfer Case Control Module (TCCM) to control the powertrain malfunction (wrench) message center indicator. The PCM provides an indicator request for Electronic Throttle Control (ETC) faults and transmission faults over the High Speed Controller Area Network (HS-CAN). The TCCM provides an indicator request for Four-Wheel Drive (4WD) faults over the HS-CAN.

If the indicator request message for ETC or transmission faults is missing or if the data is deemed invalid for less than 5 seconds, the powertrain malfunction (wrench) message center indicator remains in the last state (on or off) based upon the last known good message received. If the indicator request message for ETC or transmission faults is missing or if the data is deemed invalid by the IPC for greater than 5 seconds, the IPC sets DTC U0100:00 and defaults the powertrain malfunction (wrench) message center warning indicator active (on).

If the indicator request message for the 4WD faults is missing or deemed invalid for less than 5 seconds, the powertrain malfunction (wrench) message center indicator remains in the last state (on or off) based upon the last known good message received. If the indicator request message is missing or if the data is deemed invalid by the IPC for greater than 5 seconds, the IPC sets DTC U0102:00 and defaults the powertrain malfunction (wrench) message center warning indicator active (on).

NOTE: If DTC U0100:00 sets in the IPC, other symptoms may also be present such as an inoperative speedometer, tachometer or temperature gauge. If DTC U0102:00 sets in the IPC, other symptoms may also be present such as an inoperative 4X4 high or 4X4 low indicator when equipped with Electronic Shift-

On-The-Fly (ESOF).

This pinpoint test is intended to diagnose the following:

- Message center concern
- ETC concern
- 4WD concern (if equipped)
- Transmission concern

PINPOINT TEST Y: THE POWERTRAIN MALFUNCTION (WRENCH) MESSAGE CENTER INDICATOR IS ALWAYS ON

Test Step	Result / Action to Take
Y1 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • Ignition ON. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warning indicators. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active. • Observe the message center. • **Is the door ajar message center warning indicator active?**	**Yes** GO to Y2. **No** GO to Pinpoint Test AF.
Y2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100:00 or DTC U0102:00 recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT. For DTC U0102:00, GO to Pinpoint Test AU. **No** GO to Y3.
Y3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14. TEST the system for normal operation. **No** REFER to Section 308-07A to diagnose TCCM DTCs.

Pinpoint Test Z: The Charging System Message Center Warning Indicator Is Never/Always On

Normal Operation

The charging system indicator is controlled by the Instrument Panel Cluster (IPC) based upon data received from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The BCM receives the charging system status from the PCM over the HS-CAN. When a fault is detected in the

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charging system, the BCM sends the IPC a request to illuminate the charging system warning indicator.

If the charging system warning indicator request message is missing for less than 5 seconds, the charging system indicator remains in the last state (on or off). If the charging system message is missing for more than 5 seconds, the IPC sets DTC U0140:00 in continuous memory and defaults the charging system indicator on.

NOTE: If DTC U0140:00 sets in the IPC, other observable symptoms may be an inoperative key-in-ignition chime, door ajar message center indicator or RH/LH turn indicators.

This pinpoint test is intended to diagnose the following:

- Message center concern
- Charging system concern
- PCM

PINPOINT TEST Z: THE CHARGING SYSTEM MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
Z1 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • Ignition ON. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warning indicators. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active. • Observe the message center. • **Is the door ajar message center warning indicator active?**	**Yes** GO to Z2. **No** GO to Pinpoint Test AF.
Z2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any charging system DTCs recorded?**	**Yes** REFER to Section 303-14. TEST the system for normal operation. **No** GO to Z3.
Z3 CHECK THE CHARGING SYSTEM OPERATION	
• Check the charging system operation. Refer to Section 414-00. • **Does the charging system operate correctly?**	**Yes** GO to Z4. **No** REFER to Section 414-00.
Z4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
	Yes

• Check for recorded IPC DTCs from the self-test. • **Is DTC U0140:00 recorded?**	GO to Pinpoint Test AY . **No** If the charging system warning indicator is never on with the KOEO , the system is operating correctly at this time. If the charging system warning indicator is always on, INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test AA: The Low Oil Pressure Message Center Warning Indicator Is Never/Always On

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The engine oil pressure switch is hardwired to the PCM. The Instrument Panel Cluster (IPC) receives the engine oil pressure status from the PCM over the High Speed Controller Area Network (HS-CAN). The IPC uses both the messaged oil pressure status and engine rpm to control the low oil pressure message center warning indicator. The PCM provides a reference voltage to the engine oil pressure switch when the ignition key is in RUN. With the engine running and low or no oil pressure, the engine oil pressure switch remains open. The PCM detects no change in the reference voltage and provides the IPC a request to illuminate the low oil pressure warning indicator. With the engine running and sufficient oil pressure, the engine oil pressure switch closes, pulling the reference voltage low. The PCM detects the low reference voltage and provides the IPC a request to turn off the low oil pressure warning indicator.

If the IPC fails to receive the oil pressure status from the PCM for 5 seconds or less, the IPC defaults the low oil pressure warning indicator to the last state (on or off), based upon the last known good oil pressure status message. If the IPC fails to receive the oil pressure status from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the low oil pressure warning indicator active (on).

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative speedometer, tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Message center concern
- Communication concern
- Tachometer concern
- Engine oil pressure switch
- Base engine oil pressure concern
- PCM

PINPOINT TEST AA: THE LOW OIL PRESSURE MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON

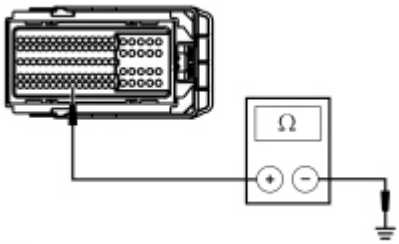
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to

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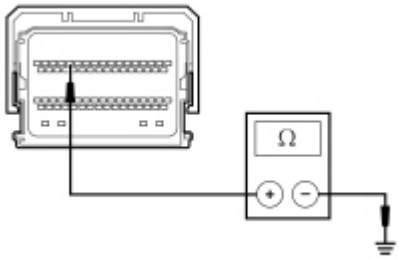
Section 414-01 .

Test Step	Result / Action to Take
AA1 VERIFY THE OPERATION OF THE TACHOMETER	
• Ignition ON. • With the engine running, verify the tachometer is operating correctly. • **Does the tachometer operate correctly?**	**Yes** GO to AA2 . **No** For an inoperative tachometer, GO to Pinpoint Test I . For an inaccurate tachometer, GO to Pinpoint Test J .
AA2 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warnings. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active. • Observe the message center. • **Is the door ajar message center warning indicator active?**	**Yes** If the low oil pressure message center warning indicator is never on, GO to AA3 . If the low oil pressure message center warning indicator is always on, GO to AA5 . **No** GO to Pinpoint Test AF .
AA3 CHECK FOR A STUCK CLOSED ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Start the engine. • Observe the low oil pressure warning indicator. • **Does the low oil pressure warning indicator illuminate?**	**Yes** INSTALL a new engine oil pressure switch. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation. **No** GO to AA4 .
AA4 CHECK THE OIL PRESSURE INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: PCM C175E (3.7L), C1381E (5.0L and 6.2L), or C1551E (3.5L) . • For 3.5L, measure the resistance between the PCM C1551E-9, circuit CMC24 (GY), harness side and ground.	**Yes** GO to AA9 . **No** REPAIR circuit CMC24 (GY) for a short to ground. TEST the system for normal operation.



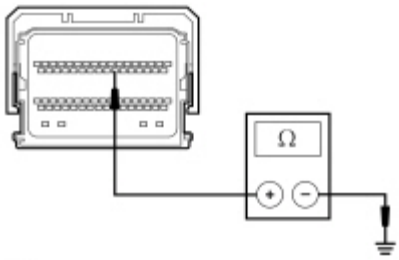
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- For 3.7L, measure the resistance between the PCM C175E-13, circuit CMC24 (GY), harness side and ground.



N0120194

- For 5.0L and 6.2L, measure the resistance between the PCM C1381E-24, circuit CMC24 (GY), harness side and ground.

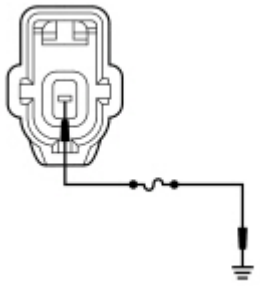


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- **Is the resistance greater than 10,000 ohms?**

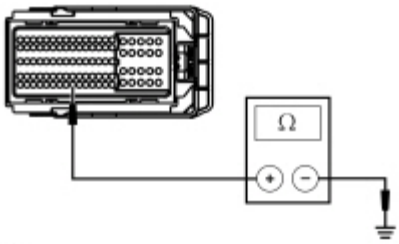
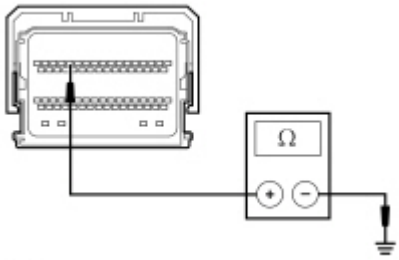
AA5 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test AT . **No** GO to AA6 .
AA6 CHECK FOR A STUCK OPEN ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Connect a fused jumper wire between the engine oil pressure switch C103-1, circuit CMC24 (GY), harness side and ground.	**Yes** REMOVE the jumper wire. GO to AA8 . **No** LEAVE the jumper wire connected. GO to AA7 .

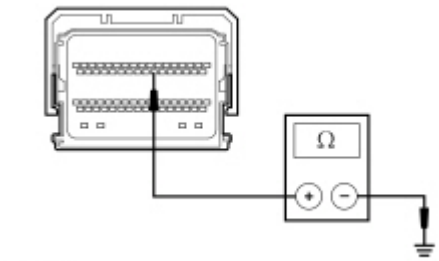
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- Start the engine.
- Observe the low oil pressure warning indicator.
- **Does the low oil pressure indicator turn off?**

AA7 CHECK THE ENGINE OIL PRESSURE INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: PCM C175E (3.7L), C1381E (5.0L and 6.2L), or C1551E (3.5L) . • For 3.5L, measure the resistance between the PCM C1551E-9, circuit CMC24 (GY), harness side and ground.  N0122305 • For 3.7L, measure the resistance between the PCM C175E-13, circuit CMC24 (GY), harness side and ground.  N0120194 • For 5.0L and 6.2L, measure the resistance between the PCM C1381E-24, circuit CMC24 (GY), harness side and ground.	**Yes** REMOVE the jumper wire. GO to AA9 . **No** REMOVE the jumper wire. REPAIR circuit CMC24 (GY) for an open. TEST the system for normal operation.

 N0112570 • **Is the resistance less than 5 ohms?**	
AA8 CHECK THE OIL PRESSURE	
• Carry out the engine oil pressure test. Refer to Section 303-00 . • **Is the oil pressure within specification?**	**Yes** INSTALL a new engine oil pressure switch. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation. **No** REFER to Section 303-00 to continue diagnosis of the engine oil pressure.
AA9 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Connect: Engine Oil Pressure Switch C103 . • Connect: PCM C175E (3.7L), C1381E (5.0L and 6.2L) or C1551E (3.5L) . • Check the recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to AA10 .
AA10 CHECK FOR CORRECT PCM OPERATION	

• Disconnect the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AB: The 4X4 Auto, 4X4 Low, 4X4 High Or 4X2 Message Center Indicator Is Never/Always On (If Equipped)

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

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The Instrument Panel Cluster (IPC) receives the Four-Wheel Drive (4WD) status from the Transfer Case Control Module (TCCM) over the High Speed Controller Area Network (HS-CAN). If the vehicle is shifted into 4X4 auto, 4WD low or high, the TCCM sends the IPC a message to illuminate the 4X4 auto, 4X4 low or 4X4 high message center indicator. If the vehicle is shifted out of either 4X4 auto, 4X4 low or 4X4 high into 4X2 mode, the TCCM sends the IPC a message to illuminate the 4X2 message center indicator, informing the driver the vehicle has shifted into 4X2 mode.

If the 4X4 status message is missing for less than 5 seconds, the IPC defaults the applicable 4X4 message center indicator to the last on/off state, based upon the last known good ABS status message received.

If the 4X4 status message is missing for greater than 5 seconds, the IPC sets DTC U0102:00 and defaults the applicable 4X4 message center indicator off.

This pinpoint test is intended to diagnose the following:

- Message center concern
- 4WD concern
- TCCM

PINPOINT TEST AB: THE 4X4 AUTO, 4X4 LOW, 4X4 HIGH OR 4X2 MESSAGE CENTER INDICATOR IS NEVER/ALWAYS ON (IF EQUIPPED)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AB1 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • Ignition ON. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warning indicators. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active. • Observe the message center. • **Is the door ajar message center warning indicator active?**	**Yes** GO to AB2. **No** GO to Pinpoint Test AF.
AB2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0102:00 recorded?**	**Yes** GO to Pinpoint Test AU. **No** GO to AB3.
AB3 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST	
• Check for recorded DTCs from the TCCM self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 308-07A. **No** GO to AB4.
AB4 CHECK THE 4WD SYSTEM OPERATION	

• Test drive the vehicle and operate the 4WD system. • **Does the 4WD system operate correctly?**	**Yes** INSTALL a new TCCM. REFER to Section 308-07A. TEST the system for normal operation. **No** REFER to Section 308-07A.

Pinpoint Test AC: The Tow Haul Message Center Indicator Is Never/Always On

Normal Operation

The tow haul indicator illuminates when the tow haul system has been engaged and is actively providing tow haul control for the vehicle. The Instrument Panel Cluster (IPC) receives the O/D off and tow haul indicator request from the PCM over the High Speed Controller Area Network (HS-CAN).

If the tow haul indicator request message is missing or invalid for less than 5 seconds, the tow haul indicator remains in the last state (on or off), based upon the last known good message received. If the or tow haul indicator request message is missing for more than 5 seconds, the IPC sets DTC U0101:00 in continuous memory and defaults the tow haul indicator off.

This pinpoint test is intended to diagnose the following:

- Message center concern
- PCM

PINPOINT TEST AC: THE TOW HAUL MESSAGE CENTER INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AC1 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warnings. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active. • Observe the message center. • **Is the door ajar message center warning indicator active?**	**Yes** GO to AC2. **No** GO to Pinpoint Test AF.
AC2 RETRIEVE AND RECORD THE IPC DTCs FROM THE SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT. For all other DTCs, REFER to DTC Charts in this section. **No** GO to AC3.
AC3 RETRIEVE AND RECORD THE DTCs FROM THE PCM	

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KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . TEST the system for normal operation. **No** GO to AC4 .
AC4 VERIFY THE OPERATION OF THE TOW HAUL SYSTEM	
• Verify the tow haul system turns off when turned off and turns on when turned on. • **Does the tow haul system function correctly?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** REFER to Section 307-05 .

Pinpoint Test AD: The Electronic Locking Differential (ELD) Message Center Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the Electronic Locking Differential (ELD) status from the Transfer Case Control Module (TCCM) over the High Speed Controller Area Network (HS-CAN). If the vehicle is shifted into ELD mode, the TCCM sends the IPC a message to illuminate the ELD message center indicator. If the vehicle is shifted out of ELD mode, the TCCM sends the IPC a message to turn off the ELD message center indicator, informing the driver the vehicle has shifted out of ELD mode.

If the ELD status message is missing or invalid for less than 5 seconds, the ELD warning indicator remains in the last state (on or off), based upon the last known good ELD status message received. If the ELD status message is missing for more than 5 seconds, the IPC sets DTC U0102:00 in continuous memory and defaults the ELD warning indicator off.

This pinpoint test is intended to diagnose the following:

- Message center concern
- ELD concern
- TCCM

PINPOINT TEST AD: THE ELD MESSAGE CENTER INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AD1 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warnings. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active.	**Yes** GO to AD2 . **No** GO to Pinpoint Test

• Observe the message center. • **Is the door ajar message center warning indicator active?**	AF .
AD2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0102:00 recorded?**	**Yes** GO to Pinpoint Test AU . **No** GO to AD3 .
AD3 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST	
• Check for recorded TCCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 308-07A . **No** GO to AD4 .
AD4 CHECK THE 4X4 OPERATION	
• Start the engine. • Shift the transfer case into 4WD mode. • **Does the transfer case shift into 4WD mode?**	**Yes** INSTALL a new TCCM . REFER to Section 308-07A . **No** REFER to Section 308-07A to diagnose 4WD concerns.

Pinpoint Test AE: The Door Ajar Message Center Warning Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the door ajar status for the LH front, RH front, LH rear and RH rear door ajar switch from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). When the IPC receives a door ajar indication request from the BCM that one or more doors are open or ajar, the IPC turns on the appropriate door ajar message center warning indicator.

If the door ajar indication request message is missing for less than 5 seconds, the door ajar indication remains in its last state (on or off) based upon the last known good message received. If the door ajar status message is missing for more than 5 seconds, the IPC sets DTC U0140:00 and defaults the door ajar message center warning indicator active (on).

NOTE: If DTC U0140:00 sets in the IPC , other symptoms may also be present such as high beam indicator, RH/LH turn indicators, instrument panel backlighting and Tire Pressure Monitoring System (TPMS).

This pinpoint test is intended to diagnose the following:

- Message center concern
- Interior lighting concern
- BCM

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PINPOINT TEST AE: THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AE1 VERIFY THE OPERATION OF THE WRENCH AND ENGINE OVER-TEMPERATURE MESSAGE CENTER WARNING INDICATORS	
• Ignition OFF. • Disconnect: PCM C175E (3.7L), C1381E (5.0L and 6.2L) or C1551E (3.5L) . • Ignition ON. • **NOTE:** If multiple warnings are present, the message center indicators rotate through each of the warnings. Allow the displays to rotate through each display while determining whether the powertrain malfunction (wrench) and over-temperature message center warning indicator is active. • Observe the message center or integrated display area of the IPC with the PCM connected and disconnected. • **Do the powertrain malfunction (wrench) and engine over-temperature warning message center indicators remain off when the PCM is connected and become active with the PCM disconnected?**	**Yes** GO to AE2 . **No** GO to Pinpoint Test AF .
AE2 CHECK THE INTERIOR LIGHTING OPERATION	
• Open and close each door while monitoring the interior lamps. • **Do the interior lamps operate correctly with each door?**	**Yes** GO to AE3 . **No** REFER to Section 417-02 .
AE3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the continuous self-test. • **Is DTC U0140:00 recorded?**	**Yes** GO to Pinpoint Test AY . **No** GO to AE4 .
AE4 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded BCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Body Control Module (BCM) DTC Chart in Section 419-10 for correct navigation of the DTC. **No** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test AF: The Message Center Is Not Operating Correctly

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The message center functionality is controlled through the message center switch (part of the LH steering wheel switch), which is hardwired to the Instrument Panel Cluster (IPC) through input and return circuits. There are 3 message center switch buttons (base IPC) or 5 message center switch buttons (optional IPC). Each button operates a unique switch within the message center switch portion of the LH steering wheel switch assembly using a different resistance value associated with each specific button. The IPC sends out a reference voltage to the message center switch on the input circuit and monitors the voltage drop when a message center switch button is pressed. The voltage drop varies depending upon the resistance of the specific button pressed, providing indication to the IPC , which switch is pressed.

DTC Description	Fault Trigger Conditions
• B1A82:11 — External Trip Switch: Circuit Short To Ground	**NOTE:** This DTC only sets when equipped with the base message center IPC and does not apply to the Raptor or optional message center IPC s. A continuous and on-demand DTC that sets in the IPC when the IPC detects a short to ground on the message center switch input circuit.
• B1A82:13 — External Trip Switch: Circuit Open	A continuous and on-demand DTC that sets in the IPC when the IPC detects an open on the message center switch input circuit.
• B1A82:23 — External Trip Switch: Signal Stuck Low	A continuous memory DTC that sets in the IPC when the IPC detects the message center switch input pulled low (message center switch button stuck) but not shorted to ground.

This pinpoint test is intended to diagnose the following:

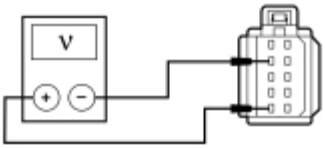
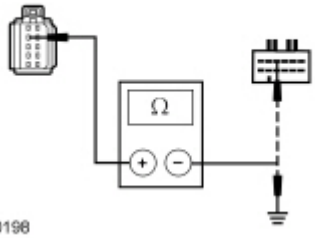
- Wiring, terminals or connectors
- Message center switch (part of the LH steering wheel switch)
- Clockspring
- IPC

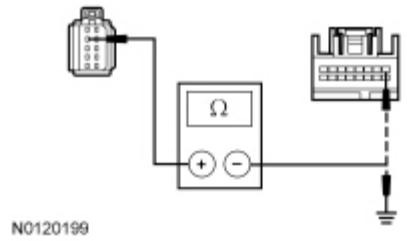
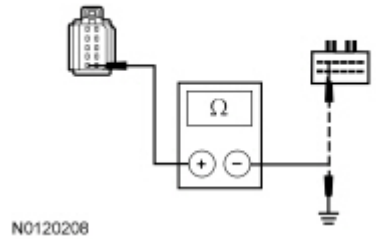
PINPOINT TEST AF: THE MESSAGE CENTER IS NOT OPERATING CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

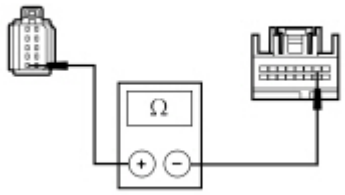
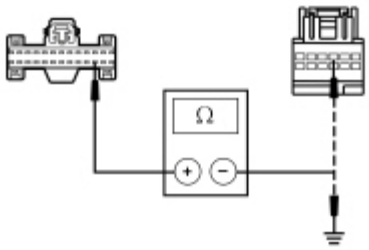
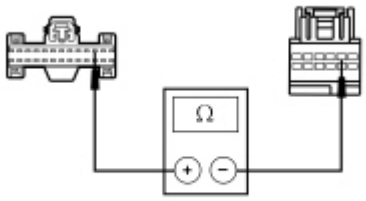
Test Step	Result / Action to Take
AF1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Retrieve the recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC B1A82:23, INSTALL a new LH steering wheel. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test. For DTC B1A82:11 or DTC B1A82:13, GO to AF2 . For all other DTCs, REFER to DTC Charts in this section. **No**

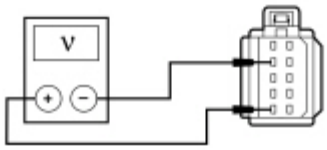
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	For the base message center, GO to AF9 . For the Raptor or optional message center, GO to AF2 .
AF2 CHECK THE IPC OUTPUT AT THE LH STEERING WHEEL SWITCH	
• Ignition OFF. • Disconnect: LH Steering Wheel Switch C2998 . • Ignition ON. • Measure the voltage between the LH steering wheel switch C2998-10, harness side and the LH steering wheel switch C2998-7, harness side.  N0120197 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new LH steering wheel. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test. **No** GO to AF3 .
AF3 CHECK THE MESSAGE CENTER SIGNAL CIRCUIT BETWEEN THE LH STEERING WHEEL SWITCH AND THE LOWER CLOCKSPRING FOR AN OPEN AND A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Lower Clockspring C218A . • Measure the resistance between the LH steering wheel switch C2998-7, harness side and the lower clockspring pin 3, component side; and between the LH steering wheel switch C2998-7, harness side and ground.  N0120198 • **Is the resistance less than 5 ohms between the LH steering wheel switch and the clockspring, and greater than 10,000 ohms between the LH steering wheel switch and ground?**	**Yes** GO to AF5 . **No** GO to AF4 .
AF4 CHECK THE MESSAGE CENTER SIGNAL CIRCUIT BETWEEN THE LH STEERING WHEEL SWITCH AND THE UPPER CLOCKSPRING FOR AN OPEN AND A SHORT TO GROUND	
• Remove the driver air bag. Refer to Section 501-20B .	**Yes**

• Disconnect: Upper Clockspring C218B . • Measure the resistance between the LH steering wheel switch C2998-7, harness side and the upper clockspring C218B-1, harness side; and between the LH steering wheel switch C2998-7, harness side and ground.  N0120199 • **Is the resistance less than 5 ohms between the LH steering wheel switch and the clockspring, and greater than 10,000 ohms between the LH steering wheel switch and ground?**	INSTALL a new clockspring. REFER to Section 501-20B . CLEAR the DTC. REPEAT the self-test **No** INSTALL a new steering wheel. REFER to Section 211-04 . CLEAR the DTC. REPEAT the self-test.
AF5 CHECK THE MESSAGE CENTER RETURN CIRCUIT BETWEEN THE LH STEERING WHEEL SWITCH AND THE LOWER CLOCKSPRING FOR AN OPEN	
• Ignition OFF. • Disconnect: Lower Clockspring C218A . • Measure the resistance between the LH steering wheel switch C2998-10, harness side and the lower clockspring pin 2, component side.  N0120208 • **Is the resistance less than 5 ohms?**	**Yes** GO to AF7 . **No** GO to AF6 .
AF6 CHECK THE MESSAGE CENTER RETURN CIRCUIT BETWEEN THE LH STEERING WHEEL SWITCH AND THE UPPER CLOCKSPRING FOR AN OPEN	
• Remove the driver air bag. Refer to Section 501-20B . • Disconnect: Lower Clockspring C218B . • Measure the resistance between the LH steering wheel switch C2998-10, harness side and the upper clockspring C218B-2, harness side.	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . CLEAR the DTC. REPEAT the self-test **No** INSTALL a new steering wheel. REFER to Section 211-04 . CLEAR the DTC. REPEAT the self-test.

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 N0120201 • **Is the resistance less than 5 ohms?**	
AF7 CHECK THE MESSAGE CENTER SIGNAL CIRCUIT BETWEEN THE IPC AND THE LOWER CLOCKSPRING FOR AN OPEN AND A SHORT TO GROUND	
• Disconnect: IPC C220 . • Measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and the lower clockspring C218A-3, circuit CMC29 (GN/VT), harness side; and between the IPC C220-16, circuit CMC29 (GN/VT), harness side and ground.  N0120209 • **Is the resistance less than 5 ohms between the IPC and the clockspring, and greater than 10,000 ohms between the IPC and ground?**	**Yes** GO to AF8 . **No** REPAIR circuit CMC29 (GN/VT) for an open or short to ground. CLEAR the DTC. REPEAT the self-test.
AF8 CHECK THE MESSAGE CENTER RETURN CIRCUIT BETWEEN THE IPC AND THE LOWER CLOCKSPRING FOR AN OPEN	
• Measure the resistance between the IPC C220-3, circuit RMC27 (WH/VT), harness side and the lower clockspring C218A-2, circuit RMC27 (WH/VT), harness side.  N0120210 • **Is the resistance less than 5 ohms?**	**Yes** GO to AF10 . **No** REPAIR circuit RMC27 (WH/VT) for an open or short to ground. CLEAR the DTC. REPEAT the self-test.
AF9 CHECK FOR VOLTAGE FROM THE IPC	

• Disconnect: LH Steering Wheel Switch C2998 . • Ignition ON. • Measure the voltage between the LH steering wheel switch C2998-10, harness side and the LH steering wheel switch C2998-7, harness side.  N0120197 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new LH steering wheel switch. REFER to Section 211-05 . TEST the system for normal operation. **No** GO to AF10 .

AF10 CHECK FOR CORRECT IPC OPERATION
• Disconnect the IPC connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AG: The Compass Is Inoperative (With 4.2" Message Center and 4.2" FCDIM))

Normal Operation

The compass is displayed in IPC and FCDIM when equipped with the 4.2" FCDIM , and in the Front Display Interface Module (FDIM) when equipped with the base Front Display Interface Module (FDIM) and the 8" Front Display Interface Module (FDIM).

The IPC receives the compass display message from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The BCM receives the compass display message from the GPSM over the MS-CAN .

If the compass display message is missing or invalid for 5 seconds or less, the compass displays the last vehicle direction based upon the last known good compass display message received. If the compass display message is invalid or missing for 5 seconds or more, the IPC defaults the compass display to all dashes (---).

- DTC U0462:82 (Invalid Data Received from Compass Module: Alive/Sequence Counter Incorrect/Not Updated) — sets in the Instrument Panel Cluster (IPC) in continuous memory if the IPC does not receive updated compass data from the BCM for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

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- Communication concern
- GPSM

PINPOINT TEST AG: THE COMPASS IS INOPERATIVE (WITH 4.2" MESSAGE CENTER AND 4.2" FCDIM))

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AG1 CHECK THE COMPASS ZONE AND CALIBRATION SETTINGS THROUGH THE MESSAGE CENTER	
• Ignition ON. • Enter the vehicle settings in the message center and verify whether the compass zone and calibration setting menu is present. • **Is the compass zone and calibration setting menu present?**	**Yes** DIAGNOSE the compass display in the 4.2" FCDIM . Refer to the appropriate section in Group 415 for the procedure. **No** GO to AG2 .
AG2 RETRIEVE THE RECORD DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE GLOBAL POSITIONING SYSTEM MODULE (GPSM) SELF-TEST	
• Carry out the GPSM self-test. • **Are any DTCs recorded?**	**Yes** Refer to the appropriate section in Group 415 for the procedure.. **No** GO to AG3 .
AG3 RETRIEVE THE RECORD DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE BODY CONTROL MODULE (BCM) SELF-TEST	
• Carry out the BCM self-test. • **Are any DTCs recorded?**	**Yes** Section 419-10 . **No** GO to AG4 .
AG4 RETRIEVE THE RECORD DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE INSTRUMENT PANEL CLUSTER (IPC) SELF-TEST	
• Carry out the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Chart: IPC in this section. **No** INSTALL a new GPSM . Refer to the appropriate section in Group 415 for the procedure..

Pinpoint Test AI: The Outside Air Temperature Display Is Inoperative/Incorrect

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The outside air temperature is displayed in the Front Display Interface Module (FDIM). The Ambient Air Temperature (AAT) sensor is hardwired to the PCM through separate input and return circuits. The PCM provides a reference voltage to the AAT sensor and monitors the change in voltage resulting from changes in resistance as determined by outside air temperature. The PCM then messages the ambient air temperature data to the HVAC module through the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The BCM then filters the temperature data and sends the updated temperature status to the FDIM over the Medium Speed Controller Area Network (MS-CAN).

The HVAC module is programmed to update the messaged outside temperature data at different rates depending on several criteria to prevent false temperature displays due to a condition known as heat soaking. Heat soaking is where the outside air temperature is hotter in the location of the AAT sensor than the actual outside air temperature.

When the sensed outside temperature rises, the display updates slowly at varying rates based on vehicle speed. When the sensed outside temperature drops, the display updates more quickly following the drop experienced by the AAT sensor.

This pinpoint test is intended to diagnose the following:

- Communication concern
- PCM concern

PINPOINT TEST AI: THE OUTSIDE AIR TEMPERATURE DISPLAY IS INOPERATIVE/INCORRECT

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AI1 RETRIEVE THE RECORDED DTCs FROM THE FDIM SELF-TEST	
• Check for recorded FDIM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0164, REFER to Refer to the appropriate section in Group 415 for the procedure.. **No** GO to AI2 .
AI2 RETRIEVE THE RECORDED DTCs FROM THE HVAC MODULE SELF-TEST	
• Check for recorded HVAC module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 412-00 . **No** GO to AI3 .
AI3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test.	**Yes** REFER to Section 303-14 . TEST the system for

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• **Are any ambient temperature sensor DTCs recorded?**	normal operation. **No** The system is operating correctly at this time. The condition may have been caused by a heat soak concern.

Pinpoint Test AJ: A Hill Descent Control Message Is Inoperative/Always On

Normal Operation

The hill descent control system maintains vehicle speed on a downhill grade at operating speeds between 3 km/h (2 mph) and 32 km/h (20 mph). The system goes into standby mode on a flat or uphill terrain. The system deactivates at speeds above 64 km/h (40 mph). During periods of sustained use, the hill descent control system may automatically deactivate in order to cool the braking system.

When the hill descent control switch is pressed, a ground signal is sent to the PCM. The PCM then sends a message to the ABS module along the High Speed Controller Area Network (HS-CAN) requesting system activation. The ABS module uses inputs from the Restraints Control Module (RCM) and wheel speed sensors to determine the mode of operation.

The Instrument Panel Cluster (IPC) receives the hill descent control status from the ABS module over the HS-CAN . The message center also displays hill descent control messages to inform the driver they have entered or exited various states of the hill descent control function.

If the hill descent message is missing for less than 5 seconds, the hill descent active message center indicator remains in the last state (on or off) based on the last status message received. If the hill descent status message is missing for more than 5 seconds, the IPC sets DTC U0121:00 and defaults the hill descent active message center indicator off.

This pinpoint test is intended to diagnose the following:

- Message center concern
- ABS module

PINPOINT TEST AJ: A HILL DESCENT CONTROL MESSAGE IS INOPERATIVE/ALWAYS ON

Test Step	Result / Action to Take
AJ1 VERIFY THE OPERATION OF THE DOOR AJAR MESSAGE CENTER WARNING INDICATOR	
• Close all doors then open the LH front door. • Ignition ON. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warning indicators. Allow the displays to cycle through each display while determining whether the door ajar message center warning indicator is active. • Observe the message center. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** GO to AJ2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AJ2 CHECK AND ENSURE THE HILL DESCENT CONTROL MODE FUNCTIONS	

• Start the engine. • Drive the vehicle between 3 km/h (2 mph) and 32 km/h (20 mph) on a downhill grade and activate the hill descent control system mode. • **Are the brakes applying on a downhill grade?**	**Yes** GO to AJ3 . **No** REFER to Section 206-09 .
AJ3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0121:00 recorded?**	**Yes** GO to Pinpoint Test AV . **No** GO to AJ4 .
AJ4 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded ABS module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** INSTALL a new ABS module. REFER to Section 206-09 .

Pinpoint Test AK: The CHECK FUEL FILL INLET Message Is Inoperative/Always On

Normal Operation

The PCM monitors the fuel tank evaporative emission system for significant leaks that occur following refueling of the vehicle. Once the PCM detects a fuel vapor leak, the PCM sends the Instrument Panel Cluster (IPC) a message over the communication network to turn on the CHECK FUEL FILL INLET message. The PCM only sets DTC P0457 following a successful cruise test, which is initiated when the vehicle is driven at a steady speed above 64 km/h (40 mph) for a duration of approximately 4-5 minutes. If the PCM is unable to successfully run the cruise test, the IPC does not receive the fuel inlet status and the CHECK FUEL FILL INLET message remains off.

If the IPC does not receive the fuel inlet status from the PCM for 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the CHECK FUEL FILL INLET message off.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge or odometer.

- DTC P0457 (Evaporative Emission System Leak Detected) (Fuel Cap Loose/Off) — sets in the PCM if the PCM detects a significant fuel tank pressure change after refueling occurs.

This pinpoint test is intended to diagnose the following:

- Evaporative fuel system concern
- PCM
- IPC

PINPOINT TEST AK: THE CHECK FUEL FILL INLET MESSAGE IS INOPERATIVE/ALWAYS ON

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Test Step	Result / Action to Take
AK1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** GO to AK2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AK2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Is DTC P0457 recorded?**	**Yes** If the CHECK FUEL FILL INLET message is illuminated, REFER to Section 303-14 . TEST the system for normal operation. If the CHECK FUEL FILL INLET message is not illuminated, GO to AK3 . **No** If the CHECK FUEL FILL INLET message is always on, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. If the check fuel cap indicator is not illuminated, the system is operating normally at this time. If the fuel cap was left off and the CHECK FUEL FILL INLET message did not turn on, driving conditions may not have allowed for the PCM to run the cruise test and message the IPC to turn the CHECK FUEL FILL INLET message on.
AK3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test AT . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.

Pinpoint Test AL: An Off-Road Mode Message Is Inoperative/Always On (Raptor Only)

Normal Operation

The message center displays off-road mode messages to inform the driver they have entered or exited various states of the off-road mode function. When the off-road mode is active, the standard vehicle speed thresholds for the Instrument Panel Cluster (IPC) are lifted and the AdvanceTrac® settings are altered for optimized off-road driving. The IPC receives the off-road mode signal from the Transfer Case Control

Module (TCCM) over the High Speed Controller Area Network (HS-CAN).

If the off-road mode message is missing for less than 5 seconds, the IPC defaults the applicable off-road mode message center indicator to the last on/off state, based upon the last off-road mode status message received.

If the off-road mode status message is missing for greater than 5 seconds, the IPC sets DTC U0102:00 and defaults the applicable off-road mode message center indicator off.

This pinpoint test is intended to diagnose the following:

- Message center concern
- Four-Wheel Drive (4WD) concern
- TCCM

PINPOINT TEST AL: AN OFF-ROAD MODE MESSAGE IS INOPERATIVE/ALWAYS ON (RAPTOR ONLY)

Test Step	Result / Action to Take
AL1 CHECK THE MESSAGE CENTER OPERATION • Close all doors. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** GO to AL2. **No** INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AL2 CHECK THE 4X4 OPERATION IN OFF-ROAD MODE • Start the engine. • Drive the vehicle in Four-Wheel Drive (4WD) and activate the off-road mode. • **Has the vehicle entered off-road mode?**	**Yes** GO to AL3. **No** REFER to Section 308-07A to diagnose 4X4 system concerns.
AL3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST • Check for recorded DTCs from the IPC self-test. • **Is DTC U0102:00 recorded?**	**Yes** GO to Pinpoint Test AU. **No** GO to AL4.
AL4 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST • Check for recorded DTCs from the TCCM self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 308-07A. **No** INSTALL a new TCCM. REFER to Section 308-07A.

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Pinpoint Test AM: The Chime Always Sounds

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the key-in-ignition warning status from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The key-in-ignition warning switch (part of the ignition switch) is hardwired to the BCM . When the key is inserted into the ignition lock cylinder, the key-in-ignition switch closes and supplies voltage to the BCM . The BCM monitors the door ajar input from the LH front door and the key-in-ignition switch status. When the key is inserted into the ignition lock cylinder and the LH front door is open or ajar, the BCM sends the IPC a chime request message to sound the key-in-ignition warning chime. The headlamps on warning chime sounds when the driver door is opened with the ignition off, and the headlamp switch is in the PARK or HEADLAMP ON position.

The BCM receives the headlamp switch status from the headlamp switch and the LH front door ajar status from the LH front door ajar switch through hardwired circuitry. The BCM communicates the headlamp on chime request to the IPC when the headlamps or parking lamps are on and the driver door is opened. The autolamps feature must not be selected for the headlamps on warning chime to operate.

- DTC B10F1:14 (Key In Switch: Circuit Short To Ground or Open) — a continuous and on-demand DTC that sets if the BCM detects an open on the key-in-ignition switch input circuit or if the BCM detects ignition START, RUN/START OR RUN/ACC inputs without the key-in-ignition input.

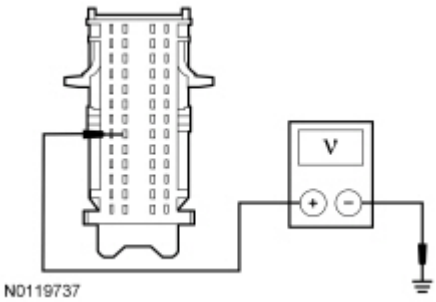
This pinpoint test is intended to diagnose the following:

- Exterior lighting concern
- Interior lighting concern
- Wiring, terminals or connectors
- Key-in-ignition warning switch (part of the ignition switch)
- Ignition lock cylinder
- BCM

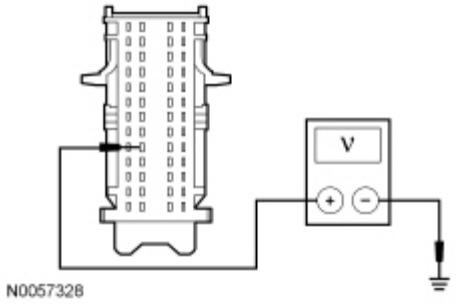
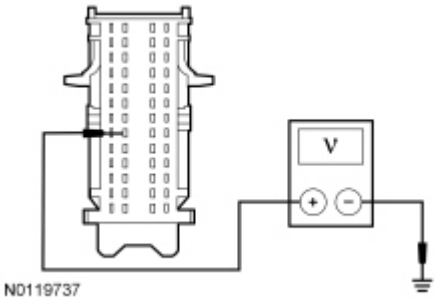
PINPOINT TEST AM: THE CHIME ALWAYS SOUNDS

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AM1 CHECK THE EXTERIOR LIGHTING OPERATION	
• Turn the headlamp switch to the OFF position. • Close all doors and wait one minute. • Wait one minute. • Observe the exterior lights. • **Are the headlamps and parking lamps off?**	**Yes** GO to AM2 . **No** REFER to Section 417-01 .
AM2 CHECK THE INTERIOR LAMPS OPERATION	
• Open and close the drivers door. • Observe the interior lamps. • **Do the interior lamps operate correctly from the driver door?**	**Yes** GO to AM3 . **No** REFER to Section 417-02 .

AM3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check the recorded DTCs from the BCM self-tests. • **Are any DTCs present?**	**Yes** For DTC B10F1:14, GO to AM4. For all other DTCs, REFER to Section 419-10. **No** GO to AM5.
AM4 CHECK THE BCM INPUT PIDs FROM THE IGNITION SWITCH	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select and monitor the BCM ignition switch state (IGN_SW_STATE) while switching through the ignition states. • **Do the BCM PIDs match the ignition switch position?**	**Yes** GO to AM9. **No** REFER to Section 211-05 to diagnose the ignition switch outputs to the BCM.
AM5 CHECK THE BCM KEY-IN-IGNITION SWITCH INPUT	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select and monitor the BCM key-in-ignition switch state (KEY_IN_SW) while wiggling the igntion key in the lock cylinder. • **Does the PID indicate the key is in at all times?**	**Yes** GO to AM6. **No** INSTALL a new igntion lock cylinder. REFER to Section 501-14. TEST the system for normal operation.
AM6 CHECK THE KEY-IN-IGNITION INPUT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Remove the key from the ignition cylinder. • Disconnect: BCM C2280B. • Measure the voltage between the BCM C2280B-34, circuit CDC30 (BU/GY), harness side and ground.  • **Is any voltage present?**	**Yes** GO to AM7. **No** GO to AM9.
AM7 CHECK THE IGNITION LOCK CYLINDER	
NOTE: Make sure there is no mechanical damage between the igntion lock cylinder and the ignition switch causing the key-in-ignition switch to remain engaged. • Remove the igntion lock cylinder. Refer to Section 501-14. • Measure the voltage between the BCM C2280b-35, circuit CDC30 (BU/GY), harness side and ground.	**Yes** GO to AM8 **No** INSTALL a new ignition lock cylinder. REFER to Section

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 N0057328 • **Is any voltage present?**	501-14 . TEST the system for normal operation.
AM8 CHECK KEY-IN-IGNITION INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Ignition Switch C250 . • Measure the voltage between the BCM C2280B-34, circuit CDC30 (BU/GY), harness side and ground.  N0119737 • **Is any voltage present?**	**Yes** REPAIR circuit CDC30 (BU/GY) for a short to voltage. TEST the system for normal operation. **No** INSTALL a new ignition switch. REFER to Section 211-05 . TEST the system for normal operation.
AM9 CHECK FOR CORRECT BCM OPERATION	
• Disconnect all the BCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the BCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AN: The Headlamps On Warning Chime Is Inoperative

Normal Operation

The Body Control Module (BCM) receives the headlamp switch status from the headlamp switch and the LH front door ajar status from the LH front door ajar switch through hardwired circuitry. The headlamps on warning chime sounds when the LH front door is opened with the ignition off, and the headlamp switch is in the PARK or HEADLAMP ON position. The BCM communicates the headlamp on chime request to the IPC over the High Speed Controller Area Network (HS-CAN) when the headlamps or parking lamps are on with the ignition off and the driver door is opened.

This pinpoint test is intended to diagnose the following:

- Interior lighting concern
- BCM
- IPC

PINPOINT TEST AN: THE HEADLAMPS ON WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
AN1 CHECK THE SAFETY BELT WARNING CHIME OPERATION • Ignition OFF. • Ignition ON. • While monitoring the safety belt warning chime, transition the ignition switch from OFF to RUN. • **Does the safety belt warning chime operate for approximately 6 seconds?**	**Yes** GO to AN2. **No** INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AN2 CHECK THE INTERIOR LAMPS OPERATION • Open and close the driver door. • Observe the interior lamps. • **Do the interior lamps operate correctly from the driver door?**	**Yes** GO to AN3. **No** REFER to Section 417-02.
AN3 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION • Ignition OFF. • Insert the key into the ignition lock cylinder. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime sound?**	**Yes** GO to AN4. **No** GO to Pinpoint Test AO.
AN4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST • Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0140:00, GO to Pinpoint Test AY. For all other DTCs, REFER to DTC Chart in this section. **No** GO to AN5.
AN5 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST • Check for recorded BCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 for correct navigation of the DTC. **No** INSTALL a new BCM. REFER to Section 419-

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	10 . TEST the system for normal operation.

Pinpoint Test AO: The Key-In-Ignition Warning Chime Is Inoperative

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the key-in-ignition warning status from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The key-in-ignition warning switch (part of the ignition switch) is hardwired to the BCM . When the key is inserted into the ignition lock cylinder, the key-in-ignition switch closes and supplies voltage to the BCM . The BCM monitors the door ajar input from the LH front door and the key-in-ignition switch status. When the key is inserted into the ignition lock cylinder and the driver door is open or ajar, the BCM sends the IPC a chime request message to sound the key-in-ignition warning chime.

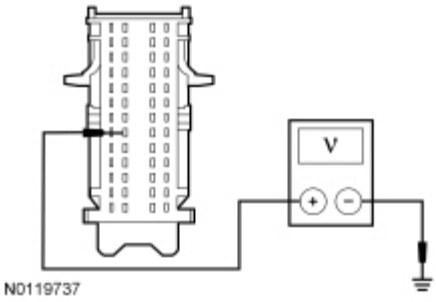
- DTC B10F1:14 (Key In Switch: Circuit Short To Ground or Open) — a continuous and on-demand DTC that sets if the BCM detects an open on the key-in-ignition switch input circuit or if the BCM detects ignition START, RUN/START OR RUN/ACC inputs without the key-in-ignition input.

This pinpoint test is intended to diagnose the following:

- Interior lighting concern
- Wiring, terminals or connectors
- Key-in-ignition warning switch (part of the ignition switch)
- Ignition lock cylinder
- BCM
- IPC

PINPOINT TEST AO: THE KEY-IN-IGNITION WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
AO1 CHECK THE SAFETY BELT WARNING CHIME OPERATION	
• Ignition OFF. • Unbuckle the driver safety belt. • Ignition ON. • Monitor the safety belt warning chime when the ignition switch is transitioned from OFF to RUN for 6 seconds. • **Does the safety belt warning chime operate for approximately 6 seconds?**	**Yes** GO to AO2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AO2 CHECK THE INTERIOR LAMPS OPERATION	
• Open and close the driver door. • Observe the interior lamps. • **Do the interior lamps operate correctly from the driver door?**	**Yes** GO to AO3 . **No** REFER to Section 417-02 .
AO3 RETRIEVE THE RECORDED DTCs FROM THE BCM	

SELF-TEST	
• Check the recorded DTCs from the BCM self-test. • **Is DTC B10F1:14 present?**	**Yes** GO to AO4 . **No** GO to AO7 .
AO4 CHECK THE BCM KEY-IN-IGNITION SWITCH INPUT	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Select and monitor the BCM key-in-ignition switch state (KEY_IN_SW) while wiggling the igntion key in the lock cylinder. • **Does the PID indicate the key is in at all times?**	**Yes** GO to AO5 . **No** INSTALL a new igntion lock cylinder. REFER to Section 501-14 . TEST the system for normal operation.
AO5 CHECK THE KEY-IN-IGNITION INPUT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Insert the key into the ignition cylinder. • Disconnect: BCM C2280B . • Measure the voltage between the BCM C2280B-34, circuit CDC30 (BU/GY), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to AO7 . **No** GO to AO6 .
AO6 CHECK THE IGNITION SWITCH	
• Ignition OFF. • Disconnect: Ignition Switch C250 . • Carry out the ignition switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the ignition switch OK?**	**Yes** REPAIR circuit CDC30 (BU/GY) for an open. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ignition switch. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test.
AO7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly

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• Operate the system and verify the concern is still present. • **Is the concern still present?**	at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AP: The Memory Feedback Warning Chime Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the memory feedback chime request from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). When a successful memory set procedure is carried out, the Driver Seat Module (DSM) sends a chime request over the Medium Speed Controller Area Network (MS-CAN) to the BCM , which gateways the chime request to the IPC to sound the memory feedback chime.

This pinpoint test is intended to diagnose the following:

- DSM
- IPC

PINPOINT TEST AP: THE MEMORY FEEDBACK WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
AP1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • Insert the key into the ignition lock cylinder. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to AP2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AP2 CHECK THE MEMORY SET FEATURE	
• Verify the memory set procedure can successfully change the memory preferences. • **Does the memory set procedure successfully change the memory preferences?**	**Yes** GO to AP3 . **No** REFER to Section 501-10 .
AP3 RETRIEVE THE RECORDED DTCs FROM THE DSM SELF-TEST	
• Check for recorded DTCs from the DSM self-test. • **Is DTC U0140:00 recorded?**	**Yes** REFER to Section 501-10 . **No** INSTALL a new DSM . REFER to Section 501-10 . TEST the system for normal operation.

Pinpoint Test AQ: The Parking Brake Warning Chime Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the parking brake warning chime request from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The parking brake warning chime sounds when the ignition switch is on, the parking brake is engaged and the vehicle speed is greater than 5 km/h (3 mph). The parking brake warning chime stops sounding and resets if the parking brake is released, the ignition switch is not on, if the vehicle speed is below 5 km/h (3 mph), or after 90 seconds from the time the chime is activated.

NOTE: Make sure the parking brake warning chime operation is verified with the vehicle moving at least 5 km/h (3 mph) with the parking brake slightly applied (just enough to turn the brake warning indicator on) without damaging the rear brakes.

This pinpoint test is intended to diagnose the following:

- Brake warning indication concern
- BCM
- IPC

PINPOINT TEST AQ: THE PARKING BRAKE WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
AQ1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • With the ignition switch in the OFF position and the key in the ignition lock cylinder, open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to AQ2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AQ2 CHECK THE BRAKE WARNING INDICATOR OPERATION	
• Apply the parking brake. • Ignition ON. • Observe the brake warning indicator. • **Does the brake warning indicator illuminate?**	**Yes** GO to AQ3 . **No** GO to Pinpoint Test M .
AQ3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0140:00, GO to Pinpoint Test AY . For all other DTCs, REFER to DTC Chart in this section. **No** GO to AQ4 .
AQ4 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded BCM DTCs from the self-test.	**Yes**

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• **Are any DTCs recorded?**	REFER to Section 419-10 for correct navigation of the DTC. **No** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test AR: The Safety Belt Warning Chime Is Inoperative/The Belt-Minder® Feature Does Not Operate Correctly

Normal Operation

The Instrument Panel Cluster (IPC) receives the safety belt and Belt-Minder® requests from the Restraints Control Module (RCM) over the High Speed Controller Area Network (HS-CAN). The safety belt warning chime sounds for approximately 6 seconds when the driver safety belt is not fastened and the ignition lock cylinder is turned from the OFF/LOCK or ACC to the ON or START position.

The Belt-Minder® feature supplements the safety belt warning function and is enabled after the safety belt warning is complete. The Belt-Minder® simultaneously sounds the chime and illuminates the safety belt warning lamp in the IPC once the vehicle speed has exceeded 5 km/h (3 mph), and remains active for 5 minutes from the time it is started.

There are 2 Belt-Minder® strategies used and implemented by the IPC as commanded by the RCM . The 2 strategies are designed to provide an increased intensity level of the chime. Belt-Minder® A provides 6 one-second sequences of 0.5 second on/0.5 second off for the first minute of the Belt-Minder® warning. Belt-Minder® B provides 6 one-second sequences of 0.2 second on/0.2 second off then 0.3 second on/0.3 second off for the remainder of the Belt-Minder® warning.

NOTE: Whenever the vehicle is operated using MyKey®, the RCM enables the Belt-Minder®.

If the Belt-Minder® is deactivated using an administrator key and driven using a MyKey® key, the MyKey® system overrides the deactivation of Belt-Minder®. When MyKey® is in use, the driver cannot configure the Belt-Minder® off. Once the Belt-Minder® is activated, the Belt-Minder® continues to chime periodically (does not time out after 5 minutes) and the audio system is muted until the driver safety belt is fastened. Refer to Section 419-01B for more information on the MyKey® feature.

NOTE: Make sure the Belt-Minder® chime operation is verified with the vehicle moving at least 5 km/h (3 mph).

This pinpoint test is intended to diagnose the following:

- Safety belt warning indication concern
- Belt-Minder® deactivated
- Speedometer concern
- RCM
- IPC

PINPOINT TEST AR: THE SAFETY BELT WARNING CHIME IS INOPERATIVE/THE BELT-MINDER® FEATURE DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
AR1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION • Ignition OFF. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to AR2. **No** INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AR2 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH • Ignition ON. • Enter the following diagnostic mode on the scan tool: RCM PIDs. • Monitor the RCM driver safety belt buckle PID (SBELT_D_ST) while buckling and unbuckling the driver safety belt. • **Does the PID display BUCKLED with the safety belt buckled and UNBUCKLED with the safety belt unbuckled?**	**Yes** GO to AR3. **No** REFER to Section 501-20B.
AR3 CHECK THE SAFETY BELT WARNING INDICATOR FOR CORRECT OPERATION • Ignition ON. • Within one minute, buckle then unbuckle the LH front safety belt. • With the engine running, verify the safety belt warning indicator illuminates with the safety belt unbuckled and turns off when buckled. • **Does the safety belt warning indicator operate correctly?**	**Yes** GO to AR4. **No** GO to Pinpoint Test U.
AR4 CHECK THE SPEEDOMETER OPERATION • Verify the speedometer is operating correctly. • **Does the speedometer operate correctly?**	**Yes** GO to AR5. **No** GO to Pinpoint Test F.
AR5 CHECK THE BELT-MINDER® CONFIGURATION **NOTE:** Verify an administrator key is used for this test and **not** a MyKey® programmed key. When a MyKey® programmed key is used, the Belt-Minder® automatically turns on and cannot be disabled (if previously disabled by an administrator, the Belt-Minder® remains disabled when an administrator key is used). • Verify the Belt-Minder® is activated or configured on for the seating position in question. Refer to Belt-Minder® Deactivating/Activating in this section to configure without a scan tool. • **Is the Belt-Minder® activated for the seating position in question?**	**Yes** If the Belt-Minder® is always on above 5 km/h (3 mph) with the safety belt unfastened, the system is operating normally. If the Belt-Minder® is always on with the safety belt fastened or never on with the safety belt unfastened above 5 km/h (3 mph), INSTALL a new RCM. REFER to Section 501-20B. TEST the system for normal operation. **No** ACTIVATE the Belt-Minder® for the

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	seating position in question. REFER to Belt-Minder® Deactivating/Activating in this section. TEST the system for normal operation.

Pinpoint Test AS: The Turn Signal On Warning Chime Is Inoperative

Normal Operation

The turn signal on warning chime sounds when the vehicle travels more than 3.2 km (2.0 miles) with the turn signal on. The Body Control Module (BCM) communicates the turn signal switch status to the IPC over the High Speed Controller Area Network (HS-CAN). The PCM communicates the odometer count data to the IPC over the HS-CAN.

This pinpoint test is intended to diagnose the following:

- Odometer operation
- Turn signal indication concern
- BCM
- IPC

PINPOINT TEST AS: THE TURN SIGNAL ON WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
AS1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • With the ignition switch off and the key in the ignition lock cylinder, open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to AS2. **No** INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AS2 CHECK THE TURN SIGNAL INDICATORS OPERATION	
• Ignition ON. • Verify the turn signal indicators operation. • **Do the turn signal indicators operate correctly?**	**Yes** GO to AS3. **No** GO to Pinpoint Test R.
AS3 CHECK THE ODOMETER FOR CORRECT OPERATION	
• Drive the vehicle and observe the odometer for correct operation. • **Does the odometer operate correctly?**	**Yes** INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation. **No** GO to Pinpoint Test H.

Pinpoint Test AT: DTC U0100:00

Normal Operation

- DTC U0100:00 (Lost Communication With ECM /PCM "A": No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the PCM over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

NOTE: Once the IPC sets DTC U0100:00, multiple gauges or indicators are likely to be inoperative in the IPC . Other modules that require data from the IPC all set communication DTCs and may also exhibit system function concerns.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST AT: DTC U0100:00

Test Step	Result / Action to Take
AT1 VERIFY THE SCAN TOOL CAN COMMUNICATE WITH THE PCM	
• Connect the scan tool. • Make sure a vehicle session can be established using the scan tool. • **Can a vehicle session be established?**	**Yes** GO to AT2 . **No** REFER to Section 418-00 to diagnose no communication with the PCM.
AT2 CHECK THE IPC CONTINUOUS MEMORY DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0100:00 retrieved again?**	**Yes** GO to AT3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AT3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded DTCs from the PCM Key ON Engine OFF (KOEO) self-test. • **Is DTC P0562 or P0563 recorded?**	**Yes** REFER to Section 303-14 . **No** GO to AT4 .
AT4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test.	**Yes**

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• **Is DTC U3003:16 or DTC U3003:17 recorded?**	For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AT5 .
AT5 CHECK FOR DTC U0100:00 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0100:87 set in the Remote Function Actuator (RFA) module (if equipped) or DTC U0100:00 in the Restraints Control Module (RCM)?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test AU: DTC U0102:00

Normal Operation

- DTC U0102:00 (Lost Communication With Transfer Case Control Module: No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the Transfer Case Control Module (TCCM) over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- TCCM
- IPC

PINPOINT TEST AU: DTC U0102:00

Test Step	Result / Action to Take
AU1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AU2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AU2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the TCCM pass the network test?**	**Yes** GO to AU3 . **No** REFER to Section 418-00 .

AU3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AU4 .
AU4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0102:00 still present?**	**Yes** GO to AU5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AU5 CHECK FOR DTC U0102:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0102:00 set in the ABS module?**	**Yes** INSTALL a new TCCM . REFER to Section 308-07A . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test AV: DTC U0121:00

Normal Operation

- DTC U0121:00 (Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the ABS module over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- ABS module
- IPC

PINPOINT TEST AV: DTC U0121:00

Test Step	Result / Action to Take
AV1 VERIFY THE CUSTOMER CONCERN	

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• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AV2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AV2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the ABS module pass the network test?**	**Yes** GO to AV3 . **No** REFER to Section 418-00 .
AV3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS module self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to Section 206-09 . **No** GO to AV4 .
AV4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AV5 .
AV5 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0121:00 still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0121:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AW: DTC U0131:00

Normal Operation

- DTC U0131:00 (Lost Communication With Power Steering Control Module: No Sub-Type Information) — sets in the Instrument Panel Cluster (IPC) if data messages received from the Power Steering Control Module (PSCM) over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- PSCM
- IPC

PINPOINT TEST AW: DTC U0131:00

Test Step	Result / Action to Take
AW1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AW2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AW2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the PSCM pass the network test?**	**Yes** GO to AW3 . **No** REFER to Section 418-00 .
AW3 RETRIEVE THE RECORDED DTCs FROM THE PSCM MODULE SELF-TEST • Check for recorded DTCs from the PSCM module self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to Section 211-00A or Section 211-00B . **No** GO to AW4 .
AW4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST • Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AW5 .
AW5 RECHECK THE IPC DTCs **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0131:00 still present?**	**Yes** GO to AW6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AW6 CHECK FOR DTC U0131:00 SET IN OTHER MODULES • Clear all DTCs.	**Yes**

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• Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0131:00 set in the ABS module?**	INSTALL a new PSCM (part of the steering gear). REFER to Section 211-02 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test AX: DTC U0137:00

Normal Operation

- DTC U0137:00 (Lost Communication With Trailer Brake Control Module: No Sub Type Information) — sets in continuous memory if data messages received from the Trailer Brake Control (TBC) module over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- TBC module
- IPC

PINPOINT TEST AX: DTC U0137:00

Test Step	Result / Action to Take
AX1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AX2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AX2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the TBC module pass the network test?**	**Yes** GO to AX3 . **No** REFER to Section 418-00 .
AX3 RETRIEVE THE RECORDED DTCs FROM THE TBC MODULE SELF-TEST • Check for recorded TBC module DTCs from the self-test. • **Is DTC B1317 or DTC B1318 recorded?**	**Yes** REFER to Section 206-10 . **No** GO to AX4 .

AX4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AX5 .
AX5 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Are any DTCs present?**	**Yes** For DTC U0137:00, INSTALL a new TBC module. REFER to Section 206-10 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0137:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AY: DTC U0140:00

Normal Operation

- DTC U0140:00 (Lost Communication With Body Control Module: No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- BCM
- IPC

PINPOINT TEST AY: DTC U0140:00

Test Step	Result / Action to Take
AY1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AY2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AY2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON.	**Yes**

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• Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the BCM pass the network test?**	GO to AY3 . **No** REFER to Section 418-00 .
AY3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded DTCs from the BCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to Section 419-10 . **No** GO to AY4 .
AY4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AY5 .
AY5 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0140:00 still present?**	**Yes** GO to AY6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AY6 CHECK FOR DTC U0140 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140 set in the Restraints Control Module (RCM), Driver Seat Module (DSM) or the Driver Door Module (DDM)?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test AZ: DTC U0151:00

Normal Operation

- DTC U0151:00 (Lost Communication With Restraints Control Module: No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the Restraints Control Module (RCM) over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- RCM
- IPC

PINPOINT TEST AZ: DTC U0151:00

Test Step	Result / Action to Take
AZ1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AZ2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AZ2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the RCM pass the network test?**	**Yes** GO to AZ3 . **No** REFER to Section 418-00 .
AZ3 RETRIEVE THE RECORDED DTCs FROM THE RCM SELF-TEST • Check for recorded DTCs from the RCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to Section 501-20B . **No** GO to AZ4 .
AZ4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST • Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to AZ5 .
AZ5 RECHECK THE IPC DTCs • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0151:00 still present?**	**Yes** GO to AZ6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AZ6 CHECK FOR DTC U0151:00 SET IN OTHER MODULES • Clear all DTCs. • Ignition OFF. • Ignition ON.	**Yes** INSTALL a new RCM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test.

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• Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0151:00 set in the Occupant Classification System Module (OCSM)?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BA: DTC U0154:00

Normal Operation

- DTC U0154:00 (Lost Communication With Occupant Classification Sensor [OCS]: No Sub-Type Information) — sets in the Instrument Panel Cluster (IPC) if data messages received from the Occupant Classification System Module (OCSM) over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- OCSM
- IPC

PINPOINT TEST BA: DTC U0154:00

Test Step	Result / Action to Take
BA1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BA2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BA2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the OCSM pass the network test?**	**Yes** GO to BA3 . **No** REFER to Section 418-00 .
BA3 RETRIEVE THE RECORDED DTCs FROM THE OCSM SELF-TEST	
• Check for recorded DTCs from the OCSM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to Section 501-20B . **No** GO to BA4 .

BA4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to BA5 .
BA5 RECHECK THE IPC DTCs	
• Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0154:00 still present?**	**Yes** GO to BA6 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BA6 CHECK FOR DTC U0154:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0154:00 set in the Restraints Control Module (RCM) module?**	**Yes** INSTALL a new OCSM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BB: DTC U0159:00

Normal Operation

- DTC U0159:00 (Lost Communication With Parking Assist Control Module "A": No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the Parking Aid Module (PAM) over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- PAM
- IPC

PINPOINT TEST BB: DTC U0159:00

Test Step	Result / Action to Take
BB1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON.	**Yes**

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• Verify there is an observable symptom present. • **Is an observable symptom present?**	GO to BB2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BB2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the PAM pass the network test?**	**Yes** GO to BB3 . **No** REFER to Section 418-00 .
BB3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to BB4 .
BB4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0159:00 still present?**	**Yes** INSTALL a new PAM . REFER to Section 413-13 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0159:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BC: DTC U0212:00

Normal Operation

- DTC U0212:00 (Lost Communication With Steering Column Control Module: No Sub-Type Information) — sets in continuous memory in the Instrument Panel Cluster (IPC) if data messages received from the Steering Column Control Module (SCCM) over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds or longer. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- SCCM
- IPC

PINPOINT TEST BC: DTC U0212:00

Test Step	Result / Action to Take
BC1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BC2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BC2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the SCCM pass the network test?**	**Yes** GO to BC3 . **No** REFER to Section 418-00 .
BC3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST • Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test BD . For DTC U3003:17, GO to Pinpoint Test BE . **No** GO to BC4 .
BC4 RECHECK THE IPC DTCs • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U0212:00 still present?**	**Yes** GO to BC5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BC5 CHECK FOR DTC U0212:87 SET IN OTHER MODULES • Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0212:87 set in the Body Control Module (BCM)?**	**Yes** INSTALL a new SCCM . REFER to Section 211-04 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BD: DTC U3003:16

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

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Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) — sets in the Instrument Panel Cluster (IPC) in continuous memory if the IPC detects battery voltage below 9 volts on the voltage supply circuit for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

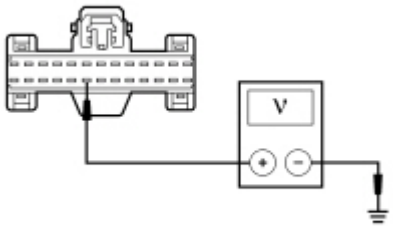
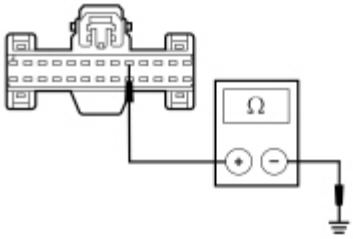
- Wiring, terminals or connectors
- High circuit resistance
- IPC

PINPOINT TEST BD: DTC U3003:16

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
BD1 RECHECK THE IPC DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • Clear the DTCs. • Wait 10 seconds. • Repeat the IPC self-test. • **Is DTC U3003:16 still present?**	**Yes** GO to BD2 . **No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
BD2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM • Enter the following diagnostic mode on the scan tool: PCM Self-Test . • Carry out the PCM Key ON Engine OFF (KOEO) self-test. • Retrieve the continuous memory DTCs from all modules. • **Are any charging system related DTCs set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to BD3 .
BD3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE • Check the battery condition and verify the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to BD4 . **No** REFER to Section 414-01 .
BD4 CHECK THE IPC VOLTAGE PID • Ignition ON. • Measure and record the voltage at the battery. • Enter the following diagnostic mode on the scan tool:	**Yes** GO to BD7 .

IPC DataLogger . • Monitor the IPC voltage PID (MODULE_VOLT). • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**No** GO to BD5 .
BD5 CHECK THE IPC VOLTAGE SUPPLY • Ignition OFF. • Disconnect: IPC C220 . • Ignition ON. • Measure the voltage between the IPC C220-21, circuit SBP11 (BU/RD), harness side and ground.  N0094461 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to BD6 . **No** REPAIR circuit SBP11 (BU/RD) for high resistance. CLEAR the DTC. REPEAT the self-test.
BD6 CHECK THE IPC GROUND CIRCUIT • Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the IPC C220-5, circuit GD133 (BK), harness side and ground.  N0115953 • **Is the resistance less than 5 ohms?**	**Yes** GO to BD7 . **No** REPAIR circuit GD133 (BK) for high resistance. CLEAR the DTCs. REPEAT the self-test.

BD7 CHECK FOR CORRECT IPC OPERATION
• Disconnect the IPC connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Pinpoint Test BE: DTC U3003:17

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) — sets in the Instrument Panel Cluster (IPC) in continuous memory if the IPC detects battery voltage above 16 volts on the voltage supply circuit for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- IPC

PINPOINT TEST BE: DTC U3003:17

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
BE1 CHECK FOR LOW VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is a low voltage DTC set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to BE2 .
BE2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to BE3 .
BE3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Clear the continuous memory DTCs. • Carry out the IPC self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test BF: The Low Fuel Message Center Indicator Is Never/Always On

Normal Operation

The low fuel message center indicator illuminates when the remaining fuel level is 1/16 tank (with an administrator key) or 1/8 tank (with a MyKey® programmed key) or less.

This pinpoint test is intended to diagnose the following:

- Fuel gauge indication concern
- IPC

PINPOINT TEST BF: THE LOW FUEL MESSAGE CENTER INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
BF1 CHECK THE MESSAGE CENTER WARNING INDICATOR FUNCTION • Close all doors, hood and liftgate. • Ignition ON. • **NOTE:** If multiple warnings are present, the message center cycles through each of the warning indicators. Allow the message center to cycle through each display while determining whether the door ajar message center warning indicator is active. • Open the driver door while monitoring the door ajar message center warning indicator. • **Does the driver door ajar message center warning indicator turn off with the driver door closed and illuminate with the driver door open?**	**Yes** GO to BF2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
BF2 CHECK THE FUEL GAUGE OPERATION • Verify the fuel gauge is operating correctly and is not registering empty (E) or full (F) all the time. • **Does the fuel gauge operate correctly?**	**Yes** GO to BF3 **No** GO to Pinpoint Test B .
BF3 CHECK THE DTE REMAINING MILEAGE DISPLAYED • Enter the dealer test mode. Refer to Dealer Test Mode in Inspection and Verification in this section. • **NOTE:** The display below uses xxxx's to represent a numeric or alpha-numeric value. The value may display the same amount of characters represented by the xxxx's	**Yes** If the low fuel message center indicator is never on, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. If the low fuel message center warning indicator is always on, the system is operating correctly at this time.

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or there may be more/less depending on the input value. • Scroll through the displays until FUEL LEVEL% STATUS xxx (base IPC) or FUEL LVL FILT FLPS IN xxxx (optional IPC) is displayed • **Does the fuel level value indicate 41 (with a MyKey®) or 26 (with an administrator programmed key) or less?**	**No** If the low fuel message center warning indicator is always on, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. If the low fuel message center warning indicator is never on, the system is operating correctly at this time. The low fuel message center indicator illuminates when the fuel level is at or below 1/16 tank (with an administrator key) or 1/8 tank (with MyKey® programmed key).

Pinpoint Test BG: The ControlTrac 4WD Gauge Is Inoperative

Normal Operation

The ControlTrac 4WD gauge indicates the level of power applied to each wheel in a continuous display over the vehicle. The Instrument Panel Cluster (IPC) uses multiple inputs to determine the ControlTrac 4WD gauge display. The first is an engine torque message sent to the IPC from the PCM over the High Speed Controller Area Network (HS-CAN). The second is an AWD torque message sent from the Transfer Case Control Module (TCCM) to the IPC over the HS-CAN . The third is wheel speed data sent from the PCM to the IPC over the HS-CAN .

As power is applied to the wheels, the display area around the wheels begin to light up and fill in. The lowest power is displayed closest to the wheel. As the amount of power increases, the display begins to fill rearward and/or forward of the vehicle.

If the engine torque data, wheel speed data or AWD torque message is missing for 5 seconds or less or if the IPC receives invalid engine torque data, wheel speed data or AWD torque for 5 seconds or less, the IPC defaults the display area fill around the wheels off.

If the IPC does not receive the engine torque data or wheel speed data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the display area fill around the wheels off.

If the IPC does not receive the AWD torque message from the TCCM for 5 seconds, the IPC sets DTC U0401:00 in continuous memory and defaults the display area fill around the wheels off.

NOTE: If DTC U0100:00 sets in the IPC , other observable symptoms may be an inoperative tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- 4WD concern
- IPC

PINPOINT TEST BG: THE CONTROLTRAC 4WD GAUGE IS INOPERATIVE

Test Step	Result / Action to Take
BG1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from	**Yes**

the self-test. • **Are any DTCs recorded?**	REFER to DTC Charts in this section. **No** GO to BG2 .
BG2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST • Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** For all 4WD related DTCs, REFER to Section 308-07A . For all other DTCs, REFER to Section 303-14 . TEST the system for normal operation. **No** GO to BG3 .
BG3 RETRIEVE THE RECORDED DTCs FROM THE TCCM SELF-TEST • Check for recorded PCM DTCs from the TCCM self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 308-07A . **No** GO to BG4 .
BG4 CHECK THE DISPLAY MODE MENU SETTING • In the gauge display mode, check the ControlTrac 4WD gauge. • **Does the ControlTrac 4WD gauge display?**	**Yes** The ControlTrac 4WD gauge is operating correctly at this time. The display mode was not set to correct display mode. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

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Belt-Minder® Deactivating/Activating

Preparation

1. **NOTE:** The driver and the front passenger Belt-Minder® are deactivated/activated independently. When deactivating/activating one seating position, do not buckle the other position as this terminates the process.

   Set the parking brake.

2. Place the transmission in PARK (P).

3. Place the ignition switch in the OFF position.

4. Unbuckle the driver and passenger safety belts.

Deactivating/Activating

NOTE: The Belt-Minder® cannot be deactivated using a MyKey® programmed key. The Belt-Minder® can only be deactivated using an administrator key.

If the Belt-Minder® is already disabled, driving the vehicle with a MyKey® programmed key overrides the deactivation, however, when the vehicle is subsequently operated using an administrator key, the Belt-Minder® once again reverts to the disabled state.

1. Turn the ignition switch to the RUN position. (do not start the engine.)

2. Wait until the safety belt warning indicator turns off (approximately 1 minute).

3. **NOTE:** Steps 3 and 4 must be completed within 30 seconds after the safety belt warning indicator turns off or the procedure must be repeated.

   Buckle then unbuckle the safety belt 3 times, ending with the safety belt unbuckled. The safety belt warning indicator then illuminates for 3 seconds.

4. Within 10 seconds of the safety belt warning indicator illuminating, buckle then unbuckle the safety belt. This enables the Belt-Minder® if disabled, or disables the Belt-Minder® if enabled.

5. The safety belt warning indicator flashing 4 times per second for 3 seconds provides confirmation that the Belt-Minder® is disabled.

6. The following sequence of events confirms the Belt-Minder® is enabled:
   - flashing of the safety belt warning indicator 4 times per second for 3 seconds
   - 3 seconds with the safety belt warning indicator off
   - flashing of the safety belt warning indicator 4 times per second for 3 seconds again

7. After confirmation, the deactivation/activation procedure is complete.

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Compass Calibration

NOTE: This procedure is only applicable to vehicles without navigation. For vehicles with navigation, there is no compass calibration.

1. **NOTE:** For optimum calibration, drive to an open, level location away from large metallic objects or structures such as bridges, steel buildings, etc. Switch off all non-essential electrical accessories (heated rear window, heater fan, A/C, map lamps, and wipers) and make sure all doors are closed.

   Start the vehicle.

2. **NOTE:** The vehicle remains in the CAL mode until the compass has been successfully calibrated.

   NOTE: While holding the Front Controls Interface Module (FCIM) 7 and 9 buttons down, the compass display first enters the ZONE setting mode (after 5 seconds) and then after another 5 seconds (approximately 10 seconds total), the compass display enters the CAL mode.

   Press and hold (for approximately 10 seconds) the 7 and 9 buttons until the CAL indicator appears in the display, then release the buttons.

3. **NOTE:** If the CAL indicator does not turn off after the vehicle is driven in a circle at least 5 times, repeat the procedure.

   Drive the vehicle slowly at less than 5 km/h (3 mph) in a continuous circle until the CAL indicator disappears from the display and the compass heading is shown.

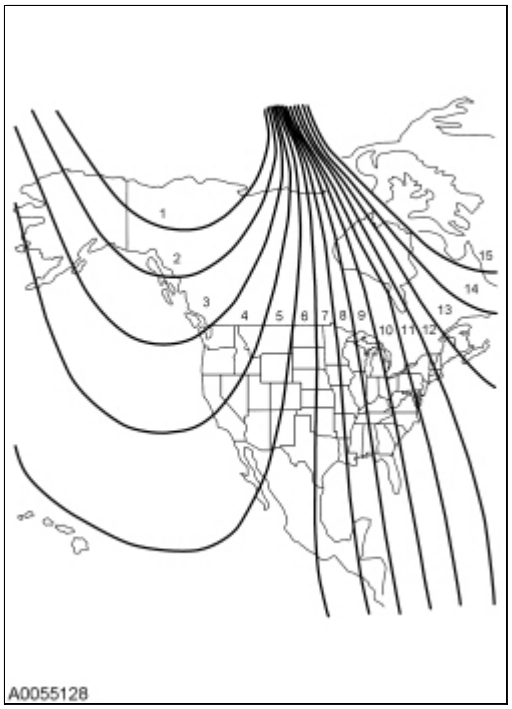
4. If the CAL indicator does not turn off after driving in a circle at least 5 times (and the procedure has been repeated at least once), install a new compass.
   For vehicles equipped an auto-dimming interior rear view mirror, install a new mirror. Refer to Section 501-09 .
   For vehicles without an auto-dimming interior rear view mirror, install a new compass module. Refer to Refer to the appropriate section in Group 415 for the procedure.

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Compass Zone Adjustment

Compass Calibration Zone Map

NOTE: This procedure is only applicable to vehicles without navigation. For vehicles with navigation, there is no compass zone adjustment.



1. Refer to the compass calibration zone map to select the correct compass zone setting for the geographic location of the vehicle.

2. With the ignition in the ON position, press and hold the Front Controls Interface Module (FCIM) 7 and 9 buttons (for approximately 5 seconds) until the compass display shows the current zone setting (ZONE XX). Release the 7 and 9 buttons.

3. Before the zone setting mode turns off (within 5 seconds), momentarily press and release the 7 and 9 buttons to increase the zone increment by one. Set the zone display number to match the vehicle geographical location on the compass calibration zone map.

4. Release the 7 and 9 buttons for 5 seconds to exit the zone setting mode.

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Message Center Configuration

Oil Life Reset — Message Center Instrument Cluster (IC)

1. Press and release the SETUP button until the message center displays OIL LIFE XXX% HOLD RESET = NEW OIL.
2. Press and hold the RESET button for 2 seconds and release when the message center displays OIL LIFE SET TO XXX%.
3. Press and release the SETUP button to exit the procedure.

Oil Life Reset — Base Instrument Cluster (IC)

NOTE: All message center functions are carried out using the single stem SELECT/RESET button in the Instrument Cluster (IC).

1. Press and release the SELECT/RESET button to scroll through the information displays until the message center displays HOLD RESET FOR SETUP MENU.
2. Press and hold the SELECT/RESET button for approximately 2 seconds until the message center displays OIL LIFE XXX% HOLD RESET = NEW.
3. Press and hold the SELECT/RESET button for approximately 2 seconds until the message center displays OIL LIFE SET TO XXX%.
4. Release the SELECT/RESET button and allow the setup timer to expire to exit the procedure.

Oil Life Start Value — Message Center Instrument Cluster (IC)

1. Press and release the SETUP button until the message center displays OIL LIFE XXX% HOLD RESET = NEW OIL.
2. Press and hold the RESET button for 2 seconds and release when the message center displays OIL LIFE SET TO XXX%.
3. Press and release the RESET button to decrease the oil life start value (from 100% to 10%) for each 10% reduction until the desired oil life start value is displayed.
4. Press and release the SETUP button to exit the procedure.

Oil Life Start Value — Base Instrument Cluster (IC)

NOTE: All message center functions are carried out using the single stem SELECT/RESET button in the IC .

1. Press and release the SELECT/RESET button to scroll through the information displays until the message center displays HOLD RESET FOR SETUP MENU.

2. Press and hold the SELECT/RESET button for approximately 2 seconds until the message center displays OIL LIFE XXX% HOLD RESET = NEW.

3. Press and hold the SELECT/RESET button for approximately 2 seconds until the message center displays OIL LIFE SET TO XXX%.

4. **NOTE:** The oil life start value reduces by 10% for each second that the SELECT/RESET button is held once the oil life start value begins decreasing.

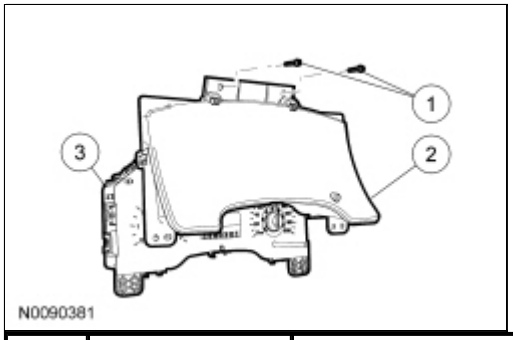
   Continue to hold the SELECT/RESET button until the oil life begins to decrease in value (from 100% down to 10%), continuing to hold until the desired start value is displayed.

5. Release the SELECT/RESET button and allow the setup timer to expire to exit the procedure.

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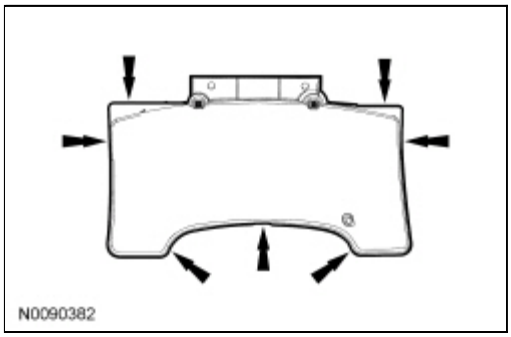
Instrument Panel Cluster (IPC) Lens



Item	Part Number	Description
1	N805589	Instrument Cluster (IC) screws (2 required)
2	10890	IC lens
3	10849	IC

Removal and Installation

1. Remove the Instrument Cluster (IC). For additional information, refer to Instrument Panel Cluster (IPC) in this section.
2. Remove the 2 screws.
3. Release the 7 tabs and remove the IC lens.



4. To install, reverse the removal procedure.

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Instrument Panel Cluster (IPC)

Removal

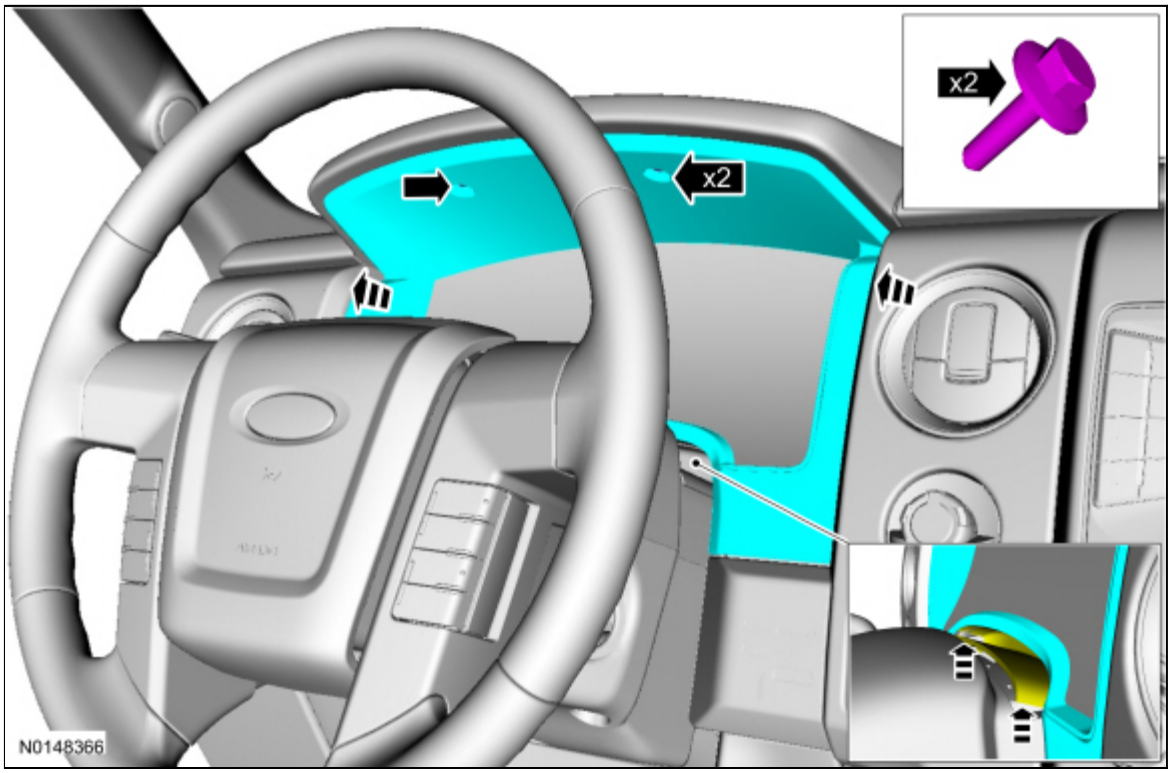
NOTE: If installing a new Instrument Panel Cluster (IPC), all vehicle keys are erased during the parameter reset procedure. Verify at least 2 of the vehicle keys are available prior to carrying out this procedure.

1. If installing a new IPC, upload the IPC configuration information to the scan tool. For additional information, refer to Section 418-01.

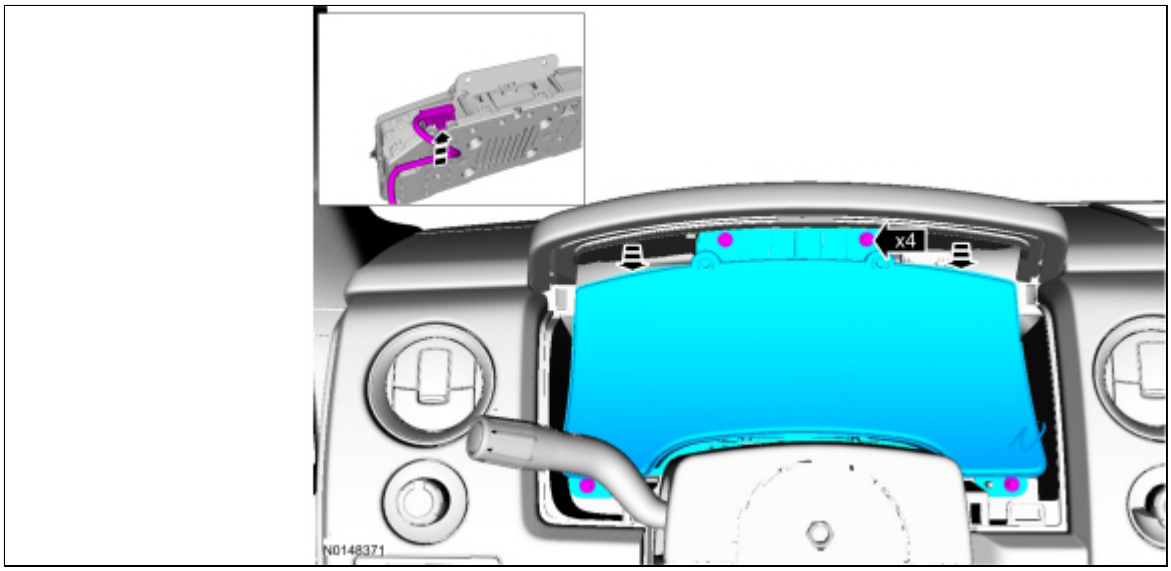
2. Tilt and telescope the steering column to the full downward and rearward position.

3. If equipped with a column shift, apply the parking brake and lower the gear shift to the lowest gear.

4. Remove the 2 screws and the IPC center finish panel.
   - Release the gap hider retainers.

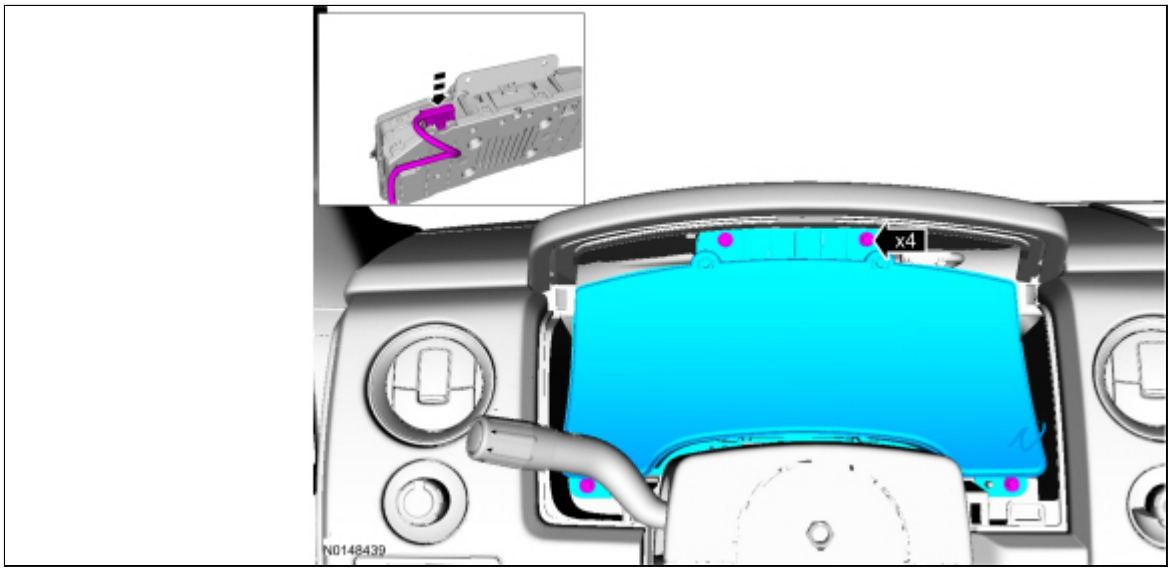


5. Remove the 4 screws and the IPC.
   - Disconnect the electrical connector.



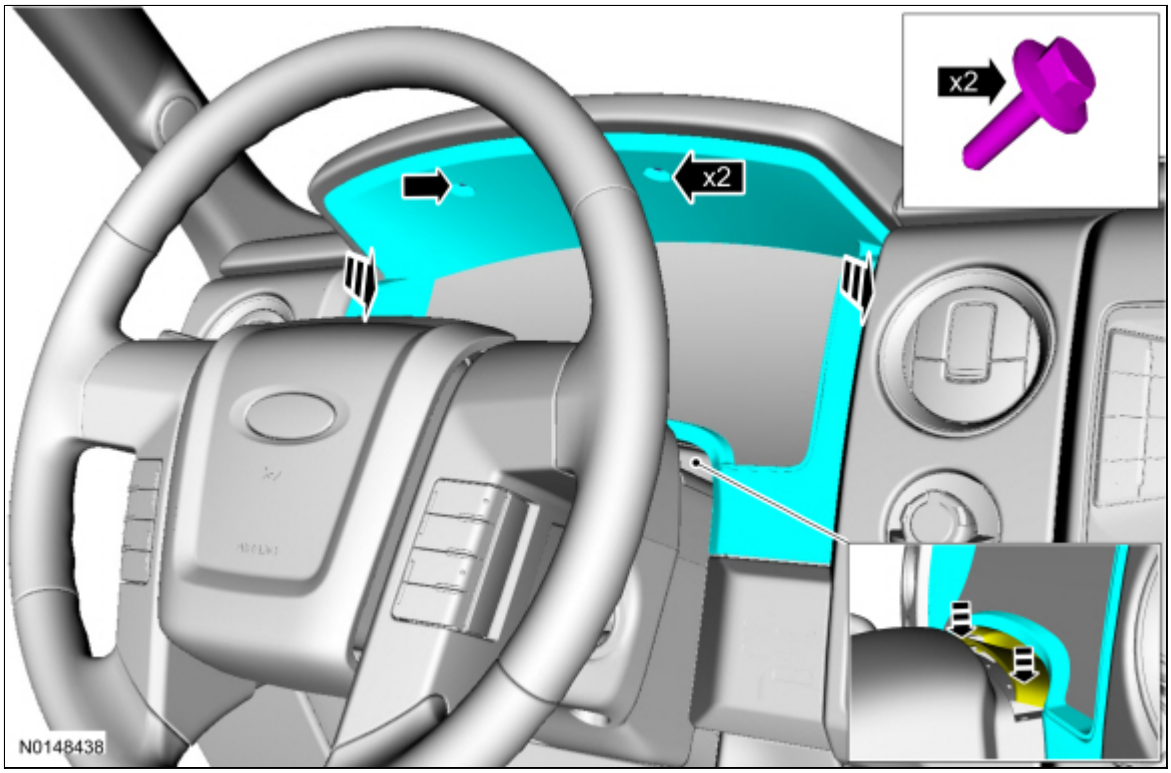
Installation

1. Position the IPC , connect the electrical connector and install the 4 screws.



2. Install the IPC finish panel and the 2 screws.
    - Attach the gap hider retainers.

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3. If installing a new IPC , download the IPC configuration information from the scan tool into the new IPC . For additional information, refer to Programmable Module Installation (PMI) in Section 418-01 .

4. **NOTE:** If a new IPC is installed, the IPC and the PCM require a parameter reset to allow the IPC and the PCM to recognize each other. Failure to carry out the parameter reset to the IC and the PCM may result in a no start condition.

   NOTE: If equipped, the vehicles Passive Anti-Theft System (PATS) keys must be programmed to the new IPC .

   If installing a new IPC , carry out the parameter reset and key programming procedure. For additional information, refer to Section 419-01B .

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Torque Specifications

Description	Nm	lb-ft
Horn bolt	35	26

Horn

The horn system consists of the following components:

- Body Control Module (BCM)
- Clockspring
- Horn switch (part of the steering wheel)
- Horn (mounted on the RH side of the upper radiator core support)
- Steering Column Control Module (SCCM)

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Horn

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Body Control Module (BCM) supplies the switched and control voltage to the horn relay (integrated into the BCM).

The horn switch consists of 2 sets of contacts separated by springs. The lower set is connected to ground and the upper set is connected to the horn signal circuit. When the driver air bag module is pressed, it pushes down on the upper set of contacts, collapsing the springs and allowing the contacts to touch. When the contacts touch, it completes the circuit and provides the ground signal which is routed through the clockspring and Steering Column Control Module (SCCM). The horn relay (integral to the BCM) is energized and the horn sounds.

The BCM provides a momentary ground to the horn relay when the anti-theft system is armed, and an alternating on/off ground when the panic button is pressed on the Remote Keyless Entry (RKE) transmitter.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Horn	• Body Control Module (BCM) fuse 22 (20A) • Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, verify the symptom. GO to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The horn is inoperative	• Fuse • Wiring, terminals or connectors • Horn • Steering wheel harness • Clockspring • Horn switch (part of the steering wheel) • Body Control Module (BCM) • Steering Column Control Module (SCCM)	• GO to Pinpoint Test A.
• The horn is always on	• Wiring, terminals or connectors • Clockspring • Steering wheel harness	• GO to Pinpoint Test B.

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	• Horn switch (part of the steering wheel) • BCM • SCCM	

Pinpoint Tests

Pinpoint Test A: The Horn Is Inoperative

Refer to Wiring Diagrams Cell 44 , Horn/Cigar Lighter for schematic and connector information.

Normal Operation

When the driver air bag module is pressed, the normally open horn switch (part of the steering wheel) is closed and a path to ground is routed through the clockspring and the Steering Column Control Module (SCCM), energizing the horn relay. The Body Control Module (BCM) supplies the switched and control voltage to the horn relay, which is integrated into the BCM . The horn relay then provides voltage to the horn, enabling the horn to sound.

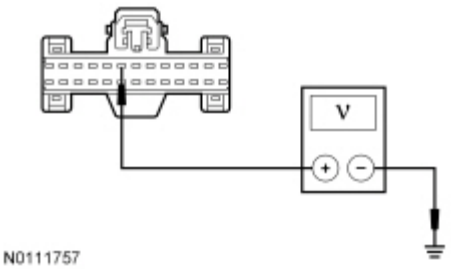
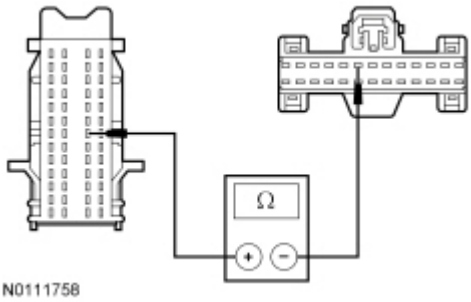
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Steering wheel harness
- Horn
- Clockspring
- Horn switch (part of the steering wheel)
- BCM
- SCCM

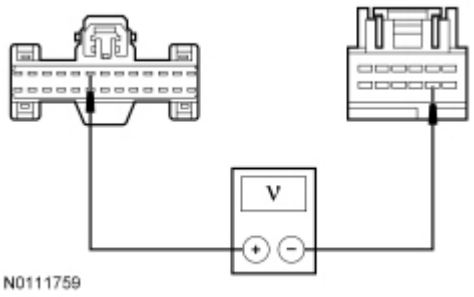
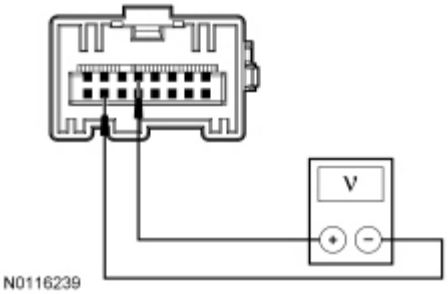
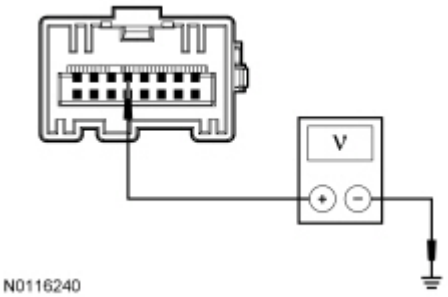
PINPOINT TEST A: THE HORN IS INOPERATIVE

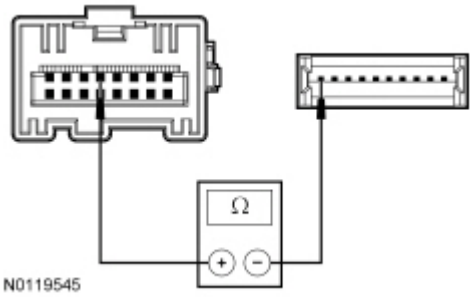
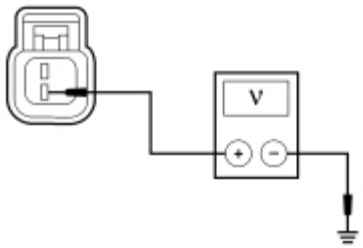
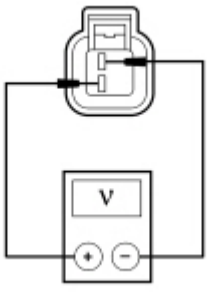
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE BCM OUTPUT	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select the active command BCM HORN PID. Command the horn on and then off. • **Does the horn sound when commanded on?**	**Yes** GO to A2 . **No** VERIFY the BCM fuse 22 (20A) is OK. If OK, GO to A8 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
A2 CHECK FOR VOLTAGE TO THE SCCM	

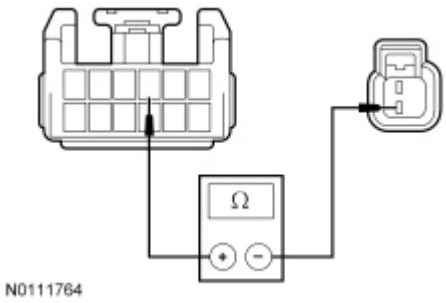
• Ignition OFF. • Disconnect: SCCM C2414A. • Ignition ON. • Measure the voltage between the SCCM C2414A-8, circuit CRH04 (VT), harness side and ground.  N0111757 • **Is the voltage greater than 10 volts?**	**Yes** GO to A4 . **No** GO to A3 .
A3 CHECK THE HORN RELAY COIL GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280B. • Measure the resistance between the BCM C2280B-33, circuit CRH04 (VT), harness side and the SCCM C2414A-8, circuit CRH04 (VT), harness side.  N0111758 • **Is the resistance less than 5 ohms?**	**Yes** GO to A11 . **No** REPAIR circuit CRH04 (VT) for an open. TEST the system for normal operation.
A4 CHECK THE CLOCKSPRING GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Clockspring C218A. • Ignition ON. • Measure the voltage between the SCCM C2414A-8, circuit CRH04 (VT), harness side and the clockspring C218A-8, circuit GD133 (BK), harness side.	**Yes** GO to A5 . **No** REPAIR circuit GD133 (BK) for an open. TEST the system for normal operation.

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 N0111759 • **Is the voltage greater than 10 volts?**	
A5 CHECK FOR VOLTAGE TO THE CLOCKSPRING	
• Ignition OFF. • Disconnect: Clockspring C218B. • Ignition ON. • Measure the voltage between the clockspring connector C218B pin 4, component side and the clockspring C218B pin 10, component side.  N0116239 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new steering wheel. REFER to Section 211-04 . TEST the system for normal operation. **No** GO to A6 .
A6 CHECK THE CLOCKSPRING FOR AN OPEN	
• Measure the voltage between the clockspring connector C218B pin 4, component side and ground.  N0116240 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation. **No** GO to A7 .
A7 CHECK FOR AN OPEN IN THE CLOCKSPRING	
• Remove the clockspring. • Measure the resistance between the clockspring connector C218B pin 4, component side and the clockspring connector C218C pin 1, component side	**Yes** GO to A12 . **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.

 N0119545 • **Is the resistance less than 5 ohms?**	
A8 CHECK FOR VOLTAGE TO THE HORN	
• Ignition OFF. • Disconnect: Horn C131. • While pressing the driver air bag module against the steering wheel, measure the voltage between the horn C131-2, circuit SRH01 (YE/RD), harness side and ground.  N0090544 • **Is the voltage greater than 10 volts?**	**Yes** GO to A9 . **No** GO to A10 .
A9 CHECK THE HORN GROUND CIRCUIT FOR CONTINUITY	
• While pressing the driver air bag module against the steering wheel, measure the voltage between the horn C131-2, circuit SRH01 (YE/RD), harness side, and the horn C131-1, circuit GD123 (BK/GY), harness side.  N0013171 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new horn. REFER to Horn in this section. TEST the system for normal operation. **No** REPAIR circuit GD123 (BK/GY) for an open. TEST the system for normal operation.
A10 CHECK THE BCM HORN OUTPUT CIRCUIT FOR AN OPEN	
• Disconnect: BCM C2280E. • Measure the resistance between the BCM C2280E-3, circuit SRH01 (YE/RD), harness side, and the horn C131-	**Yes** GO to A11 .

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2, circuit SRH01 (YE/RD), harness side.  • **Is the resistance less than 5 ohms?**	**No** REPAIR circuit SRH01 (YE/RD) for an open. TEST the system for normal operation.
A11 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

A12 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM. REFER to Section 211-05. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. RUN the on-demand self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.

Pinpoint Test B: The Horn Is Always On

Refer to Wiring Diagrams Cell 44, Horn/Cigar Lighter for schematic and connector information.

Normal Operation

When the driver air bag module is pressed, the normally open horn switch (part of the steering wheel) is closed and ground is routed through the clockspring and the Steering Column Control Module (SCCM) to the horn relay, energizing the horn relay. The Body Control Module (BCM) supplies the switched and control voltage to the horn relay, which is integrated into the BCM. The horn relay then provides voltage to the horn, enabling the horn to sound.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Steering wheel harness
- Clockspring
- Horn switches (part of the steering wheel)
- BCM
- SCCM

PINPOINT TEST B: THE HORN IS ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE BCM HORN OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280E. • **Does the horn continue to sound?**	**Yes** REPAIR circuit SRH01 (YE/RD) for a short to voltage. TEST the system for normal operation. **No** GO to B2.
B2 CHECK THE HORN SWITCH INPUT TO THE BCM	
• Connect: BCM C2280E. • Disconnect: BCM C2280B. • **Does the horn continue to sound?**	**Yes** GO to B7. **No** GO to B3.
B3 CHECK THE HORN SWITCH INPUT FOR A SHORT TO GROUND	
• Connect: BCM C2280B. • Disconnect: SCCM C2414A. • **Does the horn continue to sound?**	**Yes** REPAIR circuit CRH04 (VT) for a short to ground. TEST the system for normal operation. **No** GO to B4.
B4 CHECK THE HORN SWITCH	
• Connect: SCCM C2414A. • Remove the driver air bag module. Refer to Section 501-20B. • Disconnect: Horn Switch C217A. • **Does the horn continue to sound?**	**Yes** GO to B5. **No** INSTALL a new steering wheel. REFER to Section 211-04. TEST the system for normal operation.
B5 CHECK THE STEERING	

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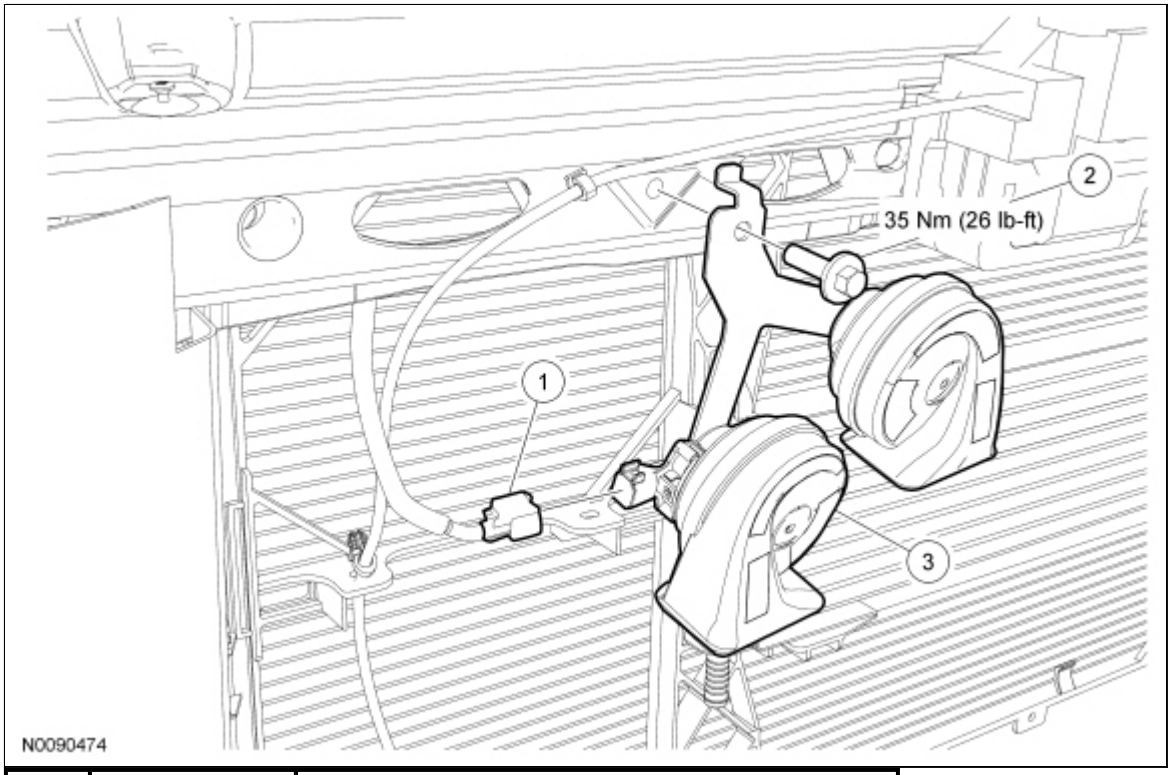
WHEEL HARNESS • Disconnect: Clockspring C218B. • **Does the horn continue to sound?**	**Yes** GO to B6. **No** The steering wheel harness has a short circuit. INSTALL a new steering wheel. REFER to Section 211-04. TEST the system for normal operation.
B6 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND • Remove the clockspring. Refer to Section 501-20B. • **Does the horn continue to sound?**	**Yes** GO to B8. **No** INSTALL a new clockspring. REFER to Section 501-20B. TEST the system for normal operation.

B7 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

B8 CHECK FOR CORRECT SCCM OPERATION
• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM. REFER to Section 211-05. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. RUN the on-demand self-test (required to clear certain DTCs). CORRECT any unresolved DTCs. CLEAR all DTCs. TEST the system for normal operation.

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Horn



Item	Part Number	Description
1	—	Horn electrical connector (part of 12A581)
2	W709435	Horn bolt
3	13832	Horn

Removal and Installation

1. Remove the bolt and the horn assembly.
    - Disconnect the electrical connector.
    - To install, tighten to 35 Nm (26 lb-ft).

2. To install, reverse the removal procedure.

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General Specifications

Item	Specification
Azimuth system check object position 1 (P1) and position 5 (P5) distance from sensor	30 cm (12 in)
Azimuth system check object position 2 (P2) and position 4 (P4) distance from sensor	91 cm (36 in)
Azimuth system check object position 3 (P3) distance from sensor	152 cm (60 in)

Parking Aid

The parking aid system consists of the following:

- Parking aid sensors (located in the rear bumper)
- Parking Aid Module (PAM) (located on the cowl above and next to the brake pedal)
- Parking aid speaker (integral to the PAM)
- **NOTE:** Parking aid disable feature is not available when a MyKey® is in use.

  Parking aid disable feature (integral to the Instrument Panel Cluster (IPC) message center)

The parking aid system uses of 4 ultrasonic sensors to calculate the distance to an object around the rear of the vehicle. The parking aid system sounds a warning to alert the driver of stationary objects near the rear bumper when REVERSE (R) is selected.

Rear Video

The rear video camera system consists of the following:

- Rear video camera (located in the blue oval Ford emblem housing in the tailgate)
- Auto-dimming interior mirror (without navigation)
- Front Display Interface Module (FDIM) (with navigation)
- IPC
- Body Control Module (BCM)
- Camera switching module (if equipped with the front video camera)

The rear video camera system visually aids the driver while reversing or reverse parking the vehicle.

For vehicles without navigation, the image from the rear video camera is displayed in the left portion of the auto-dimming interior mirror. For vehicles with navigation, the image from the rear video camera is displayed in the FDIM .

The rear video camera system features are as follows:

- Fixed guidelines — assists the driver with backing into a parking space or aligning the vehicle with an object.
- Visual park aid alert — assists the driver to visually see the object causing the parking aid system to sound.
- Manual zoom — assists the driver with connecting or towing a trailer and allowing the driver to manually zoom closer to an object behind the vehicle.
- Video camera delay — allows the driver to see the image behind the vehicle after the vehicle is shifted out of REVERSE (R). The image is not displayed if the vehicle is shifted into PARK (P).

Rear Video Camera System With Base IPC

For vehicles equipped with a base IPC (2 rows, 14 character display), only fixed guidelines are displayed in the auto-dimming interior mirror and cannot be disabled.

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Rear Video Camera System With Optional IPC

For vehicles equipped with an optional IPC (4.2 LCD message center) include all the rear video camera system features and the features are enabled and disabled within the message center.

Rear Video Camera System With Navigation

For vehicles equipped with navigation include all the rear video camera system features. These features are enabled and disabled within the FDIM .

Refer to the Owner's Literature for information on rear video camera system operation.

Front Video — F-150 Raptor Only

The front video camera system consists of the following:

- Front video camera (located in the front grille).
- FDIM
- IPC
- BCM
- Camera switching module (under dash left of the steering column)

The front video camera system visually aids the driver during off-road driving at vehicle speeds less than 24 km/h (15 mph).

The image from the front video camera is displayed in the FDIM .

The front video camera system features are as follows:

- Fixed guidelines — assists the driver to align with an object in front of the vehicle.
- Active guidelines — assists the driver with show the path of intended forward motion of the vehicle while in D (Drive).
- Manual zoom — assists drivers as an off road aid. It allows the driver to manually zoom closer to an object in front of the vehicle. The zoomed image keeps the bumper in the image to provide a reference.

Refer to the Owner's Literature for information on the video camera system operation.

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Parking Aid — Video

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The tailgate must be closed for correct operation of the rear video camera system.

Rear Video Camera

The rear video camera system is active with the ignition in run and the transmission selector in the REVERSE (R). The rear video camera receives commands and sends status to the Body Control Module (BCM) over a dedicated Local Interconnect Network (LIN). For vehicles with a 203.2 mm (8 in) touchscreen, the rear video camera sends a video signal to the APIM on a pair of shielded video circuits. The APIM then displays the rear video camera image on the FDIM . For vehicles without a 203.2 mm (8 in) touchscreen, the signal from the rear video camera is sent to the auto-dimming interior mirror on a pair of shielded video circuits, which displays the video image on the LH side of the auto-dimming interior mirror glass.

If the vehicle is equipped with a front video camera, the rear video camera sends the rear video signal to the camera switching module on a pair of shielded video circuits. The camera switching module determines which video image should be displayed based on vehicle operating conditions, and then sends the front or rear video camera signal to the APIM on a pair of shielded video circuits.

The rear video camera system has 4 video features (only the fixed guidelines are available on vehicles equipped with the base Instrument Panel Cluster (IPC)). The features are:

- Fixed guidelines
- Visual park aid alert

- Manual zoom
- Video camera delay

Vehicles equipped with a base IPC (2 rows, 14 character display), display only fixed guidelines in the auto-dimming interior mirror. The guidelines cannot be disabled.

Vehicles equipped with an optional IPC (4.2 LCD message center) include all the rear video camera system features. The features are enabled and disabled within the message center.

For vehicles with a 203.2 mm (8 in) touchscreen, the rear video camera features are controlled within the FDIM menu screen. When the driver changes any of the rear video camera system features, the APIM sends a message to the BCM via the Medium Speed Controller Area Network (MS-CAN). The BCM sends the message to the rear video camera over the LIN . The LIN is a dedicated single wire communication line that sends and receives network messages from the BCM to the rear video camera.

The messages sent from the BCM to the rear video camera are:

- transmission selector (PRNDL) status
- camera configuration data
- display manual zoom request
- parking aid audible warning status
- parking aid sensor distance to object data

The messages sent from the rear video camera to the BCM are:

- camera status
- display zoom status
- camera part number data
- visual park aid alert status
- fixed guideline status

The rear video system has a delay feature and is available on vehicles with optional Instrument Panel Cluster (IPC) or a 203.2 mm (8 in) touchscreen. For vehicles equipped with a 203.2 mm (8 in) touchscreen, the image is displayed in the FDIM for 5 minutes or until the vehicle reaches 8 km/h (5 mph), when the vehicle is shifted out of REVERSE (R), or if any button on the FDIM is pressed. The image is not displayed if the vehicle is shifted into PARK (P). For vehicles without a 203.2 mm (8 in) touchscreen, the image is displayed in the auto-dimming interior mirror and remains on for a few seconds once the vehicle is shifted out of REVERSE (R).

The fixed guidelines feature displays guidelines on top of the video image to assist the driver with alignment of the vehicle. A dashed line on the displayed image represents the center of the vehicle and 3 color-coded lines (red, yellow, green) identify different zones between the rear of the vehicle and objects.

NOTE: The color-coded lines cannot indicate accurate or consistent distances between objects located behind the vehicle and at the rear of the vehicle. This normal condition is due to variances in vehicle ride height, including, but not limited to, vehicle loading.

The visual park aid alert feature utilizes the 4 parking aid sensor inputs from the Parking Aid Module (PAM) and the rear video camera image. When the transmission selector is in REVERSE (R) and an object is detected in the path of the parking aid sensor, a network message of the distance from the parking aid sensor to the object is sent from the PAM to the BCM over the HS-CAN . The BCM networks the parking aid sensor message to the rear video camera over the LIN . The visual alerts are red, yellow or green and appear as highlights on top of the displayed image to indicate in which zone the object is detected. The highlighted visual alerts are still operational if the parking aid system is disabled within the IPC and the

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visual alert feature is enabled.

The manual zoom feature is controlled by the rear video camera. The manual zoom feature has 3 zoom levels that are only active when the vehicle is in reverse. If the manual zoom feature is enabled and the vehicle is shifted out of reverse the manual zoom feature is disabled. The manual zoom feature must be re-enabled the next time the vehicle is shifted into reverse. For vehicles with a 203.2 mm (8 in) touchscreen, when the driver inputs to the FDIM request the video image to be zoomed in or out, the APIM sends a zoom request network message to the BCM . For vehicles without a 203.2 mm (8 in) touchscreen, when the message center requests the video image to be zoomed in or out, the IPC sends a zoom request network message to the BCM . The BCM sends the zoom request message to the rear video camera over the LIN . The video image sent by the rear video camera is then digitally zoomed in or out.

Front Video Camera — F-150 Raptor Only

The front video camera system is active with the ignition in run, the transmission selector in the drive position, the vehicle is in off road mode and the Electronic Locking Differential (ELD) or 4L (4X4 LOW) is activated.

The front video camera receives commands and sends status to the Body Control Module (BCM) over a dedicated Local Interconnect Network (LIN). The front video camera sends a video signal to the camera switching module on a pair of shielded video circuits. The camera switching module determines which video image should be displayed based on vehicle operating conditions, and then sends the front or rear video camera signal to the APIM on a pair of shielded video circuits.

To help distinguish the front video display from the rear video display, there is an icon displayed in the upper left corner of the screen for the front camera. It is an image of a camera with the letter "F".

The front video camera system has 3 video features (only the fixed guidelines are available with the base Instrument Panel Cluster (IPC)). The features are:

- Fixed guidelines
- Visual park aid alert
- Manual zoom

The front video camera features are controlled within the FDIM menu screen. For each one of these system features the Audio Front Control Module (ACM) sends a network message requesting the system feature to the BCM via the Medium Speed Controller Area Network (MS-CAN). The BCM sends the message to the front video camera over the LIN . The LIN is a dedicated single wire communication line that sends and receives network messages from the BCM to the front video camera.

The messages sent from the BCM to the front video camera are:

- transmission selector (PRNDL) status
- camera configuration data
- display manual zoom request
- 4L active
- Electronic Locking Differential (ELD) active

The fixed guidelines feature displays guidelines on top of the video image to assist the driver with alignment of the vehicle. A dashed line on the displayed image represents the center of the vehicle and 3 color-coded lines (red, yellow, green) identify different zones between the front of the vehicle and objects.

NOTE: The color-coded lines cannot indicate accurate or consistent distances between objects located in front of the vehicle and at the front of the vehicle. This normal condition is due to variances in vehicle ride height, including, but not limited to, vehicle loading.

The manual zoom feature is controlled by the front video camera. The manual zoom feature has 3 zoom levels that are only active when the vehicle is in a forward gear, and either the 4L or ELD are active. The manual zoom feature must be re-enabled the next time the vehicle is shifted into a forward gear. When the FDIM requests the video image to be zoomed in or out, the ACM sends a zoom request network message to the BCM. The BCM sends the zoom request message to the front video camera over the LIN. The video image is then digitally zoomed in or out.

Camera Switching Module

The rear video camera always sends a video signal to the camera switching module. The front video camera only sends a video signal to the camera switching module when the vehicle is in a forward gear and the vehicle is in 4L or ELD modes. When the camera switching module receives only a rear video signal, the rear video signal is sent to the APIM. When the camera switching module receives both front and rear signals, the front video signal is sent to the APIM. An icon of a camera with the letter "F" is displayed while the front video signal is active.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage.

   Visual Inspection Chart

Mechanical	Electrical

• Tailgate and rear video camera
• Grille and front video camera
	• Body Control Module (BCM) fuse(s):
	  ▪ 32 (15A) (vehicles without a 203.2 mm (8 in) touchscreen)
	  ▪ 34 (10A)
	• Wiring, terminals and connectors
	• Rear video camera
	• Front video camera
	• Auto-dimming interior mirror (without a 203.2 mm (8 in) touchscreen)
	• Front Display Interface Module (FDIM) (with a 203.2 mm (8 in) touchscreen)
	• Accessory Protocol Interface Module (APIM) (with a 203.2 mm (8 in) touchscreen)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool still does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

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6. If the scan tool does not communicate with the vehicle:
    - verify the ignition key is in the RUN position.
    - verify the scan tool operation with a known good vehicle.
    - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM and Audio Front Control Module (ACM) (vehicles with navigation).

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

APIM DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
C1001:01	Vision System Camera: General Electrical Failure	For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I . For all other vehicles, GO to Pinpoint Test E .
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Charts in Section 415-00E or Section 415-00F .

Body Control Module (BCM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B115E:01	Camera Module: General Electrical Failure	DTC B115E:01 sets in the BCM when the rear video camera status indicates corrupted data with in the rear video camera. CLEAR the DTCs. REPEAT the self-test. If DTC B115E:01 is retrieved again, INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation.
B115E:08	Camera Module: Bus	GO to Pinpoint Test E .

	Signal/Message Failure	For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I .
B115E:49	Camera Module: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC B115E:49 is retrieved again, INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation.
B115E:55	Camera Module: Not Configured	DTC B115E:55 sets in the BCM when the rear video camera is not configured. The rear video camera needs to be configured through the BCM . CARRY OUT the rear video camera configuration using the scan tool under Body > RVC configuration. TEST the system for normal operation.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Charts in Section 419-10 .

Video Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The rear video is inoperative	• Wiring, terminals or connectors • Rear video camera • APIM (with a 203.2 mm (8 in) touchscreen) • Auto-dimming interior mirror (without a 203.2 mm (8 in) touchscreen) • Body Control Module (BCM)	• For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I . • For all other vehicles, GO to Pinpoint Test E .
• The front video is inoperative	• Wiring, terminals or connectors • Front video camera • APIM • Body Control Module (BCM)	• GO to Pinpoint Test I .
• Black screen or no image	• Fuse • Front video camera • Rear video camera • Wiring,	• For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I . • For all other

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	terminals or connectors • Auto-dimming interior mirror (without a 203.2 mm (8 in) touchscreen) • APIM (with a 203.2 mm (8 in) touchscreen)	vehicles, GO to Pinpoint Test E.
• Rear video displayed when the front video should be displayed	• Fuse • Front video camera • Wiring, terminals or connectors	• GO to Pinpoint Test I.
• Blue Screen (mirror only)	• Fuse • Rear video camera • Wiring, terminals or connectors	• GO to Pinpoint Test E.
• The Front Display Interface Module (FDIM) displays PLEASE CHECK SURROUNDINGS FOR SAFETY and a black screen/no image	• Fuse • Wiring, terminals or connectors • Front video camera • Rear video camera • BCM	• **NOTE:** It may take up to 30 seconds before the message is displayed on the FDIM. For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I. • For all other vehicles, GO to Pinpoint Test E.
• Front camera static/flashing/blinking/flickering/scrolling or rolling image/screen/scrolling horizontal lines	• Front video camera • Wiring, terminals or connectors	• GO to Pinpoint Test J.
• Front camera poor image quality (foggy/cloudy/fuzzy/blurry/hazy image or moisture/water in lens or black spots)	• Front video camera • Wiring, terminals or connectors	• GO to Pinpoint Test J.
• Rear camera static/flashing/blinking/flickering/scrolling or rolling image/screen/scrolling horizontal lines	• Rear video camera • Wiring, terminals or connectors	• For F-150 Raptor equipped with front video camera, GO to Pinpoint Test J.

		• For all other vehicles, GO to Pinpoint Test F .
• Rear camera poor image quality (foggy/cloudy/fuzzy/blurry/hazy image or moisture/water in lens or black spots)	• Rear video camera • Wiring, terminals or connectors	• For F-150 Raptor equipped with front video camera, GO to Pinpoint Test J . • For all other vehicles, GO to Pinpoint Test F .
• Manual zoom function is inoperative	• Rear video camera not configured after replacement (DTC B115E:55 may be present) • Rear video camera • Manual zoom feature is disabled	• CARRY OUT the rear video camera configuration using the scan tool under Body > RVC Configuration. • For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I . • For all other vehicles, GO to Pinpoint Test E .
• Visual park aid alert is inoperative	• Rear video camera not configured after replacement (DTC B115E:55 may be present) • Rear video camera • Wiring, terminals or connectors • PAM • BCM	• CARRY OUT the rear video camera configuration using the scan tool under Body > RVC Configuration. • GO to Pinpoint Test H .
• Fixed guidelines are not displayed on the video image	• Rear video camera not configured after replacement (DTC B115E:55 may be present) • Rear video camera • Fixed	• CARRY OUT the rear video camera configuration using the scan tool under Body > RVC Configuration. • For F-150 Raptor equipped with front video

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	guidelines feature is disabled	camera, GO to Pinpoint Test I . • For all other vehicles, GO to Pinpoint Test E .
• Rear video camera delay feature is inoperative	• Rear video camera delay feature is disabled	• ENABLE the rear video camera delay feature within the FDIM (with a 203.2 mm (8 in) touchscreen) or message center (without a 203.2 mm (8 in) touchscreen and optional cluster).
• The rear video display is always on (vehicles without a 203.2 mm (8 in) touchscreen)	• Wiring, terminals or connectors • Auto-dimming interior mirror	• GO to Pinpoint Test G .
• The rear video display is always on (vehicles with a 203.2 mm (8 in) touchscreen)	• Reverse lamp input always on	• For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I . • For all other vehicles, GO to Pinpoint Test E .
• All other image concerns	• Rear video camera • Front video camera	• For F-150 Raptor equipped with front video camera, GO to Pinpoint Test I . • For all other vehicles, GO to Pinpoint Test E .
• Front camera displayed when in reverse	• Rear video camera not configured after replacement (DTC B115E:55 may be present)	• CARRY OUT the rear video camera configuration using the scan tool under Body > RVC Configuration..

Pinpoint Tests

Pinpoint Test E: The Rear Video Does Not Operate Correctly

Normal Operation

When the ignition switch is in the RUN position, the rear video camera receives voltage. For vehicles without a 203.2 mm (8 in) touchscreen, with the transmission selector in REVERSE (R), a reverse signal message from the Body Control Module (BCM) is sent over a dedicated Local Interconnect Network (LIN) to the auto-dimming interior mirror, enabling the system. For vehicles with a 203.2 mm (8 in) touchscreen, with the transmission selector in REVERSE (R), the BCM sends a reverse signal message to the APIM over the Medium Speed Controller Area Network (MS-CAN), enabling the system. The video signal from the rear video camera displays an image on the left portion of the auto-dimming interior mirror for vehicles without a 203.2 mm (8 in) touchscreen, or displays an image on the Front Display Interface Module (FDIM) for vehicles with a 203.2 mm (8 in) touchscreen.

- DTC B115E:08 (Camera Module: Bus Signal/Message Failure) — an on-demand DTC that sets in the BCM when there is a LIN communication fault from the rear video camera.
- DTC C1001:01 (Vision System Camera: General Electrical Failure) — a continuous DTC that sets in the APIM when no video signal is detected from the rear video camera when the vehicle is in reverse (vehicles with a 203.2 mm (8 in) touchscreen only).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Rear video camera
- Camera switching module (with front camera)
- Auto-dimming interior mirror (without a 203.2 mm (8 in) touchscreen)
- Accessory Protocol Interface Module (APIM) (with a 203.2 mm (8 in) touchscreen)
- BCM

PINPOINT TEST E: THE REAR VIDEO DOES NOT OPERATE CORRECTLY

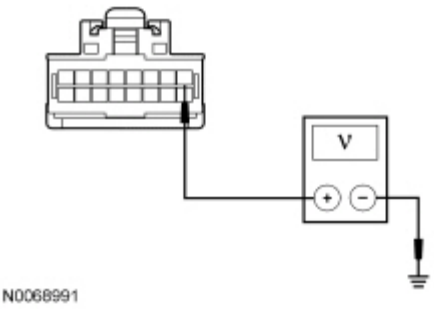
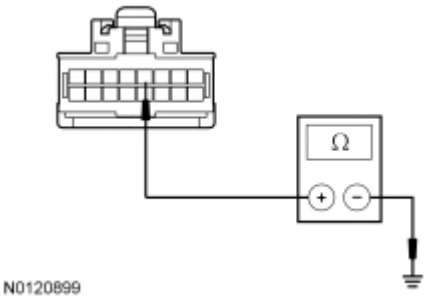
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

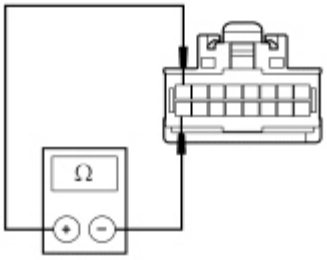
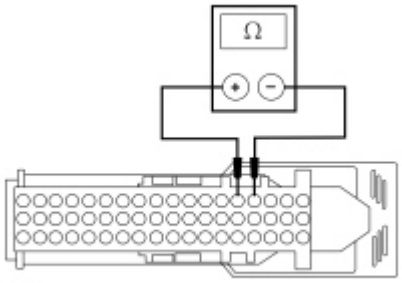
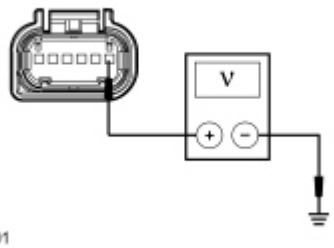
Test Step	Result / Action to Take
E1 CHECK AND CLEAN THE REAR VIDEO CAMERA LENS	
• Clean and make sure the rear video camera lens is clear of any debris. • Test the rear video camera system and verify the rear video camera image. • **Is the rear video camera concern still present?**	**Yes** GO to E2 . **No** The system is operating correctly at this time. The concern was caused by a dirty rear video camera lens.
E2 CHECK THE REVERSING LAMPS OPERATION	
• Ignition OFF. • Apply the parking brake. • Ignition ON. • Select REVERSE.	**Yes** GO to E3 . **No**

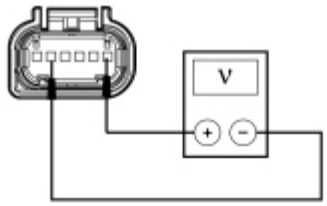
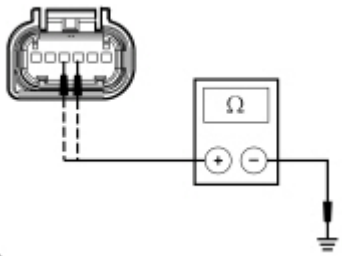
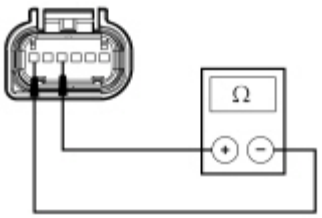
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• Check the operation of the reversing lamps. • **Do the reversing lamps operate correctly?**	REFER to Section 417-01 .
E3 CHECK THE DTCs FROM THE BCM SELF-TEST • Check the BCM DTCs from the self-test. • **Are any BCM DTCs retrieved?**	**Yes** For BCM DTC B115E:08, GO to E19 . For all other DTCs, REFER to DTC Charts in this section. **No** For an inoperative rear video camera feature concern, GO to E4 . Otherwise, GO to E5 .
E4 VERIFY AND ENABLE THE INOPERATIVE REAR VIDEO CAMERA FEATURE • Verify and enable the inoperative rear video camera feature. Refer to the Owner's Literature. • **Does the rear video camera feature operate correctly?**	**Yes** The rear video camera system is operating correctly at this time. The rear video camera feature concern was caused by the feature being disabled. INSTRUCT the customer on how to enable the rear video camera features, REFER to the Owner's Literature. **No** GO to E5 .
E5 VERIFY VEHICLE EQUIPMENT — 203.2 mm (8 in) TOUCHSCREEN • Check the vehicle for a 203.2 mm (8 in) touchscreen. • **Is the vehicle equipped with a 203.2 mm (8 in) touchscreen?**	**Yes** GO to E10 . **No** GO to E6 .
E6 CHECK THE AUTO-DIMMING INTERIOR MIRROR • Observe the auto-dimming interior mirror. • Select PARK. • Select REVERSE. • **Does the auto-dimming interior mirror momentarily display a blue screen then turn off?**	**Yes** The auto-dimming interior mirror is functional. There is no signal from the rear video camera. GO to E11 . **No** GO to E7 .
E7 CHECK THE COMPASS FOR CORRECT OPERATION • **NOTE:** The auto-dimming interior mirror uses the LIN for compass messaging along with messaging for the rear video camera operation. • Verify the compass operates correctly. • **Does the compass operate correctly?**	**Yes** GO to E8 . **No** REFER to Section 413-01 to diagnose the compass.
E8 CHECK THE AUTO-DIMMING INTERIOR MIRROR	

VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror C9039. • Ignition ON. • Measure the voltage between the auto-dimming interior mirror C9039-1, circuit CBP32 (GN/VT), harness side and ground.  N0068991 • **Is the voltage greater than 10 volts?**	**Yes** GO to E9 . **No** VERIFY the BCM fuse 32 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
E9 CHECK THE AUTO-DIMMING INTERIOR MIRROR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the auto-dimming interior mirror C9039-4, circuit GD133 (BK), harness side and ground.  N0120899 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . CONNECT the negative battery cable. TEST the system for normal operation. **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
E10 CHECK THE FDIM DISPLAY	
• Observe the FDIM while placing the vehicle in reverse. • **While selecting reverse and waiting up to 30 seconds, does the FDIM screen switch to rear video camera mode and display "Please Contact Your Dealership"?**	**Yes** The FDIM display is functional. There is no signal from the rear video camera. GO to E11 . **No** RETRIEVE and FOLLOW audio system DTCs. REFER to Section 415-00E or Section 415-00F .
E11 CHECK THE VIDEO SIGNAL CIRCUITS INTEGRITY	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror (Without Navigation) C9039.	**Yes** GO to E12 .

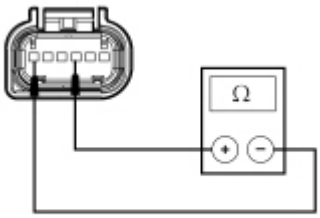
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• Disconnect: APIM (With a 203.2 mm (8 in) touchscreen) C2383. • For vehicles without a 203.2 mm (8 in) touchscreen, measure the resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side.  N0069002 • For vehicles with a 203.2 mm (8 in) touchscreen, measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.  N0149434 • **Is the resistance between 74 and 106 ohms?**	**No** GO to E14 .
E12 CHECK THE REAR VIDEO CAMERA VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: Rear Video Camera C4357. • Ignition ON. • Measure the voltage between the rear video camera C4357-1, circuit CBP34 (VT/BN), harness side and ground.  N0120901 • **Is the voltage greater than 10 volts?**	**Yes** GO to E13 . **No** VERIFY the BCM fuse 34 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
E13 CHECK THE REAR VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Measure the voltage between the rear video camera C4357-1, circuit CBP34 (VT/BN), harness side and the rear video camera C4357-5, circuit GD120 (BK/GN), harness side and ground.  N0120902 • **Is the voltage greater than 10 volts?**	**Yes** GO to E14 . **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.
E14 CHECK THE REAR VIDEO CAMERA SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Rear Video Camera C4357. • Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and ground; and between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and ground.  N0121053 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to E15 . **No** REPAIR the circuit in question. TEST the system for normal operation.
E15 CHECK THE REAR VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120904 • Measure the resistance between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and the rear	**Yes** GO to E16 . **No** REPAIR the circuit in question. TEST the system for normal operation.

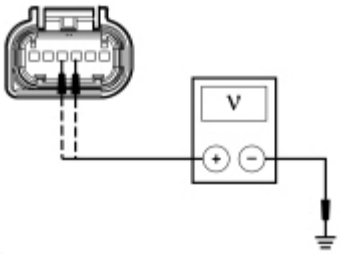
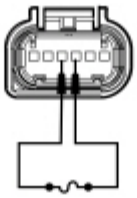
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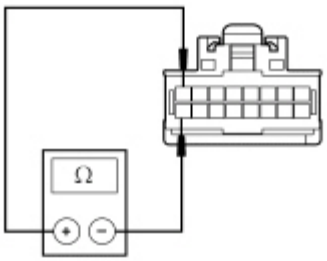
video camera C4357-6, circuit DMP19 (BK), harness side.



N0120905

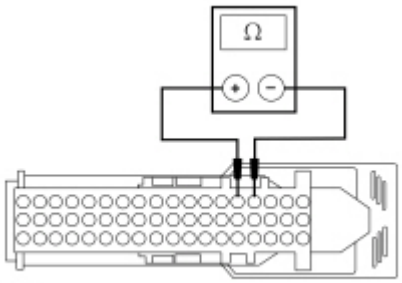
- **Are the resistances greater than 10,000 ohms?**

E16 CHECK THE REAR VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and ground; and between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and ground.  N0120909 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to E17 .
E17 CHECK VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Ignition OFF. • Connect a fused jumper wire between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side.  N0120906 • For vehicles without a 203.2 mm (8 in) touchscreen, measure the resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side.	**Yes** REMOVE the jumper wire. GO to E19 . **No** REMOVE the jumper wire. GO to E18 .



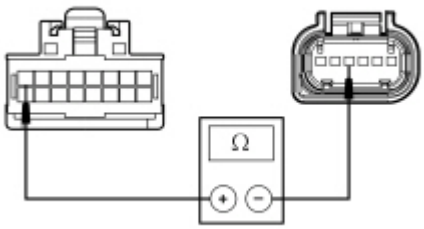
N0069002

- For vehicles with a 203.2 mm (8 in) touchscreen, measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.

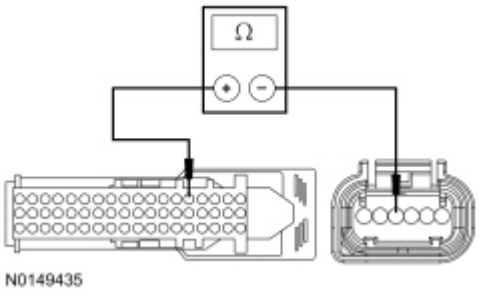
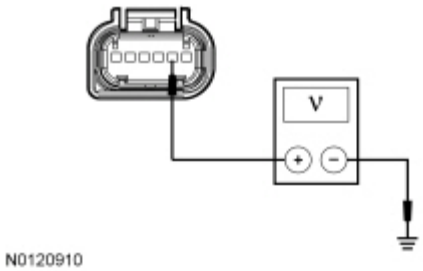
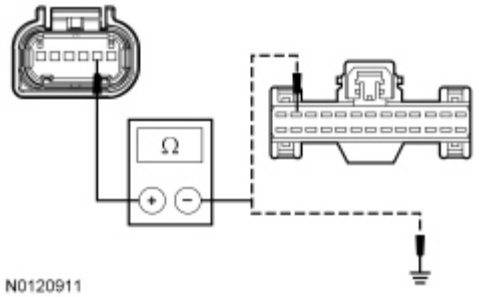


N0149434

- **Is the resistance less than 5 ohms?**

E18 CHECK VIDEO (+) SIGNAL CIRCUIT FOR AN OPEN	
- For vehicles without a 203.2 mm (8 in) touchscreen, measure the resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side.  N0120907 - For vehicles with a 203.2 mm (8 in) touchscreen, measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the video camera C4357-4, circuit VMP19 (WH/GN), harness side.	**Yes** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation. **No** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation.

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 N0149435 • **Is the resistance less than 5 ohms?**	
E19 CHECK THE LIN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Rear Video Camera C4357. • Disconnect: BCM C2280C. • Ignition ON. • Measure the voltage between the rear video camera C4357-2, circuit VDN03 (GY/VT), harness side and ground.  N0120910 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to E20 .
E20 CHECK THE LIN CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the rear video camera C4357-2, circuit VDN03 (GY/VT), harness side and the BCM C2280C-12, circuit VDN03 (GY/VT), harness side; and between the rear video camera C4357-2, circuit VDN03 (GY/VT), harness side and ground.  N0120911 • **Is resistance less than 5 ohms between the rear video camera and BCM ; and greater than 10,000 ohms between the rear video camera and ground?**	**Yes** GO to E21 . **No** REPAIR the circuit. TEST the system for normal operation.
E21 CHECK FOR CORRECT REAR VIDEO CAMERA	

OPERATION	

• Connect: All Disconnected Connectors.
• Disconnect the rear video camera connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the rear video camera connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: Poor Image Quality — Rear Video Camera

Normal Operation

A pair of shielded wires carries the video signal from the rear video camera to the Front Display Interface Module (FDIM) for vehicles with navigation, and the auto-dimming interior mirror for vehicles without navigation. The rear video system provides a clear image of objects to the rear of the vehicle.

This pinpoint test is intended to diagnose the following:

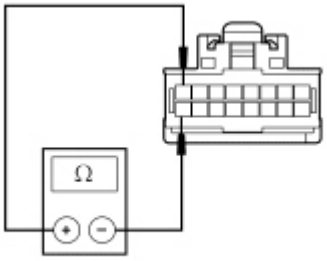
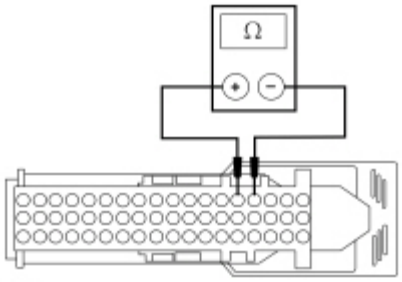
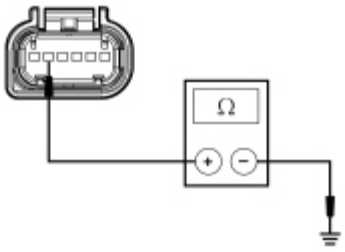
- Wiring, terminals or connectors
- Rear video camera

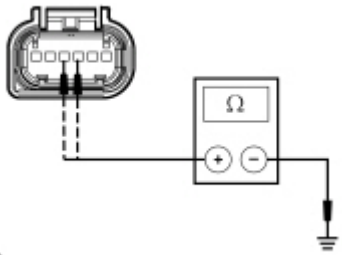
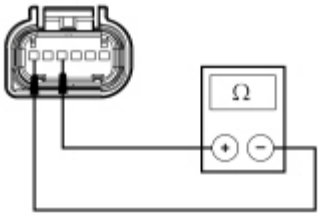
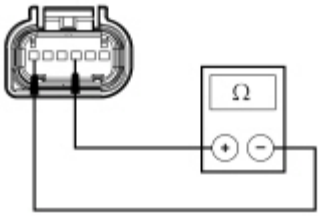
PINPOINT TEST F: POOR IMAGE QUALITY

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

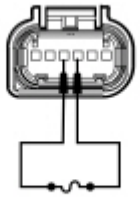
Test Step	Result / Action to Take
F1 CHECK AND CLEAN THE REAR VIDEO CAMERA LENS	
• Clean and make sure the rear video camera lens is clear of any debris. • Test the rear video camera system and verify the rear video camera image. • **Is the rear video camera concern still present?**	**Yes** GO to F2 . **No** The system is operating correctly at this time. The concern was caused by a dirty rear video camera lens.
F2 CHECK THE REAR VIDEO SIGNAL CIRCUITS INTEGRITY	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror (Without a 203.2 mm (8 in) touchscreen) C9039. • Disconnect: APIM (With a 203.2 mm (8 in) touchscreen) C2123. • For vehicles without a 203.2 mm (8 in) touchscreen, measure the	**Yes** GO to F3 . **No** GO to F4 .

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resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side.  N0069002 • For vehicles with a 203.2 mm (8 in) touchscreen, measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.  N0149434 • **Is the resistance between 74 and 106 ohms?**	
F3 CHECK THE REAR VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable. • Disconnect: Rear Video Camera C4357. • Measure the resistance between the rear video camera C4357-5, circuit GD120 (BK/GN), harness side and ground.  N0120912 • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to F4 . **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
F4 CHECK THE REAR VIDEO CAMERA SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Rear Video Camera C4357. • Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and ground; and between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side	**Yes** GO to F5 . **No**

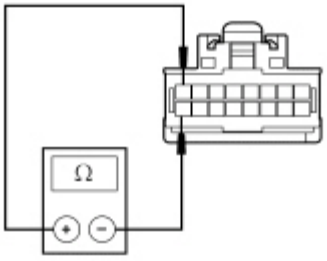
and ground.  N0121053 • **Are the resistances greater than 10,000 ohms?**	REPAIR the circuit in question. TEST the system for normal operation.
F5 CHECK THE REAR VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120904 • Measure the resistance between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120905 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F6 . **No** REPAIR the circuit in question. TEST the system for normal operation.
F6 CHECK REAR VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Connect a fused jumper wire between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side.	**Yes** REMOVE the jumper wire. GO to F8 . **No** REMOVE the jumper wire. GO to F7 .

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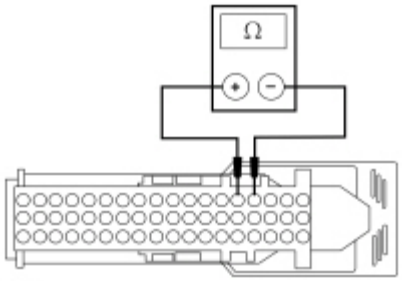
N0120906

- For vehicles without a 203.2 mm (8 in) touchscreen, measure the resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side.



N0069002

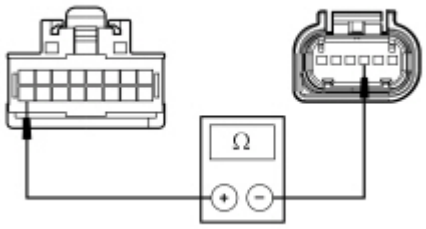
- For vehicles with a 203.2 mm (8 in) touchscreen, measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.



N0149434

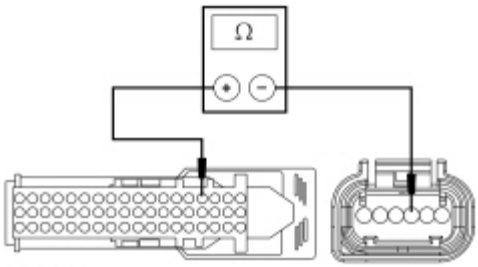
- **Is the resistance less than 5 ohms?**

F7 CHECK REAR VIDEO (-) SIGNAL CIRCUIT FOR AN OPEN	
• For vehicles without a 203.2 mm (8 in) touchscreen, measure the resistance between the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side and the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side.	**Yes** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation. **No** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation.



N0120914

- For vehicles with a 203.2 mm (8 in) touchscreen, measure the resistance between the APIM C2383-15, circuit RMP19 (BN/VT), harness side and the video camera C4357-3, circuit RMP19 (BN/VT), harness side.



N0149436

- **Is the resistance less than 5 ohms?**

F8 CHECK FOR CORRECT REAR VIDEO CAMERA OPERATION	

• Connect all disconnected connectors.
• Disconnect the rear video camera connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the rear video camera connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Rear Video Mirror Display Is Always On

Normal Operation

With the transmission selector in REVERSE (R), a reverse signal message from the Body Control Module (BCM) is sent over a dedicated Local Interconnect Network (LIN) to the auto-dimming interior mirror, enabling the system. The video signal from the rear video camera displays an image on the left portion of the auto-dimming interior mirror display.

This pinpoint test is intended to diagnose the following:

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- Wiring, terminals or connectors
- Auto-dimming interior mirror

PINPOINT TEST G: THE REAR VIDEO MIRROR DISPLAY IS ALWAYS ON

Test Step	Result / Action to Take
G1 CHECK THE REVERSING LAMPS OPERATION	
• Check the operation of the reversing lamps. • **Do the reversing lamps operate correctly?**	**Yes** DISCONNECT any aftermarket trailer lighting equipment. GO to G2 . **No** REFER to Section 417-01 .
G2 CHECK THE COMPASS FOR CORRECT OPERATION	
• **NOTE:** The auto-dimming interior mirror uses the LIN for compass messaging along with messaging for the rear video camera operation. • Verify the compass operates correctly. • **Does the compass operate correctly?**	**Yes** GO to G3 . **No** REFER to Section 413-01 to diagnose the compass.
G3 CHECK FOR CORRECT AUTO-DIMMING INTERIOR MIRROR DISPLAY OPERATION	

• Disconnect the auto-dimming interior mirror display connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the auto-dimming interior mirror display connector and make sure it seats correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: Visual Park Aid Is Inoperative

Refer to Wiring Diagrams Cell 131 , Parking Aid for schematic and connector information.

Normal Operation

When the transmission selector is in REVERSE (R) and an object is detected in the path of the parking aid sensor, a network message of the distance from the parking aid sensor to the object is sent from the Parking Aid Module (PAM) to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The BCM networks the parking aid sensor message to the rear video camera over the Local Interconnect Network (LIN). The visual alerts are red, yellow or green and appear as highlights on top of the displayed image to indicate in which zone the object is detected. The visual park aid feature can be enabled and disabled within the Front Display Interface Module (FDIM).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Rear video camera
- PAM
- BCM

PINPOINT TEST H: VISUAL PARK AID IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 VERIFY THE VISUAL PARK AID IS ENABLED	
• For vehicles with a 203.2 mm (8 in) touchscreen, verify that the visual park aid is enabled in the FDIM . • For vehicles without a 203.2 mm (8 in) touchscreen, verify that the visual park aid is enabled in the message display. • **Is the visual park aid enabled in the FDIM or message center display?**	**Yes** GO to H2 . **No** ENABLE the visual park aid. TEST the system for normal operation.
H2 CHECK THE DTCs FROM THE PAM SELF-TEST	
• Check the PAM DTCs from the self-test. • **Are any PAM DTCs recorded?**	**Yes** REPAIR all PAM DTCs first. REFER to Parking Aid in this section. TEST the system for normal operation. **No** GO to H3 .
H3 CHECK THE DTCs FROM THE BCM SELF-TEST	
• Check the BCM DTCs from the self-test. • **Are any BCM DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** GO to H4 .
H4 CHECK FOR CORRECT REAR VIDEO CAMERA OPERATION	

• Connect: All Disconnected Connectors.
• Disconnect the rear video camera connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the rear video camera connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Pinpoint Test I: The Front or Rear Video Does Not Operate Correctly — Raptor

Normal Operation — Front Video Camera

The front video camera system is active with the ignition on, the transmission selector in the drive position, the vehicle is in off road mode and the Electronic Locking Differential (ELD) or 4L activated. The front video camera receives commands from the Body Control Module (BCM) over a dedicated Local Interconnect Network (LIN). The front video camera sends a video signal to the camera switching module on a pair of shielded video circuits. The Front Display Interface Module (FDIM) receives the signal from the camera switching module, the FDIM displays the video image of the area in front of the vehicle.

Normal Operation — Rear Video Camera

The rear video camera system is active with the ignition on and the transmission selector in the reverse position. The rear video camera receives commands from the BCM over a dedicated LIN . The rear video camera sends a video signal to the camera switching module on a pair of shielded video circuits. The FDIM receives the signal from the camera switching module, the FDIM displays the video image of the area behind the vehicle.

- DTC B115E:08 (Camera Module: Bus Signal/Message Failure) — a continuous and a on-demand DTC that sets in the BCM when there is a LIN communication fault from the rear video camera.
- DTC C1001:01 (Vision System Camera: General Electrical Failure) — a continuous DTC that sets in the ACM when no video signal is detected from the rear video camera when the vehicle is in reverse.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Front video camera
- Rear video camera
- Camera switching module
- FDIM
- BCM

PINPOINT TEST I: THE FRONT OR REAR VIDEO DOES NOT OPERATE CORRECTLY — RAPTOR

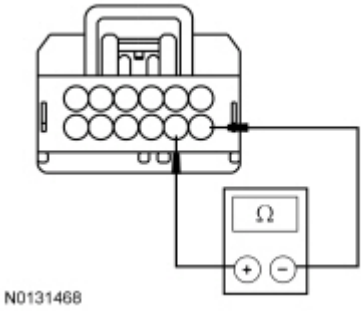
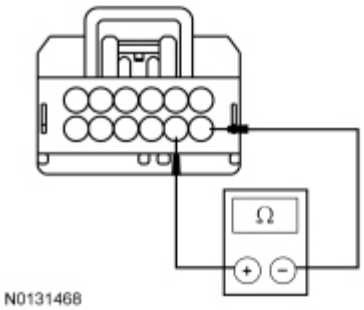
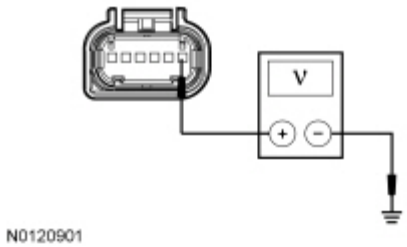
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

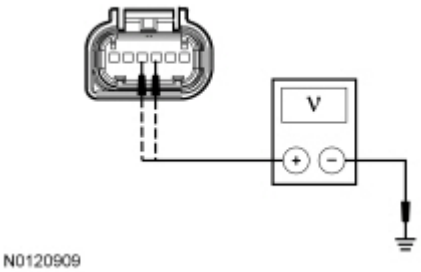
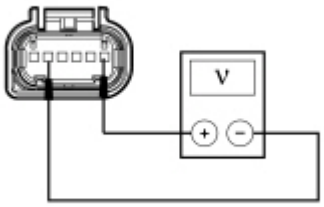
NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
I1 CHECK THE OPERATION OF THE FRONT AND REAR VIDEO CAMERAS	
• Check the operation of the front video camera system and verify the front video camera image. • Check the operation of the rear video camera system and verify the rear video camera image. • **Are both cameras inoperative?**	**Yes** GO to I35 . **No** For the front video camera, GO to I19 . For the rear video

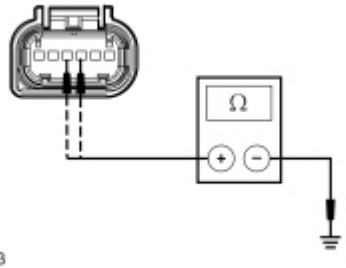
	camera, GO to I2.
I2 CHECK AND CLEAN THE REAR VIDEO CAMERA LENS • Clean and make sure the rear video camera lens is clear of any debris. • Test the rear video camera system and verify the rear video camera image. • **Is the rear video camera concern still present?**	**Yes** GO to I3. **No** The system is operating correctly at this time. The concern was caused by a dirty rear video camera lens.
I3 CHECK THE REVERSING LAMPS OPERATION • Apply the parking brake. • Ignition ON. • Select REVERSE. • Check the operation of the reversing lamps. • **Do the reversing lamps operate correctly?**	**Yes** GO to I4. **No** REFER to Section 417-01.
I4 CHECK THE DTCs FROM THE BCM SELF-TEST • Check the BCM DTCs from the self-test. • **Are any BCM DTCs retrieved?**	**Yes** For BCM DTC B115E:08, GO to I16. For all other DTCs, REFER to DTC Charts in this section. **No** For an inoperative rear video camera feature concern, GO to I5. Otherwise, GO to I6.
I5 VERIFY AND ENABLE THE INOPERATIVE REAR VIDEO CAMERA FEATURE • Verify and enable the inoperative rear video camera feature within the FDIM (with a 203.2 mm (8 in) touchscreen) or message center (without a 203.2 mm (8 in) touchscreen). • **Does the rear video camera feature operate correctly?**	**Yes** The rear video camera system is operating correctly at this time. The rear video camera feature concern was caused by the feature being disabled. INSTRUCT the customer on how to enable the rear video camera features. REFER to the Owner's Literature. **No** GO to I6.
I6 CHECK THE FDIM DISPLAY • Observe the FDIM while placing the vehicle in reverse. • **While selecting reverse and waiting up to 30 seconds, does the FDIM screen switch to rear video camera mode and display "Please Contact Your Dealership"?**	**Yes** The FDIM display is functional. There is no signal from the rear video camera. GO to I7. **No** REFER to Section 415-00E or Section 415-00F.
I7 CHECK THE REAR VIDEO SIGNAL CIRCUITS INTEGRITY	

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• Ignition OFF. • Disconnect: Camera Switching Module C1664. • Measure the resistance between the camera switching module C1664-7, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-8, circuit RMP19 (BN/VT), harness side.  N0131468 • **Is the resistance between 74 and 106 ohms?**	**Yes** GO to I9 . **No** If the resistance is less than 74 ohms, GO to I8 . If the resistance is greater than 106 ohms, GO to I14 .
I8 CHECK THE REAR VIDEO SIGNAL CIRCUITS FOR A SHORT TOGETHER	
• Disconnect: Rear Video Camera C4357. • Measure the resistance between the camera switching module C1664-7, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-8, circuit RMP19 (BN/VT), harness side.  N0131468 • **Is the resistance less than 10,000 ohms?**	**Yes** GO to I18 . **No** REPAIR the circuits.
I9 CHECK THE REAR VIDEO CAMERA VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: Rear Video Camera C4357. • Ignition ON. • Measure the voltage between the rear video camera C4357-1, circuit CBP34 (VT/BN), harness side and ground.  N0120901	**Yes** GO to I10 . **No** REPAIR the circuit.

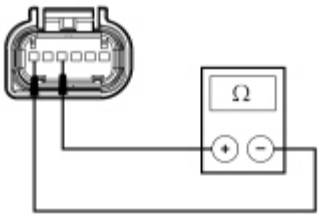
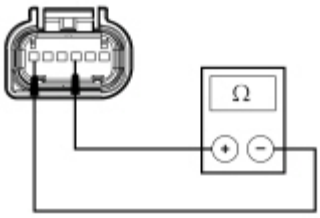
• **Is the voltage greater than 10 volts?**	
I10 CHECK THE REAR VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VOLTAGE • Ignition ON. • Measure the voltage between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and ground; and between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and ground.  N0120909 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to I11 .
I11 CHECK THE REAR VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN • Measure the voltage between the rear video camera C4357-1, circuit CBP34 (VT/BN), harness side and the rear video camera C4357-5, circuit GD120 (BK/GN), harness side and ground.  N0120902 • **Is the voltage greater than 10 volts?**	**Yes** GO to I12 . **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.
I12 CHECK THE REAR VIDEO CAMERA SIGNAL CIRCUITS FOR A SHORT TO GROUND • Ignition OFF. • Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and ground; and between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and ground.	**Yes** GO to I13 . **No** REPAIR the circuit in question. TEST the system for normal operation.

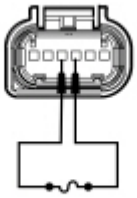
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N0121053

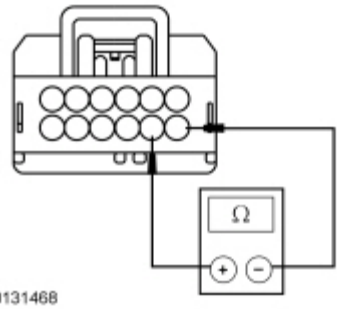
- **Are the resistances greater than 10,000 ohms?**

I13 CHECK THE REAR VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120904 • Measure the resistance between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120905 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I14 . **No** REPAIR the circuit in question. TEST the system for normal operation.
I14 CHECK REAR VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Ignition OFF. • Connect a fused jumper wire between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side.	**Yes** REMOVE the jumper wire. GO to I18 . **No** REMOVE the jumper wire. GO to I15 .



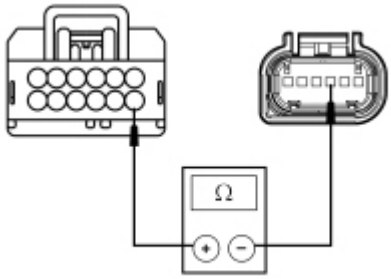
N0120906

- Measure the resistance between the camera switching module C1664-7, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-8, circuit RMP19 (BN/VT), harness side.

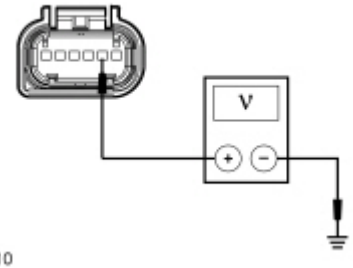
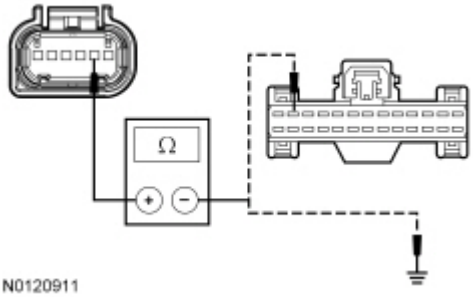


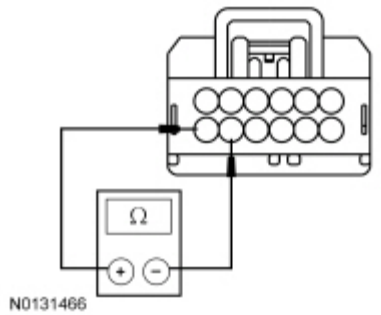
N0131468

- **Is the resistance less than 5 ohms?**

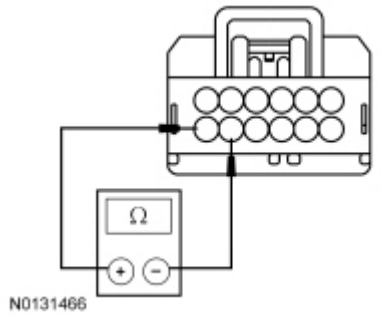
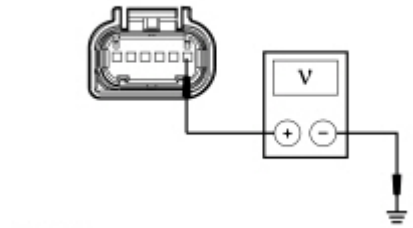
I15 CHECK REAR VIDEO (+) SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the camera switching module C1664-7, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side.  N0131469 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation. **No** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation.
I16 CHECK THE LIN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Front Video Camera C1663. • Disconnect: Rear Video Camera C4357. • Disconnect: BCM C2280C. • Ignition ON. • Measure the voltage between the rear video camera C4357-2, circuit VDN03 (GY/VT), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to I17 .

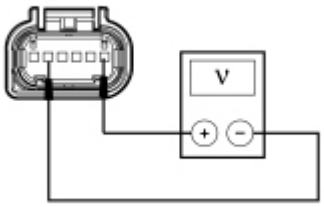
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 N0120910 • **Is any voltage present?**	
I17 CHECK THE LIN CIRCUIT FOR AN OPEN OR SHORT TO GROUND • Ignition OFF. • Measure the resistance between the rear video camera C4357-2, circuit VDN03 (GY/VT), harness side and the BCM C2280C-12, circuit VDN03 (GY/VT), harness side; and between the rear video camera C4357-2, circuit VDN03 (GY/VT), harness side and ground.  N0120911 • **Is resistance less than 5 ohms between the rear video camera and BCM ; and greater than 10,000 ohms between the rear video camera and ground?**	**Yes** GO to I18 . **No** REPAIR the circuit. TEST the system for normal operation.
I18 CHECK FOR CORRECT REAR VIDEO CAMERA OPERATION • Connect: All Disconnected Connectors. • Disconnect the rear video camera connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the rear video camera connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
I19 CHECK AND CLEAN THE FRONT VIDEO CAMERA LENS • Clean and make sure the front video camera lens is clear of any debris. • Test the front video camera system and verify the front video camera image. • **Is the front video camera concern still present?**	**Yes** GO to I20 . **No** The system is operating

	correctly at this time. The concern was caused by a dirty front video camera lens.
I20 CHECK THE 4X4 LOW OPERATION • Ignition ON. • Shift the transfer case to 4L (4X4 LOW). • Select DRIVE. • **Does the 4L engage correctly?**	**Yes** GO to I21. **No** REFER to Section 308-07A.
I21 VERIFY AND ENABLE THE INOPERATIVE FRONT VIDEO CAMERA FEATURE • Verify and enable the inoperative front video camera feature within the FDIM. • **Does the front video camera feature operate correctly?**	**Yes** The front video camera system is operating correctly at this time. The front video camera feature concern was caused by the feature being disabled. INSTRUCT the customer on how to enable the front video camera features, REFER to the Owner's Literature. **No** GO to I22.
I22 CHECK THE FDIM DISPLAY • Observe the FDIM while placing the vehicle in off road mode. • **While selecting 4L and waiting up to 30 seconds, does the FDIM screen switch to front video camera mode and display "Please Contact Your Dealership"?**	**Yes** The FDIM display is functional. There is no signal from the front video camera. GO to I23. **No** REFER to Section 415-00E or Section 415-00F.
I23 CHECK THE FRONT VIDEO SIGNAL CIRCUITS INTEGRITY • Ignition OFF. • Disconnect: Camera Switching Module C1664. • Measure the resistance between the camera switching module C1664-12, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side.  • **Is the resistance between 74 and 106 ohms?**	**Yes** GO to I25. **No** If less than 74 ohms, GO to I24. If greater than 106 ohms, GO to I28.
I24 CHECK THE FRONT VIDEO SIGNAL CIRCUITS FOR A	

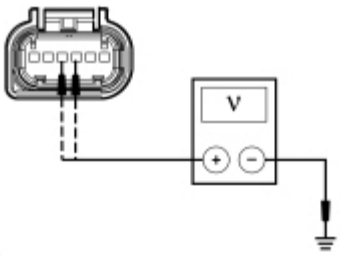
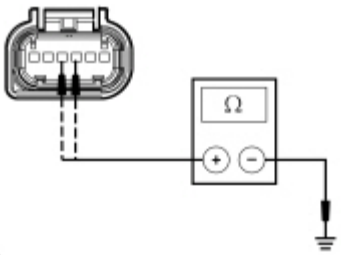
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SHORT TOGETHER	
• Disconnect: Front Video Camera C1663. • Measure the resistance between the camera switching module C1664-12, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side.  N0131466 • **Is the resistance the greater than 10,000 ohms?**	**Yes** GO to I34 . **No** REPAIR the circuits.
I25 CHECK THE FRONT VIDEO CAMERA VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: Front Video Camera C1663. • Ignition ON. • Measure the voltage between the front video camera C1663-1, circuit CBP34 (VT/BN), harness side and ground.  N0120901 • **Is the voltage greater than 10 volts?**	**Yes** GO to I26 . **No** REPAIR the circuit.
I26 CHECK THE FRONT VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the voltage between the front video camera C1663-1, circuit CBP34 (VT/BN), harness side and the front video camera C1663-5, circuit GD120 (BK/GN), harness side and ground.	**Yes** GO to I27 . **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.

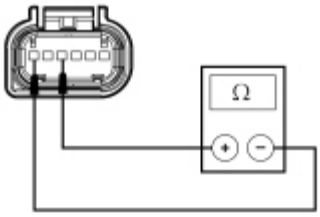


N0120902

- **Is the voltage greater than 10 volts?**

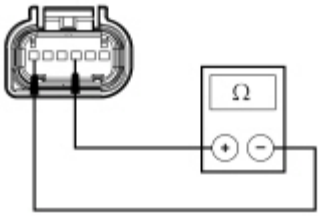
I27 CHECK THE FRONT VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and ground; and between the front video camera C1663-3, circuit RMP19 (BN/VT), harness side and ground.  N0120909 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to I28 .
I28 CHECK THE FRONT VIDEO CAMERA SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and ground; and between the front video camera C1663-3, circuit RMP19 (BN/VT), harness side and ground.  N0121053 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I29 . **No** REPAIR the circuit in question. TEST the system for normal operation.
I29 CHECK THE FRONT VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and the front video camera C1663-6, circuit DMP19 (BK), harness side.	**Yes** GO to I30 .

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N0120904

- Measure the resistance between the front video camera C1663-3, circuit RMP19 (BN/VT), harness side and the front video camera C1663-6, circuit DMP19 (BK), harness side.



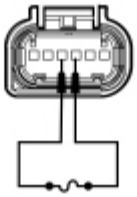
N0120905

- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question. TEST the system for normal operation.

I30 CHECK FRONT VIDEO SIGNAL CIRCUITS FOR AN OPEN

- Ignition OFF.
- Connect a fused jumper wire between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and the front video camera C1663-3, circuit RMP19 (BN/VT), harness side.

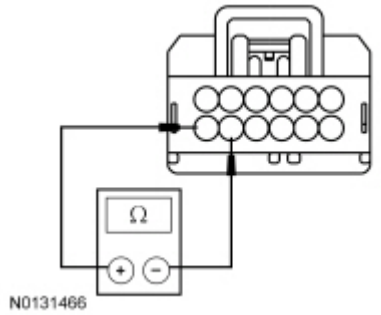
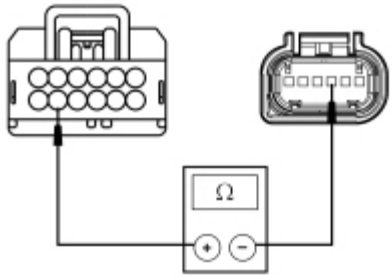
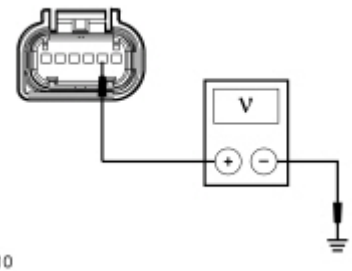


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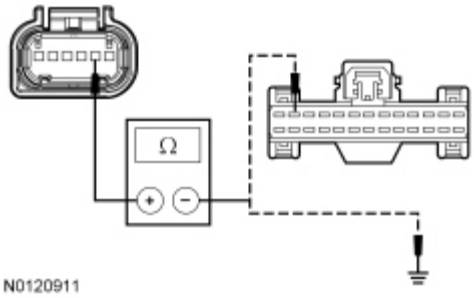
- Measure the resistance between the camera switching module C1664-12, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side.

Yes
REMOVE the jumper wire. GO to I32 .

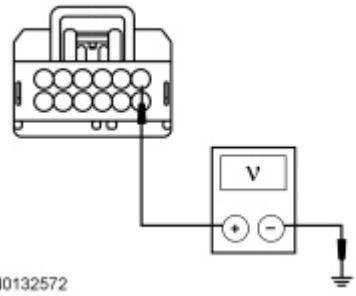
No
REMOVE the jumper wire. GO to I31 .

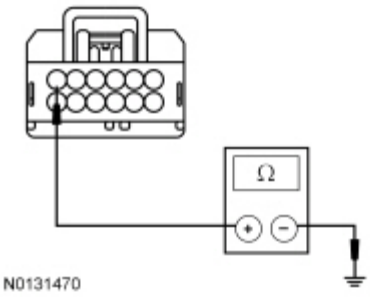
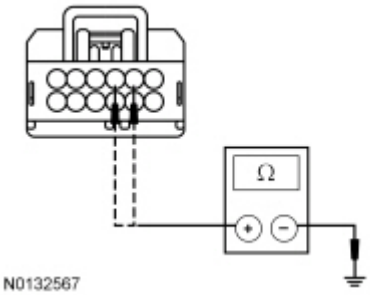
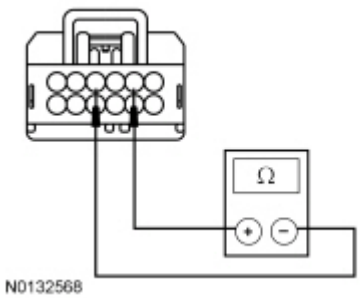
 N0131466 • **Is the resistance less than 5 ohms?**	
I31 CHECK FRONT VIDEO (+) SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side and the front video camera C1663-3, circuit RMP19 (BN/VT), harness side.  N0131467 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation. **No** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation.
I32 CHECK THE LIN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Front Video Camera C1663. • Disconnect: BCM C2280C. • Ignition ON. • Measure the voltage between the front video camera C1663-2, circuit VDN03 (GY/VT), harness side and ground.  N0120910 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to I33 .
I33 CHECK THE LIN CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the front video camera C1663-2, circuit VDN03 (GY/VT), harness side and the BCM C2280C-12, circuit VDN03 (GY/VT), harness side; and	**Yes** GO to I34 . **No**

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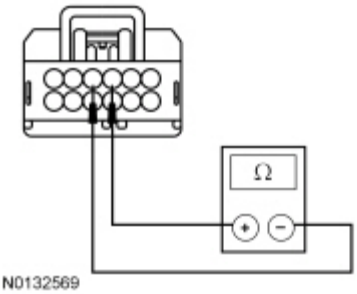
between the front video camera C1663-2, circuit VDN03 (GY/VT), harness side and ground.  N0120911 • **Is resistance less than 5 ohms between the front video camera and BCM ; and greater than 10,000 ohms between the front video camera and ground?**	REPAIR the circuit. TEST the system for normal operation.

I34 CHECK FOR CORRECT FRONT VIDEO CAMERA OPERATION
• Connect: All Disconnected Connectors.
• Disconnect the front video camera connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the front video camera connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new front video camera. REFER to Video Camera — Front in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

I35 CHECK THE CAMERA SWITCHING MODULE POWER CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Camera Switching Module C1664. • Ignition ON. • Measure the voltage between the camera switching module C1664-1, circuit CBP34 (VT/BN), harness side and ground.  N0132572 • **Is the voltage greater than 10 volts?**	**Yes** GO to I36 . **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
I36 CHECK THE CAMERA SWITCHING MODULE GROUND CIRCUIT FOR AN OPEN • Disconnect: Negative Battery Cable. • Measure the resistance between the camera switching	**Yes** CONNECT the negative battery

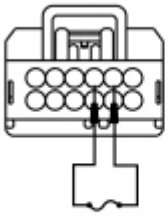
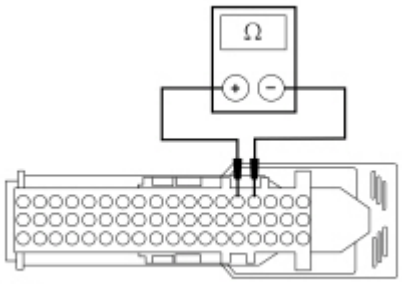
module C1664-6, circuit GD120 (BK/GN), harness side and ground.  • **Is the resistance less than 5 ohms?**	cable. GO to I37 . **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
I37 CHECK THE VIDEO SIGNAL CIRCUITS FOR A SHORT TO GROUND • Disconnect: APIM C2383. • Measure the resistance between the camera switching module C1664-2, circuit VMP19 (WH/GN), harness side and ground; and between the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I38 . **No** REPAIR the circuit in question. TEST the system for normal operation.
I38 CHECK THE VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD • Measure the resistance between the camera switching module C1664-2, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-4, circuit DMP19 (BK), harness side.  • Measure the resistance between the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side and the camera switching module C1664-4, circuit DMP19 (BK), harness side.	**Yes** GO to I39 . **No** REPAIR the circuit in question. TEST the system for normal operation.

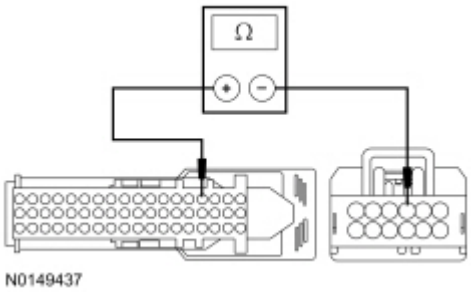
repair4less



N0132569

- **Are the resistances greater than 10,000 ohms?**

I39 CHECK VIDEO SIGNAL CIRCUITS FOR AN OPEN • Connect a fused jumper wire between the camera switching module C1664-2, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side.  N0132571 • Measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.  N0149434 • **Is the resistance less than 5 ohms?**	**Yes** REMOVE the jumper wire. GO to I41 . **No** REMOVE the jumper wire. GO to I40 .
I40 CHECK VIDEO (-) SIGNAL CIRCUIT FOR AN OPEN • Measure the resistance between the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.	**Yes** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation. **No** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation.

 N0149437 • **Is the resistance less than 5 ohms?**	
I41 CHECK FOR CORRECT CAMERA SWITCHING MODULE OPERATION	

• Connect all disconnected connectors.
• Disconnect the camera switching module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the camera switching module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new camera switching module. REFER to Camera Switching Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test J: Poor Image Quality — Raptor

Normal Operation — Front Video Camera

The front video camera system is active with the ignition on, the transmission selector in the drive position, the vehicle is in off road mode and the Electronic Locking Differential (ELD) or 4L activated. The front video camera receives commands from the Body Control Module (BCM) over a dedicated Local Interconnect Network (LIN). The front video camera sends a video signal to the camera switching module on a pair of shielded video circuits. The Front Display Interface Module (FDIM) receives the signal from the camera switching module and displays the video image of the area in front of the vehicle.

Normal Operation — Rear Video Camera

The rear video camera system is active with the ignition on and the transmission selector in the reverse position. The rear video camera receives commands from the BCM over a dedicated LIN . The rear video camera sends a video signal to the camera switching module on a pair of shielded video circuits. The FDIM receives the signal from the camera switching module and displays the video image of the area behind the vehicle.

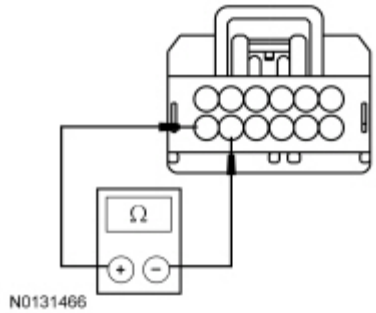
This pinpoint test is intended to diagnose the following:

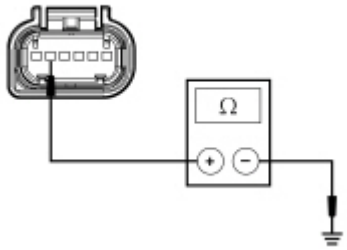
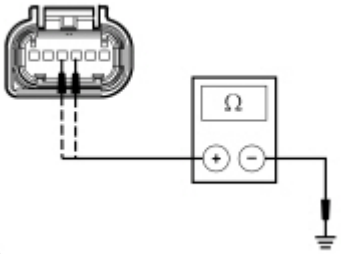
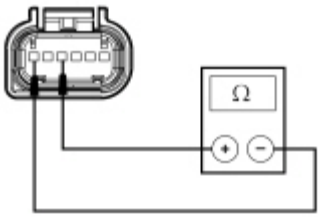
- Wiring, terminals or connectors
- Front video camera
- Rear video camera
- Camera switching module

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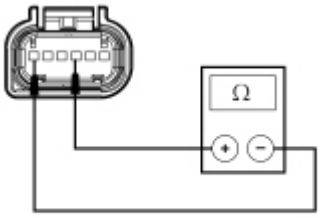
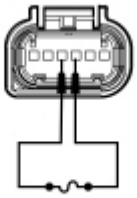
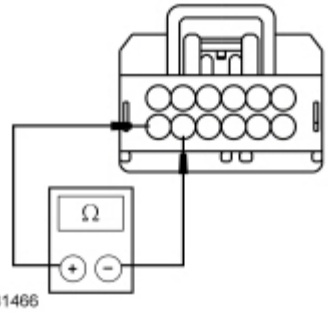
PINPOINT TEST J: POOR IMAGE QUALITY — RAPTOR

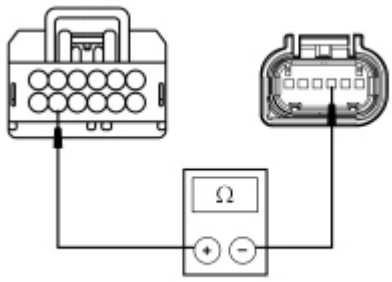
NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
J1 CHECK THE OPERATION OF THE FRONT AND REAR VIDEO CAMERAS	
• Check the operation of the front video camera system and verify the front video camera image. • Check the operation of the rear video camera system and verify the rear video camera image. • **Do both cameras have poor image quality?**	**Yes** GO to J18 . **No** For the front video camera, GO to J2 . For the rear video camera, GO to J10 .
J2 CHECK AND CLEAN THE FRONT VIDEO CAMERA LENS	
• Clean and make sure the front video camera lens is clear of any debris. • Test the front video camera system and verify the front video camera image. • **Is the front video camera concern still present?**	**Yes** GO to J3 . **No** The system is operating correctly at this time. The concern was caused by a dirty front video camera lens.
J3 CHECK THE FRONT VIDEO SIGNAL CIRCUITS INTEGRITY	
• Ignition OFF. • Disconnect: Camera Switching Module C1664. • Measure the resistance between the camera switching module C1664-12, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side.  • **Is the resistance between 74 and 106 ohms?**	**Yes** GO to J4 . **No** GO to J5 .
J4 CHECK THE FRONT VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable. • Disconnect: Front Video Camera C1663. • Measure the resistance between the front video camera C1663-5, circuit GD120 (BK/GN), harness side and ground.	**Yes** CONNECT the negative battery cable. GO to J5 . **No**

 N0120912 • **Is the resistance less than 5 ohms?**	REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
J5 CHECK THE FRONT VIDEO CAMERA SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and ground; and between the front video camera C1663-3, circuit RMP19 (BN/VT), harness side and ground.  N0121053 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J6 . **No** REPAIR the circuit in question. TEST the system for normal operation.
J6 CHECK THE FRONT VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and the front video camera C1663-6, circuit DMP19 (BK), harness side.  N0120904 • Measure the resistance between the front video camera C1663-3, circuit RMP19 (BN/VT), harness side and the front video camera C1663-6, circuit DMP19 (BK), harness side.	**Yes** GO to J7 . **No** REPAIR the circuit in question. TEST the system for normal operation.

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 N0120905 • **Are the resistances greater than 10,000 ohms?**	
J7 CHECK FRONT VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Connect a fused jumper wire between the front video camera C1663-4, circuit VMP19 (WH/GN), harness side and the front video camera C1663-3, circuit RMP19 (BN/VT), harness side.  N0120906 • Measure the resistance between the camera switching module C1664-12, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side.  N0131466 • **Is the resistance less than 5 ohms?**	**Yes** REMOVE the jumper wire. GO to J9 . **No** REMOVE the jumper wire. GO to J8 .
J8 CHECK FRONT VIDEO (-) SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the camera switching module C1664-11, circuit RMP19 (BN/VT), harness side and the front video camera C1663-3, circuit RMP19 (BN/VT), harness side.	**Yes** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation. **No** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation.

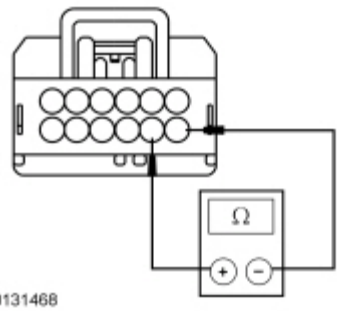


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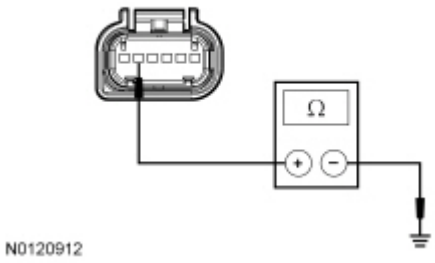
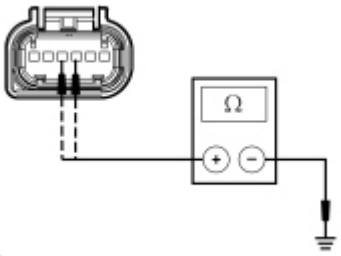
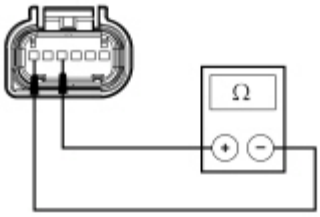
- **Is the resistance less than 5 ohms?**

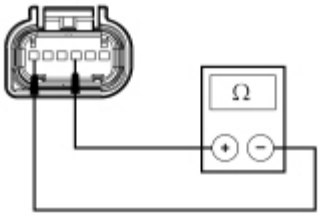
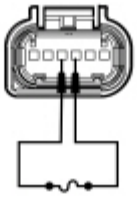
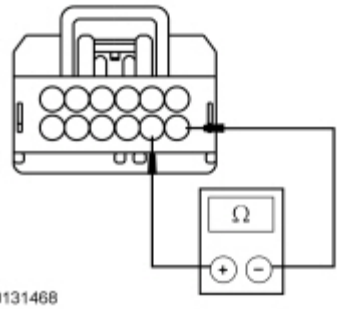
J9 CHECK FOR CORRECT FRONT VIDEO CAMERA OPERATION	

• Connect all disconnected connectors.
• Disconnect the front video camera connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the front video camera connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new front video camera. REFER to Video Camera — Front in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

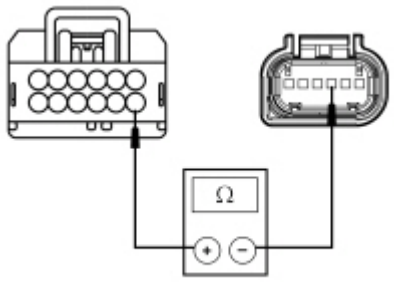
J10 CHECK AND CLEAN THE REAR VIDEO CAMERA LENS	
• Clean and make sure the rear video camera lens is clear of any debris. • Test the rear video camera system and verify the rear video camera image. • **Is the rear video camera concern still present?**	**Yes** GO to J11 . **No** The system is operating correctly at this time. The concern was caused by a dirty rear video camera lens.
J11 CHECK THE REAR VIDEO SIGNAL CIRCUITS INTEGRITY	
• Ignition OFF. • Disconnect: Camera Switching Module C1664. • Measure the resistance between the camera switching module C1664-7, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-8, circuit RMP19 (BN/VT), harness side.  N0131468 • **Is the resistance between 74 and 106 ohms?**	**Yes** GO to J12 . **No** GO to J13 .

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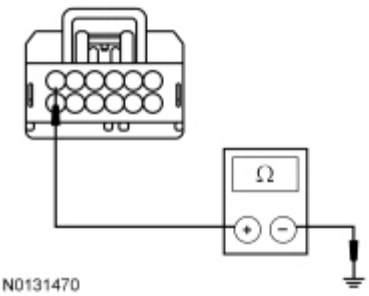
J12 CHECK THE REAR VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable. • Disconnect: Rear Video Camera C4357. • Measure the resistance between the rear video camera C4357-5, circuit GD120 (BK/GN), harness side and ground.  N0120912 • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to J13 . **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
J13 CHECK THE REAR VIDEO CAMERA SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and ground; and between the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side and ground.  N0121053 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J14 . **No** REPAIR the circuit in question. TEST the system for normal operation.
J14 CHECK THE REAR VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120904 • Measure the resistance between the rear video camera C4357-3,	**Yes** GO to J15 . **No** REPAIR the circuit in question. TEST the system for normal operation.

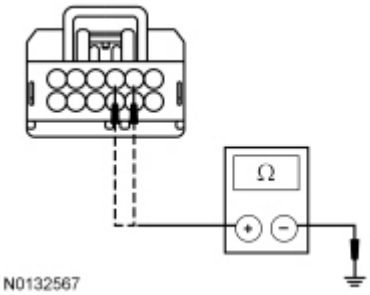
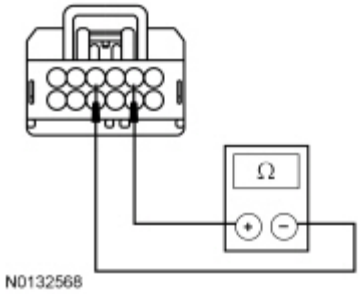
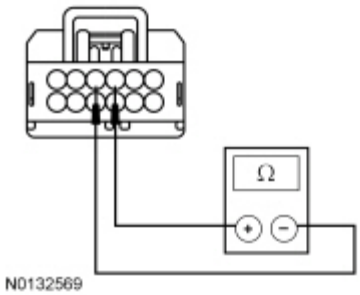
circuit RMP19 (BN/VT), harness side and the rear video camera C4357-6, circuit DMP19 (BK), harness side.  N0120905 • **Are the resistances greater than 10,000 ohms?**	
J15 CHECK REAR VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Connect a fused jumper wire between the rear video camera C4357-4, circuit VMP19 (WH/GN), harness side and the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side.  N0120906 • Measure the resistance between the camera switching module C1664-7, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-8, circuit RMP19 (BN/VT), harness side.  N0131468 • **Is the resistance less than 5 ohms?**	**Yes** REMOVE the jumper wire. GO to J17 . **No** REMOVE the jumper wire. GO to J16 .
J16 CHECK REAR VIDEO (-) SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the camera switching module C1664-8, circuit RMP19 (BN/VT), harness side and the rear video camera C4357-3, circuit RMP19 (BN/VT), harness side.	**Yes** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation. **No** REPAIR circuit RMP19 (BN/VT). TEST the system

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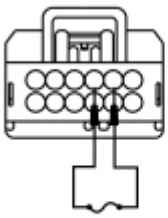
 N0131469 • **Is the resistance less than 5 ohms?**	for normal operation.
J17 CHECK FOR CORRECT REAR VIDEO CAMERA OPERATION	

• Connect all disconnected connectors.
• Disconnect the rear video camera connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the rear video camera connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new rear video camera. REFER to Video Camera — Rear in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

J18 CHECK THE CAMERA SWITCHING MODULE GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable. • Disconnect: Camera Switching Module C1664. • Measure the resistance between the camera switching module C1664-6, circuit GD120 (BK/GN), harness side and ground.  N0131470 • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to J19 . **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.
J19 CHECK THE VIDEO SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: APIM C2383. • Measure the resistance between the camera switching module C1664-2, circuit VMP19 (WH/GN), harness side and ground; and between the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side and ground.	**Yes** GO to J20 . **No** REPAIR the circuit in question. TEST the system for normal operation.

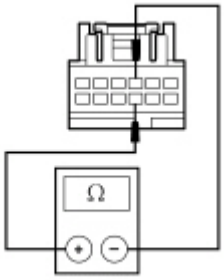
 N0132567 • **Are the resistances greater than 10,000 ohms?**	
J20 CHECK THE VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the camera switching module C1664-2, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-4, circuit DMP19 (BK), harness side.  N0132568 • Measure the resistance between the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side and the camera switching module C1664-4, circuit DMP19 (BK), harness side.  N0132569 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J21 . **No** REPAIR the circuit in question. TEST the system for normal operation.
J21 CHECK VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Connect a fused jumper wire between the camera switching module C1664-2, circuit VMP19 (WH/GN), harness side and the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side.	**Yes** REMOVE the jumper wire. GO to J23 . **No** REMOVE the jumper wire. GO to J22 .

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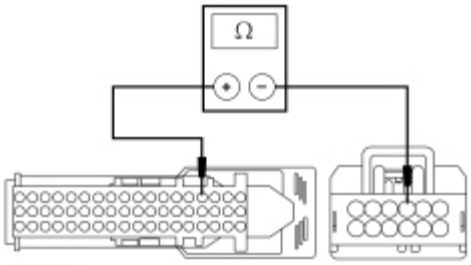
N0132571

- Measure the resistance between the APIM C2383-14, circuit VMP19 (WH/GN), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.



N0082111

- **Is the resistance less than 5 ohms?**

J22 CHECK VIDEO (-) SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the camera switching module C1664-3, circuit RMP19 (BN/VT), harness side and the APIM C2383-15, circuit RMP19 (BN/VT), harness side.  N0149437 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation. **No** REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation.
J23 CHECK FOR CORRECT CAMERA SWITCHING MODULE OPERATION	

• Connect all disconnected connectors.
• Disconnect the camera switching module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the camera switching module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new camera switching module. REFER to Camera Switching Module in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The

	concern may have been caused by a loose or corroded connector.

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Parking Aid

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The parking aid sensors detect objects approximately 152 cm (60 in) from the rear of the vehicle, 50 cm (20 in) from the rear side of the vehicle, and 30 cm (12 in) above the ground. The Parking Aid Module (PAM) calculates the distance to an object within the 170 degree semicircular area around the rear of the vehicle.

A variable-rate warning tone is generated from a speaker attached to the PAM. The speaker increases its warning tone rate as the vehicle gets closer to an obstacle. When an object is detected within 30 cm (12 in) of the sensors, the warning tone becomes continuous. When the PAM sounds the parking aid tone, it sends a volume cutback enabled message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). The BCM sends a message to the Audio Front Control Module (ACM) over the Medium Speed Controller Area Network (MS-CAN). When the ACM receives the message, it reduces the speaker output so the parking aid tone can be heard.

For vehicles that have a base audio system that is not on the Medium Speed Controller Area Network (MS-CAN), the audio speaker output does not reduce when the parking aid tone sounds.

The parking aid system is enabled when the ignition switch is in the RUN position and the transmission in reverse. The parking aid system is disabled if a fault is detected in 1 of the 4 sensors, the parking aid speaker, or the PAM. This is indicated by a parking aid disabled warning message in the message center.

The parking aid system is enabled and disabled through the message center, located in the Instrument Panel Cluster (IPC).

If a MyKey® restricted key is in the ignition cylinder, the parking aid menu is not available in the message center and cannot be deactivated.

If the vehicle is equipped with an integrated electronic Trailer Brake Control (TBC) module and a trailer with electric trailer brakes is connected to the vehicle, the parking aid system is disabled.

The PAM communicates on the HS-CAN and can be diagnosed with a scan tool. The PAM communicates with the scan tool, the BCM, the PCM and the IPC.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

   Visual Inspection Chart

Electrical
• Body Control Module (BCM) fuse 34 (10A) • Wiring, terminals or connectors • Parking Aid Module (PAM) • Parking aid sensors • Parking aid speaker (integral to the PAM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the PAM.

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9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

PID Chart

PID	Description
LRI_DIST	Left rear inner sensor distance to object
LRO_DIST	Left rear outer sensor distance to object
RRI_DIST	Right rear inner sensor distance to object
RRO_DIST	Right rear outer sensor distance to object
TRANSGR	Transmission gearshift (PRNDL) position

DTC Charts

Parking Aid Module (PAM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous Memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B1B44:01	Right Rear Outer Sensor: General Electrical Failure	GO to Pinpoint Test B .
B1B44:96	Right Rear Outer Sensor: Component Internal Failure	GO to Pinpoint Test B .
B1B46:01	Right Rear Inner Sensor: General Electrical Failure	GO to Pinpoint Test B .
B1B46:96	Right Rear Inner Sensor: Component Internal Failure	GO to Pinpoint Test B .
B1B48:01	Left Rear Outer Sensor: General Electrical Failure	GO to Pinpoint Test B .
B1B48:96	Left Rear Outer Sensor: Component Internal Failure	GO to Pinpoint Test B .
B1B50:01	Left Rear Inner Sensor: General Electrical Failure	GO to Pinpoint Test B .
B1B50:96	Left Rear Inner Sensor: Component Internal Failure	GO to Pinpoint Test B .
B1B52:12	Rear Sounder-Park Aid: Circuit Short to Battery	CLEAR the DTCs. REPEAT the self-test. If DTC B1B52:12 is recorded again, INSTALL a new Parking Aid Module (PAM). REFER to Parking Aid Module (PAM) in this section. REPEAT the self-test.
B1B52:14	Rear Sounder-Park Aid: Circuit Short to Ground or Open	CLEAR the DTCs. REPEAT the self-test. If DTC B1B52:14 is recorded again, INSTALL a new PAM .

		REFER to Parking Aid Module (PAM) in this section. REPEAT the self-test.
U0155:87	Lost Communication With Instrument Panel Cluster (IPC) Control Module: Missing Message	GO to Pinpoint Test C.
U0294:87	Lost Communication With Powertrain Control Monitor Module: Missing Message	GO to Pinpoint Test D.
U3000:41	Control Module: General Check Sum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:41 is recorded again. INSTALL a new PAM. REFER to Parking Aid Module (PAM) in this section. CLEAR all DTCs. REPEAT the self-test.
U3000:46	Control Module: Calibration/Parameter Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:46 is recorded again, INSTALL a new PAM. REFER to Parking Aid Module (PAM) in this section. REPEAT the self-test.
U3000:54	Control Module: Missing Calibration	The PAM needs to be configured. CARRY OUT Programmable Module Installation (PMI) for the PAM. REFER to Section 418-01. CLEAR all DTCs. REPEAT the self-test.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Parking Aid Module (PAM)	• Fuse • Wiring, terminals or connectors • PAM	• REFER to Section 418-00.
• The parking aid is inoperative/does not operate correctly	• Parking aid sensor alignment • PAM • Rear bumper	• GO to Pinpoint Test A.
• Continuous or intermittent tone when no obstacles or fault codes are present (certain obstacles may not be detected or recognized due to their shape, size or material)	• Dirty or iced over parking aid sensor(s)	• CLEAN the rear bumper and sensors with high-pressure water.
	• Parking aid sensor bezel(s) or parking aid sensor(s) locked into the rear bumper incorrectly • Incorrectly mounted sensor and/or grommet • Parking aid sensors are not aligned correctly	• REMOVE and correctly INSTALL the parking aid sensor(s) and or bezel(s) as necessary. REFER to Parking Aid Sensor in this section.

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	• Parking aid sensor(s) • PAM	• CARRY OUT the azimuth system check and elevation system check. REFER to Azimuth System Check and Elevation System Check in this section.
• The audio does not reduce when the parking aid tone sounds	• Communication network concern • Instrument Panel Cluster (IPC) • Audio Front Control Module (ACM)	• RETRIEVE and REPAIR all related IPC and ACM DTCs. For IPC DTCs, REFER to Section 413-01. For ACM DTCs, Refer to the appropriate section in Group 415 for the procedure.
• The reverse parking aid menu is not available in the message center and cannot be deactivated	• A MyKey® restricted key is in use	• The parking aid disable feature is not available when a MyKey® restricted key is in use. This is normal operation.
• The message center displays the "Rear Parking Aid Off" selection message and cannot be selected ON	• The vehicle is equipped with a Trailer Brake Control (TBC) module and a trailer with electric trailer brakes is connected to the vehicle.	• This is normal operation. The parking aid is selected OFF when a Trailer Brake Control (TBC) module and a trailer with electric trailer brakes is connected.

Pinpoint Tests

Pinpoint Test A: The Parking Aid Is Inoperative/Does Not Operate Correctly

Normal Operation

The parking aid system is enabled when the ignition switch is in the RUN position and the reverse gear is selected. The Parking Aid Module (PAM) receives a reverse gear input message from the PCM over the High Speed Controller Area Network (HS-CAN). The PAM supplies reference voltage and signal return to the parking aid sensors. The PAM receives an input signal from each individual parking aid sensor. The system can be disabled through the message center which is part of the Instrument Panel Cluster (IPC).

This pinpoint test is intended to diagnose the following:

- Parking aid sensor alignment
- PAM
- Rear bumper

PINPOINT TEST A: THE PARKING AID IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND PAM SELF-TESTS	
• Check the PAM DTCs from the continuous and on-demand self-tests. • **Are any PAM DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** GO to A2.
A2 CHECK THE MESSAGE CENTER FOR CORRECT OPERATION	
• While observing the message center, disable and enable the parking aid system. • **Does the message center display REAR PARK AID OFF when the parking aid system is disabled, and display REAR PARK AID ON when the parking aid system is enabled?**	**Yes** GO to A3. **No** REFER to Section 413-01.
A3 CHECK FOR CORRECT REVERSE GEAR INPUT	
• Apply the parking brake. • Ignition ON. • Select REVERSE. • Enter the following diagnostic mode on the scan tool: PAM DataLogger. • Monitor the PAM TRANSGR PID. • **Does the PID read REVERSE (transmission in reverse)?**	**Yes** GO to A4. **No** GO to A5.
A4 CHECK THE PARKING AID SENSORS FOR CORRECT ALIGNMENT	
NOTE: If the vehicle was in a rear end collision, the parking aid sensors may not be aligned correctly. • Check the bumper for correct alignment. • Carry out the azimuth system check. Refer to Azimuth System Check in this section. • Carry out the elevation system check. Refer to Elevation System Check in this section. • **Does the parking aid system pass both system checks?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. **No** REALIGN or INSTALL a new bumper cover. REFER to Section 501-19. If the vehicle was in a rear end collision, additional body work may be required to bring the parking aid sensors into correct alignment.
A5 CHECK FOR CORRECT PAM OPERATION	

• Disconnect the PAM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PAM connector and make sure it
	Yes
	INSTALL a new PAM. REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.
	
	No

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seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: DTCs B1B44:01, 96; B1B46:01, 96; B1B48:01, 96; B1B50:01, 96

Refer to Wiring Diagrams Cell 131 , Parking Aid for schematic and connector information.

Normal Operation

The Parking Aid Module (PAM) supplies a reference voltage and signal return to the parking aid sensors. When an object is present behind the vehicle, the reference voltage to the PAM changes based on how close the object is from the rear of the vehicle. The input signal from the sensors determines the distance of the object to the vehicle. A fault condition occurs when the PAM detects an open in the parking aid sensor circuits or the parking aid sensor input signal is shorted to ground.

DTC Description	Fault Trigger Conditions
• B1B44:01 — Right Rear Outer Sensor: General Electrical Failure	A continuous and on-demand DTC that sets when the right rear outer parking aid sensor circuits are shorted to battery voltage, open or the sensor signal line is shorted to ground.
• B1B44:96 — Right Rear Outer Sensor: Component Internal Failure	A continuous and on-demand DTC that sets when the PAM detects an internal failure to the right rear outer parking aid sensor.
• B1B46:01 — Right Rear Inner Sensor: General Electrical Failure	A continuous and on-demand DTC that sets when the right rear inner parking aid sensor circuits are shorted to battery voltage, open or the sensor signal line is shorted to ground.
• B1B46:96 — Right Rear Inner Sensor: Component Internal Failure	A continuous and on-demand DTC that sets when the PAM detects an internal failure to the right rear inner parking aid sensor.
• B1B48:01 — Left Rear Outer Sensor: General Electrical Failure	A continuous and on-demand DTC that sets when the left rear outer parking aid sensor circuits are shorted to battery voltage, open or the sensor signal line is shorted to ground.
• B1B48:96 — Left Rear Outer Sensor: Component Internal Failure	A continuous and on-demand DTC that sets when the PAM detects an internal failure to the left rear outer parking aid sensor.
• B1B50:01 — Left Rear Inner Sensor: General Electrical Failure	A continuous and on-demand DTC that sets when the left rear inner parking aid sensor circuits are shorted to battery voltage, open or the sensor signal line is shorted to ground.
• B1B50:96 — Left Rear Inner Sensor: Component Internal Failure	A continuous and on-demand DTC that sets when the PAM detects an internal failure to the left rear inner parking aid sensor.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PAM
- Parking aid sensor(s)

- Parking aid bumper harness

PINPOINT TEST B: DTCs B1B44:01, 96; B1B46:01, 96; B1B48:01, 96; B1B50:01, 96

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 RETRIEVE THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND PAM SELF-TESTS</td><td></td></tr>
<tr><td>• Check the PAM DTCs from the continuous and on-demand self-tests.
• Are multiple DTCs recorded?</td><td>Yes
GO to B2 .

No
For DTC B1B44:01, B1B44:96, B1B46:01, B1B46:96, B1B48:01, B1B48:96, B1B50:01 or B1B50:96, GO to B3 .

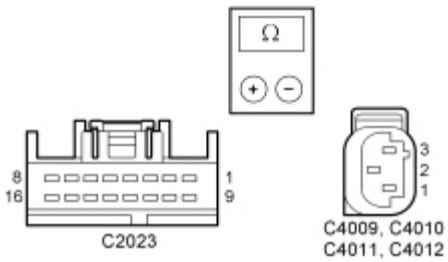
For all other DTCs, REFER to DTC Charts in this section.</td></tr>
<tr><td>B2 CHECK THE BUMPER WIRING HARNESS</td><td></td></tr>
<tr><td>• Inspect the bumper wiring harness for opens, shorts, grounds, or corrosion.
• Is the bumper wiring harness OK?</td><td>Yes
GO to B3 .

No
REPAIR or INSTALL a new bumper wiring harness. CLEAR the DTCs. REPEAT the self-test.</td></tr>
<tr><td>B3 CHECK THE SENSOR CIRCUITRY FOR OPENS</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Suspect Parking Aid Sensor C4009, C4010, C4011 or C4012.
• Disconnect: PAM C2023.
• Measure the resistance between the PAM C2023, harness side and the suspect parking aid sensor, harness side as follows:
<table>
<tr><th>DTC</th><th>Rear Sensor</th><th>PAM Connector-Pin</th><th>Sensor Connector-Pin</th><th>Circuit</th></tr>
<tr><td rowspan="2">B1B44:01, 96</td><td rowspan="2">RH outer</td><td>C2023-9</td><td>C4011-1</td><td>VMP17 (YE/OG)</td></tr>
<tr><td>C2023-13</td><td>C4011-3</td><td>RMP07 (GN/WH)</td></tr>
<tr><td rowspan="2">B1B46:01, 96</td><td rowspan="2">RH inner</td><td>C2023-10</td><td>C4012-1</td><td>VMP16 (YE/GY)</td></tr>
<tr><td>C2023-13</td><td>C4012-3</td><td>RMP07</td></tr>
</table>
</td><td>Yes
GO to B4 .

No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.</td></tr>
</table>

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				(GN/WH)
B1B48:01, 96	LH outer	C2023-12	C4009-1	VMP15 (YE/GN)
		C2023-13	C4009-3	RMP07 (GN/WH)
B1B50:01, 96	LH inner	C2023-11	C4010-1	VMP14 (WH/OG)
		C2023-13	C4010-3	RMP07 (GN/WH)



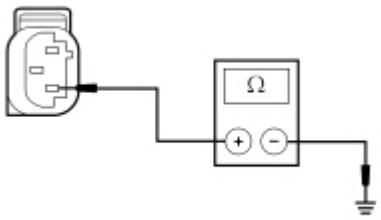
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- **Are the resistances less than 5 ohms?**

B4 CHECK THE SENSOR CIRCUITRY FOR SHORTS TO GROUND

- Measure the resistance between the suspect parking aid sensor, harness side and ground as follows:

DTC	Rear Sensor	Connector-Pin	Circuit
B1B44:01, 96	RH outer	C4011-1	VMP17 (YE/OG)
B1B46:01, 96	RH inner	C4012-1	VMP16 (YE/GY)
B1B48:01, 96	LH outer	C4009-1	VMP15 (YE/GN)
B1B50:01, 96	LH inner	C4010-1	VMP14 (WH/OG)



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Yes
GO to B5 .

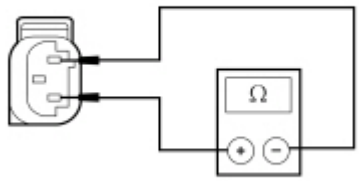
No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

- **Is the resistance greater than 10,000 ohms?**

B5 CHECK THE PARKING AID SENSOR CIRCUITRY FOR A SHORT TOGETHER

- Measure the resistance between the suspect parking aid sensor pins, harness side as follows:

DTC	Parking Aid Sensor	Connector-Pin/Circuit	Connector-Pin/Circuit
B1B44:01, 96	RH outer	C4011-1 VMP17 (YE/OG)	C4011-3 RMP07 (GN/WH)
B1B46:01, 96	RH inner	C4012-1 VMP16 (YE/GY)	C4012-3 RMP07 (GN/WH)
B1B48:01, 96	LH outer	C4009-1 VMP15 (YE/GN)	C4009-3 RMP07 (GN/WH)
B1B50:01, 96	LH inner	C4010-1 VMP14 (WH/OG)	C4010-3 RMP07 (GN/WH)



N0120897

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B6.

No
REPAIR the circuits in question. CLEAR the DTCs. TEST the system for normal operation.

B6 CHECK THE SENSOR CIRCUITRY FOR SHORTS TO VOLTAGE

- Ignition ON.
- Measure the voltage between the suspect parking aid sensor, harness side and ground as follows:

DTC	Rear Sensor	Connector-Pin	Circuit
B1B44:01, 96	RH outer	C4011-1	VMP17 (YE/OG)
B1B46:01, 96	RH inner	C4012-1	VMP16 (YE/GY)
B1B48:01, 96	LH outer	C4009-1	VMP15 (YE/GN)

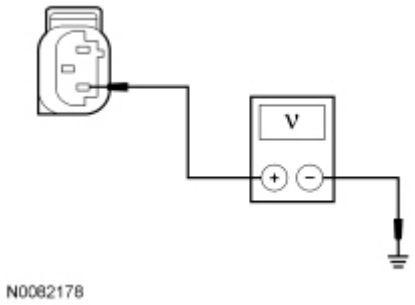
Yes
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

No
If all of the parking aid sensors recorded DTCs, GO to B7.

If one or more parking aid sensor(s) recorded DTCs, INSTALL a new sensor(s) for the one in question.

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B1B50:01, 96	LH inner	C4010-1	VMP14 (WH/OG)



- **Is any voltage present?**

REFER to Parking Aid Sensor in this section. CLEAR the DTCs. REPEAT the self-test.

B7 CHECK FOR CORRECT PAM OPERATION	

• Disconnect the PAM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PAM connector and make sure it seats correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PAM. REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: DTC U0155:87

Normal Operation

- DTC U0155:87 (Lost Communication With Instrument Panel Cluster (IPC) Control Module: Missing Message) — the Parking Aid Module (PAM) set this DTC if data messages received from the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds.

This pinpoint test is intended to diagnose the following:

- Module communication
- IPC
- PAM

PINPOINT TEST C: DTC U0155:87

Test Step	Result / Action to Take

C1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to C2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
C2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the IPC pass the network test?**	**Yes** GO to C3 . **No** REFER to Section 418-00 , The IPC Does Not Respond To The Scan Tool.
C3 CHECK THE IPC FOR DTCs	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 413-01 . **No** GO to C4 .
C4 RECHECK THE PAM DTCs	
• Clear the DTCs. • Wait 10 seconds. • Repeat the PAM self-test. • **Is DTC U0155:87 still present?**	**Yes** GO to C5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or intermittent fault condition.
C5 CHECK FOR DTC U0155 OR U0155:00 SET IN OTHER MODULES	
• Ignition ON. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0155 or U0155:00 set in the ACM or the ABS module?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.

Pinpoint Test D: DTC U0294:87

Normal Operation

- DTC U0294:87 (Lost Communication With Powertrain Control Monitor Module: Missing Message) — the Parking Aid Module (PAM) sets this DTC if data messages received from the PCM over the High Speed Controller Area Network (HS-CAN) are missing for 5 seconds.

This pinpoint test is intended to diagnose the following:

- Module communication

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- PAM
- PCM

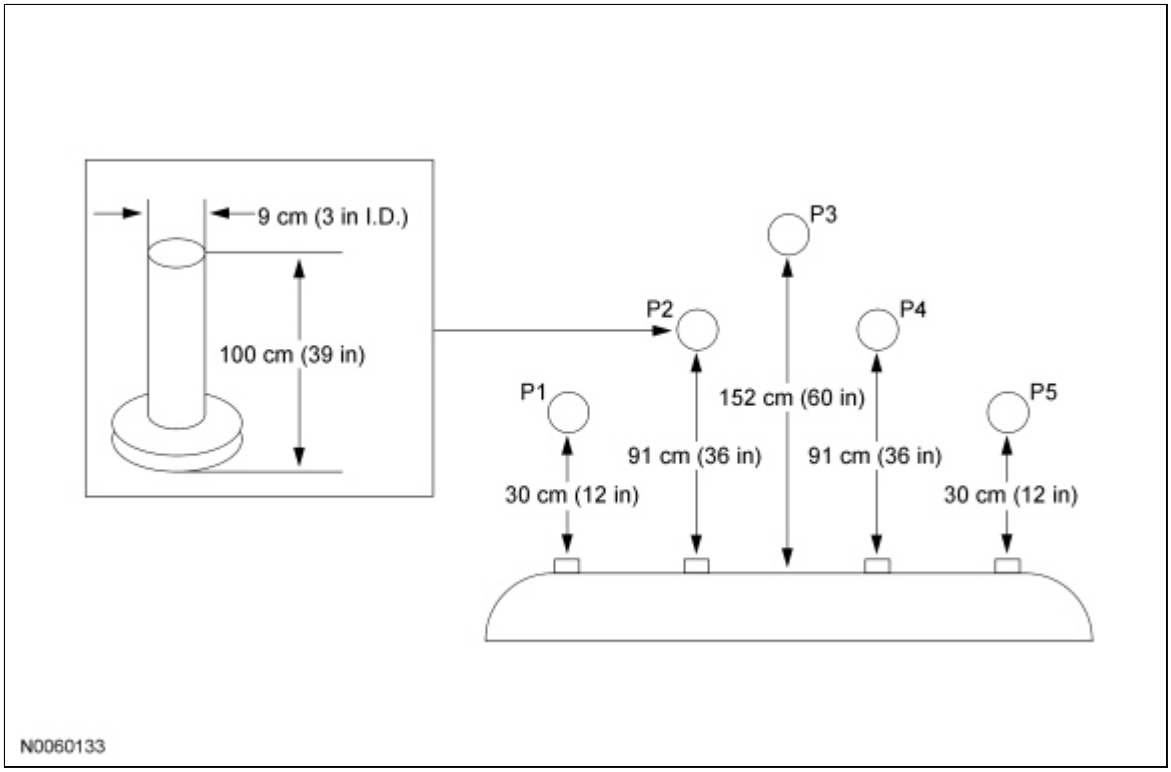
PINPOINT TEST D: DTC U0294:87

Test Step	Result / Action to Take
D1 VERIFY CUSTOMER CONCERN • Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to D2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
D2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the PCM pass the network test?**	**Yes** GO to D3 . **No** REFER to Section 418-00 , The PCM Does Not Respond To The Scan Tool.
D3 CHECK THE PCM FOR DTCs • Check for recorded PCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 303-14 . **No** GO to D4 .
D4 RECHECK THE PAM DTCs • Clear the DTCs. • Wait 10 seconds. • Repeat the PAM self-test. • **Is DTC U0294:87 still present?**	**Yes** GO to D5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or intermittent fault condition.
D5 CHECK FOR DTC U0100 OR U0100:00 SET IN OTHER MODULES • Ignition ON. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0100 or U0100:00 set in the ABS module or the IPC ?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.

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Azimuth System Check

Maximum Detectable Object Locations



1. **NOTE:** The object used in this system check can be fabricated using a 9 cm O.D. (3 in I.D.) plastic pipe 100 cm (39 in) in length (available as Polyvinyl Chloride (PVC) pipe, or similar from a hardware or plumbing supply).

   NOTE: The following system check should be carried out with the vehicle on a level surface.

   NOTE: The parking aid system will default to on when the ignition key is cycled from off to on.

   NOTE: The scan tool may be used to monitor distance PIDs. The distance PIDs read between 0 and 255 cm (0 and 8 ft) on a correctly functioning system.

   Turn the ignition switch to the ON position, engine off.

2. Set the parking brake on.

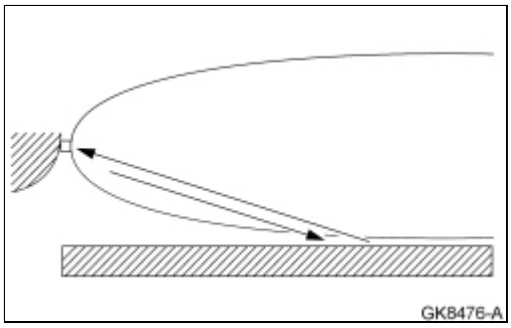
3. Place the transmission in REVERSE (R).

4. Verify that the parking aid system detects the specified object when placed in the five specified locations (P1, P2, P3, P4 and P5).
   - If the PAM does not detect the object above, refer to Parking Aid in the Diagnosis and Testing portion of this section.

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Elevation System Check

1. Check the parking aid system to make sure that the system does not see signals caused by ground reflections.



2. The following system check should be carried out with the vehicle on a 3.0 m wide by 4.5 m deep (10 ft wide by 15 ft deep) smooth concrete surface, free of all obstacles and noise from fans and pneumatic tools.

3. Turn the ignition switch to the ON position, engine off.

4. Set the parking brake on.

5. Place the transmission in REVERSE (R).

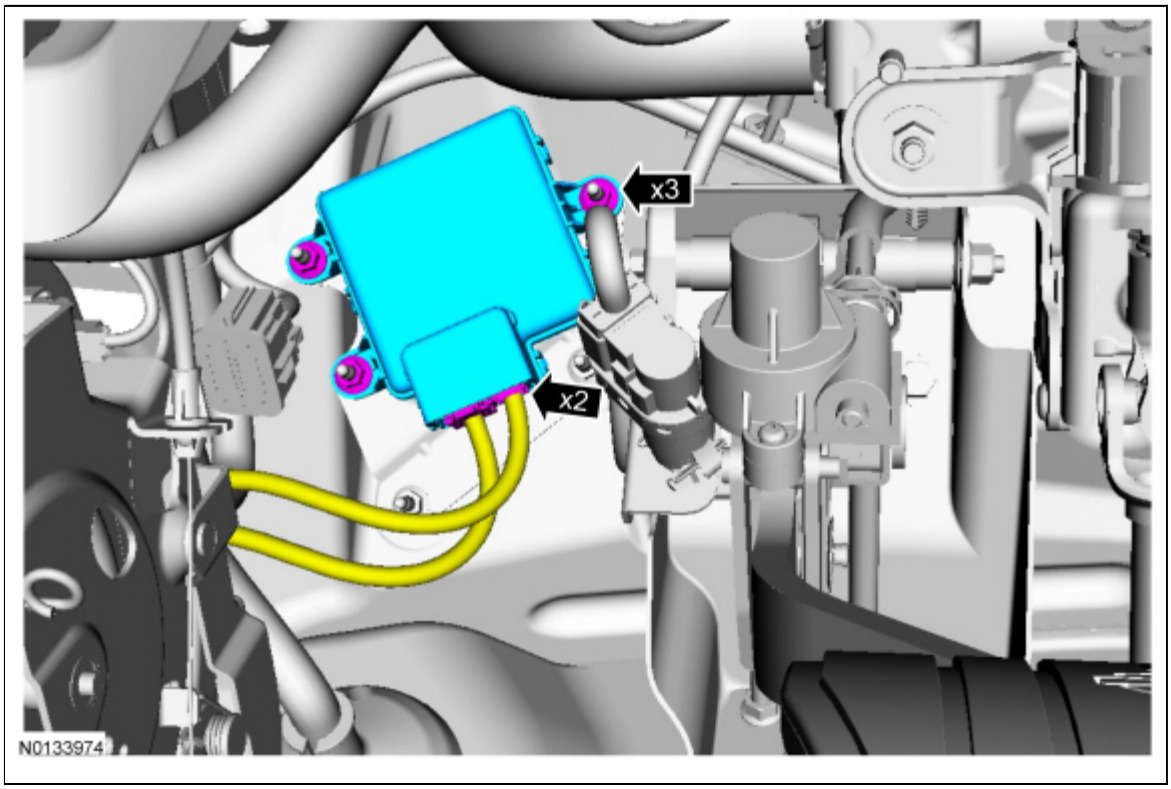
6. Verify that no audible alerts are heard. If audible alerts are heard, check to make sure the bumper is correctly installed and is not tilted downward so that the sensor is pointing toward the ground.
    - If the audible warning tone is heard, refer to Parking Aid in the Diagnosis and Testing portion of this section.

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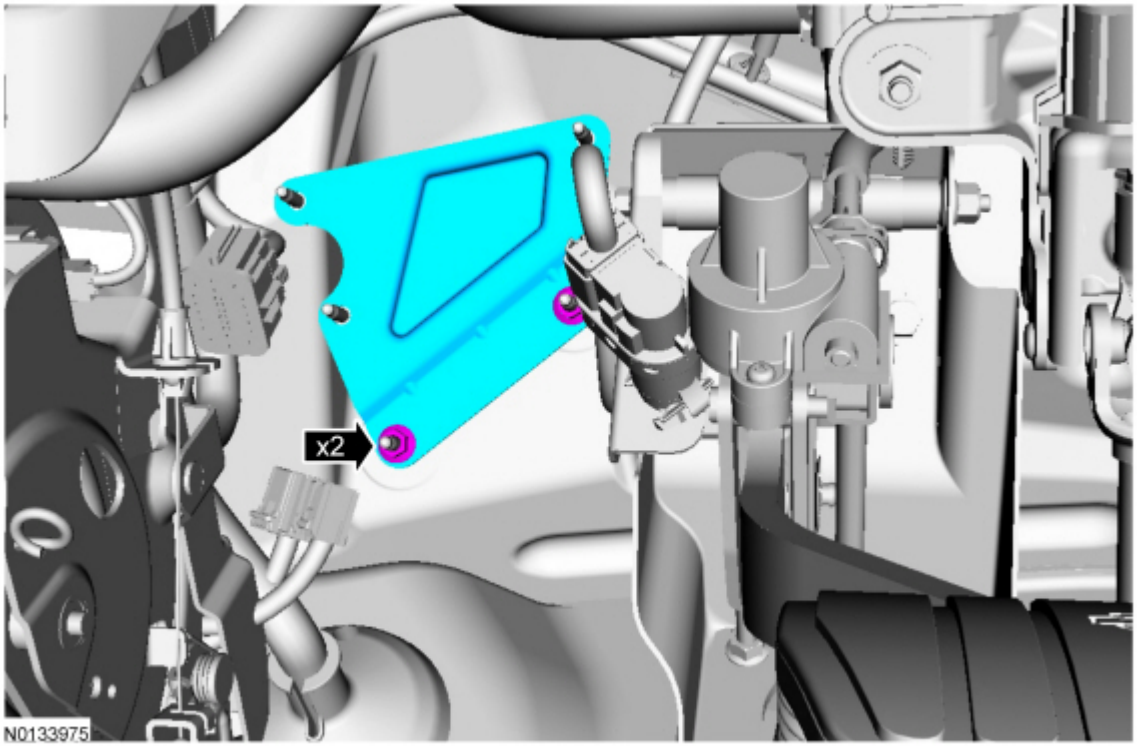
Camera Switching Module

Removal

1.



2. If required, remove the camera switching module bracket.



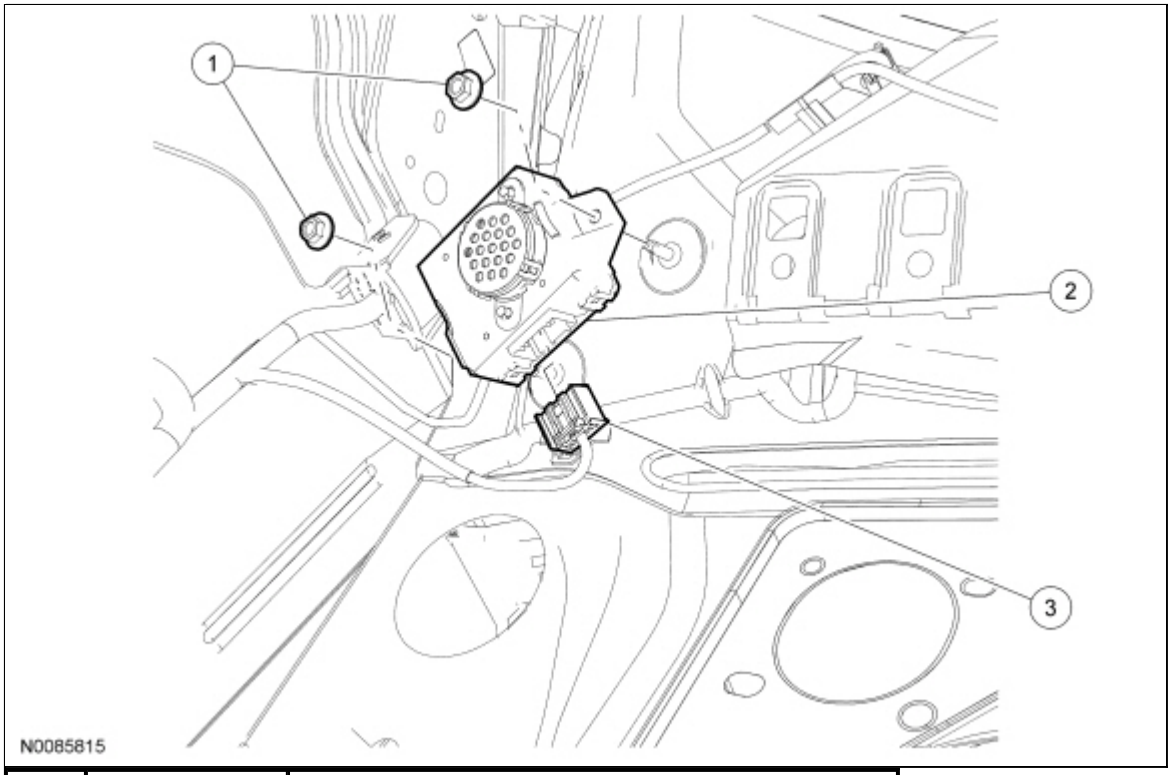
Installation

1. To install, reverse the removal procedure.

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Parking Aid Module (PAM)



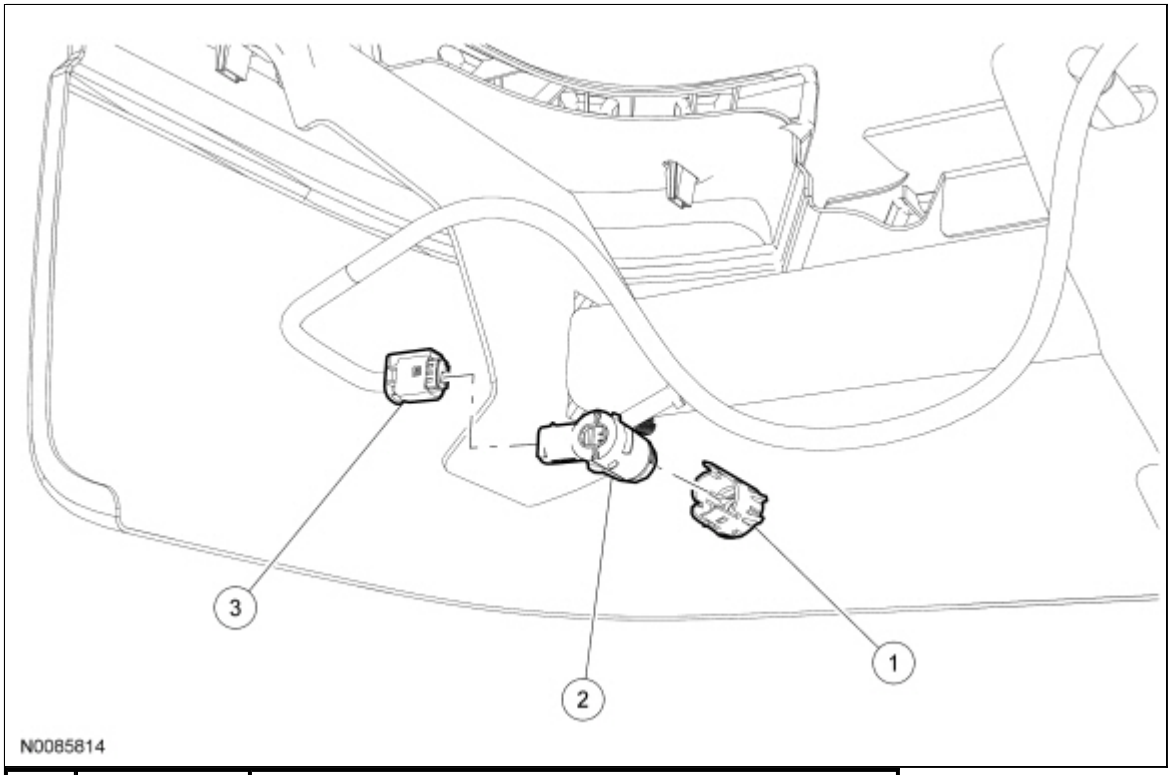
Item	Part Number	Description
1	—	Parking Aid Module (PAM) nuts (2 required)
2	157850	PAM and parking aid speaker assembly
3	—	PAM electrical connector (part of 14A005)

Removal and Installation

1. Disconnect the PAM electrical connector.
2. Remove the 2 PAM nuts.
3. Remove the PAM .
4. To install, reverse the removal procedure.

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Parking Aid Sensor



Item	Part Number	Description
1	—	Parking aid sensor bezel
2	15K859	Parking aid sensor
3	—	Parking aid sensor electrical connector (part of 13A576)

Removal

1. Disconnect the parking aid sensor electrical connector.

2. Using a suitable tool (such as a flat-bladed screwdriver), carefully pry away the retaining tabs to remove the parking aid sensor from the sensor bezel.
   - Remove the parking aid sensor from the rear bumper.

Installation

1. To install the parking aid sensor in the rear bumper, insert the sensor in the sensor bezel opening until the retaining tabs lock in position.

2. Connect the parking aid sensor electrical connector.

3. After installing the sensor(s), use the scan tool to verify that the parking aid sensor PIDs read no

object present.

4. Carry out the azimuth and elevation test. For additional information, refer to Azimuth System Check and Elevation System Check in this section

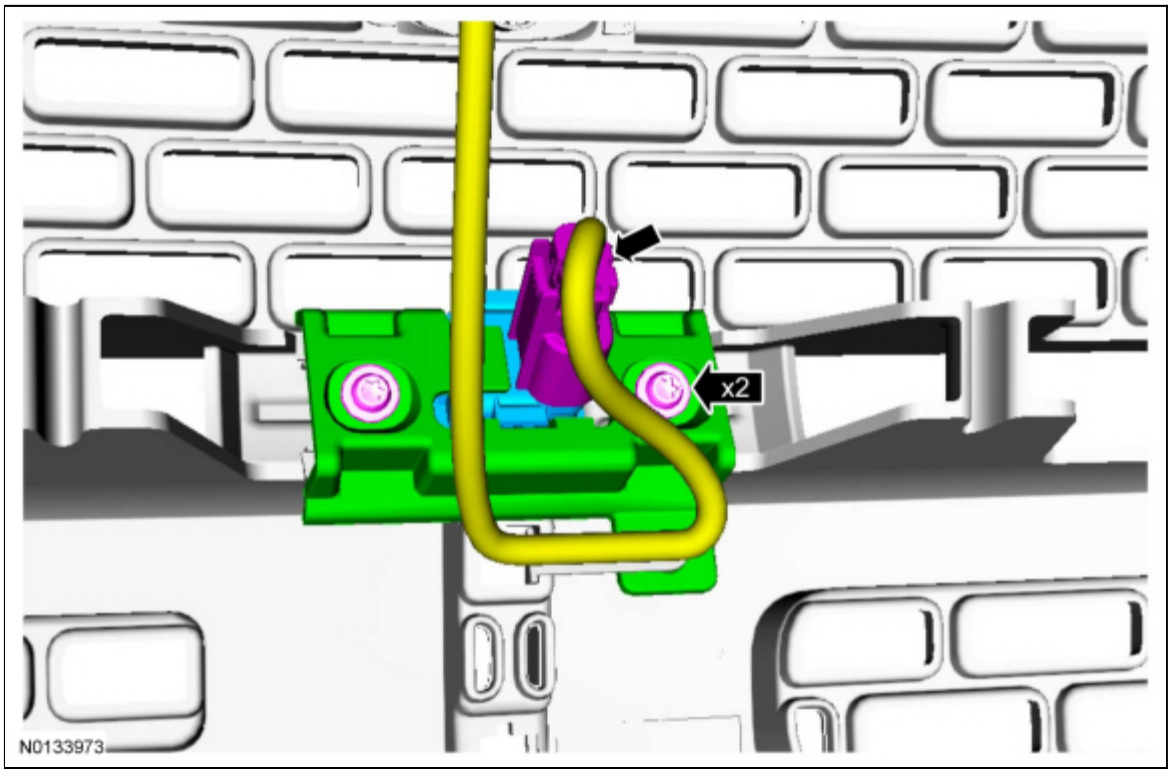
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Video Camera — Front

Removal

1.



Installation

1. To install, reverse the removal procedure.

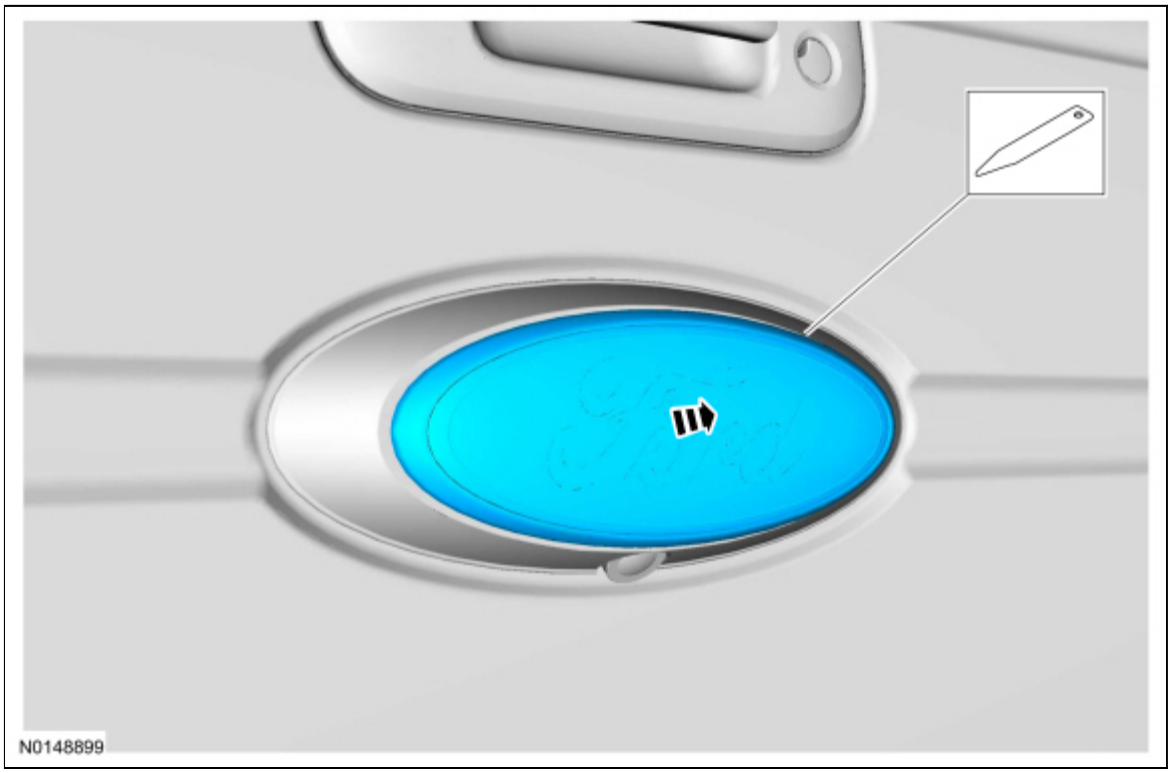
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Video Camera — Rear

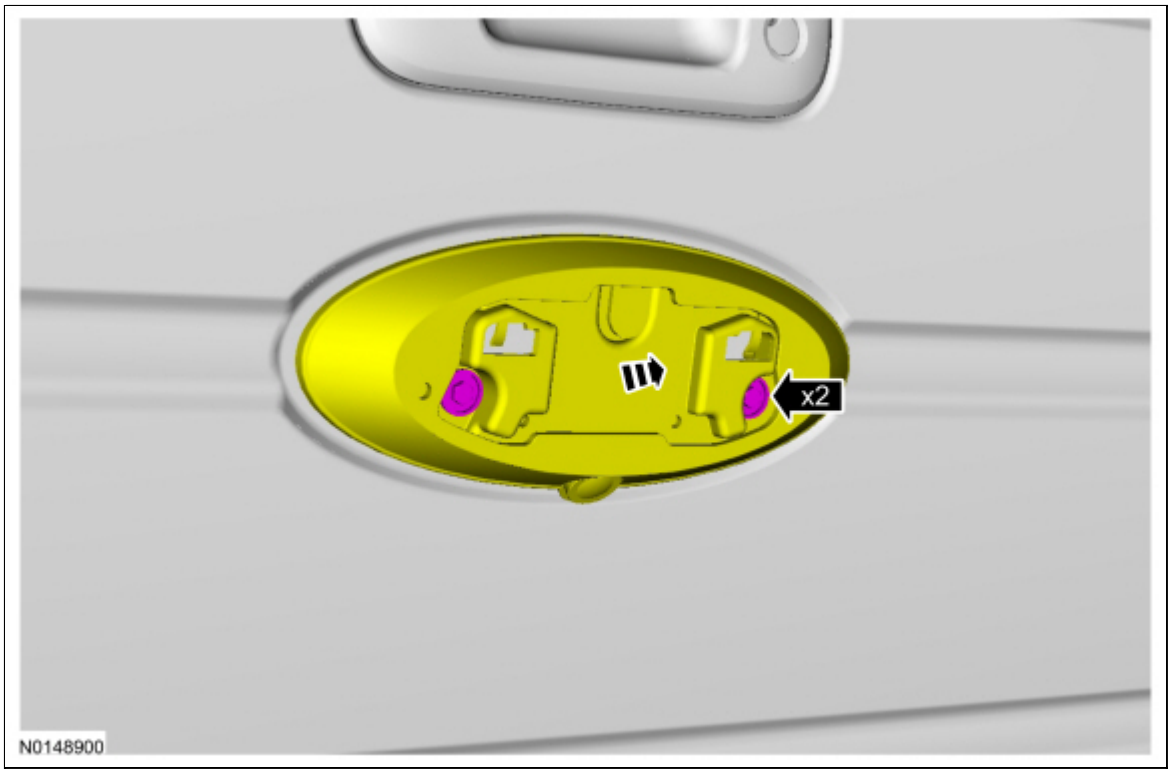
Removal and Installation

NOTE: The Ford oval emblem must be replaced, as the tabs break during removal.

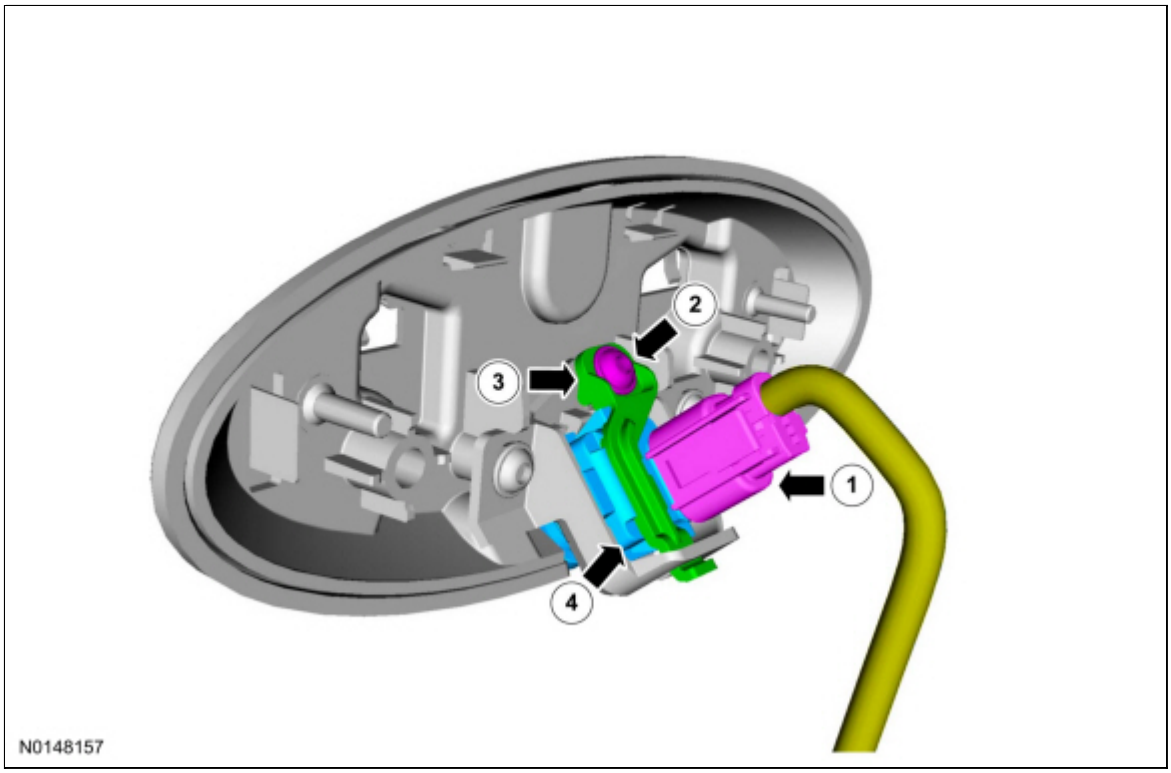
1.



2.



3.



4. To install, reverse the removal procedure.
    - Configure the rear video camera following the instructions on the scan tool.

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General Specifications

Item	Specification
Generator (3.5L, with AC powerpoint or climate control seats)	
Generator pulley ratio	2.67:1
Rating	220 amps
Output	92 amps @ 580 rpm (min) to 217 amps @ 2,000 rpm (max)
Generator (3.5L, without AC powerpoint or climate control seats)	
Generator pulley ratio	2.67:1
Rating	200 amps
Output	90 amps @ 580 rpm (min) to 209 amps @ 2,000 rpm (max)
Generator (3.7L, with AC powerpoint or climate control seats)	
Generator pulley ratio	2.67:1
Rating	220 amps
Output	74 amps @ 550 rpm (min) to 217 amps @ 2,000 rpm (max)
Generator (3.7L, without AC powerpoint or climate control seats)	
Generator pulley ratio	2.67:1
Rating	200 amps
Output	72 amps @ 550 rpm (min) to 209 amps @ 2,000 rpm (max)
Generator (5.0L, with AC powerpoint or climate control seats)	
Generator pulley ratio	2.95:1
Rating	220 amps
Output	92 amps @ 525 rpm (min) to 220 amps @ 2,000 rpm (max)
Generator (5.0L, without AC powerpoint or climate control seats)	
Generator pulley ratio	2.95:1
Rating	200 amps
Output	90 amps @ 525 rpm (min) to 211 amps @ 2,000 rpm (max)
Generator (6.2L, Base)	
Generator pulley ratio	2.95:1
Rating	155 amps
Output	66 amps @ 525 rpm (min) to 160 amps @ 2,000 rpm (max)
Generator (6.2L, Optional)	
Generator pulley ratio	2.95:1
Rating	200 amps
Output	90 amps @ 525 rpm (min) to 211 amps @ 2,000 rpm (max)

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Torque Specifications

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner bolt	48	35	—
Generator B+ terminal nut	17	—	150
Generator bolts	48	35	—
Generator stud (3.5L)	8	—	71
Generator stud nut (3.5L and 3.7L)	48	35	—

Charging System

The charging system is a negative ground system consisting of:

- a generator with an internal voltage regulator
- a charging system warning indicator
- a battery
- circuitry and cables
- a PCM
- a radial arm adapter (serviced separately from the generator)
- a battery current sensor
- a generator current sensor

The generator is driven by the accessory drive belt. When the engine is started, the generator begins to generate AC voltage which is internally converted to DC voltage. The DC voltage is controlled by the voltage regulator (located on the rear of the generator) and supplied to the battery. The PCM controls the voltage regulation set point, working with the generator internal voltage regulator over 2 control and communication circuits.

This vehicle is equipped with load shed strategy. The Body Control Module (BCM) monitors the battery state of charge using the battery current sensor attached to the negative battery cable and the battery open circuit voltage as measured by the BCM during 8 continuous hours of vehicle sleep time (ignition off with doors closed).

With the engine off and the ignition in the ACC, RUN or delayed accessory position, when the BCM determines the battery state of charge is low, a message is sent to shut down the audio/navigation system in order to save the remaining battery charge. Under this condition:

- the Front Display Interface Module (FDIM) displays SYS OFF TO SAVE BATT (without navigation) or BATTERY SAVER — SYSTEM OFF PLEASE START THE ENGINE (with navigation).
- the Instrument Panel Cluster (IPC) message center may also display TURN POWER OFF TO SAVE BATT (base message center) or TURN POWER OFF TO SAVE BATTERY (optional message center) to notify the driver that battery protection actions are active.
- the battery indicator may also illuminate.

If the vehicle battery has been charged or battery replaced , it takes approximately 8 hours for the BCM to learn the new battery state of charge. During this 8 hour period, the vehicle must be undisturbed, with no doors opened or keyless entry buttons pressed. If the vehicle is used before the BCM is allowed to learn the new battery state of charge, engine off load shedding may occur earlier than normal and a message may be displayed.

If the vehicle has been jump started , engine off load shedding can still occur and a message may be displayed until the BCM determines the battery state of charge is above 40%.

With the engine running, when the BCM and Power Steering Control Module (PSCM) voltage is low, a message is sent from the BCM to either minimize or shut down the climate controlled seats, rear defrost, heated mirrors and Dual Automatic Temperature Control (DATC) blower motor to improve system voltage. Under this condition, the IPC message center displays either LOW BATTERY LESS FEATURES (base message center) or LOW BATTERY FEATURES TEMPORARILY TURNED OFF (optional message center) to notify the driver that battery protection actions are active.

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The PCM monitors the generator current using the generator current sensor attached to the generator B+ battery cable. This is used for engine idle stability and torque control.

Diagnostic Trouble Code (DTC) Chart

NOTE: The Body Control Module (BCM) utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Source	Action
P0562	System Voltage Low	PCM	GO to Pinpoint Test B.
P0563	System Voltage High	Various Modules	GO to Pinpoint Test A.
P0620	Generator Control Circuit	PCM	GO to Pinpoint Test C.
P0625	Generator Field Terminal Circuit Low	PCM	GO to Pinpoint Test D.
P0626	Generator Field Terminal Circuit High	PCM	GO to Pinpoint Test D.
P065B	Generator Control Circuit Range/Performance	PCM	GO to Pinpoint Test E.
P0A5A	Generator Current Sensor Circuit Range/Performance	PCM	GO to Pinpoint Test H.
P0A5B	Generator Current Sensor Circuit Low	PCM	GO to Pinpoint Test H.
P0A5C	Generator Current Sensor Circuit High	PCM	GO to Pinpoint Test H.
P1397	System Voltage Out Of Self-Test Range	PCM	If combined with P0562, GO to Pinpoint Test B. If combined with P0563, GO to Pinpoint Test A.
B1317	Battery Voltage High	Various Modules	GO to Pinpoint Test A.
B1318	Battery Voltage Low	Various Modules	GO to Pinpoint Test B.
B1676	Battery Pack Voltage Out of Range	Various Modules	If combined with B1317, GO to Pinpoint Test A. If combined with B1318, GO to Pinpoint Test B.
U1007:31	Lost Communication With Battery Monitoring Sensor "A": No Signal	BCM	GO to Pinpoint Test I.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	Various Modules	GO to Pinpoint Test B.
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	Various Modules	GO to Pinpoint Test A.
All other	—	Various	REFER to Section 419-10 or the PCM DTC

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DTCs		Modules	Chart in Section 303-14 . If directed to this section from another section, GO to Symptom Chart in this section.

Inspection And Verification

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

WARNING: Always lift a plastic-cased battery with a battery carrier or with hands on opposite corners. Excessive pressure on the battery end walls may cause acid to flow through the vent caps, resulting in personal injury and/or damage to the vehicle or battery.

***NOTICE:* Do not make jumper connections except as directed. Incorrect connections may damage the voltage regulator test terminals or fuses.**

***NOTICE:* Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins. A short circuit may result and burn out the diodes.**

NOTE: While carrying out any pinpoint test, disregard any DTCs set while following a specific pinpoint test. After the completion of a test, be sure to clear all DTCs in the PCM.

NOTE: All voltage measurements are referenced to the negative (-) battery post unless otherwise specified.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Battery • Front End Accessory Drive (FEAD) belt • Generator pulley	• Wiring, terminals or connectors • Cables • Battery • Generator • Fuses

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3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. Verify the battery condition. Refer to Section 414-01 .

5. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

6. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
     - The air bag warning indicator prove-out (other indicators may NOT prove ignition is on) confirms ignition on. If ignition does not turn on, refer to Section 211-05 to diagnose no power in RUN.
   - refer to Section 418-00 , Inspection and Verification, to establish a scan tool session (without the ignition on).
   - verify the scan tool operation with a known good vehicle.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .

NOTE: Use the Integrated Diagnostic System (IDS) feature that retrieves all Continuous Memory Diagnostic Trouble Codes (CMDTCs) from all modules at one time.

9. Retrieve CMDTCs from all modules.

10. **NOTE:** If no charging system DTCs are present, the charging system is operating correctly. If the charging system has a concern, it usually sets a charging system DTC.

    If the DTCs retrieved are related to the concern, go to the Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Master DTC Chart in Section 419-10 or Powertrain Control/Emissions Diagnosis (PC/ED) manual.

11. If no DTCs related to the concern are retrieved, go to the Symptom Chart in this section.

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Pinpoint Test

Special Tool(s)

 ST3104-A	Backprobe Pins POM6411 or equivalent
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3285-A	GR 1 190 V3.0 Intelligent Diagnostic Charger 162-00036 or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-350 mA incandescent bulb test lamp SGT27000
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Pinpoint Test A: System Voltage High

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

NOTE: DTC P1397 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if vehicle accessories have been operating for an extended period of time without the engine running.

Normal Operation

With the engine running, the charging system supplies voltage to the battery and the vehicle electrical system through the battery B+ cable. The voltage that is supplied to the vehicle electrical system is used for the operation of the various vehicle systems and modules. Many modules monitor this voltage and if it rises above or below their calibrated setpoints, a DTC sets.

DTC Description	Fault Trigger Condition
• P0563 — System Voltage High	If the module detects a voltage from the charging system higher than 15.2 volts, this DTC sets. This DTC does not set in the PCM unless the vehicle speed is above 8 km/h (5 mph).
• P1397 — System Voltage Out of Self-Test Range	If the voltage rises above or drops below the calibrated set point, the PCM sets this DTC. This DTC may also be set if the vehicle has been recently jump started or has had a discharged battery.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Engine, generator and battery grounds
- Battery
- Generator
- PCM

PINPOINT TEST A: SYSTEM VOLTAGE HIGH

NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

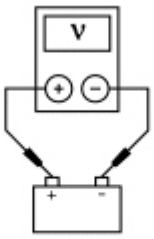
NOTE: Do not have a battery charger attached during vehicle testing.

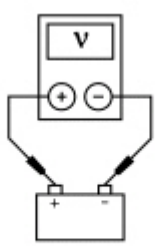
Test Step	Result / Action to Take
A1 CHECK BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to A2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A2 RETRIEVE PCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self-	**Yes**

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Test — PCM . • **Is DTC P0620, P0625, P0626 or P065B present?**	For **DTC P0620** , GO to Pinpoint Test C . For **DTCs P0625 and P0626** , GO to Pinpoint Test D . For **DTC P065B** , GO to Pinpoint Test E . **No** GO to A3 .

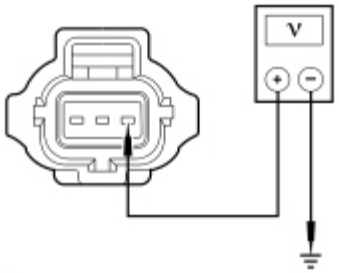
A3 MONITOR PCM PID GENERATOR VOLTAGE DESIRED (GENVDSD)
 	
• Start the engine.
• **NOTE:** Many of the PCM PIDs selected will be monitored later in this pinpoint test.
• Select and monitor the following PCM PIDs:
  ▪ Generator Monitor (GENMON)
  ▪ Generator Command (GENCMD)
  ▪ Generator Voltage Desired (GENVDSD)
  ▪ Module Supply Voltage (VPWR)
• Monitor the GENVDSD PID.
• **Does the GENVDSD PID indicate 15.1 volts or less?**
	Yes
	GO to A4 .
	
	No
	GO to A12 .

A4 MONITOR PCM PID GENERATOR VOLTAGE DESIRED (GENVDSD) • With the engine still running at idle, measure battery voltage and record.  AJ0210-A • Monitor the GENVDSD PID. • **Is battery voltage within ±0.5 volt of the PID GENVDSD?**	**Yes** The fault is not present at this time. This may indicate an intermittent fault. CARRY OUT a wiggle test on the charging system circuits to try and RECREATE the concern. CHECK generator connections for corrosion, loose connections and/or bent terminals. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A5 .
A5 MEASURE THE "A" SENSE VOLTAGE • Ignition OFF. • Disconnect: Generator C102A . • Ignition ON. • Measure battery voltage and record.	**Yes** GO to A6 . **No** **For 3.5L, 3.7L and 5.0L engines** , VERIFY Battery Junction Box (BJB) fuse 45 (10A) is OK. If OK, REPAIR circuit SBB45 (GY/RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs.



AJ0210-A

- Measure the voltage between:
  - **For 3.5L, 3.7L and 5.0L engines** , generator C102A-3, circuit SBB45 (GY/RD), harness side and ground.
  - **For 6.2L engines** , generator C102A-3, circuit SDC14 (RD), harness side and ground.



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- **Is the "A" sense voltage equal to battery voltage?**

REPEAT the self-test. TEST the system for normal operation.

For 6.2L engines , VERIFY fusible links are OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

A6 "A" SENSE CIRCUIT LOAD TEST

NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.**

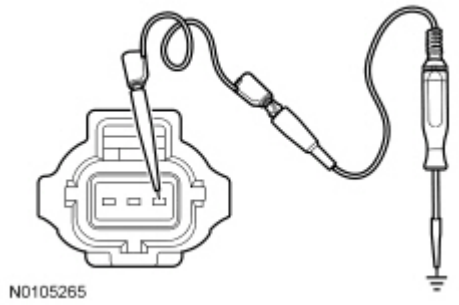
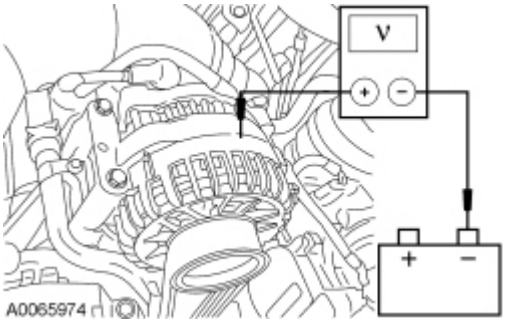
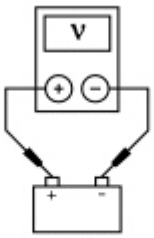
NOTE: This step puts a load on the "A" sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit cannot be loaded correctly using an LED-style test lamp.

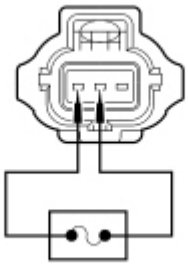
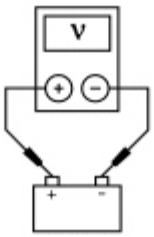
- Using a 12-volt test lamp connected to ground, while performing a wiggle test on the generator harness, check for voltage at:
  - **For 3.5L, 3.7L and 5.0L engines** , generator C102A-3, circuit SBB45 (GY/RD), harness side.
  - **For 6.2L engines** , generator C102A-3, circuit SDC14 (RD), harness side.

Yes
GO to A7 .

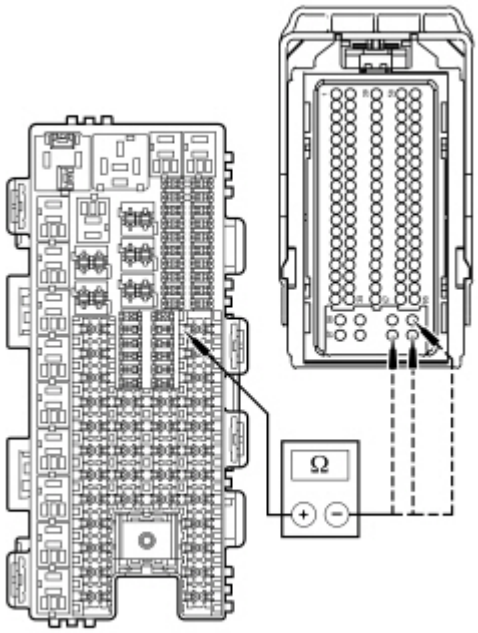
No
REPAIR corroded or loose connection on circuit SDC14 (RD). INSPECT generator C102A-3, circuit SDC14 (RD) or SBB45 (GY/RD) for damage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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 N0105265 • **Does the test lamp illuminate?**	
A7 CHECK THE VOLTAGE DROP IN THE VEHICLE GROUNDS	
• Connect: Generator C102A . • Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator case, and the negative battery terminal.  A0065974 • **Is the voltage drop less than 0.25 volt (250mV)?**	**Yes** GO to A8 . **No** INSPECT and REPAIR the engine ground, generator ground or the battery ground for corrosion as required. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A8 CHECK THE GENERATOR OUTPUT	
• With the engine still running at idle, increase engine rpm until generator starts to generate output. • With the engine running, measure battery voltage and record.  AJ0210-A • **Is the voltage above 15.2 volts?**	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A9 .
A9 MONITOR PCM PIDs GENERATOR COMMAND (GENCMD), GENERATOR MONITOR (GENMON) AND GENERATOR VOLTAGE DESIRED (GENVDSD)	
• Ignition OFF. • Disconnect: Generator C102A . • Connect a fused jumper wire between generator C102A-1, CDC15 (VT), harness side and generator C102A-2, circuit	**Yes** GO to A10 . **No**

CDC10 (BU/OG), harness side.  N0074142 • Start the engine. • Monitor the GENVDSD, GENMON and GENCMD PIDs. • Using the active command, set GENVDSD PID to 14 volts. • **Does the GENCMD PID read within 5% of GENMON PID?**	GO to A12 .
A10 COMPARE PCM SUPPLY VOLTAGE (VPWR) PID TO BATTERY VOLTAGE • With the engine still running at idle, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • **Does PCM VPWR PID accurately display battery voltage within ±0.5 volt?**	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A11 .
A11 CHECK PCM SUPPLY VOLTAGE CIRCUITS • Ignition OFF. • Disconnect: Fused Jumper Wire . • Disconnect: BJB fuse 75 . • Disconnect: PCM C1551B (3.5L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1381B (5.0L and 6.2L) . • **For 3.5L equipped vehicles** , measure resistance between BJB and PCM, harness side as follows: **PCM Connector-Pin** / **BJB Fuse** / **Circuit** C1551B-101 / 75 (25A) / CBB75 (YE/GY) C1551B-102 / 75 (25A) / CBB75 (YE/GY) C1551B-103 / 75 (25A) / CBB75 (YE/GY)	**Yes** GO to A12 . **No** REPAIR high resistance or loose connections in the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

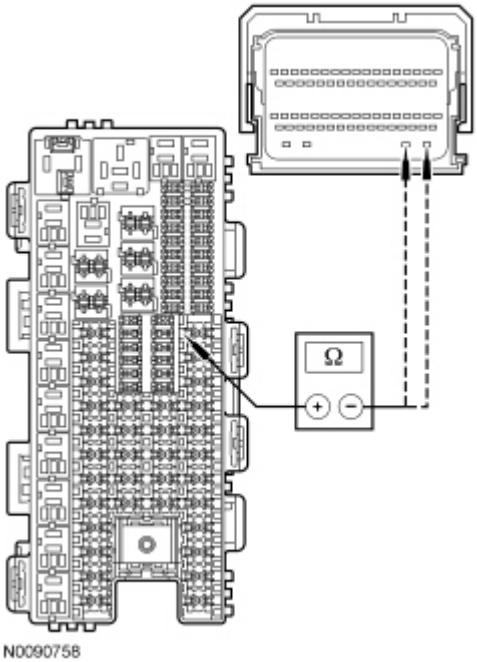
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- **For 3.7L equipped vehicles** , measure the resistance between the BJB and the PCM, harness side as follows:

PCM Connector-Pin	BJB Fuse	Circuit
C175B-67	75 (15A)	CBB75 (YE/GY)
C175B-68	75 (15A)	CBB75 (YE/GY)

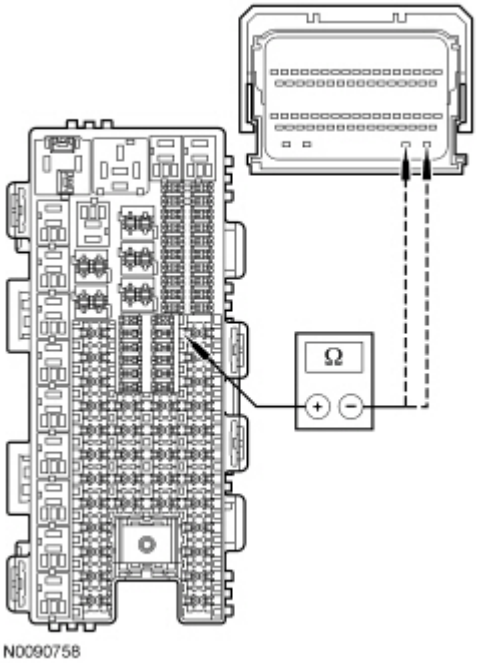


N0090758

- **For 5.0L and 6.2L equipped vehicles** , measure the resistance between the BJB and the PCM, harness side as

follows:

PCM Connector-Pin	BJB Fuse	Circuit
C1381B-67	75 (15A)	CBB75 (YE/GY)
C1381B-68	75 (15A)	CBB75 (YE/GY)



- **Are the resistances less than 0.5 ohm?**

A12 CHECK FOR CORRECT PCM OPERATION
• Ignition OFF.
• Reinstall BJB fuse 75.
• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PCM connectors and make sure they seat correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test B: System Voltage Low or Battery is Discharged

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

NOTE: DTC P0562 or P1397 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive

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load(s) on the charging system from aftermarket accessories or if vehicle accessories have been operating for an extended period of time without the engine running.

Normal Operation

With the engine running, the charging system supplies voltage to the battery and the vehicle electrical system through the battery B+ cable. The PCM monitors this voltage through the battery positive post through the Battery Junction Box (BJB). If voltage drops 1.5 volts or more below the generator voltage desired, this DTC sets after 30 seconds.

DTC Description	Fault Trigger Condition
• P0562 — System Voltage Low	If the PCM detects voltage from the charging system that is 1.5 volts lower than the generator voltage desired, this DTC sets.
• P1397 — System Voltage Out of Self-Test Range	If the voltage rises above or drops below the calibrated set point, the PCM sets this DTC. This DTC may also be set if the vehicle has been recently jump started or has had a discharged battery.

This pinpoint test is intended to diagnose the following:

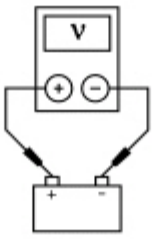
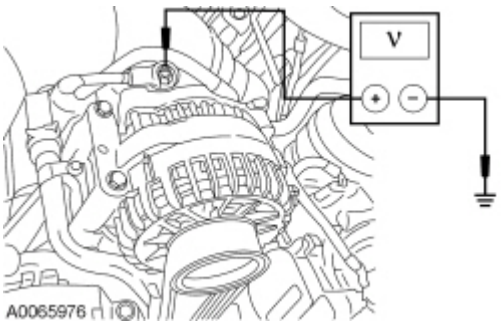
- Fuse
- Fusible link
- Wiring, terminals or connectors
- Engine, generator and battery grounds
- Abnormal ignition-off current drain(s)
- Radial arm adapter
- Battery
- Generator
- PCM

PINPOINT TEST B: SYSTEM VOLTAGE LOW OR BATTERY IS DISCHARGED

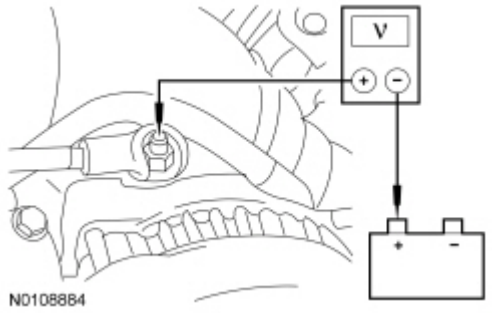
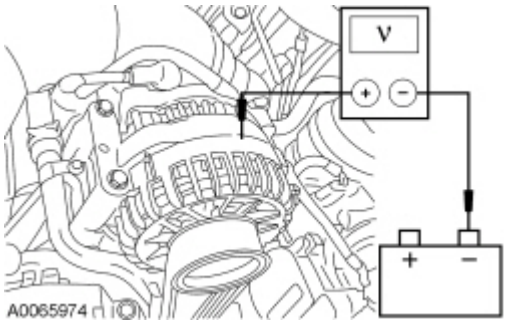
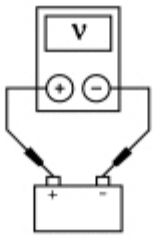
NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

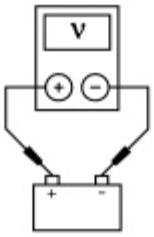
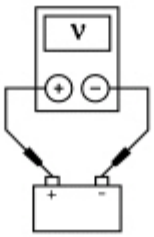
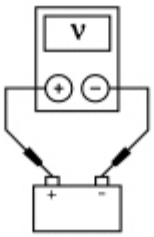
NOTE: Do not have a battery charger attached during vehicle testing.

Test Step	Result / Action to Take
B1 RETRIEVE PCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self-Test — PCM . • **Is DTC P0620, P0625, P0626 or P065B present?**	**Yes** For **DTC P0620** , GO to Pinpoint Test C . For **DTCs P0625 and P0626** , GO to Pinpoint Test D . For **DTC P065B** , GO to Pinpoint Test E . **No** GO to B2 .
B2 CHECK BATTERY CONDITION	

• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to B3 . **No** INSTALL a new battery. REFER to Section 414-01 . TEST the system for normal operation.
B3 CHECK THE GENERATOR CONNECTIONS • Ignition OFF. • Inspect generator C102A connection. Connector should be installed correctly and tight. • Disconnect: Generator C102A . • Inspect generator C102A for bent and/or pushed-out pins. • Inspect generator C102B, B+ circuit SDC14 (RD). Connection should be tight. • Measure the battery voltage.  AJ0210-A • **NOTE:** 6.2L shown, others similar. • Measure the voltage between generator C102B, B+ circuit SDC14 (RD) and ground.  A0065976 • **Is generator C102B connection tight and does the generator B+ measure battery voltage?**	**Yes** GO to B4 . **No** **For 3.5L, 3.7L and 5.0L engines** , TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B4 CHECK THE VOLTAGE DROP IN THE B+ CIRCUIT • Connect: Generator C102A . • Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator B+ C102B, circuit SDC14 (RD) and the positive battery terminal.	**Yes** GO to B5 . **No** INSPECT circuit SDC14 (RD), radial arm adapter and the positive battery cable for loose connections, physical damage or wire corrosion. REPAIR as required. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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 • Carry out a wiggle test of the generator wiring and connections while measuring voltage drop. • **Is the voltage drop less than 0.5 volt?**	
B5 CHECK THE VOLTAGE DROP IN THE VEHICLE GROUNDS	
• Connect: Generator C102A . • Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator case, and the negative battery terminal.  • **Is the voltage drop less than 0.25 (250mV) volt?**	**Yes** GO to B6 . **No** INSPECT and REPAIR the engine ground, generator ground or the battery ground for corrosion as required. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B6 COMPARE PCM MODULE SUPPLY VOLTAGE (VPWR) PID	
• With the engine still running at idle, headlamps on and blower on high, measure the battery voltage at the battery and monitor the PCM VPWR PID.  • **Does PCM VPWR PID display battery voltage within ±0.5 volt?**	**Yes** GO to B7 . **No** REPAIR high resistance or loose connections in the affected PCM power circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B7 CHECK PCM GROUND FOR HIGH RESISTANCE	
• Monitor PCM VPWR PID. • With the engine still running at idle, turn off all	**Yes** GO to B8 .

accessory loads, measure the battery voltage at the battery and note the PCM VPWR PID.  AJ0210-A • With the engine still running at idle, turn headlamps on and blower on high, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • **Does the VPWR PID read within ±0.5 volt with accessory loads on as compared to accessory loads off?**	**No** REPAIR the affected PCM ground circuits. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B8 MONITOR PID VPWR AT WOT	
• With the engine still running at idle, turn off all accessory loads, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • Monitor the VPWR PID and momentarily accelerate the engine to Wide Open Throttle (WOT) and release. Repeat this step 4-5 times while continuing to monitor the VPWR PID. • **Does the VPWR PID stay within 1.5 volt of battery voltage when the engine rpms are increased?**	**Yes** GO to B9 . **No** GO to B10 .
B9 CHECK FOR CURRENT DRAINS	
• With the engine still running at idle, measure the	**Yes**

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battery voltage at the battery. • Monitor PCM PIDs generator voltage desired (GENVDSD) and generator monitor (GENMON). • **Does GENMON PID frequently rise above 90% and battery voltage drop below GENVDSD PID by 0.5 volt or more?**	CARRY OUT the Component Test, Battery — Drain Test. REFER to Section 414-01 . **No** **For 3.5L, 3.7L and 5.0L engines** , VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , VERIFY fusible links are OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B10 CHECK FOR CORRECT PCM OPERATION • Ignition OFF. • Disconnect all the PCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the PCM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: DTC P0620

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

Normal Operation

The PCM monitors the generator output via the generator monitor (GENMON) circuit. The PCM uses the generator command (GENCOM) circuit to command the generator to either increase or decrease output. If the GENCOM circuit (generator control circuit) or the "A" sense circuit are open or shorted to ground, the PCM will not be able to control the generator output. When the engine speed is greater than approximately 2,000 rpm, the generator defaults to a steady voltage output of approximately 13.5 volts and the PCM sends a request to the Instrument Panel Cluster (IPC) to illuminate the charging system warning indicator. A GENCOM circuit fault can be confirmed by viewing the PCM PID generator command line fault (GENCMD_LF) (YES status indicator fault).

- DTC P0620 (Generator Control Circuit) — The PCM sets this DTC if the GENCOM circuit or "A" sense circuit are open or shorted to ground.

This pinpoint test is intended to diagnose the following:

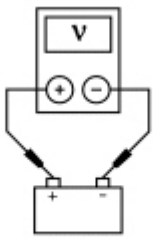
- Fuse
- Wiring, terminals or connectors

- Radial arm adapter
- Generator
- PCM

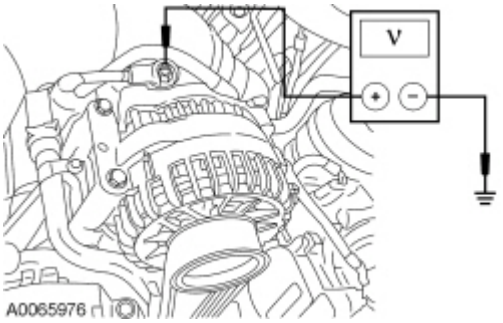
PINPOINT TEST C: DTC P0620

NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

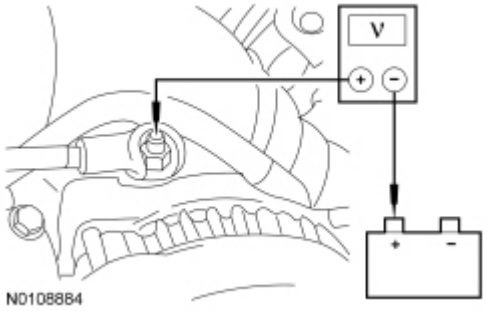
NOTE: Do not have a battery charger attached during vehicle testing.

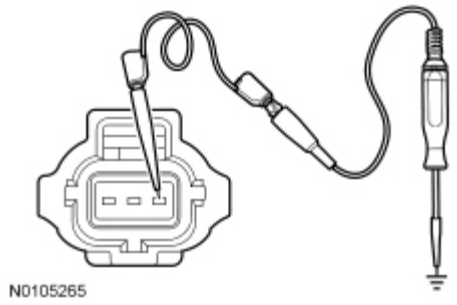
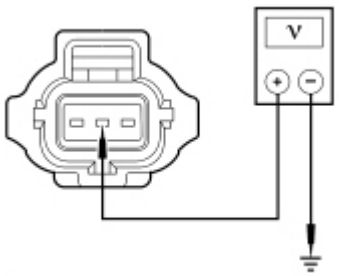
Test Step	Result / Action to Take
C1 CHECK THE BATTERY CONDITION • Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to C2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C2 CHECK THE GENERATOR CONNECTIONS • Ignition OFF. • Inspect generator C102A connection. Connector should be installed correctly and tight. • Disconnect: Generator C102A . • Inspect generator C102A for bent and/or pushed-out pins. • Inspect generator C102B, B+ circuit SDC14 (RD). Connection should be tight. • Measure the battery voltage.  AJ0210-A • **NOTE:** 6.2L shown, others similar. • Measure the voltage between generator C102B, B+ circuit SDC14 (RD) and ground.	**Yes** GO to C3 . **No** **For 3.5L, 3.7L and 5.0L engines** , VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , VERIFY fusible links are OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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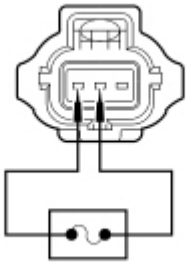
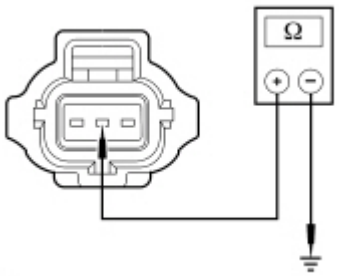


- **Is generator C102B connection tight and does the generator B+ measure battery voltage?**

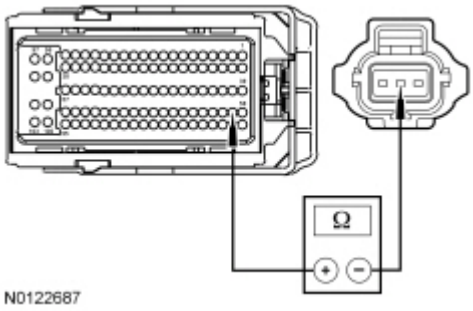
C3 CHECK THE VOLTAGE DROP IN THE B+ CIRCUIT	
• Connect: Generator C102A . • Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator B+ C102B, circuit SDC14 (RD) and the positive battery terminal.  • Carry out a wiggle test of the generator wiring and connections while measuring voltage drop. • **Is the voltage drop less than 0.5 volt?**	**Yes** GO to C4 . **No** INSPECT circuit SDC14 (RD), radial arm adapter and the positive battery cable for loose connections, physical damage or wire corrosion. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C4 "A" SENSE CIRCUIT LOAD TEST	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** **NOTE:** This step puts a load on the "A" sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be loaded properly using an LED-style test lamp. • Ignition OFF. • Disconnect: Generator C102A . • Ignition ON. • Using a 12-volt test lamp connected to ground, while performing a wiggle test on the generator harness, check for voltage at: ▪ **For 3.5L, 3.7L and 5.0L engines** , generator C102A-3, circuit SBB45 (GY/RD), harness side. ▪ **For 6.2L engines** , generator C102A-3, circuit SDC14	**Yes** GO to C5 . **No** **For 3.5L, 3.7L and 5.0L engines** , VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , VERIFY fusible links are OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs.

(RD), harness side.  N0105265 • **Does the test lamp illuminate?**	REPEAT the self-test. TEST the system for normal operation.
C5 CHECK THE GENERATOR COMMAND LINE FAULT (GENCMD_LF) PID • Ignition OFF. • Connect: Generator C102A . • Start the engine. • **NOTE:** Many of the PCM PIDs selected will be monitored later in this pinpoint test. • Select and monitor the following PCM PIDs: ▪ Generator Monitor (GENMON) ▪ Generator Command (GENCMD) ▪ Generator Command Line Fault (GENCMD_LF) • With the engine running at idle, monitor the GENCMD_LF PID. • **Does the GENMON_LF PID indicate FAULT?**	**Yes** GO to C6 . **No** GO to C9 .
C6 CHECK THE GENERATOR COMMAND CIRCUIT FOR A SHORT TO POWER • Ignition OFF. • Disconnect: Generator C102A . • Ignition ON. • Measure the voltage between generator C102A-2, circuit CDC10 (BU/OG), harness side and ground.  N0087307 • **Does voltage read 1 volt or less?**	**Yes** GO to C7 . **No** GO to C11 .
C7 COMPARE THE PCM PIDs GENERATOR MONITOR (GENMON) AND GENERATOR COMMAND (GENCMD) • Ignition OFF. • Connect a fused jumper wire between generator C102A-1, circuit CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.	**Yes** GO to C12 . **No** GO to C8 .

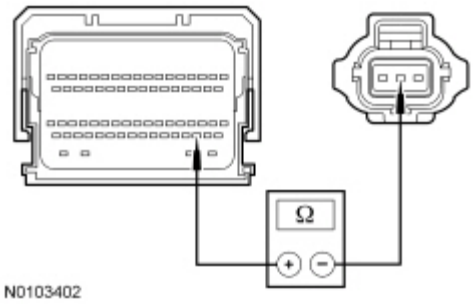
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 N0074142 • Start the engine. • Monitor the GENMON and GENCMD PIDs while performing a wiggle test on the generator harness. • **Does the GENMON PID read within 5% of the GENCMD PID?**	
C8 CHECK THE GENERATOR COMMAND CIRCUIT FOR A SHORT TO GROUND	**Yes** GO to C9 . **No** REPAIR circuit CDC10 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
• Ignition OFF. • Disconnect: Generator C102A (if not previously disconnected) . • Disconnect: PCM C1551B (3.5L) (if not previously disconnected) . • Disconnect: PCM C175B (3.7L) (if not previously disconnected) . • Disconnect: PCM C1381B (5.0L and 6.2L) (if not previously disconnected) . • Measure the resistance between the generator C102A-2, circuit CDC10 (BU/OG), harness side and ground.  N0105266 • **Is the resistance greater than 10,000 ohms?**	
C9 CHECK THE GENERATOR COMMAND CIRCUIT FOR DAMAGE OR AN OPEN	**Yes** GO to C10 . **No** REPAIR circuit CDC10 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
• Ignition OFF. • Disconnect: Fused Jumper Wire . • Disconnect: PCM C1551B (3.5L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1381B (5.0L and 6.2L) . • Inspect the following harness connectors for damaged or pushed-out pins: ▪ PCM C1551B-59, circuit CDC10 (BU/OG) (3.5L) ▪ PCM C175B-53, circuit CDC10 (BU/OG) (3.7L) ▪ PCM C1381B-53, circuit CDC10 (BU/OG) (5.0L and 6.2L) ▪ Generator C102A-2, circuit CDC10 (BU/OG) • **For 3.5L equipped vehicles** , measure the resistance	

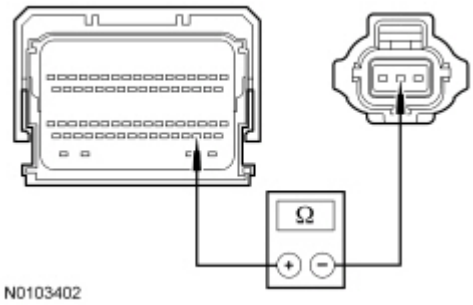
between PCM C1551B-59, circuit CDC10 (BU/OG), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.



- **For 3.7L equipped vehicles** , measure the resistance between PCM C175B-53, circuit CDC10 (BU/OG), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.



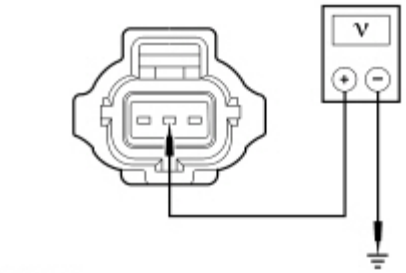
- **For 5.0L and 6.2L equipped vehicles** , measure the resistance between PCM C1381B-53, circuit CDC10 (BU/OG), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.



- **Are the connectors and pins free of damage and is the resistance less than 5 ohms?**

C10 CHECK THE CHARGING SYSTEM CIRCUITS FOR INTERMITTENT FAULTS	
• Connect: Generator C102A . • Connect: PCM C1551B (3.5L) . • Connect: PCM C175B (3.7L) . • Connect: PCM C1381B (5.0L and 6.2L) . • Ignition ON. • Clear all DTCs. • Start the engine and let the engine run for 5 minutes.	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test.

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• Retrieve Continuous Memory Diagnostic Trouble Codes (CMDTCs) from all modules. • **Did any charging system DTC get stored into memory?**	TEST the system for normal operation. **No** The fault is not present at this time. This may indicate an intermittent fault. CARRY OUT a wiggle test on the charging system circuits to try and RECREATE the concern. CHECK generator connections for corrosion, loose connections and/or bent terminals. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C11 CHECK GENERATOR COMMAND CIRCUIT FOR SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Generator C102A . • Disconnect: PCM C1551B (3.5L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1381B (5.0L and 6.2L) . • Ignition ON. • Measure the voltage between generator C102A-2, circuit CDC10 (BU/OG), harness side and ground.  N0087307 • **Is any voltage present?**	**Yes** REPAIR circuit CDC10 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to C12 .
C12 INSPECT GENERATOR CONNECTORS AND CIRCUITS • Ignition OFF. • Disconnect: PCM C1551B (3.5L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1381B (5.0L and 6.2L) . • Inspect the following connector pins for damage and/or corrosion: ▪ PCM C1551B-96, circuit GD113 (BK/YE) (3.5L) ▪ PCM C1551B-97, circuit GD113 (BK/YE) (3.5L) ▪ PCM C1551B-98, circuit GD113 (BK/YE) (3.5L) ▪ PCM C1551B-99, circuit GD113 (BK/YE) (3.5L) ▪ PCM C175B-50, circuit GD113 (BK/YE) (3.7L) ▪ PCM C175B-69, circuit GD113 (BK/YE) (3.7L) ▪ PCM C175B-70, circuit GD113 (BK/YE) (3.7L) ▪ PCM C1381B-50, circuit GD113 (BK/YE) (5.0L and 6.2L) ▪ PCM C1381B-69, circuit GD113 (BK/YE) (5.0L and 6.2L)	**Yes** GO to C13 . **No** REPAIR high resistance or loose connections in the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

▪ PCM C1381B-70, circuit GD113 (BK/YE) (5.0L and 6.2L) ▪ Generator C102A-1, circuit CDC15 (VT) ▪ Generator C102A-2, circuit CDC10 (BU/OG) • **Are the connectors and circuits OK?**	
C13 CHECK FOR CORRECT PCM OPERATION	
• Ignition OFF. • Disconnect all the PCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the PCM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: DTC P0625 or P0626

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

Normal Operation

The PCM monitors the generator output via the generator monitor (GENMON) circuit (generator field terminal circuit). If the PCM cannot read the GENMON circuit due to an open or short to ground, when the engine speed is greater than approximately 2,000 rpm, the generator defaults to a steady voltage of approximately 13.5 volts and the PCM sends a request to the Instrument Panel Cluster (IPC) to illuminate the charging system warning indicator. A GENMON duty cycle of 3% or less indicates a short to ground fault is present and results in DTC P0625 setting in the PCM. A GENMON duty cycle of 98% or more indicates an open or short to voltage fault is present and results in DTC P0626 setting in the PCM.

- DTC P0625 (Generator Field Terminal Circuit Low) — The PCM sets this DTC if the GENMON circuit is shorted to ground, the "A" sense circuit is open or the B+ circuit is open. This DTC also sets by a faulted PCM or generator.
- DTC P0626 (Generator Field Terminal Circuit High) — The PCM sets this DTC if the GENMON circuit is open or shorted to power. This DTC can also be set by a faulted PCM or generator.

This pinpoint test is intended to diagnose the following:

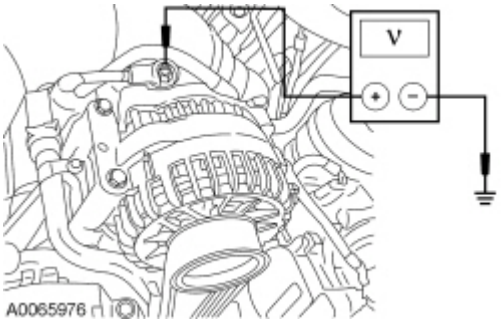
- Fuse
- Wiring, terminals or connectors
- Radial arm adapter
- Engine, generator and battery grounds
- Battery
- Generator
- PCM

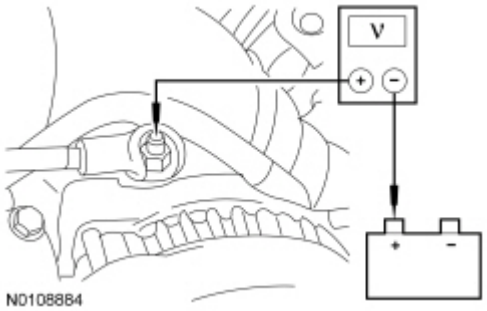
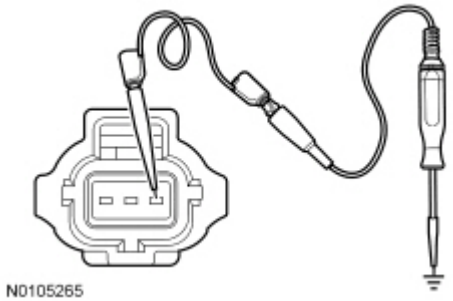
PINPOINT TEST D: DTC P0625 OR P0626

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NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

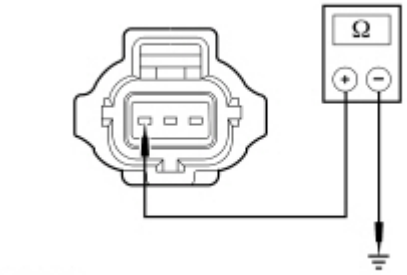
NOTE: Do not have a battery charger attached during vehicle testing.

Test Step	Result / Action to Take
D1 CHECK THE BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to D2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D2 CHECK THE GENERATOR B+ CONNECTION	
• Ignition OFF. • Inspect generator C102B, circuit SDC14 (RD), harness side. Connection should be tight. • Inspect generator radial adaptor connection on rear of generator. Connection should be tight. • Measure the voltage between generator C102B, circuit SDC14 (RD) and ground.  • **Are the generator C102B connections tight and does the generator B+ measure battery voltage?**	**Yes** GO to D3 . **No** **For 3.5L, 3.7L and 5.0L engines** , TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D3 CHECK THE VOLTAGE DROP IN THE B+ CIRCUIT	
• Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator B+ C102B, circuit SDC14 (RD) and the positive battery terminal.	**Yes** **For DTC P0625** , GO to D4 . **For DTC P0626** , GO to D6 . **No** INSPECT circuit SDC14 (RD),

 N0108884 • Carry out a wiggle test of the generator wiring and connections while measuring voltage drop. • **Is the voltage drop less than 0.5 volt?**	radial arm adapter and the positive battery cable for loose connections, physical damage or wire corrosion. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D4 "A" SENSE CIRCUIT LOAD TEST ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** **NOTE:** This step puts a load on the "A" sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be loaded properly using an LED-style test lamp. • Ignition OFF. • Disconnect: Generator C102A . • Ignition ON. • Using a 12-volt test lamp connected to ground, while performing a wiggle test on the generator harness, check for voltage at: ▪ **For 3.5L, 3.7L and 5.0L engines** , generator C102A-3, circuit SBB45 (GY/RD), harness side. ▪ **For 6.2L engines** , generator C102A-3, circuit SDC14 (RD), harness side.  N0105265 • **Does the test lamp illuminate?**	**Yes** GO to D5 . **No** **For 3.5L, 3.7L and 5.0L engines** , VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SBB45 (GY/RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , VERIFY fusible links are OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D5 CHECK GENMON CIRCUIT FOR DAMAGE OR A SHORT TO GROUND • Ignition OFF. • Disconnect: PCM C1551B (3.5L) . • Disconnect: PCM C175B (3.7L) .	**Yes** GO to D10 .

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- Disconnect: PCM C1381B (5.0L and 6.2L) .
- Inspect the following harness connectors for damaged or pushed-out pins:
  - PCM C1551B-26, circuit CDC15 (VT) (3.5L)
  - PCM C175B-14, circuit CDC15 (VT) (3.7L)
  - PCM C1381B-14, circuit CDC15 (VT) (5.0L and 6.2L)
  - Generator C102A-1, circuit CDC15 (VT)
- Measure the resistance between generator C102A-1, circuit CDC15 (VT), harness side and ground.



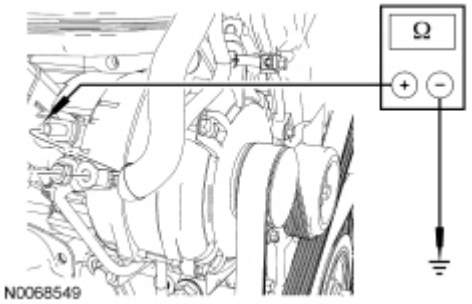
N0105271

- **Are the connectors and pins free of damage and is the resistance greater than 10,000 ohms?**

No
REPAIR the connector(s) and/or circuit CDC15 (VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

D6 CHECK THE GENERATOR B+ RESISTANCE

- Ignition OFF.
- **NOTE:** Failure to disconnect the battery will result in false resistance readings.
- Disconnect the battery. Refer to Section 414-01 .
- Disconnect: Generator C102B .
- Measure the resistance between generator C102B, component side and the generator housing.



N0068549

- **Is the resistance greater than 25K ohms?**

Yes
GO to D7 .

No
INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

D7 CHECK THE RESISTANCE OF THE VOLTAGE REGULATOR INTERNAL CIRCUITS TO GROUND

- Disconnect: Generator C102A .
- Measure the resistance between generator C102A, component side and ground. Refer to the following table.

Pin	Expected Resistance
1	Greater than 10K ohms
2	Greater than 10K ohms

Yes
GO to D8 .

No
INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the

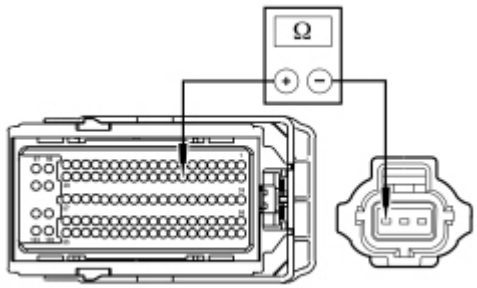
3	Greater than 10K ohms

- **Are the resistance values as indicated?**

system for normal operation.

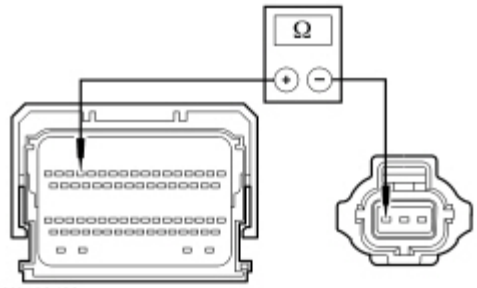
D8 CHECK THE GENMON CIRCUIT FOR DAMAGE OR AN OPEN

- Disconnect: PCM C1551B (3.5L) .
- Disconnect: PCM C175B (3.7L) .
- Disconnect: PCM C1381B (5.0L and 6.2L) .
- Inspect the following harness connectors for damaged or pushed-out pins:
  - PCM C1551B-26, circuit CDC15 (VT) (3.5L)
  - PCM C175B-14, circuit CDC15 (VT) (3.7L)
  - PCM C1381B-14, circuit CDC15 (VT) (5.0L and 6.2L)
  - Generator C102A-1, circuit CDC15 (VT)
- **For 3.5L equipped vehicles** , measure the resistance between PCM C1551B-26, circuit CDC15 (VT), harness side and generator C102A-1, circuit CDC15 (VT), harness side.



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- **For 3.7L equipped vehicles** , measure the resistance between PCM C175B-14, circuit CDC15 (VT), harness side and generator C102A-1, circuit CDC15 (VT), harness side.



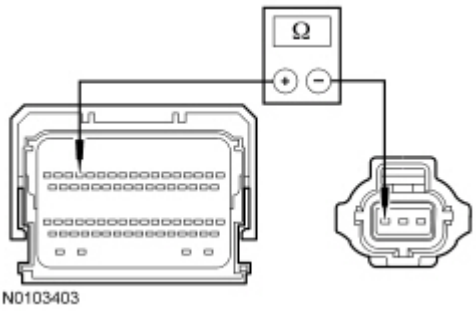
N0103403

- **For 5.0L an 6.2L equipped vehicles** , measure the resistance between PCM C1381B-14, circuit CDC15 (VT), harness side and generator C102A-1, circuit CDC15 (VT), harness side.

Yes
GO to D9 .

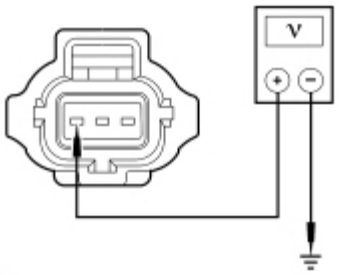
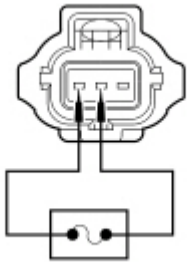
No
REPAIR the connector(s) and/or circuit CDC15 (VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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- **Are the connectors and pins free of damage and is the resistance less than 5 ohms?**

D9 CHECK THE GENMON CIRCUIT FOR A SHORT TO POWER	
• Connect the battery. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between generator C102A-1, circuit CDC15 (VT), harness side and ground.  N0105272 • **Is there any voltage present?**	**Yes** REPAIR the connector(s) and/or circuit CDC15 (VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D10 .
D10 COMPARE THE PCM PIDs GENERATOR MONITOR (GENMON) AND GENERATOR COMMAND (GENCMD)	
• Ignition OFF. • Connect: PCM C1551B (3.5L) . • Connect: PCM C175B (3.7L) . • Connect: PCM C1381B (5.0L and 6.2L) . • Connect a fused jumper wire between generator C102A-1, circuit CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.  N0074142 • Start the engine. • Using the active command, set the GENVDSD PID to 14.0 volts. • Monitor the GENMON and GENCMD PIDs while carrying	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D11 .

out a wiggle test on the generator wiring harness. • **Does the GENMON PID read within 2% of the GENCMD PID?**	
D11 CHECK FOR CORRECT PCM OPERATION	

• Ignition OFF.
• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PCM connectors and make sure they seat correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: DTC P065B

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

Normal Operation

With the engine running, the PCM monitors and expects to receive a valid generator monitor (GENMON) signal with a duty cycle greater than 5% and less than 98%. The PCM also monitors the state of the generator command (GENCMD) signal line to make sure it is not stuck high or stuck low. A DTC sets if the GENMON or GENCMD signal fluctuates between out-of-valid range, stuck high, stuck low, or some combination and normal. When the engine speed is greater than approximately 2,000 rpm, the generator defaults to a steady voltage of approximately 13.5 volts and the PCM sends a request to the Instrument Panel Cluster (IPC) to illuminate the charging system warning indicator lamp.

- DTC P065B (Generator Control Circuit Range/Performance) — The PCM sets this DTC if the input frequency was continuously less than 80 Hz or more than 200 Hz. Additionally, if the signal shows a faulted condition that is happening in a fluctuating manner, the PCM tracks the fluctuations between faulted and normal conditions. This DTC can also set if the fluctuations occur frequently within a short amount of time.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Radial arm adapter
- Generator
- PCM

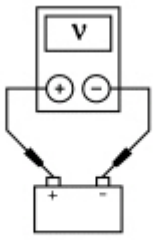
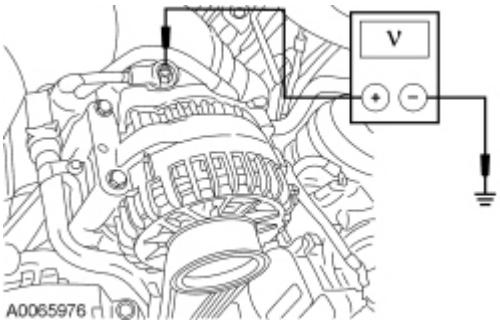
PINPOINT TEST E: DTC P065B

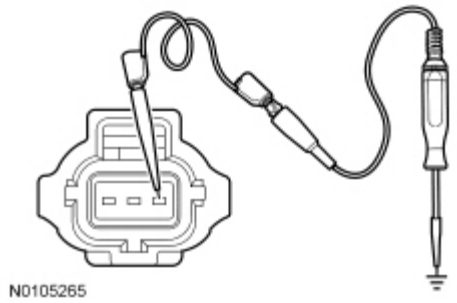
NOTE: Make sure battery voltage is greater than 12.2 volts prior to carrying out this pinpoint test.

NOTE: Do not have a battery charger attached during vehicle testing.

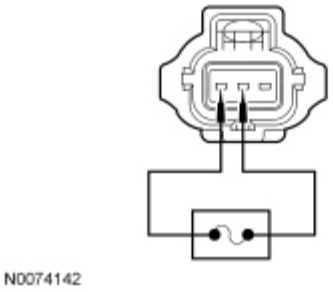
Test Step	Result / Action to Take
E1 CHECK THE BATTERY CONDITION	

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• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to E2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E2 CHECK THE GENERATOR CONNECTIONS	
• Ignition OFF. • Inspect generator C102A connection. Connector should be installed correctly and tight. • Disconnect: Generator C102A . • Inspect generator C102A for bent and/or pushed-out pins. • Inspect generator C102B, B+ circuit SDC14 (RD). Connection should be tight. • Measure the battery voltage.  AJ0210-A • **NOTE:** 6.2L shown, others similar. • Measure the voltage between generator C102B, B+ circuit SDC14 (RD) and ground.  • **Is generator C102B connection tight and does the generator B+ measure battery voltage?**	**Yes** GO to E3 . **No** **For 3.5L, 3.7L and 5.0L engines** , TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E3 "A" SENSE CIRCUIT LOAD TEST	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** **NOTE:** This step puts a load on the "A" sense circuit. If there are corroded or loose connections, loading the circuit may help	**Yes** GO to E4 . **No** **For 3.5L, 3.7L and 5.0L engines** , VERIFY high current BJB 250A fuse is OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring

show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be loaded properly using an LED-style test lamp. • Ignition ON. • Using a 12-volt test lamp connected to ground, while performing a wiggle test on the generator harness, check for voltage at: ▪ **For 3.5L, 3.7L and 5.0L engines** , generator C102A-3, circuit SBB45 (GY/RD), harness side. ▪ **For 6.2L engines** , generator C102A-3, circuit SDC14 (RD), harness side.  N0105265 • **Does the test lamp illuminate?**	Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For 6.2L engines** , VERIFY fusible links are OK. If OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E4 CHECK THE PCM GENERATOR MONITOR FREQUENCY (GENMON_HZ) PID	
• Ignition OFF. • Connect: Generator C102A . • Start the engine. • **NOTE:** Many of the PCM PIDs selected will be monitored later in this pinpoint test. • Select and monitor the following PCM PIDs: ▪ Generator Voltage Desired (GENVDSD) ▪ Generator Monitor Frequency (GENMON_HZ) • Monitor the GENMON_HZ PID. • **Does the PID read between 80-200 Hz?**	**Yes** GO to E8 . **No** GO to E5 .
E5 CHECK THE PCM GENERATOR MONITOR FREQUENCY (GENMON_HZ) PID WITH GENERATOR C102A DISCONNECTED	
• Ignition OFF. • Disconnect: Generator C102A . • Start the engine. • Monitor the GENMON_HZ PID. • **Does the PID read between 0-2 Hz?**	**Yes** GO to E7 . **No** GO to E6 .
E6 CHECK GENERATOR CIRCUITRY	
***NOTICE:* This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while making sure that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** • Ignition OFF.	**Yes** INSPECT the harness for wire to wire shorts or insulation chaffing, mis-pinned connectors and correct wire colors and REPAIR generator circuit CDC15 (VT) as needed. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

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• **For 3.5L equipped vehicles** , with PCM C175B connected, connect a fused jumper wire between PCM C1551B-26, circuit CDC15 (VT) and ground by carefully back probing the connector. • **For 3.7L equipped vehicles** , with PCM C175B connected, connect a fused jumper wire between PCM C175B-14, circuit CDC15 (VT) and ground by carefully back probing the connector. • **For 5.0L and 6.2L equipped vehicles** , with PCM C1381B connected, connect a fused jumper wire between PCM C1381B-14, circuit CDC15 (VT) and ground by carefully back probing the connector. • Start the engine. • Monitor the GENMON_HZ PID. • **Does the PID read 0 Hz?**	**No** GO to E9 .
E7 MONITOR THE PCM PID GENERATOR MONITOR FREQUENCY (GENMON_HZ) WHILE ACTIVATING THE GENERATOR VOLTAGE DESIRED (GENVDSD) PID	
• Ignition OFF. • Connect a fused jumper wire between generator C102A-1, circuit CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.  N0074142 • Start the engine. • With the engine running at idle, set the active command GENVDSD PID to 14 volts. • Monitor the GENMON_HZ PID while performing a wiggle test on the generator harness. • **Does the GENMON_HZ PID read between 120-130 Hz?**	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to E9 .
E8 CHECK THE PCM GENERATOR COMMAND LINE FAULT (GENCMD_LF) PID	
• With the engine running and all selectable loads OFF, monitor the PCM PID GENCMD_LF. • **Does the PCM PID GENCMD_LF fluctuate from YES FAULT to NO FAULT?**	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The fault is not present at this time. This may indicate an intermittent fault. CARRY OUT

	a wiggle test on the charging system circuits to try and RECREATE the concern. CHECK generator connections for corrosion, loose connections and/or bent terminals. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

E9 CHECK FOR CORRECT PCM OPERATION
• Ignition OFF.
• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PCM connectors and make sure they seat correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: The Generator is Noisy

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

Normal Operation

The generator is belt-driven by the engine accessory drive system. There are several sources of generator noise which include bearing noise, electrical fault noise, generator or belt pulley misalignment. A generator with certain types of diode or stator failures may also produce an audible noise.

This pinpoint test is intended to diagnose the following:

- Front End Accessory Drive (FEAD) belt
- Loose bolts/brackets
- Generator/pulley

PINPOINT TEST F: THE GENERATOR IS NOISY

Test Step	Result / Action to Take
F1 CHECK FOR ACCESSORY DRIVE BELT NOISE AND LOOSE MOUNTING BRACKETS • Ignition OFF. • Check the accessory drive belt and tensioner for damage and correct installation. Refer to Section 303-05 . • Check the accessory mounting brackets and generator pulley for looseness or misalignment.	**Yes** GO to F2 . **No** REPAIR as necessary. REFER to Section 303-05 for diagnosis and testing of the

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• **Is the accessory drive OK?**	accessory drive system. TEST the system for normal operation.
F2 CHECK THE GENERATOR MOUNTING • Check the generator mounting for loose bolts or misalignment. • **Is the generator mounted correctly?**	**Yes** GO to F3 . **No** REPAIR as necessary. TEST the system for normal operation.
F3 CHECK THE GENERATOR FOR NOISE • With the engine running, use a stethoscope or equivalent listening device to probe the generator and the accessory drive area for unusual mechanical noise. • **Is the generator the noise source?**	**Yes** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. **No** REFER to Section 303-00 to diagnose the source of the engine noise.

Pinpoint Test G: Radio Interference

Refer to Wiring Diagrams Cell 12 , Charging System for schematic and connector information.

Normal Operation

The generator radio suppression equipment reduces interference transmitted through the speakers by the vehicle electrical system.

This pinpoint test is intended to diagnose the following:

- Generator
- Wiring, terminals or connectors
- In-vehicle entertainment system

PINPOINT TEST G: RADIO INTERFERENCE

NOTE: If the OEM ACM has been replaced with an aftermarket unit, the vehicle may not pass this test. Return the vehicle to OEM condition before following this pinpoint test.

NOTE: If the engine is operated at greater than 2,000 rpm momentarily, the generator self-excites. Make sure when the generator is disconnected the engine rpm stays below 2,000 rpm. If it does rise above 2,000 rpm, turn the ignition to the OFF position and start the test over again.

NOTE: Inspect for any aftermarket accessories that have been added to the vehicle. Check the wiring for these accessories and be sure they have not been attached to the generator circuits and are positioned away from the generator wiring.

Test Step	Result / Action to Take
G1 VERIFY THE GENERATOR IS	

THE SOURCE OF THE RADIO INTERFERENCE	
• Start the engine and allow the engine to idle. • Tune the ACM to a station where the interference is present. • Ignition OFF. • Disconnect: Generator C102B . • Start the engine and allow the engine to idle. • **Is the interference present with the generator disconnected?**	**Yes** Refer to the appropriate section in Group 415 for the procedure.. Refer to Diagnosis and Testing of the In-Vehicle Entertainment System. **No** INSTALL a new generator. REFER to Generator — 3.5L GTDI , Generator — 3.7L , Generator — 5.0L or Generator — 6.2L in this section. TEST the system for normal operation.

Pinpoint Test H: DTC P0A5A, P0A5B, P0A5C

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Normal Operation

The generator current sensor is a Hall-effect sensor attached to the generator B+ cable. It is supplied a 5 volt reference and ground from the PCM. The PCM reads the generator current sensor feedback voltage to determine how much current is flowing through the generator B+ cable.

- DTC P0A5A (Generator Current Sensor Circuit Range/Performance) — The PCM does not detect current through the generator current sensor and there are no generator current sensor circuit DTCs are set.
- DTC P0A5B (Generator Current Sensor Circuit Low) — The PCM senses lower than expected voltage on the generator current sensor feedback circuit, indicating an open or a short directly to ground.
- DTC P0A5C (Generator Current Sensor Circuit High) — The PCM senses higher than expected voltage on the generator current sensor feedback circuit, indicating a short directly to voltage.

This pinpoint test is intended to diagnose the following:

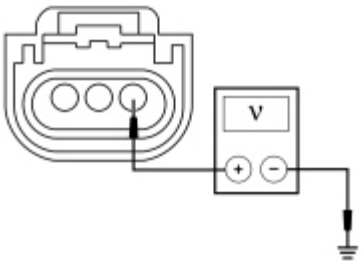
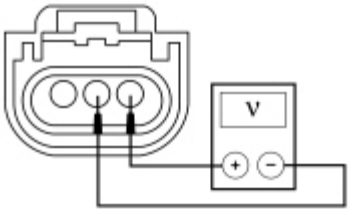
- Wiring, terminals or connectors
- Battery current sensor
- BCM

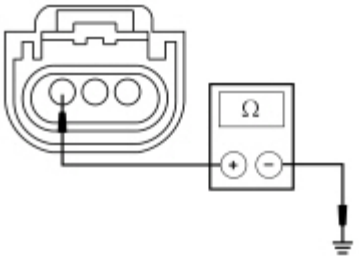
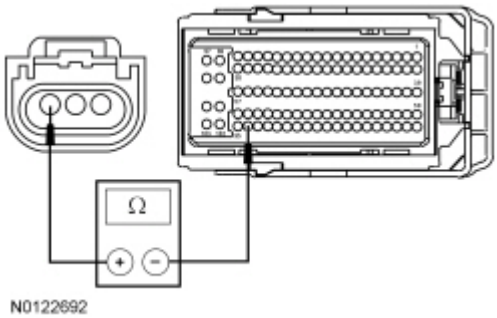
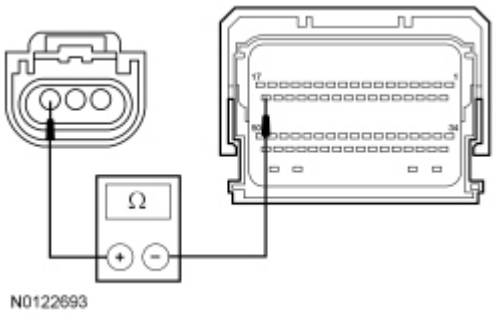
PINPOINT TEST H: DTC P0A5A, P0A5B, P0A5C

Test Step	Result / Action to Take
H1 CHECK THE PCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — PCM . • Check the PCM DTCs. • **Is DTC P0A5A present?**	**Yes** GO to H2 . **No** **For DTC P0A5B** , GO to H3 . **For DTC P0A5C** , GO to H7 .
H2 CHECK THE GENERATOR CURRENT SENSOR	

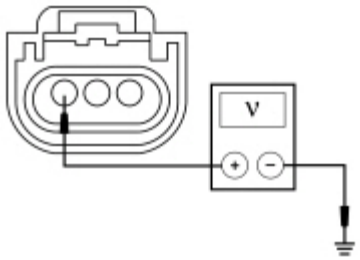
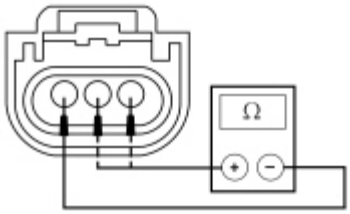
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• Inspect the generator current sensor for the following:
  ■ Physical damage
  ■ Corrosion
  ■ Disconnected electrical connector
  ■ Disconnected from generator B+ cable
  ■ Debris between the generator current sensor and the generator B+ cable
• **Are any of these conditions found during inspection?**
	Yes
	REPAIR as necessary or INSTALL a new generator current sensor. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
	
	No
	GO to H9 .

H3 CHECK THE PCM OUTPUT VOLTAGE	
• Ignition OFF. • Disconnect: Generator Current Sensor C1645 . • Ignition ON. • Measure the voltage between ground and generator current sensor C1645-1, circuit LE424 (YE/GN), harness side.  N0122689 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to H4 . **No** If the voltage is less than 4.7 volts, REPAIR circuit LE424 (YE/GN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If the voltage is greater than 5.1 volts, REPAIR circuit LE424 (YE/GN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H4 CHECK THE GENERATOR CURRENT SENSOR GROUND CIRCUIT	
• Measure the voltage between generator current sensor C1645-2, circuit RE407 (YE/VT), harness side and generator current sensor C1645-1, circuit LE424 (YE/GN), harness side.  N0122690 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to H5 . **No** REPAIR circuit RE407 (YE/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H5 CHECK THE FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: PCM C1551B (3.5L) . • Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1381B (5.0L) . • Measure the resistance between ground and generator	**Yes** GO to H6 . **No** REPAIR circuit VDC61 (VT/GN)

current sensor C1645-3, circuit VDC61 (VT/GN), harness side.  N0122691 • **Is the resistance greater than 10,000 ohms?**	for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H6 CHECK THE FEEDBACK CIRCUIT FOR AN OPEN	
• **For 3.5L engines** , measure the resistance between generator current sensor C1645-3, circuit VDC61 (VT/GN), harness side and PCM C1551B-94, circuit VDC61 (VT/GN), harness side.  N0122692 • Measure the resistance between generator current sensor C1645-3, circuit VDC61 (VT/GN), harness side and: ▪ **For 3.7L engines** , PCM C175B-33, circuit VDC61 (VT/GN), harness side. ▪ **For 5.0L engines** , PCM C1381B-33, circuit VDC61 (VT/GN), harness side.  N0122693 • **Is the resistance less than 5 ohms?**	**Yes** GO to H7 . **No** REPAIR circuit VDC61 (VT/GN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H7 CHECK THE FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Generator Current Sensor C1645 . • Disconnect: PCM C1551B (3.5L) .	**Yes** REPAIR circuit VDC61 (VT/GN) for a short to voltage. CLEAR the

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• Disconnect: PCM C175B (3.7L) . • Disconnect: PCM C1381B (5.0L) . • Ignition ON. • Measure the voltage between ground and generator current sensor C1645-3, circuit VDC61 (VT/GN), harness side.  N0122694 • **Is any voltage present?**	DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to H8 .
H8 CHECK THE FEEDBACK CIRCUIT FOR A SHORT TO THE SIGNAL RETURN OR REFERENCE CIRCUIT	
• Ignition OFF. • Measure the resistance between generator current sensor C1645-3, circuit VDC61 (VT/GN), harness side and: ▪ generator current sensor C1645-1, circuit LE424 (YE/GN), harness side. ▪ generator current sensor C1645-2, circuit RE407 (YE/VT), harness side.  N0122695 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H9 . **No** REPAIR circuit VDC61 (VT/GN) for a short to circuit LE424 (YE/GN) or RE407 (YE/VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H9 CHECK THE GENERATOR CURRENT SENSOR CONNECTION	
• Ignition OFF. • Disconnect the generator current sensor connector. • Inspect the generator current sensor connector for: ▪ corrosion ▪ pushed-out terminals ▪ damaged terminals • Connect and correctly seat the generator current sensor connector. • Ignition ON. • Clear the DTCs. • Enter the following diagnostic mode on the scan tool: Self-Test — PCM . • **Did the DTC return?**	**Yes** REPAIR as necessary or INSTALL new generator current sensor. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. If the DTC returns, GO to H10 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

H10 CHECK FOR CORRECT PCM OPERATION	

• Ignition OFF.
• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the PCM connectors and make sure they seat correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test I: DTC U1007:31

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Normal Operation

The battery current sensor is a Hall-effect sensor attached to the battery ground cable. It is supplied a 5 volt reference and ground from the Body Control Module (BCM). The BCM reads the battery current sensor feedback voltage to determine how much current is flowing through the battery ground cable.

- DTC U1007:31 (Lost Communication With Battery Monitoring Sensor "A": No Signal) — The BCM does not indicate current from the battery current sensor.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Battery current sensor
- BCM

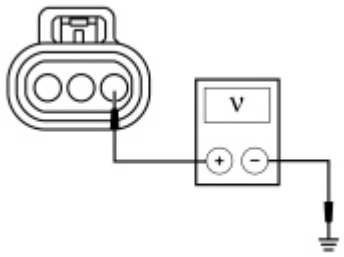
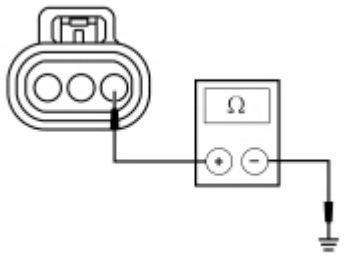
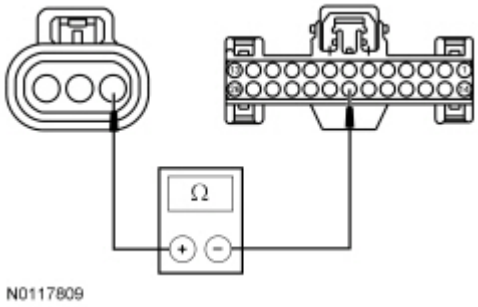
PINPOINT TEST I: DTC U1007:31

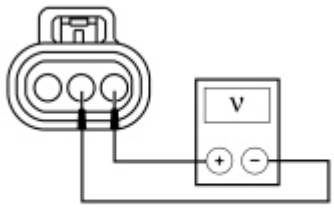
Test Step	Result / Action to Take
I1 CHECK THE BATTERY CURRENT SENSOR	

• Inspect the battery current sensor for the following:
  ▪ Physical damage
  ▪ Corrosion
  ▪ Disconnected electrical connector
  ▪ Disconnected from battery ground cable
  ▪ Debris between the battery current sensor and the battery ground cable
• **Are any of these conditions found during inspection?**
	Yes
	GO to I12 .
	
	No
	GO to I2 .

I2 CHECK THE BCM OUTPUT VOLTAGE	
• Ignition OFF. • Disconnect: Battery Current Sensor C1646 . • Ignition ON. • Measure the voltage between ground and battery current sensor C1646-1, circuit SDC57 (BU/OG), harness side.	**Yes** GO to I5 . **No** If the voltage is less than 4.7 volts, GO to I3 .

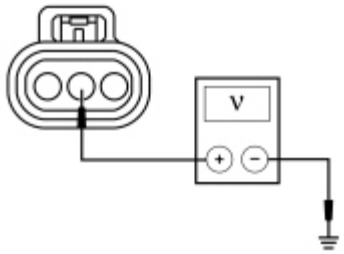
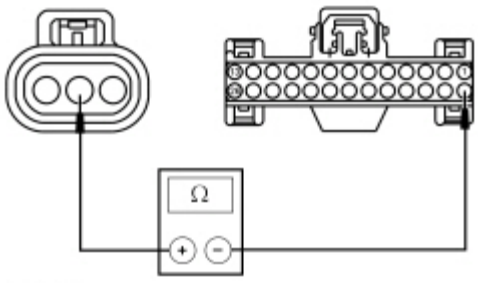
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 N0117807 • **Is the voltage between 4.7 and 5.1 volts?**	If the voltage is greater than 5.1 volts, REPAIR circuit SDC57 (BU/OG) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I3 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Body Control Module (BCM) C2280F . • Measure the resistance between ground and battery current sensor C1646-1, circuit SDC57 (BU/OG), harness side.  N0117808 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I4 . **No** REPAIR circuit SDC57 (BU/OG) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I4 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN	
• Measure the resistance between battery current sensor C1646-1, circuit SDC57 (BU/OG), harness side and Body Control Module (BCM) C2280F-20, circuit SDC57 (BU/OG), harness side.  N0117809 • **Is the resistance less than 5 ohms?**	**Yes** GO to I12 . **No** REPAIR circuit SDC57 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I5 CHECK THE BCM SENSOR GROUND	
• Measure the voltage between battery current sensor C1646-2, circuit RDC59 (GY/BN), harness side and battery current sensor C1646-1, circuit SDC57 (BU/OG), harness side.	**Yes** GO to I8 . **No** GO to I6 .

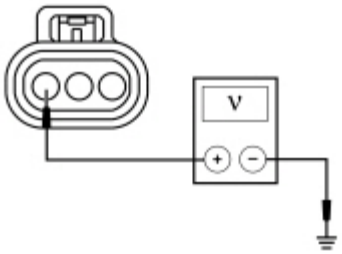
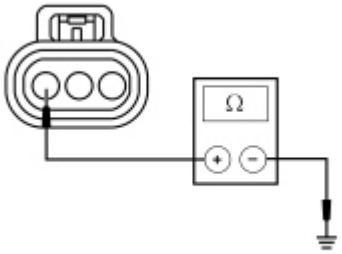
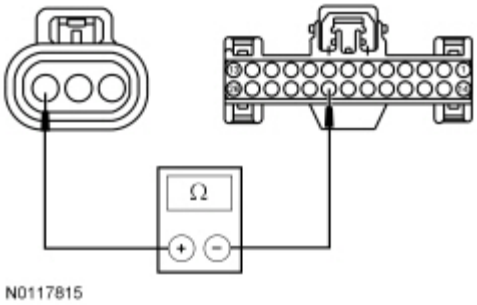


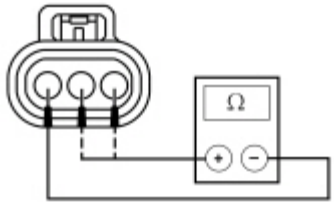
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- **Is the voltage greater than 4.7 volts?**

I6 CHECK THE SIGNAL RETURN CIRCUIT FOR VOLTAGE	
• Measure the voltage between ground and battery current sensor C1646-2, circuit RDC59 (GY/BN), harness side.  N0117811 • **Is any voltage present?**	**Yes** If the voltage is 5.1 volts or less, REPAIR circuit RDC59 (GY/BN) for a short to circuit SDC57 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If the voltage is greater than 5.1 volts REPAIR circuit RDC59 (GY/BN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to I7 .
I7 CHECK THE SIGNAL RETURN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Body Control Module (BCM) C2280F . • Measure the resistance between battery current sensor C1646-2, circuit RDC59 (GY/BN), harness side and BCM C2280F-14, circuit RDC59 (GY/BN), harness side.  N0117812 • **Is the resistance less than 5 ohms?**	**Yes** GO to I12 . **No** REPAIR circuit RDC59 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I8 CHECK THE FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Body Control Module (BCM) C2280F . • Ignition ON. • Measure the voltage between ground and battery current sensor C1646-3, circuit LDC59 (BU/WH), harness side.	**Yes** REPAIR circuit LDC59 (BU/WH) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal

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 N0117813 • **Is the voltage greater then 11 volts?**	operation. **No** GO to I9 .
I9 CHECK THE FEEDBACK CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and battery current sensor C1646-3, circuit LDC59 (BU/WH), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I10 . **No** REPAIR circuit LDC59 (BU/WH) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I10 CHECK THE FEEDBACK CIRCUIT FOR AN OPEN	
• Disconnect: BCM C2280F . • Measure the resistance between battery current sensor C1646-3, circuit LDC59 (BU/WH), harness side and BCM C2280F-21, circuit LDC59 (BU/WH), harness side.  N0117815 • **Is the resistance less than 5 ohms?**	**Yes** GO to I11 . **No** REPAIR circuit LDC59 (BU/WH) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I11 CHECK THE FEEDBACK CIRCUIT FOR A SHORT TO THE SIGNAL RETURN OR REFERENCE CIRCUIT	
• Measure the resistance between battery current sensor C1646-3, circuit LDC59 (BU/WH), harness side and: ▪ battery current sensor C1646-2, circuit RDC59 (GY/BN), harness side. ▪ battery current sensor C1646-1, circuit SDC57	**Yes** GO to I12 . **No** REPAIR circuit LDC59 (BU/WH)

(BU/OG), harness side.  N0117816 • **Is the resistance greater than 10,000 ohms?**	for a short to circuit RDC59 (GY/BN) or SDC57 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

I12 CHECK THE BATTERY CURRENT SENSOR CONNECTION
• Ignition OFF.
• Disconnect the battery current sensor connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect and correctly seat the battery current sensor connector.
• Connect and correctly seat the BCM (if previously disconnected).
• Ignition ON.
• Clear the DTCs.
• Enter the following diagnostic mode on the scan tool: Self-Test — BCM.
• **Did the DTC return?**
	Yes
	REPAIR as necessary or INSTALL a new battery cable assembly. REFER to Section 414-01. CLEAR the DTCs. REPEAT the self-test. If the DTC returns, GO to I13.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

I13 CHECK FOR CORRECT BCM OPERATION
• Ignition OFF.
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the BCM connectors and make sure they seat correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 418-01. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

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Principles of Operation

Charging System

The PCM-controlled, or Smart Charge charging system determines the optimal voltage setpoint for the charging system and communicates this information to the voltage regulator. The Smart Charge charging system is designed to set 1 of 6 DTCs any time a charging system fault is present. All of the DTCs can set continuous faults, but not all DTCs set as on-demand faults.

DTC	KOEO	KOER	Continuous
P0562	X	X	X
P0563		X [a]	X [a]
P0620			X
P0625		X	X
P0626		X	X
P065B			X

[a] Requires vehicle speed above 5 mph.

This system uses 2 communication lines between the PCM and the generator/voltage regulator. Both of these communication lines use Pulse-Width Modulation (PWM). The generator communication (GENCOM) line communicates the desired setpoint from the PCM to the voltage regulator. The generator monitor (GENMON) line communicates the generator load and error conditions to the PCM. The GENCOM command is only sent by the PCM when it is necessary to adjust the voltage setpoint. If the setpoint does not need to be changed, several seconds may elapse between PCM GENCOM commands. This normal operation appears in the PID as occasional bursts of pulse-width commands. The third pin on the voltage regulator, the "A" pin, is a circuit dedicated to monitor or sense battery voltage.

The PCM simultaneously controls and monitors the output of the generator. When the current consumption is high or the battery is discharged, the PCM raises engine speed as needed to increase generator output. The generator charges the battery and at the same time supplies power for all of the electrical loads that are required. The battery is more effectively charged with a higher voltage when the battery is cold and a lower voltage when the battery is warm. The PCM is able to adjust the charging voltage according to the battery temperature, calculated by using a signal from the Intake Air Temperature (IAT) sensor. The PCM also uses other inputs to control charging system voltage such as the Vehicle Speed Sensor (VSS) and Engine Coolant Temperature (ECT). The voltage setpoint is calculated by the PCM and communicated to the voltage regulator by the GENCOM circuit based on the needs of the vehicle and the conditions.

The PCM turns off the generator during cranking to reduce the generator load and improve cranking speed. Once the engine starts, the PCM slowly increases generator output to the desired voltage.

The PCM reports any charging system faults and sends a message through High Speed Controller Area Network (HS-CAN) to the Body Control Module (BCM). The BCM controls the charging system warning indicator by sending a message over the Medium Speed Controller Area Network (MS-CAN) to the Instrument Panel Cluster (IPC). The IPC then controls charging system warning indication based on the

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message from the PCM through the BCM. The status of the PCM charging system warning indicator and/or message can be confirmed by viewing PCM PID generator fault indicator lamp (GENFIL). Any charging system fault detected by the PCM results in 1 or more DTCs being set and the PID GENFIL having a status of On. If equipped with a charging system warning indicator, the IPC turns the indicator on or off. If equipped with a message center, the IPC displays a CHECK CHARGING SYSTEM message. When the ignition is ON and the engine is off on vehicles equipped with a message center, the CHECK CHARGING SYSTEM message may not be displayed. For information regarding the IPC and message center, refer to Section 413-01.

Under certain circumstances, the charging system may have a concern, but still keeps the battery charged and the vehicle running. GENCOM is normally used to initiate charging, but the generator may charge with a fault in this circuit. If the engine operates at more than 2,000 rpm momentarily, the generator may self-excite or start charging on its own. The charging system warning indicator is illuminated and/or CHECK CHARGING SYSTEM message is displayed, and the generator operates in a default mode (approximately 13.5 volts) until the engine is turned off. When the engine is restarted and the engine operates at more than 2,000 rpm momentarily, the generator may again self-excite and again the charging system warning indicator is illuminated and/or CHECK CHARGING SYSTEM message is displayed.

The PIDs and their associated descriptions used in the charging system diagnosis are listed below:

PID Chart

PID	Description	Normal Display	Associated Circuit Name	Connector, Circuit
GENMON	Generator Monitor	Constant fluctuating percentage 3%-98%	Generator monitor (GENMON)	C102A-1, CDC15 (VT)
GENCMD	Generator Command	Fluctuating percentage or small intermittent bursts 3%-98%	Generator communication (GENCOM)	C102A-2, CDC10 (BU/OG)
GENVDSD	Generator Voltage Desired	Voltage varies by vehicle needs - May be controlled by an output state control	—	—
GENFIL	Generator Fault Indicator Lamp	OFF if charging system is OK	—	—
GENCMD_LF	Generator Command Line Fault	NO FAULT if GENCOM circuit (GENCMD PID) is OK	—	—
GENMON_HZ	Generator Monitor Frequency	Frequency value	—	—
VPWR	Module Supply Voltage	Within 0.5 volt of battery voltage	—	—
RPM	Engine Revolutions Per Minute	Engine rpm — May be controlled by an output state control	—	—

Load Shed Operation

NOTICE: **When the Body Control Module (BCM) is being programmed, connect an external battery charger to make sure that the module programming is completed without the interruption due to the**

load shedding feature becoming active. The external battery charger must maintain a system voltage above 13 volts. This may require a charger setting higher than the lowest charge setting. The external battery charger negative connection must be made to an engine or vehicle chassis ground and not the negative battery terminal. If the connection is to the negative battery terminal, load shedding cannot be prevented from being invoked and module programming may be corrupted. After charging has begun, start the engine to clear any load shed states and then turn the engine off and proceed with programming.

NOTE: To maintain correct operation of the load shed system, any electrical devices or equipment must be grounded to the engine or chassis ground and not the negative battery terminal. A connection to the negative battery terminal may cause an inaccurate measurement of the battery state of charge and may cause incorrect load shed system operation.

This vehicle is equipped with load shed strategy. The Body Control Module (BCM) monitors system voltage to the BCM and the Power Steering Control Module (PSCM) as well as the battery state of charge using the battery current sensor attached to the negative battery cable.

Engine Off Load Shed

The BCM uses the battery current sensor to keep track of the battery state of charge. The battery current sensor is a Hall-effect sensor attached to the battery ground cable. When the engine is off, and the BCM determines the battery state of charge is below 40% or 10% of the charge has been drained or 45 minutes have elapsed, a load shed message is sent over the Controller Area Network (CAN). This message turns off the audio/navigation system to save the remaining battery charge. Under this condition, the Front Display Interface Module (FDIM) displays SYS OFF TO SAVE BATT (without navigation) or BATTERY SAVER — SYSTEM OFF PLEASE START THE ENGINE (with navigation) to notify the driver that battery protection actions are active.

Engine off load shed occurs when the engine is not running, and the ignition is in the ACC or RUN position. To clear the load shed state, restart the engine.

NOTE: To maintain correct operation of the load shed system, any electrical devices or equipment must be grounded to the engine or chassis ground and not the negative battery terminal. A connection to the negative battery terminal may cause an inaccurate measurement of the battery state of charge and may cause incorrect load shed system operation.

When charging the vehicle battery by connecting the charger to the negative battery terminal is necessary , such as when using a combination battery charger and battery tester/analyzer, like the GR 1 190 V3.0 Intelligent Diagnostic Charger, the BCM will not immediately update the battery state of charge. In this instance, after charging, you must carry out the Battery Monitoring System (BMS) Reset using the scan tool. This reset is needed for proper engine off load shedding and to prevent invoking of engine off load shedding earlier than normal.

NOTE: If the reset is not carried out, when the battery is charged by connecting the charger to the negative battery terminal, it takes approximately 8 hours for the BCM to learn the new battery state of charge. During this 8 hour period, the vehicle must be undisturbed, with no doors opened or keyless entry button presses. If the vehicle is used before the BCM is allowed to learn the new battery state of charge, engine off load shedding can still occur and a message may be displayed.

When charging the vehicle battery by connecting the charger to engine or chassis ground , the negative charger clamp must be connected to an unpainted chassis surface or a solid engine component such as a generator mount or engine lifting eye. In this instance, after charging, the BMS Reset **is not required** . Through this method of charging the BCM will update the battery state of charge during the charging process.

When the ignition is in the RUN position and load shed occurs, the IPC message center displays either TURN POWER OFF TO SAVE BATT (base message center) or TURN POWER OFF TO SAVE BATTERY

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(optional message center). The audio/navigation system will shut down after the message center displays it's warning.

If a fault occurs with the battery current sensor or circuit(s), the only engine off load shed strategy is a 45 minute timer. After 45 minutes have elapsed, the audio/navigation system turns off. To clear the load shed state, restart the engine.

Engine Running Load Shed

When the BCM and/or PSCM voltage is low, with the engine running, a message is sent by the BCM to either minimize or shut down the climate controlled seats, rear defrost, heated mirrors and Dual Automatic Temperature Control (DATC) blower motor to improve system voltage. Under this condition, the IPC message center displays either LOW BATTERY LESS FEATURES (base message center) or LOW BATTERY FEATURES TEMPORARILY TURNED OFF (optional message center) to notify the driver that battery protection actions are active.

There are 3 states of engine running load shed:

- Load shed 1
- Load shed 2 transient
- Load shed 2 continuous

Load Shed State	Entry Conditions	Impact to Features	Clear Conditions
Load shed 1	**If vehicle speed is below 16 km/h (10 mph):** ● Voltage to the PSCM is less than 11.5 volts. ● PSCM measures current draw greater than 0 amps. **If vehicle speed is above 16 kp/h (10 mph):** ● Voltage to the BCM is less than 11.6 volts.	Climate controlled seats switch from HIGH to MED. If the are already at MED, the state does not change.	Voltage to the BCM is greater than 12.7 volts **or** the generator field duty cycle is less than 88%.
Load shed 2 transient	● Voltage to the PSCM is less than 11.0 volts. ● PSCM measures current draw greater than 20 amps.	● If equipped, climate controlled seats are disabled, but the indicators remain illuminated. ● If equipped, rear defrost and heated mirrors are disabled, but the indicator remain illuminated.	Voltage to the BCM is greater than 12.4 volts.
Load shed 2 continuous	Vehicle was in load shed 2 transient state for greater than 20 seconds.	● If equipped, climate controlled seats are disabled and the indicators are off. ● If equipped, rear defrost and heated mirrors are disabled	Voltage to the BCM is greater than 12.4 volts for more than 60 seconds.

		and the indicator is off. ● If equipped with DATC , the blower motor is reduced to 50% speed. ● If equipped, DC/AC inverter (AC powerpoint) is disabled. ● The base IPC message center displays LOW BATTERY LESS FEATURES. ● The optional IPC message center displays LOW BATTERY FEATURES TEMPORARILY TURNED OFF.	

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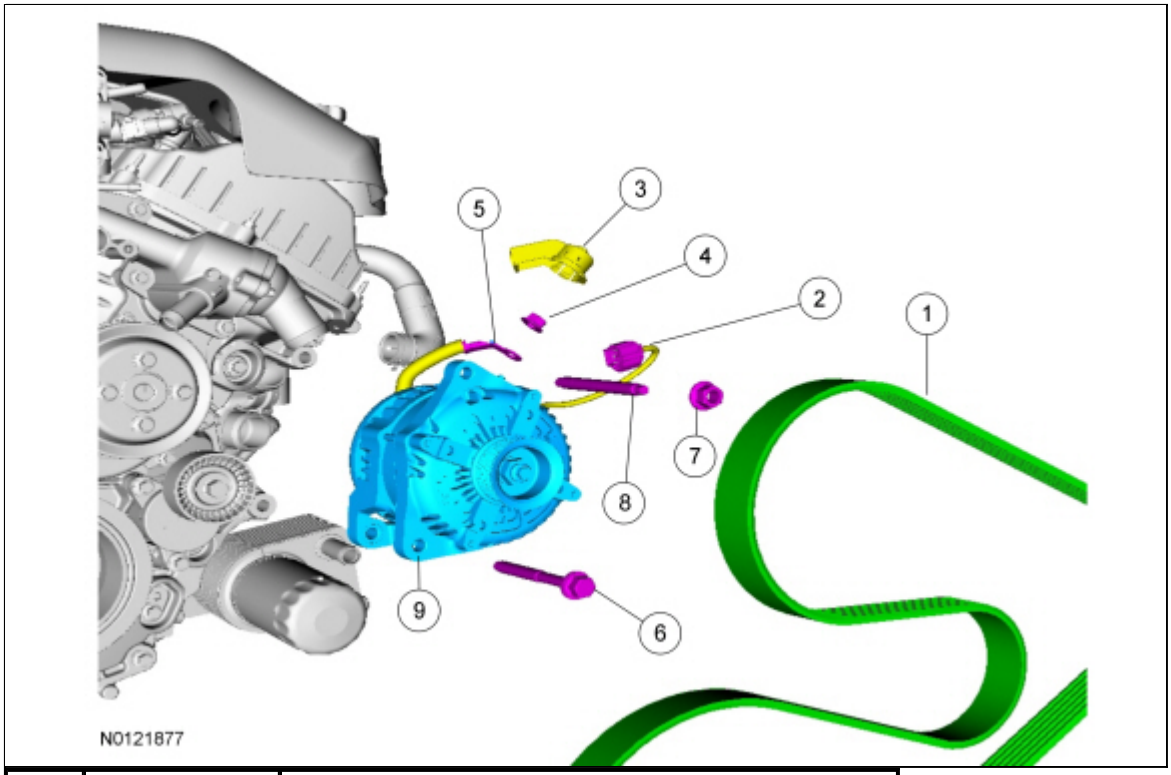
Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• System voltage high	• Fuse • Wiring, terminals or connectors • Engine, generator and battery grounds • Battery • Generator • PCM	• GO to Pinpoint Test A .
• System voltage low or battery is discharged	• Fuse • Fusible link • Wiring, terminals or connectors • Engine, generator and battery grounds • Abnormal ignition-off current drain(s) • Radial arm adapter • Battery • Generator • PCM	• GO to Pinpoint Test B .
• The generator is noisy	• Front End Accessory Drive (FEAD) belt • Loose bolts/brackets • Generator/pulleys	• GO to Pinpoint Test F .
• Radio interference	• Generator • Wiring, terminals or connectors • In-vehicle entertainment system	• GO to Pinpoint Test G .
• Charging system warning indicator is never/always on	• Wiring, terminals or connectors • Instrument Panel Cluster (IPC) • Generator • PCM	• RETRIEVE Continuous Memory Diagnostic Trouble Codes (CMDTCs) from all modules. If any charging system DTCs are found, REFER to the Diagnostic Trouble Code (DTC) Chart in this section. If no charging system DTCs are found, REFER to Section 413-01 .

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Generator — 3.5L GTDI



Item	Part Number	Description
1	8620	Accessory drive belt
2	—	Generator electrical connector (part of 14300)
3	—	Generator B+ protective boot (part of 14300)
4	W711953	Generator B+ terminal nut - 17 Nm (150 lb-in)
5	—	Generator B+ terminal (part of 14300)
6	W715092	Generator bolt (lower) - 47 Nm (35 lb-ft)
7	W520414	Generator stud nut - 47 Nm (35 lb-ft)
8	W715087	Generator stud - 8 Nm (71 lb-in)
9	10346	Generator

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery. For additional information, refer to Section 414-01 .

3. Remove the Air Cleaner (ACL) outlet pipe, LH ACL pipe-to-turbocharger pipe and the LH turbocharger-to-Charge Air Cooler (CAC) pipe. For additional information, refer to Intake Air System

Components - Exploded View in Section 303-12 .

4. Rotate the accessory drive belt tensioner and remove the accessory drive belt from the generator.

5. Remove the LH ACL and CAC pipe bracket. For additional information, refer to Intake Air System Components - Exploded View in Section 303-12 .

6. Position the generator B+ protective boot aside, remove the B+ terminal nut and position the B+ terminal aside.
   - To install, tighten to 17 Nm (150 lb-in).

7. Disconnect the generator electrical connector and position the harness aside.

8. Remove the lower generator bolt.
   - To install, tighten to 47 Nm (35 lb-ft).

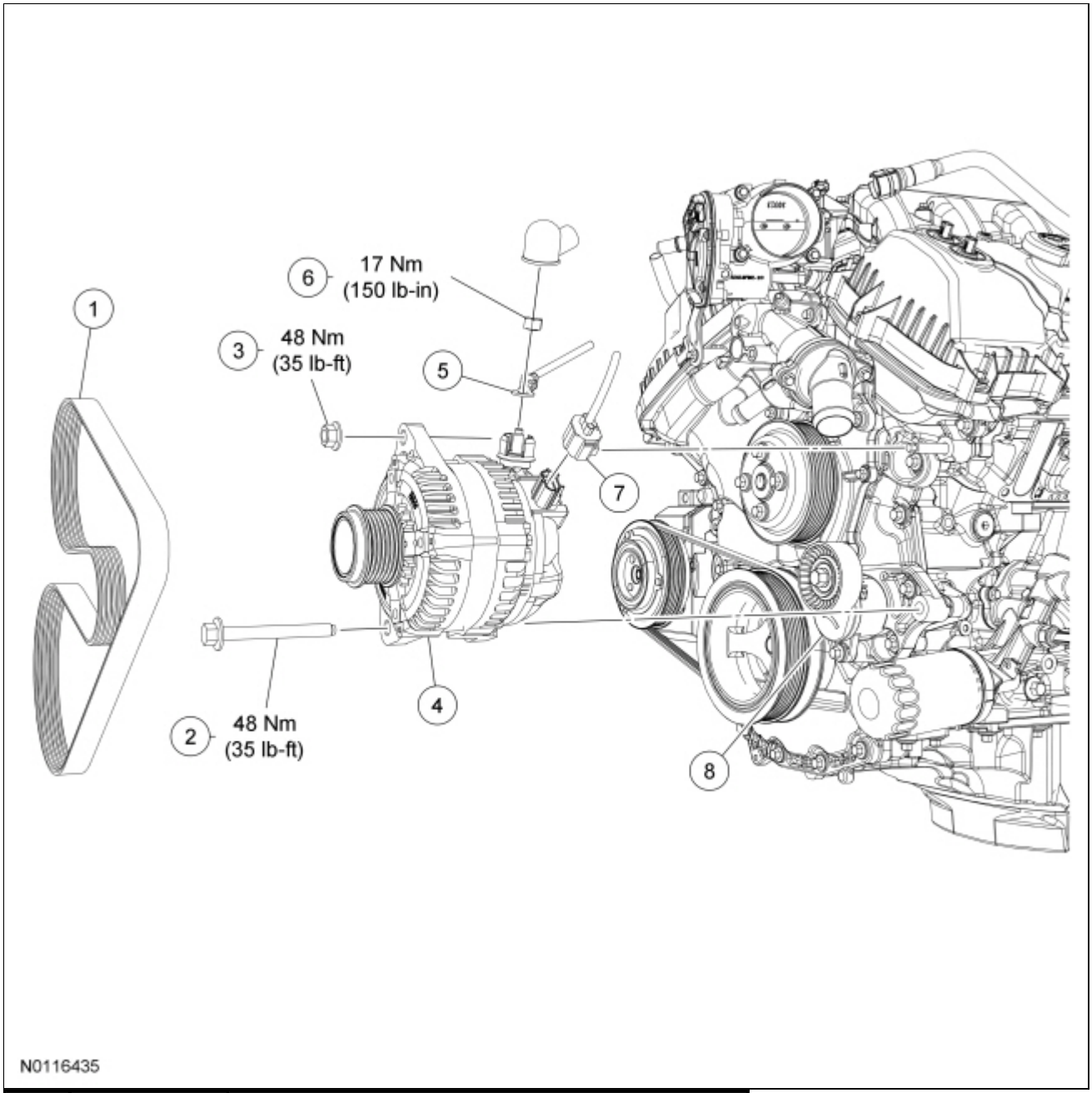
9. Remove the generator stud and the generator.
   - To install, tighten to 8 Nm (71 lb-in).

10. To install, reverse the removal procedure.

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Generator — 3.7L



Item	Part Number	Description
1	8620	Front End Accessory Drive (FEAD) belt
2	W715092	Generator bolt
3	W520414	Generator stud nut
4	10346	Generator

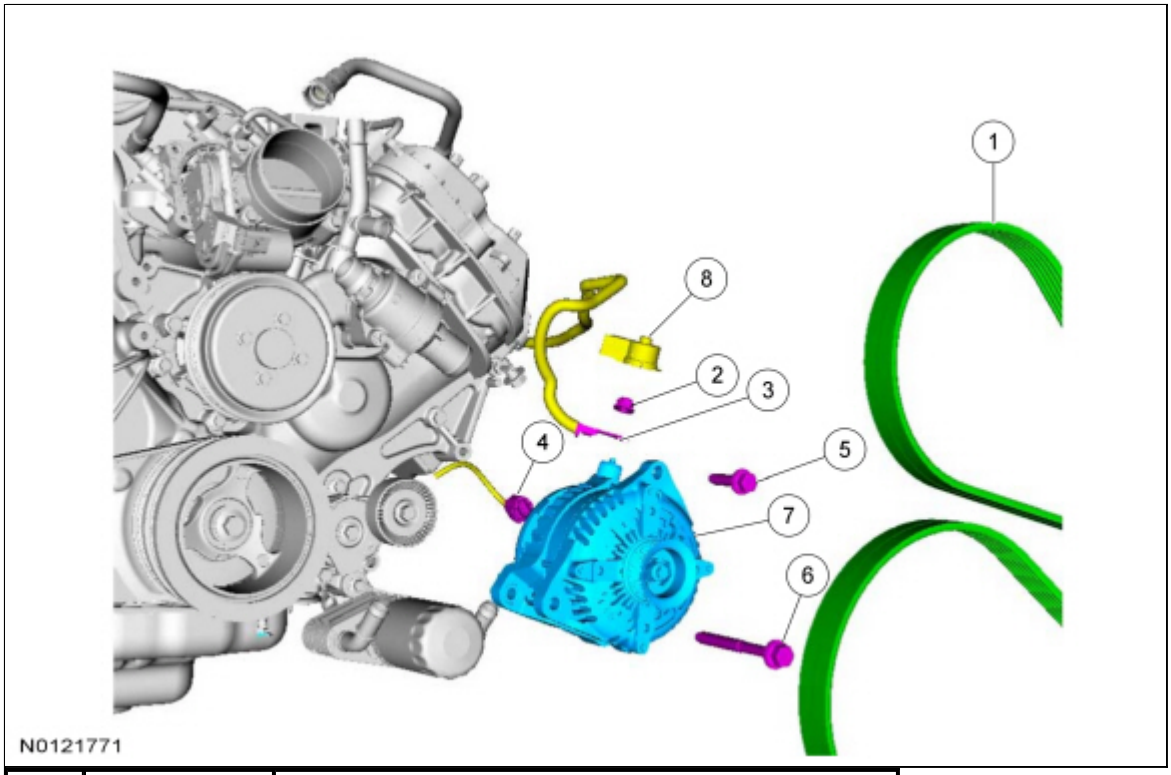
5	—	Generator B+ terminal (part of 14B060)
6	W711953	Generator B+ terminal nut
7	—	Generator electrical connector (part of 14B060)
8	6B209	FEAD belt tensioner

Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12 .
3. Rotate the Front End Accessory Drive (FEAD) belt tensioner counterclockwise and position the FEAD belt aside.
4. Disconnect the generator electrical connector.
5. Position the generator B+ protective boot aside, remove the B+ nut and position the B+ terminal aside.
    - To install, tighten to 17 Nm (150 lb-in).
6. Remove the generator stud nut.
    - To install, tighten to 48 Nm (35 lb-ft).
7. Remove the generator bolt and the generator.
    - To install, tighten to 48 Nm (35 lb-ft).
8. To install, reverse the removal procedure.

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Generator — 5.0L

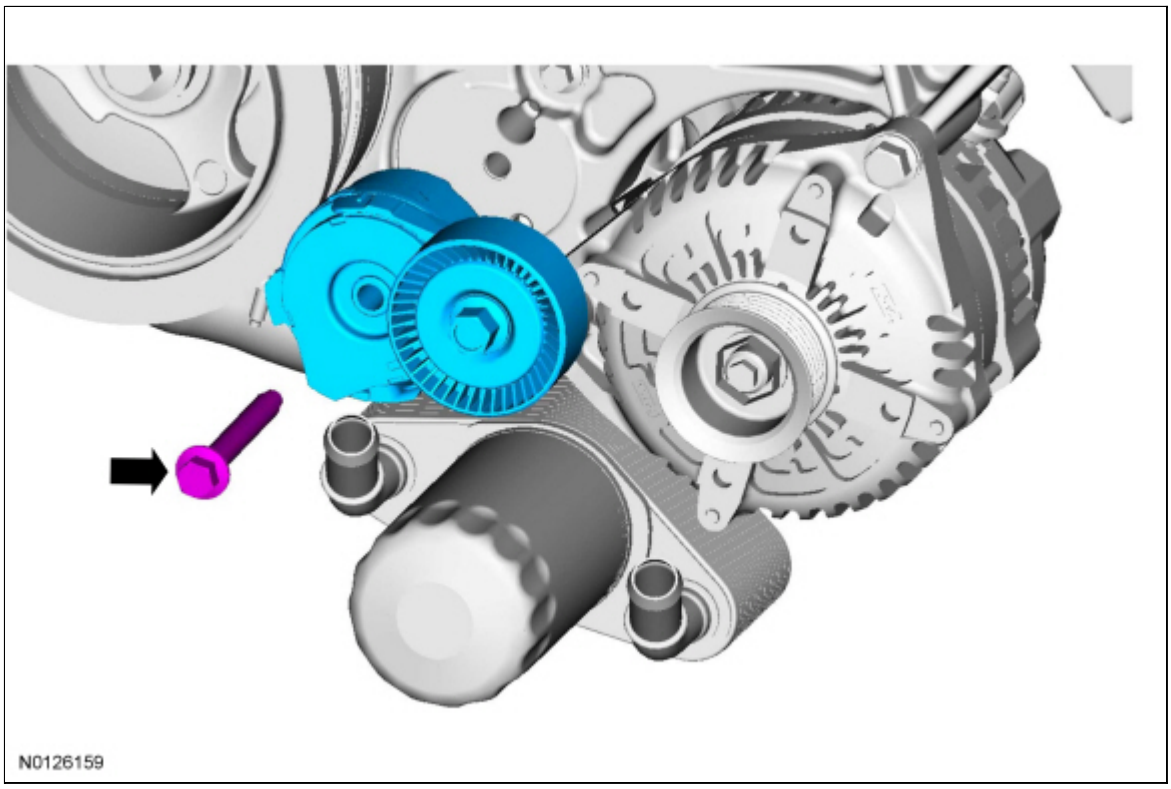


Item	Part Number	Description
1	8620	Accessory drive belt
2	W711953	Generator B+ terminal nut - 17 Nm (150 lb-in)
3	—	Generator B+ terminal (part of 14B060)
4	—	Generator electrical connector (part of 14B060)
5	W715094	Upper generator bolt - 48 Nm (35 lb-ft)
6	W715092	Lower generator bolt - 48 Nm (35 lb-ft)
7	10346	Generator
8	—	Generator B+ protective boot (part of 14B060)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery. For additional information, refer to Section 414-01 .
3. Rotate the accessory drive belt tensioner counter counterclockwise and position the accessory drive belt aside.
4. Remove the bolt and the accessory drive belt tensioner.

- To install, tighten to 48 Nm (35 lb-ft).



5. Position the generator B+ protective boot aside, remove the B+ terminal nut and position the B+ terminal aside.
    - To install, tighten to 17 Nm (150 lb-in).

6. Disconnect the generator electrical connector.

7. Remove the upper generator bolt.
    - To install, tighten to 48 Nm (35 lb-ft).

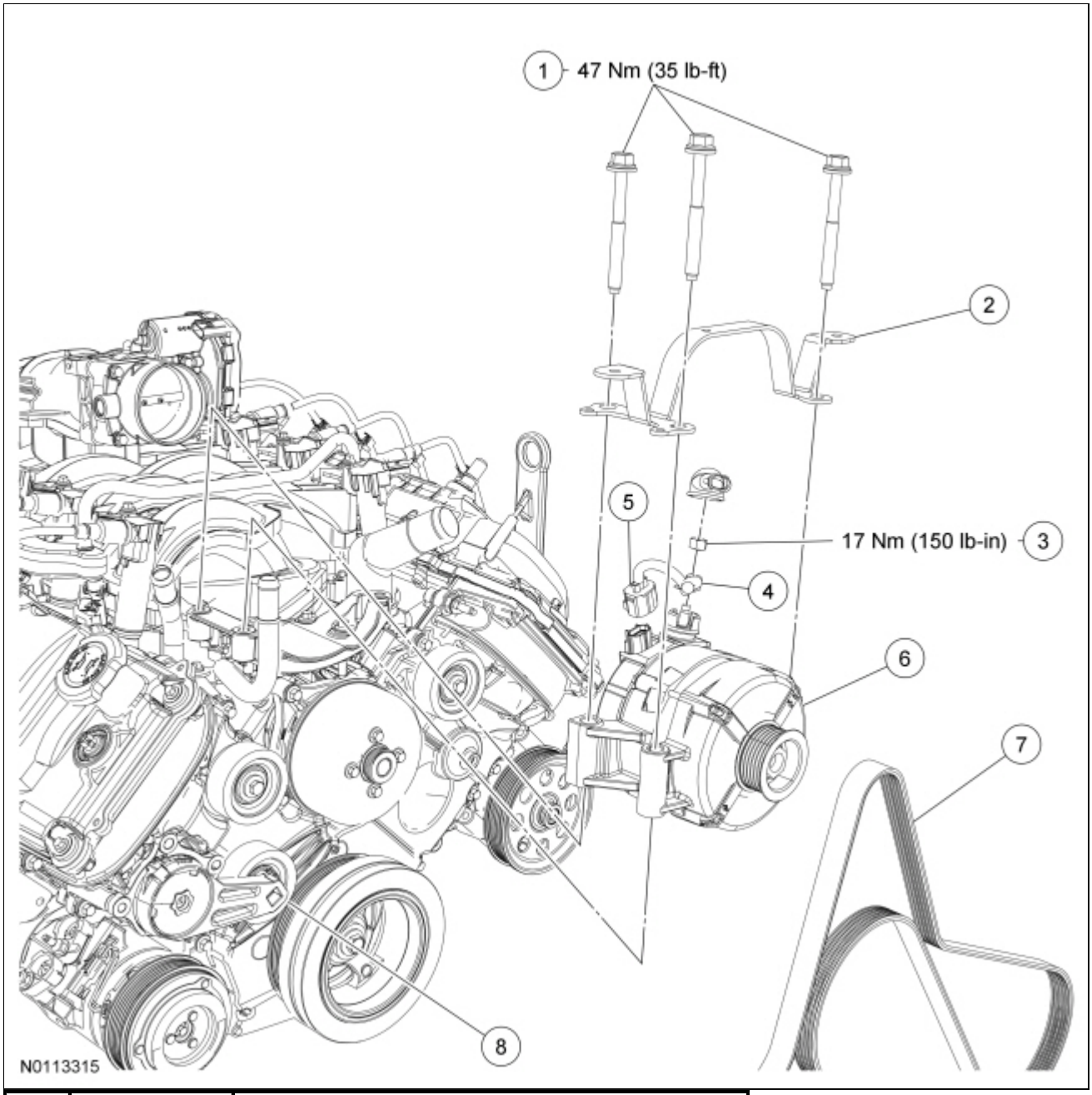
8. Remove the lower generator bolt and the generator.
    - To install, tighten to 48 Nm (35 lb-ft).

9. To install, reverse the removal procedure.

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Generator — 6.2L



Item	Part Number	Description
1	W715092	Generator bolt (3 required)
2	10153	Generator bracket
3	W711953	Generator B+ terminal nut
4	—	Generator B+ terminal (part of 14305)

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5	—	Generator electrical connector (part of 14305)
6	10300	Generator
7	8620	Accessory drive belt
8	6B209	Accessory drive belt tensioner

1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Loosen the Air Cleaner (ACL) outlet pipe clamp at the ACL upper tray and remove the ACL outlet pipe and resonator assembly. For additional information, refer to Intake Air System Components - Exploded View in Section 303-12 .

3. Rotate the accessory drive belt tensioner clockwise and position the accessory drive belt aside.

4. Disconnect the generator electrical connector.

5. Position the generator B+ protective boot aside, remove the generator B+ terminal nut and position the generator B+ terminal aside.
   - To install, tighten to 17 Nm (150 lb-in).

6. Remove the 3 bolts, generator bracket and the generator.
   - To install, tighten to 47 Nm (35 lb-ft).

7. To install, reverse the removal procedure.

General Specifications

Item	Specification
Battery	
Cold Cranking Amps (CCA) measured at -18°C (0°F)	750 CCA
Voltage	12 volts

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery cable body ground terminal bolt	13	—	115
Battery cable chassis ground terminal bolt	20	—	177
Battery cable engine ground terminal nut	25	18	—
Battery cable engine ground terminal stud bolt	47	35	—
Battery cable harness bracket bolt	20	—	177
Battery cable shield nut	12	—	106
Battery cable shield stud bolt	12	—	106
Battery cable terminal nut	5	—	44
Battery hold-down clamp bolt	7	—	62
Battery Junction Box (BJB) harness positive terminal nut	9	—	80
Battery tray bolt	17	—	150
Front axle mounting bolts	115	85	—
Generator B+ cable end nut	17	—	150
Generator B+ cable terminal/Power Distribution Box (PDB) cable terminal nut	9	—	80
Oil filter drip shield bolts	7	—	62
Power Steering Control Module (PSCM) harness positive terminal nut	9	—	80
PSCM skid plate bolts	40	30	—
Skid plate bolts	48	35	—
Starter solenoid positive cable terminal nut	12	—	106
Starter solenoid wire terminal nut	5	—	44
Transmission fluid cooler tube bracket nut	12	—	106

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Battery and Cables

Vehicles are equipped with a 12-volt, maintenance-free battery.

The battery and cable system consists of the following components:

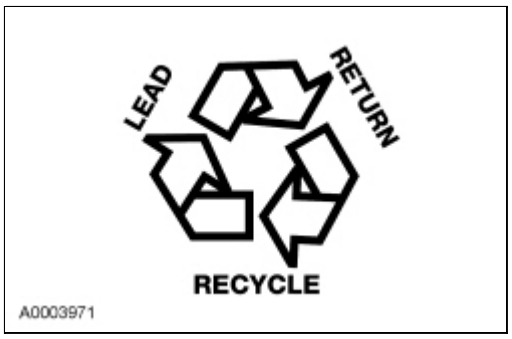
- Battery
- Battery cable assembly
- Battery tray
- Battery current sensor
- Generator current sensor

For additional information about the the battery and generator current sensors, refer to Section 414-00 .

The battery is a 12V DC source connected in a negative ground system. The battery case is sealed with 2 vent holes to release gases. The battery has 3 major functions:

- Engine cranking power source
- Voltage stabilizer for the electrical system
- Temporary power source when electrical loads exceed the generator output current

Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.



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Battery Drain Test

WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

NOTE: No factory-equipped vehicle should have more than a 50 mA (0.050 amp) draw.

NOTE: Many electronic modules draw 10 mA (0.010 amp) or more continuously.

NOTE: Typically, a drain of approximately 1 amp is attributed to an engine compartment lamp, glove compartment lamp or interior lamp staying on continually. Other component failures or wiring shorts are located by selectively pulling fuses to pinpoint the location of the current drain. When the current drain is found, the meter reading falls to an acceptable level. If the drain is still not located after checking all the fuses, it may be due to the generator. Disconnect the generator and retest.

NOTE: To accurately test the drain on a battery, an in-line ammeter must be used between the negative battery post and its respective cable. Use of a test lamp or voltmeter is not an accurate method.

1. Make sure the junction box(es)/fuse panel(s) is accessible without turning on the interior lights or the underhood lights.

2. Drive the vehicle at least 5 minutes and over 48 km/h (30 mph) to turn on and activate the vehicle systems.

3. Allow the vehicle to sit with the key out of the ignition for at least 40 minutes to allow the modules to time out/power down.

4. Connect a fused jumper wire (30A) between the negative battery cable and the negative battery post to prevent modules from resetting.

5. Disconnect the negative battery cable from the negative battery post without breaking the connection of the jumper wire.

6. ***NOTICE:*** **To prevent damage to the meter, do not crank the engine or operate accessories that draw more than 10A.**

   NOTE: It is very important that continuity is not broken between the battery and the negative battery cable when connecting the meter. If this happens, the entire 40-minute procedure must be repeated.

   Connect the battery tester between the negative battery cable and the post. The meter must be capable of reading milliamps and should have a 10-amp capability.

7. **NOTE:** If the meter settings need to be switched or the test leads need to be moved to another jack, the jumper wire must be reinstalled to avoid breaking continuity.

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Remove the jumper wire.

8. Note the amperage draw. Draw varies from vehicle to vehicle depending on the equipment package. Compare to a similar vehicle for reference.

NOTE: If the vehicle sits for an extended period of time and the battery drains, there is the possibility of a control module staying alive and not going into sleep mode. If a module does stay alive, it can also result in battery drain. If a module is suspect, isolate individual modules by disconnecting each module one at a time and note if the excessive draw goes away.

NOTE: For vehicles equipped with aftermarket bodies or boxes which contain electrical connections, disconnect the aftermarket to factory connections to isolate the body from the chassis.

9. If the current draw is excessive, remove the fuses from the Battery Junction Box (BJB) one at a time and note the current drop. When the current level drops to an acceptable level after removing a fuse, the circuit containing the excessive draw has been located. The excessive draw can be isolated by continuing to pull sub system fuses. Do not reinstall the fuses until testing is finished. To correctly isolate each of the circuits, all of the fuses may need to be removed, then install one fuse and note the amperage draw, remove the fuse and install the next fuse. Continue this process with each fuse.
    - Once the main circuit is identified, continue to remove the fuses from the Smart Junction Box (SJB) one at a time and note the current reading. Do not reinstall the fuses until testing is finished. To correctly isolate each of the circuits, all of the fuses may need to be removed, then install one fuse and note the amperage draw, remove the fuse and install the next fuse. Continue this process with each fuse.

10. Check the wiring diagrams for any circuits that run from the battery without passing through the BJB or the SJB . If the current draw is still excessive, disconnect these circuits until the draw is found. Also, disconnect the generator electrical connections and retest if the draw cannot be located. The generator may be internally shorted, causing the current drain.

Inspection And Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Battery • Battery mounting	• Battery cables • Battery posts

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the fault is not visually evident, GO to Pinpoint Test A in the Pinpoint Test procedure.

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Principles of Operation

Battery Eye Operation

The battery eye indicates the state-of-charge of the battery by responding to the specific gravity of a single battery cell electrolyte. The battery eye has a viewing plate, 2 colored balls of different specific gravity and a small passage. As the state-of-charge and specific gravity changes, the balls change their position in the passageway and subsequently display a different color in the viewing eye. The primary purpose of the battery is to be a quick indicator of state-of-charge for assembly plants and dealership pre-delivery processes.

The color of the battery eye indicates the approximate state-of-charge.

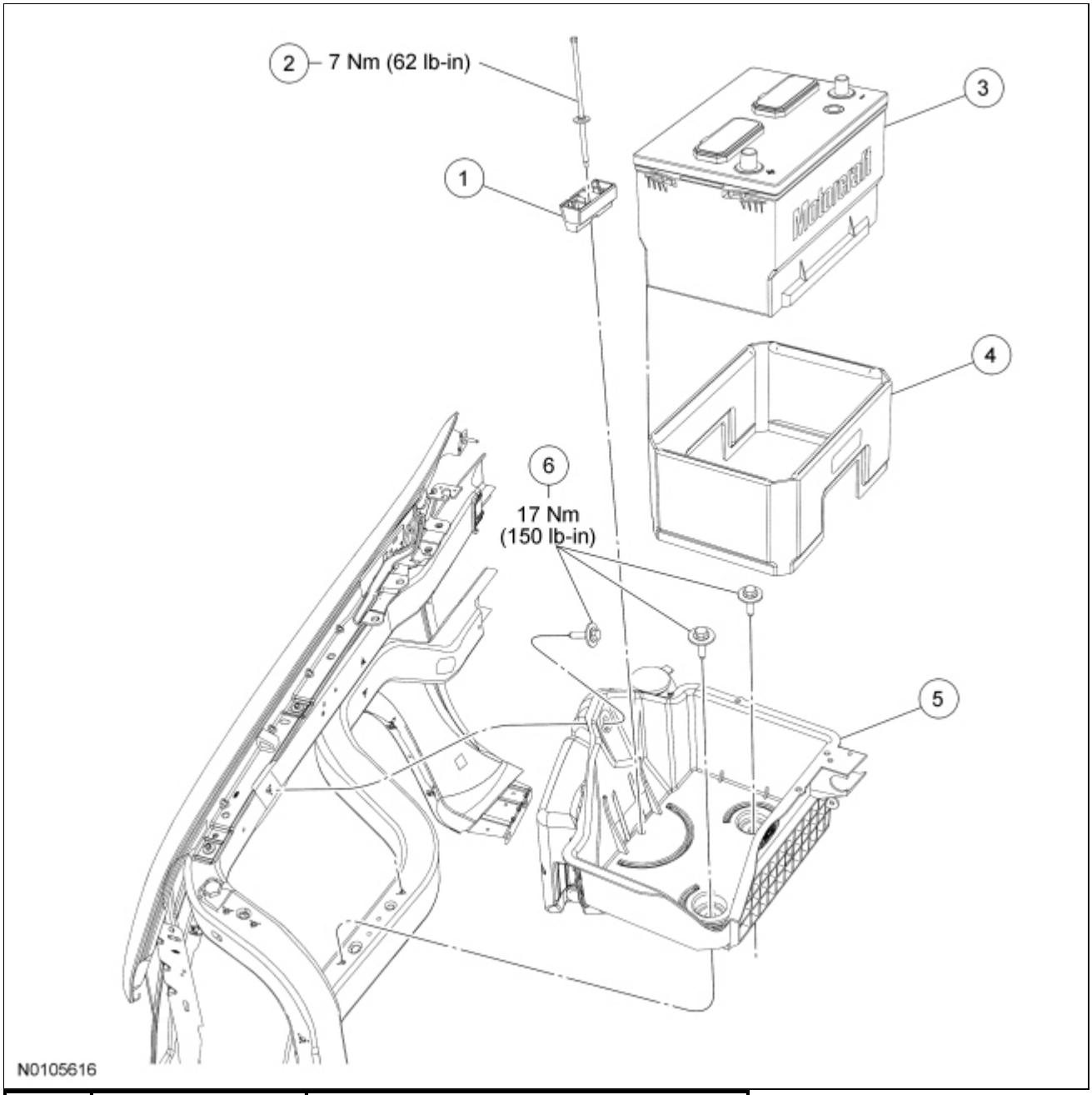
- Red — indicates low state-of-charge.
- Yellow/Black — indicates between high and low state-of-charge.
- Green — indicates high state-of-charge.
- No color can occur after the battery has been in service for several years and some of the plate material has coated the balls.
- A clear battery eye can occur if the battery case becomes damaged and the electrolyte has fallen below the plates.

NOTE: The battery eye may remain red for a period of time (up to several days), even after the battery is fully charged, because the acid is not yet fully mixed.

Do not install a new battery based solely on the indication of the battery eye. The battery eye color simply indicates the battery state-of-charge, not its condition. For example, a red or yellow/black battery eye usually indicates the battery is discharged, not damaged. If the battery eye indicates the battery may be discharged, it is necessary to recharge the battery before testing its condition.

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Battery and Battery Tray — Exploded View



Item	Part Number	Description
1	—	Battery hold-down clamp
2	N808480	Battery hold-down clamp bolt
3	10655	Battery
4	10A687	Battery cover

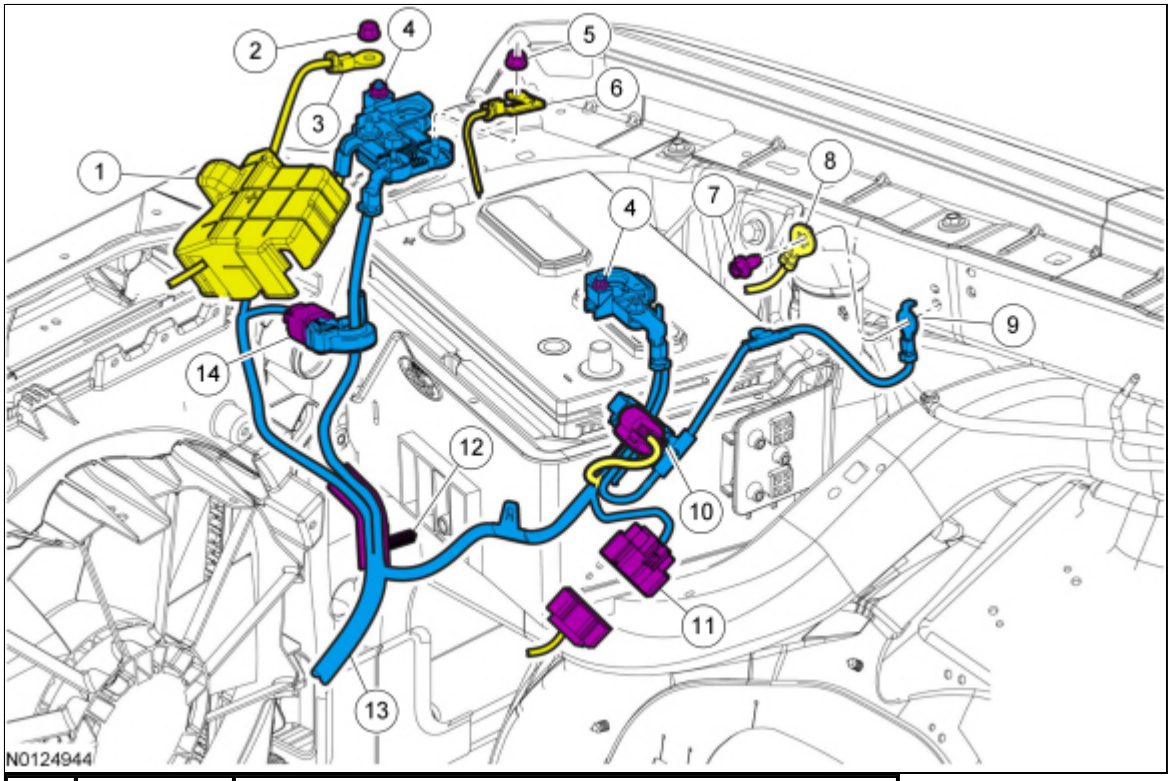
5	10732	Battery tray
6	N811479	Battery tray bolts (3 required)

1. Carry out the Battery Monitoring System (BMS) Reset using the scan tool after the battery is connected, if the battery has been replaced. If the BMS Reset is not carried out, it takes approximately 8 hours for the Body Control Module (BCM) to learn the new battery state of charge. During this 8 hour period, the vehicle must be undisturbed, with no doors opened or keyless entry button presses. If the vehicle is used before the BCM is allowed to learn the new battery state of charge, engine off load shedding can still occur and a message may be displayed.

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Battery Cables — 3.5L GTDI, 3.7L

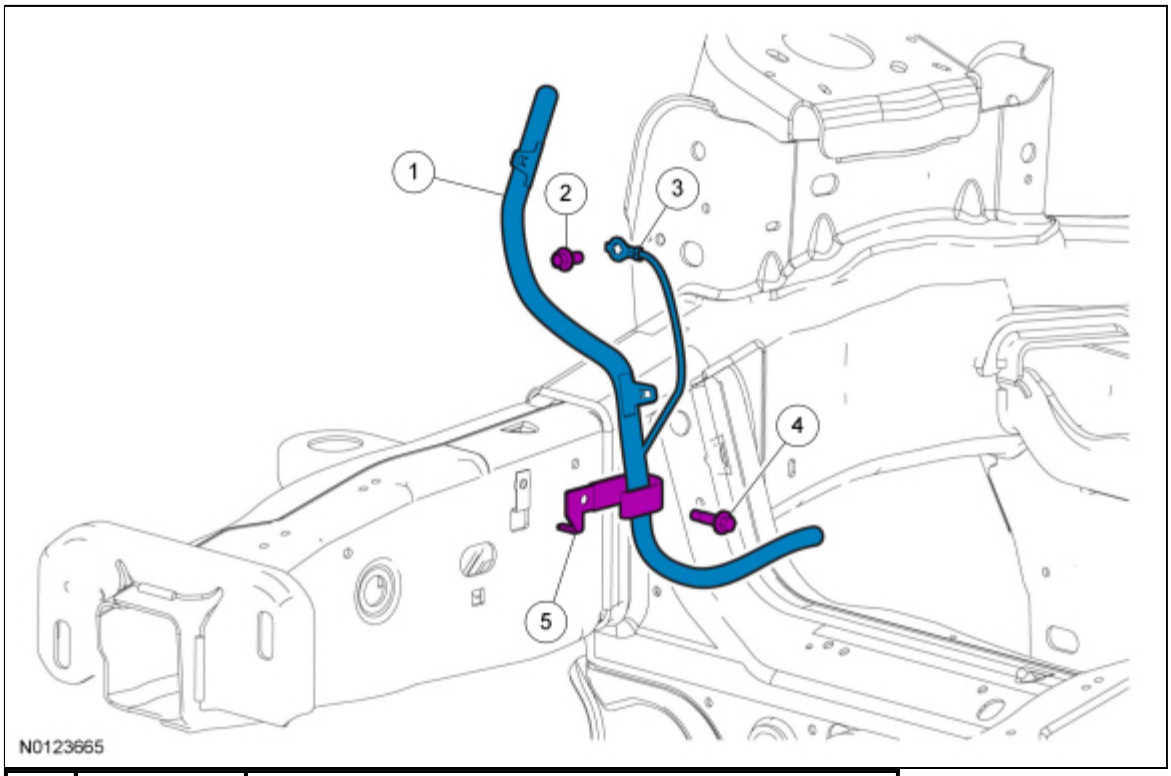
Battery Connections



Item	Part Number	Description
1	14277	Battery terminal cover
2	W705790	Battery Junction Box (BJB) harness positive terminal nut - 9 Nm (80 lb-in)
3	—	BJB harness positive terminal (part of 12A581)
4	—	Battery cable terminal nut (part of 14300) - 5 Nm (44 lb-in)
5	W705790	Power Steering Control Module (PSCM) harness positive terminal nut - 9 Nm (80 lb-in)
6	—	PSCM harness positive terminal (part of 3F720)
7	W705661	Battery cable body ground terminal bolt - 13 Nm (115 lb-in)
8	—	PSCM harness ground terminal (part of 3F720)
9	—	Battery cable body ground terminal (part of 14300)
10	—	Battery current sensor electrical connector (part of 12A581)
11	—	Battery cable in-line electrical connector (part of

		14300)
12	—	Battery cable wire harness retainer (part of 14300)
13	14300	Battery cable
14	—	Generator current sensor electrical connector (part of 14300)

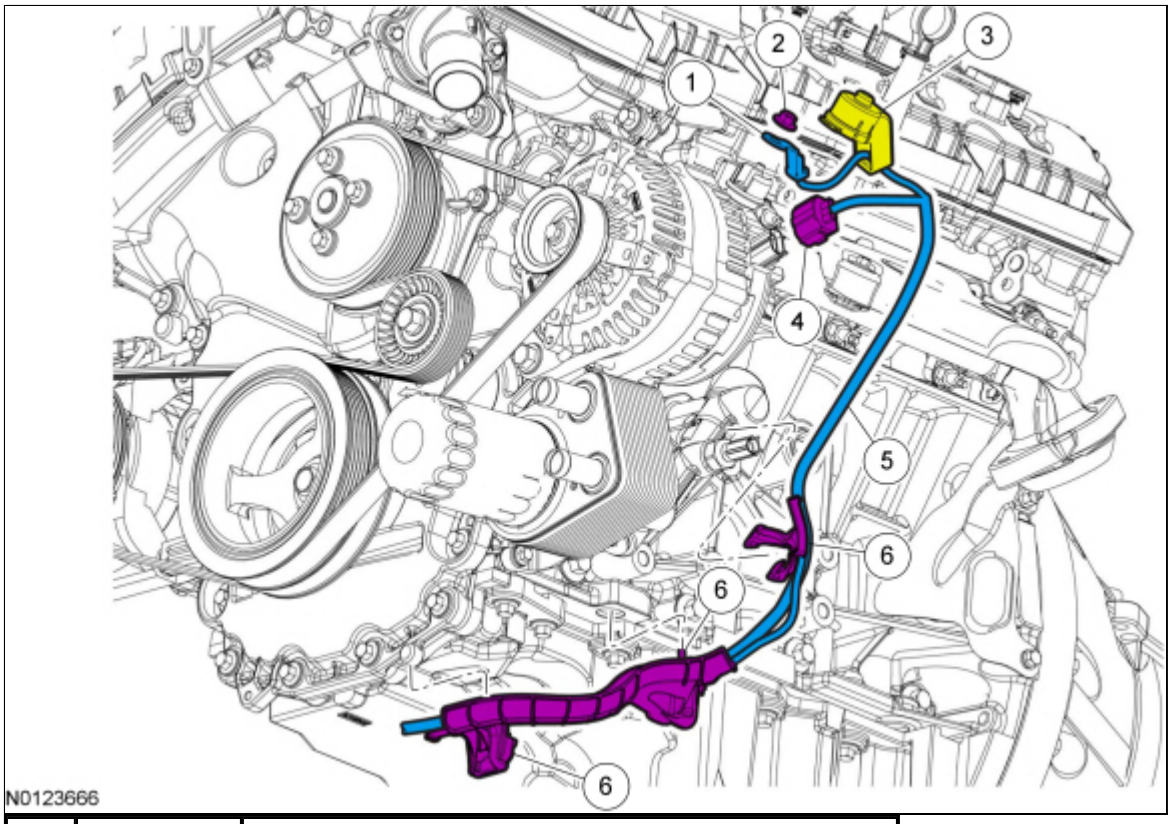
Battery Cable Chassis Ground



Item	Part Number	Description
1	14300	Battery cable
2	W505261	Battery cable chassis ground terminal bolt - 20 Nm (177 lb-in)
3	—	Battery cable chassis ground terminal (part of 14300)
4	W506424	Battery cable harness bracket bolt - 20 Nm (177 lb-in)
5	—	Battery cable harness bracket (part of 14300)

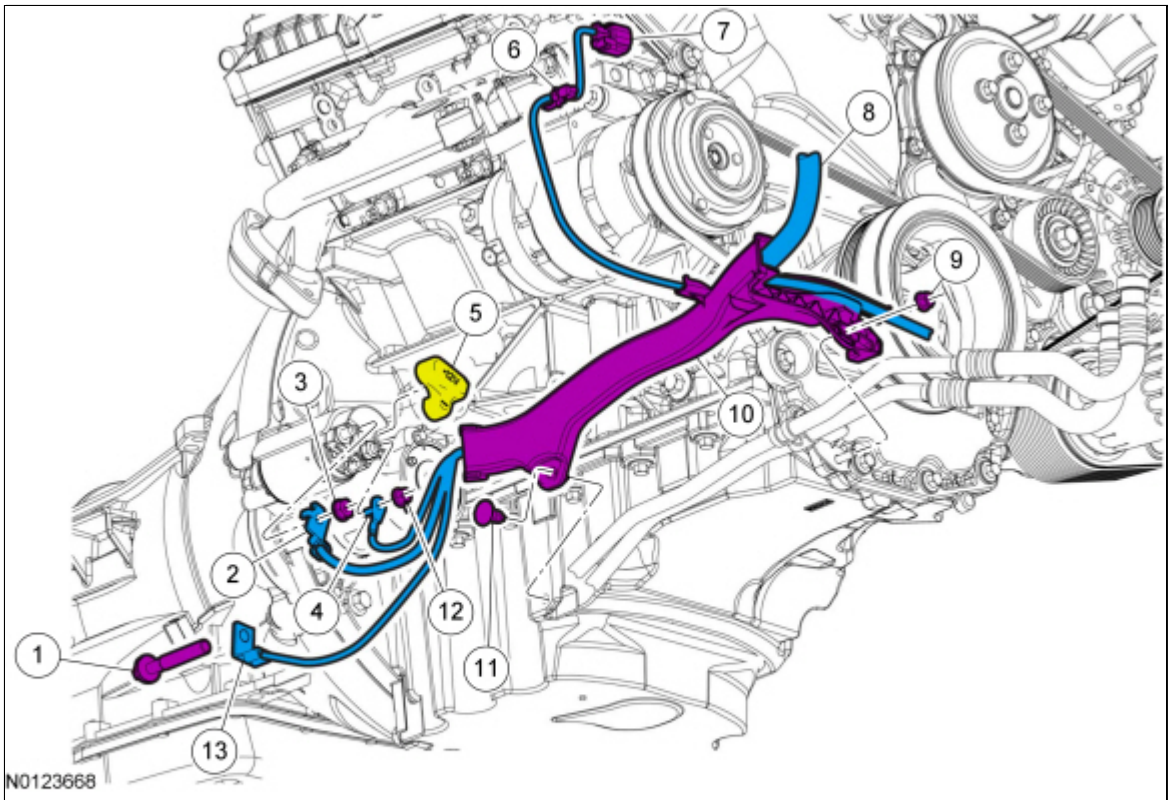
Battery Cable to Generator Connections

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Item	Part Number	Description
1	—	Generator B+ cable end (part of 14300)
2	W711953	Generator B+ cable end nut - 17 Nm (150 lb-in)
3	—	Generator B+ cable end cover (part of 14300)
4	—	Generator electrical connector (part of 14300)
5	14300	Battery cable
6	—	Battery cable wire harness retaining clip (part of 14300) (3 required)

Battery Cable to Starter Motor Connections



Item	Part Number	Description
1	W714290	Battery cable engine ground terminal stud bolt - 47 Nm (35 lb-ft)
2	—	Starter solenoid positive cable terminal (part of 14300)
3	W706414	Starter solenoid positive cable terminal nut - 12 Nm (106 lb-in)
4	—	Starter solenoid wire terminal (part of 14300)
5	11N087	Starter solenoid terminal cover
6	—	Battery cable wire harness retaining clip (part of 14300)
7	—	A/C compressor electrical connector (part of 14300)
8	14300	Battery cable
9	W520111	Battery cable shield nut - 12 Nm (106 lb-in)
10	14A099	Battery cable shield
11	—	Battery cable shield pin-type retainer
12	W705790	Starter solenoid wire terminal nut - 5 Nm (44 lb-in)

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13	—	Battery cable engine ground terminal (part of 14300)

Removal and Installation

All vehicles

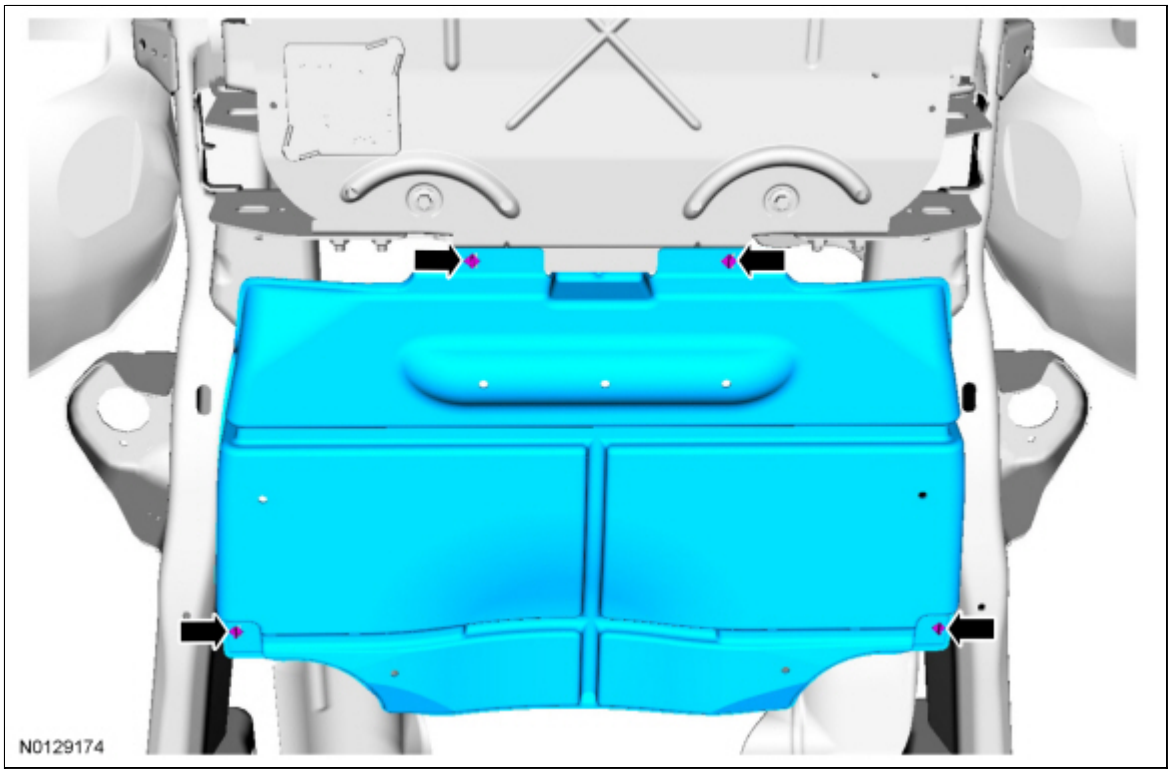
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery. For additional information, refer to Battery Disconnect in this section.
3. Remove the battery cable body ground terminal bolt and position the cable aside.
   - To install, tighten to 13 Nm (115 lb-in).
4. Disconnect the 2 battery cable harness retainers from the battery tray.
5. Disconnect the battery current sensor electrical connector.
6. Remove the Power Steering Control Module (PSCM) harness positive terminal nut and position the cable aside.
   - To install, tighten to 9 Nm (80 lb-in).
7. Remove the Battery Junction Box (BJB) harness positive terminal nut and position the cable aside.
   - To install, tighten to 9 Nm (80 lb-in).
8. Loosen the positive battery cable terminal nut and position the cable aside.
   - To install, tighten to 5 Nm (44 lb-in).
9. Disconnect the battery cable in-line electrical connector.
10. Remove the battery tray. For additional information, refer to Battery Tray in this section.

Vehicles with 3.5L GTDI

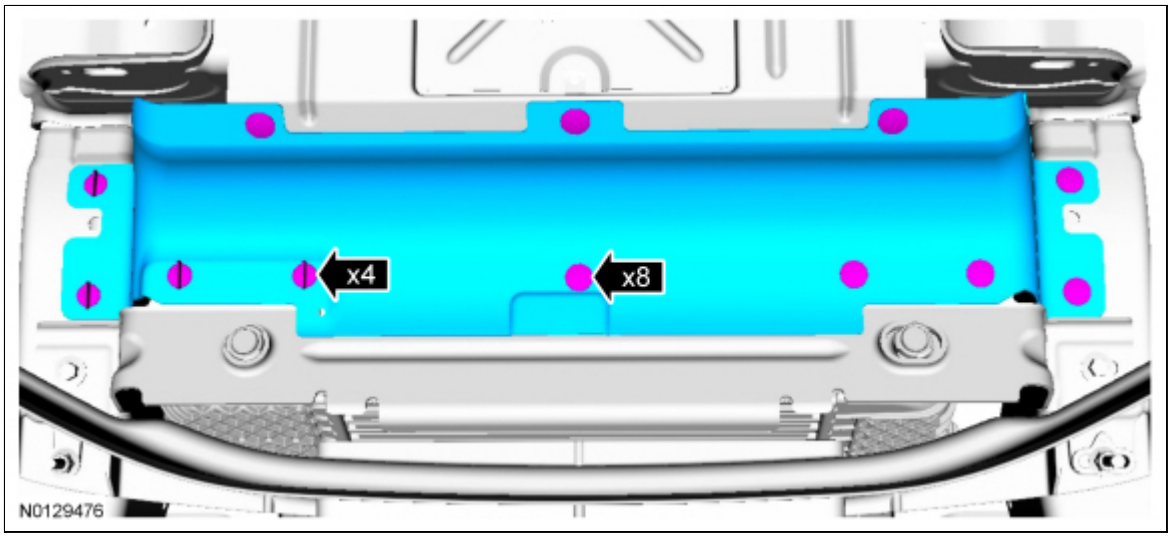
11. Remove the LH ACL pipe-to-turbocharger pipe and the LH turbocharger-to-Charge Air Cooler (CAC) pipe. For additional information, refer to Intake Air System Components - Exploded View in Section 303-12 .

All vehicles

12. Remove the generator B+ cable end cover.
13. Remove the generator B+ cable end nut and position the cable aside.
    - To install, tighten to 17 Nm (150 lb-in).
14. Disconnect the generator electrical connector.
15. If equipped, turn the 4 quarter-turn retainers and remove the rear splash shield.

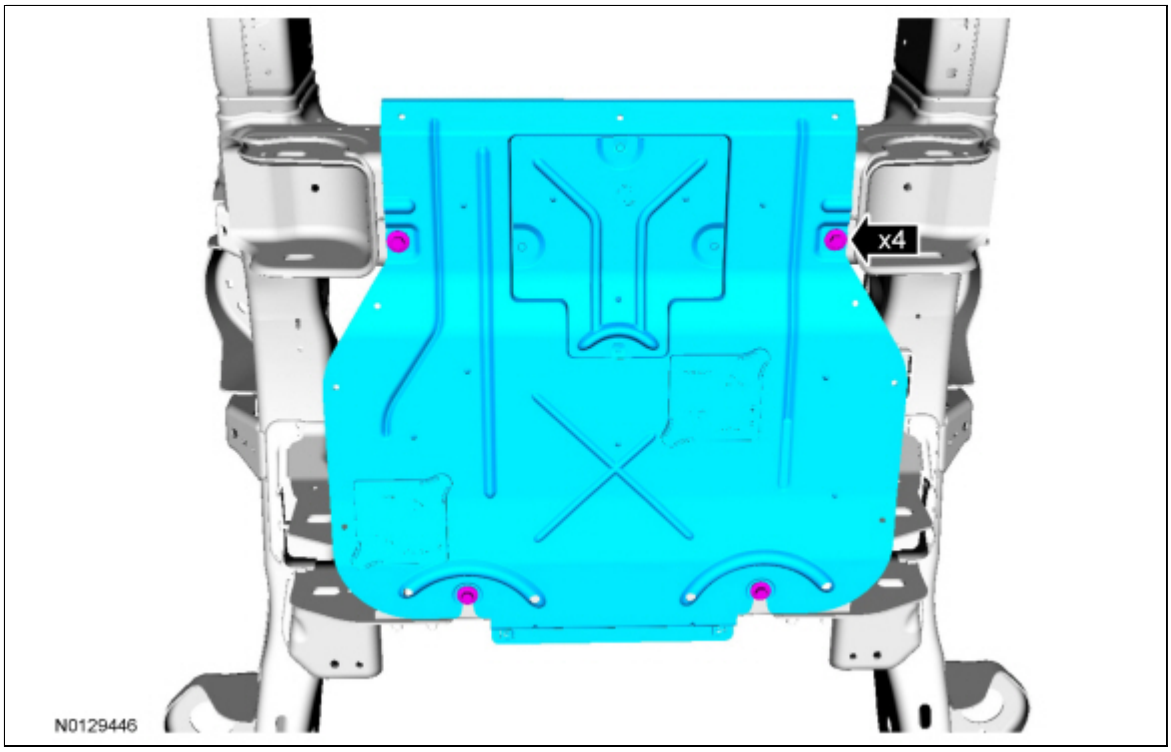


16. Turn the 4 quarter-turn retainers, detach the 8 pushpins and remove the lower air deflector.

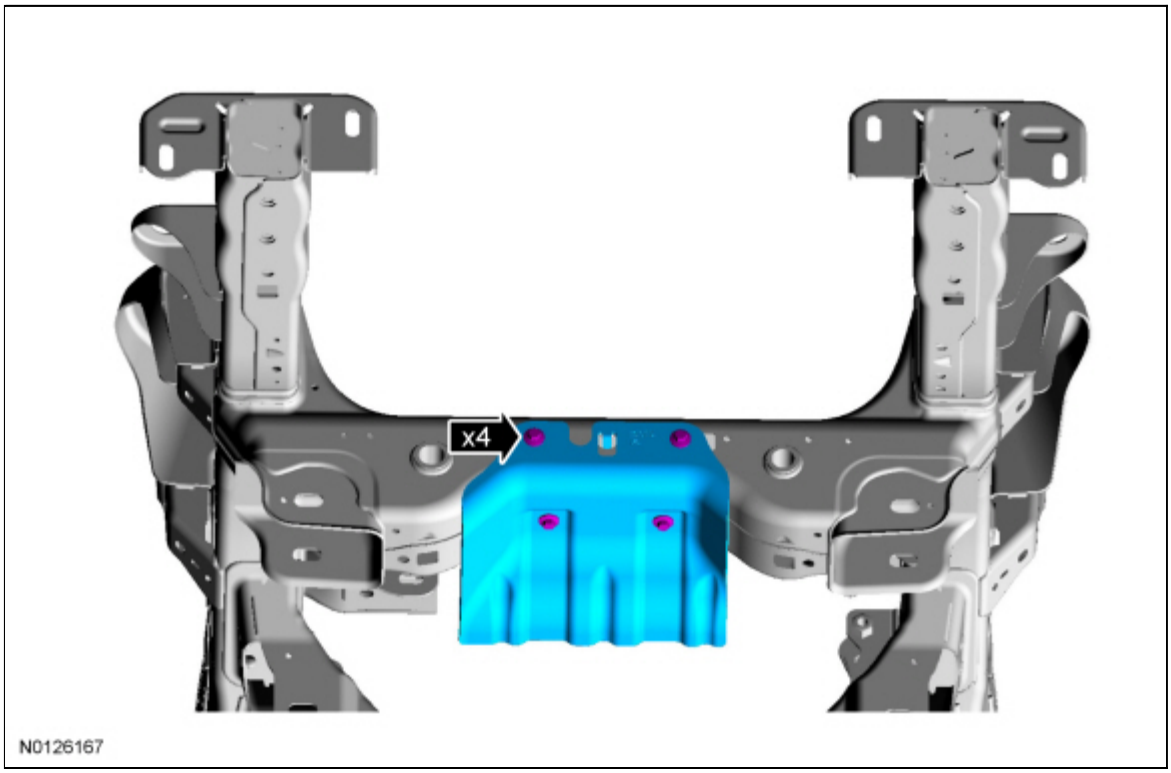


17. If equipped, remove the 4 bolts and the skid plate.
    - To install, tighten to 48 Nm (35 lb-ft).

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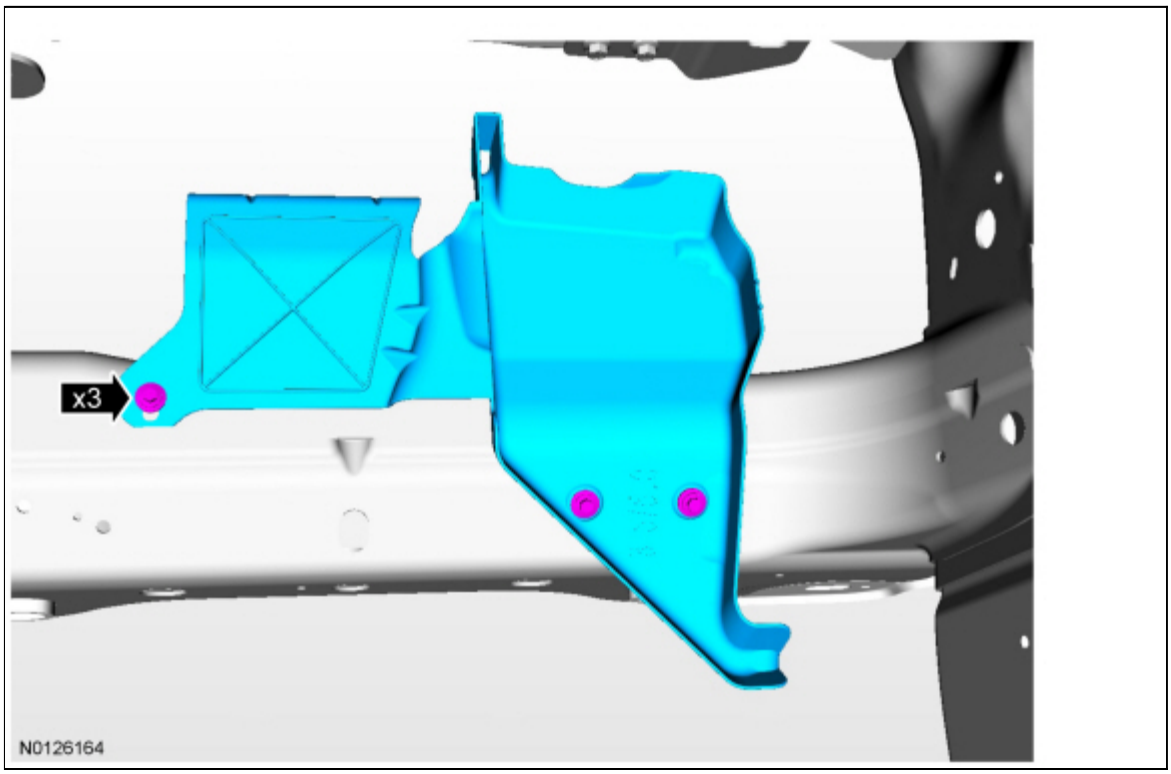
18. If equipped, remove the 4 bolts and the Power Steering Control Module (PSCM) skid plate.
    - To install, tighten to 40 Nm (30 lb-ft).



19. **NOTE:** 3.5L GTDI oil filter drip shield shown, 3.7L similar.

    Remove the 3 bolts and the oil filter drip shield.

- To install, tighten to 7 Nm (62 lb-in).



20. Remove the battery cable harness bracket bolt from the RF frame.
    - To install, tighten to 20 Nm (177 lb-in).

21. Remove the battery cable chassis ground terminal bolt.
    - To install, tighten to 20 Nm (177 lb-in).

22. Disconnect the A/C compressor electrical connector.

23. Disconnect the wire harness retainer from the A/C compressor.

24. Remove the battery cable shield nut.
    - To install, tighten to 12 Nm (106 lb-in).

25. Position the transmission fluid cooler tube bracket and wire harness aside.

26. Remove the wire harness retainer from the battery cable shield.

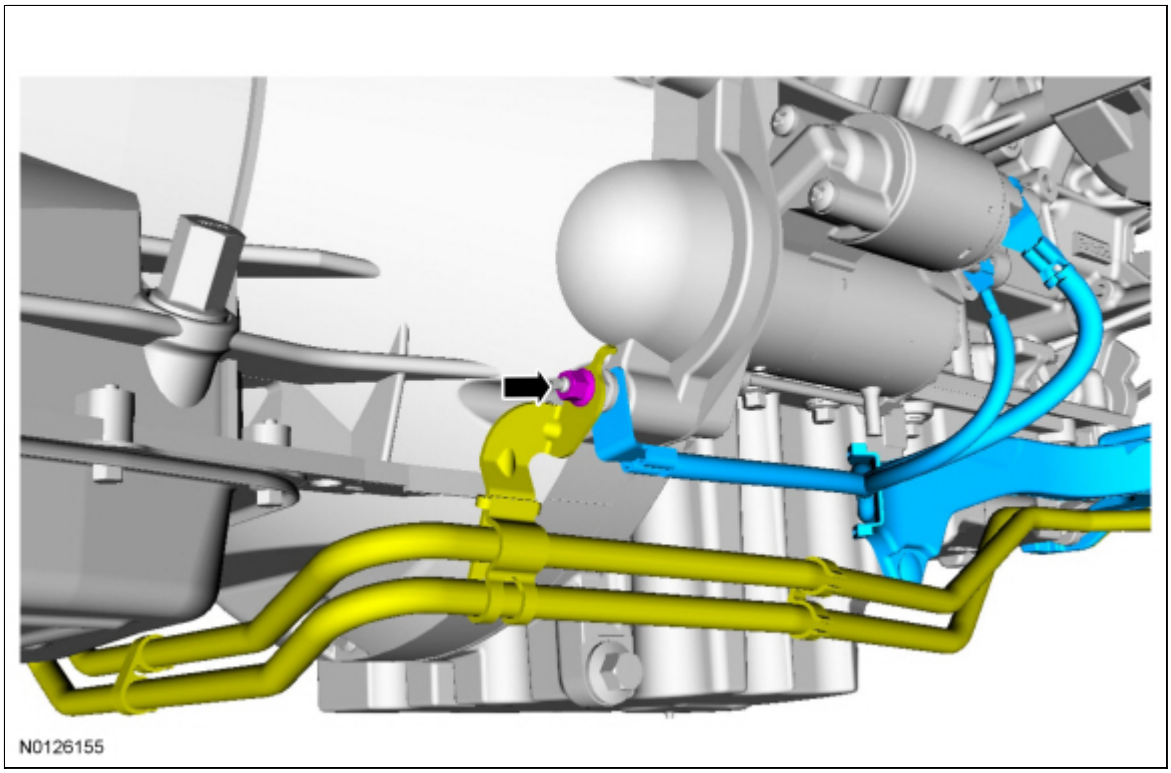
27. Remove the starter solenoid terminal cover.

28. Remove the starter solenoid wire terminal nut and position the cable aside.
    - To install, tighten to 5 Nm (44 lb-in).

29. Remove the starter solenoid positive cable terminal nut and position the cable aside.
    - To install, tighten to 12 Nm (106 lb-in).

30. Remove the nut and position the transmission fluid cooler tube bracket aside.
    - To install, tighten to 12 Nm (106 lb-in).

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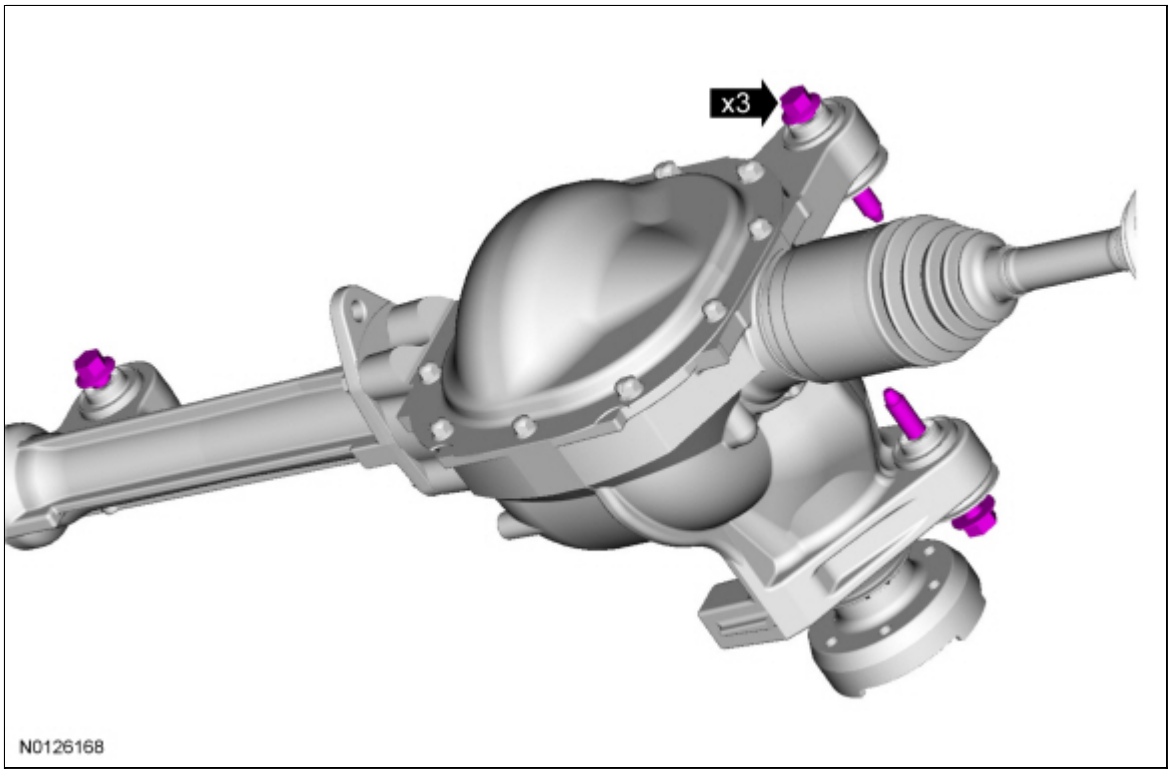


31. Remove the battery cable engine ground terminal stud bolt.
    - To install, tighten to 47 Nm (35 lb-ft).

Vehicles with Four Wheel Drive (4WD)

32. Position a suitable hydraulic jack under the front axle. Securely strap the axle to the jack.

33. Remove the 3 front axle mounting bolts.
    - To install, tighten to 115 Nm (85 lb-ft).



34. Lower the front axle to allow clearance to the 2 wire harness retainers at the engine front cover and the engine block.

All vehicles

35. Disconnect the wire harness retainers from the engine front cover, engine block and the oil filter adaptor.

36. Remove the battery cable.

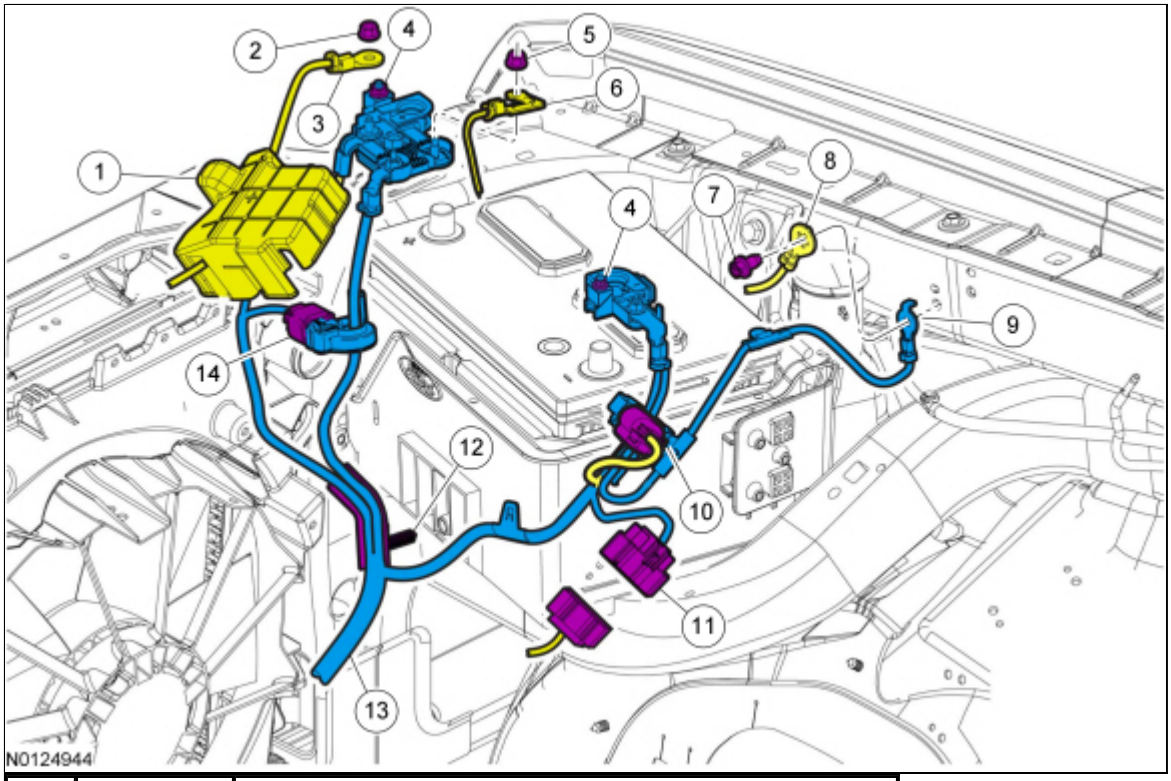
37. To install, reverse the removal procedure.

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Battery Cables — 5.0L

Battery Connections

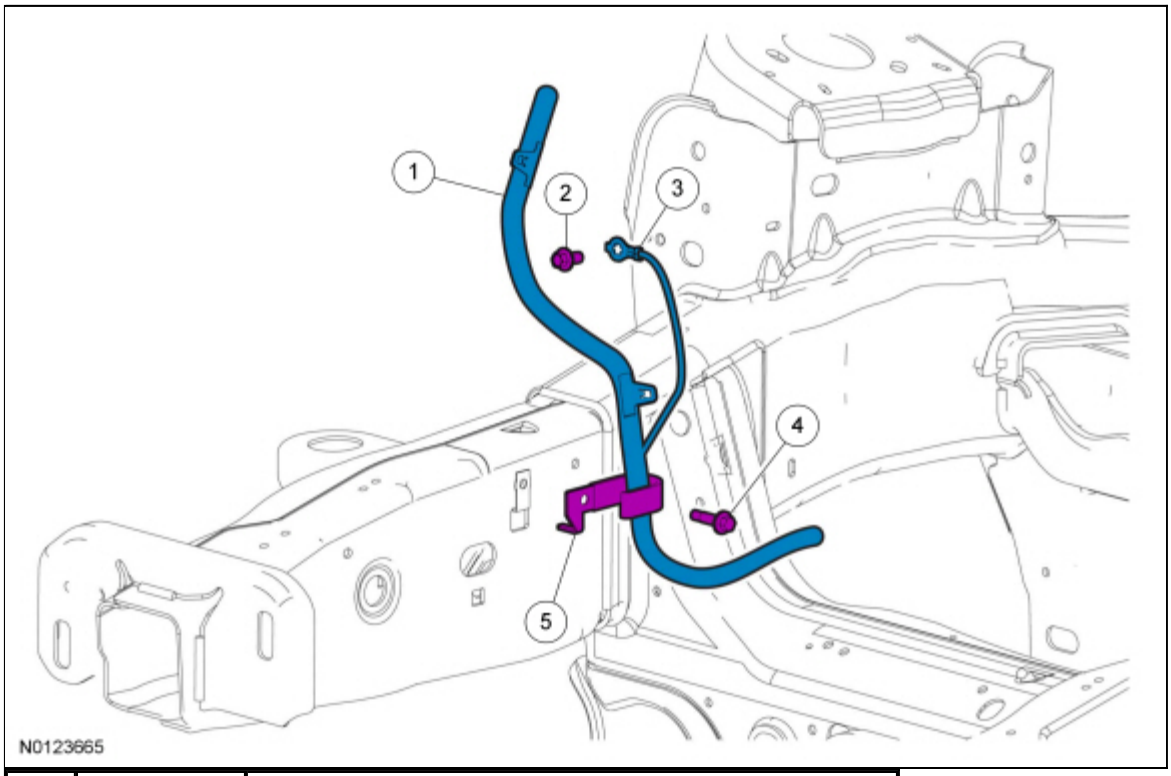


Item	Part Number	Description
1	14277	Battery terminal cover
2	W705790	Battery Junction Box (BJB) harness positive terminal nut - 9 Nm (80 lb-in)
3	—	BJB harness positive terminal (part of 12A581)
4	—	Battery cable terminal nut (part of 14300) - 5 Nm (44 lb-in)
5	W705790	Power Steering Control Module (PSCM) harness positive terminal nut - 9 Nm (80 lb-in)
6	—	PSCM harness positive terminal (part of 3F720)
7	W705661	Battery cable body ground terminal bolt - 13 Nm (115 lb-in)
8	—	PSCM harness ground terminal (part of 3F720)
9	—	Battery cable body ground terminal (part of 14300)
10	—	Battery current sensor electrical connector (part of 12A581)
11	—	Battery cable in-line electrical connector (part of

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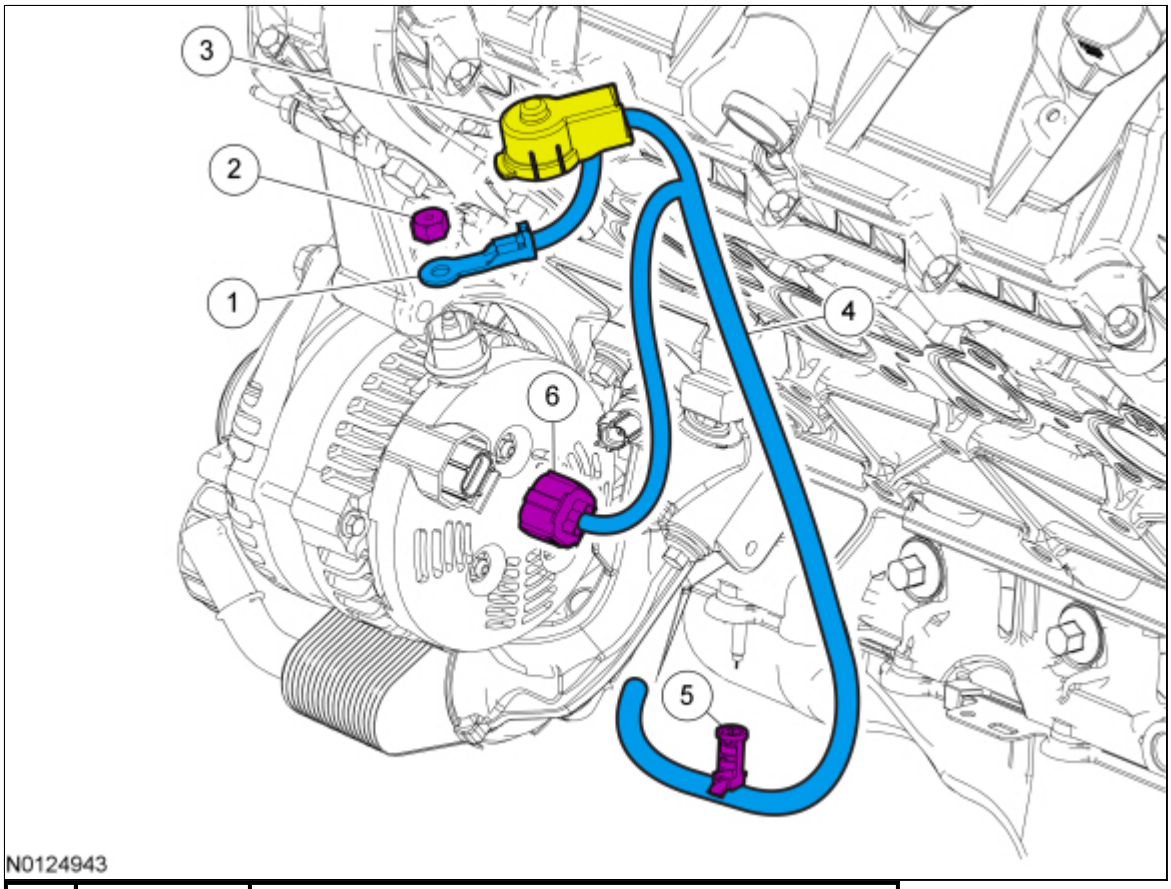
		14300)
12	—	Battery cable wire harness retainer (part of 14300)
13	14300	Battery cable
14	—	Generator current sensor electrical connector (part of 14300)

Battery Cable Chassis Ground



Item	Part Number	Description
1	14300	Battery cable
2	W505261	Battery cable chassis ground terminal bolt - 20 Nm (177 lb-in)
3	—	Battery cable chassis ground terminal (part of 14300)
4	W506424	Battery cable harness bracket bolt - 20 Nm (177 lb-in)
5	—	Battery cable harness bracket (part of 14300)

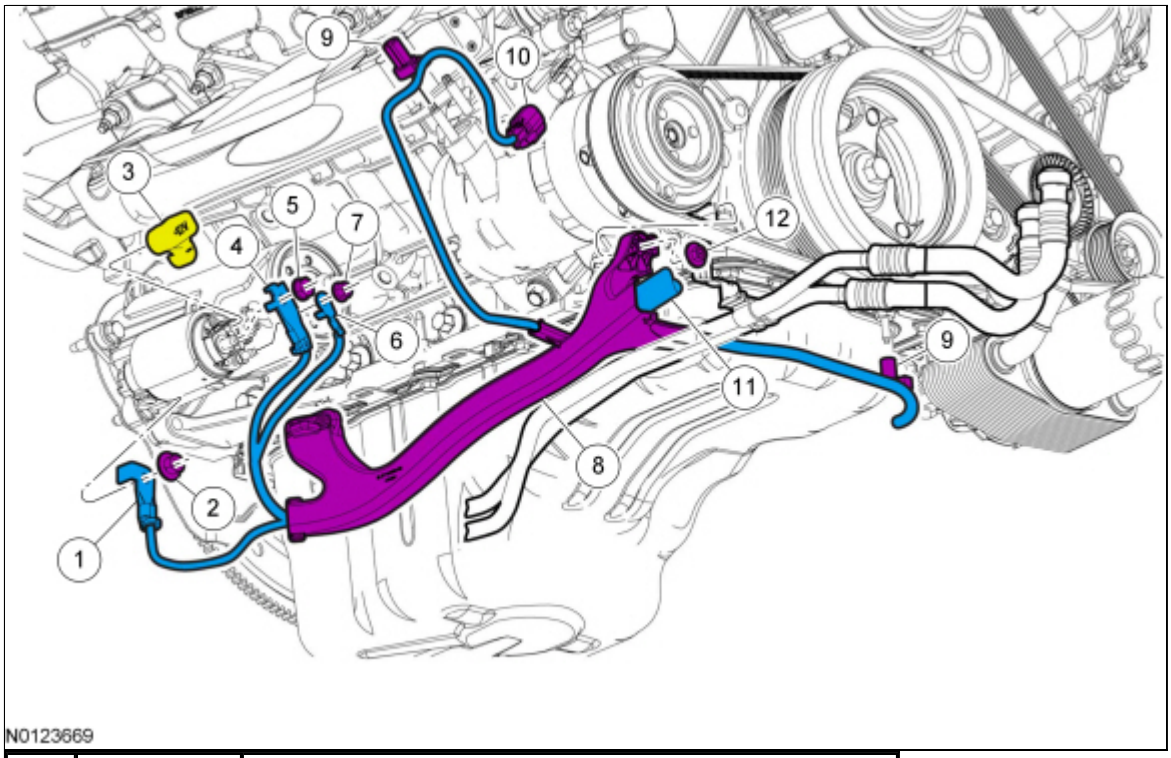
Battery Cable to Generator Connections



Item	Part Number	Description
1	—	Generator B+ cable end (part of 14300)
2	W711953	Generator B+ cable end nut - 17 Nm (150 lb-in)
3	—	Generator B+ cable end cover (part of 14300)
4	14300	Battery cable
5	—	Battery cable wire harness retaining clip (part of 14300)
6	—	Generator electrical connector (part of 14300)

Battery Cable to Starter Motor Connections

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N0123669

Item	Part Number	Description
1	—	Battery cable engine ground terminal (part of 14300)
2	N805024	Battery cable engine ground terminal nut - 25 Nm (18 lb-ft)
3	11N087	Starter solenoid terminal cover
4	—	Starter solenoid positive cable terminal (part of 14300)
5	W706414	Starter solenoid positive cable terminal nut 12 Nm (106 lb-in)
6	—	Starter solenoid wire terminal (part of 14300)
7	W705790	Starter solenoid wire terminal nut - 5 Nm (44 lb-in)
8	14A099	Battery cable shield
9	—	Battery cable wire harness retaining clip (part of 14300) (2 required)
10	—	A/C compressor electrical connector (part of 14300)
11	14300	Battery cable
12	W520111	Battery cable shield nut - 12 Nm (106 lb-in)

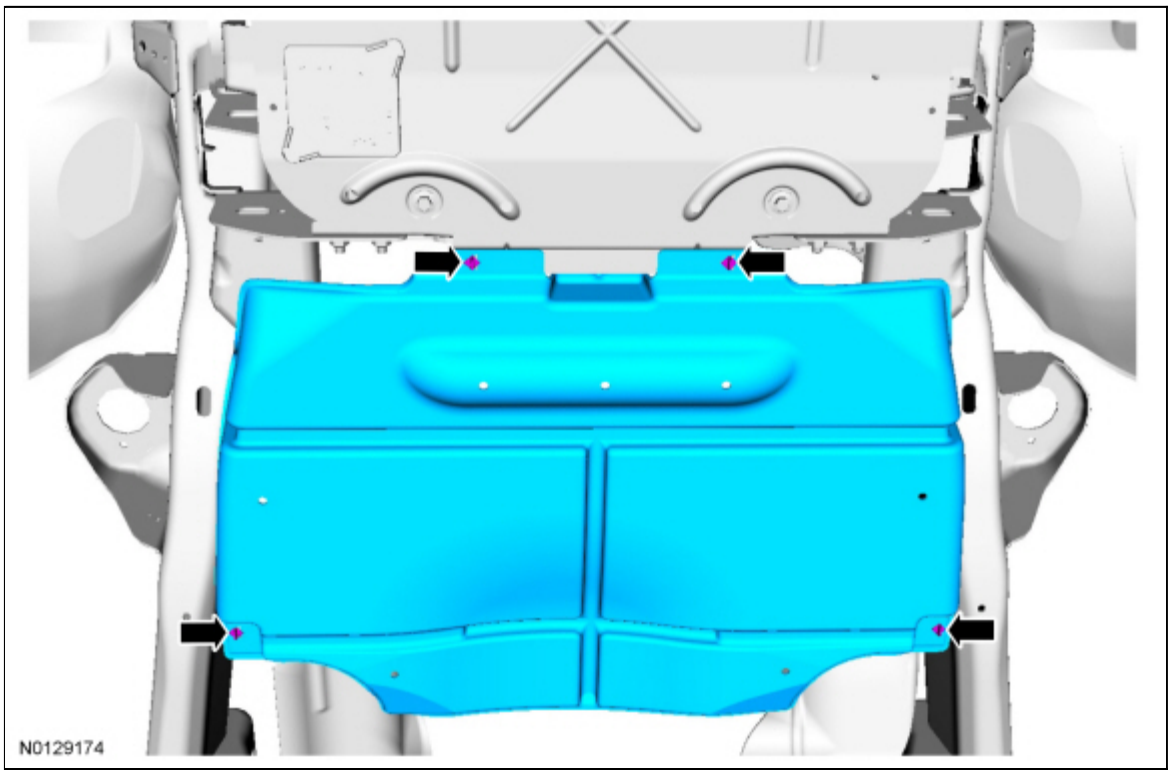
Removal and Installation

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

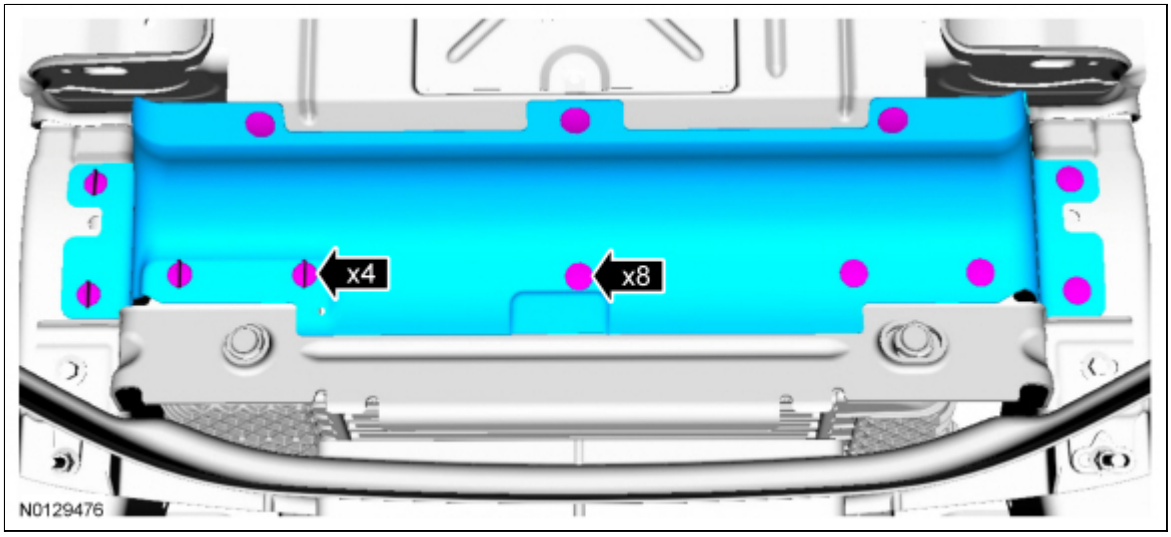
2. Disconnect the battery. For additional information, refer to Battery Disconnect in this section.

3. Remove the battery cable body ground terminal bolt and position the cable aside.
    - To install, tighten to 13 Nm (115 lb-in).
4. Disconnect the 2 battery cable harness retainers from the battery tray.
5. Disconnect the battery current sensor electrical connector.
6. Remove the Power Steering Control Module (PSCM) harness positive terminal nut and position the cable aside.
    - To install, tighten to 9 Nm (80 lb-in).
7. Remove the Battery Junction Box (BJB) harness positive terminal nut and position the cable aside.
    - To install, tighten to 9 Nm (80 lb-in).
8. Loosen the positive battery cable terminal nut and position the cable aside.
    - To install, tighten to 5 Nm (44 lb-in).
9. Disconnect the battery cable in-line electrical connector.
10. Remove the battery tray. For additional information, refer to Battery Tray in this section.
11. Remove the generator B+ cable end cover.
12. Remove the generator B+ cable end nut and position the cable aside.
    - To install, tighten to 17 Nm (150 lb-in).
13. Disconnect the generator electrical connector.
14. If equipped, turn the 4 quarter-turn retainers and remove the rear splash shield.

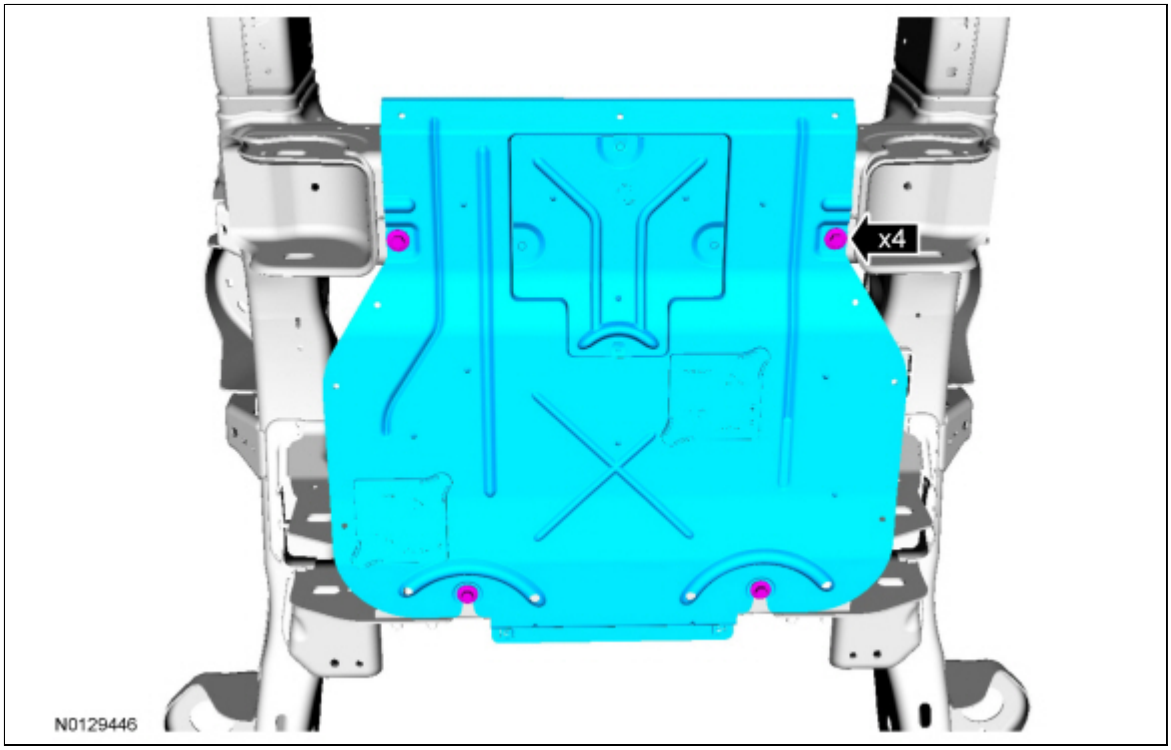


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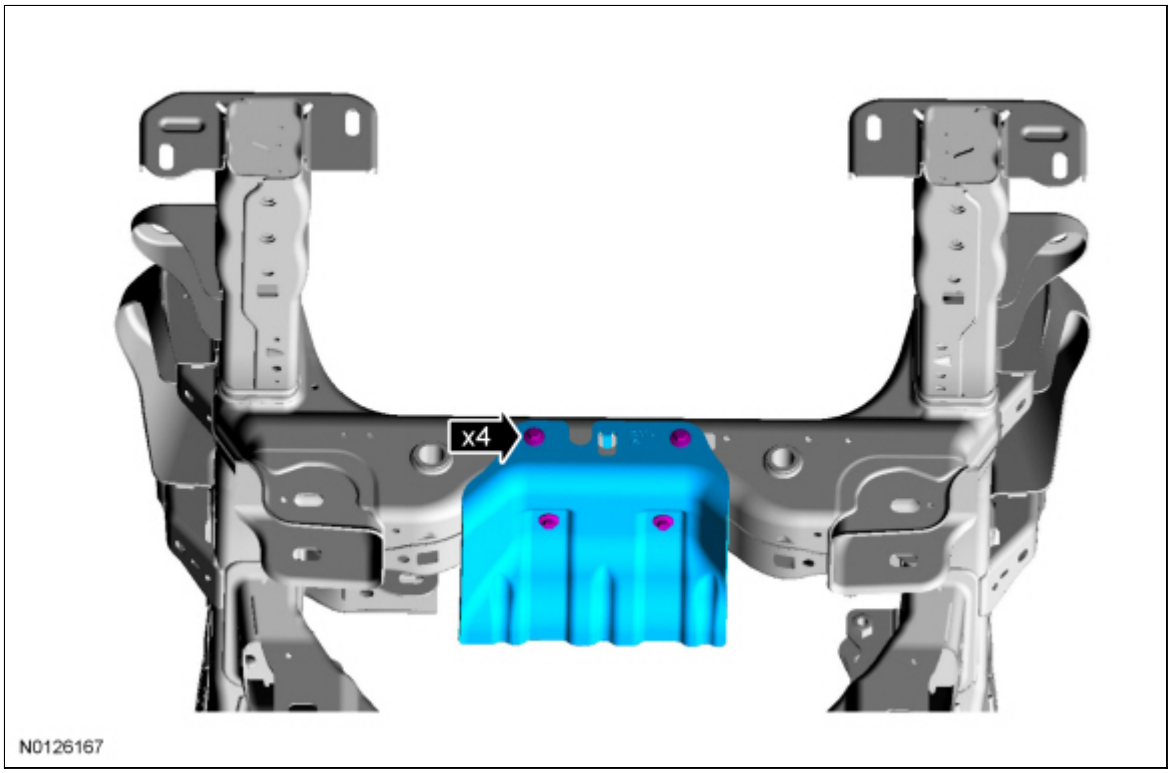
15. Turn the 4 quarter-turn retainers, detach the 8 pushpins and remove the lower air deflector.



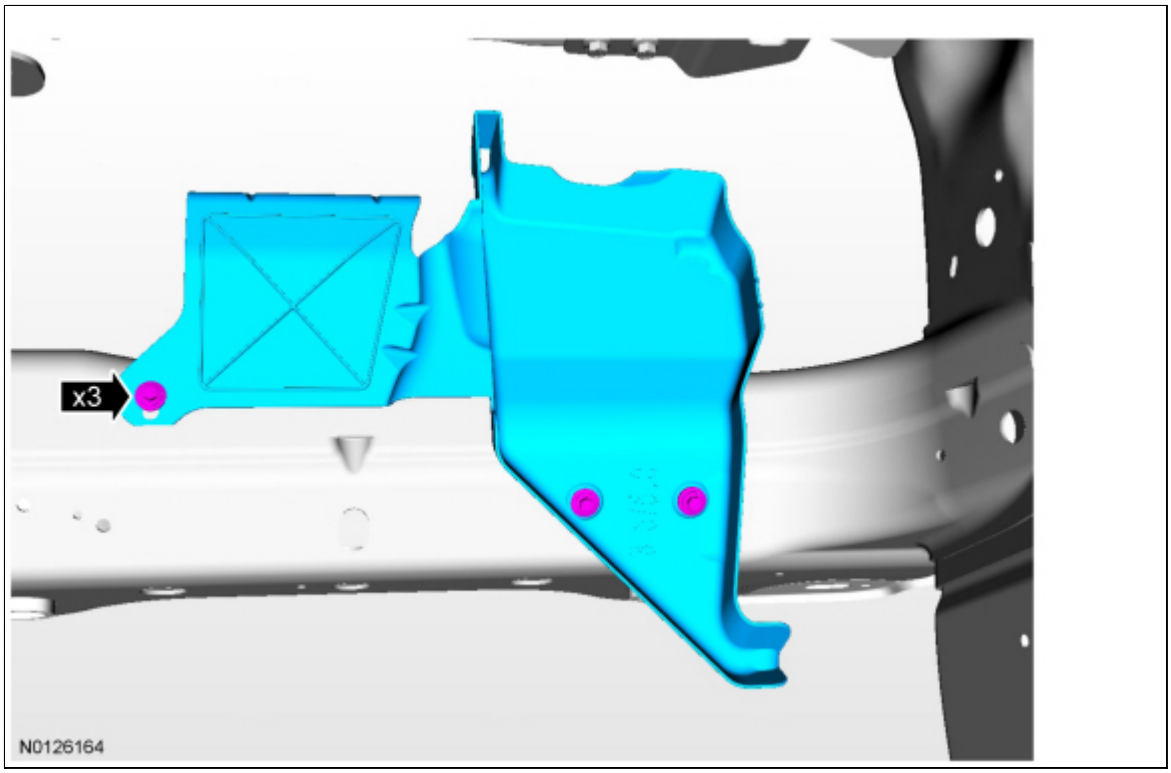
16. If equipped, remove the 4 bolts and the skid plate.
    - To install, tighten to 48 Nm (35 lb-ft).



17. If equipped, remove the 4 bolts and the Power Steering Control Module (PSCM) skid plate.
    - To install, tighten to 40 Nm (30 lb-ft).



18. Remove the 3 bolts and the oil filter drip shield.
    - To install, tighten to 7 Nm (62 lb-in).



19. Remove the battery cable harness bracket bolt from the RF frame.
    - To install, tighten to 20 Nm (177 lb-in).

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20. Remove the battery cable chassis ground terminal bolt.
    - To install, tighten to 20 Nm (177 lb-in).

21. Disconnect the A/C compressor electrical connector.

22. Disconnect the wire harness retainer from the A/C compressor.

23. Remove the battery cable shield nut.
    - To install, tighten to 12 Nm (106 lb-in).

24. Position the transmission fluid cooler tube bracket and wire harness aside.

25. Disconnect the battery cable shield from the retaining tab at the oil pan.

26. Remove the starter solenoid terminal cover.

27. Remove the starter solenoid wire terminal nut and position the cable aside.
    - To install, tighten to 5 Nm (44 lb-in).

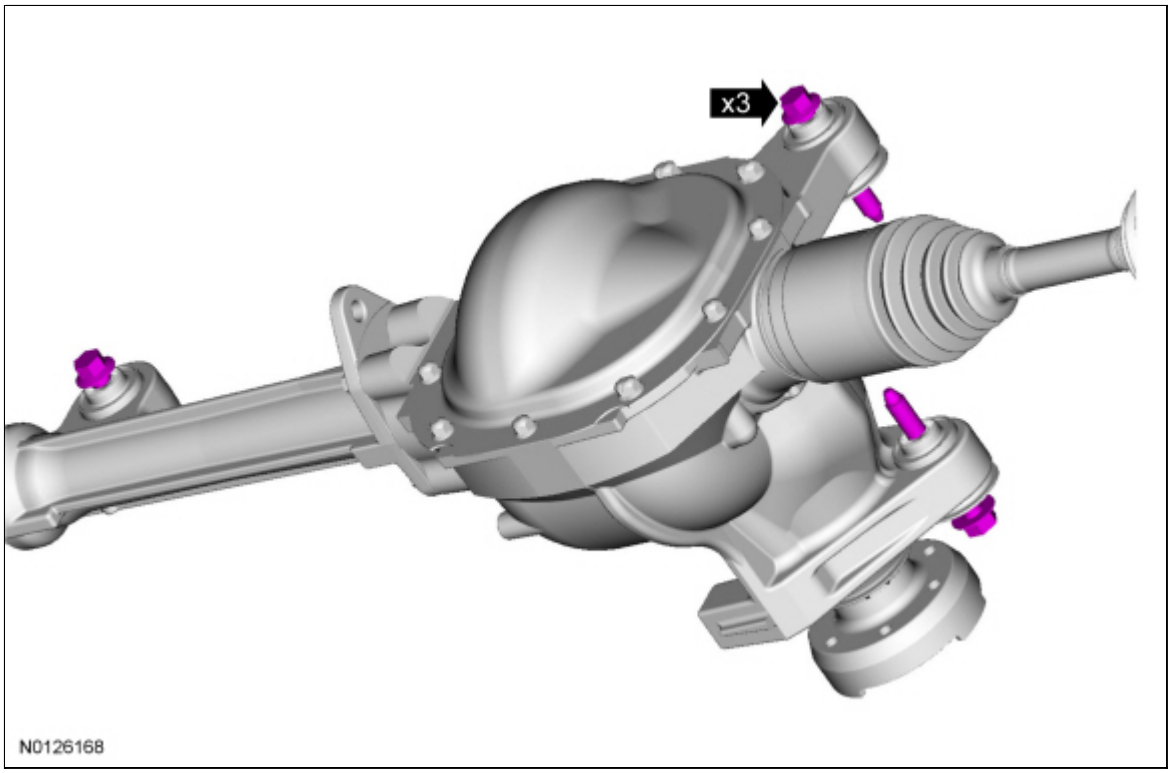
28. Remove the starter solenoid positive cable terminal nut and position the cable aside.
    - To install, tighten to 12 Nm (106 lb-in).

29. Remove the battery cable engine ground terminal nut.
    - To install, tighten to 25 Nm (18 lb-ft).

Vehicles with Four Wheel Drive (4WD)

30. Position a hydraulic jack under the front axle. Securely strap the axle to the jack.

31. Remove the 3 front axle mounting bolts.
    - To install, tighten to 115 Nm (85 lb-ft).



32. Lower the front axle to allow clearance to the 2 wire harness retainers at the oil pan stud bolts.

All vehicles

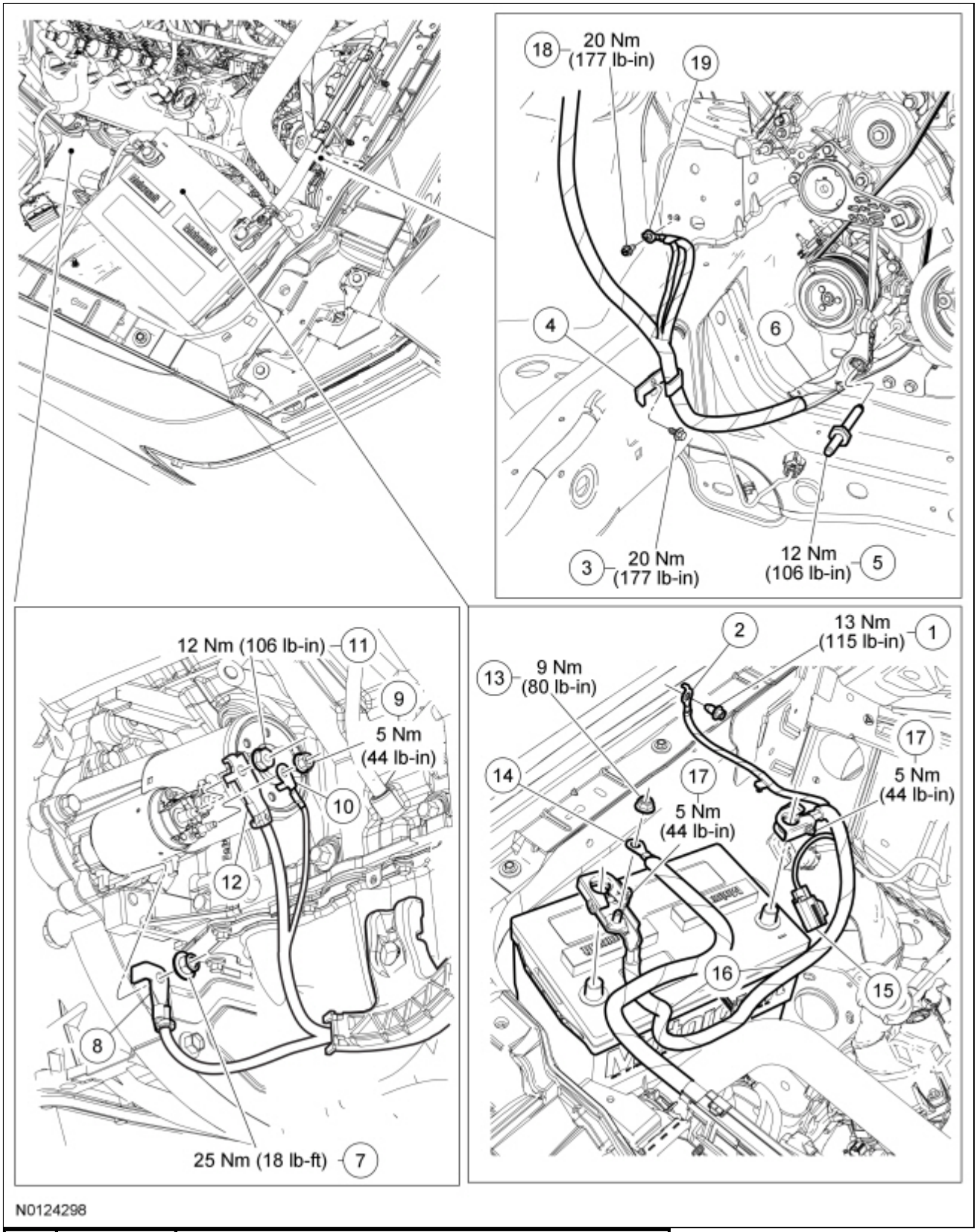
33. Disconnect the 2 wire harness retainers from the oil pan stud bolts.
34. Remove the battery cable.
35. To install, reverse the removal procedure.

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Battery Cables — 6.2L

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Item	Part Number	Description
1	W705661	Battery cable body ground terminal bolt

2	—	Battery cable body ground terminal (part of 14300)
3	W506424	Battery cable harness bracket bolt
4	—	Battery cable harness bracket
5	N808586	Battery cable shield stud bolt
6	—	Battery cable shield (part of 14300)
7	N805024	Battery cable engine ground nut
8	—	Battery cable engine ground terminal (part of 14300)
9	W705790	Starter solenoid wire terminal nut
10	—	Starter solenoid wire terminal (part of 14300)
11	W706414	Starter solenoid positive cable terminal nut
12	—	Starter solenoid positive cable terminal (part of 14300)
13	W705790	Generator B+ cable terminal nut/Power Distribution Box (PDB) cable terminal nut
14	14305	Generator B+ cable terminal
15	—	Battery cable in-line electrical connector (part of 14300)
16	14300	Battery cables
17	—	Battery cable terminal nut (part of 14300) (2 required)
18	W505261	Battery cable chassis ground terminal bolt
19	—	Battery cable chassis ground terminal (part of 14300)

Removal and Installation

1. Disconnect the battery. For additional information, refer to Battery Disconnect in this section.

2. Remove the battery cable chassis ground terminal bolt and position the cable aside.
   - To install, tighten to 20 Nm (177 lb-in).

3. Remove the battery cable body ground terminal bolt and position the cable aside.
   - To install, tighten to 13 Nm (115 lb-in).

4. Remove the bolt and position the battery cable harness bracket aside.
   - To install, tighten to 20 Nm (177 lb-in).

5. Remove the wire harness retainer from the battery cable shield.

6. Remove the stud bolt and position the battery cable shield aside.
   - To install, tighten to 12 Nm (106 lb-in).

7. Remove the battery cable engine ground terminal nut and position the cable aside.
   - To install, tighten to 25 Nm (18 lb-ft).

8. Remove the starter solenoid terminal cover.

9. Remove the nut and position the starter solenoid wire terminal aside.
   - To install, tighten to 5 Nm (44 lb-in).

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10. Remove the nut and position the starter solenoid positive cable terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).

11. Remove the nut and position the generator B+ cable terminal and the Power Distribution Box (PDB) cable terminal aside.
    - To install, tighten to 9 Nm (80 lb-in).

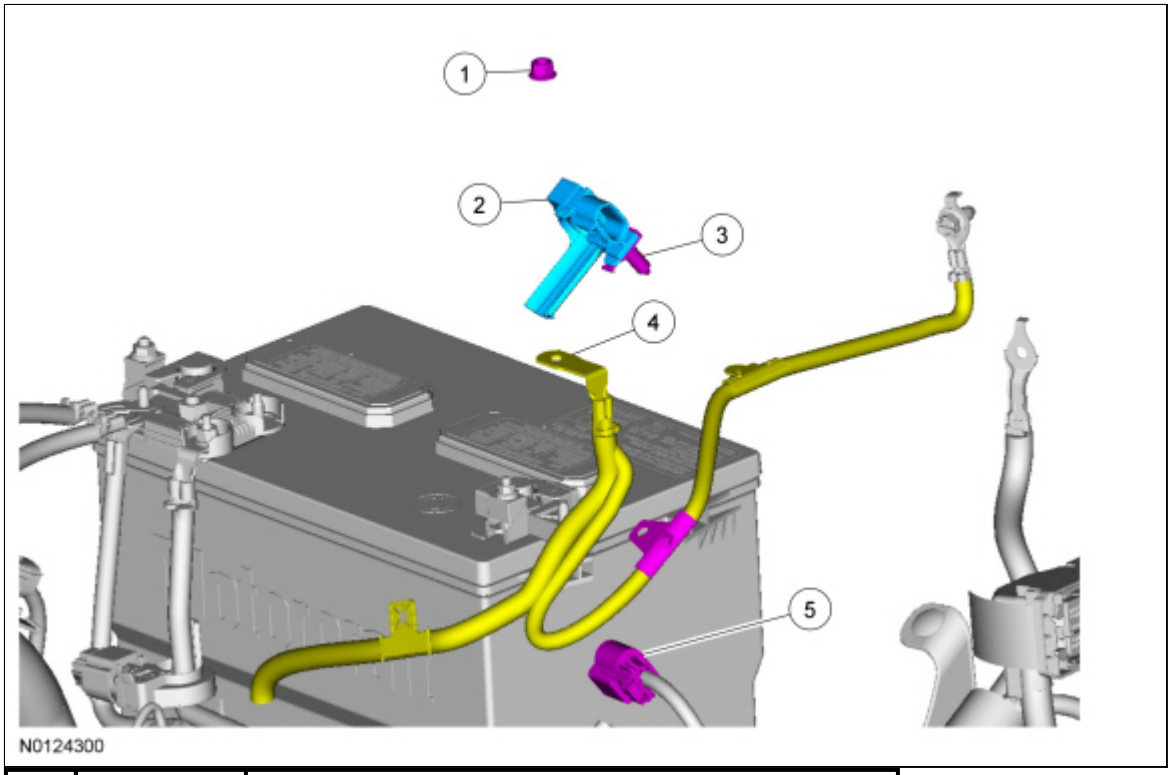
12. Disconnect the 2 battery cable harness retainers from the battery tray.

13. Disconnect the battery cable in-line electrical connector.

14. Remove the battery cable assembly.

15. To install, reverse the removal procedure.

Battery Current Sensor



Item	Part Number	Description
1	—	Battery terminal nut (part of 14300) - 9 Nm (80 lb-in)
2	14B357	Battery current sensor
3	—	Battery current sensor retainer (part of 14B357)
4	—	Negative battery cable terminal (part of 14300)
5	—	Battery current sensor electrical connector (part of 12A581)

Removal

1. Remove the nut and position the negative battery cable terminal aside.
2. Disconnect the battery current sensor electrical connector.
3. Disconnect the battery current sensor retainer from the battery cable.
4. **NOTE:** Note the orientation and position of the battery current sensor tape tab.

   Index-mark the battery cable at the battery current sensor. Remove and discard the tape securing the battery current sensor to the battery cable and remove the battery current sensor.

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Installation

1. **NOTE:** The battery current sensor must be installed in the proper position and orientation to function correctly.

   With the battery current sensor tape tab pointing downward, position the battery current sensor to the index-mark on the battery cable and secure with electrical tape.

2. Connect the battery current sensor retainer to the battery cable.

3. Connect the battery current sensor electrical connector.

4. Connect the negative battery cable terminal to the battery terminal and install the battery terminal nut.
   - Tighten to 9 Nm (80 lb-in).

Battery Tray

1. Remove the battery. For additional information, refer to Battery and Battery Tray — Exploded View in this section.

2. Disconnect the wire harness retainers from the battery tray and position the wire harness aside.

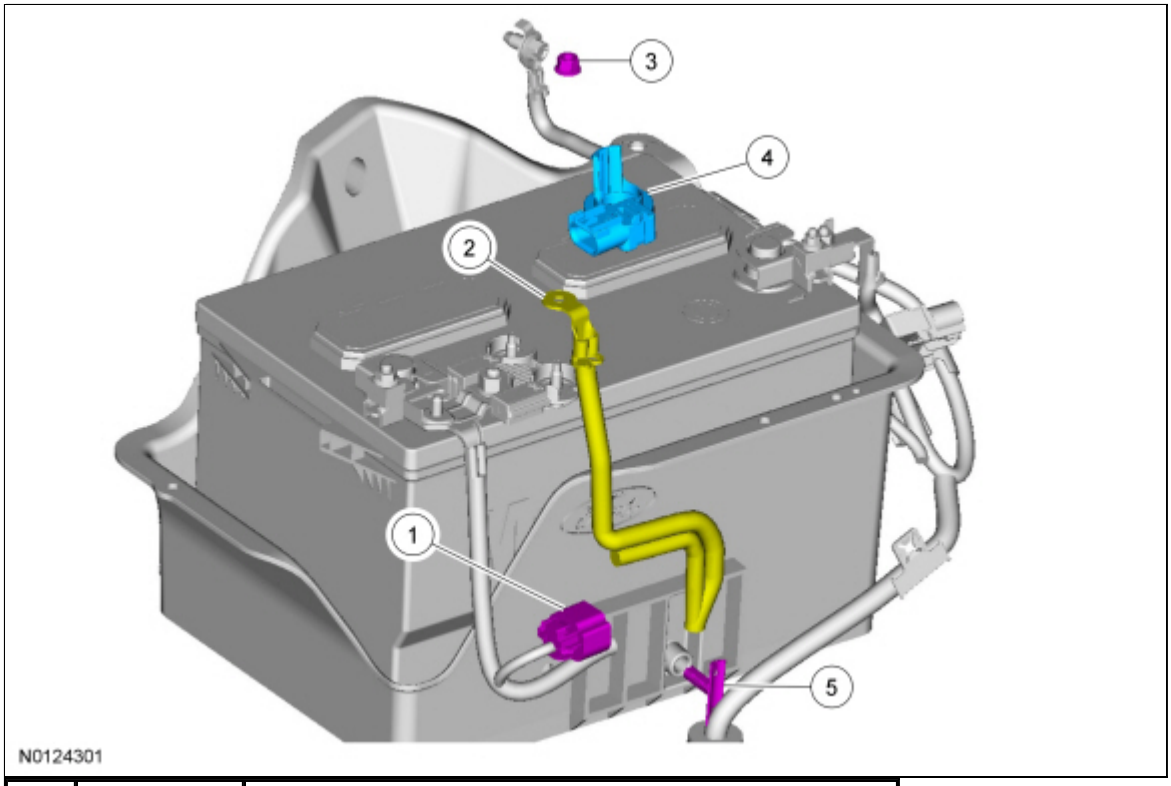
3. Remove the 3 bolts from the battery tray and carefully position the battery tray aside to gain access to the washer reservoir electrical connector.
   - To install, tighten to 17 Nm (150 lb-in).

4. Disconnect the wire connector and washer hose from the washer bottle and remove the battery tray assembly.

5. To install, reverse the removal procedure.

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Generator Current Sensor



Item	Part Number	Description
1	—	Generator current sensor electrical connector (part of 14290)
2	—	Positive battery cable terminal (part of 14300)
3	—	Battery terminal nut (part of 14300) - 9 Nm (80 lb-in)
4	14B357	Generator current sensor
5	—	Battery cable retainer (part of 14300)

Removal

1. Disconnect the battery. For additional information, refer to Battery Disconnect in this section.
2. Remove the nut and position the positive battery cable terminal aside.
3. Disconnect the generator current sensor electrical connector.
4. Disconnect the battery cable retainer from the battery tray.
5. **NOTE:** Note the orientation and position of the generator current sensor tape tab.

Index-mark the battery cable at the generator current sensor. Remove and discard the tape securing the generator current sensor to the battery cable and remove the generator current sensor.

Installation

1. **NOTE:** The generator current sensor must be installed in the proper position and orientation to function correctly.

   With the generator current sensor tape tab pointing upward, position the generator current sensor to the index-mark on the battery cable and secure with electrical tape.

2. Connect the battery cable retainer to the battery tray.

3. Connect the generator current sensor electrical connector.

4. Connect the positive battery cable terminal to the battery terminal and install the battery terminal nut.
   - Tighten to 9 Nm (80 lb-in).

5. Connect the battery. For additional information, refer to Battery Disconnect in this section.

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Torque Specifications

Description	Nm	lb-ft	lb-in
Center instrument panel support bracket bolts	9	—	80

High-Voltage Converter/Inverter

DC/AC Inverter and AC Power Point

The high-voltage converter/inverter system consists of the following components:

- AC power point
- DC/AC inverter

The DC/AC inverter converts low voltage (12 volts) DC to 110 volts AC to power a device that uses AC power with a rating of less than 150 watts. The DC/AC inverter is located behind the instrument panel, and is a serviceable part. The 110-volt AC power point is located in the rear of the front floor console and can be serviced separately from the front floor console.

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High-Voltage Converter/Inverter

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent

Principles of Operation

The 110 volts AC created by the inverter measures differently than a conventional AC outlet (utility-generated) with some multi-meters. The power point automatically shuts off if the load exceeds 150 watts to prevent damage to the inverter or load. The inverter supplies 110 volts AC power only when the ignition is ON. If the ignition is ON, but the engine is not running, the DC/AC inverter automatically shuts off after 13 minutes. The inverter can be powered back on and the timer reset by cycling the ignition from RUN to OFF and back to RUN, but only for another 13 minutes. This feature is intended to prevent the 12-volt battery from being fully discharged. If the engine is running, the inverter operation is not time-limited.

The DC/AC inverter time-out is controlled by a Local Interconnect Network (LIN) circuit. The BCM transmits the engine running status over the network to the DC/AC inverter. Once the DC/AC inverter stops receiving information that indicates the engine is running, it begins counting the amount of time the engine has not been running. If, after 13 minutes, the DC/AC inverter still has not received information that indicates the engine is running, the DC/AC inverter times out and stops supplying voltage to the AC power point. The LIN is also used by the electrochromatic mirror, but the mirror is receiving compass information, not engine running status.

The AC power point is equipped with a green LED that indicates the system status. The green LED is illuminated continuously when the ignition is ON and the system is operating normally. When the inverter shuts off after 13 minutes, the LED flashes until the ignition is cycled. Additionally, the green LED flashes constantly if the ignition is ON and a fault is detected.

The DC/AC inverter has a self-protection feature for the following conditions:

- Short circuits on the inverter output circuits — If the inverter detects a short on the output circuit(s), it shuts down. After 6 seconds, it restarts and checks for a short condition. If the condition still exists, the inverter shuts down again. The inverter restarts 5 times and, if on the 5th restart, the short still exists, the inverter disables AC output and flashes the green LED indicator.
- Low voltage input — the inverter does not operate when the input voltage is less than 11 volts.
- High voltage input — the inverter does not operate when the input voltage is greater than 16 volts.

- Overload
- High temperature — the inverter does not operate if it has overheated or if ambient temperatures exceed 75°C (167°F)

If the self-protection feature is activated, the green LED indicator flashes and the DC/AC inverter does not provide power output to the AC power point. If the LED is flashing, the problem must be corrected before DC/AC inverter operation will resume.

Refer to the Owner's Literature for a list of appropriate electrical loads/devices that can be used.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• AC power point • Battery Junction Box (BJB) fuse 33 (40A) • Body Control Module (BCM) fuse 38 (10A) • Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The DC/AC inverter does not operate correctly — no power at the AC power point	• Fuse(s) • Wiring, terminals or connectors • DC/AC inverter • AC power point	• GO to Pinpoint Test A .
• The DC/AC inverter does not operate correctly — the AC power point LED	• Overloaded DC/AC inverter • Inverter timed-out with	• DISCONNECT all electrical accessories from the AC power outlet and VERIFY that cabin temperature is below 75°C (167°F). TEST the system for normal operation. If the system is operating

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indicator flashes with the ignition in the ON position	engine not running • Overheated DC/AC inverter • Fuse(s) • Wiring, terminals or connectors • DC/AC inverter • AC power point	normally, RETURN the vehicle to the customer. If the AC power point LED indicator is still flashing, GO to Pinpoint Test A .
• The DC/AC inverter does not operate correctly — the AC power point LED indicator is never on	• Fuse(s) • Wiring, terminals or connectors • DC/AC inverter • AC power point	• GO to Pinpoint Test B .
• The DC/AC inverter does not operate correctly — the AC power point turns off after 13 minutes	• Inverter timing out with engine not running • Body Control Module (BCM) • DC/AC inverter • Wiring, terminals or connectors	• VERIFY the concern by monitoring the AC power point LED for 13 minutes with the engine running. If the AC power point LED begins to flash after 13 minutes with the engine running, GO to Pinpoint Test C .

Pinpoint Tests

Pinpoint Test A: The DC/AC Inverter Does Not Operate Correctly — No Power at the AC Power Point/The AC Power Point LED Indicator Flashes with the Ignition in the ON Position

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Normal Operation

The DC/AC inverter receives 12 volts DC from the Battery Junction Box (BJB) and the Body Control Module (BCM) and is wired to chassis ground. Power from the BJB is available at all times, regardless of ignition status. Power from the BCM is only available when the ignition is ON. The incoming DC power is internally converted to 60 Hz 110 volts AC power that is output to the AC power point.

NOTE: The electrical device powered by the AC power point must not exceed 150 watts.

NOTE: If the green LED is flashing, the AC power point may be overloaded, overheated or shorted. Unplug the electrical device from the AC power point and cycle the ignition. Refer to the Owner's Literature to determine if the electrical device is appropriate for the AC power point.

NOTE: The DC/AC inverter turns off after 13 minutes if the engine is not running. If the inverter times out, the green LED flashes. Cycle the ignition to resume normal operation.

This pinpoint test is intended to diagnose the following:

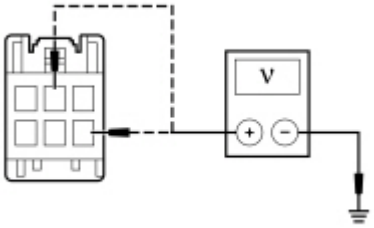
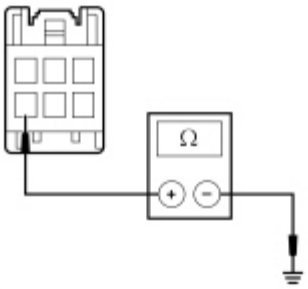
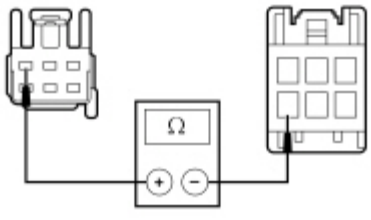
- Overloaded DC/AC inverter
- Overheated DC/AC inverter
- Inverter timed-out with engine not running
- Fuse(s)
- Wiring, terminals or connectors
- DC/AC inverter
- AC power point

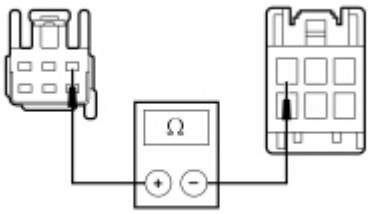
PINPOINT TEST A: THE DC/AC INVERTER DOES NOT OPERATE CORRECTLY — NO POWER AT THE AC POWER POINT/THE AC POWER POINT LED INDICATOR FLASHES WITH THE KEY IN THE ON POSITION

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
A1 CHECK THE POWER OUTLET LED STATUS • Start the engine. • Check the green LED on the AC power outlet. • **Is the green LED flashing?**	**Yes** GO to A2. **No** If the green LED is NOT illuminated, VERIFY BJB fuse 33 (40A) and BCM fuse 38 (10A) are OK. If OK, GO to Pinpoint Test B. If not OK, REFER to the Wiring Diagrams manual to identify the possible cause of the circuit short. TEST the system for normal operation. If the green LED is illuminated continuously, the DC/AC inverter may have timed-out after 13 minutes of operation without the engine running. VERIFY correct system operation with a device rated at less than 150 watts. If there is still no power at the power outlet, GO to A2. If the system is operating correctly, RETURN the vehicle to the customer.
A2 CHECK THE POWER SUPPLY CIRCUITS • Ignition OFF. • Disconnect: DC/AC Inverter C2293A. • Ignition ON. • Measure the voltage between DC/AC inverter C2293A-2, circuit CBP38 (GY/BU), harness side and ground and between DC/AC inverter C2293A-4, circuit SBB33 (RD), harness side and ground.	**Yes** GO to A3. **No** For voltage less than 11 volts, VERIFY Battery Junction Box (BJB) fuse 33 (40A) and BCM fuse 38 (10A) are OK. If OK, REPAIR the open circuit or high resistance on the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the possible cause of the circuit short. TEST the system for normal operation.

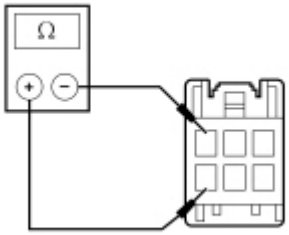
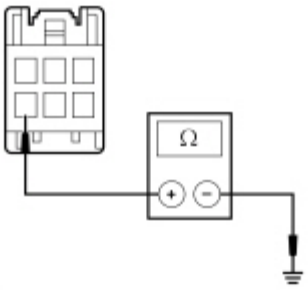
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 N0112203 • **Is the voltage greater than 11 volts?**	For voltage greater than 16 volts, REFER to System Voltage High in the Symptom Chart in Section 414-00 .
A3 CHECK THE GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Measure the resistance between DC/AC inverter C2293A-6, circuit GD138 (BK/WH), harness side and ground.  N0112204 • **Is the resistance less than 5 ohms?**	**Yes** GO to A4 . **No** REPAIR circuit GD138 (BK/WH). TEST the system for normal operation.
A4 CHECK THE AC POWER OUTPUT CIRCUITS FOR AN OPEN • Disconnect: BJB Fuse 33 (40A). • Disconnect: BCM Fuse 38 (10A). • Disconnect: AC Power Point C301. • Disconnect: DC/AC Inverter C2293B. • Measure the resistance between AC power point C301-3, circuit HYA01 (OG/GN), harness side and DC/AC inverter C2293B-6, circuit HYA01 (OG/GN), harness side.  N0112205 • Measure the resistance between AC power point C301-1, circuit HYA02 (OG/WH), harness side and DC/AC inverter C2293B-3, circuit HYA02 (OG/WH), harness side.	**Yes** GO to A5 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.

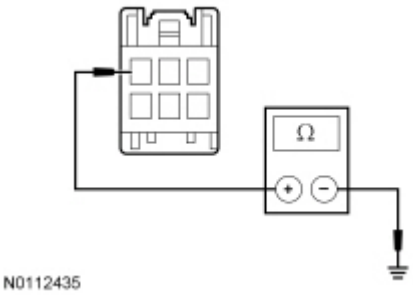
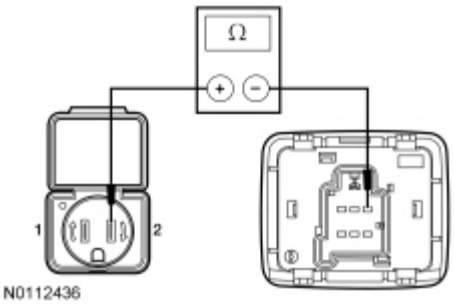
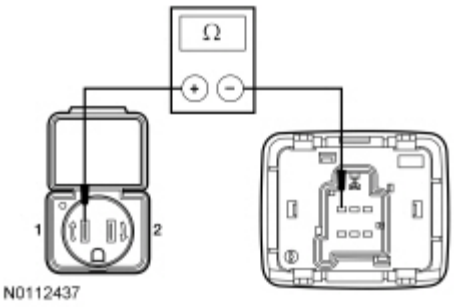


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- **Are the resistances less than 5 ohms?**

A5 CHECK THE AC POWER OUTPUT CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between DC/AC inverter C2293B-6, circuit HYA01 (OG/GN), harness side and DC/AC inverter C2293B-3, circuit HYA02 (OG/WH), harness side.  N0112434 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A6 . **No** REPAIR the circuits. TEST the system for normal operation.
A6 CHECK THE AC POWER OUTPUT CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between DC/AC inverter C2293B-6, circuit HYA01 (OG/GN), harness side and ground.  N0112204 • Measure the resistance between DC/AC inverter C2293B-3, circuit HYA02 (OG/WH), harness side and ground.	**Yes** GO to A7 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.

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 N0112435 • **Are the resistances greater than 10,000 ohms?**	
A7 CHECK THE AC POWER POINT FOR AN OPEN • Measure the resistance between AC power point C301 pin 3, component side and AC power point face side pin 2.  N0112436 • Measure the resistance between AC power point C301 pin 1, component side and AC power point face side pin 1.  N0112437 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DC/AC inverter. REFER to Direct Current/Alternating Current (DC/AC) Inverter in this section. TEST the system for normal operation. **No** INSTALL a new AC power point. REFER to Alternating Current (AC) Power Point in this section. TEST the system for normal operation.

Pinpoint Test B: The DC/AC Inverter Does Not Operate Correctly — The AC Power Point LED Indicator is Never On

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Normal Operation

The DC/AC inverter receives 12 volts DC from the Battery Junction Box (BJB) and the Body Control Module (BCM) and is wired to chassis ground. The incoming DC power is internally converted to 60 Hz 110 volts AC power that is output to the AC power point. If a fault in the system is detected, the LED flashes when the

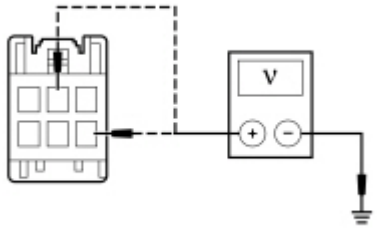
ignition is ON. The LED is continuously illuminated if the system is operating correctly when the ignition is ON. The DC/AC inverter supplies 12V DC and ground to the LED along two circuits.

This pinpoint test is intended to diagnose the following:

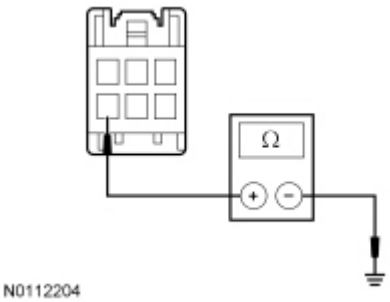
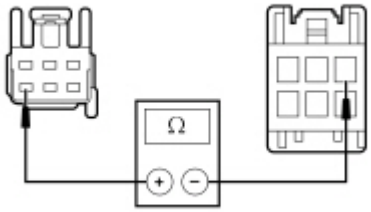
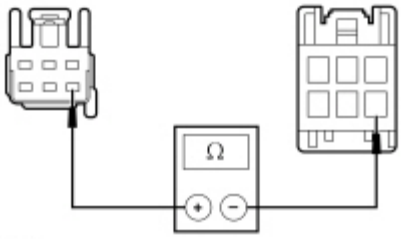
- Fuse(s)
- Wiring, terminals or connectors
- DC/AC inverter
- AC power point

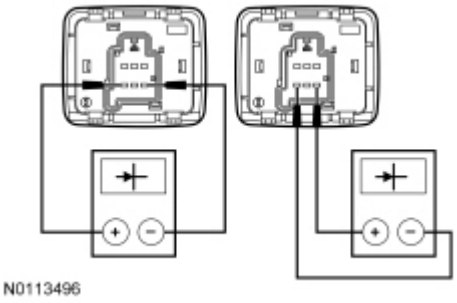
PINPOINT TEST B: THE DC/AC INVERTER DOES NOT OPERATE CORRECTLY — THE AC POWER POINT LED INDICATOR IS NEVER ON

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
B1 CHECK THE POWER SUPPLY CIRCUITS FOR VOLTAGE	
• Ignition OFF. • Disconnect: DC/AC Inverter C2293A. • Ignition ON. • Measure the voltage between DC/AC inverter C2293A-2, circuit CBP38 (GY/BU), harness side and ground and between DC/AC inverter C2293A-4, circuit SBB33 (RD), harness side and ground.  N0112203 • **Are the voltages greater than 10 volts?**	**Yes** GO to B2 . **No** VERIFY Body Control Module (BCM) fuse 38 (10A) and the Battery Junction Box (BJB) fuse 33 (40A) are OK. If OK, REPAIR the open or high resistance on the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to locate the possible cause of the circuit short. TEST the system for normal operation.
B2 CHECK THE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between DC/AC inverter C2293A-6, circuit GD138 (BK/WH), harness side and ground.	**Yes** GO to B3 . **No** REPAIR circuit GD138 (BK/WH). TEST the system for normal operation.

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 N0112204 • **Is the resistance less than 5 ohms?**	
B3 CHECK THE LED CONTROL CIRCUITS FOR AN OPEN	
• Disconnect: BJB Fuse 33 (40A). • Disconnect: BCM Fuse 38 (10A). • Disconnect: DC/AC Inverter C2293B. • Disconnect: AC Power Point C301. • Measure the resistance between AC power point C301-6, circuit LYA03 (YE/VT), harness side and DC/AC inverter C2293B-1, circuit LYA03 (YE/VT), harness side.  N0112438 • Measure the resistance between AC power point C301-4, circuit RYA03 (BU/BN), harness side and DC/AC inverter C2293B-4, circuit RYA03 (BU/BN), harness side.  N0112439 • **Are the resistances less than 5 ohms?**	**Yes** GO to B4 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.
B4 CHECK THE AC POWER POINT LED	
• Test the diode between AC power point C301 pin 4, component side and AC power point C301 pin 6, component side in both directions.	**Yes** INSTALL a new DC/AC inverter. REFER to Direct Current/Alternating Current (DC/AC) Inverter in this section. TEST the system for normal operation.

 N0113496 • **Is the resistance greater than 10,000 ohms in one direction and between 10-20 ohms in the opposite direction?**	**No** INSTALL a new AC power point. REFER to Alternating Current (AC) Power Point in this section. TEST the system for normal operation.

Pinpoint Test C: The DC/AC Inverter Does Not Operate Correctly — The AC Power Point Turns Off After 13 Minutes

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Normal Operation

The DC/AC inverter receives a signal from the Body Control Module (BCM) over the Local Interconnect Network (LIN) whenever the engine is running. If the DC/AC inverter does not receive this message for 13 minutes, the inverter stops supplying 110V to the power outlet and the green LED indicator flashes. The system can be reset by cycling the ignition from ON to OFF and back to ON, however the system only operates for another 13 minutes unless the signal is received from the BCM that the engine is running.

This pinpoint test is intended to diagnose the following:

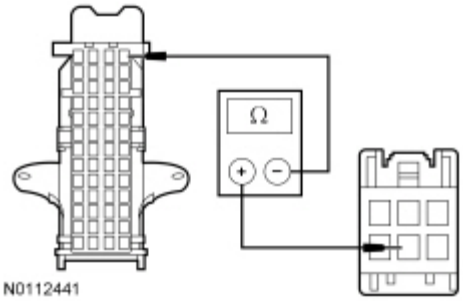
- Wiring, terminals or connectors
- DC/AC inverter
- BCM

PINPOINT TEST C: THE DC/AC INVERTER DOES NOT OPERATE CORRECTLY — THE AC POWER POINT TURNS OFF AFTER 13 MINUTES

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
C1 CHECK FOR BCM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — BCM . • Record any BCM DTCs retrieved. • **Are U0100:87 or U0401:00 present in the BCM ?**	**Yes** REFER to Section 419-10 to diagnose the BCM . **No** GO to C2 .
C2 VERIFY THE COMPASS FUNCTION	
• Verify the compass functions correctly. • **Does the compass function correctly?**	**Yes** GO to C3 .

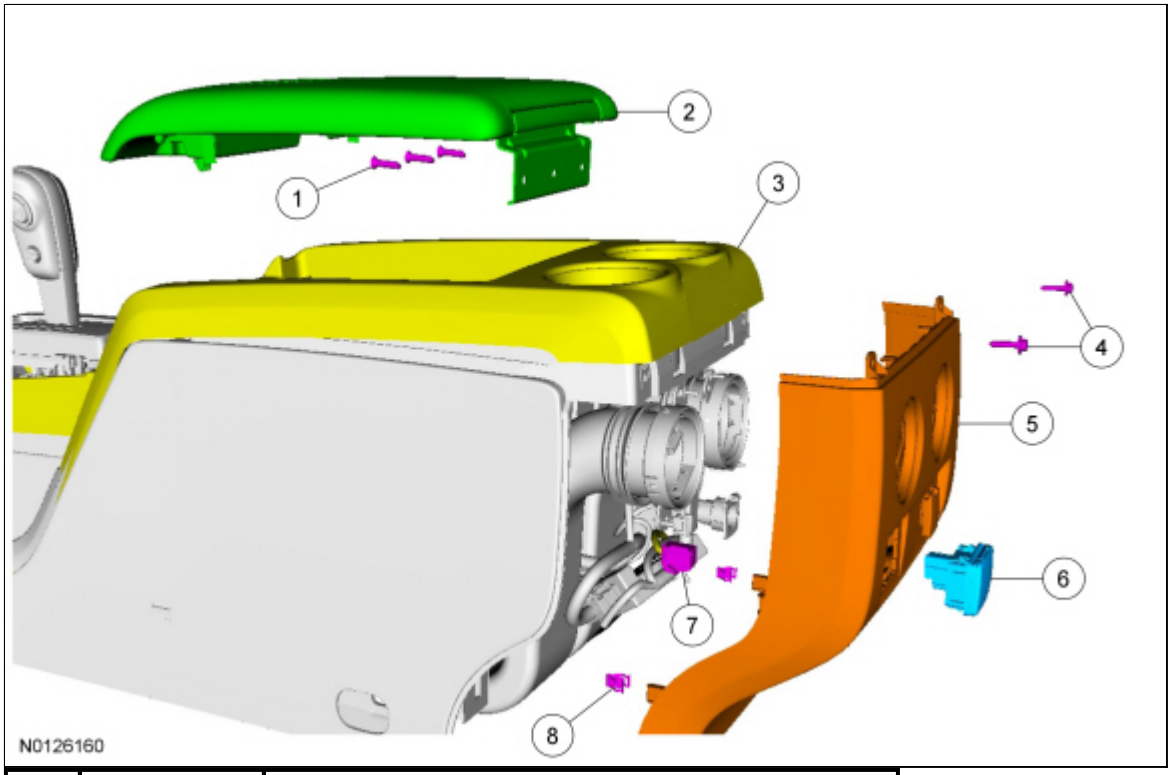
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	No REFER to Section 413-01 to diagnose the compass.
C3 CHECK THE LIN COMMUNICATION CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280B. • Disconnect: DC/AC Inverter C2293A. • Measure the resistance between BCM C2280B-52, circuit VDN01 (BU/WH), harness side and DC/AC inverter C2293A-5, circuit VDN01 (BU/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new DC/AC inverter. REFER to Direct Current/Alternating Current (DC/AC) Inverter in this section. TEST the system for normal operation. If the AC power point still turns off after 13 minutes when the engine is running, GO to C4 . **No** REPAIR circuit VDN01 (BU/WH). TEST the system for normal operation.
C4 CHECK THE BCM FOR CORRECT OPERATION	

• Check BCM C2280B for:
  ▪ corrosion.
  ▪ pushed-out pins.
  ▪ spread terminals.
• Connect: BCM C2280B.
• Connect: DC/AC Inverter C2293A.
• Make sure the connectors seat correctly, then operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

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Alternating Current (AC) Power Point



Item	Part Number	Description
1	N808641	Storage compartment door screw (3 required)
2	06024	Storage compartment door
3	04567A	Selector lever trim panel
4	W707628	Floor console rear panel screws (2 required)
5	045E24	Floor console rear panel
6	19N236	AC powerpoint
7	14A318	AC powerpoint electrical connector
8	W705289	Floor console rear panel retaining clip (2 required)

WARNING: Disconnect the 12 volt battery before servicing the direct current to alternating current (DC-AC) inverter or alternating current (AC) powerpoint to prevent the risk of high voltage shock. Failure to follow this instruction may result in serious personal injury.

1. Remove the 3 screws and the storage compartment door.

2. ***NOTICE:*** **Raise the selector lever trim panel only enough to access the floor console rear panel screws. If the selector lever trim panel is raised excessively, component damage may occur.**

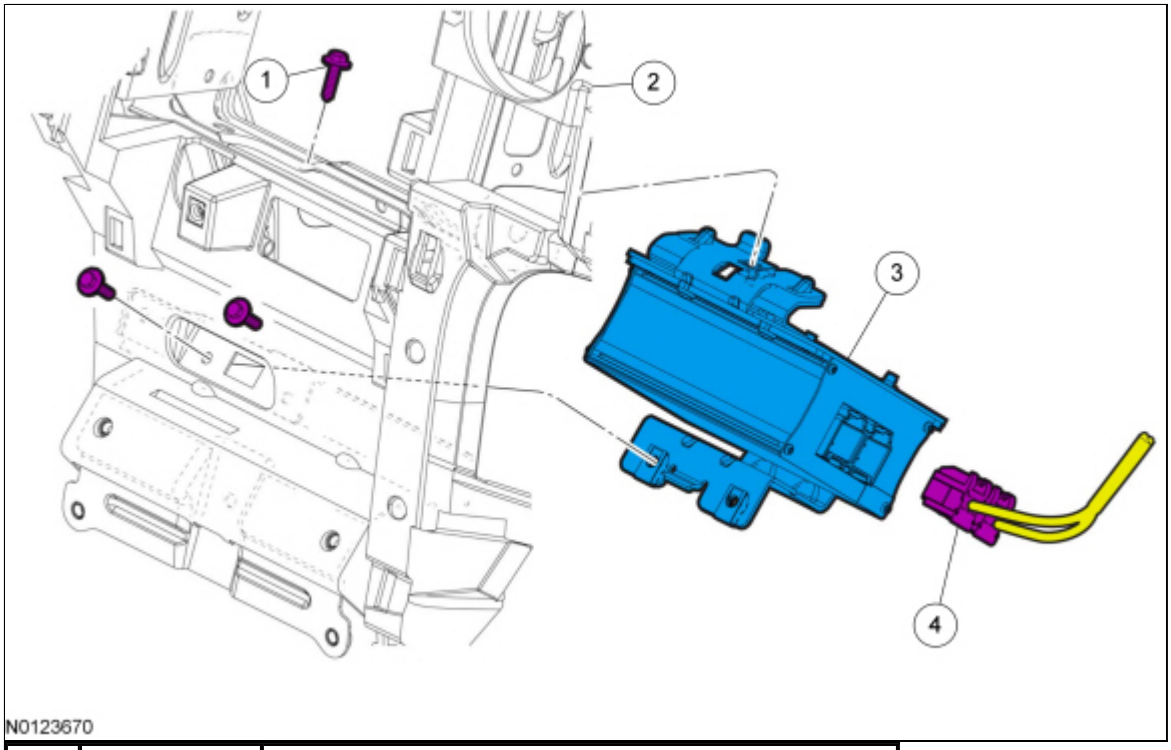
Lift the rear portion of the selector lever trim panel to release the retaining clips.

3. Remove the 2 floor console rear panel screws.
4. Using a non-marring tool, gently pry the lower portion of the floor console rear panel to release the 2 retaining clips.
5. Disconnect the AC powerpoint electrical connector.
6. Press the AC powerpoint retainers inward and remove the AC powerpoint.
7. To install, reverse the removal procedure.

---

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Direct Current/Alternating Current (DC/AC) Inverter

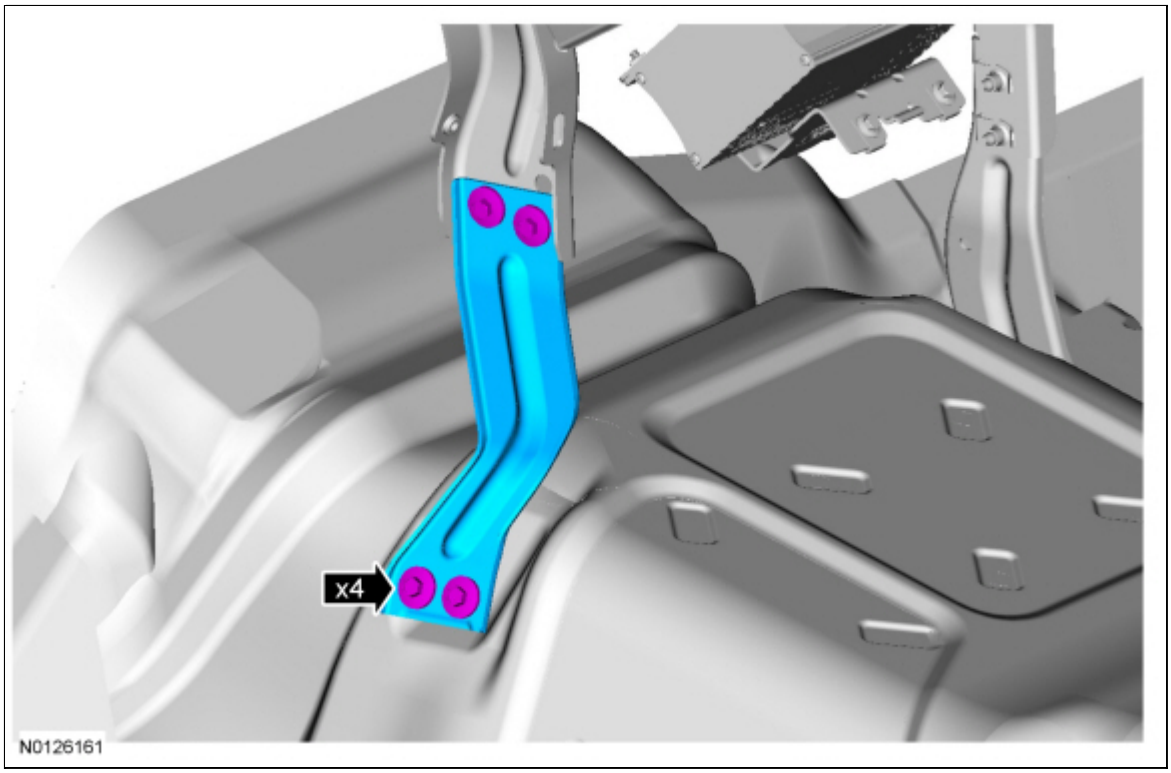


Item	Part Number	Description
1	W707628	DC/AC inverter screw (3 required)
2	04304	Instrument panel
3	19G317	DC/AC inverter
4	—	DC/AC inverter electrical connector (part of 14401)

WARNING: Disconnect the 12 volt battery before servicing the direct current to alternating current (DC-AC) inverter or alternating current (AC) powerpoint to prevent the risk of high voltage shock. Failure to follow this instruction may result in serious personal injury.

1. Remove the center instrument panel lower finish panel. For additional information, refer to Section 501-12 .

2. Remove the 4 bolts and the LH center instrument panel support bracket.
   - To install, tighten to 9 Nm (80 lb-in).



3. Disconnect the DC/AC inverter electrical connectors.
4. Remove the 3 screws and the DC/AC inverter.
5. To install, reverse the removal procedure.

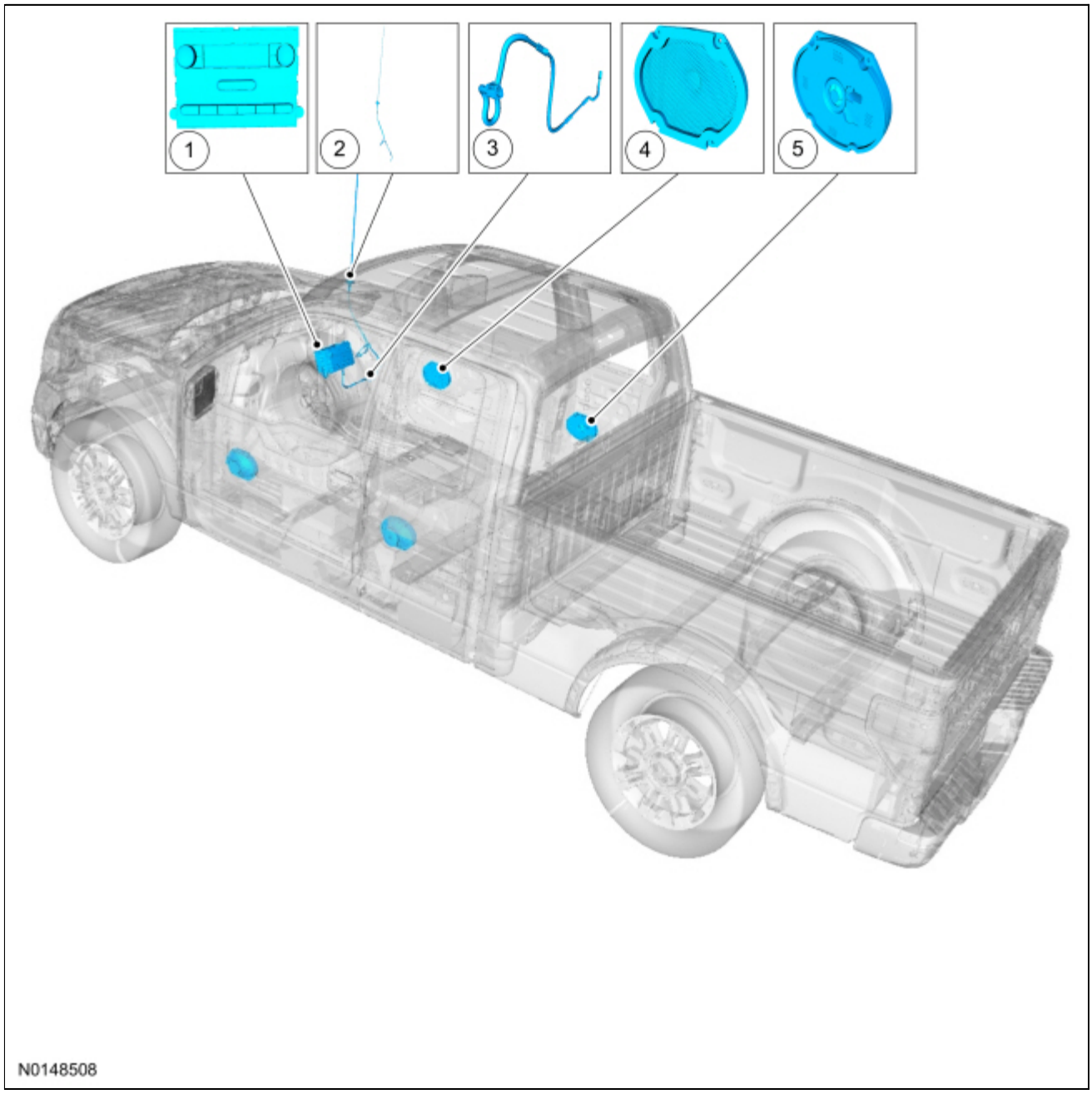
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Torque Specifications

Description	Nm	lb-in
Audio Front Control Module (ACM)	2.5	23
AM/FM antenna mast	4.2	36
AM/FM antenna base bolts	2.5	23

Information and Entertainment System

Component Location



Item	Description	Comments
1	ACM	-

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2	AM/FM antenna	-
3	AM/FM antenna coaxial cable	-
4	Front door speaker	-
5	Rear door speaker	If equipped

Overview

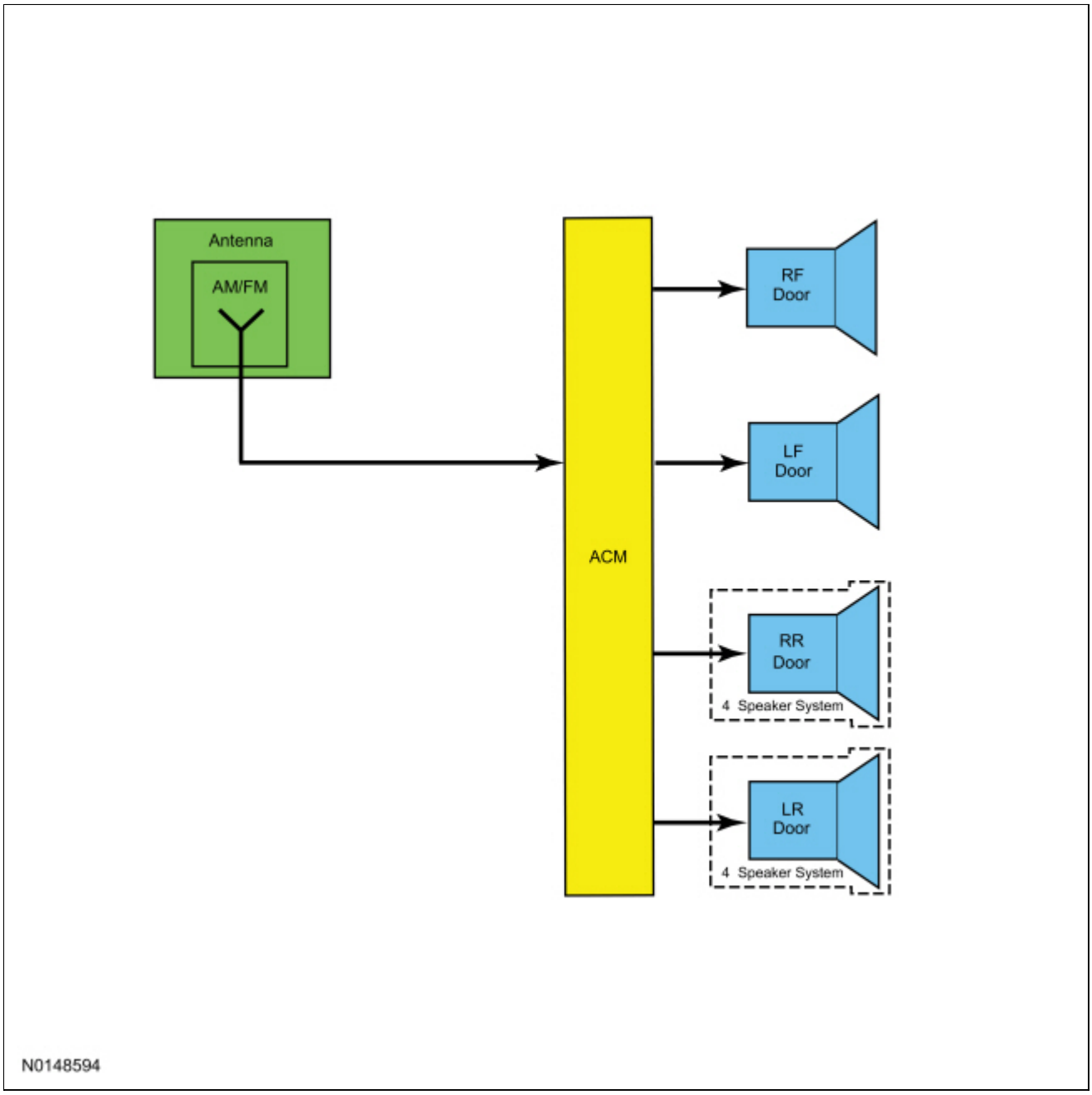
The audio system consists of the following:

Main Components

- 2 or 4 speakers
- AM/FM ACM

System Operation

System Diagram



Accessory Delay Feature

The accessory delay feature allows the audio system to be operated for a preset period of time after the ignition is turned off and a front door has not been opened.

AM/FM Radio

The AM/FM fender-mounted antenna receives radio waves and sends them through the AM/FM antenna coaxial cable to the ACM . The radio waves are converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

Battery Load Shed

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The BCM uses the battery current sensor to monitor the battery state of charge. The battery current sensor is attached to the battery ground cable. With the vehicle OFF and the ignition in ACC or ON, a load shed message is sent over the CAN when the BCM determines that the battery state of charge is below 40%, 45 minutes have elapsed, or 10% of the charge has been drained. This message turns off the audio system to save the remaining battery charge. Under this condition, SYS OFF TO SAVE BATT is displayed on the centerstack infotainment display to notify the driver that battery protection actions are active. To clear the load shed state, start the vehicle.

Component Description

ACM

The ACM can be operated with the ignition in RUN, ACC, or OFF.

The ACM receives radio waves containing audio from the antenna coaxial cable and converts them into fluctuating AC voltage. The ACM processes these inputs and sends left and right analog audio signals to the speakers as fluctuating AC voltage.

Antenna

The AM/FM fender-mounted antenna receives radio waves containing audio and sends them through the AM/FM antenna coaxial cable to the ACM . The antenna mast is used to amplify the AM/FM radio waves to improve reception.

Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent diagnostic scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3104-A	Back-probe Pins POM6411 or equivalent

DTC Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

To retrieve DTCs , refer to Audio Control Module (ACM) Self-Diagnostic Mode .

Audio Front Control Module (ACM) DTC Chart

DTC	Description	Action
B1342	Internal Failure: Flash ROM Checksum Error	**NOTE:** Repair all other DTCs first before diagnosing DTC B1342. CLEAR the DTCs. REPEAT the self-test. If only DTC B1342 is retrieved again, INSTALL a new ACM . REFER to Audio Control

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		Module (ACM) .
B2965	Speaker Failure	• For a LF door speaker concern, GO to Pinpoint Test D . • For a RF door speaker concern, GO to Pinpoint Test E . • For a RR door speaker concern (if equipped), GO to Pinpoint Test F . • For a LR door speaker concern (if equipped), GO to Pinpoint Test G .
B2924	Stuck Button	GO to Pinpoint Test A .

Symptom Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Symptom Chart — General Audio System

Condition	Possible Sources	Action
• One or more ACM buttons are inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test A .
• The ACM illumination is inoperative or does not dim	• Illumination system concern • ACM	• REFER to Section 413-00 .

Symptom Chart — Sound Quality

Condition	Possible Sources	Action
• Poor reception — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test B .
• Continuous seek or scan — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test B .
• No sound from all speakers	• Refer to the Pinpoint Test	• GO to Pinpoint Test C .
• The LF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test D .
• The RF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test E .
• The RR door speaker is inoperative (if equipped)	• Refer to the Pinpoint Test	• GO to Pinpoint Test F .
• The LR door speaker is inoperative (if equipped)	• Refer to the Pinpoint Test	• GO to Pinpoint Test G .
• Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All	• Refer to the Pinpoint Test	• GO to Pinpoint Test

Speakers)		H .

Pinpoint Tests

Pinpoint Test A: One or more ACM Buttons Are Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B2924	Stuck Button	Set by the ACM when buttons are held for more than 100 milliseconds during the self-test.

Possible Sources

- Debris
- ACM

PINPOINT TEST A: ONE OR MORE ACM BUTTONS ARE INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK BUTTON OPERATION	
• Operate all of the ACM buttons and check for proper operation. • **Do all buttons work properly?**	**Yes** The system is operating correctly at this time. **No** GO to A2 .
A2 CHECK FOR DEBRIS	
• CHECK the ACM buttons for dust collection and/or debris. • **Was any dust collection and/or debris found?**	**Yes** Clean as necessary **No** GO to A3 .
A3 RECHECK FOR DTC B2924	
• Ignition ON.	**Yes**

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• Clear the ACM DTCs. REFER to Audio Control Module (ACM) Self-Diagnostic Mode . • Ignition OFF. • Ignition ON. • Wait at least 2 minutes. • Retrieve all DTCs. • **Is DTC B2924 set?**	GO to A4 . **No** The system is operating correctly at this time.
A4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test B: Poor Reception Or Continuous Seek Or Scan — AM/FM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to AM/FM Radio, ACM , and Antenna in Information and Entertainment System .

Possible Sources

- AM/FM antenna
- AM/FM antenna coaxial cable
- Charging system
- Ignition system
- Noise suppression equipment
- Wiring, terminals, or connectors
- ACM

PINPOINT TEST B: POOR RECEPTION OR CONTINUOUS SEEK OR SCAN — AM/FM

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 CHECK THE AUDIO SYSTEM RECEPTION
• Operate the audio system in radio tuner AM/FM mode.
• Check the reception with the engine running, and with the engine off.
• Does the poor reception only occur with the engine running?</td><td>Yes
GO to B2 .

No
GO to B4 .</td></tr>
<tr><td>B2 CHECK THE GENERATOR
• Ignition OFF.
• Disconnect: Wiring harness to the generator voltage regulator.
• Start the engine.
• Operate the audio system in radio tuner AM/FM mode.
• Is the reception OK?</td><td>Yes
INSTALL a new generator. REFER to Section 414-00 .

No
GO to B3 .</td></tr>
<tr><td>B3 CHECK THE IGNITION CIRCUITS
• Ignition OFF.
• Connect: Wiring harness to the generator voltage regulator.
• Visually inspect the engine compartment and make sure all ignition coils are correctly and securely connected, and that there are no visible cracks in the coil housings.
• Inspect all the wiring harnesses and connectors for damaged insulation and loose or broken conditions.
• Are the ignition components OK?</td><td>Yes
USE a jumper cable to ground various parts of the vehicle to the frame (for example: engine, fenders, quarter panels, stone deflectors, air cleaner, and body sheet metal). When the noise is eliminated, PROVIDE a permanent ground where necessary.

No
REPAIR the ignition system as necessary.</td></tr>
<tr><td>B4 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE
• Ignition OFF.
• Disconnect: AM/FM antenna coaxial cable at the ACM . Refer to Audio Control Module (ACM) .
• Disconnect: AM/FM antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — AM/FM .
• Ignition ON.
• Measure the voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>AM/FM antenna coaxial cable core at the ACM</td><td>—</td><td>—</td><td>Ground</td></tr><tr><td>AM/FM antenna coaxial cable shield at the ACM</td><td>—</td><td>—</td><td>Ground</td></tr></table>• Is any voltage present?</td><td>Yes
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

No
GO to B5 .</td></tr>
<tr><td>B5 CHECK THE LOWER AM/FM ANTENNA COAXIAL</td><td></td></tr>
</table>

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CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B6 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

B6 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM coaxial cable core at the ACM	—	Lower AM/FM antenna coaxial cable core at the inline connection	—
AM/FM antenna coaxial cable shield at the ACM	—	Lower AM/FM antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B7 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

B7 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B8 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

B8 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: AM/FM antenna coaxial cable at the antenna unit. Refer to Antenna — AM/FM .
- Ignition ON.
- Measure the **voltage** between:

Yes
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

No
GO to B9 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

B9 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B10 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

B10 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable core at the antenna unit (harness side)	—
AM/FM antenna coaxial cable shield at the ACM	—	AM/FM antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B11 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

B11 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

Yes
GO to B12 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

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- **Is the resistance greater than 10,000 ohms?**

B12 CHECK THE AM/FM ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new AM/FM antenna.
REFER to Antenna — AM/FM .

No
GO to B13 .

B13 CHECK THE AM/FM ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B14 .

No
INSTALL a new AM/FM antenna.
REFER to Antenna — AM/FM .

B14 CHECK THE AM/FM ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B15 .

No
INSTALL a new AM/FM antenna.
REFER to Antenna — AM/FM .

B15 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: AM/FM antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Yes
GO to B17 .

No
GO to B16 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

B16 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE	
• Remove the AM/FM antenna. Refer to Antenna — AM/FM . • Measure the **resistance** between: Positive Lead: Pin — AM/FM antenna unit shield at the antenna unit (component side); Circuit — — Negative Lead: Pin — AM/FM antenna base (unpainted surface); Circuit — — • **Is the resistance less than 1 ohm?**	**Yes** GO to B17 . **No** INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .
B17 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test C: No Sound From All Speakers

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

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When the ignition is in the START position, the ACM receives voltage on the START signal circuit and mutes the speaker output. This prevents voltage spikes from producing popping noises through the speakers. A short to voltage on this circuit causes the ACM output to be muted continuously.

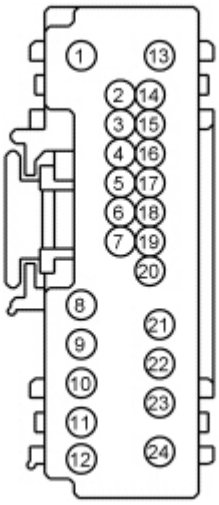
Possible Sources

- Wiring, terminals or connectors
- ACM

PINPOINT TEST C: NO SOUND FROM ALL SPEAKERS

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE START SENSE CIRCUIT FOR A SHORT TO VOLTAGE

• Ignition OFF.
• Disconnect: ACM C290A .
• Ignition ON.
• Measure the voltage between:

<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C290A-15</td><td>CDC54 (WH/GN)</td><td>—</td><td>Ground</td></tr></table>


• Is the voltage 5V or greater?</td><td>Yes
REPAIR the circuit. TEST the system for normal operation.

No
GO to C2 .</td></tr>
<tr><td>C2 CHECK FOR CORRECT ACM OPERATION

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
▪ Corrosion (clean module pins or install new connectors or terminals)
▪ Damaged or bent pins (install new terminals or pins)
▪ Pushed-out pins (install new pins as</td><td>Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOWTSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No</td></tr>
</table>

necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: The LF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B2965	Speaker Failure	Sets when a short to ground, short to voltage, or short together is detected on the LF , RF , RR (if equipped), or LR (if equipped) door speaker circuits.

Possible Sources

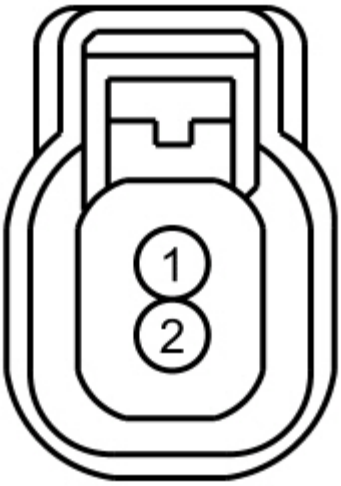
- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST D: THE LF DOOR SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>D1 CHECK THE AUDIO SIGNAL TO THE LF DOOR SPEAKER</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: LF Door Speaker C523 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>C523-2</td><td>RME07 (WH/BN)</td></tr></table></td><td>Yes
INSTALL a new LF door speaker. REFER to Speaker — Door .

No
GO to D2 .</td></tr>
</table>

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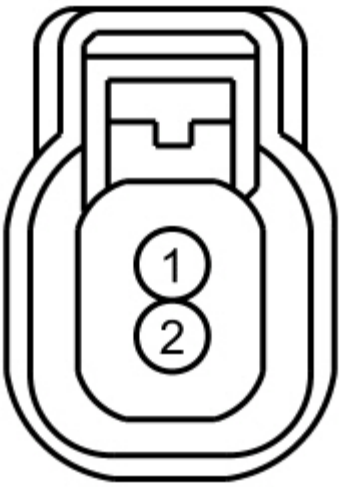


- **Is a fluctuating AC voltage present?**

D2 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C290A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



- **Is any voltage present?**

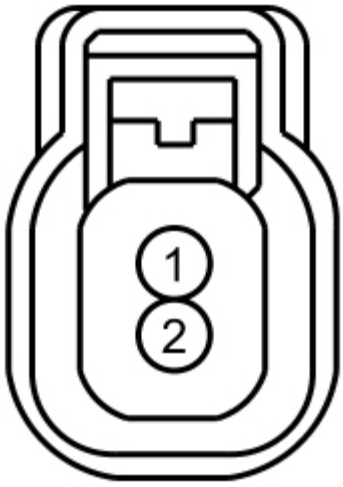
Yes
REPAIR the circuit in question.

No
GO to D3 .

D3 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

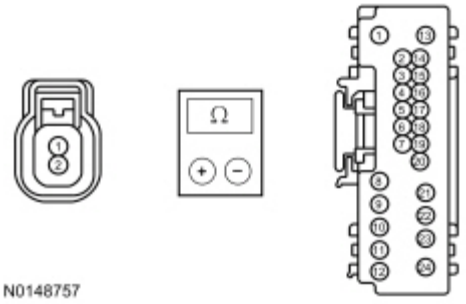
Yes
GO to D4 .

No
REPAIR the circuit in question.

D4 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C290A-8	VME07 (WH)
C523-2	RME07 (WH/BN)	C290A-21	RME07 (WH/BN)



Yes
GO to D5 .

No
REPAIR the circuit in question.

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<table>
<tr><td>

- **Are the resistances less than 3 ohms?**

</td><td></td></tr>
<tr><td>

D5 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TOGETHER

</td><td rowspan="2">

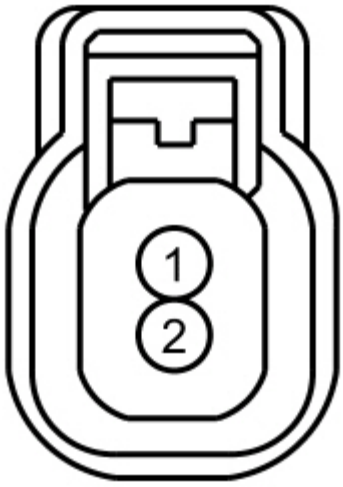
Yes
GO to D6 .

No
REPAIR the circuit in question.

</td></tr>
<tr><td>

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C523-2	RME07 (WH/BN)



- **Are the resistances greater than 10,000 ohms?**

</td></tr>
<tr><td>

D6 CHECK FOR CORRECT ACM OPERATION

</td><td rowspan="2">

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

</td></tr>
<tr><td>

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the ACM connectors. Make sure they seat and latch correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

</td></tr>
</table>

Pinpoint Test E: The RF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B2965	Speaker Failure	Sets when a short to ground, short to voltage, or short together is detected on the LF , RF , RR (if equipped), or LR (if equipped) door speaker circuits.

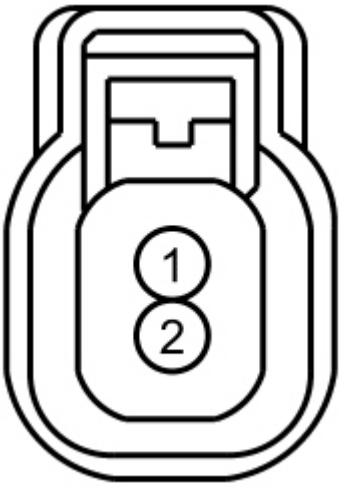
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST E: THE RF DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE AUDIO SIGNAL TO THE RF DOOR SPEAKER • Ignition OFF. • Disconnect: RF Door Speaker C612 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C612-1, Circuit VME10 (WH/VT); Negative Lead: Pin C612-2, Circuit RME10 (WH/OG)	**Yes** INSTALL a new RF door speaker. REFER to Speaker — Door . **No** GO to E2 .

repair4less

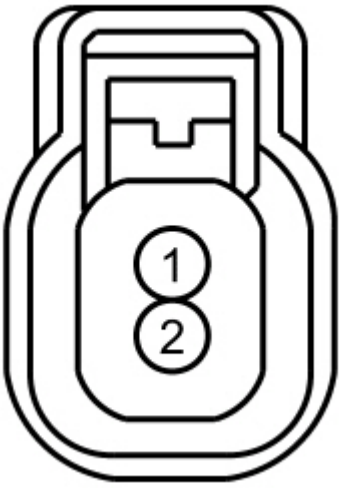


- **Is a fluctuating AC voltage present?**

E2 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C290A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

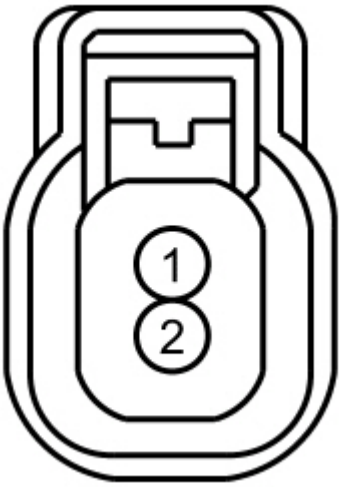
No
GO to E3 .

E3 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to E4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



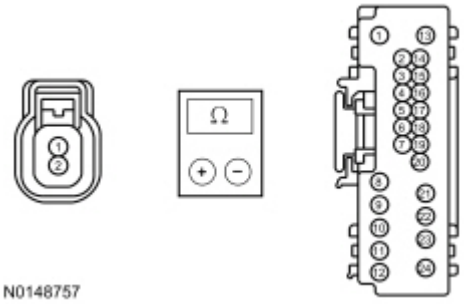
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

E4 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C290A-11	VME10 (WH/VT)
C612-2	RME10 (WH/OG)	C290A-12	RME10 (WH/OG)



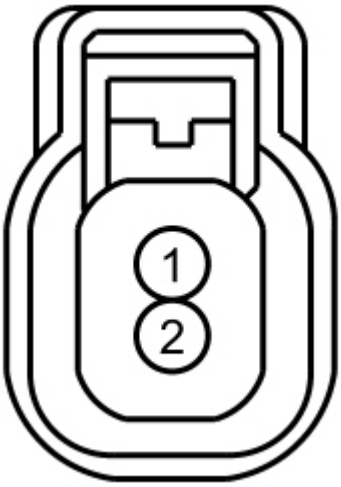
- **Are the resistances less than 3 ohms?**

Yes
GO to E5 .

No
REPAIR the circuit in question.

E5 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TOGETHER

repair4less

• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C612-2	RME10 (WH/OG) |  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to E6 . **No** REPAIR the circuit in question.

E6 CHECK FOR CORRECT ACM OPERATION
 	
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test F: The RR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

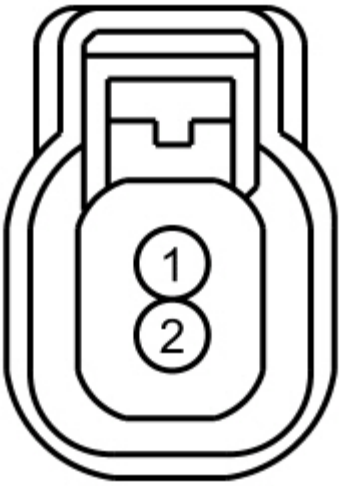
Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B2965	Speaker Failure	Sets when a short to ground, short to voltage, or short together is detected on the LF , RF , RR (if equipped), or LR (if equipped) door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST F: THE RR DOOR SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>F1 CHECK THE AUDIO SIGNAL TO THE RR DOOR SPEAKER
• Ignition OFF.
• Disconnect: RR Door Speaker C802 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:
<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C802-1</td><td>VME12 (BN/WH)</td><td>C802-2</td><td>RME12 (BN/BU)</td></tr>
</table>


• Is a fluctuating AC voltage present?</td><td>Yes
INSTALL a new RR door speaker. REFER to Speaker — Door .

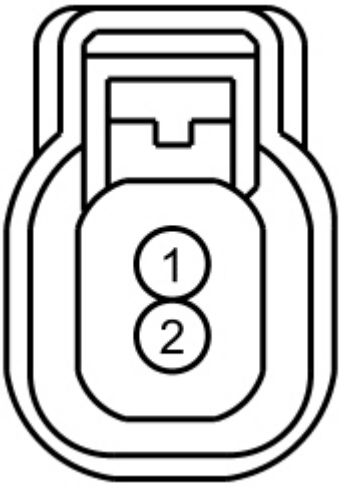
No
GO to F2 .</td></tr>
</table>

repair4less

F2 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C290A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to F3 .

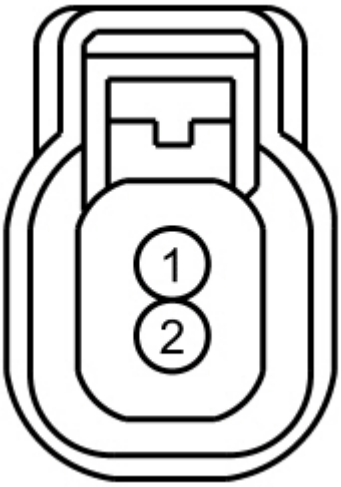
F3 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground

Yes
GO to F4 .

No
REPAIR the circuit in question.

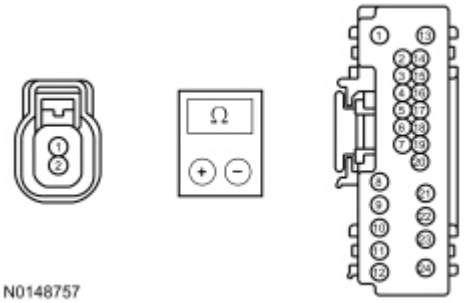


- **Are the resistances greater than 10,000 ohms?**

F4 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C290A-10	VME12 (BN/WH)
C802-2	RME12 (BN/BU)	C290A-23	RME12 (BN/BU)



- **Are the resistances less than 3 ohms?**

Yes
GO to F5 .

No
REPAIR the circuit in question.

F5 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TOGETHER

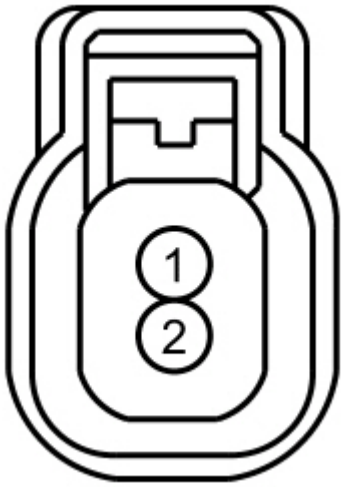
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C802-2	RME12 (BN/BU)

Yes
GO to F6 .

No
REPAIR the circuit in question.

repair4less

 • **Are the resistances greater than 10,000 ohms?**	

F6 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test G: The LR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System.

Root DTC Description	Failure Types	Fault Trigger Conditions

B2965	Speaker Failure	Sets when a short to ground, short to voltage, or short together is detected on the LF , RF , RR (if equipped), or LR (if equipped) door speaker circuits.

Possible Sources

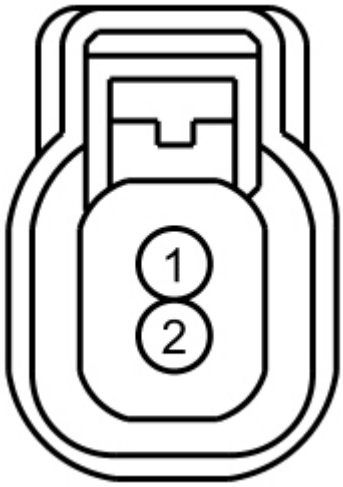
- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST G: THE LR DOOR SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>G1 CHECK THE AUDIO SIGNAL TO THE LR DOOR SPEAKER</td><td rowspan="2">Yes
INSTALL a new LR door speaker. REFER to Speaker — Door .

No
GO to G2 .</td></tr>
<tr><td>

Ignition OFF.
Disconnect: LR Door Speaker C702 .
Operate the audio system in radio tuner AM/FM mode.
Measure the AC voltage between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C702-1</td><td>VME09 (WH/GN)</td><td>C702-2</td><td>RME09 (BN/YE)</td></tr>
</table>


Is a fluctuating AC voltage present?

</td></tr>
<tr><td>G2 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO VOLTAGE</td><td rowspan="2">Yes
REPAIR the circuit in question.

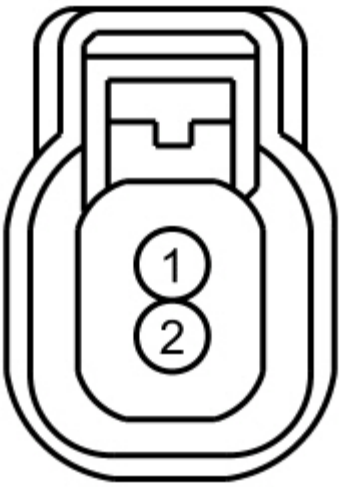
No</td></tr>
<tr><td>

Ignition OFF.
Disconnect: ACM C290A .
Ignition ON.
Measure the voltage between:

</td></tr>
</table>

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



- **Is any voltage present?**

GO to G3 .

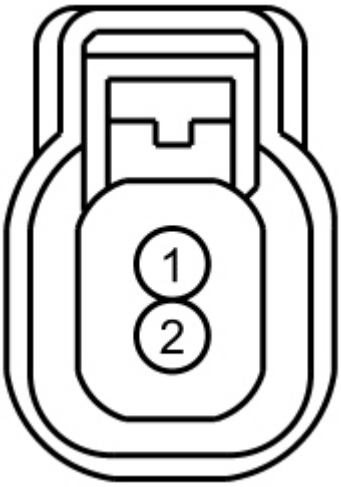
G3 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground

Yes
GO to G4 .

No
REPAIR the circuit in question.

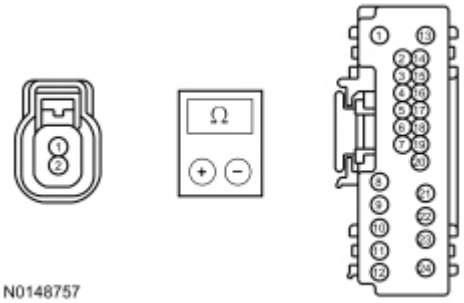


- **Are the resistances greater than 10,000 ohms?**

G4 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C290A-9	VME09 (WH/GN)
C702-2	RME09 (BN/YE)	C290A-22	RME09 (BN/YE)



- **Are the resistances less than 3 ohms?**

Yes
GO to G5 .

No
REPAIR the circuit in question.

G5 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TOGETHER

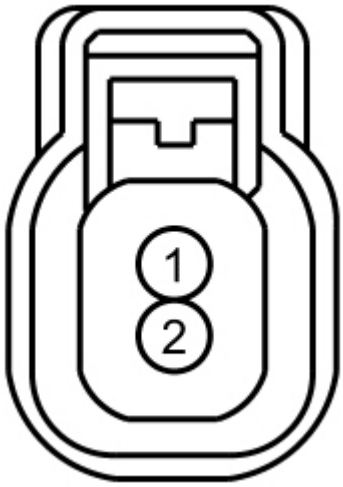
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C702-2	RME09 (BN/YE)

Yes
GO to G6 .

No
REPAIR the circuit in question.

repair4less

 • **Are the resistances greater than 10,000 ohms?**	

G6 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test H: Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All Speakers)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation

The ACM sends audio signals to the speakers in the form of AC voltage, resulting in clear audio output.

Possible Sources

- Loose component fasteners
- Loose door handle, lock, and other trim panel components and fasteners
- Loose items in storage areas

- Loose speaker grilles
- Loose wire harnesses or wire harness fasteners
- Speaker(s)
- Water shield bonding and placement

Visual Inspection and Diagnostic Pre-checks

Visually inspect around the suspect area for any possible rattle conditions such as:

- Any storage compartments including cup holders (if equipped)
- Door map pockets for contents that can rattle (if equipped)
- Door pull cup attachments (if equipped)
- Door switch bezels (if equipped)
- Package tray (if equipped)
- Speaker grilles
- Trim panels and fasteners

PINPOINT TEST H: POOR SOUND QUALITY OR DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take
H1 ISOLATE THE ZONE	
• Operate the audio system using digital media (CD, MP3, etc.). • Using the audio system fade and balance feature, adjust the audio sound to each of the four zones (LF , RF , LR , and RR) of the vehicle to isolate the poor sound quality. • Locate and apply pressure to the trim panel(s) around the poor sound quality area in question. • **Does applying pressure to a trim panel reduce or eliminate the audible noise?**	**Yes** REPAIR or REPLACE the trim panel as needed. **No** GO to H2 .
H2 REMOVE AND INSPECT BEHIND/UNDERNEATH THE SUSPECT TRIM PANEL(S)	

• Remove the trim panel to access the suspect speaker.
• Operate the audio system using digital media (CD, MP3, etc.).
• Validate where the poor sound quality area is located.
• Check:
  ▪ Trim panel for loose components around the speaker area such as the speaker grille
  ▪ Trim panel joining components for missing or broken pieces
  ▪ Lock and handle mechanical parts for correct attachment
  ▪ Wire harnesses for correct routing
  ▪ Wire harness fasteners for correct attachment
  ▪ Water shield for correct placement (speaker air path not blocked)
  ▪ Water shield for correct bonding to sheet metal
  ▪ Storage areas for loose items
	Yes
	REPAIR or REPLACE any loose or broken component or fastener as needed.
	
	No
	GO to H3 .

repair4less

■ All child safety belt anchors (if equipped) ■ All safety belt retractors ■ All speaker bracket fasteners and other fasteners are secured and tightened to specified torque ● **Was the source of the noise located?**	
H3 CHECK THE SUSPECT SPEAKER FOR WATER INTRUSION	
● Inspect for watermarks. ● Check the: ■ Cone ■ Magnet ■ Basket ● **Are any watermarks present on the speaker?**	**Yes** VERIFY the water shield is in the correct location, REPAIR or REPLACE any trim, door, or speaker seal as required. DRY the speaker in question and TEST the system for normal operation. **No** GO to H4 .
H4 ISOLATE SPEAKER TO VERIFY NOISE	
● Remove the suspect speaker from its location and leave the speaker connected to the harness. ● Hold the speaker away from any trim panel(s) and ensure the speaker is isolated from contact. ● Operate the audio system using digital media (CD, MP3, etc.). ● **Is the noise still present in the suspect speaker?**	**Yes** INSTALL a new speaker for the one in question. **No** LOCATE the source of the noise and REPAIR as needed.

Audio Control Module (ACM) Self-Diagnostic Mode

NOTE: If the Audio Front Control Module (ACM) is inoperative (blank or does not power on), obtain the ACM part number by referencing the label attached to the Audio Front Control Module (ACM) chassis.

1. Turn the ACM on.

2. Operate the audio system in radio tuner AM/FM mode.

3. Press and hold preset buttons 3 and 6 for 3 seconds until the speaker walk around test begins.
   - The display indicates each speaker as it is tested.

4. **NOTE:** If the speaker walk around test is the only test required, this procedure can be stopped after Step 3 by turning the ACM off.

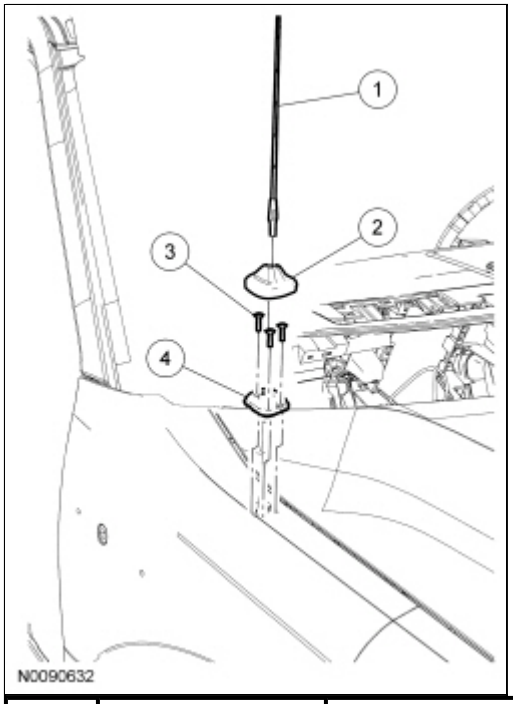
   Before the speaker walk around test is complete, the following actions can be performed:

Preset Button Press	Diagnostic Function	Display	Diagnostic Function Description
1	ACM Self-Test	SELF TEST, SELF PASS, SELF FAIL	The ACM carries out a self-test. At the end of the self-test, the display indicates either SELF PASS, or SELF FAIL. If the self-test failed, DTCs can be accessed by pressing the TUNE UP button.
2	View DTCs	NO DTCS, DTCS FOUND	The ACM displays DTCS FOUND if DTCs are present. To scroll through the DTCs, press the TUNE UP button. If no DTCs are present, the ACM displays NO DTCS. To clear DTCs, press the EJECT, then TUNE UP button.
3	AM/FM Antenna Signal Strength	SIGNAL ###	The ACM displays the AM/FM antenna signal strength. To view the AM signal strength, the audio system must be in AM radio tuner mode before entering the ACM self-diagnostic mode. To view the FM signal strength, the audio system must be in FM radio tuner mode before entering the ACM self-diagnostic mode. If no antenna is present, a signal strength of 0 will be displayed.
4	Software Levels	SOFT LEVELS	The ACM displays software levels for various components of the audio system. Knowing the software levels may aid diagnostics. Press the TUNE UP button to scroll through the software levels.
5	Display Test	DISPLAY TEST, then all segments illuminate	All of the ACM display segments illuminate.
6	Retrieve ACM Part Number	RADIO CONFIG	The ACM displays the ACM part number and various configuration levels. Press the TUNE UP button to scroll to the desired function.

5. To exit the self-diagnostic mode, turn the ACM off.

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Antenna — AM/FM

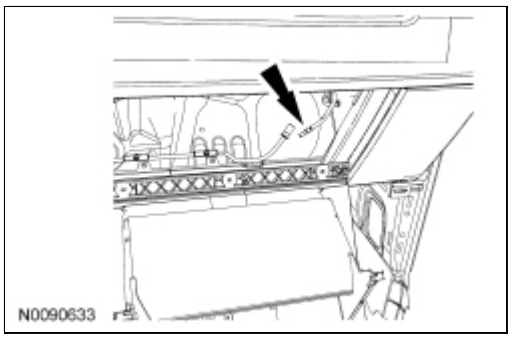


Item	Part Number	Description
1	18813	AM/FM antenna mast
2	18A927	AM/FM antenna base cap
3	N610019	AM/FM antenna screws (3 required)
4	18A894	AM/FM antenna base

Removal and Installation

1. Lower the glove compartment completely.

2. Disconnect the AM/FM antenna from the AM/FM antenna cable.
    - Push the antenna cable end and the grommet through the side cowl.



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3. ***NOTICE:*** **Do not over tighten the antenna mast or damage to the antenna base or mast may occur.**

   Remove the AM/FM antenna mast.
   1. To install, tighten to 4.2 Nm (36 lb/in).

4. **NOTE:** A new AM/FM antenna base cap must be installed.

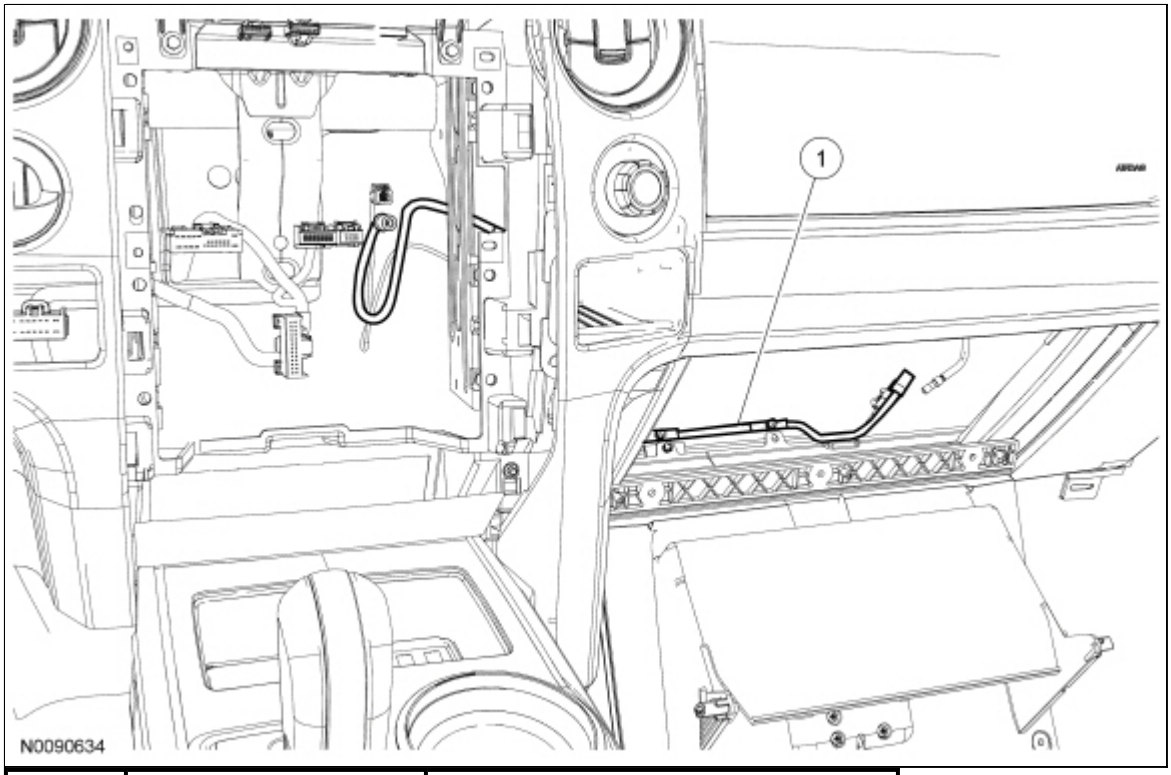
   Using a suitable tool such as a hook-shaped pick, remove the AM/FM antenna base cap by prying upward.

5. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

6. Remove the 3 screws and the AM/FM antenna base.
   1. To install, tighten to 2.5 Nm (23 lb/in).

7. To install, reverse the removal procedure.

Antenna Cable — AM/FM



Item	Part Number	Description
1	18812	AM/FM antenna cable

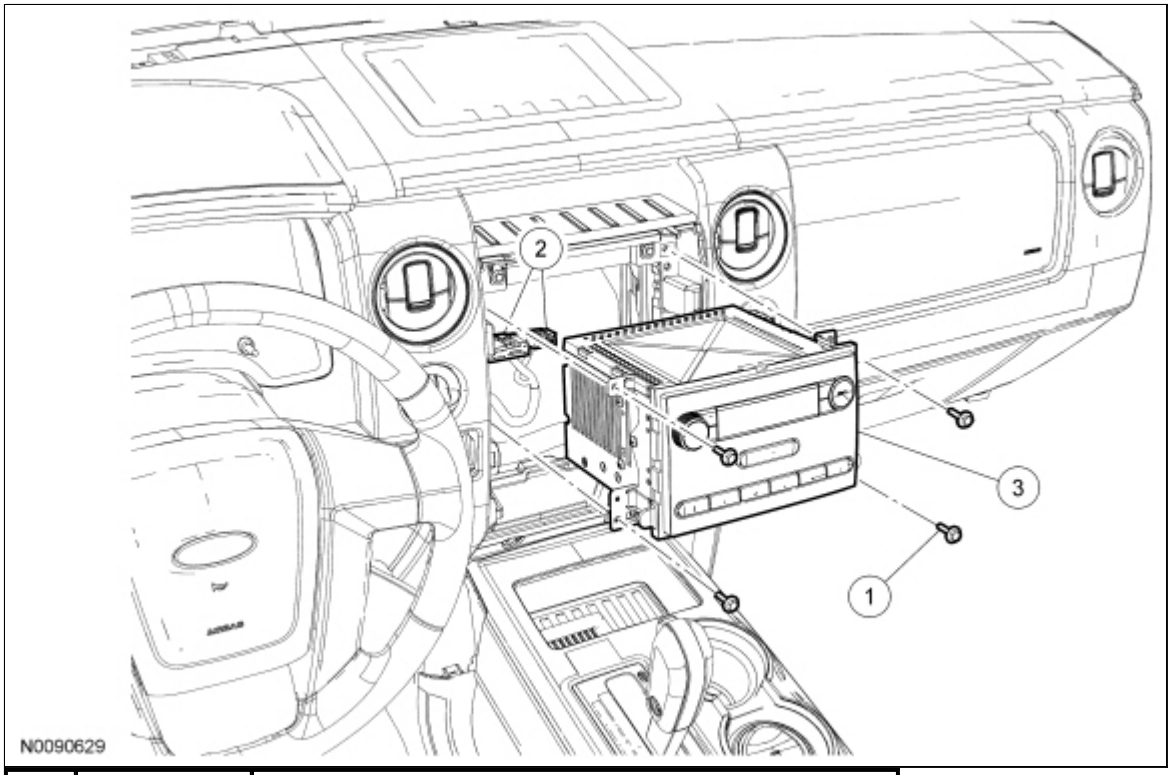
Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.
2. Lower the glove compartment completely.
3. Disconnect the AM/FM antenna cable from the AM/FM antenna.
4. Separate the pushpins and remove the AM/FM antenna cable.
5. To install, reverse the removal procedure.

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Audio Control Module (ACM)

Base AM/FM



Item	Part Number	Description
1	W707628-S	Audio Front Control Module (ACM) screws (4 required)
2	—	ACM electrical connectors (part of 14401 and 18812)
3	18806	ACM

Removal and Installation

NOTE: It is not necessary to remove the Audio Front Control Module (ACM) to retrieve the part number. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

1. Remove the center lower instrument panel finish panel. Refer to Section 501-12 .

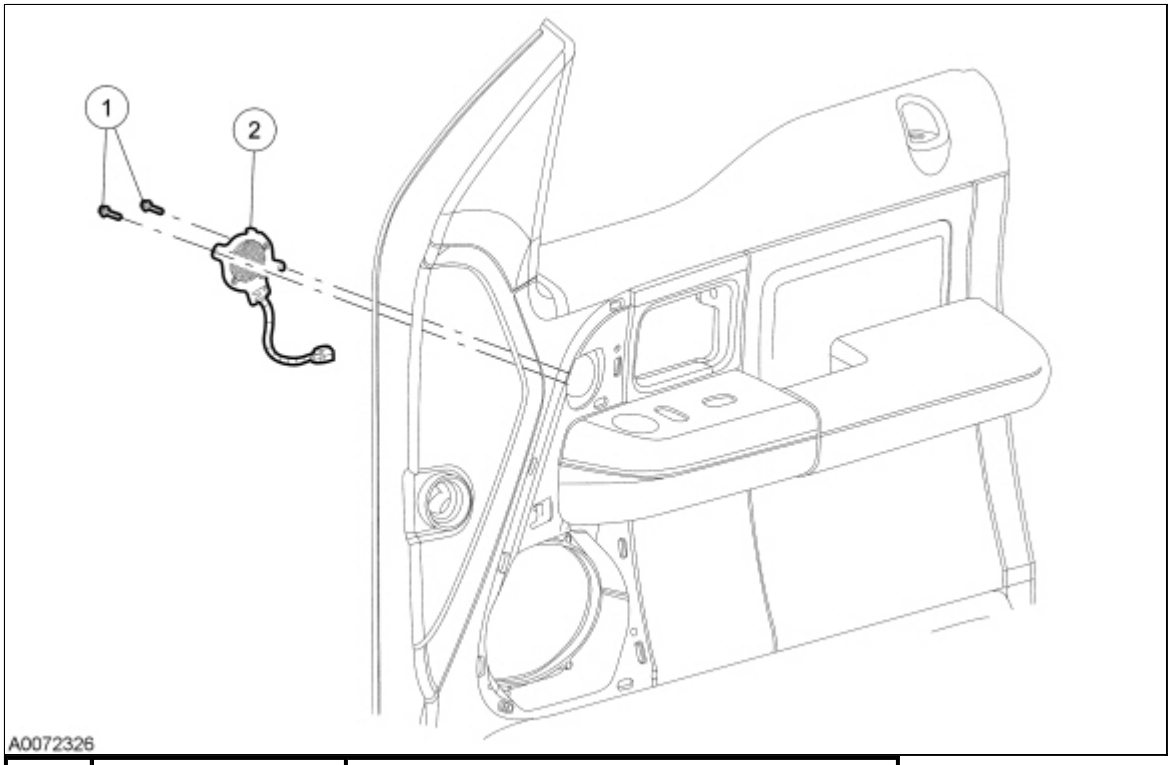
2. Remove the 4 screws and the ACM .
   - Disconnect the electrical connectors.
   - To install, tighten to 2.5 Nm (23 lb-in).

3. To install, reverse the removal procedure.

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Speaker — Door

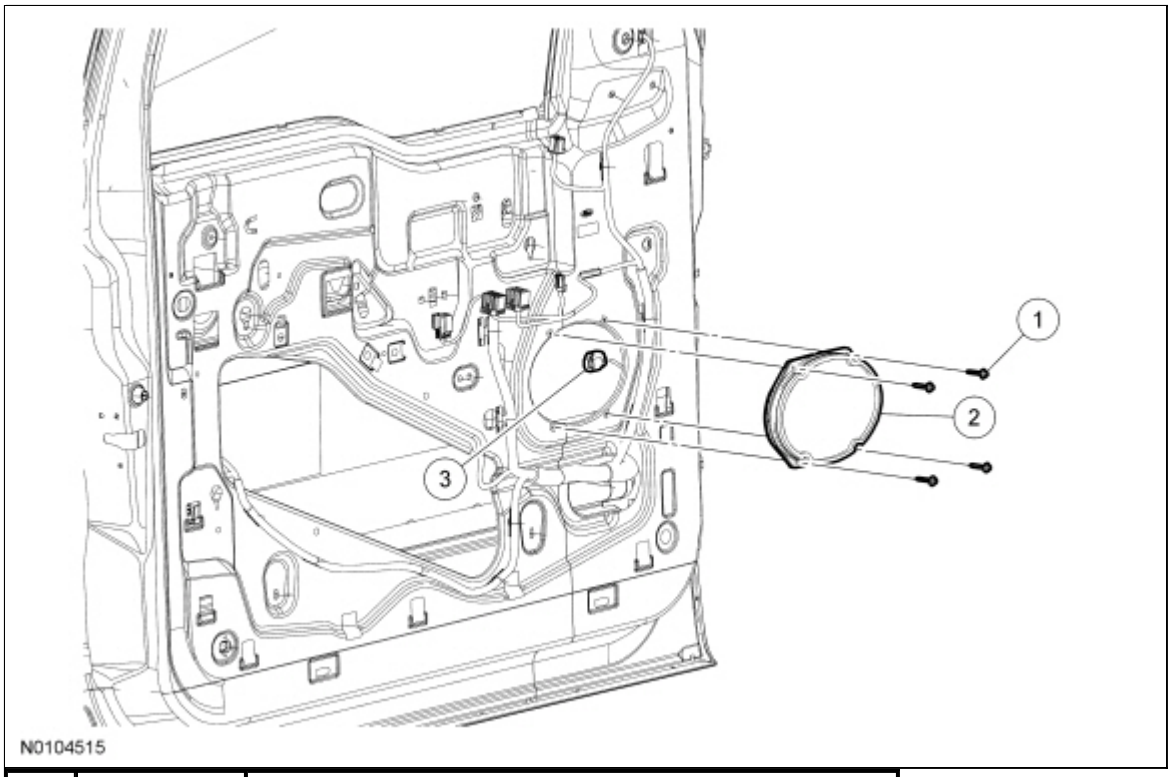
Front Door Tweeter Speaker



Item	Part Number	Description
1	W701678	Tweeter speaker screws (2 required)
2	19B170/19B171	Tweeter speaker (RH/LH)

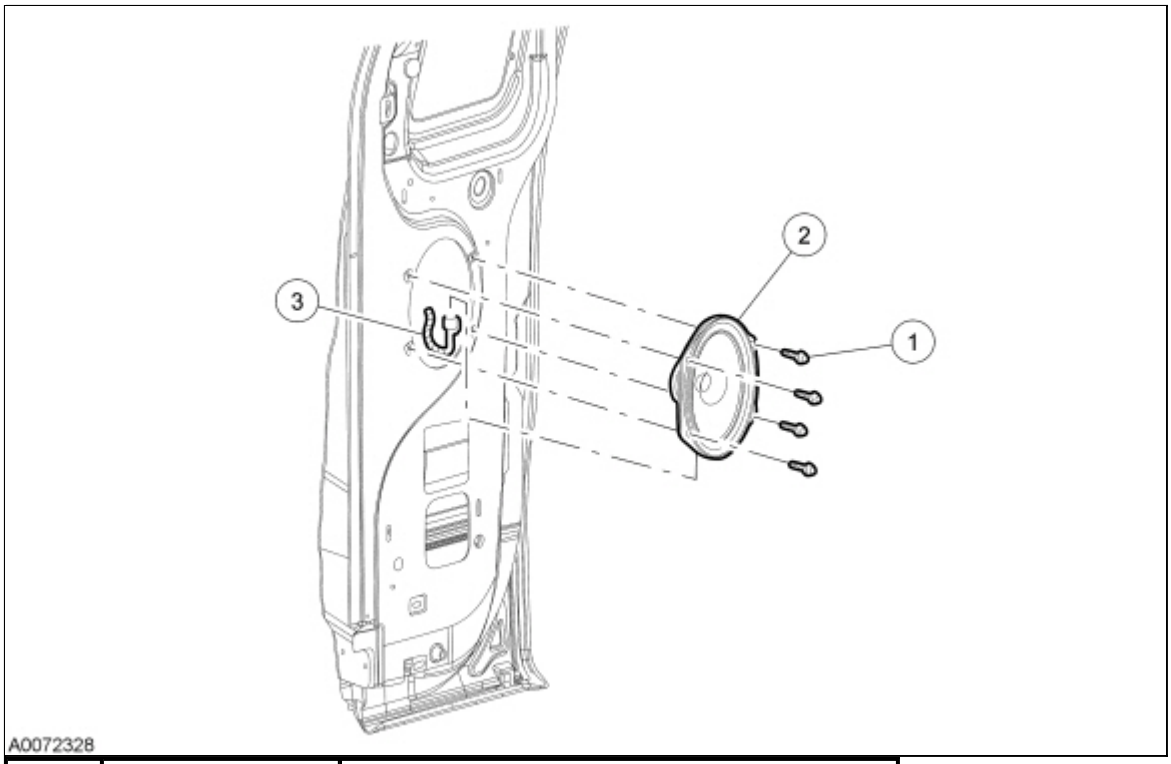
Front Door Speaker

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Item	Part Number	Description
1	W707628	Front door speaker screws (4 required)
2	18808	Front door speaker
3	—	Front door speaker electrical connector (part of door harness)

Rear Door Speaker



Item	Part Number	Description
1	W706766	Rear speaker screws (4 required)
2	18808	Rear speaker
3	180103	Rear speaker electrical connector

Removal and Installation

Front door

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws (2 for the tweeter, 4 for the door speaker) and the speaker.
   - Disconnect the electrical connector.

Rear door

3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

4. Remove the 4 screws and the rear door speaker.
   - Disconnect the electrical connector.

All speakers

5. To install, reverse the removal procedure.

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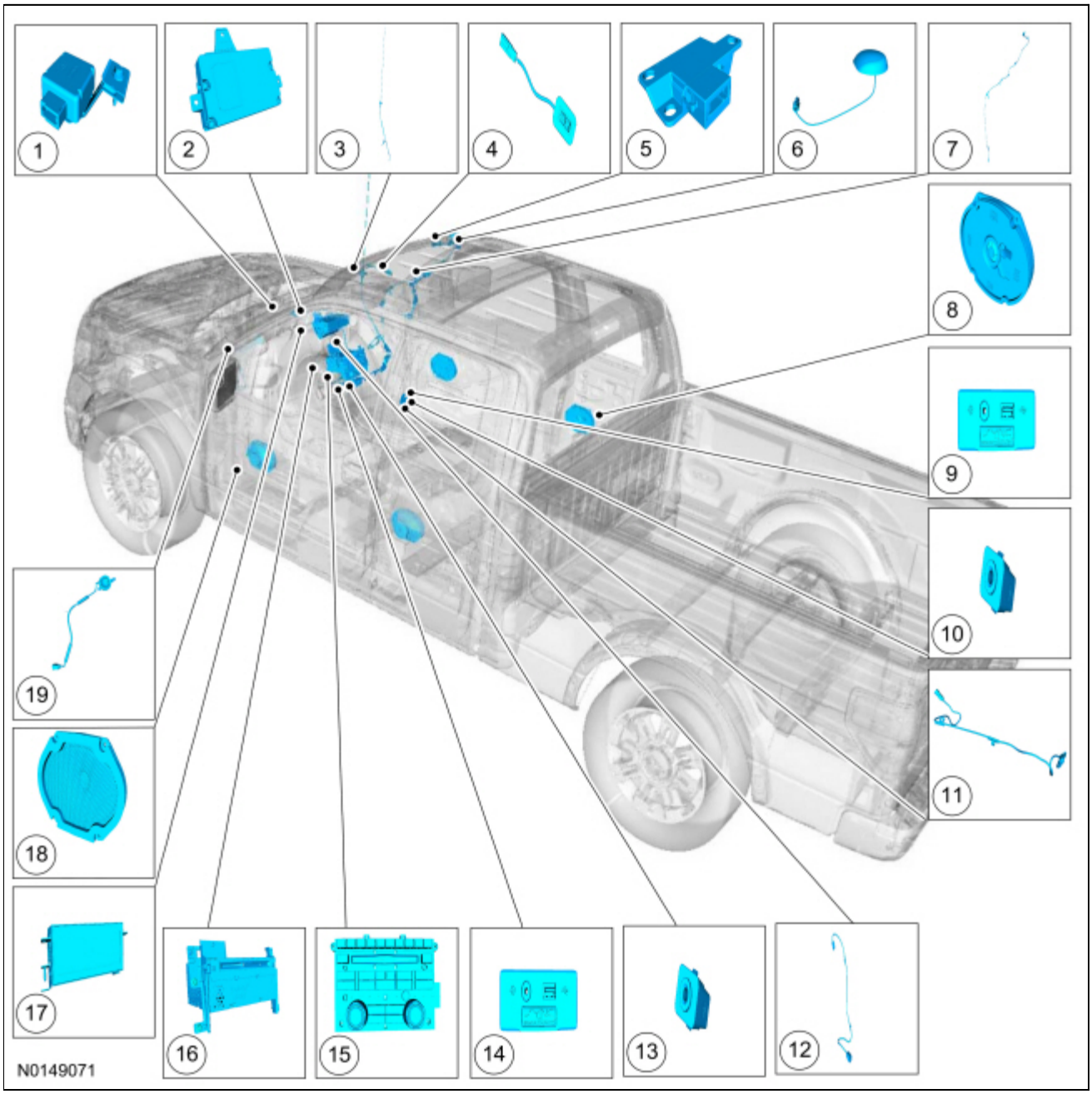
Torque Specifications

Description	Nm	lb-in
Audio Front Control Module (ACM) bolts	2.5	23
Front Display Interface Module (FDIM) bolts	2	18
AM/FM antenna mast	4.2	36
AM/FM antenna base bolts	2.5	23

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Information and Entertainment System

Component Location



Item	Description	Comments
1	GPSM	Located in the top center area of the instrument panel

		(if equipped)
2	APIM	Located in the top center area of the instrument panel (if equipped)
3	AM/FM antenna and AM/FM antenna coaxial cable	-
4	SYNC® microphone	Located in the headliner (if equipped)
5	Compass module	Located in the headliner (if equipped)
6	Satellite radio antenna	If equipped
7	Satellite radio antenna coaxial cable	If equipped
8	Rear door speaker	-
9	Audio input jack and USB port	Located in the console (with front captain chairs)
10	Audio input jack	Located in the console (with front captain chairs)
11	USB cable	Located in the console (with front captain chairs)
12	USB cable	Located in the instrument panel (with split bench)
13	Audio input jack	Located in the instrument panel (with split bench)
14	Audio input jack and USB port	Located in the instrument panel (with split bench)
15	FCIM	-
16	ACM	-
17	Non-touchscreen FDIM	-
18	Front door speaker	-
19	A-pillar speaker	LF shown, RF similar

Overview

The audio system consists of the following:

Main Components

- 6 speakers
- AM/FM single CD ACM
- APIM (with SYNC®)
- Audio input jack
- Compass module (if equipped)
- FCIM
- GPSM (with SYNC®)
- Auto-dimming interior rear view mirror (if equipped)
- Non-touchscreen FDIM
- Redundant steering wheel controls (with SYNC®)
- SYNC® microphone (with SYNC®)
- USB port (with SYNC®)

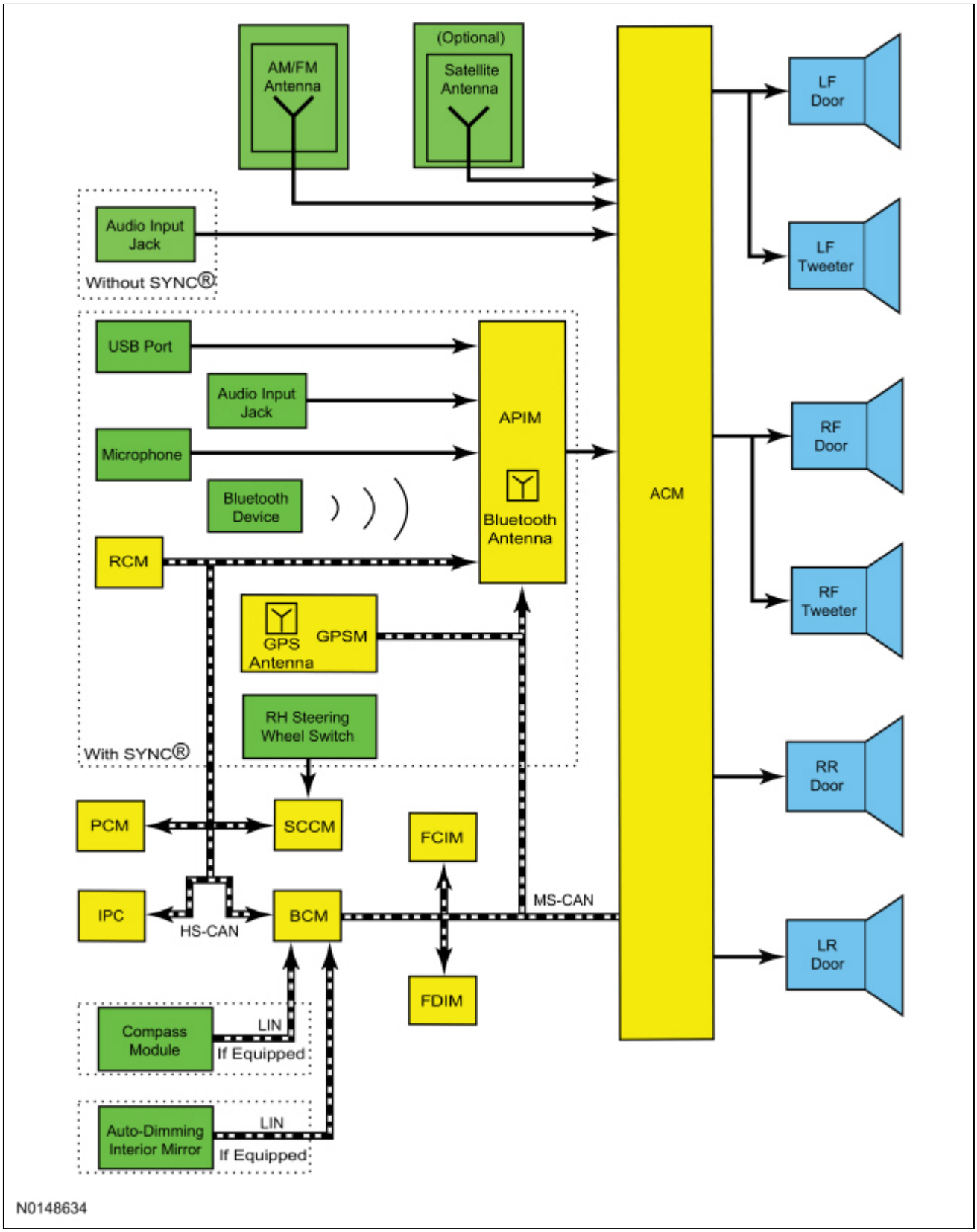
Main Features

- Optional satellite radio
- Optional SYNC®

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System Operation

System Diagram



Network Message Chart

NOTE: A missing network message is indicated by a U-code DTC . When a missing message DTC (U-code)

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sets, it is important to look for symptoms present in the audio system and throughout the vehicle, and to review the complete message list to determine which other modules rely on the same message. Refer to CAN Module Communication Message Chart in Section 418-00 . When the other modules have been identified, run the self-test for those modules. If the same message is missing from those modules, the identical, or similar lost communication DTCs may be set in those modules. Confirmation of missing messages common to multiple modules can indicate that the originating module is the source of the concern, or that the communication network may be at fault.

It is very important to understand the following:

- Where the input originates
- All of the information necessary for a feature to operate
- Which module(s) receive(s) the input or command message
- Which module controls the output of the feature
- If the module that receives the input controls the output of the feature, or whether it outputs a message over the CAN to another module.

Module Network Input Messages - ACM

Broadcast Message	Originating Module	Message Purpose
Accessory delay status	BCM	Used to determine the audio system operating mode.
Ignition switch position	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for ACM operating modes and fault reporting.
Steering wheel switch media	SCCM	Used to set the audio system listening mode (AM/FM, CD, etc.) from the steering wheel switch.
Steering wheel switch seek left	SCCM	Used to access the next strong station to the left, to restart an audio track, to access the previous satellite radio station preset (if equipped), or the previous audio track from the steering wheel switch.
Steering wheel switch seek right	SCCM	Used to access the next strong station to the right, to access the next satellite radio station preset (if equipped), or to access the next audio track from the steering wheel switch.
Steering wheel switch volume down	SCCM	Used to decrease the audio system volume from the steering wheel switch.
Steering wheel switch volume up	SCCM	Used to increase the audio system volume from the steering wheel switch.
Vehicle speed	PCM	Used for the speed compensated volume function.

Module Network Input Messages - APIM

Broadcast Message	Originating Module	Message Purpose
Accessory delay status	BCM	Used to determine the audio system operating mode.
Airbag deployment eCall notification	RCM	Used to notify of a 911 assist call being initiated due to airbag deployment.

GPS location	GPSM	Used for vehicle positioning, heading, and direction for turn by turn navigation and 911 assist.
Steering wheel switch OK	SCCM	Used to confirm various audio system selections.
Steering wheel switch phone	SCCM	Used to answer or end a phone call from the steering wheel switch.
Steering wheel switch voice	SCCM	Used to access or exit the voice command feature from the steering wheel switch.

Module Network Input Messages - FDIM

Broadcast Message	Originating Module	Message Purpose
Compass display data	BCM	Used to display the compass direction on the FDIM .
Compass zone and calibration status	BCM	Used to display compass zone and calibration status on the FDIM .

Module Network Input Messages - GPSM

Broadcast Message	Originating Module	Message Purpose
Ignition switch position	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for GPSM operating modes and fault reporting.
Selector lever (PRNDL) status	BCM	Used to verify the gear lever position for vehicle direction data.

Accessory Delay Feature

The accessory delay feature allows the audio system to be operated for a preset period of time after the ignition is turned off and a front door has not been opened.

AM/FM Radio

The AM/FM fender-mounted antenna receives radio waves and sends them through the AM/FM antenna coaxial cable to the ACM . The radio waves are converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

Audible Prompts

The APIM receives stereo inputs from connected mobile phones and mono inputs from the SYNC® microphone.

Stereo and mono inputs, voice prompts, the TTS feature, ringtones, and any audio received through a connected mobile phone are transmitted to the ACM as stereo or mono sound.

The TTS feature speaks information so that it does not have to be read from the display.

Battery Load Shed

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The BCM uses the battery current sensor to monitor the battery state of charge. The battery current sensor is attached to the battery ground cable. With the vehicle OFF and the ignition in ACC or ON, a load shed message is sent over the CAN when the BCM determines that the battery state of charge is below 40%, 45 minutes have elapsed, or 10% of the charge has been drained. This message turns off the audio system to save the remaining battery charge. Under this condition, SYS OFF TO SAVE BATT is displayed on the centerstack infotainment display to notify the driver that battery protection actions are active. To clear the load shed state, start the vehicle.

Bluetooth Mode

Bluetooth is a secure, short-range radio frequency that allows devices to communicate wirelessly through radio waves. The operating range of a Bluetooth signal is a maximum of 9.75 m (32 feet).

The Bluetooth interface can accommodate both Bluetooth-enabled mobile phones and Bluetooth-enabled media devices. The SYNC® system allows interaction with several types of customer Bluetooth devices, including mobile phones and media devices. The APIM contains an on-board Bluetooth chipset, which enables certain wireless devices to interact with the system. Any Bluetooth device used with the SYNC® system must first be paired with the system before it is operational.

Only one Bluetooth phone and one Bluetooth media device can be connected to the system at any one time. If an additional device of either type is paired with the system and made active, the APIM disconnects any active connection and establishes a connection with the new device.

When a new Bluetooth device is added, the APIM and the Bluetooth device must be paired together. Most Bluetooth devices can pair with the SYNC® system, although functionality may vary. To determine if a Bluetooth device is supported, verify the customer device is on the compatibility list for the current APIM software level.

Pairing a Bluetooth device is accomplished through the "Add Device" selection of the phone menu. When pairing a device, the SYNC® system generates a unique PIN that must be entered on the Bluetooth device in order for the pairing process to be successful. There are also some device-specific actions that must take place. For information on the pairing process, refer to the Owner's Literature.

It is important to understand that not all mobile phones have the same level of features when interacting with the SYNC® system. For a list of compatible phones, refer to SyncMyRide website.

MyKey® Audio Operation

When a MyKey® is in use, the following restrictions are activated:

- The audio system is muted until the safety belts are buckled when the Belt-Minder® feature is activated. The MyKey® "BUCKLE UP TO UNMUTE AUDIO" is displayed in the information display.
  - This is a standard setting and cannot be changed.
- Satellite radio adult content stations are blocked by being muted.
- If "Always On" is selected in the MyKey® menu, 911 assist and the Do Not Disturb features are enabled and cannot be disabled.
- The audio system volume is limited to 45%. In an attempt to exceed the limited volume, the MyKey® VOLUME LIMITED message is displayed in the centerstack infotainment display.
  - This is an optional setting.

Refer to the Owner's Literature for more information on MyKey®.

Satellite Radio (If Equipped)

Satellite radio is a subscription-based service.

The satellite radio roof-mounted antenna receives signals containing data (station call letters, artist names, song titles, etc.) and digital satellite radio audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio receiver built into the ACM . The ACM separates the data from the audio. The data is sent to be displayed on the centerstack infotainment display, and the audio is converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

Speed Compensated Volume

The ACM adjusts the audio system volume based on the VSS signal to compensate for speed and wind noise.

When a MyKey® is in use and the MyKey® radio volume limiter is enabled, the speed compensated volume is disabled.

Steering Wheel Switch Functions

The RH 8-way steering wheel switches operate the volume +/-, seek +/-, and the audio system SYNC® functions (media, voice, phone, and OK).

SYNC® AppLink™

SYNC® AppLink™ allows the customer to control smartphone applications by using voice commands and in-vehicle controls. Data is transferred from the customer's device to the APIM through Bluetooth, or through the USB port with Apple® devices.

SYNC® Services

SYNC® Services is a subscription-based service. For SYNC® Services subscription information,, refer to SyncMyRide .

The customer's mobile phone is used to access and download the SYNC® services. SYNC® services information received by the customer's mobile device is sent to the APIM .

The GPS antenna, integral to the GPSM , is used to detect the location and direction of the vehicle.

SYNC® services includes the following features:

- Business search
- Personalized text alerts
- Real-time traffic updates
- Turn-by-turn directions

SYNC® services allows the customer to receive updates for:

- Entertainment
- News
- Sports
- Stocks
- Travel
- Weather

SYNC® System

The SYNC® system is a hands-free communication and entertainment system that supports many features. All features are not available with every phone.

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The SYNC® system provides the ability to:

- Connect media devices (such as an iPod® or USB device) in order to play audio files.
- Control the entertainment system using voice controls.
- Initiate an emergency call (911 Assist™) when the airbags deploy.
- Play media files via a paired Bluetooth-enabled audio device.
- Produce vehicle health reports.
- Send and receive phone calls via a paired Bluetooth-enabled phone.
- Send and receive text messages via a paired Bluetooth-enabled phone.

USB Audio Mode

The USB port can be used for connecting a media device (such as an iPod®) with the device's available cable, or for directly plugging in a portable mass storage device, such as a thumb drive. When playing media files stored on a mass storage device, the SYNC® system only plays files that do not have DRM protection. The USB port can also be used for uploading vehicle application upgrades. The USB port is powered by the APIM , so no external power source is needed to power a device plugged into the USB port if the device supports this feature.

In addition to audio information, metadata (information such as artist, album title, song title, and genre) may also be sent to the APIM from a device plugged into the USB port. The APIM uses the metadata to create indexes that can be used to sort for particular music, based on customer preference. Not all USB devices can send metadata to the APIM . When a new media device is connected to the SYNC® system, the APIM automatically indexes the information. This may take several minutes (depending on the amount of data on the device), and is considered normal operation. When a device that was previously connected to the SYNC® system is reconnected, the APIM updates the index (rather than creating a new one), which reduces the amount of time needed to index the device.

Voice Recognition

Voice recognition is used for many vehicle functions, including the audio system. The microphone relays the microphone input to the APIM through dedicated wiring. The TTS and voice prompt features speak certain text information and interaction requests to minimize driver distraction by having to look at the audio system display while driving. The ringtone alerts the driver to an incoming call. The microphone is also used to detect outgoing audio during a phone call.

Audible prompts can range from a simple tone to more elaborate spoken text, based on the customer setting. When interaction mode is set to standard, detailed guidance is provided. When interaction mode is set to advanced, most prompts are tones only and minimal audible guidance is provided. Refer to the Owner's Literature for further information on voice interaction.

The audio signals for the TTS and voice prompt features, ringtones, and audio from the outside device during a phone call, are sent from the APIM to the ACM .

Component Description

ACM

The ACM can be operated with the ignition in RUN, ACC, or OFF.

The ACM receives radio waves containing audio from the antenna coaxial cable(s) and converts them into fluctuating AC voltage. The ACM receives audio signals from the APIM in the form of fluctuating AC voltage. The ACM processes these inputs and sends left and right analog audio signals to the speakers as fluctuating AC voltage.

If equipped with satellite radio, the ACM will also receive radio waves containing data through the antenna coaxial cable(s). The data is sent to be displayed on the centerstack infotainment display.

The ACM requires PMI when it is replaced.

Antenna

The AM/FM fender-mounted antenna receives radio waves containing audio and sends them through the AM/FM antenna coaxial cable to the ACM . The antenna mast is used to amplify the AM/FM radio waves to improve reception.

If equipped with satellite radio, the satellite radio roof-mounted antenna receives signals containing data and digital audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio receiver built into the ACM .

APIM

Audio signals received by the APIM are sent to the ACM as fluctuating AC voltage.

The APIM consists of 2 internal modules: the CIP and the VIP . The modules are not replaceable individually, but can be flashed independently, if required.

The CIP interfaces with all of the inputs to the APIM . It contains an analog-to-digital-to analog converter, as well as the Bluetooth chipset. Any Application upgrades that are available to the consumer are loaded directly to the CIP through the USB port.

The VIP provides an interface between the CIP and the vehicle. Its main functions are controlling the APIM power management and translating inbound and outbound CAN signals. In addition, the VIP queries the modules on the network to retrieve any DTCs when a vehicle health report is requested.

Audio Input Jack

The audio input jack allows for a portable MP3 audio device (such as an iPod®) to be connected to the vehicle audio system utilizing a 1/8-inch (3 mm) audio jack.

Auto-Dimming Interior Rear View Mirror (If Equipped)

If the vehicle is equipped with an auto-dimming interior rear view mirror, a compass module will not be used.

The auto-dimming interior rear view mirror communicates the vehicle direction to the BCM through a LIN circuit. The data is then sent over the MS-CAN to the FDIM , where it is displayed. The BCM is only a gateway for the compass information and does not control the compass display

Compass Module (If Equipped)

The vehicle is eqiupped with a compass module if an auto-dimming interior rear view mirror is not used.

The compass module communicates the vehicle direction to the BCM through a LIN circuit. The data is then sent over the MS-CAN to the FDIM , where it is displayed. The BCM is only a gateway for the compass information and does not control the compass display

FCIM

The FCIM can be operated with the ignition in RUN, ACC, or OFF.

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The FCIM audio system buttons provide one of the methods in which the customer interacts with the infotainment system.

The FCIM is separate from the ACM .

FDIM

The FDIM receives CAN messages for all of its displays, which include:

- Audio information
- Climate control fan speed and temperature setting
- Outside air temperature
- Compass heading
    - The magnetic fields generated by the earth's north and south poles are divided into zones that differ from each other with respect to how the magnetic fields appear. The magnetic north can change by up to 4 degrees between zones and become noticeable across multiple zones. The compass zone must be set to the correct zone for the compass to read accurately. Factors within the vehicle, and outside factors such as bridges, steel structures, tall buildings, and power lines may affect compass accuracy. Calibrating the compass allows the auto-dimming interior rear view mirror (if equipped) or compass module (if equipped) to compensate for vehicle factors that influence the accuracy of the compass heading.

Global Positioning System Module (GPSM)

The Global Positioning System Module (GPSM) provides vehicle location for real-time traffic reports and re-routing, and for identifying vehicle location in the event of a collision.

Vehicle location information is broadcast from the Global Positioning System Module (GPSM) to the APIM .

Steering Wheel Switches

The RH steering wheel switches contain series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

The SCCM sends a 5-volt reference voltage to the RH steering wheel switch on the input circuits. When a switch is pressed, the voltage is routed through the corresponding resistor(s), and then to ground through the SCCM . The SCCM monitors the resultant voltage drop to determine which switch was pressed. The voltage drop varies depending upon the resistance of the specific switch pressed.

The SCCM sends a network message to the APIM for the SYNC® switches and to the ACM for the redundant audio controls.

SYNC® Microphone

The SYNC® microphone receives SYNC® system voice commands and outgoing audio during a phone call. These signals are sent to the APIM .

USB Port

The USB port is connected to the APIM through the USB cable. The USB port can be used to play audio files, connect a media device, or upload software from mass storage.

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Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent diagnostic scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3104-A	Back-probe Pins POM6411 or equivalent
 ST3051-A	Universal Serial Bus (USB) Male-A To Male-A Cable CCMUSB2-AM-AM-10
 ST3086-A	Multi-Media Interface Tester 105-00120

DTC Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.

Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Audio Front Control Module (ACM) DTC Chart

DTC	Description	Action
B1A01:01	Speaker #1: General Electrical Failure	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A01:11	Speaker #1: Circuit Short to Ground	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A01:12	Speaker #1: Circuit Short to Battery	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A01:13	Speaker #1: Circuit Open	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A02:01	Speaker #2: General Electrical Failure	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A02:11	Speaker #2: Circuit Short to Ground	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A02:12	Speaker #2: Circuit Short to Battery	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A02:13	Speaker #2: Circuit Open	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A03:01	Speaker #3: General Electrical Failure	GO to Pinpoint Test J.
B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test J.
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test J.
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test J.
B1A04:01	Speaker #4: General Electrical Failure	GO to Pinpoint Test K.
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test K.
B1A04:12	Speaker #4: Circuit Short to Battery	GO to Pinpoint Test K.
B1A04:13	Speaker #4: Circuit Open	GO to Pinpoint Test K.

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B1A56:21	Antenna: Signal Amplitude	If DTC B1A56:21 sets after running the bezel diagnostic tests, disregard this DTC. This test is used for end of line or repair bay testing at the Ford plant. Each plant has its own assigned frequency and signal strength requirements. The running and passing of this test depends on local radio stations. If no local station is broadcasting on the required frequency, the test will fail. Therefore, tests ran from the bezel diagnostic screen and the DTC generated from the test can be disregarded.
B1A89:01	Satellite Antenna: General Electrical Failure	GO to Pinpoint Test B .
B1A89:13	Satellite Antenna: Circuit Open	GO to Pinpoint Test B .
B1D19:49	Compact Disc Unit: Internal Electronic Failure	• CLEAR the DTC. • WAIT at least 30 seconds. • REPEAT the self-test. • If DTC B1D19:49 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AC .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0159:00	Lost Communication With Parking Assist Control Module "A": No Sub Type Information	GO to Pinpoint Test AF .
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	GO to Pinpoint Test AK .
U0255:00	Lost Communication With Front Display Interface Module: No Sub Type Information	GO to Pinpoint Test AL .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AM .
U2014:41	Control Module Hardware: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:41 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U2014:42	Control Module Hardware: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:42 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U2014:96	Control Module Hardware: Component Internal Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:96 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AN .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ao .

Accessory Protocol Interface Module (APIM) DTC Chart (If Equipped)

DTC	Description	Action
B1252:04	USB Port: System Internal Failure	GO to Pinpoint Test R .
B1252:11	USB Port: Circuit Short to Ground	GO to Pinpoint Test R .
B12B8:04	USB Port #2: System Internal Failure	**NOTE:** This DTC refers to USB port #2 on the APIM itself, which is not used. • INSPECT the APIM USB port #2 for damage and REMOVE any debris. • CLEAR the DTCs. • WAIT at least 10 seconds.

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		• REPEAT the self-test. • If DTC B12B8:04 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
B12B8:11	USB Port #2: Circuit Short To Ground	**NOTE:** This DTC refers to USB port #2 on the APIM itself, which is not used. • INSPECT the APIM USB port #2 for damage and REMOVE any debris. • CLEAR the DTCs. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B12B8:11 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
B1D79:01	Microphone Input: General Electrical Failure	GO to Pinpoint Test P .
B1D79:11	Microphone Input: Circuit Short To Ground	GO to Pinpoint Test P .
B1D79:12	Microphone Input: Circuit Short To Battery	GO to Pinpoint Test P .
B1D79:13	Microphone Input: Circuit Open	GO to Pinpoint Test P .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AC .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2101:00	Control Module Configuration Incompatible: No Sub	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module,

	Type Information	REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:04	Control Module: System Internal Failure	GO to Pinpoint Test M .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:88	Control Module: Bus Off	**NOTE:** Network communication/message DTCs can result from intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set these DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. The module was unable to communicate on the network at a point in time. The fault is not currently present. To avoid repeat network concerns: • INSPECT for damaged or corroded wiring at the APIM . • TEST the vehicle battery. REFER to Charging Systems in Section 414-00 . • CLEAR the DTC. • REPEAT the network test with the diagnostic scan tool.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AN .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ao .

FCIM DTC Chart

DTC	Description	Action
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AC .
U0184:00	Lost Communication	GO to Pinpoint Test AI .

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	With Radio: No Sub Type Information	
U2013:63	Switch Pack: Circuit / Component Protection Time-Out	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2013:63 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U2014:41	Control Module Hardware: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2014:41 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U2014:42	Control Module Hardware: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2014:42 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FCIM to correct the failure to retain configuration data. REFER to Front Controls Interface Module (FCIM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AN .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ao .

FDIM DTC Chart

DTC	Description	Action
B1318	Battery Voltage Low	GO to Pinpoint Test Z .
B1342	ECU is Faulted	**NOTE:** Repair all other DTCs before diagnosing DTC B1342. • CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B1342 is retrieved again, INSTALL a new Front Display Interface Module (FDIM). REFER to Front Display Interface Module (FDIM) .
B2477	Module Configuration Failure	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic

		scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FDIM to correct the failure to retain configuration data. REFER to Front Display Interface Module (FDIM) .
U0140	Lost Communication with Body Control Module (GEM)	GO to Pinpoint Test AB .
U0155	Lost Communication with Instrument Panel Cluster (IPC) Control Panel	GO to Pinpoint Test AD .
U0164	Lost Communication With HVAC Control Module (EATC)	GO to Pinpoint Test AG .
U0184	Lost Communication With Radio (ACM)	GO to Pinpoint Test AH .
U0197	Lost Communication with Telephone Control Module	GO to Pinpoint Test AJ .
U2050	No Application Present	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FDIM to correct the failure to retain configuration data. REFER to Front Display Interface Module (FDIM) .
U2051	One or More Calibration Files Missing / Corrupt	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FDIM to correct the failure to retain configuration data. REFER to Front Display Interface Module (FDIM) .

Global Positioning System Module (GPSM) DTC Chart

DTC	Description	Action
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	GO to Pinpoint Test AA .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information: No	GO to Pinpoint Test AC .

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	Sub Type Information	
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0401:00	Invalid Data Received from ECM/PCM A: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the PCM . REFER to Section 303-14 .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the BCM . REFER to Section 419-10 .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U3000:09	Control Module: Component Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, PERFORM a battery reset by disconnecting the battery for 1 minute, then reconnecting it. • CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global

		Positioning System Module (GPSM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AN .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ao .

IPC DTC Chart

DTC	Description	Action
U0462:82	Invalid Data Received from Compass Module: Alive/Sequence Counter Incorrect/Not Updated	GO to Pinpoint Test X .
All other DTCs	—	REFER to Section 413-01 .

SCCM DTC Chart

DTC	Description	Action
B1380:09	Steering Wheel Right Switch Pack: Component Failure	GO to Pinpoint Test T .
B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	GO to Pinpoint Test T .
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	GO to Pinpoint Test T .
All other DTCs	—	REFER to Section 211-05 .

Symptom Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Symptom Chart — General Audio System

Condition	Possible Sources	Action
• A module does not respond to the diagnostic scan tool	• Fuse • Wiring, terminals, or connectors	• REFER to Section 418-00 .

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	• Module	
• The RH steering wheel controls are inoperative or do not operate correctly (if equipped)	• Refer to the Pinpoint Test	• GO to Pinpoint Test T .
• The CD player is inoperative or does not operate correctly	• CD • ACM	• INSPECT the CD for scratches, fingerprints, a loose paper label, incorrect format, or damage. INSERT a known good CD and TEST the system. If the system operates correctly, the concern was caused by a damaged CD. If the system does not operate correctly, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
• The speed compensated volume does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test C .
• The compass is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test X .
• The compass is inaccurate	• Refer to the Pinpoint Test	• GO to Pinpoint Test Y .
• The FCIM illumination is inoperative or does not dim	• Illumination system concern • FCIM	• REFER to Section 413-00 .
• The audio system does not operate correctly from the FCIM	• Refer to the Pinpoint Test	• GO to Pinpoint Test U .
• The audio input jack is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test Q .
• The FDIM is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test V .
• One or more FDIM displays are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test W .
• The FDIM illumination is inoperative or does not dim	• Illumination system concern • FDIM	• REFER to Section 413-00 .

Symptom Chart — Satellite Radio (If Equipped)

Condition	Possible Sources	Action
• Poor reception — satellite radio	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.
• Poor sound quality or no sound while in satellite radio mode - all other functions operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.
• The satellite radio is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.

Symptom Chart — Sound Quality

Condition	Possible Sources	Action
• Poor reception — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A.
• Continuous seek or scan — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A.
• Poor sound quality or distorted sound from one or more speakers (not all speakers)	• Refer to the Pinpoint Test	• GO to Pinpoint Test D.
• No sound from all speakers	• Refer to the Pinpoint Test	• GO to Pinpoint Test E.
• The LF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test F.
• The LF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test G.
• The RF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test H.
• The RF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test I.
• The RR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test J.
• The LR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test K.

Symptom Chart — SYNC® System (If Equipped)

Condition	Possible Sources	Action
• All SYNC® functions are inoperative or	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset. If the concern is still

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do not operate correctly		present, GO to Pinpoint Test M .
• All SYNC® Services features are inoperative or inaccurate	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test O .
• The SYNC® system audible prompts are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test N .
• During a phone call, no incoming audio is heard in the vehicle	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test N .
• Voice recognition is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test P .
• During a phone call, poor quality or no outgoing audio is heard on the outside device	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test P .
• Poor quality, distorted, or no sound while in SYNC® mode	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test L .
• The RH SYNC® steering wheel controls are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test T .
• The audio input jack is inoperative or does not operate correctly (with SYNC®)	• Refer to the Pinpoint Test	• PERFORM the Accessory Protocol Interface Module (APIM) Reset. REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test Q .
• The USB port is inoperative or does not	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still

operate correctly		present, GO to Pinpoint Test R .
• Unable to pair Bluetooth device	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test S .
• An individual Bluetooth device feature is inoperative (text messaging, media playback or controls, phone book download, call history, or call waiting)	• Customer's device compatibility	• PERFORM the Accessory Protocol Interface Module (APIM) Reset. REFER to Accessory Protocol Interface Module (APIM) Reset . • If the concern is still present, INSTRUCT the customer to review the device compatibility list on the SyncMyRide website. It is normal operation for unsupported or incompatible Bluetooth features to be unavailable through the SYNC® system. • If the inoperative feature is compatible, ADVISE the customer to check their device for firmware updates, and if required, reset their device following the manufacturer's instructions.
• SYNC® AppLink™ is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the Accessory Protocol Interface Module (APIM) Reset. REFER to Accessory Protocol Interface Module (APIM) Reset . • If the concern is still present, INSTRUCT the customer to review the mobile device platform, application, and application version compatibility list on the SyncMyRide website. It is normal operation for incompatible mobile device platforms, applications, and application versions to be unavailable through SYNC® AppLink™. • If the mobile device platform, application, and application version are compatible, and the device is connected through Bluetooth only, GO to Pinpoint Test S . • If the mobile device platform, application, and application version are compatible, and the device is connected through Bluetooth and the USB port, GO to Pinpoint Test R
• An individual Bluetooth device feature is inoperative	• Customer's device compatibility	• **NOTE:** If a Bluetooth device is able to pair with the SYNC® system, there are no concerns with the APIM . INSTRUCT the customer to review the device compatibility list on the the SyncMyRide website. Not all phone features are available through the SYNC® system. This is normal operation.
• Unable to pair Bluetooth	• Refer to the Pinpoint Test	• GO to Pinpoint Test S .

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device or the Bluetooth functionality is inoperative		
• SYNC® AppLink™ is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• **NOTE:** NOTE: SYNC® AppLink™ is compatible with select smartphones and select applications. INSTRUCT the customer to review the device compatibility list. REFER to the SyncMyRide website. If SYNC® AppLink™ is inoperative through Bluetooth, GO to Pinpoint Test S . • If SYNC® AppLink™ is inoperative from the USB port, GO to Pinpoint Test R .
• 911 Assist™ or Vehicle Health Report (VHR) is inoperative or does not operate correctly	• Unregistered SYNC® owner account • RCM misconfiguration • IPC misconfiguration	• Verify that the customer has a SYNC® Owner Account on the SyncMyRide website. • This error message appears due to incomplete or incorrect PMI procedures. CHECK the vehicle service history for recent service actions related to the IPC or RCM . ▪ If there have been recent service actions with the IPC or RCM , REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. REFER to Programmable Module Installation (PMI) in Section 418-01 . ▪ If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Pinpoint Tests

Pinpoint Test A: Poor Reception Or Continuous Seek Or Scan — AM/FM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to AM/FM Radio, ACM , and Antenna in Information and Entertainment System .

Possible Sources

- AM/FM antenna
- AM/FM antenna coaxial cable
- Charging system
- Ignition system
- No channel found in the selected category
- Noise suppression equipment
- Wiring, terminals, or connectors
- ACM

PINPOINT TEST A: POOR RECEPTION OR CONTINUOUS SEEK OR SCAN — AM/FM

Test Step	Result / Action to Take
A1 CHECK THE AUDIO SYSTEM RECEPTION • Operate the audio system in radio tuner AM/FM mode. • Check the reception with the engine running, and with the engine off. • **Does the poor reception only occur with the engine running?**	**Yes** GO to A2 . **No** GO to A4 .
A2 CHECK THE GENERATOR • Ignition OFF. • Disconnect: Wiring harness to the generator voltage regulator. • Start the engine. • Operate the audio system in radio tuner AM/FM mode. • **Is the reception OK?**	**Yes** INSTALL a new generator. REFER to Section 414-00 . **No** GO to A3 .
A3 CHECK THE IGNITION CIRCUITS • Ignition OFF. • Connect: Wiring harness to the generator voltage regulator. • Visually inspect the engine compartment and make sure all ignition coils are correctly and securely connected, and that there are no visible cracks in the coil housings. • Inspect all the wiring harnesses and connectors for damaged insulation and loose or broken conditions. • **Are the ignition components OK?**	**Yes** USE a jumper cable to ground various parts of the vehicle to the frame (for example: engine, fenders, quarter panels, stone deflectors, air cleaner, body sheet metal). When the noise is eliminated, PROVIDE a permanent ground where necessary. **No** REPAIR the ignition system as necessary.
A4 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: AM/FM antenna coaxial cable at the ACM . Refer to Audio Control Module (ACM) . • Disconnect: AM/FM antenna inline coaxial cable connection behind the glove compartment. Refer to	**Yes** REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

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Antenna Cable — AM/FM .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

No
GO to A5 .

A5 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A6 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A6 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM coaxial cable core at the ACM	—	Lower AM/FM antenna coaxial cable core at the inline connection	—
AM/FM antenna coaxial cable shield at the ACM	—	Lower AM/FM antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to A7 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A7 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
GO to A8 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER

AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

to Antenna Cable — AM/FM .

A8 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: AM/FM antenna coaxial cable at the antenna unit. Refer to Antenna — AM/FM .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

No
GO to A9 .

A9 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A10 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A10 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable core at the antenna unit (harness side)	—
AM/FM antenna		AM/FM antenna coaxial cable shield	—

Yes
GO to A11 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

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coaxial cable shield at the ACM	—	at the antenna unit (harness side)	

- **Is the resistance less than 1 ohm?**

A11 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A12 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A12 CHECK THE AM/FM ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

No
GO to A13 .

A13 CHECK THE AM/FM ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A14 .

No
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

A14 CHECK THE AM/FM ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Yes

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>AM/FM antenna coaxial cable core at the ACM</td><td>—</td><td>AM/FM antenna coaxial cable shield at the ACM</td><td>—</td></tr></table> • **Is the resistance greater than 10,000 ohms?**	GO to A15 . **No** INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .
A15 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND • Disconnect: AM/FM antenna coaxial cable at the antenna unit. • Measure the **resistance** between: <table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>AM/FM antenna unit shield at the antenna unit (component side)</td><td>—</td><td>—</td><td>Ground</td></tr></table> • **Is the resistance less than 1 ohm?**	**Yes** GO to A17 . **No** GO to A16 .
A16 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE • Remove the AM/FM antenna. Refer to Antenna — AM/FM . • Measure the **resistance** between: <table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>AM/FM antenna unit shield at the antenna unit (component side)</td><td>—</td><td>AM/FM antenna base (unpainted surface)</td><td>—</td></tr></table> • **Is the resistance less than 1 ohm?**	**Yes** GO to A17 . **No** INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

A17 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any

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	connector or pin issues.

Pinpoint Test B: The Satellite Radio Is Inoperative, Has Poor Reception, Or Has No Sound

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to MyKey® and Satellite Radio in Information and Entertainment System .

When a satellite radio subscription is activated, the satellite receiver ESN is associated with the VIN .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A89:01	Satellite Antenna: General Electrical Failure	Set by the ACM when a short to ground is detected in the satellite antenna circuit for more than 250 milliseconds. This DTC can be either continuous or on-demand.
B1A89:13	Satellite Antenna: Circuit Open	Set by the ACM when an open is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.

Possible Sources

- Expired subscription
- Incorrectly matched ESN
- Wiring, terminals, or connectors
- Obstructions in the antenna's line of sight
- Satellite radio antenna
- Satellite radio antenna coaxial cable
- ACM

PINPOINT TEST B: THE SATELLITE RADIO IS INOPERATIVE, HAS POOR RECEPTION, OR HAS NO SOUND

Test Step	Result / Action to Take
B1 VERIFY AN ACTIVE SUBSCRIPTION	
• Operate the infotainment system in satellite radio mode and observe the infotainment display. • **Does the display indicate that the subscription has expired?**	**Yes** The subscription has expired. INFORM the customer to contact SIRIUS to reactivate the subscription. **No**

	GO to B2 .
B2 CHECK THE RECEPTION • Drive the vehicle to an open location that is free from obstacles such as tall buildings or large trees. • Using a diagnostic scan tool, view the ACM PIDs. • Monitor the satellite signal strength (SAT_SIG_STR) PID. • If the PID reads "No Signal" or "Poor," move the vehicle to another area and retest until "Good," "Very Good," or "Excellent" PID values are obtained. • **Can a "Good," "Very Good," or "Excellent" PID value be obtained?**	**Yes** GO to B3 . **No** GO to B6 .
B3 CHECK THE SATELLITE RADIO SYSTEM FOR CORRECT OPERATION • Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of obstructions in the antenna's line of sight. **No** GO to B4 .
B4 CHECK FOR PROMOTIONAL CHANNEL 184 • Select channel 184. • **Does the satellite radio system receive channel 184 with normal sound quality?**	**Yes** GO to B5 . **No** GO to B6 .
B5 VERIFY THAT THE VIN AND ESN ON FILE MATCH THE VIN AND ESN FROM THE VEHICLE • Retrieve the satellite radio ESN . Satellite Radio Electronic Serial Number (ESN) Retrieval . • Contact the SIRIUS Dealer Support Line (888-465-8528). • Ensure that the VIN and ESN SIRIUS has on the customer's file match the VIN and ESN retrieved from the vehicle. • Follow the actions from step 2 to obtain "Good," "Very Good," or "Excellent" reception. • Operate the infotainment system in satellite radio mode. • **NOTE:** It may take up to 30 minutes for the activation signal to be received and satellite radio functions to operate. • Request for SIRIUS to send the activation signal to the vehicle 2-3 times. • Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of the activation signal needing to be resent or the VIN and ESN SIRIUS had on file not matching the VIN and ESN from the vehicle. **No** GO to B6 .
B6 CHECK FOR ACM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the ACM DTCs. • Using a diagnostic scan tool, perform the ACM self-	**Yes** For DTC B1A89:01 or DTC B1A89:13, GO to B7 . For all other ACM DTCs,

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test.

- **Are any DTCs recorded in the ACM ?**

REFER to the ACM DTC chart in Information and Entertainment System .

No
GO to B20 .

B7 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Satellite radio antenna coaxial cable at the ACM . Refer to Audio Control Module (ACM) .
- Disconnect: Satellite radio antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to B8 .

B8 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B9 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B9 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio coaxial cable core at the	—	Lower satellite radio antenna coaxial cable core at the	—

Yes
GO to B10 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

ACM		inline connection	
Satellite radio antenna coaxial cable shield at the ACM	—	Lower satellite radio antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

B10 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B11 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B11 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: Satellite radio antenna coaxial cable at the antenna unit. Refer to Antenna — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to B12 .

B12 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	

Yes
GO to B13 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite

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Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Radio .

B13 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable core at the antenna unit (harness side)	—
Satellite radio antenna coaxial cable shield at the ACM	—	Satellite radio antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B14 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B14 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B15 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B15 CHECK THE SATELLITE RADIO ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna		—	Ground

Yes
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

No
GO to B16 .

coaxial cable core at the ACM	—		
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

B16 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B17 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

B17 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B18 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

B18 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: Satellite radio antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

Yes
GO to B20 .

No
GO to B19 .

B19 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE

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<table>
<tr>
<td>

Remove the satellite radio antenna. Refer to Antenna — Satellite Radio .
Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>Satellite radio antenna unit shield at the antenna unit (component side)</td><td>—</td><td>Satellite radio antenna base (unpainted surface)</td><td>—</td></tr>
</table>

Is the resistance less than 1 ohm?

</td>
<td>Yes
GO to B20 .

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .</td>
</tr>
<tr><td>B20 CHECK FOR CORRECT ACM OPERATION</td><td></td></tr>
<tr>
<td>

Ignition OFF.
Disconnect and inspect all the ACM connectors.
Repair:

Corrosion (clean module pins or install new connectors or terminals)
Damaged or bent pins (install new terminals or pins)
Pushed-out pins (install new pins as necessary)

Reconnect the ACM connectors. Make sure they seat and latch correctly.
Operate the system and determine if the concern is still present.
Is the concern still present?

</td>
<td>Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.</td>
</tr>
</table>

Pinpoint Test C: The Speed Compensated Volume Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Speed Compensated Volume in Information and Entertainment System .

Possible Sources

- Speed compensated volume setting
- VSS signal concern
- Network communication concern
- ACM

PINPOINT TEST C: THE SPEED COMPENSATED VOLUME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take

C1 CHECK THE SPEEDOMETER OPERATION • Drive the vehicle and observe the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to C2. **No** REFER to Section 413-01.
C2 CHECK THE SPEED COMPENSATED VOLUME SETTING • Turn the speed compensated volume off. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • Set the speed compensated volume to maximum compensation. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • **Does the volume remain constant with the speed compensated volume turned off, and increase and decrease with vehicle speed with the speed compensated volume set to maximum?**	**Yes** The system is operating correctly at this time. INSTRUCT the customer in the correct usage of the speed compensated volume feature. **No** GO to C3.
C3 CHECK FOR DTC U0155:00 • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0155:00 retrieved in any audio system module?**	**Yes** GO to Pinpoint Test AC. **No** GO to C4.

C4 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All Speakers)

Diagnostic Overview

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Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

The ACM sends audio signals to the speakers in the form of AC voltage, resulting in clear audio output.

Possible Sources

- Loose component fasteners
- Loose door handle, lock, and other trim panel components and fasteners
- Loose items in storage areas
- Loose speaker grilles
- Loose wire harnesses or wire harness fasteners
- Speaker(s)
- Water shield bonding and placement

Visual Inspection and Diagnostic Pre-checks

Visually inspect around the suspect area for any possible rattle conditions such as:

- Any storage compartments including cup holders (if equipped)
- Door map pockets for contents that can rattle (if equipped)
- Door pull cup attachments (if equipped)
- Door switch bezels (if equipped)
- Package tray (if equipped)
- Speaker grilles
- Trim panels and fasteners

PINPOINT TEST D: POOR SOUND QUALITY OR DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take
D1 ISOLATE THE ZONE • Operate the audio system using digital media (CD, MP3, etc.). • Using the audio system fade and balance feature, adjust the audio sound to each of the four zones (LF , RF , LR , and RR) of the vehicle to isolate the poor sound quality. • Locate and apply pressure to the trim panel(s) around the poor sound quality area in question. • **Does applying pressure to a trim panel reduce or eliminate the audible noise?**	**Yes** REPAIR or REPLACE the trim panel as needed. **No** GO to D2 .
D2 REMOVE AND INSPECT BEHIND/UNDERNEATH THE SUSPECT TRIM PANEL(S) • Remove the trim panel to access the suspect speaker. • Operate the audio system using digital media (CD, MP3, etc.). • Validate where the poor sound quality area is located. • Check:	**Yes** REPAIR or REPLACE any loose or broken component or fastener as needed.

▪ Trim panel for loose components around the speaker area such as the speaker grille ▪ Trim panel joining components for missing or broken pieces ▪ Lock and handle mechanical parts for correct attachment ▪ Wire harnesses for correct routing ▪ Wire harness fasteners for correct attachment ▪ Water shield for correct placement (speaker air path not blocked) ▪ Water shield for correct bonding to sheet metal ▪ Storage areas for loose items ▪ All child safety belt anchors (if equipped) ▪ All safety belt retractors ▪ All speaker bracket fasteners and other fasteners are secured and tightened to specified torque • **Was the source of the noise located?**	**No** GO to D3 .
D3 CHECK THE SUSPECT SPEAKER FOR WATER INTRUSION	
• Inspect for watermarks. • Check the: ▪ Cone ▪ Magnet ▪ Basket • **Are any watermarks present on the speaker?**	**Yes** VERIFY the water shield is in the correct location, REPAIR or REPLACE any trim, door, or speaker seal as required. DRY the speaker in question and TEST the system for normal operation. **No** GO to D4 .
D4 ISOLATE SPEAKER TO VERIFY NOISE	
• Remove the suspect speaker from its location and leave the speaker connected to the harness. • Hold the speaker away from any trim panel(s) and ensure the speaker is isolated from contact. • Operate the audio system using digital media (CD, MP3, etc.). • **Is the noise still present in the suspect speaker?**	**Yes** INSTALL a new speaker for the one in question. **No** LOCATE the source of the noise and REPAIR as needed.

Pinpoint Test E: No Sound From All Speakers

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

When the ignition is in the START position, the ACM receives voltage on the START signal circuit and mutes

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the speaker output. This prevents voltage spikes from producing popping noises through the speakers. A short to voltage on this circuit causes the ACM output to be muted continuously.

A short to ground or short to voltage in the circuitry to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the ACM . In this case, a speaker fault DTC sets.

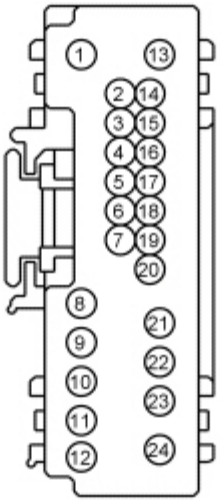
Possible Sources

- Wiring, terminals, or connectors
- ACM

PINPOINT TEST E: NO SOUND FROM ALL SPEAKERS

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>E1 CHECK FOR SPEAKER DTCS</td><td rowspan="2">Yes
REFER to the ACM DTC chart in Information and Entertainment System .

No
GO to E2 .</td></tr>
<tr><td>• Ignition ON.
• Using a diagnostic scan tool, perform the ACM self-test.
• Are any speaker fault Diagnostic Trouble Codes (DTCs) present?</td></tr>
<tr><td>E2 CHECK THE START SENSE CIRCUIT FOR A SHORT TO VOLTAGE</td><td rowspan="2">Yes
REPAIR the circuit. TEST the system for normal operation.

No
GO to E3 .</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: ACM C290A .
• Ignition ON.
• Measure the voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C290A-15</td><td>CDC54 (WH/GN)</td><td>—</td><td>Ground</td></tr></table>• Is the voltage 5V or greater?</td></tr>
</table>

E3 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test F: The LF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System.

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the ACM when a failure is detected on the LF door or tweeter speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LF door or tweeter speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.
B1A01:12	Speaker #1: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LF door or tweeter speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the ACM when an open is detected on the LF door or tweeter speaker circuits.

Possible Sources

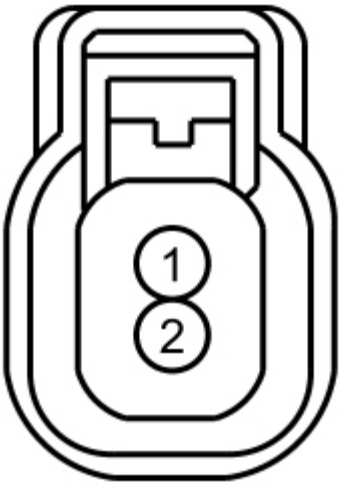
- Wiring, terminals, or connectors
- Speaker
- ACM

repair4less

PINPOINT TEST F: THE LF DOOR SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>F1 CHECK THE AUDIO SIGNAL TO THE LF DOOR SPEAKER

• Ignition OFF.
• Disconnect: LF Door Speaker C523 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>C523-2</td><td>RME07 (WH/BN)</td></tr></table>


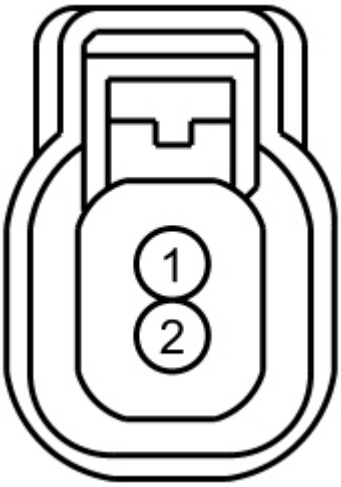
• Is a fluctuating AC voltage present?</td><td>Yes
INSTALL a new LF door speaker. REFER to Speaker — Door .

No
GO to F2 .</td></tr>
<tr><td>F2 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO VOLTAGE

• Ignition OFF.
• Disconnect: ACM C290A .
• Ignition ON.
• Measure the voltage between:

<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>—</td><td>Ground</td></tr><tr><td>C523-2</td><td>RME07 (WH/BN)</td><td>—</td><td>Ground</td></tr></table></td><td>Yes
REPAIR the circuit in question.

No
GO to F3 .</td></tr>
</table>

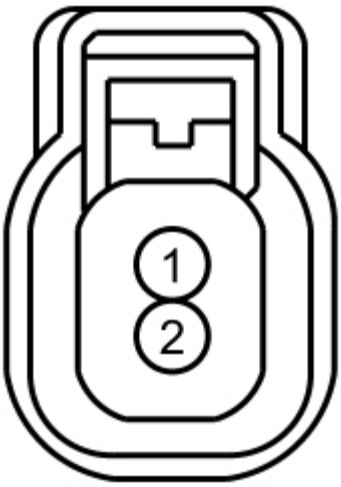


- **Is any voltage present?**

F3 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: LF Tweeter Speaker C230 .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to F4 .

No
REPAIR the circuit in question.

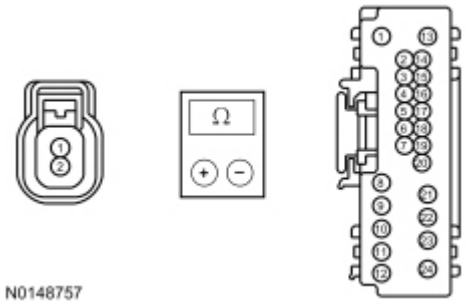
F4 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Yes
GO to F5 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C290A-8	VME07 (WH)
C523-2	RME07 (WH/BN)	C290A-21	RME07 (WH/BN)



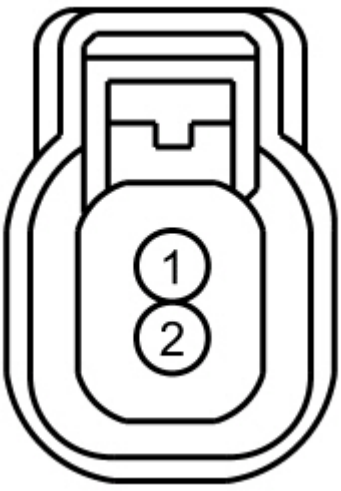
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

F5 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C523-2	RME07 (WH/BN)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to F6 .

No
REPAIR the circuit in question.

F6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test G: The LF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

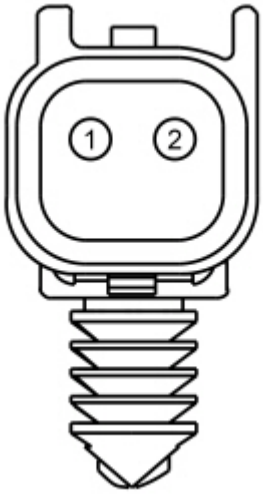
Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the ACM when a failure is detected on the LF door or tweeter speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LF door or tweeter speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.
B1A01:12	Speaker #1: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LF door or tweeter speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the ACM when an open is detected on the LF door or tweeter speaker circuits.

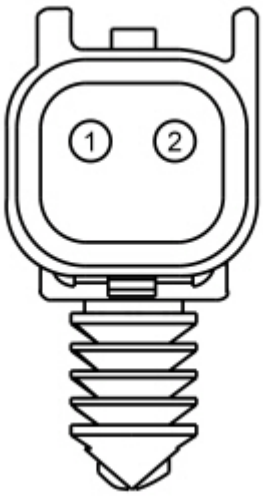
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

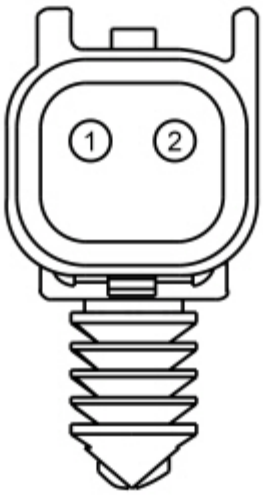
PINPOINT TEST G: THE LF TWEETER SPEAKER IS INOPERATIVE

repair4less

Test Step	Result / Action to Take
G1 CHECK THE AUDIO SIGNAL TO THE LF TWEETER SPEAKER • Ignition OFF. • Disconnect: LF Tweeter Speaker C230 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C230-1, Circuit VME07 (WH) Negative Lead: Pin C230-2, Circuit RME07 (WH/BN)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new LF tweeter speaker. REFER to Speaker — A-Pillar . **No** GO to G2 .
G2 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C290A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C230-1, Circuit VME07 (WH) Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C230-2, Circuit RME07 (WH/BN) Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to G3 .

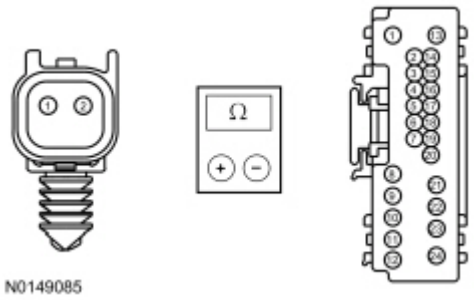


- **Is any voltage present?**

G3 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: LF Door Speaker C523 . • Measure the **resistance** between: Positive Lead: C230-1 VME07 (WH); C230-2 RME07 (WH/BN) Negative Lead: — Ground  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to G4 . **No** REPAIR the circuit in question.
G4 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR AN OPEN	
• Measure the **resistance** between:	**Yes** GO to G5 .

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME07 (WH)	C290A-8	VME07 (WH)
C230-2	RME07 (WH/BN)	C290A-21	RME07 (WH/BN)



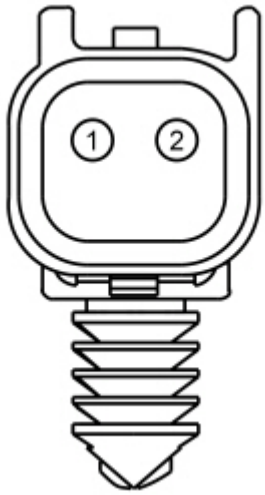
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

G5 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME07 (WH)	C230-2	RME07 (WH/BN)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to G6 .

No
REPAIR the circuit in question.

G6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test H: The RF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System.

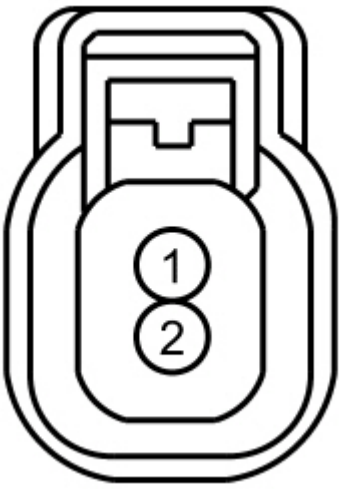
Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the ACM when a failure is detected on the RF door or tweeter speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RF door or tweeter speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RF door or tweeter speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the ACM when an open is detected on the RF door or tweeter speaker circuits.

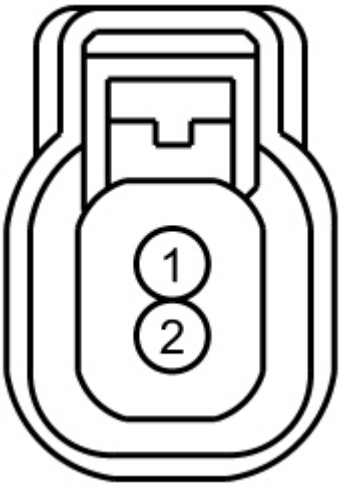
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST H: THE RF DOOR SPEAKER IS INOPERATIVE

repair4less

Test Step	Result / Action to Take
H1 CHECK THE AUDIO SIGNAL TO THE RF DOOR SPEAKER • Ignition OFF. • Disconnect: RF Door Speaker C612 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C612-1, Circuit VME10 (WH/VT); Negative Lead: Pin C612-2, Circuit RME10 (WH/OG)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new RF door speaker. REFER to Speaker — Door . **No** GO to H2 .
H2 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C290A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C612-1, Circuit VME10 (WH/VT); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C612-2, Circuit RME10 (WH/OG); Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to H3 .

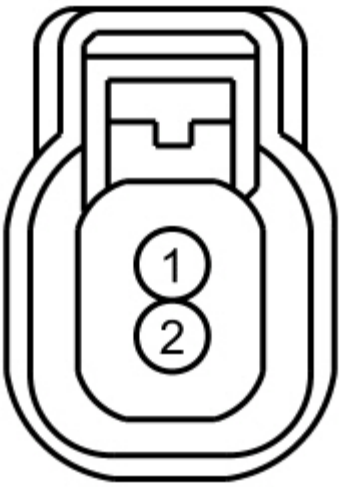


- **Is any voltage present?**

H3 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: RF Door Speaker C231 .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to H4 .

No
REPAIR the circuit in question.

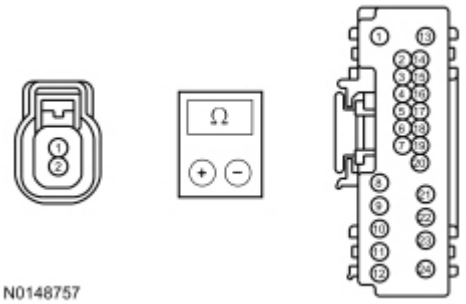
H4 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Yes
GO to H5 .

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C290A-11	VME10 (WH/VT)
C612-2	RME10 (WH/OG)	C290A-12	RME10 (WH/OG)



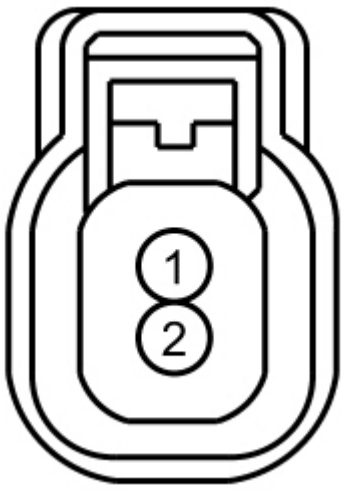
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

H5 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C612-2	RME10 (WH/OG)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to H6 .

No
REPAIR the circuit in question.

H6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test I: The RF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the ACM when a failure is detected on the RF door or tweeter speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RF door or tweeter speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RF door or tweeter speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the ACM when an open is detected on the RF door or tweeter speaker circuits.

Possible Sources

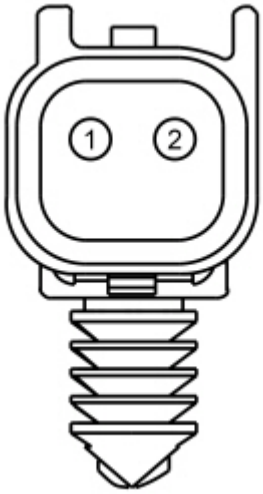
- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST I: THE RF TWEETER SPEAKER IS INOPERATIVE

repair4less

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CHECK THE AUDIO SIGNAL TO THE RF TWEETER SPEAKER

• Ignition OFF.
• Disconnect: RF Tweeter Speaker C231 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C231-1</td><td>VME10 (WH/VT)</td><td>C231-2</td><td>RME10 (WH/OG)</td></tr></table>


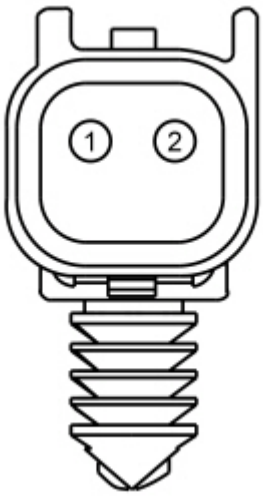
• Is a fluctuating AC voltage present?</td><td>Yes
INSTALL a new RF tweeter speaker.
REFER to Speaker — A-Pillar .

No
GO to I2 .</td></tr>
<tr><td>I2 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO VOLTAGE

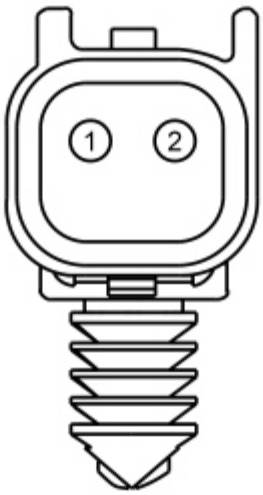
• Ignition OFF.
• Disconnect: ACM C290A .
• Ignition ON.
• Measure the voltage between:

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C231-1</td><td>VME10 (WH/VT)</td><td>—</td><td>Ground</td></tr><tr><td>C231-2</td><td>RME10 (WH/OG)</td><td>—</td><td>Ground</td></tr></table></td><td>Yes
REPAIR the circuit in question.

No
GO to I3 .</td></tr>
</table>

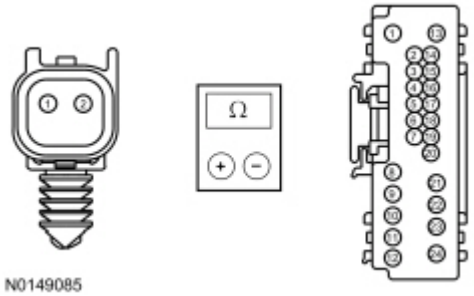


- **Is any voltage present?**

I3 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: RF Door Speaker C612 . • Measure the **resistance** between: Positive Lead: Pin C231-1, Circuit VME10 (WH/VT); Pin C231-2, Circuit RME10 (WH/OG) Negative Lead: Pin —, Circuit Ground; Pin —, Circuit Ground  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I4 . **No** REPAIR the circuit in question.
I4 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR AN OPEN	
• Measure the **resistance** between:	**Yes** GO to I5 .

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	C290A-11	VME10 (WH/VT)
C231-2	RME10 (WH/OG)	C290A-12	RME10 (WH/OG)



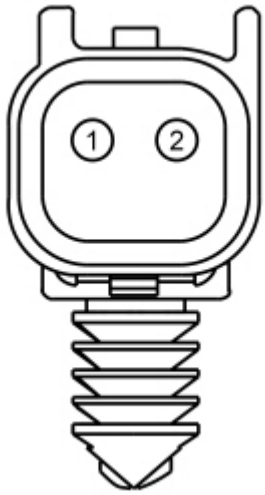
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

I5 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	C231-2	RME10 (WH/OG)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to I6 .

No
REPAIR the circuit in question.

I6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBsTSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test J: The RR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System.

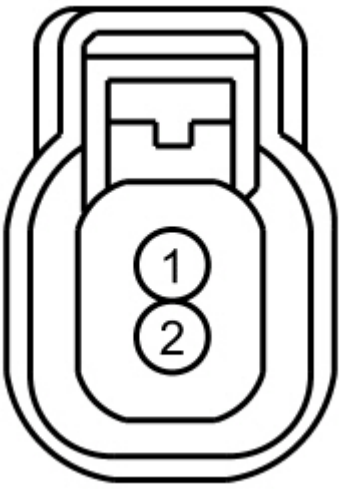
Root DTC Description	Failure Types	Fault Trigger Conditions
B1A03:01	Speaker #3: General Electrical Failure	Set by the ACM when a failure is detected on the RR door speaker circuits.
B1A03:11	Speaker #3: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RR door speaker circuits. When DTC B1A03:11 is set, the speaker output is disabled.
B1A03:12	Speaker #3: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RR door speaker circuits. When DTC B1A03:12 is set, the speaker output is disabled.
B1A03:13	Speaker #3: Circuit Open	Set by the ACM when an open is detected on the RR door speaker circuits.

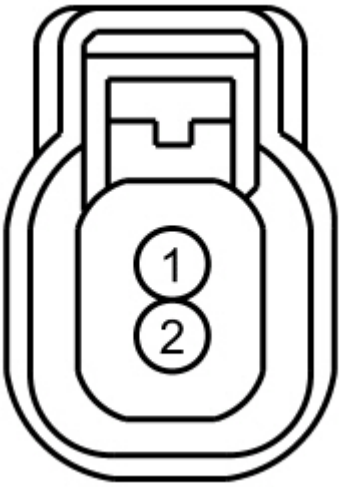
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST J: THE RR DOOR SPEAKER IS INOPERATIVE

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Test Step	Result / Action to Take
J1 CHECK THE AUDIO SIGNAL TO THE RR DOOR SPEAKER • Ignition OFF. • Disconnect: RR Door Speaker C802 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C802-1, Circuit VME12 (BN/WH); Negative Lead: Pin C802-2, Circuit RME12 (BN/BU)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new RR door speaker. REFER to Speaker — Door . **No** GO to J2 .
J2 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C290A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C802-1, Circuit VME12 (BN/WH); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C802-2, Circuit RME12 (BN/BU); Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to J3 .

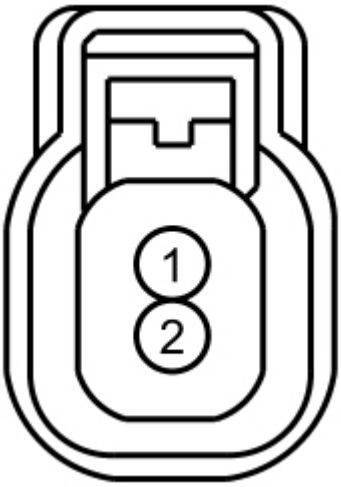


- **Is any voltage present?**

J3 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to J4 .

No
REPAIR the circuit in question.

J4 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

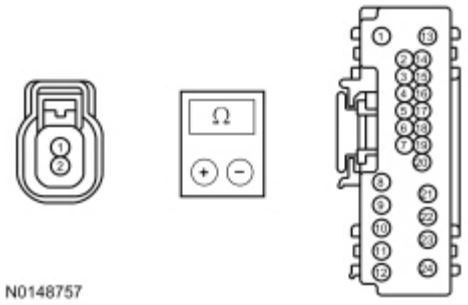
Positive Lead	Negative Lead

Yes
GO to J5 .

No

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Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C290A-10	VME12 (BN/WH)
C802-2	RME12 (BN/BU)	C290A-23	RME12 (BN/BU)



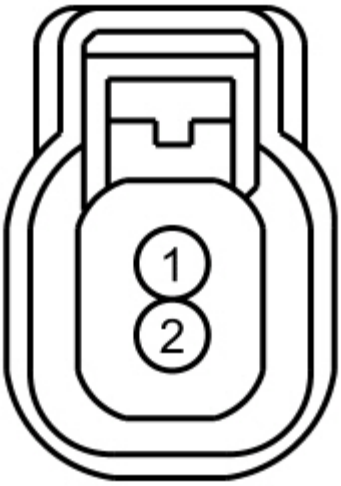
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

J5 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C802-2	RME12 (BN/BU)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to J6 .

No
REPAIR the circuit in question.

J6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.

Yes
CHECK OASIS for any applicable TSBs. If a

• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test K: The LR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A04:01	Speaker #4: General Electrical Failure	Set by the ACM when a failure is detected on the LR door speaker circuits.
B1A04:11	Speaker #4: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LR door speaker circuits. When DTC B1A04:11 is set, the speaker output is disabled.
B1A04:12	Speaker #4: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LR door speaker circuits. When DTC B1A04:12 is set, the speaker output is disabled.
B1A04:13	Speaker #4: Circuit Open	Set by the ACM when an open is detected on the LR door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST K: THE LR DOOR SPEAKER IS INOPERATIVE

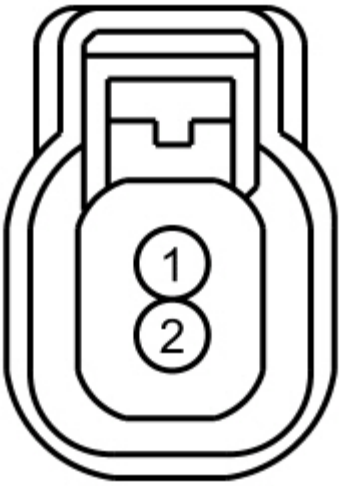
Test Step	Result / Action to Take

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K1 CHECK THE AUDIO SIGNAL TO THE LR DOOR SPEAKER

- Ignition OFF.
- Disconnect: LR Door Speaker C702 .
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C702-2	RME09 (BN/YE)



- **Is a fluctuating AC voltage present?**

Yes
INSTALL a new LR door speaker. REFER to Speaker — Door .

No
GO to K2 .

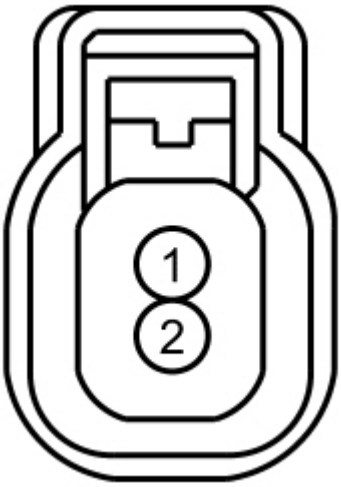
K2 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C290A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to K3 .

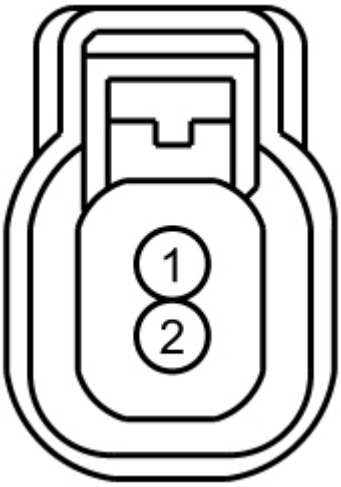


- **Is any voltage present?**

K3 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K4 .

No
REPAIR the circuit in question.

K4 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

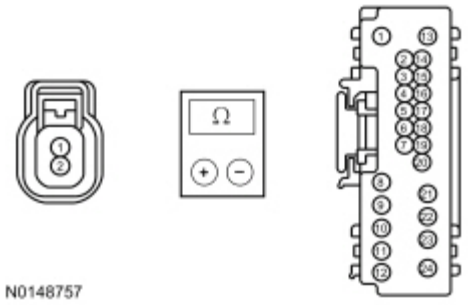
Positive Lead	Negative Lead

Yes
GO to K5 .

No

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Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C290A-9	VME09 (WH/GN)
C702-2	RME09 (BN/YE)	C290A-22	RME09 (BN/YE)



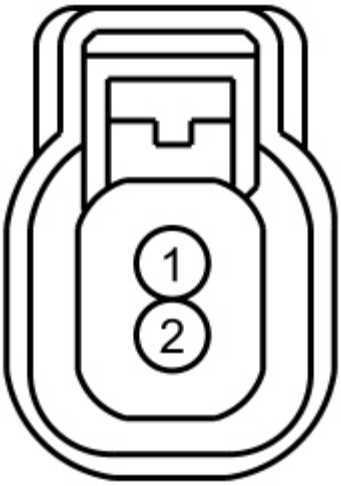
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

K5 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C702-2	RME09 (BN/YE)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K6.

No
REPAIR the circuit in question.

K6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.

Yes
CHECK OASIS for any applicable TSBs. If a

• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test L: No Sound From All SYNC® Audio Sources (Bluetooth, USB , Audio Input Jack)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System in Information and Entertainment System .

The APIM transmits left and right channel analog audio signals to the ACM . These signals include inputs from the USB port, audio input jack, and Bluetooth media device. If a USB mass storage device is used to play an audio file, the SYNC® system only plays audio files that do not have DRM protection.

Possible Sources

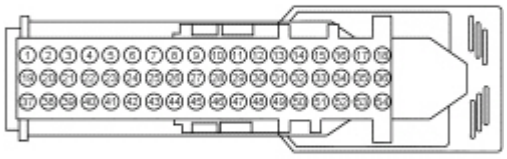
- Customer's device
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST L: NO SOUND FROM ALL SYNC® AUDIO SOURCES (BLUETOOTH, USB , AUDIO INPUT JACK)

Test Step	Result / Action to Take
L1 VERIFY THE OPERATION OF THE SYNC® SYSTEM AUDIO SOURCES	
• Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, test the audio output for the audio input jack, USB port, and Bluetooth. • **Is there poor quality, distorted, or no sound from all SYNC® audio sources?**	**Yes** GO to L2 . **No** If there is a concern with one or more, but not all audio sources, GO to Symptom Chart - SYNC® System to diagnose the observed symptom.

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	If all audio sources operate correctly, the concern is with the customer's device.
L2 CHECK THE AUDIO SIGNALS TO THE ACM ***NOTICE:*** **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.** • Operate the audio system in SYNC® mode and play an audio file. • Measure the **AC voltage** by back-probing ACM connector C290B: Positive Lead: Pin C290B-1, Circuit VME52 (BU); Negative Lead: Pin C290B-2, Circuit RME52 (GY/OG) Positive Lead: Pin C290B-9, Circuit VME53 (VT/GN); Negative Lead: Pin C290B-10, Circuit RME53 (BN/WH) • **Is a fluctuating AC voltage present?**	**Yes** GO to L7 . **No** GO to L3 .
L3 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C290B . • Disconnect: APIM C2383 . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C2383-23, Circuit VME53 (VT/GN); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C2383-24, Circuit RME53 (BN/WH); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C2383-25, Circuit VME52 (BU); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C2383-26, Circuit RME52 (GY/OG); Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to L4 .

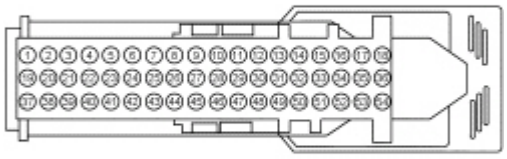


- **Is any voltage present?**

L4 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME53 (VT/GN)	—	Ground
C2383-24	RME53 (BN/WH)	—	Ground
C2383-25	VME52 (BU)	—	Ground
C2383-26	RME52 (GY/OG)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to L5 .

No
REPAIR the circuit in question.

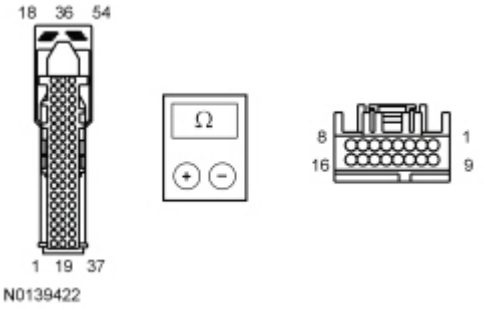
L5 CHECK THE CIRCUITS TO THE ACM FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to L6 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME53 (VT/GN)	C290B-9	VME53 (VT/GN)
C2383-24	RME53 (BN/WH)	C290B-10	RME53 (BN/WH)
C2383-25	VME52 (BU)	C290B-1	VME52 (BU)
C2383-26	RME52 (GY/OG)	C290B-2	RME52 (GY/OG)



- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

L6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

L7 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

• Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test M: The SYNC® System Is Inoperative (No Response Is Received From Phone, Voice, And Media Inputs)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® System in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3000:04	Control Module: System Internal Failure	Set by the APIM when it detects a fault due to a device conflict or internal failure.

Possible Sources

- Customer's device
- APIM

PINPOINT TEST M: THE SYNC® SYSTEM IS INOPERATIVE (NO RESPONSE IS RECEIVED FROM PHONE, VOICE, AND MEDIA INPUTS)

Test Step	Result / Action to Take
M1 VERIFY THAT THE APIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the APIM pass the network test?**	**Yes** GO to M2 . **No** REFER to Section 418-00 .
M2 CHECK THE SYNC® SYSTEM INPUTS FOR FUNCTIONALITY	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases the phone book and call histories, and deletes any	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature.

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devices paired with the SYNC® system. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNC® inputs function correctly?**	REVIEW the SYNC® system operation with the customer. If the customer's device still does not operate correctly, the fault is with the customer's device. **No** GO to M3 .
M3 RESET THE APIM AND RECHECK SYNC® SYSTEM OPERATION	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases the phone book and call histories, and deletes any devices paired with the SYNC® system. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNC® inputs function correctly?**	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature. REVIEW the SYNC® system operation with the customer. If the customer's device still does not operate correctly, the fault is with the customer's device. **No** If only some, but not all of the inputs are inoperative, GO to Symptom Chart - SYNC® System to diagnose the observed symptom. If all inputs are inoperative and/or DTC U3000:04 is present, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Pinpoint Test N: The SYNC® System Voice Or Tone Prompts, TTS Feature, Or Ringtones Are Inoperative Or Do Not Operate Correctly, Or During A Phone Call, No Incoming Audio Is Heard In The Vehicle

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System and Voice Recognition in Information and Entertainment System .

Possible Sources

- Customer's setting
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST N: THE SYNC® SYSTEM VOICE OR TONE PROMPTS, TTS FEATURE, OR RINGTONES ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY, OR DURING A PHONE CALL, NO INCOMING AUDIO IS HEARD IN THE VEHICLE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>N1 CHECK THE AUDIBLE PROMPT SETTING
• Operate the audio system in SYNC® mode.
• Verify the audible prompts are enabled. Refer to "SYNC® Voice Recognition Feature" in the Owner's Literature.
• Operate the VOICE button on the steering wheel controls and observe the SYNC® audible prompt.
• Does the SYNC® system produce an audible prompt correctly?</td><td>Yes
The system is operating correctly at this time. The concern was caused by the customer's setting. INSTRUCT the customer in the correct operation of the audible prompt feature.

No
GO to N2 .</td></tr>
<tr><td>N2 CHECK FOR A VOLTAGE SIGNAL FROM THE APIM
NOTICE: This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.
• Operate the audio system in SYNC® mode.
• While operating the VOICE button repeatedly, measure the AC voltage by back-probing ACM connector C290B:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C290B-4</td><td>VMN14 (WH/VT)</td><td>C290B-5</td><td>RMN14 (GY/BN)</td></tr></table>• Is a fluctuating AC voltage present each time the VOICE switch is operated?</td><td>Yes
GO to N7 .

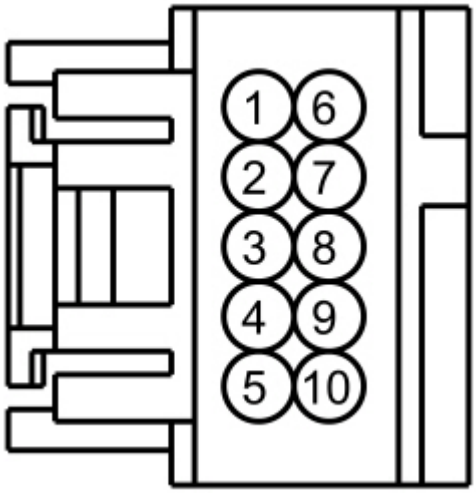
No
GO to N3 .</td></tr>
<tr><td>N3 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO VOLTAGE
• Ignition OFF.
• Disconnect: ACM C290B .
• Disconnect: APIM C2383 .
• Ignition ON.</td><td>Yes
REPAIR the circuit in question.

No</td></tr>
</table>

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- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C290B-4	VMN14 (WH/VT)	—	Ground
C290B-5	RMN14 (GY/BN)	—	Ground



- **Is any voltage present?**

GO to N4 .

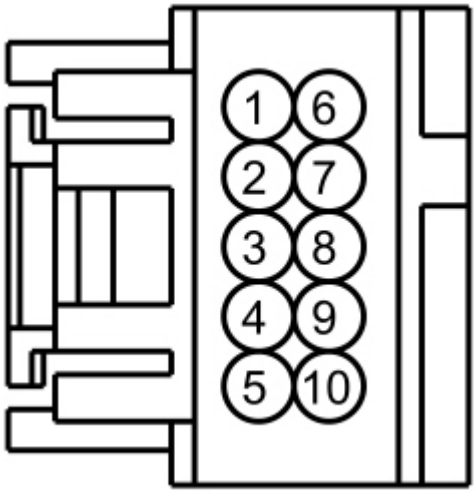
N4 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C290B-4	VMN14 (WH/VT)	—	Ground
C290B-5	RMN14 (GY/BN)	—	Ground

Yes
GO to N5 .

No
REPAIR the circuit in question.

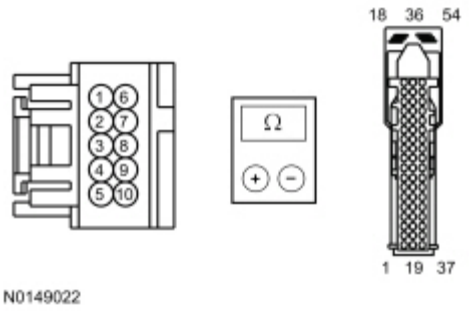


- **Are the resistances greater than 10,000 ohms?**

N5 CHECK THE AUDIBLE PROMPT CIRCUITS FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C290B-4	VMN14 (WH/VT)	C2383-3	VMN14 (WH/VT)
C290B-5	RMN14 (GY/BN)	C2383-4	RMN14 (GY/BN)



- **Are the resistances less than 3 ohms?**

Yes
GO to N6 .

No
REPAIR the circuit in question.

N6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

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• Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.
N7 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test O: All SYNC® Services Features Are Inoperative Or Inaccurate

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® Services in Information and Entertainment System.

Possible Sources

- Unregistered SYNC® owner account
- Unregistered or expired SYNC® Services subscription
- Unregistered mobile phone number
- Mobile phone being used not selected as "Active"
- SYNC® Services server
- APIM
- GPSM

PINPOINT TEST O: ALL SYNC® SERVICES FEATURES ARE INOPERATIVE OR INACCURATE

Test Step	Result / Action to Take
O1 VERIFY THE CUSTOMER'S SYNC® OWNER ACCOUNT AND SYNC® SERVICES REGISTRATION	

AND SUBSCRIPTION	
• Verify that the customer has a SYNC® Owner Account on SyncMyRide • Verify that the customer has registered for SYNC® Services and has an active subscription. • **Does the customer have a SYNC® Owner Account and an active SYNC® Services subscription?**	**Yes** GO to O2. **No** If the customer does not have a SYNC® Owner Account, INFORM the customer that an account must be created in order to sign up for SYNC® Services. REFER to SyncMyRide. If the customer does not have an active SYNC® Services subscription, INFORM the customer that in order for SYNC® Services to function, the subscription needs to be activated. REFER to SyncMyRide.
O2 VERIFY THE CUSTOMER'S REGISTERED PHONE NUMBER AND STATUS	
• Verify that the mobile phone being used has the correct phone number registered with SYNC® Services. • Verify that the mobile phone being used is selected as "Active" on SyncMyRide. • **Is the customer using the registered and active mobile phone associated with the SYNC® services account?**	**Yes** GO to O3. **No** INFORM the customer that the correct phone number must be registered on the SYNC® website and selected as "Active." REFER to SyncMyRide.
O3 CHECK FOR APIM DTCs	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Are any DTCs recorded in the APIM ?**	**Yes** REFER to the APIM DTC Chart in Information and Entertainment System. **No** GO to O4.
O4 CHECK FOR GPSM DTCs	
• Using a diagnostic scan tool, perform the GPSM self-test. • **Are any DTCs recorded in the GPSM ?**	**Yes** REFER to the GPSM DTC Chart in Information and Entertainment System. **No** GO to O5.
O5 VERIFY THE CUSTOMER'S PHONE CONNECTION TO SYNC® SERVICES	
• Advise the customer to connect their phone to SYNC® Services. Caller ID blocking must be disabled on the customer's phone. Refer to the Owner's Literature. • Operate a SYNC® Services feature. • Verify that the phone call is placed and that the phone is connected to SYNC®	**Yes** GO to O6. **No** GO to Pinpoint Test S.

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Services. • **Does the phone connect to SYNC® Services and operate correctly?**	
O6 OBSERVE THE SYNC® SERVICES SUBSCRIPTION COMMERCIAL	
• Once the customer's phone is connected to SYNC® Services, observe the subscription commercial. • **Does the SYNC® Services subscription commercial repeat with no selection option?**	**Yes** There is a potential SYNC® Services server issue, and the problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance. **No** GO to O7 .
O7 CHECK THE OPERATION OF THE DIRECTIONS FROM SYNC® SERVICES	
• When prompted, select directions from SYNC® Services and observe the audible prompts from the audio system. • **Is a single chime, audible prompt, then a short chime heard, indicating the navigation route is being sent to the vehicle?**	**Yes** SYNC® Services is operating correctly at this time. **No** If a single chime, audible prompt, then a repeating chime is heard, indicating the navigation route is being sent to the vehicle, GO to O8 . If no chime or audible prompt is heard, indicating that the system was unable to locate the vehicle, there is a potential SYNC® Services server issue. The problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance.
O8 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test P: Voice Recognition Is Inoperative Or Does Not Operate Correctly, Or During A Phone

Call, Poor Quality Or No Outgoing Audio Is Heard On The Outside Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Voice Recognition in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1D79:01	Microphone Input: General Electrical Failure	Set by the APIM when a microphone is not detected during the on-demand self-test.
B1D79:11	Microphone Input: Circuit Short To Ground	Set by the APIM when short to ground is detected on the microphone circuits.
B1D79:12	Microphone Input: Circuit Short To Battery	Set by the APIM when short to voltage is detected on the microphone circuits.
B1D79:13	Microphone Input: Circuit Open	Set by the APIM when an open is detected on the microphone circuits.

Possible Sources

- Insufficiently quiet vehicle
- Inadequate phone reception
- Wiring, terminals, or connectors
- Microphone
- APIM

PINPOINT TEST P: VOICE RECOGNITION IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY, OR DURING A PHONE CALL, POOR QUALITY OR NO OUTGOING AUDIO IS HEARD ON THE OUTSIDE DEVICE

Test Step	Result / Action to Take
P1 CHECK THE AUDIBLE PROMPT FUNCTIONALITY	
• Operate the audio system in radio tuner AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **Does the SYNC® system produce an audible prompt correctly, indicating voice recognition mode has been entered?**	**Yes** GO to P3 . **No** GO to P2 .
P2 CHECK THE OPERATION OF THE RH STEERING WHEEL SWITCHES	

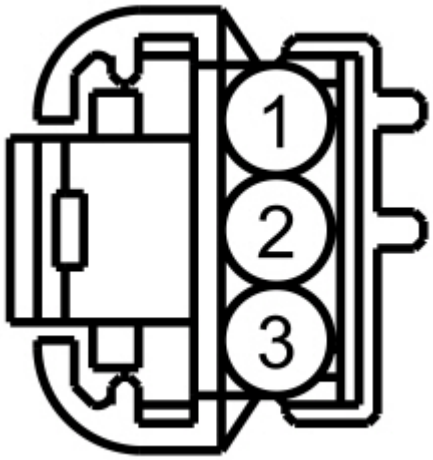
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• Operate the audio system in AM/FM mode. • Operate the VOLUME +/-, SEEK +/-, MEDIA, PHONE, and OK steering wheel switches. • **Do the VOLUME +/-, SEEK +/-, MEDIA, PHONE, and OK steering wheel switches operate correctly?**	**Yes** GO to Pinpoint Test N . **No** GO to Pinpoint Test T to diagnose the RH steering wheel switches.
P3 CHECK THE OPERATION OF THE "PHONE" VOICE COMMAND	
• Pair a Bluetooth phone with the SYNC® system. For information on the pairing process, refer to the Owner's Literature. If necessary, review the device compatibility list found on syncmyride.com . • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the system from correctly recognizing spoken commands. • Clearly speak the word "phone." • **Does the SYNC® system respond correctly to the "phone" voice command?**	**Yes** For a concern with the voice recognition being inoperative or not operating correctly, the system is operating correctly at this time. The concern may have been caused by an insufficiently quiet vehicle. Delete the just-paired Bluetooth phone from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. For a concern with poor quality or no outgoing audio being heard on the outside device during a phone call, GO to P4 **No** GO to P5 .
P4 CHECK THE OUTGOING PHONE CALL QUALITY AND VOICE VOLUME	
• Ensure that the Bluetooth phone paired in step 3 has adequate reception. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the call from having clear call quality and acceptable voice volume. • Using the SYNC® system, place a phone call. For information on making calls from the SYNC® system, refer to the Owner's Literature. • Ensure that the called party's phone has adequate reception. • Instruct the called party to determine if the call quality is clear and of acceptable volume. • Delete the Bluetooth phone paired in step 3 from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. • **Is the outgoing call quality clear and of acceptable volume?**	**Yes** The system is operating correctly at this time. The concern may have been caused by poor phone reception or an insufficiently quiet vehicle. **No** GO to P5 .
P5 CHECK THE MICROPHONE AND MICROPHONE CIRCUITS FOR CORRECT VOLTAGE DROP	
NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that**	**Yes** If diagnosing an intermittent concern, GO to P6 . If **not** diagnosing an intermittent concern, GO to P12 . **No** GO to P7 .

good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.

- Ignition ON.
- While back-probing microphone C9221, measure and record the **DC voltage** .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)



- **Is the voltage between 2.7 and 6.2 volts?**

P6 CHECK THE MICROPHONE CIRCUITS FOR INTERMITTENT CONCERNS

NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

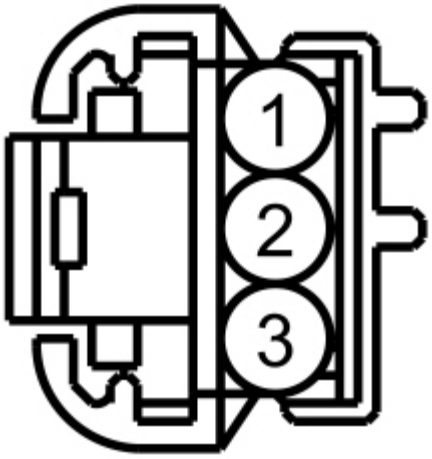
- While back-probing microphone C9221, measure the **DC voltage** while agitating the microphone harness back and forth and up and down (wiggle testing).

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)

Yes
REPAIR the circuit(s), connector, or terminal(s) in question. For corrosion, clean pins or install a new connector or terminals. For damaged or bent pins, install new terminals or pins.

No
GO to P11 .

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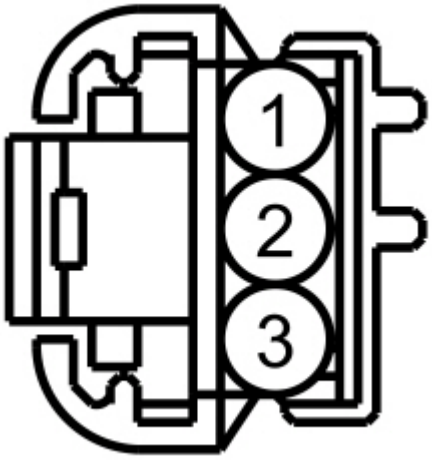


- Review the recorded results from step 5.
- **Does the voltage fluctuate more than .5 volts from the recorded result in step 5?**

P7 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Microphone C9221.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

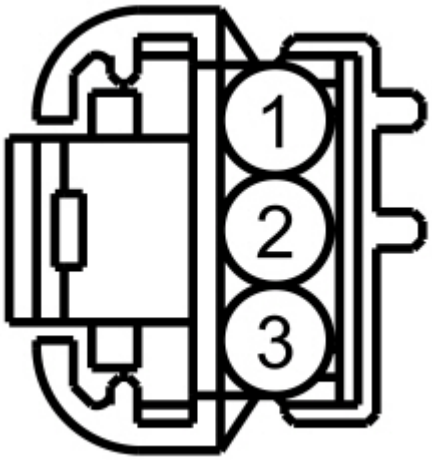
No
GO to P8 .

P8 CHECK THE MICROPHONE CIRCUITS TO THE APIM

FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

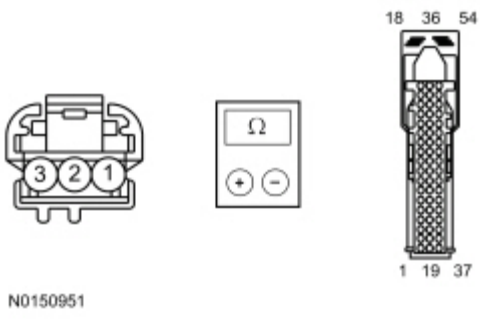
Yes
GO to P9 .

No
REPAIR the circuit in question.

P9 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR AN OPEN

- Measure the **resistance** between:

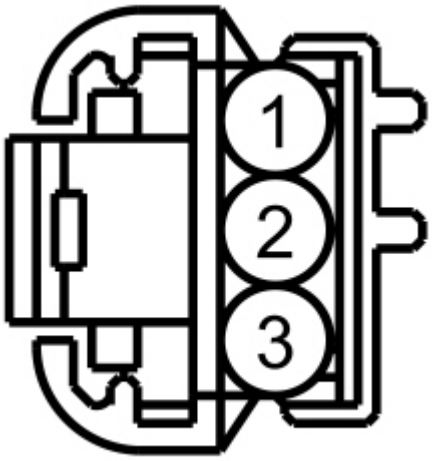
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C2383-5	VMM13 (YE/GN)
C9221-3	DMM13 (BK)	C2383-6	DMM13 (BK)



Yes
GO to P10 .

No
REPAIR the circuit in question.

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• **Are the resistances less than 3 ohms?**	
P10 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TOGETHER • Measure the **resistance** between: <table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C9221-2</td><td>VMM13 (YE/GN)</td><td>C9221-3</td><td>DMM13 (BK)</td></tr></table> • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P12 . **No** REPAIR the circuit in question.
P11 ISOLATE THE MICROPHONE • Install a new microphone. Refer to Microphone . • If necessary, connect: APIM C2383. • Operate the audio system in AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • Speak a command to test the voice recognition for normal operation. • **Is the voice recognition functioning correctly?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative microphone. **No** GO to P12 .

P12 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections.

	ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Q: The Audio Input Jack Is Inoperative Or Has Poor Sound Quality

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Audio Input Jack Mode in Information and Entertainment System .

Possible Sources

- Customer's device
- Wiring, terminals, or connectors
- Audio input jack
- APIM (with SYNC®)
- ACM (without SYNC®)

PINPOINT TEST Q: THE AUDIO INPUT JACK IS INOPERATIVE OR HAS POOR SOUND QUALITY

NOTE: Before carrying out this pinpoint test, make sure the MP3 device is operating correctly.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>Q1 CHECK THE AUDIO INPUT JACK AUDIO FUNCTIONALITY</td><td></td></tr>
<tr><td>• Connect: Multi-Media Interface Tester 105-00120.
• Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the audio input jack.
• Is the audio output OK for the audio input jack?</td><td>Yes
The system is operating correctly at this time. The concern may be with the customer's device.

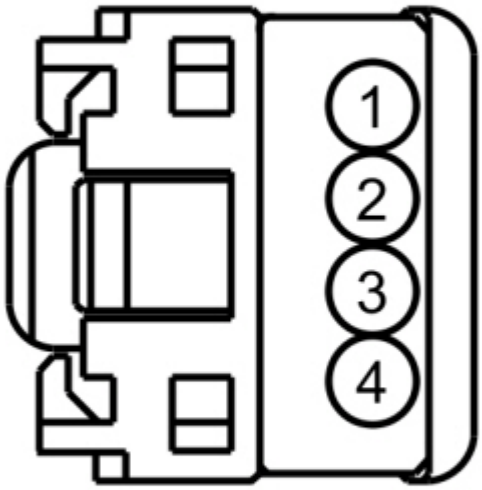
No
GO to Q2 .</td></tr>
<tr><td>Q2 CHECK THE AUDIO INPUT JACK CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Audio Input Jack C2362.
• Disconnect: APIM C2383 (with SYNC®).
• Disconnect: ACM C290B (without SYNC®).
• Ignition ON.
• Measure the voltage between:

<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td></td><td></td><td></td><td></td></tr></table></td><td>Yes
REPAIR the circuit in question.

No
GO to Q3 .</td></tr>
</table>

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C2362-1	VME46 (BU/GN)	—	Ground
C2362-3	RME45 (YE/GN)	—	Ground
C2362-4	VME45 (BU)	—	Ground



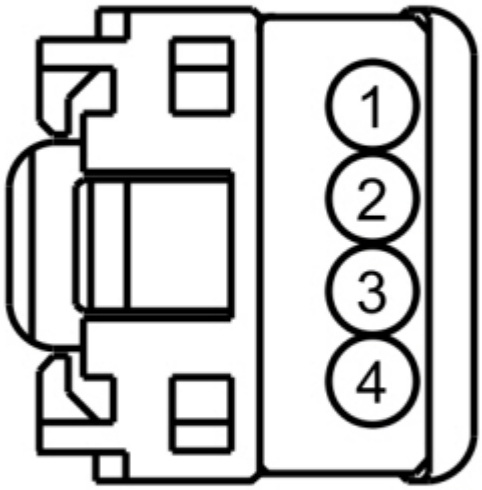
- **Is any voltage present?**

Q3 CHECK THE AUDIO INPUT JACK CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the **resistance** between:	**Yes** GO to Q4 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-1	VME46 (BU/GN)	—	Ground
C2362-3	RME45 (YE/GN)	—	Ground
C2362-4	VME45 (BU)	—	Ground

No
REPAIR the circuit.



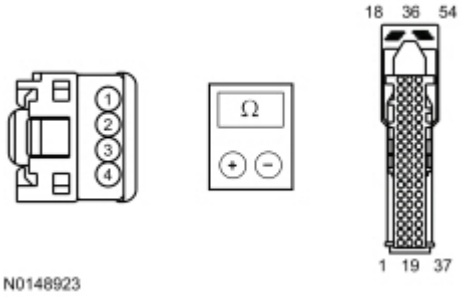
- **Is the resistance greater than 10,000 ohms?**

Q4 CHECK THE AUDIO INPUT JACK CIRCUITS FOR AN OPEN	
• For vehicles with SYNC®, measure the	**Yes**

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resistance between:

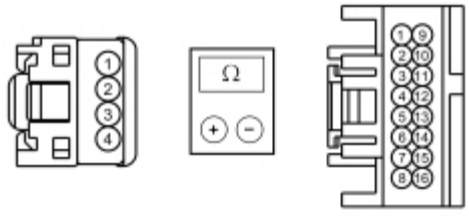
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-1	VME46 (BU/GN)	C2383-47	VME46 (BU/GN)
C2362-3	RME45 (YE/GN)	C2383-46	RME45 (YE/GN)
C2362-4	VME45 (BU)	C2383-45	VME45 (BU)



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- For vehicles without SYNC®, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-1	VME46 (BU/GN)	C290B-6	VME46 (BU/GN)
C2362-3	RME45 (YE/GN)	C290B-8	RME45 (YE/GN)
C2362-4	VME45 (BU)	C290B-7	VME45 (BU)



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- **Are the resistances less than 3 ohms?**

GO to Q5 .

No
REPAIR the circuit in question.

Q5 ISOLATE THE AUDIO INPUT JACK

- Connect: APIM C2383 (with SYNC®).

Yes

• Connect: ACM C290B (without SYNC®). • Install a new audio input jack. Refer to Audio Input Jack . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the audio input jack. • **Is the audio output OK for the audio input jack?**	The system is now correctly at this time. The concern was caused by an inoperative audio input jack. **No** GO to Q6 (with SYNC®). GO to Q7 (without SYNC®).
Q6 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Q7 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test R: The USB Port Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® AppLink™, USB Audio Mode, and USB Port. in Information and Entertainment System .

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The USB port is part of the USB cable, and cannot be replaced separately.

The Multi-Media Interface Tester 105-00120 is powered by the USB port.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1252:04	USB Port: System Internal Failure	Set by the APIM when an over-temperature condition is detected in the USB circuit. This can be caused by a fault in the USB cable, USB port, or customer's USB device.
B1252:11	USB Port: Circuit Short to Ground	Set by the APIM when a short to ground or over-current condition is detected in the USB circuit. This can be caused by a fault in the USB cable, USB port, or customer's USB device.

Possible Sources

- Customer's device
- USB cable/port
- USB cable/port connection
- APIM

PINPOINT TEST R: THE USB PORT IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
R1 RESET THE APIM AND RECHECK SYNC® SYSTEM OPERATION • Remove any devices connected to the USB port. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the USB port. • **Is the audio output OK for the USB port?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to R2.
R2 CHECK THE APIM FOR DTC B1252:04 OR DTC B1252:11 • Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:04 or DTC B1252:11 present?**	**Yes** GO to R3. **No** GO to R5.

R3 INSPECT THE USB CABLE AND APIM	
• Ignition OFF. • Disconnect: USB cable at the APIM . • Inspect the APIM connector port and both ends of the USB cable for damage. Remove any debris. • **Is any damage present?**	**Yes** For the USB cable, INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . For the APIM , For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** GO to R4 .
R4 CHECK THE USB PORT FOR FUNCTIONALITY	
• Connect: USB cable at the APIM . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the USB port. • **Is the audio output OK for the USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by the USB connector not being seated correctly. **No** GO to R5 .
R5 ISOLATE THE USB CABLE/PORT	
• Install a new USB cable/port. Universal Serial Bus (USB) Cable and Port . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play a file using the USB port. • **Is the audio output OK for the USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative USB cable. **No** GO to R6 .
R6 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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• Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test S: Unable To Pair Bluetooth Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Bluetooth Mode and SYNC® AppLink™ in Information and Entertainment System .

Possible Sources

- Incompatible Bluetooth device
- APIM

PINPOINT TEST S: UNABLE TO PAIR BLUETOOTH DEVICE

Test Step	Result / Action to Take
S1 CHECK THE BLUETOOTH CONNECTION	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases the phone book and call histories, and deletes any devices paired with the SYNC® system. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, connect to the SYNC® system using Bluetooth. Follow the tool instructions. • Using a diagnostic scan tool, view the APIM PIDs. • Monitor the Bluetooth device paired PID (BT_PAIR) and the Bluetooth device connected PID (BT_CONN). • **Do the PIDs both read "Yes"?**	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature. REVIEW the pairing process with the customer. If the customer's device still does not pair, the fault is with the customer's device. **No** GO to S2 .
S2 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect and inspect the APIM	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists

connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test T: The RH steering wheel controls are inoperative or do not operate correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Steering Wheel Switch Functions and Steering Wheel Switches in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1380:09	Steering Wheel Right Switch Pack: Component Failure	Set by the SCCM when the RH steering wheel switch is stuck.
B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	Set by the SCCM when a short to ground is detected in the RH steering wheel switch circuits.
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	Set by the SCCM when a short to voltage is detected in the RH steering wheel switch circuits.

Possible Sources

- Steering wheel switch
- Wiring, terminals, or connectors
- Clockspring
- SCCM

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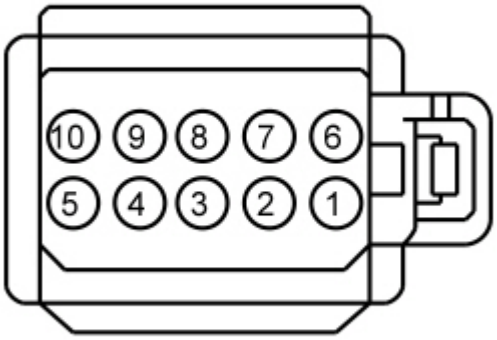
PINPOINT TEST T: THE RH STEERING WHEEL CONTROLS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>T1 CHECK THE RH STEERING WHEEL SWITCH PIDs</td><td rowspan="2">Yes
GO to T10 .

No
If one or more, but not all PID values are incorrect or always read one particular switch position, INSTALL a new RH steering wheel switch. REFER to Section 211-05 .
If all PID values are incorrect or always read one particular switch position, GO to T2 .</td></tr>
<tr><td>• Ignition ON.
• Monitor the steering wheel controls PIDs while pressing each RH steering wheel switch.
• Using a diagnostic scan tool, view the SCCM PIDs.
  ◦ SW_VOLDOWN
  ◦ SW_VOLUP
  ◦ SW_SEEKMINUS
  ◦ SW_SEEKPLUS
  ◦ SW_VOICE
  ◦ SW_MEDIA
  ◦ SW_PHONE
• Using a diagnostic scan tool, view the APIM PID.
  ◦ SW_OK
• Do the PID values agree with the switch positions?</td></tr>
<tr><td>T2 CHECK FOR IPC DTC U0212:00</td><td rowspan="2">Yes
REFER to Section 413-01 .

No
GO to T3 .</td></tr>
<tr><td>• Ignition ON.
• Using a diagnostic scan tool, clear the DTCs from the IPC .
• Ignition OFF.
• Ignition ON.
• Wait at least 10 seconds.
• Using a diagnostic scan tool, perform the IPC self-test.
• Is DTC U0212:00 set in the IPC ?</td></tr>
<tr><td>T3 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TO GROUND</td><td rowspan="2">Yes
GO to T4 .

No
INSTALL a new steering wheel. REFER to Section 211-04 .</td></tr>
<tr><td>WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.
• Ignition OFF.
• Disconnect: RH Steering Wheel Switch C2999.
• Disconnect: Clockspring C218B.
• Measure the resistance between:
<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C2999-2</td><td>VME14</td><td>—</td><td>Ground</td></tr><tr><td>C2999-4</td><td>RME14</td><td>—</td><td>Ground</td></tr><tr><td>C2999-6</td><td>VME54</td><td>—</td><td>Ground</td></tr><tr><td>C2999-7</td><td>RME54</td><td>—</td><td>Ground</td></tr></table></td></tr>
</table>



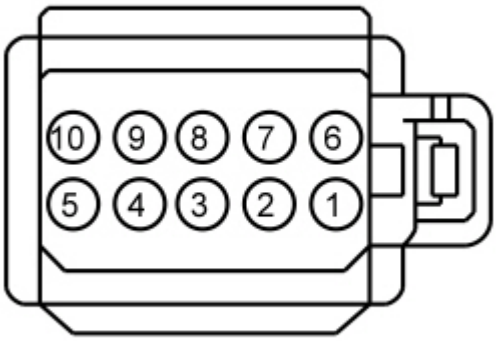
- **Are the resistances greater than 10,000 ohms?**

T4 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR AN OPEN	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218B-14	VME14
C2999-4	RME14	C218B-6	RME14
C2999-6	VME54	C218B-16	VME54
C2999-7	RME54	C218B-8	RME54 |  N0148938 • **Are the resistances less than 3 ohms?**	**Yes** GO to T5 . **No** INSTALL a new steering wheel. REFER to Section 211-04 .

T5 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TOGETHER	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
					Yes GO to T6 . **No** INSTALL a new steering wheel. REFER to Section 211-04 .

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C2999-6	VME54	C2999-7	RME54

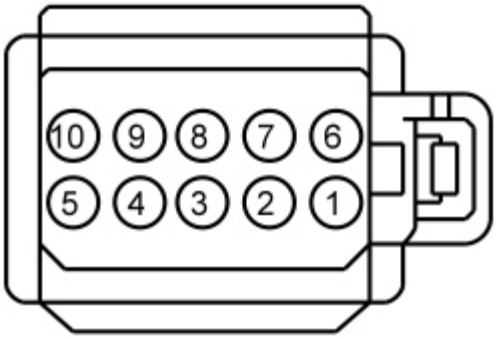


- **Are the resistances greater than 10,000 ohms?**

T6 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND

- Connect: Clockspring C218B.
- Disconnect: Clockspring C218C.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	—	Ground
C2999-4	RME14	—	Ground
C2999-6	VME54	—	Ground
C2999-7	RME54	—	Ground



Yes
GO to T7 .

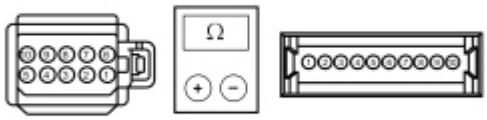
No
INSTALL a new clockspring.
REFER to Section 501-20B .

- **Are the resistances greater than 10,000 ohms?**

T7 CHECK THE CLOCKSPRING FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218C-6	—
C2999-4	RME14	C218C-5	—
C2999-6	VME54	C218C-10	—
C2999-7	RME54	C218C-9	—



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- **Are the resistances less than 3 ohms?**

Yes
GO to T8 .

No
INSTALL a new clockspring.
REFER to Section 501-20B .

T8 CHECK THE CLOCKSPRING FOR A SHORT TOGETHER

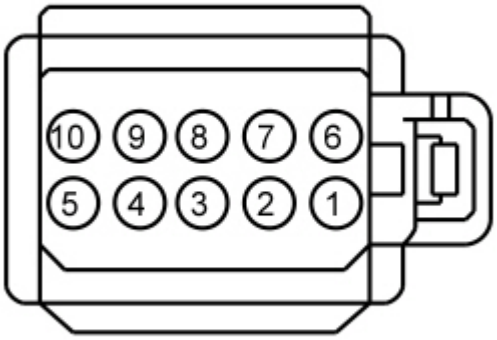
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
C2999-6	VME54	C2999-7	RME54

Yes
GO to T9 .

No
INSTALL a new clockspring.
REFER to Section 501-20B .

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- **Are the resistances greater than 10,000 ohms?**

T9 CHECK FOR VOLTAGE AT THE SCCM

- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2414D-6	—	C2414D-5	—
C2414D-10	—	C2414D-9	—



- **Is approximately 5 volts present?**

Yes
INSTALL a new RH steering wheel switch. REFER to Section 211-05 .

No
GO to T10 .

T10 CHECK FOR CORRECT SCCM OPERATION

- Ignition OFF.
- Disconnect and inspect all the SCCM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to

▪ Pushed-out pins (install new pins as necessary) • Reconnect the SCCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	Section 211-05 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test U: The Audio System Does Not Operate Correctly From The FCIM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Accessory Delay Feature and FCIM in Information and Entertainment System .

Possible Sources

- Network communication concern
- FCIM

PINPOINT TEST U: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FCIM

Test Step	Result / Action to Take
U1 VERIFY THAT THE ACM , APIM , AND FCIM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the ACM , APIM , and FCIM pass the network test?**	**Yes** GO to U2 . **No** If the ACM failed the network test, REFER to Section 418-00 The ACM Does Not Respond To The Scan Tool. If the APIM failed the network test, REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool. If the FCIM failed the network test, REFER to Section 418-00 The FCIM Does Not Respond To The Scan Tool.
U2 RESET THE AUDIO SYSTEM MODULES AND RECHECK THE FCIM OPERATION	
• Disconnect the battery for 5 minutes, then reconnect it. • Turn the infotainment system on. • Test the FCIM for normal operation.	**Yes** The FCIM is operating correctly at this time. The concern was corrected by resetting the audio system modules. **No** GO to U3

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• **Does the FCIM operate correctly?**	

U3 RETRIEVE THE ACM , APIM , AND FCIM DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  • ACM
  • APIM
  • FCIM
• **Are any DTCs present in the ACM , APIM , or FCIM ?**
	Yes
	For ACM DTCs, REFER to the ACM DTC Chart in Information and Entertainment System For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For FCIM DTCs, REFER to the FCIM DTC Chart in Information and Entertainment System
	
	No
	GO to U4 .

U4 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test V: The FDIM Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to FDIM in Information and Entertainment System .

Possible Sources

- Wiring, terminals, or connectors
- FDIM

PINPOINT TEST V: THE FDIM IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
V1 VERIFY THAT THE FDIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the FDIM pass the network test?**	**Yes** GO to V2 . **No** REFER to Section 418-00 The FDIM Does Not Respond To The Scan Tool.
V2 OBSERVE THE FDIM DISPLAY	
• Turn the audio system on and verify the FDIM operation. • **Is the FDIM screen completely inoperative or blank?**	**Yes** GO to V4 . **No** GO to V3 .
V3 CHECK FOR LOST COMMUNICATION DTCS SET IN THE FDIM	
• Ignition ON. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Are any lost communication DTCs (U-codes) present in the FDIM ?**	**Yes** REFER to the FDIM DTC Chart in Information and Entertainment System . **No** GO to V4 .
V4 CHECK FOR CORRECT FDIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FDIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FDIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test W: One Or More FDIM Displays Are Inoperative Or Do Not Operate Correctly

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Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to FDIM in Information and Entertainment System .

Possible Sources

- Customer error
- Wiring, terminals, or connectors
- FDIM

PINPOINT TEST W: ONE OR MORE FDIM DISPLAYS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
W1 VERIFY THAT THE FDIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the FDIM pass the network test?**	**Yes** GO to W2 . **No** REFER to Section 418-00 The FDIM Does Not Respond To The Scan Tool.
W2 CHECK FOR LOST COMMUNICATION DTCS SET IN THE FDIM	
• Ignition ON. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Are any lost communication DTCs (U-codes) present in the FDIM ?**	**Yes** REFER to the FDIM DTC Chart in Information and Entertainment System . **No** GO to W3 .
W3 CHECK THE FDIM DISPLAY SEGMENTS	
• Perform the Display Test. REFER to Audio Control Module (ACM) Self-Diagnostic Mode • **Do all of the FDIM segments illuminate?**	**Yes** The system is operating correctly at this time. INFORM the customer of the operation of the FDIM display. **No** GO to W4 .
W4 CHECK FOR CORRECT FDIM OPERATION	
• Ignition OFF. • Disconnect and inspect the FDIM connector. • Repair: ▪ Corrosion (clean module	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) .

pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the FDIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test X: The Compass Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Auto-Dimming Interior Rear View Mirror, Compass Module, and FDIM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
U0462:82	Invalid Data Received from Compass Module: Alive/Sequence Counter Incorrect/Not Updated	Set by the IPC when compass data from the BCM is missing or invalid for more than 5 seconds with the ignition in the RUN position.

If compass data is missing or invalid for 5 seconds or less, the compass display will indicate the vehicle direction based on the last known good compass display message received. When U0462:82 sets, the IPC defaults the compass display to all dashes (---).

Possible Sources

- Wiring, terminals, or connectors
- Compass module
- Auto-dimming interior rear view mirror
- BCM

PINPOINT TEST X: THE COMPASS IS INOPERATIVE

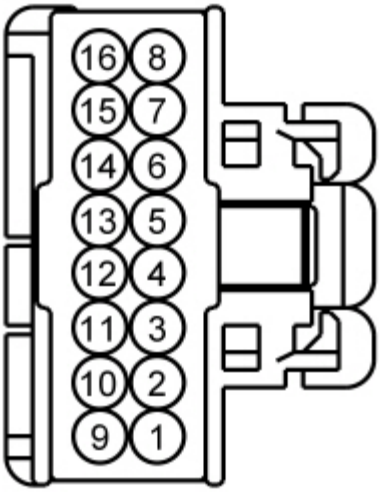
Test Step	Result / Action to Take

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X1 CHECK THE VOLTAGE SUPPLY

- Ignition OFF.
- Disconnect: Auto-Dimming Interior Rear View Mirror C9039 (With Auto-Dimming Interior Rear View Mirror).
- Disconnect: Compass Module C909 (Without Auto-Dimming Interior Rear View Mirror).
- Ignition ON.
- For vehicles with an auto-dimming interior rear view mirror, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9039-1	CBP32 (GN/VT)	—	Ground

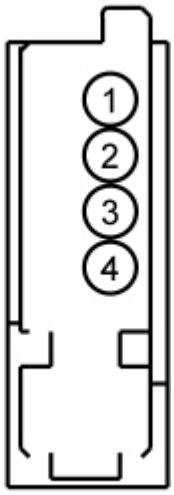


- For vehicles **without** an auto-dimming interior rear view mirror, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C909-1	CBP32 (GN/VT)	—	Ground

Yes
GO to X2 .

No
REPAIR the circuit in question.

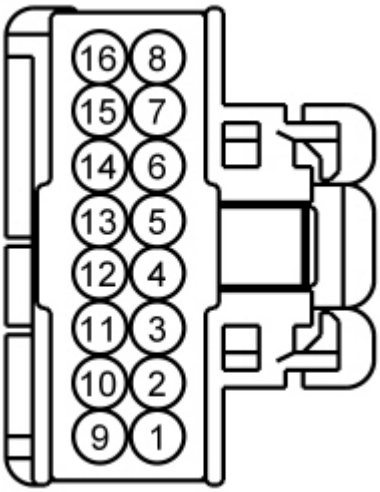


- **Is the voltage greater than 11 volts?**

X2 CHECK THE GROUND CIRCUIT

- For vehicles with an auto-dimming interior rear view mirror, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9039-1	CBP32 (GN/VT)	C9039-4	GD133 (BK)



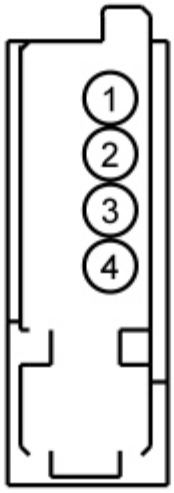
- For vehicles **without** an auto-dimming interior rear view mirror, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C909-1	CBP32 (GN/VT)	C909-2	GD133 (BK)

Yes
GO to X3 .

No
REPAIR the circuit in question.

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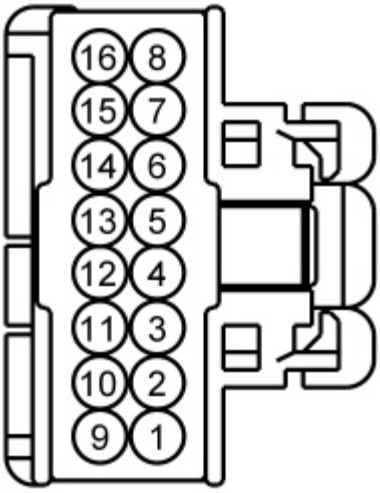


- **Is the voltage greater than 11 volts?**

X3 CHECK THE LIN CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: BCM C2280B.
- Ignition ON.
- For vehicles with an auto-dimming interior rear view mirror, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9039-2	VDN01 (BU/WH)	—	Ground



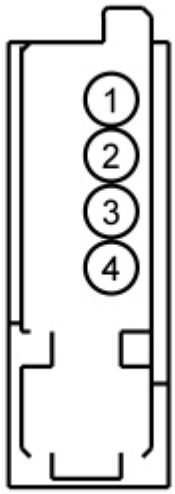
- For vehicles **without** an auto-dimming interior rear view mirror, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
REPAIR the circuit in question.

No
GO to X4 .

C909-3	VDN01 (BU/WH)	—	Ground

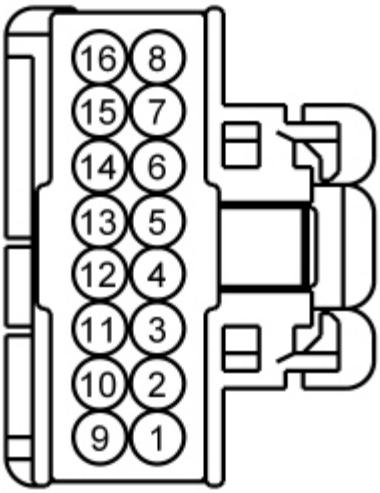


- **Is any voltage present?**

X4 CHECK THE LIN CIRCUIT FOR A SHORT TO GROUND

- For vehicles with an auto-dimming interior rear view mirror, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9039-2	VDN01 (BU/WH)	—	Ground



- For vehicles **without** an auto-dimming interior rear view mirrorr, measure the **resistance** between:

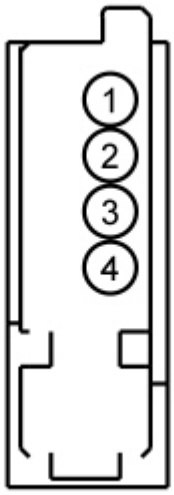
Positive Lead		Negative Lead	

Yes
GO to X5 .

No
REPAIR the circuit in question.

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Pin	Circuit	Pin	Circuit
C909-3	VDN01 (BU/WH)	—	Ground

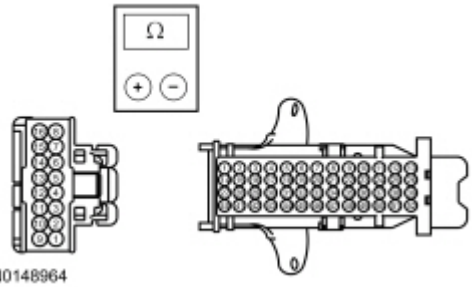


- **Are the resistances greater than 10,000 ohms?**

X5 CHECK THE LIN CIRCUIT FOR AN OPEN

- For vehicles with an auto-dimming interior rear view mirror, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9039-2	VDN01 (BU/WH)	C2280B-52	VDN01 (BU/WH)

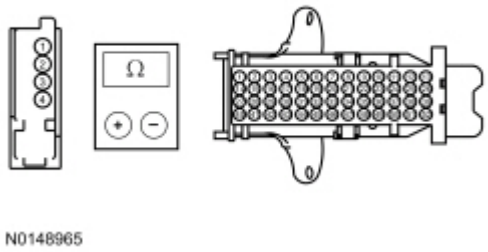


- For vehicles **without** an auto-dimming interior rear view mirror, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C909-3	VDN01 (BU/WH)	C2280B-52	VDN01 (BU/WH)

Yes
For vehicles with an auto-dimming interior rear view mirror, GO to X6 . For vehicles without an auto-dimming interior rear view mirror, GO to X7 .

No
REPAIR the circuit in question.

 N0148965 • **Are the resistances less than 3 ohms?**	
X6 ISOLATE THE AUTO-DIMMING INTERIOR REAR VIEW MIRROR	
• INSTALL a new auto-dimming interior rear view mirror. REFER to Section 501-09 . • SET the zone. REFER to the Compass Zone Adjustment General Procedure in Section 413-01 . • CALIBRATE the compass. REFER to the Compass Calibration General Procedure in Section 413-01 . • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to X8 . **No** The system is operating correctly at this time. The concern was corrected by installing a new auto-dimming interior rear view mirror.
X7 ISOLATE THE COMPASS MODULE	
• INSTALL a new compass module. REFER to Compass Module . • SET the zone. REFER to the Compass Zone Adjustment General Procedure in Section 413-01 . • CALIBRATE the compass. REFER to the Compass Calibration General Procedure in Section 413-01 . • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to X8 . **No** The system is operating correctly at this time. The concern was corrected by installing a new compass module.
X8 CHECK FOR CORRECT BCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the BCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Y: The Compass Is Inaccurate

repair4less

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Auto-Dimming Interior Rear View Mirror, Compass Module, and FDIM in Information and Entertainment System .

Possible Sources

- Zone setting
- Calibration
- Auto-dimming interior mirror
- Compass module

PINPOINT TEST Y: The Compass Is Inaccurate

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>Y1 CHECK THE COMPASS ACCURACY
• Position the vehicle and observe the compass display as follows:
<table><tr><th>Direction</th><th>Compass Display</th></tr><tr><td>North</td><td>N</td></tr><tr><td>Northeast</td><td>NE</td></tr><tr><td>East</td><td>E</td></tr><tr><td>Southeast</td><td>SE</td></tr><tr><td>South</td><td>S</td></tr><tr><td>Southwest</td><td>SW</td></tr><tr><td>West</td><td>W</td></tr><tr><td>Northwest</td><td>NW</td></tr></table>• Does the compass heading accurately display the vehicle direction?</td><td>Yes
The compass is operating correctly at this time.

No
GO to Y2 .</td></tr>
<tr><td>Y2 CHECK THE COMPASS ZONE SETTING AND CALIBRATION
• SET the zone. REFER to the Compass Zone Adjustment General Procedure in Section 413-01 .
• CALIBRATE the compass. REFER to the Compass Calibration General Procedure in Section 413-01 .
• Operate the system and verify the concern is still present.</td><td>Yes
The system is operating correctly at this time. The concern may have been caused by an incorrect compass zone selection or compass calibration.

No
For vehicles with an auto-dimming interior rear</td></tr>
</table>

• **Is the concern still present?**	view mirror, GO to Y3. For vehicles without an auto-dimming interior rear view mirror, GO to Y4.
Y3 ISOLATE THE AUTO-DIMMING INTERIOR REAR VIEW MIRROR	
• INSTALL a new auto-dimming interior rear view mirror. REFER to Section 501-09. • SET the zone. REFER to the Compass Zone Adjustment General Procedure in Section 413-01. • CALIBRATE the compass. REFER to the Compass Calibration General Procedure in Section 413-01. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to Y5. **No** The system is operating correctly at this time. The concern was corrected by installing a new auto-dimming interior rear view mirror.
Y4 ISOLATE THE COMPASS MODULE	
• INSTALL a new compass module. REFER to Compass Module. • SET the zone. REFER to the Compass Zone Adjustment General Procedure in Section 413-01. • CALIBRATE the compass. REFER to the Compass Calibration General Procedure in Section 413-01. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to Y5. **No** The system is operating correctly at this time. The concern was corrected by installing a new compass module.
Y5 CHECK FOR CORRECT BCM OPERATION	

• Ignition OFF.
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test Z: DTC B1318

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System for schematic and connector information.

Normal Operation and Fault Conditions

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DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1318	Battery Voltage Low	Set by the FDIM when the supply voltage falls below 10 volts for at least 10 seconds during normal operation or for more than 250 milliseconds during the self-test.

PINPOINT TEST Z: DTC B1318

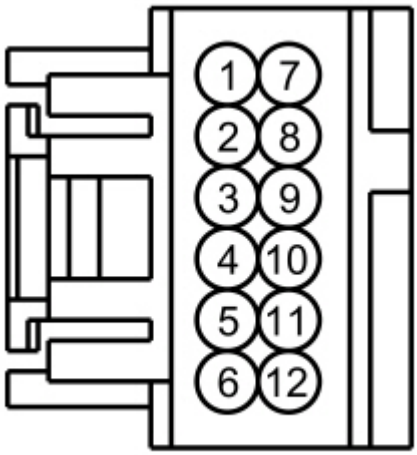
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>Z1 RECHECK FOR DTC B1318
• Ignition ON.
• Using a diagnostic scan tool, clear the FDIM DTCs.
• Wait at least 15 seconds.
• Using a diagnostic scan tool, repeat the self-test.
• Is DTC B1318 still present?</td><td>Yes
GO to Z2.

No
The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.</td></tr>
<tr><td>Z2 CHECK FOR CHARGING SYSTEM DTCS IN THE PCM
• Using a diagnostic scan tool, retrieve all CMDTCs.
• Are any voltage-related DTCs set in the PCM ?</td><td>Yes
REFER to PCM DTC Chart in Section 303-14.

No
GO to Z3.</td></tr>
<tr><td>Z3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE
• Check the battery condition and verify that the battery is fully charged. REFER to Battery Condition Test in Section 414-01.
• Is the battery OK and fully charged?</td><td>Yes
GO to Z4.

No
REFER to the Symptom Chart in Section 414-01.</td></tr>
<tr><td>Z4 CHECK THE FDIM VOLTAGE SUPPLY
• Ignition OFF.
• Measure and record the voltage at the battery.
• Disconnect: FDIM C2123.
• Ignition ON.
• Measure the voltage between:
<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C2123-12</td><td>SBP09 (RD)</td><td>—</td><td>Ground</td></tr></table></td><td>Yes
GO to Z5.

No
REPAIR the circuit for high resistance.</td></tr>
</table>

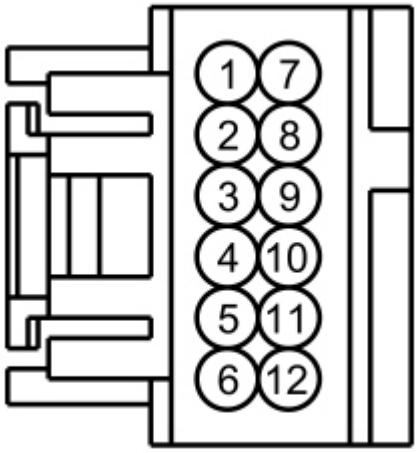


- **Is the voltage within 0.2 volts of the recorded battery voltage?**

Z5 CHECK THE FDIM GROUND CIRCUIT FOR CONTINUITY

- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2123-12	SBP09 (RD)	C2123-8	GD133 (BK)



- **Is the voltage greater than 11 volts?**

Yes
GO to Z6 .

No
REPAIR the circuit for high resistance.

Z6 CHECK FOR CORRECT FDIM OPERATION

- Ignition OFF.
- Disconnect and inspect the FDIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) .

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▪ Pushed-out pins (install new pins as necessary) • Reconnect the FDIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AA: DTC U0100:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	Set by the GPSM when network messages are missing from the PCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AA: DTC U0100:00

Test Step	Result / Action to Take
AA1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AA2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA2 RECHECK FOR DTC U0100:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0100:00 set in the GPSM ?**	**Yes** GO to AA3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA3 CHECK THE PCM FOR BATTERY VOLTAGE OUT-OF-	

RANGE DTCS	
• Using a diagnostic scan tool, perform the PCM self-test. • **Are any low or high voltage DTCs recorded in the PCM ?**	**Yes** REFER to PCM DTC Chart in Section 303-14 . **No** GO to AA4 .
AA4 CHECK THE GPSM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the GPSM self-test. • **Are any low or high voltage DTCs recorded in the GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AA5 .
AA5 CHECK FOR CORRECT PCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the PCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the PCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new PCM . REFER to Section 303-14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AB: DTC U0140

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0140	Lost Communication with Body Control Module (GEM)	Set by the FDIM when network messages are missing from the BCM for more than 5 seconds with the ignition in RUN.

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PINPOINT TEST AB: DTC U0140

Test Step	Result / Action to Take
AB1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AB2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB2 RECHECK FOR DTC U0140 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0140 set in the FDIM?**	**Yes** GO to AB3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB3 CHECK THE BCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the BCM self-test. • **Are any low or high voltage DTCs recorded in the BCM?**	**Yes** REFER to BCM DTC Chart in Section 419-10. **No** GO to AB4.

AB4 CHECK FOR CORRECT BCM OPERATION
• Ignition OFF.
• Disconnect and inspect all the BCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM. REFER to Section 419-10.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AC: DTC U0140:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	Set by the ACM , APIM (if equipped), FCIM , and GPSM when network messages are missing from the BCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AC: DTC U0140:00

Test Step	Result / Action to Take
AC1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AC2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC2 RECHECK FOR DTC U0140:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0140:00 set in the ACM , APIM (if equipped), FCIM , or GPSM ?**	**Yes** GO to AC3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC3 CHECK THE BCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the BCM self-test. • **Are any low or high voltage DTCs recorded in the BCM ?**	**Yes** REFER to BCM DTC Chart in Section 419-10 . **No** GO to AC4 .
AC4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

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• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM (if equipped)
  ▪ FCIM
  ▪ GPSM
• **Are low or high voltage DTCs recorded in the ACM, APIM (if equipped), FCIM, or GPSM?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao
	
	No
	GO to AC5.

AC5 CHECK FOR DTC U0140:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0140:00 set in more than one audio system module?**	**Yes** GO to AC6. **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC6 CHECK FOR CORRECT BCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the BCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM. REFER to Section 419-10.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AD: DTC U0155

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0155	Lost Communication with Instrument Panel Cluster (IPC) Control Panel	Set by the FDIM when network messages are missing from the IPC for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AD: DTC U0155

Test Step	Result / Action to Take
AD1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AD2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD2 RECHECK FOR DTC U0155	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155 set in the FDIM ?**	**Yes** GO to AD3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD3 CHECK THE IPC FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the IPC self-test. • **Are any low or high voltage DTCs recorded in the IPC ?**	**Yes** REFER to IPC DTC Chart in Section 413-01 . **No** GO to AD4 .
AD4 CHECK FOR CORRECT IPC OPERATION	

• Ignition OFF.
• Disconnect and inspect the IPC connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the IPC connector.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new IPC . REFER to Section 413-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test AE: DTC U0155:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	Set by the ACM , APIM (if equipped), and GPSM when network messages are missing from the IPC for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AE: DTC U0155:00

Test Step	Result / Action to Take
AE1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AE2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE2 RECHECK FOR DTC U0155:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155:00 set in the ACM , APIM (if equipped), or GPSM ?**	**Yes** GO to AE3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE3 CHECK THE IPC FOR BATTERY VOLTAGE OUT-OF-	

RANGE DTCS	
• Using a diagnostic scan tool, perform the IPC self-test. • **Are any low or high voltage DTCs recorded in the IPC ?**	**Yes** REFER to IPC DTC Chart in Section 413-01 . **No** GO to AE4 .
AE4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM (if equipped) ▪ GPSM • **Are low or high voltage DTCs recorded in the ACM , APIM (if equipped), or GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AE5 .
AE5 CHECK FOR DTC U0155:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0155:00 set in more than one audio system module?**	**Yes** GO to AE6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE6 CHECK FOR CORRECT IPC OPERATION	
• Ignition OFF. • Disconnect and inspect the IPC connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the IPC connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new IPC . REFER to Section 413-01 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AF: DTC U0159:00

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Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0159:00	Lost Communication With Parking Assist Control Module "A": No Sub Type Information	Set by the ACM when the volume cutback message is missing from the PAM for more than 5 seconds with the ignition in RUN. When the message is missing, the ACM defaults to no volume cutback when the parking aid tone is sounding.

PINPOINT TEST AF: DTC U0159:00

Test Step	Result / Action to Take
AF1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AF2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF2 RECHECK FOR DTC U0159:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0159:00 set in the ACM ?**	**Yes** GO to AF3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF3 CHECK THE PAM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the PAM self-test. • **Are any low or high voltage DTCs recorded in the PAM ?**	**Yes** REFER to PAM DTC Chart in Section 413-13 . **No** GO to AF4 .
AF4 CHECK THE ACM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool,	**Yes**

perform the ACM self-test. • **Are any low or high voltage DTCs recorded in the ACM ?**	For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AF5 .
AF5 CHECK FOR CORRECT PAM OPERATION	
• Ignition OFF. • Disconnect and inspect the PAM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the PAM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new PAM . REFER to Section 413-13 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AG: DTC U0164

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0164	Lost Communication With HVAC Control Module (EATC)	Set by the FDIM when network messages are missing from the HVAC module for more than 5 seconds with the ignition in RUN. .

PINPOINT TEST AG: DTC U0164

Test Step	Result / Action to Take
AG1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present.	**Yes** GO to AG2 .

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• **Is an observable symptom present?**	**No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG2 RECHECK FOR DTC U0164	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0164 set in the FDIM ?**	**Yes** GO to AG3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG3 CHECK THE HVAC MODULE FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the HVAC module self-test. • **Are any low or high voltage DTCs recorded in the HVAC module?**	**Yes** REFER to HVAC module DTC Chart in Section 412-00 . **No** GO to AG4 .
AG4 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the HVAC module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the HVAC module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new HVAC module. REFER to Section 412-01 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AH: DTC U0184

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0184	Lost Communication With Radio (ACM)	Set by the FDIM when network messages are missing from the ACM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AH: DTC U0184

Test Step	Result / Action to Take
AH1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AH2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH2 RECHECK FOR DTC U0184	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0184 set in the FDIM ?**	**Yes** GO to AH3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH3 CHECK THE ACM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the ACM self-test. • **Are any low or high voltage DTCs recorded in the ACM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AH4 .
AH4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test AI: DTC U0184:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0184:00	Lost Communication With Radio: No Sub Type Information	Set by the FCIM when network messages are missing from the ACM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AI: DTC U0184:00

Test Step	Result / Action to Take
AI1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AI2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AI2 RECHECK FOR DTC U0184:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0184:00 set in the FCIM ?**	**Yes** GO to AI3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

AI3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ FCIM
• **Are low or high voltage DTCs recorded in the ACM or FCIM ?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao
	
	No
	GO to AI4 .

AI4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AJ: DTC U0197

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0197	Lost Communication with Telephone Control Module	Set by the FDIM when network messages are missing from the APIM (if equipped) for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AJ: DTC U0197

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Test Step	Result / Action to Take
AJ1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AJ2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AJ2 RECHECK FOR DTC U0197 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0197 set in the FDIM ?**	**Yes** GO to AJ3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AJ3 CHECK THE APIM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the APIM self-test. • **Are any low or high voltage DTCs recorded in the APIM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AJ4 .

AJ4 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

• Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test AK: DTC U0197:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	Set by the ACM when network messages are missing from the APIM (if equipped) for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AK: DTC U0197:00

Test Step	Result / Action to Take
AK1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AK2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AK2 RECHECK FOR DTC U0197:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0197:00 set in the ACM ?**	**Yes** GO to AK3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AK3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

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• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
• **Are low or high voltage DTCs recorded in the ACM or APIM ?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao
	
	No
	GO to AK4 .

AK4 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AL: DTC U0255:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0255:00	Lost Communication With Front Display Interface Module: No Sub Type Information	Set by the ACM when network messages are missing from the FDIM for greater than 5 seconds with the ignition in RUN.

PINPOINT TEST AL: DTC U0255:00

Test Step	Result / Action to Take
AL1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AL2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AL2 RECHECK FOR DTC U0255:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0255:00 set in the ACM ?**	**Yes** GO to AL3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AL3 CHECK THE ACM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the ACM self-test. • **Are any low or high voltage DTCs recorded in the ACM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AL4 .
AL4 CHECK FOR CORRECT FDIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FDIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FDIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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• **Is the concern still present?**	

Pinpoint Test AM: DTC U0256:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	Set by the ACM when network messages are missing from the FCIM for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AM: DTC U0256:00

Test Step	Result / Action to Take
AM1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AM2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AM2 RECHECK FOR DTC U0256:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0256:00 set in the ACM ?**	**Yes** GO to AM3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AM3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ FCIM	**Yes** For DTC U3003:16, GO to Pinpoint Test AN For DTC U3003:17, GO to Pinpoint Test ao **No** GO to AM4 .

• **Are low or high voltage DTCs recorded in the ACM or FCIM ?**	

AM4 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AN: DTC U3003:16

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

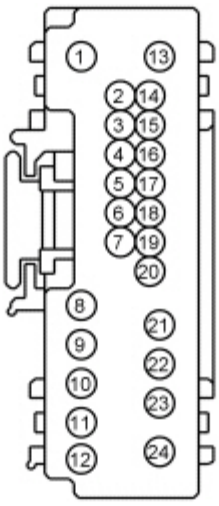
DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	Set by the ACM , APIM , FCIM , and GPSM when the supply voltage falls below 10 volts for at least 10 seconds during normal operation or for more than 250 milliseconds during the self-test.

PINPOINT TEST AN: DTC U3003:16

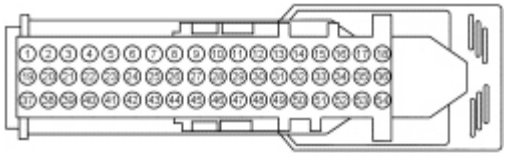
Test Step	Result / Action to Take
AN1 RECHECK FOR DTC U3003:16 • Ignition ON. • Using a diagnostic scan tool, clear the DTCs	**Yes** GO to AN2 .

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for the module in question. • Wait at least 15 seconds. • Using a diagnostic scan tool, repeat the self-test for the module in question. • **Is DTC U3003:16 still present?**	**No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
AN2 CHECK FOR CHARGING SYSTEM DTCS IN THE PCM	
• Using a diagnostic scan tool, perform the PCM self-test. • **Are any voltage-related DTCs set in the PCM ?**	**Yes** REFER to PCM DTC Chart in Section 303-14 . **No** GO to AN3 .
AN3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. REFER to Battery Condition Test in Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AN4 . **No** REFER to the Symptom Chart in Section 414-00 .
AN4 CHECK THE MODULE VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect the audio system module setting DTC U3003:16. • Ignition ON. • Measure the voltage between the module setting DTC U3003:16 and ground. • For the ACM , measure the **voltage** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit C290A-1 / SBP29 (GY/RD) / — / Ground  	**Yes** GO to AN5 . **No** REPAIR the circuit for high resistance.

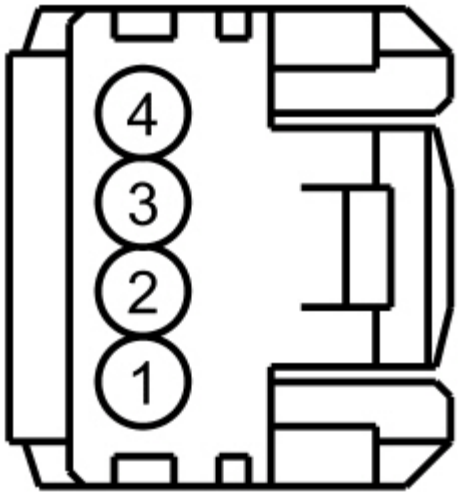
- For the APIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	—	Ground



- For the FCIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	—	Ground

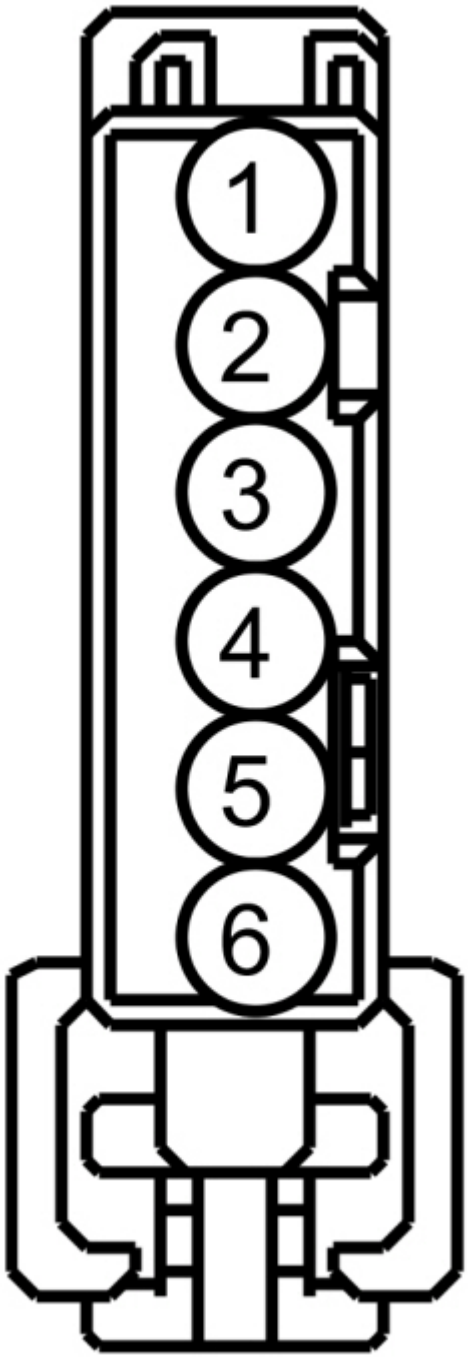


- For the GPSM , measure the **voltage** between:

Positive Lead		Negative Lead	

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Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	—	Ground

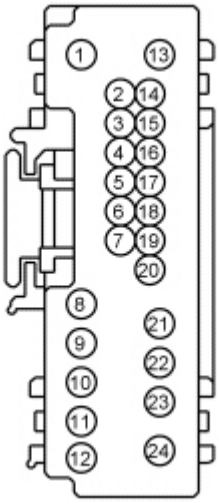


- **Is the voltage within 0.2 volts of the recorded battery voltage?**

AN5 CHECK THE SUSPECT MODULE GROUND CIRCUIT FOR CONTINUITY

- Measure the voltage at the suspect module.
- For the ACM, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C290A-1	SBP29 (GY/RD)	C290A-13	GD114 (BK/BU)



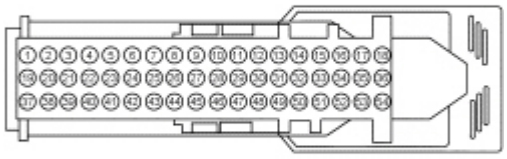
- For the APIM, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	C2383-37	GD114 (BK/BU)
		C2383-38	GD114 (BK/BU)

Yes
For the ACM, GO to AN6. For the APIM, GO to AN7. For the FCIM, GO to AN8. For the GPSM, GO to AN9.

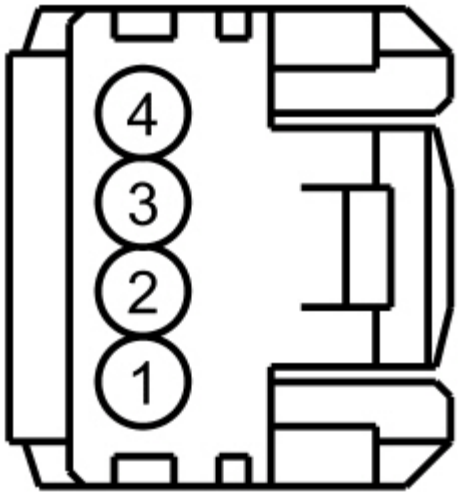
No
REPAIR the circuit for high resistance.

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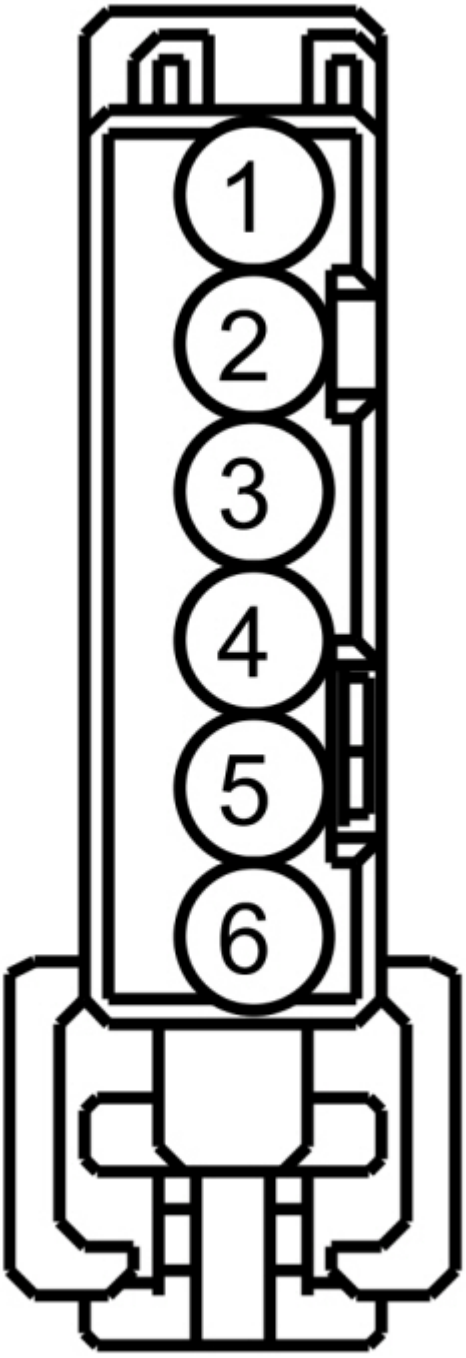
- For the FCIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	C2402-4	GD133 (BK)



- For the GPSM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	C2398-6	GD114 (BK/BU)



- **Is the suspect module voltage greater than 11 volts?**

AN6 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect and inspect all the ACM	**Yes** CHECK OASIS for any applicable TSBs. If a

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connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN7 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN8 CHECK FOR CORRECT FCIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN9 CHECK FOR CORRECT GPSM OPERATION	

• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) .
	
	No
	The system is operating correctly at this time.

seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AO: DTC U3003:17

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	Set by the ACM , APIM , FCIM , and GPSM when the supply voltage is more than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

PINPOINT TEST AO: DTC U3003:17

Test Step	Result / Action to Take
AO1 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Using a diagnostic scan tool, clear the DTC for the module in question. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question. • **Is DTC U3003:17 present?**	**Yes** GO to AO2 . **No** The system is operating correctly at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.
AO2 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Using a diagnostic scan tool, retrieve all CMDTCs . • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question. • **Are high voltage DTCs such as B1676, P0563, U3003:17 set in more than one module?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** GO to AO3 .

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AO3 CHECK THE BATTERY VOLTAGE	
• Turn off all interior lights, exterior lights, and accessories. • Start and run the engine at approximately 2,000 RPM for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** For the ACM , GO to AO4 . For the APIM , GO to AO5 . For the FCIM , GO to AO6 . For the GPSM , GO to AO7 .
AO4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AO5 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

• Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

AO6 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AO7 CHECK FOR CORRECT GPSM OPERATION
• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Accessory Protocol Interface Module (APIM) Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool
 ST3051-A	Universal Serial Bus (USB) Male-A to Male-A Cable CCMUSB2-AM-AM-10 or equivalent

Accessory Protocol Interface Module (APIM) Programming Using the Integrated Diagnostic System (IDS)

NOTE:

- If a new Accessory Protocol Interface Module (APIM) is being installed, install the new APIM before carrying out the following procedure. Refer to the appropriate section in Group 415 for the procedure.

NOTE:

- The programming procedure deletes any phones that were paired with the SYNC® system.
- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- A file of approximately 80 megabytes needs to be downloaded from the online database for the programming. Allow extra time for the file to download.
- The USB male A to male A cable (CCMUSB2-AM-AM-10 or equivalent) is required.
- The diagnostic scan tool is required.
  - Ensure that the IDS version and patch software levels are up to date.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.

1.
   - Close the IDS program before attempting to program the Accessory Protocol Interface Module (APIM).
   - Connect a battery charger set on low.
     - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.
   - Connect one end of the USB male-A to male-A cable to the diagnostic scan tool, and the other end to the vehicle's USB port.

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- Connect the diagnostic scan tool to the DLC .
- Access the technician service publication website and run On-Line Automotive Service Information System (OASIS) using "Read VIN & DTCs."
    - If the "Read VIN & DTCs" button is green with a red IDS icon, refer to the "SYNC - Software Programming" document under the "Service Tips" tab.
    - If the "Read VIN & DTCs" button is red with a grey IDS icon, ensure pop ups are enabled, follow the Internet Explorer pop ups, and then refer to the "SYNC - Software Programming" document under the "Service Tips" tab.
- If the "SYNC - Software Programming" document is not followed, the programming may stop or encounter errors due to improperly configured Internet browser settings.

2. From the OASIS tab, select the "SYNC" button.

3. **NOTE:** There are 3 types of Accessory Protocol Interface Module (APIM) programming available:
    - Standard — Used to update the Accessory Protocol Interface Module (APIM) and any currently installed applications to the latest software levels.
    - Custom — Used to show all the available software options (including applications that may not have been installed previously) that can be programmed into the Accessory Protocol Interface Module (APIM). Use this selection when upgrades become available or as directed by a TSB.
    - Module Replacement — Used when the Accessory Protocol Interface Module (APIM) has been replaced. This type of programming performs the required provisioning (restores software for newly installed hardware).

4. After selecting 1 of the 3 options (Standard, Custom, or Module Replacement), select the "Read SYNC" button to verify the current Accessory Protocol Interface Module (APIM) assembly, VIP , and CIP software levels. The software levels are compared to an online database, followed by the available software being displayed.

5. **NOTE:** Do not disconnect the VCM or USB cable during Accessory Protocol Interface Module (APIM) programming.

   Select the "Program SYNC" button to begin the Accessory Protocol Interface Module (APIM) programming process.

6. Follow the diagnostic scan tool on-screen directions.
    - After programming is complete, the diagnostic scan tool displays "Programming has been successfully completed."

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Accessory Protocol Interface Module (APIM) Reset

NOTE: Carrying out an APIM Reset consists of a battery disconnect and a SYNC® system Master Reset.

NOTE: NOTE: This procedure will clear all CMDTCs . The DTCs must be recorded now if other (non SYNC®) diagnoses are to be performed after this procedure.

1. Remove any devices connected to the USB port(s), audio input jack (if equipped), or media hub (if equipped).

2. **NOTE:** After the APIM reset procedure has been completed the customer should be advised to reset their device following the manufacturer's instructions. Refer to the device's owner's manual and/or website for information on how to perform a Manual / Master Reset or Clear. Devices can be powered off and back on for a simple re-boot. In some cases the device's battery may also need to be removed and re-installed to complete a re-boot. In addition, cell phones may need to have SYNC® deleted from the Bluetooth menu prior to re-pairing the phone to the SYNC® system. Customer devices may affect the operation of SYNC® and this should be understood to prevent unnecessary diagnosis or repairs to the system.

   Disconnect the negative battery cable for 1 minute, then reconnect it. Refer to Section 414-01 .

3. **NOTE:** Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. On vehicles equipped MyFord Touch or MyLincoln Touch with navigation, the customer’s saved destination points (home address and points of interest) and preferences will also be lost with a Master Reset.

   Carry out a SYNC® system Master Reset. Refer to the owner's literature

4. Verify system function using the Multi-Media Interface Tester 105-00120, to test the audio output for the audio input jack/socket (if equipped), USB port(s), and Bluetooth. If equipped, use the RCA Adapter 105-00121 to test the audio output for the RCA jacks.

5. If a concern is still present return to the Symptom Charts.

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Audio Control Module (ACM) Self-Diagnostic Mode

NOTE: If the Audio Front Control Module (ACM), FCIM , or FDIM are inoperative (blank or do not power on), obtain the ACM part number by referencing the label attached to the Audio Front Control Module (ACM) chassis.

1. Turn the ACM on.

2. Operate the audio system in radio tuner AM/FM mode.

3. Press and hold preset buttons 3 and 6 for 3 seconds until the speaker walk around test begins.
   - The display indicates each speaker as it is tested.

4. **NOTE:** If the speaker walk around test is the only test required, this procedure can be stopped after Step 3 by turning the ACM off.

   Before the speaker walk around test is complete, the following actions can be performed:

Preset Button Press	Diagnostic Function	Display	Diagnostic Function Description
1	ACM Self-Test	SELF TEST, SELF PASS, SELF FAIL	The ACM carries out a self-test. At the end of the self-test, the FDIM display indicates either SELF PASS, or SELF FAIL. If the self-test failed, DTCs can be accessed by pressing the TUNE UP button.
2	View DTCs	NO DTCS, DTCS FOUND	The FDIM displays DTCS FOUND if DTCs are present. To scroll through the DTCs, press the TUNE UP button. If no DTCs are present, the FDIM displays NO DTCS. To clear DTCs, press the EJECT, then TUNE UP button.
3	AM/FM Antenna Signal Strength	SIGNAL ###	The FDIM displays the AM/FM antenna signal strength. To see the AM signal strength, the audio system must be in AM radio tuner mode before entering the ACM self-diagnostic mode. To see the FM signal strength, the audio system must be in FM radio tuner mode before entering the ACM self-diagnostic mode. If no antenna is present, a signal strength of 0 will be displayed.
4	Software Levels	SOFT LEVELS	The FDIM displays software levels for various components of the audio system. Knowing the software levels may aid diagnostics. Press the TUNE UP button to scroll through the software levels.
5	Display Test	DISPLAY TEST, then all segments illuminate	All of the FDIM display segments illuminate.
6	Retrieve ACM Part Number	RADIO CONFIG	The FDIM displays the ACM part number and various configuration levels. Press the TUNE UP button to scroll to the desired function.

5. To exit the self-diagnostic mode, turn the ACM off.

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Satellite Radio Electronic Serial Number (ESN) Retrieval

NOTE: If the SDARS , Audio Front Control Module (ACM), FCIM (if equipped), or FDIM (if equipped) are inoperative (blank or do not power on), obtain the Electronic Serial Number (ESN) by referencing the label attached to the Audio Front Control Module (ACM) chassis.

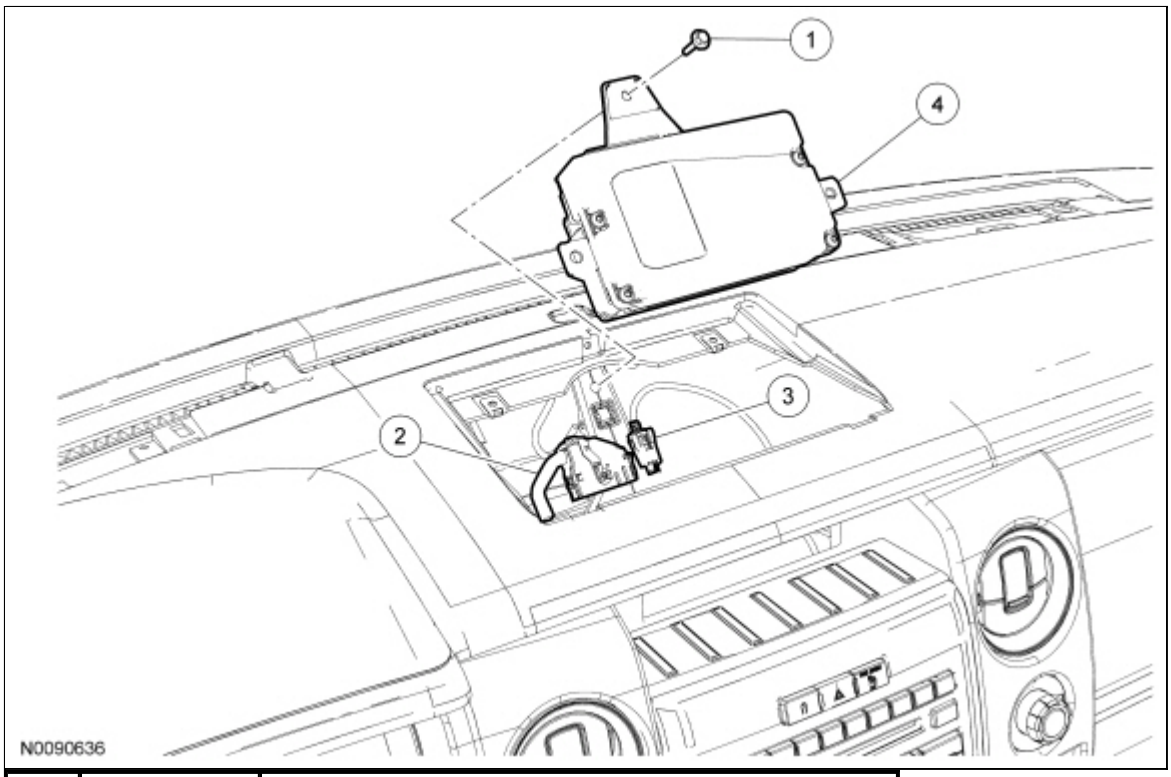
1. Turn the Audio Front Control Module (ACM) on.

2. Operate the audio system in satellite radio mode.

3. Depending on vehicle configuration, simultaneously press and hold the AUX button and preset button 1, or the SIRIUS button and preset button 1.
   - The Satellite Digital Audio Receiver System (SDARS) module Electronic Serial Number (ESN) displays on the FDIM .

4. Record the SDARS module ESN .

Accessory Protocol Interface Module (APIM)



Item	Part Number	Description
1	W704875-S	Accessory Protocol Interface Module (APIM) screw
2	—	APIM electrical connector (part of 14401)
3	—	Universal Serial Bus (USB) cable (part of 14D202)
4	14D212	APIM

Removal and Installation

1. Remove the instrument panel upper bin.
    1. Remove the rubber mat.
    2. Remove the 2 screws.
    3. Remove the instrument panel upper bin.

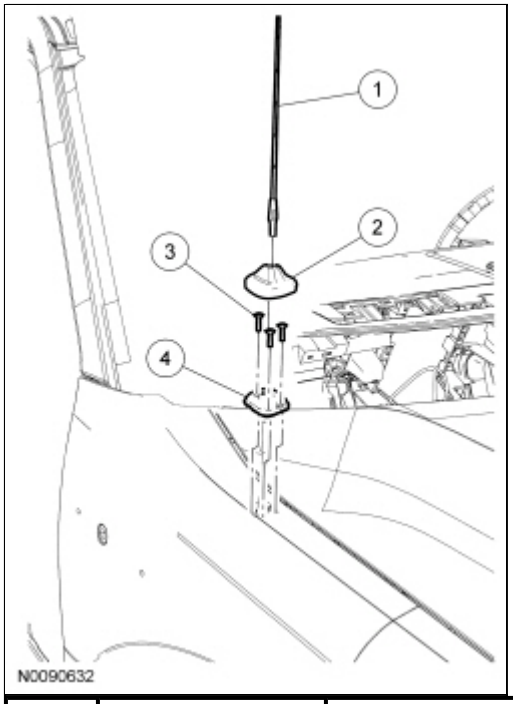
2. Remove the APIM screw and position the APIM upward.

3. Remove the APIM .
    - Disconnect the electrical connector and the Universal Serial Bus (USB) cable.

4. To install, reverse the removal procedure.
    - If a new APIM is being installed, program the APIM . For additional information, refer to Accessory Protocol Interface Module (APIM) Programming .

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Antenna — AM/FM

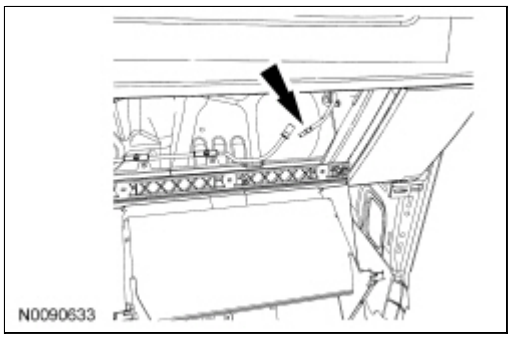


Item	Part Number	Description
1	18813	AM/FM antenna mast
2	18A927	AM/FM antenna base cap
3	N610019	AM/FM antenna screws (3 required)
4	18A894	AM/FM antenna base

Removal and Installation

1. Lower the glove compartment completely.

2. Disconnect the AM/FM antenna from the AM/FM antenna cable.
    - Push the antenna cable end and the grommet through the side cowl.



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3. ***NOTICE:*** **Do not over tighten the antenna mast or damage to the antenna base or mast may occur.**

   Remove the AM/FM antenna mast.
   1. To install, tighten to 4.2 Nm (36 lb/in).

4. **NOTE:** A new AM/FM antenna base cap must be installed.

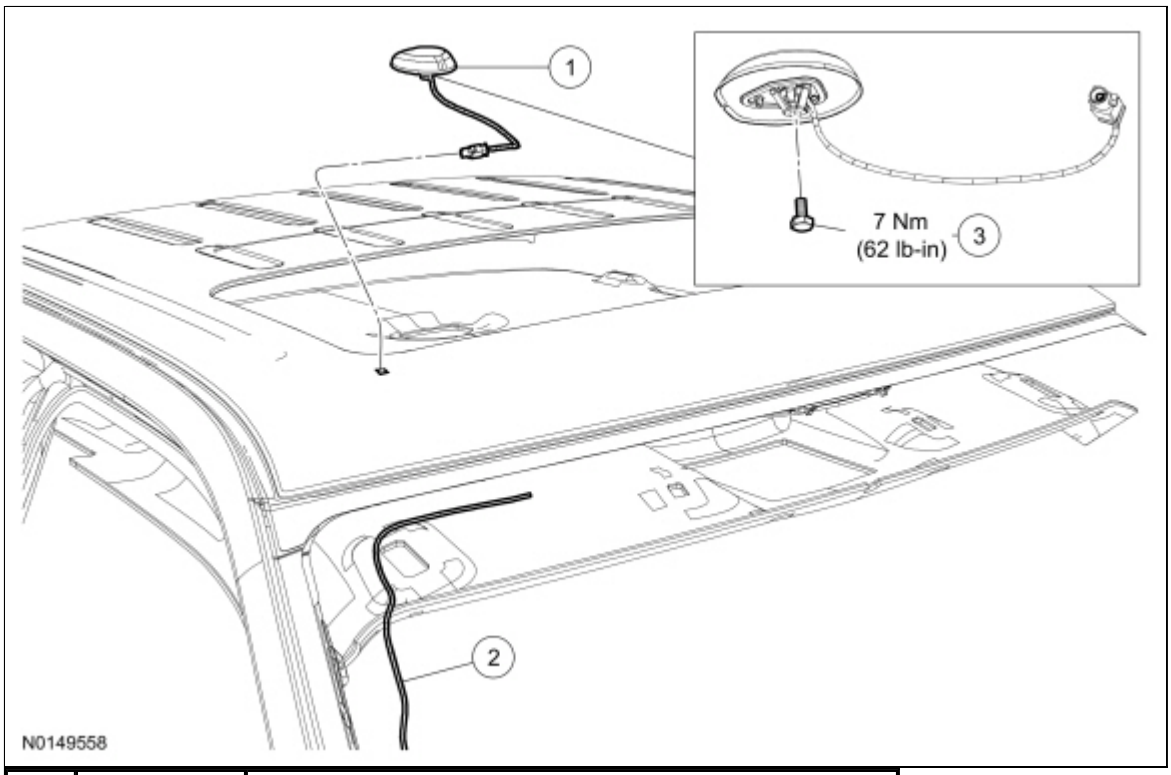
   Using a suitable tool such as a hook-shaped pick, remove the AM/FM antenna base cap by prying upward.

5. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

6. Remove the 3 screws and the AM/FM antenna base.
   1. To install, tighten to 2.5 Nm (23 lb/in).

7. To install, reverse the removal procedure.

Antenna — Satellite Radio



Item	Part Number	Description
1	10E893	Satellite radio antenna
2	—	Satellite radio antenna electrical connector (part of 19A397)
2	—	Satellite radio antenna retaining bolt (part of 10E893)

Removal and Installation

1. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .

2. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.

3. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical connector.

4. **NOTE:** Remove the satellite antenna and pigtail through the mounting opening in the roof panel.

   Remove the satellite antenna.
   - Disconnect the electrical connector.
   - Remove the satellite antenna retaining bolt and retainer then remove the satellite antenna from

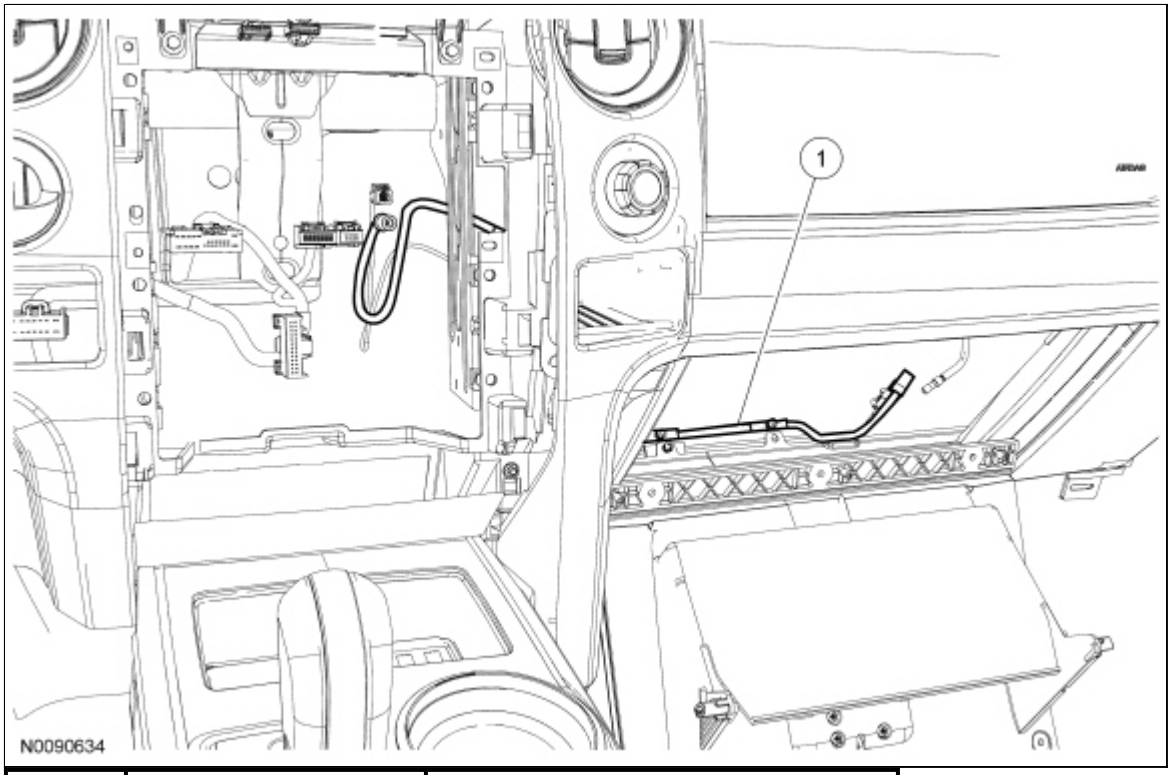
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the roof panel.

- To install, tighten to 7 Nm (62 lb-in).

5. To install, reverse the removal procedure.

Antenna Cable — AM/FM



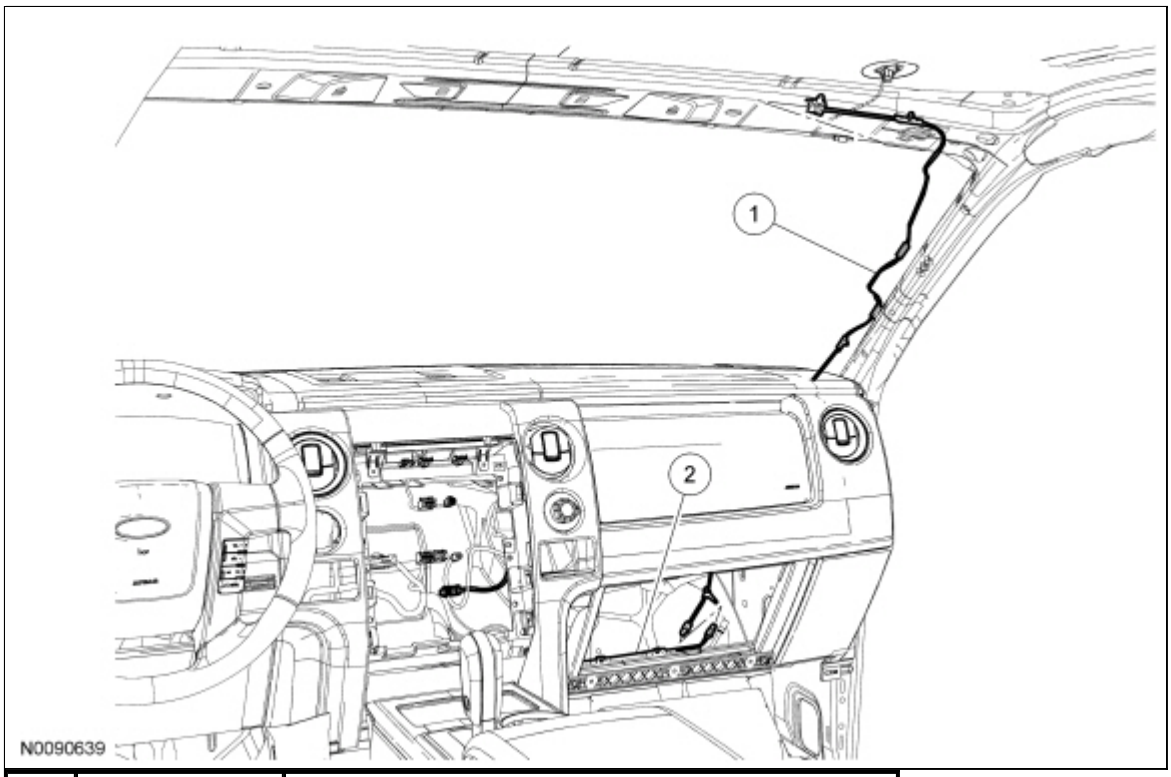
Item	Part Number	Description
1	18812	AM/FM antenna cable

Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.
2. Lower the glove compartment completely.
3. Disconnect the AM/FM antenna cable from the AM/FM antenna.
4. Separate the pushpins and remove the AM/FM antenna cable.
5. To install, reverse the removal procedure.

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Antenna Cable — Satellite Radio



Item	Part Number	Description
1	19A397	Upper satellite radio antenna cable
2	19A397/10E928	Lower satellite radio antenna cable (without/with navigation)

Removal and Installation

Both cables

1. Lower the glove compartment completely.
2. Disconnect the upper-to-lower satellite radio antenna cable connection.

Upper cable

3. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .
4. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.
5. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical connector.

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6. Remove the upper satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the A-pillar and instrument panel.

Lower cable

7. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.

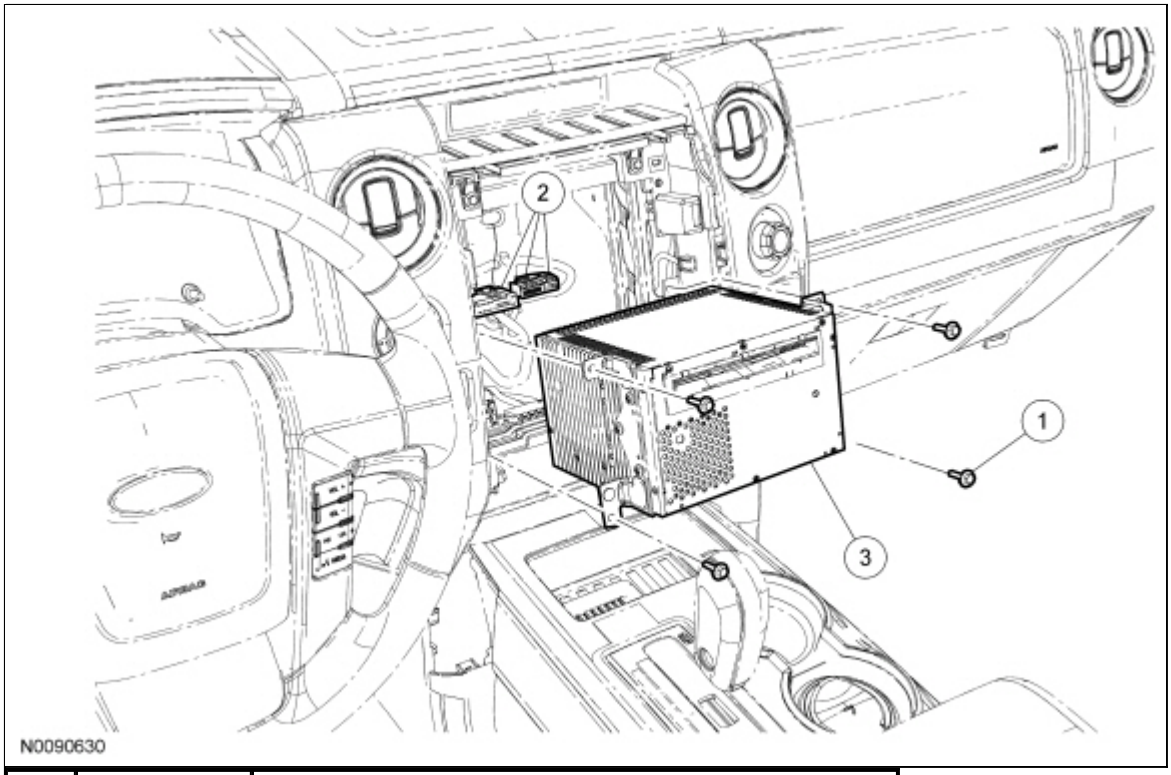
8. Remove the lower satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the instrument panel.

Both cables

9. To install, reverse the removal procedure.

Audio Control Module (ACM)

Single CD



Item	Part Number	Description
1	W707628-S	Audio Front Control Module (ACM) screws (4 required)
2	—	ACM electrical connectors (part of 14401 and 18812)
3	18806	ACM

Removal and Installation

NOTE: It is not necessary to remove the Audio Front Control Module (ACM) to retrieve the part number. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

1. **NOTE:** Module configuration is required when a new ACM is being installed.

   Upload the ACM configuration information to the scan tool . Refer to Programmable Module Installation (PMI) in Section 418-01 .

2. Remove the Front Controls Interface Module (FCIM). Refer to Front Controls Interface Module (FCIM) .

3. Remove the 4 screws and the ACM .

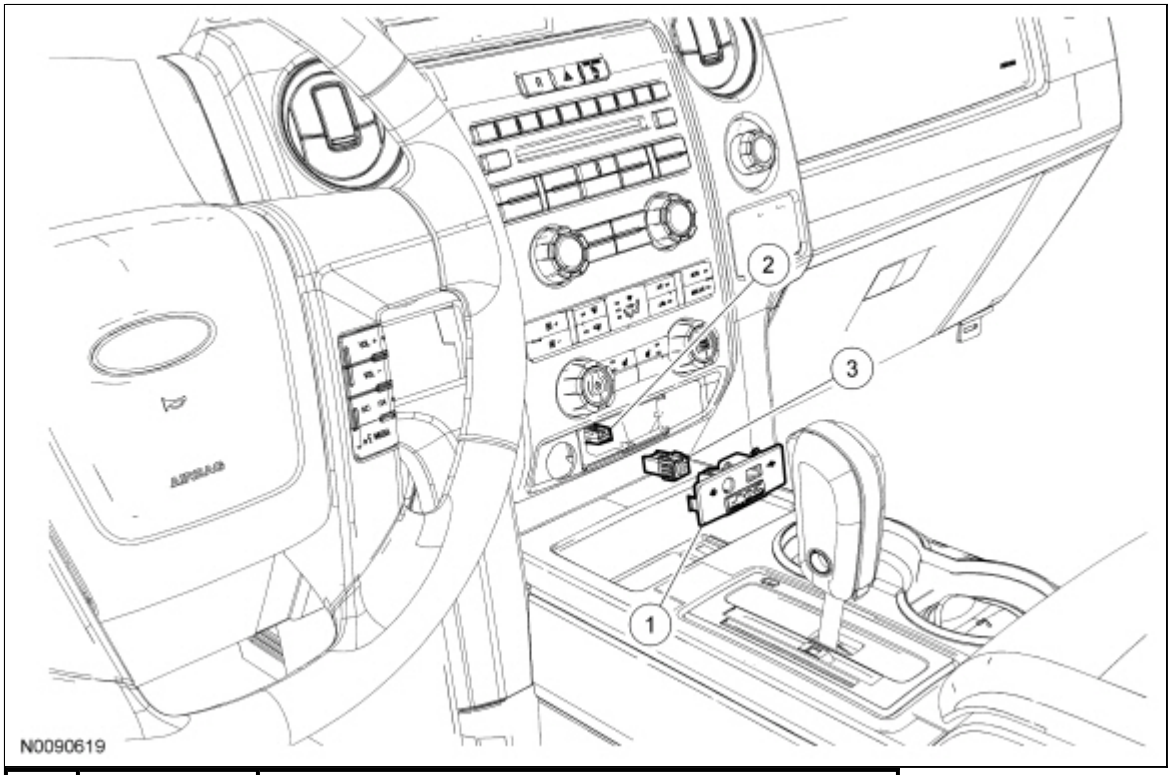
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- Disconnect the electrical connectors.
- To install, tighten to 2.5 Nm (23 lb-in).

4. To install, reverse the removal procedure.
    - Download the configuration information to the ACM . Refer to PMI in Section 418-01 .

Audio Input Jack

NOTE: Vehicle with the SYNC® system shown, others similar.



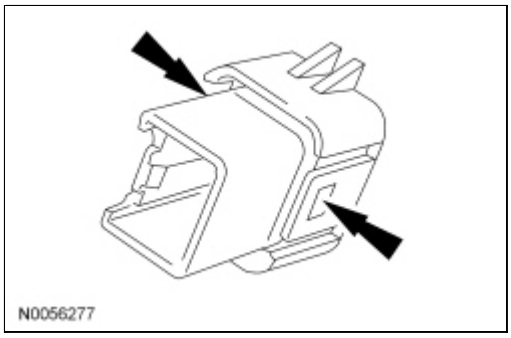
Item	Part Number	Description
1	19C149	Audio input jack bezel
2	—	Audio input jack electrical connector (part of 14401)
3	19A164	Audio input jack

Removal and Installation

1. Using a suitable tool such as a hook-shaped pick, remove the audio input jack bezel by prying rearward.
    - Disconnect the electrical connector(s).

2. Release the tabs and remove the audio input jack.

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3. To install, reverse the removal procedure.

Compass Module

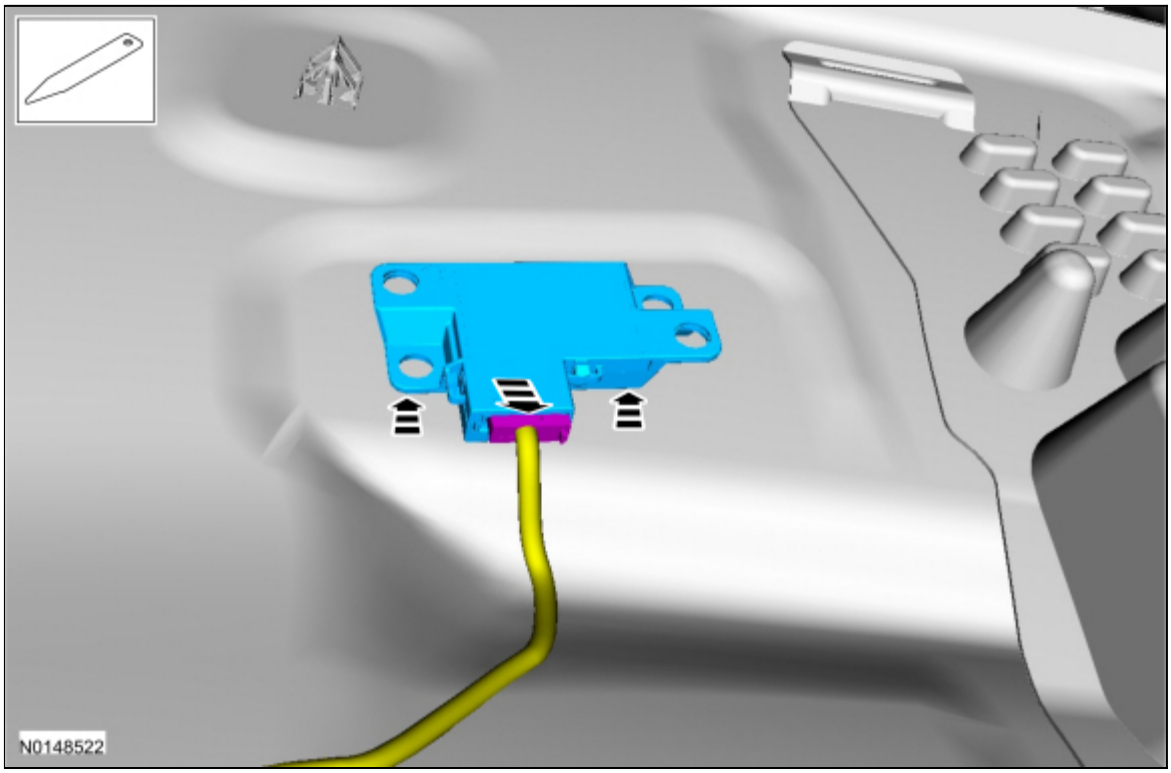
Removal and Installation

NOTE: The compass module is glued to the headliner.

NOTE: When replacing the compass module, obtain 3M™ Duramix™ 4747 Super Fast Adhesive commercially to attach the compass module to the headliner. The 3M™ Duramix™ 4747 Super Fast Adhesives is a 2- part adhesive in a 50 ml dual-tube applicator.

1. Remove the headliner. Refer to Section 501-05 .

2. Remove the compass module from the headliner.
   - Disconnect the electical connector.

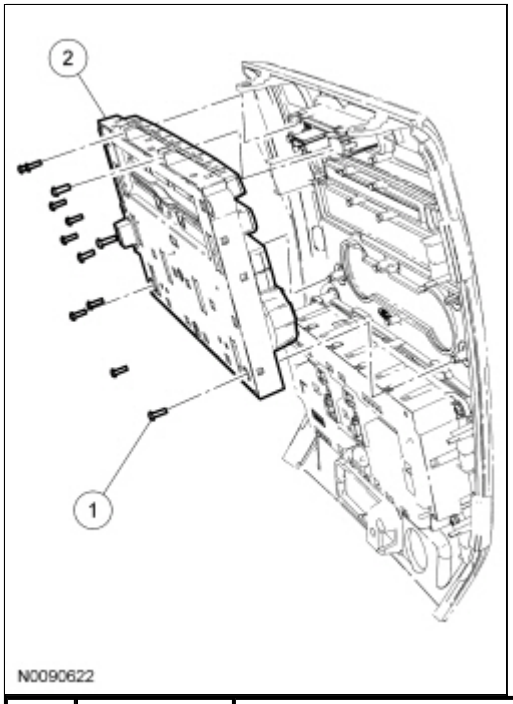


3. To install, reverse the removal procedure.

4. CALIBRATE the compass. Refer to General Procedures in Section 413-01 .

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Front Controls Interface Module (FCIM)



Item	Part Number	Description
1	—	Front Controls Interface Module (FCIM) screws (12 required) (part of 18842)
2	18842	FCIM

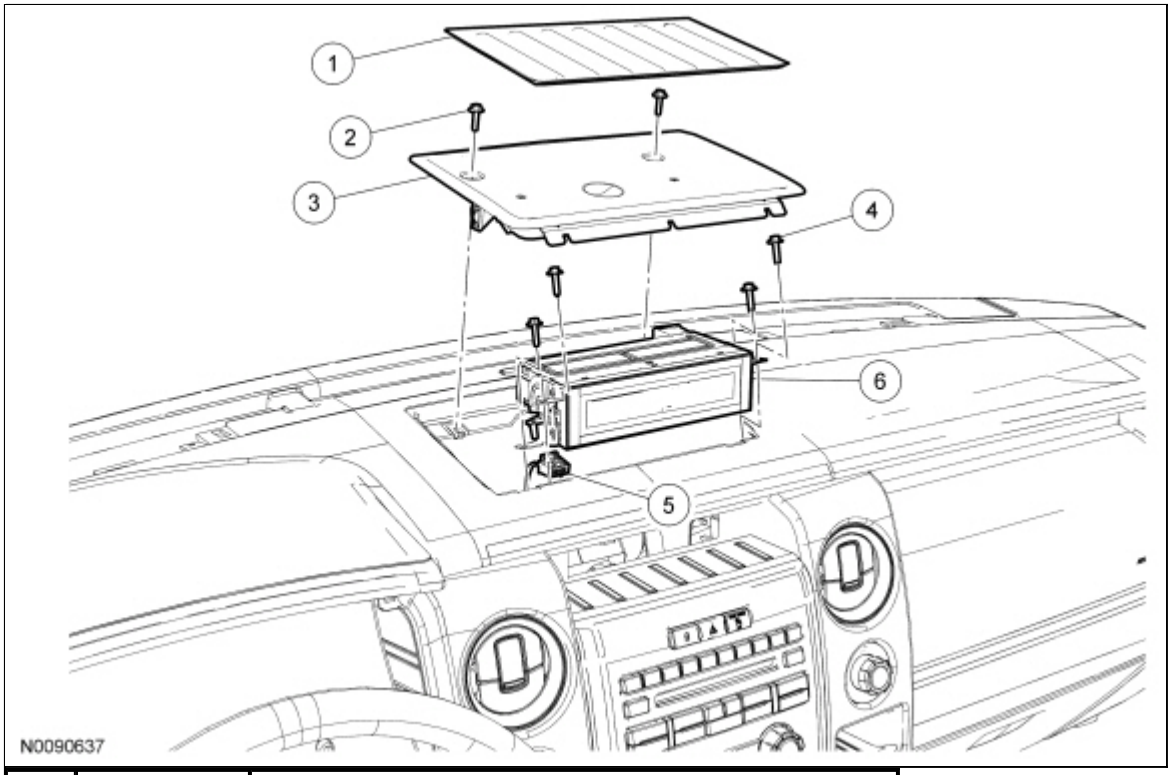
Removal and Installation

1. Remove the instrument panel finish panel - center lower. For additional information, refer to Section 501-12 .
2. Remove the 12 screws and the Front Controls Interface Module (FCIM).
3. To install, reverse the removal procedure.

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Front Display Interface Module (FDIM)

Vehicles Without Navigation



Item	Part Number	Description
1	15044G24	Instrument panel upper bin mat
2	W707628	Instrument panel upper bin screws (2 required)
3	—	Instrument panel upper bin
4	W707628-S	Front Display Interface Module (FDIM) screws (4 required)
5	—	FDIM electrical connector (part of 14401)
6	10D885	FDIM

Removal and Installation

1. **NOTE:** Module configuration is required when a new Front Display Interface Module (FDIM) is being installed.

   Upload the FDIM configuration information to the scan tool . Refer to Programmable Module Installation (PMI) in Section 418-01 .

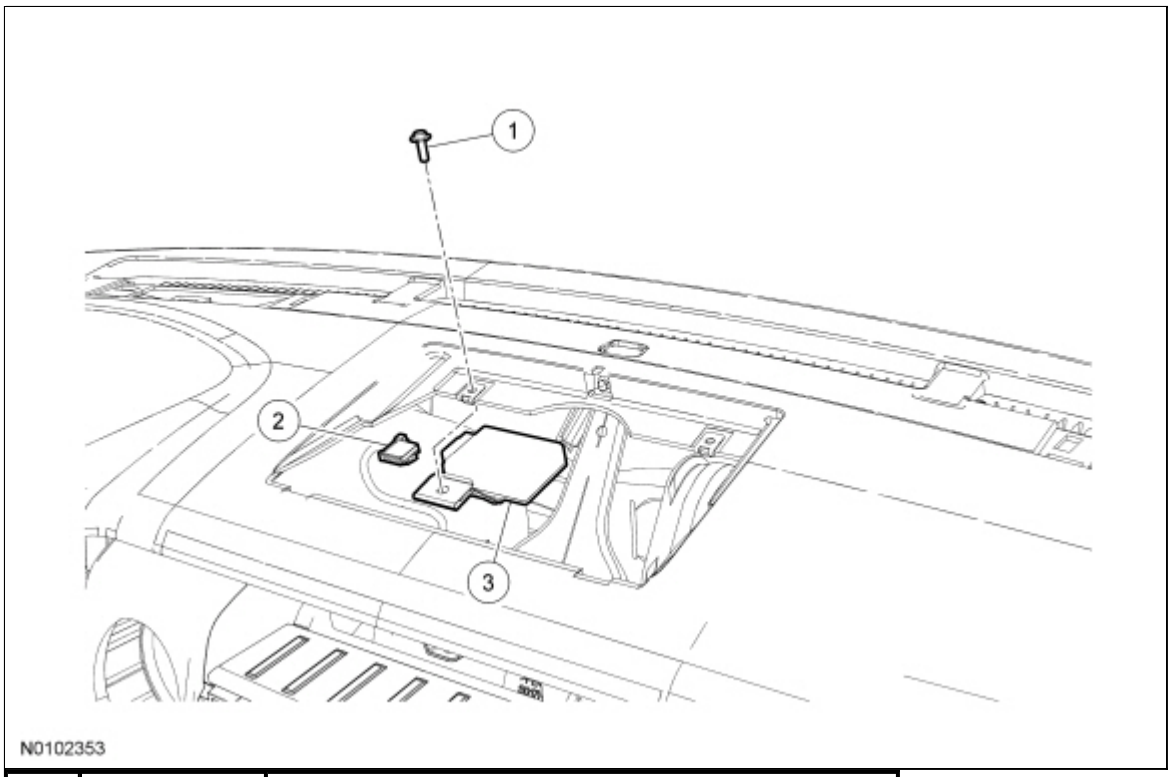
2. Remove the mat, the 2 screws, and the instrument panel upper bin.

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3. Remove the 4 screws and the FDIM .
    - Disconnect the electrical connector(s).
    - To install, tighten to 2 Nm (18 lb-in).

4. To install, reverse the removal procedure.
    - Download the configuration information to the FDIM . Refer to PMI in Section 418-01 .

Global Positioning System Module (GPSM)



Item	Part Number	Description
1	W707628-S	Global Positioning System Module (GPSM) screw
2	—	GPSM electrical connector (part of 14401)
3	10E893	GPSM

Removal and Installation

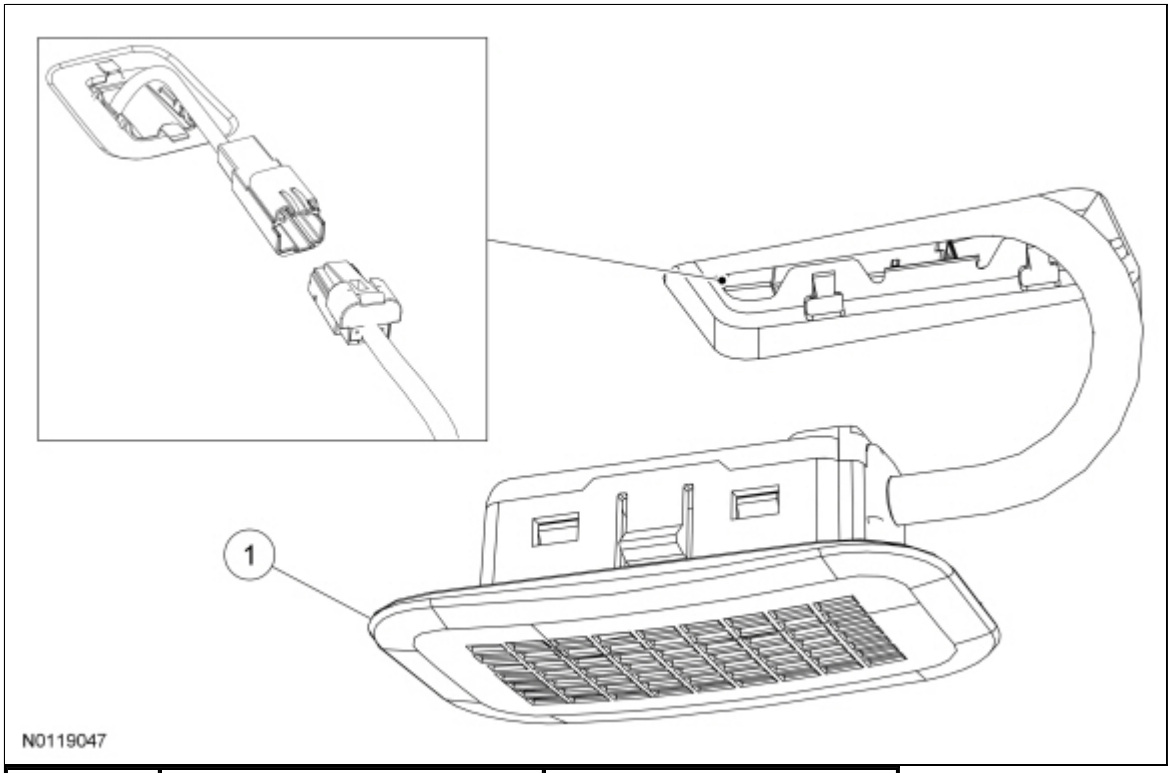
1. Remove the Front Display Interface Module (FDIM). For additional information, refer to Front Display Interface Module (FDIM) in this section.

2. Remove the screw and the Global Positioning System Module (GPSM).
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

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Microphone



Item	Part Number	Description
1	19A391	Microphone

Removal

1. Using a suitable tool, (such as a thin small flat head screwdriver) twist and pry the microphone bezel from the headliner metal mounting bracket.

2. Remove the microphone from the headliner by grasping the microphone pigtail.
    - Disconnect the microphone electrical connector.

Installation

1. Reconnect the microphone electrical connector.

2. Wrap the connection with anti-rattle tape.

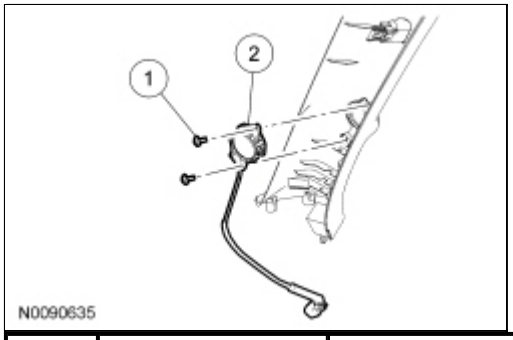
3. Feed the microphone pigtail into the headliner through the microphone hole.
    - Verify the microphone pigtail points towards the front of the vehicle.

4. Snap the microphone into the headliner mounting bracket.
    - Verify the mounting bracket and microphone are snug to the headliner.

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Speaker — A-Pillar

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	W701678-S	A-pillar speaker screws (2 required)
2	18978	A-pillar speaker

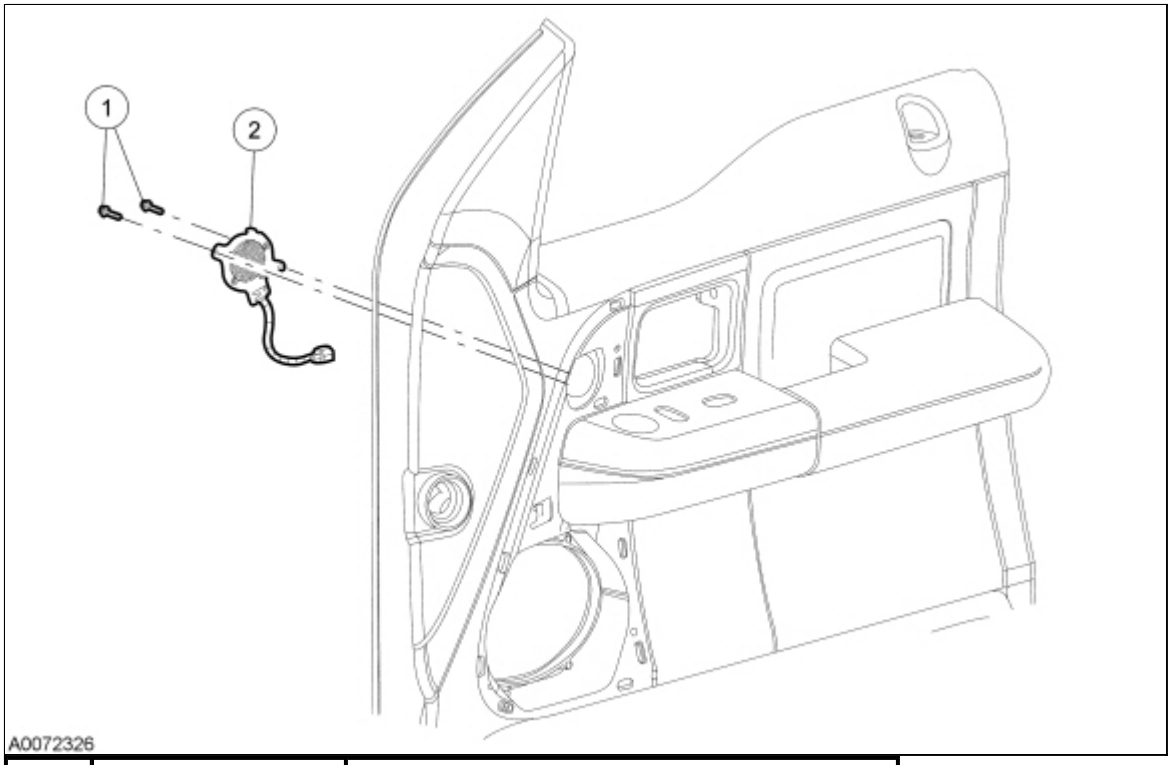
Removal and Installation

1. Remove the A-pillar trim panel. For additional information, refer to Section 501-05 .
2. Remove the 2 screws and the A-pillar speaker.
3. To install, reverse the removal procedure.

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Speaker — Door

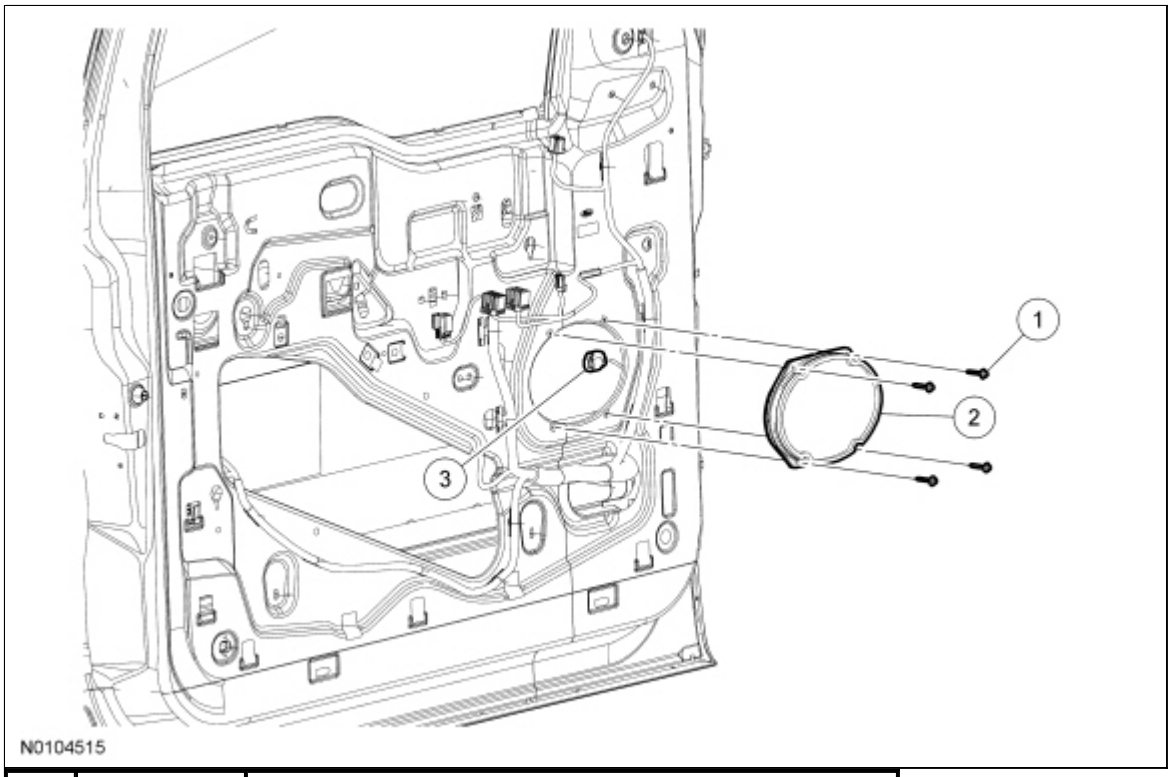
Front Door Tweeter Speaker



Item	Part Number	Description
1	W701678	Tweeter speaker screws (2 required)
2	19B170/19B171	Tweeter speaker (RH/LH)

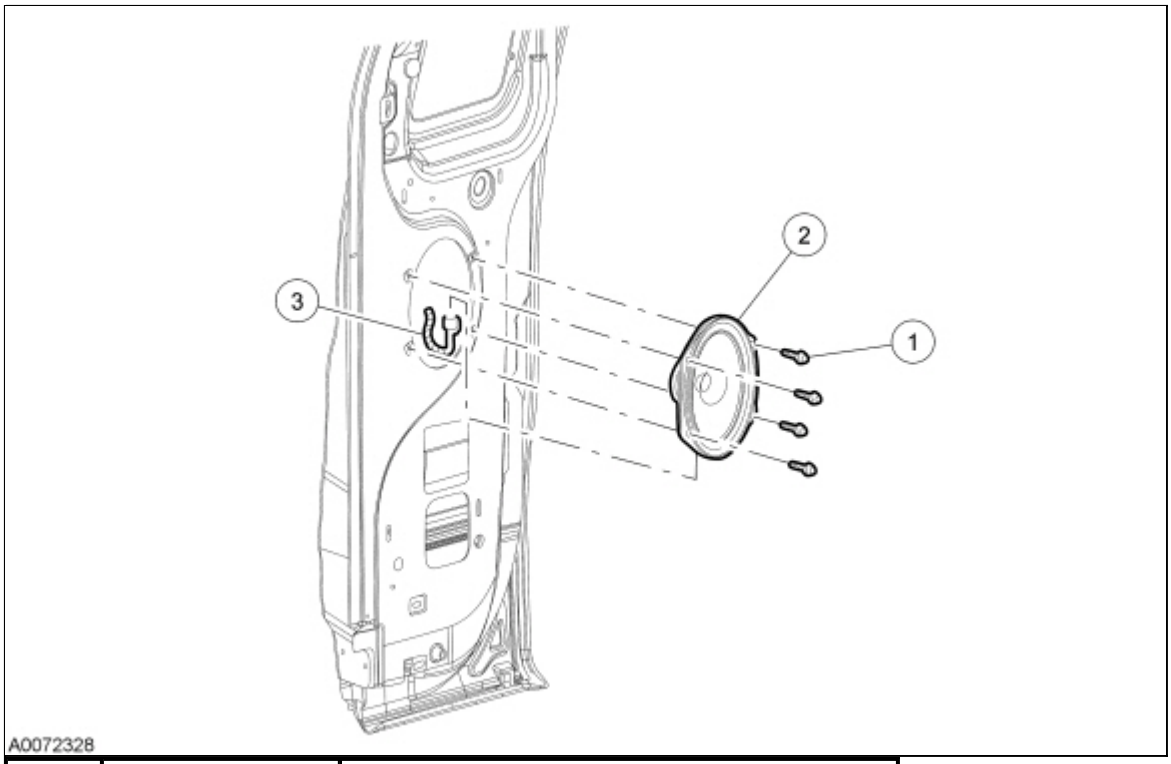
Front Door Speaker

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Item	Part Number	Description
1	W707628	Front door speaker screws (4 required)
2	18808	Front door speaker
3	—	Front door speaker electrical connector (part of door harness)

Rear Door Speaker



Item	Part Number	Description
1	W706766	Rear speaker screws (4 required)
2	18808	Rear speaker
3	180103	Rear speaker electrical connector

Removal and Installation

Front door

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws (2 for the tweeter, 4 for the door speaker) and the speaker.
   - Disconnect the electrical connector.

Rear door

3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

4. Remove the 4 screws and the rear door speaker.
   - Disconnect the electrical connector.

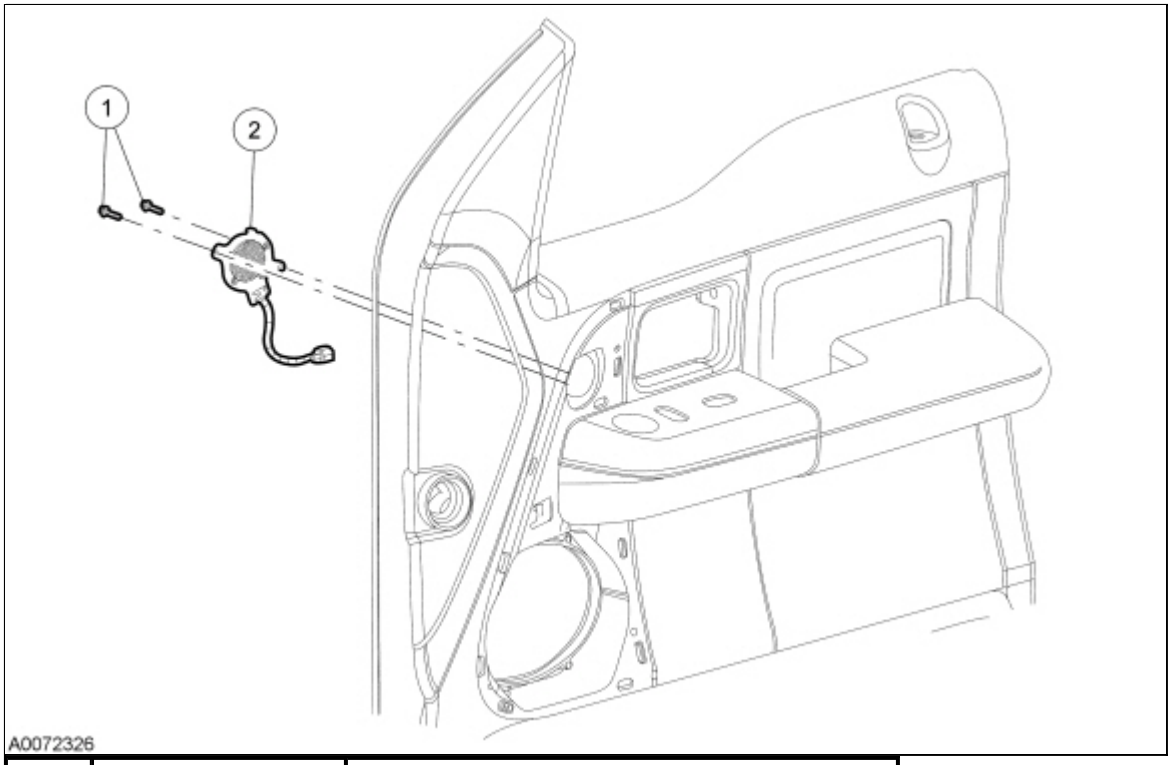
All speakers

5. To install, reverse the removal procedure.

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Speaker — Door

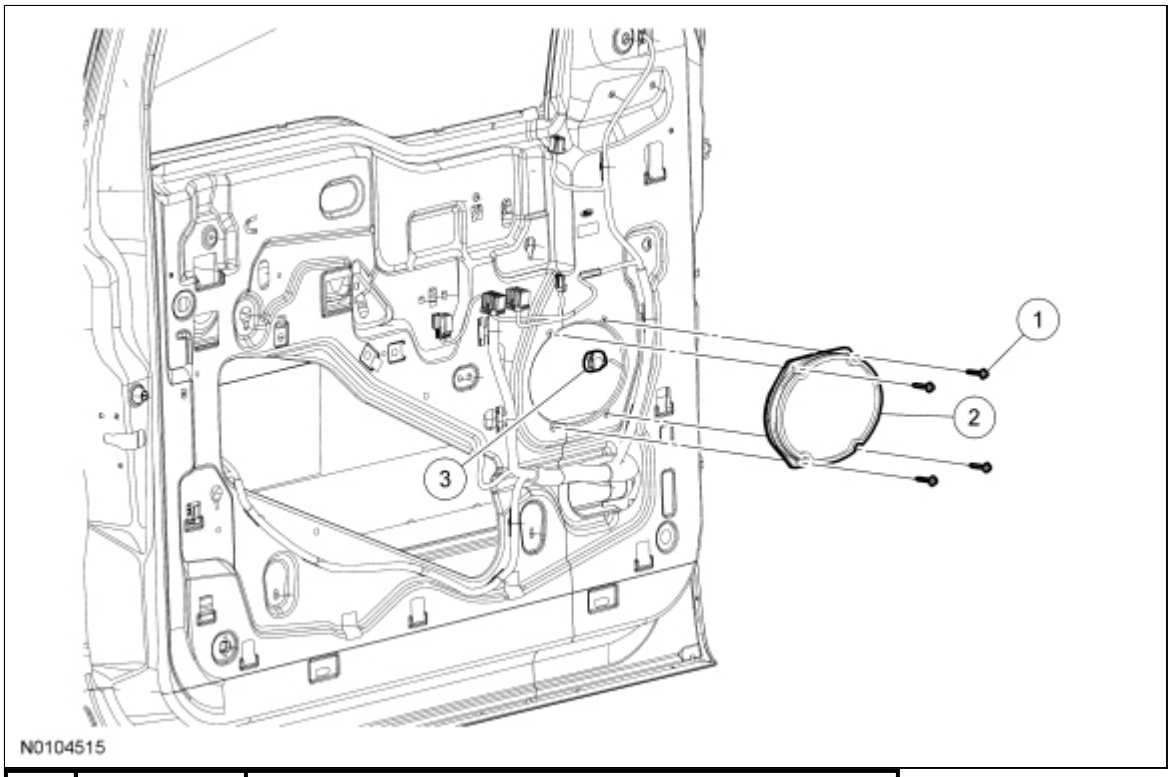
Front Door Tweeter Speaker



Item	Part Number	Description
1	W701678	Tweeter speaker screws (2 required)
2	19B170/19B171	Tweeter speaker (RH/LH)

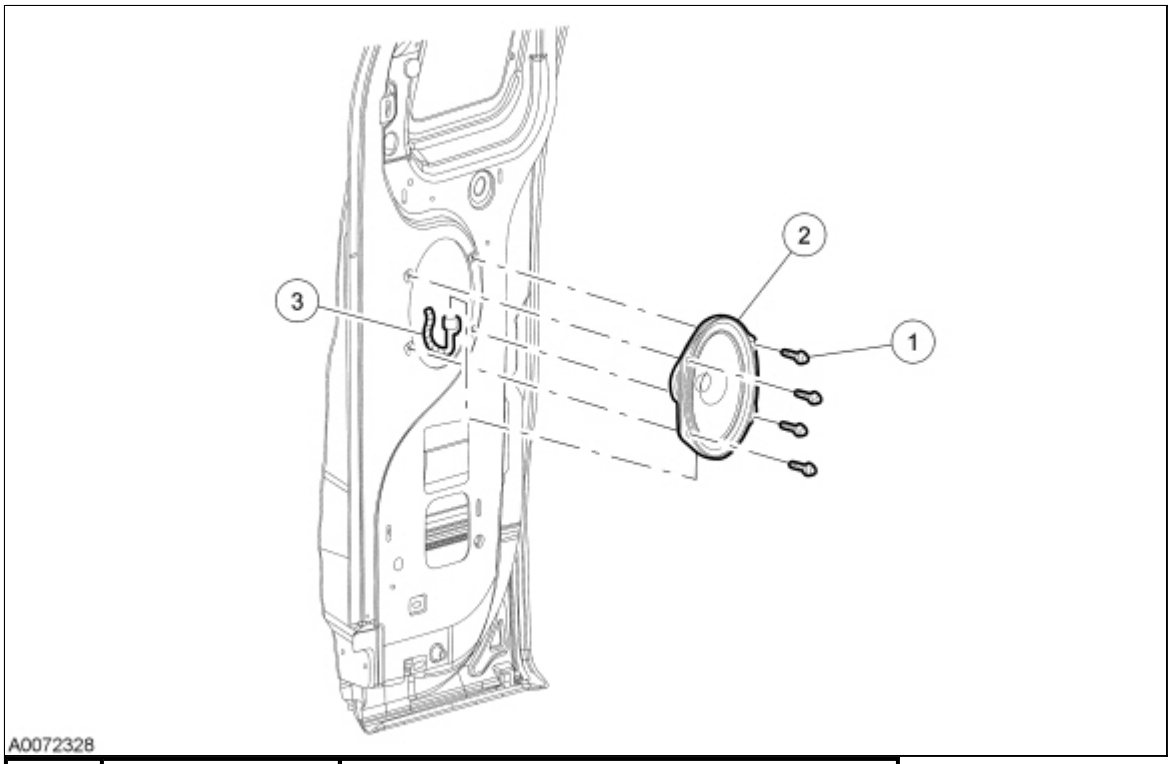
Front Door Speaker

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Item	Part Number	Description
1	W707628	Front door speaker screws (4 required)
2	18808	Front door speaker
3	—	Front door speaker electrical connector (part of door harness)

Rear Door Speaker



Item	Part Number	Description
1	W706766	Rear speaker screws (4 required)
2	18808	Rear speaker
3	180103	Rear speaker electrical connector

Removal and Installation

Front door

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws (2 for the tweeter, 4 for the door speaker) and the speaker.
   - Disconnect the electrical connector.

Rear door

3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

4. Remove the 4 screws and the rear door speaker.
   - Disconnect the electrical connector.

All speakers

5. To install, reverse the removal procedure.

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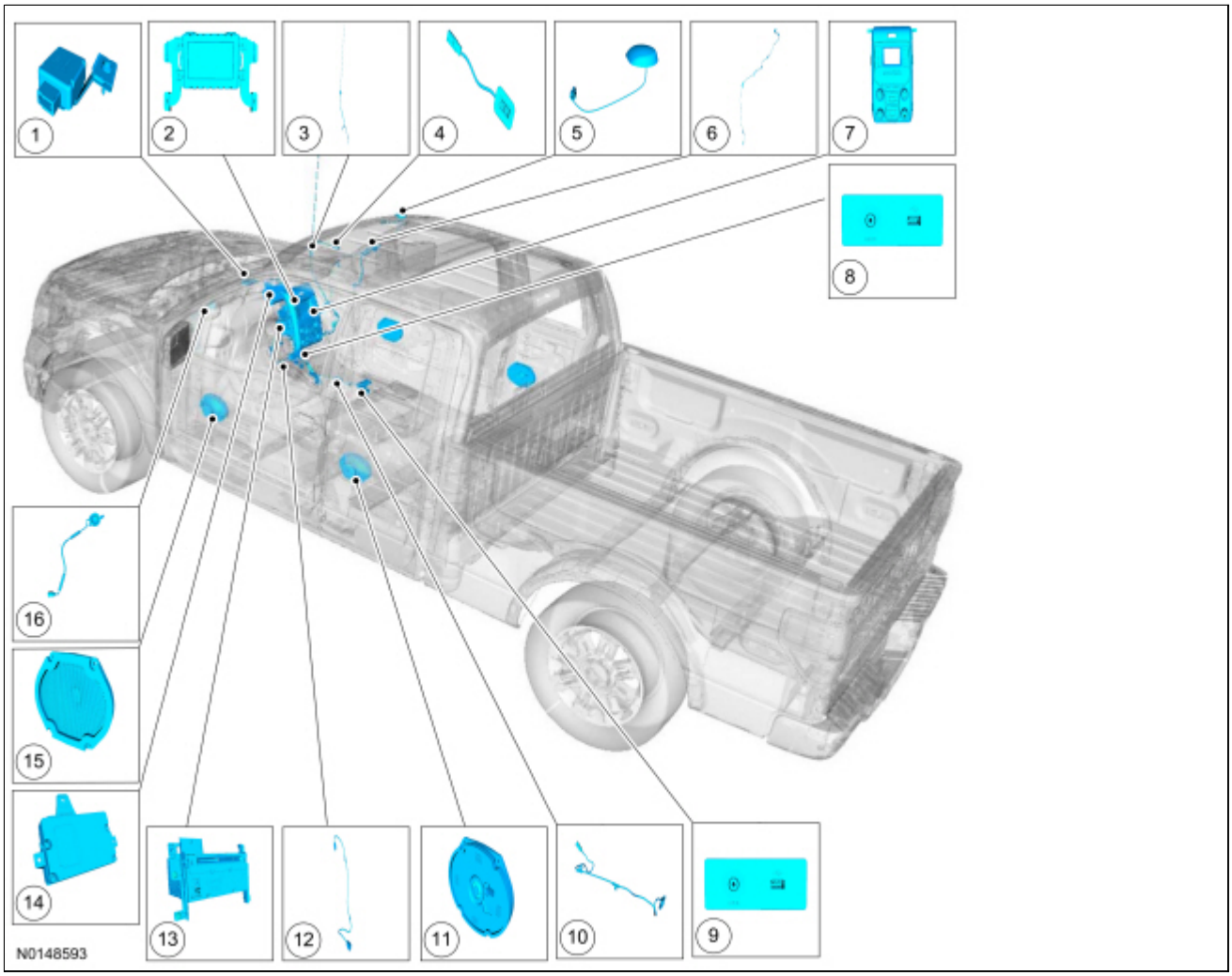
Torque Specifications

Description	Nm	lb-in
AM/FM antenna mast	4.2	36
AM/FM antenna base bolts	2.5	23
Audio Front Control Module (ACM)	2.5	23
Front Controls Interface Module (FCIM)	3	27
Front Control/Display Interface Module (FCDIM)	2.5	23
Satellite Antenna retaining nut	7	62

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Information and Entertainment System

Component Location



Item	Description	Comments
1	GPSM	Located in the top center area of the instrument panel
2	FCDIM	-
3	AM/FM antenna and AM/FM antenna coaxial cable	-
4	SYNC® microphone	Located in the headliner

5	Satellite radio antenna	If equipped
6	Satellite radio antenna coaxial cable	If equipped
7	FCIM	-
8	Audio input jack and USB port	Located in the instrument panel (with split bench)
9	Audio input jack and USB port	Located in the console (with front captain chairs)
10	USB cable	Located in the console (with front captain chairs)
11	Rear door speaker	-
12	USB cable	Located in the instrument panel (with split bench)
13	ACM	
14	APIM	Located in the top center area of the instrument panel
15	Front door speaker	-
16	A-pillar speaker	LF shown, RF similar

Overview

The audio system consists of the following:

Main Components

- 6 speakers
- 4.2-inch (107 mm) non-touchscreen FCDIM
- AM/FM single CD ACM
- APIM
- Audio input jack
- FCIM
- GPSM
- SYNC® microphone
- Redundant steering wheel controls
- USB port

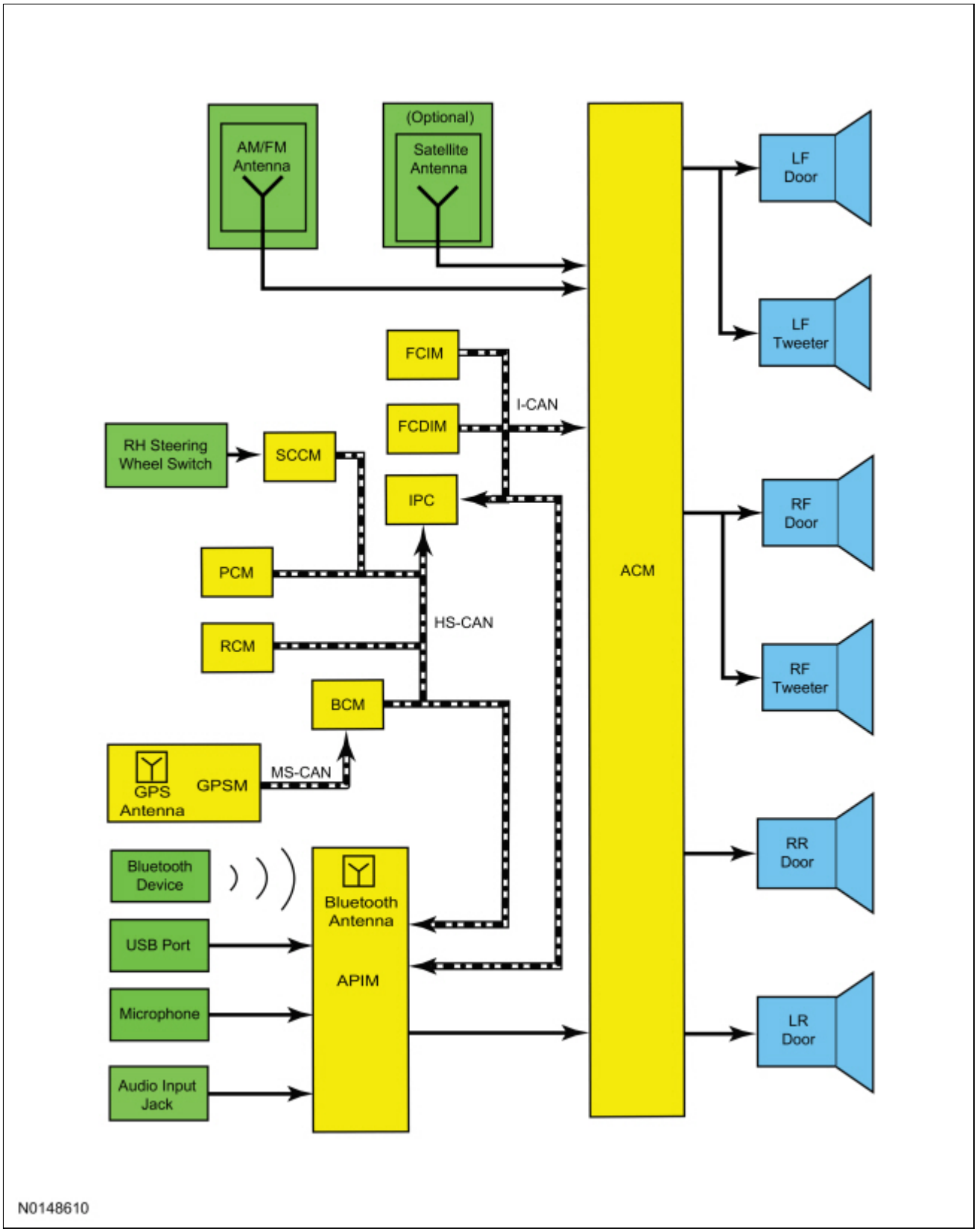
Main Features

- Optional satellite radio
- SYNC®

System Operation

System Diagram

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Network Message Chart

NOTE: A missing network message is indicated by a U-code DTC . When a missing message DTC (U-code)

sets, it is important to look for symptoms present in the audio system and throughout the vehicle, and to review the complete message list to determine which other modules rely on the same message. Refer to CAN Module Communication Message Chart in Section 418-00 . When the other modules have been identified, run the self-test for those modules. If the same message is missing from those modules, the identical, or similar lost communication DTCs may be set in those modules. Confirmation of missing messages common to multiple modules can indicate that the originating module is the source of the concern, or that the communication network may be at fault.

It is very important to understand the following:

- Where the input originates
- All of the information necessary for a feature to operate
- Which module(s) receive(s) the input or command message
- Which module controls the output of the feature
- If the module that receives the input controls the output of the feature, or whether it outputs a message over the CAN to another module.

Module Network Input Messages - ACM

Broadcast Message	Originating Module	Message Purpose
Media player display request	FCDIM	Used to display detailed folder and track information on the FCDIM from the ACM for the different audio system operating modes when the appropriate FCIM button is pressed.

Module Network Input Messages - APIM

Broadcast Message	Originating Module	Message Purpose
Airbag status	RCM	Used to monitor airbag deployment status for 911 assist.
Front seat belt latched status	RCM	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.
Ignition key type	BCM	Used to determine if a MyKey® is enabled and in use.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for APIM operating modes and fault reporting.
Seat belt buckle status	RCM	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.

Module Network Input Messages - FCDIM

Broadcast Message	Originating Module	Message Purpose

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ACM radio functions	ACM	Used to display the ACM radio functions such as seek, tune and AM/FM stations on the FCDIM .
Audio source	ACM	Used to display the selected audio source on the FCDIM .
CD load/eject	ACM	Used to display the loaded or ejected CD status on the FCDIM .
Date and time	IPC	Used to display the current date and time on the FCDIM .
Gear lever position	BCM	Used to verify the gear selector position for bezel diagnostics.
FCIM button press	FCIM	Used to indicate when a button is pressed on the FCIM so the audio system can make the desired setting change.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for FCDIM operating modes and fault reporting.
Illumination dimming level	IPC	Used to control the backlight intensity of the FCDIM based on the dimmer switch input.
Language selection	IPC	Used to display information on the FCDIM in the selected language.
Steering wheel switch media	SCCM	Used to set the audio system listening mode (AM/FM, CD, etc.) from the steering wheel switch.
Steering wheel switch OK	SCCM	Used to confirm various audio system selections.
Steering wheel switch seek left	SCCM	Used to access the next strong station to the left, to restart an audio track, to access the previous satellite radio station preset (if equipped), or the previous audio track from the steering wheel switch.
Steering wheel swtich seek right	SCCM	Used to access the next strong station to the right, to access the next satellite radio station preset (if equipped), or to access the next audio track from the steering wheel switch.
Steering wheel switch voice	SCCM	Used to access or exit the voice command feature from the steering wheel switch.
Steering wheel switch volume down	SCCM	Used to decrease the audio system volume from the steering wheel switch.
Steering wheel switch volume up	SCCM	Used to increase the audio system volume from the steering wheel switch.
Voice recognition status	APIM	Used to display the voice recognition status in the FCDIM .

Module Network Input Messages - FCIM

Broadcast Message	Originating Module	Message Purpose
Door ajar status	BCM	Used to determine the door ajar status for the accessory delay feature.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for FCIM operating modes and fault reporting.
Illumination dimming level	IPC	Used to control the backlight intensity of the FCIM based on the dimmer switch input.

Module Network Input Messages - GPSM

Broadcast Message	Originating Module	Message Purpose
Ignition switch position	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for GPSM operating modes and fault reporting.
Selector lever (PRNDL) status	BCM	Used to verify the gear lever position for vehicle direction data.

Accessory Delay Feature

The accessory delay feature allows the audio system to be operated for a preset period of time after the ignition is turned off and a front door has not been opened.

AM/FM Radio

The AM/FM fender-mounted antenna receives radio waves and sends them through the AM/FM antenna coaxial cable to the ACM . The radio waves are converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

Audible Prompts

The APIM receives stereo inputs from connected mobile phones and mono inputs from the SYNC® microphone.

Stereo and mono inputs, voice prompts, the TTS feature, ringtones, and any audio received through a connected mobile phone are transmitted to the ACM as stereo or mono sound.

The TTS feature speaks information so that it does not have to be read from the display.

Audio Extended Play

This feature allows the audio system to operate with the ignition OFF, regardless of door latch position. When the power button on the FCIM is pressed, audio system functionality is enabled and remains active for a period of 20-60 minutes, depending on configuration settings. To turn the audio system off, the power button on the FCIM is pressed. Audio extended play will not function if the battery load shed is active.

Battery Load Shed

The BCM uses the battery current sensor to monitor the battery state of charge. The battery current sensor is attached to the battery ground cable. With the vehicle OFF and the ignition in ACC or ON, a load shed message is sent over the CAN when the BCM determines that the battery state of charge is below 40%, 45 minutes have elapsed, or 10% of the charge has been drained. This message turns off the audio system to save the remaining battery charge. Under this condition, SYS OFF TO SAVE BATT is displayed on the centerstack infotainment display to notify the driver that battery protection actions are active. To clear the load shed state, start the vehicle.

Bluetooth Mode

Bluetooth is a secure, short-range radio frequency that allows devices to communicate wirelessly through radio waves. The operating range of a Bluetooth signal is a maximum of 9.75 m (32 feet).

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The Bluetooth interface can accommodate both Bluetooth-enabled mobile phones and Bluetooth-enabled media devices. The SYNC® system allows interaction with several types of customer Bluetooth devices, including mobile phones and media devices. The APIM contains an on-board Bluetooth chipset, which enables certain wireless devices to interact with the system. Any Bluetooth device used with the SYNC® system must first be paired with the system before it is operational.

Only one Bluetooth phone and one Bluetooth media device can be connected to the system at any one time. If an additional device of either type is paired with the system and made active, the APIM disconnects any active connection and establishes a connection with the new device.

When a new Bluetooth device is added, the APIM and the Bluetooth device must be paired together. Most Bluetooth devices can pair with the SYNC® system, although functionality may vary. To determine if a Bluetooth device is supported, verify the customer device is on the compatibility list for the current APIM software level.

Pairing a Bluetooth device is accomplished through the "Add Device" selection of the phone menu. When pairing a device, the SYNC® system generates a unique PIN that must be entered on the Bluetooth device in order for the pairing process to be successful. There are also some device-specific actions that must take place. For information on the pairing process, refer to the Owner's Literature.

It is important to understand that not all mobile phones have the same level of features when interacting with the SYNC® system. For a list of compatible phones, refer to SyncMyRide website.

MyKey® Audio Operation

When a MyKey® is in use, the following restrictions are activated:

- The audio system is muted until the safety belts are buckled when the Belt-Minder® feature is activated. The MyKey® "BUCKLE UP TO UNMUTE AUDIO" is displayed in the information display.
  - This is a standard setting and cannot be changed.
- Satellite radio adult content stations are blocked by being muted.
- If "Always On" is selected in the MyKey® menu, 911 assist and the Do Not Disturb features are enabled and cannot be disabled.
- The audio system volume is limited to 45%. In an attempt to exceed the limited volume, the MyKey® VOLUME LIMITED message is displayed in the centerstack infotainment display.
  - This is an optional setting.

Refer to the Owner's Literature for more information on MyKey®.

Satellite Radio (If Equipped)

Satellite radio is a subscription-based service.

The satellite radio roof-mounted antenna receives signals containing data (station call letters, artist names, song titles, etc.) and digital satellite radio audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio receiver built into the ACM . The ACM separates the data from the audio. The data is sent to be displayed on the centerstack infotainment display, and the audio is converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

Speed Compensated Volume

The ACM adjusts the audio system volume based on the VSS signal to compensate for speed and wind noise.

When a MyKey® is in use and the MyKey® radio volume limiter is enabled, the speed compensated volume is disabled.

Steering Wheel Switch Functions

The RH 8-way steering wheel switches operate the volume +/-, seek +/-, and the audio system SYNC® functions (media, voice, phone, and OK).

SYNC® AppLink™

SYNC® AppLink™ allows the customer to control smartphone applications by using voice commands and in-vehicle controls. Data is transferred from the customer's device to the APIM through Bluetooth, or through the USB port with Apple® devices.

SYNC® Services

SYNC® Services is a subscription-based service. For SYNC® Services subscription information,, refer to SyncMyRide .

The customer's mobile phone is used to access and download the SYNC® services. SYNC® services information received by the customer's mobile device is sent to the APIM .

The GPS antenna, integral to the GPSM , is used to detect the location and direction of the vehicle.

SYNC® services includes the following features:

- Business search
- Personalized text alerts
- Real-time traffic updates
- Turn-by-turn directions

SYNC® services allows the customer to receive updates for:

- Entertainment
- News
- Sports
- Stocks
- Travel
- Weather

SYNC® System

The SYNC® system is a hands-free communication and entertainment system that supports many features. All features are not available with every phone.

The SYNC® system provides the ability to:

- Connect media devices (such as an iPod® or USB device) in order to play audio files.
- Control the entertainment system using voice controls.
- Initiate an emergency call (911 Assist™) when the airbags deploy.
- Play media files via a paired Bluetooth-enabled audio device.
- Produce vehicle health reports.
- Send and receive phone calls via a paired Bluetooth-enabled phone.
- Send and receive text messages via a paired Bluetooth-enabled phone.

USB Audio Mode

The USB port can be used for connecting a media device (such as an iPod®) with the device's available cable, or for directly plugging in a portable mass storage device, such as a thumb drive. When playing media

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files stored on a mass storage device, the SYNC® system only plays files that do not have DRM protection. The USB port can also be used for uploading vehicle application upgrades. The USB port is powered by the APIM , so no external power source is needed to power a device plugged into the USB port if the device supports this feature.

In addition to audio information, metadata (information such as artist, album title, song title, and genre) may also be sent to the APIM from a device plugged into the USB port. The APIM uses the metadata to create indexes that can be used to sort for particular music, based on customer preference. Not all USB devices can send metadata to the APIM . When a new media device is connected to the SYNC® system, the APIM automatically indexes the information. This may take several minutes (depending on the amount of data on the device), and is considered normal operation. When a device that was previously connected to the SYNC® system is reconnected, the APIM updates the index (rather than creating a new one), which reduces the amount of time needed to index the device.

Voice Recognition

Voice recognition is used for many vehicle functions, including the audio system. The microphone relays the microphone input to the APIM through dedicated wiring. The TTS and voice prompt features speak certain text information and interaction requests to minimize driver distraction by having to look at the audio system display while driving. The ringtone alerts the driver to an incoming call. The microphone is also used to detect outgoing audio during a phone call.

Audible prompts can range from a simple tone to more elaborate spoken text, based on the customer setting. When interaction mode is set to standard, detailed guidance is provided. When interaction mode is set to advanced, most prompts are tones only and minimal audible guidance is provided. Refer to the Owner's Literature for further information on voice interaction.

The audio signals for the TTS and voice prompt features, ringtones, and audio from the outside device during a phone call, are sent from the APIM to the ACM .

Component Description

ACM

The ACM can be operated with the ignition in RUN, ACC, or OFF.

The ACM receives radio waves containing audio from the antenna coaxial cable(s) and converts them into fluctuating AC voltage. The ACM receives audio signals from the APIM in the form of fluctuating AC voltage. The ACM processes these inputs and sends left and right analog audio signals to the speakers as fluctuating AC voltage.

If equipped with satellite radio, the ACM will also receive radio waves containing data through the antenna coaxial cable(s). The data is sent to be displayed on the centerstack infotainment display.

The ACM requires PMI when it is replaced.

Antenna

The AM/FM fender-mounted antenna receives radio waves containing audio and sends them through the AM/FM antenna coaxial cable to the ACM . The antenna mast is used to amplify the AM/FM radio waves to improve reception.

If equipped with satellite radio, the satellite radio roof-mounted antenna receives signals containing data and digital audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio

receiver built into the ACM .

APIM

Audio signals received by the APIM are sent to the ACM as fluctuating AC voltage.

The APIM consists of 2 internal modules: the CIP and the VIP . The modules are not replaceable individually, but can be flashed independently, if required.

The CIP interfaces with all of the inputs to the APIM . It contains an analog-to-digital-to analog converter, as well as the Bluetooth chipset. Any Application upgrades that are available to the consumer are loaded directly to the CIP through the USB port.

The VIP provides an interface between the CIP and the vehicle. Its main functions are controlling the APIM power management and translating inbound and outbound CAN signals. In addition, the VIP queries the modules on the network to retrieve any DTCs when a vehicle health report is requested.

Audio Input Jack

The audio input jack allows for a portable MP3 audio device (such as an iPod®) to be connected to the vehicle audio system utilizing a 1/8-inch (3 mm) audio jack.

FCDIM

The FCDIM can be operated with the ignition in RUN, ACC, or OFF.

The FCDIM displays driver information messages, vehicle settings, infotainment, audio, and climate control system information.

The FCDIM requires PMI when it is replaced.

FCIM

The FCIM can be operated with the ignition in RUN, ACC, or OFF.

The FCIM audio system buttons provide one of the methods in which the customer interacts with the infotainment system.

The FCIM is separate from the ACM .

Global Positioning System Module (GPSM)

The Global Positioning System Module (GPSM) provides vehicle location for real-time traffic reports and re-routing, and for identifying vehicle location in the event of a collision.

Vehicle location information is broadcast from the Global Positioning System Module (GPSM) to the APIM .

Steering Wheel Switches

The RH steering wheel switches contain series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

The SCCM sends a 5-volt reference voltage to the RH steering wheel switch on the input circuits. When a switch is pressed, the voltage is routed through the corresponding resistor(s), and then to ground through

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the SCCM . The SCCM monitors the resultant voltage drop to determine which switch was pressed. The voltage drop varies depending upon the resistance of the specific switch pressed.

The SCCM sends a network message to the APIM for the SYNC® switches and to the ACM for the redundant audio controls.

SYNC® Microphone

The SYNC® microphone receives SYNC® system voice commands and outgoing audio during a phone call. These signals are sent to the APIM .

USB Port

The USB port is connected to the APIM through the USB cable. The USB port can be used to play audio files, connect a media device, or upload software from mass storage.

Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent diagnostic scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3104-A	Back-probe Pins POM6411 or equivalent
 ST3051-A	Universal Serial Bus (USB) Male-A To Male-A Cable CCMUSB2-AM-AM-10
 ST3086-A	Multi-Media Interface Tester 105-00120

DTC Charts

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Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

NOTE: For SYNC® related concerns, REFER to the SYNC® Symptom Chart before connecting the scan tool and beginning DTC-based diagnostics.

Audio Front Control Module (ACM) DTC Chart

DTC	Description	Action
B1A01:01	Speaker #1: General Electrical Failure	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A01:11	Speaker #1: Circuit Short to Ground	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A01:12	Speaker #1: Circuit Short to Battery	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A01:13	Speaker #1: Circuit Open	• For a LF door speaker concern, GO to Pinpoint Test F • For a LF tweeter speaker concern, GO to Pinpoint Test G
B1A02:01	Speaker #2: General Electrical Failure	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A02:11	Speaker #2: Circuit Short to Ground	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A02:12	Speaker #2: Circuit Short to Battery	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A02:13	Speaker #2: Circuit Open	• For a RF door speaker concern, GO to Pinpoint Test H • For a RF tweeter speaker concern, GO to Pinpoint Test I
B1A03:01	Speaker #3: General Electrical Failure	GO to Pinpoint Test J .
B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test J .
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test J .
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test J .
B1A04:01	Speaker #4: General Electrical Failure	GO to Pinpoint Test K .
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test K .
B1A04:12	Speaker #4: Circuit	GO to Pinpoint Test K .

	Short to Battery	
B1A04:13	Speaker #4: Circuit Open	GO to Pinpoint Test K .
B1A56:21	Antenna: Signal Amplitude	If DTC B1A56:21 sets after running the bezel diagnostic tests, disregard this DTC. This test is used for end of line or repair bay testing at the Ford plant. Each plant has its own assigned frequency and signal strength requirements. The running and passing of this test depends on local radio stations. If no local station is broadcasting on the required frequency, the test will fail. Therefore, tests ran from the bezel diagnostic screen and the DTC generated from the test can be disregarded.
B1A89:11	Satellite Antenna: Circuit Short To Ground	GO to Pinpoint Test B .
B1A89:13	Satellite Antenna: Circuit Open	GO to Pinpoint Test B .
B1D19:49	Compact Disc Unit: Internal Electronic Failure	• CLEAR the DTC. • WAIT at least 30 seconds. • REPEAT the self-test. • If DTC B1D19:49 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
B1D19:4B	Compact Disc Unit: Over Temperature	The ACM was over temperature. This may occur during extended use. Audio operation can resume after the ACM cools. CLEAR the DTC. This is normal operation.
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AA .
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	GO to Pinpoint Test AC .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AD .
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AE .
U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2100:00	Initial Configuration Not	CHECK vehicle service history for recent service actions related to

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	Complete: No Sub Type Information	this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3000:96	Control Module: Component Internal Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:96 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AF .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ag .

Accessory Protocol Interface Module (APIM) DTC Chart

DTC	Description	Action
B1252:04	USB Port: System Internal Failure	GO to Pinpoint Test R .
B1252:11	USB Port: Circuit Short to Ground	GO to Pinpoint Test R .
B12B8:04	USB Port #2: System Internal Failure	**NOTE:** This DTC refers to USB port #2 on the APIM itself, which is not used.

		• INSPECT the APIM USB port #2 for damage and REMOVE any debris. • CLEAR the DTCs. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B12B8:04 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
B12B8:11	USB Port #2: Circuit Short To Ground	**NOTE:** This DTC refers to USB port #2 on the APIM itself, which is not used. • INSPECT the APIM USB port #2 for damage and REMOVE any debris. • CLEAR the DTCs. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B12B8:11 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
B1D79:01	Microphone Input: General Electrical Failure	GO to Pinpoint Test P .
B1D79:11	Microphone Input: Circuit Short To Ground	GO to Pinpoint Test P .
B1D79:12	Microphone Input: Circuit Short To Battery	GO to Pinpoint Test P .
B1D79:13	Microphone Input: Circuit Open	GO to Pinpoint Test P .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test Z .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AA .
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AE .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic

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		scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:04	Control Module: System Internal Failure	GO to Pinpoint Test M .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:88	Control Module: Bus Off	**NOTE:** Network communication/message DTCs can result from intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set these DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. The module was unable to communicate on the network at a point in time. The fault is not currently present. To avoid repeat network concerns: • INSPECT for damaged or corroded wiring at the APIM . • TEST the vehicle battery. REFER to Charging Systems in Section 414-00 . • CLEAR the DTC. • REPEAT the network test with the diagnostic scan tool.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AF .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ag .

FCDIM DTC Chart

DTC	Description	Action
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AA .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AB .
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	GO to Pinpoint Test AC .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AD .
U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FCDIM to correct the failure to retain configuration data. REFER to Front Controls/Display Interface Module (FCDIM) .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FCDIM to correct the failure to retain configuration data. REFER to Front Controls/Display Interface Module (FCDIM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new FCDIM to correct the failure to retain configuration data. REFER to Front Controls/Display Interface Module (FCDIM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new FCDIM . REFER to Front Controls/Display Interface Module (FCDIM) .

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U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new FCDIM. REFER to Front Controls/Display Interface Module (FCDIM).
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AF.
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ag.

FCIM DTC Chart

DTC	Description	Action
B00D5:01	Restraint System Passenger Disable Indicator: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B00D5:01 is retrieved again, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
B113C:11	Hazard switch illumination: Circuit Short To Ground	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B113C:11 is retrieved again, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
B1202:01	Restraint System Passenger Enable Indicator: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B1202:01 is retrieved again, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AA.
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AE.
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC. REFER to Section 413-01.
U2013:63	Switch Pack: Circuit / Component Protection Time-Out	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2013:63 is retrieved again, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test.

		• If DTC U3000:41 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AF .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ag .

Global Positioning System Module (GPSM) DTC Chart

DTC	Description	Action
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	GO to Pinpoint Test Y .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information: No Sub Type Information	GO to Pinpoint Test Z .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AA .
U0401:00	Invalid Data Received from ECM/PCM A: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the PCM . REFER to Section 303-14 .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the BCM . REFER to Section 419-10 .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .

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U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U3000:09	Control Module: Component Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, PERFORM a battery reset by disconnecting the battery for 1 minute, then reconnecting it. • CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AF .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ag .

SCCM DTC Chart

DTC	Description	Action
B1380:09	Steering Wheel Right Switch Pack: Component Failure	GO to Pinpoint Test T .
B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	GO to Pinpoint Test T .
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	GO to Pinpoint Test T .
All other DTCs	—	REFER to Section 211-05 .

Symptom Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Symptom Chart — General Audio System

Condition	Possible Sources	Action
• A module does not respond to the diagnostic scan tool	• Fuse • Wiring, terminals, or connectors • Module	• REFER to Section 418-00 .
• The RH steering wheel controls are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test T .
• The CD player is inoperative or does not operate correctly	• CD • ACM	• INSPECT the CD for scratches, fingerprints, a loose paper label, incorrect format, or damage. INSERT a known good CD and TEST the system. If the system operates correctly, the concern was caused by a damaged CD. If the system does not operate correctly, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
• The speed compensated volume does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test C .
• The compass is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test X .
• The FCIM illumination is inoperative or does not dim	• Illumination system concern • FCIM	• REFER to Section 413-00 .
• The audio system does not operate correctly from the FCIM	• Refer to the Pinpoint Test	• GO to Pinpoint Test U .
• The FCDIM is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test V .
• One or more FCDIM displays are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test W .
• The FCDIM	• Illumination	• REFER to Section 413-00 .

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illumination is inoperative or does not dim	system concern • FCDIM	

Symptom Chart — Satellite Radio (If Equipped)

Condition	Possible Sources	Action
• Poor reception — satellite radio	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.
• Poor sound quality or no sound while in satellite radio mode - all other functions operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.
• The satellite radio is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.

Symptom Chart — Sound Quality

Condition	Possible Sources	Action
• Poor reception — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A.
• Continuous seek or scan — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A.
• Poor sound quality or distorted sound from one or more speakers (not all speakers)	• Refer to the Pinpoint Test	• GO to Pinpoint Test D.
• No sound from all speakers	• Refer to the Pinpoint Test	• GO to Pinpoint Test E.
• The LF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test F.
• The LF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test G.
• The RF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test H.
• The RF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test I.
• The RR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test J.
• The LR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test K.

SYNC System

Condition	Possible Sources	Action
• The SYNC® system is inoperative (no response is received from phone, voice, and media inputs)	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test M .
• All SYNC® Services features are inoperative or inaccurate (traffic, directions, and information)	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test O .
• The SYNC® system voice or tone prompts, TTS feature, or ringtones are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test N .
• During a phone call, no incoming audio is heard in the vehicle	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test N .
• Voice recognition is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test P .
• During a phone call, poor quality or no outgoing audio is heard on the outside device	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test P .
• No sound from all SYNC® audio sources (Bluetooth, USB , audio input jack)	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test L .
• The SYNC® steering wheel switches are inoperative or	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test T .

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do not operate correctly		
• The audio input jack is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the Accessory Protocol Interface Module (APIM) Reset. REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test Q .
• The Universal Serial Bus (USB) port is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test R .
• Unable to pair Bluetooth device	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test S .
• An individual Bluetooth device feature is inoperative (text messaging, media playback or controls, phone book download, call history, or call waiting)	• Customer's device compatibility	• PERFORM the Accessory Protocol Interface Module (APIM) Reset. REFER to Accessory Protocol Interface Module (APIM) Reset . • If the concern is still present, INSTRUCT the customer to review the device compatibility list on the SyncMyRide website. It is normal operation for unsupported or incompatible Bluetooth features to be unavailable through the SYNC® system. • If the inoperative feature is compatible, ADVISE the customer to check their device for firmware updates, and if required, reset their device following the manufacturer's instructions.
• SYNC® AppLink™ is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the Accessory Protocol Interface Module (APIM) Reset. REFER to Accessory Protocol Interface Module (APIM) Reset . • If the concern is still present, INSTRUCT the customer to review the mobile device platform, application, and application version compatibility list on the SyncMyRide website. It is normal operation for incompatible mobile device platforms, applications, and application versions to be unavailable through SYNC® AppLink™. • If the mobile device platform, application, and application version are compatible, and the device is connected through Bluetooth only, GO to Pinpoint Test S . • If the mobile device platform, application, and application version are compatible, and the device is connected through Bluetooth and the USB port, GO to

		Pinpoint Test R
• 911 Assist™ or Vehicle Health Report (VHR) is inoperative or does not operate correctly	• Unregistered SYNC® owner account • RCM misconfiguration • IPC misconfiguration	• Verify that the customer has a SYNC® Owner Account on the SyncMyRide website. • This error message appears due to incomplete or incorrect PMI procedures. CHECK the vehicle service history for recent service actions related to the IPC or RCM . ▪ If there have been recent service actions with the IPC or RCM , REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. REFER to Programmable Module Installation (PMI) in Section 418-01 . ▪ If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Pinpoint Tests

Pinpoint Test A: Poor Reception Or Continuous Seek Or Scan — AM/FM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to AM/FM Radio, ACM , and Antenna in Information and Entertainment System .

The RDS function allows the vehicle operator to choose which genre (category) of music to listen to. When the SCAN button is pressed, the ACM only stops at channels falling within the selected category. If no channel in the selected category is found, the ACM continues to scan without stopping. This can appear to be a reception issue, but it is actually due to the customer's setting.

Possible Sources

- AM/FM antenna
- AM/FM antenna coaxial cable
- Charging system
- Ignition system
- No channel found in the selected category
- Noise suppression equipment
- Wiring, terminals, or connectors

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- ACM

PINPOINT TEST A: POOR RECEPTION OR CONTINUOUS SEEK OR SCAN — AM/FM

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>A1 CHECK THE AUDIO SYSTEM RECEPTION
• Operate the audio system in radio tuner AM/FM mode.
• Check the reception with the engine running, and with the engine off.
• Does the poor reception only occur with the engine running?</td><td>Yes
GO to A2 .

No
GO to A4 .</td></tr>
<tr><td>A2 CHECK THE GENERATOR
• Ignition OFF.
• Disconnect: Wiring harness to the generator voltage regulator.
• Start the engine.
• Operate the audio system in radio tuner AM/FM mode.
• Is the reception OK?</td><td>Yes
INSTALL a new generator. REFER to Section 414-00 .

No
GO to A3 .</td></tr>
<tr><td>A3 CHECK THE IGNITION CIRCUITS
• Ignition OFF.
• Connect: Wiring harness to the generator voltage regulator.
• Visually inspect the engine compartment and make sure all ignition coils are correctly and securely connected, and that there are no visible cracks in the coil housings.
• Inspect all the wiring harnesses and connectors for damaged insulation and loose or broken conditions.
• Are the ignition components OK?</td><td>Yes
USE a jumper cable to ground various parts of the vehicle to the frame (for example: engine, fenders, quarter panels, stone deflectors, air cleaner, body sheet metal). When the noise is eliminated, PROVIDE a permanent ground where necessary.

No
REPAIR the ignition system as necessary.</td></tr>
<tr><td>A4 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE
• Ignition OFF.
• Disconnect: AM/FM antenna coaxial cable at the ACM . Refer to Audio Control Module (ACM) .
• Disconnect: AM/FM antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — AM/FM .
• Ignition ON.
• Measure the voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>AM/FM antenna coaxial cable core at the ACM</td><td>—</td><td>—</td><td>Ground</td></tr><tr><td>AM/FM antenna coaxial cable</td><td></td><td>—</td><td>Ground</td></tr></table></td><td>Yes
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

No
GO to A5 .</td></tr>
</table>

shield at the ACM —	
• **Is any voltage present?**	
A5 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the **resistance** between: Positive Lead: Pin — AM/FM antenna coaxial cable core at the ACM; Circuit — Negative Lead: Pin —; Circuit Ground • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A6 . **No** REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .
A6 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN	
• Measure the **resistance** between: Positive Lead: Pin — AM/FM coaxial cable core at the ACM; Circuit — Negative Lead: Pin — Lower AM/FM antenna coaxial cable core at the inline connection; Circuit — Positive Lead: Pin — AM/FM antenna coaxial cable shield at the ACM; Circuit — Negative Lead: Pin — Lower AM/FM antenna coaxial cable shield at the inline connection; Circuit — • **Is the resistance less than 1 ohm?**	**Yes** GO to A7 . **No** REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .
A7 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER	
• Measure the **resistance** between: Positive Lead: Pin — AM/FM antenna coaxial cable core at the ACM; Circuit — Negative Lead: Pin — AM/FM antenna coaxial cable shield at the ACM; Circuit — • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A8 . **No** REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .
A8 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Connect: AM/FM antenna inline coaxial cable connection behind the glove compartment.	**Yes** REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER

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- Disconnect: AM/FM antenna coaxial cable at the antenna unit. Refer to Antenna — AM/FM .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

to Antenna Cable — AM/FM .

No
GO to A9 .

A9 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A10 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A10 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable core at the antenna unit (harness side)	—
AM/FM antenna coaxial cable shield at the ACM	—	AM/FM antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to A11 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A11 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead	Negative Lead

Yes
GO to A12 .

No

Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A12 CHECK THE AM/FM ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

No
GO to A13 .

A13 CHECK THE AM/FM ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A14 .

No
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

A14 CHECK THE AM/FM ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A15 .

No
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

A15 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

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<table>
<tr>
<td>

Disconnect: AM/FM antenna coaxial cable at the antenna unit.
Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>AM/FM antenna unit shield at the antenna unit (component side)</td><td>—</td><td>—</td><td>Ground</td></tr>
</table>

Is the resistance less than 1 ohm?

</td>
<td>Yes
GO to A17 .

No
GO to A16 .</td>
</tr>
<tr>
<td>A16 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE

Remove the AM/FM antenna. Refer to Antenna — AM/FM .
Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>AM/FM antenna unit shield at the antenna unit (component side)</td><td>—</td><td>AM/FM antenna base (unpainted surface)</td><td>—</td></tr>
</table>

Is the resistance less than 1 ohm?

</td>
<td>Yes
GO to A17 .

No
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .</td>
</tr>
<tr>
<td>A17 CHECK FOR CORRECT ACM OPERATION

Ignition OFF.
Disconnect and inspect all the ACM connectors.
Repair:

Corrosion (clean module pins or install new connectors or terminals)
Damaged or bent pins (install new terminals or pins)
Pushed-out pins (install new pins as necessary)

Reconnect the ACM connectors. Make sure they seat and latch correctly.
Operate the system and determine if the concern is still present.
Is the concern still present?

</td>
<td>Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.</td>
</tr>
</table>

Pinpoint Test B: The Satellite Radio Is Inoperative, Has Poor Reception, Or Has No Sound

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to MyKey® and Satellite Radio in Information and Entertainment System .

When a satellite radio subscription is activated, the satellite receiver ESN is associated with the VIN .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A89:11	Satellite Antenna: Circuit Short To Ground	Set by the ACM when a short to ground is detected in the satellite antenna circuit for more than 250 milliseconds. This DTC can be either continuous or on-demand.
B1A89:13	Satellite Antenna: Circuit Open	Set by the ACM when an open is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.

Possible Sources

- Expired subscription
- Incorrectly matched ESN
- Wiring, terminals, or connectors
- Obstructions in the antenna's line of sight
- Satellite radio antenna
- Satellite radio antenna coaxial cable
- ACM

PINPOINT TEST B: THE SATELLITE RADIO IS INOPERATIVE, HAS POOR RECEPTION, OR HAS NO SOUND

Test Step	Result / Action to Take
B1 VERIFY AN ACTIVE SUBSCRIPTION	
• Operate the infotainment system in satellite radio mode and observe the infotainment display. • **Does the display indicate that the subscription has expired?**	**Yes** The subscription has expired. INFORM the customer to contact SIRIUS to reactivate the subscription. **No** GO to B2 .
B2 CHECK THE RECEPTION	
• Drive the vehicle to an open location that is free from obstacles such as tall buildings or large trees. • Using a diagnostic scan tool, view the ACM PIDs. • Monitor the satellite signal strength (SAT_SIG_STR) PID. • If the PID reads "No Signal" or "Poor," move the vehicle to another area and retest until "Good," "Very Good," or "Excellent" PID values are obtained. • **Can a "Good," "Very Good," or "Excellent" PID value be obtained?**	**Yes** GO to B3 . **No** GO to B6 .
B3 CHECK THE SATELLITE RADIO SYSTEM FOR	

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CORRECT OPERATION • Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of obstructions in the antenna's line of sight. **No** GO to B4.
B4 CHECK FOR PROMOTIONAL CHANNEL 184 • Select channel 184. • **Does the satellite radio system receive channel 184 with normal sound quality?**	**Yes** GO to B5. **No** GO to B6.
B5 VERIFY THAT THE VIN AND ESN ON FILE MATCH THE VIN AND ESN FROM THE VEHICLE • Retrieve the satellite radio ESN. Satellite Radio Electronic Serial Number (ESN) Retrieval. • Contact the SIRIUS Dealer Support Line (888-465-8528). • Ensure that the VIN and ESN SIRIUS has on the customer's file match the VIN and ESN retrieved from the vehicle. • Follow the actions from step 2 to obtain "Good," "Very Good," or "Excellent" reception. • Operate the infotainment system in satellite radio mode. • **NOTE:** It may take up to 30 minutes for the activation signal to be received and satellite radio functions to operate. • Request for SIRIUS to send the activation signal to the vehicle 2-3 times. • Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of the activation signal needing to be resent or the VIN and ESN SIRIUS had on file not matching the VIN and ESN from the vehicle. **No** GO to B6.
B6 CHECK FOR ACM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the ACM DTCs. • Using a diagnostic scan tool, perform the ACM self-test. • **Are any DTCs recorded in the ACM?**	**Yes** For DTC B1A89:11 or DTC B1A89:13, GO to B7. For all other ACM DTCs, REFER to the ACM DTC chart in Information and Entertainment System. **No** GO to B20.
B7 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Satellite radio antenna coaxial cable at the ACM. Refer to Audio Control Module (ACM). • Disconnect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.	**Yes** REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio.

Refer to Antenna Cable — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

No
GO to B8 .

B8 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B9 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B9 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio coaxial cable core at the ACM	—	Lower satellite radio antenna coaxial cable core at the inline connection	—
Satellite radio antenna coaxial cable shield at the ACM	—	Lower satellite radio antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B10 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B10 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Yes
GO to B11 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B11 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: Satellite radio antenna coaxial cable at the antenna unit. Refer to Antenna — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to B12 .

B12 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B13 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B13 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
GO to B14 .

No
REPAIR or INSTALL a new upper

Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable core at the antenna unit (harness side)	—
Satellite radio antenna coaxial cable shield at the ACM	—	Satellite radio antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B14 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B15 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B15 CHECK THE SATELLITE RADIO ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

No
GO to B16 .

B16 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead	Negative

Yes
GO to B17 .

No
INSTALL a new satellite radio antenna.

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		Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

REFER to Antenna — Satellite Radio .

B17 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B18 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

B18 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: Satellite radio antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

Yes
GO to B20 .

No
GO to B19 .

B19 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE

- Remove the satellite radio antenna. Refer to Antenna — Satellite Radio .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	Satellite radio antenna base (unpainted surface)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B20 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

B20 CHECK FOR CORRECT ACM OPERATION

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test C: The Speed Compensated Volume Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Speed Compensated Volume in Information and Entertainment System.

Possible Sources

- Speed compensated volume setting
- VSS signal concern
- Network communication concern
- ACM

PINPOINT TEST C: THE SPEED COMPENSATED VOLUME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
C1 CHECK THE SPEEDOMETER OPERATION	
• Drive the vehicle and observe the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to C2. **No** REFER to Section 413-01.
C2 CHECK THE SPEED COMPENSATED VOLUME SETTING	
• Turn the speed compensated volume off. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume.	**Yes** The system is operating correctly at this time. INSTRUCT the customer in the correct usage of the speed compensated volume feature. **No**

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• Set the speed compensated volume to maximum compensation. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • **Does the volume remain constant with the speed compensated volume turned off, and increase and decrease with vehicle speed with the speed compensated volume set to maximum?**	GO to C3 .
C3 CHECK FOR DTC U0155:00	
• Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155:00 retrieved in any audio system module?**	**Yes** GO to Pinpoint Test AA . **No** GO to C4 .
C4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All Speakers)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

The ACM sends audio signals to the speakers in the form of AC voltage, resulting in clear audio output.

Possible Sources

- Loose component fasteners
- Loose door handle, lock, and other trim panel components and fasteners
- Loose items in storage areas
- Loose speaker grilles
- Loose wire harnesses or wire harness fasteners

- Speaker(s)
- Water shield bonding and placement

Visual Inspection and Diagnostic Pre-checks

Visually inspect around the suspect area for any possible rattle conditions such as:

- Any storage compartments including cup holders (if equipped)
- Door map pockets for contents that can rattle (if equipped)
- Door pull cup attachments (if equipped)
- Door switch bezels (if equipped)
- Package tray (if equipped)
- Speaker grilles
- Trim panels and fasteners

PINPOINT TEST D: POOR SOUND QUALITY OR DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take
D1 ISOLATE THE ZONE	
• Operate the audio system using digital media (CD, MP3, etc.). • Using the audio system fade and balance feature, adjust the audio sound to each of the four zones (LF , RF , LR , and RR) of the vehicle to isolate the poor sound quality. • Locate and apply pressure to the trim panel(s) around the poor sound quality area in question. • **Does applying pressure to a trim panel reduce or eliminate the audible noise?**	**Yes** REPAIR or REPLACE the trim panel as needed. **No** GO to D2 .
D2 REMOVE AND INSPECT BEHIND/UNDERNEATH THE SUSPECT TRIM PANEL(S)	

• Remove the trim panel to access the suspect speaker.
• Operate the audio system using digital media (CD, MP3, etc.).
• Validate where the poor sound quality area is located.
• Check:
  ▪ Trim panel for loose components around the speaker area such as the speaker grille
  ▪ Trim panel joining components for missing or broken pieces
  ▪ Lock and handle mechanical parts for correct attachment
  ▪ Wire harnesses for correct routing
  ▪ Wire harness fasteners for correct attachment
  ▪ Water shield for correct placement (speaker air path not blocked)
  ▪ Water shield for correct bonding to sheet metal
  ▪ Storage areas for loose items
  ▪ All child safety belt anchors (if equipped)
  ▪ All safety belt retractors
  ▪ All speaker bracket fasteners and other fasteners
	Yes
	REPAIR or REPLACE any loose or broken component or fastener as needed.
	
	No
	GO to D3 .

repair4less

are secured and tightened to specified torque • **Was the source of the noise located?**	
D3 CHECK THE SUSPECT SPEAKER FOR WATER INTRUSION	

• Inspect for watermarks.
• Check the:
  ▪ Cone
  ▪ Magnet
  ▪ Basket
• **Are any watermarks present on the speaker?**
	Yes
	VERIFY the water shield is in the correct location, REPAIR or REPLACE any trim, door, or speaker seal as required.
	
	DRY the speaker in question and TEST the system for normal operation.
	
	No
	GO to D4 .

D4 ISOLATE SPEAKER TO VERIFY NOISE	
• Remove the suspect speaker from its location and leave the speaker connected to the harness. • Hold the speaker away from any trim panel(s) and ensure the speaker is isolated from contact. • Operate the audio system using digital media (CD, MP3, etc.). • **Is the noise still present in the suspect speaker?**	**Yes** INSTALL a new speaker for the one in question. **No** LOCATE the source of the noise and REPAIR as needed.

Pinpoint Test E: No Sound From All Speakers

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

When the ignition is in the START position, the ACM receives voltage on the START signal circuit and mutes the speaker output. This prevents voltage spikes from producing popping noises through the speakers. A short to voltage on this circuit causes the ACM output to be muted continuously.

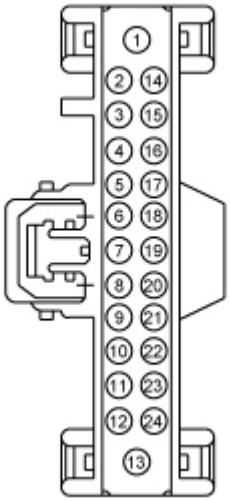
A short to ground or short to voltage in the circuitry to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the ACM . In this case, a speaker fault DTC sets.

Possible Sources

- Wiring, terminals, or connectors
- ACM

PINPOINT TEST E: NO SOUND FROM ALL SPEAKERS

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>E1 CHECK FOR SPEAKER DTCS
• Ignition ON.
• Using a diagnostic scan tool, perform the ACM self-test.
• Are any speaker fault Diagnostic Trouble Codes (DTCs) present?</td><td>Yes
REFER to the ACM DTC chart in Information and Entertainment System .

No
GO to E2 .</td></tr>
<tr><td>E2 CHECK THE START SENSE CIRCUIT FOR A SHORT TO VOLTAGE
• Ignition OFF.
• Disconnect: ACM C240A .
• Ignition ON.
• Measure the voltage between:
<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C240A-3</td><td>CDC54 (WH/GN)</td><td>—</td><td>Ground</td></tr></table>
• Is the voltage 5V or greater?</td><td>Yes
REPAIR the circuit. TEST the system for normal operation.

No
GO to E3 .</td></tr>
<tr><td>E3 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
▪ Corrosion (clean module pins or install new connectors or terminals)
▪ Damaged or bent pins (install new terminals or pins)
▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.</td><td>Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.</td></tr>
</table>

repair4less

• **Is the concern still present?**	

Pinpoint Test F: The LF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the ACM when a failure is detected on the LF door or tweeter speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LF door or tweeter speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.
B1A01:12	Speaker #1: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LF door or tweeter speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the ACM when an open is detected on the LF door or tweeter speaker circuits.

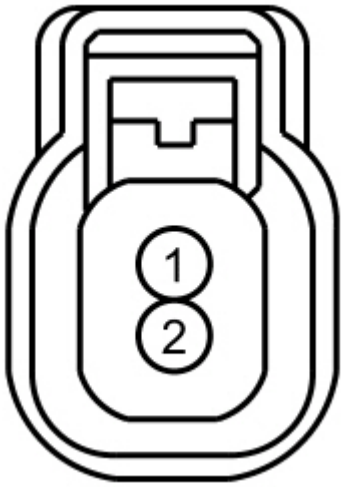
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST F: THE LF DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
F1 CHECK THE AUDIO SIGNAL TO THE LF DOOR SPEAKER	
• Ignition OFF. • Disconnect: LF Door Speaker C523 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between:	**Yes** INSTALL a new LF door speaker. REFER to Speaker — Door . **No** GO to F2 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C523-2	RME07 (WH/BN)



- **Is a fluctuating AC voltage present?**

F2 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO VOLTAGE

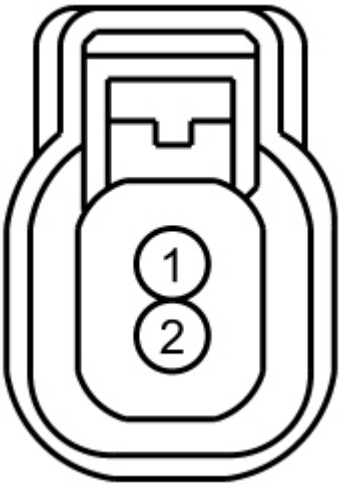
- Ignition OFF.
- Disconnect: ACM C240A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to F3 .

repair4less

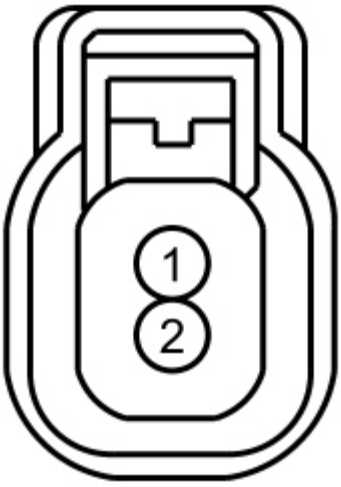


- **Is any voltage present?**

F3 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: LF Tweeter Speaker C230 .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to F4 .

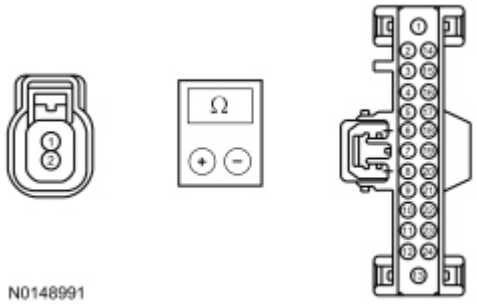
No
REPAIR the circuit in question.

F4 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Yes
GO to F5 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C240A-22	VME07 (WH)
C523-2	RME07 (WH/BN)	C240A-10	RME07 (WH/BN)



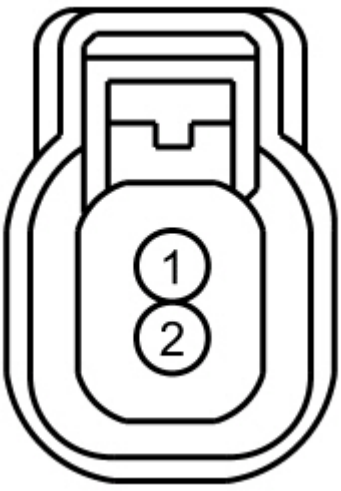
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

F5 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C523-2	RME07 (WH/BN)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to F6 .

No
REPAIR the circuit in question.

F6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

repair4less

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test G: The LF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

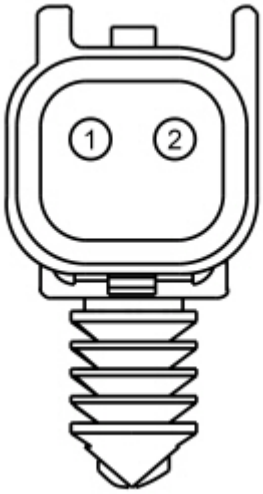
Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the ACM when a failure is detected on the LF door or tweeter speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LF door or tweeter speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.
B1A01:12	Speaker #1: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LF door or tweeter speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the ACM when an open is detected on the LF door or tweeter speaker circuits.

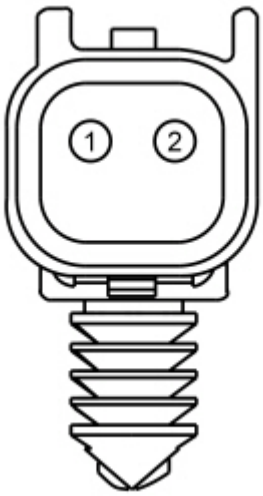
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

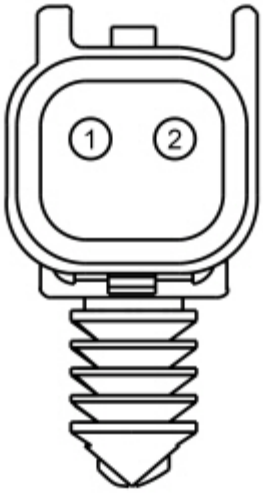
PINPOINT TEST G: THE LF TWEETER SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
G1 CHECK THE AUDIO SIGNAL TO THE LF TWEETER SPEAKER • Ignition OFF. • Disconnect: LF Tweeter Speaker C230 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C230-1, Circuit VME07 (WH) Negative Lead: Pin C230-2, Circuit RME07 (WH/BN)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new LF tweeter speaker. REFER to Speaker — A-Pillar . **No** GO to G2 .
G2 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C230-1, Circuit VME07 (WH) Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C230-2, Circuit RME07 (WH/BN) Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to G3 .

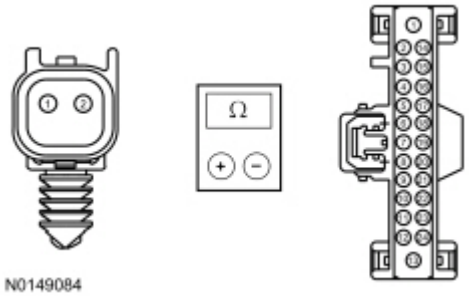
repair4less



- **Is any voltage present?**

G3 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: LF Door Speaker C523 . • Measure the **resistance** between: Positive Lead: Pin C230-1, Circuit VME07 (WH); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C230-2, Circuit RME07 (WH/BN); Negative Lead: Pin —, Circuit Ground  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to G4 . **No** REPAIR the circuit in question.
G4 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR AN OPEN	
• Measure the **resistance** between:	**Yes** GO to G5 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME07 (WH)	C240A-22	VME07 (WH)
C230-2	RME07 (WH/BN)	C240A-10	RME07 (WH/BN)



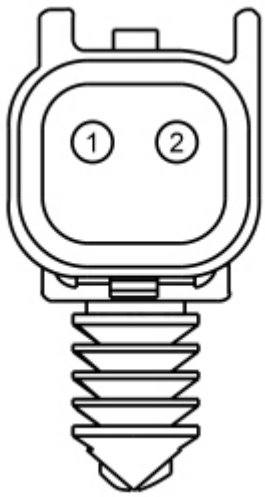
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

G5 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME07 (WH)	C230-2	RME07 (WH/BN)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to G6 .

No
REPAIR the circuit in question.

G6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

repair4less

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test H: The RF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

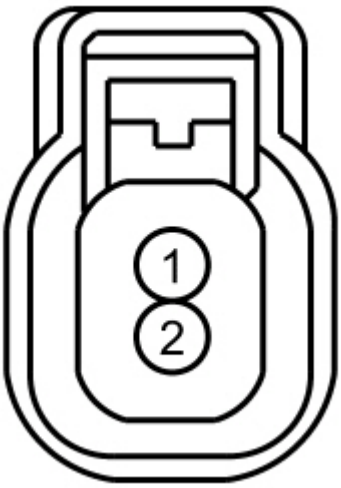
Refer to ACM in Information and Entertainment System.

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the ACM when a failure is detected on the RF door or tweeter speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RF door or tweeter speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RF door or tweeter speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the ACM when an open is detected on the RF door or tweeter speaker circuits.

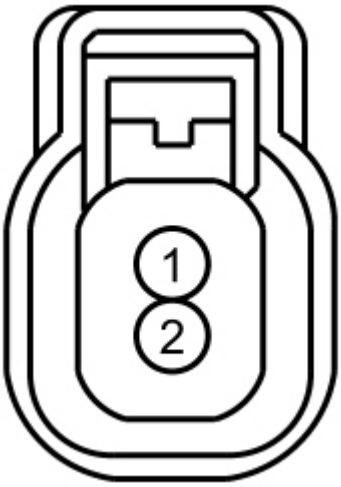
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST H: THE RF DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
H1 CHECK THE AUDIO SIGNAL TO THE RF DOOR SPEAKER • Ignition OFF. • Disconnect: RF Door Speaker C612 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C612-1, Circuit VME10 (WH/VT) Negative Lead: Pin C612-2, Circuit RME10 (WH/OG)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new RF door speaker. REFER to Speaker — Door . **No** GO to H2 .
H2 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C612-1, Circuit VME10 (WH/VT) Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C612-2, Circuit RME10 (WH/OG) Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to H3 .

repair4less

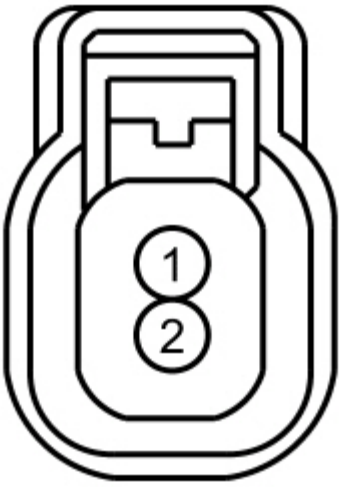


- **Is any voltage present?**

H3 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: RF Door Speaker C231 .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to H4 .

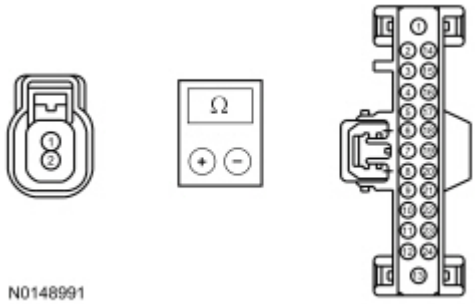
No
REPAIR the circuit in question.

H4 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Yes
GO to H5 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C240A-23	VME10 (WH/VT)
C612-2	RME10 (WH/OG)	C240A-11	RME10 (WH/OG)



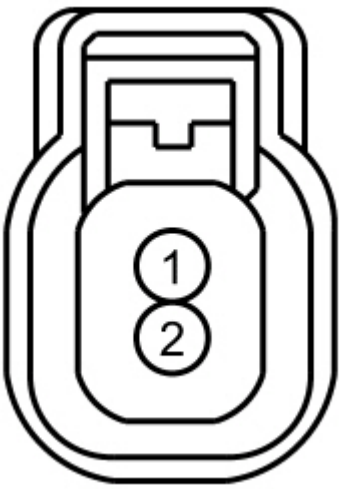
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

H5 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C612-2	RME10 (WH/OG)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to H6 .

No
REPAIR the circuit in question.

H6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

repair4less

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test I: The RF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

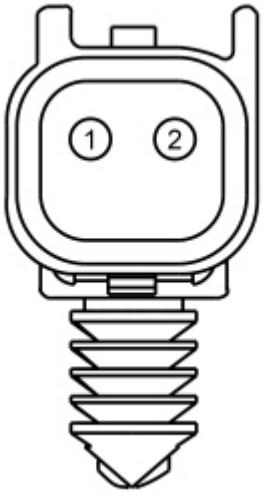
Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the ACM when a failure is detected on the RF door or tweeter speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RF door or tweeter speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RF door or tweeter speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the ACM when an open is detected on the RF door or tweeter speaker circuits.

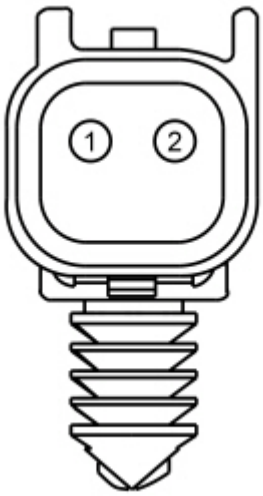
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST I: THE RF TWEETER SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
I1 CHECK THE AUDIO SIGNAL TO THE RF TWEETER SPEAKER • Ignition OFF. • Disconnect: RF Tweeter Speaker C231 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C231-1, Circuit VME10 (WH/VT) Negative Lead: Pin C231-2, Circuit RME10 (WH/OG)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new RF tweeter speaker. REFER to Speaker — A-Pillar . **No** GO to I2 .
I2 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C231-1, Circuit VME10 (WH/VT) Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C231-2, Circuit RME10 (WH/OG) Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to I3 .

repair4less

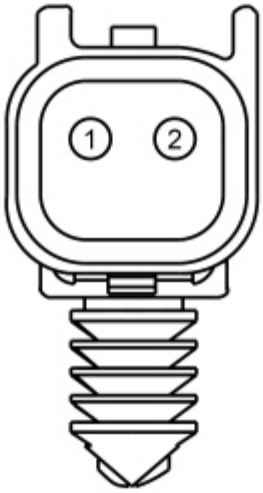


- **Is any voltage present?**

I3 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: RF Door Speaker C612 .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	—	Ground
C231-2	RME10 (WH/OG)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to I4 .

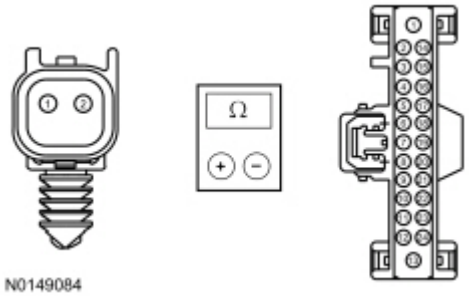
No
REPAIR the circuit in question.

I4 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Yes
GO to I5 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	C240A-23	VME10 (WH/VT)
C231-2	RME10 (WH/OG)	C240A-11	RME10 (WH/OG)



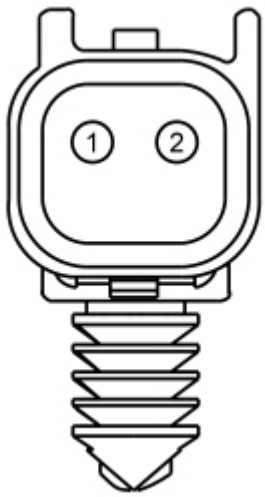
- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

I5 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	C231-2	RME10 (WH/OG)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to I6 .

No
REPAIR the circuit in question.

I6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.

Yes

repair4less

• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test J: The RR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

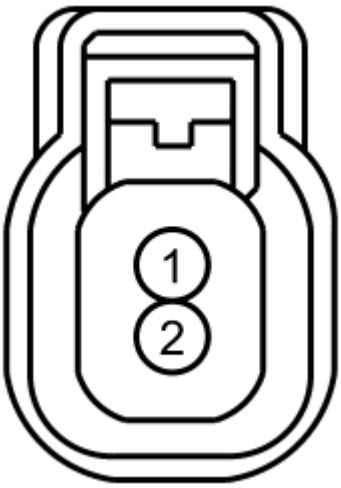
Refer to ACM in Information and Entertainment System.

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A03:01	Speaker #3: General Electrical Failure	Set by the ACM when a failure is detected on the RR door speaker circuits.
B1A03:11	Speaker #3: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RR door speaker circuits. When DTC B1A03:11 is set, the speaker output is disabled.
B1A03:12	Speaker #3: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RR door speaker circuits. When DTC B1A03:12 is set, the speaker output is disabled.
B1A03:13	Speaker #3: Circuit Open	Set by the ACM when an open is detected on the RR door speaker circuits.

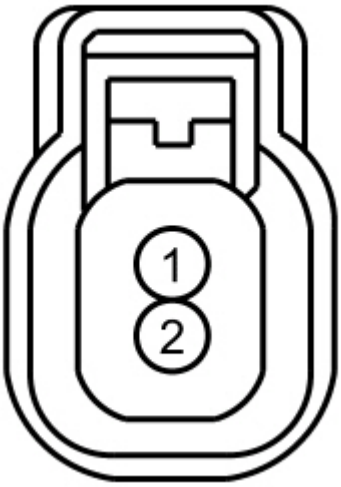
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST J: THE RR DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
J1 CHECK THE AUDIO SIGNAL TO THE RR DOOR SPEAKER • Ignition OFF. • Disconnect: RR Door Speaker C802 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C802-1, Circuit VME12 (BN/WH) Negative Lead: Pin C802-2, Circuit RME12 (BN/BU)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new RR door speaker. REFER to Speaker — Door . **No** GO to J2 .
J2 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C802-1, Circuit VME12 (BN/WH) Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C802-2, Circuit RME12 (BN/BU) Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to J3 .

repair4less

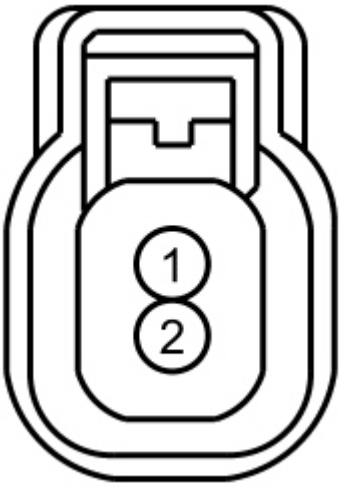


- **Is any voltage present?**

J3 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to J4 .

No
REPAIR the circuit in question.

J4 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR AN OPEN

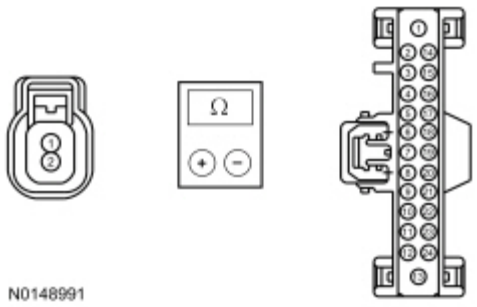
- Measure the **resistance** between:

Positive Lead	Negative Lead

Yes
GO to J5 .

No

Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C240A-24	VME12 (BN/WH)
C802-2	RME12 (BN/BU)	C240A-12	RME12 (BN/BU)



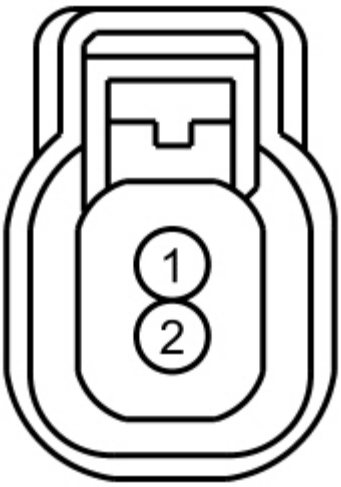
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

J5 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C802-2	RME12 (BN/BU)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to J6 .

No
REPAIR the circuit in question.

J6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.

Yes
CHECK OASIS for any applicable TSBs. If a

repair4less

• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test K: The LR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A04:01	Speaker #4: General Electrical Failure	Set by the ACM when a failure is detected on the LR door speaker circuits.
B1A04:11	Speaker #4: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LR door speaker circuits. When DTC B1A04:11 is set, the speaker output is disabled.
B1A04:12	Speaker #4: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LR door speaker circuits. When DTC B1A04:12 is set, the speaker output is disabled.
B1A04:13	Speaker #4: Circuit Open	Set by the ACM when an open is detected on the LR door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

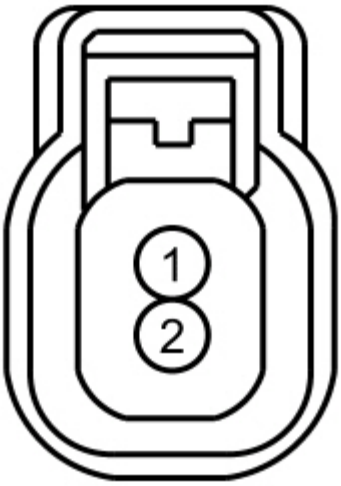
PINPOINT TEST K: THE LR DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take

K1 CHECK THE AUDIO SIGNAL TO THE LR DOOR SPEAKER

- Ignition OFF.
- Disconnect: LR Door Speaker C702 .
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C702-2	RME09 (BN/YE)



- **Is a fluctuating AC voltage present?**

Yes
INSTALL a new LR door speaker. REFER to Speaker — Door .

No
GO to K2 .

K2 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO VOLTAGE

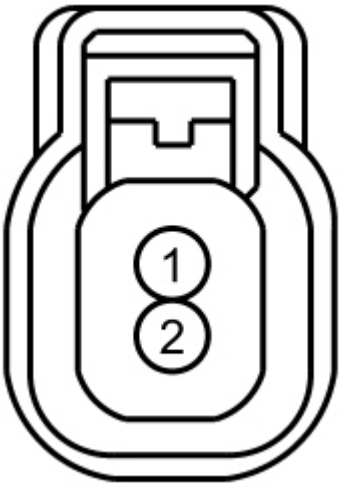
- Ignition OFF.
- Disconnect: ACM C240A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to K3 .

repair4less

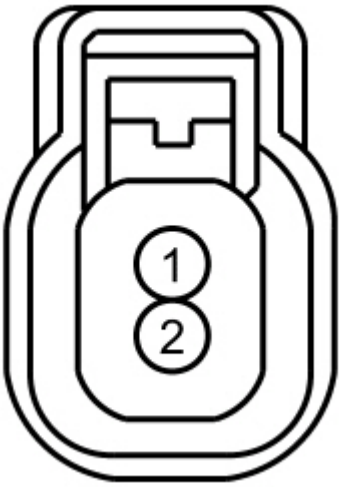


- **Is any voltage present?**

K3 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K4 .

No
REPAIR the circuit in question.

K4 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR AN OPEN

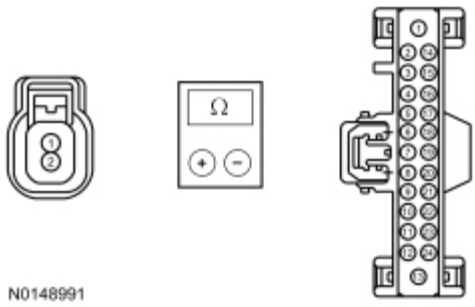
- Measure the **resistance** between:

Positive Lead	Negative Lead

Yes
GO to K5 .

No

Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C240A-21	VME09 (WH/GN)
C702-2	RME09 (BN/YE)	C240A-9	RME09 (BN/YE)



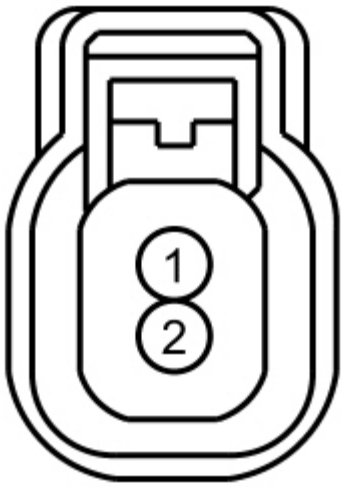
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

K5 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C702-2	RME09 (BN/YE)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K6.

No
REPAIR the circuit in question.

K6 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.

Yes
CHECK OASIS for any applicable TSBs. If a

repair4less

• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test L: Poor Quality, Distorted, Or No Sound While In SYNC® Mode

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System in Information and Entertainment System .

The APIM transmits left and right channel analog audio signals to the ACM . These signals include inputs from the USB port, audio input jack, and Bluetooth media device. If a USB mass storage device is used to play an audio file, the SYNC® system only plays audio files that do not have DRM protection.

Possible Sources

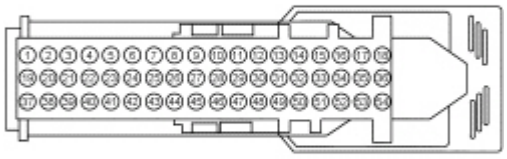
- Customer's device
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST L: POOR QUALITY, DISTORTED, OR NO SOUND WHILE IN SYNC® MODE

Test Step	Result / Action to Take
L1 VERIFY THE OPERATION OF THE SYNC® SYSTEM AUDIO SOURCES	
• Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, test the audio output for the audio input jack, USB port, and Bluetooth. • **Is there poor quality, distorted, or no sound from all SYNC® audio sources?**	**Yes** GO to L2 . **No** If there is a concern with one or more, but not all audio sources, GO to Symptom Chart - SYNC® System to diagnose the observed symptom. If all audio sources operate correctly,

	the concern is with the customer's device.
L2 CHECK THE AUDIO SIGNALS TO THE ACM ***NOTICE:*** **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.** • Operate the audio system in SYNC® mode and play an audio file. • Measure the **AC voltage** by back-probing ACM connector C240B: Positive Lead: Pin C240B-12, Circuit VME52 (BU); Negative Lead: Pin C240B-25, Circuit RME52 (GY/OG) Positive Lead: Pin C240B-13, Circuit VME53 (VT/GN); Negative Lead: Pin C240B-26, Circuit RME53 (BN/WH) • **Is a fluctuating AC voltage present?**	**Yes** GO to L7 . **No** GO to L3 .
L3 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240B . • Disconnect: APIM C2383 . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C2383-23, Circuit VME53 (VT/GN); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C2383-24, Circuit RME53 (BN/WH); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C2383-25, Circuit VME52 (BU); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C2383-26, Circuit RME52 (GY/OG); Negative Lead: Pin —, Circuit Ground	**Yes** REPAIR the circuit in question. **No** GO to L4 .

repair4less

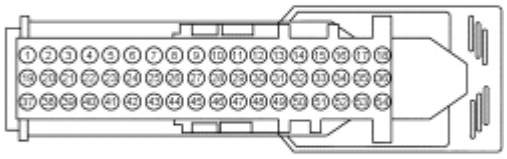


- **Is any voltage present?**

L4 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME53 (VT/GN)	—	Ground
C2383-24	RME53 (BN/WH)	—	Ground
C2383-25	VME52 (BU)	—	Ground
C2383-26	RME52 (GY/OG)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to L5 .

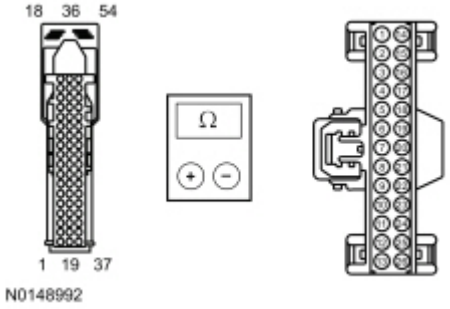
No
REPAIR the circuit in question.

L5 CHECK THE CIRCUITS TO THE ACM FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to L6 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME53 (VT/GN)	C240B-13	VME53 (VT/GN)
C2383-24	RME53 (BN/WH)	C240B-26	RME53 (BN/WH)
C2383-25	VME52 (BU)	C240B-12	VME52 (BU)
C2383-26	RME52 (GY/OG)	C240B-25	RME52 (GY/OG)



- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

L6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

L7 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

repair4less

• Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test M: All SYNC® Functions Are Inoperative Or Do Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® System in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3000:04	Control Module: System Internal Failure	Set by the APIM when it detects a fault due to a device conflict or internal failure.

Possible Sources

- Network communication concern
- Customer error
- Customer's device
- APIM

PINPOINT TEST M: ALL SYNC® FUNCTIONS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
M1 VERIFY THAT THE APIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the APIM pass the network test?**	**Yes** GO to M2 . **No** REFER to Section 418-00 .
M2 CHECK THE SYNC® SYSTEM INPUTS FOR FUNCTIONALITY	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases the phone book and call	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature.

histories, and deletes any devices paired with the SYNC® system. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNC® inputs function correctly?**	REVIEW the SYNC® system operation with the customer. If the customer's device still does not operate correctly, the fault is with the customer's device. **No** GO to M3.
M3 RESET THE APIM AND RECHECK SYNC® SYSTEM OPERATION	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases the phone book and call histories, and deletes any devices paired with the SYNC® system. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNC® inputs function correctly?**	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature. REVIEW the SYNC® system operation with the customer. If the customer's device still does not operate correctly, the fault is with the customer's device. **No** If only some, but not all of the inputs are inoperative, GO to Symptom Chart - SYNC® System to diagnose the observed symptom. If all inputs are inoperative and/or DTC U3000:04 is present, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Pinpoint Test N: The SYNC® System Voice Or Tone Prompts, TTS Feature, Or Ringtones Are Inoperative Or Do Not Operate Correctly, Or During A Phone Call, No Incoming Audio Is Heard In The Vehicle

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System and Voice Recognition in Information and Entertainment System.

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Possible Sources

- Customer's setting
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST N: THE SYNC® SYSTEM VOICE OR TONE PROMPTS, TTS FEATURE, OR RINGTONES ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY, OR DURING A PHONE CALL, NO INCOMING AUDIO IS HEARD IN THE VEHICLE

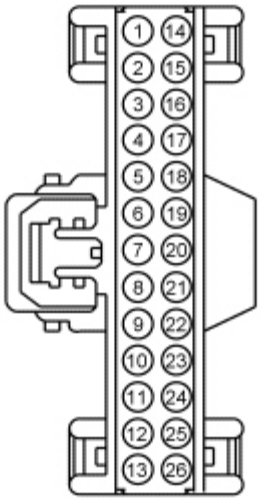
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>N1 CHECK THE AUDIBLE PROMPT SETTING</td><td rowspan="2">Yes
The system is operating correctly at this time. The concern was caused by the customer's setting. INSTRUCT the customer in the correct operation of the audible prompt feature.

No
GO to N2 .</td></tr>
<tr><td>• Operate the audio system in SYNC® mode.
• Verify the audible prompts are enabled. Refer to "SYNC® Voice Recognition Feature" in the Owner's Literature.
• Operate the VOICE button on the steering wheel controls and observe the SYNC® audible prompt.
• Does the SYNC® system produce an audible prompt correctly?</td></tr>
<tr><td>N2 CHECK FOR A VOLTAGE SIGNAL FROM THE APIM</td><td rowspan="2">Yes
GO to N7 .

No
GO to N3 .</td></tr>
<tr><td>NOTICE: This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.
• Operate the audio system in SYNC® mode.
• While operating the VOICE button repeatedly, measure the AC voltage by back-probing ACM connector C240B:
<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C240B-8</td><td>VMN14 (WH/VT)</td><td>C240B-21</td><td>RMN14 (GY/BN)</td></tr></table>• Is a fluctuating AC voltage present each time the VOICE switch is operated?</td></tr>
<tr><td>N3 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO VOLTAGE</td><td rowspan="2">Yes
REPAIR the circuit in question.</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: ACM C240B .
• Disconnect: APIM C2383 .</td></tr>
</table>

- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-8	VMN14 (WH/VT)	—	Ground
C240B-21	RMN14 (GY/BN)	—	Ground



- **Is any voltage present?**

No
GO to N4 .

N4 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO GROUND

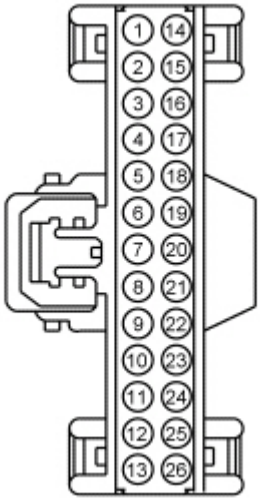
- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-8	VMN14 (WH/VT)	—	Ground
C240B-21	RMN14 (GY/BN)	—	Ground

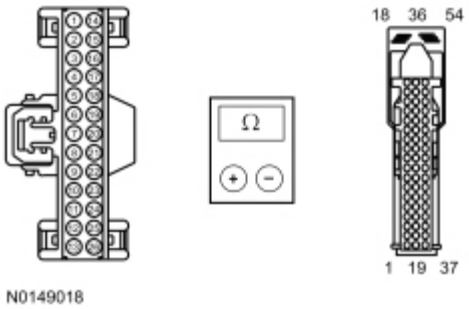
Yes
GO to N5 .

No
REPAIR the circuit in question.

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- **Are the resistances greater than 10,000 ohms?**

N5 CHECK THE AUDIBLE PROMPT CIRCUITS FOR AN OPEN	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-8	VMN14 (WH/VT)	C2383-3	VMN14 (WH/VT)
C240B-21	RMN14 (GY/BN)	C2383-4	RMN14 (GY/BN) |  • **Are the resistances less than 3 ohms?**	**Yes** GO to N6 . **No** REPAIR the circuit in question.
N6 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

• Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.
N7 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test O: All SYNC® Services Features Are Inoperative Or Inaccurate

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® Services in Information and Entertainment System.

Possible Sources

- Expired subscription
- APIM
- GPSM
- SYNC® Services server

PINPOINT TEST O: ALL SYNC® SERVICES FEATURES ARE INOPERATIVE OR INACCURATE

Test Step	Result / Action to Take
O1 VERIFY THE CUSTOMER'S SYNC® OWNER ACCOUNT AND SYNC® SERVICES REGISTRATION AND SUBSCRIPTION	
• Verify that the customer has a SYNC® Owner Account on	**Yes** GO to O2.

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SyncMyRide • Verify that the customer has registered for SYNC® Services and has an active subscription. • **Does the customer have a SYNC® Owner Account and an active SYNC® Services subscription?**	**No** If the customer does not have a SYNC® Owner Account, INFORM the customer that an account must be created in order to sign up for SYNC® Services. REFER to SyncMyRide . If the customer does not have an active SYNC® Services subscription, INFORM the customer that in order for SYNC® Services to function, the subscription needs to be activated. REFER to SyncMyRide .
O2 VERIFY THE CUSTOMER'S REGISTERED PHONE NUMBER AND STATUS	
• Verify that the mobile phone being used has the correct phone number registered with SYNC® Services. • Verify that the mobile phone being used is selected as "Active" on SyncMyRide . • **Is the customer using the registered and active mobile phone associated with the SYNC® services account?**	**Yes** GO to O3 . **No** INFORM the customer that the correct phone number must be registered on the SYNC® website and selected as "Active." REFER to SyncMyRide .
O3 CHECK FOR APIM DTCs	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Are any DTCs recorded in the APIM ?**	**Yes** REFER to the APIM DTC Chart in Information and Entertainment System . **No** GO to O4 .
O4 CHECK FOR GPSM DTCs	
• Using a diagnostic scan tool, perform the GPSM self-test. • **Are any DTCs recorded in the GPSM ?**	**Yes** REFER to the GPSM DTC Chart in Information and Entertainment System . **No** GO to O5 .
O5 VERIFY THE CUSTOMER'S PHONE CONNECTION TO SYNC® SERVICES	
• Advise the customer to connect their phone to SYNC® Services. Caller ID blocking must be disabled on the customer's phone. Refer to the Owner's Literature. • Operate a SYNC® Services feature. • Verify that the phone call is placed and that the phone is connected to SYNC® Services. • **Does the phone connect to SYNC® Services and operate correctly?**	**Yes** GO to O6 . **No** GO to Pinpoint Test S .

O6 OBSERVE THE SYNC® SERVICES SUBSCRIPTION COMMERCIAL	
• Once the customer's phone is connected to SYNC® Services, observe the subscription commercial. • **Does the SYNC® Services subscription commercial repeat with no selection option?**	**Yes** There is a potential SYNC® Services server issue, and the problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance. **No** GO to O7 .
O7 CHECK THE OPERATION OF THE DIRECTIONS FROM SYNC® SERVICES	
• When prompted, select directions from SYNC® Services and observe the audible prompts from the audio system. • **Is a single chime, audible prompt, then a short chime heard, indicating the navigation route is being sent to the vehicle?**	**Yes** SYNC® Services is operating correctly at this time. **No** If a single chime, audible prompt, then a repeating chime is heard, indicating the navigation route is being sent to the vehicle, GO to O8 . If no chime or audible prompt is heard, indicating that the system was unable to locate the vehicle, there is a potential SYNC® Services server issue. The problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance.
O8 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test P: Voice Recognition Is Inoperative Or Does Not Operate Correctly, Or During A Phone Call, Poor Quality Or No Outgoing Audio Is Heard On The Outside Device

Diagnostic Overview

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Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Voice Recognition in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1D79:01	Microphone Input: General Electrical Failure	Set by the APIM when a microphone is not detected during the on-demand self-test.
B1D79:11	Microphone Input: Circuit Short To Ground	Set by the APIM when short to ground is detected on the microphone circuits.
B1D79:12	Microphone Input: Circuit Short To Battery	Set by the APIM when short to voltage is detected on the microphone circuits.
B1D79:13	Microphone Input: Circuit Open	Set by the APIM when an open is detected on the microphone circuits.

Possible Sources

- Insufficiently quiet vehicle
- Inadequate phone reception
- Wiring, terminals, or connectors
- Microphone
- APIM

PINPOINT TEST P: VOICE RECOGNITION IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY, OR DURING A PHONE CALL, POOR QUALITY OR NO OUTGOING AUDIO IS HEARD ON THE OUTSIDE DEVICE

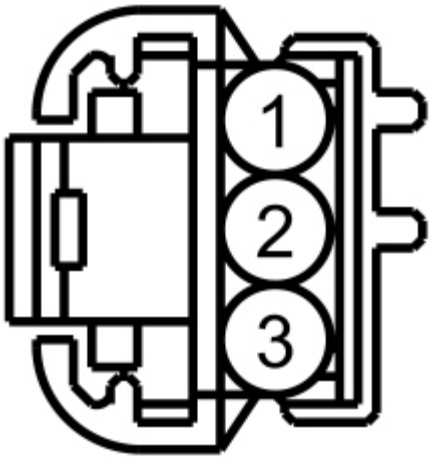
Test Step	Result / Action to Take
P1 CHECK THE AUDIBLE PROMPT FUNCTIONALITY	
• Operate the audio system in radio tuner AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **Does the SYNC® system produce an audible prompt correctly, indicating voice recognition mode has been entered?**	**Yes** GO to P3 . **No** GO to P2 .
P2 CHECK THE OPERATION OF THE RH STEERING WHEEL SWITCHES	
• Operate the audio system in AM/FM mode. • Operate the VOLUME +/-, SEEK +/-, MEDIA, PHONE, and OK steering wheel switches. • **Do the VOLUME +/-, SEEK +/-, MEDIA, PHONE,**	**Yes** GO to Pinpoint Test N . **No**

and OK steering wheel switches operate correctly?	GO to Pinpoint Test T to diagnose the RH steering wheel switches.
P3 CHECK THE OPERATION OF THE "PHONE" VOICE COMMAND	
• Pair a Bluetooth phone with the SYNC® system. For information on the pairing process, refer to the Owner's Literature. If necessary, review the device compatibility list found on syncmyride.com . • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the system from correctly recognizing spoken commands. • Clearly speak the word "phone." • **Does the SYNC® system respond correctly to the "phone" voice command?**	**Yes** For a concern with the voice recognition being inoperative or not operating correctly, the system is operating correctly at this time. The concern may have been caused by an insufficiently quiet vehicle. Delete the just-paired Bluetooth phone from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. For a concern with poor quality or no outgoing audio being heard on the outside device during a phone call, GO to P4 **No** GO to P5 .
P4 CHECK THE OUTGOING PHONE CALL QUALITY AND VOICE VOLUME	
• Ensure that the Bluetooth phone paired in step 3 has adequate reception. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the call from having clear call quality and acceptable voice volume. • Using the SYNC® system, place a phone call. For information on making calls from the SYNC® system, refer to the Owner's Literature. • Ensure that the called party's phone has adequate reception. • Instruct the called party to determine if the call quality is clear and of acceptable volume. • Delete the Bluetooth phone paired in step 3 from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. • **Is the outgoing call quality clear and of acceptable volume?**	**Yes** The system is operating correctly at this time. The concern may have been caused by poor phone reception or an insufficiently quiet vehicle. **No** GO to P5 .
P5 CHECK THE MICROPHONE AND MICROPHONE CIRCUITS FOR CORRECT VOLTAGE DROP	
***NOTICE:* This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**	**Yes** If diagnosing an intermittent concern, GO to P6 . If **not** diagnosing an intermittent concern, GO to P12 . **No** GO to P7 .

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- Ignition ON.
- While back-probing microphone C9221, measure and record the **DC voltage** .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)



- **Is the voltage between 2.7 and 6.2 volts?**

P6 CHECK THE MICROPHONE CIRCUITS FOR INTERMITTENT CONCERNS

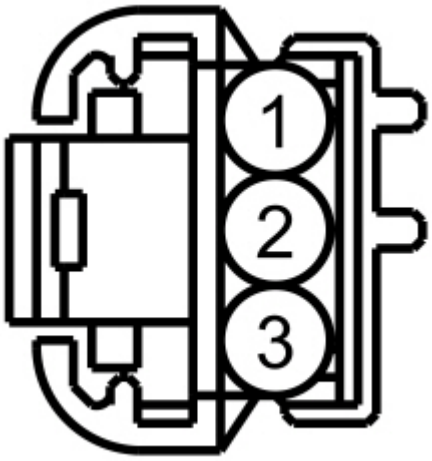
NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

- While back-probing microphone C9221, measure the **DC voltage** while agitating the microphone harness back and forth and up and down (wiggle testing).

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)

Yes
REPAIR the circuit(s), connector, or terminal(s) in question. For corrosion, clean pins or install a new connector or terminals. For damaged or bent pins, install new terminals or pins.

No
GO to P11 .

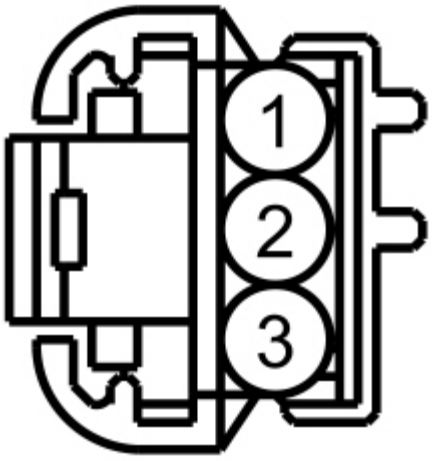


- Review the recorded results from step 5.
- **Does the voltage fluctuate more than .5 volts from the recorded result in step 5?**

P7 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Microphone C9221.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

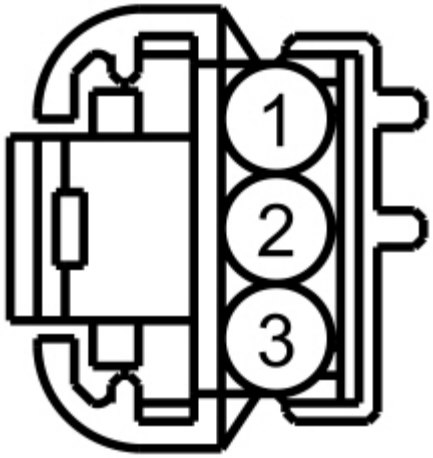
No
GO to P8 .

P8 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO GROUND

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- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

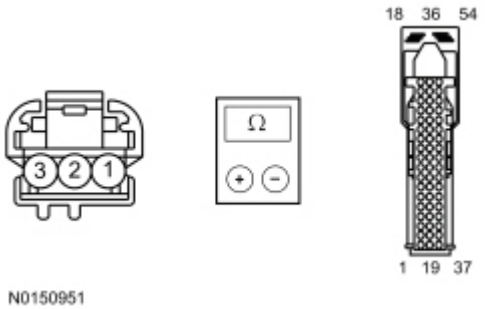
Yes
GO to P9 .

No
REPAIR the circuit in question.

P9 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR AN OPEN

- Measure the **resistance** between:

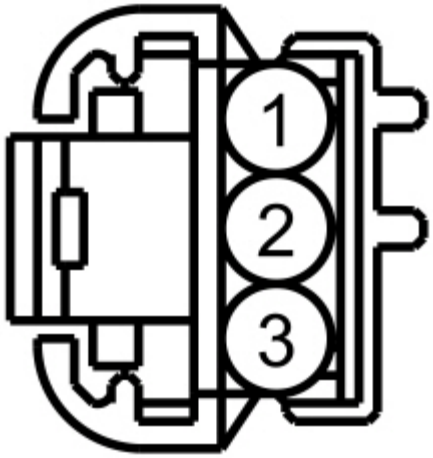
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C2383-5	VMM13 (YE/GN)
C9221-3	DMM13 (BK)	C2383-6	DMM13 (BK)



- **Are the resistances less than 3 ohms?**

Yes
GO to P10 .

No
REPAIR the circuit in question.

P10 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TOGETHER	
• Measure the **resistance** between: Positive Lead: Pin C9221-2, Circuit VMM13 (YE/GN) Negative Lead: Pin C9221-3, Circuit DMM13 (BK)  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P12 . **No** REPAIR the circuit in question.
P11 ISOLATE THE MICROPHONE	
• Install a new microphone. Refer to Microphone . • If necessary, connect: APIM C2383. • Operate the audio system in AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • Speak a command to test the voice recognition for normal operation. • **Is the voice recognition functioning correctly?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative microphone. **No** GO to P12 .
P12 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Pinpoint Test Q: The Audio Input Jack Is Inoperative Or Has Poor Sound Quality

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Audio Input Jack Mode in Information and Entertainment System .

Possible Sources

- Customer's device
- Wiring, terminals, or connectors
- Audio input jack
- APIM

PINPOINT TEST Q: THE AUDIO INPUT JACK IS INOPERATIVE OR HAS POOR SOUND QUALITY

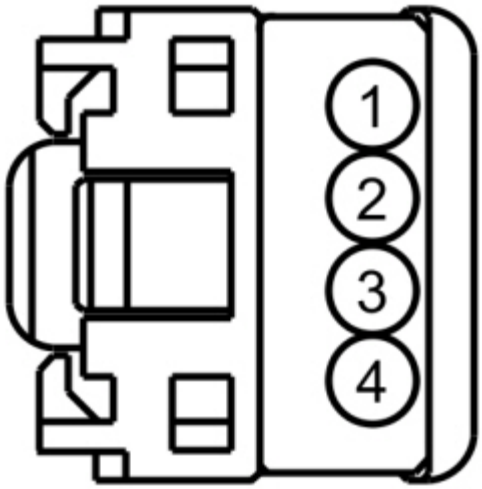
NOTE: Before carrying out this pinpoint test, make sure the MP3 device is operating correctly.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>Q1 CHECK THE AUDIO INPUT JACK AUDIO FUNCTIONALITY</td><td></td></tr>
<tr><td>• Connect: Multi-Media Interface Tester 105-00120.
• Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the audio input jack.
• Is the audio output OK for the audio input jack?</td><td>Yes
The system is operating correctly at this time. The concern may be with the customer's device.

No
GO to Q2 .</td></tr>
<tr><td>Q2 CHECK THE AUDIO INPUT JACK CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Audio Input Jack C2362.
• Disconnect: APIM C2383.
• Ignition ON.
• Measure the voltage between:

<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C2362-1</td><td>VME46 (BU/GN)</td><td>—</td><td>Ground</td></tr><tr><td>C2362-3</td><td>RME45 (YE/GN)</td><td>—</td><td>Ground</td></tr><tr><td>C2362-4</td><td>VME45 (BU)</td><td>—</td><td>Ground</td></tr></table></td><td>Yes
REPAIR the circuit in question.

No
GO to Q3 .</td></tr>
</table>



- **Is any voltage present?**

Q3 CHECK THE AUDIO INPUT JACK CIRCUITS FOR A SHORT TO GROUND

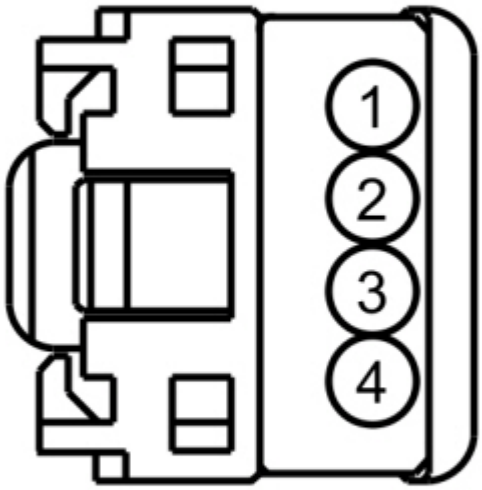
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- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-1	VME46 (BU/GN)	—	Ground
C2362-3	RME45 (YE/GN)	—	Ground
C2362-4	VME45 (BU)	—	Ground

Yes
GO to Q4 .

No
REPAIR the circuit.

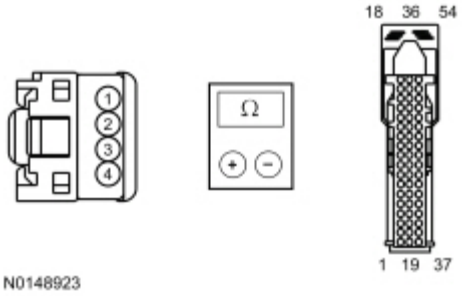


- **Is the resistance greater than 10,000 ohms?**

Q4 CHECK THE AUDIO INPUT JACK CIRCUITS FOR AN OPEN	
• Measure the **resistance** between:	**Yes**

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-1	VME46 (BU/GN)	C2383-47	VME46 (BU/GN)
C2362-3	RME45 (YE/GN)	C2383-46	RME45 (YE/GN)
C2362-4	VME45 (BU)	C2383-45	VME45 (BU)



- **Are the resistances less than 3 ohms?**

GO to Q5.

No
REPAIR the circuit in question.

Q5 ISOLATE THE AUDIO INPUT JACK

- Connect: APIM C2383.
- Install a new audio input jack. Refer to Audio Input Jack.
- Connect: Multi-Media Interface Tester 105-00120.
- Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the audio input jack.
- **Is the audio output OK for the audio input jack?**

Yes
The system is now correctly at this time. The concern was caused by an inoperative audio input jack.

No
GO to Q6.

Q6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test R: The USB Port Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® AppLink™, USB Audio Mode and USB Port. in Information and Entertainment System .

The USB port is part of the USB cable, and cannot be replaced separately.

The Multi-Media Interface Tester 105-00120 is powered by the USB port

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1252:04	USB Port: System Internal Failure	Set by the APIM when an over-temperature condition is detected in the USB circuit. This can be caused by a fault in the USB cable, USB port, or customer's USB device.
B1252:11	USB Port: Circuit Short to Ground	Set by the APIM when a short to ground or over-current condition is detected in the USB circuit. This can be caused by a fault in the USB cable, USB port, or customer's USB device.

Possible Sources

- Customer's device
- USB cable/port
- USB cable/port connection
- APIM

PINPOINT TEST R: THE USB PORT IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
R1 RESET THE APIM AND RECHECK SYNC® SYSTEM OPERATION	
• Remove any devices connected to the USB port. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Connect: Multi-Media Interface Tester 105-00120.	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to R2 .

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• Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the USB port. • **Is the audio output OK for the USB port?**	
R2 CHECK THE APIM FOR DTC B1252:04 OR DTC B1252:11	
• Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:04 or DTC B1252:11 present?**	**Yes** GO to R3 . **No** GO to R5 .
R3 INSPECT THE USB CABLE AND APIM	
• Ignition OFF. • Disconnect: USB cable at the APIM . • Inspect the APIM connector port and both ends of the USB cable for damage. Remove any debris. • **Is any damage present?**	**Yes** For the USB cable, INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . For the APIM , For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** GO to R4 .
R4 CHECK THE USB PORT FOR FUNCTIONALITY	
• Connect: USB cable at the APIM . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using the USB port. • **Is the audio output OK for the USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by the USB connector not being seated correctly. **No** GO to R5 .
R5 ISOLATE THE USB CABLE/PORT	
• Install a new USB cable/port. Universal Serial Bus (USB) Cable and Port . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play a file using the USB port. • **Is the audio output OK for the USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative USB cable. **No** GO to R6 .
R6 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect and inspect the APIM connector.	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions.

• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test S: Unable To Pair Bluetooth Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Bluetooth Mode and SYNC® AppLink™ in Information and Entertainment System .

Possible Sources

- Incompatible Bluetooth device
- APIM

PINPOINT TEST S: UNABLE TO PAIR BLUETOOTH DEVICE

Test Step	Result / Action to Take
S1 CHECK THE BLUETOOTH CONNECTION	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases the phone book and call histories, and deletes any devices paired with the SYNC® system. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature. REVIEW the pairing process with the customer. If the customer's device still does not pair, the fault is with the customer's device. **No**

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Tester 105-00120, connect to the SYNC® system using Bluetooth. Follow the tool instructions. • Using a diagnostic scan tool, view the APIM PIDs. • Monitor the Bluetooth device paired PID (BT_PAIR) and the Bluetooth device connected PID (BT_CONN). • **Do the PIDs both read "Yes"?**	GO to S2.

S2 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test T: The RH steering wheel controls are inoperative or do not operate correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Steering Wheel Switch Functions and Steering Wheel Switches in Information and Entertainment System.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1380:09	Steering Wheel Right Switch Pack: Component Failure	Set by the SCCM when the RH steering wheel switch is stuck.
B1380:11	Steering Wheel Right Switch Pack:	Set by the SCCM when a short to ground is detected

	Circuit Short To Ground	in the RH steering wheel switch circuits.
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	Set by the SCCM when a short to voltage is detected in the RH steering wheel switch circuits.

Possible Sources

- Steering wheel switch
- Wiring, terminals, or connectors
- Clockspring
- SCCM

PINPOINT TEST T: THE RH STEERING WHEEL CONTROLS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take

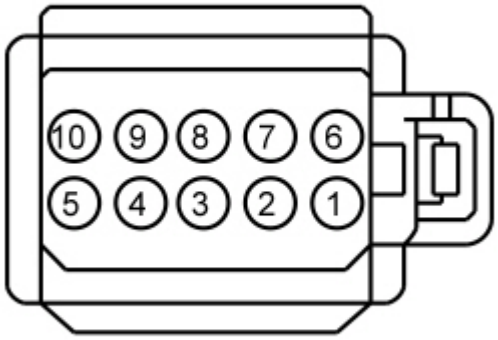
T1 CHECK THE RH STEERING WHEEL SWITCH PIDs
• Ignition ON.
• Monitor the steering wheel controls PIDs while pressing each RH steering wheel switch.
• Using a diagnostic scan tool, view the SCCM PIDs.
  ◦ SW_VOLDOWN
  ◦ SW_VOLUP
  ◦ SW_SEEKMINUS
  ◦ SW_SEEKPLUS
  ◦ SW_VOICE
  ◦ SW_MEDIA
  ◦ SW_PHONE
• Using a diagnostic scan tool, view the APIM PID.
  ◦ SW_OK
• **Do the PID values agree with the switch positions?**
	Yes
	GO to T10.
	
	No
	If one or more, but not all PID values are incorrect or always read one particular switch position, INSTALL a new RH steering wheel switch. REFER to Section 211-05. If all PID values are incorrect or always read one particular switch position, GO to T2.

T2 CHECK FOR IPC DTC U0212:00 • Ignition ON. • Using a diagnostic scan tool, clear the DTCs from the IPC. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the IPC self-test. • **Is DTC U0212:00 set in the IPC ?**	**Yes** REFER to Section 413-01. **No** GO to T3.
T3 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TO GROUND **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Ignition OFF. • Disconnect: RH Steering Wheel Switch C2999. • Disconnect: Clockspring C218B.	**Yes** GO to T4. **No** INSTALL a new steering wheel. REFER to Section 211-04.

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- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	—	Ground
C2999-4	RME14	—	Ground
C2999-6	VME54	—	Ground
C2999-7	RME54	—	Ground



- **Are the resistances greater than 10,000 ohms?**

T4 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218B-14	VME14
C2999-4	RME14	C218B-6	RME14
C2999-6	VME54	C218B-16	VME54
C2999-7	RME54	C218B-8	RME54

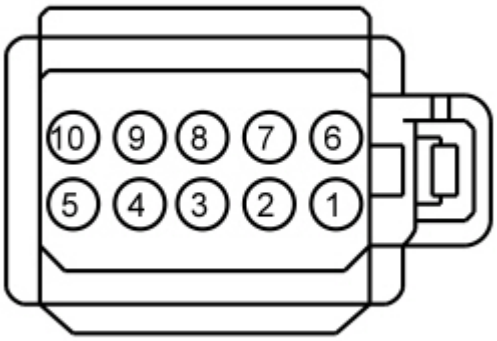
Yes
GO to T5 .

No
INSTALL a new steering wheel.
REFER to Section 211-04 .



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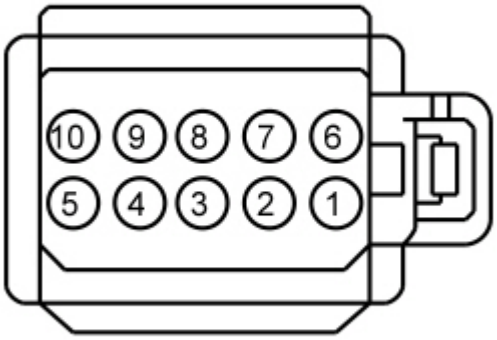
- **Are the resistances less than 3 ohms?**

T5 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TOGETHER	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
C2999-6	VME54	C2999-7	RME54 |  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to T6 . **No** INSTALL a new steering wheel. REFER to Section 211-04 .

T6 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND	
• Connect: Clockspring C218B. • Disconnect: Clockspring C218C. • Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C2999-2	VME14	—	Ground
C2999-4	RME14	—	Ground		**Yes** GO to T7 . **No** INSTALL a new clockspring. REFER to Section 501-20B .

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C2999-6	VME54	—	Ground
C2999-7	RME54	—	Ground

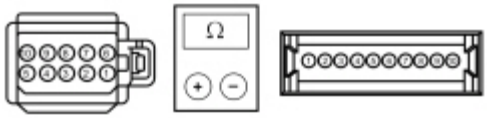


- **Are the resistances greater than 10,000 ohms?**

T7 CHECK THE CLOCKSPRING FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218C-6	—
C2999-4	RME14	C218C-5	—
C2999-6	VME54	C218C-10	—
C2999-7	RME54	C218C-9	—



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- **Are the resistances less than 3 ohms?**

Yes
GO to T8 .

No
INSTALL a new clockspring.
REFER to Section 501-20B .

T8 CHECK THE CLOCKSPRING FOR A SHORT TOGETHER

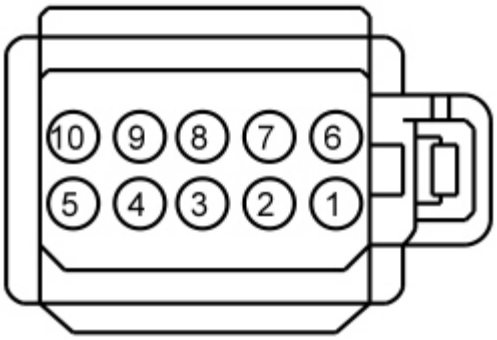
- Measure the **resistance** between:

Positive Lead		Negative Lead	

Yes
GO to T9 .

No

Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
C2999-6	VME54	C2999-7	RME54



- **Are the resistances greater than 10,000 ohms?**

INSTALL a new clockspring. REFER to Section 501-20B .

T9 CHECK FOR VOLTAGE AT THE SCCM

- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2414D-6	—	C2414D-5	—
C2414D-10	—	C2414D-9	—



- **Is approximately 5 volts present?**

Yes
INSTALL a new RH steering wheel switch. REFER to Section 211-05 .

No
GO to T10 .

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T10 CHECK FOR CORRECT SCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the SCCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the SCCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to Section 211-05 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test U: The Audio System Does Not Operate Correctly From The FCIM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Accessory Delay Feature and FCIM in Information and Entertainment System .

Possible Sources

- Network communication concern
- FCIM

PINPOINT TEST U: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FCIM

Test Step	Result / Action to Take
U1 VERIFY THAT THE ACM , APIM , AND FCIM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the ACM , APIM , and FCIM pass the network test?**	**Yes** GO to U2 . **No** If the ACM failed the network test, REFER to Section 418-00 The ACM Does Not Respond To The Scan Tool. If the APIM failed the network test, REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool. If the FCIM failed the network test, REFER to Section 418-00 The FCIM Does Not Respond To The Scan Tool.
U2 RESET THE AUDIO SYSTEM MODULES AND	

RECHECK THE FCIM OPERATION • Disconnect the battery for 5 minutes, then reconnect it. • Turn the infotainment system on. • Test the FCIM for normal operation. • **Does the FCIM operate correctly?**	**Yes** The FCIM is operating correctly at this time. The concern was corrected by resetting the audio system modules. **No** GO to U3

U3 RETRIEVE THE ACM, APIM, AND FCIM DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ ACM
  ◦ APIM
  ◦ FCIM
• **Are any DTCs present in the ACM, APIM, or FCIM?**
	Yes
	For ACM DTCs, REFER to the ACM DTC Chart in Information and Entertainment System For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For FCIM DTCs, REFER to the FCIM DTC Chart in Information and Entertainment System
	
	No
	GO to U4.

U4 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test V: The FCDIM Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

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Refer to FCDIM in Information and Entertainment System .

Possible Sources

- Wiring, terminals, or connectors
- FCDIM

PINPOINT TEST V: THE FCDIM IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
V1 VERIFY THAT THE FCDIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the FCDIM pass the network test?**	**Yes** GO to V2 . **No** REFER to Section 418-00 The FCDIM Does Not Respond To The Scan Tool.
V2 OBSERVE THE FCDIM DISPLAY	
• Turn the audio system on and verify the FCDIM operation. • **Is the FCDIM screen completely inoperative or blank?**	**Yes** GO to V4 . **No** GO to V3 .
V3 CHECK FOR LOST COMMUNICATION DTCS SET IN THE FCDIM	
• Ignition ON. • Using a diagnostic scan tool, perform the FCDIM self-test. • **Are any lost communication DTCs (U-codes) present in the FCDIM ?**	**Yes** REFER to the FCDIM DTC Chart in Information and Entertainment System . **No** GO to V4 .
V4 CHECK FOR CORRECT FCDIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FCDIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCDIM . REFER to Front Controls/Display Interface Module (FCDIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

• Reconnect the FCDIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test W: One Or More FCDIM Displays Are Inoperative Or Do Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to FCDIM in Information and Entertainment System .

All of the displays on the FCDIM screen are controlled through network messages. The modules sending display data to the FCDIM are:

- ACM : audio system information
- APIM : SYNC® system information
- IPC : warning messages and indicators

If the FCDIM loses the signal from any of these modules, only those specific displays will be inoperative.

Possible Sources

- ACM
- APIM
- FCDIM
- IPC

PINPOINT TEST W: ONE OR MORE FCDIM DISPLAYS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
W1 VERIFY THAT THE FCDIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the FCDIM pass the network test?**	**Yes** GO to W2 . **No** REFER to Section 418-00 The FCDIM Does Not Respond To The Scan Tool.
W2 CHECK FOR LOST COMMUNICATION DTCS SET IN THE FCDIM	

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• Ignition ON. • Using a diagnostic scan tool, perform the FCDIM self-test. • **Are any lost communication DTCs (U-codes) present in the FCDIM ?**	**Yes** REFER to the FCDIM DTC Chart in Information and Entertainment System . **No** GO to W3 .
W3 CHECK THE FCDIM DISPLAY SEGMENTS	
• Using a diagnostic scan tool, view the FCDIM PIDs. • Command all of the LCD segments on using the FCDIM active command LCD_SEG (All LCD Segments). • **Do all of the FCDIM segments illuminate?**	**Yes** The system is operating correctly at this time. INFORM the customer of the operation of the FCDIM display. **No** GO to W4 .
W4 CHECK FOR CORRECT FCDIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FCDIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCDIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCDIM . REFER to Front Controls/Display Interface Module (FCDIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test X: The Compass Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to FCDIM in Information and Entertainment System .

Possible Sources

- Network communication concern
- FCDIM
- GPSM

PINPOINT TEST X: THE COMPASS IS INOPERATIVE

Test Step	Result / Action to Take
X1 VERIFY THAT THE FCDIM AND GPSM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the FCDIM and GPSM pass the network test?**	**Yes** GO to X2. **No** If the FCDIM failed the network test, REFER to Section 418-00 The FCDIM Does Not Respond To The Scan Tool. If the GPSM failed the network test, REFER to Section 418-00 The GPSM Does Not Respond To The Scan Tool.
X2 RETRIEVE THE FCDIM AND GPSM DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ FCDIM
  ◦ GPSM
• **Are any DTCs present in the FCDIM or GPSM ?**
	Yes
	For FCDIM DTCs, REFER to the FCDIM DTC Chart in Information and Entertainment System For GPSM DTCs, REFER to the GPSM DTC Chart in Information and Entertainment System
	
	No
	GO to X3.

X3 CHECK FOR CORRECT GPSM OPERATION	

• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Y: DTC U0100:00

Diagnostic Overview

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Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	Set by the GPSM when network messages are missing from the PCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST Y: DTC U0100:00

Test Step	Result / Action to Take
Y1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to Y2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
Y2 RECHECK FOR DTC U0100:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0100:00 set in the GPSM?**	**Yes** GO to Y3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
Y3 CHECK THE PCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the PCM self-test. • **Are any low or high voltage DTCs recorded in the PCM?**	**Yes** REFER to PCM DTC Chart in Section 303-14. **No** GO to Y4.
Y4 CHECK THE GPSM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the GPSM self-test. • **Are any low or high voltage DTCs recorded in the GPSM?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AF. For DTC U3003:17, GO to Pinpoint Test ag. **No**

	GO to Y5 .
Y5 CHECK FOR CORRECT PCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the PCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the PCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new PCM . REFER to Section 303-14 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Z: DTC U0140:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	Set by the APIM and GPSM when network messages are missing from the BCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST Z: DTC U0140:00

Test Step	Result / Action to Take
Z1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to Z2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

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Z2 RECHECK FOR DTC U0140:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0140:00 set in the APIM or GPSM ?**	**Yes** GO to Z3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
Z3 CHECK THE BCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the BCM self-test. • **Are any low or high voltage DTCs recorded in the BCM ?**	**Yes** REFER to BCM DTC Chart in Section 419-10 . **No** GO to Z4 .
Z4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ APIM ▪ GPSM • **Are low or high voltage DTCs recorded in the APIM or GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AF . For DTC U3003:17, GO to Pinpoint Test ag . **No** GO to Z5 .
Z5 CHECK FOR DTC U0140:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0140:00 set in more than one audio system module?**	**Yes** GO to Z6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
Z6 CHECK FOR CORRECT BCM OPERATION	
• Ignition OFF. • Disconnect and inspect all the BCM connectors. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root

pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the BCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	cause of any connector or pin issues.

Pinpoint Test AA: DTC U0155:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	Set by the ACM , APIM , FCDIM , FCIM , and GPSM when network messages are missing from the IPC for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AA: DTC U0155:00

Test Step	Result / Action to Take
AA1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AA2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA2 RECHECK FOR DTC U0155:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool,	**Yes** GO to AA3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

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retrieve all CMDTCs . • **Is DTC U0155:00 set in the ACM , APIM , FCDIM , FCIM , or GPSM ?**	
AA3 CHECK THE IPC FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the IPC self-test. • **Are any low or high voltage DTCs recorded in the IPC ?**	**Yes** REFER to IPC DTC Chart in Section 413-01 . **No** GO to AA4 .
AA4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM ▪ FCDIM ▪ FCIM ▪ GPSM • **Are low or high voltage DTCs recorded in the ACM , APIM , FCDIM , FCIM , or GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AF . For DTC U3003:17, GO to Pinpoint Test ag . **No** GO to AA5 .
AA5 CHECK FOR DTC U0155:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0155:00 set in more than one audio system module?**	**Yes** GO to AA6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA6 CHECK FOR CORRECT IPC OPERATION	
• Ignition OFF. • Disconnect and inspect the IPC connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the IPC connector. Make sure it seats and latches correctly.	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new IPC . REFER to Section 413-01 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

• Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test AB: DTC U0184:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0184:00	Lost Communication With Radio: No Sub Type Information	Set by the FCDIM when network messages are missing from the ACM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AB: DTC U0184:00

Test Step	Result / Action to Take
AB1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AB2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB2 RECHECK FOR DTC U0184:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0184:00 set in the FCDIM?**	**Yes** GO to AB3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the	**Yes** For DTC U3003:16, GO to Pinpoint Test AF. For DTC U3003:17, GO to Pinpoint Test ag.

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following modules: ■ ACM ■ FCDIM • **Are low or high voltage DTCs recorded in the ACM or FCDIM ?**	**No** GO to AB4 .
AB4 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect and inspect all the ACM connectors. • Repair: ■ Corrosion (clean module pins or install new connectors or terminals) ■ Damaged or bent pins (install new terminals or pins) ■ Pushed-out pins (install new pins as necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AC: DTC U0253:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	Set by the ACM and FCDIM when network messages are missing from the APIM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AC: DTC U0253:00

Test Step	Result / Action to Take
AC1 VERIFY THE CUSTOMER'S CONCERN	
	Yes

• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	GO to AC2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC2 RECHECK FOR DTC U0253:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0253:00 set in the ACM or FCDIM ?**	**Yes** GO to AC3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
  ▪ FCDIM
• **Are low or high voltage DTCs recorded in the ACM , APIM , or FCDIM ?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AF . For DTC U3003:17, GO to Pinpoint Test ag .
	
	No
	GO to AC4 .

AC4 CHECK FOR DTC U0253:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0253:00 set in more than one audio system module?**	**Yes** GO to AC5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC5 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect and inspect the APIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals)	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** The system is operating correctly at this time. The concern may

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▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AD: DTC U0256:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	Set by the ACM and FCDIM when network messages are missing from the FCIM for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AD: DTC U0256:00

Test Step	Result / Action to Take
AD1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AD2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD2 RECHECK FOR DTC U0256:00	
• Ignition ON. • Using a diagnostic scan	**Yes** GO to AD3 .

tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0256:00 set in the ACM or FCDIM ?**	**No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ FCDIM ▪ FCIM • **Are low or high voltage DTCs recorded in the ACM , FCDIM , or FCIM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AF . For DTC U3003:17, GO to Pinpoint Test ag . **No** GO to AD4 .
AD4 CHECK FOR DTC U0256:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0256:00 set in more than one audio system module?**	**Yes** GO to AD5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD5 CHECK FOR CORRECT FCIM OPERATION	
• Ignition OFF. • Disconnect and inspect the FCIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the FCIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Pinpoint Test AE: DTC U0257:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	Set by the ACM , APIM , and FCIM when Infotainment Controller Area Network (I-CAN) network messages are missing from the FCDIM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AE: DTC U0257:00

Test Step	Result / Action to Take
AE1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AE2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE2 RECHECK FOR DTC U0257:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0257:00 set in the ACM , APIM , or FCIM ?**	**Yes** GO to AE3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs • Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM ▪ FCDIM	**Yes** For DTC U3003:16, GO to Pinpoint Test AF . For DTC U3003:17, GO to Pinpoint Test ag . **No** GO to AE4 .

▪ FCIM • **Are low or high voltage DTCs recorded in the ACM , APIM , FCDIM , or FCIM ?**	
AE4 CHECK FOR DTC U0257:00 SET IN MULTIPLE MODULES • Review the recorded results from the self-test. • **Is DTC U0257:00 set in more than one audio system module?**	**Yes** GO to AE5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE5 CHECK FOR CORRECT FCDIM OPERATION • Ignition OFF. • Disconnect and inspect the FCDIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the FCDIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCDIM . REFER to Front Controls/Display Interface Module (FCDIM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AF: DTC U3003:16

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

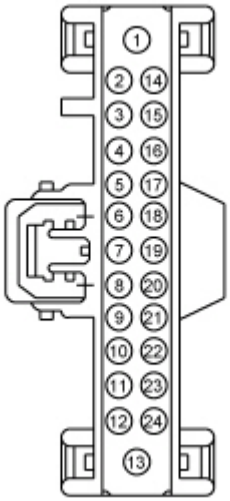
DTC Fault Trigger Conditions

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DTC	Description	Fault Trigger Conditions
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	Set by the ACM, APIM, FCDIM, FCIM, and GPSM when the supply voltage falls below 10 volts for at least 10 seconds during normal operation or for more than 250 milliseconds during the self-test.

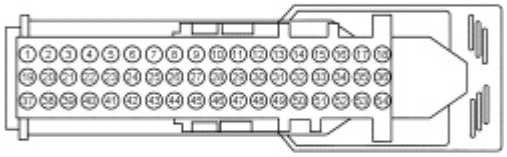
PINPOINT TEST AF: DTC U3003:16

Test Step	Result / Action to Take
AF1 RECHECK FOR DTC U3003:16	
• Ignition ON. • Using a diagnostic scan tool, clear the DTCs for the module in question. • Wait at least 15 seconds. • Using a diagnostic scan tool, repeat the self-test for the module in question. • **Is DTC U3003:16 still present?**	**Yes** GO to AF2. **No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
AF2 CHECK FOR CHARGING SYSTEM DTCS IN THE PCM	
• Using a diagnostic scan tool, perform the PCM self-test. • **Are any voltage-related DTCs set in the PCM?**	**Yes** REFER to PCM DTC Chart in Section 303-14. **No** GO to AF3.
AF3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. REFER to Battery Condition Test in Section 414-01. • **Is the battery OK and fully charged?**	**Yes** GO to AF4. **No** REFER to the Symptom Chart in Section 414-00.
AF4 CHECK THE MODULE VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect the audio system module setting DTC U3003:16. • Ignition ON. • Measure the voltage between the module setting DTC U3003:16 and ground. • For the ACM, measure the **voltage** between: Positive Lead: Pin C240A-1, Circuit SBP29 (GY/RD) Negative Lead: Pin —, Circuit Ground	**Yes** GO to AF5. **No** REPAIR the circuit for high resistance.



- For the APIM, measure the **voltage** between:

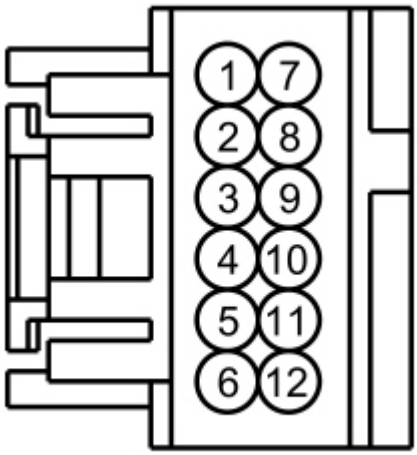
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	—	Ground



- For the FCDIM, measure the **voltage** between:

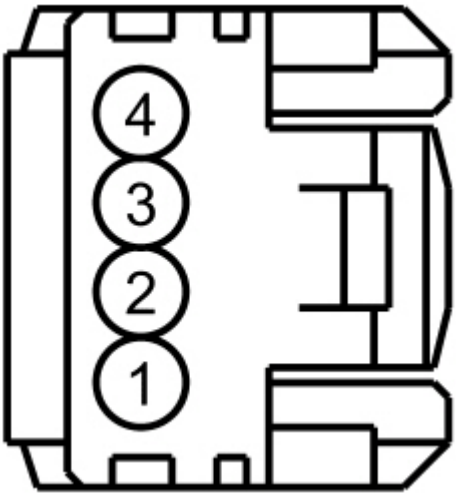
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2123-1	SBP09 (RD)	—	Ground

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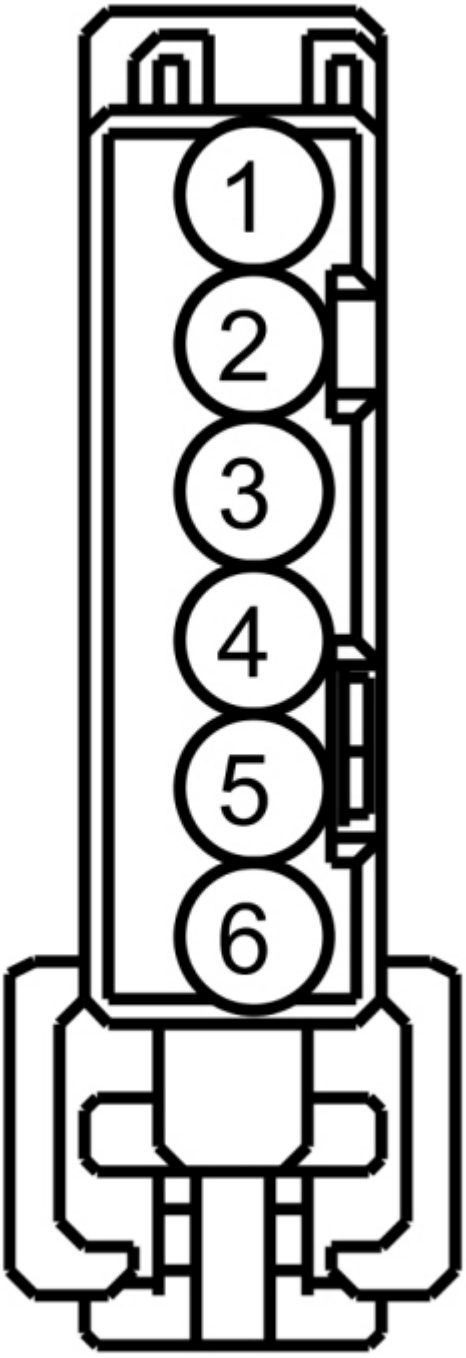
- For the FCIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	—	Ground



- For the GPSM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	—	Ground



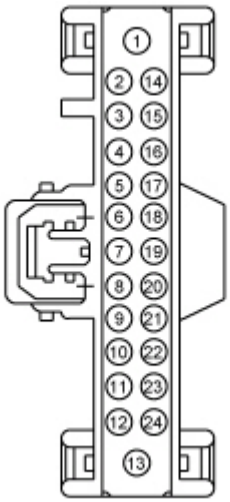
- **Is the voltage within 0.2 volts of the recorded battery voltage?**

AF5 CHECK THE SUSPECT MODULE GROUND CIRCUIT FOR CONTINUITY	
• Measure the voltage at the suspect module.	**Yes**

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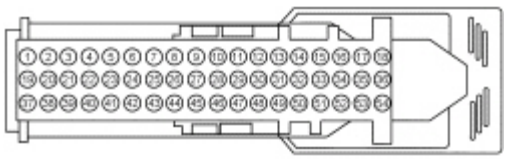
- For the ACM, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240A-1	SBP29 (GY/RD)	C240A-13	GD114 (BK/BU)



- For the APIM, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	C2383-37	GD114 (BK/BU)
		C2383-38	GD114 (BK/BU)



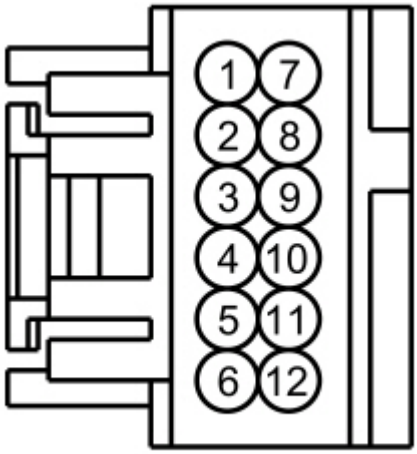
- For the FCDIM, measure the **voltage**

For the ACM, GO to AF6. For the APIM, GO to AF7. For the FCDIM, GO to AF8. For the FCIM, GO to AF9. For the GPSM, GO to AF10.

No
REPAIR the circuit for high resistance.

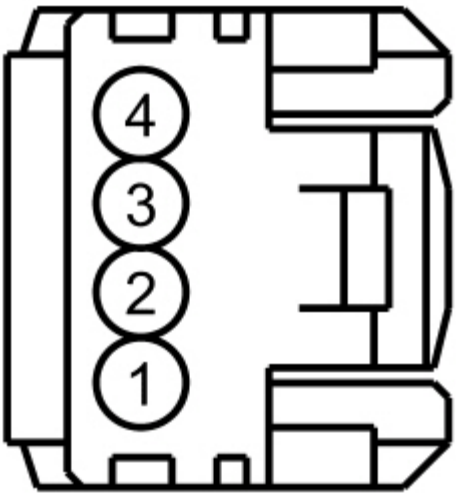
between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2123-1	SBP09 (RD)	C2123-9	GD114 (BK/BU)



- For the FCIM , measure the **voltage** between:

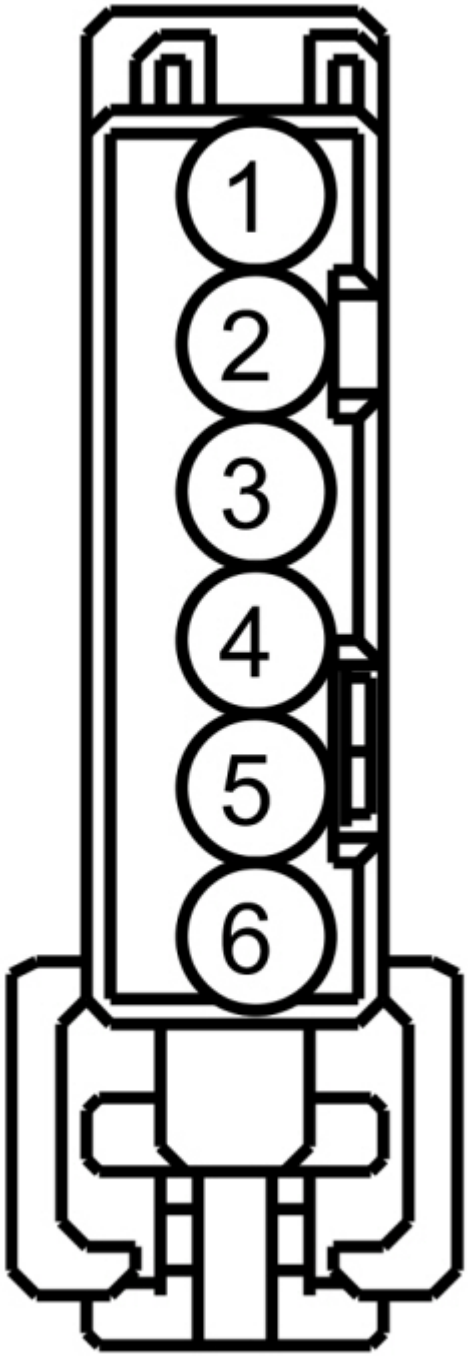
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	C2402-4	GD133 (BK)



- For the GPSM , measure the **voltage** between:

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	C2398-6	GD114 (BK/BU)

 • **Is the suspect module voltage greater than 11 volts?**	
AF6 CHECK FOR CORRECT ACM OPERATION • Ignition OFF. • Disconnect and inspect all the ACM	**Yes** CHECK OASIS for any applicable TSBs. If a

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connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AF7 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AF8 CHECK FOR CORRECT FCDIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCDIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCDIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCDIM . REFER to Front Controls/Display Interface Module (FCDIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AF9 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
	
	No
	The system is operating correctly at this time.

seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.
AF10 CHECK FOR CORRECT GPSM OPERATION • Ignition OFF. • Disconnect and inspect the GPSM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the GPSM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM). **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AG: DTC U3003:17

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	Set by the ACM, APIM, FCDIM, FCIM, and GPSM when the supply voltage is more than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

PINPOINT TEST AG: DTC U3003:17

Test Step	Result / Action to Take
AG1 RECHECK FOR DTC U3003:17 • Turn the engine off. • Ignition ON. • Using a diagnostic scan tool, clear the DTC for the module in question. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question.	**Yes** GO to AG2. **No** The system is operating correctly at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

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• **Is DTC U3003:17 present?**	
AG2 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Using a diagnostic scan tool, retrieve all CMDTCs . • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question. • **Are high voltage DTCs such as B1676, P0563, U3003:17 set in more than one module?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** GO to AG3 .
AG3 CHECK THE BATTERY VOLTAGE	
• Turn off all interior lights, exterior lights, and accessories. • Start and run the engine at approximately 2,000 RPM for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** For the ACM , GO to AG4 . For the APIM , GO to AG5 . For the FCDIM , GO to AG6 For the FCIM , GO to AG7 For the GPSM , GO to AG8 .
AG4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AG5 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF.	**Yes**

• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AG6 CHECK FOR CORRECT FCDIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FCDIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCDIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCDIM . REFER to Front Controls/Display Interface Module (FCDIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AG7 CHECK FOR CORRECT FCIM OPERATION	
• Ignition OFF. • Disconnect and inspect the FCIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals)	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) . **No** The system is operating correctly at this time. The concern may

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▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the FCIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	have been caused by module connections. ADDRESS the root cause of any connector or pin issues.
AG8 CHECK FOR CORRECT GPSM OPERATION • Ignition OFF. • Disconnect and inspect the GPSM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the GPSM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Accessory Protocol Interface Module (APIM) Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool
 ST3051-A	Universal Serial Bus (USB) Male-A to Male-A Cable CCMUSB2-AM-AM-10 or equivalent

Accessory Protocol Interface Module (APIM) Programming Using the Integrated Diagnostic System (IDS)

NOTE:

- If a new Accessory Protocol Interface Module (APIM) is being installed, install the new APIM before carrying out the following procedure. Refer to the appropriate section in Group 415 for the procedure.

NOTE:

- The programming procedure deletes any phones that were paired with the SYNC® system.
- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- A file of approximately 80 megabytes needs to be downloaded from the online database for the programming. Allow extra time for the file to download.
- The USB male A to male A cable (CCMUSB2-AM-AM-10 or equivalent) is required.
- The diagnostic scan tool is required.
  - Ensure that the IDS version and patch software levels are up to date.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.

1.
   - Close the IDS program before attempting to program the Accessory Protocol Interface Module (APIM).
   - Connect a battery charger set on low.
     - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.
   - Connect one end of the USB male-A to male-A cable to the diagnostic scan tool, and the other

end to the vehicle's USB port.
- Connect the diagnostic scan tool to the DLC .
- Access the technician service publication website and run On-Line Automotive Service Information System (OASIS) using "Read VIN & DTCs."
    - If the "Read VIN & DTCs" button is green with a red IDS icon, refer to the "SYNC - Software Programming" document under the "Service Tips" tab.
    - If the "Read VIN & DTCs" button is red with a grey IDS icon, ensure pop ups are enabled, follow the Internet Explorer pop ups, and then refer to the "SYNC - Software Programming" document under the "Service Tips" tab.
- If the "SYNC - Software Programming" document is not followed, the programming may stop or encounter errors due to improperly configured Internet browser settings.

2. From the OASIS tab, select the "SYNC" button.

3. **NOTE:** There are 3 types of Accessory Protocol Interface Module (APIM) programming available:
    - Standard — Used to update the Accessory Protocol Interface Module (APIM) and any currently installed applications to the latest software levels.
    - Custom — Used to show all the available software options (including applications that may not have been installed previously) that can be programmed into the Accessory Protocol Interface Module (APIM). Use this selection when upgrades become available or as directed by a TSB.
    - Module Replacement — Used when the Accessory Protocol Interface Module (APIM) has been replaced. This type of programming performs the required provisioning (restores software for newly installed hardware).

4. After selecting 1 of the 3 options (Standard, Custom, or Module Replacement), select the "Read SYNC" button to verify the current Accessory Protocol Interface Module (APIM) assembly, VIP , and CIP software levels. The software levels are compared to an online database, followed by the available software being displayed.

5. **NOTE:** Do not disconnect the VCM or USB cable during Accessory Protocol Interface Module (APIM) programming.

   Select the "Program SYNC" button to begin the Accessory Protocol Interface Module (APIM) programming process.

6. Follow the diagnostic scan tool on-screen directions.
    - After programming is complete, the diagnostic scan tool displays "Programming has been successfully completed."

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Accessory Protocol Interface Module (APIM) Reset

NOTE: Carrying out an APIM Reset consists of a battery disconnect and a SYNC® system Master Reset.

NOTE: NOTE: This procedure will clear all CMDTCs . The DTCs must be recorded now if other (non SYNC®) diagnoses are to be performed after this procedure.

1. Remove any devices connected to the USB port(s), audio input jack (if equipped), or media hub (if equipped).

2. **NOTE:** After the APIM reset procedure has been completed the customer should be advised to reset their device following the manufacturer's instructions. Refer to the device's owner's manual and/or website for information on how to perform a Manual / Master Reset or Clear. Devices can be powered off and back on for a simple re-boot. In some cases the device's battery may also need to be removed and re-installed to complete a re-boot. In addition, cell phones may need to have SYNC® deleted from the Bluetooth menu prior to re-pairing the phone to the SYNC® system. Customer devices may affect the operation of SYNC® and this should be understood to prevent unnecessary diagnosis or repairs to the system.

   Disconnect the negative battery cable for 1 minute, then reconnect it. Refer to Section 414-01 .

3. **NOTE:** Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. On vehicles equipped MyFord Touch or MyLincoln Touch with navigation, the customer’s saved destination points (home address and points of interest) and preferences will also be lost with a Master Reset.

   Carry out a SYNC® system Master Reset. Refer to the owner's literature

4. Verify system function using the Multi-Media Interface Tester 105-00120, to test the audio output for the audio input jack/socket (if equipped), USB port(s), and Bluetooth. If equipped, use the RCA Adapter 105-00121 to test the audio output for the RCA jacks.

5. If a concern is still present return to the Symptom Charts.

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Audio Control Module (ACM) Self-Diagnostic Mode

NOTE: If the Audio Front Control Module (ACM), Front Control/Display Interface Module (FCDIM) (if equipped), Front Controls Interface Module (FCIM), or Front Display Interface Module (FDIM) (if equipped) are inoperative (blank or do not power on), obtain the ACM part number by referencing the label attached to the ACM chassis.

1. Turn the ACM on.

2. Operate the audio system in radio tuner AM/FM mode.

3. Press and hold the EJECT button, and within 1 second, press and hold the SEEK UP button until the speaker walk-around test begins.

   NOTE: AHU Diagnostics refers to the ACM , EFP Diagnostics refers to the FCIM , and MFD Diagnostics (if supported) refers to the FCDIM (if equipped).

4. To exit the self-diagnostic mode, turn the ACM off, or select "Exit Diagnostics."

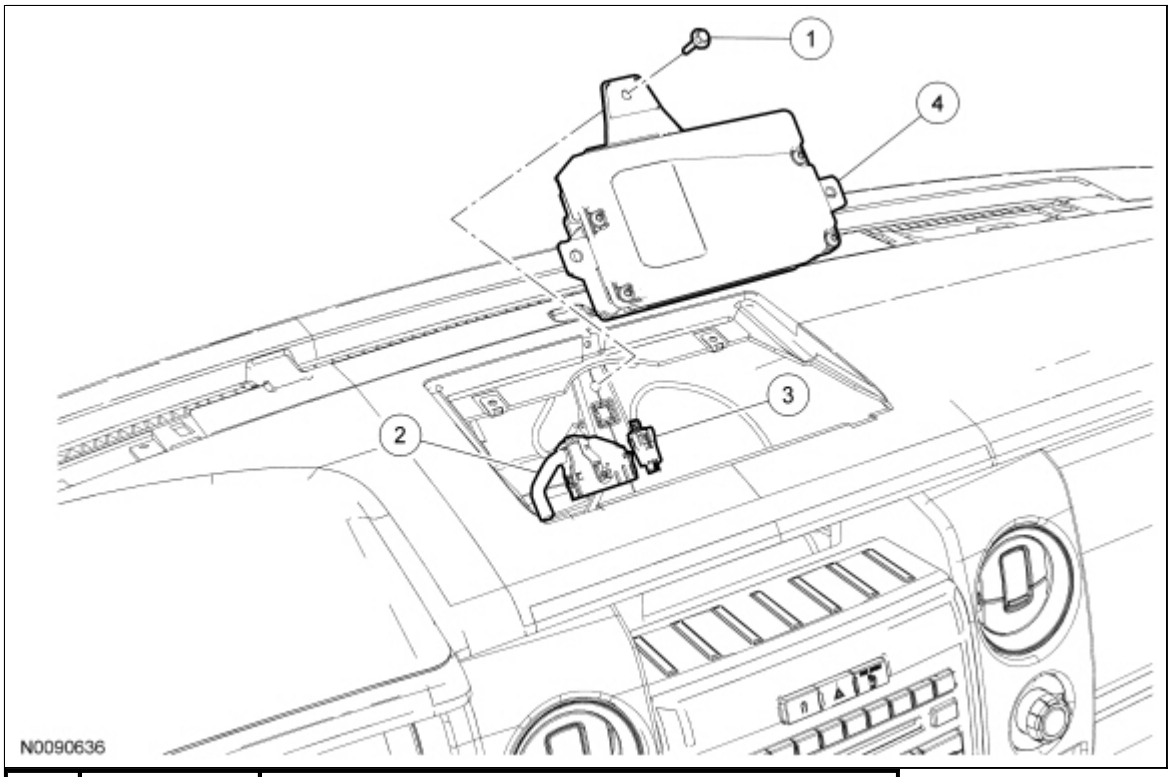
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Satellite Radio Electronic Serial Number (ESN) Retrieval

NOTE: If the Audio Front Control Module (ACM), FCDIM (if equipped), FCIM , or FDIM (if equipped) are inoperative (blank or do not power on), obtain the Electronic Serial Number (ESN) by referencing the label attached to the Audio Front Control Module (ACM) chassis.

1. Turn the Audio Front Control Module (ACM) on.
2. Operate the audio system in radio tuner AM/FM mode.
3. Press and hold the eject button, and within 1 second, press and hold the seek up button. If supported, the speaker walk around test will begin.
4. Select AHU Diagnostics.
5. Select SIRIUS ESN.

Accessory Protocol Interface Module (APIM)



Item	Part Number	Description
1	W704875-S	Accessory Protocol Interface Module (APIM) screw
2	—	APIM electrical connector (part of 14401)
3	—	Universal Serial Bus (USB) cable (part of 14D202)
4	14D212	APIM

Removal and Installation

1. Remove the instrument panel upper bin.
    1. Remove the rubber mat.
    2. Remove the 2 screws.
    3. Remove the instrument panel upper bin.

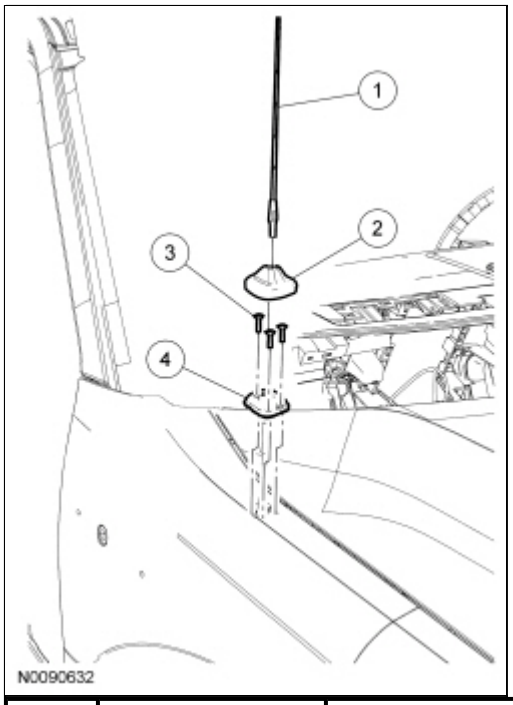
2. Remove the APIM screw and position the APIM upward.

3. Remove the APIM .
    - Disconnect the electrical connector and the Universal Serial Bus (USB) cable.

4. To install, reverse the removal procedure.
    - If a new APIM is being installed, program the APIM . For additional information, refer to Accessory Protocol Interface Module (APIM) Programming .

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Antenna — AM/FM

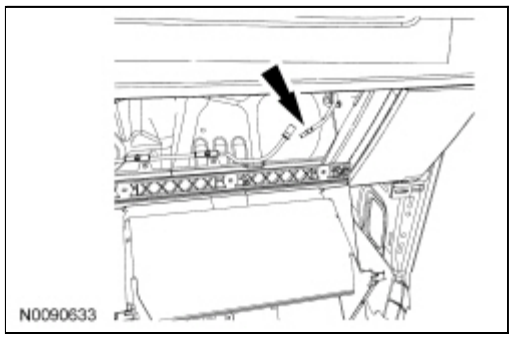


Item	Part Number	Description
1	18813	AM/FM antenna mast
2	18A927	AM/FM antenna base cap
3	N610019	AM/FM antenna screws (3 required)
4	18A894	AM/FM antenna base

Removal and Installation

1. Lower the glove compartment completely.

2. Disconnect the AM/FM antenna from the AM/FM antenna cable.
   - Push the antenna cable end and the grommet through the side cowl.



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3. ***NOTICE:*** **Do not over tighten the antenna mast or damage to the antenna base or mast may occur.**

   Remove the AM/FM antenna mast.
   1. To install, tighten to 4.2 Nm (36 lb/in).

4. **NOTE:** A new AM/FM antenna base cap must be installed.

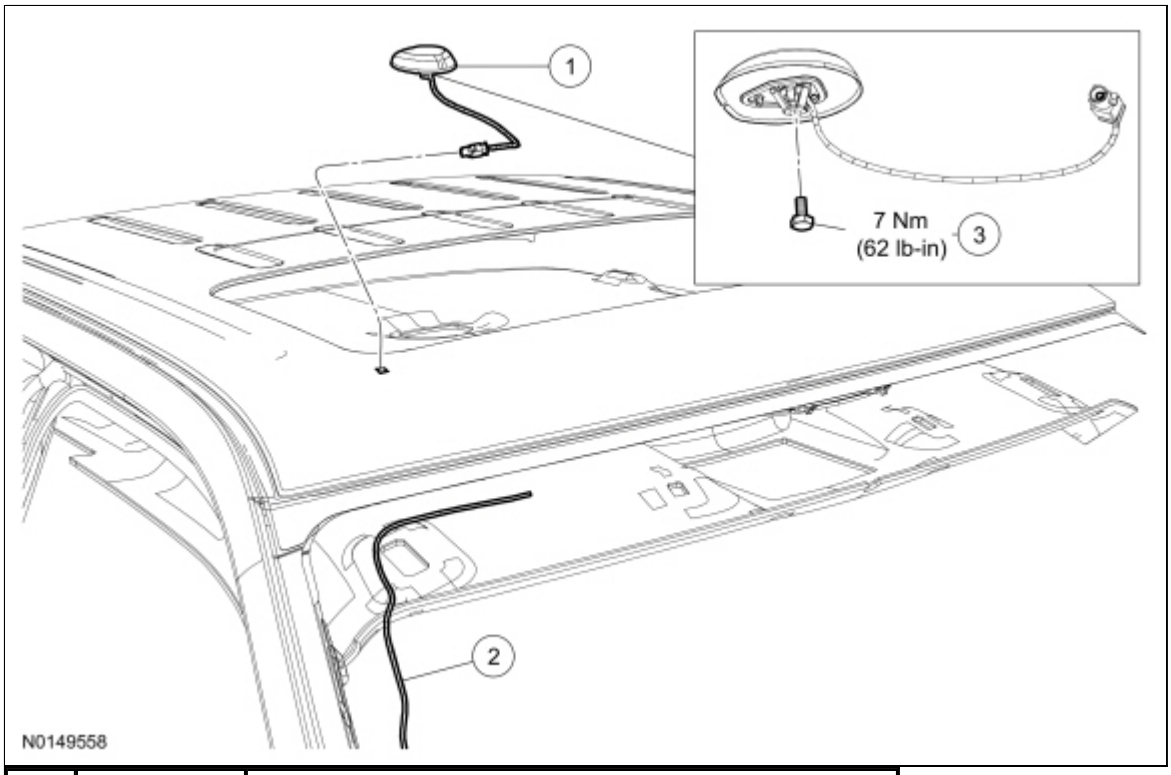
   Using a suitable tool such as a hook-shaped pick, remove the AM/FM antenna base cap by prying upward.

5. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

6. Remove the 3 screws and the AM/FM antenna base.
   1. To install, tighten to 2.5 Nm (23 lb/in).

7. To install, reverse the removal procedure.

Antenna — Satellite Radio



Item	Part Number	Description
1	10E893	Satellite radio antenna
2	—	Satellite radio antenna electrical connector (part of 19A397)
2	—	Satellite radio antenna retaining bolt (part of 10E893)

Removal and Installation

1. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .

2. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.

3. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical connector.

4. **NOTE:** Remove the satellite antenna and pigtail through the mounting opening in the roof panel.

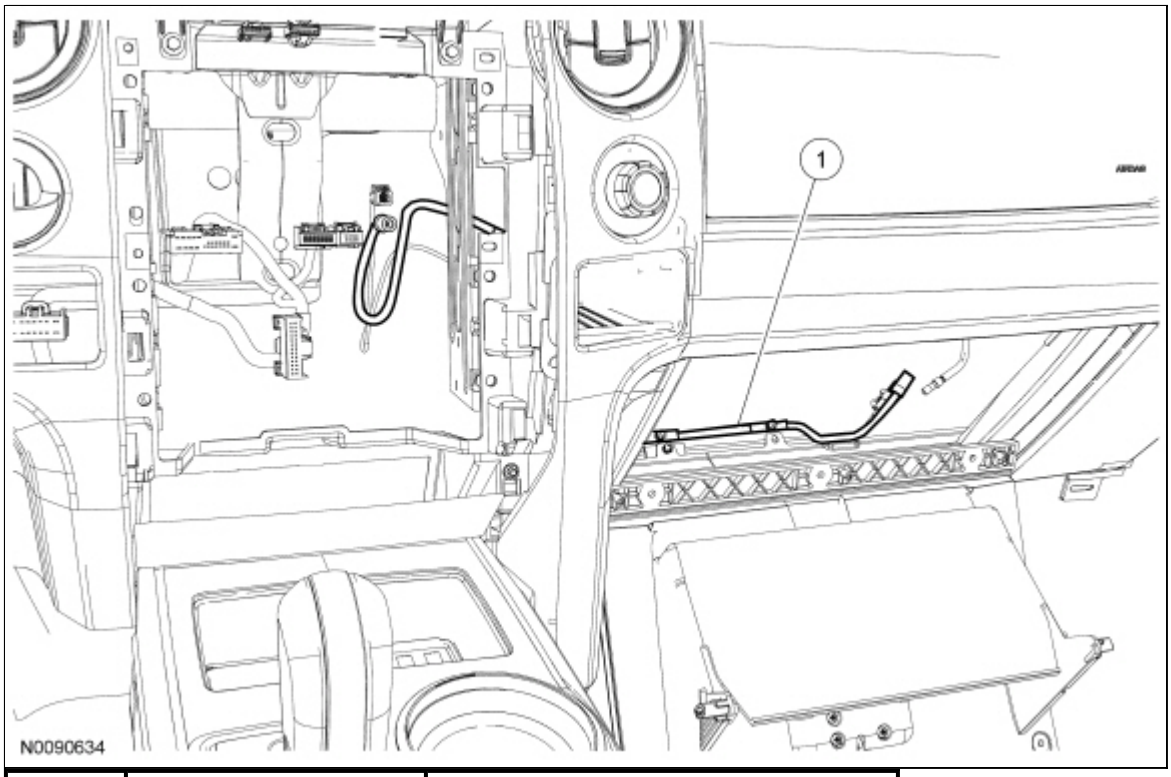
   Remove the satellite antenna.
   - Disconnect the electrical connector.

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- Remove the satellite antenna retaining bolt and retainer then remove the satellite antenna from the roof panel.
    - To install, tighten to 7 Nm (62 lb-in).

5. To install, reverse the removal procedure.

Antenna Cable — AM/FM



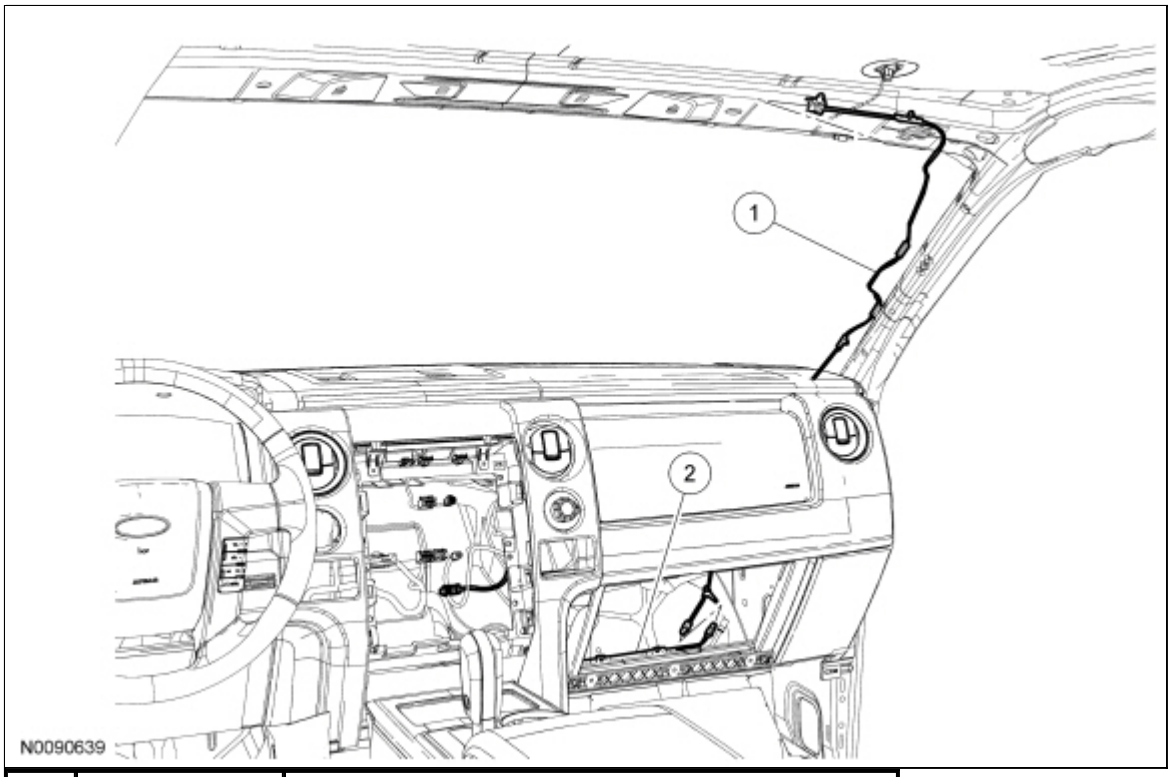
Item	Part Number	Description
1	18812	AM/FM antenna cable

Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.
2. Lower the glove compartment completely.
3. Disconnect the AM/FM antenna cable from the AM/FM antenna.
4. Separate the pushpins and remove the AM/FM antenna cable.
5. To install, reverse the removal procedure.

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Antenna Cable — Satellite Radio



Item	Part Number	Description
1	19A397	Upper satellite radio antenna cable
2	19A397/10E928	Lower satellite radio antenna cable (without/with navigation)

Removal and Installation

Both cables

1. Lower the glove compartment completely.
2. Disconnect the upper-to-lower satellite radio antenna cable connection.

Upper cable

3. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .
4. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.
5. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical

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connector.

6. Remove the upper satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the A-pillar and instrument panel.

Lower cable

7. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.

8. Remove the lower satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the instrument panel.

Both cables

9. To install, reverse the removal procedure.

Audio Control Module (ACM)

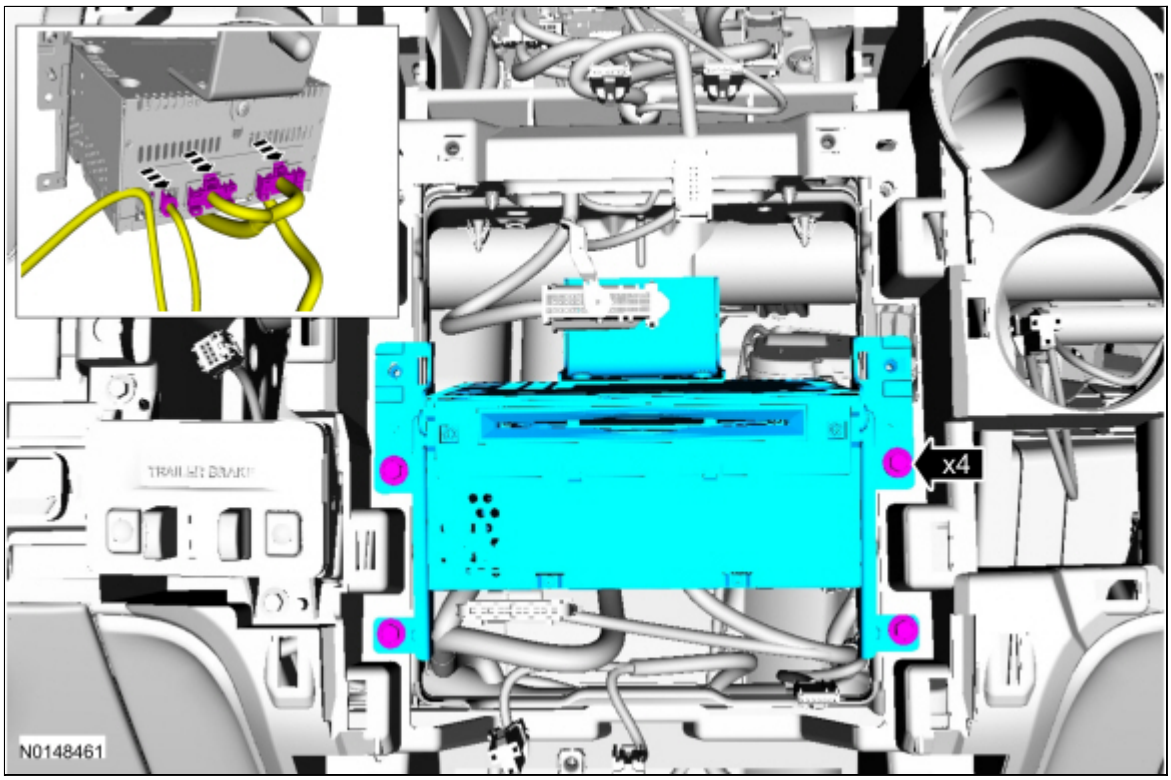
Removal and Installation

1. **NOTE:** If installing a new module, it is necessary to upload the module configuration information to the scan tool prior to removing the module. This information must be downloaded into the new module after installation.

   Upload the Audio Front Control Module (ACM) configuration information to the scan tool by following the scan tool on screen instructions.

2. Remove the Front Control/Display Interface Module (FCDIM). Refer to Front Controls/Display Interface Module (FCDIM) .

3. Remove the 4 ACM bolts.
   - Disconnect the electrical connectors.
   - To install, tighten to 2.5 Nm (23 lb-in).



4. To install, reverse the removal procedure.

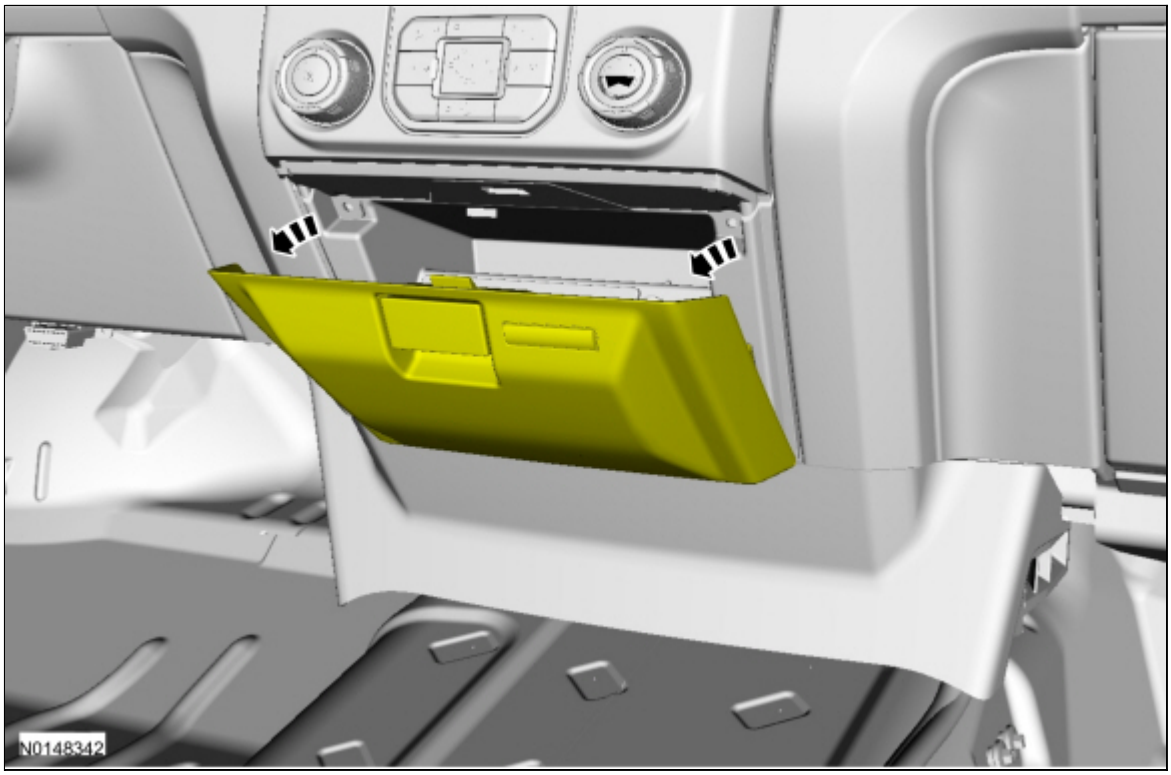
5. Download the ACM configuration information from the scan tool to the new ACM following the scan tool on screen instructions.

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Audio Input Jack

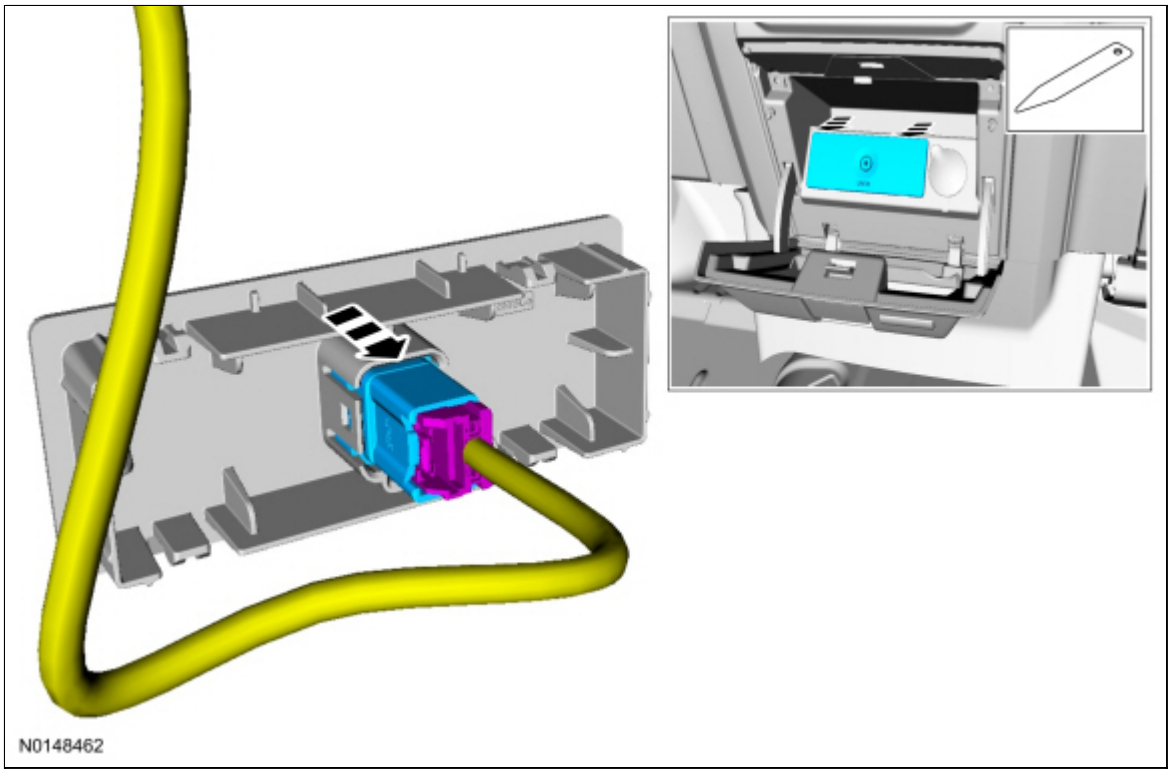
Removal and Installation

1.



2. Remove the audio input jack bezel by prying rearward.
    - Disconnect the electrical connector.
    - Release the tabs and remove the audio input jack.

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3. To install, reverse the removal procedure.

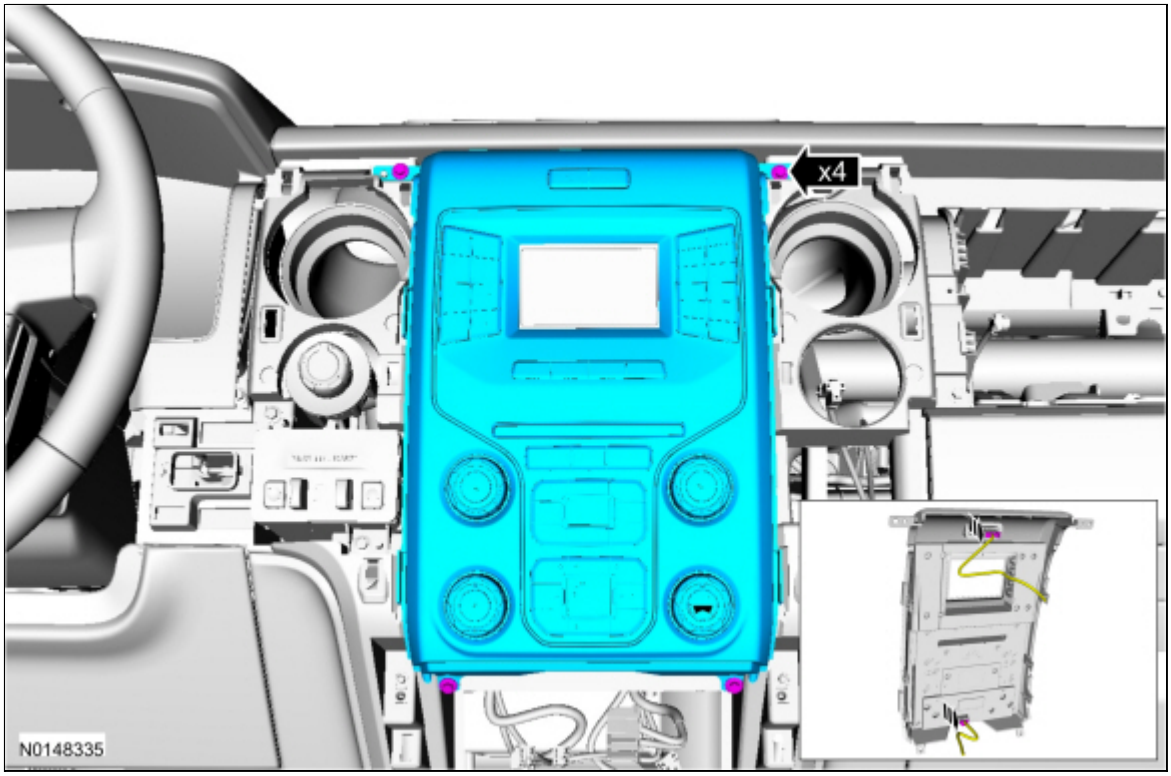
Front Controls Interface Module (FCIM)

Removal and Installation

1. Remove the LH center instrument panel finish panel. For additional information, refer to Section 501-12 .

2. Remove the RH center instrument panel finish panel. For additional information, refer to Section 501-12 .

3. Remove the 4 screws and the Front Controls Interface Module (FCIM).
   - Disconnect the electrical connectors.
   - To install, tighten to 3 Nm (27 lb-in).



4. To install, reverse the removal procedure.

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Front Controls/Display Interface Module (FCDIM)

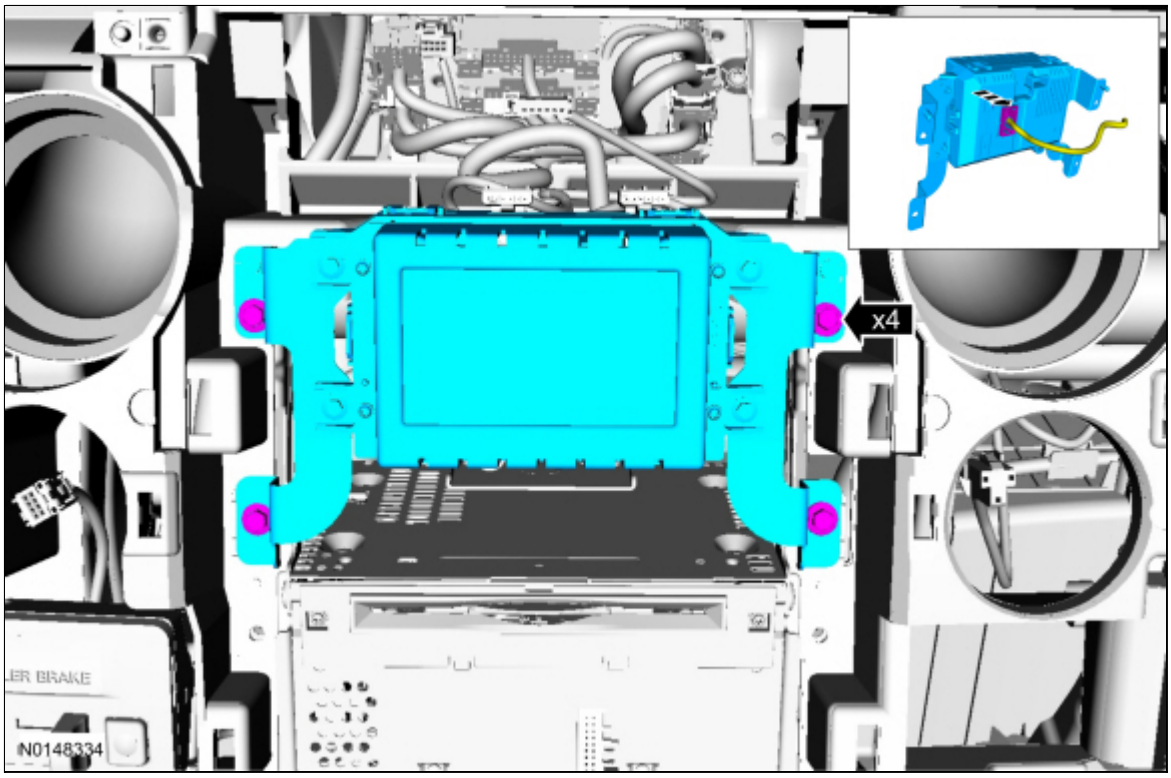
Removal and Installation

1. **NOTE:** If installing a new module, it is necessary to upload the module configuration information to the scan tool prior to removing the module. This information must be downloaded into the new module after installation.

   Upload the Front Control/Display Interface Module (FCDIM) configuration information to the scan tool by following the scan tool on screen instructions.

2. Remove the Front Controls Interface Module (FCIM). Refer to Section 415-00C .

3. Remove the 4 screws and remove the Front Control/Display Interface Module (FCDIM).
   - Disconnect the electrical connector.
   - To install, tighten to 2.5 Nm (23 lb-in).

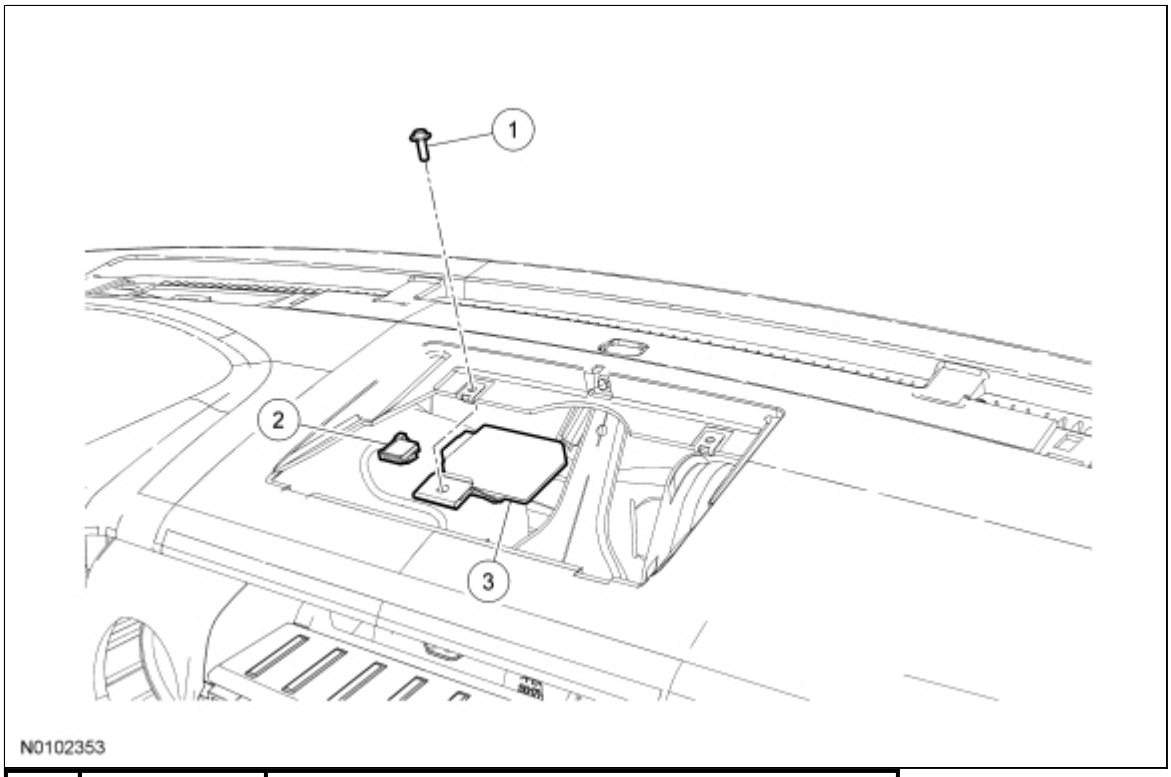


4. To install, reverse the removal procedure.

5. Download the Front Control/Display Interface Module (FCDIM) configuration information from the scan tool to the new Front Control/Display Interface Module (FCDIM) following the scan tool on screen instructions.

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Global Positioning System Module (GPSM)



Item	Part Number	Description
1	W707628-S	Global Positioning System Module (GPSM) screw
2	—	GPSM electrical connector (part of 14401)
3	10E893	GPSM

Removal and Installation

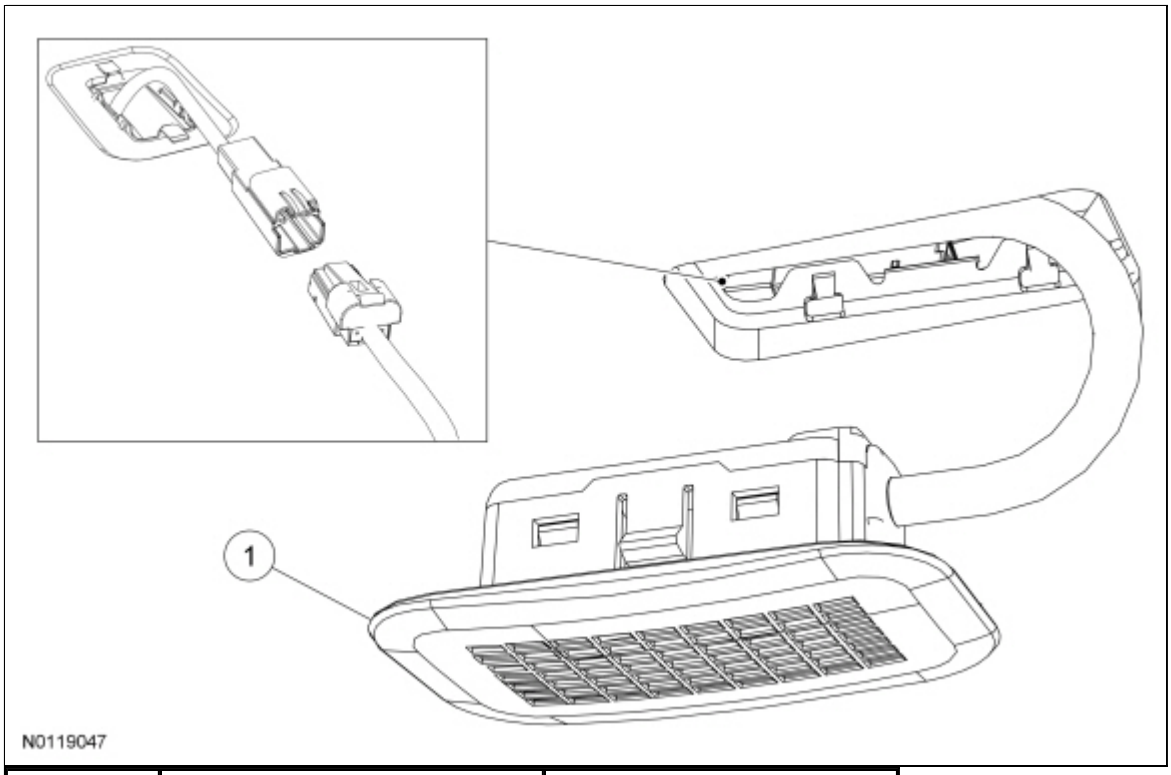
1. Remove the Front Display Interface Module (FDIM). For additional information, refer to Front Controls/Display Interface Module (FCDIM) in this section.

2. Remove the screw and the Global Positioning System Module (GPSM).
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

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Microphone



Item	Part Number	Description
1	19A391	Microphone

Removal

1. Using a suitable tool, (such as a thin small flat head screwdriver) twist and pry the microphone bezel from the headliner metal mounting bracket.

2. Remove the microphone from the headliner by grasping the microphone pigtail.
    - Disconnect the microphone electrical connector.

Installation

1. Reconnect the microphone electrical connector.

2. Wrap the connection with anti-rattle tape.

3. Feed the microphone pigtail into the headliner through the microphone hole.
    - Verify the microphone pigtail points towards the front of the vehicle.

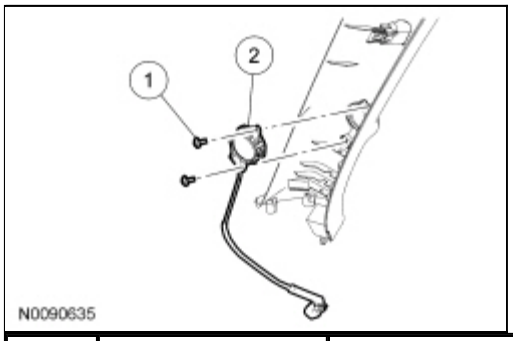
4. Snap the microphone into the headliner mounting bracket.

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- Verify the mounting bracket and microphone are snug to the headliner.

Speaker — A-Pillar

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	W701678-S	A-pillar speaker screws (2 required)
2	18978	A-pillar speaker

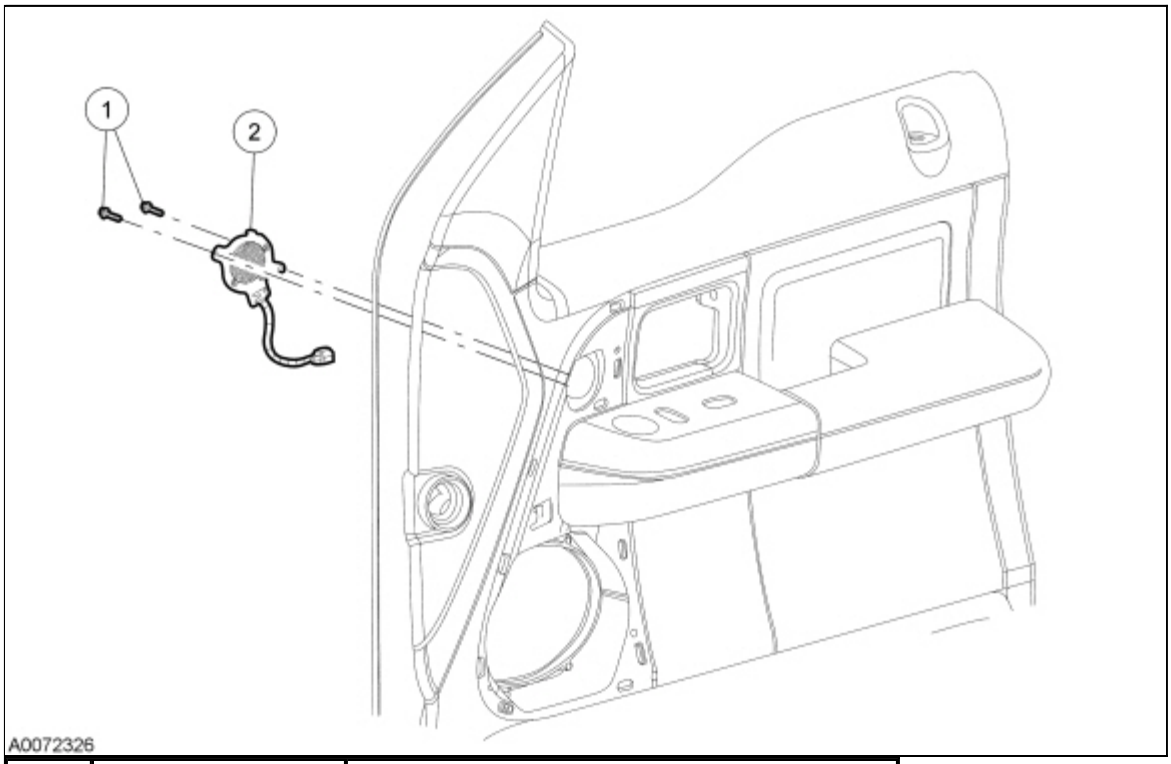
Removal and Installation

1. Remove the A-pillar trim panel. For additional information, refer to Section 501-05 .
2. Remove the 2 screws and the A-pillar speaker.
3. To install, reverse the removal procedure.

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Speaker — Door

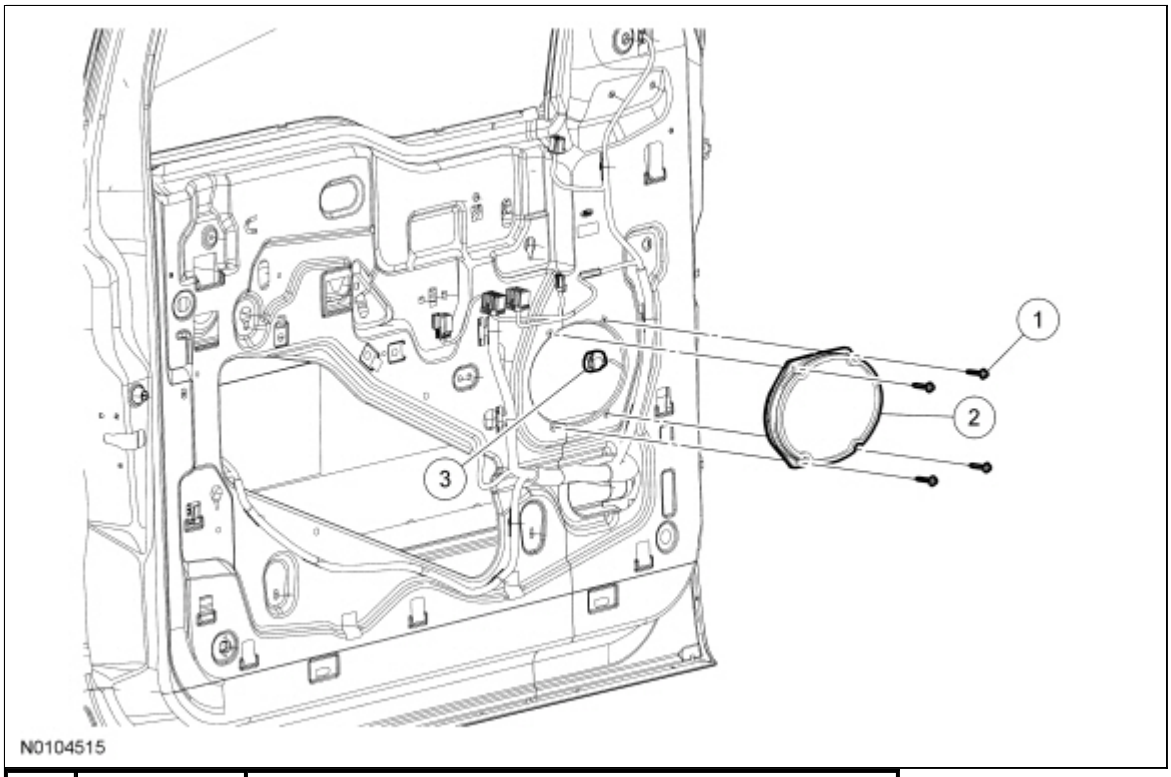
Front Door Tweeter Speaker



Item	Part Number	Description
1	W701678	Tweeter speaker screws (2 required)
2	19B170/19B171	Tweeter speaker (RH/LH)

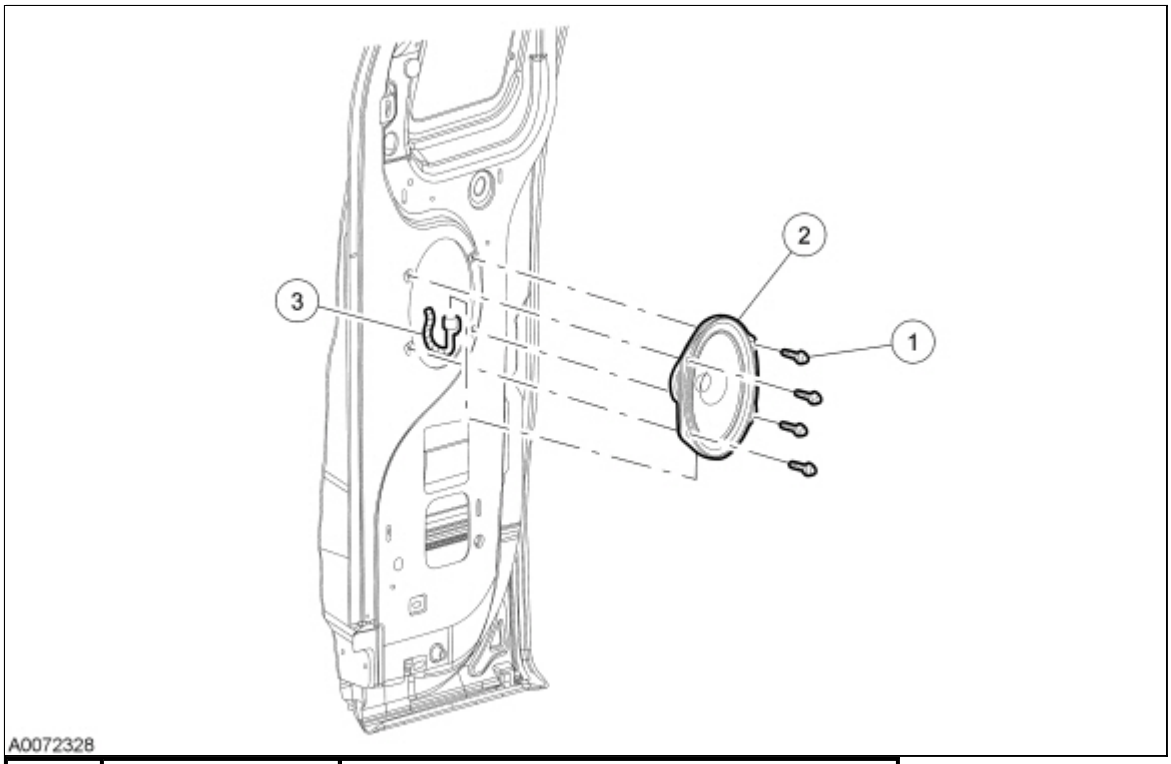
Front Door Speaker

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Item	Part Number	Description
1	W707628	Front door speaker screws (4 required)
2	18808	Front door speaker
3	—	Front door speaker electrical connector (part of door harness)

Rear Door Speaker



Item	Part Number	Description
1	W706766	Rear speaker screws (4 required)
2	18808	Rear speaker
3	180103	Rear speaker electrical connector

Removal and Installation

Front door

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws (2 for the tweeter, 4 for the door speaker) and the speaker.
   - Disconnect the electrical connector.

Rear door

3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

4. Remove the 4 screws and the rear door speaker.
   - Disconnect the electrical connector.

All speakers

5. To install, reverse the removal procedure.

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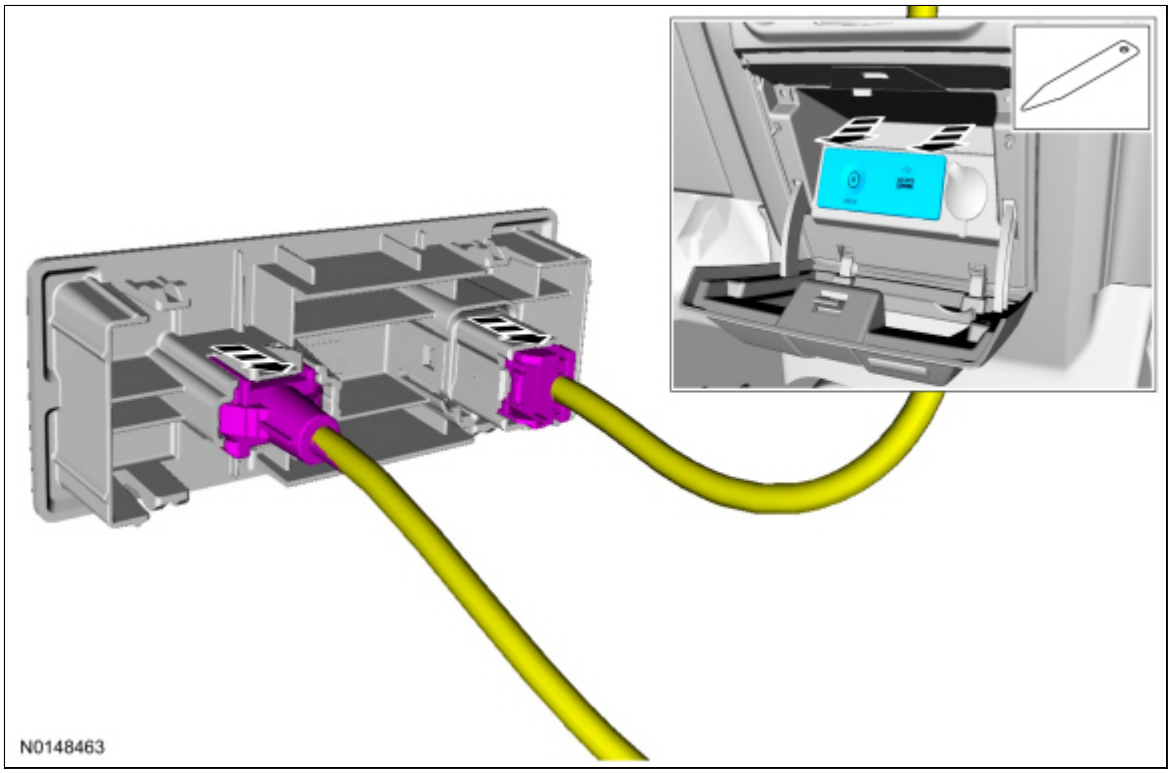
Universal Serial Bus (USB) Cable and Port

Removal and Installation

Instrument Panel USB Cable Without Floor Console

1. Remove the APIM. Refer to Accessory Protocol Interface Module (APIM).

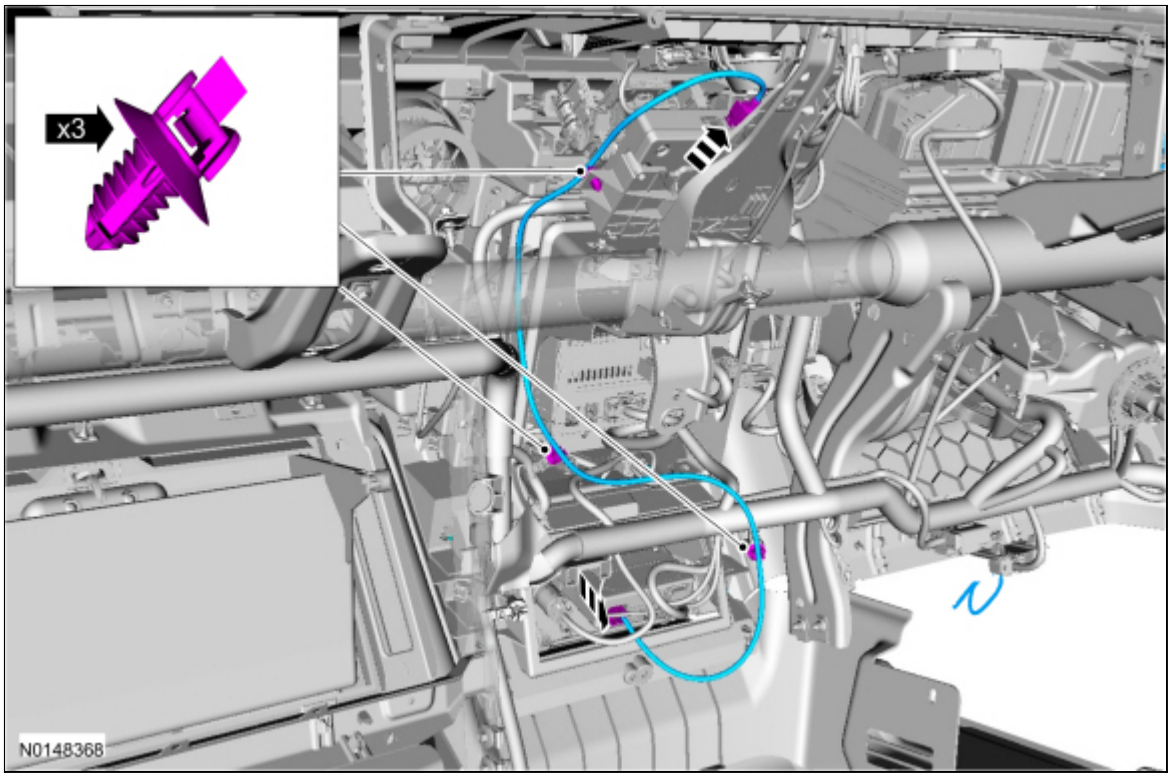
2. Remove the audio input jack USB bezel.
   - Disconnect the electrical connectors.



3. For access remove the glove box. Refer to Section 501-12.

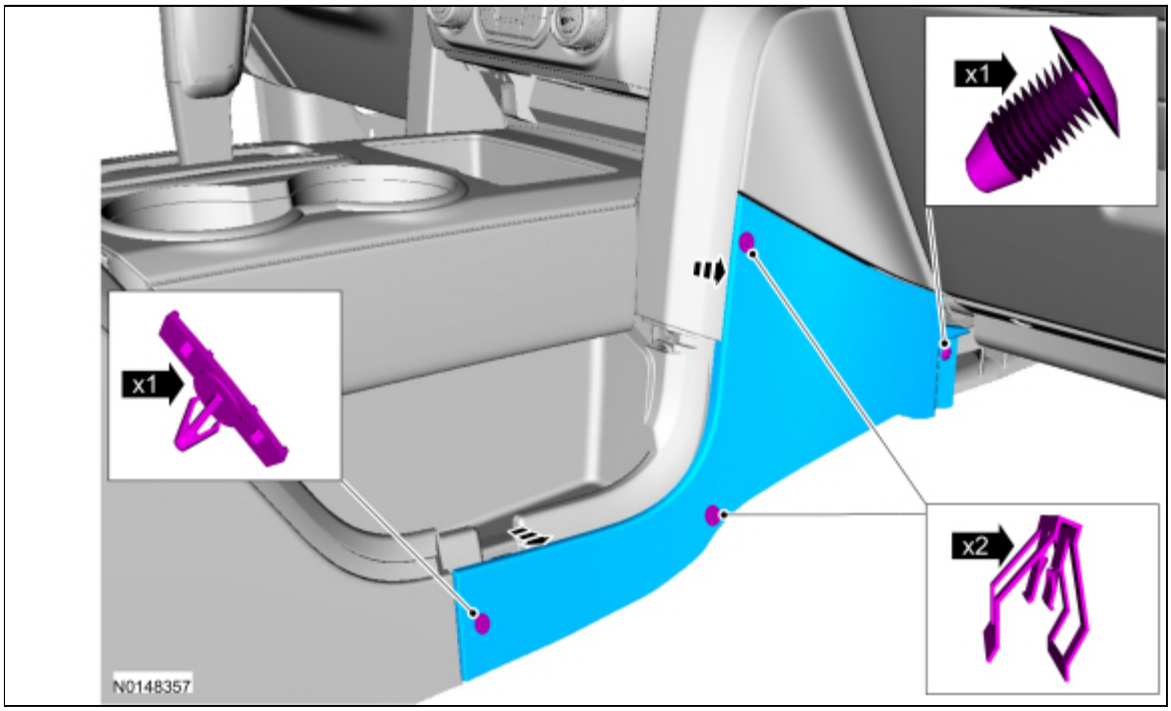
4. Remove the USB cable following the routing shown.

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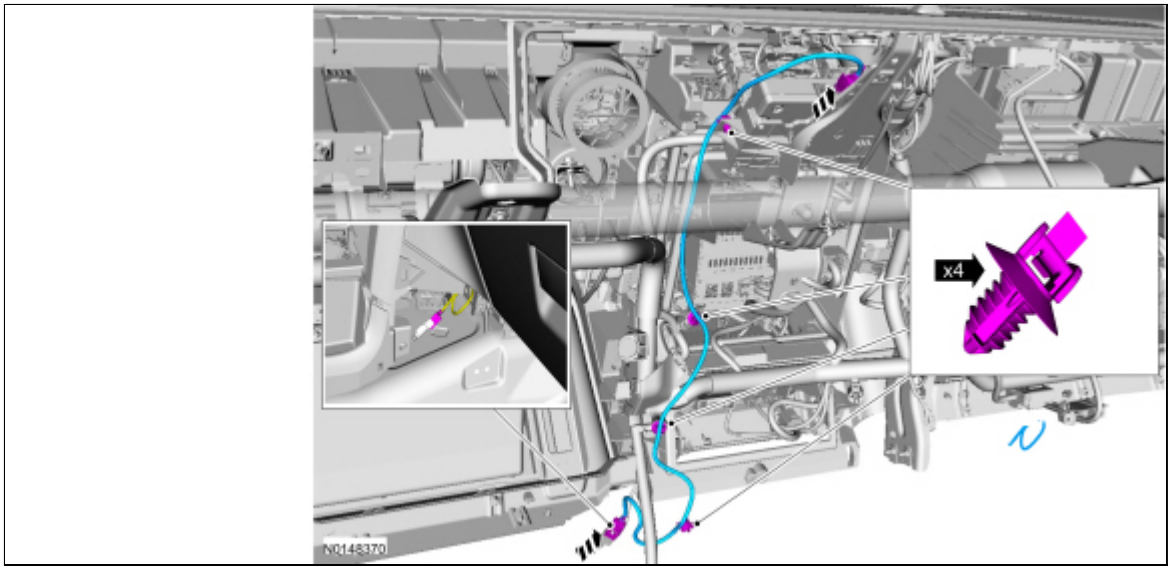


Instrument Panel USB Cable With Floor Console

5. Remove the APIM . Refer to Accessory Protocol Interface Module (APIM) .
6. For access remove the glove box. Refer to Section 501-12 .
7. Remove the RH lower floor console trim panel.

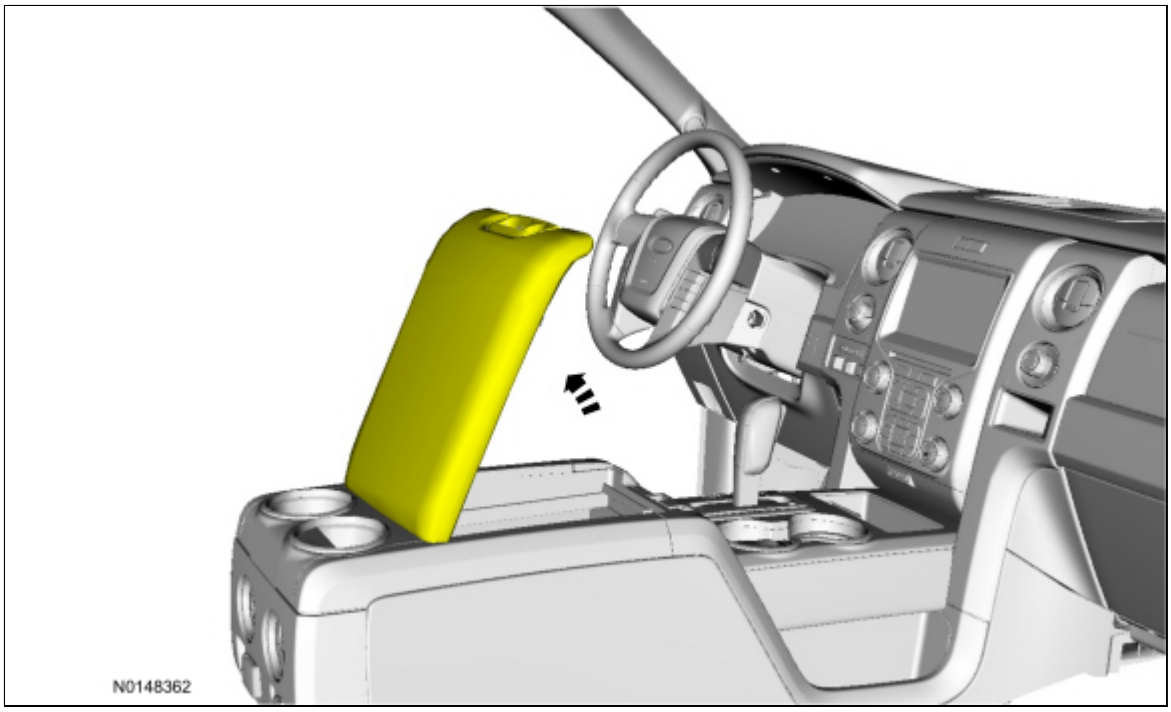


8. Remove the USB cable following the routing shown.



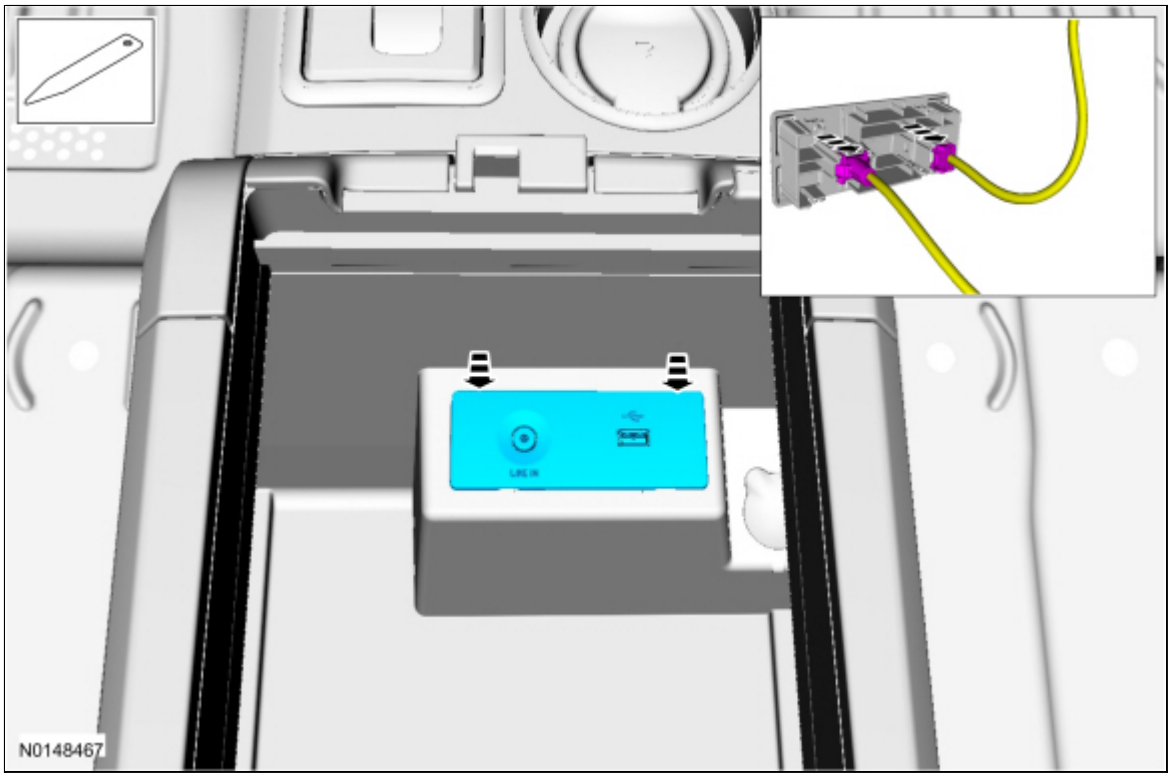
Floor Console USB Cable

9. Open the floor console stowage bin door.



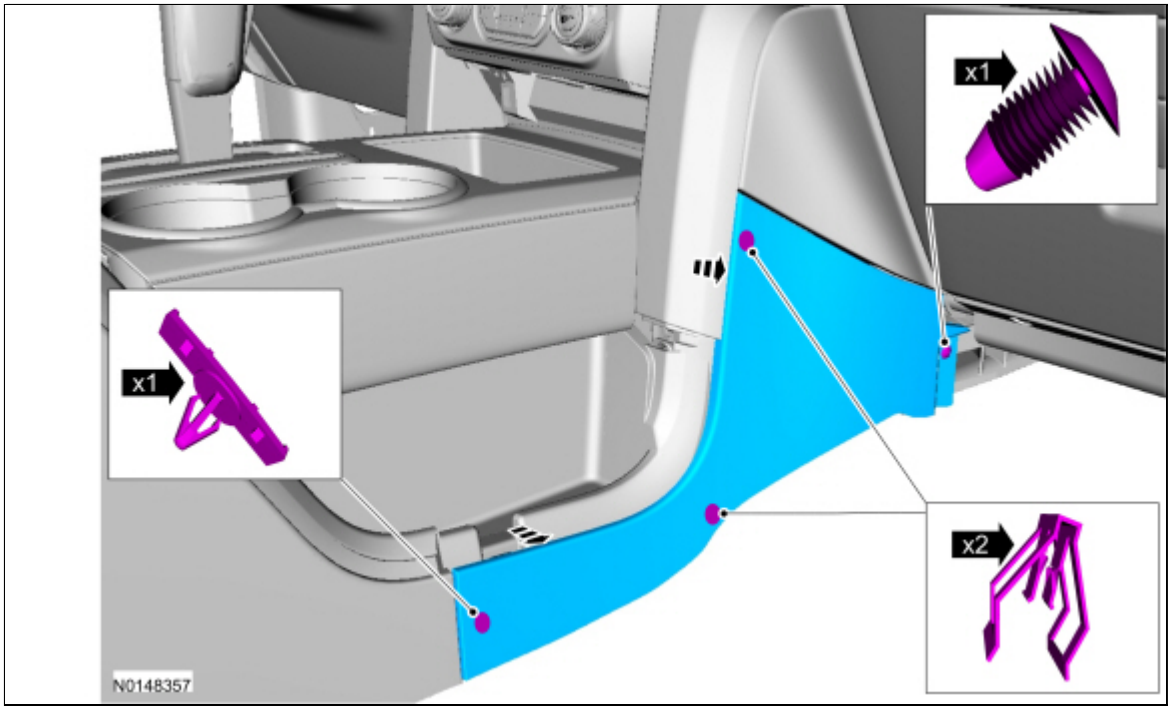
10. Remove the audio input jack USB bezel from the floor console.
    - Disconnect the electrical connectors.

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11.

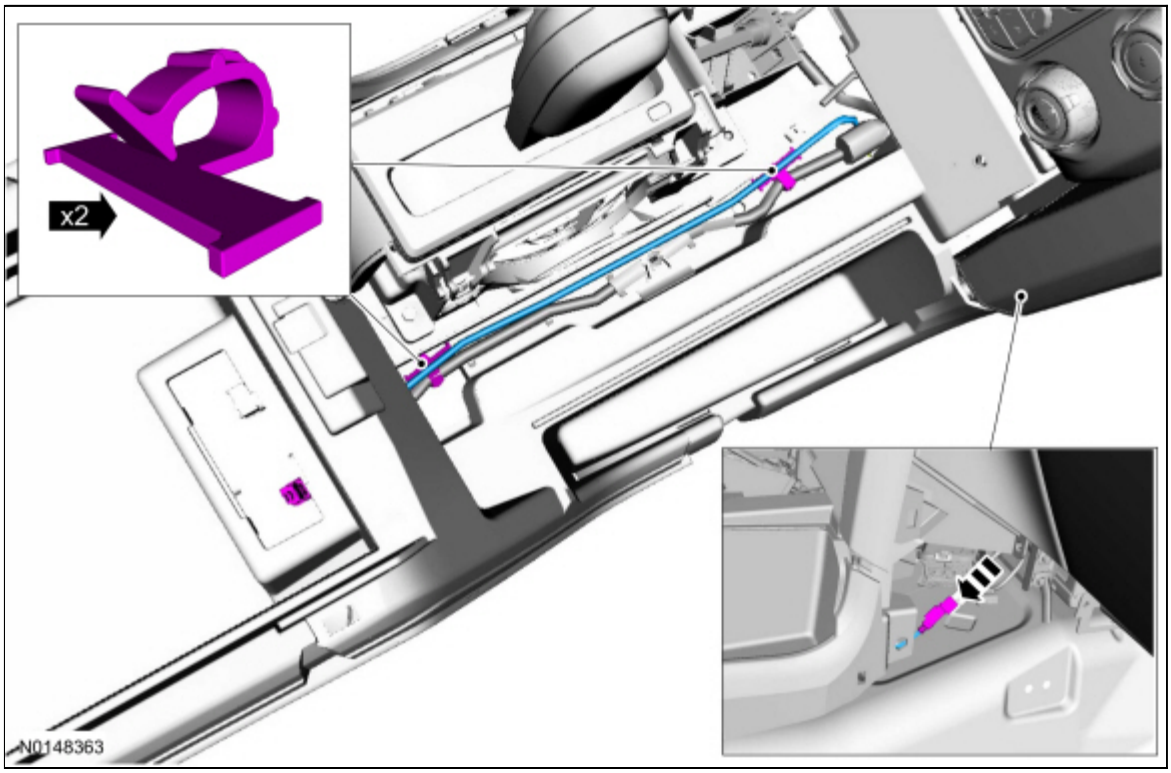
12. Remove the RH lower floor console trim panel.



13. Remove the floor console upper finish panel.



14. Remove the floor console USB cable following the routing shown.



All Cables

15. To install, reverse the removal procedure.

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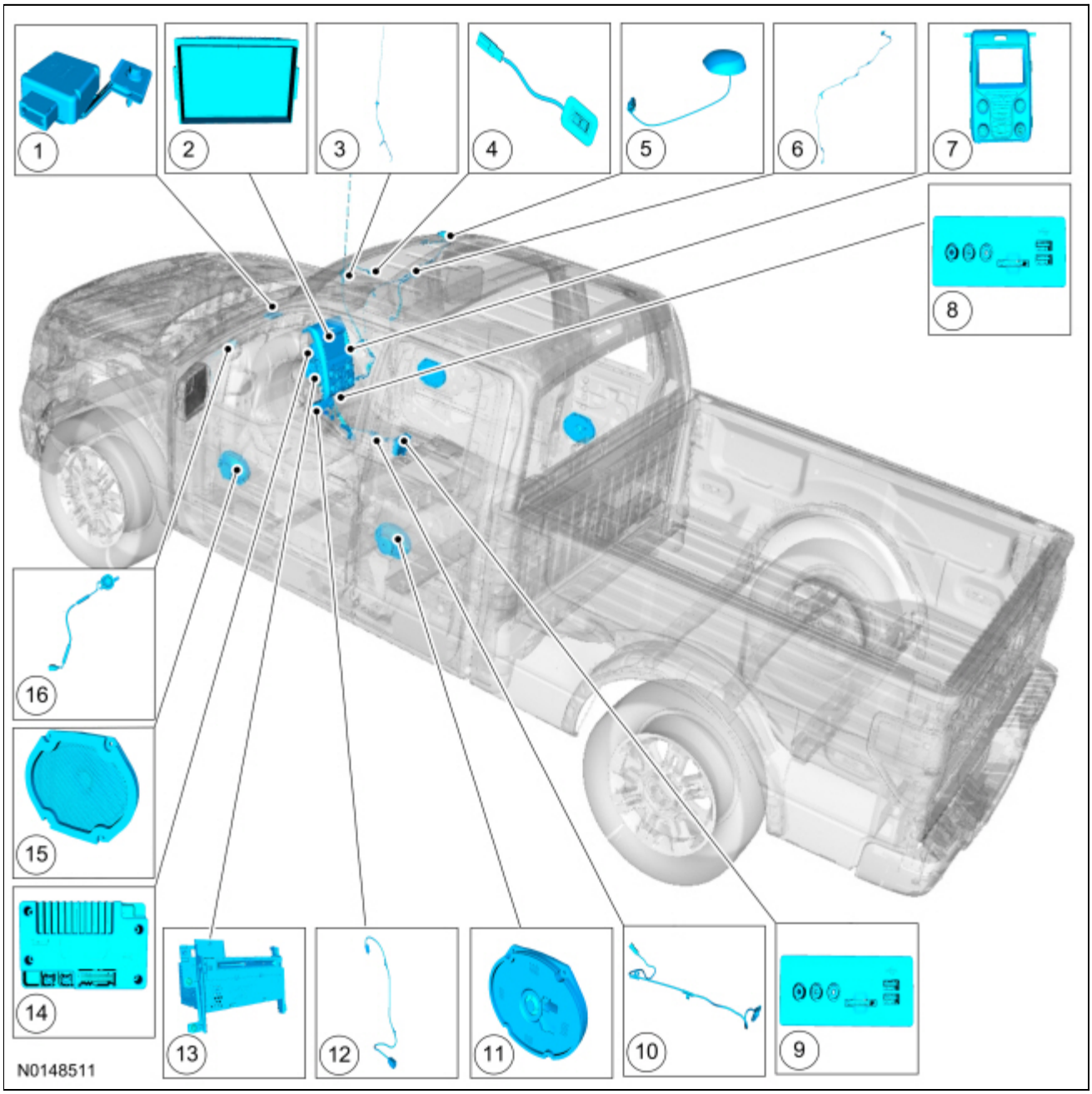
Torque Specifications

Description	Nm	lb-in
AM/FM antenna mast	4.2	36
AM/FM antenna base bolts	2.5	23
Audio Front Control Module (ACM)	2.5	23
Accessory Protocol Interface Module (APIM)	0.6	5
Front Controls Interface Module (FCIM)	3	27
Front Display Interface Module (FDIM)	2.5	23
Satellite Antenna retaining nut	7	62

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Information and Entertainment System

Component Location



Item	Description	Comments

1	GPSM	Located in the top center area of the instrument panel
2	FDIM	Attached to the APIM
3	AM/FM/ HD Radio® antenna and AM/FM/ HD Radio® coaxial cable	HD Radio® (if equipped)
4	SYNC® microphone	Located in the headliner
5	Satellite radio antenna	If equipped
6	Satellite radio antenna coaxial cable	If equipped
7	FCIM	-
8	Media hub	Located in the instrument panel (with split bench)
9	Media hub	Located in the console (with front captain chairs)
10	USB cable	Located in the console (with front captain chairs)
11	Rear door speaker	-
12	USB cable	Located in the instrument panel (with split bench)
13	ACM	-
14	APIM	Attached to the FDIM
15	Front door speaker	-
16	A-pillar speaker	LF shown, RF similar

Overview

The audio system consists of the following:

Main Components

- 6 speakers
- 8-inch (203 mm) FDIM touchscreen
- AM/FM single CD ACM
- APIM
- FCIM
- GPSM
- Media hub
- Redundant steering wheel controls
- SYNC® microphone

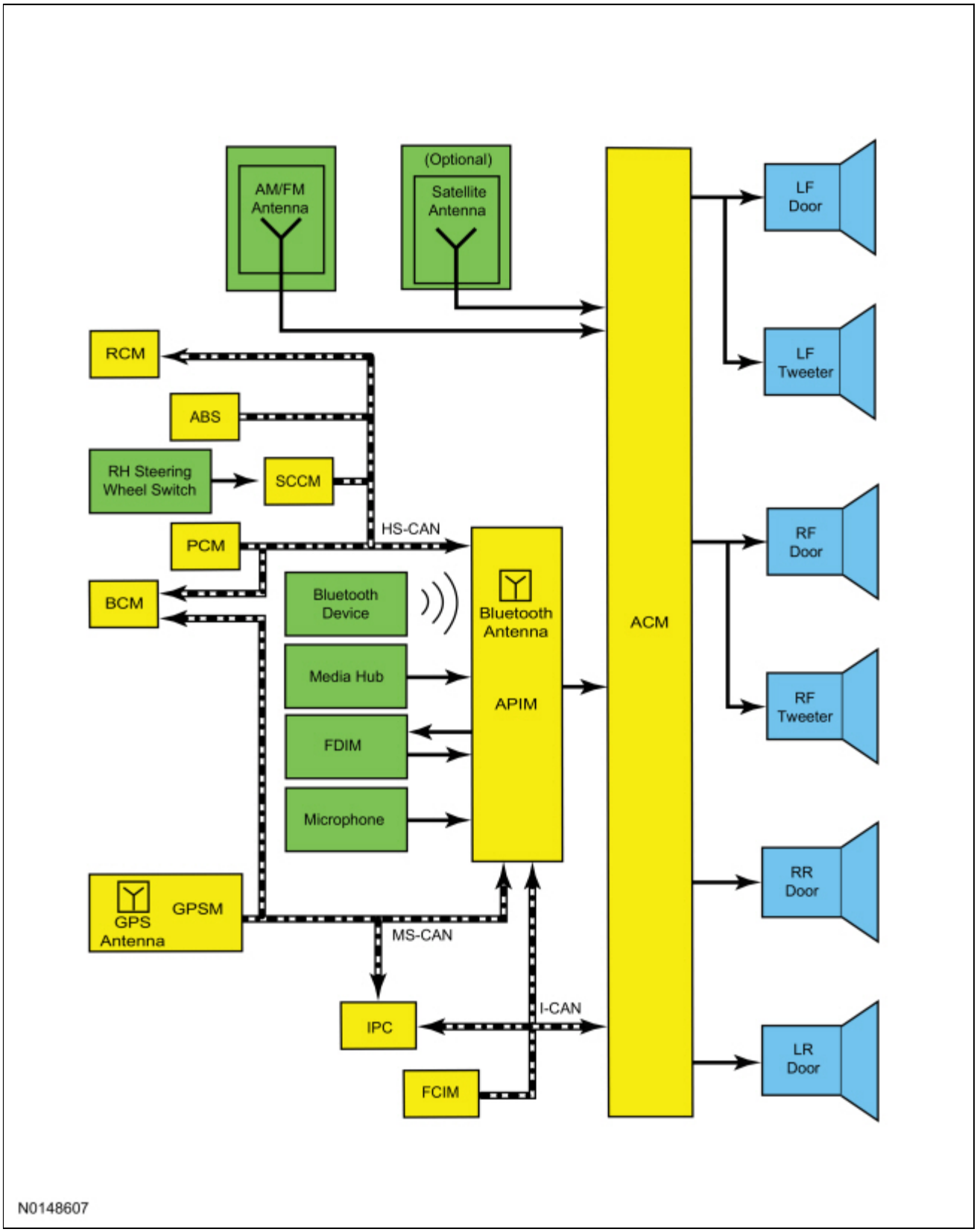
Main Features

- Optional HD Radio®
- Optional navigation
- Optional satellite radio
- SYNC®

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System Operation

System Diagram



Network Message Chart

NOTE: A missing network message is indicated by a U-code DTC . When a missing message DTC (U-code) sets, it is important to look for symptoms present in the audio system and throughout the vehicle, and to review the complete message list to determine which other modules rely on the same message. Refer to CAN Module Communication Message Chart in Section 418-00 . When the other modules have been identified, run the self-test for those modules. If the same message is missing from those modules, the identical, or similar lost communication DTCs may be set in those modules. Confirmation of missing messages common to multiple modules can indicate that the originating module is the source of the concern, or that the communication network may be at fault.

It is very important to understand the following:

- Where the input originates
- All of the information necessary for a feature to operate
- Which module(s) receive(s) the input or command message
- Which module controls the output of the feature
- If the module that receives the input controls the output of the feature, or whether it outputs a message over the CAN to another module.

Module Network Input Messages - ACM

Broadcast Message	Originating Module	Message Purpose
Belt-Minder® audio mute	IPC	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.
FCIM set volume	FCIM	Used to set the ACM volume from the FCIM .
Media player display request	APIM	Used to display detailed folder and track information on the FDIM from the ACM for the different audio system operating modes when the appropriate FCIM button is pressed.
MyKey® volume limit	IPC	Used to limit the maximum audio system volume when a MyKey® restricted key is in use.
Navigation audio settings	APIM	Used to set the navigation command volume.
SYNC® alerts	APIM	Used for text message, news, sports, weather, satellite radio artist/title favorites (if activated), and traffic alert notifications.

Module Network Input Messages - APIM

Broadcast Message	Originating Module	Message Purpose
ACM radio functions	ACM	Used to display the ACM radio functions such as seek, tune and AM/FM stations on the FDIM .
Airbag status	RCM	Used to monitor airbag deployment status for 911 assist.
Audio source	ACM	Used to display the selected audio source on the FDIM .

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CD load/eject	ACM	Used to display the loaded or ejected CD status on the FDIM .
Date and time	IPC	Used to display the current date and time on the FDIM .
Door ajar status	BCM	Used to determine the door ajar status for the accessory delay feature.
FCIM button press	FCIM	Used to indicate when a button is pressed on the FCIM so the audio system can make the desired setting change.
Front seat belt latched status	RCM	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.
Ignition key type	BCM	Used to determine if a MyKey® is enabled and in use.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for APIM operating modes and fault reporting.
Illumination dimming level	BCM	Used to control the backlight intensity of the FDIM based on the dimmer switch input.
Language selection	IPC	Used to display information on the FDIM in the selected language.
Navigation rolling wheel count	ABS module	Used to provide more accurate vehicle position tracking when the GPS signal is temporarily unavailable.
Seat belt buckle status	RCM	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.
Steering wheel switch media	SCCM	Used to set the audio system listening mode (AM/FM, CD, etc.) from the steering wheel switch.
Steering wheel switch seek left	SCCM	Used to access the next strong station to the left, to restart an audio track, to access the previous satellite radio station preset (if equipped), or the previous audio track from the steering wheel switch.
Steering wheel swtich seek right	SCCM	Used to access the next strong station to the right, to access the next satellite radio station preset (if equipped), or to access the next audio track from the steering wheel switch.
Steering wheel switch voice	SCCM	Used to access or exit the voice command feature from the steering wheel switch.
Steering wheel switch volume down	SCCM	Used to decrease the audio system volume from the steering wheel switch.
Steering wheel switch volume up	SCCM	Used to increase the audio system volume from the steering wheel switch.

Module Network Input Messages - FCIM

Broadcast Message	Originating Module	Message Purpose
Door ajar status	BCM	Used to determine the door ajar status for the accessory delay feature.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for FCIM operating modes and fault reporting.

Illumination dimming level	IPC	Used to control the backlight intensity of the FCIM based on the dimmer switch input.

Module Network Input Messages - GPSM

Broadcast Message	Originating Module	Message Purpose
Ignition switch position	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for GPSM operating modes and fault reporting.
Selector lever (PRNDL) status	BCM	Used to verify the gear lever position for vehicle direction data.

Accessory Delay Feature

The accessory delay feature allows the audio system to be operated for a preset period of time after the ignition is turned off and a front door has not been opened.

AM/FM Radio

The AM/FM fender-mounted antenna receives radio waves and sends them through the AM/FM antenna coaxial cable to the ACM . The radio waves are converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

APIM Programming

The APIM requires specific programming procedures for correct operation. APIM programming is required when:

- The APIM is replaced
- Directed by a TSB. Updates to resolve SYNC® performance concerns can only be performed when directed by a TSB.
- Feature upgrades are requested. Occasional feature upgrades and/or new applications can be programmed when they become available. This type of programming is available upon customer request and expense.

There are 3 types of APIM programming available:

- Module Replacement — Used when the APIM has been replaced. This type of programming performs the required provisioning (restores software for newly installed hardware).
- Standard — Used to update the APIM and any currently installed Applications to the latest software level.
- Custom — Used to show all the available software options (including applications that may not have been installed previously) that can be programmed into the APIM . Use this selection when upgrades become available or as directed by a TSB.

There are 3 types of software installation methods:

- Full Flash (Force CIP) — A CIP program is the entire software package for the APIM . Performing a Full Flash erases the existing APIM software and installs the complete program. A Full Flash should only be performed if a Service Pack is not available. If a Full Flash is performed, all applications must be re-installed. Performing a Full Flash by selecting Force CIP requires additional programming time

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and is not necessary unless directed by a TSB.

- Service Pack — A Service Pack update only provides the necessary software to update the existing APIM program to a new level. For example, a Service Pack changes the software program from an 'AA' to an 'AB' version level. It does not delete or overwrite the existing APIM software. A Service Pack is a much smaller program than a Full Flash and requires less downloading and programming time. A Service Pack software installation should always be performed instead of a Full Flash, if possible.
- Applications — Applications are special software programs that may be installed on the APIM . Applications necessary for each vehicle are determined by the vehicle build information stored in the Ford online database. Selecting individual applications for installation may not be necessary every time the APIM is programmed.

NOTE: VIP programming is not selectable because the VIP is configured automatically during programming.

There are some general programming guidelines that are applicable to multiple types of programming:

- Full Flash/Force CIP
  - The media hub must be removed for programming.
  - The diagnostic scan tool and SYNC® Re-Flash Kit (or equivalent), are required to complete the flash procedure.
  - All previously paired phones are deleted from the SYNC® system.
  - The file needs to be downloaded from the Ford online database. Allow for extra time in order to complete the download. The compressed files are between 200 and 400 megabytes (MB), and once downloaded, are extracted to the full size of approximately 2 gigabytes (GB).
  - Once diagnostic scan tool programming is complete, applications need to be installed with the USB flash drive. This should be accomplished by reinstalling the media hub and connecting the USB flash drive to the media hub.
- Service Pack and Applications
  - A USB flash drive with a minimum 1 gigabyte (GB) storage capacity is required.
  - The file is downloaded from the Ford online database onto the flash drive. The files are then transferred via the flash drive to the APIM through the vehicle USB port.

To perform module replacement programming, refer to Accessory Protocol Interface Module (APIM) Module Replacement Programming

To perform standard programming, refer to Accessory Protocol Interface Module (APIM) Standard Programming

To perform custom programming, refer to Accessory Protocol Interface Module (APIM) Custom Programming

Audible Prompts

The APIM receives stereo inputs from connected mobile phones and mono inputs from the SYNC® microphone.

Stereo and mono inputs, voice prompts, the TTS feature, ringtones, and any audio received through a connected mobile phone are transmitted to the ACM as stereo or mono sound.

The TTS feature speaks information so that it does not have to be read from the display.

Audio Extended Play

This feature allows the audio system to operate with the ignition OFF, regardless of door latch position.

When the power button on the FCIM is pressed, audio system functionality is enabled and remains active for a period of 20-60 minutes, depending on configuration settings. To turn the audio system off, the power button on the FCIM is pressed. Audio extended play will not function if the battery load shed is active.

Battery Load Shed

The BCM uses the battery current sensor to monitor the battery state of charge. The battery current sensor is attached to the battery ground cable. With the vehicle OFF and the ignition in ACC or ON, a load shed message is sent over the CAN when the BCM determines that the battery state of charge is below 40%, 45 minutes have elapsed, or 10% of the charge has been drained. This message turns off the audio system to save the remaining battery charge. Under this condition, SYS OFF TO SAVE BATT is displayed on the centerstack infotainment display to notify the driver that battery protection actions are active. To clear the load shed state, start the vehicle.

Bluetooth Mode

Bluetooth is a secure, short-range radio frequency that allows devices to communicate wirelessly through radio waves. The operating range of a Bluetooth signal is a maximum of 9.75 m (32 feet).

The Bluetooth interface can accommodate both Bluetooth-enabled mobile phones and Bluetooth-enabled media devices. The SYNC® system allows interaction with several types of customer Bluetooth devices, including mobile phones and media devices. The APIM contains an on-board Bluetooth chipset, which enables certain wireless devices to interact with the system. Any Bluetooth device used with the SYNC® system must first be paired with the system before it is operational.

Only one Bluetooth phone and one Bluetooth media device can be connected to the system at any one time. If an additional device of either type is paired with the system and made active, the APIM disconnects any active connection and establishes a connection with the new device.

When a new Bluetooth device is added, the APIM and the Bluetooth device must be paired together. Most Bluetooth devices can pair with the SYNC® system, although functionality may vary. To determine if a Bluetooth device is supported, verify the customer device is on the compatibility list for the current APIM software level.

Pairing a Bluetooth device is accomplished through the "Add Device" selection of the phone menu. When pairing a device, the SYNC® system generates a unique PIN that must be entered on the Bluetooth device in order for the pairing process to be successful. There are also some device-specific actions that must take place. For information on the pairing process, refer to the Owner's Literature.

It is important to understand that not all mobile phones have the same level of features when interacting with the SYNC® system. For a list of compatible phones, refer to SyncMyRide website.

Composite Audio-Video Input Mode

The composite audio and video inputs consist of the RCA jack connections that are used for playing video or audio content from an external device (such as a gaming system). The media hub contains an internal composite audio/video translator connected to the external RCA jacks, which outputs video and audio signals to the APIM via a shielded audio and video harness.

HD Radio® (If Equipped)

HD Radio® is a free to the public digital radio broadcast. HD Radio® channels duplicate certain analog FM channels, and some subdivide (multicast) the digital signal into multiple channels that do not have analog equivalents.

The AM/FM fender-mounted antenna receives radio waves containing data (station call letters, artist names,

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song titles, etc.) and digital HD Radio® audio. The radio waves are sent through the AM/FM antenna coaxial cable to the ACM , where the data is separated from the audio. The data is sent to be displayed on the centerstack infotainment display, and the audio is converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

MyKey® Audio Operation

When a MyKey® is in use, the following restrictions are activated:

- The audio system is muted until the safety belts are buckled when the Belt-Minder® feature is activated. The MyKey® "BUCKLE UP TO UNMUTE AUDIO" is displayed in the information display.
  - This is a standard setting and cannot be changed.
- Satellite radio adult content stations are blocked by being muted.
- If "Always On" is selected in the MyKey® menu, 911 assist and the Do Not Disturb features are enabled and cannot be disabled.
- The audio system volume is limited to 45%. In an attempt to exceed the limited volume, the MyKey® VOLUME LIMITED message is displayed in the centerstack infotainment display.
  - This is an optional setting.

Refer to the Owner's Literature for more information on MyKey®.

Navigation

The navigation system guides the user to a pre-entered destination. Map data is read from the map data SD card plugged into the media hub. The APIM calculates route information based on GPS data received by the GPSM . The APIM also uses vehicle speed and transmission gear selected signals received through the network to detect vehicle speed and direction, resulting in more accurate navigation tracking. The navigation display is shown on the FDIM . Installing different size tires other than what is indicated on the vehicle placard may cause the navigation system to be inaccurate.

The voice recognition system allows the user to interface with the system without using the touchscreen. A microphone located in the headliner provides a direct input to the APIM .

Satellite Radio (If Equipped)

Satellite radio is a subscription-based service.

The satellite radio roof-mounted antenna receives signals containing data (station call letters, artist names, song titles, etc.) and digital satellite radio audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio receiver built into the ACM . The ACM separates the data from the audio. The data is sent to be displayed on the centerstack infotainment display, and the audio is converted into fluctuating AC voltage and sent as left and right analog audio signals to the speakers.

SD Card Mode

The SD card slot can be used for playing audio content that is stored on a SD card.

Image files can be saved to the APIM from a SD card in order to be used as wallpaper backgrounds displayed on the FDIM .

SD card data is transmitted to the APIM through the USB cable.

SIRIUS Data Services - If Equipped

SIRIUS Data Services is a subscription-based service and requires a separate subscription from the satellite radio.

The combination HD /satellite radio roof-mounted antenna receives digital signals and sends them to the satellite radio receiver through the satellite radio antenna coaxial cable. The satellite radio receiver is built into the ACM . The signals are then sent to the APIM , and then to the FDIM touchscreen to be displayed.

SIRIUS Data Services allows the customer to receive updates for:

- Fuel Prices
- Movies (movie listings, start times, ratings)
- Sports (in game and final scores, weekly schedules)
- Stocks
- Ski Conditions
- Traffic (traffic speed, accidents, construction, road closings)
- Weather (current weather, forecasts, radar images)

Some services may be available separately while others are only available as packages.

Speed Compensated Volume

The ACM adjusts the audio system volume based on the VSS signal to compensate for speed and wind noise.

When a MyKey® is in use and the MyKey® radio volume limiter is enabled, the speed compensated volume is disabled.

Steering Wheel Switch Functions

The RH 8-way steering wheel switches operate the volume +/-, seek +/-, and the audio system SYNC® functions (media, voice, and phone).

SYNC® Services

SYNC® Services is a subscription-based service. For SYNC® Services subscription information,, refer to SyncMyRide .

The customer's mobile phone is used to access and download the SYNC® services. SYNC® services information received by the customer's mobile device is sent to the APIM .

The GPS antenna, integral to the GPSM , is used to detect the location and direction of the vehicle.

SYNC® services includes the following features:

- Business search
- Personalized text alerts
- Real-time traffic updates
- Turn-by-turn directions

SYNC® services allows the customer to receive updates for:

- Entertainment
- News
- Sports
- Stocks
- Travel
- Weather

SYNC® System

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The SYNC® system is a hands-free communication and entertainment system that supports many features. All features are not available with every phone.

The SYNC® system provides the ability to:

- Connect media devices (such as an iPod® or USB device) in order to play audio files.
- Control the entertainment system, climate control system, ambient lighting system, and several other vehicle systems using the touchscreen or voice controls.
- Initiate an emergency call (911 Assist™) when the airbags deploy.
- Play media files via a paired Bluetooth-enabled audio device.
- Produce vehicle health reports.
- Send and receive phone calls via a paired Bluetooth-enabled phone.
- Send and receive text messages via a paired Bluetooth-enabled phone.
- Wi-Fi signal receiver for in-car Internet access (requires customer-supplied USB modem).

USB Mode

The USB port can be used for connecting a media device (such as an iPod®) with the device's available cable, or for directly plugging in a portable mass storage device, such as a thumb drive. When playing media files stored on a mass storage device, the SYNC® system only plays files that do not have DRM protection. The USB port can also be used for uploading vehicle application upgrades. The USB port is powered by the APIM , so no external power source is needed to power a device plugged into the USB port if the device supports this feature.

In addition to audio information, metadata (information such as artist, album title, song title, and genre) may also be sent to the APIM from a device plugged into the USB port. The APIM uses the metadata to create indexes that can be used to sort for particular music, based on customer preference. Not all USB devices can send metadata to the APIM . When a new media device is connected to the SYNC® system, the APIM automatically indexes the information. This may take several minutes (depending on the amount of data on the device), and is considered normal operation. When a device that was previously connected to the SYNC® system is reconnected, the APIM updates the index (rather than creating a new one), which reduces the amount of time needed to index the device.

Image files can be saved to the APIM from a USB device. These images can be displayed on the FDIM as wallpaper backgrounds.

Voice Recognition

Voice recognition is used for many vehicle functions, including audio system and climate controls. The microphone relays the microphone input to the APIM through dedicated wiring. The TTS and voice prompt features speak certain text information and interaction requests to minimize driver distraction by having to look at the audio system display while driving. The ringtone alerts the driver to an incoming call. The microphone is also used to detect outgoing audio during a phone call.

Audible prompts can range from a simple tone to more elaborate spoken text, based on the customer setting. When interaction mode is set to standard, detailed guidance is provided. When interaction mode is set to advanced, most prompts are tones only and minimal audible guidance is provided. Refer to the Owner's Literature for further information on voice interaction.

The audio signals for the TTS and voice prompt features, ringtones, and audio from the outside device during a phone call, are sent from the APIM to the ACM .

Component Description

ACM

The ACM can be operated with the ignition in RUN, ACC, or OFF.

The ACM receives radio waves containing audio from the antenna coaxial cable(s) and converts them into fluctuating AC voltage. The ACM receives audio signals from the APIM in the form of fluctuating AC voltage. The ACM processes these inputs and sends left and right analog audio signals to the speakers as fluctuating AC voltage.

If equipped with satellite radio or HD Radio®, the ACM will also receive radio waves containing data through the antenna coaxial cable(s). The data is sent to be displayed on the centerstack infotainment display.

The ACM requires PMI when it is replaced.

Antenna

The AM/FM fender-mounted antenna receives radio waves containing audio and sends them through the AM/FM antenna coaxial cable to the ACM . The antenna mast is used to amplify the AM/FM radio waves to improve reception.

If equipped with HD Radio®, the AM/FM fender-mounted antenna receives radio waves containing data and digital audio and sends them through the AM/FM antenna coaxial cable to the ACM .

If equipped with satellite radio, the satellite radio roof-mounted antenna receives signals containing data and digital audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio receiver built into the ACM .

APIM

Audio signals received by the APIM are sent to the ACM as fluctuating AC voltage.

The APIM consists of 2 internal modules: the CIP and the VIP . The modules are not replaceable individually, but can be flashed independently, if required.

The CIP interfaces with all of the inputs to the APIM . It contains an analog-to-digital-to analog converter, as well as the Bluetooth chipset. Any Application upgrades that are available to the consumer are loaded directly to the CIP through the USB port.

The VIP provides an interface between the CIP and the vehicle. Its main functions are controlling the APIM power management and translating inbound and outbound CAN signals. In addition, the VIP queries the modules on the network to retrieve any DTCs when a vehicle health report is requested.

FCIM

The FCIM can be operated with the ignition in RUN, ACC, or OFF.

The FCIM audio system buttons provide one of the methods in which the customer interacts with the infotainment system.

The FCIM is separate from the ACM .

FDIM

The FDIM can be operated with the ignition in RUN, ACC, or OFF.

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The FDIM touchscreen provides one of the methods in which the customer interacts with the infotainment system.

The FDIM plugs directly into the APIM , and therefore does not communicate directly on any network, and no external circuits are connected.

Global Positioning System Module (GPSM)

The Global Positioning System Module (GPSM) provides vehicle location for real-time traffic reports and re-routing, and for identifying vehicle location in the event of a collision.

For vehicles with navigation, the Global Positioning System Module (GPSM) acts as the antenna for the navigation system.

Vehicle location information is broadcast from the Global Positioning System Module (GPSM) to the APIM .

Media Hub

The media hub allows for various audio and video devices to play content through the vehicle speakers and to be viewed in the FDIM .

The media hub receives inputs from:

- 2 USB ports
- 1 Secure Digital (SD) card slot
- 1 set of component RCA jacks

Steering Wheel Switches

The RH steering wheel switches contain series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

The SCCM sends a 5-volt reference voltage to the RH steering wheel switch on the input circuits. When a switch is pressed, the voltage is routed through the corresponding resistor(s), and then to ground through the SCCM . The SCCM monitors the resultant voltage drop to determine which switch was pressed. The voltage drop varies depending upon the resistance of the specific switch pressed.

The SCCM sends a network message to the APIM for the SYNC® switches and to the ACM for the redundant audio controls.

SYNC® Microphone

The SYNC® microphone receives SYNC® system voice commands and outgoing audio during a phone call. These signals are sent to the APIM .

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Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent diagnostic scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3104-A	Back-probe Pins POM6411 or equivalent
 ST3051-A	Universal Serial Bus (USB) Male-A To Male-A Cable CCMUSB2-AM-AM-10
 ST3086-A	Multi-Media Interface Tester 105-00120

DTC Charts

NOTE: For SYNC® related concerns, REFER to the SYNC® Symptom Chart before connecting the scan tool and beginning DTC-based diagnostics.

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Audio Front Control Module (ACM) DTC Chart

DTC	Description	Action
B1A01:01	Speaker #1: General Electrical Failure	• For a LF door speaker concern, GO to Pinpoint Test G • For a LF tweeter speaker concern, GO to Pinpoint Test H
B1A01:11	Speaker #1: Circuit Short to Ground	• For a LF door speaker concern, GO to Pinpoint Test G • For a LF tweeter speaker concern, GO to Pinpoint Test H
B1A01:12	Speaker #1: Circuit Short to Battery	• For a LF door speaker concern, GO to Pinpoint Test G • For a LF tweeter speaker concern, GO to Pinpoint Test H
B1A01:13	Speaker #1: Circuit Open	• For a LF door speaker concern, GO to Pinpoint Test G • For a LF tweeter speaker concern, GO to Pinpoint Test H
B1A02:01	Speaker #2: General Electrical Failure	• For a RF door speaker concern, GO to Pinpoint Test I • For a RF tweeter speaker concern, GO to Pinpoint Test J
B1A02:11	Speaker #2: Circuit Short to Ground	• For a RF door speaker concern, GO to Pinpoint Test I • For a RF tweeter speaker concern, GO to Pinpoint Test J
B1A02:12	Speaker #2: Circuit Short to Battery	• For a RF door speaker concern, GO to Pinpoint Test I • For a RF tweeter speaker concern, GO to Pinpoint Test J
B1A02:13	Speaker #2: Circuit Open	• For a RF door speaker concern, GO to Pinpoint Test I • For a RF tweeter speaker concern, GO to Pinpoint Test J
B1A03:01	Speaker #3: General Electrical Failure	GO to Pinpoint Test K .
B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test K .
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test K .
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test K .
B1A04:01	Speaker #4: General Electrical Failure	GO to Pinpoint Test L .
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test L .
B1A04:12	Speaker #4: Circuit	GO to Pinpoint Test L .

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	Short to Battery	
B1A04:13	Speaker #4: Circuit Open	GO to Pinpoint Test L .
B1A56:21	Antenna: Signal Amplitude	If DTC B1A56:21 sets after running the bezel diagnostic tests, disregard this DTC. This test is used for end of line or repair bay testing at the Ford plant. Each plant has its own assigned frequency and signal strength requirements. The running and passing of this test depends on local radio stations. If no local station is broadcasting on the required frequency, the test will fail. Therefore, tests ran from the bezel diagnostic screen and the DTC generated from the test can be disregarded.
B1A89:11	Satellite Antenna: Circuit Short To Ground	• For a satellite radio concern, GO to Pinpoint Test B • For a SIRIUS Data Services concern, GO to Pinpoint Test C
B1A89:13	Satellite Antenna: Circuit Open	• For a satellite radio concern, GO to Pinpoint Test B • For a SIRIUS Data Services concern, GO to Pinpoint Test C
B1D19:49	Compact Disc Unit: Internal Electronic Failure	• CLEAR the DTC. • WAIT at least 30 seconds. • REPEAT the self-test. • If DTC B1D19:49 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
B1D19:4B	Compact Disc Unit: Over Temperature	The ACM was over temperature. This may occur during extended use. Audio operation can resume after the ACM cools. CLEAR the DTC. This is normal operation.
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AD .
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	GO to Pinpoint Test AG .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AH .
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AI .
U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2100:00	Initial Configuration Not	CHECK vehicle service history for recent service actions related to

	Complete: No Sub Type Information	this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3000:96	Control Module: Component Internal Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:96 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AJ .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ak .

Accessory Protocol Interface Module (APIM) DTC Chart

DTC	Description	Action
C1001:01	Vision System Camera: General Electrical Failure	REFER to The rear video is inoperative in Section 413-13 .
B108E:01	Display: General Electrical Failure	GO to Pinpoint Test x .
B116A:01	Handset Microphone: General Electrical	GO to Pinpoint Test p .

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	Failure	
B1215:00	External Memory Card: No Sub Type Information	GO to Pinpoint Test y .
B1252:11	USB Port: Circuit Short to Ground	• For an inoperative USB port, GO to Pinpoint Test R • For an inoperative SD card slot, GO to Pinpoint Test S
B1252:13	USB Port: Circuit Open	• For an inoperative USB port, GO to Pinpoint Test R • For an inoperative SD card slot, GO to Pinpoint Test S
B12B8:11	USB Port #2: Circuit Short To Ground	**NOTE:** This DTC refers to USB port #2 on the APIM itself, which is not used. • INSPECT the APIM USB port #2 for damage and REMOVE any debris. • CLEAR the DTCs. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B12B8:11 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AB .
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	GO to Pinpoint Test AC .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AD .
U0162:00	Lost Communication With Navigation Display Module: No Sub Type Information	GO to Pinpoint Test X .
U016A:00	Lost Communication With Global Positioning System Module: No Sub Type Information	GO to Pinpoint Test AE .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AF .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AH .
U0423:00	Invalid Data Received	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to

	from Instrument Panel Cluster Control Module: No Sub Type Information	Section 413-01 .
U1A00:87	Private Communication Network: Missing Message	GO to Pinpoint Test C .
U2017:45	Control Module Software #2: Program Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2017:45 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2017:51	Control Module Software #2: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2017:52	Control Module Software #2: Not Activated	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2017:54	Control Module Software #2: Missing Calibration	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2101:00	Control Module	CHECK vehicle service history for recent service actions related to this

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	Configuration Incompatible: No Sub Type Information	module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:04	Control Module: System Internal Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:04 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:88	Control Module: Bus Off	**NOTE:** Network communication/message DTCs can result from intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set these DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. The module was unable to communicate on the network at a point in time. The fault is not currently present. To avoid repeat network concerns: • INSPECT for damaged or corroded wiring at the APIM . • TEST the vehicle battery. REFER to Charging Systems in Section 414-00 . • CLEAR the DTC. • REPEAT the network test with the diagnostic scan tool.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AJ .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ak .

FCIM DTC Chart

DTC	Description	Action

B00D5:01	Restraint System Passenger Disable Indicator: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B00D5:01 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
B113C:11	Hazard switch illumination: Circuit Short To Ground	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B113C:11 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
B1202:01	Restraint System Passenger Enable Indicator: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B1202:01 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AD .
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AI .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2013:63	Switch Pack: Circuit / Component Protection Time-Out	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2013:63 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AJ .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ak .

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Global Positioning System Module (GPSM) DTC Chart

DTC	Description	Action
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	GO to Pinpoint Test AA .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information: No Sub Type Information	GO to Pinpoint Test AB .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AD .
U0401:00	Invalid Data Received from ECM/PCM A: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the PCM . REFER to Section 303-14 .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the BCM . REFER to Section 419-10 .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U3000:09	Control Module: Component Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, PERFORM a battery reset by disconnecting the battery for 1 minute, then reconnecting it. • CLEAR the DTC. • WAIT at least 10 seconds.

		• REPEAT the self-test. • If DTC U3000:09 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AJ .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test ak .

SCCM DTC Chart

DTC	Description	Action
B1380:09	Steering Wheel Right Switch Pack: Component Failure	GO to Pinpoint Test V .
B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	GO to Pinpoint Test V .
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	GO to Pinpoint Test V .
All other DTCs	—	REFER to Section 211-05 .

Symptom Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Symptom Chart — General Audio System

Condition	Possible Sources	Action
• A module does not respond to the diagnostic scan tool	• Fuse • Wiring, terminals, or connectors • Module	• REFER to Section 418-00 .
• The RH steering wheel controls are	• Refer to the Pinpoint Test	• GO to Pinpoint Test V .

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inoperative or do not operate correctly		
• The CD player is inoperative or does not operate correctly	• CD • ACM	• INSPECT the CD for scratches, fingerprints, a loose paper label, incorrect format, or damage. INSERT a known good CD and TEST the system. If the system operates correctly, the concern was caused by a damaged CD. If the system does not operate correctly, INSTALL a new ACM. REFER to Audio Control Module (ACM).
• The speed compensated volume does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test D.
• The compass is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test Z.
• The FCIM illumination is inoperative or does not dim	• Illumination system concern • FCIM	• REFER to Section 413-00.
• The audio system does not operate correctly from the FCIM	• Refer to the Pinpoint Test	• GO to Pinpoint Test W.
• The FDIM touchscreen is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test X.
• The FDIM displays “SD CARD FAULT”	• Refer to the Pinpoint Test	• GO to Pinpoint Test Y.

Symptom Chart — HD Radio® System (If Equipped)

Condition	Possible Sources	Action
• Data errors for text display	• Data error from radio broadcaster	• This condition is due to the data from the radio broadcaster. ADVISE the customer that the HD Radio® is functioning correctly.
• Echo, stutter, skip, repeat or volume fluctuation in HD	• Signal alignment error from radio broadcaster	• This condition is due to the signal alignment from the radio broadcaster. ADVISE the customer that the HD Radio® is functioning correctly.
• Sound fading in and out or sound delay	• Transition between HD and analog	• This condition is due to the transition between HD and analog. ADVISE the customer that the HD Radio® must have an available channel in order to output HD content.

• Sound dropout or channel unavailable in HD 2 or HD 3	• HD 2 and HD 3 do not have analog equivalents causing complete signal loss when HD signal fades	• This condition is due to the HD 2 and HD 3 do not have analog equivalents causing complete signal loss when HD signal fades. ADVISE the customer that the HD Radio® must have an available channel in order to output HD content.

Symptom Chart — Navigation (If Equipped)

Condition	Possible Sources	Action
• Navigation is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test Y.
• The SIRIUS data services are not available	• Refer to the Pinpoint Test	• GO to Pinpoint Test C.

Symptom Chart — Satellite Radio (If Equipped)

Condition	Possible Sources	Action
• Poor reception — satellite radio	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.
• Poor sound quality or no sound while in satellite radio mode - all other functions operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.
• The satellite radio is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B.

Symptom Chart — Sound Quality

Condition	Possible Sources	Action
• Poor reception — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A.
• Continuous seek or scan — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A.
• Poor sound quality or distorted sound from one or more speakers (not all speakers)	• Refer to the Pinpoint Test	• GO to Pinpoint Test E.
• No sound from all speakers	• Refer to the Pinpoint Test	• GO to Pinpoint Test F.
• The LF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test G.
• The LF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test H.
• The RF door speaker is inoperative	• Refer to the	• GO to

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	Pinpoint Test	Pinpoint Test L.
• The RF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test J.
• The RR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test K.
• The LR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test L.

SYNC System

Condition	Possible Sources	Action
• All SYNC® Services features are inoperative or inaccurate (traffic, directions, and information)	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset. If the concern is still present, GO to Pinpoint Test O.
• The SYNC® system voice or tone prompts, Text-To-Speech (TTS) feature, or ringtones are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset. If the concern is still present, GO to Pinpoint Test N.
• During a phone call, no incoming audio is heard in the vehicle	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset If the concern is still present, GO to Pinpoint Test N.
• Voice recognition is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset. If the concern is still present, GO to Pinpoint Test P.
• During a phone call, poor quality or no outgoing audio is heard on the outside device	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset. If the concern is still present, GO to Pinpoint Test P.
• No sound from all	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module

SYNC® audio sources (Bluetooth, USB, audio input jack)		(APIM) Reset . If the concern is still present, GO to Pinpoint Test M .
• The SYNC® steering wheel switches are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test V .
• All media hub functions are inoperative or do not operate correctly (USB ports, Secure Digital (SD) card, and RCA jacks)	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test Q .
• The USB port (s) are/is inoperative or do/does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test R .
• The Secure Digital (SD) card slot is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test S .
• The RCA jacks are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test T .
• Unable to pair Bluetooth device	• Refer to the Pinpoint Test	• PERFORM the APIM Reset., REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test U .
• An individual Bluetooth device feature is inoperative (text messaging, media playback or controls, phone book download, call history, or call waiting)	• Customer's device compatibility	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, INSTRUCT the customer to review the device compatibility list. REFER to www.syncmyride.com. It is normal operation for unsupported or incompatible Bluetooth features to be unavailable through the SYNC® system. If the inoperative feature is compatible, ADVISE the customer to check their device for firmware updates, and if required, reset their device following the

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		manufacturer's instructions.
• 911 Assist™ or Vehicle Health Report (VHR) is inoperative or does not operate correctly	• Unregistered SYNC® owner account • RCM misconfiguration • IPC misconfiguration	• Verify that the customer has a SYNC® Owner Account on www.syncmyride.com. This error message appears due to incomplete or incorrect PMI procedures. CHECK the vehicle service history for recent service actions related to the IPC or RCM. If there have been recent service actions with the IPC or RCM, REPEAT/PERFORM the Programmable Module Installation (PMI) procedure as directed by the diagnostic scan tool. REFER to: Section 418-01. If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Pinpoint Tests

Pinpoint Test A: Poor Reception Or Continuous Seek Or Scan — AM/FM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to AM/FM Radio, ACM, and Antenna in Information and Entertainment System.

The RDS function allows the vehicle operator to choose which genre (category) of music to listen to. When the SCAN button is pressed, the ACM only stops at channels falling within the selected category. If no channel in the selected category is found, the ACM continues to scan without stopping. This can appear to be a reception issue, but it is actually due to the customer's setting.

Possible Sources

- AM/FM antenna
- AM/FM antenna coaxial cable
- Charging system
- Ignition system
- No channel found in the selected category
- Noise suppression equipment
- Wiring, terminals, or connectors
- ACM

PINPOINT TEST A: POOR RECEPTION OR CONTINUOUS SEEK OR SCAN — AM/FM

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>A1 CHECK THE AUDIO SYSTEM RECEPTION
• Operate the audio system in radio tuner AM/FM mode.
• Check the reception with the engine running, and with the engine off.
• Does the poor reception only occur with the engine running?</td><td>Yes
GO to A2 .

No
GO to A4 .</td></tr>
<tr><td>A2 CHECK THE GENERATOR
• Ignition OFF.
• Disconnect: Wiring harness to the generator voltage regulator.
• Start the engine.
• Operate the audio system in radio tuner AM/FM mode.
• Is the reception OK?</td><td>Yes
INSTALL a new generator. REFER to Section 414-00 .

No
GO to A3 .</td></tr>
<tr><td>A3 CHECK THE IGNITION CIRCUITS
• Ignition OFF.
• Connect: Wiring harness to the generator voltage regulator.
• Visually inspect the engine compartment and make sure all ignition coils are correctly and securely connected, and that there are no visible cracks in the coil housings.
• Inspect all the wiring harnesses and connectors for damaged insulation and loose or broken conditions.
• Are the ignition components OK?</td><td>Yes
USE a jumper cable to ground various parts of the vehicle to the frame (for example: engine, fenders, quarter panels, stone deflectors, air cleaner, body sheet metal). When the noise is eliminated, PROVIDE a permanent ground where necessary.

No
REPAIR the ignition system as necessary.</td></tr>
<tr><td>A4 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE
• Ignition OFF.
• Disconnect: AM/FM antenna coaxial cable at the ACM . Refer to Audio Control Module (ACM) .
• Disconnect: AM/FM antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — AM/FM .
• Ignition ON.
• Measure the voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>AM/FM antenna coaxial cable core at the ACM</td><td>—</td><td>—</td><td>Ground</td></tr><tr><td>AM/FM antenna coaxial cable shield at the ACM</td><td>—</td><td>—</td><td>Ground</td></tr></table>• Is any voltage present?</td><td>Yes
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

No
GO to A5 .</td></tr>
<tr><td>A5 CHECK THE LOWER AM/FM ANTENNA COAXIAL</td><td></td></tr>
</table>

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CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A6.

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM.

A6 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM coaxial cable core at the ACM	—	Lower AM/FM antenna coaxial cable core at the inline connection	—
AM/FM antenna coaxial cable shield at the ACM	—	Lower AM/FM antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to A7.

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM.

A7 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A8.

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM.

A8 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: AM/FM antenna coaxial cable at the antenna unit. Refer to Antenna — AM/FM.
- Ignition ON.
- Measure the **voltage** between:

Yes
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM.

No
GO to A9.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

A9 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A10 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A10 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable core at the antenna unit (harness side)	—
AM/FM antenna coaxial cable shield at the ACM	—	AM/FM antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to A11 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A11 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

Yes
GO to A12 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

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- **Is the resistance greater than 10,000 ohms?**

A12 CHECK THE AM/FM ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new AM/FM antenna.
REFER to Antenna — AM/FM .

No
GO to A13 .

A13 CHECK THE AM/FM ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A14 .

No
INSTALL a new AM/FM antenna.
REFER to Antenna — AM/FM .

A14 CHECK THE AM/FM ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A15 .

No
INSTALL a new AM/FM antenna.
REFER to Antenna — AM/FM .

A15 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: AM/FM antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Yes
GO to A17 .

No
GO to A16 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

A16 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE	
• Remove the AM/FM antenna. Refer to Antenna — AM/FM . • Measure the **resistance** between: Positive Lead: Pin — AM/FM antenna unit shield at the antenna unit (component side); Circuit — — Negative Lead: Pin — AM/FM antenna base (unpainted surface); Circuit — — • **Is the resistance less than 1 ohm?**	**Yes** GO to A17 . **No** INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .
A17 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test B: The Satellite Radio Is Inoperative, Has Poor Reception, Or Has No Sound

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to MyKey® and Satellite Radio in Information and Entertainment System .

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When a satellite radio subscription is activated, the satellite receiver ESN is associated with the VIN .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A89:11	Satellite Antenna: Circuit Short To Ground	Set by the ACM when a short to ground is detected in the satellite antenna circuit for more than 250 milliseconds. This DTC can be either continuous or on-demand.
B1A89:13	Satellite Antenna: Circuit Open	Set by the ACM when an open is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.

Possible Sources

- Expired subscription
- Incorrectly matched ESN
- Wiring, terminals, or connectors
- Obstructions in the antenna's line of sight
- Satellite radio antenna
- Satellite radio antenna coaxial cable
- ACM

PINPOINT TEST B: THE SATELLITE RADIO IS INOPERATIVE, HAS POOR RECEPTION, OR HAS NO SOUND

Test Step	Result / Action to Take
B1 VERIFY AN ACTIVE SUBSCRIPTION	
• Operate the infotainment system in satellite radio mode and observe the infotainment display. • **Does the display indicate that the subscription has expired?**	**Yes** The subscription has expired. INFORM the customer to contact SIRIUS to reactivate the subscription. **No** GO to B2 .
B2 CHECK THE RECEPTION	
• Drive the vehicle to an open location that is free from obstacles such as tall buildings or large trees. • Using a diagnostic scan tool, view the ACM PIDs. • Monitor the satellite signal strength (SAT_SIG_STR) PID. • If the PID reads "No Signal" or "Poor," move the vehicle to another area and retest until "Good," "Very Good," or "Excellent" PID values are obtained. • **Can a "Good," "Very Good," or "Excellent" PID value be obtained?**	**Yes** GO to B3 . **No** GO to B6 .
B3 CHECK THE SATELLITE RADIO SYSTEM FOR CORRECT OPERATION	
• Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple**	**Yes** The system is operating correctly at this time. The concern was a result of

channels with normal sound quality?	obstructions in the antenna's line of sight. **No** GO to B4.
B4 CHECK FOR PROMOTIONAL CHANNEL 184 • Select channel 184. • **Does the satellite radio system receive channel 184 with normal sound quality?**	**Yes** GO to B5. **No** GO to B6.
B5 VERIFY THAT THE VIN AND ESN ON FILE MATCH THE VIN AND ESN FROM THE VEHICLE • Retrieve the satellite radio ESN. Satellite Radio Electronic Serial Number (ESN) Retrieval. • Contact the SIRIUS Dealer Support Line (888-465-8528). • Ensure that the VIN and ESN SIRIUS has on the customer's file match the VIN and ESN retrieved from the vehicle. • Follow the actions from step 2 to obtain "Good," "Very Good," or "Excellent" reception. • Operate the infotainment system in satellite radio mode. • **NOTE:** It may take up to 30 minutes for the activation signal to be received and satellite radio functions to operate. • Request for SIRIUS to send the activation signal to the vehicle 2-3 times. • Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of the activation signal needing to be resent or the VIN and ESN SIRIUS had on file not matching the VIN and ESN from the vehicle. **No** GO to B6.
B6 CHECK FOR ACM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the ACM DTCs. • Using a diagnostic scan tool, perform the ACM self-test. • **Are any DTCs recorded in the ACM?**	**Yes** For DTC B1A89:11 or DTC B1A89:13, GO to B7. For all other ACM DTCs, REFER to the ACM DTC chart in Information and Entertainment System. **No** GO to B20.
B7 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Satellite radio antenna coaxial cable at the ACM. Refer to Audio Control Module (ACM). • Disconnect: Satellite radio antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — Satellite Radio. • Ignition ON. • Measure the **voltage** between:	**Yes** REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio. **No** GO to B8.

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

B8 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B9 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B9 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio coaxial cable core at the ACM	—	Lower satellite radio antenna coaxial cable core at the inline connection	—
Satellite radio antenna coaxial cable shield at the ACM	—	Lower satellite radio antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B10 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B10 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
GO to B11 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable.

Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

REFER to Antenna Cable — Satellite Radio .

B11 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: Satellite radio antenna coaxial cable at the antenna unit. Refer to Antenna — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to B12 .

B12 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B13 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B13 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable	—	Satellite radio antenna coaxial cable core at the	—

Yes
GO to B14 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

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core at the ACM		antenna unit (harness side)	
Satellite radio antenna coaxial cable shield at the ACM	—	Satellite radio antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

B14 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B15 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B15 CHECK THE SATELLITE RADIO ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

No
GO to B16 .

B16 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
GO to B17 .

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

B17 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B18 .

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

B18 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: Satellite radio antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

Yes
GO to B20 .

No
GO to B19 .

B19 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE

- Remove the satellite radio antenna. Refer to Antenna — Satellite Radio .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	Satellite radio antenna base (unpainted surface)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B20 .

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

B20 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern,

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▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM). **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test C: The SIRIUS Data Services Are Not Available

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SIRIUS Data Services in Information and Entertainment System.

When a SIRIUS Data Services subscription is activated, the satellite receiver ESN is associated with the VIN.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A89:11	Satellite Antenna: Circuit Short To Ground	Set by the ACM when a short to ground is detected in the satellite antenna circuit for more than 250 milliseconds. This DTC can be either continuous or on-demand.
B1A89:13	Satellite Antenna: Circuit Open	Set by the ACM when an open is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.
U1A00:87	Private Communication Network: Missing Message	Set by the APIM when messages are missing from the ACM on the satellite digital radio data link (SDL) circuits.

Removal of the navigation SD card results in loss of navigation while the card is removed. This is normal operation.

Possible Sources

- Navigation map SD card not present, not fully seated, or damaged
- Expired subscription
- Obstructions in the antenna's line of sight
- Incorrectly matched ESN
- Wiring, terminals, or connectors
- APIM
- ACM
- Satellite radio antenna

- Satellite radio antenna coaxial cable

PINPOINT TEST C: THE SIRIUS DATA SERVICES ARE NOT AVAILABLE

Test Step	Result / Action to Take
C1 VERIFY THE NAVIGATION MAP SD CARD IS PRESENT • Check for the presence of a navigation map SD card in the media hub SD slot. • **Is the navigation map SD card present and fully seated?**	**Yes** GO to C2. **No** INSTALL the navigation map SD card. TEST the system for normal operation.
C2 INSPECT THE NAVIGATION MAP SD CARD • Remove the navigation map SD card. • Inspect the navigation map SD card for damage. • **Is any damage present?**	**Yes** INSTALL a new navigation map SD card. **No** GO to C3.
C3 VERIFY AN ACTIVE SUBSCRIPTION **NOTE:** The status of the satellite radio subscription should be disregarded in this step since SIRIUS data services does not require a satellite radio subscription to operate. • Access the Subscription Info selection in the touchscreen Travel Link menu. • **Does the display indicate the subscription has expired for traffic, weather, fuel prices, movie times, sports, weather map, or ski conditions?**	**Yes** If the subscription has expired for one or more, but not all categories mentioned above, GO to C28 If the subscription has expired for all categories mentioned above, INFORM the customer to contact SIRIUS to reactivate the subscription. **No** GO to C4.
C4 CHECK THE RECEPTION • Drive the vehicle to an open location that is free from obstacles such as tall buildings or large trees. • Using a diagnostic scan tool, view the ACM PIDs. • Monitor the satellite signal strength (SAT_SIG_STR) PID. • If the PID reads "No Signal" or "Poor," move the vehicle to another area and retest until "Good," "Very Good," or "Excellent" PID values are obtained. • **Can a "Good," "Very Good," or "Excellent" PID value be obtained?**	**Yes** GO to C5. **No** GO to C8.
C5 CHECK THE SIRIUS DATA SERVICES FOR CORRECT OPERATION • Operate the infotainment system in SIRIUS data services mode and observe the infotainment display. • **Do SIRIUS data services operate correctly?**	**Yes** The system is operating correctly at this time. The concern was a result of obstructions in the antenna's line of sight.

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	No GO to C6 .
C6 CHECK FOR PROMOTIONAL CHANNEL 184 • Operate the infotainment system in satellite radio mode. • Select channel 184. • **Does the satellite radio system receive promotional channel 184 with normal sound quality?**	**Yes** GO to C7 . **No** GO to C8 .
C7 VERIFY THAT THE VIN AND ESN ON FILE MATCH THE VIN AND ESN FROM THE VEHICLE • Retrieve the satellite radio ESN . Satellite Radio Electronic Serial Number (ESN) Retrieval . • Contact the SIRIUS Dealer Support Line (888-465-8528). • Ensure that the VIN and ESN SIRIUS has on the customer's file match the VIN and ESN retrieved from the vehicle. • Follow the actions from step 4 to obtain "Good," "Very Good," or "Excellent" reception. • Operate the infotainment system in SIRIUS data services mode. • **NOTE:** It may take up to 30 minutes for the activation signal to be received and satellite radio functions to operate. • Request for SIRIUS to send the activation signal to the vehicle 2-3 times. • Operate the infotainment system in SIRIUS data services mode and observe the infotainment display. • **Do SIRIUS data services operate correctly?**	**Yes** The system is operating correctly at this time. The concern was a result of the activation signal needing to be resent or the VIN and ESN SIRIUS had on file not matching the VIN and ESN from the vehicle. **No** GO to C8 .
C8 CHECK FOR ACM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the ACM DTCs. • Using a diagnostic scan tool, perform the ACM self-test. • **Are any DTCs recorded in the ACM ?**	**Yes** For DTC B1A89:11 or DTC B1A89:13, GO to C10 . For all other ACM DTCs, REFER to the ACM DTC chart in Information and Entertainment System . **No** GO to C9 .
C9 CHECK FOR APIM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the APIM DTCs. • Using a diagnostic scan tool, perform the APIM self-test. • **Are any DTCs recorded in the APIM ?**	**Yes** For DTC U1A00:87, GO to C23 . For all other APIM DTCs, REFER to the APIM DTC chart in Information and Entertainment System . **No** GO to C27 .
C10 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Satellite radio antenna coaxial cable	**Yes** REPAIR or INSTALL a new lower satellite

at the ACM . Refer to Audio Control Module (ACM) .
- Disconnect: Satellite radio antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to C11 .

C11 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C12 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C12 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio coaxial cable core at the ACM	—	Lower satellite radio antenna coaxial cable core at the inline connection	—
Satellite radio antenna coaxial cable shield at the ACM	—	Lower satellite radio antenna coaxial cable shield at the inline connection	—

Yes
GO to C13 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

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- **Is the resistance less than 1 ohm?**

C13 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C14 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C14 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: Satellite radio antenna coaxial cable at the antenna unit. Refer to Antenna — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to C15 .

C15 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

Yes
GO to C16 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

- **Is the resistance greater than 10,000 ohms?**

C16 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable core at the antenna unit (harness side)	—
Satellite radio antenna coaxial cable shield at the ACM	—	Satellite radio antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to C17 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C17 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C18 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C18 CHECK THE SATELLITE RADIO ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna		—	Ground

Yes
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

No
GO to C19 .

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coaxial cable shield at the ACM —	
• **Is any voltage present?**	
C19 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the **resistance** between: Positive Lead: Pin — Satellite radio antenna coaxial cable core at the ACM; Circuit — Negative Lead: Pin —; Circuit Ground • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C20 . **No** INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .
C20 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER	
• Measure the **resistance** between: Positive Lead: Pin — Satellite radio antenna coaxial cable core at the ACM; Circuit — Negative Lead: Pin — Satellite radio antenna coaxial cable shield at the ACM; Circuit — • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C21 . **No** INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .
C21 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND	
• Disconnect: Satellite radio antenna coaxial cable at the antenna unit. • Measure the **resistance** between: Positive Lead: Pin — Satellite radio antenna unit shield at the antenna unit (component side); Circuit — Negative Lead: Pin —; Circuit Ground • **Is the resistance less than 1 ohm?**	**Yes** GO to C27 . **No** GO to C22 .
C22 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE	
• Remove the satellite radio antenna. Refer to Antenna — Satellite Radio .	**Yes** GO to C27 .

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	Satellite radio antenna base (unpainted surface)	—

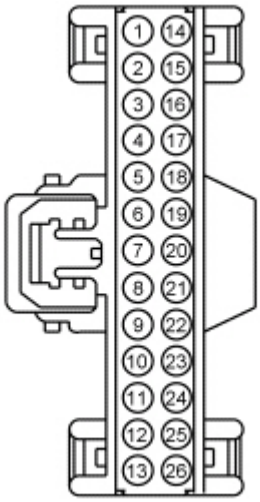
- **Is the resistance less than 1 ohm?**

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

C23 CHECK THE SATELLITE DATA CIRCUITS FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240B.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	—	Ground
C240B-19	VME91 (WH/BN)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to C24 .

C24 CHECK THE SATELLITE DATA CIRCUITS FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

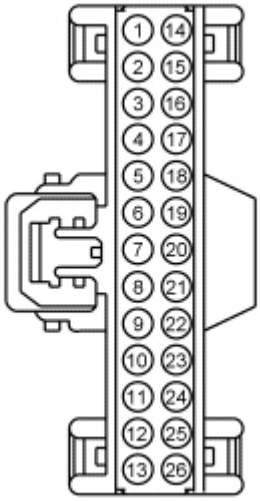
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
GO to C25 .

No
REPAIR the circuit in question.

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C240B-6	VME90 (GY/BU)	—	Ground
C240B-19	VME91 (WH/BN)	—	Ground

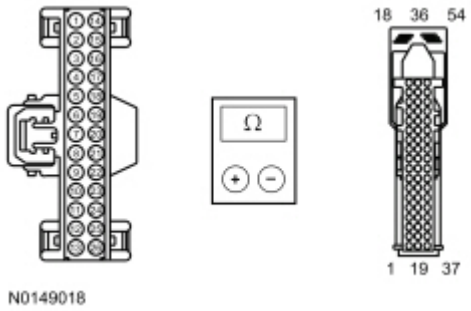


- **Are the resistances greater than 10,000 ohms?**

C25 CHECK THE SATELLITE DATA CIRCUITS FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	C2383-51	VME90 (GY/BU)
C240B-19	VME91 (WH/BN)	C2383-52	VME91 (WH/BN)



- **Are the resistances less than 3 ohms?**

Yes
GO to C26 .

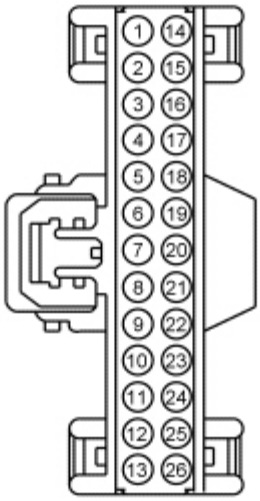
No
REPAIR the circuit in question.

C26 CHECK THE SATELLITE DATA CIRCUITS FOR A SHORT TOGETHER

- Measure the **resistance** between:

Yes

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	C240B-19	VME91 (WH/BN)



- **Is the resistance greater than 10,000 ohms?**

GO to C28 .

No
REPAIR the circuit in question.

C27 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the ACM connectors. Make sure they seat and latch correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

C28 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused

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• Operate the system and determine if the concern is still present. • **Is the concern still present?**	by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: The Speed Compensated Volume Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Speed Compensated Volume in Information and Entertainment System .

Possible Sources

- Speed compensated volume setting
- VSS signal concern
- Network communication concern
- ACM

PINPOINT TEST D: THE SPEED COMPENSATED VOLUME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 CHECK THE SPEEDOMETER OPERATION	
• Drive the vehicle and observe the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to D2 . **No** REFER to Section 413-01 .
D2 CHECK THE SPEED COMPENSATED VOLUME SETTING	
• Turn the speed compensated volume off. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • Set the speed compensated volume to maximum compensation. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • **Does the volume remain constant with the speed compensated volume turned off, and increase and decrease with vehicle speed with the speed compensated volume set to maximum?**	**Yes** The system is operating correctly at this time. INSTRUCT the customer in the correct usage of the speed compensated volume feature. **No** GO to D3 .

D3 CHECK FOR DTC U0155:00	
• Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155:00 retrieved in any audio system module?**	**Yes** GO to Pinpoint Test AD . **No** GO to D4 .
D4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test E: Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All Speakers)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

The ACM sends audio signals to the speakers in the form of AC voltage, resulting in clear audio output.

Possible Sources

- Loose component fasteners
- Loose door handle, lock, and other trim panel components and fasteners
- Loose items in storage areas
- Loose speaker grilles
- Loose wire harnesses or wire harness fasteners
- Speaker(s)
- Water shield bonding and placement

Visual Inspection and Diagnostic Pre-checks

Visually inspect around the suspect area for any possible rattle conditions such as:

- Any storage compartments including cup holders (if equipped)
- Door map pockets for contents that can rattle (if equipped)
- Door pull cup attachments (if equipped)
- Door switch bezels (if equipped)

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- Package tray (if equipped)
- Speaker grilles
- Trim panels and fasteners

PINPOINT TEST E: POOR SOUND QUALITY OR DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take
E1 ISOLATE THE ZONE • Operate the audio system using digital media (CD, MP3, etc.). • Using the audio system fade and balance feature, adjust the audio sound to each of the four zones (LF , RF , LR , and RR) of the vehicle to isolate the poor sound quality. • Locate and apply pressure to the trim panel(s) around the poor sound quality area in question. • **Does applying pressure to a trim panel reduce or eliminate the audible noise?**	**Yes** REPAIR or REPLACE the trim panel as needed. **No** GO to E2 .

E2 REMOVE AND INSPECT BEHIND/UNDERNEATH THE SUSPECT TRIM PANEL(S)
• Remove the trim panel to access the suspect speaker.
• Operate the audio system using digital media (CD, MP3, etc.).
• Validate where the poor sound quality area is located.
• Check:
  ▪ Trim panel for loose components around the speaker area such as the speaker grille
  ▪ Trim panel joining components for missing or broken pieces
  ▪ Lock and handle mechanical parts for correct attachment
  ▪ Wire harnesses for correct routing
  ▪ Wire harness fasteners for correct attachment
  ▪ Water shield for correct placement (speaker air path not blocked)
  ▪ Water shield for correct bonding to sheet metal
  ▪ Storage areas for loose items
  ▪ All child safety belt anchors (if equipped)
  ▪ All safety belt retractors
  ▪ All speaker bracket fasteners and other fasteners are secured and tightened to specified torque
• **Was the source of the noise located?**
	Yes
	REPAIR or REPLACE any loose or broken component or fastener as needed.
	
	No
	GO to E3 .

E3 CHECK THE SUSPECT SPEAKER FOR WATER INTRUSION
• Inspect for watermarks.
• Check the:
  ▪ Cone
  ▪ Magnet
  ▪ Basket
• **Are any watermarks present on the speaker?**
	Yes
	VERIFY the water shield is in the correct location, REPAIR or REPLACE any trim, door, or speaker seal as required.
	
	DRY the speaker in question and

	TEST the system for normal operation. **No** GO to E4.
E4 ISOLATE SPEAKER TO VERIFY NOISE	
• Remove the suspect speaker from its location and leave the speaker connected to the harness. • Hold the speaker away from any trim panel(s) and ensure the speaker is isolated from contact. • Operate the audio system using digital media (CD, MP3, etc.). • **Is the noise still present in the suspect speaker?**	**Yes** INSTALL a new speaker for the one in question. **No** LOCATE the source of the noise and REPAIR as needed.

Pinpoint Test F: No Sound From All Speakers

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System.

When the ignition is in the START position, the ACM receives voltage on the START signal circuit and mutes the speaker output. This prevents voltage spikes from producing popping noises through the speakers. A short to voltage on this circuit causes the ACM output to be muted continuously.

A short to ground or short to voltage in the circuitry to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the ACM. In this case, a speaker fault DTC sets.

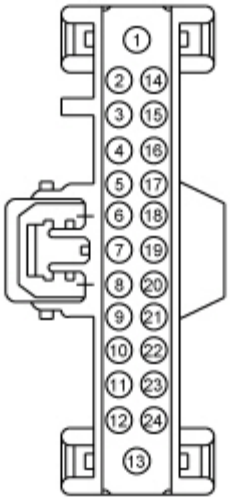
Possible Sources

- Wiring, terminals, or connectors
- ACM

PINPOINT TEST F: NO SOUND FROM ALL SPEAKERS

Test Step	Result / Action to Take
F1 CHECK FOR SPEAKER DTCS	
• Ignition ON. • Using a diagnostic scan tool, perform the ACM self-test. • **Are any speaker fault Diagnostic Trouble Codes (DTCs) present?**	**Yes** REFER to the audio ACM module DTC chart in Information and Entertainment System. **No** GO to F2.
F2 CHECK THE START SENSE CIRCUIT FOR A	

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SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C240A-3, Circuit CDC54 (WH/GN) Negative Lead: Pin —, Circuit Ground  • **Is the voltage 5V or greater?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to F3 .

F3 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test G: The LF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the ACM when a failure is detected on the LF door or tweeter speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LF door or tweeter speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.
B1A01:12	Speaker #1: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LF door or tweeter speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the ACM when an open is detected on the LF door or tweeter speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST G: THE LF DOOR SPEAKER IS INOPERATIVE

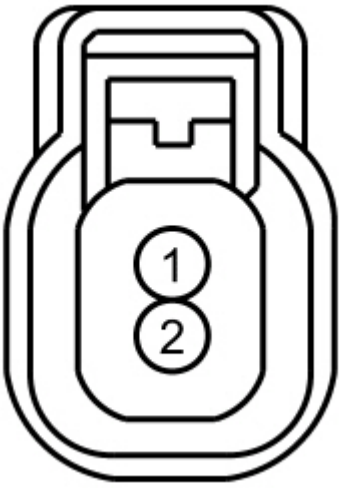
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>G1 CHECK THE AUDIO SIGNAL TO THE LF DOOR SPEAKER

• Ignition OFF.
• Disconnect: LF Door Speaker C523 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>C523-2</td><td>RME07 (WH/BN)</td></tr></table></td><td>Yes
INSTALL a new LF door speaker. REFER to Speaker — Door .

No
GO to G2 .</td></tr>
</table>

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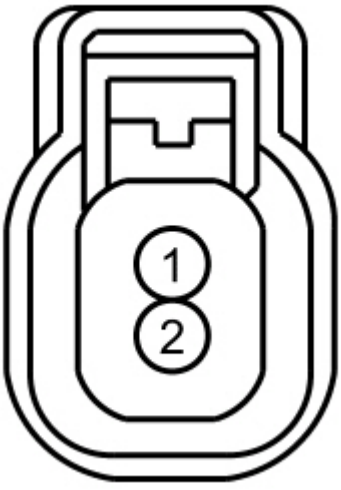


- **Is a fluctuating AC voltage present?**

G2 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

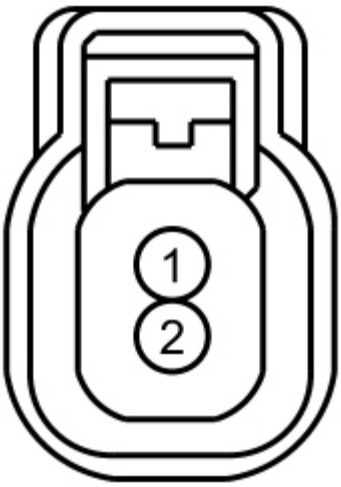
No
GO to G3 .

G3 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: LF Tweeter Speaker C230 .
- Measure the **resistance** between:

Yes
GO to G4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



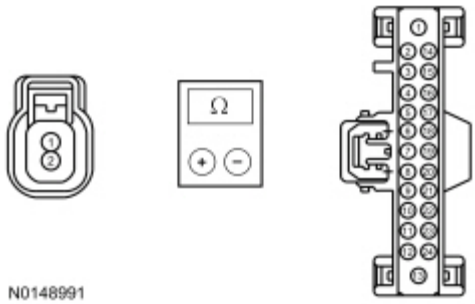
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

G4 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C240A-22	VME07 (WH)
C523-2	RME07 (WH/BN)	C240A-10	RME07 (WH/BN)



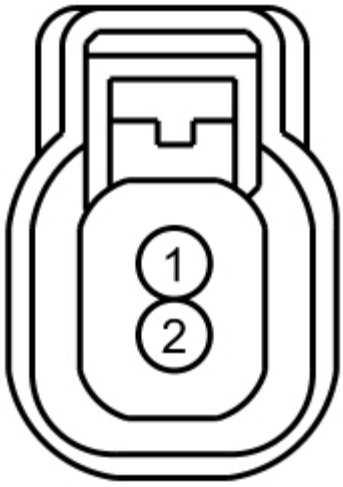
- **Are the resistances less than 3 ohms?**

Yes
GO to G5 .

No
REPAIR the circuit in question.

G5 CHECK THE AUDIO CIRCUITS TO THE LF

repair4less

DOOR SPEAKER FOR A SHORT TOGETHER • Measure the **resistance** between: <table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>C523-2</td><td>RME07 (WH/BN)</td></tr></table>  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to G6 . **No** REPAIR the circuit in question.

G6 CHECK FOR CORRECT ACM OPERATION
• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test H: The LF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the ACM when a failure is detected on the LF door or tweeter speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LF door or tweeter speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.
B1A01:12	Speaker #1: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LF door or tweeter speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the ACM when an open is detected on the LF door or tweeter speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST H: THE LF TWEETER SPEAKER IS INOPERATIVE

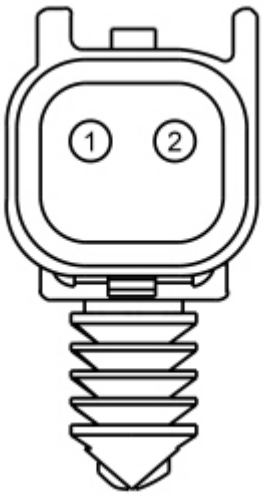
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>H1 CHECK THE AUDIO SIGNAL TO THE LF TWEETER SPEAKER

• Ignition OFF.
• Disconnect: LF Tweeter Speaker C230 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

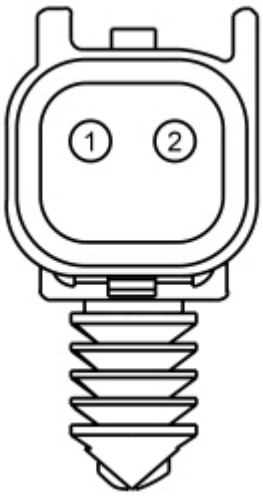
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C230-1</td><td>VME07 (WH)</td><td>C230-2</td><td>RME07 (WH/BN)</td></tr></table></td><td>Yes
INSTALL a new LF tweeter speaker.
REFER to Speaker — A-Pillar .

No
GO to H2 .</td></tr>
</table>

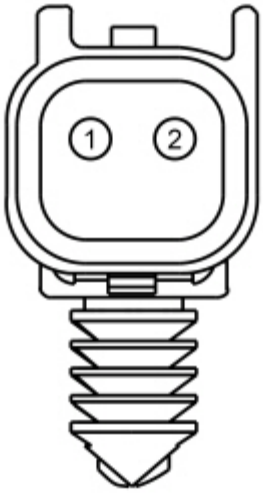
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- **Is a fluctuating AC voltage present?**

H2 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C230-1, Circuit VME07 (WH); Pin C230-2, Circuit RME07 (WH/BN) Negative Lead: Pin —, Circuit Ground  • **Is any voltage present?**	**Yes** REPAIR the circuit in question. **No** GO to H3 .
H3 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: LF Door Speaker C523 . • Measure the **resistance** between:	**Yes** GO to H4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME07 (WH)	—	Ground
C230-2	RME07 (WH/BN)	—	Ground



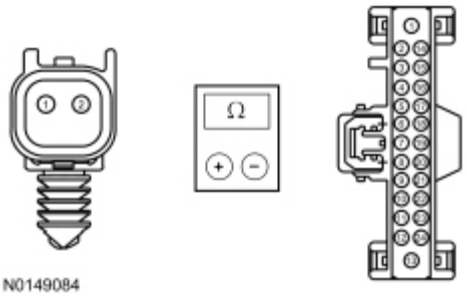
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

H4 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME07 (WH)	C240A-22	VME07 (WH)
C230-2	RME07 (WH/BN)	C240A-10	RME07 (WH/BN)



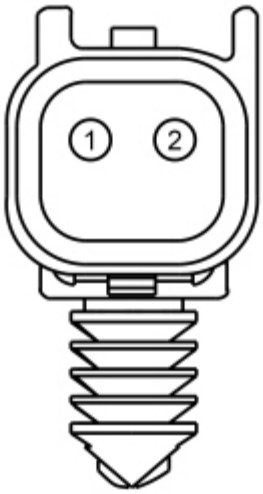
- **Are the resistances less than 3 ohms?**

Yes
GO to H5 .

No
REPAIR the circuit in question.

H5 CHECK THE AUDIO CIRCUITS TO THE LF

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TWEETER SPEAKER FOR A SHORT TOGETHER	
• Measure the **resistance** between: Positive Lead: Pin C230-1, Circuit VME07 (WH) Negative Lead: Pin C230-2, Circuit RME07 (WH/BN)  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to H6. **No** REPAIR the circuit in question.
H6 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test I: The RF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the ACM when a failure is detected on the RF door or tweeter speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RF door or tweeter speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RF door or tweeter speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the ACM when an open is detected on the RF door or tweeter speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST I: THE RF DOOR SPEAKER IS INOPERATIVE

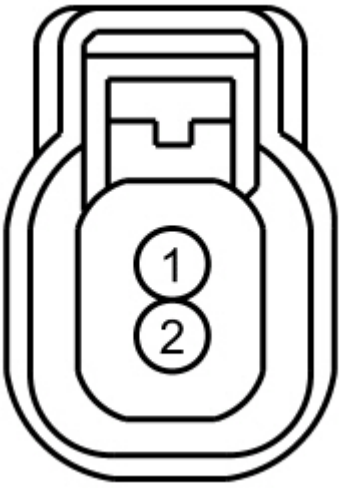
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CHECK THE AUDIO SIGNAL TO THE RF DOOR SPEAKER

• Ignition OFF.
• Disconnect: RF Door Speaker C612 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C612-1</td><td>VME10 (WH/VT)</td><td>C612-2</td><td>RME10 (WH/OG)</td></tr></table></td><td>Yes
INSTALL a new RF door speaker. REFER to Speaker — Door .

No
GO to I2 .</td></tr>
</table>

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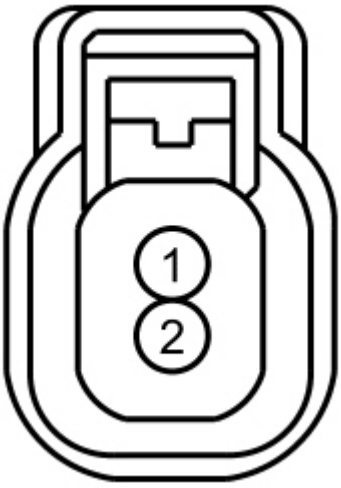


- **Is a fluctuating AC voltage present?**

I2 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

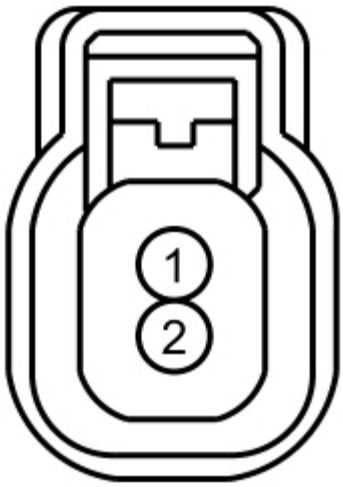
No
GO to I3 .

I3 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: RF Door Speaker C231 .
- Measure the **resistance** between:

Yes
GO to I4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



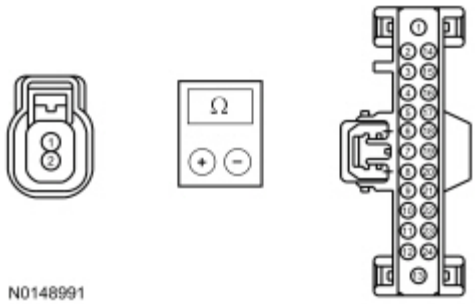
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

I4 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C240A-23	VME10 (WH/VT)
C612-2	RME10 (WH/OG)	C240A-11	RME10 (WH/OG)



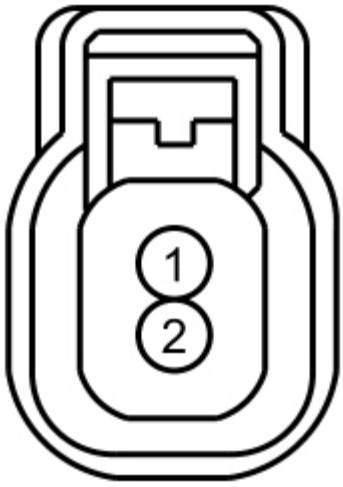
- **Are the resistances less than 3 ohms?**

Yes
GO to I5 .

No
REPAIR the circuit in question.

I5 CHECK THE AUDIO CIRCUITS TO THE RF

repair4less

DOOR SPEAKER FOR A SHORT TOGETHER • Measure the **resistance** between: <table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C612-1</td><td>VME10 (WH/VT)</td><td>C612-2</td><td>RME10 (WH/OG)</td></tr></table> • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I6 . **No** REPAIR the circuit in question.
I6 CHECK FOR CORRECT ACM OPERATION • Ignition OFF. • Disconnect and inspect all the ACM connectors. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test J: The RF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the ACM when a failure is detected on the RF door or tweeter speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RF door or tweeter speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RF door or tweeter speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the ACM when an open is detected on the RF door or tweeter speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST J: THE RF TWEETER SPEAKER IS INOPERATIVE

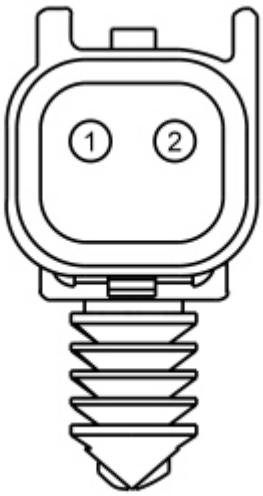
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>J1 CHECK THE AUDIO SIGNAL TO THE RF TWEETER SPEAKER

• Ignition OFF.
• Disconnect: RF Tweeter Speaker C231 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

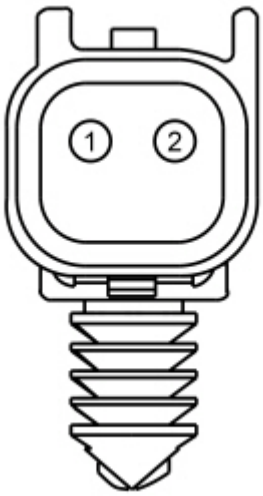
<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C231-1</td><td>VME10 (WH/VT)</td><td>C231-2</td><td>RME10 (WH/OG)</td></tr></table></td><td>Yes
INSTALL a new RF tweeter speaker.
REFER to Speaker — A-Pillar .

No
GO to J2 .</td></tr>
</table>

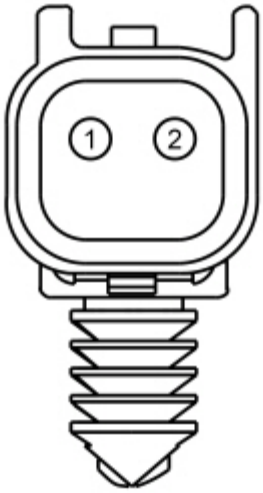
repair4less



- **Is a fluctuating AC voltage present?**

J2 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C231-1, Circuit VME10 (WH/VT); Pin C231-2, Circuit RME10 (WH/OG) Negative Lead: Pin —, Circuit Ground  • **Is any voltage present?**	**Yes** REPAIR the circuit in question. **No** GO to J3 .
J3 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: RF Door Speaker C612 . • Measure the **resistance** between:	**Yes** GO to J4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	—	Ground
C231-2	RME10 (WH/OG)	—	Ground



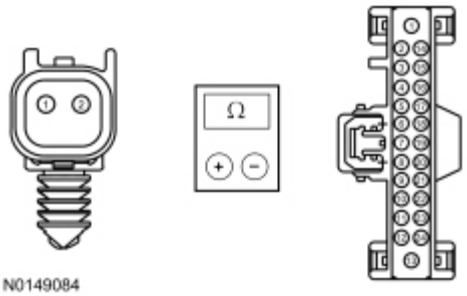
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

J4 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	C240A-23	VME10 (WH/VT)
C231-2	RME10 (WH/OG)	C240A-11	RME10 (WH/OG)



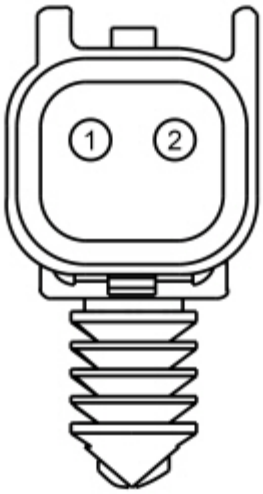
- **Are the resistances less than 3 ohms?**

Yes
GO to J5 .

No
REPAIR the circuit in question.

J5 CHECK THE AUDIO CIRCUITS TO THE RF

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TWEETER SPEAKER FOR A SHORT TOGETHER	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C231-1	VME10 (WH/VT)	C231-2	RME10 (WH/OG) |  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J6. **No** REPAIR the circuit in question.
J6 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test K: The RR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A03:01	Speaker #3: General Electrical Failure	Set by the ACM when a failure is detected on the RR door speaker circuits.
B1A03:11	Speaker #3: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the RR door speaker circuits. When DTC B1A03:11 is set, the speaker output is disabled.
B1A03:12	Speaker #3: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the RR door speaker circuits. When DTC B1A03:12 is set, the speaker output is disabled.
B1A03:13	Speaker #3: Circuit Open	Set by the ACM when an open is detected on the RR door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST K: THE RR DOOR SPEAKER IS INOPERATIVE

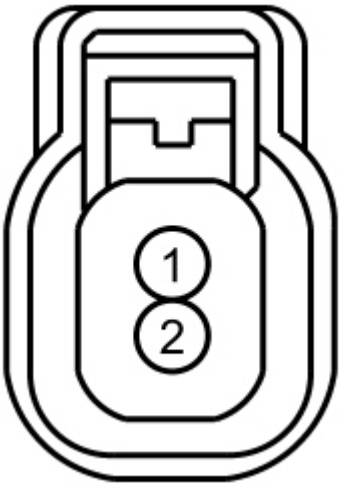
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>K1 CHECK THE AUDIO SIGNAL TO THE RR DOOR SPEAKER

• Ignition OFF.
• Disconnect: RR Door Speaker C802 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C802-1</td><td>VME12 (BN/WH)</td><td>C802-2</td><td>RME12 (BN/BU)</td></tr>
</table>
</td><td>Yes
INSTALL a new RR door speaker. REFER to Speaker — Door .

No
GO to K2 .</td></tr>
</table>

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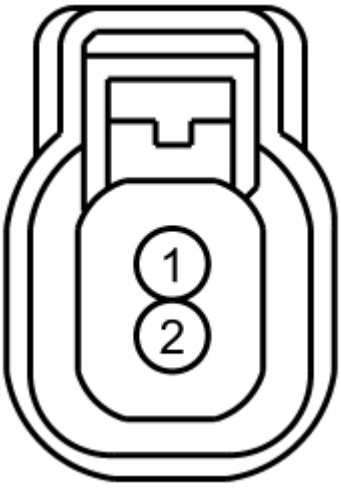


- **Is a fluctuating AC voltage present?**

K2 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

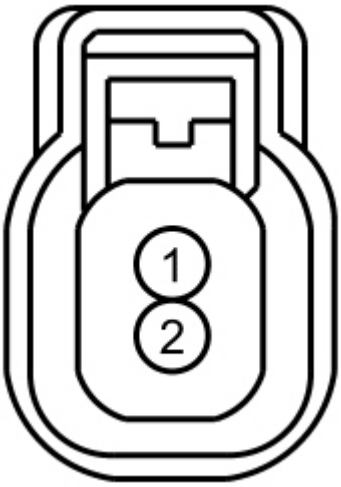
No
GO to K3 .

K3 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to K4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground



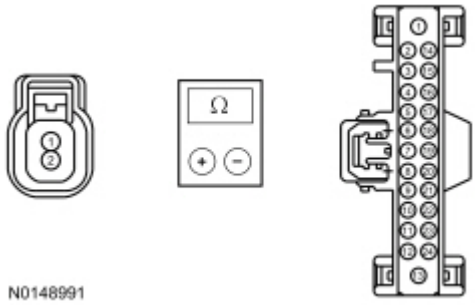
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

K4 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C240A-24	VME12 (BN/WH)
C802-2	RME12 (BN/BU)	C240A-12	RME12 (BN/BU)



- **Are the resistances less than 3 ohms?**

Yes
GO to K5 .

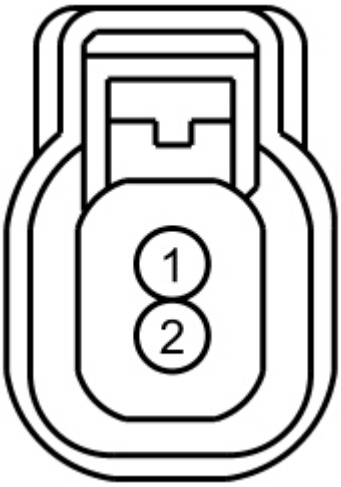
No
REPAIR the circuit in question.

K5 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TOGETHER

repair4less

<table>
<tr>
<td>

Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C802-1</td><td>VME12 (BN/WH)</td><td>C802-2</td><td>RME12 (BN/BU)</td></tr>
</table>


Are the resistances greater than 10,000 ohms?

</td>
<td>Yes
GO to K6 .

No
REPAIR the circuit in question.</td>
</tr>
<tr>
<td>K6 CHECK FOR CORRECT ACM OPERATION

Ignition OFF.
Disconnect and inspect all the ACM connectors.
Repair:

Corrosion (clean module pins or install new connectors or terminals)
Damaged or bent pins (install new terminals or pins)
Pushed-out pins (install new pins as necessary)

Reconnect the ACM connectors. Make sure they seat and latch correctly.
Operate the system and determine if the concern is still present.
Is the concern still present?

</td>
<td>Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.</td>
</tr>
</table>

Pinpoint Test L: The LR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A04:01	Speaker #4: General Electrical Failure	Set by the ACM when a failure is detected on the LR door speaker circuits.
B1A04:11	Speaker #4: Circuit Short to Ground	Set by the ACM when a short to ground is detected on the LR door speaker circuits. When DTC B1A04:11 is set, the speaker output is disabled.
B1A04:12	Speaker #4: Circuit Short to Battery	Set by the ACM when a short to battery is detected on the LR door speaker circuits. When DTC B1A04:12 is set, the speaker output is disabled.
B1A04:13	Speaker #4: Circuit Open	Set by the ACM when an open is detected on the LR door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM

PINPOINT TEST L: THE LR DOOR SPEAKER IS INOPERATIVE

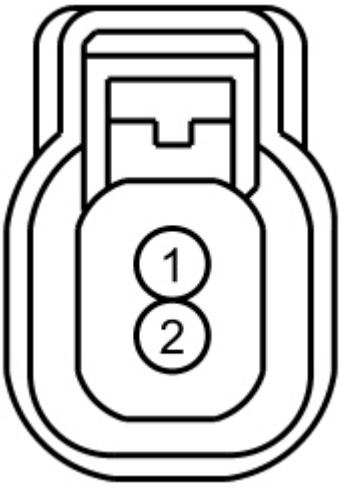
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>L1 CHECK THE AUDIO SIGNAL TO THE LR DOOR SPEAKER

• Ignition OFF.
• Disconnect: LR Door Speaker C702 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C702-1</td><td>VME09 (WH/GN)</td><td>C702-2</td><td>RME09 (BN/YE)</td></tr></table></td><td>Yes
INSTALL a new LR door speaker. REFER to Speaker — Door .

No
GO to L2 .</td></tr>
</table>

repair4less

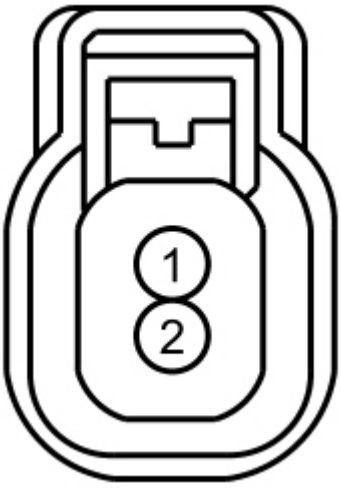


- **Is a fluctuating AC voltage present?**

L2 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

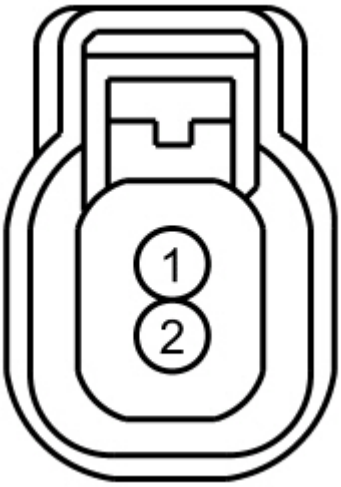
No
GO to L3 .

L3 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to L4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



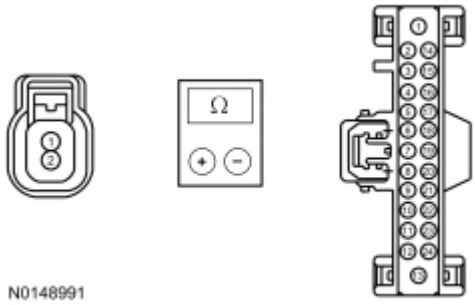
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

L4 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C240A-21	VME09 (WH/GN)
C702-2	RME09 (BN/YE)	C240A-9	RME09 (BN/YE)



- **Are the resistances less than 3 ohms?**

Yes
GO to L5 .

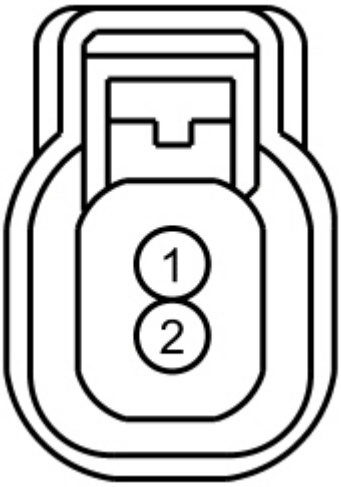
No
REPAIR the circuit in question.

L5 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TOGETHER

repair4less

<table>
<tr>
<td>

Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C702-1</td><td>VME09 (WH/GN)</td><td>C702-2</td><td>RME09 (BN/YE)</td></tr>
</table>


Are the resistances greater than 10,000 ohms?

</td>
<td>Yes
GO to L6 .

No
REPAIR the circuit in question.</td>
</tr>
<tr>
<td>L6 CHECK FOR CORRECT ACM OPERATION</td>
<td></td>
</tr>
<tr>
<td>

Ignition OFF.
Disconnect and inspect all the ACM connectors.
Repair:

Corrosion (clean module pins or install new connectors or terminals)
Damaged or bent pins (install new terminals or pins)
Pushed-out pins (install new pins as necessary)

Reconnect the ACM connectors. Make sure they seat and latch correctly.
Operate the system and determine if the concern is still present.
Is the concern still present?

</td>
<td>Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.</td>
</tr>
</table>

Pinpoint Test M: Poor Quality, Distorted, Or No Sound While In SYNC® Mode

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System in Information and Entertainment System .

The APIM transmits left and right channel analog audio signals to the ACM . These signals include inputs from the USB port, the SD card slot, the RCA jacks, and a Bluetooth media device. If a USB mass storage device is used to play an audio file, the SYNC® system only plays audio files that do not have DRM protection.

Possible Sources

- Customer's device
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST M: POOR QUALITY, DISTORTED, OR NO SOUND WHILE IN SYNC® MODE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>M1 VERIFY THE OPERATION OF THE SYNC® SYSTEM AUDIO SOURCES</td><td></td></tr>
<tr><td>• Connect: Multi-Media Interface Tester 105-00120.
• Using the Multi-Media Interface Tester 105-00120 and RCA Adapter 105-00121, test the audio output for the RCA jacks, USB ports, and Bluetooth.
• Is there poor quality, distorted, or no sound from all SYNC® audio sources?</td><td>Yes
GO to M2 .

No
If there is a concern with one or more, but not all audio sources, GO to Symptom Chart - SYNC® System to diagnose the observed symptom.

If all audio sources operate correctly, the concern is with the customer's device.</td></tr>
<tr><td>M2 CHECK THE AUDIO SIGNALS TO THE ACM</td><td></td></tr>
<tr><td>NOTICE: This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.
• Operate the audio system in SYNC® mode and play an audio file.
• Measure the AC voltage by back-probing ACM connector C240B:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C240B-12</td><td>VME52 (BU)</td><td>C240B-25</td><td>RME52 (GY/OG)</td></tr></table></td><td>Yes
GO to M7 .

No
GO to M3 .</td></tr>
</table>

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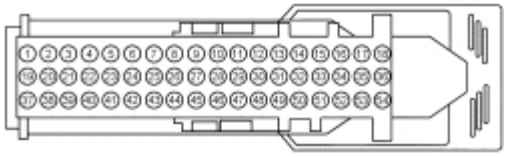
C240B-13	VME53 (VT/GN)	C240B-26	RME53 (BN/WH)

- **Is a fluctuating AC voltage present?**

M3 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240B .
- Disconnect: APIM C2383 .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME52 (BU)	—	Ground
C2383-24	RME52 (GY/OG)	—	Ground
C2383-25	VME53 (VT/GN)	—	Ground
C2383-26	RME53 (BN/WH)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to M4 .

M4 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO GROUND

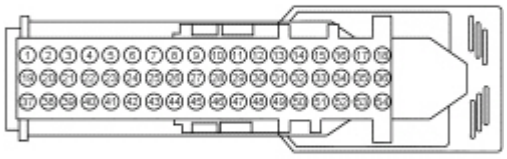
- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME52 (BU)	—	Ground
C2383-24	RME52 (GY/OG)	—	Ground
C2383-25	VME53 (VT/GN)	—	Ground

Yes
GO to M5 .

No
REPAIR the circuit in question.

C2383-26	RME53 (BN/WH)	—	Ground

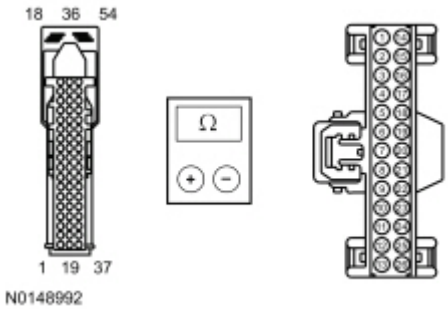


- **Are the resistances greater than 10,000 ohms?**

M5 CHECK THE CIRCUITS TO THE ACM FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME52 (BU)	C240B-12	VME52 (BU)
C2383-24	RME52 (GY/OG)	C240B-25	RME52 (GY/OG)
C2383-25	VME53 (VT/GN)	C240B-13	VME53 (VT/GN)
C2383-26	RME53 (BN/WH)	C240B-26	RME53 (BN/WH)



- **Are the resistances less than 3 ohms?**

Yes
GO to M6 .

No
REPAIR the circuit in question.

M6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.

Yes

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• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

M7 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test N: The SYNC® System Audible Prompts Are Inoperative Or Do Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System and Voice Recognition in Information and Entertainment System .

Possible Sources

- Customer's setting
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST N: THE SYNC® SYSTEM AUDIBLE PROMPTS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

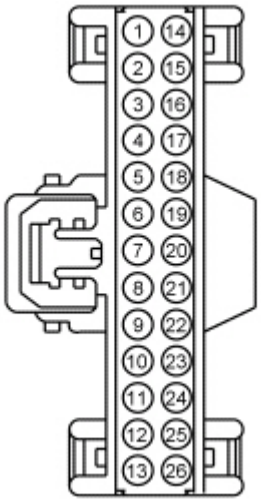
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>N1 CHECK THE AUDIBLE PROMPT SETTING
• Operate the audio system in SYNC® mode.
• Verify the audible prompts are enabled. Refer to "SYNC® Voice Recognition Feature" in the Owner's Literature.
• Operate the VOICE button on the steering wheel controls and observe the SYNC® audible prompt.
• Does the SYNC® system produce an audible prompt correctly?</td><td>Yes
The system is operating correctly at this time. The concern was caused by the customer's setting. INSTRUCT the customer in the correct operation of the audible prompt feature.

No
GO to N2 .</td></tr>
<tr><td>N2 CHECK FOR A VOLTAGE SIGNAL FROM THE APIM
NOTICE: This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.
• Operate the audio system in SYNC® mode.
• While operating the VOICE button repeatedly, measure the AC voltage by back-probing ACM connector C240B:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C240B-8</td><td>VMN14 (WH/VT)</td><td>C240B-21</td><td>RMN14 (GY/BN)</td></tr></table>• Is a fluctuating AC voltage present each time the VOICE switch is operated?</td><td>Yes
GO to N7 .

No
GO to N3 .</td></tr>
<tr><td>N3 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO VOLTAGE
• Ignition OFF.
• Disconnect: ACM C240B .
• Disconnect: APIM C2383 .
• Ignition ON.
• Measure the voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C240B-8</td><td>VMN14 (WH/VT)</td><td>—</td><td>Ground</td></tr><tr><td>C240B-21</td><td>RMN14 (GY/BN)</td><td>—</td><td>Ground</td></tr></table></td><td>Yes
REPAIR the circuit in question.

No
GO to N4 .</td></tr>
</table>

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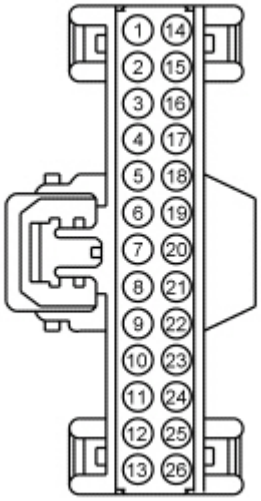


- **Is any voltage present?**

N4 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-8	VMN14 (WH/VT)	—	Ground
C240B-21	RMN14 (GY/BN)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to N5 .

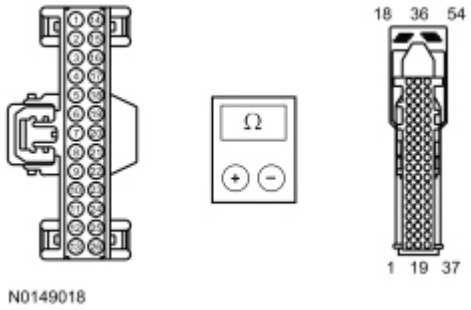
No
REPAIR the circuit in question.

N5 CHECK THE AUDIBLE PROMPT CIRCUITS FOR AN OPEN

- Measure the **resistance** between:

Yes
GO to N6 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-8	VMN14 (WH/VT)	C2383-3	VMN14 (WH/VT)
C240B-21	RMN14 (GY/BN)	C2383-4	RMN14 (GY/BN)



- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

N6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

N7 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the ACM connectors. Make sure they seat and latch correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any

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	connector or pin issues.

Pinpoint Test O: All SYNC® Services Features Are Inoperative Or Inaccurate

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® Services in Information and Entertainment System .

Possible Sources

- Expired subscription
- APIM
- GPSM
- SYNC® Services server

PINPOINT TEST O: ALL SYNC® SERVICES FEATURES ARE INOPERATIVE OR INACCURATE

Test Step	Result / Action to Take
O1 VERIFY THE CUSTOMER'S SYNC® OWNER ACCOUNT AND SYNC® SERVICES REGISTRATION AND SUBSCRIPTION	
• Verify that the customer has a SYNC® Owner Account on SyncMyRide • Verify that the customer has registered for SYNC® Services and has an active subscription. • **Does the customer have a SYNC® Owner Account and an active SYNC® Services subscription?**	**Yes** GO to O2 . **No** If the customer does not have a SYNC® Owner Account, INFORM the customer that an account must be created in order to sign up for SYNC® Services. REFER to SyncMyRide . If the customer does not have an active SYNC® Services subscription, INFORM the customer that in order for SYNC® Services to function, the subscription needs to be activated. REFER to SyncMyRide .
O2 VERIFY THE CUSTOMER'S REGISTERED PHONE NUMBER AND STATUS	
• Verify that the mobile phone being used has the correct phone number registered with SYNC® Services. • Verify that the mobile phone being used is selected as "Active" on SyncMyRide . • **Is the customer using the registered and active mobile phone associated with the**	**Yes** GO to O3 . **No** INFORM the customer that the correct phone number must be registered on the SYNC® website and selected as "Active." REFER to SyncMyRide .

SYNC® services account?	
O3 CHECK FOR APIM DTCs	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Are any DTCs recorded in the APIM ?**	**Yes** REFER to the APIM DTC Chart in Information and Entertainment System . **No** GO to O4 .
O4 CHECK FOR GPSM DTCs	
• Using a diagnostic scan tool, perform the GPSM self-test. • **Are any DTCs recorded in the GPSM ?**	**Yes** REFER to the GPSM DTC Chart in Information and Entertainment System . **No** GO to O5 .
O5 VERIFY THE CUSTOMER'S PHONE CONNECTION TO SYNC® SERVICES	
• Advise the customer to connect their phone to SYNC® Services. Caller ID blocking must be disabled on the customer's phone. Refer to the Owner's Literature. • Operate a SYNC® Services feature. • Verify that the phone call is placed and that the phone is connected to SYNC® Services. • **Does the phone connect to SYNC® Services and operate correctly?**	**Yes** GO to O6 . **No** GO to Pinpoint Test S .
O6 OBSERVE THE SYNC® SERVICES SUBSCRIPTION COMMERCIAL	
• Once the customer's phone is connected to SYNC® Services, observe the subscription commercial. • **Does the SYNC® Services subscription commercial repeat with no selection option?**	**Yes** There is a potential SYNC® Services server issue, and the problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance. **No** GO to O7 .
O7 CHECK THE OPERATION OF THE DIRECTIONS FROM SYNC® SERVICES	
• When prompted, select directions from SYNC® Services and observe the audible prompts from the audio system. • **Is a single chime, audible prompt, then a short chime**	**Yes** SYNC® Services is operating correctly at this time. **No** If a single chime, audible prompt, then a repeating chime is heard, indicating the navigation route is being sent to the vehicle, GO to O8 . If no chime or audible prompt is heard,

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heard, indicating the navigation route is being sent to the vehicle?	indicating that the system was unable to locate the vehicle, there is a potential SYNC® Services server issue. The problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance.

O8 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test P: Voice Recognition Is Inoperative Or Does Not Operate Correctly, Or During A Phone Call, Poor Quality Or No Outgoing Audio Is Heard On The Outside Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Voice Recognition in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B116A:01	Handset Microphone: General Electrical Failure	Set by the APIM when a short to voltage, short to ground, or open is detected on the microphone circuits.

Possible Sources

- Insufficiently quiet vehicle
- Inadequate phone reception

- Wiring, terminals, or connectors
- Microphone
- APIM

PINPOINT TEST P: VOICE RECOGNITION IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY, OR DURING A PHONE CALL, POOR QUALITY OR NO OUTGOING AUDIO IS HEARD ON THE OUTSIDE DEVICE

Test Step	Result / Action to Take
P1 CHECK THE AUDIBLE PROMPT FUNCTIONALITY • Operate the audio system in radio tuner AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **Does the SYNC® system produce an audible prompt correctly, indicating voice recognition mode has been entered?**	**Yes** GO to P3 . **No** GO to P2 .
P2 CHECK THE OPERATION OF THE RH STEERING WHEEL SWITCHES • Operate the audio system in AM/FM mode. • Operate the VOLUME +/-, SEEK +/-, MEDIA, and PHONE steering wheel switches. • **Do the VOLUME +/-, SEEK +/-, MEDIA, and PHONE steering wheel switches operate correctly?**	**Yes** GO to Pinpoint Test N . **No** GO to Pinpoint Test V to diagnose the RH steering wheel switches.
P3 CHECK THE OPERATION OF THE "PHONE" VOICE COMMAND • Pair a Bluetooth phone with the SYNC® system. For information on the pairing process, refer to the Owner's Literature. If necessary, review the device compatibility list found on syncmyride.com . • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the system from correctly recognizing spoken commands. • Clearly speak the word "phone." • **Does the SYNC® system respond correctly to the "phone" voice command?**	**Yes** For a concern with the voice recognition being inoperative or not operating correctly, the system is operating correctly at this time. The concern may have been caused by an insufficiently quiet vehicle. Delete the just-paired Bluetooth phone from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. For a concern with poor quality or no outgoing audio being heard on the outside device during a phone call, GO to P4 **No** GO to P5 .
P4 CHECK THE OUTGOING PHONE CALL QUALITY AND VOICE VOLUME • Ensure that the Bluetooth phone paired in step 3 has adequate reception. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the	**Yes** The system is operating correctly at this time. The concern may have been caused by poor phone reception or an insufficiently quiet vehicle.

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call from having clear call quality and acceptable voice volume.
- Using the SYNC® system, place a phone call. For information on making calls from the SYNC® system, refer to the Owner's Literature.
- Ensure that the called party's phone has adequate reception.
- Instruct the called party to determine if the call quality is clear and of acceptable volume.
- Delete the Bluetooth phone paired in step 3 from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature.
- **Is the outgoing call quality clear and of acceptable volume?**

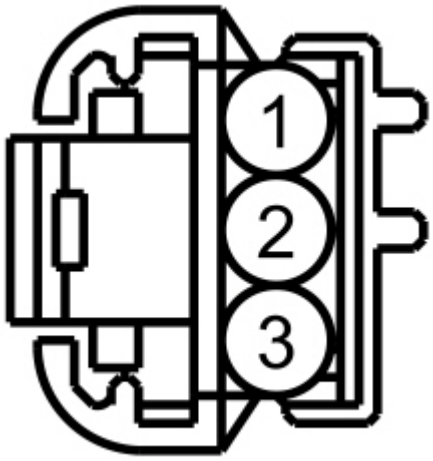
No
GO to P5 .

P5 CHECK THE MICROPHONE AND MICROPHONE CIRCUITS FOR CORRECT VOLTAGE DROP

NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

- Ignition ON.
- While back-probing microphone C9221, measure and record the **DC voltage** .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)



- **Is the voltage between 2.7 and 6.2 volts?**

Yes
If diagnosing an intermittent concern, GO to P6 . If **not** diagnosing an intermittent concern, GO to P13

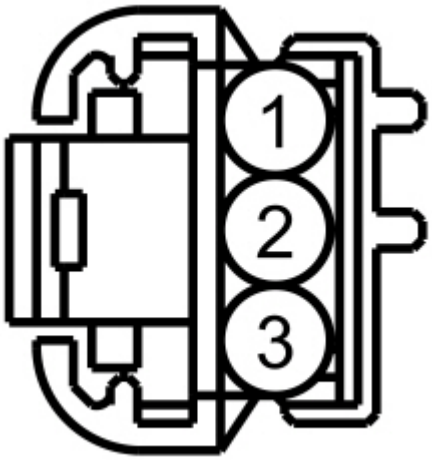
No
GO to P7 .

P6 CHECK THE MICROPHONE CIRCUITS FOR INTERMITTENT CONCERNS

NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

- While back-probing microphone C9221, measure the **DC voltage** while agitating the microphone harness back and forth and up and down (wiggle testing).

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)



- Review the recorded results from step 5.
- **Does the voltage fluctuate more than .5 volts from the recorded result in step 5?**

Yes
REPAIR the circuit(s), connector, or terminal(s) in question. For corrosion, clean pins or install a new connector or terminals. For damaged or bent pins, install new terminals or pins.

No
GO to P12 .

P7 CHECK THE MICROPHONE CIRCUITS FOR CORRECT VOLTAGE

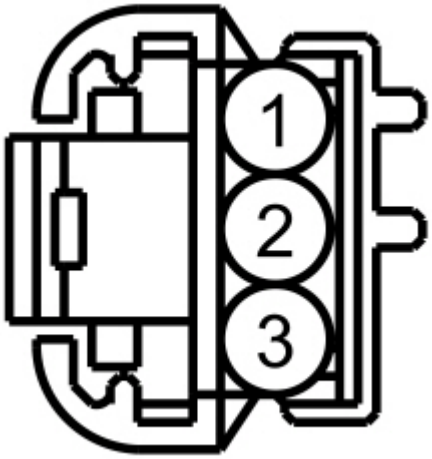
- Ignition OFF.
- Disconnect: Microphone C9221.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)

Yes
GO to P12 .

No
GO to P8 .

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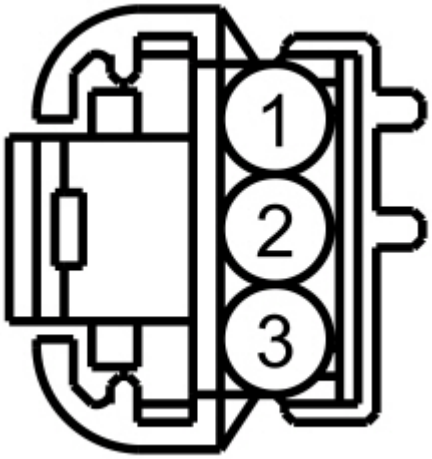


- **Is the voltage between 7.9 and 9.0 volts?**

P8 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



- **Is any voltage present?**

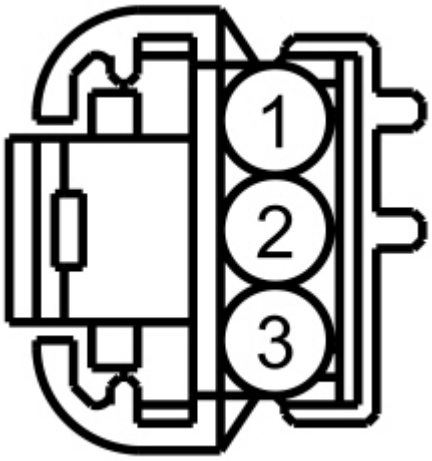
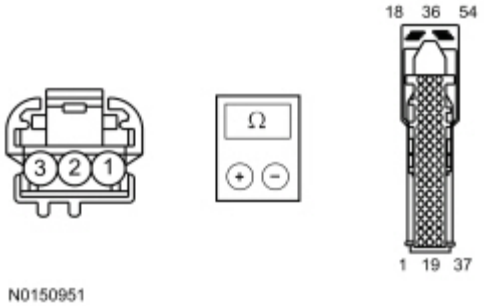
Yes
REPAIR the circuit in question.

No
GO to P9 .

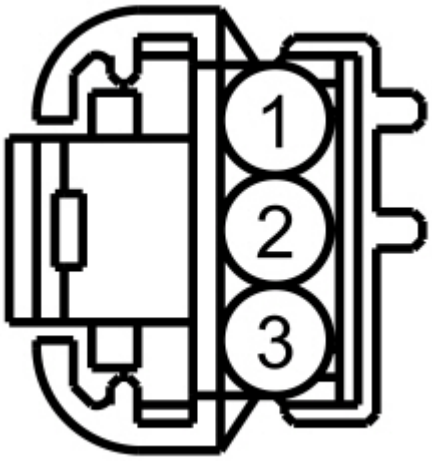
P9 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO GROUND

- Ignition OFF.

Yes

• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground |  • **Are the resistances greater than 10,000 ohms?**	GO to P10 . **No** REPAIR the circuit in question.
P10 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR AN OPEN • Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C2383-12	VMM13 (YE/GN)
C9221-3	DMM13 (BK)	C2383-13	DMM13 (BK) |  • **Are the resistances less than 3 ohms?**	**Yes** GO to P11 . **No** REPAIR the circuit in question.
P11 CHECK THE MICROPHONE CIRCUITS TO THE	

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APIM FOR A SHORT TOGETHER • Measure the **resistance** between: <table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C9221-2</td><td>VMM13 (YE/GN)</td><td>C9221-3</td><td>DMM13 (BK)</td></tr></table> • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P13 . **No** REPAIR the circuit in question.
P12 ISOLATE THE MICROPHONE • Install a new microphone. Refer to Microphone . • If necessary, connect: APIM C2383. • Operate the audio system in AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • Speak a command to test the voice recognition for normal operation. • **Is the voice recognition functioning correctly?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative microphone. **No** GO to P13 .

P13 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Q: All Media Hub Functions Are Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub, Composite Audio-Video Input Mode, SD Card Mode, and USB Mode in Information and Entertainment System .

The media hub requires a power and ground circuit from the APIM to operate. Loss of power or ground disables all media hub functionality.

Possible Sources

- Device conflict
- Wiring, terminals, or connectors
- Media hub
- APIM

PINPOINT TEST Q: ALL MEDIA HUB FUNCTIONS ARE INOPERATIVE

NOTE: Before carrying out this pinpoint test, make sure the MP3 device is operating correctly.

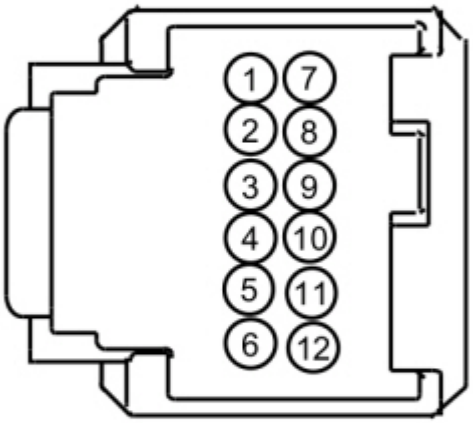
Test Step	Result / Action to Take
Q1 CHECK FOR APIM BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the APIM self-test. • **Are any low or high voltage DTCs recorded in the APIM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AJ . For DTC U3003:17, GO to Pinpoint Test ak . **No** GO to Q2 .
Q2 RESET THE APIM	
• Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Test the system for normal operation. • **Does the system operate correctly?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to Q3 .
Q3 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT	
• Ignition OFF. • Disconnect: Media Hub C3618.	**Yes** GO to Q4 .

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- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	—	Ground

No
GO to Q5 .



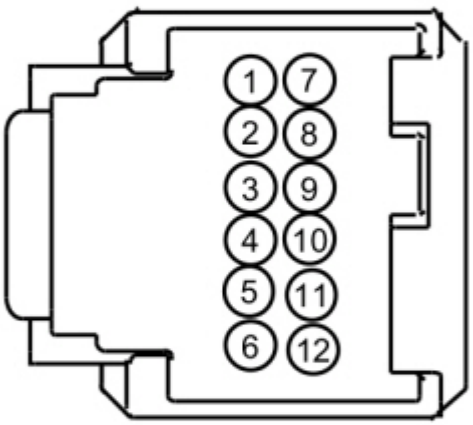
- **Is the voltage greater than 11 volts?**

Q4 CHECK THE MEDIA HUB GROUND CIRCUIT	
• Measure the **voltage** between: Positive Lead / Negative Lead	**Yes** Install a new media hub. Media Hub

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Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	C3618-10	RME89 (WH/BU)

No
GO to Q5 .



- **Is the voltage greater than 11 volts?**

Q5 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT AND GROUND CIRCUIT FOR A SHORT TOGETHER	
• Ignition OFF.	**Yes**

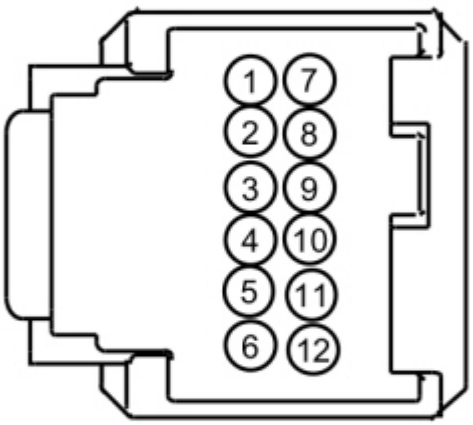
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- Disconnect: APIM C2383.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	C3618-10	RME89 (WH/BU)

GO to Q6 .

No
Repair the circuit in question.

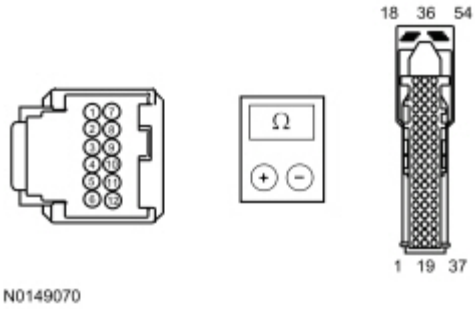


- **Is the resistance greater than 10,000 ohms?**

Q6 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT AND GROUND CIRCUIT FOR AN OPEN	
• Measure the **resistance** between:	**Yes**

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	C2383-8	LME89 (YE/BU)
C3618-10	RME89 (WH/BU)	C2383-38	RME89 (WH/BU)



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- **Are the resistances less than 3 ohms?**

GO to Q7 .

No
Repair the circuit in question.

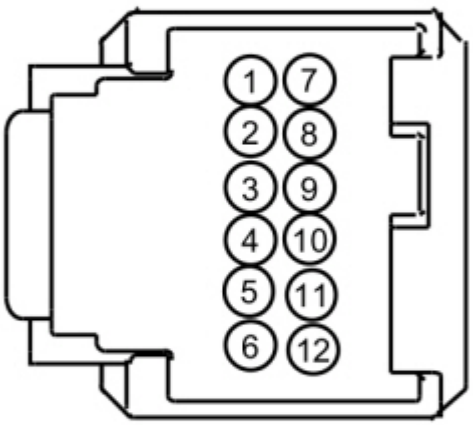
Q7 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	—	Ground

Yes
GO to Q8 .

No
REPAIR the circuit.



- **Is the resistance greater than 10,000 ohms?**

Q8 CHECK THE MEDIA HUB GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON.	**Yes**

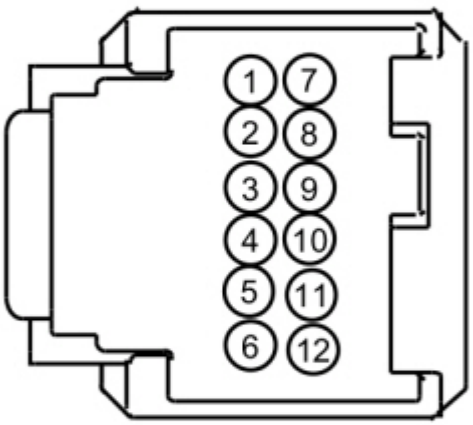
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- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-10	RME89 (WH/BU)	—	Ground

REPAIR the circuit.

No
GO to Q9 .



- **Is any voltage present?**

Q9 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect and inspect the APIM connector. • Repair:	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE

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▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test R: The USB Port(s) Is/Are Inoperative Or Do/Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub and USB Mode in Information and Entertainment System .

Although there are two USB ports, there is only one USB cable connecting the media hub to the APIM . The USB cable is used for data transfer, and does not supply power. The Multi-Media Interface Tester 105-00120 is powered by the USB port.

USB and SD card data is transmitted to the APIM through the USB cable.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1252:11	USB Port: Circuit Short to Ground	Set by the APIM when a short to ground or over-current condition is detected in the USB cable. This can be caused by a fault in the USB cable, USB port, or customer's USB or SD card device.
B1252:13	USB Port: Circuit Open	Set by the APIM when an open is detected in the USB cable.

Possible Sources

- Device conflict
- USB cable
- Media hub
- APIM

PINPOINT TEST R: THE USB PORT(S) IS/ARE INOPERATIVE OR DO/DOES NOT OPERATE

CORRECTLY

Test Step	Result / Action to Take
R1 CHECK THE USB PORT FOR POWER OUTPUT • Connect: Multi-Media Interface Tester 105-00120. • **Does the Multi-Media Interface Tester 105-00120 power on from both USB ports?**	**Yes** GO to R2. **No** If the Multi-Media Interface Tester 105-00120 powers on from only one USB port, INSTALL a new media hub. REFER to Media Hub. If the Multi-Media Interface Tester 105-00120 does not power on from either USB port, GO to Pinpoint Test Q.
R2 RESET THE APIM • Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** If the audio output is not OK from one USB port, INSTALL a new media hub. REFER to Media Hub. If the audio output is not OK from both USB ports, GO to R3.
R3 CHECK THE SD CARD SLOT FUNCTIONALITY • Using a known good SD card, attempt to play an audio file using the SD card slot. • **Is the audio output OK for the SD card slot?**	**Yes** INSTALL a new media hub. REFER to Media Hub. **No** GO to R4.
R4 CHECK THE APIM FOR DTC B1252:11 OR DTC B1252:13 • Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:11 or DTC B1252:13 present?**	**Yes** GO to R5. **No** GO to R7.
R5 INSPECT THE USB CABLE, MEDIA HUB, AND APIM • Ignition OFF. • Disconnect: USB cable at the media hub. • Disconnect: USB cable at the APIM. • Inspect the USB cable ends, media hub USB connector	**Yes** For the USB cable, INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port. For the media hub, INSTALL a new media hub. REFER to Media Hub. For the APIM, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

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port, and APIM USB connector port for damage. Remove any debris. • **Is any damage present?**	**No** GO to R6 .
R6 CHECK EACH USB PORT FOR FUNCTIONALITY • Connect: USB cable at the media hub. • Connect: USB cable at the APIM . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by the USB connector not being seated correctly. **No** GO to R7 .
R7 ISOLATE THE USB CABLE • INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative USB cable. **No** GO to R8 .

R8 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test S: The SD Card Slot Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub and SD Card Mode in Information and Entertainment System .

SD card data is transmitted to the APIM through the USB cable.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1252:11	USB Port: Circuit Short to Ground	Set by the APIM when a short to ground or over-current condition is detected in the USB cable. This can be caused by a fault in the USB cable, USB port, or customer's USB or SD card device.
B1252:13	USB Port: Circuit Open	Set by the APIM when an open is detected in the USB cable.

Possible Sources

- Device conflict
- USB cable
- Media hub
- APIM

PINPOINT TEST S: THE SD CARD SLOT IS INOPERATIVE

Test Step	Result / Action to Take
S1 RESET THE APIM	
• Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Using a known good SD card, attempt to play an audio file using the SD card slot. • **Is the audio output OK for the SD card slot?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to S2 .
S2 CHECK THE USB PORTS FOR	

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FUNCTIONALITY	
• Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** Install a new media hub. REFER to Media Hub . **No** If the audio output is not OK from one USB port, INSTALL a new media hub. REFER to Media Hub . If the audio output is not OK from both USB ports, GO to S3 .
S3 CHECK THE APIM FOR DTC B1252:11 OR DTC B1252:13	
• Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:11 or DTC B1252:13 present?**	**Yes** GO to S4 . **No** Isolate the USB cable. INSTALL a new USB cable. Universal Serial Bus (USB) Cable and Port . Retest the system for normal operation. If the concern is still present, GO to S6 .
S4 INSPECT USB CABLE, MEDIA HUB, AND APIM	
• Ignition OFF. • Disconnect: USB cable at media hub. • Disconnect: USB cable at APIM . • Inspect the USB cable ends, media hub USB connector port, and APIM USB connector port for damage and remove any debris. • **Is any damage present?**	**Yes** For the USB cable, INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . For the media hub, INSTALL a new media hub. REFER to Media Hub . For the APIM , For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** GO to S5 .
S5 RECHECK FOR APIM DTC B1252:11 OR DTC B1252:13	
• Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:11 or DTC B1252:13 present?**	**Yes** GO to S6 . **No** Isolate the USB cable. INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . Retest the system for normal operation. If the concern is still present, GO to S6 .
S6 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

• Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test T: The RCA Jacks Are Inoperative Or Have Poor Sound Quality

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub and Composite Audio-Video Input Mode in Information and Entertainment System .

The data transmitted through the RCA cables to the media hub is sent to the APIM through dedicated audio and video circuits.

Possible Sources

- Device conflict
- Wiring, terminals, or connectors
- Media hub
- APIM

PINPOINT TEST T: THE RCA JACKS ARE INOPERATIVE OR HAVE POOR SOUND QUALITY

Test Step	Result / Action to Take
T1 RESET THE APIM	
• Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Using the Multi-Media Interface Tester 105-00120 and RCA Adapter 105-00121, attempt to play audio content using the RCA jacks. • **Is the audio output OK for the RCA jacks?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to T2 .
T2 CHECK THE RCA CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF.	**Yes**

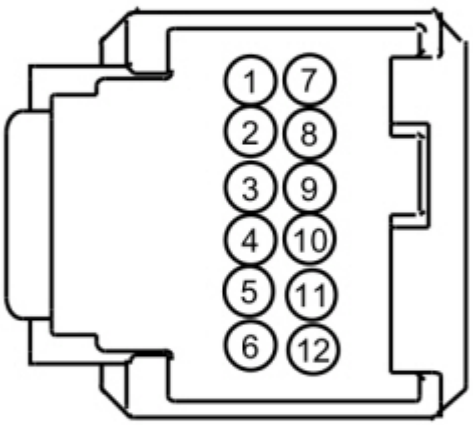
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- Disconnect: Media Hub C3618.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-2	DME88	—	Ground
C2362-3	VME88 (BU/WH)	—	Ground
C2362-4	DME45	—	Ground
C2362-5	VME45 (BU)	—	Ground
C2362-6	RME45 (YE/GN)	—	Ground
C2362-9	RME88 (GN/BU)	—	Ground
C2362-11	VME46 (BU/GN)	—	Ground
C2362-12	RME46 (WH/GN)	—	Ground

REPAIR the circuit in question.

No
GO to T3 .



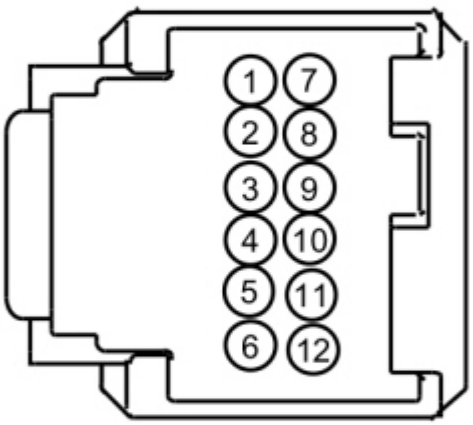
- **Is any voltage present?**

T3 CHECK THE RCA CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the **resistance** between:	**Yes** REPAIR the circuit in question.

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-2	DME88	—	Ground
C2362-3	VME88 (BU/WH)	—	Ground
C2362-4	DME45	—	Ground
C2362-5	VME45 (BU)	—	Ground
C2362-6	RME45 (YE/GN)	—	Ground
C2362-9	RME88 (GN/BU)	—	Ground
C2362-11	VME46 (BU/GN)	—	Ground
C2362-12	RME46 (WH/GN)	—	Ground

No
GO to T4 .

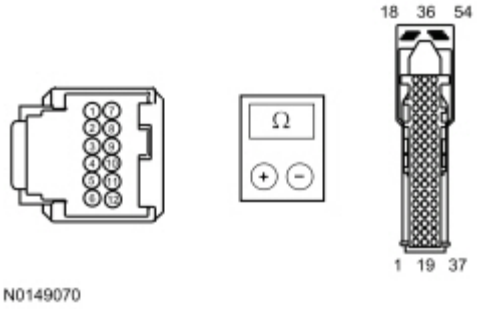


- **Are the resistances greater than 10,000 ohms?**

T4 CHECK THE RCA CIRCUITS FOR AN OPEN	
• Measure the **resistance** between:	**Yes** INSTALL a new media hub. REFER to Media

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-2	DME88	C2383-36	DME88
C2362-3	VME88 (BU/WH)	C2383-34	VME88 (BU/WH)
C2362-4	DME45	C2383-9	DME45
C2362-5	VME45 (BU)	C2383-10	VME45 (BU)
C2362-6	RME45 (YE/GN)	C2383-11	RME45 (YE/GN)
C2362-9	RME88 (GN/BU)	C2383-35	RME88 (GN/BU)
C2362-11	VME46 (BU/GN)	C2383-28	VME46 (BU/GN)
C2362-12	RME46 (WH/GN)	C2383-29	RME46 (WH/GN)



- **Are the resistances less than 3 ohms?**

Hub .

Retest the system for normal operation. If the concern is still present, GO to T5 .

No
REPAIR the circuit in question.

T5 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test U: Unable To Pair Bluetooth Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Bluetooth Mode in Information and Entertainment System .

Possible Sources

- Incompatible Bluetooth device
- Customer error
- Customer's Bluetooth device
- APIM

PINPOINT TEST U: UNABLE TO PAIR BLUETOOTH DEVICE

Test Step	Result / Action to Take
U1 CHECK THE BLUETOOTH CONNECTION **NOTE:** Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, connect to the SYNC® system using Bluetooth. Follow the tool instructions. • Using a diagnostic scan tool, view the APIM PIDs. • Monitor the Bluetooth device paired PID (BT_PAIR) and the Bluetooth device connected PID (BT_CONN). • **Do the PIDs both read "Yes"?**	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature. REVIEW the pairing process with the customer. If the customer's device still does not pair, the fault is with the customer's device. **No** GO to U2 .
U2 CHECK FOR CORRECT APIM OPERATION • Ignition OFF. • Disconnect and inspect the APIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No**

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pins) ■ Pushed-out pins (install new pins as necessary) ● Reconnect the APIM connector. Make sure it seats and latches correctly. ● Wait at least 2 minutes for the APIM to re-initialize. ● Operate the system and determine if the concern is still present. ● **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test V: The RH Steering Wheel Controls Are Inoperative Or Do Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Steering Wheel Switch Functions and Steering Wheel Switches in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1380:09	Steering Wheel Right Switch Pack: Component Failure	Set by the SCCM when the RH steering wheel switch is stuck.
B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	Set by the SCCM when a short to ground is detected in the RH steering wheel switch circuits.
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	Set by the SCCM when a short to voltage is detected in the RH steering wheel switch circuits.

Possible Sources

- Wiring, terminals, or connectors
- Clockspring
- Steering wheel switch
- SCCM

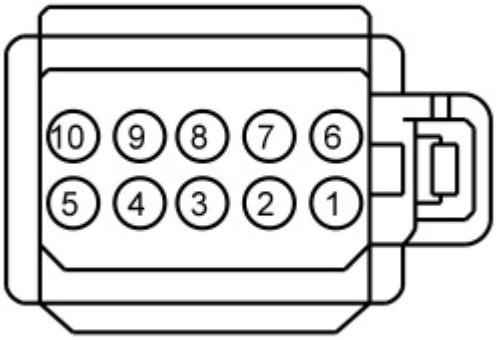
PINPOINT TEST V: THE RH STEERING WHEEL CONTROLS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
V1 CHECK THE RH STEERING WHEEL SWITCH PIDs	

• Ignition ON.
• Monitor the steering wheel controls PIDs while pressing each RH steering wheel switch.
• Using a diagnostic scan tool, view the SCCM PIDs.
  • SW_VOLDOWN
  • SW_VOLUP
  • SW_SEEKMINUS
  • SW_SEEKPLUS
  • SW_VOICE
  • SW_MEDIA
  • SW_PHONE
• **Do the PID values agree with the switch positions?**
	Yes
	GO to V10.
	
	No
	If one or more, but not all PID values are incorrect or always read one particular switch position, INSTALL a new RH steering wheel switch. REFER to Section 211-05. If all PID values are incorrect or always read one particular switch position, GO to V2.

V2 CHECK FOR IPC DTC U0212:00	
• Ignition ON. • Using a diagnostic scan tool, clear the DTCs from the IPC. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the IPC self-test. • **Is DTC U0212:00 set in the IPC ?**	**Yes** REFER to Section 413-01. **No** GO to V3.
V3 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TO GROUND	
WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment. • Ignition OFF. • Disconnect: RH Steering Wheel Switch C2999. • Disconnect: Clockspring C218B. • Measure the **resistance** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit C2999-2 / VME14 / — / Ground C2999-4 / RME14 / — / Ground C2999-6 / VME54 / — / Ground C2999-7 / RME54 / — / Ground	**Yes** GO to V4. **No** INSTALL a new steering wheel. REFER to Section 211-04.

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- **Are the resistances greater than 10,000 ohms?**

V4 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218B-14	VME14
C2999-4	RME14	C218B-6	RME14
C2999-6	VME54	C218B-16	VME54
C2999-7	RME54	C218B-8	RME54



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- **Are the resistances less than 3 ohms?**

Yes
GO to V5 .

No
INSTALL a new steering wheel.
REFER to Section 211-04 .

V5 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TOGETHER

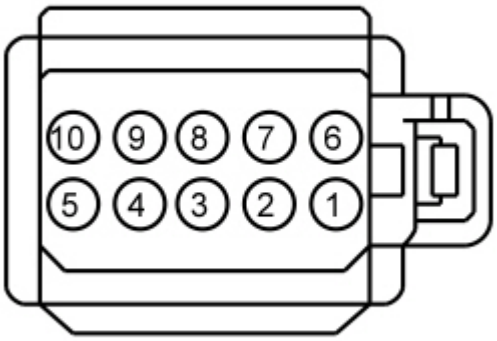
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14

Yes
GO to V6 .

No
INSTALL a new steering wheel.
REFER to Section 211-04 .

C2999-6	VME54	C2999-7	RME54

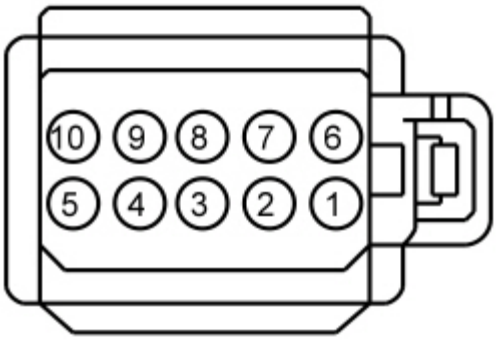


- **Are the resistances greater than 10,000 ohms?**

V6 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND

- Connect: Clockspring C218B.
- Disconnect: Clockspring C218C.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	—	Ground
C2999-4	RME14	—	Ground
C2999-6	VME54	—	Ground
C2999-7	RME54	—	Ground



Yes
GO to V7 .

No
INSTALL a new clockspring.
REFER to Section 501-20B .

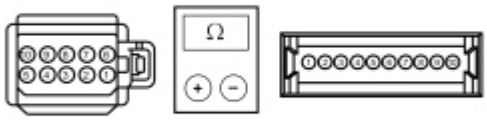
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- **Are the resistances greater than 10,000 ohms?**

V7 CHECK THE CLOCKSPRING FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218C-6	—
C2999-4	RME14	C218C-5	—
C2999-6	VME54	C218C-10	—
C2999-7	RME54	C218C-9	—



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- **Are the resistances less than 3 ohms?**

Yes
GO to V8.

No
INSTALL a new clockspring.
REFER to Section 501-20B.

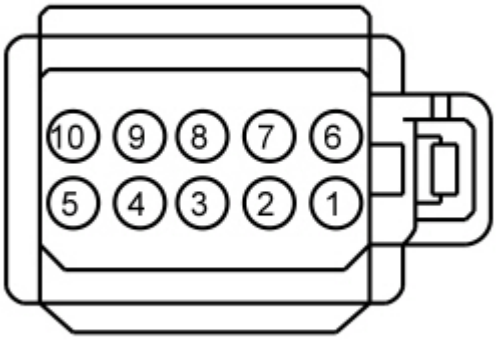
V8 CHECK THE CLOCKSPRING FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
C2999-6	VME54	C2999-7	RME54

Yes
GO to V9.

No
INSTALL a new clockspring.
REFER to Section 501-20B.



- **Are the resistances greater than 10,000 ohms?**

V9 CHECK FOR VOLTAGE AT THE SCCM	
• Ignition ON. • Measure the **voltage** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit C2414D-6 / — / C2414D-5 / — C2414D-10 / — / C2414D-9 / —  • **Is approximately 5 volts present?**	**Yes** INSTALL a new RH steering wheel switch. REFER to Section 211-05 . **No** GO to V10 .
V10 CHECK FOR CORRECT SCCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the SCCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to

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▪ Pushed-out pins (install new pins as necessary) • Reconnect the SCCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	Section 211-05 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test W: The Audio System Does Not Operate Correctly From The FCIM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Accessory Delay Feature, Audio Extended Play, and FCIM in Information and Entertainment System .

Possible Sources

- Network communication concern
- FCIM

PINPOINT TEST W: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FCIM

Test Step	Result / Action to Take
W1 CHECK THE FDIM OPERATION	
• Verify the FDIM screen operation. • **Does the FDIM operate correctly?**	**Yes** GO to W2 . **No** GO to Pinpoint Test X .
W2 VERIFY THAT THE ACM , APIM , AND FCIM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the ACM , APIM , and FCIM pass the network test?**	**Yes** GO to W3 . **No** If the ACM failed the network test, REFER to Section 418-00 The ACM Does Not Respond To The Scan Tool. If the APIM failed the network test, REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool. If the FCIM failed the network test, REFER to Section 418-00 The FCIM Does Not Respond To The Scan Tool.
W3 RESET THE AUDIO	

SYSTEM MODULES AND RECHECK THE FCIM OPERATION • Disconnect the battery for 5 minutes, then reconnect it. • Turn the infotainment system on. • Test the FCIM for normal operation. • **Does the FCIM operate correctly?**	**Yes** The FCIM is operating correctly at this time. The concern was corrected by resetting the audio system modules. **No** GO to W4.

W4 RETRIEVE THE ACM, APIM, AND FCIM DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ ACM
  ◦ APIM
  ◦ FCIM
• **Are any DTCs present in the ACM, APIM, or FCIM?**
	Yes
	For ACM DTCs, REFER to the ACM DTC Chart in Information and Entertainment System For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For FCIM DTCs, REFER to the FCIM DTC Chart in Information and Entertainment System
	
	No
	GO to W5.

W5 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test X: The FDIM Touchscreen Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

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Normal Operation and Fault Conditions

Refer to FDIM in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B108E:01	Display: General Electrical Failure	Set by the APIM when an error is detected in the touch sensing ability of the FDIM .
U0162:00	Lost Communication With Navigation Display Module: No Sub Type Information	Set by the APIM when communication is missing from the FDIM for more than 1 second with the ignition in the RUN position.

Possible Sources

- Network communication concern
- APIM
- FDIM

PINPOINT TEST X: THE FDIM TOUCHSCREEN IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
X1 OBSERVE THE FDIM SCREEN	
• Ignition ON. • Verify the FDIM operation. • **Is the FDIM screen completely inoperative or blank?**	**Yes** GO to X2 . **No** GO to X4 .
X2 VERIFY THAT THE APIM PASSES THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the APIM pass the network test?**	**Yes** GO to X3 . **No** REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool.
X3 CHECK FOR DTC U0162:00 SET IN THE APIM	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Is DTC U0162:00 present?**	**Yes** INSTALL a new FDIM . Front Display Interface Module (FDIM) . **No** GO to X6 .
X4 VERIFY THE TOUCHSCREEN RESPONDS TO TOUCH COMMANDS	
• While pressing each tab of the 4	**Yes**

corners on the FDIM, observe the touchscreen operation. • **Does the FDIM respond correctly when each tab is pressed?**	VERIFY the customer's concern and the steps to reproduce the inoperative state. If the inoperative state is not duplicated, the system is operating correctly at this time. INFORM the customer on the operation of the FDIM display. **No** GO to X5.
X5 ENSURE THE TOUCHSCREEN IS CALIBRATED	
• Calibrate the touchscreen. REFER to Touchscreen Calibration. • Verify the touchscreen operation. • **Does the FDIM touchscreen respond correctly?**	**Yes** The system is operating correctly at this time. The concern was a result of the touchscreen not being calibrated. **No** GO to X6.
X6 CHECK FOR DTC B108E:01 SET IN THE APIM	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Is DTC B108E:01 present?**	**Yes** INSTALL a new FDIM. REFER to Front Display Interface Module (FDIM). **No** GO to X7.
X7 RESET THE APIM AND RECHECK THE SYSTEM OPERATION	
NOTE: Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Turn the infotainment system on. • While pressing each tab of the 4 corners on the FDIM, observe the touchscreen operation. • **Does the touchscreen operate correctly?**	**Yes** The FDIM is operating correctly at this time. PERFORM a SYNC® system Master Reset. REFER to the Owner's Literature. **No** GO to X8.
X8 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

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(install new terminals or pins) ■ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Y: Navigation Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Navigation in Information and Entertainment System .

Removal of the navigation SD card results in the loss of navigation while the card is removed. This is normal operation.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1215:00	External Memory Card: No Sub Type Information	Set by the APIM when the navigation SD card is missing.

Possible Sources

- Navigation map SD card not present, not fully seated, or damaged
- Communications network concern
- GPSM

PINPOINT TEST Y: NAVIGATION IS INOPERATIVE

Test Step	Result / Action to Take
Y1 CHECK THE NAVIGATION SYSTEM OPERATION	
• Verify the navigation system operation. • **Does the FDIM display "SD CARD FAULT?"**	**Yes** GO to Y2 . **No** GO to Y4 .

Y2 VERIFY THE NAVIGATION MAP SD CARD IS PRESENT	
• Check for the presence of a navigation map SD card in the media hub SD slot. • **Is the navigation map SD card present and fully seated?**	**Yes** GO to Y3 . **No** INSTALL the navigation map SD card. TEST the system for normal operation.
Y3 INSPECT THE NAVIGATION MAP SD CARD	
• Remove the navigation map SD card. • Inspect the navigation map SD card for damage. • **Is any damage present?**	**Yes** INSTALL a new navigation map SD card. **No** GO to Y4 .
Y4 CHECK FOR DIAGNOSTIC SCAN TOOL COMMUNICATION WITH THE GPSM	
• Ignition ON. • Using a diagnostic scan tool, perform the network test. • **Does the diagnostic scan tool communicate with the GPSM ?**	**Yes** GO to Y5 . **No** REFER to Section 418-00 The GPSM Does Not Respond To The Scan Tool.
Y5 RETRIEVE THE DTCS FROM THE APIM AND GPSM	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ APIM
  ◦ GPSM
• **Are any DTCs present in the APIM or GPSM ?**
	Yes
	For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For GPSM DTCs, REFER to the GPSM DTC Chart in Information and Entertainment System
	
	No
	GO to Y6 .

Y6 CHECK FOR CORRECT GPSM OPERATION	

• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ◦ Corrosion (clean module pins or install new connectors or terminals)
  ◦ Damaged or bent pins (install new terminals or pins)
  ◦ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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• **Is the concern still present?**	

Pinpoint Test Z: The Compass Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Possible Sources

- Network communication concern
- APIM
- GPSM

PINPOINT TEST Z: THE COMPASS IS INOPERATIVE

Test Step	Result / Action to Take
Z1 VERIFY THAT THE APIM AND GPSM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the APIM and GPSM pass the network test?**	**Yes** GO to Z2 . **No** If the APIM failed the network test, REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool. If the GPSM failed the network test, REFER to Section 418-00 The GPSM Does Not Respond To The Scan Tool.
Z2 RETRIEVE THE APIM AND GPSM DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ APIM
  ◦ GPSM
• **Are any DTCs present in the APIM or GPSM ?**
	Yes
	For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For GPSM DTCs, REFER to the GPSM DTC Chart in Information and Entertainment System
	
	No
	GO to Z3 .

Z3 CHECK FOR CORRECT GPSM OPERATION	

• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
	Yes
	CHECK OASIS for any applicable TSBs. If a TSBTSB exists for this concern, DISCONTINUE this test and FOLLOW TSBTSB instructions. If no TSBs address this concern, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

▪ Pushed-out pins (install new pins as necessary) • Reconnect the GPSM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test AA: DTC U0100:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	Set by the GPSM when network messages are missing from the PCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AA: DTC U0100:00

Test Step	Result / Action to Take
AA1 VERIFY THE CUSTOMER'S CONCERN	
• **NOTE:** Confirm that the tire size is correct as indicated on the vehicle placard. Incorrect tire size will affect navigation system accuracy. • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AA2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AA2 RECHECK FOR DTC U0100:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs.	**Yes** GO to AA3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

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• **Is DTC U0100:00 set in the GPSM ?**	
AA3 CHECK THE PCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the PCM self-test. • **Are any low or high voltage DTCs recorded in the PCM ?**	**Yes** REFER to PCM DTC Chart in Section 303-14 . **No** GO to AA4 .
AA4 CHECK THE GPSM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the GPSM self-test. • **Are any low or high voltage DTCs recorded in the GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AJ . For DTC U3003:17, GO to Pinpoint Test ak . **No** GO to AA5 .
AA5 CHECK FOR CORRECT PCM OPERATION • Ignition OFF. • Disconnect and inspect all the PCM connectors. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the PCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new PCM . REFER to Section 303-14 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AB: DTC U0140:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	Set by the APIM and GPSM when network messages are missing from the BCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AB: DTC U0140:00

Test Step	Result / Action to Take
AB1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AB2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB2 RECHECK FOR DTC U0140:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0140:00 set in the APIM or GPSM ?**	**Yes** GO to AB3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB3 CHECK THE BCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the BCM self-test. • **Are any low or high voltage DTCs recorded in the BCM ?**	**Yes** REFER to BCM DTC Chart in Section 419-10 . **No** GO to AB4 .

AB4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ APIM
  ▪ GPSM
• **Are low or high voltage DTCs recorded in the APIM or GPSM ?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AJ . For DTC U3003:17, GO to Pinpoint Test ak .
	
	No
	GO to AB5 .

AB5 CHECK FOR DTC U0140:00 SET IN MULTIPLE MODULES • Review the recorded results from the self-test. • **Is DTC U0140:00 set in more than one audio system module?**	**Yes** GO to AB6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly

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	at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AB6 CHECK FOR CORRECT BCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the BCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AC: DTC U0151:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	Set by the APIM when the airbag deployment notification message from the RCM is missing for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AC: DTC U0151:00

Test Step	Result / Action to Take
AC1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present.	**Yes** GO to AC2 .

• **Is an observable symptom present?**	**No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC2 RECHECK FOR DTC U0151:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0151:00 set in the APIM ?**	**Yes** GO to AC3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC3 CHECK THE RCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the RCM self-test. • **Are any low or high voltage DTCs recorded in the RCM ?**	**Yes** For DTC U3003:16, REFER to RCM DTC Chart in Section 501-20B . For DTC U3003:16, REFER to RCM DTC Chart in Section 501-20B . **No** GO to AC4 .
AC4 CHECK THE APIM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS • Using a diagnostic scan tool, perform the APIM self-test. • **Are any low or high voltage DTCs recorded in the APIM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AJ . For DTC U3003:17, GO to Pinpoint Test ak . **No** GO to AC5 .

AC5 CHECK FOR CORRECT RCM OPERATION
• Ignition OFF.
• Disconnect and inspect all the RCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the RCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new RCM . REFER to Section 501-20B .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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present. • **Is the concern still present?**	

Pinpoint Test AD: DTC U0155:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	Set by the ACM , APIM , FCIM , and GPSM when network messages are missing from the IPC for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AD: DTC U0155:00

Test Step	Result / Action to Take
AD1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AD2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD2 RECHECK FOR DTC U0155:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155:00 set in the ACM , APIM , FCIM , or GPSM ?**	**Yes** GO to AD3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD3 CHECK THE IPC FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the IPC self-test.	**Yes** REFER to IPC DTC Chart in Section 413-01 .

• **Are any low or high voltage DTCs recorded in the IPC ?**	**No** GO to AD4 .
AD4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs • Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM ▪ FCIM ▪ GPSM • **Are low or high voltage DTCs recorded in the ACM , APIM , FCIM , or GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AJ . For DTC U3003:17, GO to Pinpoint Test ak . **No** GO to AD5 .
AD5 CHECK FOR DTC U0155:00 SET IN MULTIPLE MODULES • Review the recorded results from the self-test. • **Is DTC U0155:00 set in more than one audio system module?**	**Yes** GO to AD6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD6 CHECK FOR CORRECT IPC OPERATION • Ignition OFF. • Disconnect and inspect the IPC connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the IPC connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new IPC . REFER to Section 413-01 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AE: DTC U016A:00

Diagnostic Overview

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Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U016A:00	Lost Communication With Global Positioning System Module: No Sub Type Information	Set by the APIM when network messages are missing from the GPSM for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AE: DTC U016A:00

Test Step	Result / Action to Take
AE1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AE2. **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring. CHECK the MS-CAN wiring between the APIM and the GPSM for a fault.
AE2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Carry out the network test using the scan tool. • **Does the GPSM pass the network test?**	**Yes** GO to AE3. **No** REFER to Section 418-00.
AE3 CHECK FOR ANY RECENT PMI CHANGES **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Check the vehicle service history for recent service actions related to the GPSM. • **Have there been any recent service actions with either module?**	**Yes** CARRY out a manual PMI on the GPSM using As-Built data. REFER to the diagnostic scan tool instructions. **No** GO to AE4.
AE4 RETRIEVE THE RECORDED DTCs FROM THE GPSM • Clear the GPSM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds.	**Yes** REFER to the GPSM DTC chart in this section. **No**

• Repeat the GPSM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	GO to AE5 .
AE5 RETRIEVE THE RECORDED DTCs FROM THE APIM • Repeat the APIM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test aj . For DTC U3003:17, GO to Pinpoint Test ak **No** GO to AE6 .
AE6 RECHECK THE APIM DTCs • Perform the APIM self-test. • **Is DTC U016A:00 still present?**	**Yes** GO to AE7 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AE7 CHECK FOR DTC U016A:00 SET IN OTHER MODULES • Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the APIM self-test. • **Is DTC U016A:00 set in any other module?**	**Yes** GO to AE8 . **No** GO to AE9

AE8 CHECK FOR CORRECT GPSM OPERATION
• Ignition OFF.
• Disconnect the GPSM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the GPSM connector and make sure it seats correctly.
• **Is the concern still present?**
	Yes
	INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

AE9 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect the APIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the APIM connector and make sure it seats correctly.
• Wait 2 minutes for the APIM to re-initialize.
• **Is the concern still present?**
	Yes
	For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Pinpoint Test AF: DTC U0184:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0184:00	Lost Communication With Radio: No Sub Type Information	Set by the APIM when network messages are missing from the ACM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AF: DTC U0184:00

Test Step	Result / Action to Take
AF1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AF2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF2 RECHECK FOR DTC U0184:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0184:00 set in the APIM?**	**Yes** GO to AF3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
• **Are low or high voltage DTCs recorded in the ACM or APIM?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AJ. For DTC U3003:17, GO to Pinpoint Test ak.
	
	No
	GO to AF4.

AF4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AG: DTC U0253:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	Set by the ACM when network messages are missing from the APIM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AG: DTC U0253:00

Test Step	Result / Action to Take
AG1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AG2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG2 RECHECK FOR DTC U0253:00	
	Yes

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• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0253:00 set in the ACM ?**	GO to AG3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
• **Are low or high voltage DTCs recorded in the ACM or APIM ?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AJ . For DTC U3003:17, GO to Pinpoint Test ak .
	
	No
	GO to AG4 .

AG4 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AH: DTC U0256:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	Set by the ACM and APIM when network messages are missing from the FCIM for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AH: DTC U0256:00

Test Step	Result / Action to Take
AH1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AH2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH2 RECHECK FOR DTC U0256:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0256:00 set in the ACM or APIM?**	**Yes** GO to AH3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
  ▪ FCIM
• **Are low or high voltage DTCs recorded in the ACM, APIM, or FCIM?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AJ. For DTC U3003:17, GO to Pinpoint Test ak.
	
	No
	GO to AH4.

AH4 CHECK FOR DTC U0256:00 SET IN MULTIPLE MODULES	

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• Review the recorded results from the self-test. • **Is DTC U0256:00 set in more than one audio system module?**	**Yes** GO to AH5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH5 CHECK FOR CORRECT FCIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AI: DTC U0257:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	**NOTE:** The FDIM is a non-networked module attached to the APIM . The APIM acts as the gateway module for messages sent over the I-CAN between the FDIM , ACM , and FCIM . Set by the ACM and FCIM when I-CAN network messages are missing from the APIM for more than 5 seconds with the ignition in RUN.

		This DTC may be set in conjunction with DTC U0253:00.

PINPOINT TEST AI: DTC U0257:00

Test Step	Result / Action to Take
AI1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AI2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AI2 RECHECK FOR DTC U0257:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0257:00 set in the ACM or FCIM?**	**Yes** GO to AI3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

AI3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
  ▪ FCIM
• **Are low or high voltage DTCs recorded in the ACM, APIM, or FCIM?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AJ. For DTC U3003:17, GO to Pinpoint Test ak.
	
	No
	GO to AI4.

AI4 CHECK FOR DTC U0257:00 SET IN MULTIPLE MODULES • Review the recorded results from the self-test. • **Is DTC U0257:00 set in more than one audio system module?**	**Yes** GO to AI5. **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AI5 CHECK FOR CORRECT	

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APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AJ: DTC U3003:16

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	Set by the ACM , APIM , FCIM , and GPSM when the supply voltage falls below 10 volts for at least 10 seconds during normal operation or for more than 250 milliseconds during the self-test.

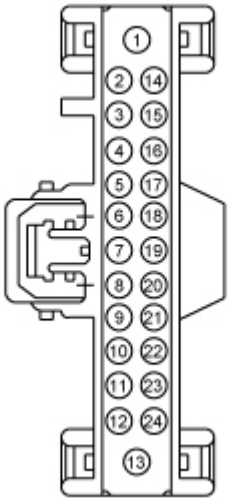
PINPOINT TEST AJ: DTC U3003:16

Test Step	Result / Action to Take
AJ1 RECHECK FOR DTC U3003:16	

• Ignition ON. • Using a diagnostic scan tool, clear the DTCs for the module in question. • Wait at least 15 seconds. • Using a diagnostic scan tool, repeat the self-test for the module in question. • **Is DTC U3003:16 still present?**	**Yes** GO to AJ2 . **No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
AJ2 CHECK FOR CHARGING SYSTEM DTCS IN THE PCM	
• Using a diagnostic scan tool, retrieve all CMDTCs . • **Are any voltage-related DTCs set in the PCM ?**	**Yes** REFER to PCM DTC Chart in Section 303-14 . **No** GO to AJ3 .
AJ3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. REFER to Battery Condition Test in Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AJ4 . **No** REFER to the Symptom Chart in Section 414-00 .
AJ4 CHECK THE MODULE VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect the audio system module setting DTC U3003:16. • Ignition ON. • Measure the voltage between the module setting DTC U3003:16 and ground. • For the ACM , measure the **voltage** between:	**Yes** GO to AJ5 . **No** REPAIR the circuit for high resistance.

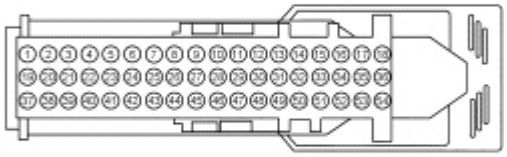
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240A-1	SBP29 (GY/RD)	—	Ground

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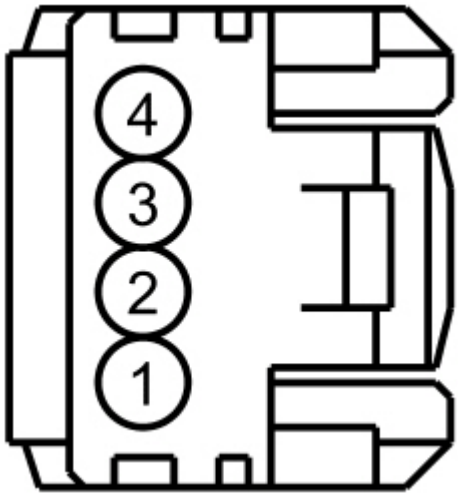
- For the APIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	—	Ground



- For the FCIM , measure the **voltage** between:

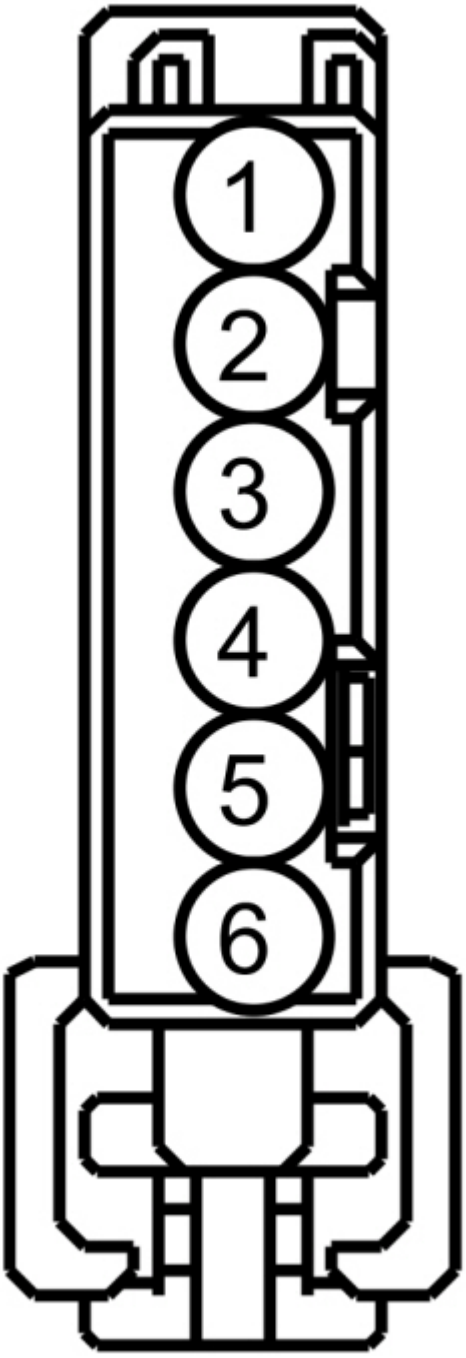
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	—	Ground



- For the GPSM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	—	Ground

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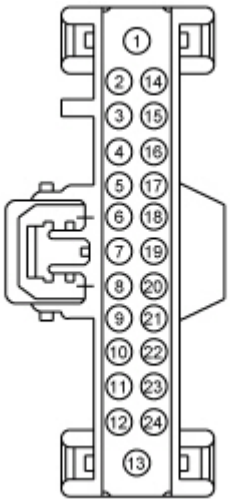


- **Is the voltage within 0.2 volts of the recorded battery voltage?**

AJ5 CHECK THE SUSPECT MODULE GROUND CIRCUIT FOR CONTINUITY	
• Measure the voltage at the suspect module.	**Yes**

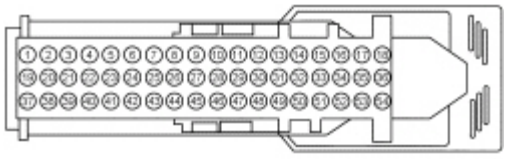
- For the ACM, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240A-1	SBP29 (GY/RD)	C240A-13	GD114 (BK/BU)



- For the APIM, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	C2383-37	GD114 (BK/BU)



- For the FCIM, measure the **voltage** between:

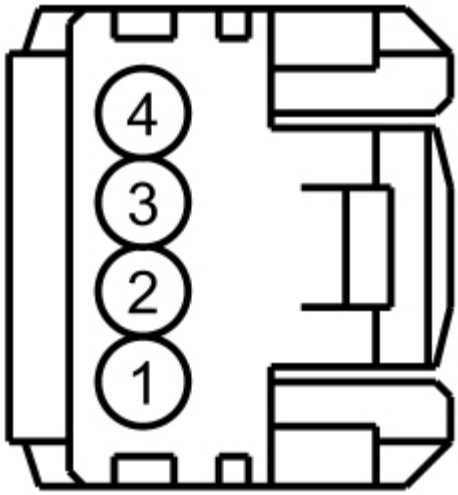
Positive Lead		Negative Lead	

For the ACM, GO to AJ6. For the APIM, GO to AJ7. For the FCIM, GO to AJ8. For the GPSM, GO to AJ9.

No
REPAIR the circuit for high resistance.

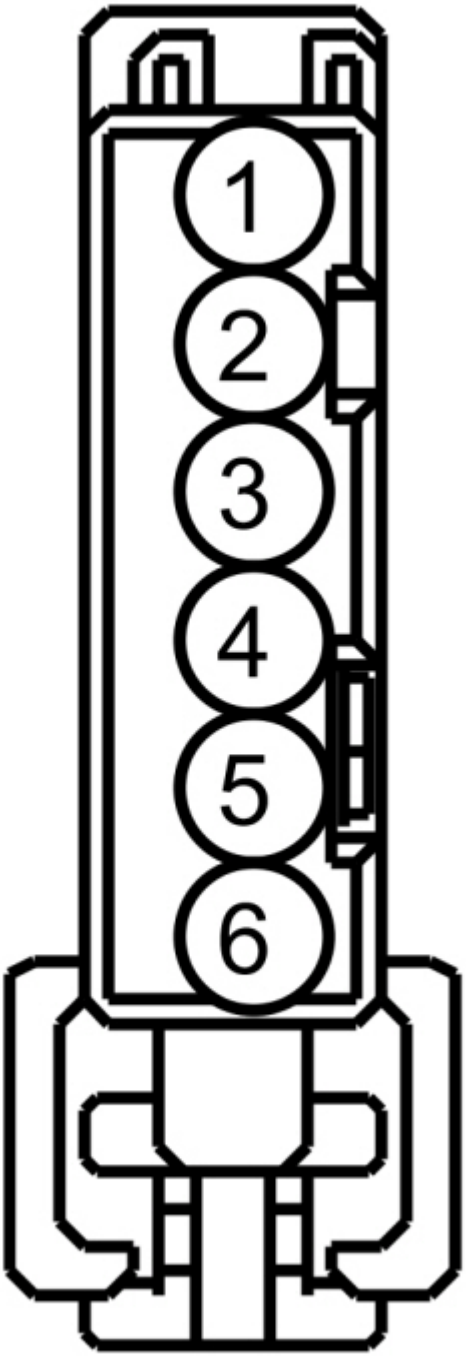
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Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	C2402-4	GD133 (BK)



- For the GPSM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	C2398-6	GD114 (BK/BU)



- **Is the suspect module voltage greater than 11 volts?**

AJ6 CHECK FOR CORRECT ACM OPERATION • Ignition OFF. • Disconnect and inspect all the ACM	**Yes** CHECK OASIS for any applicable TSBs. If a

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connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AJ7 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AJ8 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AJ9 CHECK FOR CORRECT GPSM OPERATION
• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) .
	
	No
	The system is operating correctly at this time.

seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AK: DTC U3003:17

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	Set by the ACM , APIM , FCIM , and GPSM when the supply voltage is more than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

PINPOINT TEST AK: DTC U3003:17

Test Step	Result / Action to Take
AK1 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Using a diagnostic scan tool, clear the DTC for the module in question. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question. • **Is DTC U3003:17 present?**	**Yes** GO to AK2 . **No** The system is operating correctly at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.
AK2 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Using a diagnostic scan tool, retrieve all CMDTCs . • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question. • **Are high voltage DTCs such as B1676, P0563, U3003:17 set in more than one module?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** GO to AK3 .

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AK3 CHECK THE BATTERY VOLTAGE	
• Turn off all interior lights, exterior lights, and accessories. • Start and run the engine at approximately 2,000 RPM for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** For the ACM , GO to AK4 . For the APIM , GO to AK5 . For the FCIM , GO to AK6 For the GPSM , GO to AK7 .
AK4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AK5 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

• Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

AK6 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AK7 CHECK FOR CORRECT GPSM OPERATION
• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Accessory Protocol Interface Module (APIM) Custom Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool.
 ST3256-A	SYNC® Re-Flash Kit CCMSYNC-KIT or equivalent [Tools are also available individually CCMUSB2-AM-AM-10 (cable) and CCMUSB-AF-BF5 (adapter)]

NOTE: Use this procedure to show all available software options, including Applications, that can be programmed into the APIM when upgrades become available, or as directed by a TSB. For additional information about choosing the correct APIM programming procedure, refer to Information and Entertainment System , APIM Programming.

NOTE: A USB flash drive with a minimum storage size of 1 gigabyte (GB) may be required for this procedure.

NOTE: Some programming files are large (greater than 2 gigabytes). It is important that the diagnostic scan tool has enough available hard drive space to accommodate the programming file download. If a "Disk Space Error" is received, create additional free space on the hard drive.

NOTE:

- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- During programming, the vehicle display may go blank momentarily.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.
- Close the IDS program before attempting to perform this procedure.

1. Connect a battery charger set on low.
    - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.

2. Place the ignition in the ON/RUN position.

3. Connect the diagnostic scan tool and VCM to the vehicle.

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4. Open Internet Explorer on the diagnostic scan tool and go to the technician service publications web site. On the OASIS tab, select "Read VIN & DTCs," and select "Go."

5. **NOTE:** This procedure clears all CMDTCs. The DTCs must be recorded now if other diagnoses are to be performed after this procedure.

   Select "Toolbox" from the technician service publications web site to retrieve and record all CMDTCs.

6. **NOTE:** If unable to complete programming because the operation stops or errors are received, the web browser settings may need to be configured. Refer to "Software Programming v1.1" on the technician service publications web site under the Service Tips tab.

   From the OASIS tab, select the "SYNC" button. The Last Recorded State — Software is displayed.

7. Scroll to the bottom of the screen, select "Custom," and select the "Read SYNC" button to compare the current APIM Vehicle Interface Processor (VIP), Consumer Interface Processor (CIP), and Application software levels to the last reported state in the Ford online database.
   - After the comparison is performed, the diagnostic scan tool displays a list of available software. Select the software level needed as indicated by the TSB. If the software level is not known, stop this procedure and perform standard programming, which automatically selects the latest software levels. Refer to Accessory Protocol Interface Module (APIM) Standard Programming.
   - Applications may require selection for installation. Applications with a green check mark next to them indicates the APIM already has the latest level installed (no re-installation required). All Applications can be selected for installation.
   - Depending on the software level required, the diagnostic scan tool automatically selects either the Service Pack or Full Flash programming method.
   - Although there may be an option available to override the Service Pack installation and perform a Full Flash/Force CIP, choosing this option requires additional programming time and is not recommended unless directed by a TSB.

8. Select the customer-requested upgrade or the Application directed by the TSB.

9. **NOTE:** Only Applications on a flash drive may be loaded to the APIM through the media hub.

   NOTE: If not performing a Full Flash/Force CIP, go to Step 11.

   Remove the media hub. REFER to Media Hub.

10. **NOTE:** Do not disconnect the diagnostic scan tool or cable from the APIM during programming unless directed by the diagnostic scan tool on-screen prompts.

    Connect the SYNC® Re-Flash Kit cable and adapter between the diagnostic scan tool USB port and the vehicle USB cable.

11. **NOTE:** Diagnostic scan tools that have never been used to program SYNC® may encounter a Hardware Wizard pop-up requesting a "WMA SBOOT" driver installation. If this request is encountered, install the driver and select the diagnostic scan tool "retry" button to continue programming.

    NOTE: This step may take 20 minutes or longer.

    Select the "Program SYNC" button to begin the APIM programming process.
    - When prompted by the diagnostic scan tool, disconnect the battery charger, start the engine, and select "OK." Once "OK" is selected, do not interrupt this step, which may take 20 minutes or longer.

- The updates are downloaded to the diagnostic scan tool or USB flash drive.

12. **NOTE:** If the diagnostic scan tool does not have an available USB port, the Re-Flash Kit cable can be unplugged at this time to make room for the USB flash drive. Do **not** disconnect the VCM from the diagnostic scan tool.

    NOTE: This step may take 20 minutes or longer.

    Connect the USB flash drive to the diagnostic scan tool and follow the on-screen instructions for downloading service packs and Applications onto the USB flash drive.

13. **NOTE:** If the media hub was removed, install it before connecting the USB flash drive to the vehicle.Refer to Media Hub .

    This step may take 20 minutes or longer.

    When prompted by the diagnostic scan tool, remove the USB flash drive and connect it to the media hub to install the Applications into the APIM .
    - The update should start automatically, and may take 20 minutes or longer.
    - It is normal for the APIM to reset during this step.

14. **NOTE:** Re-installing the USB flash drive into the diagnostic scan tool initiates the remaining automated configuration steps. Failure to do so results in the loss of feature functionality such as navigation and SYNC® traffic, directions, and information services.

    Once diagnostic scan tool programming and USB flash drive programming are complete, re-install the flash drive into the diagnostic scan tool and select "OK" to report software installation to the Ford online database.

15. Calibrate the touchscreen. Refer to Touchscreen Calibration .

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Accessory Protocol Interface Module (APIM) Module Replacement Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool
 ST3256-A	SYNC® Re-Flash Kit CCMSYNC-KIT or equivalent [Tools are also available individually CCMUSB2-AM-AM-10 (cable) and CCMUSB-AF-BF5 (adapter)]

NOTE: Use this procedure to program and provision the module when a new Accessory Protocol Interface Module (APIM) is being installed. For additional information about choosing the correct programming procedure, refer to Information and Entertainment System , APIM Programming.

NOTE: A USB flash drive with a minimum storage size of 1 gigabyte (GB) may be required for this procedure.

NOTE: Some programming files are large (greater than 2 gigabytes). It is important that the diagnostic scan tool has enough available hard drive space to accommodate the programming file download. If a "Disk Space Error" is received, create additional free space on the hard drive.

NOTE:

- Install the new APIM before performing this procedure. Refer to Accessory Protocol Interface Module (APIM)
- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- During programming, the vehicle display may go blank momentarily.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.
- Close the IDS program before attempting to perform this procedure.

1. Connect a battery charger set on low.
    - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.

2. Place the ignition in the ON/RUN position.

3. Connect the diagnostic scan tool and VCM to the vehicle.

4. Open Internet Explorer on the diagnostic scan tool and go to the technician service publications web site. On the OASIS tab, select "Read VIN & DTCs," and select "Go."

5. **NOTE:** This procedure clears all CMDTCs . The DTCs must be recorded now if other diagnoses are to be performed after this procedure.

   Select "Toolbox" from the technician service publications web site to retrieve and record all CMDTCs .

6. **NOTE:** If unable to complete programming because the operation stops or errors are received, the web browser settings may need to be configured. Refer to "Software Programming v1.1" on the technician service publications web site under the Service Tips tab.

   From the OASIS tab, select the "SYNC" button. The Last Recorded State — Software is displayed.

7. Scroll to the bottom of the screen, and select "Module Replacement," and select the "Read SYNC" button to compare the current APIM VIP , CIP , and Application software levels to the last reported state in the Ford online database.
   - After the comparison is performed, the diagnostic scan tool automatically selects software for programming.
   - Applications may require selection for installation. Applications with a green check mark next to them indicates the APIM already has the latest level installed (no re-installation required).
   - Depending on the software level required, the diagnostic scan tool automatically selects either the Service Pack or Full Flash programming method.
   - Although there may be an option available to override the Service Pack installation and perform a Full Flash/Force CIP , choosing this option requires additional programming time and is not recommended unless directed by a TSB .

8. **NOTE:** Only Applications on a flash drive may be loaded to the APIM through the media hub.

   NOTE: If not performing a Full Flash/Force CIP , go to Step 10.

   Remove the media hub. REFER to Media Hub .

9. **NOTE:** Do not disconnect the diagnostic scan tool or cable from the APIM during programming unless directed by the diagnostic scan tool on-screen prompts.

   Connect the SYNC® Re-Flash Kit cable and adapter between the diagnostic scan tool USB port and the vehicle USB cable.

10. **NOTE:** Diagnostic scan tools that have never been used to program SYNC® may encounter a Hardware Wizard pop-up requesting a "WMA SBOOT" driver installation. If this request is encountered, install the driver and select the diagnostic scan tool "retry" button to continue programming.

    NOTE: This step may take 20 minutes or longer.

    Select the "Program SYNC" button to begin the APIM programming process.
    - When prompted by the diagnostic scan tool, disconnect the battery charger, start the engine, and select "OK." Once "OK" is selected, do not interrupt this step, which may take 20 minutes or longer.
    - The updates are downloaded to the diagnostic scan tool or USB flash drive.

11. **NOTE:** If the diagnostic scan tool does not have an available USB port, the Re-Flash Kit cable can be unplugged at this time to make room for the USB flash drive. Do **not** disconnect the VCM from the diagnostic scan tool.

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NOTE: This step may take 20 minutes or longer.

Connect the USB flash drive to the diagnostic scan tool and follow the on-screen instructions for downloading service packs and Applications onto the USB flash drive.

12. **NOTE:** If the media hub was removed, install it before connecting the USB flash drive to the vehicle.Refer to Media Hub .

    This step may take 20 minutes or longer.

    When prompted by the diagnostic scan tool, remove the USB flash drive and connect it to the media hub to install the Applications into the APIM .
    - The update should start automatically, and may take 20 minutes or longer.
    - It is normal for the APIM to reset during this step.

13. **NOTE:** Re-installing the USB flash drive into the diagnostic scan tool initiates the remaining automated configuration steps. Failure to do so results in the loss of feature functionality such as navigation and SYNC® traffic, directions, and information services.

    Once diagnostic scan tool programming and USB flash drive programming are complete, re-install the flash drive into the diagnostic scan tool and select "OK" to report software installation to the Ford online database.

14. Calibrate the touchscreen. Refer to Touchscreen Calibration .

Accessory Protocol Interface Module (APIM) Reset

NOTE: Carrying out an APIM Reset consists of a battery disconnect and a SYNC® system Master Reset.

NOTE: NOTE: This procedure will clear all CMDTCs . The DTCs must be recorded now if other (non SYNC®) diagnoses are to be performed after this procedure.

1. Remove any devices connected to the USB port(s), audio input jack (if equipped), or media hub (if equipped).

2. **NOTE:** After the APIM reset procedure has been completed the customer should be advised to reset their device following the manufacturer's instructions. Refer to the device's owner's manual and/or website for information on how to perform a Manual / Master Reset or Clear. Devices can be powered off and back on for a simple re-boot. In some cases the device's battery may also need to be removed and re-installed to complete a re-boot. In addition, cell phones may need to have SYNC® deleted from the Bluetooth menu prior to re-pairing the phone to the SYNC® system. Customer devices may affect the operation of SYNC® and this should be understood to prevent unnecessary diagnosis or repairs to the system.

   Disconnect the negative battery cable for 1 minute, then reconnect it. Refer to Section 414-01 .

3. **NOTE:** Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. On vehicles equipped MyFord Touch or MyLincoln Touch with navigation, the customer’s saved destination points (home address and points of interest) and preferences will also be lost with a Master Reset.

   Carry out a SYNC® system Master Reset. Refer to the owner's literature

4. Verify system function using the Multi-Media Interface Tester 105-00120, to test the audio output for the audio input jack/socket (if equipped), USB port(s), and Bluetooth. If equipped, use the RCA Adapter 105-00121 to test the audio output for the RCA jacks.

5. If a concern is still present return to the Symptom Charts.

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Accessory Protocol Interface Module (APIM) Standard Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool
 ST3256-A	SYNC® Re-Flash Kit CCMSYNC-KIT or equivalent [Tools are also available individually CCMUSB2-AM-AM-10 (cable) and CCMUSB-AF-BF5 (adapter)]

NOTE: Use this procedure to update the Accessory Protocol Interface Module (APIM) and any installed Applications to the latest level. For additional information about choosing the correct programming procedure, refer to Information and Entertainment System , APIM Programming.

NOTE: A USB flash drive with a minimum storage size of 1 gigabyte (GB) may be required for this procedure.

NOTE: Some programming files are large (greater than 2 gigabytes). It is important that the diagnostic scan tool has enough available hard drive space to accommodate the programming file download. If a "Disk Space Error" is received, create additional free space on the hard drive.

NOTE:

- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- During programming, the vehicle display may go blank momentarily.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.
- Close the IDS program before attempting to perform this procedure.

1. Connect a battery charger set on low.
    - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.

2. Place the ignition in the ON/RUN position.

3. Connect the diagnostic scan tool and VCM to the vehicle.

4. Open Internet Explorer on the diagnostic scan tool and go to the technician service publications web

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site. On the OASIS tab, select "Read VIN & DTCs," and select "Go."

5. **NOTE:** This procedure clears all CMDTCs . The DTCs must be recorded now if other diagnoses are to be performed after this procedure.

   Select "Toolbox" from the technician service publications web site to retrieve and record all CMDTCs .

6. **NOTE:** If unable to complete programming because the operation stops or errors are received, the web browser settings may need to be configured. Refer to "Software Programming v1.1" on the technician service publications web site under the Service Tips tab.

   From the OASIS tab, select the "SYNC" button. The Last Recorded State — Software is displayed.

7. Scroll to the bottom of the screen, select "Standard", and select the "Read SYNC" button to compare the current APIM Vehicle Interface Processor (VIP), Consumer Interface Processor (CIP), and Application software levels to the last reported state in the Ford online database.
   - After the comparison is performed, the diagnostic scan tool automatically selects software for programming.
   - Applications may require selection for installation. Applications with a green check mark next to them indicates the APIM already has the latest level installed (no re-installation required).
   - Depending on the software level required, the diagnostic scan tool automatically selects either the Service Pack or Full Flash programming method.
   - Although there may be an option available to override the Service Pack installation and perform a Full Flash/Force CIP , choosing this option requires additional programming time and is not recommended unless directed by a TSB .

8. **NOTE:** Only Applications on a flash drive may be loaded to the APIM through the media hub.

   NOTE: If not performing a Full Flash/Force CIP , go to Step 10.

   Remove the media hub. REFER to Media Hub .

9. **NOTE:** Do not disconnect the diagnostic scan tool or cable from the APIM during programming unless directed by the diagnostic scan tool on-screen prompts.

   Connect the SYNC® Re-Flash Kit cable and adapter between the diagnostic scan tool USB port and the vehicle USB cable.

10. **NOTE:** Diagnostic scan tools that have never been used to program SYNC® may encounter a Hardware Wizard pop-up requesting a "WMA SBOOT" driver installation. If this request is encountered, install the driver and select the diagnostic scan tool "retry" button to continue programming.

    NOTE: This step may take 20 minutes or longer.

    Select the "Program SYNC" button to begin the APIM programming process.
    - When prompted by the diagnostic scan tool, disconnect the battery charger, start the engine, and select "OK." Once "OK" is selected, do not interrupt this step, which may take 20 minutes or longer.
    - The updates are downloaded to the diagnostic scan tool or USB flash drive.

11. **NOTE:** If the diagnostic scan tool does not have an available USB port, the Re-Flash Kit cable can be unplugged at this time to make room for the USB flash drive. Do **not** disconnect the VCM from the diagnostic scan tool.

NOTE: This step may take 20 minutes or longer.

Connect the USB flash drive to the diagnostic scan tool and follow the on-screen instructions for downloading service packs and Applications onto the USB flash drive.

12. **NOTE:** If the media hub was removed, install it before connecting the USB flash drive to the vehicle.Refer to Media Hub .

    This step may take 20 minutes or longer.

    When prompted by the diagnostic scan tool, remove the USB flash drive and connect it to the media hub to install the Applications into the APIM .
    - The update should start automatically, and may take 20 minutes or longer.
    - It is normal for the APIM to reset during this step.

13. **NOTE:** Re-installing the USB flash drive into the diagnostic scan tool initiates the remaining automated configuration steps. Failure to do so results in the loss of feature functionality such as navigation and SYNC® traffic, directions, and information services.

    Once diagnostic scan tool programming and USB flash drive programming are complete, re-install the flash drive into the diagnostic scan tool and select "OK" to report software installation to the Ford online database.

14. Calibrate the touchscreen. Refer to Touchscreen Calibration .

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Audio Control Module (ACM) Self-Diagnostic Mode

NOTE: If the Audio Front Control Module (ACM), Front Control/Display Interface Module (FCDIM) (if equipped), Front Controls Interface Module (FCIM), or Front Display Interface Module (FDIM) (if equipped) are inoperative (blank or do not power on), obtain the ACM part number by referencing the label attached to the ACM chassis.

1. Turn the ACM on.

2. Operate the audio system in radio tuner AM/FM mode.

3. Press and hold the EJECT button, and within 1 second, press and hold the SEEK UP button until the speaker walk-around test begins.

   NOTE: AHU Diagnostics refers to the ACM, EFP Diagnostics refers to the FCIM, and MFD Diagnostics (if supported) refers to the FCDIM (if equipped).

4. To exit the self-diagnostic mode, turn the ACM off, or select "Exit Diagnostics."

Satellite Radio Electronic Serial Number (ESN) Retrieval

NOTE: If the Audio Front Control Module (ACM), FCDIM (if equipped), FCIM , or FDIM (if equipped) are inoperative (blank or do not power on), obtain the Electronic Serial Number (ESN) by referencing the label attached to the Audio Front Control Module (ACM) chassis.

1. Turn the Audio Front Control Module (ACM) on.
2. Operate the audio system in radio tuner AM/FM mode.
3. Press and hold the eject button, and within 1 second, press and hold the seek up button. If supported, the speaker walk around test will begin.
4. Select AHU Diagnostics.
5. Select SIRIUS ESN.

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Touchscreen Calibration

NOTE: Recalibrate the touchscreen by following the scan tool prompts or the steps below.

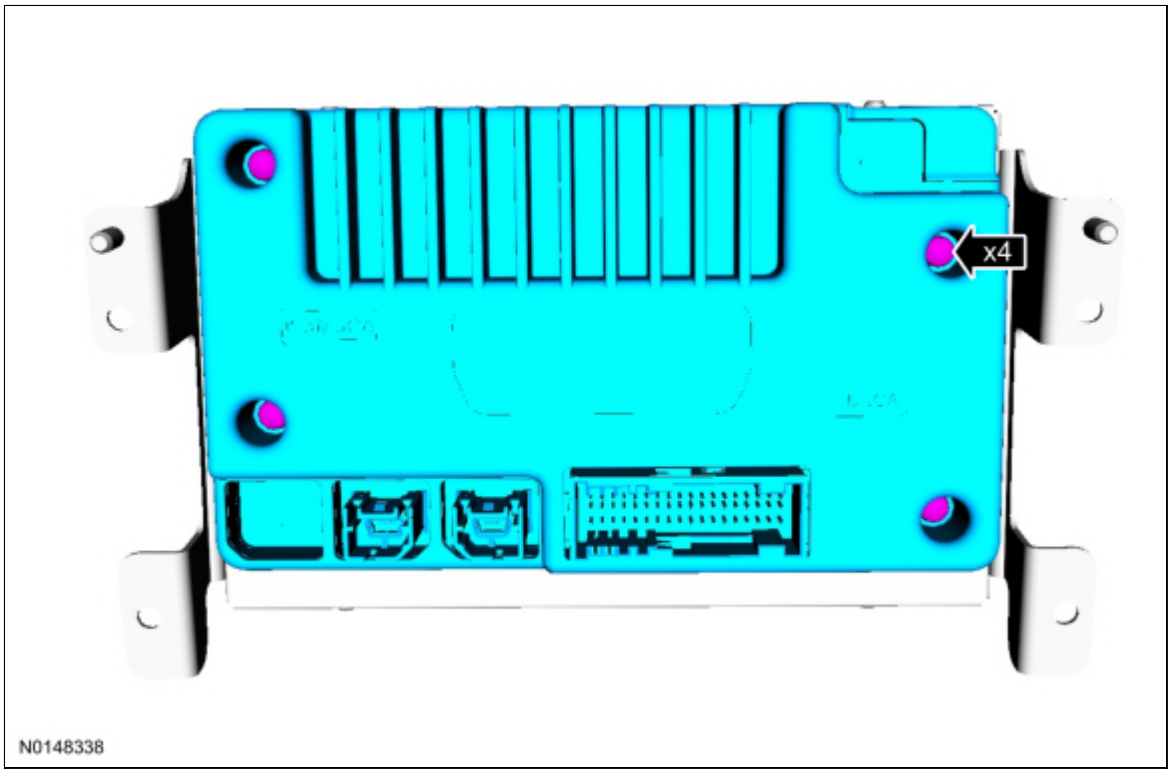
1. To avoid an inoperative touchscreen, make sure the vehicle battery is fully charged.
2. Turn on the ACM .
3. While in AM/FM mode, press and hold the EJECT button, and within 1 second, press the SEEK UP button.
4. Press and hold the SEEK DOWN button to enter the touchscreen calibration.
5. Touch and hold the touch points as they appear on the touchscreen (a stylus is not required).
6. To accept the new settings, touch anywhere on the screen when the screen displays “New calibration settings have been measured. Press the Enter key to accept the new settings.”
7. Clear all CMDTCs .

Accessory Protocol Interface Module (APIM)

Removal and Installation

1. Remove the Front Display Interface Module (FDIM). Refer to Front Display Interface Module (FDIM) .

2. Remove the 4 APIM screws and remove the APIM .
   - To install, tighten to 0.6 Nm (5 lb-in).

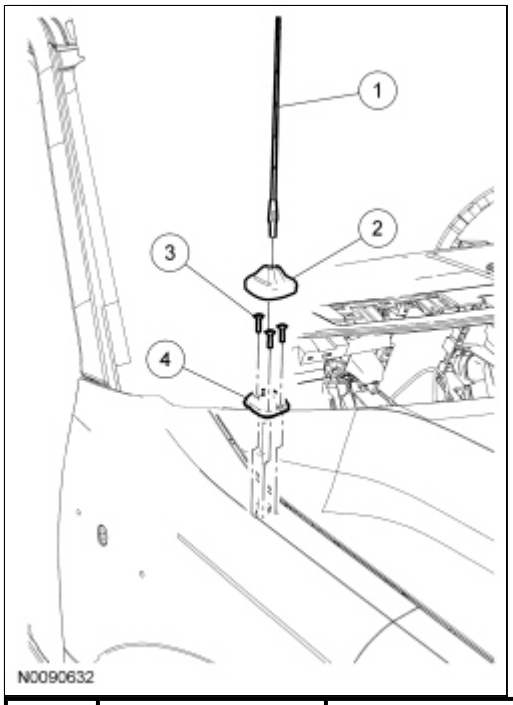


3. To install, reverse the removal procedure.

4. Program the APIM . Refer to Accessory Protocol Interface Module (APIM) Module Replacement Programming .

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Antenna — AM/FM

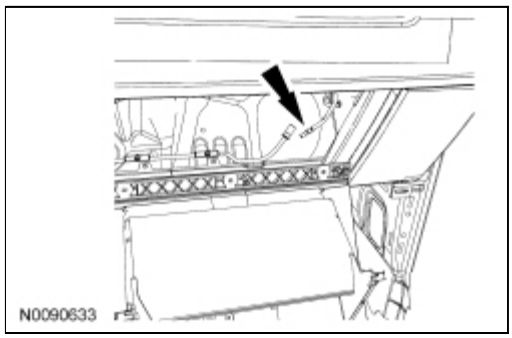


Item	Part Number	Description
1	18813	AM/FM antenna mast
2	18A927	AM/FM antenna base cap
3	N610019	AM/FM antenna screws (3 required)
4	18A894	AM/FM antenna base

Removal and Installation

1. Lower the glove compartment completely.

2. Disconnect the AM/FM antenna from the AM/FM antenna cable.
   - Push the antenna cable end and the grommet through the side cowl.



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3. ***NOTICE:*** **Do not over tighten the antenna mast or damage to the antenna base or mast may occur.**

   Remove the AM/FM antenna mast.
   1. To install, tighten to 4.2 Nm (36 lb/in).

4. **NOTE:** A new AM/FM antenna base cap must be installed.

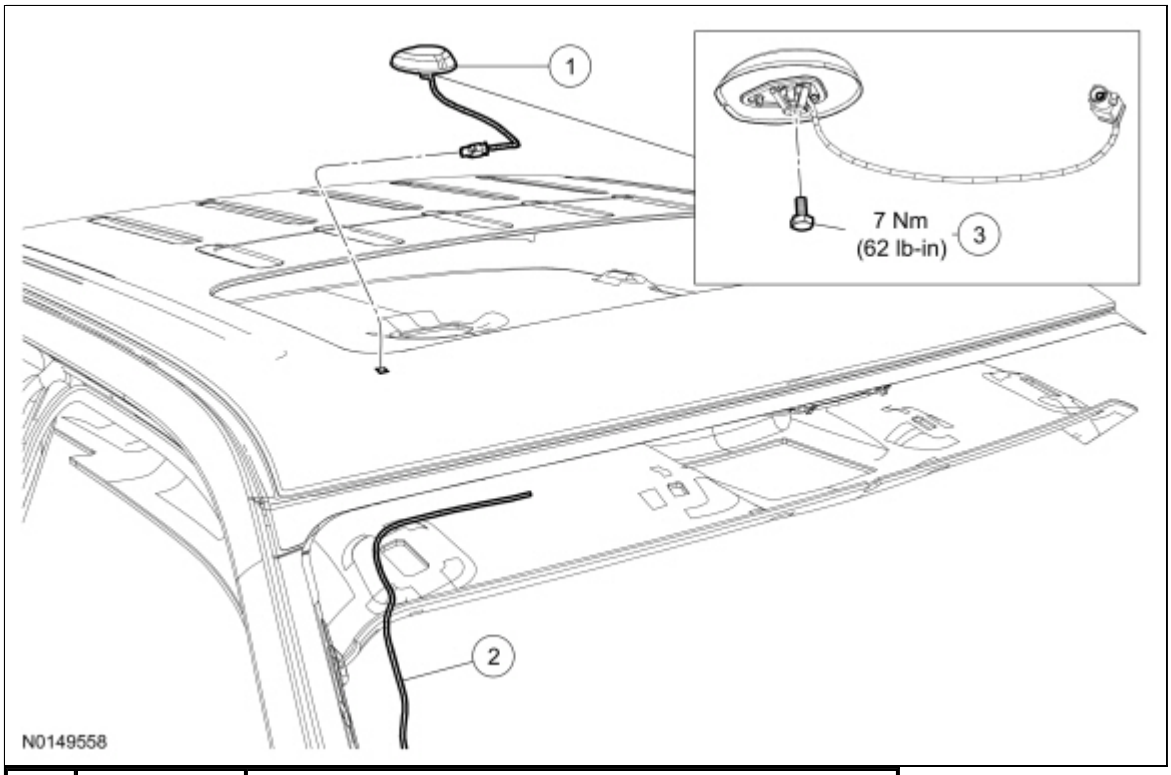
   Using a suitable tool such as a hook-shaped pick, remove the AM/FM antenna base cap by prying upward.

5. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

6. Remove the 3 screws and the AM/FM antenna base.
   1. To install, tighten to 2.5 Nm (23 lb/in).

7. To install, reverse the removal procedure.

Antenna — Satellite Radio



Item	Part Number	Description
1	10E893	Satellite radio antenna
2	—	Satellite radio antenna electrical connector (part of 19A397)
2	—	Satellite radio antenna retaining bolt (part of 10E893)

Removal and Installation

1. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .

2. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.

3. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical connector.

4. **NOTE:** Remove the satellite antenna and pigtail through the mounting opening in the roof panel.

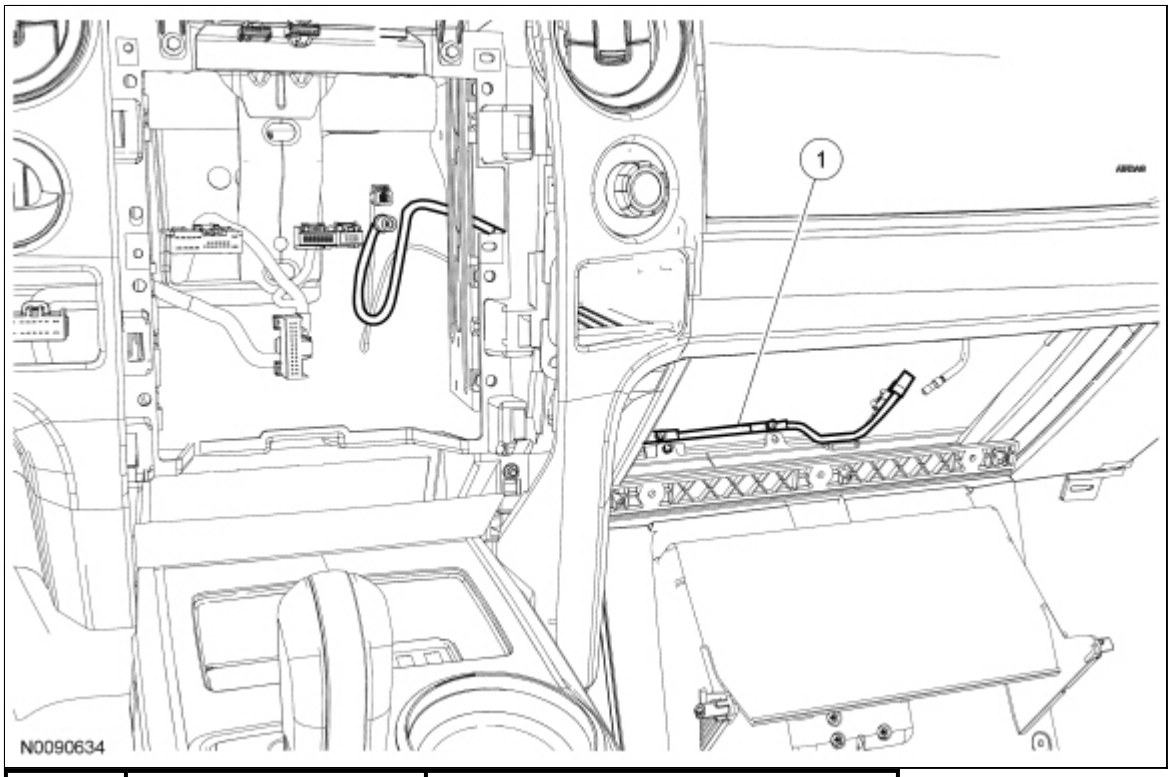
   Remove the satellite antenna.
   - Disconnect the electrical connector.

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- Remove the satellite antenna retaining bolt and retainer then remove the satellite antenna from the roof panel.
    - To install, tighten to 7 Nm (62 lb-in).

5. To install, reverse the removal procedure.

Antenna Cable — AM/FM



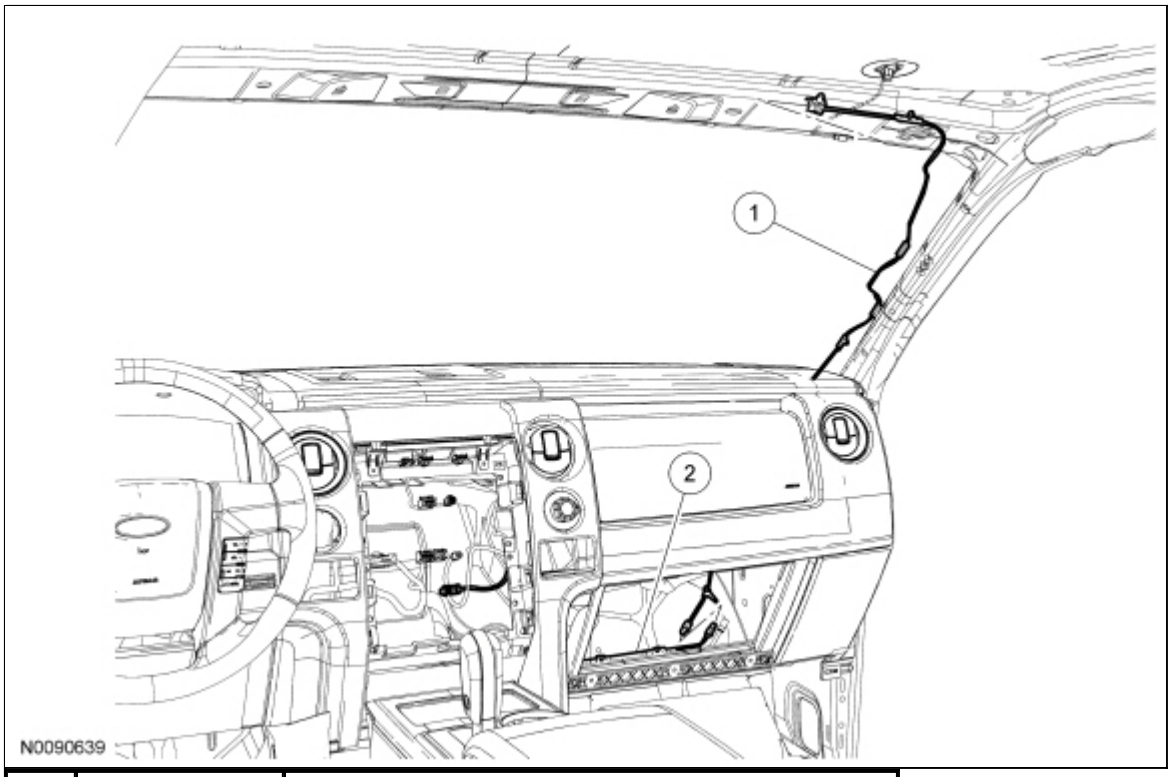
Item	Part Number	Description
1	18812	AM/FM antenna cable

Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.
2. Lower the glove compartment completely.
3. Disconnect the AM/FM antenna cable from the AM/FM antenna.
4. Separate the pushpins and remove the AM/FM antenna cable.
5. To install, reverse the removal procedure.

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Antenna Cable — Satellite Radio



Item	Part Number	Description
1	19A397	Upper satellite radio antenna cable
2	19A397/10E928	Lower satellite radio antenna cable (without/with navigation)

Removal and Installation

Both cables

1. Lower the glove compartment completely.
2. Disconnect the upper-to-lower satellite radio antenna cable connection.

Upper cable

3. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .
4. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.
5. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical

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connector.

6. Remove the upper satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the A-pillar and instrument panel.

Lower cable

7. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.

8. Remove the lower satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the instrument panel.

Both cables

9. To install, reverse the removal procedure.

Audio Control Module (ACM)

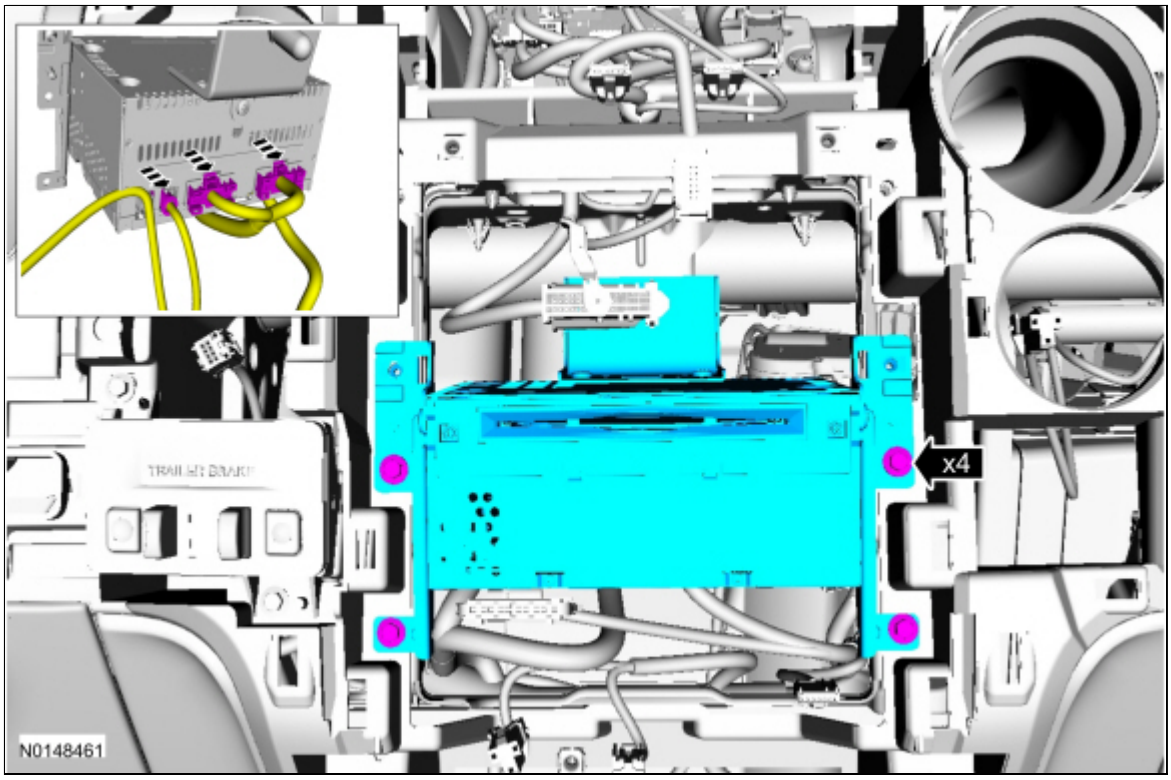
Removal and Installation

1. **NOTE:** If installing a new module, it is necessary to upload the module configuration information to the scan tool prior to removing the module. This information must be downloaded into the new module after installation.

   Upload the Audio Front Control Module (ACM) configuration information to the scan tool by following the scan tool on screen instructions.

2. Remove the Front Display Interface Module (FDIM). Refer to Front Display Interface Module (FDIM) .

3. Remove the 4 ACM bolts and the ACM .
   - Disconnect the electrical connectors.
   - To install, tighten to 2.5 Nm (23 lb-in).



4. To install, reverse the removal procedure.

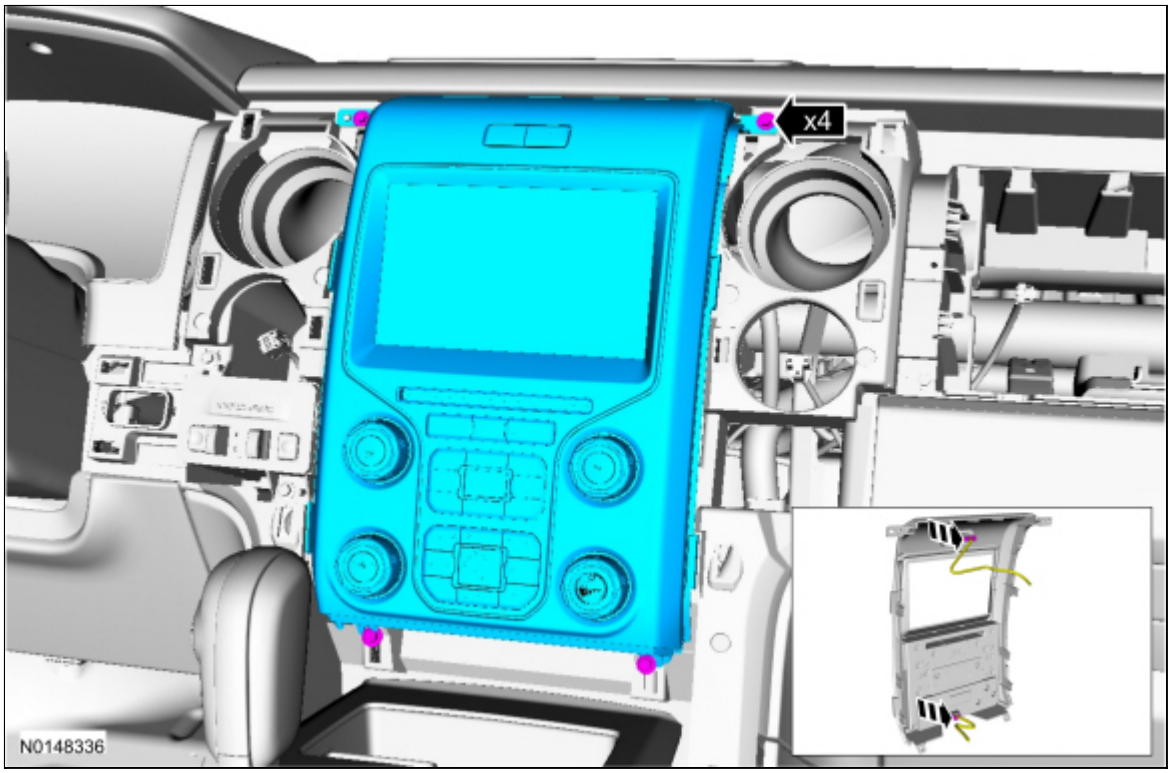
5. Download the ACM configuration information from the scan tool to the new ACM following the scan tool on screen instructions.

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Front Controls Interface Module (FCIM)

Removal and Installation

1. Remove the LH center instrument panel finish panel. Refer to Section 501-12 .
2. Remove the RH center instrument panel finish panel. Refer to Section 501-12 .
3. Remove the 4 screws and the FCIM .
   - Disconnect the electrical connectors.
   - To install, tighten to 3 Nm (27 lb-in).



4. To install, reverse the removal procedure.

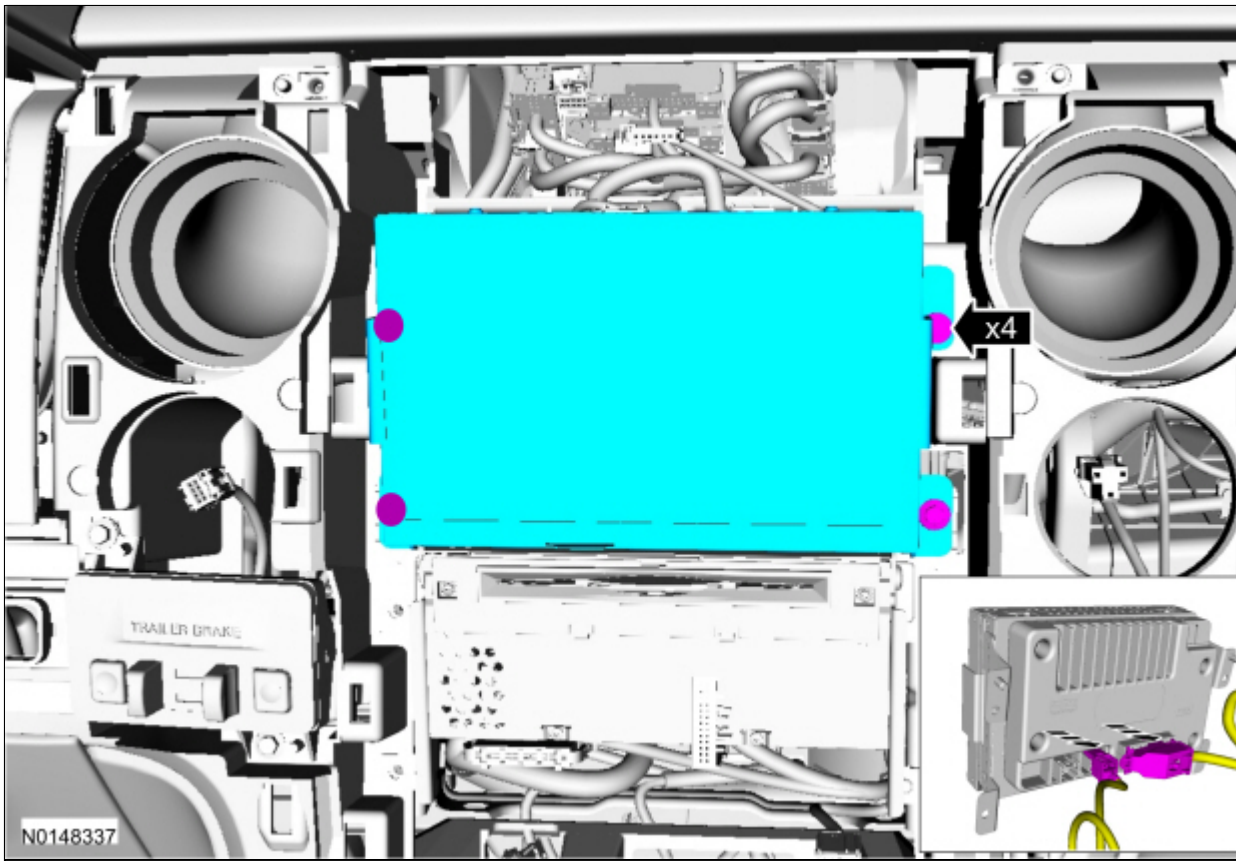
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Front Display Interface Module (FDIM)

Removal and Installation

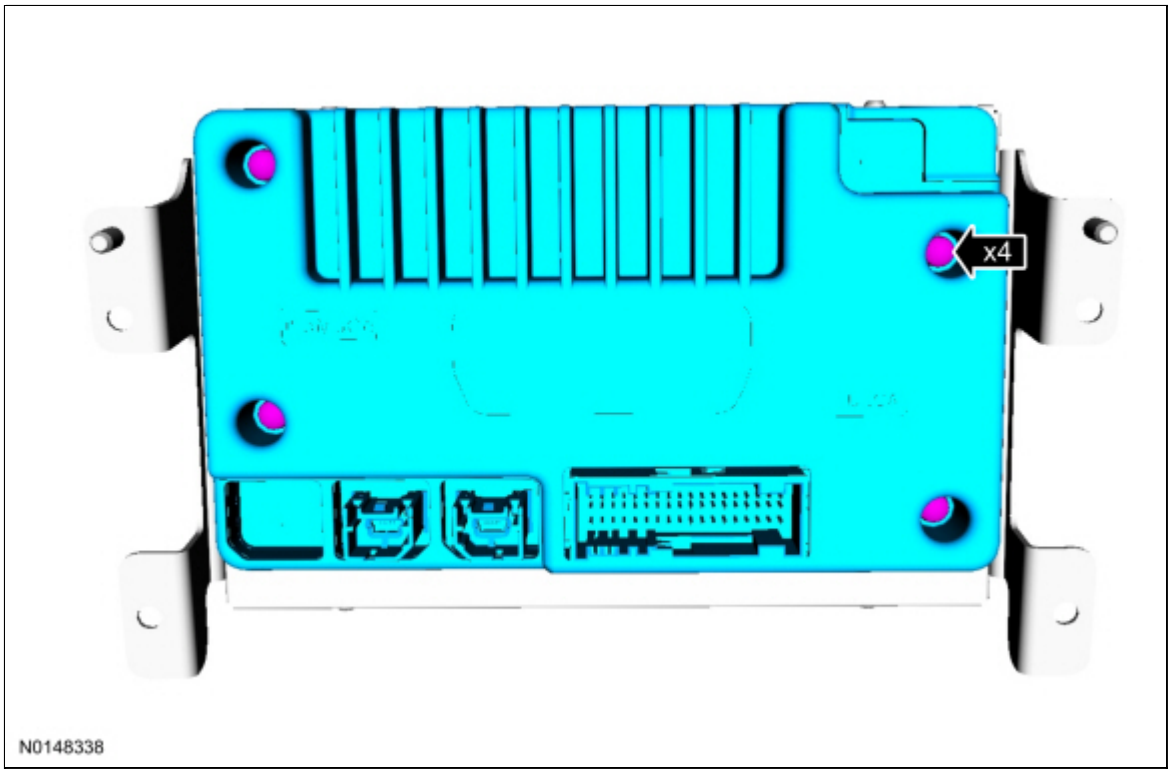
1. Remove the Front Controls Interface Module (FCIM). Front Controls Interface Module (FCIM) .

2. Remove the 4 bolts and the Front Display Interface Module (FDIM).
   - Disconnect the electrical connectors.
   - To install, tighten to 2.5 Nm (23 lb-in).



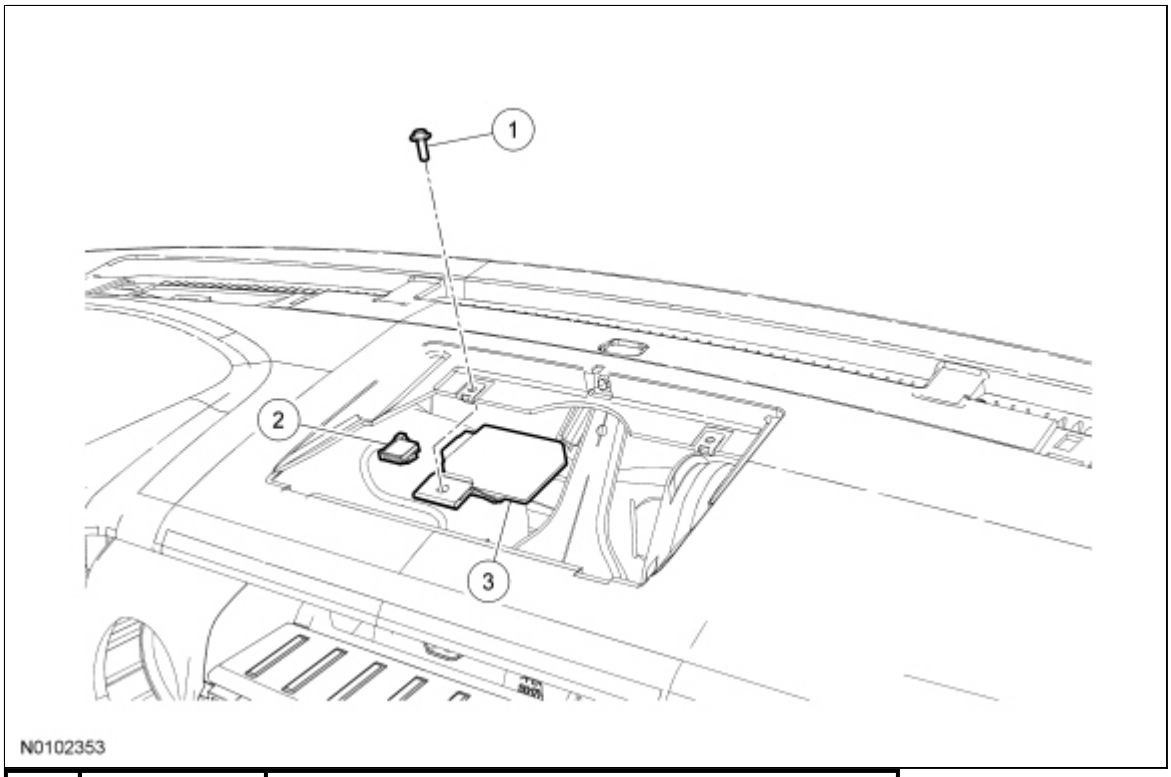
3. Remove the 4 screws and remove theAccessory Protocol Interface Module (APIM) from the FDIM .
   - To install, tighten to 0.6 Nm (5 lb-in).

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4. To install, reverse the removal procedure.
5. Calibrate FDIM touchscreen. Refer to Touchscreen Calibration .

Global Positioning System Module (GPSM)



Item	Part Number	Description
1	W707628-S	Global Positioning System Module (GPSM) screw
2	—	GPSM electrical connector (part of 14401)
3	10E893	GPSM

Removal and Installation

1. Remove the Front Display Interface Module (FDIM). For additional information, refer to Front Display Interface Module (FDIM) in this section.

2. Remove the screw and the Global Positioning System Module (GPSM).
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

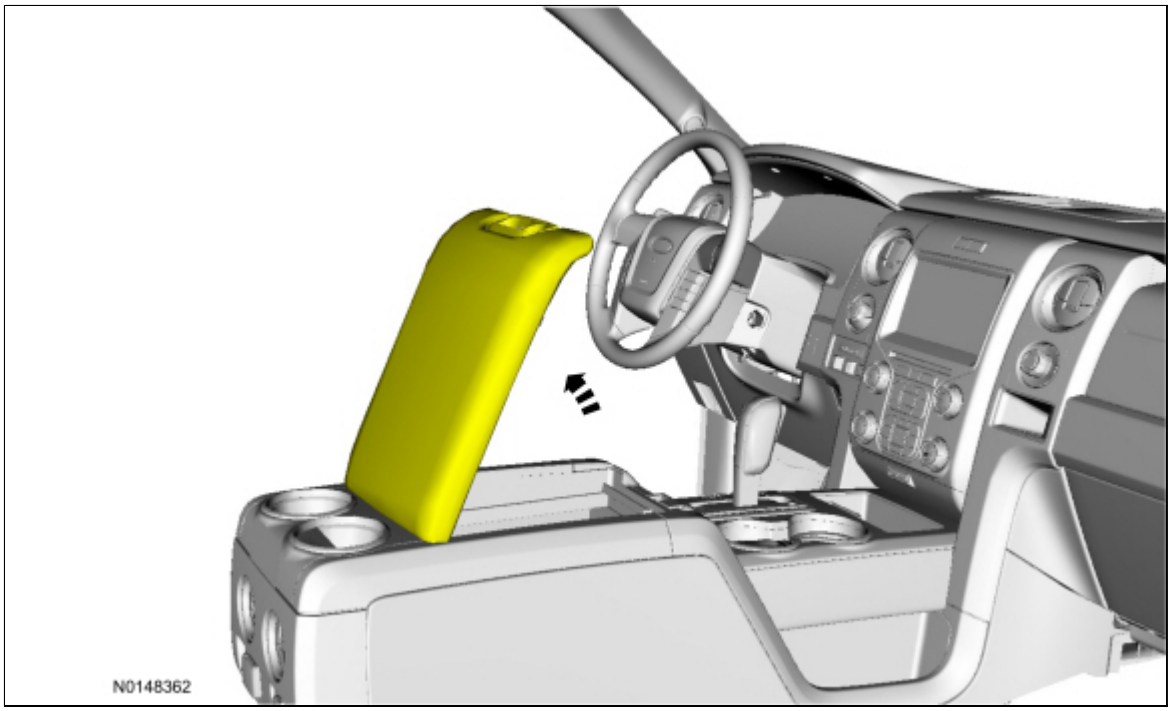
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Media Hub

Removal and Installation

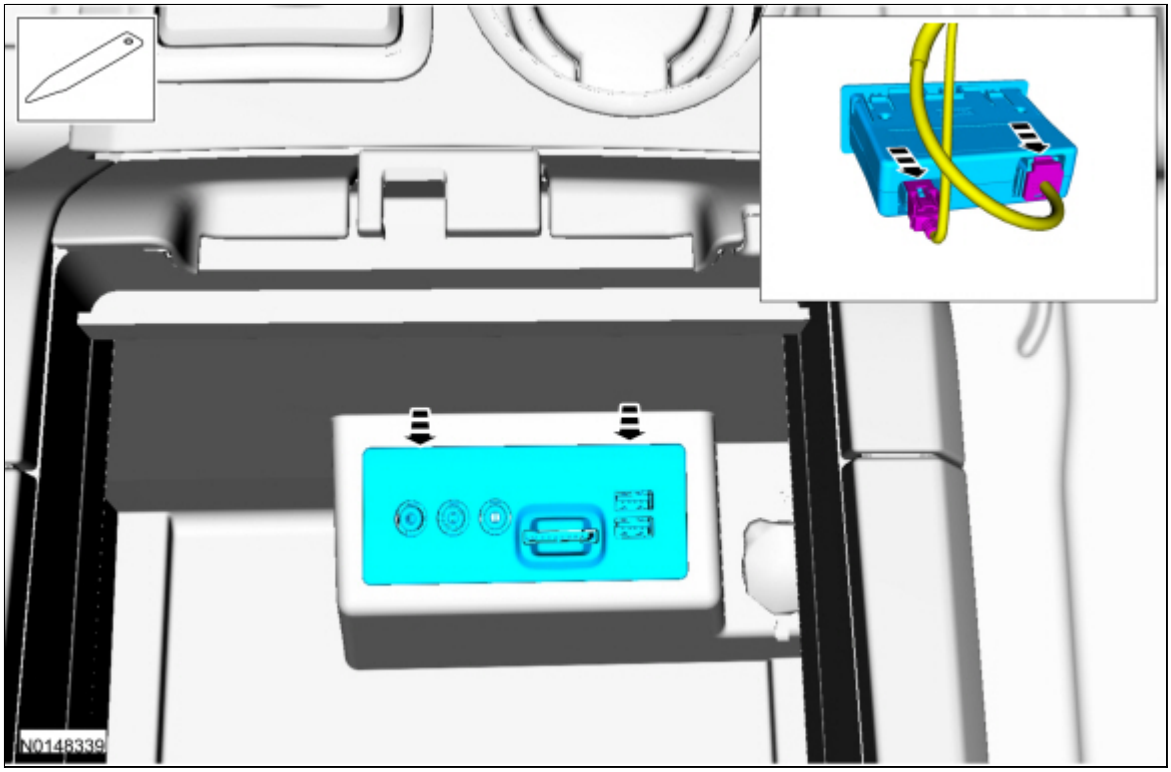
Vehicles with floor console

1. Open the floor console stowage bin door.



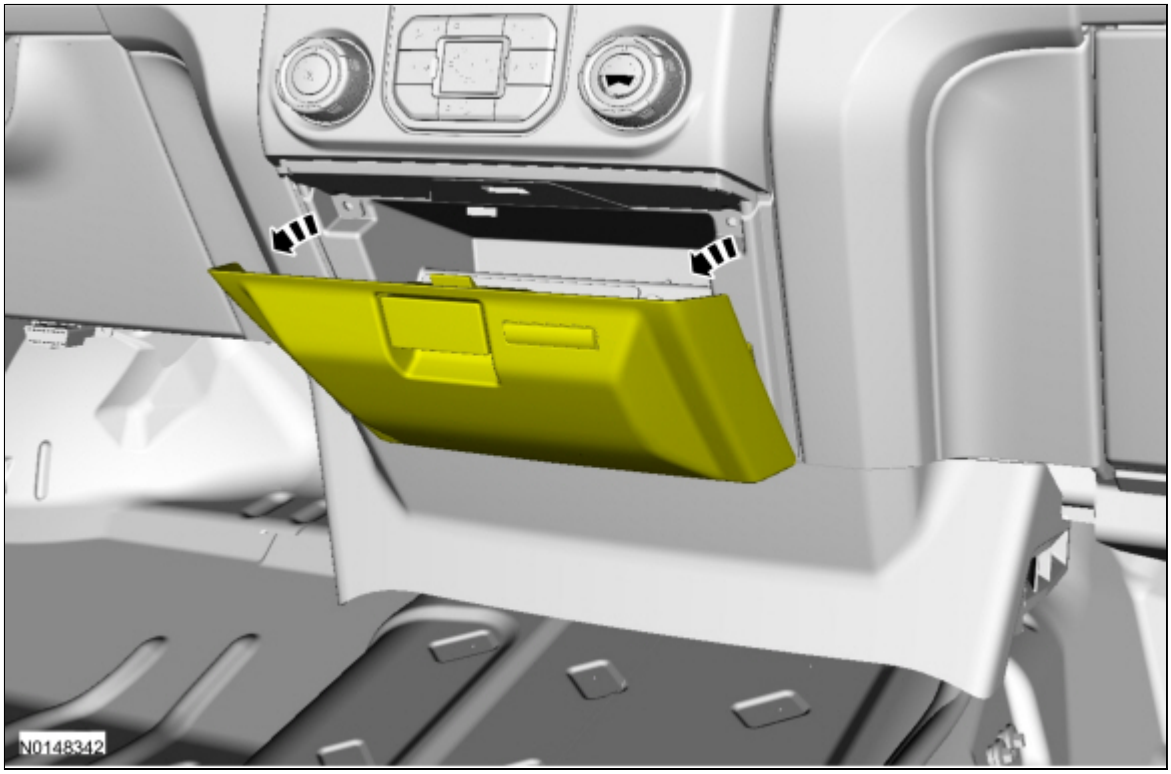
2. Remove the media hub.
    - Disconnect the electrical connectors.

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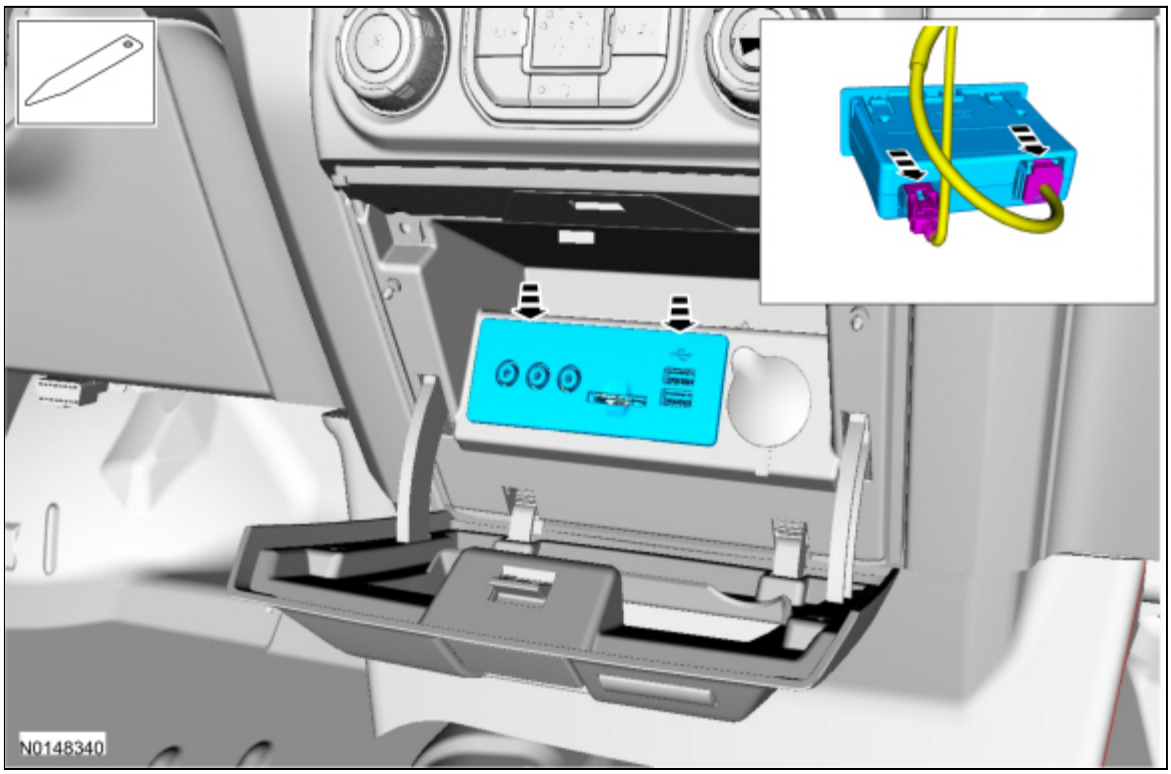
Vehicles without floor console

3. Open the lower instrument panel door.



4. Remove the media hub.

- Disconnect the electrical connectors.



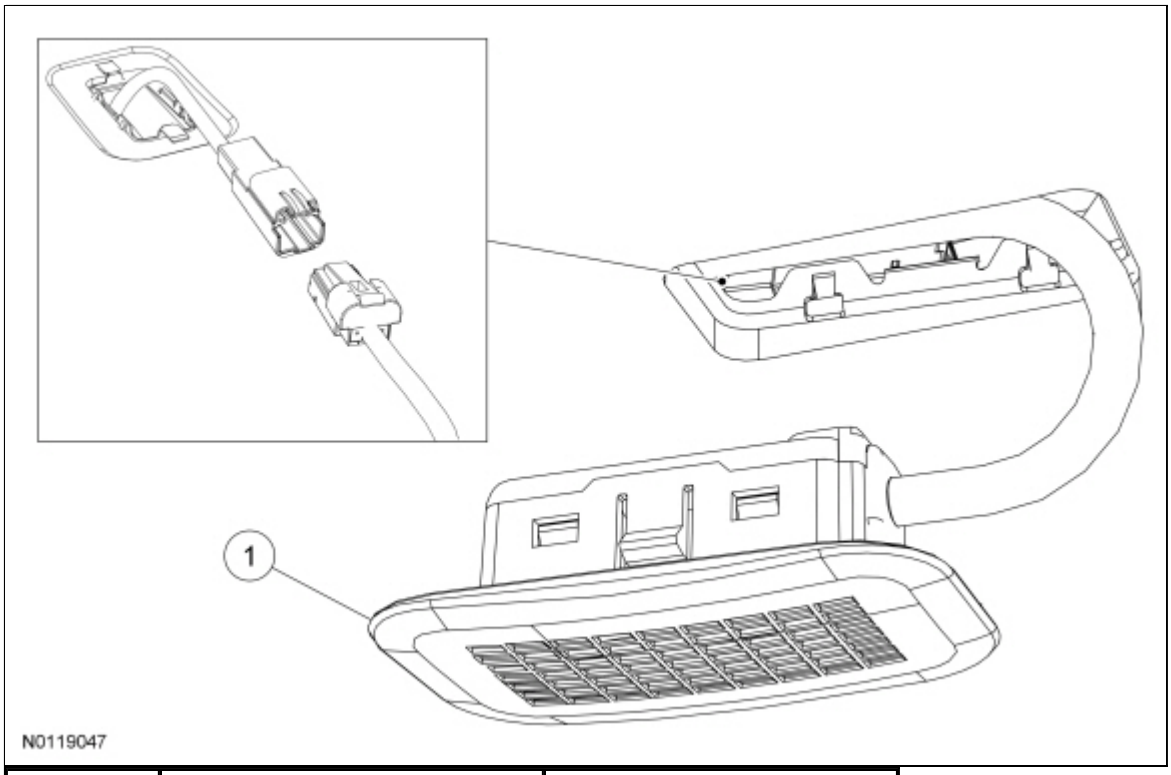
All vehicles

5. To install, reverse the removal procedure.

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Microphone



Item	Part Number	Description
1	19A391	Microphone

Removal

1. Using a suitable tool, (such as a thin small flat head screwdriver) twist and pry the microphone bezel from the headliner metal mounting bracket.

2. Remove the microphone from the headliner by grasping the microphone pigtail.
    - Disconnect the microphone electrical connector.

Installation

1. Reconnect the microphone electrical connector.

2. Wrap the connection with anti-rattle tape.

3. Feed the microphone pigtail into the headliner through the microphone hole.
    - Verify the microphone pigtail points towards the front of the vehicle.

4. Snap the microphone into the headliner mounting bracket.

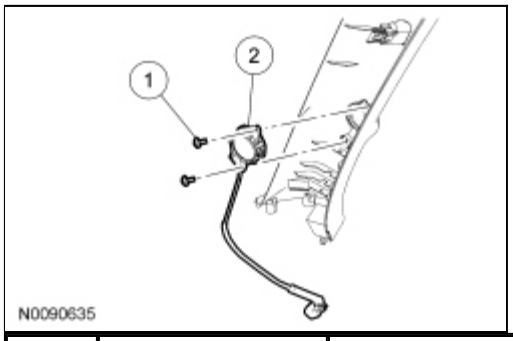
- Verify the mounting bracket and microphone are snug to the headliner.

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Speaker — A-Pillar

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	W701678-S	A-pillar speaker screws (2 required)
2	18978	A-pillar speaker

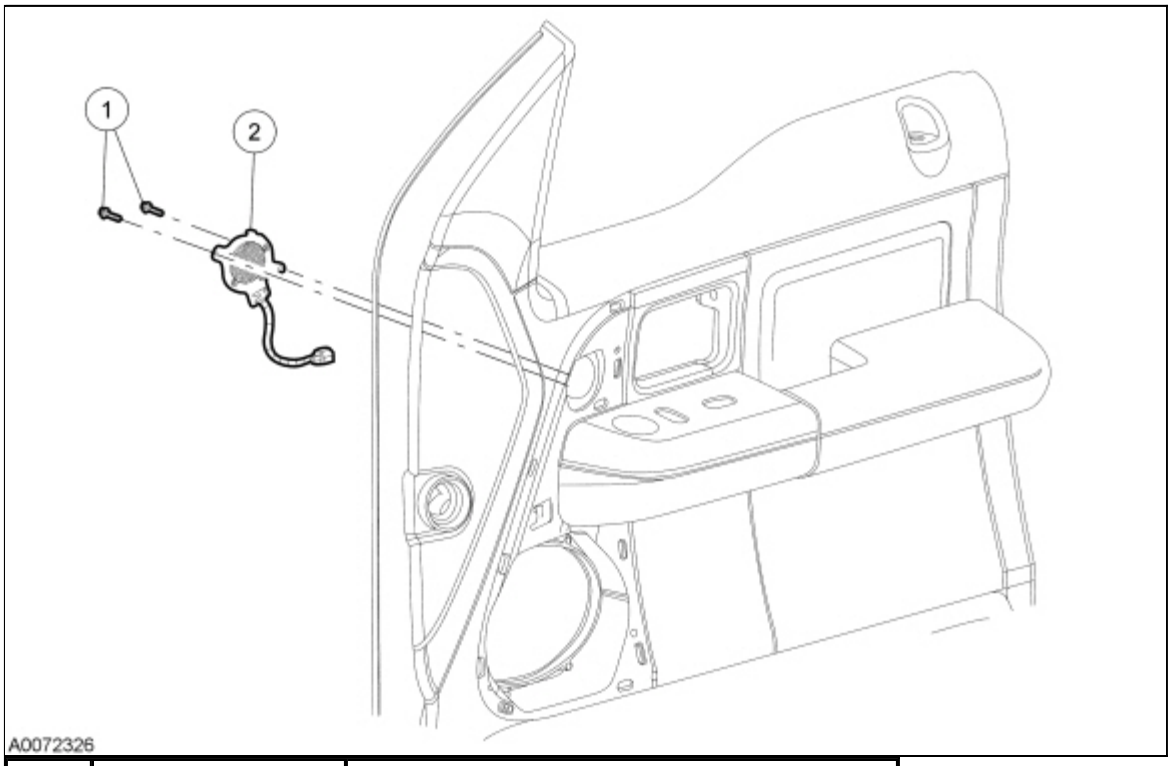
Removal and Installation

1. Remove the A-pillar trim panel. For additional information, refer to Section 501-05 .
2. Remove the 2 screws and the A-pillar speaker.
3. To install, reverse the removal procedure.

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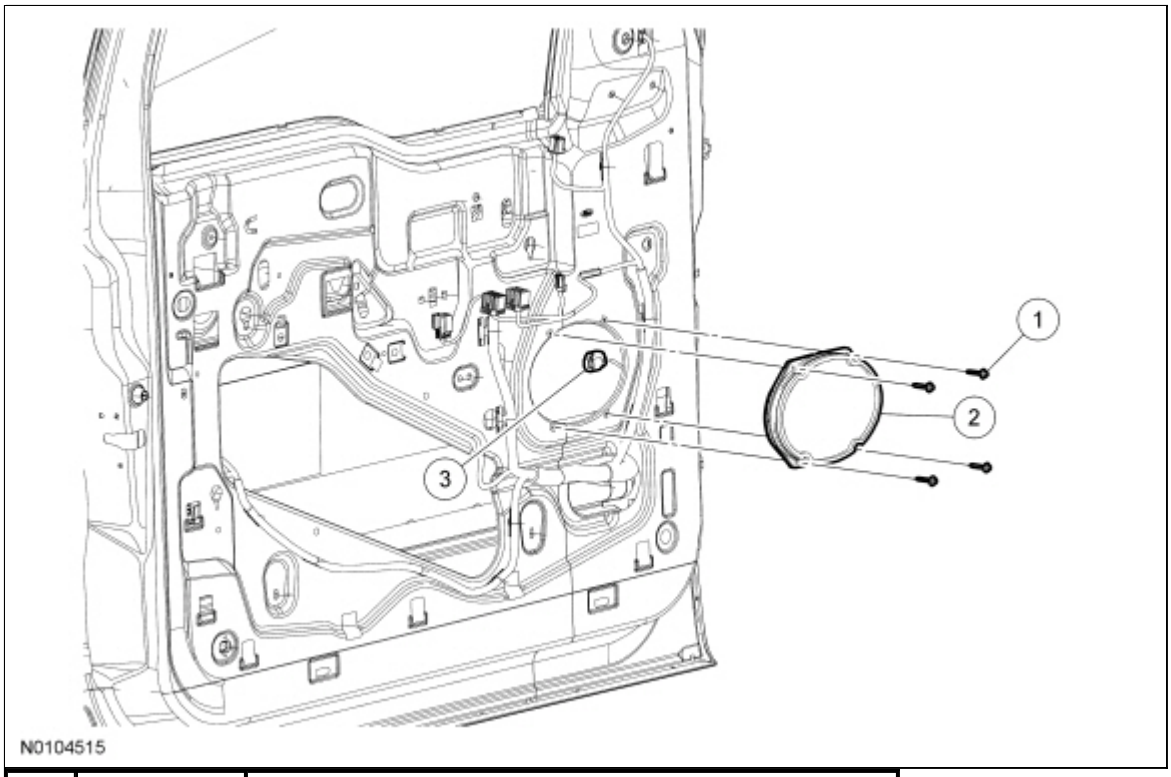
Speaker — Door

Front Door Tweeter Speaker



Item	Part Number	Description
1	W701678	Tweeter speaker screws (2 required)
2	19B170/19B171	Tweeter speaker (RH/LH)

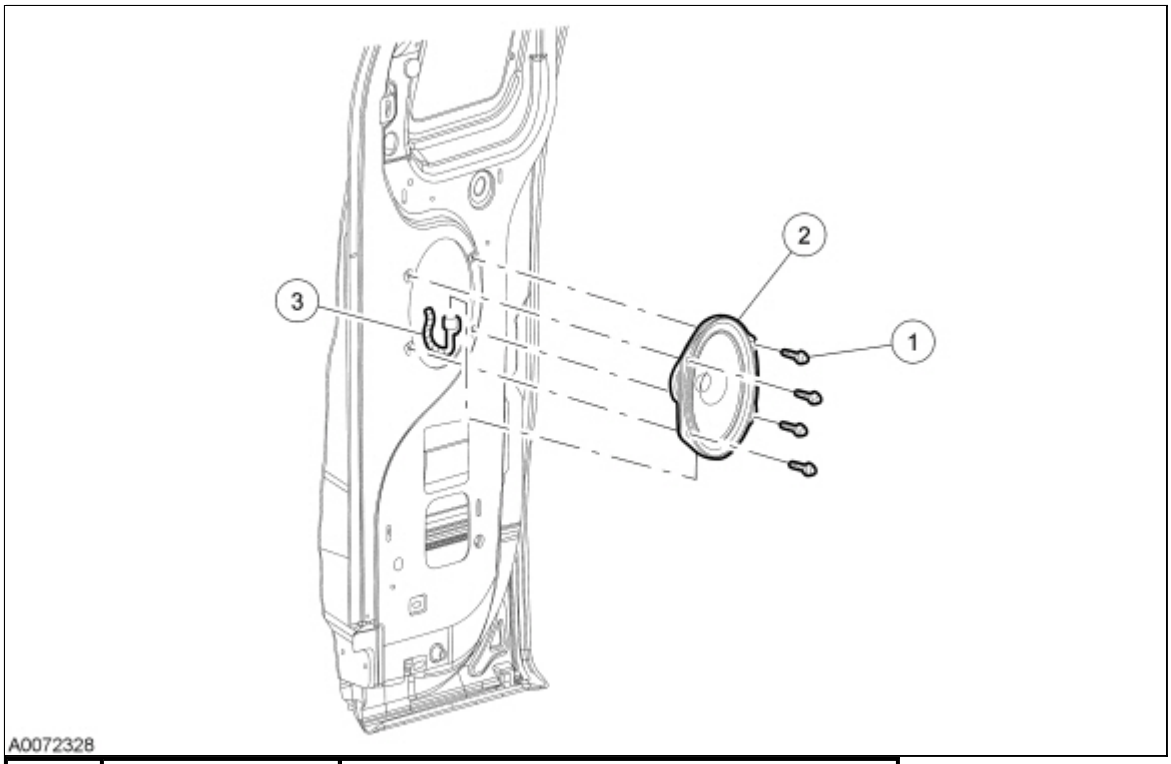
Front Door Speaker



Item	Part Number	Description
1	W707628	Front door speaker screws (4 required)
2	18808	Front door speaker
3	—	Front door speaker electrical connector (part of door harness)

Rear Door Speaker

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Item	Part Number	Description
1	W706766	Rear speaker screws (4 required)
2	18808	Rear speaker
3	180103	Rear speaker electrical connector

Removal and Installation

Front door

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws (2 for the tweeter, 4 for the door speaker) and the speaker.
   - Disconnect the electrical connector.

Rear door

3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

4. Remove the 4 screws and the rear door speaker.
   - Disconnect the electrical connector.

All speakers

5. To install, reverse the removal procedure.

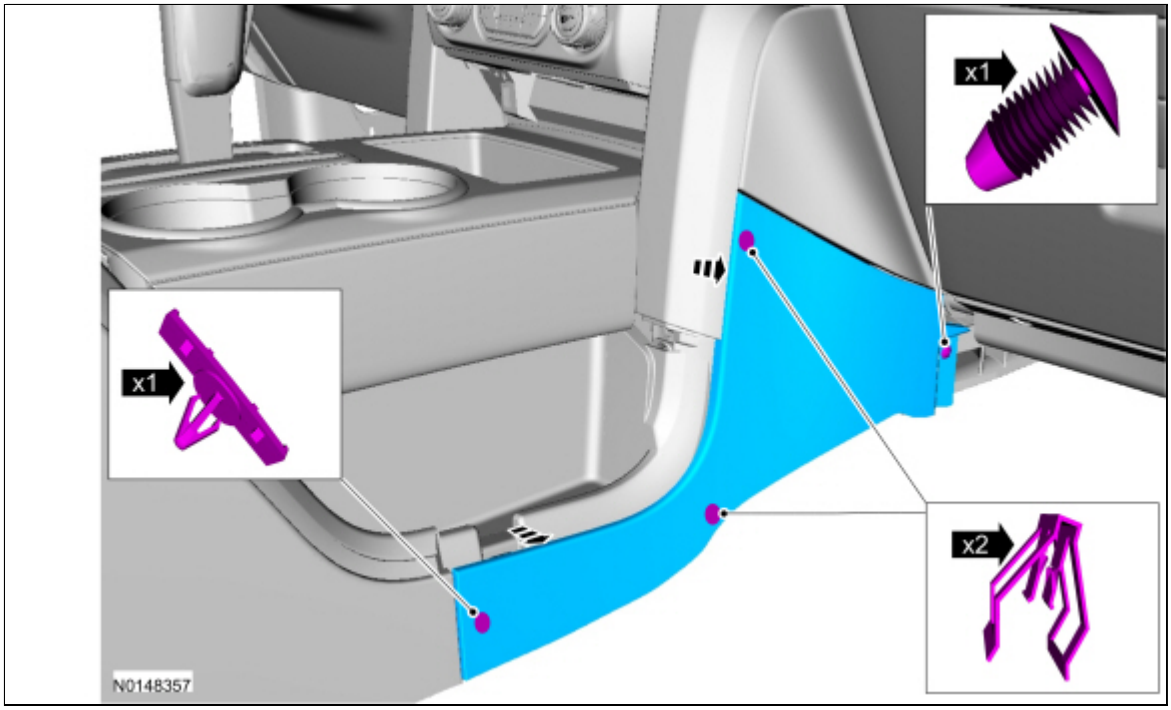
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Universal Serial Bus (USB) Cable and Port

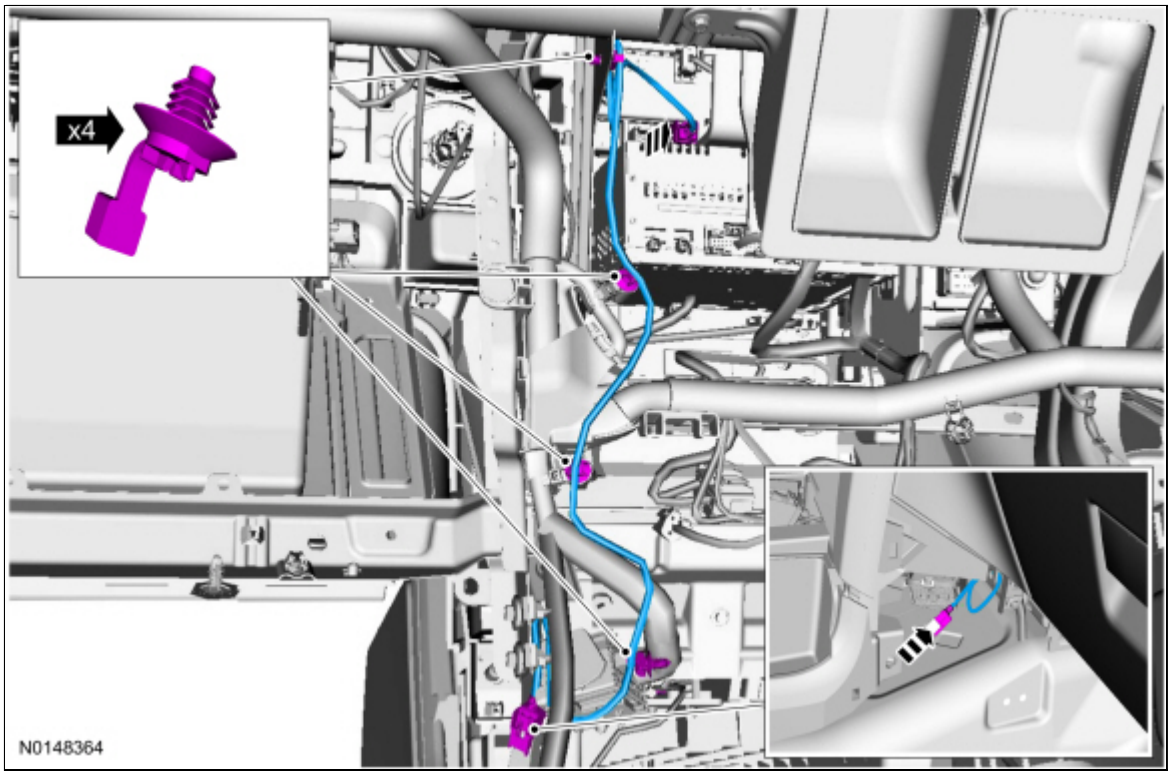
Removal and Installation

Instrument panel USB cable with floor console

1. Remove the Accessory Protocol Interface Module (APIM). Refer to Accessory Protocol Interface Module (APIM) .
2. For access remove the glove box. Refer to Section 501-12 .
3. Remove the RH lower floor console trim panel



4. Remove the USB cable following the routing shown.



Instrument panel USB without floor console

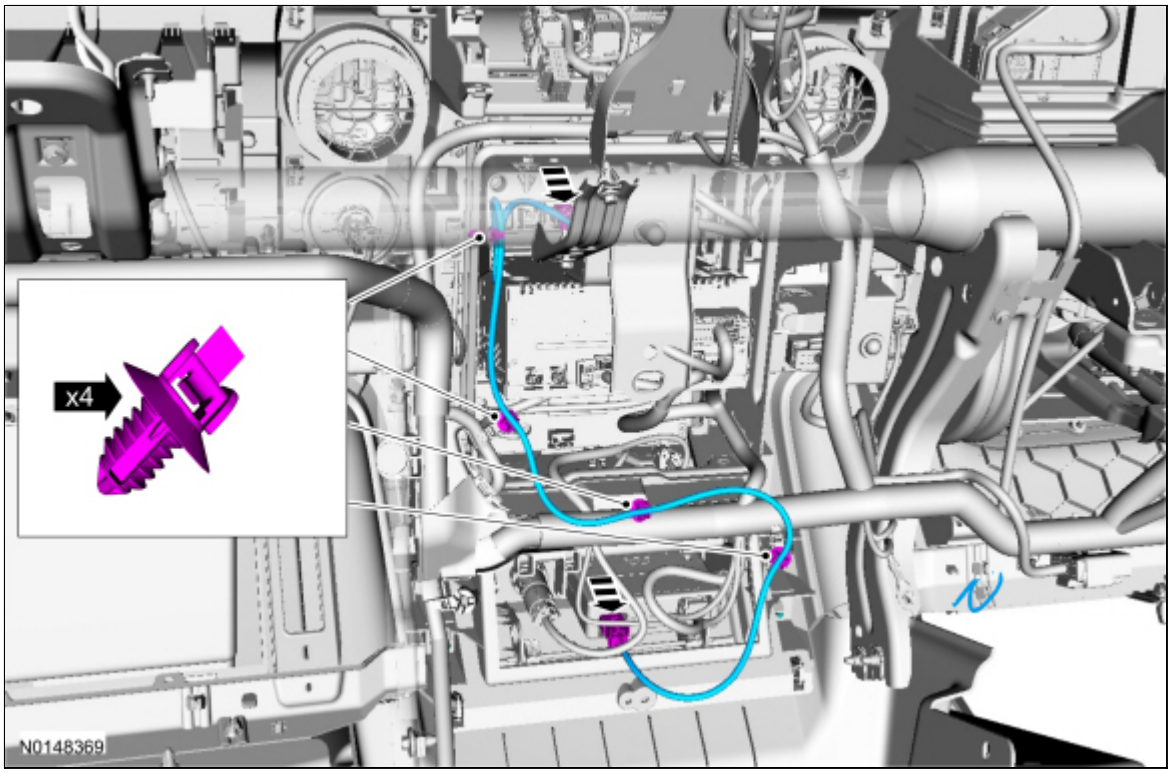
5. Remove the Accessory Protocol Interface Module (APIM). Refer to Accessory Protocol Interface Module (APIM) .

6. For access remove the glove box. Refer to Section 501-12 .

7. Remove the media hub. Refer to Media Hub .

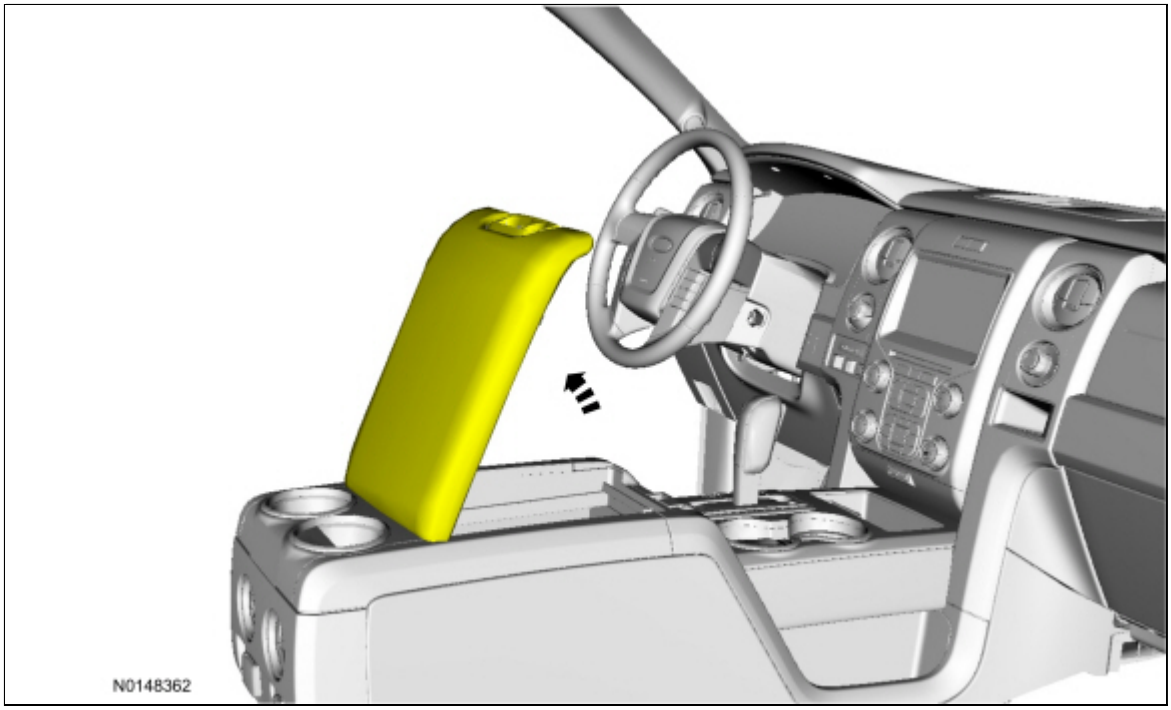
8. Remove the USB cable following the routing shown.

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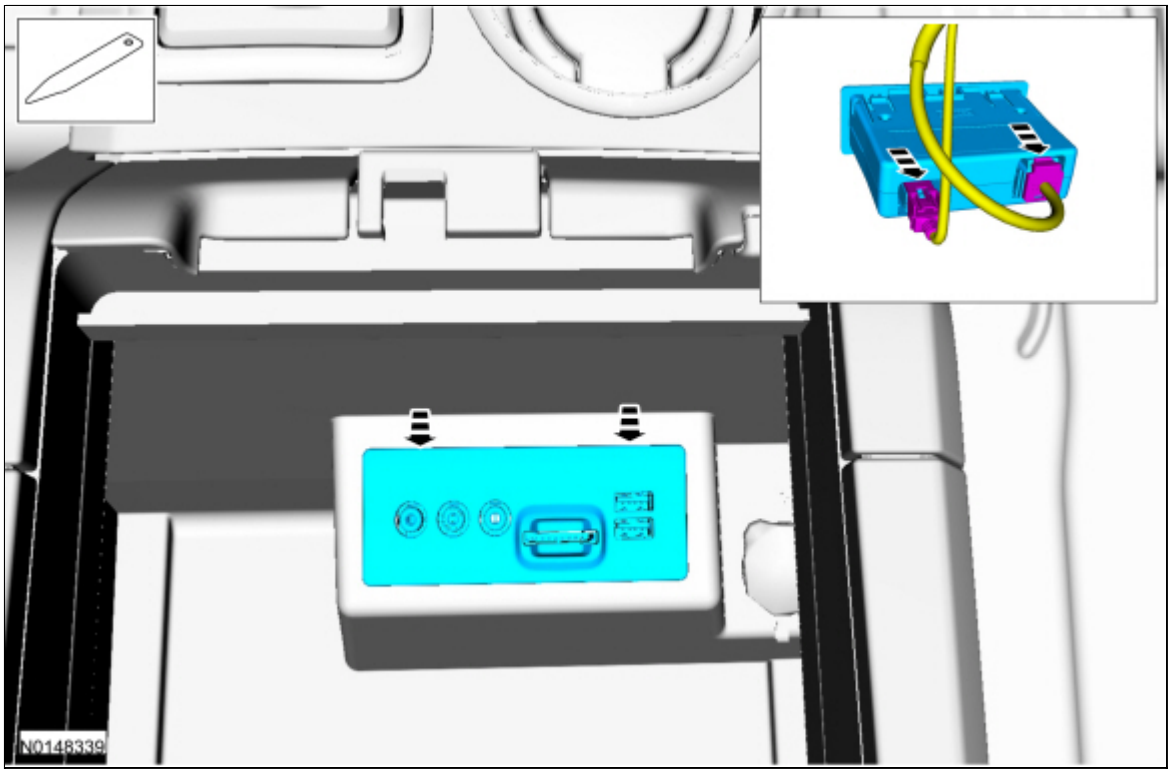


Floor console USB cable

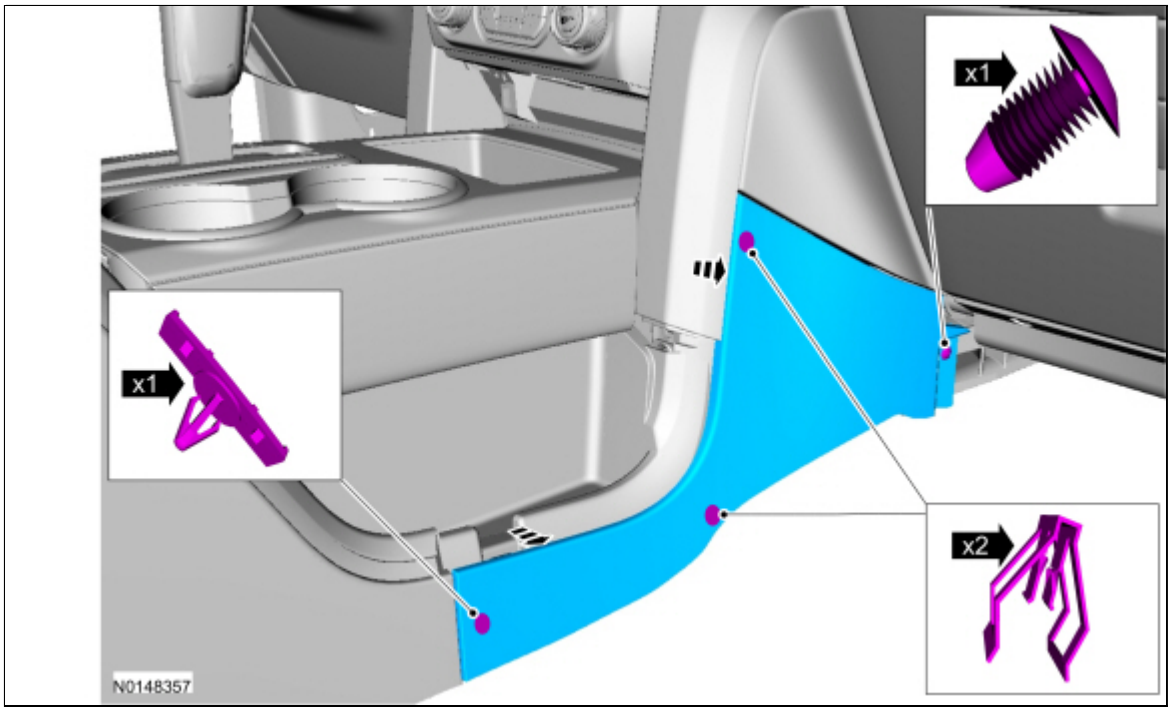
9. Open the floor console stowage bin door.



10. Remove the media hub.



11. Remove the RH lower floor console trim panel.

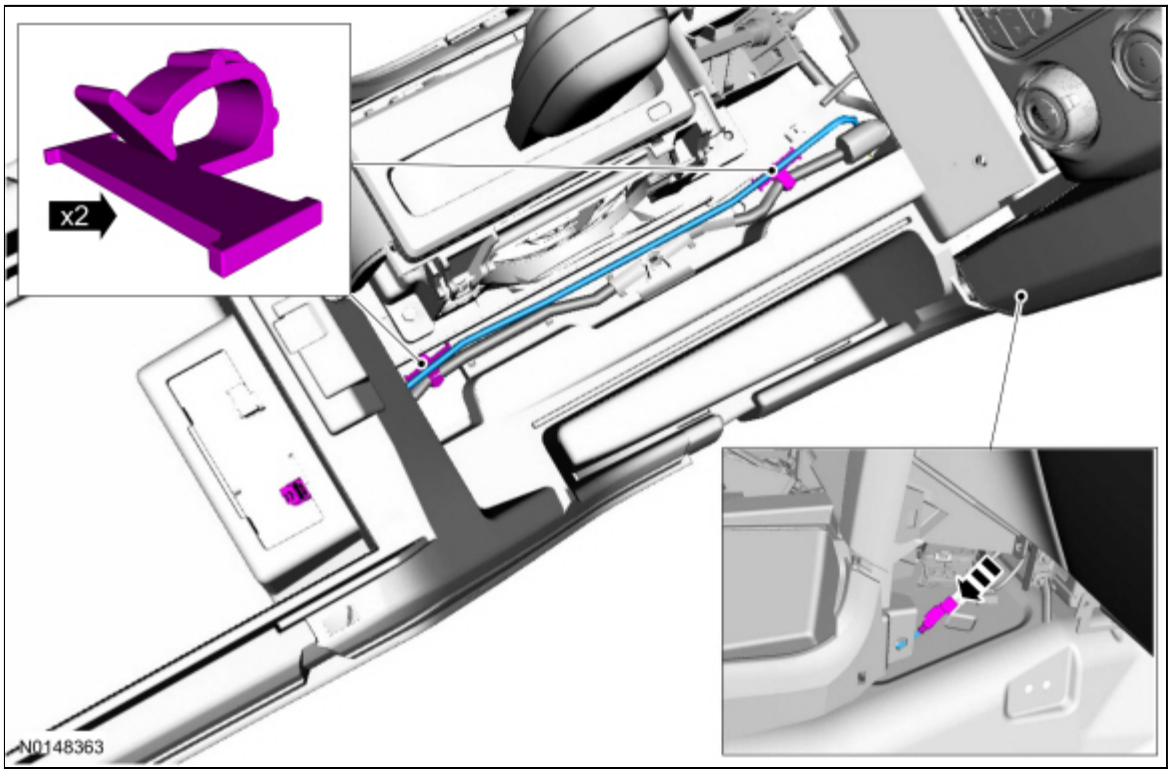


12. Remove the floor console upper finish panel.

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13. Remove the floor console USB cable following the routing shown.



All USB cables

14. To install, reverse the removal procedure.

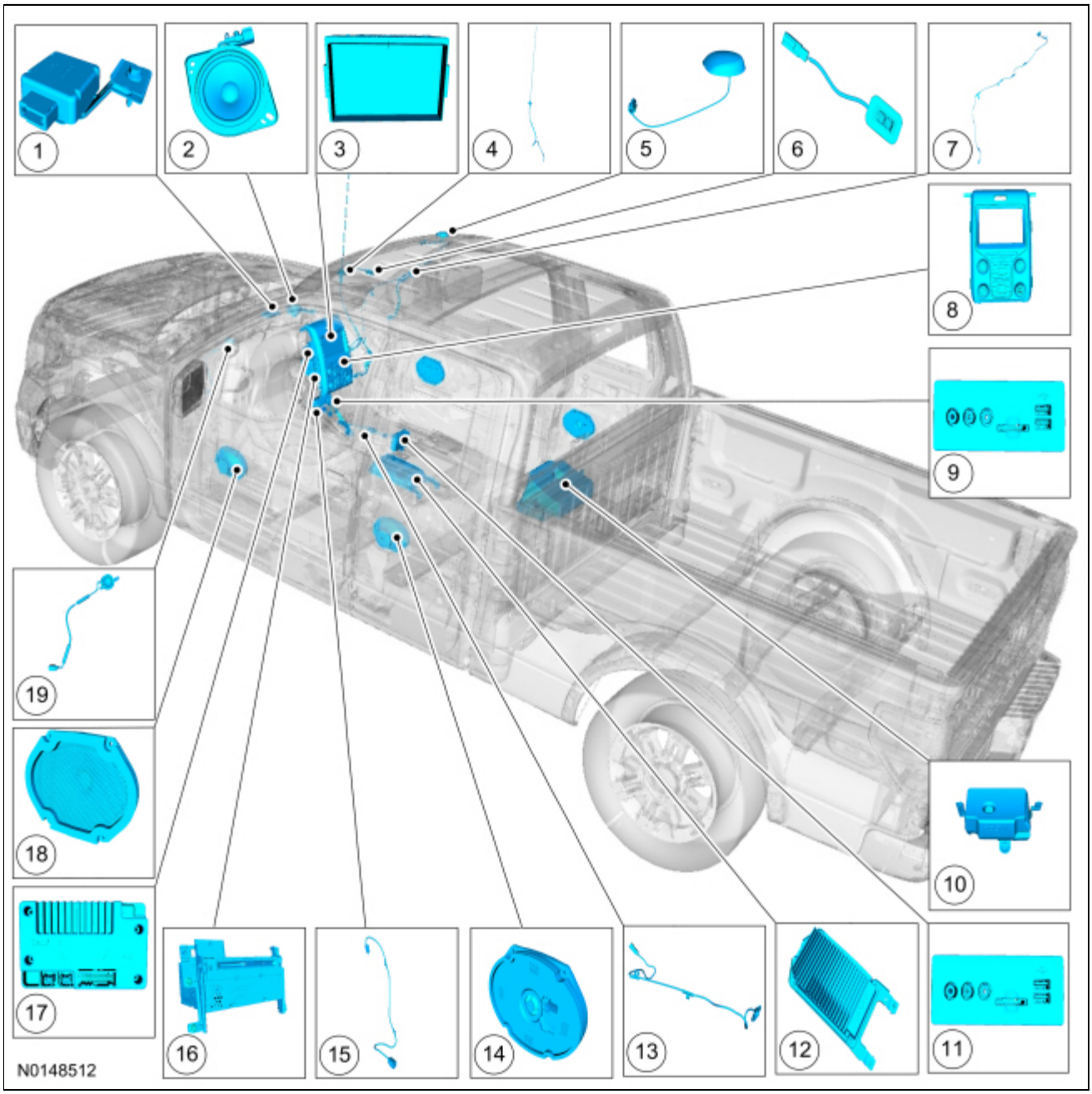
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Torque Specifications

Description	Nm	lb-in
AM/FM antenna mast	4.2	36
AM/FM antenna base bolts	2.5	23
Audio Front Control Module (ACM)	2.5	23
Accessory Protocol Interface Module (APIM)	0.6	5
Front Controls Interface Module (FCIM)	3	27
Front Display Interface Module (FDIM)	2.5	23
Satellite Antenna retaining nut	7	62

Information and Entertainment System

Component Location



Item	Description	Comments

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1	GPSM	Located in the top center area of the instrument panel
2	Instrument panel speaker	-
3	FDIM	Attached to the APIM
4	AM/FM/ HD Radio® antenna and AM/FM/ HD Radio® coaxial cable	HD Radio® (if equipped)
5	Satellite radio antenna	If equipped
6	SYNC® microphone	Located in the headliner
7	Satellite radio antenna coaxial cable	If equipped
8	FCIM	-
9	Media hub	Located in the instrument panel (with split bench)
10	Subwoofer speaker enclosure	Located under the LR seat
11	Media hub	Located in the console (with front captain chairs)
12	Audio DSP module	With split bench shown, with front captain chairs similar
13	USB cable	Located in the console (with front captain chairs)
14	Rear door speaker	-
15	USB cable	Located in the instrument panel (with split bench)
16	ACM	-
17	APIM	Attached to the FDIM
18	Front door speaker	-
19	A-pillar speaker	LF shown, RF similar

Overview

The audio system consists of the following:

Main Components

- 8 speakers
- 8-inch (203 mm) FDIM touchscreen
- AM/FM single CD ACM
- APIM
- Audio DSP module
- FCIM
- GPSM
- Media hub
- Redundant steering wheel controls
- SYNC® microphone

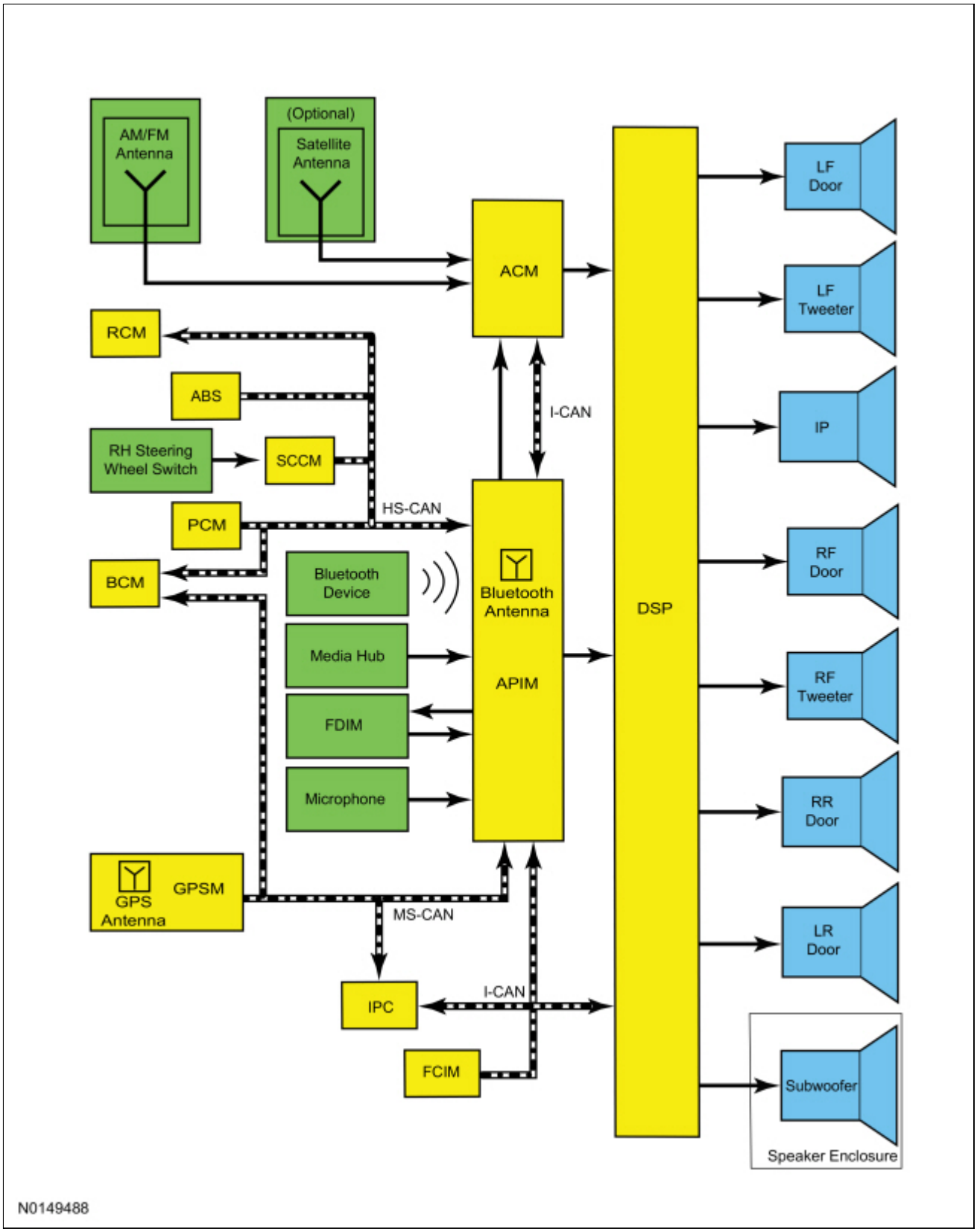
Main Features

- Optional HD Radio®
- Optional navigation
- Optional satellite radio
- SYNC®

System Operation

System Diagram

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Network Message Chart

NOTE: A missing network message is indicated by a U-code DTC . When a missing message DTC (U-code)

sets, it is important to look for symptoms present in the audio system and throughout the vehicle, and to review the complete message list to determine which other modules rely on the same message. Refer to CAN Module Communication Message Chart in Section 418-00 . When the other modules have been identified, run the self-test for those modules. If the same message is missing from those modules, the identical, or similar lost communication DTCs may be set in those modules. Confirmation of missing messages common to multiple modules can indicate that the originating module is the source of the concern, or that the communication network may be at fault.

It is very important to understand the following:

- Where the input originates
- All of the information necessary for a feature to operate
- Which module(s) receive(s) the input or command message
- Which module controls the output of the feature
- If the module that receives the input controls the output of the feature, or whether it outputs a message over the CAN to another module.

Module Network Input Messages - ACM

Broadcast Message	Originating Module	Message Purpose
FCIM set volume	FCIM	Used to set the ACM volume from the FCIM .
Media player display request	APIM	Used to display detailed folder and track information on the FDIM from the ACM for the different audio system operating modes when the appropriate FCIM button is pressed.
SYNC® alerts	APIM	Used for text message, news, sports, weather, satellite radio artist/title favorites (if activated), and traffic alert notifications.

Module Network Input Messages - APIM

Broadcast Message	Originating Module	Message Purpose
ACM radio functions	ACM	Used to display the ACM radio functions such as seek, tune and AM/FM stations on the FDIM .
Airbag status	RCM	Used to monitor airbag deployment status for 911 Assist®.
Audio source	ACM	Used to display the selected audio source on the FDIM .
DSP volume status	Audio DSP module	Used to display the audio DSP module volume on the FDIM .
CD load/eject	ACM	Used to display the loaded or ejected CD status on the FDIM .
Date and time	IPC	Used to display the current date and time on the FDIM .
Door ajar status	BCM	Used to determine the door ajar status for the accessory delay feature.
FCIM button press	FCIM	Used to indicate when a button is pressed on the FCIM so the audio system can make the desired setting change.
Front seat belt latched status	RCM	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s)

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		are buckled.
Ignition key type	BCM	Used to determine if a MyKey® is enabled and in use.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for APIM operating modes and fault reporting.
Illumination dimming level	BCM	Used to control the backlight intensity of the FDIM based on the dimmer switch input.
Language selection	IPC	Used to display information on the FDIM in the selected language.
Navigation rolling wheel count	ABS module	Used to provide more accurate vehicle position tracking when the GPS signal is temporarily unavailable.
Seat belt buckle status	RCM	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.
Steering wheel switch media	SCCM	Used to set the audio system listening mode (AM/FM, CD, etc.) from the steering wheel switch.
Steering wheel switch seek left	SCCM	Used to access the next strong station to the left, to restart an audio track, to access the previous satellite radio station preset (if equipped), or the previous audio track from the steering wheel switch.
Steering wheel swtich seek right	SCCM	Used to access the next strong station to the right, to access the next satellite radio station preset (if equipped), or to access the next audio track from the steering wheel switch.
Steering wheel switch voice	SCCM	Used to access or exit the voice command feature from the steering wheel switch.
Steering wheel switch volume down	SCCM	Used to decrease the audio system volume from the steering wheel switch.
Steering wheel switch volume up	SCCM	Used to increase the audio system volume from the steering wheel switch.

Module Network Input Messages - Audio DSP Module

Broadcast Message	Originating Module	Message Purpose
Belt-Minder® audio mute	IPC	Used to mute speaker output so the Belt-Minder® tone can be more easily heard. This message only applies to vehicles with a MyKey® enabled and in use. The audio system is muted until the safety belt(s) are buckled.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for audio DSP module operating modes and fault reporting.
MyKey® volume limit	IPC	Used to limit the maximum audio system volume when a MyKey® restricted key is in use.
Navigation audio settings	APIM	Used to set the navigation command volume.

Module Network Input Messages - FCIM

Broadcast Message	Originating Module	Message Purpose
Door ajar status	BCM	Used to determine the door ajar status for the accessory delay feature.
Ignition status	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for FCIM operating modes and fault reporting.
Illumination dimming level	IPC	Used to control the backlight intensity of the FCIM based on the dimmer switch input.

Module Network Input Messages - GPSM

Broadcast Message	Originating Module	Message Purpose
Ignition switch position	BCM	Used to indicate the ignition state (OFF, ACCESSORY, RUN, and START) required for GPSM operating modes and fault reporting.
Selector lever (PRNDL) status	BCM	Used to verify the gear lever position for vehicle direction data.

Accessory Delay Feature

The accessory delay feature allows the audio system to be operated for a preset period of time after the ignition is turned off and a front door has not been opened.

AM/FM Radio

The AM/FM fender-mounted antenna receives radio waves and sends them through the AM/FM antenna coaxial cable to the ACM . The radio waves are converted into fluctuating AC voltage and sent as left and right analog audio signals to the audio DSP module. The audio DSP module processes the audio signals and sends them to the speakers as fluctuating AC voltage.

APIM Programming

The APIM requires specific programming procedures for correct operation. APIM programming is required when:

- The APIM is replaced
- Directed by a TSB. Updates to resolve SYNC® performance concerns can only be performed when directed by a TSB.
- Feature upgrades are requested. Occasional feature upgrades and/or new applications can be programmed when they become available. This type of programming is available upon customer request and expense.

There are 3 types of APIM programming available:

- Module Replacement — Used when the APIM has been replaced. This type of programming performs the required provisioning (restores software for newly installed hardware).
- Standard — Used to update the APIM and any currently installed Applications to the latest software level.
- Custom — Used to show all the available software options (including applications that may not have

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been installed previously) that can be programmed into the APIM . Use this selection when upgrades become available or as directed by a TSB.

There are 3 types of software installation methods:

- Full Flash (Force CIP) — A CIP program is the entire software package for the APIM . Performing a Full Flash erases the existing APIM software and installs the complete program. A Full Flash should only be performed if a Service Pack is not available. If a Full Flash is performed, all applications must be re-installed. Performing a Full Flash by selecting Force CIP requires additional programming time and is not necessary unless directed by a TSB.
- Service Pack — A Service Pack update only provides the necessary software to update the existing APIM program to a new level. For example, a Service Pack changes the software program from an 'AA' to an 'AB' version level. It does not delete or overwrite the existing APIM software. A Service Pack is a much smaller program than a Full Flash and requires less downloading and programming time. A Service Pack software installation should always be performed instead of a Full Flash, if possible.
- Applications — Applications are special software programs that may be installed on the APIM . Applications necessary for each vehicle are determined by the vehicle build information stored in the Ford online database. Selecting individual applications for installation may not be necessary every time the APIM is programmed.

NOTE: VIP programming is not selectable because the VIP is configured automatically during programming.

There are some general programming guidelines that are applicable to multiple types of programming:

- Full Flash/Force CIP
  - The media hub must be removed for programming.
  - The diagnostic scan tool and SYNC® Re-Flash Kit (or equivalent), are required to complete the flash procedure.
  - All previously paired phones are deleted from the SYNC® system.
  - The file needs to be downloaded from the Ford online database. Allow for extra time in order to complete the download. The compressed files are between 200 and 400 megabytes (MB), and once downloaded, are extracted to the full size of approximately 2 gigabytes (GB).
  - Once diagnostic scan tool programming is complete, applications need to be installed with the USB flash drive. This should be accomplished by reinstalling the media hub and connecting the USB flash drive to the media hub.
- Service Pack and Applications
  - A USB flash drive with a minimum 1 gigabyte (GB) storage capacity is required.
  - The file is downloaded from the Ford online database onto the flash drive. The files are then transferred via the flash drive to the APIM through the vehicle USB port.

To perform module replacement programming, refer to Accessory Protocol Interface Module (APIM) Module Replacement Programming

To perform standard programming, refer to Accessory Protocol Interface Module (APIM) Standard Programming

To perform custom programming, refer to Accessory Protocol Interface Module (APIM) Custom Programming

Audible Prompts

The APIM receives stereo inputs from connected mobile phones and mono inputs from the SYNC® microphone.

Stereo and mono inputs, voice prompts, the TTS feature, ringtones, and any audio received through a connected mobile phone are transmitted to the ACM as stereo or mono sound.

The TTS feature speaks information so that it does not have to be read from the display.

Audio Extended Play

This feature allows the audio system to operate with the ignition OFF, regardless of door latch position. When the power button on the FCIM is pressed, audio system functionality is enabled and remains active for a period of 20-60 minutes, depending on configuration settings. To turn the audio system off, the power button on the FCIM is pressed. Audio extended play will not function if the battery load shed is active.

Battery Load Shed

The BCM uses the battery current sensor to monitor the battery state of charge. The battery current sensor is attached to the battery ground cable. With the vehicle OFF and the ignition in ACC or ON, a load shed message is sent over the CAN when the BCM determines that the battery state of charge is below 40%, 45 minutes have elapsed, or 10% of the charge has been drained. This message turns off the audio system to save the remaining battery charge. Under this condition, SYS OFF TO SAVE BATT is displayed on the centerstack infotainment display to notify the driver that battery protection actions are active. To clear the load shed state, start the vehicle.

Bluetooth Mode

Bluetooth is a secure, short-range radio frequency that allows devices to communicate wirelessly through radio waves. The operating range of a Bluetooth signal is a maximum of 9.75 m (32 feet).

The Bluetooth interface can accommodate both Bluetooth-enabled mobile phones and Bluetooth-enabled media devices. The SYNC® system allows interaction with several types of customer Bluetooth devices, including mobile phones and media devices. The APIM contains an on-board Bluetooth chipset, which enables certain wireless devices to interact with the system. Any Bluetooth device used with the SYNC® system must first be paired with the system before it is operational.

Only one Bluetooth phone and one Bluetooth media device can be connected to the system at any one time. If an additional device of either type is paired with the system and made active, the APIM disconnects any active connection and establishes a connection with the new device.

When a new Bluetooth device is added, the APIM and the Bluetooth device must be paired together. Most Bluetooth devices can pair with the SYNC® system, although functionality may vary. To determine if a Bluetooth device is supported, verify the customer device is on the compatibility list for the current APIM software level.

Pairing a Bluetooth device is accomplished through the "Add Device" selection of the phone menu. When pairing a device, the SYNC® system generates a unique PIN that must be entered on the Bluetooth device in order for the pairing process to be successful. There are also some device-specific actions that must take place. For information on the pairing process, refer to the Owner's Literature.

It is important to understand that not all mobile phones have the same level of features when interacting with the SYNC® system. For a list of compatible phones, Refer to SyncMyRide website.

Composite Audio-Video Input Mode

The composite audio and video inputs consist of the RCA jack connections that are used for playing video or audio content from an external device (such as a gaming system). The media hub contains an internal composite audio/video translator connected to the external RCA jacks, which outputs video and audio signals to the APIM via a shielded audio and video harness.

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DSP

The Sony® audio system provides theater quality sound in the vehicle. Audio signals are sent from the ACM to the audio DSP module, where the signals are processed and sent to the speakers.

The audio DSP module determines the correct audio environment based on the audio signals and network messages it receives from other audio system modules. These messages include such information as fade/balance and speed compensated volume settings.

HD Radio® (If Equipped)

HD Radio® is a free to the public digital radio broadcast. HD Radio® channels duplicate certain analog FM channels, and some subdivide (multicast) the digital signal into multiple channels that do not have analog equivalents.

The AM/FM fender-mounted antenna receives radio waves containing data (station call letters, artist names, song titles, etc.) and digital HD Radio® audio. The radio waves are sent through the AM/FM antenna coaxial cable to the ACM where the data is separated from the audio. The data is sent to be displayed on the centerstack infotainment display, and the audio is converted into fluctuating AC voltage and sent as left and right analog audio signals to the audio DSP module. The audio DSP module processes the audio signals and sends them to the speakers as fluctuating AC voltage.

MyKey® Audio Operation

When a MyKey® is in use, the following restrictions are activated:

- The audio system is muted until the safety belts are buckled when the Belt-Minder® feature is activated. The MyKey® "BUCKLE UP TO UNMUTE AUDIO" is displayed in the information display.
  - This is a standard setting and cannot be changed.
- Satellite radio adult content stations are blocked by being muted.
- If "Always On" is selected in the MyKey® menu, 911 Assist® and the Do Not Disturb features are enabled and cannot be disabled.
- The audio system volume is limited to 45%. In an attempt to exceed the limited volume, the MyKey® VOLUME LIMITED message is displayed in the centerstack infotainment display.
  - This is an optional setting.

Refer to the Owner's Literature for more information on MyKey®.

Navigation

The navigation system guides the user to a pre-entered destination. Map data is read from the map data SD card plugged into the media hub. The APIM calculates route information based on GPS data received by the GPSM . The APIM also uses vehicle speed and transmission gear selected signals received through the network to detect vehicle speed and direction, resulting in more accurate navigation tracking. The navigation display is shown on the FDIM . Installing different size tires other than what is indicated on the vehicle placard may cause the navigation system to be inaccurate.

The voice recognition system allows the user to interface with the system without using the touchscreen. A microphone located in the headliner provides a direct input to the APIM .

Satellite Radio (If Equipped)

Satellite radio is a subscription-based service.

The satellite radio roof-mounted antenna receives signals containing data (station call letters, artist names, song titles, etc.) and digital satellite radio audio. These signals are sent through the satellite radio antenna

coaxial cable to the satellite radio receiver built into the ACM . The ACM separates the data from the audio. The data is sent to be displayed on the centerstack infotainment display, and the audio is converted into fluctuating AC voltage and sent as left and right analog audio signals to the audio DSP module. The audio DSP module processes the audio signals and sends them to the speakers as fluctuating AC voltage.

SD Card Mode

The SD card slot can be used for playing audio content that is stored on a SD card.

Image files can be saved to the APIM from a SD card in order to be used as wallpaper backgrounds displayed on the FDIM .

SD card data is transmitted to the APIM through the USB cable.

SIRIUS Data Services - If Equipped

SIRIUS Data Services is a subscription-based service and requires a separate subscription from the satellite radio.

The combination HD /satellite radio roof-mounted antenna receives digital signals and sends them to the satellite radio receiver through the satellite radio antenna coaxial cable. The satellite radio receiver is built into the ACM . The signals are then sent to the APIM , and then to the FDIM touchscreen to be displayed.

SIRIUS Data Services allows the customer to receive updates for:

- Fuel Prices
- Movies (movie listings, start times, ratings)
- Sports (in game and final scores, weekly schedules)
- Stocks
- Ski Conditions
- Traffic (traffic speed, accidents, construction, road closings)
- Weather (current weather, forecasts, radar images)

Some services may be available separately while others are only available as packages.

Speed Compensated Volume

The audio DSP module adjusts the audio system volume based on the VSS signal to compensate for speed and wind noise.

When a MyKey® is in use and the MyKey® radio volume limiter is enabled, the speed compensated volume is disabled.

Steering Wheel Switch Functions

The RH 8-way steering wheel switches operate the volume +/-, seek +/-, and the audio system SYNC® functions (media, voice, and phone).

SYNC® System

The SYNC® system is a hands-free communication and entertainment system that supports many features. All features are not available with every phone.

The SYNC® system provides the ability to:

- Connect media devices (such as an iPod® or USB device) in order to play audio files.

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- Control the entertainment system, climate control system, ambient lighting system, and several other vehicle systems using the touchscreen or voice controls.
- Initiate an emergency call (911 Assist®) when the airbags deploy.
- Play media files via a paired Bluetooth-enabled audio device.
- Produce vehicle health reports.
- Send and receive phone calls via a paired Bluetooth-enabled phone.
- Send and receive text messages via a paired Bluetooth-enabled phone.
- Wi-Fi signal receiver for in-car Internet access (requires customer-supplied USB modem).

SYNC® Services

SYNC® Services is a subscription-based service. For SYNC® Services subscription information, refer to SyncMyRide .

The customer's mobile phone is used to access and download the SYNC® services. SYNC® services information received by the customer's mobile device is sent to the APIM .

The GPS antenna, integral to the GPSM , is used to detect the location and direction of the vehicle.

SYNC® services includes the following features:

- Business search
- Personalized text alerts
- Real-time traffic updates
- Turn-by-turn directions

SYNC® services allows the customer to receive updates for:

- Entertainment
- News
- Sports
- Stocks
- Travel
- Weather

USB Mode

The USB port can be used for connecting a media device (such as an iPod®) with the device's available cable, or for directly plugging in a portable mass storage device, such as a thumb drive. When playing media files stored on a mass storage device, the SYNC® system only plays files that do not have DRM protection. The USB port can also be used for uploading vehicle application upgrades. The USB port is powered by the APIM , so no external power source is needed to power a device plugged into the USB port if the device supports this feature.

In addition to audio information, metadata (information such as artist, album title, song title, and genre) may also be sent to the APIM from a device plugged into the USB port. The APIM uses the metadata to create indexes that can be used to sort for particular music, based on customer preference. Not all USB devices can send metadata to the APIM . When a new media device is connected to the SYNC® system, the APIM automatically indexes the information. This may take several minutes (depending on the amount of data on the device), and is considered normal operation. When a device that was previously connected to the SYNC® system is reconnected, the APIM updates the index (rather than creating a new one), which reduces the amount of time needed to index the device.

Image files can be saved to the APIM from a USB device. These images can be displayed on the FDIM as wallpaper backgrounds.

Voice Recognition

Voice recognition is used for many vehicle functions, including audio system and climate controls. The microphone relays the microphone input to the APIM through dedicated wiring. The TTS and voice prompt features speak certain text information and interaction requests to minimize driver distraction by having to look at the audio system display while driving. The ringtone alerts the driver to an incoming call. The microphone is also used to detect outgoing audio during a phone call.

Audible prompts can range from a simple tone to more elaborate spoken text, based on the customer setting. When interaction mode is set to standard, detailed guidance is provided. When interaction mode is set to advanced, most prompts are tones only and minimal audible guidance is provided. Refer to the Owner's Literature for further information on voice interaction.

The audio signals for the TTS and voice prompt features, ringtones, and audio from the outside device during a phone call, are sent from the APIM to the ACM .

Component Description

ACM

The ACM can be operated with the ignition in RUN, ACC, or OFF.

The ACM receives radio waves containing audio from the antenna coaxial cable(s) and converts them into fluctuating AC voltage. The ACM receives audio signals from the APIM in the form of fluctuating AC voltage. The ACM processes these inputs and sends left and right analog audio signals to the audio DSP module as fluctuating AC voltage. The audio DSP module processes the audio signals and sends them to the speakers as fluctuating AC voltage.

If equipped with satellite radio or HD Radio®, the ACM will also receive radio waves containing data through the antenna coaxial cable(s). The data is sent to be displayed on the centerstack infotainment display.

The ACM requires PMI when it is replaced.

Antenna

The AM/FM fender-mounted antenna receives radio waves containing audio and sends them through the AM/FM antenna coaxial cable to the ACM . The antenna mast is used to amplify the AM/FM radio waves to improve reception.

If equipped with HD Radio®, the AM/FM fender-mounted antenna receives radio waves containing data and digital audio and sends them through the AM/FM antenna coaxial cable to the ACM .

If equipped with satellite radio, the satellite radio roof-mounted antenna receives signals containing data and digital audio. These signals are sent through the satellite radio antenna coaxial cable to the satellite radio receiver built into the ACM .

APIM

Audio signals received by the APIM are sent to the ACM as fluctuating AC voltage.

The APIM consists of 2 internal modules: the CIP and the VIP . The modules are not replaceable individually, but can be flashed independently, if required.

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The CIP interfaces with all of the inputs to the APIM . It contains an analog-to-digital-to analog converter, as well as the Bluetooth chipset. Any Application upgrades that are available to the consumer are loaded directly to the CIP through the USB port.

The VIP provides an interface between the CIP and the vehicle. Its main functions are controlling the APIM power management and translating inbound and outbound CAN signals. In addition, the VIP queries the modules on the network to retrieve any DTCs when a vehicle health report is requested.

Audio DSP Module

The audio DSP module enhances the input audio signal sound quality from the ACM .

Audio signals received by the audio DSP module are sent to the audio system speakers as fluctuating AC voltage.

The audio DSP module receives audio signals from the ACM in the form of fluctuating AC voltage. The audio DSP module processes these inputs and sends left and right analog audio signals to the speakers as fluctuating AC voltage.

The audio DSP module requires PMI when it is replaced.

FCIM

The FCIM can be operated with the ignition in RUN, ACC, or OFF.

The FCIM audio system buttons provide one of the methods in which the customer interacts with the infotainment system.

The FCIM is separate from the ACM .

FDIM

The FDIM can be operated with the ignition in RUN, ACC, or OFF.

The FDIM touchscreen provides one of the methods in which the customer interacts with the infotainment system.

The FDIM plugs directly into the APIM , and therefore does not communicate directly on any network, and no external circuits are connected.

Global Positioning System Module (GPSM)

The Global Positioning System Module (GPSM) provides vehicle location for real-time traffic reports and re-routing, and for identifying vehicle location in the event of a collision.

For vehicles with navigation, the Global Positioning System Module (GPSM) acts as the antenna for the navigation system.

Vehicle location information is broadcast from the Global Positioning System Module (GPSM) to the APIM .

Media Hub

The media hub allows for various audio and video devices to play content through the vehicle speakers and to be viewed in the FDIM .

The media hub receives inputs from:

- 2 USB ports
- 1 Secure Digital (SD) card slot
- 1 set of component RCA jacks

Steering Wheel Switches

The RH steering wheel switches contain series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

The SCCM sends a 5-volt reference voltage to the RH steering wheel switch on the input circuits. When a switch is pressed, the voltage is routed through the corresponding resistor(s), and then to ground through the SCCM . The SCCM monitors the resultant voltage drop to determine which switch was pressed. The voltage drop varies depending upon the resistance of the specific switch pressed.

The SCCM sends a network message to the APIM for the SYNC® switches and to the ACM for the redundant audio controls.

Subwoofer Speaker

The subwoofer speaker is contained within an enclosure and recieves audio signals from the audio DSP module.

SYNC® Microphone

The SYNC® microphone receives SYNC® system voice commands and outgoing audio during a phone call. These signals are sent to the APIM .

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Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent diagnostic scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3104-A	Back-probe Pins POM6411 or equivalent
 ST3051-A	Universal Serial Bus (USB) Male-A To Male-A Cable CCMUSB2-AM-AM-10
 ST3086-A	Multi-Media Interface Tester 105-00120

DTC Charts

NOTE: For SYNC® related concerns, REFER to the SYNC® Symptom Chart before connecting the scan tool and beginning DTC-based diagnostics.

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Audio Front Control Module (ACM) DTC Chart

DTC	Description	Action
B1A56:21	Antenna: Signal Amplitude	If DTC B1A56:21 sets after running the bezel diagnostic tests, disregard this DTC. This test is used for end of line or repair bay testing at the Ford plant. Each plant has its own assigned frequency and signal strength requirements. The running and passing of this test depends on local radio stations. If no local station is broadcasting on the required frequency, the test will fail. Therefore, tests ran from the bezel diagnostic screen and the DTC generated from the test can be disregarded.
B1A89:11	Satellite Antenna: Circuit Short To Ground	• For a satellite radio concern, GO to Pinpoint Test B • For a SIRIUS Data Services concern, GO to Pinpoint Test C
B1A89:13	Satellite Antenna: Circuit Open	• For a satellite radio concern, GO to Pinpoint Test B • For a SIRIUS Data Services concern, GO to Pinpoint Test C
B1D19:49	Compact Disc Unit: Internal Electronic Failure	• CLEAR the DTC. • WAIT at least 30 seconds. • REPEAT the self-test. • If DTC B1D19:49 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
B1D19:4B	Compact Disc Unit: Over Temperature	The ACM was over temperature. This may occur during extended use. Audio operation can resume after the ACM cools. CLEAR the DTC. This is normal operation.
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0238:00	Lost Communication With Digital Audio Control Module "D" : No Sub Type Information	GO to Pinpoint Test AI .
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	GO to Pinpoint Test AJ .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AK .
U0257:00	Lost Communication With Front Controls / Display Interface	GO to Pinpoint Test AL .

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	Module: No Sub Type Information	
U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new ACM to correct the failure to retain configuration data. REFER to Audio Control Module (ACM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3000:96	Control Module: Component Internal Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:96 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AM .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test an .

Accessory Protocol Interface Module (APIM) DTC Chart

DTC	Description	Action
C1001:01	Vision System Camera: General Electrical Failure	REFER to The rear video is inoperative in Section 413-13 .
B108E:01	Display: General Electrical Failure	GO to Pinpoint Test z .
B116A:01	Handset Microphone: General Electrical Failure	GO to Pinpoint Test r .
B1215:00	External Memory Card: No Sub Type Information	GO to Pinpoint Test aa .
B1252:11	USB Port: Circuit Short to Ground	• For an inoperative USB port, GO to Pinpoint Test T • For an inoperative SD card slot, GO to Pinpoint Test U
B1252:13	USB Port: Circuit Open	• For an inoperative USB port, GO to Pinpoint Test T • For an inoperative SD card slot, GO to Pinpoint Test U
B12B8:11	USB Port #2: Circuit Short To Ground	**NOTE:** This DTC refers to USB port #2 on the APIM itself, which is not used. • INSPECT the APIM USB port #2 for damage and REMOVE any debris. • CLEAR the DTCs. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B12B8:11 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AD .
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0162:00	Lost Communication With Navigation Display Module: No Sub Type Information	GO to Pinpoint Test Z .
U016A:00	Lost Communication	GO to Pinpoint Test AG .

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	With Global Positioning System Module: No Sub Type Information	
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AH .
U0238:00	Lost Communication With Digital Audio Control Module "D" : No Sub Type Information	GO to Pinpoint Test AI .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AK .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U1A00:87	Private Communication Network: Missing Message	GO to Pinpoint Test C .
U2017:45	Control Module Software #2: Program Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2017:45 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2017:51	Control Module Software #2: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2017:52	Control Module Software #2: Not Activated	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2017:54	Control Module Software #2: Missing	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures.

	Calibration	If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:04	Control Module: System Internal Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:04 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
U3000:88	Control Module: Bus Off	**NOTE:** Network communication/message DTCs can result from intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set these DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. The module was unable to communicate on the network at a point in time. The fault is not currently present. To avoid repeat network concerns:

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		• INSPECT for damaged or corroded wiring at the APIM . • TEST the vehicle battery. REFER to Charging Systems in Section 414-00 . • CLEAR the DTC. • REPEAT the network test with the diagnostic scan tool.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AM .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test an .

Audio DSP Module DTC Chart

DTC	Description	Action
B1A01:01	Speaker #1: General Electrical Failure	GO to Pinpoint Test I .
B1A01:11	Speaker #1: Circuit Short to Ground	GO to Pinpoint Test I .
B1A01:12	Speaker #1: Circuit Short to Battery	GO to Pinpoint Test I .
B1A01:13	Speaker #1: Circuit Open	GO to Pinpoint Test I .
B1A02:01	Speaker #2: General Electrical Failure	GO to Pinpoint Test G .
B1A02:11	Speaker #2: Circuit Short to Ground	GO to Pinpoint Test G .
B1A02:12	Speaker #2: Circuit Short to Battery	GO to Pinpoint Test G .
B1A02:13	Speaker #2: Circuit Open	GO to Pinpoint Test G .
B1A03:01	Speaker #3: General Electrical Failure	GO to Pinpoint Test H .
B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test H .
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test H .
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test H .
B1A04:01	Speaker #4: General Electrical Failure	GO to Pinpoint Test N .
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test N .
B1A04:12	Speaker #4: Circuit Short to Battery	GO to Pinpoint Test N .
B1A05:13	Speaker #4: Circuit Open	GO to Pinpoint Test N .
B1A06:01	Speaker #6: General Electrical Failure	GO to Pinpoint Test J .

B1A06:11	Speaker #6: Circuit Short to Ground	GO to Pinpoint Test J .
B1A06:12	Speaker #6: Circuit Short to Battery	GO to Pinpoint Test J .
B1A06:13	Speaker #6: Circuit Open	GO to Pinpoint Test J .
B1A07:01	Speaker #7: General Electrical Failure	GO to Pinpoint Test K .
B1A07:11	Speaker #7: Circuit Short to Ground	GO to Pinpoint Test K .
B1A07:12	Speaker #7: Circuit Short to Battery	GO to Pinpoint Test K .
B1A07:13	Speaker #7: Circuit Open	GO to Pinpoint Test K .
B1A08:01	Speaker #8: General Electrical Failure	GO to Pinpoint Test L .
B1A08:11	Speaker #8: Circuit Short to Ground	GO to Pinpoint Test L .
B1A08:12	Speaker #8: Circuit Short to Battery	GO to Pinpoint Test L .
B1A08:13	Speaker #8: Circuit Open	GO to Pinpoint Test L .
B1A09:11	Speaker #9: Circuit Short to Ground	GO to Pinpoint Test M .
B1A09:12	Speaker #9: Circuit Short to Battery	GO to Pinpoint Test M .
B1A09:13	Speaker #9: Circuit Open	GO to Pinpoint Test M .
B1A10:11	Speaker #10: Circuit Short to Ground	GO to Pinpoint Test M .
B1A10:12	Speaker #10: Circuit Short to Battery	GO to Pinpoint Test M .
B1A10:13	Speaker #10: Circuit Open	GO to Pinpoint Test M .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AH .
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	GO to Pinpoint Test AJ .
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	GO to Pinpoint Test AK .
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AL .

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U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2014:01	Control Module Hardware: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2014:01 is retrieved again, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U2014:41	Control Module Hardware: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U2014:41 is retrieved again, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U201A:51	Control Module Main Calibration Data: Not Programmed	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new audio DSP module to correct the failure to retain configuration data. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new audio DSP module to correct the failure to retain configuration data. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new audio DSP module to correct the failure to retain configuration data. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds.

		• REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AM .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test an .

FCIM DTC Chart

DTC	Description	Action
B00D5:01	Restraint System Passenger Disable Indicator: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B00D5:01 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
B113C:11	Hazard switch illumination: Circuit Short To Ground	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B113C:11 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
B1202:01	Restraint System Passenger Enable Indicator: General Electrical Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC B1202:01 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	GO to Pinpoint Test AL .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2013:63	Switch Pack: Circuit / Component Protection Time-Out	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test.

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		• If DTC U2013:63 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AM .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test an .

Global Positioning System Module (GPSM) DTC Chart

DTC	Description	Action
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	GO to Pinpoint Test AC .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information: No Sub Type Information	GO to Pinpoint Test AD .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0401:00	Invalid Data Received from ECM/PCM A: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the PCM . REFER to Section 303-14 .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the BCM . REFER to Section 419-10 .
U0423:00	Invalid Data Received from Instrument Panel Cluster Control Module: No Sub Type Information	RETRIEVE and FOLLOW DTCs present in the IPC . REFER to Section 413-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the

		diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	CHECK vehicle service history for recent service actions related to this module. This DTC sets due to incomplete or incorrect PMI procedures. If there have been recent service actions with this module, REPEAT/PERFORM the PMI procedure as directed by the diagnostic scan tool. For more information, REFER to Programmable Module Installation (PMI) in Section 418-01 . If there have been no recent service actions, INSTALL a new Global Positioning System Module (GPSM) to correct the failure to retain configuration data. REFER to Global Positioning System Module (GPSM) .
U3000:09	Control Module: Component Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, PERFORM a battery reset by disconnecting the battery for 1 minute, then reconnecting it. • CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:09 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:41	Control Module: General Checksum Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:41 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3000:42	Control Module: General Memory Failure	• CLEAR the DTC. • WAIT at least 10 seconds. • REPEAT the self-test. • If DTC U3000:42 is retrieved again, INSTALL a new Global Positioning System Module (GPSM). REFER to Global Positioning System Module (GPSM) .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AM .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test an .

SCCM DTC Chart

DTC	Description	Action
B1380:09	Steering Wheel Right Switch Pack: Component Failure	GO to Pinpoint Test X .

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B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	GO to Pinpoint Test X .
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	GO to Pinpoint Test X .
All other DTCs	—	REFER to Section 211-05 .

Symptom Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Symptom Chart — General Audio System

Condition	Possible Sources	Action
• A module does not respond to the diagnostic scan tool	• Fuse • Wiring, terminals, or connectors • Module	• REFER to Section 418-00 .
• The RH steering wheel controls are inoperative or do not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test X .
• The CD player is inoperative or does not operate correctly	• CD • ACM	• INSPECT the CD for scratches, fingerprints, a loose paper label, incorrect format, or damage. INSERT a known good CD and TEST the system. If the system operates correctly, the concern was caused by a damaged CD. If the system does not operate correctly, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
• The speed compensated volume does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test D .
• The compass is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test AB .
• The FCIM illumination is inoperative or does not dim	• Illumination system concern • FCIM	• REFER to Section 413-00 .
• The audio system does not operate correctly from the FCIM	• Refer to the Pinpoint Test	• GO to Pinpoint Test Y .
• The FDIM touchscreen is inoperative or	• Refer to the Pinpoint Test	• GO to Pinpoint Test Z .

does not operate correctly		
• The FDIM displays “SD CARD FAULT”	• Refer to the Pinpoint Test	• GO to Pinpoint Test AA .

Symptom Chart — HD Radio® System (If Equipped)

Condition	Possible Sources	Action
• Data errors for text display	• Data error from radio broadcaster	• This condition is due to the data from the radio broadcaster. ADVISE the customer that the HD Radio® is functioning correctly.
• Echo, stutter, skip, repeat or volume fluctuation in HD	• Signal alignment error from radio broadcaster	• This condition is due to the signal alignment from the radio broadcaster. ADVISE the customer that the HD Radio® is functioning correctly.
• Sound fading in and out or sound delay	• Transition between HD and analog	• This condition is due to the transition between HD and analog. ADVISE the customer that the HD Radio® must have an available channel in order to output HD content.
• Sound dropout or channel unavailable in HD 2 or HD 3	• HD 2 and HD 3 do not have analog equivalents causing complete signal loss when HD signal fades	• This condition is due to the HD 2 and HD 3 do not have analog equivalents causing complete signal loss when HD signal fades. ADVISE the customer that the HD Radio® must have an available channel in order to output HD content.

Symptom Chart — Navigation (If Equipped)

Condition	Possible Sources	Action
• Navigation is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test AA .
• The SIRIUS data services are not available	• Refer to the Pinpoint Test	• GO to Pinpoint Test C .

Symptom Chart — Satellite Radio (If Equipped)

Condition	Possible Sources	Action
• Poor reception — satellite radio	• Refer to the Pinpoint Test	• GO to Pinpoint Test B .
• Poor sound quality or no sound while in satellite radio mode - all other functions operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B .
• The satellite radio is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test B .

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Symptom Chart — Sound Quality

Condition	Possible Sources	Action
• Poor reception — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A .
• Continuous seek or scan — AM/FM	• Refer to the Pinpoint Test	• GO to Pinpoint Test A .
• Poor sound quality or distorted sound from one or more speakers (not all speakers)	• Refer to the Pinpoint Test	• GO to Pinpoint Test E .
• No sound from all speakers	• Refer to the Pinpoint Test	• GO to Pinpoint Test F .
• The LF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test G .
• The LF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test H .
• The instrument panel speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test I .
• The RF door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test J .
• The RF tweeter speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test K .
• The RR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test L .
• The subwoofer speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test M .
• The LR door speaker is inoperative	• Refer to the Pinpoint Test	• GO to Pinpoint Test N .

SYNC System

Condition	Possible Sources	Action
• All SYNC® Services features are inoperative or inaccurate (traffic, directions, and information)	• Unregistered SYNC® owner account • Unregistered or expired SYNC® Services subscription • Unregistered mobile phone number • Mobile phone being used not selected as "Active" • SYNC® Services server • Accessory Protocol Interface Module (APIM) • GPSM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test Q .

• The SYNC® system voice or tone prompts, Text-To-Speech (TTS) feature, or ringtones are inoperative or do not operate correctly	• Customer's setting • Wiring, terminals, or connectors • APIM • Audio Front Control Module (ACM) (for vehicles without the Audio DSP Module) or Audio DSP Module (If equipped)	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test P .
• During a phone call, no incoming audio is heard in the vehicle	• Customer's setting • Wiring, terminals, or connectors • APIM • Audio Front Control Module (ACM) (for vehicles without the Audio DSP Module) or Audio DSP Module (If equipped)	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset If the concern is still present, GO to Pinpoint Test P .
• Voice recognition is inoperative or does not operate correctly	• Wiring, terminals, or connectors • Microphone • APIM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test R .
• During a phone call, poor quality or no outgoing audio is heard on the outside device	• Wiring, terminals, or connectors • Microphone • APIM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test R .
• No sound from all SYNC® audio sources (Bluetooth, USB, audio input jack)	• Customer's device • Wiring, terminals, or connectors • APIM • Audio Front Control Module (ACM)	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test O .
• The SYNC® steering wheel switches are inoperative or do not operate correctly	• Steering wheel switch • Wiring, terminals, or connectors • Clockspring • SCCM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test X .
• All media hub	• Customer's	• PERFORM the APIM Reset, REFER to

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functions are inoperative or do not operate correctly (USB ports, Secure Digital (SD) card, and RCA jacks)	device • Media hub • Wiring, terminals, or connectors • APIM	Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test S .
• The USB port (s) are/is inoperative or do/does not operate correctly	• USB cable/port • Customer's device • APIM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test T .
• The Secure Digital (SD) card slot is inoperative or does not operate correctly	• Customer's device • Media hub • USB cable • APIM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test U .
• The RCA jacks are inoperative or do not operate correctly	• Customer's device • Wiring, terminals, or connectors • Media hub • APIM	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test V .
• Unable to pair Bluetooth device	• Incompatible Bluetooth device • APIM	• PERFORM the APIM Reset., REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, GO to Pinpoint Test W .
• An individual Bluetooth device feature is inoperative (text messaging, media playback or controls, phone book download, call history, or call waiting)	• Customer's device compatibility	• PERFORM the APIM Reset, REFER to Accessory Protocol Interface Module (APIM) Reset . If the concern is still present, INSTRUCT the customer to review the device compatibility list. REFER to www.syncmyride.com. It is normal operation for unsupported or incompatible Bluetooth features to be unavailable through the SYNC® system. If the inoperative feature is compatible, ADVISE the customer to check their device for firmware updates, and if required, reset their device following the manufacturer's instructions.
• 911 Assist™ or Vehicle Health Report (VHR) is inoperative or does not operate correctly	• Unregistered SYNC® owner account • RCM misconfiguration • IPC misconfiguration	• Verify that the customer has a SYNC® Owner Account on www.syncmyride.com. This error message appears due to incomplete or incorrect PMI procedures. CHECK the vehicle service history for recent service actions related to the IPC or RCM . If there have been recent service actions

		with the IPC or RCM , REPEAT/PERFORM the Programmable Module Installation (PMI) procedure as directed by the diagnostic scan tool. REFER to: Section 418-01 . If there have been no recent service actions, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Pinpoint Tests

Pinpoint Test A: Poor Reception Or Continuous Seek Or Scan — AM/FM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to AM/FM Radio, ACM , and Antenna in Information and Entertainment System .

The RDS function allows the vehicle operator to choose which genre (category) of music to listen to. When the SCAN button is pressed, the ACM only stops at channels falling within the selected category. If no channel in the selected category is found, the ACM continues to scan without stopping. This can appear to be a reception issue, but it is actually due to the customer's setting.

Possible Sources

- AM/FM antenna
- AM/FM antenna coaxial cable
- Charging system
- Ignition system
- No channel found in the selected category
- Noise suppression equipment
- Wiring, terminals, or connectors
- ACM

PINPOINT TEST A: POOR RECEPTION OR CONTINUOUS SEEK OR SCAN — AM/FM

Test Step	Result / Action to Take
A1 CHECK THE AUDIO SYSTEM RECEPTION	**Yes**
• Operate the audio system in radio tuner AM/FM	

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mode. • Check the reception with the engine running, and with the engine off. • **Does the poor reception only occur with the engine running?**	GO to A2. **No** GO to A4.
A2 CHECK THE GENERATOR • Ignition OFF. • Disconnect: Wiring harness to the generator voltage regulator. • Start the engine. • Operate the audio system in radio tuner AM/FM mode. • **Is the reception OK?**	**Yes** INSTALL a new generator. REFER to Section 414-00. **No** GO to A3.
A3 CHECK THE IGNITION CIRCUITS • Ignition OFF. • Connect: Wiring harness to the generator voltage regulator. • Visually inspect the engine compartment and make sure all ignition coils are correctly and securely connected, and that there are no visible cracks in the coil housings. • Inspect all the wiring harnesses and connectors for damaged insulation and loose or broken conditions. • **Are the ignition components OK?**	**Yes** USE a jumper cable to ground various parts of the vehicle to the frame (for example: engine, fenders, quarter panels, stone deflectors, air cleaner, body sheet metal). When the noise is eliminated, PROVIDE a permanent ground where necessary. **No** REPAIR the ignition system as necessary.
A4 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: AM/FM antenna coaxial cable at the ACM. Refer to Audio Control Module (ACM). • Disconnect: AM/FM antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — AM/FM. • Ignition ON. • Measure the **voltage** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit AM/FM antenna coaxial cable core at the ACM / — / — / Ground AM/FM antenna coaxial cable shield at the ACM / — / — / Ground • **Is any voltage present?**	**Yes** REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM. **No** GO to A5.
A5 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND • Ignition OFF. • Measure the **resistance** between: Positive Lead / Negative	**Yes** GO to A6. **No** REPAIR or INSTALL a new lower

			Lead	
	Pin	Circuit	Pin	Circuit
	AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A6 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM coaxial cable core at the ACM	—	Lower AM/FM antenna coaxial cable core at the inline connection	—
AM/FM antenna coaxial cable shield at the ACM	—	Lower AM/FM antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to A7 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A7 CHECK THE LOWER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A8 .

No
REPAIR or INSTALL a new lower AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A8 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: AM/FM antenna coaxial cable at the antenna unit. Refer to Antenna — AM/FM .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable	—	—	Ground

Yes
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

No
GO to A9 .

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core at the ACM			
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

A9 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A10 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A10 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable core at the antenna unit (harness side)	—
AM/FM antenna coaxial cable shield at the ACM	—	AM/FM antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to A11 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A11 CHECK THE UPPER AM/FM ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A12 .

No
REPAIR or INSTALL a new upper AM/FM antenna coaxial cable. REFER to Antenna Cable — AM/FM .

A12 CHECK THE AM/FM ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: AM/FM antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground
AM/FM antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

No
GO to A13 .

A13 CHECK THE AM/FM ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A14 .

No
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

A14 CHECK THE AM/FM ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna coaxial cable core at the ACM	—	AM/FM antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A15 .

No
INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

A15 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: AM/FM antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna unit shield at		—	Ground

Yes
GO to A17 .

No
GO to A16 .

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the antenna unit (component side)	—		

- **Is the resistance less than 1 ohm?**

A16 CHECK THE AM/FM ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE	
• Remove the AM/FM antenna. Refer to Antenna — AM/FM . • Measure the **resistance** between:	**Yes** GO to A17 . **No** INSTALL a new AM/FM antenna. REFER to Antenna — AM/FM .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
AM/FM antenna unit shield at the antenna unit (component side)	—	AM/FM antenna base (unpainted surface)	—

- **Is the resistance less than 1 ohm?**

A17 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test B: The Satellite Radio Is Inoperative, Has Poor Reception, Or Has No Sound

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to MyKey® and Satellite Radio in Information and Entertainment System .

When a satellite radio subscription is activated, the satellite receiver ESN is associated with the VIN .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A89:11	Satellite Antenna: Circuit Short To Ground	Set by the ACM when a short to ground is detected in the satellite antenna circuit for more than 250 milliseconds. This DTC can be either continuous or on-demand.
B1A89:13	Satellite Antenna: Circuit Open	Set by the ACM when an open is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.

Possible Sources

- Expired subscription
- Incorrectly matched ESN
- Wiring, terminals, or connectors
- Obstructions in the antenna's line of sight
- Satellite radio antenna
- Satellite radio antenna coaxial cable
- ACM

PINPOINT TEST B: THE SATELLITE RADIO IS INOPERATIVE, HAS POOR RECEPTION, OR HAS NO SOUND

Test Step	Result / Action to Take
B1 VERIFY AN ACTIVE SUBSCRIPTION	
• Operate the infotainment system in satellite radio mode and observe the infotainment display. • **Does the display indicate that the subscription has expired?**	**Yes** The subscription has expired. INFORM the customer to contact SIRIUS to reactivate the subscription. **No** GO to B2.
B2 CHECK THE RECEPTION	
• Drive the vehicle to an open location that is free from obstacles such as tall buildings or large trees. • Using a diagnostic scan tool, view the ACM PIDs. • Monitor the satellite signal strength (SAT_SIG_STR) PID. • If the PID reads "No Signal" or "Poor," move the vehicle to another area and retest until "Good," "Very Good," or "Excellent" PID values are obtained. • **Can a "Good," "Very Good," or "Excellent" PID value be obtained?**	**Yes** GO to B3. **No** GO to B6.
B3 CHECK THE SATELLITE RADIO SYSTEM FOR CORRECT OPERATION	
• Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of obstructions in the antenna's line of sight.

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	No GO to B4 .
B4 CHECK FOR PROMOTIONAL CHANNEL 184 • Select channel 184. • **Does the satellite radio system receive channel 184 with normal sound quality?**	**Yes** GO to B5 . **No** GO to B6 .
B5 VERIFY THAT THE VIN AND ESN ON FILE MATCH THE VIN AND ESN FROM THE VEHICLE • Retrieve the satellite radio ESN . Satellite Radio Electronic Serial Number (ESN) Retrieval . • Contact the SIRIUS Dealer Support Line (888-465-8528). • Ensure that the VIN and ESN SIRIUS has on the customer's file match the VIN and ESN retrieved from the vehicle. • Follow the actions from step 2 to obtain "Good," "Very Good," or "Excellent" reception. • Operate the infotainment system in satellite radio mode. • **NOTE:** It may take up to 30 minutes for the activation signal to be received and satellite radio functions to operate. • Request for SIRIUS to send the activation signal to the vehicle 2-3 times. • Operate multiple channels with the infotainment system in satellite radio mode. • **Does the satellite radio system receive multiple channels with normal sound quality?**	**Yes** The system is operating correctly at this time. The concern was a result of the activation signal needing to be resent or the VIN and ESN SIRIUS had on file not matching the VIN and ESN from the vehicle. **No** GO to B6 .
B6 CHECK FOR ACM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the ACM DTCs. • Using a diagnostic scan tool, perform the ACM self-test. • **Are any DTCs recorded in the ACM ?**	**Yes** For DTC B1A89:11 or DTC B1A89:13, GO to B7 . For all other ACM DTCs, REFER to the ACM DTC chart in Information and Entertainment System . **No** GO to B20 .
B7 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Satellite radio antenna coaxial cable at the ACM . Refer to Audio Control Module (ACM) . • Disconnect: Satellite radio antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — Satellite Radio . • Ignition ON. • Measure the **voltage** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit	**Yes** REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio . **No** GO to B8 .

Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

B8 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B9.

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio.

B9 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio coaxial cable core at the ACM	—	Lower satellite radio antenna coaxial cable core at the inline connection	—
Satellite radio antenna coaxial cable shield at the ACM	—	Lower satellite radio antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B10.

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio.

B10 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

Yes
GO to B11.

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio.

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- **Is the resistance greater than 10,000 ohms?**

B11 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: Satellite radio antenna coaxial cable at the antenna unit. Refer to Antenna — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to B12 .

B12 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B13 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B13 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable core at the antenna unit (harness side)	—
Satellite radio antenna		Satellite radio antenna coaxial	—

Yes
GO to B14 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

coaxial cable shield at the ACM	—	cable shield at the antenna unit (harness side)	

- **Is the resistance less than 1 ohm?**

B14 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B15 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

B15 CHECK THE SATELLITE RADIO ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

No
GO to B16 .

B16 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

Yes
GO to B17 .

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

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- **Is the resistance greater than 10,000 ohms?**

B17 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to B18.

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio.

B18 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: Satellite radio antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

Yes
GO to B20.

No
GO to B19.

B19 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE

- Remove the satellite radio antenna. Refer to Antenna — Satellite Radio.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	Satellite radio antenna base (unpainted surface)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to B20.

No
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio.

B20 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).

▪ Pushed-out pins (install new pins as necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test C: The SIRIUS Data Services Are Not Available

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SIRIUS Data Services in Information and Entertainment System .

When a SIRIUS Data Services subscription is activated, the satellite receiver ESN is associated with the VIN .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1A89:11	Satellite Antenna: Circuit Short To Ground	Set by the ACM when a short to ground is detected in the satellite antenna circuit for more than 250 milliseconds. This DTC can be either continuous or on-demand.
B1A89:13	Satellite Antenna: Circuit Open	Set by the ACM when an open is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.
U1A00:87	Private Communication Network: Missing Message	Set by the APIM when messages are missing from the ACM on the satellite digital radio data link (SDL) circuits.

Removal of the navigation SD card results in loss of navigation while the card is removed. This is normal operation.

Possible Sources

- Navigation map SD card not present, not fully seated, or damaged
- Expired subscription
- Obstructions in the antenna's line of sight
- Incorrectly matched ESN
- Wiring, terminals, or connectors
- APIM
- ACM
- Satellite radio antenna
- Satellite radio antenna coaxial cable

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PINPOINT TEST C: CHECK FOR SATELLITE AUDIO CONCERNS

Test Step	Result / Action to Take
C1 VERIFY THE NAVIGATION MAP SD CARD IS PRESENT • Check for the presence of a navigation map SD card in the media hub SD slot. • **Is the navigation map SD card present and fully seated?**	**Yes** GO to C2. **No** INSTALL the navigation map SD card. TEST the system for normal operation.
C2 INSPECT THE NAVIGATION MAP SD CARD • Remove the navigation map SD card. • Inspect the navigation map SD card for damage. • **Is any damage present?**	**Yes** INSTALL a new navigation map SD card. **No** GO to C3.
C3 VERIFY AN ACTIVE SUBSCRIPTION **NOTE:** The status of the satellite radio subscription should be disregarded in this step since SIRIUS data services does not require a satellite radio subscription to operate. • Access the Subscription Info selection in the touchscreen Travel Link menu. • **Does the display indicate the subscription has expired for traffic, weather, fuel prices, movie times, sports, weather map, or ski conditions?**	**Yes** If the subscription has expired for one or more, but not all categories mentioned above, GO to C28. If the subscription has expired for all categories mentioned above, INFORM the customer to contact SIRIUS to reactivate the subscription. **No** GO to C4.
C4 CHECK THE RECEPTION • Drive the vehicle to an open location that is free from obstacles such as tall buildings or large trees. • Using a diagnostic scan tool, view the ACM PIDs. • Monitor the satellite signal strength (SAT_SIG_STR) PID. • If the PID reads "No Signal" or "Poor," move the vehicle to another area and retest until "Good," "Very Good," or "Excellent" PID values are obtained. • **Can a "Good," "Very Good," or "Excellent" PID value be obtained?**	**Yes** GO to C5. **No** GO to C8.
C5 CHECK THE SIRIUS DATA SERVICES FOR CORRECT OPERATION • Operate the infotainment system in SIRIUS data services mode and observe the infotainment display. • **Do SIRIUS data services operate correctly?**	**Yes** The system is operating correctly at this time. The concern was a result of obstructions in the antenna's line of sight. **No** GO to C6.

C6 CHECK FOR PROMOTIONAL CHANNEL 184 • Operate the infotainment system in satellite radio mode. • Select channel 184. • **Does the satellite radio system receive promotional channel 184 with normal sound quality?**	**Yes** GO to C7. **No** GO to C8.
C7 VERIFY THAT THE VIN AND ESN ON FILE MATCH THE VIN AND ESN FROM THE VEHICLE • Retrieve the satellite radio ESN. Satellite Radio Electronic Serial Number (ESN) Retrieval. • Contact the SIRIUS Dealer Support Line (888-465-8528). • Ensure that the VIN and ESN SIRIUS has on the customer's file match the VIN and ESN retrieved from the vehicle. • Follow the actions from step 4 to obtain "Good," "Very Good," or "Excellent" reception. • Operate the infotainment system in SIRIUS data services mode. • **NOTE:** It may take up to 30 minutes for the activation signal to be received and satellite radio functions to operate. • Request for SIRIUS to send the activation signal to the vehicle 2-3 times. • Operate the infotainment system in SIRIUS data services mode and observe the infotainment display. • **Do SIRIUS data services operate correctly?**	**Yes** The system is operating correctly at this time. The concern was a result of the activation signal needing to be resent or the VIN and ESN SIRIUS had on file not matching the VIN and ESN from the vehicle. **No** GO to C8.
C8 CHECK FOR ACM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the ACM DTCs. • Using a diagnostic scan tool, perform the ACM self-test. • **Are any DTCs recorded in the ACM?**	**Yes** For DTC B1A89:11 or DTC B1A89:13, GO to C10. For all other ACM DTCs, REFER to the ACM DTC chart in Information and Entertainment System. **No** GO to C9.
C9 CHECK FOR APIM DTCS • Ignition ON. • Using a diagnostic scan tool, clear the APIM DTCs. • Using a diagnostic scan tool, perform the APIM self-test. • **Are any DTCs recorded in the APIM?**	**Yes** For DTC U1A00:87, GO to C23. For all other APIM DTCs, REFER to the APIM DTC chart in Information and Entertainment System. **No** GO to C27.
C10 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: Satellite radio antenna coaxial cable at the ACM. Refer to Audio Control Module (ACM).	**Yes** REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio.

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- Disconnect: Satellite radio antenna inline coaxial cable connection behind the glove compartment. Refer to Antenna Cable — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

No
GO to C11 .

C11 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C12 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C12 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio coaxial cable core at the ACM	—	Lower satellite radio antenna coaxial cable core at the inline connection	—
Satellite radio antenna coaxial cable shield at the ACM	—	Lower satellite radio antenna coaxial cable shield at the inline connection	—

- **Is the resistance less than 1 ohm?**

Yes
GO to C13 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C13 CHECK THE LOWER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C14 .

No
REPAIR or INSTALL a new lower satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C14 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna inline coaxial cable connection behind the glove compartment.
- Disconnect: Satellite radio antenna coaxial cable at the antenna unit. Refer to Antenna — Satellite Radio .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

- **Is any voltage present?**

Yes
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

No
GO to C15 .

C15 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C16 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

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C16 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable core at the antenna unit (harness side)	—
Satellite radio antenna coaxial cable shield at the ACM	—	Satellite radio antenna coaxial cable shield at the antenna unit (harness side)	—

- **Is the resistance less than 1 ohm?**

Yes
GO to C17 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C17 CHECK THE UPPER SATELLITE RADIO ANTENNA COAXIAL CABLE CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C18 .

No
REPAIR or INSTALL a new upper satellite radio antenna coaxial cable. REFER to Antenna Cable — Satellite Radio .

C18 CHECK THE SATELLITE RADIO ANTENNA UNIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Satellite radio antenna coaxial cable at the antenna unit.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground
Satellite radio antenna coaxial cable shield at the ACM	—	—	Ground

Yes
INSTALL a new satellite radio antenna. REFER to Antenna — Satellite Radio .

No
GO to C19 .

- **Is any voltage present?**

C19 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	—	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C20 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

C20 CHECK THE SATELLITE RADIO ANTENNA UNIT CORE AND SHIELD FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna coaxial cable core at the ACM	—	Satellite radio antenna coaxial cable shield at the ACM	—

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C21 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

C21 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO GROUND

- Disconnect: Satellite radio antenna coaxial cable at the antenna unit.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	—	Ground

- **Is the resistance less than 1 ohm?**

Yes
GO to C27 .

No
GO to C22 .

C22 CHECK THE SATELLITE RADIO ANTENNA UNIT SHIELD FOR CONTINUITY TO ANTENNA UNIT BASE

- Remove the satellite radio antenna. Refer to Antenna — Satellite Radio .
- Measure the **resistance** between:

Positive Lead	Negative Lead

Yes
GO to C27 .

No
INSTALL a new satellite radio antenna.
REFER to Antenna — Satellite Radio .

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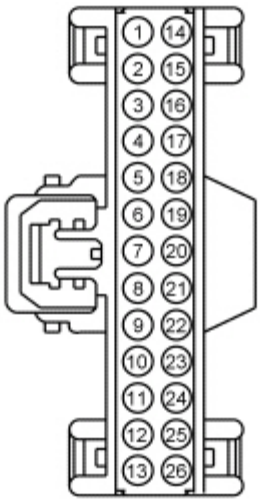
Pin	Circuit	Pin	Circuit
Satellite radio antenna unit shield at the antenna unit (component side)	—	Satellite radio antenna base (unpainted surface)	—

- **Is the resistance less than 1 ohm?**

C23 CHECK THE SATELLITE DATA CIRCUITS FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240B.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	—	Ground
C240B-19	VME91 (WH/BN)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to C24 .

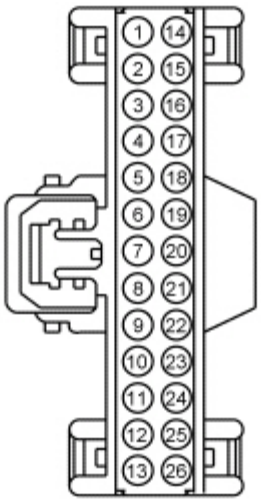
C24 CHECK THE SATELLITE DATA CIRCUITS FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	—	Ground
C240B-19	VME91 (WH/BN)	—	Ground

Yes
GO to C25 .

No
REPAIR the circuit in question.

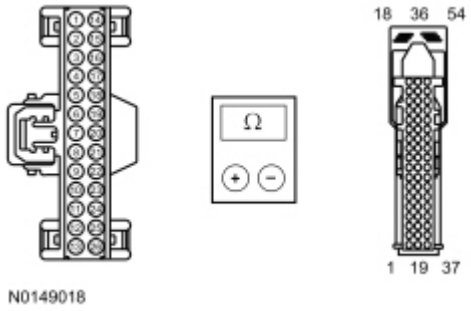


- **Are the resistances greater than 10,000 ohms?**

C25 CHECK THE SATELLITE DATA CIRCUITS FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	C2383-51	VME90 (GY/BU)
C240B-19	VME91 (WH/BN)	C2383-52	VME91 (WH/BN)



- **Are the resistances less than 3 ohms?**

Yes
GO to C26 .

No
REPAIR the circuit in question.

C26 CHECK THE SATELLITE DATA CIRCUITS FOR A SHORT TOGETHER

- Measure the **resistance** between:

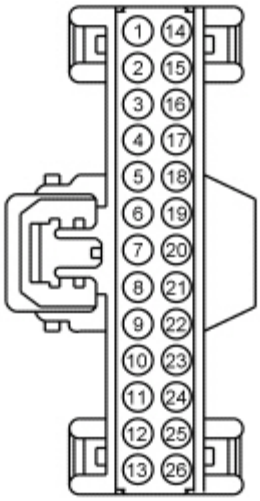
Positive Lead		Negative Lead	

Yes
GO to C28 .

No
REPAIR the circuit in question.

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Pin	Circuit	Pin	Circuit
C240B-6	VME90 (GY/BU)	C240B-19	VME91 (WH/BN)



- **Is the resistance greater than 10,000 ohms?**

C27 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the ACM connectors. Make sure they seat and latch correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

C28 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: The Speed Compensated Volume Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Speed Compensated Volume in Information and Entertainment System .

Possible Sources

- Speed compensated volume setting
- VSS signal concern
- Network communication concern
- Audio DSP module

PINPOINT TEST D: THE SPEED COMPENSATED VOLUME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 CHECK THE SPEEDOMETER OPERATION	
• Drive the vehicle and observe the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to D2 . **No** REFER to Section 413-01 .
D2 CHECK THE SPEED COMPENSATED VOLUME SETTING	
• Turn the speed compensated volume off. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • Set the speed compensated volume to maximum compensation. Refer to the Owner's Literature. • Operate the audio system in radio tuner AM/FM mode. • Drive the vehicle at various speeds and observe the speaker volume. • **Does the volume remain constant with the speed compensated volume turned off, and increase and decrease with vehicle speed with the speed compensated volume set to maximum?**	**Yes** The system is operating correctly at this time. INSTRUCT the customer in the correct usage of the speed compensated volume feature. **No** GO to D3 .
D3 CHECK FOR DTC U0155:00	

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• Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155:00 or U0238:00 retrieved in any audio system module?**	**Yes** For DTC U0155:00, GO to Pinpoint Test AF . For DTC U0238:00, GO to Pinpoint Test AI . **No** GO to D4 .
D4 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test E: Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All Speakers)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

The audio DSP module sends audio signals to the speakers in the form of AC voltage, resulting in clear audio output.

Possible Sources

- Loose component fasteners
- Loose door handle, lock, and other trim panel components and fasteners
- Loose items in storage areas
- Loose speaker grilles
- Loose wire harnesses or wire harness fasteners
- Speaker(s)
- Water shield bonding and placement

Visual Inspection and Diagnostic Pre-checks

Visually inspect around the suspect area for any possible rattle conditions such as:

- Any storage compartments including cup holders (if equipped)

- Door map pockets for contents that can rattle (if equipped)
- Door pull cup attachments (if equipped)
- Door switch bezels (if equipped)
- Package tray (if equipped)
- Speaker grilles
- Trim panels and fasteners

PINPOINT TEST E: POOR SOUND QUALITY OR DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take
E1 ISOLATE THE ZONE • Operate the audio system using digital media (CD, MP3, etc.). • Using the audio system fade and balance feature, adjust the audio sound to each of the four zones (LF , RF , LR , and RR) of the vehicle to isolate the poor sound quality. • Locate and apply pressure to the trim panel(s) around the poor sound quality area in question. • **Does applying pressure to a trim panel reduce or eliminate the audible noise?**	**Yes** REPAIR or REPLACE the trim panel as needed. **No** GO to E2 .

E2 REMOVE AND INSPECT BEHIND/UNDERNEATH THE SUSPECT TRIM PANEL(S)
• Remove the trim panel to access the suspect speaker.
• Operate the audio system using digital media (CD, MP3, etc.).
• Validate where the poor sound quality area is located.
• Check:
  ▪ Trim panel for loose components around the speaker area such as the speaker grille
  ▪ Trim panel joining components for missing or broken pieces
  ▪ Lock and handle mechanical parts for correct attachment
  ▪ Wire harnesses for correct routing
  ▪ Wire harness fasteners for correct attachment
  ▪ Water shield for correct placement (speaker air path not blocked)
  ▪ Water shield for correct bonding to sheet metal
  ▪ Storage areas for loose items
  ▪ All child safety belt anchors (if equipped)
  ▪ All safety belt retractors
  ▪ All speaker bracket fasteners and other fasteners are secured and tightened to specified torque
• **Was the source of the noise located?**
	Yes
	REPAIR or REPLACE any loose or broken component or fastener as needed.
	
	No
	GO to E3 .

E3 CHECK THE SUSPECT SPEAKER FOR WATER INTRUSION
• Inspect for watermarks.
• Check the:
  ▪ Cone
  ▪ Magnet
	Yes
	VERIFY the water shield is in the correct location, REPAIR or REPLACE any trim, door, or speaker

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▪ Basket • **Are any watermarks present on the speaker?**	seal as required. DRY the speaker in question and TEST the system for normal operation. **No** GO to E4 .
E4 ISOLATE SPEAKER TO VERIFY NOISE	
• Remove the suspect speaker from its location and leave the speaker connected to the harness. • Hold the speaker away from any trim panel(s) and ensure the speaker is isolated from contact. • Operate the audio system using digital media (CD, MP3, etc.). • **Is the noise still present in the suspect speaker?**	**Yes** INSTALL a new speaker for the one in question. **No** LOCATE the source of the noise and REPAIR as needed.

Pinpoint Test F: No Sound From All Speakers

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM in Information and Entertainment System .

When the ignition is in the START position, the ACM receives voltage on the START signal circuit and mutes the speaker output. This prevents voltage spikes from producing popping noises through the speakers. A short to voltage on this circuit causes the ACM output to be muted continuously.

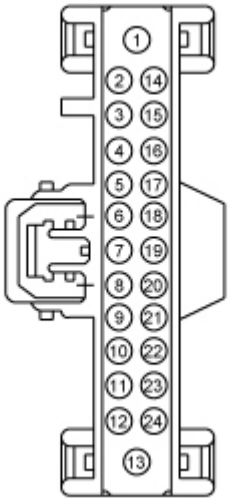
The audio DSP module is enabled through software. Additionally, the ACM can mute the audio DSP module through the mute/unmute circuit. If the audio DSP module detects less than 3.5 volts on the mute/unmute circuit, it mutes the speaker output. As a result, an open or short to ground in the mute/unmute circuit causes the audio system to produce no sound, because the enable signal does not reach the audio DSP module. In the event of an overload, the audio DSP module clips the audio output signal to the speakers and subwoofer (heard as distortion) in order to prevent damage to the speakers.

A short to ground or short to voltage in the circuitry to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the ACM . In this case, a speaker fault DTC sets.

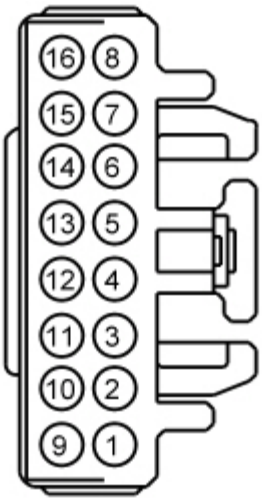
Possible Sources

- Wiring, terminals, or connectors
- ACM
- Audio DSP module

PINPOINT TEST F: NO SOUND FROM ALL SPEAKERS

Test Step	Result / Action to Take
F1 CHECK FOR SPEAKER DTCS • Ignition ON. • Using a diagnostic scan tool, perform the audio DSP module self-test. • **Are any speaker fault Diagnostic Trouble Codes (DTCs) present?**	**Yes** REFER to the audio DSP module DTC chart in Information and Entertainment System . **No** GO to F2 .
F2 CHECK THE START SENSE CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: ACM C240A . • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C240A-3, Circuit CDC54 (WH/GN); Negative Lead: Pin —, Circuit Ground  • **Is the voltage 5V or greater?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to F3 .
F3 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY • Ignition OFF. • Disconnect: Audio DSP C3154C. • Ignition ON. • Measure the **voltage** between: Positive Lead: Pin C3154C-5, Circuit SBP19 (BU/RD); Negative Lead: Pin —, Circuit Ground Positive Lead: Pin C3154C-6, Circuit SBP19 (BU/RD); Negative Lead: Pin —, Circuit Ground	**Yes** GO to F4 . **No** REPAIR the circuit.

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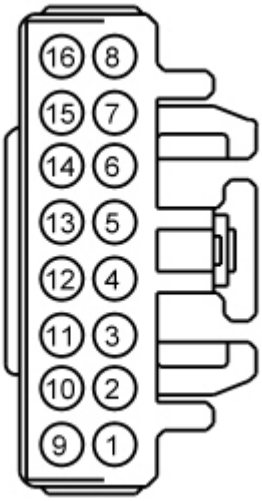


- **Are the voltages greater than 11 volts?**

F4 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS

- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154C-5	SBP19 (BU/RD)	C3154C-15	GD148 (BK/YE)
C3154C-6	SBP19 (BU/RD)	C3154C-16	GD148 (BK/YE)



- **Are the voltages greater than 11 volts?**

Yes
GO to F5 .

No
REPAIR the circuit.

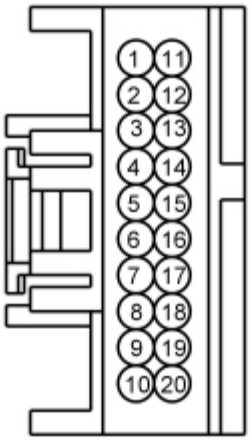
F5 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR CORRECT VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP C3154A.
- Ignition ON.

Yes
GO to F10 .

- Operate the audio system in radio tuner AM/FM mode.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-3	SME23 (VT/RD)	—	Ground



- **Is the voltage between 3.5 and 5 volts?**

No
GO to F6 .

F6 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR A SHORT TO VOLTAGE

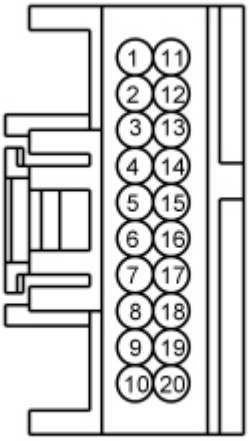
- Ignition OFF.
- Disconnect: ACM C240B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-3	SME23 (VT/RD)	—	Ground

Yes
REPAIR the circuit.

No
GO to F7 .

repair4less

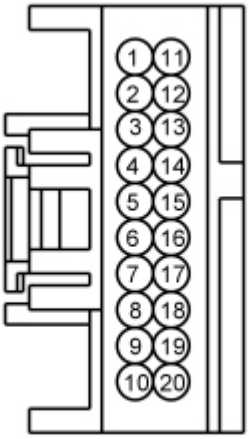


- **Is any voltage present?**

F7 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-3	SME23 (VT/RD)	—	Ground



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to F8 .

No
REPAIR the circuit in question.

F8 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR AN OPEN

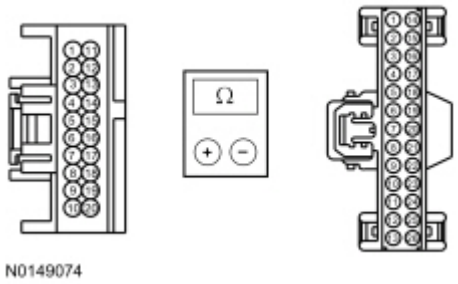
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit

Yes
GO to F9 .

No
REPAIR the circuit in question.

C3154A-3	SME23 (VT/RD)	C240B-18	SME23 (VT/RD)



- **Is the resistance less than 3 ohms?**

F9 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

F10 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test G: The LF Door Speaker Is Inoperative

Diagnostic Overview

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Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM , Audio DSP Module, and DSP in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A02:01	Speaker #2: General Electrical Failure	Set by the audio DSP module when a failure is detected on the LF door speaker circuits.
B1A02:11	Speaker #2: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the LF door speaker circuits. When DTC B1A02:11 is set, the speaker output is disabled.
B1A02:12	Speaker #2: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the LF door speaker circuits. When DTC B1A02:12 is set, the speaker output is disabled.
B1A02:13	Speaker #2: Circuit Open	Set by the audio DSP module when an open is detected on the LF door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM
- Audio DSP module

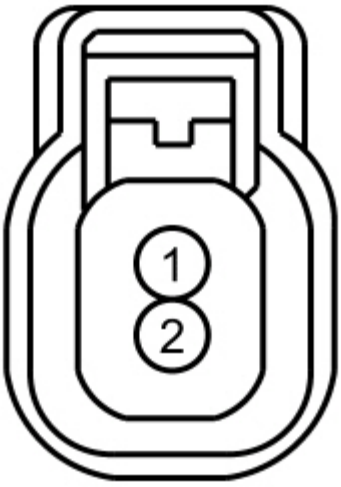
PINPOINT TEST G: THE LF DOOR SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>G1 CHECK THE AUDIO SIGNAL TO THE LF DOOR SPEAKER

• Ignition OFF.
• Disconnect: LF Door Speaker C523.
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>C523-2</td><td>RME07 (WH/BN)</td></tr></table></td><td>Yes
INSTALL a new LF door speaker. REFER to Speaker — Door .

No
GO to G2 .</td></tr>
</table>

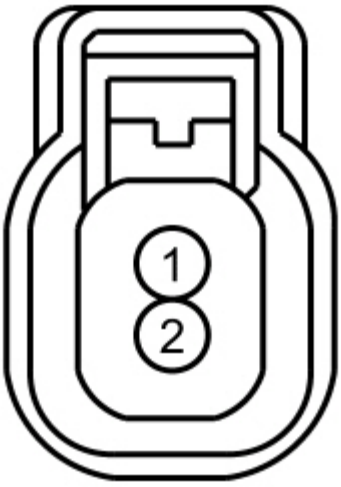


- **Is a fluctuating AC voltage present?**

G2 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP module C3154B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to G3.

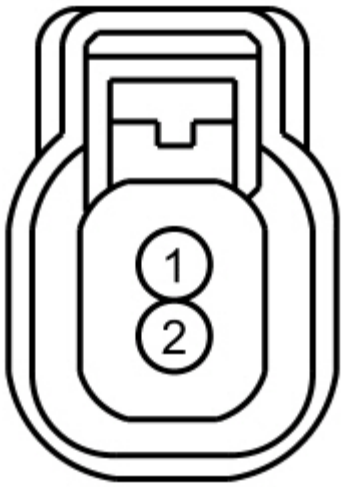
G3 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to G4.

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	—	Ground
C523-2	RME07 (WH/BN)	—	Ground



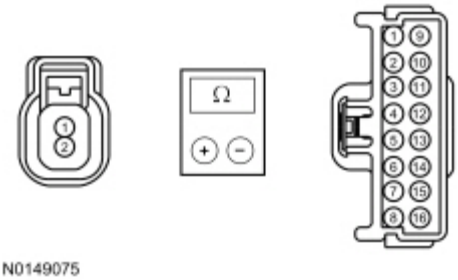
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

G4 CHECK THE AUDIO CIRCUITS TO THE LF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C523-1	VME07 (WH)	C3154B-2	VME07 (WH)
C523-2	RME07 (WH/BN)	C3154B-10	RME07 (WH/BN)

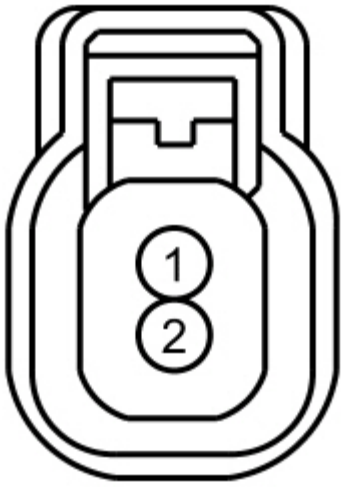


- **Are the resistances less than 3 ohms?**

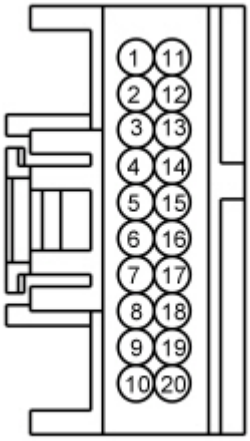
Yes
GO to G5 .

No
REPAIR the circuit in question.

G5 CHECK THE AUDIO CIRCUITS TO THE LF

DOOR SPEAKER FOR A SHORT TOGETHER • Measure the **resistance** between: <table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C523-1</td><td>VME07 (WH)</td><td>C523-2</td><td>RME07 (WH/BN)</td></tr></table>  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G6 . **No** REPAIR the circuit in question.
G6 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE • Ignition OFF. • Disconnect: Audio DSP module C3154A. • Ignition ON. • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: <table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C3154A-7</td><td>VME17 (GN)</td><td>C3154A-17</td><td>RME17 (GY)</td></tr></table>	**Yes** GO to G12 . **No** GO to G7 .

repair4less

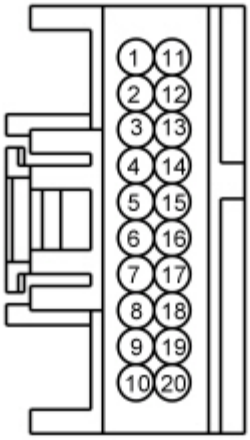


- **Is a fluctuating AC voltage present?**

G7 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	—	Ground
C3154A-17	RME17 (GY)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

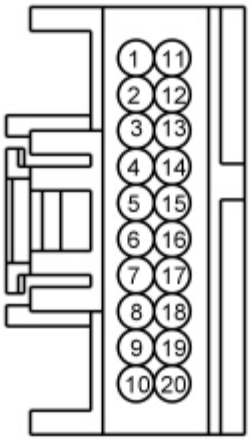
No
GO to G8.

G8 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to G9.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	—	Ground
C3154A-17	RME17 (GY)	—	Ground



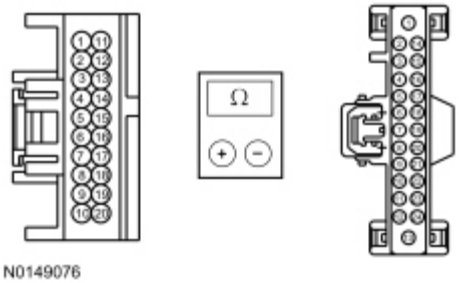
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

G9 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	C240A-22	VME17 (GN)
C3154A-17	RME17 (GY)	C240A-10	RME17 (GY)



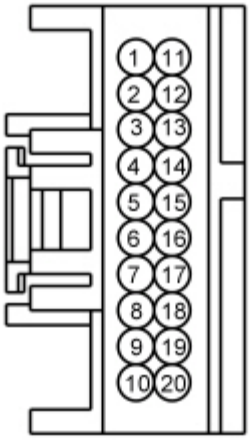
- **Are the resistances less than 3 ohms?**

Yes
GO to G10 .

No
REPAIR the circuit in question.

G10 CHECK THE LEFT AUDIO SIGNAL TO THE

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AUDIO DSP MODULE FOR A SHORT TOGETHER	
• Measure the **resistance** between: Positive Lead: Pin C3154A-7, Circuit VME17 (GN) Negative Lead: Pin C3154A-17, Circuit RME17 (GY)  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G11. **No** REPAIR the circuit in question.
G11 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

G12 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench.

necessary) • Reconnect the audio DSP module connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test H: The LF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM , Audio DSP Module, and DSP in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A03:01	Speaker #3: General Electrical Failure	Set by the audio DSP module when a failure is detected on the LF tweeter speaker circuits.
B1A03:11	Speaker #3: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the LF tweeter speaker circuits. When DTC B1A03:11 is set, the speaker output is disabled.
B1A03:12	Speaker #3: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the LF tweeter speaker circuits. When DTC B1A03:12 is set, the speaker output is disabled.
B1A03:13	Speaker #3: Circuit Open	Set by the audio DSP module when an open is detected on the LF tweeter speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM
- Audio DSP module

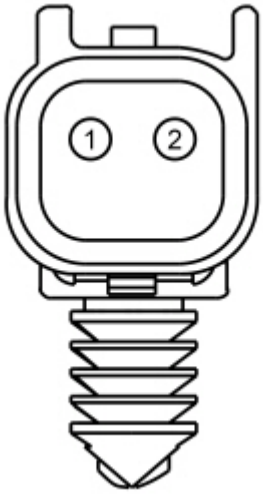
PINPOINT TEST H: THE LF TWEETER SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
H1 CHECK THE AUDIO SIGNAL TO THE LF TWEETER SPEAKER	
	Yes

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- Ignition OFF.
- Disconnect: LF Tweeter Speaker C230 .
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME08 (GN/OG)	C230-2	RME08 (GY/OG)



- **Is a fluctuating AC voltage present?**

INSTALL a new LF tweeter speaker. REFER to Speaker — A-Pillar .

No
GO to H2 .

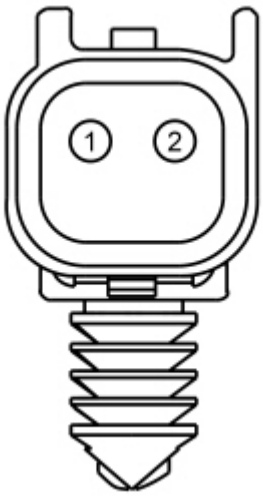
H2 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP module C3154B.
- Ignition ON.
- Measure the **voltage** between:

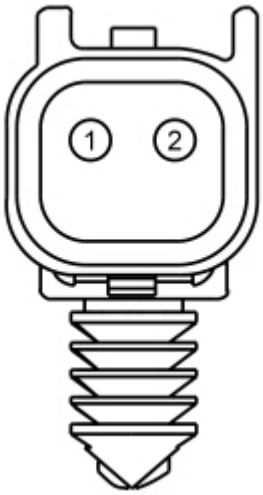
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME08 (GN/OG)	—	Ground
C230-2	RME08 (GY/OG)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to H3 .

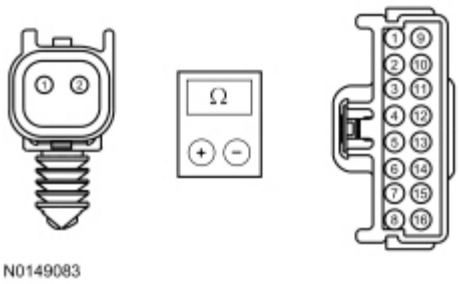


- **Is any voltage present?**

H3 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TO GROUND • Ignition OFF. • Measure the **resistance** between: Positive Lead: Pin C230-1, Circuit VME08 (GN/OG); C230-2, RME08 (GY/OG) Negative Lead: Pin —, Circuit Ground  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to H4 . **No** REPAIR the circuit in question.
H4 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR AN OPEN • Measure the **resistance** between: Positive Lead Negative Lead	**Yes** GO to H5 . **No**

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Pin	Circuit	Pin	Circuit
C230-1	VME08 (GN/OG)	C3154B-3	VME08 (GN/OG)
C230-2	RME08 (GY/OG)	C3154B-11	RME08 (GY/OG)



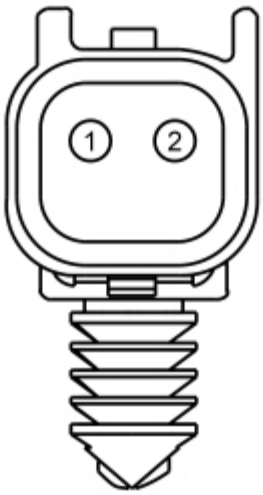
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

H5 CHECK THE AUDIO CIRCUITS TO THE LF TWEETER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C230-1	VME08 (GN/OG)	C230-2	RME08 (GY/OG)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to H6.

No
REPAIR the circuit in question.

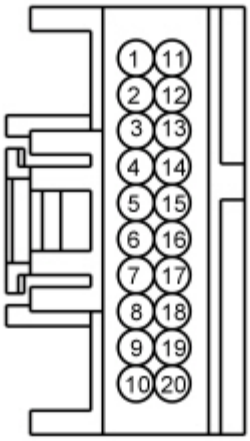
H6 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE

- Ignition OFF.
- Disconnect: Audio DSP module C3154A.

Yes
GO to H12.

- Ignition ON.
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	C3154A-17	RME17 (GY)



- **Is a fluctuating AC voltage present?**

No
GO to H7 .

H7 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE

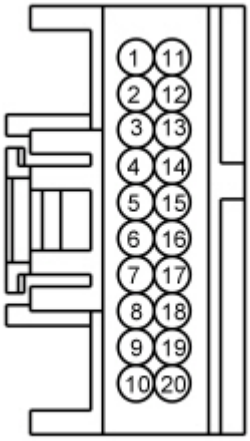
- Ignition OFF.
- Disconnect: ACM C240A.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	—	Ground
C3154A-17	RME17 (GY)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to H8 .

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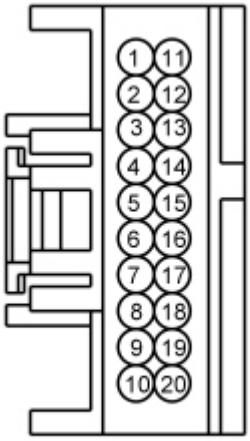


- **Is any voltage present?**

H8 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	—	Ground
C3154A-17	RME17 (GY)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to H9 .

No
REPAIR the circuit in question.

H9 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR AN OPEN

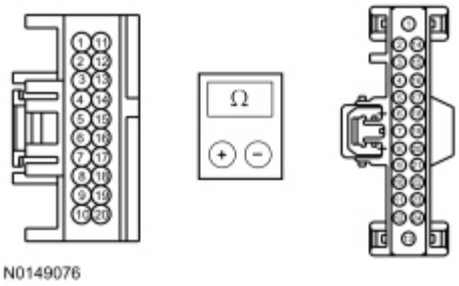
- Measure the **resistance** between:

Positive Lead	Negative Lead

Yes
GO to H10 .

No

Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	C240A-22	VME17 (GN)
C3154A-17	RME17 (GY)	C240A-10	RME17 (GY)



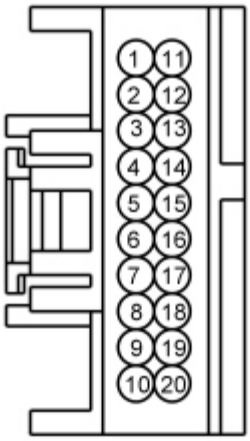
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

H10 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	C3154A-17	RME17 (GY)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to H11 .

No
REPAIR the circuit in question.

H11 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE

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• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

H12 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test I: The Instrument Panel Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM, Audio DSP Module, and DSP in Information and Entertainment System.

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A01:01	Speaker #1: General Electrical Failure	Set by the audio DSP module when a failure is detected on the instrument panel speaker circuits.
B1A01:11	Speaker #1: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the instrument panel speaker circuits. When DTC B1A01:11 is set, the speaker output is disabled.

B1A01:12	Speaker #1: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the instrument panel speaker circuits. When DTC B1A01:12 is set, the speaker output is disabled.
B1A01:13	Speaker #1: Circuit Open	Set by the audio DSP module when an open is detected on the instrument panel speaker circuits.

Possible Sources

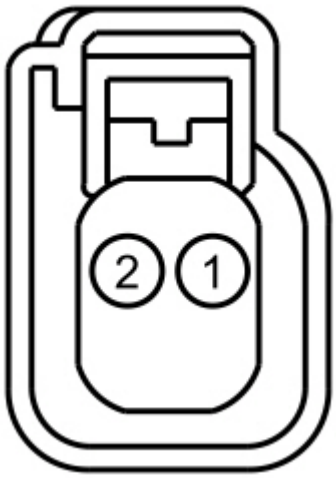
- Wiring, terminals, or connectors
- Speaker
- Audio DSP module

PINPOINT TEST I: THE INSTRUMENT PANEL SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CHECK THE AUDIO SIGNAL TO THE INSTRUMENT PANEL SPEAKER</td><td rowspan="2">Yes
INSTALL a new instrument panel speaker.
REFER to Speaker — Instrument Panel .

No
GO to I2 .</td></tr>
<tr><td>

Ignition OFF.
Disconnect: Instrument Panel Speaker C2356.
Operate the audio system in radio tuner AM/FM mode.
Measure the AC voltage between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C2356-1</td><td>VME06 (GN)</td><td>C2356-2</td><td>RME06 (GY/YE)</td></tr>
</table>


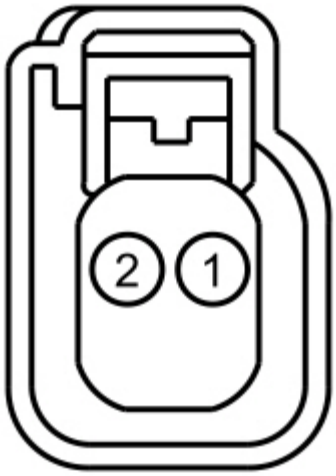
Is a fluctuating AC voltage present?

</td></tr>
<tr><td>I2 CHECK THE AUDIO CIRCUITS TO THE INSTRUMENT PANEL SPEAKER FOR A SHORT TO VOLTAGE</td><td></td></tr>
</table>

repair4less

- Ignition OFF.
- Disconnect: Audio DSP Module C3154B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2356-1	VME06 (GN)	—	Ground
C2356-2	RME06 (GY/YE)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to I3 .

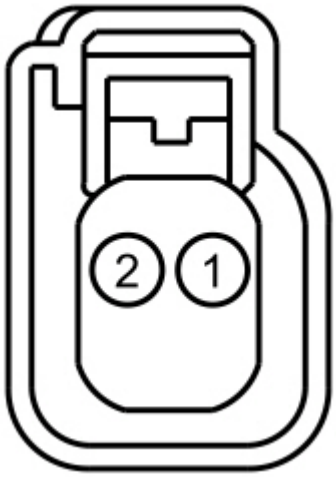
I3 CHECK THE AUDIO CIRCUITS TO THE INSTRUMENT PANEL SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

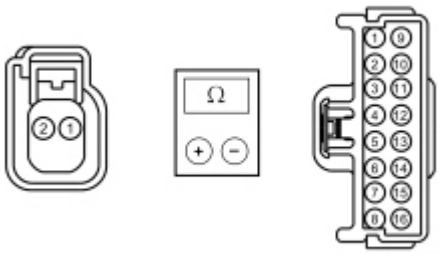
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2356-1	VME06 (GN)	—	Ground
C2356-2	RME06 (GY/YE)	—	Ground

Yes
GO to I4 .

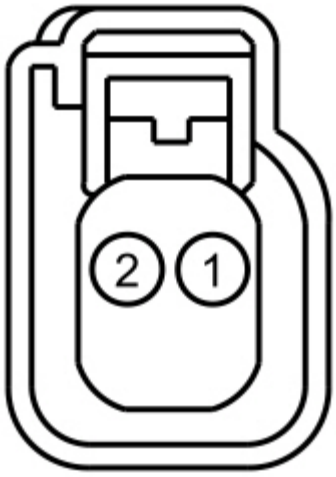
No
REPAIR the circuit in question.



- **Are the resistances greater than 10,000 ohms?**

I4 CHECK THE AUDIO CIRCUITS TO THE INSTRUMENT PANEL SPEAKER FOR AN OPEN	
• Measure the **resistance** between: | Positive Lead		Negative Lead	| | --- | --- | --- | --- | | Pin | Circuit | Pin | Circuit | | C2356-1 | VME06 (GN) | C3154B-1 | VME06 (GN) | | C2356-2 | RME06 (GY/YE) | C3154B-9 | RME06 (GY/YE) |  N0149077 • **Are the resistances less than 3 ohms?**	**Yes** GO to I5 . **No** REPAIR the circuit in question.
I5 CHECK THE AUDIO CIRCUITS TO THE INSTRUMENT PANEL SPEAKER FOR A SHORT TOGETHER	
• Measure the **resistance** between: | Positive Lead		Negative Lead	| | --- | --- | --- | --- | | Pin | Circuit | Pin | Circuit | | C2356-1 | VME06 (GN) | C2356-2 | RME06 (GY/YE) |	**Yes** GO to I6 . **No** REPAIR the circuit in question.

repair4less

 • **Is the resistance greater than 10,000 ohms?**	

I6 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION
• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test J: The RF Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM , Audio DSP Module, and DSP in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A06:01	Speaker #6: General Electrical Failure	Set by the audio DSP module when a failure is detected on the RF door speaker circuits.
B1A06:11	Speaker #6: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the RF door speaker circuits. When DTC B1A06:11 is set, the speaker output is disabled.
B1A06:12	Speaker #6: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the RF door speaker circuits. When DTC B1A06:12 is set, the speaker output is disabled.
B1A06:13	Speaker #6: Circuit Open	Set by the audio DSP module when an open is detected on the RF door speaker circuits.

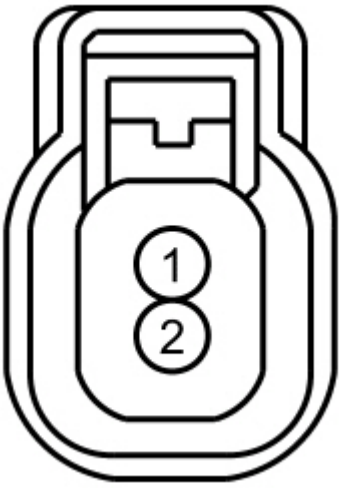
Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM
- Audio DSP module

PINPOINT TEST J: THE RF DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
J1 CHECK THE AUDIO SIGNAL TO THE RF DOOR SPEAKER • Ignition OFF. • Disconnect: RF Door Speaker C612 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C612-1, Circuit VME10 (WH/VT) Negative Lead: Pin C612-2, Circuit RME10 (WH/OG)	**Yes** INSTALL a new RF door speaker. REFER to Speaker — Door . **No** GO to J2 .

repair4less

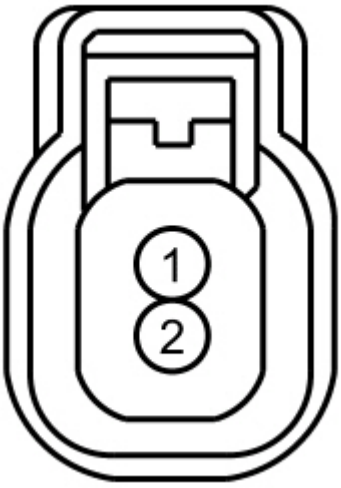


- **Is a fluctuating AC voltage present?**

J2 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP module C3154B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

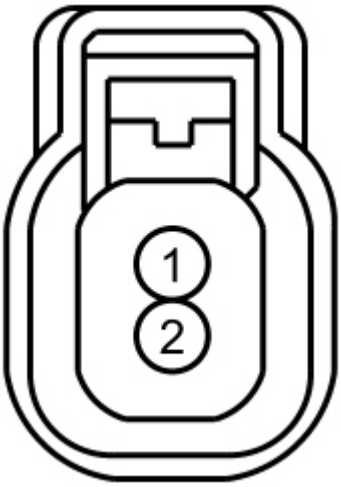
No
GO to J3 .

J3 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to J4 .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	—	Ground
C612-2	RME10 (WH/OG)	—	Ground



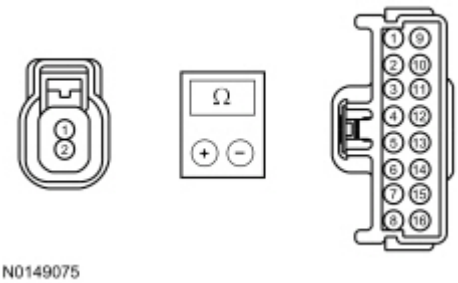
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

J4 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C3154B-6	VME10 (WH/VT)
C612-2	RME10 (WH/OG)	C3154B-14	RME10 (WH/OG)



- **Are the resistances less than 3 ohms?**

Yes
GO to J5 .

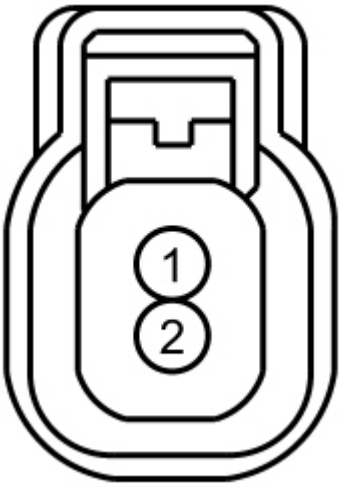
No
REPAIR the circuit in question.

J5 CHECK THE AUDIO CIRCUITS TO THE RF DOOR SPEAKER FOR A SHORT TOGETHER

repair4less

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C612-1	VME10 (WH/VT)	C612-2	RME10 (WH/OG)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to J6 .

No
REPAIR the circuit in question.

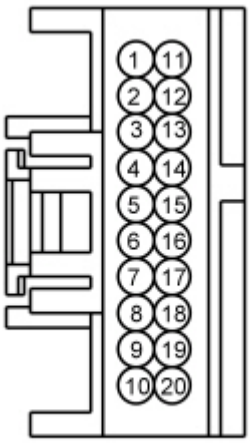
J6 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE

- Ignition OFF.
- Disconnect: Audio DSP module C3154A.
- Ignition ON.
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C3154A-19	RME18 (YE)

Yes
GO to J12 .

No
GO to J7 .

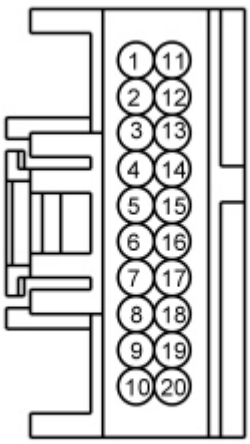


- **Is a fluctuating AC voltage present?**

J7 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	—	Ground
C3154A-19	RME18 (YE)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to J8 .

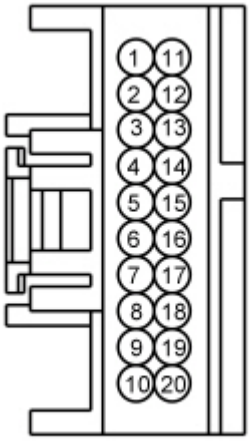
J8 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to J9 .

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	—	Ground
C3154A-19	RME18 (YE)	—	Ground



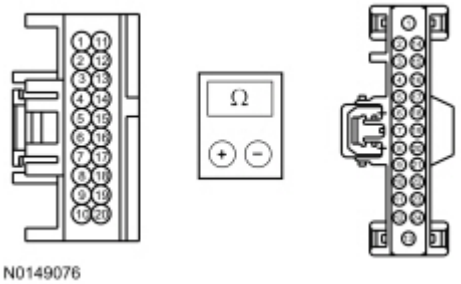
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

J9 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C240A-23	VME18 (VT)
C3154A-19	RME18 (YE)	C240A-11	RME18 (YE)



- **Are the resistances less than 3 ohms?**

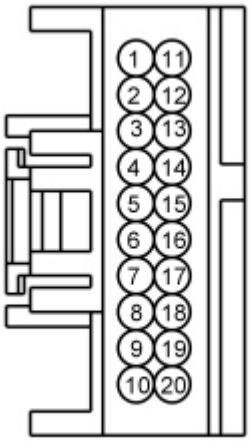
Yes
GO to J10 .

No
REPAIR the circuit in question.

J10 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C3154A-19	RME18 (YE)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to J11 .

No
REPAIR the circuit in question.

J11 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the ACM connectors. Make sure they seat and latch correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

J12 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION

- Ignition OFF.
- Disconnect and inspect all the audio DSP module connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .

repair4less

• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test K: The RF Tweeter Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM , Audio DSP Module, and DSP in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A07:01	Speaker #7: General Electrical Failure	Set by the audio DSP module when a failure is detected on the RF tweeter speaker circuits.
B1A07:11	Speaker #7: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the RF tweeter speaker circuits. When DTC B1A07:11 is set, the speaker output is disabled.
B1A07:12	Speaker #7: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the RF tweeter speaker circuits. When DTC B1A07:12 is set, the speaker output is disabled.
B1A07:13	Speaker #7: Circuit Open	Set by the audio DSP module when an open is detected on the RF tweeter speaker circuits.

Possible Sources

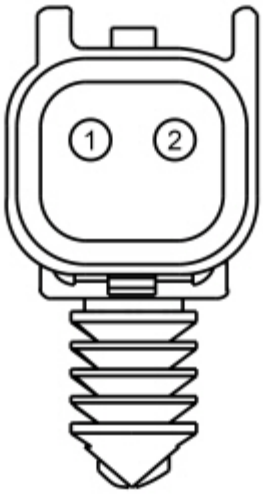
- Wiring, terminals, or connectors
- Speaker
- ACM
- Audio DSP module

PINPOINT TEST K: THE RF TWEETER SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
K1 CHECK THE AUDIO SIGNAL TO THE RF TWEETER SPEAKER	
• Ignition OFF.	**Yes** INSTALL a new RF tweeter speaker. REFER

- Disconnect: RF Tweeter Speaker C231 .
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME11 (VT/OG)	C231-2	RME11 (YE/OG)



- **Is a fluctuating AC voltage present?**

to Speaker — A-Pillar .

No
GO to K2 .

K2 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO VOLTAGE

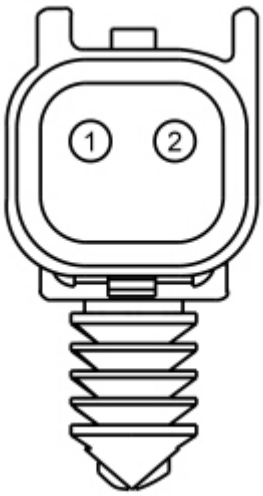
- Ignition OFF.
- Disconnect: Audio DSP module C3154B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME11 (VT/OG)	—	Ground
C231-2	RME11 (YE/OG)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to K3 .

repair4less

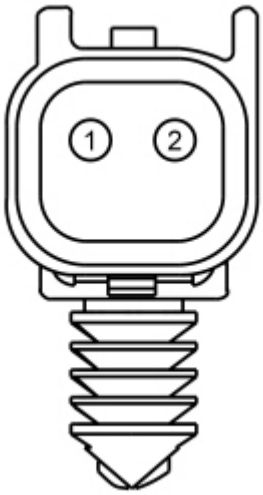


- **Is any voltage present?**

K3 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME11 (VT/OG)	—	Ground
C231-2	RME11 (YE/OG)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K4 .

No
REPAIR the circuit in question.

K4 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR AN OPEN

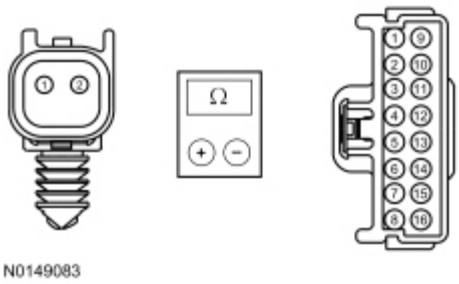
- Measure the **resistance** between:

Positive Lead	Negative Lead

Yes
GO to K5 .

No

Pin	Circuit	Pin	Circuit
C231-1	VME11 (VT/OG)	C3154B-7	VME11 (VT/OG)
C231-2	RME11 (YE/OG)	C3154B-15	RME11 (YE/OG)



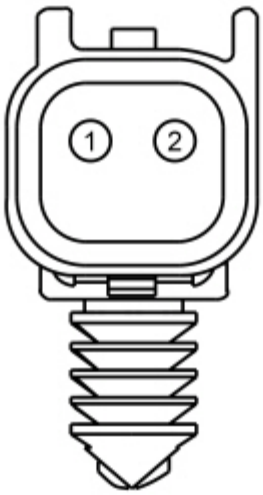
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

K5 CHECK THE AUDIO CIRCUITS TO THE RF TWEETER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C231-1	VME11 (VT/OG)	C231-2	RME11 (YE/OG)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to K6.

No
REPAIR the circuit in question.

K6 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE

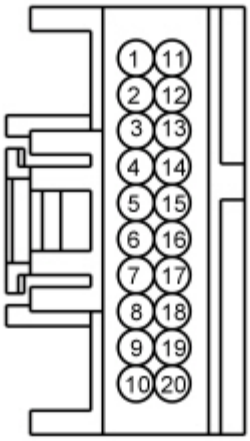
- Ignition OFF.
- Disconnect: Audio DSP module C3154A.

Yes
GO to K12.

repair4less

- Ignition ON.
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C3154A-19	RME18 (YE)



- **Is a fluctuating AC voltage present?**

No
GO to K7 .

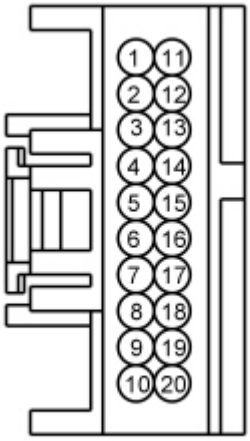
K7 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	—	Ground
C3154A-19	RME18 (YE)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to K8 .

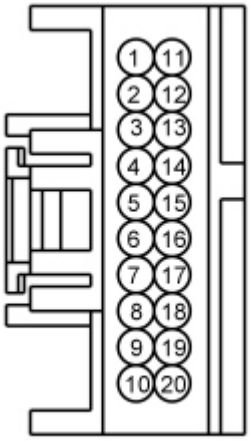


- **Is any voltage present?**

K8 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	—	Ground
C3154A-19	RME18 (YE)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K9 .

No
REPAIR the circuit in question.

K9 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR AN OPEN

- Measure the **resistance** between:

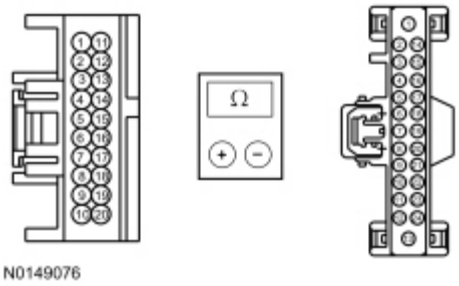
Positive Lead	Negative Lead

Yes
GO to K10 .

No

repair4less

Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C240A-23	VME18 (VT)
C3154A-19	RME18 (YE)	C240A-11	RME18 (YE)



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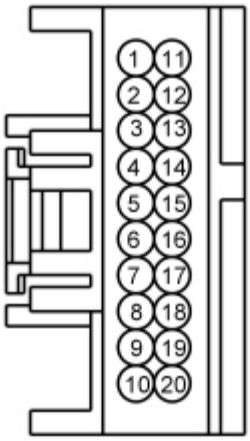
- **Are the resistances less than 3 ohms?**

REPAIR the circuit in question.

K10 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C3154A-19	RME18 (YE)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to K11 .

No
REPAIR the circuit in question.

K11 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE

• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

K12 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test L: The RR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM, Audio DSP Module, and DSP in Information and Entertainment System.

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A08:01	Speaker #8: General Electrical Failure	Set by the audio DSP module when a failure is detected on the RR door speaker circuits.
B1A08:11	Speaker #8: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the RR door speaker circuits. When DTC B1A08:11 is set, the speaker output is disabled.

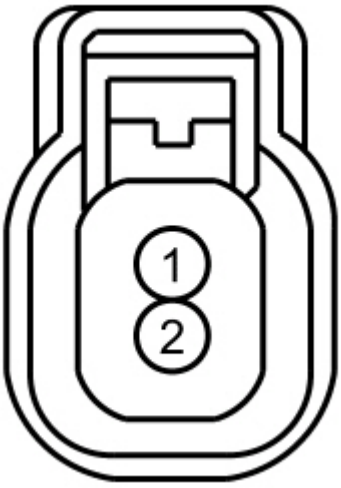
repair4less

B1A08:12	Speaker #8: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the RR door speaker circuits. When DTC B1A08:12 is set, the speaker output is disabled.
B1A08:13	Speaker #8: Circuit Open	Set by the audio DSP module when an open is detected on the RR door speaker circuits.

Possible Sources

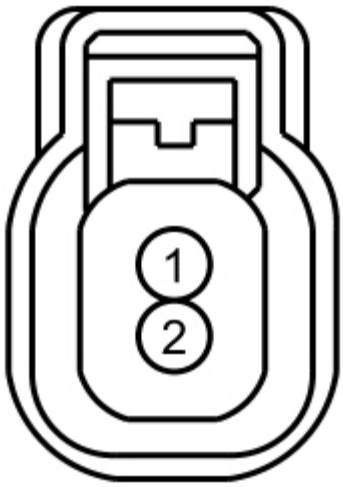
- Wiring, terminals, or connectors
- Speaker
- ACM
- Audio DSP module

PINPOINT TEST L: THE RR DOOR SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
L1 CHECK THE AUDIO SIGNAL TO THE RR DOOR SPEAKER	
• Ignition OFF. • Disconnect: RR Door Speaker C802 . • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C802-1, Circuit VME12 (BN/WH) Negative Lead: Pin C802-2, Circuit RME12 (BN/BU)  • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new RR door speaker. REFER to Speaker — Door . **No** GO to L2 .
L2 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO VOLTAGE	

- Ignition OFF.
- Disconnect: Audio DSP module C3154B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to L3 .

L3 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TO GROUND

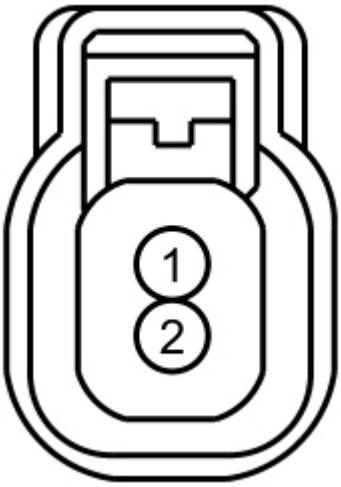
- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	—	Ground
C802-2	RME12 (BN/BU)	—	Ground

Yes
GO to L4 .

No
REPAIR the circuit in question.

repair4less

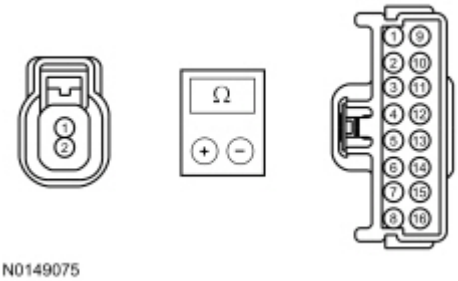


- **Are the resistances greater than 10,000 ohms?**

L4 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C3154B-8	VME12 (BN/WH)
C802-2	RME12 (BN/BU)	C3154B-16	RME12 (BN/BU)



- **Are the resistances less than 3 ohms?**

Yes
GO to L5 .

No
REPAIR the circuit in question.

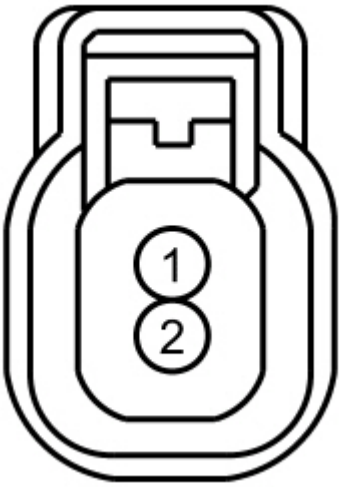
L5 CHECK THE AUDIO CIRCUITS TO THE RR DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

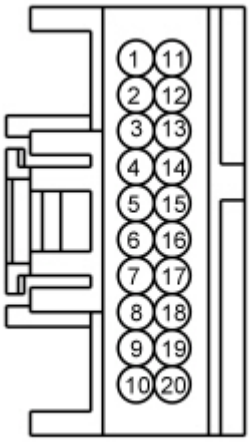
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C802-1	VME12 (BN/WH)	C802-2	RME12 (BN/BU)

Yes
GO to L6 .

No
REPAIR the circuit in question.



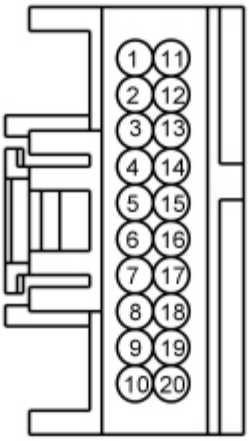
- **Is the resistance greater than 10,000 ohms?**

L6 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE	
• Ignition OFF. • Disconnect: Audio DSP module C3154A. • Ignition ON. • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between: Positive Lead: Pin C3154A-9, Circuit VME18 (VT) Negative Lead: Pin C3154A-19, Circuit RME18 (YE)  • **Is a fluctuating AC voltage present?**	**Yes** GO to L12 . **No** GO to L7 .
L7 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE	

repair4less

- Ignition OFF.
- Disconnect: ACM C240A.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	—	Ground
C3154A-19	RME18 (YE)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to L8 .

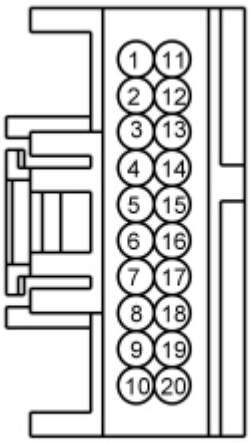
L8 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	—	Ground
C3154A-19	RME18 (YE)	—	Ground

Yes
GO to L9 .

No
REPAIR the circuit in question.

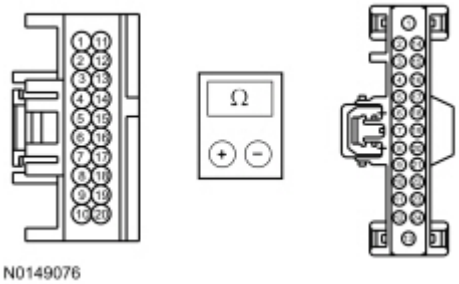


- **Are the resistances greater than 10,000 ohms?**

L9 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C240A-23	VME18 (VT)
C3154A-19	RME18 (YE)	C240A-11	RME18 (YE)



- **Are the resistances less than 3 ohms?**

Yes
GO to L10 .

No
REPAIR the circuit in question.

L10 CHECK THE RIGHT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TOGETHER

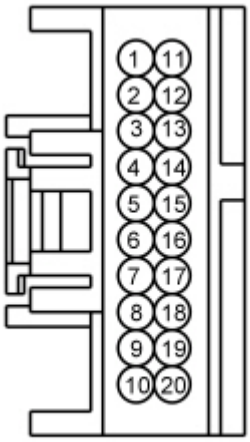
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-9	VME18 (VT)	C3154A-19	RME18 (YE)

Yes
GO to L11 .

No
REPAIR the circuit in question.

repair4less

 • **Is the resistance greater than 10,000 ohms?**	
L11 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

L12 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test M: The Subwoofer Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM , Audio DSP Module, DSP , and Subwoofer Speaker in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions
B1A09:11	Speaker #9: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the subwoofer speaker circuits. When DTC B1A09:11 is set, the speaker output is disabled.
B1A09:12	Speaker #9: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the subwoofer speaker circuits. When DTC B1A09:12 is set, the speaker output is disabled.
B1A09:13	Speaker #9: Circuit Open	Set by the audio DSP module when an open is detected on the subwoofer speaker circuits.
B1A10:11	Speaker #10: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the subwoofer speaker circuits. When DTC B1A10:11 is set, the speaker output is disabled.
B1A10:12	Speaker #10: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the subwoofer speaker circuits. When DTC B1A10:12 is set, the speaker output is disabled.
B1A10:13	Speaker #10: Circuit Open	Set by the audio DSP module when an open is detected on the subwoofer speaker circuits.

Possible Sources

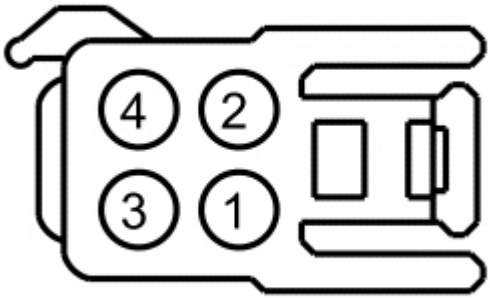
- Wiring, terminals, or connectors
- Speaker
- Audio DSP module

PINPOINT TEST M: THE SUBWOOFER SPEAKER IS INOPERATIVE

Test Step	Result / Action to Take
M1 CHECK THE AUDIO SIGNAL TO THE SUBWOOFER SPEAKER	
• Ignition OFF. • Disconnect: Subwoofer Speaker C3020. • Operate the audio system in radio tuner AM/FM mode. • Measure the **AC voltage** between:	**Yes** INSTALL a new subwoofer speaker. REFER to Speaker Enclosure . **No** GO to M2 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3020-1	VME22 (VT/GN)	C3020-2	RME22 (GN/WH)
C3020-3	VME01 (GN/VT)	C3020-4	RME01 (GY)



- **Is a fluctuating AC voltage present?**

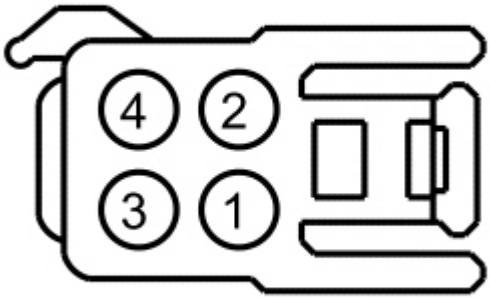
M2 CHECK THE AUDIO CIRCUITS TO THE SUBWOOFER SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP Module C3154C.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3020-1	VME22 (VT/GN)	—	Ground
C3020-2	RME22 (GN/WH)	—	Ground
C3020-3	VME01 (GN/VT)	—	Ground
C3020-4	RME01 (GY)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to M3 .

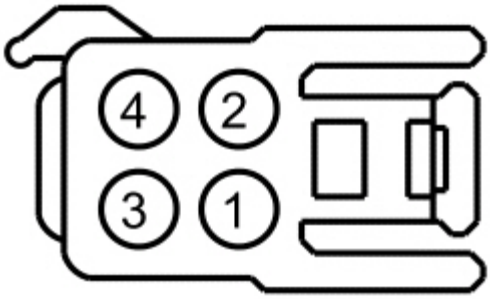


- **Is any voltage present?**

M3 CHECK THE AUDIO CIRCUITS TO THE SUBWOOFER SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3020-1	VME22 (VT/GN)	—	Ground
C3020-2	RME22 (GN/WH)	—	Ground
C3020-3	VME01 (GN/VT)	—	Ground
C3020-4	RME01 (GY)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to M4 .

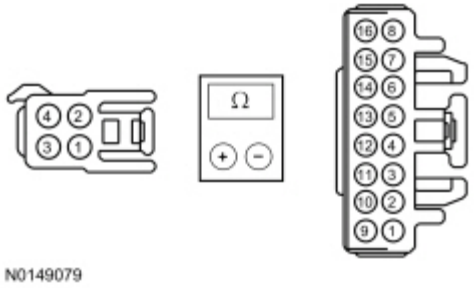
No
REPAIR the circuit in question.

M4 CHECK THE AUDIO CIRCUITS TO THE SUBWOOFER SPEAKER FOR AN OPEN

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- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3020-1	VME22 (VT/GN)	C3154C-1	VME22 (VT/GN)
C3020-2	RME22 (GN/WH)	C3154C-9	RME22 (GN/WH)
C3020-3	VME01 (GN/VT)	C3154C-2	VME01 (GN/VT)
C3020-4	RME01 (GY)	C3154C-10	RME01 (GY)



- **Are the resistances less than 3 ohms?**

Yes
GO to M5.

No
REPAIR the circuit in question.

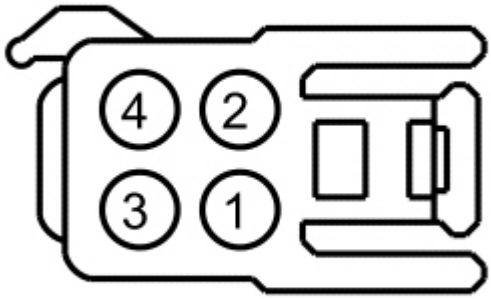
M5 CHECK THE AUDIO CIRCUITS TO THE SUBWOOFER SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3020-1	VME22 (VT/GN)	C3020-2	RME22 (GN/WH)
C3020-1	VME22 (VT/GN)	C3020-3	VME01 (GN/VT)
C3020-1	VME22 (VT/GN)	C3020-4	RME01 (GY)
C3020-2	RME22 (GN/WH)	C3020-3	VME01 (GN/VT)
C3020-2	RME22 (GN/WH)	C3020-4	RME01 (GY)
C3020-3	VME01 (GN/VT)	C3020-4	RME01 (GY)

Yes
GO to M6.

No
REPAIR the circuit in question.

 • **Are the resistances greater than 10,000 ohms?**	

M6 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION
• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test N: The LR Door Speaker Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to ACM , Audio DSP Module, and DSP in Information and Entertainment System .

Root DTC Description	Failure Types	Fault Trigger Conditions

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B1A04:01	Speaker #4: General Electrical Failure	Set by the audio DSP module when a failure is detected on the LR door speaker circuits.
B1A04:11	Speaker #4: Circuit Short to Ground	Set by the audio DSP module when a short to ground is detected on the LR door speaker circuits. When DTC B1A04:11 is set, the speaker output is disabled.
B1A04:12	Speaker #4: Circuit Short to Battery	Set by the audio DSP module when a short to battery is detected on the LR door speaker circuits. When DTC B1A04:12 is set, the speaker output is disabled.
B1A04:13	Speaker #4: Circuit Open	Set by the audio DSP module when an open is detected on the LR door speaker circuits.

Possible Sources

- Wiring, terminals, or connectors
- Speaker
- ACM
- Audio DSP module

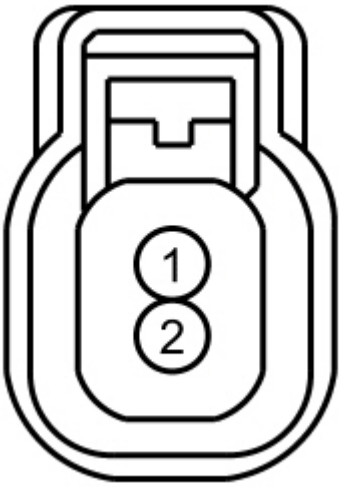
PINPOINT TEST N: THE LR DOOR SPEAKER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>N1 CHECK THE AUDIO SIGNAL TO THE LR DOOR SPEAKER

• Ignition OFF.
• Disconnect: LR Door Speaker C702 .
• Operate the audio system in radio tuner AM/FM mode.
• Measure the AC voltage between:

<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>C702-1</td><td>VME09 (WH/GN)</td><td>C702-2</td><td>RME09 (BN/YE)</td></tr></table></td><td>Yes
INSTALL a new LR door speaker. REFER to Speaker — Door .

No
GO to N2 .</td></tr>
</table>

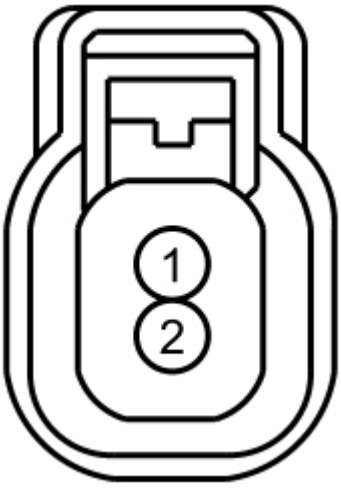


- **Is a fluctuating AC voltage present?**

N2 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP module C3154B.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to N3 .

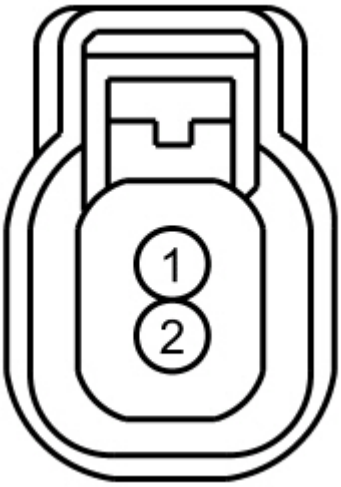
N3 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to N4 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	—	Ground
C702-2	RME09 (BN/YE)	—	Ground



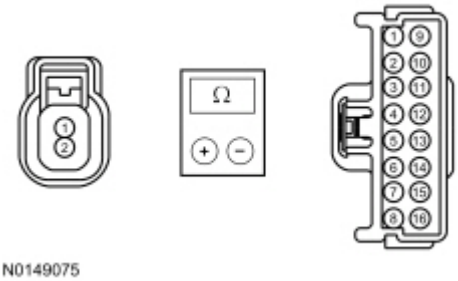
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

N4 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C3154B-4	VME09 (WH/GN)
C702-2	RME09 (BN/YE)	C3154B-12	RME09 (BN/YE)



- **Are the resistances less than 3 ohms?**

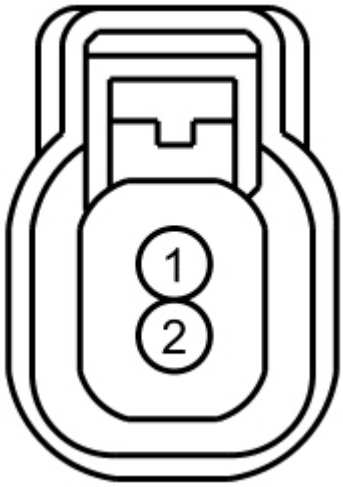
Yes
GO to N5 .

No
REPAIR the circuit in question.

N5 CHECK THE AUDIO CIRCUITS TO THE LR DOOR SPEAKER FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C702-1	VME09 (WH/GN)	C702-2	RME09 (BN/YE)



- **Is the resistance greater than 10,000 ohms?**

Yes
GO to N6 .

No
REPAIR the circuit in question.

N6 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE

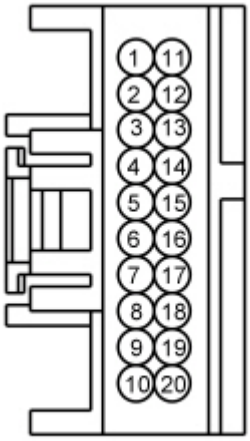
- Ignition OFF.
- Disconnect: Audio DSP module C3154A.
- Ignition ON.
- Operate the audio system in radio tuner AM/FM mode.
- Measure the **AC voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	C3154A-17	RME17 (GY)

Yes
GO to N12 .

No
GO to N7 .

repair4less

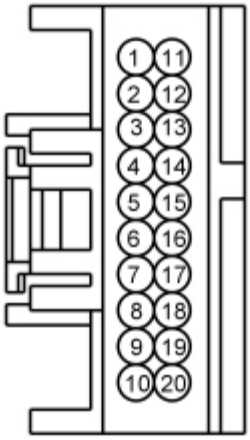


- **Is a fluctuating AC voltage present?**

N7 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240A.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	—	Ground
C3154A-17	RME17 (GY)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

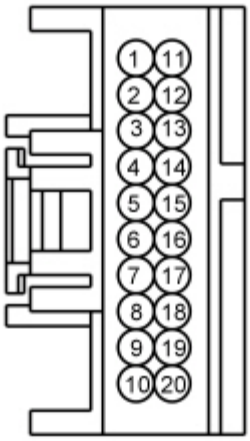
No
GO to N8.

N8 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to N9.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	—	Ground
C3154A-17	RME17 (GY)	—	Ground



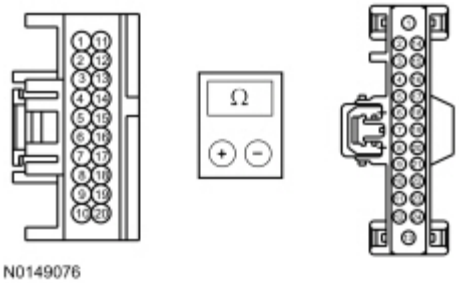
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

N9 CHECK THE LEFT AUDIO SIGNAL TO THE AUDIO DSP MODULE FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-7	VME17 (GN)	C240A-22	VME17 (GN)
C3154A-17	RME17 (GY)	C240A-10	RME17 (GY)



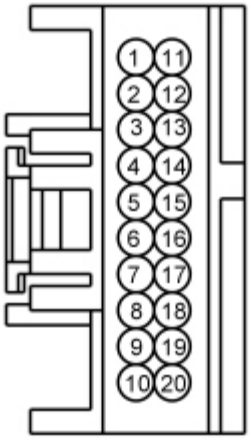
- **Are the resistances less than 3 ohms?**

Yes
GO to N10 .

No
REPAIR the circuit in question.

N10 CHECK THE LEFT AUDIO SIGNAL TO THE

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AUDIO DSP MODULE FOR A SHORT TOGETHER	
• Measure the **resistance** between: Positive Lead: Pin C3154A-7, Circuit VME17 (GN) Negative Lead: Pin C3154A-17, Circuit RME17 (GY)  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to N11 . **No** REPAIR the circuit in question.
N11 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

N12 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .

necessary) • Reconnect the audio DSP module connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test O: Poor Quality, Distorted, Or No Sound While In SYNC® Mode

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System in Information and Entertainment System .

The APIM transmits left and right channel analog audio signals to the ACM . These signals include inputs from the USB port, the SD card slot, the RCA jacks, and a Bluetooth media device. If a USB mass storage device is used to play an audio file, the SYNC® system only plays audio files that do not have DRM protection.

Possible Sources

- Customer's device
- Wiring, terminals, or connectors
- APIM
- ACM

PINPOINT TEST O: POOR QUALITY, DISTORTED, OR NO SOUND WHILE IN SYNC® MODE

Test Step	Result / Action to Take
O1 VERIFY THE OPERATION OF THE SYNC® SYSTEM AUDIO SOURCES	
• Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120 and RCA Adapter 105-00121, test the audio output for the RCA jacks, USB ports, and Bluetooth. • **Is there poor quality, distorted, or no sound from all SYNC® audio sources?**	**Yes** GO to O2 . **No** If there is a concern with one or more, but not all audio sources, GO to Symptom Chart - SYNC® System to diagnose the observed symptom. If all audio sources operate correctly, the concern is with the customer's device.

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O2 CHECK THE AUDIO SIGNALS TO THE ACM

NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

- Operate the audio system in SYNC® mode and play an audio file.
- Measure the **AC voltage** by back-probing ACM connector C240B:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240B-12	VME52 (BU)	C240B-25	RME52 (GY/OG)
C240B-13	VME53 (VT/GN)	C240B-26	RME53 (BN/WH)

- **Is a fluctuating AC voltage present?**

Yes
GO to O7.

No
GO to O3.

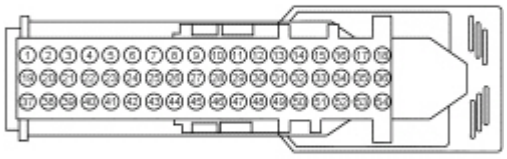
O3 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240B .
- Disconnect: APIM C2383 .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME52 (BU)	—	Ground
C2383-24	RME52 (GY/OG)	—	Ground
C2383-25	VME53 (VT/GN)	—	Ground
C2383-26	RME53 (BN/WH)	—	Ground

Yes
REPAIR the circuit in question.

No
GO to O4.

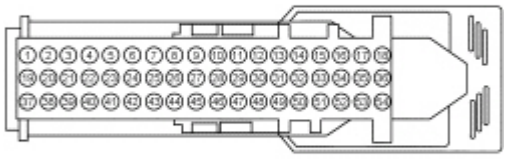


- **Is any voltage present?**

O4 CHECK THE AUDIO CIRCUITS TO THE ACM FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME52 (BU)	—	Ground
C2383-24	RME52 (GY/OG)	—	Ground
C2383-25	VME53 (VT/GN)	—	Ground
C2383-26	RME53 (BN/WH)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to O5 .

No
REPAIR the circuit in question.

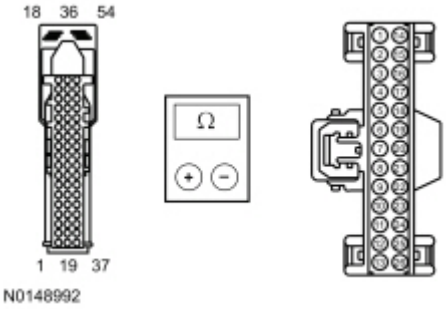
O5 CHECK THE CIRCUITS TO THE ACM FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to O6 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-23	VME52 (BU)	C240B-12	VME52 (BU)
C2383-24	RME52 (GY/OG)	C240B-25	RME52 (GY/OG)
C2383-25	VME53 (VT/GN)	C240B-13	VME53 (VT/GN)
C2383-26	RME53 (BN/WH)	C240B-26	RME53 (BN/WH)



- **Are the resistances less than 3 ohms?**

No
REPAIR the circuit in question.

O6 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new APIM. REFER to Accessory Protocol Interface Module (APIM).

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

O7 CHECK FOR CORRECT ACM OPERATION

- Ignition OFF.
- Disconnect and inspect all the ACM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the ACM connectors. Make sure they seat and latch correctly.

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control

• Operate the system and determine if the concern is still present. • **Is the concern still present?**	Module (ACM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test P: The SYNC® System Audible Prompts Are Inoperative Or Do Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to SYNC® System and Voice Recognition in Information and Entertainment System .

Possible Sources

- Customer's setting
- Wiring, terminals, or connectors
- APIM
- Audio DSP module

PINPOINT TEST P: THE SYNC® SYSTEM AUDIBLE PROMPTS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
P1 CHECK THE AUDIBLE PROMPT SETTING	
• Operate the audio system in SYNC® mode. • Verify the audible prompts are enabled. Refer to "SYNC® Voice Recognition Feature" in the Owner's Literature. • Operate the VOICE button on the steering wheel controls and observe the SYNC® audible prompt. • **Does the SYNC® system produce an audible prompt correctly?**	**Yes** The system is operating correctly at this time. The concern was caused by the customer's setting. INSTRUCT the customer in the correct operation of the audible prompt feature. **No** GO to P2 .
P2 CHECK FOR A VOLTAGE SIGNAL FROM THE APIM	
NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage**	**Yes** GO to P7 . **No** GO to P3 .

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while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.

- Operate the audio system in SYNC® mode.
- While operating the VOICE button repeatedly, measure the **AC voltage** by back-probing audio DSP module connector C3154A:

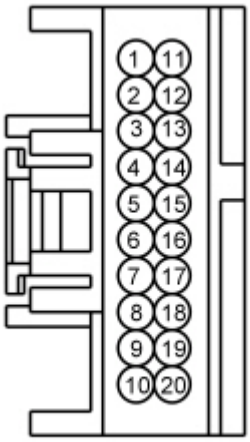
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-5	VME80 (VT/GN)	C3154A-15	RME80 (BU/GY)

- **Is a fluctuating AC voltage present each time the VOICE switch is operated?**

P3 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP Module C3154A .
- Disconnect: APIM C2383 .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-5	VME80 (VT/GN)	—	Ground
C3154A-15	RME80 (BU/GY)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

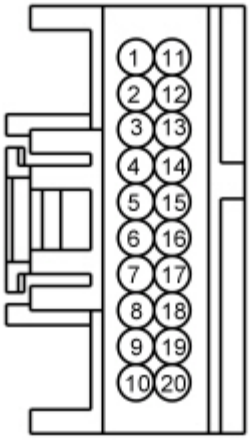
No
GO to P4 .

P4 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO GROUND

Yes

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-5	VME80 (VT/GN)	—	Ground
C3154A-15	RME80 (BU/GY)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

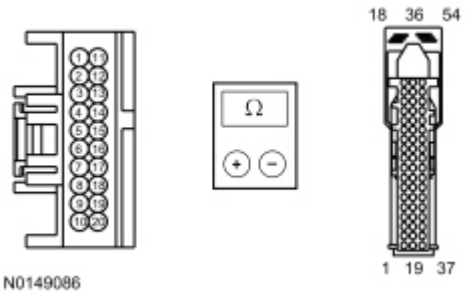
GO to P5.

No
REPAIR the circuit in question.

P5 CHECK THE AUDIBLE PROMPT CIRCUITS FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154A-5	VME80 (VT/GN)	C2383-3	VME80 (VT/GN)
C3154A-15	RME80 (BU/GY)	C2383-4	RME80 (BU/GY)



- **Are the resistances less than 3 ohms?**

Yes
GO to P6.

No
REPAIR the circuit in question.

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P6 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

P7 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Q: All SYNC® Services Features Are Inoperative Or Inaccurate

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to SYNC® Services in Information and Entertainment System .

Possible Sources

- Expired subscription
- APIM

- GPSM
- SYNC® Services server

PINPOINT TEST Q: ALL SYNC® SERVICES FEATURES ARE INOPERATIVE OR INACCURATE

Test Step	Result / Action to Take
Q1 VERIFY THE CUSTOMER'S SYNC® OWNER ACCOUNT AND SYNC® SERVICES REGISTRATION AND SUBSCRIPTION	
• Verify that the customer has a SYNC® Owner Account on SyncMyRide • Verify that the customer has registered for SYNC® Services and has an active subscription. • **Does the customer have a SYNC® Owner Account and an active SYNC® Services subscription?**	**Yes** GO to Q2 . **No** If the customer does not have a SYNC® Owner Account, INFORM the customer that an account must be created in order to sign up for SYNC® Services. REFER to SyncMyRide . If the customer does not have an active SYNC® Services subscription, INFORM the customer that in order for SYNC® Services to function, the subscription needs to be activated. REFER to SyncMyRide .
Q2 VERIFY THE CUSTOMER'S REGISTERED PHONE NUMBER AND STATUS	
• Verify that the mobile phone being used has the correct phone number registered with SYNC® Services. • Verify that the mobile phone being used is selected as "Active" on SyncMyRide . • **Is the customer using the registered and active mobile phone associated with the SYNC® services account?**	**Yes** GO to Q3 . **No** INFORM the customer that the correct phone number must be registered on the SYNC® website and selected as "Active." REFER to SyncMyRide .
Q3 CHECK FOR APIM DTCs	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Are any DTCs recorded in the APIM ?**	**Yes** REFER to the APIM DTC Chart in Information and Entertainment System . **No** GO to Q4 .
Q4 CHECK FOR GPSM DTCs	
• Using a diagnostic scan tool, perform the GPSM self-test. • **Are any DTCs recorded in the GPSM ?**	**Yes** REFER to the GPSM DTC Chart in Information and Entertainment System . **No** GO to Q5 .
Q5 VERIFY THE CUSTOMER'S PHONE CONNECTION TO SYNC®	

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SERVICES	
• Advise the customer to connect their phone to SYNC® Services. Caller ID blocking must be disabled on the customer's phone. Refer to the Owner's Literature. • Operate a SYNC® Services feature. • Verify that the phone call is placed and that the phone is connected to SYNC® Services. • **Does the phone connect to SYNC® Services and operate correctly?**	**Yes** GO to Q6 . **No** GO to Pinpoint Test S .
Q6 OBSERVE THE SYNC® SERVICES SUBSCRIPTION COMMERCIAL	
• Once the customer's phone is connected to SYNC® Services, observe the subscription commercial. • **Does the SYNC® Services subscription commercial repeat with no selection option?**	**Yes** There is a potential SYNC® Services server issue, and the problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance. **No** GO to Q7 .
Q7 CHECK THE OPERATION OF THE DIRECTIONS FROM SYNC® SERVICES	
• When prompted, select directions from SYNC® Services and observe the audible prompts from the audio system. • **Is a single chime, audible prompt, then a short chime heard, indicating the navigation route is being sent to the vehicle?**	**Yes** SYNC® Services is operating correctly at this time. **No** If a single chime, audible prompt, then a repeating chime is heard, indicating the navigation route is being sent to the vehicle, GO to Q8 . If no chime or audible prompt is heard, indicating that the system was unable to locate the vehicle, there is a potential SYNC® Services server issue. The problem does not reside in the vehicle's audio system. CONTACT the Ford Technical Hotline for assistance.
Q8 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test R: Voice Recognition Is Inoperative Or Does Not Operate Correctly, Or During A Phone Call, Poor Quality Or No Outgoing Audio Is Heard On The Outside Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Voice Recognition in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B116A:01	Handset Microphone: General Electrical Failure	Set by the APIM when a short to voltage, short to ground, or open is detected on the microphone circuits.

Possible Sources

- Insufficiently quiet vehicle
- Inadequate phone reception
- Wiring, terminals, or connectors
- Microphone
- APIM

PINPOINT TEST R: VOICE RECOGNITION IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY, OR DURING A PHONE CALL, POOR QUALITY OR NO OUTGOING AUDIO IS HEARD ON THE OUTSIDE DEVICE

Test Step	Result / Action to Take
R1 CHECK THE AUDIBLE PROMPT FUNCTIONALITY	
• Operate the audio system in radio tuner AM/FM mode. • Operate the VOICE steering wheel switch and listen	**Yes** GO to R3 . **No**

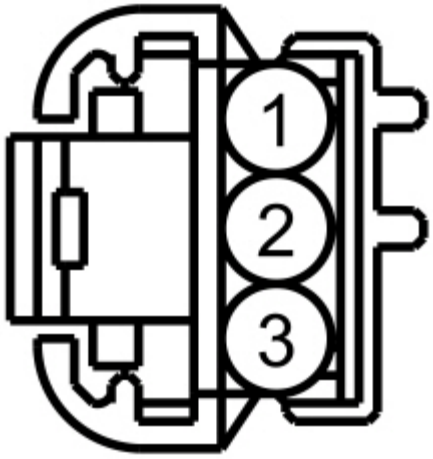
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for the SYNC® audible prompt. • **Does the SYNC® system produce an audible prompt correctly, indicating voice recognition mode has been entered?**	GO to R2.
R2 CHECK THE OPERATION OF THE RH STEERING WHEEL SWITCHES	
• Operate the audio system in AM/FM mode. • Operate the VOLUME +/-, SEEK +/-, MEDIA, and PHONE steering wheel switches. • **Do the VOLUME +/-, SEEK +/-, MEDIA, and PHONE steering wheel switches operate correctly?**	**Yes** GO to Pinpoint Test P. **No** GO to Pinpoint Test X to diagnose the RH steering wheel switches.
R3 CHECK THE OPERATION OF THE "PHONE" VOICE COMMAND	
• Pair a Bluetooth phone with the SYNC® system. For information on the pairing process, refer to the Owner's Literature. If necessary, review the device compatibility list found on syncmyride.com. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the system from correctly recognizing spoken commands. • Clearly speak the word "phone." • **Does the SYNC® system respond correctly to the "phone" voice command?**	**Yes** For a concern with the voice recognition being inoperative or not operating correctly, the system is operating correctly at this time. The concern may have been caused by an insufficiently quiet vehicle. Delete the just-paired Bluetooth phone from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. For a concern with poor quality or no outgoing audio being heard on the outside device during a phone call, GO to R4 **No** GO to R5.
R4 CHECK THE OUTGOING PHONE CALL QUALITY AND VOICE VOLUME	
• Ensure that the Bluetooth phone paired in step 3 has adequate reception. • **NOTE:** Make sure the interior of the vehicle is as quiet as possible. Excessive noise may prevent the call from having clear call quality and acceptable voice volume. • Using the SYNC® system, place a phone call. For information on making calls from the SYNC® system, refer to the Owner's Literature. • Ensure that the called party's phone has adequate reception. • Instruct the called party to determine if the call quality is clear and of acceptable volume. • Delete the Bluetooth phone paired in step 3 from the SYNC® system. For information on deleting a Bluetooth device from the SYNC® system, refer to the Owner's Literature. • **Is the outgoing call quality clear and of acceptable volume?**	**Yes** The system is operating correctly at this time. The concern may have been caused by poor phone reception or an insufficiently quiet vehicle. **No** GO to R5.
R5 CHECK THE MICROPHONE AND MICROPHONE CIRCUITS FOR CORRECT VOLTAGE DROP	

NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

- Ignition ON.
- While back-probing microphone C9221, measure and record the **DC voltage** .

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)



- **Is the voltage between 2.7 and 6.2 volts?**

Yes
If diagnosing an intermittent concern, GO to R6 . If **not** diagnosing an intermittent concern, GO to R13

No
GO to R7 .

R6 CHECK THE MICROPHONE CIRCUITS FOR INTERMITTENT CONCERNS

NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool POM6411. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage, while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors, and may cause subsequent electrical faults.**

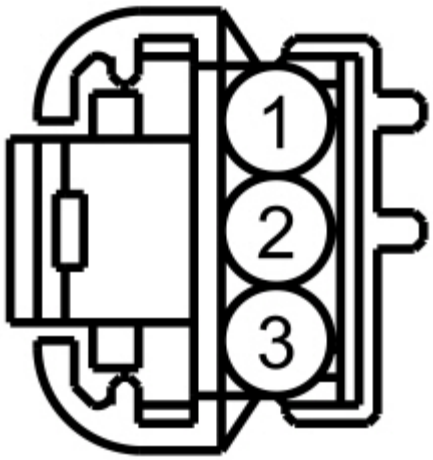
- While back-probing microphone C9221, measure the **DC voltage** while agitating the microphone harness back and forth and up and down (wiggle testing).

Yes
REPAIR the circuit(s), connector, or terminal(s) in question. For corrosion, clean pins or install a new connector or terminals. For damaged or bent pins, install new terminals or pins.

No
GO to R12 .

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)



- Review the recorded results from step 5.
- **Does the voltage fluctuate more than .5 volts from the recorded result in step 5?**

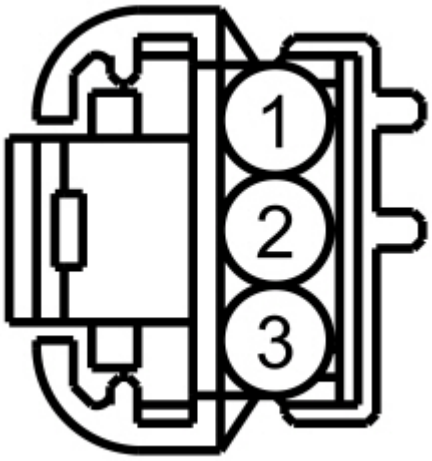
R7 CHECK THE MICROPHONE CIRCUITS FOR CORRECT VOLTAGE

- Ignition OFF.
- Disconnect: Microphone C9221.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK)

Yes
GO to R12 .

No
GO to R8 .

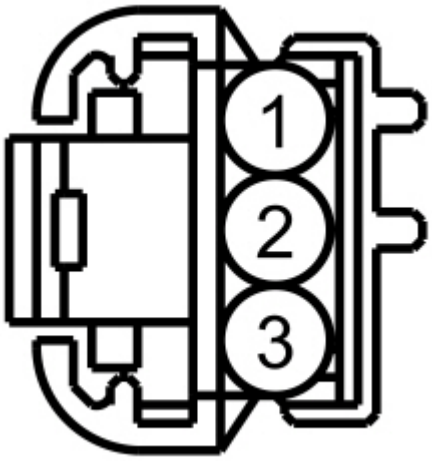


- **Is the voltage between 7.9 and 9.0 volts?**

R8 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to R9 .

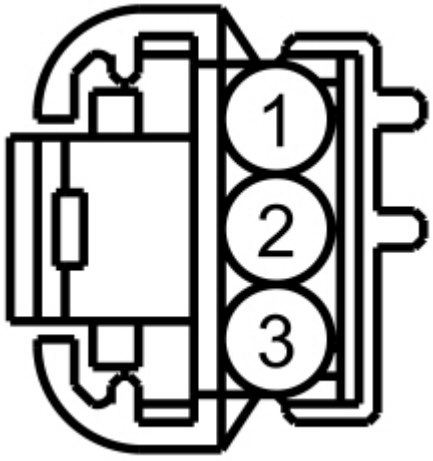
R9 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Yes
GO to R10 .

repair4less

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	—	Ground
C9221-3	DMM13 (BK)	—	Ground



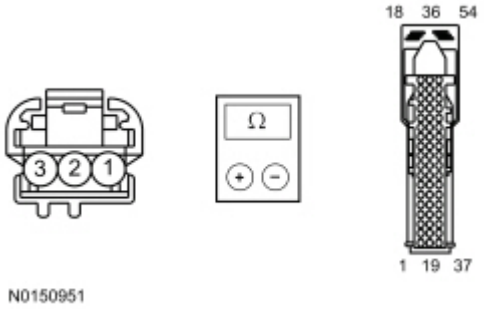
- **Are the resistances greater than 10,000 ohms?**

No
REPAIR the circuit in question.

R10 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C2383-12	VMM13 (YE/GN)
C9221-3	DMM13 (BK)	C2383-13	DMM13 (BK)

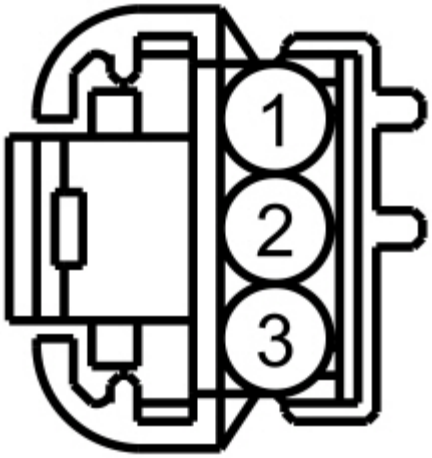


- **Are the resistances less than 3 ohms?**

Yes
GO to R11 .

No
REPAIR the circuit in question.

R11 CHECK THE MICROPHONE CIRCUITS TO THE APIM FOR A SHORT TOGETHER

• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C9221-2	VMM13 (YE/GN)	C9221-3	DMM13 (BK) |  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R13 . **No** REPAIR the circuit in question.
R12 ISOLATE THE MICROPHONE • Install a new microphone. Refer to Microphone . • If necessary, connect: APIM C2383. • Operate the audio system in AM/FM mode. • Operate the VOICE steering wheel switch and listen for the SYNC® audible prompt. • Speak a command to test the voice recognition for normal operation. • **Is the voice recognition functioning correctly?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative microphone. **No** GO to R13 .

R13 CHECK FOR CORRECT APIM OPERATION
 	
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

repair4less

Pinpoint Test S: All Media Hub Functions Are Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub, Composite Audio-Video Input Mode, SD Card Mode, and USB Mode in Information and Entertainment System .

The media hub requires a power and ground circuit from the APIM to operate. Loss of power or ground disables all media hub functionality.

Possible Sources

- Device conflict
- Wiring, terminals, or connectors
- Media hub
- APIM

PINPOINT TEST S: ALL MEDIA HUB FUNCTIONS ARE INOPERATIVE

NOTE: Before carrying out this pinpoint test, make sure the MP3 device is operating correctly.

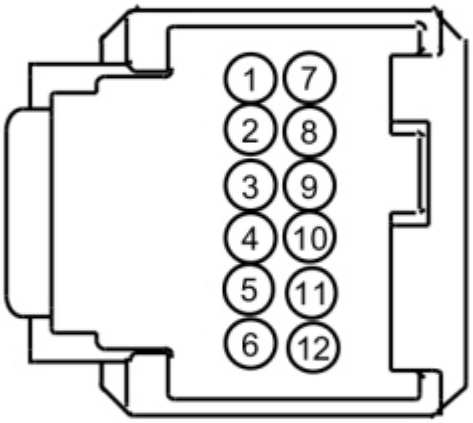
Test Step	Result / Action to Take
S1 CHECK FOR APIM BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the APIM self-test. • **Are any low or high voltage DTCs recorded in the APIM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an . **No** GO to S2 .
S2 RESET THE APIM	
• Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Test the system for normal operation. • **Does the system operate correctly?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to S3 .
S3 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT	
• Ignition OFF. • Disconnect: Media Hub C3618.	**Yes** GO to S4 .

- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	—	Ground

No
GO to S5 .

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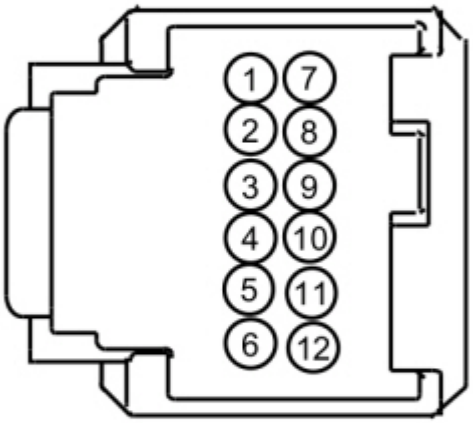
- **Is the voltage greater than 11 volts?**

S4 CHECK THE MEDIA HUB GROUND CIRCUIT	
• Measure the **voltage** between: Positive Lead / Negative Lead	**Yes** Install a new media hub. REFER to Media Hub .

Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	C3618-10	RME89 (WH/BU)

No
GO to S5 .

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- **Is the voltage greater than 11 volts?**

S5 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT AND GROUND CIRCUIT FOR A SHORT TOGETHER	
• Ignition OFF.	**Yes**

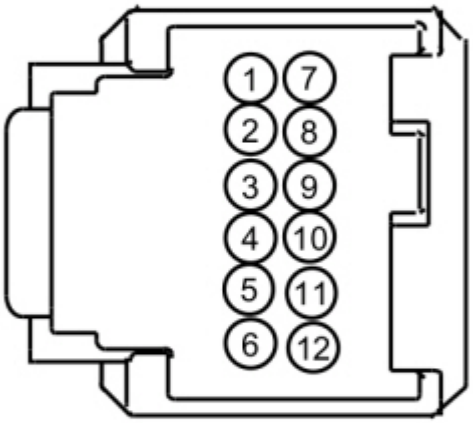
- Disconnect: APIM C2383.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	C3618-10	RME89 (WH/BU)

GO to S6 .

No
Repair the circuit in question.

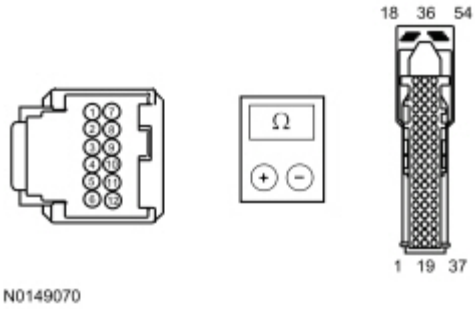
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- **Is the resistance greater than 10,000 ohms?**

S6 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT AND GROUND CIRCUIT FOR AN OPEN	
• Measure the **resistance** between:	**Yes**

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	C2383-8	LME89 (YE/BU)
C3618-10	RME89 (WH/BU)	C2383-38	RME89 (WH/BU)



- **Are the resistances less than 3 ohms?**

GO to S7 .

No
Repair the circuit in question.

S7 CHECK THE MEDIA HUB VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND

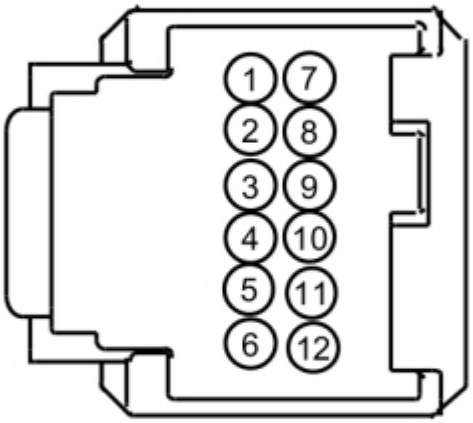
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-1	LME89 (YE/BU)	—	Ground

Yes
GO to S8 .

No
REPAIR the circuit.

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- **Is the resistance greater than 10,000 ohms?**

S8 CHECK THE MEDIA HUB GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON.	**Yes**

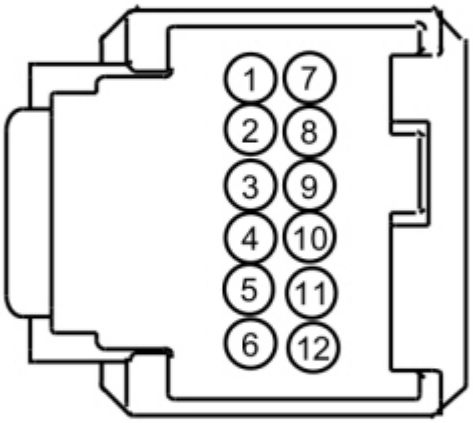
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3618-10	RME89 (WH/BU)	—	Ground

REPAIR the circuit.

No
GO to S9 .

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- **Is any voltage present?**

S9 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect and inspect the APIM connector. • Repair:	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE

▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test T: The USB Port(s) Is/Are Inoperative Or Do/Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub and USB Mode in Information and Entertainment System .

Although there are two USB ports, there is only one USB cable connecting the media hub to the APIM . The USB cable is used for data transfer, and does not supply power. The Multi-Media Interface Tester 105-00120 is powered by the USB port.

USB and SD card data is transmitted to the APIM through the USB cable.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1252:11	USB Port: Circuit Short to Ground	Set by the APIM when a short to ground or over-current condition is detected in the USB cable. This can be caused by a fault in the USB cable, USB port, or customer's USB or SD card device.
B1252:13	USB Port: Circuit Open	Set by the APIM when an open is detected in the USB cable.

Possible Sources

- Device conflict
- USB cable
- Media hub
- APIM

PINPOINT TEST T: THE USB PORT(S) IS/ARE INOPERATIVE OR DO/DOES NOT OPERATE

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CORRECTLY

Test Step	Result / Action to Take
T1 CHECK THE USB PORT FOR POWER OUTPUT • Connect: Multi-Media Interface Tester 105-00120. • **Does the Multi-Media Interface Tester 105-00120 power on from both USB ports?**	**Yes** GO to T2. **No** If the Multi-Media Interface Tester 105-00120 powers on from only one USB port, INSTALL a new media hub. REFER to Media Hub. If the Multi-Media Interface Tester 105-00120 does not power on from either USB port, GO to Pinpoint Test R.
T2 RESET THE APIM • Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** If the audio output is not OK from one USB port, INSTALL a new media hub. REFER to Media Hub. If the audio output is not OK from both USB ports, GO to T3.
T3 CHECK THE SD CARD SLOT FUNCTIONALITY • Using a known good SD card, attempt to play an audio file using the SD card slot. • **Is the audio output OK for the SD card slot?**	**Yes** INSTALL a new media hub. REFER to Media Hub. **No** GO to T4.
T4 CHECK THE APIM FOR DTC B1252:11 OR DTC B1252:13 • Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:11 or DTC B1252:13 present?**	**Yes** GO to T5. **No** GO to T7.
T5 INSPECT THE USB CABLE, MEDIA HUB, AND APIM • Ignition OFF. • Disconnect: USB cable at the media hub. • Disconnect: USB cable at the APIM. • Inspect the USB cable ends, media hub USB connector	**Yes** For the USB cable, INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port. For the media hub, INSTALL a new media hub. REFER to Media Hub. For the APIM, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

port, and APIM USB connector port for damage. Remove any debris. • **Is any damage present?**	**No** GO to T6 .
T6 CHECK EACH USB PORT FOR FUNCTIONALITY	
• Connect: USB cable at the media hub. • Connect: USB cable at the APIM . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by the USB connector not being seated correctly. **No** GO to T7 .
T7 ISOLATE THE USB CABLE	
• INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** The system is operating correctly at this time. The concern was caused by an inoperative USB cable. **No** GO to T8 .
T8 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Pinpoint Test U: The SD Card Slot Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub and SD Card Mode in Information and Entertainment System .

SD card data is transmitted to the APIM through the USB cable.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1252:11	USB Port: Circuit Short to Ground	Set by the APIM when a short to ground or over-current condition is detected in the USB cable. This can be caused by a fault in the USB cable, USB port, or customer's USB or SD card device.
B1252:13	USB Port: Circuit Open	Set by the APIM when an open is detected in the USB cable.

Possible Sources

- Device conflict
- USB cable
- Media hub
- APIM

PINPOINT TEST U: THE SD CARD SLOT IS INOPERATIVE

Test Step	Result / Action to Take
U1 RESET THE APIM	
• Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Using a known good SD card, attempt to play an audio file using the SD card slot. • **Is the audio output OK for the SD card slot?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to U2 .
U2 CHECK THE USB PORTS FOR	

FUNCTIONALITY	
• Using the Multi-Media Interface Tester 105-00120, attempt to play an audio file using each USB port. • **Is the audio output OK for each USB port?**	**Yes** Install a new media hub. REFER to Media Hub . **No** If the audio output is not OK from one USB port, INSTALL a new media hub. REFER to Media Hub . If the audio output is not OK from both USB ports, GO to U3 .
U3 CHECK THE APIM FOR DTC B1252:11 OR DTC B1252:13	
• Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:11 or DTC B1252:13 present?**	**Yes** GO to U4 . **No** Isolate the USB cable. INSTALL a new USB cable. Universal Serial Bus (USB) Cable and Port . Retest the system for normal operation. If the concern is still present, GO to U6 .
U4 INSPECT USB CABLE, MEDIA HUB, AND APIM	
• Ignition OFF. • Disconnect: USB cable at media hub. • Disconnect: USB cable at APIM . • Inspect the USB cable ends, media hub USB connector port, and APIM USB connector port for damage and remove any debris. • **Is any damage present?**	**Yes** For the USB cable, INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . For the media hub, INSTALL a new media hub. REFER to Media Hub . For the APIM , For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** GO to U5 .
U5 RECHECK FOR APIM DTC B1252:11 OR DTC B1252:13	
• Using a diagnostic scan tool, clear the APIM DTCs. • Perform the APIM self-test. • **Is DTC B1252:11 or DTC B1252:13 present?**	**Yes** GO to U6 . **No** Isolate the USB cable. INSTALL a new USB cable. REFER to Universal Serial Bus (USB) Cable and Port . Retest the system for normal operation. If the concern is still present, GO to U6 .
U6 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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• Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test V: The RCA Jacks Are Inoperative Or Have Poor Sound Quality

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Media Hub and Composite Audio-Video Input Mode in Information and Entertainment System .

The data transmitted through the RCA cables to the media hub is sent to the APIM through dedicated audio and video circuits.

Possible Sources

- Device conflict
- Wiring, terminals, or connectors
- Media hub
- APIM

PINPOINT TEST V: THE RCA JACKS ARE INOPERATIVE OR HAVE POOR SOUND QUALITY

Test Step	Result / Action to Take
V1 RESET THE APIM	
• Remove any devices connected to the media hub. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Using the Multi-Media Interface Tester 105-00120 and RCA Adapter 105-00121, attempt to play audio content using the RCA jacks. • **Is the audio output OK for the RCA jacks?**	**Yes** The system is operating correctly at this time. The concern was corrected by performing the APIM power reset. **No** GO to V2 .
V2 CHECK THE RCA CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF.	**Yes**

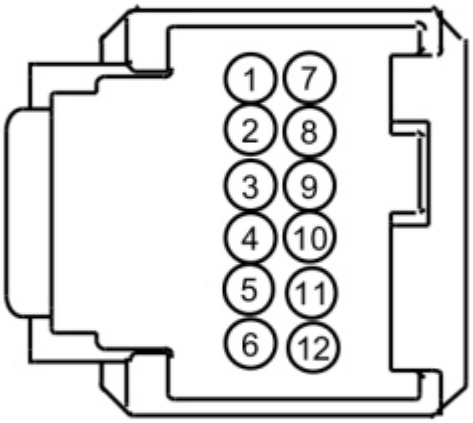
- Disconnect: Media Hub C3618.
- Disconnect: APIM C2383.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-2	DME88	—	Ground
C2362-3	VME88 (BU/WH)	—	Ground
C2362-4	DME45	—	Ground
C2362-5	VME45 (BU)	—	Ground
C2362-6	RME45 (YE/GN)	—	Ground
C2362-9	RME88 (GN/BU)	—	Ground
C2362-11	VME46 (BU/GN)	—	Ground
C2362-12	RME46 (WH/GN)	—	Ground

REPAIR the circuit in question.

No
GO to V3 .

repair4less



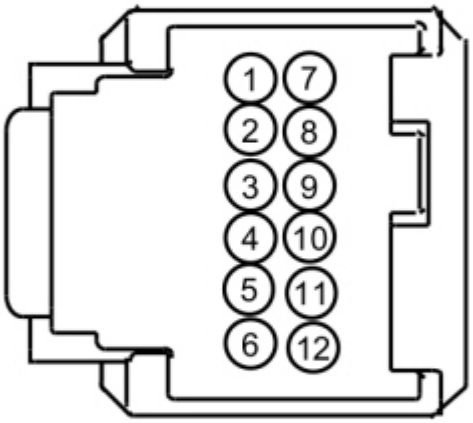
- **Is any voltage present?**

V3 CHECK THE RCA CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the **resistance** between:	**Yes** REPAIR the circuit in question.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-2	DME88	—	Ground
C2362-3	VME88 (BU/WH)	—	Ground
C2362-4	DME45	—	Ground
C2362-5	VME45 (BU)	—	Ground
C2362-6	RME45 (YE/GN)	—	Ground
C2362-9	RME88 (GN/BU)	—	Ground
C2362-11	VME46 (BU/GN)	—	Ground
C2362-12	RME46 (WH/GN)	—	Ground

No
GO to V4 .

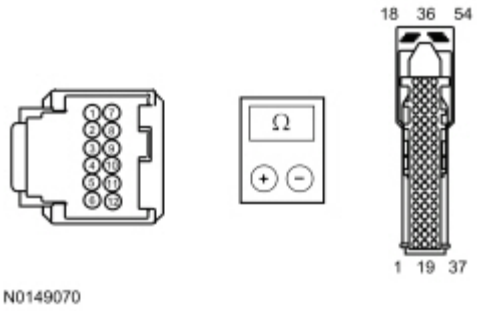
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- **Are the resistances greater than 10,000 ohms?**

V4 CHECK THE RCA CIRCUITS FOR AN OPEN	
• Measure the **resistance** between:	**Yes** INSTALL a new media hub. REFER to Media

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2362-2	DME88	C2383-36	DME88
C2362-3	VME88 (BU/WH)	C2383-34	VME88 (BU/WH)
C2362-4	DME45	C2383-9	DME45
C2362-5	VME45 (BU)	C2383-10	VME45 (BU)
C2362-6	RME45 (YE/GN)	C2383-11	RME45 (YE/GN)
C2362-9	RME88 (GN/BU)	C2383-35	RME88 (GN/BU)
C2362-11	VME46 (BU/GN)	C2383-28	VME46 (BU/GN)
C2362-12	RME46 (WH/GN)	C2383-29	RME46 (WH/GN)



- **Are the resistances less than 3 ohms?**

Hub .

Retest the system for normal operation. If the concern is still present, GO to V5 .

No
REPAIR the circuit in question.

V5 CHECK FOR CORRECT APIM OPERATION

- Ignition OFF.
- Disconnect and inspect the APIM connector.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)
  - Pushed-out pins (install new pins as necessary)
- Reconnect the APIM connector. Make sure it seats and latches correctly.
- Wait at least 2 minutes for the APIM to re-initialize.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Pinpoint Test W: Unable To Pair Bluetooth Device

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Bluetooth Mode in Information and Entertainment System .

Possible Sources

- Incompatible Bluetooth device
- Customer error
- Customer's Bluetooth device
- APIM

PINPOINT TEST W: UNABLE TO PAIR BLUETOOTH DEVICE

Test Step	Result / Action to Take
W1 CHECK THE BLUETOOTH CONNECTION	**Yes** The SYNC® system is operating correctly at this time. CARRY OUT a SYNC® system Master Reset. REFER to the Owner's Literature. REVIEW the pairing process with the customer. If the customer's device still does not pair, the fault is with the customer's device. **No** GO to W2 .
NOTE: Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. • Connect: Multi-Media Interface Tester 105-00120. • Using the Multi-Media Interface Tester 105-00120, connect to the SYNC® system using Bluetooth. Follow the tool instructions. • Using a diagnostic scan tool, view the APIM PIDs. • Monitor the Bluetooth device paired PID (BT_PAIR) and the Bluetooth device connected PID (BT_CONN). • **Do the PIDs both read "Yes"?**	
W2 CHECK FOR CORRECT APIM OPERATION	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No**

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or	

pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test X: The RH Steering Wheel Controls Are Inoperative Or Do Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Steering Wheel Switch Functions and Steering Wheel Switches in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1380:09	Steering Wheel Right Switch Pack: Component Failure	Set by the SCCM when the RH steering wheel switch is stuck.
B1380:11	Steering Wheel Right Switch Pack: Circuit Short To Ground	Set by the SCCM when a short to ground is detected in the RH steering wheel switch circuits.
B1380:17	Steering Wheel Right Switch Pack: Circuit Voltage Above Threshold	Set by the SCCM when a short to voltage is detected in the RH steering wheel switch circuits.

Possible Sources

- Wiring, terminals, or connectors
- Clockspring
- Steering wheel switch
- SCCM

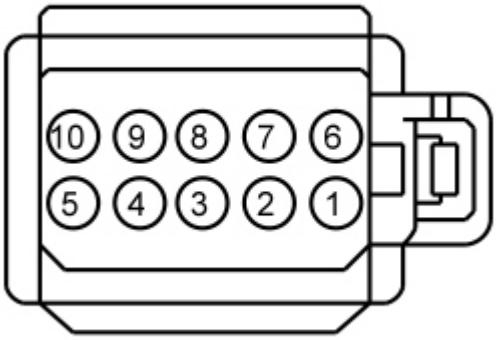
PINPOINT TEST X: THE RH STEERING WHEEL CONTROLS ARE INOPERATIVE OR DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
X1 CHECK THE RH STEERING WHEEL SWITCH PIDs	

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• Ignition ON.
• Monitor the steering wheel controls PIDs while pressing each RH steering wheel switch.
• Using a diagnostic scan tool, view the SCCM PIDs.
  • SW_VOLDOWN
  • SW_VOLUP
  • SW_SEEKMINUS
  • SW_SEEKPLUS
  • SW_MEDIA
  • SW_VOICE
  • SW_PHONE
• **Do the PID values agree with the switch positions?**
	Yes
	GO to X10.
	
	No
	If one or more, but not all PID values are incorrect or always read one particular switch position, INSTALL a new RH steering wheel switch. REFER to Section 211-05. If all PID values are incorrect or always read one particular switch position, GO to X2.

X2 CHECK FOR IPC DTC U0212:00	
• Ignition ON. • Using a diagnostic scan tool, clear the DTCs from the IPC. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the IPC self-test. • **Is DTC U0212:00 set in the IPC ?**	**Yes** REFER to Section 413-01. **No** GO to X3.
X3 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TO GROUND	
WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment. • Ignition OFF. • Disconnect: RH Steering Wheel Switch C2999. • Disconnect: Clockspring C218B. • Measure the **resistance** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit C2999-2 / VME14 / — / Ground C2999-4 / RME14 / — / Ground C2999-6 / VME54 / — / Ground C2999-7 / RME54 / — / Ground	**Yes** GO to X4. **No** INSTALL a new steering wheel. REFER to Section 211-04.



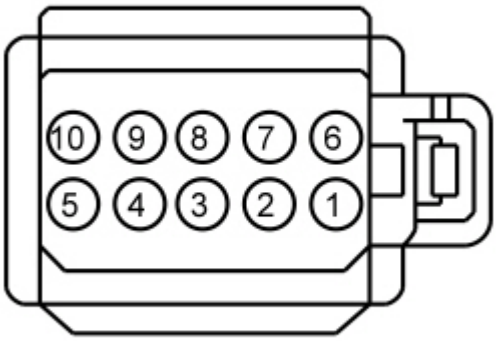
- **Are the resistances greater than 10,000 ohms?**

X4 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR AN OPEN	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218B-14	VME14
C2999-4	RME14	C218B-6	RME14
C2999-6	VME54	C218B-16	VME54
C2999-7	RME54	C218B-8	RME54 |  N0148938 • **Are the resistances less than 3 ohms?**	**Yes** GO to X5 . **No** INSTALL a new steering wheel. REFER to Section 211-04 .

X5 CHECK THE CIRCUITRY BETWEEN THE CLOCKSPRING AND STEERING WHEEL CONTROLS FOR A SHORT TOGETHER	
• Measure the **resistance** between: 	Positive Lead		Negative Lead	
---	---	---	---
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
					Yes GO to X6 . **No** INSTALL a new steering wheel. REFER to Section 211-04 .

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C2999-6	VME54	C2999-7	RME54

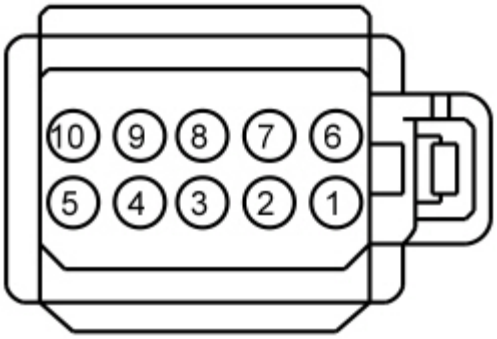


- **Are the resistances greater than 10,000 ohms?**

X6 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND

- Connect: Clockspring C218B.
- Disconnect: Clockspring C218C.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	—	Ground
C2999-4	RME14	—	Ground
C2999-6	VME54	—	Ground
C2999-7	RME54	—	Ground



Yes
GO to X7 .

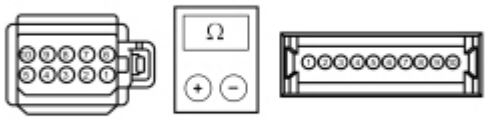
No
INSTALL a new clockspring.
REFER to Section 501-20B .

- **Are the resistances greater than 10,000 ohms?**

X7 CHECK THE CLOCKSPRING FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C218C-6	—
C2999-4	RME14	C218C-5	—
C2999-6	VME54	C218C-10	—
C2999-7	RME54	C218C-9	—



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- **Are the resistances less than 3 ohms?**

Yes
GO to X8 .

No
INSTALL a new clockspring.
REFER to Section 501-20B .

X8 CHECK THE CLOCKSPRING FOR A SHORT TOGETHER

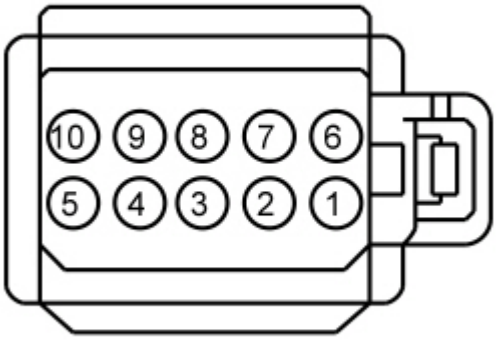
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2999-2	VME14	C2999-4	RME14
C2999-6	VME54	C2999-7	RME54

Yes
GO to X9 .

No
INSTALL a new clockspring.
REFER to Section 501-20B .

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- **Are the resistances greater than 10,000 ohms?**

X9 CHECK FOR VOLTAGE AT THE SCCM

- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2414D-6	—	C2414D-5	—
C2414D-10	—	C2414D-9	—



- **Is approximately 5 volts present?**

Yes
INSTALL a new RH steering wheel switch. REFER to Section 211-05 .

No
GO to X10 .

X10 CHECK FOR CORRECT SCCM OPERATION

- Ignition OFF.
- Disconnect and inspect all the SCCM connectors.
- Repair:
  - Corrosion (clean module pins or install new connectors or terminals)
  - Damaged or bent pins (install new terminals or pins)

Yes
CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to

▪ Pushed-out pins (install new pins as necessary) • Reconnect the SCCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	Section 211-05 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Y: The Audio System Does Not Operate Correctly From The FCIM

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Accessory Delay Feature, Audio Extended Play, and FCIM in Information and Entertainment System .

Possible Sources

- Network communication concern
- FCIM

PINPOINT TEST Y: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FCIM

Test Step	Result / Action to Take
Y1 CHECK THE FDIM OPERATION	
• Verify the FDIM screen operation. • **Does the FDIM operate correctly?**	**Yes** GO to Y2 . **No** GO to Pinpoint Test Z .
Y2 VERIFY THAT THE ACM , APIM , AND FCIM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the ACM , APIM , and FCIM pass the network test?**	**Yes** GO to Y3 . **No** If the ACM failed the network test, REFER to Section 418-00 The ACM Does Not Respond To The Scan Tool. If the APIM failed the network test, REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool. If the FCIM failed the network test, REFER to Section 418-00 The FCIM Does Not Respond To The Scan Tool.
Y3 RESET THE AUDIO	

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SYSTEM MODULES AND RECHECK THE FCIM OPERATION • Disconnect the battery for 5 minutes, then reconnect it. • Turn the infotainment system on. • Test the FCIM for normal operation. • **Does the FCIM operate correctly?**	**Yes** The FCIM is operating correctly at this time. The concern was corrected by resetting the audio system modules. **No** GO to Y4.

Y4 RETRIEVE THE ACM, APIM, AND FCIM DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ ACM
  ◦ APIM
  ◦ FCIM
• **Are any DTCs present in the ACM, APIM, or FCIM?**
	Yes
	For ACM DTCs, REFER to the ACM DTC Chart in Information and Entertainment System. For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System. For FCIM DTCs, REFER to the FCIM DTC Chart in Information and Entertainment System.
	
	No
	GO to Y5.

Y5 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ◦ Corrosion (clean module pins or install new connectors or terminals)
  ◦ Damaged or bent pins (install new terminals or pins)
  ◦ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test Z: The FDIM Touchscreen Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to FDIM in Information and Entertainment System .

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B108E:01	Display: General Electrical Failure	Set by the APIM when an error is detected in the touch sensing ability of the FDIM .
U0162:00	Lost Communication With Navigation Display Module: No Sub Type Information	Set by the APIM when communication is missing from the FDIM for more than 1 second with the ignition in the RUN position.

Possible Sources

- Network communication concern
- APIM
- FDIM

PINPOINT TEST Z: THE FDIM TOUCHSCREEN IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
Z1 OBSERVE THE FDIM SCREEN • Ignition ON. • Verify the FDIM operation. • **Is the FDIM screen completely inoperative or blank?**	**Yes** GO to Z2 . **No** GO to Z4 .
Z2 VERIFY THAT THE APIM PASSES THE NETWORK TEST • Using a diagnostic scan tool, perform the network test. • **Did the APIM pass the network test?**	**Yes** GO to Z3 . **No** REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool.
Z3 CHECK FOR DTC U0162:00 SET IN THE APIM • Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Is DTC U0162:00 present?**	**Yes** INSTALL a new FDIM . Front Display Interface Module (FDIM) . **No** GO to Z6 .
Z4 VERIFY THE TOUCHSCREEN RESPONDS TO TOUCH COMMANDS • While pressing each tab of the 4	**Yes**

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corners on the FDIM, observe the touchscreen operation. • **Does the FDIM respond correctly when each tab is pressed?**	VERIFY the customer's concern and the steps to reproduce the inoperative state. If the inoperative state is not duplicated, the system is operating correctly at this time. INFORM the customer on the operation of the FDIM display. **No** GO to Z5.
Z5 ENSURE THE TOUCHSCREEN IS CALIBRATED	
• Calibrate the touchscreen. REFER to Touchscreen Calibration. • Verify the touchscreen operation. • **Does the FDIM touchscreen respond correctly?**	**Yes** The system is operating correctly at this time. The concern was a result of the touchscreen not being calibrated. **No** GO to Z6.
Z6 CHECK FOR DTC B108E:01 SET IN THE APIM	
• Ignition ON. • Using a diagnostic scan tool, perform the APIM self-test. • **Is DTC B108E:01 present?**	**Yes** INSTALL a new FDIM. REFER to Front Display Interface Module (FDIM). **No** GO to Z7.
Z7 RESET THE APIM AND RECHECK THE SYSTEM OPERATION	
NOTE: Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. • Carry out an APIM power reset by disconnecting the battery for 1 minute, then reconnecting it. • Wait at least 2 minutes for the APIM to re-initialize. • Turn the infotainment system on. • While pressing each tab of the 4 corners on the FDIM, observe the touchscreen operation. • **Does the touchscreen operate correctly?**	**Yes** The FDIM is operating correctly at this time. PERFORM a SYNC® system Master Reset. REFER to the Owner's Literature. **No** GO to Z8.
Z8 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

(install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AA: Navigation Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation and Fault Conditions

Refer to Navigation in Information and Entertainment System .

Removal of the navigation SD card results in the loss of navigation while the card is removed. This is normal operation.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
B1215:00	External Memory Card: No Sub Type Information	Set by the APIM when the navigation SD card is missing.

Possible Sources

- Navigation map SD card not present, not fully seated, or damaged
- Communications network concern
- GPSM

PINPOINT TEST AA: NAVIGATION IS INOPERATIVE

Test Step	Result / Action to Take
AA1 CHECK THE NAVIGATION SYSTEM OPERATION	
• **NOTE:** Confirm that the tire size is correct as indicated on the vehicle placard. Incorrect tire size will affect navigation system accuracy. • Verify the navigation system	**Yes** GO to AA2 . **No** GO to AA4 .

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operation. • **Does the FDIM display "SD CARD FAULT?"**	
AA2 VERIFY THE NAVIGATION MAP SD CARD IS PRESENT	
• Check for the presence of a navigation map SD card in the media hub SD slot. • **Is the navigation map SD card present and fully seated?**	**Yes** GO to AA3 . **No** INSTALL the navigation map SD card. TEST the system for normal operation.
AA3 INSPECT THE NAVIGATION MAP SD CARD	
• Remove the navigation map SD card. • Inspect the navigation map SD card for damage. • **Is any damage present?**	**Yes** INSTALL a new navigation map SD card. **No** GO to AA4 .
AA4 CHECK FOR DIAGNOSTIC SCAN TOOL COMMUNICATION WITH THE GPSM	
• Ignition ON. • Using a diagnostic scan tool, perform the network test. • **Does the diagnostic scan tool communicate with the GPSM ?**	**Yes** GO to AA5 . **No** REFER to Section 418-00 The GPSM Does Not Respond To The Scan Tool.
AA5 RETRIEVE THE DTCS FROM THE APIM AND GPSM	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ◦ APIM
  ◦ GPSM
• **Are any DTCs present in the APIM or GPSM ?**
	Yes
	For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For GPSM DTCs, REFER to the GPSM DTC Chart in Information and Entertainment System
	
	No
	GO to AA6 .

AA6 CHECK FOR CORRECT GPSM OPERATION	

• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ◦ Corrosion (clean module pins or install new connectors or terminals)
  ◦ Damaged or bent pins (install new terminals or pins)
  ◦ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it seats and latches correctly.
• Operate the system and determine if
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

the concern is still present. • **Is the concern still present?**	

Pinpoint Test AB: The Compass Is Inoperative

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Possible Sources

- Network communication concern
- APIM
- GPSM

PINPOINT TEST AB: THE COMPASS IS INOPERATIVE

Test Step	Result / Action to Take
AB1 VERIFY THAT THE APIM AND GPSM PASS THE NETWORK TEST	
• Using a diagnostic scan tool, perform the network test. • **Did the APIM and GPSM pass the network test?**	**Yes** GO to AB2. **No** If the APIM failed the network test, REFER to Section 418-00 The APIM Does Not Respond To The Scan Tool. If the GPSM failed the network test, REFER to Section 418-00 The GPSM Does Not Respond To The Scan Tool.
AB2 RETRIEVE THE APIM AND GPSM DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ APIM
  ▪ GPSM
• **Are any DTCs present in the APIM or GPSM ?**
	Yes
	For APIM DTCs, REFER to the APIM DTC Chart in Information and Entertainment System For GPSM DTCs, REFER to the GPSM DTC Chart in Information and Entertainment System
	
	No
	GO to AB3.

AB3 CHECK FOR CORRECT GPSM OPERATION	

• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root

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or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the GPSM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	cause of any connector or pin issues.

Pinpoint Test AC: DTC U0100:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0100:00	Lost Communication with ECM/PCM "A": No Sub Type Information	Set by the GPSM when network messages are missing from the PCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AC: DTC U0100:00

Test Step	Result / Action to Take
AC1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AC2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC2 RECHECK FOR DTC U0100:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0100:00 set in the**	**Yes** GO to AC3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

GPSM ?	
AC3 CHECK THE PCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the PCM self-test. • **Are any low or high voltage DTCs recorded in the PCM ?**	**Yes** REFER to PCM DTC Chart in Section 303-14 . **No** GO to AC4 .
AC4 CHECK THE GPSM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the GPSM self-test. • **Are any low or high voltage DTCs recorded in the GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an . **No** GO to AC5 .
AC5 CHECK FOR CORRECT PCM OPERATION	
• Ignition OFF. • Disconnect and inspect all the PCM connectors. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the PCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new PCM . REFER to Section 303-14 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AD: DTC U0140:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0140:00	Lost Communication With Body	Set by the APIM and GPSM when network messages

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	Control Module: No Sub Type Information	are missing from the BCM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AD: DTC U0140:00

Test Step	Result / Action to Take
AD1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AD2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD2 RECHECK FOR DTC U0140:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0140:00 set in the APIM or GPSM?**	**Yes** GO to AD3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD3 CHECK THE BCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the BCM self-test. • **Are any low or high voltage DTCs recorded in the BCM?**	**Yes** REFER to BCM DTC Chart in Section 419-10. **No** GO to AD4.
AD4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ APIM
  ▪ GPSM
• **Are low or high voltage DTCs recorded in the APIM or GPSM?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AM. For DTC U3003:17, GO to Pinpoint Test an.
	
	No
	GO to AD5.

AD5 CHECK FOR DTC U0140:00 SET IN MULTIPLE MODULES	

• Review the recorded results from the self-test. • **Is DTC U0140:00 set in more than one audio system module?**	**Yes** GO to AD6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD6 CHECK FOR CORRECT BCM OPERATION	
• Ignition OFF. • Disconnect and inspect all the BCM connectors. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the BCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AE: DTC U0151:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	Set by the APIM when the airbag deployment notification message from the RCM is missing for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AE: DTC U0151:00

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Test Step	Result / Action to Take
AE1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AE2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE2 RECHECK FOR DTC U0151:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0151:00 set in the APIM?**	**Yes** GO to AE3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE3 CHECK THE RCM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the RCM self-test. • **Are any low or high voltage DTCs recorded in the RCM?**	**Yes** For DTC U3003:16, REFER to RCM DTC Chart in Section 501-20B. For DTC U3003:16, REFER to RCM DTC Chart in Section 501-20B. **No** GO to AE4.
AE4 CHECK THE APIM FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the APIM self-test. • **Are any low or high voltage DTCs recorded in the APIM?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AM. For DTC U3003:17, GO to Pinpoint Test an. **No** GO to AE5.
AE5 CHECK FOR CORRECT RCM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the RCM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new RCM. REFER to Section 501-20B.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

▪ Pushed-out pins (install new pins as necessary) • Reconnect the RCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	

Pinpoint Test AF: DTC U0155:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	Set by the ACM , APIM , audio DSP module, FCIM , and GPSM when network messages are missing from the IPC for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AF: DTC U0155:00

Test Step	Result / Action to Take
AF1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AF2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF2 RECHECK FOR DTC U0155:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0155:00 set in the ACM , APIM , audio DSP module, FCIM , or GPSM ?**	**Yes** GO to AF3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

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AF3 CHECK THE IPC FOR BATTERY VOLTAGE OUT-OF-RANGE DTCS	
• Using a diagnostic scan tool, perform the IPC self-test. • **Are any low or high voltage DTCs recorded in the IPC ?**	**Yes** REFER to IPC DTC Chart in Section 413-01 . **No** GO to AF4 .
AF4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM ▪ Audio DSP module ▪ FCIM ▪ GPSM • **Are low or high voltage DTCs recorded in the ACM , APIM , audio DSP module, FCIM , or GPSM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an . **No** GO to AF5 .
AF5 CHECK FOR DTC U0155:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0155:00 set in more than one audio system module?**	**Yes** GO to AF6 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF6 CHECK FOR CORRECT IPC OPERATION	
• Ignition OFF. • Disconnect and inspect the IPC connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the IPC connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new IPC . REFER to Section 413-01 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AG: DTC U016A:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U016A:00	Lost Communication With Global Positioning System Module: No Sub Type Information	Set by the APIM when network messages are missing from the GPSM for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AG: DTC U016A:00

Test Step	Result / Action to Take
AG1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AG2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring. CHECK the MS-CAN wiring between the APIM and the GPSM for a fault.
AG2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Carry out the network test using the scan tool. • **Does the GPSM pass the network test?**	**Yes** GO to AG3 . **No** REFER to Section 418-00 .
AG3 CHECK FOR ANY RECENT PMI CHANGES **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Check the vehicle service history for recent service actions related to the GPSM . • **Have there been any recent service actions with either module?**	**Yes** CARRY out a manual PMI on the GPSM using As-Built data. REFER to the diagnostic scan tool instructions. **No** GO to AG4 .
AG4 RETRIEVE THE RECORDED DTCs FROM THE GPSM	

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• Clear the GPSM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the GPSM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** REFER to the GPSM DTC chart in this section. **No** GO to AG5 .
AG5 RETRIEVE THE RECORDED DTCs FROM THE APIM • Repeat the APIM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test am . For DTC U3003:17, GO to Pinpoint Test an **No** GO to AG6 .
AG6 RECHECK THE APIM DTCs • Perform the APIM self-test. • **Is DTC U016A:00 still present?**	**Yes** GO to AG7 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AG7 CHECK FOR DTC U016A:00 SET IN OTHER MODULES • Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the APIM self-test. • **Is DTC U016A:00 set in any other module?**	**Yes** GO to AG8 . **No** GO to AG9

AG8 CHECK FOR CORRECT GPSM OPERATION
• Ignition OFF.
• Disconnect the GPSM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the GPSM connector and make sure it seats correctly.
• **Is the concern still present?**
	Yes
	INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

AG9 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect the APIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the APIM connector and make sure it seats correctly.
• Wait 2 minutes for the APIM to re-
	Yes
	For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or

initialize. • **Is the concern still present?**	corroded connector.

Pinpoint Test AH: DTC U0184:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0184:00	Lost Communication With Radio: No Sub Type Information	Set by the APIM and audio DSP module when network messages are missing from the ACM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AH: DTC U0184:00

Test Step	Result / Action to Take
AH1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AH2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH2 RECHECK FOR DTC U0184:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0184:00 set in the APIM and audio DSP module?**	**Yes** GO to AH3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules:	**Yes** For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an .

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■ ACM ■ APIM ■ Audio DSP module • **Are low or high voltage DTCs recorded in the ACM , APIM , or audio DSP module?**	**No** GO to AH4 .
AH4 CHECK FOR DTC U0184:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0184:00 set in more than one audio system module?**	**Yes** GO to AH5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AH5 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect and inspect all the ACM connectors. • Repair: ■ Corrosion (clean module pins or install new connectors or terminals) ■ Damaged or bent pins (install new terminals or pins) ■ Pushed-out pins (install new pins as necessary) • Reconnect the ACM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AI: DTC U0238:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions

U0238:00	Lost Communication With Digital Audio Control Module "D" : No Sub Type Information	Set by the ACM and APIM when network messages are missing from the audio DSP module for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AI: DTC U0238:00

Test Step	Result / Action to Take
AI1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AI2. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AI2 RECHECK FOR DTC U0238:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs. • **Is DTC U0238:00 set in the ACM and APIM?**	**Yes** GO to AI3. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

AI3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs
• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
  ▪ Audio DSP module
• **Are low or high voltage DTCs recorded in the ACM, APIM, or audio DSP module?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AM. For DTC U3003:17, GO to Pinpoint Test an.
	
	No
	GO to AI4.

AI4 CHECK FOR DTC U0238:00 SET IN MULTIPLE MODULES • Review the recorded results from the self-test. • **Is DTC U0238:00 set in more than one audio system module?**	**Yes** GO to AI5. **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network

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	traffic or an intermittent fault condition.
AI5 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AJ: DTC U0253:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	Set by the ACM and audio DSP module when network messages are missing from the APIM for more than 5 seconds with the ignition in RUN.

PINPOINT TEST AJ: DTC U0253:00

Test Step	Result / Action to Take
AJ1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON.	**Yes**

• Verify if there is an observable symptom present. • **Is an observable symptom present?**	GO to AJ2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AJ2 RECHECK FOR DTC U0253:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0253:00 set in the ACM and audio DSP module?**	**Yes** GO to AJ3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AJ3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM ▪ Audio DSP module • **Are low or high voltage DTCs recorded in the ACM , APIM , or audio DSP module?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an . **No** GO to AJ4 .
AJ4 CHECK FOR DTC U0253:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0253:00 set in more than one audio system module?**	**Yes** GO to AJ5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AJ5 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect and inspect the APIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals)	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** The system is operating correctly at this time. The concern may

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▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the APIM connector. Make sure it seats and latches correctly. • Wait at least 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AK: DTC U0256:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0256:00	Lost Communication With Front Controls Interface Module "A": No Sub Type Information	Set by the ACM APIM , and audio DSP module when network messages are missing from the FCIM for more than 5 seconds with the ignition in the RUN position.

PINPOINT TEST AK: DTC U0256:00

Test Step	Result / Action to Take
AK1 VERIFY THE CUSTOMER'S CONCERN	
• Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AK2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AK2 RECHECK FOR DTC U0256:00	
• Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs .	**Yes** GO to AK3 .

• Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0256:00 set in the ACM , APIM , or audio DSP module?**	**No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AK3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Using a diagnostic scan tool, perform the self-test for the following modules: ▪ ACM ▪ APIM ▪ Audio DSP module ▪ FCIM • **Are low or high voltage DTCs recorded in the ACM , APIM , audio DSP module, or FCIM ?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an . **No** GO to AK4 .
AK4 CHECK FOR DTC U0256:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0256:00 set in more than one audio system module?**	**Yes** GO to AK5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AK5 CHECK FOR CORRECT FCIM OPERATION	
• Ignition OFF. • Disconnect and inspect the FCIM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the FCIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Pinpoint Test AL: DTC U0257:00

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U0257:00	Lost Communication With Front Controls / Display Interface Module: No Sub Type Information	**NOTE:** The FDIM is a non-networked module attached to the APIM . The APIM acts as the gateway module for messages sent over the I-CAN between the FDIM , ACM , and FCIM . Set by the ACM , audio DSP module, and FCIM when I-CAN network messages are missing from the APIM for more than 5 seconds with the ignition in RUN. This DTC may be set in conjunction with DTC U0253:00.

PINPOINT TEST AL: DTC U0257:00

Test Step	Result / Action to Take
AL1 VERIFY THE CUSTOMER'S CONCERN • Ignition ON. • Verify if there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AL2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AL2 RECHECK FOR DTC U0257:00 • Ignition ON. • Using a diagnostic scan tool, clear all CMDTCs . • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Using a diagnostic scan tool, retrieve all CMDTCs . • **Is DTC U0257:00 set in the ACM , audio DSP module, or FCIM ?**	**Yes** GO to AL3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AL3 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	

• Using a diagnostic scan tool, perform the self-test for the following modules:
  ▪ ACM
  ▪ APIM
  ▪ Audio DSP module
  ▪ FCIM
• **Are low or high voltage DTCs recorded in the ACM , APIM , audio DSP module, or FCIM ?**
	Yes
	For DTC U3003:16, GO to Pinpoint Test AM . For DTC U3003:17, GO to Pinpoint Test an .
	
	No
	GO to AL4 .

AL4 CHECK FOR DTC U0257:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0257:00 set in more than one audio system module?**	**Yes** GO to AL5 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, the system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AL5 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AM: DTC U3003:16

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.

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Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

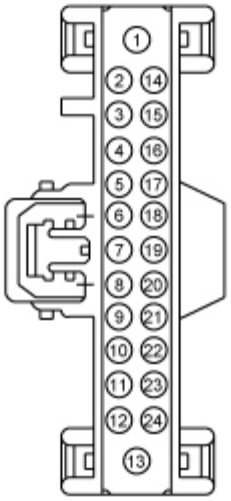
DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	Set by the ACM , APIM , audio DSP module, FCIM , and GPSM when the supply voltage falls below 10 volts for at least 10 seconds during normal operation or for more than 250 milliseconds during the self-test.

PINPOINT TEST AM: DTC U3003:16

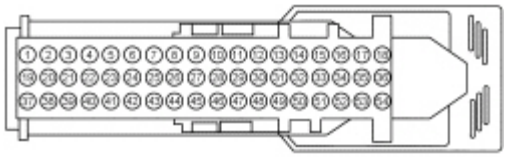
Test Step	Result / Action to Take
AM1 RECHECK FOR DTC U3003:16 • Ignition ON. • Using a diagnostic scan tool, clear the DTCs for the module in question. • Wait at least 15 seconds. • Using a diagnostic scan tool, repeat the self-test for the module in question. • **Is DTC U3003:16 still present?**	**Yes** GO to AM2 . **No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
AM2 CHECK FOR CHARGING SYSTEM DTCS IN THE PCM • Using a diagnostic scan tool, retrieve all CMDTCs . • **Are any voltage-related DTCs set in the PCM ?**	**Yes** REFER to PCM DTC Chart in Section 303-14 . **No** GO to AM3 .
AM3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE • Check the battery condition and verify that the battery is fully charged. REFER to Battery Condition Test in Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AM4 . **No** REFER to the Symptom Chart in Section 414-00 .
AM4 CHECK THE MODULE VOLTAGE SUPPLY • Ignition OFF. • Measure and record the voltage at the battery. • Disconnect the audio system module setting DTC U3003:16. • Ignition ON. • Measure the voltage between the module setting DTC U3003:16 and ground. • For the ACM , measure the **voltage** between:	**Yes** GO to AM5 . **No** REPAIR the circuit(s) for high resistance.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240A-1	SBP29 (GY/RD)	—	Ground



- For the APIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	—	Ground

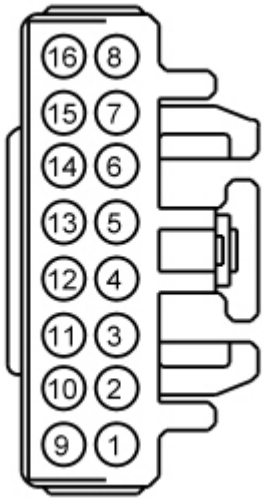


- For the audio DSP module, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154C-5	SBP19 (BU/RD)	—	Ground

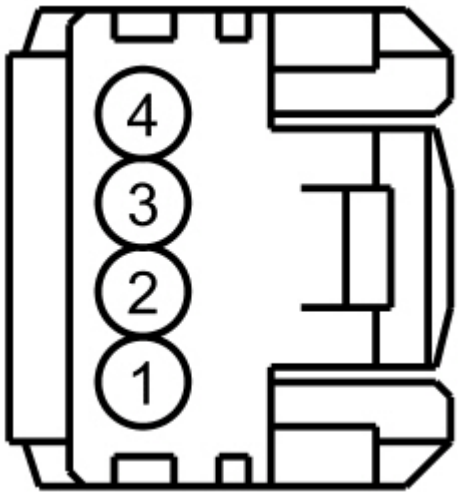
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C3154C-6	SBP19 (BU/RD)	—	Ground



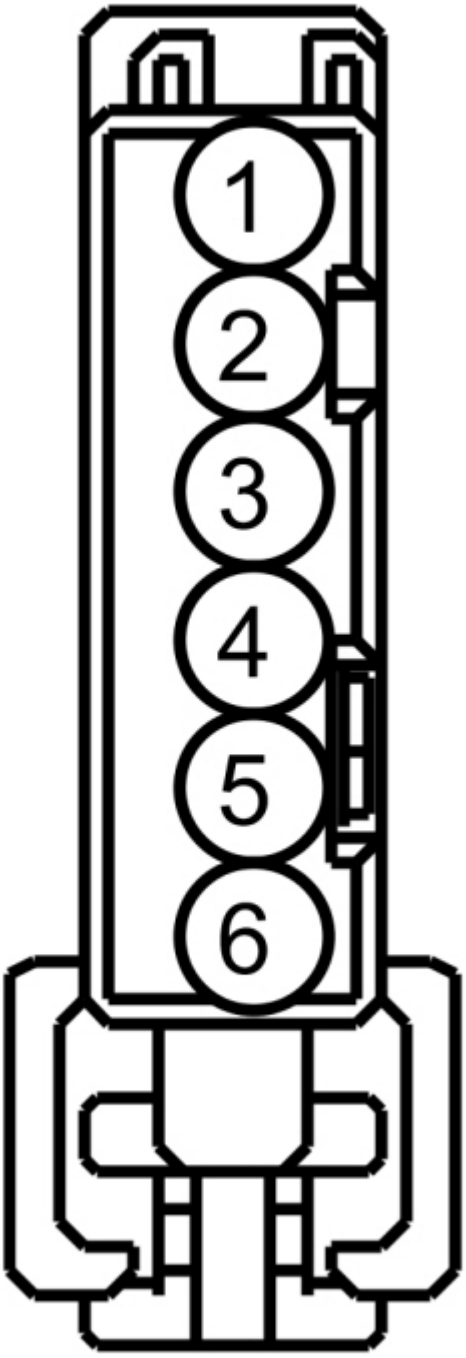
- For the FCIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	—	Ground



- For the GPSM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	—	Ground



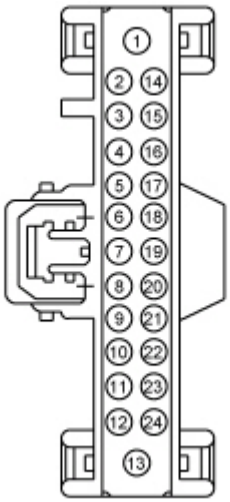
- **Is the voltage within 0.2 volts of the recorded battery voltage?**

AM5 CHECK THE SUSPECT MODULE GROUND CIRCUIT FOR CONTINUITY	
• Measure the voltage at the suspect module.	**Yes**

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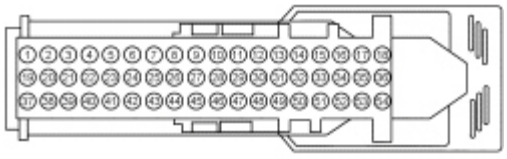
- For the ACM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C240A-1	SBP29 (GY/RD)	C240A-13	GD114 (BK/BU)



- For the APIM , measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2383-1	SBP02 (YE/RD)	C2383-37	GD114 (BK/BU)

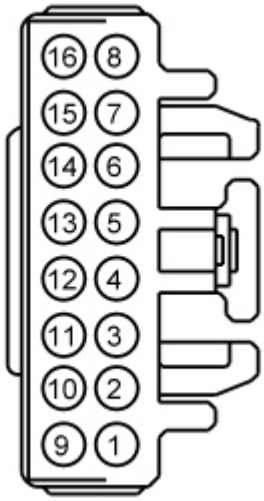


- For the audio DSP module, measure the **voltage** between:

For the ACM , GO to AM6 . For the APIM , GO to AM7 . For the audio DSP module, GO to AM8 . For the FCIM , GO to AM9 . For the GPSM , GO to AM10 .

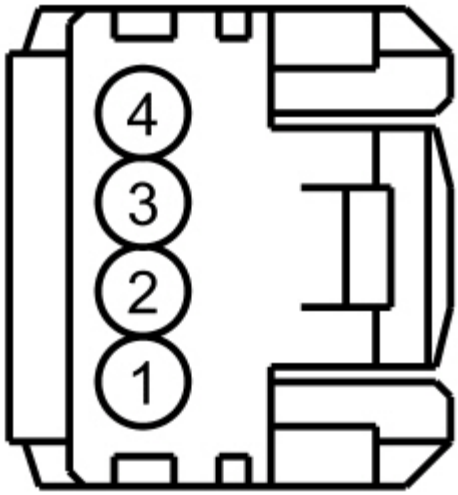
No
REPAIR the circuit for high resistance.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C3154C-5	SBP19 (BU/RD)	C3154C-15	GD148 (BK/YE)
C3154C-6	SBP19 (BU/RD)	C3154C-16	GD148 (BK/YE)



- For the FCIM , measure the **voltage** between:

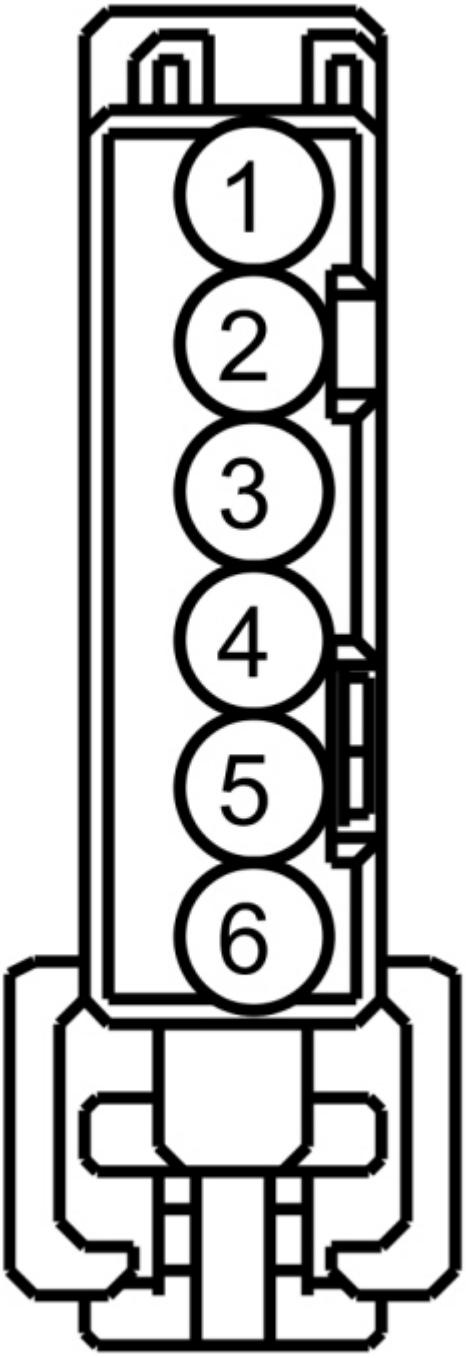
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2402-1	SBP09 (RD)	C2402-4	GD133 (BK)



- For the GPSM , measure the **voltage** between:

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2398-1	SBP09 (RD)	C2398-6	GD114 (BK/BU)



- **Is the suspect module voltage greater than 11 volts?**

AM6 CHECK FOR CORRECT ACM OPERATION • Ignition OFF. • Disconnect and inspect all the ACM	**Yes** CHECK OASIS for any applicable TSBs. If a

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connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM . REFER to Audio Control Module (ACM) .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AM7 CHECK FOR CORRECT APIM OPERATION
• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AM8 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION
• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AM9 CHECK FOR CORRECT FCIM OPERATION
• Ignition OFF.
• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) .

necessary) • Reconnect the FCIM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.
AM10 CHECK FOR CORRECT GPSM OPERATION	
• Ignition OFF. • Disconnect and inspect the GPSM connector. • Repair: ▪ Corrosion (clean module pins or install new connectors or terminals) ▪ Damaged or bent pins (install new terminals or pins) ▪ Pushed-out pins (install new pins as necessary) • Reconnect the GPSM connector. Make sure it seats and latches correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM). **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test AN: DTC U3003:17

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

DTC Fault Trigger Conditions

DTC	Description	Fault Trigger Conditions
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	Set by the ACM, APIM, audio DSP module, FCIM, and GPSM when the supply voltage is more than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

PINPOINT TEST AN: DTC U3003:17

Test Step	Result / Action to Take
AN1 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Using a diagnostic scan tool, clear the DTC for the module in question. • Wait at least 10 seconds.	**Yes** GO to AN2. **No** The system is operating correctly at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

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• Using a diagnostic scan tool, perform the self-test for the module in question. • **Is DTC U3003:17 present?**	
AN2 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Using a diagnostic scan tool, retrieve all CMDTCs. • Wait at least 10 seconds. • Using a diagnostic scan tool, perform the self-test for the module in question. • **Are high voltage DTCs such as B1676, P0563, U3003:17 set in more than one module?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** GO to AN3.
AN3 CHECK THE BATTERY VOLTAGE	
• Turn off all interior lights, exterior lights, and accessories. • Start and run the engine at approximately 2,000 RPM for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-01 to diagnose an overcharging condition. **No** For the ACM, GO to AN4. For the APIM, GO to AN5. For the audio DSP module, GO to AN6. For the FCIM, GO to AN7 For the GPSM, GO to AN8.
AN4 CHECK FOR CORRECT ACM OPERATION	

• Ignition OFF.
• Disconnect and inspect all the ACM connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the ACM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new ACM. REFER to Audio Control Module (ACM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN5 CHECK FOR CORRECT APIM OPERATION	

• Ignition OFF.
• Disconnect and inspect the APIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the APIM connector. Make sure it seats and latches correctly.
• Wait at least 2 minutes for the APIM to re-initialize.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN6 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect all the audio DSP module connectors.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the audio DSP module connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module — Front Captain's Chair or Audio Digital Signal Processing (DSP) Module — Split Bench .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN7 CHECK FOR CORRECT FCIM OPERATION	
• Ignition OFF.	**Yes**

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• Disconnect and inspect the FCIM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the FCIM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new FCIM. REFER to Front Controls Interface Module (FCIM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

AN8 CHECK FOR CORRECT GPSM OPERATION
• Ignition OFF.
• Disconnect and inspect the GPSM connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the GPSM connector. Make sure it seats and latches correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new GPSM. REFER to Global Positioning System Module (GPSM).
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

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Accessory Protocol Interface Module (APIM) Custom Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool.
 ST3256-A	SYNC® Re-Flash Kit CCMSYNC-KIT or equivalent [Tools are also available individually CCMUSB2-AM-AM-10 (cable) and CCMUSB-AF-BF5 (adapter)]

NOTE: Use this procedure to show all available software options, including Applications, that can be programmed into the APIM when upgrades become available, or as directed by a TSB. For additional information about choosing the correct APIM programming procedure, refer to Information and Entertainment System , APIM Programming.

NOTE: A USB flash drive with a minimum storage size of 1 gigabyte (GB) may be required for this procedure.

NOTE: Some programming files are large (greater than 2 gigabytes). It is important that the diagnostic scan tool has enough available hard drive space to accommodate the programming file download. If a "Disk Space Error" is received, create additional free space on the hard drive.

NOTE:

- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- During programming, the vehicle display may go blank momentarily.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.
- Close the IDS program before attempting to perform this procedure.

1. Connect a battery charger set on low.
    - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.

2. Place the ignition in the ON/RUN position.

3. Connect the diagnostic scan tool and VCM to the vehicle.

4. Open Internet Explorer on the diagnostic scan tool and go to the technician service publications web site. On the OASIS tab, select "Read VIN & DTCs," and select "Go."

5. **NOTE:** This procedure clears all CMDTCs. The DTCs must be recorded now if other diagnoses are to be performed after this procedure.

   Select "Toolbox" from the technician service publications web site to retrieve and record all CMDTCs.

6. **NOTE:** If unable to complete programming because the operation stops or errors are received, the web browser settings may need to be configured. Refer to "Software Programming v1.1" on the technician service publications web site under the Service Tips tab.

   From the OASIS tab, select the "SYNC" button. The Last Recorded State — Software is displayed.

7. Scroll to the bottom of the screen, select "Custom," and select the "Read SYNC" button to compare the current APIM Vehicle Interface Processor (VIP), Consumer Interface Processor (CIP), and Application software levels to the last reported state in the Ford online database.
   - After the comparison is performed, the diagnostic scan tool displays a list of available software. Select the software level needed as indicated by the TSB. If the software level is not known, stop this procedure and perform standard programming, which automatically selects the latest software levels. Refer to Accessory Protocol Interface Module (APIM) Standard Programming.
   - Applications may require selection for installation. Applications with a green check mark next to them indicates the APIM already has the latest level installed (no re-installation required). All Applications can be selected for installation.
   - Depending on the software level required, the diagnostic scan tool automatically selects either the Service Pack or Full Flash programming method.
   - Although there may be an option available to override the Service Pack installation and perform a Full Flash/Force CIP, choosing this option requires additional programming time and is not recommended unless directed by a TSB.

8. Select the customer-requested upgrade or the Application directed by the TSB.

9. **NOTE:** Only Applications on a flash drive may be loaded to the APIM through the media hub.

   NOTE: If not performing a Full Flash/Force CIP, go to Step 11.

   Remove the media hub. REFER to Media Hub.

10. **NOTE:** Do not disconnect the diagnostic scan tool or cable from the APIM during programming unless directed by the diagnostic scan tool on-screen prompts.

    Connect the SYNC® Re-Flash Kit cable and adapter between the diagnostic scan tool USB port and the vehicle USB cable.

11. **NOTE:** Diagnostic scan tools that have never been used to program SYNC® may encounter a Hardware Wizard pop-up requesting a "WMA SBOOT" driver installation. If this request is encountered, install the driver and select the diagnostic scan tool "retry" button to continue programming.

    NOTE: This step may take 20 minutes or longer.

    Select the "Program SYNC" button to begin the APIM programming process.
    - When prompted by the diagnostic scan tool, disconnect the battery charger, start the engine, and select "OK." Once "OK" is selected, do not interrupt this step, which may take 20 minutes or longer.

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- The updates are downloaded to the diagnostic scan tool or USB flash drive.

12. **NOTE:** If the diagnostic scan tool does not have an available USB port, the Re-Flash Kit cable can be unplugged at this time to make room for the USB flash drive. Do **not** disconnect the VCM from the diagnostic scan tool.

    NOTE: This step may take 20 minutes or longer.

    Connect the USB flash drive to the diagnostic scan tool and follow the on-screen instructions for downloading service packs and Applications onto the USB flash drive.

13. **NOTE:** If the media hub was removed, install it before connecting the USB flash drive to the vehicle.Refer to Media Hub .

    This step may take 20 minutes or longer.

    When prompted by the diagnostic scan tool, remove the USB flash drive and connect it to the media hub to install the Applications into the APIM .
    - The update should start automatically, and may take 20 minutes or longer.
    - It is normal for the APIM to reset during this step.

14. **NOTE:** Re-installing the USB flash drive into the diagnostic scan tool initiates the remaining automated configuration steps. Failure to do so results in the loss of feature functionality such as navigation and SYNC® traffic, directions, and information services.

    Once diagnostic scan tool programming and USB flash drive programming are complete, re-install the flash drive into the diagnostic scan tool and select "OK" to report software installation to the Ford online database.

15. Calibrate the touchscreen. Refer to Touchscreen Calibration .

Accessory Protocol Interface Module (APIM) Module Replacement Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool
 ST3256-A	SYNC® Re-Flash Kit CCMSYNC-KIT or equivalent [Tools are also available individually CCMUSB2-AM-AM-10 (cable) and CCMUSB-AF-BF5 (adapter)]

NOTE: Use this procedure to program and provision the module when a new Accessory Protocol Interface Module (APIM) is being installed. For additional information about choosing the correct programming procedure, refer to Information and Entertainment System , APIM Programming.

NOTE: A USB flash drive with a minimum storage size of 1 gigabyte (GB) may be required for this procedure.

NOTE: Some programming files are large (greater than 2 gigabytes). It is important that the diagnostic scan tool has enough available hard drive space to accommodate the programming file download. If a "Disk Space Error" is received, create additional free space on the hard drive.

NOTE:

- Install the new APIM before performing this procedure. Refer to Accessory Protocol Interface Module (APIM)
- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- During programming, the vehicle display may go blank momentarily.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.
- Close the IDS program before attempting to perform this procedure.

1. Connect a battery charger set on low.
    - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.

2. Place the ignition in the ON/RUN position.

3. Connect the diagnostic scan tool and VCM to the vehicle.

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4. Open Internet Explorer on the diagnostic scan tool and go to the technician service publications web site. On the OASIS tab, select "Read VIN & DTCs," and select "Go."

5. **NOTE:** This procedure clears all CMDTCs. The DTCs must be recorded now if other diagnoses are to be performed after this procedure.

   Select "Toolbox" from the technician service publications web site to retrieve and record all CMDTCs.

6. **NOTE:** If unable to complete programming because the operation stops or errors are received, the web browser settings may need to be configured. Refer to "Software Programming v1.1" on the technician service publications web site under the Service Tips tab.

   From the OASIS tab, select the "SYNC" button. The Last Recorded State — Software is displayed.

7. Scroll to the bottom of the screen, and select "Module Replacement," and select the "Read SYNC" button to compare the current APIM VIP, CIP, and Application software levels to the last reported state in the Ford online database.
   - After the comparison is performed, the diagnostic scan tool automatically selects software for programming.
   - Applications may require selection for installation. Applications with a green check mark next to them indicates the APIM already has the latest level installed (no re-installation required).
   - Depending on the software level required, the diagnostic scan tool automatically selects either the Service Pack or Full Flash programming method.
   - Although there may be an option available to override the Service Pack installation and perform a Full Flash/Force CIP, choosing this option requires additional programming time and is not recommended unless directed by a TSB.

8. **NOTE:** Only Applications on a flash drive may be loaded to the APIM through the media hub.

   NOTE: If not performing a Full Flash/Force CIP, go to Step 10.

   Remove the media hub. REFER to Media Hub.

9. **NOTE:** Do not disconnect the diagnostic scan tool or cable from the APIM during programming unless directed by the diagnostic scan tool on-screen prompts.

   Connect the SYNC® Re-Flash Kit cable and adapter between the diagnostic scan tool USB port and the vehicle USB cable.

10. **NOTE:** Diagnostic scan tools that have never been used to program SYNC® may encounter a Hardware Wizard pop-up requesting a "WMA SBOOT" driver installation. If this request is encountered, install the driver and select the diagnostic scan tool "retry" button to continue programming.

    NOTE: This step may take 20 minutes or longer.

    Select the "Program SYNC" button to begin the APIM programming process.
    - When prompted by the diagnostic scan tool, disconnect the battery charger, start the engine, and select "OK." Once "OK" is selected, do not interrupt this step, which may take 20 minutes or longer.
    - The updates are downloaded to the diagnostic scan tool or USB flash drive.

11. **NOTE:** If the diagnostic scan tool does not have an available USB port, the Re-Flash Kit cable can be unplugged at this time to make room for the USB flash drive. Do **not** disconnect the VCM from the diagnostic scan tool.

NOTE: This step may take 20 minutes or longer.

Connect the USB flash drive to the diagnostic scan tool and follow the on-screen instructions for downloading service packs and Applications onto the USB flash drive.

12. **NOTE:** If the media hub was removed, install it before connecting the USB flash drive to the vehicle.Refer to Media Hub .

    This step may take 20 minutes or longer.

    When prompted by the diagnostic scan tool, remove the USB flash drive and connect it to the media hub to install the Applications into the APIM .
    - The update should start automatically, and may take 20 minutes or longer.
    - It is normal for the APIM to reset during this step.

13. **NOTE:** Re-installing the USB flash drive into the diagnostic scan tool initiates the remaining automated configuration steps. Failure to do so results in the loss of feature functionality such as navigation and SYNC® traffic, directions, and information services.

    Once diagnostic scan tool programming and USB flash drive programming are complete, re-install the flash drive into the diagnostic scan tool and select "OK" to report software installation to the Ford online database.

14. Calibrate the touchscreen. Refer to Touchscreen Calibration .

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Accessory Protocol Interface Module (APIM) Reset

NOTE: Carrying out an APIM Reset consists of a battery disconnect and a SYNC® system Master Reset.

NOTE: NOTE: This procedure will clear all CMDTCs . The DTCs must be recorded now if other (non SYNC®) diagnoses are to be performed after this procedure.

1. Remove any devices connected to the USB port(s), audio input jack (if equipped), or media hub (if equipped).

2. **NOTE:** After the APIM reset procedure has been completed the customer should be advised to reset their device following the manufacturer's instructions. Refer to the device's owner's manual and/or website for information on how to perform a Manual / Master Reset or Clear. Devices can be powered off and back on for a simple re-boot. In some cases the device's battery may also need to be removed and re-installed to complete a re-boot. In addition, cell phones may need to have SYNC® deleted from the Bluetooth menu prior to re-pairing the phone to the SYNC® system. Customer devices may affect the operation of SYNC® and this should be understood to prevent unnecessary diagnosis or repairs to the system.

   Disconnect the negative battery cable for 1 minute, then reconnect it. Refer to Section 414-01 .

3. **NOTE:** Performing a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC® system. On vehicles equipped MyFord Touch or MyLincoln Touch with navigation, the customer’s saved destination points (home address and points of interest) and preferences will also be lost with a Master Reset.

   Carry out a SYNC® system Master Reset. Refer to the owner's literature

4. Verify system function using the Multi-Media Interface Tester 105-00120, to test the audio output for the audio input jack/socket (if equipped), USB port(s), and Bluetooth. If equipped, use the RCA Adapter 105-00121 to test the audio output for the RCA jacks.

5. If a concern is still present return to the Symptom Charts.

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Accessory Protocol Interface Module (APIM) Standard Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent diagnostic scan tool
 ST3256-A	SYNC® Re-Flash Kit CCMSYNC-KIT or equivalent [Tools are also available individually CCMUSB2-AM-AM-10 (cable) and CCMUSB-AF-BF5 (adapter)]

NOTE: Use this procedure to update the Accessory Protocol Interface Module (APIM) and any installed Applications to the latest level. For additional information about choosing the correct programming procedure, refer to Information and Entertainment System , APIM Programming.

NOTE: A USB flash drive with a minimum storage size of 1 gigabyte (GB) may be required for this procedure.

NOTE: Some programming files are large (greater than 2 gigabytes). It is important that the diagnostic scan tool has enough available hard drive space to accommodate the programming file download. If a "Disk Space Error" is received, create additional free space on the hard drive.

NOTE:

- To prevent timeout errors and to minimize programming time, a hardwired Internet connection is strongly recommended when programming.
- During programming, the vehicle display may go blank momentarily.
- Make sure the diagnostic scan tool is plugged into a power supply due to the length of programming time.
- Close the IDS program before attempting to perform this procedure.

1. Connect a battery charger set on low.
    - When connecting the charger, the negative battery charger lead must be connected to a clean chassis ground, not the negative battery post.

2. Place the ignition in the ON/RUN position.

3. Connect the diagnostic scan tool and VCM to the vehicle.

4. Open Internet Explorer on the diagnostic scan tool and go to the technician service publications web

site. On the OASIS tab, select "Read VIN & DTCs," and select "Go."

5. **NOTE:** This procedure clears all CMDTCs . The DTCs must be recorded now if other diagnoses are to be performed after this procedure.

   Select "Toolbox" from the technician service publications web site to retrieve and record all CMDTCs .

6. **NOTE:** If unable to complete programming because the operation stops or errors are received, the web browser settings may need to be configured. Refer to "Software Programming v1.1" on the technician service publications web site under the Service Tips tab.

   From the OASIS tab, select the "SYNC" button. The Last Recorded State — Software is displayed.

7. Scroll to the bottom of the screen, select "Standard", and select the "Read SYNC" button to compare the current APIM Vehicle Interface Processor (VIP), Consumer Interface Processor (CIP), and Application software levels to the last reported state in the Ford online database.
   - After the comparison is performed, the diagnostic scan tool automatically selects software for programming.
   - Applications may require selection for installation. Applications with a green check mark next to them indicates the APIM already has the latest level installed (no re-installation required).
   - Depending on the software level required, the diagnostic scan tool automatically selects either the Service Pack or Full Flash programming method.
   - Although there may be an option available to override the Service Pack installation and perform a Full Flash/Force CIP , choosing this option requires additional programming time and is not recommended unless directed by a TSB .

8. **NOTE:** Only Applications on a flash drive may be loaded to the APIM through the media hub.

   NOTE: If not performing a Full Flash/Force CIP , go to Step 10.

   Remove the media hub. REFER to Media Hub .

9. **NOTE:** Do not disconnect the diagnostic scan tool or cable from the APIM during programming unless directed by the diagnostic scan tool on-screen prompts.

   Connect the SYNC® Re-Flash Kit cable and adapter between the diagnostic scan tool USB port and the vehicle USB cable.

10. **NOTE:** Diagnostic scan tools that have never been used to program SYNC® may encounter a Hardware Wizard pop-up requesting a "WMA SBOOT" driver installation. If this request is encountered, install the driver and select the diagnostic scan tool "retry" button to continue programming.

    NOTE: This step may take 20 minutes or longer.

    Select the "Program SYNC" button to begin the APIM programming process.
    - When prompted by the diagnostic scan tool, disconnect the battery charger, start the engine, and select "OK." Once "OK" is selected, do not interrupt this step, which may take 20 minutes or longer.
    - The updates are downloaded to the diagnostic scan tool or USB flash drive.

11. **NOTE:** If the diagnostic scan tool does not have an available USB port, the Re-Flash Kit cable can be unplugged at this time to make room for the USB flash drive. Do **not** disconnect the VCM from the diagnostic scan tool.

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NOTE: This step may take 20 minutes or longer.

Connect the USB flash drive to the diagnostic scan tool and follow the on-screen instructions for downloading service packs and Applications onto the USB flash drive.

12. **NOTE:** If the media hub was removed, install it before connecting the USB flash drive to the vehicle.Refer to Media Hub .

    This step may take 20 minutes or longer.

    When prompted by the diagnostic scan tool, remove the USB flash drive and connect it to the media hub to install the Applications into the APIM .
    - The update should start automatically, and may take 20 minutes or longer.
    - It is normal for the APIM to reset during this step.

13. **NOTE:** Re-installing the USB flash drive into the diagnostic scan tool initiates the remaining automated configuration steps. Failure to do so results in the loss of feature functionality such as navigation and SYNC® traffic, directions, and information services.

    Once diagnostic scan tool programming and USB flash drive programming are complete, re-install the flash drive into the diagnostic scan tool and select "OK" to report software installation to the Ford online database.

14. Calibrate the touchscreen. Refer to Touchscreen Calibration .

Audio Control Module (ACM) Self-Diagnostic Mode

NOTE: If the Audio Front Control Module (ACM), Front Control/Display Interface Module (FCDIM) (if equipped), Front Controls Interface Module (FCIM), or Front Display Interface Module (FDIM) (if equipped) are inoperative (blank or do not power on), obtain the ACM part number by referencing the label attached to the ACM chassis.

1. Turn the ACM on.

2. Operate the audio system in radio tuner AM/FM mode.

3. Press and hold the EJECT button, and within 1 second, press and hold the SEEK UP button until the speaker walk-around test begins.

   NOTE: AHU Diagnostics refers to the ACM, EFP Diagnostics refers to the FCIM, and MFD Diagnostics (if supported) refers to the FCDIM (if equipped).

4. To exit the self-diagnostic mode, turn the ACM off, or select "Exit Diagnostics."

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Satellite Radio Electronic Serial Number (ESN) Retrieval

NOTE: If the Audio Front Control Module (ACM), FCDIM (if equipped), FCIM , or FDIM (if equipped) are inoperative (blank or do not power on), obtain the Electronic Serial Number (ESN) by referencing the label attached to the Audio Front Control Module (ACM) chassis.

1. Turn the Audio Front Control Module (ACM) on.
2. Operate the audio system in radio tuner AM/FM mode.
3. Press and hold the eject button, and within 1 second, press and hold the seek up button. If supported, the speaker walk around test will begin.
4. Select AHU Diagnostics.
5. Select SIRIUS ESN.

Touchscreen Calibration

NOTE: Recalibrate the touchscreen by following the scan tool prompts or the steps below.

1. To avoid an inoperative touchscreen, make sure the vehicle battery is fully charged.
2. Turn on the ACM .
3. While in AM/FM mode, press and hold the EJECT button, and within 1 second, press the SEEK UP button.
4. Press and hold the SEEK DOWN button to enter the touchscreen calibration.
5. Touch and hold the touch points as they appear on the touchscreen (a stylus is not required).
6. To accept the new settings, touch anywhere on the screen when the screen displays “New calibration settings have been measured. Press the Enter key to accept the new settings.”
7. Clear all CMDTCs .

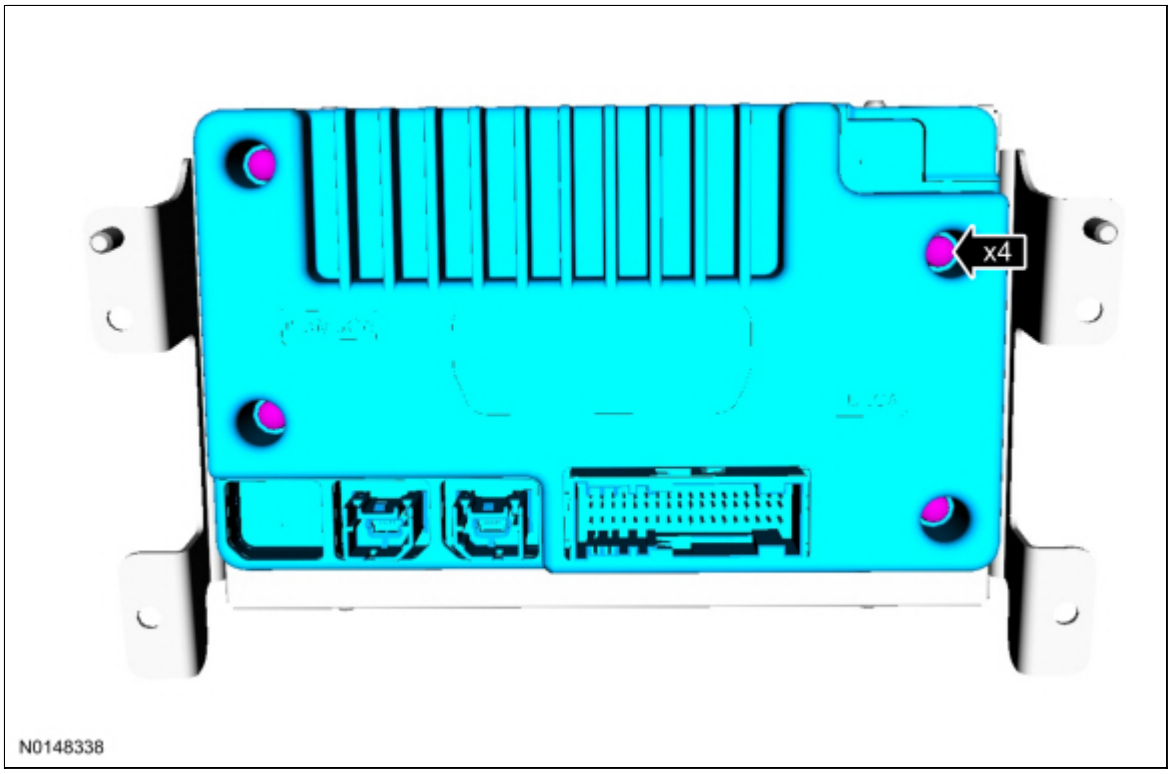
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Accessory Protocol Interface Module (APIM)

Removal and Installation

1. Remove the Front Display Interface Module (FDIM). Refer to Front Display Interface Module (FDIM) .

2. Remove the 4 APIM screws and remove the APIM .
   - To install, tighten to 0.6 Nm (5 lb-in).

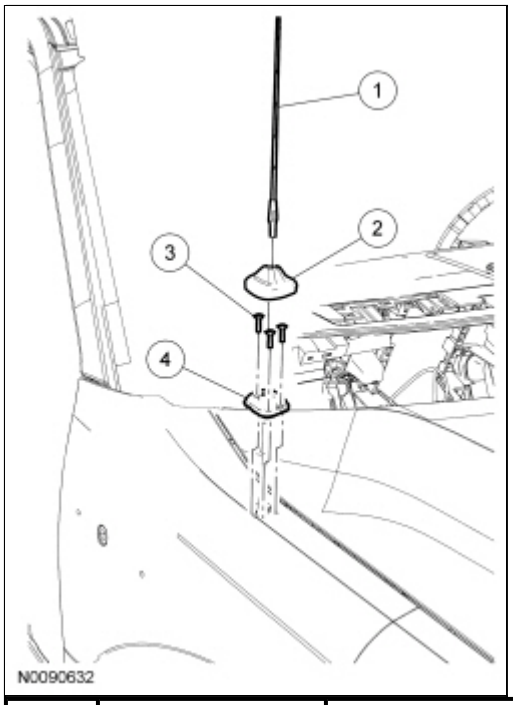


3. To install, reverse the removal procedure.

4. Program the APIM . Refer to Accessory Protocol Interface Module (APIM) Module Replacement Programming .

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Antenna — AM/FM

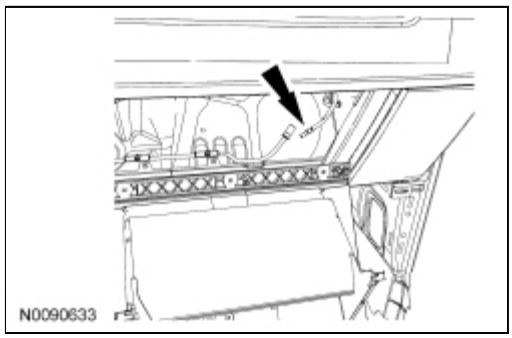


Item	Part Number	Description
1	18813	AM/FM antenna mast
2	18A927	AM/FM antenna base cap
3	N610019	AM/FM antenna screws (3 required)
4	18A894	AM/FM antenna base

Removal and Installation

1. Lower the glove compartment completely.

2. Disconnect the AM/FM antenna from the AM/FM antenna cable.
    - Push the antenna cable end and the grommet through the side cowl.



3. ***NOTICE:*** **Do not over tighten the antenna mast or damage to the antenna base or mast may occur.**

   Remove the AM/FM antenna mast.
   1. To install, tighten to 4.2 Nm (36 lb/in).

4. **NOTE:** A new AM/FM antenna base cap must be installed.

   Using a suitable tool such as a hook-shaped pick, remove the AM/FM antenna base cap by prying upward.

5. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

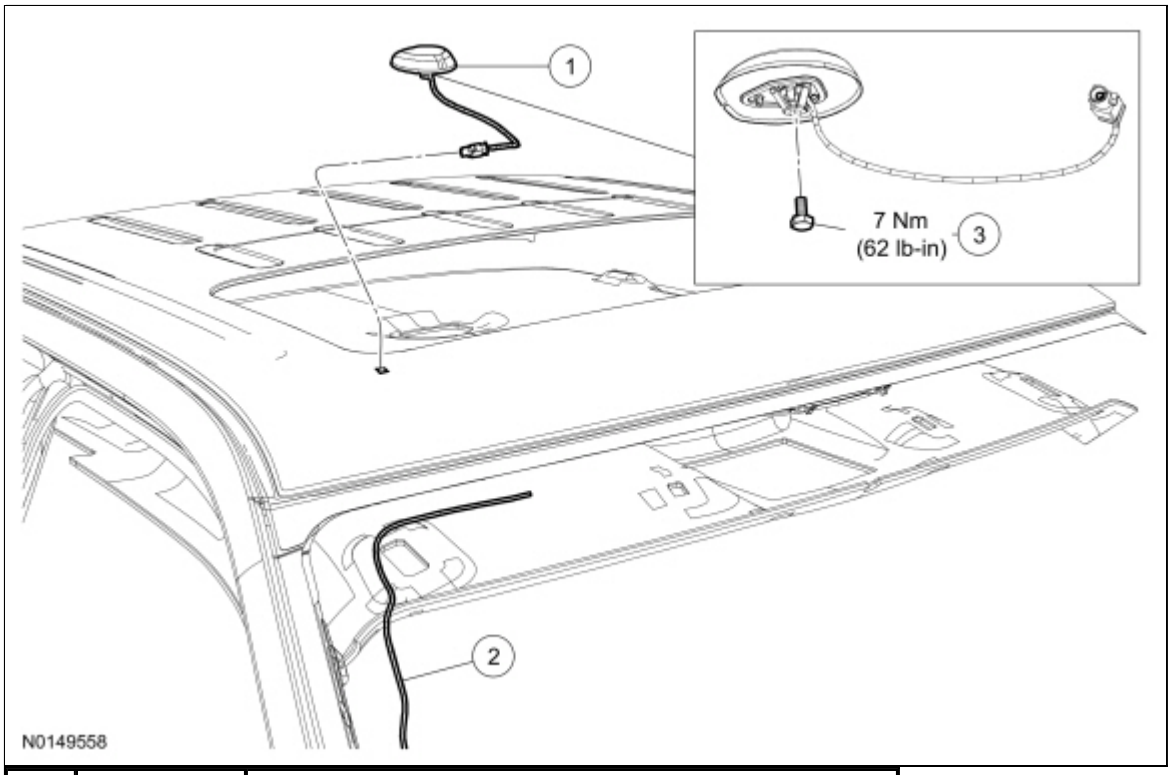
6. Remove the 3 screws and the AM/FM antenna base.
   1. To install, tighten to 2.5 Nm (23 lb/in).

7. To install, reverse the removal procedure.

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Antenna — Satellite Radio



Item	Part Number	Description
1	10E893	Satellite radio antenna
2	—	Satellite radio antenna electrical connector (part of 19A397)
2	—	Satellite radio antenna retaining bolt (part of 10E893)

Removal and Installation

1. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .

2. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
   - If equipped, disconnect the electrical connector.

3. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical connector.

4. **NOTE:** Remove the satellite antenna and pigtail through the mounting opening in the roof panel.

   Remove the satellite antenna.
   - Disconnect the electrical connector.

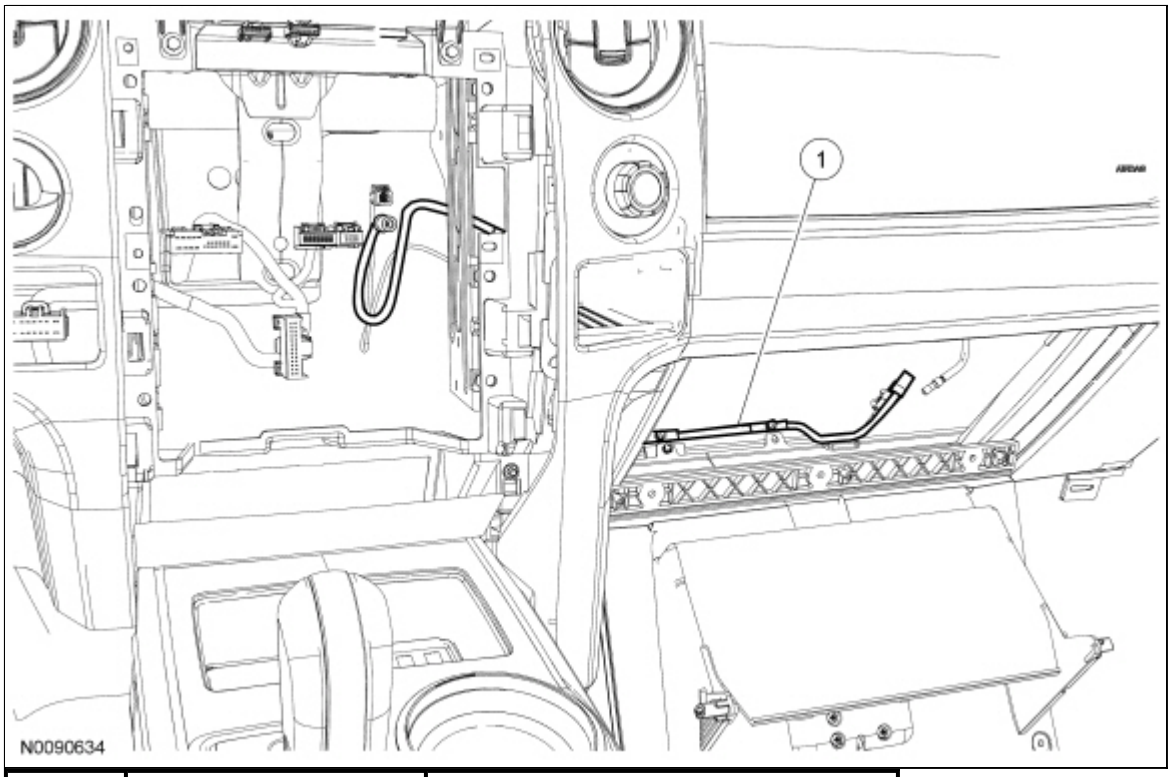
- Remove the satellite antenna retaining bolt and retainer then remove the satellite antenna from the roof panel.
    - To install, tighten to 7 Nm (62 lb-in).

5. To install, reverse the removal procedure.

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Antenna Cable — AM/FM



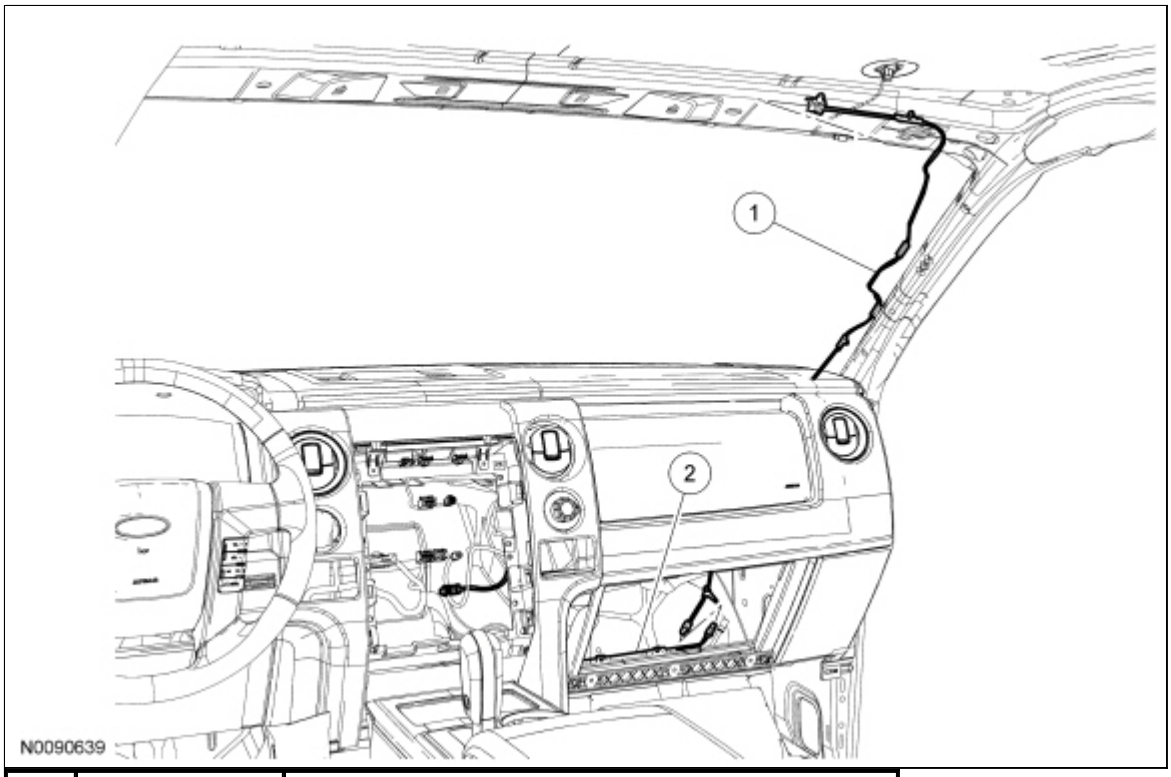
Item	Part Number	Description
1	18812	AM/FM antenna cable

Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.
2. Lower the glove compartment completely.
3. Disconnect the AM/FM antenna cable from the AM/FM antenna.
4. Separate the pushpins and remove the AM/FM antenna cable.
5. To install, reverse the removal procedure.

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Antenna Cable — Satellite Radio



Item	Part Number	Description
1	19A397	Upper satellite radio antenna cable
2	19A397/10E928	Lower satellite radio antenna cable (without/with navigation)

Removal and Installation

Both cables

1. Lower the glove compartment completely.
2. Disconnect the upper-to-lower satellite radio antenna cable connection.

Upper cable

3. Remove the RH A-pillar trim panel. For additional information, refer to Section 501-05 .
4. Remove the 3 screws, the RH sun visor retaining clip, and the RH sun visor.
    - If equipped, disconnect the electrical connector.
5. Lower the front of the headliner enough to gain access to the satellite radio antenna electrical

connector.

6. Remove the upper satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the A-pillar and instrument panel.

Lower cable

7. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) in this section.

8. Remove the lower satellite radio antenna cable.
    - Disconnect the electrical connector.
    - Separate the pushpins from the instrument panel.

Both cables

9. To install, reverse the removal procedure.

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Audio Control Module (ACM)

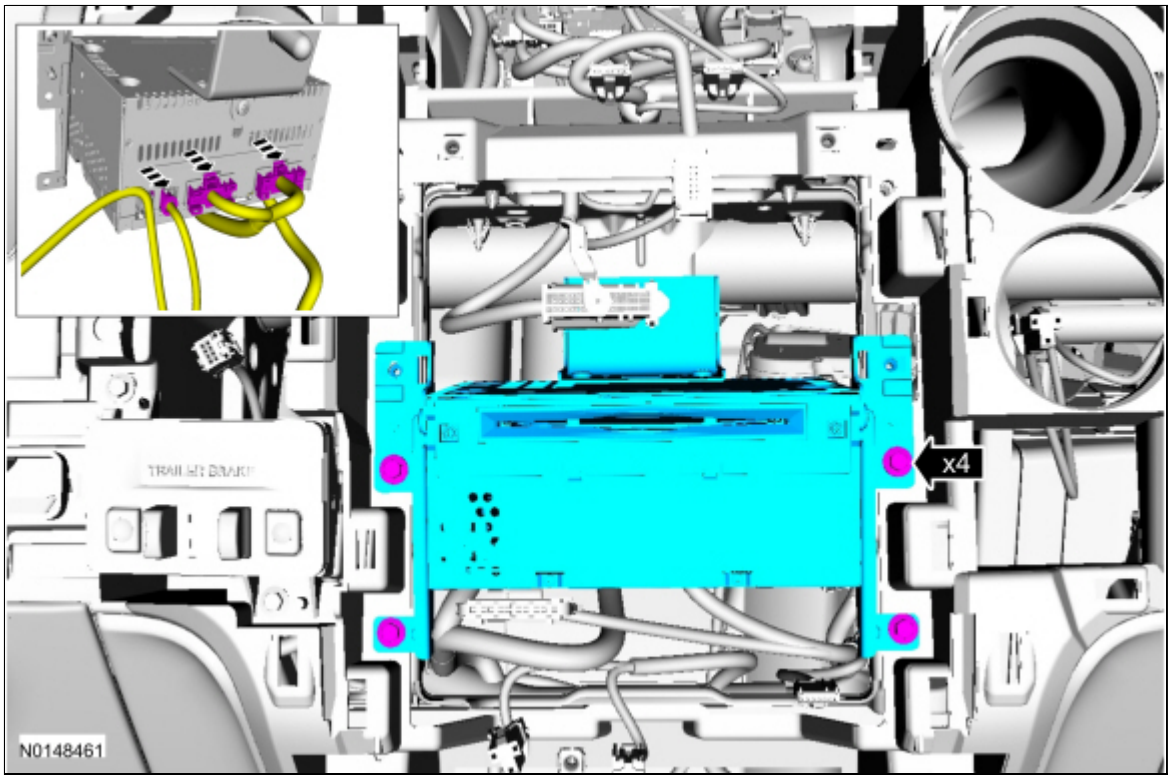
Removal and Installation

1. **NOTE:** If installing a new module, it is necessary to upload the module configuration information to the scan tool prior to removing the module. This information must be downloaded into the new module after installation.

   Upload the Audio Front Control Module (ACM) configuration information to the scan tool by following the scan tool on screen instructions.

2. Remove the Front Display Interface Module (FDIM). Refer to Front Display Interface Module (FDIM) .

3. Remove the 4 ACM bolts and the ACM .
   - Disconnect the electrical connectors.
   - To install, tighten to 2.5 Nm (23 lb-in).

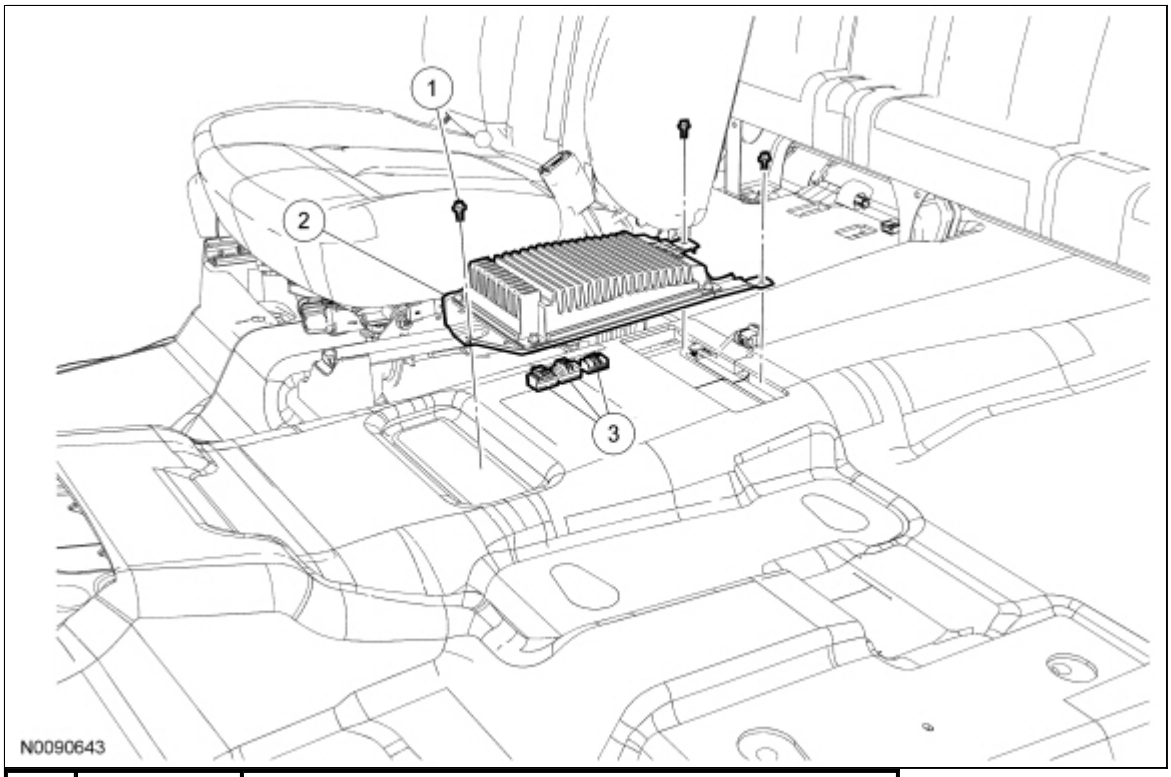


4. To install, reverse the removal procedure.

5. Download the ACM configuration information from the scan tool to the new ACM following the scan tool on screen instructions.

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Audio Digital Signal Processing (DSP) Module — Front Captain's Chair



Item	Part Number	Description
1	—	Audio Digital Signal Processing (DSP) module bolts (3 required)
2	18B849	Audio DSP module
3	—	Audio DSP module electrical connectors (part of 14A005)

Removal and Installation

1. **NOTE:** Module configuration is required when a new audio Digital Signal Processing (DSP) module is being installed.

   Upload the audio DSP module configuration information to the scan tool. For additional information, refer to Programmable Module Installation (PMI) in Section 418-01 .

2. Remove the floor console. For additional information, refer to Section 501-12 .

3. Disconnect the audio DSP module electrical connectors.

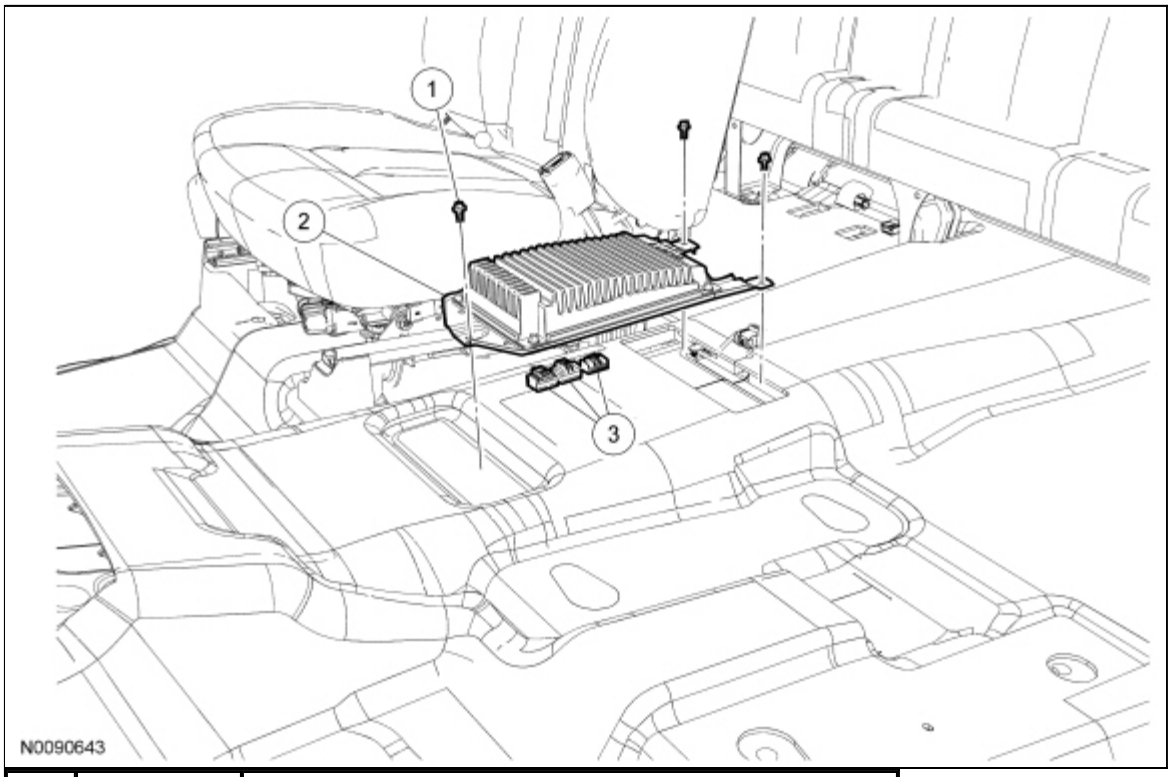
4. Remove the 3 bolts and the audio DSP module.

5. To install, reverse the removal procedure.
    - Download the configuration information to the audio DSP module. For additional information, refer to PMI in Section 418-01 .

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Audio Digital Signal Processing (DSP) Module — Split Bench

NOTE: The seats are shown removed for clarity only.



Item	Part Number	Description
1	—	Audio Digital Signal Processing (DSP) module bolts (3 required)
2	18B849	Audio DSP module
3	—	Audio DSP module electrical connectors (part of 14A005)

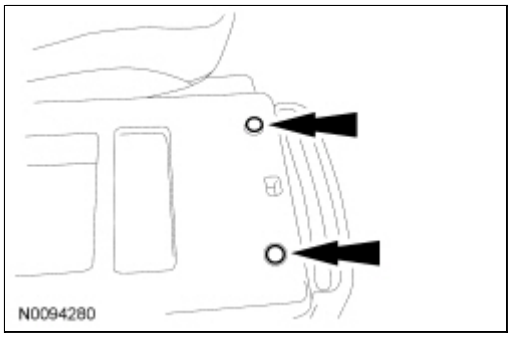
Removal and Installation

1. **NOTE:** Module configuration is required when a new audio Digital Signal Processing (DSP) module is being installed.

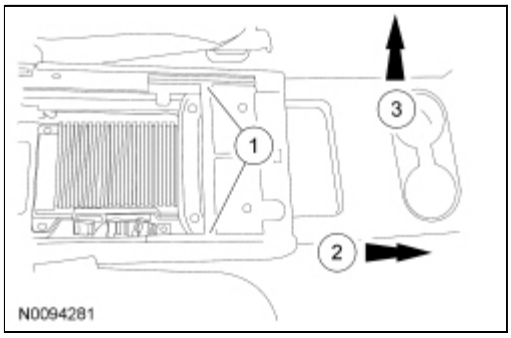
   Upload the audio DSP module configuration information to the scan tool. For additional information, refer to Programmable Module Installation (PMI) in Section 418-01 .

2. Raise the middle seat completely.

3. Remove the 2 pushpins and the top tray.

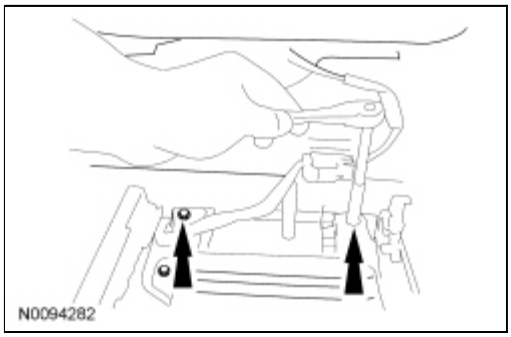


4. Position the cupholder aside.
    1. Release the tabs.
    2. Move the cupholder as far forward as possible.
    3. Move the front of the cupholder as far to the driver side of the vehicle as possible.



5. Disconnect the audio Digital Signal Processing (DSP) module electrical connectors.

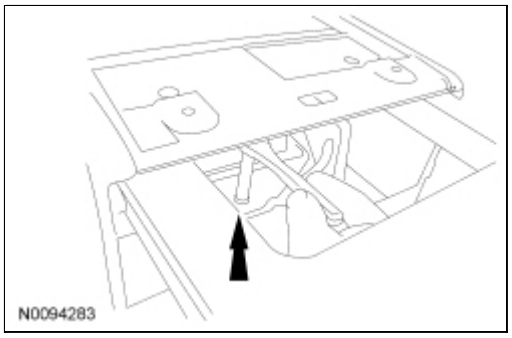
6. Remove the 2 rear audio DSP module bolts.



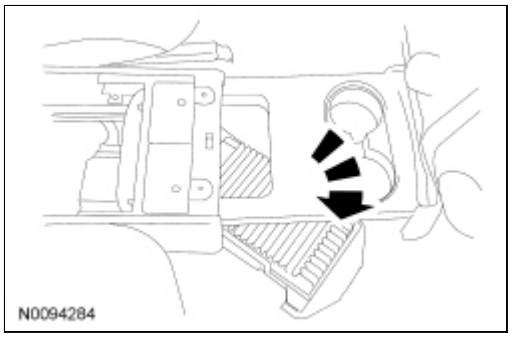
7. **NOTE:** Access the bolt from underneath the cupholder.

    Remove the front audio DSP module bolt.

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8. Remove the audio DSP module.
    - Route the audio DSP module forward and towards the passenger side of the vehicle.

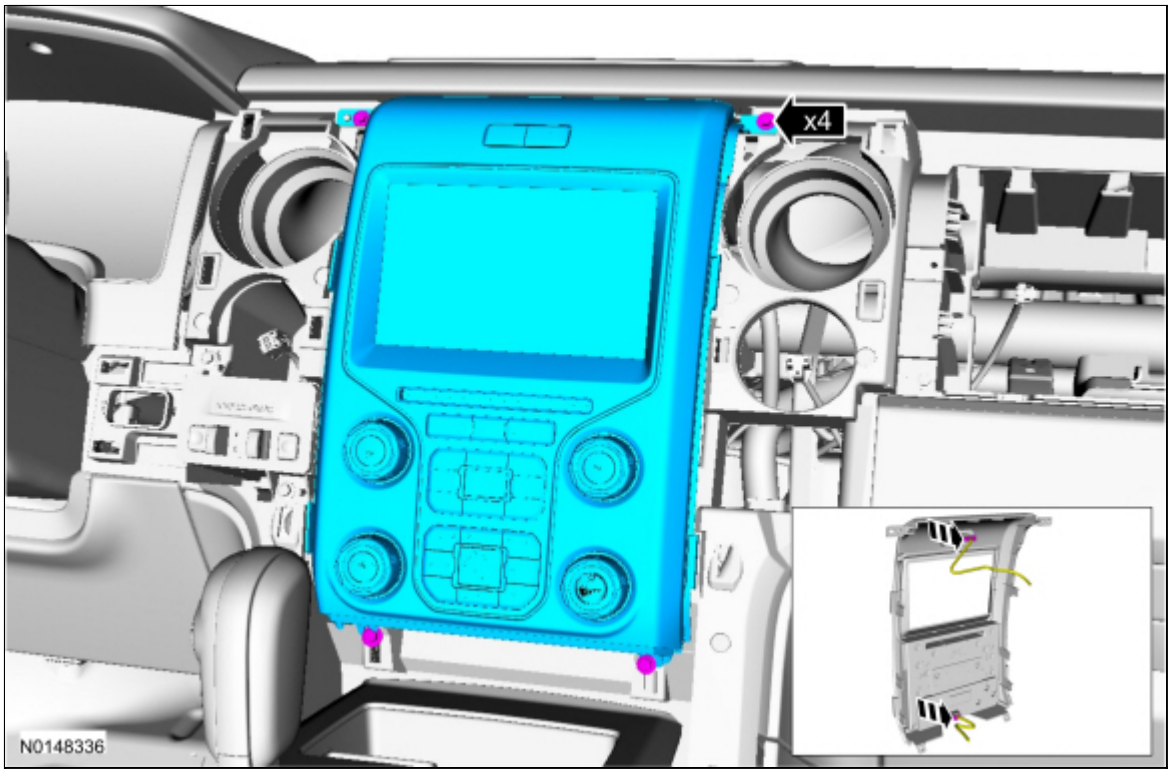


9. To install, reverse the removal procedure.
    - Download the configuration information to the audio DSP module. For additional information, refer to PMI in Section 418-01 .

Front Controls Interface Module (FCIM)

Removal and Installation

1. Remove the LH center instrument panel finish panel. Refer to Section 501-12 .
2. Remove the RH center instrument panel finish panel. Refer to Section 501-12 .
3. Remove the 4 screws and the FCIM .
   - Disconnect the electrical connectors.
   - To install, tighten to 3 Nm (27 lb-in).



4. To install, reverse the removal procedure.

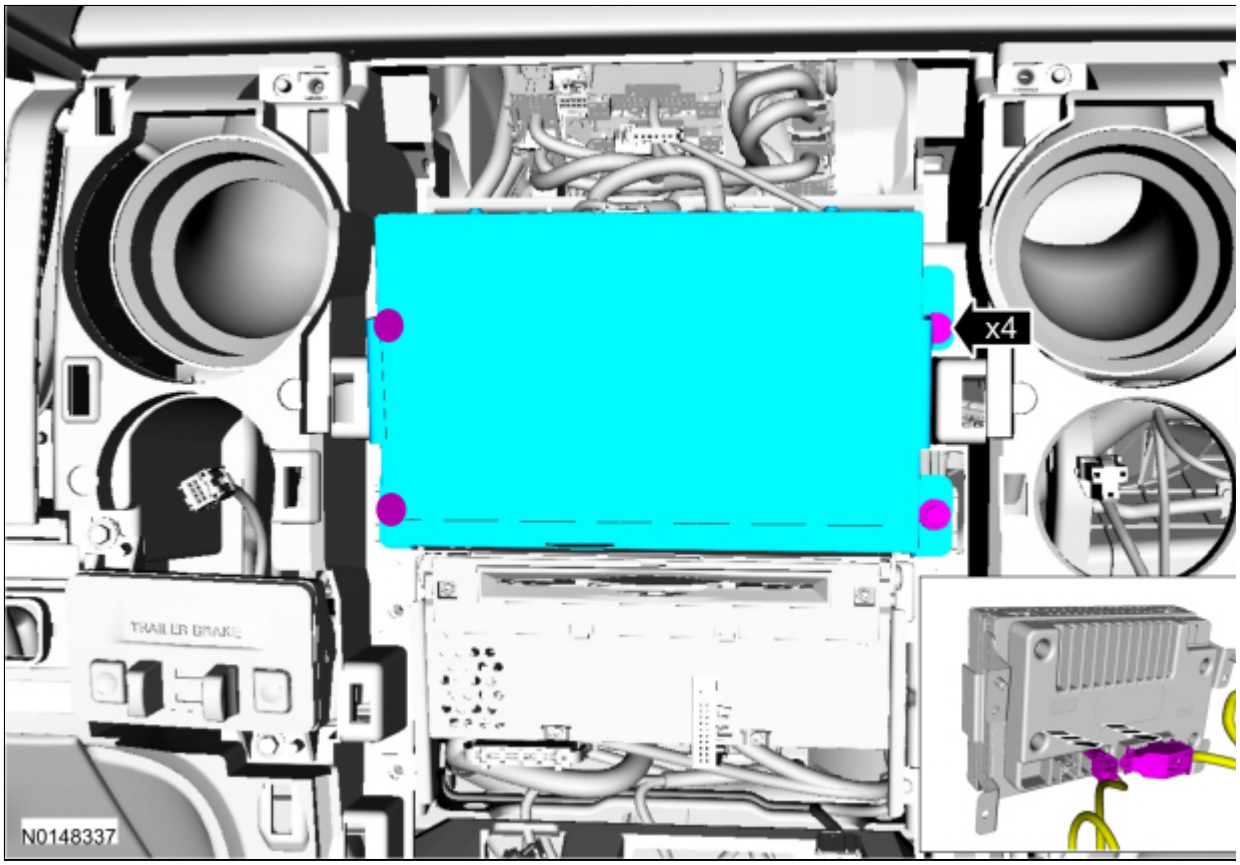
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Front Display Interface Module (FDIM)

Removal and Installation

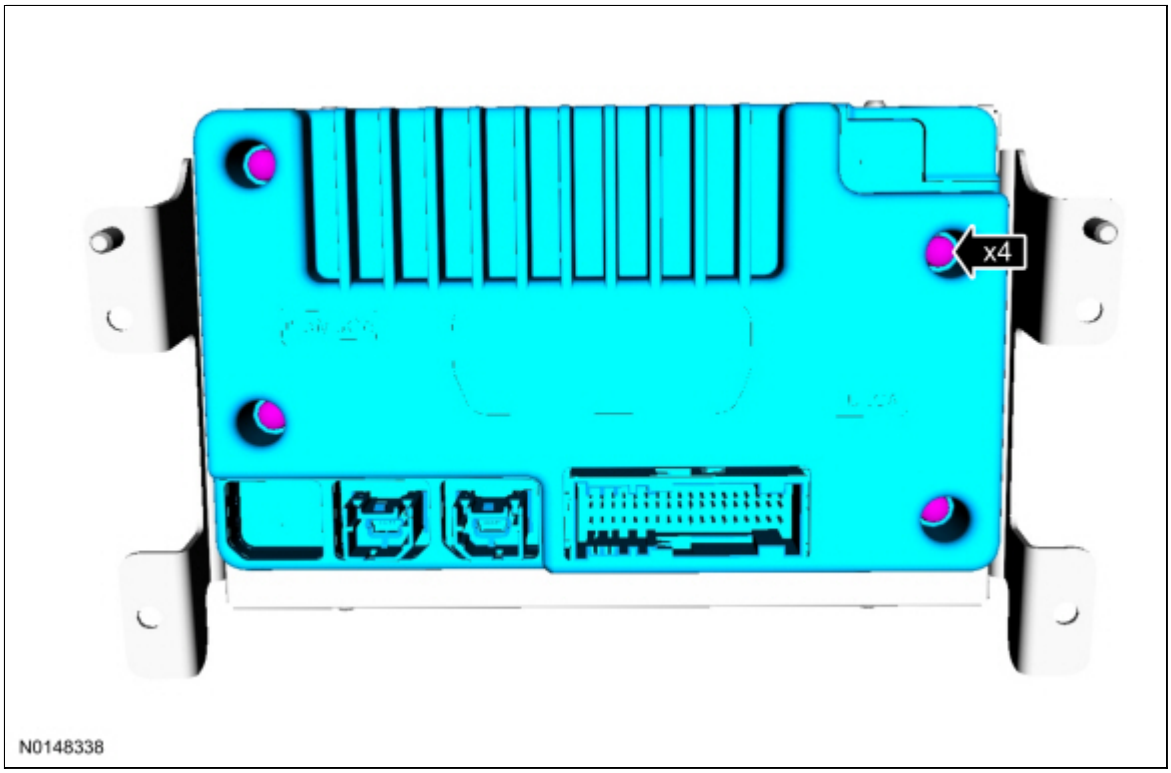
1. Remove the Front Controls Interface Module (FCIM). Front Controls Interface Module (FCIM) .

2. Remove the 4 bolts and the Front Display Interface Module (FDIM).
   - Disconnect the electrical connectors.
   - To install, tighten to 2.5 Nm (23 lb-in).



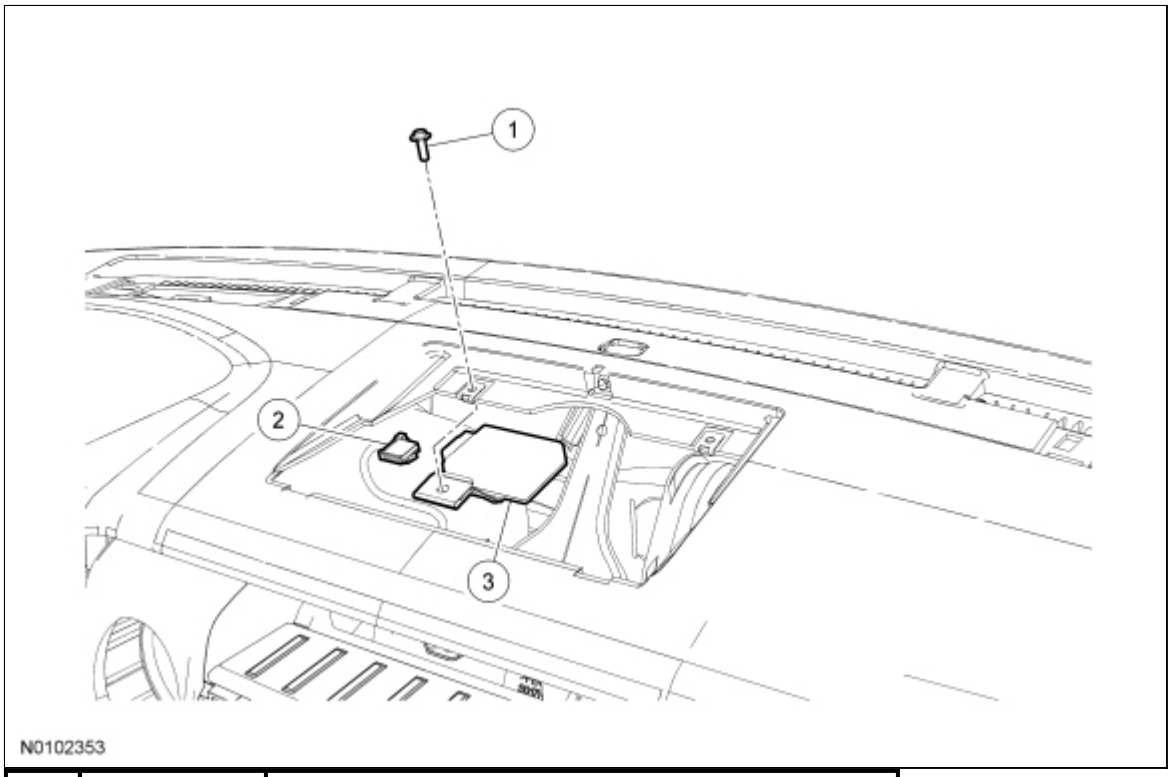
3. Remove the 4 screws and remove the Accessory Protocol Interface Module (APIM) from the FDIM .
   - To install, tighten to 0.6 Nm (5 lb-in).

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4. To install, reverse the removal procedure.
5. Calibrate the FDIM touchscreen. Refer to Touchscreen Calibration .

Global Positioning System Module (GPSM)



Item	Part Number	Description
1	W707628-S	Global Positioning System Module (GPSM) screw
2	—	GPSM electrical connector (part of 14401)
3	10E893	GPSM

Removal and Installation

1. Remove the Front Display Interface Module (FDIM). For additional information, refer to Front Display Interface Module (FDIM) in this section.

2. Remove the screw and the Global Positioning System Module (GPSM).
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

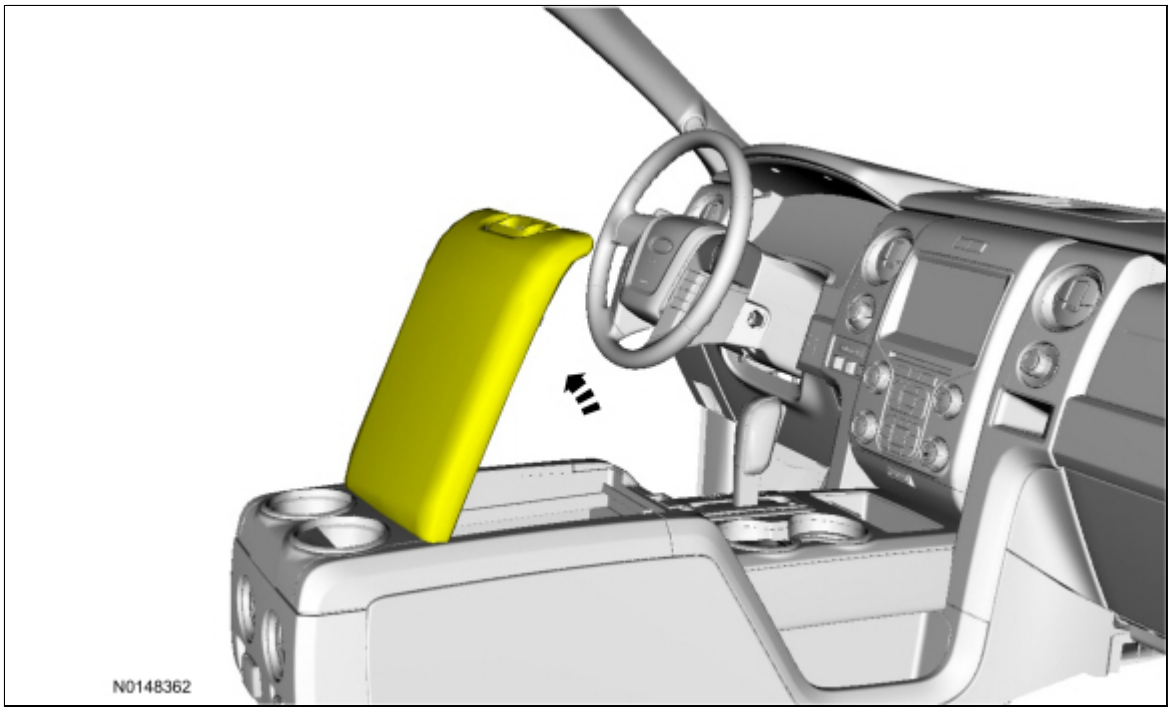
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Media Hub

Removal and Installation

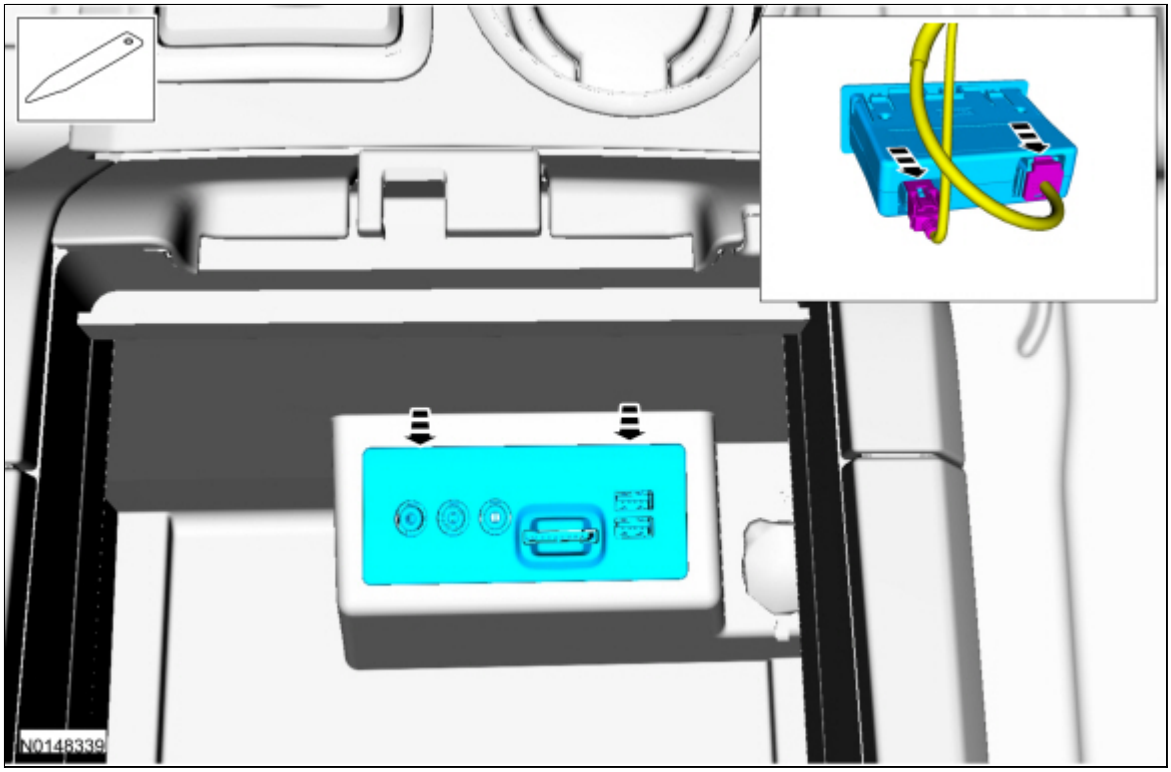
Vehicles with floor console

1. Open the floor console stowage bin door.



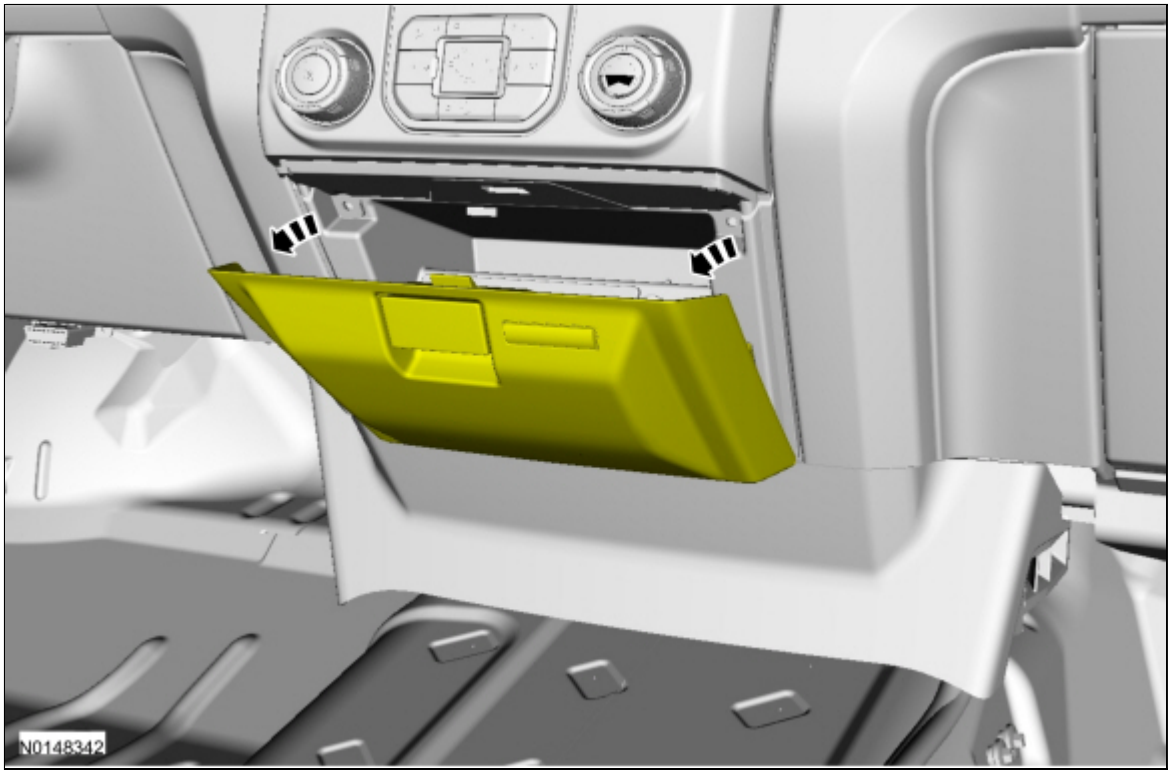
2. Remove the media hub.
    - Disconnect the electrical connectors.

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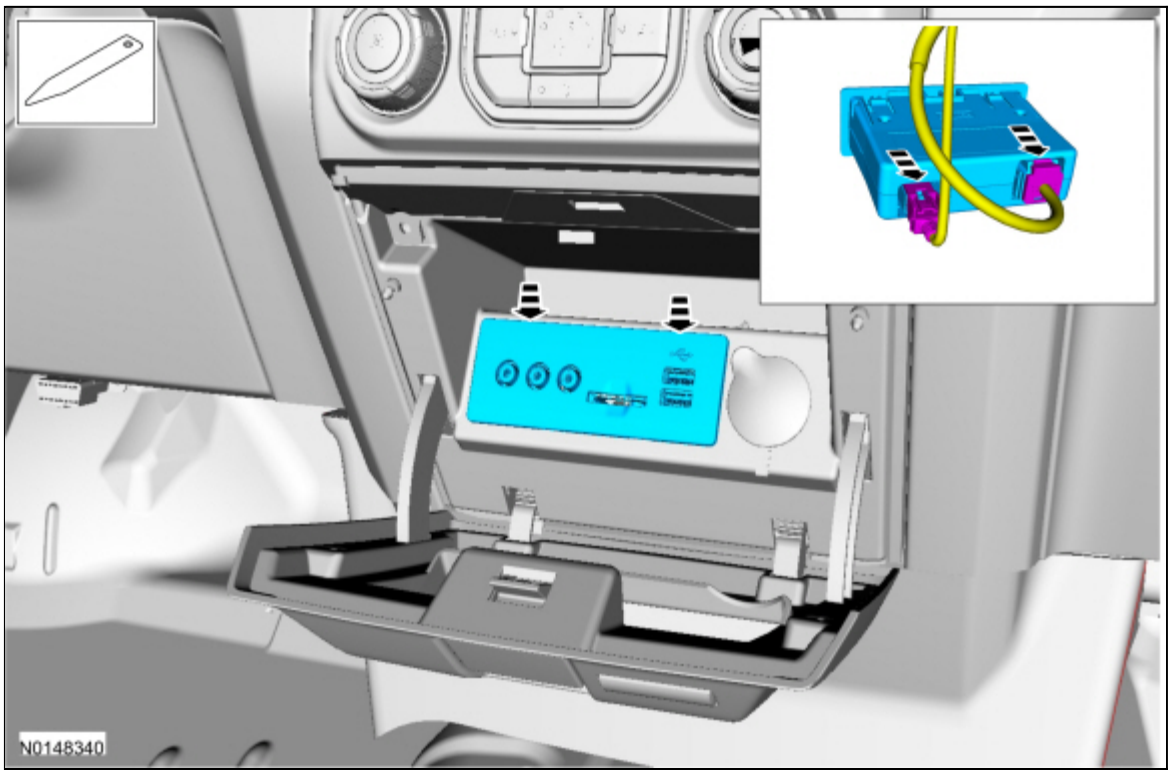
Vehicles without floor console

3. Open the lower instrument panel door.



4. Remove the media hub.

- Disconnect the electrical connectors.



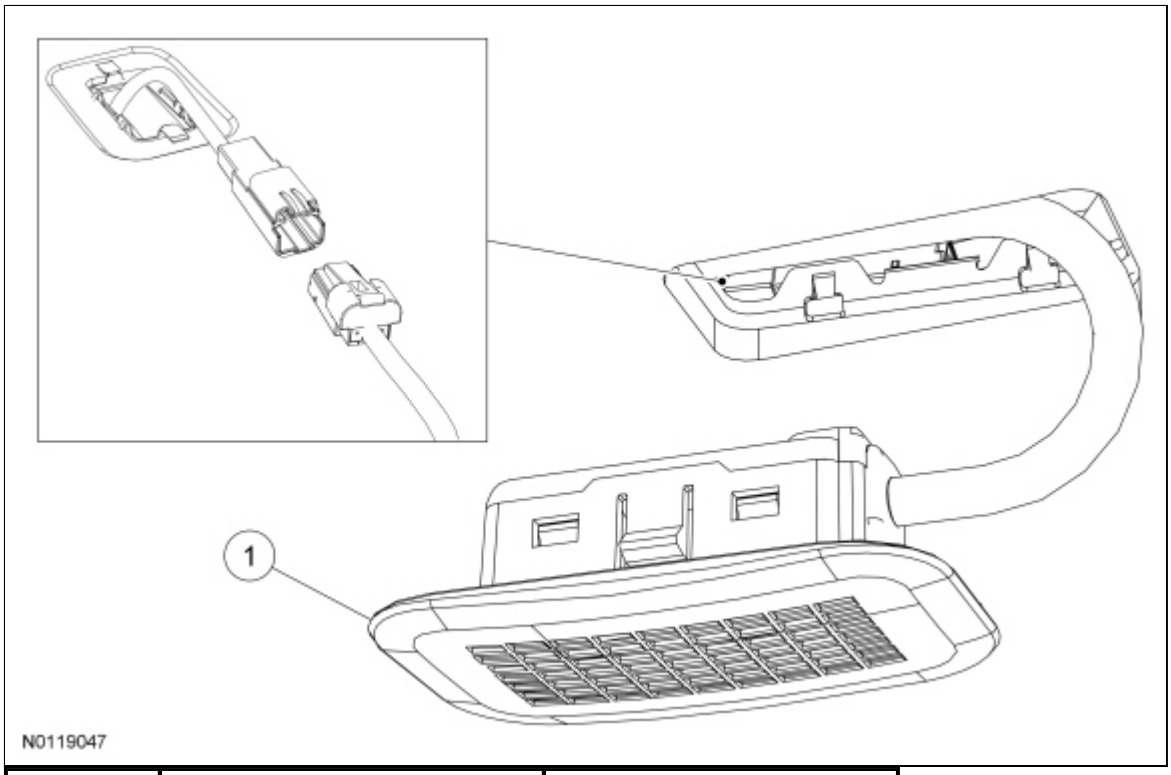
All vehicles

5. To install, reverse the removal procedure.

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Microphone



Item	Part Number	Description
1	19A391	Microphone

Removal

1. Using a suitable tool, (such as a thin small flat head screwdriver) twist and pry the microphone bezel from the headliner metal mounting bracket.

2. Remove the microphone from the headliner by grasping the microphone pigtail.
    - Disconnect the microphone electrical connector.

Installation

1. Reconnect the microphone electrical connector.

2. Wrap the connection with anti-rattle tape.

3. Feed the microphone pigtail into the headliner through the microphone hole.
    - Verify the microphone pigtail points towards the front of the vehicle.

4. Snap the microphone into the headliner mounting bracket.

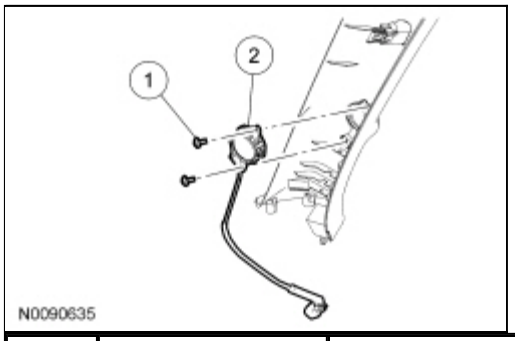
- Verify the mounting bracket and microphone are snug to the headliner.

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Speaker — A-Pillar

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	W701678-S	A-pillar speaker screws (2 required)
2	18978	A-pillar speaker

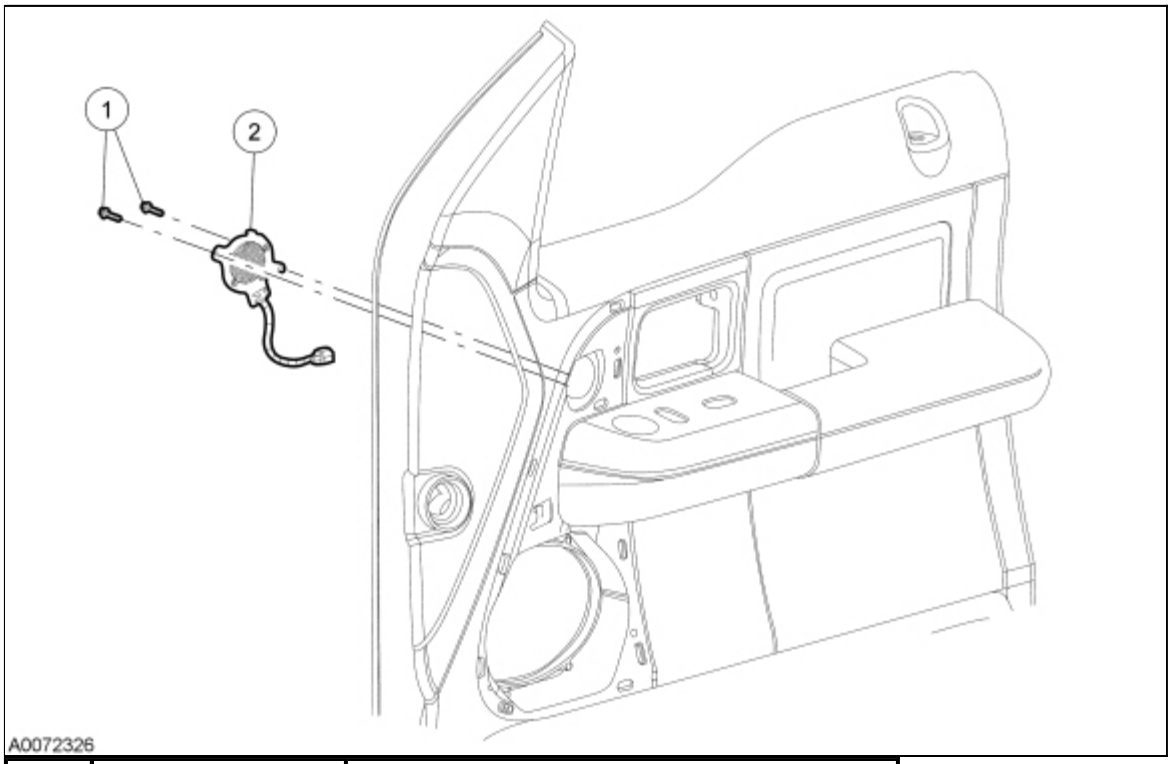
Removal and Installation

1. Remove the A-pillar trim panel. For additional information, refer to Section 501-05 .
2. Remove the 2 screws and the A-pillar speaker.
3. To install, reverse the removal procedure.

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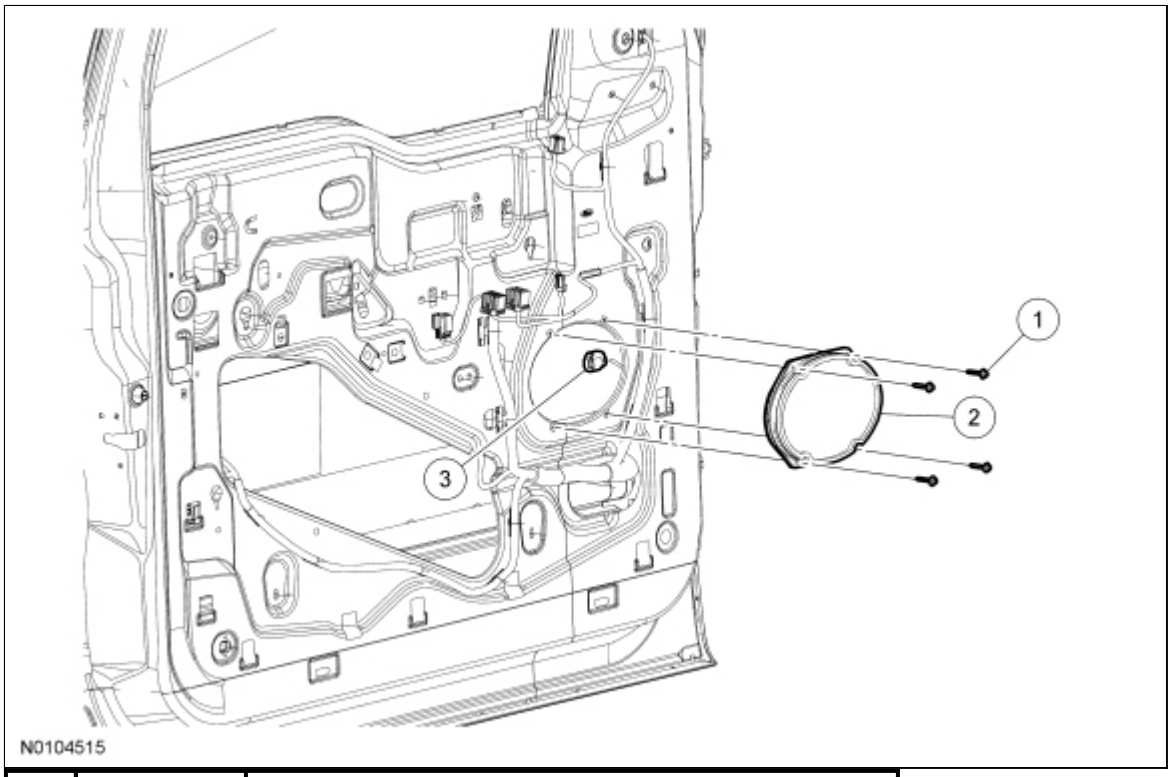
Speaker — Door

Front Door Tweeter Speaker



Item	Part Number	Description
1	W701678	Tweeter speaker screws (2 required)
2	19B170/19B171	Tweeter speaker (RH/LH)

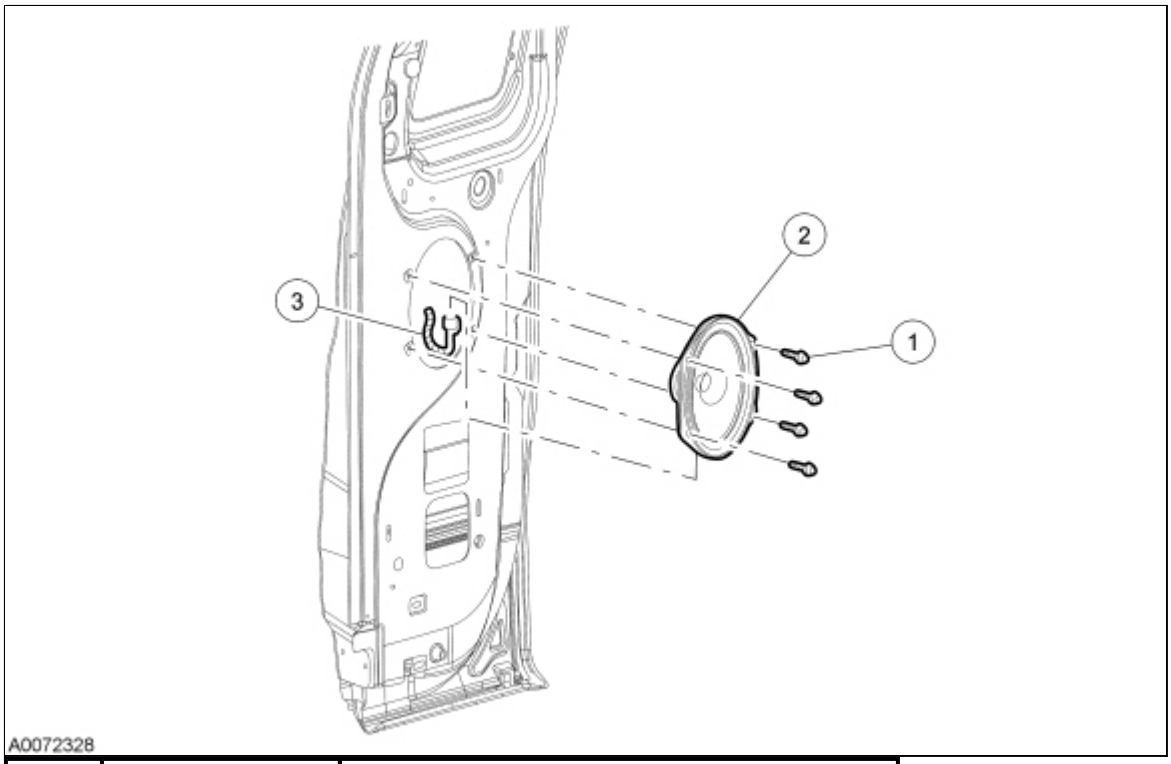
Front Door Speaker



Item	Part Number	Description
1	W707628	Front door speaker screws (4 required)
2	18808	Front door speaker
3	—	Front door speaker electrical connector (part of door harness)

Rear Door Speaker

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Item	Part Number	Description
1	W706766	Rear speaker screws (4 required)
2	18808	Rear speaker
3	180103	Rear speaker electrical connector

Removal and Installation

Front door

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws (2 for the tweeter, 4 for the door speaker) and the speaker.
   - Disconnect the electrical connector.

Rear door

3. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

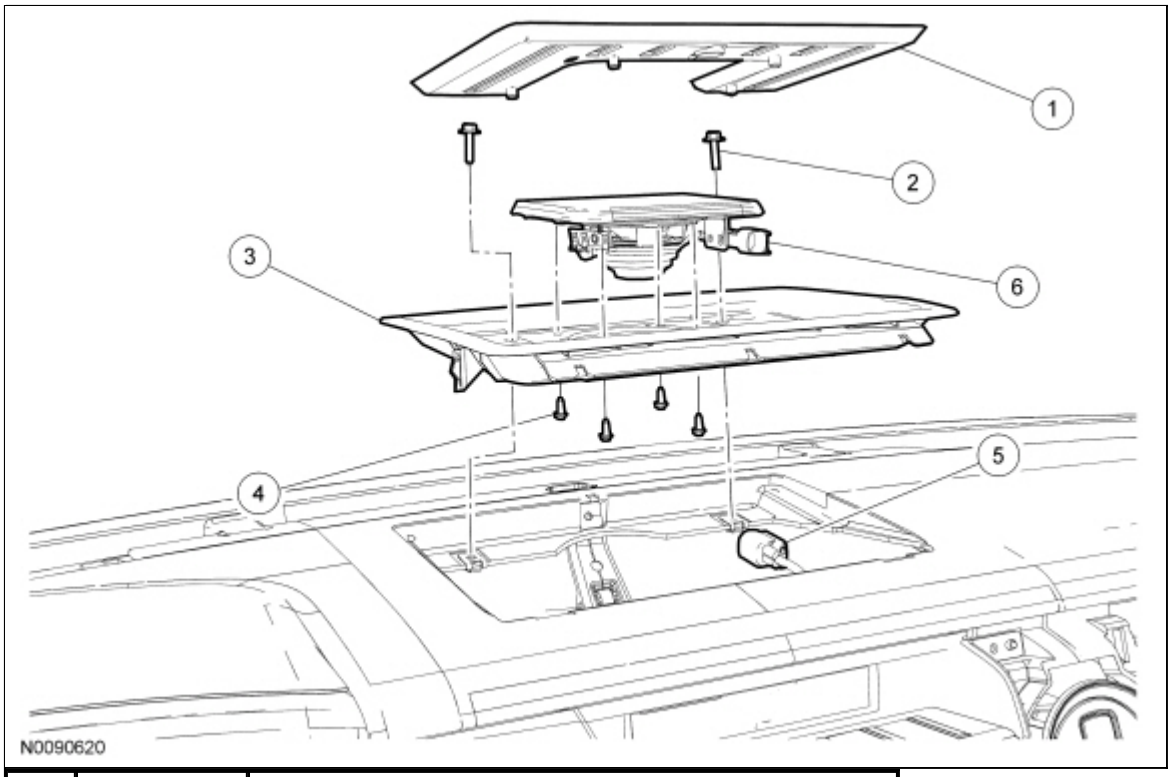
4. Remove the 4 screws and the rear door speaker.
   - Disconnect the electrical connector.

All speakers

5. To install, reverse the removal procedure.

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Speaker — Instrument Panel



Item	Part Number	Description
1	15045G34	Instrument panel top bin mat
2	W707628-S	Instrument panel top bin screw (2 required)
3	15042A82	Instrument panel top bin
4	W506821	Instrument panel speaker screw (4 required)
5	—	Instrument panel speaker electrical connector (part of 14401)
6	18808	Instrument panel speaker

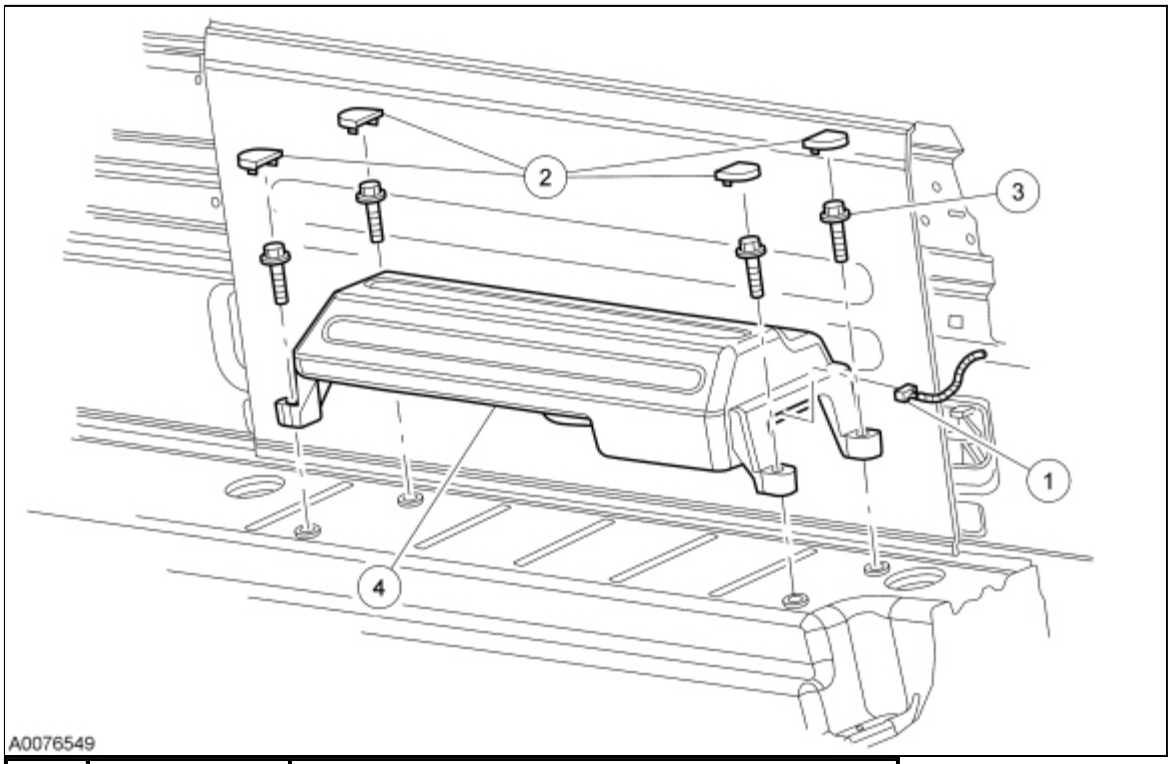
Removal and Installation

1. Remove the mat, the 2 screws, and the instrument panel top bin.
    - Disconnect the instrument panel speaker electrical connector.
2. Remove the 4 screws and the instrument panel speaker.
3. To install, reverse the removal procedure.

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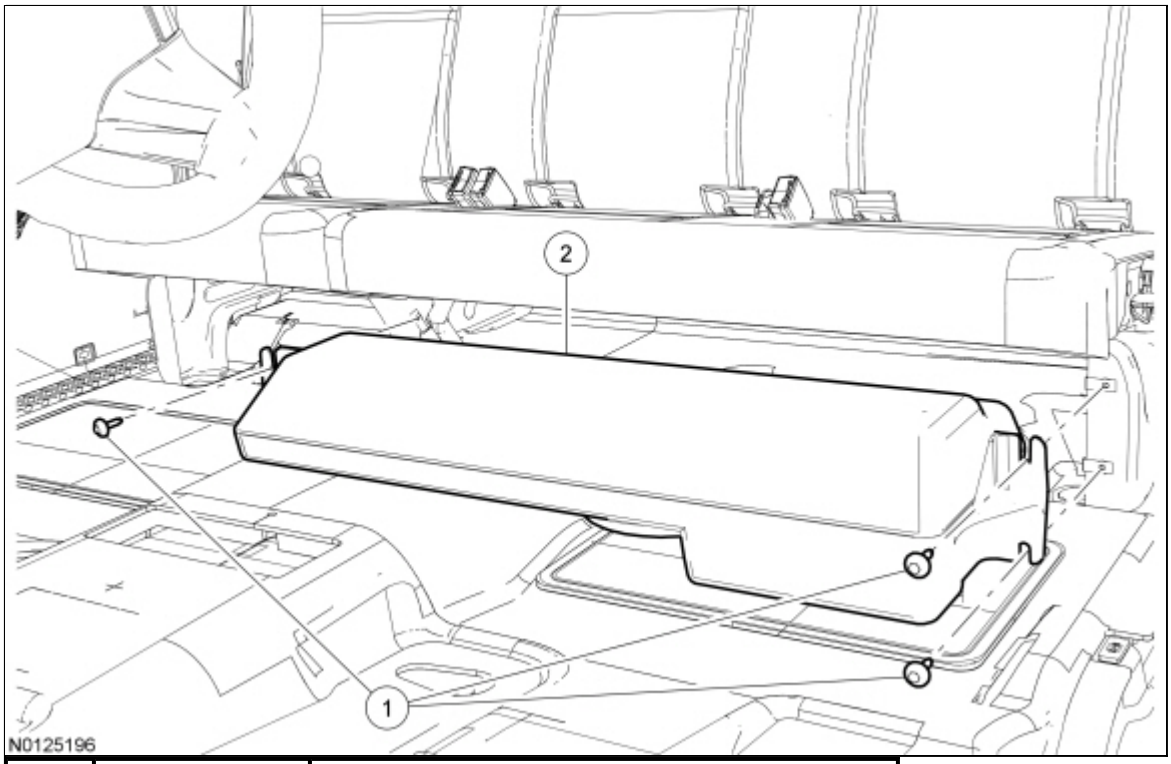
Speaker Enclosure

Regular Cab



Item	Part Number	Description
1	14A005	Subwoofer enclosure electrical connector
2	4273	Subwoofer enclosure bolt caps (4 required)
3	W709027	Subwoofer enclosure bolts (4 required)
4	18C804	Subwoofer enclosure

SuperCab and Super Crew



Item	Part Number	Description
1	W714310	Subwoofer enclosure bolts (3 required)
2	18808	Subwoofer enclosure

Removal and Installation

1. Remove the 3 bolts (Regular Cab) or 4 bolts (SuperCab and Super Crew) and the subwoofer enclosure.
    - If equipped, remove the 4 bolt caps.
    - Disconnect the electrical connector.

2. To install, reverse the removal procedure.

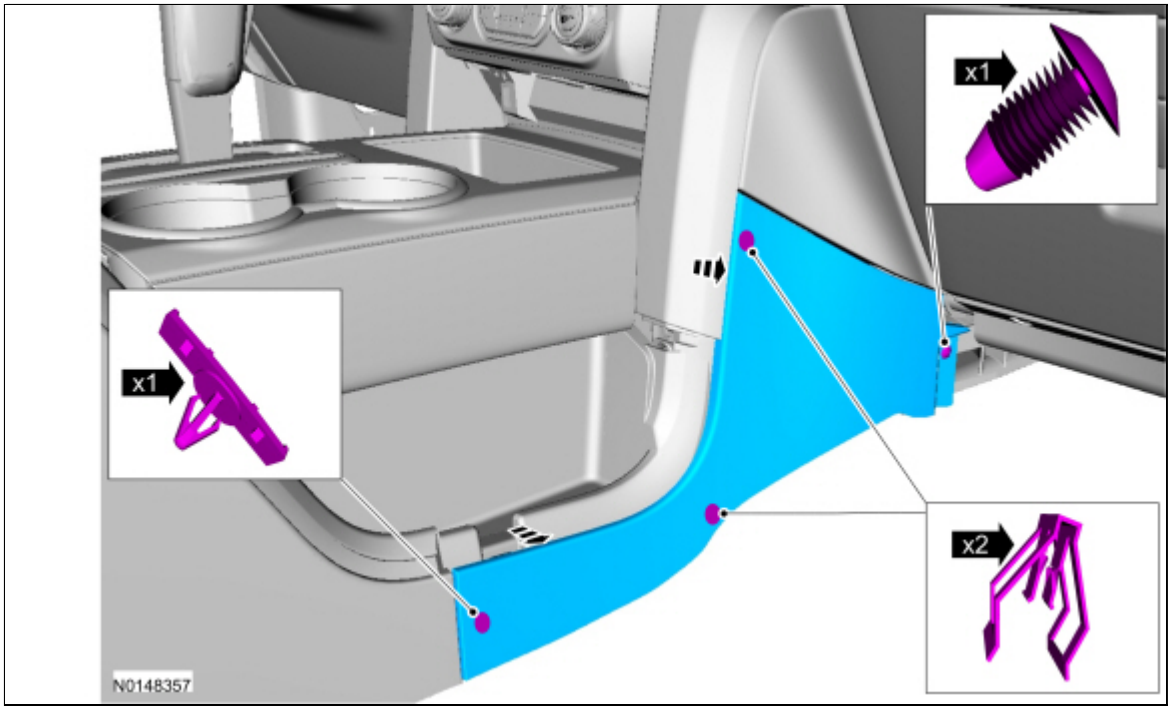
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Universal Serial Bus (USB) Cable and Port

Removal and Installation

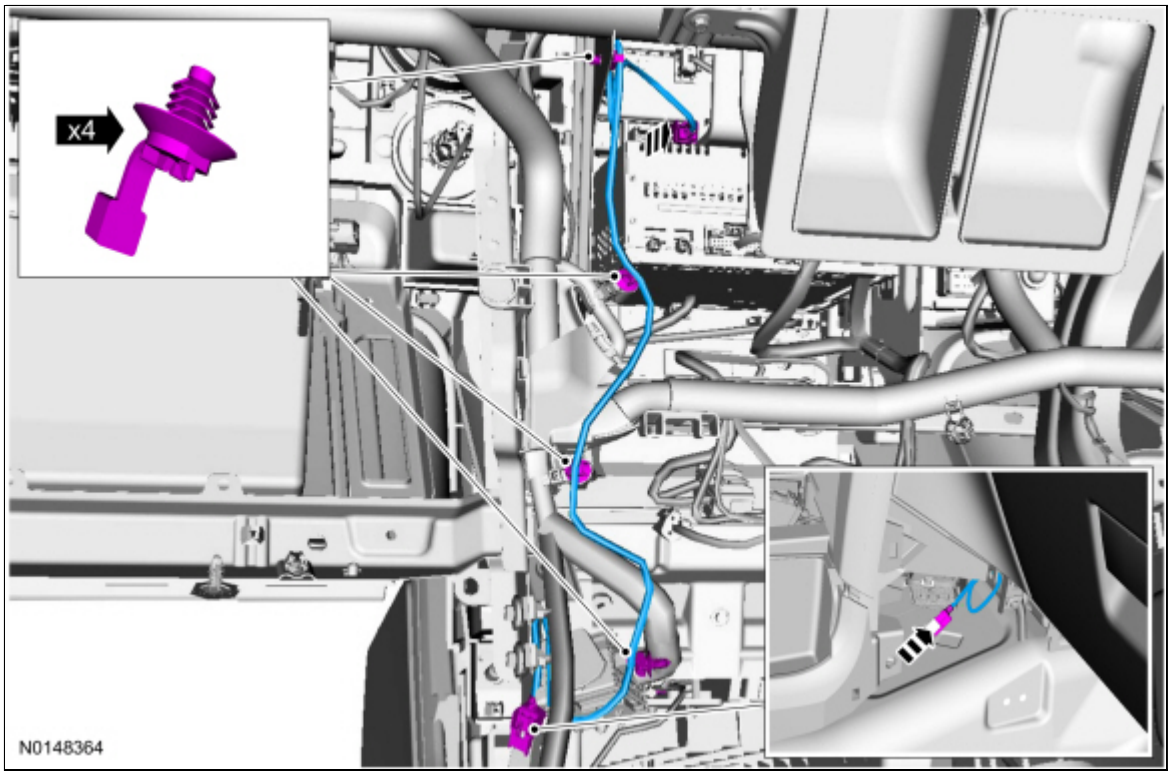
Instrument panel USB cable with floor console

1. Remove the Accessory Protocol Interface Module (APIM). Refer to Accessory Protocol Interface Module (APIM) .
2. For access remove the glove box. Refer to Section 501-12 .
3. Remove the RH lower floor console trim panel



4. Remove the USB cable following the routing shown.

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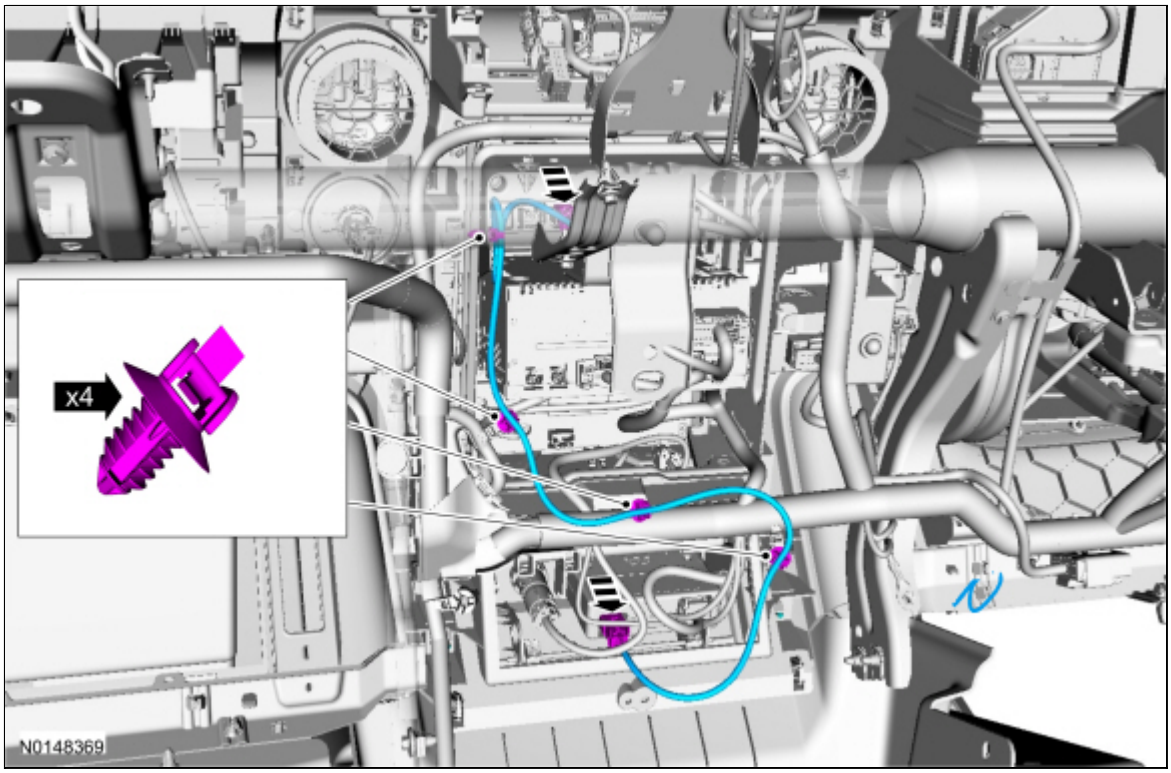
Instrument panel USB without floor console

5. Remove the Accessory Protocol Interface Module (APIM). Refer to Accessory Protocol Interface Module (APIM) .

6. For access remove the glove box. Refer to Section 501-12 .

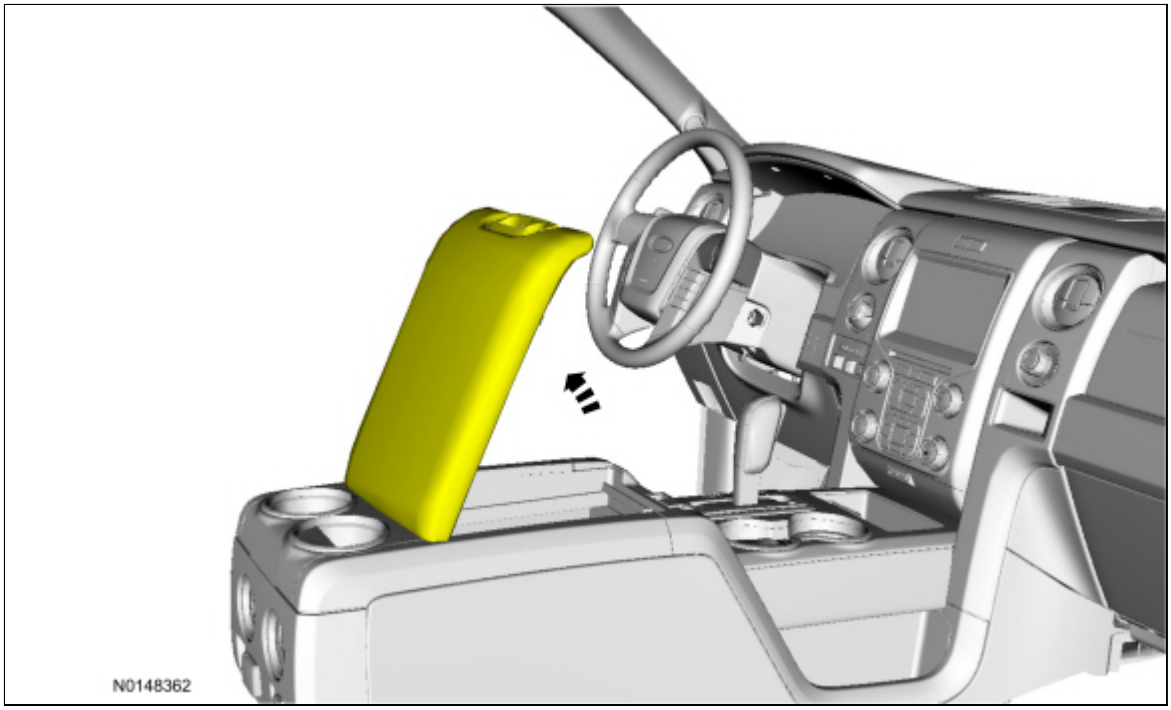
7. Remove the media hub. Refer to Media Hub .

8. Remove the USB cable following the routing shown.



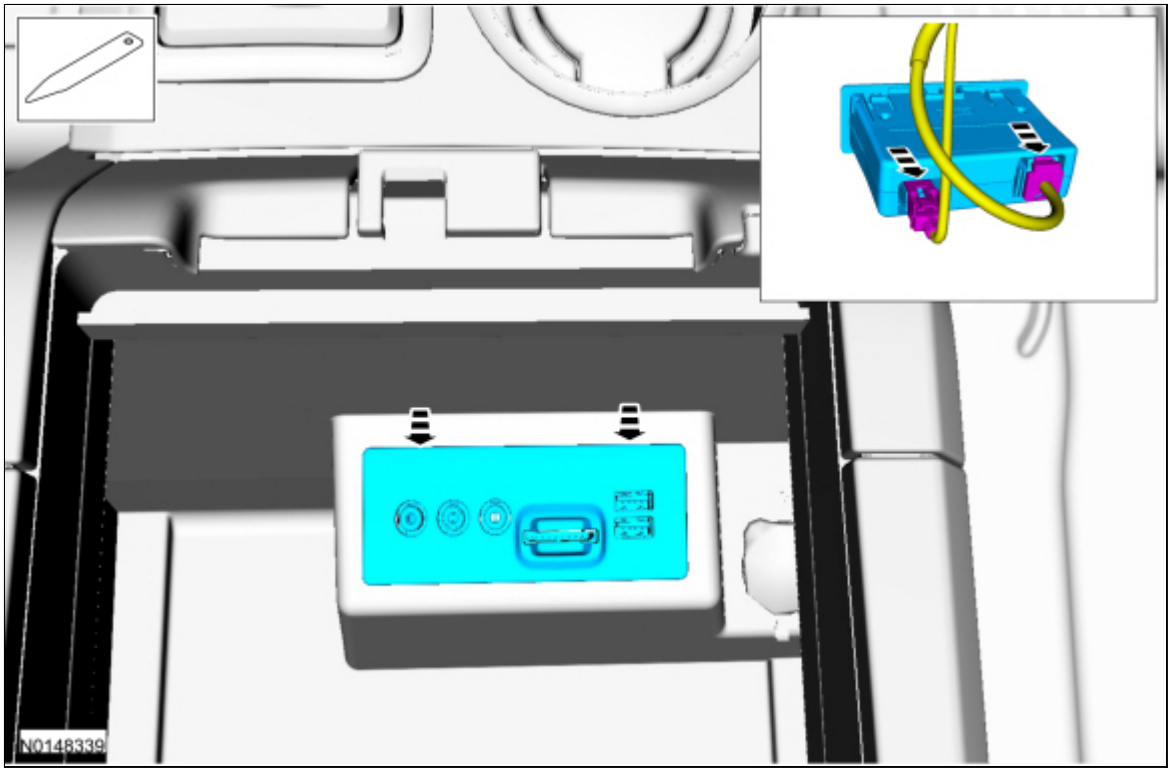
Floor console USB cable

9. Open the floor console stowage bin door.

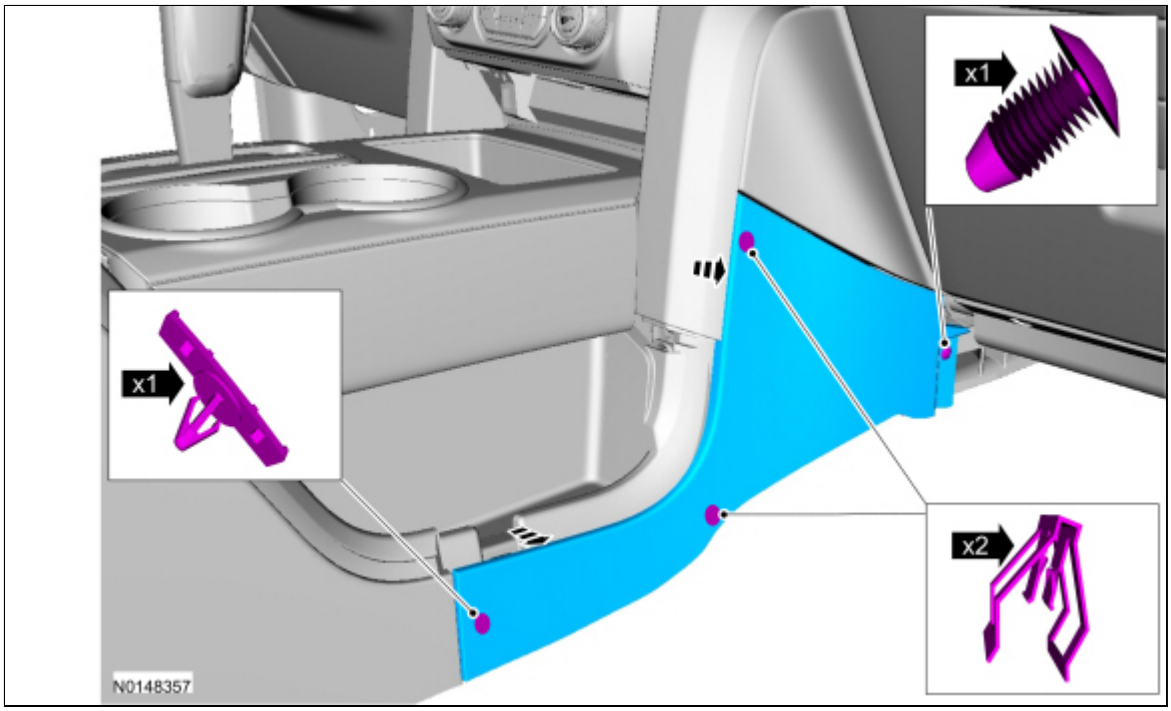


10. Remove the media hub.

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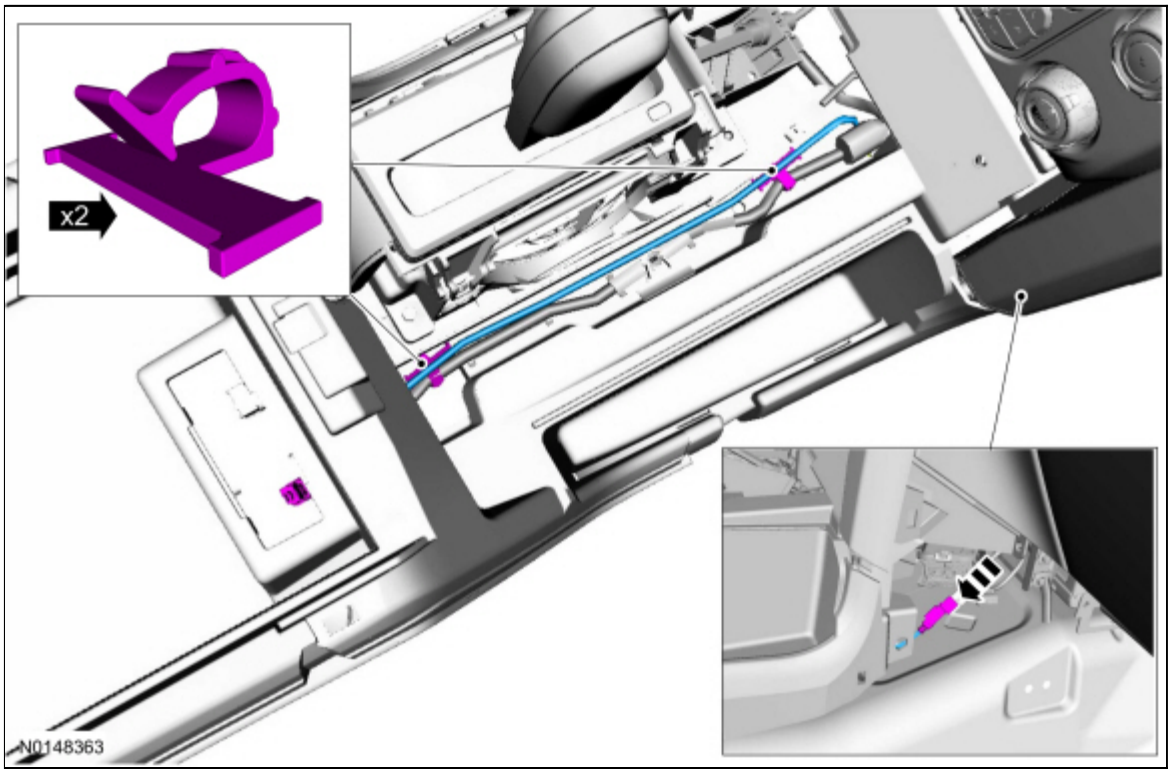
11. Remove the RH lower floor console trim panel.



12. Remove the floor console upper finish panel.



13. Remove the floor console USB cable following the routing shown.



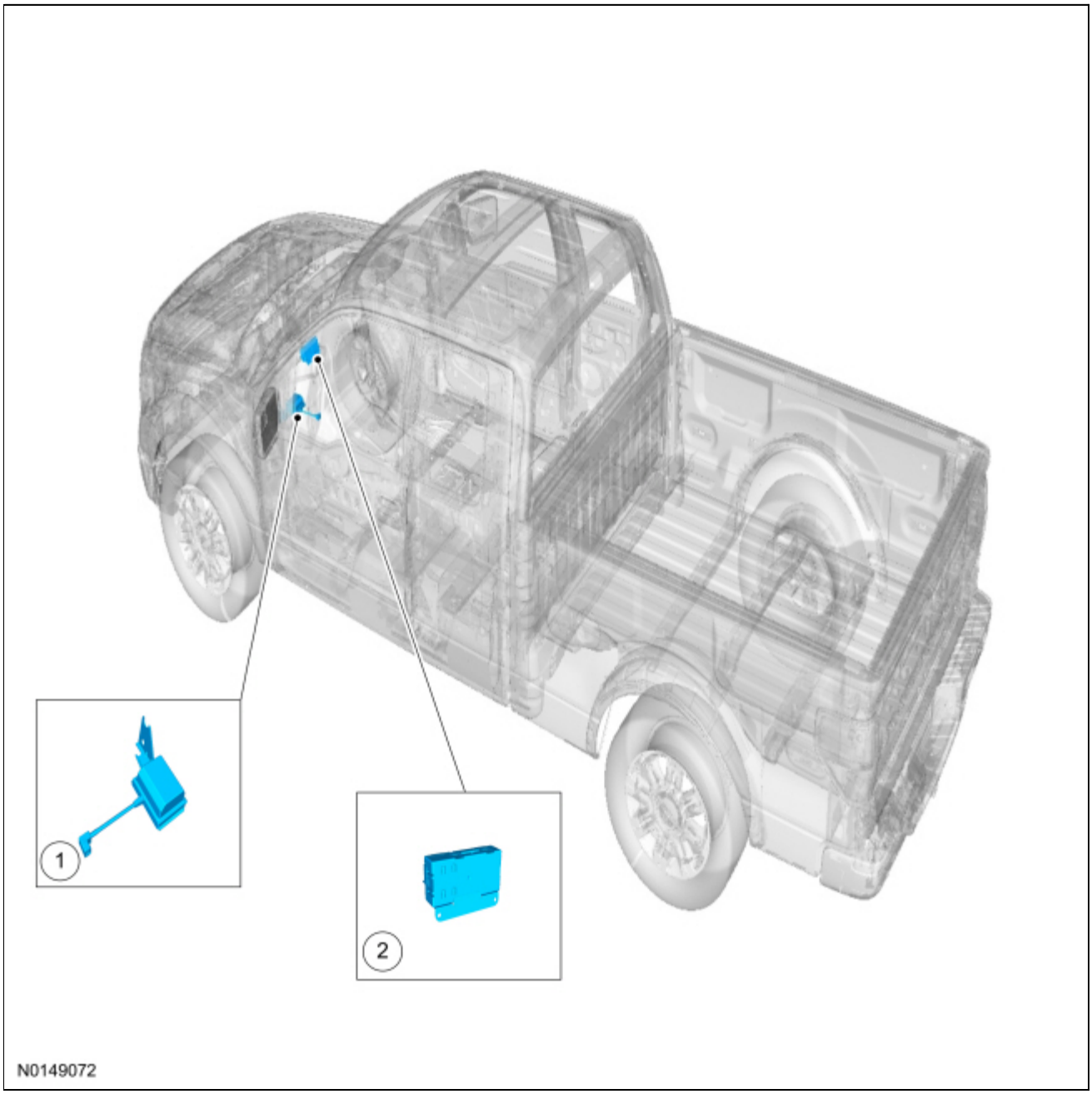
All USB cables

14. To install, reverse the removal procedure.

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Information and Entertainment System

Component Location



Item	Description	Comments

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1	Modem-antenna	Located in the instrument panel behind the LH instrument panel side finish panel
2	Telematics module	Located in the instrument panel behind the IPC

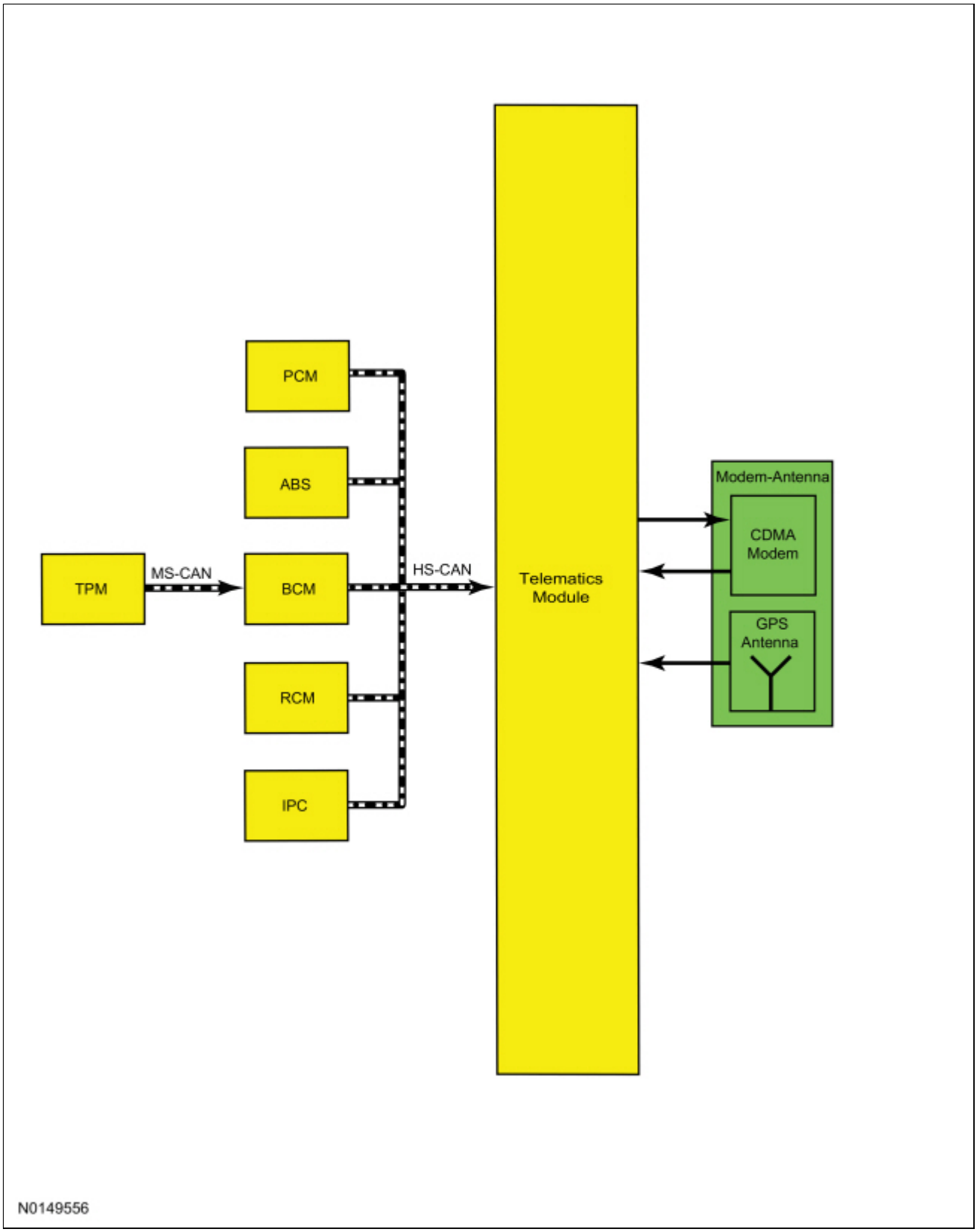
Overview

Ford Work Solutions™ Crew Chief package consists of the following:

- Telematics module
- Modem-antenna
- Crew Chief harness

System Operation

System Diagram



Crew Chief

Crew Chief is a web-based application used to view vehicle data, create reports, and monitor real-time

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alerts.

Component Description

Modem-Antenna

The modem-antenna contains a CDMA (Code Division Multiple Access) modem and a GPS antenna.

The CDMA (Code Division Multiple Access) modem receives vehicle information from the telematics module and transmits this data via a mobile phone network to a server, where it can be accessed through a secure website.

The GPS antenna is used to determine the vehicle's location. The GPS information is processed and sent to the telematics module.

Telematics Module

The telematics module can be operated with the ignition in ON/RUN, ACC, or OFF.

The telematics module does not communicate with a diagnostic scan tool.

All information collected by the telematics module is transmitted to the CDMA (Code Division Multiple Access) modem contained within the modem-antenna.

The telematics module reads and requests vehicle information by communicating with other vehicle modules through the HS-CAN . The telematics module may collect or calculate vehicle information such as:

- Airbag indicator status
- Battery voltage
- Driver seatbelt status
- DTCs
- Engine coolant temperature
- Engine speed
- Fuel level
- Fuel used
- Harsh acceleration occurrences
- Harsh braking occurrences
- Idle time
- MIL status
- Odometer reading
- Oil life status
- Throttle position
- TPMS indicator status
- Vehicle location
- Vehicle speed

Some vehicle information can be collected and transmitted to the modem-antenna with the ignition in ACC, but the majority requires the ignition to be in ON/RUN in order to be collected and transmitted. With the ignition in ON/RUN, the telematics module packages and transmits a message approximately every 3 minutes, except for special instances which are transmitted per occurrence, such as harsh braking or an airbag deployment. With the ignition in OFF, the telematics module transmits a message approximately

every 12 hours to indicate the vehicle location and that contact is being maintained between the telematics module and server.

The telematics module receives GPS information from the GPS antenna. The GPS information is packaged with collected vehicle information in order to associate a vehicle location with the collected vehicle information.

In addition to transmitting information, the telematics module receives information from the modem-antenna such as vehicle location and over-the-air firmware updates.

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Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Symptom Charts

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Symptom Chart — General Audio System

Condition	Possible Sources	Action
• Crew Chief is inoperative or does not operate correctly	• Refer to the Pinpoint Test	• GO to Pinpoint Test A .

Pinpoint Test

Pinpoint Test A: Crew Chief Is Inoperative Or Does Not Operate Correctly

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Refer to Telematics Module and Modem-Antenna.

Refer to Wiring Diagrams Cell 141 for schematic and connector information.

Normal Operation and Fault Conditions

Refer to Crew Chief, Telematics Module, and Modem-Antenna in Information and Entertainment System .

Possible Sources

- Inadequate reception
- Improper installation
- Wiring, terminals, or connectors
- Modem-antenna
- Telematics module

PINPOINT TEST A: CREW CHIEF IS INOPERATIVE OR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
A1 CHECK THE RECEPTION	
• Check to make sure the location where the vehicle is being diagnosed is within CDMA (Code Division Multiple Access) network coverage. Refer to the coverage map. • **Is the location where the vehicle is being diagnosed within CDMA (Code Division Multiple Access) network coverage?**	**Yes** GO to A2 . **No** Drive the vehicle to a location with adequate CDMA (Code Division Multiple Access) network coverage, and retest the system for normal operation. If the concern is still present, GO to A2 .
A2 CHECK THE FOUR STATUS INDICATORS	
• Access the technician service publications website. • Enter the vehicle VIN . • Select GO. • Select the OASIS tab. • Choose FW Status. • Start the vehicle and allow it to idle. • **NOTE:** A system that is operating correctly will have a green status indicator next to four data fields: VIN , Last Contact, Last GPS Fix, and Last CAN Data. • Observe the color of the four status indicators. • **Are all four status indicators green?**	**Yes** The system is operating correctly at this time. The concern may have been caused by the vehicle being outside of CDMA (Code Division Multiple Access) network coverage. **No** Record the date and time stamp for any red status indicator. GO to A3 .
A3 CHECK FOR UPDATED DATE AND/OR TIME STAMPS	
NOTE: The telematics module has the capability to accumulate messages if it is unable to transmit due to a loss of CDMA (Code Division Multiple Access) network coverage or a system fault. • Start the vehicle and allow it to idle for a minimum of 30 seconds. • Ignition OFF. • Review the recorded date and time stamp(s) for the red status indicator(s). • **Did the date and/or time change for any recorded red status indicator?**	**Yes** GO to A4 . **No** GO to A5 .
A4 CHECK FOR ACCUMULATED MESSAGES IN THE	

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TELEMATICS MODULE

- Start the vehicle and allow it to idle.
- Waiting at least 3 minutes between attempts, select the Refresh button on the technician service publications website continuously until the time stamp(s) for the recorded red status indicator(s) no longer update.
- Ignition OFF.
- Observe the color of the four status indicators.
- **Are all four status indicators green?**

Yes
The system is operating correctly at this time. The concern was corrected by allowing the telematics module to send all of the accumulated messages.

No
GO to A5 .

A5 VERIFY PROPER INSTALLATION AND PROVISIONING

- Perform steps A, B, C, and D three times, for a total of three ignition cycles.
  A. Ignition ON.
  B. Wait 10 seconds or until the airbag indicator has turned off.
  C. Start the vehicle and run the engine for a minimum of 30 seconds.
  D. Ignition OFF.
- Select Refresh on the technician service publications website and observe the color of the four status indicators.
- **Are all four status indicators green?**

Yes
The system is operating correctly at this time. The concern may have been caused by an incorrectly provisioned or incorrectly installed telematics module or modem-antenna.

No
If the VIN status indicator is red, GO to A8 . If the Last Contact status indicator is red, GO to A6 . If the Last GPS Fix status indicator is red, GO to A9 . If the Last CAN Data status indicator is red, GO to A8 .

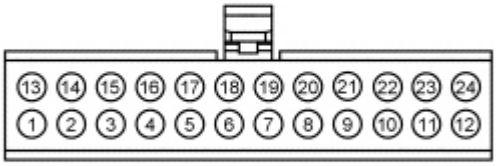
A6 CHECK THE TELEMATICS MODULE POWER SUPPLY

- Ignition OFF.
- Disconnect: Telematics Module C2409.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2409-12	VB1 (GY/RD)	—	Ground
C2409-10	IGRUN-C (WH/BN)	—	Ground

Yes
GO to A7 .

No
REPAIR the circuit in question.

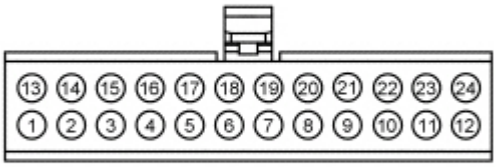


- **Is the voltage greater than 11 volts?**

A7 CHECK THE TELEMATICS MODULE GROUND CIRCUIT

- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2409-12	VB1 (GY/RD)	C2409-1	GND1 (BK/GY)



- **Is the voltage greater than 11 volts?**

Yes
GO to A8 .

No
REPAIR the circuit.

A8 CHECK THE TELEMATICS MODULE COMMUNICATION CIRCUITS FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

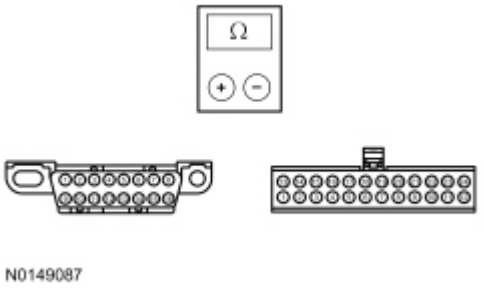
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C251-6	VDB04 (WH/BU)	C2409-15	HSC-1 (WH/BU)

Yes
GO to A9 .

No
REPAIR the circuit in question.

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C251-14	VDB05 (WH)	C2409-16	HSC-2 (WH)

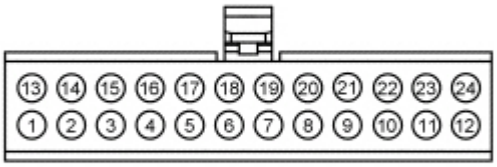


- **Are the resistances less than 3 ohms?**

A9 CHECK THE CIRCUITS TO THE MODEM ANTENNA FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Modem Antenna C2410.
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2409-3	TXD (YE)	—	Ground
C2409-4	RXD (GN)	—	Ground
C2409-6	CGND (BK)	—	Ground
C2409-24	5VTB (RD)	—	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question.

No
GO to A10 .

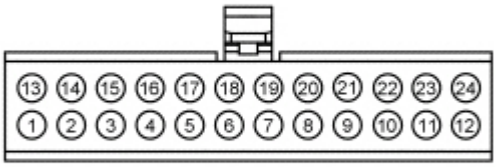
A10 CHECK THE CIRCUITS TO THE MODEM ANTENNA FOR A SHORT TO GROUND

- Ignition OFF.

Yes

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2409-3	TXD (YE)	—	Ground
C2409-4	RXD (GN)	—	Ground
C2409-6	CGND (BK)	—	Ground
C2409-24	5VTB (RD)	—	Ground



- **Are the resistances greater than 10,000 ohms?**

GO to A11 .

No
REPAIR the circuit in question.

A11 CHECK THE CIRCUITS TO THE MODEM ANTENNA FOR AN OPEN

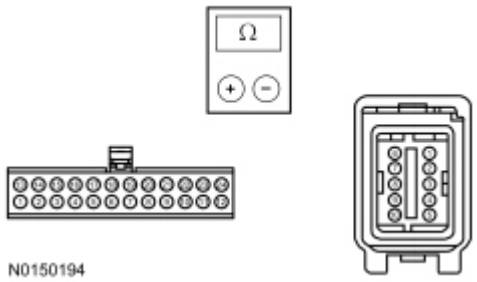
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2409-3	TXD (YE)	C2410-6	TXD (YE)
C2409-4	RXD (GN)	C2410-7	RXD (GN)
C2409-6	CGND (BK)	C2410-4	CGND (BK)
C2409-24	5VTB (RD)	C2410-8	5VTB (RD)

Yes
GO to A12 .

No
REPAIR the circuit in question.

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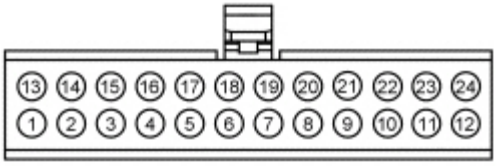


- **Are the resistances less than 3 ohms?**

A12 CHECK THE CIRCUITS TO THE MODEM ANTENNA FOR A SHORT TOGETHER

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C2409-3	TXD (YE)	C2409-4	RXD (GN)
C2409-3	TXD (YE)	C2409-6	CGND (BK)
C2409-3	TXD (YE)	C2409-24	5VTB (RD)
C2409-4	RXD (GN)	C2409-24	5VTB (RD)
C2409-4	RXD (GN)	C2409-6	CGND (BK)
C2409-6	CGND (BK)	C2409-24	5VTB (RD)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to A13 .

No
REPAIR the circuit in question.

A13 ISOLATE THE MODEM-ANTENNA

- Connect: Telematics Module C2409.
- Install a new modem-antenna. Refer to Modem — Antenna .
- Start the vehicle and allow it to idle.
- Select Refresh on the technician service publications website and observe the color of the four status

Yes
The system is operating correctly at this time. The concern was caused by an inoperative modem-antenna.

No

indicators. • **Are all four status indicators green?**	GO to A14 .
A14 CHECK FOR CORRECT TELEMATICS MODULE OPERATION	

• Ignition OFF.
• Disconnect and inspect the telematics module connector.
• Repair:
  ▪ Corrosion (clean module pins or install new connectors or terminals)
  ▪ Damaged or bent pins (install new terminals or pins)
  ▪ Pushed-out pins (install new pins as necessary)
• Reconnect the telematics module connector. Make sure it seats and latches correctly.
• Start the vehicle and allow it to idle.
• Select Refresh on the technician service publications website and observe the color of the four status indicators.
• **Are all four status indicators green?**
	Yes
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.
	
	No
	CHECK OASIS for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new telematics module. REFER to Telematics Module .

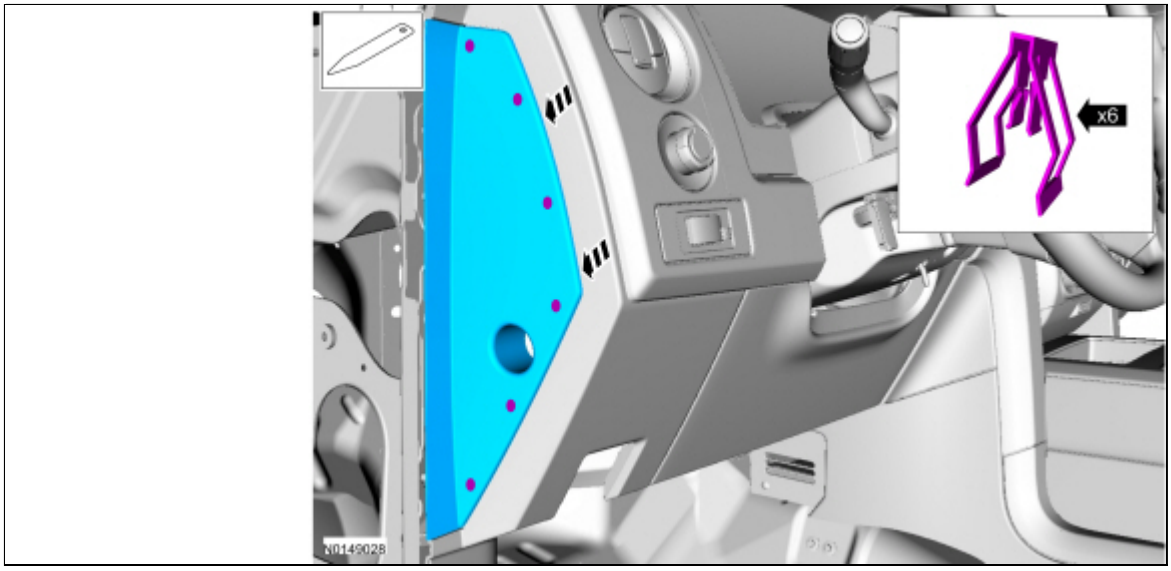
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Modem — Antenna

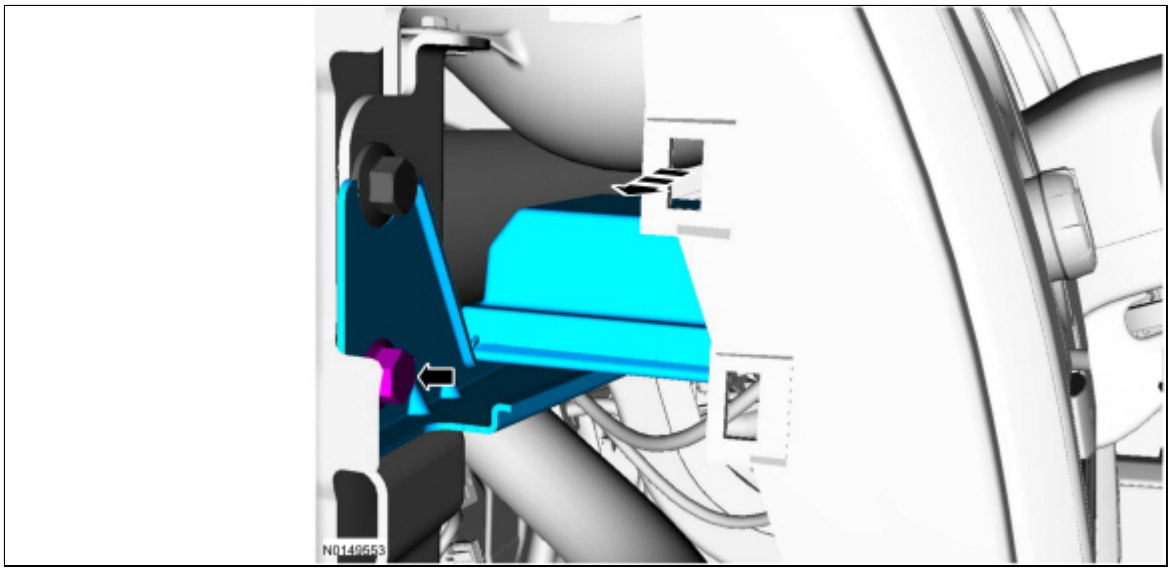
Removal

NOTE: For vehicles with an in-dash computer, the customer must contact the internet service provider to re-activate the account after the modem-antenna has been replaced. The account must be re-activated before internet services can operate correctly.

1. Turn the ignition to OFF.
2. Remove the LH instrument panel side finish panel.



3. Remove the modem-antenna bolt and the modem-antennna.
    - Disconnect the electrical connector.
    - To install, tighten to 30 Nm (22 lb-ft).



Installation

1. To install, reverse the removal procedure.

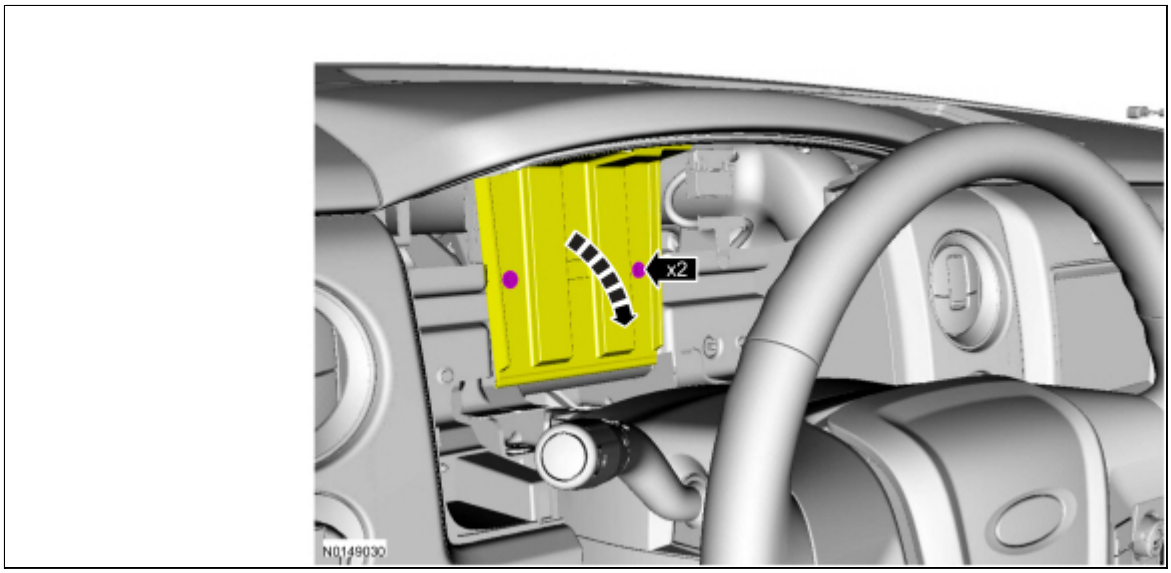
2. Initialize the modem-antenna.
    1. Connect all electrical connectors.
    2. Wait 5 minutes after the modem-antenna is installed.
    3. Turn the ignition to RUN.
    4. Wait 10 seconds.
    5. Start the vehicle and run the engine for 30 seconds.
    6. Turn the ignition to OFF.

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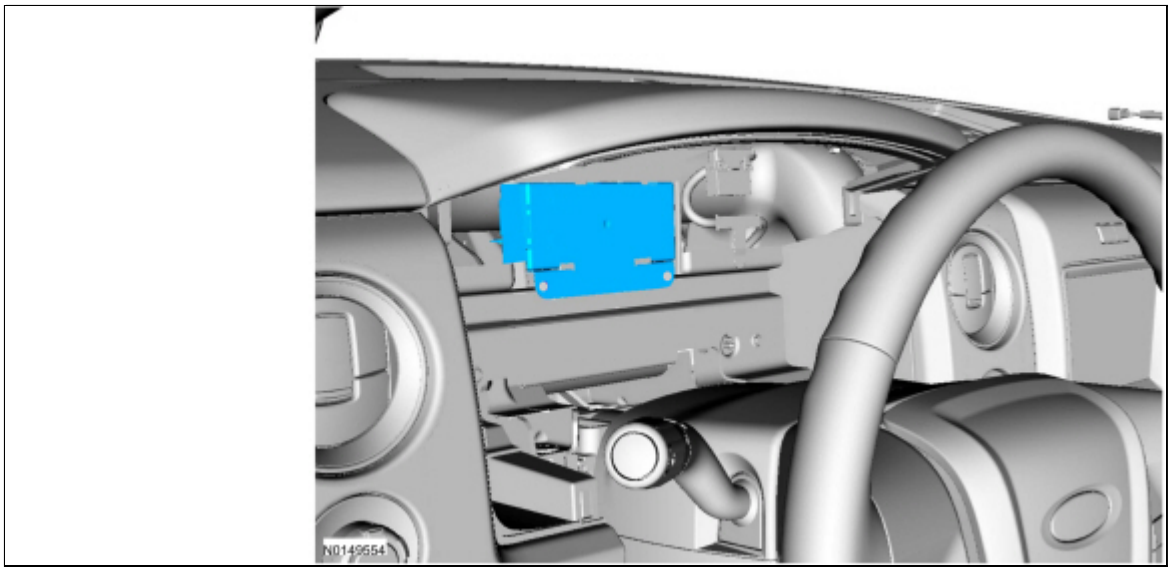
Telematics Module

Removal

1. Turn the ignition to OFF.
2. Remove the Instrument Panel Cluster (IPC). Refer to Section 413-01 .
3. Remove the 2 bolts and position the panel down.



4. Remove the 2 screws and the telematics module.
    - Disconnect the electrical connector.



Installation

1. To install, reverse the removal procedure.

2. Initialize the telematics module.
    1. Wait 5 minutes after the modem-antenna is connected.
    2. Turn the ignition to RUN.
    3. Wait 10 seconds for the airbag light to turn off.
    4. Start the vehicle and run the engine for 30 seconds.
    5. Turn the ignition to OFF.
    6. Repeat steps 4 and 5 two more times for a total of 3 ignition key cycles.

3. Go to the technician service publications web site. On the On-Line Automotive Service Information System (OASIS) tab, select the "FW Status" tab.
    1. Enter data in at least one of the required fields.
    2. All 4 green status indicators will illuminate to validate the telematics module installation. If all 4 of the green status indicators do not illuminate, refer to Information and Entertainment System .

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Torque Specifications

Description	Nm	lb-in
Fog lamp bracket bolts	5	44
Headlamp bolts	3	27
High mounted stoplamp screws	1.5	14
Rear lamp bolts	5	44

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Exterior Lighting

NOTE: The puddle lamps are listed and diagnosed in Section 417-02 .

The exterior lighting system consists of the following components:

- Headlamp assemblies
- Ballasts (HID only)
- Fog lamps
- LED marker lamps (Raptor only)
- Exterior mirrors
- High mounted stoplamp
- Rear lamp assemblies
- License plate lamps
- Headlamp switch
- Stoplamp switch
- Multifunction switch
- Light sensor
- Body Control Module (BCM) (located on the RH side cowl)
- Steering Column Control Module (SCCM) (located on the steering column)

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

NOTE: The battery saver does **not** control the parking lamps if the headlamp switch is in the PARKING LAMPS ON position.

To save battery voltage, the BCM provides automatic shut-off of the headlamps and parking lamps after a time-out period when the ignition is off. A timer in the BCM starts when any of the following occur:

- the ignition state changes to off
- any door becomes ajar while the ignition is off
- an unlock button of the Remote Keyless Entry (RKE) transmitter is pressed while the ignition is off
- a valid keypad code is entered while the ignition is off
- the instrument panel dimmer switch is used to turn the courtesy lamps on while the ignition is off

When 10 minutes have elapsed, the BCM automatically shuts off voltage to the lamps. The timer restarts (voltage is restored if the BCM is in battery saver mode) if any of the following occurs:

- the ignition changes out of off
- any door becomes ajar
- the unlock button of the RKE transmitter is pressed
- a valid keypad code is entered
- the instrument panel dimmer switch is pressed

Lamp Assembly Condensation

Exterior lamps are vented to accommodate normal changes in pressure. Condensation can be a natural by product of this design. When moist air enters the lamp assembly through the vents, there is a possibility that condensation can occur if the temperature is cold. When normal condensation occurs, a thin mist forms on the interior of the lens. The thin mist eventually clears and exits through the vents during normal operation. The amount of time it takes to clear the lens of acceptable mist varies with ambient humidity and lamp types. Normal condensation clears from any lamp in 48 hours under dry conditions.

Do **not** replace a lamp assembly with acceptable levels of condensation such as:

- presence of thin mist (no streaks, drip marks or droplets are present)
- fine mist covers less than 50% of the lens

Examples of unacceptable moisture (usually caused by a lamp housing leak):

- water puddling inside the lamp
- large water droplets, drip marks or streaks present on the interior of the lens

Headlamps

The halogen headlamp system is a dual-beam pattern system and consists of replaceable low/high beam bulbs.

The HID headlamp system is a dual-beam pattern system. It consists of a single replaceable HID bulb in each headlamp assembly.

The BCM supplies voltage to the headlamps when demanded. If the headlamps are on when the ignition switch is turned off, the battery saver feature turns the headlamps off after 10 minutes have elapsed.

Daytime Running Lamps (DRL)

NOTE: The Daytime Running Lamps (DRL) are a programmable parameter for this vehicle.

If equipped with halogen headlamps, the DRL system utilizes the existing circuitry and components from the headlamp low beam system. The DRL system operates the low beam headlamps at a reduced intensity.

If equipped with HID headlamps, the DRL system utilizes the existing circuitry and components from the front turn lamp system.

The DRL are activated when the following conditions are met:

- the ignition is in run
- the headlamps have not been turned on by the autolamp system or the headlamp switch
- the transmission is not in park

Autolamps

The autolamp system provides light sensitive automatic on/off control of the exterior lamps. The autolamp system keeps the exterior lamps on for a preselected period of time after the ignition is turned off (20 seconds is the factory default setting). The preselected time lapse is adjustable up to approximately 3 minutes. To change the autolamps time delay, refer to Autolamps Time Delay Adjustment in this section.

Headlamps On With Wipers On Feature

When the headlamp switch is in the AUTOLAMPS ON position and the front wipers are on for more than 3

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seconds (except during a mist wipe or while the wipers are on to clear washer fluid during a wash condition), the exterior lamps turn on. The exterior lamps turn off when the ignition is changed to off or accessory, the headlamp switch is placed in the OFF position, or the front wipers are off for more than 30 seconds. The exception to this is when the exterior lights are on because of darkness determined by the light sensor.

Stoplamps

The stoplamp switch, located on the brake pedal assembly, activates the rear stoplamps and the high mounted stoplamp when the brake pedal is applied. The rear lamps are combination stop/turn lamps.

Turn Signal/Hazard Lamps

When the multifunction switch is placed in the LH or RH TURN position, the corresponding turn lamps cycle on and off approximately 80 times per minute. If a front or rear turn bulb is inoperative, the remaining turn lamps cycle on and off approximately 160 times per minute.

The multifunction switch is a momentary contact switch, with 2 detents for the LH turn position and 2 detents for the RH turn position. When placed in the first detent and released, the corresponding turn signals flash 3 times and turn off. When the multifunction switch is moved to the second detent and released, the turn signal flashes until the steering wheel is turned in the opposite direction, the multifunction switch is moved to the second detent a second time or the vehicle travels farther than 3.2 km (2 miles).

The hazard flasher switch is located in the center instrument panel finish panel (integrated into the Passenger Air Bag Deactivation (PAD)). When the hazard function is active, all the turn lamps cycle on and off approximately 80 times per minute. The hazard flasher lamp switch is a momentary contact switch.

The front turn signal indicator lamps are integrated into the headlamp assemblies.

The rear lamps share functionality with the stoplamps.

Parking Lamps

The parking lamps illuminate when requested from the headlamp switch or the autolamp system.

The front parking and side lamps are integrated into the headlamp assemblies.

When the vehicle is equipped with power telescoping exterior mirrors, the mirrors are equipped with exterior mirror marker lamps.

The rear parking lamps are located in the rear lamp assemblies.

Vehicles equipped with the Raptor option also have LED marker lamps located in the grille and at each corner of the vehicle.

Fog Lamps

The fog lamp switch is integrated into the headlamp switch. The fog lamps can be turned on when the ignition switch is in run or accessory, the parking lamps are on, and the high beams are off.

Reversing Lamps

When the transmission is placed in reverse, the reversing lamps are illuminated. The reversing lamps are located within the rear lamp assemblies.

Trailer Tow

The Battery Junction Box (BJB) supplies voltage to the trailer tow stop/turn, parking and reversing lamps. When the vehicle's rear stop/turn, parking lamps or reversing are illuminated, voltage is supplied to a corresponding trailer tow relay located in the BJB .

The trailer tow battery charge relay provides voltage to the trailer tow connector when the ignition switch is in run.

The vehicle can be equipped with a factory manufactured Trailer Brake Control (TBC) module. For diagnostic information, refer to Section 206-10 .

On vehicles not equipped with a factory manufactured TBC module, the vehicle comes equipped with circuitry to support an aftermarket TBC module.

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Autolamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

Exterior Lighting

The Steering Column Control Module (SCCM) monitors the headlamp switch position by sending voltage signals on multiple circuits to the headlamp switch. There is one circuit for each headlamp switch position. At any given time, one of the signal circuits is switched to ground. The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the headlamp switch position.

If the SCCM does not detect any active inputs from the headlamp switch for 5 seconds, or if the SCCM detects multiple headlamp switch input circuits are active, the SCCM sends a message to the BCM to indicate the fault. The BCM then turns the parking lamps and headlamps on and keeps them on until the battery saver feature times out.

Refer to Exterior Lighting in the Description and Operation portion of this section for information regarding the battery saver feature.

If either situation occurs, the SCCM and the BCM **cannot** be ruled immediately as being at fault. This is normal behavior of the SCCM and the BCM design as a fault has been detected with the inputs from the headlamp switch.

The autolamp feature is enabled when the BCM receives a network message from the SCCM indicating the headlamp switch is in the AUTOLAMPS ON position.

Autolamps Feature

The BCM monitors the light sensor with a voltage signal. The light sensor input to the BCM varies with the ambient light conditions.

When the BCM receives a message from the SCCM indicating a request for the autolamps, the BCM monitors the light sensor for the ambient light condition. If the BCM determines the ambient light level is dark, the BCM supplies voltage to the exterior lamps.

If the ignition is already in RUN and the vehicle enters a dark/lighted area (such as when entering/exiting a non-lighted tunnel during the daytime), the transition from light to dark (or dark to light) needs to last 15 seconds before the BCM turns the exterior lamps on or off. This strategy prevents the exterior lamps from unnecessarily flashing on and off.

The BCM reacts quicker under extreme light conditions. If the BCM has detected a very dark condition, the exterior lamps are turned on after 1.5 seconds. If the BCM has detected a very high ambient light level, the exterior lamps are turned off after 4 seconds.

If a fault is detected with the light sensor input, the BCM turns the parking lamps and headlamps on.

Headlamps On With Wipers On Feature

When the autolamps feature is active and the front wipers are on for more than 3 seconds (except during a mist wipe or while the wipers are on to clear washer fluid during a wash condition), the exterior lamps are turned on. The exterior lamps are turned off when the ignition is changed to OFF or ACC, the headlamp switch is placed in the OFF position, or the front wipers are off for more than 30 seconds. The exception to this is when the exterior lights are on because of darkness determined by the light sensor.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Headlamp switch	• Wiring, terminals or connectors • Light sensor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .

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- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the Body Control Module (BCM) and the Steering Column Control Module (SCCM).

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The autolamps are inoperative	• Light sensor • Body Control Module (BCM)	• GO to Pinpoint Test G .
• The autolamps are on continuously	• Wiring, terminals or connectors • Light sensor • Headlamp switch • Steering Column Control Module (SCCM) • BCM	• GO to Pinpoint Test H .

Pinpoint Tests

Pinpoint Test G: The Autolamps Are Inoperative

Refer to Wiring Diagrams Cell 85 , Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) sends voltage signals to the headlamp switch through the

headlamp switch input circuits (off, parking lamps, headlamps, autolamps). At any given time, the headlamp switch routes one of the input circuits to ground, indicating the headlamp switch position to the SCCM .

The SCCM sends the status of the headlamp switch position to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN).

The autolamps feature is enabled when the BCM receives a message from the SCCM indicating the headlamp switch is in the AUTOLAMPS ON position.

When the BCM enables the autolamps feature, the BCM monitors the light sensor input. The light sensor determines the amount of light based on the input received from the ambient lighting conditions. When the ambient level has reached a point (determined by the internal programming of the BCM), the BCM provides voltage to the exterior lamps.

Any fault detected from the light sensor or headlamp switch inputs causes the exterior lamps to be turned on.

This pinpoint test is intended to diagnose the following:

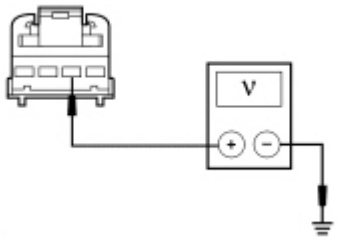
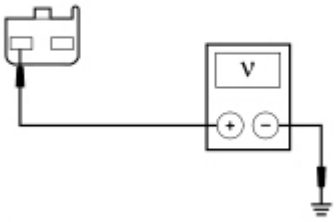
- Light sensor
- BCM

PINPOINT TEST G: THE AUTOLAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 CHECK THE MANUAL HEADLAMP OPERATION	
• Place the headlamp switch in the HEADLAMPS ON and OFF positions. • **Do the headlamps operate correctly?**	**Yes** GO to G2 . **No** REFER to Headlamps in this section.
G2 CHECK FOR VOLTAGE TO THE LIGHT SENSOR	
• Ignition OFF. • Disconnect: Light Sensor C287 (Manual Temperature Control) or C286 (Automatic Temperature Control). • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU), harness side and ground.	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. TEST the system for normal operation. **No** GO to G3 .

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 N0057372 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	
G3 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: The Autolamps Are On Continuously

Refer to Wiring Diagrams Cell 85, Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) sends voltage signals to the headlamp switch through the headlamp switch input circuits (off, parking lamps, headlamps, autolamps). At any given time, the headlamp switch routes one of the input circuits to ground, indicating the headlamp switch position to the SCCM.

The SCCM sends the status of the headlamp switch position to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN).

The autolamp feature is enabled when the BCM receives a message from the SCCM indicating the headlamp switch in the AUTOLAMPS ON position.

When the BCM enables the autolamps feature, the BCM monitors the light sensor input. The light sensor determines the amount of light based on the input received from the ambient lighting conditions. When the ambient level has reached a point (determined by the internal programming of the BCM), the BCM provides voltage to the exterior lamps.

If the SCCM detects multiple or no active headlamp switch inputs, it sends a message to the BCM to indicate a fault with the headlamp switch input.

The BCM defaults the exterior lamps on when the BCM detects any of the following conditions:

- a fault with the light sensor input
- a message from the SCCM indicating a fault with the headlamp switch input
- the BCM loses communication with the SCCM

Autolamp System DTCs

- DTC B1A85:11 (Ambient Light Sensor: Circuit Short To Ground) — This DTC sets when the BCM detects a short to ground from the light sensor input circuit.
- DTC B1A85:13 (Ambient Light Sensor: Circuit Open) — This DTC sets when the BCM detects an open or short to voltage from the light sensor input circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Light sensor
- Headlamp switch
- SCCM
- BCM

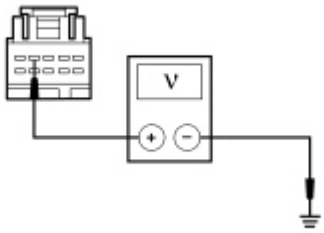
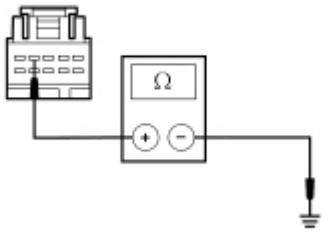
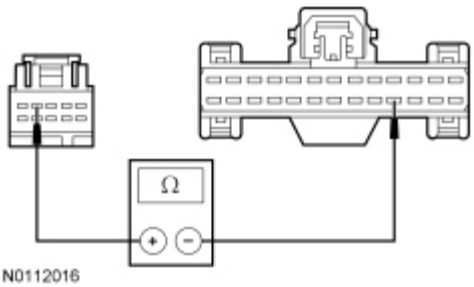
PINPOINT TEST H: THE AUTOLAMPS ARE ON CONTINUOUSLY

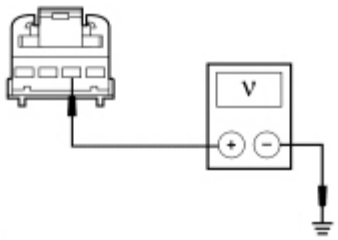
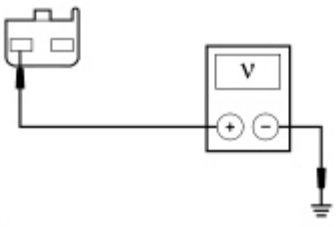
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Make sure the HVAC control operates correctly before diagnosing the autolamp system.

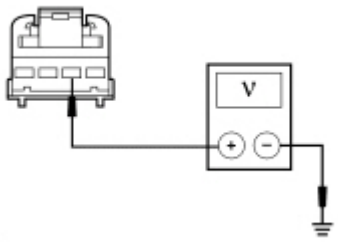
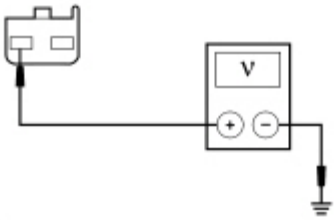
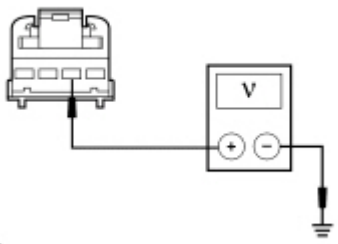
Test Step	Result / Action to Take
H1 CHECK THE SCCM AUTOLAMP ON REQUEST PID	
NOTE: Make sure the headlamp switch is lined up in the correct position when monitoring the PID. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • While placing the headlamp switch in the AUTOLAMPS ON and then OFF position, monitor the SCCM headlamp switch PID (EXT_LMP_SW). • **Does the PID agree with the headlamp switch when it is in the AUTOLAMPS ON position and indicate it is not in the AUTOLAMPS ON position when the headlamp switch is in the OFF position?**	**Yes** GO to H5 . **No** GO to H2 .
H2 CHECK FOR A VOLTAGE SIGNAL TO THE HEADLAMP SWITCH	

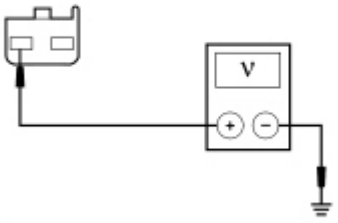
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• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch C205-4, circuit CLF19 (VT), harness side and ground.  N0099677 • **Is the voltage greater than 5 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** GO to H3.
H3 CHECK AUTOLAMPS REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: SCCM C2414A. • Measure the resistance between the headlamp switch C205-4, circuit CLF19 (VT), harness side and ground.  N0083964 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H4. **No** REPAIR circuit CLF19 (VT) for a short to ground. TEST the system for normal operation.
H4 CHECK THE AUTOLAMPS REQUEST INPUT CIRCUIT FOR AN OPEN	
• Measure the resistance between the headlamp switch C205-4, circuit CLF19 (VT), harness side and the SCCM C2414A-17, circuit CLF19 (VT), harness side.  N0112016 • **Is the resistance less than 5 ohms?**	**Yes** GO to H14. **No** REPAIR circuit CLF19 (VT) for an open. TEST the system for normal operation.
H5 CHECK THE SCCM HEADLAMP SWITCH PIDs	
NOTE: Make sure the headlamp switch is aligned in the correct	**Yes** GO to H6.

position when monitoring the PID. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger . • While moving the headlamp switch through all positions (OFF, PARKING LAMPS and HEADLAMPS), monitor the SCCM headlamp switch input PID (EXT_LMP_SW). • **Do the headlamp switch positions agree with the PID?**	**No** GO to Pinpoint Test C .
H6 USE THE RECORDED DTCs FROM THE BCM SELF-TEST • Check the recorded results from the BCM self-test. • **Is DTC B1A85:13 or DTC B1A85:11 present?**	**Yes** For DTC B1A85:13, GO to H8 . For DTC B1A85:11, GO to H12 . **No** GO to H7 .
H7 CHECK FOR VOLTAGE TO THE LIGHT SENSOR (NO DTC) • Ignition OFF. • Disconnect: Light Sensor C287 (Manual Temperature Control) or C286 (Automatic Temperature Control). • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • On vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU), harness side and ground.  N0057372 • On vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. TEST the system for normal operation. **No** GO to H15 .
H8 CHECK FOR VOLTAGE TO THE LIGHT SENSOR (DTC B1A85:13) • Ignition OFF. • Disconnect: Light Sensor C287 (Manual Temperature Control) or	**Yes** GO to H11 .

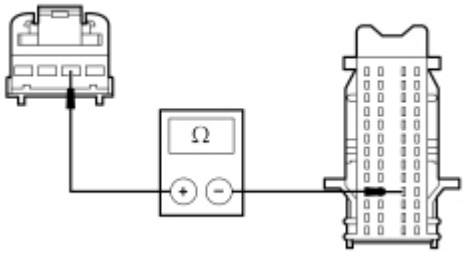
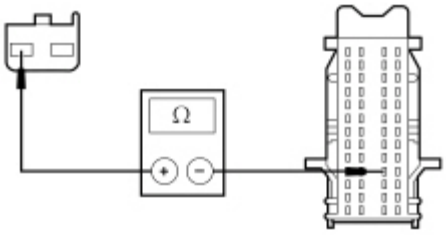
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C286 (Automatic Temperature Control). • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • On vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU), harness side and ground.  N0057372 • On vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	**No** GO to H9 .
H9 CHECK THE LIGHT SENSOR INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280B. • Ignition ON. • On vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU), harness side and ground.  N0057372 • On vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.	**Yes** REPAIR circuit VLF14 (BU/BN) or VLF14 (BU) for a short to voltage. TEST the system for normal operation. **No** GO to H10 .

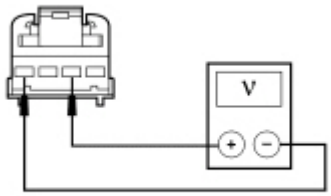
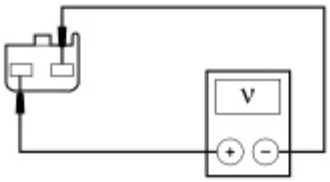
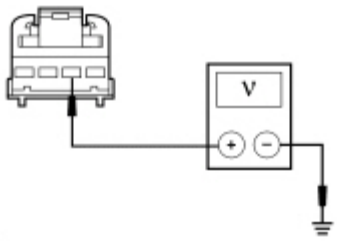


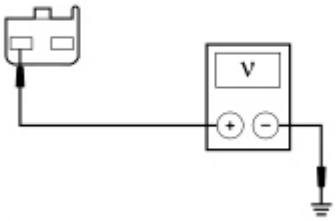
N0057373

- **Is any voltage present?**

H10 CHECK THE LIGHT SENSOR INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • On vehicles with automatic temperature control, measure the resistance between the light sensor C286-2, circuit VLF14 (BU), harness side and the BCM C2280B-30, circuit VLF14 (BU), harness side.  N0112017 • On vehicles with manual temperature control, measure the resistance between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and the BCM C2280B-30, circuit VLF14 (BU/BN), harness side.  N0112018 • **Is the resistance less than 5 ohms?**	**Yes** GO to H15 . **No** REPAIR circuit VLF14 (BU/BN) or VLF14 (BU) for an open. TEST the system for normal operation.
H11 CHECK THE LIGHT SENSOR GROUND CIRCUIT FOR AN OPEN	
• For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU), harness side and the light sensor C286-4, circuit RH111 (GY/BU), harness side.	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. TEST the system for normal operation. **No** REPAIR circuit RH111

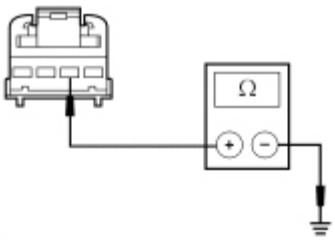
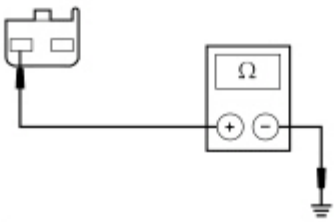
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 N0088170 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and the light sensor C287-B, circuit RH111 (GY/BU), harness side.  N0088171 • **Is the voltage approximately 5 volts?**	(GY/BU) for an open. TEST the system for normal operation.
H12 CHECK FOR VOLTAGE TO THE LIGHT SENSOR (DTC B1A85:11)	
• Ignition OFF. • Disconnect: Light Sensor C287 (Manual Temperature Control) or C286 (Automatic Temperature Control). • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • On vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU), harness side and ground.  N0057372 • On vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. TEST the system for normal operation. **No** GO to H13 .



N0057373

- **Is the voltage approximately 5 volts?**

H13 CHECK THE LIGHT SENSOR INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: BCM C2280B. • On vehicles with automatic temperature control, measure the resistance between the light sensor C286-2, circuit VLF14 (BU), harness side and ground.  N0057374 • On vehicles with manual temperature control, measure the resistance between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057375 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H15 . **No** REPAIR circuit VLF14 (BU/BN) or VLF14 (BU) for a short to ground. TEST the system for normal operation.
H14 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The

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	concern may have been caused by a loose or corroded connector.
H15 CHECK FOR CORRECT BCM OPERATION ● Disconnect all the BCM connectors. ● Check for: ■ corrosion ■ damaged pins ■ pushed-out pins ● Connect all the BCM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Daytime Running Lamps (DRL)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The Body Control Module (BCM) controls the Daytime Running Lamps (DRL) by using various inputs to determine whether or not the DRL should be illuminated. These inputs include:

- Ignition status
- Headlamp switch position
- Headlamps on or off
- Transmission gear selection

If equipped with halogen headlamps, when the DRL is active, the BCM provides a pulse-width modulated voltage to the low beam headlamps. This illuminates the headlamps at a reduced intensity.

If equipped with HID headlamps, when the DRL is active, the BCM provides voltage to the front turn lamps.

The DRL is a programmable parameter for this vehicle.

Inspection and Verification

1. Verify the customer concern.

2. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

3. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

4. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.

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- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

5. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

6. Check the operation of the PRNDL display by placing the gear selector lever in each of its positions.
   - If the PRNDL display does not operate correctly, refer to Section 413-01 .

7. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

8. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Daytime Running Lamps (DRL) are inoperative	• Exterior lighting system input/output • Transmission gear input • Body Control Module (BCM)	• GO to Pinpoint Test F .

Pinpoint Tests

Pinpoint Test F: The Daytime Running Lamps (DRL) Are Inoperative

Normal Operation

When the ignition is in RUN, the headlamps are not on (from the autolamp system or manual control from the headlamp switch), and the transmission is not in park, the Body Control Module (BCM) activates the DRL .

If equipped with halogen headlamps, when the DRL is active, the BCM provides a pulse-width modulated voltage to the low beam headlamps. This illuminates the headlamps at a reduced intensity.

If equipped with HID headlamps, when the DRL is active, the BCM provides voltage to the front turn lamps.

This pinpoint test is intended to diagnose the following:

- Exterior lighting system input/output

- Transmission gear input
- BCM

PINPOINT TEST F: THE DRL ARE INOPERATIVE

Test Step	Result / Action to Take
F1 VERIFY THE DRL OPERATION • Ignition ON. • Place the headlamp switch in the OFF position. • Place the gear selector lever in any gear other than PARK (P). • **Are the DRL illuminated?**	**Yes** The system is operating correctly. INFORM the customer of the conditions required for the DRL to operate correctly. **No** GO to F2.
F2 CHECK THE OPERATION OF THE HEADLAMPS • Place the headlamp switch in the HEADLAMPS ON position and observe the headlamps. • **Do the headlamps illuminate?**	**Yes** GO to F3. **No** GO to Pinpoint Test A.
F3 CHECK THE TRANSMISSION GEAR INPUT • Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM transmission gear status PID (TR_F) while placing the gear selector lever through all its positions. • **Does the PID agree with the gear selection?**	**Yes** INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation. **No** REFER to Section 307-01 to diagnose the transmission range input.

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Diagnostic Trouble Code (DTC) Chart

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1115:11	High Mounted Stop Lamp Control: Circuit Short To Ground	GO to Pinpoint Test J .
B123A:11	Left Front Turn Indicator: Circuit Short To Ground	GO to Pinpoint Test M .
B123A:15	Left Front Turn Indicator: Circuit Short To Battery or Open	GO to Pinpoint Test M .
B123B:11	Right Front Turn Indicator: Circuit Short To Ground	GO to Pinpoint Test M .
B123B:15	Right Front Turn Indicator: Circuit Short To Battery or Open	GO to Pinpoint Test M .
B1277:11	Reverse Lamp: Circuit Short To Ground	GO to Pinpoint Test U .
B1277:15	Reverse Lamp: Circuit Short To Battery or Open	If the reverse lamps are inoperative, GO to Pinpoint Test U . If the reverse lamps are always on, GO to Pinpoint Test W .
B130C:12	Load Shed Control: Circuit Short To Battery	GO to Pinpoint Test AC .
B130C:14	Load Shed Control: Circuit Short To Ground or Open	GO to Pinpoint Test AC .
B132B:11	Left Stop/Turn Lamp: Circuit Short To Ground	GO to Pinpoint Test J .
B132B:15	Left Stop/Turn Lamp: Circuit Short To Battery or Open	If the stoplamp is inoperative, GO to Pinpoint Test J . If the stoplamp is always on, GO to Pinpoint Test K .
B132C:11	Right Stop/Turn Lamp: Circuit Short To Ground	GO to Pinpoint Test J .
B132C:15	Right Stop/Turn Lamp: Circuit Short To Battery or Open	If the stoplamp is inoperative, GO to Pinpoint Test J . If the stoplamp is always on, GO to Pinpoint Test K .

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B1A85:11	Ambient Light Sensor: Circuit Short To Ground	GO to Pinpoint Test H .
B1A85:13	Ambient Light Sensor: Circuit Open	GO to Pinpoint Test H .
B1C98:11	Left Corner Lamp Circuit: Circuit Short To Ground	GO to Pinpoint Test M .
B1C99:11	Right Corner Lamp Circuit: Circuit Short To Ground	GO to Pinpoint Test M .
B1D00:11	Left Low Beam: Circuit Short To Ground	GO to Pinpoint Test A .
B1D01:11	Right Low Beam: Circuit Short To Ground	GO to Pinpoint Test A .
B1D02:11	Left High Beam Circuit: Circuit Short To Ground	GO to Pinpoint Test B .
B1D02:15	Left High Beam Circuit: Circuit Short To Battery or Open	If the high beam is inoperative, GO to Pinpoint Test B . If the high beam is always on, GO to Pinpoint Test D .
B1D03:11	Right High Beam Circuit: Circuit Short To Ground	GO to Pinpoint Test B .
B1D03:15	Right High Beam Circuit: Circuit Short To Battery or Open	If the high beam is inoperative, GO to Pinpoint Test B . If the high beam is always on, GO to Pinpoint Test D .
B1D35:11	Hazard Switch: Circuit Short To Ground	GO to Pinpoint Test N .
C0040:12	Brake Pedal Switch "A": Circuit Short To Battery	GO to Pinpoint Test K .
U1000:00	Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	**The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The Body Control Module (BCM) cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first.** After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
U3000:49	Control Module: Internal Electronic Failure	**The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. The cause of the excessive current draw MUST be corrected before a new BCM is installed. ADDRESS all other DTCs first.** After the cause of the concern is corrected, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1007:09	High-Beam Headlamp Switch: Component Failure	INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If the concern still exists, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.
B10A6:09	Main Light Switch: Component Failure	GO to Pinpoint Test C .
B1D36:09	Turn Indicator Switch: Component Failure	If the turn lamp function is inoperative, GO to Pinpoint Test L . If the turn lamp function is always on, INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If the concern still exists, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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Fog Lamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Steering Column Control Module (SCCM) monitors the fog lamp switch (integrated into the headlamp switch) and sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the fog lamp switch position.

The fog lamps can be turned on when the following conditions are met:

- The ignition is in RUN or START
- The low beam headlamps or the parking lamps are on
- The high beams are off

When the BCM receives an input from the headlamp switch indicating a request for the fog lamps, the BCM provides ground to the fog lamp relay (integrated into the BCM). When the fog lamp relay is energized, voltage is routed to the fog lamps.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Body Control Module (BCM) fuse 47 (15A) (fog lamps) • Bulb • Wiring, terminals or connectors • Headlamp switch

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM and the SCCM.

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action

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• Both fog lamps are inoperative	• Fuse • Wiring, terminals or connectors • Headlamp switch • Steering Column Control Module (SCCM) • Body Control Module (BCM)	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test Q .
• An individual fog lamp is inoperative	• Wiring, terminals or connectors	• VERIFY the bulb is OK. If OK, GO to Pinpoint Test R .
• The fog lamps are on continuously	• Wiring, terminals or connectors • Headlamp switch • SCCM • BCM	• GO to Pinpoint Test S .
• The fog lamps on indicator is inoperative	• Wiring, terminals or connectors • Headlamp switch • BCM	• GO to Pinpoint Test T .

Pinpoint Tests

Pinpoint Test Q: Both Fog Lamps Are Inoperative

Refer to Wiring Diagrams Cell 86 , Fog Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors the fog lamp switch position by sending a voltage signal to the headlamp switch. When the fog lamp switch is engaged, the voltage signal is routed to ground indicating a request for the fog lamps.

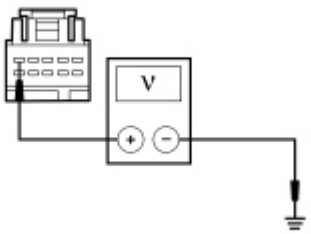
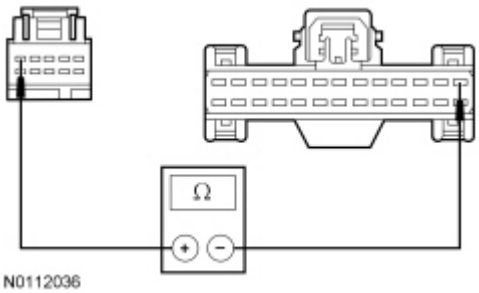
The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the fog lamp switch position. When the BCM receives input from the SCCM indicating a request for the fog lamps, the BCM provides ground to the fog lamp relay (integrated into the BCM). When the fog lamp relay is energized, voltage is routed to the fog lamps.

This pinpoint test is intended to diagnose the following:

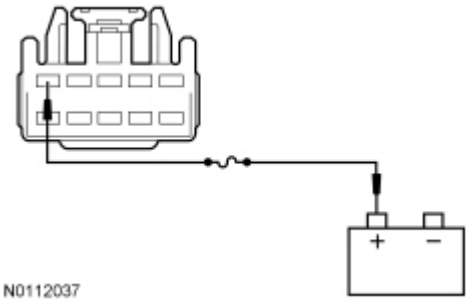
- Fuse
- Wiring, terminals or connectors
- Headlamp switch
- SCCM
- BCM

PINPOINT TEST Q: BOTH FOG LAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Q1 CHECK THE FOG LAMP SWITCH PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • Monitor the SCCM fog lamp switch PID (FOG_F_SW) while engaging the fog lamp switch. • **Does the PID indicate the fog lamp switch is on?**	**Yes** VERIFY the BCM fuse 47 (15A) is OK. If OK, GO to Q4 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. **No** GO to Q2 .
Q2 CHECK FOR A VOLTAGE SIGNAL TO THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch C205-5, circuit CLF21 (GY/VT), harness side and ground.  N0099713 • **Is the voltage greater than 5 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** GO to Q3 .
Q3 CHECK THE FOG LAMP REQUEST INPUT CIRCUIT FOR AN OPEN	
• Disconnect: SCCM C2414A. • Measure the resistance between the headlamp switch C205-5, circuit CLF21 (GY/VT), harness side and the SCCM C2414A-1, circuit CLF21 (GY/VT), harness side.  N0112036 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q5 . **No** REPAIR circuit CLF21 (GY/VT) for an open. TEST the system for normal operation.
Q4 BYPASS THE BCM	

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NOTE: If the fuse in the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. • Ignition OFF. • Disconnect: BCM C2280E. • Connect a fused jumper wire between the BCM C2280E-5, circuit CLF12 (BN/YE), harness side and battery positive.  • **Do the fog lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to Q6 . **No** REMOVE the jumper wire. REPAIR circuit CLF12 (BN/YE) for an open. TEST the system for normal operation.

Q5 CHECK FOR CORRECT SCCM OPERATION
• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Q6 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test R: An Individual Fog Lamp Is Inoperative

Refer to Wiring Diagrams Cell 86 , Fog Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors the fog lamp switch position by sending a voltage signal to the headlamp switch. When the fog lamp switch is engaged, the voltage signal is routed to ground indicating a request for the fog lamps.

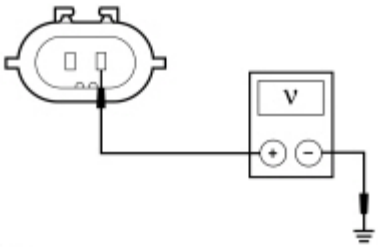
The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the fog lamp switch position. When the BCM receives input from the SCCM indicating a request for the fog lamps, the BCM provides ground to the fog lamp relay (integrated into the BCM). When the fog lamp relay is energized, voltage is routed to the fog lamps. The fog lamps share a common ground circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

PINPOINT TEST R: AN INDIVIDUAL FOG LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
R1 CHECK FOR VOLTAGE TO THE FOG LAMP • Ignition OFF. • Disconnect: Inoperative Fog Lamp. • Ignition ON. • Place the headlamp switch in the PARKING LAMPS ON position and engage the fog lamp switch. • Measure the voltage between the LH fog lamp C152-B, circuit CLF12 (BN/YE), harness side and ground; or between the RH fog lamp C162-B, circuit CLF12 (BN/YE), harness side and ground.  N0117368 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit GD120 (BK/GN) (LH fog lamp) or circuit GD123 (BK/GY) (RH fog lamp) for an open. TEST the system for normal operation. **No** REPAIR circuit CLF12 (BN/YE) for an open. TEST the system for normal operation.

Pinpoint Test S: The Fog Lamps Are On Continuously

Refer to Wiring Diagrams Cell 86 , Fog Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors the fog lamp switch position by sending a voltage signal to the headlamp switch. When the fog lamp switch is engaged, the voltage signal is routed to ground indicating a request for the fog lamps.

The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the fog lamp switch position. When the BCM receives input from the SCCM

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indicating a request for the fog lamps, the BCM provides ground to the fog lamp relay (integrated into the BCM). When the fog lamp relay is energized, voltage is routed to the fog lamps.

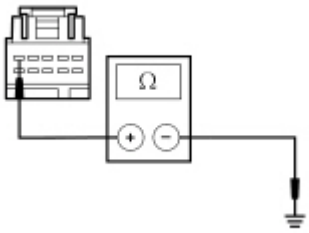
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp switch
- SCCM
- BCM

PINPOINT TEST S: THE FOG LAMPS ARE ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
S1 CHECK THE FOG LAMP SWITCH PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • Monitor the SCCM fog lamp switch PID (FOG_F_SW) while turning the fog lamp switch on and off. • **Does the PID indicate the fog lamp switch is operating correctly?**	**Yes** GO to S4 . **No** GO to S2 .
S2 CHECK THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • Monitor the SCCM fog lamp switch PID (FOG_F_SW). • **Does the PID indicate the fog lamp switch is on?**	**Yes** GO to S3 . **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.
S3 CHECK THE FOG LAMP REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SCCM C2414A. • Measure the resistance between the headlamp switch C205-5, circuit CLF21 (GY/VT), harness side and ground.	**Yes** GO to S6 . **No** REPAIR circuit CLF21 (GY/VT) for a short to ground. TEST the system for normal operation.

 N0083977 • **Is the resistance greater than 10,000 ohms?**	
S4 CHECK THE BCM FOG LAMP INDICATOR OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280A. • Ignition ON. • **Do the fog lamps continue to illuminate?**	**Yes** GO to S5 . **No** REPAIR circuit CLF12 (BN/YE) (between the BCM and the headlamp switch) for a short to voltage. TEST the system for normal operation.
S5 CHECK THE BCM FOG LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280E. • Ignition ON. • **Do the fog lamps continue to illuminate?**	**Yes** REPAIR circuit CLF12 (BN/YE) (between the BCM and the fog lamps) for a short to voltage. TEST the system for normal operation. **No** GO to S7 .

S6 CHECK FOR CORRECT SCCM OPERATION
• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

S7 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Pinpoint Test T: The Fog Lamps On Indicator Is Inoperative

Refer to Wiring Diagrams Cell 86 , Fog Lamps for schematic and connector information.

Normal Operation

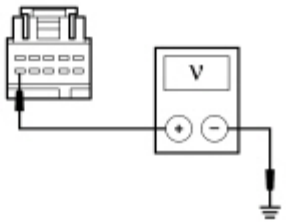
The Steering Column Control Module (SCCM) sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the fog lamp switch position. When the BCM receives input from the SCCM indicating a request for the fog lamps, the BCM provides ground to the fog lamp relay (integrated into the BCM). When the fog lamp relay is energized, voltage is routed to the fog lamps and on a separate circuit, to the headlamp switch for the fog lamps on indicator.

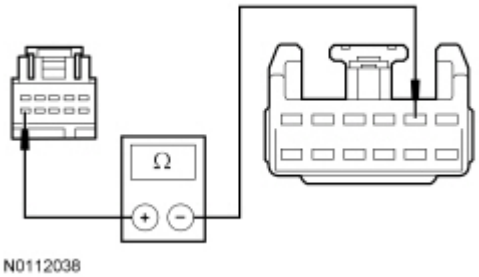
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp switch
- BCM

PINPOINT TEST T: THE FOG LAMPS ON INDICATOR IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
T1 CHECK THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select the BCM fog lamps active command PID (FOG_LAMPS). Command the fog lamps on. • **NOTE:** Make sure the fog lamps are illuminated when taking a reading. • Measure the voltage between the headlamp switch C205-10, circuit CLF12 (BN/YE), harness side and ground.  N0083978 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** GO to T2 .
T2 CHECK THE BCM FOG LAMP INDICATOR OUTPUT CIRCUIT	

FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280A. • Measure the resistance between the headlamp switch C205-10, circuit CLF12 (BN/YE), harness side and the BCM C2280A-2, circuit CLF12 (BN/YE), harness side.  N0112038 • **Is the resistance less than 5 ohms?**	**Yes** GO to T3 . **No** REPAIR circuit CLF12 (BN/YE) for an open. TEST the system for normal operation.
T3 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM .
	REFER to Section 419-10 .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Headlamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

Exterior Lighting

The Steering Column Control Module (SCCM) monitors the headlamp switch position by sending voltage signals on multiple circuits to the headlamp switch. There is one circuit for each headlamp switch position. At any given time, one of the signal circuits is switched to ground. The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the headlamp switch status.

When the BCM receives input requesting the headlamps on, it supplies voltage to the headlamp bulbs.

If the SCCM does not detect any active inputs from the headlamp switch for 5 seconds, or if the SCCM detects multiple headlamp switch input circuits are active, the SCCM sends a message to the BCM to indicate the fault. The BCM then turns the parking lamps and headlamps on and keeps them on until the battery saver times out.

Refer to Exterior Lighting in the Description and Operation portion of this section for information regarding the battery saver function.

If either situation occurs, the SCCM and the BCM **cannot** be ruled immediately as being at fault. This is normal behavior for the SCCM and the BCM when a fault has been detected with the inputs from the headlamp switch.

High Beam and Flash-to-Pass

The SCCM monitors the multifunction switch for a flash-to-pass and high beam request. When the multifunction switch is in the FLASH-TO-PASS or HIGH BEAM position, the SCCM sends a message to the BCM to indicate the request.

On vehicles with halogen headlamps, when the BCM receives a request for high beams (the low beams must be on), the BCM supplies voltage to the high beam bulbs.

On vehicles with HID headlamps, when the BCM receives a request for high beams (the low beams must be on), the headlamps remain powered on, and the BCM supplies voltage to the shutter (located within each headlamp). This changes the headlamp beam pattern to illuminate a greater distance.

When the flash-to-pass is requested, the high beams are illuminated as long as the multifunction switch is held in the FLASH-TO-PASS position (regardless if the low beams are on or off).

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

The BCM utilizes a FET protective circuit strategy for many of its outputs (such as a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection, allowing the circuit to function. If the circuit is still shorted the next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection), the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When a tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by the clear the continuous DTCs command. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns. The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuits for the headlamp system are both low and high beam output circuits.

Inspection and Verification

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1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical

• Headlamp switch
• Multifunction switch
	• Body Control Module (BCM) fuse(s):
	  ▪ 16 (10A) (RH low beam)
	  ▪ 17 (10A) (LH low beam)
	  ▪ 39 (15A) (high beams)
	• BJB fuse(s):
	  ▪ 16 (20A) RH ballast (HID headlamps)
	  ▪ 35 (20A) LH ballast (HID headlamps)
	• Bulb
	• Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM and the SCCM .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• One or both low beams are inoperative	• Fuse • Bulb • Wiring, terminals or connectors • Ballast (HID headlamps) • Body Control Module (BCM)	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test A .
• One or both high beams are inoperative	• Fuse • Bulb • Wiring, terminals or connectors • Multifunction switch • Headlamp assembly (HID headlamps) • Steering Column Control Module (SCCM) • BCM	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test B .
• The low beam(s) are always on	• Wiring, terminals or connectors • Headlamp switch • SCCM • BCM	• GO to Pinpoint Test C .
• The high beam(s) are always on	• Wiring, terminals or connectors • Multifunction switch • Headlamp assembly (HID headlamps) • SCCM • BCM	• GO to Pinpoint Test D .
• The flash-to-pass feature is inoperative	• Multifunction switch • SCCM	• GO to Pinpoint Test E .

Pinpoint Tests

Pinpoint Test A: One Or Both Low Beams Are Inoperative

Refer to Wiring Diagrams Cell 85 , Headlamps/Autolamps for schematic and connector information.

Normal Operation

When the Body Control Module (BCM) receives a message that the headlamp switch is in the HEADLAMPS ON position and the multifunction switch is in the LOW BEAM position (or the autolamps feature has requested the headlamps on), the BCM provides voltage through the headlamp output circuits to the LH and RH low beam headlamps.

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The BCM also provides an overload protection of the low beam output circuits. When an excessive current draw is detected, the BCM disables the affected low beam circuit driver.

DTC Description	Fault Trigger Conditions
• B1D00:11 — Left Low Beam: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the LH low beam output circuit.
• B1D01:11 — Right Low Beam: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the RH low beam output circuit.
• U1000:00 — Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	This DTC sets when the BCM has temporarily shut down the output driver. **The module has temporarily disabled a low beam output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the low beam output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	This DTC sets when the BCM has permanently shut down the output driver. **The module has permanently disabled a low beam output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. CORRECT the cause of the excessive current draw before installing a new BCM .**

This pinpoint test is intended to diagnose the following:

- Fuse
- Bulb
- Ballast (HID headlamps)
- Wiring, terminals or connectors
- BCM

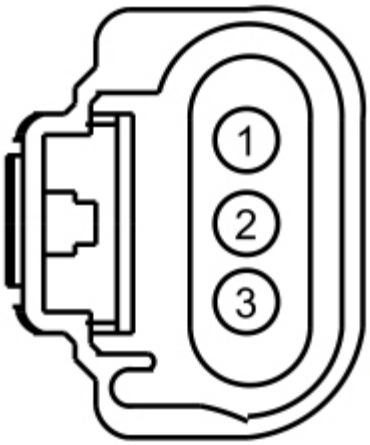
PINPOINT TEST A: ONE OR BOTH LOW BEAMS ARE INOPERATIVE

NOTE: Due to varying wattage ratings and the resulting current draw differences of certain aftermarket halogen headlamp bulbs, the BCM may activate its short circuit protection strategy, resulting in the low beam output circuit becoming inoperative. Verify the bulbs meet Ford specifications. If the bulbs do not meet Ford specifications, install the correct bulbs. Run the self-test (required to clear certain DTCs and reset the BCM). Correct any unresolved DTCs. Clear all DTCs. Test the system for normal operation.

Test Step	Result / Action to Take
A1 CHECK FOR VOLTAGE TO THE HEADLAMP ASSEMBLY • Ignition OFF. • Disconnect: Inoperative LH Headlamp C1021 or RH Headlamp C1041 (Halogen headlamps). • Disconnect: Inoperative LH Headlamp C1284 or RH Headlamp C1285 (HID Headlamps). • Place the headlamp switch in the headlamps on position.	**Yes** GO to A2 . **No** VERIFY the BCM fuse 17 (10A) (LH low beam) or fuse 16 (10A) (RH low beam) is OK. If OK, GO to A6 . If not OK, REFER to the

- For halogen headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-1	CLF04 (BN/BU)	—	Ground
RH Headlamp			
C1041-1	CLF05 (BU/GN)	—	Ground

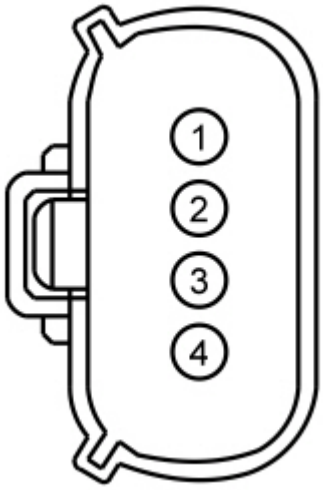


- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-1	CLF04 (BN/BU)	—	Ground
RH Headlamp			
C1285-1	CLF05 (BU/GN)	—	Ground

Wiring Diagrams manual to identify the possible causes of the circuit short.

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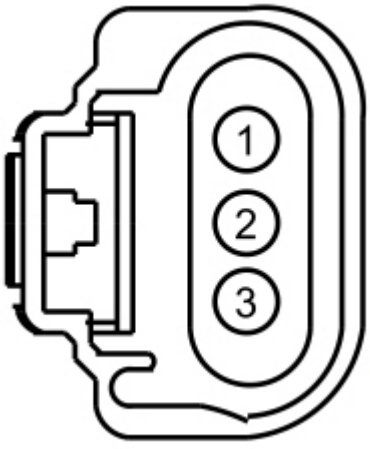


- **Is the voltage greater than 11 volts?**

A2 CHECK THE HEADLAMP ASSEMBLY GROUND CIRCUIT FOR AN OPEN

- For halogen headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-1	CLF04 (BN/BU)	C1021-2	GD120 (BK/GN)
RH Headlamp			
C1041-1	CLF05 (BU/GN)	C1041-2	GD123 (BK/GY)



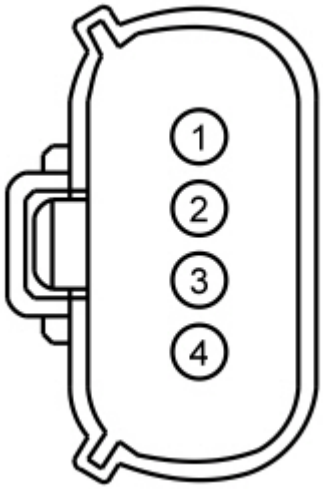
- For HID headlamps, measure the **voltage** between:

Yes
For halogen headlamps, INSTALL a new headlamp bulb. REFER to Headlamp Bulb — Halogen .

For HID headlamps, GO to A3 .

No
REPAIR the circuit.

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-1	CLF04 (BN/BU)	C1284-4	GD120 (BK/GN)
RH Headlamp			
C1285-1	CLF05 (BU/GN)	C1285-4	GD123 (BK/GY)



- **Is the voltage greater than 11 volts?**

A3 CHECK FOR BALLAST SUPPLY VOLTAGE TO THE HEADLAMP ASSEMBLY

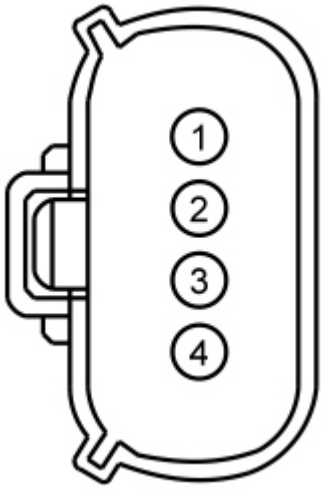
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-2	SBB35 (BU/RD)	—	Ground
RH Headlamp			
C1285-2	SBB16 (VT/RD)	—	Ground

Yes
GO to A4 .

No
VERIFY the BJB fuse 35 (20A) (LH headlamp) or fuse 16 (20A) (RH headlamp) is OK. If OK, REPAIR the affected circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

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- **Is the voltage greater than 11 volts?**

A4 CHECK THE BALLAST

- Place the headlamp switch in the off position.
- Substitute a known good ballast.
- Place the headlamp switch in the headlamps on position.
- **Does the inoperative headlamp illuminate?**

Yes
REMOVE the known good ballast. INSTALL a new ballast. REFER to Ballast .

No
REMOVE the known good ballast. GO to A5 .

A5 CHECK THE HID BULB

- Place the headlamp switch in the off position.
- Substitute a known good HID bulb.
- Place the headlamp switch in the headlamps on position.
- **Does the inoperative headlamp illuminate?**

Yes
REMOVE the known good HID bulb. INSTALL a new HID bulb. REFER to Headlamp Bulb — HID .

No
REMOVE the known good HID bulb. REPAIR or INSTALL a new headlamp assembly. REFER to Headlamp Assembly .

A6 REPEAT THE BCM SELF-TEST AND CHECK FOR VOLTAGE TO THE HEADLAMP

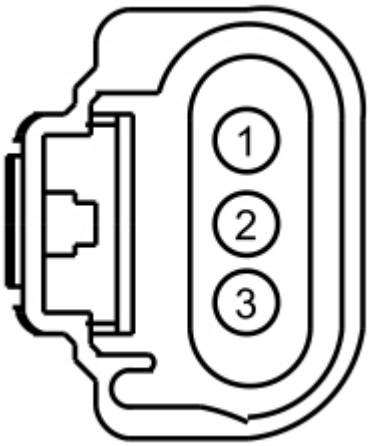
- Place the headlamp switch in the off position.
- Ignition ON.
- Using a scan tool, clear the DTCs and perform the BCM self-test.
- Place the headlamp switch in the headlamps on position.
- For halogen headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-1	CLF04 (BN/BU)	—	Ground
RH Headlamp			
C1041-1	CLF05 (BU/GN)	—	Ground

Yes
For halogen headlamps, INSTALL a new headlamp bulb. REFER to Headlamp Bulb — Halogen .

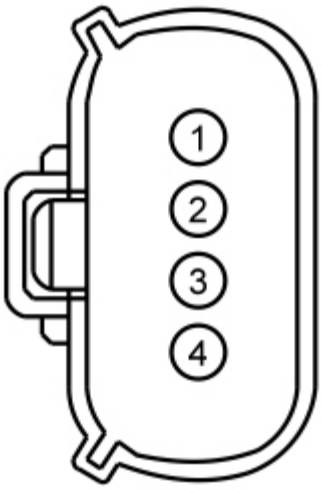
For HID headlamps, GO to A7 .

No
GO to A8 .



- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-1	CLF04 (BN/BU)	—	Ground
RH Headlamp			
C1285-1	CLF05 (BU/GN)	—	Ground



- **Is the voltage greater than 11 volts?**

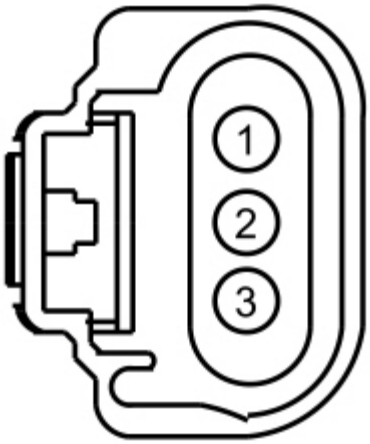
A7 CHECK THE HEADLAMP HARNESS

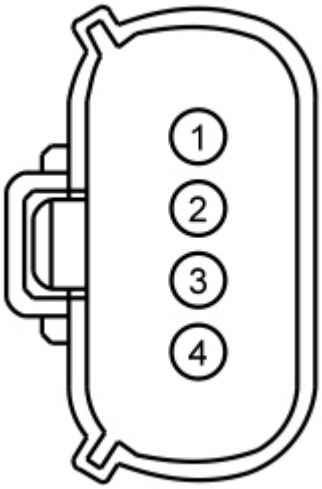
- Ignition OFF.
- Place the headlamp switch in the off position.
- Check the headlamp harness for an internal short to the ground circuit.
- **Is the headlamp harness OK?**

Yes
INSTALL a new ballast. REFER to Ballast .

No
REPAIR or INSTALL a new headlamp

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	assembly. REFER to Headlamp Assembly .
A8 CHECK THE BCM LOW BEAM VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Place the headlamp switch in the off position. • Disconnect: BCM C2280E. • For halogen headlamps, measure the **resistance** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit **LH Headlamp** C1021-1 / CLF04 (BN/BU) / — / Ground **RH Headlamp** C1041-1 / CLF05 (BU/GN) / — / Ground  • For HID headlamps, measure the **resistance** between: Positive Lead / Negative Lead Pin / Circuit / Pin / Circuit **LH Headlamp** C1284-1 / CLF04 (BN/BU) / — / Ground **RH Headlamp** C1285-1 / CLF05 (BU/GN) / — / Ground	**Yes** GO to A9 . **No** REPAIR the circuit.

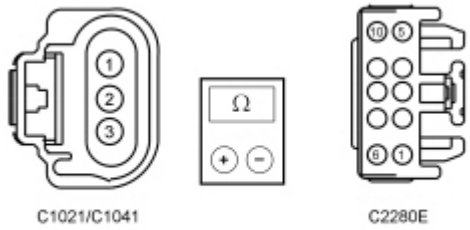


- **Is the resistance greater than 10,000 ohms?**

A9 CHECK THE BCM LOW BEAM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN

- For halogen headlamps, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-1	CLF04 (BN/BU)	C2280E-2	CLF04 (BN/BU)
RH Headlamp			
C1041-1	CLF05 (BU/GN)	C2280E-1	CLF05 (BU/GN)



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- For HID headlamps, measure the **resistance** between:

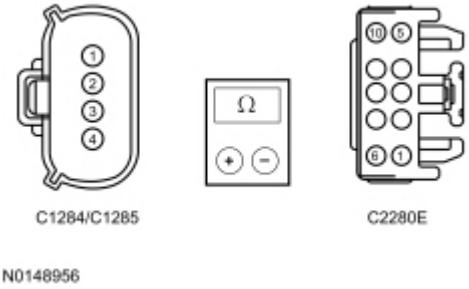
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-	CLF04	C2280E-	CLF04

Yes
GO to A10 .

No
REPAIR the circuit.

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1	(BN/BU)	2	(BN/BU)
RH Headlamp			
C1285-1	CLF05 (BU/GN)	C2280E-1	CLF05 (BU/GN)



- **Is the resistance less than 3 ohms?**

A10 CHECK FOR CORRECT BCM OPERATION
• Disconnect and inspect all the BCM connectors.
• Repair:
  • corrosion (install new connector or terminals – clean module pins)
  • damaged or bent pins – install new terminals/pins
  • pushed-out pins – install new pins as necessary
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK On-Line Automotive Service Information System (OASIS) for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test B: One or Both High Beams are Inoperative

Refer to Wiring Diagrams Cell 85 , Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors input from the multifunction and headlamp switches. When the headlamp switch is in the HEADLAMPS ON position and the multifunction switch is placed in the HIGH BEAM position, the SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating a high beam request.

On vehicles with halogen headlamps, when the BCM receives a request for high beams (the low beams must be on), the BCM supplies voltage to the high beam bulbs.

On vehicles with HID headlamps, when the BCM receives a request for high beams (the low beams must be on), the headlamps remain powered on, and the BCM supplies voltage to the shutter (located within each headlamp). This changes the headlamp beam pattern to illuminate a greater distance.

The BCM provides an overload protection of the high beam output circuits. When an excessive current draw is detected, the BCM disables the affected high beam circuit driver.

The Instrument Panel Cluster (IPC) also receives a message over the HS-CAN to illuminate the high beam indicator when a request for the high beams is received.

DTC Description	Fault Trigger Conditions
• B1007:09 — High-Beam Headlamp Switch: Component Failure	This DTC sets when the SCCM detects a fault from the multifunction switch input.
• B1D02:11 — Left High Beam Circuit: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the LH high beam output circuit.
• B1D02:15 — Left High Beam Circuit: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open from the LH high beam output circuit.
• B1D03:11 — Right High Beam Circuit: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the RH high beam output circuit.
• B1D03:15 — Right High Beam Circuit: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open from the RH high beam output circuit.
• U1000:00 — Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	This DTC sets when the BCM has temporarily shut down the output driver. **The module has temporarily disabled a high beam output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the high beam output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	This DTC sets when the BCM has permanently shut down the output driver. **The module has permanently disabled a high beam output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. CORRECT the cause of the excessive current draw before installing a new BCM .**

This pinpoint test is intended to diagnose the following:

- Fuse
- Bulb
- Wiring, terminals or connectors
- Multifunction switch
- Headlamp assembly (HID headlamps)
- SCCM
- BCM

PINPOINT TEST B: ONE OR BOTH HIGH BEAMS ARE INOPERATIVE

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<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 CHECK THE LOW BEAM OPERATION

• Ignition OFF.
• Place the headlamp switch in the headlamps on position and observe the headlamps.
• Place the multifunction switch in the HIGH BEAM position and observe the headlamps.
• Place the multifunction switch in the LOW BEAM position and observe the headlamps.
• Do the low beams illuminate?</td><td>Yes
If an individual high beam is inoperative, GO to B3.

If both high beams are inoperative, VERIFY the BCM fuse 39 (15A) is OK. If OK, GO to B2. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

No
GO to Pinpoint Test A.</td></tr>
<tr><td>B2 CHECK THE MULTIFUNCTION SWITCH INPUT

• Ignition ON.
• Using a scan tool, view SCCM PIDs.
• Monitor the SCCM HEADLAMP_SW PID while placing the multifunction switch in the flash-to-pass and high beam positions.
• Do the PID states agree with the multifunction switch positions?</td><td>Yes
GO to B8.

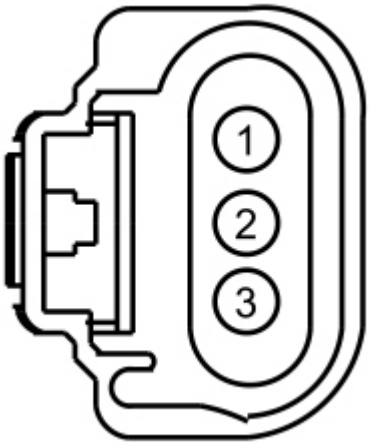
No
INSTALL a new multifunction switch. REFER to Section 211-05.

If the concern still exists, INSTALL an new SCCM. REFER to Section 211-05.</td></tr>
<tr><td>B3 CHECK FOR VOLTAGE TO THE HEADLAMP

• Place the headlamp switch in the off position.
• Disconnect: Inoperative LH Headlamp C1021 or RH Headlamp C1041 (Halogen headlamps).
• Disconnect: Inoperative LH Headlamp C1284 or RH Headlamp C1285 (HID Headlamps).
• Place the headlamp switch in the headlamps on position and the multifunction switch in the HIGH BEAM position.
• For halogen headlamps, measure the voltage between:

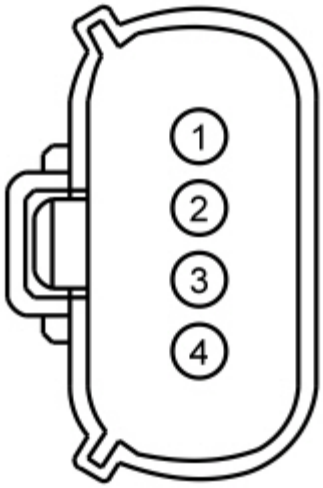
<table>
<tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr>
<tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr>
<tr><td colspan="4">LH Headlamp</td></tr>
<tr><td>C1021-3</td><td>CLF02 (GY/BN)</td><td>—</td><td>Ground</td></tr>
<tr><td colspan="4">RH Headlamp</td></tr>
<tr><td>C1041-3</td><td>CLF03 (VT/OG)</td><td>—</td><td>Ground</td></tr>
</table>
</td><td>Yes
GO to B4.

No
GO to B5.</td></tr>
</table>



- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1285-3	CLF03 (VT/OG)	—	Ground



- **Is the voltage greater than 11 volts?**

B4 CHECK THE HEADLAMP GROUND CIRCUIT FOR AN OPEN

- For halogen headlamps, measure the **voltage** between:

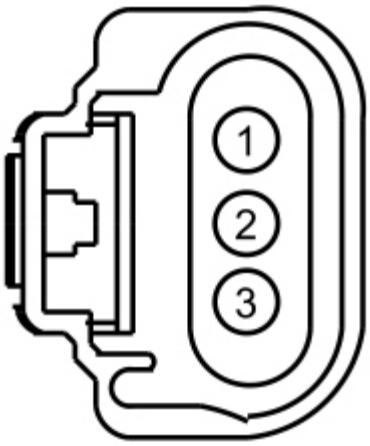
Positive Lead		Negative Lead	

Yes
For halogen headlamps, INSTALL a new headlamp bulb. REFER to Headlamp Bulb — Halogen .

For HID headlamps, INSTALL a new

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Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-3	CLF02 (GY/BN)	C1021-2	GD120 (BK/GN)
RH Headlamp			
C1041-3	CLF03 (VT/OG)	C1041-2	GD123 (BK/GY)

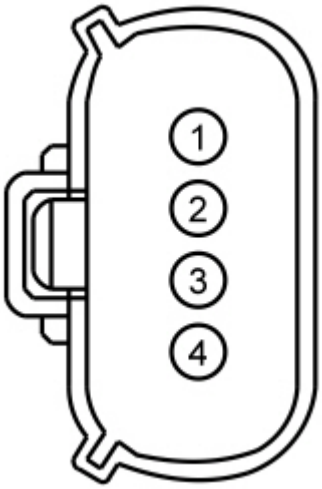


- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-3	CLF02 (GY/BN)	C1284-4	GD120 (BK/GN)
RH Headlamp			
C1285-3	CLF03 (VT/OG)	C1285-4	GD123 (BK/GY)

headlamp assembly. REFER to Headlamp Assembly .

No
REPAIR the circuit.



- **Is the voltage greater than 11 volts?**

B5 REPEAT THE ON-DEMAND SELF-TEST AND CHECK FOR VOLTAGE TO THE HEADLAMP

- Place the headlamp switch in the off position.
- Ignition ON.
- Using a scan tool, clear the DTCs and perform the BCM self-test.
- Place the headlamp switch in the headlamps on position and the multifunction switch in the HIGH BEAM position.
- For halogen headlamps, measure the **voltage** between:

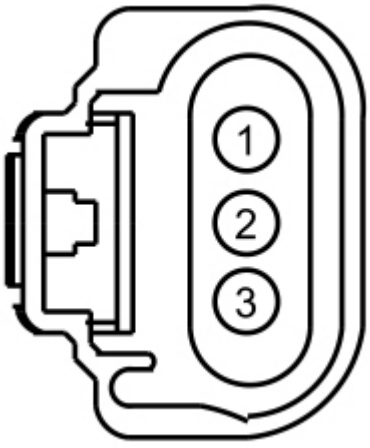
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1041-3	CLF03 (VT/OG)	—	Ground

Yes
For halogen headlamps, INSTALL a new headlamp bulb. REFER to Headlamp Bulb — Halogen .

For HID headlamps, INSTALL a new headlamp assembly. REFER to Headlamp Assembly .

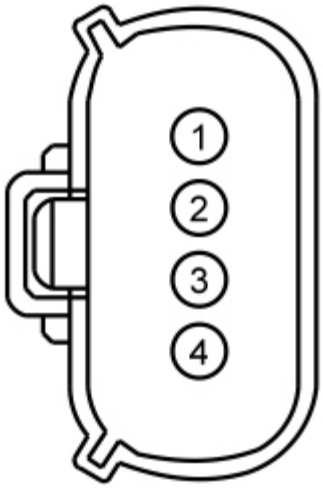
No
GO to B6 .

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- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1285-3	CLF03 (VT/OG)	—	Ground



- **Is the voltage greater than 11 volts?**

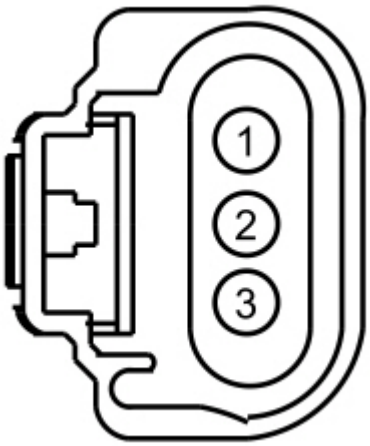
B6 CHECK THE BCM HIGH BEAM VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: BCM C2280E.
- For halogen headlamps, measure the **resistance** between:

Yes
GO to B7.

No
REPAIR the circuit.

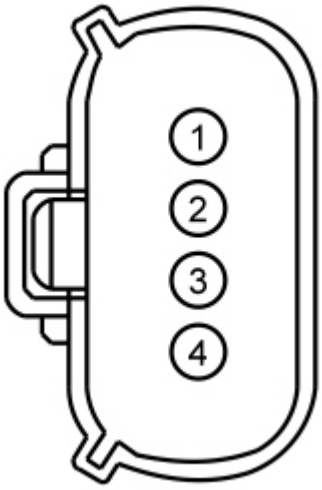
Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1041-3	CLF03 (VT/OG)	—	Ground



- For HID headlamps, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1285-3	CLF03 (VT/OG)	—	Ground

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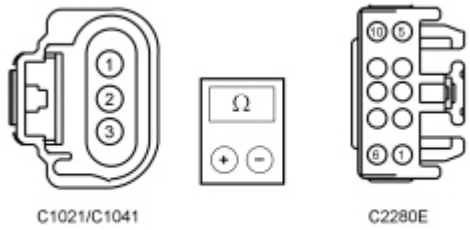


- **Is the resistance greater than 10,000 ohms?**

B7 CHECK THE BCM HIGH BEAM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN

- For halogen headlamps, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-3	CLF02 (GY/BN)	C2280E-8	CLF02 (GY/BN)
RH Headlamp			
C1041-3	CLF03 (VT/OG)	C2280E-7	CLF03 (VT/OG)



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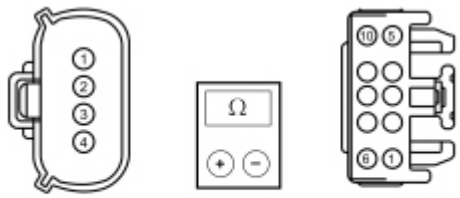
- For HID headlamps, measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-	CLF02	C2280E-	CLF02

Yes
GO to B8 .

No
REPAIR the circuit.

3	(GY/BN)	8	(GY/BN)
RH Headlamp			
C1285-3	CLF03 (VT/OG)	C2280E-7	CLF03 (VT/OG)



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- **Is the resistance less than 3 ohms?**

B8 CHECK FOR CORRECT BCM OPERATION	

• Disconnect and inspect all the BCM connectors.
• Repair:
  • corrosion (install new connector or terminals – clean module pins)
  • damaged or bent pins – install new terminals/pins
  • pushed-out pins – install new pins as necessary
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK On-Line Automotive Service Information System (OASIS) for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test C: The Low Beam(s) Are Always On

Refer to Wiring Diagrams Cell 85 , Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) sends voltage signals to the headlamp switch through the headlamp switch input circuits (off, parking lamps, headlamps). At any given time, the headlamp switch routes one of the input circuits to ground, indicating the headlamp switch position to the SCCM . The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the headlamp switch position. When the BCM receives a message from the SCCM indicating the headlamp switch in the HEADLAMPS ON position, the BCM provides voltage to the LH and RH low beams.

If the SCCM detects multiple or no active headlamp switch inputs, the BCM receives a message from the SCCM indicating a fault with the headlamp switch input and the BCM defaults the parking lamps and headlamps on.

If the BCM loses communication with the SCCM , the BCM defaults the parking lamps and headlamps on.

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- DTC B10A6:09 (Main Light Switch: Component Failure) — a continuous and on-demand DTC that sets when the SCCM detects a fault from the headlamp switch input circuit(s).

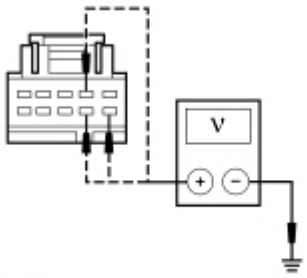
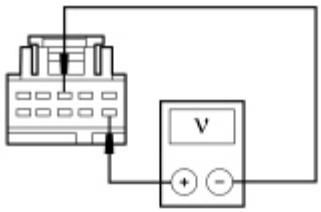
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp switch
- SCCM
- BCM

PINPOINT TEST C: THE LOW BEAM(S) ARE ALWAYS ON

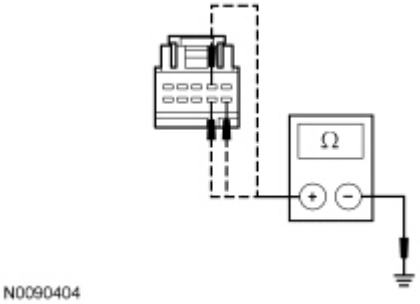
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SCCM module pass the network test?**	**Yes** If equipped with autolamps, GO to C2. If not equipped with autolamps, GO to C4. **No** REFER to Section 418-00.
C2 CHECK FOR LIGHT SENSOR DTCs • Review the DTCs recorded from the BCM self-test. • **Is DTC B1A85:11 or DTC B1A85:13 present?**	**Yes** GO to Pinpoint Test H. **No** GO to C3.
C3 CHECK THE SCCM AUTOLAMP ON REQUEST PID • Ignition ON. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • While placing the headlamp switch in the AUTOLAMPS ON and then OFF position, monitor the SCCM headlamp switch PID (EXT_LMP_SW). • **Does the PID agree with the headlamp switch when it is in the AUTOLAMPS ON position and indicate it is not in the AUTOLAMPS ON position when the headlamp switch is in the OFF position?**	**Yes** GO to C4. **No** GO to Pinpoint Test H.
C4 CHECK THE SCCM HEADLAMP SWITCH PIDs **NOTE:** Make sure the headlamp switch is aligned in the correct position when monitoring the PID. • Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • While moving the headlamp switch through all positions (OFF, PARKING LAMPS and HEADLAMPS), monitor the SCCM headlamp switch input PID (EXT_LMP_SW). • **Do the headlamp switch positions agree with the PID?**	**Yes** GO to C9. **No** GO to C5.

C5 CHECK FOR VOLTAGE TO THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch, harness side and ground as follows: **Headlamp Switch Connector-Pin** / **Circuit** C205-6 / CLF23 (WH/VT) C205-2 / CLS34 (GY) C205-7 / CLF24 (YE)  N0099675 • **Are the voltages greater than 5 volts?**	**Yes** GO to C6 . **No** GO to C7 .
C6 CHECK THE HEADLAMP SWITCH GROUND CIRCUIT FOR AN OPEN	
• Measure the voltage between the headlamp switch C205-6, circuit CLF23 (WH/VT), harness side and headlamp switch C205-3, circuit GD133 (BK), harness side.  N0099676 • **Is the voltage greater than 5 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** REPAIR circuit GD133 (BK) for an open. TEST the system for normal operation.
C7 CHECK THE HEADLAMP SWITCH INPUT CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: SCCM C2414A. • Measure the resistance between the headlamp switch, harness side and ground as follows: **Headlamp Switch Connector-Pin** / **Circuit** C205-6 / CLF23 (WH/VT) C205-2 / CLS34 (GY)	**Yes** GO to C8 . **No** REPAIR the circuit in question for a short to ground. TEST the system for normal operation.

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C205-7	CLF24 (YE)



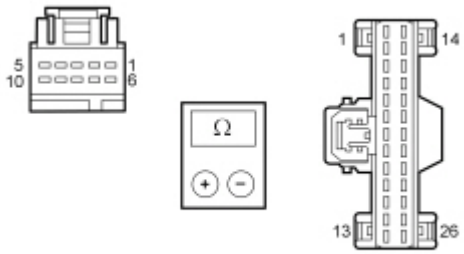
N0090404

- **Are the resistances greater than 10,000 ohms?**

C8 CHECK THE HEADLAMP SWITCH INPUT CIRCUITS FOR AN OPEN

- Measure the resistance between the headlamp switch, harness side and the SCCM, harness side as follows:

Headlamp Switch Connector-Pin	SCCM Connector-Pin	Circuit
C205-6	C2414A-21	CLF23 (WH/VT)
C205-2	C2414A-22	CLS34 (GY)
C205-7	C2414A-18	CLF24 (YE)



N0112015

- **Are the resistances less than 5 ohms?**

Yes
GO to C10.

No
REPAIR the circuit in question for an open. TEST the system for normal operation.

C9 CHECK THE BCM OUTPUT

- Ignition OFF.
- Disconnect: BCM C2280E.
- Ignition ON.
- **Does the LH or RH headlamp continue to illuminate?**

Yes
REPAIR circuit CLF04 (BN/BU) (LH headlamp) or circuit CLF05 (BU/GN) (RH headlamp) for a short to voltage as necessary. TEST the system for normal operation.

No
GO to C11.

C10 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM.
	REFER to Section 211-05.
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

C11 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM.
	REFER to Section 419-10.
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: The High Beam(s) Are Always On

Refer to Wiring Diagrams Cell 85, Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors input from the multifunction switch. When the multifunction switch is placed in the FLASH-TO-PASS position (first detent when pulled towards the operator) or the headlamp switch is in the HEADLAMPS ON position and the multifunction switch is placed in the HIGH BEAM position (second detent), the SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating a flash-to-pass or high beam request.

On vehicles with halogen headlamps, when the BCM receives a request for high beams (the low beams must be on), the BCM supplies voltage to the high beam bulbs.

On vehicles with HID headlamps, when the BCM receives a request for high beams (the low beams must be on), the headlamps remain powered on, and the BCM supplies voltage to the shutter (located within each headlamp). This changes the headlamp beam pattern to illuminate a greater distance.

The multifunction switch returns to a rest position when released. The switch positions for the flash-to-pass and high beam features are momentary contact.

- DTC B1007:09 (High-Beam Headlamp Switch: Component Failure) — this DTC sets when the SCCM detects a fault from the multifunction switch input.
- DTC B1D02:15 (Left High Beam Circuit: Circuit Short To Battery or Open) — this DTC sets when the BCM detects a short to voltage from the LH high beam output circuit.

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- DTC B1D03:15 (Right High Beam Circuit: Circuit Short To Battery or Open) — this DTC sets when the BCM detects a short to voltage from the RH high beam output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- SCCM
- BCM

PINPOINT TEST D: THE HIGH BEAMS ARE ON CONTINUOUSLY

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>D1 CHECK THE MULTIFUNCTION SWITCH INPUT

• Ignition ON.
• Using a scan tool, view SCCM PIDs.
• Monitor the SCCM FLASH-to-PASS and HIGH_BEAM_SW PIDs while placing the multifunction switch in the flash-to-pass, high beam and rest positions.
• Do the PID values agree with the multifunction switch position?</td><td>Yes
GO to D2.

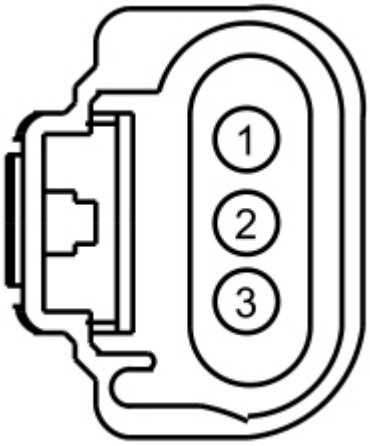
No
INSTALL a new multifunction switch. REFER to Section 211-05.

If the concern still exists, INSTALL a new SCCM. REFER to Section 211-05.</td></tr>
<tr><td>D2 CHECK THE HIGH BEAM VOLTAGE SUPPLY CIRCUIT FOR VOLTAGE

• Ignition OFF.
• Disconnect: Incorrectly Operating LH Headlamp C1021 or RH Headlamp C1041 (Halogen headlamps).
• Disconnect: Incorrectly Operating LH Headlamp C1284 or RH Headlamp C1285 (HID Headlamps).
• Ignition ON.
• Make sure the multifunction switch in the rest position.
• For halogen headlamps, measure the voltage between:

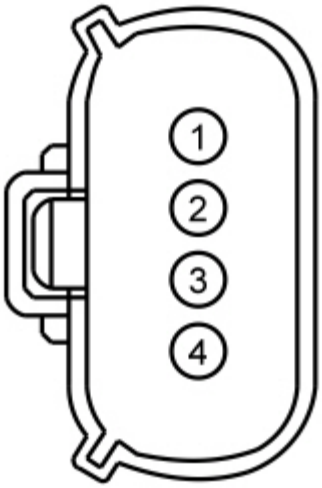
<table>
<tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr>
<tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr>
<tr><td colspan="4">LH Headlamp</td></tr>
<tr><td>C1021-3</td><td>CLF02 (GY/BN)</td><td>—</td><td>Ground</td></tr>
<tr><td colspan="4">RH Headlamp</td></tr>
<tr><td>C1041-3</td><td>CLF03 (VT/OG)</td><td>—</td><td>Ground</td></tr>
</table>
</td><td>Yes
GO to D3.

No
INSTALL a new headlamp assembly. REFER to Headlamp Assembly.</td></tr>
</table>



- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1285-3	CLF03 (VT/OG)	—	Ground

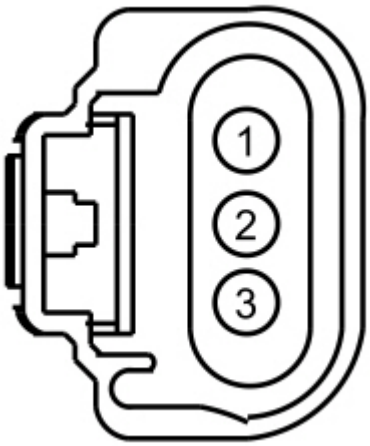


- **Is any voltage present?**

D3 CHECK THE BCM HIGH BEAM OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280E. • Ignition ON. • For halogen headlamps, measure the **voltage** between:	**Yes** REPAIR the circuit. **No** GO to D4.

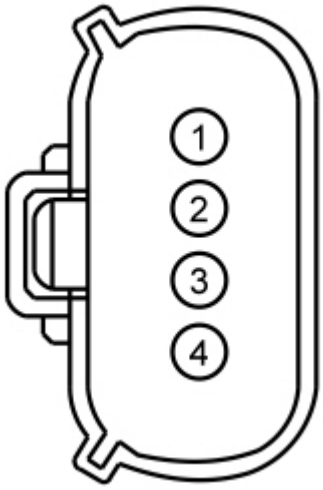
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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1021-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1041-3	CLF03 (VT/OG)	—	Ground



- For HID headlamps, measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
LH Headlamp			
C1284-3	CLF02 (GY/BN)	—	Ground
RH Headlamp			
C1285-3	CLF03 (VT/OG)	—	Ground

 • **Is any voltage present?**	

D4 CHECK FOR CORRECT BCM OPERATION
• Disconnect and inspect all the BCM connectors.
• Repair:
  • corrosion (install new connector or terminals – clean module pins)
  • damaged or bent pins – install new terminals/pins
  • pushed-out pins – install new pins as necessary
• Reconnect the BCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK On-Line Automotive Service Information System (OASIS) for any applicable TSBs. If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new BCM . REFER to Section 419-10 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test E: The Flash-To-Pass Feature Is Inoperative

Normal Operation

The Steering Column Control Module (SCCM) monitors input from the multifunction switch. When the multifunction switch is placed in the FLASH-TO-PASS position, the SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating a flash-to-pass request. The BCM then provides voltage to the high beams.

This pinpoint test is intended to diagnose the following:

- Multifunction switch
- SCCM

PINPOINT TEST E: THE FLASH-TO-PASS FEATURE IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

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Test Step	Result / Action to Take
E1 VERIFY THE HIGH BEAM HEADLAMP OPERATION • Ignition ON. • Place the headlamp switch in the HEADLAMPS ON position and activate the high beams. • **Do the high beam headlamps illuminate?**	**Yes** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If the concern still exists, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation. **No** GO to Pinpoint Test B .

Parking, Rear and License Plate Lamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Steering Column Control Module (SCCM) monitors the headlamp switch position by sending voltage signals on multiple circuits to the headlamp switch. There is one circuit for each headlamp switch position. At any given time, one of the signal circuits is switched to ground. The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the headlamp switch position.

When the BCM receives a network message from the SCCM that the headlamp switch is in the PARKING LAMPS ON position, the BCM provides voltage to the parking lamps.

If the SCCM does not detect any active inputs from the headlamp switch for 5 seconds, or if the SCCM detects multiple headlamp switch input circuits are active, the SCCM sends a message to the BCM to indicate the fault. The BCM then turns the parking lamps and headlamps on and keeps them on until the battery saver feature times out.

Refer to Exterior Lighting in the Description and Operation portion of this section for information regarding the battery saver feature.

If either situation occurs, the SCCM and the BCM **cannot** be ruled immediately as being at fault. This is normal behavior of the SCCM and the BCM when a fault has been detected with the inputs from the headlamp switch.

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Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Headlamp switch	• Body Control Module (BCM) fuse(s):
	  ▪ 30 (15A) (front parking lamps)
	  ▪ 40 (10A) (rear parking lamps)
	• Bulb
	• Bulb socket
	• Exterior mirrors
	• Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM.

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• One or more parking, rear or license plate lamps is inoperative	• Fuse • Wiring, terminals or connectors • Bulb socket • Exterior mirror • Body Control Module (BCM)	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test O .
• The parking, rear or license plate lamps are on continuously	• Wiring, terminals or connectors • BCM	• GO to Pinpoint Test P .

Pinpoint Tests

Pinpoint Test O: One Or More Parking, Rear or License Plate Lamps Is Inoperative

Refer to Wiring Diagrams Cell 92 , Parking, Rear and License Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) sends voltage signals to the headlamp switch through the headlamp switch input circuits (off, parking lamps, headlamps, autolamps). At any given time, the headlamp switch routes one of the input circuits to ground, indicating the headlamp switch position to the SCCM .

The SCCM sends the status of the headlamp switch position to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN).

The BCM provides voltage to the parking lamps based on the headlamp switch position.

If the SCCM detects multiple or no active headlamp switch inputs, the SCCM sends a message to the BCM to indicate a fault with the headlamp switch input.

If the BCM receives a message from the SCCM indicating a fault with the headlamp switch inputs or the BCM loses communication with the SCCM , the BCM defaults the exterior lamps (headlamps and parking lamps) on.

There are 2 output circuits from the BCM for the parking lamps. One is for the front parking lamps, the other is for the rear parking lamps.

This pinpoint test is intended to diagnose the following:

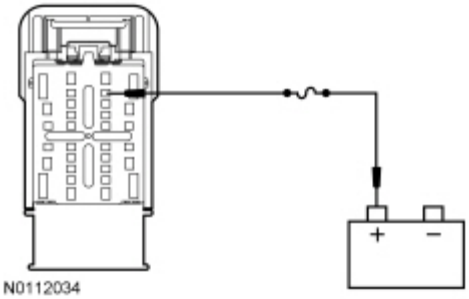
- Fuse
- Wiring, terminals or connectors

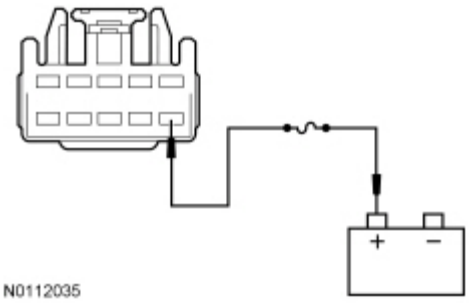
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- Bulb socket
- Exterior mirror
- BCM

PINPOINT TEST O: ONE OR MORE PARKING, REAR OR LICENSE PLATE LAMPS IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
O1 DETERMINE IF ALL THE PARKING LAMPS ARE INOPERATIVE	
• Ignition OFF. • Place the headlamp switch in the PARKING LAMPS ON position. • **Are all the parking lamps inoperative?**	**Yes** GO to O7. **No** If all the rear parking lamps are inoperative, VERIFY the BCM fuse 40 (10A) is OK. If OK, GO to O2. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. If all the front parking lamps are inoperative, VERIFY the BCM fuse 30 (15A) is OK. If OK, GO to O4. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. For any other inoperative lamp, GO to O5.
O2 BYPASS THE BCM (REAR PARKING LAMPS)	
NOTE: If the fuse in the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. • Place the headlamp switch in the OFF position. • Disconnect: BCM C2280D. • Connect a fused jumper wire between the positive battery terminal and the BCM C2280D-18, circuit CBP40 (YE/GN), harness side.  N0112034 • **Do the rear parking lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to O7. **No** REMOVE the jumper wire. GO to O3.
O3 CHECK THE STOPLAMP OPERATION	
• Observe the stoplamps while applying the brake	**Yes** REPAIR circuit CBP40 (YE/GN) for an open.

pedal. • **Are the stoplamps illuminated with he brake pedal applied?**	TEST the system for normal operation. **No** REPAIR circuit GD117 (BK) for an open. TEST the system for normal operation.
O4 BYPASS THE BCM (FRONT LAMPS) **NOTE:** If the fuse in the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. • Place the headlamp switch to the OFF position. • Disconnect: BCM C2280E. • Connect a fused jumper wire between the positive battery terminal and the BCM C2280E-6, circuit CBP30 (YE/BU), harness side.  • **Do the front parking lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to O7 . **No** REMOVE the jumper wire. REPAIR circuit CBP30 (YE/BU) for an open. TEST the system for normal operation.
O5 CHECK FOR VOLTAGE TO THE INOPERATIVE PARKING LAMP • Place the headlamp switch in the OFF position. • Disconnect: Inoperative Lamp. • Place the headlamp switch in the PARKING LAMPS ON position. • Measure the voltage between the inoperative lamp, harness side and ground as follows:	**Yes** GO to O6 . **No** REPAIR the parking lamp voltage supply circuit in question for an open. TEST the system for normal operation.

Inoperative Lamp	Connector-Pin	Circuit
LH front	C1023-2	CBP30 (YE/BU)
RH front	C1043-2	CBP30 (YE/BU)
LH front side lamp	C1127-1	CBP30 (YE/BU)
RH front side lamp	C1126-1	CBP30 (YE/BU)
LH front marker (Raptor only)	C1596-1	CBP30 (YE/BU)
RH front marker (Raptor only)	C1597-1	CBP30 (YE/BU)
LH grille marker (Raptor only)	C1592-1	CLS30 (VT/WH)

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Center grille marker (Raptor only)	C1593-1	CLS30 (VT/WH)
RH grille marker (Raptor only)	C1594-1	CLS30 (VT/WH)
High mounted stoplamp (Raptor only)	C904-5	CBP30 (YE/BU)
LH exterior mirror	C521-11	CBP30 (YE/BU)
RH exterior mirror	C615-11	CBP30 (YE/BU)
LH rear upper	C4112-2	CBP40 (YE/GN)
LH rear lower	C4113-2	CBP40 (YE/GN)
RH rear upper	C4114-2	CBP40 (YE/GN)
RH rear lower	C4115-2	CBP40 (YE/GN)
LH rear marker (Raptor only)	C4136-1	CBP40 (YE/GN)
RH rear marker (Raptor only)	C4138-1	CBP40 (YE/GN)
LH license plate	C452-2	CBP40 (YE/GN)
RH license plate	C462-2	CBP40 (YE/GN)

- **Is the voltage greater than 10 volts?**

O6 CHECK THE INOPERATIVE PARKING LAMP GROUND CIRCUIT FOR AN OPEN

- Measure the voltage between the inoperative lamp, harness side as follows:

Inoperative Lamp	Connector-Pin Circuit	Connector-Pin Circuit
LH front	C1023-2 CBP30 (YE/BU)	C1023-1 GD123 (BK/GY)
RH front	C1043-2 CBP30 (YE/BU)	C1043-1 GD120 (BK/GN)
LH front side lamp	C1127-1 CBP30	C1127-2 GD120

Yes
For exterior mirror lamp, INSTALL a new exterioir mirror. REFER to Section 501-09 .

For all other lamps, INSTALL a new bulb socket in question. TEST the system for normal operation.

No
REPAIR the ground circuit in question for an open. TEST the system for normal operation.

	(YE/BU)	(BK/GN)
RH front side lamp	C1126-1 CBP30 (YE/BU)	C1126-2 GD123 (BK/GY)
LH front marker (Raptor only)	C1596-1 CBP30 (YE/BU)	C1596-2 GD123 (BK/GY)
RH front marker (Raptor only)	C1597-1 CBP30 (YE/BU)	C1597-2 GD120 (BK/GN)
LH grille marker (Raptor only)	C1592-1 CLS30 (VT/WH)	C1592-2 GD123 (BK/GY)
Center grille marker (Raptor only)	C1593-1 CLS30 (VT/WH)	C1593-2 GD123 (BK/GY)
RH grille marker (Raptor only)	C1594-1 CLS30 (VT/WH)	C1594-2 GD123 (BK/GY)
LH exterior mirror	C521-11 CBP30 (YE/BU)	C521-8 GD134 (BK/VT)
RH exterior mirror	C615-11 CBP30 (YE/BU)	C615-8 GD139 (BK/YE)
High mounted stoplamp (Raptor only)	C904-5 CBP30 (YE/BU)	C904-1 GD139 (BK/YE)
LH rear upper	C4112-2 CBP40 (YE/GN)	C4112-1 GD117 (BK)
LH rear lower	C4113-2 CBP40 (YE/GN)	C4113-1 GD117 (BK)
RH rear upper	C4114-2 CBP40 (YE/GN)	C4114-1 GD117 (BK)
RH rear lower	C4115-2	C4115-1

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	CBP40 (YE/GN)	GD117 (BK)
LH rear marker (Raptor only)	C4136-1 CBP40 (YE/GN)	C4136-2 GD117 (BK)
RH rear marker (Raptor only)	C4138-1 CBP40 (YE/GN)	C4138-2 GD117 (BK)
LH license plate	C452-2 CBP40 (YE/GN)	C452-1 GD117 (BK)
RH license plate	C462-2 CBP40 (YE/GN)	C462-1 GD117 (BK)

- **Is the voltage greater than 10 volts?**

O7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test P: The Parking, Rear Or License Plate Lamps Are On Continuously

Refer to Wiring Diagrams Cell 92, Parking, Rear and License Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) sends voltage signals to the headlamp switch through the headlamp switch input circuits (off, parking lamps, headlamps, autolamps). At any given time, the headlamp switch routes one of the input circuits to ground, indicating the headlamp switch position to the SCCM.

The SCCM sends the status of the headlamp switch position to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN).

The BCM provides voltage to the parking lamps when the it receives a message from the SCCM indicating the headlamp switch in the PARKING LAMPS ON position.

If the SCCM detects multiple or no active headlamp switch inputs, the SCCM sends a message to the BCM to indicate a fault with the headlamp switch input.

If the BCM receives a message from the SCCM indicating a fault with the headlamp switch inputs or the BCM loses communication with the SCCM , the BCM defaults the exterior lamps on.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BCM

PINPOINT TEST P: THE PARKING, REAR OR LICENSE PLATE LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
P1 CHECK IF THE HEADLAMPS ARE ON • Ignition ON. • Observe the headlamps. • **Are the headlamps illuminated?**	**Yes** GO to Pinpoint Test C . **No** GO to P2 .
P2 CHECK THE BCM REAR PARKING LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280D. • Ignition ON. • **Do the rear lamps continue to illuminate?**	**Yes** REPAIR circuit CBP40 (YE/GN) for a short to voltage. TEST the system for normal operation. **No** GO to P3 .
P3 CHECK THE BCM FRONT PARKING LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280E. • Ignition ON. • **Do the parking lamps continue to illuminate?**	**Yes** REPAIR circuit CBP30 (YE/BU) for a short to voltage. TEST the system for normal operation. **No** GO to P4 .

P4 CHECK FOR CORRECT BCM OPERATION
• Ignition OFF.
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Reversing Lamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

When the transmission is in reverse, the PCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the transmission is in reverse. The BCM provides voltage to the reversing lamps when it receives the message that the transmission is in reverse and the ignition is in RUN.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

The BCM utilizes a FET protective circuit strategy for many of its outputs (such as a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection, allowing the circuit to function. If the circuit is still shorted the next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection), the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair

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procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When a tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by the clear the continuous DTCs command. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns. The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuits for the reverse lamp system is the reverse lamps output circuit.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Bulb • Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no

power in run.
- verify the scan tool operation with a known good vehicle.
- refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM and the PCM.

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Both reversing lamps are inoperative	• Wiring, terminals or connectors • Transmission gear input • Body Control Module (BCM)	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test U .
• An individual reversing lamp is inoperative	• Wiring, terminals or connectors • Bulb socket	• VERIFY the bulb is OK. If OK, GO to Pinpoint Test V .
• The reversing lamps are on continuously	• Wiring, terminals or connectors • Auto-dimming interior mirror • Transmission gear input • BCM	• GO to Pinpoint Test W .

Pinpoint Tests

Pinpoint Test U: Both Reversing Lamps Are Inoperative

Refer to Wiring Diagrams Cell 93 , Reversing Lamps for schematic and connector information.

Normal Operation

The PCM monitors the transmission gear status. When the transmission is in reverse, the PCM sends a

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message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the transmission is in reverse. When the BCM receives the message indicating the transmission is in reverse and the ignition is in RUN, the BCM provides voltage to the reversing lamps.

The reversing lamps share the fused power supply with the high mounted stoplamp and the ground circuit with the rear stoplamps.

- DTC B1277:11 (Reverse Lamp: Circuit Short To Ground) — This DTC sets when the BCM detects a short to ground from the reversing lamp output circuit.
- DTC B1277:15 (Reverse Lamp: Circuit Short To Battery or Open) — This DTC sets when the BCM detects an open from the reversing lamp output circuit.

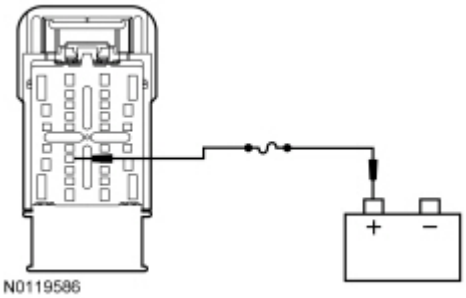
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Transmission gear input
- BCM

PINPOINT TEST U: BOTH REVERSING LAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
U1 CHECK THE STOPLAMP OPERATION	
• Ignition OFF. • Apply the brake pedal while observing all the stoplamps. • **Do the stoplamps illuminate?**	**Yes** GO to U2 . **No** GO to Pinpoint Test I .
U2 CHECK THE BCM OUTPUT	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select the BCM reverse lamps active command (RVRS_LMPS). Command the reverse lamps on then off. • **Do the reversing lamps illuminate when commanded on?**	**Yes** REFER to Section 307-01 to diagnose a Transmission Range (TR) concern. **No** GO to U3 .
U3 BYPASS THE BCM	
NOTE: If the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC U1000:00 is present, clear the DTCs **and** repeat the self-test **(required to enable the reversing lamp output driver if DTC U1000:00 is present).** Test the system for normal operation. If DTC U3000:49 is present, install a new BCM . Refer to Section 419-10 . Test the system for normal operation.	**Yes** REMOVE the jumper wire. GO to U4 . **No** REMOVE the jumper wire. REPAIR circuit CLS28 (BU/WH) for an open. TEST the system for normal operation.

• Ignition OFF. • Disconnect: BCM C2280D. • Connect a fused jumper wire between the BCM C2280D-13, circuit CLS28 (BU/WH), harness side and battery positive.  N0119586 • **Do the reversing lamps illuminate?**	

U4 CHECK FOR CORRECT BCM OPERATION
• Disconnect the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test V: An Individual Reversing Lamp Is Inoperative

Refer to Wiring Diagrams Cell 93, Reversing Lamps for schematic and connector information.

Normal Operation

When the transmission is in reverse, the PCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the transmission is in reverse. When the BCM receives the message indicating the transmission is in reverse, the BCM provides voltage to the reversing lamps.

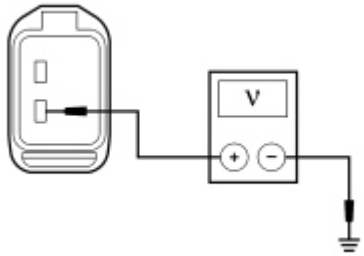
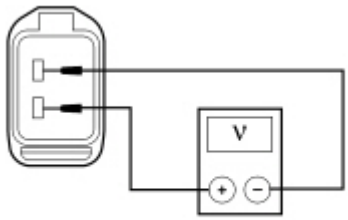
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Bulb socket

PINPOINT TEST V: AN INDIVIDUAL REVERSING LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

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Test Step	Result / Action to Take
V1 CHECK FOR VOLTAGE TO THE REVERSING LAMP	**Yes** GO to V2 . **No** REPAIR circuit CLS28 (BU/WH) for an open. TEST the system for normal operation.
• Ignition OFF. • Apply the parking brake. • Disconnect: Inoperative Reversing Lamp. • Ignition ON. • Select REVERSE. • Measure the voltage between the LH reversing lamp C487-1, circuit CLS28 (BU/WH), harness side and ground; or between the RH reversing lamp C488-1, circuit CLS28 (BU/WH), harness side and ground.  A0057554 • **Is the voltage greater than 10 volts?**	
V2 CHECK THE REVERSING LAMP GROUND CIRCUIT FOR AN OPEN	**Yes** INSTALL a new bulb socket. TEST the system for normal operation. **No** REPAIR circuit GD117 (BK) for an open. TEST the system for normal operation.
• Measure the voltage between the LH reversing lamp C487-1, circuit CLS28 (BU/WH), harness side and the LH reversing lamp C487-2, circuit GD117 (BK), harness side; or between the RH reversing lamp C488-1, circuit CLS28 (BU/WH), harness side and the RH reversing lamp C488-2, circuit GD117 (BK), harness side.  N0088182 • **Is the voltage greater than 10 volts?**	

Pinpoint Test W: The Reversing Lamps Are On Continuously

Refer to Wiring Diagrams Cell 93 , Reversing Lamps for schematic and connector information.

Normal Operation

The PCM monitors the transmission gear status. When the transmission is in reverse, the PCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the transmission is in reverse. When the BCM receives the message indicating the transmission is in reverse and the ignition is in RUN, the BCM provides voltage to the reversing lamps and the auto-dimming interior mirror.

- DTC B1277:15 (Reverse Lamp: Circuit Short To Battery or Open) — This DTC sets when the BCM detects a short to voltage from the reversing lamp output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Auto-dimming interior mirror
- Transmission gear input
- BCM

PINPOINT TEST W: THE REVERSING LAMPS ARE ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
W1 CHECK THE BCM CONTROL OF THE REVERSING LAMPS • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select the BCM reverse lamps active command (RVRS_LMPS). Command the reverse lamps off. • **Do the reversing lamps turn off?**	**Yes** REFER to Section 307-01 to diagnose a Transmission Range (TR) concern. **No** GO to W2.
W2 CHECK THE BCM OUTPUT • Ignition OFF. • Disconnect: BCM C2280D. • Ignition ON. • **Do the reversing lamps continue to illuminate?**	**Yes** REPAIR circuit CLS28 (BU/WH) for a short to voltage. TEST the system for normal operation. **No** GO to W3.

W3 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Stoplamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Body Control Module (BCM) monitors the input from the stoplamp switch. When the brake pedal is applied, voltage is routed to the BCM and the PCM. The BCM then supplies voltage to the stoplamps.

Aside from the stoplamp operation, when the brake pedal is applied, voltage passes through the BCM fuse 31 (5A) to the Trailer Brake Control (TBC) module and a separate circuit for customer use.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

The BCM utilizes a FET protective circuit strategy for many of its outputs (such as a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection, allowing the circuit to function. If the circuit is still shorted the next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection), the FET protection shuts off the circuit again and the cumulative counter advances.

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When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When a tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by the clear the continuous DTCs command. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns. The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuits for the stoplamps system are the high mounted stoplamp, and the LH and RH rear stoplamp output circuits.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
● Stoplamp switch	● Battery Junction Box (BJB) fuse 46 (10A) (stoplamp switch) ● Body Control Module (BCM) fuse(s): ■ 13 (15A) (RH rear stoplamp) ■ 14 (15A) (LH rear stoplamp) ■ 15 (15A) (high mounted stoplamp) ● Bulb ● Bulb socket ● Wiring, terminals or connectors ● Rear lamp assembly ● High mounted stoplamp

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .

- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All the stoplamps are inoperative	• Fuse • Wiring, terminals or connectors • Stoplamp switch • Body Control Module (BCM)	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test I .
• One or more stoplamps are inoperative	• Fuse • Wiring, terminals or connectors • Bulb socket • High mounted stoplamp • BCM	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test J .
• The stoplamp(s) are on continuously	• Wiring, terminals or connectors • Stoplamp switch • Trailer Brake Control (TBC) module • PCM • BCM	• GO to Pinpoint Test K .

Pinpoint Tests

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Pinpoint Test I: All The Stoplamps Are Inoperative

Refer to Wiring Diagrams Cell 90 , Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The stoplamp switch is supplied voltage from the Battery Junction Box (BJB) fuse 46 (10A). When the brake pedal is applied, the stoplamp switch routes voltage to the Body Control Module (BCM), indicating the brake pedal is applied.

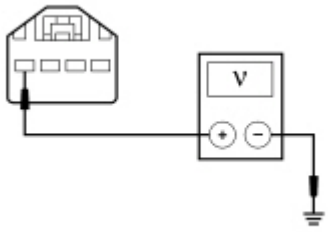
The BCM provides voltage to all the stoplamps (on independent circuits) when it detects the brake pedal is applied.

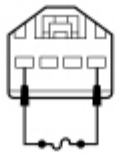
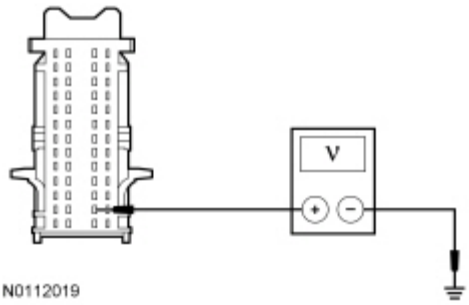
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Stoplamp switch
- BCM

PINPOINT TEST I: ALL THE STOPLAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
I1 CHECK FOR VOLTAGE TO THE STOPLAMP SWITCH	**Yes** GO to I2 . **No** VERIFY the BJB fuse 46 (10A) is OK. If OK, REPAIR circuit SBB46 (BN/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
• Ignition OFF. • Disconnect: Stoplamp Switch C278. • Measure the voltage between the stoplamp switch C278-4, circuit SBB46 (BN/RD), harness side and ground.  N0104362 • **Is the voltage greater than 10 volts?**	
I2 BYPASS THE STOPLAMP SWITCH	**Yes** REMOVE the jumper wire. INSTALL a new stoplamp switch. REFER to Stoplamp Switch in this section.
• Connect a fused jumper wire between the stoplamp switch C278-4, circuit SBB46 (BN/RD), harness side and the stoplamp switch C278-1, circuit CCB08 (VT/WH), harness side.	

 N0038807 • **Are the stoplamps illuminated?**	TEST the system for normal operation. **No** LEAVE the jumper wire connected. GO to I3 .
I3 CHECK THE STOPLAMP SWITCH SIGNAL TO THE BCM	
• Disconnect: BCM C2280B. • Measure the voltage between the BCM C2280B-28, circuit CCB08 (VT/WH), harness side and ground.  N0112019 • **Is the voltage greater than 10 volts?**	**Yes** REMOVE the jumper wire. GO to I4 . **No** REMOVE the jumper wire. REPAIR circuit CCB08 (VT/WH) for an open. TEST the system for normal operation.
I4 CHECK FOR CORRECT BCM OPERATION	
• Disconnect all the BCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the BCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test J: One Or More Stoplamps Are Inoperative

Refer to Wiring Diagrams Cell 90 , Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

When the brake pedal is applied, the stoplamp switch routes voltage to the Body Control Module (BCM), indicating the brake pedal is applied.

The BCM provides voltage to all the stoplamps (on independent circuits) when it detects the brake pedal is applied.

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The LH stoplamps share the fused power source with the LH front turn lamp and the LH exterior mirror turn lamp.

The RH stoplamps share the fused power source with the RH front turn lamp and the RH exterior mirror turn lamp.

The high mounted stoplamp shares the fused power source with the reversing lamps.

The rear stoplamps share a common ground circuit.

DTC Description	Fault Trigger Conditions
• B1115:11 — High Mounted Stop Lamp Control: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the high mounted stoplamp voltage supply circuit.
• B132B:11 — Left Stop/Turn Lamp: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the LH rear stop/turn lamp voltage supply circuit.
• B132B:15 — Left Stop/Turn Lamp: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open from the LH rear stop/turn lamp voltage supply circuit.
• B132C:11 — Right Stop/Turn Lamp: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the RH rear stop/turn lamp voltage supply circuit.
• B132C:15 — Right Stop/Turn Lamp: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open from the RH rear stop/turn lamp voltage supply circuit.
• U1000:00 — Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	This DTC sets when the BCM has temporarily shut down the output driver. **The module has temporarily disabled a stoplamp output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the stoplamp output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	This DTC sets when the BCM has permanently shut down the output driver. **The module has permanently disabled a stoplamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. CORRECT the cause of the excessive current draw before installing a new BCM .**

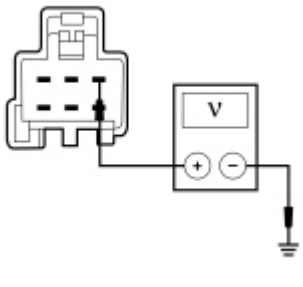
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Bulb socket
- High mounted stoplamp
- BCM

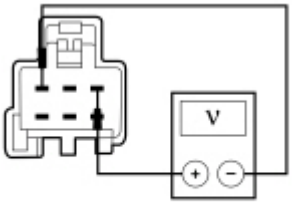
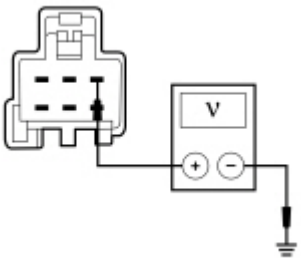
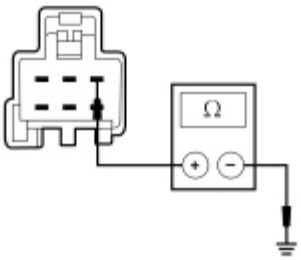
PINPOINT TEST J: ONE OR MORE STOPLAMPS ARE INOPERATIVE

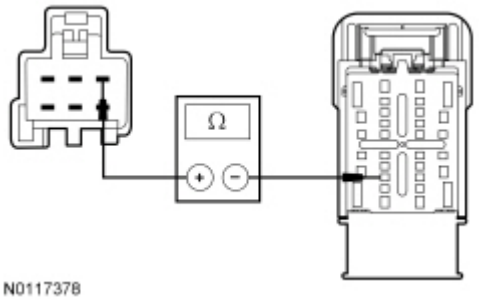
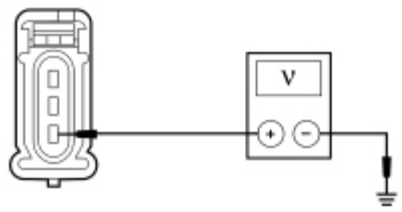
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Make sure the bulb is good before continuing diagnostics.

Test Step	Result / Action to Take
J1 DETERMINE THE INOPERATIVE STOPLAMP • Ignition OFF. • Apply the brake pedal and observe the stoplamps. • **Are all the stoplamps inoperative?**	**Yes** GO to Pinpoint Test I . **No** For the high mounted stoplamp, GO to J2 . If an individual rear stoplamp is inoperative, GO to J7 . If both LH and RH rear stoplamps are inoperative, REPAIR circuit GD117 (BK) for an open. TEST the system for normal operation.
J2 CHECK FOR VOLTAGE TO THE HIGH MOUNTED STOPLAMP • Disconnect: High Mounted Stoplamp C904. • While applying the brake pedal, measure the voltage between the high mounted stoplamp C904-3, circuit CLS52 (BN), harness side and ground.  N0117374 • **Is the voltage greater than 10 volts?**	**Yes** GO to J3 . **No** VERIFY the BCM fuse 15 (15A) is OK. If OK, GO to J4 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the stoplamp output driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
J3 CHECK THE HIGH MOUNTED STOPLAMP GROUND CIRCUIT FOR AN OPEN • While applying the brake pedal, measure the voltage between the high mounted stoplamp C904-3, circuit CLS52 (BN), harness side and the high mounted stoplamp C904-1, circuit GD139 (BK/YE), harness side.	**Yes** INSTALL a new high mounted stoplamp. TEST the system for normal operation. **No** REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation.

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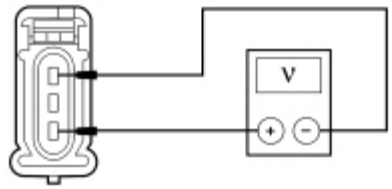
 N0117376 • **Is the voltage greater than 10 volts?**	
J4 CARRY OUT THE BCM ON-DEMAND SELF-TEST AND RECHECK FOR VOLTAGE TO THE HIGH MOUNTED STOPLAMP	**Yes** INSTALL a new high mounted stoplamp. TEST the system for normal operation. **No** GO to J5.
• Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • Clear the DTCs and repeat the BCM on-demand self-test. • While applying the brake pedal, measure the voltage between the high mounted stoplamp C904-3, circuit CLS52 (BN), harness side and ground.  N0117374 • **Is the voltage greater than 10 volts?**	
J5 CHECK THE HIGH MOUNTED STOPLAMP OUTPUT CIRCUIT FOR A SHORT TO GROUND	**Yes** GO to J6.
• Ignition OFF. • Disconnect: BCM C2280D. • Measure the resistance between the high mounted stoplamp C904-3, circuit CLS52 (BN), harness side and ground.  N0117377 • **Is the resistance greater than 10,000 ohms?**	**No** REPAIR circuit CLS52 (BN) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the stoplamp output driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.

J6 CHECK THE HIGH MOUNTED STOPLAMP OUTPUT CIRCUIT FOR AN OPEN	
• Measure the resistance between the high mounted stoplamp C904-3, circuit CLS52 (BN), harness side and the BCM C2280D-14, circuit CLS52 (BN), harness side.  N0117378 • **Is the resistance less than 5 ohms?**	**Yes** GO to J12 . **No** REPAIR circuit CLS52 (BN) for an open. TEST the system for normal operation.
J7 CHECK FOR VOLTAGE TO THE REAR STOPLAMP	
• Disconnect: Inoperative Rear Lamp. • While applying the brake pedal, measure the voltage between the inoperative lamp, harness side and ground as follows: **Inoperative Lamp** / **Connector-Pin** / **Circuit** LH upper / C4112-3 / CLS18 (GY/BN) LH lower / C4113-3 / CLS18 (GY/BN) RH upper / C4114-3 / CLS19 (VT/OG) RH lower / C4115-3 / CLS19 (VT/OG)  N0064675 • **Is the voltage greater than 10 volts?**	**Yes** GO to J8 . **No** VERIFY the BCM fuse 14 (15A) (LH stoplamps) or fuse 13 (15A) (RH stoplamps) is OK. If OK, GO to J9 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the stoplamp output driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
J8 CHECK THE REAR STOPLAMP GROUND CIRCUIT FOR AN OPEN	
• While applying the brake pedal, measure the	**Yes**

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voltage between the inoperative lamp, harness side and ground as follows:

Inoperative Lamp	Connector-Pin Circuit	Connector-Pin Circuit
LH upper	C4112-3 CLS18 (GY/BN)	C4112-1 GD117 (BK)
LH lower	C4113-3 CLS18 (GY/BN)	C4113-1 GD117 (BK)
RH upper	C4114-3 CLS19 (VT/OG)	C4114-1 GD117 (BK)
RH lower	C4115-3 CLS19 (VT/OG)	C4115-1 GD117 (BK)



N0090078

- **Is the voltage greater than 10 volts?**

Yes
INSTALL a new bulb socket. TEST the system for normal operation.

No
REPAIR circuit GD176 (BK/WH) for an open. TEST the system for normal operation.

J9 CARRY OUT THE BCM ON-DEMAND SELF-TEST AND RECHECK FOR VOLTAGE TO THE REAR STOPLAMP

NOTE: If both lamps are inoperative on the same side, disconnect one lamp at a time when carrying out this test.

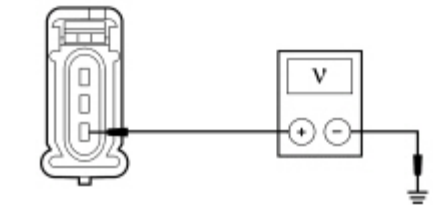
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: BCM Self-Test.
- Clear the DTCs and repeat the BCM on-demand self-test.
- While applying the brake pedal, measure the voltage between the inoperative lamp, harness side and ground as follows:

Inoperative	Connector-	

Yes
INSTALL a new bulb socket. TEST the system for normal operation.

No
GO to J10 .

Lamp	Pin	Circuit
LH upper	C4112-3	CLS18 (GY/BN)
LH lower	C4113-3	CLS18 (GY/BN)
RH upper	C4114-3	CLS19 (VT/OG)
RH lower	C4115-3	CLS19 (VT/OG)



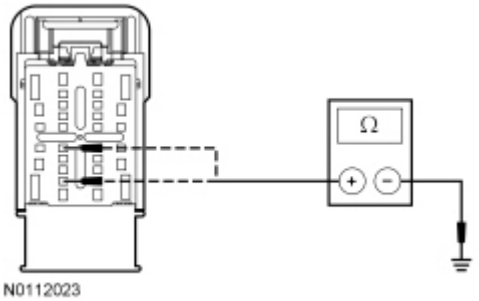
N0064675

- **Is the voltage greater than 10 volts?**

J10 CHECK THE REAR STOPLAMP VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND

NOTE: It is important to disconnect the corresponding trailer tow stop/turn relay for correct test results.

- Ignition OFF.
- Disconnect: BCM C2280D.
- Disconnect: Corresponding Trailer Tow Stop/Turn Relay.
- Measure the resistance between the BCM C2280D-12 (LH stoplamps), circuit CLS18 (GY/BN), harness side and ground; or between the BCM C2280D-15 (RH stoplamps), circuit CLS19 (VT/OG), harness side and ground.



N0112023

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to J11.

No
REPAIR circuit CLS18 (GY/BN) (LH stoplamps) or circuit CLS19 (VT/OG) (RH stoplamps) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the stoplamp output driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.

J11 CHECK THE REAR STOPLAMP VOLTAGE SUPPLY CIRCUIT FOR AN OPEN

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<table>
<tr>
<td>

Measure the resistance between the inoperative rear lamp, harness side and the BCM, harness side as follows:

<table>
<tr><th>Inoperative Lamp

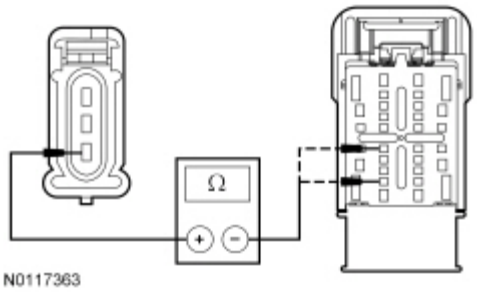
Connector-Pin</th><th>BCM

Connector-Pin</th><th>Circuit</th></tr>
<tr><td>LH upper

C4112-3</td><td>C2280D-12</td><td>CLS18 (GY/BN)</td></tr>
<tr><td>LH lower

C4113-3</td><td>C2280D-12</td><td>CLS18 (GY/BN)</td></tr>
<tr><td>RH upper

C4114-3</td><td>C2280D-15</td><td>CLS19 (VT/OG)</td></tr>
<tr><td>RH lower

C4115-3</td><td>C2280D-15</td><td>CLS19 (VT/OG)</td></tr>
</table>


Is the resistance less than 5 ohms?

</td>
<td>Yes
GO to J12.

No
REPAIR circuit CLS18 (GY/BN) (LH stoplamps) or circuit CLS19 (VT/OG) (RH stoplamps) for an open. TEST the system for normal operation.</td>
</tr>
<tr>
<td>J12 CHECK FOR CORRECT BCM OPERATION

Disconnect all the BCM connectors.
Check for:

corrosion
damaged pins
pushed-out pins

Connect all the BCM connectors and make sure they seat correctly.
Operate the system and verify the concern is still present.
Is the concern still present?

</td>
<td>Yes
INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.</td>
</tr>
</table>

Pinpoint Test K: The Stoplamp(s) Are On Continuously

Refer to Wiring Diagrams Cell 90, Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

When the brake pedal is applied, the stoplamp switch routes voltage to the PCM and to the Body Control Module (BCM) to indicate that the brake pedal is applied.

The BCM provides voltage to all the stoplamps (on independent circuits) when it detects that the brake pedal is applied.

The voltage from the stoplamp switch also passes through the BCM fuse 31 (5A) and is routed to the Trailer Brake Control (TBC) module on one circuit and for a customer access use on another circuit.

DTC Description	Fault Trigger Conditions
• B132B:15 — Left Stop/Turn Lamp: Circuit Short To Battery or Open	This DTC sets when the BCM detects a short to voltage from the LH rear stop/turn lamp voltage supply circuit.
• B132C:15 — Right Stop/Turn Lamp: Circuit Short To Battery or Open	This DTC sets when the BCM detects a short to voltage from the RH rear stop/turn lamp voltage supply circuit.
• C0040:12 — Brake Pedal Switch "A": Circuit Short To Battery	This DTC sets when the BCM detects a short to voltage from the stoplamp switch input circuit.

This pinpoint test is intended to diagnose the following:

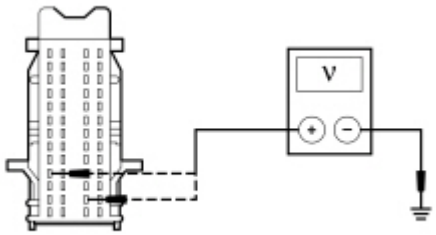
- Wiring, terminals or connectors
- Stoplamp switch
- TBC module
- PCM
- BCM

PINPOINT TEST K: THE STOPLAMP(S) ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
K1 DETERMINE IF ALL THE STOPLAMPS ARE ON	
• Ignition ON. • Observe the stoplamps. • **Are all the stoplamps on?**	**Yes** GO to K3 . **No** GO to K2 .
K2 CHECK THE STOPLAMP VOLTAGE SUPPLY CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280D. • Ignition ON. • **Does any stoplamp continue to illuminate?**	**Yes** If the LH rear lamps continue to illuminate, REPAIR circuit CLS18 (GY/BN) for a short to voltage. TEST the system for normal operation. If the RH rear lamps continue to illuminate, REPAIR circuit CLS19 (VT/OG) for a short to voltage. TEST the system for normal operation. If the high mounted stoplamp continues to illuminate, REPAIR circuit CLS52 (BN) for a short to

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	voltage. TEST the system for normal operation. **No** GO to K9.
K3 CHECK THE STOPLAMP SWITCH • Disconnect: Stoplamp Switch C278. • **Do the stoplamps continue to illuminate?**	**Yes** GO to K4. **No** INSTALL a new stoplamp switch. REFER to Stoplamp Switch in this section. TEST the system for normal operation.
K4 CHECK THE PCM • Ignition OFF. • Disconnect: PCM C1551 (3.5L), C175B (3.7L) or C1381B (5.0L/6.2L). • Ignition ON. • **Do the stoplamps continue to illuminate?**	**Yes** If the vehicle is equipped with an aftermarket TBC module, GO to K5. If the vehicle is not equipped with an aftermarket TBC module, GO to K6. **No** GO to K8.
K5 CHECK THE TBC MODULE • Ignition OFF. • Disconnect: TBC Module C2142. • Ignition ON. • **Do the stoplamps continue to illuminate?**	**Yes** GO to K6. **No** INSTALL a new TBC module. TEST the system for normal operation.
K6 CHECK THE CUSTOMER ACCESS CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280F. • Ignition ON. • **Do the stoplamps continue to illuminate?**	**Yes** GO to K7. **No** REPAIR circuit CBP31 (BU/OG) for a short to voltage. TEST the system for normal operation.
K7 CHECK THE STOPLAMP SWITCH INPUT AND TBC MODULE BRAKE INPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280B. • Ignition ON. • Measure the voltage between the BCM C2280B-28, circuit CCB08 (VT/WH), harness side and ground; and between the BCM C2280B-4, circuit CBP31 (BU/OG), harness side and ground	**Yes** REPAIR circuit CCB08 (VT/WH) or circuit CBP31 (BU/OG) for a short to voltage as necessary. TEST the system for normal operation. **No** GO to K9.

 N0117379 • **Is any voltage present?**	
K8 CHECK FOR CORRECT PCM OPERATION	

• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

K9 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Trailer Lamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The trailer lamps and trailer battery charge are supplied power by relays that are energized to correspond with the exterior lighting and ignition state functions of the vehicle.

If the vehicle is not equipped with the factory manufactured Trailer Brake Control (TBC) module, the vehicle supplies circuitry to support the installation of an aftermarket TBC module (installed by the customer). To support the aftermarket TBC module, the vehicle circuitry only supplies voltage, ground, stoplamp switch input and a brake controlling circuit to the trailer tow connector. The trailer electric brakes themselves are controlled by the aftermarket trailer brake controller and not the vehicle itself.

For diagnostics and a description of the factory manufactured trailer brake control system, refer to Section 206-10 .

The trailer tow battery charge relay is controlled by the Body Control Module (BCM). If the BCM detects a low voltage concern when the ignition is in ACC or RUN, the BCM disables the trailer tow battery charge relay coil circuit.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

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The BCM utilizes a FET protective circuit strategy for many of its outputs (such as a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection, allowing the circuit to function. If the circuit is still shorted the next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection), the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When a tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by the clear the continuous DTCs command. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns. The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuits for the trailer tow electrical system is the trailer tow battery charge relay coil ground controlled circuit.

Inspection and Verification

1. Verify the customer concern.

2. Verify the exterior lighting and charging system of the vehicle is operating correctly. If not, refer to the appropriate pinpoint test in this section.

3. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical

• Battery Junction Box (BJB) fuse(s):
  ▪ 17 (30A) (Trailer Brake Control (TBC) module)
  ▪ 21 (30A) (trailer tow battery charge relay switch side)
  ▪ 43 (15A) (trailer tow reversing lamps)
  ▪ 54 (5A) (trailer tow battery charge relay coil)
  ▪ 67 (20A) (trailer tow parking lamps)
  ▪ 73 (20A) (trailer tow turn relays)
• Body Control Module (BCM) fuse 31 (5A) (stoplamp switch input)
• Wiring, terminals or connectors
• Trailer tow connector
• Trailer tow stop/turn relays
• Trailer tow battery charge relay

- Trailer tow parking lamp relay
- TBC module (aftermarket)
- Trailer

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

5. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

6. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

9. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM.

10. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

11. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All the trailer lamps are inoperative	• Wiring, terminals or connectors • Trailer tow connector • Trailer	• GO to Pinpoint Test X.
• The trailer stop/turn lamp is	• Fuse	• GO to

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inoperative	• Wiring, terminals or connectors • Trailer tow connector • Trailer tow stop/turn relay • Trailer	Pinpoint Test Y.
• The trailer parking lamps are inoperative	• Fuse • Wiring, terminals or connectors • Trailer tow connector • Trailer tow parking lamp relay • Trailer	• GO to Pinpoint Test Z.
• The trailer reversing lamps are inoperative	• Fuse • Wiring, terminals or connectors • Trailer tow connector • Trailer tow reversing lamp relay • Trailer	• GO to Pinpoint Test AA.
• The trailer lamps are on continuously	• Wiring, terminals or connectors • Trailer tow relay • Trailer	• GO to Pinpoint Test AB.
• The trailer battery charging is inoperative/does not operate correctly	• Fuse • Wiring, terminals or connectors • Trailer tow connector • Trailer tow battery charge relay • Trailer • Body Control Module (BCM)	• GO to Pinpoint Test AC.
• The trailer electric brakes are inoperative/always applied	• Fuse • Wiring, terminals or connectors • Trailer tow connector • Trailer Brake Control (TBC) module (aftermarket) • Trailer • BCM	• GO to Pinpoint Test AD.

Pinpoint Tests

Pinpoint Test X: All The Trailer Lamps Are Inoperative

Refer to Wiring Diagrams Cell 11, Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 95, Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The trailer tow connector receives ground through a dedicated ground circuit. This circuit is the shared ground for all of the trailer lamps.

All of the trailer lamp relays share a common ground.

This pinpoint test is intended to diagnose the following:

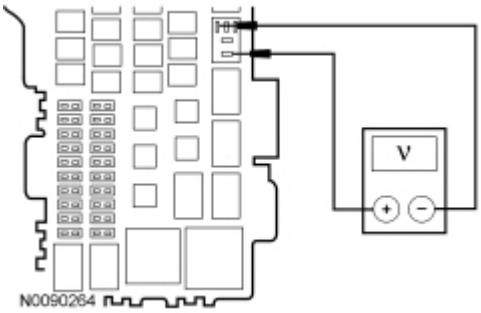
- Wiring, terminals or connectors
- Trailer tow connector
- Trailer

PINPOINT TEST X: ALL THE TRAILER LAMPS ARE INOPERATIVE

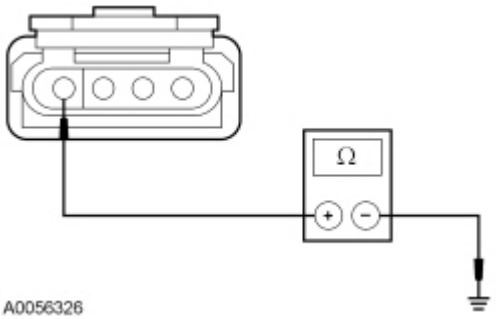
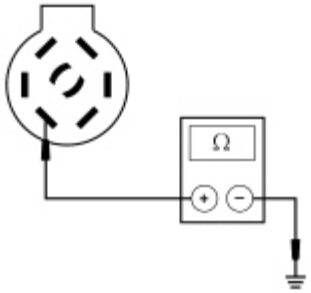
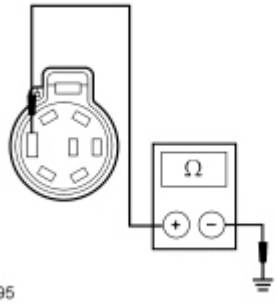
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before beginning diagnostics, visually inspect the trailer tow connector mounted on the bumper for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
X1 CHECK THE RELAY GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Trailer Tow Parking Lamp Relay. • Measure the voltage between the trailer tow parking lamp relay pin 3, circuit SBB67 (BU/RD), BJB face side and the trailer tow parking lamp relay pin 2, circuit GD123 (BK/GY), BJB face side.  • **Is the voltage greater than 10 volts?**	**Yes** GO to X2 . **No** REPAIR circuit GD123 (BK/GY) for an open. TEST the system for normal operation
X2 CHECK THE TRAILER TOW GROUND CIRCUIT FOR CONTINUITY TO GROUND	
• Disconnect: Negative Battery Cable. • For the 4-pin connector, measure the resistance between the trailer tow C439B-4, circuit RAT08 (WH), harness side and ground.	**Yes** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility. **No**

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 A0056326 • For the 7-pin connector, measure the resistance between the trailer tow connector pin 2, circuit RAT08 (WH), component side and ground.  N0068878 • **Is the resistance less than 5 ohms?**	For the 4-pin connector, REPAIR circuit RAT08 (WH) for an open. TEST the system for normal operation. For the 7-pin connector, GO to X3 .
X3 CHECK THE TRAILER TOW GROUND CIRCUIT FOR AN OPEN • Disconnect: Trailer Tow C439A. • Measure the resistance between the trailer tow C439A-2, circuit RAT08 (WH), harness side and ground.  N0066295 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** REPAIR circuit RAT08 (WH) for an open. TEST the system for normal operation.

Pinpoint Test Y: The Trailer Stop/Turn Lamp Is Inoperative

Refer to Wiring Diagrams Cell 11 , Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The trailer tow LH stop/turn relay coil receives voltage when the vehicle LH rear stoplamp is illuminated. When the trailer tow LH stop/turn relay is energized, voltage is routed to the trailer tow connector.

The trailer tow RH stop/turn relay coil receives voltage when the vehicle RH rear stoplamp is illuminated. When the trailer tow RH stop/turn relay is energized, voltage is routed to the trailer tow connector.

The Battery Junction Box (BJB) fuse 73 (20A) supplies voltage to both trailer tow stop/turn relays.

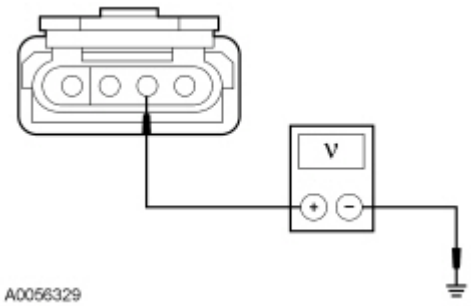
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Trailer tow connector
- Trailer tow stop/turn relay
- Trailer

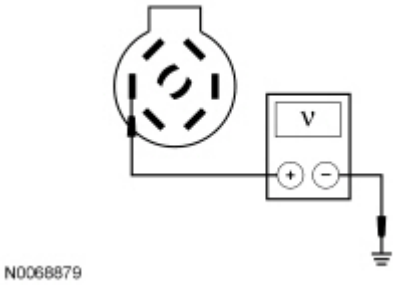
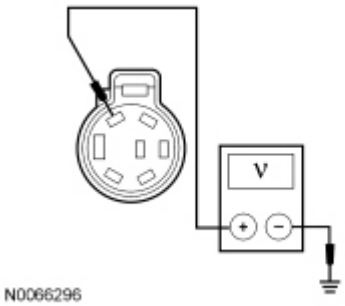
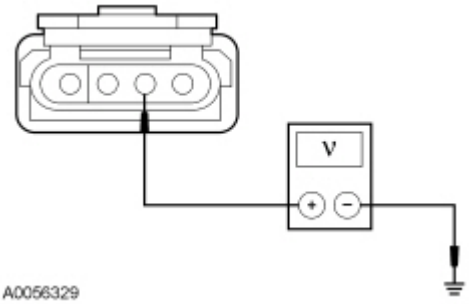
PINPOINT TEST Y: THE TRAILER STOP/TURN LAMP IS INOPERATIVE

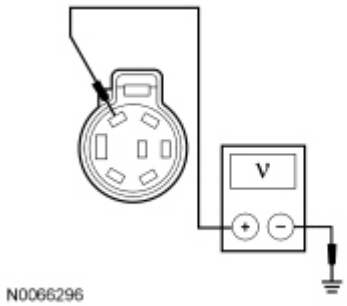
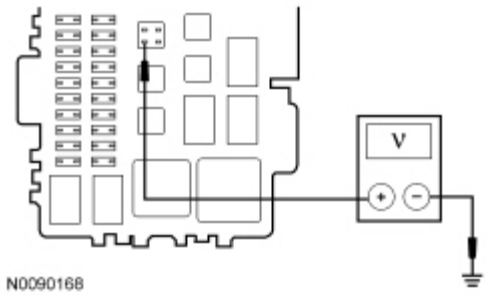
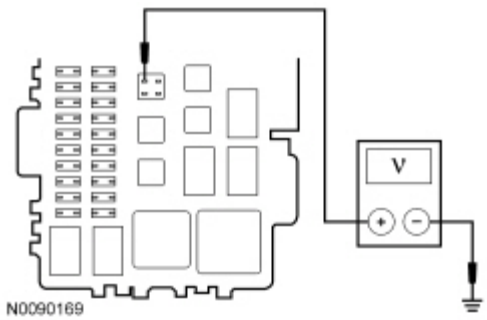
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before beginning diagnostics, visually inspect the trailer tow connector for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

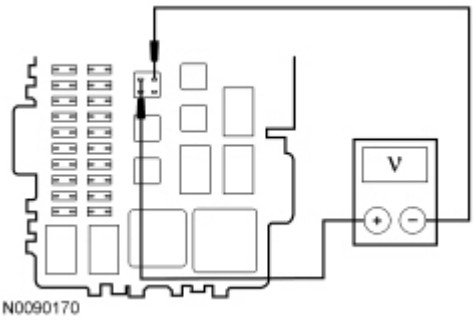
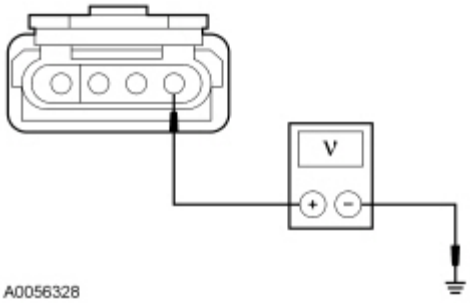
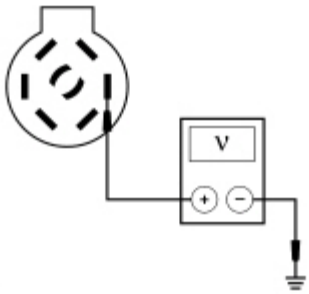
Test Step	Result / Action to Take
Y1 VERIFY THE TRAILER LAMP OPERATION	
• Ignition OFF. • Determine if both trailer stop/turn lamps are inoperative. • **Are both trailer stop/turn lamps inoperative?**	**Yes** VERIFY the BJB fuse 73 (20A) is OK. If OK, REPAIR circuit SBB73 (RD) for an open. TEST the system for normal operation. **No** For an inoperative LH trailer lamp, GO to Y2 . For an inoperative RH trailer lamp, GO to Y8 .
Y2 CHECK FOR VOLTAGE THROUGH THE TRAILER TOW CONNECTOR (LH TRAILER STOP/TURN LAMP)	
• For the 4-pin connector, while applying the brake pedal, measure the voltage between the trailer tow C439B-2, circuit CAT06 (YE), harness side and ground.  	**Yes** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility. **No** For the 4-pin connector, GO to Y4 . For the 7-pin connector, GO to Y3 .

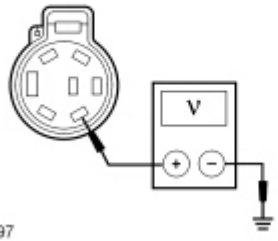
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• For the 7-pin connector, while applying the brake pedal, measure the voltage between the trailer tow connector pin 1, circuit CAT06 (YE), component side and ground.  N0068879 • **Is the voltage greater than 10 volts?**	
Y3 CHECK FOR VOLTAGE TO THE TRAILER TOW CONNECTOR (LH STOP/TURN 7-PIN)	
• Disconnect: Trailer Tow C439A. • While applying the brake pedal, measure the voltage between the trailer tow C439A-1, circuit CAT06 (YE), harness side and ground.  N0066296 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** GO to Y4 .
Y4 CHECK THE TRAILER TOW LH STOP/TURN RELAY	
• Disconnect: Trailer Tow LH Stop/Turn Relay. • Substitute a known good relay. • For the 4-pin connector, while applying the brake pedal, measure the voltage between the trailer tow C439B-2, circuit CAT06 (YE), harness side and ground.  A0056329 • For the 7-pin connector, while applying the brake pedal, measure the voltage between the trailer tow C439A-1, circuit CAT06 (YE), harness side and ground.	**Yes** REMOVE the known good relay. INSTALL a new trailer tow turn relay. TEST the system for normal operation. **No** REMOVE the known good relay. GO to Y5 .

 N0066296 • **Is the voltage greater than 10 volts?**	
Y5 CHECK FOR VOLTAGE TO THE LH STOP/TURN LAMP RELAY COIL	
• While applying the brake pedal, measure the voltage between the trailer tow LH turn relay pin 1, circuit CLS18 (GY/BN), BJB face side and ground.  N0090168 • **Is the voltage greater than 10 volts?**	**Yes** GO to Y6 . **No** REPAIR circuit CLS18 (GY/BN) for an open. TEST the system for normal operation.
Y6 CHECK THE VOLTAGE SUPPLY CIRCUIT TO THE LH STOP/TURN LAMP RELAY	
• Measure the voltage between the trailer tow LH turn relay pin 3, circuit SBB73 (RD), BJB face side and ground.  N0090169 • **Is the voltage greater than 10 volts?**	**Yes** GO to Y7 . **No** REPAIR circuit SBB73 (RD) for an open. TEST the system for normal operation.
Y7 CHECK THE LH STOP/TURN LAMP RELAY GROUND CIRCUIT FOR AN OPEN	
• Measure the voltage between the trailer tow LH turn relay pin 3, circuit SBB73 (RD), BJB face side and the trailer tow LH turn relay pin 2, circuit GD123 (BK/GY), BJB face side.	**Yes** REPAIR circuit CAT06 (YE) for an open. TEST the system for normal operation. **No** REPAIR circuit GD123

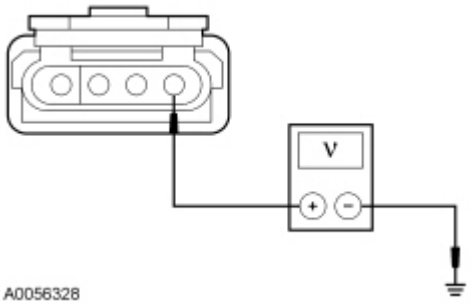
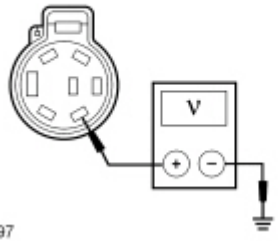
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 N0090170 • **Is the voltage greater than 10 volts?**	(BK/GY) for an open. TEST the system for normal operation.
Y8 CHECK FOR VOLTAGE THROUGH THE TRAILER TOW CONNECTOR (RH TRAILER STOP/TURN LAMP)	
• For the 4-pin connector, while applying the brake pedal, measure the voltage between the trailer tow C439B-1, circuit CAT09 (GN), harness side and ground.  A0056328 • For the 7-pin connector, while applying the brake pedal, measure the voltage between the trailer tow connector pin 4, circuit CAT09 (GN), component side and ground.  N0068880 • **Is the voltage greater than 10 volts?**	**Yes** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility. **No** For the 4-pin connector, GO to Y10 . For the 7-pin connector, GO to Y9 .
Y9 CHECK FOR VOLTAGE TO THE TRAILER TOW CONNECTOR (RH STOP/TURN 7-PIN)	
• Disconnect: Trailer Tow C439A. • While applying the brake pedal, measure the voltage between the trailer tow C439A-4, circuit CAT09 (GN), harness side and ground.	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** GO to Y10 .

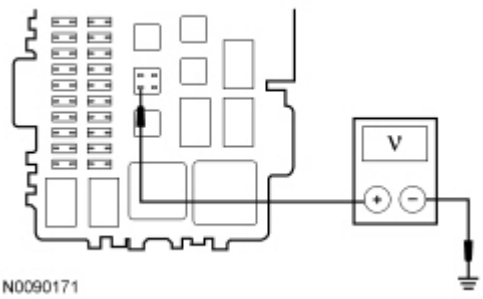
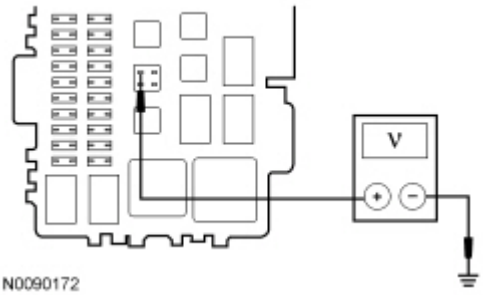
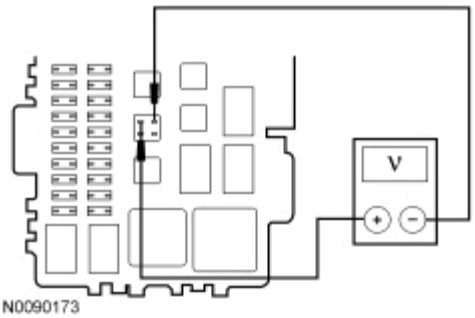


N0066297

- **Is the voltage greater than 10 volts?**

Y10 CHECK THE TRAILER TOW RH STOP/TURN RELAY	
• Disconnect: Trailer Tow RH Stop/Turn Relay. • Substitute a known good relay. • For the 4-pin connector, while applying the brake pedal, measure the voltage between the trailer tow C439B-1, circuit CAT09 (GN), harness side and ground.  A0056328 • For the 7-pin connector, while applying the brake pedal, measure the voltage between the trailer tow C439A-4, circuit CAT09 (GN), harness side and ground.  N0066297 • **Is the voltage greater than 10 volts?**	**Yes** REMOVE the known good relay. INSTALL a new trailer tow turn relay. TEST the system for normal operation. **No** REMOVE the known good relay. GO to Y11 .
Y11 CHECK FOR VOLTAGE TO THE RH STOP/TURN LAMP RELAY COIL	
• While applying the brake pedal, measure the voltage between the trailer tow RH turn relay pin 1, circuit CLS19 (VT/OG), BJB face side and ground.	**Yes** GO to Y12 . **No** REPAIR circuit CLS19 (VT/OG) for an open. TEST the system for normal operation.

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 N0090171 • **Is the voltage greater than 10 volts?**	
Y12 CHECK THE VOLTAGE SUPPLY CIRCUIT TO THE RH STOP/TURN LAMP RELAY	
• Measure the voltage between the trailer tow RH turn relay pin 3, circuit SBB73 (RD), BJB face side and ground.  N0090172 • **Is the voltage greater than 10 volts?**	**Yes** GO to Y13 . **No** REPAIR circuit SBB73 (RD) for an open. TEST the system for normal operation.
Y13 CHECK THE RH STOP/TURN LAMP RELAY GROUND CIRCUIT FOR AN OPEN	
• Measure the voltage between the trailer tow RH turn relay pin 3, circuit SBB73 (RD), BJB face side and the trailer tow RH turn relay pin 2, circuit GD123 (BK/GY), BJB face side.  N0090173 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit CAT09 (GN) for an open. TEST the system for normal operation. **No** REPAIR circuit GD123 (BK/GY) for an open. TEST the system for normal operation.

Pinpoint Test Z: The Trailer Parking Lamps Are Inoperative

Refer to Wiring Diagrams Cell 11 , Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The trailer tow parking lamp relay coil receives voltage when the vehicle parking lamps are illuminated. The Battery Junction Box (BJB) fuse 67 (20A) supplies voltage to the trailer tow parking lamp relay switch side. When the trailer tow parking lamp relay is energized, voltage is routed to the trailer tow connector.

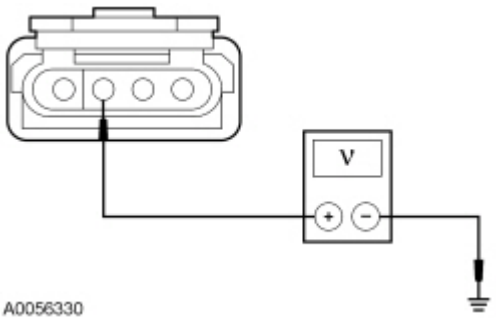
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Trailer tow connector
- Trailer tow parking lamp relay
- Trailer

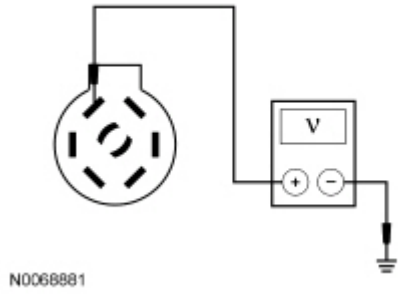
PINPOINT TEST Z: THE TRAILER PARKING LAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before beginning diagnostics, visually inspect the trailer tow connector for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

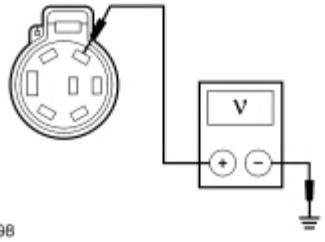
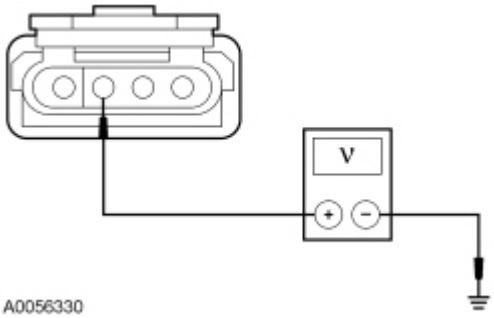
Test Step	Result / Action to Take
Z1 CHECK FOR VOLTAGE THROUGH THE TRAILER TOW CONNECTOR	
• Ignition OFF. • Place the headlamp switch in the PARKING LAMPS ON position. • For the 4-pin connector, measure the voltage between the trailer tow C439B-3, circuit CAT17 (BN), harness side and ground.  A0056330 • For the 7-pin connector, measure the voltage between the trailer tow connector pin 6, circuit CAT17 (BN), component side and ground.	**Yes** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility. **No** For the 4-pin connector, GO to Z3 . For the 7-pin connector, GO to Z2 .

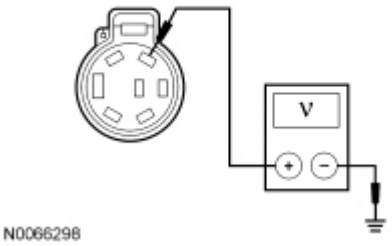
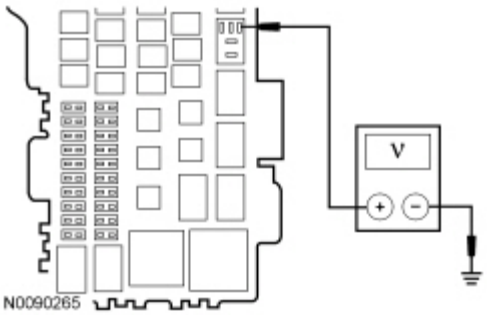
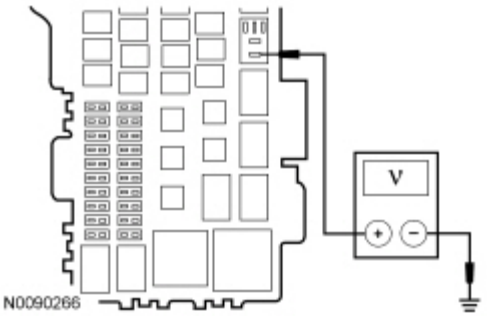
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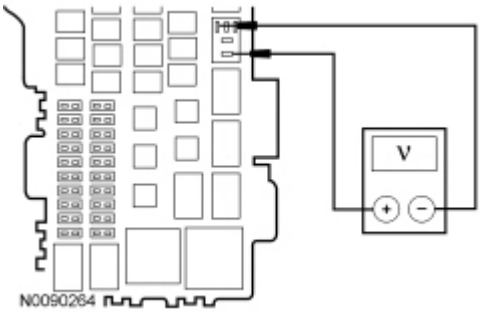
N0068881

- **Is the voltage greater than 10 volts?**

Z2 CHECK FOR VOLTAGE TO THE TRAILER TOW CONNECTOR (7-PIN)	
• Disconnect: Trailer Tow C439A. • Measure the voltage between the trailer tow C439A-6, circuit CAT17 (BN), harness side and ground.  N0066298 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** GO to Z3 .
Z3 CHECK THE TRAILER TOW PARKING LAMP RELAY	
• Place the headlamp switch in the OFF position. • Disconnect: Trailer Tow Parking Lamp Relay. • Substitute a known good relay. • Place the headlamp switch in the PARKING LAMPS ON position. • For the 4-pin connector, measure the voltage between the trailer tow C439B-3, circuit CAT17 (BN), harness side and ground.  A0056330 • For the 7-pin connector, measure the voltage between the trailer tow C439A-6, circuit CAT17 (BN), harness side and ground.	**Yes** REMOVE the known good relay. GO to Z4 . **No** REMOVE the known good relay. INSTALL a new trailer tow parking lamp relay. TEST the system for normal operation.

 N0066298 • **Is the trailer tow parking lamp relay OK?**	
Z4 CHECK FOR VOLTAGE TO THE TRAILER TOW PARKING LAMP RELAY COIL	
• Measure the voltage between the trailer tow parking lamp relay pin 1, circuit CBP40 (YE/GN), BJB face side and ground.  N0090265 • **Is the voltage greater than 10 volts?**	**Yes** GO to Z5 . **No** REPAIR circuit CBP40 (YE/GN) for an open. TEST the system for normal operation.
Z5 CHECK THE VOLTAGE SUPPLY CIRCUIT TO THE TRAILER TOW PARKING LAMP RELAY	
• Place the headlamp switch in the OFF position. • Measure the voltage between the trailer tow parking lamp relay pin 3, circuit SBB67 (BU/RD), BJB face side and ground.  N0090266 • **Is the voltage greater than 10 volts?**	**Yes** GO to Z6 . **No** VERIFY the BJB fuse 67 (20A) is OK. If OK, REPAIR circuit SBB67 (BU/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
Z6 CHECK THE TRAILER TOW PARKING LAMP RELAY GROUND CIRCUIT FOR AN OPEN	
• Measure the voltage between the trailer tow parking lamp relay pin 3, circuit SBB67 (BU/RD), BJB face side and the trailer tow parking lamp relay pin 2, circuit GD123 (BK/GY), BJB face side.	**Yes** REPAIR circuit CAT17 (BN) for an open. TEST the system for normal operation.

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 • **Is the voltage greater than 10 volts?**	**No** REPAIR circuit GD123 (BK/GY) for an open. TEST the system for normal operation.

Pinpoint Test AA: The Trailer Reversing Lamps Are Inoperative

Refer to Wiring Diagrams Cell 11 , Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The trailer tow reversing lamp relay coil receives voltage when the vehicle reversing lamps are illuminated. The Battery Junction Box (BJB) fuse 43 (15A) supplies voltage to the trailer tow reversing lamp relay switch side. When the trailer tow reversing lamp relay is energized, voltage is routed to the trailer tow connector.

This pinpoint test is intended to diagnose the following:

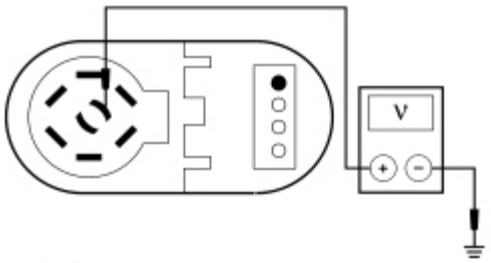
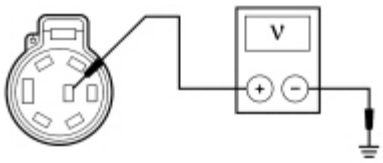
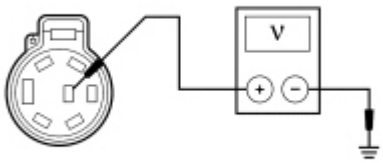
- Fuse
- Wiring, terminals or connectors
- Trailer tow connector
- Trailer tow reversing lamp relay
- Trailer

PINPOINT TEST AA: THE TRAILER REVERSING LAMPS ARE INOPERATIVE

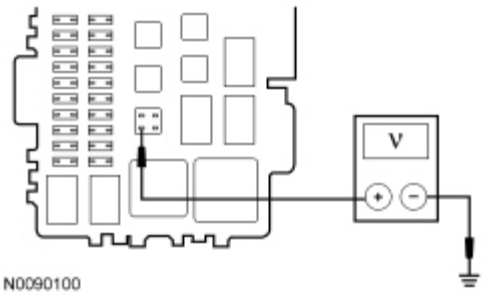
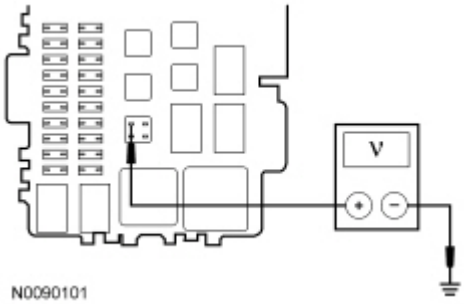
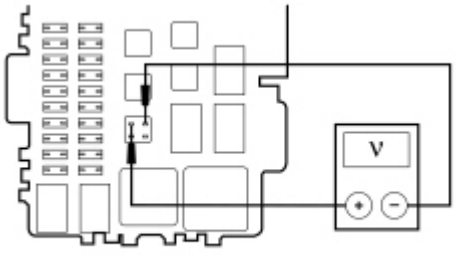
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before beginning diagnostics, visually inspect the trailer tow connector mounted on the bumper for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

Test Step	Result / Action to Take
AA1 CHECK FOR VOLTAGE THROUGH THE TRAILER TOW CONNECTOR	
• Apply the parking brake. • Ignition ON. • Select REVERSE. • Measure the voltage between the trailer tow connector reversing lamp voltage supply pin, circuit CAT16 (GY/BN), component side and ground.	**Yes** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility.

 N0084021 • **Is the voltage greater than 10 volts?**	**No** VERIFY the BJB fuse 43 (15A) is OK. If OK, GO to AA2 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
AA2 CHECK FOR VOLTAGE TO THE TRAILER TOW CONNECTOR (VEHICLE HARNESS)	
• Ignition OFF. • Disconnect: Trailer Tow C439A. • Ignition ON. • Select REVERSE. • Measure the voltage between the trailer tow C439A-7, circuit CAT16 (GY/BN), harness side and ground.  A0025848 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** GO to AA3 .
AA3 CHECK THE TRAILER TOW REVERSING LAMP RELAY	
• Ignition OFF. • Disconnect: Trailer Tow Parking Lamp Relay. • Substitute a known good relay. • Ignition ON. • Select REVERSE. • Measure the voltage between the trailer tow C439A-7, circuit CAT16 (GY/BN), harness side and ground.  A0025848 • **Is the voltage greater than 10 volts?**	**Yes** REMOVE the known good relay. INSTALL a new trailer tow reversing lamp relay. TEST the system for normal operation. **No** REMOVE the known good relay. GO to AA4 .
AA4 CHECK FOR VOLTAGE TO THE TRAILER TOW	

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REVERSING LAMP RELAY COIL	
• Select REVERSE. • Measure the voltage between the trailer tow reversing lamp relay pin 1, circuit CLS28 (BU/WH), BJB face side and ground.  N0090100 • **Is the voltage greater than 10 volts?**	**Yes** GO to AA5 . **No** REPAIR circuit CLS28 (BU/WH) for an open. TEST the system for normal operation.
AA5 CHECK THE TRAILER TOW REVERSING LAMP RELAY BJB VOLTAGE SUPPLY	
• Select PARK. • Ignition OFF. • Measure the voltage between the trailer tow reversing lamp relay pin 3, circuit SBB43 (BU/RD), BJB face side and ground.  N0090101 • **Is the voltage greater than 10 volts?**	**Yes** GO to AA6 . **No** REPAIR circuit SBB43 (BU/RD) for an open. TEST the system for normal operation.
AA6 CHECK THE TRAILER TOW REVERSING LAMP RELAY GROUND CIRCUIT FOR AN OPEN	
• Measure the voltage between the trailer tow reversing lamp relay pin 3, circuit SBB43 (BU/RD), BJB face side and the trailer tow reversing lamp relay pin 2, circuit GD123 (BK/GY), BJB face side.  N0117369	**Yes** REPAIR circuit CAT16 (GY/BN) for an open. TEST the system for normal operation. **No** REPAIR circuit GD123 (BK/GY) for an open. TEST the system for normal operation.

• **Is the voltage greater than 10 volts?**	

Pinpoint Test AB: The Trailer Lamps Are On Continuously

Refer to Wiring Diagrams Cell 11 , Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation — Trailer Tow Stop/Turn Lamps

The trailer tow LH stop/turn relay coil receives voltage when the vehicle LH rear stoplamp is illuminated. When the trailer tow LH stop/turn relay is energized, voltage is routed to the trailer tow connector.

The trailer tow RH stop/turn relay coil receives voltage when the vehicle RH rear stoplamp is illuminated. When the trailer tow RH stop/turn relay is energized, voltage is routed to the trailer tow connector.

Trailer Tow Parking Lamps

The trailer tow parking lamp relay coil receives voltage when the vehicle parking lamps are illuminated. When the trailer tow parking lamp relay is energized, voltage is routed to the trailer tow connector.

Trailer Tow Reversing Lamps

The trailer tow reversing lamp relay coil receives voltage when the vehicle reversing lamps are illuminated. When the trailer tow reversing lamp relay is energized, voltage is routed to the trailer tow connector.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Trailer tow relay
- Trailer

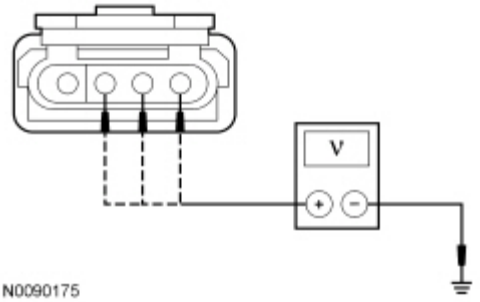
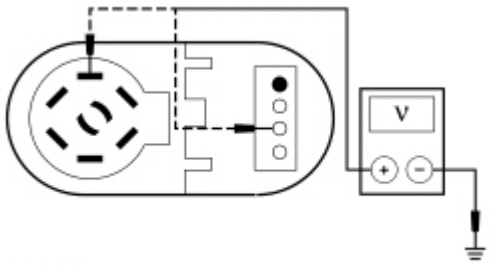
PINPOINT TEST AB: THE TRAILER LAMPS ARE ON CONTINUOUSLY

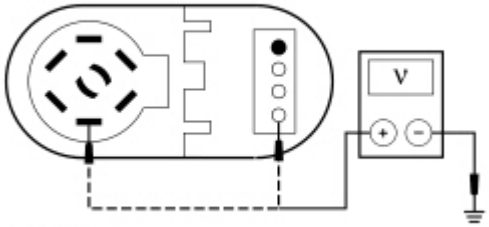
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before beginning diagnostics, visually inspect the trailer tow connector mounted on the bumper for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

Test Step	Result / Action to Take
AB1 CHECK THE VEHICLE EQUIPMENT FOR A 7-PIN CONNECTOR	
• Ignition OFF. • Inspect the vehicle for a 7-pin trainer tow connector. • **Is the vehicle equipped with a 7-pin trailer tow connector?**	**Yes** GO to AB3 . **No** GO to AB2 .
AB2 CHECK FOR VOLTAGE AT THE TRAILER TOW 4-PIN	

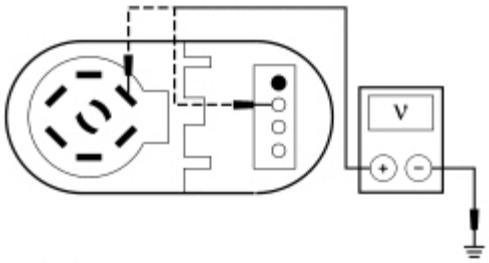
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CONNECTOR • Ignition ON. • Measure the voltage between the trailer tow 4-pin connector, harness side and ground as follows: **Connector-Pin** / **Circuit** C439B-1 (RH stop/turn lamp) / CAT09 (GN) C439B-2 (LH stop/turn lamp) / CAT06 (YE) C439B-3 (parking lamps) / CAT17 (BN)  N0090175 • **Is any voltage present?**	**Yes** GO to AB4 . **No** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility.
AB3 CHECK FOR VOLTAGE AT THE TRAILER TOW 7-PIN CONNECTOR • Ignition ON. • For the LH trailer stop/turn lamp, measure the voltage between the trailer tow connector LH stop/turn lamp voltage supply pins, circuit CAT06 (YE), component side and ground.  N0084018 • For the RH trailer stop/turn lamp, measure the voltage between the trailer tow connector RH stop/turn lamp voltage supply pins, circuit CAT09 (GN), component side and ground.	**Yes** GO to AB4 . **No** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility.



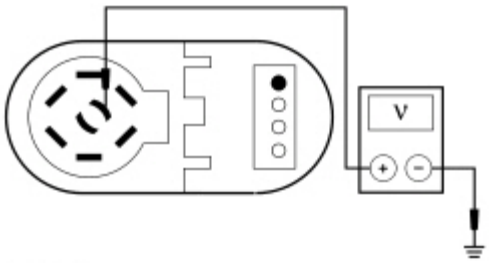
N0084019

- For the trailer parking lamps, measure the voltage between the trailer tow connector parking lamp voltage supply pins, circuit CAT17 (BN), component side and ground.



N0084020

- For the trailer reversing lamps, measure the voltage between the trailer tow connector reversing lamp voltage supply pin, circuit CAT16 (GY/BN), component side and ground.



N0084021

- **Is any voltage present?**

AB4 CHECK THE SUSPECT RELAY	
• Ignition OFF. • Disconnect: Suspect Trailer Tow Relay. • Carry out the component test for the suspect trailer tow relay. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the trailer tow relay OK?**	**Yes** REPAIR circuit CAT06 (YE) (LH stop/turn), circuit CAT09 (GN) (RH stop/turn), circuit CAT17 (BN) (parking lamps) or CAT16 (GY/BN) (reversing lamps) for a short to voltage. TEST the system for normal operation. **No** INSTALL a new trailer tow relay in question. TEST the system for normal operation.

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Pinpoint Test AC: The Trailer Battery Charging Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 11 , Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The trailer battery charge relay coil receives voltage from the Battery Junction Box (BJB) fuse 54 (5A) when the ignition is in RUN. The BJB fuse 21 (30A) supplies voltage to the trailer battery charge relay switch side at all times. The Body Control Module (BCM) controls the ground side for the battery charge relay coil.

The BCM provides ground for the trailer battery charge relay when the ignition is in RUN and the BCM determines that the battery voltage is not low. When the trailer battery charge relay is energized, the voltage is routed to the trailer tow connector.

DTC Description	Fault Trigger Conditions
• B130C:12 — Load Shed Control: Circuit Short To Battery	This DTC sets when the BCM detects a short to battery from the trailer battery charge relay coil ground controlled circuit.
• B130C:14 — Load Shed Control: Circuit Short To Ground or Open	This DTC sets when the BCM detects an open or short to ground from the trailer battery charge relay coil ground controlled circuit.
• U1000:00 — Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	This DTC sets when the BCM has temporarily shut down the control driver. **The module has temporarily disabled the trailer battery charge relay control because an excessive current draw exists (such as a short to ground). The BCM cannot enable the trailer battery charge relay control until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	This DTC sets when the BCM has permanently shut down the output driver. **The module has permanently disabled the trailer battery charge relay control because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. CORRECT the cause of the excessive current draw before installing a new BCM .**

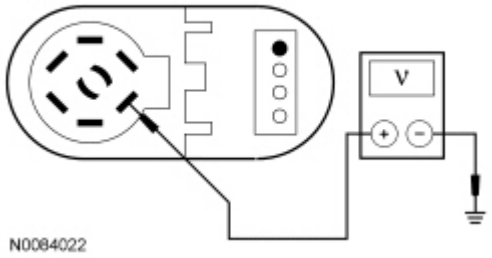
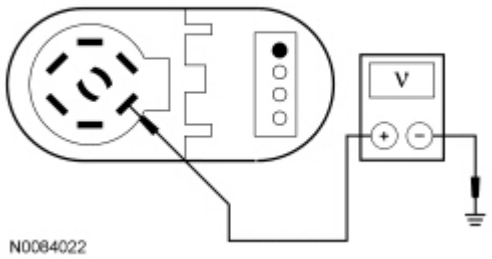
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Trailer tow connector
- Trailer battery charge relay
- Trailer
- BCM

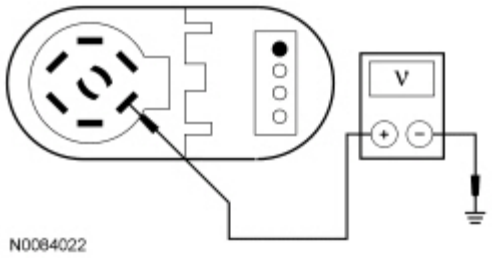
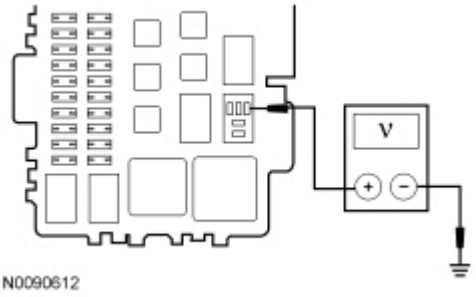
PINPOINT TEST AC: THE TRAILER BATTERY CHARGING IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

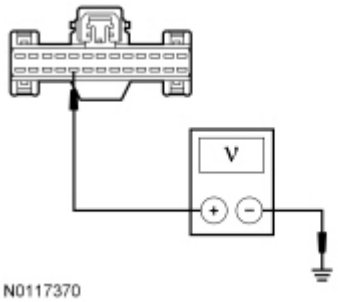
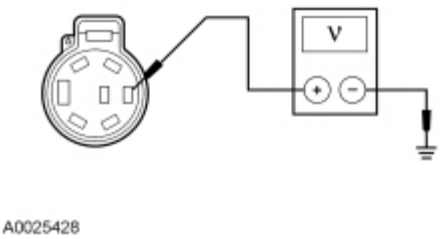
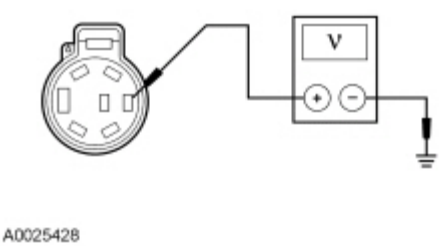
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before beginning diagnostics, visually inspect the trailer tow connector mounted on the bumper for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

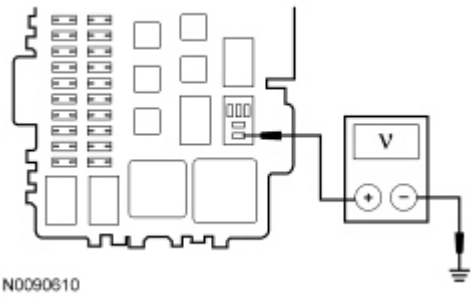
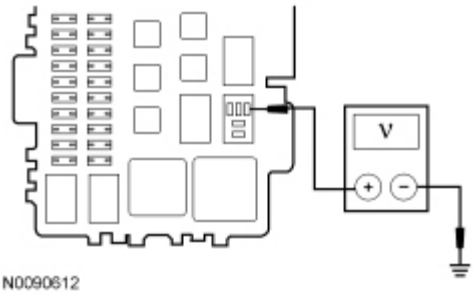
Test Step	Result / Action to Take
AC1 CHECK FOR VOLTAGE THROUGH THE TRAILER TOW CONNECTOR (BATTERY CHARGE INOPERATIVE)	
• Start the engine. • Measure the voltage between the trailer tow connector battery charge voltage supply pin, circuit CAT14 (OG), component side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to AC2 . **No** VERIFY the BJB fuse 21 (30A) is OK. If OK, GO to AC7 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
AC2 CHECK FOR VOLTAGE AT THE TRAILER TOW CONNECTOR (BATTERY CHARGE ALWAYS ON)	
• Ignition OFF. • Measure the voltage between the trailer tow connector battery charge voltage supply pin, circuit CAT14 (OG), component side and ground.  • **Is any voltage present?**	**Yes** GO to AC3 . **No** GO to AC5 .
AC3 CHECK THE TRAILER BATTERY CHARGE VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE	

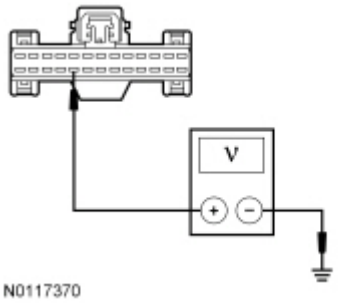
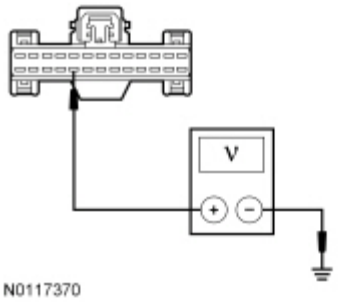
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• Disconnect: Trailer Battery Charge Relay. • Measure the voltage between the trailer tow connector battery charge voltage supply pin, circuit CAT14 (OG), component side and ground.  N0084022 • **Is any voltage present?**	**Yes** REPAIR circuit CAT14 (OG) for a short to voltage. TEST the system for normal operation. **No** GO to AC4 .
AC4 CHECK FOR VOLTAGE TO THE TRAILER BATTERY CHARGE RELAY COIL (ALWAYS ON)	
• Measure the voltage between the trailer battery charge relay pin 1, circuit CBB54 (VT/OG), BJB face side and ground.  N0090612 • **Is any voltage present?**	**Yes** REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. **No** INSTALL a new trailer battery charge relay. TEST the system for normal operation.
AC5 CHECK FOR DTC B130C:14	
• Review the DTCs recorded from the BCM self-test. • **Is DTC B130C:14 present?**	**Yes** GO to AC6 . **No** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility.
AC6 CHECK FOR VOLTAGE TO THE BCM (DTC B130C:14)	
• Disconnect: BCM C2280F. • Measure the voltage between the BCM C2280F-22, circuit CDC66 (BN/YE), harness side and ground.	**Yes** GO to AC13 . **No** REPAIR circuit CDC66 (BN/YE) for a short to ground. TEST the system for normal operation.

 • **Is the voltage greater than 10 volts?**	
AC7 CHECK FOR VOLTAGE AT THE TRAILER TOW CONNECTOR (BATTERY CHARGE INOPERATIVE)	
• Ignition OFF. • Disconnect: Trailer Tow C439A. • Ignition ON. • Measure the voltage between the trailer tow C439A-5, circuit CAT14 (OG), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** GO to AC8 .
AC8 CHECK THE TRAILER BATTERY CHARGE RELAY (INOPERATIVE CONDITION)	
• Ignition OFF. • Disconnect: Trailer Battery Charge Relay. • Substitute a known good relay. • Ignition ON. • Measure the voltage between the trailer tow C439A-5, circuit CAT14 (OG), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** REMOVE the known good relay. INSTALL a new trailer battery charge relay. TEST the system for normal operation. **No** REMOVE the known good relay. GO to AC9 .

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AC9 CHECK FOR VOLTAGE TO THE BATTERY CHARGE RELAY (SWITCH SIDE)	
• Ignition OFF. • Measure the voltage between the trailer battery charge relay pin 3, SBB21 (GY/RD), BJB face side and ground.  N0090610 • **Is the voltage greater than 10 volts?**	**Yes** GO to AC10 . **No** REPAIR circuit SBB21 (GY/RD) for an open. TEST the system for normal operation.
AC10 CHECK FOR VOLTAGE TO THE TRAILER BATTERY CHARGE RELAY COIL (INOPERATIVE CONDITION)	
• Ignition ON. • Measure the voltage between the trailer battery charge relay pin 1, circuit CBB54 (VT/OG), BJB face side and ground.  N0090612 • **Is the voltage greater than 10 volts?**	**Yes** GO to AC11 . **No** VERIFY the BJB fuse 54 (5A) is OK. If OK, REPAIR circuit CBB54 (VT/OG) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
AC11 CHECK THE BATTERY CHARGE RELAY COIL GROUND CONTROLLED CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Trailer Battery Charge Relay. • Disconnect: BCM C2280F. • Ignition ON. • Measure the voltage between the BCM C2280F-22, circuit CDC66 (BN/YE), harness side and ground.	**Yes** REPAIR circuit CDC66 (BN/YE) for a short to voltage. TEST the system for normal operation. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the trailer battery charge relay control driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.

 • **Is any voltage present?**	**No** GO to AC12.
AC12 CHECK THE BATTERY CHARGE RELAY COIL GROUND CONTROLLED CIRCUIT FOR AN OPEN	
• Ignition OFF. • Connect: Trailer Battery Charge Relay. • Ignition ON. • Measure the voltage between the BCM C2280F-22, circuit CDC66 (BN/YE), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to AC13. **No** REPAIR circuit CDC66 (BN/YE) for an open. TEST the system for normal operation.
AC13 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AD: The Trailer Electric Brakes Are Inoperative/Always Applied

Refer to Wiring Diagrams Cell 95, Trailer/Camper Adapter for schematic and connector information.

NOTE: This pinpoint test diagnoses the circuitry supplied for an aftermarket Trailer Brake Control (TBC) module. For diagnostics of the factory trailer brake control system, refer to Section 206-10.

Normal Operation

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The TBC module is provided voltage at all times by the Battery Junction Box (BJB) fuse 17 (30A). The TBC module receives voltage from the Body Control Module (BCM) fuse 31 (5A) when the brake pedal is applied. When a brake application is detected from the stoplamp switch, the TBC module sends voltage to the trailer tow connector.

This pinpoint test is intended to diagnose the following:

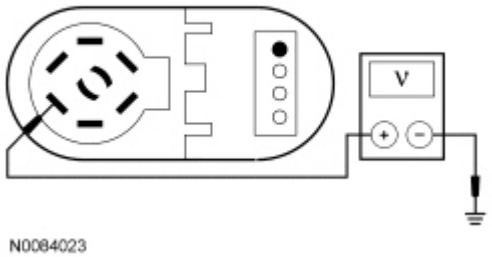
- Fuse
- Wiring, terminals or connectors
- Trailer tow connector
- TBC module (aftermarket)
- Trailer
- BCM

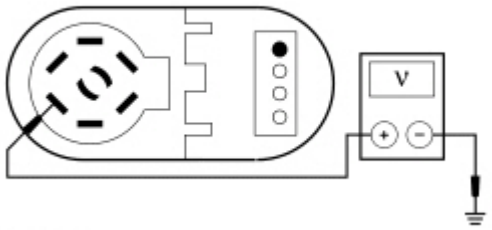
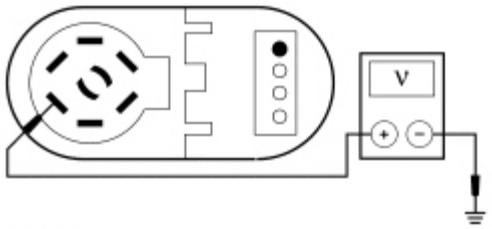
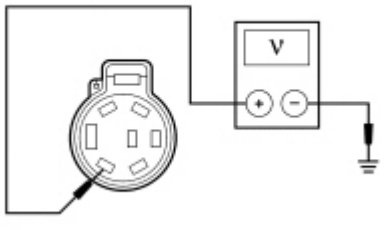
PINPOINT TEST AD: THE TRAILER ELECTRIC BRAKES ARE INOPERATIVE/ALWAYS APPLIED

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

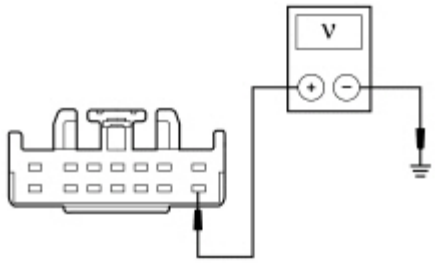
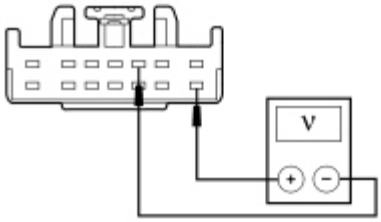
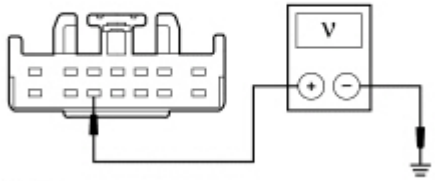
NOTE: Before beginning diagnostics, visually inspect the trailer tow connector mounted on the bumper for signs of corrosion or damage. Repair or install a new trailer tow connector as required.

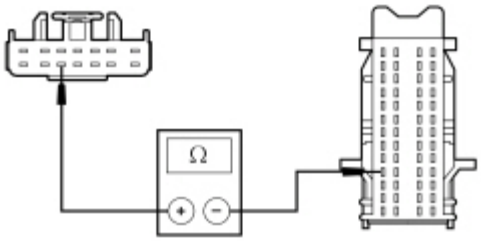
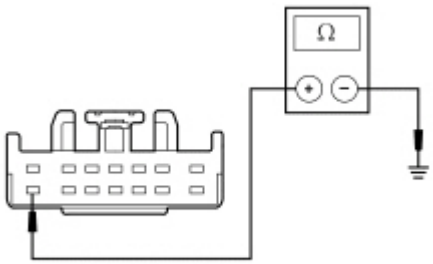
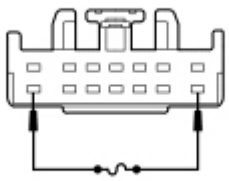
NOTE: Make sure the vehicle stoplamps operate correctly before beginning diagnostics of the trailer brakes.

Test Step	Result / Action to Take
AD1 CHECK THE TRAILER ELECTRIC BRAKE CONTROLLER FOR A SHORTED OUTPUT	
• Ignition ON. • Measure the voltage between the trailer tow connector electric brake control supply pin, circuit CAT19 (BU), component side and ground.  N0084023 • **Is any voltage present?**	**Yes** GO to AD2 . **No** GO to AD3 .
AD2 CHECK THE TBC MODULE OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: TBC Module C2142. • Measure the voltage between the trailer tow connector electric brake control supply pin, circuit CAT19 (BU), component side and ground.	**Yes** REPAIR circuit CAT19 (BU) for a short to voltage. TEST the system for normal operation. **No**

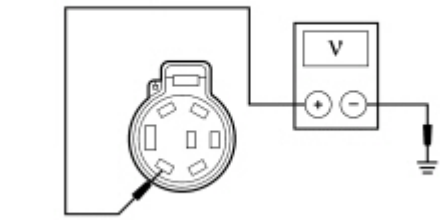
 N0084023 • **Is any voltage present?**	INSTALL a new TBC module. TEST the system for normal operation.
AD3 CHECK THE TBC MODULE OUTPUT	
• Set the gain on the trailer electric brake controller to the maximum setting. • While applying the brake pedal, measure the voltage between the trailer tow connector electric brake control supply pin, circuit CAT19 (BU), component side and ground.  N0084023 • **Is the voltage greater than 10 volts?**	**Yes** The vehicle is operating correctly. SEND the trailer to an authorized camper/trailer repair facility. **No** GO to AD4.
AD4 CHECK FOR VOLTAGE TO THE TRAILER TOW CONNECTOR (VEHICLE HARNESS)	
• Disconnect: Trailer Tow C439A. • **NOTE:** Make sure the gain is set to the maximum setting. • While applying the brake pedal, measure the voltage between the trailer tow C439A-3, circuit CAT19 (BU), harness side and ground.  A0025430 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new trailer tow connector. TEST the system for normal operation. **No** GO to AD5.
AD5 CHECK FOR VOLTAGE TO THE TBC MODULE	
• Disconnect: TBC Module C2142. • Measure the voltage between the TBC module C2142-8, circuit SBB17 (RD), harness side and ground.	**Yes** GO to AD6.

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 N0066300 • **Is the voltage greater than 10 volts?**	**No** VERIFY the BJB fuse 17 (30A) is OK. If OK, REPAIR circuit SBB17 (RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
AD6 CHECK THE TBC MODULE GROUND CIRCUIT FOR AN OPEN • Measure the voltage between the trailer electric brake controller C2142-8, circuit SBB17 (RD), harness side and the trailer electric brake controller C2142-3, circuit GD138 (BK/WH), harness side.  N0090613 • **Is the voltage greater than 10 volts?**	**Yes** GO to AD7 . **No** REPAIR circuit GD138 (BK/WH) for an open. TEST the system for normal operation.
AD7 CHECK THE STOPLAMP SWITCH INPUT TO THE TBC MODULE • While applying the brake pedal, measure the voltage between the TBC module C2142-12, circuit CBP31 (BU/OG), harness side and ground.  N0090614 • **Is the voltage greater than 10 volts?**	**Yes** GO to AD9 . **No** VERIFY the BCM fuse 31 (5A) Is OK. If OK, GO to AD8 . If not OK, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short.
AD8 CHECK THE STOPLAMP SWITCH INPUT CIRCUIT TO THE TBC MODULE FOR AN OPEN • Disconnect: BCM C2280B. • Measure the resistance between the TBC module C2142-12, circuit CBP31 (BU/OG), harness side and the BCM C2280B-4, circuit CBP31 (BU/OG), harness side.	**Yes** GO to AD11 . **No**

 N0117380 • **Is the resistance less than 5 ohms?**	REPAIR circuit CBP31 (BU/OG) for an open. TEST the system for normal operation.
AD9 CHECK THE TBC MODULE OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between the trailer electric brake controller C2142-14, circuit CAT19 (BU), harness side and ground.  N0066303 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AD10 . **No** REPAIR circuit CAT19 (BU) for a short to ground. TEST the system for normal operation.
AD10 CHECK THE TBC MODULE OUTPUT CIRCUIT FOR AN OPEN	
• Connect a fused jumper wire between the trailer electric brake controller C2142-8, circuit SBB17 (RD), harness side and the trailer electric brake controller C2142-14, circuit CAT19 (BU), harness side.  N0088194 • Measure the voltage between the trailer tow C439A-3, circuit CAT19 (BU), harness side and ground.	**Yes** INSTALL a new trailer electric brake controller. TEST the system for normal operation. **No** REPAIR circuit CAT19 (BU) for an open. TEST the system for normal operation.

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- **Is the voltage greater than 10 volts?**

AD11 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Turn Signal and Hazard Lamps

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

Turn Signals

The Steering Column Control Module (SCCM) monitors the multifunction switch position. When the multifunction switch is in the LH or RH TURN position, the SCCM sends a message over the High Speed Controller Area Network (HS-CAN) to the Body Control Module (BCM) indicating a request for the LH or RH turn signal.

The multifunction switch is a momentary contact switch, with 2 detents for the LH turn position and 2 detents for the RH turn position. When placed in the first detent, the corresponding turn signals flash 3 times and turn off. When the multifunction switch is moved to the second detent, the turn signal flashes until the steering wheel is turned in the opposite direction (based on input from the steering wheel rotation sensor), the multifunction switch is moved to the second detent a second time or the vehicle travels farther than 3.2 km (2 miles). The BCM monitors the steering wheel rotation sensor, the multifunction switch input and the distance traveled to determine when to cancel the turn signals.

When the BCM receives a request for a turn signal, the BCM supplies on/off voltage to the appropriate turn lamps.

The timed on/off cycle for turn lamps is determined by the BCM and is set to flash approximately 80 times per minute if both the front and rear turn signal lamps operate correctly. If an individual turn signal lamp is inoperative, the BCM fast flashes the remaining turn lamps approximately 160 times per minute to indicate a bulb outage to the driver.

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There is no bulb outage indication for the auxiliary turn signal lamps located in the exterior mirrors.

The rear turn signal lamps share functionality with the rear stoplamps.

Hazard Lamps

The BCM sends a voltage signal to the hazard flasher lamp switch (part of the Passenger Air Bag Deactivation (PAD) indicator). When the hazard flasher switch (a momentary contact switch) is pressed, the voltage signal is routed to ground, indicating a request to activate or deactivate the hazard lamp function.

When the BCM receives a request for the hazard lamps, the BCM supplies on/off voltage to all of the turn lamps.

The timed on/off cycle for the hazard lamps is approximately 80 times per minute regardless of bulb outage.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

The BCM utilizes a FET protective circuit strategy for many of its outputs (such as a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection, allowing the circuit to function. If the circuit is still shorted the next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection), the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When a tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by the clear the continuous DTCs command. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns. The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuits for the turn lamps system are the front turn and mirror turn lamp output circuits.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Multifunction switch	• Body Control Module (BCM) fuse(s)
	  ▪ 13 (15A) (RH lamps)
	  ▪ 14 (15A) (LH lamps)
	  ▪ 47 (15A) (mirror turn lamps)
	• Bulb
	• Bulb socket
	• Wiring, terminals or connectors
	• Passenger Air Bag Deactivation (PAD) indicator
	• Auxiliary turn signal lamp
	• Exterior mirror

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is on.
     - The air bag warning indicator prove-out confirms ignition on (other indicators may not prove ignition on). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in run.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM and the Steering Column Control Module (SCCM).

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

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10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• **NOTE:** LED lamps draw low current compared to an incandescent bulb. The Body Control Module (BCM) interprets this as a bulb out and fast flashes (bulb outage mode) the turn lamps. The turn signal lamps flash fast and no bulbs are inoperative	• Bulb	• INSTALL the correct bulb. TEST the system for normal operation.
• The turn signal function is inoperative	• Multifunction switch • Steering Column Control Module (SCCM)	• VERIFY the bulbs are OK. If OK, GO to Pinpoint Test L.
• The turn signal function is always on	• Multifunction switch • SCCM	• INSTALL a new multifunction switch. REFER to Section 211-05. TEST the system for normal operation. If the concern still exists, INSTALL a new SCCM. REFER to Section 211-05. TEST the system for normal operation.
• One turn signal lamp is inoperative/always on	• Fuse • Wiring, terminals or connectors • Bulb socket • Exterior mirror turn lamp • Exterior mirror • BCM	• VERIFY the bulb is OK. If OK, GO to Pinpoint Test M.
• The hazard lamp function is inoperative/always on	• Wiring, terminals or connectors • Multifunction switch • Passenger Air Bag Deactivation (PAD)	• GO to Pinpoint Test N.

	indicator • BCM	

Pinpoint Tests

Pinpoint Test L: The Turn Signal Function Is Inoperative

Refer to Wiring Diagrams Cell 90 , Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors multifunction switch input. The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the multifunction switch is in the OFF, LH or RH TURN position. When the BCM receives a message indicating a LH or RH turn request, the BCM provides on/off voltage to the appropriate turn lamps.

- DTC B1D36:09 (Turn Indicator Switch: Component Failure) — This DTC sets when the BCM detects an input concern from the multifunction switch.

This pinpoint test is intended to diagnose the following:

- Multifunction switch
- SCCM

PINPOINT TEST L: THE TURN SIGNAL FUNCTION IS INOPERATIVE

Test Step	Result / Action to Take
L1 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SCCM module pass the network test?**	**Yes** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If the concern still exists, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation. **No** REFER to Section 418-00 .

Pinpoint Test M: One Turn Signal Lamp Is Inoperative/Always On

Refer to Wiring Diagrams Cell 90 , Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) monitors multifunction switch input. The SCCM sends a message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN), indicating the multifunction switch is in the OFF, LH or RH TURN position. When the BCM receives a

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message indicating a LH or RH turn request, the BCM provides on/off voltage to the appropriate turn lamps.

The front turn lamps share the same fuses as the rear stoplamps. The rear turn lamps are controlled utilizing the rear stoplamp circuitry.

DTC Description	Fault Trigger Conditions
• B123A:11 — Left Front Turn Indicator: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the LH front turn lamp voltage supply circuit.
• B123A:15 — Left Front Turn Indicator: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open or short to voltage from the LH front turn lamp voltage supply circuit.
• B123B:11 — Right Front Turn Indicator: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the RH front turn lamp voltage supply circuit.
• B123B:15 — Right Front Turn Indicator: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open or short to voltage from the RH front turn lamp voltage supply circuit.
• B1C98:11 — Left Corner Lamp Circuit: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the LH mirror turn lamp voltage supply circuit.
• B1C99:11 — Right Corner Lamp Circuit: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the RH mirror turn lamp voltage supply circuit.
• U1000:00 — Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	This DTC sets when the BCM has temporarily shut down the output driver. **The module has temporarily disabled a turn lamp output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the turn lamp output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	This DTC sets when the BCM has permanently shut down the output driver. **The module has permanently disabled a turn lamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. CORRECT the cause of the excessive current draw before installing a new BCM .**

This pinpoint test is intended to diagnose the following:

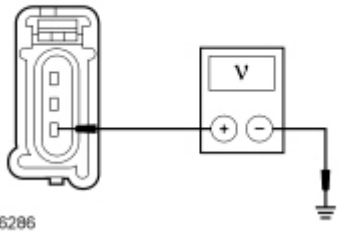
- Fuse
- Wiring, terminals or connectors
- Bulb socket
- Exterior mirror turn lamp
- Exterior mirror
- BCM

PINPOINT TEST M: ONE TURN SIGNAL LAMP IS INOPERATIVE/ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

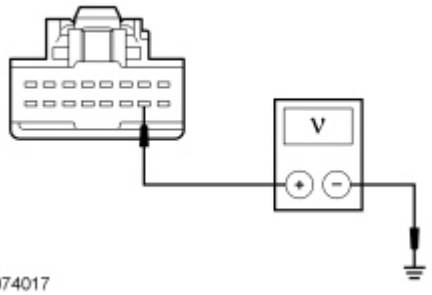
Test Step	Result / Action to Take
M1 CHECK THE STOPLAMPS	
• Apply and release the brake pedal while observing the stoplamps. • **Do the stoplamps operate correctly?**	**Yes** GO to M2 . **No** GO to Pinpoint Test J .
M2 DETERMINE IF A TURN LAMP IS ALWAYS ON	
• Ignition ON. • Observe the front turn lamps and the signal mirror lamps if equipped. • **Is any turn lamp always on?**	**Yes** GO to M3 . **No** GO to M4 .
M3 CHECK THE TURN LAMP OUTPUT CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280F. • Ignition ON. • **Does the turn lamp in question continue to illuminate?**	**Yes** For a LH turn lamp, REPAIR circuit CLS21 (BU/GN) for a short to voltage between the lamp and the BCM . TEST the system for normal operation. For a RH turn lamp, REPAIR circuit CLS25 (YE/VT) for a short to voltage between the lamp and the BCM . TEST the system for normal operation. **No** GO to M10 .
M4 CHECK FOR VOLTAGE TO THE INOPERATIVE TURN LAMP	
NOTE: If both exterior mirror turn lamps are inoperative, verify the BCM fuse 47 (15A) is OK. If not OK, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. • Ignition OFF. • Disconnect: Inoperative Turn Lamp. • Activate the hazard flasher lamp function. • For a front turn lamp, measure the voltage between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and ground; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and ground.	**Yes** GO to M5 . **No** GO to M7 .

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N0066286

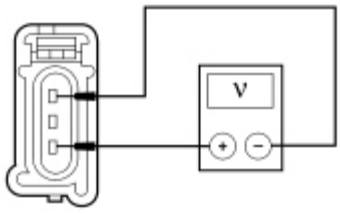
- For an exterior mirror turn lamp, measure the voltage between the LH exterior mirror C521-10, circuit CLS21 (BU/GN), harness side and ground; or between the RH exterior mirror C615-10, circuit CLS25 (YE/VT), harness side and ground.



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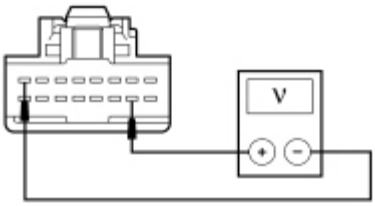
- **Does the voltage alternate between 0 and greater than 10 volts?**

M5 CHECK THE TURN LAMP GROUND CIRCUIT FOR AN OPEN	
• For a front turn lamp, measure the voltage between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and the LH front turn lamp C1023-1, circuit GD123 (BK/GY), harness side; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and the RH front turn lamp C1043-1, circuit GD120 (BK/GN), harness side.	**Yes** For a front turn lamp, INSTALL a new bulb socket. TEST the system for normal operation. For exterior mirror turn lamp, GO to M6 . **No** REPAIR the ground circuit in question for an open. TEST the system for normal operation.



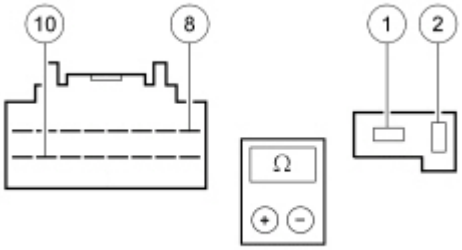
N0088174

- For an exterior mirror turn lamp, measure the voltage between the LH exterior mirror C521-10, circuit CLS21 (BU/GN), harness side and the LH exterior mirror C521-8, circuit GD134 (BK/VT), harness side; or between the RH exterior mirror C615-10, circuit CLS25 (YE/VT), harness side and the RH exterior mirror C615-8, circuit GD139 (BK/YE), harness side.

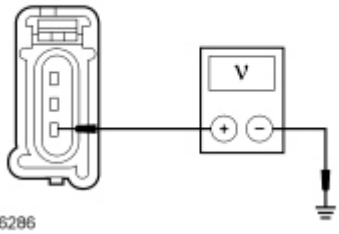


N0090592

- **Does the voltage alternate between 0 and greater than 10 volts?**

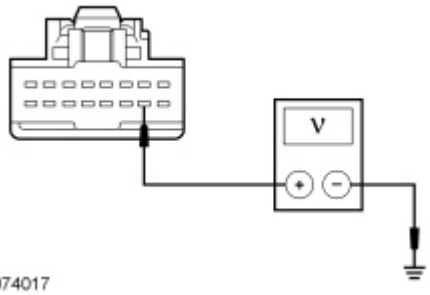
M6 CHECK THE CIRCUITS TO THE LED ASSEMBLY FOR AN OPEN	
• Turn the hazard function off. • Disconnect: Suspect LED Turn Lamp. • Measure the resistance between the suspect exterior mirror pin 10, component side and the LED turn lamp connector pin 1 (GN/WH), harness side; and between the suspect exterior mirror pin 8, component side and the LED turn lamp connector pin 2 (BK), harness side.  N0090618 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new exterior mirror turn lamp. REFER to Side Lamp Assembly — Outside Rear View Mirror, Aero or Side Lamp Assembly — Outside Rear View Mirror, Trailer Tow in this section. TEST the system for normal operation. **No** INSTALL a new exterior mirror. REFER to Section 501-09 . TEST the system for normal operation.
M7 REPEAT THE ON-DEMAND SELF-TEST AND CHECK FOR VOLTAGE TO THE INOPERATIVE TURN LAMP	
• Deactivate the hazard flasher lamp function. • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • Clear the DTCs **and** repeat the self-test **(required to enable the turn lamp output driver if DTC U1000:00 is present).** • Activate the hazard flasher lamp function. • For a front lamp, measure the voltage between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and ground; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and ground.	**Yes** For a front turn lamp, INSTALL a new bulb socket. TEST the system for normal operation. For an exterior mirror turn lamp, INSTALL a new exterior mirror in question. REFER to Section 501-09 . TEST the system for normal operation. **No** GO to M8 .

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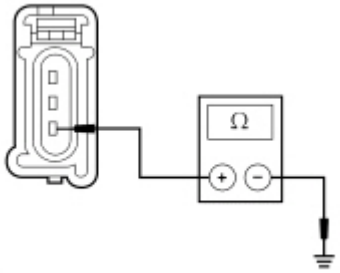
N0066286

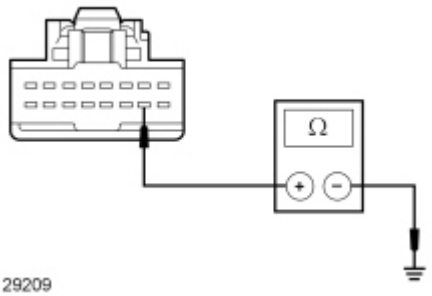
- For an exterior mirror turn lamp, measure the voltage between the LH exterior mirror C521-10, circuit CLS21 (BU/GN), harness side and ground; or between the RH exterior mirror C615-10, circuit CLS25 (YE/VT), harness side and ground.



A0074017

- **Does the voltage alternate between 0 and greater than 10 volts?**

M8 CHECK THE TURN LAMP OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Turn the hazard lamp function off. • Ignition OFF. • Disconnect: BCM C2280F. • For a front turn lamp, measure the resistance between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and ground; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and ground.  N0077657 • For an exterior mirror turn lamp, measure the resistance between the LH exterior mirror C521-10, circuit CLS21 (BU/GN), harness side and ground; or between the RH exterior mirror C615-10, circuit CLS25 (YE/VT), harness side and ground.	**Yes** GO to M9 . **No** REPAIR the circuit in question for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs and REPEAT the self-test **(required to enable the turn lamp output driver if DTC U1000:00 is present).** TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.



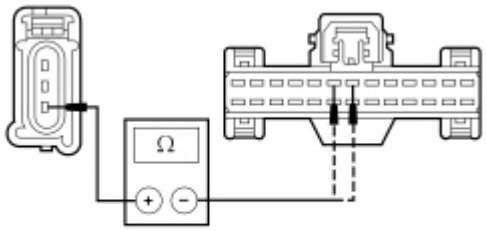
N0129209

- **Is the resistance greater than 10,000 ohms?**

M9 CHECK THE BCM TURN LAMP OUTPUT CIRCUIT FOR AN OPEN

- For a front turn lamp, measure the resistance between the inoperative front turn lamp, harness side and the BCM, harness side as follows:

Inoperative Turn Lamp Connector-Pin	BCM Connector-Pin	Circuit
LH front C1023-3	C2280F-8	CLS21 (BU/GN)
RH front C1043-3	C2280F-7	CLS25 (YE/VT)



N0117364

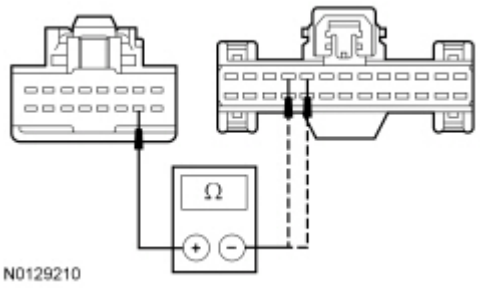
- For an exterior mirror turn lamp, measure the resistance between the exterior mirror in question, harness side and the BCM, harness side as follows:

Exterior Mirror Connector-Pin	BCM Connector-Pin	Circuit
LH exterior mirror C521-10	C2280F-9	CLS21 (BU/GN)
RH exterior mirror C615-10	C2280F-10	CLS25 (YE/VT)

Yes
GO to M10.

No
REPAIR the circuit in question for an open. TEST the system for normal operation.

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 • **Is the resistance less than 5 ohms?**	
M10 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test N: The Hazard Lamp Function Is Inoperative/Always On

Refer to Wiring Diagrams Cell 90, Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends a voltage signal to the hazard flasher lamp switch (part of the Passenger Air Bag Deactivation (PAD) indicator) for the hazard lamp function input. When the hazard flasher lamp switch is pressed, the voltage signal is routed to ground, indicating a request for the hazard lamp function. When the BCM detects a request for the hazard lamps, the BCM provides on/off voltage to all the turn lamps.

The hazard flasher lamp switch is a momentary contact switch.

- DTC B1D35:11 (Hazard Switch: Circuit Short to Ground) — This DTC sets when the BCM detects a short to ground from the hazard lamp function input circuit.

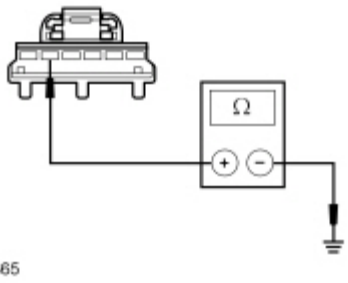
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- PAD indicator
- BCM

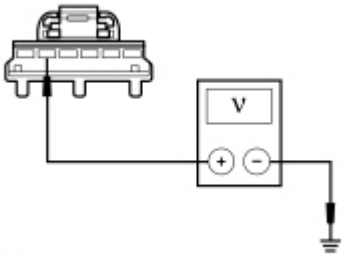
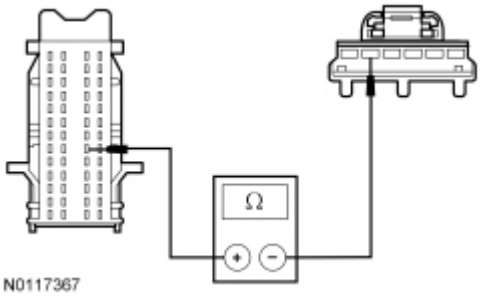
PINPOINT TEST N: THE HAZARD LAMP FUNCTION IS INOPERATIVE/ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct**

probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
N1 CHECK THE RECORDED DTCs FROM THE BCM SELF-TEST • Check the recorded DTCs from the BCM self-test. • **Is DTC B1D35:11 present?**	**Yes** GO to N2. **No** GO to N4.
N2 ISOLATE THE PAD INDICATOR AS THE CAUSE OF DTC B1D35:11 • Ignition OFF. • Disconnect: PAD Indicator C2355. • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • Repeat the BCM self-test. • **Is DTC B1D35:11 still present?**	**Yes** GO to N3. **No** INSTALL a new PAD indicator. REFER to Section 501-20B. TEST the system for normal operation.
N3 CHECK THE HAZARD LAMP REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: BCM C2280B. • Measure the resistance between the PAD indicator C2355-5, circuit CLS32 (BN), harness side and ground.  N0117365 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to N6. **No** REPAIR circuit CLS32 (BN) for a short to ground. TEST the system for normal operation.
N4 CHECK FOR A VOLTAGE SIGNAL TO THE PAD INDICATOR • Disconnect: PAD Indicator C2355. • Ignition OFF. • Measure the voltage between the PAD indicator C2355-5, circuit CLS32 (BN), harness side and ground.	**Yes** INSTALL a new PAD indicator. REFER to Section 501-20B. TEST the system for normal operation. **No** GO to N5.

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 N0117366 • **Is the voltage greater than 10 volts?**	
N5 CHECK THE HAZARD FLASHER LAMP REQUEST INPUT CIRCUIT FOR AN OPEN	**Yes** GO to N6 . **No** REPAIR circuit CLS32 (BN) for an open. TEST the system for normal operation.
• Disconnect: BCM C2280B. • Measure the resistance between the BCM C2280B-32, circuit CLS32 (BN), harness side and the PAD indicator C2355-5, circuit CLS32 (BN), harness side.  N0117367 • **Is the resistance less than 5 ohms?**	
N6 CHECK FOR CORRECT BCM OPERATION	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
• Disconnect all the BCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the BCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	

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Autolamps Time Delay Adjustment

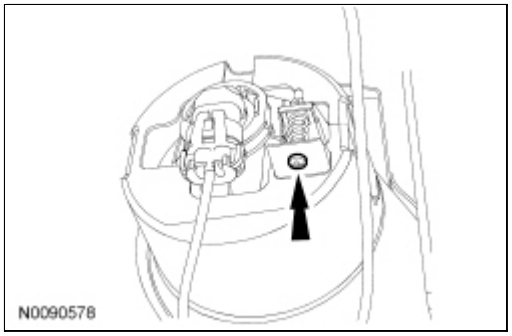
NOTE: The time delay can be programmed through the message center using the message center buttons (if equipped) or using the following steps.

NOTE: Steps 2 through 5 must be carried out within a 10-second period.

1. Start with the ignition switch off and the headlamp switch in the AUTOLAMPS ON position.
2. Place the headlamp switch in the OFF position.
3. Place the ignition switch in the RUN position.
4. Place the ignition switch in the OFF position.
5. Place the headlamp switch in the AUTOLAMPS ON position. The exterior lamps turn on at this point.
6. Wait the desired amount of time and place the headlamp switch in the OFF position (maximum of 3 minutes). The exterior lamps turn off and the autolamp time delay is now set.

Front Fog Lamp Adjustment

Front Fog Lamp Adjustment Screw

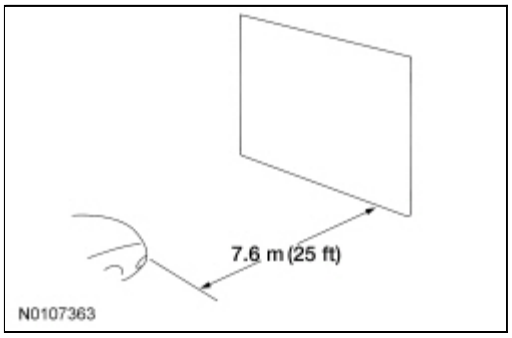


1. **NOTE:** Horizontal aim is not required for this vehicle and is not adjustable. Consult your state vehicle inspection center for recommended tolerance ranges for visual aiming.

   Before starting the fog lamp assembly adjustment:
   - check the tire inflation.
   - make sure there are no other loads in the vehicle other than a half tank of fuel.
   - make sure the vehicle is on level ground.
   - make sure the fog lamps and headlamps are clean.
   - make sure the headlamps are operating and are correctly aimed.

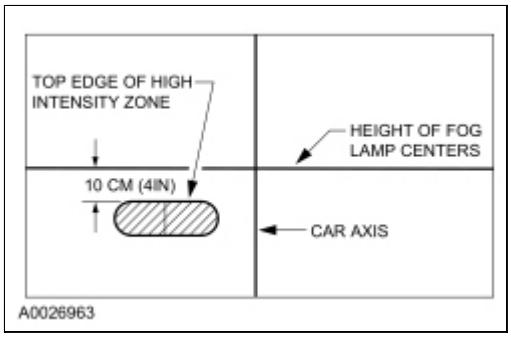
2. **NOTE:** The vertical wall screen must be a minimum of 2.4 m (8 ft) wide.

   Park the vehicle on a level surface approximately 7.6 m (25 ft) from the vertical wall or screen directly in front of it.



3. The correct visual aim for the fog lamps is with the top edge of the high-intensity zone 10 cm (4 in) below the horizontal center of the fog lamps.

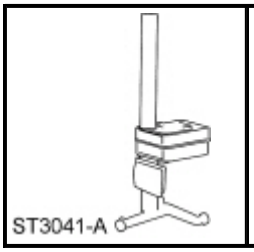
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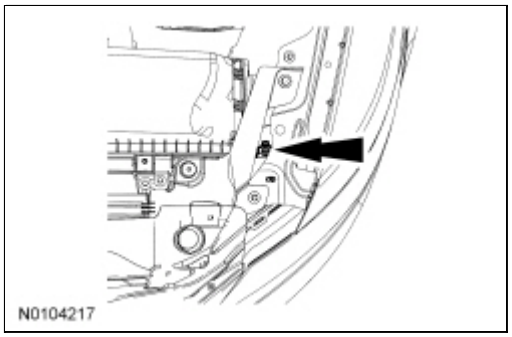
4. If necessary, rotate the adjustment screw until the fog lamp beam is within specification.

Headlamp Adjustment

Special Tool(s)

 ST3041-A	Vision 100 Headlamp Aimer 196-00005 or equivalent

Headlamp Adjustment Screw Location


N0104217

Headlamp Aiming

1. The headlamp aiming procedure depends on what type of beam pattern the headlamp is equipped with. Vehicles may come equipped with visually optically aligned left (VOL) or visually optically aligned right (VOR) headlamps. To identify the headlamp beam pattern, look on the headlamp lens. Molded in small letters on the headlamp lens is one of the following:
   - VOL and SAE
   - VOR and SAE

2. **NOTE:** Mechanical aimers cannot be used with VOR- or VOL-type headlamps.

   Once the headlamp beam pattern is identified, aim the headlamps using one of the following methods:
   - Photometric aimers can aim VOL- and VOR- headlamps. This is the preferred method of headlamp aiming.
   - Visual or screen method aiming can be used to aim VOL- and VOR- headlamps.

Photometric Aiming

1. For the photometric aiming procedure, refer to the appropriate photometric headlamp aimer

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instruction manual.

Screen Method Aiming

All headlamp types

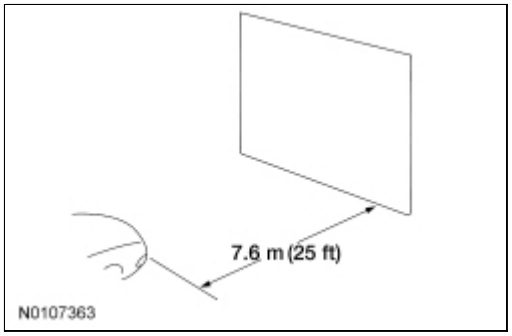
NOTE: Horizontal aim is not adjustable.

NOTE: Consult your state vehicle inspection manual for recommended tolerance ranges for visual aiming.

1. Before starting headlamp adjustment:
   - check that the vehicle is on level ground.
   - check the tire inflation.
   - check that no other load is in the vehicle other than a half tank of fuel.
   - check that the headlamps are clean.
   - check for correct headlamp operation.
   - if the vehicle is equipped with air suspension, make sure that the switch is on.

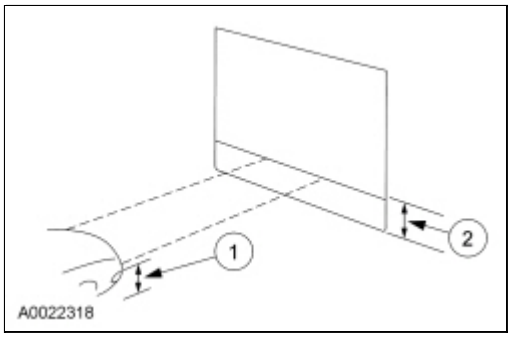
2. **NOTE:** The vertical wall or screen must be a minimum of 2.4 m (8 ft) wide.

   Park the vehicle on a level surface approximately 7.6 m (25 ft) from the vertical wall or screen directly in front of it.



3. **NOTE:** The center of the lamp is marked either on the lens (circle, crosshair or other mark) or on the bulb shield internal to the lamp (crosshair or other mark).

   Mark a horizontal reference line on the vertical wall or screen.
   1. Measure the center of the headlamp height to ground and record the measurement.
   2. Make a 2.4 m (8 ft) horizontal mark (using masking tape) on the vertical wall or screen at the same distance from the ground as previously recorded.



4. **NOTE:** This procedure should be done in a dark environment to effectively see the headlamp beam pattern.

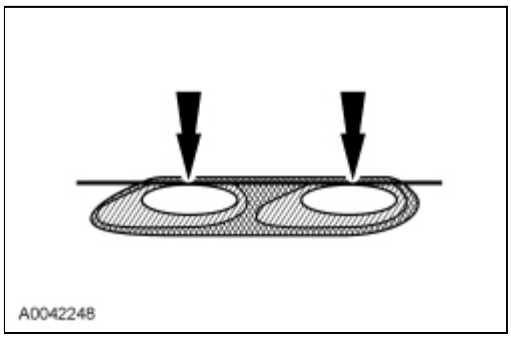
   Turn on the low beam headlamps to illuminate the wall or screen and open the hood.

5. On the wall or screen, locate the high intensity area of the beam pattern.

VOR-type headlamps

6. **NOTE:** The appearance of the VOR beam pattern may vary between vehicles.

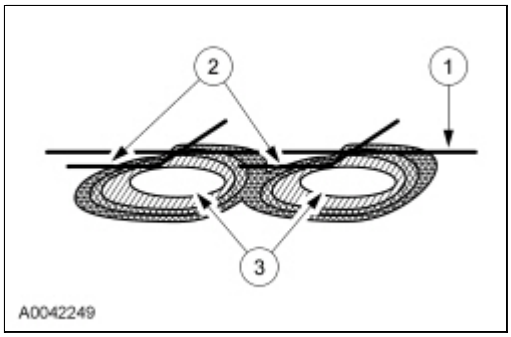
   Identify at the top edge of this high intensity area a distinct horizontal cutoff in the beam pattern. If the top edge of this cutoff is not even with the horizontal reference line, the headlamp beam needs to be adjusted using the headlamp adjusting screw.



VOL-type headlamps

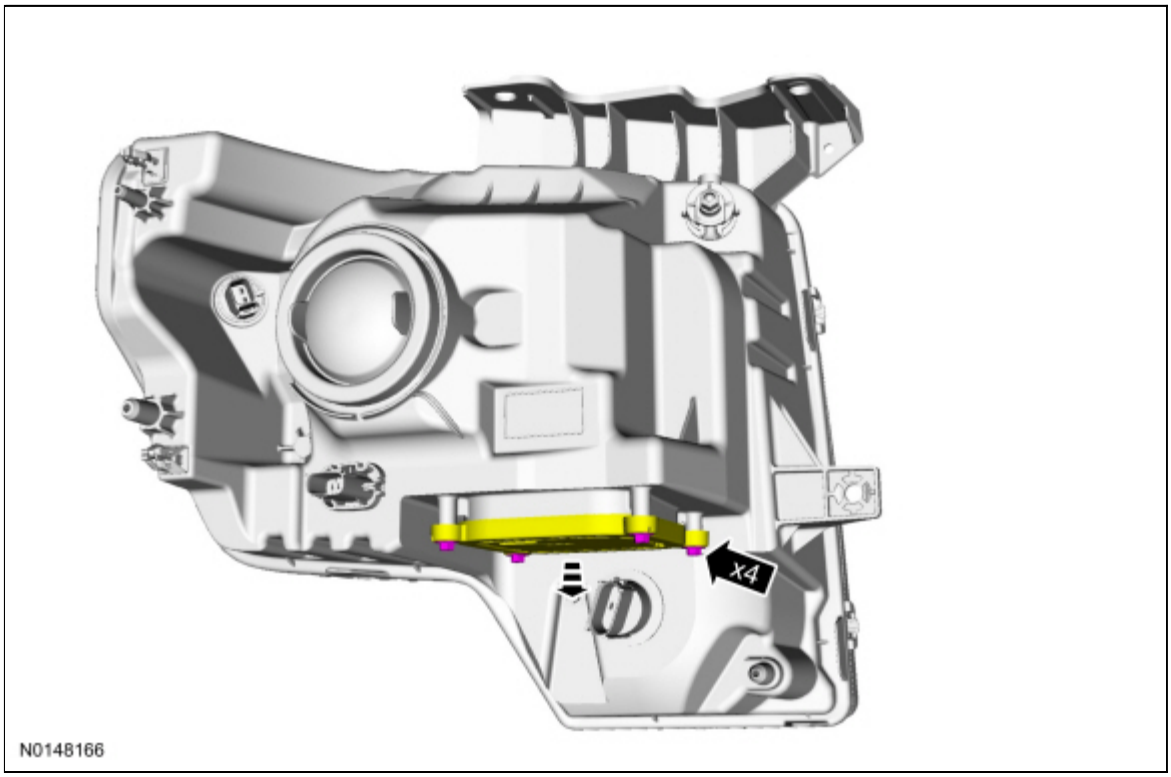
7. There is a distinct cutoff in the left portion of the beam pattern. The edge of this cutoff should be positioned 50.2 mm (2 in) below the horizontal reference line. Adjust the headlamp as necessary using the headlamp adjusting screw.
   1. Horizontal reference line.
   2. Top edge of the beam pattern.
   3. High intensity zone.

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2
1
3
A0042249

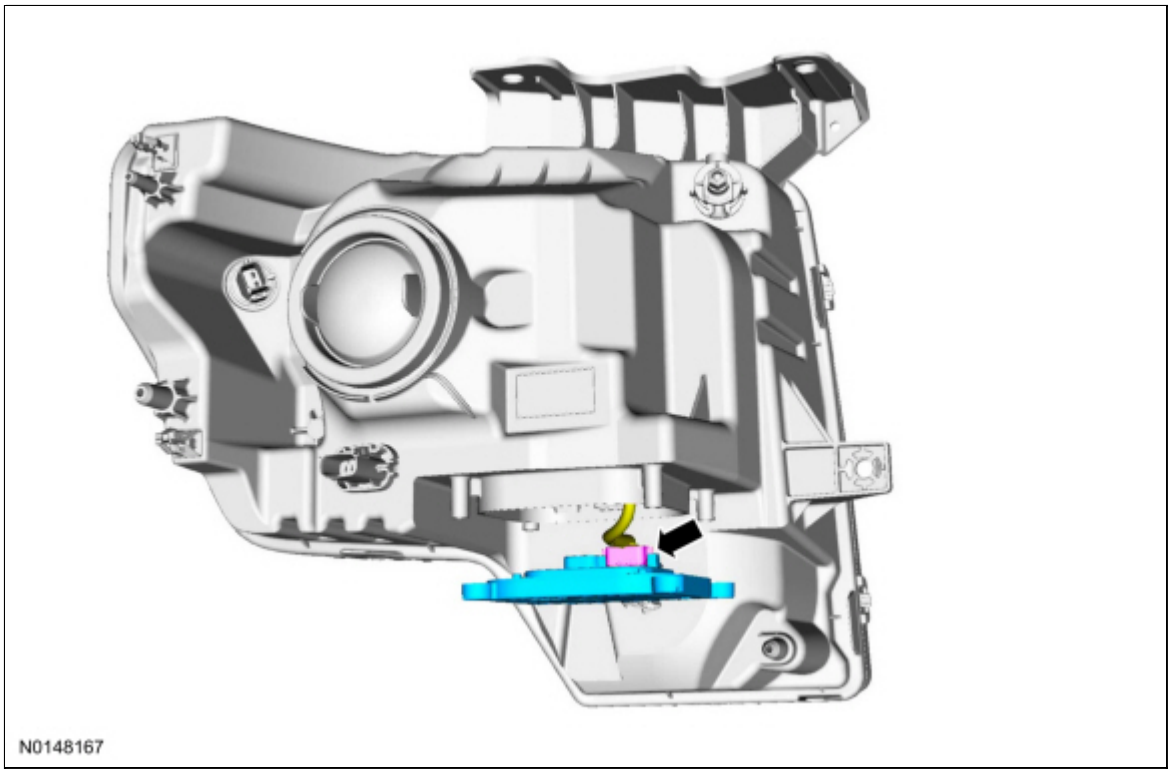
Ballast

Removal and Installation

1. Remove the headlamp assembly. Refer to Headlamp Assembly .
2. 

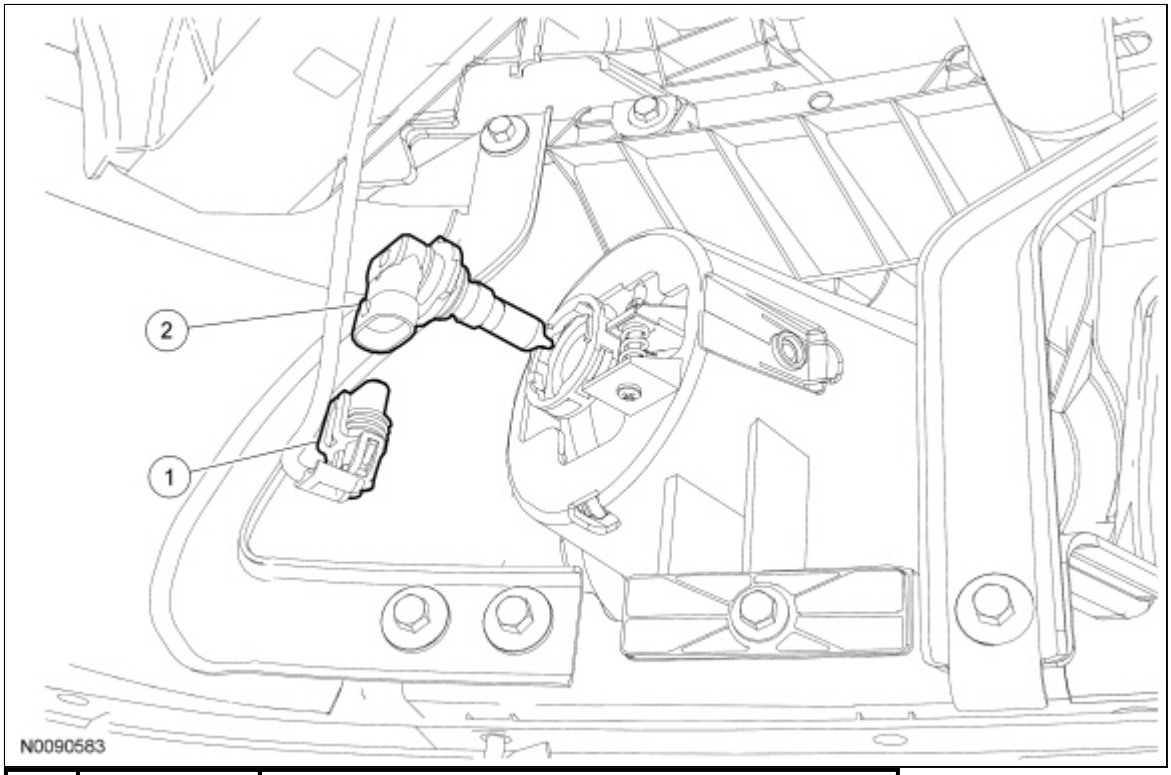
3.

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4. To install, reverse the removal procedure.

Fog Lamp Bulb



Item	Part Number	Description
1	—	Fog lamp bulb electrical connector (part of 12A581)
2	13466	Fog lamp bulb

Removal and Installation

WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The fog lamp bulb should not be removed from the fog lamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the fog lamp with the bulb removed from the fog lamp.

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

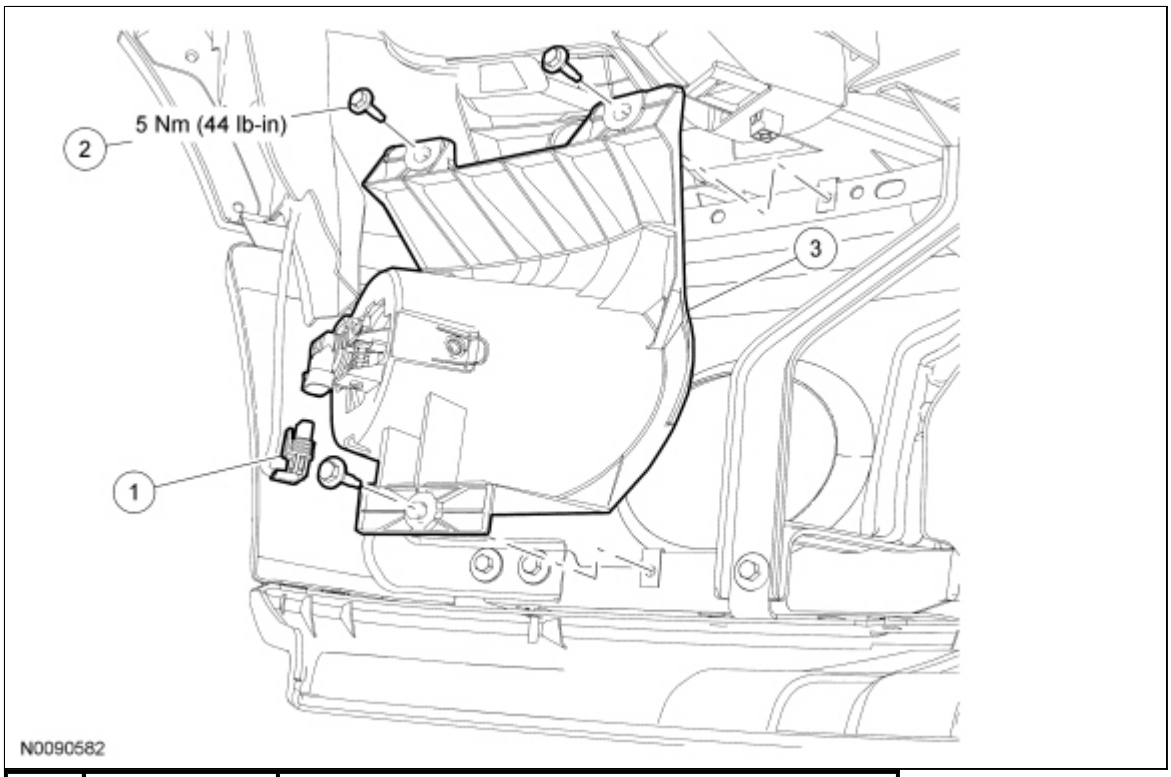
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the fog lamp electrical connector.

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3. Rotate the fog lamp bulb approximately one-eighth turn counterclockwise and remove it.
4. To install, reverse the removal procedure.

Fog Lamp



Item	Part Number	Description
1	—	Fog lamp electrical connector (part of 12A581)
2	W505424	Fog lamp bolts (3 required)
3	15200/15201	Fog lamp assembly (RH/LH)

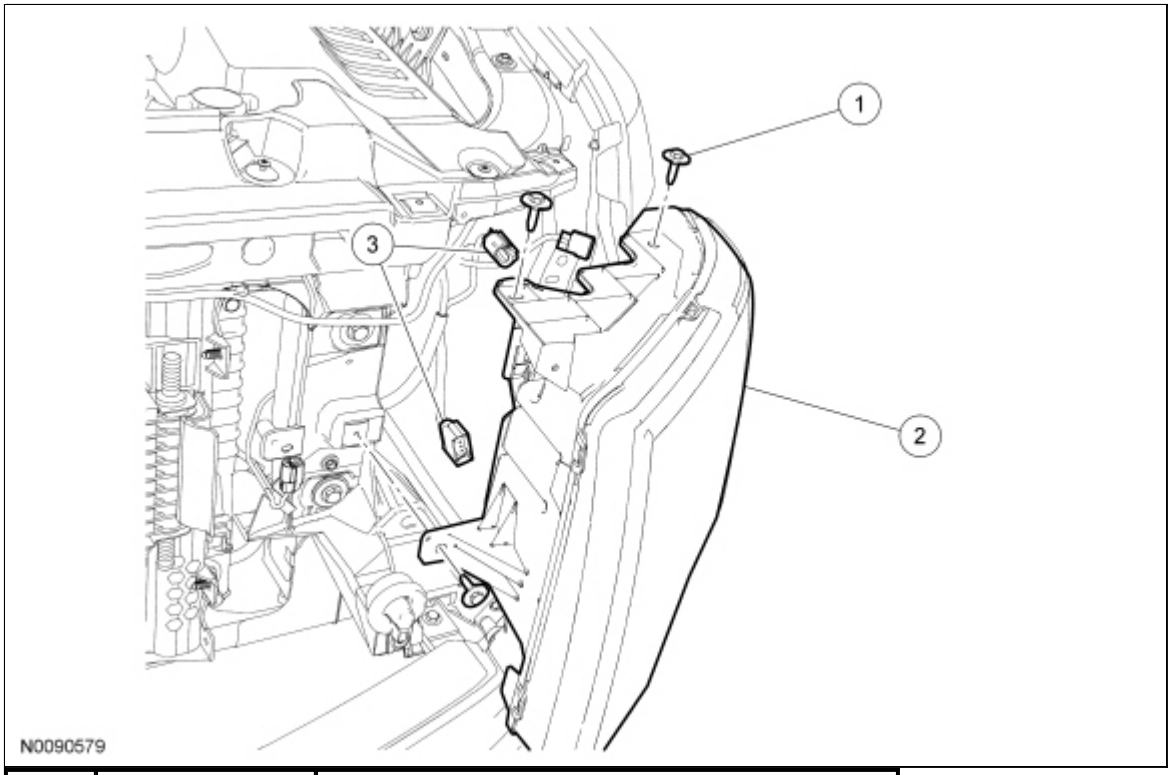
Removal and Installation

NOTE: Make sure the fog lamp switch and ignition switch are in the OFF position.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the fog lamp electrical connector.
3. Remove the 3 bolts and the fog lamp bracket.
4. To install, reverse the removal procedure.

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Headlamp Assembly

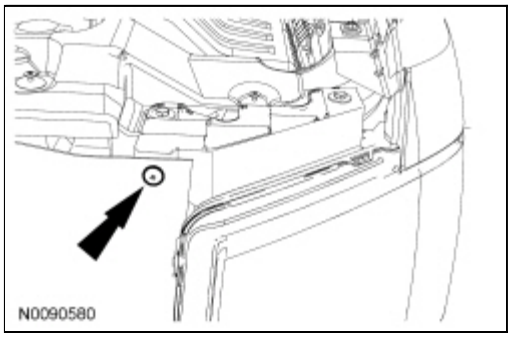


Item	Part Number	Description
1	W703277	Headlamp bolts (3 required)
2	13008	Headlamp assembly
3	—	Electrical connectors (part of 12A581)

Removal and Installation

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

1. Remove the pin-type retainer and position the radiator side air deflector aside.



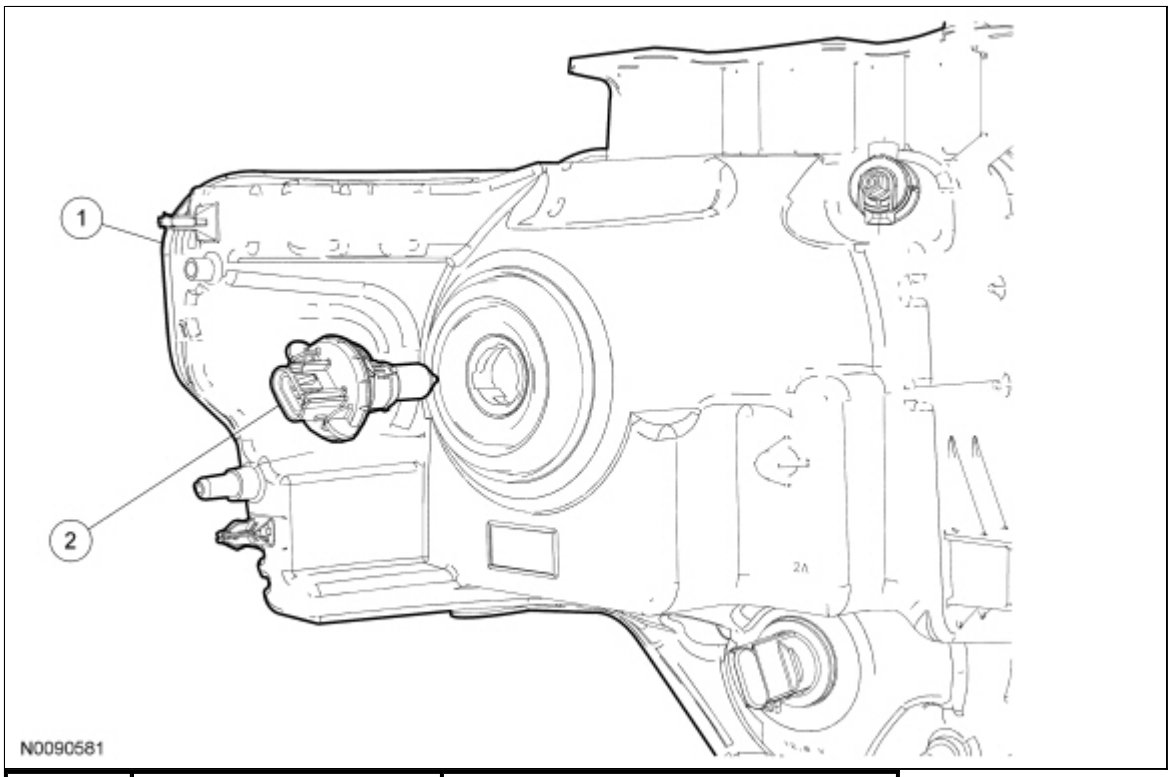
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2. **NOTE:** Grasp the headlamp assembly firmly and pull forward to release the 2 metal clips.

   Remove the 3 bolts and the headlamp assembly.
   - Disconnect the electrical connectors.

3. To install, reverse the removal procedure.

Headlamp Bulb — Halogen



Item	Part Number	Description
1	13008	Headlamp assembly
2	13N021	Headlamp bulb

Removal and Installation

WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamp with the bulb removed from the headlamp.

1. Remove the headlamp assembly. For additional information, refer to Headlamp Assembly in this section.
2. Rotate the headlamp bulb approximately one-eighth turn counterclockwise and remove the bulb from the headlamp assembly.
3. To install, reverse the removal procedure.

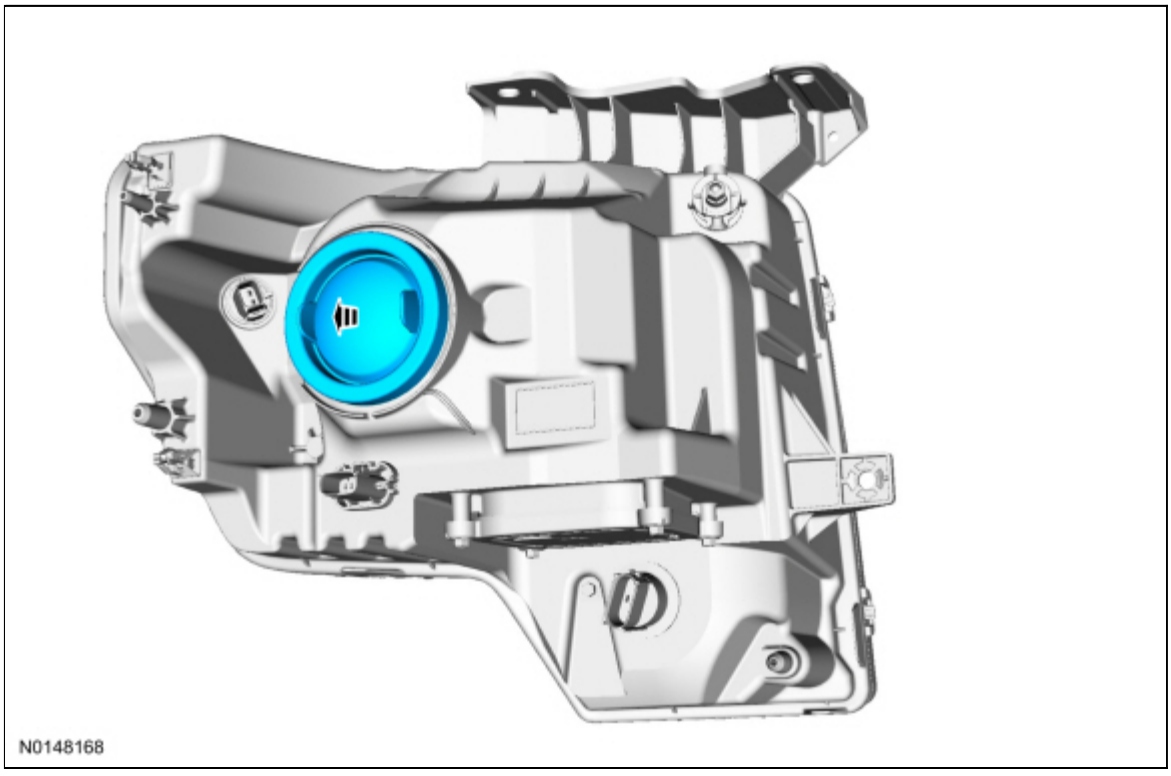
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Headlamp Bulb — HID

Removal

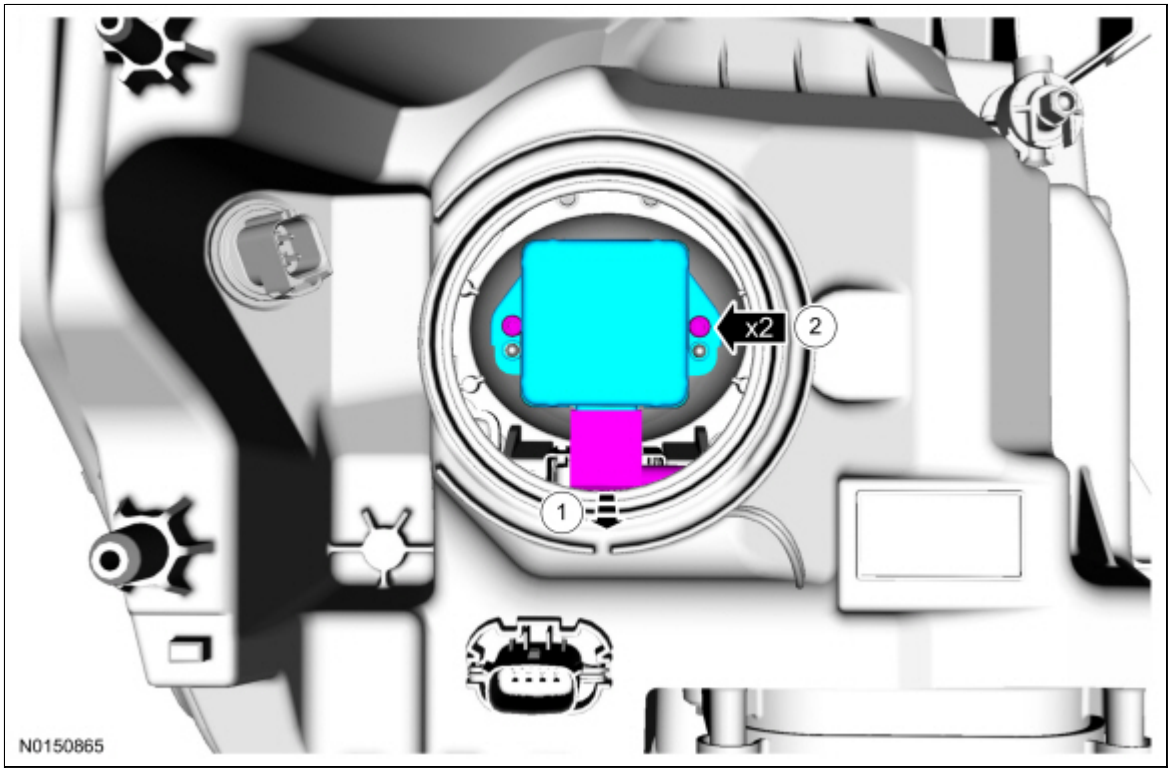
WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamp with the bulb removed from the headlamp.

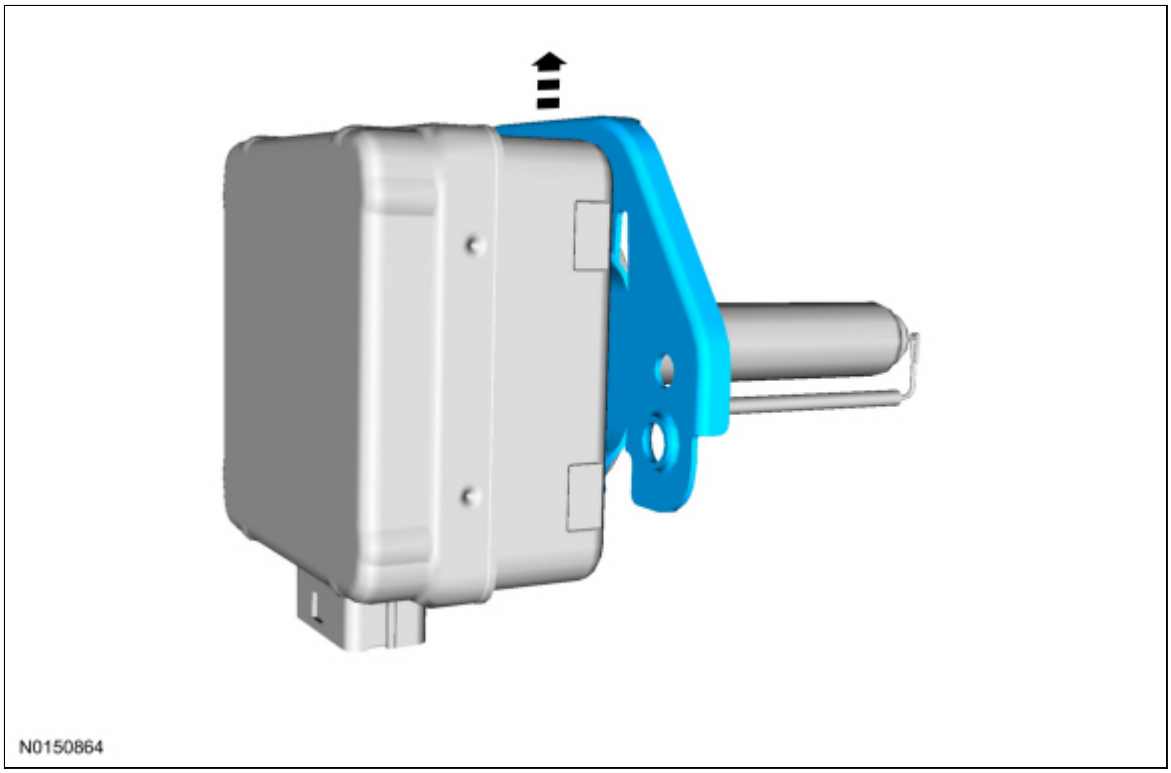
1. Remove the headlamp assembly. Refer to Headlamp Assembly .
2. 

3.

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4.

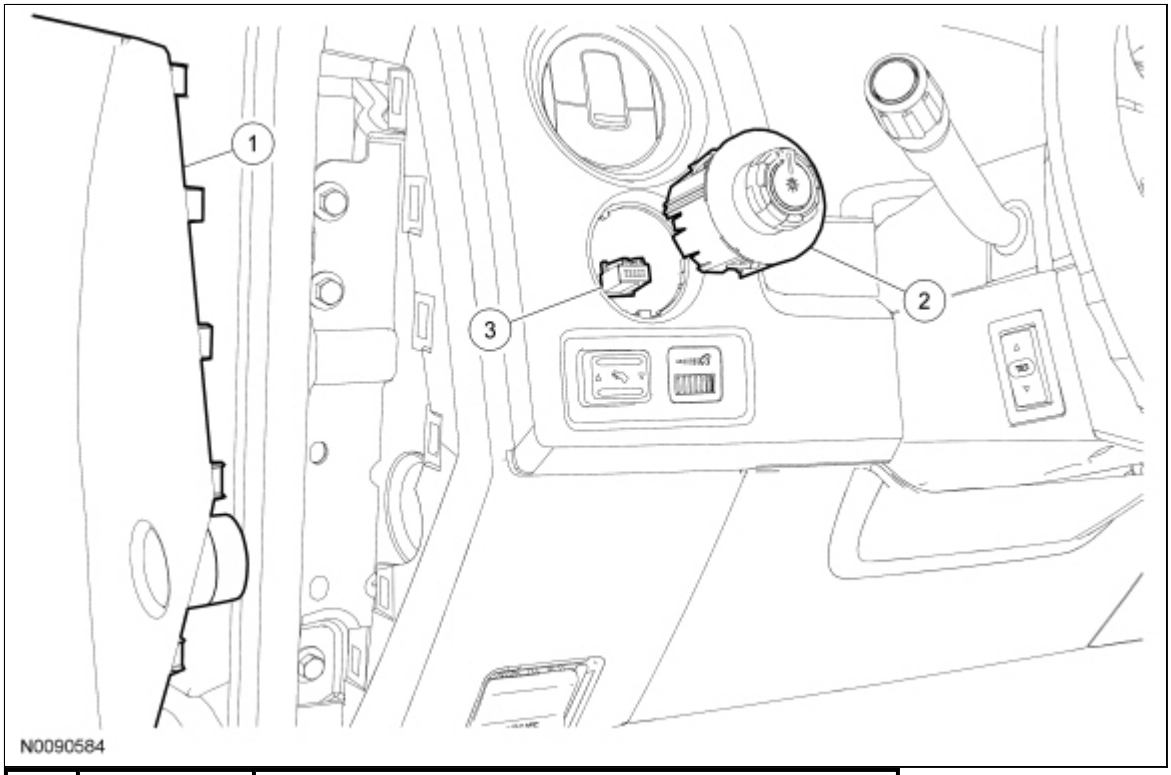


Installation

1. To install, reverse the removal procedure.

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Headlamp Switch



Item	Part Number	Description
1	1504481	LH instrument panel side finish panel
2	11654	Headlamp switch
3	—	Headlamp switch electrical connector (part of 14401)

Removal and Installation

1. Remove the instrument panel side finish panel.

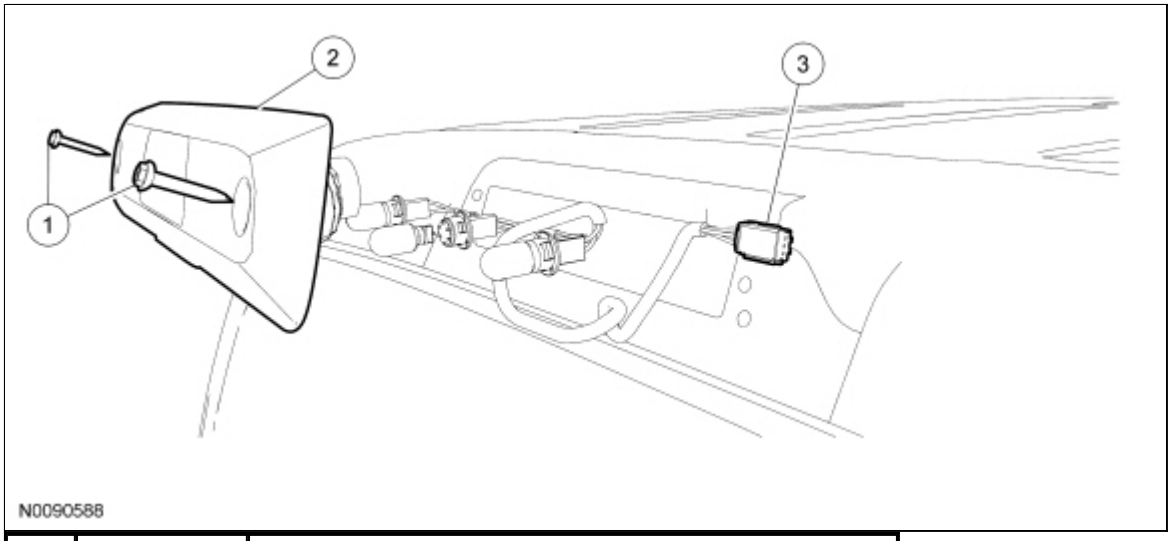
2. **NOTE:** The 3 retaining tabs on the headlamp switch are located at approximately 3, 6 and 11 o'clock positions when viewed from the front.

   Reaching from behind, release the 3 tabs and push the headlamp switch through the opening.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

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High Mounted Stoplamp



Item	Part Number	Description
1	W713620	High mounted stoplamp screws (2 required)
2	13A613	High mounted stoplamp
3	—	High mounted stoplamp electrical connector (part of 14335)

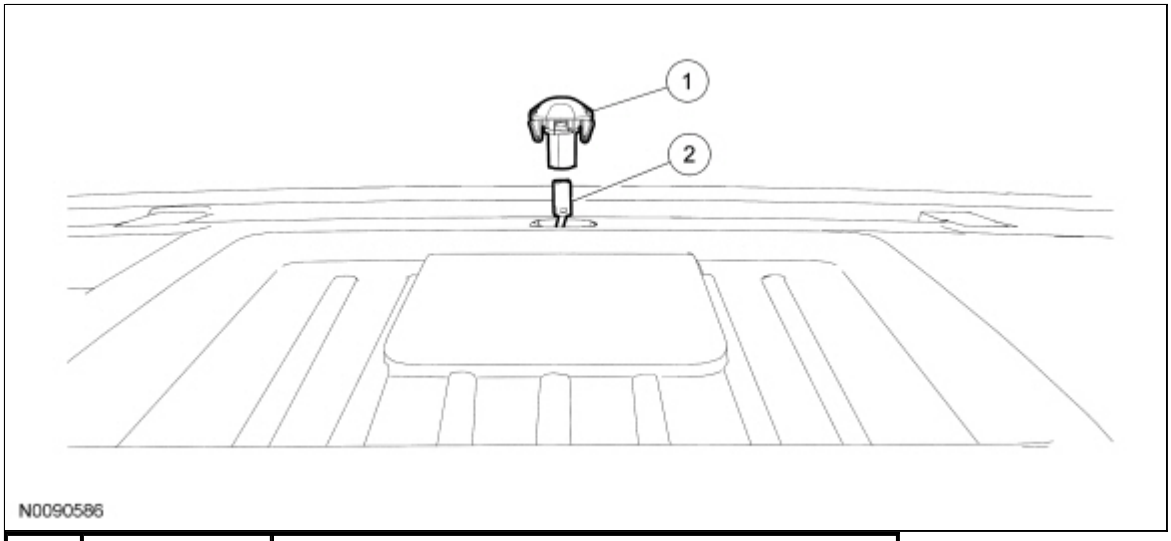
Removal and Installation

1. Remove the 2 screws and the high mounted stoplamp.
    - Disconnect the electrical connector.

2. To install, reverse the removal procedure.

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Light Sensor



Item	Part Number	Description
1	13A018	Light sensor
2	—	Light sensor electrical connector (part of 14401)

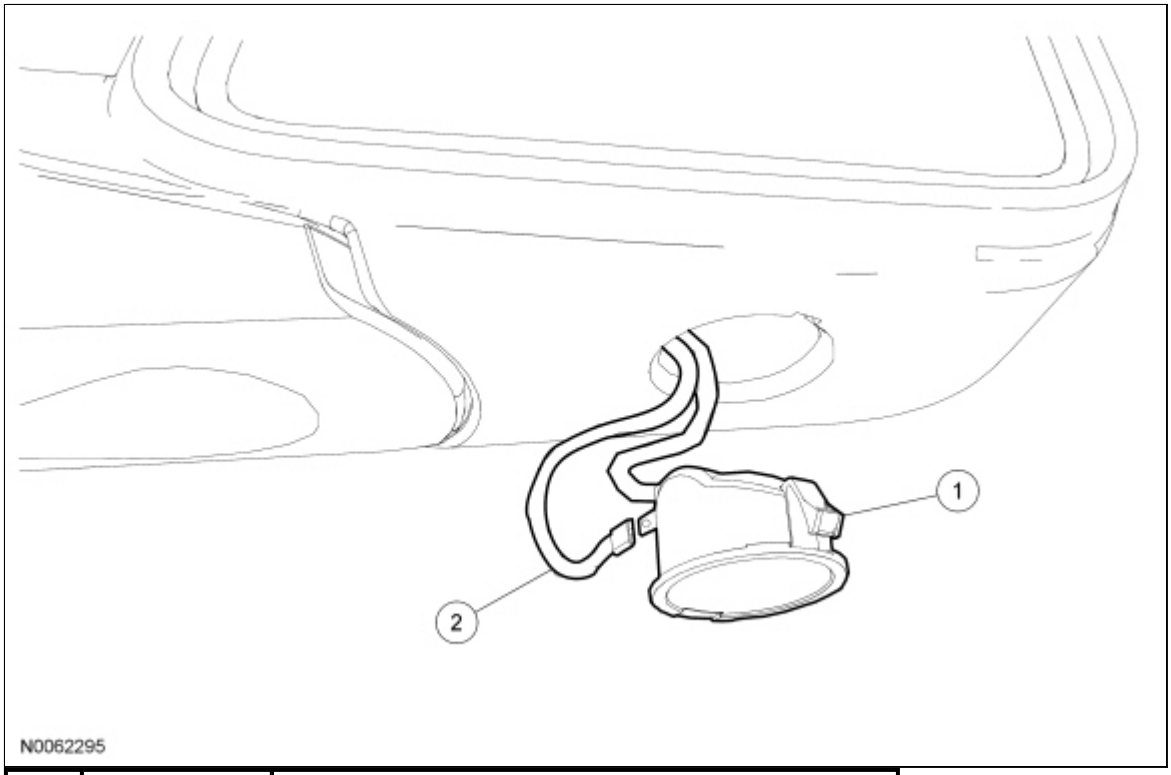
Removal and Installation

1. Using a thin-bladed flat tool, remove the light sensor.
    - Disconnect the electrical connector.

2. To install, reverse the removal procedure.

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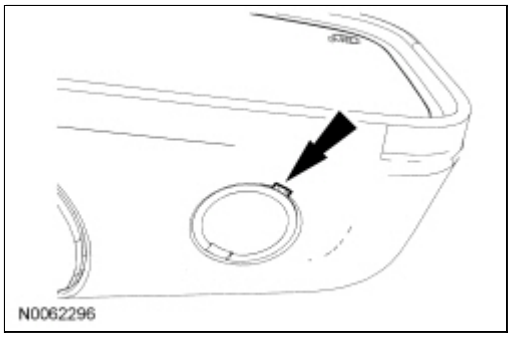
Puddle Lamp



Item	Part Number	Description
1	13B375	Puddle lamp
2	—	Puddle lamp electrical connector (part of 17683)

Removal and Installation

1. Release the tab to remove the puddle lamp from the mirror housing.
    - Disconnect the electrical connector.



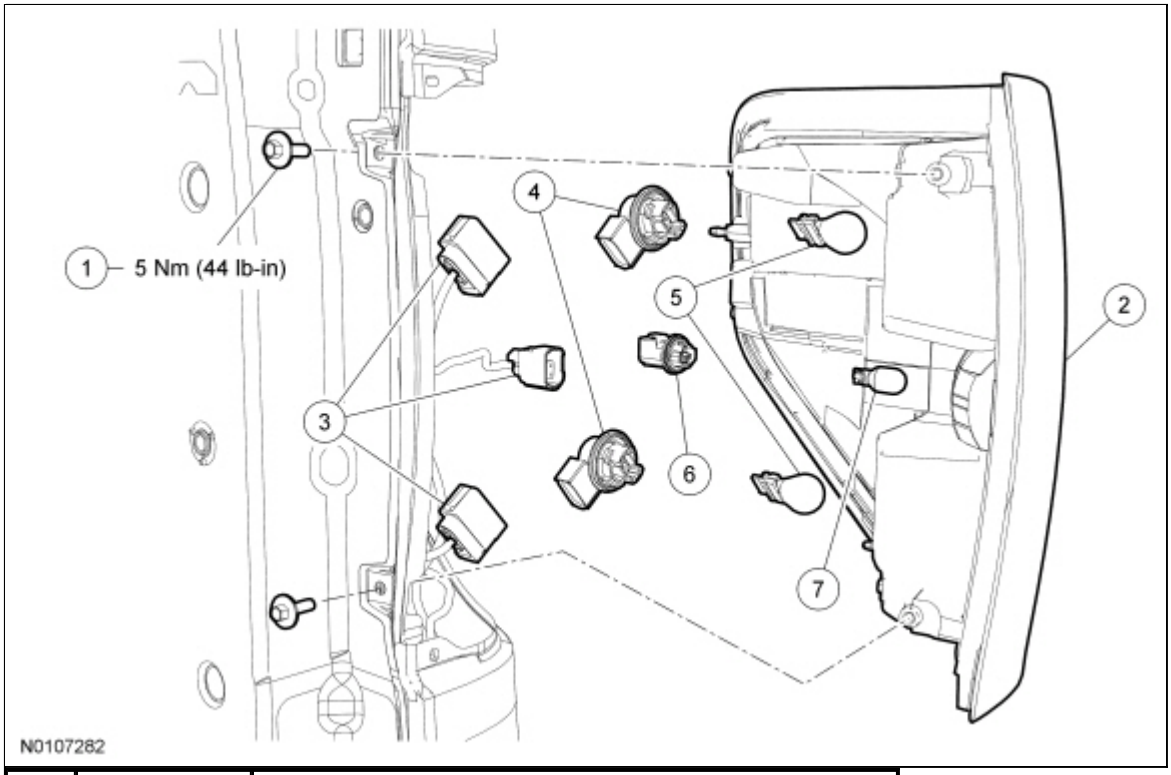
2. **NOTE:** An audible click can be heard when the puddle lamp is fully seated.

   To install, reverse the removal procedure.

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Rear Lamp Assembly

NOTE: Styleside lamp shown, flareside similar.



Item	Part Number	Description
1	N808955	Rear lamp assembly bolts (2 required)
2	13405/13404	Rear lamp assembly (LH/RH)
3	—	Rear lamp assembly electrical connectors (part of 13A409)
4	13411	Rear stop/turn lamp bulb holder
5	13466	Rear stop/turn lamp bulb
6	13411	Reversing lamp bulb holder
7	13466	Reversing lamp bulb

Removal and Installation

1. Remove the 2 rear lamp assembly bolts.
    - To install, tighten to 5 Nm (44 lb-in).

2. Firmly pull the rear lamp assembly rearward to disengage the metal studs from the grommets on the outboard side of the sheet metal.
    - Disconnect the electrical connectors.

3. If necessary, rotate the bulb holder counterclockwise approximately one-eighth turn and remove it.
    - Separate the bulb from the bulb holder.

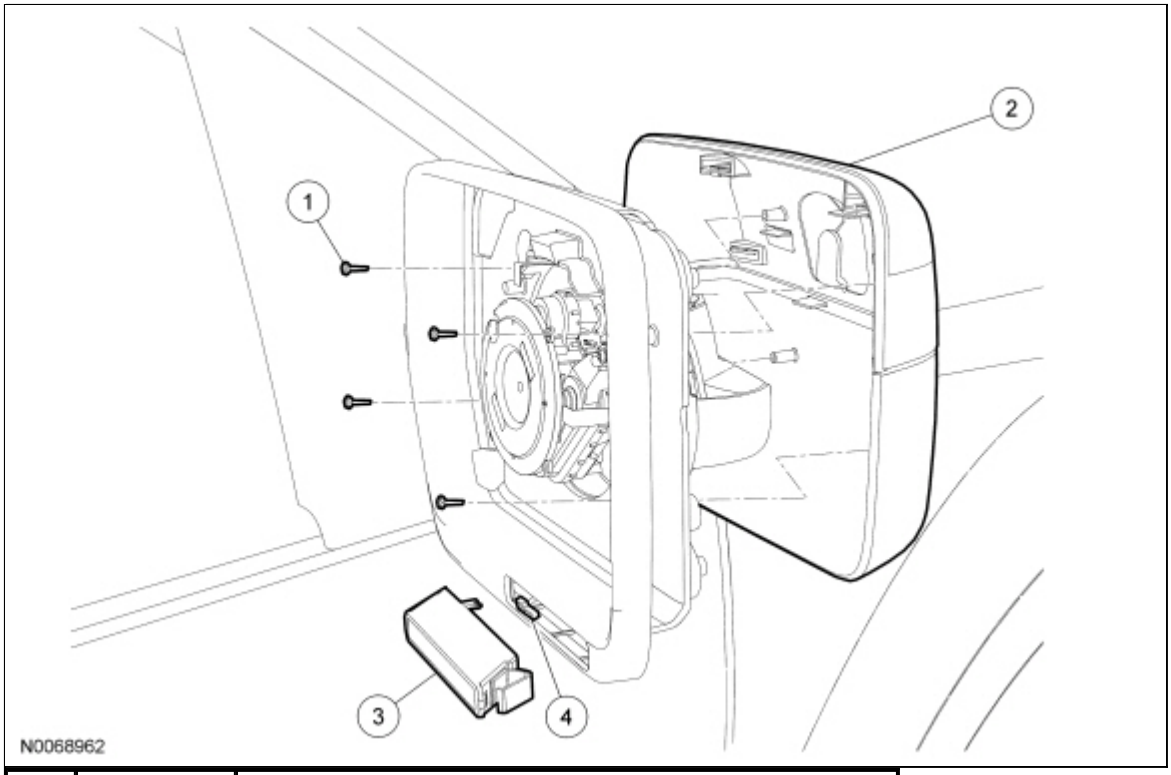
4. To install, reverse the removal procedure.

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Side Lamp Assembly — Outside Rear View Mirror, Aero

Aero-Styled Mirror



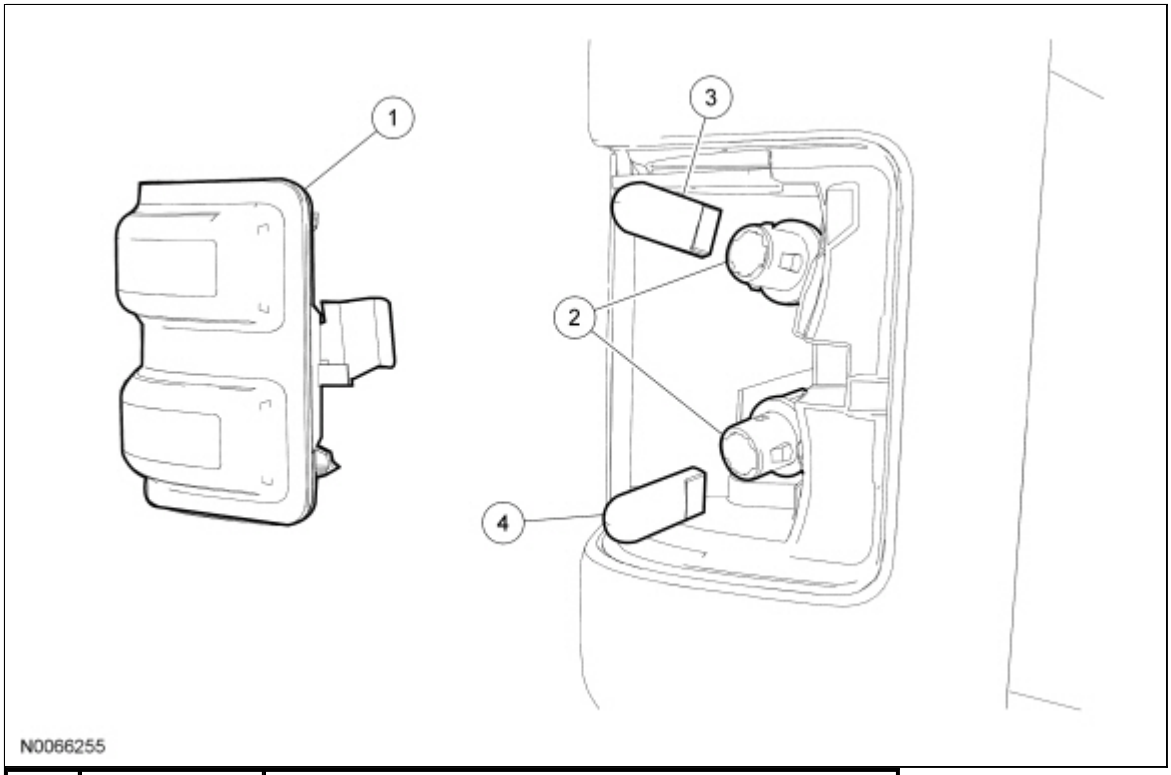
Item	Part Number	Description
1	—	Exterior mirror cover screws (4 required) (part of 17682 RH/17683 LH)
2	17682	Exterior mirror cover
3	13B374	Trailer tow turn lamp
4	—	Trailer tow turn lamp electrical connector (part of 17682 RH/17683 LH)

Removal and Installation

1. Remove the exterior mirror glass. For additional information, refer to Section 501-09 .
2. Remove the 4 screws and the outboard exterior mirror cover.
3. Using a thin-bladed tool, release the tab by pushing it inward and remove the trailer tow turn lamp.
   - Disconnect the electrical connector.
4. To install, reverse the removal procedure.

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Side Lamp Assembly — Outside Rear View Mirror, Trailer Tow



Item	Part Number	Description
1	13776	Exterior mirror side lamp assembly
2	—	Mirror bulb holders (part of 17683/17682) (LH/RH)
3	13465	Side marker lamp bulb
4	13465	Turn lamp bulb

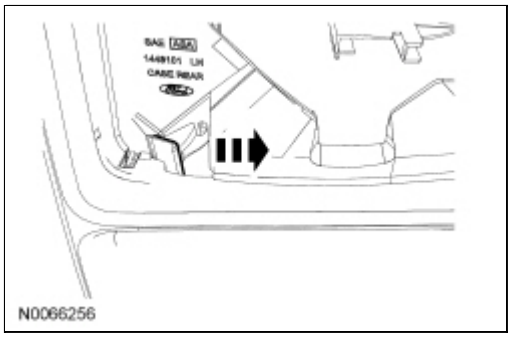
Removal and Installation

1. Position the exterior mirror glass inward toward the vehicle.

2. ***NOTICE:*** **Use caution to not trap the side lamp assembly wiring during installation, or damage to the wiring may occur.**

   NOTE: Mirror glass removed for clarity.

   Using a flat blade screwdriver or suitable tool, push the mirror side lamp assembly forward while releasing the retaining clip.

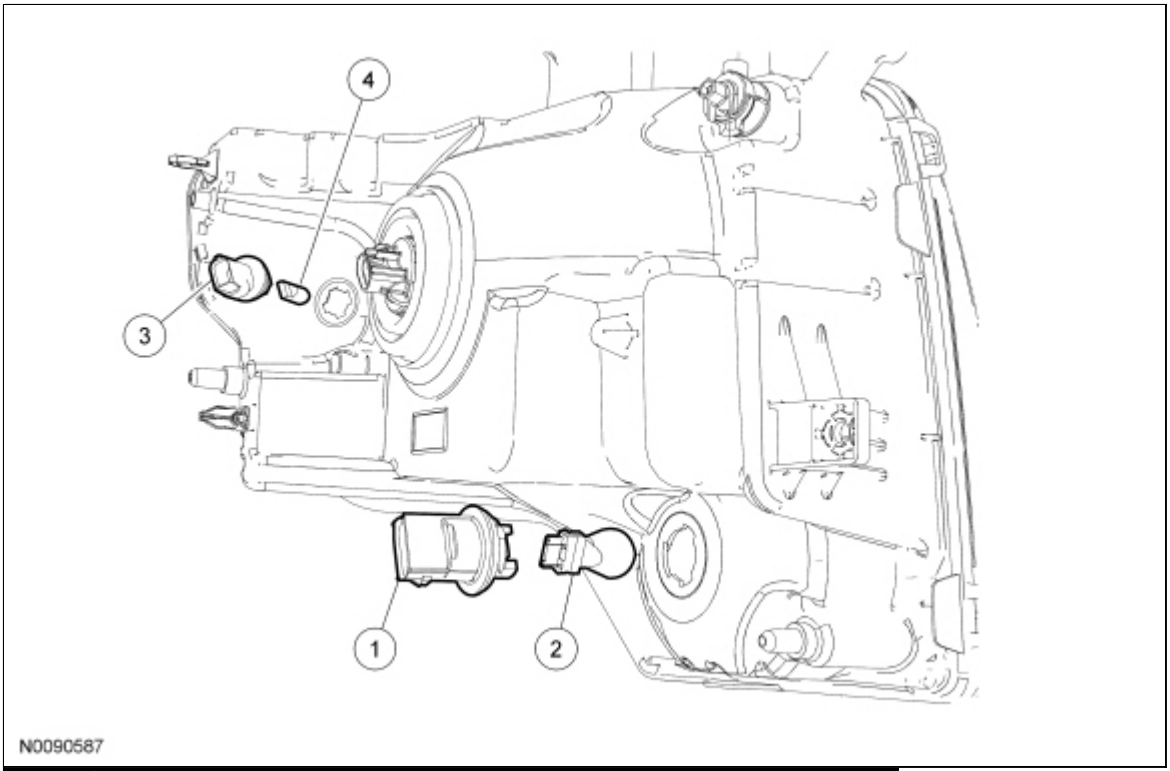


3. Separate the bulb holders from the mirror side lamp assembly and remove the side lamp.
4. To install, reverse the removal procedure.

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Side Lamp/Front Turn Signal Lamp Bulb



Item	Part Number	Description
1	13411	Front park/turn signal lamp bulb holder
2	13466	Front park/turn signal lamp bulb
3	13411	Side marker lamp bulb holder
4	13466	Side marker lamp bulb

Removal and Installation

1. Remove the headlamp assembly. For additional information, refer to Headlamp Assembly in this section.

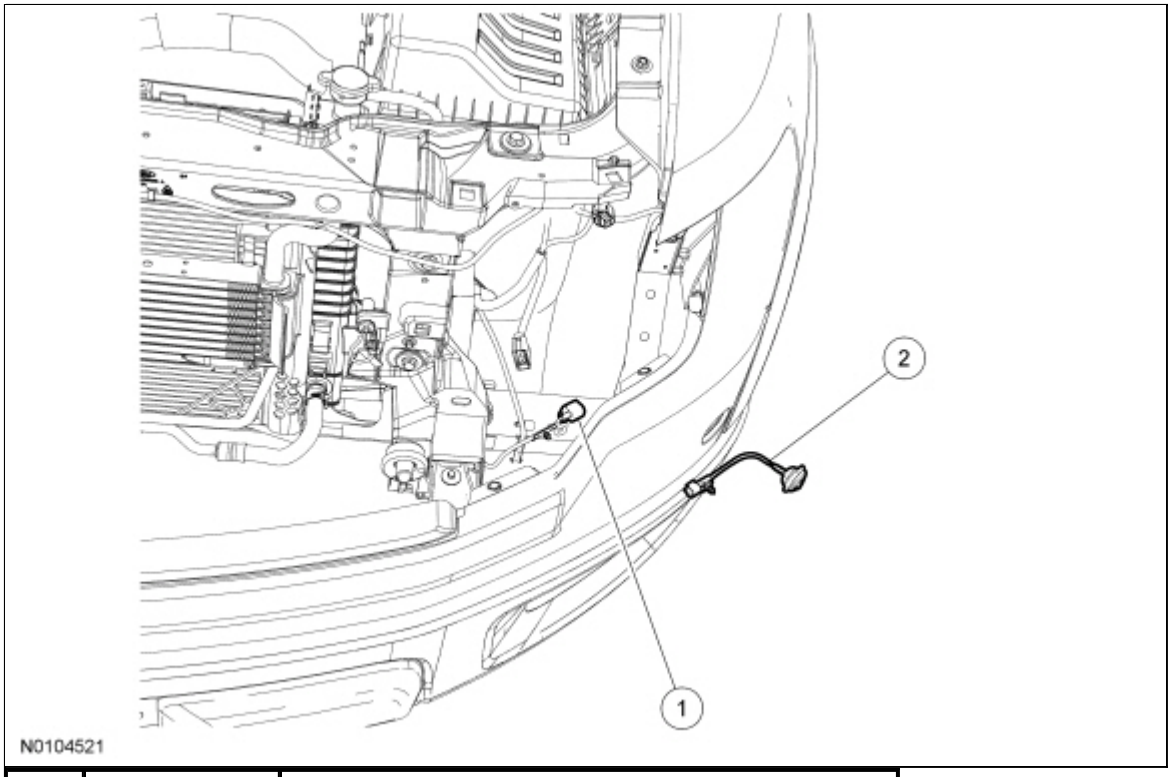
2. Rotate the bulb holder counterclockwise approximately one-eighth turn and remove it.
   - If necessary, separate the bulb from the bulb holder.

3. To install, reverse the removal procedure.

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Side Marker Lamp — Front

NOTE: Headlamp removed for clarity.



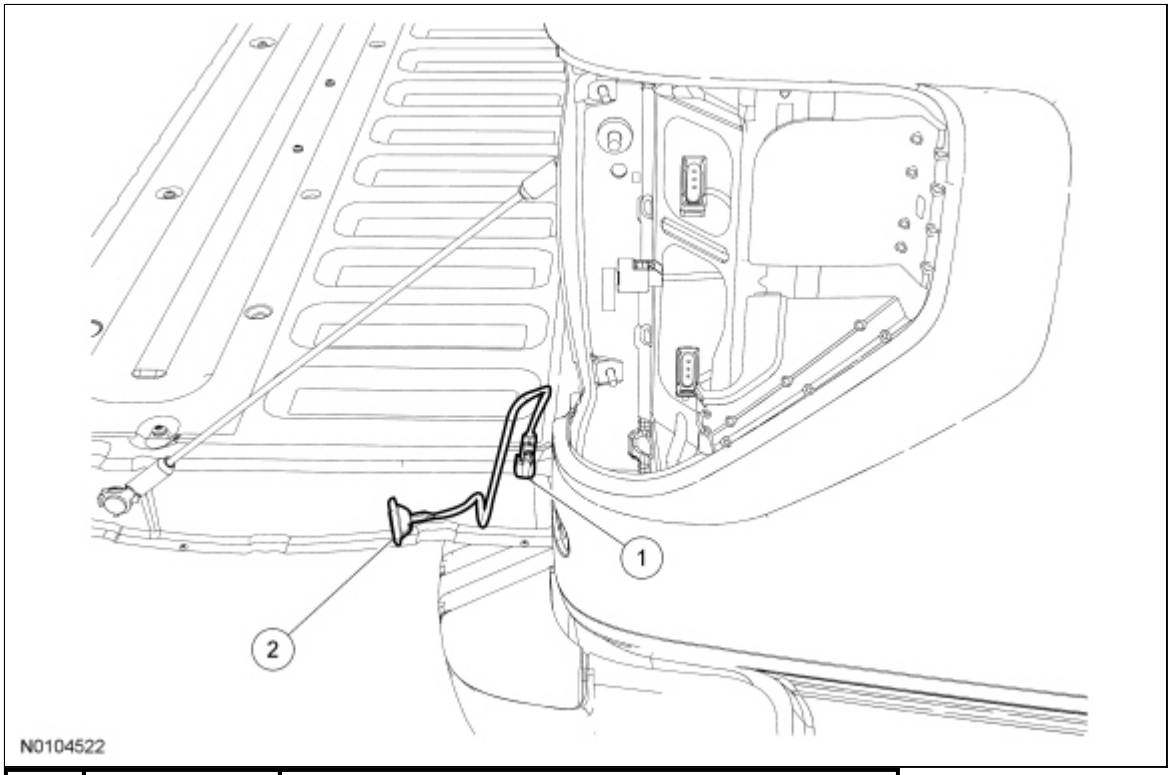
Item	Part Number	Description
1	—	Side lamp electrical connector (part of 13192)
2	13192	Side LED lamp

Removal and Installation

1. Disconnect the electrical connector and separate the LED connector push-pin from the vehicle harness.
2. Push the LED harness through the front bumper cover and remove.
3. To install, reverse the removal procedure.

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Side Marker Lamp — Rear



Item	Part Number	Description
1	—	Side lamp electrical connector (part of 13192)
2	13192	Side LED lamp

Removal and Installation

1. Remove the rear lamp assembly. For additional information, refer to Rear Lamp Assembly in this section.

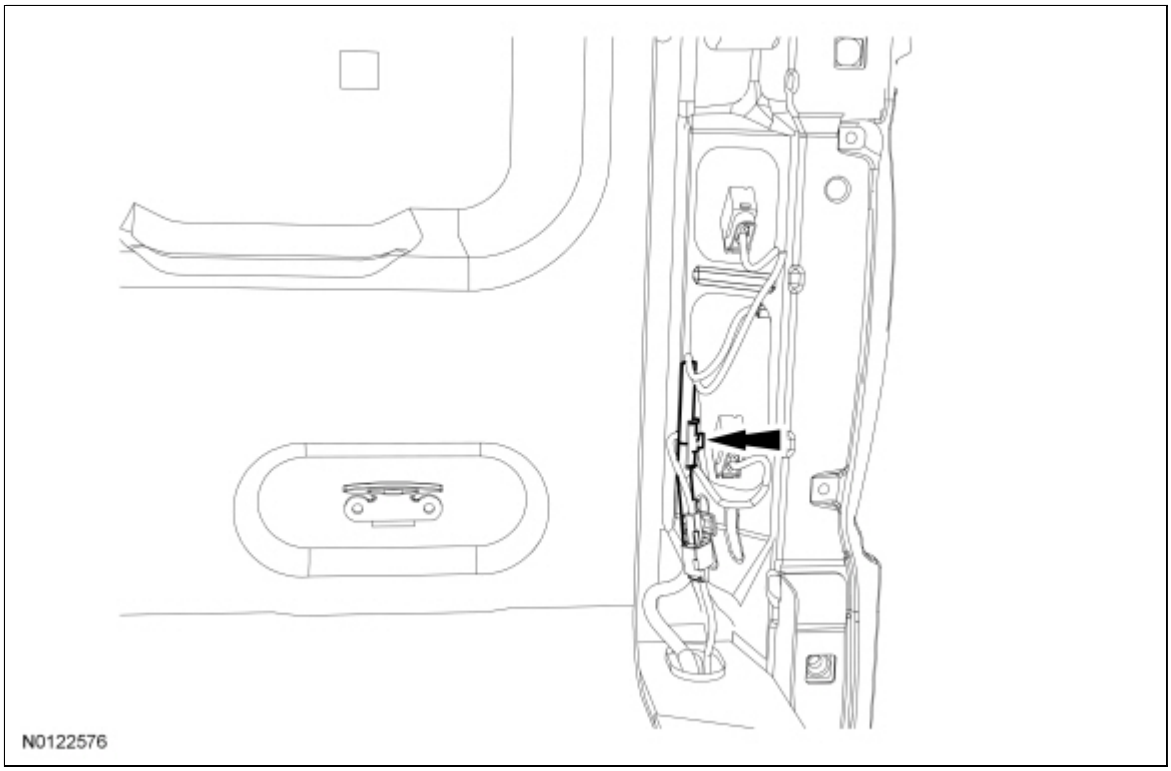
2. Disconnect the electrical connector and separate the LED connector push-pin from the vehicle harness.

3. Push the LED harness through the sheet metal and remove.

4. **NOTE:** Make sure the edge biter clip is attached to the outboard side of the sheet metal during installation.

   NOTE: Edge biter clip must be retained so that the wire bundle is positioned behined the sheet metal.

   To install, reverse the removal procedure.



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Stoplamp Switch



Item	Part Number	Description
1	—	Stoplamp switch electrical connector (part of 12A581)
2	13480	Stoplamp switch

Removal and Installation

NOTICE: **Do not press or pull on the brake pedal when installing or removing the stoplamp switch, otherwise misadjustment or damage to the stoplamp switch can occur.**

1. Disconnect the stoplamp switch electrical connector.
2. Rotate the stoplamp switch clockwise approximately one-eighth turn and remove it.
3. To install, reverse the removal procedure.

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Interior Lighting

The interior lighting system consists of the following:

- Interior lamp(s)
- Cargo lamp
- Puddle lamps
- Vanity mirror lamps
- Door ajar switches
- Instrument panel dimmer switch
- FDIM
- HVAC module.
- Steering Column Control Module (SCCM)
- Body Control Module (BCM)

NOTE: All the door ajar switches are integral to the door latch **except** for the rear door ajar switches on Super Cab vehicles. The rear door ajar switches on Super Cab vehicles can be replaced independently of the door latch.

The interior lighting system consists of up to 3 subsystems:

- Courtesy lamps
- Demand lamps
- Ambient lighting (if equipped)

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

To save battery voltage, the BCM provides automatic shut-off of the courtesy and demand lamps after a time-out period when the ignition is OFF. A timer in the BCM starts when any of the following occur:

- the ignition changes to OFF
- any door becomes ajar while the ignition is OFF
- an UNLOCK button of the Remote Keyless Entry (RKE) transmitter is pressed while the ignition is OFF
- a valid keypad code is entered while the ignition is OFF
- the instrument panel dimmer switch is used to turn the courtesy lamps on while the ignition is OFF

When 10 minutes have elapsed, the BCM automatically shuts off voltage to the lamps. The timer restarts (voltage is restored if the BCM is in battery saver mode) if any of the following occurs:

- the ignition changes out of OFF
- any door becomes ajar
- the UNLOCK button of the RKE transmitter is pressed
- a valid keypad code is entered
- the instrument panel dimmer switch is pressed

Courtesy Lamps

The courtesy lamp subsystem consists of the door ajar switches, the interior dome lamps, the cargo lamp, the puddle lamps, the instrument panel dimmer switch, the SCCM , and the BCM .

Illuminated Entry

The illuminated entry requests the dimmable backlighting, the parking lamps and the courtesy lamps to illuminate when the ignition is OFF and a door is opened, the RKE transmitter UNLOCK button is pressed, or the vehicle is unlocked using the keyless entry keypad. If no doors are open, the illuminated entry requests the lamps off after 25 seconds have elapsed, the ignition is switched out of OFF, the RKE transmitter LOCK button is pressed, or the vehicle is locked using the keyless entry keypad.

Interior Lighting Delay

The interior lighting delay feature provides temporary illumination of the dimmable backlighting, the parking lamps and the courtesy lamps after the doors are opened and then closed. The interior lighting delay feature keeps the lamps on for a period of 25 seconds after all the doors are closed. If during the 25-second delay time the BCM detects the ignition has been switched out of OFF, or if the vehicle is locked using the RKE transmitter or the keyless entry keypad, the lamp illumination is discontinued.

Illuminated Exit

The illuminated exit requests the dimmable backlighting, the parking lamps, and the courtesy lamps to illuminate for 25 seconds after all doors are closed and the ignition is turned OFF. The illuminated exit deactivates when the ignition transitions out of OFF, a door becomes ajar, or 25 seconds have elapsed.

Theater Lighting

The theater lighting feature ramps-up the courtesy lamps over 0.7 second when courtesy lamp activation is requested. The theater lighting feature ramps-down the courtesy lamps over 1.7 seconds when interior lighting deactivation is requested by any feature other than the panic alarm or battery saver.

Dark Car Feature

The dark car configuration disables the activation of the illuminated entry and illuminated exit features when active. The courtesy lamps can still be activated by the instrument panel dimmer switch.

Demand Lamps

The demand lamps subsystem consists of the map/reading lamps and the vanity mirror lamps located in the visors. The BCM energizes the battery saver relay to supply voltage to the demand lamps when the battery saver feature is not active.

Ambient Lighting

The ambient lighting subsystem provides illumination to the center console cup holders, the storage bin and the front and rear footwells. The ambient lighting is controlled using the touch screen display in the center of the instrument panel.

The touch screen display is used to select one of 7 color combinations or turn the ambient lighting feature on or off. The ambient lighting system retains the last color setting and brightness between uses.

When the illuminated entry feature is active, the ambient lighting defaults to a pre-set color and brightness setting. When all the doors are closed and the illuminated entry is no longer active, the ambient lighting

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returns to the last color and brightness setting that was set by the operator.

Interior Lighting

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Body Control Module (BCM) controls all the interior lighting functions and timing by monitoring inputs from the following:

- door ajar switches
- ignition state
- instrument panel dimmer switch (monitored by the Steering Column Control Module (SCCM))
- Remote Keyless Entry (RKE) system
- vehicle speed

The BCM turns off the courtesy lamps when the vehicle speed exceeds 15 km/h (9 mph) or 5 km/h (3 mph) for the puddle lamps, unless the courtesy lamps are turned on using the instrument panel dimmer switch.

Interior Lamp Arbitrator

The interior lamp arbitrator (programming within the BCM) chooses between the interior lighting delay, the illuminated entry and exit, the battery saver, and the alarm flash processing to determine which feature has precedence of activating and deactivating the interior lamps.

Ambient Lighting

The HVAC provides voltage and ground to the LEDs. There are 3 different color LEDs (red, blue and green)

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housed within each LED assembly. By illuminating various color combinations, the LEDs can produce 7 different colors of ambient light.

The HVAC module receives input from the APIM and the Body Control Module (BCM) over the communication network for color and brightness settings.

The display interface in the center of the instrument panel is used to cycle through different color variations or turn the ambient lighting feature on or off. APIM communicates messages over the HS-CAN to the Body Control Module (BCM) .

The Body Control Module (BCM) gateways the messages to the HVAC module over the MS-CAN . The HVAC module retains the last color and brightness setting between uses.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow. For additional information, refer to Principles of Operation in Section 419-10 .

The BCM FET protected output circuits for the interior lighting system are the interior courtesy lamp and puddle lamp output circuits.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Door ajar switches	• Body Control Module (BCM) fuse(s):
	  ▪ 12 (15A) (courtesy lamps)
	  ▪ 21 (10A) (ambient lighting)
	• Wiring, terminals, or connectors
	• Cargo lamp (part of the high mounted stoplamp)
	• Instrument panel dimmer switch
	• Interior lamps
	• Puddle lamps
	• Vanity mirror lamps
	• BCM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

If the scan tool does not communicate with the VCM :

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
     - The air bag warning indicator prove-out confirms ignition ON (other indicators may not prove ignition ON). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in RUN.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication with one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM , the Interior Lighting Control Module (ILCM) and the Steering Column Control Module (SCCM).

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1175:01	Drivers Door Ajar Switch: General Electrical Failure	GO to Pinpoint Test F .
B1176:01	Passenger Door Ajar Switch: General Electrical Failure	GO to Pinpoint Test F .
B11C0:01	Driver Side Rear Door Ajar Switch: General Electrical Failure	GO to Pinpoint Test F .
B11C1:01	Passenger Side Rear Door Ajar Switch: General Electrical Failure	GO to Pinpoint Test F .
B12C2:11	Puddle Lamp: Circuit Short To Ground	GO to Pinpoint Test E .
B1313:11	Interior Lighting	GO to Pinpoint Test C .

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	Output: Circuit Short To Ground	
B1313:15	Interior Lighting Output: Circuit Short To Battery or Open	If the interior courtesy lamps are inoperative, GO to Pinpoint Test C . If the interior courtesy lamps stay on continuously, GO to Pinpoint Test G .
U1000:00	Solid State Driver Protection Active - Driver Disabled: No Sub Type Information	**The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The Body Control Module (BCM) cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first.** After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
U3000:49	Control Module: Internal Electronic Failure	**The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. The cause of the excessive current draw MUST be corrected before a new BCM is installed. ADDRESS all other DTCs first.** After the cause of the concern is corrected, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1124:09	Lamp Fade Control: Component Failure	REFER to Section 413-00 .
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

HVAC Module DTC Chart

DTC	Description	Action
B127C:11	Ambient Lighting Zone 2 Output Red LED: Circuit Short To Ground	GO to Pinpoint Test L .
B127C:12	Ambient Lighting Zone 2 Output Red LED: Circuit Short To Battery	GO to Pinpoint Test L .
B127C:13	Ambient Lighting Zone 2 Output Red LED: Circuit Open	GO to Pinpoint Test L .
B127F:11	Ambient Lighting Zone 2 Output Green LED: Circuit Short To Ground	GO to Pinpoint Test L .
B127F:12	Ambient Lighting Zone 2 Output Green LED: Circuit Short To Battery	GO to Pinpoint Test L .
B127F:13	Ambient Lighting Zone 2 Output Green LED: Circuit Open	GO to Pinpoint Test L .

B1282:11	Ambient Lighting Zone 2 Output Blue LED: Circuit Short To Ground	GO to Pinpoint Test L .
B1282:12	Ambient Lighting Zone 2 Output Blue LED: Circuit Short To Battery	GO to Pinpoint Test L .
B1282:13	Ambient Lighting Zone 2 Output Blue LED: Circuit Open	GO to Pinpoint Test L .
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The courtesy lamps flash on and off	• The Body Control Module (BCM) is not configured correctly	• CARRY OUT the Programmable Module Installation (PMI) for the BCM . REFER to Section 418-01 . TEST the system for normal operation.
• The courtesy lamps do not illuminate with a door open	• Wiring, terminals or connectors • Door ajar switch • BCM	• GO to Pinpoint Test A .
• The courtesy lamps do not illuminate from the instrument panel dimmer switch	• Wiring, terminals or connectors • Instrument panel dimmer switch • Steering Column Control Module (SCCM)	• GO to Pinpoint Test B .
• One or more interior courtesy lamp is inoperative	• Fuse • Wiring, terminals or connectors • Interior lamp • BCM	• VERIFY the bulb(s) is OK. If OK, GO to Pinpoint Test C .
• One or more puddle lamp is inoperative	• Wiring, terminals or connectors • Puddle lamp • Exterior mirror	• VERIFY the bulb(s) is OK. If OK, GO to Pinpoint Test D .
• The cargo lamp is inoperative	• Fuse • Wiring, terminals or connectors • High mounted stoplamp • BCM	• VERIFY the bulb(s) is OK. If OK, GO to Pinpoint Test E .
• All the courtesy lamps stay on continuously	• Wiring, terminals or connectors • Door ajar switch • BCM	• GO to Pinpoint Test F .

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• The interior courtesy lamps stay on continuously	• Wiring, terminals or connectors • BCM	• GO to Pinpoint Test G .
• The cargo lamp/puddle lamps stay on continuously	• Wiring, terminals or connectors • BCM	• GO to Pinpoint Test H .
• One or more demand lamp is inoperative	• Fuse • Wiring, terminals or connectors • Sun visor • Interior lamp • BCM	• VERIFY the bulb(s) is OK. If OK, GO to Pinpoint Test I .
• The battery saver does not deactivate after time-out	• Wiring, terminals or connectors • BCM	• GO to Pinpoint Test J .
• An individual ambient lighting LED is inoperative/does not cycle through all color combinations	• Ambient lighting harness	• **NOTE:** The LEDs are not serviceable separate from the harness. REPAIR or INSTALL a new ambient lighting harness in question. TEST the system for normal operation.
• The ambient lighting is inoperative	• Wiring, terminals or connectors • HVAC module	• GO to Pinpoint Test K .
• The ambient lighting does not cycle through all color combinations	• Wiring, terminals or connectors • HVAC module	• GO to Pinpoint Test L .

Pinpoint Tests

Pinpoint Test A: The Courtesy Lamps Do Not Illuminate With A Door Open

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends a voltage signal to each door ajar switch, which is routed to ground when the door is closed (the door ajar switch is closed when the door is closed). When the door is opened, the signal to ground is interrupted indicating an open door to the BCM .

When the BCM detects an open door, voltage is provided to the courtesy lamps.

NOTE: All the door ajar switches are integral to the door latch **except** for the rear door ajar switches on Super Cab vehicles. The rear door ajar switches on Super Cab vehicles are replaced independently of the door latch.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door ajar switch
- BCM

PINPOINT TEST A: THE COURTESY LAMPS DO NOT ILLUMINATE WITH A DOOR OPEN

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>A1 CHECK THE OPERATION OF THE COURTESY LAMPS FROM THE INSTRUMENT PANEL DIMMER SWITCH</td><td rowspan="2">Yes
GO to A2 .

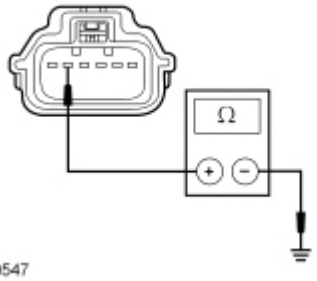
No
GO to Pinpoint Test C .</td></tr>
<tr><td>• Ignition OFF.
• Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds.
• Do the interior courtesy lamps illuminate?</td></tr>
<tr><td>A2 CHECK THE DOOR AJAR SWITCH OPERATION</td><td rowspan="2">Yes
INSTALL a new door latch or ajar switch in question. REFER to Section 501-14 . TEST the system for normal operation.

No
GO to A3 .</td></tr>
<tr><td>• Press and hold the instrument panel dimmer switch to the DOME LAMP OFF (second detent down) position for 3 seconds.
• Disconnect: Suspect Door Ajar Switch.
• Do the courtesy lamps illuminate?</td></tr>
<tr><td>A3 CHECK THE DOOR AJAR SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND</td><td rowspan="2">Yes
GO to A4 .

No
REPAIR the circuit in question for a short to ground. TEST the system for normal operation.</td></tr>
<tr><td>• Disconnect: BCM C2280C.
• For any door except a rear door on Super Cab vehicles, measure the resistance between the suspect door latch, harness side and ground as follows:

<table>
<tr><th>Location</th><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>LH front</td><td>C525-5</td><td>CPL26 (GN/VT)</td></tr>
<tr><td>RH front</td><td>C609-5</td><td>CPL31 (WH)</td></tr>
<tr><td>LH rear</td><td>C705-5</td><td>CPL36 (GN)</td></tr>
<tr><td>RH rear</td><td>C805-5</td><td>CPL39 (YE)</td></tr>
</table>
</td></tr>
</table>

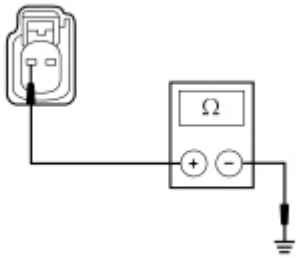
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N0090547

- For a rear door on Super Cab vehicles, measure the resistance between the suspect door ajar switch, harness side and ground as follows:

Location	Connector-Pin	Circuit
LH rear	C715-2	CPL36 (GN)
RH rear	C820-2	CPL39 (YE)



N0058790

- **Is the resistance greater than 10,000 ohms?**

A4 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: The Courtesy Lamps Do Not Illuminate From The Instrument Panel Dimmer Switch

Refer to Wiring Diagrams Cell 89, Interior Lighting for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) sends 3 voltage signals to the instrument panel dimmer switch to monitor the DIM UP, DIM DOWN and DOME LAMP request inputs. The SCCM sends a message

over the communication network to the Body Control Module (BCM) to indicate the instrument panel dimmer switch position.

The BCM turns the courtesy lamps on and off by monitoring the dimmer switch and dome lamp request input circuits. When the instrument panel dimmer switch is pressed to the second detent up, the SCCM receives signals indicating DIM UP and DOME LAMP request circuits at the same time, indicating a request to turn the courtesy lamps on. When the instrument panel dimmer switch is pressed to the second detent down, the SCCM receives signals indicating DIM DOWN and DOME LAMP request circuits at the same time, indicating a request to turn the courtesy lamps off. When the SCCM detects these inputs from the instrument panel dimmer switch, the SCCM sends the appropriate message to the BCM and voltage is supplied to the courtesy lamps.

If the SCCM detects a fault with any of the 3 inputs from the switch (circuit shorted to ground for example), the SCCM sets DTC B1124:09 (Lamp Fade Control: Component Failure). The BCM then defaults the dimmable backlighting to a preset level that cannot be adjusted.

This pinpoint test is intended to diagnose the following:

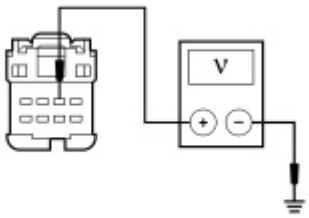
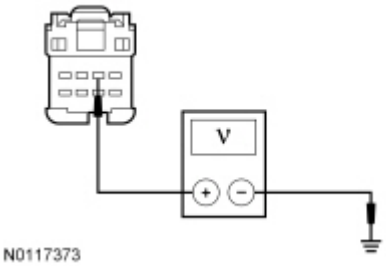
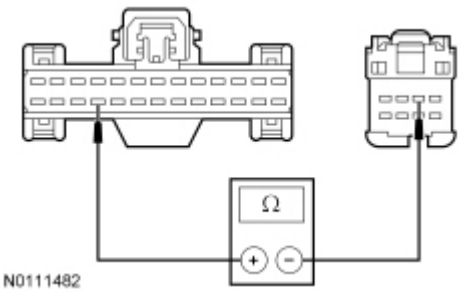
- Wiring, terminals or connectors
- Instrument panel dimmer switch
- SCCM

PINPOINT TEST B: THE COURTESY LAMPS DO NOT ILLUMINATE FROM THE INSTRUMENT PANEL DIMMER SWITCH

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE OPERATION OF THE COURTESY LAMPS FROM A DOOR	
• Place the headlamp switch in the OFF position. • Open any door and observe the interior courtesy lamps. • **Do the interior courtesy lamps illuminate?**	**Yes** GO to B2. **No** GO to Pinpoint Test C.
B2 CHECK THE DIMMABLE BACKLIGHTING OPERATION	
• Place the headlamp switch in the PARKING LAMPS ON position. • Monitor the instrument panel dimmable backlighting while pressing (and holding) the instrument panel dimmer switch to the first detent up and then the first detent down. • **Does the dimmable backlighting intensity change with the instrument panel dimmer switch position?**	**Yes** GO to B3. **No** REFER to Section 413-00.
B3 CHECK FOR A VOLTAGE SIGNAL TO THE INSTRUMENT PANEL DIMMER SWITCH	
• Ignition OFF. • Disconnect: Instrument Panel Dimmer Switch C2298. • Measure the voltage between the instrument panel dimmer switch C2298-2, circuit VLN36 (GY/OG), harness side and ground.	**Yes** INSTALL a new instrument panel dimmer switch. REFER to Section 413-00. TEST the system for normal operation.

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 N0102465 • **Is the voltage approximately 5 volts?**	**No** GO to B4 .
B4 CHECK THE DOME LAMP REQUEST INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: SCCM C2414A. • Ignition ON. • Measure the voltage between the instrument panel dimmer switch C2298-2, circuit VLN36 (GY/OG), harness side and ground.  N0117373 • **Is any voltage present?**	**Yes** REPAIR circuit VLN36 (GY/OG) for a short to voltage. TEST the system for normal operation. **No** GO to B5 .
B5 CHECK THE DOME LAMP REQUEST INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the SCCM C2414A-23, circuit VLN36 (GY/OG), harness side and the instrument panel dimmer switch C2298-2, circuit VLN36 (GY/OG), harness side.  N0111482 • **Is the resistance less than 5 ohms?**	**Yes** GO to B6 . **No** REPAIR circuit VLN36 (GY/OG) for an open. TEST the system for normal operation.
B6 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
	Yes
	INSTALL a new SCCM .
	REFER to Section 211-05 .
	TEST the system for normal operation.

• Connect all the SCCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: One Or More Interior Courtesy Lamp Is Inoperative

Refer to Wiring Diagrams Cell 89 , Interior Lamps for schematic and connector information.

Normal Operation

The Body Control Module (BCM) fuse 12 (15A) supplies power for the interior courtesy lamps (and the running board lamps if equipped). When the BCM receives the required input (such as an open door or request from the instrument panel dimmer switch), it provides voltage to the interior courtesy lamps.

DTC Description	Fault Trigger Conditions
• B1313:11 — Interior Lighting Output: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the courtesy lighting output circuit.
• B1313:15 — Interior Lighting Output: Circuit Short To Battery or Open	This DTC sets when the BCM detects an open from the courtesy lighting output circuit.
• U1000:00 — Solid State Driver Protection Active -Driver Disabled: No Sub Type Information	This DTC sets when the BCM has temporarily shut down the output driver. **The module has temporarily disabled the interior courtesy lamp output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the courtesy lamp output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	This DTC sets when the BCM has permanently shut down the output driver. **The module has permanently disabled the interior courtesy lamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. The cause of the excessive current draw MUST be corrected before a new BCM is installed.**

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Interior lamp
- BCM

PINPOINT TEST C: ONE OR MORE INTERIOR COURTESY LAMP IS INOPERATIVE

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NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE OPERATION OF ALL THE INTERIOR COURTESY LAMPS</td><td></td></tr>
<tr><td>

Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds.
Are all the interior courtesy lamps inoperative?

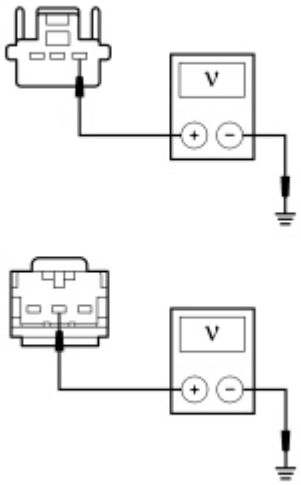
</td><td>Yes
VERIFY the BCM fuse 12 (15A) is OK. If OK, GO to C4 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC U1000:00 is present, CLEAR the DTCs and REPEAT the self-test (required to enable the courtesy lamp output driver if DTC U1000:00 is present) . TEST the system for normal operation. If DTC U3000:49 is present, INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.

No
GO to C2 .</td></tr>
<tr><td>C2 CHECK FOR VOLTAGE TO THE INTERIOR LAMP</td><td></td></tr>
<tr><td>

Turn the interior courtesy lamps off.
Disconnect: Inoperative Interior Lamp.
Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds.
Measure the voltage between the inoperative interior lamp, harness side and ground as follows:

<table>
<tr><th>Inoperative Lamp</th><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>Front interior lamp (without overhead console)</td><td>C901-1</td><td>VLN33 (GY/VT)</td></tr>
<tr><td>Front interior lamp (with overhead console)</td><td>C929-2</td><td>VLN33 (GY/VT)</td></tr>
<tr><td>Rear interior lamp</td><td>C932-1</td><td>VLN33 (GY/VT)</td></tr>
</table>
</td><td>Yes
GO to C3 .

No
REPAIR circuit VLN33 (GY/VT) for an open. TEST the system for normal operation.</td></tr>
</table>



N0090548

- **Is the voltage greater than 10 volts?**

C3 CHECK THE INTERIOR LAMP GROUND CIRCUIT FOR AN OPEN

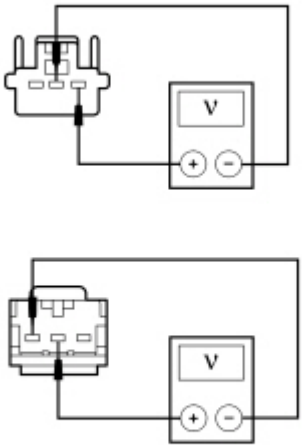
- Measure the voltage between the suspect interior lamp pins, harness side as follows:

Inoperative Lamp	Connector-Pin Circuit	Connector-Pin Circuit
Front interior lamp (without overhead console)	C901-1 VLN33 (GY/VT)	C901-2 GD139 (BK/YE)
Front interior lamp (with overhead console)	C929-2 VLN33 (GY/VT)	C929-1 GD139 (BK/YE)
Rear interior lamp	C932-1 VLN33 (GY/VT)	C932-2 GD139 (BK/YE)

Yes
INSTALL a new interior lamp for the lamp in question. REFER to Interior Lamp in this section. TEST the system for normal operation.

No
REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation.

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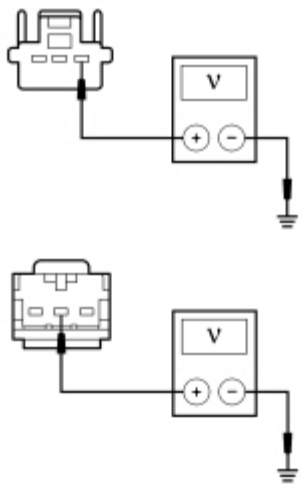


N0090549

- **Is the voltage greater than 10 volts?**

C4 CHECK THE OPERATION OF THE DEMAND LIGHTING	
• Operate the demand lighting function (such as the map light) on any interior lamp. • **Does the interior lamp illuminate?**	**Yes** For vehicles that only have a single interior lamp, GO to C5 . For vehicles that have 2 interior lamps, GO to C6 . **No** REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation.
C5 CHECK FOR VOLTAGE TO THE INTERIOR LAMP	
• Press and hold the instrument panel dimmer switch to the DOME LAMP OFF (second detent down) position for 3 seconds. • Disconnect: Front Interior Lamp. • Ignition ON. • Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds. • Measure the voltage between the interior lamp, harness side and ground as follows:	**Yes** INSTALL a new interior lamp. REFER to Interior Lamp in this section. TEST the system for normal operation. **No** GO to C6 .

Inoperative Lamp	Connector-Pin	Circuit
Front interior/map lamp (without overhead console)	C901-1	VLN33 (GY/VT)
Front interior/map lamp (with overhead console)	C929-2	VLN33 (GY/VT)

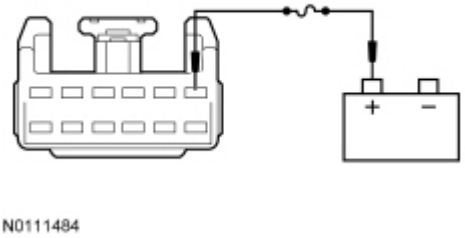


N0090548

- **Is the voltage greater than 10 volts?**

C6 BYPASS THE BCM	
NOTE: If the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC U1000:00 is present, clear the DTCs and repeat the self-test **(required to enable the courtesy lamp output driver if DTC U1000:00 is present).** Test the system for normal operation. If DTC U3000:49 is present, install a new BCM. Refer to Section 419-10. Test the system for normal operation. • Connect: Front Interior Lamp. • Disconnect: BCM C2280A. • Connect a fused jumper wire between the BCM C2280A-1, circuit VLN33 (GY/VT), harness side and battery positive.	**Yes** REMOVE the jumper wire. GO to C7. **No** REMOVE the jumper wire. REPAIR circuit VLN33 (GY/VT) for an open. TEST the system for normal operation.

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 N0111484 • **Do the courtesy lamps illuminate?**	
C7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: One Or More Puddle Lamp Is Inoperative

Refer to Wiring Diagrams Cell 89, Interior Lamps for schematic and connector information.

Normal Operation

The puddle lamps illuminate when the cargo lamp illuminates. The Body Control Module (BCM) uses a separate output circuit independent of the interior courtesy lamps that supplies voltage to the cargo lamp and puddle lamps.

This pinpoint test is intended to diagnose the following:

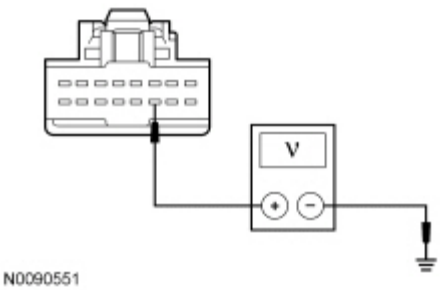
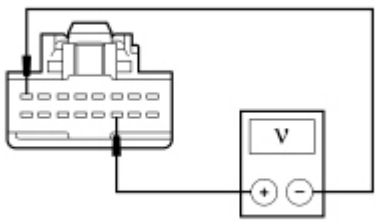
- Wiring, terminals or connectors
- Puddle lamp
- Exterior mirror

PINPOINT TEST D: ONE OR MORE PUDDLE LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Make sure the interior courtesy lamps operate before continuing diagnostics.

Test Step	Result / Action to Take
D1 DETERMINE IF THE CARGO LAMP IS INOPERATIVE	
• Ignition OFF.	**Yes**

• Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds. • **Is the cargo lamp illuminated?**	GO to D2 . **No** GO to Pinpoint Test E .
D2 CHECK FOR VOLTAGE TO THE EXTERIOR MIRROR	
NOTE: Make sure the suspect puddle lamp bulb is OK before continuing diagnostics. • Press and hold the instrument panel dimmer switch to the DOME LAMP OFF (second detent down) position for 3 seconds. • Disconnect: Suspect Exterior Mirror. • Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds. • Measure the voltage between the LH exterior mirror connector C521-11, circuit CLN25 (VT), harness side and ground; or between the RH exterior mirror connector C615-11, circuit CLN25 (VT), harness side and ground.  N0090551 • **Is the voltage greater than 10 volts?**	**Yes** GO to D3 . **No** REPAIR circuit CLN25 (VT) for an open. TEST the system for normal operation.
D3 CHECK THE PUDDLE LAMP GROUND CIRCUIT FOR AN OPEN	
• Measure the voltage between the LH exterior mirror connector C521-11, circuit CLN25 (VT), harness side and the LH exterior mirror connector C521-8, circuit GD134 (BK/VT), harness side; or between the RH exterior mirror connector C615-11, circuit CLN25 (VT), harness side and the RH exterior mirror connector C615-8, circuit GD139 (BK/YE), harness side.  N0090552 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new exterior mirror in question. REFER to Section 501-09 . TEST the system for normal operation. **No** For the LH exterior mirror, REPAIR circuit GD134 (BK/VT) for an open. TEST the system for normal operation. For the RH exterior mirror, REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation.

Pinpoint Test E: The Cargo Lamp is Inoperative

Refer to Wiring Diagrams Cell 89 , Interior Lamps for schematic and connector information.

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Normal Operation

The cargo lamp illuminates when the courtesy lamps illuminate. The Body Control Module (BCM) uses a separate output circuit that supplies voltage to the cargo lamp. The cargo lamp shares the ground circuit with the high mounted stoplamp.

The puddle lamps (if equipped) share the voltage supply with the cargo lamp.

DTC Description	Fault Trigger Conditions
• B12C2:11 — Puddle Lamp: Circuit Short To Ground	This DTC sets when the BCM detects a short to ground from the cargo lamp output circuit.
• U1000:00 — Solid State Driver Protection Active -Driver Disabled: No Sub Type Information	A continuous DTC that sets when the BCM has temporarily shut down the output driver. **The module has temporarily disabled the cargo lamp output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the cargo lamp output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• U3000:49 — Control Module: Internal Electronic Failure	A continuous DTC that sets when the BCM has permanently shut down the output driver. **The module has permanently disabled the cargo lamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the BCM can withstand. The cause of the excessive current draw MUST be corrected before a new BCM is installed.**

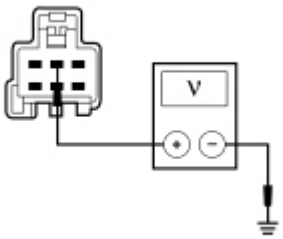
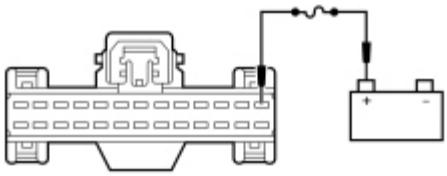
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- High mounted stoplamp
- BCM

PINPOINT TEST E: THE CARGO LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE OPERATION OF THE HIGH MOUNTED STOPLAMP	
• Apply the brake pedal. • **Does the high mounted stoplamp illuminate?**	**Yes** GO to E2 . **No** REFER to Section 417-01 .
E2 CHECK FOR VOLTAGE TO THE CARGO LAMP	
• Ignition OFF. • Disconnect: High Mounted Stoplamp C904.	**Yes** INSTALL a new high

• Press and hold the instrument panel dimmer switch to the DOME LAMP ON (second detent up) position for 3 seconds. • Measure the voltage between the high mounted stoplamp C904-2, circuit CLN25 (VT), harness side and ground.  N0104860 • **Is the voltage greater than 10 volts?**	mounted stoplamp. REFER to Section 417-01 . TEST the system for normal operation. **No** GO to E3 .
E3 BYPASS THE BCM	
NOTE: If the jumper wire fails, refer to the Wiring Diagrams manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC U1000:00 is present, clear the DTCs and repeat the self-test **(required to enable the cargo lamp output driver if DTC U1000:00 is present)** . Test the system for normal operation. If DTC U3000:49 is present, install a new BCM . REFER to Section 419-10 . Test the system for normal operation. • Press and hold the instrument panel dimmer switch to the DOME LAMP OFF (second detent down) position for 3 seconds. • Connect: High Mounted Stoplamp C904. • Disconnect: BCM C2280C. • Connect a fused jumper wire between the BCM C2280C-1, circuit CLN25 (VT), harness side and battery positive.  N0111485 • **Does the cargo lamp illuminate?**	**Yes** REMOVE the jumper wire. GO to E4 . **No** REMOVE the jumper wire. REPAIR circuit CLN25 (VT) for an open. TEST the system for normal operation.
E4 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for

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▪ pushed-out pins • Connect all the BCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: All The Courtesy Lamps Stay On Continuously

Refer to Wiring Diagrams Cell 89 , Interior Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends a voltage signal to each door ajar switch, which is routed to ground when the door is closed (the door ajar switch is closed when the door is closed). When the door is opened, the signal to ground is interrupted indicating an open door to the BCM .

NOTE: All the door ajar switches are integral to the door latch **except** for the rear door ajar switches on Super Cab vehicles. The rear door ajar switches on Super Cab vehicles are replaced independently of the door latch.

When the BCM detects an open door or a request from the instrument panel dimmer switch, voltage is provided to the courtesy lamps.

DTC Description	Fault Trigger Conditions
• B1175:01 — Drivers Door Ajar Switch: General Electrical Failure	This DTC sets when the BCM detects an open from the LH front door ajar circuit.
• B1176:01 — Passenger Door Ajar Switch: General Electrical Failure	This DTC sets when the BCM detects an open from the RH front door ajar circuit.
• B11C0:01 — Driver Side Rear Door Ajar Switch: General Electrical Failure	This DTC sets sets when the BCM detects an open from the LH rear door ajar circuit.
• B11C1:01 — Passenger Side Rear Door Ajar Switch: General Electrical Failure	This DTC sets when the BCM detects an open from the RH rear door ajar circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door ajar switch
- BCM

PINPOINT TEST F: ALL THE COURTESY LAMPS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>F1 CHECK THE DOOR AJAR SWITCH PIDs</td><td></td></tr>
<tr><td>

Ignition ON.
Enter the following diagnostic mode on the scan tool: BCM DataLogger.
Monitor the BCM door ajar switch PIDs (DOOR_SW_DRVR, DOOR_SW_PSGR, DOOR_SW_LR, DOOR_SW_RR) while opening and closing all the doors.
Do all the door ajar switch PID values agree with the door positions?

</td><td>Yes
If the interior courtesy lamps are on, GO to Pinpoint Test G. If the cargo lamp or puddle lamps are on, GO to Pinpoint Test H.

No
GO to F2.</td></tr>
<tr><td>F2 BYPASS THE SUSPECT DOOR AJAR SWITCH</td><td></td></tr>
<tr><td>

Disconnect: Suspect Door Ajar Switch.
For any door except a rear door on Super Cab vehicles, connect a fused jumper wire between the suspect door ajar switch connector pins, harness side as follows:

<table>
<tr><th>Suspect Door Ajar Switch</th><th>Connector-Pin

Circuit</th><th>Connector-Pin

Circuit</th></tr>
<tr><td>LH front</td><td>C525-5

CPL26 (GN/VT)</td><td>C525-6

GD134 (BK/VT)</td></tr>
<tr><td>RH front</td><td>C609-5

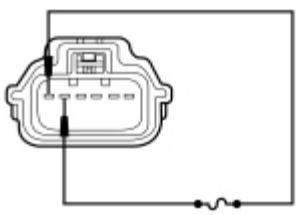
CPL31 (WH)</td><td>C609-6

GD139 (BK/YE)</td></tr>
<tr><td>LH rear</td><td>C705-5

CPL36 (GN)</td><td>C705-6

GD134 (BK/VT)</td></tr>
<tr><td>RH rear</td><td>C805-5

CPL39 (YE)</td><td>C805-6

GD139 (BK/YE)</td></tr>
</table>

N0119594

For a rear door on Super Cab vehicles, connect a fused

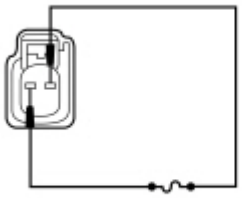
</td><td>Yes
REMOVE the jumper wire. INSTALL a new door latch or door ajar switch in question. REFER to Section 501-14. TEST the system for normal operation.

No
REMOVE the jumper wire. GO to F3.</td></tr>
</table>

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jumper wire between the suspect door ajar switch connector pins, harness side as follows:

Location	Connector-Pin Circuit	Connector-Pin Circuit
LH rear	C715-2 CPL36 (GN)	C715-1 GD134 (BK/VT)
RH rear	C820-2 CPL39 (YE)	C820-1 GD139 (BK/YE)



N0119593

- Enter the following diagnostic mode on the scan tool: BCM DataLogger.
- Monitor the suspect BCM door ajar switch PID (DOOR_SW_DRVR, DOOR_SW_PSGR, DOOR_SW_LR, DOOR_SW_RR).
- **Does the PID indicate the door is closed?**

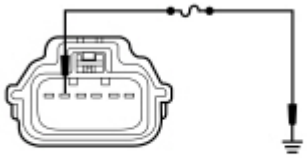
F3 BYPASS THE DOOR AJAR SWITCH GROUND CIRCUIT

- For any door except a rear door on Super Cab vehicles, connect a fused jumper wire between the suspect door ajar switch connector, harness side and ground as follows:

Suspect Door Ajar Switch	Connector-Pin	Circuit
LH front	C525-5	CPL26 (GN/VT)
RH front	C609-5	CPL31 (WH)
LH rear	C705-5	CPL36 (GN)
RH rear	C805-5	CPL39 (YE)

Yes
REMOVE the jumper wire. REPAIR the ground circuit in question for an open. TEST the system for normal operation.

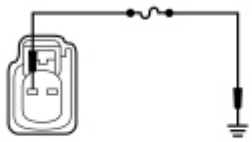
No
REMOVE the jumper wire. GO to F4 .



N0119595

- For a rear door on Super Cab vehicles, connect a fused jumper wire between the suspect door ajar switch connector, harness side and ground as follows:

Location	Connector-Pin	Circuit
LH rear	C715-2	CPL36 (GN)
RH rear	C820-2	CPL39 (YE)



N0119596

- Enter the following diagnostic mode on the scan tool: BCM DataLogger.
- Monitor the suspect BCM door ajar switch PID (DOOR_SW_DRVR, DOOR_SW_PSGR, DOOR_SW_LR, DOOR_SW_RR).
- **Does the PID indicate the door is closed?**

F4 CHECK THE SUSPECT DOOR AJAR SWITCH INPUT CIRCUIT FOR AN OPEN

- Disconnect: BCM C2280C.
- Measure the resistance between the suspect door ajar switch connector, harness side and the BCM connector, harness side as follows:

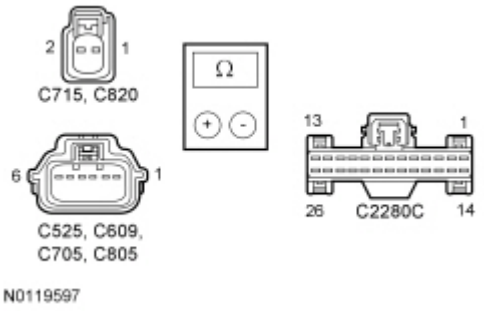
Suspect Door Ajar Switch Connector-Pin	BCM Connector-Pin	Circuit
LH front C525-5	C2280C-9	CPL26 (GN/VT)
RH front C609-5	C2280C-5	CPL31 (WH)
LH rear (Super Crew) C705-5	C2280C-20	CPL36 (GN)

Yes
GO to F5 .

No
REPAIR the ajar input circuit in question for an open. TEST the system for normal operation.

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LH rear (Super Cab) C715-2	C2280C-20	CPL36 (GN)
RH rear (Super Crew) C805-5	C2280C-21	CPL39 (YE)
RH rear (Super Crew) C820-2	C2280C-21	CPL39 (YE)



- **Is the resistance less than 5 ohms?**

F5 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Interior Courtesy Lamps Stay On Continuously

Refer to Wiring Diagrams Cell 89, Interior Lamps for schematic and connector information.

Normal Operation

When the Body Control Module (BCM) detects a request for the courtesy lamps (such as an open door or from the instrument panel dimmer switch), the BCM provides voltage to the interior courtesy lamps.

- DTC B1313:15 (Interior Lighting Output: Circuit Short To Battery or Open) — this DTC sets when the BCM detects a short to voltage from the interior courtesy lighting output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BCM

PINPOINT TEST G: THE INTERIOR COURTESY LAMPS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 CHECK THE DOOR AJAR SWITCH PIDs • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Monitor the BCM door ajar switch PIDs (DOOR_SW_DRVR, DOOR_SW_PSGR, DOOR_SW_LR, DOOR_SW_RR) while opening and closing all the doors. • **Do all the door ajar switch PID values agree with the door positions?**	**Yes** GO to G2. **No** GO to Pinpoint Test F.
G2 CHECK THE INTERIOR COURTESY LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: BCM C2280A. • Ignition ON. • **Do the interior courtesy lamps continue to illuminate?**	**Yes** REPAIR circuit VLN33 (GY/VT) for a short to voltage. TEST the system for normal operation. **No** GO to G3.

G3 CHECK FOR CORRECT BCM OPERATION
• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: The Cargo Lamp/Puddle Lamps Stay On Continuously

Refer to Wiring Diagrams Cell 89, Interior Lamps for schematic and connector information.

Normal Operation

When the Body Control Module (BCM) detects a request for the courtesy lamps (such as an open door or from the instrument panel dimmer switch), the BCM provides voltage to the cargo lamp and puddle lamps (if equipped).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BCM

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PINPOINT TEST H: THE CARGO LAMP/PUDDLE LAMPS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 CHECK THE INTERIOR COURTESY LAMPS	
• Observe the interior courtesy lamps. • **Are the interior courtesy lamps illuminated?**	**Yes** GO to Pinpoint Test F . **No** GO to H2 .
H2 CHECK THE CARGO LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280C. • Ignition ON. • **Does the cargo lamp continue to illuminate?**	**Yes** REPAIR circuit CLN25 (VT) for a short to voltage. TEST the system for normal operation. **No** GO to H3 .
H3 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test I: One Or More Demand Lamp Is Inoperative

Refer to Wiring Diagrams Cell 89 , Interior Lamps for schematic and connector information.

Normal Operation

The Body Control Module (BCM) controls the operation of the battery saver relay. The BCM deactivates the battery saver relay 10 minutes after the ignition is switched to off and no other inputs are detected by the BCM to energize the battery saver relay (such as a flash-to-pass request or a button is pressed on a Remote Keyless Entry (RKE) transmitter).

When the battery saver relay is energized, the BCM supplies voltage to the demand lamps.

This pinpoint test is intended to diagnose the following:

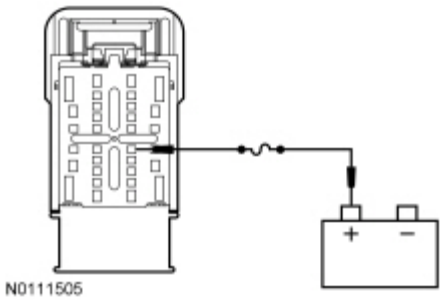
- Fuse

- Wiring, terminals or connectors
- Sun visor
- Interior lamp
- BCM

PINPOINT TEST I: ONE OR MORE DEMAND LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CHECK ALL THE DEMAND LAMPS
• Ignition OFF.
• Check the operation of all the interior demand lamps (map lamps and vanity mirror lamps).
• Are all the interior demand lamps inoperative?</td><td>Yes
GO to I2 .

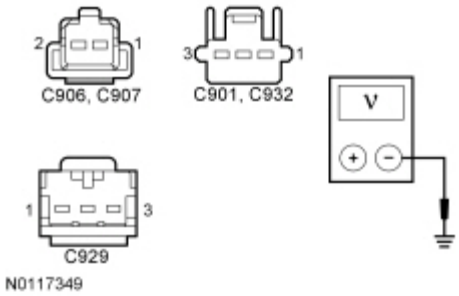
No
GO to I3 .</td></tr>
<tr><td>I2 BYPASS THE BCM
NOTE: If the fuse fails, repair circuit CLN09 (YE/GN) for a short to ground.
• Disconnect: BCM C2280D.
• Connect a fused jumper wire between the BCM C2280d-22, circuit CLN09 (YE/GN), harness side and battery positive.

N0111505
• Switch any demand lamp (map or vanity mirror) on.
• Does the demand lamp illuminate when switched on?</td><td>Yes
REMOVE the jumper wire. VERIFY the BCM fuse 4 (10A) is OK. If OK, GO to I5 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

No
REMOVE the jumper wire. REPAIR circuit CLN09 (YE/GN) for an open. TEST the system for normal operation.</td></tr>
<tr><td>I3 CHECK FOR VOLTAGE TO THE INOPERATIVE LAMP
• Ignition OFF.
• Disconnect: Inoperative Lamp.
• Ignition ON.
• Measure the voltage between the inoperative demand lamp, harness side and ground as follows:
<table><tr><th>Inoperative Lamp</th><th>Connector-Pin</th><th>Circuit</th></tr><tr><td>LH vanity mirror</td><td>C907-1</td><td>CLN09 (YE/GN)</td></tr></table></td><td>Yes
GO to I4 .

No
REPAIR circuit CLN09 (YE/GN) for an open. TEST the system for normal operation.</td></tr>
</table>

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RH vanity mirror	C906-1	CLN09 (YE/GN)
Front interior/map (without overhead console)	C901-3	CLN09 (YE/GN)
Front interior/map (with overhead console)	C929-3	CLN09 (YE/GN)
Rear interior/map	C932-3	CLN09 (YE/GN)



- **Is the voltage greater than 10 volts?**

I4 CHECK THE INOPERATIVE LAMP GROUND CIRCUIT FOR AN OPEN

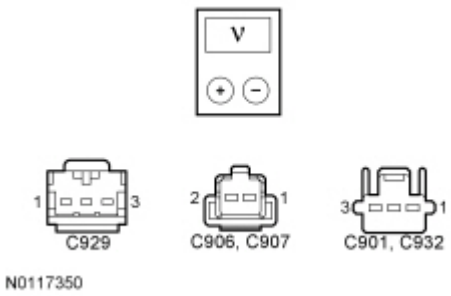
- Measure the voltage between the inoperative lamp connector pins, harness side as follows:

Inoperative Lamp	Connector-Pin Circuit	Connector-Pin Circuit
LH vanity mirror	C907-1 CLN09 (YE/GN)	C907-2 GD139 (BK/YE)
RH vanity mirror	C906-1 CLN09 (YE/GN)	C906-2 GD139 (BK/YE)
Front interior (without overhead console)	C901-3 CLN09 (YE/GN)	C901-2 GD139 (BK/YE)
Front interior (with overhead console)	C929-3 CLN09 (YE/GN)	C929-1 GD139 (BK/YE)
Rear interior	C932-3 CLN09	C932-2 GD139

Yes
INSTALL a new lamp for the lamp in question. REFER to Interior Lamp in this section. TEST the system for normal operation.

No
REPAIR the ground circuit in question for an open. TEST the system for normal operation.

	(YE/GN)	(BK/YE)



- **Is the voltage greater than 10 volts?**

I5 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test J: The Battery Saver Does Not Deactivate After Time-Out

Refer to Wiring Diagrams Cell 89, Interior Lamps for schematic and connector information.

Normal Operation

The Body Control Module (BCM) controls the operation of the battery saver relay. The BCM deactivates the battery saver relay 10 minutes after the ignition is switched to off and no other inputs are detected by the BCM to energize the battery saver relay (such as a flash-to-pass request or a button is pressed on a Remote Keyless Entry (RKE) transmitter).

When the battery saver relay is energized, the BCM supplies voltage to the demand lamps.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BCM

PINPOINT TEST J: THE BATTERY SAVER DOES NOT DEACTIVATE AFTER TIME-OUT

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

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Test Step	Result / Action to Take
J1 CHECK THE INTERIOR DEMAND LAMP VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280D. • Ignition ON. • Turn any demand lamp (map or vanity mirror) on. • **Does the demand lamp turn on?**	**Yes** REPAIR circuit CLN09 (YE/GN) for a short to voltage. TEST the system for normal operation. **No** GO to J2.
J2 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test K: The Ambient Lighting Is Inoperative

Refer to Wiring Diagrams Cell 89, Interior Lamps for schematic and connector information.

Normal Operation

The HVAC module provides voltage and ground to the LEDs. There are 3 LEDs (red, blue and green) housed within each LED assembly. By illuminating various color combinations, the LEDs are able to produce 7 different colors of ambient light.

The HVAC module receives input from the Accessory Protocol Interface Module (APIM) and the Body Control Module (BCM) over the communication network for color and brightness settings. The HVAC module retains the last color and brightness setting between uses.

There ambient lighting system illuminates the following:

- Cupholders (located in the center console)
- Center console storage compartment
- Front footwells
- Rear footwells

The HVAC module has a separate ground circuit for the ambient lighting system.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- HVAC module

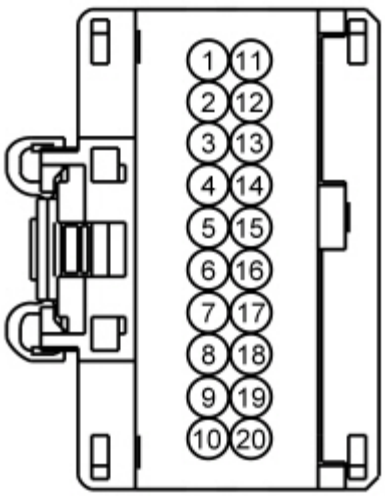
PINPOINT TEST K: THE AMBIENT LIGHTING IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>K1 CHECK FOR COMMUNICATION TO THE HVAC MODULE</td><td rowspan="2">Yes
GO to K2 .

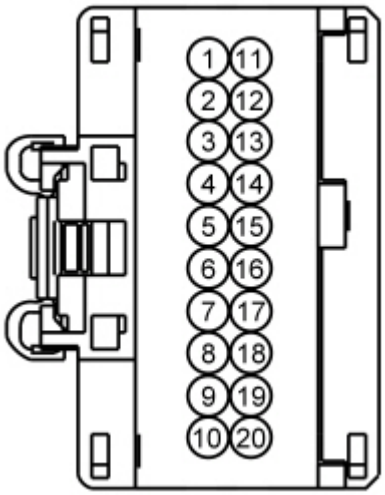
No
REFER to Section 418-00 .</td></tr>
<tr><td>• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Network Test.
• Carry out the network test using the scan tool.
• Does the scan tool communicate with the HVAC module?</td></tr>
<tr><td>K2 CHECK THE CLIMATE CONTROL OPERATION</td><td rowspan="2">Yes
GO to K3 .

No
REFER to Section 412-00 .</td></tr>
<tr><td>• Check the operation of the climate control system and verify that all of the climate controls operate correctly.
• Does the climate control system operate correctly?</td></tr>
<tr><td>K3 CHECK THE AMBIENT LIGHTING GROUND CIRCUIT FOR AN OPEN</td><td rowspan="2">Yes
GO to K4 .

No
REPAIR circuit GD133 (BK) for an open. TEST the system for normal operation.</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Negative Battery Cable.
• Disconnect: HVAC Module C228C.
• Measure the resistance between:
<table><tr><td colspan="2">Positive Lead</td><td colspan="2">Negative Lead</td></tr><tr><td>Pin</td><td>Circuit</td><td>Pin</td><td>Circuit</td></tr><tr><td>C228C-8</td><td>GD133 (BK)</td><td>—</td><td>Ground</td></tr></table>
• Is the resistance less than 3 ohms?</td></tr>
<tr><td>K4 CHECK THE AMBIENT LIGHTING RETURN CIRCUIT FOR AN OPEN</td><td rowspan="2">Yes</td></tr>
<tr><td>• Measure the resistance between:</td></tr>
</table>

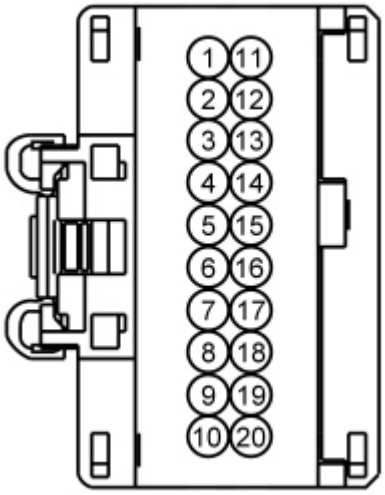
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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C228C-5	VLN46 (BU)	C228C-17	RLN44 (BN)



- **NOTE:** This step will reverse the test leads, checking the diode.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C228C-17	RLN44 (BN)	C228C-5	VLN46 (BU)



- **Does the resistance measure less than 3 ohms one way and geater than 10,000 ohms the other way?**

GO to K5 .

No
REPAIR circuit RLN44 (BN) for an open. TEST the system for normal operation.

K5 CHECK FOR CORRECT HVAC MODULE OPERATION

Yes

• Disconnect all the HVAC module connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the HVAC module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	INSTALL a new HVAC module. REFER to Section 412-00 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test L: The Ambient Lighting Does Not Cycle Through All Color Combinations

Refer to Wiring Diagrams Cell 89 , Interior Lamps for schematic and connector information.

Normal Operation

The HVAC module provides voltage and ground to the LEDs. There are 3 LEDs (red, blue and green) housed within each LED assembly. By illuminating various color combinations, the LEDs are able to produce 7 different colors of ambient light.

The HVAC module receives input from the Accessory Protocol Interface Module (APIM) and the Body Control Module (BCM) over the communication network for color and brightness settings. The HVAC module retains the last color and brightness setting between uses.

There ambient lighting system illuminates the following:

- Cupholders (located in the center console)
- Center console storage compartment
- Front footwells
- Rear footwells

Based on input from the APIM and the BCM , the HVAC module provides voltage to the red, green and/or blue output circuits to produce the color selected.

DTC Description	Fault Trigger Conditions
• B127C:11 — Ambient Lighting Zone 2 Output Red LED: Circuit Short To Ground	A continuous and on-demand DTC that sets when the HVAC module detects a short to ground from the zone 2, red ambient lighting output circuit.
• B127C:12 — Ambient Lighting Zone 2 Output Red LED: Circuit Short To Battery	A continuous and on-demand DTC that sets when the HVAC module detects an open from the zone 2, red ambient lighting output circuit.
• B127C:13 — Ambient Lighting Zone 2 Output Red LED: Circuit Open	A continuous and on-demand DTC that sets when the HVAC module detects an open from the zone 2, red ambient lighting output circuit.
• B127F:11 — Ambient Lighting Zone 2 Output Green LED: Circuit Short To Ground	A continuous and on-demand DTC that sets when the HVAC module detects a short to ground from the zone 2, green ambient lighting output circuit.
• B127F:11 — Ambient Lighting Zone 2 Output Green LED: Circuit Short	A continuous and on-demand DTC that sets when the HVAC module detects an open from the zone 2, green ambient

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To Battery	lighting output circuit.
• B127F:13 — Ambient Lighting Zone 2 Output Green LED: Circuit Open	A continuous and on-demand DTC that sets when the HVAC module detects an open from the zone 2, green ambient lighting output circuit.
• B1282:11 — Ambient Lighting Zone 2 Output Blue LED: Circuit Short To Ground	A continuous and on-demand DTC that sets when the HVAC module detects a short to ground from the zone 2, blue ambient lighting output circuit.
• B1282:12 — Ambient Lighting Zone 2 Output Blue LED: Circuit Short To Battery	A continuous and on-demand DTC that sets when the HVAC module detects an open from the zone 2, blue ambient lighting output circuit.
• B1282:12 — Ambient Lighting Zone 2 Output Blue LED: Circuit Open	A continuous and on-demand DTC that sets when the HVAC module detects an open from the zone 2, blue ambient lighting output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- HVAC module

PINPOINT TEST L: THE AMBIENT LIGHTING DOES NOT CYCLE THROUGH ALL COLOR COMBINATIONS

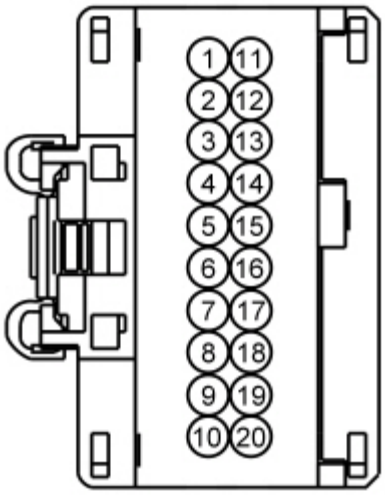
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>L1 CHECK THE DISPLAY INTERFACE OPERATION</td><td rowspan="2">Yes
GO to L2 .

No
REFER to Section 412-00 .</td></tr>
<tr><td>• Ignition ON.
• Check the operation of the HVAC system using the buttons on the touch screen.
• Does the HVAC system operate correctly?</td></tr>
<tr><td>L2 CHECK THE AMBIENT LIGHTING HARNESS USING DIODE CHECK</td><td rowspan="2">Yes
GO to L3 .

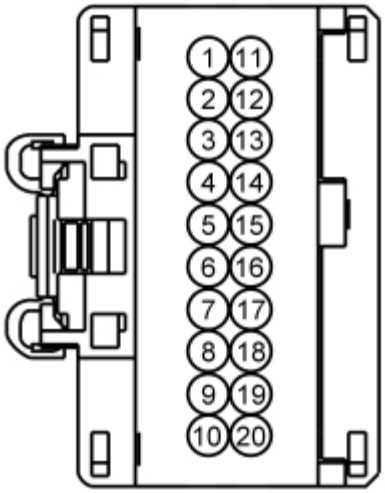
No
INSTALL a new ambient lighting harness. TEST the system for normal operation.</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: HVAC Module C228C.
• Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td colspan="4">Red LED Color</td></tr>
<tr><td>C228C-7</td><td>VLN44 (OG)</td><td>C228C-17</td><td>RLN44 (BN)</td></tr>
<tr><td colspan="4">Green LED Color</td></tr>
<tr><td>C228C-6</td><td>VLN45 (GN)</td><td>C228C-17</td><td>RLN44 (BN)</td></tr>
<tr><td colspan="4">Blue LED Color</td></tr>
<tr><td>C228C-5</td><td>VLN46 (BU)</td><td>C228C-17</td><td>RLN44 (BN)</td></tr>
</table>
</td></tr>
</table>



- **NOTE:** This step will reverse the test leads, checking the diode.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Red LED Color			
C228C-17	RLN44 (BN)	C228C-7	VLN44 (OG)
Green LED Color			
C228C-17	RLN44 (BN)	C228C-6	VLN45 (GN)
Blue LED Color			
C228C-17	RLN44 (BN)	C228C-5	VLN46 (BU)



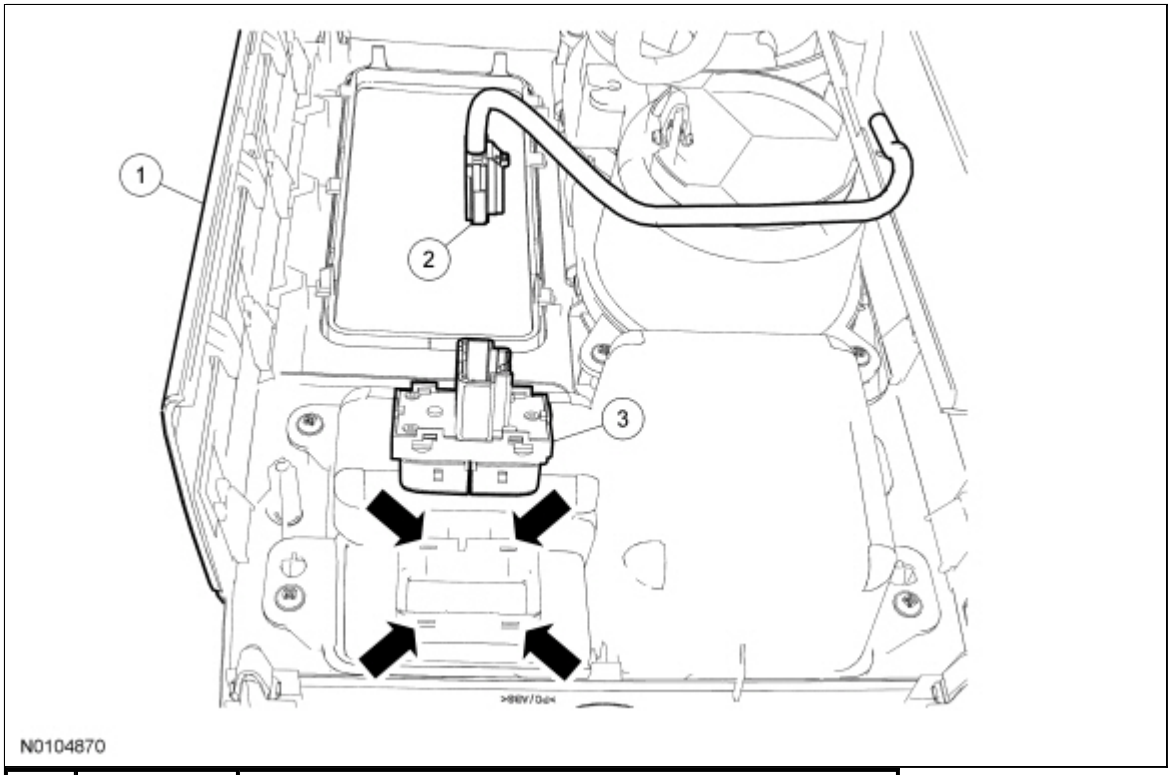
- **Does the resistance measure less than 3 ohms one way and geater than 10,000 ohms the other way?**

L3 CHECK FOR CORRECT HVAC MODULE OPERATION

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• Disconnect all the HVAC module connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the HVAC module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new HVAC module. REFER to Section 412-00 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Ambient Lighting Switch



Item	Part Number	Description
1	045A76	Floor console upper finish panel
2	—	Ambient lighting switch electrical connector (part of harness 14E078)
3	13D806	Ambient lighting switch

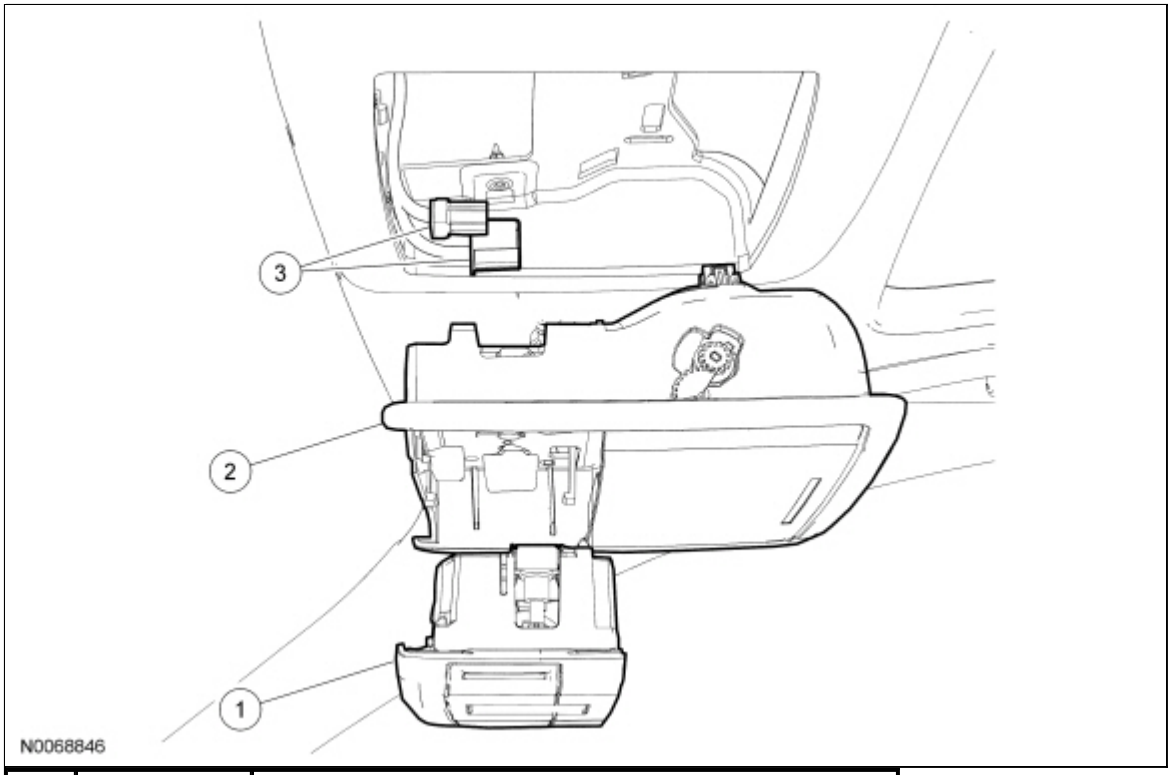
Removal and Installation

1. Remove the floor console upper finish panel.
   - Lift the floor console finish panel upward to release the retaining clips
2. Disconnect the electrical connector.
3. Release the tabs and remove the ambient lighting switch.
4. To install, reverse the removal procedure.

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Interior Lamp

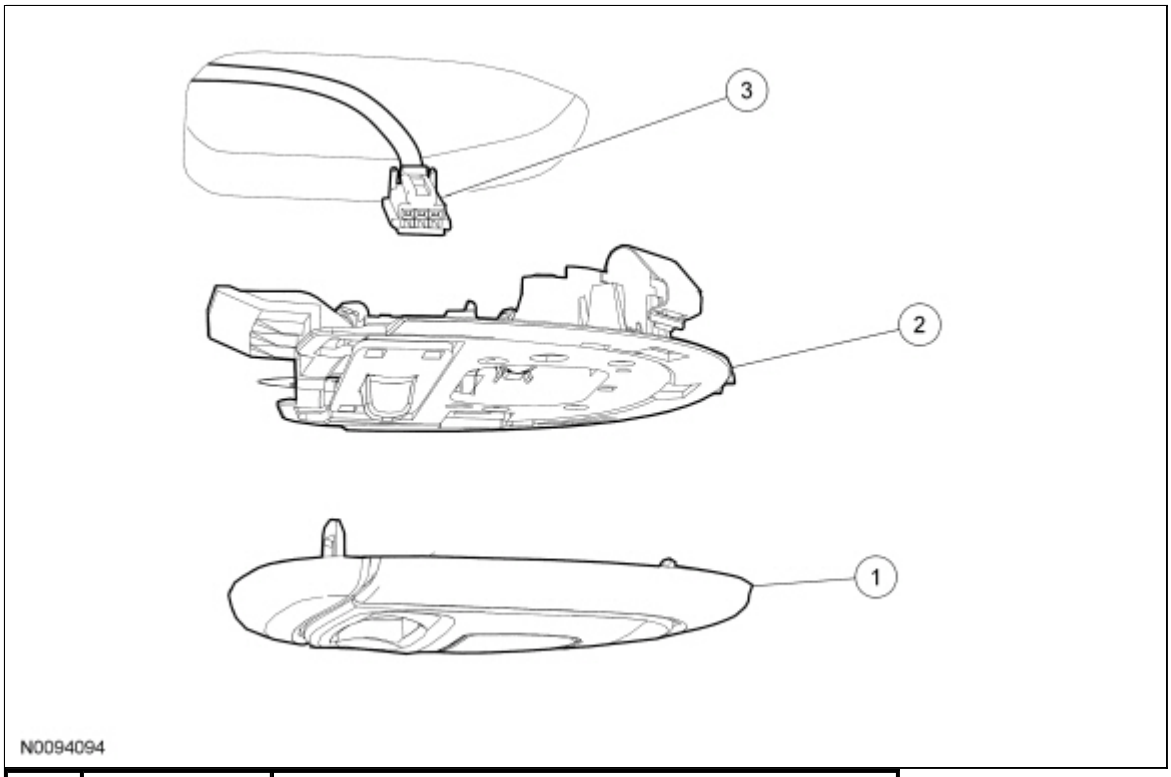
Front Lamp (Vehicles With Overhead Console)



Item	Part Number	Description
1	13776	Lamp assembly
2	54519A70	Overhead console
3	—	Overhead console electrical connectors (part of 14358)

Front Lamp (Vehicles Without Overhead Console) and Rear Lamp

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Item	Part Number	Description
1	13783	Interior lamp lens
2	13776	Interior lamp
3	—	Interior lamp electrical connector (part of 14358)

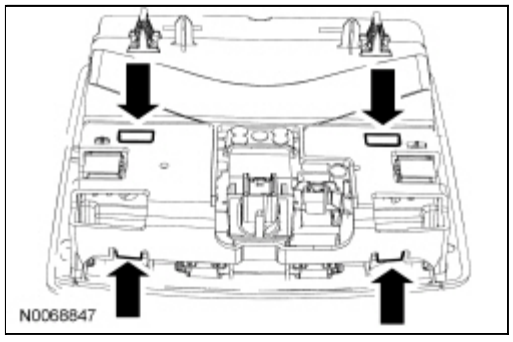
Removal

Front lamp (vehicles with overhead console)

1. **NOTE:** Do not pull-down on the front of the overhead console.

   Pull-down on the rear of the overhead console to release the overhead console from the retaining clips.
   - Disconnect the electrical connectors.

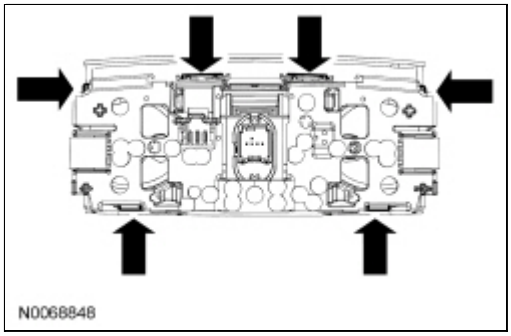
2. Release the 4 retaining clips, and remove the lamp assembly from the overhead console.



3. Release the 6 retaining clips, and remove the lens from the lamp assembly.

- **NOTE:** The bulbs are removed by pushing from the backside of the lamp assembly.

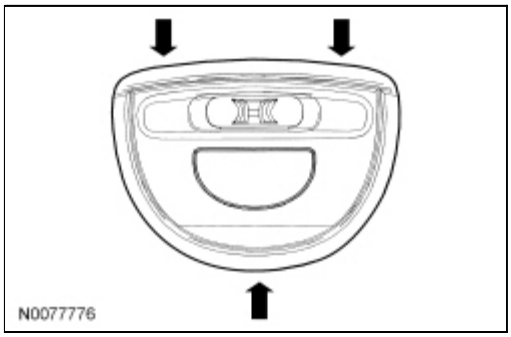
  Replace the bulb(s) as necessary.



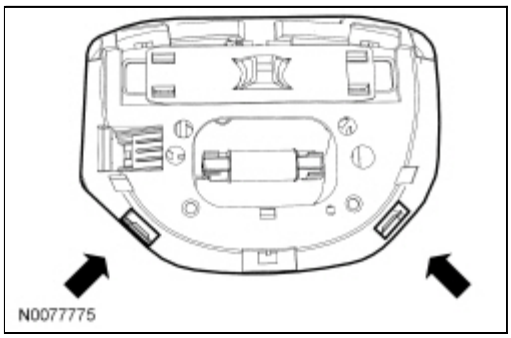
Front lamp (vehicles without overhead console) or rear lamp

4. **NOTE:** The tabs (located just above the headliner) can be accessed with a small angled pick tool. They are released by pulling them away from the lamp assembly. Use care not to use too much pressure or the tabs may break.

   Release the 3 locking tabs and remove the interior lamp lens.



5. Release the 2 retaining clips (through the access holes) and remove the interior lamp.
   - Disconnect the electrical connector.



Installation

Front lamp (vehicles with overhead console)

1. Install the lens onto the lamp assembly.

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2. Install the lamp assembly into the overhead console.
3. Connect the electrical connectors and install the overhead console.

Front lamp (vehicles without overhead console) or rear lamp

4. Install the interior lamp lens.
5. Connect the electrical connector and install the interior lamp.

Communications Network

Multiplexing is a method of sending 2 or more signals simultaneously over a single circuit. Multiplexing allows 2 or more electronic modules (nodes) to communicate simultaneously over a twisted wire pair [data (+) and data (-)] network. The information or messages that can be communicated on these wires consists of commands, status or data. The advantage of using multiplexing is to reduce the weight of the vehicle by reducing the number of redundant components and electrical wiring.

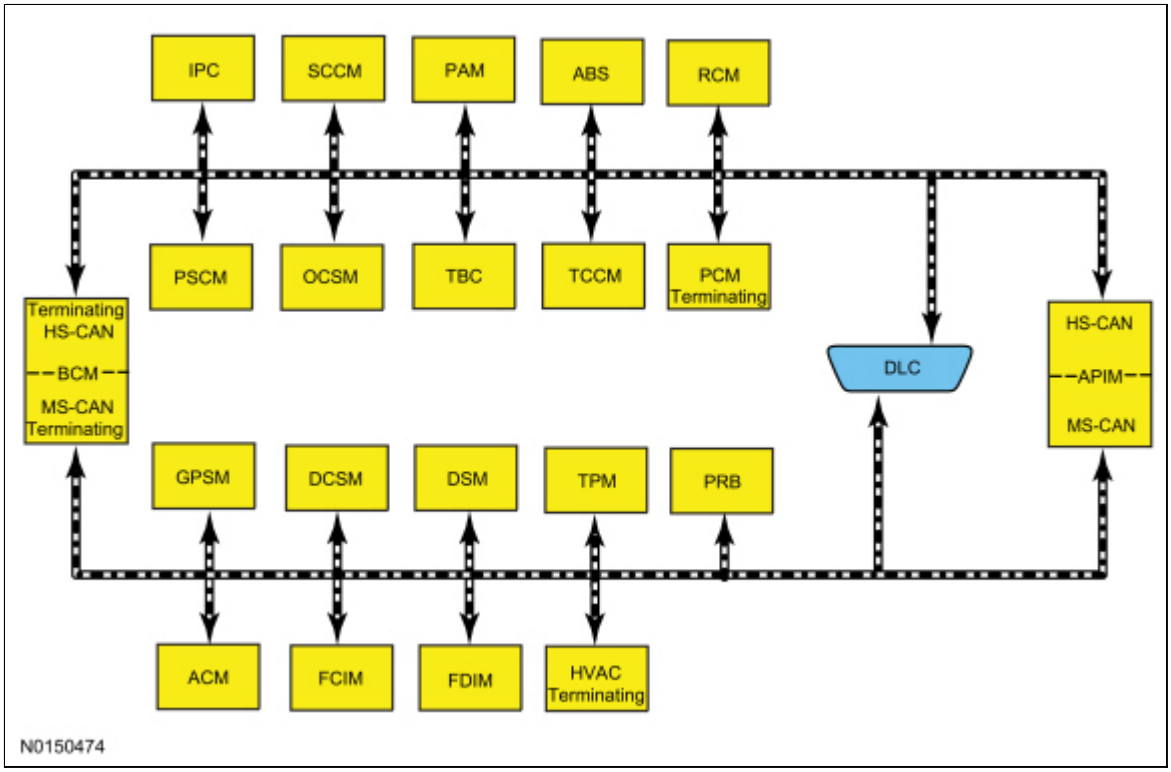
The vehicle has 2 module communication networks which are connected to the Data Link Connector (DLC), located under the driver side instrument panel:

- High Speed Controller Area Network (HS-CAN)
- Medium Speed Controller Area Network (MS-CAN)

Vehicles with the optional 4.2-inch screen and 8-inch touchscreen audio units have an Infotainment Controller Area Network (I-CAN) that is **not** connected to the Data Link Connector (DLC). The Instrument Panel Cluster (IPC) operates as the gateway for modules on the I-CAN to communicate with the scan tool over the HS-CAN .

- Infotainment Controller Area Network (I-CAN)

Network Topology - Vehicles with AM/FM/Single CD

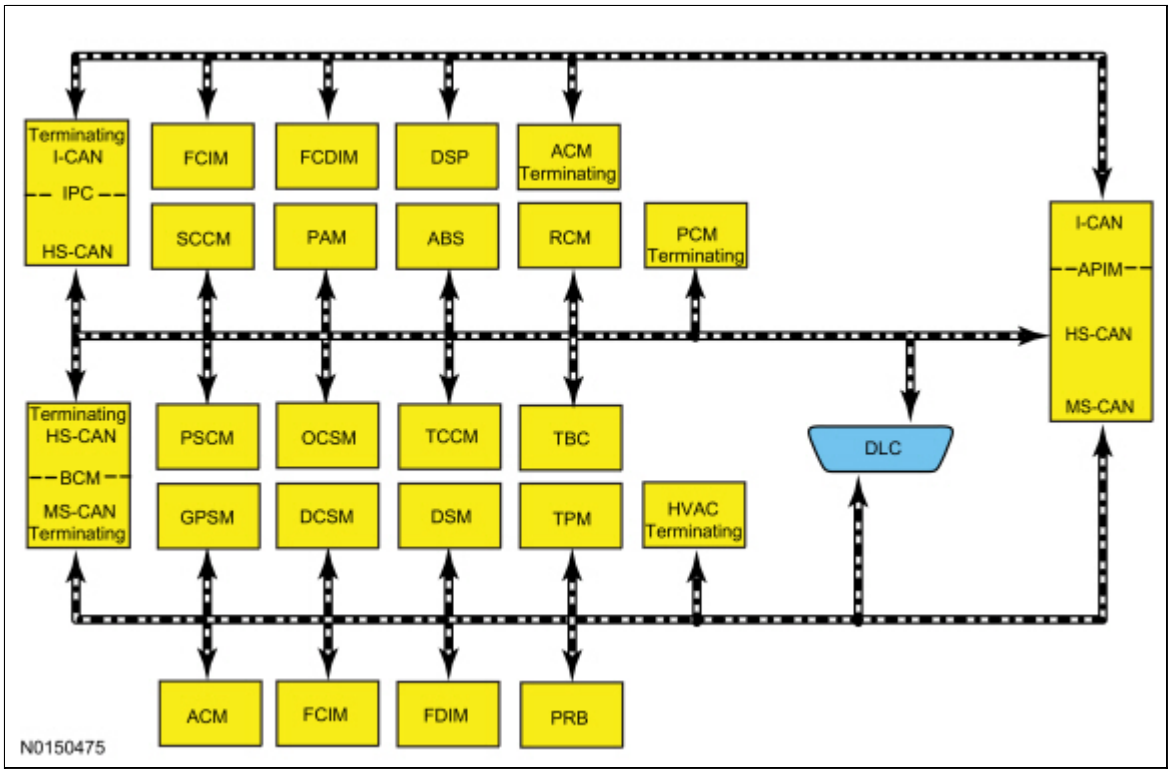


Module Name	Network Type	Termination Module

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ABS module	HS-CAN	No
Accessory Protocol Interface Module (APIM) (if equipped)	HS-CAN MS-CAN	No No
Audio Front Control Module (ACM) (if equipped)	MS-CAN	No
Body Control Module (BCM) (gateway module)	MS-CAN HS-CAN	Yes Yes
Driver Seat Module (DSM) (if equipped)	MS-CAN	No
Dual Climate Controlled Seat Module (DCSM) (if equipped)	MS-CAN	No
Front Controls Interface Module (FCIM) (if equipped)	MS-CAN	No
Front Display Interface Module (FDIM)	MS-CAN	No
Global Positioning System Module (GPSM) (if equipped)	MS-CAN	No
HVAC module	MS-CAN	Yes
Instrument Panel Cluster (IPC)	HS-CAN	No
Occupant Classification System Module (OCSM)	HS-CAN	No
Parking Aid Module (PAM) (if equipped)	HS-CAN	No
Power Steering Control Module (PSCM) (if equipped)	HS-CAN	No
PCM	HS-CAN	Yes
Power Running Board (PRB) module (if equipped)	MS-CAN	No
Restraints Control Module (RCM)	HS-CAN	No
Steering Column Control Module (SCCM)	HS-CAN	No
Tire Pressure Monitor (TPM) module (if equipped)	MS-CAN	No
Trailer Brake Control (TBC) module (if equipped)	HS-CAN	No
Transfer Case Control Module (TCCM) (if equipped)	HS-CAN	No

Network Topology - Vehicles with 4.2-Inch Screen and 8-Inch Touchscreen



Module Name	Network Type	Termination Module
ABS module	HS-CAN	No
Accessory Protocol Interface Module (APIM) (if equipped)	HS-CAN	No
	MS-CAN I-CAN	No No
Audio Front Control Module (ACM) (if equipped)	I-CAN	Yes
Audio Digital Signal Processing (DSP) module (if equipped)	I-CAN	No
Body Control Module (BCM) (gateway module)	MS-CAN HS-CAN	Yes Yes
Driver Seat Module (DSM) (if equipped)	MS-CAN	No
Dual Climate Controlled Seat Module (DCSM) (if equipped)	MS-CAN	No
Front Controls Interface Module (FCIM) (if equipped)	I-CAN	No
Front Control/Display Interface Module (FCDIM) (if equipped)	I-CAN	No
Front Display Interface Module (FDIM)	MS-CAN	No
Global Positioning System Module (GPSM) (if equipped)	MS-CAN	No
HVAC module	MS-CAN	Yes
Instrument Panel Cluster (IPC)	HS-CAN I-CAN	No Yes
Occupant Classification System Module (OCSM)	HS-CAN	No
Parking Aid Module (PAM) (if equipped)	HS-CAN	No
Power Steering Control Module (PSCM) (if equipped)	HS-CAN	No

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PCM	HS-CAN	Yes
Power Running Board (PRB) module (if equipped)	MS-CAN	No
Restraints Control Module (RCM)	HS-CAN	No
Steering Column Control Module (SCCM)	HS-CAN	No
Tire Pressure Monitor (TPM) module (if equipped)	MS-CAN	No
Trailer Brake Control (TBC) module (if equipped)	HS-CAN	No
Transfer Case Control Module (TCCM) (if equipped)	HS-CAN	No

Network Termination And Gateway Function

The Controller Area Network (CAN) uses network termination to improve communication reliability. Termination modules are located at both ends of the network. As network messages are broadcast in the form of voltage signals, the network voltage signals are stabilized by the termination resistors.

Each termination module has an internal 120 ohm resistor that bridges across the positive and negative bus connection. With two 120 ohm resistors located in a parallel circuit configuration, the total network impedance, or total resistance, is 60 ohms.

Network termination improves bus message reliability by stabilizing bus voltage and eliminating electrical interference.

The BCM is the gateway module, translating messages on the HS-CAN to the MS-CAN and vice versa, allowing a message to be distributed throughout both networks.

Vehicles equipped with the 4.2-inch screen or 8-inch touchscreen audio units use an I-CAN network for these modules. The IPC is the gateway module, translating messages on the HS-CAN to the modules on the I-CAN , and vice versa. This allows messages to be distributed throughout both networks, if required.

The BCM and IPC are the only modules on this vehicle that have this ability.

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Communications Network

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The vehicle has 3 module communication networks which are connected to the Data Link Connector (DLC), located under the instrument panel.

Both the HS-CAN and the MS-CAN use an unshielded twisted pair cable of data (+) and data (-) circuits. The HS-CAN operates at a maximum data transfer speed of 500 Kbps and is designed for real time information transfer and control. The MS-CAN operates at a maximum data transfer speed of 125 Kbps for bus messages and is designed for general information transfer.

The I-CAN is not connected to the DLC . The I-CAN modules communicate with the scan tool over the HS-CAN . The Instrument Panel Cluster (IPC) is used as a gateway for the messages to transfer between the scan tool and the modules on the I-CAN .

Controller Area Network (CAN) Fault Tolerance

NOTE: The oscilloscope traces below are from the Integrated Diagnostic System (IDS) oscilloscope taken using the CAN setup defaults. The traces are for both data (+) and data (-) taken simultaneously (2-channel) at a sample rate of 1 mega-sample per second (1MS/s) or greater and viewed at 20 microseconds (20µs) per division. Readings taken with a different oscilloscope will vary from those shown. Compare any suspect readings to a known good vehicle.

Normal CAN Operation

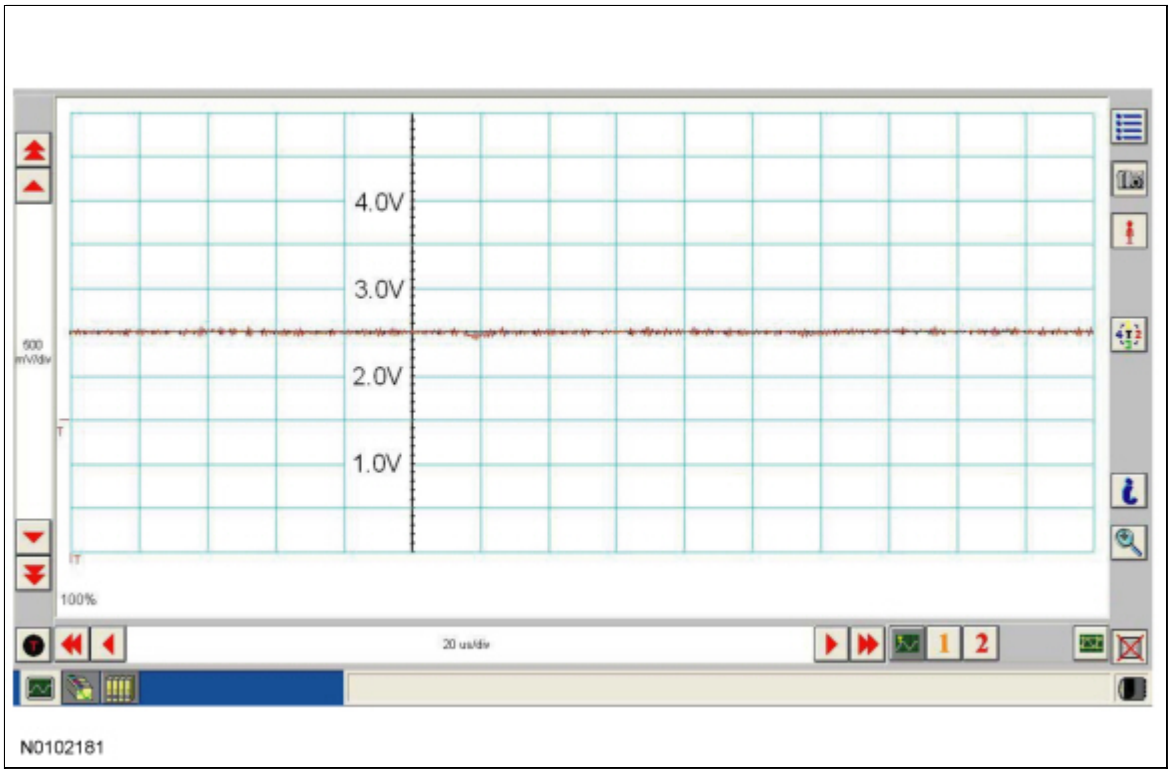


The data (+) and data (-) circuits are each regulated to approximately 2.5 volts during neutral or rested network traffic. As messages are sent on the data (+) circuit, voltage is increased by approximately 1.0 volt. Inversely, the data (-) circuit is reduced by approximately 1.0 volt when a message is sent.

Successful communication of a message can usually be identified by the slight spike at the end of a message transmission. This spike is a "positive acknowledge" signal from multiple modules confirming receipt of the message sent.

CAN Circuits Shorted Together

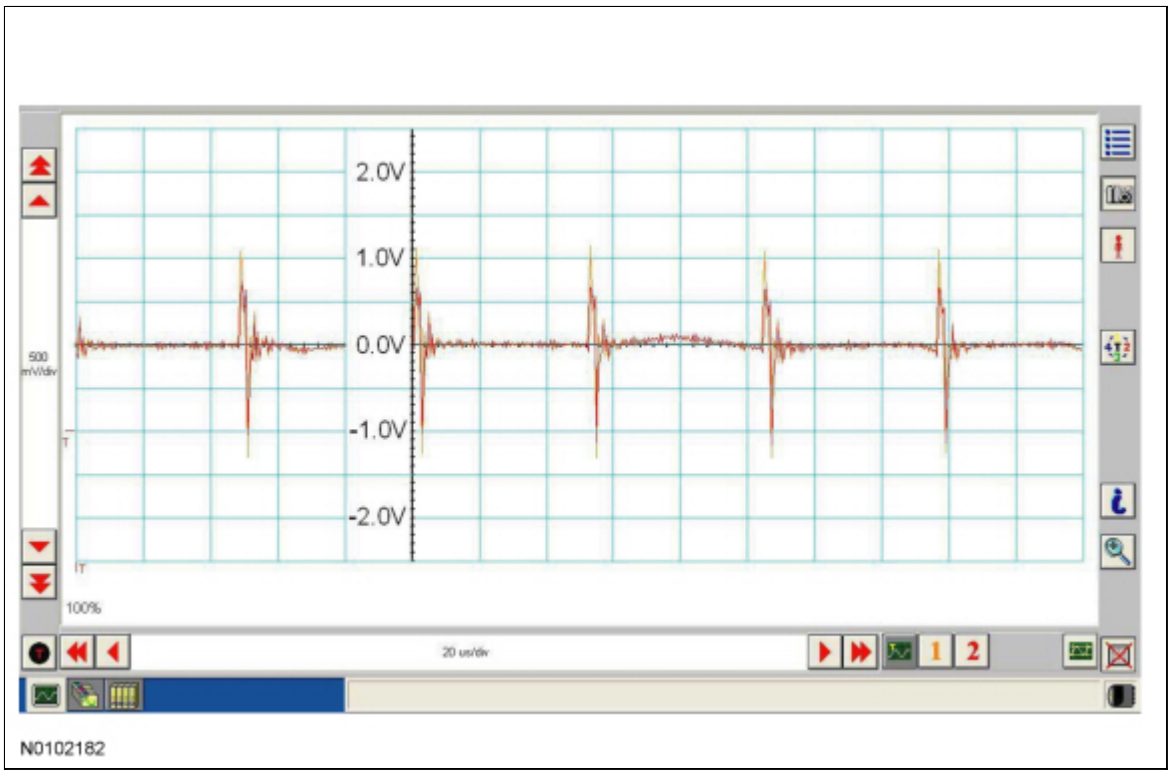
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N0102181

In the event the data (+) and data (-) circuits become shorted together, the signal stays at base voltage (2.5V) continuously and all communication capabilities are lost.

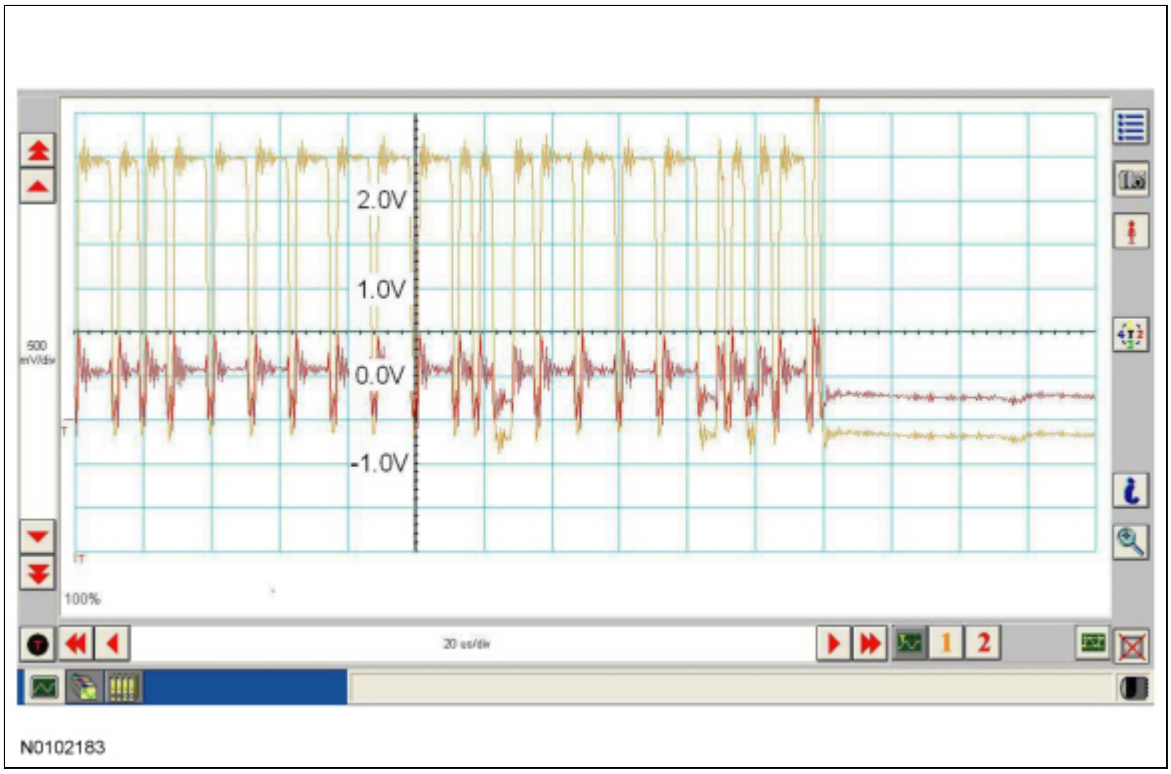
CAN (+) Circuit Shorted To Ground



N0102182

In the event the data (+) circuit becomes shorted to ground, both the data (+) and data (-) circuits are pulled low (0V) and all communication capabilities are lost.

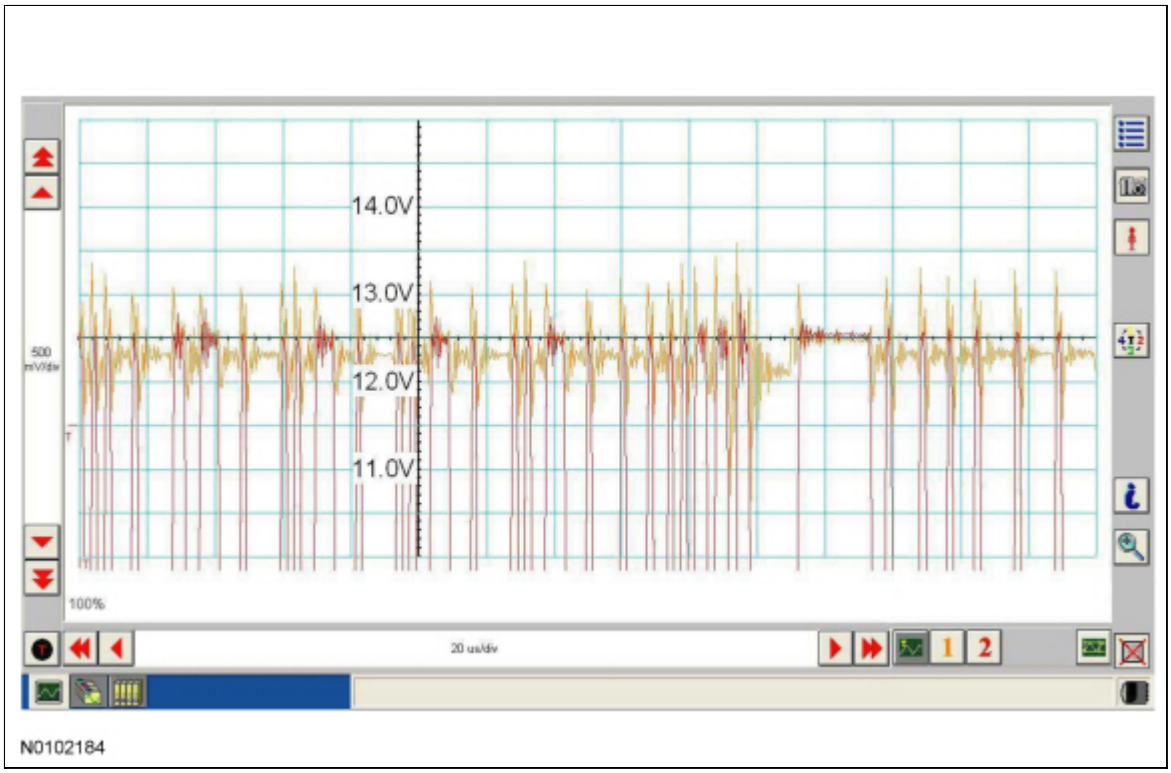
CAN (-) Circuit Shorted To Ground



In the event the data (-) circuit becomes shorted to ground, the data (-) circuit is pulled low (0V) and the data (+) circuit reaches normal peak voltage (3.5V) during communication but falls to 0V instead of normal base voltage (2.5V). Communication can continue but at a degraded level.

CAN (+) Circuit Shorted To Battery Voltage

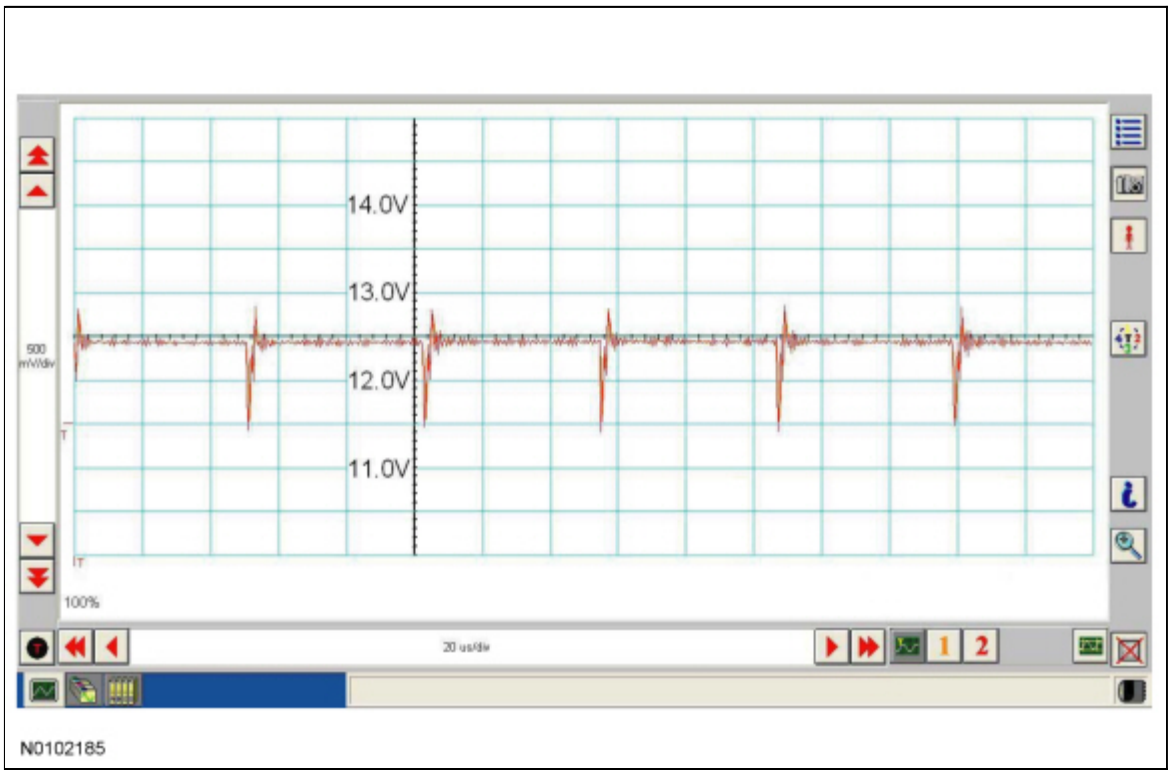
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N0102184

In the event the data (+) circuit becomes shorted to battery voltage, the data (+) circuit is pulled high (12V) and the data (-) circuit falls to abnormally high voltage (above 5V) during communication and reaches battery voltage (12V) for peak voltage. Communication can continue but at a degraded level.

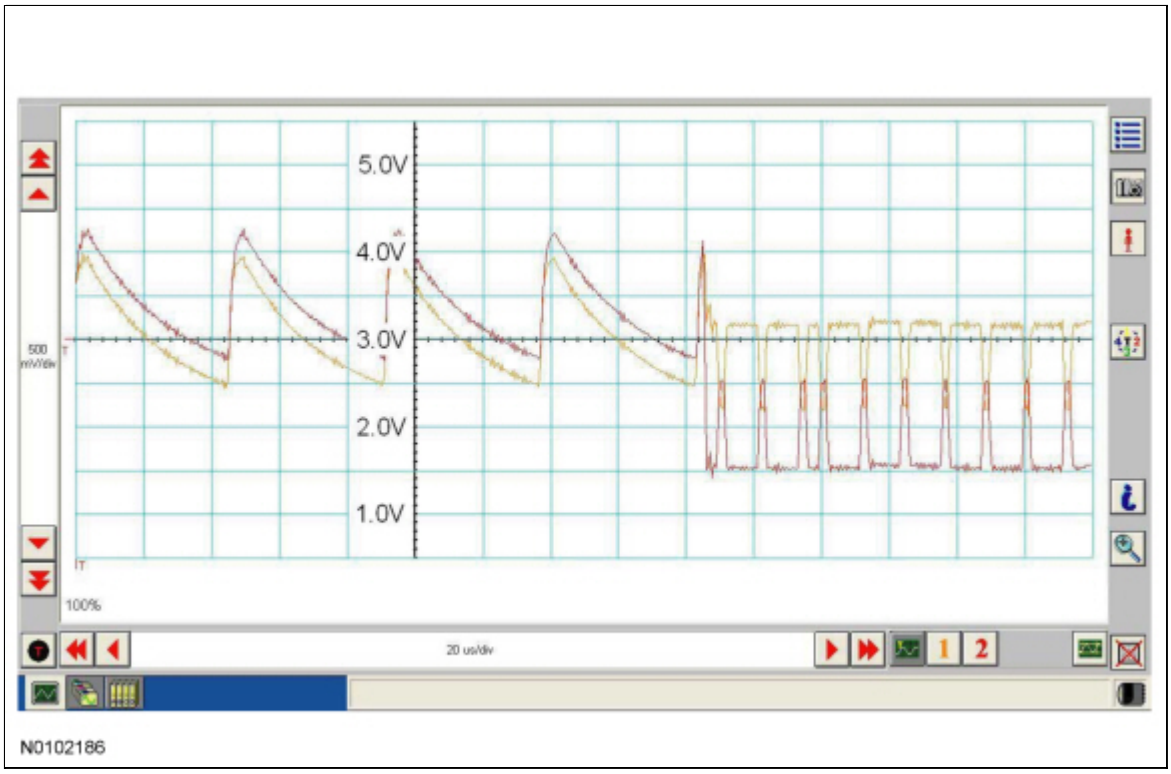
CAN (-) Circuit Shorted To Battery Voltage



N0102185

In the event the data (-) circuit becomes shorted to battery voltage, both the data (+) and data (-) circuits are pulled high (12V) and all communication capabilities are lost.

CAN Circuit Signal Corruption



Rhythmic oscillations, inductive spikes or random interference can corrupt the network communications. The corruption signal source may be outside electrical interference such as motors or solenoids or internal interference generated from a module on the network. In some cases, an open in either the data (+) or data (-) circuit to a network module may cause the module to emit interference on the one circuit which is still connected. The trace shown is an example of a "sawtooth" pattern transmitted from a module with one open network circuit.

Other corruptions may be present when a module is intermittently powered up and down. The module on power up can initiate communication out of sync with other modules on the network causing momentary communication outages. These types of message corruptions are referred to as a Negative-Acknowledge (NACK) message and lack an acknowledgement spike at the end of the transmitted message.

Controller Area Network (CAN) Multiplex Messages

Modules on the CAN utilize simultaneous communication of 2 or more messages on the same network circuits. The following chart summarizes the messages sent and received on the network.

CAN Module Communication Message Chart

NOTE: This chart describes the specific HS-CAN , MS-CAN and I-CAN messages broadcast by each module, and the module(s) that receive the message.

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Broadcast Message	Originating Module	Network Type	Receiving Module (s)
4X4 indicator status	TCCM	HS-CAN	• IPC
4X4 message display	TCCM	HS-CAN	• IPC
4X4 mode	TCCM	HS-CAN	• ABS module • IPC • PCM • BCM
4X4 range selection	TCCM	HS-CAN	• ABS module • PCM • BCM • PSCM • IPC
4X4 service required	TCCM	HS-CAN	• IPC • RCM
4X4 warning indicator request	TCCM	HS-CAN	• IPC
A/C clutch status	PCM	HS-CAN	• BCM
A/C clutch status (gateway)	BCM	MS-CAN	• HVAC module
A/C pressure	PCM	HS-CAN	• BCM
A/C recirc request	BCM	MS-CAN	• HVAC module
A/C request	FCIM	I-CAN	• IPC • APIM • FCDIM
A/C request (gateway)	IPC	HS-CAN	• BCM
A/C request (gateway)	BCM	MS-CAN	• HVAC module
A/C request	HVAC module	MS-CAN	• BCM
A/C request (gateway)	BCM	HS-CAN	• PCM
ABS event in progress	ABS module	HS-CAN	• PCM • RCM • TBC module
ABS warning indicator request	ABS module	HS-CAN	• IPC • RCM
ABS/stability control chime request	ABS module	HS-CAN	• IPC
Accelerator pedal position	PCM	HS-CAN	• TCCM • ABS module • BCM • RCM
Accelerometer and yaw sensor data	ABS module	HS-CAN	• TCCM • IPC • PCM
Accessory delay status	BCM	HS-CAN	• IPC
Accessory delay status	BCM	MS-CAN	• APIM • ACM
ACM radio functions	ACM	I-CAN	• APIM • FCDIM
Airbag deployment eCall confirmation	APIM	HS-CAN	• BCM

			• RCM
Airbag deployment eCall notification	RCM	HS-CAN	• APIM
Airbag deployment status	RCM	HS-CAN	• BCM
Airbag deployment status enabled	RCM	HS-CAN	• OCSM
Airbag status	RCM	HS-CAN	• APIM
Airbag warning indicator request	RCM	HS-CAN	• IPC
Airbag warning indicator status	IPC	HS-CAN	• RCM
Alternator charge mode	BCM	HS-CAN	• IPC • PCM
Alternator charge voltage request	BCM	HS-CAN	• PCM
Alternator current output	PCM	HS-CAN	• BCM
Alternator duty cycle	PCM	HS-CAN	• BCM
Alternator fault	PCM	HS-CAN	• BCM
Ambient air temperature	PCM	HS-CAN	• TCCM • BCM • IPC • PAM
Ambient air temperature (gateway)	BCM	MS-CAN	• ACM • HVAC module
Ambient lighting color	APIM	HS-CAN	• BCM
Ambient lighting color	BCM	MS-CAN	• HVAC module
Ambient lighting intensity	APIM	HS-CAN	• BCM
Ambient lighting intensity	BCM	MS-CAN	• HVAC module
Audio settings	IPC	I-CAN	• ACM
Audio source	ACM	I-CAN	• APIM • IPC • Audio DSP module • FCDIM
Audio volume status	Audio DSP module	I-CAN	• APIM
Autolamp delay status	BCM	HS-CAN	• IPC
Autolamp delay time	IPC	HS-CAN	• BCM
Back up camera command	IPC	HS-CAN	• BCM
Back up camera status	BCM	HS-CAN	• IPC
Battery charge low	BCM	HS-CAN	• IPC
Battery charge low	IPC	I-CAN	• APIM • FCDIM
Belt-minder® audio mute	IPC	I-CAN	• ACM • Audio DSP module
Beltminder programming request	RCM	HS-CAN	• IPC
Beltminder warning status	RCM	HS-CAN	• BCM

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			• IPC
Beltminder warning status (gateway)	BCM	MS-CAN	• ACM • Audio DSP module
Brake on/off switch status	PCM	HS-CAN	• ABS module • RCM • TBC module
Brake (red) warning indicator request	ABS module	HS-CAN	• IPC • RCM
Brake fluid level low	BCM	HS-CAN	• IPC
Brake lamp switch status	PCM	HS-CAN	• ABS module • RCM • TBC module
Brake required	ABS module	HS-CAN	• PCM • TBC module
Camera settings	APIM	I-CAN	• IPC
Camera settings	FCDIM	I-CAN	• IPC
Camera status	BCM	HS-CAN	• IPC
Camera status	BCM	MS-CAN	• ACM
Camera status (gateway)	IPC	I-CAN	• APIM • FCDIM
CD data	APIM	I-CAN	• ACM
CD data	FCDIM	I-CAN	• ACM
CD load/eject	ACM	I-CAN	• APIM • FCDIM
Chime selection	IPC	I-CAN	• ACM • Audio DSP module
Climate controlled seat command, front	HVAC module	MS-CAN	• DCSM
Climate controlled seat command, front	FCIM	I-CAN	• IPC
Climate controlled seat command, front (gateway)	IPC	HS-CAN	• BCM
Climate controlled seat command, front (gateway)	BCM	MS-CAN	• DCSM
Climate controlled seat status, front	DCSM	MS-CAN	• HVAC module
Climate controlled seat request, front	IPC	HS-CAN	• BCM
Climate controlled seat request, front	BCM	MS-CAN	• HVAC module
Climate controlled seat request, rear	IPC	HS-CAN	• BCM
Climate controlled seat request, rear	BCM	MS-CAN	• HVAC module
Climate controlled seat status, front	DCSM	MS-CAN	• BCM
Climate controlled seat status, front (gateway)	BCM	HS-CAN	• IPC
Climate controlled seat status, front (gateway)	IPC	I-CAN	• FCIM
Compass display data	BCM	MS-CAN	• ACM • FDIM
Compass zone and calibration status	BCM	HS-CAN	• IPC

Compass zone and calibration status	BCM	MS-CAN	• ACM • FDIM
Courtesy delay status	BCM	MS-CAN	• HVAC module
Cruise control mode	PCM	HS-CAN	• IPC
Cruise control override	PCM	HS-CAN	• TCCM • BCM • IPC • RCM
Cruise control set speed	PCM	HS-CAN	• IPC
Cruise control status	PCM	HS-CAN	• TCCM • BCM • IPC • RCM
Date and time	IPC	I-CAN	• APIM • FCDIM
Date and time request	APIM	I-CAN	• IPC
Day/night status	BCM	HS-CAN	• TBC module • SCCM • IPC
Day/night status	BCM	MS-CAN	• HVAC module
Day/night status (gateway)	IPC	I-CAN	• APIM • FCIM • FCDIM
Differential lock disable request	ABS module	HS-CAN	• TCCM
Differential lock indicator request	TCCM	HS-CAN	• BCM • IPC
Door ajar status	BCM	HS-CAN	• ABS module • IPC • OCSM • SCCM • TCCM
Door ajar status	BCM	MS-CAN	• PRB module
Door ajar status	IPC	I-CAN	• APIM • FCIM • FCDIM
Drivers seat memory command	DSM	MS-CAN	• BCM
Drivers seat status	DSM	MS-CAN	• BCM
Drivers seat status (gateway)	BCM	HS-CAN	• SCCM
DRL status	BCM	HS-CAN	• IPC
Easy entry exit command	IPC	HS-CAN	• BCM
Easy entry request	DSM	MS-CAN	• BCM
Easy entry/exit request	BCM	HS-CAN	• SCCM
Easy entry/exit status	BCM	HS-CAN	• IPC
Easy entry/exit status	DSM	MS-CAN	• BCM
Engine air intake temperature	PCM	HS-CAN	• BCM

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Engine air intake temperature	BCM	MS-CAN	• HVAC module
Engine coolant temperature	PCM	HS-CAN	• BCM • IPC
Engine MIL request	PCM	HS-CAN	• BCM • IPC • RCM
Engine off	BCM	HS-CAN	• ABS module • IPC • PCM
Engine oil life percent	PCM	HS-CAN	• IPC
Engine oil life reset	IPC	HS-CAN	• PCM
Engine overheat mitigation	PCM	HS-CAN	• IPC
Engine RPM	PCM	HS-CAN	• TCCM • ABS module • BCM • IPC • RCM
Engine RPM (gateway)	BCM	MS-CAN	• APIM
Engine RPM (gateway)	IPC	I-CAN	• APIM • ACM • Audio DSP module • FCDIM
Engine service required	PCM	HS-CAN	• IPC • RCM
Engine torque reduction request	ABS module	HS-CAN	• TCCM • PCM
English/metric display - navigation	ACM	MS-CAN	• BCM
English/metric mode	APIM	I-CAN	• IPC
English/metric mode	FCDIM	I-CAN	• IPC
English/metric mode (gateway)	IPC	HS-CAN	• BCM • PCM
EPAS calculated current flow	PSCM	HS-CAN	• BCM
EPAS fault indicator	PSCM	HS-CAN	• IPC
EPAS measured voltage	PSCM	HS-CAN	• BCM
ePRNDL mode	IPC	HS-CAN	• PCM
Gear lever position	PCM	HS-CAN	• BCM • RCM • IPC • PAM • SCCM • TCCM • ABS module
Gear lever position	BCM	MS-CAN	• APIM • GPSM • HVAC module
Gear lever position	IPC	I-CAN	• APIM

			• ACM • Audio DSP module • FCDIM
FCIM button press data	FCIM	MS-CAN	• BCM
FCIM button press data (gateway)	BCM	HS-CAN	• IPC
FCIM button press data (4.2-inch screen, 8-inch touchscreen)	FCIM	I-CAN	• APIM • FCDIM
FCIM set volume	FCIM	I-CAN	• ACM • Audio DSP module
FDIM display status	HVAC module	MS-CAN	• FDIM
Fuel economy reset request	BCM	HS-CAN	• IPC
Fuel flow display	PCM	HS-CAN	• IPC
Fuel level status	IPC	HS-CAN	• APIM • BCM
Fuel level status (gateway)	BCM	MS-CAN	• ACM • HVAC module
Fuel level status	IPC	I-CAN	• APIM
Fuel cutoff request	RCM	HS-CAN	• PCM
GPS compass direction	GPSM	MS-CAN	• APIM • BCM
GPS compass direction (gateway)	BCM	HS-CAN	• IPC
GPS location	GPSM	MS-CAN	• APIM
Headlamp high beam indicator request	BCM	HS-CAN	• IPC
Headlamp high beam flash to pass	SCCM	HS-CAN	• BCM
Headlamp low beam status	BCM	HS-CAN	• SCCM
Headlamp switch status	SCCM	HS-CAN	• BCM
Headlamp switch status (gateway)	BCM	MS-CAN	• ACM • HVAC module
Headlamps on warning chime command	BCM	HS-CAN	• IPC
Hill descent active	ABS module	HS-CAN	• PCM
Hill descent mode status	ABS module	HS-CAN	• IPC
Hood ajar status	BCM	HS-CAN	• IPC • OCSM • ABS module • SCCM
HVAC auto A/C indicator temperature	BCM	HS-CAN	• IPC
HVAC auto A/C indicator temperature (gateway)	IPC	I-CAN	• APIM • FCDIM
HVAC blower motor command	HVAC module	MS-CAN	• BCM
HVAC button status (with navigation)	HVAC module	MS-CAN	• ACM
HVAC button status (without navigation)	FCIM	MS-CAN	• HVAC module

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HVAC button status, navigation ACM	ACM	MS-CAN	• HVAC module
HVAC floor mode request	IPC	HS-CAN	• BCM
HVAC floor mode request	BCM	MS-CAN	• HVAC module
HVAC floor mode status	HVAC module	MS-CAN	• BCM
HVAC floor mode status	BCM	HS-CAN	• IPC
HVAC floor mode status	IPC	I-CAN	• APIM • FCDIM
HVAC front temperature set point request	FCIM	I-CAN	• IPC • APIM • FCDIM
HVAC front temperature set point request (gateway)	IPC	HS-CAN	• BCM
HVAC front temperature set point request (gateway)	BCM	HS-CAN	• HVAC module
HVAC front temperature set point status	HVAC module	MS-CAN	• BCM
HVAC front temperature set point status (gateway)	BCM	HS-CAN	• IPC
HVAC indicator status	HVAC module	MS-CAN	• FCIM
HVAC indicator status, navigation ACM	HVAC module	MS-CAN	• ACM
HVAC panel mode request	IPC	HS-CAN	• BCM
HVAC panel mode request	BCM	MS-CAN	• HVAC module
HVAC panel mode status	HVAC module	MS-CAN	• BCM
HVAC panel mode status (gateway)	BCM	HS-CAN	• IPC
HVAC panel mode status (gateway)	IPC	I-CAN	• APIM • FCDIM
HVAC rear control status	IPC	HS-CAN	• BCM
HVAC rear control status	BCM	MS-CAN	• HVAC module
HVAC rear defrost, heated mirror request	IPC	HS-CAN	• BCM
HVAC rear defrost, heated mirror request	BCM	MS-CAN	• HVAC module
HVAC rear system mode request	IPC	HS-CAN	• BCM
HVAC rear system mode request	BCM	MS-CAN	• HVAC module
HVAC rear temperature set point request	FCIM	I-CAN	• IPC • APIM • FCDIM
HVAC rear temperature set point request (gateway)	IPC	HS-CAN	• BCM
HVAC rear temperature set point request (gateway)	BCM	MS-CAN	• HVAC module
HVAC rear temperature set point status	HVAC module	MS-CAN	• BCM
HVAC rear temperature set point status (gateway)	BCM	HS-CAN	• IPC
HVAC recirc door status	HVAC module	MS-CAN	• BCM
HVAC recirc door status (gateway)	BCM	HS-CAN	• IPC
HVAC recirc door status (gateway)	IPC	I-CAN	• APIM

			• FCDIM
HVAC recirc request	IPC	HS-CAN	• BCM
HVAC recirc request	BCM	MS-CAN	• HVAC module
HVAC temperature units	HVAC module	MS-CAN	• BCM
HVAC temperature units	BCM	HS-CAN	• IPC
HVAC voice request	ACM	MS-CAN	• HVAC module
Ignition key read data	BCM	HS-CAN	• PCM
Ignition key type	BCM	HS-CAN	• PCM • RCM • IPC • APIM
Ignition status	BCM	HS-CAN	• TCCM • ABS module • IPC • PAM • PCM • PSCM • SCCM • TBC module • OCSM • RCM
Ignition status	BCM	MS-CAN	• HVAC module • DSM • GPSM • ACM • PRB module
Ignition status	IPC	I-CAN	• APIM • Audio DSP module • FCIM • FCDIM
Ignition switch position	BCM	MS-CAN	• ACM • DSM • GPSM • HVAC module • PRB module
IKT programming status	BCM	HS-CAN	• IPC
Illuminated dimming level	IPC	I-CAN	• APIM • Audio ACM module • FCIM • FCDIM
Illumination display	IPC	I-CAN	• APIM • FCIM • FCDIM
Illuminated entry status	BCM	MS-CAN	• HVAC module
Illuminated exit status	BCM	MS-CAN	• HVAC module
Illumination dimming level	BCM	HS-CAN	• IPC • TBC module

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Illumination dimming level	BCM	MS-CAN	• ACM • HVAC module
In-car temperature sensor	HVAC module	MS-CAN	• BCM
IPC chime	IPC	I-CAN	• ACM • Audio DSP module
Keycode status	BCM	HS-CAN	• IPC
Key-in-ignition status	BCM	HS-CAN	• IPC
Key-in-ignition status	BCM	MS-CAN	• ACM • DSM
Key-in-ignition warning chime command	BCM	HS-CAN	• IPC
Language selection	IPC	I-CAN	• APIM • FCDIM
Light sensor status	BCM	HS-CAN	• IPC • SCCM • TBC module
Media player display request	APIM	I-CAN	• ACM
Media player display request	FCDIM	I-CAN	• ACM
Memory feedback request	DSM	MS-CAN	• BCM
Memory feedback request (gateway)	BCM	HS-CAN	• IPC
Memory switch status	DSM	MS-CAN	• BCM
Message center display	IPC	HS-CAN	• APIM • BCM • SCCM
Message center display (gateway)	BCM	MS-CAN	• DSM • HVAC module
Multifunction button push display	HVAC module	MS-CAN	• BCM
Multifunction button push display (gateway)	BCM	HS-CAN	• IPC
Multimedia system status	IPC	HS-CAN	• SCCM
MyKey® volume limit	IPC	I-CAN	• ACM • Audio DSP module
Navigation audio settings	APIM	I-CAN	• ACM • Audio DSP module
Navigation audio settings	FCDIM	I-CAN	• ACM • Audio DSP module
Navigation rolling wheel count	ABS module	HS-CAN	• BCM • IPC
Navigation rolling wheel count (gateway)	BCM	MS-CAN	• APIM • ACM • GPSM
Navigation rolling wheel count (gateway)	IPC	I-CAN	• APIM
Navigation unit settings	BCM	HS-CAN	• IPC

Navigation wheel direction	ABS module	HS-CAN	• BCM • IPC
Navigation wheel direction (gateway)	BCM	MS-CAN	• APIM • ACM • GPSM
OCS calibration data	OCSM	HS-CAN	• RCM
OCS fault status	OCSM	HS-CAN	• RCM
OCS object entrapped message request	OCSM	HS-CAN	• IPC
OCS sensor data	OCSM	HS-CAN	• RCM
OCS serial number	OCSM	HS-CAN	• RCM
Odometer count	PCM	HS-CAN	• IPC
Odometer master value	IPC	HS-CAN	• BCM • PCM
Oil pressure warning	PCM	HS-CAN	• IPC
Outside air temperature	HVAC module	MS-CAN	• BCM
Outside air temperature (gateway)	BCM	HS-CAN	• IPC • PAM
Outside air temperature (gateway)	IPC	I-CAN	• APIM • Audio DSP module • FCIM • FCDIM
Park brake chime request	BCM	HS-CAN	• IPC
Parking aid audible warning indicator	PAM	HS-CAN	• IPC
Parking aid enabled status	PAM	HS-CAN	• IPC
Parking aid enabled status (gateway)	IPC	I-CAN	• APIM • FCDIM
Parking aid fault status	PAM	HS-CAN	• BCM
Parking aid range to object	PAM	HS-CAN	• BCM • IPC
Parking aid range to object (gateway)	IPC	I-CAN	• APIM • FCDIM
Parking aid sensors status	PAM	HS-CAN	• BCM • IPC
Parking aid sensors status (gateway)	IPC	I-CAN	• APIM • FCDIM
Parking aid volume cutback request	PAM	HS-CAN	• BCM • IPC
Parking aid volume cutback request (gateway)	BCM	MS-CAN	• ACM
Parking aid warning command	IPC	HS-CAN	• PAM
Parking brake status	BCM	HS-CAN	• IPC • PCM • ABS module • TCCM
Parking brake status	BCM	MS-CAN	• ACM

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			• HVAC module
Parklamp status	BCM	HS-CAN	• IPC • TBC module
Parklamp status	BCM	MS-CAN	• ACM • HVAC module • TBC module
Passenger restraint indictor status	FCIM	I-CAN	• IPC
Passenger seat belt buckle status	RCM	HS-CAN	• OCS module
Passive entry lock request	BCM	HS-CAN	• IPC
Passive entry lock status	BCM	HS-CAN	• IPC
PATS security data	BCM	HS-CAN	• PCM
PATS security status	PCM	HS-CAN	• BCM
Perimeter alarm chime request	BCM	HS-CAN	• IPC
Power running board enable command	IPC	HS-CAN	• BCM
Power running board enable command (gateway)	BCM	MS-CAN	• PRB module
Power running board status	PRB module	MS-CAN	• BCM
Power running board status (gateway)	BCM	HS-CAN	• IPC
PSCM fault status	PSCM	HS-CAN	• IPC
RCM serial number	RCM	HS-CAN	• ABS module
Remote start quiet mode	HVAC module	MS-CAN	• BCM • TPM module
Remote start quiet mode	BCM	HS-CAN	• IPC
Remote start status	BCM	MS-CAN	• APIM • HVAC module • TPM module
Remote start status	BCM	HS-CAN	• IPC
Remote start warning	BCM	HS-CAN	• IPC
Reverse mirror command	IPC	HS-CAN	• BCM
Reverse mirror command (gateway)	BCM	MS-CAN	• DSM
Reverse mirror status	DSM	MS-CAN	• BCM
Reverse mirror status (gateway)	BCM	HS-CAN	• IPC
RKE configuration	TPM module	MS-CAN	• BCM
RKE data	BCM	MS-CAN	• TPM module
Seat belt buckle status	RCM	HS-CAN	• APIM
Seat belt indicator request	RCM	HS-CAN	• IPC
Seat belt indicator status	IPC	HS-CAN	• RCM
Seat belt warning chime request	RCM	HS-CAN	• IPC
Seat belt warning chime status	IPC	HS-CAN	• RCM
Selector lever (PRNDL) status	PCM	HS-CAN	• TCCM • ABS module • BCM • IPC

			• PAM • RCM • SCCM
Selector lever (PRNDL) status (gateway)	BCM	MS-CAN	• APIM • ACM • DSM • GPSM
Speed control deactivation request	ABS module	HS-CAN	• PCM
Stability control event in progress	ABS module	HS-CAN	• TCCM • PCM • RCM • TBC module
Starter crank request	BCM	HS-CAN	• PCM
Steering angle calibration (hydraulic power steering)	SCCM	HS-CAN	• BCM • ABS module
Steering angle calibration (Electronic Power Assist Steering (EPAS))	PSCM	HS-CAN	• BCM • ABS module
Steering angle count (hydraulic power steering)	SCCM	HS-CAN	• BCM • ABS module
Steering angle count (EPAS)	PSCM	HS-CAN	• BCM • ABS module • SCCM
Steering angle initialization (hydraulic power steering)	SCCM	HS-CAN	• BCM
Steering angle initialization (EPAS)	PSCM	HS-CAN	• BCM • SCCM
Steering column manual override	SCCM	HS-CAN	• BCM
Steering column manual override (gateway)	BCM	MS-CAN	• DSM
Steering column status	SCCM	HS-CAN	• BCM
Steering column status (gateway)	BCM	MS-CAN	• DSM
Steering wheel angle offset	ABS module	HS-CAN	• TCCM • IPC • PSCM • PCM • RCM
Steering wheel switch control mode	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_flash to pass	SCCM	HS-CAN	• BCM
Steering wheel switch_media	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_media (gateway)	BCM	MS-CAN	• ACM
Steering wheel switch_media (gateway)	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_OK	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_OK (gateway)	BCM	MS-CAN	• APIM
Steering wheel switch_OK (gateway)	IPC	I-CAN	• APIM

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			• FCDIM
Steering wheel switch_phone	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_phone (gateway)	BCM	MS-CAN	• APIM • ACM
Steering wheel switch_seek left	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_seek left (gateway)	BCM	MS-CAN	• ACM • APIM
Steering wheel switch_seek left (gateway)	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_seek right	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_seek right (gateway)	BCM	MS-CAN	• ACM • APIM
Steering wheel switch_seek right (gateway)	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_speed control	SCCM	HS-CAN	• PCM
Steering wheel switch_turn signal	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_voice	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_voice (gateway)	BCM	MS-CAN	• APIM • ACM
Steering wheel switch_voice (gateway)	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_volume down	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_volume down (gateway)	BCM	MS-CAN	• ACM
Steering wheel switch_volume down (gateway)	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_volume up	SCCM	HS-CAN	• BCM • IPC
Steering wheel switch_volume up (gateway)	BCM	MS-CAN	• ACM
Steering wheel switch_volume up (gateway)	IPC	I-CAN	• APIM • FCDIM
Steering wheel switch_wiper switch	SCCM	HS-CAN	• BCM • PCM
Steering wheel switch_wiper wash	SCCM	HS-CAN	• PCM
Steering wheel switch_wiper wash	SCCM	HS-CAN	• PCM
Stoplamp request	ABS module	HS-CAN	• BCM
Sunload sensor data	HVAC module	MS-CAN	• BCM
SYNC® alerts	APIM	I-CAN	• ACM • Audio DSP module

Tailgate ajar status	BCM	HS-CAN	• ABS module • IPC • OCSM • SCCM
Tire pressure data	BCM	HS-CAN	• APIM • IPC
Tire pressure status	BCM	HS-CAN	• APIM • IPC
Torque transfer percent command	TCCM	HS-CAN	• ABS module • IPC
TPMS data	TPM module	MS-CAN	• BCM
TPMS pressure information	BCM	MS-CAN	• TPM module
Traction control event in progress	ABS module	HS-CAN	• TCCM • PCM • RCM
Traction control mode	ABS module	HS-CAN	• RCM
Trailer brake configuration	IPC	HS-CAN	• TBC module
Trailer brake fault status	TBC module	HS-CAN	• IPC
Trailer brake gain display request	TBC module	HS-CAN	• IPC
Trailer brake gain setting	TBC module	HS-CAN	• IPC
Trailer brake lamp request	TBC module	HS-CAN	• IPC
Trailer brake output request	ABS module	HS-CAN	• TBC module
Trailer brake stoplamp request	TBC module	HS-CAN	• BCM
Trailer brake type (electric/electric over hydraulic)	IPC	HS-CAN	• TBC module
Trailer connect/disconnect status	TBC module	HS-CAN	• ABS module • BCM • IPC • PAM • SCCM
Trailer connect/disconnect status (gateway)	IPC	I-CAN	• APIM • FCDIM
Trailer sway event in progress	ABS module	HS-CAN	• IPC
Transfer case maximum torque required	ABS module	HS-CAN	• TCCM
Transfer case minimum torque required	ABS module	HS-CAN	• TCCM
Transmission gear display	PCM	HS-CAN	• IPC
Transmission in reverse	PCM	HS-CAN	• BCM • RCM • SCCM
Transmission malfunction indicator request	PCM	HS-CAN	• IPC • RCM
Transmission mode	PCM	HS-CAN	• IPC
Transmission oil temperature	PCM	HS-CAN	• TCCM • IPC
Transmission shift in progress	PCM	HS-CAN	• ABS module

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Transmission shift mode	PCM	HS-CAN	• IPC • ABS module
Turn indicator command	BCM	HS-CAN	• IPC • SCCM
Vehicle lateral acceleration	RCM	HS-CAN	• PSCM • PCM • OCSM
Vehicle lock status	BCM	HS-CAN	• IPC
Vehicle longitudinal acceleration	RCM	HS-CAN	• PCM • OCSM
Vehicle roll sense	RCM	HS-CAN	• PCM
Vehicle speed	PCM	HS-CAN	• ABS module • BCM • IPC • OCSM • PAM • PSCM • RCM • SCCM
Vehicle speed (gateway)	BCM	MS-CAN	• APIM • ACM • GPSM • PRB module
Vehicle yaw rate (gateway)	BCM	MS-CAN	• GPSM
Vehicle yaw rate	RCM	HS-CAN	• BCM • PCM
Voice commands	APIM	I-CAN	• IPC
Voice recognition status	APIM	I-CAN	• FCDIM
Wheel speed data	ABS module	HS-CAN	• TCCM • BCM • IPC • PSCM • PCM
Wiper motor status	BCM	MS-CAN	• HVAC module

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.
    - If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

Visual Inspection Chart

Electrical

- Battery Junction Box (BJB) fuse(s):
  - High current 1 (125A) (PSCM)
  - 11 (30A) (PRB module)
  - 17 (30A) (TBC module)
  - 20 (20A) (TCCM ESOF)
  - 23 (15A) (SCCM)
  - 24 (15A) (SCCM)
  - 26 (10A) (PCM)
  - 36 (30A) (ABS module)
  - 45 (10A) BCM
  - 47 (60A) (ABS module)
  - 52 (5A) (PSCM)
  - 54 (5A) (TCCM , ABS module)
  - 68 (25A) (TCCM)
  - 69 (30A) (DCSM)
  - 75 (25A) (3.5L PCM)
  - 75 (15A) (3.7L, 5.0L and 6.2L PCM)
- Body Control Module (BCM) fuse(s):
  - 2 (15A) (APIM)
  - 7 (7.5A) (DSM)
  - 9 (10A) (FCIM , FDIM , GPSM)
  - 11 (10A) (IPC)
  - 19 (20A) (audio DSP module)
  - 24 (15A) (DLC)
  - 26 (5A) (TPM module)
  - 29 (20A) (ACM)
  - 34 (10A) (PAM)
  - 36 (10A) (RCM and OCSM)
  - 37 (10A) (TBC module)
  - 46 (10A) (HVAC module)
- Data Link Connector (DLC)
- Wiring harness
- Wiring, terminals or connectors

3. Connect the scan tool to the DLC .
   - **NOTE:** Make sure to use the latest scan tool software release.

     NOTE: The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

     If the Integrated Diagnostic System (IDS) does not communicate with the VCM :
     - check the VCM connection to the vehicle.
     - check the scan tool connection to the VCM .
     - GO to Pinpoint Test AA to diagnose No Power To The Scan Tool.

4. Establish a scan tool session.
   - **NOTE:** The scan tool first attempts to communicate with the PCM. After establishing communication with the PCM, the scan tool then attempts to communicate with all other modules on the vehicle.

     If an IDS session cannot be established with the vehicle, (IDS may state "No communication can be established with the PCM"):
     - Choose "NO" when the scan tool prompts whether or not to retry communication.
     - Enter either a PCM part number, tear tag or calibration number to identify the vehicle and start a session (the PCM part number and 4-character tear tag are printed on the PCM label).

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- GO to Pinpoint Test A to diagnose The PCM Does Not Respond To The Scan Tool.

5. Carry out the network test.
   - If the network test passes, retrieve and record the Continuous Memory Diagnostic Trouble Codes (CMDTCs) and proceed to Step 6.
   - If the network test fails, GO to Symptom Chart to diagnose the failed communication network.
   - If a module fails to communicate during the network test, GO to Symptom Chart .

6. Retrieve and review the DTCs.
   - If the DTCs retrieved are related to the concern, go to DTC Charts. Follow the non-network DTC diagnostics (B-codes, C-codes, P-codes) prior to the network DTC diagnostics (U-codes). For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
   - If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

NOTE: Network DTCs (U-codes) are often a result of intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures such as module reprogramming often set network DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. To prevent repeat network DTC concerns, inspect all network wiring, especially connectors. Test the vehicle battery, refer to Section 414-01 .

NOTE: Some modules on this vehicle utilize a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

Communication Network DTC Chart

DTC	Description	Source	Action
U0001:88	High Speed CAN Communication Bus: Bus off	Power Steering Control Module (PSCM)	The module could not communicate on the network at a point in time. The fault is currently not present since the module is currently communicating with the scan tool reporting this DTC. CLEAR the DTC. REPEAT the network test with the scan tool. VERIFY the integrity of the connectors and wiring. Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.
U0028:08	Vehicle Communication Bus A: Bus Signal / Message Failures	Restraints Control Module (RCM)	The module could not communicate on the network at a point in time. The fault is currently not present since the module is currently communicating with the scan tool reporting this DTC. CLEAR the DTC. REPEAT the network test with the scan tool. VERIFY the integrity of the connectors and wiring. Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.
U0028:88	Vehicle Communication Bus A: Bus Off	Restraints Control Module (RCM)	The module could not communicate on the network at a point in time. The fault is currently not present since the module is currently communicating with the scan tool reporting this DTC. CLEAR the DTC. REPEAT the network test with the scan tool. VERIFY the integrity of the

			connectors and wiring. Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.
U0073	Vehicle Communication Bus A "Off"	ABS module	The module could not communicate on the network at a point in time. The fault is currently not present since the module is currently communicating with the scan tool reporting this DTC. CLEAR the DTC. REPEAT the network test with the scan tool. VERIFY the integrity of the connectors and wiring. Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.
U1900	CAN Communication Bus Fault - Receive Error	Power Running Board (PRB) module	CARRY out the network test. GO to Symptom Chart for the module that fails the network test.
U3000:88	Control Module: Bus Off	Accessory Protocol Interface Module (APIM)	The module could not communicate on the network at a point in time. The fault is currently not present since the module is currently communicating with the scan tool reporting this DTC. CLEAR the DTC. REPEAT the network test with the scan tool. VERIFY the integrity of the connectors and wiring. Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The vehicle does not start with the scan tool connected to the Data Link Connector (DLC) and/or multiple malfunction indicators are only on when the scan tool is connected to the DLC	• Wiring, terminals or connectors • Scan tool	• GO to Pinpoint Test AA .
• The PCM does not respond to the scan tool	• Wiring, terminals or connectors • PCM	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, Section 5, pinpoint test QA before proceeding to Pinpoint Test A . If pinpoint test QA has been completed, GO to Pinpoint Test A .
• The ABS module does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • ABS module	• GO to Pinpoint Test B .
• The Instrument Panel	• Fuse	• GO to Pinpoint Test C .

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Cluster (IPC) does not respond to the scan tool	• Wiring, terminals or connectors • IPC	
• The Restraints Control Module (RCM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • RCM	• GO to Pinpoint Test D .
• The OCSM does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • OCSM	• GO to Pinpoint Test E .
• The TCCM does not respond to the scan tool	• Fuse(s) • Wiring, terminals or connectors • TCCM	• GO to Pinpoint Test F .
• The Trailer Brake Control (TBC) module does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • TBC module	• GO to Pinpoint Test G .
• The Power Steering Control Module (PSCM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • PSCM	• GO to Pinpoint Test H .
• The Body Control Module (BCM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • BCM	• GO to Pinpoint Test I .
• The HVAC module does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • HVAC module	• GO to Pinpoint Test J .
• The Audio Front Control Module (ACM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • ACM	• GO to Pinpoint Test K .
• The audio Digital Signal Processing (DSP) module does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • Audio DSP module	• GO to Pinpoint Test L .
• The Front Controls Interface Module (FCIM) does not respond to the	• Fuse • Wiring, terminals or	• GO to Pinpoint Test M .

scan tool	connectors • FCIM	
• The Front Display Interface Module (FDIM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • Front Display Interface Module (FDIM)	• GO to Pinpoint Test N .
• The FCDIM does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • FCDIM	• GO to Pinpoint Test O
• The Driver Seat Module (DSM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • DSM	• GO to Pinpoint Test P .
• The Dual Climate Controlled Seat Module (DCSM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • DCSM	• GO to Pinpoint Test Q .
• The Power Running Board (PRB) module does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • PRB module	• GO to Pinpoint Test R .
• The Parking Aid Module (PAM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • PAM	• GO to Pinpoint Test S .
• The Global Positioning System Module (GPSM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • GPSM	• GO to Pinpoint Test T .
• The Accessory Protocol Interface Module (APIM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • APIM	• GO to Pinpoint Test U .
• The Steering Column Control Module (SCCM) does not respond to the scan tool	• Fuse • Wiring, terminals or connectors • SCCM	• GO to Pinpoint Test V .
• The Tire Pressure Monitor (TPM) module does not respond to the scan tool	• Fuse • Wiring, terminals or	• GO to Pinpoint Test W .

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	connectors • TPM module	
• No Medium Speed Controller Area Network (MS-CAN) communication, all modules are not responding	• Wiring, terminals or connectors • APIM (if equipped) • ACM (if equipped) • BCM • DSM (if equipped) • DCSM (if equipped) • FCIM (if equipped) • FDIM (if equipped) • GPSM (if equipped) • HVAC module • PRB module (if equipped) • TPM module	• GO to Pinpoint Test X .
• No High Speed Controller Area Network (HS-CAN) communication, all modules are not responding	• Wiring, terminals or connectors • TCCM (if equipped) • ABS module • APIM (if equipped) • BCM • IPC • OCSM • PAM (if equipped) • PCM • PSCM (if equipped) • RCM • SCCM • TBC module (if equipped)	• GO to Pinpoint Test Y .
• No Infotainment Controller Area Network (I-CAN) communication, all modules are not responding	• ACM (if equipped) • APIM (if equipped) • Audio DSP module (if equipped) • FCIM (if equipped) • FCDIM (if equipped) • IPC	• GO to Pinpoint Test Z

• No power to the scan tool	• Fuse • Wiring, terminals or connectors • DLC • Scan tool	• GO to Pinpoint Test AA .

Pinpoint Tests

Pinpoint Test A: The PCM Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 23 , Electronic Engine Controls - 3.7L for schematic and connector information.

Refer to Wiring Diagrams Cell 24 , Electronic Engine Controls - 5.0L for schematic and connector information.

Refer to Wiring Diagrams Cell 25 , Electronic Engine Controls - 3.5L for schematic and connector information.

Refer to Wiring Diagrams Cell 26 , Electronic Engine Controls - 6.2L for schematic and connector information.

Normal Operation

The PCM communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PCM

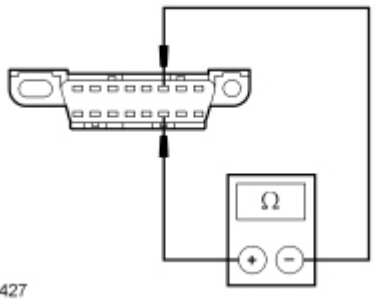
PINPOINT TEST A: THE PCM DOES NOT RESPOND TO THE SCAN TOOL

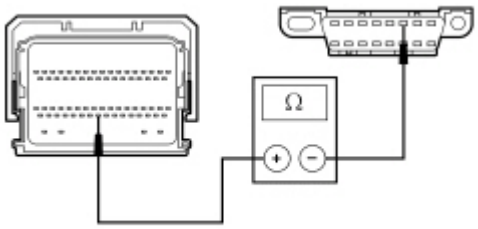
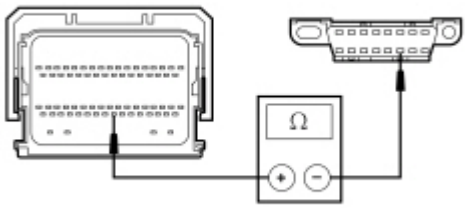
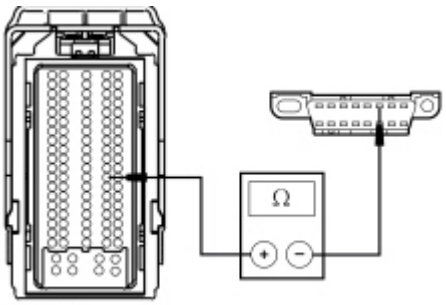
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

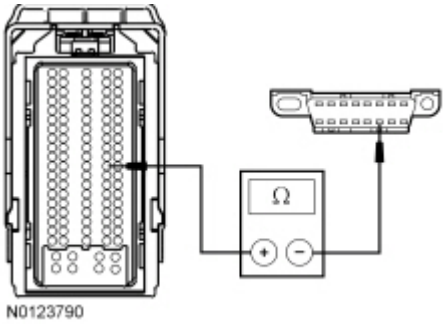
Test Step	Result / Action to Take
A1 VERIFY IF OTHER HS-CAN MODULES PASS THE NETWORK TEST	
• Enter the following diagnostic mode on the scan tool: Network Test . • In the LH pane of the IDS network test display screen, verify	**Yes** If "pass" or a DTC was

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whether any HS-CAN modules passed the network test. • **Is the text "pass" or a DTC listed next to any of the following modules (if equipped): TCCM , ABS module, Accessory Protocol Interface Module (APIM), Body Control Module (BCM), Instrument Panel Cluster (IPC), Occupant Classification System (OCS) module, Parking Aid Module (PAM), Power Steering Control Module (PSCM), Restraints Control Module (RCM), Steering Column Control Module (SCCM) or Trailer Brake Control (TBC) module or PCM?**	listed next to the PCM, a network fault is not currently present. If "pass" or a DTC was listed next to one or more modules other than the PCM, GO to A2 . **No** No modules are currently communicating on the HS-CAN . GO to Pinpoint Test Y to diagnose no HS-CAN communication.
A2 VERIFY THE PC/ED MANUAL PINPOINT TEST QA HAS BEEN CARRIED OUT	
• Verify that pinpoint test QA has been carried out. • **Has pinpoint test QA been carried out?**	**Yes** GO to A3 . **No** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, Section 5, pinpoint test QA to diagnose no communication with the PCM.
A3 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance between 54 and 66 ohms?**	**Yes** CONNECT the negative battery cable. GO to A6 . **No** For the 3.7L, 5.0L or 6.2L engine GO to A4 . For the 3.5L engine GO to A5 .
A4 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN	
• Disconnect: PCM C175B or C1381B . • Measure the resistance between the PCM C175B-59 or C1381B-59, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.	**Yes** CONNECT the negative battery cable. GO to A6 . **No** REPAIR the circuit in

 N0077607 • Measure the resistance between the PCM C175B-58 or C1381B-58, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0113941 • **Are the resistances less than 5 ohms?**	question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
A5 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN • Disconnect: PCM C1551B . • Measure the resistance between the PCM C1551B-69, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0123791 • Measure the resistance between the PCM C1551B-68, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to A6 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 N0123790 • **Are the resistances less than 5 ohms?**	
A6 CHECK FOR CORRECT PCM OPERATION	

• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: The ABS Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 42 , Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

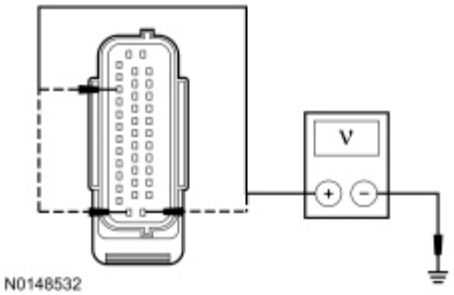
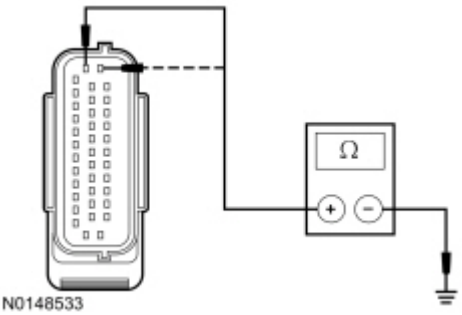
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- ABS module

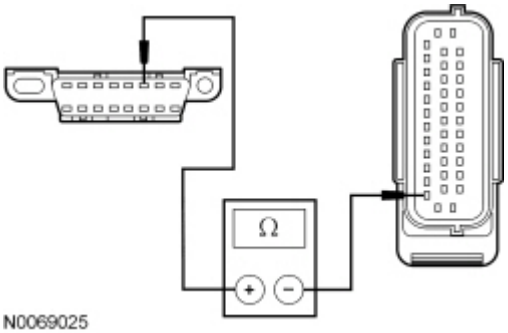
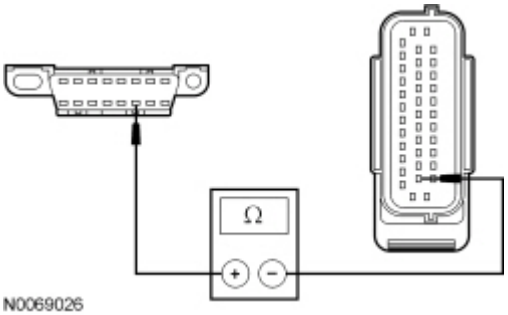
PINPOINT TEST B: THE ABS MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
B1 CHECK THE ABS MODULE VOLTAGE SUPPLY CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between the ABS module C135-1, circuit SBB47 (WH/RD), harness side and ground; between the ABS module C135-25, circuit SBB36 (GN/RD), harness side and ground; and between the ABS module C135-35, circuit CBB54 (VT/OG), harness side and ground.  N0148532 • **Is the voltage greater than 10 volts?**	**Yes** GO to B2 . **No** VERIFY the Battery Junction Box (BJB) fuse 36 (30A), 47 (60A) or 54 (5A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
B2 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the ABS module C135-38, circuit GD121 (BK/YE), harness side and ground; and between the ABS module C135-13, circuit GD121 (BK/YE), harness side and ground.  N0148533 • **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
B3 CHECK THE HS-CAN CIRCUITS BETWEEN THE DLC AND THE ABS MODULE FOR AN OPEN • Measure the resistance between the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side and the ABS module C135-26, circuit VDB04 (WH/BU), harness side.	**Yes** CONNECT the negative battery cable. GO to B4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with

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 N0069025 • Measure the resistance between the DLC C251-14, circuit VDB05 (WH), harness side and the ABS module C135-14, circuit VDB05 (WH), harness side.  N0069026 • **Are the resistances less than 5 ohms?**	the scan tool.

B4 CHECK FOR CORRECT ABS MODULE OPERATION
• Disconnect the ABS module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the ABS module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ABS module. REFER to Section 206-09. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Instrument Panel Cluster (IPC) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 60, Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN). For vehicles equipped with a 4.2-inch screen or 8-inch touchscreen audio system, the IPC is a gateway for messages sent between the scan tool and the modules on the Infotainment Controller Area Network (I-CAN).

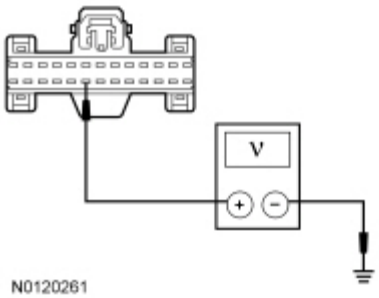
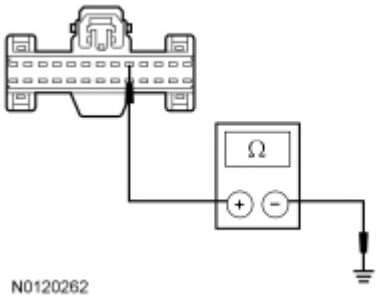
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- IPC

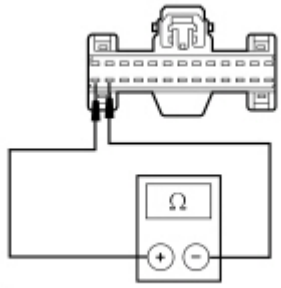
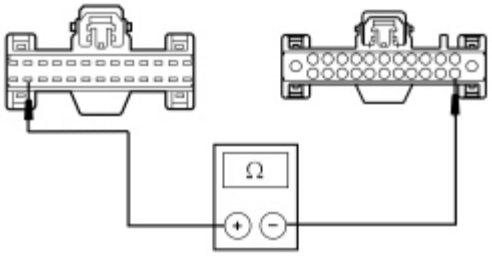
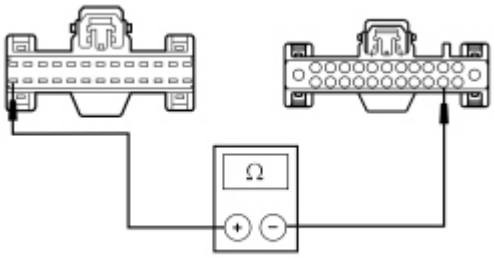
PINPOINT TEST C: THE IPC DOES NOT RESPOND TO THE SCAN TOOL

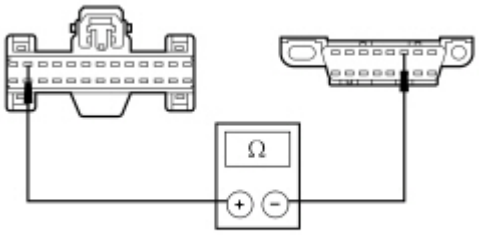
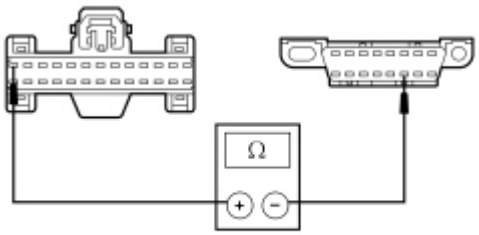
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
C1 CHECK THE IPC VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Disconnect: IPC C220 . • Ignition ON. • Measure the voltage between the IPC C220-21, circuit SBP11 (BU/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 **No** VERIFY the Body Control Module (BCM) fuse 11 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
C2 CHECK THE IPC GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the IPC C220-5, circuit GD133 (BK), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. If equipped with 4.2-inch screen or 8-inch touchscreen, GO to C3 . If not equipped with 4.2-inch screen or 8-inch touchscreen, GO to C5 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
C3 CHECK THE I-CAN TERMINATION RESISTANCE	
• Ignition OFF.	**Yes**

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• Disconnect: Negative Battery Cable . • Measure the resistance between the IPC C220-25, circuit VDB13 (BU/GY) and IPC C220-26, circuit VDB14 (VT/GY), harness side.  N0150481 • **Is the resistance between 54 and 66 ohms?**	CONNECT the battery cable. GO to C5 . **No** GO to C4
C4 CHECK THE I-CAN CIRCUITS BETWEEN IPC AND THE ACM FOR AN OPEN	
• Disconnect: ACM C240A . • Measure the resistance between the IPC C220-25, circuit VDB13 (BU/GY), harness side and the Audio Front Control Module (ACM) C240A-14, circuit VDB13 (BU/GY), harness side.  N0150482 • Measure the resistance between the IPC C220-26, circuit VDB14 (VT/GY), harness side and the ACM C240A-15, circuit VDB14 (VT/GY), harness side.  N0150483 • **Are the resistances less than 5 ohms?**	**Yes** GO to C5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
C5 CHECK THE HS-CAN CIRCUITS BETWEEN IPC AND THE DLC FOR AN OPEN	
• Measure the resistance between the IPC C220-12, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU),	**Yes** CONNECT the negative battery cable. GO to C6 .

harness side.  N0120263 • Measure the resistance between the IPC C220-13, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0120264 • **Are the resistances less than 5 ohms?**	**No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
C6 CHECK FOR CORRECT IPC OPERATION • Disconnect the IPC connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: The Restraints Control Module (RCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

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- Fuse
- Wiring, terminals or connectors
- RCM

PINPOINT TEST D: THE RCM DOES NOT RESPOND TO THE SCAN TOOL

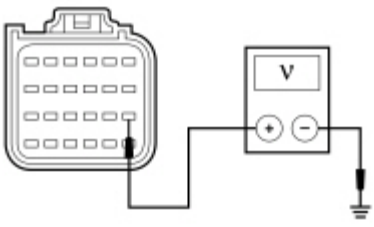
WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

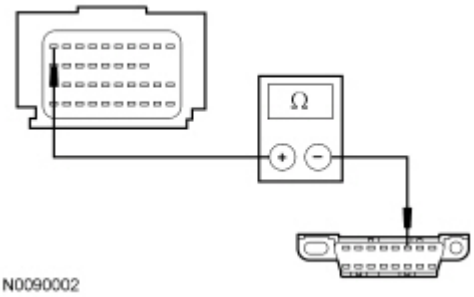
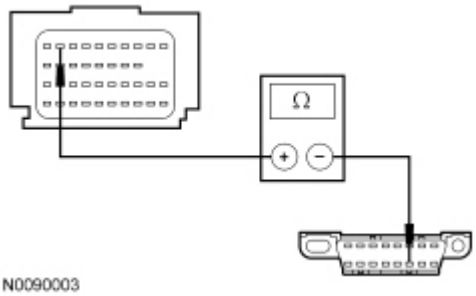
WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
D1 CHECK THE RCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Section 501-20B . • Disconnect: RCM C310A . • Repower the SRS . Refer to Section 501-20B . • Ignition ON. • Measure the voltage between the RCM C310A-13, circuit CBP36 (BU/BN), harness side and ground.  N0117680 • **Is the voltage greater than 10 volts?**	**Yes** GO to D2 . **No** VERIFY the Body Control Module (BCM) fuse 36 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
D2 CHECK THE RCM CASE GROUND	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the RCM case and a	**Yes** GO to D3 .

good chassis ground. • **Is the resistance less than 5 ohms?**	**No** REPAIR the RCM case ground as necessary. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
D3 CHECK THE HS-CAN CIRCUITS BETWEEN THE RCM AND THE DLC FOR AN OPEN	
• Disconnect: RCM C310B . • Measure the resistance between the RCM C310B-10, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0090002 • Measure the resistance between the RCM C310B-9, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0090003 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to D4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
D4 CHECK FOR CORRECT RCM OPERATION	

• Disconnect all the RCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the RCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new RCM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test E: The Occupant Classification System Module (OCSM) Does Not Respond To The Scan Tool

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Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Occupant Classification System Module (OCSM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- OCSM

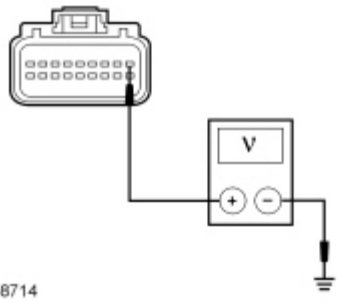
PINPOINT TEST E: THE OCSM DOES NOT RESPOND TO THE SCAN TOOL

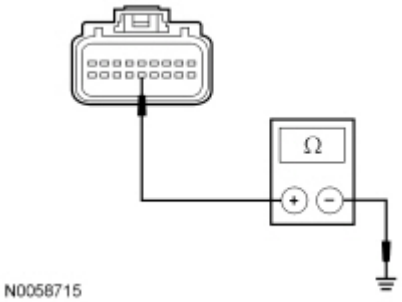
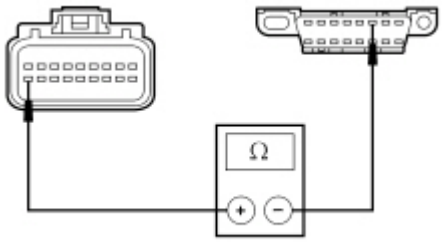
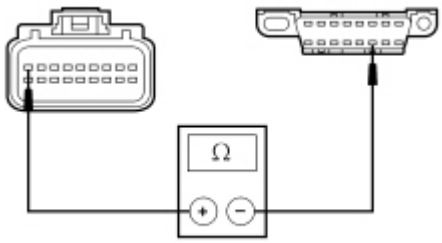
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
E1 CHECK THE OCSM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: OCSM C3159 . • Ignition ON. • Measure the voltage between the OCSM C3159-1, circuit CBX02 (BN/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to E2 . **No** VERIFY the Body Control Module (BCM) fuse 36 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CONNECT the OCSM . CLEAR the DTCs. REPEAT the network test with the scan tool.
E2 CHECK THE OCSM GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the OCSM C3159-14, circuit GD901 (BK), harness side and ground.  N0058715 • **Is the resistance less than 5 ohms?**	**Yes** GO to E3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
E3 CHECK THE HS-CAN CIRCUITS BETWEEN THE OCSM AND THE DLC FOR AN OPEN	
• Measure the resistance between the OCSM C3159-18, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0026670 • Measure the resistance between the OCSM C3159-9, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026671 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to E4 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
E4 CHECK FOR CORRECT OCSM OPERATION	
• Disconnect the OCSM connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins	**Yes** INSTALL a new OCSM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.

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• Connect the OCSM connector and make sure it seats correctly. • Verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: The Transfer Case Control Module (TCCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 34 , All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

The Transfer Case Control Module (TCCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

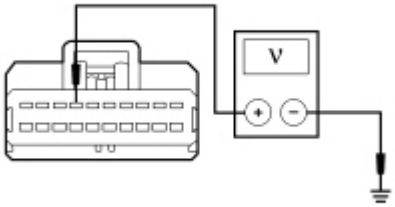
- Fuse(s)
- Wiring, terminals or connectors
- TCCM

PINPOINT TEST F: THE TCCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

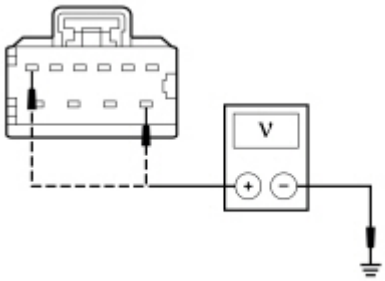
NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
F1 CHECK THE TCCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: TCCM C2371A . • Disconnect: TCCM C2371B . • Ignition ON. • Measure the voltage between the TCCM C2371A-7, circuit CBB54 (VT/OG), harness side and ground.	**Yes** GO to F2 . **No** VERIFY the Battery Junction Box (BJB) fuses 20 (20A) (ESOF only), 54 (5A) and 68 (25A) are OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.



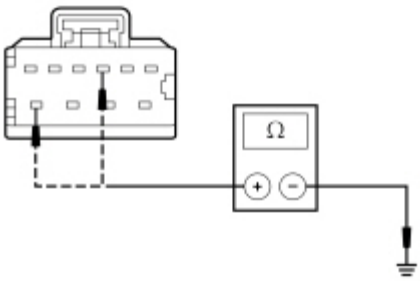
N0090212

- Measure the voltage between the TCCM C2371B-6 (Electronic Shift-On-The-Fly (ESOF)), circuit SBB20 (GN/RD), harness side and ground; and between the TCCM C2371B-7, circuit SBB68 (GN/RD), harness side and ground.

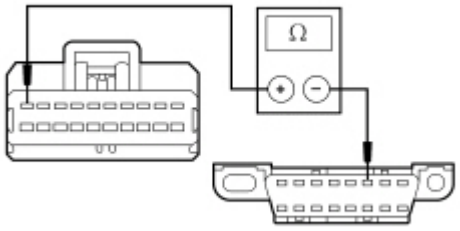
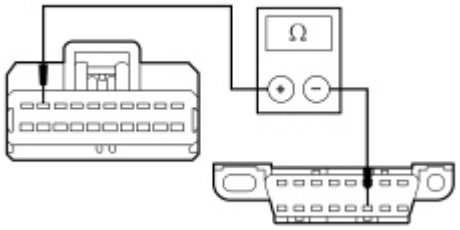


N0122241

- **Are the voltages greater than 10 volts?**

F2 CHECK THE TCCM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the TCCM C2371B-3, circuit GD123 (BK/GY), harness side and ground; and between the TCCM C2371B-10, circuit GD123 (BK/GY), harness side and ground.  N0122242 • **Is the resistance less than 5 ohms?**	**Yes** GO to F3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
F3 CHECK THE HS-CAN CIRCUITS BETWEEN THE TCCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the TCCM C2371A-10, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.	**Yes** CONNECT the negative battery cable. GO to F4 . **No** REPAIR the circuit in question.

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 N0053241 • Measure the resistance between the TCCM C2371A-9, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0053242 • **Are the resistances less than 5 ohms?**	CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
F4 CHECK FOR CORRECT TCCM OPERATION	

• Disconnect all the TCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the TCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Section 308-07A. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Trailer Brake Control (TBC) Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 95, Trailer/Camper Adapter for schematic and connector information.

Normal Operation

The Trailer Brake Control (TBC) module communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

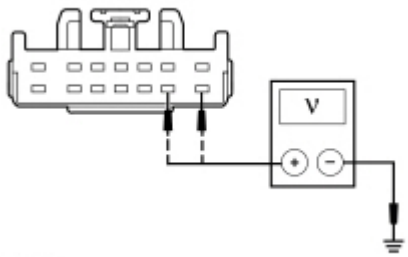
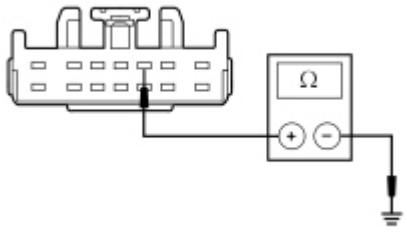
- Fuse

- Wiring, terminals or connectors
- TBC module

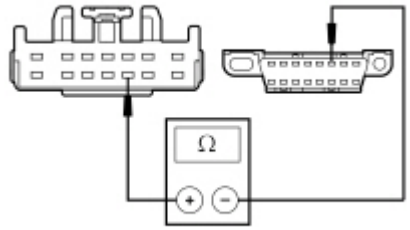
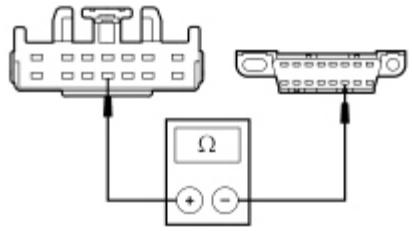
PINPOINT TEST G: THE TBC MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
G1 CHECK THE TBC MODULE VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: TBC Module C2142 . • Ignition ON. • Measure the voltage between the TBC module C2142-9, circuit CBP37 (WH), harness side and ground, and measure the voltage between the TBC module C2142-8, circuit SBB17 (RD), harness side and ground.  N0131577 • **Are the voltages greater than 10 volts?**	**Yes** GO to G2 . **No** VERIFY Body Control Module (BCM) fuse 37 (10A) and BJB fuse 17 (30A) are OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
G2 CHECK THE TBC MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the TBC module C2142-3, circuit GD138 (BK/WH), harness side and ground.  N0122244 • **Is the resistance less than 5 ohms?**	**Yes** GO to G3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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G3 CHECK THE HS-CAN CIRCUITS BETWEEN THE TBC MODULE AND THE DLC FOR AN OPEN	
• Measure the resistance between the TBC module C2142-10, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0122245 • Measure the resistance between the TBC module C2142-11, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0090216 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to G4 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
G4 CHECK FOR CORRECT TBC MODULE OPERATION	
• Disconnect the TBC module connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the TBC module connector and make sure it seats correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new TBC module. REFER to Section 206-10 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: The Power Steering Control Module (PSCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 43 , Power Steering Controls for schematic and connector information.

Normal Operation

The Power Steering Control Module (PSCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

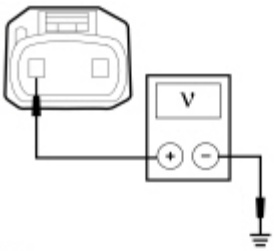
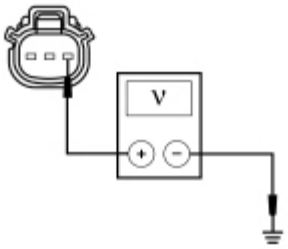
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- PSCM

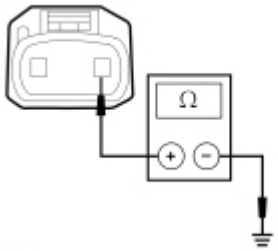
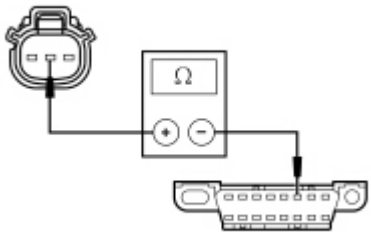
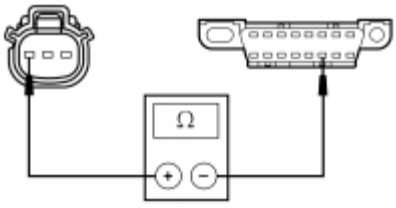
PINPOINT TEST H: THE PSCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
H1 CHECK THE PSCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: PSCM C1463A and C1463B . • Ignition ON. • Measure the voltage between the PSCM C1463A-2, circuit SDC02 (RD), harness side and ground.  N0148536 • Measure the voltage between the PSCM C1463B-1, circuit CBB52 (GN/WH), harness side and ground.  N0122248 • **Is the voltage greater than 10 volts?**	**Yes** GO to H2 . **No** VERIFY the High Current Battery Junction Box (BJB) fuse 1 (125A) or BJB fuse 52 (5A) is OK. If OK, REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
H2 CHECK THE PSCM GROUND CIRCUIT FOR AN OPEN	

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• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the PSCM C1463A-1, circuit GD108 (BK/VT), harness side and ground  N0113935 • **Are the resistances less than 1 ohms?**	**Yes** GO to H3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
H3 CHECK THE HS-CAN CIRCUITS BETWEEN THE PSCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the PSCM C1463B-2, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0122247 • Measure the resistance between the PSCM C1463B-3, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0122246 • **Are the resistances less than 5 ohms?**	**Yes** GO to H4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
H4 CHECK FOR CORRECT PSCM OPERATION	

• Disconnect all the PSCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
	Yes
	INSTALL a new EPAS steering gear. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the network test with the scan tool.

• Connect all the PSCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test I: The Body Control Module (BCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 13 , Power Distribution/BCM for schematic and connector information.

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Normal Operation

The Body Control Module (BCM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- BCM

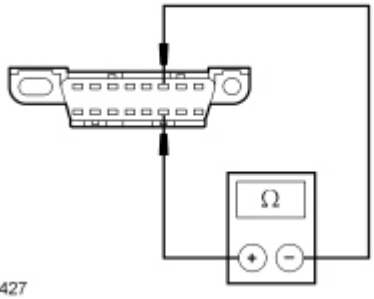
PINPOINT TEST I: THE BCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

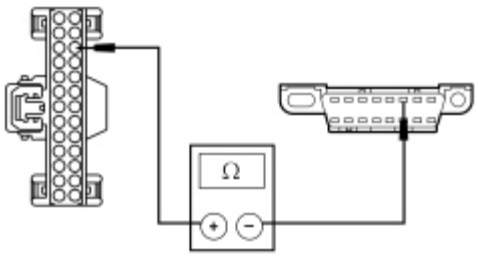
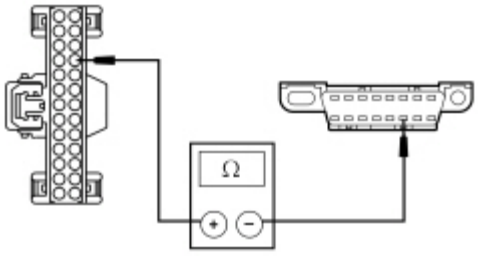
Test Step	Result / Action to Take
I1 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect the scan tool cable from the Data Link Connector (DLC). • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to I3 . **No** GO to I2 .

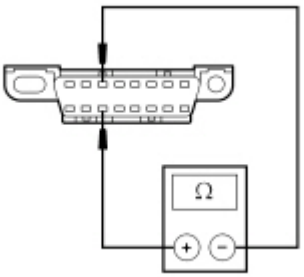
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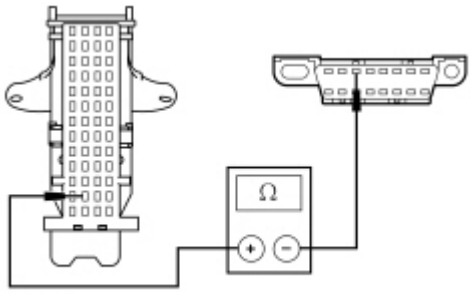
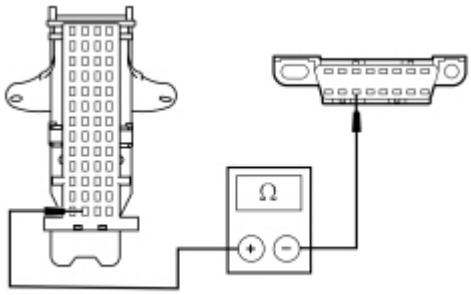
- **Is the resistance between 54 and 66 ohms?**

I2 CHECK THE HS-CAN CIRCUITS BETWEEN THE BCM AND THE DLC FOR AN OPEN • Disconnect: BCM C2280F . • Measure the resistance between the BCM C2280F-16, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0115338 • Measure the resistance between the BCM C2280F-17, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0115339 • **Are the resistances less than 5 ohms?**	**Yes** GO to I7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
I3 CHECK THE MS-CAN TERMINATION RESISTANCE • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to I5 . **No** GO to I4 .

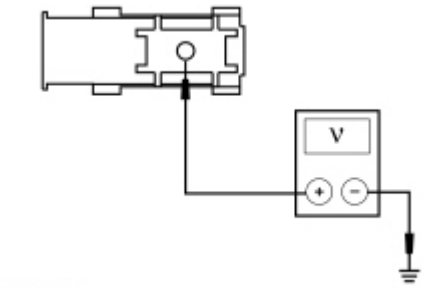


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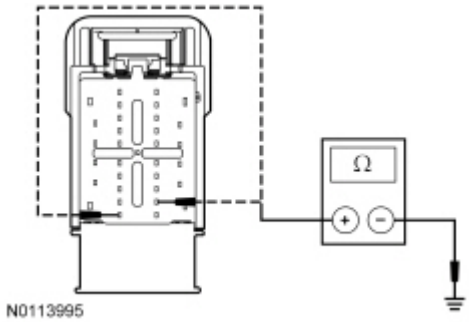
- **Is the resistance between 54 and 66 ohms?**

I4 CHECK THE MS-CAN CIRCUITS BETWEEN THE BCM AND THE DLC FOR AN OPEN	
• Disconnect: BCM C2280B . • Measure the resistance between the BCM C2280B-38, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0114057 • Measure the resistance between the BCM C2280B-39, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0114058 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to I7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
I5 CHECK THE BCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
NOTE: Measurements are taken with the fuse installed and probes placed at the terminals on the back of the fuse blade. • Disconnect: BCM C2280G . • Connect: Negative Battery Cable . • Ignition ON. • Measure the voltage between the BCM C2280G-1, SDC04 (RD), and ground.	**Yes** GO to I6 . **No** VERIFY the BJB fuse 45 (10A) is OK. If OK, GO to I6 .

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- **Is the voltage greater than 10 volts?**

I6 CHECK THE BCM GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Disconnect: BCM C2280D . • Measure the resistance between the BCM , harness side and ground as follows: **Connector-Pin** / **Circuit** C2280D-16 / GD139 (BK/YE) C2280D-25 / GD139 (BK/YE)  • **Are the resistances less than 5 ohms?**	**Yes** GO to I7 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
I7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test J: The HVAC Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector

information.

Refer to Wiring Diagrams Cell 54 , Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 , Automatic Climate Control System for schematic and connector information.

Normal Operation

The HVAC module communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

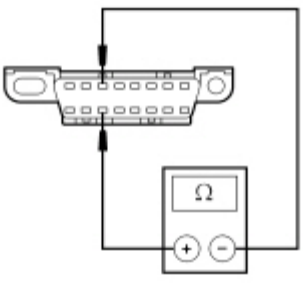
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- HVAC module

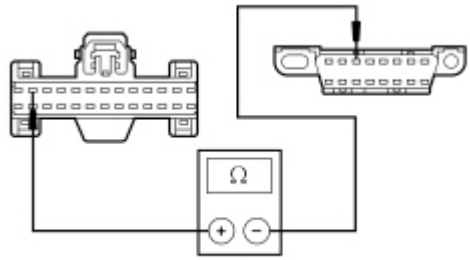
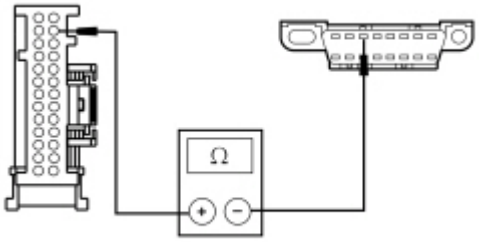
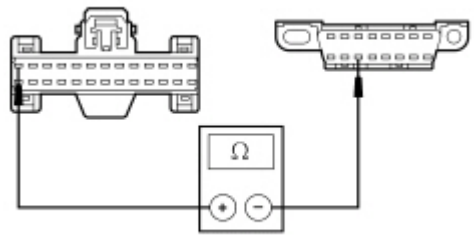
PINPOINT TEST J: THE HVAC MODULE DOES NOT RESPOND TO THE SCAN TOOL

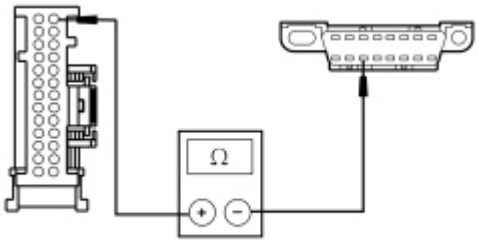
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
J1 CHECK THE MS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative battery cable . • Disconnect the scan tool cable from the DLC . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 54 and 66 ohms?**	**Yes** CONNECT the negative battery cable. GO to J4 . **No** GO to J2 .
J2 CHECK THE MS-CAN (+) CIRCUIT BETWEEN THE HVAC MODULE AND THE DLC FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module C294A (Electronic Manual	**Yes** GO to J3 .

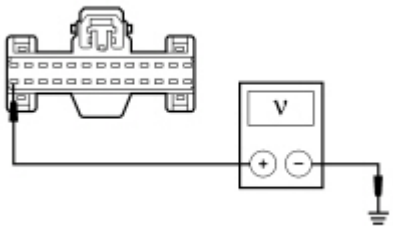
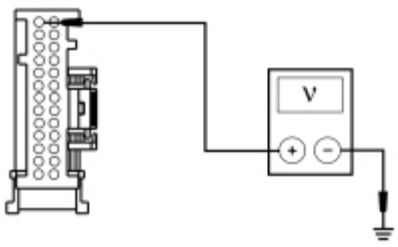
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Temperature Control (EMTC)) or C228A (EATC) . • For EMTC , measure the resistance between the HVAC module C294A-12, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0104911 • For EATC , measure the resistance between the HVAC module C228A-25, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0148816 • **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
J3 CHECK THE MS-CAN (-) CIRCUIT BETWEEN THE HVAC MODULE AND THE DLC FOR AN OPEN • For EMTC , measure the resistance between the HVAC module C294A-13, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0104912 • For EATC , measure the resistance between the HVAC module C228A-26, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to J6 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

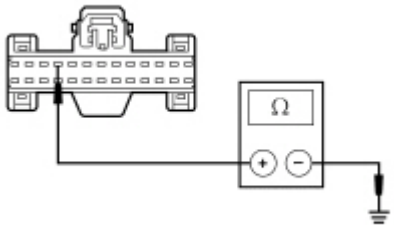
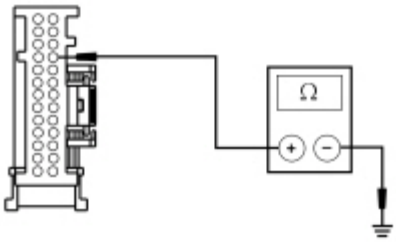


N0148817

- **Is the resistance less than 5 ohms?**

J4 CHECK THE HVAC MODULE VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Disconnect: HVAC Module C294A (EMTC) or C228A (EATC . • Ignition ON. • For EMTC , measure the voltage between the HVAC module C294A-26, circuit SBP46 (BN/RD), harness side and ground.  N0104909 • For EATC , measure the voltage between the HVAC module C228A-13, circuit SBP46 (BN/RD), harness side and ground.  N0148818 • **Is the voltage greater than 10 volts?**	**Yes** GO to J5 . **No** VERIFY the Body Control Module (BCM) fuse 46 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
J5 CHECK THE HVAC MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • For EMTC , measure the resistance between the HVAC module C294A-10, circuit GD133 (BK), harness side and ground.	**Yes** GO to J6 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with

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 N0104910 • For EATC , measure the resistance between the HVAC module C228A-23, circuit GD133 (BK), harness side and ground.  N0148819 • **Is the resistance less than 5 ohms?**	the scan tool.
J6 CHECK FOR CORRECT HVAC MODULE OPERATION • Disconnect all the HVAC module connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the HVAC module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test K: The Audio Front Control Module (ACM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation

The base and premium audio system Audio Front Control Module (ACM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN). For vehicles equipped with 4.2-inch screen or 8-inch touchscreen, the Audio Front Control Module (ACM) communicates with the scan tool through the IPC (gateway) on the HS-CAN .

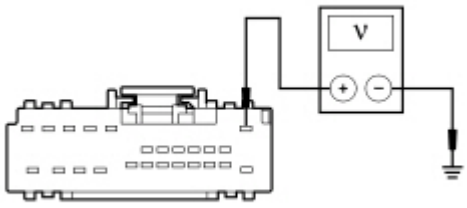
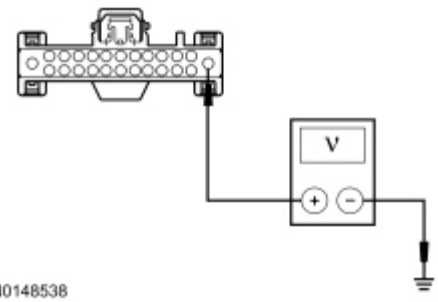
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- ACM

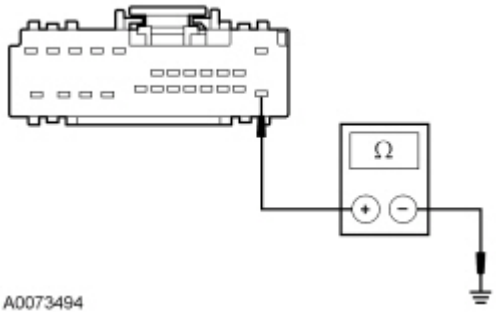
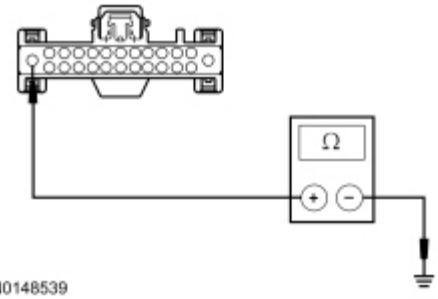
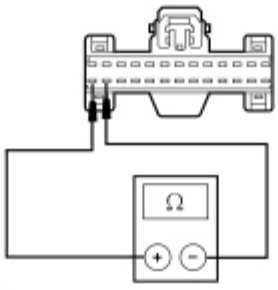
PINPOINT TEST K: THE ACM DOES NOT RESPOND TO THE SCAN TOOL

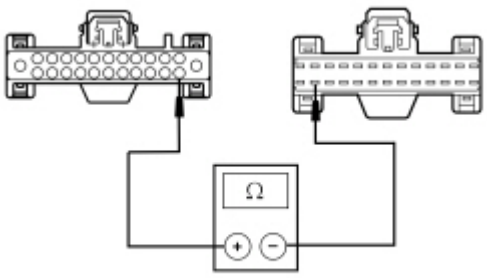
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
K1 CHECK THE ACM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: ACM C290A or C240A (4.2-inch screen or 8-inch touchscreen) . • Ignition ON. • If equipped with AM/FM radio with single CD, measure the voltage between the ACM C290A-1, circuit SBP29 (GY/RD), harness side and ground.  N0058708 • If equipped with 4.2-inch screen or 8-inch touchscreen, measure the voltage between the ACM C240A-1, circuit SBP29 (GY/RD), harness side and ground.  N0148538 • **Is the voltage greater than 10 volts?**	**Yes** GO to K2 . **No** VERIFY the Body Control Module (BCM) fuse 29 (20A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
K2 CHECK THE ACM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable .	**Yes** If equipped with AM/FM radio with

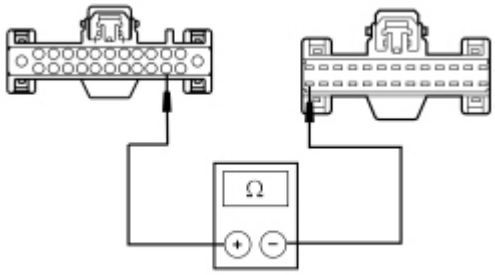
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• If equipped with AM/FM radio with single CD, measure the resistance between the ACM C290A-13, circuit GD114 (BK/BU), harness side and ground.  A0073494 • If equipped with 4-inch screen or 8-inch touchscreen, measure the resistance between the ACM C240A-13, circuit GD114 (BK/BU), harness side and ground.  N0148539 • **Is the resistance less than 5 ohms?**	single CD, GO to K5 . If equipped with 4-inch screen or 8-inch touchscreen, GO to K3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
K3 CHECK THE I-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: IPC C220 . • Measure the resistance between the IPC C220-25 and IPC C220-26, harness side.  N0150481 • **Is the resistance 120 ohms?**	**Yes** CONNECT the IPC and the battery cable. GO to K6 . **No** GO to K4 .
K4 CHECK THE I-CAN CIRCUITS BETWEEN THE ACM AND THE IPC FOR AN OPEN	
• Measure the resistance between the ACM C240A-14, circuit VDB13 (BU/GY), harness side and the Instrument Panel Cluster (IPC) C220-25, circuit VDB13 (BU/GY), harness side.	**Yes** GO to K6 . **No** REPAIR the circuit in question.



N0150484

- Measure the resistance between the ACM C240A-15, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.



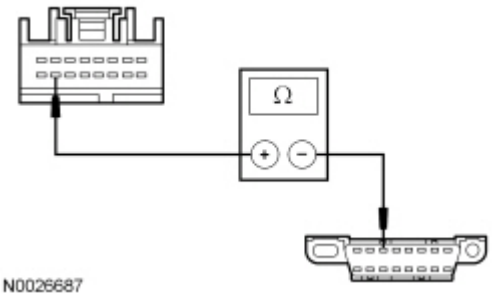
N0150485

- **Are the resistances less than 5 ohms?**

CONNECT the IPC and negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

K5 CHECK THE MS-CAN CIRCUITS BETWEEN THE ACM AND THE DLC FOR AN OPEN

- Disconnect: ACM C290B .
- Measure the resistance between the ACM C290B-15, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.



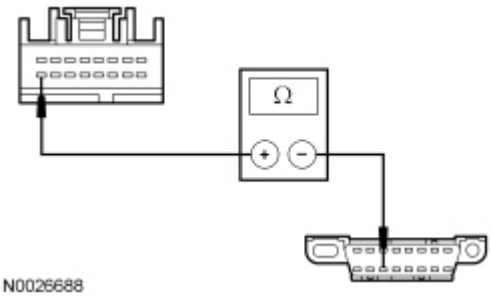
N0026687

- Measure the resistance between the ACM C290B-16, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.

Yes
CONNECT the negative battery cable. GO to K6 .

No
REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 N0026688 • **Are the resistances less than 5 ohms?**	
K6 CHECK FOR CORRECT ACM OPERATION	

• Disconnect all the ACM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the ACM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ACM . Refer to the appropriate section in Group 415 for the procedure. CLEAR the DTCs. REPEAT the network test with the scan tool. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test L: The Audio Digital Signal Processing (DSP) Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation

The audio Digital Signal Processing (DSP) module communicates with other modules on the I-CAN , but communicates with the scan tool through the IPC (gateway) on the HS-CAN .

This pinpoint test is intended to diagnose the following:

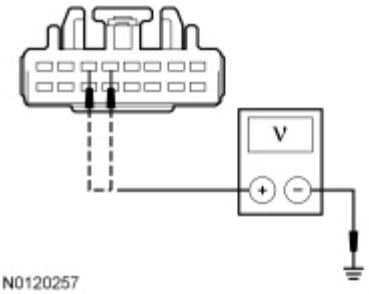
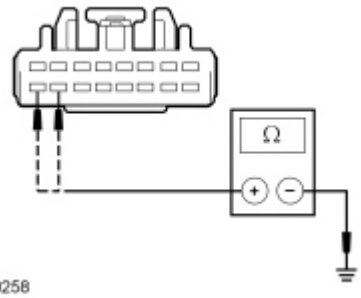
- Fuse
- Wiring, terminals or connectors
- Audio DSP module

PINPOINT TEST L: THE AUDIO DSP MODULE DOES NOT RESPOND TO THE SCAN TOOL

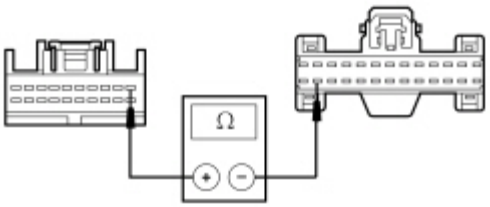
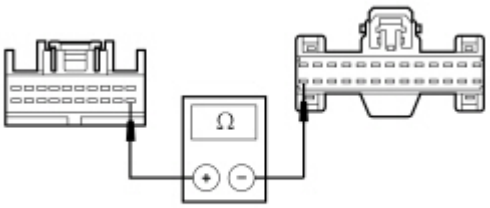
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to

Section 414-01 .

Test Step	Result / Action to Take
L1 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Audio DSP Module C3154C . • Ignition ON. • Measure the voltage between the audio DSP module, harness side and ground as follows: **Connector-Pin / Circuit** C3154C-5 — SBP19 (BU/RD) C3154C-6 — SBP19 (BU/RD)  N0120257 • **Are the voltages greater than 10 volts?**	**Yes** GO to L2 . **No** VERIFY the Body Control Module (BCM) fuse 19 (20A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
L2 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the audio DSP module, harness side and ground as follows: **Connector-Pin / Circuit** C3154C-15 — GD148 (BK/YE) C3154C-16 — GD148 (BK/YE)  N0120258	**Yes** GO to L3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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• **Are the resistances less than 5 ohms?**	
L3 CHECK THE I-CAN CIRCUITS BETWEEN THE AUDIO DSP MODULE AND THE IPC FOR AN OPEN • Disconnect: Audio DSP Module C3154A . • Disconnect: IPC C220 . • Measure the resistance between the audio DSP module C3154A-1, circuit VDB13 (BU/GY), harness side and the IPC C220-25, circuit VDB13 (BU/GY), harness side.  N0150486 • Measure the resistance between the audio DSP module C3154A-11, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.  N0150487 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to L4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
L4 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION • Disconnect all the audio DSP module connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new audio DSP module. REFER to Section 415-00E . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test M: The Front Controls Interface Module (FCIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation

For vehicles equipped with AM/FM radio with single CD, the Front Controls Interface Module (FCIM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN). For vehicles equipped with 4.2-inch screen or 8-inch touchscreen, the Front Controls Interface Module (FCIM) communicates with other modules on the I-CAN , but communicates with the scan tool through the IPC (gateway) on the HS-CAN .

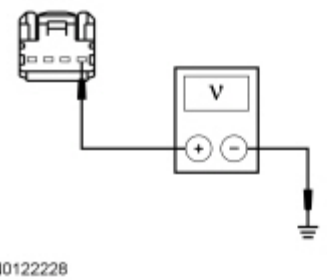
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- FCIM

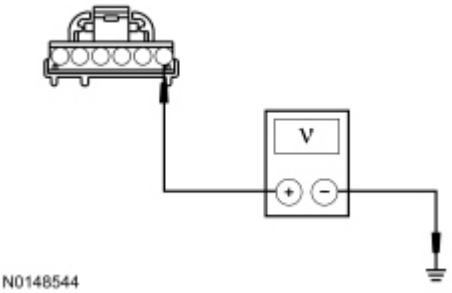
PINPOINT TEST M: THE FCIM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

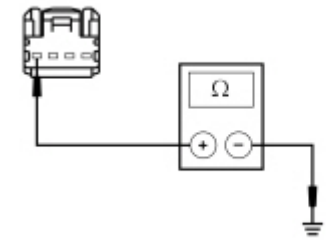
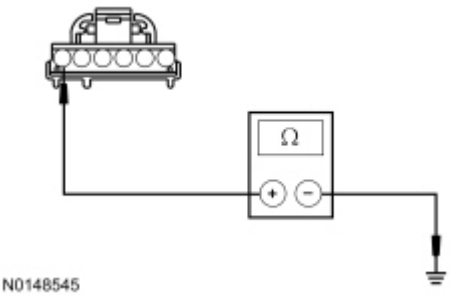
Test Step	Result / Action to Take
M1 CHECK THE FCIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: FCIM C2402 . • Ignition ON. • If equipped with AM/FM radio with single CD, measure the voltage between the FCIM C2402-1, circuit SBP09 (RD), harness side and ground.  N0122228 • If equipped with 4.2-inch screen or 8-inch touchscreen, measure the voltage between the FCIM C2402-1, circuit SBP09 (RD), harness side and ground.	**Yes** GO to M2 . **No** VERIFY the Body Control Module (BCM) fuse 9 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

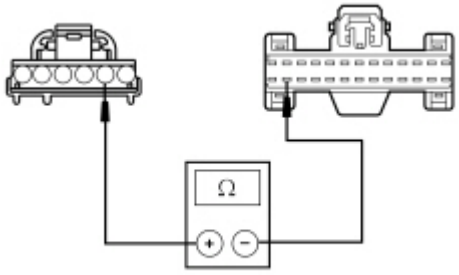
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N0148544

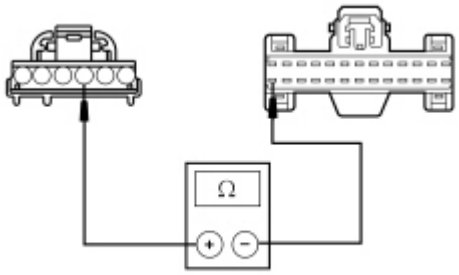
- **Is the voltage greater than 10 volts?**

M2 CHECK THE FCIM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • If equipped with AM/FM radio with single CD, measure the resistance between the FCIM C2402-4, circuit GD133 (BK), harness side and ground.  N0122229 • If equipped with 4.2-inch screen or 8-inch touchscreen, measure the resistance between the FCIM C2402-6, circuit GD133 (BK), harness side and ground.  N0148545 • **Is the resistance less than 5 ohms?**	**Yes** If equipped with 4.2-inch screen or 8-inch touchscreen, GO to M3 . If equipped with AM/FM radio with single CD, GO to M4 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
M3 CHECK THE I-CAN CIRCUITS BETWEEN THE FCIM AND THE IPC FOR AN OPEN	
• Disconnect: IPC C220 . • Measure the resistance between the FCIM C2402-2, circuit VDB13 (BU/GY), harness side and the IPC C220-25, circuit VDB13 (BU/GY), harness side.	**Yes** CONNECT the negative battery cable. GO to M5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.



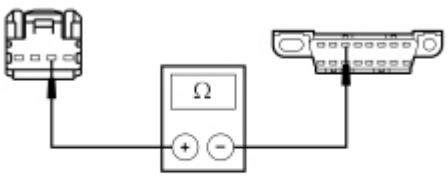
N0150488

- Measure the resistance between the FCIM C2402-3, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.

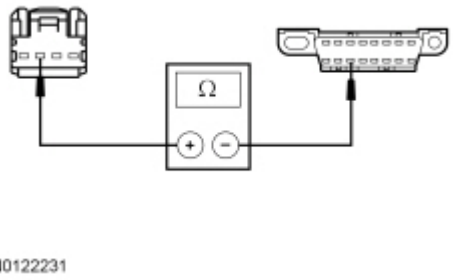


N0150489

- **Are the resistances less than 5 ohms?**

M4 CHECK THE MS-CAN CIRCUITS BETWEEN THE FCIM AND THE DLC FOR AN OPEN	
• Measure the resistance between the FCIM C2402-2, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0122230 • Measure the resistance between the FCIM C2402-3, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to M5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 N0122231 • **Are the resistances less than 5 ohms?**	
M5 CHECK FOR CORRECT FCIM OPERATION	

• Disconnect the FCIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the FCIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new FCIM. Refer to the appropriate section in Group 415 for the procedure. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test N: The Front Display Interface Module (FDIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation

The Front Display Interface Module (FDIM) (vehicles not equipped with navigation) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

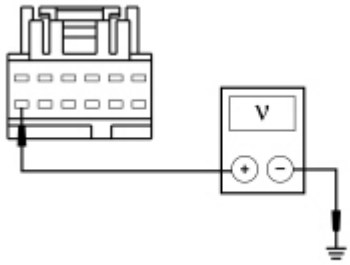
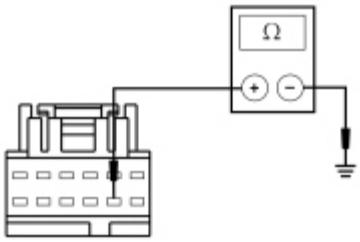
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- FDIM

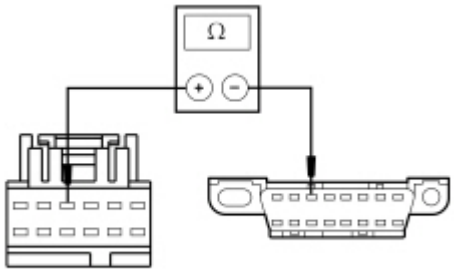
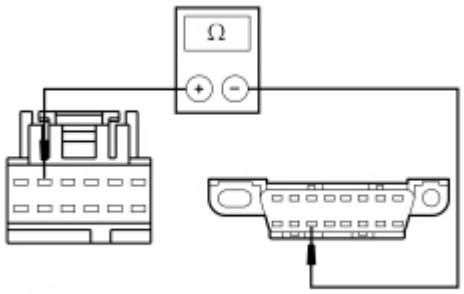
PINPOINT TEST N: THE FDIM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01.

Test Step	Result / Action to Take
N1 CHECK THE FDIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: FDIM C2123 . • Ignition ON. • Measure the voltage between the FDIM C2123-12, circuit SBP09 (RD), harness side and ground.  N0122249 • **Is the voltage greater than 10 volts?**	**Yes** GO to N2 . **No** VERIFY the Body Control Module (BCM) fuse 9 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
N2 CHECK THE FDIM GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the FDIM C2123-8, circuit GD133 (BK), harness side and ground.  N0122251 • **Is the resistance less than 5 ohms?**	**Yes** GO to N3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
N3 CHECK THE MS-CAN CIRCUITS BETWEEN THE FDIM AND THE DLC FOR AN OPEN • Measure the resistance between the FDIM C2123-4, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to N4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 N0122252 • Measure the resistance between the FDIM C2123-5, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0122253 • **Are the resistances less than 5 ohms?**	

N4 CHECK FOR CORRECT FDIM OPERATION
• Disconnect the FDIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the FDIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new FDIM. Refer to the appropriate section in Group 415 for the procedure.. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test O: The Front Control/Display Interface Module (FCDIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation

The FCDIM communicates with other modules on the I-CAN, but communicates with the scan tool through the IPC (gateway) on the HS-CAN.

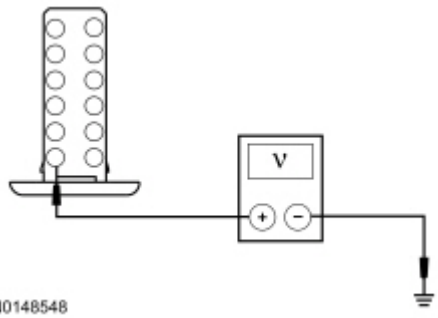
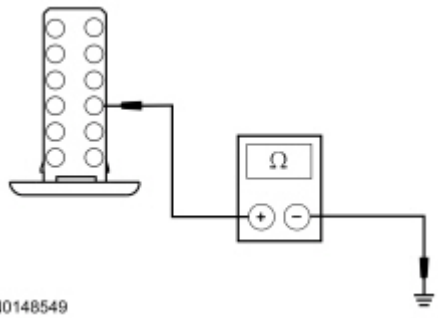
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- FCDIM

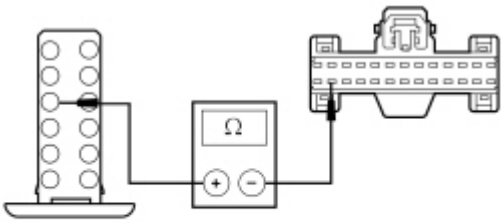
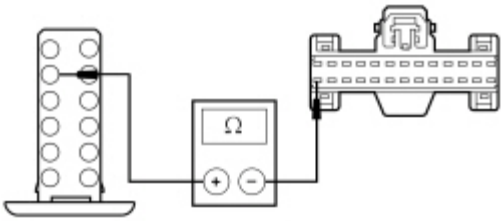
PINPOINT TEST O: THE FCDIM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
O1 CHECK THE FCDIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: FCDIM C2123 . • Ignition ON. • Measure the voltage between the FCDIM C2123-1, circuit SBP09 (RD), harness side and ground.  N0148548 • **Is the voltage greater than 10 volts?**	**Yes** GO to O2 . **No** VERIFY the Body Control Module (BCM) fuse 9 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
O2 CHECK THE FCDIM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the FCDIM C2123-9, circuit GD114 (BK/BU), harness side and ground.  N0148549 • **Is the resistance less than 5 ohms?**	**Yes** GO to O3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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O3 CHECK THE I-CAN CIRCUITS BETWEEN THE FCDIM AND THE IPC FOR AN OPEN	
• Disconnect: IPC C220 . • Measure the resistance between the FCDIM C2123-4, circuit VDB13 (BU/GY), harness side and the IPC C220-25, circuit VDB13 (BU/GY), harness side.  N0150490 • Measure the resistance between the FCDIM C2123-5, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.  N0150491 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the IPC and the negative battery cable. GO to O4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
O4 CHECK FOR CORRECT FCDIM OPERATION	

• Disconnect the FCDIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the FCDIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new FCDIM . REFER to Section 415-00C . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test P: The Driver Seat Module (DSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

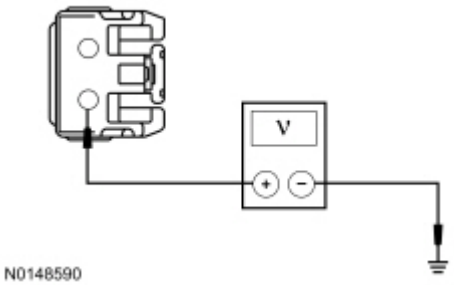
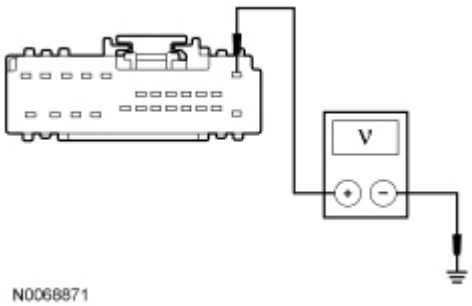
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- DSM

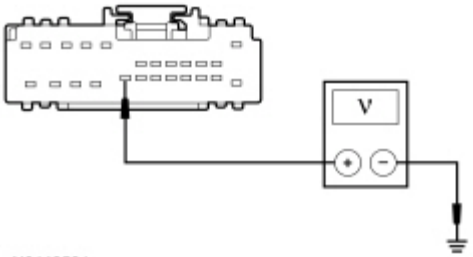
PINPOINT TEST P: THE DSM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

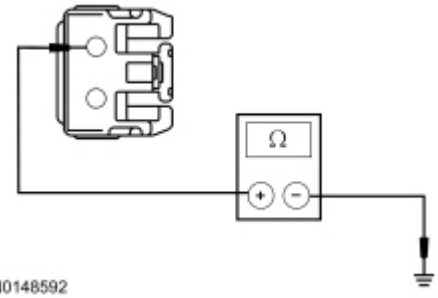
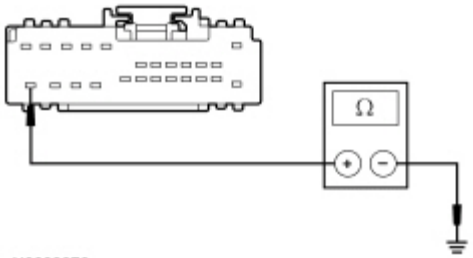
Test Step	Result / Action to Take
P1 CHECK THE DSM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN • Ignition OFF. • Disconnect: DSM C341A, C341B and C341C . • Ignition ON. • Measure the voltage between the DSM C341A-1, circuit CBX05 (VT/RD), harness side and ground.  N0148590 • Measure the voltage between the DSM C341B-1, circuit CBX03 (BU/RD), harness side and ground.  N0068871 • Measure the voltage between the DSM C341C-20, circuit CPP14 (BN/WH), harness side and ground.	**Yes** GO to P2 . **No** VERIFY the BJB fuse 74 (30A) or Body Control Module (BCM) fuse 7 (7.5A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

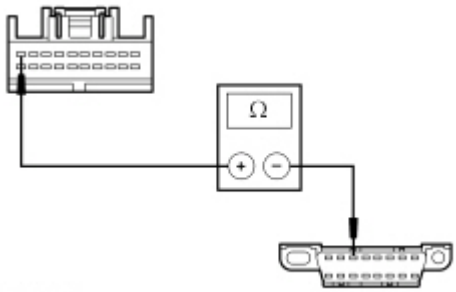
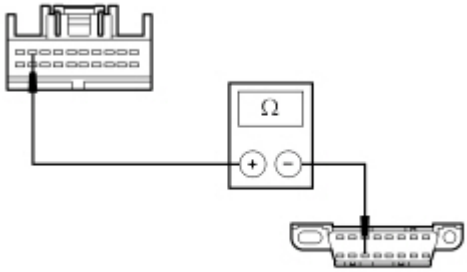
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N0148591

- **Are the voltages greater than 10 volts?**

P2 CHECK THE DSM GROUND CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DSM C341A-2, circuit GD906 (BK/GY), harness side and ground.  N0148592 • Measure the resistance between the DSM C341B-24, circuit GD905 (BK/GN), harness side and ground.  N0068872 • **Are the resistances less than 5 ohms?**	**Yes** GO to P3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
P3 CHECK THE MS-CAN CIRCUITS BETWEEN THE DSM AND THE DLC FOR AN OPEN	
• Disconnect: DSM C341D . • Measure the resistance between the DSM C341D-10, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to P4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0090369 • Measure the resistance between the DSM C341D-9, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0090370 • **Are the resistances less than 5 ohms?**	
P4 CHECK FOR CORRECT DSM OPERATION	

• Disconnect all the DSM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the DSM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new DSM. REFER to Section 501-10. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test Q: The Dual Climate Controlled Seat Module (DCSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 119, Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse

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- Wiring, terminals or connectors
- DCSM

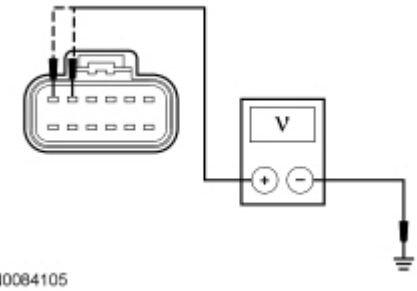
PINPOINT TEST Q: THE DCSM DOES NOT RESPOND TO THE SCAN TOOL

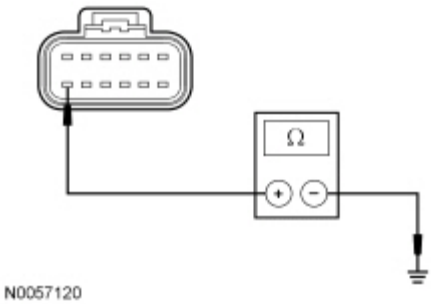
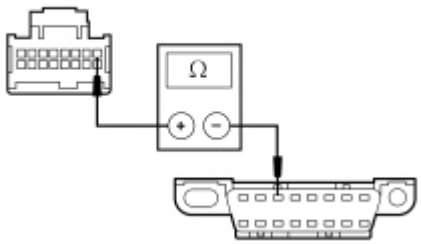
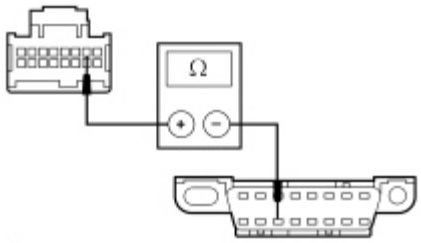
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is on. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
Q1 CHECK THE DCSM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN • Ignition OFF. • For vehicles with seat side air bags, carry out the following: ▪ Depower the SRS . Refer to Section 501-20B . ▪ Disconnect the driver seat side air bag module. ▪ Disconnect the passenger seat side air bag module. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Disconnect: DCSM C3265A . • Ignition ON. • Measure the voltage between the DCSM C3265A-E, circuit CBX01 (GN/RD), harness side and ground; and between the DCSM C3265A-F, circuit CBX01 (GN/RD), harness side and ground.  • **Are the voltages greater than 10 volts?**	**Yes** GO to Q2 . **No** VERIFY the Battery Junction Box (BJB) fuse 69 (30A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool. REPOWER the SRS . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.

Q2 CHECK THE DCSM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DCSM C3265A-M, circuit GD903 (BK/WH), harness side and ground.  N0057120 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q3 . **No** REPAIR the circuit. CONNECT the negative battery cable. REPOWER the SRS . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
Q3 CHECK THE MS-CAN CIRCUITS BETWEEN THE DCSM AND THE DLC FOR AN OPEN	
• Disconnect: DCSM C3265C . • Measure the resistance between the DCSM C3265C-1, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0058709 • Measure the resistance between the DCSM C3265C-2, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0058710 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to Q4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. REPOWER the SRS . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
Q4 CHECK FOR CORRECT DCSM OPERATION	
• Disconnect all the DCSM connectors. • Check for:	**Yes** INSTALL a new DCSM . REFER to

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▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the DCSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	Section 501-10 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test R: The Power Running Board (PRB) Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 109 , Retractable Running Boards for schematic and connector information.

Normal Operation

The Power Running Board (PRB) module communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

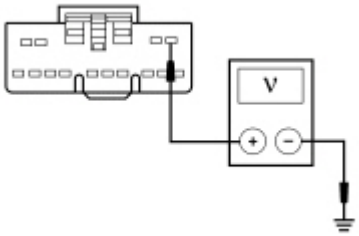
- Fuse
- Wiring, terminals or connectors
- PRB module

PINPOINT TEST R: THE PRB MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

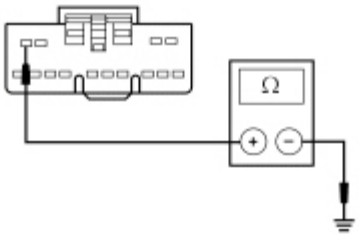
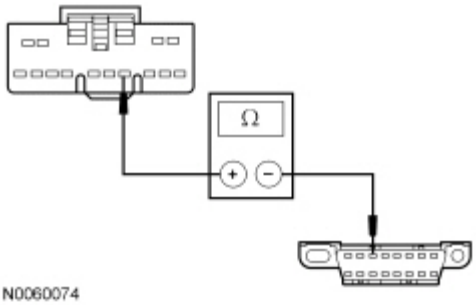
NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
R1 CHECK THE PRB MODULE VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PRB Module C3313B . • Ignition ON. • Measure the voltage between the PRB module C3313B-1, circuit SBB11 (BU/RD), harness side and ground.	**Yes** GO to R2 . **No** VERIFY the Battery Junction Box (BJB) fuse 11 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

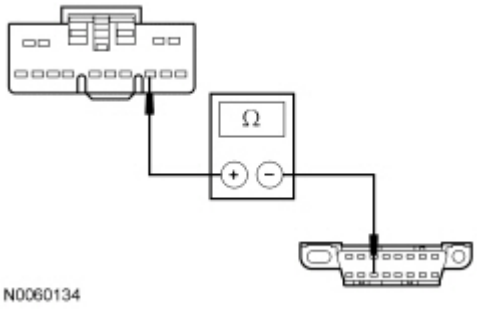


N0060072

- **Is the voltage greater than 10 volts?**

R2 CHECK THE PRB MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the PRB module C3313B-4, circuit GD139 (BK/YE), harness side and ground.  N0060073 • **Is the resistance less than 5 ohms?**	**Yes** GO to R3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
R3 CHECK THE MS-CAN CIRCUITS BETWEEN THE PRB MODULE AND THE DLC FOR AN OPEN	
• Measure the resistance between the PRB module C3313B-8, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0060074 • Measure the resistance between the PRB module C3313B-7, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to R4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 • **Are the resistances less than 5 ohms?**	
R4 CHECK FOR CORRECT PRB MODULE OPERATION	

• Disconnect all the PRB module connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PRB module. REFER to Section 501-08 . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test S: The Parking Aid Module (PAM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 131 , Parking Aid for schematic and connector information.

Normal Operation

The Parking Aid Module (PAM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

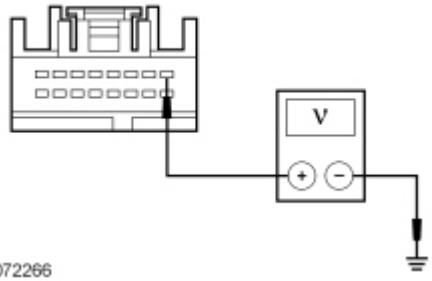
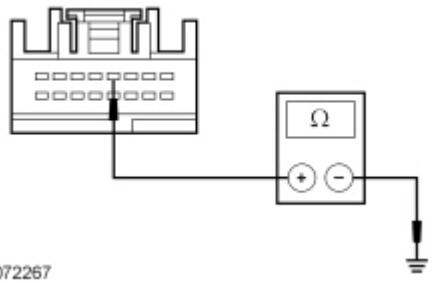
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- PAM

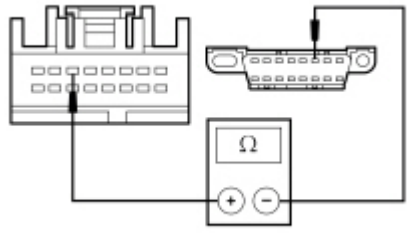
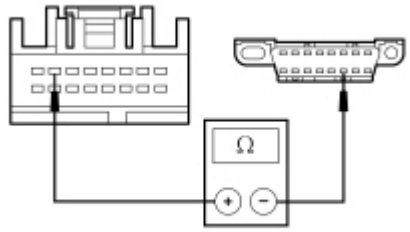
PINPOINT TEST S: THE PAM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
S1 CHECK THE PAM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PAM C2023 . • Ignition ON. • Measure the voltage between the PAM C2023-1, circuit CBP34 (VT/BN), harness side and ground.  A0072266 • **Is the voltage greater than 10 volts?**	**Yes** GO to S2 . **No** VERIFY the Body Control Module (BCM) fuse 34 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
S2 CHECK THE PAM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the PAM C2023-4, circuit GD134 (BK/VT), harness side and ground.  A0072267 • **Is the resistance less than 5 ohms?**	**Yes** GO to S3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
S3 CHECK THE HS-CAN CIRCUITS BETWEEN THE PAM AND THE DLC FOR AN OPEN	
• Measure the resistance between the PAM C2023-6, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.	**Yes** CONNECT the negative battery cable. GO to S4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 N0120214 ● Measure the resistance between the PAM C2023-7, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0120213 ● **Are the resistances less than 5 ohms?**	
S4 CHECK FOR CORRECT PAM OPERATION ● Disconnect the PAM connector. ● Check for: ■ corrosion ■ damaged pins ■ pushed-out pins ● Connect the PAM connector and make sure it seats correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new PAM. REFER to Section 413-13. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test T: The Global Positioning System Module (GPSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130, Audio System/Navigation for schematic and connector information.

Normal Operation

The Global Positioning System Module (GPSM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

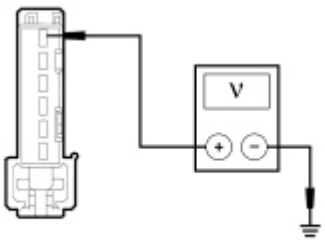
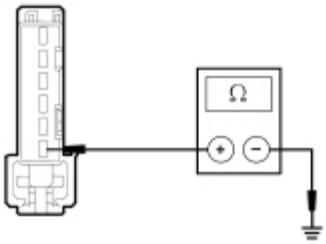
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- GPSM

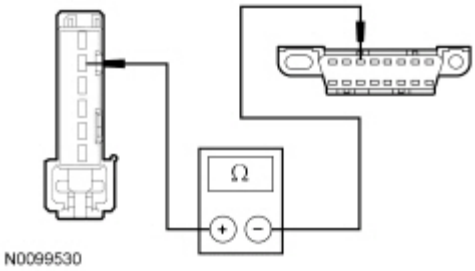
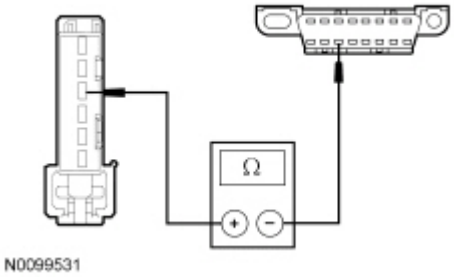
PINPOINT TEST T: THE GPSM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
T1 CHECK THE GPSM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: GPSM C2398 . • Ignition ON. • Measure the voltage between the GPSM C2398-1, circuit SBP09 (RD), harness side and ground.  N0094349 • **Is the voltage greater than 10 volts?**	**Yes** GO to T2 . **No** VERIFY the Body Control Module (BCM) fuse 9 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
T2 CHECK THE GPSM GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the GPSM C2398-6, circuit GD114 (BK/BU), harness side and ground.  N0094350 • **Is the resistance less than 5 ohms?**	**Yes** GO to T3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
T3 CHECK THE MS-CAN CIRCUITS BETWEEN THE GPSM	

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AND THE DLC FOR AN OPEN	
• Measure the resistance between the GPSM C2398-2, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0099530 • Measure the resistance between the GPSM C2398-3, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099531 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to T4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
T4 CHECK FOR CORRECT GPSM OPERATION	

• Disconnect the GPSM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the GPSM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new GPSM . Refer to the appropriate section in Group 415 for the procedure.. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test U: The Accessory Protocol Interface Module (APIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 , Audio System/Navigation for schematic and connector information.

Normal Operation

The Accessory Protocol Interface Module (APIM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN). For vehicles equipped with 4.2-inch screen and 8-inch touchscreen, the APIM communicates on the Infotainment Controller Area Network (I-CAN).

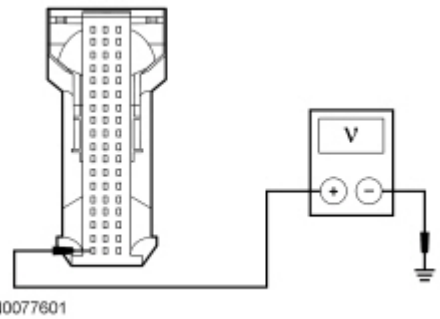
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- APIM

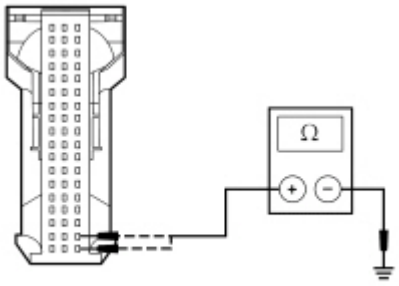
PINPOINT TEST U: THE APIM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

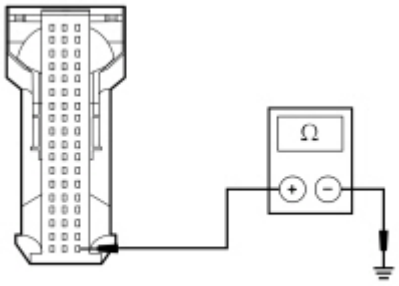
Test Step	Result / Action to Take
U1 CHECK THE APIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: APIM C2383 . • Ignition ON. • Measure the voltage between the APIM C2383-1, circuit SBP02 (YE/RD), harness side and ground.  N0077601 • **Is the voltage greater than 10 volts?**	**Yes** GO to U2 . **No** VERIFY the Body Control Module (BCM) fuse 2 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
U2 CHECK THE APIM GROUND CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • For 4.2-inch display, measure the resistance between the APIM C2383-37, circuit GD114 (BK/BU), harness side and ground; and between the APIM C2383-38, circuit GD114 (BK/BU), harness side and ground.	**Yes** CONNECT the negative battery cable. GO to U3 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool.

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N0077602

- For 8-inch display, measure the resistance between the APIM C2383-37, circuit GD114 (BK/BU), harness side and ground.

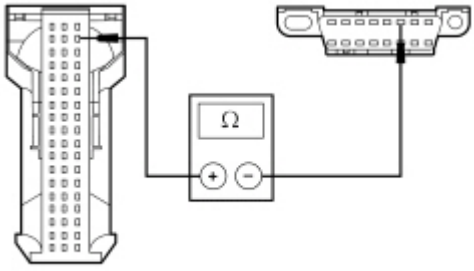


N0152486

- **Are the resistances less than 5 ohms?**

U3 CHECK THE HS-CAN CIRCUITS BETWEEN THE APIM AND THE DLC FOR AN OPEN

- Measure the resistance between the APIM C2383-53, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.

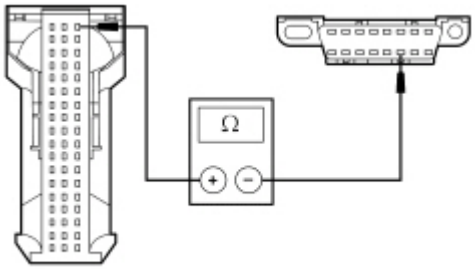


N0077603

- Measure the resistance between the APIM C2383-54, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.

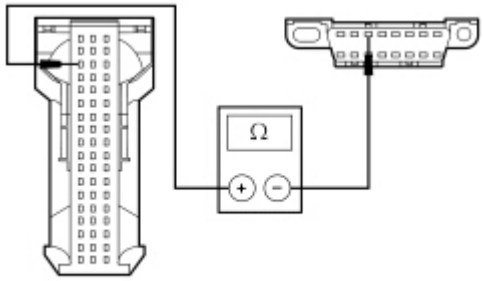
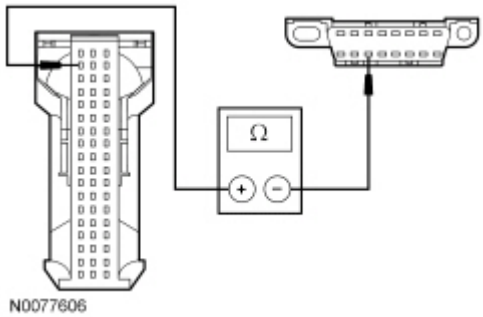
Yes
GO to U4 .

No
REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

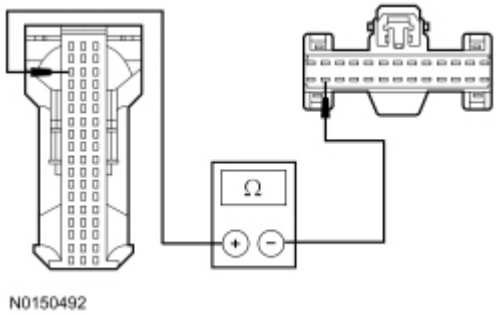
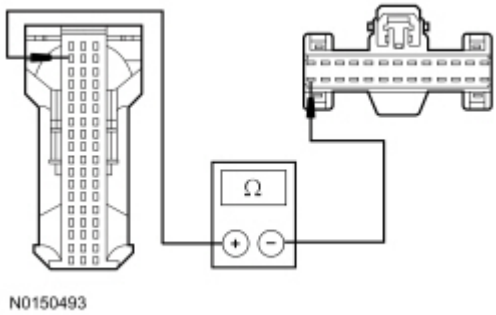
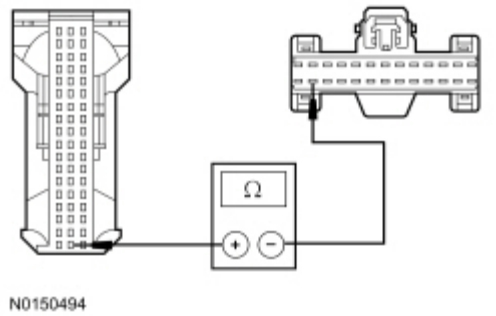


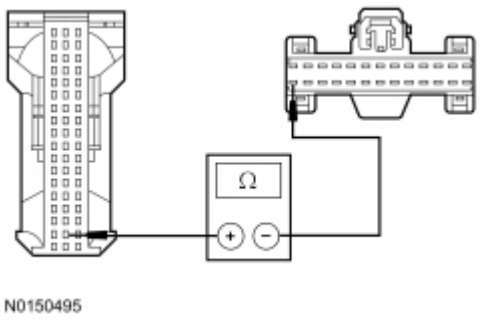
N0077604

- **Are the resistances less than 5 ohms?**

U4 CHECK THE MS-CAN CIRCUITS BETWEEN THE APIM AND THE DLC FOR AN OPEN	
NOTE: For vehicles equipped with AM/FM radio with single CD, 4.2-inch screen or 8-inch touchscreen. • Measure the resistance between the APIM C2383-16, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0077605 • Measure the resistance between the APIM C2383-17, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0077606 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. If equipped with 4.2-inch screen, GO to U5 . If equipped with 8-inch touchscreen, GO to U6 . If not equipped with 4.2-inch screen or 8-inch touchscreen, GO to U7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
U5 CHECK THE I-CAN CIRCUITS BETWEEN THE APIM AND THE IPC FOR AN OPEN	
NOTE: For vehicles equipped with 4.2-inch audio screen. • Disconnect: IPC C220 . • Measure the resistance between the APIM C2383-	**Yes** GO to U7 . **No** REPAIR the circuit in question.

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16, circuit VDB13 (BU/GY), harness side and the Instrument Panel Cluster (IPC) C220-25, circuit VDB13 (BU/GY), harness side.  N0150492 • Measure the resistance between the APIM C2383-17, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.  N0150493 • **Are the resistances less than 5 ohms?**	CONNECT the IPC and negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
U6 CHECK THE I-CAN CIRCUITS BETWEEN THE APIM AND THE IPC FOR AN OPEN **NOTE:** For vehicles equipped with 8-inch audio screen. • Disconnect: IPC C220 . • Measure the resistance between the APIM C2383-19, circuit VDB13 (BU/GY), harness side and the Instrument Panel Cluster (IPC) C220-25, circuit VDB13 (BU/GY), harness side.  N0150494 • Measure the resistance between the APIM C2383-20, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.	**Yes** GO to U7 . **No** REPAIR the circuit in question. CONNECT the IPC and negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0150495 • **Are the resistances less than 5 ohms?**	
U7 CHECK FOR CORRECT APIM OPERATION	

• Disconnect the APIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the APIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test V: The Steering Column Control Module (SCCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 44 , Horn/Cigar Lighter for schematic and connector information.

Normal Operation

The Steering Column Control Module (SCCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

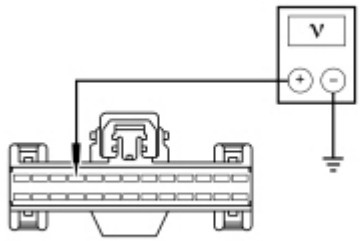
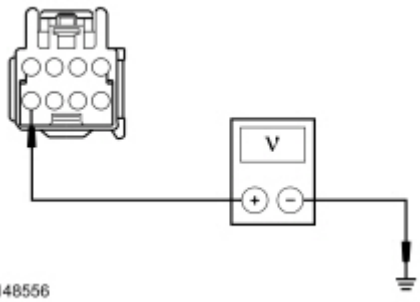
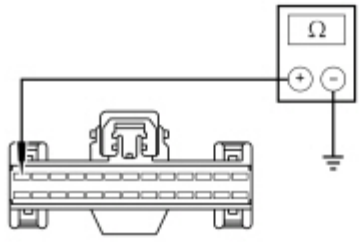
- Fuse
- Wiring, terminals or connectors
- SCCM

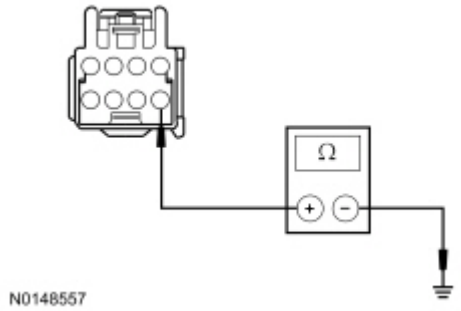
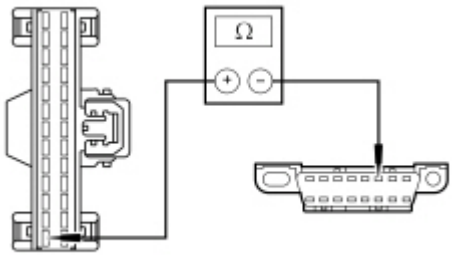
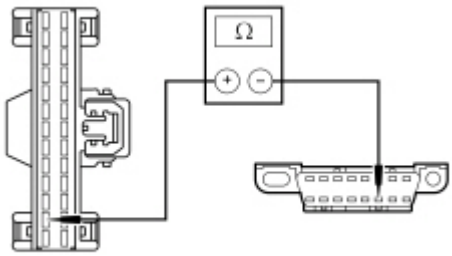
PINPOINT TEST V: THE SCCM DOES NOT RESPOND TO THE SCAN TOOL

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
V1 CHECK THE SCCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	

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• Disconnect: SCCM C2414A and C2414B . • Ignition ON. • Measure the voltage between the SCCM C2414A-10, circuit SBP23 (WH/RD), harness side and ground.  N0114048 • Measure the voltage between the SCCM C2414B-8, circuit SBP24 (VT/RD), harness side and ground.  N0148556 • **Are the voltages greater than 10 volts?**	**Yes** GO to V2 . **No** VERIFY the BJB fuse 23 (15A) or BJB fuse 24 (15A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
V2 CHECK THE SCCM GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the SCCM C2414A-13, circuit GD133 (BK), harness side and ground.  N0114050 • Measure the resistance between the SCCM C2414B-5, circuit GD138 (BK/WH), harness side and ground.	**Yes** GO to V3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0148557 • **Are the resistances less than 5 ohms?**	
V3 CHECK THE HS-CAN CIRCUITS BETWEEN THE SCCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the SCCM C2414A-14, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0114053 • Measure the resistance between the SCCM C2414A-15, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0114054 • **Are the resistances less than 5 ohms?**	**Yes** GO to V4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
V4 CHECK FOR CORRECT SCCM OPERATION	
• Disconnect all the SCCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the SCCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded

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	connector.

Pinpoint Test W: The Tire Pressure Monitor (TPM) Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 118 , Tire Pressure Monitor System for schematic and connector information.

Normal Operation

The Tire Pressure Monitor (TPM) module communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

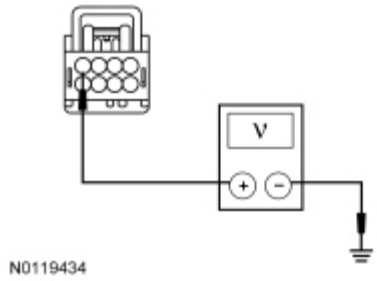
This pinpoint test is intended to diagnose the following:

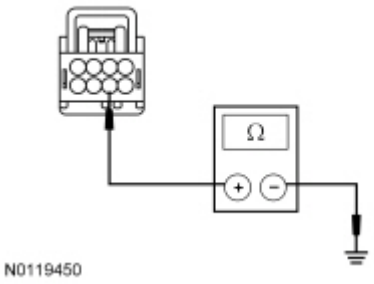
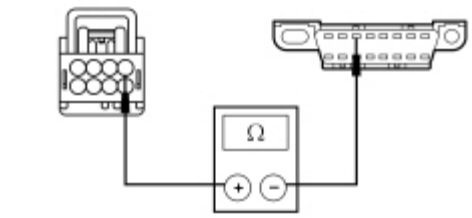
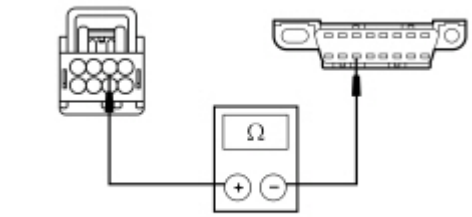
- Fuse
- Wiring, terminals or connectors
- TPM module

PINPOINT TEST W: THE TPM MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
W1 CHECK THE TPM MODULE VOLTAGE SUPPLY CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: TPM C2415 . • Ignition ON. • Measure the voltage between the TPM module C2415-4, circuit SBP26 (YE/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to W2 . **No** VERIFY the Body Control Module (BCM) fuse 26 (5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
W2 CHECK THE TPM MODULE GROUND CIRCUITS FOR	

AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the TPM module C2415-6, circuit GD133 (BK), harness side and ground.  N0119450 • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to W3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
W3 CHECK THE MS-CAN CIRCUITS BETWEEN THE TPM MODULE AND THE DLC FOR AN OPEN	
• Measure the resistance between the TPM module C2415-1, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0119451 • Measure the resistance between the TPM module C2415-2, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0119452 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to W4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
W4 CHECK FOR CORRECT TPM MODULE OPERATION	
• Disconnect the TPM module connector. • Check for: ▪ corrosion	**Yes** INSTALL a new TPM module. REFER to Section 204-04 . CLEAR the DTCs.

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▪ damaged pins ▪ pushed-out pins • Connect the TPM module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test X: No Medium Speed Controller Area Network (MS-CAN) Communication, All Modules Are Not Responding

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Normal Operation

The Medium Speed Controller Area Network (MS-CAN) uses an unshielded twisted pair cable.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Accessory Protocol Interface Module (APIM) (if equipped)
- Audio Front Control Module (ACM)
- Body Control Module (BCM)
- Driver Seat Module (DSM) (if equipped)
- Dual Climate Controlled Seat Module (DCSM) (if equipped)
- Front Controls Interface Module (FCIM) (if equipped)
- Front Display Interface Module (FDIM) (if equipped)
- Global Positioning System Module (GPSM) (if equipped)
- HVAC module
- Power Running Board (PRB) module (if equipped)
- Tire Pressure Monitor (TPM) module

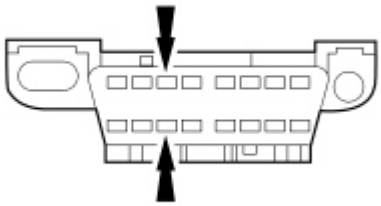
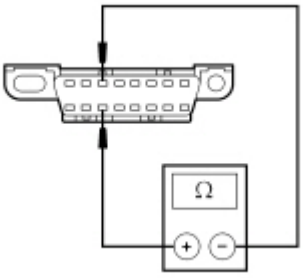
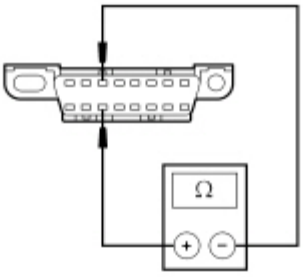
PINPOINT TEST X: NO MS-CAN COMMUNICATION, ALL MODULES ARE NOT RESPONDING

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

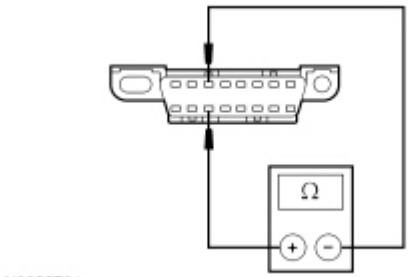
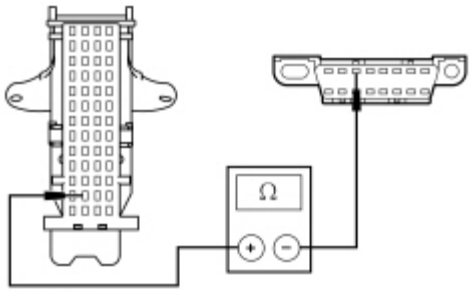
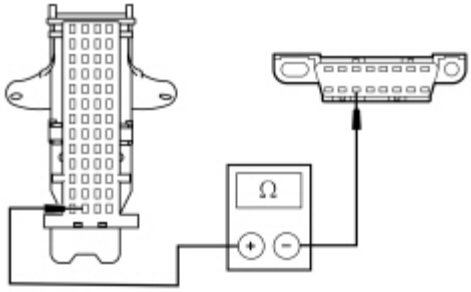
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

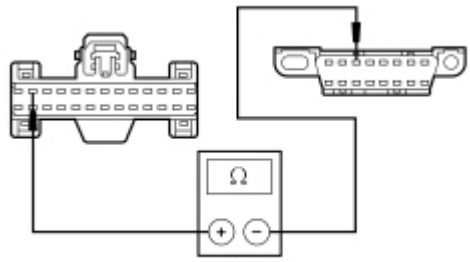
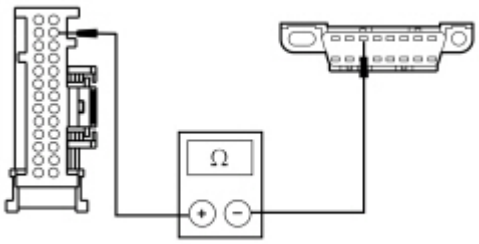
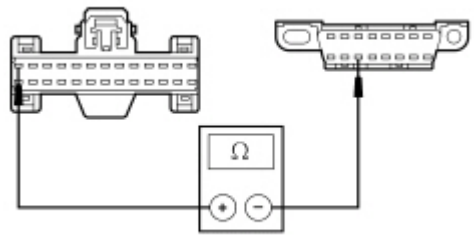
NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
X1 CHECK THE DLC PINS FOR DAMAGE	

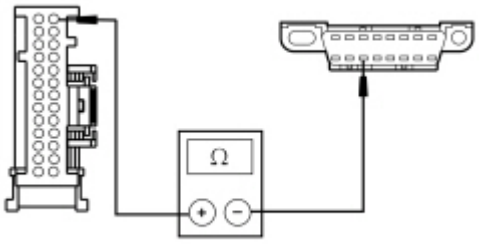
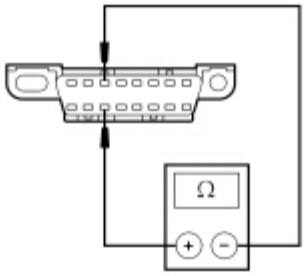
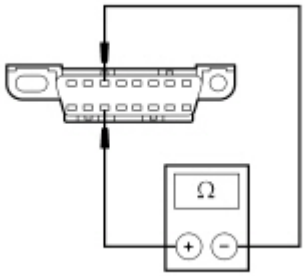
• Ignition OFF. • Disconnect the scan tool cable from the Data Link Connector (DLC). • Inspect DLC pins 3 and 11 for damage.  N0053178 • **Are DLC pins 3 and 11 OK?**	**Yes** GO to X2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
X2 CHECK THE MS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 54 and 66 ohms?**	**Yes** GO to X11 . **No** GO to X3 .
X3 CHECK THE MS-CAN TERMINATION RESISTOR	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to X4 . **No** GO to X8 .
X4 CHECK THE MS-CAN TERMINATION RESISTOR WITH THE BCM DISCONNECTED	
• Disconnect: Body Control Module (BCM) C2280B .	**Yes**

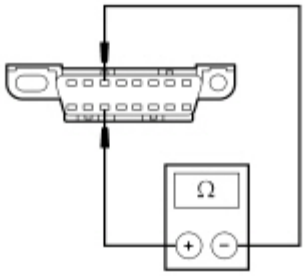
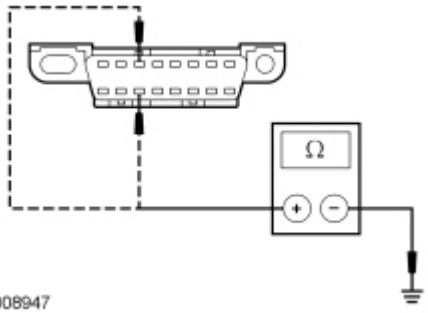
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• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 108 and 132 ohms?**	GO to X5 . **No** GO to X6 .
X5 CHECK THE MS-CAN CIRCUITS BETWEEN THE BCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the BCM C2280B-38, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0114057 • Measure the resistance between the BCM C2280B-39, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0114058 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to X29 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
X6 CHECK THE MS-CAN (+) CIRCUIT BETWEEN THE HVAC MODULE AND THE DLC FOR AN OPEN	
• For EMTC , measure the resistance between the HVAC module C294A-12, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to X7 . **No** REPAIR the circuit. CONNECT the

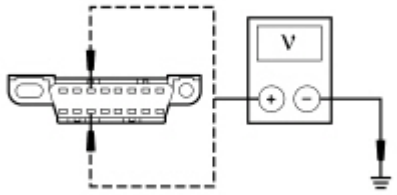
 N0104911 • For EATC , measure the resistance between the HVAC module C228A-25, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0148816 • **Is the resistance less than 5 ohms?**	negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
X7 CHECK THE MS-CAN (-) CIRCUIT BETWEEN THE HVAC MODULE AND THE DLC FOR AN OPEN • For EMTC , measure the resistance between the HVAC module C294A-13, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0104912 • For EATC , measure the resistance between the HVAC module C228A-26, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to X35 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

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 N0148817 • **Is the resistance less than 5 ohms?**	
X8 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to X10 . **No** GO to X9 .
X9 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR AN OPEN	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the DLC or the circuit in question. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** A capacitor internal to a module may still be draining causing irregular resistance readings. WAIT 5 minutes. REPEAT the pinpoint test.
X10 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH MODULES DISCONNECTED	
• While measuring the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side, disconnect the following modules one at a time until the resistance is greater than 5 ohms.	**Yes** CONNECT the negative battery cable. For the APIM , GO to X27 . For the ACM , GO to X28 . For the BCM , GO to X29 . For the DSM , GO to X30 . For the

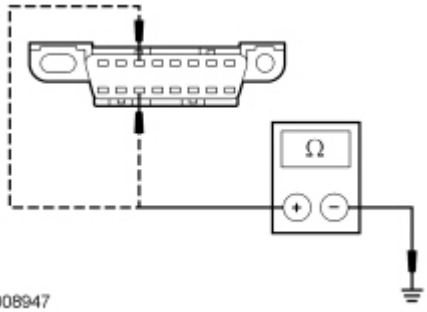
■ APIM C2383 (if equipped) ■ ACM C290B (if equipped) ■ BCM C2280B ■ DSM C341D (if equipped) ■ DCSM C3265C (if equipped) ■ FCIM C2402 (if equipped) ■ FDIM C2123 (if equipped) ■ GPSM C2398 (if equipped) ■ HVAC module C294A (EMTC) or C228A (EATC) ■ PRB module C3313B (if equipped) ■ TPM module C2415  N0050701 • **Is the resistance less than 5 ohms?**	DCSM , GO to X31 . For the FCIM , GO to X32 . For the FDIM , GO to X33 . For the GPSM , GO to X34 . For the HVAC module, GO to X35 . For the PRB module, GO to X36 . For the TPM module, GO to X37 . **No** REPAIR circuits VDB06 (GY/OG) and VDB07 (VT/OG) for being shorted together. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the Network Test with the scan tool.
X11 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.  N0008947 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to X12 . **No** GO to X13 .
X12 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** GO to X14 .

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N0050702

- **Is the voltage greater than 6 volts?**

X13 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH MODULES DISCONNECTED	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground. Check for the short to ground on both circuits after disconnecting each module. Disconnect the following modules one at a time until the resistance to ground is greater than 1,000 ohms. ▪ APIM C2383 (if equipped) ▪ ACM C290B (if equipped) ▪ BCM C2280B ▪ DSM C341D (if equipped) ▪ DCSM C3265C (if equipped) ▪ FCIM C2402 (if equipped) ▪ FDIM C2123 (if equipped) ▪ GPSM C2398 (if equipped) ▪ HVAC module C294A (EMTC) or C228A (EATC) ▪ PRB module C3313B (if equipped) ▪ TPM module C2415  N0008947 • **Is the resistance greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. For the APIM , GO to X27 . For the ACM , GO to X28 . For the BCM , GO to X29 . For the DSM , GO to X30 . For the DCSM , GO to X31 . For the FCIM , GO to X32 . For the FDIM , GO to X33 . For the GPSM , GO to X34 . For the HVAC module, GO to X35 . For the PRB module, GO to X36 . For the TPM module, GO to X37 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the Network Test with the scan tool.
X14 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE BCM DISABLED	
• Disconnect: BCM Fuse 45 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test I . **No** INSTALL the removed fuse. GO to

	X15 .
X15 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ACM DISABLED	
• Disconnect: BCM Fuse 29 (20A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test K . **No** INSTALL the removed fuse. GO to X16 .
X16 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE FCIM , FDIM AND GPSM DISABLED	
• Disconnect: BCM Fuse 9 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to X17 . **No** INSTALL the removed fuse. GO to X18 .
X17 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE FCIM , FDIM AND GPSM DISCONNECTED	
• Disconnect modules one at a time until other MS-CAN modules pass the network test. Skip to the end once network operation is restored. • Disconnect: GPSM C2398 (if equipped) . • Enter the following diagnostic mode on the scan tool: Network Test . • Disconnect: FDIM C2123 (if equipped) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • Disconnect: FCIM C2402 (if equipped) . • Enter the following diagnostic mode on the scan tool: Network Test . • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT all modules. For restored operation with the FCIM disconnected, GO to Pinpoint Test M . For restored operation with the FDIM disconnected, GO to Pinpoint Test N . For restored operation with the GPSM disconnected, GO to Pinpoint Test T . **No** CONNECT all modules. The MS-CAN tests within specification. VERIFY the correct operation of the scan tool on a known good vehicle.
X18 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE HVAC MODULE DISABLED	
• Disconnect: BCM Fuse 46 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test J . **No** INSTALL the removed fuse. If the vehicle is equipped with an Accessory Protocol Interface Module (APIM), GO to X19 .

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	If the vehicle is not equipped with an APIM , GO to X20 .
X19 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE APIM DISABLED • Disconnect: BCM Fuse 2 (15A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test U . **No** INSTALL the removed fuse. GO to X20 .
X20 VERIFY VEHICLE EQUIPMENT — PRB MODULE • Verify whether the vehicle is equipped with a Power Running Board (PRB) module. • **Is the vehicle equipped with a PRB module?**	**Yes** GO to X21 . **No** GO to X22 .
X21 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE PRB MODULE DISABLED • Disconnect: Battery Junction Box (BJB) Fuse 11 (30A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test R . **No** INSTALL the removed fuse. GO to X22 .
X22 VERIFY VEHICLE EQUIPMENT — DSM • Verify whether the vehicle is equipped with a Driver Seat Module (DSM). • **Is the vehicle equipped with a DSM ?**	**Yes** GO to X23 . **No** GO to X24 .
X23 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE DSM DISABLED • Disconnect: BCM Fuse 74 (30A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test P . **No** INSTALL the removed fuse. GO to X24 .
X24 VERIFY VEHICLE EQUIPMENT — DCSM • Verify whether the vehicle is equipped with a Dual Climate Controlled Seat Module (DCSM). • **Is the vehicle equipped with a DCSM ?**	**Yes** GO to X25 . **No** GO to X26 .
X25 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE DCSM DISABLED • Disconnect: BJB Fuse 69 (30A) . • Enter the following diagnostic mode on the scan tool: Network Test .	**Yes** INSTALL the removed fuse. GO to Pinpoint Test Q .

• Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**No** GO to X26 .
X26 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE TPM MODULE DISABLED	
• Disconnect: BCM Fuse 26 (5A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test W . **No** INSTALL the removed fuse. The MS-CAN tests within specification. VERIFY the correct operation of the scan tool on a known good vehicle.
X27 CHECK FOR CORRECT APIM OPERATION	

• Disconnect the APIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the APIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

X28 CHECK FOR CORRECT ACM OPERATION	

• Disconnect all the ACM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the ACM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ACM . Refer to the appropriate section in Group 415 for the procedure.. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

X29 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

X30 CHECK FOR CORRECT DSM OPERATION	
• Disconnect all the DSM connectors. • Check for:	**Yes** INSTALL a new DSM . REFER to

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▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	Section 501-10 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
X31 CHECK FOR CORRECT DCSM OPERATION	
• Disconnect all the DCSM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the DCSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DCSM . REFER to Section 501-10 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
X32 CHECK FOR CORRECT FCIM OPERATION	
• Disconnect the FCIM connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the FCIM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure.. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
X33 CHECK FOR CORRECT FDIM OPERATION	
• Disconnect the FDIM connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the FDIM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FDIM . Refer to the appropriate section in Group 415 for the procedure.. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
X34 CHECK FOR CORRECT GPSM OPERATION	
• Disconnect the GPSM connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the GPSM connector and make sure it seats correctly. • Operate the system and verify the concern is still	**Yes** INSTALL a new GPSM . Refer to the appropriate section in Group 415 for the procedure.. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No**

present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
X35 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Disconnect all the HVAC module connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the HVAC module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new HVAC module. REFER to Section 412-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

X36 CHECK FOR CORRECT PRB MODULE OPERATION	

• Disconnect all the PRB module connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PRB module. REFER to Section 501-08 . CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.

X37 CHECK FOR CORRECT TPM MODULE OPERATION	

• Disconnect the TPM module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the TPM module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TPM module. REFER to Section 204-04 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Pinpoint Test Y: No High Speed Controller Area Network (HS-CAN) Communication, All Modules Are Not Responding

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Normal Operation

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The High Speed Controller Area Network (HS-CAN) uses an unshielded twisted pair cable.

This pinpoint test is intended to diagnose the following:

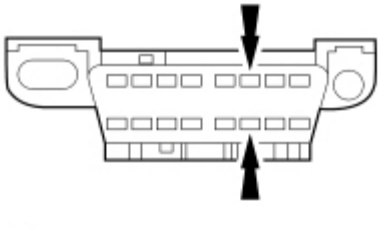
- Wiring, terminals or connectors
- TCCM (if equipped)
- ABS module
- Accessory Protocol Interface Module (APIM) (if equipped)
- Body Control Module (BCM)
- Instrument Panel Cluster (IPC)
- Occupant Classification System Module (OCSM)
- Parking Aid Module (PAM) (if equipped)
- PCM
- Power Steering Control Module (PSCM) (if equipped)
- Restraints Control Module (RCM)
- Steering Column Control Module (SCCM)
- Trailer Brake Control (TBC) module (if equipped)

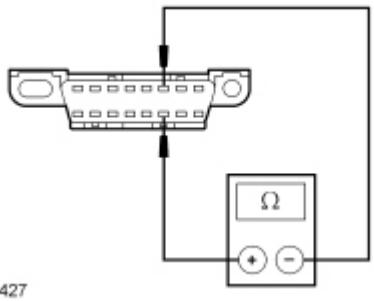
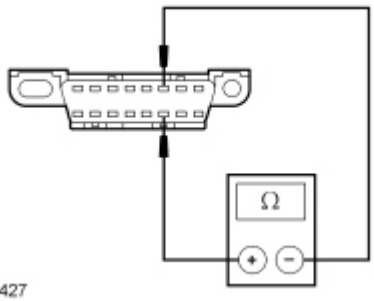
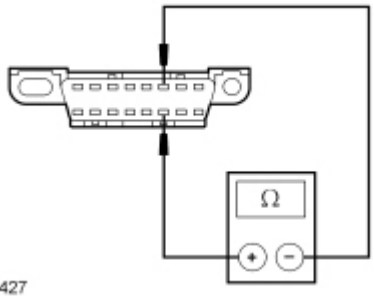
PINPOINT TEST Y: NO HS-CAN COMMUNICATION, ALL MODULES ARE NOT RESPONDING

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

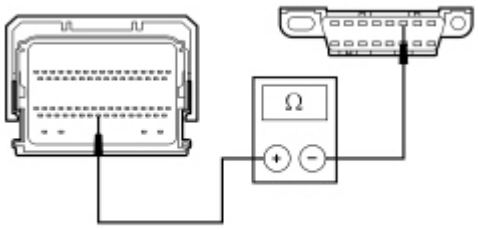
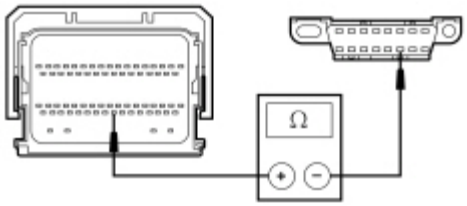
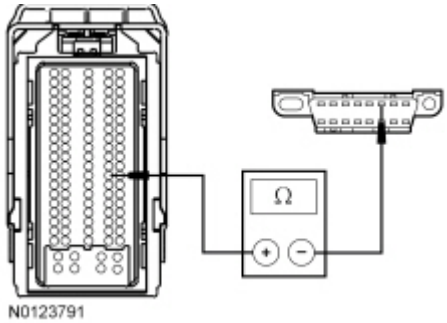
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

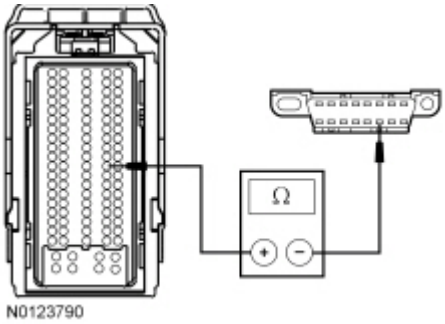
NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
Y1 CHECK THE DLC PINS FOR DAMAGE	
• Ignition OFF. • Disconnect the scan tool cable from the Data Link Connector (DLC). • Inspect the DLC pins 6 and 14 for damage.  A0093867 • **Are DLC pins 6 and 14 OK?**	**Yes** GO to Y2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
Y2 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Ignition OFF.	**Yes**

• Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance between 54 and 66 ohms?**	GO to Y11 . **No** GO to Y3 .
Y3 CHECK THE HS-CAN TERMINATION RESISTOR	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to Y4 . **No** GO to Y8 .
Y4 CHECK THE HS-CAN TERMINATION RESISTOR WITH THE PCM DISCONNECTED	
• Disconnect: PCM C175B (3.7L), C1551B (3.5L), or C1381B (5.0L and 6.2L) . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance between 108 and 132 ohms?**	**Yes** For 3.7L, 5.0L or 6.2L, GO to Y5 . For 3.5L, GO to Y6 . **No** GO to Y7 .
Y5 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the PCM C175B-59	**Yes**

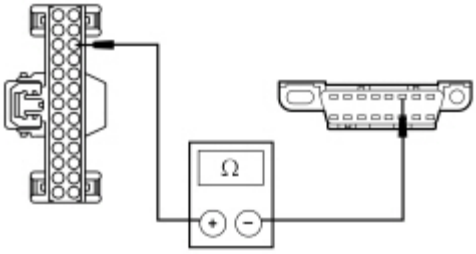
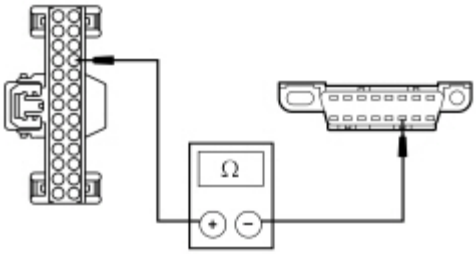
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(3.7L) or C1381B-59 (5.0L and 6.2L), circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0077607 • Measure the resistance between the PCM C175B-58 (3.7L) or C1381B-58 (5.0L and 6.2L), circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0113941 • **Are the resistances less than 5 ohms?**	CONNECT the negative battery cable. GO to Y34 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
Y6 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN • Measure the resistance between the PCM C1551B-69, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0123791 • Measure the resistance between the PCM C1551B-68, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to Y34 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

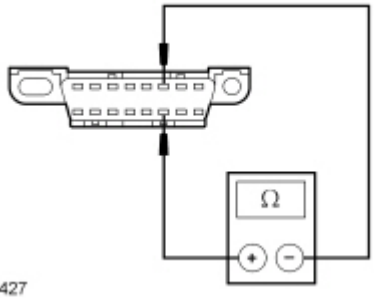
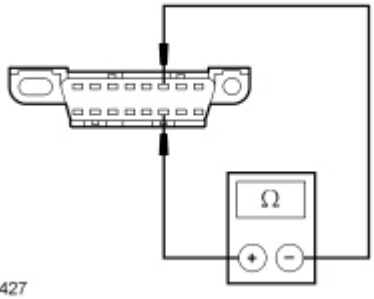


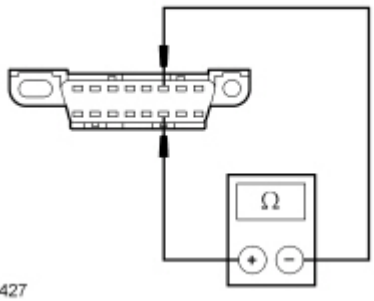
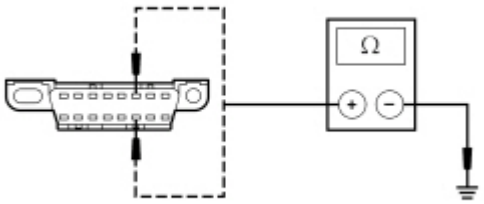
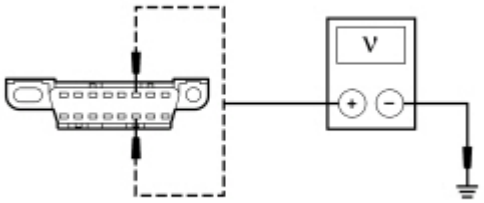
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- **Are the resistances less than 5 ohms?**

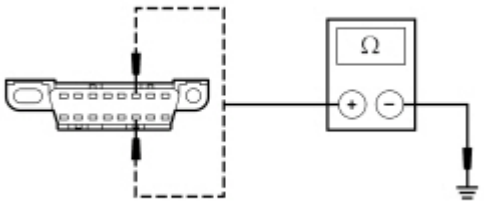
Y7 CHECK THE HS-CAN CIRCUITS BETWEEN THE DLC AND THE BCM FOR AN OPEN	
• Disconnect: BCM C2280F . • Measure the resistance between the BCM C2280F-16, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB06 (WH), harness side.  N0115338 • Measure the resistance between the BCM C2280F-17, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0115339 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to Y29 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
Y8 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** GO to Y10 . **No** GO to Y9 .

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 N0026427 • **Is the resistance less than 5 ohms?**	
Y9 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR AN OPEN	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the DLC or the circuit in question. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** A capacitor internal to a module may still be draining, causing irregular resistance readings. WAIT 5 minutes. REPEAT the pinpoint test.
Y10 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER	
• While measuring the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side, disconnect the following modules one at a time until the resistance is greater than 5 ohms. ▪ TCCM C2371A (if equipped) ▪ APIM C2383 (if equipped) ▪ ABS module C135 ▪ BCM C2280F ▪ IPC C220 ▪ OCSM C3159 ▪ PAM C2023 (if equipped) ▪ PSCM C1463B (if equipped) ▪ PCM C175B, C1381B or C1551B ▪ RCM C310B ▪ SCCM C2414A ▪ TBC module C2142 (if equipped)	**Yes** CONNECT the negative battery cable. For the TCCM, GO to Y26. For the APIM, GO to Y27. For the ABS module, GO to Y28. For the BCM, GO to Y29. For the IPC, GO to Y30. For the OCSM, GO to Y31. For the PAM, GO to Y32. For the PSCM, GO to Y33. For the PCM, GO to Y34. For the RCM, GO to Y35. For the SCCM, GO to Y36. For the TBC module, GO to Y37. **No** REPAIR circuits VDB04 (WH/BU) and VDB05 (WH) for being shorted together. CLEAR the DTCs. REPEAT the Network Test with the scan tool.

 N0026427 • **Is the resistance less than 5 ohms?**	
Y11 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to Y12 . **No** GO to Y13 .
Y12 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002964 • **Are the voltages greater than 6 volts?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** GO to Y14 .
Y13 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE MODULES DISCONNECTED	
• While measuring the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit	**Yes** CONNECT the negative battery cable. For the TCCM , GO to Y26 . For the

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VDB05 (WH), harness side and ground, check for the short to ground on both circuits after disconnecting each module. Disconnect the following modules one at a time until the resistance to ground is greater than 10,000 ohms. ■ TCCM C2371A (if equipped) ■ APIM C2383 (if equipped) ■ ABS module C135 ■ BCM C2280F ■ IPC C220 ■ OCSM C3159 ■ PAM C2023 (if equipped) ■ PSCM C1463B (if equipped) ■ PCM C175B, C1381B or C1551B ■ RCM C310B ■ SCCM C2414A ■ TBC module C2142 (if equipped)  N0002963 • **Are the resistances greater than 1,000 ohms?**	APIM, GO to Y27. For the ABS module, GO to Y28. For the BCM, GO to Y29. For the IPC, GO to Y30. For the OCSM, GO to Y31. For the PAM, GO to Y32. For the PSCM, GO to Y33. For the PCM, GO to Y34. For the RCM, GO to Y35. For the SCCM, GO to Y36. For the TBC module, GO to Y37. **No** REPAIR the circuit in question. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the Network Test with the scan tool.
Y14 CHECK FOR RESTORED COMMUNICATION WITH THE PCM DISABLED	
• Disconnect: Battery Junction Box (BJB) Fuses 26 (10A) and 75 (15A) (25A for 3.5L engine). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test A. **No** GO to Y15.
Y15 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE PSCM DISABLED	
• Disconnect: High Current Battery Junction Box (BJB) fuse 1 (125A) and Battery Junction Box (BJB) Fuse 52 (5A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test H. **No** GO to Y16.
Y16 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ABS MODULE AND TCCM DISABLED	
• Disconnect: BJB Fuses 20 (20A)(ESOF only), 36 (30A), 47 (60A), 54 (5A) and 68 (25A). • Enter the following diagnostic mode on the scan tool:	**Yes** INSTALL the removed fuses. GO to Y17.

Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**No** INSTALL the removed fuses. If the vehicle is equipped with a TCCM , GO to Y17 . If the vehicle is not equipped with a TCCM , GO to Y18 .
Y17 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE TCCM DISCONNECTED	
• Disconnect: TCCM . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test F . **No** INSTALL the removed fuses. GO to Pinpoint Test B .
Y18 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE RCM AND OCSM DISABLED	
• Disconnect: Body Control Module (BCM) Fuse 36 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Y19 . **No** INSTALL the removed fuse. If the vehicle is equipped with a PAM , GO to Y20 . If the vehicle is not equipped with a PAM , GO to Y21 .
Y19 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE RCM AND OCSM DISCONNECTED	
• Disconnect: RCM C310B . • Enter the following diagnostic mode on the scan tool: Network Test . • Disconnect: OCSM C3159 . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** CONNECT all modules. For restored operation with the RCM disconnected, GO to Pinpoint Test D . For restored operation with the OCSM disconnected, GO to Pinpoint Test E . **No** CONNECT all modules. The HS-CAN tests within specification. VERIFY the correct operation of the scan tool on a known good vehicle.
Y20 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE PAM DISABLED	
• Disconnect: Body Control Module (BCM) Fuse 34 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test S . **No** GO to Y21 .
Y21 CHECK FOR RESTORED NETWORK	

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COMMUNICATION WITH THE SCCM DISABLED	
• Disconnect: BJB Fuses 23 (15A) and 24 (15A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test V . **No** INSTALL the removed fuse. If the vehicle is equipped with an Accessory Protocol Interface Module (APIM), GO to Y22 . If the vehicle is not equipped with an APIM , GO to Y23 .
Y22 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE APIM DISABLED	
• Disconnect: BCM Fuse 2 (15A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test U . **No** INSTALL the removed fuse. GO to Y23 .
Y23 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE BCM DISABLED	
• Disconnect: BJB Fuse 45 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test I . **No** INSTALL the removed fuse. If the vehicle is equipped with an Trailer Brake Control (TBC), GO to Y24 . If the vehicle is not equipped with a TBC , GO to Y25 .
Y24 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE TBC MODULE DISABLED	
• Disconnect: BCM Fuse 37 (10A), BJB Fuse 17 (30A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test G . **No** INSTALL the removed fuses. GO to Y25 .
Y25 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE IPC DISABLED	
• Disconnect: BCM Fuse 11 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test C . **No** INSTALL the removed fuse. The HS-CAN tests within specification. VERIFY the correct operation of the

	scan tool on a known good vehicle.
Y26 CHECK FOR CORRECT TCCM OPERATION	

• Disconnect all the TCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the TCCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TCCM. REFER to Section 308-07A. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Y27 CHECK FOR CORRECT APIM OPERATION	

• Disconnect the APIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the APIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Y28 CHECK FOR CORRECT ABS MODULE OPERATION	

• Disconnect the ABS module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the ABS module connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new ABS module. REFER to Section 206-09. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Y29 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Y30 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ▪ corrosion	**Yes** INSTALL a new IPC. REFER to Section 413-01. CONNECT all modules.

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▪ damaged pins ▪ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Y31 CHECK FOR CORRECT OCSM OPERATION	
• Disconnect the OCSM connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the OCSM connector and make sure it seats correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new OCSM . REFER to Section 501-20B . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Y32 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Section 413-13 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Y33 CHECK FOR CORRECT PSCM OPERATION	
• Disconnect all the PSCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the PSCM connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new EPAS steering gear. REFER to Section 211-02 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Y34 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present.	**Yes** INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been

• **Is the concern still present?**	caused by a loose or corroded connector.
Y35 CHECK FOR CORRECT RCM OPERATION	

• Disconnect all the RCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the RCM connectors and make sure they seat correctly.
• Verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new RCM. REFER to Section 501-20B. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Y36 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM. REFER to Section 211-05. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Y37 CHECK FOR CORRECT TBC MODULE OPERATION	

• Disconnect the TBC module connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the TBC module connector and make sure it seats correctly.
• Verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TBC module. REFER to Section 206-10. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Pinpoint Test Z: No Infotainment Controller Area Network (I-CAN) Communication, All Modules Are Not Responding

Refer to Wiring Diagrams Cell 14, Module Communications Network for schematic and connector information.

Normal Operation

The Infotainment Controller Area Network (I-CAN) uses an unshielded twisted pair cable.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

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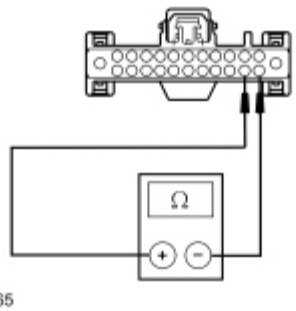
- Accessory Protocol Interface Module (APIM) (if equipped)
- Audio Front Control Module (ACM)
- Audio DSP module (if equipped)
- Front Controls Interface Module (FCIM) (if equipped)
- Front Control/Display Interface Module (FCDIM) (if equipped)
- Instrument Panel Cluster (IPC)

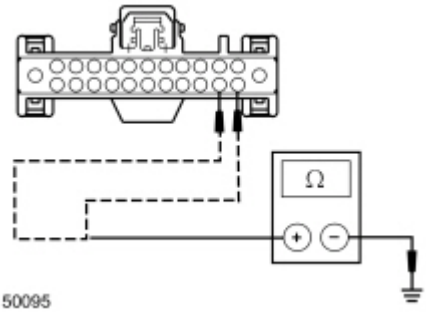
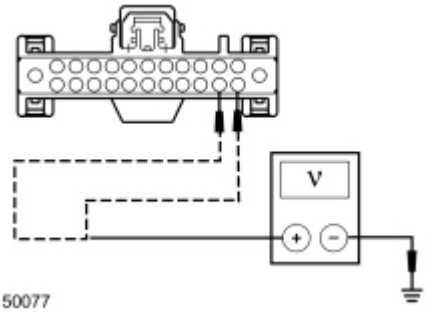
PINPOINT TEST Z: NO I-CAN COMMUNICATION, ALL MODULES ARE NOT RESPONDING

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

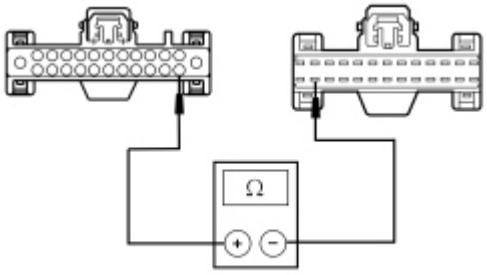
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
Z1 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ACM DISCONNECTED	
NOTE: When re-running the network test, close the network test application first or the screen display reverts back to the previously run network test results. • Disconnect: ACM C240A . • Using a scan tool, perform a network test. • **Do all other I-CAN modules pass the network test?**	**Yes** GO to Z10 . **No** GO to Z2 .
Z2 CHECK THE I-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the ACM C240A-14, circuit VDB13 (BU/GY), harness side and the ACM C240A-15, circuit VDB14 (VT/GY), harness side.  N0150065 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to Z3 . **No** GO to Z6 .
Z3 CHECK THE I-CAN (+) AND I-CAN (-) CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the ACM C240A-14,	**Yes** GO to Z4 .

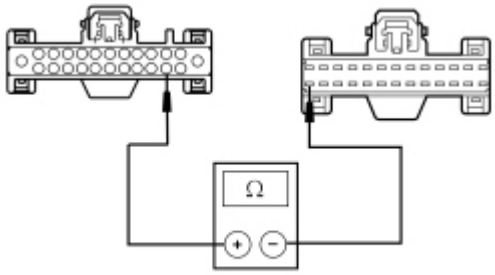
circuit VDB13 (BU/GY), harness side and ground; and between the ACM C240A-15, circuit VDB14 (VT/GY), harness side and ground.  N0150095 • **Are the resistances greater than 1,000 ohms?**	**No** REPAIR the circuit in question.
Z4 CHECK THE I-CAN (+) AND I-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Connect: negative battery cable . • Ignition ON. • Measure the voltage between the ACM C240A-14, circuit VDB13 (BU/GY), harness side and ground; and between the ACM C240A-15, circuit VDB14 (VT/GY), harness side and ground.  N0150077 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. **No** GO to Z5 .
Z5 CHECK FOR RESTORED NETWORK COMMUNICATION	
NOTE: When re-running the network test, close the network test application first or the screen display reverts back to the previously run network test results. • Ignition OFF. • Connect all module(s). Make sure all connectors seat and latch correctly. • Ignition ON. • Using a scan tool, perform the network test. • **Do all other I-CAN modules pass the network test?**	**Yes** The I-CAN tests within specification. VERIFY the correct operation of the scan tool on a known good vehicle. **No** GO to Z14 .
Z6 CHECK THE I-CAN CIRCUITS BETWEEN THE ACM AND THE IPC FOR AN OPEN	
• Disconnect: IPC C220 . • Measure the resistance between the ACM C240A-14, circuit VDB13 (BU/GY), harness side and the IPC C220-25, circuit VDB13 (BU/GY), harness side.	**Yes** CONNECT the negative battery cable. GO to Z7 . **No** REPAIR the circuit in question.

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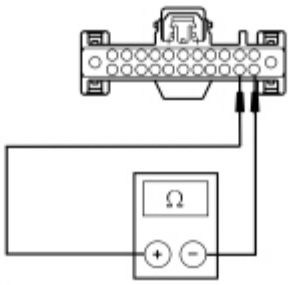
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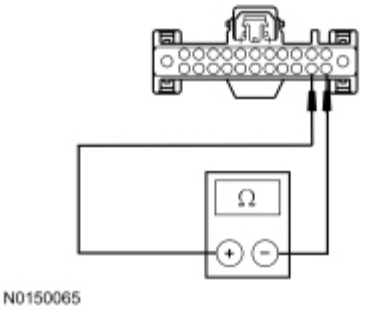
- Measure the resistance between the ACM C240A-15, circuit VDB14 (VT/GY), harness side and the IPC C220-26, circuit VDB14 (VT/GY), harness side.



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- **Are the resistances less than 5 ohms?**

Z7 CHECK THE I-CAN (+) AND I-CAN (-) CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between the ACM C240A-14, circuit VDB13 (BU/GY), harness side and the ACM C240A-15, circuit VDB14 (VT/GY), harness side.  N0150065 • **Is the resistance greater than 1,000 ohms?**	**Yes** GO to Z8 . **No** REPAIR the circuit in question.
Z8 CHECK THE I-CAN (+) AND I-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH MODULES DISCONNECTED	
NOTE: Skip to the end of this test once the suspect module(s) has been identified. • Disconnect: negative battery cable . • While measuring the resistance between the ACM C290A-14, circuit VDB13 (BU/GY), harness side and the ACM C290A-15, circuit VDB14 (VT/GY), harness side, disconnect the following modules one at a time until the resistance is greater than 5 ohms. ▪ APIM C2298 (if equipped)	**Yes** CONNECT the negative battery cable. For the APIM , GO to Z9 . For the audio DSP module, GO to Z11 . For the FCIM , GO to Z12 . For the FCDIM , GO to Z13 . For the IPC , GO to Z14 . **No** REPAIR circuits in question for a short

■ Audio DSP module C3154 (if equipped) ■ FCIM C2402 (if equipped) ■ FCDIM C2123 (if equipped) ■ IPC C220  N0150065 • **Did the resistance change to between 108 and 132 ohms with one of the modules disconnected?**	together. CONNECT the modules. CONNECT the negative battery cable. CLEAR the DTCs.
Z9 CHECK FOR CORRECT APIM OPERATION • Disconnect the APIM connector. • Check for: ■ corrosion ■ damaged pins ■ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Z10 CHECK FOR CORRECT ACM OPERATION • Disconnect all the ACM connectors. • Check for: ■ corrosion ■ damaged pins ■ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . Refer to the appropriate section in Group 415 for the procedure. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Z11 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION • Disconnect the audio DSP module connector. • Check for: ■ corrosion ■ damaged pins ■ pushed-out pins • Connect the audio DSP module connector and make sure it seats correctly. • Operate the system and verify the concern is still present.	**Yes** INSTALL a new audio DSP module. REFER to Section 415-00E . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at

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• **Is the concern still present?**	this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.
Z12 CHECK FOR CORRECT FCIM OPERATION	

• Disconnect the FCIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the FCIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Z13 CHECK FOR CORRECT FCDIM OPERATION	

• Disconnect the FCDIM connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the FCDIM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new FCDIM . REFER to Section 415-00C . CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Z14 CHECK FOR CORRECT IPC OPERATION	

• Disconnect the IPC connector.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the IPC connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new IPC . REFER to Section 413-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules.

Pinpoint Test AA: No Power To The Scan Tool

Refer to Wiring Diagrams Cell 14 , Module Communications Network for schematic and connector information.

Normal Operation

The scan tool is connected to the Data Link Connector (DLC) to communicate with the High Speed Controller Area Network (HS-CAN), Medium Speed Controller Area Network (MS-CAN) and Infotainment Controller Area Network (I-CAN) communications networks.

A loss of ground or poor ground at the DLC may result in HS-CAN , MS-CAN or I-CAN faults while the scan tool is connected.

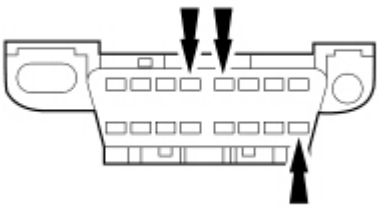
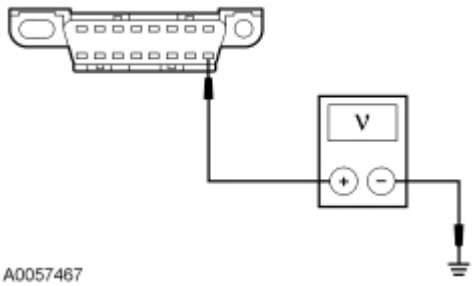
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Scan tool
- DLC

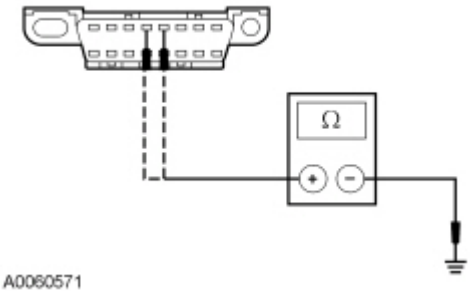
PINPOINT TEST AA: NO POWER TO THE SCAN TOOL

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AA1 CHECK THE DLC PINS FOR DAMAGE	
• Disconnect the scan tool cable from the DLC . • Inspect the DLC pins 4, 5 and 16 for damage.  N0050767 • **Are DLC pins 4, 5 and 16 OK?**	**Yes** GO to AA2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
AA2 CHECK THE DLC VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Measure the voltage between the DLC C251-16, circuit SBP24 (VT/RD), harness side and ground.  A0057467 • **Is the voltage greater than 10 volts?**	**Yes** GO to AA3 . **No** VERIFY the Body Control Module (BCM) fuse 24 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPEAT the network test with the scan tool.
AA3 CHECK THE DLC GROUND CIRCUITS FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-4, circuit	**Yes** REPAIR the scan tool. CONNECT

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GD133 (BK), harness side and ground; and between the DLC C251-5, circuit GD133 (BK), harness side and ground.  A0060571 • **Are the resistances less than 5 ohms?**	the negative battery cable. REPEAT the network test with the scan tool. **No** REPAIR the circuit in question. CONNECT the negative battery cable. REPEAT the network test with the scan tool.

Module Configuration

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Configurable modules accommodate a variety of vehicle options, eliminating the need for many unique modules for one vehicle line. These modules must be configured when replaced as part of a repair procedure. Configurable modules should not be exchanged between vehicles since the settings are unique to each vehicle. Failure to configure a new module can result in improper operation and/or DTCs setting.

The following are the 3 different methods of configuration:

- Programmable Module Installation (PMI)
- Module reprogramming ("flashing")
- Programmable parameters

Some modules do not support all 3 methods.

Definition of Terms

The following are definitions of configuration terms:

Programmable Module Installation (PMI)

PMI is a scan tool process which configures settings in a new module. Data used for the PMI process is automatically downloaded from the original module and stored when a scan tool session is started. If this data cannot be retrieved from the module being replaced, the scan tool may prompt for As-Built data entry or display a list of parameter values that need to be manually selected. Some modules are reprogrammed during PMI when a strategy/calibration update is available. To carry out PMI , refer to Programmable Module Installation (PMI) in this section.

NOTE: It is important that the scan tool identifies the vehicle and obtains configuration data prior to removing any modules. The new module must be able to communicate with the scan tool in order to carry out PMI .

Module Reprogramming

Module reprogramming (also referred to as "flashing") is a scan tool process which updates the strategy/calibration in a module. Reprogramming a module with the same level of software does not improve module operation or repair a hardware failure. Module reprogramming is automatically carried out during

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PMI when a later strategy/calibration is available.

NOTE: Limit module reprogramming to circumstances where a published TSB procedure recommends doing so.

NOTE: A module cannot communicate with other modules on the communication network while being reprogrammed. After the reprogramming process, clear any network communication DTCs which may have been set in other modules.

NOTE: Some modules are reprogrammed in coordination with other modules. Follow the Integrated Diagnostic System (IDS) key cycling instructions carefully to avoid reprogramming errors, including failure of programming one or more of the coordinated modules.

Accessory Protocol Interface Module (APIM) Programming

APIM programming is a process that updates the APIM Consumer Interface Processor (CIP) and Vehicle Interface Processor (VIP) software. The VIP programming updates the calibration files in the portion of the APIM that interfaces with the Controller Area Network (CAN). The CIP programming updates calibration files in the portion of the APIM that interfaces with mobile phones and other customer devices.

APIM programming uses the VCM to read and program the VIP software through the Data Link Connector (DLC). A web-based On-Line Automotive Service Information System (OASIS) application reads and programs the CIP software via a Universal Serial Bus (USB) cable between the scan tool and vehicle USB port. Both the VCM and the Universal Serial Bus (USB) cable must remain connected, and OASIS application must be running on the scan tool during APIM programming. Carry out APIM programming. Refer to the appropriate section in Group 415 for the procedure.

Programmable Parameters

Programmable parameters are customer preference items that may be modified by the dealer via the scan tool, or in some cases, by the customer following a procedure listed in the vehicle Owner's Literature. While many configuration options may exist for a module, only a few of these options are programmable parameters.

Adaptive Learning and Calibration

Some modules require a separate learning procedure be carried out if replaced as part of a repair procedure. For adaptive learning and calibration instructions, refer to the specific module removal and installation procedures.

Vehicle Identification (VID) Block

Some PCMs contain a memory area called a Vehicle Identification (VID) block. The PCM VID block commonly stores powertrain configuration items such as Vehicle Identification Number (VIN), tire size, axle ratio, and whether or not the vehicle is equipped with speed control.

Module Address

A unique module address is assigned to each module on the network for identification.

As-Built Data

As-Built data is a VIN -specific module configuration record. During vehicle build, the configuration from all modules is downloaded and stored in the As-Built database. As-Built data does not reflect customer preference items that have been changed from the default state. These items need to be changed using programmable parameters after the module is configured.

NOTE: It is not necessary to obtain As-Built data unless directed to do so by the scan tool. This data may be accessed from the technician service publication web site.

Module Configuration and Parameter Chart

Module	Requires PMI	Reprogram/ Flash Capable	Requires Adaptive Learning or Calibration	Available Programmable Parameters
ABS module	Yes	Yes	• Stability control initialization	• Hill start assist enabled
Accessory Protocol Interface Module (APIM)	Yes	Yes	No	• Stereo in pass-through
Audio Front Control Module (ACM)	Yes	Yes	No	None
Audio Digital Signal Processing (DSP) module	Yes	Yes	No	None
Body Control Module (BCM)	Yes	Yes	No	• Axle ratio • Autolamps delay time • Front turn lamp outage configuration • Fog lamps present • Cruise control • Police dark car feature • Police rear door enable/disable • Smart unlocking • Rear turn lamp outage configuration • Tire placard pressure • Tire size • Daytime running lamps
Driver Seat Module (DSM)	Yes	Yes	No	None
Dual Climate Controlled Seat Module (DCSM)	Yes	Yes	No	None
Front Controls Interface Module (FCIM)	No	Yes	No	None
Front Control/Display Interface Module (FCDIM)	Yes	Yes	No	None
Front Display Interface Module (FDIM) (without navigation)	Yes	Yes	No	None
Global Positioning	No	Yes	No	None

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System Module (GPSM)				
HVAC module — DATC	Yes	Yes	No	None
HVAC module — EMTC	Yes	Yes	No	None
Instrument Panel Cluster (IPC)	Yes	Yes	No	• Trailer Brake Control (TBC) gain • Trailer sway • Fuel tank selection (3.5L only) • Fuel capacity
OCSM	No	Yes	• Seat weight sensor re-zero	None
Parking Aid Module (PAM)	No	Yes	No	None
Power Steering Control Module (PSCM)	Yes	Yes	No	None
PCM	Yes	Yes	• Adaptive airflow • Idle speed • Refueling event • Fuel trim	• Speed control
Power Running Board (PRB) module	No	Yes	No	None
Restraints Control Module (RCM)	Yes	Yes	• Seat weight sensor re-zero • Stability control initialization	• Driver seat Belt-Minder® activation
Steering Column Control Module (SCCM)	Yes	Yes	No	None
Trailer Brake Control (TBC) module	No	No	No	None
Transfer Case Control Module (TCCM)	No	No	No	None
Tire Pressure Monitor (TPM) module	No	Yes	No	None

Inspection and Verification

This section provides step-by-step module configuration procedures. Carry out the Programmable Module Installation (PMI) procedure in this section when another workshop manual section directs you to carry out configuration or when DTCs from the following chart are present:

DTC Chart

NOTE: Some modules on this vehicle utilize a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous Memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Source	Action
B2477	Module Configuration Failure	• ABS module • Dual Climate Controlled Seat Module (DCSM) • Driver Seat Module (DSM) • Front Display Interface Module (FDIM)	CARRY OUT Programmable Module Installation (PMI). REFER to Programmable Module Installation (PMI) in this section.
B2900	VIN Mismatch	• ABS module	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
B6050	No Application Present	• DCSM	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
P0602	Powertrain Control Module Programming Error	• PCM	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
P0605	Internal Control Module Read Only Memory (ROM) Error	• PCM	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
P0630	VIN Not Programmed or Incompatible - ECM/PCM	• PCM	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
P1639	Vehicle ID Block Corrupted, Not Programmed	• PCM	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
U0300	Internal Control Module Software Incompatibility	• PCM	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
U0300:00	Internal Control Module Software Incompatibility: No Sub Type Information	• Restraints Control Module (RCM)	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
U2014:41	Control Module Hardware: General Checksum Failure	• Audio Front Control Module (ACM) • Audio Digital Signal Processing (DSP) module	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
U2014:41	Control Module Hardware: General Checksum Failure	• Front Controls Interface Module (FCIM)	INSTALL a new FCIM. Refer to the appropriate section in Group 415 for the procedure.
U2014:42	Control Module Hardware: General Memory Failure	• ACM • Audio DSP module	CARRY OUT PMI. REFER to Programmable Module Installation (PMI) in this section.
U2014:42	Control Module Hardware: General Memory Failure	• FCIM	INSTALL a new FCIM. Refer to the appropriate section in Group 415 for the procedure.
U201A:51	Control Module Main	• ACM	CARRY OUT PMI. REFER to

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	Calibration Data: Missing Calibration	• FCDIM	Programmable Module Installation (PMI) in this section.
U201A:51	Control Module Main Calibration Data: Not Programmed	• FCIM	INSTALL a new FCIM . REFER to Refer to the appropriate section in Group 415 for the procedure..
U201A:51	Control Module Main Calibration Data: Not Programmed	• Audio DSP module	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2050	No Application Present	• ABS module • DSM • FDIM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2050	No Application Present	• PRB module	INSTALL a new PRB module. REFER to Section 501-08 .
U2051	One or More Calibration Files Missing / Corrupt	• ABS module • FDIM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	• BCM • ACM • Audio DSP module • FCDIM • Instrument Panel Cluster (IPC) • HVAC module • Power Steering Control Module (PSCM) • RCM • Steering Column Control Module (SCCM)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	• GPSM	INSTALL a new GPSM . Refer to the appropriate section in Group 415 for the procedure.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	• APIM	CARRY OUT APIM programming. Refer to the appropriate section in Group 415 for the procedure.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	• ACM • Audio DSP module • FCDIM • Steering Column Control Module (SCCM)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	• GPSM	INSTALL a new GPSM . Refer to the appropriate section in Group 415 for the procedure.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	• APIM	CARRY OUT APIM programming. Refer to the appropriate section in Group 415 for the procedure.
U2200:00	Control Module Configuration Memory Corrupt: No Sub Type Information	• RCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.

U2200:55	Control Module Configuration Memory Corrupt	• BCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2300:54	Central Configuration: Not Configured	• Transfer Case Control Module (TCCM)	INSTALL a new Transfer Case Control Module (TCCM). REFER to Section 308-07A .
U2300:55	Central Configuration: Not Configured	• Transfer Case Control Module (TCCM)	INSTALL a new Transfer Case Control Module (TCCM). REFER to Section 308-07A .
U2300:55	Central Configuration: Not Configured	• PSCM • RCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2300:56	Central Configuration: Invalid/Incompatible Configuration	• Transfer Case Control Module (TCCM)	INSTALL a new Transfer Case Control Module (TCCM). REFER to Section 308-07A .
U3000:41	Control Module: Calibration / General Checksum Failure	• ACM • Audio DSP module • FCDIM • HVAC module • PSCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U3000:41	Control Module: Calibration / General Checksum Failure	• Parking Aid Module (PAM)	INSTALL a new PAM . REFER to Section 413-13 .
U3000:41	Control Module: Calibration / General Checksum Failure	• FCIM • GPSM	INSTALL a new FCIM or GPSM . Refer to the appropriate section in Group 415 for the procedure.
U3000:41	Control Module: Calibration / General Checksum Failure	• Transfer Case Control Module (TCCM)	INSTALL a new Transfer Case Control Module (TCCM). REFER to Section 308-07A .
U3000:41	Control Module: Calibration / General Checksum Failure	• APIM	CARRY OUT APIM programming. Refer to the appropriate section in Group 415 for the procedure.
U3000:46	Control Module: Calibration / Parameter Memory Failure	• Transfer Case Control Module (TCCM)	INSTALL a new Transfer Case Control Module (TCCM). REFER to Section 308-07A .
U3000:46	Control Module: Calibration / Parameter Memory Failure	• PSCM • RCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	• PAM	INSTALL a new PAM . REFER to Section 413-13 .
U3000:54	Control Module: Missing Calibration	• OCSM	INSTALL a new OCSM . REFER to Section 501-20B .
U3000:54	Control Module: Missing Calibration	• PAM	INSTALL a new PAM. REFER to Section 413-13 .
U3002:62	Vehicle Identification Number: Signal Compare Failure	• RCM • HVAC module	The PCM Vehicle Identification Number (VIN) is not correct. CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.

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Programmable Module Installation (PMI)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is Available

NOTE: Following module installation, some modules require a separate procedure be carried out. For instructions, refer to the specific module removal and installation procedures.

1. Connect the IDS and identify the vehicle as normal.
2. From the Toolbox icon, select Module Programming and press the check mark.
3. Select Programmable Module Installation.
4. Select the module that is being replaced.
5. Follow the on-screen instructions, turn the ignition key to the OFF position, and press the check mark.
6. Install the new module and press the check mark.
7. Follow the on-screen instructions, turn the ignition key to the ON position, and press the check mark.
8. The IDS downloads the data into the new module and displays Module Configuration Complete.
9. Test module for correct operation.

Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available

NOTE: Following module installation, some modules require a separate procedure be carried out. For instructions, refer to the specific module removal and installation procedures.

1. Install the new module.
2. Connect the IDS and identify the vehicle as normal.

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3. From the Toolbox icon, select Module Programming and press the check mark.
4. Select Programmable Module Installation.
5. Select the module that was replaced.
6. Follow the on-screen instructions, turn the ignition key to the OFF position, and press the check mark.
7. Follow the on-screen instructions, turn the ignition key to the ON position, and press the check mark.
8. If the data is not available, the IDS displays a screen stating to contact the As-Built Data Center. Retrieve the data from the technician service publication website at this time and press the check mark.
9. Enter the module data and press the check mark.
10. The IDS downloads the data into the new module and displays Module Configuration Complete.
11. Test module for correct operation.

Anti-Theft

The perimeter anti-theft alarm system consists of the following:

- Door ajar input
- Door lock control switch input
- Hood switch
- Horn
- Integrated Keyhead Transmitter (IKT) key
- Keyless entry keypad
- Passive Anti-Theft System (PATS) key read
- Turn signals
- Body Control Module (BCM)

The perimeter alarm system protects the vehicle from unauthorized entry by sounding the horn and flashing both the turn signals and courtesy lights when an unauthorized entry occurs. The horn and lights are active for 30 seconds. After 30 seconds, the horn stops sounding, but the lights continue to flash for up to 5 minutes.

The perimeter alarm only activates 10 times per arming cycle. After that the alarm does not activate. To enable the perimeter alarm again, disarm the perimeter alarm and then arm it again.

Arming the Perimeter Alarm

The perimeter alarm is ready to arm any time the ignition is off. Any of the following pre-arms the alarm system:

- pressing the LOCK button on an IKT .
- pressing the door lock control switch to the lock position with the door open, then closing the door.
- pressing the 7/8 and 9/0 buttons simultaneously on the keyless entry keypad.

Once the system is pre-armed, there is a 20-second countdown before the perimeter alarm is armed. Each entry point to the vehicle (hood or door) are armed separately and must be closed before that entry point begins the 20-second countdown to become armed. If all entry points are closed, the turn signals flash indicating that all entry points are entering the 20-second countdown.

Perimeter Alarm Activation

The perimeter alarm has a 12-second delay when the driver door is unlocked using a key in the door lock cylinder and then opened. During the delay, a chime sounds and "TO STOP ALARM START VEHICLE" is displayed in the message center. If the perimeter alarm is not disarmed within the 12-second delay, the alarm is activated.

The perimeter alarm is activated when:

- any passenger door or the hood is opened without first receiving an electronic unlock command from an IKT or keyless entry keypad.
- the driver door is opened without first receiving an unlock command from an IKT or keyless entry keypad and the 12-second delay has expired.

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- the ignition is turned to the RUN position without a valid PATS key read received.

Disarming the Perimeter Alarm

The perimeter alarm can be disarmed by:

- pressing the UNLOCK button on a programmed IKT .
- using a programmed IKT to transition the ignition to the RUN position.
- entering the correct vehicle unlock code on the keyless entry keypad.

The perimeter alarm can be deactivated by pressing the PANIC button on an IKT . All of the lamps stop flashing and the horn stops sounding, but the alarm is still armed.

Panic Alarm

The panic alarm operates similar to the perimeter alarm, but is only controlled by the panic button on the IKT . Refer to Section 501-14 for information on the panic alarm operation.

Anti-Theft

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Body Control Module (BCM) controls the operation of the perimeter alarm based on inputs from all of the door ajar switch inputs, hood switch input, keyless entry keypad, door lock control switches, Passive Anti-Theft System (PATS) input, and the Remote Keyless Entry (RKE) transmitters. If the perimeter alarm is armed, and the BCM receives an input indicating an unauthorized entry into the vehicle or the ignition is turned to the RUN position without a programmed PATS key, the BCM activates the perimeter alarm. When the perimeter alarm is activated, the horn sounds and both the turn signals and courtesy lights flash in regular intervals.

If the driver door is unlocked by using a key in the door lock cylinder and then opened, the perimeter alarm starts a 12-second countdown. During the 12-second countdown there is a chime from the Instrument Panel Cluster (IPC) and the message center displays TO STOP ALARM START VEHICLE. If the alarm is not deactivated during this countdown, the perimeter alarm activates.

Battery Disconnect

If the battery is disconnected and then reconnected, the perimeter alarm remains in the same state (disarmed, pre-armed, armed, or activated) it was prior to the battery disconnect.

Alarm Event PIDs

The BCM has PIDs available that show what caused the last alarm events. The 4 BCM alarm event PIDs are ALARM_EVT_1 through 4. The cause for the most recent alarm activation is always listed in the first

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alarm event PID. These PIDs display what caused the alarm to activate and can be a very useful tool when trying to identify the cause of a false alarm activation.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Wiring, terminals or connectors • Hood switch • Body Control Module (BCM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM.

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1305:01	Hood Switch: General Electrical Failure	GO to Pinpoint Test B.
All other DTCs	—	REFER to the Master DTC Chart in Section 419-10.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The alarm system does not activate from an unauthorized entry at the hood	• Wiring, terminals or connectors • Hood switch • Body Control Module (BCM)	• GO to Pinpoint Test A.
• The alarm system does not activate from an unauthorized entry at a door	• Door ajar input	• REFER to Section 417-02.
• The alarm system does not arm/no turn signal flash confirmation	• Door ajar input • Hood ajar input • Turn signals • Keyless entry keypad concern • Remote Keyless Entry (RKE) transmitter concern • BCM	• GO to Pinpoint Test C.
• No horn output during alarm activation	• Horn	• REFER to Section 413-06.
• No turn signal flash during alarm activation	• Turn signals	• REFER to Section 417-01.
• No courtesy lamp flash during alarm activation	• Courtesy lamps	• REFER to Section 417-02.
• False alarm activation	• Door ajar input • Hood switch input • Panic button pressed on an IKT • A valid Passive Anti-Theft System (PATS) key read is **NOT** received when	• An intermittent fault exists. MONITOR the BCM alarm event PIDs ALARM_EVT_1 through 4 to identify and isolate the cause of the last alarm activations.

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	the ignition is turned to RUN	
• All keys/ RKE transmitters lost, perimeter alarm activated, and unable to program new keys	• Customer lost all keys/ RKE transmitters	• PROGRAM an RKE transmitter. REFER to Section 501-14 . UNLOCK the doors with the programmed RKE transmitter. PROGRAM the new keys. REFER to Section 419-01B .

Pinpoint Tests

Pinpoint Test A: The Alarm System Does Not Activate From An Unauthorized Entry At The Hood

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

When the alarm system is armed, the Body Control Module (BCM) monitors the hood switch. If the hood is opened while the alarm is armed, the hood switch removes ground from the signal circuit. This signals the BCM that an unauthorized intrusion to the engine compartment has occurred and the BCM activates the alarm.

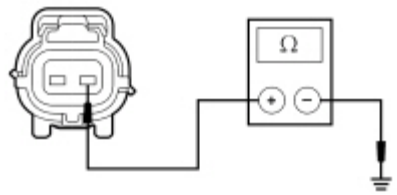
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Hood switch
- BCM

PINPOINT TEST A: THE ALARM SYSTEM DOES NOT ACTIVATE FROM AN UNAUTHORIZED ENTRY AT THE HOOD

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 RETRIEVE THE RECORDED DTCs IN THE BCM	
NOTE: DTC B1305:01 sets if the hood is open. Make sure the hood is closed prior to running the self-test. • Retrieve the recorded DTCs from the Body Control Module (BCM) self-test. • **Is DTC B1305:01 present?**	**Yes** GO to Pinpoint Test B . **No** GO to A2 .
A2 CHECK THE HOOD SWITCH (HOOD_SW) PID	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger.	**Yes** INSTALL a new hood switch. TEST

• Disconnect: Hood Switch C127. • Monitor the BCM PID HOOD_SW while disconnecting the hood switch. • **Does the BCM PID read AJAR when the switch is disconnected?**	the system for normal operation. **No** GO to A3 .
A3 CHECK THE HOOD SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: BCM C2280F. • Measure the resistance between the hood switch C127-1, circuit CPL25 (BU/OG), harness side and ground.  N0056246 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A4 . **No** REPAIR circuit CPL25 (BU/OG) for a short to ground. TEST the system for normal operation.
A4 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: DTC B1305:01

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry and Alarm for schematic and connector information.

When the alarm system is armed, the Body Control Module (BCM) monitors the hood switch. If the hood is opened while the alarm is armed, the hood switch removes ground from the signal circuit. This signals the BCM that an unauthorized intrusion to the engine compartment has occurred and the BCM activates the perimeter alarm.

- DTC B1305:01 (Hood Switch: General Electrical Failure) — set by the BCM if it detects an open on the hood switch sense circuit. This DTC also sets if the hood is open during a BCM self-test.

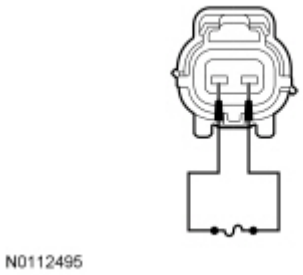
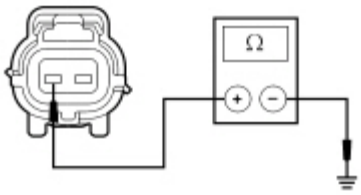
This pinpoint test is intended to diagnose the following:

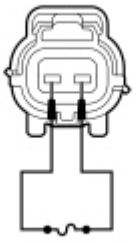
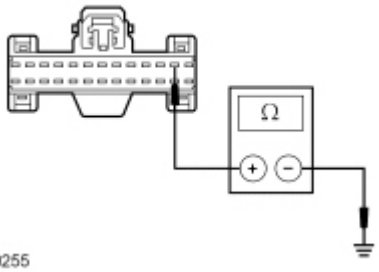
- Wiring, terminals or connectors
- Hood switch
- BCM

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PINPOINT TEST B: DTC B1305:01

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE HOOD SWITCH	
• Disconnect: Hood Switch C127. • Connect a fused jumper wire between the hood switch C127-1, circuit CPL25 (BU/OG), harness side and the hood switch C127-2, circuit GD120 (BK/GN), harness side.  N0112495 • Clear the BCM DTCs. • Repeat the BCM self-test. • **Is the BCM DTC B1305:01 retrieved?**	**Yes** REMOVE the jumper wire. GO to B2 . **No** REMOVE the jumper wire. INSTALL a new hood switch. TEST the system for normal operation.
B2 CHECK THE HOOD SWITCH GROUND CIRCUIT	
• Measure the resistance between the hood switch C127-2, circuit GD120 (BK/GN), harness side and ground.  N0082085 • **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.
B3 CHECK THE HOOD SWITCH SIGNAL CIRCUIT TO THE BCM FOR AN OPEN	
• Disconnect: BCM C2280F. • Connect a fused jumper wire between the hood switch C127-1, circuit CPL25 (BU/OG), harness side and the hood switch C127-2, circuit GD120 (BK/GN), harness side.	**Yes** GO to B4 . **No** REPAIR circuit CPL25 (BU/OG) for an open. TEST the system for normal operation.

 N0112495 • Measure the resistance between the BCM C2280F-2, circuit CPL25 (BU/OG), harness side and ground.  N0090255 • **Is the resistance less than 5 ohms?**	
B4 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM .
	REFER to Section 419-10 .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Alarm System Does Not Arm/No Turn Signal Flash Confirmation

Normal Operation

The Body Control Module (BCM) controls the perimeter alarm system and based on inputs either arms, disarms or activates the alarm. When the alarm is activated, the BCM sounds the horn and flashes both the turn signals and courtesy lamps in regular intervals. The BCM receives inputs for the door lock status, hood ajar, door ajar and the keyless entry keypad. The BCM also receives signals from the Remote Keyless Entry (RKE) transmitters.

For the perimeter alarm to arm and provide a flash of the turn signals, the following conditions must be met:

- Ignition must be OFF
- The hood closed
- All doors closed

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- An electronic lock command received from an RKE transmitter, keyless entry keypad, or door lock control switch (front door opened and then shut after lock is pressed).

Once all the conditions are met, the alarm system enters a pre-arm phase and begins a 20-second countdown. After 20 seconds have passed and no unlock command is received or any hood or door is opened, the perimeter alarm arms.

The perimeter alarm is activated when:

- any passenger door or the hood is opened without an electronic unlock command from an RKE transmitter or keyless entry keypad received first.
- the driver door is opened without an unlock command from an RKE transmitter or keyless entry keypad received first and the 12 second countdown has expired.
- the ignition is turned to the RUN position without a valid Passive Anti-Theft System (PATS) key read received.

This pinpoint test is intended to diagnose the following:

- Door ajar input
- Hood switch input
- Turn signals
- Keyless entry keypad concern
- RKE transmitter concern
- BCM

PINPOINT TEST C: THE ALARM SYSTEM DOES NOT ARM/NO TURN SIGNAL FLASH CONFIRMATION

Test Step	Result / Action to Take
C1 RETRIEVE THE RECORDED DTCs IN THE BCM	
• Retrieve the recorded DTCs from the Body Control Module (BCM) self-test. • **Is DTC B1305:01 present?**	**Yes** GO to Pinpoint Test B . **No** GO to C2 .
C2 CHECK THE COURTESY LAMP OPERATION	
• Open and close all the doors while checking the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** GO to C3 . **No** REFER to Section 417-02 to diagnose the door ajar inputs.
C3 VERIFY THE HAZARD LAMP OPERATION	
• Place the hazard switch in the ON position. • **Do the hazard lamps operate correctly?**	**Yes** GO to C4 . **No** REFER to Section 417-01 to diagnose the hazard

	lamps.
C4 CHECK THE RKE TRANSMITTER FUNCTION • Using the RKE transmitter, lock and unlock the doors and operate the panic function. • **Do the RKE transmitter functions operate correctly?**	**Yes** GO to C5 . **No** REFER to Section 501-14 to diagnose the RKE function.
C5 CHECK THE KEYLESS ENTRY KEYPAD FUNCTION • Lock the doors using the keyless entry keypad. • **Do all the doors lock using the keyless entry keypad?**	**Yes** GO to C6 . **No** REFER to Section 501-14 to diagnose the keyless entry keypad.
C6 CHECK FOR CORRECT BCM OPERATION • Disconnect all the BCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the BCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Anti-Theft

Passive Anti-Theft System (PATS) consists of the following components:

- Integrated Keyhead Transmitter (IKT)
- PATS transceiver
- Body Control Module (BCM)
- PCM

PATS protects the vehicle from theft by preventing the engine from starting unless a programmed key is used.

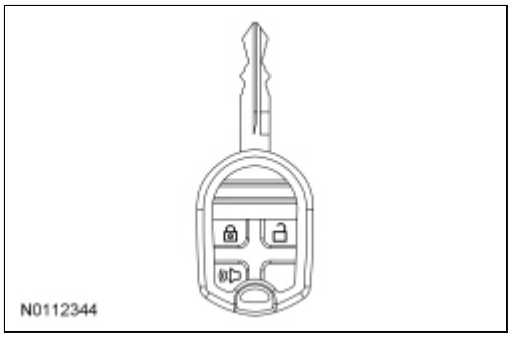
Passive Anti-Theft System (PATS) Operation

PATS prevents the engine from starting by disabling the starter relay and fuel injector operation. If an unprogrammed key is used or if there is a PATS system concern, STARTING SYSTEM FAULT is displayed in the message center and the engine does not start. PATS cannot disable an already running engine.

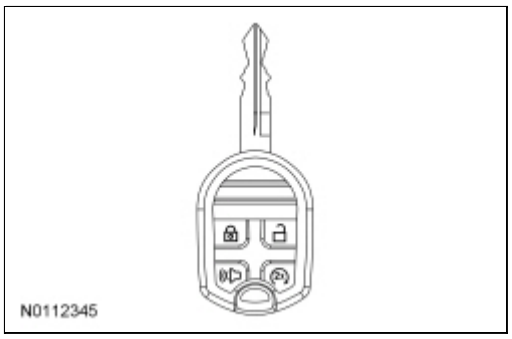
Passive Anti-Theft System (PATS) Keys

NOTE: The keys must have "HA" or "SA" stamped on the key blade.

IKT Without Remote Start



IKT With Remote Start



The vehicle comes equipped from the factory with two programmed IKTs . The IKT incorporates both the

PATS functions and the Remote Keyless Entry (RKE) transmitter functions in a single device. During key programming procedures, the PATS and RKE transmitter of an IKT are both programmed into the BCM. In addition to the IKTs, conventional PATS keys can also be programmed to the vehicle if requested by the customer. The BCM accepts the programming of up to 8 keys. Of those 8 keys a maximum of 4 IKTs can be programmed. If more than 4 IKTs are programmed, INT KEY COULD NOT PROGRAM is displayed in the message center during the key programming procedure and the RKE function of that IKT is non-functional.

MyKey® Feature

The MyKey® feature allows a restricted driving mode to be programmed into one (or more) key(s) supplied with the vehicle or into any PATS programmed spare key(s). The MyKey® is a restricted key for all consecutive key cycles until the MyKey® restricted key is cleared. The remaining key(s) is referred to as an administrator key or admin key. There must always be at least one admin key. The BCM does not allow the last admin key to be programmed into a MyKey® restricted key. Both the admin key and the MyKey® can be used to see how many admin keys and MyKey® restricted keys are programmed to the vehicle, and how many total miles have been driven with the MyKey® restricted key active.

When the MyKey® feature is programmed, several features are modified including:

Standard Restricted Features

- **NOTE:** The standard restricted features below cannot be configured in any way.

  Belt-Minder® chimes periodically with the audio system muted until the driver safety belt is buckled. If Belt-Minder® has been disabled when the admin key is in the vehicle, Belt-Minder® still functions for the MyKey® driver. Belt-Minder® cannot be disabled by the MyKey® driver.
- Audible and visual low fuel warnings are issued when the programmed Distance To Empty (DTE) value is reached (typically 75 miles).
- The parking aid system (if equipped) cannot be turned off.

Optional Restricted Features

- **NOTE:** The optional restricted features below can be configured to the customer preferences.

  The volume of the audio system can be programmed to limit the volume to 45% of the maximum volume.
- Vehicle speed can be programmed to be limited to 130 km/h (80 mph). Audible and visual warnings are issued when the vehicle speed of 130 km/h (80 mph) is attained.
- Audible and visual warnings are issued when the preselected vehicle speed of 75, 90 or 105 km/h (45, 55 or 65 mph) is attained.
- The AdvanceTrac® always on feature can be configured on or off. If configured to always on, the traction control cannot be disabled by the MyKey® driver.

Refer to Information and Message Center in the Description and Operation portion of Section 413-01 for all of the MyKey® system checks and system warning displays.

Refer to MyKey® Programming in this section or to the Owner's Literature for MyKey® programming information.

Check MyKey® System Status

The vehicle system check provides the status of the following MyKey® parameters:

- MYKEY DISTANCE — This odometer only tracks mileage when a MyKey® is used. If mileage does not accumulate, the intended MyKey® is not being used. The only way to reset this odometer to zero

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is by disabling the MyKey®. If this odometer is lower than the last time it was checked, the MyKey® system has been cleared.
- MYKEY(S) PROGRAMMED — Indicates how many MyKey® are programmed to the vehicle. It can also be used to determine if a MyKey® has been cleared.
- ADMIN KEYS PROGRAMMED — Indicates how many admin keys are programmed to the vehicle. It can also be used to determine if an additional spare key has been programmed to the vehicle.

Refer to the Owner's Literature for information on accessing the MyKey® system status in the message center.

Using MyKey® with Aftermarket Remote Start System

When using an aftermarket remote start system, the default settings recognize the remote start system as an additional admin key. If the remote start system has not been programmed as a MyKey® and the driver is a MyKey® driver, the driver could drive the vehicle using the remote start system as an admin key with no MyKey® restrictions. If requested by the customer to resolve this concern, the aftermarket remote start system needs to be programmed as a MyKey® . For information on programming the aftermarket remote start system as a MyKey® , refer to MyKey® Programming in this section.

Anti-Theft

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

Passive Anti-Theft System (PATS) Operation

The Passive Anti-Theft System (PATS) is controlled by the Body Control Module (BCM). There are 2 main checks that PATS carries out before allowing the engine to start. If either of these checks fail, PATS does not allow the engine to start and STARTING SYSTEM FAULT is displayed in the message center. These two checks are the BCM verifying the PCM ID to make sure it matches the PCM ID stored in memory and to verify that a programmed key was used to turn the ignition to the RUN or START position.

The first check is initiated by the BCM waking up the PCM by supplying voltage on the wake up control circuit. The BCM activates the wake up control circuit when:

- the driver door is opened.
- a remote start request is received (if equipped with factory remote start).
- the brake pedal is pressed.
- a key is inserted into the ignition.
- or when the ignition is in the RUN or START position.

Once the PCM is awake, the BCM sends the PCM a challenge message over the High Speed Controller Area Network (HS-CAN). When the PCM receives the challenge message, it generates a response and sends it back to the BCM . If the response from the PCM does not match the response in the BCM memory, this first check fails and the engine will not start.

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Once the PCM ID has been verified, PATS performs the second check to make sure a programmed key is in the ignition. When the BCM determines the ignition has been turned to the RUN or START position, it generates a challenge message. It sends the challenge message to the PATS transceiver on the transmit (TX) circuit. The transceiver in turn reads the key and generates a response message that is sent back to the BCM on the receive (RX) circuit. If the message received from the transceiver does not match a key stored in the BCM memory, the engine will not start.

If both the PCM ID and key verification pass, PATS is enabled and allows the engine to start. PATS cannot disable an engine that has already been started.

Spare Key Programming

The customer spare key programming allows spare keys to be programmed (up to a maximum of 8) to the BCM without having to use a scan tool. Two programmed keys are required to carry out the procedure. This procedure can be disabled so that spare keys can only be programmed to the vehicle using a scan tool. Refer to Key Programming — Program a Key Using Two Programmed Keys in this section for the customer spare key programming procedure or Key Programming — Enable/Disable Spare Key Programming in this section for the enable/disable procedure.

Unlimited Key Mode

Passive Anti-Theft System (PATS) contains a feature called unlimited key mode. This feature allows a customer to program more than 8 keys to their vehicle if they request it. Each vehicle in unlimited key mode is set up with a special unlimited transponder security key code. This allows all of the customer vehicles to share the same mechanically cut keys. For an individual customer, any randomly selected security key that has been previously mechanically cut and electronically programmed to the vehicle is acceptable. Refer to Key Programming — Unlimited Key Mode in this section.

Passive Anti-Theft System (PATS) PIDs

The PATS PIDs are a useful tool when diagnosing a PATS concerns. They can also be used to determine if unlimited key mode or customer spare key programming are enabled/disabled.

BCM PATS PID	PID Description	PID reading required for PATS to be enabled
PROGRMD_KEY	Determines if the key in the ignition lock cylinder is a programmed key.	Present
MIN_KEYS_RQD	Minimum number of programmed keys required. This PID always reads 2.	—
KEYS_PROGMD	Number of keys currently programmed into the BCM (If unlimited key mode is enabled, this PID will only read 2 regardless of how many keys are programmed).	2 to 8
START_ENABLD	Indicates if PATS will allow the engine to start	Enabled
PCM_ID	Indicates if there is a PCM ID currently stored into the BCM	Stored
PCM_VERIFY	Indicates if the PCM ID received by the BCM matches the PCM ID stored in the BCM memory	Yes
UNL_KEY_ID	Displays the unlimited key code 8 digit keycode (this PID is not available when unlimited key mode is enabled).	—
UNL_KEY_MODE	Indicates if unlimited key mode is enabled/disabled.	—

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that when used with module software can be used to monitor and control current flow on module outputs. The FET protection strategy is used to prevent module damage in the event of excessive current flow.

The BCM utilizes an FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit is still shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by a command to clear the continuous DTCs. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When each level is reached, the DTC associated with the short circuit sets along with DTC U1000:00. These DTCs can be cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuit for PATS is the wake up control output.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Large metallic objects or electronic devices on the key ring that can be used to purchase gasoline or similar items	• Body Control Module (BCM) fuse 18 (10A)

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• Passive Anti-Theft System (PATS) key • Use of a non- PATS key or incorrect PATS key • More than one PATS key on key ring • Aftermarket remote start system installed	• Wiring, terminals or connectors • BCM • PCM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM and PCM.

9. If the DTCs retrieved are related to the concern, go to the BCM DTC Chart or the PCM DTC Chart. For all other BCM DTCs, refer to Section 419-10 . For all other PCM DTCs, refer to Section 303-14 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B10D5:13	PATS Antenna: Circuit Open	The Body Control Module (BCM) received an incomplete or corrupt response from the transceiver. INSTALL a new transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section.
B10D7:05	PATS Key: System Programming Failure	GO to Pinpoint Test A .
B10D7:51	PATS Key: Not Programmed	There is an unprogrammed Passive Anti-Theft System (PATS) key. PROGRAM the PATS key. REFER to Key Programming —

		Program a Key Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section.
B10D7:55	PATS Key: Not Configured	**NOTE:** Once the BCM Programmable Module Installation (PMI) is complete, follow the scan tool on-screen instructions for carrying out the Configurable Engine Immobilizer (CEI) Lock Configuration. The BCM (CEI) was not configured after Programmable Module Installation (PMI). CARRY OUT the BCM PMI . REFER to Section 418-01 .
B10D7:87	PATS Key: Missing Message	GO to Pinpoint Test B .
B10D7:8F	PATS Key: Erratic	GO to Pinpoint Test B .
B10D8:00	PATS Key Less Than Minimum Programmed: No Sub Type Information	Less than 2 keys are programmed into the BCM . CYCLE the customer's second key in the ignition to program (when less than 2 keys are programmed, the BCM automatically programs the first 2 keys that are cycled in the ignition).
B10D9:87	PATS Transponder: Missing Message	GO to Pinpoint Test C .
B10DA:51	PATS Target Identifier: Not Programmed	There is no PCM ID stored in the BCM . CARRY OUT a parameter reset. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. REPEAT the self-test.
C113A:11	Wakeup Control: Circuit Short to Ground	GO to Pinpoint Test D .
C113A:15	Wakeup Control: Circuit Short to Battery or Open	GO to Pinpoint Test D .
U1000:00	Solid State Driver Protection Activated - Driver Disabled: No Sub Type Information	The BCM has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first. After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

PCM DTC Chart

DTC	Description	Action
P161A	Incorrect Response from Immobilizer Control Module	The BCM ID received by the PCM does not match the ID stored in the PCM memory. CARRY OUT a parameter reset. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. REPEAT the self-test.
All other DTCs	—	REFER to Section 303-14 .

Symptom Chart

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Symptom Chart

Condition	Possible Sources	Action
• The engine does not start	• Driveability concern • Passive Anti-Theft System (PATS) concern • Starting system concern	• GO to Pinpoint Test E .
• All keys/ RKE transmitters lost, perimeter alarm activated, and unable to program new keys	• Customer lost all keys/ RKE transmitters	• PROGRAM an RKE transmitter. REFER to Section 501-14 . UNLOCK the doors with the programmed RKE transmitter. ERASE all keys and PROGRAM two keys. REFER to Key Programming Using Diagnostic Equipment .

Pinpoint Tests

Pinpoint Test A: DTC B10D7:05

Normal Operation

When the Body Control Module (BCM) enters a key programming state, it activates the transceiver to read the key in the ignition. If a valid Passive Anti-Theft System (PATS) key is used and there are no concerns with the PATS the key is programed into the BCM memory.

- DTC B10D7:05 (PATS Key: System Programming Failure) — sets when a Passive Anti-Theft System (PATS) key is unsuccessfully programmed into the BCM .

This pinpoint test is intended to diagnose the following:

- PATS key

PINPOINT TEST A: DTC B10D7:05

Test Step	Result / Action to Take
A1 CHECK THE BCM DTCs FROM THE SELF-TEST	
• Check the recorded results from the BCM self-test. • **Is DTC B10D5:13, B10D7:87, B10D7:8F, or B10D9:87 retrieved?**	**Yes** REFER to the BCM DTC Chart in this section. RESOLVE these DTCs first. **No** GO to A2 .

A2 CHECK THE PATS KEY	
• **NOTE:** The keys must have "HA" or "SA" stamped on the key blade. • Check that the correct PATS keys are used with the vehicle. Compare the Integrated Keyhead Transmitters (IKTs) with the one shown in Anti-Theft in the Description and Operation portion of this section. • **Are the correct keys being used?**	**Yes** ATTEMPT to program the key again. If key programming fails, DISCARD the damaged key and PROGRAM a new key. REFER to Key Programming — Program a Key Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** OBTAIN the correct key(s) for the vehicle. PROGRAM the new key(s). REFER to Key Programming — Program a Key Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test B: DTC B10D7:87 or B10D7:8F

Normal Operation

When the ignition is turned to the RUN or START position, the Body Control Module (BCM) activates the transceiver to read the key in the ignition. If the BCM does not receive a Passive Anti-Theft System (PATS) key code or if the code is invalid, PATS is disabled and the engine does not start.

- DTC B10D7:87 (PATS Key: Missing Message) — sets when there is no Passive Anti-Theft System (PATS) key read. This DTC sets if a non- PATS key is used to turn the ignition on.
- DTC B10D7:8F (PATS Key: Erratic) — sets when there is a partial or corrupt PATS key read.

This pinpoint test is intended to diagnose the following:

- PATS key
- PATS transceiver

PINPOINT TEST B: DTC B10D7:87 OR B10D7:8F

NOTE: Large metallic objects or electronic devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the ignition switch off and restart the engine with all other objects on the key ring held away from the ignition key.

NOTE: Aftermarket or dealer-installed remote start systems may adversely affect the PATS operation. Disconnect these systems before diagnosing any PATS concerns.

Test Step	Result / Action to Take
B1 CHECK THE PATS KEYS	
• **NOTE:** The keys must have "HA" or "SA"	**Yes**

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stamped on the key blade. • Check that the correct PATS keys are used with the vehicle. Compare the Integrated Keyhead Transmitters (IKTs) with the one shown in Anti-Theft in the Description and Operation portion of this section. • **Are the correct keys being used?**	GO to B2. **No** OBTAIN the correct key(s) for the vehicle. PROGRAM the new key(s). REFER to Key Programming — Program a Key Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test.
B2 ISOLATE THE PATS KEYS • **NOTE:** Follow this procedure using both PATS keys (using one at a time). • Place a PATS key in the ignition and turn to the RUN position. • Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs. • Cycle the ignition from RUN to OFF and then back to the RUN position. • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • **Is DTC B10D7:87 or B10D7:8F retrieved for both keys?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. REPEAT the self-test. **No** DISCARD the key in question and PROGRAM a new key. REFER to Key Programming — Program a Key Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: DTC B10D9:87

Refer to Wiring Diagrams Cell 112, Passive Anti-Theft System for schematic and connector information.

Normal Operation

The Body Control Module (BCM) fuse 18 (10A) supplies voltage to the Passive Anti-Theft System (PATS) transceiver. When the ignition is turned to the RUN or START positions, the BCM initiates the key interrogation sequence. The BCM starts the interrogation sequence by generating a signal and sending that signal to the transceiver on the transmit (TX) circuit. When the transceiver receives the signal from the BCM, it reads the PATS key and generates a challenge response to the BCM signal. The transceiver sends the challenge response back to the BCM on the receive (RX) circuit.

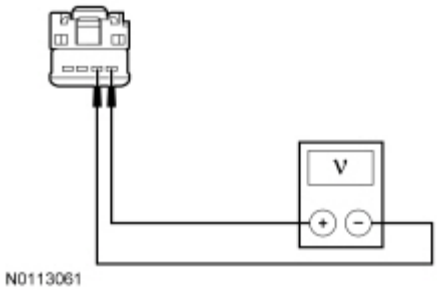
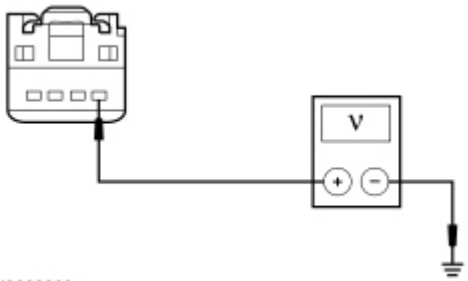
- DTC B10D9:87 (PATS Transponder: Missing Message) — sets when the BCM does not receive a response from the PATS transceiver

This pinpoint test is intended to diagnose the following:

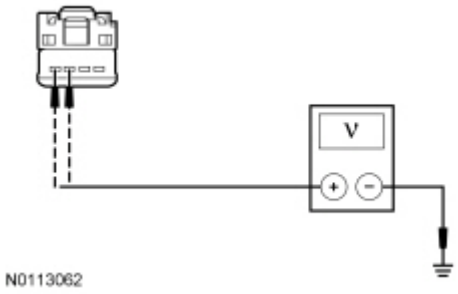
- Fuse
- Wiring, terminals or connectors
- PATS transceiver
- BCM

PINPOINT TEST C: DTC B10D9:87

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 RETRIEVE THE BCM DTCs FROM THE SELF-TEST	
• Check the recorded results from the BCM self-test. • **Is DTC C113A:11 or DTC C113A:15 recorded?**	**Yes** GO to Pinpoint Test D . **No** GO to C2 .
C2 CHECK FOR VOLTAGE TO THE PATS TRANSCEIVER	
• Disconnect: PATS Transceiver C252. • Ignition ON. • Measure the voltage between the PATS transceiver C252-1, circuit CE436 (VT/OG), harness side and the PATS transceiver C252-2, circuit GD133 (BK).  N0113061 • **Is the voltage greater than 10 volts?**	**Yes** GO to C4 . **No** GO to C3 .
C3 CHECK THE PATS TRANSCEIVER VOLTAGE SUPPLY CIRCUIT	
• Measure the voltage between the PATS transceiver C252-1, circuit CE436 (VT/OG), harness side and ground.  N0002393 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit GD133 (BK) for an open. CLEAR the DTCs. REPEAT the self-test. **No** VERIFY the BCM fuse 18 (10A) is OK. If OK, REPAIR circuit CE436 (VT/OG) for an open. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test.
C4 CHECK THE PATS TRANSCEIVER CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280B. • Ignition ON. • Measure the voltage between the PATS transceiver C252-3, circuit VRT24 (YE/OG), harness side and ground; and between the PATS transceiver C252-4, circuit VRT23 (VT/GY), harness side and ground.	**Yes** REPAIR the circuit in question for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to C5 .

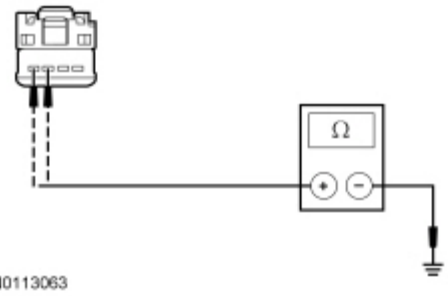
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- **Is any voltage present?**

C5 CHECK THE PATS TRANSCEIVER CIRCUITS FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the PATS transceiver C252-3, circuit VRT24 (YE/OG), harness side and ground; and between the PATS transceiver C252-4, circuit VRT23 (VT/GY), harness side and ground.



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to C6 .

No
REPAIR the circuit in question for a short to ground. CLEAR the DTCs. REPEAT the self-test.

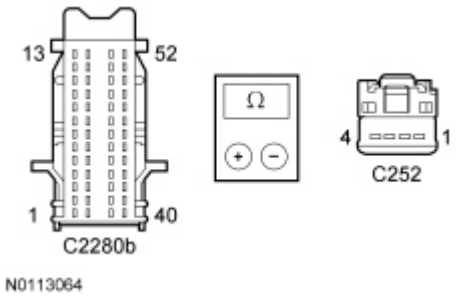
C6 CHECK THE PATS TRANSCEIVER CIRCUITS FOR AN OPEN

- Measure the resistance between the BCM , harness side and the PATS transceiver, harness side as follows:

BCM Connector-Pin	Circuit	PATS Transceiver Connector-Pin
C2280B-36	VRT23 (VT/GY)	C252-4
C2280B-37	VRT24 (YE/OG)	C252-3

Yes
INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. REPEAT the self-test. If DTC B10D9:87 is retrieved again, GO to C7 .

No
REPAIR the circuit in question for an open. CLEAR the DTCs. REPEAT the self-test.

 • **Are the resistances less than 5 ohms?**	
C7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the BCM connectors and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: DTC C113A:11 or C113A:15

Refer to Wiring Diagrams Cell 112, Passive Anti-Theft System for schematic and connector information.

Normal Operation

The wake up control circuit is used to wake up the PCM prior to engine cranking. The PCM needs to wake up prior to a crank request so that it has time to go through its initialization. The wake up control circuit is also used to power the Passive Anti-Theft System (PATS) transceiver. The wake up control circuit is controlled by the Body Control Module (BCM) and receives voltage from fuse 18 (10A).

The BCM activates the wake up control circuit when:

- the driver door is opened.
- a remote start request is received (if equipped with factory remote start).
- the brake pedal is pressed.
- a key is inserted into the ignition.
- or when the ignition is in the RUN or START position.

- DTC C113A:11 (Wakeup Control: Circuit Short To Ground) — sets when the BCM detects a short to ground on the wake up control circuit.
- DTC C113A:15 (Wakeup Control: Circuit Short To Battery or Open) — sets when the BCM detects a short to voltage or an open on the wake up control circuit.
- DTC U1000:00 (Solid State Driver Protection Activated - Driver Disabled: No Sub Type Information) — sets when the BCM has temporarily shut down the output driver. The module has temporarily disabled the wake up control circuit because an excessive current draw exists (such as a short to ground). The BCM cannot enable the wake up control circuit until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.

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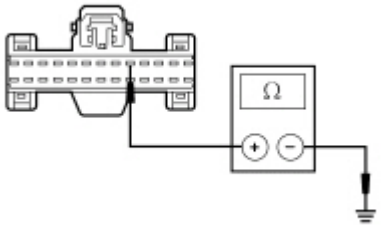
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PATS transceiver
- PCM
- BCM

PINPOINT TEST D: DTC C113A:11 or C113A:15

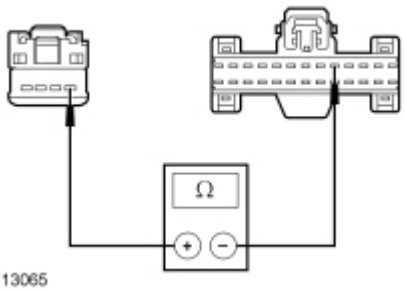
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 RETRIEVE THE BCM DTCs FROM THE SELF-TEST • Check the recorded results from the BCM self-test. • **Is DTC C113A:11 recorded?**	**Yes** GO to D2. **No** For DTC C113A:15, GO to D5.
D2 CHECK THE PCM FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: PCM C175B (3.7L) or C1381B (5.0/6.2L). • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs. • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • **Is DTC C113A:11 retrieved?**	**Yes** GO to D3. **No** GO to D9.
D3 CHECK THE PATS TRANSCEIVER FOR A SHORT TO GROUND • Disconnect: PATS Transceiver C252. • Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs. • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • **Is DTC C113A:11 retrieved?**	**Yes** GO to D4. **No** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. TEST the system for normal operation.
D4 CHECK THE WAKEUP CONTROL CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Disconnect: BCM C2280F. • Measure the resistance between the BCM C2280F-5, circuit CE436 (VT/OG), harness side and ground.	**Yes** GO to D10. **No** REPAIR circuit CE436 (VT/OG) for a short to ground. CLEAR the DTCs. REPEAT the self-test.

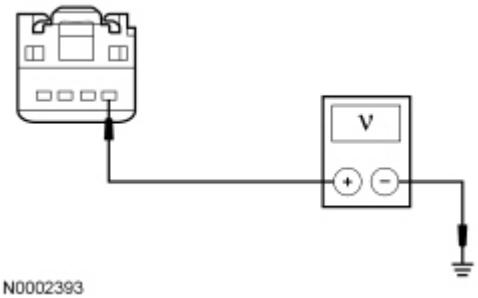
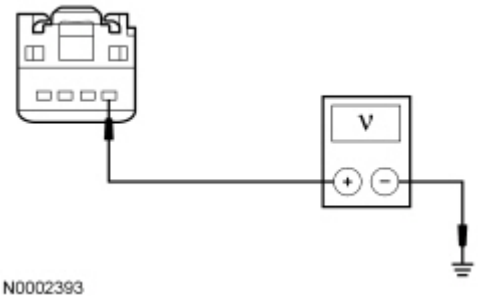


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- **Is the resistance greater than 10,000 ohms?**

D5 CHECK THE WAKEUP CONTROL CIRCUIT FOR AN OPEN OR SHORT TO VOLTAGE	
• Start the engine. • **Does the engine start?**	**Yes** GO to D7 . **No** GO to D6 .
D6 CHECK THE WAKEUP CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PATS Transceiver C252. • Disconnect: BCM C2280F. • Measure the resistance between the PATS transceiver C252-1, circuit CE436 (VT/OG), harness side and the BCM C2280F-5, circuit CE436 (VT/OG), harness side.  N0113065 • **Is the resistance less than 5 ohms?**	**Yes** GO to D10 . **No** REPAIR circuit CE436 (VT/OG) for an open. CLEAR the DTCs. REPEAT the self-test.
D7 CHECK THE WAKEUP CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PATS Transceiver C252. • Disconnect: BCM C2280F. • Ignition ON. • Measure the voltage between the PATS transceiver C252-1, circuit CE436 (VT/OG), harness side and ground.	**Yes** GO to D8 . **No** GO to D10 .

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 N0002393 • **Is any voltage present?**	
D8 CHECK THE PCM FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: PCM C175B (3.7L) or C1381B (5.0/6.2L). • Ignition ON. • Measure the voltage between the PATS transceiver C252-1, circuit CE436 (VT/OG), harness side and ground.  N0002393 • **Is any voltage present?**	**Yes** REPAIR circuit CE436 (VT/OG) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to D9.
D9 CHECK FOR CORRECT PCM OPERATION • Disconnect the PCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the PCM connectors and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
D10 CHECK FOR CORRECT BCM OPERATION • Disconnect the BCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the BCM connectors and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test E: The Engine Does Not Start

Normal Operation

The Passive Anti-Theft System (PATS) disables the engine from starting by disabling the fuel injectors and starter. When the ignition is turned to the RUN or START position, the PATS reads the PATS key and checks the PCM ID. If an unprogrammed PATS key is used or an invalid PCM ID is received, the PATS disables the engine. If there is a PATS concern that caused the engine to be disabled, "STARTING SYSTEM FAULT" is displayed in the message center.

This pinpoint test is intended to diagnose the following:

- Driveability concern
- PATS concern
- Starting system concern

PINPOINT TEST E: THE ENGINE DOES NOT START

Test Step	Result / Action to Take
E1 CHECK FOR COMMUNICATION WITH THE PCM AND THE BCM • Carry out the network test using the scan tool. • **Does the scan tool establish communication with the PCM and the Body Control Module (BCM)?**	**Yes** GO to E2 . **No** REFER to Section 418-00 to diagnose the module that is not communicating with the scan tool.
E2 CHECK FOR BCM DTCs • Enter the following diagnostic mode on the scan tool: BCM Self-Test. • **Are any BCM DTCs present?**	**Yes** REFER to the BCM DTC Chart in this section. **No** The no-start condition is not caused by PATS . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the cause of the no-start condition.

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MyKey® Restrictions on Vehicle Operation

Principles of Operation

The MyKey® feature allows a restricted driving mode to be programmed into one (or more) key(s) supplied with the vehicle or into any (Passive Anti-Theft System (PATS)) programmed spare key(s) to promote good driving habits. The MyKey® is a restricted key for all consecutive key cycles until the MyKey® restricted key is cleared. The remaining key(s) is referred to as an administrator key(s) or admin key(s). There must always be at least one admin key. The Body Control Module (BCM) does not allow the last administrator key to be programmed as a MyKey® restricted key. Both the admin key and the MyKey® can be used to see how many admin keys and MyKey® restricted keys are programmed to the vehicle, and how many total miles have been driven with the MyKey® active.

When the MyKey® feature is programmed, several features are modified for the MyKey® driver only.

Inspection and Verification

1. Verify the customer concern.
2. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
3. If the cause is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No known admin key available	• The admin key is lost/stolen	• PURCHASE a new key and PROGRAM it to the Passive Anti-Theft System (PATS). REFER to Key Programming Using Diagnostic Equipment in this section.
	• Aftermarket remote start system has been programmed as the admin MyKey®	• REFER to MyKey® Programming in this section to clear all programmed MyKey®. PROGRAM the aftermarket remote start system as a MyKey®.
• No MyKey® messages available	• Unlimited key mode is enabled	• INFORM the customer of the normal vehicle operation. If the

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		customer desires MyKey® to be enabled, DISABLE the unlimited key mode. REFER to Key Programming — Unlimited Key Mode in this section.
• MyKey® acts as an admin key	• Aftermarket remote start system was used to start the vehicle	• REFER to MyKey® Programming in this section to clear all programmed MyKey®. PROGRAM the aftermarket remote start system as a MyKey®.
• Cannot locate the MyKey® restricted key	• The MyKey® restricted key is lost/stolen	• PURCHASE a new key and PROGRAM it to PATS. REFER to Key Programming Using Diagnostic Equipment or Key Programming — Program a Key Using Two Programmed Keys in this section. PROGRAM the new key to the MyKey® restricted key status. REFER to MyKey® Programming in this section.
• All keys have been programmed to a MyKey® restricted key status	• Aftermarket remote start system has been programmed as the admin MyKey®	• REFER to MyKey® Programming in this section to clear all programmed MyKey®. PROGRAM the aftermarket remote start system as a MyKey®.
• Total number of admin keys and MyKey® programmed includes one more key than customer has	• An unauthorized key has been programmed to the vehicle as a MyKey® restricted key or as an admin key • The vehicle has an aftermarket remote start system	• ERASE all keys and PROGRAM all of the customer's keys. REFER to Key Programming Using Diagnostic Equipment in this section. If necessary, PROGRAM the desired key to a MyKey® restricted key status. REFER to MyKey® Programming in this section. • INFORM the customer of the normal vehicle operation. RELEASE the vehicle to the customer. If necessary, REFER to Clear MyKey® Restricted Features in this section to clear all programmed MyKey®. This action also clears any MyKey® restrictions the remote start system may have.
• The MyKey® distance does not accumulate	• The MyKey® is not being used by the intended driver • The MyKey® system has recently been cleared	• MAKE SURE the key being used is a MyKey® restricted key by observing the message center messages when the vehicle is started using the MyKey®. VERIFY the MyKey® restricted key is being used by driving the vehicle using the MyKey® restricted key and checking the miles accumulated before and

		after the drive.
• Cannot create a MyKey®	• Engine was started using an aftermarket remote start system that is programmed as a MyKey® restricted key • MyKey® restricted key is already in the ignition lock cylinder	• REFER to MyKey® Programming in this section for the programming procedures.
	• Unlimited key mode is enabled	• INFORM the customer of the normal vehicle operation. If the customer desires MyKey® to be enabled, DISABLE the unlimited key mode. REFER to Key Programming — Unlimited Key Mode in this section.
	• Key in the ignition lock cylinder is the only one admin key left	• INFORM the customer of the normal vehicle operation. There must always be one admin key.
• Cannot configure/clear the MyKey® feature	• MyKey® restricted key in the ignition lock cylinder • Engine was started using an aftermarket remote start system that is programmed as a MyKey® restricted key	• INFORM the customer of the normal vehicle operation. An admin key must be used to configure or clear MyKey®.
	• No MyKey® restricted keys are programmed	• PROGRAM MyKey®. REFER to MyKey® Programming in this section for the programming procedures.

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Key Programming — Enable/Disable Spare Key Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: This procedure provides the capability to enable/disable the normal customer spare key programming procedure detailed in the Owner's Literature and Key Programming — Program a Key Using Two Programmed Keys . If spare key programming is disabled, spare keys can only be programmed by using the Key Programming Using Diagnostic Equipment procedure in this section.

1. Turn the key from the OFF position to the RUN position.
2. From the scan tool, enter TOOLBOX. Select BODY — SECURITY — PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS.
3. From the scan tool menu select "Customer Spare Key Programming Enable" or "Customer Spare Key Programming Disable" and follow the IDS on-screen instructions.

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Key Programming — Program a Key Using Two Programmed Keys

NOTE: This procedure works only if 2 or more programmed keys are available. If 2 programmed keys are not available, refer to Key Programming Using Diagnostic Equipment in this section.

NOTE: This procedure works only if the customer spare key programming is enabled. If customer spare key programming is disabled, refer to Key Programming — Enable/Disable Spare Key Programming or Key Programming Using Diagnostic Equipment in this section.

1. Insert the first programmed Passive Anti-Theft System (PATS) key into the ignition and turn the key from the OFF position to the RUN position (maintain the key in the RUN position for approximately 6 seconds).

2. Turn the first key to the OFF position and remove the key from the ignition.

3. Within 10 seconds of turning the key to the OFF position, insert a second programmed PATS key into the ignition and turn the key from the OFF position to the RUN position (maintain the key in the RUN position for approximately 6 seconds).

4. Turn the second key to the OFF position and remove the key from the ignition.

5. **NOTE:** The doors lock and then unlock to confirm that each Integrated Keyhead Transmitter (IKT) is programmed.

   Within 10 seconds of turning the second key to the OFF position, insert the new, unprogrammed PATS key into the ignition and turn the key from the OFF position to the RUN position (maintain the key in the RUN position for approximately 6 seconds).

6. If it is desired to program additional key(s) (up to a total of 8 keys can be programmed), repeat Steps 1 - 5 for each additional key.

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Key Programming — Unlimited Key Mode

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Enabling Unlimited Key Mode

NOTE: When in the unlimited key mode, the KEYS_PROGMD PID in the Body Control Module (BCM) always reads 2, no matter how many keys are programmed to the vehicle (after the first 2 keys have been programmed to the vehicle).

NOTE: If the BCM PID UNL_KEY_ID is not available, unlimited key mode is turned on, and must be turned off before viewing the stored code. At this time, unlimited keys may be programmed to the vehicle. To view/disable/change the stored code, follow the procedure below for disabling the unlimited key mode.

1. The customer must choose an 8-digit number (except for 00000000, 00000001, or FFFFFFFF) to be programmed to all of their vehicles or, to all of the keys for one vehicle. Valid digits are 0-9 and the letters A-F.
2. From the scan tool, enter TOOLBOX. Select BODY — SECURITY — PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS.
3. Once in security access, select "unlimited key mode ON" and follow the IDS on-screen instructions.
4. Select "program unlimited key code" and follow the IDS on-screen instructions. Enter the 8-digit code chosen by the customer in Step 1 of this procedure and follow the IDS on-screen instructions.
5. Select "Ignition Key Code Erase" and follow the IDS on-screen instructions.
6. Turn the key to the OFF position and disconnect the scan tool (the key does not need to be removed from the ignition at this time).
7. Turn the first PATS key to the RUN position for a minimum of 6 seconds.
8. Turn the first PATS key to the OFF position and remove the key from the ignition.
9. Insert the second PATS key into the ignition and turn the key to the RUN position for a minimum of 6 seconds.
10. The engine should now start with both PATS keys.
11. If it is desired to program additional key(s), refer to Key Programming — Program a Key Using Two Programmed Keys in this section.

Disabling Unlimited Key Mode

1. From the scan tool, enter TOOLBOX. Select BODY — SECURITY — PATS Functions and follow the IDS on-screen instructions to ENTER SECURITY ACCESS.
2. Select "unlimited key mode OFF" and follow the IDS on-screen instructions.
3. Select "Ignition Key Code Erase" and follow the IDS on-screen instructions.
4. Turn the key to the OFF position and disconnect the scan tool (the key does not need to be removed from the ignition at this time).
5. Turn the first PATS key to the RUN position for a minimum of 6 seconds.
6. Turn the first PATS key to the OFF position and remove the key from the ignition.
7. Insert the second PATS key into the ignition and turn the key to the RUN position for a minimum of 6 seconds.
8. The engine should now start with both PATS keys.
9. If it is desired to program additional key(s) (only a total of 8 keys can be programmed into the BCM), refer to Key Programming — Program a Key Using Two Programmed Keys in this section.

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Key Programming Using Diagnostic Equipment

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Erase All Keys And Program Two Keys

NOTE: This procedure erases all programmed ignition keys from the vehicle memory. The vehicle cannot start until a minimum of 2 keys are programmed into the Body Control Module (BCM).

NOTE: Two Passive Anti-Theft System (PATS) keys with the correct mechanical cut must be available to carry out this procedure.

1. Turn the key from the OFF position to the ON position.
2. From the scan tool, enter TOOLBOX. Select BODY — SECURITY — PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS.
3. From the scan tool menu select "Ignition Key Code Erase" and follow the IDS on-screen instructions until the key erase procedure completes. The scan tool will then instruct you to program 2 keys to complete the process.
4. Turn the key to the OFF position and disconnect the scan tool (the key does not need to be removed from the ignition at this time).
5. **NOTE:** The doors lock and then unlock to confirm that each Integrated Keyhead Transmitter (IKT) is programmed.

   Turn the first PATS key to the RUN position for a minimum of 6 seconds.
6. Turn the first PATS key to the OFF position and remove the key from the ignition.
7. Insert the second PATS key into the ignition and turn the key to the RUN position for a minimum of 6 seconds.
8. The engine should now start with both PATS keys.
9. If it is desired to program additional key(s) (only a total of 8 keys can be programmed into the BCM), refer to Key Programming — Program a Key Using Two Programmed Keys in this section for each additional key that needs to be programmed.

Spare Key Programming

NOTE: If 8 keys are already programmed, this procedure does not allow any more Passive Anti-Theft System (PATS) keys to be programmed without erasing all stored key codes first.

1. Insert the unprogrammed PATS key into the ignition and turn the key from the OFF position to the RUN position.

2. From the scan tool, enter TOOLBOX. Select BODY — SECURITY — PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS.

3. From the scan tool menu select "Program additional ignition key" and follow the IDS on-screen instructions.

4. The engine should now start with the new PATS key.

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MyKey® Programming

Program a MyKey®

With Base Message Center

NOTE: After a MyKey® has been programmed, the remaining standard key(s) (the key[s] that is not programmed with the MyKey® feature) is referred to as an "administrator key(s)" or "admin" key(s). There must always be at least one admin key.

NOTE: The MyKey® feature can be cleared within the same key cycle that it was programmed. Follow the Disable MyKey® procedure in this section to clear the key of any restricted MyKey® status. If the key has been cycled, an admin key is required to clear the MyKey® programming.

1. Insert a programmed Passive Anti-Theft System (PATS) key into the ignition and turn the key from the OFF to the RUN position. This key must be the one that is being programmed to the MyKey® restricted status.

2. Press the SETUP button until PRESS RESET TO CREATE MYKEY is displayed.

3. Press and release the RESET button. HOLD RESET TO CONFIRM MYKEY is displayed.

4. Press and hold the RESET button (for approximately 2 seconds) until MARK THIS KEY AS RESTRICTED is displayed.

5. Wait until KEY RESTRICTED AT NEXT START is displayed, then release the RESET button.

6. The MyKey® feature (standard restricted features) is successfully programmed into this particular key. Make sure it is labeled for easy identification. If you would like to customize the MyKey® with the audio volume limited, maximum speed limit, speed alert chimes, and AdvanceTrac® on/off restrictions, refer to Configuring MyKey® Optional Restricted Features in this section.
    - If the vehicle is equipped with an aftermarket remote start, also refer to Using MyKey® with Aftermarket Remote Start Systems in this section.

With Optional Message Center

NOTE: After a MyKey® has been programmed, the remaining standard key(s) (the key[s] that is not programmed with the MyKey® feature) is referred to as an "administrator key(s)" or "admin" key(s). There must always be at least one admin key.

NOTE: The MyKey® feature can be cleared within the same key cycle that it was programmed. Follow the Disable MyKey® procedure in this section to clear the key of any restricted MyKey® status. If the key has been cycled, an admin key is required to clear the MyKey® programming.

1. Insert a programmed Passive Anti-Theft System (PATS) key into the ignition and turn the key from the OFF to the RUN position. This key must be the one that is being programmed to the MyKey® restricted status.

2. From the message center main menu, use the up and down arrow buttons to scroll to and select Settings. Press the OK button.

3. Use the up and down arrow buttons to scroll to and select MyKey®. Press the OK button.

4. Use the up and down arrow buttons to scroll to and select Create MyKey®. Press the OK button.

5. Press and hold the OK button to create the MyKey®.

6. The MyKey® feature (standard restricted features) is successfully programmed into this particular key. Make sure it is labeled for easy identification. If you would like to customize the MyKey® with the audio volume limited, maximum speed limit, speed alert chimes, and AdvanceTrac® on/off restrictions, refer to Configuring MyKey® Optional Restricted Features in this section.
    - If the vehicle is equipped with an aftermarket remote start, also refer to Using MyKey® with Aftermarket Remote Start Systems in this section.

Configuring MyKey® Optional Restricted Features

With Base Message Center

NOTE: The following features can be restricted on a MyKey®:

- audio volume level set to a pre-determined level (45% of the maximum volume)
- maximum speed limit of 130 km/h (80 mph) on or off
- speed alert chimes set for 75, or 90 or 105 km/h (45, or 55 or 65 mph)
- AdvanceTrac® always on feature turned on or off

1. Insert an admin key into the ignition and turn the key to the RUN position.

2. Press the SETUP button until RESET FOR MYKEY SETUP is displayed.

3. Press and release the RESET button to display the MyKey® setup menus. The first programmable feature is: MYKEY MAX MPH OFF.
    - If you do not want to change the status of a feature that appears, press and release SETUP to accept the current setting and display the next programmable feature.
    - If you want to change the status of the feature that is displayed, press RESET to turn a feature on/off (or toggle between choices). After the feature selection has been made, press and release SETUP to accept the current setting and display the next programmable feature.

4. Repeat the process for the next features:
    - MYKEY MPH TONES 45 55 65 (choose the desired speed for the chime to sound)
    - MYKEY VOLUME LIMIT OFF (choose the audio volume to be limited to 45%)
    - MYKEY ADVTRAC CTRL ON (choose for the AdvanceTrac® to be automatically locked on or able to be turned on or off by the MyKey® driver)

With Optional Message Center

NOTE: The following features can be restricted on a MyKey®:

- audio volume level set to a pre-determined level (45% of the maximum volume)
- maximum speed limit of 130 km/h (80 mph) on or off
- speed alert chimes set for 75, or 90 or 105 km/h (45, or 55 or 65 mph)
- AdvanceTrac® always on feature turned on or off

1. Insert an admin key into the ignition and turn the key to the RUN position.

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2. From the message center main menu, use the up and down arrow buttons to scroll to and select Settings. Press the OK button.

3. Use the up and down arrow buttons to scroll to and select MyKey®. Press the OK button.

4. Use the up and down arrow buttons to scroll to and select AdvanceTrac®. Press the OK button.

5. Use the left and right arrow buttons to configure the AdvanceTrac® to be automatically locked on or able to be turned on or off by the MyKey® driver. Press the OK button.

6. Repeat steps 4 and 5 for the next features:
    - MAX MPH: 80 MPH or OFF
    - Speed Warning: 45 55 or 65 MPH (choose the desired speed for the chime to sound)
    - Volume Limiter ON or OFF (choose the audio volume to be limited to 45%)

Clear MyKey®

With Base Message Center

1. **NOTE:** This procedure is used to clear the MyKey® feature on all of the keys that are programmed to the vehicle. All of the keys then operate as normal (admin) keys with no restrictions.

   Insert an admin key into the ignition and turn the key to the RUN position.

2. Press SETUP until PRESS RESET TO CLEAR MYKEY is displayed.

3. Press and release the RESET button until HOLD RESET TO CONFIRM CLEAR is displayed.

4. Press and hold the RESET button until ALL MYKEYS CLEARED is displayed.
    - A MyKey® can also be cleared during the same key cycle that it was programmed by following Steps 2, 3 and 4 of this procedure.

With Optional Message Center

1. **NOTE:** This procedure is used to clear the MyKey® feature on all of the keys that are programmed to the vehicle. All of the keys then operate as normal (admin) keys with no restrictions.

   Insert an admin key into the ignition and turn the key to the RUN position.

2. From the message center main menu, use the up and down arrow buttons to scroll to and select Settings. Press the OK button.

3. Use the up and down arrow buttons to scroll to and select MyKey®. Press the OK button.

4. Use the up and down arrow buttons to scroll to and select Clear MyKey®. Press the OK button.

Using MyKey® with Aftermarket Remote Start System

Program Remote Start System as a MyKey®

1. Enter the vehicle and close all doors.

2. Remote start the vehicle using a remote start fob.

3. Follow Steps 1-6 of the Program a MyKey® procedure in this section.

Clear MyKey® with the Remote Start System

NOTE: It is possible to program all of the keys as MyKey®, with the remote start system being the only admin key. This procedure clears MyKey® in the event of the aftermarket remote start system being programmed as the only admin key.

1. Enter the vehicle and close all doors.

2. Remote start the vehicle using the remote start fob.

3. Follow Steps 1-4 of the Clear MyKey® procedure in this section.

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Passive Anti-Theft System (PATS) Parameter Reset

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

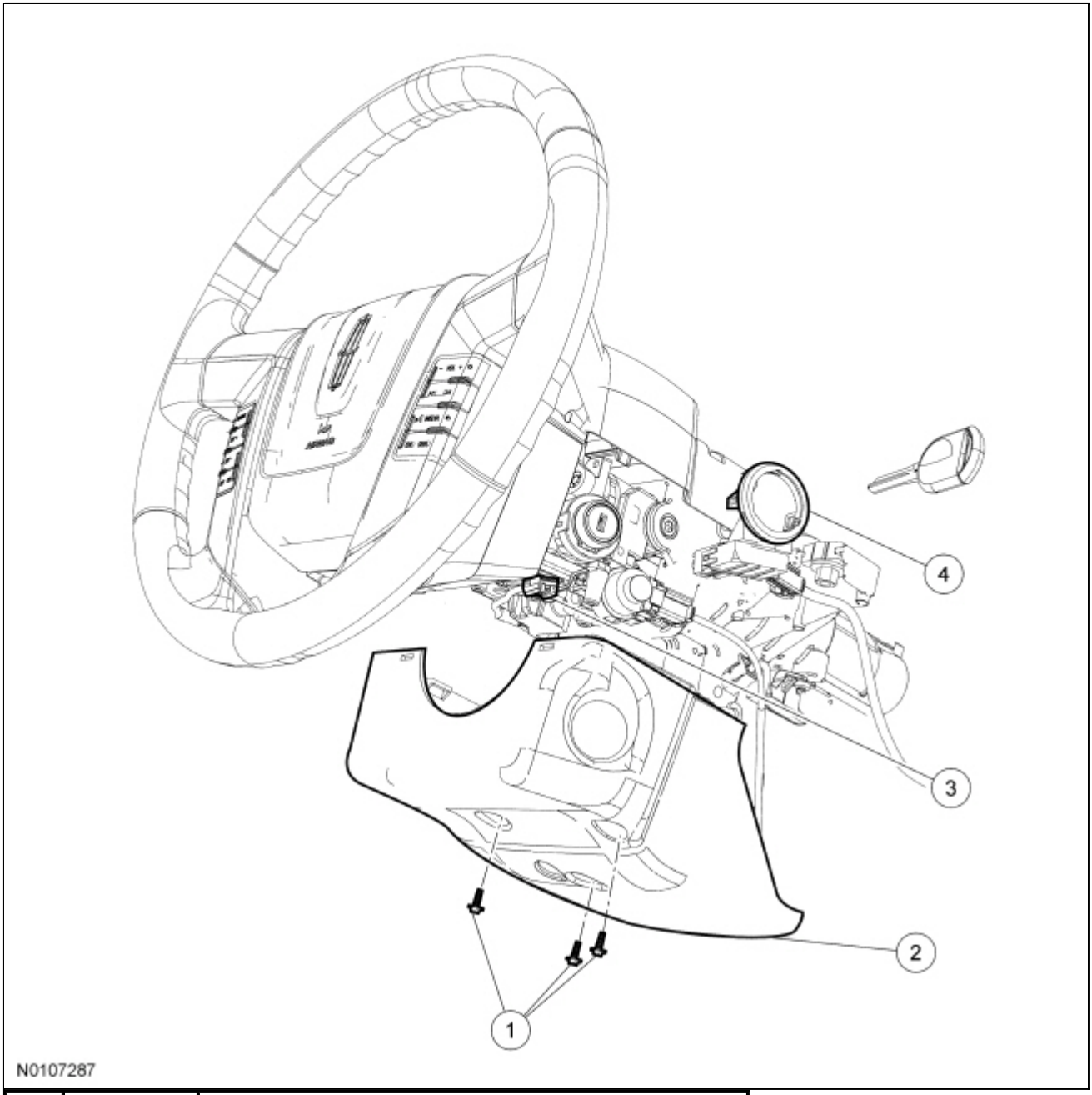
1. Turn the key from the OFF position to the RUN position.

2. From the scan tool, enter TOOLBOX. Select BODY — SECURITY — PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS.

3. **NOTE:** If the Body Control Module (BCM) was replaced on vehicles equipped with PATS , at least two keys must be programmed to the BCM . After completing step 3, do not disconnect the scan tool and follow the Erase All Keys and Program Two Keys procedure.

   From the scan tool, select "Parameter Reset" and follow the IDS on-screen instructions.

Passive Anti-Theft System (PATS) Transceiver



Item	Part Number	Description
1	W710485-S	Steering column shroud screws (3 required)
2	3533	Steering column shroud, lower
3	—	Passive Anti-Theft System (PATS) transceiver electrical connector (part of 14401)

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4	15607	PATS transceiver

Removal and Installation

1. Remove the 3 screws and the lower steering column shroud.
2. Disconnect the Passive Anti-Theft System (PATS) transceiver electrical connector.
3. Using a suitable tool (such as a dentist pick), pry the PATS transceiver tangs outward and remove the PATS transceiver.
4. **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the Instrument Cluster (IC) again.

   To install, reverse the removal procedure.

Universal Transmitter

Functional Components

The only functional component of the universal transmitter system is the universal transmitter, which is part of the LH sun visor.

System Operation

The universal transmitter provides a convenient way to substitute up to 3 hand-held transmitters with a single built-in device. The universal transmitter can learn the radio frequency codes of most current transmitters. The universal transmitter:

- operates garage doors, gates and home/office lighting and security systems.
- learns and transmits the radio frequency of up to 3 hand-held transmitters from any of the systems mentioned above.
- is powered by the vehicle battery and charging system.

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Universal Transmitter

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Universal transmitter	• Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The universal transmitter is inoperative	• Interior lamps concern • Universal transmitter (part of the LH sun visor)	• GO to Pinpoint Test A .

Pinpoint Tests

Pinpoint Test A: The Universal Transmitter is Inoperative

Normal Operation

The universal transmitter and LH vanity mirror lamp share the same circuits. Both components are part of the LH sun visor.

This pinpoint test is intended to diagnose the following:

- Interior lamps concern
- Universal transmitter (part of the LH sun visor)

PINPOINT TEST A: THE UNIVERSAL TRANSMITTER IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK FOR VOLTAGE TO THE UNIVERSAL TRANSMITTER • Check the illumination of the universal transmitter by pressing one of the buttons. • **Does the red indicator on the universal transmitter illuminate?**	**Yes** GO to A2 . **No** GO to A3 .
A2 PROGRAM A HAND-HELD TRANSMITTER TO THE UNIVERSAL TRANSMITTER • Program the universal transmitter. Refer to the Owner's Literature. • **Does the universal transmitter program successfully?**	**Yes** The universal transmitter is OK. VERIFY the receiver unit operates correctly. **No** INSTALL a new LH sun visor assembly. REFER to Headliner — Exploded View in Section 501-05 . TEST the system for normal operation.
A3 CHECK THE OPERATION OF THE LH VANITY MIRROR LAMP • Verify the operation of the LH vanity mirror lamp. Refer to Section 417-02 . • **Does the LH vanity mirror lamp operate correctly?**	**Yes** INSTALL a new LH sun visor assembly. REFER to Headliner — Exploded View in Section 501-05 . TEST the system for normal operation. **No** REFER to Section 417-02 to continue diagnosis.

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Universal Transmitter Programming

Lear Car2U® Transmitter Programming (Rolling Code)

WARNING: To avoid the risk of serious injury from the door closing, make sure that people and objects are clear of the garage door opener or security device that is being programmed. When programming a garage door, it is advised to park outside of the garage.

NOTE: Read the instructions completely before attempting to program the Lear Car2U® System. Because of the steps involved, it may be helpful to have an assistant when programming the universal transmitter. Programming the rolling code garage door opener involves time-sensitive actions. Read the entire procedure before beginning so the procedure can be carried out in a timely fashion. If the time-sensitive actions are not carried out in a timely fashion, the device times out and the procedure needs to be repeated.

NOTE: Make sure to keep the original remote control transmitter for use in other vehicles as well as for future Lear Car2U® System programming. It is only needed for fixed code device programming.

NOTE: In order to determine if you have a fixed code or a rolling code device, open the garage door opener transmitter and if there is a panel of coded dip switches present, the device is a fixed code device. Refer to Lear Car2U® Transmitter Programming (Fixed Code) procedure in this section. If there are no coded dip switches present, the device is a rolling code device and this procedure should be followed. If necessary, contact the Lear Car2U® Customer Service Center at 866-572-2728, or the customer support website at www.learcar2u.com .

1. Turn the ignition to the ON position.

2. Firmly press the 2 outside Lear Car2U® System buttons (at the same time) for 1-2 seconds, then release the buttons.

3. **NOTE:** Step 4 must be initiated within 30 seconds of pressing and releasing the "learn" or "smart" button.

   At the garage door opener receiver (the motor-head unit) in the garage, locate the "learn" or "smart" button. This can usually be found near where the hanging antenna wire is attached to the motor-head unit; or it may be under the light bulb cover of the motor-head unit. Press and release the "learn" or "smart" button.
   - For technical assistance, refer to the Owner's Literature. If necessary, contact the Lear Car2U® Customer Service Center at 866-572-2728, or the customer support website at www.learcar2u.com .

4. Return to the vehicle and firmly press and hold for 5-20 seconds the universal transmitter button that is desired to be programmed. During this time, the selected button red indicator light blinks slowly. Once the garage door begins to move, within one second, release the button. With the button released, the red indicator light begins to blink rapidly until programming is complete. Repeat the press/hold/release sequence a second time and depending on the brand of the garage door opener (or other rolling code equipped device), repeat this sequence a third time to complete the programming process.

5. After successful programming, the Lear Car2U® System operates the garage door opener using the

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button that was programmed. The red indicator light behind the programmed button illuminates to confirm the Lear Car2U® System is responding (and is programmed) to the button command.

Erasing the Lear Car2U® System Buttons (Rolling Code)

1. To erase the rolling code programming from the Lear Car2U® System, turn the ignition key to the ON position, firmly press and hold the 2 outside Lear Car2U® System buttons at the same time for approximately 20 seconds until the 3 red indicator lights begin to blink rapidly.

2. When the 3 red indicator lights begin to blink, release the buttons. The codes for all of the 3 buttons are erased.

Lear Car2U® Transmitter Programming (Fixed Code)

WARNING: To avoid the risk of serious injury from the door closing, make sure that people and objects are clear of the garage door opener or security device that is being programmed. When programming a garage door, it is advised to park outside of the garage.

NOTE: Do not use the Lear Car2U® System with any garage door opener that does not have a "stop and reverse" feature. This includes any garage door opener model manufactured before April 1, 1982.

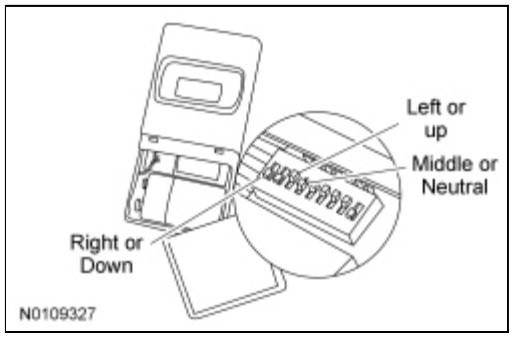
NOTE: Read the instructions completely before attempting to program the Lear Car2U® System. Because of the steps involved, it may be helpful to have an assistant when programming the universal transmitter.

NOTE: Make sure to keep the original remote control transmitter for use in other vehicles as well as for future Lear Car2U® System programming. It is only needed for fixed code device programming.

NOTE: In order to determine if you have a fixed code or a rolling code device, open the garage door opener transmitter and if there is a panel of coded dip switches present, the device is a fixed code device. If there are no coded dip switches present, the device is a rolling code device. Refer to Lear Car2U® Transmitter Programming (Rolling Code) procedure in this section.

NOTE: In order to program a fixed code device, paper and a pen (or pencil) is necessary. Use the Switch Settings chart in Specifications as a note pad.

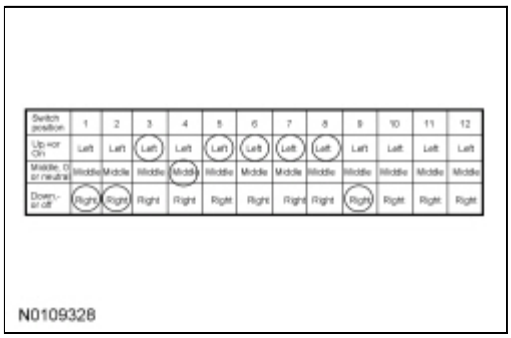
1. Open the battery cover of the universal transmitter to reveal the coded dip switches and their associated settings.



2. **NOTE:** When a coded dip switch is in the up, +, or on position, circle "Left" on the chart under the

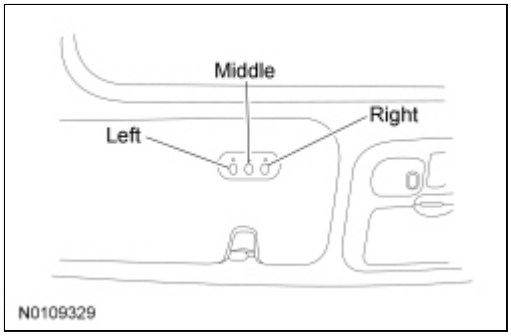
correct switch position number. When a switch is in the middle, 0 or neutral position, circle "Middle" on the chart. When a switch is in the down, -, or off position, circle "Right" on the chart.

Record the dip switch settings on the copy of the switch settings chart by circling the setting under the correct switch position number. Do this from left to right for all 8 to 12 switches (the number of switches varies between transmitter manufacturers). For additional information, refer to the chart below or to the Switch Settings chart in Specifications in this section.



3. Turn the ignition to the ON position.

4. To input the dip switch settings into the Lear Car2U® System, press (at the same time) all 3 Lear Car2U® System buttons for a few seconds and then release to put the device into the programming mode. The 3 red indicator lights blink slowly. Within 2.5 minutes, enter the corresponding dip switch settings from left to right (starting with number 1) into the Lear Car2U® System by pressing and releasing the buttons corresponding to the settings you circled.
    - For example, if the dip switch settings were switch 1 (Right), switch 2 (Right), switch 3 (Left), switch 4 (Middle) etc., press and release the right Lear Car2U® System button, then the right button, then the left button, then the middle button, etc.



5. After inputting the dip switch settings, press and release (at the same time) all 3 Lear Car2U® System buttons. The 3 red indicator lights are turned on continuously.

6. Press and hold the Lear Car2U® System button chosen to control the garage door.

7. Once the garage door starts to move, within one second, release the button. During this time, the selected button indicator light blinks slowly. Do not release the button until the garage door moves, which may take anywhere from 5-55 seconds, depending on the make/model of the garage door opener.

8. The 3 red indicator lights begin to blink rapidly until programming is complete. If the garage door opener does not operate, repeat Steps 1-7.
    - For technical assistance, refer to the Owner's Literature. If necessary, contact the Lear Car2U® Customer Service Center at 866-572-2728, or the customer support website at

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www.learcar2u.com .

9. After successful programming, the Lear Car2U® System operates the garage door opener using the button that was programmed. The red indicator light behind the programmed button turns on to confirm the Lear Car2U® System is responding (and is programmed) to the button command.

Erasing the Lear Car2U® System Buttons (Fixed Code)

1. To erase the fixed code programming from the Lear Car2U® System, turn the ignition key to the ON position, firmly press and hold the 2 outside Lear Car2U® System buttons at the same time for approximately 20 seconds until the 3 red indicator lights begin to blink rapidly.

2. When the 3 red indicator lights begin to blink, release the buttons. The codes for all of the 3 buttons are erased.

Cruise Control

The cruise control system consists of the following components:

- Cruise control switches (integral to the LH steering wheel switch)
- Cruise control indicator
- Clockspring
- Electronic Throttle Body (ETB)
- PCM
- Stoplamp switch
- Steering Column Control Module (SCCM) (located on the steering column)

During normal driving the vehicle speed can vary slightly from the set speed due to road conditions. The vehicle speed can fluctuate when driving up and down a steep hill. If the vehicle speed decreases more than 16 km/h (10 mph) below the set speed, the cruise control disengages.

When a My Key® is in use vehicle speed is limited to 130 km/h (80 mph).

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Cruise Control

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The cruise control system is controlled by the PCM. The cruise control system is designed to maintain a selected vehicle speed between 40 km/h (25 mph) and the maximum limited vehicle speed. The cruise control system is controlled by the cruise control switches (ON/OFF, SET+, SET-, and CNCL/RSM) that are integrated into the LH steering wheel switch, and by the brake pedal. The cruise control switches are hardwired to the Steering Column Control Module (SCCM). The SCCM sends High Speed Controller Area Network (HS-CAN) messages to the PCM to control the cruise control system.

The clockspring provides the electrical interface between the steering column wiring and the cruise control switches in the steering wheel.

The cruise control functions include:

- turning on the cruise control system.
- setting and maintaining the desired vehicle speed.
- accelerating the vehicle speed.
- coasting down to a lower speed.
- resuming the prior vehicle speed.
- turning off the cruise control system.

Pressing and releasing the ON/OFF switch turns the cruise control system on. The cruise control indicator located in the Instrument Panel Cluster (IPC) illuminates amber to indicate the cruise control system is in

standby mode. Pressing and releasing the SET+ or SET- switch while the vehicle is traveling at the desired speed activates the cruise control system. The cruise control indicator illuminates green to indicate the cruise control system is active.

Tapping the SET+ or the SET- switch while in the set mode, increases or decreases the maintained vehicle speed by 1.6 km/h (1 mph) per tap. If the respective switch is pressed and held, the vehicle speed continues to accelerate or decelerate until the switch is released.

Pressing and releasing the ON/OFF switch, or turning the ignition switch to the OFF position, turns the cruise control system off. Applying the brake pedal or pressing the CNCL/RSM switch while the cruise control system is active, puts the cruise control system into the standby mode. Pressing the CNCL/RSM switch when the cruise control system is in the standby mode causes the vehicle to accelerate to the last set speed. Resume does not function if the ON/OFF switch is pressed, the ignition switch is in the OFF position, or if the current vehicle speed is below the minimum operational speed.

The cruise control deactivator switch is an additional safety feature. Normally, when the brake pedal is applied, an electrical signal from the stoplamp circuit to the PCM deactivates the system. Under increased brake pedal effort, the cruise control deactivator switch opens and removes the ground signal (3.7L, 5.0L, 6.2L engine) or reference voltage (3.5L engine) from the PCM input circuit, and the PCM commands the throttle body closed.

The inputs to the PCM are:

- Output Shaft Speed (OSS) sensor
- Digital Transmission Range (TR) sensor
- Cruise control switch(es) (networked from SCCM)
- Cruise control deactivator switch (integral to the stoplamp switch)
- Stoplamp switch
- Accelerator Pedal Position (APP) sensor
- Vehicle speed (networked from ABS module)

The outputs of the PCM are:

- Cruise control indicator lamp request to the IPC
- Throttle body

The vehicle speed is controlled by the PCM through the Electronic Throttle Control (ETC) subsystem.

In the event of an ON/OFF switch command or a deactivation request from the deactivator switch, the cruise control system carries out a deactivation and immediately returns the throttle to the idle position.

The cruise control system provides self-diagnostics. Cruise control is disabled anytime an error is detected in the system. No IPC indicator or message center messages are displayed when faults occur. Fault codes are logged by the PCM or SCCM .

An ETC system fault also disables the cruise control system. In this case, an ETC system powertrain malfunction (wrench) warning indicator is displayed.

Additionally, the following conditions cause the cruise control system to deactivate:

- Transmission gear selector in a position other than D or OD
- Cruise control set speed is overridden with the accelerator pedal for a period longer than 5 minutes
- Vehicle speed loss from set speed of greater than 16 km/h (10 mph) occurs
- Vehicle speed falls below the minimum allowable limit of 40 km/h (25 mph)

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- Cruise control switch pressed or stuck longer than 2 minutes
- ABS fault

Cruise Control Deactivation Event PIDs

The PCM has PIDs available, through the powertrain DataLogger, that show what caused the cruise control deactivation during the current key cycle. The PCM has 24 cruise control deactivation event PIDs, identified as CRUISEOFF_00 through 24. All deactivation events that occur during active cruise operation are listed in the event PID. Switching the ignition off will erase all recorded deactivation events. These PIDs display what caused the cruise control deactivation to trigger and can be a very useful tool when trying to identify the cause of a deactivation or non-activation trigger. The event PIDs displays the deactivation or non-activation trigger based on when the cruise control is turned on and the fault condition exist. If the cruise control system is turned on or off prior to or in advance to the triggering condition, the events PIDs may display inaccurate deactivation conditions. The event PIDs should be read when the conditions of deactivation or non-activation exist.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Throttle body	• Battery Junction Box (BJB) fuse 46 (10A) • Wiring, terminals or connectors • Cruise control switch(es) (part of the LH steering wheel switch) • Stoplamp switch • PCM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.

- verify the scan tool operation with a known good vehicle.
- refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM and SCCM .

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

PCM DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTCs	Description	Action
P0504:00	Brake Switch A / B Correlation: No Sub Type Information	GO to Pinpoint Test B .
P0572:00	Brake Switch A Circuit Low: No Sub Type Information	GO to Pinpoint Test B .
P0573:00	Brake Switch A Circuit High: No Sub Type Information	GO to Pinpoint Test B .
P0579:00	Cruise Control Multifunction Input "A" Circuit Range/Performance	GO to Pinpoint Test C .
P1703:00	Brake Switch Out Of Self-Test Range: No Sub Type Information	GO to Pinpoint Test B .
P193D:00	Cruise Control Multi-Function Input Signal: No Sub Type Information	GO to Pinpoint Test D .
All other DTCs	—	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

SCCM DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

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DTCs	Description	Action
B137F:09	Steering Wheel Left Switch Pack: Component Failure	GO to Pinpoint Test C .
B137F:11	Steering Wheel Left Switch Pack: Circuit Short To Ground	GO to Pinpoint Test C .
B137F:17	Steering Wheel Left Switch Pack: Circuit Voltage Above Threshold	GO to Pinpoint Test C .
All other DTCs	—	REFER to the Diagnostic Trouble Code (DTC) Charts in Section 211-05 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The cruise control is inoperative	• Cruise control switches (part of the LH steering wheel switch) • Stoplamp switch • Cruise control deactivator switch (integral to the stoplamp switch) • Digital Transmission Range (TR) sensor • PCM • Steering Column Control Module (SCCM) • ABS fault	• GO to Pinpoint Test A .
• The cruise control indicator lamp is never/always on	• Instrument Panel Cluster (IPC) • PCM	• REFER to Section 413-01 .
• The cruise control switches do not operate correctly	• Wiring, terminals or connectors • Clockspring • Cruise control switches (part of the LH steering wheel switch) • SCCM	• GO to Pinpoint Test C .
• The cruise control cannot set speed above 130 km/h (80 mph)	• A MyKey® restricted key is in use and MyKey® speed limiter is turned on	• VERIFY if a MyKey® restricted key is in use. REFER to Section 419-01B . With an administrator key, VERIFY if MyKey® speed limiter is turned on. REFER to the Owner's Literature. If necessary, VERIFY

		cruise control normal operation with an administrator key.

Pinpoint Tests

Pinpoint Test A: The Cruise Control Is Inoperative

Normal Operation

The cruise control switches, which are integral to the LH steering wheel switch, use the Steering Column Control Module (SCCM) run/start voltage and the SCCM ground. The cruise control functionality is controlled through the cruise control switches, which are hardwired to the SCCM through signal and return circuits.

There are 4 cruise control switches with each switch operating a specific function that uses different resistance values. The SCCM sends out a reference voltage to the cruise control switches and monitors the voltage drop when a cruise control switch is pressed. The voltage drop varies depending upon the resistance of each switch, providing a specific indication to the SCCM of which switch is pressed. The SCCM sends a network message to the PCM over the High Speed Controller Area Network (HS-CAN), activating and controlling the cruise control system.

The stoplamp switch is a single plunger 2-stage switch with 2 inputs to the PCM. When the brake pedal is applied, the first stage, which is a normally open stoplamp switch, closes and sends a voltage signal to the PCM deactivating the cruise control, if engaged. The second stage is the normally closed cruise control deactivator switch (integral to the stoplamp switch), which opens and removes the ground signal to the PCM when the brake pedal is firmly applied. This is a redundant signal to the PCM. There is less than one millimeter in plunger travel between the first and second stage.

The PCM has cruise control deactivation event PIDs available, through the powertrain datalogger, that show what caused the cruise control deactivation during the current key cycle. Refer to Cruise Control Deactivation Event PIDs in this section.

This pinpoint test is intended to diagnose the following:

- Cruise control switches (part of the LH steering wheel switch)
- Stoplamp switch
- Cruise control deactivator switch (integral to the stoplamp switch)
- Digital Transmission Range (TR) sensor
- PCM
- SCCM
- ABS fault

PINPOINT TEST A: THE CRUISE CONTROL IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK FOR DTCs	
• Review the recorded DTCs from the PCM and SCCM self-test.	**Yes** REFER to DTC Charts in this section.

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- **Are any DTCs recorded?**

No
GO to A2.

A2 CHECK FOR ABS MODULE DTCs

- Review the recorded DTCs from the ABS module self-test.
- **Are any DTCs recorded?**

Yes
REFER to Section 206-09. REPAIR all ABS module DTCs and RETEST the system.

No
GO to A3.

A3 CHECK THE STOPLAMP SWITCH (BOO1 AND BOO2) PIDs

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: PCM DataLogger.
- Monitor the PCM PIDs BOO1 (stoplamp switch) and BOO2 (cruise control deactivator switch) while applying and releasing the brake pedal as follows:

Brake Pedal Position	BOO1 PID	BOO2 PID
Released	Off	Off
Applied lightly	On	Off
Applied firmly	On	On

- **Do the PID values agree with the brake pedal position?**

Yes
GO to A4.

No
GO to Pinpoint Test B.

A4 MONITOR THE PRNDL DISPLAY

- Monitor the PRNDL display in the Instrument Panel Cluster (IPC).
- Select DRIVE.
- **Does the PRNDL display agree with the TR selector lever position?**

Yes
GO to A5.

No
REFER to Section 413-01, to continue diagnosis of the PRNDL display.

A5 CHECK THE CRUISE CONTROL SWITCH

- Enter the following diagnostic mode on the scan tool: SCCM DataLogger.
- Press each cruise control switch button while monitoring the cruise control switch PID (SCCS).

Cruise Control Switch	SCCS PID Value
—	NONE Pressed
CNCL/RSM	RESUME/COAST
ON/OFF	Cruise Off or Cruise On
SET +	SET +
SET -	SET -

- **Does the PID value agree with the switch position?**

Yes
GO to A6.

No
If only one switch does not display the correct PID value, INSTALL a new cruise control switch. REFER to Section 211-05. TEST the system for normal operation.

Otherwise, GO to Pinpoint Test C.

A6 CHECK FOR CORRECT PCM OPERATION

• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: DTC P0504:00, P0572:00, P0573:00 Or P1703:00

Refer to Wiring Diagrams Cell 31 , Cruise Control for schematic and connector information.

Normal Operation

The stoplamp switch is a single plunger 2-stage switch with 2 inputs to the PCM. When the brake pedal is applied, the first stage, which is a normally open stoplamp switch, closes and sends a voltage signal to the PCM deactivating the cruise control, if engaged. The second stage is the normally closed cruise control deactivator switch (integral to the stoplamp switch), which opens and removes the ground signal (3.7L, 5.0L and 6.2L engine) or reference voltage (3.5L engine) to the PCM when the brake pedal is firmly applied. This is a redundant signal to the PCM. There is less than one millimeter in plunger travel between the first and second stage.

DTC Description	Fault Trigger Conditions
P0504:00 — Brake Switch A / B Correlation: No Sub Type Information	A DTC that sets when the PCM does not sense the correct sequence of the brake pedal input signal from both the cruise control deactivator and stoplamp switches when the brake pedal is pressed and released.
P0572:00 — Brake Switch A Circuit Low: No Sub Type Information	A DTC that sets when the PCM detects an open in the stoplamp switch signal. The PCM monitors the vehicle speed, the engine speed, the engine torque and the stoplamp BOO input during start and stop driving cycles. If the BOO input to the PCM is always off during start and stop driving cycles this DTC sets in continuous memory.
P0573:00 — Brake Switch A Circuit High: No Sub Type Information	A DTC that sets when the PCM detects an short to voltage on the stoplamp switch signal. The PCM monitors the vehicle speed, the engine speed, the engine torque and the stoplamp BOO input during start and stop driving cycles. If the BOO input to the PCM is always on during start and stop driving cycles this DTC sets in continuous memory.
P1703:00 — Brake Switch Out Of Self -Test Range: No Sub Type Information	A DTC that sets in the PCM during the self-test, when the brake switch input signal is high or does not cycle high and low.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Stoplamp switch
- Cruise control deactivator switch (integral to the stoplamp switch)
- PCM

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- ABS module

PINPOINT TEST B: DTC P0504:00, P0572:00, P0573:00 Or P1703:00

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 CHECK THE OPERATION OF THE STOPLAMPS
• Ignition ON.
• Operate the stoplamps.
• Do the stoplamps and high mounted stoplamp operate correctly?</td><td>Yes
GO to B2 .

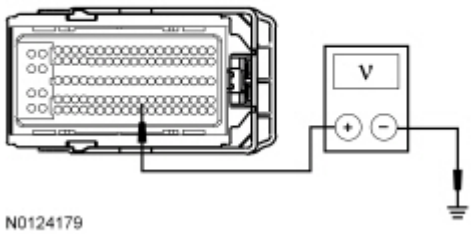
No
REFER to Section 417-01 , to continue diagnosis of the stoplamps.</td></tr>
<tr><td>B2 CHECK THE STOPLAMP SWITCH (BOO1) AND CRUISE CONTROL DEACTIVATOR SWITCH (BOO2) PIDs
• Enter the following diagnostic mode on the scan tool: PCM DataLogger.
• Monitor the PCM PIDs BOO1 (stoplamp input) and BOO2 (cruise control deactivator switch) while applying and releasing the brake pedal as follows:
<table><tr><th>Brake Pedal Position</th><th>BOO1 PID</th><th>BOO2 PID</th></tr><tr><td>Released</td><td>Off</td><td>Off</td></tr><tr><td>Applied lightly</td><td>On</td><td>Off</td></tr><tr><td>Applied firmly</td><td>On</td><td>On</td></tr></table>• Do the PID values agree with the brake pedal position?</td><td>Yes
GO to B7 .

No
For an incorrect BOO1 PID value, GO to B3 .

For an incorrect BOO2 PID value (3.5L engine), GO to B8 .

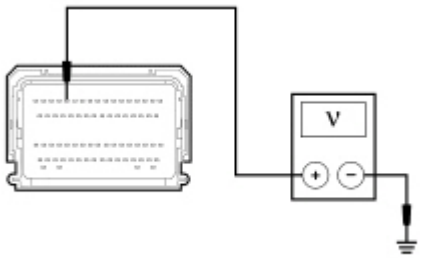
For an incorrect BOO2 PID value (3.7L, 5.0L and 6.2L engines), GO to B4 .</td></tr>
<tr><td>B3 CHECK THE STOPLAMP SWITCH CIRCUIT FOR VOLTAGE
• Ignition OFF.
• Disconnect: PCM C1551B (3.5L), C175B (3.7L) or PCM C1381B (5.0L/6.2L).
• Ignition ON.
• For 3.5L engine, while applying the brake pedal, measure the voltage between the PCM C1551B-66, circuit CCB08 (VT/WH), harness side and ground.</td><td>Yes
GO to B12 .

No
REPAIR the circuit for an open. CLEAR the DTCs. REPEAT the self-test.</td></tr>
</table>



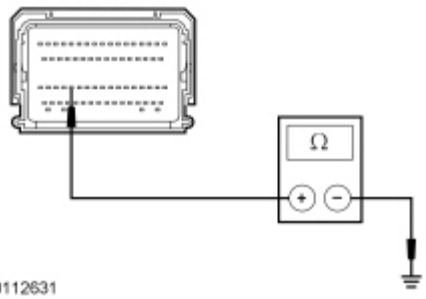
N0124179

- For 3.7L, 5.0L and 6.2L engines, while applying the brake pedal, measure the voltage between the PCM C175B-13 (3.7L) or C1381B-13 (5.0L/6.2L), circuit CCB08 (VT/WH), harness side and ground.

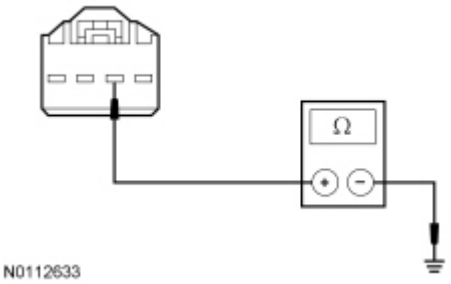
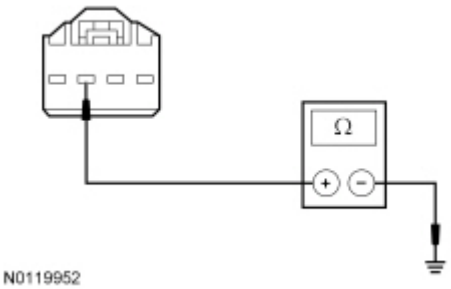
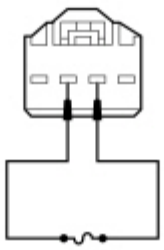


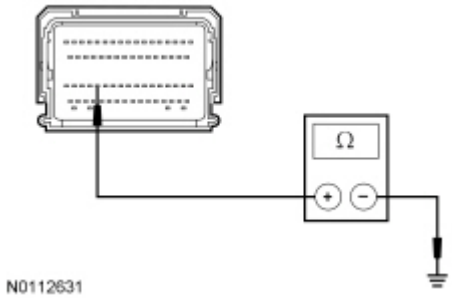
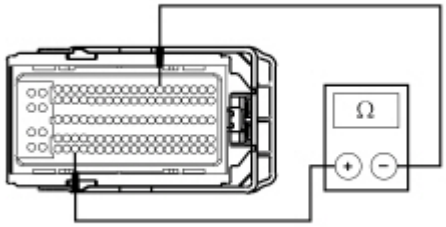
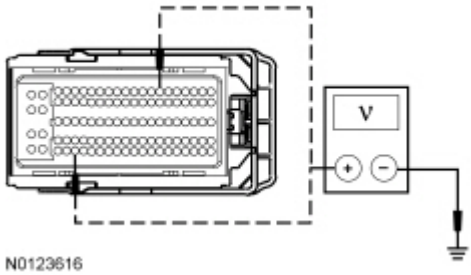
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- **Is the voltage greater than 10 volts with the brake pedal applied?**

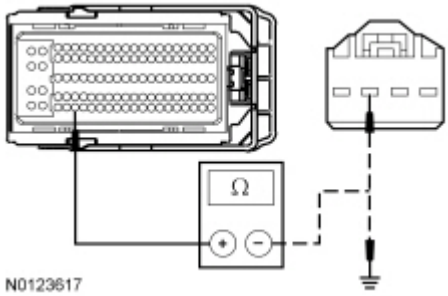
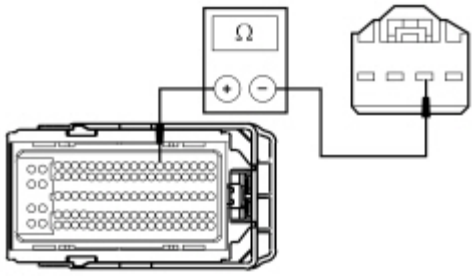
B4 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH FOR CORRECT OPERATION (3.7L, 5.0L and 6.2L)	
• Disconnect: PCM C175B (3.7L) or PCM C1381B (5.0L/6.2L). • While firmly applying and releasing the brake pedal, measure the resistance between the PCM C175B-46 (3.7L) or C1381B-46 (5.0L/6.2L), circuit CES09 (VT/OG), harness side and ground.  N0112631 • **Is the resistance less than 5 ohms with the brake pedal released, and greater than 10,000 ohms with the brake pedal firmly applied?**	**Yes** GO to B12 . **No** GO to B5 .
B5 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Stoplamp Switch C278. • Measure the resistance between the stoplamp switch C278-2, circuit GD120 (BK/GN), harness side and ground.	**Yes** GO to B6 . **No** REPAIR the circuit for an open. CLEAR the DTCs.

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 N0112633 • **Is the resistance less than 5 ohms?**	TEST the system for normal operation.
B6 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between the stoplamp switch C278-3, circuit CES09 (VT/OG), harness side and ground.  N0119952 • **Is the resistance less than 5 ohms?**	**Yes** GO to B7 . **No** REPAIR the circuit for an open. CLEAR the DTCs. TEST the system for normal operation.
B7 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH SIGNAL CIRCUIT FOR AN OPEN	
• Connect a fused jumper wire between the stoplamp switch C278-3, circuit CES09 (VT/OG), harness side and the stoplamp switch C278-2, circuit GD120 (BK/GN), harness side.  N0112634 • Measure the resistance between the PCM C175B-46 (3.7L) or C1381B-46 (5.0L/6.2L), circuit CES09 (VT/OG), harness side and ground.	**Yes** INSTALL a new stoplamp switch. REFER to Section 417-01 . CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR circuit CES09 (VT/OG) for an open. CLEAR the DTCs. TEST the system for normal operation.

 N0112631 • **Is the resistance less than 5 ohms?**	
B8 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH FOR CORRECT OPERATION (3.5L)	
• Ignition OFF. • Disconnect: PCM C1551B . • While firmly applying and releasing the brake pedal, measure the resistance between the PCM C1551B-93, circuit CES09 (VT/OG), harness side and the PCM C1551B-7, circuit RE407 (YE/VT), harness side.  N0123615 • **Is the resistance less than 5 ohms with the brake pedal released, and greater than 10,000 ohms with the brake pedal firmly applied?**	**Yes** GO to B9 . **No** GO to B10 .
B9 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Stoplamp Switch C278. • Ignition ON. • Measure the voltage between the PCM C1551B-93, circuit CES09 (VT/OG), harness side and ground; and the PCM C1551B-7, circuit RE407 (YE/VT), harness side and ground.  N0123616 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation. **No** GO to B12 .
B10 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH	

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SIGNAL CIRCUIT FOR AN OPEN OR SHORT TO GROUND • Ignition OFF. • Measure the resistance between the PCM C1551B-93, circuit CES09 (VT/OG), harness side and the stoplamp switch C278-3, circuit CES09 (VT/OG) harness side; and the PCM C1551B-93, circuit CES09 (VT/OG), harness side and ground.  N0123617 • **Is the resistance less than 5 ohms between the PCM and the stoplamp switch and greater than 10,000 ohms between the PCM and ground?**	**Yes** GO to B11 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
B11 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH SIGNAL RETURN CIRCUIT FOR AN OPEN • Measure the resistance between the PCM C1551B-7, circuit RE407 (YE/VT), harness side and the stoplamp switch C278-2, circuit RE407 (YE/VT) harness side.  N0123618 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new stoplamp switch. REFER to Section 417-01 . CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.

B12 CHECK FOR CORRECT PCM OPERATION
• Connect: All Disconnected Connectors.
• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Cruise Control Switches Do Not Operate Correctly

Refer to Wiring Diagrams Cell 31 , Cruise Control for schematic and connector information.

Normal Operation

The cruise control switches, which are integral to the LH steering wheel controls, use the Steering Column Control Module (SCCM) run/start voltage and the SCCM ground. The cruise control functionality is controlled through the cruise control switches and is hardwired to the SCCM through a signal and return circuit.

There are 4 cruise control switches with each switch operating a specific function that uses different resistance values. The SCCM sends out a reference voltage to the cruise control switches and monitors the voltage drop when a cruise control switch is pressed. The voltage drop varies depending upon the resistance of each switch, providing a specific indication to the SCCM of which switch is pressed. The SCCM sends a network message to the PCM over the High Speed Controller Area Network (HS-CAN) relaying the switch status and requesting cruise control operation.

The PCM has cruise control deactivation event PIDs available, through the powertrain datalogger, that show what caused the cruise control deactivation during the current key cycle. Refer to Cruise Control Deactivation Event PIDs in this section.

Powertrain Control Module (PCM)

- P0579:00 (Cruise Control Multifunction Input "A" Circuit Range/Performance) — sets when the cruise control switch circuits are open, shorted to voltage or ground.

SCCM

- B137F:09 (Steering Wheel Left Switch Pack: Component Failure) — a continuous and on-demand DTC that sets when one or more of the cruise control switches are stuck.
- B137F:11 (Steering Wheel Left Switch Pack: Circuit Short To Ground) — a continuous and on-demand DTC that sets when the cruise control switch circuits are shorted to ground.
- B137F:17 (Steering Wheel Left Switch Pack: Circuit Voltage Above Threshold) — a continuous and on-demand DTC that sets when the cruise control switch circuits are shorted to voltage.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clockspring
- Cruise control switches (part of the LH steering wheel switch)
- SCCM
- PCM

PINPOINT TEST C: THE CRUISE CONTROL SWITCHES DO NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK THE CRUISE CONTROL SWITCH	
• Enter the following diagnostic mode on the scan tool: SCCM DataLogger. • Press each cruise control switch button while monitoring the cruise control switch PID (SCCS).	**Yes** GO to C5 . **No**

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Cruise Control Switch	SCCS PID Value
—	NONE Pressed
CNCL/RSM	RESUME/COAST
ON/OFF	Cruise Off or Cruise On
SET +	SET +
SET -	SET -

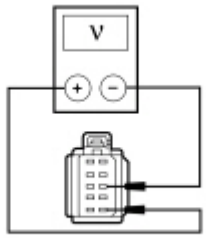
- **Does the PID value agree with the switch position?**

If only one switch does not display the correct PID value, INSTALL a new LH steering wheel switch. REFER to Section 211-05 . TEST the system for normal operation.

Otherwise, GO to C2 .

C2 CHECK FOR VOLTAGE TO THE CRUISE CONTROL SWITCHES

- Ignition OFF.
- Disconnect: LH Steering Wheel Controls C2998.
- Ignition ON.
- Measure the voltage between the LH steering wheel switch C2998-5, harness side and the LH steering wheel switch C2998-3, harness side.



N0120425

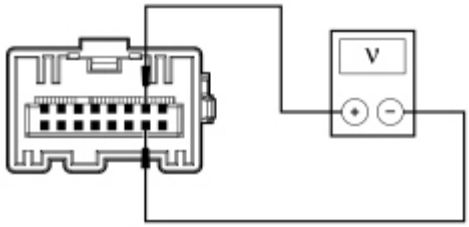
- **Is the voltage approximately 5 volts?**

Yes
INSTALL a new LH steering wheel controls. REFER to Section 211-05 . CLEAR the DTCs. TEST the system for normal operation.

No
GO to C3 .

C3 CHECK FOR VOLTAGE TO THE CLOCKSPRING

- Ignition OFF.
- Remove the driver air bag module. Refer to Section 501-20B .
- Disconnect: Clockspring C218B.
- Ignition ON.
- Measure the voltage between the clockspring connector C218B pin 7, component side and the clockspring C218B pin 15, component side.



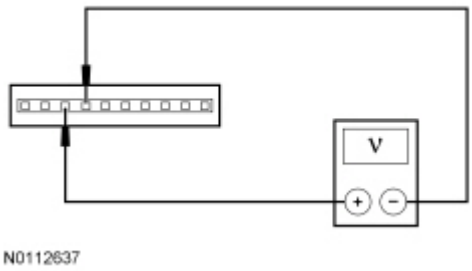
N0120426

- **Is the voltage approximately 5 volts present?**

Yes
REPAIR the steering wheel harness or INSTALL a new steering wheel. REFER to Section 211-04 . INSTALL the driver air bag module. REFER to Section 501-20B . TEST the system for normal operation.

No
GO to C4 .

C4 CHECK FOR VOLTAGE AT THE SCCM

• Ignition OFF. • Remove the clockspring. Refer to Section 501-20B . • Ignition ON. • Measure the voltage between the SCCM C2414D-8 , component side and the SCCM C2414D-7, component side.  N0112637 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation. **No** GO to C5 .
C5 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect all the SCCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the SCCM connectors and make sure they seat correctly.
• Connect: All Disconnected Connectors.
• Install the driver air bag module. Refer to Section 501-20B .
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new SCCM . REFER to Section 211-05 . INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. TEST the system for normal operation.
	
	If DTC P0579 is still present, GO to C6 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

C6 CHECK FOR CORRECT PCM OPERATION	

• Connect: All Disconnected Connectors.
• Disconnect all the PCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the PCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: DTC P193D:00

Normal Operation

- DTC P193D:00 (Cruise Control Multi-Function Input Signal: No Sub Type Information) — sets when the PCM is not receiving the High Speed Controller Area Network (HS-CAN) signal from the Steering Column Control Module (SCCM) for the cruise control switches.

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This pinpoint test is intended to diagnose the following:

- PCM
- SCCM

PINPOINT TEST D: DTC P193D:00

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>D1 CHECK THE CRUISE CONTROL SWITCH PID IN THE PCM
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Powertrain DataLogger — Cruise Control.
• Press each cruise control switch while monitoring the cruise control switch PID (SCCS).
<table><tr><th>Cruise Control Switch</th><th>SCCS PID Value</th></tr><tr><td>—</td><td>NONE Pressed</td></tr><tr><td>CNCL/RSM</td><td>RESUME/COAST</td></tr><tr><td>ON/OFF</td><td>Cruise Off or Cruise On</td></tr><tr><td>SET +</td><td>SET +</td></tr><tr><td>SET -</td><td>SET -</td></tr></table>• Does the PID value agree with the switch position?</td><td>Yes
GO to D2.

No
GO to Pinpoint Test C.</td></tr>
<tr><td>D2 CHECK THE COMMUNICATION NETWORK
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Network Test.
• Carry out the network test.
• Does the SCCM pass the network test?</td><td>Yes
GO to D3.

No
REFER to Section 418-00.</td></tr>
<tr><td>D3 RECHECK THE PCM DTCs
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out.
• Clear the DTCs. Repeat the PCM self-test.
• Is DTC P193D still present?</td><td>Yes
GO to D4.

No
The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</td></tr>
<tr><td>D4 CHECK FOR CORRECT PCM OPERATION
• Connect: All Disconnected Connectors.
• Disconnect all the PCM connectors.
• Check for:
▪ corrosion
▪ damaged pins
▪ pushed-out pins
• Connect all the PCM connectors and make sure they seat correctly.</td><td>Yes
INSTALL a new PCM. REFER to Section 303-14.

TEST the system for normal operation.

No</td></tr>
</table>

• Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

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Torque Specifications

Description	Nm	lb-in
Driver Seat Module (DSM) screws	7	62
Smart Junction Box (SJB) bolts	2	18

Module Controlled Functions

Body Control Module (BCM)

The Body Control Module (BCM) is located behind the RH side cowl trim panel and controls the following:

- Interior lighting
- Exterior lighting
- Dimmable backlighting
- Battery saver function
- Delayed accessory relay function
- Horn
- Brake shift interlock
- Post crash alert function
- Power door locks
- Remote Keyless Entry (RKE) system
- Anti-theft system (perimeter and passive)
- Remote engine start
- Tire Pressure Monitoring System (TPMS)

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

The BCM provides automatic shut-off of some system controlled components after a time-out period in order to save battery voltage. A timer in the BCM is started when the ignition is turned off and all the doors are closed. When 10 minutes have elapsed, the voltage is automatically shut off by the BCM. While the BCM has voltage disabled, if the ignition state is changed to any position other than OFF, any door becomes ajar, the UNLOCK button of the RKE transmitter is pressed, a valid keypad code is entered, or the instrument panel dimmer switch is pressed, the BCM restores voltage and starts the timer again.

Post Crash Alert Function

The post crash alert function is controlled by the BCM. If the Restraints Control Module (RCM) determines an impact of enough severity (the air bags may or may not be deployed), the RCM sends a message to the BCM over the High Speed Controller Area Network (HS-CAN) and the post crash alert function is activated. The post crash alert function activates the hazard lamp function and cycles the horn on 3 times, then off for 4 seconds, and repeats this cycle until the battery is discharged or the function is turned off. The post crash alert function can be turned off by:

- pressing the hazard flasher lamp switch (which may need to be pressed more than once).
- pressing the RKE transmitter UNLOCK button.
- pressing the RKE transmitter PANIC button.

Upfitter System

The upfitter system consists of upfitter relays and switches. The upfitter switches are located on the center console.

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The upfitter switches each have an indicator that illuminates when the switch is in the ON position. The upfitter switches control relays for switching customer installed accessories on and off. The 4 upfitter switches can enable its corresponding relay only when the ignition is in run or accessory.

Upfitter relays 1 and 2 can support up to a 30A output each, upfitter relay 3 can support up to a 15A output and upfitter relay 4 can support up to a 10A output.

Disabling Transport or Factory Mode

Transport Mode

NOTE: During vehicle build, some vehicle modules (Instrument Panel Cluster (IPC), Body Control Module (BCM) and Remote Functions Receiver (RFR) module [if equipped]) are set in factory mode. While in the factory mode, the IPC displays FACTORY MODE CONTACT DEALER in the message center. If the vehicle is set in factory mode, the system does not automatically revert to another mode and must be manually set to either the transport or normal operation mode. When the vehicle build is complete, the vehicle is set to transport mode. While in transport mode, the IPC displays TRANSPORT MODE CONTACT DEALER in the message center. Transport mode is used to reduce the drain on the battery during longer periods where the vehicle is not used. Various systems may be altered or are disabled when in the transport mode. The vehicle automatically reverts to normal operation mode after being driven 201 km (125 mi).

1. Verify the battery is fully charged.

2. To disable or turn off the transport mode, carry out (within 10 seconds):
   - With ignition in RUN, press brake pedal 5 times.
   - Press hazard switch 4 times (on, off, on, off).

Factory Mode

NOTE: During vehicle build, some vehicle modules (IPC , BCM and Remote Functions Receiver (RFR) module [if equipped]) are set in factory mode. While in the factory mode, the IPC displays FACTORY MODE CONTACT DEALER in the message center. If the vehicle is set in factory mode, the system automatically reverts back to normal mode after 60 ignition cycles.

1. Verify the battery is fully charged.

2. Cycle the ignition 60 times.

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Body Control Module (BCM)

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

The Body Control Module (BCM) controls various systems by monitoring inputs from switches, sensors and messages sent from other modules. The BCM activates outputs based on the inputs received. For example, the Steering Column Control Module (SCCM) monitors the headlamp switch and transmits the headlamp switch position to the BCM over the network. Based on this input, the BCM may provide voltage to the exterior lamps.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that, when used with module software, monitors and controls current flow on module outputs. The FET protection strategy prevents module damage in the event of excessive current flow.

The BCM utilizes an FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit is still shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

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When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, DTC U1000:00 should set along with the short circuit DTC that was stored on the first failure. These DTCs cannot be cleared until the vehicle is repaired.

After the repair, it is necessary for the module successfully complete a self-test (the module no longer detects the fault), to clear the DTCs using the Clear DTC operation on the scan tool, and then cycling the ignition for the circuit function to return.

The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur. If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the initial fault is repaired.

Gateway Function

The BCM acts as a gateway module by receiving information in one format and transmitting it to other modules using another format. For example, the BCM receives the vehicle speed data from the PCM over the High Speed Controller Area Network (HS-CAN), converts the data into a Medium Speed Controller Area Network (MS-CAN) message and sends (gateways) the message to other network modules such as the HVAC module and the Audio Front Control Module (ACM). This enables network communication between modules that do not communicate using the same network (HS-CAN or MS-CAN).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Body Control Module (BCM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
5. **NOTE:** The Vehicle Communication Module (VCM) prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.

- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
     - The air bag warning indicator prove-out confirms ignition ON (other indicators may not prove ignition ON). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in RUN.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 , The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication with one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM .

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1048:01	Brake Fluid Level Switch: General Electrical Failure	REFER to Section 413-01 .
B10AB:00	Remote Keyless Entry Synchronization: No Sub Type Information	REFER to Section 501-14 .
B10D5:13	PATS Antenna: Circuit Open	REFER to Section 419-01B .
B10D7:05	PATS Key: System Programming Failure	REFER to Section 419-01B .
B10D7:51	PATS Key: Not Programmed	REFER to Section 419-01B .
B10D7:55	PATS Key: Not Configured	REFER to Section 419-01B .
B10D7:87	PATS Key: Missing Message	REFER to Section 419-01B .
B10D7:8F	PATS Key: Erratic	REFER to Section 419-01B .
B10D8:00	PATS Key Less Than Minimum Programmed: No Sub Type Information	REFER to Section 419-01B .
B10D9:87	PATS Transponder: Missing Message	REFER to Section 419-01B .

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B10DA:51	PATS Target Identifier: Not Programmed	REFER to Section 419-01B .
B10F1:14	Key In switch: Circuit Short To Ground or Open	REFER to Section 413-01 .
B1115:11	High Mounted Stop Lamp control: Circuit Short To Ground	REFER to Section 417-01 .
B1142:29	Ignition Status 1: Signal Invalid	REFER to Section 211-05 .
B1175:01	Drivers Door Ajar Switch: General Electrical Failure	REFER to Section 417-02 .
B1176:01	Passenger Door Ajar Switch: General Electrical Failure	REFER to Section 417-02 .
B1182:00	Tire Pressure Monitoring System: No Sub Type Information	REFER to Section 204-04 .
B1182:55	Tire Pressure Monitoring System: Not Configured	REFER to Section 204-04 .
B11C0:01	Driver Side Rear Door Ajar Switch: General Electrical Failure	REFER to Section 417-02 .
B11C1:01	Passenger Side Rear Door Ajar Switch: General Electrical Failure	REFER to Section 417-02 .
B1218:00	Transmitter Identification Code: No Sub Type Information	REFER to Section 501-14 .
B121A:11:	Keypad Illumination Output: Circuit Short To Ground	REFER to Section 501-14 .
B121B:01	Keypad Input Switch: General Electrical Failure	REFER to Section 501-14 .
B123A:11	Left Front Turn Indicator: Circuit Short To Ground	REFER to Section 417-01 .
B123A:15	Left Front Turn Indicator: Circuit Short To Battery or Open	REFER to Section 417-01 .
B123B:11	Right Front Turn Indicator: Circuit Short To Ground	REFER to Section 417-01 .
B123B:15	Right Front Turn Indicator: Circuit Short To Battery or Open	REFER to Section 417-01 .
B124D:02	Tire Pressure Sensor: General Signal Failure	REFER to Section 204-04 .
B124D:4A	Tire Pressure Sensor: Incorrect Component Installed	REFER to Section 204-04 .
B1250:00	Tire Pressure Monitoring System (TPMS) Sensor	REFER to Section 204-04 .

	Pressure Range: No Sub Type Information	
B1251:00	Tire Pressure Sensor Low Battery: No Sub Type Information	REFER to Section 204-04 .
B1254:51	Right Rear (Outside on Duel Wheel) Tire Pressure Sensor and Transmitter Assembly: Not Programmed	REFER to Section 204-04 .
B1255:51	Left Rear (Outside On Duel Wheel) Tire Pressure Sensor and Transmitter Assembly: Not Programmed	REFER to Section 204-04 .
B126A:01	Drivers Door Interior Lock Switch: General Electrical Failure	REFER to Section 501-14 .
B1277:11	Reverse Lamp: Circuit Short To Ground	REFER to Section 417-01 .
B1277:15	Reverse Lamp: Circuit Short To Battery or Open	REFER to Section 417-01 .
B12C2:11	Puddle Lamp: Circuit Short To Ground	REFER to Section 417-02 .
B1305:01	Hood Switch: General Electrical Failure	REFER to Section 419-01A .
B130C:12	Load Shed Control: Circuit Short To Battery	REFER to Section 417-01 .
B130C:14	Load Shed Control: Circuit Short To Ground or Open	REFER to Section 417-01 .
B130D:00	Memory Full for Integrated Key Programming: No Sub Type Information	REFER to Section 501-14 .
B1310:12	Run/Start Control: Circuit Short To Battery	REFER to Section 211-05 .
B1310:14	Run/Start Control: Circuit Short To Ground or Open	REFER to Section 211-05 .
B1313:11	Interior Lighting Output: Circuit Short To Ground	REFER to Section 417-02 .
B1313:15	Interior Lighting Output: Circuit Short To Battery or Open	REFER to Section 417-02 .
B1315:11	Backlighting (Non Reflective Controls) Illumination Output: Circuit Short To Ground	REFER to Section 413-00 .
B1319:11	Shift Interlock (BSI) Output Circuit: Circuit Short To Ground	REFER to Section 307-05 .

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B1319:15	Shift Interlock (BSI) Output Circuit: Circuit Short To Battery or Open	REFER to Section 307-05 .
B131A:12	Delayed Accessory Power: Circuit Short To Battery	REFER to Section 501-11 .
B131A:14	Delayed Accessory Power: Circuit Short To Ground or Open	REFER to Section 501-11 .
B132B:11	Left Stop/Turn Lamp: Circuit Short To Ground	REFER to Section 417-01 .
B132B:15	Left Stop/Turn Lamp: Circuit Short To Battery or Open	REFER to Section 417-01 .
B132C:11	Right Stop/Turn Lamp: Circuit Short To Ground	REFER to Section 417-01 .
B132C:15	Right Stop/Turn Lamp: Circuit Short To Battery or Open	REFER to Section 417-01 .
B1A85:11	Ambient Light Sensor: Circuit Short To Ground	REFER to Section 417-01 .
B1A85:13	Ambient Light Sensor: Circuit Open	REFER to Section 417-01 .
B1C98:11	Left Corner Lamp Circuit: Circuit Short To Ground	REFER to Section 417-01 .
B1C99:11	Right Corner Lamp Circuit: Circuit Short To Ground	REFER to Section 417-01 .
B1D00:11	Left Low Beam: Circuit Short To Ground	REFER to Section 417-01 .
B1D01:11	Right Low Beam: Circuit Short To Ground	REFER to Section 417-01 .
B1D02:11	Left High Beam Circuit: Circuit Short To Ground	REFER to Section 417-01 .
B1D02:15	Left High Beam Circuit: Circuit Short To Battery or Open	REFER to Section 417-01 .
B1D03:11	Right High Beam Circuit: Circuit Short To Ground	REFER to Section 417-01 .
B1D03:15	Right High Beam Circuit: Circuit Short To Battery or Open	REFER to Section 417-01 .
B1D35:11	Hazard Switch: Circuit Short To Ground	REFER to Section 417-01 .
C0040:12	Brake Pedal Switch "A": Circuit Short To Battery	REFER to Section 417-01 .
C113A:11	Wakeup Control: Circuit Short To Ground	REFER to Section 419-01B (Passive Anti-Theft System (PATS)).
C113A:15	Wakeup Control: Circuit Short To Battery or Open	REFER to Section 419-01B (PATS).

C1A56:51	Left Front Tire Pressure Sensor and Transmitter Assembly: Not Programmed	REFER to Section 204-04 .
C1A58:51	Right Front Tire Pressure Sensor and Transmitter Assembly: Not Programmed	REFER to Section 204-04 .
C1D00:11	Park Brake Apply Switch: Circuit Short To Ground	REFER to Section 413-01 .
P0230:12	Fuel Pump Primary Circuit: Circuit Short To Battery	DIAGNOSE PCM DTC P025A. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0230:14	Fuel Pump Primary Circuit: Circuit Short To Ground or Open	DIAGNOSE PCM DTC P025A. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	GO to Pinpoint Test A .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub Type Information	GO to Pinpoint Test B .
U0131:00	Lost Communication With Power Steering Control Module: No Sub Type Information	GO to Pinpoint Test C .
U0182:00	Lost Communication With Lighting Control Module - Front: No Sub Type Information	GO to Pinpoint Test D .
U0212:00	Lost Communication With Steering Column Control Module: No Sub Type Information	GO to Pinpoint Test E .
U1000:00	Solid State Driver Protection Activated - Driver Disabled: No Sub Type Information	GO to Pinpoint Test F .
U1007:31	Lost Communication With Battery Monitoring Sensor "A": No Signal	REFER to Section 414-00 .
U2005:85	Vehicle Speed: Signal Above Allowable Range	A speed signal is detected during the self-test. DIAGNOSE any symptoms or other module DTCs that are present. CLEAR the DTCs. MAKE SURE the vehicle is not moving and REPEAT the Body Control Module (BCM) self-test. If no other symptoms or DTCs are present, INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CARRY OUT Programmable Module Installation (PMI) on the BCM . REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC U2100:00 is retrieved again, INSTALL a new BCM . REFER to Body Control Module (BCM) in this section.

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		TEST the system for normal operation.
U2200:55	Control Module Configuration Memory Corrupt: Not Configured	CARRY OUT PMI on the BCM. REFER to Section 418-01. CLEAR the DTCs. REPEAT the self-test. If DTC U2200:55 is retrieved again, INSTALL a new BCM. REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.
U3000:49	Control Module: Internal Electronic Failure	ADDRESS all other DTCs first. CLEAR the DTCs. REPEAT the self-test. If DTC U3000:49 is retrieved again, INSTALL a new BCM. REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test G.
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test H.
U300A:01	Ignition Switch: General Electrical Failure	REFER to Section 211-05.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Body Control Module (BCM)	• Wiring, terminals or connectors • BCM	• REFER to Section 418-00, The BCM Does Not Respond To The Scan Tool.

Pinpoint Tests

Pinpoint Test A: DTC U0100:00

Normal Operation

- DTC U0100:00 (Lost Communication With ECM/PCM "A": No Sub Type Information) — sets in the Body Control Module (BCM) if data messages received (vehicle speed) from the PCM are missing for more than 1 second.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- PCM
- BCM

PINPOINT TEST A: DTC U0100:00

Test Step	Result / Action to Take
A1 VERIFY THE SCAN TOOL CAN COMMUNICATE WITH THE PCM • Connect the scan tool. • Check that a vehicle session can be established using the scan tool. • **Can a vehicle session be established?**	**Yes** GO to A2 . **No** REFER to Section 418-00 , The PCM Does Not Respond To The Scan Tool.
A2 CHECK THE BCM CONTINUOUS MEMORY DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test . • Clear the DTCs. Repeat the BCM self-test. • **Is DTC U0100:00 retrieved again?**	**Yes** GO to A3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
A3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST • Check for recorded BCM DTCs from the self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test G . For DTC U3003:17, GO to Pinpoint Test H . **No** GO to A4 .
A4 CHECK FOR DTC U0100, U0100:00 OR U0100:87 SET IN OTHER MODULES • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0100, U0100:00 or U0100:87 set in any other module?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.

Pinpoint Test B: DTC U0121:00

Normal Operation

- DTC U0121:00 (Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub Type Information) — sets in the Body Control Module (BCM) if data messages received from the ABS module are missing.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- ABS module
- BCM

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PINPOINT TEST B: DTC U0121:00

Test Step	Result / Action to Take
B1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to B2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
B2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the ABS module pass the network test?**	**Yes** GO to B3 . **No** REFER to Section 418-00 , The ABS Module Does Not Respond To The Scan Tool.
B3 RETRIEVE THE RECORDED DTCs FROM THE BCM AND SELF-TEST	
• Check for recorded BCM DTCs from the self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test G . For DTC U3003:17, GO to Pinpoint Test H . **No** GO to B4 .
B4 RECHECK THE BCM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the BCM self-test. • **Is DTC U0121:00 still present?**	**Yes** GO to B5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
B5 CHECK FOR DTC U0121, U0121:00 OR U0121:87 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0121, U0121:00 or U0121:87 set in any other module?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the BCM self-test. **No** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.

Pinpoint Test C: DTC U0131:00

Normal Operation

- DTC U0131:00 (Lost Communication With Power Steering Control Module: No Sub Type Information) — sets in the Body Control Module (BCM) if data messages received from the Power Steering Control Module (PSCM) are missing.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- PSCM
- BCM

PINPOINT TEST C: DTC U0131:00

Test Step	Result / Action to Take
C1 VERIFY THE CUSTOMER CONCERN • Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to C2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
C2 CHECK THE COMMUNICATION NETWORK • Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the PSCM pass the network test?**	**Yes** GO to C3 . **No** REFER to Section 418-00 , The PSCM Does Not Respond To The Scan Tool.
C3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST • Check for recorded BCM DTCs from the self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test G . For DTC U3003:17, GO to Pinpoint Test H . **No** GO to C4 .
C4 RECHECK THE BCM DTCs **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the BCM self-test. • **Is DTC U0131:00 still present?**	**Yes** GO to C5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
C5 CHECK FOR DTC U0131, U0131:00 OR U0131:87 SET IN OTHER MODULES	

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• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0131, U0131:00 or U0131:87 set in any other module?**	**Yes** INSTALL a new Electronic Power Assist Steering (EPAS) steering gear. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the BCM self-test. **No** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.

Pinpoint Test D: DTC U0182:00

Normal Operation

- DTC U0182:00 (Lost Communication With Lighting Control Module - Front: No Sub Type Information) — sets in the Body Control Module (BCM) if headlamp switch data messages received from the Steering Column Control Module (SCCM) are missing.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- SCCM
- BCM

PINPOINT TEST D: DTC U0182:00

Test Step	Result / Action to Take
D1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to D2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
D2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the SCCM pass the network test?**	**Yes** GO to D3 . **No** REFER to Section 418-00 , The SCCM Does Not Respond To The Scan Tool.
D3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded BCM DTCs from the self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test G . For DTC U3003:17, GO to Pinpoint Test H .

	No GO to D4 .
D4 RECHECK THE BCM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the BCM self-test. • **Is DTC U0182:00 still present?**	**Yes** GO to D5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
D5 CHECK FOR DTC U0182, U0182:00 OR U0182:87 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0182, U0182:00 or U0182:87 set in any other module?**	**Yes** INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. REPEAT the BCM self-test. **No** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.

Pinpoint Test E: DTC U0212:00

Normal Operation

- DTC U0212:00 (Lost Communication With Steering Column Control Module: No Sub Type Information) — sets in the Body Control Module (BCM) if turn signal switch data messages received from the Steering Column Control Module (SCCM) are missing.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- SCCM
- BCM

PINPOINT TEST E: DTC U0212:00

Test Step	Result / Action to Take
E1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to E2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

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E2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the SCCM pass the network test?**	**Yes** GO to E3 . **No** REFER to Section 418-00 , The SCCM Does Not Respond To The Scan Tool.
E3 RETRIEVE THE RECORDED DTCs FROM THE BCM SELF-TEST	
• Check for recorded BCM DTCs from the self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test G . For DTC U3003:17, GO to Pinpoint Test H . **No** GO to E4 .
E4 RECHECK THE BCM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the BCM self-test. • **Is DTC U0212:00 still present?**	**Yes** GO to E5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
E5 CHECK FOR DTC U0212, U0212:00 OR U0212:87 SET IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0212, U0212:00 OR U0212:87 set in any other module?**	**Yes** INSTALL a new SCCM . REFER to Section 211-05 . CLEAR the DTCs. REPEAT the BCM self-test. **No** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.

Pinpoint Test F: DTC U1000:00

Normal Operation

The Body Control Module (BCM) controls the output of several vehicle systems using solid state drivers. A DTC sets when an overload occurs on any of these drivers. The module tracks the number of repetitive faults on each of these circuits and compares this number of overloads to 3 progressive thresholds established for each circuit.

At the each threshold, DTC U1000:00 sets along with the DTC associated with the affected circuit.

- DTC U1000:00 (Solid State Driver Protection Activated - Driver Disabled: No Sub Type Information) — sets when the BCM has disabled a circuit due to a repetitive circuit overload and a progressive threshold is met.

This pinpoint test is intended to diagnose the following:

- Output circuit short
- BCM

PINPOINT TEST F: DTC U1000:00

Test Step	Result / Action to Take
F1 REVIEW THE DTCs	**Yes** CORRECT the DTCs. REFER to the Body Control Module (BCM) DTC chart in this section. After the repair, GO to F2 . **No** GO to F2 .
NOTICE: **First follow the necessary diagnostics to resolve DTC U1000:00 and any other present DTCs (ignoring U3000:49). DTC U1000:00 is only present when there is another DTC due to software or circuitry issues that must be resolved before another self-test is run. DTC U3000:49 is only present once the final threshold has been met. Failure to correct the fault condition first may cause damage to the new BCM , resulting in a repeat repair.** • Review the DTCs from the BCM self-test. • **Are any other DTCs present, besides U1000:00 or U3000:49?**	
F2 REPEAT THE BCM SELF-TEST	**Yes** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The circuit short has been repaired.
• Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test . • Clear the DTCs and repeat the BCM self-test. • **Is DTC U3000:49 present?**	

Pinpoint Test G: DTC U3003:16

Refer to Wiring Diagrams Cell 13 , Power Distribution/SJB for schematic and connector information.

Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) — sets in the Body Control Module (BCM) when the BCM detects that battery voltage has dropped below 9 volts on the voltage supply circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- High circuit resistance
- BCM

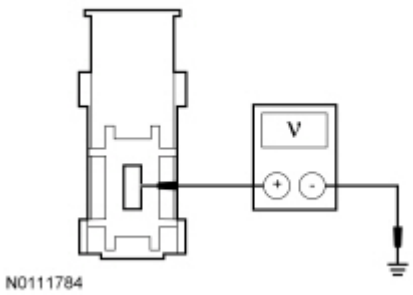
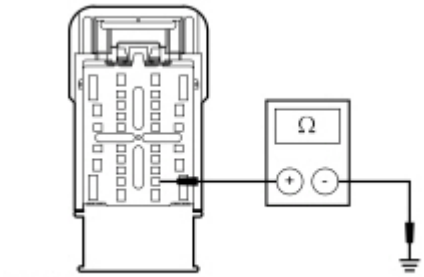
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PINPOINT TEST G: DTC U3003:16

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed results in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
G1 RECHECK THE BCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test . • Clear the DTCs. Repeat the BCM self-test. • **Is DTC U3003:16 still present?**	**Yes** GO to G2 . **No** The system is operating normally at this time. The DTC may have been set due to a previous low battery voltage condition.
G2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM • Enter the following diagnostic mode on the scan tool: PCM Self-Test . • Carry out the PCM Key ON Engine OFF (KOEO) self-test. • Retrieve the continuous memory DTCs from the PCM. • **Is DTC P0620, P0622, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to G3 .
G3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE • Check the battery condition and verify the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to G4 . **No** REFER to Section 414-00 .
G4 CHECK THE BCM VOLTAGE PID • Ignition ON. • Measure and record the voltage at the battery. • Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Monitor the BCM voltage PID (V_BATT). • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to G7 . **No** GO to G5 .
G5 CHECK THE BCM VOLTAGE SUPPLY • Ignition OFF. • Disconnect: BCM C2280G . • Ignition ON. • Measure the voltage between the BCM C2280G-1, circuit SDC04 (RD), harness side and ground.	**Yes** GO to G6 . **No** REPAIR circuit SDC04 (RD) for high resistance. CLEAR the DTC. REPEAT the self-test.

 N0111784 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	
G6 CHECK THE BCM GROUND CIRCUIT FOR HIGH RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: BCM C2280D . • Measure the resistance between the BCM C2280D-25, circuit GD139 (BK/YE), harness side and ground.  N0111785 • **Is the resistance less than 5 ohms?**	**Yes** GO to G7 . **No** REPAIR circuit GD139 (BK/YE) for high resistance. CLEAR the DTC. REPEAT the self-test.
G7 CHECK FOR CORRECT BCM OPERATION	

• Disconnect the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: DTC U3003:17

Refer to Wiring Diagrams Cell 13 , Power Distribution/SJB for schematic and connector information.

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) — sets in the Body Control Module (BCM) when the BCM detects that battery voltage is more than 16 volts on the voltage supply circuit.

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This pinpoint test is intended to diagnose the following:

- Charging system concern
- BCM

PINPOINT TEST H: DTC U3003:17

NOTE: DTC U3003:17 may be stored in the module memory due to previous battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
H1 CHECK FOR DTC B1317, B1676, P0563 (PCM) OR U3003:17 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC B1317, B1676, P0563 (PCM) or U3003:17 set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to H2 .
H2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to H3 .
H3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: BCM Self-Test . • Clear the continuous memory DTCs. • Carry out the BCM self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

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Diagnostic Trouble Code (DTC) Chart

Each module has a comprehensive DTC chart listed in an appropriate section. Refer to the table below for the appropriate section.

Master DTC Chart Index

ABS Module	REFER to Section 206-09 .
Audio Front Control Module (ACM)	• For vehicles with AM/FM/CD, REFER to Section 415-00B . • For vehicles with 4.2-inch (107 mm) display, REFER to Section 415-00C . • For vehicles with 8-inch (203 mm) touchscreen, REFER to Section 415-00D . • For vehicles with Sony® 8-inch (203 mm) touchscreen, REFER to Section 415-00E .
Accessory Protocol Interface Module (APIM)	• For vehicles with AM/FM/CD, REFER to Section 415-00B . • For vehicles with 4.2-inch (107 mm) display, REFER to Section 415-00C . • For vehicles with 8-inch (203 mm) touchscreen, REFER to Section 415-00D . • For vehicles with Sony® 8-inch (203 mm) touchscreen, REFER to Section 415-00E .
Body Control Module (BCM)	REFER to Section 419-10 .
Driver Seat Module (DSM)	REFER to Section 501-10 .
Audio Digital Signal Processing (DSP) Module	REFER to Section 415-00E .
Dual Climate Controlled Seat Module (DCSM)	REFER to Section 501-10 .
Front Controls Interface Module (FCIM)	• For vehicles with AM/FM/CD, REFER to Section 415-00B . • For vehicles with 4.2-inch (107 mm) display, REFER to Section 415-00C . • For vehicles with 8-inch (203 mm) touchscreen, REFER to Section 415-00D . • For vehicles with Sony® 8-inch (203 mm) touchscreen, REFER to Section 415-00E .
Front Display Interface Module (FDIM)	• For vehicles with 8-inch (203 mm) touchscreen, REFER to Section 415-00D . • For vehicles with Sony® 8-inch (203 mm) touchscreen, REFER to Section 415-00E .
Global Positioning System Module (GPSM)	• For vehicles with AM/FM/CD, REFER to Section 415-00B . • For vehicles with 4.2-inch (107 mm) display, REFER to Section 415-00C . • For vehicles with 8-inch (203 mm) touchscreen, REFER to Section 415-00D . • For vehicles with Sony® 8-inch (203 mm) touchscreen, REFER to Section 415-00E .

HVAC Module	REFER to Section 412-00 .
Interior Lighting Control Module (ILCM)	REFER to Section 417-02 .
Instrument Panel Cluster (IPC)	REFER to Section 413-01 .
OCS Module	REFER to Section 501-20B .
Parking Aid Module (PAM)	REFER to Section 413-13 .
PCM	REFER to Section 303-14 .
Power Running Board (PRB) Module	REFER to Section 501-08 .
Power Steering Control Module (PSCM)	REFER to Section 211-00A .
Restraints Control Module (RCM)	REFER to Section 501-20B .
Steering Column Control Module (SCCM)	REFER to Section 211-05 .
Tire Pressure Monitor (TPM) Module	REFER to Section 204-04 .
Trailer Brake Control (TBC) Module	REFER to Section 206-10 .
Transfer Case Control Module (TCCM)	REFER to Section 308-07A .

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Upfitter Relay Box

Principles of Operation

When the ignition is in run or accessory, the upfitter switch assembly receives voltage from the Body Control Module (BCM). The upfitter switches control the 4 upfitter relays in the upfitter relay box. When the relay is energized, voltage is supplied to the customer installed accessories.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical

• Battery Junction Box (BJB) fuse(s):
  ▪ 18 (30A) (upfitter relay 1)
  ▪ 19 (30A) (upfitter relay 2)
  ▪ 28 (10A) (upfitter relay 4)
  ▪ 44 (15A) (upfitter relay 3)
• Body Control Module (BCM) fuse 41 (7.5A) (upfitter switches)
• Wiring, terminals or connectors
• Upfitter relay(s)
• Upfitter switch

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The upfitter switch controlled component is inoperative	• Fuse • Wiring, terminals or connectors	• GO to Pinpoint Test I .

	• Customer installed accessory • Upfitter relay • Upfitter switch • Body Control Module (BCM)	
• An upfitter switch on indicator is inoperative	• Upfitter switch	• INSTALL a new upfitter switch. REFER to Upfitter Switch in this section. TEST the system for normal operation.

Pinpoint Tests

Pinpoint Test I: The Upfitter Switch Controlled Component is Inoperative

Refer to Wiring Diagrams Cell 140 , Customer Access for schematic and connector information.

Normal Operations

With the ignition is in run or accessory, voltage is supplied to the upfitter switches from the Body Control Module (BCM). When an upfitter switch is activated (moved to the on position), voltage is routed to the coil side of the corresponding upfitter relay.

Each of the upfitter relays (switch side) are supplied voltage at all times from the Battery Junction Box (BJB). When the upfitter relay is switched activated, the relay energizes and supplies voltage to the customer supplied accessory.

All of the upfitter relays share the same ground circuit.

This pinpoint is intended to diagnose the following:

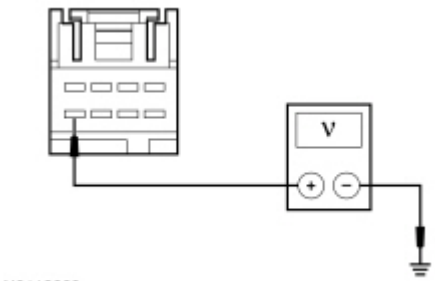
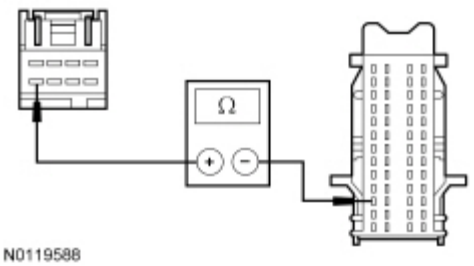
- Fuse
- Wiring, terminals or connectors
- Customer installed accessory
- Upfitter relay
- Upfitter switch
- BCM

PINPOINT TEST I: THE UPFITTER SWITCH CONTROLLED COMPONENT IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
I1 CHECK THE UPFITTER SYSTEM	
• Ignition ON.	**Yes**

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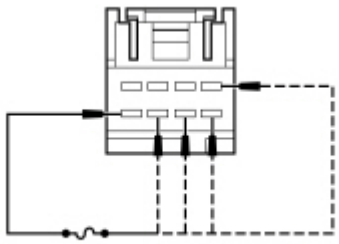
• Operate all the upfitter accessories. • **Are all the upfitter accessories inoperative?**	VERIFY the BCM fuse 41 (7.5A) is OK. If OK, GO to I2 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the short circuit. **No** GO to I5 .
I2 CHECK THE UPFITTER SWITCH ON INDICATORS	
• Place the upfitter switches to the ON position. • **Do the on indicators illuminate?**	**Yes** REPAIR circuit GD138 (BK/WH) between the relays and ground for an open. TEST the system for normal operation. **No** GO to I3 .
I3 CHECK FOR VOLTAGE TO THE UPFITTER SWITCH	
• Ignition OFF. • Disconnect: Upfitter Switch C3389 . • Ignition ON. • Measure the voltage between the upfitter switch C3389-8, circuit CBP41 (BU), harness side and ground.  N0112003 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new upfitter switch. REFER to Upfitter Switch in this section. TEST the system for normal operation. **No** GO to I4 .
I4 CHECK THE UPFITTER SWITCH VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280B . • Measure the resistance between the upfitter switch C3389-8, circuit CBP41 (BU), harness side and the BCM C2280B-3, circuit CBP41 (BU), harness side.  N0119588	**Yes** GO to I11 . **No** REPAIR circuit CBP41 (BU) for an open. TEST the system for normal operation.

- **Is the resistance less than 5 ohms?**

I5 BYPASS THE UPFITTER SWITCH

- Ignition OFF.
- Disconnect: Upfitter Switch C3389 .
- Ignition ON.
- Connect a fused jumper wire between the upfitter switch connector, harness side as follows:

Inoperative Switch	Connector-Pin Circuit	Connector-Pin Circuit
Switch 1	C3389-8 CBP41 (BU)	C3389-7 CAC01 (GN/BU)
Switch 2	C3389-8 CBP41 (BU)	C3389-6 CAC02 (GY/BN)
Switch 3	C3389-8 CBP41 (BU)	C3389-5 CAC03 (WH/VT)
Switch 4	C3389-8 CBP41 (BU)	C3389-1 CAC04 (WH/BU)



N0112005

- **Does the upfitter accessory operate?**

Yes
REMOVE the jumper wire. INSTALL a new upfitter switch. REFER to Upfitter Switch in this section. TEST the system for normal operation.

No
REMOVE the jumper wire. VERIFY the BJB fuse 18 (30A) (relay 1), fuse 19 (30A) (relay 2), fuse 44 (15A) (relay 3) or fuse 28 (10A) (relay 4) is OK. If OK, GO to I6 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the short circuit.

I6 CHECK THE UPFITTER RELAY

- Ignition OFF.
- Connect: Upfitter Switch C3389 .
- Disconnect: Suspect Upfitter Relay .
- Substitute a known good relay.
- Ignition ON.
- Place the upfitter switch in question to the ON position.
- **Does the upfitter accessory operate?**

Yes
REMOVE the known good relay. INSTALL a new upfitter relay. TEST the system for normal operation.

No
REMOVE the known good relay. GO to I7 .

I7 CHECK FOR VOLTAGE TO THE UPFITTER RELAY

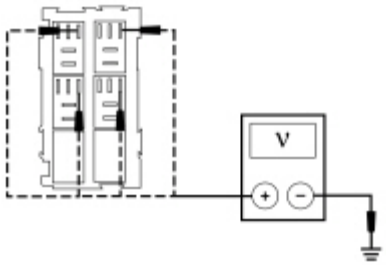
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COIL

NOTE: Make sure the upfitter switch and the ignition are on.

- Measure the voltage between the suspect upfitter relay, relay box face side and ground as follows:

Upfitter Relay	Cavity	Circuit
Relay 1	1	CAC01 (GN/BU)
Relay 2	1	CAC02 (GY/BN)
Relay 3	1	CAC03 (WH/VT)
Relay 4	1	CAC04 (WH/BU)



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- **Is the voltage greater than 10 volts?**

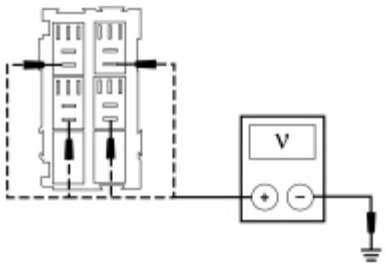
Yes
GO to I8 .

No
REPAIR the circuit in question for an open. TEST the system for normal operation.

I8 CHECK THE UPFITTER RELAY VOLTAGE SUPPLY CIRCUIT FOR VOLTAGE

- Ignition OFF.
- Measure the voltage between the suspect upfitter relay, relay box face side and ground as follows:

Upfitter Relay	Cavity	Circuit
Relay 1	3	SBB18 (YE/RD)
Relay 2	3	SBB19 (BU/RD)
Relay 3	3	SBB44 (GN/RD)
Relay 4	3	SBB28 (GN/RD)



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Yes
GO to I9 .

No
REPAIR the voltage supply circuit in question for an open. TEST the system for normal operation.

- **Is the voltage greater than 10 volts?**

I9 CHECK THE UPFITTER RELAY GROUND CIRCUIT FOR AN OPEN

- Measure the voltage between the suspect upfitter relay, relay box face side and ground as follows:

Upfitter Relay	Cavity Circuit	Cavity Circuit
Relay 1	3 SBB18 (YE/RD)	2 GD120 (BK/GN)
Relay 2	3 SBB19 (BU/RD)	2 GD120 (BK/GN)
Relay 3	3 SBB44 (GN/RD)	2 GD120 (BK/GN)
Relay 4	3 SBB28 (GN/RD)	2 GD120 (BK/GN)

- **Is the voltage greater than 10 volts?**

Yes
GO to I10 .

No
REPAIR the upfitter relay ground circuit in question for an open. TEST the system for normal operation.

I10 CHECK THE UPFITTER RELAY OUTPUT CIRCUIT

- Measure the resistance between the upfitter relay in question and the customer access point as follows:

Upfitter Relay	Cavity	Output Circuit
Relay 1	5	CAC05 (YE)
Relay 2	5	CAC06 (GN/BN)
Relay 3	5	CAC07 (VT/GN)
Relay 4	5	CAC08 (BN)

- **Is the resistance less than 5 ohms?**

Yes
The vehicle is operating correctly. REPAIR or INSTALL a new customer installed accessory.

No
REPAIR the upfitter relay output circuit in question for an open. TEST the system for normal operation.

I11 CHECK FOR CORRECT BCM OPERATION

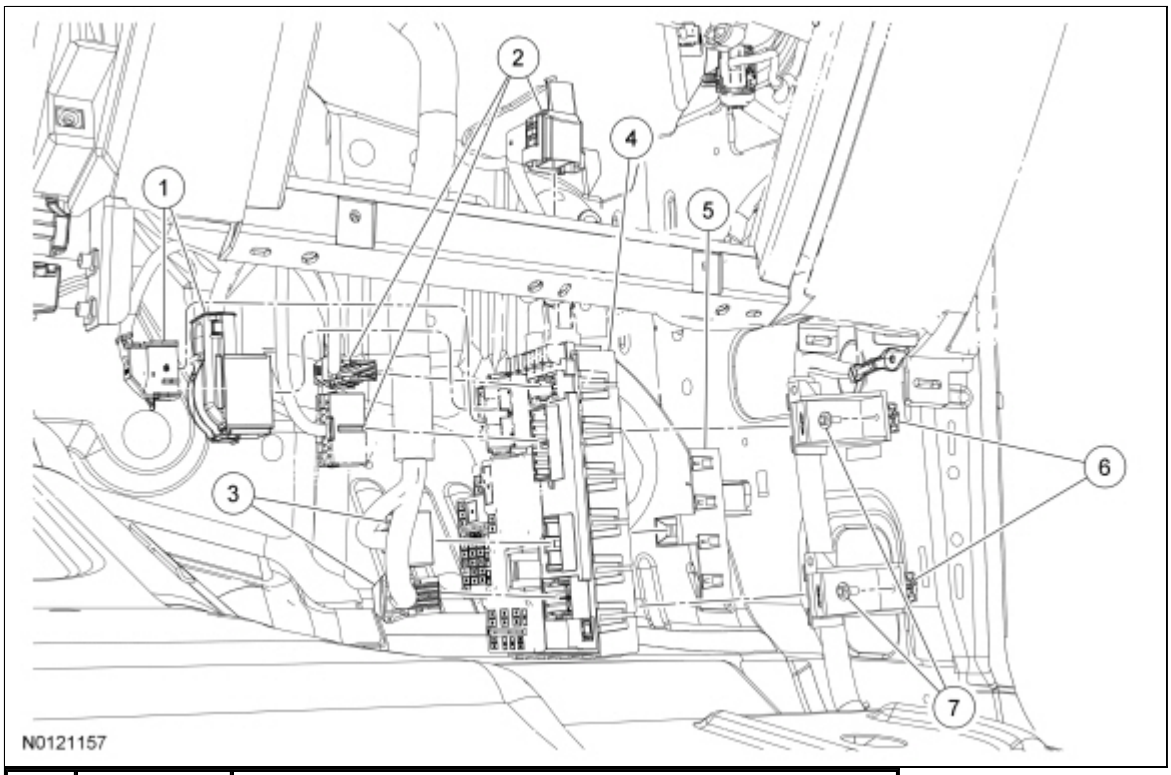
- Disconnect all the BCM connectors.
- Check for:
  - corrosion
  - damaged pins
  - pushed-out pins
- Connect all the BCM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new BCM . REFER to Body Control Module (BCM) in this section. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Body Control Module (BCM)



Item	Part Number	Description
1	—	Body Control Module (BCM) electrical connectors (2 required) (part of 14A005)
2	—	BCM electrical connectors (3 required) (part of 12A581)
3	—	BCM electrical connectors (2 required) (part of 14401)
4	15604	BCM
5	—	BCM front bracket
6	—	BCM bracket (2 required)
7	—	BCM bolt (2 required)

Removal

NOTICE: **Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

NOTE: Prior to the replacement of the Body Control Module (BCM), it is necessary to upload the module configuration information to the appropriate scan tool. This information must be downloaded into the new BCM after installation. For additional information, refer to Section 418-01 . In the event that As-Built data entry is required (BCM will not communicate), all Integrated Keyhead Transmitters (IKTs) devices must be programmed. A minimum of 2 devices are necessary to complete the configuration and turn off the flashing

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interior lights.

1. **NOTE:** This step is necessary only if the BCM is being replaced.

   NOTE: If installing a new BCM, all vehicle keys are erased during the parameter reset procedure. Verify at least 2 of the vehicle keys are available prior to carrying out this procedure.

   Upload the module configuration information from the BCM. For additional information, refer to Section 418-01.

2. Remove the passenger cowl side trim panel. For additional information, refer to Section 501-05.

3. **NOTE:** The upper 12A581 harness BCM (B+) connector may be more easily removed after the BCM brackets and bolts are removed and the BCM can be positioned lower and away from the body in order for the connector release tangs to be accessed and pressed.

   Disconnect the 7 BCM electrical connectors.

4. Remove the in-line connector wiring harness push pins (2) from the BCM.

5. Remove the 2 bolts and the BCM.

6. Remove the BCM front bracket and the 2 BCM brackets from the BCM.

Installation

1. Install the 2 bolts and the BCM.
   - Tighten to 2 Nm (18 lb-in).

2. Install the in-line connector wiring harness push-pins (2) on the BCM.

3. Connect the 7 BCM electrical connectors.

4. **NOTE:** If the BCM was not replaced, this is the last step that is necessary.

   Install the passenger cowl side trim panel. For additional information, refer to Section 501-05.

5. **NOTE:** Once the BCM Programmable Module Installation (PMI) is complete, follow the scan tool's on-screen instructions for performing the Configurable Engine Immobilizer (CEI) Lock Configuration.

   Download the BCM configuration information from the scan tool. For additional information, refer to Section 418-01.

6. **NOTE:** If a new BCM is installed, the BCM and the PCM require a parameter reset to allow the BCM and the PCM to recognize each other.

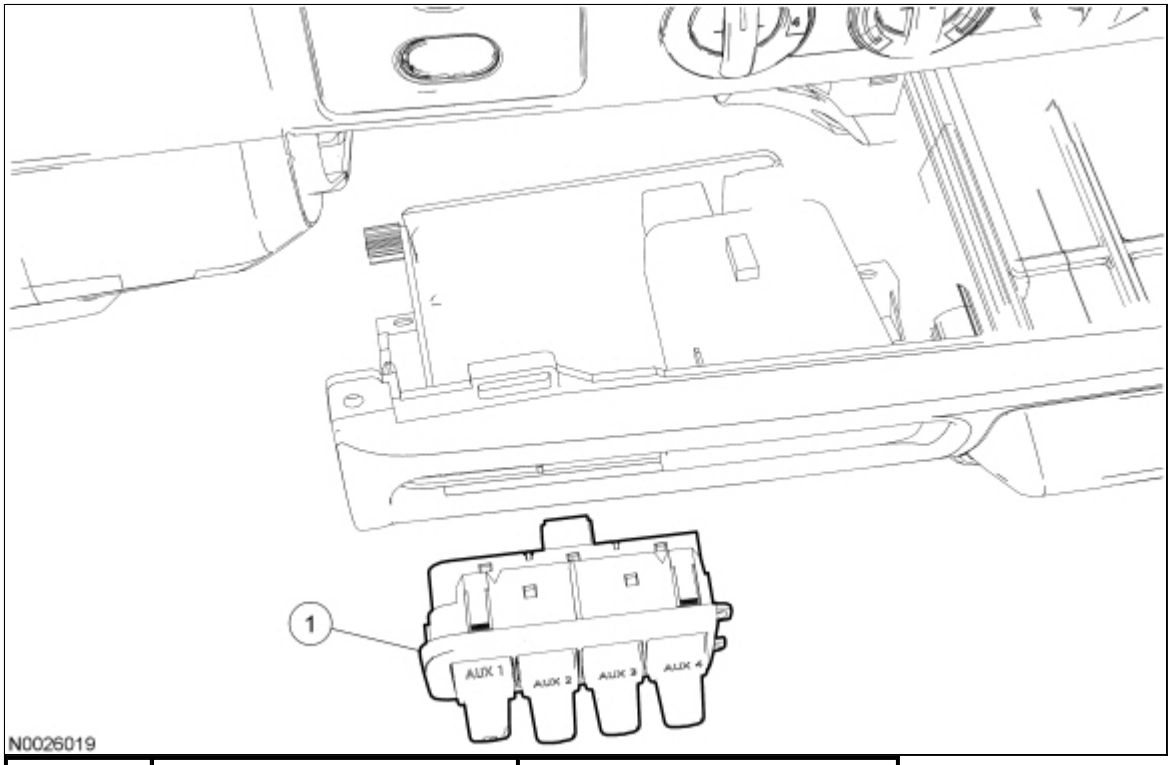
   NOTE: If equipped, the vehicle's IKTs must be programmed to the new BCM.

   If installing a new BCM, carry out the parameter reset and key programming procedure. For additional information, refer to Section 419-01B.

7. Carry out the BCM on-demand self-test to confirm all DTCs have been cleared.

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Upfitter Switch



Item	Part Number	Description
1	13D730	Upfitter switch

Removal and Installation

All vehicles

1. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .

Vehicles with trailer brakes

2. Using a suitable tool (such as a small screwdriver), press the retaining tab at the top and remove the Trailer Brake Control (TBC) module.

Vehicles without trailer brakes

3. Using a suitable tool (such as a small screwdriver), press the 4 retaining tabs and remove the storage bin.

All vehicles

4. Using a suitable tool (such as a small screwdriver), press the 4 retaining tabs and remove the upfitter switch.

5. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
3M™ Strip Caulk - Black 051135-08578	WSB-M4G32-C	—
Seam Sealer TA-2	—	—
Clear Silicone Rubber TA-32	ESB-M4G92-A	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Silicone Spray Lubricant XL-6	ESR-M13P4-A	—
Trim and Weatherstrip Adhesive Permatex® 81850 or equivalent	—	—

Body System

Material

Item	Specification
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Inspection and Verification

Dust and Water Leaks

Most dust and water leaks occur due to missing or mis-installed body sealer or components. The source of the leak is detected by:

- pressurizing the vehicle and testing with soapy water.
  - Locate and tape off the body vents.
  - Turn the blower motor on the high position.
  - Turn the air recurculation to the off mode.
  - Close the windows and doors.
  - Open the hood and spray soapy water along body seams and grommets. Make sure to test the areas arround the A-pillar at the fender and the hood hinge area.
  - Check for bubbles.
- inspecting for a dust pattern or water path near and above the area in question.
- removing any trim or carpet in the general area of the leak.
- road testing or water-hose testing the vehicle.
- placing a bright light under the vehicle, removing any necessary trim or carpet and inspecting the interior of the body at joints and weld lines.

Wind Noise

Most wind noise leaks occur at the corners of the windows or in the doors. Wind noise is detected by driving the vehicle at highway speeds or at speeds as specified by the customer. The vehicle should be driven in 4 different directions, with all the windows CLOSED, the radio OFF and the A/C blower motor OFF.

Squeak and Rattle

Squeak and rattle noises are generally caused by loose parts, contact or relative movement between 2 surfaces or loose wires and connectors. The source of the noise can be detected by stopping movement of the suspect part by hand or by using dampening or low friction materials.

Symptom Chart — NVH

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Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible that any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Draft/wind noise and water leak around door perimeter	• Loose fit seal	• PINCH seal carrier to improve retention on seal flange.
	• Seal installed incorrectly	• REINSTALL the seal.
	• Door misaligned	• REALIGN the door. CHECK door gaps and fit in door opening and ADJUST as necessary. REFER to Section 501-03 .
	• Scuff plate installed incorrectly	• REINSTALL the scuff plate.
	• Seal or seal pushpins damaged	• INSTALL a new seal/pushpins.
	• Sheet metal joints in door or door opening	• SEAL leaks with silicone gasket and sealant.
• Draft/wind noise and water leak around glass run	• Door glass misaligned	• ADJUST door glass.
	• Glass run installed incorrectly	• REINSTALL glass run. INSERT foam in glass run carrier if necessary.
	• Leak path behind glass run	• INSTALL foam rope behind glass run.
	• Glass run channel spread wide	• PINCH glass run channel to reduce size of opening.
	• Glass run damaged	• INSTALL a new glass run.
• Draft/wind noise and water leak at inner belt line	• Belt line seal installed incorrectly on flange	• ADJUST seal. (Do not bend the flange.)
	• No contact with side glass	• ADJUST door glass.
	• No contact with glass runs at both ends of belt line seal	• ADJUST belt line seal or ADD foam at seal ends.
	• Belt line seal damaged	• INSTALL a new seal.
• Draft/wind noise and water leak at outer belt line	• Belt line seal installed incorrectly on flange (no glass contact)	• ADJUST seal.
	• Belt line seal does not	• ADJUST door glass.

	contact the glass • No contact with glass runs at both ends of belt line seal • Belt line seal damaged	• ADJUST belt line seal or ADD foam at seal ends. • INSTALL a new seal.
• Draft/wind noise at inner door handle/speaker opening	• Hole in weathershield • Weathershield misaligned • Exterior door handle seal misaligned/damaged • Speaker or speaker seal missing or damaged	• SEAL hole with suitable tape. • REALIGN weathershield. INSTALL a new weathershield if pressure sensitive adhesive fails. • REALIGN or INSTALL a new seal as necessary. REFER to Section 501-14 . • REPAIR speaker seal or INSTALL a new door speaker.
• Draft/wind noise and water leaks at floor pan and grommets	• Missing or damaged plugs/grommets	• CHECK plugs/grommets for correct installation or damage. INSTALL new plugs/grommets if necessary.
• Road noise	• Missing mastic insulators • Missing body insulators	• CHECK for missing mastic insulators. REFER to Section 501-35 . • CHECK for missing body insulators.
• Rattles in body/doors and instrument panel	• Loose wires/cables • Loose objects/components in door wells, pillars quarter trim panels • Buzz from instrument panel components	• CHECK that all wires/cables are correctly routed and inserted in correct retainers. • CHECK doors by carefully striking underside of doors with a rubber mallet while listening for rattles in doors and pillars. REMOVE or TIGHTEN loose objects/components. • IDENTIFY which components of the instrument panel are buzzing. SECURE/FASTEN components as necessary, ADD foam or felt as needed if rattle persists.
• Door drain holes collecting water	• Holes clogged with mud or road tar	• CLEAN drain holes of foreign material with a

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		punch or screwdriver. CHECK drain holes regularly.
• Wind noise from exterior rear view mirror	• Exterior mirror housing misaligned • Mirror sail gasket folded/misaligned • Mirror housing trim cap installed incorrectly • Air leak through mirror housing hinge • Inner sail trim installed incorrectly • Inner sail gasket/barrier installed incorrectly • Air path through wiring bundle/fastener access holes • Exposed fastener access hole on mirror housing/sail	• REALIGN with edges shingled to airflow, with no gaps. • REINSTALL with gasket unfolded and aligned correctly. • REINSTALL with edges shingled to airflow. • Fully ENGAGE mirror into its operating position/USE foam to block air path through hinge. • REINSTALL sail trim/ADJUST door trim. • REINSTALL trim cover with gasket/barrier aligned correctly • BLOCK air path(s) with foam/tape. • INSTALL a new cap if missing.
• Rattle/vibration from exterior rear view mirror	• Mirror glass adjustment screws loose • Mirror mounting nuts loose • Aftermarket air deflector/stone shields • If equipped with power fold mirrors, power fold mirrors folded/unfolded manually or are not synchronized	• REMOVE mirror glass and TIGHTEN mirror glass adjustment motor screws. REFER to Section 501-09 . • TIGHTEN mirror mounting nuts. REFER to Section 501-09 . • If possible, REMOVE aftermarket air deflector/stone shield, then ROAD TEST vehicle. If concern is no longer present, ADVISE customer that aftermarket component was causing concern. • If equipped with power fold mirrors, SYNCHRONIZE power fold mirrors. REFER to Section 501-09 .
• Draft/wind noise and water leak around perimeter of all fixed glass	• Gaps in the sealant bead • Air traveling up	• APPLY approved sealant. • INSTALL foam rope full

	windshield molding along A-pillar • Gaps in sealant bead of windshield/rear glass • Windshield/rear glass misaligned or not installed correctly • Rear hood seal at base of windshield misaligned/damaged • High-mounted stoplamp	length of the A-pillar. • RESEAL windshield/rear glass. REFER to Section 501-11 . • REINSTALL windshield/rear glass. REFER to Section 501-11 . • REALIGN or INSTALL a new seal as necessary • CHECK high-mounted stoplamp seal. REPAIR or INSTALL as necessary.
• Draft noise at cowl	• Cowl seal misaligned/damaged	• REALIGN or INSTALL a new seal as necessary.
• Draft/water leak or noise from roof opening panel	• Roof opening panel/components	• REFER to Section 501-17 for diagnosis.
• Wind noise created by airflow over or behind body panels	• Fender splash shield misaligned • Body panel misaligned (exposed edge) • Hood misaligned (front margin) • Front grille edge noise	• REALIGN fender splash shield. • REALIGN appropriate body panel. • CHECK hood gaps and fit. ADJUST hood as necessary. • APPLY foam in hollow areas behind louvers.
• Wind noise created by grille opening panel	• Grille relationship to leading edge on hood • Sharp edges due to material imperfections	• If possible, ADJUST grille opening panel forward to eliminate wind noise. • REMOVE sharp edges (no damage to visible surface).
• Wind noise from air extractor (body vent)	• Air extractor housing seated incorrectly • Air extractor housing or flaps damaged	• REINSTALL air extractor housing. • INSTALL a new air extractor.
• Wind noise from bug shield/exterior windshield sun visor	• Turbulence created by location and shape	• Determine if an OEM part or aftermarket. If aftermarket advise customer accordingly. If OEM, verify correctly installed. If noise is abnormal repair or replace as required.
• **NOTE:** The sliding back glass is a "wet" system. Water is allowed to come into	• Sliding back glass drain holes are clogged	• REMOVE any foreign material from the sliding back glass drain holes.

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the vehicle and collect at the bottom of the assembly in the lower rail, as long as it drains out in a timely fashion and does not overflow. Water collecting in the sliding back glass lower channel		
• Rattle from tailgate	• Loose tailgate latch	• If possible. ADJUST the tailgate latch. TIGHTEN the tailgate latch bolts. REFER to Section 501-14 .
	• Loose or worn tailgate assist handle	• TIGHTEN or REPLACE the tailgate assist handle. REFER to Section 501-04 .
	• Loose or worn tailgate step	• ADJUST or REPLACE the tailgate step. REFER to Section 501-04 .
	• Loose or broken tailgate lift assist torsion rod	• RESEAL or REPLACE the tailgate lift assist torsion rod. REFER to Section 501-04 .
	• Loose or worn tailgate latch striker sleeve	• TIGHTEN or REPLACE the tailgate striker.

Body Sealer Types And Applications

Seam Sealer

Seam Sealer TA-2 or equivalent:

- is a heavy-bodied, non-sag adhesive/sealer for use on standing cosmetic seams, truck bed seams, tooled door skin seams and floor pans.
- can be used on water leaks and noise concerns.

Clear Silicone Rubber

Clear Silicone Rubber TA-32 or equivalent meeting Ford Specification ESB-M4G92-A:

- does not run.
- is fast drying.
- remains semi-elastic.
- can be used for sealing water leaks, noise concerns, remounting trim and repairing torn weatherstripping.

Silicone Gasket and Sealant

Silicone Gasket and Sealant TA-30 or equivalent meeting Ford specification WSE-M4G323-A4:

- is a form-in-place gasket and multi-purpose adhesive/sealant.
- is a room temperature curing silicone rubber.

Caulking Cord

3M™ Strip Caulk-Black 051135-08578 or equivalent meeting Ford specification WSB-M4G32-C:

- is a heavy-bodied, plastic base with a filler.
- is commonly known as perma-gum.
- is used on spot-weld holes and between surfaces not sealed with a gasket.

Weatherstrip Adhesive

Trim and Weatherstrip Adhesive Permatex® 8150 or equivalent:

- is a quick drying, strong adhesive designed to hold weatherstripping onto all body panels and surrounding metal.

Silicone Lubricant

Silicone Spray Lubricant XL-6 or equivalent meeting Ford specification ESR-M13P4-A:

- is used to keep the door and the window weatherstrip pliable and soft.

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- makes the door easier to close.
- retards weatherstrip squeaks.
- retards weatherstrip wear.
- helps retain door window alignment by reducing friction between the glass frame and the rubber weatherstrip.
- should not be used prior to painting.

Insulation

Insulation is used as a sound-deadener to reduce exterior road and powertrain noises from the interior of the vehicle. Mastic insulators are also used as insulation. For information on the location of the mastic insulators, refer to Section 501-35 . Insulation is installed:

- under the roof.
- above and below the instrument panel.
- at the cowl side panels.
- over the front and rear tunnel.
- over the front and rear floor pans.

It has heat-bondable mastic deadeners for improved NVH characteristics.

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Material

Item	Specification	Fill Capacity
Flexible Foam Repair Fusor® 121, or equivalent; obtain locally	—	—

Torque Specifications

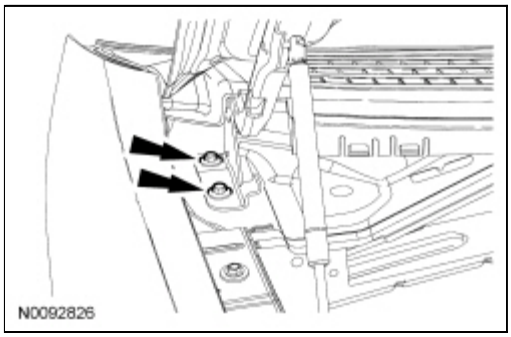
Description	Nm	lb-ft	lb-in
Coolant module bolt-to-radiator grille support	15	—	133
Fender rear inner bolt	9	—	80
Fender upper rear bolt	9	—	80
Front air dam bolts	20	—	177
Hood hinge-to-body bolts	30	22	—
Hood hinge-to-hood bolts	30	22	—
Hood release bolts	35	26	—
Hood striker bolts	12	—	106
Horn bracket bolt	35	26	—
Lower fender bolt	9	—	80
Radiator grille support	30	22	—
Smart Junction Box (SJB)	35	26	—
Upper fender bolts	6	—	53
Radiator grille bolts	5	—	42
Radiator grille nuts	5	—	42

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Hood Alignment

1. Raise and support the hood.

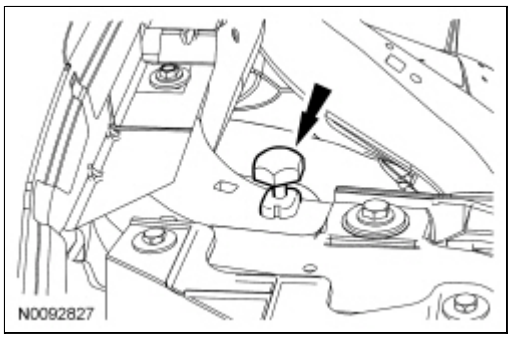
2. Loosen the lower hood hinge bolts so the hood will move slightly.



3. Lower the hood and position the hood for correct and proper fit. For additional information, refer to Margins in Section 501-35 .

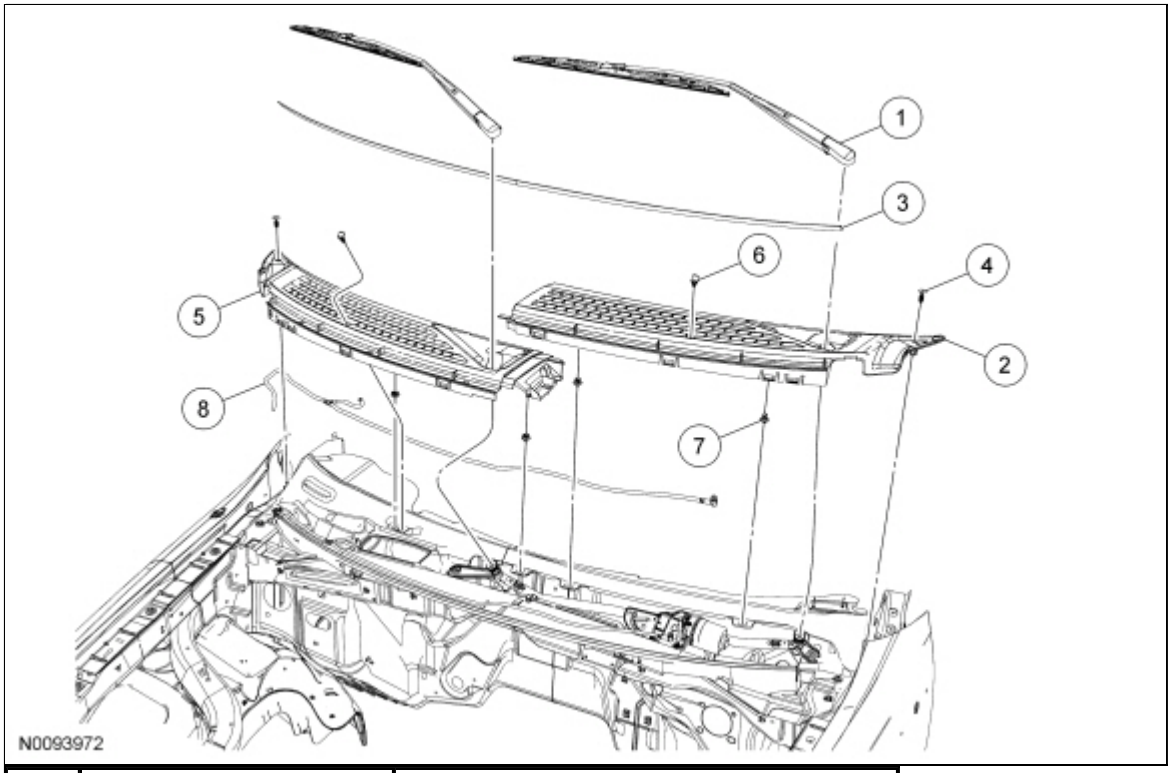
4. Tighten the hood hinge-to-body bolts.
   - To install, tighten to 30 Nm (22 lb-ft).

5. Adjust the hood height using the adjustable hood bumpers until the hood fits flush with the fenders. Check the hood for correct latching and if necessary, adjust the hood latch.



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Cowl Panel Grille



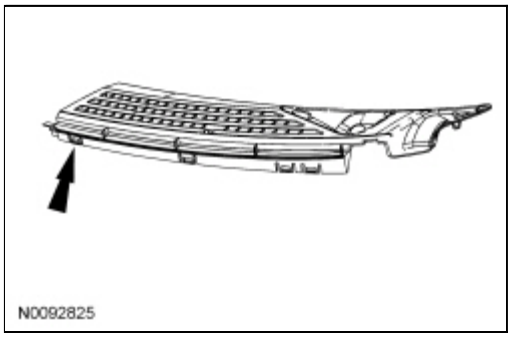
Item	Part Number	Description
1	17526A LH/ 17527A RH	Wiper pivot arm
2	15022A69A	Left cowl panel grille
3	1502824A	Cowl panel grille seal
4	W710312	Cowl grille pushpin retainer (2 required)
5	15022A68A	Right cowl panel grille
6	17603	Windshield washer nozzle (2 required)
7	W708771	Cowl grille pushpin retainer (4 required)
8	17K664	Windshield washer hose

Removal and Installation

NOTE: It is necessary to remove the left cowl grille panel before removing the right cowl grille panel.

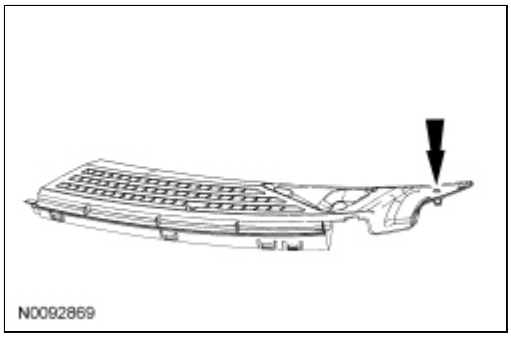
1. Remove the wiper pivot arms. For additional information, refer to Section 501-16 .
2. Open the hood.
3. Remove the left cowl panel grille pushpin retainer.

4. Release the front edge of the left cowl grille panel.
    - Starting at the center of the vehicle, depress the forward tab and press upward on the front edge of the cowl grille panel to release it from the cowl.
    - Continuing out from the center of the vehicle, depress the remaining forward tabs and release the rest of the front edge of the cowl grille panel from the cowl.



5. **NOTE:** Attaching clips will remain connected to the cowl sheet metal.

    Pull up on the rear LH edge of the cowl grille panel and disengage the 2 rear attaching clips from the cowl grille panel.



6. **NOTE:** The attaching clips will need to be removed from the cowl sheet metal and inspected. Replace any damaged clips.

    Remove the attaching clips by rotating the clips one-fourth of a turn to release them from the cowl sheet metal. Inspect and replace any damaged clips and reinstall the clips onto the cowl grille panel.

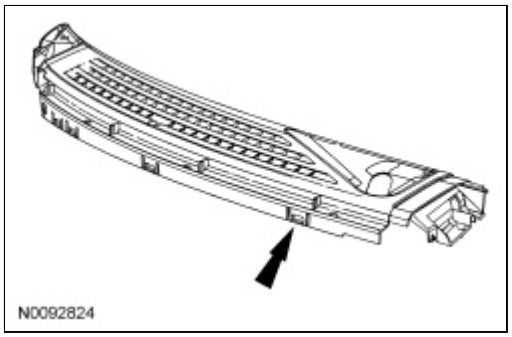
7. Disconnect the windshield washer hose.

8. Remove the left cowl grille panel.

9. Remove the right cowl panel grille pushpin retainer.

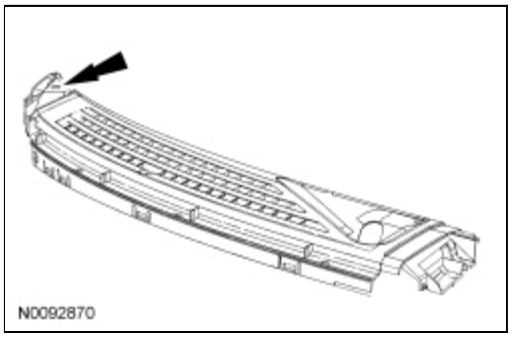
10. Release the front edge of the right cowl grille panel.
    - Starting at the center of the vehicle, depress the forward tab and press upward on the front edge of the cowl grille panel to release it from the cowl.
    - Continuing out from the center of the vehicle, depress the remaining forward tabs and release the rest of the front edge of the cowl grille panel from the cowl.

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11. **NOTE:** Attaching clips will remain connected to the cowl sheet metal.

    Pull up on the rear RH edge of the cowl grille panel and disengage the 2 rear attaching clips from the cowl grille panel.



12. **NOTE:** The attaching clips will need to be removed from the cowl sheet metal and inspected. Replace any damaged clips.

    Remove the attaching clips by rotating the clips one-fourth of a turn to release them from the cowl sheet metal. Inspect and replace any damaged clips and reinstall the clips onto the cowl grille panel.

13. Disconnect the windshield washer hose.

14. Remove the right cowl grille panel.

15. To install, reverse the removal procedure.

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Fender Splash Shield

Removal and Installation

Both splash shields

1. If equipped, remove the fender moulding. For additional information, refer to Section 501-08 .
2. Remove the wheel and tire. For additional information, refer to Section 204-04

LH splash shield

3. Open the hood and remove the 5 wiring harness pushpins attached to the splash shield in the engine compartment.
4. Remove the 3 splash shield pushpins and the 5 splash shield screws.
5. Partially lower the splash shield and remove the 2 air box deflector pushpins from the engine side of the splash shield.

RH splash shield

6. Open the hood and remove the 4 wiring harness pushpins attached to the splash shield in the engine compartment.
7. Remove the 3 splash shield pushpins and the 5 splash shield screws.

Both splash shields

8. Remove the splash shield.
9. To install, reverse the removal procedure.

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Fender

Material

Item	Specification
Flexible Foam Repair Fusor® 121, or equivalent; obtain locally	—

Removal and Installation

Both fenders

1. On vehicles equipped with 3.5L GTDI engine, remove the front fender foam hood seal.
2. If equipped, remove the fender mouldings. For additional information, refer to Section 501-08 .
3. Remove the headlamp assembly. For additional information, refer to Section 417-01 .

RH fender

4. Remove the antenna cable. Refer to the appropriate section in Group 415 for the procedure..

Both fenders

5. Remove the fender splash shield. For additional information, refer to Fender Splash Shield in this section.
6. Remove the 3 front bumper cover-to-fender bolts.
7. Remove the fender lower reinforcement bolt.
8. Remove the bumper cover-to-fender support brace bolts (1 each side).
9. Remove the fender upper rear bolt.
   - To install, tighten to 9 Nm (80 lb-in).
10. **NOTE:** It will be necessary to remove the rear expandable foam baffle pushpins and position the foam baffle aside to gain access to the fender rear inside bolt.

    Remove the rear expandable foam baffle pushpin retainers.
11. **NOTE:** If expandable foam sealant has been used between the rear expandable foam baffle and the cowling, carefully cut the foam sealant to remove the rear expandable foam baffle from the cowling.

    NOTE: If reusing an existing expandable foam baffle, use Flexible Foam Repair or equivalent to seal the area around the entire perimeter of the rear expandable foam baffle.

Remove the rear expandable foam baffle.

12. Remove the fender rear inner bolt.
    - To install, tighten to 9 Nm (80 lb-in).

13. If equipped, remove the fender lower trim cover pushpins (2 each side).

14. Remove the lower fender bolts (2 each side).
    - To install, tighten to 9 Nm (80 lb-in).

15. Remove the upper fender bolts.
    - To install, tighten to 6 Nm (53 lb-in).

16. Remove the fender.

17. To install, reverse the removal procedure.

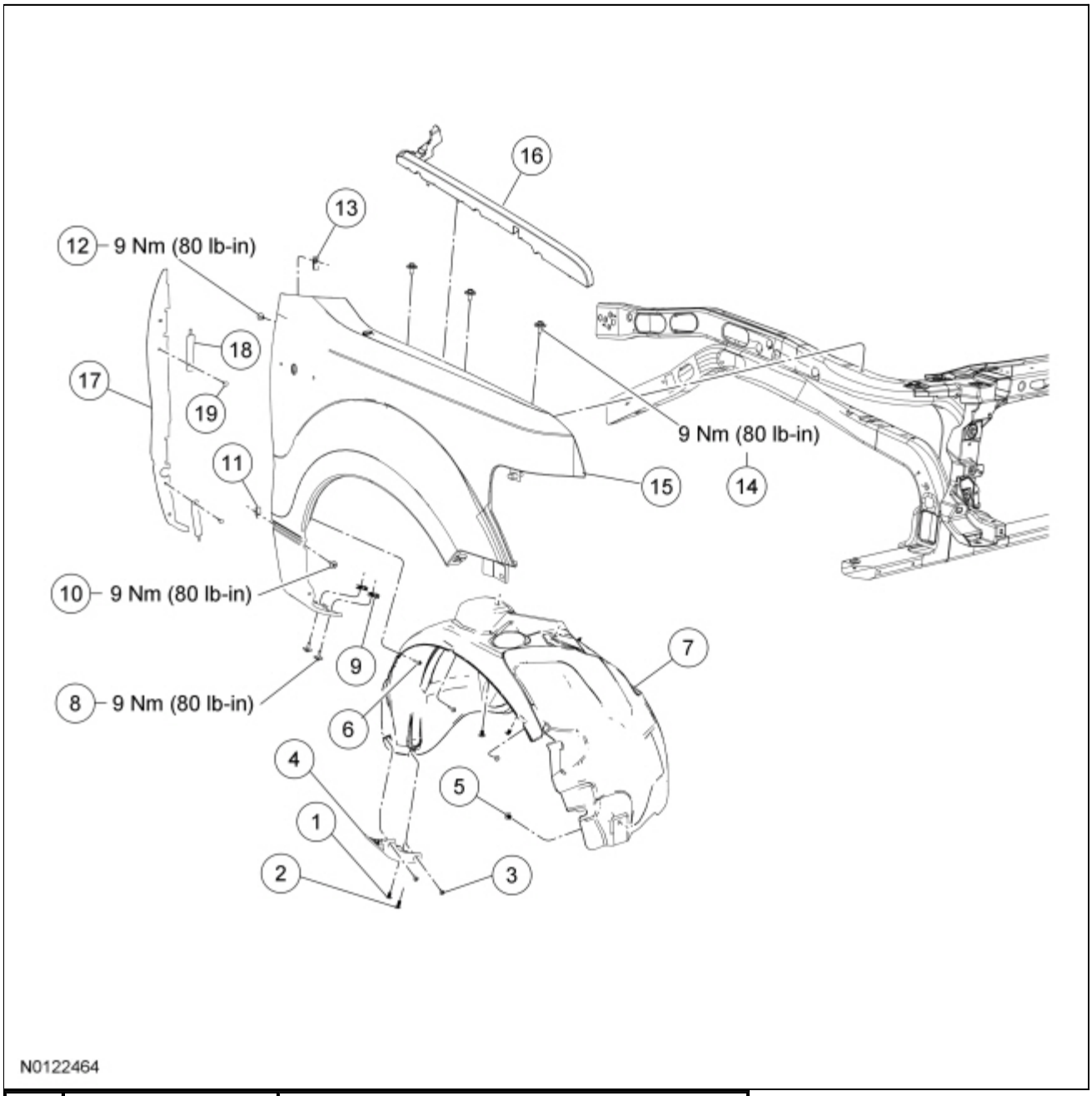
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Front End Body Panels — Exploded View

All Models Except F-150 SVT Raptor

NOTE: Right side shown, left side similar.

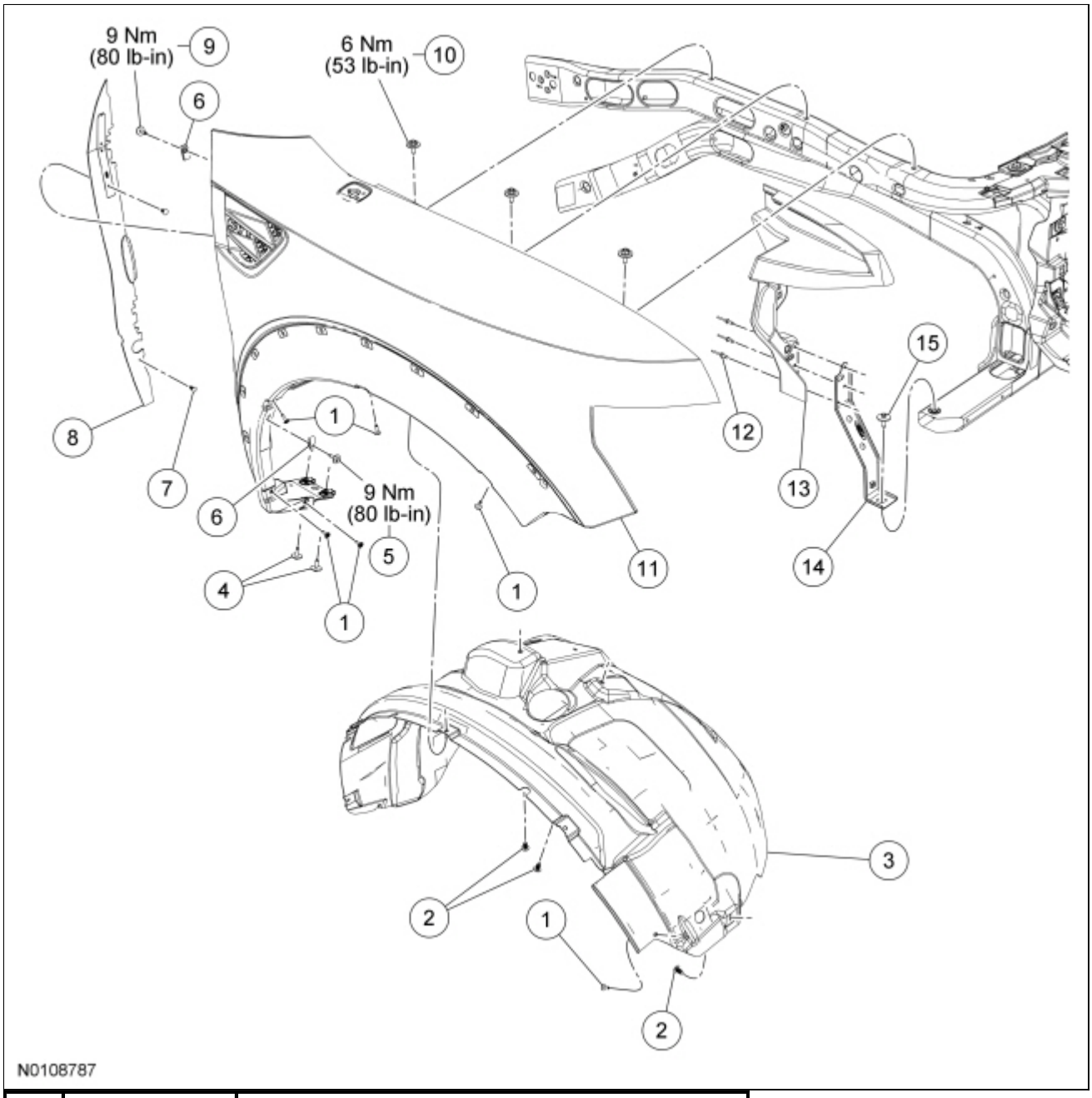


Item	Part Number	Description
1	W705589	Fender lower trim cover pushpin

2	W709346	Fender lower trim cover pushpin
3	W705392	Fender lower trim cover screw (2 required)
4	16B569 LH/ 16B568 RH	Fender lower trim cover
5	W705589	Fender splash shield pushpin (3 required)
6	W705392	Fender splash shield screw (5 required)
7	16055 LH/ 16054 RH	Fender splash shield
8	W714338	Lower fender bolt (2 required)
9	W713705	Fender J-clip nut (2 required)
10	W530924	Fender rear inside bolt
11	W520832	Fender J-clip nut
12	W503924	Fender upper rear bolt
13	W520832	Fender J-clip nut
14	W714339	Fender upper bolt (3 required)
15	16006A LH/ 16005A RH	Fender
16	16K780/ 16K781	Front fender foam hood seal (only on 3.5L GTDI engine) (RH/LH)
17	16E133A LH/ 16E097A RH	Rear expandable baffle
18	—	Rear expandable baffle bracket (part of 16E133A LH/ 16E097A RH)
19	—	Rear expandable baffle pushpin (part of 16E133A LH/ 16E097A RH)

F-150 SVT Raptor

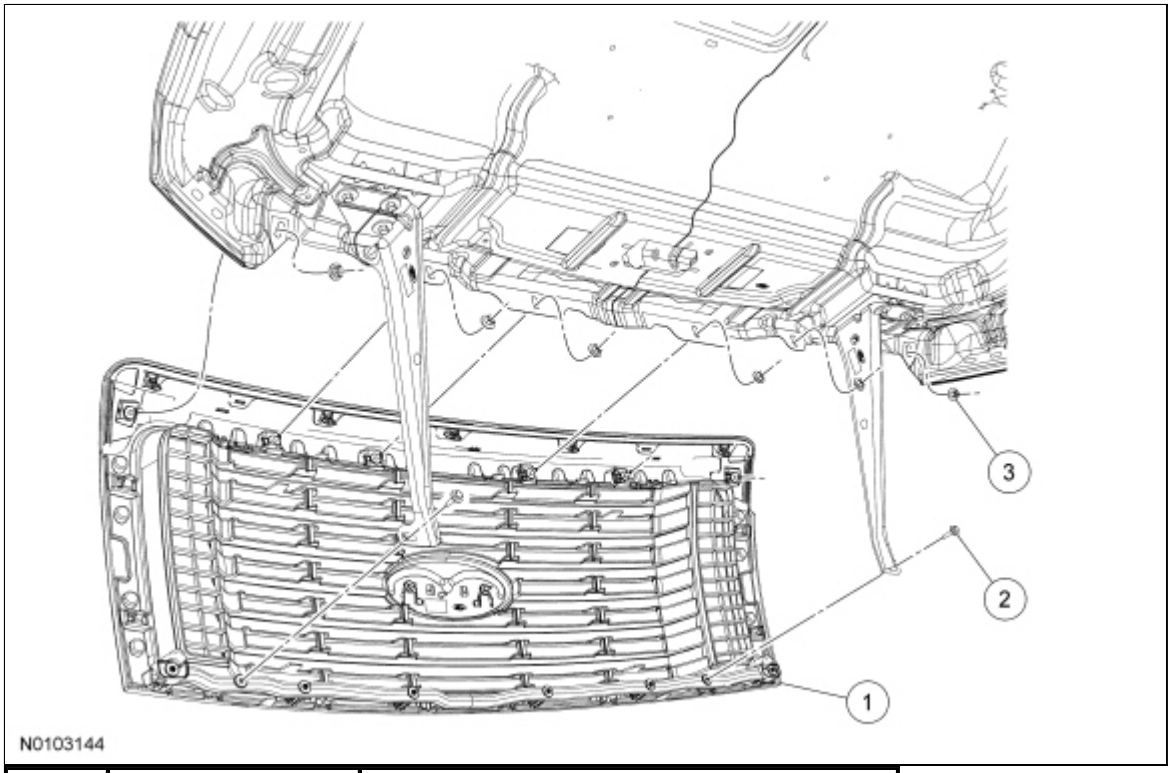
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Item	Part Number	Description
1	W705392	Fender splash shield screws
2	W705589	Fender splash shield pushpins
3	16055 LH/ 16054 RH	Fender splash shield
4	W714338	Lower fender bolts
5	W530924	Fender rear inner bolt
6	N806851	Fender J-clip nuts
7	—	Rear expandable baffle pushpin (part of 16E133A LH/ 16E097A RH)
8	16E133A LH/	Rear expandable baffle

	16E097A RH	
9	W530924	Fender upper rear bolt
10	W714339	Fender upper bolt (3 required)
11	16006-A LH/ 16005-A RH	Fender
12	—	Fender upper reinforcement-to-fender lower reinforcement rivet (part of 16005-B RH/ 16005-A LH) (3 required)
13	—	Fender upper reinforcement (part of 16005-B RH/ 16005-A LH)
14	—	Fender lower reinforcement (part of 16005-B RH/ 16005-A LH)
15	N801169	Fender lower reinforcement bolt

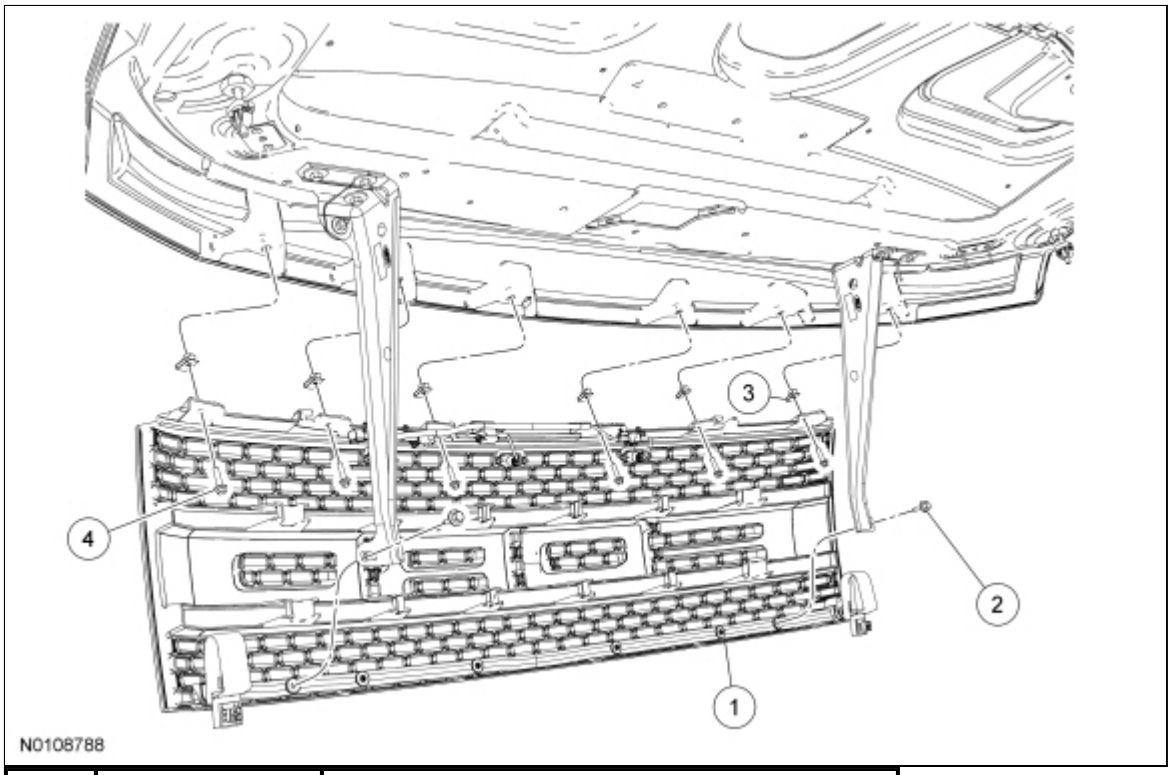
F-150 Radiator Grille



Item	Part Number	Description
1	8200	Radiator grille
2	W714661	Radiator grille bolt (2 required)
3	W520832	Radiator grille nut (6 required)

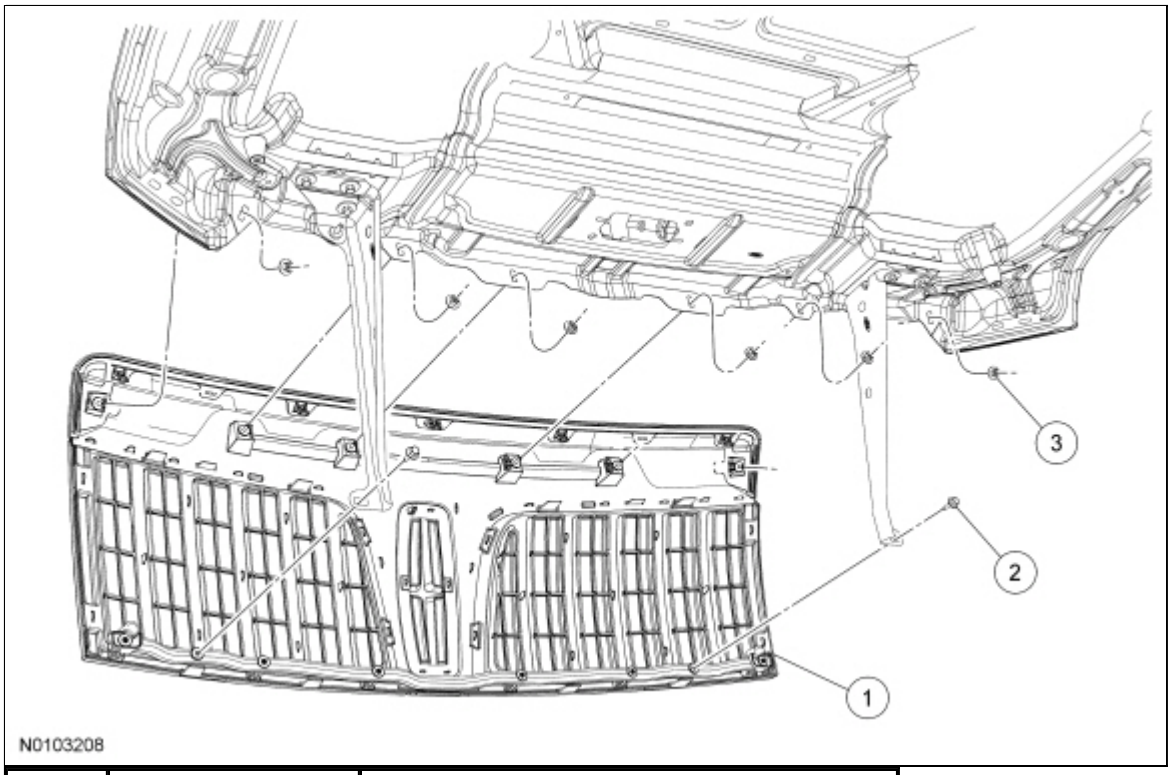
F-150 SVT Raptor Radiator Grille

repair4less



Item	Part Number	Description
1	8200	Radiator grille
2	W714661	Radiator grille bolt (2 required)
3	W520822	Radiator grille J-clip nut (6 required)
4	W505424	Radiator grille upper bolt (6 required)

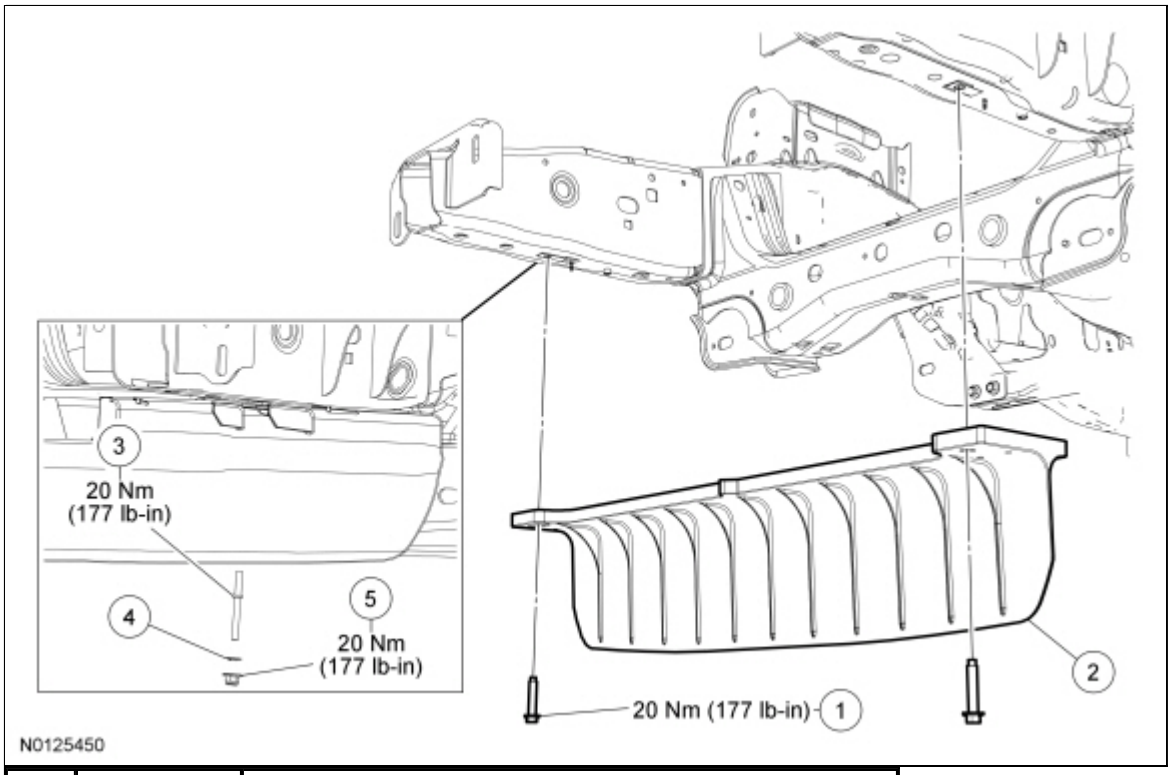
Lincoln Mark LT Radiator Grille (Mexico Only)



Item	Part Number	Description
1	8200	Radiator grille
2	W709931	Radiator grille bolt (2 required)
3	W520832	Radiator grille nut (6 required)

Front Air Dam

repair4less

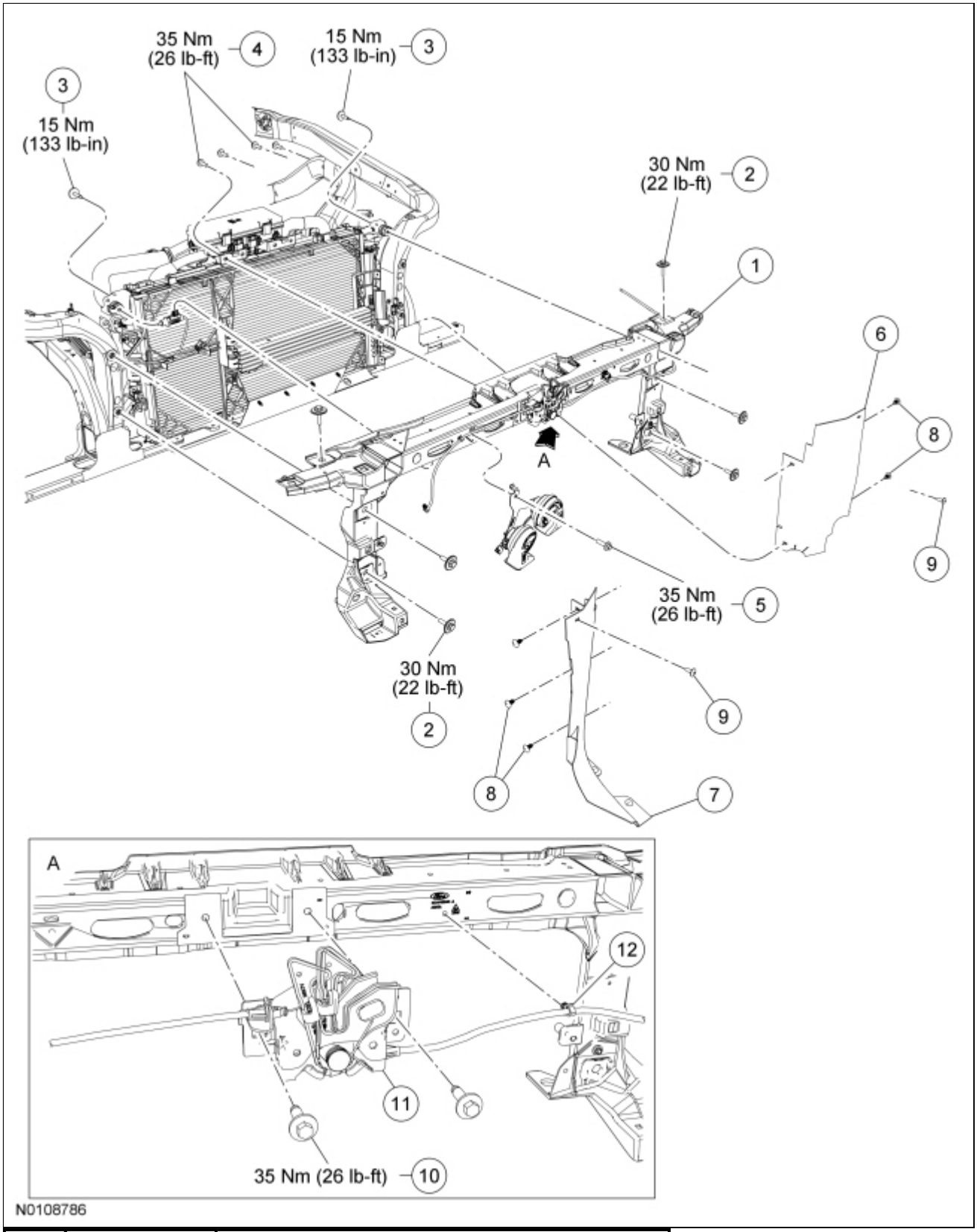


Item	Part Number	Description
1	W710656	Front air dam bolts (2 required Kansas City plant build only)
2	6B629	Front air dam
3	W711375	Front air dam studs (2 required Dearborn Truck Plant build only)
4	W623484	Front air dam retainer (2 required Dearborn Truck Plant build only)
5	W712334	Front air dam nuts (2 required Dearborn Truck Plant build only)

1. For additional information, refer to the procedures in this section.

repair4less

Radiator Grille Support

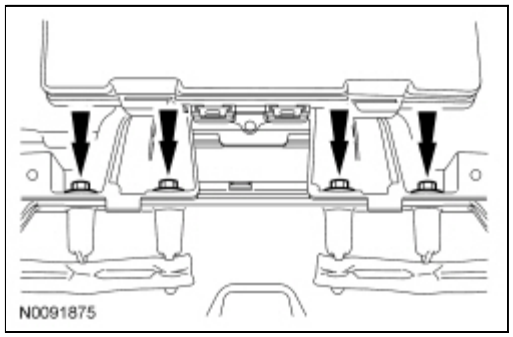


Item	Part Number	Description
1	16E166	Radiator grille support
2	W712360	Radiator grille support bolts (6 required)

repair4less

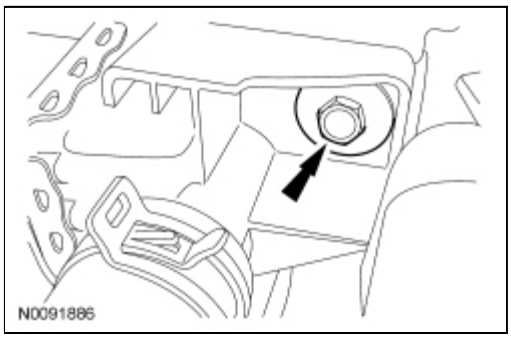
3	W710309	Coolant module bolts (2 required)
4	W711851	Smart Junction Box (SJB) bolts (4 required)
5	W711848	Horn bracket bolt
6	8A261	LH air deflector
7	8A211	RH air deflector
8	W388577	Air deflector pushpins (5 required)
9	W706350	Air deflector scrivets (2 required)
10	W711848	Hood release bolt (2 required)
11	16700	Hood release
12	W712867	Hood release cable retainer (5 required)

1. Remove the front bumper. For additional information, refer to Section 501-19 .
2. Remove the front bumper cover. For additional information, refer to Section 501-19 .
3. Depower the Supplemental Restraint System (SRS). For additional information, refer to Supplement Restraint System Depower and Repower in Section 501-20B .
4. Remove the front LH and RH SRS impact sensor bolt and position the sensor and harness aside.
5. Remove the 2 hood release bolts.
   - To install, tighten to 35 Nm (26 lb-ft).
6. Release the hood cable retainers from the radiator grille support and position the hood release and cable aside.
7. Disconnect the horn wiring connector.
8. Remove the ambient air sensor retainer from the radiator grille support and position the sensor and harness aside.
9. Remove the horn bracket bolt.
   - To install, tighten to 35 Nm (26 lb-ft).
10. Remove the 4 Smart Junction Box (SJB) bolts and position the SJB inward.
    - To install, tighten to 35 Nm (26 lb-ft).



11. Remove the 2 coolant module bolts-to-radiator from the rear of the grille support.

- To install, tighten to 15 Nm (133 lb-in).



12. Remove the 6 radiator grille support bolts (3 each side).
    - To install, tighten to 30 Nm (22 lb-ft).

13. **NOTE:** It will be necessary to lift the cooling module upward and slide the radiator support forward to separate the radiator grille support from the cooling module.

    Remove the radiator grille support.

14. **NOTE:** Inspect all of the radiator grille support insulters. Replace as necessary.

    To install, reverse the removal procedure.
    - Transfer all necessary components.
    - Repower the Supplemental Restraint System (SRS). For additional information, refer to Supplement Restraint System Depower and Repower in Section 501-20B .

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Torque Specifications

Description	Nm	lb-ft	lb-in
Front door check arm-to-body nuts	12	—	106
Front door check arm-to-door screws	25	18	—
Front door hinge-to-body bolts	30	22	—
Front door hinge-to-body nuts	30	22	—
Front door hinge-to-door nuts	30	22	—
Front door hinge-to-door bolts	30	22	—
Front door latch striker bolts	25	18	—
Lower rear door striker bolts	25	18	—
Rear door check arm-to-body screws	25	18	—
Rear door check arm-to-door nuts	12	—	106
Rear door hinge-to-body bolts	25	18	—
Rear door hinge-to-body nuts	30	22	—
Rear door hinge-to-rear door bolts	30	22	—
Rear door latch striker bolts	25	18	—
Rear door striker bolts	25	18	—
Upper rear door striker bolts	25	18	—

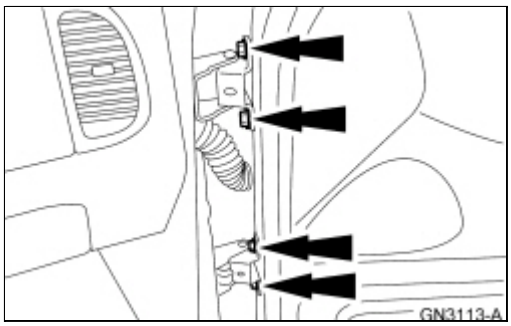
Door Alignment — Front

All adjustments

1. Remove the door latch striker.

Horizontal and vertical adjustment

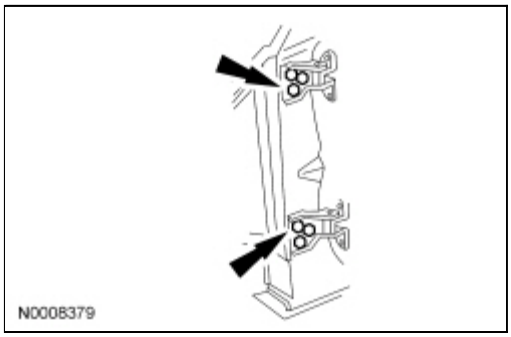
2. Loosen the front door hinge-to-front door bolts.



3. Adjust the front door. For additional information, refer to the dimensions in Section 501-35 .
4. Tighten the front door hinge-to-front door bolts to 30 Nm (22 lb-ft).

Fore and aft adjustment

5. Remove the front fender. For additional information, refer to Section 501-02 .
6. Loosen the door hinge-to-body bolts.



7. Adjust the front door. For additional information, refer to the dimensions in Section 501-35 .
8. Tighten the front door hinge-to-body bolts to 30 Nm (22 lb-ft).
9. Install the front fender. For additional information, refer to Section 501-02 .

All adjustments

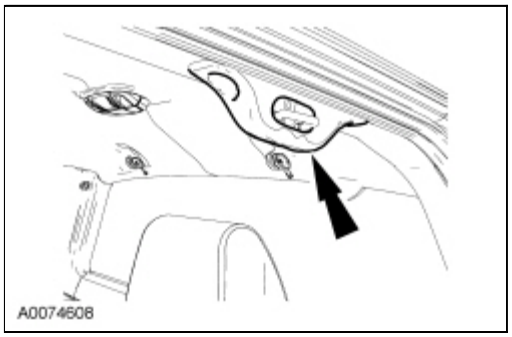
repair4less

10. Install the front door latch striker.
    - Tighten to 25 Nm (18 lb-ft).

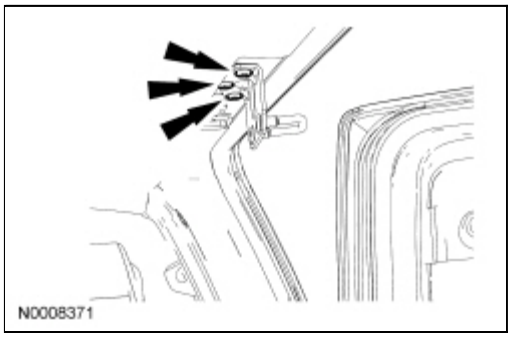
Door Alignment — Rear, SuperCab

All adjustments

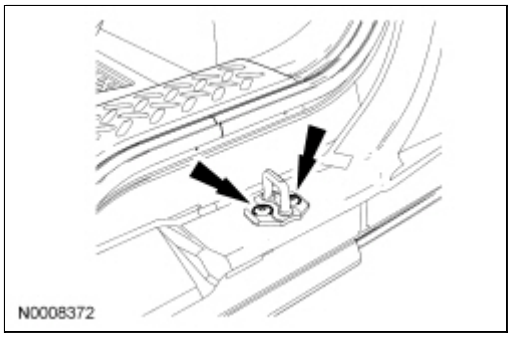
1. Remove the upper rear door striker cover.



2. Remove the upper rear door striker.



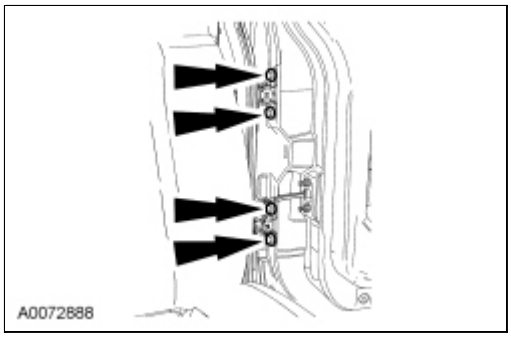
3. Remove the lower rear door striker.



Horizontal and vertical adjustments

4. Loosen the rear door hinge-to-rear door bolts.

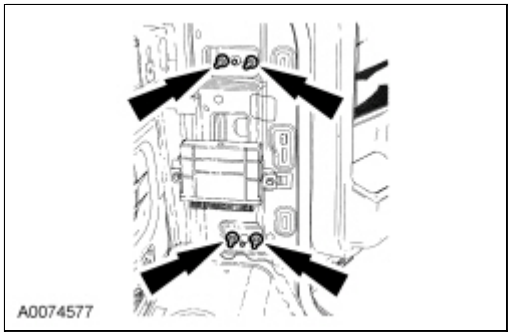
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5. Adjust the rear door. For additional information, refer to the dimensions in Section 501-35 .
6. Tighten the rear door hinge-to-rear door bolts to 30 Nm (22 lb-ft).

Fore and aft adjustment

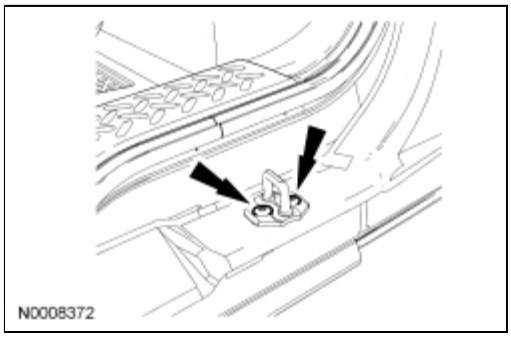
7. Remove the corner trim panel. For additional information, refer to Section 501-05 .
8. Loosen the rear door hinge-to-body nuts.



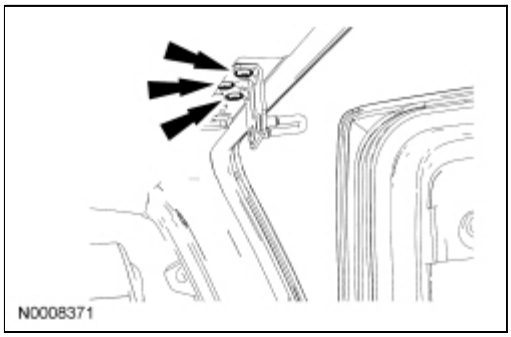
9. Adjust the door. For additional information, refer to the dimensions in Section 501-35 .
10. Tighten the rear door hinge-to-body nuts to 30 Nm (22 lb-ft).
11. Install the corner trim panel. For additional information, refer to Section 501-05 .

All adjustments

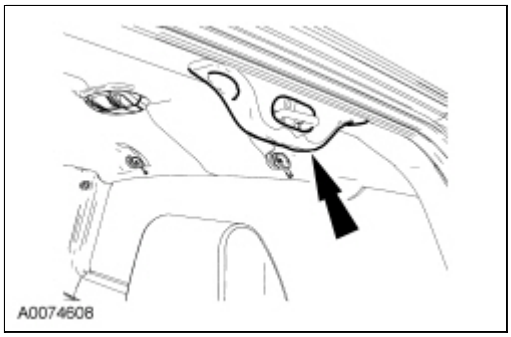
12. Install the lower rear door striker.
    - Tighten to 25 Nm (18 lb-ft).



13. Install the upper rear door striker.
    - Tighten to 25 Nm (18 lb-ft).



14. Install the upper rear door striker cover.

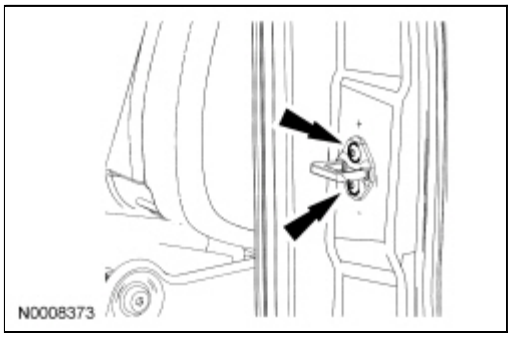


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Door Alignment — Rear, SuperCrew

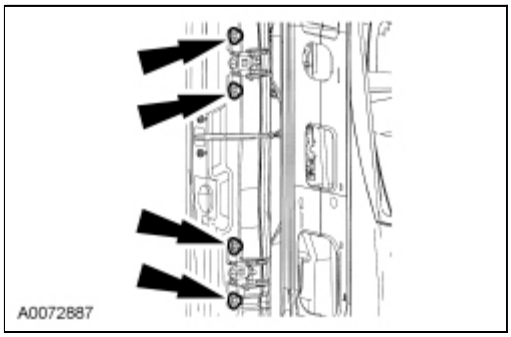
All adjustments

1. Remove the rear door striker.



Horizontal and vertical adjustments

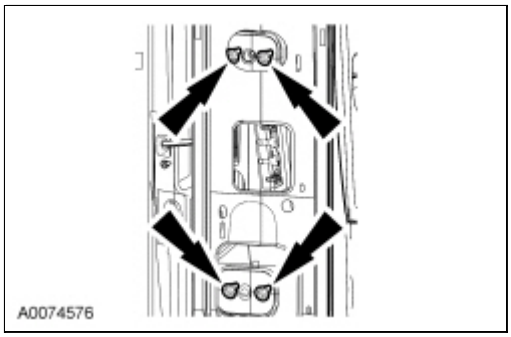
2. Loosen the rear door hinge-to-rear door bolts.



3. Adjust the rear door. For additional information, refer to the dimensions in Section 501-35 .
4. Tighten the rear door hinge-to-rear door bolts to 30 Nm (22 lb-ft).

Fore and aft adjustment

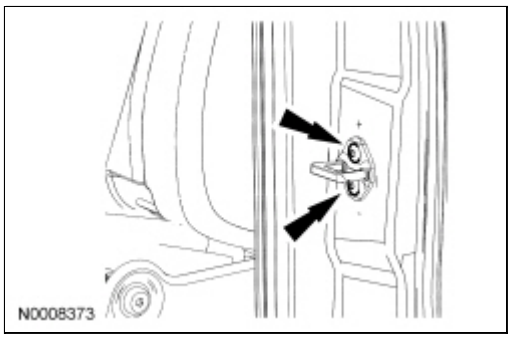
5. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .
6. Loosen the rear door hinge-to-body nuts.



7. Adjust the door. For additional information, refer to the dimensions in Section 501-35 .
8. Tighten the rear door hinge-to-body nuts to 30 Nm (22 lb-ft).
9. Install the B-pillar trim panel. For additional information, refer to Section 501-05 .

All adjustments

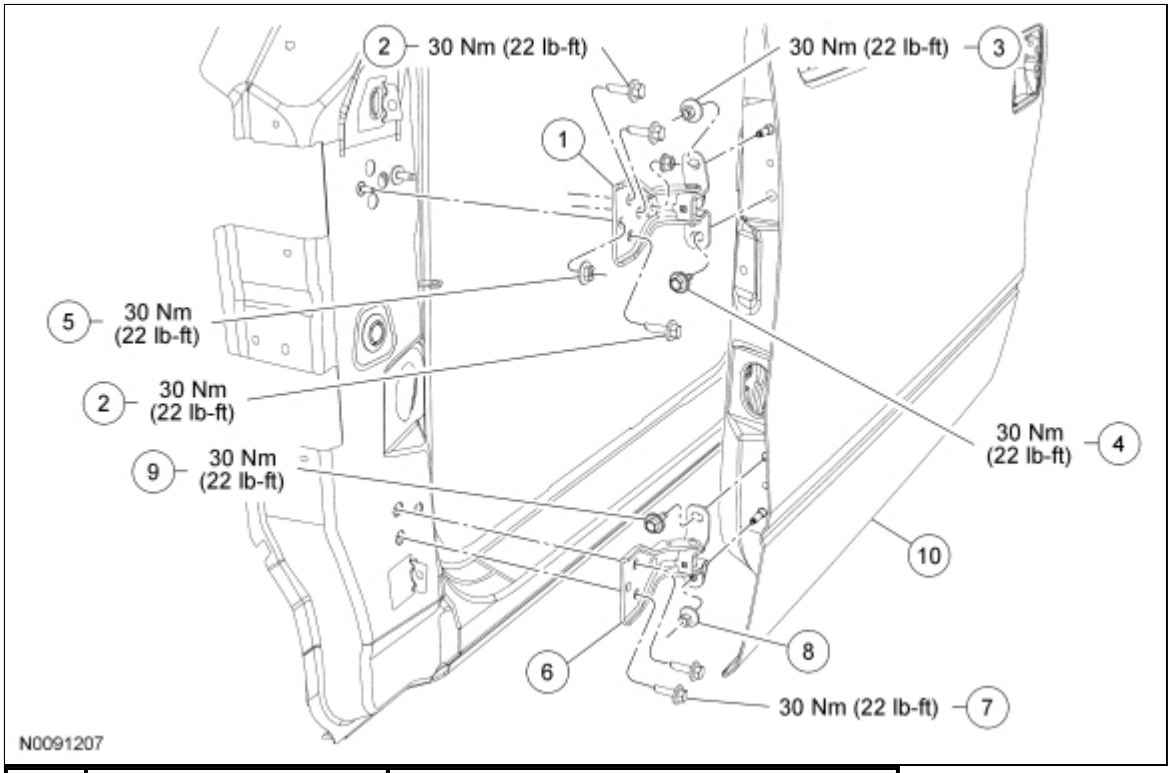
10. Install the rear door striker.
    - Tighten to 25 Nm (18 lb-ft).



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Door — Front

NOTE: Right side shown, left side similar.



Item	Part Number	Description
1	22800 RH/ 22801 LH	Front door upper hinge
2	W708880	Front door upper hinge-to-body bolts
3	22810	Front door upper hinge-to-door nut
4	W708877	Front door upper hinge-to-door bolt
5	N621941	Front door upper hinge-to-body nut
6	22810 RH/ 22811 LH	Front door lower hinge
7	W708877	Front door lower hinge-to-body bolt
8	N806564	Front door lower hinge-to-door nut
9	W708877	Front door lower hinge-to-door bolt
10	20124 RH/ 20125 LH	Front door

Removal and Installation

All vehicles

1. Depower the Supplemental Restraint System (SRS). For additional information, refer to Section 501-20B .

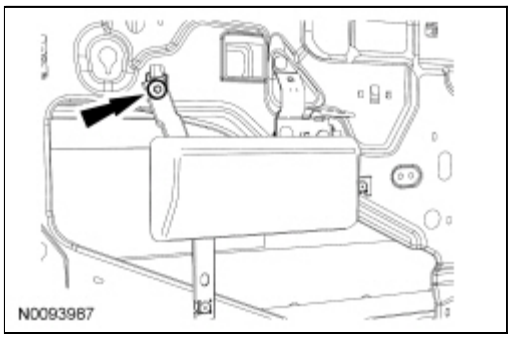
repair4less

2. Open the front door and support as needed.

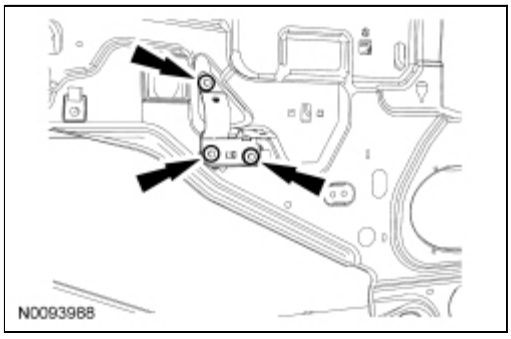
Vehicles not equipped with an A-pillar electrical connector

3. Remove the door speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.

4. Remove the armrest backing screw and remove the armrest backing.



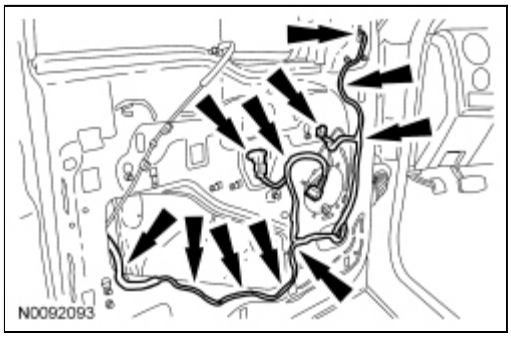
5. Remove the armrest bracket bolts and remove the bracket.



6. Pull outward to release the water shield adhesive and remove the water shield.

7. Pull outward to release the sail panel water shield adhesive and remove the sail panel water shield.

8. Pull outward to release the wiring harness retainers.



9. Disconnect the keyless entry and door lock electrical connectors.

10. Disconnect the mirror electrical connectors.

11. Disconnect the side impact sensor electrical connector.

12. Route the wiring harness through the door.

Vehicles equipped with an A-pillar electrical connector

13. Disconnect the front door A-pillar electrical connector.

All vehicles

NOTICE: **The following steps require the aid of an assistant. Failure to follow this direction may result in damage to the vehicle.**

14. Remove the lower front door hinge-to-door nut and bolt.
    - To install, tighten the bolt to 30 Nm (22 lb-ft).
    - To install, tighten the nut to 30 Nm (22 lb-ft).

15. Remove the upper front door hinge-to-door nut and bolt and remove the front door.
    - To install, tighten the bolt to 30 Nm (22 lb-ft).
    - To install, tighten the nut to 30 Nm (22 lb-ft).

16. ***NOTICE:*** **To minimize the possibility of cross threading, hand-start all fasteners during the installation.**

    To install, reverse the removal procedure.
    - If installing a new front door, transfer parts as necessary.

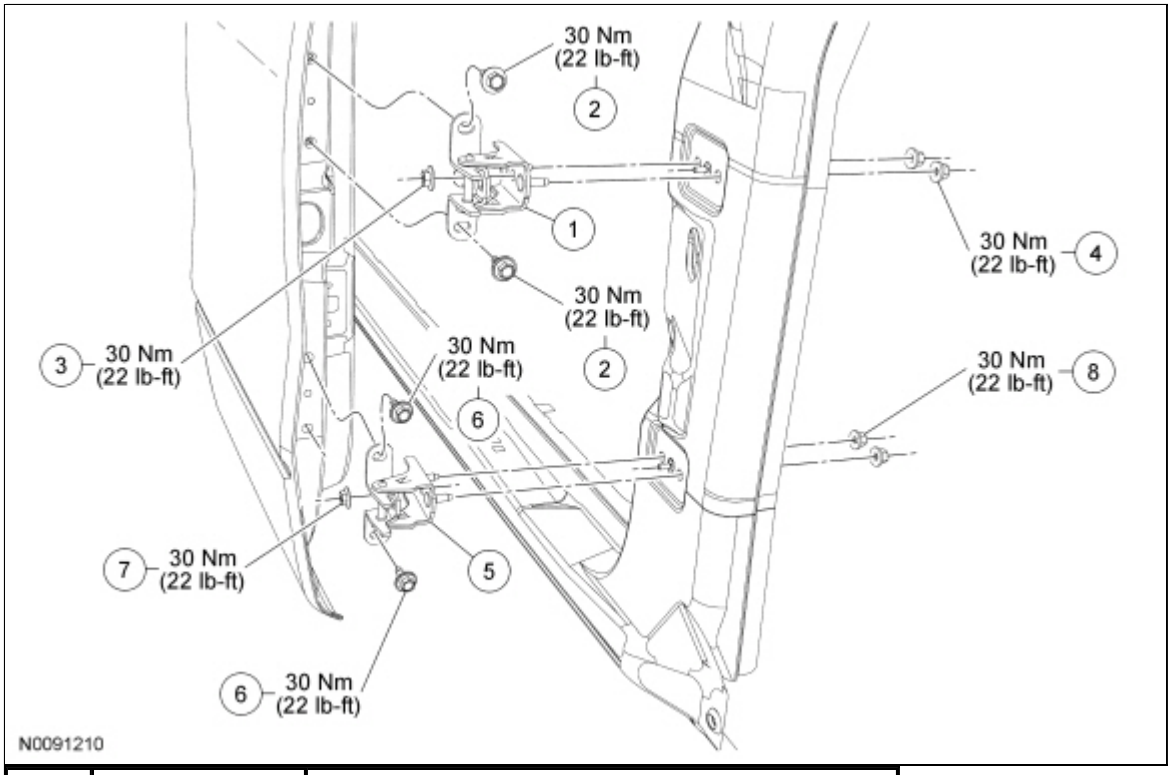
17. Adjust the front door. For additional information, refer to Door Alignment — Front in this section.

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Door — Rear, SuperCab

NOTE: Right side shown, left side similar.



Item	Part Number	Description
1	26800	Rear door upper hinge
2	W709544	Upper rear door hinge-to-rear door bolts
3	W709361	Upper rear door hinge-to-body nut
4	W709361	Body-to-upper rear door hinge nut
5	26800	Lower rear door hinge
6	W709544	Lower rear door hinge-to-door bolts
7	W709361	Lower rear door hinge-to-body nut
8	W709361	Body-to-lower rear door hinge nut

Removal and Installation

All vehicles

1. Open the rear door and support as needed.

Vehicles not equipped with a B-pillar electrical connector

2. Depower the Supplemental Restraint System (SRS). For additional information, refer to Section 501-20B .

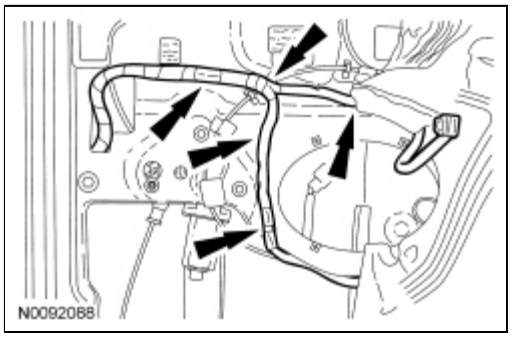
3. Remove the door speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.

4. Reposition the water shield.

5. Disconnect the window motor electrical connector.

6. Disconnect the door lock electical connector.

7. Pull outward to release the wiring harness retainers from the door.



8. Route the wiring harness out of the door.

Vehicles equipped with a B-pillar electrical connector

9. Disconnect the rear door electrical connector.

All vehicles

10. Remove the lower rear door hinge-to-rear door bolts.
    - To install, tighten bolt to 30 Nm (22 lb-ft).

11. ***NOTICE:*** **To avoid damaging the door, this step requires an assistant.**

    Remove the upper rear door hinge-to-rear door bolts and remove the rear door.
    - To install, tighten bolt to 30 Nm (22 lb-ft).

12. ***NOTICE:*** **To minimize the possibility of cross threading, hand-start all fasteners during the installation.**

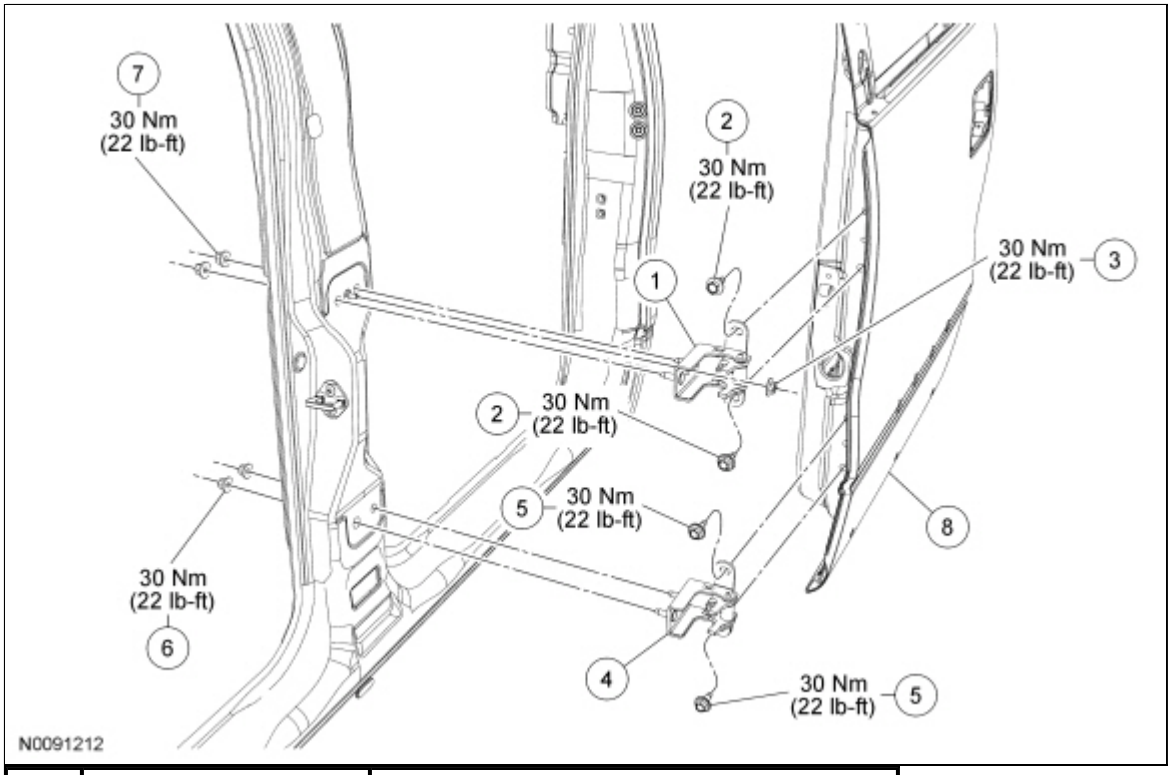
    To install, reverse the removal procedure.
    - If installing a new rear door, transfer parts as necessary.

13. Adjust the rear door. For additional information, refer to Door Alignment — Rear, SuperCab in this section.

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Door — Rear, SuperCrew

NOTE: Right side shown, left side similar.



Item	Part Number	Description
1	26800	Rear door upper hinge
2	W709544	Upper rear door hinge-to-rear door bolts
3	W709361	Upper rear door hinge-to-body nut
4	W709189	Lower rear door hinge
5	26810	Lower rear door hinge-to-rear door bolts
6	W709361	Lower rear door hinge-to-body nut
7	W709361	Upper rear door hinge-to-body nut
8	24630 RH/ 24631 LH	Rear door

Removal and Installation

All vehicles

1. Open the rear door and support as needed.

Vehicles not equipped with a B-pillar electrical connector

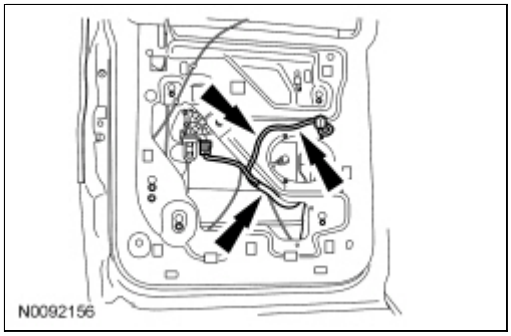
repair4less

2. Depower the Supplemental Restraint System (SRS). For additional information, refer to Section 501-20B .

3. Remove the door speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.

4. Reposition the water shield.

5. Pull outward to release the wiring harness retainers from the door.



6. Disconnect the window motor electrical connector.

7. Disconnect the door lock electical connector.

8. Route the wiring harness out of the door.

Vehicles equipped with a B-pillar electrical connector

9. Disconnect the rear door electrical connector.

All vehicles

10. Remove the lower rear door hinge-to-rear door bolts.
    - To install, tighten bolt to 30 Nm (22 lb-ft).

11. ***NOTICE:*** **To avoid damaging the door, this step requires an assistant.**

    Remove the upper rear door hinge-to-rear door bolts and remove the rear door.
    - To install, tighten bolt to 30 Nm (22 lb-ft).

12. ***NOTICE:*** **To minimize the possibility of cross threading, hand-start all fasteners during the installation.**

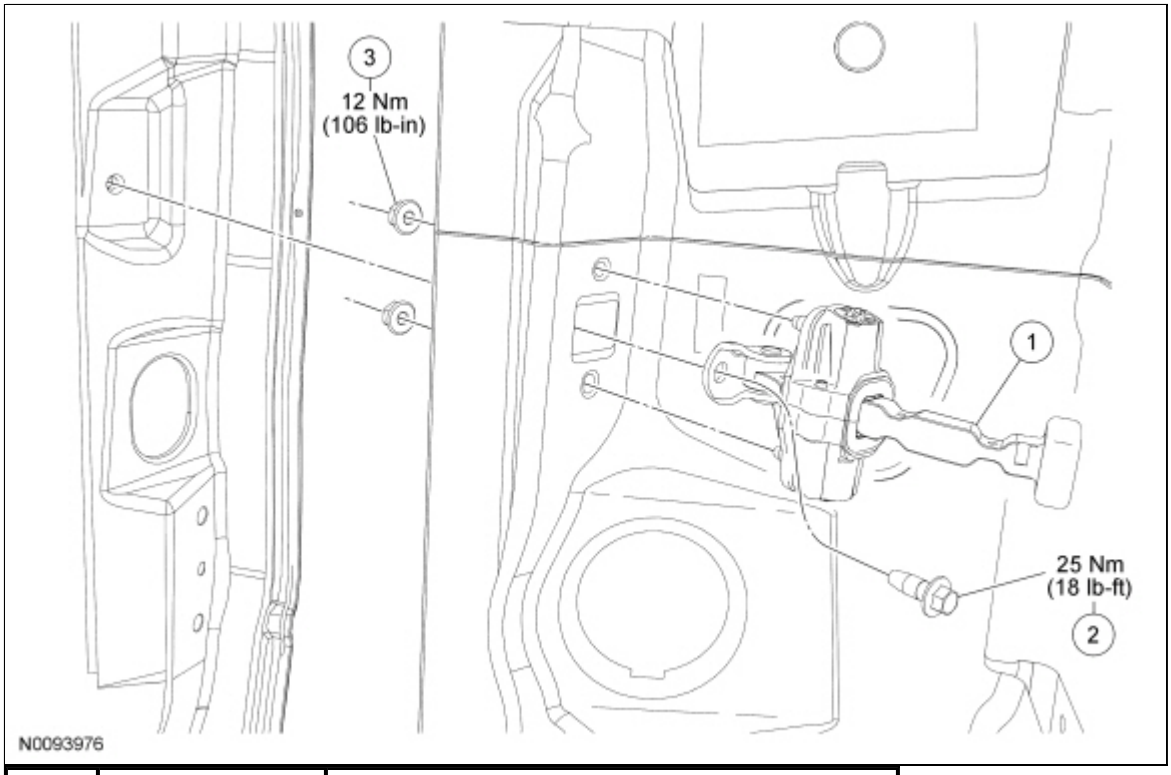
    To install, reverse the removal procedure.
    - If installing a new rear door, transfer parts as necessary.

13. Adjust the rear door. For additional information, refer to Door Alignment — Rear, SuperCrew in this section.

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Door Check Arm — Front

NOTE: Right side shown, left side similar.



Item	Part Number	Description
1	152700	Front door check arm
2	W707375	Front door check arm-to-door screw
3	W712741	Front door check arm-to-body nut

Removal and Installation

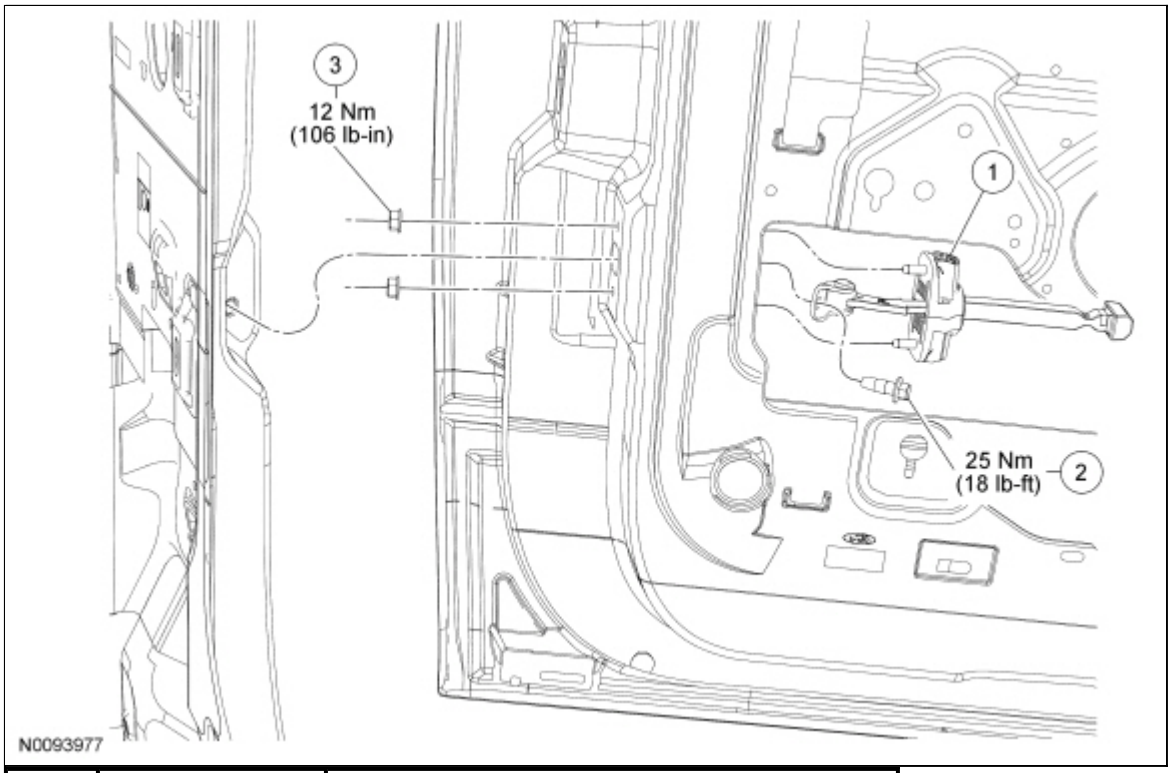
1. Remove the cowl side trim panel. For additional information, refer to Section 501-05 .
2. Remove the front door check arm-to-door screw.
   - To install, tighten to 25 Nm (18 lb-ft).
3. Remove the front door check arm-to-body nuts.
   - To install, tighten to 12 Nm (106 lb-in).
4. Remove the front door check arm.
5. To install, reverse the removal procedure.

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Door Check Arm — Rear, SuperCab and SuperCrew

SuperCab

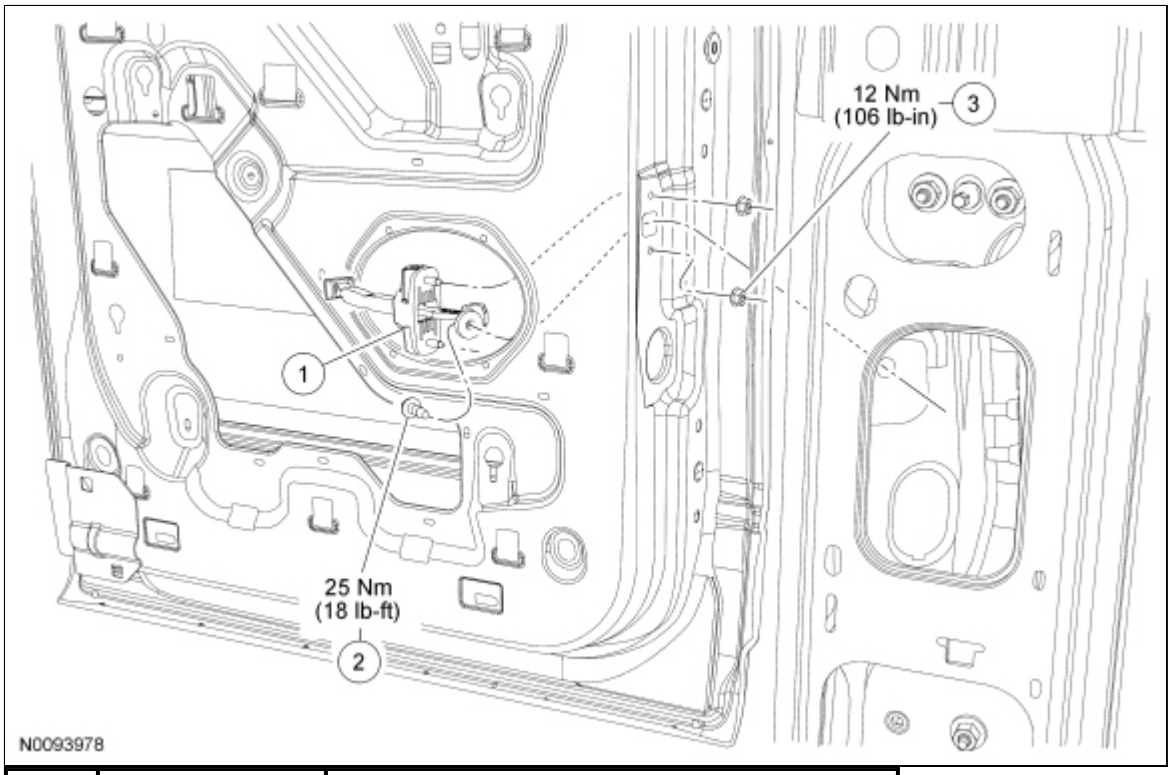
NOTE: Right side shown, left side similar.



Item	Part Number	Description
1	182700	Rear door check arm
2	W707375	Rear door check arm-to-body screw
3	W712741	Rear door check arm-to-door nut

CrewCab

NOTE: Right side shown, left side similar.



Item	Part Number	Description
1	162700	Rear door check arm
2	W707375	Rear door check arm-to-body screw
3	W712741	Rear door check arm-to-door nut

Removal and Installation

1. Remove the door trim panel. For additional information, refer to Section 501-05 .
2. Remove the rear door check arm-to-body screw.
   - To install, tighten to 25 Nm (18 lb-ft).
3. Remove the rear door check arm-to-door nuts.
   - To install, tighten to 12 Nm (106 lb-in).
4. Remove the rear door check arm.
5. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Assist handle bolt	25	18	—
Clamp block machine screw	14	—	124
Pickup box bolts	80	59	—
Side step bracket-to-bed bolt	22	16	—
Side step bracket-to-step bolt	55	41	—
Tail light ground bolt	10	—	89
Tailgate step inside bolt	25	18	—
Tailgate step nab pin nut	11	—	97
Tailgate step upper bolt	25	18	—
Tailgate striker	40	30	—
Wiring harness ground bolt	10	—	89

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Pickup Bed

The pickup bed consists of:

- styleside pickup bed (pan assembly).
- pickup box tie-down hooks.
- body side wheel opening splash shield.
- rear-wheel opening moulding (Four-Wheel Drive (4WD) only).

The styleside pickup bed:

- is standard.
- comes in standard lengths of 1.67 m (5.5 ft) or 1.98 m (6.5 ft) or optional 2.43 m (8 ft) length.
- is double-wall steel construction.
- houses 4 stake pockets in the top of the 1.98 m (6.5 ft) bed and 6 stake pockets on the 2.43 m (8 ft) bed.
- on 4WD vehicles, includes rear-wheel opening mouldings.
- is constructed of an inner steel box and steel tailgate with stamped outer panels.

The F-150 SVT Raptor:

- is offered on 4WD only.
- is offered on 1.67 m (5.5 ft) length only.
- has extended styleside outer panels to provide extra clearance for the wheel.

Styleside pickup beds:

- come standard with 4 pickup bed tie-down hooks.

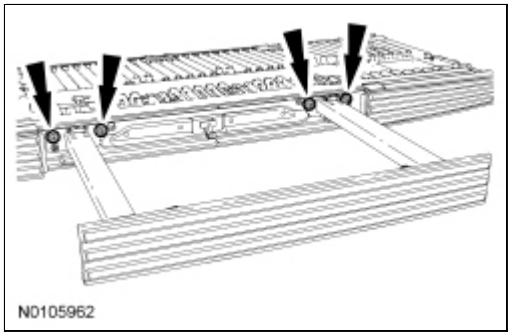
The tailgate assembly consists of:

- tailgate.
- tailgate hinges.
- tailgate support cables.
- torsion rod.
- tailgate step (if equipped).
- tailgate step handle (if equipped).
- rear view camera (if equipped).

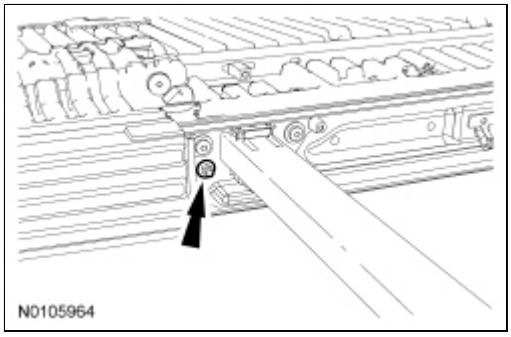
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Tailgate Step Adjustment

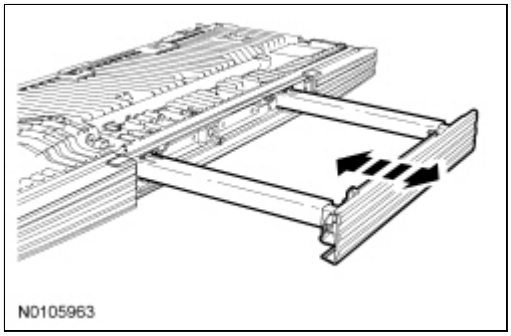
1. Loosen the 4 tailgate step bolts.



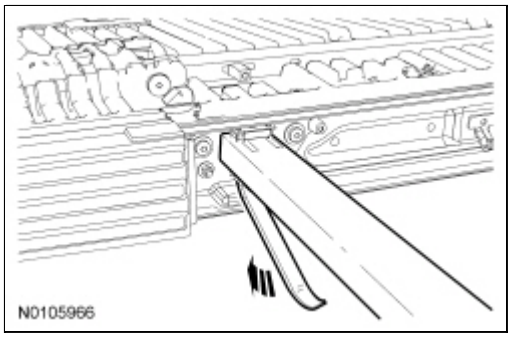
2. Loosen the driver side tailgate step nab pin nut.



3. Cycle the tailgate step to the fully extended position 2 times.



4. Using a suitable trim tool or wedge, pry upward on the driver side of the flex step.

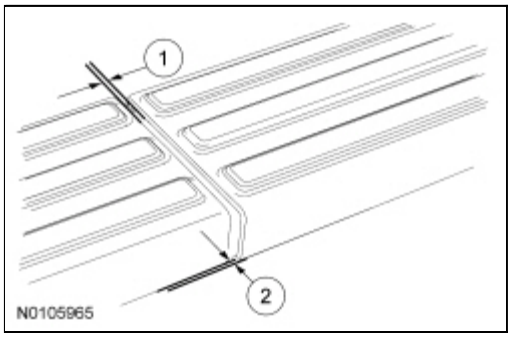


5. Tighten the driver side tailgate step nab pin to 11 Nm (97 lb-in).

6. Tighten the 4 tailgate step bolts to 25 Nm (18 lb-ft).

7. **NOTE:** Make sure the tailgate step does not pinch against the tailgate moulding.

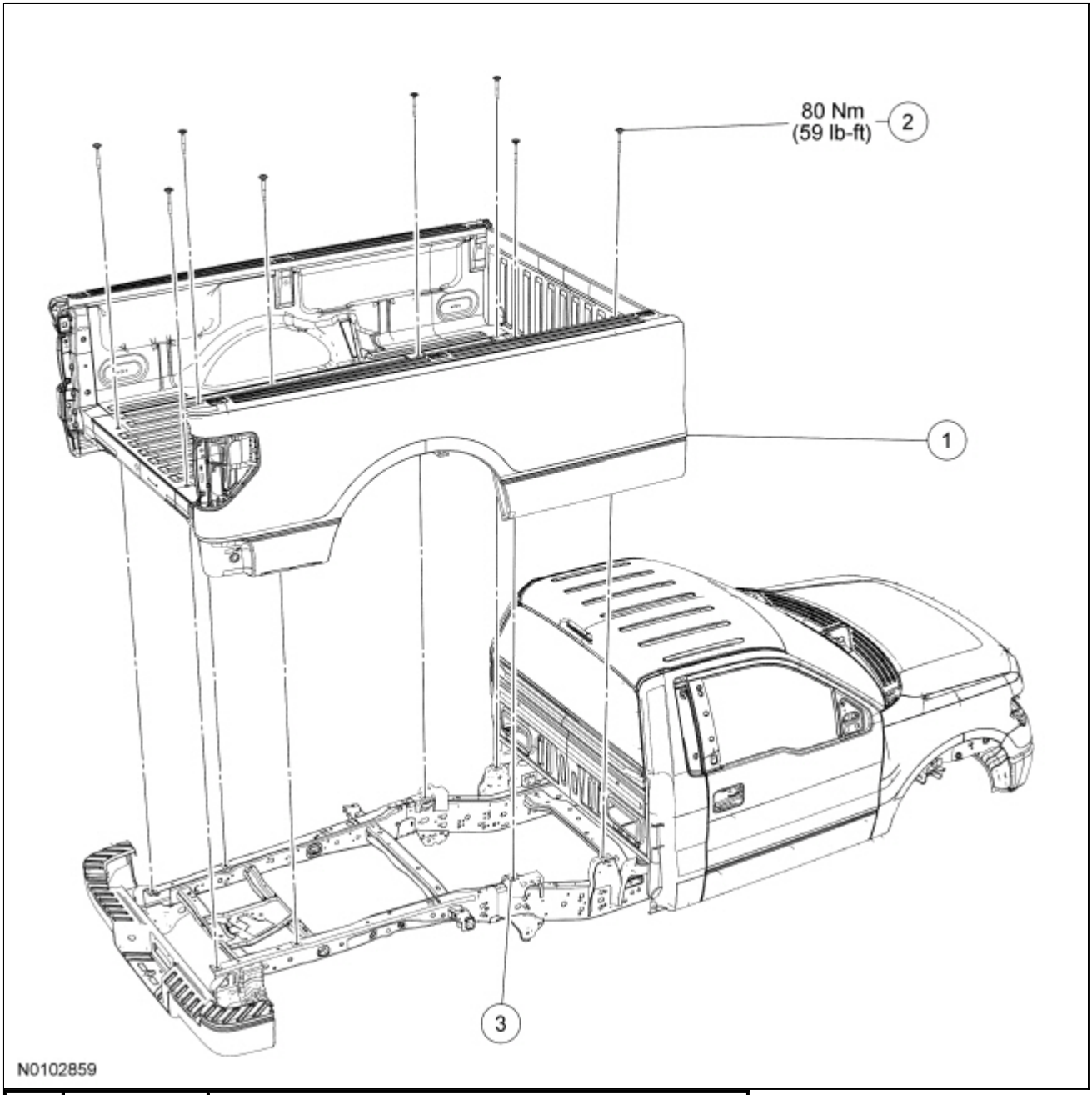
   Inspect the tailgate step gap margin and flushness and adjust as necessary.
   1. Gap Margin = 4.0 mm (0.157 in) ± 2.0 mm (0.078 in).
   2. Flushness = 1.0 mm (0.039 in) ± 3.0 mm (0.118 in).
      - Cycle the tailgate step to the fully extended position to make sure of normal operation.



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Pickup Bed

NOTE: Eight-foot styleside pickup bed shown, all other styleside similar.

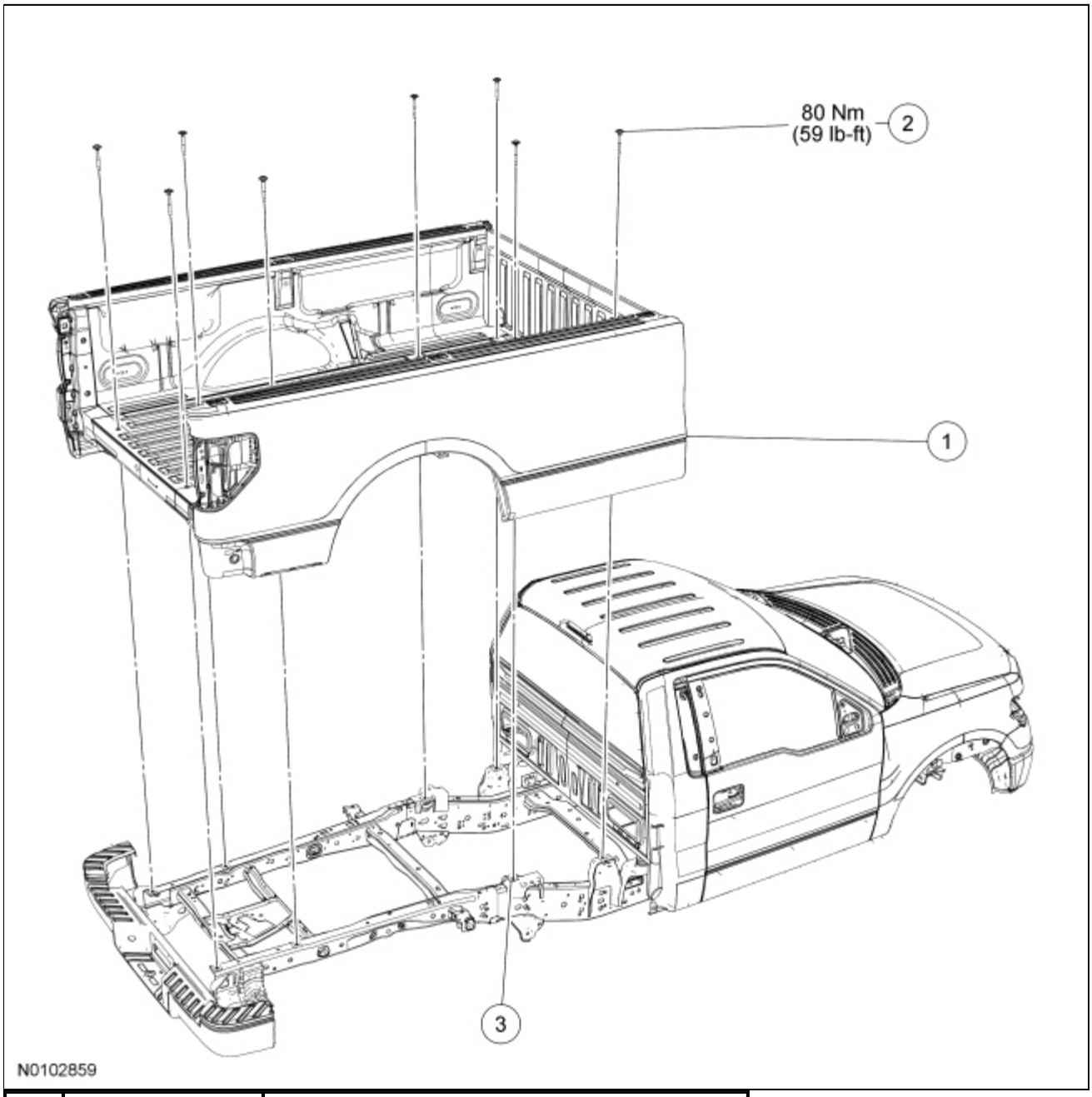


Item	Part Number	Description
1	9928508	Pickup box (complete assembly)
2	W709424	Pickup box bolt (all 8-foot pickup beds have 8 bolts; all others will have 6 bolts)

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3	W708605/ W712174	Pickup box attachment clip (8-foot beds [6-W708605, 2-W712174], 6.5 foot beds, [4-W708605, 2-W712174], 5.5 foot beds, [2-W708605, 4-W712174])

F-150 SVT Raptor



Item	Part Number	Description
1	9928508	Pickup box (complete assembly)
2	W709424	Pickup box bolt (6 required)
3	W708605/ W712174	Pickup box attachment clip (4-W708605) (2-W712174)

Removal and Installation

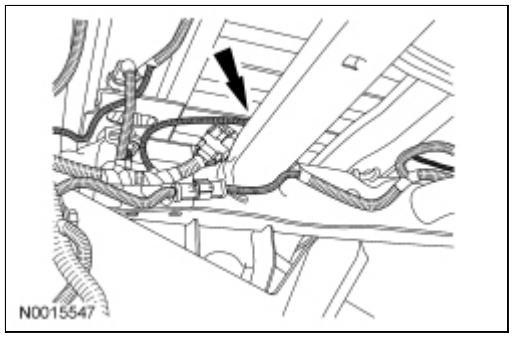
1. If equipped, remove the bed liner.

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

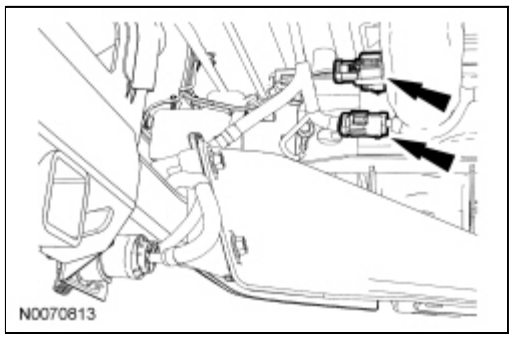
3. Remove the rear bumper. For additional information, refer to Section 501-19 .

4. Remove the fuel filler pipe. For additional information, refer to Section 310-01 .

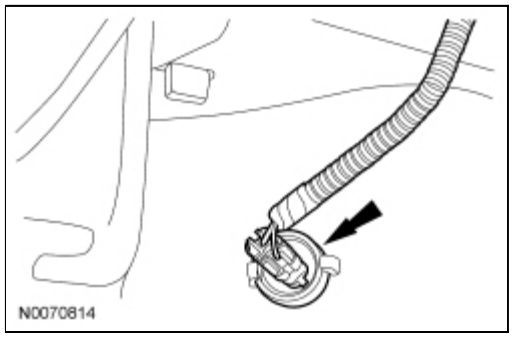
5. Remove the wiring harness ground bolt located on the frame cross member, just above the spare tire.
   - To install, tighten to 10 Nm (89 lb-in).



6. Disconnect the main tail lamp connector. If equipped, disconnect the reverse parking aid harness connector and the reverse camera wiring harness.



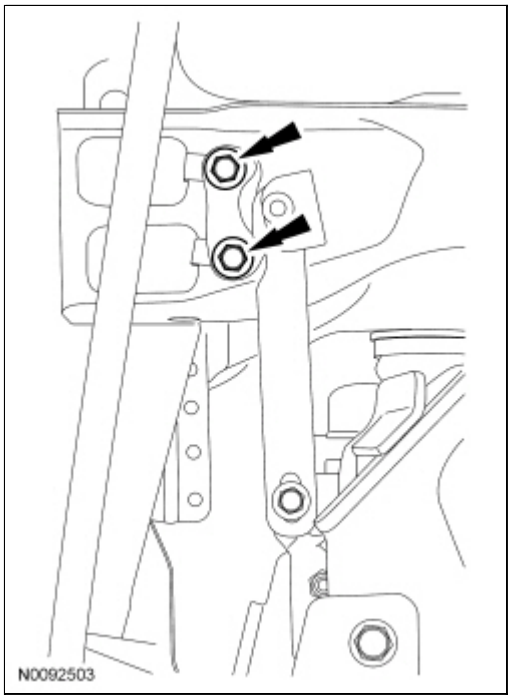
7. Disconnect the license lamp connectors.



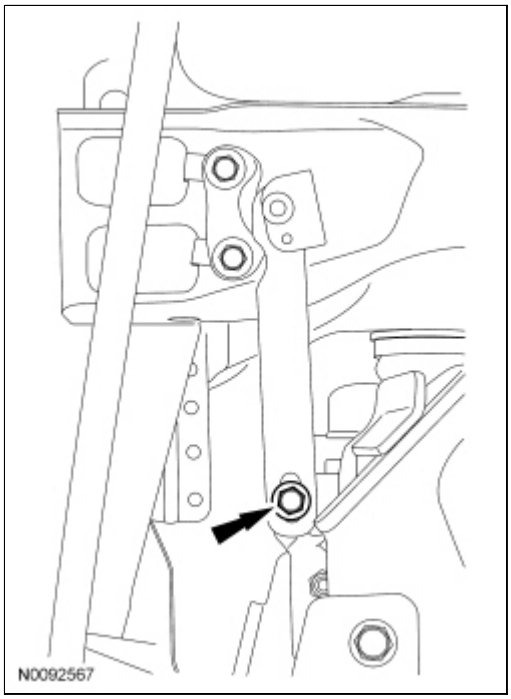
8. Remove the axle vent tube clip from the pickup bed floor crossmember and position the tube to the side.

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9. If equipped, remove the 2 upper bolts from the side step bracket-to-bed.
    - Tighten to 22 Nm (16 lb-ft).



10. If equipped, loosen the lower side step bracket-to-step bolt and position the bracket so it will rest on the step housing.
    - To install, tighten to 55 Nm (41 lb-ft).



11. **NOTE:** The pickup bed bolts are one-time-use only. Install new bolts whenever the bolts are removed.

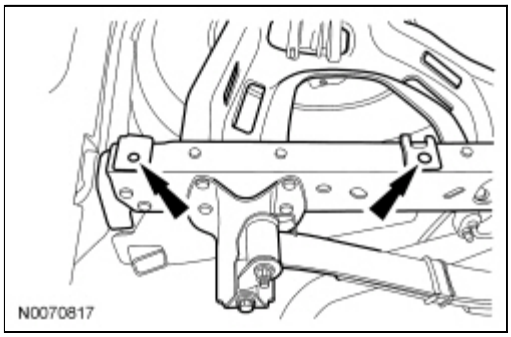
NOTE: All 8-foot pickup beds will have 8 bolts; all others will have 6 bolts.

Remove and discard the 8 pickup box bolts.

- To install, tighten the new bolts to 80 Nm (59 lb-ft).

12. **NOTE:** New attachment clips must be installed whenever the pickup box is removed. All 8-foot pickup beds will have 8 attachment clips; all others will have 6 attachment clips.

    Install new attachment clips before reinstalling the pickup box.



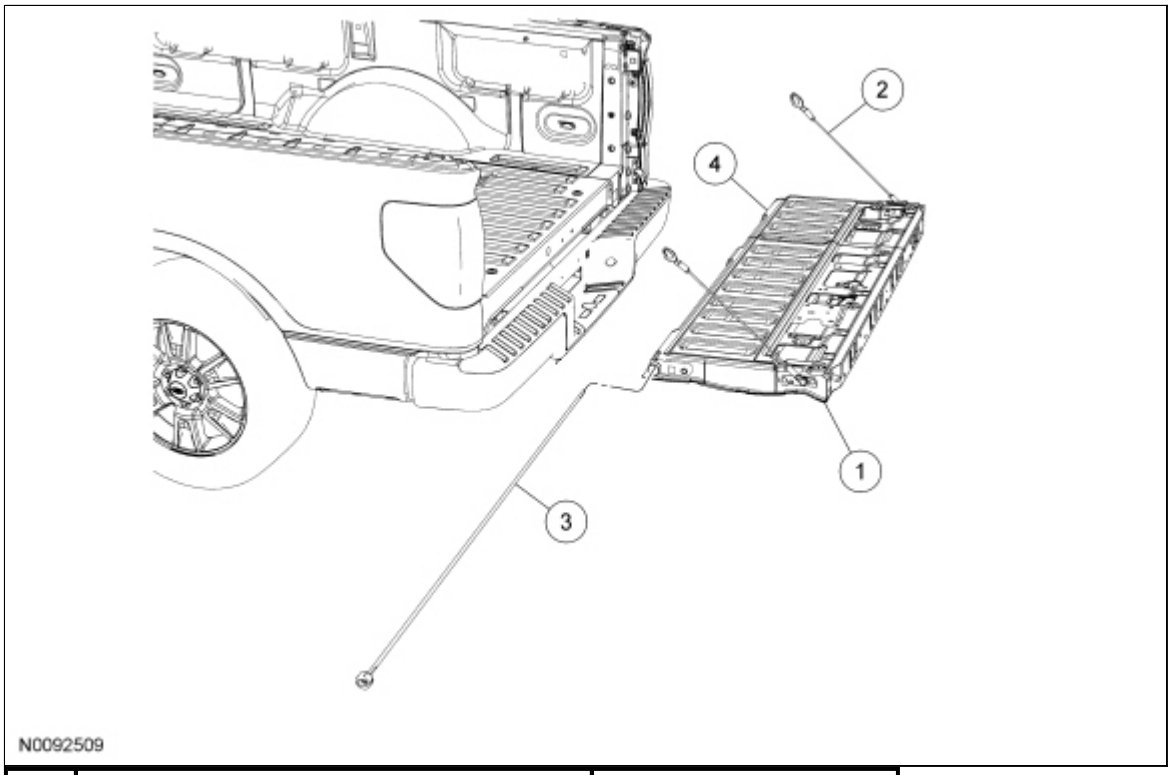
13. To install, reverse the removal procedure.

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Tailgate Lift Assist Torsion Rod

Material

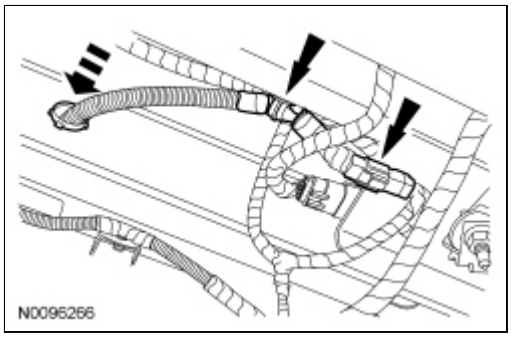
Item	Specification
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4



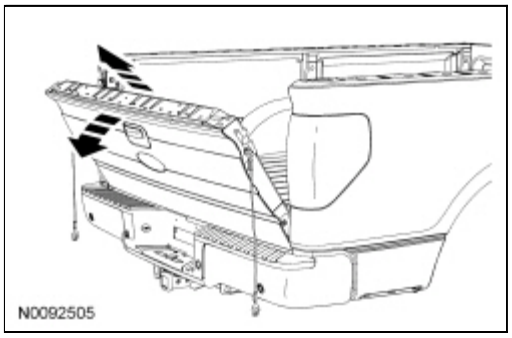
Item	Part Number	Description
1	9940700	Tailgate assembly
2	9944410 RH/ 9944411 LH	Tailgate support cable
3	99402A68-A (without step)/ 99402A68-B (with step)	Torsion rod
4	W505258	Clamp block machine screw

Removal

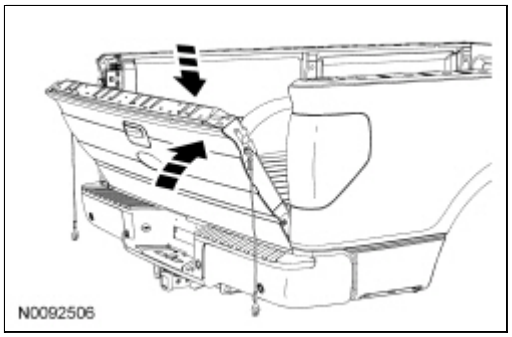
1. If equipped, disconnect the reverse camera wiring harness connector from the main harness and release the retaining clip. Slide the harness through the box crossmember.



2. Remove the tailgate from the vehicle.
    - Detach both tailgate support cables from the sides of the pickup bed, then lower the tailgate to approximately 41 degrees from vertical.
    - Pull the RH side of the gate out and away from the hinge.



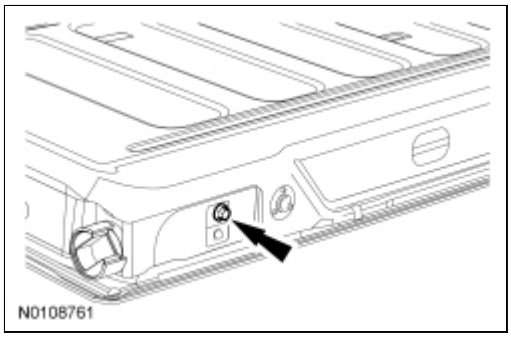
3. Raise the gate back up to approximately 10 degrees from vertical while keeping the RH tailgate pivot close to the hinge. Slide the tailgate to the right to release the LH hinge.



4. Set the tailgate on a no-scratch surface.

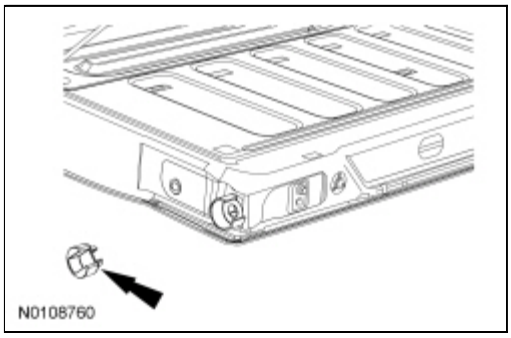
5. Loosen the clamp block machine screw 2-3 turns.

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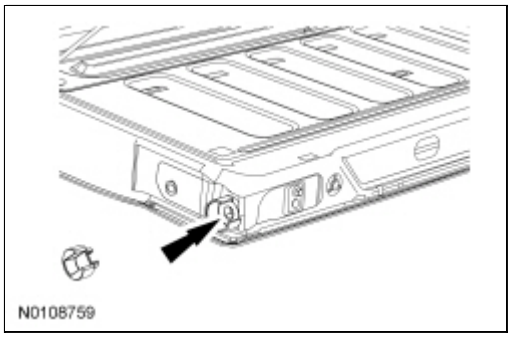


6. Remove the torsion rod from the tailgate. If the broken end of the torsion rod is stuck in the clamp block, carry out Steps 7 through 11.

7. Remove the urethane bushing from the RH pivot.

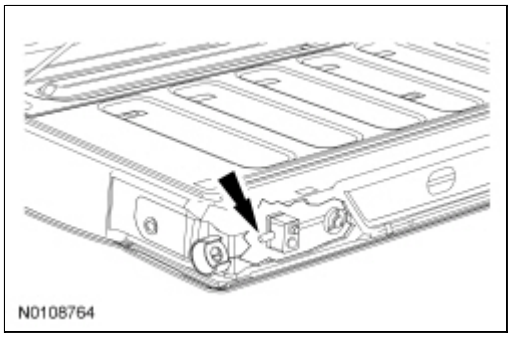


8. From the hole in the base of the RH pivot, drill an 8 mm (0.31 in) access hole through the tailgate inner panel.

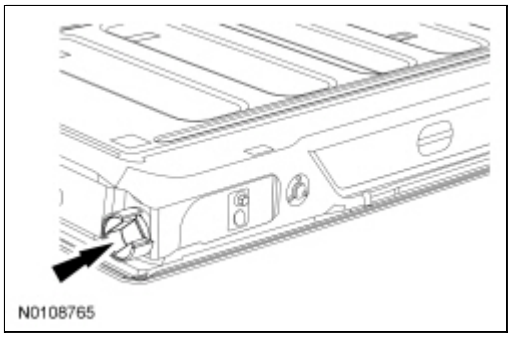


9. **NOTE:** Portions of the tailgate are removed for clarity.

   Use a drift to press the broken end of the rod from the clamp block, then remove broken end through drain hole in the bottom edge of the tailgate.



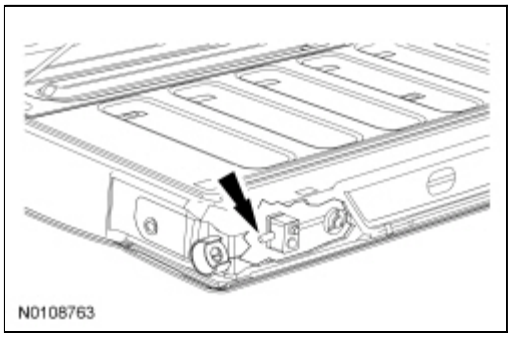
10. Seal the 8 mm (0.31 in) access hole in the tailgate inner panel with silicone gasket and sealant.
11. Install the urethane bushing in the RH pivot.



Installation

1. **NOTE:** Portions of the tailgate are removed for clarity.

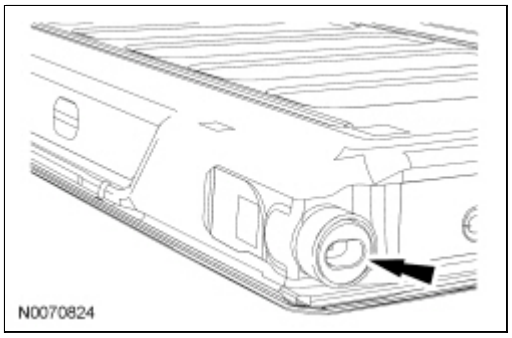
   Install a new torsion rod through the LH pivot. Guide the rod into the clamp block.



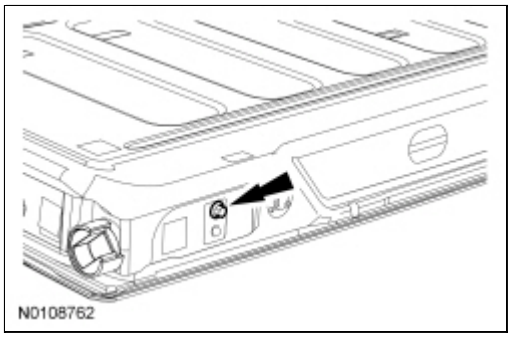
2. **NOTE:** The torsion rod must be installed with the same orientation as shown.

   Position the torsion rod so that the end bottoms out and is flush with the LH pivot.

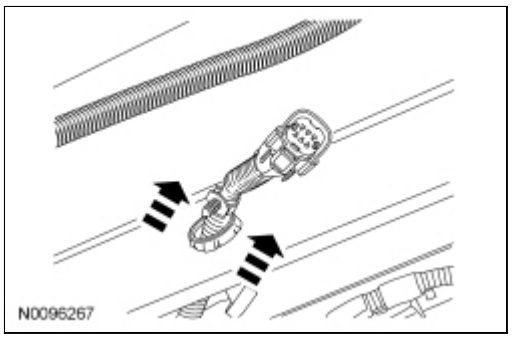
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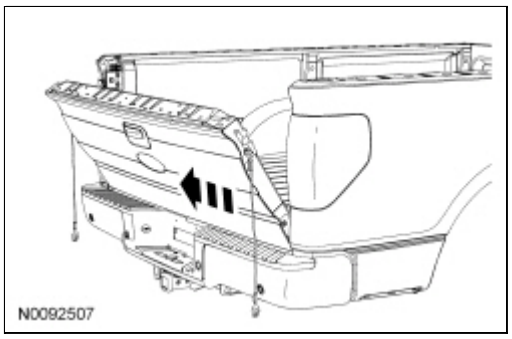
3. Tighten the 2 clamp block machine screws.
    - To install, tighten to 14 Nm (124 lb-in).



4. Position the reverse camera wiring harness through the box crossmember.

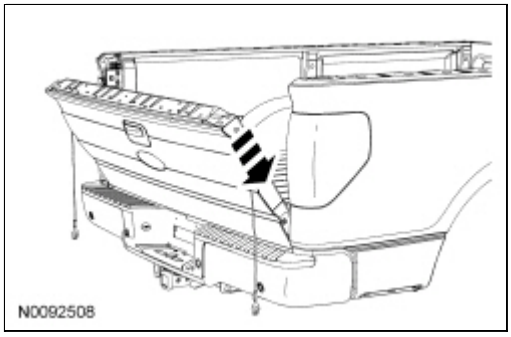


5. Position the tailgate so the LH tailgate pivot is close to the LH hinge and the tailgate is approximately 10 degrees from vertical. Keep the RH tailgate pivot close to the RH hinge, then slide the tailgate left to engage the LH pivot on the LH hinge.

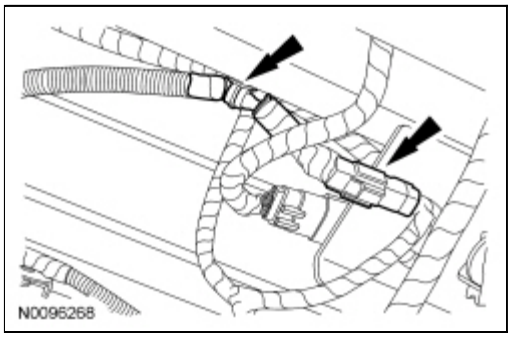


6. Position the tailgate so that it is approximately 41 degrees from vertical. Push the RH pivot onto the

hinge. Attach both tailgate support cables to the sides of the pickup bed.

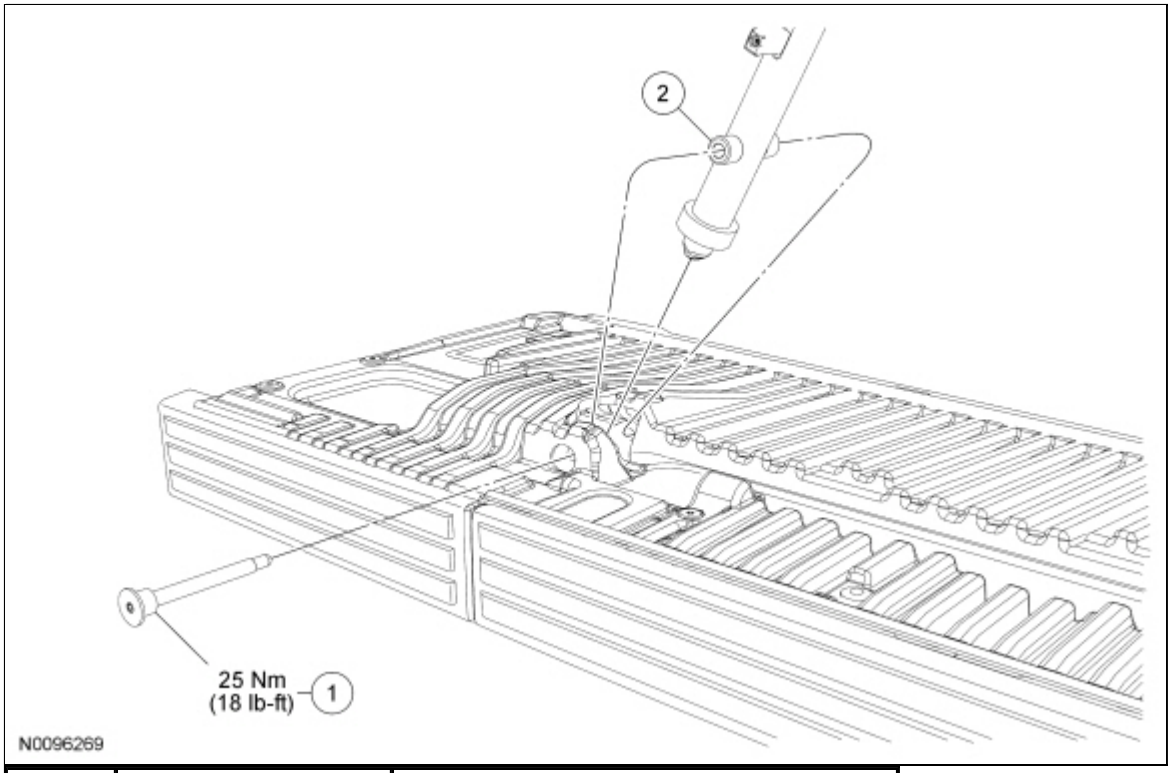


7. Connect the reverse camera wiring harness connector to the main harness connector and position the reverse camera wiring harness into the retainer. Close the retainer.



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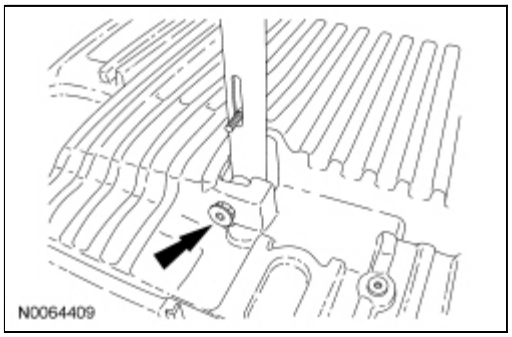
Tailgate Step Assist Handle



Item	Part Number	Description
1	99402B64	Tailgate assist handle bolt
2	9943300	Tailgate assist handle

1. Lower the tailgate.

2. Remove the T40 Torx head bolt from the assist handle.
   - To install, tighten to 25 Nm (18 lb-ft).

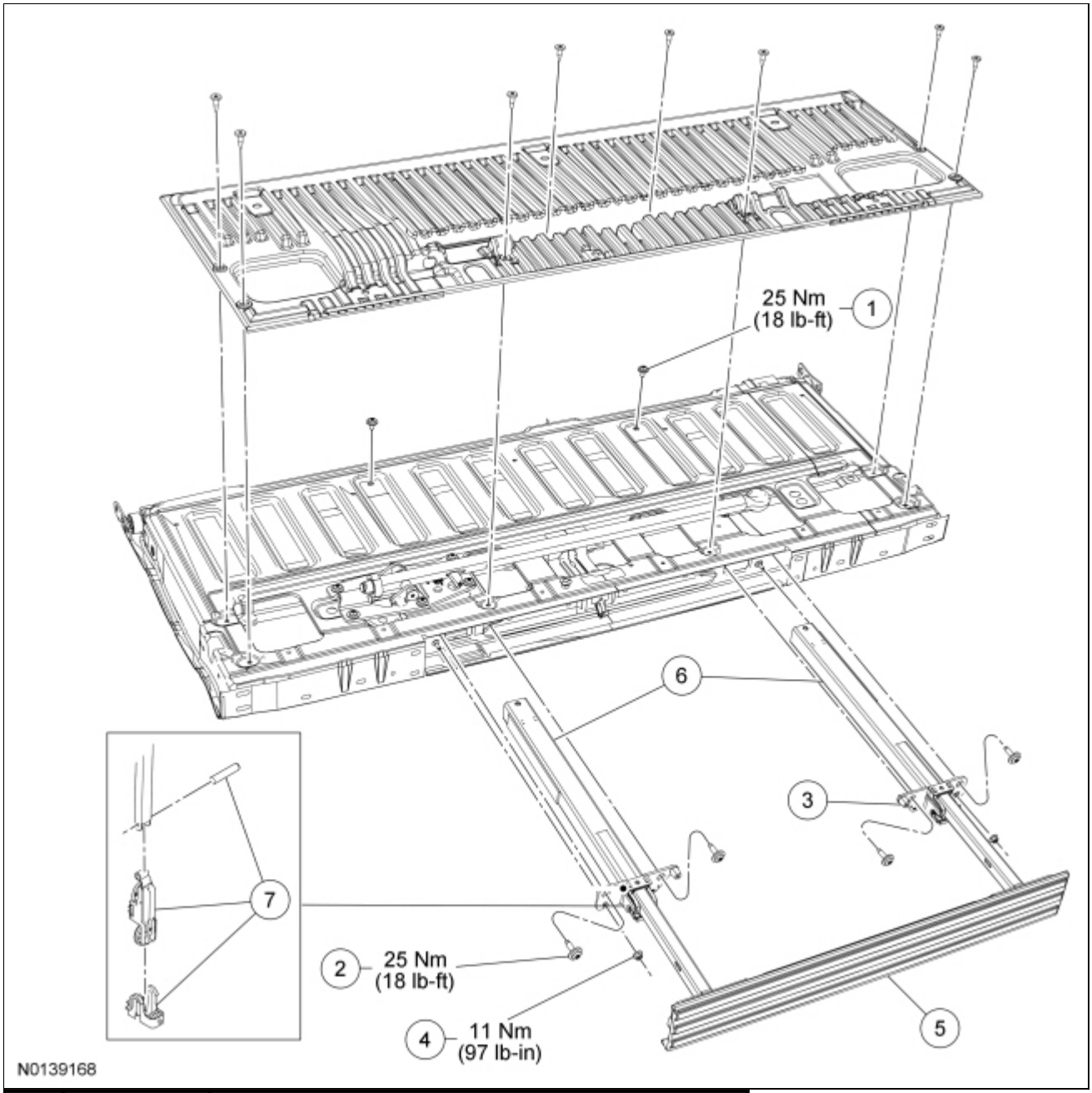


3. Remove the assist handle.

4. To install, reverse the removal procedure.

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Tailgate Step



Item	Part Number	Description
1	W712069	Tailgate step inside bolt (2 required)
2	W707916	Tailgate step upper bolt (4 required)
3	99439A00	Rubber bumper
4	—	Tailgate step nab pin nuts (part of 402A48) (2

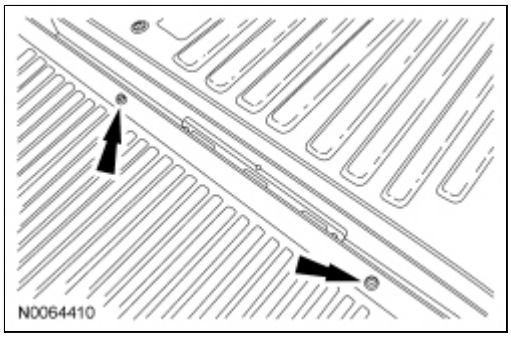
		required)
5	9940602	Moulding repair kit
6	99402A48	Tailgate step assembly
7	99402K19	Rail slider and roller assembly repair kit (2 required)

Removal and Installation

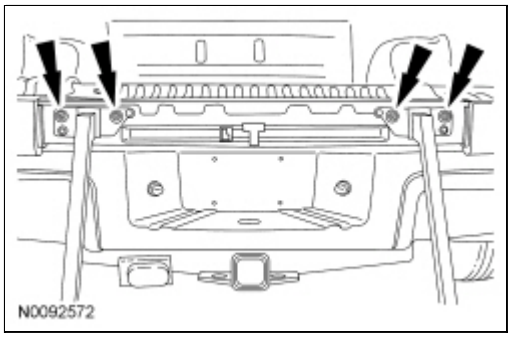
NOTE: Select parts are available for repair of some individual tailgate step components.

1. Lower the tailgate and open the assist step.

2. Remove the 2 tailgate step inside bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

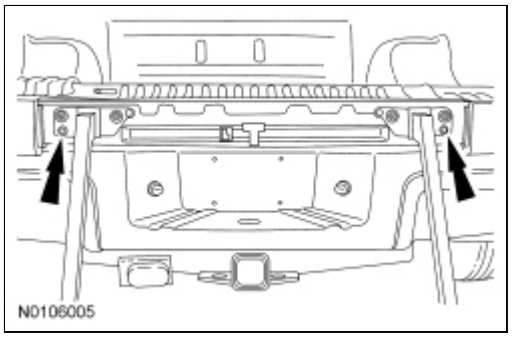


3. Remove the 4 tailgate step upper bolts.
   - To install, tighten to 25 Nm (18 lb-ft).



4. Remove the 2 tailgate step nab pin nuts.
   - To install, tighten to 11 Nm (97 lb-in).

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5. Remove the tailgate step.

6. To install, reverse the removal procedure.
    - Adjust as necessary. For additional information, refer to Tailgate Step Adjustment in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
2-stage high-retention clip bracket screw	5	—	44
Assist handle bolts	8	—	71
B-pillar trim panel screw	9	—	80
C-pillar trim panel screw	9	—	80
Lower safety belt anchor bolt	40	30	—
Safety belt anchor bolt	40	30	—
Safety belt D-ring bolt	40	30	—

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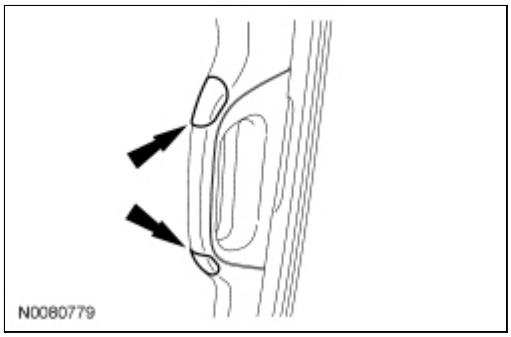
A-Pillar Trim Panel

Removal and Installation

Passenger side

1. ***NOTICE:*** **Use a non-marring flat-blade tool and start on the inside edge of the covers. Covers are equipped with a tether. Failure to follow this direction may result in damage to the component.**

   Remove the assist handle bolt covers.

2. Remove the assist handle bolts.
   - To install, tighten to 8 Nm (71 lb-in).

3. If equipped with a speaker in the A-pillar trim panel, remove the instrument panel side finish panel and disconnect the speaker electrical connector.

4. Remove the A-pillar trim panel.
   - Pull outward to release the retainer clip.

Driver side

5. If equipped with a speaker in the A-pillar trim panel, remove the instrument panel side finish panel and disconnect the speaker electrical connector.

6. ***NOTICE:*** **During installation, the A-pillar trim panel locator pins must be inserted into the slots on the instrument panel. Failure to follow this instruction may result in damage to the component.**

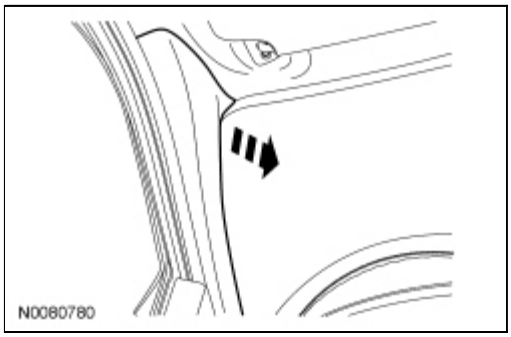
   NOTE: The trim panel has a 2-stage high-retention clip.

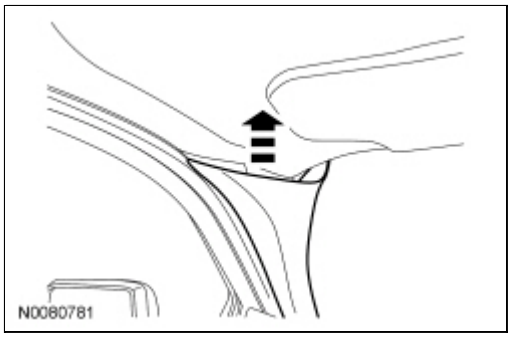
   Remove the A-pillar trim panel.
   - Pull outward to disengage the first stage of the high-retension clip.
   - **NOTE:** This step will temporarily distort the A-pillar trim panel. There will be a "pop" noise when the pin is released from the sheet metal.

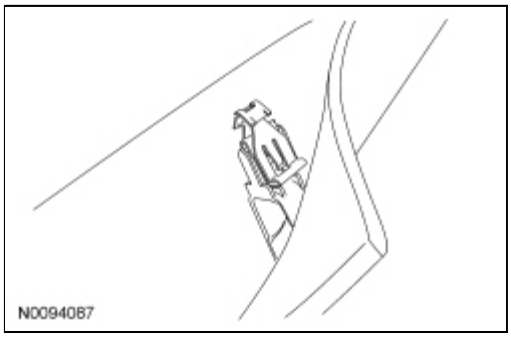
     Pull outward in the middle of the trim panel to disengage the 4-way locator pin from the sheet

metal.

- Pull upward then inboard to disengage the high-retension clip from the mounting bracket.







All vehicles

7. **NOTE:** The A-pillar trim panel is equipped with 3 locator tabs and a 4-way locator pin that must be positioned correctly during reinstallation.

   To install, reverse the removal procedure.

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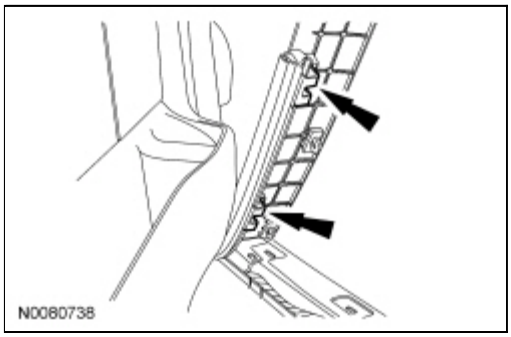
B-Pillar Trim Panel — Regular Cab

Removal and Installation

1. Position seats fully down and forward.

2. Depower the Supplemental Restraint System (SRS). For additional information, refer to Section 501-20B .

3. Pull upward to release the scuff plate clips and remove the front door scuff plate.
   - Detach the scuff plate from the weatherstrip.



4. Position the weatherstrips aside.
   - If equipped, position the rear weatherstrips aside.

5. Remove the safety belt D-ring trim cover.

6. Remove the safety belt D-ring bolt.
   - To install, tighten to 40 Nm (30 lb-ft).

7. Remove the B-pillar trim panel pin-type retainer.

8. **NOTE:** Starting at the top of the cover, use a non-marring tool.

   Remove the B-pillar trim panel bolt cover.

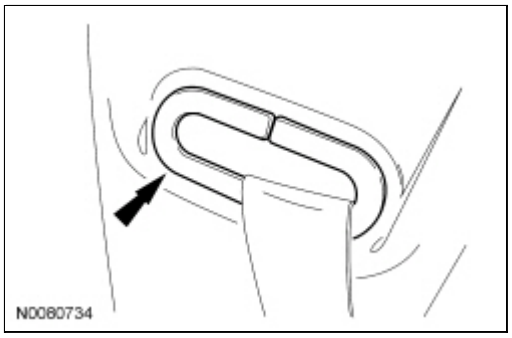
9. Remove the B-pillar trim panel bolt.
   - To install, tighten to 9 Nm (80 lb-in).

10. Remove the safety belt anchor bolt trim cover.

11. Remove the safety belt anchor bolt.
    - Disconnect electrical connector.
    - To install, tighten to 40 Nm (30 lb-ft).

12. Remove the safety belt trim ring.

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13. Remove the B-pillar trim panel.
    - Position the safety belt through the B-pillar trim panel.

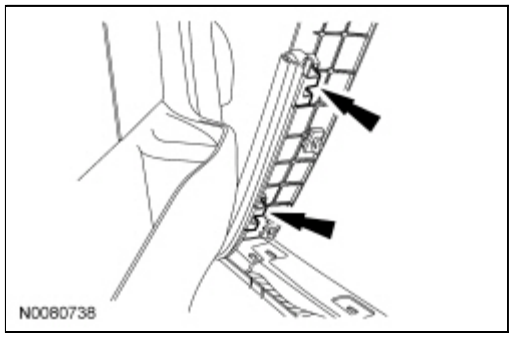
14. **NOTE:** The B-pillar trim panel has a 2-way locator and a 4-way locator that must be positioned correctly on installation.

    To install, reverse the removal procedure.

B-Pillar Trim Panel — SuperCab

Removal and Installation

1. Remove the rear seat backrest. For additional information, refer to Section 501-10 .
2. Pull upward to release the scuff plate clips and remove the scuff plate trim panel.
   - Detach the scuff plate from the weatherstrip.



3. Reposition the rear door weatherstrip.
4. Remove the B-pillar trim panel pin-type retainer.
5. Remove the B-pillar trim panel bolt cover.
6. **NOTE:** Starting at the top of the cover, use a non-marring tool.

   Remove the B-pillar trim panel bolt.
   - To install, tighten to 9 Nm (80 lb-in).
7. Pull inward to release the B-pillar trim panel clips.
8. Reposition the B-pillar trim panel.
9. Remove the safety belt anchor bolt.
   - To install, tighten to 40 Nm (30 lb-ft).
10. Reposition the safety belt through the B-pillar trim panel and remove the B-pillar trim panel.
11. To install, reverse the removal procedure.

repair4less

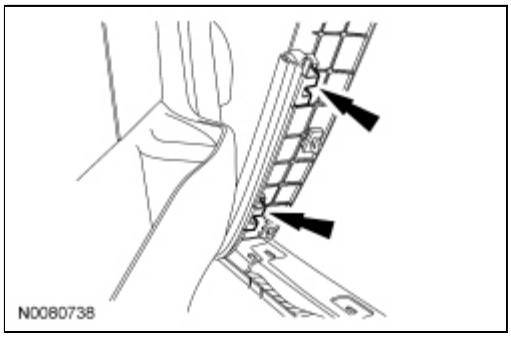
B-Pillar Trim Panel — SuperCrew

Removal and Installation

1. Position seats fully down and forward.

2. Depower the Supplemental Restraint System (SRS). For additional information, refer to Section 501-20B .

3. Pull upward to release the scuff plate clips and remove the front door scuff plate.
   - Detach the scuff plate from the weatherstrip.



4. Position the front and rear weatherstrips aside.

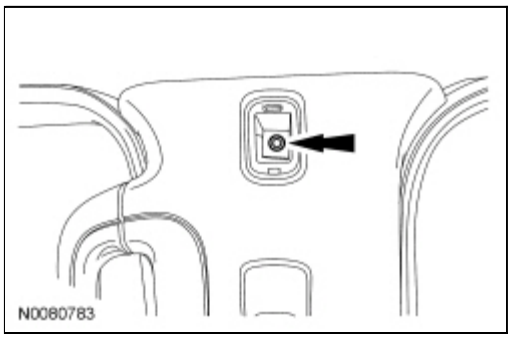
5. Remove the safety belt D-ring trim cover.

6. Remove the safety belt D-ring bolt.
   - To install, tighten to 40 Nm (30 lb-ft).

7. **NOTE:** Starting at the top of the cover, use a non-marring tool.

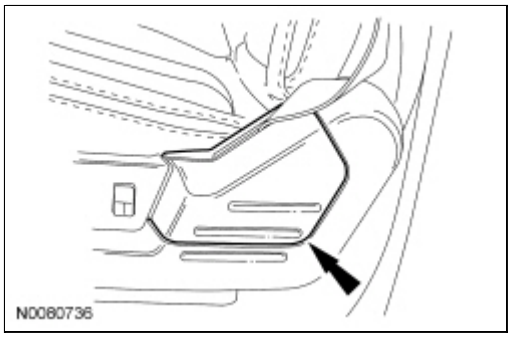
   Remove the B-pillar bolt cover.

8. Remove the B-pillar bolt.



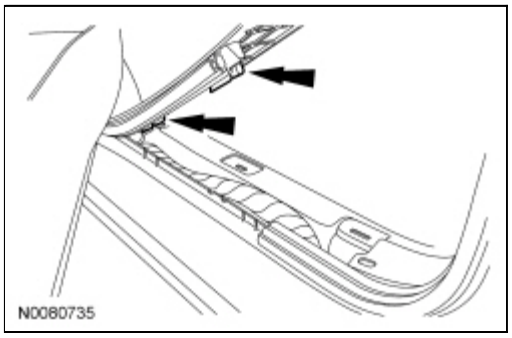
9. Remove the safety belt anchor bolt trim cover.

repair4less

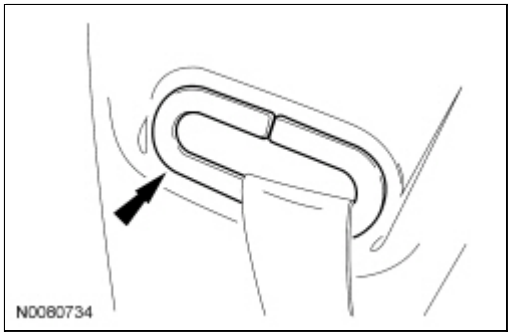


10. Remove the safety belt anchor bolt.
    - Disconnect electrical connector.
    - To install, tighten to 40 Nm (30 lb-ft).

11. Pull upward to release the scuff plate clips and remove the rear door scuff plate.
    - Detach the scuff plate from the weatherstrip clip.



12. Remove the safety belt trim ring and pull the safety belt through the B-pillar.



13. Remove the B-pillar trim panel.

14. **NOTE:** The B-pillar trim panel has a 2-way locator and a 4-way locator that must be positioned correctly on installation.

    To install, reverse the removal procedure.

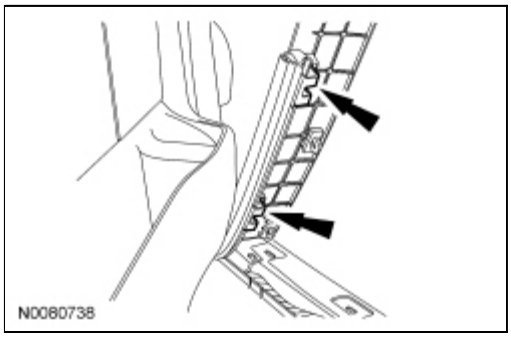
repair4less

Cowl Side Trim Panel

Removal and Installation

Both sides

1. Pull upward to release the scuff plate clips and remove the front door scuff plate.
    - Detach the scuff plate from the weatherstrip.

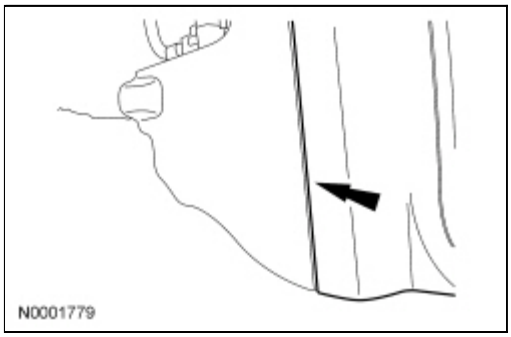


LH side

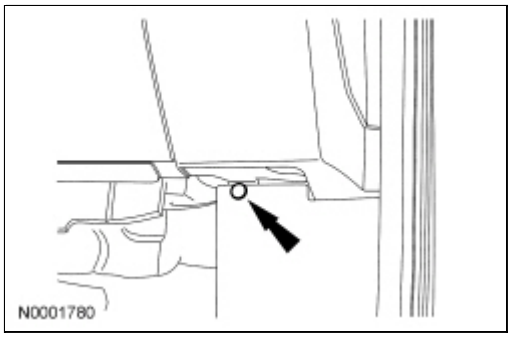
2. Remove the cowl trim panel.

RH side

3. Remove the fuse panel access door.



4. Remove the pin-type retainer from the cowl trim panel.



Both sides

5. Remove the cowl trim panel.
6. **NOTE:** Make sure the cowl side trim panel J-hook is correctly installed.

   To install, reverse the removal procedure.

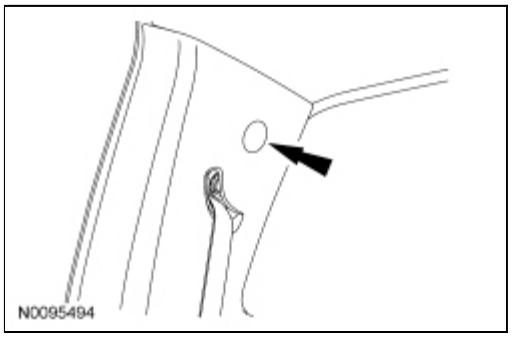
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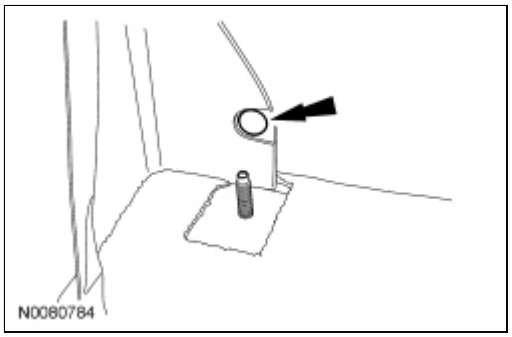
C-Pillar Trim Panel

Removal and Installation

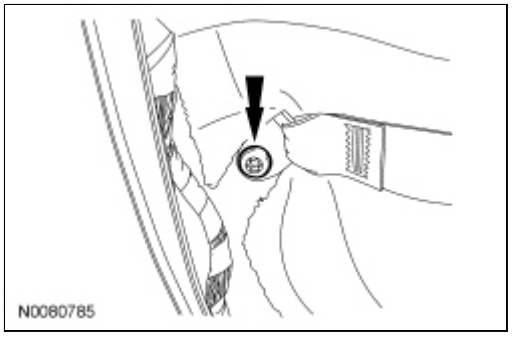
1. Remove the rear seat assembly. For additional information, refer to Section 501-10 .
2. Using a non-marring flat-blade tool, remove the C-pillar screw cover.



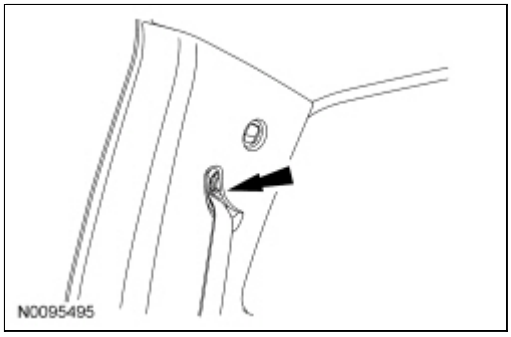
3. Remove the C-pillar screw.
4. Remove the C-pillar pin-type retainer.



5. Reposition the C-pillar trim.
6. Remove the safety belt anchor bolt.
    - To install, tighten to 40 Nm (30 lb-ft).



7. Reposition the safety belt through the trim panel.



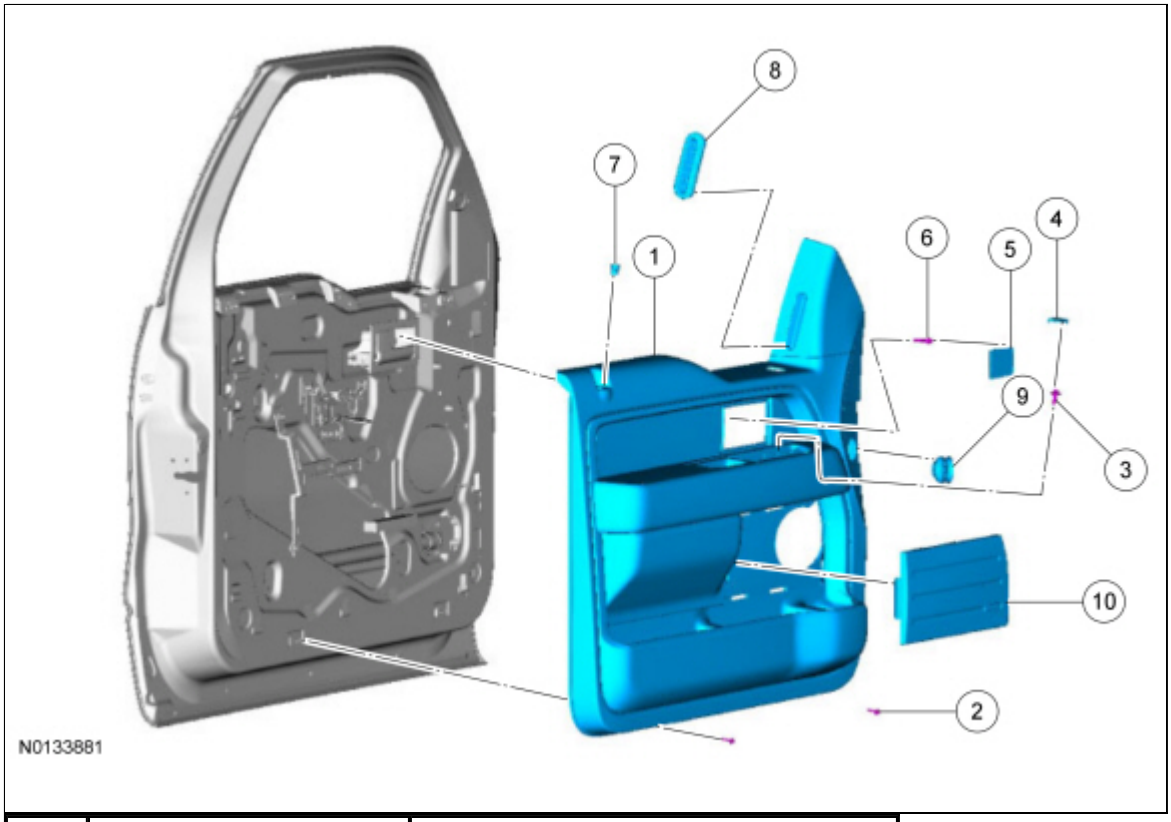
8. Remove C-pillar trim panel.
9. **NOTE:** The C-pillar trim panel has locator pins that must be positioned correctly for installation.

   NOTE: The C-pillar trim panel should be parallel to the rear window blackout.

   To install, reverse removal procedure.

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Door Trim Panel — Front



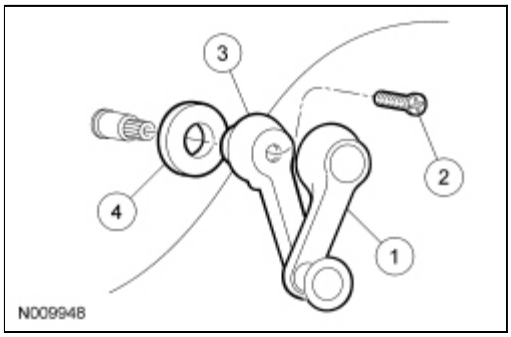
Item	Part Number	Description
1	23942	Front door trim panel
2	W701930	Front door trim panel lower screws
3	W701930	Front door pull cup screw
4	237W24	Front door pull cup screw cover
5	31458	Front door handle screw cover
6	W500215	Front door handle screw
7	21999	Door lock button bezel
8	18202A42 / 18202A43	Demist grille (RH/LH)
9	19E882	Demist grommet
10	18978C / 18979C	Speaker grille (RH/LH)

Removal and Installation

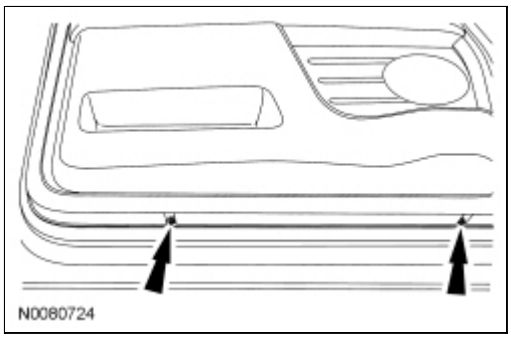
NOTE: LH side shown, RH side similar.

1. If equipped, remove the window regulator handle.
    1. Separate the handle cover from the handle.

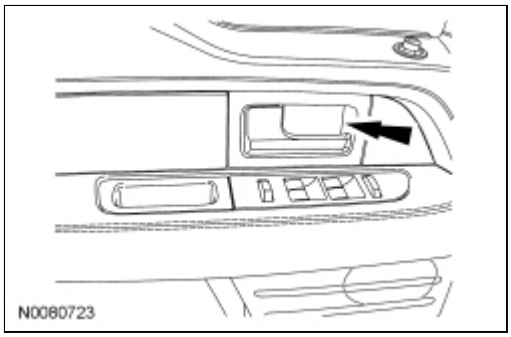
2. Remove the screw.
3. Remove the window regulator handle.
4. Remove the spacer.



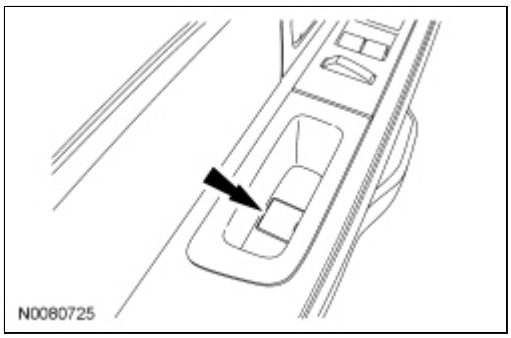
2. Remove the 2 front door trim panel lower screws.



3. Remove the door handle cover plate.

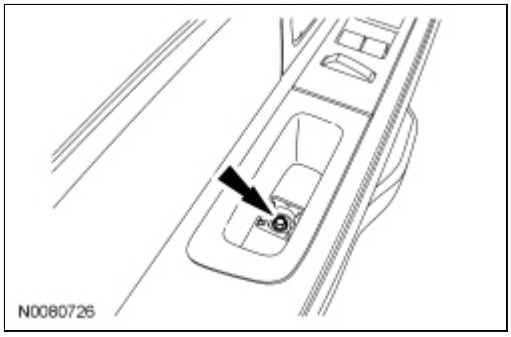


4. Remove the pull cup screw cover.



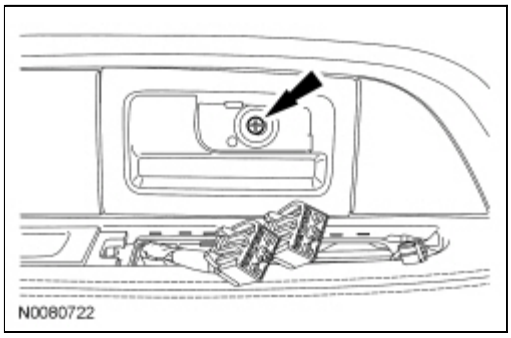
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5. Remove the pull cup screw.



6. Remove the window control switch. For additional information, refer to Section 501-11 .

7. Remove the door handle screw.



8. ***NOTICE:*** **Do not pull directly outward on the front door trim panel, as damage may occur.**

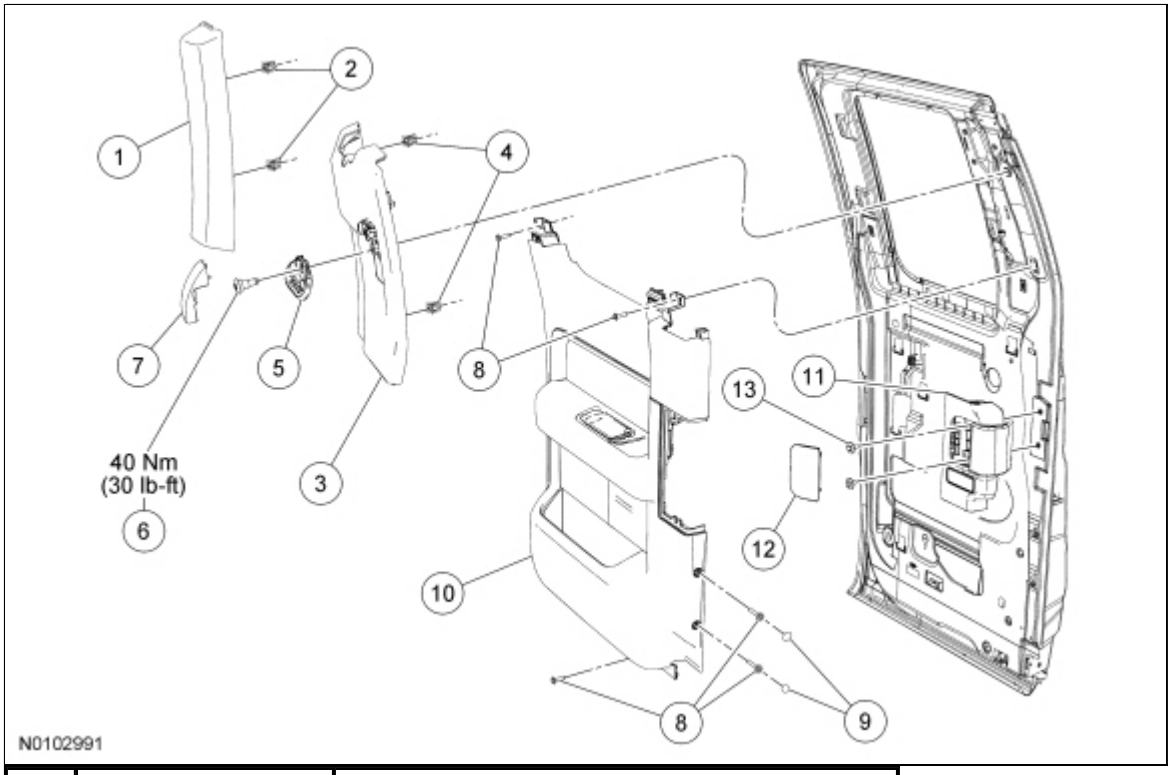
   Remove the front door trim panel.
   - Lift upward to remove the front door trim panel.
   - Disconnect mirror adjustment switch electrical connector.
   - Remove the front door handle.
     - Guide the door handle through the opening in the trim panel.

9. To install, reverse the removal procedure.

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Door Trim Panel — Rear, SuperCab

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	25504-G RH/ 25505-G LH	Rear door rear garnish moulding
2	W701882	Rear door rear garnish moulding clips (2 required)
3	25504-A RH/ 25505-A LH	Rear door front garnish moulding
4	W701882	Rear door front garnish moulding clips (2 required)
5	—	Safety belt D-ring (part of 612D64 RH/ 612D65 LH)
6	—	Safety belt D-ring bolt (part of 612D64 RH/ 612D65 LH)
7	—	Safety belt D-ring bolt cover (part of 612D64 RH/ 612D65 LH)
8	W701930	Rear door trim panel screws (5 required)
9	—	Rear door trim panel screw covers (part of 27406 RH/ 27407 LH)
10	27406 RH/ 27407	Rear door trim panel

	LH	
11	1822601 LH/ 1822600 RH	Rear door inside door handle bolt
12	1822670	Rear door inside door handle cover
13	W707398	Rear door inside door handle bolt (2 required)

Removal and Installation

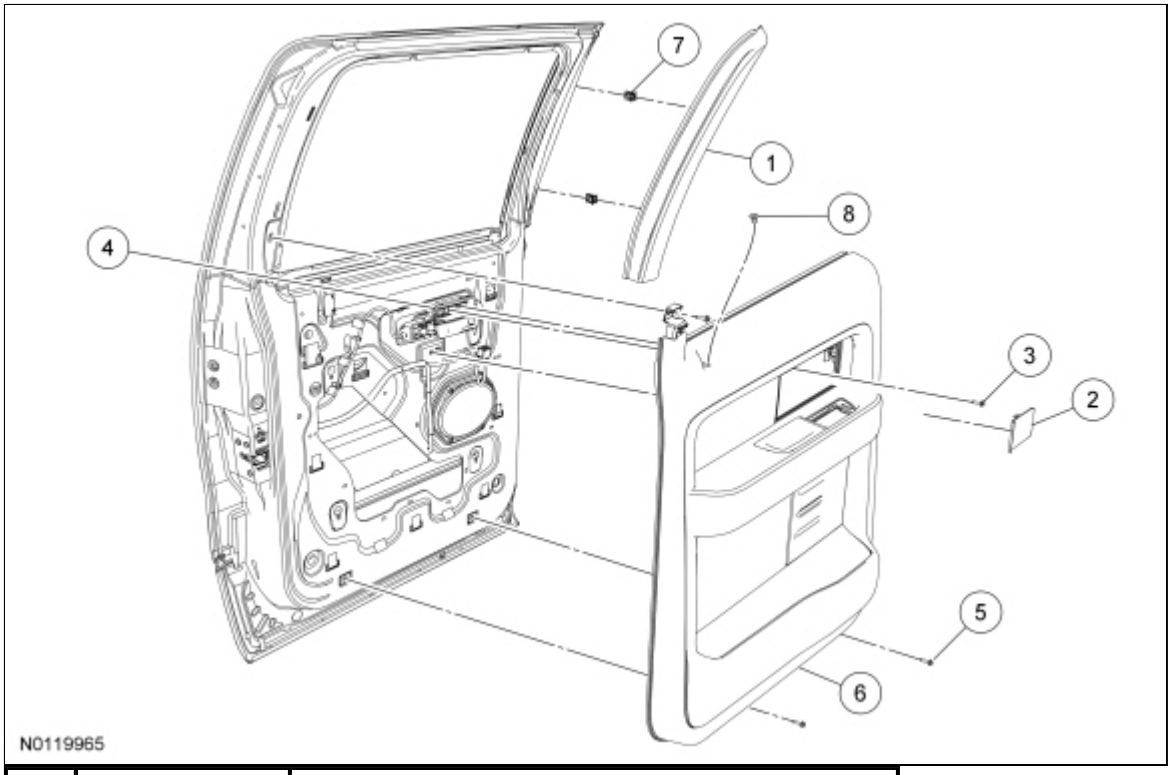
1. Remove the inside door handle cover.
2. Remove the 2 inside door handle bolts.
3. Pull out the inside door handle and position the handle aside.
4. If equipped, remove the window control switch. For additional information, refer to Section 501-11 .
5. Remove the rear window rear garnish moulding.
    - Pull outward to release the garnish moulding clips from the door.
6. Remove the safety belt D-ring.
    - Remove the safety belt D-ring cover.
    - Remove the safety belt D-ring bolt.
        - To install, tighten to 40 Nm (30 lb-ft).
7. Remove the rear door front garnish moulding.
    - Pull outward to release the garnish moulding clips from the door.
8. Remove the rear door trim panel screw covers.
9. Remove the 5 rear door trim panel screws.
10. ***NOTICE:*** **Do not pull directly outward on the rear door trim panel, as damage may occur.**

    Remove the rear door trim panel.
    - Lift upward and remove the rear door trim panel.
11. To install, reverse the removal procedure.

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Door Trim Panel — Rear, SuperCrew

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	25504 RH/ 25505 LH	Rear door garnish moulding
2	31458	Rear door handle cover plate
3	W714017	Rear door handle screw
4	26460 RH/ 26461 LH	Rear door handle
5	W502661	Rear door trim panel screw (3 required)
6	27406 RH/ 27407 LH	Rear door trim panel
7	—	Rear door garnish moulding clip (part of 25504 RH/ 25505 LH) (2 required)
8	21999	Door lock button bezel

Removal and Installation

1. Remove the rear door garnish moulding.
    - Pull outward to release the rear door garnish moulding clips from the door.

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2. Remove the window control switch panel. For additional information, refer to Section 501-11 .

3. Remove the rear door handle cover plate.

4. Remove the rear door handle screw.

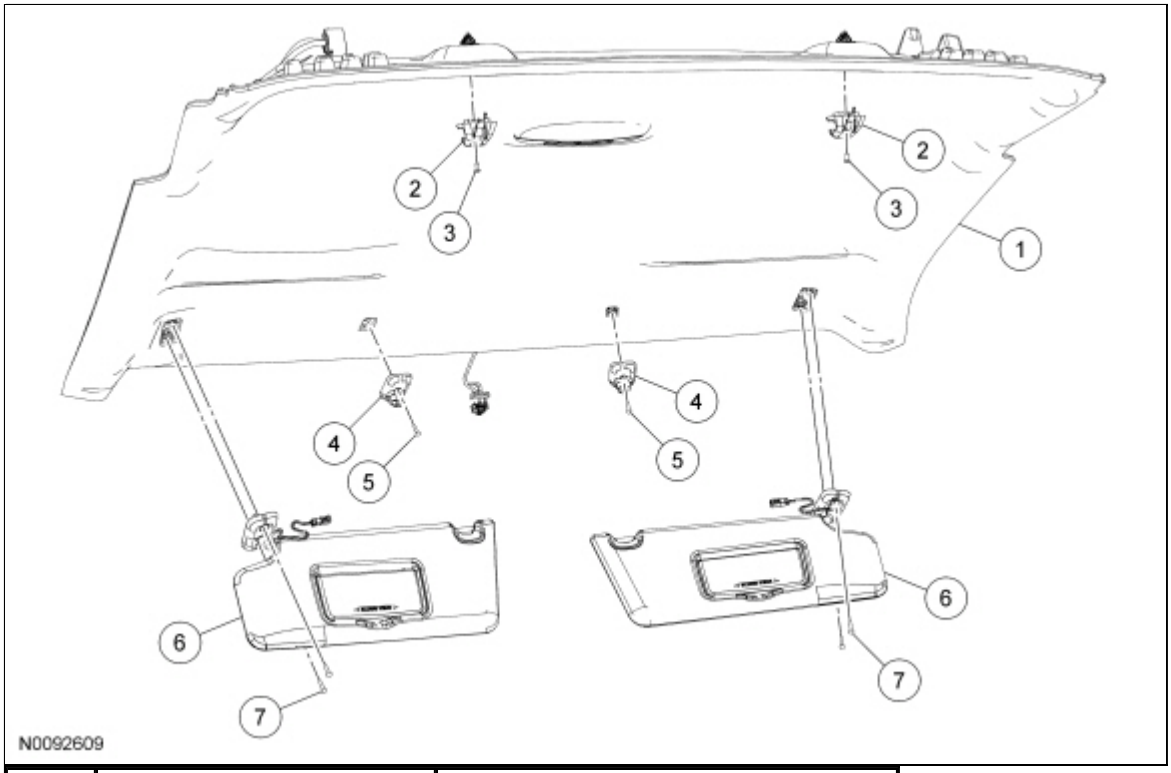
5. Remove the 3 rear door trim panel screws.

6. ***NOTICE:*** **Do not pull directly outward on the rear door trim panel. Damage may occur.**

   Remove the rear door trim panel.
   - Lift upward to remove the rear door trim panel and position aside.
   - Disconnect the interior handle activating cable from the interior door handle and remove the rear door trim panel.

7. To install, reverse the removal procedure.

Headliner — Regular Cab

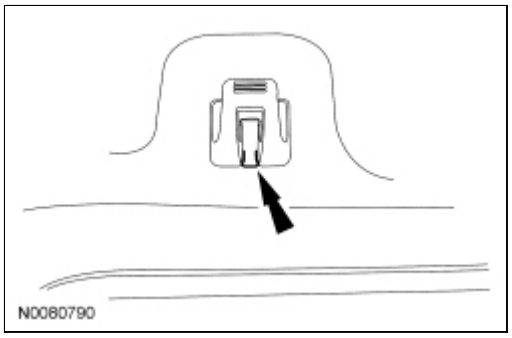


Item	Part Number	Description
1	51944	Headliner
2	29024	Garment hooks
3	N610938A	Garment hook screws
4	04132	Sun visor clips
5	N610938	Sun visor clip screws
6	04104 RH/ 04105 LH	Sun visors
7	N610938	Sun visor screws (4 required)

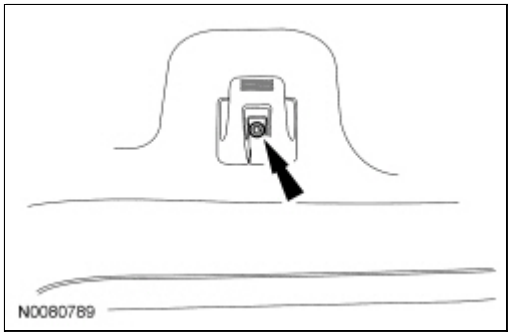
Removal and Installation

1. Remove the A-pillar trim panels. For additional information, refer to A-Pillar Trim Panel in this section.
2. Remove the B-pillar trim panels. For additional information, refer to B-Pillar Trim Panel — Regular Cab in this section.
3. Open the garment hook screw covers.

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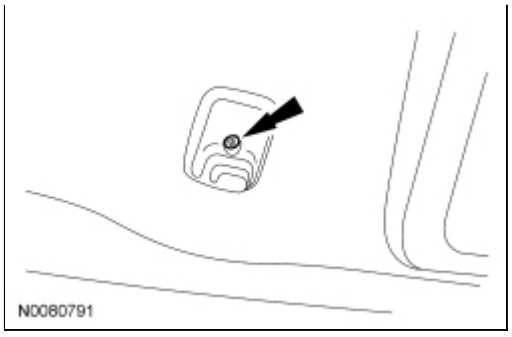
4. Remove the garment hook screws and remove the hooks.



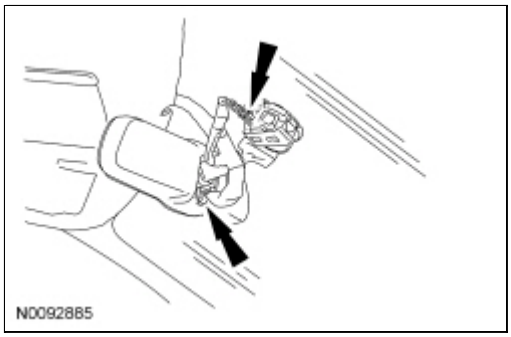
5. Remove the sun visor screws and remove the sun visors.
    - If equipped, disconnect the electrical connector.



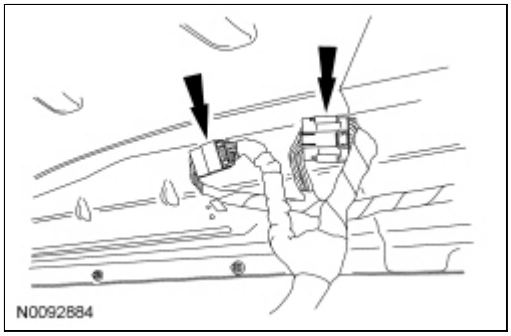
6. Remove the sun visor clip screws and remove the sun visor clips.



7. If equipped, disconnect the mirror electrical connector and the rain sensor.



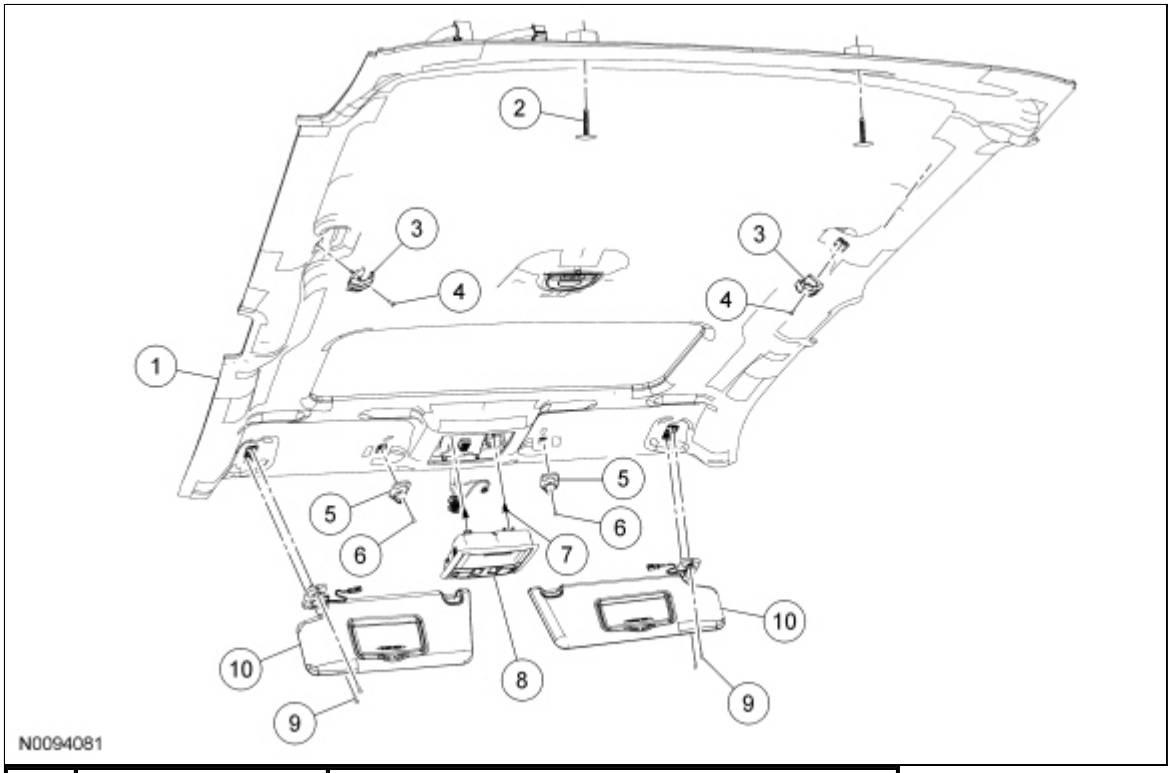
8. Disconnect the headliner electrical connectors.



9. Position the seats to the full reclined position.
10. Remove the headliner out of the passenger side door.

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Headliner — SuperCrew



Item	Part Number	Description
1	51944	Headliner
2	W710041	Headliner pin-type retainer (2 required)
3	29024	Garment hooks
4	N610938A	Garment hook screws
5	04132	Sun visor clips
6	N610938A	Sun visor clip screws
7	—	Overhead console clip (part of 519A70) (2 required)
8	519A70	Overhead console
9	N610938	Sun visor screws (4 required)
10	04104 RH/ 04105 LH	Sun visors

Removal

1. Remove the front passenger seat. For additional information, refer to Section 501-10 .
2. Remove the driver seat. For additional information, refer to Section 501-10 .

3. Remove the floor console. For additional information, refer to Section 501-12 .

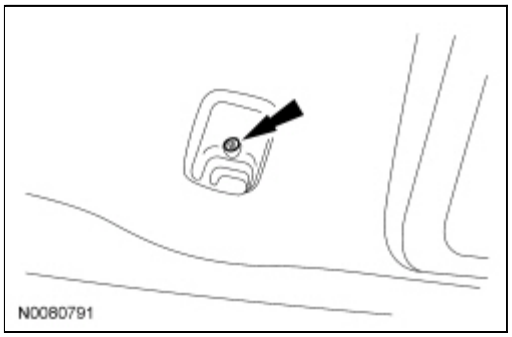
4. Remove the A-pillar trim panel. For additional information, refer to A-Pillar Trim Panel in this section.

5. Reposition the B-pillar trim panels. For additional information, refer to B-Pillar Trim Panel — SuperCrew in this section.

6. Reposition the C-pillar trim panels. For additional information, refer to C-Pillar Trim Panel in this section.

7. Remove the overhead console. For additional information, refer to Section 501-12 .

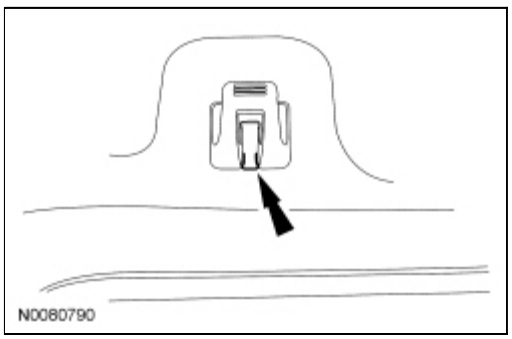
8. Remove the sun visor clip screws and clips.



9. Remove the LH and RH sun visors.
    - Remove the sun visor screws.
    - Reposition the sun visor and disconnect the electrical connector.

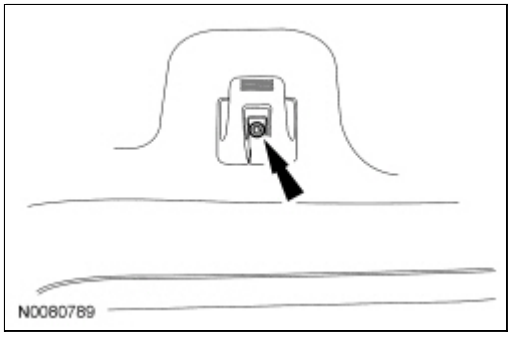


10. Open the garment hook screw cover.

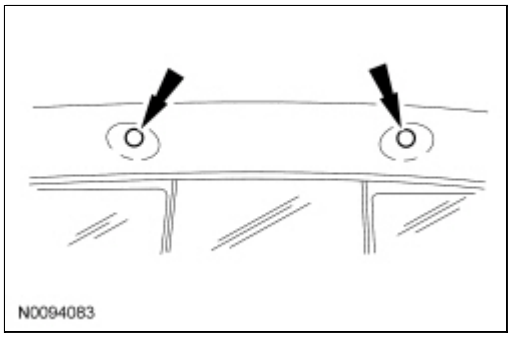


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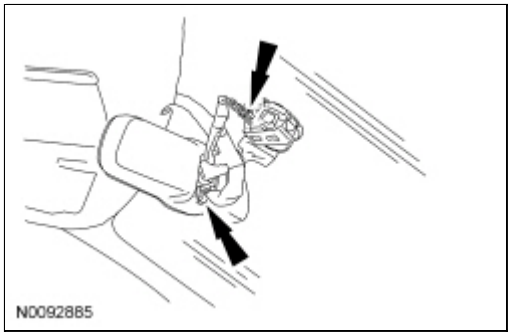
11. Remove the garment hook screw and remove the hook.



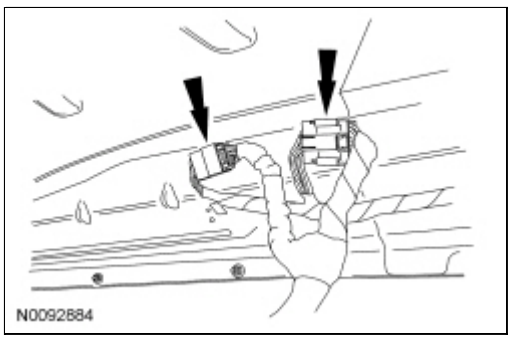
12. Remove the headliner pin-type retainers.



13. If equipped, disconnect the mirror electrical connector and the rain sensor.



14. Disconnect the headliner electrical connectors.



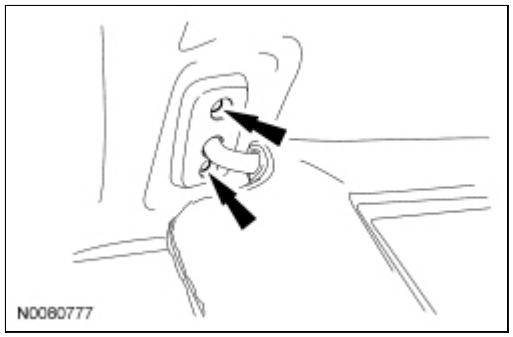
15. With the aid of an assistant, remove the headliner through the passenger door.

16. To install, reverse the removal procedure.

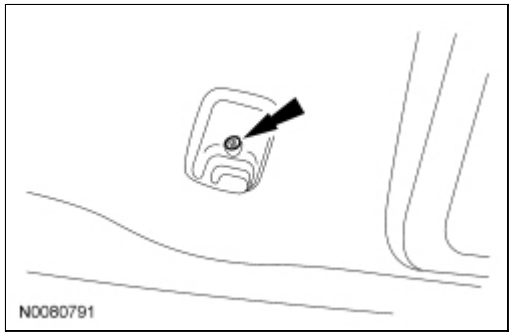
Installation

1. Position the headliner in the vehicle so that the sun visor and coat hook openings are aligned.

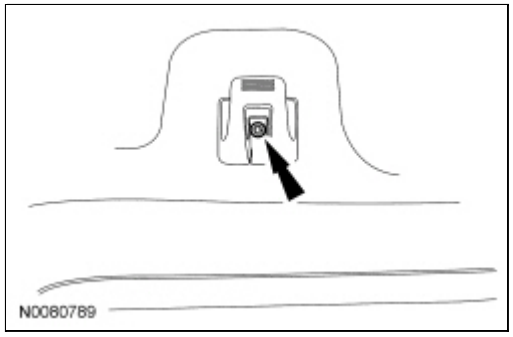
2. Install the LH and RH sun visors.
   - Reposition headliner and connect electrical connector.
   - Install the sun visor retainer screws.



3. Install the sun visor clip and sun visor clip screws.

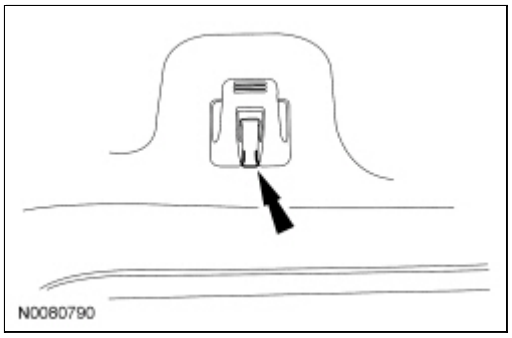


4. Install the garment hooks and garment hook screws.



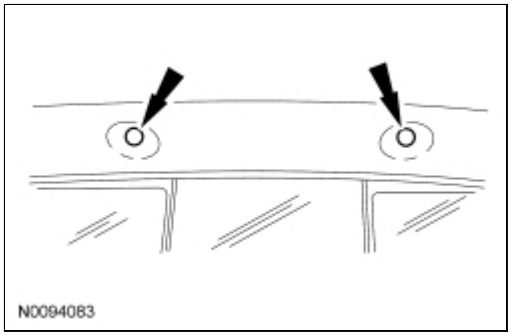
5. Close the garment hook screw covers.

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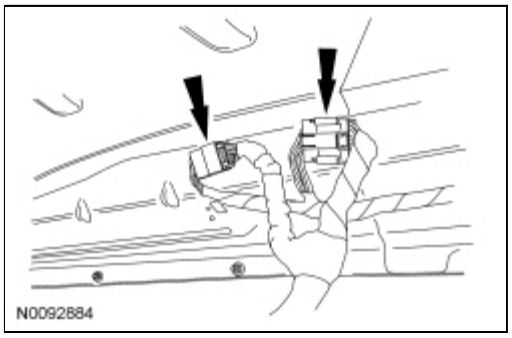


6. If equipped with a roof opening panel, secure the hook-and-loop tape around the front edge of the roof opening panel and then secure the back edge of the roof opening panel so that it is flush and the headliner does not sag. If sagging occurs, loosen the sun visors and coat hooks to realign the headliner. Retighten the sunvisors and coat hooks.

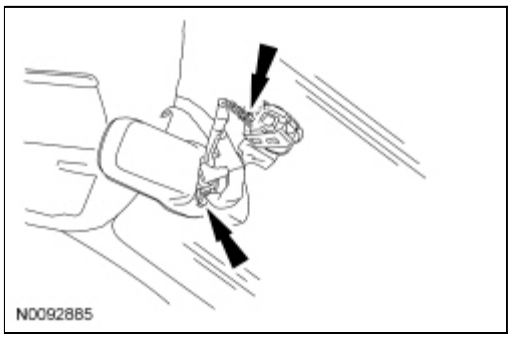
7. Install the headliner pin-type retainers.



8. Connect the headliner electrical connectors.



9. If equipped, connect the mirror electrical connector and the rain sensor.



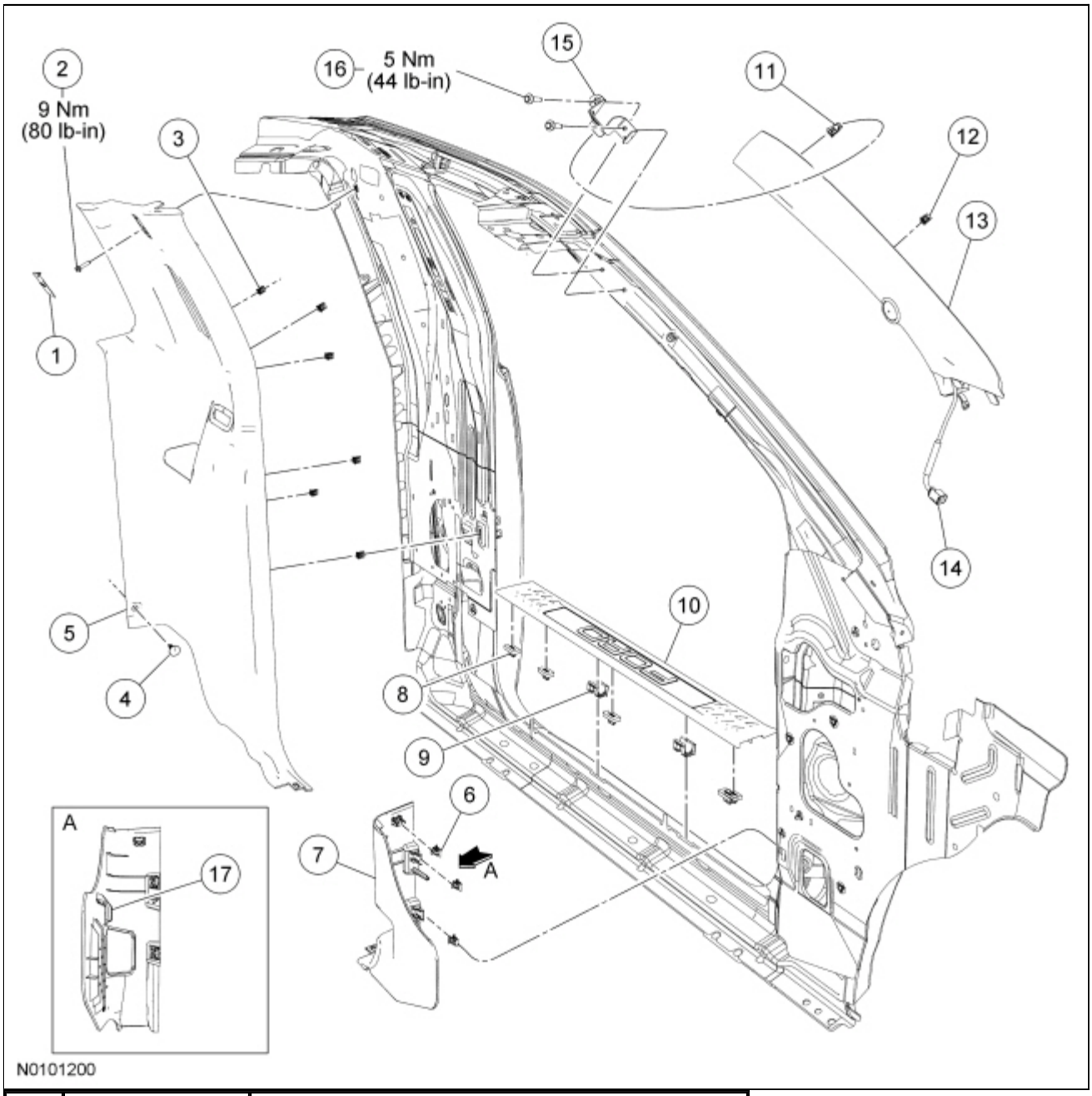
10. Install the overhead console. For additional information, refer to Section 501-12 .
11. Install the A-pillar trim panel. For additional information, refer to A-Pillar Trim Panel in this section.
12. Install the B-pillar trim panels. For additional information, refer to B-Pillar Trim Panel — SuperCrew in this section.
13. Install the C-pillar trim panels. For additional information, refer to C-Pillar Trim Panel in this section.
14. Install the floor console. For additional information, refer to Section 501-12 .
15. Install the driver seat. For additional information, refer to Section 501-10 .
16. Install the front passenger seat. For additional information, refer to Section 501-10 .

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Interior Trim — Exploded View

Regular Cab

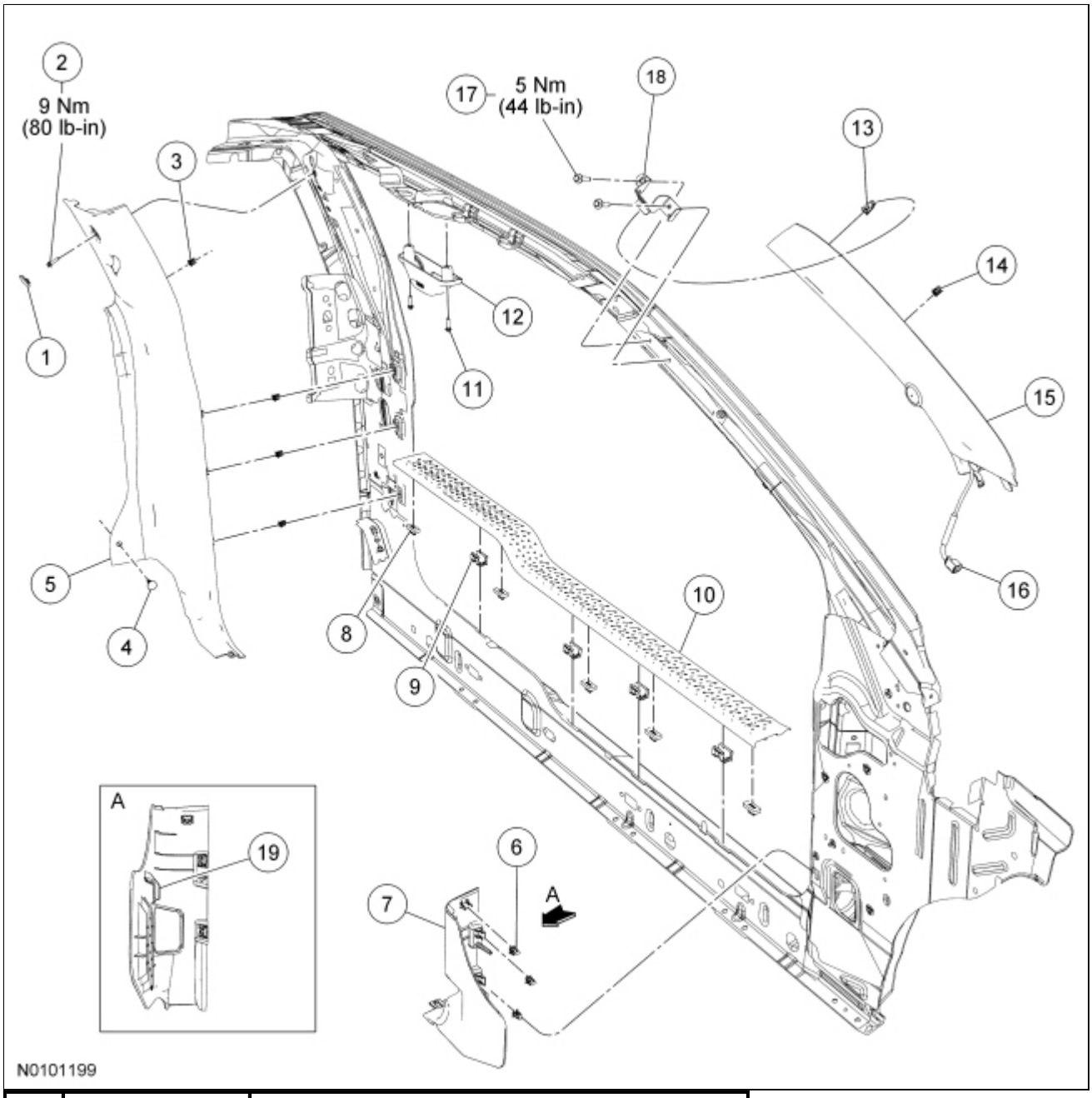


Item	Part Number	Description
1	234B76	B-pillar trim panel screw cover

2	W712518	B-pillar trim panel screw
3	—	B-pillar trim panel clip (part of 234B76) (6 required)
4	W714076	B-pillar trim panel pin-type retainer
5	278D12 RH/ 278D13 LH	B-pillar trim panel
6	—	Cowl side trim panel clip (part of 02344 RH/ 02345 LH)
7	02344 RH/ 02345 LH	Cowl side trim panel
8	—	Scuff plate trim panel clip (part 13208 RH/ 13209 LH) (4 required)
9	13284	Scuff plate trim panel S-clip (2 required)
10	13208 RH/ 13209 LH	Scuff plate trim panel
11	W714232	A-pillar trim panel 2-stage high retension clip
12	—	A-pillar trim panel clip (part of 03598 RH/ 03599 LH)
13	03598 RH/ 03599 LH	A-pillar trim panel
14	—	A-pillar trim panel speaker electrical connector (part of 18978-A LH/ 18978-B RH)
15	312A48	2-stage high-retention clip bracket
16	W712518	2-stage high-retention clip bracket screw (2 required)
17	—	Cowl side trim panel J-hook (part of 02344 RH/02345 LH)

SuperCab

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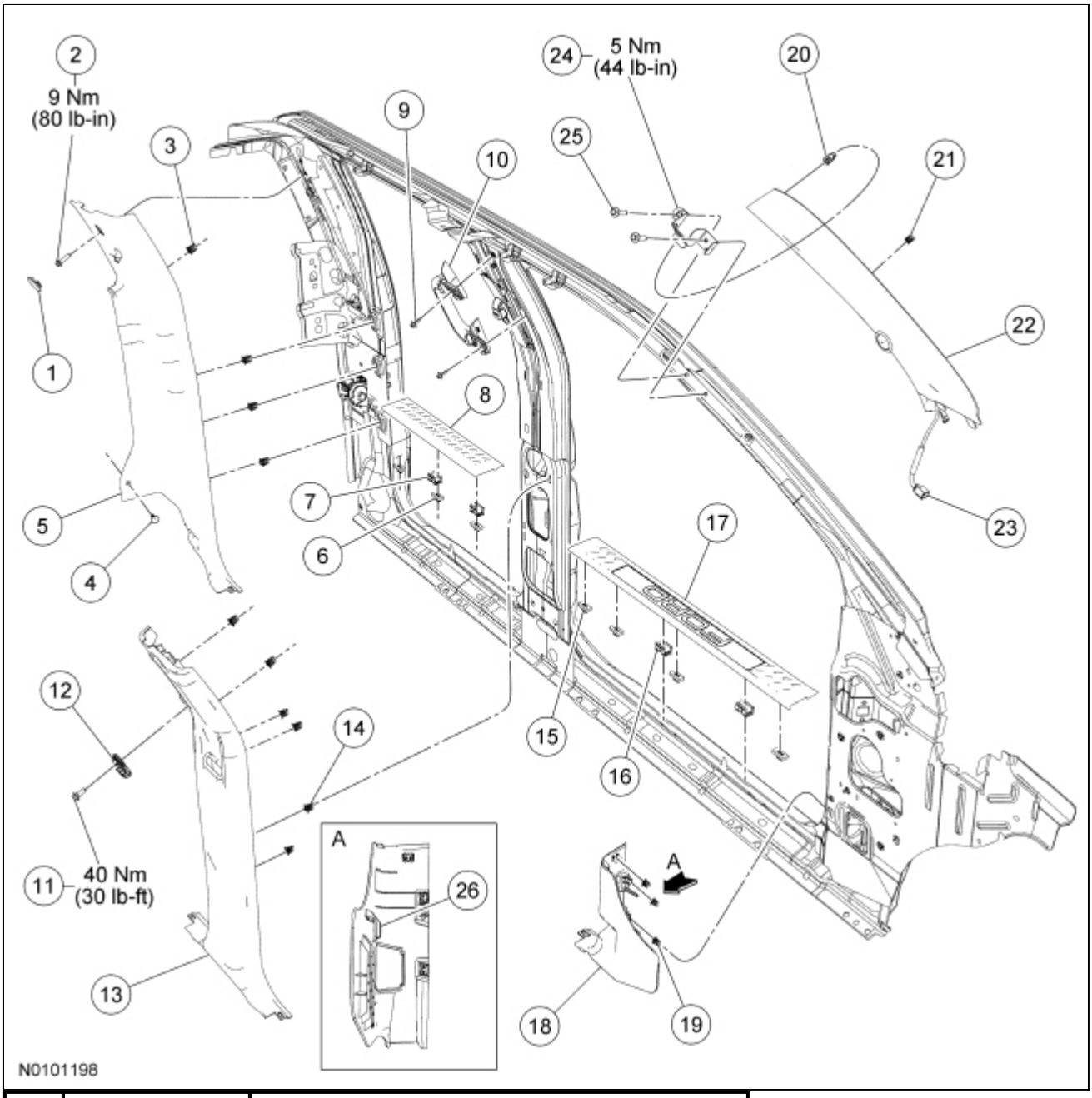


Item	Part Number	Description
1	234B76	B-pillar trim panel screw cover
2	W712518	B-pillar trim panel screw
3	—	B-pillar trim panel clip (part of 234B76) (6 required)
4	W714076	B-pillar trim panel pin-type retainer
5	278D12 RH/ 278D13 LH	B-pillar trim panel
6	—	Cowl side trim panel clip (part of 02344 RH/ 02345 LH)
7	02344 RH/	Cowl side trim panel

	02345 LH	
8	—	Scuff plate trim panel clip (part of 13208 RH/ 13209 LH) (4 required)
9	13284	Scuff plate trim panel S-clip (2 required)
10	13208 RH/ 13209 LH	Scuff plate trim panel
11	W712518	Rear door striker cover screw (2 required)
12	519C38 RH/ 519C39 LH	Rear door striker cover
13	W714232	A-pillar trim panel 2-stage high-retention clip
14	—	A-pillar trim panel clip (part of 03598 RH/ 03599 LH)
15	03598 RH/ 03599 LH	A-pillar trim panel
16	—	A-pillar trim panel speaker electrical connector (part of 18978-A LH/ 18978-B RH)
17	W712518	2-stage high-retention clip bracket screw (2 required)
18	312A48	2-stage high-retention clip bracket
19	—	Cowl side trim panel J-hook (part of 02344 RH/02345 LH)

SuperCrew

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Item	Part Number	Description
1	234B76	C-pillar trim panel screw cover
2	W712518	C-pillar trim panel screw
3	—	C-pillar trim panel clip (part of 278D12 RH/ 278D13 LH) (4 required)
4	W714076	C-pillar trim panel pin-type retainer
5	278D12 RH/ 278D13 LH	C-pillar trim panel
6	—	Rear door scuff plate clip (part of 13228 RH/ 13229 LH) (3 required)
7	13284	Rear door scuff plate S-clip (2 required)

8	13228 RH/ 13229 LH	Rear door scuff plate
9	W703242	Assist handle screw (2 required)
10	31406 RH/ 31407 LH	Assist handle
11	—	Safety belt D-ring bolt (part of 31099)
12	—	Safety belt D-ring (part of 31099)
13	24346 RH/ 24347 LH	B-pillar trim panel
14	—	B-pillar trim panel clip (part of 24346 RH/ 24347 LH) (6 required)
15	—	Front door scuff plate clip (part of 13208 RH/ 13209 LH) (4 required)
16	13284	Front door scuff plate S-clip (2 required)
17	13208 RH/ 13209 LH	Front door scuff plate
18	02344 RH/ 02345 LH	Cowl side trim panel
19	—	Cowl side trim panel clip (part of 02344 RH/ 02345 LH) (3 required)
20	W714232	A-pillar trim panel 2-stage high-retention clip
21	—	A-pillar trim panel clip (part of 03598 RH/ 03599 LH)
22	03598 RH/ 03599 LH	A-pillar trim panel
23	—	A-pillar trim panel speaker electrical connector (part of 18978-A LH/ 18978-B RH)
24	W712518	2-stage high-retention clip bracket screw (2 required)
25	312A48	2-stage high-retention clip bracket
26	—	Cowl side trim panel J-hook (part of 02344 RH/02345 LH)

1. For additional information, refer to the procedures in this section.

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Torque Specifications

Description	Nm	lb-ft	lb-in
Power Running Board (PRB) assembly bolts	22	16	—
PRB bracket-to-step screws	12	—	106
Pickup bed side step body lower nuts	55	41	—
Pickup bed side step body upper bolts	55	41	—
Pickup bed side step bracket bolts	55	41	—
Pickup bed side step bracket slide strap support-to-box bolts	22	16	—
Pickup bed side step bracket slide strap support-to-step bracket bolt	55	41	—
Pickup bed side step latch assembly nuts	9	—	80

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Exterior Trim

The exterior trim and ornamentation consists of the:

- window mouldings.
- running boards.
- Power Running Boards (PRBs) (if equipped).
- PRB step.
- PRB motor (includes linkage).
- PRB step end caps.
- PRB module.

The PRB step end caps can be serviced separately.

If equipped, the PRBs automatically move when the doors are opened to assist entering and exiting the vehicle.

The PRB feature may be enabled/disabled through the message center. For information on how to access the PRB feature within the message center, refer to the Owner's Literature.

When the PRB is disabled (OFF), the PRBs will immediately move to the stowed position regardless of the position of the doors.

When the PRB is enabled (AUTO), the PRBs will extend when the doors are opened and return to the stowed position when the doors are closed or vehicle speed is greater than 8 km/h (5 mph).

When the PRBs are manually set to the deployed position (OUT), they will return to the stowed position and AUTO mode when the vehicle speed is greater than 8 km/h (5 mph).

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Power Running Board (PRB)

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The Power Running Boards (PRBs) are controlled by the PRBs module. The PRB motors receive motor power and ground from the PRB module. The PRB module receives door ajar switch status and vehicle speed information from the Controller Area Network (CAN).

When in AUTO mode, the PRBs will deploy when a door on the same side of the vehicle is opened. When both doors on the same side are closed, the PRBs will retract.

When in OUT mode, both PRBs will stay deployed until OUT mode is deselected, reset to AUTO mode or vehicle speed is greater than 8 km/h (5 mph). Mode will automatically switch back to AUTO once above 8 km/h (5 mph).

When an obstacle is detected, the PRB will reverse direction. If a second obstacle is detected, the PRB will reverse direction again. If a third obstacle is detected, the PRB will stop against the third obstacle until the following conditions are met:

- Change in door ajar status
- Change in the message center status (AUTO, OUT, OFF)
- Vehicle speed greater than 8 km/h (5 mph)

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Power Running Board (PRB)	• Battery Junction Box (BJB) fuse 11 (30A)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PRB module.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the CMDTCs and carry out the self-test diagnostics for the PRB module.

9. If the DTCs retrieved are related to the concern, go to Power Running Board (PRB) Module DTC Chart. For all other DTCs, refer to Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Chart

Power Running Board (PRB) Module DTC Chart

DTC	Description	Action
B1162	Power Running Board Hall Effect Sensor Power Circuit Short to Battery	GO to Pinpoint Test E.
B1163	Left Power Running Board Hall Effect Sensor Failure	GO to Pinpoint Test E.
B1164	Power Running Board Hall	GO to Pinpoint Test E.

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	Effect Sensor Power Circuit Short To Ground	
B1167	Left Power Running Board Deploy and/or Stow Circuit Short To Battery	GO to Pinpoint Test D .
B1168	Left Power Running Board Stow Circuit Short To Ground	GO to Pinpoint Test D .
B1169	LH Motor Traveled Too Far	LH motor is freewheeling (broken geartrain linkage). INSTALL a new LH Power Running Board (PRB) motor. REFER to Power Running Board (PRB) Motor in this section.
B116A	RH Motor Traveled Too Far	RH motor is freewheeling (broken geartrain linkage). INSTALL a new RH PRB motor. REFER to Power Running Board (PRB) Motor in this section.
B116B	LH Power Running Board Motor Short	GO to Pinpoint Test D .
B116C	RH Power Running Board Motor Short	GO to Pinpoint Test D .
B116D	LH Power Running Board Motor Line Open	GO to Pinpoint Test D .
B116E	RH Power Running Board Motor Line Open	GO to Pinpoint Test D .
B1170	Right Power Running Board Hall Effect Sensor Failure	GO to Pinpoint Test E .
B1171	Left Power Running Board Hall Effect Signal Noisy	INSTALL a new LH PRB motor. REFER to Power Running Board (PRB) Motor in this section.
B1172	Right Power Running Board Hall Effect Signal Noisy	INSTALL a new RH PRB motor. REFER to Power Running Board (PRB) Motor in this section.
B1175	Right Power Running Board Stow Circuit Short To Ground	GO to Pinpoint Test D .
B1178	Right Power Running Board Deploy and/or Stow Circuit Short To Battery	GO to Pinpoint Test D .
B1317	Battery Voltage High	GO to Pinpoint Test F .
B1318	Battery Voltage Low	GO to Pinpoint Test F .
B1342	ECU is Faulted	INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section.
B2139	Data Mismatch (receive data does not match what was expected)	REFER to Section 419-10 .
B2813	LH Power Running Board Stow Time Fail	GO to Pinpoint Test B .
B2814	LH Power Running Board Deploy Time Fail	GO to Pinpoint Test B .
B2816	RH Power Running Board Stow Time Fail	GO to Pinpoint Test C .
B2817	RH Power Running Board	GO to Pinpoint Test C .

	Deploy Time Fail	
U1900	CAN Communication Bus Fault - Receive Error	Do not install a new PRB module as part of the repair for a PRB DTC U1900 fault. The PRB is not the source of the fault when DTC U1900 is present. REFER to Section 418-00 to diagnose the Controller Area Network (CAN) concern.
U2050	No Application Present	INSTALL a new PRB module. REFER to Section 419-10 . REPEAT the self-test.
All other DTCs	—	REFER to the Master DTC Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Power Running Board (PRB) does not operate correctly — both running boards	• Fuse • Circuitry • Smart Junction Box (SJB) • PRB module • PCM • Instrument Cluster (IC)	• GO to Pinpoint Test A .
• The PRB does not operate correctly — left running board does not deploy/stow or reverses direction	• Circuitry • Door ajar switch • PRB mechanical assembly • PRB motor • PRB module	• GO to Pinpoint Test B .
• The PRB does not operate correctly — right running board does not deploy/stow or reverses direction	• Circuitry • Door ajar switch • PRB mechanical assembly • PRB motor • PRB module	• GO to Pinpoint Test C .

Pinpoint Tests

Pinpoint Test A: The Power Running Board (PRB) Does Not Operate Correctly — Both Running Boards

Refer to Wiring Diagrams Cell 109 , Power Liftgate/Retractable Running Boards for schematic and connector information.

NOTE: The Power Running Board (PRB) module will stop functionality when battery voltage drops below 9.5 volts (early build) or 9.0 volts (late build). The PRB system will recover at the next door ajar transition provided that the battery voltage remains above 9.0 volts (late build only).

Normal Operation

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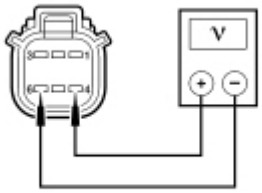
The PRB module receives power through circuit SBB11 (BU/RD) and ground through circuit GD134 (BK/VT). The LH and RH PRB motor Hall-effect sensors receive a regulated 10-volt power supply from the PRB module through circuit CPR47 (GY/BN). The Hall-effect ground is provided by the PRB module through circuit RPR47 (BU/GN). The PRB module receives door ajar and vehicle speed status over the Controller Area Network (CAN).

This pinpoint test is intended to diagnose the following:

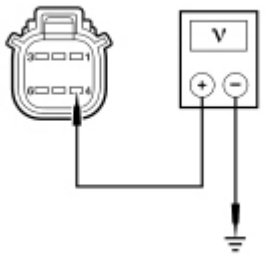
- Fuse
- Wiring, terminals or connectors
- PCM
- Instrument Cluster (IC)
- PRB module

PINPOINT TEST A: THE POWER RUNNING BOARD (PRB) DOES NOT OPERATE CORRECTLY — BOTH RUNNING BOARDS

Test Step	Result / Action to Take
A1 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test — ALL CMDTCs . • **Are any door ajar switch or vehicle speed related DTCs present?**	**Yes** REFER to Section 419-10 to diagnose the door ajar switch or vehicle speed related DTCs. **No** GO to A2 .
A2 CHECK THE OPERATION OF THE PRBs — AUTOMATIC MODE	
• Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when a door on the same side is opened, and retract when the door is closed. • Open and close the LH front door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the LH rear door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH front door. The RH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH rear door. The RH PRB should deploy when the door is open, and retract when the door is closed. • **Did both PRBs operate correctly, with no reversal of motion or noise while in motion?**	**Yes** The system is operating as designed. REVIEW operation of the PRB system with the customer. **No** GO to A3 .
A3 CHECK THE OPERATION OF THE PRBs — MANUAL MODE	
• Set the PRB system to the OUT mode, where the boards are deployed all the time, regardless of door open/closed status and vehicle speed is less than 8 km/h (5 mph). • **Did both PRBs deploy?**	**Yes** GO to A5 . **No** GO to A4 .
A4 CHECK THE PRBs FOR FOREIGN MATERIAL	
• **NOTE:** If the system has false bounce-back, stops in mid-travel, is noisy or will not deploy or stow completely, check to see if any foreign material is caught in the PRB hinge points, step area or door sill. If foreign material is found, clean the PRB hinge points, step	**Yes** The system is operating normally. The concern may have been caused

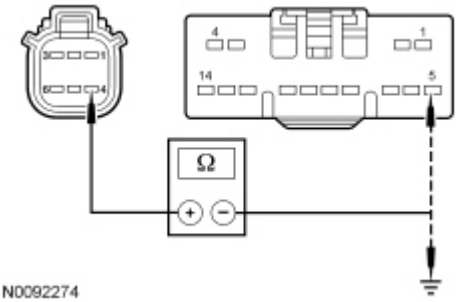
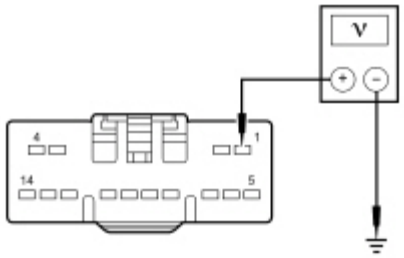
area and door sill with a high-pressure washer. If the system operates correctly after cleaning, refer the customer to the Owner's Literature for correct cleaning instructions. • Check the PRB hinge points, step area and door sill of the LH and RH PRBs for foreign material or blockage. If any foreign material or blockage is found, remove it, and if necessary, set the PRB system to the OUT mode and clean the PRB hinge points, step area and door sill with a high-pressure washer. Avoid direct spray to the motor. • Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when a door on the same side is opened, and retract when the door is closed. • Open and close the LH front door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH front door. The RH PRB should deploy when the door is open, and retract when the door is closed. • **Does the PRB system operate normally during all test steps?**	by foreign material or blockage in the PRB hinge points, step area or door sill. REFER the customer to the Owner's Literature for correct cleaning instructions. **No** GO to A5.
A5 VERIFY THE DOOR AJAR SWITCH OPERATION	
• Open and close each door, verify the interior lights operate correctly and door ajar is noted on the vehicle message center. • **Do the interior lights turn ON when the door is opened and OFF when the door is closed?**	**Yes** GO to A6. **No** REFER to Section 417-02 to diagnose the interior lighting concern before attempting to diagnose the PRB concern.
A6 CHECK THE HALL-EFFECT SENSOR POWER AND GROUND	
• Disconnect: PRB LH Motor C3185. • Disconnect: PRB RH Motor C3186. • Ignition ON. • Measure the voltage between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and C3186-6, circuit RPR47 (BU/GN), harness side.  N0092272 • Open RH door. • Voltage signal will only be present for less than one second. • **Is the voltage between 7 and 10.5 volts?**	**Yes** GO to A13. **No** If the voltage was less than 7 volts, GO to A7. If the voltage was greater than 10.5 volts, GO to A12.
A7 CHECK HALL-EFFECT SENSOR POWER CIRCUIT FOR VOLTAGE	
• Measure the voltage between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and ground.	**Yes** GO to A11. **No** GO to A8.

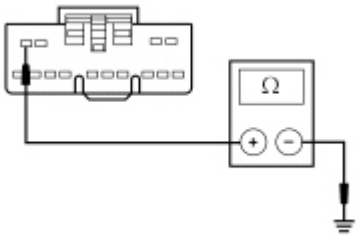
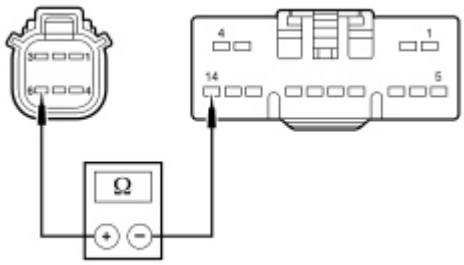
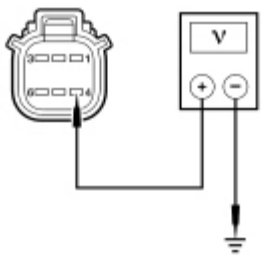
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N0092273

- Open RH door.
- Voltage signal will only be present for less than one second.
- **Is the voltage between 7 and 10.5 volts?**

A8 CHECK HALL-EFFECT SENSOR POWER CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Measure the resistance between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and PRB module C3313B-5, circuit CPR47 (GY/BN), harness side; and between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and ground.  N0092274 • **Is the resistance less than 5 ohms between the PRB motor and PRB module; and greater than 10,000 ohms between the PRB motor and ground?**	**Yes** GO to A9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A9 CHECK THE PRB MODULE POWER CIRCUIT FOR VOLTAGE	
• Measure the voltage between PRB module C3313B-1, circuit SBB11 (BU/RD), harness side and ground.  N0055096 • **Is battery voltage present?**	**Yes** GO to A10 . **No** VERIFY Battery Junction Box (BJB) fuse 11 (30A) is OK. If OK, REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A10 CHECK THE PRB MODULE GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Measure the resistance between the PRB module C3313B-4, circuit GD139 (BK/YE), harness side and ground.  N0060073 • **Is the resistance less than 5 ohms?**	**Yes** GO to A13 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A11 CHECK THE HALL-EFFECT SENSOR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Measure the resistance between RH PRB motor C3186-6, circuit RPR47 (BU/GN), harness side and PRB module C3313B-14, circuit RPR47 (BU/GN), harness side.  N0092275 • **Is the resistance less than 5 ohms?**	**Yes** GO to A13 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A12 CHECK THE HALL-EFFECT SENSOR POWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Ignition ON. • Measure the voltage between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and ground.  N0092273 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR The DTCs. REPEAT the self-test. **No** GO to A13 .

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A13 CHECK THE PRB MODULE FOR CORRECT OPERATION	

• Connect: PRB LH Motor C3185.
• Connect: PRB RH Motor C3186.
• Visually inspect all PRB module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section.
	CLEAR the DTCs.
	REPEAT the self-test.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.
	CLEAR the DTCs.
	REPEAT the self-test.

Pinpoint Test B: The Power Running Board (PRB) Does Not Operate Correctly — Left Running Board Does Not Deploy/Stow or Reverses Direction

Refer to Wiring Diagrams Cell 109 , Power Liftgate/Retractable Running Boards for schematic and connector information.

Normal Operation

During self-test, the Power Running Board (PRB) module monitors the length of time it takes to deploy and stow the LH and RH PRBs . If the time exceeds 4 seconds, DTC B2813 or B2814 will be generated.

The PRB module receives door ajar and vehicle speed status over the Controller Area Network (CAN). During LH PRB deployment, the PRB module supplies power to the LH PRB motor through circuit CPR41 (BU/WH) and ground through circuit CPR42 (WH). The PRB module stows the LH PRB by supplying power to the LH PRB motor through circuit CPR42 (WH) and ground through circuit CPR41 (BU/WH). The PRB module provides a regulated 10-volt power supply to the Hall-effect sensor (internal to the PRB motor) through circuit CPR47 (GY/BN). The Hall-effect ground is provided by the PRB module through circuit RPR47 (BU/GN). The PRB module monitors the LH PRB Hall-effect signal through circuit VPR43 (GY/BU). If the PRB module does not receive any signal from the Hall-effect sensor during operation, the PRB will stop.

- DTC B2813 (LH Power Running Board Stow Time Fail) — When the left running board takes greater than 4 seconds to stow.
- DTC B2814 (LH Power Running Board Deploy Time Fail) — When the left running board takes greater than 4 seconds to deploy.

This pinpoint test is intended to diagnose the following:

- Mechanical resistance due to foreign material
- Wiring, terminals or connectors
- Door ajar switch
- PRB module
- LH PRB motor

PINPOINT TEST B: THE POWER RUNNING BOARD (PRB) DOES NOT OPERATE CORRECTLY — LEFT RUNNING BOARD DOES NOT DEPLOY/STOW OR REVERSES DIRECTION

Test Step	Result / Action to Take
B1 CHECK THE OPERATION OF THE PRB — AUTOMATIC MODE • Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when a door on the same side is opened, and retract when the door is closed. • Open and close the LH front door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the LH rear door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH front door. The RH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH rear door. The RH PRB should deploy when the door is open, and retract when the door is closed. • **Did both PRBs operate correctly, with no reversal of motion, or noise while in motion?**	**Yes** The system is operating as designed. REVIEW operation of the PRBs system with the customer. **No** GO to B2.
B2 CHECK THE OPERATION OF THE PRBs — MANUAL MODE • Set the PRB system to the OUT mode, where the boards are deployed all the time, regardless of door open/closed status and vehicle speed is less than 8 km/h (5 mph). • **Did both PRBs deploy?**	**Yes** GO to B5. **No** GO to B3.
B3 CHECK THE PRBs FOR FOREIGN MATERIAL • **NOTE:** If the system has false bounce-back, stops in mid-travel, is noisy or will not stow completely, extend the PRB and check to see if any foreign material is caught in the PRB hinge points, step area or door sill. If foreign material is found, clean the PRB hinge points, step area and door sill with a high-pressure washer. If the system operates correctly after cleaning, refer the customer to the Owner's Literature for correct cleaning instructions. • Check the PRB hinge points, step area and door sill of the LH PRB for foreign material or blockage. If any foreign material or blockage is found, remove it, and if necessary, set the PRB system to the OUT mode and clean the PRB hinge points, step area and door sill with a high-pressure washer. Avoid direct spray to the motor. • Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when either door on the same side is opened, and retract when the door is closed. • Open and close the LH front door. The LH PRB should deploy when the door is open, and retract when the door is closed. • **Does the LH PRB operate normally during all test steps?**	**Yes** The system is operating normally. The concern may have been caused by foreign material or blockage in the PRB hinge points, step area or door sill. REFER the customer to the Owner's Literature for correct cleaning instructions. **No** GO to B4.
B4 CHECK IF DTCs ARE PRESENT • Use the recorded PRB module DTCs from the continuous and on-demand self tests. • **Is DTC B2813 or B2814 present?**	**Yes** INSTALL a new PRB motor. REFER to Power Running Board (PRB) Motor in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to B6.
B5 VERIFY THE DOOR AJAR SWITCH OPERATION • Open and close the LH front and LH rear door, and verify the interior lights operate correctly and door ajar is noted on the vehicle	**Yes** GO to B6.

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message center.

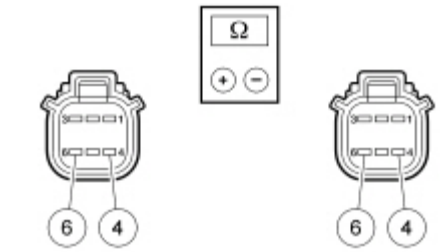
- **Do the interior lights turn ON when the door is opened, and OFF when the door is closed?**

No
REFER to Section 417-02 to diagnose the interior lighting concern before attempting to diagnose the PRB concern.

B6 CHECK FOR CONTINUITY BETWEEN LH AND RH PRB MOTORS ON THE HALL-EFFECT SENSOR POWER AND GROUND CIRCUITS

- Disconnect: PRB LH Motor C3185.
- Disconnect: PRB RH Motor C3186.
- Ignition OFF.
- Measure the resistance between LH PRB motor C3185, harness side and RH PRB motor C3186, harness side using the following chart:

LH PRB Motor	Circuit	RH PRB Motor
C3185-4	CPR47 (GY/BN)	C3186-4
C3185-6	RPR47 (BU/GN)	C3186-6



N0092493

- **Is the resistance less than 5 ohms?**

Yes
GO to B7.

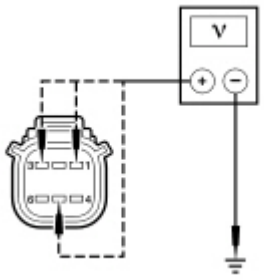
No
REPAIR the circuit.
CLEAR the DTCs.
REPEAT the self-test.

B7 CHECK FOR A SHORT TO VOLTAGE IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT

- Ignition OFF.
- Disconnect: PRB Module C3313A.
- Disconnect: PRB Module C3313B.
- Ignition ON.
- Measure the voltage between LH PRB motor C3185-5, circuit VPR43 (GY/BU), harness side and ground; and between LH PRB motor C3185-3, circuit CPR41 (BU/WH), harness side and ground; and between C3185-1, circuit CPR42 (WH), harness side and ground.

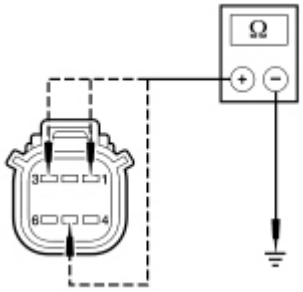
Yes
REPAIR the circuit.
CLEAR the DTCs.
REPEAT the self-test.

No
GO to B8.

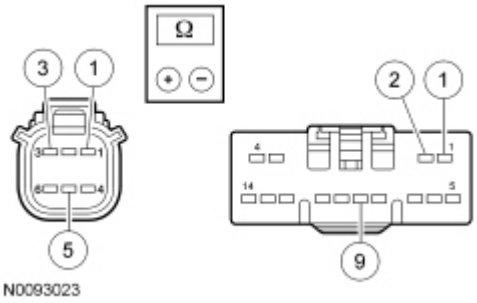
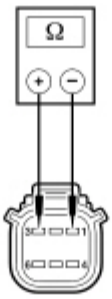


N0092494

- **Is any voltage present?**

B8 CHECK FOR A SHORT TO GROUND IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Ignition OFF. • Measure the resistance between LH PRB motor C3185-5, circuit VPR43 (GY/BU), harness side and ground; and between LH PRB motor C3185-3, circuit CPR41 (BU/WH), harness side and ground; and between C3185-1, circuit CPR42 (WH), harness side and ground.  N0093022 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B9 CHECK FOR AN OPEN IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Measure the resistances between PRB module C3313A or C3313B, harness side and LH PRB motor C3185, harness side using the following chart: **LH Motor Connector** / **Circuit** / **PRB Module Connector** C3185-5 / VPR43 (GY/BU) / C3313B-9 C3185-3 / CPR41 (BU/WH) / C3313A-1 C3185-1 / CPR42 (WH) / C3313A-2	**Yes** GO to B10 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

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 N0093023 • **Is the resistance less than 5 ohms?**	
B10 CHECK FOR A SHORT BETWEEN THE STOW AND DEPLOY CIRCUITS	
• Measure the resistance between LH PRB motor C3185-3, circuit CPR41 (BU/WH), harness side and C3185-1, circuit CPR42 (WH) harness side.  N0092496 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new LH PRB bracket assembly. REFER to Power Running Board (PRB) Motor in this section. CLEAR the DTCs. REPEAT the self-test. If the concern is still present, GO to B11. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B11 CHECK THE PRB MODULE FOR CORRECT OPERATION	

• Connect: PRB LH Motor C3185.
• Connect: PRB RH Motor C3186.
• Visually inspect all PRB module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section. CLEAR the DTCs. REPEAT the self-test.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: The Power Running Board (PRB) Does Not Operate Correctly — Right Running Board Does Not Deploy/Stow or Reverses Direction

Refer to Wiring Diagrams Cell 109, Power Liftgate/Power Running Boards for schematic and connector information.

Normal Operation

During self-test, the Power Running Board (PRB) module monitors the length of time it takes to deploy and stow the LH and RH PRBs . If the time exceeds 4 seconds, B2816 or B2817 will be generated.

The PRB module receives door ajar and vehicle speed status over the Controller Area Network (CAN). During RH PRB deployment, the PRB module supplies power to the RH PRB motor through circuit CPR44 (BN/WH) and ground through circuit CPR45 (VT/GY). The PRB module stows the RH PRB by supplying power to the RH PRB motor through circuit CPR45 (VT/GY) and ground through circuit CPR44 (BN/WH). The PRB module provides a regulated 10-volt power supply to the Hall-effect sensor (internal to the PRB motor) through circuit CPR47 (GY/BN). The Hall-effect ground is provided by the PRB module through circuit RPR47 (BU/GN). The PRB module monitors the RH PRB Hall-effect signal through circuit VPR46 (GY). If the PRB module does not receive any signal from the Hall-effect sensor during operation, the PRB will stop.

- DTC B2816 (RH Power Running Board Stow Time Fail) — Right running board takes greater than 4 seconds to stow.
- DTC B2817 (RH Power Running Board Deploy Time Fail) — Right running board takes greater than 4 seconds to deploy.

This pinpoint test is intended to diagnose the following:

- Mechanical resistance due to foreign material
- Wiring, terminals or connectors
- Door ajar switch
- PRB module
- RH PRB motor

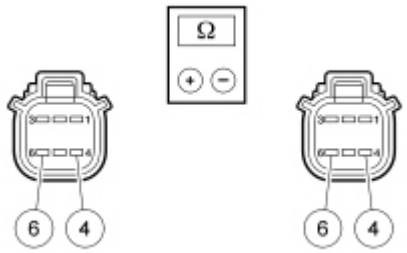
PINPOINT TEST C: THE POWER RUNNING BOARD (PRB) DOES NOT OPERATE CORRECTLY — RIGHT RUNNING BOARD DOES NOT DEPLOY/STOW OR REVERSES DIRECTION

Test Step	Result / Action to Take
C1 CHECK THE OPERATION OF THE PRB — AUTOMATIC MODE	
• Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when a door on the same side is opened, and retract when the door is closed. • Open and close the LH front door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the LH rear door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH front door. The RH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH rear door. The RH PRB should deploy when the door is open, and retract when the door is closed. • **Did both PRBs operate correctly, with no reversal of motion or noise while in motion?**	**Yes** The system is operating as designed. REVIEW operation of the PRBs system with the customer. **No** GO to C2 .
C2 CHECK THE OPERATION OF THE PRBs — MANUAL MODE	
• Set the PRB system to the OUT mode, where the boards are deployed all the time, regardless of door open/closed status and vehicle speed is less than 8 km/h (5 mph). • **Did both PRBs deploy?**	**Yes** GO to C5 . **No** GO to C3 .
C3 CHECK THE PRB FOR FOREIGN MATERIAL	
• **NOTE:** If the system has false bounce-back, stops in mid-travel, is	**Yes**

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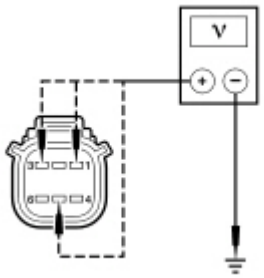
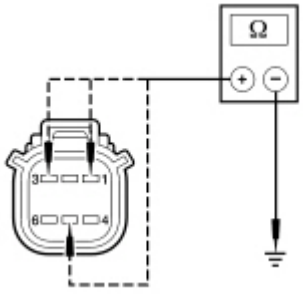
noisy or will not stow completely, extend the PRB and check to see if any foreign material is caught in the PRB hinge points, step area or door sill. If foreign material is found, clean the PRB hinge points, step area and door sill with a high-pressure washer. If the system operates correctly after cleaning, refer the customer to the Owner's Literature for correct cleaning instructions. • Check the PRB hinge points, step area and door sill of the RH PRB for foreign material or blockage. If any foreign material or blockage is found, remove it, and if necessary, set the PRB system to the OUT mode and clean the PRB hinge points, step area and door sill with a high-pressure washer. Avoid direct spray to the motor. • Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when either door on the same side is opened, and retract when the door is closed. • Open and close the RH front door. The RH PRB should deploy when the door is open, and retract when the door is closed. • **Does the RH PRB operate normally during all test steps?**	The system is operating normally. The concern may have been caused by foreign material or blockage in the PRB hinge points, step area or door sill. REFER the customer to the Owner's Literature for correct cleaning instructions. **No** GO to C4 .
C4 CHECK IF DTCs ARE PRESENT	
• Use the recorded PRB module DTCs from the continuous and on-demand self tests. • **Is DTC B2816 or B2817 present?**	**Yes** INSTALL a new PRB motor. REFER to Power Running Board (PRB) Motor in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to C6 .
C5 VERIFY THE DOOR AJAR SWITCH OPERATION	
• Open and close the RH front and RH rear door, and verify the interior lights operate correctly and door ajar is noted on the vehicle message center. • **Do the interior lights turn ON when the door is opened, and OFF when the door is closed?**	**Yes** GO to C6 . **No** REFER to Section 417-02 to diagnose the interior lighting concern before attempting to diagnose the PRB concern.
C6 CHECK FOR CONTINUITY BETWEEN LH AND RH PRB MOTORS ON THE HALL-EFFECT SENSOR POWER AND GROUND CIRCUITS	
• Disconnect: PRB LH Motor C3185. • Disconnect: PRB RH Motor C3186. • Ignition OFF. • Measure the resistance between LH PRB motor C3185, harness side and RH PRB motor C3186, harness side using the following chart:	**Yes** GO to C7 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

LH PRB Motor	Circuit	RH PRB Motor
C3185-4	CPR47 (GY/BN)	C3186-4
C3185-6	RPR47 (BU/GN)	C3186-6

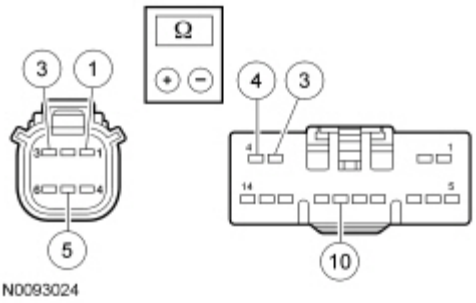


N0092493

- **Is the resistance less than 5 ohms?**

C7 CHECK FOR A SHORT TO VOLTAGE IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Ignition OFF. • Disconnect: PRB Module C3313A. • Disconnect: PRB Module C3313B. • Ignition ON. • Measure the voltage between RH PRB motor C3186-5, circuit VPR46 (GY), harness side and ground; and between RH PRB motor C3186-3, circuit CPR44 (BN/WH), harness side and ground; and between C3186-1, circuit CPR45 (VT/GY), harness side and ground.  N0092494 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to C8 .
C8 CHECK FOR A SHORT TO GROUND IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Ignition OFF. • Measure the resistance between RH PRB motor C3186-5, circuit VPR46 (GY), harness side and ground; and between RH PRB motor C3186-3, circuit CPR44 (BN/WH), harness side and ground; and between C3186-1, circuit CPR45 (VT/GY), harness side and ground.  N0093022 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

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C9 CHECK FOR AN OPEN IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Measure the resistances between PRB module C3313A or C3313B, harness side and RH PRB motor C3185, harness side using the following chart: **RH Motor Connector** / **Circuit** / **PRB Module Connector** C3186-5 / VPR46 (GY) / C3313B-10 C3186-3 / CPR44 (BN/WH) / C3313A-4 C3186-1 / CPR45 (VT/GY) / C3313A-3  N0093024 • **Is the resistance less than 5 ohms?**	**Yes** GO to C10 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
C10 CHECK FOR A SHORT BETWEEN THE STOW AND DEPLOY CIRCUITS	
• Measure the resistance between RH PRB motor C3186-3, circuit CPR44 (BN/WH), harness side and C3186-1, circuit CPR45 (VT/GY), harness side.  N0092496 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new RH PRB bracket assembly. REFER to Power Running Board (PRB) Motor in this section. CLEAR the DTCs. REPEAT the self-test. If the concern is still present, GO to C11 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
C11 CHECK THE PRB MODULE FOR CORRECT OPERATION	

• Connect: PRB LH Motor C3185.
• Connect: PRB RH Motor C3186.
• Visually inspect all PRB module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all PRB module connectors and make sure they seat correctly.
	Yes
	INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section.
	CLEAR the DTCs.
	REPEAT the self-test.

• Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: DTCs B1167, B1168, B1175, B1178, B116B, B116D, B116C and B116E

Refer to Wiring Diagrams Cell 109 , Power Liftgate/Power Running Boards for schematic and connector information.

Normal Operation

During Power Running Board (PRB) deployment, the PRB module supplies power to the PRB motor through circuit CPR41 (BU/WH) (LH) or CPR44 (BN/WH) (RH) and ground through circuit CPR42 (WH) (LH) or CPR45 (VT/GY) (RH). The PRB module stows the PRB by supplying power to the PRB motor through circuit CPR42 (WH) (LH) or CPR45 (VT/GY) (RH) and ground through circuit CPR41 (BU/WH) (LH) or CPR44 (BN/WH) (RH). The PRB module provides a regulated 10-volt power supply to the Hall-effect sensor (internal to the PRB motor) through circuit CPR47 (GY/BN). The Hall-effect ground is provided by the PRB module through circuit RPR47 (BU/GN). The PRB module monitors the PRB Hall-effect signal through circuit VPR43 (GY/BU) (LH) or VPR46 (GY) (RH). If the PRB module does not receive any signal from the Hall-effect sensor during operation, the PRB will stop.

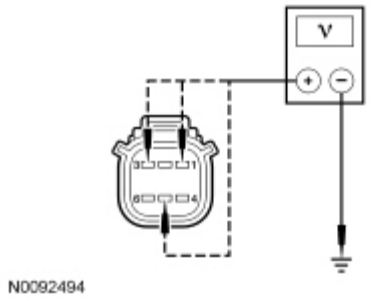
DTC Description	Fault Trigger Conditions
• B1167 — Left Power Running Board Deploy and/or Stow Circuit Short to Battery	The PRB module sets this DTC if a short to battery voltage is detected in the LH running board motor circuit(s).
• B1168 — Left Power Running Board Motor Circuit Short to Ground	The PRB module sets this DTC if a short to ground is detected in the motor circuit while attempting to retract/stow the LH running board.
• B1175 — Right Power Running Board Stow Circuit Short to Ground	The PRB module sets this DTC if a short to ground is detected in the motor circuit while attempting to retract/stow the RH running board.
• B1178 — Right Power Running Board Deploy and/or Stow Circuit Short to Battery	The PRB module sets this DTC if a short to battery voltage is detected in the RH running board motor circuit(s).
• B116B — LH Power Running Board Motor Short	The PRB module sets this DTC if it detects the LH running board motor circuit(s) are shorted together.
• B116C — RH Power Running Board Motor Short	The PRB module sets this DTC if it detects the RH running board motor circuit(s) are shorted together.
• B116D — LH Power Running Board Motor Line Open	The PRB module sets this DTC when it detects an open in the LH running board motor circuit(s).
• B116E — RH Power Running Board Motor Line Open	The PRB module sets this DTC when it detects an open in the RH running board motor circuit(s).

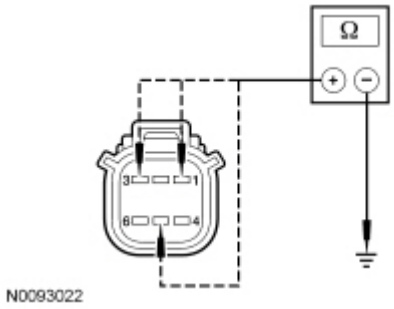
This pinpoint test is intended to diagnose the following:

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- Wiring, terminals or connectors
- LH or RH PRB motor assembly
- PRB module

PINPOINT TEST D: DTCs B1167, B1168, B1175, B1178, B116B, B116D, B116C and B116E

Test Step	Result / Action to Take
D1 CHECK FOR A SHORT TO VOLTAGE IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Ignition OFF. • Disconnect: PRB Module C3313A. • Disconnect: PRB Module C3313B. • Ignition ON. • For DTC B1167, B1168, B116B or B116D, measure the voltage between LH PRB motor C3185-5, circuit VPR43 (GY), harness side and ground; and between LH PRB motor C3185-3, circuit CPR41 (BU/WH), harness side and ground; and between C3185-1, circuit CPR42 (WH), harness side and ground.  N0092494 • For DTC B1175, B1178, B116C or B116E, measure the voltage between RH PRB motor C3186-5, circuit VPR46 (GY/OG), harness side and ground; and between RH PRB motor C3186-3, circuit CPR44 (BN/WH), harness side and ground; and between C3186-1, circuit CPR45 (VT/GY), harness side and ground. • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to D2.
D2 CHECK FOR A SHORT TO GROUND IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT	
• Ignition OFF. • For DTC B1167, B1168, B116B or B116D, measure the resistance between LH PRB motor C3185-5, circuit VPR43 (GY/BU), harness side and ground; and between LH PRB motor C3185-3, circuit CPR41 (BU/WH), harness side and ground; and between C3185-1, circuit CPR42 (WH), harness side and ground.	**Yes** GO to D3. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.



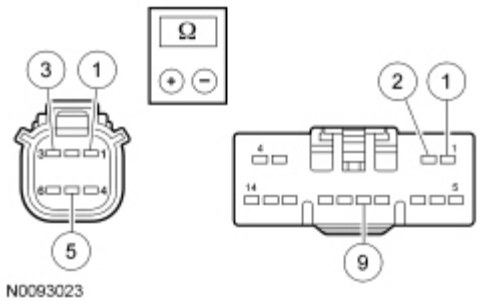
N0093022

- For DTC B1175, B1178, B116C or B116E, measure the resistance between RH PRB motor C3186-5, circuit VPR46 (GY), harness side and ground; and between RH PRB motor C3186-3, circuit CPR44 (BN/WH), harness side and ground; and between C3186-1, circuit CPR45 (VT/GY), harness side and ground.
- **Is the resistance greater than 10,000 ohms?**

D3 CHECK FOR AN OPEN IN THE HALL-EFFECT SENSOR SIGNAL, DEPLOY OR STOW CIRCUIT

- Ignition OFF.
- For DTC B1167, B1168, B116B or B116D, measure the resistances between PRB module C4322A or C4322B, harness side and LH PRB motor C3185, harness side using the following chart:

LH Motor Connector	Circuit	PRB Module Connector
C3185-5	VPR43 (GY/BU)	C3313B-9
C3185-3	CPR41 (BU/WH)	C3313A-1
C3185-1	CPR42 (WH)	C3313A-2



N0093023

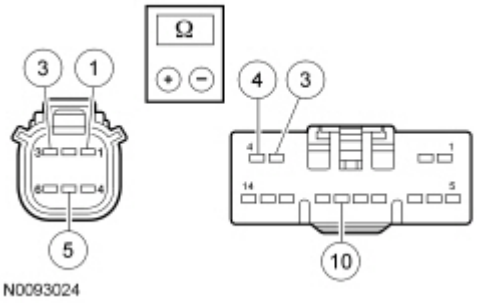
- For DTC B1175, B1178, B116C or B116E, measure the resistances between PRB module C4322A or C4322B, harness side and RH PRB motor C3186, harness side using the following chart:

RH Motor Connector	Circuit	PRB Module Connector
C3186-5	VPR46 (GY)	C3313B-10
C3186-3	CPR44 (BN/WH)	C3313A-4
C3186-1	CPR45 (VT/GY)	C3313A-3

Yes
GO to D4 .

No
REPAIR the circuit(s).
CLEAR the DTCs.
REPEAT the self-test.

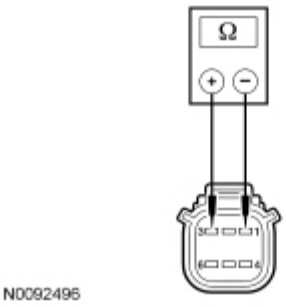
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- **Is the resistance less than 5 ohms?**

D4 CHECK FOR A SHORT BETWEEN THE STOW AND DEPLOY CIRCUITS

- For DTC B1167, B1168, B116B or B116D, measure the resistance between LH PRB motor C3185-3, circuit CPR41 (BU/WH), harness side and C3185-1, circuit CPR42 (WH), harness side.



- For DTC B1175, B1178, B116C or B116E, measure the resistance between RH PRB motor C3186-3, circuit CPR44 (BN/WH), harness side and C3186-1, circuit CPR45 (VT/GY), harness side.
- **Is the resistance greater than 10,000 ohms?**

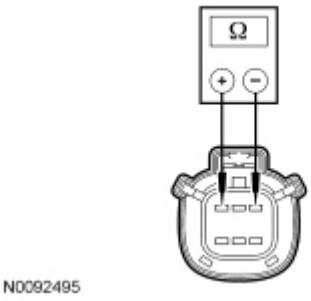
Yes
GO to D5 .

No
REPAIR the circuit.
CLEAR the DTCs.
REPEAT the self-test.

D5 CHECK THE PRB MOTOR FOR AN OPEN CIRCUIT

NOTE: The running board motor(s) has approximately 0.42 ohms of resistance at 20°C (68°F). The running board motor(s) should not show an open circuit (no continuity) when measured with a DMM .

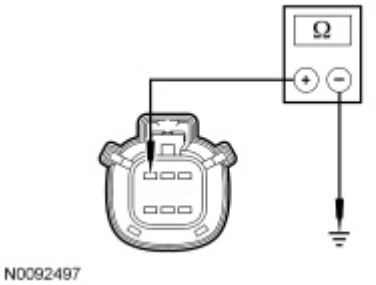
- For DTC B1167, B1168, B116B or B116D, measure the resistance between LH PRB motor C3185-3, circuit CPR41 (BU/WH), component side and C3185-1, circuit CPR42 (WH), component side.



- For DTC B1175, B1178, B116C or B116E, measure the resistance between RH PRB motor C3186-3, circuit CPR44 (BN/WH), component side and C3186-1, circuit CPR45 (VT/GY), component

Yes
GO to D6 .

No
INSTALL a new PRB motor. REFER to Power Running Board (PRB) Motor in this section.
CLEAR the DTCs.
REPEAT the self-test.

side. • **Is any continuity present?**	
D6 CHECK THE PRB MOTOR FOR A SHORT TO GROUND	
• For DTC B1167, B1168, B116B or B116D, measure the resistance between LH PRB motor C3185-1, circuit CPR 42 (WH), component side and ground.  N0092497 • For DTC B1175, B1178, B116C or B116E, measure the resistance between RH motor C3186-1, circuit CPR45 (VT/GY), component side and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D7. **No** INSTALL a new PRB motor. REFER to Power Running Board (PRB) Motor in this section. CLEAR the DTCs. REPEAT the self-test.
D7 CHECK THE PRB MODULE FOR CORRECT OPERATION	

• Connect: PRB LH Motor C3185.
• Connect: PRB RH Motor C3186.
• Visually inspect all PRB module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section. CLEAR the DTCs. REPEAT the self-test.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: DTCs B1162, B1163, B1164 and B1170

Refer to Wiring Diagrams Cell 109, Power Liftgate/Power Running Boards for schematic and connector information.

Normal Operation

The Power Running Board (PRB) module provides a regulated 10-volt power supply to the Hall-effect sensor (internal to the PRB motor) through circuit CPR47 (GY/BN). The Hall-effect ground is provided by the PRB module through circuit RPR47 (BU/GN). The PRB module monitors the PRB Hall-effect signal through circuit VPR43 (GY/BU) (LH) or VPR46 (GY) (RH). If the PRB module does not receive any signal from the Hall-effect sensor during operation, the PRB will stop.

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DTC Description	Fault Trigger Conditions
• B1162 — Power Running Board Hall-Effect Sensor Power Circuit Short to Battery	The PRB module sets this DTC if it detects the Hall-Effect sensor power circuit is shorted to battery voltage.
• B1163 — Left Power Running Board Hall-Effect Sensor Failure	The PRB module sets this DTC if it does not see any feedback from the Hall-Effect sensor during the stowing/deploying of the LH running board.
• B1164 — Power Running Board Hall-Effect Sensor Power Circuit Short to Ground	The PRB module sets this DTC if it detects the Hall-Effect sensor power circuit is shorted to ground.
• B1170 — Right Power Running Board Deploy and/or Stow Circuit Short to Battery	The PRB module sets this DTC if it does not see any feedback from the Hall-Effect sensor during the stowing/deploying of the RH running board.

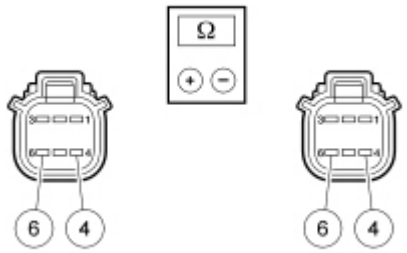
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PRB module
- LH or RH PRB motor assembly

PINPOINT TEST E: DTCs B1162, B1163, B1164 AND B1170

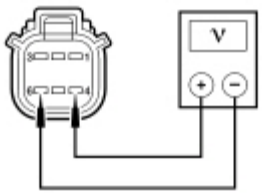
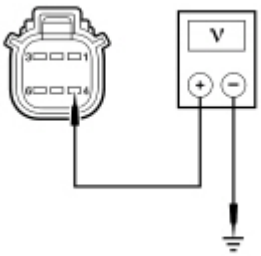
Test Step	Result / Action to Take
E1 CHECK FOR CONTINUITY BETWEEN LH AND RH PRB MOTORS ON THE HALL-EFFECT SENSOR POWER AND GROUND CIRCUITS	
• Disconnect: PRB LH Motor C3185. • Disconnect: PRB RH Motor C3186. • Ignition OFF. • Measure the resistance between LH PRB motor C3185, harness side and RH PRB motor C3186, harness side using the following chart:	**Yes** GO to E2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

LH PRB Motor	Circuit	RH PRB Motor
C3185-4	CPR47 (GY/BN)	C3186-4
C3185-6	RPR47 (BU/GN)	C3186-6

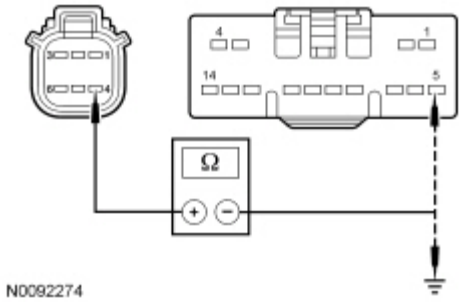
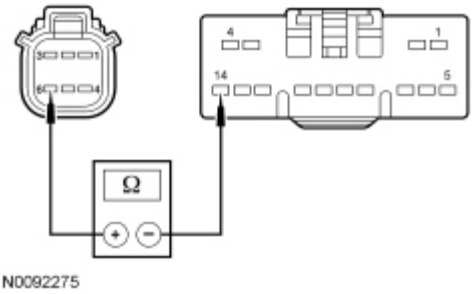
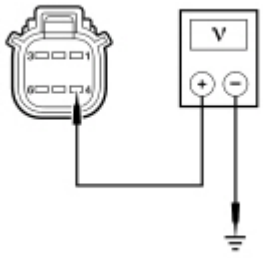


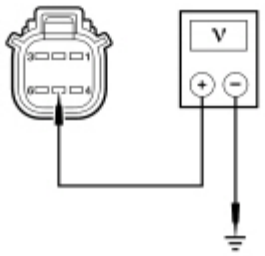
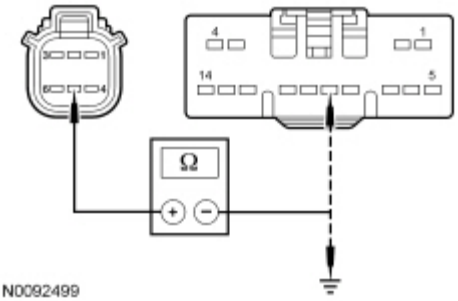
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- **Is the resistance less than 5 ohms?**

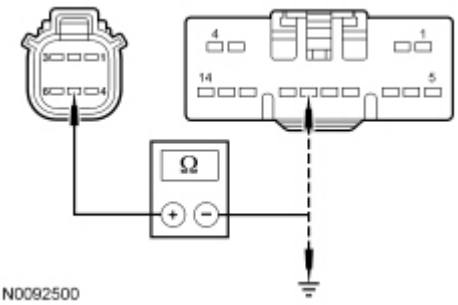
E2 CHECK THE HALL-EFFECT SENSOR POWER AND GROUND	
• Ignition ON. • Measure the voltage between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and C3186-6, circuit RPR47 (BU/GN), harness side.  N0092272 • Open RH door. • Voltage signal will only be present for less than one second. • **Is the voltage between 7 and 10.5 volts?**	**Yes** GO to E7 . **No** If the voltage was less than 7 volts, GO to E3 . If the voltage was greater than 10.5 volts, GO to E6 .
E3 CHECK HALL-EFFECT SENSOR POWER CIRCUIT FOR VOLTAGE	
• Measure the voltage between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and ground.  N0092273 • Open RH door. • Voltage signal will only be present for less than one second. • **Is the voltage between 7 and 10.5 volts?**	**Yes** GO to E5 . **No** GO to E4 .
E4 CHECK HALL-EFFECT SENSOR POWER CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Measure the resistance between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and PRB module C3313B-5, circuit	**Yes** GO to E9 . **No**

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CPR47 (GY/BN), harness side; and between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and ground.  N0092274 • **Is the resistance less than 5 ohms between the PRB motor and the PRB module; and greater than 10,000 ohms between the PRB motor and ground?**	REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
E5 CHECK THE HALL-EFFECT SENSOR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Measure the resistance between RH PRB motor C3186-6, circuit RPR47 (BU/GN), harness side and PRB module C3313B-14, circuit RPR47 (BU/GN), harness side.  N0092275 • **Is the resistance less than 5 ohms?**	**Yes** GO to E9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
E6 CHECK THE HALL-EFFECT SENSOR POWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Ignition ON. • Measure the voltage between RH PRB motor C3186-4, circuit CPR47 (GY/BN), harness side and ground.  N0092273 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to E9 .

E7 CHECK THE HALL-EFFECT SENSOR SIGNAL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PRB Module C3313B. • Ignition ON. • For DTC B1163, measure the voltage between LH PRB motor C3185-5, circuit VPR43 (GY/BU), harness side and ground.  N0092498 • For DTC B1170, measure the voltage between RH PRB motor C3186-5, circuit VPR46 (GY), harness side and ground. • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to E8 .
E8 CHECK THE HALL-EFFECT SENSOR SIGNAL CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • For DTC B1163, measure the resistance between LH PRB motor C3185-5, circuit VPR43 (GY/BU), harness side and PRB module C3313B-9, circuit VPR43 (GY/BU), harness side; and between LH PRB motor C3185-5, circuit VPR43 (GY/BU), harness side and ground.  N0092499 • For DTC B1170, measure the resistance between RH PRB motor C3186-5, circuit VPR46 (GY), harness side and PRB module C3313B-10, circuit VPR46 (GY), harness side; and between RH PRB motor C3186-5, circuit VPR46 (GY), harness side and ground.	**Yes** GO to E10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

repair4less



- **Is the resistance less than 5 ohms between the PRB motor and PRB module; and greater than 10,000 ohms between the PRB motor and ground?**

E9 CHECK THE PRB MODULE FOR CORRECT OPERATION	

• Connect: PRB LH Motor C3185.
• Connect: PRB RH Motor C3186.
• Disconnect all PRB module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section. CLEAR the DTCs. REPEAT the self-test.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

E10 CHECK THE PRB MODULE FOR CORRECT OPERATION	

• Connect: PRB LH Motor C3185.
• Connect: PRB RH Motor C3186.
• Disconnect all PRB module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all PRB module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	GO to E11 .
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

E11 CHECK THE PRB FOR FOREIGN MATERIAL	
• **NOTE:** If the system has false bounce-back, stops in mid-travel, is noisy or will not deploy or stow completely, extend the PRB and check to see if any foreign material is caught in the PRB hinge points, step area or door sill. If foreign material is found, clean the PRB hinge points, step area and door sill with a high-pressure washer. If the system operates correctly after cleaning, refer the customer to the Owner's Literature for correct cleaning instructions. • Check the PRB hinge points, step area and door sill of the PRBs for foreign material or blockage. If any foreign material or blockage is found, remove it, and if necessary, set the PRB system to the OUT mode and clean the PRB hinge points, step area and door sill with a	**Yes** The system is operating normally. The concern may have been caused by foreign material or blockage in the pivot areas or track guides. REFER the customer to the Owner's Literature for correct cleaning instructions.

high-pressure washer. Avoid direct spray to the motor. • Set the PRB system to the AUTO (enabled) mode, where the boards automatically deploy when either door on the same side is opened, and retract when the door is closed. • Open and close the LH front door. The LH PRB should deploy when the door is open, and retract when the door is closed. • Open and close the RH front door. The RH PRB should deploy when the door is open, and retract when the door is closed. • **Do the LH and RH PRBs operate normally during all test steps?**	**No** INSTALL a new PRB motor. REFER to Power Running Board (PRB) Motor in this section. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: DTC B1317/B1318 — Battery Voltage High/Battery Voltage Low

Refer to Wiring Diagrams Cell 109 , Power Liftgate/Retractable Running Boards for schematic and connector information.

NOTE: DTC B1317 or B1318 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

Normal Operation

The Power Running Board (PRB) module continuously monitors the input voltage for correct operation. If the PRB module detects input voltage below 9.5 volts, it will store DTC B1318 in memory. If the PRB module detects input voltage greater than 16 volts, it will store DTC B1317 in memory. If the PRB module sets DTC B1317 or B1318, it will inhibit the power liftgate system operation.

- DTC B1317 (Battery Voltage High) — If the PRB module detects voltage above 16 volts while the running boards are in motion (deploy/stow), it will set this DTC. Once this DTC is set, the PRB system will be disabled until the battery voltage returns to normal.
- DTC B1318 (Battery Voltage Low) — If the PRB module detects voltage below 9.5 volts while the running boards are in motion (deploy/stow), it will set this DTC.

This pinpoint test is intended to diagnose the following:

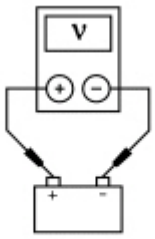
- Wiring, terminals or connectors
- PRB module

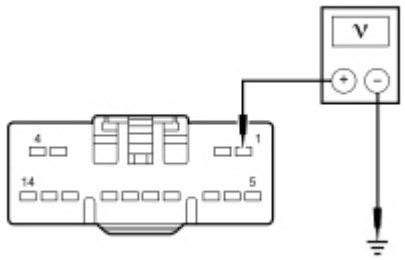
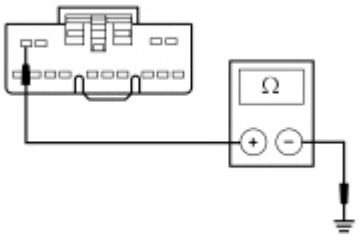
PINPOINT TEST F: DTC B1317/B1318 — BATTERY VOLTAGE HIGH/BATTERY VOLTAGE LOW

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

Test Step	Result / Action to Take
F1 RETRIEVE ALL CMDTCs IN ALL MODULES • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ALL CMDTCs . • **Is DTC B1317 or B1318 retrieved from one or more modules and P0563, P0620, P0626 or P065B retrieved from the PCM?**	**Yes** REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). REPEAT the PRB module self-test.

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	No GO to F2 .
F2 TEST BATTERY CONDITION • Ignition OFF. • Carry out the Battery Condition Test. Refer to Section 414-01 . • **Did the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . REPEAT the PRB module self-test. If the battery passed the condition test and did not require a recharge, GO to F3 . **No** INSTALL a new battery. CLEAR all CMDTCs . REPEAT the PRB module self-test.
F3 CHECK CHARGING SYSTEM VOLTAGE **NOTE:** Do not allow the engine speed to increase above 2,000 rpm while performing this step or the generator may self excite and result in default charging system output voltage. If engine speed goes above 2,000 rpm, shut the vehicle OFF and restart the engine before performing this step. • Measure the voltage of the battery: ▪ For DTC B1317, turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage. ▪ For DTC B1318, turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage.  AJ0210-A • **Is the voltage between 13 and 15.2 volts?**	**Yes** For DTC B1318, GO to F4 . For DTC B1317, GO to F6 . **No** REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . REPEAT the PRB module self-test.
F4 CHECK THE PRB MODULE POWER CIRCUIT • Ignition OFF. • Disconnect: PRB module C3313B. • Measure the voltage between PRB module C3313B-1, circuit SBB11 (BU/RD), harness side and ground.	**Yes** GO to F5 . **No** VERIFY Battery Junction Box

 N0055096 • **Is the voltage greater than 10 volts?**	(BJB) fuse 11 (30A) is OK. If OK, REPAIR the circuit. CLEAR the DTCs. REPEAT the PRB module self-test. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the PRB module self-test.
F5 CHECK THE PRB MODULE GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between PRB module C3313B-4, circuit GD139 (BK/YE), harness side and ground.  N0060073 • **Is the resistance less than 5 ohms?**	**Yes** GO to F6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the PRB module self-test.
F6 CHECK FOR PRB MODULE OPERATION	
• Check PRB module C3313A and C3313B for the following: ▪ corrosion. ▪ damaged pins. ▪ pushed-out pins. • Connect PRB module C3313A and C3313B and make sure the connectors seat correctly. • Clear all CMDTCs . • Operate the system to verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PRB module. REFER to Power Running Board (PRB) Module in this section. REPEAT the PRB module self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the PRB module self-test.

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Applique — Rear

Special Tool(s)

 ST1073-A	Heat Gun 107-R0300

General Equipment

Moulding Removal Tool
C-Clamp Pliers
38 mm (1.496 in) x 89 mm (3.503 in) x 2.13 m (84 in) Common Whitewood Stud
Hand Roller
Stripe Removal Wheel

Material

Item	Specification
Motorcraft® Detail Wash ZC-3-A	—

1. If equipped, remove the rear video camera. For additional information, refer to Section 413-13 .

2. Apply masking tape over the tailgate badges and on the tailgate surfaces surrounding the applique.

3. **NOTE:** 3M™ Prep Solvent-70 is commercially available.

   Spray a liberal amount of 3M™ Prep Solvent-70 or equivalent along the top of the applique and in the separated areas between the applique and in the separated area between the applique and tailgate sheet metal.
   - Allow 10 minutes of saturation time for the solvent to break down the adhesive tape.

4. ***NOTICE:*** **Applique is equipped with 4 attaching clips located horizontally across the middle of the applique. Vehicles built after 12/20/2009 may have 2 additional clips, staggered equal distance along the top edge. Use care not to damage the clips and clip mounting tabs during removal.**

   NOTICE: **Do not use excessive pressure or prying leverage to remove the applique or damage to it or the tailgate sheet metal could occur.**

   Break the bond of the adhesive tape at the top of the applique using a moulding removal tool.
   - General Equipment: Moulding Removal Tool.

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5. Work the applique free from the sheet metal from the top and sides as far as the tool will reach.
    - Continue to apply solvent as required to help break the adhesive bond.

6. Remove the tailgate from the vehicle and place on a workstand.

7. Saturate the lower portion of the tailgate applique adhesive with solvent.
    - Allow 10 minutes of saturation time for the solvent to break down the adhesive tape.

8. ***NOTICE:*** **Do not use excessive pressure or prying leverage to remove the applique or damage to the applique or the tailgate sheet metal could occur.**

    Break the bond of the adhesive tape on the bottom section using the moulding removal tool and remove the tailgate applique.
    - Place the tailgate applique on a workstand equipped with padding that will protect the finish side of the part from damage.
    - General Equipment: Moulding Removal Tool.

9. Remove the tailgate release handle from the tailgate. For additional information, refer to Section 501-14 .

10. ***NOTICE:*** **High speed RPM usage of the stripe removal tool may result in applique damage. Slower RPM will allow for faster adhesive tape removal and prevent applique damage.**

    Carefully remove all existing adhesive tape from the tailgate sheet metal and the applique using stripe removal tool. Operate the wheel at slower RPM for best results. If necessary, have an assistant hold the part.
    - General Equipment: Stripe Removal Wheel

NOTICE: **Solvent will be absorbed in the original tape and will drip on the replacement tape causing a bonding failure. It is critical to remove all the original tape.**

11. **NOTE:** 3M™ General Purpose Adhesive Cleaner and 3M™ Specialty Adhesive Remover Liquid are commercially available.

    Soak the residual adhesive on the ribbed sections along the top and bottom of the appliques using 3M™ General Purpose Adhesive Cleaner or 3M™ Specialty Adhesive Remover Liquid (Low VOC Compliant). Remove all adhesive from the ribs with a wire detail brush and dry with compressed air.

12. Thoroughly wash the tailgate and applique with Motorcraft® Detail Wash or equivalent to remove all solvent residue. Blow dry and repeat as required.

NOTICE: **Failure to completely remove solvent residue will prevent replacement tape from adhering correctly.**

13. Apply a 13 cm (5 in) to 15 cm (6 in) wide layer of masking tape along the entire length of the top and bottom sections on the finish side of the applique.



14. Tape will be applied to the outside perimeter of the applique in a picture frame pattern. Wipe the flat vertical sides and ribbed horizontal sections along the top and bottom of the applique with isopropyl alcohol. Repeat on the corresponding locations of the tailgate.

15. Place the tailgate on a workstand with the outside surface exposed.

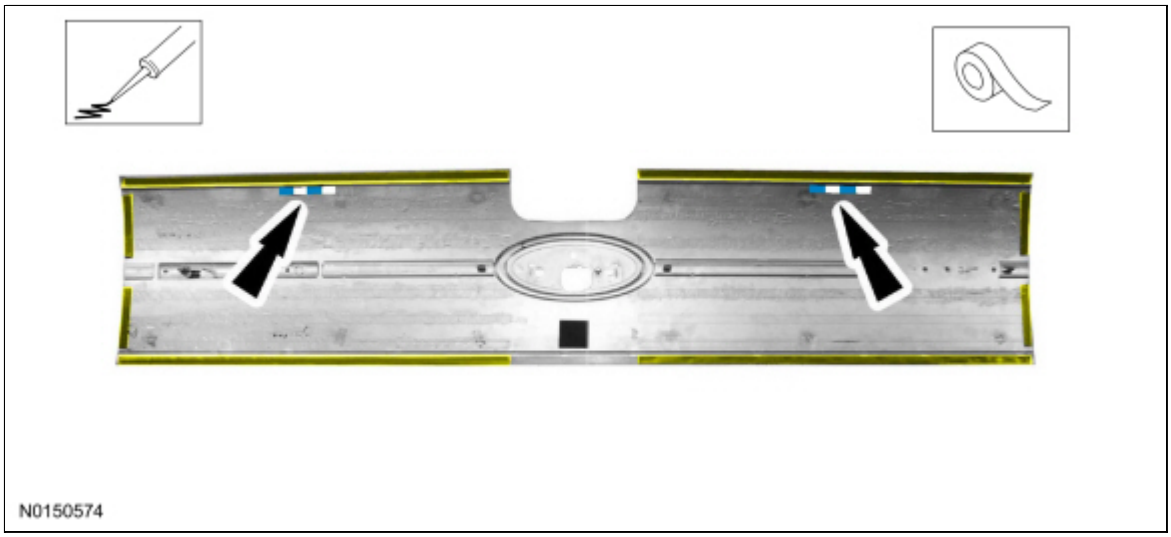
16. **NOTE:** 3M™ Acrylic Plus Tape is commercially available.

    NOTE: Do not apply one continuous length of tape across the bottom. Distance between the two sections must be present for drainage.

    NOTE: Do not allow the tape to extend past the ribbed sections.

    Apply 3M™ Acrylic Plus Tape over the top and bottom ribbed sections of the applique as shown.

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17. Apply tape to the vertical outside edges. Do not allow tape to extend to the ribbed sections or near the raised profile in the middle of the part. The individual sections of tape in this area should be no longer than 112 mm (4.409 in).

18. Use a hand roller to firmly wet-out the tape.
    - General Equipment: Hand Roller.

19. **NOTE:** 3M™ Duramix Universal Adhesive 08214 is commercially available.

    Apply a 13 mm (0.511 in) by 76 mm (2.992 in) bead of 3M™ Duramix Universal Adhesive 08214, approximately 13 mm (0.511 in) below the center of the upper sections of tape. Do not allow the adhesive to make contact with tape.

20. **NOTE:** The adhesive has a 10 minute work time.

    Remove the tape backing, and with the aid of an assistant immediately place the applique on the tailgate and seat the attaching clips.

21. **NOTE:** Do not remove the tape backing until the applique is ready to be installed.

    Use a hand roller to firmly wet-out the tape around the perimeter of the applique.
    - General Equipment: Hand Roller.

22. Place a 38 mm (1.496 in) x 89 mm (3.503 in) x 2.13 m (84 in) common whitewood stud along the top edge of the applique. Secure the lumber on each side of the tailgate using locking C-clamp pliers with swivel pads. When clamped properly the lumber will form to the contour of the applique.
    - General Equipment: C-Clamp Pliers.
    - General Equipment: 38 mm (1.496 in) x 89 mm (3.503 in) x 2.13 m (84 in) Common Whitewood Stud.



23. **NOTE:** The C-clamps should be oriented as in illustration to achieve proper clamping force.

    NOTE: If the stud being used is slightly bowed, orient the bowed (crowned) side down against the applique to achieve proper clamping force.

    Place a second stud along the bottom section of the applique, attaching in the same way.
    - General Equipment: C-Clamp Pliers.
    - General Equipment: 38 mm (1.496 in) x 89 mm (3.503 in) x 2.13 m (84 in) Common Whitewood Stud.



24. The applique must remain clamped for a minimum of 4 hours to properly set the adhesive.

25. Remove the clamps and studs and reinstall the tailgate handle. For additional information, refer to Section 501-14 .

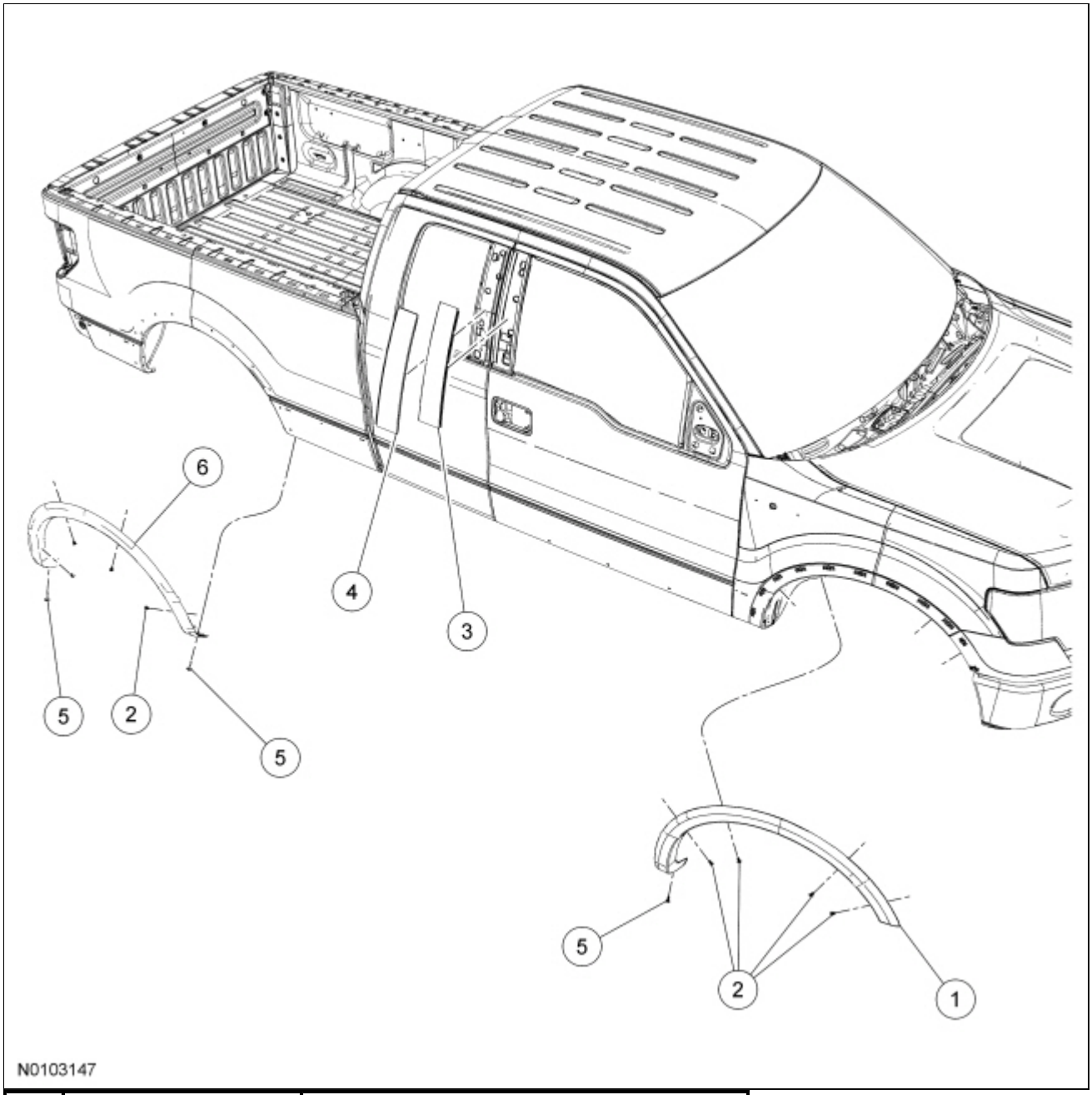
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26. Install the tailgate.

27. If equipped, reinstall the rear video camera. For additional information, refer to Section 413-13 .

Exterior Trim — Exploded View

F-150 Except SVT Raptor

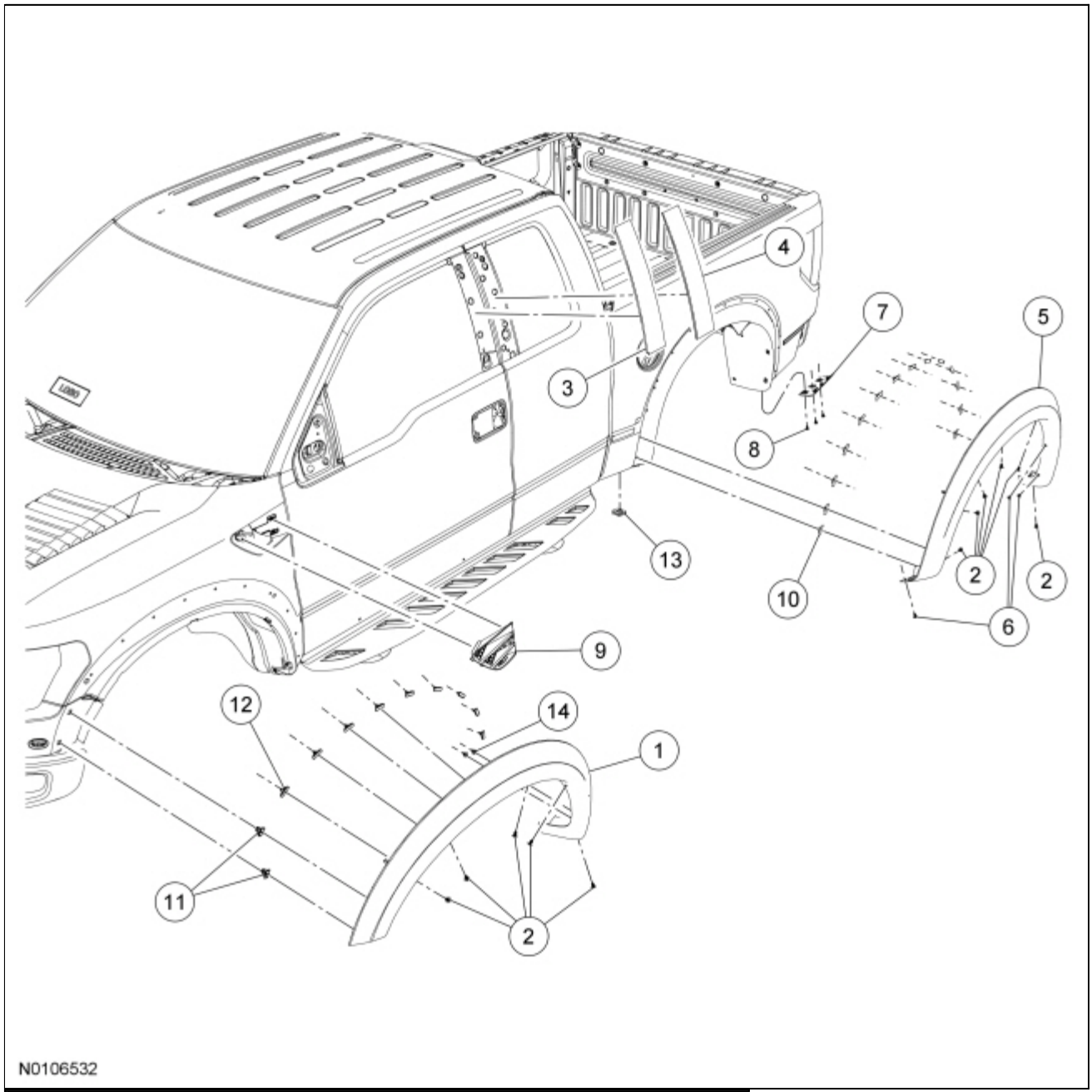


Item	Part Number	Description
1	16038 RH/ 16039 LH	Front fender moulding
2	W705589	Fender moulding pin-type retainers (8 required)

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3	20554 RH/ 20555 LH	Front door window moulding
4	255A34 RH/ 255A35 LH	Rear door window moulding
5	W709346	Fender moulding screws
6	29164 RH/ 29165 LH	Rear fender moulding

SVT Raptor



Item	Part Number	Description
1	16A074 RH/ 16A075 LH	Front fender moulding

2	W705589	Fender moulding pin-type retainers (11 required)
3	20554 RH/ 20555 LH	Front door window moulding
4	255A34 RH/ 255A35 LH	Rear door window moulding
5	291C20 RH/ 291C21 LH	Rear fender moulding
6	W710763	Fender moulding screw (3 required)
7	292A23	Rear quarter trim panel
8	W705589	Rear quarter trim panel pin-type retainers (3 required)
9	16C027	Fender vent
10	—	Rear fender moulding pin-type retainer (part of 291C20 RH/ 291C21 LH) (14 required)
11	—	Front fender moulding forward pin-type retainers (part of 16A074 RH/ 16A075 LH)
12	—	Front fender moulding pin-type retainer (part of 16A074 RH/ 16A075 LH) (9 required)
13	W705546	Rear fender moulding U-nut
14	—	Rear fender moulding rear pin-type retainer (2 required)

1. For additional information, refer to the procedures in this section.

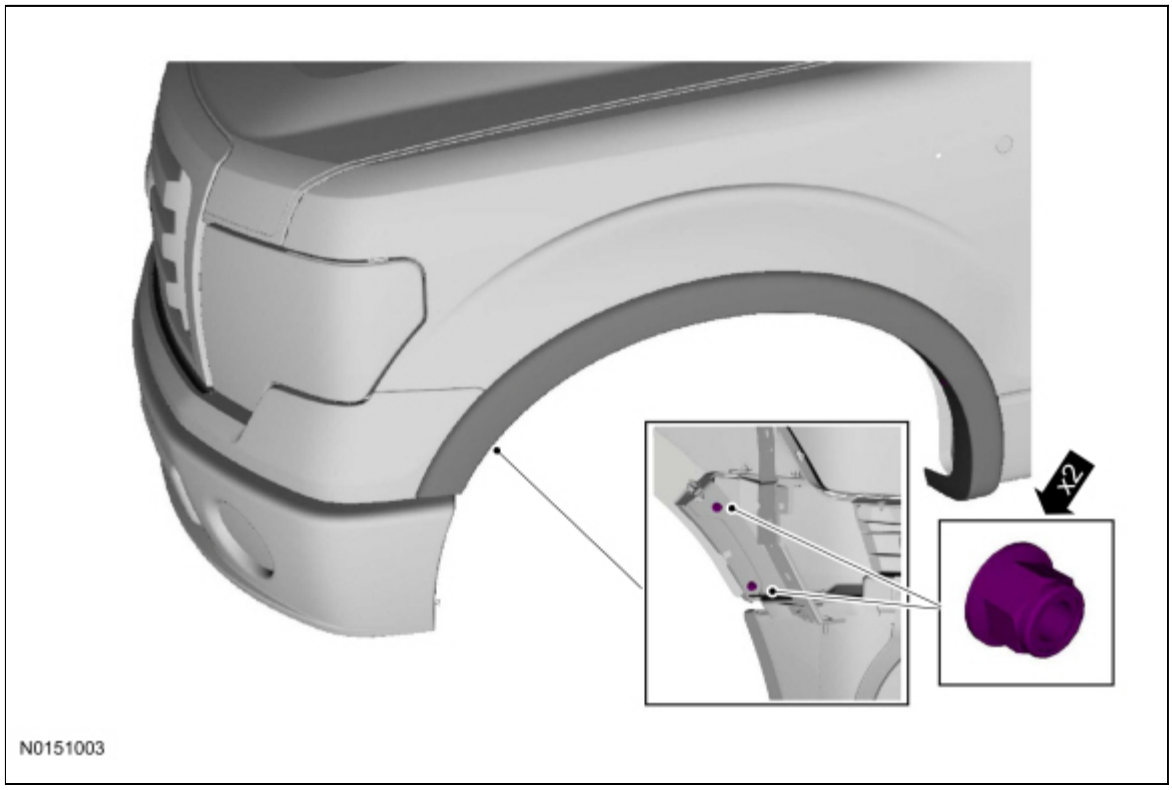
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Fender Moulding — Front

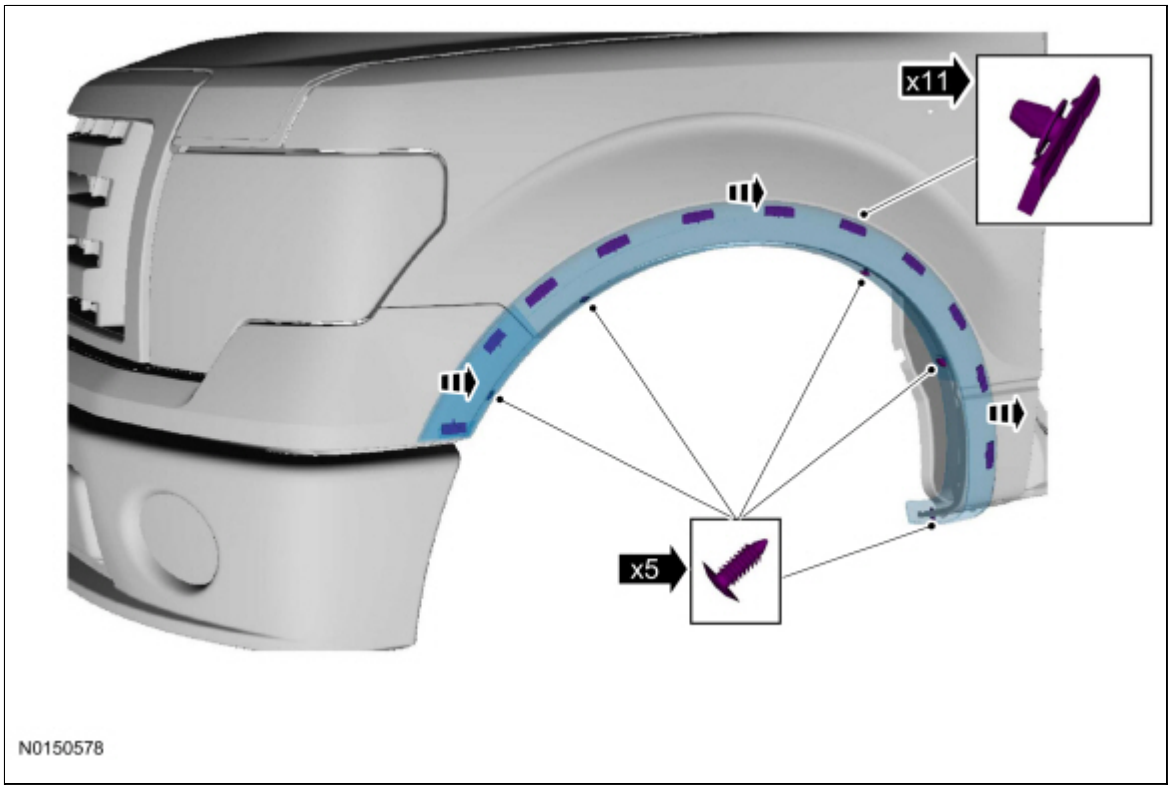
Removal and Installation

Standard

1. Remove the 2 front fender moulding nuts.
    - Tighten to 3.5 Nm (31 lb-in).



2. Remove the 5 front fender moulding pin-type retainers.
    - Starting at the front of the fender moulding, pull outward to release moulding from the fender.



3. Using a non-marring trim tool, carefully pry the moulding outward to gain access to the forward pin-type retainers.

4. ***NOTICE:*** **Pry directly on the pin-type retainer. Do not pry on the fender moulding. Failure to follow this direction may result in damage to the component.**

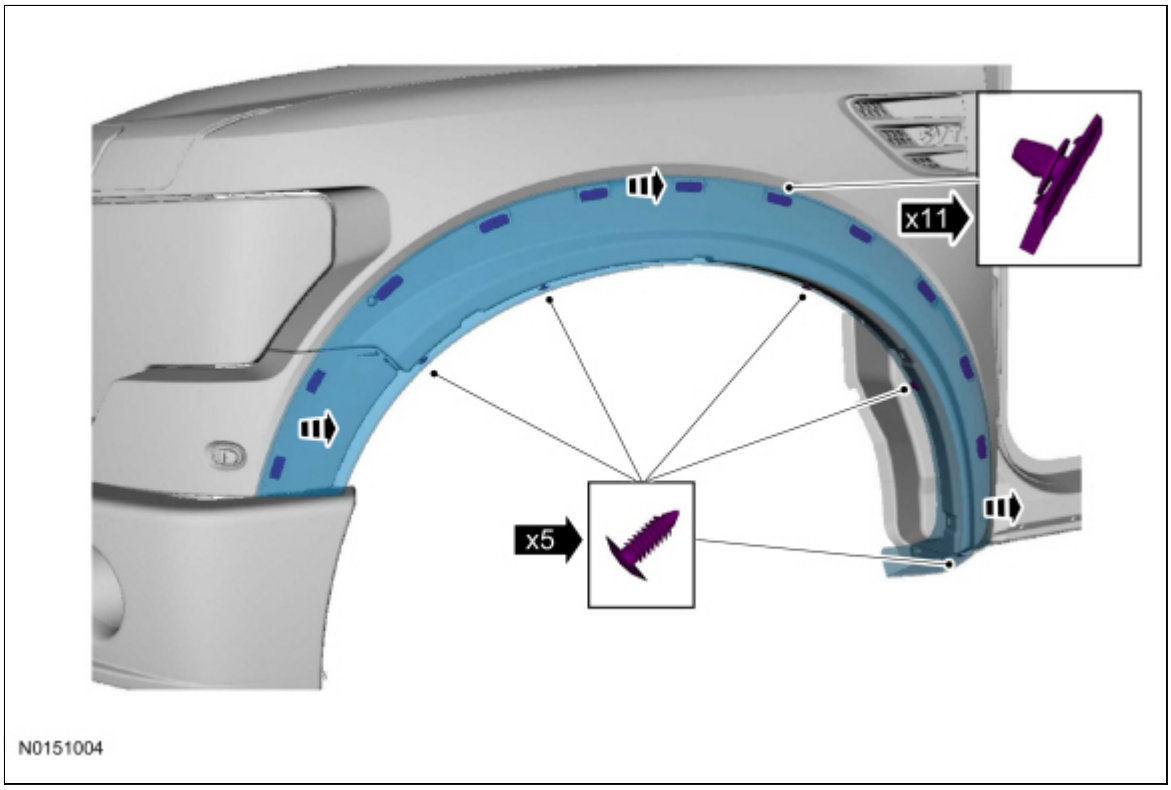
   Using a non-marring tool, release the front fender moulding front pin-type retainers.
   - Pry outward on the first front fender moulding front pin-type retainer by pushing the handle toward the fender.
   - Pry outward on the second front fender moulding front pin-type retainer by pushing the handle toward the fender.
   - Follow this sequence for the remaining retainers.

5. Remove the front fender moulding.
   - Pull outward to release the rear fender moulding pin-type retainers.

SVT Raptor

6. Remove the 5 front fender moulding pin-type retainers.

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7. Using a non-marring trim tool, carefully pry the moulding outward to gain access to the forward pin-type retainers.

8. ***NOTICE:*** **Pry directly on the pin-type retainer. Do not pry on the fender moulding. Failure to follow this direction may result in damage to the component.**

   Using a non-marring tool, release the front fender moulding front pin-type retainers.
   - Pry outward on the first front fender moulding front pin-type retainer by pushing the handle toward the fender.
   - Pry outward on the second front fender moulding front pin-type retainer by pushing the handle toward the fender.
   - Follow this sequence for the remaining retainers.

9. Remove the front fender moulding.
   - Pull outward to release the rear fender moulding pin-type retainers.

All vehicles

10. To install, reverse the removal procedure.

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Fender Moulding — Rear

Removal and Installation

Standard

1. Remove the 2 rear fender moulding screws.
2. Remove the 4 rear fender moulding pin-type retainers.
3. Starting at the front of the fender moulding, pull outward to release it from the fender.

SVT Raptor

4. Remove the 6 rear fender moulding pin-type retainers.
5. Remove the rear fender moulding screws.
6. ***NOTICE:*** **Pry directly on the pin-type retainer. Do not pry on the fender moulding. Failure to follow this direction may result in damage to the component.**

   Using a non-marring tool, starting at the front of the rear fender moulding, pry outward on the pin-type retainers by pushing the handle toward the fender.
7. Remove the rear fender moulding.

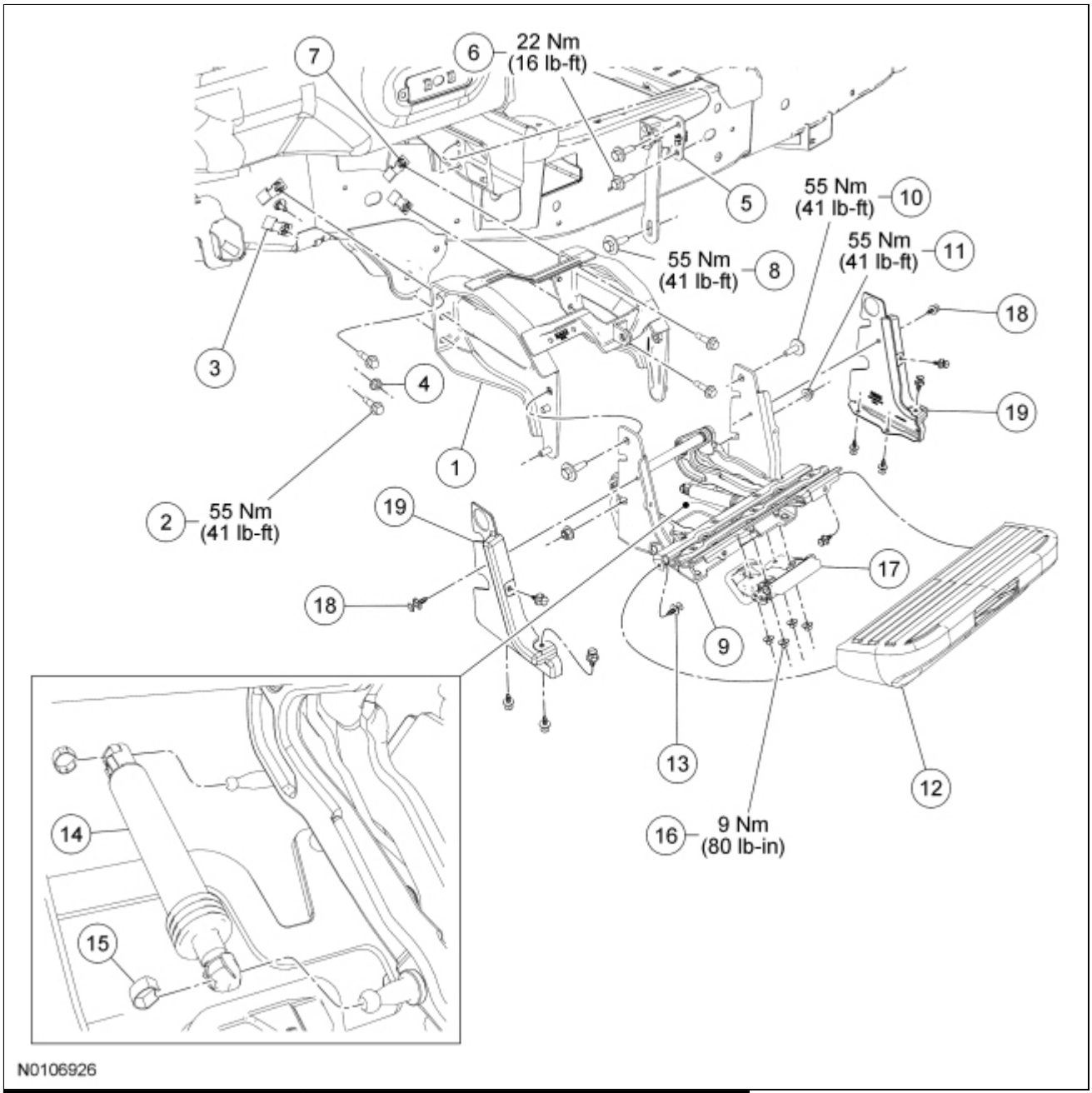
All vehicles

8. To install, reverse the removal procedure.

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Pickup Bed Side Step

NOTE: The pickup bed side step latch is a serviceable component. For additional information, refer to Section 501-14 .



Item	Part Number	Description
1	16A417 LH/ 16A416 RH	Pickup bed side step bracket
2	W506433	Pickup bed side step bracket bolt (4

		required)
3	W520824	Pickup bed side step bracket nut (4 required)
4	—	Pickup bed side step bracket locating nut (part of 16A417)
5	99200B39A LH/ 99200B38A RH	Pickup bed side step bracket slide strap support
6	W705196	Pickup bed side step bracket slide strap support-to-box bolt (2 required)
7	W520833	Pickup bed side step bracket slide strap support-to-box nut (2 required)
8	W505443	Pickup bed side step bracket slide strap support-to-step bracket bolt
9	1520040A	Pickup bed side step body
10	W505443	Pickup bed side step body upper bolt (2 required)
11	W520113	Pickup bed side step body lower nut (2 required)
12	16490C	Pickup bed side step body trim cover
13	W505153	Pickup bed side step body trim cover pin-type retainer (2 required)
14	15200M48A	Pickup bed side step body strut
15	—	Pickup bed side step body shock clip (part of 15200M48A) (2 required)
16	W520101	Pickup bed side step latch nuts
17	16516	Pickup bed side step latch
18	W709176	Pickup bed side step cover pin-type retainer (10 required)
19	200A20 RH/ 200A21 LH	Pickup bed side step cover

Removal and Installation

Side step assembly

NOTE: The pickup bed side step must be closed to complete this procedure.

1. Remove the pickup bed side step bracket slide strap support bracket-to-side step bracket bolt.
    - To install, tighten to 55 Nm (41 lb-ft).

2. Remove the 4 pickup bed side step-to-frame bolts.
    - Tighten to 55 Nm (41 lb-ft).

3. Remove the locating nut.
    - To install, tighten to 55 Nm (41 lb-ft).

4. Remove the pickup bed side step assembly.

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Side step body

5. Remove the pickup bed side step body upper retainer bolts.
    - To install, tighten to 55 Nm (41 lb-ft).

6. Loosen the pickup bed side step body lower nuts.
    - To install, tighten to 55 Nm (41 lb-ft).

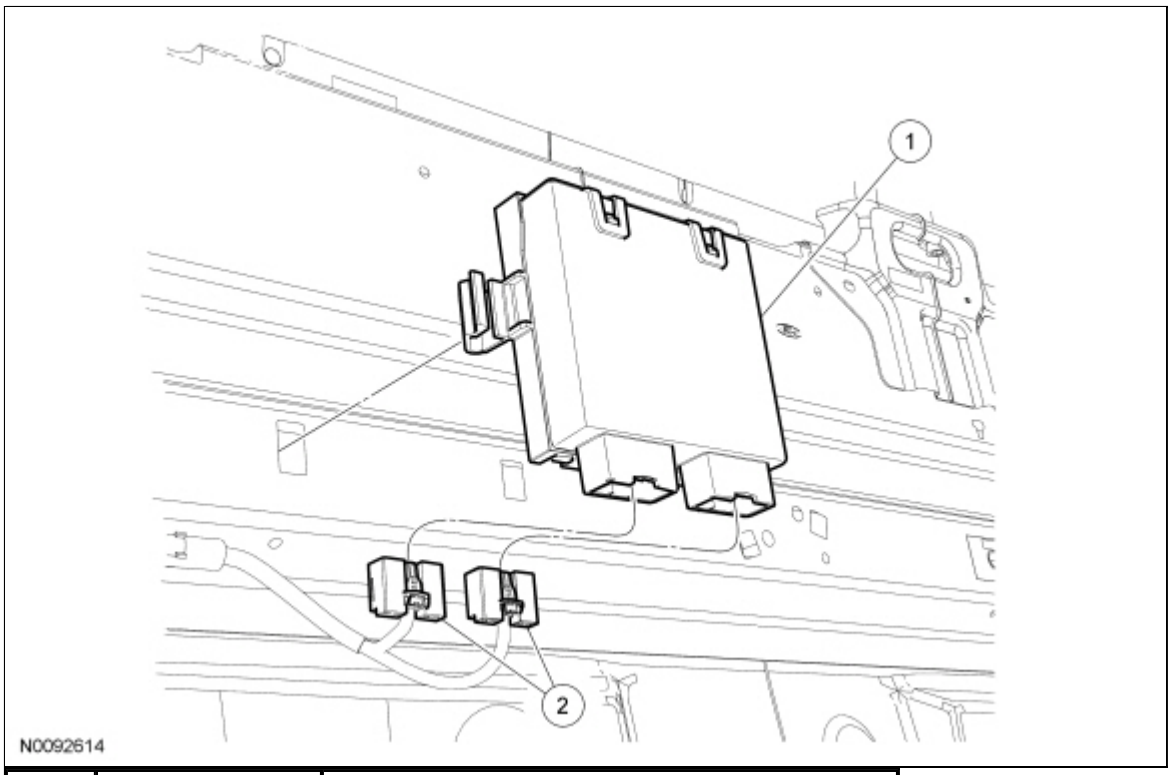
7. **NOTE:** Pull outward to release the step body from the pickup bed side step bracket studs.

   Remove the pickup bed side step body.

All procedures

8. To install, reverse the removal procedure.

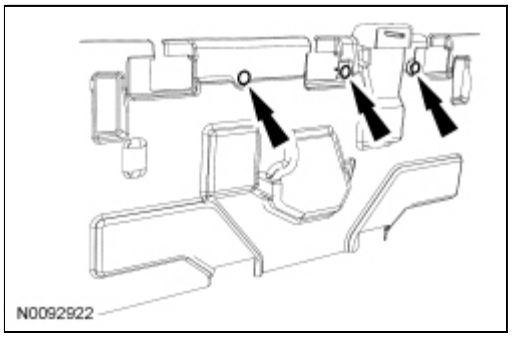
Power Running Board (PRB) Module



Item	Part Number	Description
1	14C177	Power Running Board (PRB) module
2	—	PRB module electrical connectors

Removal and Installation

1. Remove the C-pillar trim panels. For additional information, refer to Section 501-05 .
2. Remove the 3 rear sound insulator pin-type retainers and remove the rear sound insulator.

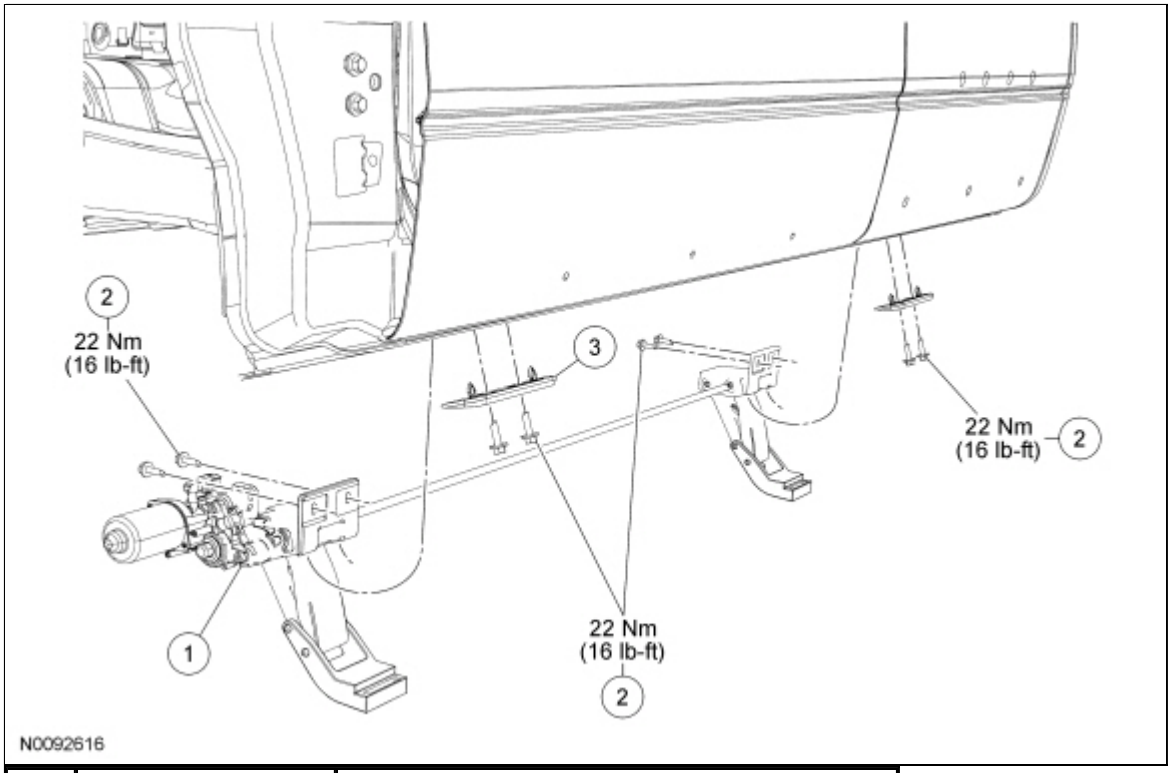


3. Disconnect the Power Running Board (PRB) module electrical connectors.

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4. Remove the PRB module.
5. To install, reverse the removal procedure.

Power Running Board (PRB) Motor



Item	Part Number	Description
1	16A506 RH/ 16A507 LH	Power Running Board (PRB) motor and bracket assembly
2	W705196	PRB motor and bracket assembly bolts (8 required)
3	16N454	PRB bracket cover (2 required)

Removal and Installation

NOTE: The Power Running Board (PRB) motor and brackets are serviced as an assembly.

1. Remove the PRB step. For additional information, refer to Power Running Board (PRB) Step in this section.

2. Disconnect the PRB electrical connector.

NOTICE: **The following steps require an assistant. Failure to follow this instruction may result in damage to the vehicle.**

3. Remove the PRB motor and bracket assembly front bracket upper bolts.
   - To install, tighten to 22 Nm (16 lb-ft).

4. Remove the PRB motor and bracket assembly front bracket lower bolts.

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- To install, tighten to 22 Nm (16 lb-ft).

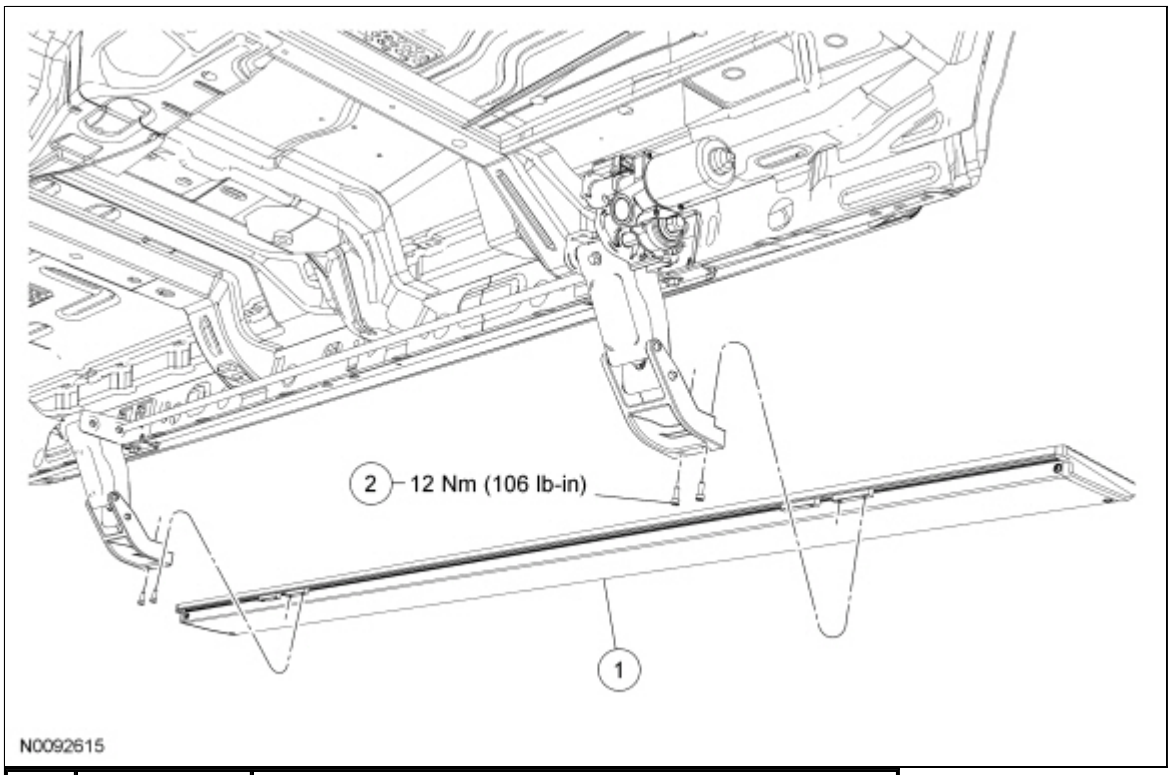
5. Remove the PRB motor and bracket assembly rear bracket upper bolts.
    - To install, tighten to 22 Nm (16 lb-ft).

6. Remove the PRB motor and bracket assembly rear bracket lower bolts.
    - To install, tighten to 22 Nm (16 lb-ft).

7. Remove the PRB motor and bracket assembly.

8. To install, reverse the removal procedure.

Power Running Board (PRB) Step



Item	Part Number	Description
1	16490	Power Running Board (PRB) step
2	—	PRB bracket-to-step screw (part of 16490) (4 required)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** If the Power Running Board (PRB) cannot be extracted, extend the running board by hand.

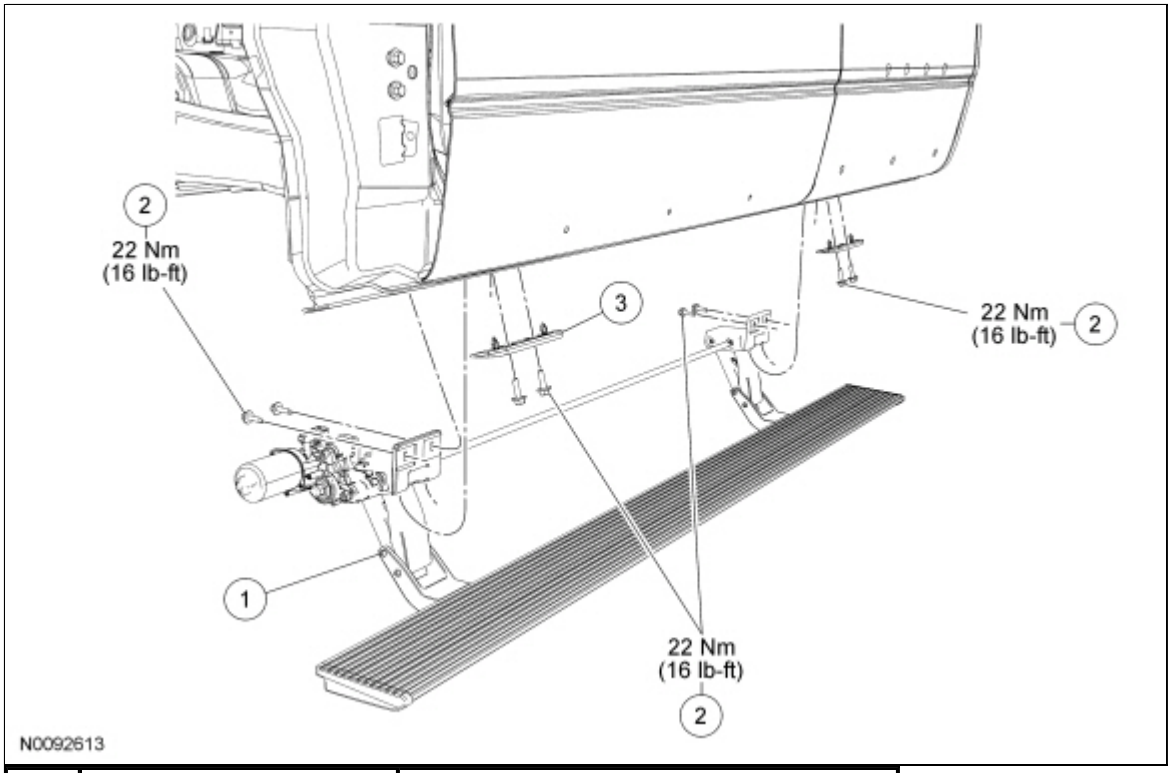
   Extend the PRB .

3. Remove the 2 front and 2 rear PRB bracket-to-step screws and the PRB step
   - To install, tighten to 12 Nm (106 lb-in).

4. To install, reverse the removal procedure.

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Power Running Board (PRB)



Item	Part Number	Description
1	16451C LH/ 16450E RH	Power Running Board (PRB) assembly
2	W705196	PRB assembly bolts (8 required)
3	16N454	PRB bracket cover (2 required)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** If the Power Running Board (PRB) cannot be extracted, extend the running board by hand.

   Extend the PRB .

3. Disconnect the PRB electrical connector.

NOTICE: **The following steps require an assistant. Failure to follow this instruction may result in damage to the vehicle.**

4. Remove the PRB assembly front bracket upper bolts.
   - To install, tighten to 22 Nm (16 lb-ft).

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5. Remove the PRB assembly front bracket lower bolts.
    - To install, tighten to 22 Nm (16 lb-ft).

6. Remove the PRB assembly rear bracket upper bolts.
    - To install, tighten to 22 Nm (16 lb-ft).

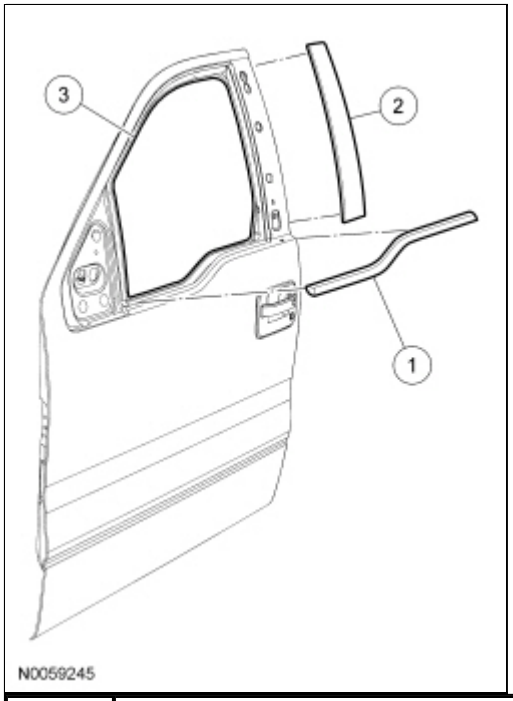
7. Remove the PRB assembly rear bracket lower bolts.
    - To install, tighten to 22 Nm (16 lb-ft).

8. Remove the PRB assembly.

9. To install, reverse the removal procedure.

Window Moulding

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	22596 RH/ 22597 LH	Outer belt moulding
2	20554 RH/ 20555 LH	Window moulding
3	1452 RH/ 1453 LH	Glass run

Removal

1. Remove the outer belt moulding.
   - Release the retaining clip at the rear of the belt moulding, then slide the front of the moulding off of the flange to remove the belt moulding from the door.

2. **NOTE:** The window moulding is held on by double-sided tape from the forward edge of the moulding and by trim clips near the center of the moulding. The rearmost edge rolls over the door frame sheet metal.

   Starting at the upper forward corner of the moulding, insert a suitable removal tool between the moulding and the door frame.

3. Determine the location of the double-sided tape. Carefully spread spray-on adhesive cleaner down the space between the applique and door frame. Allow the cleaner to set for several minutes.

4. Using the removal tool, begin removing the moulding, spraying additional adhesive cleaner as needed.

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Installation

1. Remove all remaining adhesive tape on the mating surfaces of the door and apply new adhesive tape.

2. **NOTE:** Make sure the forward edge of the moulding is underneath the glass run lip.

   Install the window moulding on the edge of the door, engage the groove then gently press down to engage the clips and tape.

3. Install the outer belt moulding.

Torque Specifications

Description	Nm	lb-in
Exterior mirror nuts	12	106

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Rear View Mirrors

Exterior Mirrors

Aero Exterior Mirrors

The main serviceable components of the aero exterior mirrors are:

- Exterior mirror glass
- Exterior mirror plastic housing
- Exterior mirror control switch (optional)
- Heated exterior mirror glass (optional)
- Exterior mirror glass (blind spot optional, LH only)
- LH auto-dimming exterior mirror glass (optional)
- Exterior mirror glass adjustment motors (optional)
- Exterior mirror cover (plastic, chrome or painted)
- Exterior mirror glass adjustment motors (optional — with memory)
- Exterior mirror glass adjustment motor (manual) (standard)
- Exterior mirror puddle lamps (optional)
- Exterior mirror turn signals (optional)

Trailer Tow Exterior Mirrors

The main serviceable components of the trailer tow exterior mirrors are:

- Exterior mirror glass
- Exterior mirror spotter glass
- Heated exterior mirror glass (optional)
- Exterior mirror cover (optional — chrome or painted)
- Exterior mirror control switch (optional)
- Exterior telescoping mirror control switch (optional — part of the exterior mirror control switch)
- Exterior mirror glass adjustment motors (optional — power mirrors only)
- Exterior mirror puddle lamps (optional)
- Exterior mirror turn signals (optional)
- Exterior mirror side marker (optional — telescoping mirrors only)
- Exterior mirror fold relay (power folding with telescoping mirrors only)
- DSM (optional — memory exterior mirrors)

Interior Mirror

Interior Rear View Mirrors

The vehicle may be equipped with one of the following interior rear view mirrors:

- Interior rear view mirror
- Interior auto-dimming rear view mirror with compass
- Interior auto-dimming rear view mirror with video display
- Interior auto-dimming rear view mirror with compass and video display

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Exterior Mirror Motor Synchronization — Power Folding

NOTE: The power folding mirrors may need to be synchronized anytime the mirrors are folded or unfolded without using the exterior mirror control switch, or if a new power folding mirror is installed.

NOTE: If the power folding mirrors are electronically folded or unfolded continuously (6 to 10 cycles), the power lockout feature will disable the system for 3-10 minutes to prevent damage to the power fold motors. After 3-10 minutes have elapsed, normal operation will resume.

1. **NOTE:** For vehicles equipped with the mirror control switch integral to the window switch, Click here to view a video version of this procedure. For the stand alone switch, Click here to view a video version of this procedure.

   Fold the mirrors back on each side so they are parallel with the side windows.

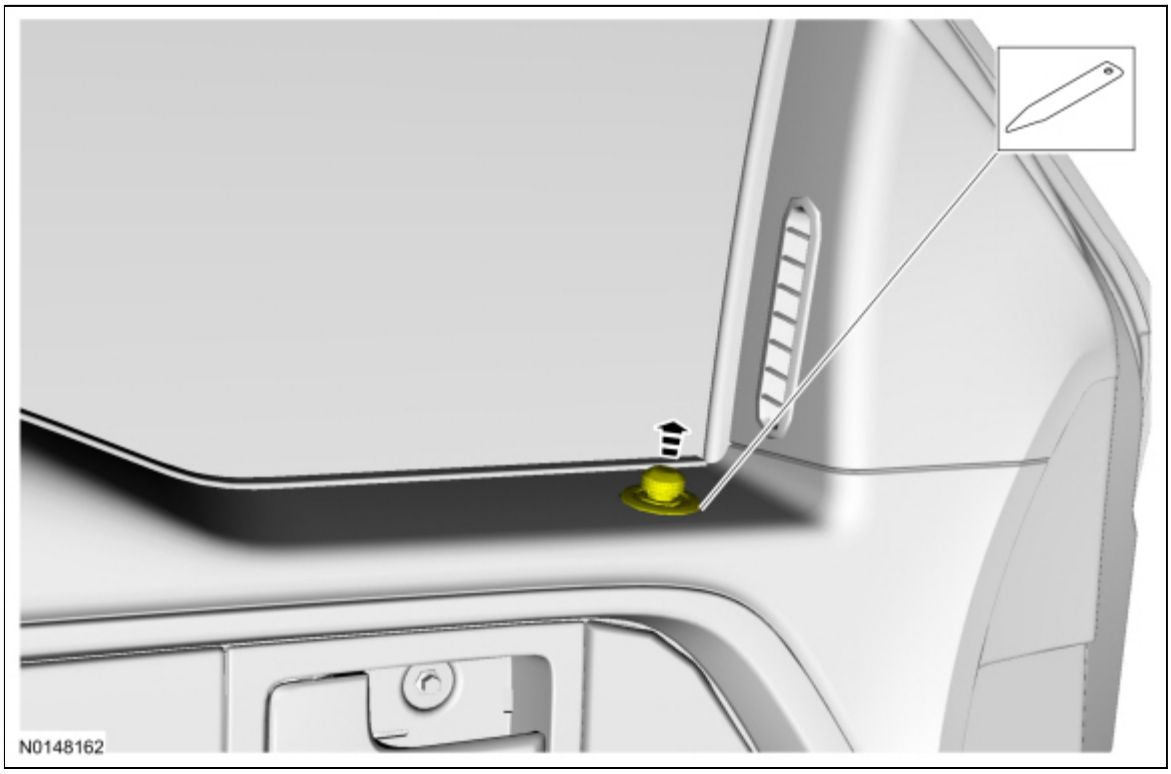
2. Position the exterior mirror control switch to the CENTER position.

3. Press the exterior mirror control switch rearward to the FOLD/UNFOLD position and cycle the power folding mirrors in and out until a loud popping noise is heard.

Exterior Mirror Control Switch — Aero

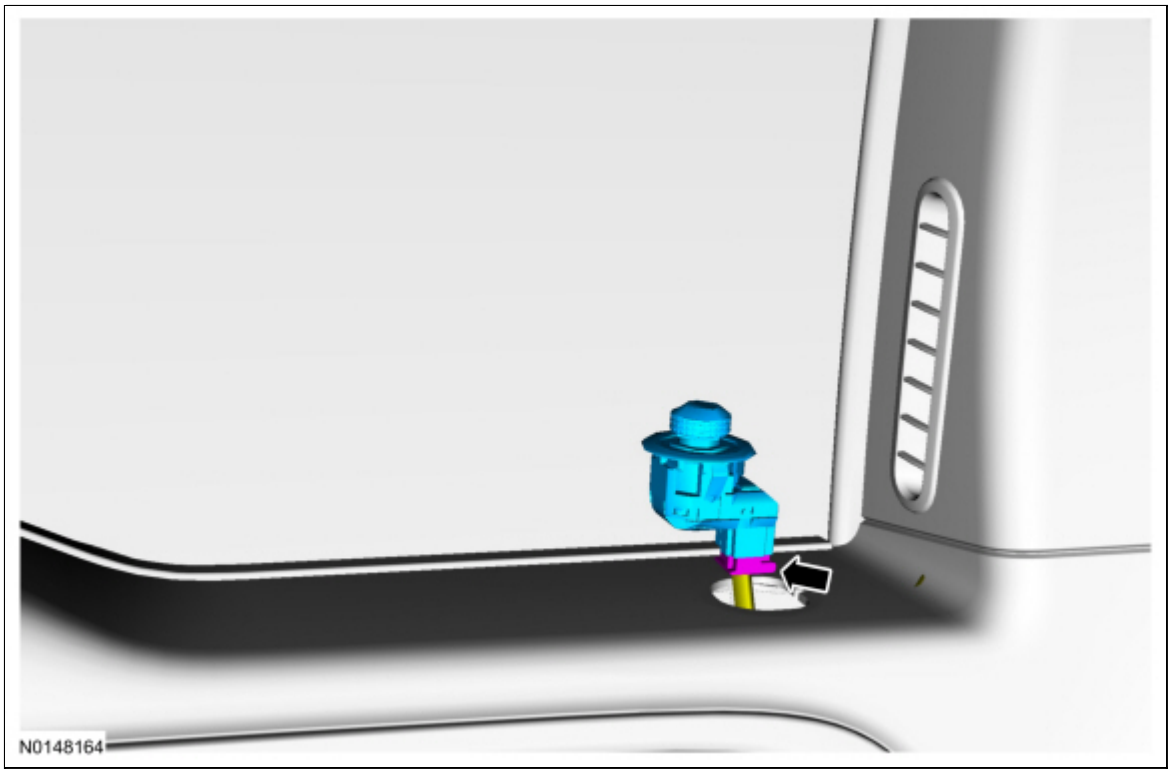
Removal and Installation

1. Using a non-marring tool, lift upward on the exterior mirror control switch at the location shown.



2.

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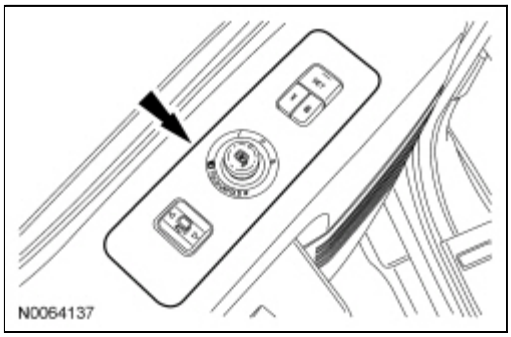


3. To install, reverse the removal procedure.

Exterior Mirror Control Switch — Trailer Tow

Removal and Installation

1. Lift upward and remove the exterior mirror trim panel.
    - Disconnect the electrical connectors.



2. Depress the locking tabs and remove the exterior mirror control switch.
3. To install, reverse the removal procedure.

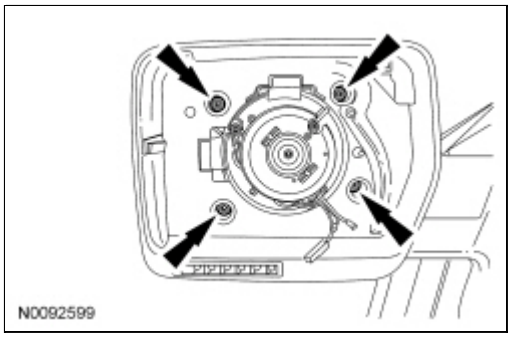
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Exterior Mirror Cover — Aero

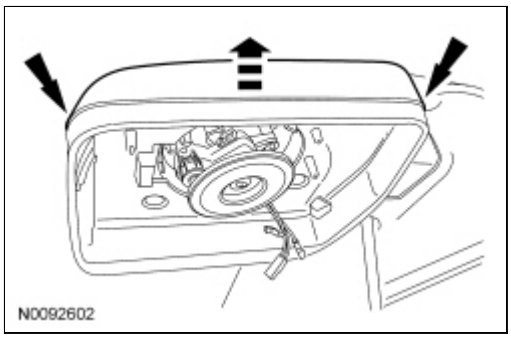
Removal and Installation

NOTE: The power folding mirrors may need to be synchronized anytime the mirrors are folded or unfolded without using the exterior mirror control switch, or if a new power folding mirror is installed. For additional information, refer to Exterior Mirror Motor Synchronization — Power Folding in this section.

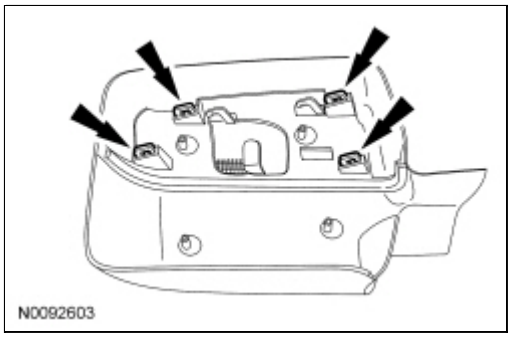
1. Remove the exterior mirror glass. For additional information, refer to Exterior Mirror .
2. Remove the 4 exterior mirror lower cover screws.



3. Remove the exterior mirror upper and lower covers from the exterior mirror.
   - Pull the exterior mirror upper and lower covers towards the front of the vehicle.



4. Release the exterior mirror cover retaining tabs.



5. Separate and remove the upper exterior mirror cover from the lower exterior mirror cover.
6. To install, reverse the removal procedure.

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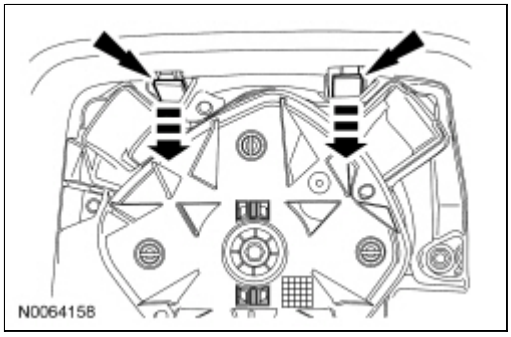
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Exterior Mirror Cover — Trailer Tow

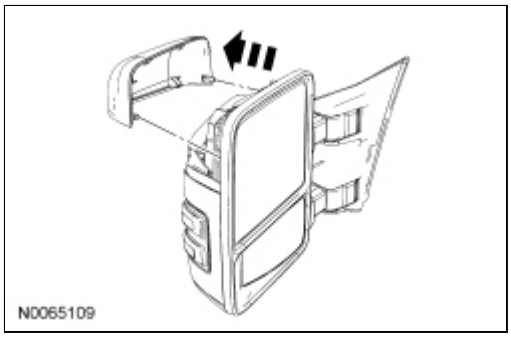
Removal and Installation

1. Remove the exterior mirror glass. For additional information, refer to Exterior Mirror Glass — Trailer Tow in this section.

2. Insert a flat-blade screwdriver into the clip slots at the top of the mirror and release the clips.



3. Separate and remove the exterior mirror cover from the exterior rear view mirror.



4. To install, reverse the removal procedure.

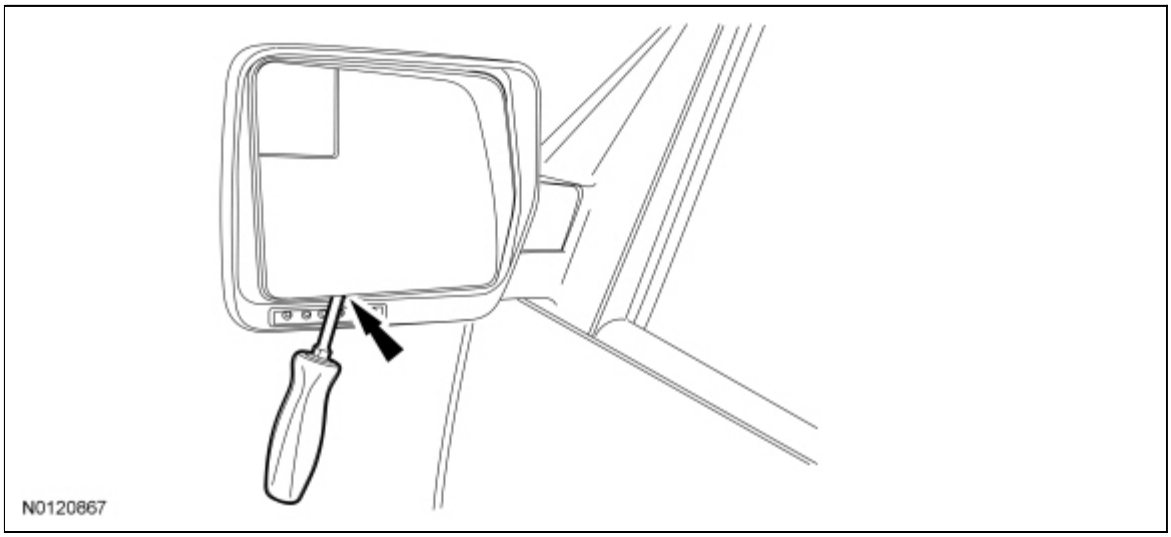
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Exterior Mirror Glass — Aero

Removal

NOTE: The power folding mirrors may need to be synchronized anytime the mirrors are folded or unfolded without using the exterior mirror control switch, or if a new power folding mirror is installed. For additional information, refer to Exterior Mirror Motor Synchronization — Power Folding in this section.

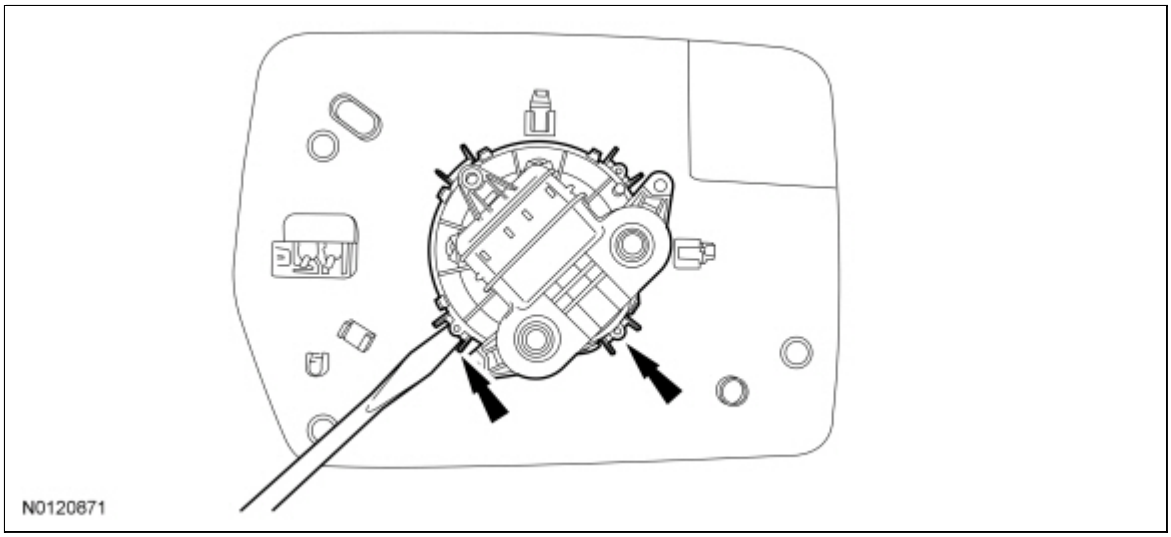
1. Position the exterior mirror glass to the full upward and inboard position and insert a thin flat-blade screwdriver.



2. **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   NOTE: LH mirror and motor shown removed from the housing and from the back to show location of clips and placement of screwdriver.

   Using the thin flat-blade screwdriver, release the tabs starting at the lower outboard side of the exterior mirror and continue to the lower inboard side and remove the exterior mirror glass.



Installation

1. If equipped, connect the electrical connectors.
2. Position the exterior mirror glass on the mirror motor.
3. **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   Place a hand against the back of the exterior mirror housing and a hand flat against the exterior mirror glass. Press the mirror glass in place until it is fully seated.

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Exterior Mirror Glass — Spotter, Trailer Tow

Removal

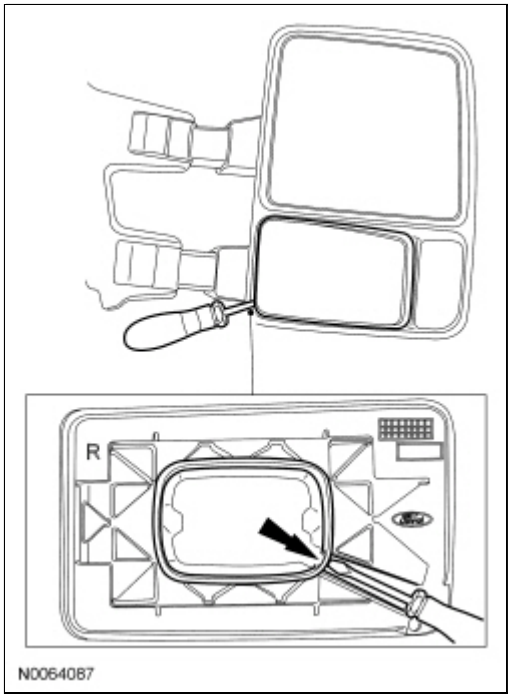
NOTE: RH spotter mirror shown, LH spotter mirror similar.

1. Position the spotter mirror glass fully upward and outward.

2. **NOTE:** The backside of the spotter mirror glass backing plate is shown to help with the location of the spotter mirror glass removal slot.

   NOTE: Non-heated spotter mirror glass shown, heated spotter mirror glass similar.

   Insert a 5 mm (3/16 in) flat-blade screwdriver into the spotter mirror glass removal slot, located on the backside of the spotter mirror glass backing plate at the inboard side of the spotter mirror glass assembly.



3. **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   Remove the spotter mirror glass in the following sequence:
   1. Twist the screwdriver handle 90 degrees.
   2. Lift outward on the upper inboard spotter mirror glass backing plate using light hand pressure.
   3. Remove the spotter mirror glass from the spotter mirror glass pivot assembly.
      - If equipped, disconnect the electrical connectors.

Installation

1. If equipped, connect the electrical connectors.
2. Position the spotter mirror glass assembly onto the spotter mirror glass pivot assembly.
3. **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   NOTICE: **The spotter mirror glass can break if pressure is not applied directly over the spotter mirror glass pivot assembly.**

   Place a hand against the back of the exterior rear view mirror housing and a hand flat against the center of the spotter mirror glass. Press the spotter mirror glass in place until it is fully seated.

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Exterior Mirror Glass — Trailer Tow

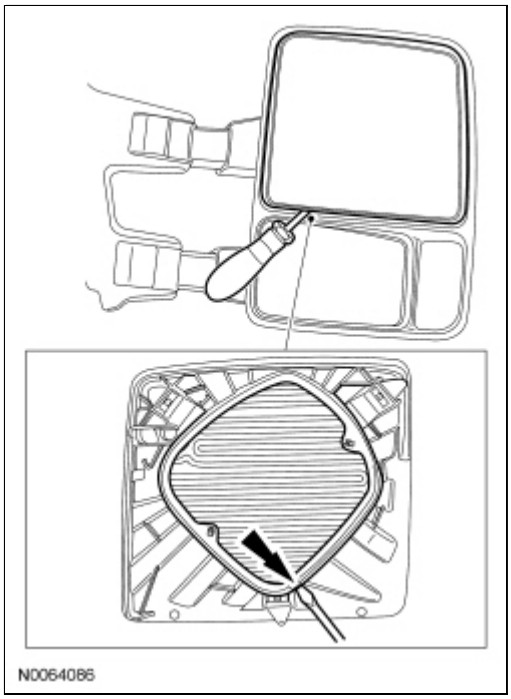
Removal

NOTE: RH trailer tow mirror shown, LH trailer tow mirror similar.

1. Position the exterior mirror glass fully upward and outward.

NOTE: The backside of the exterior mirror glass backing plate is shown to help with the location of the exterior mirror glass removal slot.

2. Insert a 5 mm (3/16 in) flat-blade screwdriver into the exterior mirror glass removal slot, located on the backside of the exterior mirror glass backing plate at the inboard side of the exterior mirror glass assembly.



3. **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   Remove the exterior mirror glass.
   - Twist the screwdriver handle 90 degrees.
   - Lift outward on the lower inboard exterior mirror glass backing plate using light hand pressure.
   - Remove the exterior mirror glass from the exterior mirror glass pivot assembly.
     - If equipped, disconnect the heated mirror glass electrical connector.

Installation

1. If equipped, connect the heated mirror glass electrical connector.

2. Position the exterior mirror glass assembly onto the exterior mirror glass pivot assembly.

3. **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   NOTICE: **The exterior mirror glass can break if pressure is not applied directly over the exterior mirror glass pivot assembly.**

   Place a hand against the back of the exterior rear view mirror housing and a hand flat against the center of the exterior mirror glass. Press the exterior mirror glass in place until it is fully seated.

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Exterior Mirror Motor

Removal and Installation

NOTE: The power folding mirrors may need to be synchronized anytime the mirrors are folded or unfolded without using the exterior mirror control switch, or if a new power folding mirror is installed. For additional information, refer to Exterior Mirror Motor Synchronization — Power Folding in this section.

1. Remove the exterior rear view mirror glass. For additional information, refer to Exterior Mirror Glass — Aero or Exterior Mirror Glass — Trailer Tow in this section.
2. Remove the 3 exterior rear view mirror motor screws.
3. Disconnect the exterior rear view mirror motor electrical connectors.
4. Remove the exterior rear view mirror motor.
5. To install, reverse the removal procedure.
    - If equipped, synchronize the power folding mirrors. For additional information, refer to Exterior Mirror Motor Synchronization — Power Folding in this section.

Exterior Mirror

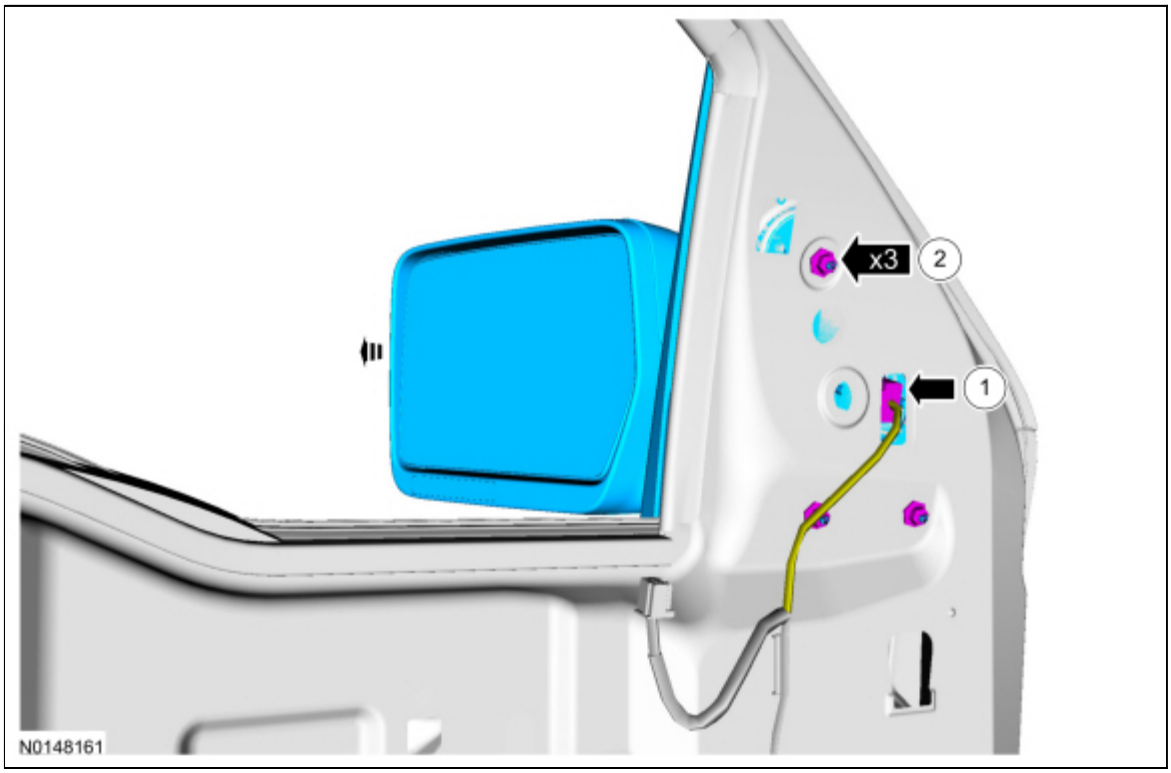
Removal and Installation

NOTE: Do not remove the exterior mirror assembly when repairing an individual part. Individual components can be installed without removing the exterior mirror.

NOTE: The power folding mirrors may need to be synchronized anytime the mirrors are folded or unfolded without using the exterior mirror control switch, or if a new power folding mirror is installed. For additional information, refer to Exterior Mirror Motor Synchronization — Power Folding in this section.

NOTE: The aero mirror is shown, the trailer tow mirror is similar.

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Position aside the water shield to gain access to the electrical connector.
3.
   - To install, tighten to 12 Nm (106 lb-in).

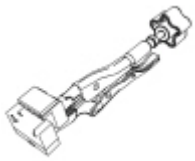


4. Remove the exterior mirror.
5. To install, reverse the removal procedure.
   - If equipped with power folding mirrors, they must be synchronized. For additional information, refer to Exterior Mirror Motor Synchronization — Power Folding in this section.

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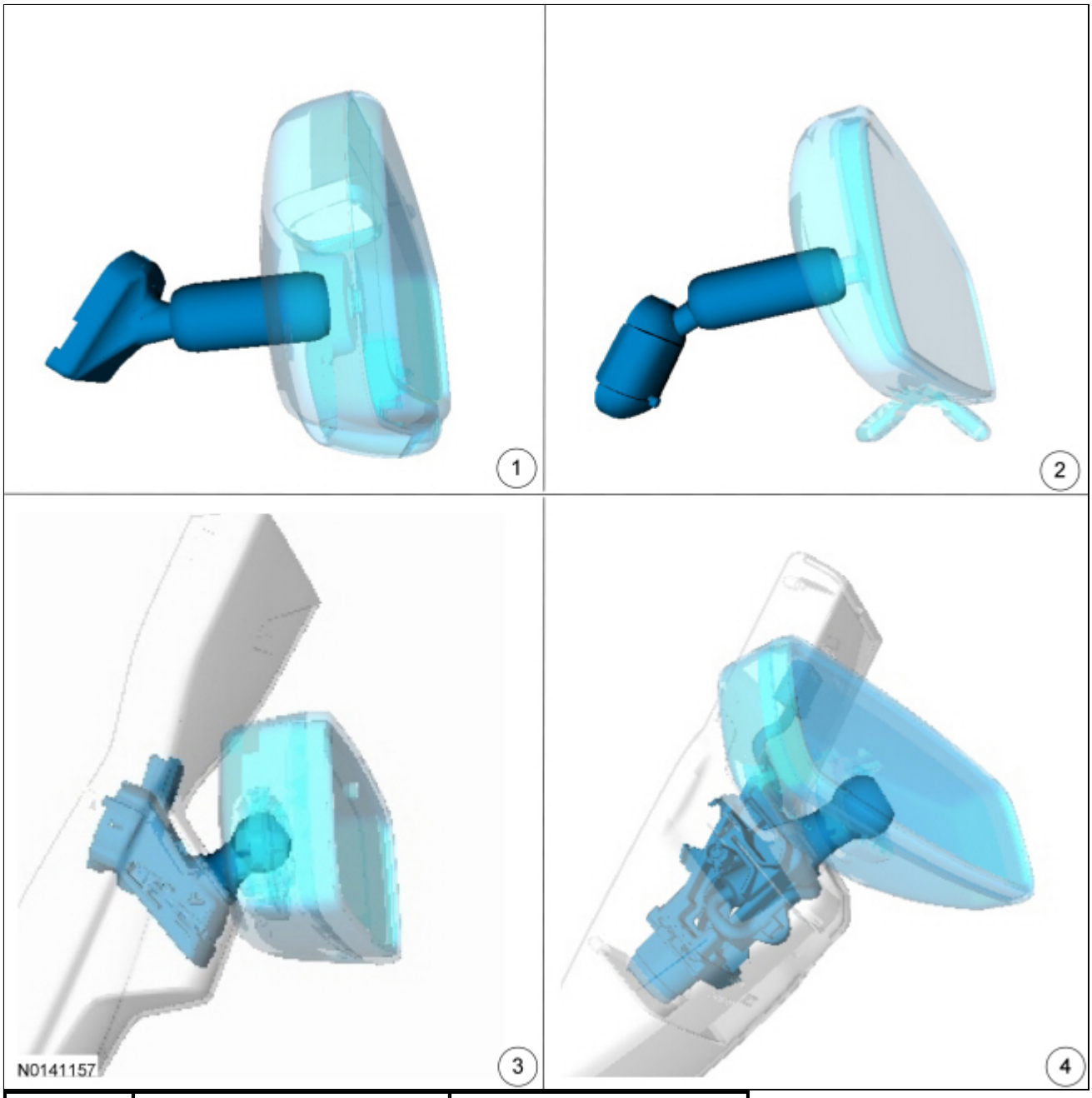
Interior Rear View Mirror

Special Tool(s)

 ST1793-A	Installer, Rear View Mirror 501-025 (T94P-17700-AH)
 ST3250-A	Mirror Remover 501-D118A
 ST3311-A	Installer, Rear View Mirror 501-191
 ST3310-A	Mirror Remover 501-190

Mirror Identification

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Item	Part Number	Description
1	-	Mirror type 1
2	-	Mirror type 2
3	-	Mirror type 3
4	-	Mirror type 4

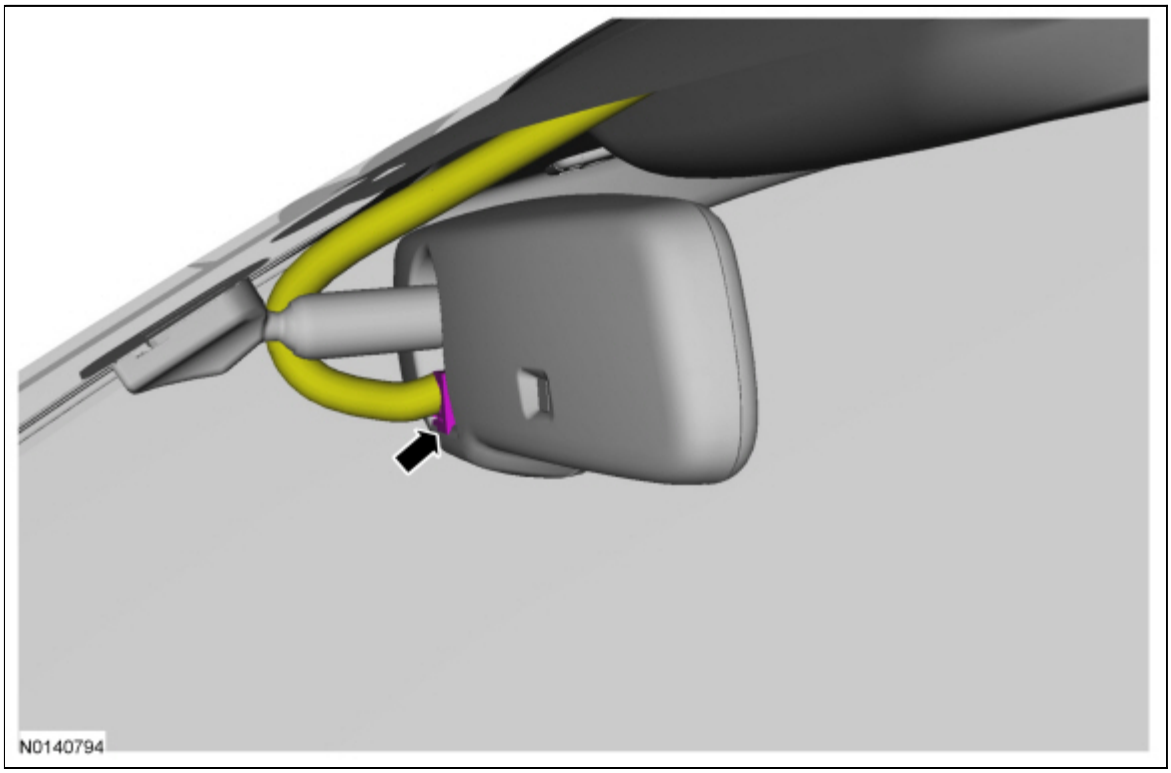
Removal

Mirror Type 1

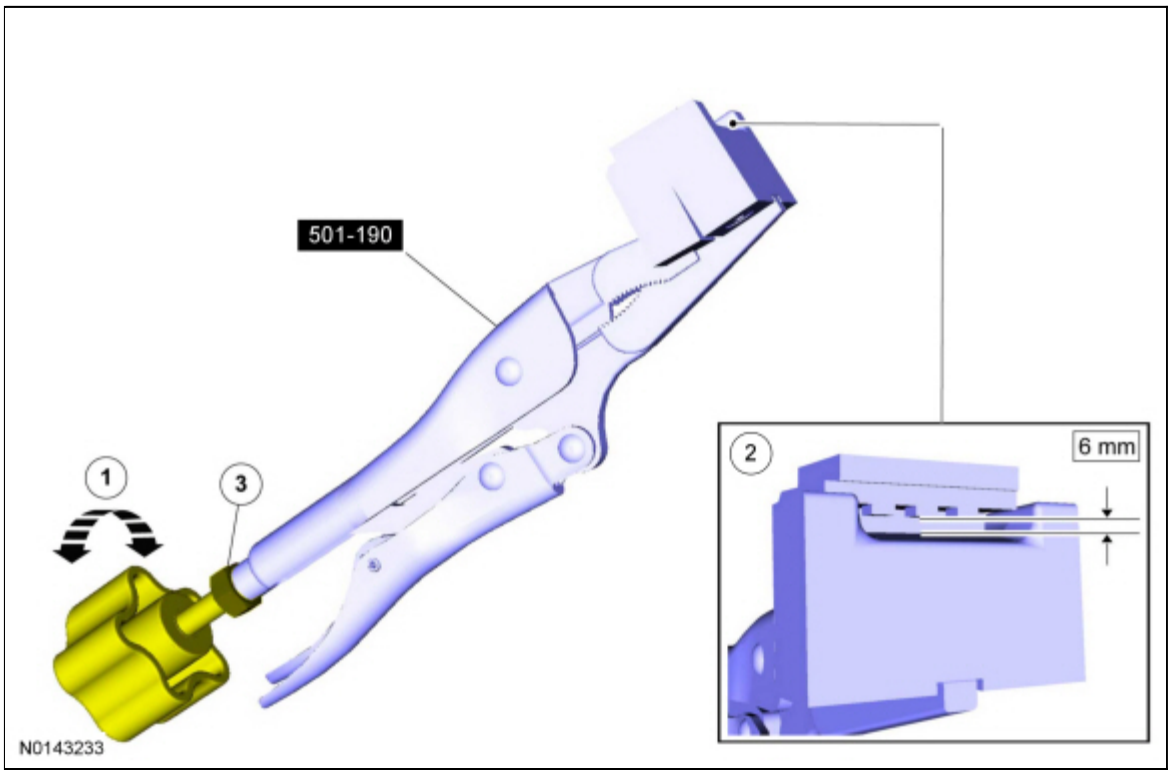
NOTICE: **The windshield must be at room temperature. Otherwise, damage to the windshield glass may occur.**

NOTE: Click here to view a video version of this procedure.

1. If equipped.

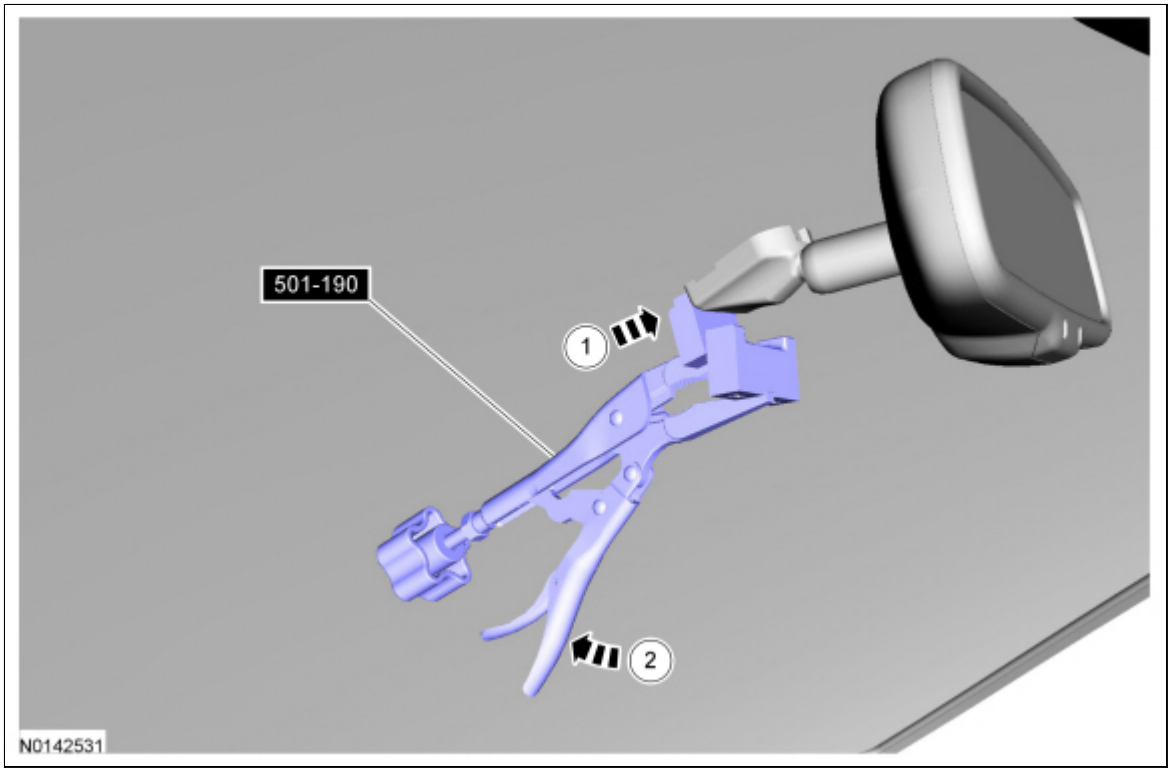


2.

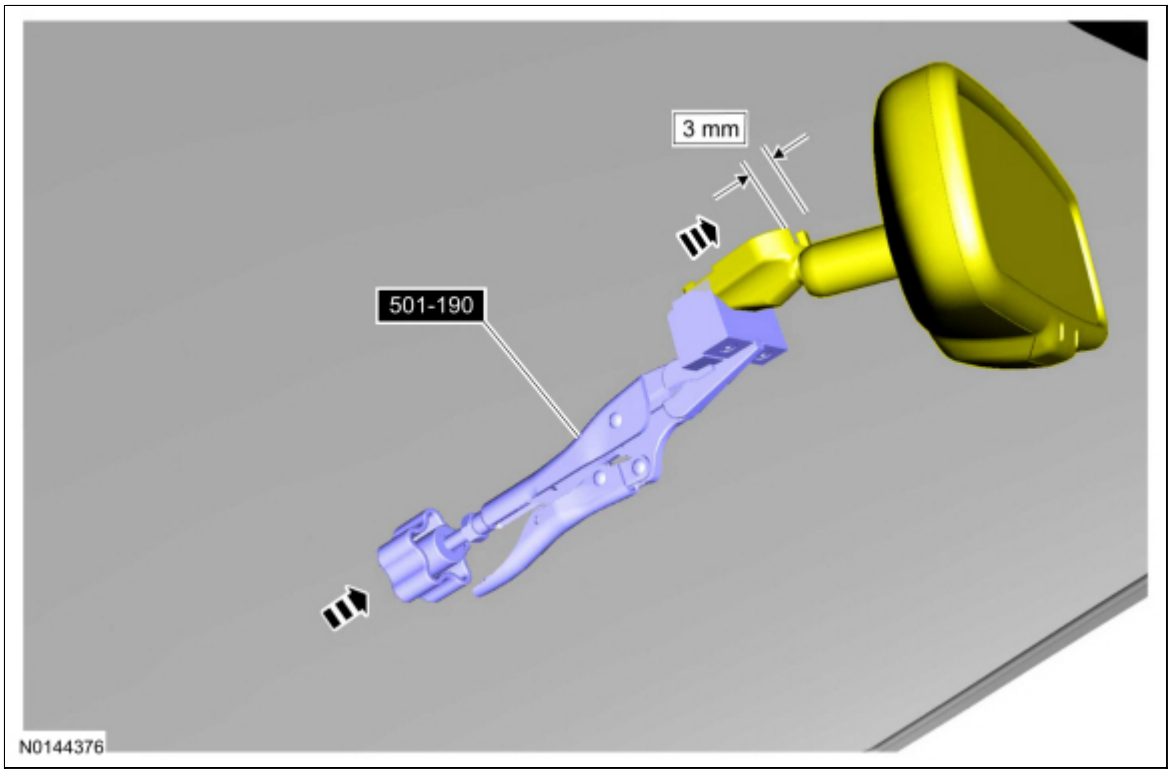


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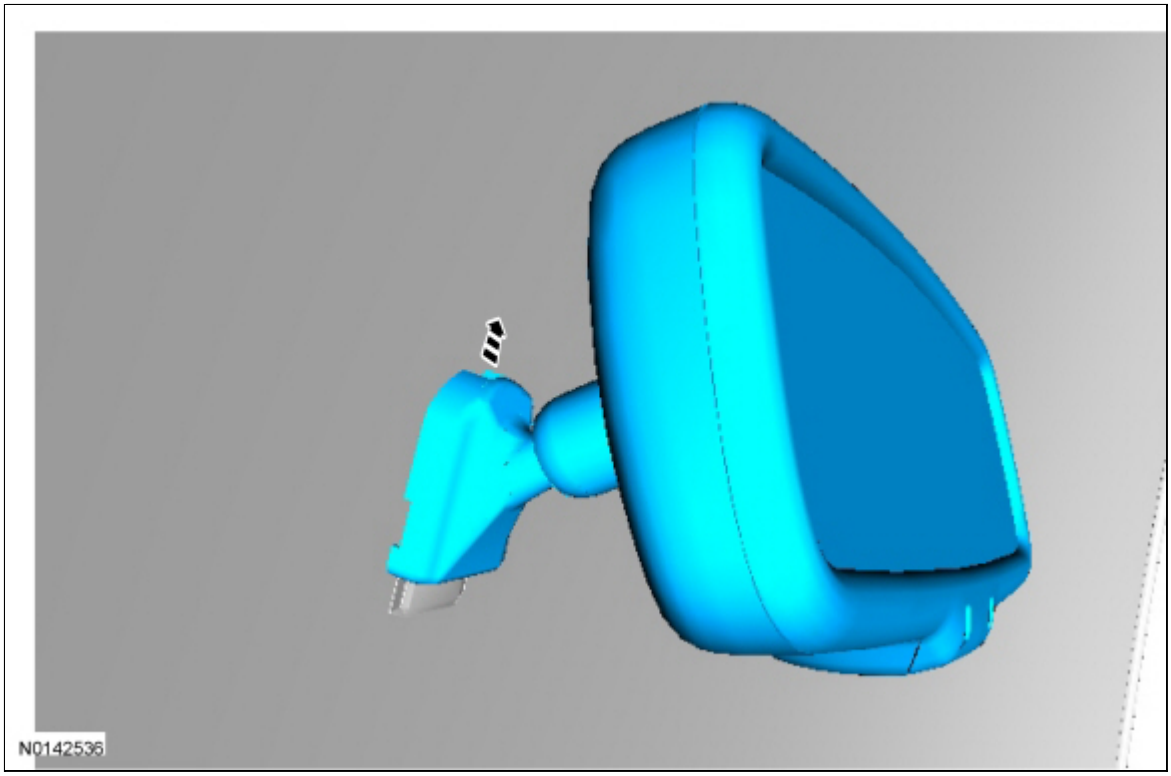
3. ***NOTICE:*** **Make sure the Mirror Remover is fully inserted into the interior rear view mirror mount access hole. Otherwise, damage to the windshield glass may occur.**



4. Using a closed hand, bump the adjustment handle of the Mirror Remover to slide the mirror upward on the mirror mount.

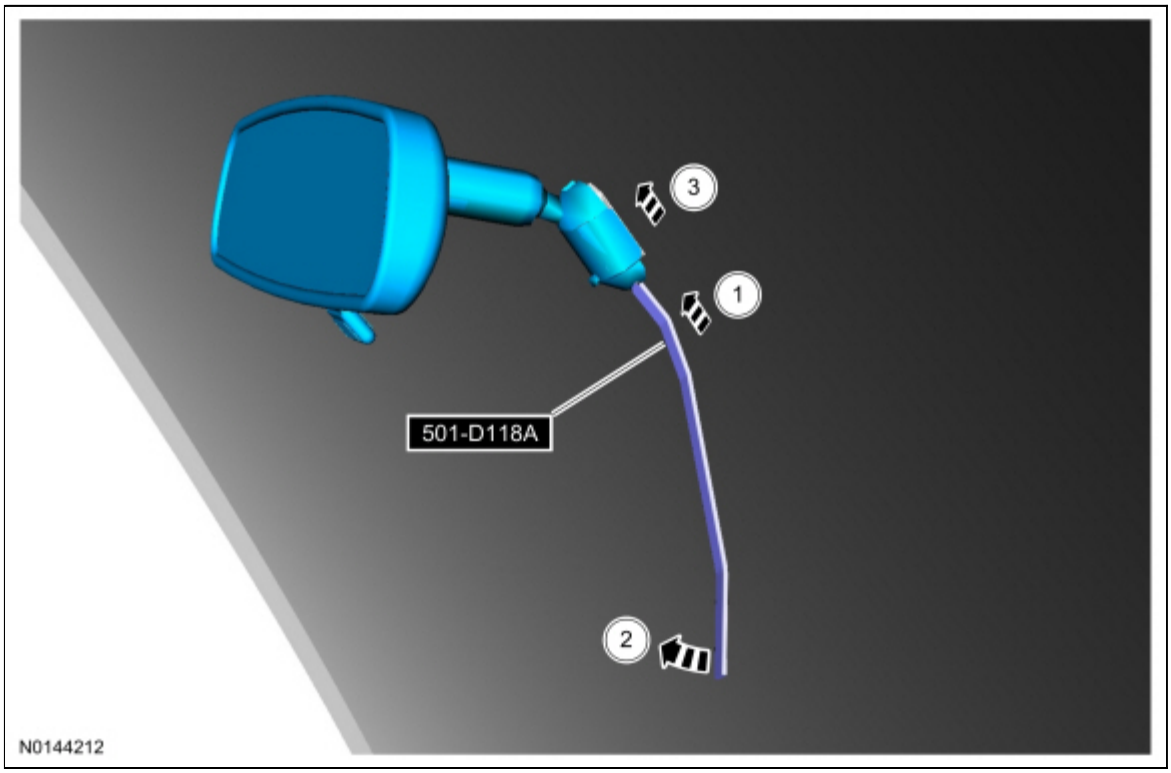


5.



Mirror Type 2

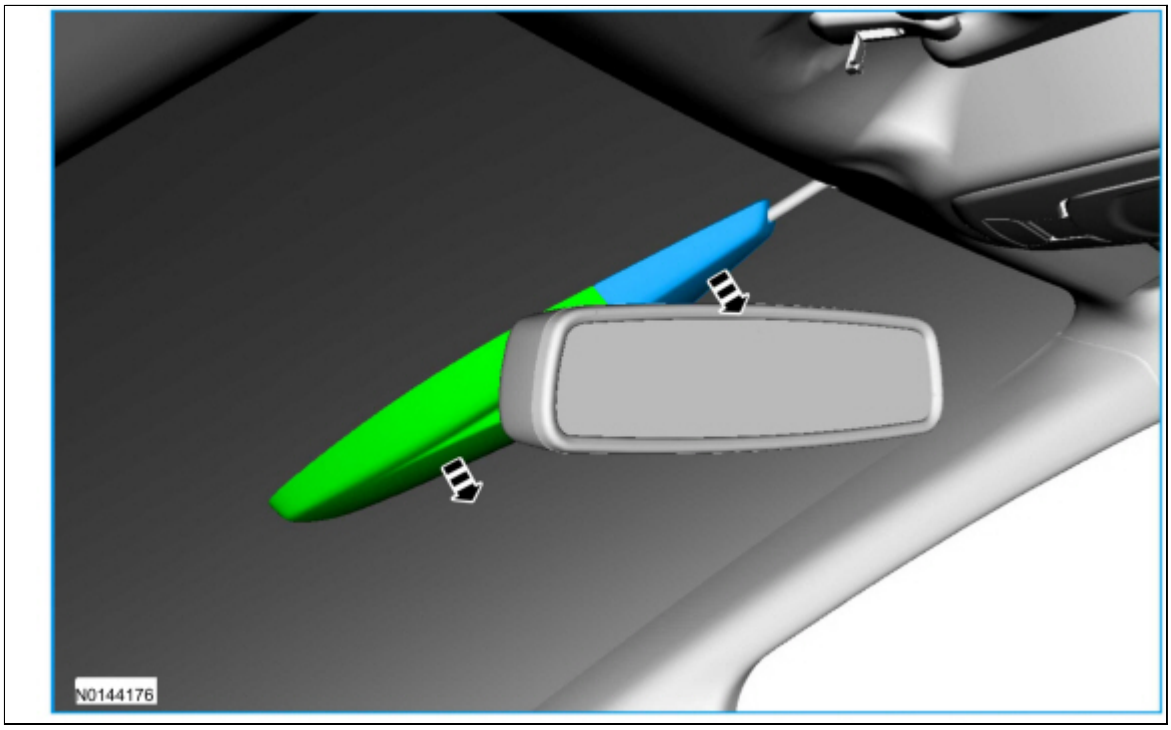
6.



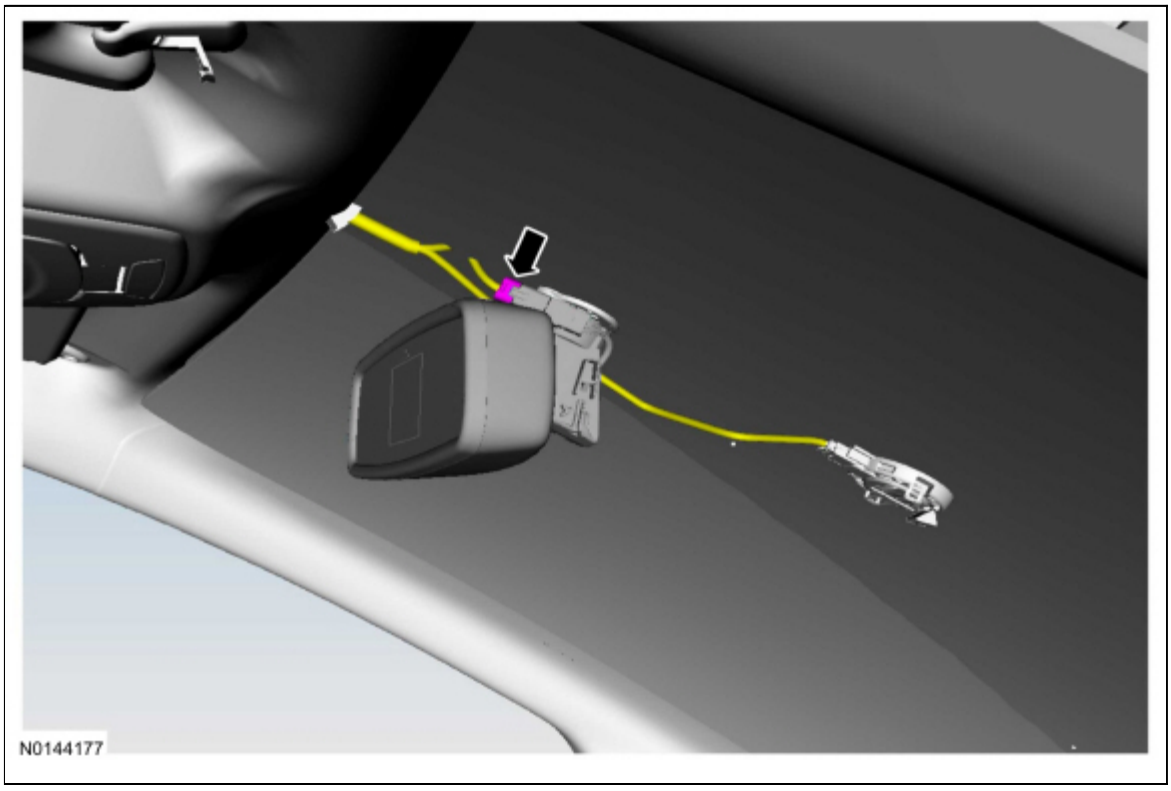
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Mirror Type 3

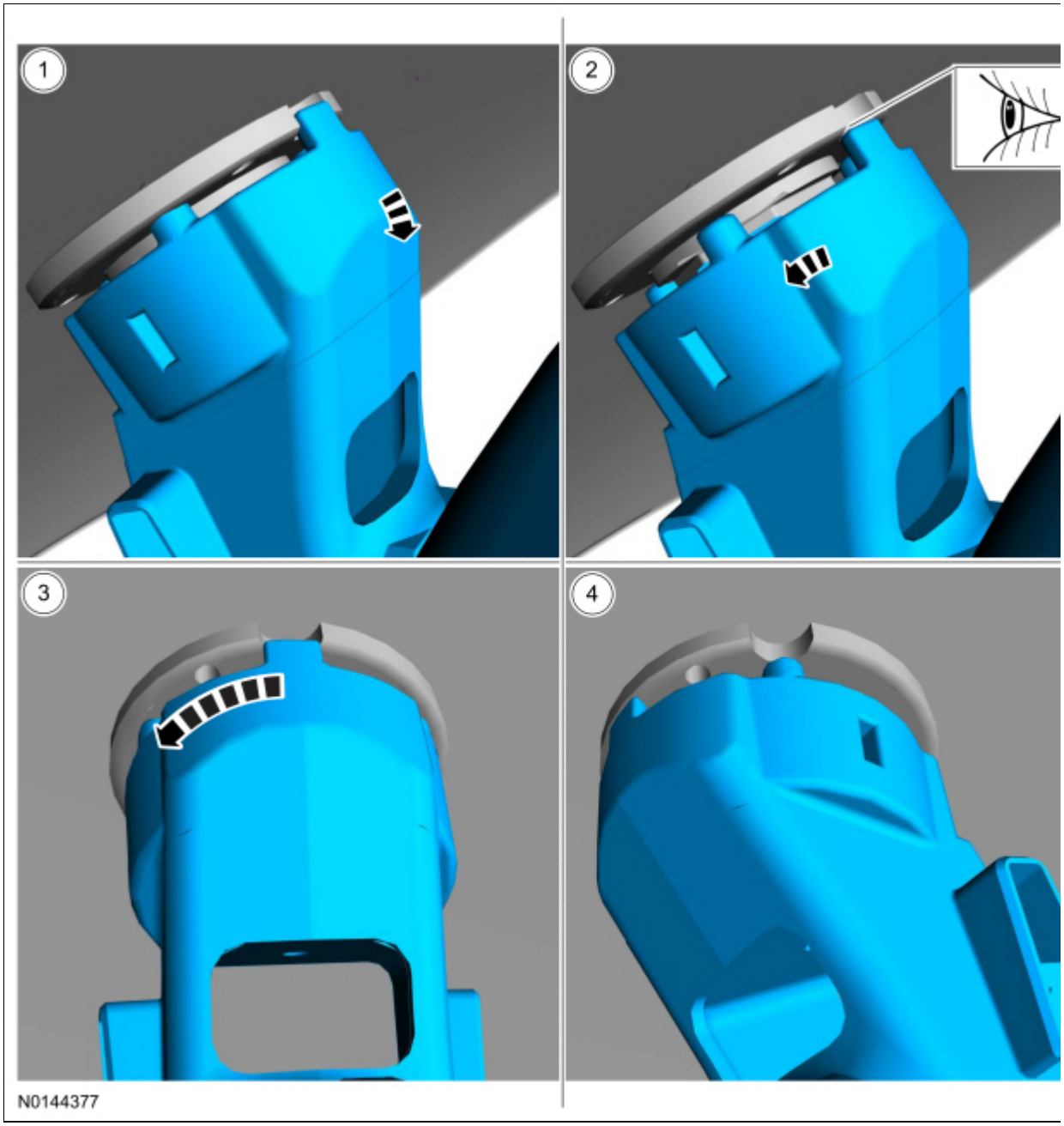
7.



8.



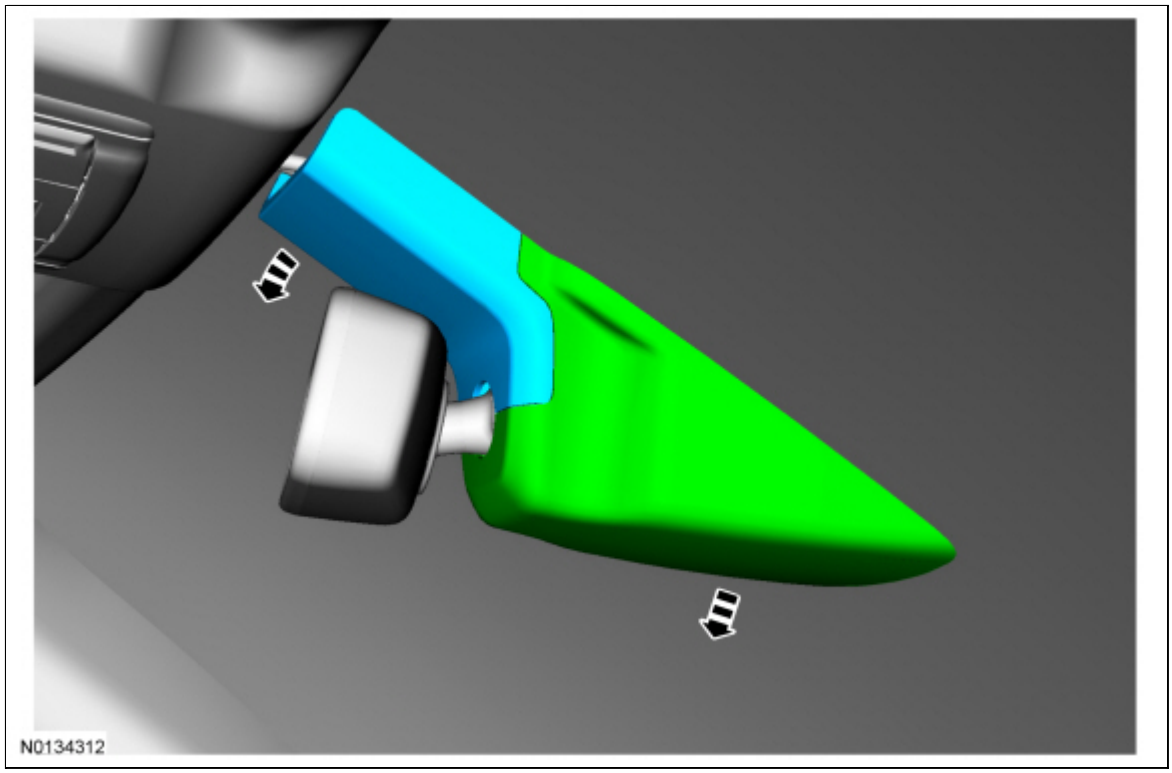
9.



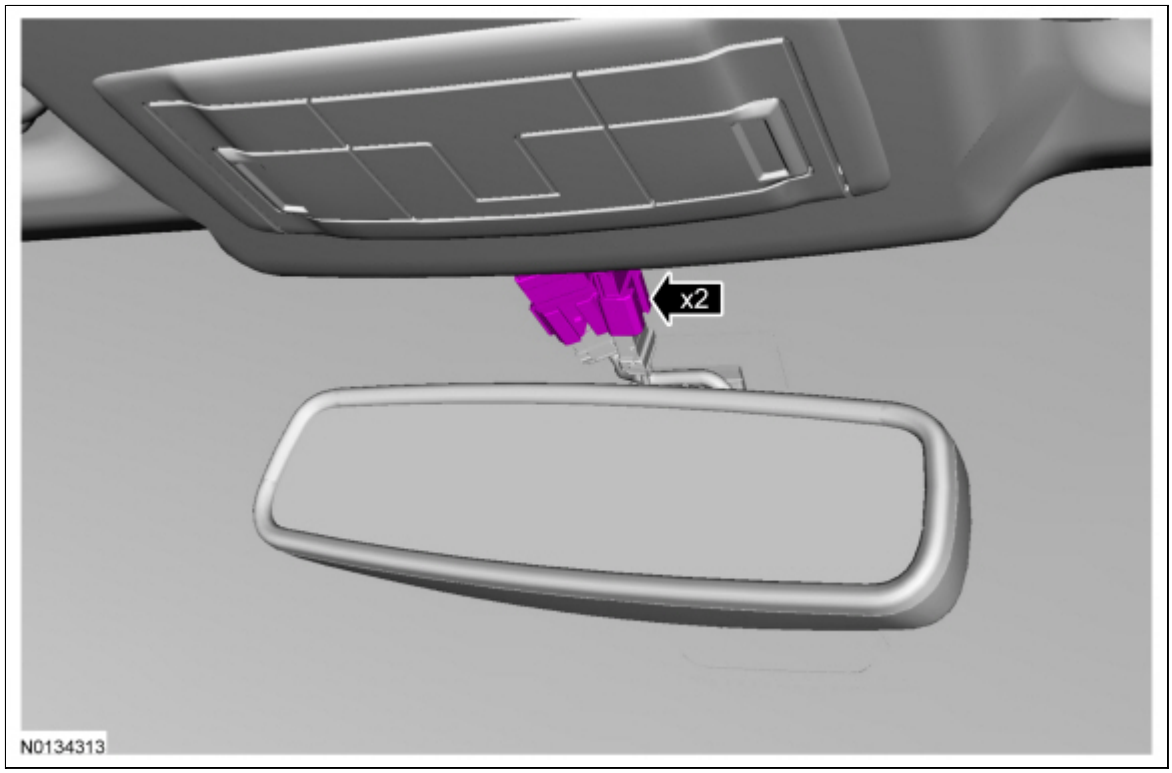
Mirror Type 4

10.

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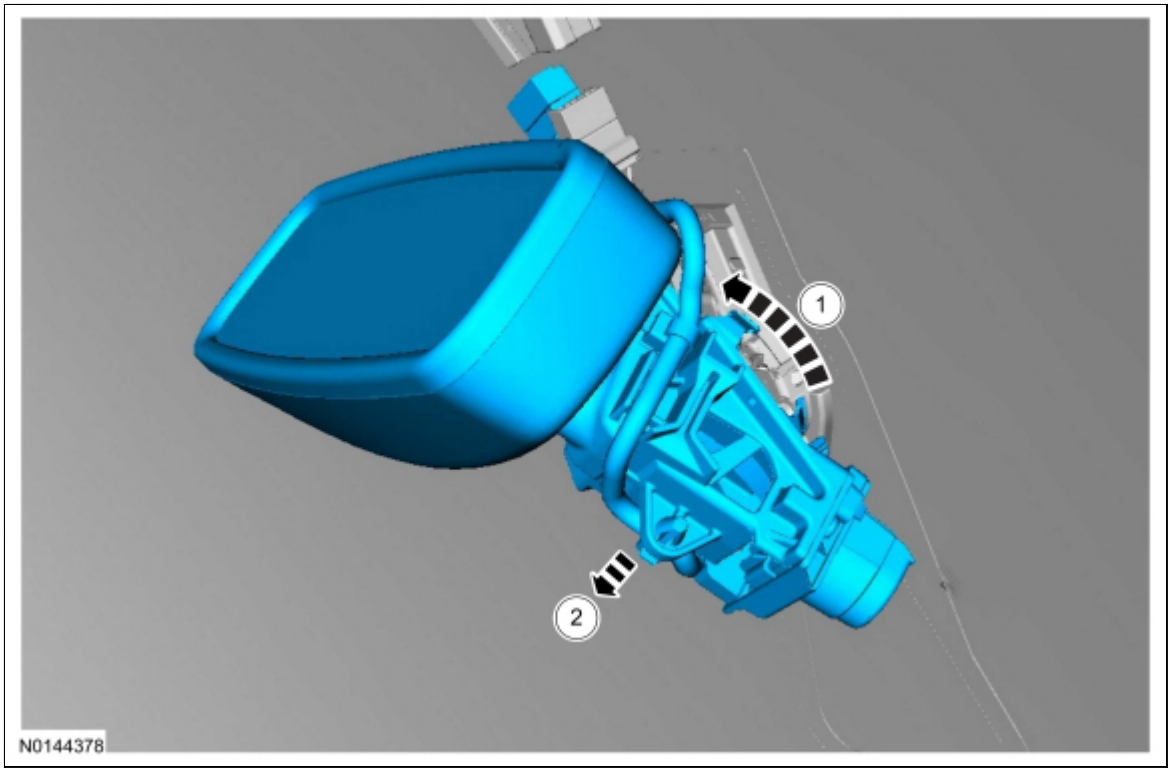


11.



12. ***NOTICE:*** **To prevent damage to the mirror or base, rotate the mirror base with hands only do not use tools.**

NOTICE: **To prevent damage to the mirror wiring, do not rotate the mirror head beyond 180 degrees.**



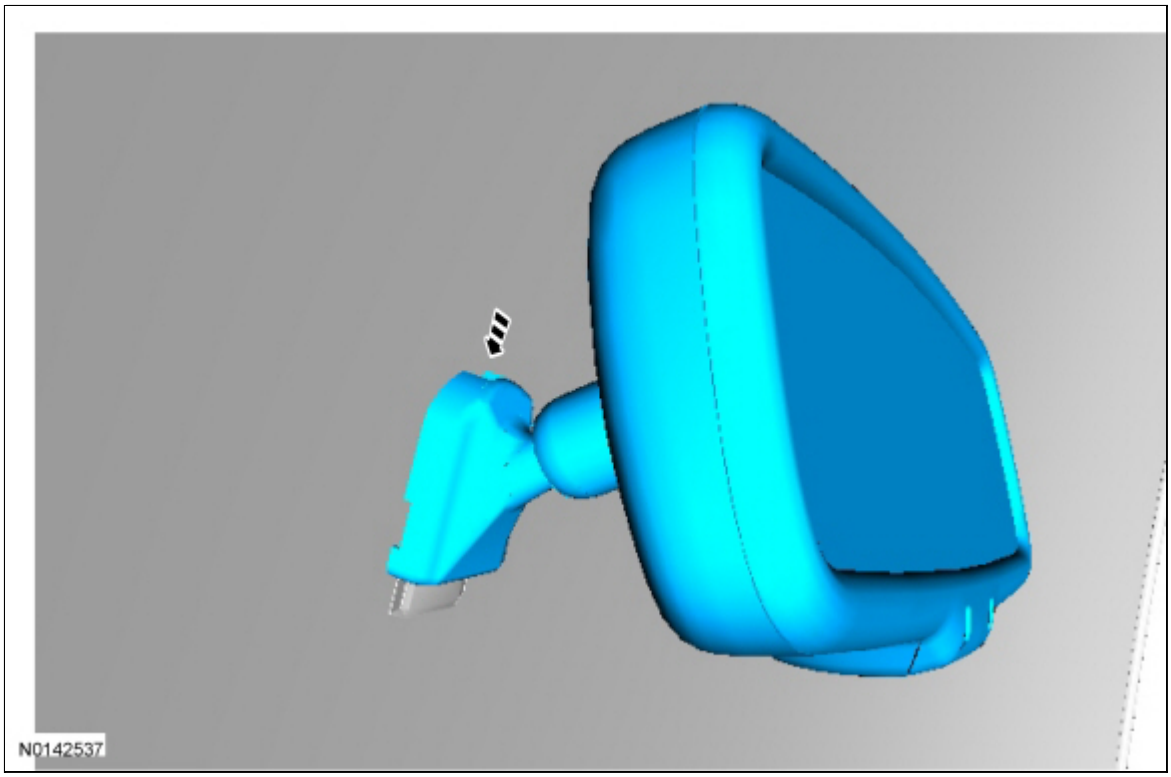
Installation

Mirror Type 1

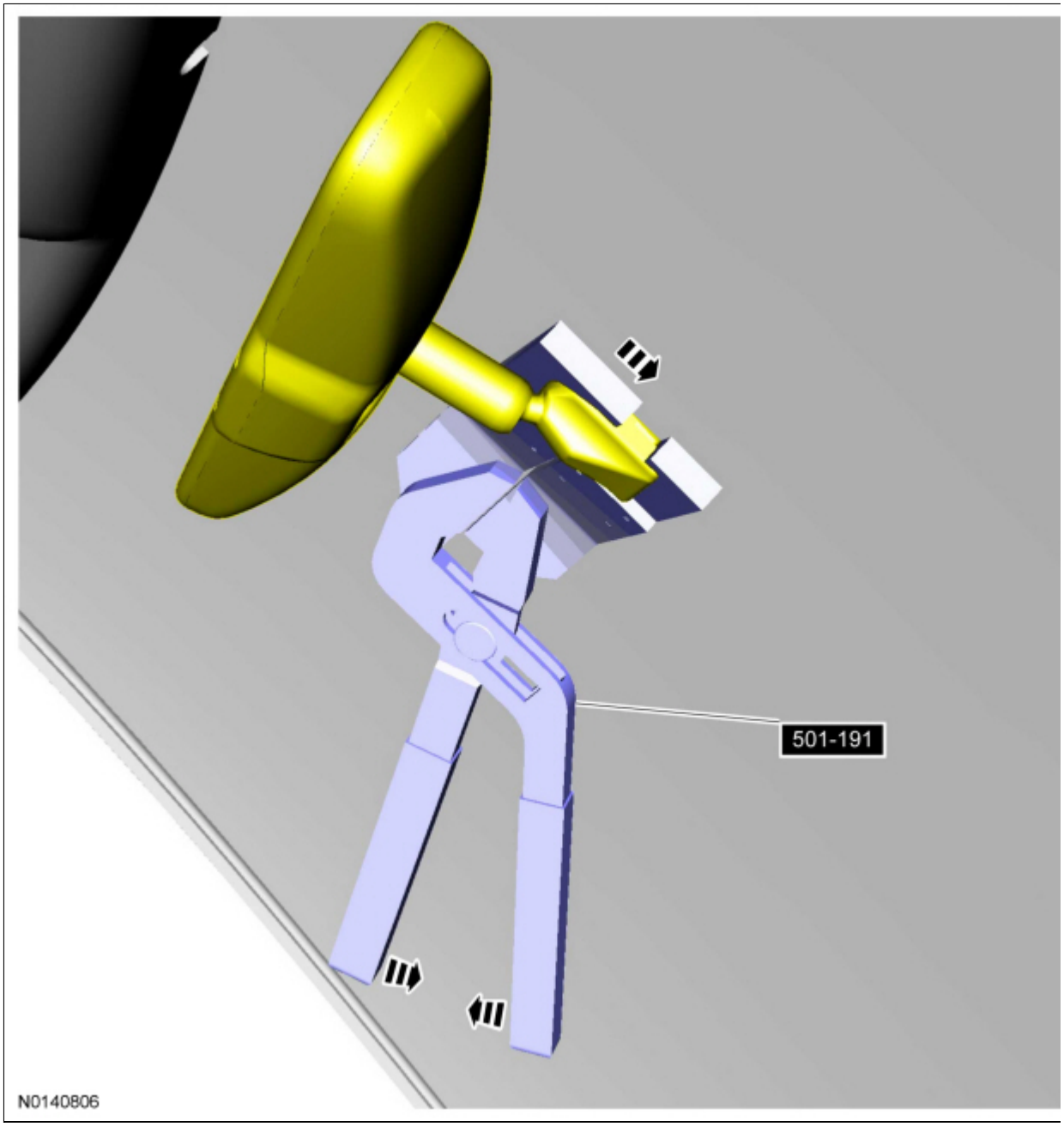
NOTE: Click here to view a video version of this procedure.

1. Slide the interior rear view mirror mount over the windshield bracket from the top.

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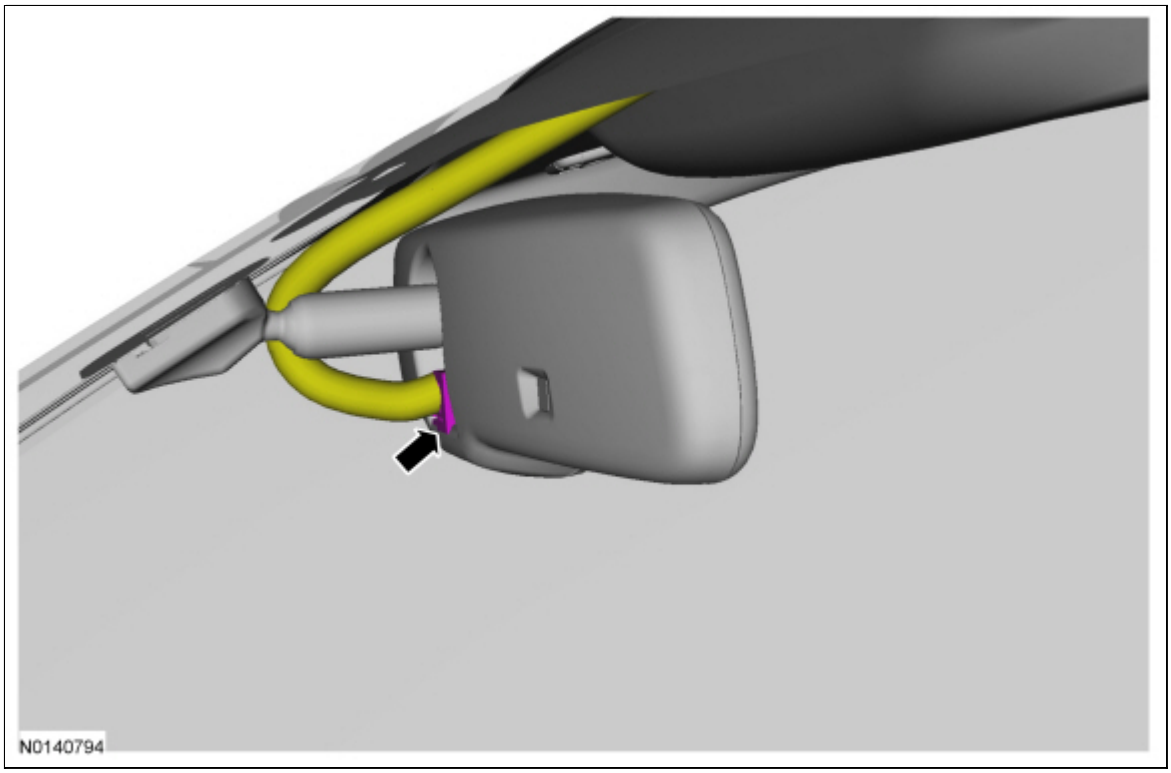


2. **NOTE:** An audible click will be heard as the mirror fully seats.



3. If equipped.

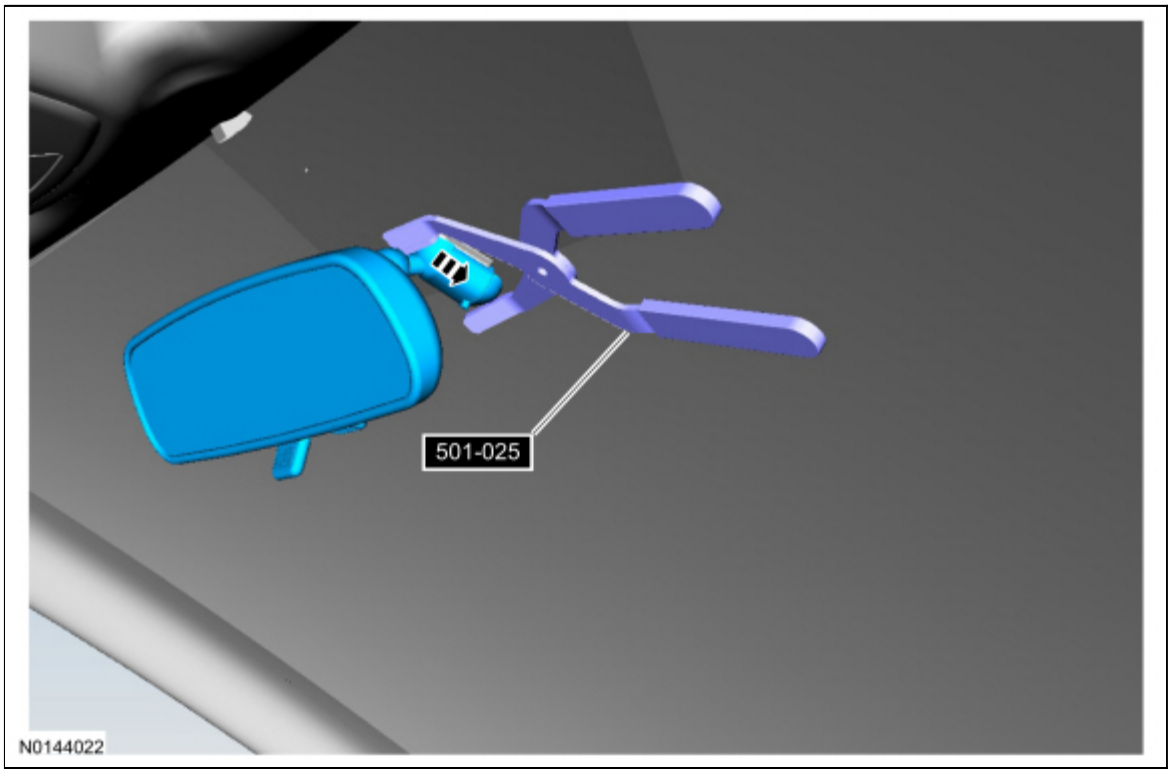
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4. If equipped, check the compass zone and calibration. Refer to Section 413-01 .

Mirror Type 2

5.



6. If equipped with a compass module which requires calibration, check the compass zone adjustment and calibration. Refer to General Procedures in Section 413-01.

Mirror Type 3

7. To install, reverse the removal procedure.

Mirror Type 4

8. To install, reverse the removal procedure.
    - If a new mirror has been installed, download the IPM-A configuration information from the scan tool to the new IPM-A .
    - If the vehicle is equipped with lane departure and a new mirror has been installed, perform camera alignment using a scan tool.

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Torque Specifications

Description	Nm	lb-ft	lb-in
Front Bucket Seat — Driver or Passenger			
Backrest bolts	45	33	—
Front seat bolts [a]	—	—	—
Rear seat bolts [a]	—	—	—
Recliner motor bolt	5	—	44
Safety belt anchor bolt	40	30	—
Safety belt buckle bolt	40	30	—
Side air bag module nuts	9	—	80
Front Center Seat			
Backrest latch lower bolts	45	33	—
Backrest latch upper bolts	60	44	—
Backrest pivot bolt	45	33	—
Backrest stop bolt	18	—	159
Cushion pivot bolts	35	26	—
Cushion release handle screws	8	—	71
Pedestal bolts (front)	47	35	—
Pedestal bolts (rear)	55	40	—
Safety belt anchor bolt	45	33	—
Safety belt buckle bolt	45	33	—
Seat mounting bolts	47	35	—
Rear Seat — Crew Cab			
Armrest pivot bolt	25	18	—
Backrest latch bolts	10	—	89
Backrest pivot bolts	25	18	—
Cushion pivot bolts	32	24	—
Front latch bolt	32	24	—
Front seat bolts	47	35	—
Heated seat module bracket screw	14	—	124
Heated seat module screw	14	—	124
Rear latch bolt	32	24	—
Rear seat nuts	80	59	—
Safety belt buckle bolt (seat mounted)	32	24	—
Safety belt retractor anchor nut	80	59	—

Seat connecting bolts	12	—	106
Rear Seat — SuperCab			
Front latch bolt	32	24	—
Front seat bolts	47	35	—
Pivot bolts	33	24	—
Rear latch bolt	24	18	—
Rear seat nuts	80	59	—
Riser rear screws	6	—	53

[a] Refer to the procedure in this section.

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Seating

Front Seats

Front Bucket Seats

NOTE: For component identification and locations, refer to Seat — Exploded View, Front in this section.

The front bucket seats can be equipped with the following serviceable items:

- Adjustable head restraint and guide sleeves attached to the backrest frame
- Backrest and cushion covers
- Backrest and cushion foam pads
- Backrest frames (equipped with manual and power recliners) attached to the seat track
- Climate controlled seat system components (heated/cooled seats)
- Cushion side shield attached to the outboard side of the seat cushion frames
- Heated seat system
- Manual adjustable lumbar assembly attached to the backrest and seat track
- Manual and power seat tracks located at the seat base (includes cushion frame)
- Memory system components attached to the driver seat
- Occupant Classification System (OCS) system on passenger seat
- Power adjustable lumbar assembly attached to the backrest frame
- Power recliner motor attached to the backrest frames
- Safety belt buckle attached to the seat track
- Seat control switches attached to the cushion side shield inserts
- Seat side air bag attached to the seat backrest frames
- Seat track position sensor attached to driver seat track (part of the Supplemental Restraint System (SRS))

Driver Seat Module (DSM) — Memory Seat

The driver power seat is controlled by the DSM . The DSM is located on the driver seat track.

This system allows automatic positioning of the driver seat to 2 programmable positions. For information on programming memory positions or recalling a stored memory position, refer to Memory Position Programming in this section.

Memory Recall — Remote Keyless Entry (RKE)

When the vehicle is equipped with a memory driver seat, the RKE can be used with a key that includes an

Integrated Keyhead Transmitter (IKT). A personality or memory position for the driver seat and exterior rear view mirrors can be assigned to an IKT . Up to 2 personalities can be assigned, 1 per IKT . If the remote IKT has been associated to a memory position, pushing IKT unlock button recalls the memory seat and exterior rear view mirror positions.

For information on diagnosing a RKE concern or associating an IKT to a memory position, refer to Section 501-14 .

Easy Entry/Exit

The easy entry/exit feature is a function of the DSM . The memory driver seat easy entry/exit feature moves the seat slightly rearward for easier exit from the vehicle and returns the seat forward after entry. The easy entry/exit feature can be enabled/disabled using the selections on the message center. For additional information on how to enable/disable the easy entry/exit feature, refer to the Owner's Literature or Section 413-01 for information on the message center.

Heated Seats — Front

This system allows independent seat electrical heating of the driver and front passenger seats on demand.

The heated seat system includes the following serviceable components:

- Heater mats attached to the seat backrest and cushion foam pads
- Front Display Interface Module (FDIM) (touchscreen)
- HVAC module

Climate Controlled Seats

The climate control seat system is able to heat and cool the driver and front passenger seats. Each climate controlled seat is operated by push-buttons on the Front Display Interface Module (FDIM) located on the instrument panel. Each front seat temperature is then monitored and controlled by the Dual Climate Controlled Seat Module (DCSM) located on the passenger front seat track.

The climate controlled seat system contains the following serviceable components:

- Air filter (attached to each Thermo-Electric Device (TED) and blower assembly) (See the Owner's Literature for additional service and scheduled maintenance interval information)
- Cushion and backrest foam pads
- Cushion and backrest manifolds
- DCSM attached to the passenger seat track
- Front Display Interface Module (FDIM)
- HVAC module
- TED and blower assembly within each front seat cushion and backrest
- Ventilated cushion and backrest trim covers

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Remote Start Climate Operation (If Equipped With Heated Or Climate Controlled Seats)

The customer can select different climate control modes/preferences when the vehicle is started using the remote start feature. This can be accessed through the message center. For information on how to set the remote start preferences, refer to the Owner's Literature. When the driver seat and/or passenger seat is set to AUTO mode, the driver/passenger heated/climate controlled seat activates in full heat mode when the outside temperature is less than 0°C (32°F) and full cool mode (climate controlled seats only) when outside temperature is greater than 27°C (80°F) any time the vehicle is started using the remote start feature. No heated/climate controlled seat adjustments are recognized during remote start operation. When the ignition is cycled to the ON position after a remote start event, the heated/climate controlled seat switches off.

Front Seat Track Motor

There are 3 front seat track motors present on power seat tracks. The horizontal (fore/aft) front seat track motor is the only seat track motor which can be serviced separately from the seat track assembly. All other seat track motors (front up/down, rear up/down) are serviced as part of the seat track assembly.

Front Seat Motor Cable

The horizontal (fore/aft) front seat track motor rotates 2 cables which drive each side of the seat track uniformly. The outboard (long) cable can be serviced separately from the horizontal front seat track motor.

Manual Lumbar

The manual front seat backrest lumbar is adjusted by a knob attached at the side of the seat cushion side shield. The lumbar adjuster is mounted to the seat track assembly and drives a cable connected to the lumbar assembly attached to the backrest frame.

Power Lumbar

The lumbar switch is attached to the cushion side shield insert and is part of the seat control switch. The lumbar motor is mounted to the lumbar assembly and is serviced only with a new lumbar assembly.

Manual Recliner

The manual recliner can be adjusted by a handle mounted on the outboard side of the cushion side shield. Manual recliners are only serviceable by installing a new backrest frame assembly.

Power Recliner

The power recliner switch is part of the seat control switch attached to the seat cushion side shield insert. The power recliner motor can be serviced separately but the power recliner assembly is serviceable only with a new backrest frame.

Occupant Classification System (OCS) System

The OCS system is standard equipment on all front outboard passenger seats. For information on

diagnosing or servicing the OCS system, refer to Section 501-20B .

Front Center Seat

Front center seat can be equipped with the following serviceable items:

- Backrest cover (without backrest storage)
- Backrest latch and latch cover attached to the RH side of the backrest and seat frame
- Cushion cover
- Cushion latch release handle
- Front and rear cup holders
- Front and rear storage trays attached to the seat frame
- LH and RH side shields attached to the seat frame
- Power Point and wiring attached to the rear cup holder and seat frame
- Safety belt buckle attached to the seat frame
- Seat frame
- Storage tray (in seat frame under cushion) (if equipped)

The front center seat is mounted to a pedestal under the carpet. Pedestal removal is not required for seat removal. The pedestal is also used for floor console mounting when not equipped with a front center seat. The pedestal is equipped with press fit spacers and washers above and below to prevent corrosion of body and seat structures. If removed, any of these items that become separated from the pedestal during service must be reinstalled to prevent corrosion damage that may compromise structural integrity of the body and seats.

Rear Seats — SuperCab

The SuperCab rear seat is equipped with a non-folding bench style backrest mounted to the rear cab panel and seat cushion frame and a 40/60 split folding cushion attached to the floor.

The SuperCab rear seat can be equipped with the following serviceable items:

- Adjustable head restraints and head restraint covers
- Backrest and cushion covers
- Backrest and cushion foam pads
- Backrest, cushion and seat frames
- Backrest latches attached to the seat frame
- Backrest upper clips attached to the backrest frame
- Cushion latches, latch bolt covers and release handles
- Head restraint guide sleeves attached to the backrest frame
- Inboard and outboard seat risers
- Non-serviceable lower anchors and tethers for children welded to the seat frame

Rear Seats — Crew Cab

The Crew Cab rear seat is a 40/60 split bench style with folding cushions and optional folding armrest with

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cup holder. The backrests are fixed to the rear cab panel by latches that can be accessed from behind only for service allowing the backrest to fold down. The backrest latches are accessible only when the seat cushion is folded upright.

The Crew Cab rear seat can be equipped with the following serviceable items:

- Accessory hooks attached to the bottom of each cushion
- Adjustable head restraints and head restraint covers
- Armrest, backrest and cushion covers
- Armrest, backrest and cushion foam pads
- Armrest, backrest, cushion and seat frames
- Backrest latch attached to each backrest frame
- Backrest latch strikers attached to the rear cab panel
- Cup holder attached to the armrest frame
- Cushion latches attached to the cushion frame and outboard risers
- Cushion release handle and bezel attached to the bottom of each cushion frame (includes release cable)
- Head restraint guide sleeves attached to the backrest frames
- Heated seat system
- Inboard and outboard seat risers
- Inboard and outboard side shields attached to the seat risers
- Non-serviceable lower anchors and tethers for children welded to the seat cushion frames
- Safety belt buckle attached to each inboard seat riser

Heated Seats — Rear

This system allows independent seat electrical heating of the 40 percent and outboard 60 percent seat positions on demand.

The heated seat system includes the following serviceable components:

- Heater mats attached to the seat backrest and cushion foam pads
- Heated seat module attached behind the 60 percent seat backrest
- Heated seat switches attached to the rear door power window switch bezels
- Wire harness attached to the base of each backrest frame

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Seating

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Driver (Without Memory) and Passenger Power Seats

The 6-way power seat feature operates independently of the ignition position and moves the seat in 6 possible directions:

- forward or backward
- front and back of the cushion can be moved up and down independently

The 10-way power seat feature operates independently of the ignition position and moves the seat in 10 possible directions:

- forward or backward
- front and back of the cushion can be moved up and down independently
- backrest of the seat can be moved forward and backward
- lumbar can be moved in and out

All 10 positions are controlled by a single switch.

The power seat motors are hardwired to the seat control switch. The circuits are normally grounded through

the seat control switch. An individual circuit is switched to voltage when a specific adjustment position is selected.

Driver Power Seat With Memory

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition can interfere with memory seat operation, even if vehicle starting is possible.

NOTE: A memory recall in progress does not prohibit the initiation of another memory recall; the most recently requested memory recall is executed.

The Driver Seat Module (DSM) controls the driver power memory seat. The DSM is located underneath the driver seat. The memory seat feature allows the driver to program a personalized seat position that can be recalled using the memory SET switch or a Remote Keyless Entry (RKE) transmitter. There are 2 memory settings possible.

For information on programming memory positions or recalling a stored memory position, refer to Memory Position Programming in this section. For information on RKE transmitter programming or to diagnose a concern, refer to Section 501-14 .

The NEUTRAL position of the driver seat control switch is at a ground state through the seat control switch normally-closed contacts. The driver seat control switch provides voltage to the DSM only when activated. A voltage input causes the DSM to power the appropriate motor until the input is removed. Ground is the normal state of the motor circuits through the DSM . The DSM internally switches the appropriate circuit from ground to voltage to operate the motors.

As the seat is adjusted, the DSM monitors the motor position sensors to record the current seat position. The DSM removes voltage from the motor upon termination of the seat control switch input or if the DSM does not detect movement from the motor while monitoring the position sensor during a memory recall operation.

The DSM communicates DTCs and other information using the MS-CAN . Refer to Section 418-00 for information concerning MS-CAN .

This section only diagnoses concerns specific to the memory seat. To diagnose an exterior mirror concern, refer to Section 501-09 . To diagnose a power adjustable pedal concern, refer to Section 206-06 . To diagnose a power steering column concern, refer to Section 211-04 .

For information on programming memory positions or recalling a stored memory position, refer to Memory Position Programming in this section.

Remote Keyless Entry (RKE) Transmitter

NOTE: A memory recall in progress does not prohibit the initiation of another memory recall; the most recently requested memory recall is executed.

A Remote Keyless Entry (RKE) transmitter can be used to recall previously set memory positions but must first be associated to that memory position. The transmitter associated with personality 1 is capable of recalling memory position 1 only. Similarly, the associated personality 2 transmitter can recall only memory position 2.

Memory recall occurs when the unlock button is pressed on the RKE transmitter if it has been associated

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with a memory position.

For information on diagnosing an RKE concern or associating an RKE transmitter to a memory position, refer to Section 501-14 .

Easy Entry/Easy Exit Feature

The easy entry/exit feature is a function of the DSM that moves the driver seat back approximately 50.8 mm (2 in) (unless seat is already positioned at or near the end of travel) when the ignition key is removed from the ignition switch. The DSM receives the key-in ignition status over the MS-CAN . The DSM cancels this operation if a valid input command is received from the driver seat control switch, memory SET switch, exterior mirror control switch or if the function has been disabled.

The DSM records the current seat positions before operating the seat for an easy exit operation. During easy entry operation, the seat is returned to the seat position previous to the easy exit operation. Easy entry operation is cancelled if a valid input command is received by the DSM .

The easy entry/easy exit feature is a user accessible item on the message center allowing the user to turn the feature on and off. Refer to the Owner's Literature or Section 413-01 for information on the message center.

Driver Seat Module (DSM) Hard Stop/Soft Stop

The DSM has the ability for soft stops both at the upper and lower limits on all axes of the driver seat. When an axis reaches the hard stop and the switch is held for approximately one second, it then backs up 180 ms and establishes the soft stop for that axis in that direction. The DSM uses this back up strategy to check sensor integrity any time movement has stopped prematurely due to a sensor failure or obstruction.

A hard stop occurs when one of the memory seat track axes or backrest recline physically reach the end of travel and can go no further. A soft stop occurs when the seat stops before physically reaching the end of travel. The hard stop is set by seat design and cannot be changed or adjusted. The seat track axes are forward/rearward, front up/down and rear up/down. The backrest axis is recline forward/backward. To prevent unnecessary stress on the seat and motors, the DSM sets soft stop positions, 2 for each moving axis. The DSM uses a preset distance from the hard stop to determine where the soft stop occurs.

Setting the Soft Stop

NOTE: If a new DSM or driver seat track has been installed, reset all driver seat track soft stops.

Use the following procedure once a new seat track or DSM has been installed.

During the setting procedure, if the seat track stops before the end of travel has been reached, the DSM has stopped at a previously set soft stop. To set the new soft stop, release the seat control switch and immediately press again in the same direction until the seat track stops at the hard stop for that given direction.

1. Turn the ignition to the ON position.

2. Press the seat control switch horizontal button forward until the seat track stops.

3. Keep the horizontal button pressed forward for one second after the seat track reaches its forward end of travel. The horizontal forward soft stop has been set, release the switch button.

4. Repeat Steps 2 and 3 for all seat track axes in both directions.

Heated Seats — Front

The driver and passenger heated seat control buttons and indicators are located on the touchscreen interface (Front Display Interface Module (FDIM)). The FDIM is mounted directly to the Accessory Protocol Interface Module (APIM). The heated seat system functions independently of the vehicle's climate control system. Each time the heated seat button is pressed, the APIM sends the request to the Front Controls Interface Module (FCIM) using the Infotainment Controller Area Network (I-CAN). The FCIM sends the message to the Instrument Panel Cluster (IPC) using the I-CAN . The IPC sends the request message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). Finally, the BCM sends the request to the HVAC module which decreases one setting (the sequence is high, low, off, high, etc.).

When activated, the HVAC module supplies voltage to the selected seat's heater circuit. Each seat's cushion heater mat and backrest heater mat is connected in a series circuit to the HVAC module and powered by the output circuit for that seat. The HVAC module monitors inputs from a temperature sensor located in each seat's cushion heater mat, and maintains seat temperature by cycling the heater circuits on/off. The heated seat remains ON until the heated seat switch button is pressed to cycle the HVAC module OFF or the ignition is set to OFF.

If a fault is detected by the HVAC module, the module stops supplying voltage to that individual left or right seat that the fault was detected on until the ignition is turned OFF and then ON.

Heated Seats — Rear, Crew Cab

Rear heated seats are controlled by the heated seat module located behind the rear 60 percent seat backrest and a dual momentary switch attached to each rear door panel. When the heated seat switch is pressed, a momentary ground signal is sent to the heated seat module. The heated seat module then supplies voltage to the heater circuit. The seat cushion and backrest heater mats are wired in series and supplied voltage by the same output. The heated seat module monitors inputs from a temperature sensor, located in each cushion heater mat and maintains seat temperature by cycling output voltage to the heater grids as necessary to maintain the set point temperature. The heated seat module supplies voltage to the appropriate indicator circuit in the heated seat switch. The heated seat module does not time out and remains on until switched off or ignition is OFF.

The heated seat module does not report DTCs and does not communicate on any network. If a fault is detected, the affected seat system is disabled. The faults detected are:

- a heater feed circuit short to battery, ground or open.
- sensor circuit short to battery or open.
- heated seat switch stuck closed to ground.
- heated seat switch low and high inputs shorted together.

To reset the module, cycle the ignition OFF and then ON. After the heated seat module has been reset, the module returns to an off state.

A new heated seat module must be configured after installation for correct operation. Heated seat module configuration occurs automatically when the low heat mode button is pressed on either rear heated seat

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switch. Until the module is correctly configured, the heated seats operates incorrectly from the high heat mode button on either heated seat switch by following a sequence of high, low and off with each button press. After the low heat mode button is pressed on either heated seat switch, the module correctly configures and the system operates correctly.

Climate Controlled Seat System

NOTICE: **Avoid applying voltage directly to a Thermo-Electric Device (TED) for testing its operation. Doing so may cause damage to the TED .**

NOTE: When installing a new Dual Climate Controlled Seat Module (DCSM), it is necessary to carry out Programmable Module Installation (PMI). Refer to Section 418-01 .

Both the driver and front passenger climate controlled seats are independently controlled electronically by the DCSM mounted to the bottom of the passenger seat cushion. The climate controlled seat system only operates with the engine running. However, if a scan tool is used to command the DCSM , diagnostic testing can be carried out with the ignition ON engine OFF in 15 second durations.

If one of the voltage supply circuits opens, both seats will remain operational because the circuits are connected internally in the DCSM .

If a fault occurs and sets a DTC specific to either climate controlled seat, only the affected seat is disabled by the module. If the system shuts down due to a DTC fault, cycling the ignition to OFF and then ON again resets the DCSM to function until the DTC sets again.

When the climate control seat buttons are activated on the touchscreen interface, the Accessory Protocol Interface Module (APIM) sends the climate controlled seat commands to the Front Controls Interface Module (FCIM) using the Infotainment Controller Area Network (I-CAN). The FCIM sends the request message to the Instrument Panel Cluster (IPC) using the I-CAN . The IPC sends the request message to the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN). Finally, the BCM sends the climate controlled seat commands to the DCSM using the MS-CAN .

Each driver and front passenger seat cushion and backrest is equipped with a Thermo-Electric Device (TED) and blower motor assembly. Applying voltage to the TED in one direction causes it to heat. Applying voltage polarity in the opposite direction causes the TED to cool. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the incoming air depending on the control switch settings. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once activated, the DCSM maintains the heating/cooling modes until deactivated.

The temperature differences between the individual heated and cooled settings is minimal. For example, it is difficult to distinguish between LOW cool and MED cool settings. Measuring seat temperature at different settings is possible by monitoring the DCSM PIDs using the scan tool.

Heating Characteristics

- In heat mode, the TED can add up to 40-60°C (72-108°F) to the ambient inlet air temperature as it passes over the TED .
- The system control settings are indicated next to each climate controlled seat heat switch button on the touchscreen. The first setting is HIGH (3 indicators), the second setting is MED (2 indicators) and the third is LOW (1 indicator) then OFF (no indicators).
- When heating, the DCSM varies the speed of the blowers and the TED duty cycle in order to reach and maintain the temperature determined by the switch setting.

Cooling Characteristics

- In cool mode, the TED can remove up to 8°C (14°F) from the ambient air temperature entering the system.
- The system control settings are based on the 3 indicators next to each climate controlled seat cool switch button on the touchscreen. The first setting is HIGH (3 indicators), the second setting is MED (2 indicators) and the third is LOW (1 indicator) then OFF (no indicators).
- When cooling, the DCSM maintains constant speed of the blowers and constant TED supply voltage (the duty cycle is determined by the switch setting) in COOL mode.

Climate Controlled Seat System Recovery Mode

NOTE: The presence of overtemperature faults (DTCs B2729, B2730, B272A and B272B) can be induced by incorrect operation of the climate controlled seat system after an initial heat setting has been attained. If a heat setting is repeatedly turned OFF and ON in an attempt to increase the seat temperature or repeatedly toggled between heat and cool modes, an overtemperature condition can result and the DTCs are set.

If the temperature at one of the TEDs rises above 110°C (230°F) in the heat mode or 65°C (149°F) in the cool mode for more than 4 seconds, the DCSM records an overtemperature DTC, remove voltage from the TEDs and go into recovery mode (blower only) for 30 seconds to cool down the TEDs . The same occurs if a temperature difference of 60°C (108°F) or greater is seen between the backrest and cushion TEDs on either front seat. The DCSM continues to monitor the TEDs while in recovery mode. If the temperature of the TEDs does not drop to 105°C (221°F) in the heat mode or 60°C (140°F) in the cool mode after 30 seconds, the system continues to cool the TEDs in recovery mode for up to 5 minutes. If the TEDs cool down at anytime after 30 seconds, but before 5 minutes (checked at 4-second intervals), the system operates as normal. An overtemperature DTC still is recorded even if the system recovers and is operating normally. This is more likely to occur during extreme cabin temperatures with significant seat back sunload. If the system does not recover within 30 seconds in heat mode or within 5 minutes in cool mode, the DCSM disables that seat (fault mode) and remain off until the ignition is cycled. Also, if the DCSM detects temperature differential fault twice during the same ignition cycle, it shutdowns. When a fault causes a shutdown, the climate controlled seat indicators turns off and that seat is not operational until the next key cycle.

Remote Start Climate Operation (If Equipped With Heated Or Climate Controlled Seats)

The customer can select different climate control modes/preferences when the vehicle is started using the remote start feature. This can be accessed through the message center. For information on how to set the remote start preferences, refer to the Owner's Literature. When the driver seat and/or passenger seat is set to AUTO mode, the driver/passenger heated/climate controlled seat activates in full heat mode when the outside temperature is less than 0°C (32°F) and full cool mode (climate controlled seats only) when outside temperature is greater than 27° (80°F) any time the vehicle is started using the remote start feature. No heated/climate controlled seat adjustments are recognized during remote start operation. When the ignition is cycled to the ON position after a remote start event, the heated/climate controlled seat switches off.

Inspection and Verification

1. Verify the customer concern by operating the power seat, memory seat or climate controlled seat functions.

2. Visually inspect for obvious signs of mechanical and electrical damage.

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Visual Inspection Chart

Mechanical	Electrical

• Switch(es)
• Seat tracks obstructed or damaged
• Lumbar assembly damaged
• Recliner assembly damaged (backrest frame)
• Thermo-Electric Device (TED) assembly filter dirty (cushion or backrest)
	• Battery Junction Box (BJB) fuse(s):
	  ▪ 14 (30A) (passenger seat control switch)
	  ▪ 69 (30A) (Dual Climate Controlled Seat Module (DCSM) and front heated seat module)
	  ▪ 71 (20A) (rear heated seat module)
	  ▪ 74 (30A) (driver seat control switch)
	• Body Control Module (BCM) fuse(s):
	  ▪ 5 (20A) (Driver Seat Module (DSM) and front heated seat module)
	  ▪ 7 (7.5A) (DSM logic)
	• Wiring harness
	• Loose or corroded connector(s)
	• Seat control switch
	• Memory SET switch
	• Heated seat switch(es)
	• Power seat motor (seat track)
	• Power lumbar motor (lumbar assembly)
	• TED assembly (cushion or backrest)
	• Power recliner motor (backrest frame)
	• DSM
	• DCSM
	• FDIM
	• HVAC module
	• Seat cushion heater mat
	• Seat backrest heater mat
	• Heated seat module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the concern is with the power seat (non-memory seat), power lumbar or heated seat(s) and the cause is not visually evident, verify the symptom and GO to Symptom Chart .

5. If the concern is with the memory seat or climate controlled seat and the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

6. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms voltage and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .

- If the network test passes, retrieve and record on-demand and Continuous Memory Diagnostic Trouble Codes (CMDTCs).

9. Clear the CMDTCs and carry out the self-test diagnostics for the DSM, HVAC module, or DCSM.

10. If the DTCs retrieved are related to the concern, go to Driver Seat Module (DSM) DTC Chart, HVAC Module DTC Chart or Dual Climate Controlled Seat Module (DCSM) DTC Chart. For all other DTCs, refer to Section 419-10.

11. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

Driver Seat Module (DSM) DTC Chart

DTC	Description	Retrieved	Action
B106E	Solid State Driver Disabled due to Short Circuit	—	REFER to Section 501-09.
B106F	Module Disabled Due to External Fault	—	REFER to Section 501-09.
B1317	Continuous	Battery Voltage High	GO to Pinpoint Test AL.
B1318	Continuous	Battery Voltage Low	GO to Pinpoint Test AL.
B1534	Memory 1 Switch Circuit Short to Ground	On-Demand and Continuous	GO to Pinpoint Test F.
B1538	Memory 2 Switch Circuit Short to Ground	On-Demand and Continuous	GO to Pinpoint Test F.
B1663	Seat Driver Front Up/Down Motor Stalled	On-Demand	If the motor does not operate, GO to Pinpoint Test E. If motor operates, GO to Pinpoint Test F.
B1664	Seat Driver Rear Up/Down Motor Stalled	On-Demand	If the motor does not operate, GO to Pinpoint Test E. If motor operates, GO to Pinpoint Test F.
B1665	Seat Driver Forward/Backward Motor Stalled	On-Demand	If the motor does not operate, GO to Pinpoint Test E. If motor operates, GO to Pinpoint Test F.
B1666	Seat Driver Recline Motor Stalled	On-Demand	If the motor does not operate, GO to Pinpoint Test E. If motor operates, GO to Pinpoint Test F.
B1667	Mirror Driver Up/Down Motor Stalled	—	REFER to Section 501-09.
B1668	Mirror Driver Right/Left Motor Stalled	—	REFER to Section 501-09.
B1669	Mirror Passenger Up/Down Motor Stalled	—	REFER to Section 501-09.
B1670	Mirror Passenger Right/Left Motor Stalled	—	REFER to Section 501-09.

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B1703	Seat Driver Recline Forward Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1707	Seat Driver Recline Rearward Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1711	Seat Driver Front Up Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1715	Seat Driver Front Down Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1719	Seat Driver Forward Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1723	Seat Driver Rearward Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1727	Seat Driver Rear Up Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1731	Seat Driver Rear Down Switch Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test E .
B1733	Mirror Driver Vertical Switch Circuit Failure	—	REFER to Section 501-09 .
B1737	Mirror Driver Horizontal Switch Circuit Failure	—	REFER to Section 501-09 .
B1741	Mirror Passenger Vertical Switch Circuit Failure	—	REFER to Section 501-09 .
B1745	Mirror Passenger Horizontal Switch Circuit Failure	—	REFER to Section 501-09 .
B1952	Seat Rear Up/Down Position Feedback Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test F .
B1953	Seat Rear Up/Down Position Feedback Circuit Short to Ground	On-Demand and Continuous	GO to Pinpoint Test F .
B1956	Seat Front Up/Down Position Feedback Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test F .
B1957	Seat Front Up/Down Position Feedback Circuit Short to Ground	On-Demand and Continuous	GO to Pinpoint Test F .
B1960	Seat Recline Forward/Backward Position Feedback Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test F .
B1961	Seat Recline Forward/Backward Position	On-Demand and	GO to Pinpoint Test F .

	Feedback Circuit Short to Ground	Continuous	
B1964	Seat Horizontal Forward/Rearward Position Feedback Circuit Short to Battery	On-Demand and Continuous	GO to Pinpoint Test F .
B1965	Seat Horizontal Forward/Rearward Position Feedback Circuit Short to Ground	On-Demand and Continuous	GO to Pinpoint Test F .
B2223	Mirror Driver Drive Circuit Failure	—	REFER to Section 501-09 .
B2224	Mirror Passenger Drive Circuit Failure	—	REFER to Section 501-09 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	—	REFER to Section 501-09 .
B2314	Mirror Passenger Horizontal Feedback Potentiometer Circuit Short To Battery	—	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	—	REFER to Section 501-09 .
B2318	Mirror Passenger Vertical Feedback Potentiometer Circuit Short to Battery	—	REFER to Section 501-09 .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	—	REFER to Section 501-09 .
B2322	Mirror Driver Horizontal Feedback Potentiometer Circuit Short to Battery	—	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	—	REFER to Section 501-09 .
B2326	Mirror Driver Vertical Feedback Potentiometer Circuit Short to Battery	—	REFER to Section 501-09 .
B2477	Module Configuration Failure	Continuous	**NOTE:** This DTC indicates Programmable Module Installation (PMI) has not been done to a newly installed module or configuration data has been lost. Presence of this DTC alone does not prevent basic seat operation from the seat control switch. CARRY OUT PMI on the DSM . REFER to Section 418-01 . REPEAT the self-test and VERIFY successful PMI . CLEAR the DTCs.
U0140	Lost Communication With Body Control Module (GEM)	Continuous	CLEAR the DTC. REPEAT the self-test. If the DTC is retrieved again, REFER to Section 418-00 to diagnose the Medium Speed Controller Area Network (MS-CAN) concern.

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U2050	No Application Present	Continuous	INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section.

Dual Climate Controlled Seat Module (DCSM) DTC Chart

DTC	Description	Retrieved	Action
B103B	Thermoelectric Driver Overcurrent Low	On-Demand and Continuous	GO to Pinpoint Test X .
B103C	Thermoelectric Driver Open Load	On-Demand and Continuous	GO to Pinpoint Test Y .
B103D	Blower Driver Overtemperature	On-Demand and Continuous	GO to Pinpoint Test Z .
B1111	Driver Thermoelectric Device Control Overtemperature Fault	On-Demand and Continuous	GO to Pinpoint Test X .
B1113	Passenger Thermoelectric Device Control Overtemperature Fault	On-Demand and Continuous	GO to Pinpoint Test AA .
B111B	Passenger Thermoelectric Driver Overcurrent Low	On-Demand and Continuous	GO to Pinpoint Test AA .
B111C	Passenger Thermoelectric Driver Open Load	On-Demand and Continuous	GO to Pinpoint Test AB .
B111D	Passenger Blower Driver Overtemperature	On-Demand and Continuous	GO to Pinpoint Test AC .
B1342	ECU is Faulted	On-Demand and Continuous	INSTALL a new Dual Climate Controlled Seat Module (DCSM). REFER to Dual Climate Controlled Seat Module (DCSM) in this section.
B19A1	Passenger Seat Cushion Blower Speed Short to Battery	On-Demand and Continuous	GO to Pinpoint Test AD .
B19A2	Passenger Seat Back Blower Speed Short to Battery	On-Demand and Continuous	GO to Pinpoint Test AE .
B19A3	Driver Seat Cushion Blower Speed Short to Battery	On-Demand and Continuous	GO to Pinpoint Test AF .
B19A4	Driver Seat Back Blower Speed Short to Battery	On-Demand and Continuous	GO to Pinpoint Test AG .
B19A5	Passenger Seat Cushion Blower Speed Short to Ground	On-Demand and	GO to Pinpoint Test AH .

		Continuous	
B19A6	Passenger Seat Back Blower Speed Short to Ground	On-Demand and Continuous	GO to Pinpoint Test AI .
B19A7	Driver Seat Cushion Blower Speed Short to Ground	On-Demand and Continuous	GO to Pinpoint Test AJ .
B19A8	Driver Seat Back Blower Speed Short to Ground	On-Demand and Continuous	GO to Pinpoint Test AK .
B2477	Module Configuration Failure	On-Demand and Continuous	**NOTE:** This DTC indicates PMI has not been done to a newly installed module or configuration data has been lost. CARRY OUT PMI on the DCSM . REFER to Section 418-01 . REPEAT the self-test. If PMI is successful, the DTC is not present.
B2486	Climate Control Seat Module Voltage Out of Range	On-Demand and Continuous	GO to Pinpoint Test AL .
B2729	Cushion Over-Temp Detected (Driver)	On-Demand and Continuous	GO to Pinpoint Test AM .
B272A	Passenger Cushion Over-Temp Detected	On-Demand and Continuous	GO to Pinpoint Test AN .
B272B	Passenger Back Over-Temp Detected	On-Demand and Continuous	GO to Pinpoint Test AO .
B272C	Driver Differential Temperature Fault	On-Demand and Continuous	GO to Pinpoint Test AP .
B272D	Passenger Differential Temperature Fault	On-Demand and Continuous	GO to Pinpoint Test AQ .
B272E	Driver Ignition Run/Blower Circuit Short to Ground (this DTC sets for an open or short to voltage)	On-Demand and Continuous	GO to Pinpoint Test AR .
B272F	Passenger Ignition Run/Blower Circuit Short to Ground (this DTC sets for an open or short to voltage)	On-Demand and Continuous	GO to Pinpoint Test AS .
B2730	Back Over-Temp Detected (Driver)	On-Demand and Continuous	GO to Pinpoint Test AT .
U2050	No Application Present	Continuous	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section.

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HVAC Module DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

DTC	Description	Action to Take
B1034:11	Left Front Seat Heater Element: Circuit Short To Ground	GO to Pinpoint Test N.
B1034:13	Left Front Seat Heater Element: Circuit Open	GO to Pinpoint Test N.
B1036:11	Right Front Seat Heater Element: Circuit Short To Ground	GO to Pinpoint Test O.
B1036:13	Right Front Seat Heater Element: Circuit Open	GO to Pinpoint Test O.
B1038:11	Left Front Seat Heater Sensor: Circuit Short To Ground	GO to Pinpoint Test N.
B1038:12	Left Front Seat Heater Sensor: Circuit Short To Battery	GO to Pinpoint Test N.
B103A:11	Right Front Seat Heater Sensor: Circuit Short To Ground	GO to Pinpoint Test O.
B103A:12	Right Front Seat Heater Sensor: Circuit Short To Battery	GO to Pinpoint Test O.
All other DTCs	—	REFER to Section 412-00.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the Driver Seat Module (DSM)	• Fuse • Wiring, terminals or connectors • DSM	• REFER to Section 418-00.
• No communication with the Dual Climate Controlled Seat Module (DCSM)	• Fuse • Wiring, terminals or connectors • DCSM	• REFER to Section 418-00.
• The power seat is inoperative — driver, with manual recliner	• Fuse • Wiring, terminals or connectors • Seat control switch	• GO to Pinpoint Test A.
• The power seat is inoperative — passenger	• Fuse • Wiring, terminals or connectors	• GO to Pinpoint Test B.

	• Seat control switch	
• The power seat moves but is noisy (squeals) when moving the seat horizontally	• Front seat motor cable	• INSTALL a new front seat motor cable. REFER to Front Seat Motor Cable .
• The power seat does not move horizontally/vertically — driver, with manual recliner	• Wiring, terminals or connectors • Seat control switch • Horizontal seat track motor • Power seat track assembly	• GO to Pinpoint Test C .
• The power seat does not move horizontally/vertically/recline — passenger	• Wiring, terminals or connectors • Seat control switch • Horizontal seat track motor • Power seat track assembly	• GO to Pinpoint Test D .
• The power seat does not move horizontally/vertically/recline — driver, with memory	• Fuse • Wiring, terminals or connectors • Seat control switch • Horizontal seat track motor • Memory seat track assembly • DSM	• GO to Pinpoint Test E .
• The memory seat does not operate correctly — motor(s) operate in one second intervals or memory seat recall not functioning correctly	• Wiring, terminals or connectors • Memory SET switch • Horizontal seat track motor • Memory seat track assembly • DSM	• GO to Pinpoint Test F .
• The memory seat does not operate correctly — does not operate using the Remote Keyless Entry (RKE) transmitter	• RKE Integrated Keyhead Transmitter (IKT) is not correctly associated to a memory position • Wiring, terminals or connectors • IKT	• VERIFY the RKE transmitter is operating correctly and is associated to a memory position. REFER to the Owner's Literature or Section 501-14 for information on associating a RKE transmitter. RUN the DSM self-test. REFER to the Driver Seat Module (DSM) DTC Chart to diagnose

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	• DSM • Body Control Module (BCM)	any DTCs retrieved.

• Easy entry/easy exit is inoperative/does not operate correctly	• Easy entry/exit feature is not enabled
	• Wiring, terminals or connectors
	• Missing status information — Medium Speed Controller Area Network (MS-CAN)
	  ▪ ignition status
	  ▪ gear selector position
	• Key-in-ignition switch
	• DSM
		• GO to Pinpoint Test G .

• The power lumbar is inoperative — driver	• Wiring, terminals or connectors • Seat control switch • Power lumbar motor • Power lumbar assembly	• GO to Pinpoint Test H .
• The power lumbar is inoperative — passenger	• Wiring, terminals or connectors • Seat control switch • Power lumbar motor • Power lumbar assembly	• GO to Pinpoint Test I .
• All climate controlled seats are inoperative	• Fuse • Wiring, terminals or connectors • I-CAN communication fault • HS-CAN communication fault • MS-CAN communication fault • DCSM • FCIM • APIM	• VERIFY Battery Junction Box (BJB) fuse 69 (30A) is OK. If OK, CARRY OUT the network test using a scan tool and VERIFY network communication of the Front Controls Interface Module (FCIM) and DCSM . REFER to Section 418-00 to diagnose a module communication or network concern. If OK, CARRY OUT the DCSM self-test and RETRIEVE any DTCs. If any DTC is

	• FDIM	present, REFER to the Dual Climate Controlled Seat Module (DCSM) DTC Chart. VERIFY the touchscreen operation. If the touchscreen does not operate correctly, REFER to Section 415-00D or Section 415-00E to diagnose the inoperative touchscreen. If OK, INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section.
• A single climate controlled seat is inoperative	• Wiring, terminals or connectors • APIM • FDIM • DCSM	• **NOTE:** If a fault occurs setting a DTC specific to only one climate controlled seat, the DCSM disables only the affected seat outputs and allow the other seat to remain operational. CHECK for DTCs specific to the affected climate controlled seat and if a DTC is present, REFER to the Dual Climate Controlled Seat Module (DCSM) DTC Chart. GO to Pinpoint Test L.
• A single climate controlled seat does not operate correctly — poor or intermittent cooling/heating	• Excessive sun load or extreme cabin temperatures • Incorrectly installed Thermo-Electric Device (TED) or manifold • Air flow blockage • TED • DCSM	• CARRY OUT the DCSM self-test and retrieve any DTCs. If any DTC is present, REFER to the Dual Climate Controlled Seat Module (DCSM) DTC Chart. If no DTC is present, CHECK the affected seat cushion or backrest for correct installation of the climate controlled seat components (TED, manifold air duct and foam pad) and REPAIR as needed. If OK, CHECK for air flow restrictions (TED inlets and outlets, TED -to-manifold connections, filters and ducts) and REPAIR as needed. CHECK the TED cooling performance on the affected seat and VERIFY the system is operating correctly. REFER to

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		Component Test — Thermo-Electric Device (TED) Cooling Performance.
• A single climate controlled seat does not operate correctly — exhibits poor air flow or performance	• Incorrectly installed Thermo-Electric Device (TED) or manifold • Air flow blockage • Disconnected air duct	• CARRY OUT the DCSM self-test and retrieve any DTCs. If any DTC is present, CHECK the affected seat cushion or backrest for correct installation of the climate controlled seat components (TED , manifold air duct and foam pad) and REPAIR as needed. If OK, CHECK for air flow restrictions (TED inlets and outlets, TED -to-manifold connections, filters and ducts) and REPAIR as needed. RETEST the system for normal operation.
• The heated seat is inoperative — driver	• Fuse • Wiring, terminals or connectors • FDIM • APIM • FCIM • Heater mat • HVAC module	• GO to Pinpoint Test N .
• The heated seat is inoperative — front passenger	• Fuse • Wiring, terminals or connectors • FDIM • APIM • FCIM • Heater mat • HVAC module	• GO to Pinpoint Test O .
• The heated seats are inoperative — rear	• Fuse(s) • Wiring, terminals or connectors • Heated seat module	• GO to Pinpoint Test Q .
• The heated seat is inoperative — left rear	• Fuse • Wiring, terminals or connectors • Heated seat switch • Heater mat • Heated seat module	• GO to Pinpoint Test R .

• The heated seat is inoperative — right rear	• Fuse • Wiring, terminals or connectors • Heated seat switch • Heater mat • Heated seat module	• GO to Pinpoint Test S .
• The heated seat does not operate correctly — left rear seat does heat but the heated seat indicator does not illuminate when pressed	• Wiring, terminals or connectors • Heated seat switch • Heated seat module	• GO to Pinpoint Test T .
• The heated seat does not operate correctly — right rear seat does heat but the heated seat indicator does not illuminate when pressed	• Wiring, terminals or connectors • Heated seat switch • Heated seat module	• GO to Pinpoint Test U .
• The heated seat does not operate correctly — left rear heated seat indicator is always on	• Wiring, terminals or connectors • Heated seat module	• GO to Pinpoint Test V .
• The heated seat does not operate correctly — right rear heated seat indicator is always on	• Wiring, terminals or connectors • Heated seat module	• GO to Pinpoint Test W .

Pinpoint Tests

NOTICE: **Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.**

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Refer to Inspection and Verification, the Driver Seat Module (DSM) DTC Chart, Dual Climate Controlled Seat Module (DCSM) DTC Chart, HVAC Module DTC Chart and the Symptom Chart for direction to the appropriate pinpoint test.

Pinpoint Test A: The Power Seat is Inoperative — Driver, With Manual Recliner

Refer to Wiring Diagrams Cell 120 , Power Seats for schematic and connector information.

Normal Operation

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The driver seat control switch is supplied voltage and ground. When the driver seat control switch is activated, voltage and ground is supplied to the applicable seat track motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly.

This pinpoint test is intended to diagnose the following:

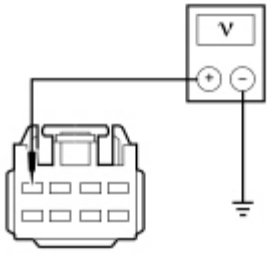
- Fuse
- Wiring, terminals or connectors
- Seat control switch

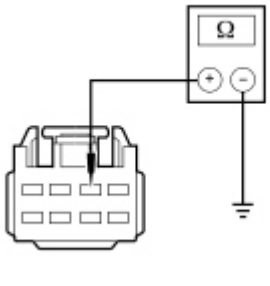
PINPOINT TEST A: THE POWER SEAT IS INOPERATIVE — DRIVER, WITH MANUAL RECLINER

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
A1 CHECK THE DRIVER SEAT CONTROL SWITCH FOR VOLTAGE • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Driver Seat Control Switch C360 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between driver seat control switch C360-4, circuit CBX05 (VT/RD), harness side and ground.  N0010817 • **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** VERIFY Battery Junction Box (BJB) fuse 74 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
A2 CHECK THE DRIVER SEAT CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN • Measure the resistance between driver seat control switch	**Yes**

C360-2, circuit GD904 (BK/BU), harness side and ground.  N0010818 • **Is the resistance less than 5 ohms?**	INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test B: The Power Seat is Inoperative — Passenger

Refer to Wiring Diagrams Cell 120, Power Seats for schematic and connector information.

Normal Operation

When the passenger seat control switch is activated, voltage and ground is supplied to the applicable seat track motor or seat recliner motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward. If a new seat track motor needs to be installed, it is necessary to install an entire seat track assembly.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Seat control switch

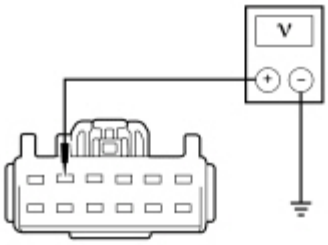
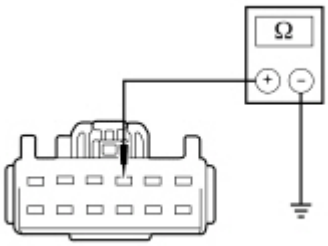
PINPOINT TEST B: THE POWER SEAT IS INOPERATIVE — PASSENGER

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B.

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

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NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
B1 CHECK THE PASSENGER SEAT CONTROL SWITCH FOR VOLTAGE	
• Ignition OFF. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Passenger Seat Side Air Bag Module C339. • Disconnect: Passenger Seat Control Switch C330. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Measure the voltage between passenger seat control switch C330-5, circuit CBX05 (VT/RD), harness side and ground.  N0010819 • **Is the voltage greater than 10 volts?**	**Yes** GO to B2. **No** VERIFY Battery Junction Box (BJB) fuse 14 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
B2 CHECK THE PASSENGER SEAT CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between passenger seat control switch C330-3, circuit GD903 (BK/WH), harness side and ground.  N0010825 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side

	air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test C: The Power Seat Does Not Move Horizontally/Vertically — Driver, With Manual Recliner

Refer to Wiring Diagrams Cell 120 , Power Seats for schematic and connector information.

Normal Operation

When the driver seat control switch is activated, voltage and ground is supplied to the applicable seat track motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). If a new seat track motor needs to be installed, it is necessary to install an entire seat track assembly.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Seat control switch
- Horizontal seat track motor
- Power seat track assembly

PINPOINT TEST C: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY — DRIVER, WITH MANUAL RECLINER

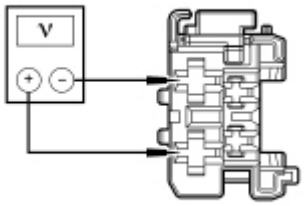
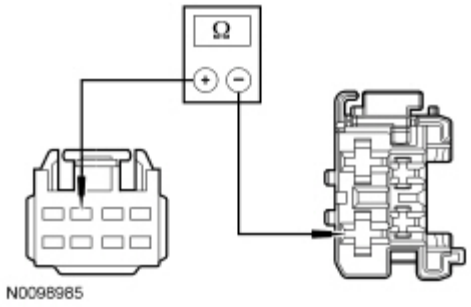
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

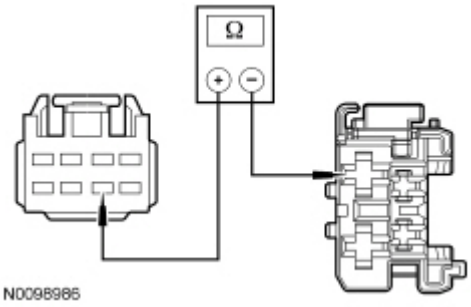
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

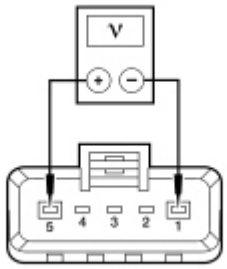
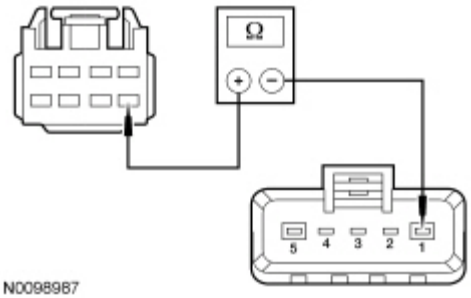
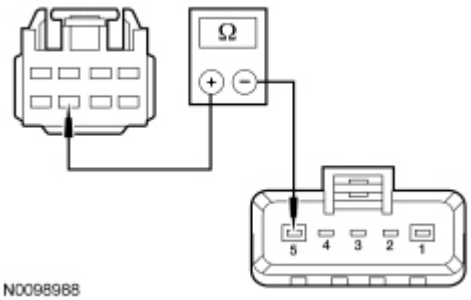
Test Step	Result / Action to Take
C1 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
• Operate the driver power seat forward and rearward. • **Will the seat move horizontally?**	**Yes** GO to C5 . **No** GO to C2 .
C2 CHECK VOLTAGE TO THE HORIZONTAL MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Driver Seat Horizontal Motor C362 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may**	**Yes** INSTALL a new front seat track motor. REFER to Seat Track Motor — Front in this section. TEST the system for normal operation.

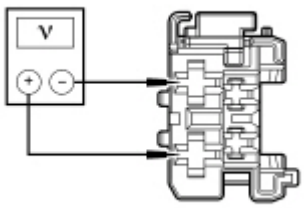
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result in serious personal injury in the event of an accidental deployment. • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between driver seat horizontal motor C362-1, circuit CPS23 (GN/VT), harness side and C362-2, circuit CPS28 (GN), harness side, while pressing the driver seat control switch forward and rearward.  N0057525 • **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to C3 .
C3 CHECK THE HORIZONTAL MOTOR CIRCUIT FOR AN OPEN	
• Disconnect: Driver Seat Control Switch C360 . • Measure the resistance between driver seat control switch C360-3, circuit CPS23 (GN/VT), harness side and driver seat horizontal motor C362-1, circuit CPS23 (GN/VT), harness side.  N0098985 • **Is the resistance less than 5 ohms?**	**Yes** GO to C4 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
C4 CHECK THE HORIZONTAL MOTOR CIRCUIT FOR AN OPEN	
• Measure the resistance between driver seat control switch C360-6, circuit CPS28 (GN), harness side and driver seat horizontal motor C362-2, circuit CPS28 (GN), harness side.	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051.

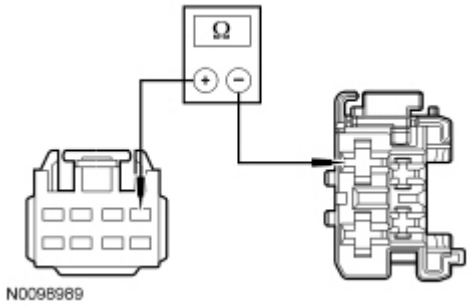
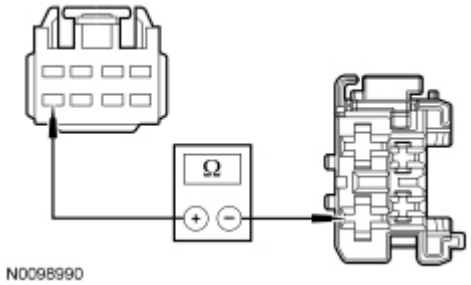
 • **Is the resistance less than 5 ohms?**	REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
C5 DETERMINE THE SEAT HEIGHT ADJUST FAILURE	
• Operate the front and rear seat height adjustments. • **Are both front and rear seat height adjustments inoperative?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** If only front height adjust operates, GO to C6 . If only rear height adjust operates, GO to C9 .
C6 CHECK VOLTAGE TO THE REAR HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Driver Seat Rear Height Motor C363 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated.	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS .

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• Measure the voltage between driver seat rear height motor C363-5, circuit CPS26 (YE/BU), harness side and C363-1, circuit CPS27 (BU/BN), harness side, while operating the seat control switch rear height adjust up and down.  N0091109 • **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**	REFER to Section 501-20B . **No** GO to C7 .
C7 CHECK THE REAR HEIGHT MOTOR CIRCUIT FOR AN OPEN	
• Disconnect: Driver Seat Control Switch C360 . • Measure the resistance between driver seat control switch C360-5, circuit CPS27 (BU/BN), harness side and driver seat rear height motor C363-1, circuit CPS27 (BU/BN), harness side.  N0098987 • **Is the resistance less than 5 ohms?**	**Yes** GO to C8 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
C8 CHECK THE REAR HEIGHT MOTOR CIRCUIT FOR AN OPEN	
• Measure the resistance between driver seat control switch C360-7, circuit CPS26 (YE/BU), harness side and driver seat rear height motor C363-5, circuit CPS26 (YE/BU), harness side.  N0098988 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST

	the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
C9 CHECK VOLTAGE TO THE FRONT HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Driver Seat Front Height Motor C382 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between driver seat front height motor C382-1, circuit CPS24 (GY), harness side and C382-2, circuit CPS25 (WH/VT), while operating the seat control switch front height adjust up and down.  N0057525 • **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to C10 .
C10 CHECK THE FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN	
• Disconnect: Driver Seat Control Switch C360 . • Measure the resistance between driver seat control switch C360-1, circuit CPS25 (WH/VT), harness side and driver seat front height motor C382-2, circuit CPS25 (WH/VT), harness side.	**Yes** GO to C11 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable.

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 N0098989 • **Is the resistance less than 5 ohms?**	CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.
C11 CHECK THE FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN	
• Measure the resistance between driver seat control switch C360-8, circuit CPS24 (GY) harness side, and driver seat front height motor C382-1, circuit CPS24 (GY), harness side.  N0098990 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test D: The Power Seat Does Not Move Horizontally/Vertically/Recline — Passenger

Refer to Wiring Diagrams Cell 120, Power Seats for schematic and connector information.

Normal Operation

When the passenger seat control switch is activated, voltage and ground is supplied to the applicable seat track motor or seat recliner motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward. If a new seat track motor needs to be installed, it is necessary to install an entire seat track

assembly.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Seat control switch
- Horizontal seat track motor
- Power seat track assembly

PINPOINT TEST D: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY/RECLINE — PASSENGER

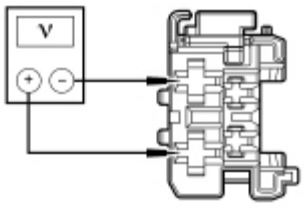
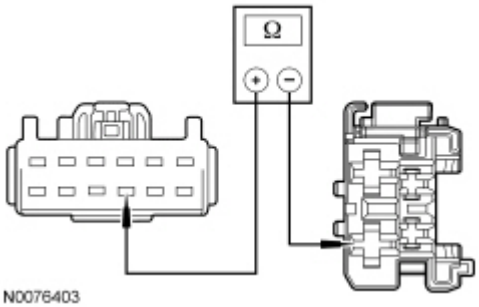
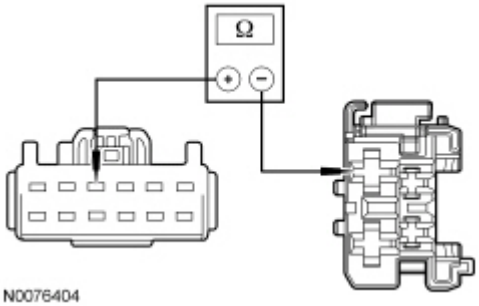
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

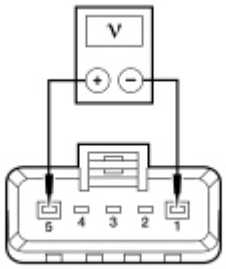
Test Step	Result / Action to Take
D1 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
• Operate the passenger power seat forward and rearward. • **Will the seat move horizontally?**	**Yes** GO to D2 . **No** GO to D3 .
D2 CHECK THE RECLINER MOTOR FOR CORRECT OPERATION	
• Recline the passenger backrest forward and rearward. • **Will the seat backrest recline forward and rearward?**	**Yes** GO to D6 . **No** GO to D13 .
D3 CHECK VOLTAGE TO THE HORIZONTAL MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: Passenger Seat Horizontal Motor C332 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat horizontal motor C332-1, circuit CPS38 (GN/BU), harness side and C332-2, circuit CPS33 (WH), harness side, while pressing the passenger seat control switch forward and rearward.	**Yes** INSTALL a new front seat track motor. REFER to Seat Track Motor — Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

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 N0057525 • **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**	**No** GO to D4 .
D4 CHECK THE HORIZONTAL MOTOR CIRCUIT FOR AN OPEN	
• Disconnect: Passenger Seat Control Switch C330 . • Measure the resistance between passenger seat control switch C330-9, circuit CPS38 (GN/BU), harness side and passenger seat horizontal motor C332-1, circuit CPS38 (GN/BU), harness side.  N0076403 • **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D5 CHECK THE HORIZONTAL MOTOR CIRCUIT FOR AN OPEN	
• Measure the resistance between passenger seat control switch C330-4, circuit CPS33 (WH), harness side and passenger seat horizontal motor C332-2, circuit CPS33 (WH), harness side.  N0076404 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation.

	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D6 DETERMINE THE SEAT HEIGHT ADJUST FAILURE	
• Operate the front and rear seat height adjustments. • **Does the seat front and rear height adjust up and down?**	**Yes** If only front height adjust operates, GO to D7 . If only rear height adjust operates, GO to D10 . **No** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D7 CHECK VOLTAGE TO THE REAR HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: Rear Height Motor C3075 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat rear height motor C3075-5, circuit CPS36 (YE/GY), harness side and C3075-1, circuit CPS37 (WH/BU), harness side, while depressing the seat control switch rear height adjust up and down.	**Yes** INSTALL a new passenger seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to D8 .

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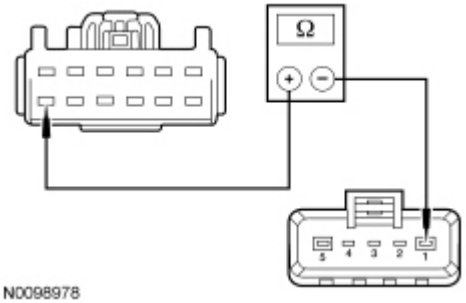


N0091003

- **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**

D8 CHECK THE REAR SEAT HEIGHT MOTOR FOR AN OPEN

- Disconnect: Passenger Seat Control Switch C330 .
- Measure the resistance between passenger seat control switch C330-12, circuit CPS37 (WH/BU), harness side and passenger seat rear height motor C3075-1, circuit CPS37 (WH/BU), harness side.



N0098978

- **Is the resistance less than 5 ohms?**

Yes
GO to D9 .

No
REPAIR the circuit. TEST the system for normal operation.

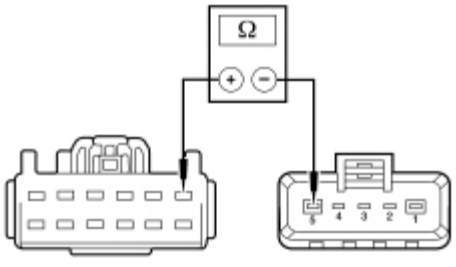
DISCONNECT the battery ground cable.

CONNECT passenger seat side air bag module C339.

REPOWER the SRS .
REFER to Section 501-20B .

D9 CHECK THE REAR SEAT HEIGHT MOTOR CIRCUIT FOR AN OPEN

- Measure the resistance between passenger seat control switch C330-1, circuit CPS36 (YE/GY), harness side and passenger seat rear height motor C3075-5, circuit CPS36 (YE/GY), harness side.



N0098977

- **Is the resistance less than 5 ohms?**

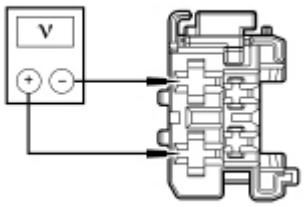
Yes
INSTALL a new passenger seat control switch.
REFER to Seat Control Switch in this section.
TEST the system for normal operation.

DISCONNECT the battery ground cable.

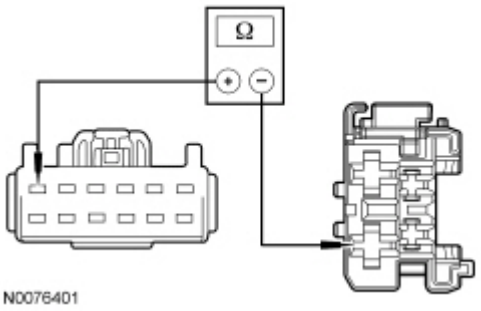
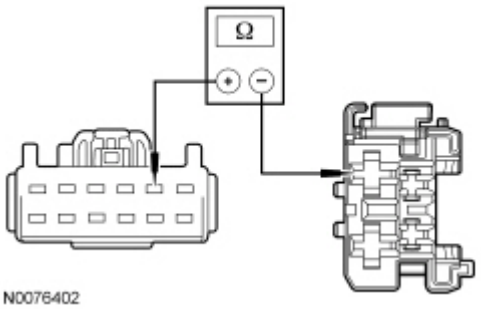
CONNECT passenger seat side air bag module C339.

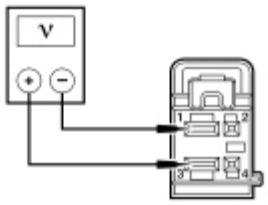
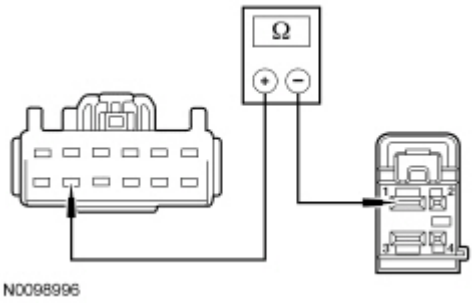
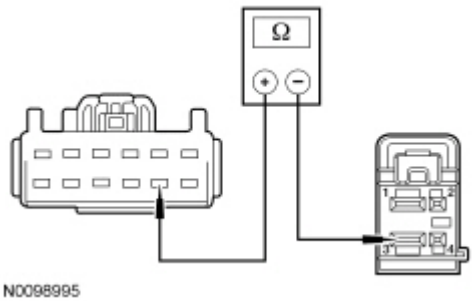
REPOWER the SRS .
REFER to Section 501-20B .

No
REPAIR the circuit. TEST the system for normal operation.

	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D10 CHECK VOLTAGE TO THE FRONT HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: Passenger Seat Front Height Motor C3074 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat front height motor C3074-1, circuit CPS35 (VT/GN), harness side and C3074-2, circuit CPS34 (GY/BU), while pressing the seat control switch front height adjust up and down.  N0057525 • **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**	**Yes** INSTALL a new seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to D11 .
D11 CHECK THE FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN	
• Disconnect: Passenger Seat Control Switch C330 . • Measure the resistance between passenger seat control switch C330-6, circuit CPS35 (VT/GN), harness side and front height motor C3074-1, circuit CPS35 (VT/GN), harness side.	**Yes** GO to D12 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat

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 N0076401 • **Is the resistance less than 5 ohms?**	side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D12 CHECK THE FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN	
• Measure the resistance between passenger seat control switch C330-2, circuit CPS34 (GY/BU) harness side, and front height motor C3074-2, circuit CPS34 (GY/BU), harness side.  N0076402 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D13 CHECK VOLTAGE TO THE SEAT RECLINER MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: Passenger Seat Recliner Motor C3189 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 .	**Yes** INSTALL a new seat recliner motor. REFER to Seat Recliner Motor in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat

• **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat recliner motor C3189-3, circuit CPS08 (VT/OG), harness side and C3189-1, circuit CPS07 (GY/BN), while pressing the recline switch forward and rearward.  N0091006 • **Is the voltage greater than 10 volts when the seat control switch is operated in both directions and 0 volt in the rest position?**	side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to D14 .
D14 CHECK THE RECLINER MOTOR CIRCUIT FOR AN OPEN	
• Disconnect: Passenger Seat Control Switch C330 . • Measure the resistance between passenger seat control switch C330-11, circuit CPS39 (GY/YE), harness side and seat recliner motor C3189-1, circuit CPS07 (GY/BN), harness side.  N0098996 • **Is the resistance less than 5 ohms?**	**Yes** GO to D15 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
D15 CHECK THE RECLINER MOTOR CIRCUIT FOR AN OPEN	
• Measure the resistance between passenger seat control switch C330-8, circuit CPS40 (VT/GY) harness side, and seat recliner motor C3189-3, circuit CPS08 (VT/OG), harness side.  N0098995 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-

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	20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test E: The Power Seat Does Not Move Horizontally/Vertically/Recline — Driver, With Memory

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 149 , Component Testing for component testing.

Normal Operation

The seat control switch supplies voltage and ground to the applicable Driver Seat Module (DSM) inputs. The DSM then supplies voltage and ground to the appropriate seat track motor or seat recliner motor to move the seat in the desired direction. There are 3 seat track motors that combine to move the seat horizontally (forward/backward) and vertically (front up/down and rear up/down). The seat recliner mechanism uses a single motor to pivot the seat backrest forward and backward.

The following pinpoint test diagnoses a power seat with memory that does not operate or does not operate correctly. If the seat does not operate using the memory SET switch or operates in one second intervals, GO to Pinpoint Test F .

DTC Description	Fault Trigger Conditions
• B1663 — Seat Driver Front Up/Down Motor Stalled • B1664 — Seat Driver Rear Up/Down Motor Stalled • B1665 — Seat Driver Forward/Backward Motor Stalled	During self-test, the DSM attempts to operate the appropriate seat track motor and uses the motor's position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no movement continues to be monitored after 250 milliseconds, the DSM disables the output.
• B1666 — Seat Driver Recline Motor Stalled	During self-test, the DSM attempts to operate the recliner motor and uses the recliner motor position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no motor movement is still monitored after 250 milliseconds, the DSM disables the output.
• B1703 — Seat Driver Recline Forward Switch	If voltage is sensed on the switch input circuit during the DSM self-test, the DTC is set. If voltage is sensed on the input circuit for greater than

Circuit Short to Battery • B1707 — Seat Driver Recline Rearward Switch Circuit Short to Battery	2 minutes the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1711 — Seat Driver Front Up Switch Circuit Short to Battery • B1715 — Seat Driver Front Down Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM self-test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1719 — Seat Driver Forward Switch Circuit Short to Battery • B1723 — Seat Driver Rearward Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM self-test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1727 — Seat Driver Rear Up Switch Circuit Short to Battery • B1731 — Seat Driver Rear Down Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM self-test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Seat control switch
- Horizontal seat track motor
- Memory seat track assembly
- DSM

PINPOINT TEST E: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY/RECLINE — DRIVER, WITH MEMORY

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

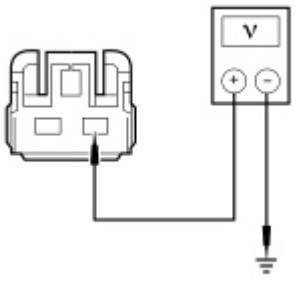
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

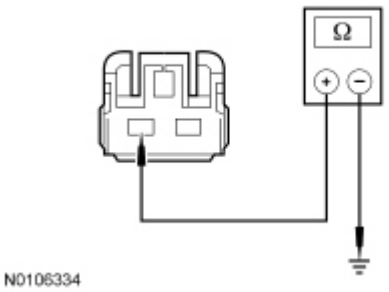
NOTE: If a new DSM has been installed, all seat soft stops must be reset. If a new seat track or recline motor has been installed, only reset the soft stops for that component being installed new. To reset the soft stops, refer to Principles of Operation in this section.

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

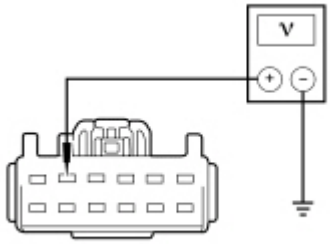
Test Step	Result / Action to Take
E1 RETRIEVE THE DSM DTCs	

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• Enter the following diagnostic mode on the scan tool: Self Test — DSM . • **Are any DSM DTCs retrieved?**	**Yes** If DTCs B1663, B1664, B1665 and B1666 are all retrieved, GO to E2 . If DTC B1663, GO to E11 . If DTC B1664, GO to E14 . If DTC B1665, GO to E17 . If DTC B1666, GO to E20 . If DTC B1703, B1707, B1711, B1715, B1719, B1723, B1727 or B1731, GO to E8 . For any other DSM DTCs, REFER to the Driver Seat Module (DSM) DTC Chart. **No** GO to E4 .
E2 CHECK FOR VOLTAGE TO THE DSM • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: DSM C341A . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between DSM C341A-1, circuit CBX05 (VT/RD), harness side and ground.  N0067979 • **Is the voltage greater than 10 volts?**	**Yes** GO to E3 . **No** VERIFY Battery Junction Box (BJB) fuse 74 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
E3 CHECK THE DSM GROUND CIRCUIT FOR AN OPEN • Measure the resistance between DSM C341A-2, circuit GD906 (BK/GY), harness side and ground.	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test.

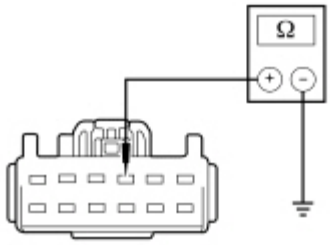
 N0106334 • **Is the resistance less than 5 ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
E4 MONITOR THE DSM PIDs AND CHECK FOR CORRECT SEAT CONTROL SWITCH INPUTS • Enter the following diagnostic mode on the scan tool: DataLogger — DSM . ▪ Driver Power Seat Front Up/Down Switch (SFNT_SW) ▪ Driver Power Seat Forward/Backward Switch (SFWD_SW) ▪ Driver Power Seat Recline Switch Status (SRCL_SW) ▪ Driver Power Seat Rear Up/Down Switch (SREARSW) • Operate the seat control switch in all positions while monitoring the DSM driver seat control switch input status PIDs. • **Do the PID values agree with the switch positions?**	**Yes** GO to E10 . **No** If no response from any PID, GO to E5 . Otherwise, GO to E7 .
E5 CHECK VOLTAGE TO THE SEAT CONTROL SWITCH • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Seat Control Switch C369 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between seat control switch C369-5, circuit CBX04 (WH/RD), harness side and ground.	**Yes** GO to E6 . **No** VERIFY Body Control Module (BCM) fuse 5 (20A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

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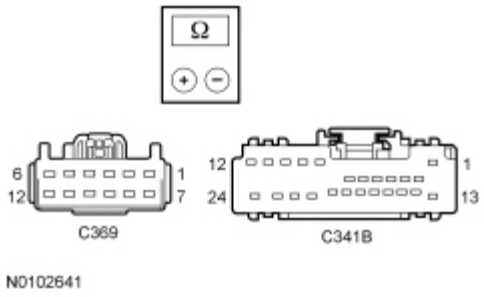
N0010816

- **Is the voltage greater than 10 volts?**

E6 CHECK THE SEAT CONTROL SWITCH GROUND FOR AN OPEN	
• Measure the resistance between seat control switch C369-3, circuit GD904 (BK/BU), harness side and ground.  N0010815 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. CLEAR the DTCs. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
E7 CHECK THE AFFECTED CIRCUITS BETWEEN THE SEAT CONTROL SWITCH AND DSM FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: DSM C341B . • Disconnect: Seat Control Switch C369 . • Measure the resistance between seat control switch C369, harness side and DSM C341B, harness side using the following chart:	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. CLEAR the DTCs. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

Seat Control Switch Connector	Circuit	DSM Connector
C369-1	CPS27 (BU/BN)	C341B-17

C369-2	CPS25 (WH/VT)	C341B-18
C369-4	CPS23 (GN/VT)	C341B-16
C369-6	CPS24 (GY)	C341B-6
C369-8	CPS30 (VT/BN)	C341B-7
C369-9	CPS28 (GN)	C341B-15
C369-11	CPS29 (WH/BN)	C341B-19
C369-12	CPS26 (YE/BU)	C341B-5



N0102641

- **Are the resistances less than 5 ohms?**

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable.

CONNECT driver seat side air bag module C3051.

REPOWER the SRS. REFER to Section 501-20B.

E8 CHECK THE SEAT CONTROL SWITCH

- Remove the seat control switch. Refer to Seat Control Switch in this section.
- Check the seat control switch.

  Refer to Wiring Diagrams Cell 149, Component Testing for component testing.

- **Is the seat control switch OK?**

Yes
GO to E9.

No
INSTALL a new seat control switch. REFER to Seat Control Switch in this section. CLEAR the DTCs. TEST the system for normal operation.

E9 CHECK THE AFFECTED CIRCUITS BETWEEN THE SEAT CONTROL SWITCH AND DSM FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Depower the SRS. Refer to Section 501-20B.
- Disconnect: Driver Seat Side Air Bag Module C3051.
- Disconnect: DSM C341B.
- **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
- Connect the battery ground cable. Refer to Section 414-01.
- Ignition ON.

Yes
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable.

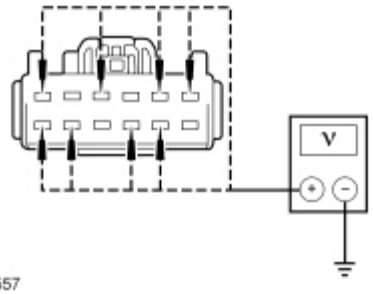
CONNECT driver seat side air bag module C3051.

REPOWER the SRS. REFER to Section 501-20B.

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- Measure the voltage between seat control switch C369, harness side and ground using the following chart:

Seat Control Switch Connector	Circuit
C369-1	CPS27 (BU/BN)
C369-2	CPS25 (WH/VT)
C369-4	CPS23 (GN/VT)
C369-6	CPS24 (GY)
C369-8	CPS30 (VT/BN)
C369-9	CPS28 (GN)
C369-11	CPS29 (WH/BN)
C369-12	CPS26 (YE/BU)



N0013557

- **Is any voltage present on any circuit?**

No
INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable.

CONNECT driver seat side air bag module C3051.

REPOWER the SRS . REFER to Section 501-20B .

E10 CHECK THE DSM FOR CORRECT OUTPUTS

- Enter the following diagnostic mode on the scan tool: DataLogger — DSM .
  - Front Motor Up (FRONT_UP)
  - Front Motor Down (FRONT_DWN)
  - Rear Motor Up (REAR_UP)
  - Rear Motor Down (REAR_DWN)
  - Horizontal Motor Forward (HORZ_FWD)
  - Horizontal Motor Backward (HORZ_BWD)
  - Recline Motor Forward (RECL_FWD)
  - Recline Motor Backward (RECL_BWD)
- Toggle the DSM active commands ON and OFF while monitoring the seat movement.
- **Does the driver seat operate correctly using the active commands?**

Yes
The fault is intermittent. CHECK the electrical connectors for corrosion, poor pin contact or pushed out pins, particularly the pins and terminals of electrical connectors that were disconnected. **Do not install any new components at this time. Components should only be installed when directed to do so in the pinpoint test.** REPAIR any intermittent wiring, terminal or connector concerns found. CLEAR the DTCs. REPEAT the self-test.

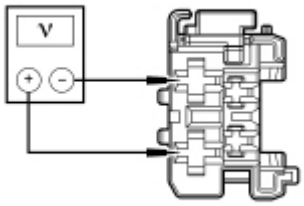
DISCONNECT the battery ground cable.

CONNECT driver seat side air bag module C3051.

REPOWER the SRS . REFER to Section 501-20B .

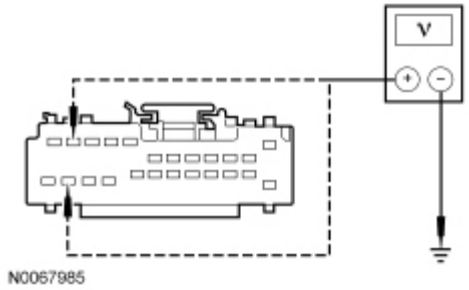
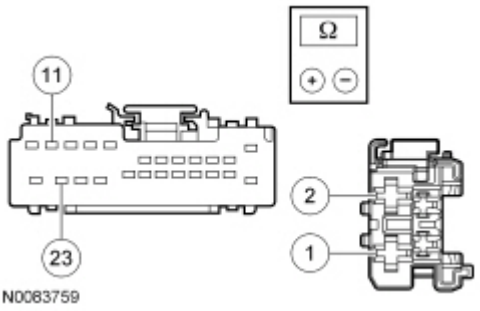
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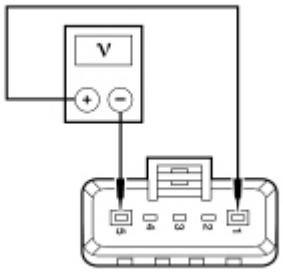
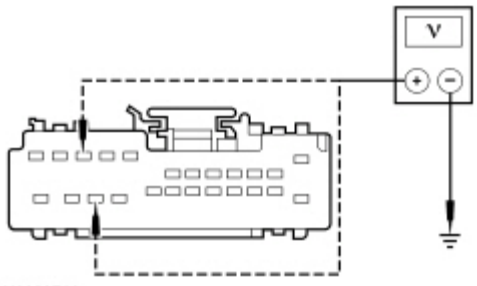
	If no front height seat movement, GO to E11. If no rear height seat movement, GO to E14. If no horizontal seat movement, GO to E17. If no seat recliner movement, GO to E20.

E11 CHECK THE FRONT HEIGHT MOTOR FOR CORRECT OPERATION USING ACTIVE COMMANDS
 	
• Ignition OFF.
• Depower the SRS. Refer to Section 501-20B.
• Disconnect: Driver Seat Side Air Bag Module C3051.
• Disconnect: Front Height Motor C382.
• **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
• Connect the battery ground cable. Refer to Section 414-01.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: DataLogger — DSM.
  ▪ Front Motor Up (FRONT_UP)
  ▪ Front Motor Down (FRONT_DWN)
• Measure the voltage between front height motor C382-1, circuit CPS02 (GY/YE) and C382-2, circuit CPS03 (VT/GY), harness side while using the scan tool to operate DSM active commands front motor up and front motor down, ON and OFF.
 	

 	
N0057525
 	
• **Is the voltage greater than 10 volts when commanded ON in both directions and no voltage present when commanded OFF?**
	Yes
	INSTALL a new seat track assembly. REFER to Seat Track in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS. REFER to Section 501-20B.
	
	No
	GO to E12.

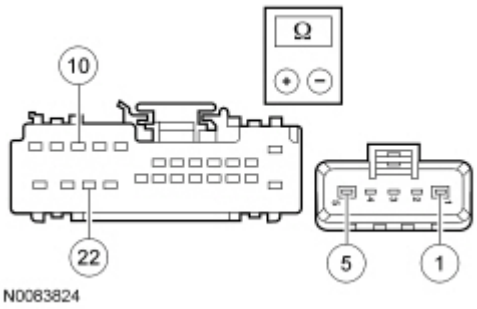
E12 CHECK THE FRONT HEIGHT MOTOR CIRCUITS FOR A SHORT TO VOLTAGE • Ignition OFF. • Disconnect: DSM C341B. • Ignition ON. • Measure the voltage between:	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

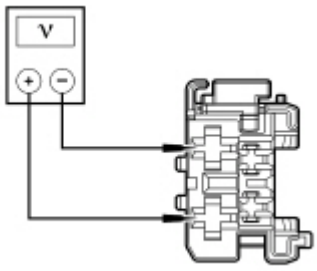
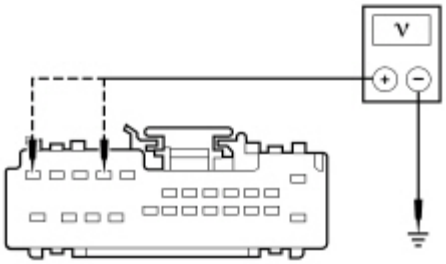
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▪ DSM C341B-23, circuit CPS03 (VT/GY), harness side and ground. ▪ DSM C341B-11, circuit CPS02 (GY/YE), harness side and ground.  N0067985 • **Is any voltage present on either circuit?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to E13 .
E13 CHECK FRONT HEIGHT MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Measure the resistance between: ▪ DSM C341B-23, circuit CPS03 (VT/GY), harness side and front height motor C382-2, circuit CPS03 (VT/GY), harness side. ▪ DSM C341B-11, circuit CPS02 (GY/YE), harness side and front height motor C382-1, circuit CPS02 (GY/YE), harness side.  N0083759 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
E14 CHECK THE REAR HEIGHT MOTOR FOR CORRECT OPERATION USING ACTIVE COMMANDS	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Rear Height Motor C363 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure**	**Yes** INSTALL a new seat track assembly. REFER to Seat Track in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable.

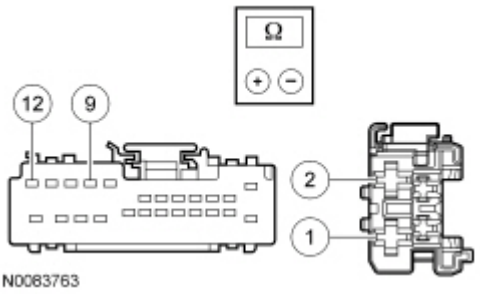
to follow these instructions may result in serious personal injury in the event of an accidental deployment. • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — DSM . ▪ Rear Motor Up (REAR_UP) ▪ Rear Motor Down (REAR_DWN) • Measure the voltage between rear height motor C363-1, circuit CPS05 (BU/WH), harness side and C363-5, circuit CPS04 (YE/OG), harness side while using the scan tool to operate DSM active commands rear motor up and rear motor down, ON and OFF.  N0083823 • **Is the voltage greater than 10 volts when command ON in both directions and no voltage present when commanded OFF?**	CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to E15 .
E15 CHECK THE REAR HEIGHT MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: DSM C341B . • Ignition ON. • Measure the voltage between: ▪ DSM C341B-22, circuit CPS05 (BU/WH), harness side and ground. ▪ DSM C341B-10, circuit CPS04 (YE/OG), harness side and ground.  N0083760 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to E16 .
E16 CHECK REAR HEIGHT MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF.	**Yes**

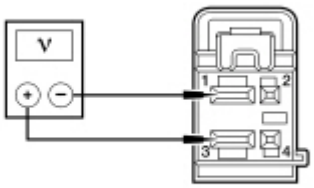
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• Measure the resistance between: ▪ DSM C341B-22, circuit CPS05 (BU/WH), harness side and rear height motor C363-1, circuit CPS05 (BU/WH), harness side. ▪ DSM C341B-10, circuit CPS04 (YE/OG), harness side and rear height motor C363-5, circuit CPS04 (YE/OG), harness side.  N0083824 • **Are the resistances less than 5 ohms?**	INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
E17 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION USING ACTIVE COMMANDS • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Driver Seat Horizontal Motor C362 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — DSM . ▪ Horizontal Motor Forward (HORZ_FWD) ▪ Horizontal Motor Backward (HORZ_BWD) • Measure the voltage between horizontal motor C362-1, circuit CPS01 (GN/BU) and C362-2, circuit CPS06 (GN/WH), harness side while using the scan tool to operate DSM active commands horizontal motor forward and horizontal motor backward, ON and OFF.	**Yes** INSTALL a new front seat track motor. REFER to Seat Track Motor — Front in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to E18 .

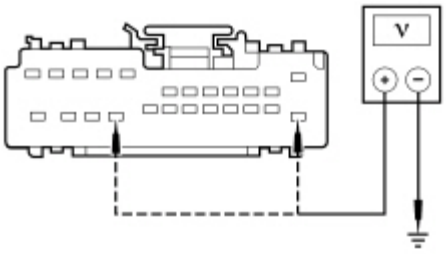
 N0083761 • **Is the voltage greater than 10 volts when command ON in both directions and no voltage present when commanded OFF?**	
E18 CHECK THE HORIZONTAL MOTOR CIRCUITS FOR A SHORT TO VOLTAGE • Disconnect: DSM C341B . • Ignition ON. • Measure the voltage between: ▪ DSM C341B-9, circuit CPS06 (GN/WH), harness side and ground. ▪ DSM C341B-12, circuit CPS01 (GN/BU), harness side and ground.  N0083762 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to E19 .
E19 CHECK THE HORIZONTAL MOTOR CIRCUITS FOR AN OPEN • Ignition OFF. • Measure the resistance between: ▪ DSM C341B-12, circuit CPS01 (GN/BU), harness side and horizontal motor C362-1, circuit CPS01 (GN/BU), harness side. ▪ DSM C341B-9, circuit CPS06 (GN/WH), harness side and horizontal motor C362-2, circuit CPS06 (GN/WH), harness side.	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

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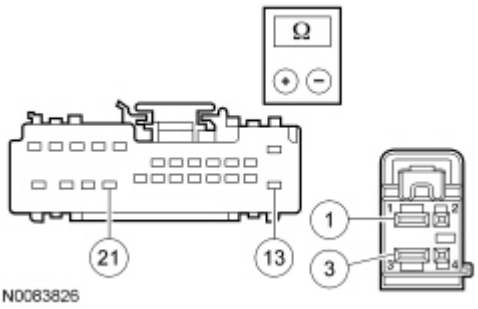
 N0083763 • **Are the resistances less than 5 ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
E20 CHECK THE RECLINER MOTOR FOR CORRECT OPERATION USING ACTIVE COMMANDS	

• Ignition OFF.
• Depower the SRS . Refer to Section 501-20B .
• Disconnect: Driver Seat Side Air Bag Module C3051 .
• Disconnect: Seat Recliner Motor C3187 .
• **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
• Connect the battery ground cable. Refer to Section 414-01 .
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: DataLogger — DSM .
  ▪ Recline Motor Forward (RECL_FWD)
  ▪ Recline Motor Backward (RECL_BWD)
• Measure the voltage between seat recliner motor C3187-1, circuit CPS07 (GY/BN) and C3187-3, circuit CPS08 (VT/OG), harness side while using the scan tool to operate the DSM active commands recline motor forward and recline motor backward, ON and OFF.

N0083825
• **Is the voltage greater than 10 volts when command ON in both directions and no voltage present when commanded OFF?**
	Yes
	INSTALL a new seat recliner motor. REFER to Seat Recliner Motor in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS . REFER to Section 501-20B .
	
	No
	GO to E21 .

E21 CHECK THE RECLINER MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: DSM C341B .	**Yes** REPAIR the circuit(s). CLEAR the

• Ignition ON.
• Measure the voltage between:
  ▪ DSM C341B-13, circuit CPS07 (GY/BN), harness side and ground.
  ▪ DSM C341B-21, circuit CPS08 (VT/OG), harness side and ground.

 	
N0083764
• **Is any voltage present on either circuit?**
	DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS. REFER to Section 501-20B.
	
	No
	GO to E22.

E22 CHECK THE RECLINER MOTOR CIRCUITS FOR AN OPEN	

• Ignition OFF.
• Measure the resistance between:
  ▪ DSM C341B-13, circuit CPS07 (GY/BN), harness side and recliner motor C3187-1, circuit CPS07 (GY/BN), harness side.
  ▪ DSM C341B-21, circuit CPS08 (VT/OG), harness side and recliner motor C3187-3, circuit CPS08 (VT/OG), harness side.

 	
N0083826
• **Are the resistances less than 5 ohms?**
	Yes
	INSTALL a new DSM. REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS. REFER to Section 501-20B.
	
	No
	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test F: The Memory Seat Does Not Operate Correctly — Motor(s) Operate In One Second Intervals or Memory Seat Recall Not Functioning Correctly

Refer to Wiring Diagrams Cell 123, Memory Seats for schematic and connector information.

Normal Operation

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When the memory SET switch is activated, it supplies a ground signal to the Driver Seat Module (DSM) to initiate a memory SET or recall command. Memory button 1 and memory button 2 each have separate circuits to the DSM .

The DSM supplies a shared signal feed circuit to each position sensor. Each position sensor sends a signal pulse back to the DSM to monitor the position of the seat track and seat recliner. The DSM stores the sensor position data when a SET command is received and uses this information to return the seat to the stored position when a recall command is received.

When a recall command is initiated, the DSM supplies voltage and ground to the seat track motors and seat recliner motor to move the seat to the stored position. For information on programming memory positions or recalling a stored memory position, refer to Memory Position Programming in this section.

The following pinpoint test diagnoses a memory seat that does not operate correctly using the memory SET switch. If the memory seat does not move in all directions using the seat control switch, GO to Pinpoint Test E .

DTC Description	Fault Trigger Conditions
• B1534 — Memory 1 Switch Circuit Short to Ground • B1538 — Memory 2 Switch Circuit Short to Ground	If a short to ground is sensed on the switch input circuit during the DSM self-test, the DTC is set. If activity is sensed on the input circuit for greater than 2 minutes, the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1663 — Seat Driver Front Up/Down Motor Stalled • B1664 — Seat Driver Rear Up/Down Motor Stalled • B1665 — Seat Driver Forward/Backward Motor Stalled	During self-test the DSM attempts to operate the seat track motors and uses the motor's position sensor to monitor movement. If no motor movement is sensed, a DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no movement continues to be monitored after 250 milliseconds, the DSM disables the output.
• B1666 — Seat Driver Recline Motor Stalled	During self-test the DSM attempts to operate the recliner motor and uses the recliner motor position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no motor movement is still monitored after 250 milliseconds, the DSM disables the output.
• B1952 — Seat Rear Up/Down Position Feedback Circuit Short to Battery • B1956 — Seat Front Up/Down Position Feedback Circuit Short to Battery • B1960 — Seat Recline Forward/Backward Position Feedback Circuit Short to Battery • B1964 — Seat Horizontal Forward/Rearward Position Feedback Circuit Short to Battery	If a short to voltage condition is present on the affected motor's position sensor (Hall effect) feedback circuit, the DTC is set. After a DTC is set, a memory recall is not possible but the seat control switch can operate the associated motor in one-second increments.
• B1953 — Seat Rear Up/Down Position Feedback Circuit Short to Ground • B1957 — Seat Front	If a short to ground or open condition is present on the affected motor's position sensor (Hall effect) feedback circuit, the DTC is set. After a DTC is set, a memory recall is not possible but the seat control switch can operate the associated motor in one-second

Up/Down Position Feedback Circuit Short to Ground • B1961 — Seat Recline Forward/Backward Position Feedback Circuit Short to Ground • B1965 — Seat Horizontal Forward/Rearward Position Feedback Circuit Short to Ground	increments.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Memory SET switch
- Missing status information — Medium Speed Controller Area Network (MS-CAN) communication bus messages:
  - ignition status
  - gear selector position
- Remote Keyless Entry (RKE) transmitter
- Horizontal seat track motor
- Memory seat track assembly
- DSM

PINPOINT TEST F: THE MEMORY SEAT DOES NOT OPERATE CORRECTLY — MOTOR(S) OPERATE IN ONE SECOND INTERVALS OR MEMORY SEAT RECALL NOT FUNCTIONING CORRECTLY

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

NOTE: Verify the PID(s) states agree with the ignition and transmission gear selector in all positions before proceeding with memory seat diagnosis.

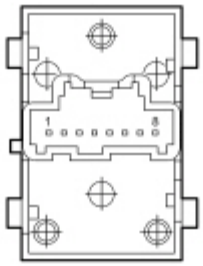
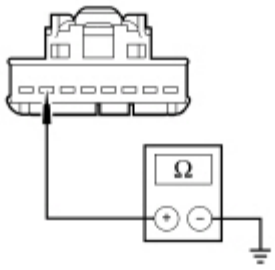
Test Step	Result / Action to Take
F1 CHECK THE TRANSMISSION GEAR SELECTOR TRANSMISSION RANGE (TR) PID STATES	
• Enter the following diagnostic mode on the scan tool: DataLogger — PCM PID: TR . • Operate the selector lever in all positions while monitoring the PCM PID TR states. • **Do the PID states agree with the selected positions?**	**Yes** GO to F2 . **No** To diagnose a transmission gear selector (PRNDL) status concern, REFER to Section 307-05 .

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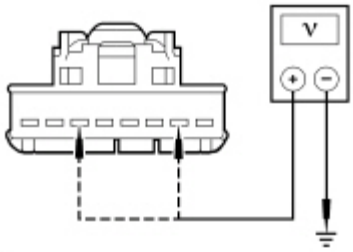
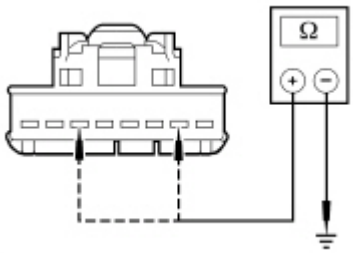
F2 CHECK THE IGNITION SWITCH PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — DSM . • Cycle the ignition switch in all positions while monitoring the DSM IGN_SW PID states. • **Do the PID states agree with the selected positions?**	**Yes** GO to F3 . **No** To diagnose an ignition switch status concern, REFER to Section 211-05 .
F3 RETRIEVE THE DSM DTCs	
• Using the switches, operate the memory seat and memory mirrors in all directions through the full range of travel. • Place the memory seat and memory mirrors in central travel positions. • Enter the following diagnostic mode on the scan tool: Self Test — DSM . • **Are any DSM DTCs retrieved?**	**Yes** If DTCs B1952, B1956, B1960 and B1964 are all retrieved, GO to F10 . If DTCs B1953, B1957, B1961 and B1965 are all retrieved, GO to F10 . If DTC B1534 or B1538, GO to F5 . If DTC B1663, B1956 or B1957, GO to F11 . If DTC B1664, B1952 or B1953, GO to F14 . If DTC B1665, B1964 or B1965, GO to F17 . If DTC B1666, B1960 or B1961, GO to F20 . For any other DSM DTCs, REFER to the Driver Seat Module (DSM) DTC Chart. **No** GO to F4 .
F4 MONITOR THE DSM PIDs AND CHECK THE DSM FOR CORRECT MEMORY SET SWITCH INPUTS	

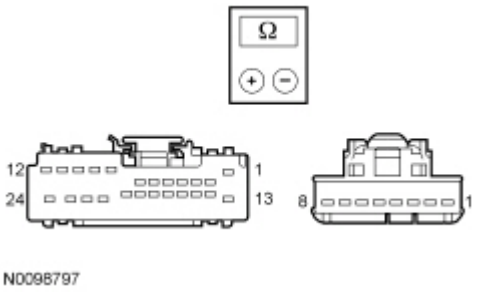
• Enter the following diagnostic mode on the scan tool: DataLogger — DSM .
  ▪ Memory 1 recall switch status (MEM_1)
  ▪ Memory 2 recall switch status (MEM_2)
• Monitor the DSM PIDs while pressing each memory SET switch button.
• **Do the PID values agree with the switch button positions?**
	Yes
	GO to F10 .
	
	No
	GO to F5 .

F5 CHECK THE MEMORY SET SWITCH	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Memory SET Switch C3246 . • Using the following table to check the memory SET switch, measure the resistance between the memory SET switch pins, component side, while pressing and releasing the indicated	**Yes** GO to F6 . **No** INSTALL a new memory SET switch. REFER to

switch buttons and compare the results to the table. **Switch Button / Pins / Ohms** Button 1 / 2 and 7 / Less than 20 when pressed; Greater than 10,000 when released Button 2 / 6 and 7 / Less than 20 when pressed; Greater than 10,000 when released  A0074536 • **Is the memory SET switch OK?**	Memory Set Switch in this section. CLEAR the DTCs. REPEAT the self-test. REPOWER the SRS. REFER to Section 501-20B.
F6 CHECK THE MEMORY SET SWITCH GROUND FOR AN OPEN • Ignition OFF. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Driver Seat Side Air Bag Module C3051. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Measure the resistance between memory SET switch C3246-7, circuit GD904 (BK/BU), harness side and ground.  A0042473 • **Is the resistance less than 5 ohms?**	**Yes** GO to F7. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.
F7 CHECK THE MEMORY SET SWITCH CIRCUITS FOR A SHORT TO VOLTAGE • Disconnect: DSM C341C. • Ignition ON. • Measure the voltage between:	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT

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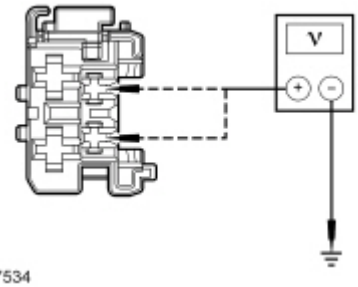
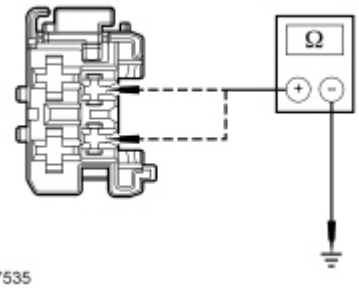
■ memory SET switch C3246-2, circuit CPS15 (VT/WH), harness side and ground. ■ memory SET switch C3246-6, circuit CPS16 (YE), harness side and ground.  N0083765 • **Is any voltage present on either circuit?**	the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B. **No** GO to F8.
F8 CHECK THE MEMORY SET SWITCH CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ■ memory SET switch C3246-2, circuit CPS15 (VT/WH), harness side and ground. ■ memory SET switch C3246-6, circuit CPS16 (YE), harness side and ground.  N0083766 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F9. **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.
F9 CHECK THE MEMORY SET SWITCH CIRCUITS FOR AN OPEN	
• Measure the resistance between: ■ DSM C341C-16, circuit CPS15 (VT/WH), harness side and memory SET switch C3246-2, circuit CPS15 (VT/WH), harness side. ■ DSM C341C-17, circuit CPS16 (YE), harness side and memory SET switch C3246-6, circuit CPS16 (YE), harness side.	**Yes** INSTALL a new DSM. REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.

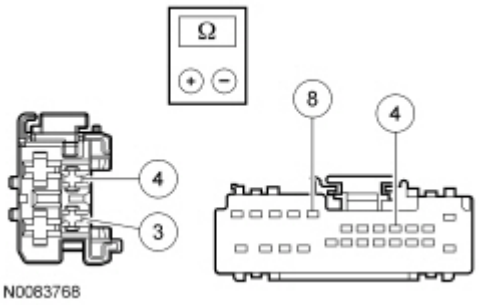
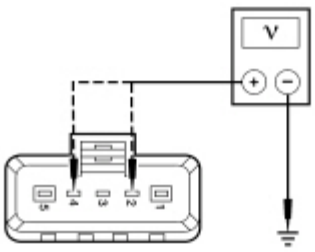
 N0098797 • **Are the resistances less than 5 ohms?**	**No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.

F10 MONITOR THE DSM PIDs
• Enter the following diagnostic mode on the scan tool: DataLogger — DSM.
  ▪ Driver Power Seat Front Up/Down Sense (SFNT_MT)
  ▪ Driver Power Seat Forward/Backward Sense (SFWD_MT)
  ▪ Driver Power Seat Recline Sense (SRCL_MT)
  ▪ Driver Power Seat Rear Up/Down Sense (SREARMT)
• Operate the memory seat in all directions through the full range of travel while monitoring the PIDs.
• **Does each PID indicate the sensor is operational throughout each associated motor's full range of travel?**
	Yes
	INSTALL a new DSM. REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test.
	
	No
	If front up/down position sensor PID value indicates not present, GO to F11.
	
	If rear up/down position sensor PID value indicates not present, GO to F14.
	
	If forward/rearward position sensor PID value indicates not present, GO to F17.
	
	If recline position sensor PID value indicates not present, GO to F20.

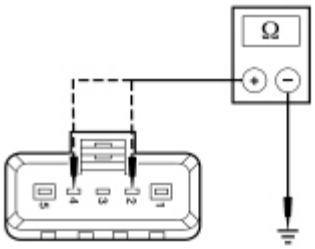
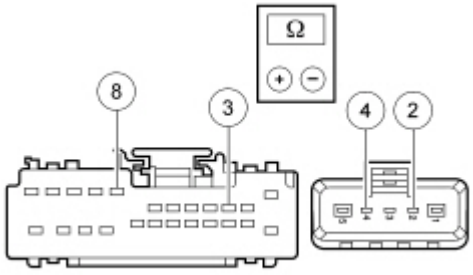
F11 CHECK THE FRONT HEIGHT POSITION SENSOR CIRCUITS FOR A SHORT TO VOLTAGE • Ignition OFF. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Driver Seat Side Air Bag Module C3051. • Disconnect: DSM C341B. • Disconnect: Front Height Motor C382. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Ignition ON. • Measure the voltage between: ▪ front height motor C382-3, circuit RPS13 (GN/OG), harness side and ground.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B. **No**

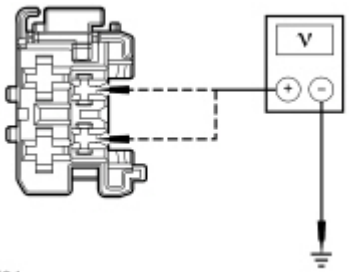
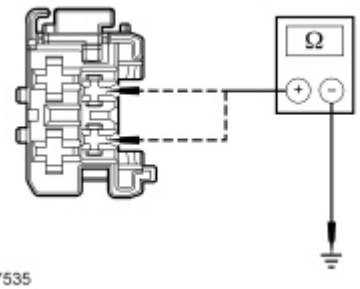
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■ front height motor C382-4, circuit VPS10 (BU/GN), harness side and ground.  N0057534 • **Is any voltage present on either circuit?**	GO to F12 .
F12 CHECK FRONT HEIGHT POSITION SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ■ front height motor C382-3, circuit RPS13 (GN/OG), harness side and ground. ■ front height motor C382-4, circuit VPS10 (BU/GN), harness side and ground.  N0057535 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F13 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
F13 CHECK FRONT HEIGHT POSITION SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ■ front height motor C382-3, circuit RPS13 (GN/OG), harness side and DSM C341B-8, circuit RPS13 (GN/OG), harness side. ■ front height motor C382-4, circuit VPS10 (BU/GN), harness side and DSM C341B-4, circuit VPS10 (BU/GN), harness side.	**Yes** INSTALL a new seat track assembly. REFER to Seat Track in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

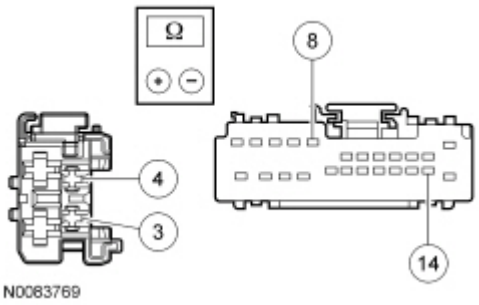
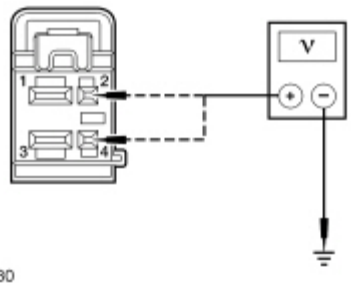
 N0083768 • **Are the resistances less than 5 ohms?**	**No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
F14 CHECK THE REAR HEIGHT POSITION SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: DSM C341B . • Disconnect: Rear Height Motor C363 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between: ▪ rear height motor C363-2, circuit RPS13 (GN/OG), harness side and ground. ▪ rear height motor C363-4, circuit VPS11 (GN/BN), harness side and ground.  N0083827 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to F15 .
F15 CHECK THE REAR HEIGHT POSITION SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ▪ rear height motor C363-2, circuit RPS13 (GN/OG), harness side and ground. ▪ rear height motor C363-4, circuit VPS11 (GN/BN), harness side and ground.	**Yes** GO to F16 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

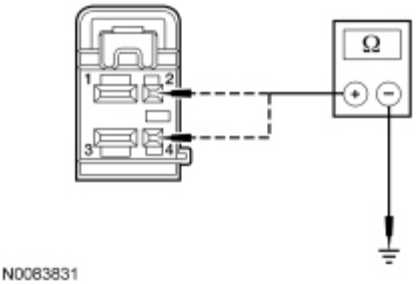
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 N0083828 • **Are the resistances greater than 10,000 ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
F16 CHECK THE REAR HEIGHT POSITION SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ▪ rear height motor C363-2, circuit RPS13 (GN/OG), harness side and DSM C341B-8, circuit RPS13 (GN/OG), harness side. ▪ rear height motor C363-4, circuit VPS11 (GN/BN), harness side and DSM C341B-3, circuit VPS11 (GN/BN), harness side.  N0083829 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new seat track assembly. REFER to Seat Track in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
F17 CHECK THE HORIZONTAL POSITION SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: DSM C341B . • Disconnect: Driver Seat Horizontal Motor C362 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side

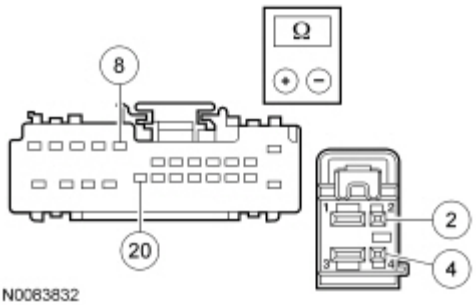
may result in serious personal injury in the event of an accidental deployment. • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between: ▪ horizontal motor C362-3, circuit RPS13 (GN/OG), harness side and ground. ▪ horizontal motor C362-4, circuit VPS09 (BN/BU), harness side and ground.  N0057534 • **Is any voltage present on either circuit?**	air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to F18 .
F18 CHECK THE HORIZONTAL POSITION SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ▪ horizontal motor C362-3, circuit RPS13 (GN/OG), harness side and ground. ▪ horizontal motor C362-4, circuit VPS09 (BN/BU), harness side and ground.  N0057535 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F19 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
F19 CHECK THE HORIZONTAL POSITION SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ▪ horizontal motor C362-3, circuit RPS13 (GN/OG), harness side and DSM C341B-8, circuit RPS13 (GN/OG), harness side. ▪ horizontal motor C362-4, circuit VPS09 (BN/BU), harness side and DSM C341B-14, circuit VPS09 (BN/BU), harness side.	**Yes** INSTALL a new front seat track motor. REFER to Seat Track Motor — Front in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable.

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 N0083769 • **Are the resistances less than 5 ohms?**	CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
F20 CHECK THE RECLINER POSITION SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: DSM C341B . • Disconnect: Seat Recliner Motor C3187 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between: ▪ seat recliner motor C3187-2, circuit VPS12 (GY/OG), harness side and ground. ▪ seat recliner motor C3187-4, circuit RPS13 (GN/OG), harness side and ground.  N0083830 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to F21 .
F21 CHECK THE RECLINER POSITION SENSOR CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Measure the resistance between:
  ■ seat recliner motor C3187-2, circuit VPS12 (GY/OG), harness side and ground.
  ■ seat recliner motor C3187-4, circuit RPS13 (GN/OG), harness side and ground.

 	
N0083831
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to F22 .
	
	No
	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS . REFER to Section 501-20B .

F22 CHECK THE RECLINER POSITION SENSOR CIRCUITS FOR AN OPEN	

• Measure the resistance between:
  ■ seat recliner motor C3187-2, circuit VPS12 (GY/OG), harness side and DSM C341B-20, circuit VPS12 (GY/OG), harness side.
  ■ seat recliner motor C3187-4, circuit RPS13 (GN/OG), harness side and DSM C341B-8, circuit RPS13 (GN/OG), harness side.

 	
N0083832
• **Are the resistances less than 5 ohms?**
	Yes
	INSTALL a new seat recliner motor. REFER to Seat Recliner Motor in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS . REFER to Section 501-20B .
	
	No
	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable.
	
	CONNECT driver seat side air bag module C3051.
	
	REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test G: Easy Exit/Easy Entry is Inoperative/Does Not Operate Correctly

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Normal Operation

The Driver Seat Module (DSM) receives a key out command from the Body Control Module (BCM) over the Medium Speed Controller Area Network (MS-CAN) and moves the driver seat rearward about 51 mm (2 in).

This pinpoint test is intended to diagnose the following:

- Easy entry/exit feature is not enabled
- Missing Medium Speed Controller Area Network (MS-CAN) status information:
  - ignition status
  - gear selector position
- Wiring, terminals or connectors
- Key-in-ignition warning switch
- DSM

PINPOINT TEST G: EASY EXIT/EASY ENTRY IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

NOTE: The transmission gear selector must be in PARK for the easy entry/exit feature to function.

NOTE: Make sure all memory seat DTC and symptom based faults are corrected before proceeding with easy entry/exit diagnosis. Verify the PID(s) states agree with the ignition and transmission gear selector in all positions before proceeding with easy entry/exit diagnosis.

Test Step	Result / Action to Take
G1 CHECK FOR SEAT OPERATION AND RETRIEVE DTCs	
• Ignition ON. • Check the message center to verify the easy entry/exit feature is enabled. Refer to the Owner's Literature or Section 413-01 for information on the message center. • Using the seat control switch, verify the driver power seat operates fully forward and rearward. • Place the memory seat and memory mirrors in central travel positions. • Enter the following diagnostic mode on the scan tool: Self Test — DSM . • **Are any DSM DTCs retrieved?**	**Yes** REFER to the Driver Seat Module (DSM) DTC Chart. **No** If OFF, turn the easy entry/exit feature ON with the message center. REFER to the Owner's Literature or Section 413-01 . TEST the system for normal operation. If OK, INSTRUCT the customer on correct system operation. If the seat does not move horizontally from the seat control switch, GO to Pinpoint Test E . Otherwise, GO to G2 .
G2 CHECK THE TRANSMISSION GEAR SELECTOR TRANSMISSION RANGE (TR) PID STATES	
• Enter the following diagnostic mode on the scan tool: DataLogger — PCM PID: TR . • Operate the selector lever in all positions while monitoring the PCM PID TR states.	**Yes** GO to G3 . **No** To diagnose a transmission gear selector (PRNDL) status concern, REFER to Section 307-05 .

• **Do the PID states agree with the selected positions?**	
G3 CHECK THE KEY IN IGNITION SWITCH (KEY_IN_SW) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — BCM . • Insert and remove the ignition key from the ignition lock cylinder while monitoring the KEY_IN_SW PID states. • **Does the PID agree with key positions in and out of the ignition switch?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR the DTCs. REPEAT the self-test. **No** To diagnose the key-in-ignition warning switch fault, REFER to Section 413-01 .

Pinpoint Test H: The Power Lumbar is Inoperative — Driver

Refer to Wiring Diagrams Cell 120 , Power Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Normal Operation

The seat control switch contains the lumbar button and when pressed, supplies battery voltage and ground to the power lumbar motor to move the lumbar assembly in the desired direction.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Seat control switch
- Power lumbar motor assembly

PINPOINT TEST H: THE POWER LUMBAR IS INOPERATIVE — DRIVER

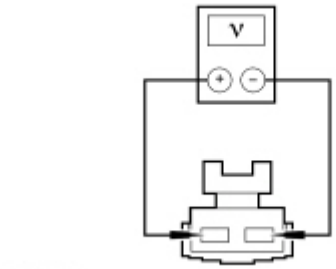
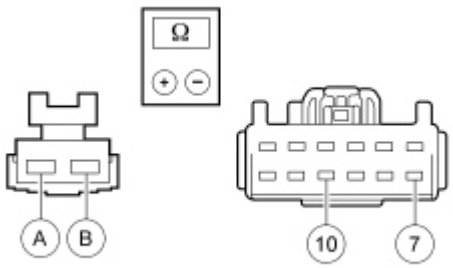
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
H1 CHECK OTHER SEAT CONTROL SWITCH FEATURES FOR CORRECT OPERATION	
• Operate the seat horizontally and vertically. • **Does the seat operate horizontally and vertically?**	**Yes** GO to H2 . **No** GO to Pinpoint Test E to diagnose the inoperative seat.

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H2 CHECK FOR VOLTAGE TO THE LUMBAR MOTOR • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Power Lumbar Motor C3215 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between power lumbar motor C3215-B, circuit CPS18 (BN/GN), harness side and power lumbar motor C3215-A, circuit CPS19 (GY/VT), harness side, while operating the lumbar switch in both directions.  N0040627 • **Is the voltage greater than 10 volts when the switch is operated in both directions and 0 volt in the rest position?**	**Yes** INSTALL a new power lumbar assembly. REFER to Lumbar Assembly — Power in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to H3 .
H3 CHECK THE LUMBAR MOTOR CIRCUITS FOR AN OPEN • Disconnect: Driver Seat Control Switch C369 . • Measure the resistance between: ▪ seat control switch C369-7, circuit CPS19 (GY/VT), harness side and power lumbar motor C3215-A, circuit CPS19 (GY/VT), harness side. ▪ seat control switch C369-10, circuit CPS18 (BN/GN), harness side and power lumbar motor C3215-B, circuit CPS18 (BN/GN), harness side.  N0092043 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable.

	CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test I: The Power Lumbar is Inoperative — Passenger

Refer to Wiring Diagrams Cell 120, Power Seats for schematic and connector information.

Normal Operation

The seat control switch contains the lumbar button and when pressed, supplies battery voltage and ground to the power lumbar motor to move the lumbar assembly in the desired direction.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Seat control switch
- Power lumbar motor assembly

PINPOINT TEST I: THE POWER LUMBAR IS INOPERATIVE — PASSENGER

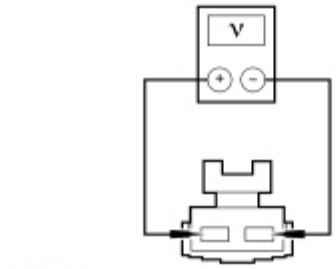
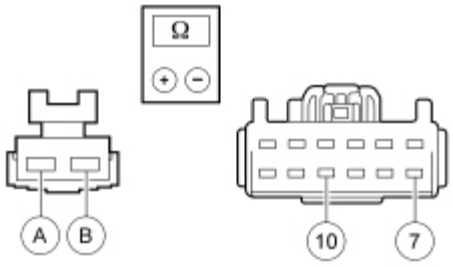
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B.

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
I1 CHECK OTHER SEAT CONTROL SWITCH FEATURES FOR CORRECT OPERATION	
• Operate the seat horizontally and vertically. • **Does the seat operate horizontally and vertically?**	**Yes** GO to I2. **No** GO to Pinpoint Test B to diagnose the inoperative seat.
I2 CHECK FOR VOLTAGE TO THE LUMBAR MOTOR	
• Ignition OFF. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Passenger Seat Side Air Bag Module C339. • Disconnect: Power Lumbar Motor C3216. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the**	**Yes** INSTALL a new power lumbar assembly. REFER to Lumbar Assembly — Power in this section. TEST the system for normal operation.

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battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment. • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between power lumbar motor C3216-B, circuit CPS18 (BN/GN), harness side and power lumbar motor C3216-A, circuit CPS19 (GY/VT), harness side, while operating the lumbar switch in both directions.  N0040627 • **Is the voltage greater than 10 volts when the lumbar switch is operated in both directions and 0 volt in the rest position?**	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to I3 .
I3 CHECK THE LUMBAR MOTOR CIRCUITS FOR AN OPEN	
• Disconnect: Passenger Seat Control Switch C330 . • Measure the resistance between: ▪ seat control switch C330-10, circuit CPS20 (VT), harness side and power lumbar motor C3216-B, circuit CPS18 (BN/GN), harness side. ▪ seat control switch C330-7, circuit CPS21 (WH/OG), harness side and power lumbar motor C3216-A, circuit CPS19 (GY/VT), harness side.  N0092043 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test L: A Single Climate Controlled Seat is Inoperative

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15 second intervals. Both DCSM voltage supply circuits are spliced together inside the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

When the climate control seat buttons are activated on the touchscreen interface, this initiates the CAN communication to request climate controlled seat operation.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- APIM
- FDIM
- DCSM

PINPOINT TEST L: A SINGLE CLIMATE CONTROLLED SEAT IS INOPERATIVE

Test Step	Result / Action to Take
L1 CHECK THE OPERATION OF BOTH CLIMATE CONTROLLED SEATS AND VERIFY THE SYMPTOM	
• Check the operation of both climate controlled seats and verify the symptom. • **Is only a single climate controlled seat inoperative?**	**Yes** GO to L2 . **No** If both seats are inoperative, GO to Symptom Chart .
L2 CHECK FOR DCSM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Were any DTCs retrieved during the self-tests?**	**Yes** GO to the Dual Climate Controlled Seat Module (DCSM) DTC Chart. **No** GO to L3 .
L3 CHECK OPERATION OF THE DCSM USING PIDs	
NOTE: The purpose of this step is to verify the DCSM is able to receive and process inbound command messages from the communication bus and demonstrate if the DCSM is operational. This indicates the FCIM may not be sending the commands correctly. • Enter the following diagnostic mode on the scan tool: DataLogger — DCSM .	**Yes** GO to L4 . **No** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. TEST the system for normal operation.

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Driver Seat ■ Seat cushion Thermo-Electric Device (TED) temperature (CSHTEMP) ■ Seat back TED temperature (BK_TEMP) ■ Climate-controlled seat heat command (TED_HEAT_D) **Front Passenger Seat** ■ Passenger Cushion TED Temperature (PCSHTMP) ■ Passenger Back TED Temperature (PBKTMP) ■ Passenger TED Heat Mode (TED_HEAT_P) ● **NOTE:** The DCSM active commands TED_HEAT_D (driver seat) and TED_HEAT_P (passenger seat) are limited to 15 seconds in the ON state, then turn OFF. ● Operate the affected climate controlled seat using the active command while monitoring the appropriate PIDs for that seat. ■ When the command is in process the TED temperature PIDs on the affected seat should momentarily increase. If no temperature increase is noted, remove the cushion blower filter and repeat the active command while physically monitoring the cushion blower for movement. ● **Do the PID states or cushion blower movement indicate climate controlled seat operation when using the active command?**	
L4 USE THE CLIMATE CONTROLLED SEAT SWITCH AND MONITOR THE DCSM PID FOR A RESPONSE	
● Enter the following diagnostic mode on the scan tool: DataLogger — DCSM . ■ Driver State Seat Mode (DCCSMOD) (driver seat) ■ Passenger State Seat Mode (PCCSMOD) (passenger seat) ● Start the engine. ● **NOTE:** Operation of the climate controlled seats repeatedly ON and OFF or repeatedly switching between heat and cool modes may cause DCSM DTCs to set, disabling one or both seat systems and may require DTCs to be cleared before seat operation may continue. It is recommended to allow time between modes for seat temperatures to return toward ambient temperatures before continuing. ● Attempt to operate the affected climate controlled seat in all modes using the appropriate switch while monitoring the DCSM PID DCCSMOD (driver seat) or PCCSMOD (passenger seat). ● **Do all the PID states match the climate controlled seat settings selected?**	**Yes** If the fault is intermittent, CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose DCSM connector pins. CLEAR the DTCs. REPEAT the self-test. **No** REFER to Section 415-00D or Section 415-00E to diagnose the inoperative touchscreen button(s). CLEAR the DTCs. TEST the system for normal operation.

Pinpoint Test N: The Heated Seat is Inoperative — Driver

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The engine must be running for the heated seat system to operate. The driver and passenger heated seat buttons are selected from the touchscreen interface, which initiates the CAN communication to request heated seat operation. Upon receiving the request, the HVAC module supplies voltage to the appropriate driver and/or passenger seat cushion and backrest heater mats, which are connected in series. Temperature is maintained by the HVAC module using a sensor contained within the cushion heater mat. The HVAC module supplies a reference voltage to the temperature sensor and monitors the return signal from the temperature sensor for controlling current flow to the heater mats. The HVAC module remains on, heating the seat and maintaining temperature until commanded off from the touchscreen (or until the ignition is turned OFF).

DTC Description	Fault Trigger Conditions
• B1034:11 — Left Front Seat Heater Element: Circuit Short To Ground	Sets when the HVAC module senses the left front heater element current draw has exceeded a specified threshold. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.
• B1034:13 — Left Front Seat Heater Element: Circuit Open	Sets when the HVAC module senses the left front heater element current draw is less than a specified threshold. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.
• B1038:11 — Left Front Seat Heater Sensor: Circuit Short To Ground	Sets when the HVAC module senses the left front heater sensor voltage is out-of-range low. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.
• B1038:12 — Left Front Seat Heater Sensor: Circuit Short To Battery	Sets when the HVAC module senses the left front heater sensor voltage is out-of-range high. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- FDIM
- APIM
- FCIM
- Heater mat
- HVAC module

PINPOINT TEST N: THE HEATED SEAT IS INOPERATIVE — DRIVER

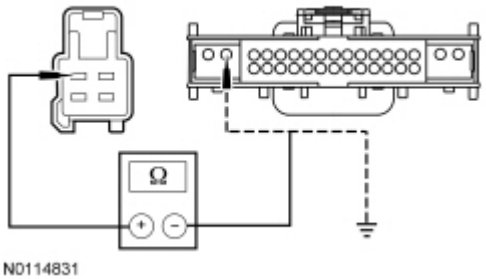
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

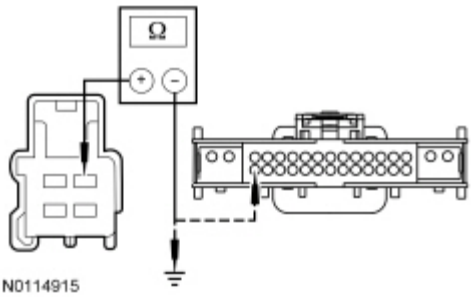
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

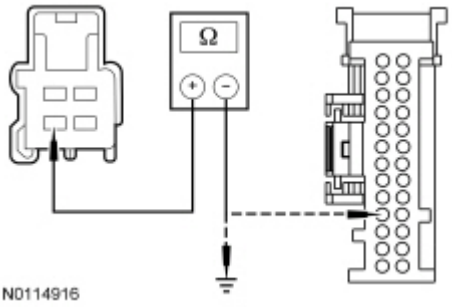
Test Step	Result / Action to Take

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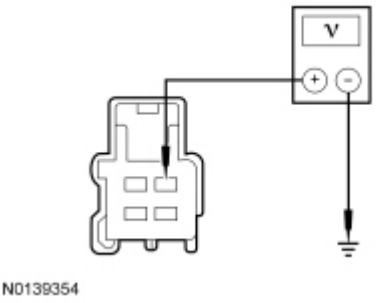
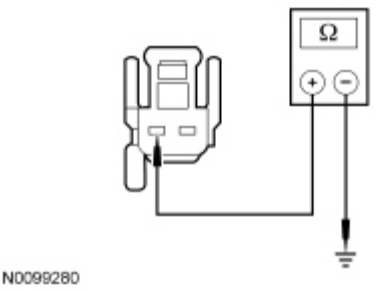
N1 CHECK FOR HVAC DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — HVAC Module . • **Were any DTCs retrieved during the self-tests?**	**Yes** For DTCs B1034:11 or B1034:13, GO to N3 . For DTCs B1038:11 or B1038:12, GO to N4 . For all other DTCs, REFER to the HVAC Module DTC Chart in this section. **No** GO to N2 .
N2 CHECK THE TOUCHSCREEN CONTROLS OPERATION • Start the engine. • Select each audio and climate control function using the touchscreen controls. • **Do all touchscreen controls operate?**	**Yes** GO to N3 . **No** REFER to Section 415-00D or Section 415-00E to diagnose the inoperative touchscreen.
N3 CHECK THE HEATER ELEMENT POWER CIRCUIT FOR AN OPEN OR SHORT TO GROUND • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: HVAC Module C228B . • Disconnect: Driver Cushion Heater Mat C364 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ▪ driver seat cushion heater mat C364-1, circuit CHS02 (YE/BU), harness side and ground. ▪ driver seat cushion heater mat C364-1, circuit CHS02 (YE/BU), harness side and HVAC module C228B-16, circuit CHS02 (YE/BU), harness side.  N0114831 • **Is the resistance greater than 10,000 ohms between the driver seat cushion heater mat and ground; and less than 3 ohms between the driver seat cushion heater mat and the**	**Yes** GO to N7 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

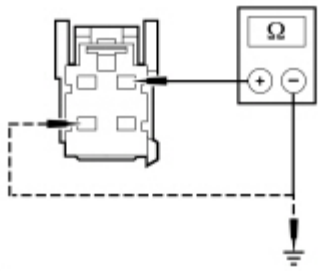
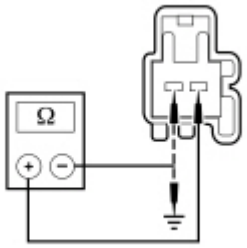
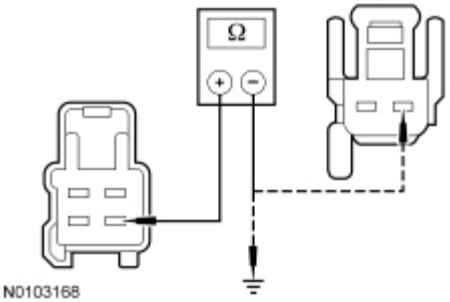
HVAC module?	
N4 CHECK RESISTANCE OF THE DRIVER SEAT HEATER MATS AND HEATER CIRCUITS • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: HVAC Module C228B . • Disconnect: Driver Cushion Heater Mat C364 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ▪ driver seat cushion heater mat C364-2, circuit VHS26 (VT), harness side and ground. ▪ driver seat cushion heater mat C364-2, circuit VHS26 (VT), harness side and HVAC module C228B-30, circuit VHS26 (VT), harness side.  N0114915 • **Is the resistance greater than 10,000 ohms between the driver seat cushion heater mat and ground; and less than 3 ohms between the driver seat cushion heater mat and the HVAC module?**	**Yes** GO to N5 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
N5 CHECK THE HEATED SEAT TEMPERATURE SENSOR RETURN CIRCUIT FOR AN OPEN OR SHORT TO GROUND • Disconnect: HVAC Module C228A . • Measure the resistance between: ▪ driver seat cushion heater mat C364-3, circuit RHS05 (YE/VT), harness side and ground. ▪ driver seat cushion heater mat C364-3, circuit RHS05 (YE/VT), harness side and HVAC module C228A-23, circuit RH111 (GY/BU), harness side.	**Yes** GO to N6 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

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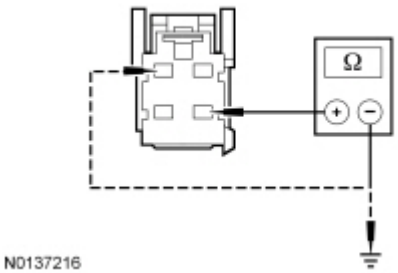


- **Is the resistance greater than 10,000 ohms between the driver seat cushion heater mat and ground; and less than 3 ohms between the driver seat cushion heater mat and the HVAC module?**

N6 CHECK THE HEATED SEAT TEMPERATURE SENSOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between driver seat cushion heater mat C364-2, circuit VHS26 (VT), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** GO to N11 .
N7 CHECK THE HEATER ELEMENT GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Driver Seat Backrest Heater Mat C365 . • Measure the resistance between driver seat backrest heater mat C365-2, circuit GD904 (BK/BU), harness side and ground.  • **Is the resistance less than 0.5 ohms?**	**Yes** GO to N8 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
N8 CHECK CUSHION HEATED SEAT MAT FOR AN OPEN OR SHORT TO GROUND	
• Measure the resistance between driver seat cushion heater mat C364 pins 1 and 4, component side; and between driver seat cushion heater mat C364 pin 1, component side and ground.	**Yes** GO to N9 .

 N0137106 • **Is the resistance between 0.6 ohms and 2 ohms between pins 1 and 4; and greater than 10,000 ohms between pin 1 and ground?**	**No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Front in this section. TEST the system for normal operation. . DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
N9 CHECK THE BACKREST HEATED SEAT MAT FOR AN OPEN OR SHORT TO GROUND	
• Measure the resistance between driver seat backrest heater mat C365 pins 1 and 2, component side; and between driver seat backrest heater mat C365 pin 2, component side and ground.  N0137108 • **Is the resistance between 0.9 and 1.1 ohms between pins 1 and 2: and greater than 10,000 ohms between pin 2 and ground?**	**Yes** GO to N10 . **No** INSTALL a new passenger seat backrest heater mat. REFER to Seat Backrest Heater Mat — Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
N10 CHECK THE CIRCUIT BETWEEN THE CUSHION HEATER MAT AND BACKREST HEATER MAT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ▪ seat cushion heater mat C364-4, circuit CHS01 (GY/VT), harness side and seat backrest heater mat C365-1, circuit CHS01 (GY/VT) harness side. ▪ seat cushion heater mat C364-4, circuit CHS01 (GY/VT), harness side and ground.  N0103168	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation.

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• **Is the resistance less than 3 ohms between C364-4 and C365-1; and greater than 10,000 ohms between C364-4 and ground?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
N11 CHECK THE HEATED SEAT TEMPERATURE SENSOR FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between heated seat cushion C364 pins 2 and 3, component side; and between heated seat cushion C364 pin 2, component side and ground.  N0137216 • **Is the resistance between 300 ohms and 300K ohms between pins 2 and 3; and greater than 10,000 ohms between pin 2 and ground?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Front in this section. TEST the system for normal operation. . DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test O: The Heated Seat is Inoperative — Front Passenger

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The engine must be running for the heated seat system to operate. The driver and passenger heated seat buttons are selected from the touchscreen interface, which initiates the CAN communication to request heated seat operation. Upon receiving the request, the HVAC module supplies voltage to the appropriate driver and/or passenger seat cushion and backrest heater mats, which are connected in series. Temperature is maintained by the HVAC module using a sensor contained within the cushion heater mat. The HVAC module supplies a reference voltage to the temperature sensor and monitors the return signal from the temperature sensor for controlling current flow to the heater mats. The HVAC module remains on, heating the seat and maintaining temperature until commanded off from the touchscreen (or until the ignition is turned OFF).

DTC Description	Fault Trigger Conditions
• B1036:11 — Right Front Seat Heater Element: Circuit Short To Ground	Sets when the HVAC module senses the right front heater element current draw has exceeded a specified threshold. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.
• B1036:13 — Right Front Seat Heater Element: Circuit Open	Sets when the HVAC module senses the right front heater element current draw is less than a specified threshold. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.
• B103A:11 — Right Front Seat Heater Sensor: Circuit Short To Ground	Sets when the HVAC module senses the right front heater sensor voltage is out-of-range low. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.
• B103A:12 — Right Front Seat Heater Sensor: Circuit Short To Battery	Sets when the HVAC module senses the right front heater sensor voltage is out-of-range high. When this DTC sets, the HVAC module disables the circuit until the ignition is cycled.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- FDIM
- APIM
- FCIM
- Heater mat
- HVAC module

PINPOINT TEST O: THE HEATED SEAT IS INOPERATIVE — FRONT PASSENGER

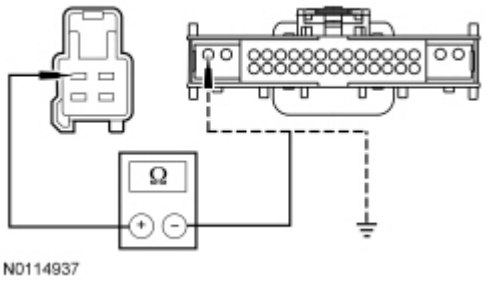
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

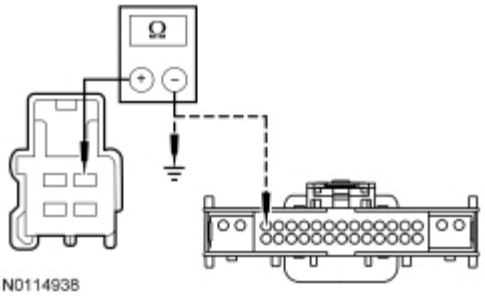
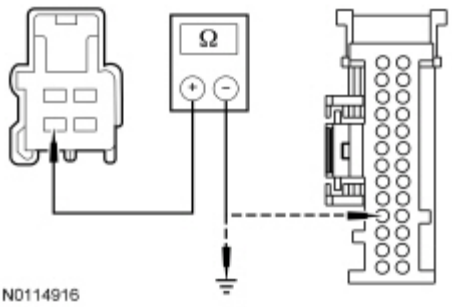
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

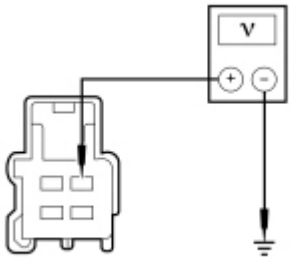
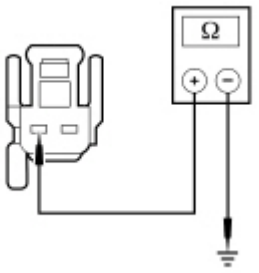
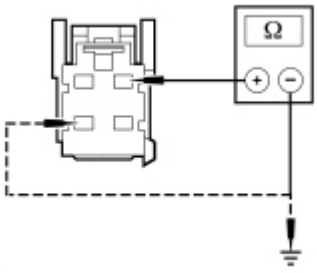
Test Step	Result / Action to Take
O1 CHECK FOR HVAC DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — HVAC Module . • **Were any DTCs retrieved during the self-tests?**	**Yes** For DTCs B1036:11 or B1036:13, GO to O3 . For DTCs B103A:11 or B103A:12, GO to O4 . For all other DTCs, REFER to the HVAC Module DTC Chart in this section. **No** GO to O2 .
O2 CHECK THE TOUCHSCREEN CONTROLS OPERATION	
• Start the engine. • Select each audio and climate control function using the	**Yes** GO to O3 .

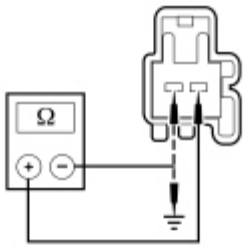
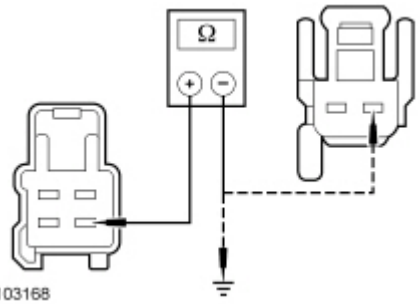
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touchscreen controls. • **Do all touchscreen controls operate?**	**No** REFER to Section 415-00D or Section 415-00E to diagnose the inoperative touchscreen.
O3 CHECK THE HEATER ELEMENT POWER CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: HVAC Module C228B . • Disconnect: Passenger Cushion Heater Mat C334 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ▪ passenger seat cushion heater mat C334-1, circuit CHS07 (GY/BU), harness side and ground. ▪ passenger seat cushion heater mat C334-1, circuit CHS07 (GY/BU), harness side and HVAC module C228B-17, circuit CHS07 (GY/BU), harness side.  N0114937 • **Is the resistance greater than 10,000 ohms between the passenger seat cushion heater mat and ground; and less than 3 ohms between the passenger seat cushion heater mat and the HVAC module?**	**Yes** GO to O7 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
O4 CHECK THE HEATED SEAT TEMPERATURE SENSOR CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: HVAC Module C228B . • Disconnect: Passenger Cushion Heater Mat C334 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 .	**Yes** GO to O5 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat

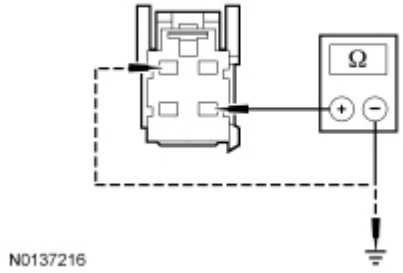
• Measure the resistance between: ▪ passenger seat cushion heater mat C334-2, circuit VHS27 (WH/OG), harness side and ground. ▪ passenger seat cushion heater mat C334-2, circuit VHS27 (WH/OG), harness side and HVAC module C228B-15, circuit VHS27 (WH/OG), harness side.  N0114938 • **Is the resistance greater than 10,000 ohms between the passenger seat cushion heater mat and ground; and less than 3 ohms between the passenger seat cushion heater mat and the HVAC module?**	side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
O5 CHECK THE HEATED SEAT TEMPERATURE SENSOR RETURN CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Disconnect: HVAC Module C228A . • Measure the resistance between: ▪ passenger seat cushion heater mat C334-3, circuit RHS05 (YE/VT), harness side and ground. ▪ passenger seat cushion heater mat C334-3, circuit RHS05 (YE/VT), harness side and HVAC module C228A-23, circuit RH111 (GY/BU), harness side.  N0114916 • **Is the resistance greater than 10,000 ohms between the passenger seat cushion heater mat and ground; and less than 3 ohms between the passenger seat cushion heater mat and the HVAC module?**	**Yes** GO to O6 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
O6 CHECK THE HEATED SEAT TEMPERATURE SENSOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between the following passenger seat cushion heater mat C334-2, circuit VHS27 (WH/OG), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery

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 N0139354 • **Is any voltage present?**	ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to O11 .
O7 CHECK THE HEATER ELEMENT GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Passenger Seat Backrest Heater Mat C335 . • Measure the resistance between passenger seat backrest heater mat C335-2, circuit GD904 (BK/BU), harness side and ground.  N0099280 • **Is the resistance less than 0.5 ohms?**	**Yes** GO to O8 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
O8 CHECK CUSHION HEATED SEAT MAT FOR AN OPEN OR SHORT TO GROUND	
• Measure the resistance between passenger seat cushion heater mat C334 pins 1 and 4, component side; and between passenger seat cushion heater mat C334 pin 1, component side and ground.  N0137106 • **Is the resistance between 0.6 and 2 ohms between pins 1 and 4; and greater than 10,000 ohms between pin 1 and ground?**	**Yes** GO to O9 . **No** INSTALL a new passenger seat cushion heater mat. REFER to Seat Cushion Heater Mat — Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
O9 CHECK THE BACKREST HEATED SEAT MAT FOR AN OPEN OR SHORT TO GROUND	
• Measure the resistance between passenger seat backrest heater mat C335 pins 1 and 2, component side; and between	**Yes** GO to O10 .

passenger seat backrest heater mat C335 pin 2, component side and ground.  N0137108 • **Is the resistance between 0.9 and 1.1 ohms between pins 1 and 2: and greater than 10,000 ohms between pin 2 and ground?**	**No** INSTALL a new passenger front seat backrest heater mat. REFER to Seat Backrest Heater Mat — Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
O10 CHECK THE CIRCUIT BETWEEN THE CUSHION HEATER MAT AND BACKREST HEATER MAT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ▪ passenger seat cushion heater mat C334-4, circuit CHS01 (GY/VT), harness side and seat backrest heater mat C365-1, circuit CHS01 (GY/VT) harness side. ▪ passenger seat cushion heater mat C334-4, circuit CHS01 (GY/VT), harness side and ground.  N0103168 • **Is the resistance less than 3 ohms between C334-4 and C335-1, and greater than 10,000 ohms between C334-4 and ground?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
O11 CHECK THE HEATED SEAT TEMPERATURE SENSOR FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between passenger heated seat cushion C334 pins 2 and 3, component side; and between heated seat cushion C334 pin 2, component side and ground.	**Yes** INSTALL a new HVAC module. REFER to Section 412-01. TEST the system for normal operation. DISCONNECT the battery

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 N0137216 • **Is the resistance between 300 ohms and 300,000 ohms between pins 2 and 3; and greater than 10,000 ohms between pin 2 and ground?**	ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test Q: The Heated Seats are Inoperative — Rear

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

When the LH or RH rear heated seat control switch is activated with the ignition ON, a ground signal is supplied to the heated seat module to command the system in high heat mode or low heat mode. When commanded ON, voltage is supplied to the heated seat switch from the heated seat module to illuminate the switch indicator. The heated seat module also supplies voltage to the LH or RH rear seat cushion and backrest heater mats, which are connected in series. Temperature is maintained by the heated seat module using a sensor contained within the cushion heater mat. The heated seat module supplies a reference voltage to the temperature sensor and monitors the return signal from the temperature sensor for controlling current flow to the heater mats. The heated seat module remains ON, heating the seat and maintaining temperature until switched OFF or the ignition voltage is switched OFF.

A new heated seat module must be configured after installation for correct operation. To configure, press the low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

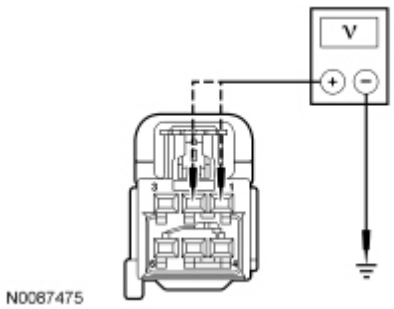
This pinpoint test is intended to diagnose the following:

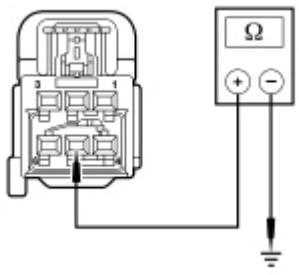
- Fuse(s)
- Wiring, terminals or connectors
- Heated seat module

PINPOINT TEST Q: THE HEATED SEATS ARE INOPERATIVE — REAR

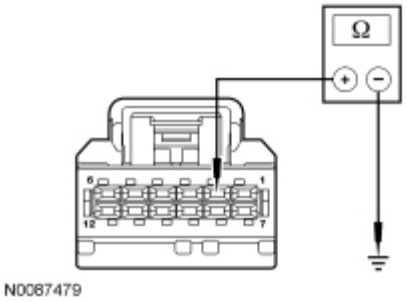
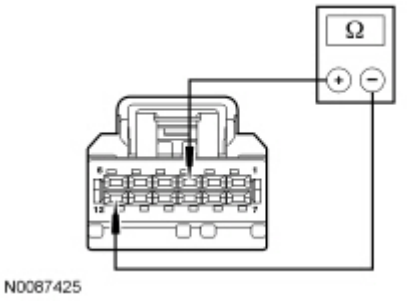
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Q1 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULE	

• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section.
• Disconnect: Heated Seat Module C3162B .
• Ignition ON.
• Measure the voltage between:
  ▪ rear heated seat module C3162B-2, circuit CBP33 (WH/BN), harness side and ground.
  ▪ rear heated seat module C3162B-1, circuit SBB71 (WH/RD), harness side and ground.

 	
N0087475
• **Are the voltages greater than 10 volts?**
	Yes
	GO to Q2 .
	
	No
	VERIFY Battery Junction Box (BJB) fuse 71 (20A) and Body Control Module (BCM) fuse 33 (10A) are OK. If OK, REPAIR the circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. TEST the system for normal operation.

Q2 CHECK THE REAR HEATED SEAT MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between rear heated seat module C3162B-5, circuit GD134 (BK/VT), harness side and ground.  N0087476 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q3 . **No** REPAIR the circuit. TEST the system for normal operation.
Q3 CHECK THE REAR HEATED SEAT SWITCH GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Heated Seat Module C3162A . • **NOTE:** This step will verify if the shared ground supplied to both heated seat switches is open by measuring the switch input resistance at the heated	**Yes** GO to Q4 . **No**

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seat module. • Measure the resistance between rear heated seat module C3162A-2, circuit CHS46 (YE/GN), harness side and ground while pressing the LH heated seat switch to high.  N0087479 • **Is the resistance less than 30 ohms when the switch is pressed and greater than 10,000 ohms when not pressed?**	REPAIR circuit GD139 (BK/YE). TEST the system for normal operation.
Q4 CHECK THE TEMPERATURE SENSOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between heated seat module C3162A-12, circuit RHS41 (GN/BN), harness side and C3162A-3, circuit VHS42 (GN), harness side.  N0087425 • **Is the resistance between 300 and 300K ohms?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** REPAIR circuit RHS41 (GN/BN). TEST the system for normal operation.

Pinpoint Test R: The Heated Seat is Inoperative — Left Rear

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

When the LH or RH rear heated seat control switch is activated with the ignition ON, a ground signal is supplied to the heated seat module to command the system in high heat mode or low heat mode. When commanded ON, voltage is supplied to the heated seat switch from the heated seat module to illuminate the switch indicator. The heated seat module also supplies voltage to the LH or RH rear seat cushion and backrest heater mats, which are connected in series. Temperature is maintained by the heated seat module using a sensor contained within the cushion heater mat. The heated seat module supplies a reference voltage to the temperature sensor and monitors the return signal from the temperature sensor for controlling current flow to the heater mats. The heated seat module remains ON, heating the seat and maintaining temperature until switched OFF or the ignition voltage is switched OFF.

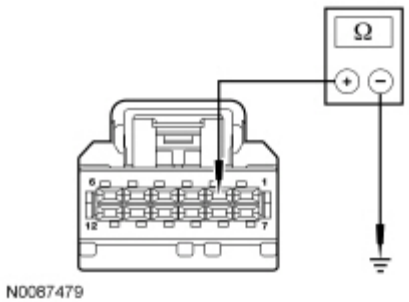
A new heated seat module must be configured after installation for correct operation. To configure, press the

low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

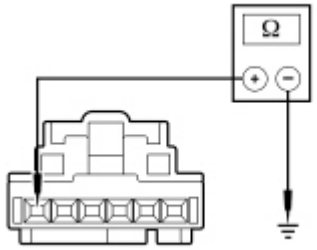
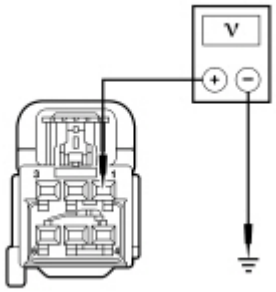
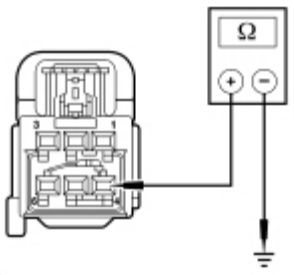
This pinpoint test is intended to diagnose the following:

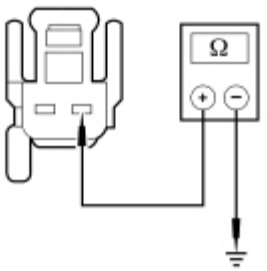
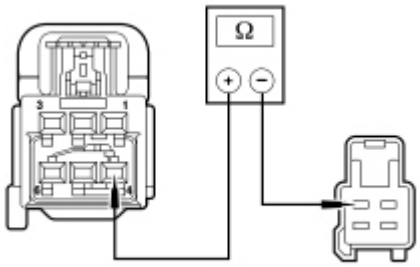
- Fuse
- Wiring, terminals or connectors
- Heater mat
- Heated seat switch
- Heated seat module

PINPOINT TEST R: THE HEATED SEAT IS INOPERATIVE — LEFT REAR

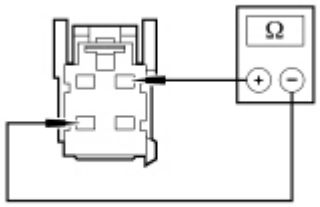
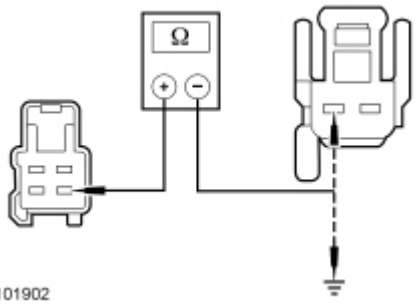
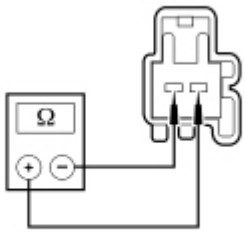
Test Step	Result / Action to Take
R1 CHECK THE HEATED SEAT OPERATION	
• Ignition ON. • Operate the left rear heated seat switch. • **Does the seat operate in either setting?**	**Yes** If only the low setting operates, GO to R15 . If only the high setting operates, GO to R16 . **No** GO to R2 .
R2 CHECK THE HEATED SEAT SWITCH INPUT	
• Ignition OFF. • For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section. • Disconnect: Rear Heated Seat Module C3162A . • Measure the resistance between rear heated seat module C3162A-2, circuit CHS46 (YE/GN), harness side and ground while pressing the heated seat switch to high.  N0087479 • **Is the resistance less than 30 ohms when the switch is pressed and greater than 10,000 ohms when not pressed?**	**Yes** GO to R4 . **No** GO to R3 .

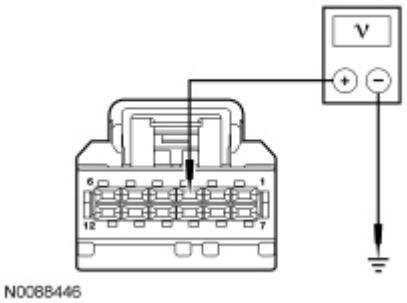
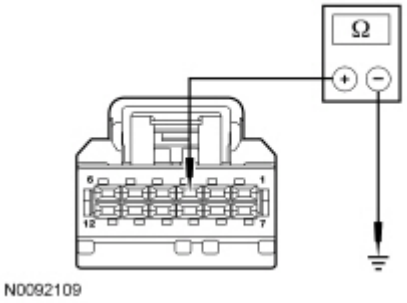
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R3 CHECK THE HEATED SEAT SWITCH GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Left Rear Heated Seat Switch C731 . • Measure the resistance between left rear heated seat switch C731-6, circuit GD134 (BK/VT), harness side and ground.  N0101900 • **Is the resistance less than 5 ohms?**	**Yes** GO to R17 . **No** REPAIR the circuit. TEST the system for normal operation.
R4 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULE	
• Disconnect: Rear Heated Seat Module C3162B . • Measure the voltage between rear heated seat module C3162B-1, circuit SBB71 (WH/RD), harness side and ground.  N0087480 • **Is the voltage greater than 10 volts?**	**Yes** GO to R5 . **No** VERIFY BCM fuse 71 (20A) is OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
R5 CHECK THE HEATER CIRCUITS AND HEATER MATS FOR AN OPEN	
• Measure the resistance between rear heated seat module C3162B-4, circuit CHS39 (GN/BU), harness side and ground.  N0091126 • **Is the resistance between 2.5 and 4.5 ohms?**	**Yes** GO to R11 . **No** GO to R6 .

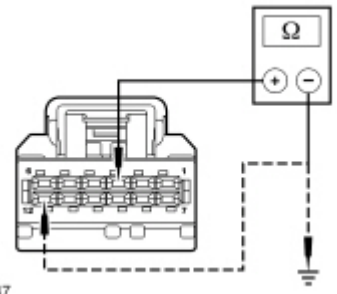
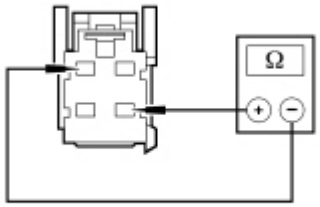
R6 CHECK THE HEATER MAT GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Left Rear Backrest Heater Mat C3168 . • Measure the resistance between left rear backrest heater mat C3168-1, circuit GD134 (BK/VT), harness side and ground.  N0101901 • **Is the resistance less than 5 ohms?**	**Yes** GO to R7 . **No** REPAIR the circuit. TEST the system for normal operation.
R7 CHECK THE HEATER CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Disconnect: Left Rear Cushion Heater Mat C3167 . • Measure the resistance between: ▪ rear heated seat module C3162B-4, circuit CHS39 (GN/BU), harness side and left rear cushion heater mat C3167-1, circuit CHS39 (GN/BU), harness side. ▪ rear heated seat module C3162B-4, circuit CHS39 (GN/BU), harness side and ground.  N0090833 • **Is the resistance less than 5 ohms between C3162B-4 and C3167-1, and greater than 10,000 ohms between C3162B-4 and ground?**	**Yes** GO to R8 . **No** REPAIR the circuit. TEST the system for normal operation.
R8 CHECK THE CUSHION HEATER MAT FOR AN OPEN	
• Measure the resistance between left rear heated seat cushion C3167 pins 1 and 4, component side.	**Yes** GO to R9 . **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Rear in this section. TEST the system for normal operation.

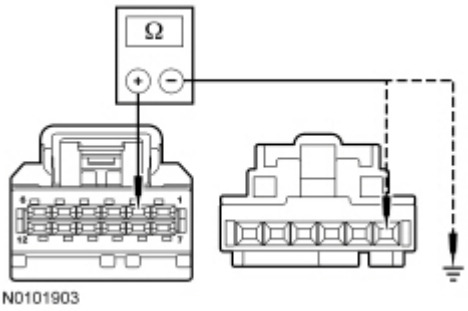
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 N0088932 • **Is the resistance between 1.5 and 2.5 ohms?**	
R9 CHECK FOR AN OPEN OR A SHORT TO GROUND BETWEEN THE HEATER MATS	
• Measure the resistance between: ▪ left rear cushion heater mat C3167-4, circuit CHS40 (GY/VT), harness side and left rear backrest heater mat C3168-2, circuit CHS40 (GY/VT), harness side. ▪ left rear cushion heater mat C3167-4, circuit CHS40 (GY/VT), harness side and ground.  N0101902 • **Is the resistance less than 5 ohms between C3167-4 and C3168-2, and greater than 10,000 ohms between C3167-4 and ground?**	**Yes** GO to R10 . **No** REPAIR the circuit. TEST the system for normal operation.
R10 CHECK THE BACKREST HEATER MAT FOR AN OPEN	
• Measure the resistance between left rear backrest heater mat C3168 pins 1 and 2, component side.  N0091136 • **Is the resistance between 1 and 2 ohms?**	**Yes** The fault is intermittent. CHECK the electrical connectors for corrosion, poor pin contact or pushed out pins, particularly the pins and terminals of electrical connectors that were disconnected. **Do not install any new components at this time. Components should only be installed when directed to do so in the pinpoint test.** REPAIR any intermittent wiring, terminal or connector concerns found. TEST the system for normal operation. **No** INSTALL a new backrest heater mat. REFER to Seat Backrest Heater Mat — Rear in this section. TEST the system for

	normal operation.
R11 CHECK THE TEMPERATURE SENSOR CIRCUIT FOR A SHORT TO VOLTAGE • Ignition ON. • Measure the voltage between rear heated seat module C3162A-3, circuit VHS42 (GN), harness side and ground.  N0088446 • **Is any voltage present?**	**Yes** REPAIR the circuit. GO to R14 to check the temperature sensor for damage. If temperature sensor is OK, TEST the system for normal operation. **No** GO to R12 .
R12 CHECK THE TEMPERATURE SENSOR CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Measure the resistance between rear heated seat module C3162A-3, circuit VHS42 (GN), harness side and ground.  N0092109 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R13 . **No** REPAIR the circuit. TEST the system for normal operation.
R13 CHECK THE TEMPERATURE SENSOR AND CIRCUITS FOR AN OPEN OR SHORT TO GROUND • Connect: Left Rear Cushion Heater Mat C3167 (if previously disconnected) . • Measure the resistance between: ▪ rear heated seat module C3162A-3, circuit VHS42 (GN), harness side and C3162A-12, circuit RHS41 (GN/BN), harness side. ▪ rear heated seat module C3162A-3, circuit VHS42 (GN), harness side and ground.	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** GO to R14 .

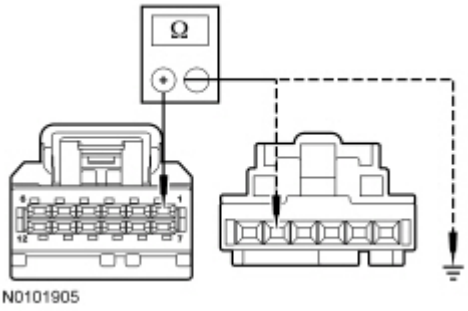
repair4less

 N0088447 • **Is the resistance between 300 and 300K ohms between C3162A-3 and C3162A-12 and greater than 10,000 ohms between C3162A-3 and ground?**	
R14 CHECK THE TEMPERATURE SENSOR FOR AN OPEN	
• Disconnect: Left Rear Cushion Heater Mat C3167 . • Measure the resistance between left rear cushion heater mat C3167 pins 2 and 3, component side.  N0088935 • **Is the resistance between 8,000 and 15,000 ohms?**	**Yes** REPAIR circuit RHS41 (GN/BN) or VHS42 (GN). TEST the system for normal operation. **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Rear in this section. TEST the system for normal operation.
R15 CHECK THE HIGH HEAT REQUEST CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section. • Disconnect: Left Rear Heated Seat Switch C731 . • Measure the resistance between: ▪ rear heated seat module C3162A-2, circuit CHS46 (YE/GN), harness side and left rear heated seat switch C731-1, circuit CHS46 (YE/GN), harness side. ▪ rear heated seat module C3162A-2, circuit CHS46 (YE/GN), harness side and ground.	**Yes** GO to R17 . **No** REPAIR the circuit. TEST the system for normal operation.



- **Is the resistance less than 5 ohms between C3162A-2 and C731-1 and greater than 10,000 ohms between C3162A-2 and ground?**

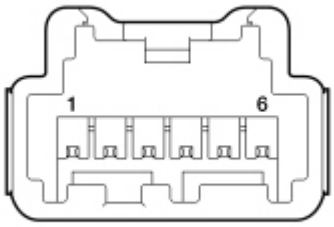
R16 CHECK THE LOW HEAT REQUEST CIRCUIT FOR AN OPEN OR SHORT TO GROUND	

• Disconnect: Left Rear Heated Seat Switch C731 .
• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section.
• Measure the resistance between:
  ▪ rear heated seat module C3162A-1, circuit CHS47 (VT/GN), harness side and left rear heated seat switch C731-5, circuit CHS47 (VT/GN), harness side.
  ▪ rear heated seat module C3162A-1, circuit CHS47 (VT/GN), harness side and ground.
 	

 	
• **Is the resistance less than 5 ohms between C3162A-1 and C731-5 and greater than 10,000 ohms between C3162A-1 and ground?**
	Yes
	GO to R17 .
	
	No
	REPAIR the circuit. TEST the system for normal operation.

R17 CHECK THE HEATED SEAT SWITCH	
• Disconnect: Left Rear Heated Seat Switch C731 . • Use the following chart and measure the resistance between rear heated seat switch pins, component side, while pressing the indicated switch buttons and compare the results. **Heated Seat Switch Mode** / **Pins** / **Ohms** High / 1 and 6 / Less than 30	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** INSTALL a new heated seat switch. REFER to Heated Seat Switch — Rear in this section.

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At rest	1 and 6	Greater than 10,000
Low	5 and 6	Less than 30
At rest	5 and 6	Greater than 10,000



N0088486

- **Is the heated seat switch OK?**

Pinpoint Test S: The Heated Seat is Inoperative — Right Rear

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

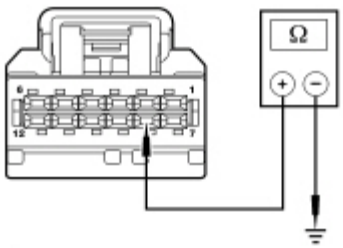
When the LH or RH rear heated seat control switch is activated with the ignition ON, a ground signal is supplied to the heated seat module to command the system in high heat mode or low heat mode. When commanded ON, voltage is supplied to the heated seat switch from the heated seat module to illuminate the switch indicator. The heated seat module also supplies voltage to the LH or RH rear seat cushion and backrest heater mats, which are connected in series. Temperature is maintained by the heated seat module using a sensor contained within the cushion heater mat. The heated seat module supplies a reference voltage to the temperature sensor and monitors the return signal from the temperature sensor for controlling current flow to the heater mats. The heated seat module remains ON, heating the seat and maintaining temperature until switched OFF or the ignition voltage is switched OFF.

A new heated seat module must be configured after installation for correct operation. To configure, press the low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

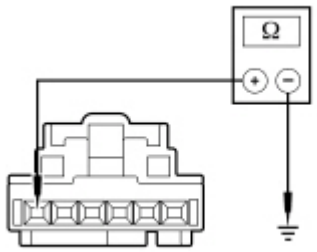
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Heater mat
- Heated seat switch
- Heated seat module

PINPOINT TEST S: THE HEATED SEAT IS INOPERATIVE — RIGHT REAR

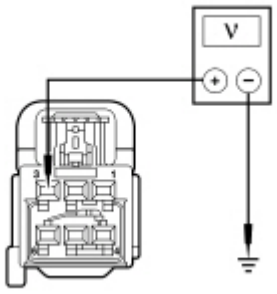
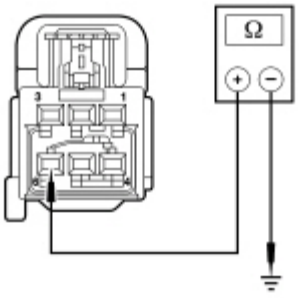
Test Step	Result / Action to Take
S1 CHECK THE HEATED SEAT OPERATION • Ignition ON. • Operate the right rear heated seat switch. • **Does the seat operate in either setting?**	**Yes** If only the low setting operates, GO to S15 . If only the high setting operates, GO to S16 . **No** GO to S2 .
S2 CHECK THE HEATED SEAT SWITCH INPUT • Ignition OFF. • For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section. • Disconnect: Rear Heated Seat Module C3162A . • Measure the resistance between rear heated seat module C3162A-8, circuit CHS50 (BU/GY), harness side and ground while pressing the heated seat switch to high.  N0088472 • **Is the resistance less than 30 ohms when the switch is pressed and greater than 10,000 ohms when not pressed?**	**Yes** GO to S4 . **No** GO to S3 .
S3 CHECK THE HEATED SEAT SWITCH GROUND CIRCUIT FOR AN OPEN • Disconnect: Right Rear Heated Seat Switch C831 . • Measure the resistance between right rear heated seat switch C831-6, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to S17 . **No** REPAIR the circuit. TEST the system for normal operation.

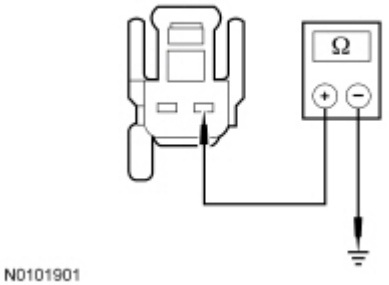
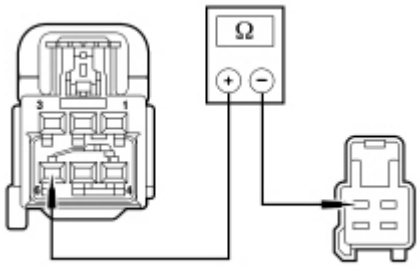
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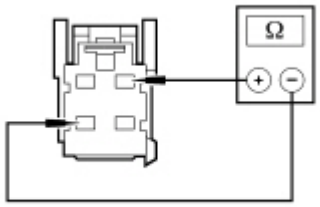
N0101900

- **Is the resistance less than 5 ohms?**

S4 CHECK VOLTAGE TO THE RIGHT REAR HEATED SEAT MODULE FEED CIRCUIT	
• Disconnect: Rear Heated Seat Module C3162B . • Measure the voltage between rear heated seat module C3162B-3, circuit SBB71 (WH/RD), harness side and ground.  N0088707 • **Is the voltage greater than 10 volts?**	**Yes** GO to S5 . **No** VERIFY BCM fuse 71 (20A) is OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
S5 CHECK THE HEATER CIRCUITS AND HEATER MATS FOR AN OPEN	
• Measure the resistance between rear heated seat module C3162B-6, circuit CHS43 (GY/BU), harness side and ground.  N0091155 • **Is the resistance between 2.5 and 4.5 ohms?**	**Yes** GO to S11 . **No** GO to S6 .
S6 CHECK THE HEATER MAT GROUND CIRCUIT FOR AN OPEN	
• For electrical connector access, release and lower the rear 40 percent seat backrest. Refer to the appropriate steps in Seat Backrest Latch — Rear, Crew Cab in this section. • Disconnect: Right Rear Backrest Heater Mat	**Yes** GO to S7 . **No** REPAIR the circuit. TEST the system for

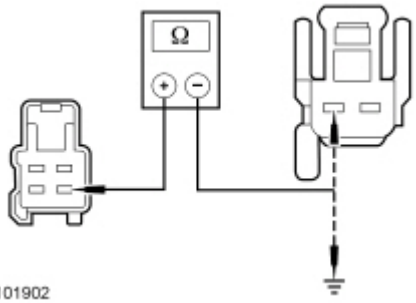
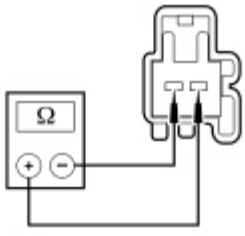
C3170 . • Measure the resistance between right rear backrest heater mat C3170-1, circuit GD139 (BK/YE), harness side and ground.  N0101901 • **Is the resistance less than 5 ohms?**	normal operation.
S7 CHECK THE HEATER CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Disconnect: Right Rear Cushion Heater Mat C3169 . • Measure the resistance between: ▪ rear heated seat module C3162B-6, circuit CHS43 (GY/BU), harness side and right rear cushion heater mat C3169-1, circuit CHS43 (GY/BU), harness side. ▪ rear heated seat module C3162B-6, circuit CHS43 (GY/BU), harness side and ground.  N0090843 • **Is the resistance less than 5 ohms between C3162B-6 and C3169-1, and greater than 10,000 ohms between C3162B-6 and ground?**	**Yes** GO to S8 . **No** REPAIR the circuit. TEST the system for normal operation.
S8 CHECK THE CUSHION HEATER MAT FOR AN OPEN	
• Measure the resistance between right rear cushion heater mat C3169 pins 1 and 4, component side.	**Yes** GO to S9 . **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Rear in this section. TEST the system for normal operation.

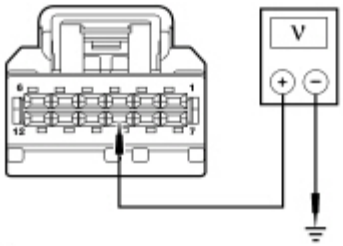
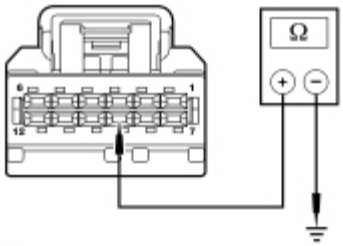
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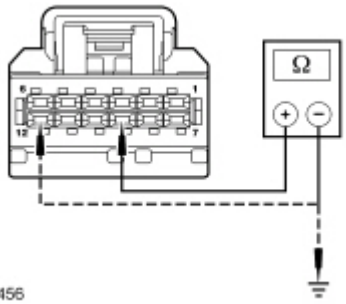
N0088932

- **Is the resistance between 1.5 and 2.5 ohms?**

S9 CHECK FOR AN OPEN OR A SHORT TO GROUND BETWEEN THE HEATER MATS	
• Measure the resistance between: ▪ right rear cushion heater mat C3169-4, circuit CHS44 (GN/VT), harness side and right rear backrest heater mat C3170-2, circuit CHS44 (GN/VT), harness side. ▪ right rear seat cushion heater mat C3169-4, circuit CHS44 (GN/VT), harness side and ground.  N0101902 • **Is the resistance less than 5 ohms between C3169-4 and C3170-2, and greater than 10,000 ohms between C3169-4 and ground?**	**Yes** GO to S10 . **No** REPAIR the circuit. TEST the system for normal operation.
S10 CHECK THE BACKREST HEATER MAT FOR AN OPEN	
• Measure the resistance between right rear backrest heater mat C3170 pins 1 and 2, component side.  N0091136 • **Is the resistance between 1 and 2 ohms?**	**Yes** The fault is intermittent. CHECK the electrical connectors for corrosion, poor pin contact or pushed out pins, particularly the pins and terminals of electrical connectors that were disconnected. **Do not install any new components at this time. Components should only be installed when directed to do so in the pinpoint test.** REPAIR any intermittent wiring, terminal or connector concerns found. TEST the system for normal operation. **No** INSTALL a new rear seat backrest heater mat. REFER to Seat Backrest Heater Mat

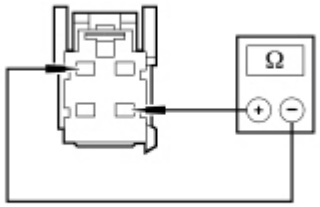
	— Rear in this section. TEST the system for normal operation.
S11 CHECK THE TEMPERATURE SENSOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between heated seat module C3162A-9, circuit VHS45 (GY/BN), harness side and ground.  N0088706 • **Is any voltage present?**	**Yes** REPAIR the circuit. GO to S14 to check the temperature sensor for damage. If the temperature sensor is OK, TEST the system for normal operation. **No** GO to S12 .
S12 CHECK THE TEMPERATURE SENSOR CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between heated seat module C3162A-9, circuit VHS45 (GY/BN), harness side and ground.  N0092115 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to S13 . **No** REPAIR the circuit. TEST the system for normal operation.
S13 CHECK RIGHT REAR HEATED SEAT TEMPERATURE SENSOR CIRCUITS FOR AN OPEN OR SHORT TO GROUND	
• Connect: Right Rear Cushion Heater Mat C3169 (if previously disconnected) . • Measure the resistance between: ▪ rear heated seat module C3162A-9, circuit VHS45 (GY/BN), harness side and C3162A-12, circuit RHS41 (GN/BN), harness side. ▪ rear heated seat module C3162A-9, circuit VHS45 (GY/BN), harness side and ground.	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** GO to S14 .

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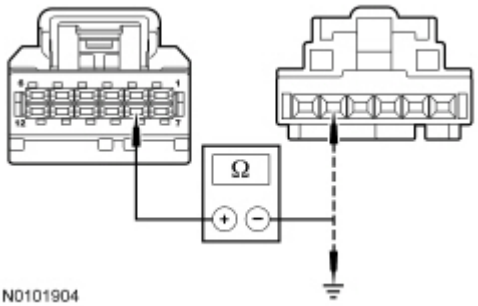


N0088456

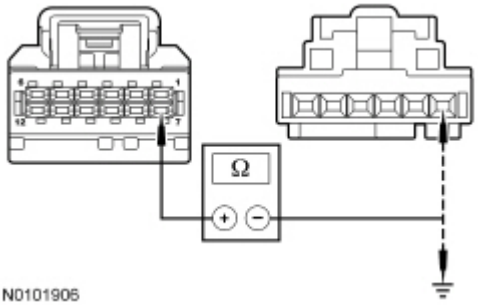
- **Is the resistance between 300 and 300K ohms between C3162A-9 and C3162A-12 and greater than 10,000 ohms between C3162A-9 and ground?**

S14 CHECK THE TEMPERATURE SENSOR FOR AN OPEN	
• For electrical connector access, release and lower the rear 40 percent seat backrest. Refer to the appropriate steps in Seat Backrest Latch — Rear, Crew Cab in this section. • Disconnect: Right Rear Cushion Heater Mat C3169 . • Measure the resistance between rear cushion heater mat C3169 pins 2 and 3, component side.  N0088935 • **Is the resistance between 8,000 and 15,000 ohms?**	**Yes** REPAIR circuit RHS41 (GN/BN) or VHS45 (GY/BN). TEST the system for normal operation. **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Heater Mat — Rear in this section. TEST the system for normal operation.
S15 CHECK THE HIGH HEAT REQUEST CIRCUIT FOR AN OPEN OR SHORT TO GROUND	

• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section.
• Disconnect: Right Rear Heated Seat Switch C831 .
• Measure the resistance between:
  ▪ rear heated seat module C3162A-8, circuit CHS50 (BU/GY), harness side and right rear heated seat switch C831-5, circuit CHS50 (BU/GY), harness side.
  ▪ rear heated seat module C3162A-8, circuit CHS50 (BU/GY), harness side and ground.
	Yes
	GO to S17 .
	
	No
	REPAIR the circuit. TEST the system for normal operation.



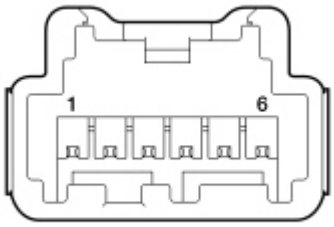
- **Is the resistance less than 5 ohms between C3162A-8 and C831-5 and greater than 10,000 ohms between C3162A-8 and ground?**

S16 CHECK THE LOW HEAT REQUEST CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section. • Disconnect: Right Rear Heated Seat Switch C831 . • Measure the resistance between: ▪ rear heated seat module C3162A-7, circuit CHS51 (YE/GY), harness side and right rear heated seat switch C831-1, circuit CHS51 (YE/GY), harness side. ▪ rear heated seat module C3162A-7, circuit CHS51 (YE/GY), harness side and ground.  • **Is the resistance less than 5 ohms between C3162A-7 and C831-1 and greater than 10,000 ohms between C3162A-7 and ground?**	**Yes** GO to S17 . **No** REPAIR the circuit. TEST the system for normal operation.
S17 CHECK THE HEATED SEAT SWITCH	
• Disconnect: Right Rear Heated Seat Switch C831 . • Use the following chart and measure the resistance between rear heated seat switch pins, component side, while pressing the indicated switch buttons and compare the results.	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** INSTALL a new heated seat switch. REFER to Heated Seat Switch — Rear in this section.

Heated Seat Switch Mode	Pins	Ohms
High	5 and 6	Less than 30

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At rest	5 and 6	Greater than 10,000
Low	1 and 6	Less than 30
At rest	1 and 6	Greater than 10,000



N0088486

- **Is the heated seat switch OK?**

Pinpoint Test T: The Heated Seat Does Not Operate Correctly — Left Rear Seat Does Heat But the Heated Seat Indicator Does Not Illuminate When Pressed

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

With the ignition and heated seat on, the heated seat module supplies voltage to the indicator circuit(s) to illuminate the appropriate switch indicator. The heated seat and indicator deactivates with a second button press.

A new heated seat module must be configured after installation for correct operation. To configure, press the low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

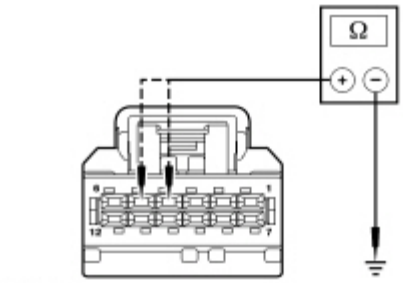
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Heated seat switch
- Heated seat module

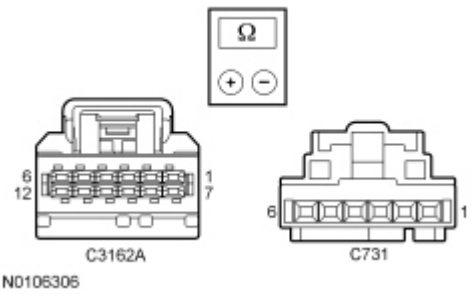
PINPOINT TEST T: THE HEATED SEAT DOES NOT OPERATE CORRECTLY — LEFT REAR SEAT DOES HEAT BUT THE HEATED SEAT INDICATOR DOES NOT ILLUMINATE WHEN PRESSED

Test Step	Result / Action to Take
T1 CHECK THE HEATED SEAT INDICATOR CIRCUITS FOR A	

SHORT TO GROUND	

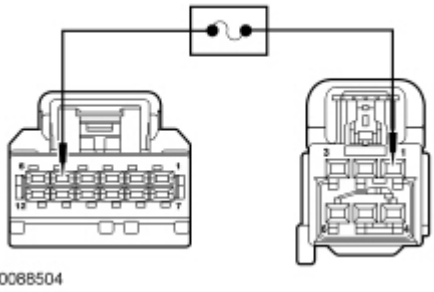
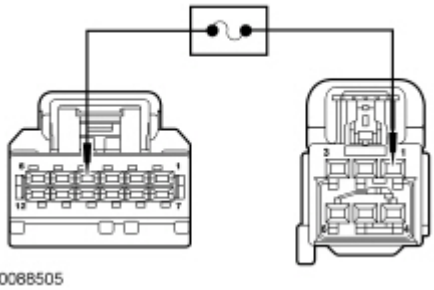
• Ignition OFF.
• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section.
• Disconnect: Rear Heated Seat Module C3162A .
• Disconnect: Left Rear Heated Seat Switch C731 .
• Measure the resistance between:
  ▪ heated seat module C3162A-4, circuit CHS49 (VT), harness side and ground.
  ▪ heated seat module C3162A-5, circuit CHS48 (YE), harness side and ground.

 	
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to T2 .
	
	No
	REPAIR the circuit(s). TEST the system for normal operation.

T2 CHECK THE HEATED SEAT INDICATOR CIRCUITS FOR AN OPEN	

• Measure the resistance between:
  ▪ heated seat module C3162A-4, circuit CHS49 (VT), harness side and left rear heated seat switch C731-4, circuit CHS49 (VT), harness side.
  ▪ heated seat module C3162A-5, circuit CHS48 (YE), harness side and left rear heated seat switch C731-3, circuit CHS48 (YE), harness side.

 	
• **Are the resistances less than 5 ohms?**
	Yes
	GO to T3 .
	
	No
	REPAIR the circuit(s). TEST the system for normal operation.

T3 CHECK THE HIGH HEAT INDICATOR	
• Connect: Left Rear Heated Seat Switch C731 . • Disconnect: Rear Heated Seat Module C3162B . • Connect a fused jumper lead between rear heated seat module C3162A-5, circuit CHS48 (YE), harness side and C3162B-1, circuit SBB71 (WH/RD), harness side.	**Yes** GO to T4 . **No** INSTALL a new heated seat switch. REFER to Heated Seat

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 N0088504 • **Does the indicator illuminate?**	Switch — Rear in this section. TEST the system for normal operation.
T4 CHECK THE LOW HEAT INDICATOR	
• Connect a fused jumper lead between rear heated seat module C3162A-4, circuit CHS49 (VT), harness side and C3162B-1, circuit SBB71 (WH/RD), harness side.  N0088505 • **Does the indicator illuminate?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** INSTALL a new heated seat switch. REFER to Heated Seat Switch — Rear in this section. TEST the system for normal operation.

Pinpoint Test U: The Heated Seat Does Not Operate Correctly — Right Rear Seat Does Heat But the Heated Seat Indicator Does Not Illuminate When Pressed

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

With the ignition and heated seat on, the heated seat module supplies voltage to the indicator circuit(s) to illuminate the appropriate switch indicator. The heated seat and indicator deactivates with a second button press.

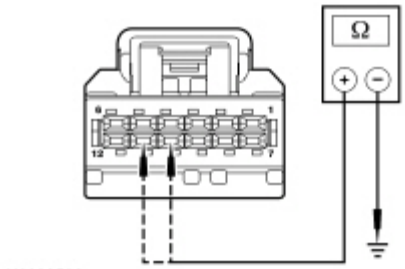
A new heated seat module must be configured after installation for correct operation. To configure, press the low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

This pinpoint test is intended to diagnose the following:

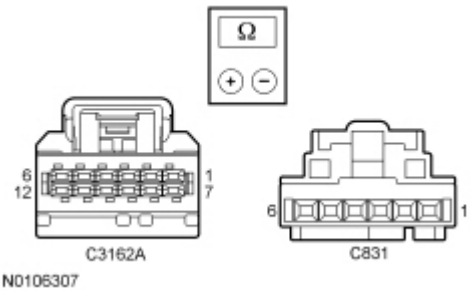
- Wiring, terminals or connectors
- Heated seat switch
- Heated seat module

PINPOINT TEST U: THE HEATED SEAT DOES NOT OPERATE CORRECTLY — RIGHT REAR SEAT DOES HEAT BUT THE HEATED SEAT INDICATOR DOES NOT ILLUMINATE WHEN PRESSED

Test Step	Result / Action to Take
U1 CHECK THE HEATED SEAT INDICATOR CIRCUITS FOR A SHORT TO GROUND	

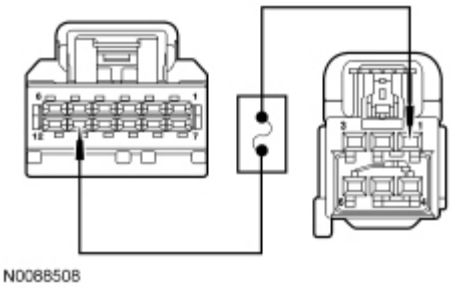
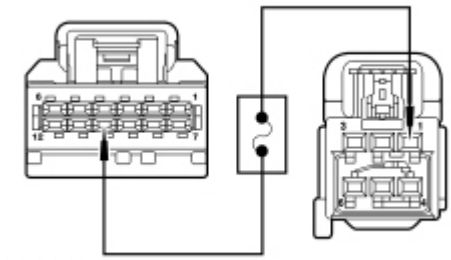
• Ignition OFF.
• For electrical connector access, release and lower the rear 60 percent seat backrest. Refer to the appropriate steps in Heated Seat Module — Rear in this section.
• Disconnect: Rear Heated Seat Module C3162A .
• Disconnect: Right Rear Heated Seat Switch C831 .
• Measure the resistance between:
  ▪ heated seat module C3162A-10, circuit CHS53 (WH/BN), harness side and ground.
  ▪ heated seat module C3162A-11, circuit CHS52 (BU), harness side and ground.

 	
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to U2 .
	
	No
	REPAIR the circuit(s). TEST the system for normal operation.

U2 CHECK THE HEATED SEAT INDICATOR CIRCUITS FOR AN OPEN	

• Measure the resistance between:
  ▪ heated seat module C3162A-10, circuit CHS53 (WH/BN), harness side and right rear heated seat switch C831-3, circuit CHS53 (WH/BN), harness side.
  ▪ heated seat module C3162A-11, circuit CHS52 (BU), harness side and right rear heated seat switch C831-4, circuit CHS52 (BU), harness side.

 	
• **Are the resistances less than 5 ohms?**
	Yes
	GO to U3 .
	
	No
	REPAIR the circuit(s). TEST the system for normal operation.

U3 CHECK THE HIGH HEAT INDICATOR	

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• Connect: Right Rear Heated Seat Switch C831 . • Disconnect: Rear Heated Seat Module C3162B . • Connect a fused jumper lead between rear heated seat module C3162A-11, circuit CHS52 (BU), harness side and C3162B-1, circuit SBB71 (WH/RD), harness side.  N0088508 • **Does the indicator illuminate?**	**Yes** GO to U4 . **No** INSTALL a new heated seat switch. REFER to Heated Seat Switch — Rear in this section. TEST the system for normal operation.
U4 CHECK THE LOW HEAT INDICATOR	
• Connect a fused jumper lead between rear heated seat module C3162A-10, circuit CHS53 (WH/BN), harness side and C3162B-1, circuit SBB71 (WH/RD), harness side.  N0088509 • **Does the indicator illuminate?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** INSTALL a new heated seat switch. REFER to Heated Seat Switch — Rear in this section. TEST the system for normal operation.

Pinpoint Test V: The Heated Seat Does Not Operate Correctly — Left Rear Heated Seat Indicator is Always On

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

With the ignition and heated seat on, the heated seat module supplies voltage to the indicator circuit(s) to illuminate the appropriate switch indicator. The heated seat and indicator deactivates with a second button press.

A new heated seat module must be configured after installation for correct operation. To configure, press the low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Heated seat module

PINPOINT TEST V: THE HEATED SEAT DOES NOT OPERATE CORRECTLY — LEFT REAR HEATED SEAT INDICATOR IS ALWAYS ON

Test Step	Result / Action to Take
V1 CHECK THE INDICATOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Rear Heated Seat Module C3162A . • **Does the indicator turn off when the heated seat module is disconnected?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** REPAIR circuit CHS49 (VT) or CHS48 (YE) for a short to voltage. TEST the system for normal operation.

Pinpoint Test W: The Heated Seat Does Not Operate Correctly — Right Rear Heated Seat Indicator is Always On

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

With the ignition and heated seat on, the heated seat module supplies voltage to the indicator circuit(s) to illuminate the appropriate switch indicator. The heated seat and indicator deactivates with a second button press.

A new heated seat module must be configured after installation for correct operation. To configure, press the low heat mode button on either rear heated seat switch. Module configuration will occur automatically after the low heat mode button is pressed. Until the module is correctly configured, the heated seats will operate incorrectly when selecting the high heat mode by following a sequence of high, low and off with each button press. The system will operate correctly after the heated seat module receives a low heat request on either of the low heat request circuits and rear heated seat module configuration is activated.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Heated seat module

PINPOINT TEST W: THE HEATED SEAT DOES NOT OPERATE CORRECTLY — RIGHT REAR HEATED SEAT INDICATOR IS ALWAYS ON

Test Step	Result / Action to Take
W1 CHECK THE INDICATOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Rear Heated Seat Module	**Yes**

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C3162A . • **Does the indicator turn off when the heated seat module is disconnected?**	INSTALL a new heated seat module. REFER to Heated Seat Module — Rear in this section. TEST the system for normal operation. **No** REPAIR circuit CHS53 (WH/BN) or CHS52 (BU) for a short to voltage. TEST the system for normal operation.

Pinpoint Test X: DTCs B103B and B1111

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The seat cushion and backrest are equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). When the Dual Climate Controlled Seat Module (DCSM) detects an overcurrent and/or overtemperature in the output circuits to the TEDs , it will disable the affected seat and set the following DTCs:

- DTC B103B (Thermoelectric Driver Overcurrent Low) — If DCSM outputs to the driver seat backrest or cushion TED (circuit pin G, H, J or K at the DCSM connector) or any components within these circuit loops are shorted to ground or a TED resistance of less than 0.9 ohm is sensed, the DCSM shuts down the driver seat system and sets this DTC.
- DTC B1111 (Driver Thermal Electric Device Control Overtemperature Fault) — If the DCSM TED driver integrated circuit temperature exceeds 175°C (347°F), the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST X: DTCs B103B AND B1111

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

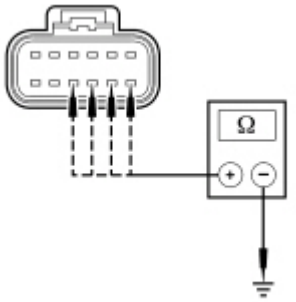
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
X1 CHECK THE TED CIRCUITS FOR A SHORT TO GROUND	

- Ignition OFF.
- Depower the SRS . Refer to Section 501-20B .
- Disconnect: Driver Seat Side Air Bag Module C3051 .
- Disconnect: Passenger Seat Side Air Bag Module C339 .
- Disconnect: DCSM C3265A .
- Measure the resistance between DCSM C3265A, harness side and ground using the following chart:

DCSM Connector	Circuit
C3265A-G	CHS02 (YE/BU)
C3265A-H	RHS02 (BU/OG)
C3265A-J	CHS01 (GY/VT)
C3265A-K	RHS01 (WH/VT)



- **Are the resistances greater than 10,000 ohms?**

Yes
GO to X2 .

No
If the resistance of C3265A-G, circuit(s) CHS02 (YE/BU) and/or C3265A-H, circuit RHS02 (BU/OG) to ground is **not** greater than 10,000 ohms to ground, GO to X6 .

If the resistance of C3265A-J, circuit(s) CHS01 (GY/VT) and/or C3265A-K, circuit RHS01 (WH/VT) to ground is **not** greater than 10,000 ohms to ground, GO to X7 .

X2 CHECK THE TED CIRCUITS FOR A SHORT TO VOLTAGE

- **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
- Connect the battery ground cable. Refer to Section 414-01 .
- Ignition ON.
- Measure the voltage between DCSM C3265A, harness side and ground using the following chart:

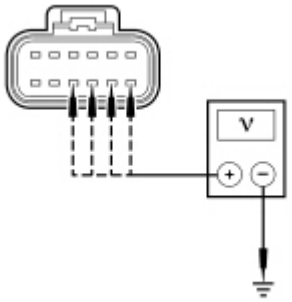
DCSM Connector	Circuit
C3265A-G	CHS02 (YE/BU)
C3265A-H	RHS02 (BU/OG)
C3265A-J	CHS01 (GY/VT)
C3265A-K	RHS01 (WH/VT)

Yes
If voltage is present at C3265A-G and/or C3265A-H, GO to X8 .

If voltage is present at C3265A-J and/or C3265A-K, GO to X9 .

No
GO to X3 .

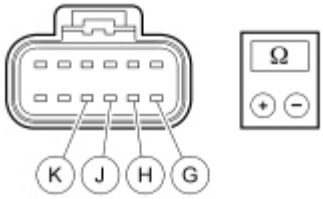
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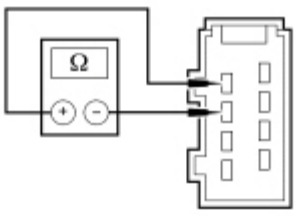


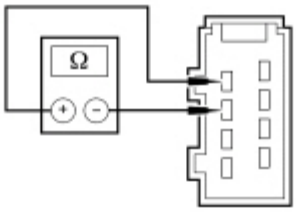
N0097825

- **Is any voltage present on any circuits?**

X3 CHECK THE TED AND WIRING RESISTANCE	

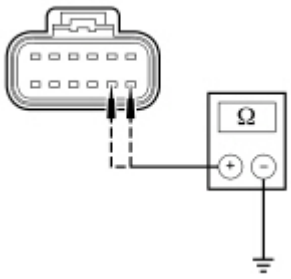
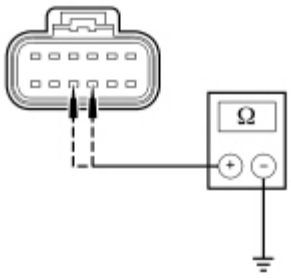
• Ignition OFF.
• Measure the resistance between:
  ▪ DCSM C3265A-G, circuit CHS02 (YE/BU), harness side and DCSM C3265A-H, circuit RHS02 (BU/OG), harness side.
  ▪ DCSM C3265A-J, circuit CHS01 (GY/VT), harness side and C3265A-K, circuit RHS01 (WH/VT), harness side.

 	
N0092076
• **Are the resistances between 0.9 and 10 ohms?**
	Yes
	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
	
	No
	If the resistance is between DCSM C3265A-G and C3265A-H is **not** between 0.9 and 10 ohms, GO to X5 .
	
	If the resistance is between DCSM C3265A-J and C3265A-K is **not** between 0.9 and 10 ohms, GO to X4 .

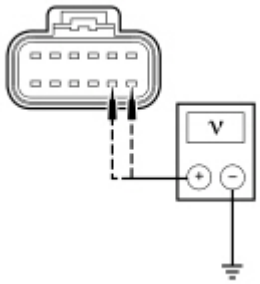
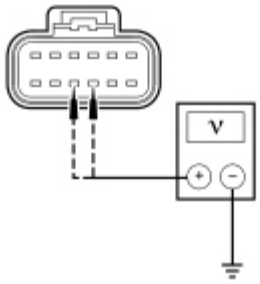
X4 CHECK THE BACKREST TED RESISTANCE	
• Disconnect: Backrest TED C3034 . • Measure the resistance between backrest TED C3034 pins 1 and 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric

	Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
X5 CHECK THE CUSHION TED RESISTANCE • Disconnect: Cushion TED C3035 . • Measure the resistance between cushion TED C3035 pins 1 and 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

X6 CHECK THE CUSHION TED CIRCUITS FOR A SHORT TO GROUND
 	
• Disconnect: Cushion TED C3035 .
• Measure the resistance between:
  ▪ DCSM C3265A-G, circuit CHS02 (YE/BU), harness side and ground.
  ▪ DCSM C3265A-H, circuit RHS02 (BU/OG), harness side and ground.
	Yes
	INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
	
	No

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 N0042875 • **Are the resistances greater than 10,000 ohms?**	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
X7 CHECK THE BACKREST TED CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Backrest TED C3034 . • Measure the resistance between: ▪ DCSM C3265A-J, circuit CHS01 (GY/VT), harness side and ground. ▪ DCSM C3265A-K, circuit RHS01 (WH/VT), harness side and ground.  N0042876 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
X8 CHECK THE CUSHION TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3035 . • Ignition ON. • Measure the voltage between: ▪ DCSM C3265A-G, circuit CHS02 (YE/BU), harness side and ground. ▪ DCSM C3265A-H, circuit RHS02 (BU/OG), harness side and ground.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

 N0042877 • **Is any voltage present on either circuit?**	**No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
X9 CHECK THE BACKREST TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3034 . • Ignition ON. • Measure the voltage between: ▪ DCSM C3265A-J, circuit CHS01 (GY/VT), harness side and ground. ▪ DCSM C3265A-K, circuit RHS01 (WH/VT), harness side and ground.  N0042878 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test Y: DTC B103C

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The seat cushion and backrest are equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). If the Dual Climate Controlled Seat Module (DCSM) detects an open circuit or high TED resistance, the following DTC will be set:

- DTC B103C (Thermoelectric Driver Open Load) — If DCSM outputs to the driver seat backrest or

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cushion TED (circuit pin G, H, J or K at the DCSM connector) or any components within these circuit loops are open, disconnected or a TED resistance greater than 90,000 ohms is sensed, the DCSM continues normal operation and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST Y: DTC B103C

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

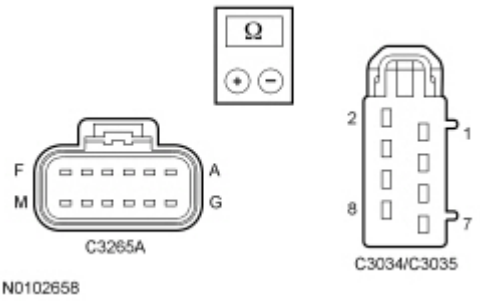
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>Y1 CHECK THE TED CIRCUITS FOR AN OPEN</td><td></td></tr>
<tr><td>

Ignition OFF.
Depower the SRS . Refer to Section 501-20B .
Disconnect: Driver Seat Side Air Bag Module C3051 .
Disconnect: Passenger Seat Side Air Bag Module C339 .
Disconnect: DCSM C3265A .
Disconnect: Cushion TED C3035 .
Disconnect: Backrest TED C3034 .
Measure the resistance between DCSM C3265A, harness side and cushion TED C3035, harness side; and between DCSM C3265A, harness side and backrest TED C3034, harness side using the following chart:

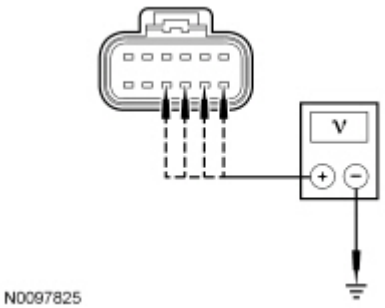
<table>
<tr><th>DCSM Connector</th><th>Circuit</th><th>TED Connector</th></tr>
<tr><td>C3265A-G</td><td>CHS02 (YE/BU)</td><td>C3035-1</td></tr>
<tr><td>C3265A-H</td><td>RHS02 (BU/OG)</td><td>C3035-3</td></tr>
<tr><td>C3265A-J</td><td>CHS01 (GY/VT)</td><td>C3034-1</td></tr>
<tr><td>C3265A-K</td><td>RHS01 (WH/VT)</td><td>C3034-3</td></tr>
</table>
</td><td>Yes
GO to Y2 .

No
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .</td></tr>
</table>

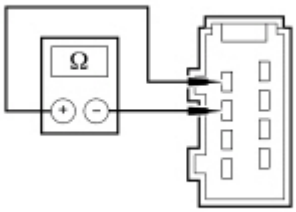


- **Are the resistances less than 5 ohms?**

Y2 CHECK THE TED CIRCUITS FOR A SHORT TO VOLTAGE	
• **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3265A, harness side and ground using the following chart: **DCSM Connector** / **Circuit** C3265A-G — CHS02 (YE/BU) C3265A-H — RHS02 (BU/OG) C3265A-J — CHS01 (GY/VT) C3265A-K — RHS01 (WH/VT)  • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to Y3 .
Y3 CHECK THE BACKREST TED AND CUSHION TED RESISTANCES	

• Ignition OFF.
• Measure the resistance between:
  ▪ backrest TED C3034 pins 1 and 3, component side.
  ▪ cushion TED C3035 pins 1 and 3, component side.
	Yes
	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.

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 N0053766 • **Are the resistances between 0.9 and 10 ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** If the backrest TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the cushion TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test Z: DTC B103D

Refer to Wiring Diagrams Cell 119, Climate Controlled Seats for schematic and connector information.

Normal Operation

Climate controlled seats are independently controlled by the Dual Climate Controlled Seat Module (DCSM) mounted to the bottom of the passenger seat cushion. The climate controlled seat system only operates with the engine running, however, if using a scan tool to command the DCSM, diagnostic testing can be carried out with the ignition ON. Both voltage supply circuits to the DCSM are spliced together internally, so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat will be disabled by the module and the other will remain operational.

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the seat switch settings.

- DTC B103D (Blower Driver Overtemperature) — If the DCSM outputs to the driver seat blower or any components within these circuit loops are shorted to ground or cause an excessive current draw, the DCSM overheats, shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED assembly
- DCSM

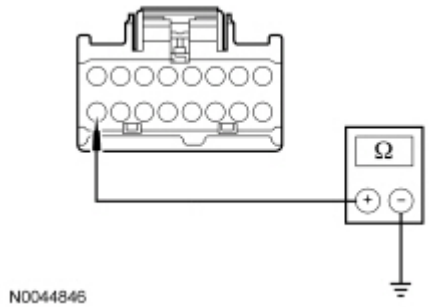
PINPOINT TEST Z: DTC B103D

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

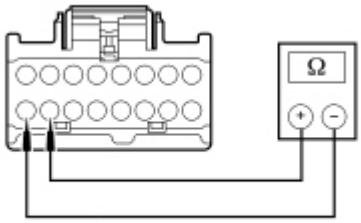
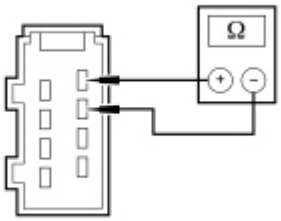
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
Z1 CHECK THE TED BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Cushion TED C3035 . • Disconnect: Backrest TED C3034 . • Measure the resistance between DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to Z2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
Z2 CHECK FOR A SHORT BETWEEN THE TED BLOWER CIRCUITS	

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• Measure the resistance between DCSM C3265C-15, circuit RHS03 (GY/OG), harness side and C3265C-16, circuit CHS03 (GN/BN), harness side.  N0044847 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to Z3 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
Z3 CHECK THE BACKREST BLOWER AND CUSHION BLOWER RESISTANCES • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between: ▪ backrest TED C3034 pins 2 and 4, component side. ▪ cushion TED C3035 pins 2 and 4, component side.  N0053768 • **Are the resistances between 4,000 and 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** If the cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the backrest TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AA: DTCs B1113 and B111B

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The seat cushion and backrest are equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). When the Dual Climate Controlled Seat Module (DCSM) detects an overcurrent and/or overtemperature in the output circuits to the TEDs , it will disable the affected seat and set the following DTCs:

- DTC B1113 (Passenger Thermal Electric Device Control Overtemperature Fault) — If the DCSM TED driver integrated circuit temperature exceeds 175°C (347°F), the DCSM shuts down the passenger seat system and sets this DTC.
- DTC B111B (Passenger Thermoelectric Driver Overcurrent Low) — If DCSM outputs to the passenger seat backrest or cushion TED (circuit pin A, B, C or D at the DCSM connector) or any components within these circuit loops are shorted to ground or a TED resistance of less than 0.9 ohms is sensed, the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST AA: DTCs B1113 AND B111B

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>AA1 CHECK THE TED CIRCUITS FOR A SHORT TO GROUND</td><td rowspan="2">Yes
GO to AA2 .

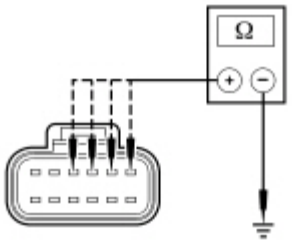
No
If the resistance between C3265A-A and/or C3265A-B to ground is not greater than 10,000 ohms, GO to AA6 .</td></tr>
<tr><td>

Ignition OFF.
Depower the SRS . Refer to Section 501-20B .
Disconnect: Passenger Seat Side Air Bag Module C339 .
Disconnect: DCSM C3265A .
Measure the resistance between DCSM C3265A, harness side and ground using the following chart:

<table>
<tr><th>DCSM Connector</th><th>Circuit</th></tr>
<tr><td>C3265A-A</td><td>CHS07 (GY/BU)</td></tr>
</table>
</td></tr>
</table>

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C3265A-B	RHS07 (BU)
C3265A-C	CHS06 (BU/BN)
C3265A-D	RHS06 (WH)



N0097827

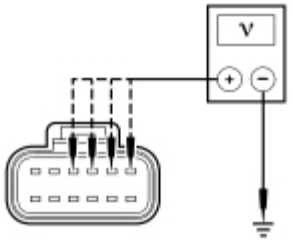
- **Are the resistances greater than 10,000 ohms?**

If the resistance between C3265A-C and/or C3265A-D to ground is **not** greater than 10,000 ohms, GO to AA7 .

AA2 CHECK THE TED CIRCUITS FOR A SHORT TO VOLTAGE

- **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
- Connect the battery ground cable. Refer to Section 414-01 .
- Ignition ON.
- Measure the voltage between DCSM C3265A, harness side and ground using the following chart:

DCSM Connector	Circuit
C3265A-A	CHS07 (GY/BU)
C3265A-B	RHS07 (BU)
C3265A-C	CHS06 (BU/BN)
C3265A-D	RHS06 (WH)



N0097828

- **Is any voltage present on either circuit?**

Yes
If voltage is present at C3265A-A and/or C3265A-B, GO to AA8 .

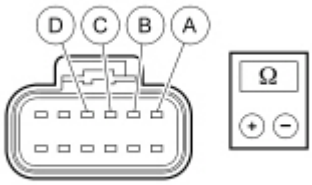
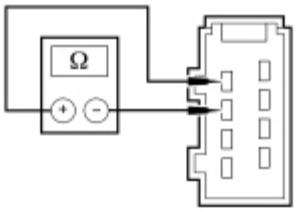
If voltage is present at C3265A-C and/or C3265A-D, GO to AA9 .

No
GO to AA3 .

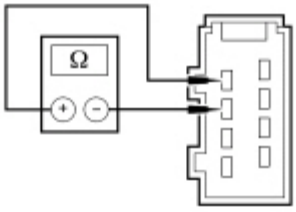
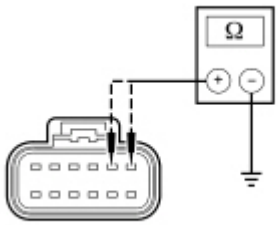
AA3 CHECK THE TED AND WIRING RESISTANCE

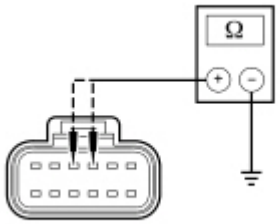
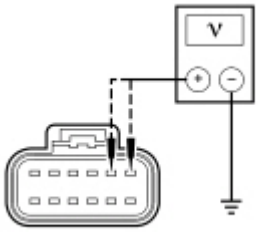
- Ignition OFF.

Yes

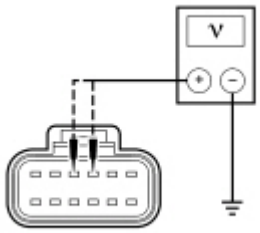
• Measure the resistance between: ▪ DCSM C3265A-A, circuit CHS07 (GY/BU), harness side and DCSM C3265A-B, circuit RHS07 (BU), harness side. ▪ DCSM C3265A-C, circuit CHS06 (BU/BN), harness side and C3265A-D, circuit RHS06 (WH), harness side.  N0092077 • **Are the resistances between 0.9 and 10 ohms?**	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** If the resistance is between DCSM C3265A-A and C3265A-B is **not** between 0.9 and 10 ohms, GO to AA5 . If the resistance is between DCSM C3265A-C and C3265A-D is **not** between 0.9 and 10 ohms, GO to AA4 .
AA4 CHECK THE BACKREST TED RESISTANCE	
• Disconnect: Backrest TED C3039 . • Measure the resistance between backrest TED C3039 pins 1 and 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AA5 CHECK THE CUSHION TED RESISTANCE	
• Disconnect: Cushion TED C3040 . • Measure the resistance between cushion TED C3040 pins 1 and 3, component side.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT

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 N0053766 • **Is the resistance between 0.9 and 10 ohms?**	the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AA6 CHECK THE CUSHION TED CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Cushion TED C3040 . • Measure the resistance between: ▪ DCSM C3265A-A, circuit CHS07 (GY/BU), harness side and ground. ▪ DCSM C3265A-B, circuit RHS07 (BU), harness side and ground.  N0042883 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AA7 CHECK THE BACKREST TED CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Backrest TED C3039 . • Measure the resistance between: ▪ DCSM C3265A-C, circuit CHS06 (BU/BN), harness side and ground.	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric

■ DCSM C3265A-D, circuit RHS06 (WH), harness side and ground.  N0042884 • **Are the resistances greater than 10,000 ohms?**	Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AA8 CHECK THE CUSHION TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3040. • Ignition ON. • Measure the voltage between: ■ DCSM C3265A-A, circuit CHS07 (GY/BU), harness side and ground. ■ DCSM C3265A-B, circuit RHS07 (BU), harness side and ground.  N0042885 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AA9 CHECK THE BACKREST TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3039. • Ignition ON. • Measure the voltage between: ■ DCSM C3265A-C, circuit CHS06 (BU/BN), harness side and ground.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

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▪ DCSM C3265A-D, circuit RHS06 (WH), harness side and ground.  N0042886 ● **Is any voltage present on either circuit?**	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test AB: DTC B111C

Refer to Wiring Diagrams Cell 119, Climate Controlled Seats for schematic and connector information.

Normal Operation

The seat cushion and backrest are equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). If the Dual Climate Controlled Seat Module (DCSM) detects an open circuit or high TED resistance, the following DTC will be set:

- DTC B111C (Passenger Thermoelectric Driver Open Load) — If DCSM outputs to the passenger seat backrest or cushion TED (circuit pin A, B, C or D at the DCSM connector) or any components within these circuit loops are open, disconnected or a TED resistance greater than 90,000 ohms is sensed, the DCSM continues normal operation and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST AB: DTC B111C

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B.

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

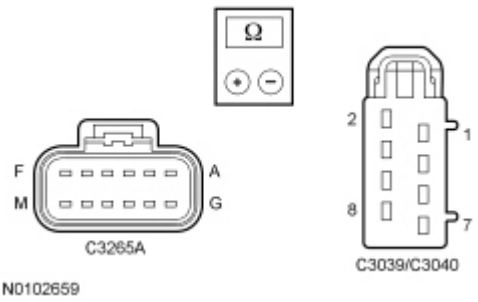
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>AB1 CHECK THE TED CIRCUITS FOR AN OPEN</td><td rowspan="2">Yes
GO to AB2 .

No
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .</td></tr>
<tr><td>

Ignition OFF.
Depower the SRS . Refer to Section 501-20B .
Disconnect: Passenger Seat Side Air Bag Module C339 .
Disconnect: DCSM C3265A .
Disconnect: Cushion TED C3040 .
Disconnect: Backrest TED C3039 .
Measure the resistance between DCSM C3265A, harness side and cushion TED C3040, harness side; and between DCSM C3265A, harness side and backrest TED C3039, harness side using the following chart:

<table>
<tr><th>DCSM Connector</th><th>Circuit</th><th>TED Connector</th></tr>
<tr><td>C3265A-A</td><td>CHS07 (GY/BU)</td><td>C3040-1</td></tr>
<tr><td>C3265A-B</td><td>RHS07 (BU)</td><td>C3040-3</td></tr>
<tr><td>C3265A-C</td><td>CHS06 (BU/BN)/ CHS01 (GY/VT)</td><td>C3039-1</td></tr>
<tr><td>C3265A-D</td><td>RHS06 (WH)/

RHS01 (WH/VT)</td><td>C3039-3</td></tr>
</table>


Are the resistances less than 5 ohms?

</td></tr>
<tr><td>AB2 CHECK THE TED CIRCUITS FOR A SHORT TO VOLTAGE</td><td rowspan="2">Yes
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

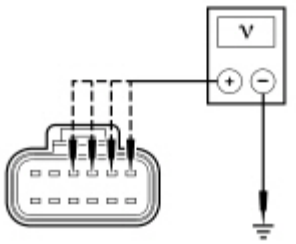
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .</td></tr>
<tr><td>

WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.
Connect the battery ground cable. Refer to Section 414-01 .
Ignition ON.
Measure the voltage between DCSM C3265A, harness side and ground using the following chart:

</td></tr>
</table>

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DCSM Connector	Circuit
C3265A-A	CHS07 (GY/BU)
C3265A-B	RHS07 (BU)
C3265A-C	CHS06 (BU/BN)
C3265A-D	RHS06 (WH)



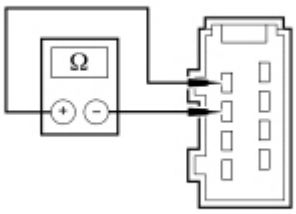
N0097828

- **Is any voltage present on any circuits?**

No
GO to AB3.

AB3 CHECK THE BACKREST TED AND CUSHION TED RESISTANCES

- Ignition OFF.
- Measure the resistance between:
  - backrest TED C3039 pins 1 and 3, component side.
  - cushion TED C3040 pins 1 and 3, component side.



N0053766

- **Are the resistances between 0.9 and 10 ohms?**

Yes
INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

No
If the backrest TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

If the cushion TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AC: DTC B111D

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

Climate controlled seats are independently controlled by the Dual Climate Controlled Seat Module (DCSM) mounted to the bottom of the passenger seat cushion. The climate controlled seat system only operates with the engine running, however, if using a scan tool to command the DCSM , diagnostic testing can be carried out with the ignition ON. Both voltage supply circuits to the DCSM are spliced together internally, so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat will be disabled by the module and the other will remain operational.

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the seat switch settings.

- DTC B111D (Passenger Blower Driver Overtemperature) — If the DCSM outputs to the passenger seat blower or any components within these circuit loops are shorted to ground or cause an excessive current draw, the DCSM overheats, shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST AC: DTC B111D

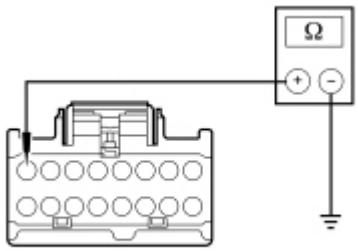
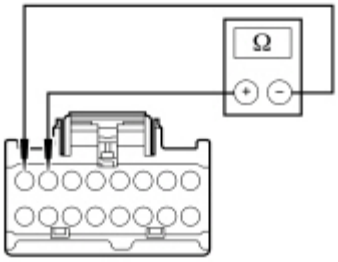
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

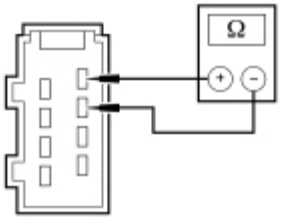
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

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NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AC1 CHECK THE TED BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Cushion TED C3040 . • Disconnect: Backrest TED C3039 . • Measure the resistance between DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and ground.  N0044848 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AC2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AC2 CHECK FOR A SHORT BETWEEN THE TED BLOWER CIRCUITS	
• Measure the resistance between DCSM C3265C-7, circuit RHS08 (VT/WH), harness side and C3265C-8, circuit CHS08 (BN/YE), harness side.  N0044849 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AC3 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AC3 CHECK THE BACKREST BLOWER AND CUSHION BLOWER RESISTANCES	

• **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.
• Measure the resistance between:
  ▪ cushion TED C3040 pins 2 and 4, component side.
  ▪ backrest TED C3039 pins 2 and 4, component side.
	Yes
	INSTALL a new DCSM .
	REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT

 N0053768 • **Are the resistances between 4,000 and 10,000 ohms?**	passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** If the cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the backrest TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AD: DTC B19A1

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A1 (Passenger Seat Cushion Blower Speed Short to Battery) — If the passenger seat cushion blower speed circuit is shorted to voltage, the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AD: DTC B19A1

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting**

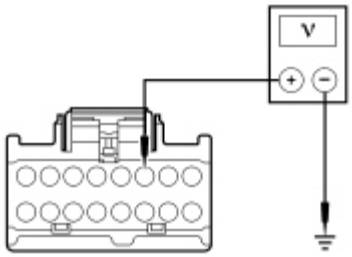
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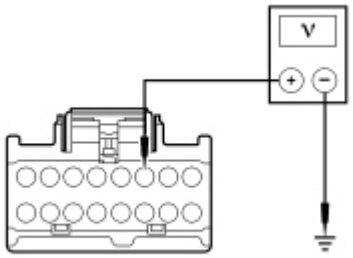
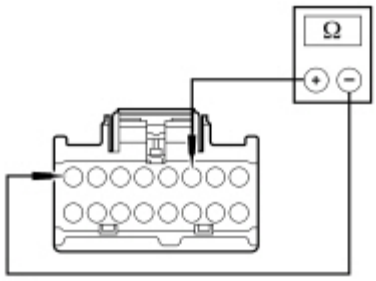
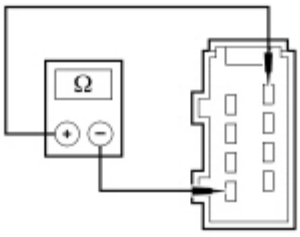
in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AD1 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3265C-3, circuit VHS23 (BN/BU), harness side and ground.  N0083372 • **Is any voltage present?**	**Yes** GO to AD2 . **No** GO to AD3 .
AD2 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3040 . • Measure the voltage between DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-

 N0083372 • **Is any voltage present?**	20B . **No** GO to AD3 .
AD3 CHECK THE CUSHION TED BLOWER SPEED CONTROL AND BLOWER OUTPUT CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Cushion TED C3040 . • Measure the resistance between DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and C3265C-8, circuit CHS08 (BN/YE), harness side.  N0083808 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AD4 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AD4 CHECK THE CUSHION TED RESISTANCE FOR AN INTERNAL SHORT	
• Measure the resistance between cushion TED C3040 pins 2 and 7, component side.  N0092066 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section.

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	CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AE: DTC B19A2

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A2 (Passenger Seat Back Blower Speed Short to Battery) — If the passenger seat backrest blower speed circuit is shorted to voltage, the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AE: DTC B19A2

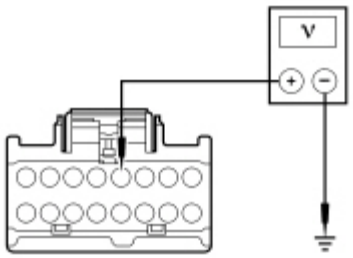
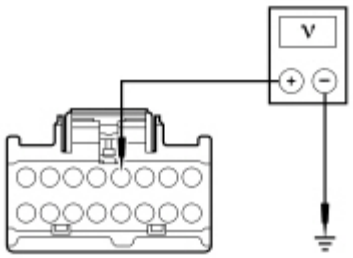
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

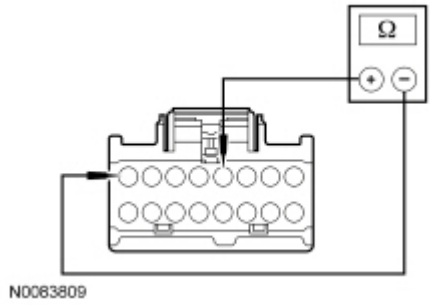
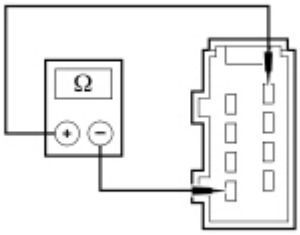
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AE1 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3265C-4, circuit VHS21 (BU/WH), harness side and ground.  N0083799 • **Is any voltage present?**	**Yes** GO to AE2 . **No** GO to AE3 .
AE2 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3039 . • Measure the voltage between DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and ground.  N0083799 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AE3 .
AE3 CHECK THE BACKREST TED BLOWER SPEED CONTROL AND BLOWER OUTPUT CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Backrest TED C3039 . • Measure the resistance between DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and C3265C-8, circuit CHS08 (BN/YE), harness side.	**Yes** GO to AE4 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery

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 N0083809 • **Is the resistance greater than 10,000 ohms?**	ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AE4 CHECK THE BACKREST TED RESISTANCE FOR AN INTERNAL SHORT	
• Measure the resistance between backrest TED C3039 pins 2 and 7, component side.  N0092066 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AF: DTC B19A3

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat cushion

Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A3 (Driver Seat Cushion Blower Speed Short to Battery) — If the driver seat cushion blower speed circuit is shorted to voltage, the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AF: DTC B19A3

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

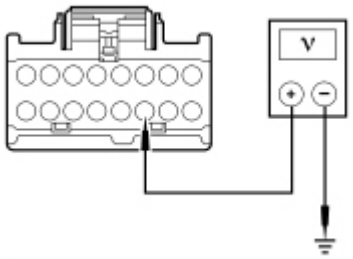
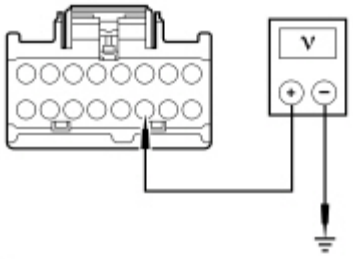
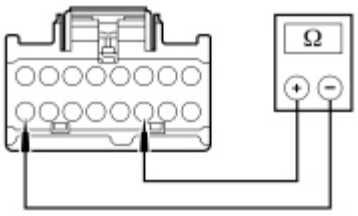
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

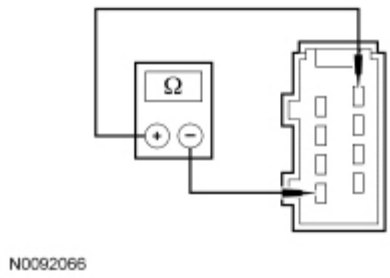
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AF1 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3265C-11, circuit VHS18 (BN/GN), harness side and ground.	**Yes** GO to AF2 . **No** GO to AF3 .

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 N0083800 • **Is any voltage present?**	
AF2 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3035 . • Measure the voltage between C3265C-11, circuit VHS18 (BN/GN), harness side and ground.  N0083800 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AF3 .
AF3 CHECK THE CUSHION TED BLOWER SPEED CONTROL AND BLOWER OUTPUT CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Cushion TED C3035 . • Measure the resistance between DCSM C3265C-11, circuit VHS18 (BN/GN), harness side and C3265C-16, circuit CHS03 (GN/BN), harness side.  N0083810 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AF4 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AF4 CHECK THE CUSHION TED RESISTANCE FOR AN INTERNAL SHORT	

• Measure the resistance between cushion TED C3035 pins 2 and 7, component side.  N0092066 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AG: DTC B19A4

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A4 (Driver Seat Back Blower Speed Short to Battery) — If the driver seat backrest blower speed circuit is shorted to voltage, the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

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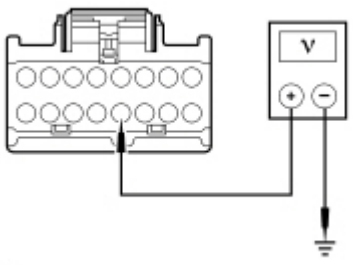
PINPOINT TEST AG: DTC B19A4

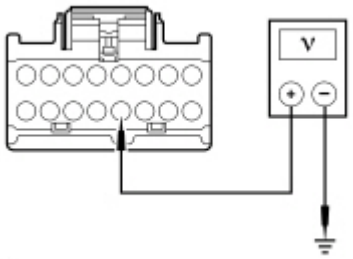
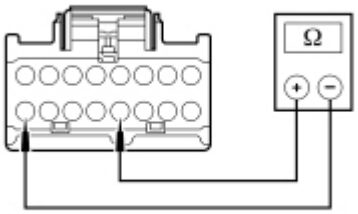
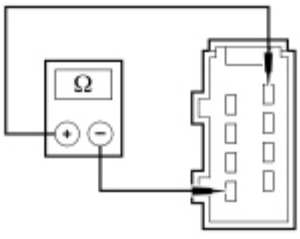
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AG1 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3265C-12, circuit CHS09 (GY), harness side and ground.  N0083801 • **Is any voltage present?**	**Yes** GO to AG2 . **No** GO to AG3 .
AG2 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3034 . • Measure the voltage between C3265C-12, circuit CHS09 (GY), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 N0083801 • **Is any voltage present?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AG3 .
AG3 CHECK THE BACKREST TED BLOWER SPEED CONTROL AND BLOWER OUTPUT CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Backrest TED C3034 . • Measure the resistance between DCSM C3265C-12, circuit CHS09 (GY), harness side and C3265C-16, circuit CHS03 (GN/BN), harness side.  N0083811 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AG4 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AG4 CHECK THE BACKREST TED RESISTANCE FOR AN INTERNAL SHORT	
• Measure the resistance between backrest TED C3034 pins 2 and 7, component side.  N0092066 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

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	No INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AH: DTC B19A5

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A5 (Passenger Seat Cushion Blower Speed Short to Ground) — If the passenger seat cushion blower speed circuit is shorted to ground, the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

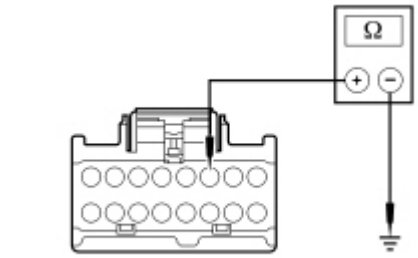
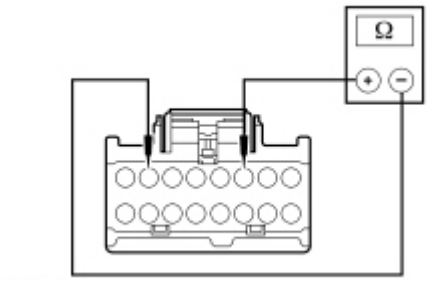
PINPOINT TEST AH: DTC B19A5

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AH1 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Cushion TED C3040 . • Measure the resistance between DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and ground.  N0083842 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AH2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AH2 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT AND BLOWER GROUND CIRCUIT FOR A SHORT TOGETHER	
• Measure the resistance between DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and C3265C-7, circuit RHS08 (VT/WH), harness side.  N0083843 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the DTC is retrieved again, INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

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Pinpoint Test AI: DTC B19A6

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A6 (Passenger Seat Back Blower Speed Short to Ground) — If the passenger seat backrest blower speed circuit is shorted to ground, the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AI: DTC B19A6

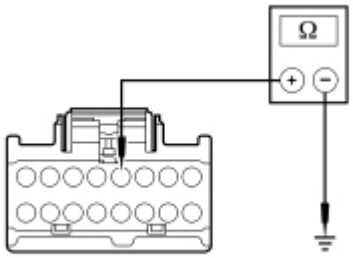
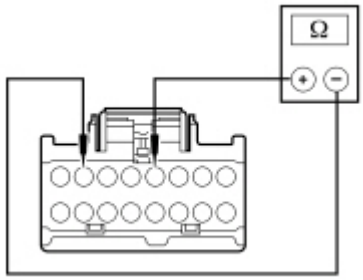
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AI1 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Backrest TED C3039 . • Measure the resistance between DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and ground.	**Yes** GO to AI2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

 N0083844 • **Is the resistance greater than 10,000 ohms?**	
AI2 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT AND BLOWER GROUND CIRCUIT FOR A SHORT TOGETHER	
• Measure the resistance between DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and C3265C-7, circuit RHS08 (VT/WH), harness side.  N0083845 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the DTC is retrieved again, INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test AJ: DTC B19A7

Refer to Wiring Diagrams Cell 119, Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control

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blower speed.

- DTC B19A7 (Driver Seat Cushion Blower Speed Short to Ground) — If the driver seat cushion blower speed circuit is shorted to ground, the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

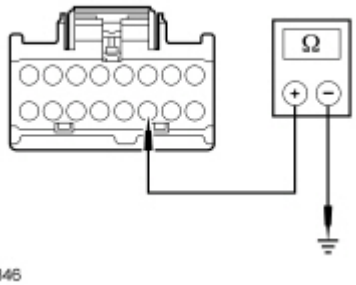
PINPOINT TEST AJ: DTC B19A7

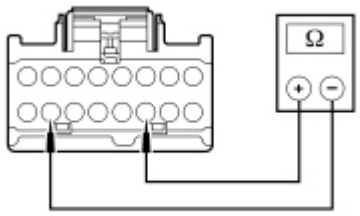
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AJ1 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Cushion TED C3035 . • Measure the resistance between DCSM C3265C-11, circuit VHS18 (BN/GN), harness side and ground.  N0083846 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AJ2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AJ2 CHECK THE CUSHION TED BLOWER SPEED CONTROL CIRCUIT AND BLOWER GROUND CIRCUIT FOR	

A SHORT TOGETHER	
• Measure the resistance between DCSM C3265C-11, circuit VHS18 (BN/GN), harness side and C3265C-15, circuit RHS03 (GY/OG), harness side.  N0083847 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the DTC is retrieved again, INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

Pinpoint Test AK: DTC B19A8

Refer to Wiring Diagrams Cell 119, Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A8 (Driver Seat Back Blower Speed Short to Ground) — If the driver seat backrest blower speed circuit is shorted to ground, the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

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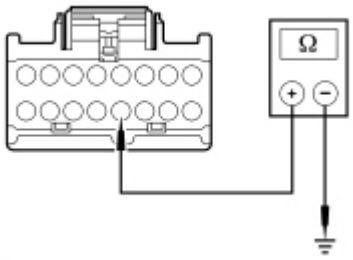
PINPOINT TEST AK: DTC B19A8

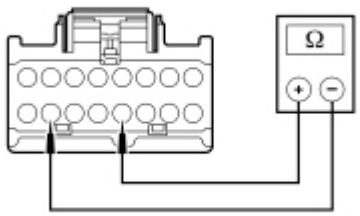
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AK1 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Backrest TED C3034 . • Measure the resistance between DCSM C3265C-12, circuit CHS09 (GY), harness side and ground.  N0083848 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AK2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AK2 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT AND BLOWER GROUND CIRCUIT FOR A SHORT TOGETHER	
• Measure the resistance between DCSM C3265C-12, circuit VHS16 (BU/GN), harness side and C3265C-15, circuit RHS03 (GY/OG), harness side.	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the DTC is retrieved again, INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.

 N0083849 • **Is the resistance greater than 10,000 ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AL: DTCs B1317, B1318 and B2486

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation — Driver Seat Module (DSM)

The Driver Seat Module (DSM) continuously monitors the input voltage for correct operation. If the DSM detects input voltage below 10 volts, it stores DTC B1318 in memory. If the DSM detects input voltage above 15 volts, it stores DTC B1317 in memory. If DTC B1317 or B1318 is set, the DSM disables the memory system outputs for the driver seat and memory mirror operation.

Normal Operation — Dual Climate Controlled Seat Module (DCSM)

The Dual Climate Controlled Seat Module (DCSM) monitors the input voltage for correct operation. If the DCSM detects input voltage below 10 volts or above 15 volts, it stores DTC B2486 in memory. If DTC B2486 sets, the DCSM enters a standby mode and suspends the system outputs for the operation of both seats until system voltage between 10 and 15 volts is restored and a climate controlled seat switch button is selected on.

- DTC B1317 (Battery Voltage High) — If the DSM detects voltage above 15 volts, the DTC is set.
- DTC B1318 (Battery Voltage Low) — If the DSM detects voltage below 10 volts, the DTC is set.
- DTC B2486 (Climate Control Seat Module Voltage Out of Range) — If the DCSM detects voltage below 10 volts or greater than 15 volts, the DTC is set.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- DSM
- DCSM

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PINPOINT TEST AL: DTCs B1317, B1318 AND B2486

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

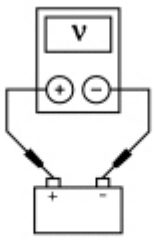
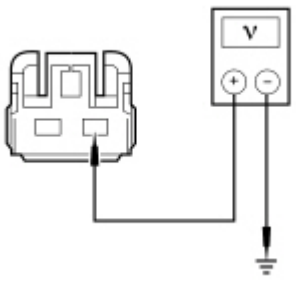
NOTE: DTC B1317, B1318 or B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

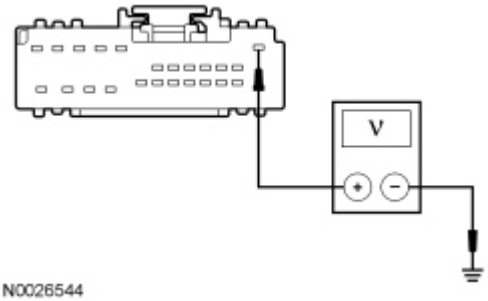
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AL1 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — ALL CMDTCs . • **Is DTC B1317, B1318, B2486, B1676, U3003:16 or U3003:17 present in one or more modules and are any charging system DTCs present in the PCM?**	**Yes** REFER to Section 414-00 to diagnose the charging system. **No** GO to AL2 .
AL2 CHECK THE BATTERY CONDITION	
NOTE: DTC B1317, B1318, B2486, B1676, U3003:16 or U3003:17 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on. • Ignition OFF. • Carry out the Battery Condition Test. Refer to Section 414-01 . • **Did the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to AL3 . **No** INSTALL a new battery. CLEAR all CMDTCs . TEST the system for normal operation.
AL3 CHECK THE CHARGING SYSTEM VOLTAGE	
NOTE: Do not allow the engine speed to increase above 2,000 rpm while performing this step or the generator may self excite	**Yes** For DSM DTC B1317 or

and result in default charging system output voltage. If engine speed goes above 2,000 rpm, shut the vehicle OFF and restart the engine before performing this step. • Start the engine. • Measure the voltage of the battery with and without a load on the charging system as follows: ▪ Turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes while measuring the battery voltage. ▪ Turn on the headlights and HVAC blower on high and run engine at 1,500 rpm for a minimum of 2 minutes while measuring the battery voltage.  AJ0210-A • **Are the voltages between 13 and 15.2 volts?**	B1318, GO to AL4 . For DCSM DTC B2486, GO to AL7 . **No** REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.
AL4 CHECK FOR VOLTAGE TO THE DSM • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: DSM C341A and C341B . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DSM C341A-1, circuit CBX05 (VT/RD), harness side and ground.  N0067979 • Measure the voltage between DSM C341B-1, circuit CBX03 (BU/RD), harness side and ground.	**Yes** GO to AL5 . **No** VERIFY the Battery Junction Box (BJB) fuse 74 (30A) and Body Control Module (BCM) 7 (7.5A) are OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR all CMDTCs . REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

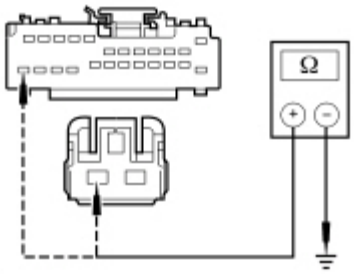
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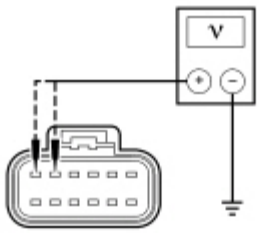
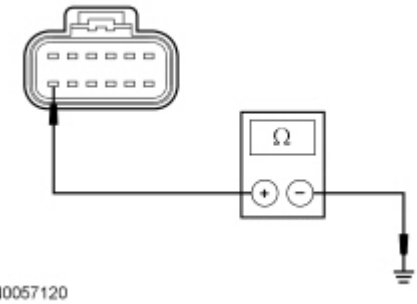
- **Are the voltages greater than 10 volts?**

AL5 CHECK THE DSM GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF.
• Measure the resistance between:
  ▪ DSM C341A-2, circuit GD906 (BK/GY), harness side and ground.
  ▪ DSM C341B-24, circuit GD905 (BK/GN), harness side and ground.

 	
N0067980
• Repeat this measurement while wiggling the harness.
• **Are the resistances less than 5 ohms?**
	Yes
	GO to AL6 .
	
	No
	REPAIR the circuit(s). CLEAR all CMDTCs . REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .

AL6 CHECK FOR CORRECT DSM OPERATION	

• Check the harness and component side connectors for the following:
  ▪ corrosion.
  ▪ damaged pins.
  ▪ pushed-out pins.
• Connect: DSM C341A and C341B .
• Make sure the DSM connectors are seated correctly.
• Operate the memory seat, mirrors and pedals to verify correct memory system operation.
• Enter the following diagnostic mode on the scan tool: Self Test — DSM .
• **Is DTC B1317 or B1318 still present?**
	Yes
	INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. CLEAR all CMDTCs . REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS . REFER to Section 501-20B .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all CMDTCs . REPEAT the self-test.

	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051. REPOWER the SRS. REFER to Section 501-20B.
AL7 CHECK FOR VOLTAGE TO THE DCSM • Ignition OFF. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Passenger Seat Side Air Bag Module C339. • Disconnect: DCSM C3265A. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Ignition ON. • Measure the voltage between: ▪ DCSM C3265A-E, circuit CBX01 (GN/RD), harness side and ground. ▪ DCSM C3265A-F, circuit CBX01 (GN/RD), harness side and ground.  N0042997 • **Are the voltages greater than 10 volts?**	**Yes** GO to AL8. **No** VERIFY the BJB fuse 69 (30A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR all CMDTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AL8 CHECK THE DCSM GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Measure the resistance between DCSM C3265A-M, circuit GD903 (BK/WH), harness side and ground.  N0057120 • Repeat this measurement while wiggling the harness. • **Is the resistance less than 5 ohms?**	**Yes** GO to AL9. **No** REPAIR the circuit. CLEAR all CMDTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AL9 CHECK FOR CORRECT DCSM OPERATION	

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• Check the harness and component side connectors for the following:
  ▪ corrosion.
  ▪ damaged pins.
  ▪ pushed-out pins.
• Connect: DCSM C3265A .
• Make sure the DCSM connector is seated correctly.
• Start the engine.
• Operate the climate controlled seats and verify system operation.
• Enter the following diagnostic mode on the scan tool: Self Test — DCSM .
• **Is DTC B2486 still present?**
	Yes
	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR all CMDTCs . REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all CMDTCs . REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AM: DTC B2729

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat cushion temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Heated or cooled air exits the TED and flows through a manifold attached to the foam pad.

- DTC B2729 (Cushion Over-Temp Detected) — If the driver seat cushion TED temperature exceeds 85°C (185°F) in heat mode or 70°C (158°F) in cool mode for more than 34 seconds the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

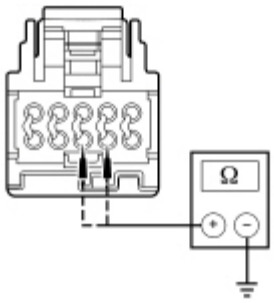
- Wiring, terminals or connectors
- Restricted cushion TED filter
- Crushed or restricted climate controlled seat manifold
- Cushion TED assembly

PINPOINT TEST AM: DTC B2729

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

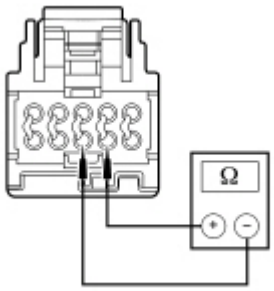
Test Step	Result / Action to Take
AM1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the driver seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Was DTC B2729 retrieved on-demand during the self-test?**	**Yes** GO to AM2 . **No** GO to AM5 .
AM2 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C3051 and Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265B . • Disconnect: Driver Seat Cushion TED C3035 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ▪ DCSM C3265B-7, circuit VHS26 (VT), harness side and ground. ▪ DCSM C3265B-8, circuit RHS05 (YE/VT), harness side and ground.  N0042889 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AM3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AM3 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR	

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AND WIRING

- Connect: Driver Seat Cushion TED C3035 .
- Measure the resistance between DCSM C3265B-7, circuit VHS26 (VT), harness side and DCSM C3265B-8, circuit RHS05 (YE/VT), harness side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
GO to AM18 .

No
GO to AM4 .

AM4 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR

- Disconnect: Driver Seat Cushion TED C3035 .
- Measure the resistance between driver seat cushion TED C3035 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table.

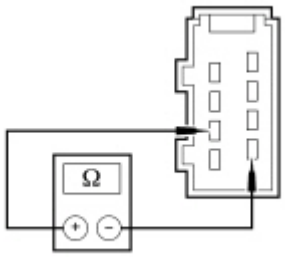
Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms

Yes
REPAIR circuit VHS26 (VT) or RHS05 (YE/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339.

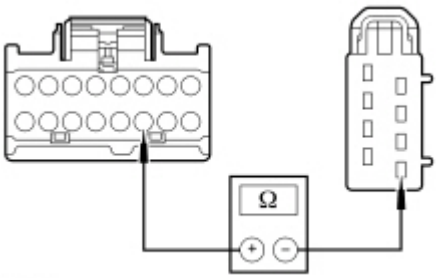
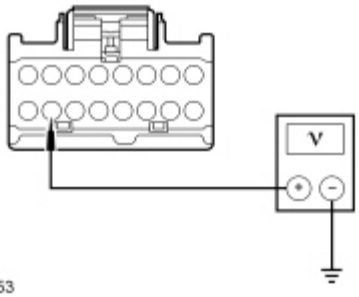
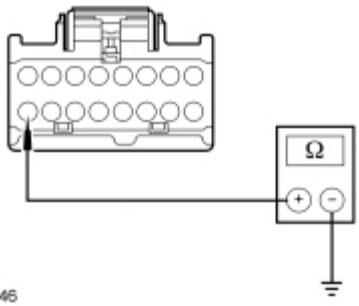
REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

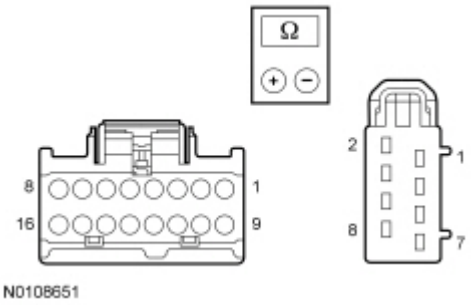
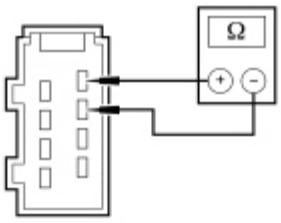
 N0053767 • **Is the resistance within the limits indicated?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AM5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (BK_TEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (CSHTEMP) PIDs	
• Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs BK_TEMP and CSHTEMP. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the driver seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**Yes** The fault is not present at this time. The fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive passenger compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the CSHTEMP PID increases incrementally and is greater than 15°C (27°F) of the BK_TEMP PID, GO to AM6 . If the CSHTEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the BK_TEMP PID, GO to AM16 .
AM6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the driver seat cushion TED and compare it to the airflow exhausting from the passenger seat cushion TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the driver seat cushion TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds. • **Is the airflow exhausting from the driver seat cushion TED comparable to the airflow exhausting from the passenger seat cushion TED with no change in operation when carrying out the wiggle test?**	**Yes** GO to AM7 . **No** If the airflow exhausting from the driver seat cushion TED is not comparable to the airflow exhausting from the passenger seat cushion TED , GO to AM8 . If the driver seat cushion TED

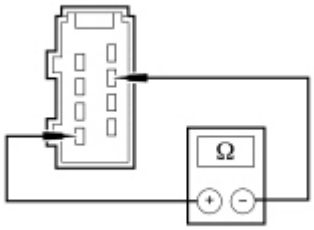
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	blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AM7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the driver seat cushion TED with the driver seat occupied and compare it to the airflow exhausting from the passenger seat cushion TED with the passenger seat occupied. • **Is the airflow exhausting from the driver seat cushion TED comparable to the airflow exhausting from the passenger seat cushion TED ?**	**Yes** GO to AM16 . **No** INSTALL a new driver seat cushion foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AM8 CHECK THE DRIVER SEAT CUSHION BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the driver seat cushion TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AM9 .
AM9 CHECK THE DRIVER SEAT CUSHION BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C3051 and Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265C . • Disconnect: Driver Seat Cushion TED C3035 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265C-11, circuit VHS18 (BN/GN), harness side and driver seat cushion TED C3035-7, circuit VHS18 (BN/GN), harness side.	**Yes** GO to AM10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

 N0058092 • **Is the resistance less than 5 ohms?**	
AM10 CHECK THE DRIVER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between DCSM C3265C-15, circuit RHS03 (GY/OG), harness side and ground.  N0044853 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** GO to AM11.
AM11 CHECK THE DRIVER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground.  N0044846 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AM12. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AM12 CHECK THE DRIVER SEAT CUSHION BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ▪ DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and driver seat cushion TED C3035-2, circuit CHS03 (GN/BN), harness side.	**Yes** GO to AM13. **No**

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▪ DCSM C3265C-15, circuit RHS03 (GY/OG), harness side and driver seat cushion TED C3035-4, circuit RHS03 (GY/OG), harness side.  N0108651 • **Are the resistances less than 5 ohms?**	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AM13 CHECK THE DRIVER SEAT CUSHION BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat cushion TED C3035 pin 2 and pin 4, component side.  N0053768 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	**Yes** GO to AM14. **No** INSTALL a new driver seat cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AM14 CHECK THE DRIVER SEAT CUSHION BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat cushion TED C3035 pin 7 and pin 4, component side.	**Yes** GO to AM15. **No** INSTALL a new driver seat cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag

 N0054028 • **Is the resistance between 240K ohms and 400K ohms?**	module C339. REPOWER the SRS . REFER to Section 501-20B .
AM15 CHECK THE DRIVER SEAT CUSHION TED INSTALLATION AND FOR CRUSHED SEAT CUSHION	

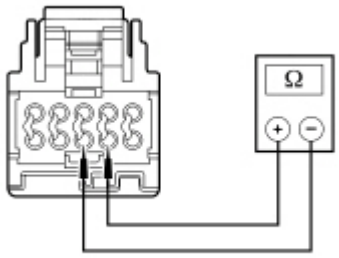
• Ignition OFF.
• Remove the driver seat. Refer to Seat — Front in this section.
• Remove the driver seat cushion cover. Refer to Seat Cushion Cover — Front in this section.
• Inspect the driver seat cushion for the following:
  ▪ Is the driver seat cushion TED correctly installed?
  ▪ Is the driver seat cushion seat cushion foam pad crushed or restricted?
  ▪ Is the driver seat cushion climate controlled seat manifold crushed or restricted?
• **Is the driver seat cushion TED correctly installed and are there no signs of damage to the foam pad and manifold?**
	Yes
	INSTALL the driver seat cushion cover and seat and GO to AM18 .
	
	No
	CORRECTLY install the driver seat cushion TED or INSTALL a new driver seat cushion foam pad and/or climate controlled seat manifold. CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339.
	
	REPOWER the SRS .
	REFER to Section 501-20B .

AM16 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR AND WIRING	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C3051 and Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265B . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265B-7, circuit	**Yes** GO to AM18 . **No** GO to AM17 .

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VHS26 (VT), harness side and C3265B-8 circuit RHS05 (YE/VT), harness side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



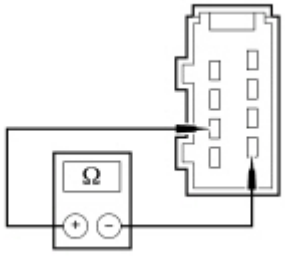
N0100803

- **Is the resistance within the limits indicated?**

AM17 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR

- Measure the resistance between driver seat cushion TED C3035 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0053767

- **Is the resistance within the limits indicated?**

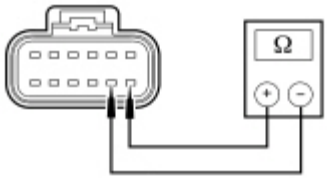
Yes
REPAIR circuit VHS26 (VT) or RHS05 (YE/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339.

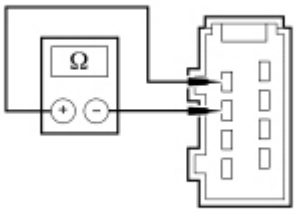
REPOWER the SRS. REFER to Section 501-20B.

No
INSTALL a new TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag

	module C339. REPOWER the SRS . REFER to Section 501-20B .
AM18 CHECK THE DRIVER SEAT CUSHION TED HEATING/COOLING CIRCUITRY CURRENT DRAW	
• Connect: All DCSM , TED and body harness-to-seat harness connectors . • ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.** • **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted. • Place an inductive current probe around circuit CHS02 (YE/BU) near DCSM C3265A-G and monitor the current draw. • Start the vehicle and set the driver seat to HIGH heat. • **Is the current draw less than 11 amps?**	**Yes** GO to AM19 . **No** INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AM19 CHECK RESISTANCE OF THE DRIVER SEAT CUSHION TED AND WIRING	
• Ignition OFF. • Disconnect: DCSM C3265A . • Measure the resistance between DCSM C3265A-G circuit CHS02 (YE/BU), harness side and C3265A-H, circuit RHS02 (BU/OG), harness side.  N0042194 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AM21 . **No** GO to AM20 .
AM20 CHECK THE RESISTANCE OF THE DRIVER SEAT CUSHION TED	
• Disconnect: Driver Seat Cushion TED C3035 . • Measure the resistance between driver seat cushion TED C3035 pin 1 and pin 3, component side.	**Yes** REPAIR circuit CHS02 (YE/BU) or RHS02 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery

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 N0053766 • **Is the resistance between 0.9 and 10 ohms?**	ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new driver seat cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AM21 CHECK FOR CORRECT DCSM OPERATION • Inspect the DCSM and driver seat cushion TED harness and component side connectors and the body harness-to-seat harness connectors for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect: All DCSM, TED and Body Harness-to-Seat Harness Connectors . • Make sure the connectors are seated correctly. • Start the engine. • Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM. • Attempt to recreate the fault. With the engine still running set the driver seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	**Yes** INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag

	module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AN: DTC B272A

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat cushion temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Heated or cooled air exits the TED and flows through a manifold attached to the foam pad.

- DTC B272A (Passenger Cushion Over-Temp Detected) — If the passenger seat cushion TED temperature exceeds 85°C (185°F) in heat mode or 70°C (158°F) in cool mode for more than 34 seconds the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted cushion TED filter
- Crushed or restricted climate controlled seat manifold
- Cushion TED assembly

PINPOINT TEST AN: DTC B272A

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

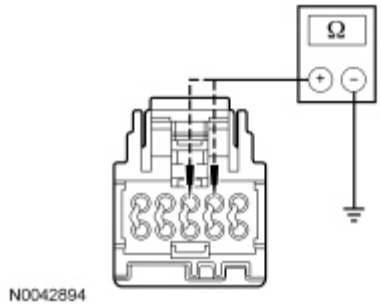
NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AN1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the passenger seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Was DTC B272A retrieved on-demand during the self-test?**	**Yes** GO to AN2 . **No** GO to AN5 .
AN2 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	

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- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .
- Disconnect: Passenger Seat Side Air Bag C339 .
- Disconnect: DCSM C3265B .
- Disconnect: Passenger Seat Cushion TED C3040 .
- **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
- Connect the battery ground cable. Refer to Section 414-01 .
- Measure the resistance between:
  - DCSM C3265B-2, circuit VHS27 (WH/OG), harness side and ground.
  - DCSM C3265B-3, circuit RHS10 (BU/OG), harness side and ground.



N0042894

- **Are the resistances greater than 10,000 ohms?**

Yes
GO to AN3 .

No
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

REPOWER the SRS .
REFER to Section 501-20B .

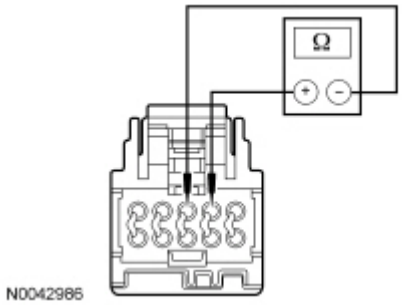
AN3 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR AND WIRING

- Connect: Passenger Seat Cushion TED C3040 .
- Measure the resistance between DCSM C3265B-2, circuit VHS27 (WH/OG), harness side and DCSM C3265B-3, circuit RHS10 (BU/OG), harness side. Note the ambient temperature and refer to the following table.

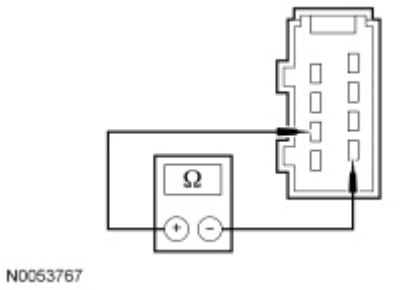
Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms

Yes
GO to AN18 .

No
GO to AN4 .

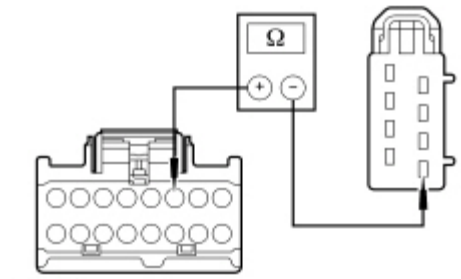
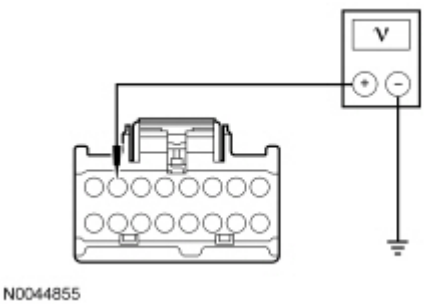


- **Is the resistance within the limits indicated?**

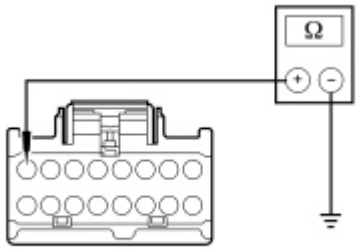
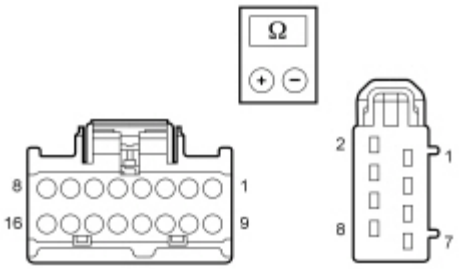
AN4 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR	
• Disconnect: Passenger Seat Cushion TED C3040 . • Measure the resistance between passenger seat cushion TED C3040 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  • **Is the resistance within the limits indicated?**	**Yes** REPAIR circuit VHS27 (WH/OG) or RHS10 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AN5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (PBKTEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (PCSHTEMP) PIDs	
• Set the passenger seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs PBKTEMP and PCSHTEMP. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault.	**Yes** The fault is not present at this time. The fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive passenger

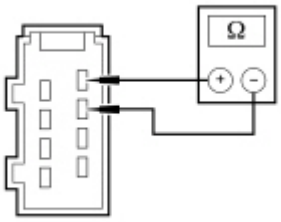
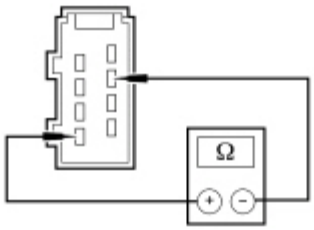
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• Attempt to recreate the fault. Start the vehicle and set the passenger seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the PCSHTEMP PID increases incrementally and is greater than 15°C (27°F) of the PBKTEMP PID, GO to AN6 . If the PCSHTEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the PBKTEMP PID, GO to AN16 .
AN6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the passenger seat cushion TED and compare it to the airflow exhausting from the driver seat cushion TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the passenger seat cushion TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds. • **Is the airflow exhausting from the passenger seat cushion TED comparable to the airflow exhausting from the driver seat cushion TED with no change in operation when carrying out the wiggle test?**	**Yes** GO to AN7 . **No** If the airflow exhausting from the passenger seat cushion TED is not comparable to the airflow exhausting from the driver seat cushion TED , GO to AN8 . If the passenger seat cushion TED blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AN7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the passenger seat cushion TED with the passenger seat occupied and compare it to the airflow exhausting from the driver seat cushion TED with the driver seat occupied. • **Is the airflow exhausting from the passenger seat cushion TED comparable to the airflow exhausting from the driver seat cushion TED ?**	**Yes** GO to AN16 . **No** INSTALL a new passenger seat cushion foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AN8 CHECK THE PASSENGER SEAT CUSHION BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the passenger seat cushion TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test.

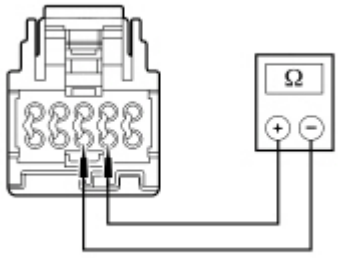
	No GO to AN9 .
AN9 CHECK THE PASSENGER SEAT CUSHION BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265C . • Disconnect: Passenger Seat Cushion TED C3040 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and passenger seat cushion TED C3040-7, circuit VHS23 (BN/BU), harness side.  N0058093 • **Is the resistance less than 5 ohms?**	**Yes** GO to AN10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AN10 CHECK THE PASSENGER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO VOLTAGE • Ignition ON. • Measure the voltage between DCSM C3265C-7, circuit RHS08 (VT/WH), harness side and ground.  N0044855 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AN11 .
AN11 CHECK THE PASSENGER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO GROUND • Ignition OFF. • Measure the resistance between DCSM C3265C-8, circuit	**Yes** GO to AN12 .

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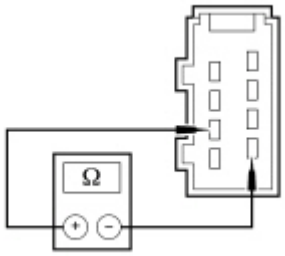
CHS08 (BN/YE), harness side and ground.  N0044848 • **Is the resistance greater than 10,000 ohms?**	**No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AN12 CHECK THE PASSENGER SEAT CUSHION BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ▪ DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and passenger seat cushion TED C3040-2, circuit CHS08 (BN/YE), harness side. ▪ DCSM C3265C-7, circuit RHS08 (VT/WH), harness side and passenger seat cushion TED C3040-4, circuit RHS08 (VT/WH), harness side.  N0108651 • **Are the resistances less than 5 ohms?**	**Yes** GO to AN13. **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AN13 CHECK THE PASSENGER SEAT CUSHION BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat cushion TED C3040 pin 2 and pin 4, component side.	**Yes** GO to AN14. **No** INSTALL a new passenger seat cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

 N0053768 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	
AN14 CHECK THE PASSENGER SEAT CUSHION BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat cushion TED C3040 pin 7 and pin 4, component side.  N0054028 • **Is the resistance between 240K ohms and 400K ohms?**	**Yes** GO to AN15 . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AN15 CHECK THE PASSENGER SEAT CUSHION TED INSTALLATION AND FOR CRUSHED SEAT CUSHION	
• Ignition OFF. • Remove the passenger seat. Refer to Seat — Front in this section. • Remove the passenger seat cushion cover. Refer to Seat Cushion Cover — Front in this section. • Inspect the passenger seat cushion for the following: ▪ Is the passenger seat cushion TED correctly installed? ▪ Is the passenger seat cushion seat cushion foam pad crushed or restricted? ▪ Is the passenger seat cushion climate controlled seat manifold crushed or restricted? • **Is the passenger seat cushion TED correctly installed and are there no signs of damage to the foam pad and manifold?**	**Yes** INSTALL the passenger seat cushion cover and seat and GO to AN18 . **No** CORRECTLY install the passenger seat cushion TED or INSTALL a new passenger seat cushion foam pad and/or climate controlled seat manifold. CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

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	REPOWER the SRS . REFER to Section 501-20B .
AN16 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR AND WIRING • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265B . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265B-2, circuit VHS27 (WH/OG), harness side and C3265B-3 circuit RHS10 (BU/OG), harness side. Note the ambient temperature and refer to the following table. Temperature / Resistance 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  N0100803 • **Is the resistance within the limits indicated?**	**Yes** GO to AN18 . **No** GO to AN17 .
AN17 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR • Measure the resistance between passenger seat cushion TED C3040 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. Temperature / Resistance 0-10°C (32-50°F) / 2,782-1,663 ohms	**Yes** REPAIR circuit VHS27 (WH/OG) or RHS10 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery

10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0053767

- **Is the resistance within the limits indicated?**

ground cable. CONNECT passenger seat side air bag module C339.

REPOWER the SRS. REFER to Section 501-20B.

No
INSTALL a new TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

REPOWER the SRS. REFER to Section 501-20B.

AN18 CHECK THE PASSENGER SEAT CUSHION TED HEATING/COOLING CIRCUITRY CURRENT DRAW

- Connect: All DCSM, TED and Body Harness-to-Seat Harness Connectors.
- ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.**
- **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted.
- Place an inductive current probe around circuit CHS07 (GY/BU) near DCSM C3265A-A and monitor the current draw.
- Start the vehicle and set the passenger seat to HIGH heat.
- **Is the current draw less than 11 amps?**

Yes
GO to AN19.

No
INSTALL a new passenger seat cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

REPOWER the SRS. REFER to Section 501-20B.

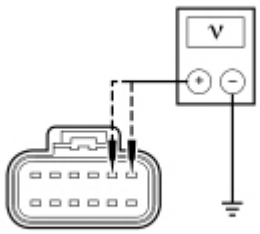
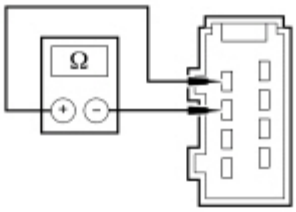
AN19 CHECK RESISTANCE OF THE PASSENGER SEAT CUSHION TED AND WIRING

- Ignition OFF.
- Disconnect: DCSM C3265A.
- Measure the resistance between DCSM C3265A-A circuit CHS07 (GY/BU), harness side and C3265A-B, circuit RHS07 (BU), harness side.

Yes
GO to AN21.

No
GO to AN20.

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 N0042885 • **Is the resistance between 0.9 and 10 ohms?**	
AN20 CHECK THE RESISTANCE OF THE PASSENGER SEAT CUSHION TED	
• Disconnect: Passenger Seat Cushion TED C3040 . • Measure the resistance between passenger seat cushion TED C3040 pin 1 and pin 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS07 (GY/BU) or RHS07 (BU) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AN21 CHECK FOR CORRECT DCSM OPERATION	
• Inspect the DCSM and passenger seat cushion TED harness and component side connectors and the body harness-to-seat harness connectors for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors . • Make sure the connectors are seated correctly. • Start the engine. • Set the passenger seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag

DTCs - DCSM . • Attempt to recreate the fault. With the engine still running set the passenger seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	module C339. REPOWER the SRS . REFER to Section 501-20B . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AO: DTC B272B

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat backrest temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Heated or cooled air exits the TED and flows through a manifold attached to the foam pad.

- DTC B272B (Passenger Back Over-Temp Detected) — If the passenger seat backrest TED temperature exceeds 85°C (185°F) in heat mode or 70°C (158°F) in cool mode for more than 34 seconds the DCSM shuts down the passenger seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted backrest TED filter
- Crushed or restricted climate controlled seat manifold
- Backrest TED assembly

PINPOINT TEST AO: DTC B272B

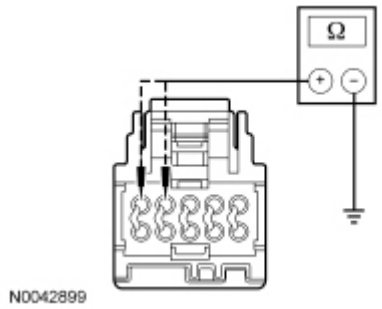
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

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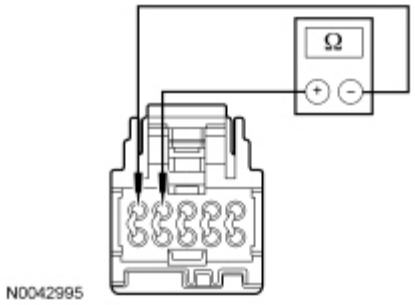
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AO1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the passenger seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Was DTC B272B retrieved on-demand during the self-test?**	**Yes** GO to AO2 . **No** GO to AO5 .
AO2 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .
• Disconnect: Passenger Seat Side Air Bag C339 .
• Disconnect: DCSM C3265B .
• Disconnect: Passenger Seat Backrest TED C3039 .
• **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
• Connect the battery ground cable. Refer to Section 414-01 .
• Measure the resistance between:
  ▪ DCSM C3265B-4, circuit VHS36 (YE/BU), harness side and ground.
  ▪ DCSM C3265B-5, circuit RHS20 (GN/BU), harness side and ground.

 	
N0042899
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to AO3 .
	
	No
	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.
	
	REPOWER the SRS .
	REFER to Section 501-20B .

AO3 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR AND WIRING	
• Connect: Passenger Seat Backrest TED C3039 . • Measure the resistance between DCSM C3265B-4, circuit VHS36 (YE/BU), harness side and DCSM C3265B-5, circuit RHS20 (GN/BU), harness side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance**	**Yes** GO to AO18 . **No** GO to AO4 .

0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms

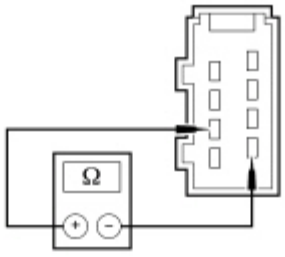


- **Is the resistance within the limits indicated?**

AO4 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR

- Disconnect: Passenger Seat Backrest TED C3039 .
- Measure the resistance between passenger seat backrest TED C3039 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
REPAIR circuit VHS35 (VT/OG) or RHS15 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

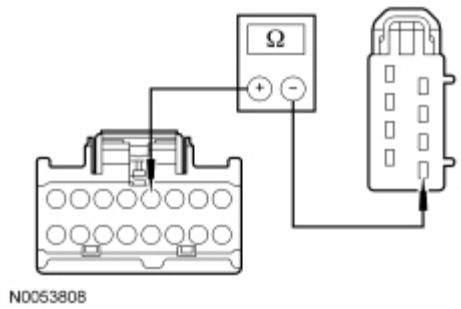
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

REPOWER the SRS . REFER to Section 501-20B .

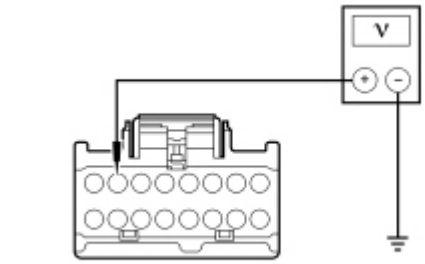
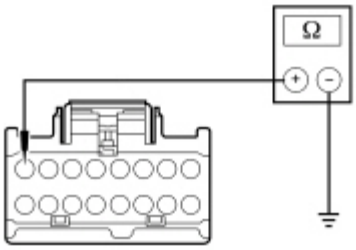
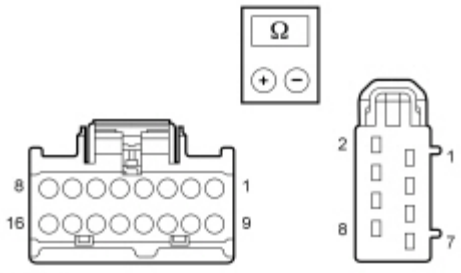
AO5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (PBKTEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE

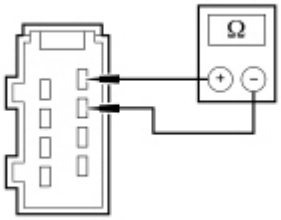
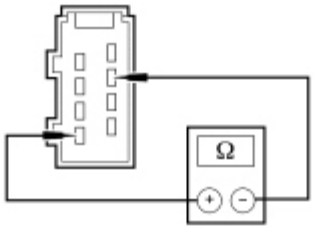
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TEMPERATURE (PCSHTEMP) PIDs	
• Set the passenger seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs PBKTEMP and PCSHTEMP. • **NOTE:** A crushed seat backrest foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the passenger seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**Yes** The fault is not present at this time. The fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive passenger compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the PBKTEMP PID increases incrementally and is greater than 15°C (27°F) of the PCSHTEMP PID, GO to AO6 . If the PBKTEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the PCSHTEMP PID, GO to AO16 .
AO6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the passenger seat backrest TED and compare it to the airflow exhausting from the driver seat backrest TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the passenger seat backrest TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds. • **Is the airflow exhausting from the passenger seat backrest TED comparable to the airflow exhausting from the driver seat backrest TED with no change in operation when carrying out the wiggle test?**	**Yes** GO to AO7 . **No** If the airflow exhausting from the passenger seat backrest TED is not comparable to the airflow exhausting from the driver seat backrest TED , GO to AO8 . If the passenger seat backrest TED blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AO7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the passenger seat backrest TED with the passenger seat occupied and compare it to the airflow exhausting from the driver seat backrest TED with the driver seat occupied. • **Is the airflow exhausting from the passenger seat backrest**	**Yes** GO to AO16 . **No** INSTALL a new passenger seat backrest foam pad

TED comparable to the airflow exhausting from the driver seat backrest TED ?	and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AO8 CHECK THE PASSENGER SEAT BACKREST BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the passenger seat backrest TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AO9 .
AO9 CHECK THE PASSENGER SEAT BACKREST BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265C . • Disconnect: Passenger Seat Backrest TED C3039 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and passenger seat backrest TED C3039-7, circuit VHS16 (BU/GN), harness side.  N0053808 • **Is the resistance less than 5 ohms?**	**Yes** GO to AO10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AO10 CHECK THE PASSENGER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between DCSM C3265C-7, circuit RHS08 (VT/WH), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

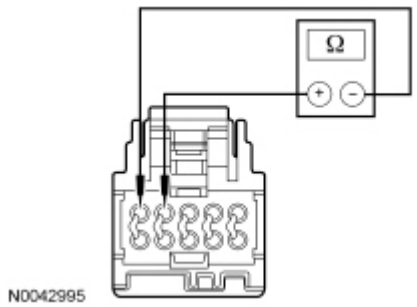
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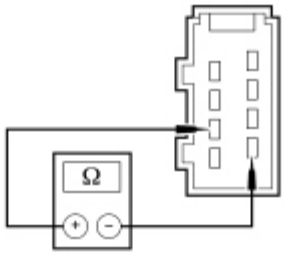
 N0044855 • **Is any voltage present?**	REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO11 .
AO11 CHECK THE PASSENGER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and ground.  N0044848 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AO12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AO12 CHECK THE PASSENGER SEAT BACKREST BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ▪ DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and passenger seat backrest TED C3039-2, circuit CHS03 (GN/BN), harness side. ▪ DCSM C3265C-7, circuit RHS08 (VT/WH), harness side and passenger seat backrest TED C3039-4, circuit RHS03 (GY/OG), harness side.  N0108651 • **Are the resistances less than 5 ohms?**	**Yes** GO to AO13 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AO13 CHECK THE PASSENGER SEAT BACKREST BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the**	**Yes**

positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged. • Measure the resistance between passenger seat backrest TED C3039 pin 2 and pin 4, component side.  N0053768 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	GO to AO14 . **No** INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AO14 CHECK THE PASSENGER SEAT BACKREST BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat backrest TED C3039 pin 7 and pin 4, component side.  N0054028 • **Is the resistance between 240K ohms and 400K ohms?**	**Yes** GO to AO15 . **No** INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AO15 CHECK THE PASSENGER SEAT BACKREST TED INSTALLATION AND FOR CRUSHED SEAT BACKREST	

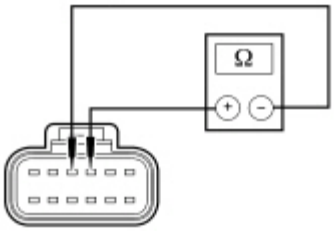
• Ignition OFF.
• Remove the passenger seat. Refer to Seat — Front in this section.
• Remove the passenger seat backrest cover. Refer to Seat Backrest Cover — Front in this section.
• Inspect the passenger seat backrest for the following:
  ▪ Is the passenger seat backrest TED correctly installed?
  ▪ Is the passenger seat backrest foam pad crushed or restricted?
  ▪ Is the passenger seat backrest climate controlled seat manifold crushed or restricted?
• **Is the passenger seat backrest TED correctly installed and are there no signs of damage to the foam pad and manifold?**
	Yes
	INSTALL the passenger seat backrest cover and seat and GO to AO18 .
	
	No
	CORRECTLY install the passenger seat backrest TED or INSTALL a new passenger seat backrest foam pad and/or climate controlled seat manifold. CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR

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	the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AO16 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR AND WIRING • Ignition OFF. • Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B. • Disconnect: Passenger Seat Side Air Bag C339. • Disconnect: DCSM C3265B. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Measure the resistance between DCSM C3265B-4, circuit VHS36 (YE/BU), harness side and C3265B-5 circuit RHS20 (GN/BU), harness side. Note the ambient temperature and refer to the following table. | Temperature	Resistance | |---|---| | 0-10°C (32-50°F) | 2,782-1,663 ohms | | 10-20°C (50-68°F) | 1,837-1,140 ohms | | 20-30°C (68-86°F) | 1,260-806 ohms | | 30-40°C (86-104°F) | 893-570 ohms | | 40-50°C (104-122°F) | 630-428 ohms |  • **Is the resistance within the limits indicated?**	**Yes** GO to AO18. **No** GO to AO17.
AO17 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR • Measure the resistance between passenger seat backrest TED	**Yes**

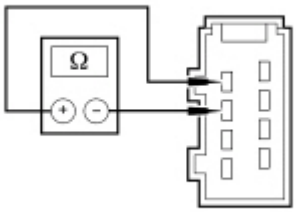
C3039 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  N0053767 • **Is the resistance within the limits indicated?**	REPAIR circuit VHS35 (VT/OG) or RHS15 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AO18 CHECK THE PASSENGER SEAT BACKREST TED HEATING/COOLING CIRCUITRY CURRENT DRAW	
• Connect: All DCSM, TED and Body Harness-to-Seat Harness Connectors. • ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.** • **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted. • Place an inductive current probe around circuit CHS06 (BU/BN) near DCSM C3265A-C and monitor the current draw. • Start the vehicle and set the passenger seat to HIGH heat. • **Is the current draw less than 11 amps?**	**Yes** GO to AO19. **No** INSTALL a new passenger seat backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AO19 CHECK RESISTANCE OF THE PASSENGER SEAT BACKREST TED AND WIRING	
• Ignition OFF. • Disconnect: DCSM C3265A. • Measure the resistance between DCSM C3265A-C circuit CHS06 (BU/BN), harness side and C3265A-D, circuit RHS06 (WH), harness side.	**Yes** GO to AO21. **No** GO to AO20.

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- **Is the resistance between 0.9 and 10 ohms?**

AO20 CHECK THE RESISTANCE OF THE PASSENGER SEAT BACKREST TED	
• Disconnect: Passenger Seat Backrest TED C3039 . • Measure the resistance between passenger seat backrest TED C3039 pin 1 and pin 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS01 (GY/VT) or RHS01 (WH/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AO21 CHECK FOR CORRECT DCSM OPERATION	

• Inspect the DCSM and passenger seat backrest TED harness and component side connectors and the body harness-to-seat harness connectors for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors .
• Make sure the connectors are seated correctly.
• Start the engine.
• Set the passenger seat to OFF.
	Yes
	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation.
	
	DISCONNECT the battery ground cable. CONNECT

• Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Attempt to recreate the fault. With the engine still running set the passenger seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AP: DTC B272C

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

Climate controlled seats are independently controlled by the Dual Climate Controlled Seat Module (DCSM) mounted to the bottom of the passenger seat cushion. The climate controlled seat system only operates with the engine running, however, if using a scan tool to command the DCSM , diagnostic testing can be carried out with the ignition ON. Both voltage supply circuits to the DCSM are spliced together internally, so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat will be disabled by the module and the other will remain operational.

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the seat switch settings.

A differential fault occurs when the cushion and backrest TEDs on an affected seat are reporting very different temperatures to the DCSM . This may result from an airflow restriction or a circuit fault of either TED area. If a TED and manifold is clear of obstruction and is operational, the other TED and circuitry on the seat should be checked. It is important to note that a TED with a higher temperature may be operating correctly and not the area of concern. The other TED may be indicating a much lower temperature, causing the DTC to set.

- DTC B272C (Driver Differential Temperature Fault) — If there is a temperature differential between the driver backrest and cushion TED of 60°C (108°F) or more for more than 4 seconds, if the TED is disconnected or if the duct is blocked, this DTC sets. When this happens the first time in a key cycle, the DCSM puts the driver seat system into recovery mode (see Principles of Operation). If the system is able to recover, it functions normally. If the system is able to recover and it occurs a second time in the same key cycle, the DCSM shuts down the driver seat system.

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This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted cushion or backrest TED filter
- Crushed or restricted cushion or backrest foam pad
- Crushed or restricted cushion or backrest climate controlled seat manifold
- Cushion or backrest TED assembly
- DCSM

PINPOINT TEST AP: DTC B272C

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

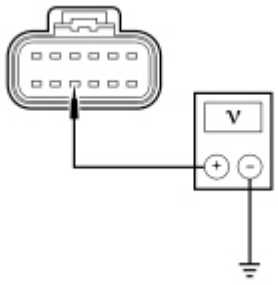
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

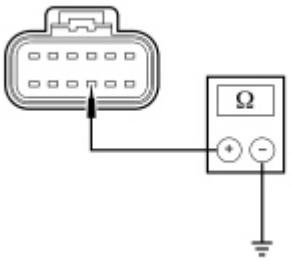
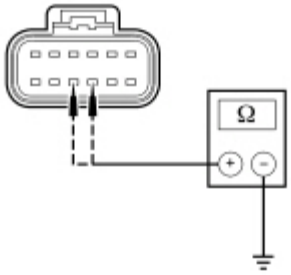
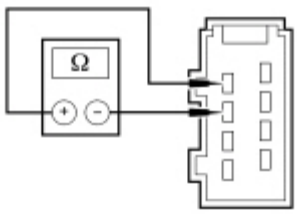
Test Step	Result / Action to Take
AP1 CHECK FOR DCSM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Was DTC B2729 or B2730 retrieved?**	**Yes** For DTC B2729, GO to Pinpoint Test AM . For DTC B2730, GO to Pinpoint Test AT . **No** GO to AP2 .
AP2 MONITOR THE DCSM TED TEMPERATURE PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger — DCSM . ▪ Passenger Cushion TED Temperature (PCSHTMP) ▪ Passenger Back TED Temperature (PBKTMP) ▪ Seat cushion TED temperature (CSHTEMP) ▪ Seat back TED temperature (BK_TEMP) • **NOTE:** Make sure the temperature of the climate controlled seats has stabilized before monitoring the PIDs. Not allowing stabilization can cause incorrect readings and lead to incorrect identification of components that are not faulty. • Monitor TED temperature PIDs with the climate controlled seats OFF. Compare the PID values of the driver seat to those of the front passenger seat, this can help identify if there is a concern with the driver seat cushion or backrest PID value readings. • **Are both driver seat TED temperature PIDs within 10°**	**Yes** GO to AP3 . **No** If the driver seat cushion PID varies 10°C (18°F) or more from ambient temperature, GO to AP16 . If the driver seat backrest PID varies 10°C (18°F) or more from ambient temperature, GO to AP31 .

C (18°F) of the ambient temperature?	
AP3 CONFIRM THE FAULT IS IN THE SEAT CUSHION OR THE BACKREST • Ignition OFF. • Ignition ON. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault. It may be necessary to sit on the seat or place something of reasonable size and weight on the seat to recreate the fault. • After cycling the ignition and with the engine running, set the driver seat to high heat. Allow the seat to heat for at least 15 minutes while monitoring the TED temperature PIDs of the driver seat. • **Do the driver seat cushion TED and backrest TED PIDs vary more than 60°C (108°F) from each other?**	**Yes** If the driver seat cushion PID is 60° C (108°F) hotter than the backrest PID, GO to AP5 . If the driver seat backrest PID is 60° C (108°F) hotter than the cushion PID, GO to AP20 . **No** GO to AP4 .
AP4 CHECK THE TEDs COOLING PERFORMANCE • Check the TEDs cooling performance on the affected seat. Refer to Component Test — Thermo-Electric Device (TED) Cooling Performance in this section. • **Did the TEDs pass the component test?**	**Yes** The DTC may have been set by extreme cabin temperatures or excessive sunload on the seat causing the system to enter recovery mode. Occupant size and weight characteristics can also be a factor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If a concern cannot be found or duplicated, RETURN the vehicle to the customer. **No** CHECK the affected seat cushion or backrest for correct installation of the climate controlled seat components (TED , manifold, plenum, air ducts and foam pad). CHECK for airflow restrictions (TED inlets and outlets, TED -to-manifold or plenum connections, filters and ducts) and REPAIR as needed. CHECK for an intermittent wiring fault. REPAIR as needed. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

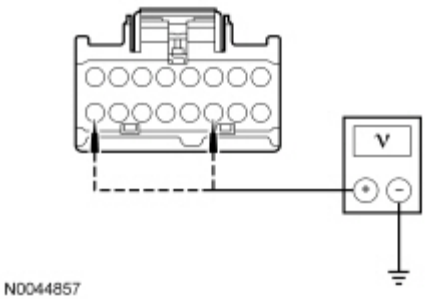
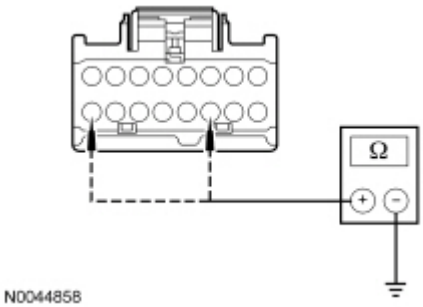
AP5 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM
• Ignition OFF.
• Remove the seat. Refer to Seat — Front in this section.
• Remove the seat cushion trim cover. Refer to Seat Cushion Cover — Front in this section.
• Inspect the seat cushion for the following:
  ▪ Is the cushion blower obstructed?
  ▪ Is the blower filter restricted or plugged?
  ▪ Is the TED correctly installed?
	Yes
	GO to AP6 .
	
	No
	CORRECTLY install the cushion TED or INSTALL a new seat cushion foam pad and/or climate controlled seat manifold. INSTALL

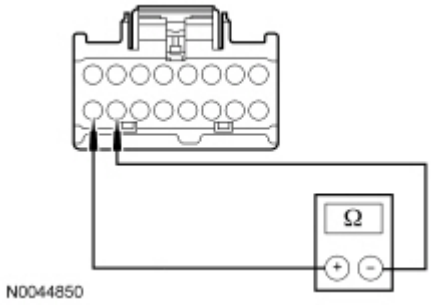
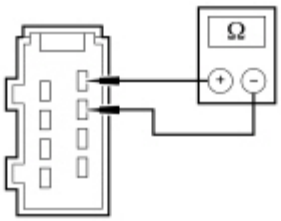
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▪ Is the seat cushion foam pad crushed or restricted? ▪ Is the climate controlled seat manifold crushed or restricted? • **Is the TED correctly installed and the foam pad and manifold OK?**	the seat. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. REPOWER the SRS. REFER to Section 501-20B.
AP6 CHECK THE BACKREST TED - CIRCUIT FOR A SHORT TO VOLTAGE	
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B. **NOTE:** The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault. **NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Ignition OFF. • Position the driver seat in the vehicle and connect the seat-to-floor connectors. • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265A . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Ignition ON. • Measure the voltage between DCSM C3265A-K, circuit RHS01 (WH/VT), harness side and ground.  N0044951 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** GO to AP7.
AP7 CHECK THE BACKREST TED + CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265A-J, circuit CHS01 (GY/VT), harness side and ground.	**Yes** GO to AP8. **No** REPAIR the circuit. CLEAR the

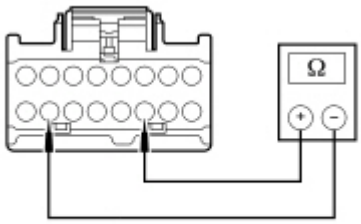
 N0042910 • **Is the resistance greater than 10,000 ohms?**	DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AP8 CHECK THE BACKREST TED AND WIRING RESISTANCE	
• Measure the resistance between DCSM C3265A-J, circuit CHS01 (GY/VT), harness side and DCSM C3265A-K, circuit RHS01 (WH/VT), harness side.  N0042876 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AP10. **No** GO to AP9.
AP9 CHECK THE BACKREST TED RESISTANCE	
• Disconnect: Backrest TED C3034. • Measure the resistance between backrest TED C3034 pins 1 and 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AP10 CHECK THE BLOWER AND SPEED CONTROL	

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CIRCUITS FOR A SHORT TO VOLTAGE • Disconnect: DCSM C3265C . • Ignition ON. • Measure the voltage between: ▪ DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground. ▪ DCSM C3265C-11, circuit VHS18 (BN/GN), harness side and ground.  N0044857 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP11 .
AP11 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND • Ignition OFF. • Measure the resistance between: ▪ DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground. ▪ DCSM C3265C-11, circuit VHS18 (BN/GN), harness side and ground.  N0044858 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AP12 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AP12 CHECK THE BLOWER AND WIRING RESISTANCE • **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3265C-16, circuit CHS03 (GN/BN) and the negative lead to DCSM C3265C-15, circuit RHS03 (GY/OG) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and DCSM C3265C-15, circuit RHS03 (GY/OG), harness side.	**Yes** GO to AP14 . **No** GO to AP13 .

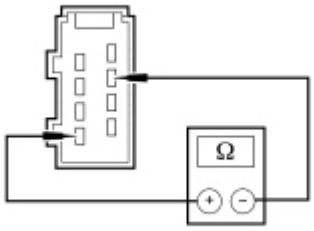
 N0044850 • **Is the resistance between 4,000 and 10,000 ohms?**	
AP13 CHECK THE BLOWER RESISTANCE	
• Disconnect: Cushion TED C3035 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between cushion TED C3035 pins 2 and 4, component side.  N0053768 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AP14 CHECK THE BLOWER SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3265C-11, circuit VHS18 (BN/GN), harness side and the negative lead to C3265C-15, circuit RHS03 (GY/OG), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-11, circuit VHS18 (BN/GN) harness side and DCSM C3265C-15, circuit RHS03 (GY/OG), harness side.	**Yes** GO to AP16 . **No** GO to AP15 .

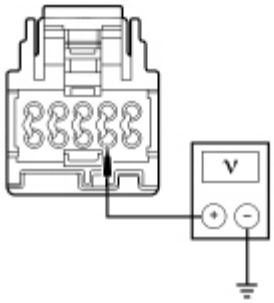
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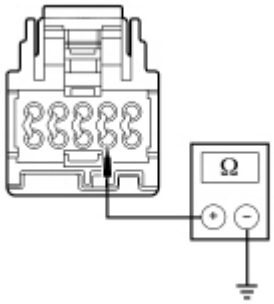
- **Is the resistance between 240K ohms and 4M ohms?**

AP15 CHECK THE BLOWER SPEED CONTROL RESISTANCE	
• Disconnect: Cushion TED C3035 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between cushion TED C3035 pins 7 and 4, component side.  N0054028 • **Is the resistance between 240K ohms and 4M ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AP16 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265B . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3265B-7, circuit VHS26 (VT), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP17 .

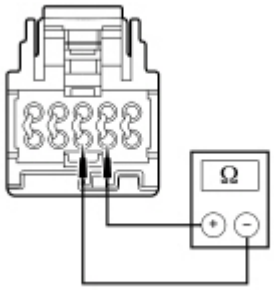


N0042906

- **Is any voltage present?**

AP17 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO GROUND - Ignition OFF. - Measure the resistance between DCSM C3265B-7, circuit VHS26 (VT), harness side and ground.  N0042907 - **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AP18 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AP18 CHECK THE TED THERMISTOR AND WIRING RESISTANCE AT THE DCSM - Measure the resistance between DCSM C3265B-7, circuit VHS26 (VT), harness side and DCSM C3265B-8, circuit RHS05 (YE/VT), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP19 .

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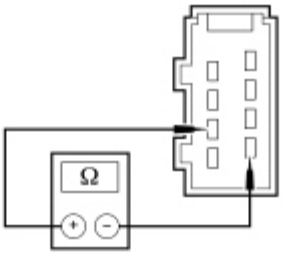


- **Is the resistance within the limits indicated?**

AP19 CHECK THE TED THERMISTOR RESISTANCE

- Disconnect: Cushion TED C3035 .
- Measure the resistance between cushion TED pins 5 and 8, component side. Note the ambient temperature and compare result to the following table:

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
REPAIR the circuit(s) for high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

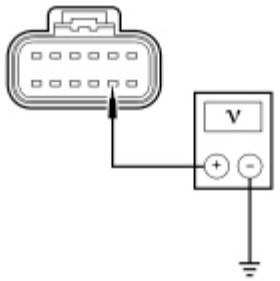
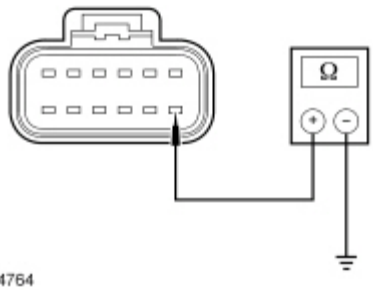
AP20 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM

- Ignition OFF.
- Remove the seat. Refer to Seat — Front in this section.
- Remove the seat backrest trim cover. Refer to Seat Backrest Cover — Front in this section.
- Inspect the seat backrest for the following:
  - Is the backrest blower obstructed?
  - Is the blower filter restricted or plugged?
  - Is the TED correctly installed?
  - Is the seat backrest foam pad crushed or restricted?
  - Is the climate controlled seat manifold crushed or restricted?

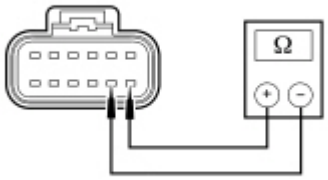
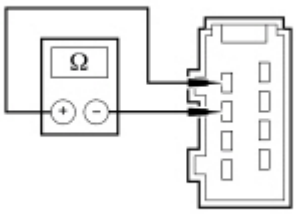
Yes
GO to AP21 .

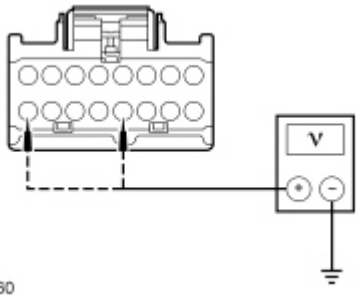
No
CORRECTLY install the backrest TED or INSTALL a new seat backrest foam pad and/or climate controlled seat manifold. INSTALL the seat. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground

• **Is the TED correctly installed and the foam pad and manifold OK?**	cable. REPOWER the SRS. REFER to Section 501-20B.
AP21 CHECK THE CUSHION TED CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Position the driver seat in the vehicle and connect the seat-to-floor connectors. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Driver Seat Side Air Bag Module C3051. • Disconnect: Passenger Seat Side Air Bag Module C339. • Disconnect: DCSM C3265A. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Ignition ON. • Measure the voltage between DCSM C3265A-H, circuit RHS02 (BU/OG), harness side and ground.  N0044952 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** GO to AP22.
AP22 CHECK THE CUSHION TED + CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265A-G, circuit CHS02 (YE/BU), harness side and ground.  N0044764 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AP23. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AP23 CHECK THE CUSHION TED AND WIRING RESISTANCE	

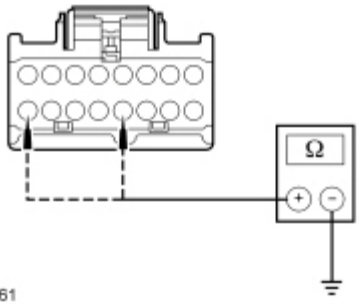
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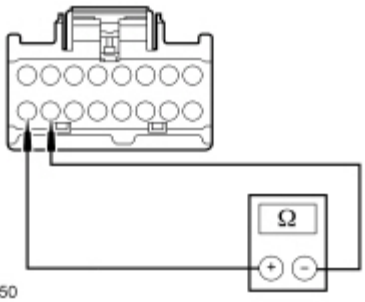
• Measure the resistance between DCSM C3265A-G circuit CHS02 (YE/BU), harness side and DCSM C3265A-H, circuit RHS02 (BU/OG), harness side.  N0042194 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AP25 . **No** GO to AP24 .
AP24 CHECK THE CUSHION TED RESISTANCE • Disconnect: Cushion TED C3035 . • Measure the resistance between cushion TED C3035 pins 1 and 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AP25 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE • Disconnect: DCSM C3265C . • Ignition ON. • Measure the voltage between: ▪ DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground. ▪ DCSM C3265C-12, circuit CHS09 (GY), harness side and ground.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP26 .



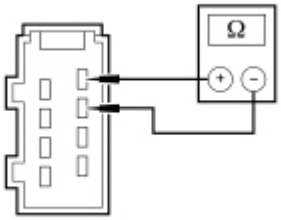
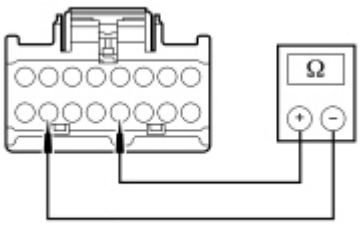
- **Is any voltage present on either circuit?**

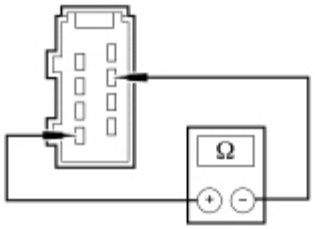
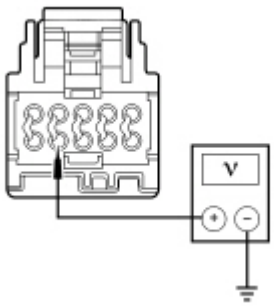
AP26 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Measure the resistance between:
  ▪ DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground.
  ▪ DCSM C3265C-12, circuit CHS09 (GY), harness side and ground.

 	
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to AP27 .
	
	No
	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

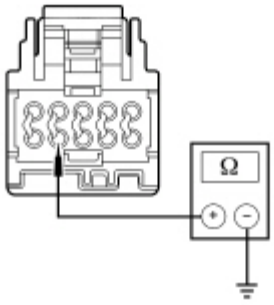
AP27 CHECK THE BLOWER AND WIRING RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3265C-16, circuit CHS03 (GN/BN) and the negative lead to DCSM C3265C-15, circuit RHS03 (GY/OG) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and DCSM C3265C-15, circuit RHS03 (GY/OG), harness side.  	**Yes** GO to AP29 . **No** GO to AP28 .

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• **Is the resistance between 4,000 and 10,000 ohms?**	
AP28 CHECK THE BLOWER RESISTANCE	
• Disconnect: Backrest TED C3034 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3034 pins 2 and 4, component side.  N0053768 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AP29 CHECK THE BLOWER SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3265C-12, circuit CHS09 (GY), harness side and the negative lead to C3265C-15, circuit RHS03 (GY/OG), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-12, circuit CHS09 (GY) harness side and DCSM C3265C-15, circuit RHS03 (GY/OG), harness side.  N0044862 • **Is the resistance between 240K ohms and 4M ohms?**	**Yes** GO to AP31 . **No** GO to AP30 .
AP30 CHECK THE BLOWER SPEED CONTROL RESISTANCE	
• Disconnect: Backrest TED C3034 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3034 pins 7 and 4, component side.  N0054028 • **Is the resistance between 240K ohms and 4M ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AP31 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Driver Seat Side Air Bag Module C3051. • Disconnect: Passenger Seat Side Air Bag Module C339. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Disconnect: DCSM C3265B. • Ignition ON. • Measure the voltage between DCSM C3265B-9, circuit CHS14 (GN), harness side and ground.  N0042974 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** GO to AP32.
AP32 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between DCSM C3265B-9, circuit CHS14 (GN), harness side and ground.	**Yes** GO to AP33.

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- **Is the resistance greater than 10,000 ohms?**

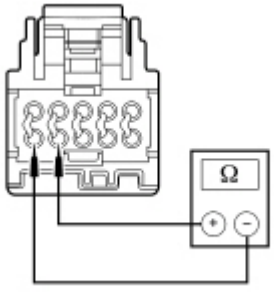
No
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

AP33 CHECK THE TED THERMISTOR AND WIRING RESISTANCE

- Measure the resistance between DCSM C3265B-9, circuit CHS14 (GN), harness side and DCSM C3265B-10, circuit CHS29 (WH/BU), harness side. Note the ambient temperature and compare result to the following table:

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

No
GO to AP34 .

AP34 CHECK THE TED THERMISTOR RESISTANCE

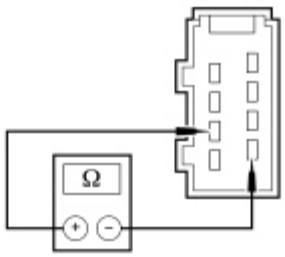
- Disconnect: Backrest TED C3034 .
- Measure the resistance between backrest TED pins 5 and 8, component side. Note the ambient temperature and compare result to the following table:

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms

Yes
REPAIR the circuit(s) for high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS .

20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0053767

- **Is the resistance within the limits indicated?**

REFER to Section 501-20B .

No
INSTALL a new backrest TED .
REFER to Seat Backrest Thermo-Electric Device in this section.
CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS .
REFER to Section 501-20B .

Pinpoint Test AQ: DTC B272D

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

Climate controlled seats are independently controlled by the Dual Climate Controlled Seat Module (DCSM) mounted to the bottom of the passenger seat cushion. The climate controlled seat system only operates with the engine running, however, if using a scan tool to command the DCSM , diagnostic testing can be carried out with the ignition ON. Both voltage supply circuits to the DCSM are spliced together internally, so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat will be disabled by the module and the other will remain operational.

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the seat switch settings.

A differential fault occurs when the cushion and backrest TEDs on an affected seat are reporting very different temperatures to the DCSM . This may result from an airflow restriction or a circuit fault of either TED area. If a TED and manifold is clear of obstruction and is operational, the other TED and circuitry on the seat should be checked. It is important to note that a TED with a higher temperature may be operating correctly and is not the area of concern. The other TED may be indicating a much lower temperature, causing the DTC to set.

- DTC B272D (Passenger Differential Temperature Fault) — If there is a temperature differential between the passenger backrest and cushion TED of 60°C (108°F) or more for more than 4 seconds, the TED is disconnected or the duct is blocked, this DTC sets. When this happens the first time in a key cycle, the DCSM puts the passenger seat system into recovery mode (see Principles of Operation). If the system is able to recover, it functions normally. If the system is able to recover and it occurs a second time in the same key cycle, the DCSM shuts down the passenger seat system.

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This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted cushion or backrest TED filter
- Crushed or restricted cushion or backrest foam pad
- Crushed or restricted cushion or backrest climate controlled seat manifold
- Cushion or backrest TED assembly
- DCSM

PINPOINT TEST AQ: DTC B272D

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

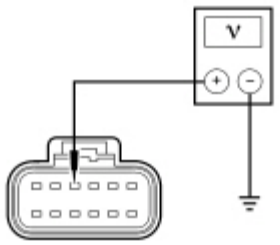
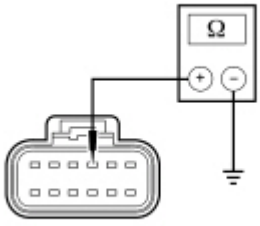
Test Step	Result / Action to Take
AQ1 CHECK THE DCSM FOR DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Was DTC B272A or B272B retrieved?**	**Yes** For DTC B272A, GO to Pinpoint Test AN . For DTC B272B, GO to Pinpoint Test AO . **No** GO to AQ2 .
AQ2 MONITOR THE DCSM TED TEMPERATURE PIDs	

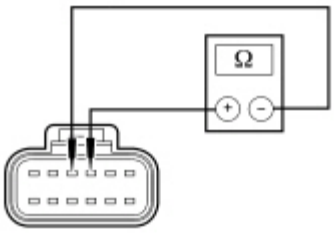
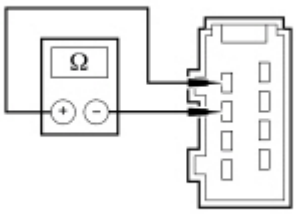
• Enter the following diagnostic mode on the scan tool: DataLogger — DCSM .
  ▪ Passenger cushion TED temperature (PCSHTMP)
  ▪ Passenger back TED temperature (PBKTMP)
  ▪ Seat cushion TED temperature (CSHTEMP)
  ▪ Seat back TED temperature (BK_TEMP)
• **NOTE:** Make sure the temperature of the climate controlled seats has stabilized before monitoring the PIDs. Not allowing stabilization can cause incorrect readings and lead to incorrect identification of components that are not faulty.
• Monitor the TED temperature PIDs with the climate controlled seats OFF. Compare the PIDs of the front passenger seat to those of the driver seat, this can help identify if there is a concern with the front passenger seat cushion or backrest PID readings.
• **Are both front passenger seat TED temperature PIDs within 10°C (18°F) of the ambient temperature?**
	Yes
	GO to AQ3 .
	
	No
	If the front passenger seat cushion PID varies 10°C (18°F) or more from ambient temperature, GO to AQ16 .
	
	If the front passenger seat backrest PID varies 10°C (18°F) or more from ambient temperature, GO to AQ31 .

AQ3 CONFIRM THE FAULT IS IN THE SEAT CUSHION OR BACKREST	
• Ignition OFF. • Ignition ON. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault. It may be necessary to sit on the seat or place something of reasonable size and weight on the seat to recreate the fault. • After cycling the ignition and with the engine running, set the passenger seat to high heat. Allow the seat to heat for at least 15 minutes while monitoring the TED temperature PIDs of the passenger seat. • **Do the passenger seat cushion TED and backrest TED PIDs vary more than 60°C (108°F) from each other?**	**Yes** If the front passenger seat cushion PID is 60°C (108°F) hotter than the backrest PID, GO to AQ5 . If the front passenger seat backrest PID is 60°C (108°F) hotter than the cushion PID, GO to AQ20 . **No** GO to AQ4 .
AQ4 CHECK THE TEDs COOLING PERFORMANCE	
• Check TEDs cooling performance on the affected seat. Refer to Component Test — Thermo-Electric Device (TED) Cooling Performance in this section. • **Did the TEDs pass the component test?**	**Yes** The DTC may have been set by extreme cabin temperatures or excessive sunload on the seat causing the system to enter recovery mode. Occupant size and weight characteristics can also be a factor. CLEAR the DTCs. TEST the system for normal operation. If a concern cannot be found or duplicated, RETURN the vehicle to the customer. **No** CHECK the affected seat cushion or backrest for correct installation of the climate controlled seat components (TED , manifold, plenum, air ducts and foam pad). CHECK for airflow restrictions (TED inlets and outlets, TED -to-manifold or plenum connections, filters and ducts) and REPAIR as needed. CHECK for an intermittent wiring fault. REPAIR as needed. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AQ5 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM	

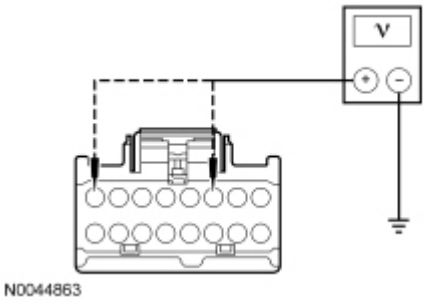
• Ignition OFF.
• Remove the seat. Refer to Seat — Front in this section.
• Remove the seat cushion trim cover. Refer to Seat Cushion Cover — Front in this section.
• Inspect the seat cushion for the following:
  ▪ Is the cushion blower obstructed?
  ▪ Is the blower filter restricted or plugged?
  ▪ Is the TED correctly installed?
  ▪ Is the seat cushion foam pad crushed or
	Yes
	GO to AQ6 .
	
	No
	CORRECTLY install the cushion TED or INSTALL a new seat cushion foam pad and/or climate controlled seat manifold. INSTALL the seat. CLEAR the DTCs.

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restricted? ▪ Is the climate controlled seat manifold crushed or restricted? • **Is the TED correctly installed and the foam pad and manifold OK?**	REPEAT the self-test. DISCONNECT the battery ground cable. REPOWER the SRS. REFER to Section 501-20B.
AQ6 CHECK THE BACKREST TED - CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Position the front passenger seat in the vehicle and connect the seat-to-floor connectors. • Depower the SRS. Refer to Section 501-20B. • Disconnect: Passenger Seat Side Air Bag Module C339. • Disconnect: DCSM C3265A. • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01. • Ignition ON. • Measure the voltage between DCSM C3265A-D, circuit RHS06 (WH), harness side and ground.  N0044950 • **Is any voltage present?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** GO to AQ7.
AQ7 CHECK THE BACKREST TED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265A-C, circuit CHS06 (BU/BN), harness side and ground.  N0042988 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AQ8. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

AQ8 CHECK THE BACKREST TED AND WIRING RESISTANCE	
• Measure the resistance between DCSM C3265A-C, circuit CHS06 (BU/BN), harness side and DCSM C3265A-D, circuit RHS06 (WH), harness side.  N0042989 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AQ10 . **No** GO to AQ9 .
AQ9 CHECK THE BACKREST TED RESISTANCE	
• Disconnect: Backrest TED C3039 . • Measure the resistance between backrest TED C3039 pins 1 and 3, component side.  N0053766 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ10 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DCSM C3265C . • Ignition ON. • Measure the voltage between: ▪ DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and ground. ▪ DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and ground.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AQ11 .

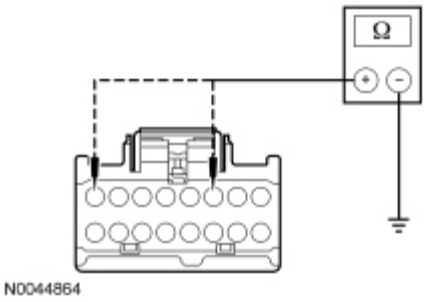
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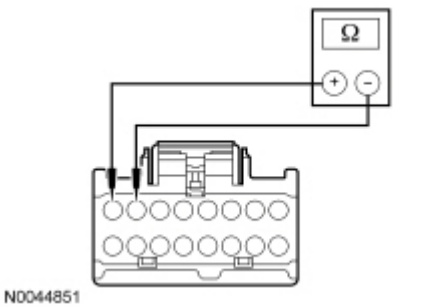


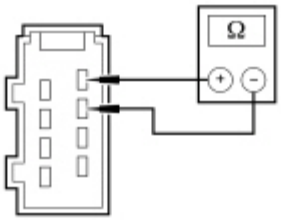
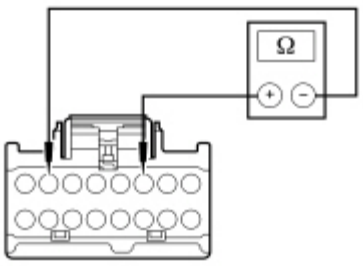
N0044863

- **Is any voltage present on either circuit?**

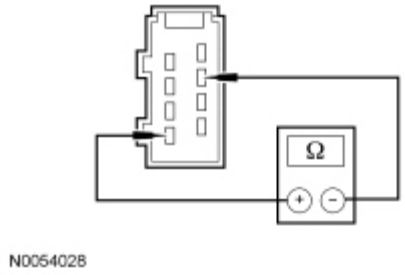
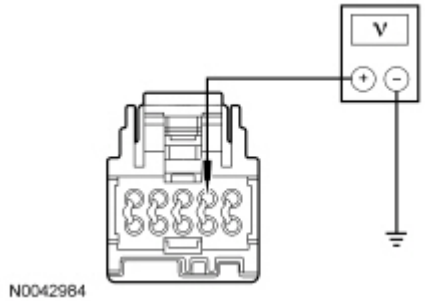
AQ11 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	

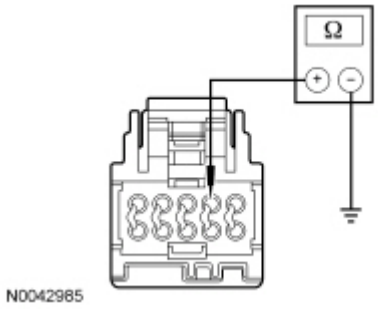
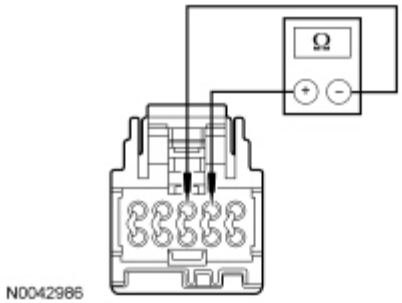
• Ignition OFF.
• Measure the resistance between:
  ▪ DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and ground.
  ▪ DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and ground.

 	
N0044864
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to AQ12 .
	
	No
	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

AQ12 CHECK THE BLOWER AND WIRING RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3265C-8, circuit CHS08 (BN/YE) and the negative lead to DCSM C3265C-7, circuit RHS08 (VT/WH) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and DCSM C3265C-7, circuit RHS08 (VT/WH), harness side.  N0044851 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** GO to AQ14 . **No** GO to AQ13 .

AQ13 CHECK THE BLOWER RESISTANCE	
• Disconnect: Cushion TED C3040 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between cushion TED C3040 pins 2 and 4, component side.  N0053768 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ14 CHECK THE BLOWER SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3265C-3, circuit VHS23 (BN/BU), harness side and the negative lead to C3265C-7, circuit RHS08 (VT/WH), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-3, circuit VHS23 (BN/BU), harness side and DCSM C3265C-7, circuit RHS08 (VT/WH), harness side.  N0047113 • **Is the resistance between 240K ohms and 4M ohms?**	**Yes** GO to AQ16 . **No** GO to AQ15 .
AQ15 CHECK THE BLOWER SPEED CONTROL RESISTANCE	
• Disconnect: Cushion TED C3040 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat

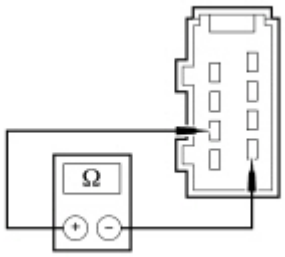
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• Measure the resistance between cushion TED C3040 pins 7 and 4, component side.  N0054028 • **Is the resistance between 240K ohms and 4M ohms?**	side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ16 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265B . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3265B-2, circuit VHS27 (WH/OG), harness side and ground.  N0042984 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AQ17 .
AQ17 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265B-2, circuit VHS27 (WH/OG), harness side and ground.	**Yes** GO to AQ18 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground

 N0042985 • **Is the resistance greater than 10,000 ohms?**	cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ18 CHECK THE TED THERMISTOR AND WIRING RESISTANCE	
• Measure the resistance between DCSM C3265B-2, circuit VHS27 (WH/OG), harness side and DCSM C3265B-3, circuit RHS10 (BU/OG), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  N0042986 • **Is the resistance within the limits indicated?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AQ19 .
AQ19 CHECK THE TED THERMISTOR RESISTANCE	
• Disconnect: Cushion TED C3040 . • Measure the resistance between cushion TED pins 5 and 8, component side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms	**Yes** REPAIR the circuit(s) for high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

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30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0053767

- **Is the resistance within the limits indicated?**

No
INSTALL a new cushion TED. REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

AQ20 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM

- Ignition OFF.
- Remove the seat. Refer to Seat — Front in this section.
- Remove the seat backrest trim cover. Refer to Seat Backrest Cover — Front in this section.
- Inspect the seat backrest for the following:
  - Is the backrest blower obstructed?
  - Is the blower filter restricted or plugged?
  - Is the TED correctly installed?
  - Is the seat backrest foam pad crushed or restricted?
  - Is the climate controlled seat manifold crushed or restricted?
- **Is the TED correctly installed and the foam pad and manifold OK?**

Yes
GO to AQ21.

No
Correctly INSTALL the backrest TED or INSTALL a new seat backrest foam pad and/or climate controlled seat manifold. REFER to Seat Backrest Thermo-Electric Device in this section. INSTALL the seat. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. REPOWER the SRS. REFER to Section 501-20B.

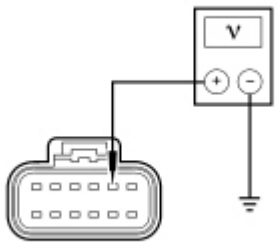
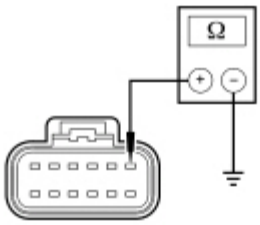
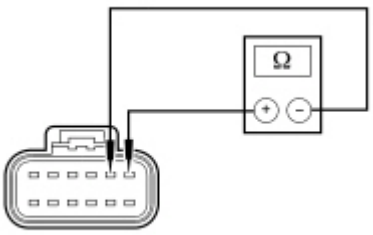
AQ21 CHECK THE CUSHION TED CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Position the front passenger seat in the vehicle and connect the seat-to-floor connectors.
- Depower the SRS. Refer to Section 501-20B.
- Disconnect: Passenger Seat Side Air Bag Module C339.
- Disconnect: DCSM C3265A.
- **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**
- Connect the battery ground cable. Refer to Section 414-01.
- Ignition ON.
- Measure the voltage between DCSM C3265A-B, circuit RHS07 (BU), harness side and ground.

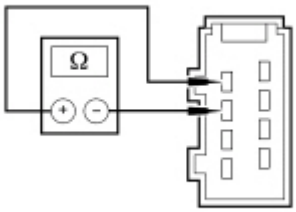
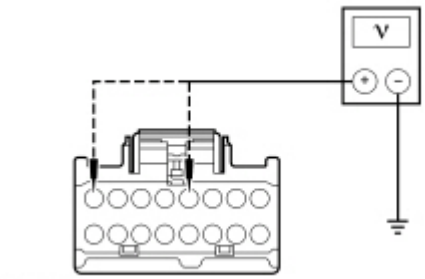
Yes
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

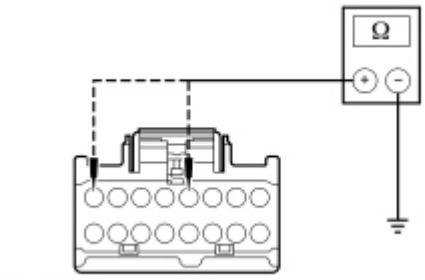
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

No
GO to AQ22.

 N0044870 • **Is any voltage present?**	
AQ22 CHECK THE CUSHION TED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265A-A, circuit CHS07 (GY/BU), harness side and ground.  N0042978 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AQ23 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ23 CHECK THE CUSHION TED AND WIRING RESISTANCE	
• Measure the resistance between DCSM C3265A-A circuit CHS07 (GY/BU), harness side and DCSM C3265A-B, circuit RHS07 (BU), harness side.  N0042979 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AQ25 . **No** GO to AQ24 .
AQ24 CHECK THE CUSHION TED RESISTANCE	
• Disconnect: Cushion TED C3040 . • Measure the resistance between cushion TED C3040 pins 1 and 3, component side.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339.

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 N0053766 • **Is the resistance between 0.9 and 10 ohms?**	REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ25 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DCSM C3265C . • Ignition ON. • Measure the voltage between: ▪ DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and ground. ▪ DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and ground.  N0044866 • **Is any voltage present on either circuit?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AQ26 .
AQ26 CHECK THE BLOWER AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ▪ DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and ground. ▪ DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and ground.	**Yes** GO to AQ27 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

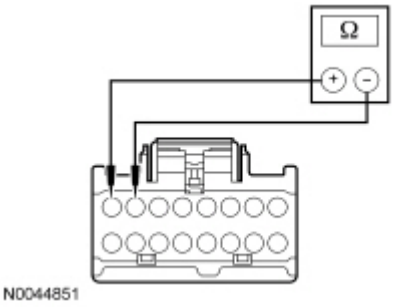


N0044867

- **Are the resistances greater than 10,000 ohms?**

AQ27 CHECK THE BLOWER AND WIRING RESISTANCE

- **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3265C-8, circuit CHS08 (BN/YE) and the negative lead to DCSM C3265C-7, circuit RHS08 (VT/WH) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.
- Measure the resistance between DCSM C3265C-8, circuit CHS08 (BN/YE), harness side and DCSM C3265C-7, circuit RHS08 (VT/WH), harness side.



N0044851

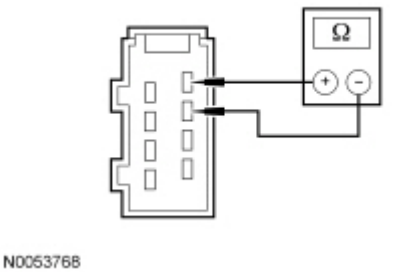
- **Is the resistance between 4,000 and 10,000 ohms?**

Yes
GO to AQ29 .

No
GO to AQ28 .

AQ28 CHECK THE BLOWER RESISTANCE

- Disconnect: Backrest TED C3039 .
- **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.
- Measure the resistance between backrest TED C3039 pins 2 and 4, component side.



N0053768

- **Is the resistance between 4,000 and 10,000 ohms?**

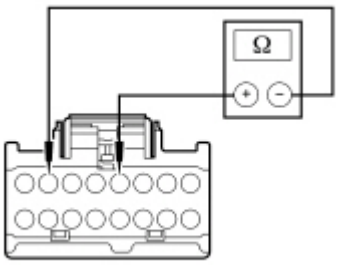
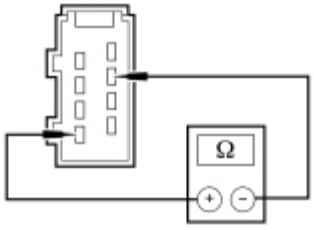
Yes
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

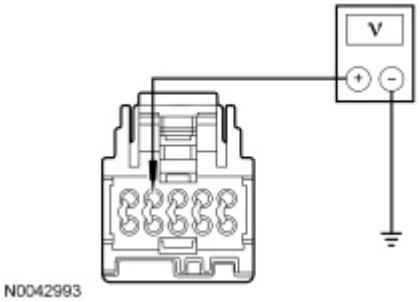
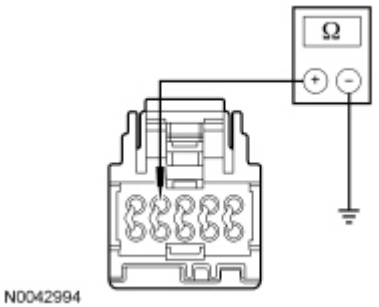
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to

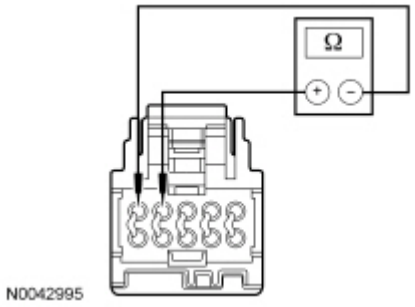
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	Section 501-20B .
AQ29 CHECK THE BLOWER SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3265C-4, circuit VHS21 (BU/WH), harness side and the negative lead to C3265C-7, circuit RHS08 (VT/WH), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3265C-4, circuit VHS21 (BU/WH), harness side and DCSM C3265C-7, circuit RHS08 (VT/WH), harness side.  N0044868 • **Is the resistance between 240K ohms and 4M ohms?**	**Yes** GO to AQ31 . **No** GO to AQ30 .
AQ30 CHECK THE BLOWER SPEED CONTROL RESISTANCE	
• Disconnect: Backrest TED C3039 . • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3039 pins 7 and 4, component side.  N0054028 • **Is the resistance between 240K ohms and 4M ohms?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ31 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265B .	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

• **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3265B-4, circuit VHS36 (YE/BU), harness side and ground.  N0042993 • **Is any voltage present?**	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AQ32 .
AQ32 CHECK THE THERMISTOR CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between DCSM C3265B-4, circuit VHS36 (YE/BU), harness side and ground.  N0042994 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AQ33 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AQ33 CHECK THE TED THERMISTOR AND WIRING RESISTANCE AT THE DCSM	
• Measure the resistance between DCSM C3265B-4, circuit VHS36 (YE/BU), harness side and DCSM C3265B-5, circuit RHS20 (GN/BU), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

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30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



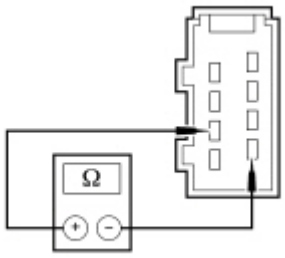
- **Is the resistance within the limits indicated?**

No
GO to AQ34 .

AQ34 CHECK THE TED THERMISTOR RESISTANCE

- Disconnect: Backrest TED C3039 .
- Measure the resistance between backrest TED pins 5 and 8, component side. Note the ambient temperature and compare result to the following table:

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
REPAIR the circuit(s) for high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AR: DTC B272E

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The driver climate controlled seat blowers are located within the backrest and cushion Thermo-Electric Devices (TEDs). The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to both blowers. The blowers are independently controlled by separate speed control circuits from the DCSM .

- DTC B272E (Driver Ignition Run/Blower Circuit Short to Ground) — If either the blower voltage supply or return circuits are open (to both cushion or backrest blowers) or shorted to voltage, the DTC is set and after 4-6 seconds the DCSM disables outputs to the driver seat. The DTC also sets if the blower voltage supply or return circuit is open to only one blower when DCSM supply voltage is less than 12 volts.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Backrest or cushion TED
- DCSM

PINPOINT TEST AR: DTC B272E

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

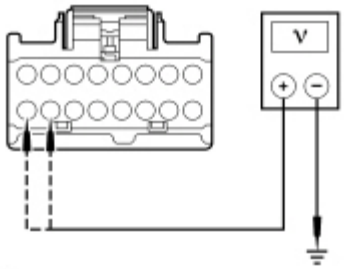
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AR1 CHECK THE TED BLOWER MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Cushion TED C3035 . • Disconnect: Backrest TED C3034 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3265C, harness side and ground using the following chart.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AR2 .

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DCSM Connector	Circuit
C3265C-15	RHS03 (GY/OG)
C3265C-16	CHS03 (GN/BN)



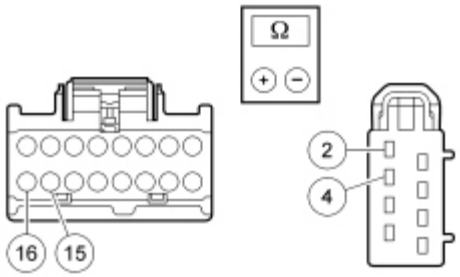
N0100444

- **Is any voltage present on either circuit?**

AR2 CHECK THE TED BLOWER MOTOR CIRCUITS FOR AN OPEN

- Ignition OFF.
- Measure the resistance between DCSM C3265C pins, harness side and cushion TED C3035 pins, harness side using the following chart.

DCSM Connector	Circuit	Cushion TED Connector
C3265C-15	RHS03 (GY/OG)	C3035-4
C3265C-16	CHS03 (GN/BN)	C3035-2



N0093634

- **Are the resistances less than 5 ohms?**

Yes
GO to AR3.

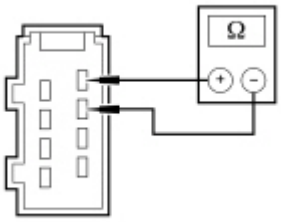
No
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.

AR3 CHECK THE RESISTANCE OF THE CUSHION AND BACKREST TED BLOWER MOTORS

- **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.

Yes
INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR

• Measure the resistance between: ▪ cushion TED C3035 pins 2 and 4, component side. ▪ backrest TED C3034 pins 2 and 4, component side.  N0053768 • **Are the resistances between 4,000 and 10,000 ohms?**	the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** If the cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the backrest TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AS: DTC B272F

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The passenger climate controlled seat blowers are located within the backrest and cushion Thermo-Electric Devices (TEDs). The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to both blowers. The blowers are independently controlled by separate speed control circuits from the DCSM .

- DTC B272F (Passenger Ignition Run/Blower Circuit Short to Ground) — If either the blower voltage supply or return circuits are open (to both cushion and backrest blowers) or shorted to voltage, the DTC is set and after 4-6 seconds the DCSM disables outputs to the passenger seat. The DTC also sets if the blower voltage supply or return circuit is open to only one blower when DCSM supply voltage is less than 12 volts.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

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- Backrest or cushion TED
- DCSM

PINPOINT TEST AS: DTC B272F

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

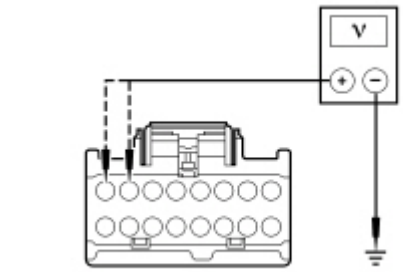
NOTE: If a seat equipped with a seat mounted side air bag is being repaired, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

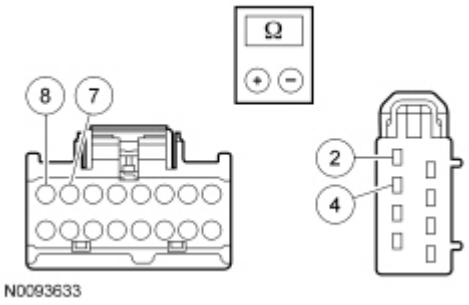
Test Step	Result / Action to Take
AS1 CHECK THE TED BLOWER MOTOR CIRCUITS FOR A SHORT TO VOLTAGE • Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: DCSM C3265C . • Disconnect: Cushion TED C3040 . • Disconnect: Backrest TED C3039 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3265C, harness side and ground using the following chart.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AS2 .

DCSM Connector	Circuit
C3265C-7	RHS08 (VT/WH)
C3265C-8	CHS08 (BN/YE)



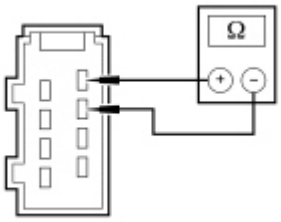
N0100445

- **Is any voltage present on either circuit?**

AS2 CHECK THE TED BLOWER MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Measure the resistance between DCSM C3265C pins, harness side and cushion TED C3040 pins, harness side using the following chart. **DCSM Connector** / **Circuit** / **Cushion TED Connector** C3265C-7 / RHS08 (VT/WH) / C3040-4 C3265C-8 / CHS08 (BN/YE) / C3040-2  N0093633 • **Are the resistances less than 5 ohms?**	**Yes** GO to AS3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AS3 CHECK THE RESISTANCE OF THE CUSHION AND BACKREST TED BLOWER MOTORS	

• **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.
• Measure the resistance between:
  ▪ cushion TED C3040 pins 2 and 4, component side.
  ▪ backrest TED C3039 pins 2 and 4, component side.
	Yes
	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-

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 N0053768 • **Are the resistances between 4,000 and 10,000 ohms?**	20B . **No** If the cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. If the backrest TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AT: DTC B2730

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat backrest temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Heated or cooled air exits the TED and flows through a manifold attached to the foam pad.

- DTC B2730 (Back Over-Temp Detected) — If the driver seat backrest TED temperature exceeds 85° C (185°F) in heat mode or 70°C (158°F) in cool mode for more than 34 seconds the DCSM shuts down the driver seat system and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted backrest TED filter
- Crushed or restricted climate controlled seat manifold
- Backrest TED assembly

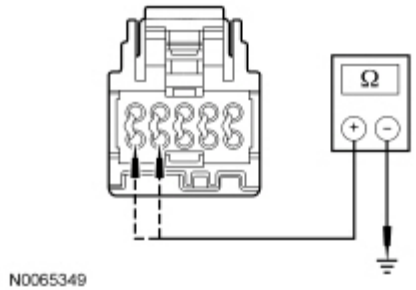
PINPOINT TEST AT: DTC B2730

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes**

into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

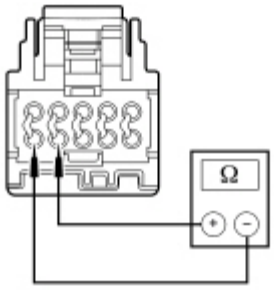
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AT1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the driver seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test — DCSM . • **Was DTC B2730 retrieved on-demand during the self-test?**	**Yes** GO to AT2 . **No** GO to AT5 .
AT2 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C3051 and Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265B . • Disconnect: Driver Seat Backrest TED C3034 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ▪ DCSM C3265B-9, circuit CHS14 (GN), harness side and ground. ▪ DCSM C3265B-10, circuit CHS29 (WH/BU), harness side and ground.  N0065349 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AT3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AT3 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR AND WIRING	

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- Connect: Driver Seat Backrest TED C3034 .
- Measure the resistance between DCSM C3265B-9, circuit CHS14 (GN), harness side and DCSM C3265B-10, circuit CHS29 (WH/BU), harness side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
GO to AT18 .

No
GO to AT4 .

AT4 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR

- Disconnect: Driver Seat Backrest TED C3034 .
- Measure the resistance between driver seat backrest TED C3034 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms

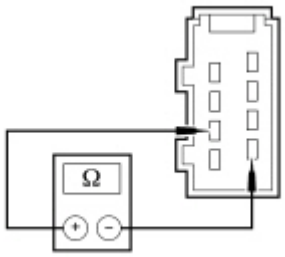
Yes
REPAIR circuit VHS35 (VT/OG) or RHS15 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339.

REPOWER the SRS .
REFER to Section 501-20B .

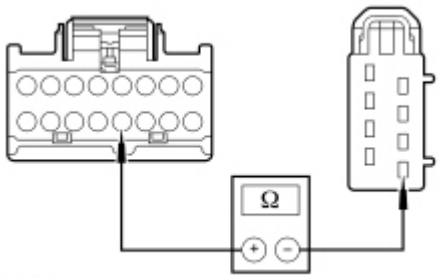
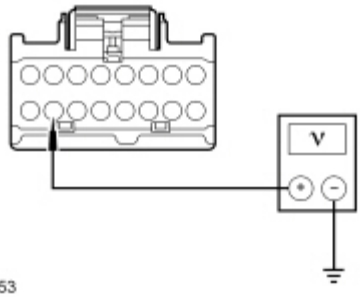
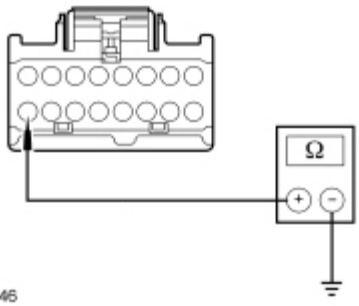
No
INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT

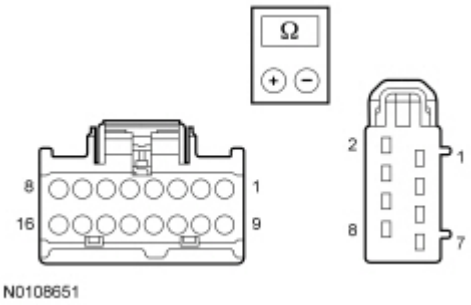
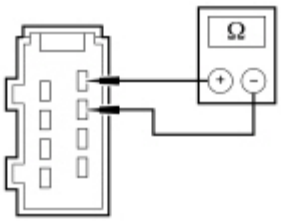
 N0053767 • **Is the resistance within the limits indicated?**	driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AT5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (BK_TEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (CSHTEMP) PIDs	
• Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM. • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM. • Monitor the DCSM PIDs BK_TEMP and CSHTEMP. • **NOTE:** A crushed seat backrest foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the driver seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**Yes** The fault is not present at this time. The fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive driver compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the BK_TEMP PID increases incrementally and is greater than 15°C (27°F) of the CSHTEMP PID, GO to AT6. If the BK_TEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the CSHTEMP PID, GO to AT16.
AT6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the driver seat backrest TED and compare it to the airflow exhausting from the passenger seat backrest TED. • Carry out a wiggle test of the wire harnesses between the DCSM and the driver seat backrest TED while monitoring blower operation of the TED. The blower should operate consistently and not change speeds. • **Is the airflow exhausting from the driver seat backrest TED comparable to the airflow exhausting from the passenger seat backrest TED with no change in operation when**	**Yes** GO to AT7. **No** If the airflow exhausting from the driver seat backrest TED is not comparable to the airflow exhausting from the passenger seat backrest TED, GO to AT8.

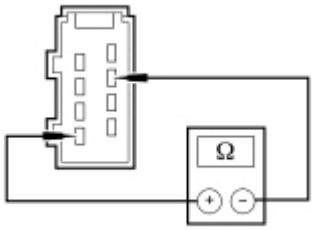
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carrying out the wiggle test?	If the driver seat backrest TED blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AT7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the driver seat backrest TED with the driver seat occupied and compare it to the airflow exhausting from the passenger seat backrest TED with the passenger seat occupied. • **Is the airflow exhausting from the driver seat backrest TED comparable to the airflow exhausting from the passenger seat backrest TED ?**	**Yes** GO to AT16 . **No** INSTALL a new driver seat backrest foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AT8 CHECK THE DRIVER SEAT BACKREST BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the driver seat backrest TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AT9 .
AT9 CHECK THE DRIVER SEAT BACKREST BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C3051 and Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265C . • Disconnect: Driver Seat Backrest TED C3034 . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265C-12, circuit CHS09 (GY), harness side and driver seat backrest TED C3034-7, circuit VHS16 (BU/GN), harness side.	**Yes** GO to AT10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .

 N0053810 • **Is the resistance less than 5 ohms?**	
AT10 CHECK THE DRIVER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between DCSM C3265C-15, circuit RHS03 (GY/OG), harness side and ground.  N0044853 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** GO to AT11.
AT11 CHECK THE DRIVER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and ground.  N0044846 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AT12. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AT12 CHECK THE DRIVER SEAT BACKREST BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ▪ DCSM C3265C-16, circuit CHS03 (GN/BN), harness side and driver seat backrest TED C3034-2, circuit CHS03 (GN/BN), harness side.	**Yes** GO to AT13. **No**

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▪ DCSM C3265C-15, circuit RHS03 (GY/OG), harness side and driver seat backrest TED C3034-4, circuit RHS03 (GY/OG), harness side.  N0108651 • **Are the resistances less than 5 ohms?**	REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AT13 CHECK THE DRIVER SEAT BACKREST BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat backrest TED C3034 pin 2 and pin 4, component side.  N0053768 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	**Yes** GO to AT14. **No** INSTALL a new driver seat backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AT14 CHECK THE DRIVER SEAT BACKREST BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat backrest TED C3034 pin 7 and pin 4, component side.	**Yes** GO to AT15. **No** INSTALL a new driver seat backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag

 N0054028 • **Is the resistance between 240K ohms and 400K ohms?**	module C339. REPOWER the SRS . REFER to Section 501-20B .
AT15 CHECK THE DRIVER SEAT BACKREST TED INSTALLATION AND FOR CRUSHED SEAT BACKREST	

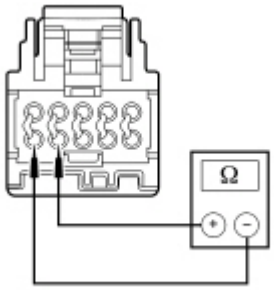
• Ignition OFF.
• Remove the driver seat. Refer to Seat — Front in this section.
• Remove the driver seat backrest cover. Refer to Seat Backrest Cover — Front in this section.
• Inspect the driver seat backrest for the following:
  ▪ Is the driver seat backrest TED correctly installed?
  ▪ Is the driver seat backrest foam pad crushed or restricted?
  ▪ Is the driver seat backrest climate controlled seat manifold crushed or restricted?
• **Is the driver seat backrest TED correctly installed and are there no signs of damage to the foam pad and manifold?**
	Yes
	INSTALL the driver seat backrest cover and seat and GO to AT18 .
	
	No
	CORRECTLY install the driver seat backrest TED or INSTALL a new driver seat backrest foam pad and/or climate controlled seat manifold. CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test.
	
	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339.
	
	REPOWER the SRS .
	REFER to Section 501-20B .

AT16 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR AND WIRING	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C3051 and Passenger Seat Side Air Bag C339 . • Disconnect: DCSM C3265B . • **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3265B-9, circuit	**Yes** GO to AT18 . **No** GO to AT17 .

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CHS14 (GN), harness side and C3265B-10 circuit CHS29 (GY), harness side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



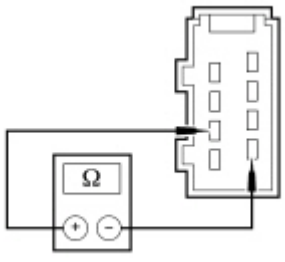
N0042976

- **Is the resistance within the limits indicated?**

AT17 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR

- Measure the resistance between driver seat backrest TED C3034 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0053767

- **Is the resistance within the limits indicated?**

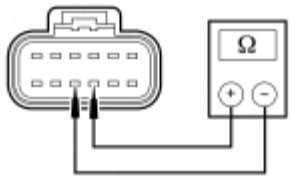
Yes
REPAIR circuit VHS35 (VT/OG) or RHS15 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339.

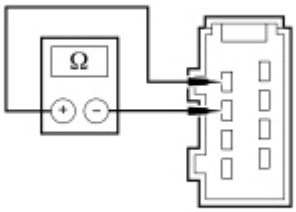
REPOWER the SRS. REFER to Section 501-20B.

No
INSTALL a new TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag

	module C339. REPOWER the SRS . REFER to Section 501-20B .
AT18 CHECK THE DRIVER SEAT BACKREST TED HEATING/COOLING CIRCUITRY CURRENT DRAW	
• Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors . • ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.** • **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted. • Place an inductive current probe around circuit CHS01 (GY/VT) near DCSM C3265A-J and monitor the current draw. • Start the vehicle and set the driver seat to HIGH heat. • **Is the current draw less than 11 amps?**	**Yes** GO to AT19 . **No** INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS . REFER to Section 501-20B .
AT19 CHECK RESISTANCE OF THE DRIVER SEAT BACKREST TED AND WIRING	
• Ignition OFF. • Disconnect: DCSM C3265A . • Measure the resistance between DCSM C3265A-J circuit CHS01 (GY/VT), harness side and C3265A-K, circuit RHS01 (WH/VT), harness side.  N0132223 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AT21 . **No** GO to AT20 .
AT20 CHECK THE RESISTANCE OF THE DRIVER SEAT BACKREST TED	
• Disconnect: Driver Seat Backrest TED C3034 . • Measure the resistance between driver seat backrest TED C3034 pin 1 and pin 3, component side.	**Yes** REPAIR circuit CHS01 (GY/VT) or RHS01 (WH/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery

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 N0053766 • **Is the resistance between 0.9 and 10 ohms?**	ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** INSTALL a new driver seat backrest TED. REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B.
AT21 CHECK FOR CORRECT DCSM OPERATION • Inspect the DCSM and driver seat backrest TED harness and component side connectors and the body harness-to-seat harness connectors for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect: All DCSM, TED and Body Harness-to-Seat Harness Connectors . • Make sure the connectors are seated correctly. • Start the engine. • Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM. • Attempt to recreate the fault. With the engine still running set the driver seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	**Yes** INSTALL a new DCSM. REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C339. REPOWER the SRS. REFER to Section 501-20B. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag

	module C339. REPOWER the SRS . REFER to Section 501-20B .

Component Test

Component Test — Thermo-Electric Device (TED) Cooling Performance

NOTE: This test is intended to check the cooling mode performance of an operational climate controlled seat backrest or cushion Thermo-Electric Device (TED) and verify it is cooling inlet air at the TED (ambient cabin air) between 6-8°C (10-14°F).

NOTE: Make sure the vehicle is out of direct sunlight and is in an area with a stable air temperature when testing the climate controlled seat system.

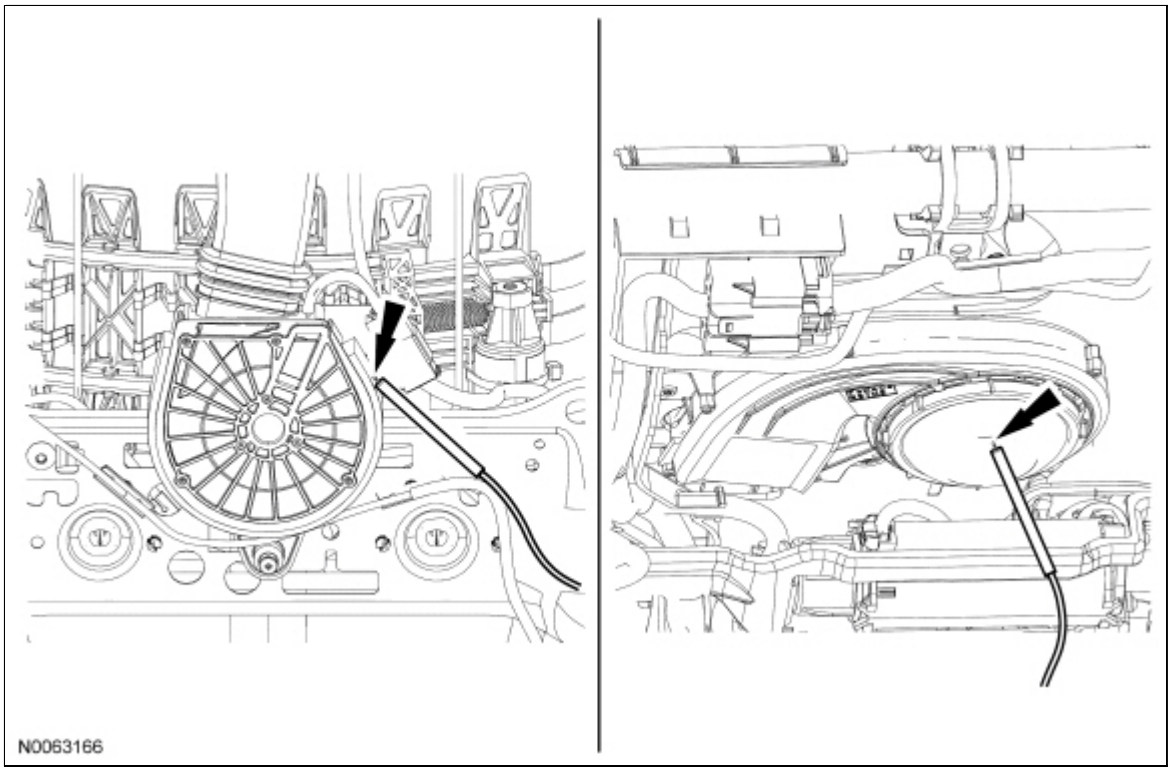
NOTE: For correct temperature measurements, the seat being tested should be occupied.

1. Enter DataLogger and monitor the following Dual Climate Controlled Seat Module (DCSM) PIDs:
   - Seat cushion TED temperature (CSHTEMP)
   - Seat back TED temperature (BK_TEMP)
   - Passenger cushion TED temperature (PCSHTMP)
   - Passenger back TED temperature (PBKTMP)
   - Driver state seat mode (DCCSMOD)
   - Passenger state seat mode (PCCSMOD)

2. Any initial PID value of greater than 205°C (401°F) or less than 2°C (36°F) indicates a system hardware failure. Do not proceed with this test. GO to Symptom Chart or Dual Climate Controlled Seat Module (DCSM) DTC Chart for diagnosis.

3. Gain access to the seat cushion and backrest TEDs and use a suitable thermo-couple temperature measuring device to monitor the air inlet temperature.
   - Release the J-clip at the backrest bottom and unzip the 2 zippers at the backrest side edges.
   - Place the temperature probe near each TEDs air filter.

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4. **NOTE:** The engine must be running to operate the climate controlled seat system and carry out this test.

   Operate system in high cool mode and measure the temperature at the cushion TED filter using the thermo-couple device.
   - Obtain and record the air inlet temperature at the TED .
     - Secure the temperature probe at the cushion TED air filter before measuring.

5. Use a scan tool to measure the cushion TED PID temperature and record the value.
   - Monitor the MODE PID and verify the system is operating. If during testing, the PID value changes to Blower Only state, the system has entered into recovery mode and voltage to the TEDs is disabled. If this occurs, the seat has failed the test. Do not continue. Return to the diagnostic routine.

6. Subtract the cushion TED PID temperature from the cushion air inlet temperature and record the temperature difference value.

7. Continue to operate the system in high cool mode and use the thermo-couple device to measure the temperature at the backrest TED filter.
   - Obtain and record the air inlet temperature at the TED .
     - Secure the temperature probe at the backrest TED air filter and close the backrest cover before measuring.

8. Use a scan tool to measure the backrest TED PID temperature and record the value.
   - Monitor the MODE PID and verify the system is operating. If during testing, the PID value changes to Blower Only state, the system has entered into recovery mode and voltage to the TEDs is disabled. If this occurs, the seat has failed the test. Do not continue. Return to the diagnostic routine.

9. Subtract the backrest TED PID temperature from the backrest air inlet temperature and record the

value.

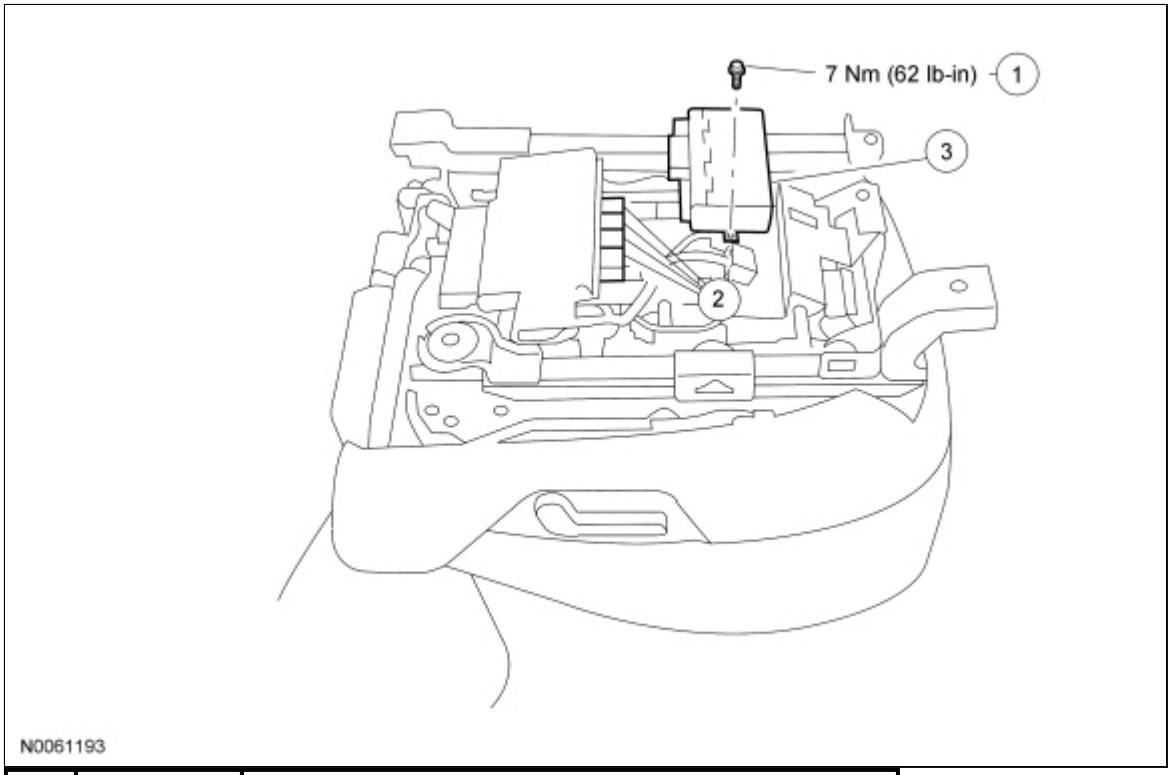
10. Compare the cushion and backrest calculated temperature values. The temperature difference should be between 6 and 8 degrees.

11. If the calculated temperature values are not within these specifications, check the climate controlled seat components for air duct or filter restrictions, blockages, duct or electrical disconnections and for incorrect assembly. Repair as needed. If OK, carry out the DCSM self-test and if any DTC is retrieved, go to Dual Climate Controlled Seat Module (DCSM) DTC Chart for diagnostic direction. Return to the diagnostic routine.

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Driver Seat Module (DSM)



Item	Part Number	Description
1	—	Driver Seat Module (DSM) screws (2 required) (part of 14C708)
2	—	DSM electrical connectors (part of 14C719)
3	14C708	DSM

Removal and Installation

1. **NOTE:** This step is only necessary when installing a new component.

   NOTE: The PMI process must begin with the current DSM installed. If the current DSM does not respond to the diagnostic scan tool, the tool may prompt for As-Build Data as part of the repair.

   Using a diagnostic scan tool, begin the PMI process for the DSM following the onscreen instructions.

2. **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Ignition must remain OFF until repair is complete. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.**

   Turn key off, wait one minute.

3. Move the seat back and up to access the DSM .



4. Remove the 2 screws.
   - To install, tighten to 7 Nm (62 lb-in).
5. Disconnect the electrical connectors and remove the DSM .
6. To install, reverse the removal procedure.
7. **NOTE:** This step is only necessary when installing a new component.

   Using a diagnostic scan tool, complete the PMI process for the DSM following the on-screen instructions.
8. **NOTE:** This step is only necessary when installing a new component.

   Operate the driver seat, column and pedals through the full range of travel to register stop positions.

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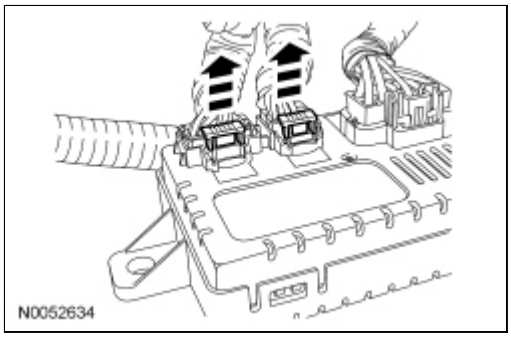
Dual Climate Controlled Seat Module (DCSM)

Removal and Installation

1. When installing a new Dual Climate Controlled Seat Module (DCSM), carry out the appropriate steps in the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

2. Remove the front passenger seat. For additional information, refer to Seat — Front in this section.

3. Disconnect the 3 DCSM electrical connectors.
   - Release the 2 locking wedges.
   - Disconnect the 3 connectors.



4. Remove the 2 screws and DCSM .

5. To install, reverse the removal procedure.

6. If a new DCSM has been installed, carry out the appropriate steps to complete the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

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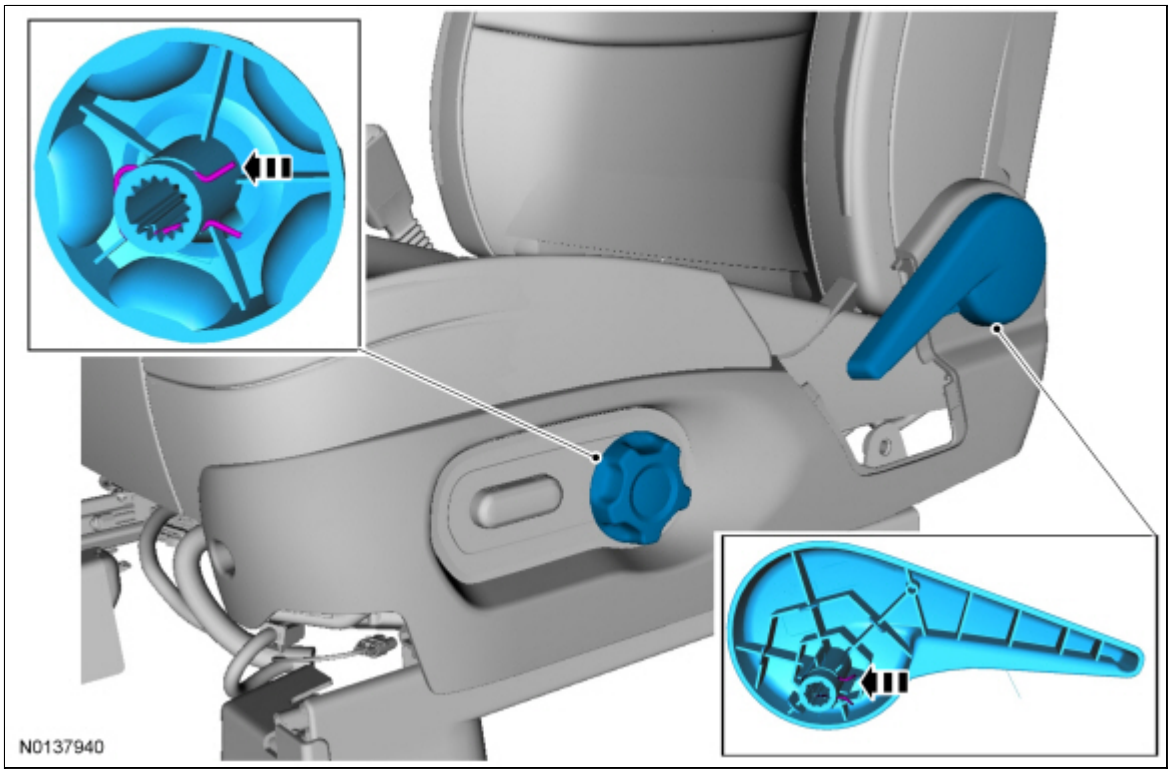
Front Seat Motor Cable

Removal

WARNING: Wear protective gloves when handling components or parts that have pointed or sharp edges. Failure to follow this instruction may result in serious personal injury.

NOTE: Typical driver seat shown, others similar.

1. Remove the seat. Refer to Seat — Front .
2. If equipped.



3. If equipped.

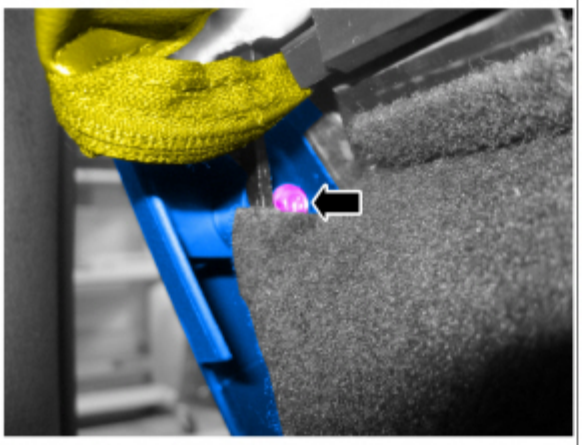
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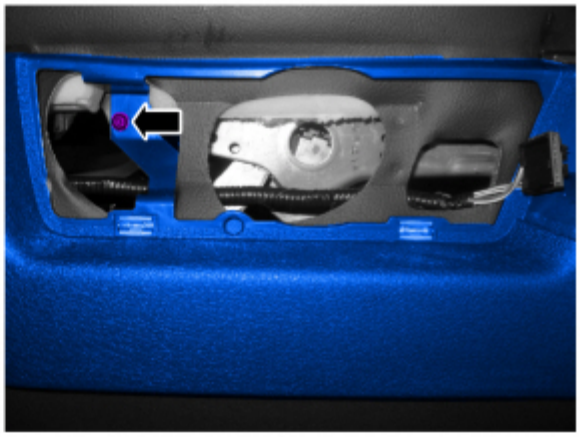




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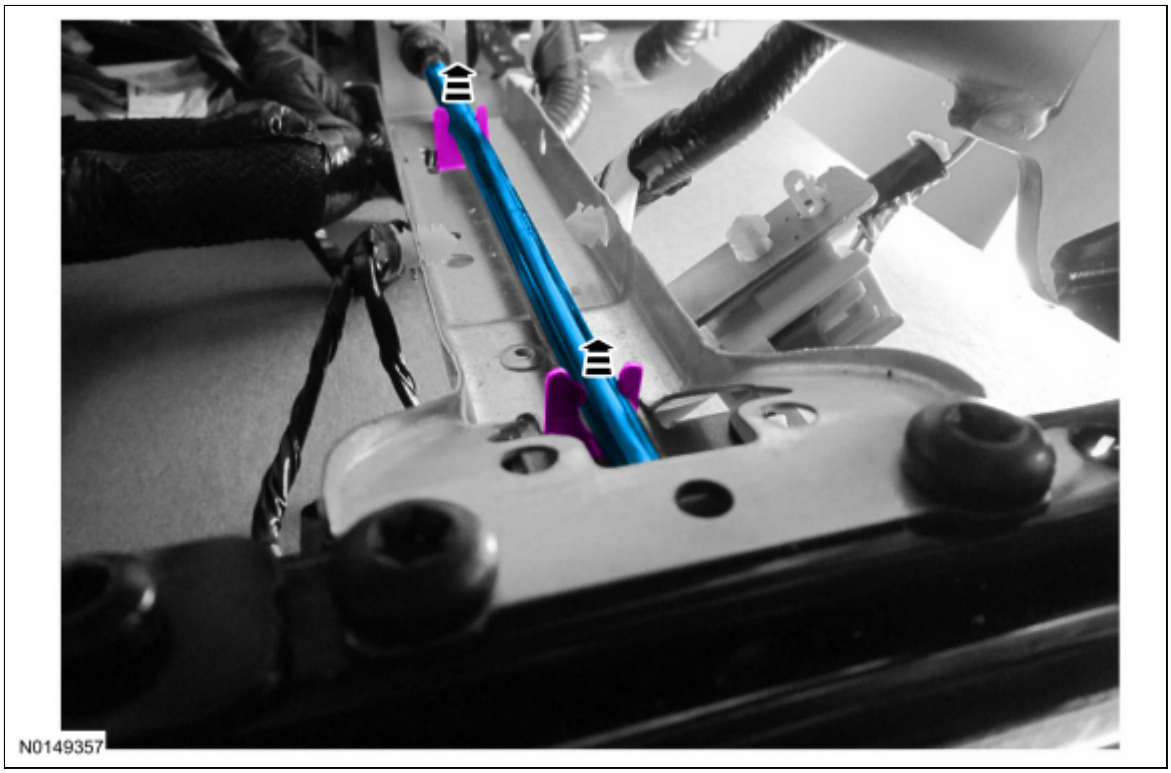
4. Remove the screws and side shield.





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5.



Installation

NOTE: The front seat motor cable service part for the driver seat is different than the service part for passenger seat. Make sure to install the correct service part required for the seat.

1.

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2. **NOTE:** The cable felt covering should not be visible when the cable is correctly engaged to the horizontal motor square drive.

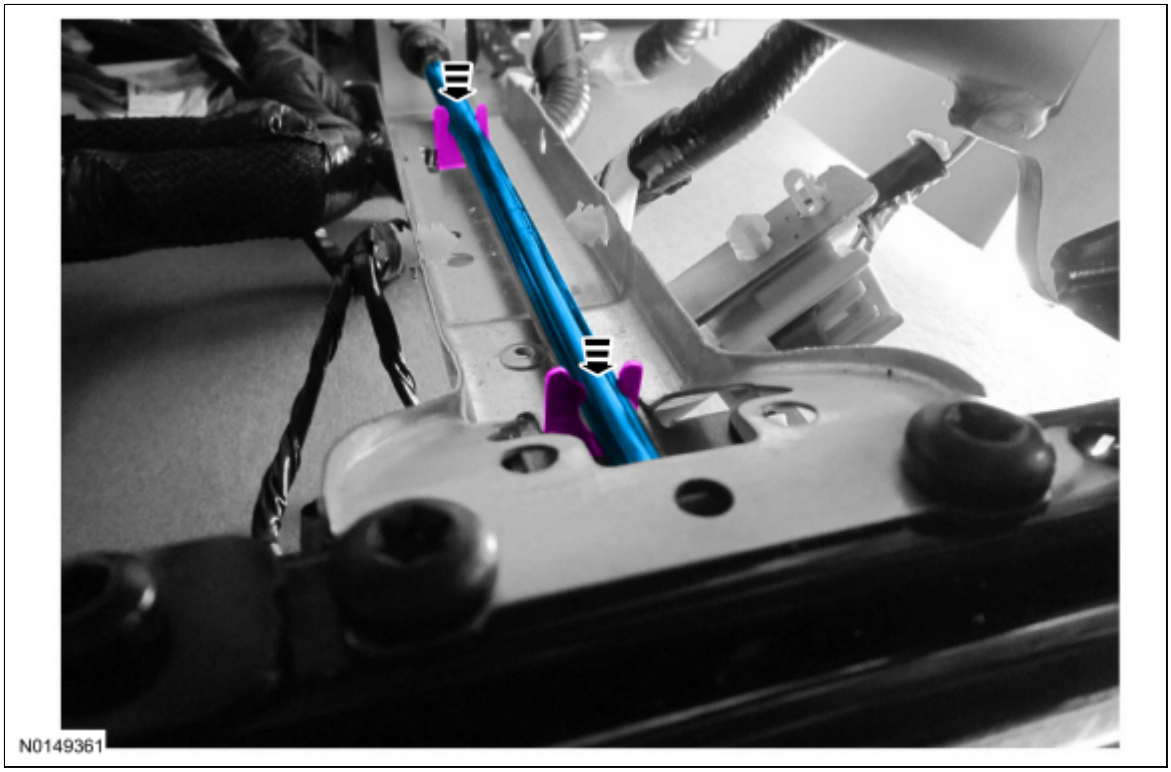
    - Push the cable into the horizontal motor square drive twisting back and forth to engage the cable.



3.

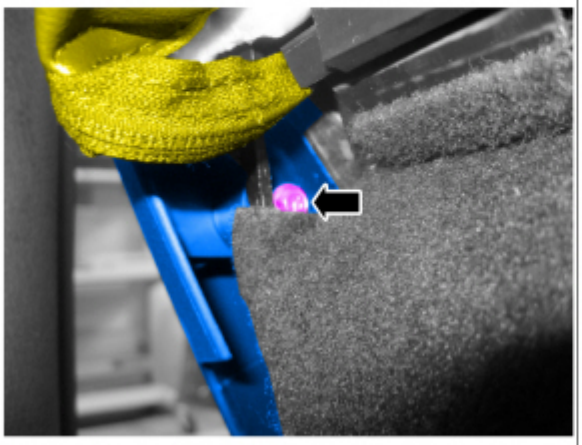


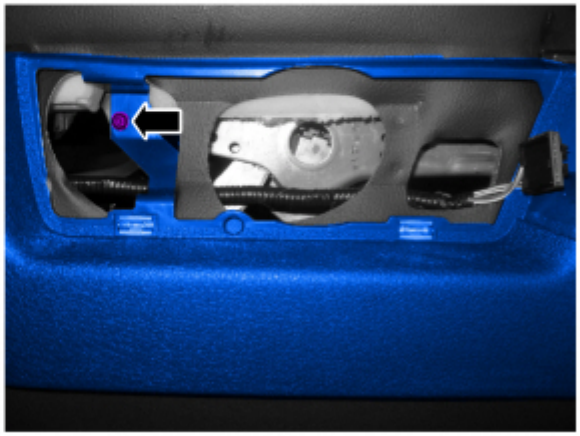
4.



5. Install the side shield and screws.

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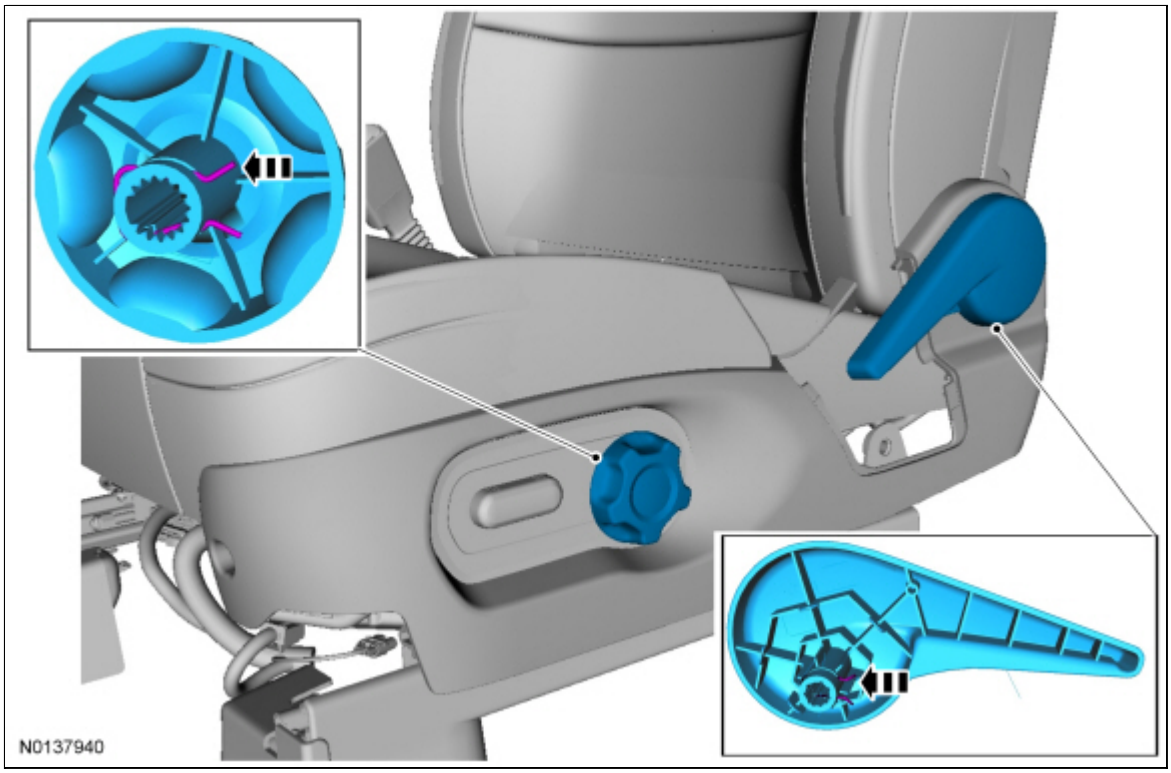
6. If equipped.





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7. If equipped.



8. Install the front seat. Refer to Seat — Front .

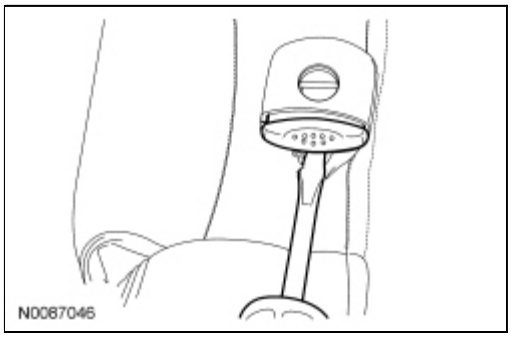
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Head Restraint Guide Sleeve

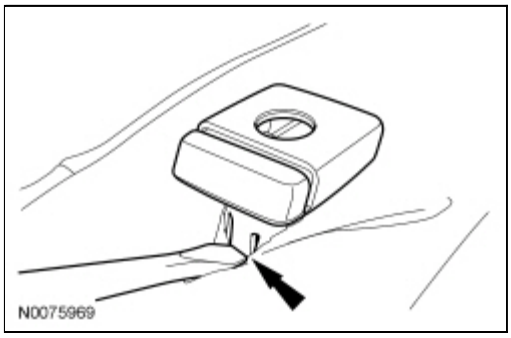
Removal

NOTE: Typical head restraint guide sleeve shown, others similar.

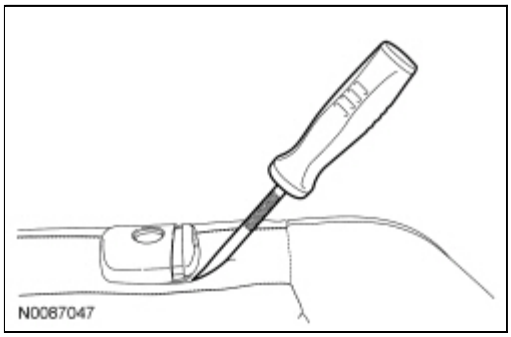
1. Push in on the 2 head restraint guide sleeve release buttons and remove the head restraint.
2. Obtain a flat-head screwdriver with a width of 4 mm (0.157 in) to 7 mm (0.275 in) and a thickness of approximately 1 mm (0.039 in).
3. Align the screwdriver to the middle of the head restraint guide sleeve release button.



4. Position the screwdriver between the head restraint guide sleeve neck, backrest cover and foam pad.

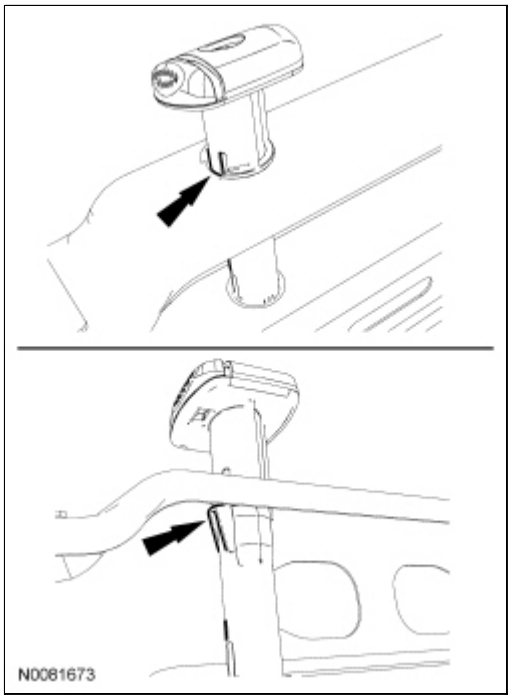


5. Position the screwdriver at a 45-degree angle.

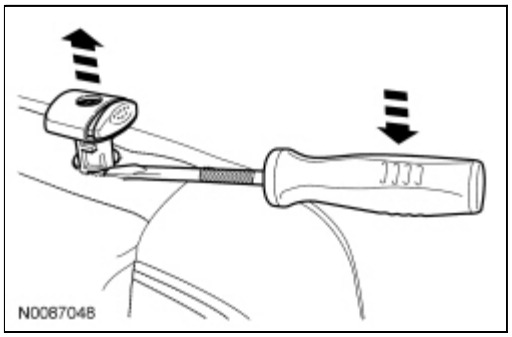


6. **NOTE:** For retainer clarity, backrest cover and foam pad are omitted.

   Push in the screwdriver, bending the lock feature on the head restraint guide sleeve in.



7. While bending the lock feature in, push down on the screwdriver handle, prying the head restraint guide sleeve up and disengaging it from the backrest frame crossmember.



8. Remove the head restraint guide sleeve.
   - Discard the head restraint guide sleeve.

9. Repeat these steps for the head restraint guide sleeve on the opposite side.

Installation

NOTICE: **Always install new head restraint guide sleeves. Difficult adjustment of the head restraint may occur. Failure to follow these instructions may result in component failure.**

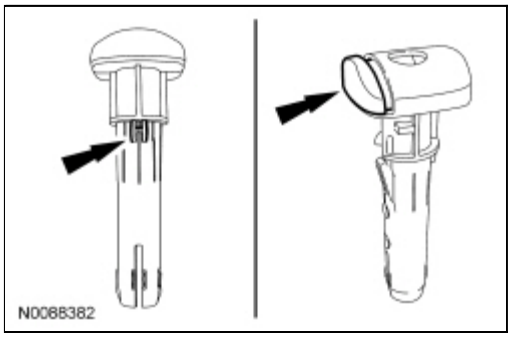
NOTICE: **The head restraint guide sleeves are not interchangeable. Failure to install the correct head restraint guide sleeve at the correct position may result in component failure.**

1. Make sure the holes in the backrest foam pad and backrest cover are aligned to the holes in the

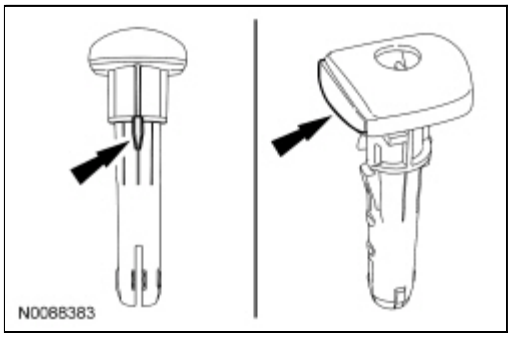
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backrest frame.

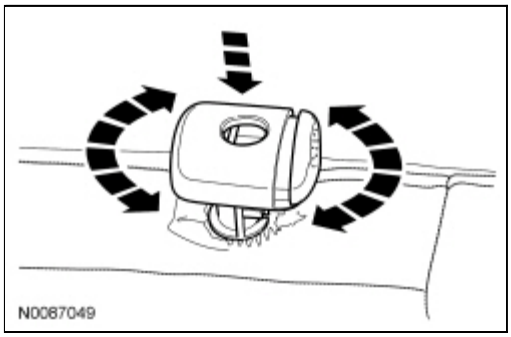
2. Install the head restraint guide sleeve with the large button and wide key to the LH side.



3. Install the head restraint guide sleeve with the small button and thin key to the RH side.



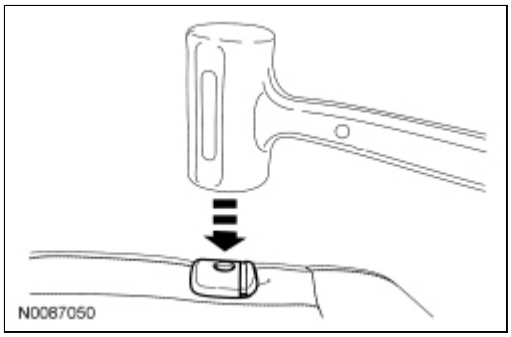
4. To allow the head restraint guide sleeve to slide freely through the backrest foam pad and backrest cover, twist the head restraint guide sleeve while pushing it into the backrest frame hole as far as it will go with hand pressure.



5. ***NOTICE:*** **Do not attempt to seat the head restraint guide sleeve by hand. This may result in excessive head restraint adjustment efforts and permanent damage to the head restraint guide sleeve.**

   NOTICE: **Striking effort should not result in any type of damage or distortion to the head restraint guide sleeve. If a head restraint guide sleeve is damaged, install a new one.**

   Using a non-marring mallet, strike the top of the head restraint guide sleeve with moderate force, seating it in the backrest frame.
   - Striking effort must be high enough to snap the head restraint guide sleeve retainer in place in the backrest frame.



6. Inspect the head restraint guide sleeve.
    - Pull the head restraint guide sleeve out by hand, making sure it is locked in place. If the head restraint guide sleeve can be removed by hand, repeat the installation procedure. If the head restraint guide sleeve can be removed again after installing a second time, install a new head restraint guide sleeve.

7. Repeat these steps for the head restraint guide sleeve on the opposite side.

8. After installation of 2 new head restraint guide sleeves, install the head restraint in the following sequence.
    1. Position the head restraint rods to the head restraint guide sleeve holes.
    2. Push the head restraint down, guiding the rods into the head restraint guide sleeve holes.
    3. Make sure the head restraint adjusts without excessive effort and locks in place.

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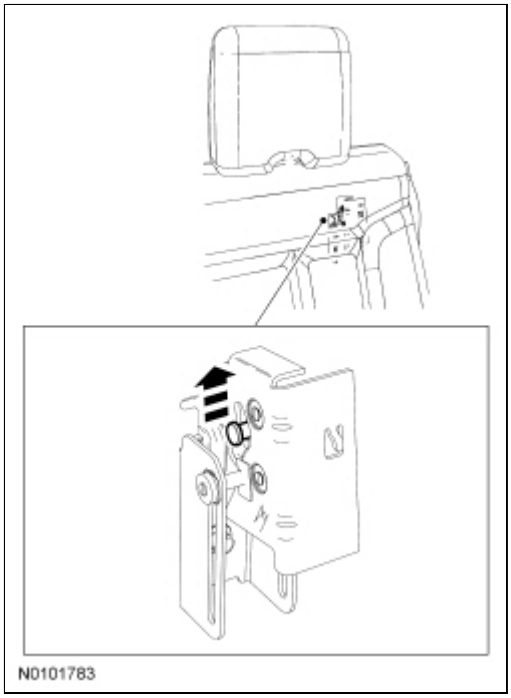
Heated Seat Module — Rear

Removal

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. **NOTE:** The seat backrest latch is only accessible when the seat cushion is raised.

   Release and lower the 60 percent seat backrest.
   - From behind the backrest, pull up on the latch release and pull the backrest forward.
   - Release the cushion latch and lower the cushion and backrest.



2. Disconnect the 2 electrical connectors.

3. Remove the screw and un-hook the heated seat module.

Installation

1. Install the heated seat module and screw.
   - Tighten to 14 Nm (124 lb-in).

2. Connect the 2 electrical connectors.

3. Raise and latch the backrest.
   - Slide the striker pin up/down and align to the backrest latch.
   - Make sure the backrest is fully latched.

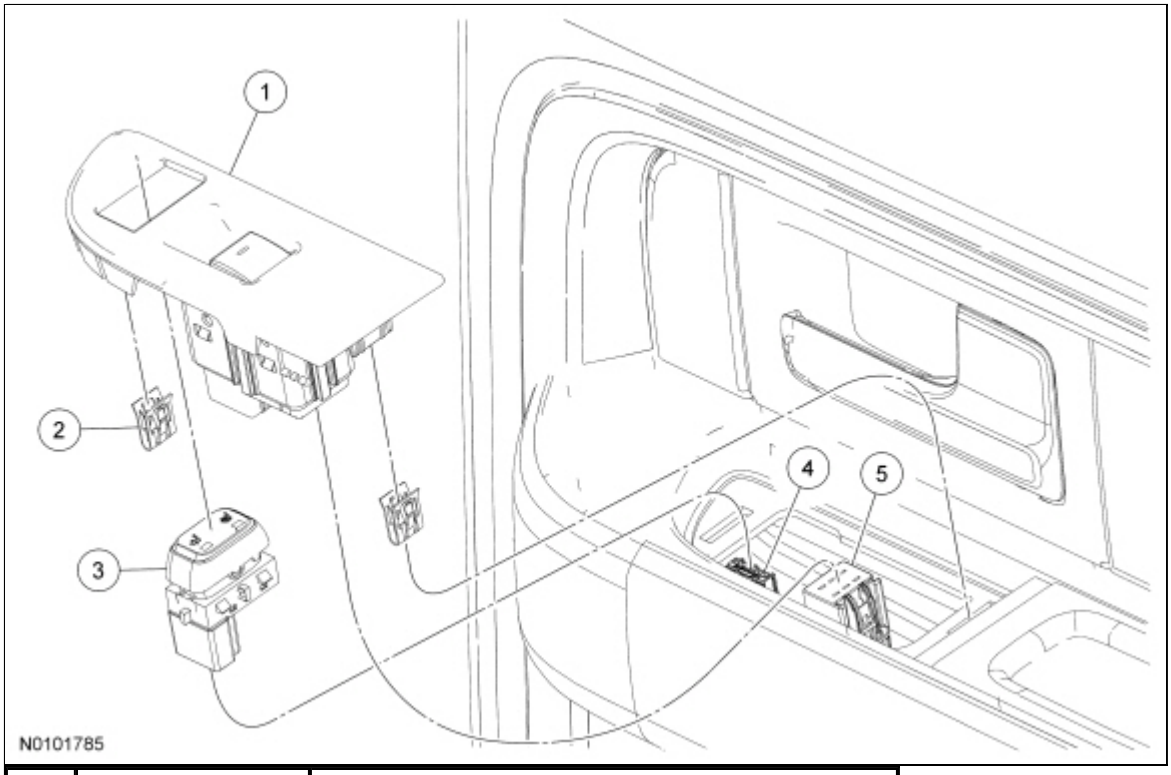
4. Carry out the auto-configuration sequence to program the heated seat module for use with a dual momentary switch.
    - Start the vehicle and push the low button on either heated seat switch.
    - Operate the heated seats, monitor the indicators and verify the system is operating correctly in high and low.

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Heated Seat Switch — Rear

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	14528 RH/ 14527 LH	Window control switch bezel
2	W705289	Retainer (2 required)
3	14D694 RH/ 14D695 LH	Heated seat switch
4	—	Heated seat switch electrical connector (part of 14630 RH/ 14631 LH)
5	—	Window control switch electrical connector (part of 14630 RH/ 14631 LH)

Removal and Installation

1. Using a suitable trim tool, release the 2 retainers and window control switch bezel.
2. Disconnect the heated seat switch and window control switch electrical connectors.
3. Release the locking tabs and remove the heated seat switch.
4. To install, reverse the removal procedure.

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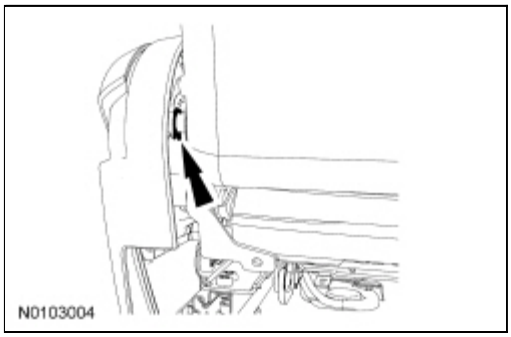
Lumbar Assembly — Manual

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat. For additional information, refer to Seat — Front in this section.

2. For SuperCab, remove the manual recline handle, if equipped.
   - Insert an appropriate tool behind the cushion side shield, release the retainer and remove the handle.



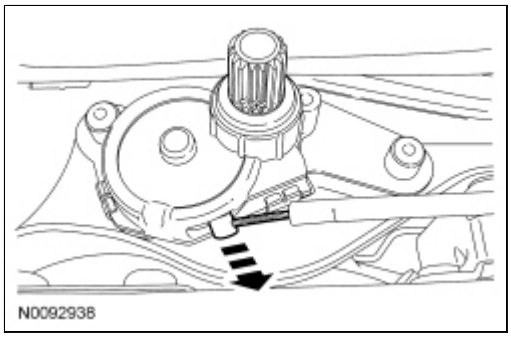
3. If equipped, remove the adjustable lumbar knob.
   - Adjust the lumbar until fully relaxed.
   - Release the retainer and remove the knob.

4. Remove the side shield insert.
   - Release the lower retainers and lift to release the upper retainers.
   - If equipped, disconnect the seat control switch electrical connector.

5. Remove the side shield.
   - Remove the front and rear side shield screws.
   - Pull the cushion side shield outward to release the retainers.
   - Reinstall all retainers back to the side shield.

6. Release the cushion cover outboard J-clip and access the lumbar adjuster.

7. Detach the cable from the lumbar adjuster, release the pin-type retainer and route out the cable from the cushion frame.
   - Note cable routing for correct installation.



8. Remove and discard the 2 rivets from the lumbar adjuster.

9. Release the backrest cover J-clip and unzip the 2 zippers.

10. Remove the lumbar assembly.
    - Detach the cable from the backrest frame.
        - Note cable routing for correct installation.
    - Pinch the lumbar retainers together to release from the backrest frame.
    - For installation, make sure the arrow is pointed up.

11. To install, reverse the removal procedure.

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Lumbar Assembly — Power

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Release the backrest cover J-clip and unzip the 2 zippers.

2. If equipped, remove the backrest Thermo-Electric Device (TED). For additional information, refer to Seat Backrest Thermo-Electric Device in this section.

3. Disconnect the lumbar motor electrical connector.

4. Remove the lumbar assembly.
   - Pinch the lumbar retainers together to release from the backrest frame.
   - For installation, make sure the arrow is pointed up.

5. To install, reverse the removal procedure.

Memory Set Switch

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the side shield insert.
   - Release the lower retainers and lift to release the upper retainers.
   - Disconnect the seat control switch electrical connector.
   - Disconnect the memory SET switch electrical connector.

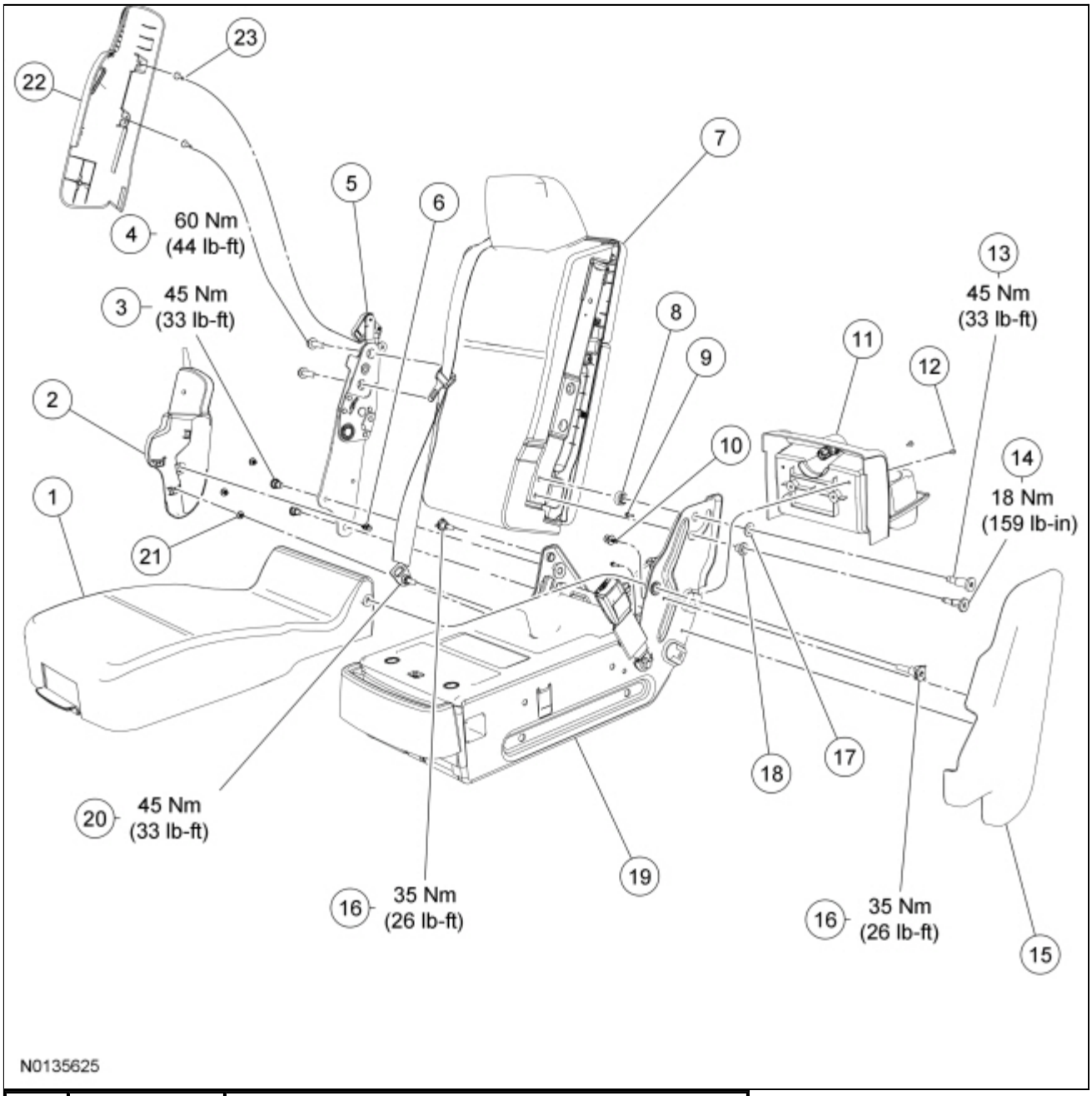
2. Release the retaining tabs and remove the switch.

3. To install, reverse the removal procedure.

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Seat — Exploded View, Front, Center

Seat Retainers and Trim

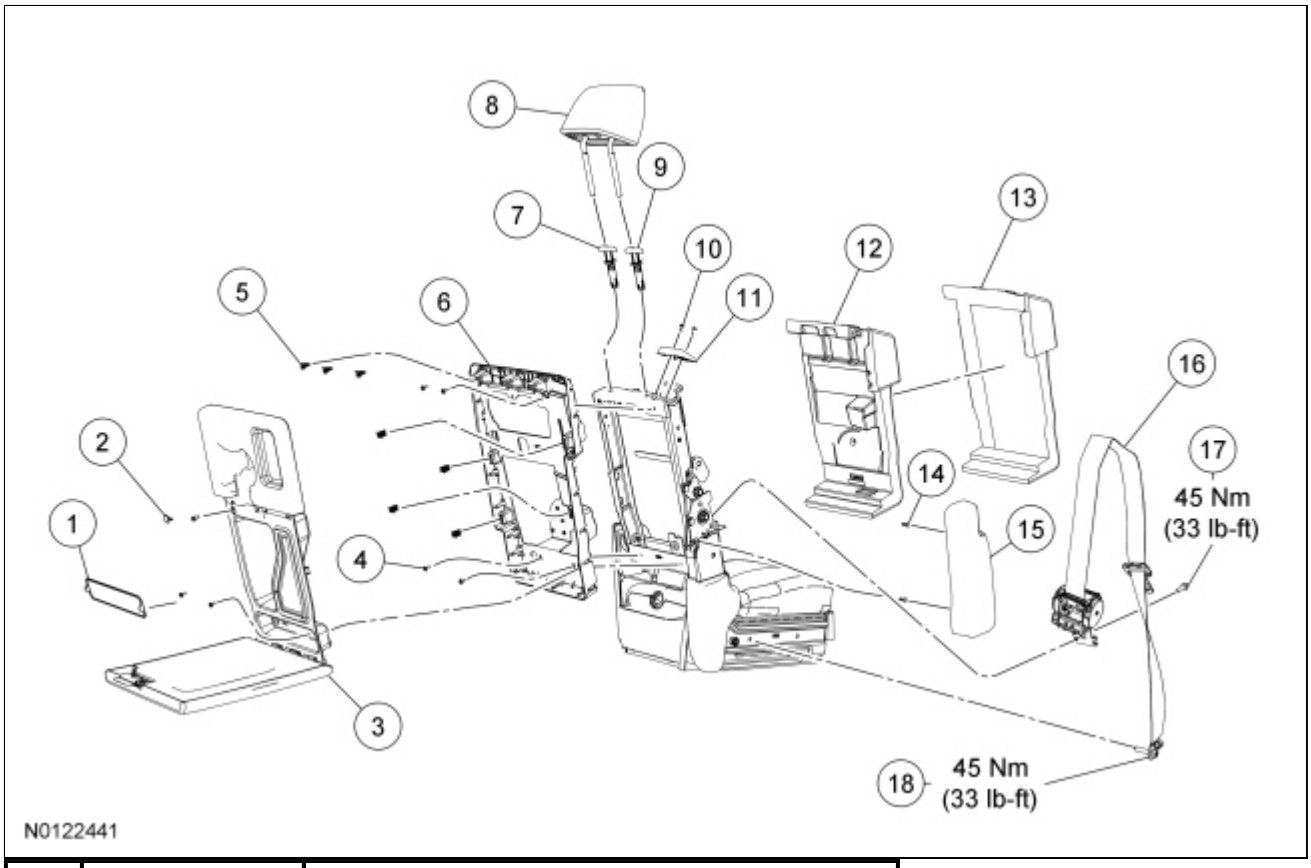


Item	Part Number	Description
1	632A22	Cushion assembly

2	672A32	RH side shield
3	W714792	Backrest latch lower bolt (2 required)
4	W715031	Backrest latch upper bolt (2 required)
5	645A04	Backrest latch
6	N803678	Pin-type retainer
7	65478	Backrest assembly
8	654A76	Backrest pivot spacer
9	W303547	LH side shield screw (2 required)
10	—	Side shield retainer (part of 672A29)
11	13562	Rear cupholder
12	600A58	Rear cupholder screw (2 required)
13	W707769	Backrest pivot bolt
14	W303546	Backrest stop bolt
15	672A29	LH side shield
16	W714277	Cushion pivot bolt (2 required)
17	654A76	Backrest pivot spacer
18	—	Backrest pivot guide
19	61708	Seat base frame
20	—	Safety belt anchor bolt (part of 611B64)
21	—	Side shield retainer (part of 672A32) (3 required)
22	672A33	Backrest latch cover
23	—	Pin-type retainer (part of 672A33) (2 required)

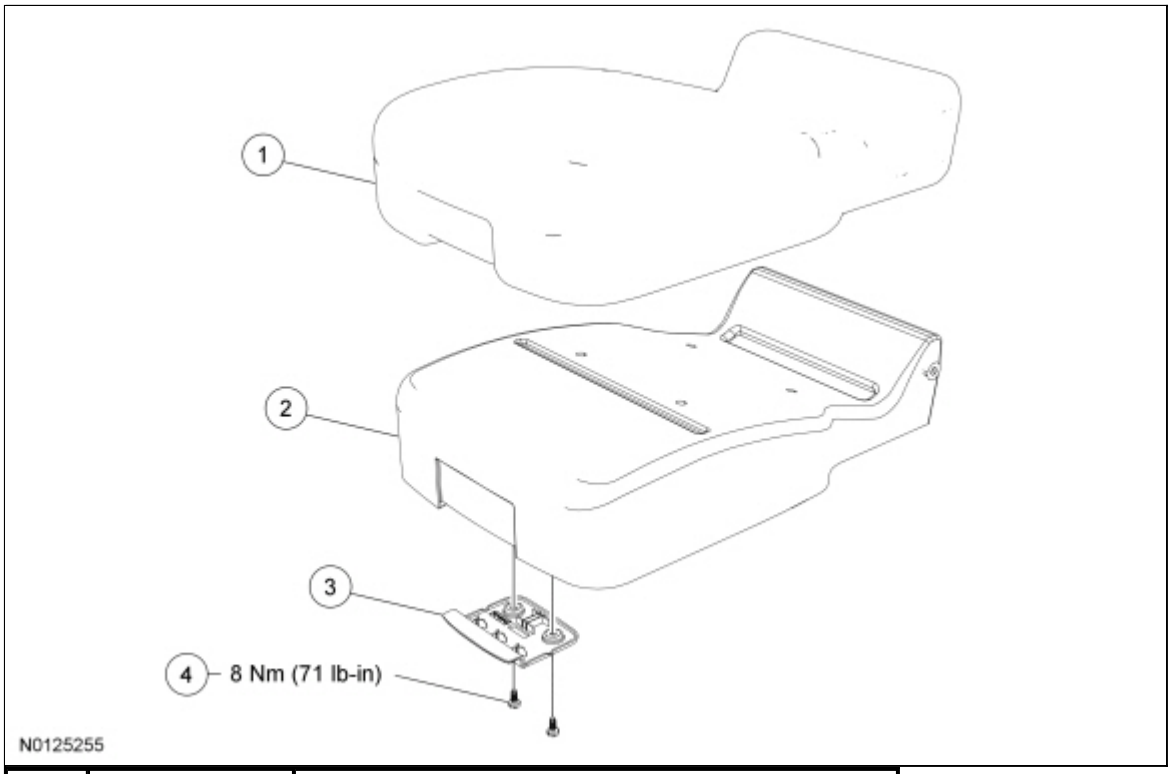
Seat Backrest

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Item	Part Number	Description
1	045G34	Trim cover
2	W506841	Screw
3	644A22	Armrest/storage bin
4	W303547	Screw (4 required)
5	W711045	Clip (7 required)
6	624A14	Armrest/storage bin bracket
7	610A18	Head restraint guide sleeve (master)
8	611A08/610A62	Head restraint/head restraint cover
9	610A18	Head restraint guide sleeve (slave)
10	W303547	Screw (2 required)
11	601B30	Safety belt bezel
12	64810	Backrest foam pad
13	64416	Backrest cover
14	W707211	Pin-type retainer (part of 672A33) (2 required)
15	672A28	Backrest latch cover
16	611B64	Safety belt retractor
17	W505275	Safety belt retractor bolt
18	—	Safety belt anchor bolt (part of 611B64)

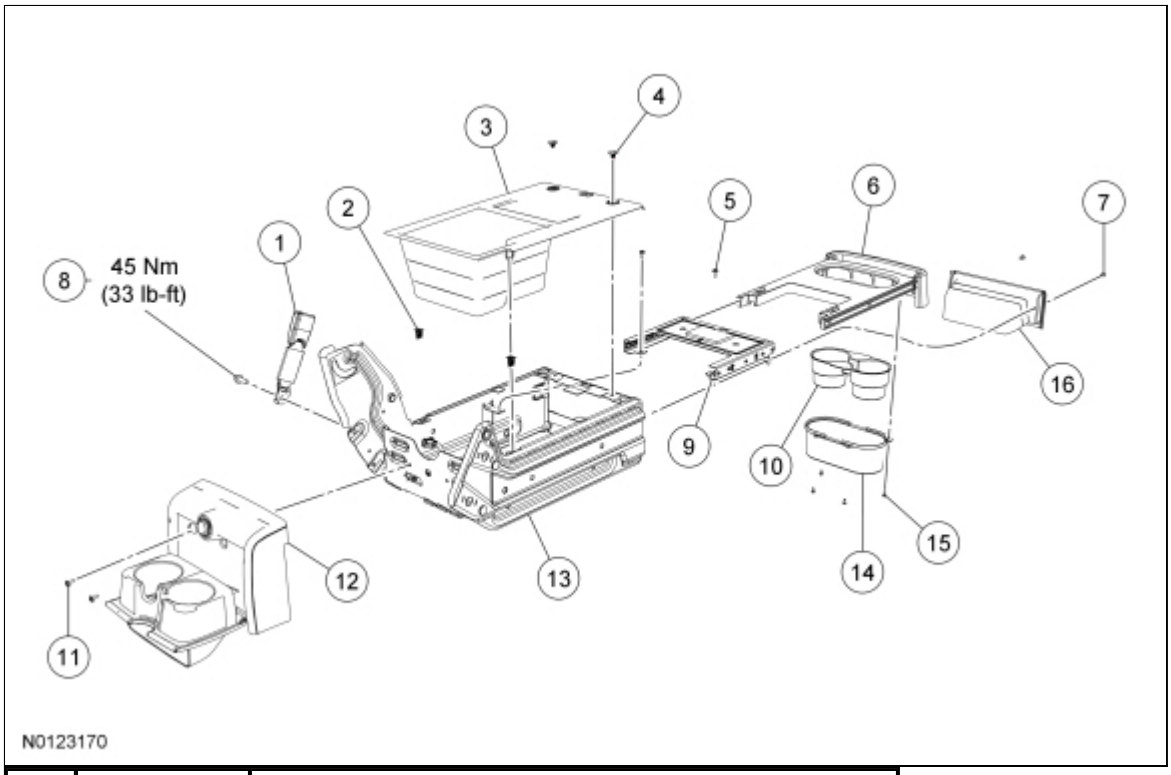
Seat Cushion



Item	Part Number	Description
1	62900	Cushion cover
2	632A22	Cushion
3	454A48	Cushion release handle
4	W714751	Cushion release handle screw (2 required)

Seat Base

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Item	Part Number	Description
1	611B70	Safety belt buckle
2	W711045	Retainer clips (2 required)
3	115A00	Storage tray
4	N803678	Pin-type retainers (2 required)
5	600A58	Front cupholder screw (2 required)
6	13562	Front cupholder
7	600A58	Front storage tray screw (2 required)
8	—	Safety belt buckle bolt (part of 611B70)
9	—	Front cupholder carriage (part of 13562)
10	—	Cup insert (part of 13562)
11	600A58	Rear cupholder screw (2 required)
12	13562	Rear cupholder
13	61708	Seat base frame
14	—	Lower cupholder tray (part of 13562)
15	—	Lower cupholder tray screw (part of 13562) (4 required)
16	115A00	Front storage tray

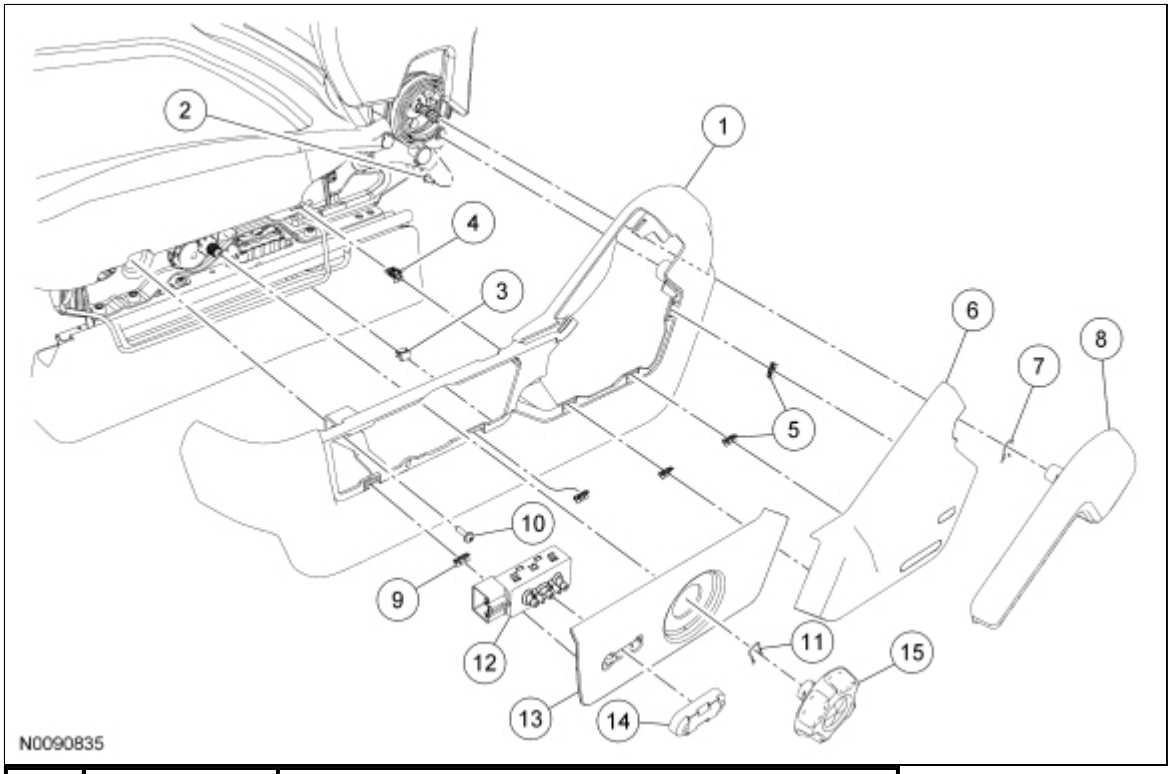
1. For additional information, refer to the procedures in this section.

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Seat — Exploded View, Front

Seat Side Shield — Power Seat Track With Manual Recline and Manual Lumbar, Regular Cab and Crew Cab

NOTE: LH shown, RH similar.

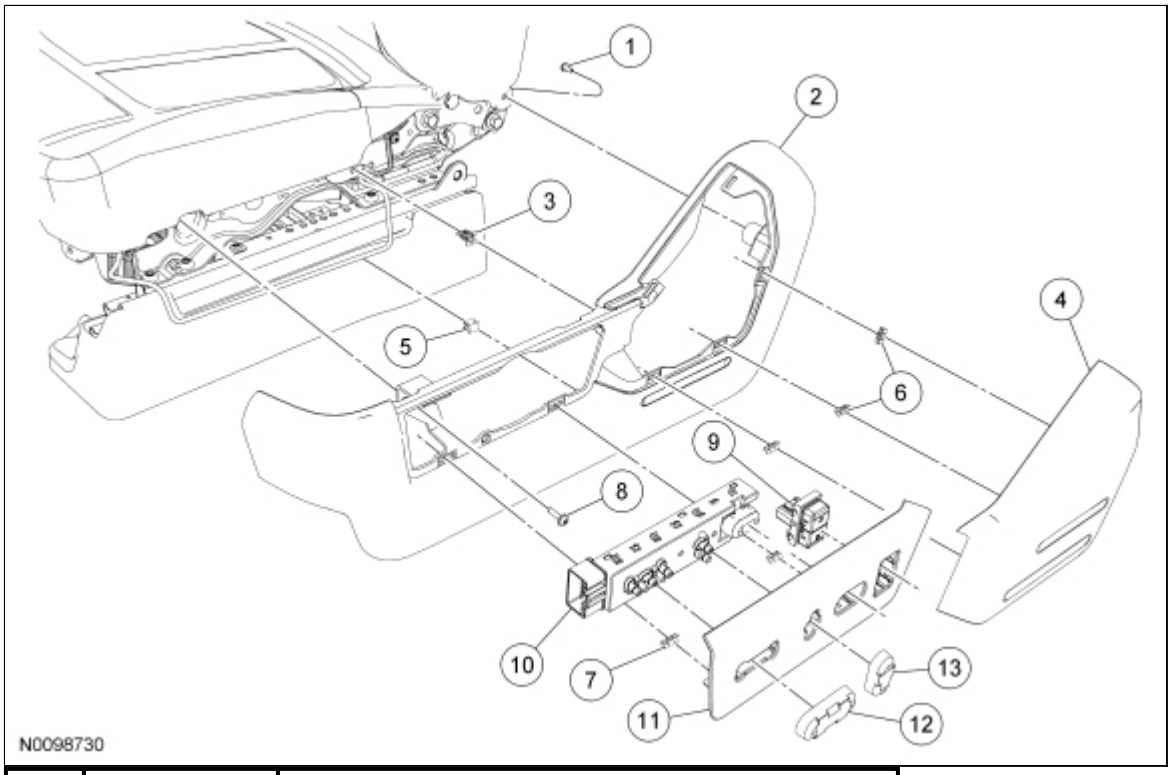


Item	Part Number	Description
1	62187	Side shield
2	—	Side shield screw, rear
3	W713010	Side shield retainer, Z-clip
4	W711045	Side shield retainer
5	W712973	Safety belt anchor cover retainers (3 required)
6	61693	Safety belt anchor cover
7	W790123	Recliner handle retainer
8	62622	Recliner handle
9	W712973	Side shield insert retainer (2 required)
10	—	Side shield screw, front
11	W790123	Adjustable lumbar knob retainer

12	14A701	Seat control switch
13	14A706	Side shield insert
14	14711	Seat control switch knob
15	61199	Adjustable lumbar knob

Seat Side Shield — Power Seat Track With Memory, Power Recline and Power Lumbar, Regular Cab and Crew Cab

NOTE: LH shown, RH similar.



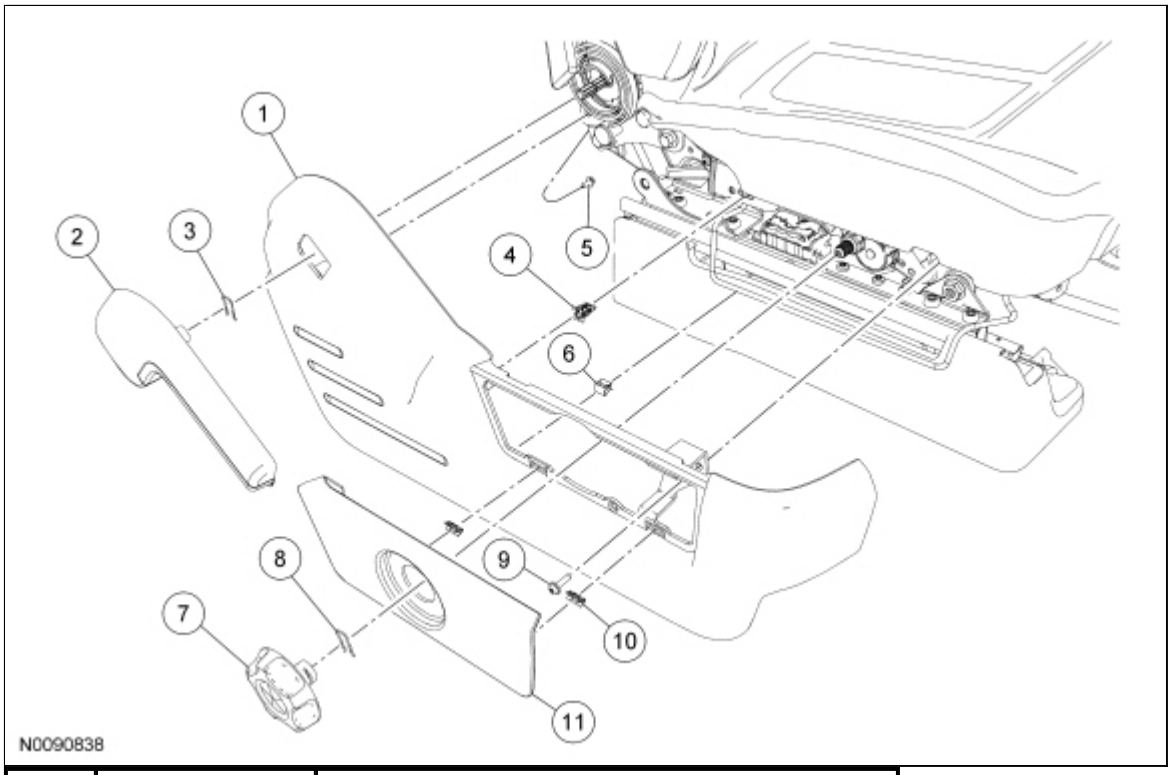
Item	Part Number	Description
1	—	Side shield screw, rear
2	62187	Side shield
3	W711045	Side shield retainer
4	61693	Safety belt anchor cover
5	W713010	Side shield retainer, Z-clip
6	W712973	Safety belt anchor cover retainers (3 required)
7	W712973	Side shield insert retainer (2 required)
8	—	Side shield screw, front
9	14776	Memory SET switch
10	14A701	Seat control switch

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11	14A706	Side shield insert
12	14711	Seat control switch knob
13	—	Recliner switch knob

Seat Side Shield — Manual Seat Track With Manual Lumbar, SuperCab

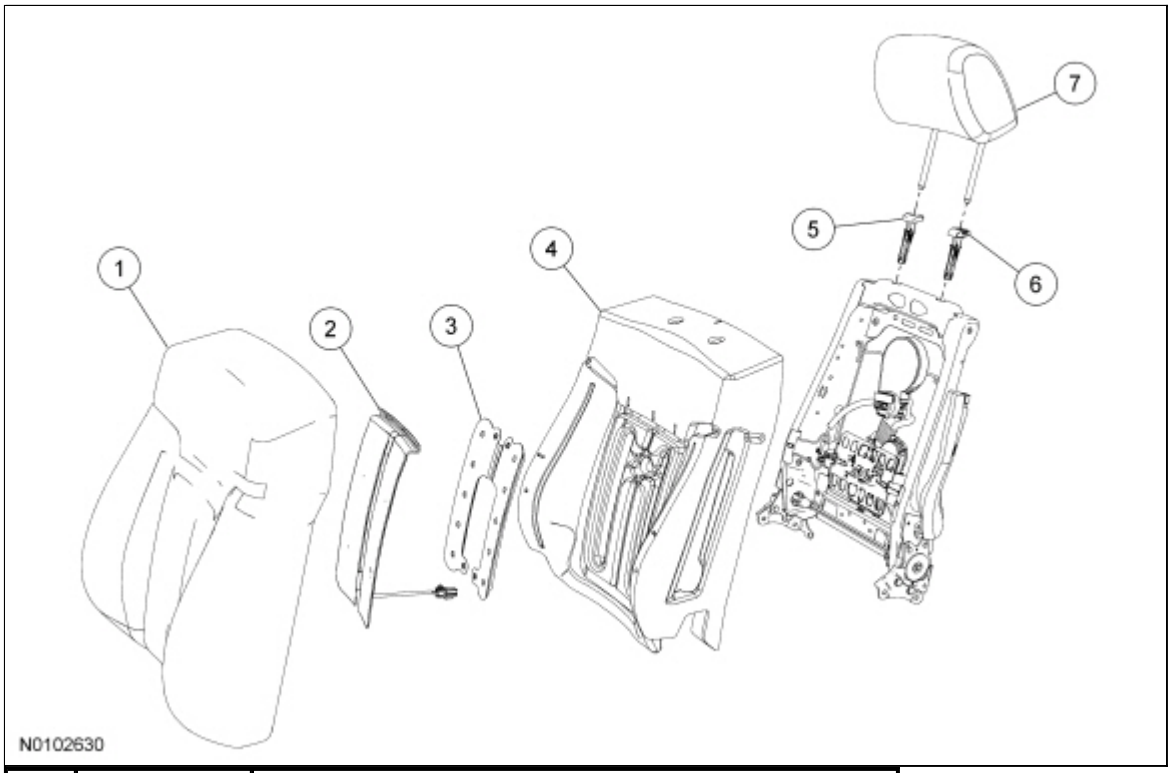
NOTE: RH shown, LH similar.



Item	Part Number	Description
1	62186	Side shield
2	62622	Recliner handle
3	—	Recliner handle retainer
4	W711045	Side shield retainer
5	—	Side shield screw, rear
6	W713010	Side shield retainer, Z-clip
7	61199	Adjustable lumbar knob
8	—	Adjustable lumbar knob retainer
9	—	Side shield screw, front
10	W712973	Side shield insert retainer (2 required)
11	14A076	Side shield insert

Seat Backrest — Trim Parts

NOTE: LH shown, RH similar.

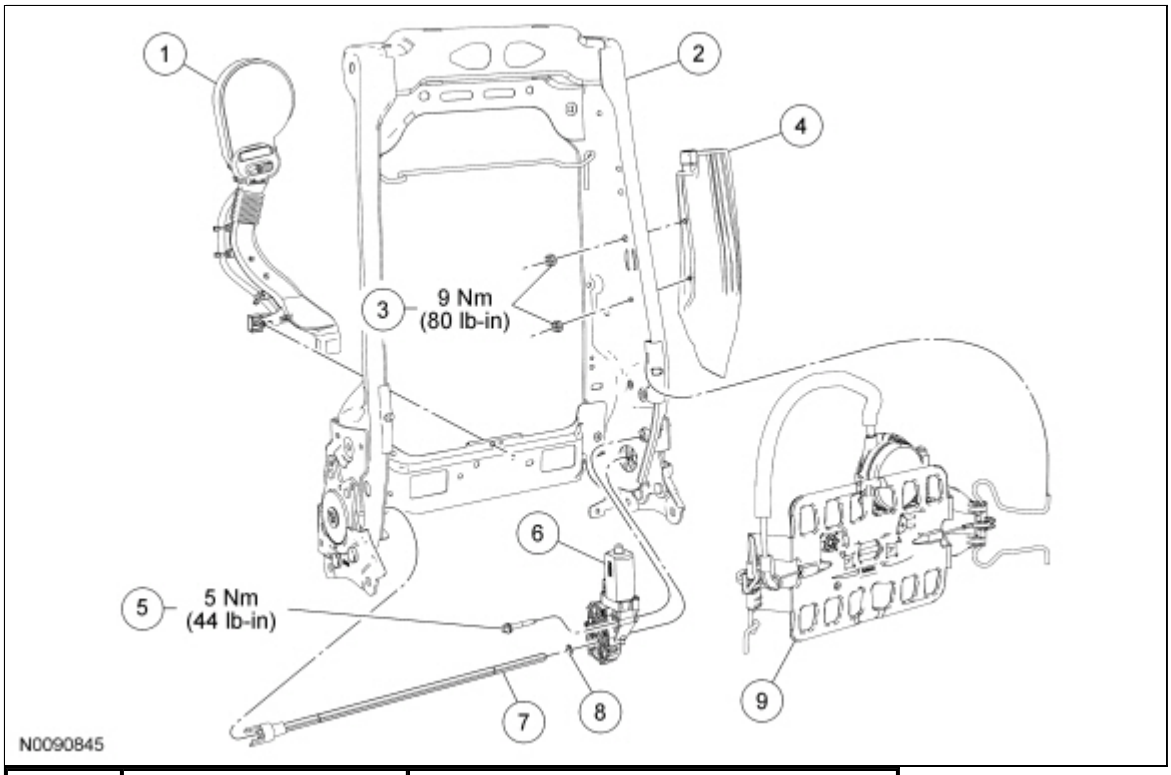


Item	Part Number	Description
1	64417	Backrest cover
2	14D696	Backrest heater mat (if equipped)
3	18D507	Climate controlled seat backrest manifold (if equipped)
4	64811	Backrest foam pad
5	610A18	Head restraint guide sleeve, slave
6	610A16	Head restraint guide sleeve, master
7	611A08	Head restraint

Seat Backrest — Frame Parts, Power Seat With Power Lumbar and Climate Controlled Seat System

NOTE: LH shown, RH similar.

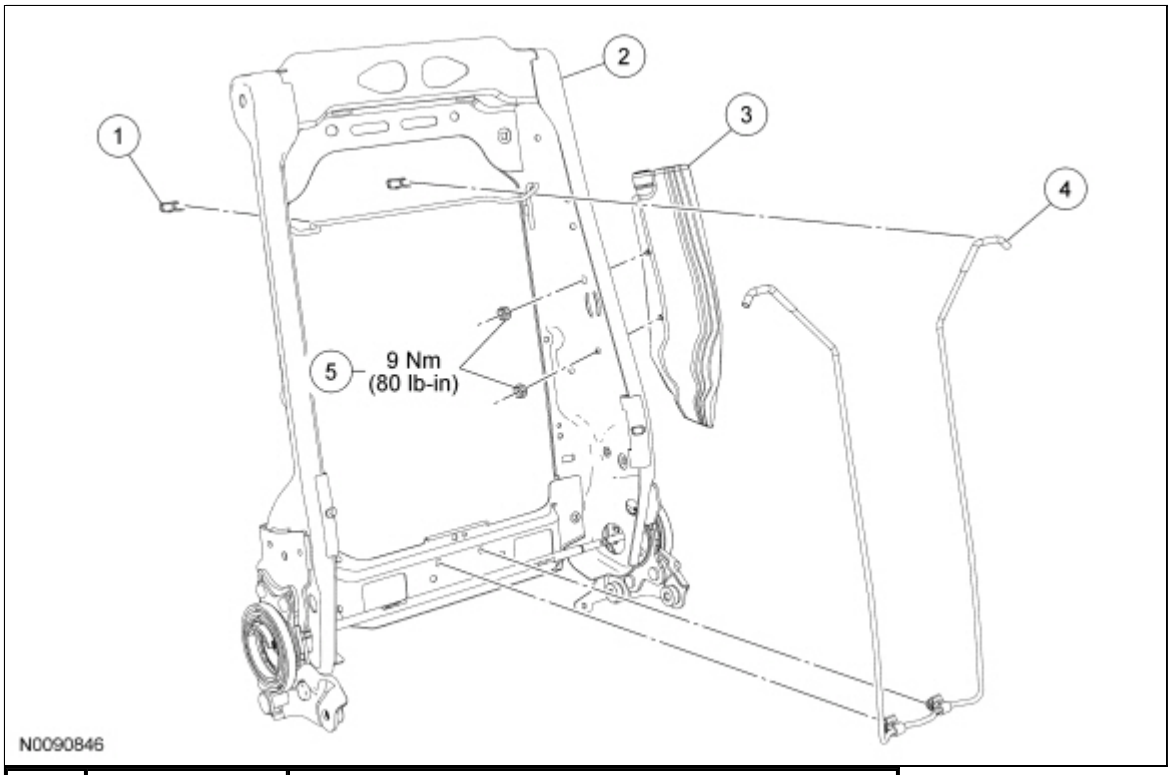
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Item	Part Number	Description
1	19N550	Backrest TED
2	61018	Backrest frame
3	W520111	Side air bag nuts
4	611D10	Side air bag module
5	W701242	Recliner motor bolt
6	14547	Recliner motor
7	613A68	Torque shaft
8	61479	Torque shaft retainer
9	65500	Power lumbar assembly

Seat Backrest — Frame Parts, Manual Seat Without Adjustable Lumbar

NOTE: LH shown, RH similar.

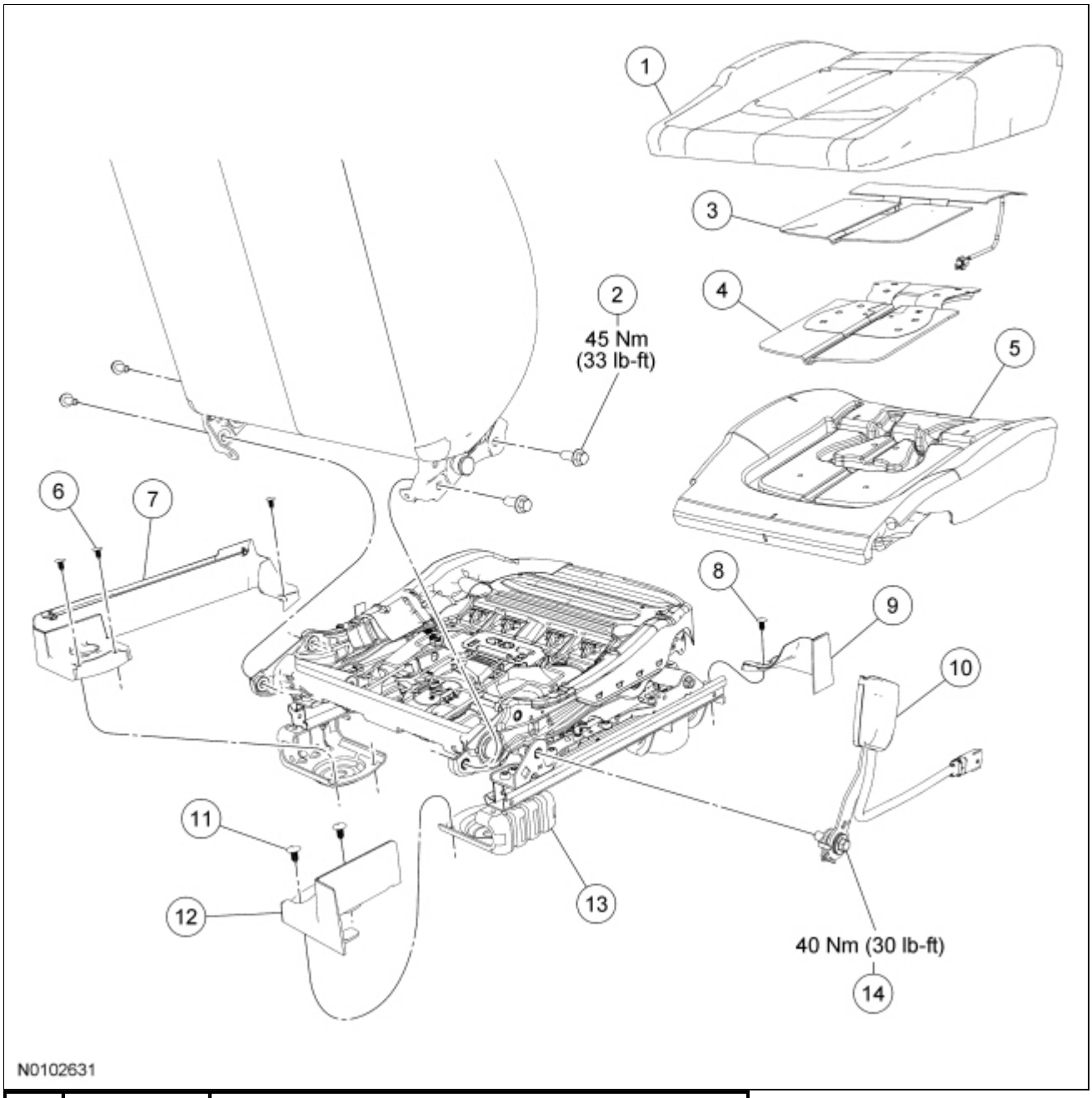


Item	Part Number	Description
1	W790133	Backrest support upper retainer (2 required)
2	61018	Backrest frame
3	611D10	Side air bag module
4	64842	Backrest support
5	W520111	Side air bag nuts

Seat Cushion

NOTE: LH shown, RH similar.

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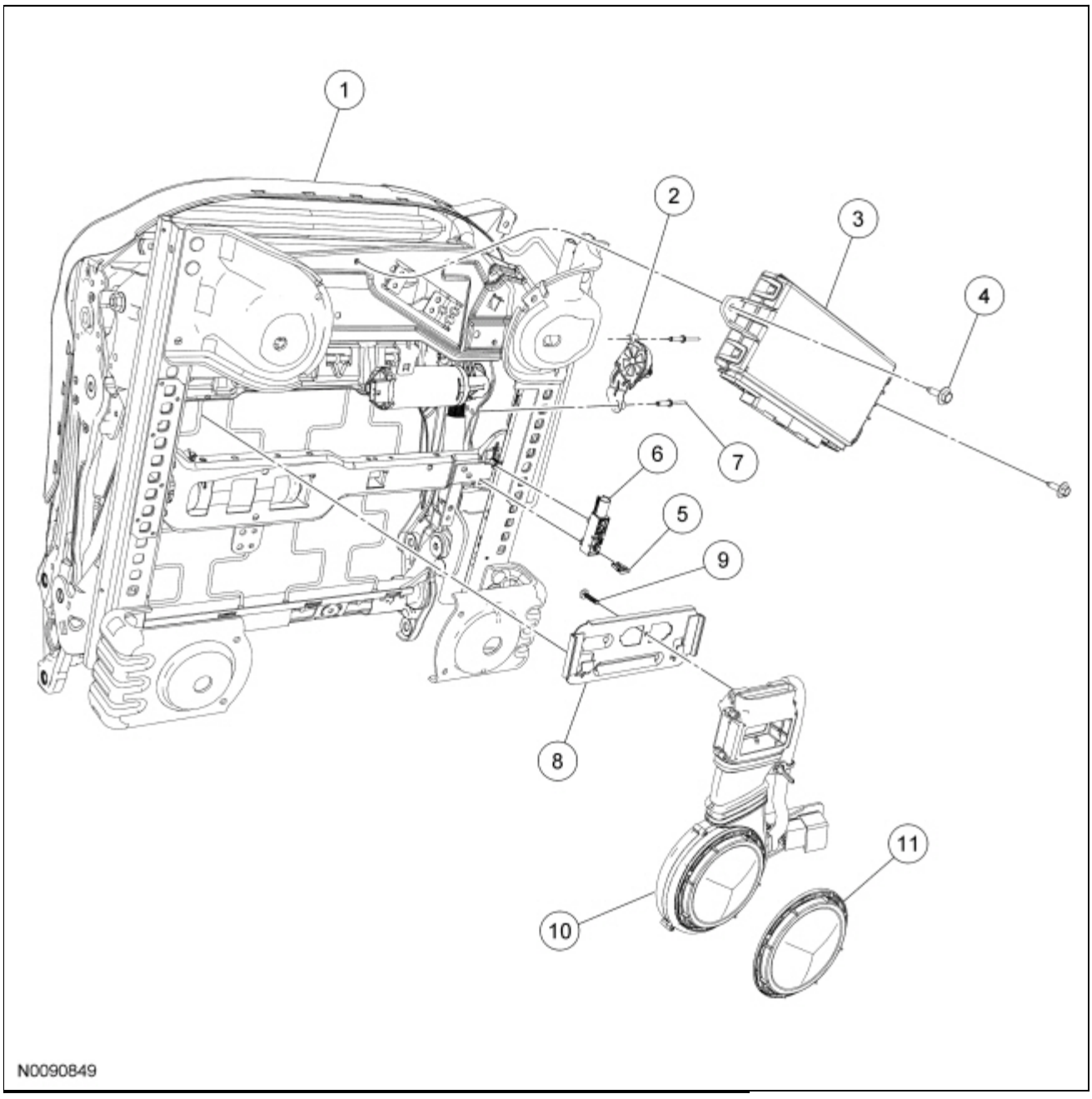


Item	Part Number	Description
1	62900	Cushion cover
2	W500433	Backrest bolt (4 required)
3	14D696	Cushion heater mat (if equipped)
4	18D507	Climate controlled seat cushion manifold (if equipped)
5	622A23	Cushion foam pad
6	W705589	Outboard seat track cover retainer (3 required)
7	62187	Outboard seat track cover
8	W705589	Front inboard seat track cover retainer

9	62186	Front inboard seat track cover
10	61203	Safety belt buckle
11	W705589	Rear inboard seat track cover retainer (2 required)
12	62186	Rear inboard seat track cover
13	61711	Seat track
14	—	Safety belt buckle bolt (part of 61203)

Seat Track — Driver

NOTE: Power seat shown, manual similar.

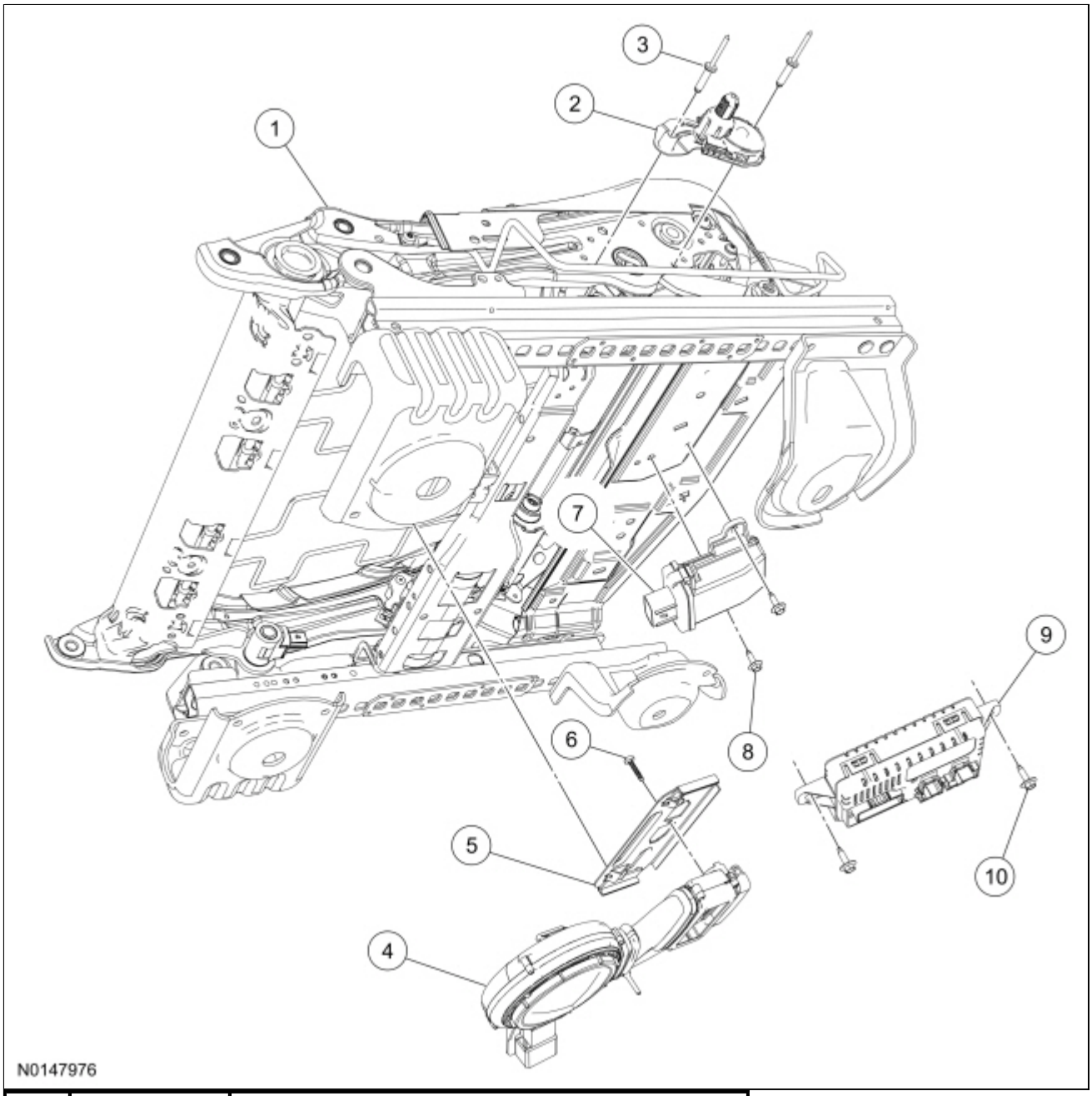


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Item	Part Number	Description
1	61711	Seat track
2	—	Lumbar adjuster (if equipped) (part of 65500)
3	14C708	DSM (if equipped)
4	S505153	DSM screw (2 required) (if equipped)
5	—	Seat track position sensor lock tab
6	14B416	Seat track position sensor
7	—	Lumbar adjuster rivet (2 required) (if equipped)
8	—	Cushion TED mounting bracket (if equipped)
9	—	TED mounting bracket screw (if equipped)
10	19N550	Cushion TED (if equipped)
11	—	Cushion TED filter (if equipped)

Seat Track — Passenger

NOTE: Power seat shown, manual similar.



Item	Part Number	Description
1	61710	Seat track
2	—	Lumbar adjuster (if equipped) (part of 65500)
3	—	Lumbar adjuster rivet (2 required) (if equipped)
4	19N550	Cushion TED (if equipped)
5	—	Cushion TED mounting bracket (if equipped)
6	—	TED mounting bracket screw (if equipped)
7	14B056	OCSM
8	—	OCSM screw (2 required)
9	14B633	DCSM (if equipped)

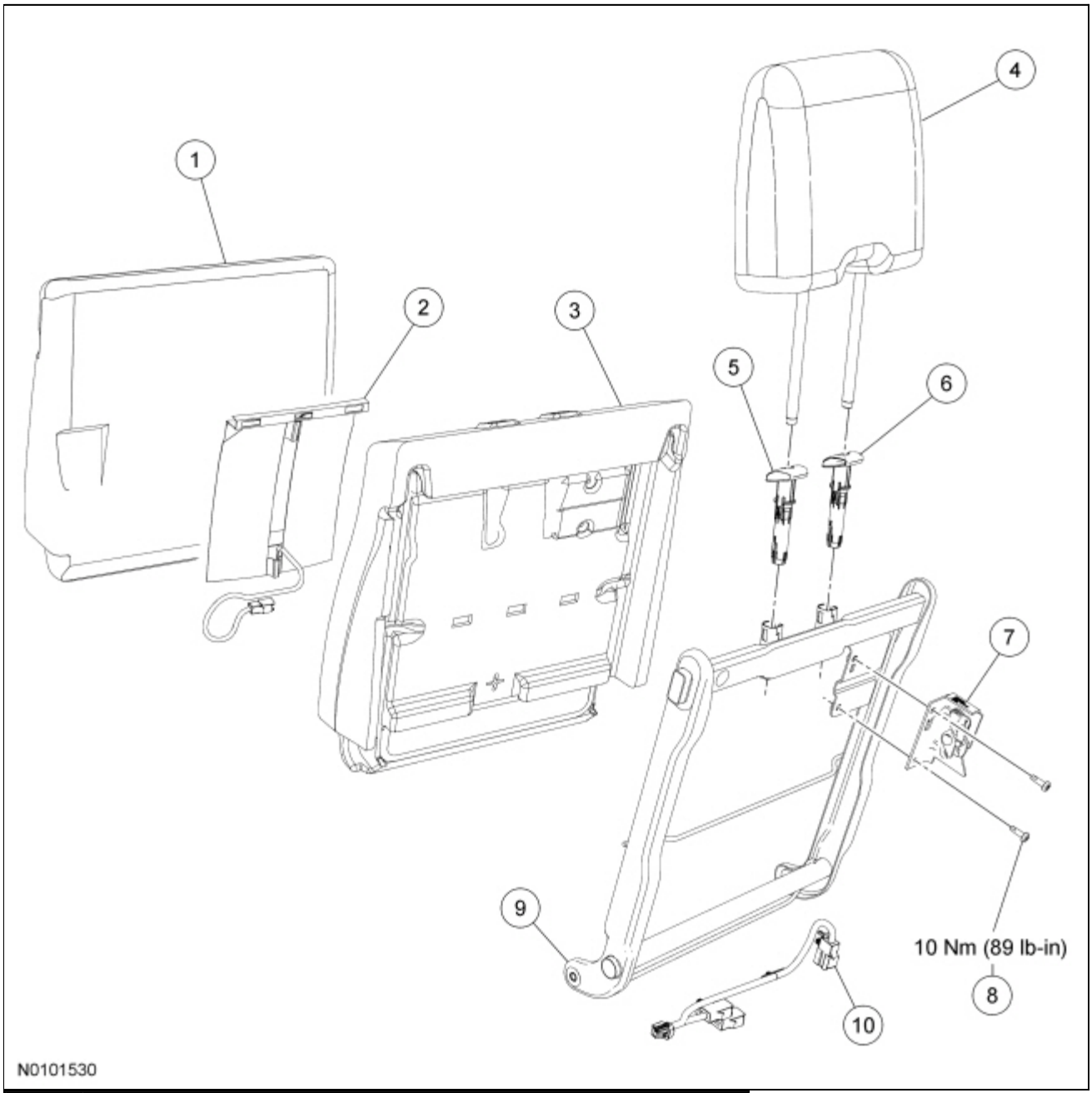
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10	—	DCSM screw (2 required) (if equipped)

1. For additional information, refer to the procedures in this section.

Seat — Exploded View, Rear, Crew Cab

Seat Backrest — 40 Percent

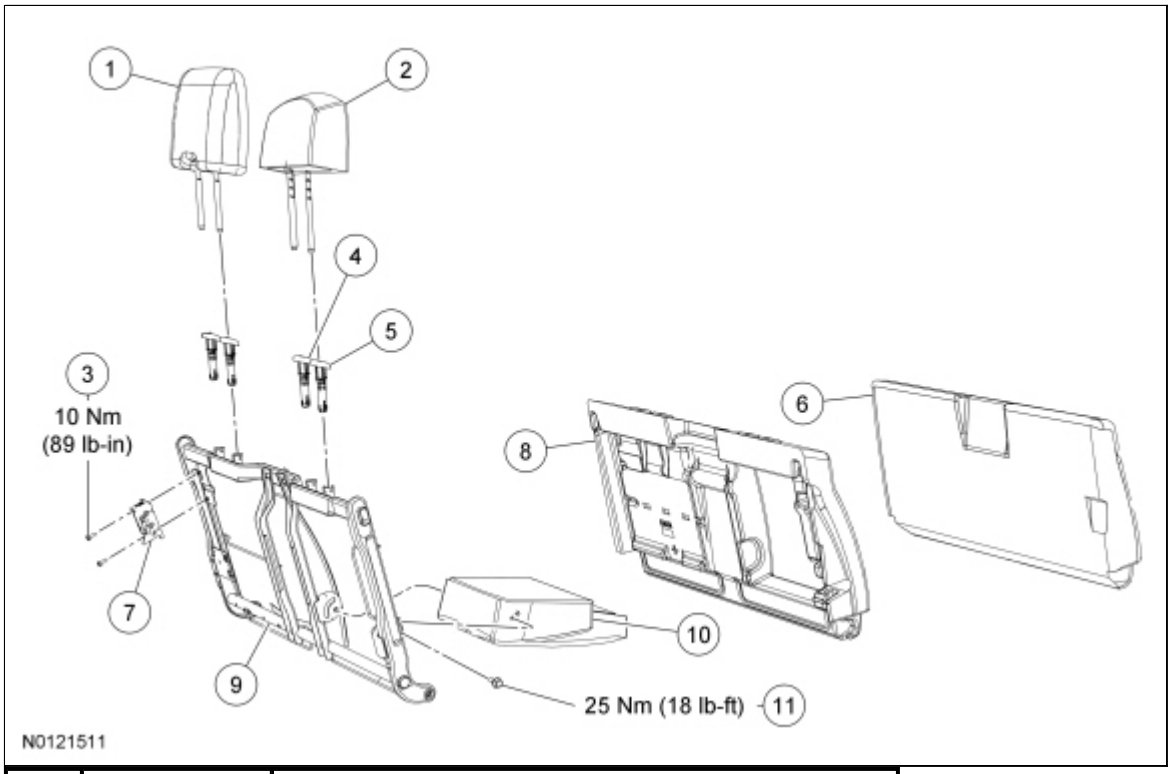


Item	Part Number	Description
1	66600	Backrest cover

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2	14D696	Backrest heater mat
3	66800	Backrest foam pad
4	611A08	Head restraint
5	610A16	Head restraint guide sleeve, master
6	610A18	Head restraint guide sleeve, slave
7	61383	Backrest latch
8	W701945	Backrest latch bolt (2 required)
9	613A38	Backrest frame
10	14A699	Wire harness

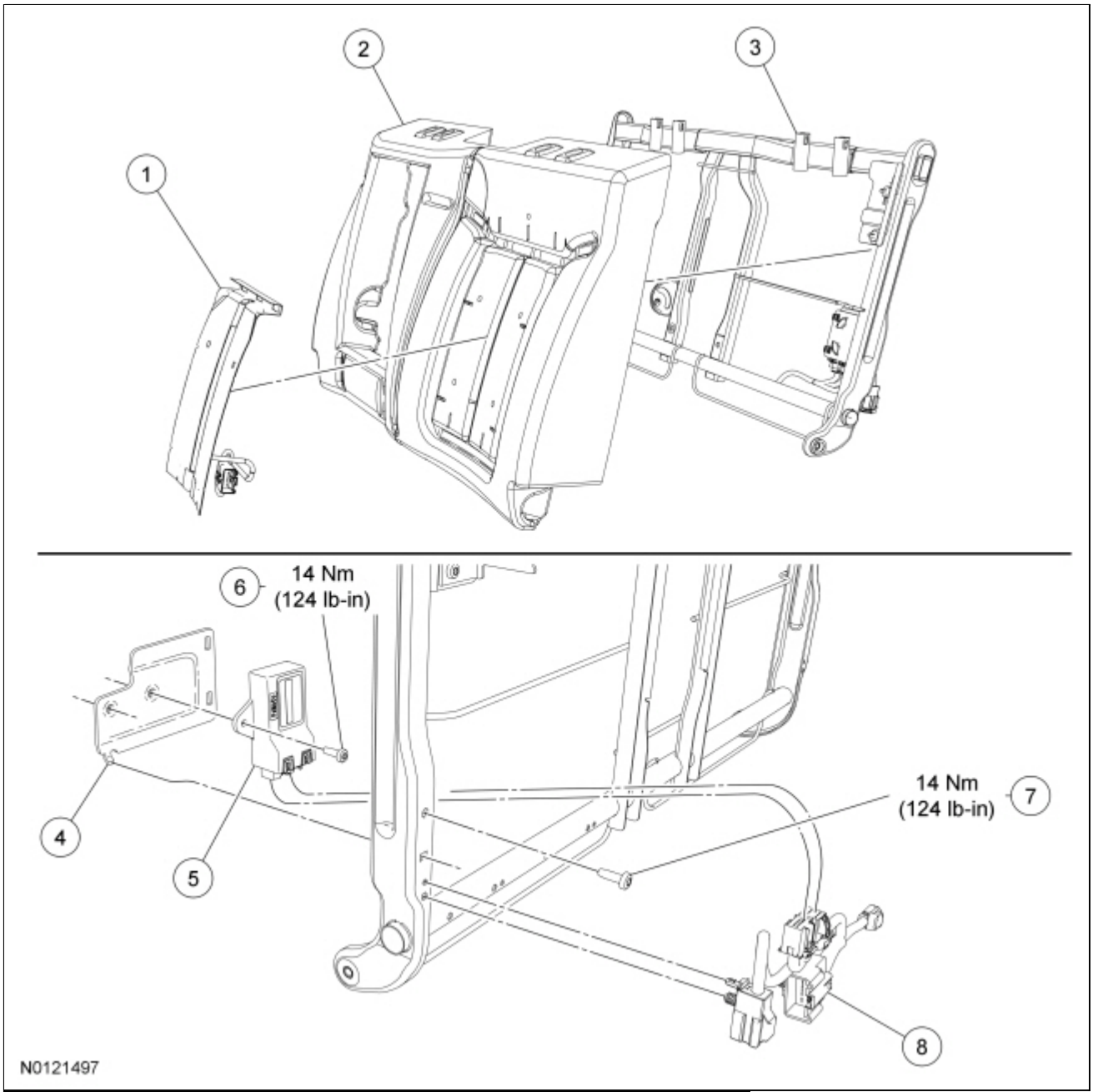
Seat Backrest — 60 Percent



Item	Part Number	Description
1	611A08	Head restraint
2	611A08	Center head restraint
3	W701945	Backrest latch bolt (2 required)
4	610A16	Head restraint guide sleeve, master (2 required)
5	610A18	Head restraint guide sleeve, slave (2 required)
6	66601	Backrest cover
7	61383	Backrest latch

8	66801	Backrest foam pad
9	613A39	Backrest frame
10	60508	Armrest assembly
11	W714769	Armrest pivot bolt

Heated Seat System — 60 Percent Backrest

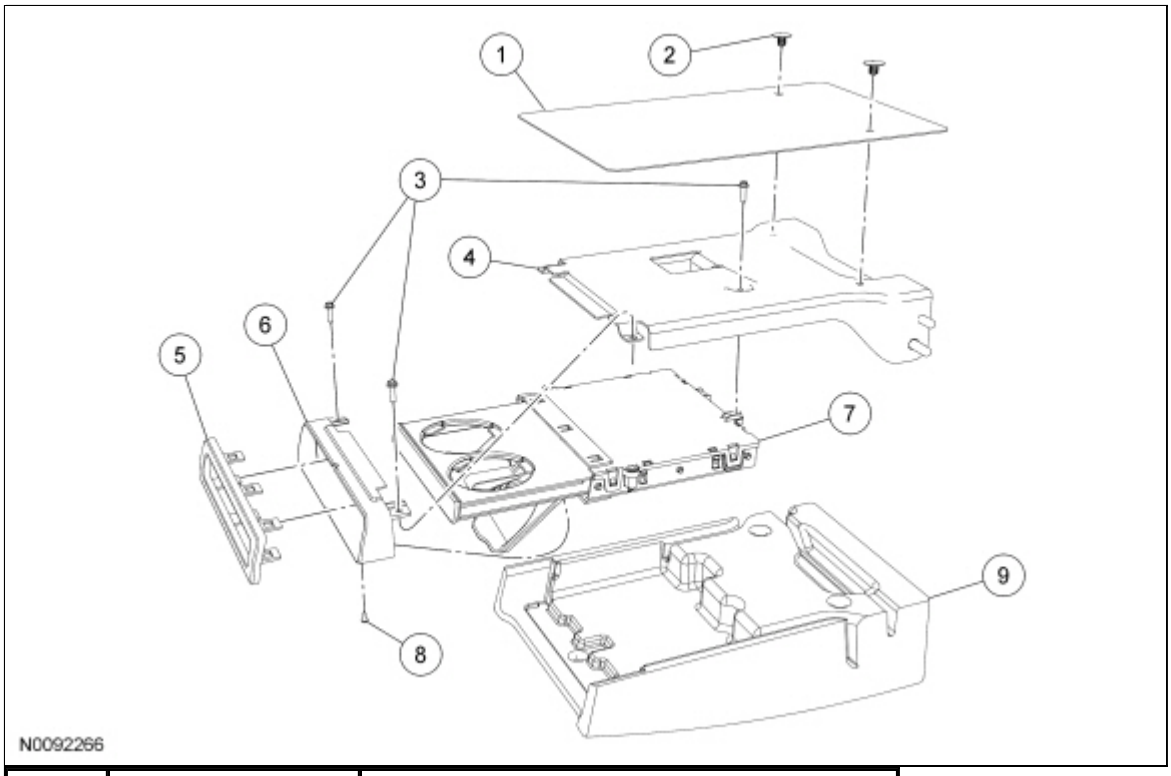


Item	Part Number	Description

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1	14D696	Backrest heater mat
2	66801	Backrest foam pad
3	613A39	Backrest frame
4	—	Heated seat module bracket
5	14C724	Heated seat module
6	—	Heated seat module screw
7	—	Heated seat module bracket screw
8	14A699	Wire harness

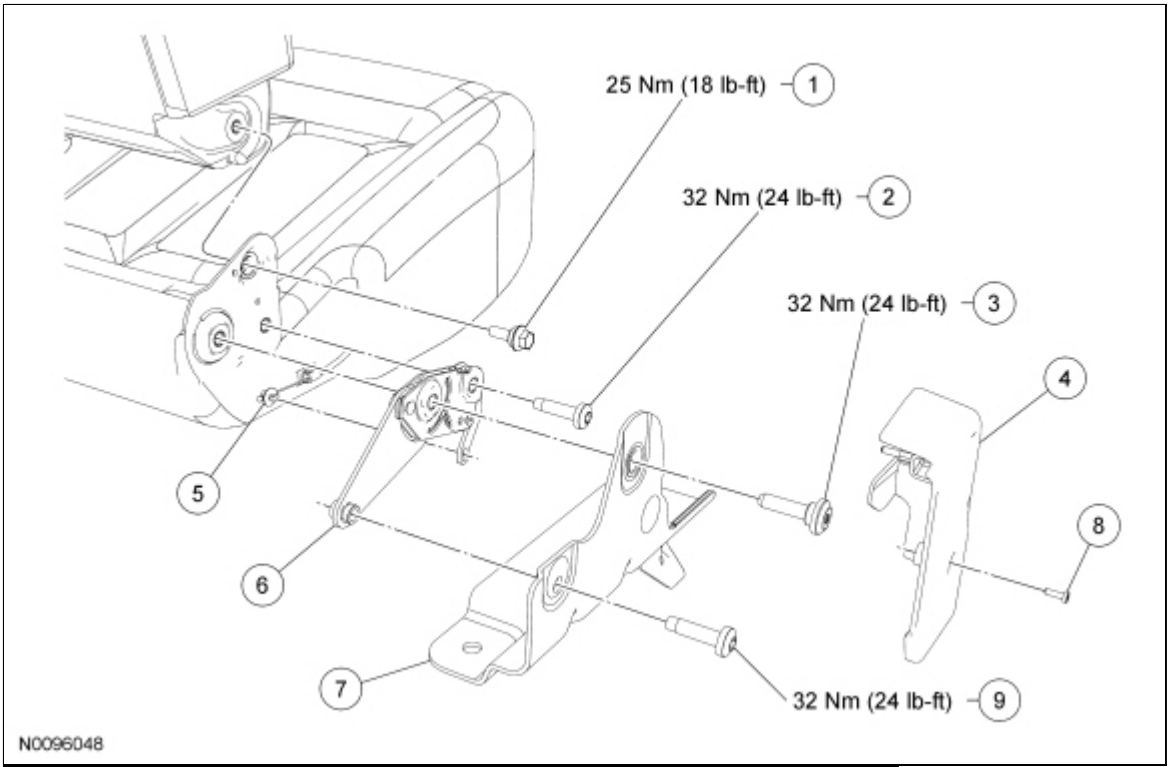
Seat Armrest — 60 Percent



Item	Part Number	Description
1	63804	Shield
2	N803678	Shield retainer (2 required)
3	W506824	Cupholder screws (3 required)
4	67336	Armrest frame
5	7E391	Cupholder bezel cover
6	67336	Cupholder bezel
7	13562	Cupholder
8	W506824	Cupholder bezel screw

9	60508/67273	Armrest cover/foam pad

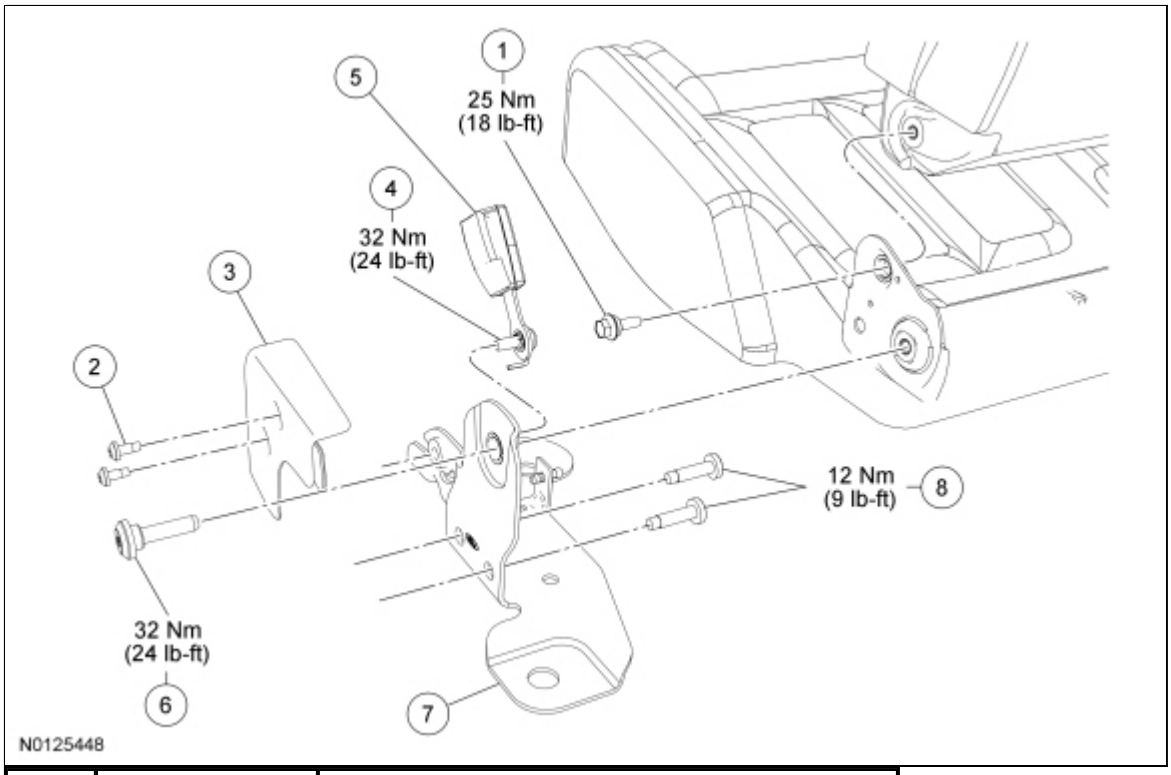
Outboard Cushion Latch — 40 Percent



Item	Part Number	Description
1	W714769	Backrest pivot bolt
2	W504777	Front latch bolt
3	W713205	Cushion pivot bolt
4	61350	Outboard side shield
5	62418	Cushion latch release cable
6	67412	Cushion latch
7	62526	Outboard riser
8	N811172	Side shield screw
9	W504777	Rear latch bolt

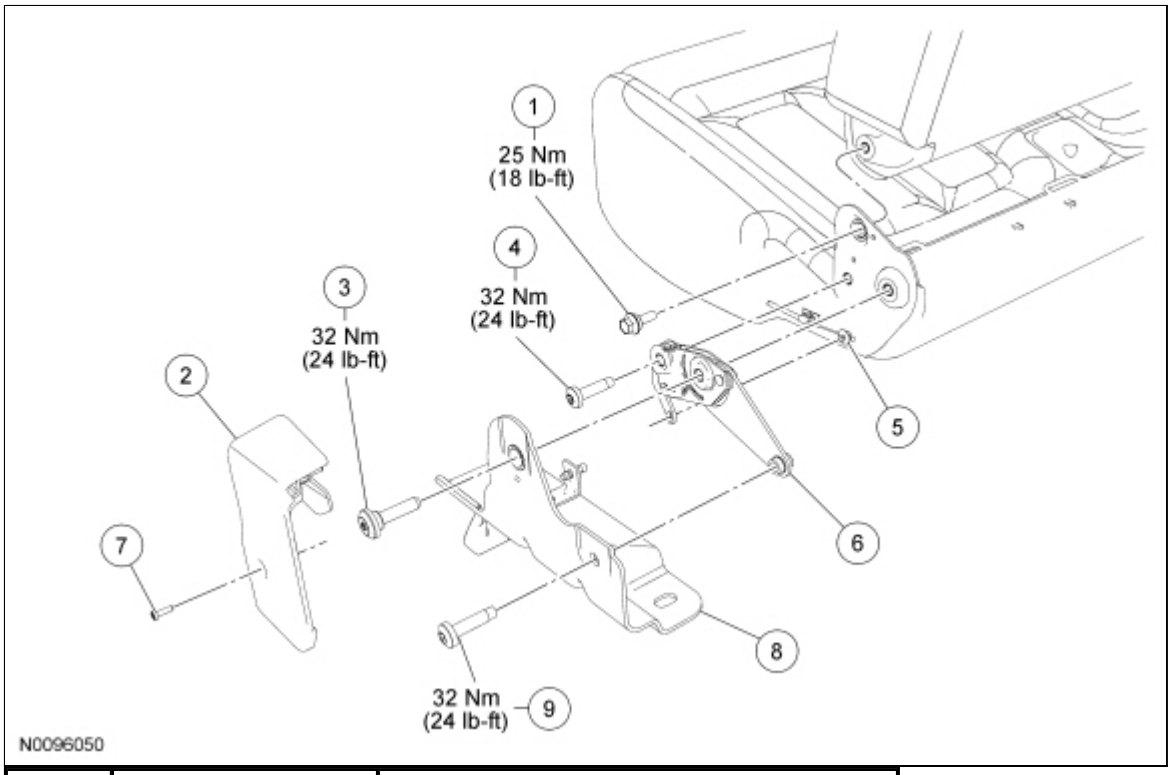
Inboard Cushion Latch — 40 Percent

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Item	Part Number	Description
1	W714769	Backrest pivot bolt
2	W504752	Side shield screw (2 required)
3	61351	Inboard side shield
4	—	Safety belt buckle bolt (part of 60045)
5	60045	Safety belt buckle
6	W713205	Cushion pivot bolt
7	62527	Inboard riser
8	N806910	Seat connecting bolts (2 required)

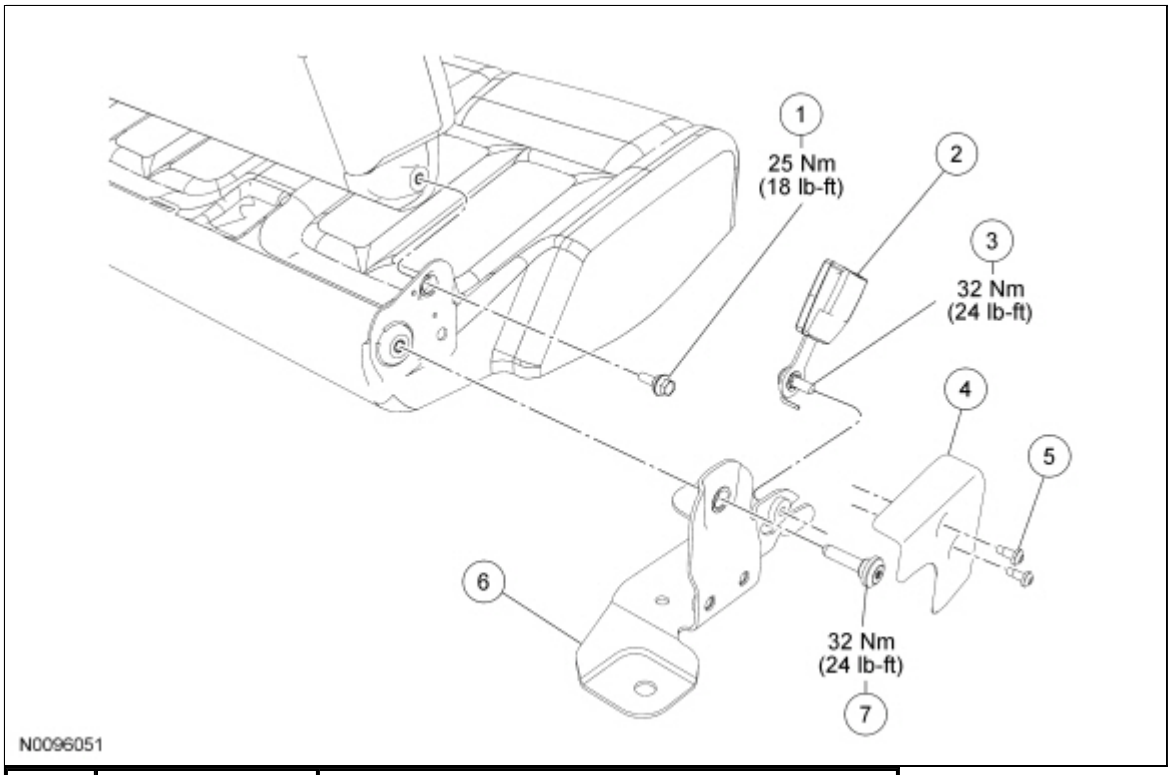
Outboard Cushion Latch — 60 Percent



Item	Part Number	Description
1	W714769	Backrest pivot bolt
2	61351	Outboard side shield
3	W713205	Cushion pivot bolt
4	W504777	Front latch bolt
5	62419	Cushion latch release cable
6	67412	Cushion latch
7	N811172	Side shield screw
8	62527	Outboard riser
9	W504777	Rear latch bolt

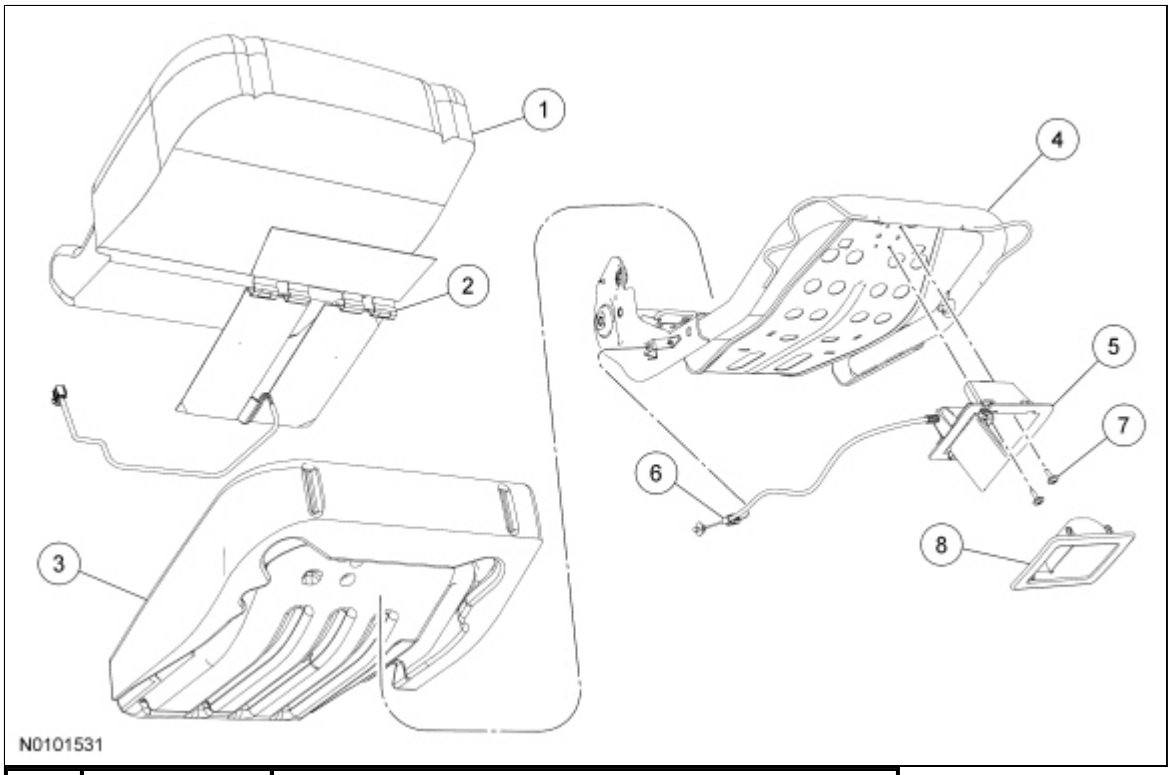
Inboard Cushion Latch — 60 Percent

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Item	Part Number	Description
1	W714769	Backrest pivot bolt
2	60045	Safety belt buckle
3	—	Safety belt buckle bolt (part of 60045)
4	61350	Inboard side shield
5	W504752	Side shield screw (2 required)
6	62526	Inboard riser
7	W713205	Cushion pivot bolt

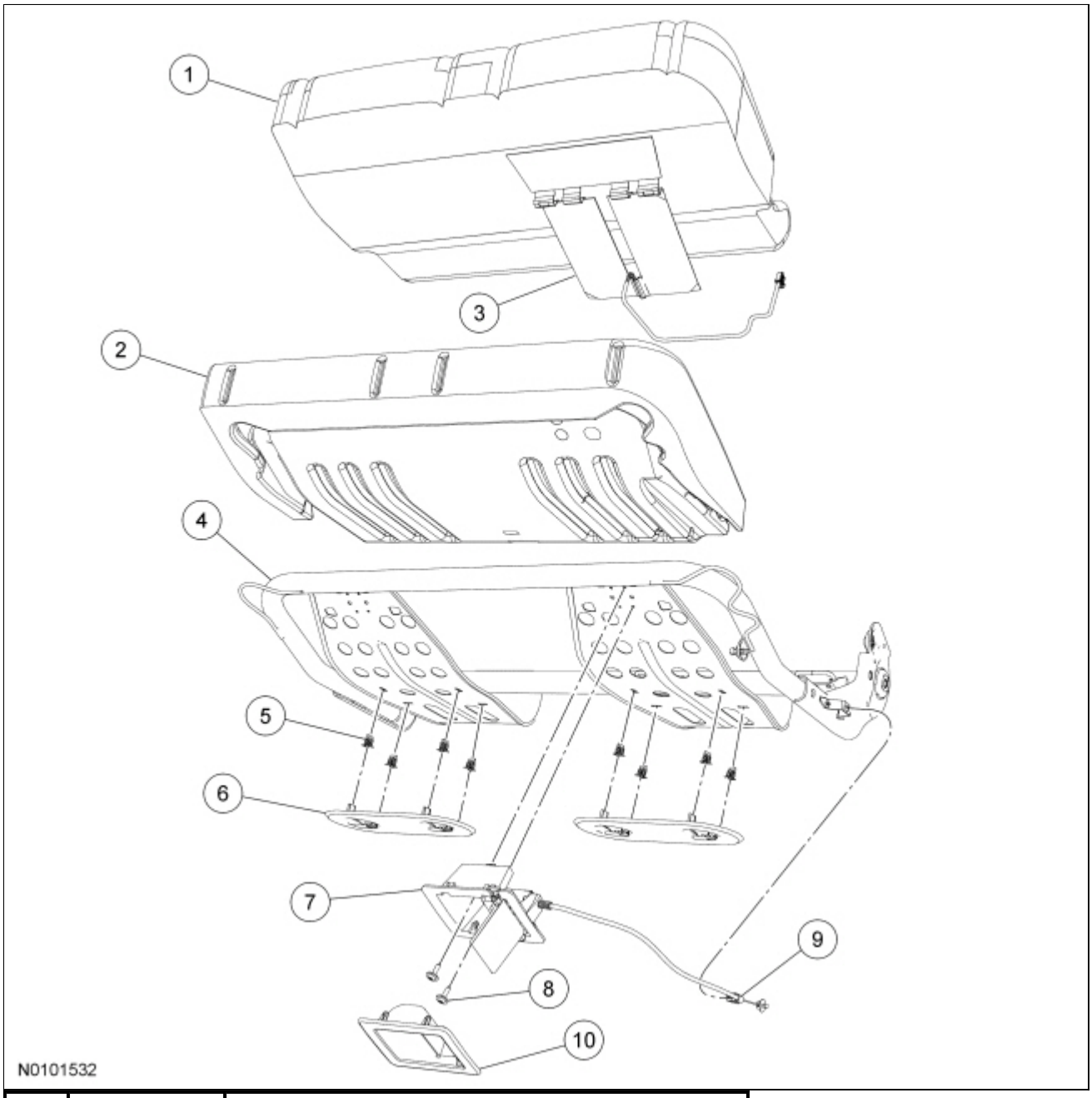
Seat Cushion — 40 Percent



Item	Part Number	Description
1	63804	Cushion cover
2	14D696	Cushion heater mat
3	63840	Cushion foam pad
4	63160	Cushion frame
5	62418	Cushion latch release handle
6	—	Cable retainer (part of 62418)
7	N808322	Cushion latch release handle screw (2 required)
8	67460	Cushion latch release handle bezel

Seat Cushion — 60 Percent

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Item	Part Number	Description
1	63805	Cushion cover
2	63841	Cushion foam pad
3	14D696	Cushion heater mat
4	63161	Cushion frame
5	—	Utility hook retainer (part of 061B44) (8 required)
6	061B44	Utility hook (2 required)
7	62419	Cushion latch release handle
8	N808322	Cushion latch release handle screw (2 required)
9	—	Cable retainer (part of 62419)

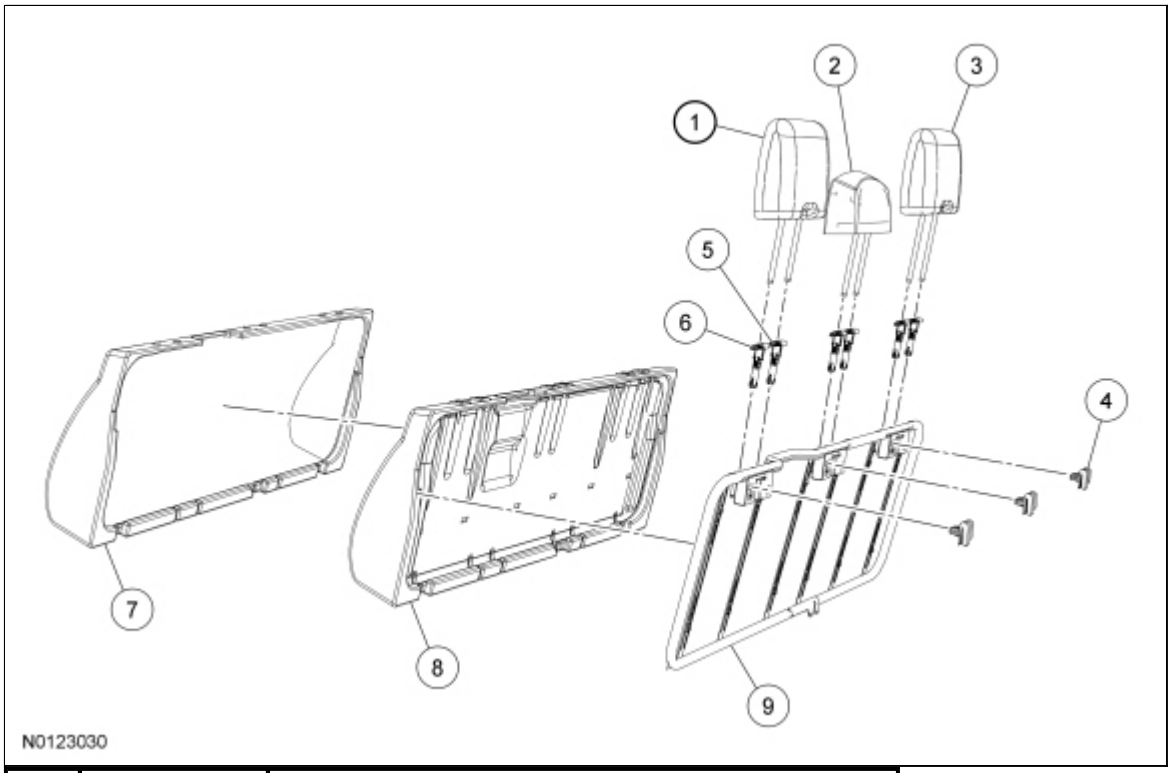
10	67460	Cushion latch release handle bezel

1. For additional information, refer to the procedures in this section.

repair4less

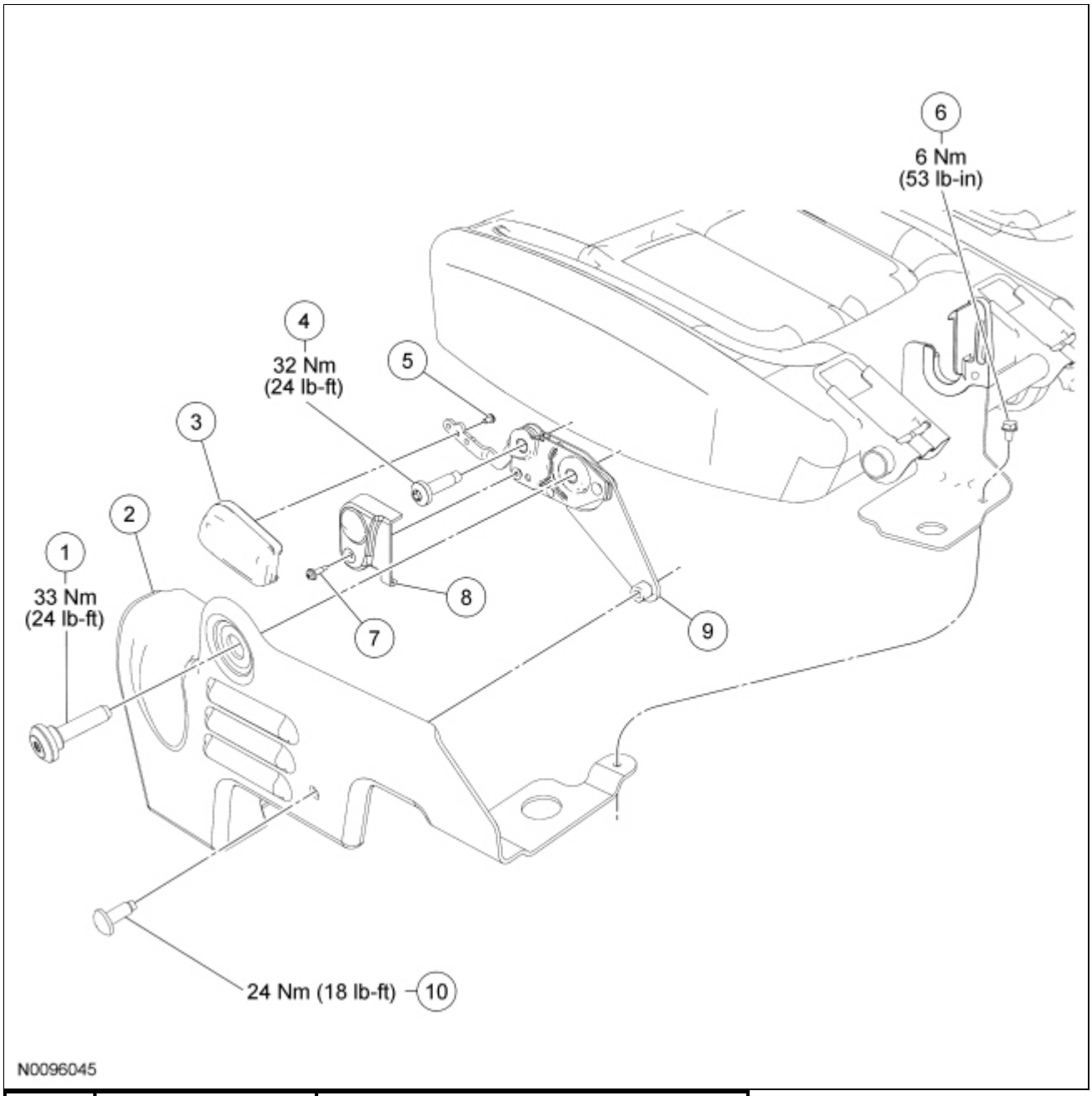
Seat — Exploded View, Rear, SuperCab

Seat Backrest



Item	Part Number	Description
1	611A08	LH head restraint
2	611A08	Center head restraint
3	611A08	RH head restraint
4	613F60	Upper clip (3 required)
5	610A16	Head restraint guide sleeves, slave (3 required)
6	610A18	Head restraint guide sleeves, master (3 required)
7	66600	Backrest cover
8	66800	Backrest foam pad
9	613A38	Backrest frame

Seat Cushion Latch — 60 Percent

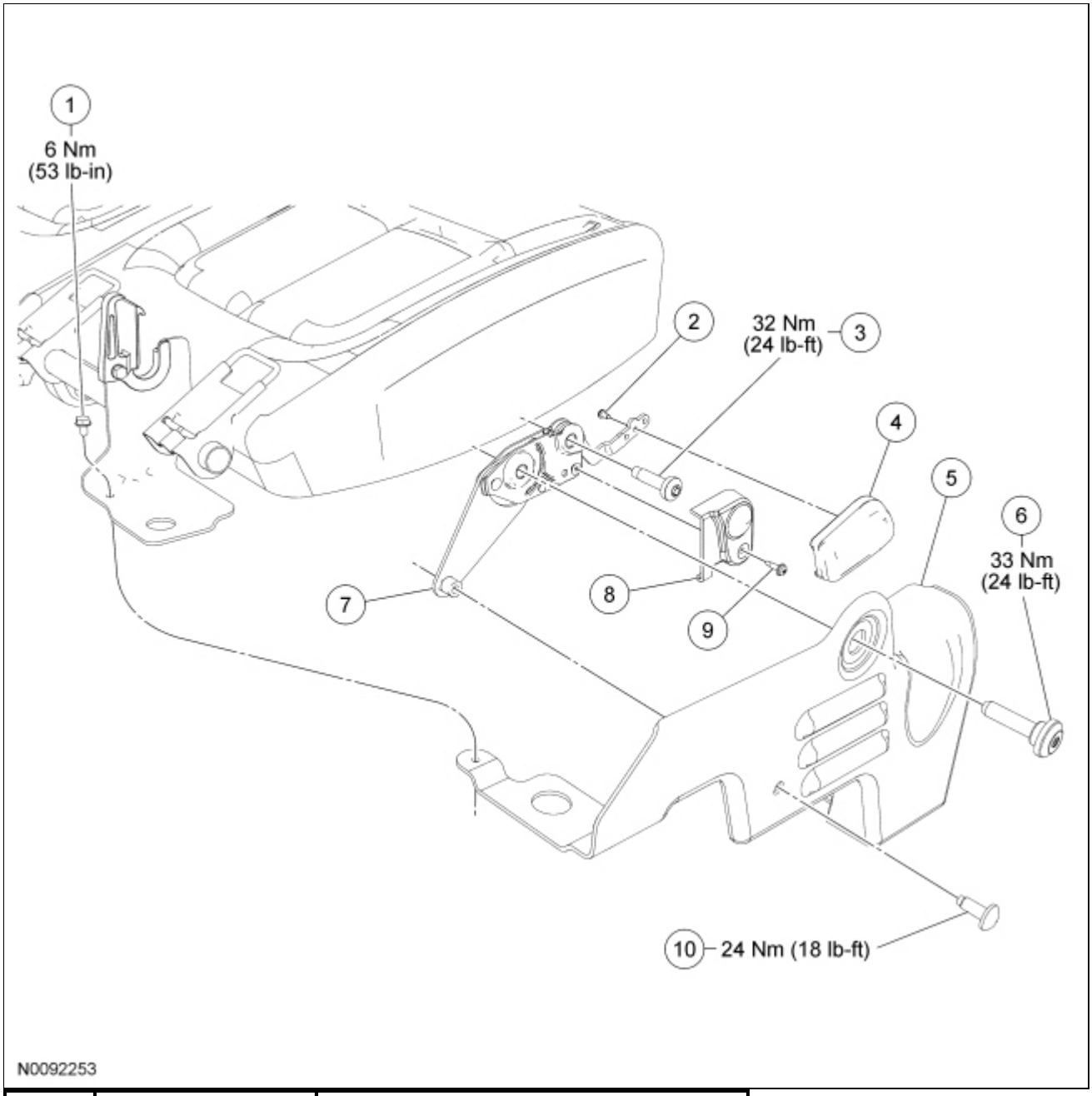


Item	Part Number	Description
1	W713205	Pivot bolt
2	60693	Outboard riser
3	62419	Latch release handle
4	W504777	Front latch bolt
5	W700915	Latch release handle screw
6	60108	Riser rear screw
7	N811172	Latch bolt cover screw
8	61351	Latch bolt cover
9	67413	Cushion latch

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10	N806910	Rear latch bolt

Seat Cushion Latch — 40 Percent

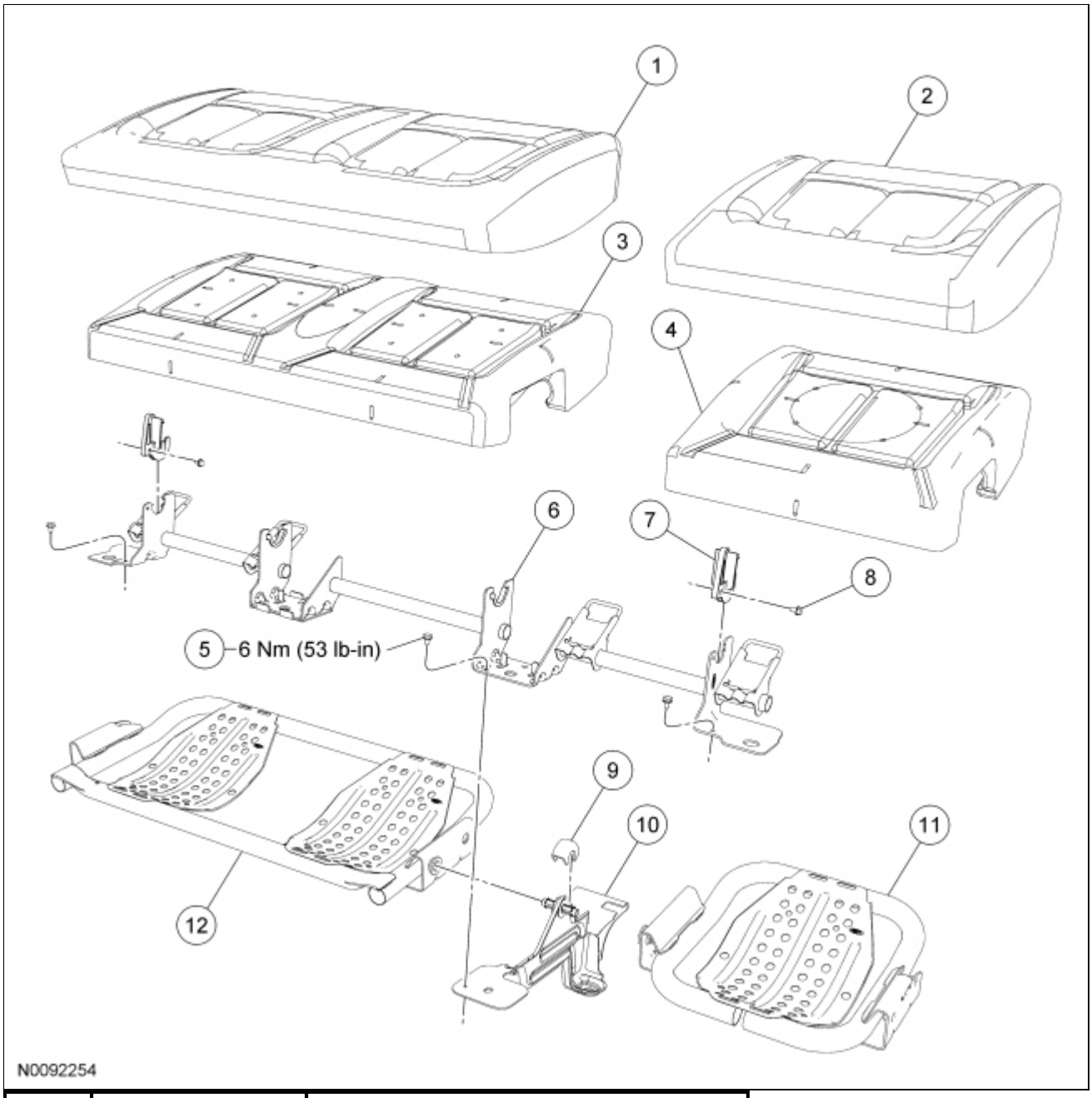


Item	Part Number	Description
1	60108	Riser rear screw
2	W700915	Latch release handle screw
3	W504777	Front latch bolt

4	62418	Latch release handle
5	60692	Outboard riser
6	W713205	Pivot bolt
7	67412	Cushion latch
8	61350	Latch bolt cover
9	N811172	Latch bolt cover screw
10	W806910	Rear latch bolt

Seat Cushion — 40 and 60 Percent

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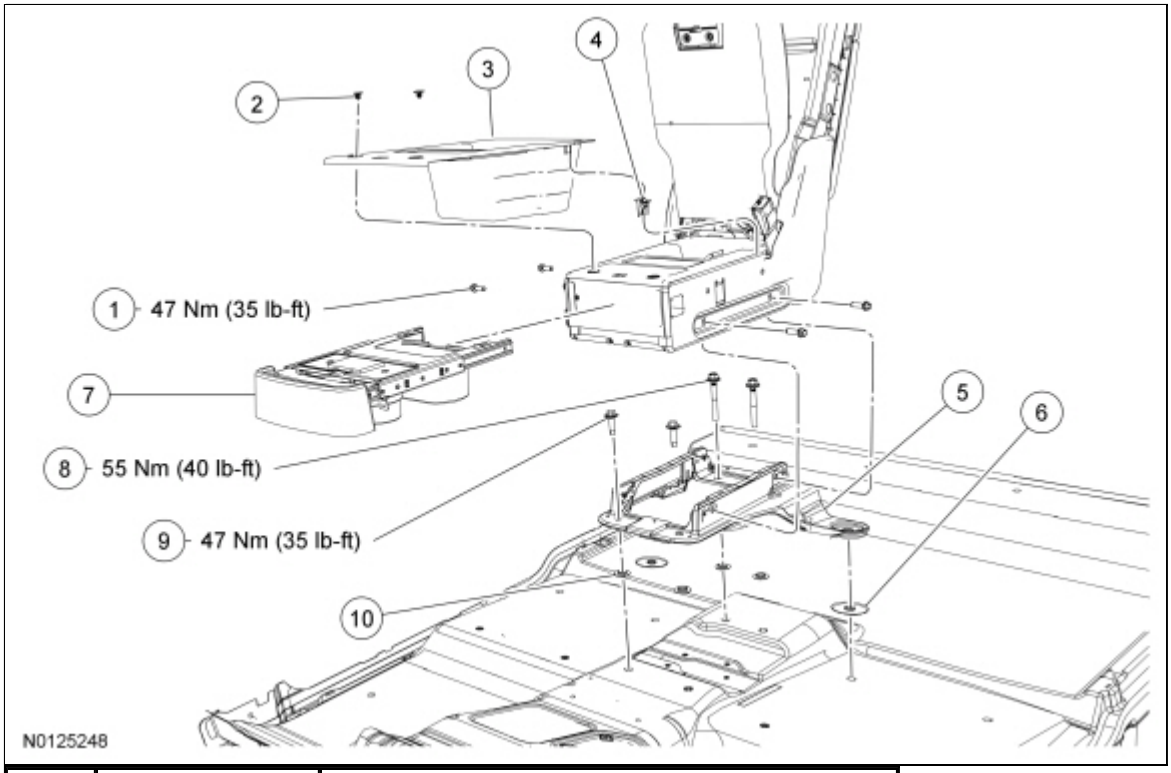
Item	Part Number	Description
1	63805	60 percent cushion cover
2	63804	40 percent cushion cover
3	63841	60 percent cushion foam pad
4	63840	40 percent cushion foam pad
5	60108	Riser rear screw (3 required)
6	601B28	Rear seat frame
7	613F60	Backrest latch (2 required)
8	—	Backrest latch screw
9	638A96	Retention clip

10	60692	Inboard riser
11	63160	40 percent cushion frame
12	63161	60 percent cushion frame

1. For additional information, refer to the procedures in this section.

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Seat — Front, Center



Item	Part Number	Description
1	W714278	Seat mounting bolt (4 required)
2	N803678	Pin-type retainers (2 required)
3	115A00	Storage tray
4	W711045	Retainer clips (2 required)
5	045B34	Pedestal
6	—	Spacer (part of 045B34) (2 required)
7	13562	Front cupholder
8	W714792	Pedestal bolts (rear) (2 required)
9	W714276	Pedestal bolts (front) (2 required)
10	—	Washer (part of 045B34) (4 required)

Removal

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTICE: **The pedestal used for the front center seat and floor console mounting contains press fit washers and spacers designed to prevent corrosion at the front center seat and floor console mounting areas. Do not remove these parts from the pedestal during service and make sure they are correctly positioned before installation. Failure to follow these instructions may result in severe corrosion damage to mounting areas and fasteners.**

All seats

1. If equipped, disconnect the power point electrical connector.
    - For access, raise the cushion and remove the storage tray.
        - Release the retainers at the rear edge and pull rearward to unhook and remove.

2. Position the outboard front seats as needed to access and remove the 4 seat mounting bolts.

3. Remove the seat.

Seat pedestal removal

4. Remove the front seats. For additional information, refer to Seat — Front in this section.

5. Remove the 2 front and 2 rear pedestal bolts and pedestal.
    - Install any washers or spacers that separate from the pedestal.

Installation

NOTE: Make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

1. ***NOTICE:*** **Use care when removing and installing the pedestal to avoid damage to the Restraints Control Module (RCM) and Supplemental Restraint System (SRS) electrical wiring.**

   If removed, install the pedestal and the 2 front and 2 rear pedestal bolts.
    - Make sure the 2 spacers are positioned between the floor and pedestal at the rear bolt holes.
    - Make sure the 4 washers are positioned between the floor and pedestal at the bolt holes.
    - To install, tighten front pedestal bolts to 47 Nm (35 lb-ft).
    - To install, tighten rear pedestal bolts to 55 Nm (40 lb-ft).

2. Position the seat in the vehicle and install the 4 seat mounting bolts.
    - To install, tighten to 47 Nm (35 lb-ft).

3. If equipped, connect the power point electrical connector and install the storage tray.

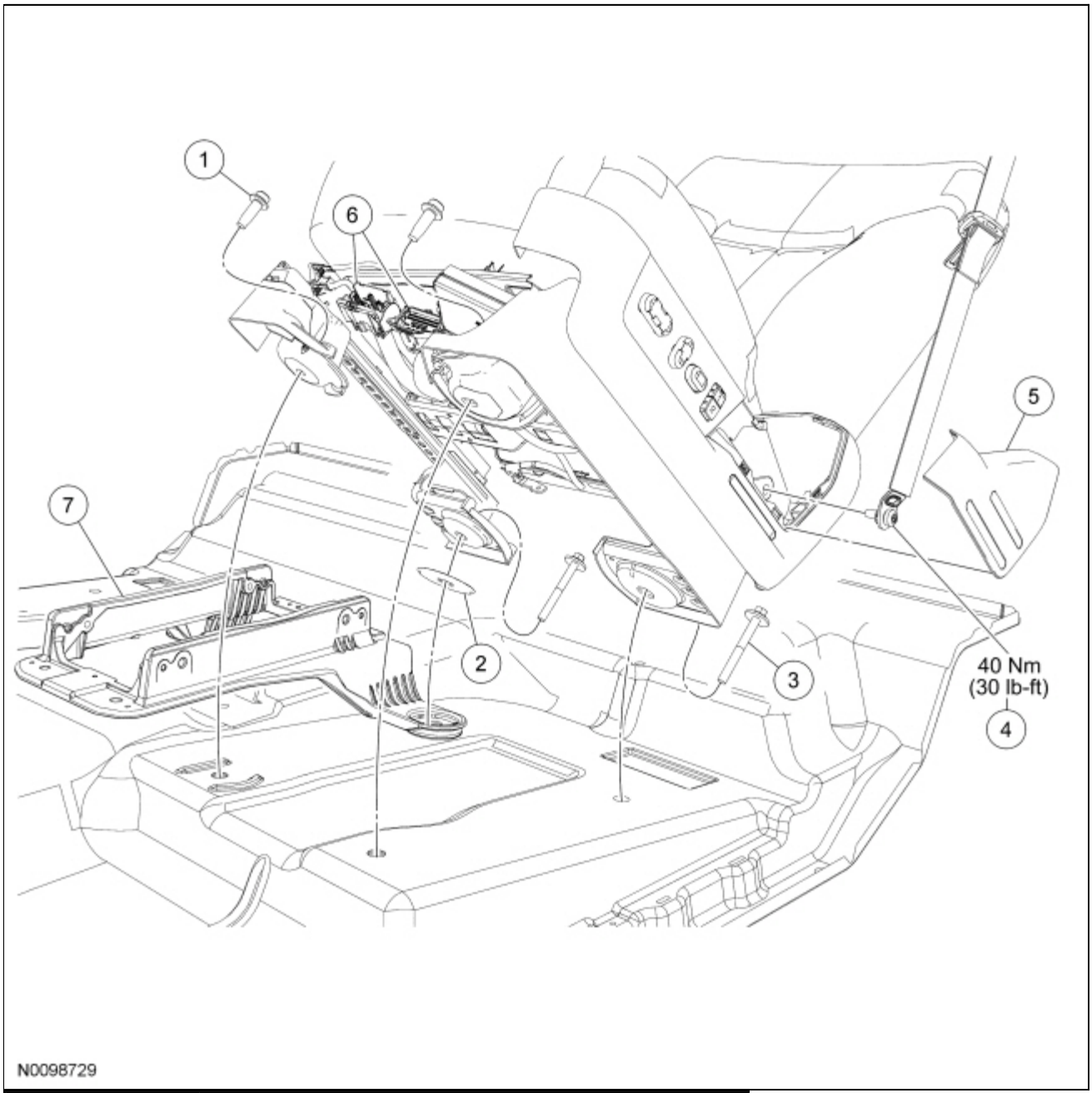
4. If removed, install the front seats. For additional information, refer to Seat — Front in this section.

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Seat — Front

Driver Seat

NOTE: Refer to the installation steps for tightening sequence and torque specification.



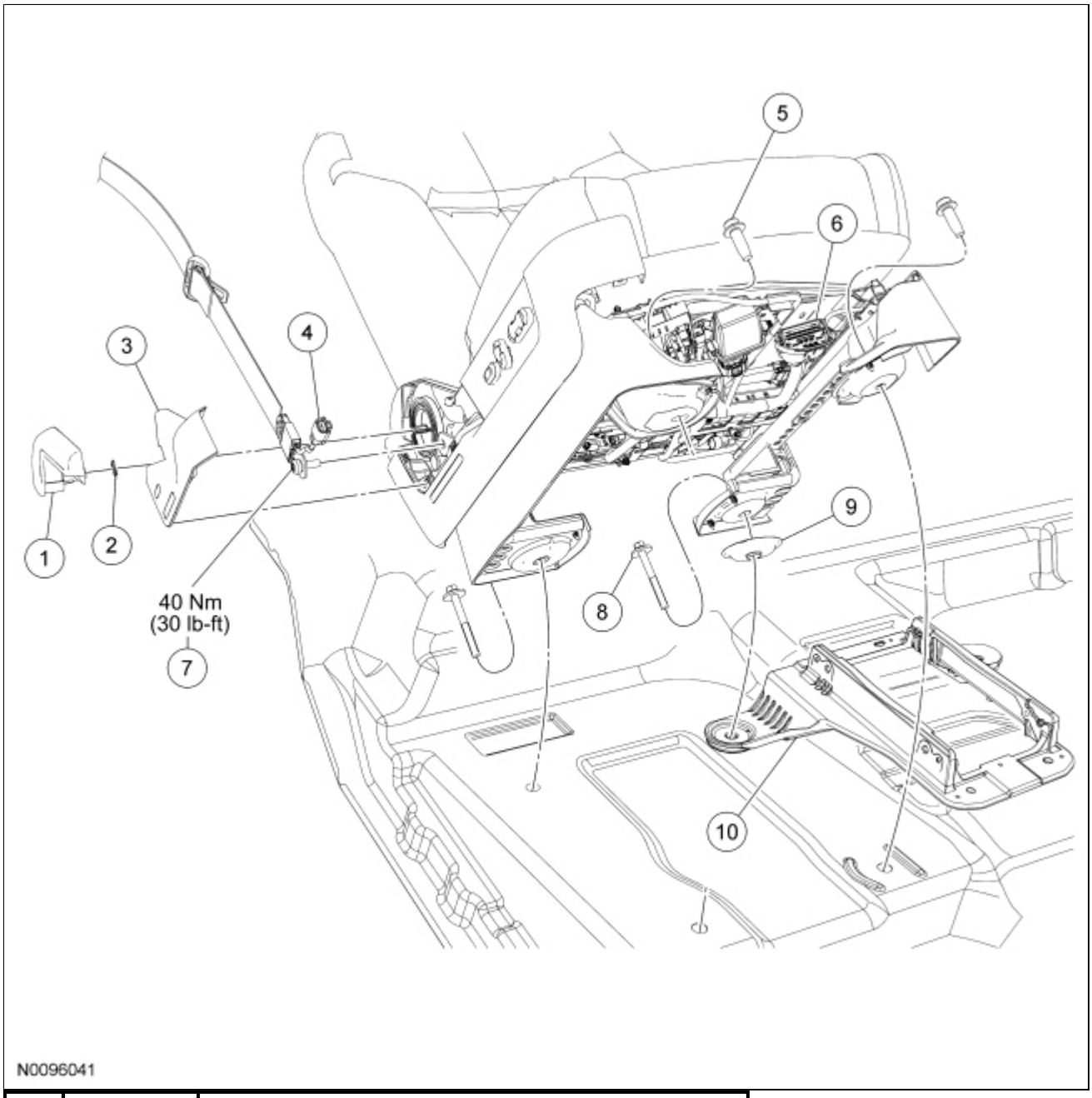
Item	Part Number	Description
1	W714302	Front seat mounting bolt (2 required)

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2	—	Upper spacer (part of 045B34)
3	W714093	Rear seat mounting bolt (2 required)
4	—	Safety belt anchor and bolt (part of 611B09) (regular and Crew Cab only)
5	61693	Safety belt anchor cover (regular and Crew Cab only)
6	—	Seat electrical connectors (part of 14D231)
7	045B34	Pedestal

Passenger Seat

NOTE: Refer to the installation steps for tightening sequence and torque specification.



Item	Part Number	Description
1	62622	Manual recliner handle (if equipped)
2	—	Manual recliner handle retainer (if equipped)
3	61692	Safety belt anchor cover (regular and Crew Cab only)
4	—	Belt Tension Sensor (BTS) electrical connector (part of 611B08)
5	W714302	Front seat mounting bolt (2 required)
6	—	Seat electrical connector (part of 14D230)
7	—	Safety belt anchor and bolt (part of 611B08) (regular and Crew Cab only)

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8	W714093	Rear seat mounting bolt (2 required)
9	—	Upper spacer (part of 045B34)
10	045B34	Pedestal

Removal

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **The pedestal used for front center seat and floor console mounting contains press fit washers and spacers designed to prevent corrosion at the front seat and floor console mounting areas. Do not remove these parts from the pedestal during service and make sure they are correctly positioned before installation. Failure to follow these instructions may result in severe corrosion damage to mounting areas and fasteners.**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

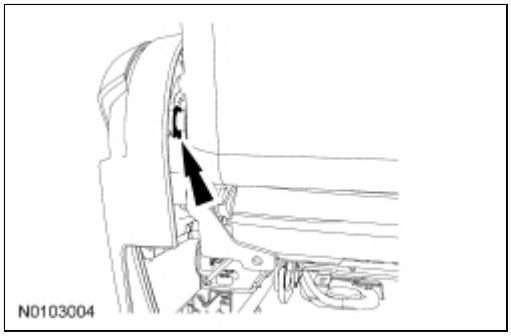
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. Remove the covers and 2 rear seat mounting bolts.

Regular cab and Crew Cab

2. If equipped, remove the manual recline handle.
    - Insert an appropriate tool behind the cushion side shield, release the retainer and remove the handle.



3. Remove the safety belt anchor cover.
    - If power seat, position the seat fully down.
    - Insert an appropriate tool, release the lower retainers, lift to release the upper retainers tabs and remove the cover.
    - Return any detached retainers to the side shield.

4. Remove the bolt and safety belt anchor.
    - If passenger seat, disconnect the Belt Tension Sensor (BTS) electrical connector.

All vehicles

5. Position the seat and remove the 2 front seat mounting bolts.

6. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

7. **WARNING: Use care when handling the front passenger seat and track assembly. Dropping the assembly, placing excessive weight on or sitting on a front passenger seat that is not secured in the vehicle may result in damaged seat components. Failure to follow these instructions may result in incorrect operation of the occupant classification system (OCS) and increases the risk of serious personal injury or death in a crash.**

   Disconnect the seat electrical connector(s) from the body wiring harness and remove the seat from the vehicle.
   - If the upper spacer (at rear inboard mount) separates from the pedestal (under carpet), make sure it is returned for correct installation.

Installation

WARNING: Make sure the front passenger seat is correctly installed and fastened to the vehicle. Do not force the alignment to the floorpan mounting holes. If the seat does not align to the floorpan mounting holes, repair the seat or floorpan as needed. Failure to follow these instructions may result in incorrect operation of the occupant classification system (OCS) and increase the risk of serious personal injury or death in a crash.

All vehicles

1. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   Position the seat in the vehicle and connect the seat to body wire harness electrical connector(s).
   - Make sure the upper spacer is correctly positioned between the pedestal and seat at the rear inboard mount.

2. Install the 2 front mounting bolts and tighten in the following sequence:
   1. If manual seat track, make sure the seat track rails are in sync and locked for correct mounting alignment.
   2. Tighten the front seat mounting bolt on the inboard side.
      - Tighten to 55 Nm (41 lb-ft).
   3. Tighten the front seat mounting bolt on the outboard side.
      - Tighten to 55 Nm (41 lb-ft).

Regular cab and Crew Cab

3. Install the safety belt anchor and bolt.
   - Tighten to 40 Nm (30 lb-ft).
   - If passenger seat, connect the BTS electrical connector.

4. Install the safety belt anchor cover.

5. If equipped, install the manual recline handle and retainer.

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All vehicles

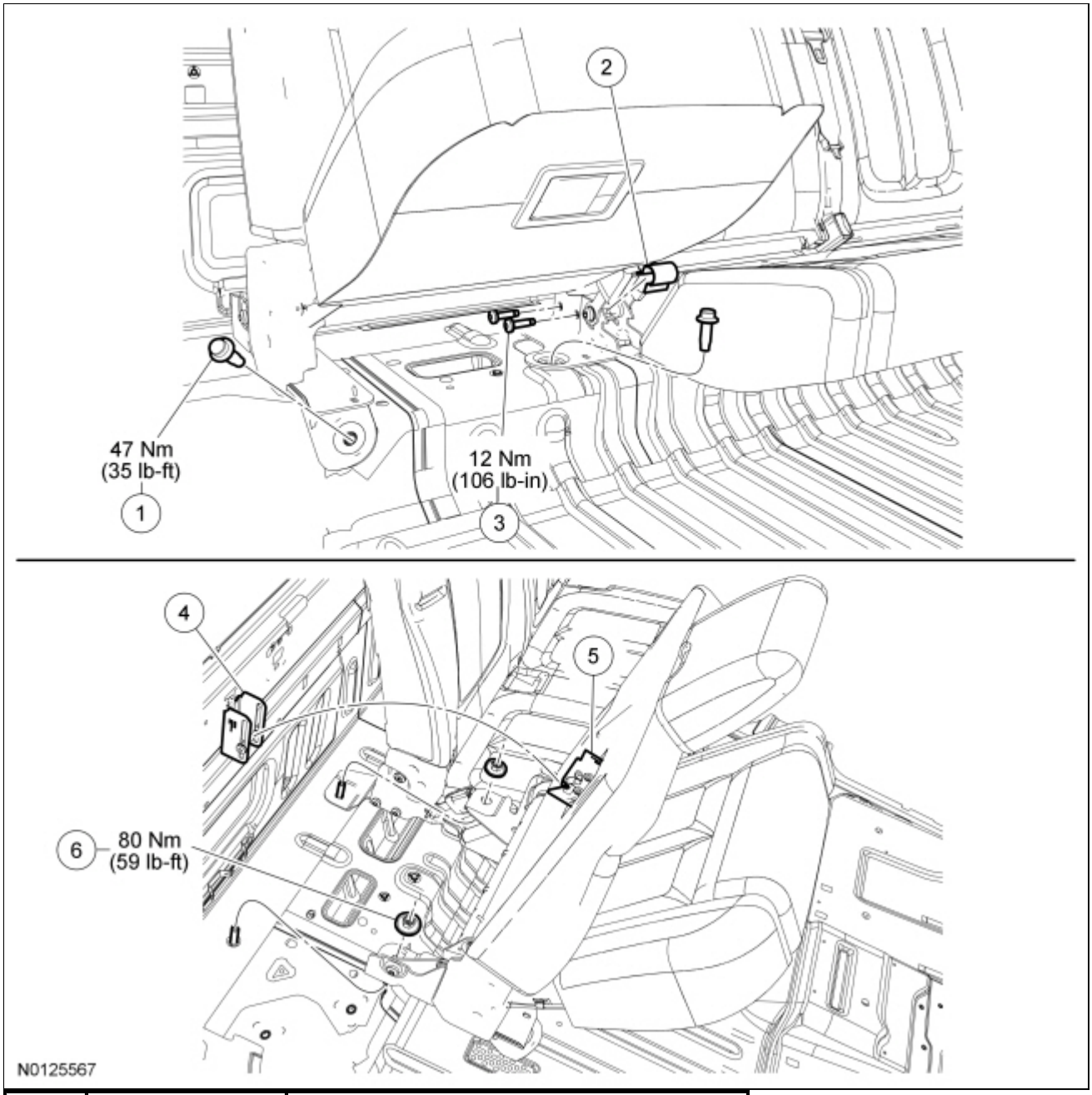
6. Repower the SRS . **If a passenger seat has been serviced, do not prove out the SRS at this time** . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

7. Position the seat forward and install the 2 rear seat mounting bolts and covers.
   - Tighten to 55 Nm (41 lb-ft).

8. For passenger seat, carry out the Occupant Classification System (OCS) System Reset. For additional information, refer to the General Procedures portion of Section 501-20B .

Seat — Rear, Crew Cab, 40 Percent

40 Percent Seat



Item	Part Number	Description
1	W710721	Front seat bolt (2 required)
2	—	Safety belt buckle bolt cover
3	N806910	Seat connecting bolt (2 required)

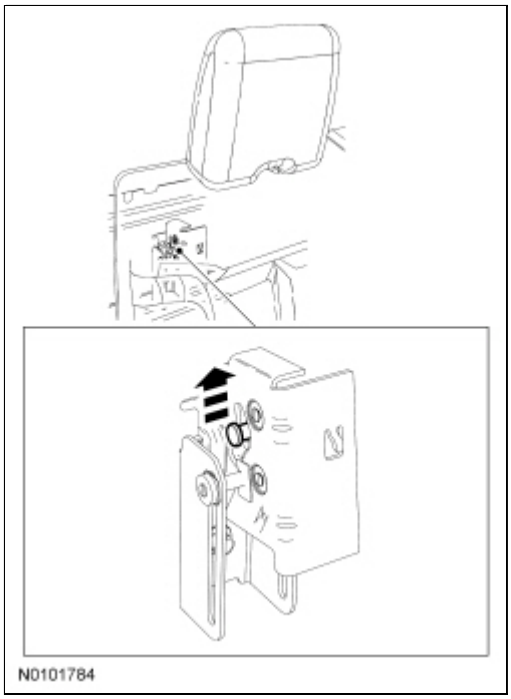
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4	62452	Striker
5	61383	Backrest latch
6	W708731	Rear seat nut (2 required)

Removal

1. Raise the seat cushion and remove the 2 front seat bolts.
2. Remove the 2 seat connecting bolts.
3. Remove the safety belt buckle bolt cover.
4. **NOTE:** The seat backrest latch is only accessible when the seat cushion is raised.

   Release the backrest latch.
   - From behind the backrest, pull up on the latch release and pull the backrest forward.
   - Release the cushion latch and lower the cushion and backrest.



5. If equipped with heated seats, disconnect the electrical connector.
6. Remove the 2 rear seat nuts and seat.

Installation

1. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   Position the seat in the vehicle and raise the backrest and cushion but do not latch the backrest at this time.

2. Install the 2 seat connecting bolts.
    - Tighten to 12 Nm (106 lb-in).

3. Install the outboard front seat bolt.
    - Tighten to 47 Nm (35 lb-ft).

4. Install the inboard front seat bolt.
    - Tighten to 47 Nm (35 lb-ft).

5. Lower the cushion and backrest and install the 2 rear seat nuts.
    - Tighten to 80 Nm (59 lb-ft).

6. If equipped with heated seats, connect the electrical connector.

7. Raise and latch the backrest.
    - Slide the striker pin up/down and align to the backrest latch.
    - Make sure the backrest is fully latched.

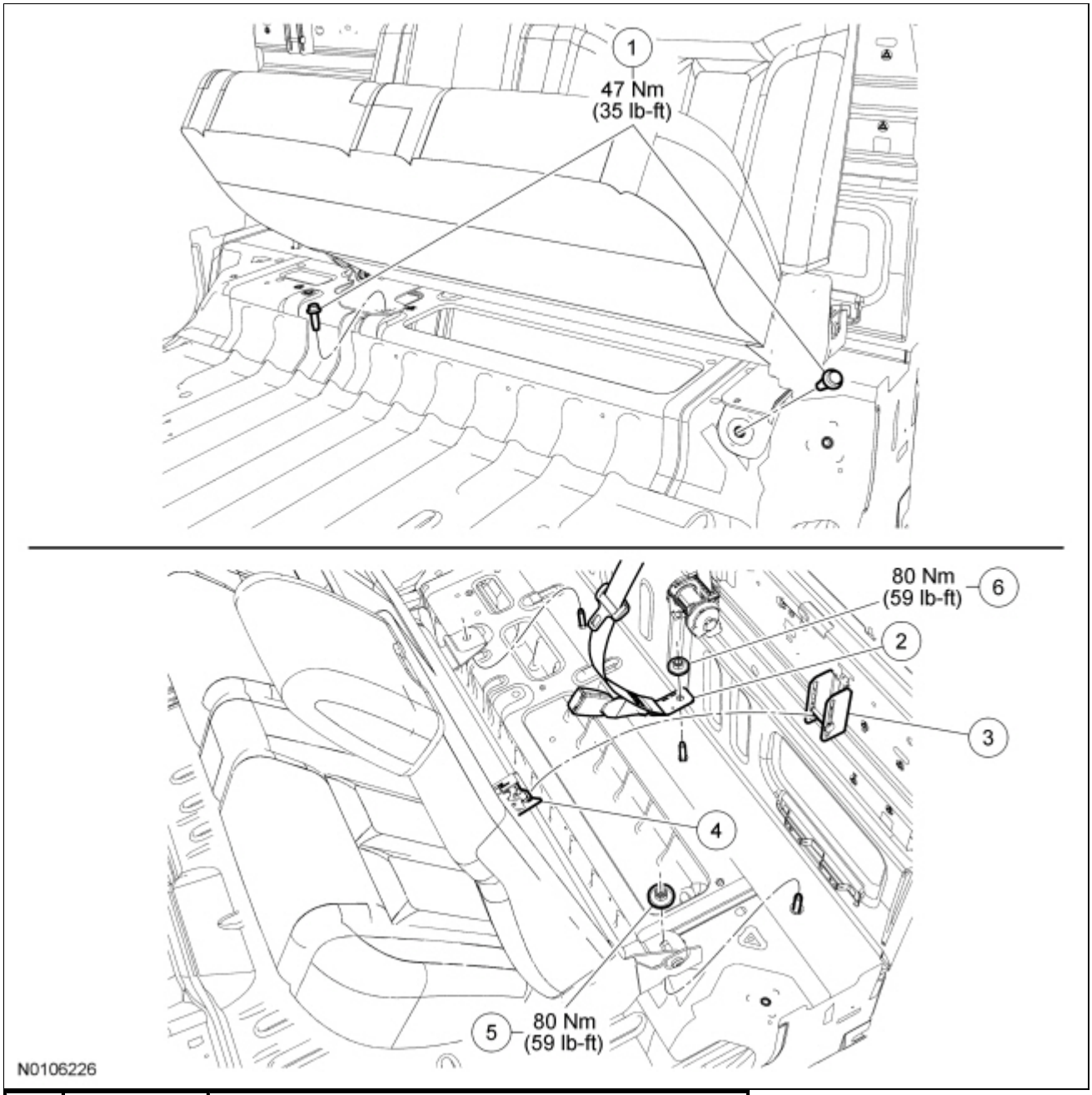
8. Install the safety belt buckle bolt cover.

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Seat — Rear, Crew Cab, 60 Percent

60 Percent Seat



Item	Part Number	Description
1	W710721	Front seat bolts (2 required)
2	—	Safety belt retractor anchor and buckle (part of 611B64)

3	62452	Striker
4	61383	Backrest latch
5	W708731	Rear seat nut
6	W708731	Safety belt retractor anchor nut

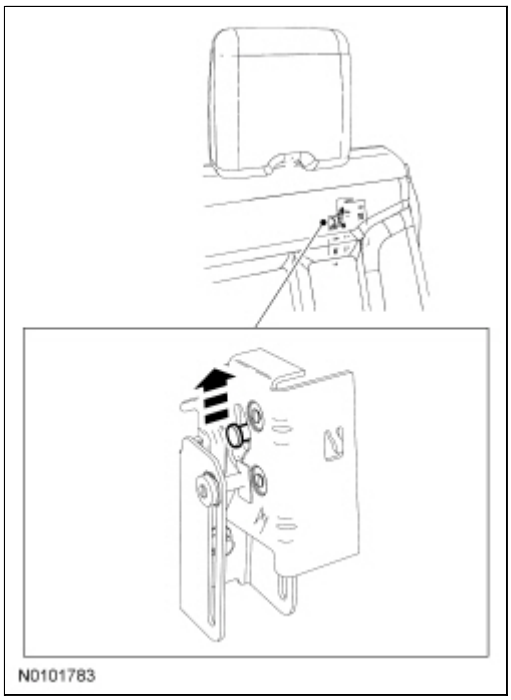
Removal

1. Remove the 40 percent seat. For additional information, refer to Seat — Rear, Crew Cab, 40 Percent in this section.

2. Raise the seat cushion and remove the 2 front seat bolts.

3. **NOTE:** The seat backrest latch is only accessible when the seat cushion is raised.

   Release the backrest latch.
   - From behind the backrest, pull up on the latch release and pull the backrest forward.
   - Release the cushion latch and lower the cushion and backrest.



4. If equipped with heated seats, disconnect the electrical connector.

5. Remove the safety belt retractor anchor nut.
   - Pull the safety belt retractor anchor and buckle through the seat cushion.

6. Remove the rear seat nut and seat.

Installation

1. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

repair4less

Position the seat in the vehicle and raise the backrest and cushion but do not latch the backrest at this time.

2. Install the outboard front seat bolt.
    - Tighten to 47 Nm (35 lb-ft).

3. Install the inboard front seat bolt.
    - Tighten to 47 Nm (35 lb-ft).

4. Lower the cushion and backrest and install the rear seat nut.
    - Tighten to 80 Nm (59 lb-ft).

5. Install the safety belt retractor anchor and buckle through the seat cushion and install the nut.
    - Tighten to 80 Nm (59 lb-ft).

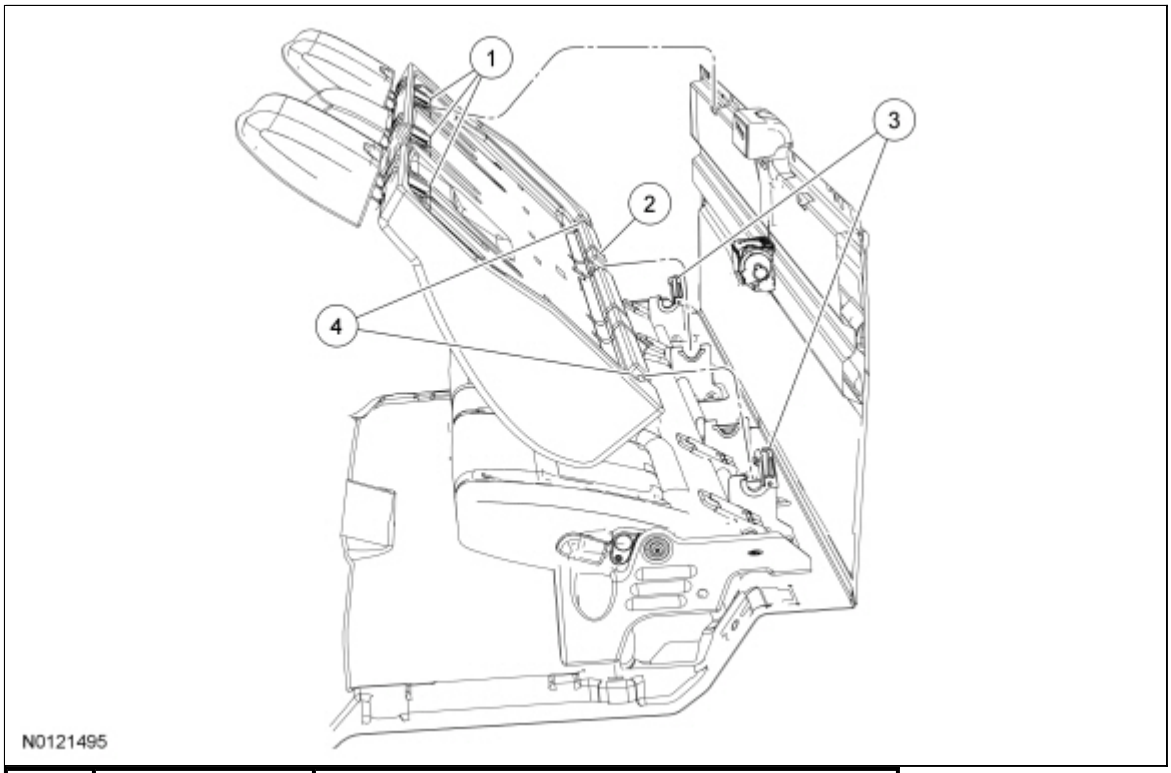
6. If equipped with heated seats, connect the electrical connector.

7. Raise and latch the backrest.
    - Slide the striker pin up/down and align to the backrest latch.
    - Make sure the backrest is fully latched.

8. Install the 40 percent seat. For additional information, refer to Seat — Rear, Crew Cab, 40 Percent in this section.

Seat — Rear, SuperCab

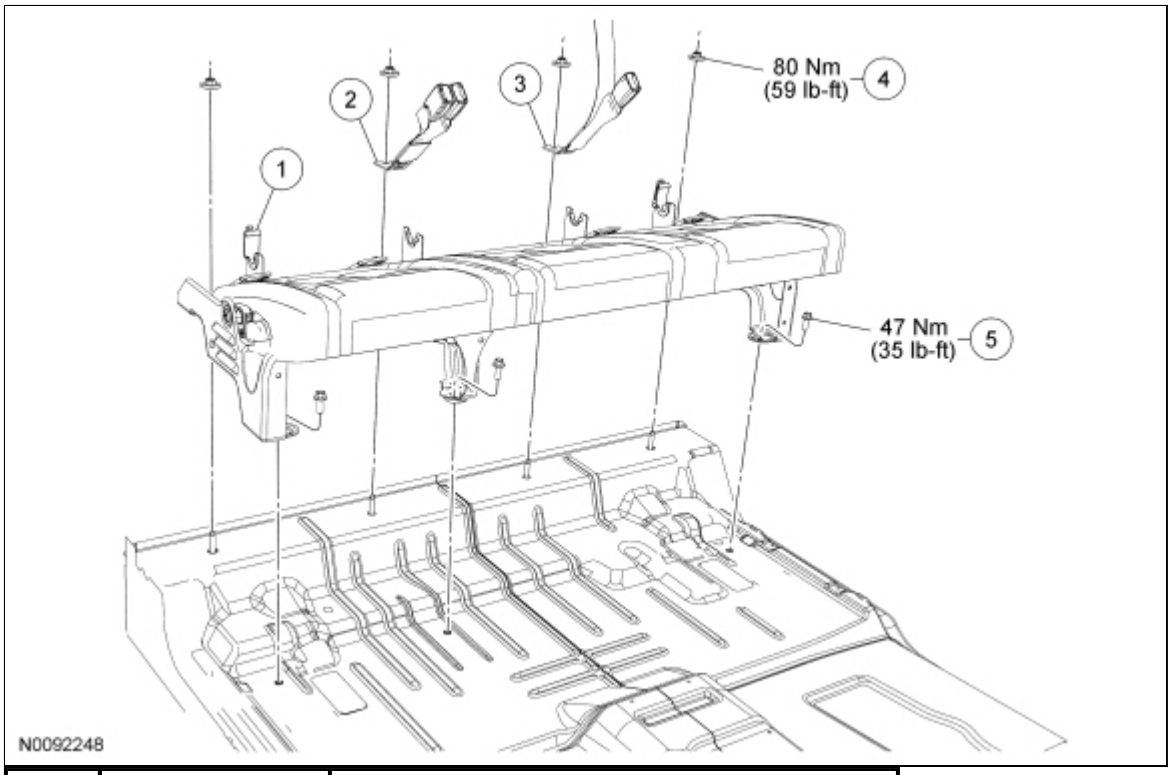
Seat Backrest



Item	Part Number	Description
1	613F60	Upper clips (3 required)
2	—	Backrest frame guide (part of 613A38)
3	613F60	Backrest latches (2 required)
4	—	Locking tabs (part of 613A38)

Seat Cushion

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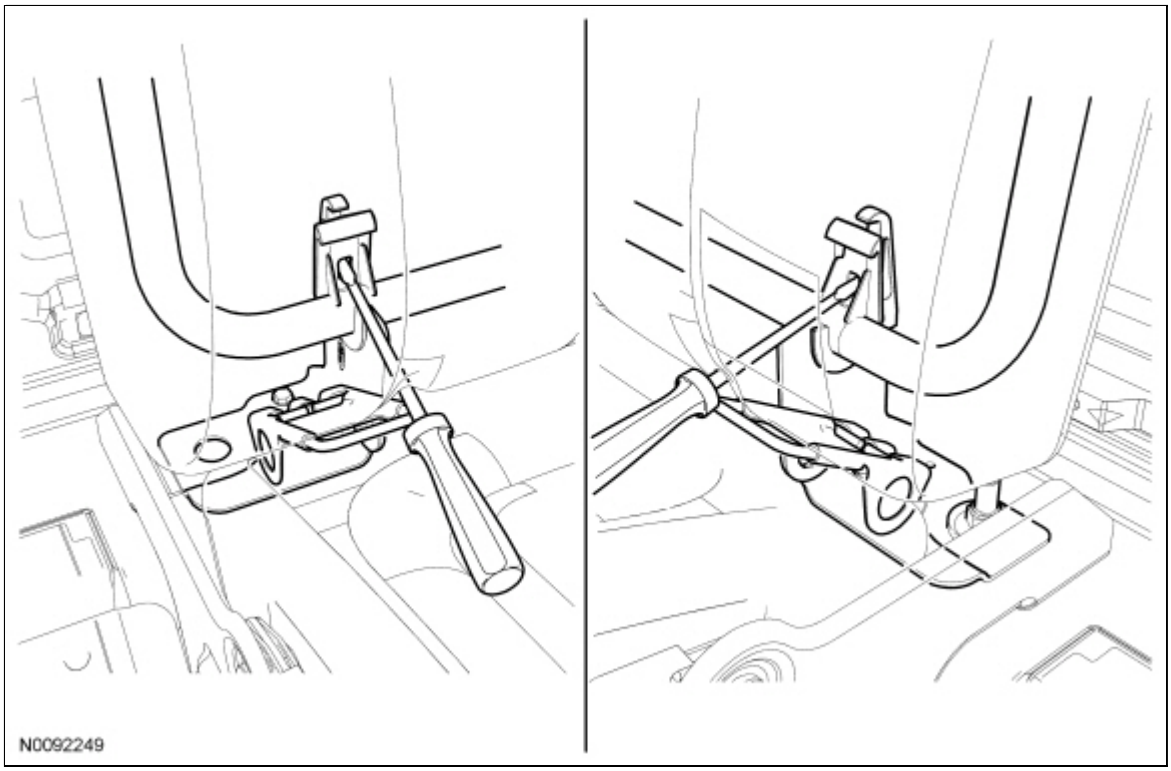


Item	Part Number	Description
1	613F60	Backrest latch (2 required)
2	60044	Safety belt buckle
3	—	Safety belt anchor (part of 611B64)
4	W708731	Rear seat nut (4 required)
5	W710721	Front seat bolt (3 required)

Removal

Seat backrest removal

1. Release the 2 backrest latches.
    - Locate the 2 access holes in the backrest frame aligned with the inboard edge of the child safety seat anchors and insert a suitable tool through the access holes.
        - Be careful not to damage the seat trim covers.
    - Push in and release the 2 backrest latches.
        - Push the backrest down slightly to allow the latches to release, then raise the backrest away from the latch.



2. Raise the backrest and release the upper clips.

3. Route the backrest through the center safety belt webbing and remove.

Seat cushion removal

4. With the backrest removed, remove the 4 rear seat nuts.
    - Position the rear center safety belt anchor aside.
    - Remove the safety belt buckle.

5. Remove the spare tire jack to access the front seat bolts.

6. Remove the 3 front seat bolts and seat cushion.

Installation

NOTE: Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

Seat cushion installation

1. Position the seat cushion in the vehicle.

2. Install the 3 front seat bolts.
    - Tighten to 47 Nm (35 lb-ft).

3. Install the rear center safety belt anchor, safety belt buckle and 4 rear seat nuts.
    - Tighten to 80 Nm (59 lb-ft).
    - Route the safety belt buckle through the elastic strap.

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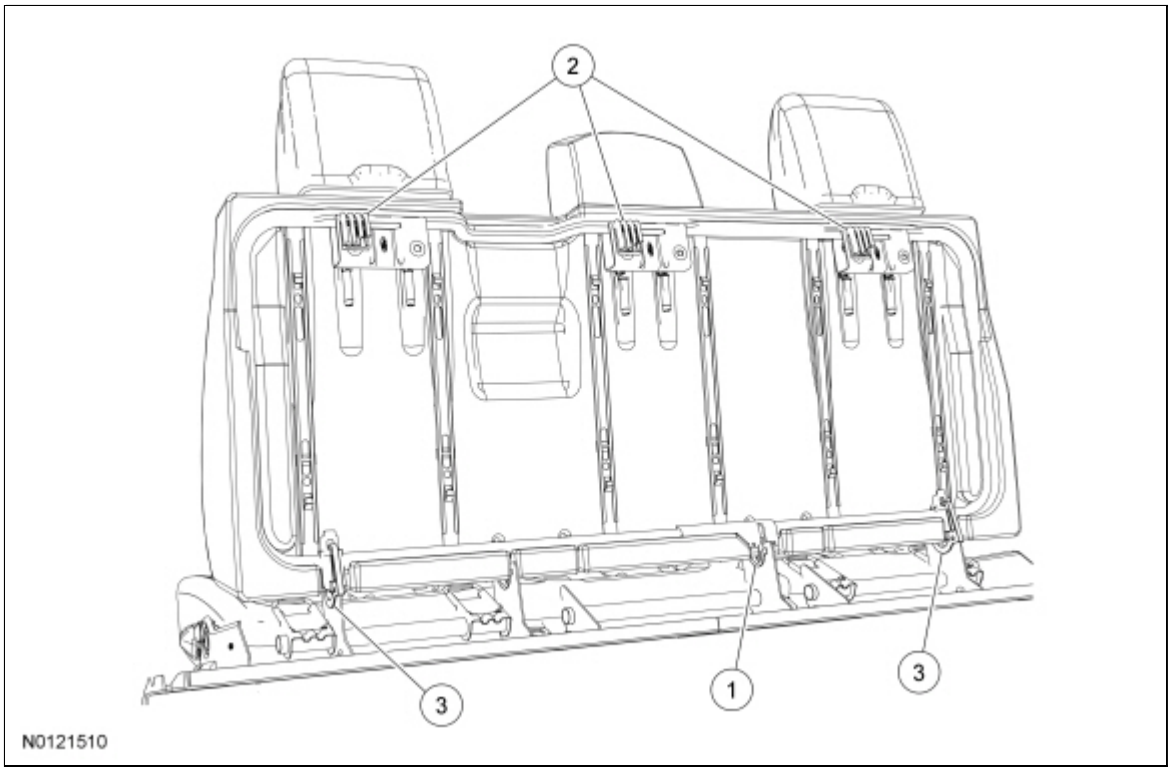
4. Install the spare tire jack.

Seat backrest installation

5. Route the backrest through the center safety belt webbing and position in the vehicle.

NOTE: Cab back panel not shown for clarity.

6. Install the backrest.
    1. Align the backrest frame guide to the cushion frame.
    2. Align the 3 upper clips to the rear cab sheet metal.
    3. Press down on the backrest until the 2 backrest latches engage.
        - Make sure all 3 upper clips are engaged and both backrest latches are locked.



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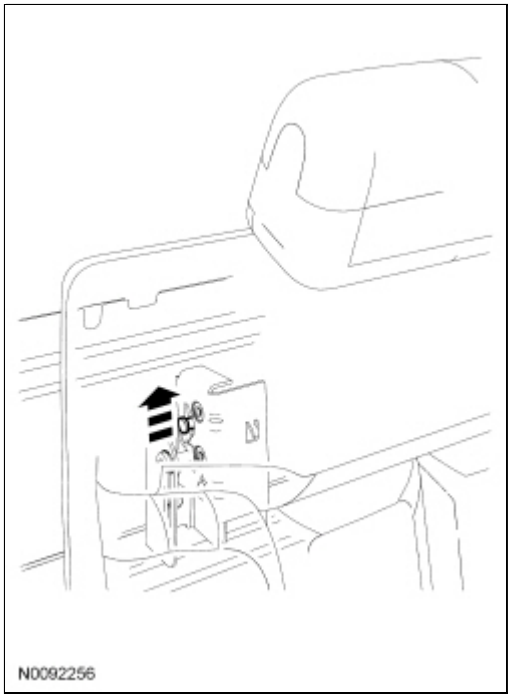
Seat Armrest — Rear, Crew Cab

Removal and Installation

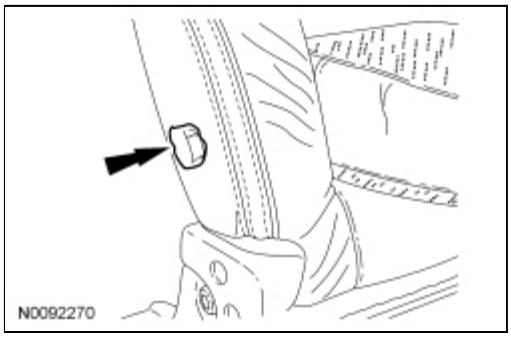
NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. **NOTE:** The seat backrest latch is only accessible when the seat cushion is raised.

   Release the backrest latch on the 40 percent seat and lower the backrest.
   - From behind the backrest, pull up on the latch release and pull the backrest forward.
   - Release the cushion latch and lower the cushion and backrest.



2. Remove armrest bolt through the access hole on the inboard edge of the 60 percent seat backrest.
   - To install, tighten to 25 Nm (18 lb-ft).



3. Push the armrest to the inboard side of the seat to disengage the pivot and remove the armrest.

4. To install, reverse the removal procedure.

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Seat Backrest — Front, Center

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front, Center in this section.

1. Remove the seat. For additional information, refer to Seat — Front, Center in this section.

2. Remove the rear cupholder.
   - Remove the 2 rear cupholder screws.
   - If equipped, disconnect the power point electrical connector.

3. Remove the LH side shield.
   - Remove the 2 LH side shield screws.
   - Release the pin-type retainer.

4. Remove the backrest latch cover.

5. Remove the backrest stop bolt.
   - To install, tighten to 18 Nm (159 lb-in).

6. Remove the backrest pivot bolt.
   - To install, tighten to 45 Nm (33 lb-ft).

7. Remove the safety belt anchor bolt.
   - To install, tighten to 45 Nm (33 lb-ft).

8. Remove the 2 backrest latch upper bolts and backrest.
   - To install, tighten to 60 Nm (44 lb-ft).

9. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

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Seat Backrest — Front

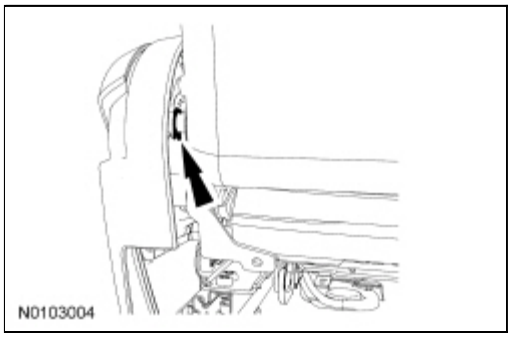
Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

All seats

1. Remove the seat. For additional information, refer to Seat — Front in this section.

2. For SuperCab, remove the manual recline handle, if equipped.
   - Insert an appropriate tool behind the cushion side shield, release the retainer and remove the handle.



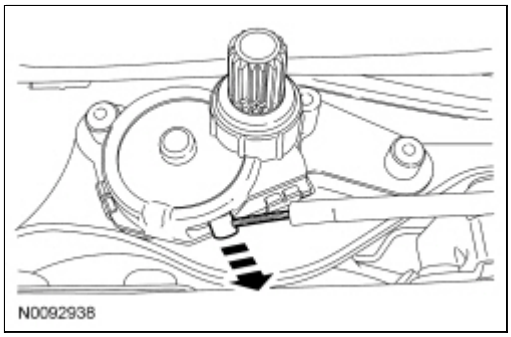
3. If equipped, remove the adjustable lumbar knob.
   - Adjust the lumbar until fully relaxed.
   - Release the retainer and remove the knob.

4. Remove the side shield insert.
   - Release the lower retainers and lift to release the upper retainers.
   - If equipped, disconnect the seat control switch and memory SET switch electrical connectors.

5. Remove the side shield.
   - Remove the front and rear side shield screws.
   - Pull the side shield outward to release the retainers and remove.
   - Reinstall all retainers back to the side shield.

6. Release the cushion cover rear J-clip and rear flaps.

7. If equipped, detach the cable from the lumbar adjuster, release the pin-type retainer and route out the cable from the cushion frame.
   - Note cable routing for correct installation.



Power and climate controlled seats

8. Disconnect the backrest wiring harness electrical connector and detach the wiring harness pin-type retainers from the seat track.
    - Note wiring harness routing for correct installation.

All seats

9. Disconnect and detach the side air bag wiring harness electrical connector from the seat track.
    - Note wiring harness routing for correct installation.

10. **WARNING: Use care when the seat back frame is removed and when releasing the recliners from a backrest upright position. The recliners are spring-loaded, which may cause the recliner upper arms to fold with significant speed/force. Failure to follow this instruction may result in serious personal injury.**

    Remove the 4 bolts and seat backrest.
    - To install, tighten to 45 Nm (33 lb-ft).

11. To install, reverse the removal procedure.

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Seat Backrest — Rear, Crew Cab

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the seat. For additional information, refer to Seat — Rear, Crew Cab, 40 Percent or Seat — Rear, Crew Cab, 60 Percent in this section.

2. Remove the 2 screws and inboard side shield.

3. Remove the screw and outboard side shield.
   - If detached, return the retainer clip to the side shield before installation.

4. If equipped, disconnect the cushion heater mat electrical connector.

5. Remove the 2 backrest pivot bolts and backrest.
   - To install, tighten to 25 Nm (18 lb-ft).

6. To install, reverse the installation procedure.

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Seat Backrest Cover — Front, Center

Removal and Installation

NOTE: The seat backrest cover on a backrest equipped with storage tray is not serviceable separately. A new backrest must be installed. For additional information, refer to Seat Backrest — Front, Center in this section.

NOTE: For parts identification and location, refer to Seat — Exploded View, Front, Center in this section.

1. Remove the seat backrest. For additional information, refer to Seat Backrest — Front, Center in this section.
2. Un-tuck the zipper and open the backrest cover.
3. Invert the backrest cover and remove the hog rings.
4. Remove the backrest cover.
5. To install, reverse the removal procedure.

Seat Backrest Cover — Front

Removal and Installation

WARNING: Front seat backrest trim covers installed on seats equipped with seat side airbags cannot be repaired. A new trim cover must be installed. Cleaning is permissible. Failure to follow these instructions may result in the seat side airbag deploying incorrectly and increase the risk of serious personal injury or death in a crash.

NOTE: If a side air bag deployment took place, a new seat backrest foam pad, backrest trim cover, deployment chute and side air bag module and nuts must be installed. A new seat backrest frame should be installed if necessary.

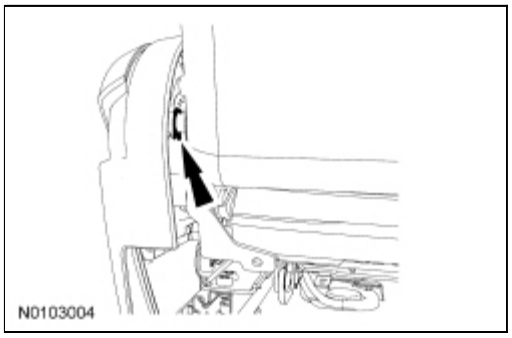
NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat. For additional information, refer to Seat — Front in this section.

2. Remove the 2 head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.

3. Release the backrest cover J-clip and unzip the 2 zippers.
   - Route the J-clip between the seat cushion and backrest.

4. For SuperCab, remove the manual recline handle, if equipped.
   - Insert an appropriate tool behind the cushion side shield, release the retainer and remove the handle.



5. If equipped, remove the adjustable lumbar knob.
   - Adjust the lumbar until fully relaxed.
   - Release the retainer and remove the knob.

6. Remove the side shield insert.
   - Release the lower retainer clips and lift to release the upper retainer tabs.
   - If equipped, disconnect the seat control switch electrical connector.
   - If equipped, disconnect the memory SET switch electrical connector.

7. Remove the side shield.

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- Remove the front and rear side shield screws.
- Pull the side shield outward to release the retainers and remove.
- Remove any retainers remaining in the seat track and reinstall them to the side shield.

8. **WARNING: Always carry a live airbag with the deployment door, trim cover or tear seam pointed away from the body. Do not place a live airbag down with the deployment door, trim cover or tear seam facing down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**

   WARNING: Before installing the seat side air bag module/deployment chute assembly:
   - **Inspect the side air bag module and mounting surfaces for any damage or foreign material.**
   - **Remove any foreign material from the mounting surfaces of the deployment chute, the seat backrest frame mounting bracket and the air bag module cavity in the seat backrest foam pad.**
   - **Install new parts if damaged.**

   Failure to follow these instructions may result in the seat side air bag deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

   Remove the side air bag module.
   - Remove the 2 side air bag nuts.
     - To install, tighten to 9 Nm (80 lb-in).
   - Separate the side air bag module from the backrest frame and disconnect the electrical connector.
   - Slide the side air bag module out of the deployment chute.
   - Route the deployment chute through the opening in the backrest foam pad.

9. ***NOTICE:*** **Use care when separating the seat backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the foam pad.**

   Release the J-clip from the backrest frame and partially invert the backrest cover to the row of hog rings.

10. Remove all the hog rings and backrest cover.
    - For climate controlled seat, before installation, make sure the backrest manifold is correctly fitted into the valleys in the foam pad.

11. To install, reverse the removal procedure.

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Seat Backrest Cover — Rear, Crew Cab

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the seat. For additional information, refer to Seat — Rear, Crew Cab, 40 Percent or Seat — Rear, Crew Cab, 60 Percent in this section.

2. For 60 percent seat, remove the backrest. For additional information, refer to Seat Backrest — Rear, Crew Cab in this section.

NOTE: 60 percent seat has 4 head restraint guides. 40 percent seat 2 head restraint guides.

3. Remove and discard the head restraint guides. For additional information, refer to Head Restraint Guide Sleeve in this section.

4. If equipped, remove the armrest. For additional information, refer to Seat Armrest — Rear, Crew Cab in this section.

5. Release the lower J-clip.
   - If 40 percent seat equipped with heat, disconnect the cushion heater mat electrical connector.

6. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip or the hook-and-loop strip can be torn from the foam pad.**

   Partially invert the backrest cover.
   - For 60 percent seat, release the center J-clip(s) and armrest cavity retainers, if equipped.

7. Remove all the hog rings attaching the backrest cover to the foam pad.
   - If needed, remove the hog rings attaching the foam pad to the backrest frame and disconnect the backrest heater mat electrical connector (if equipped).

8. To install, reverse the removal procedure.

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Seat Backrest Cover — Rear, SuperCab

Removal and Installation

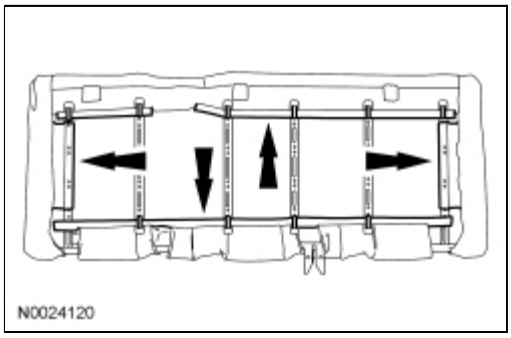
NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, SuperCab in this section.

1. Remove the rear seat backrest. For additional information, refer to Seat — Rear, SuperCab in this section.

2. Push the release buttons and remove the 3 head restraints.

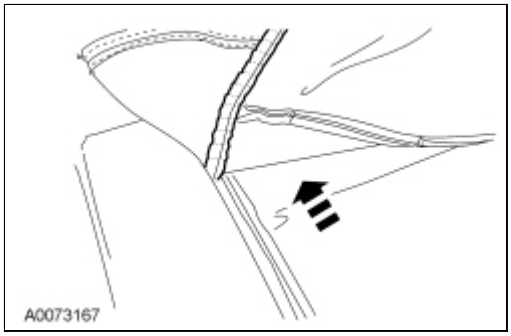
3. Remove and discard the 6 head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.
   - To install, install 6 new head restraint guide sleeves.

4. Release all the backrest cover J-clips and retainer strips.

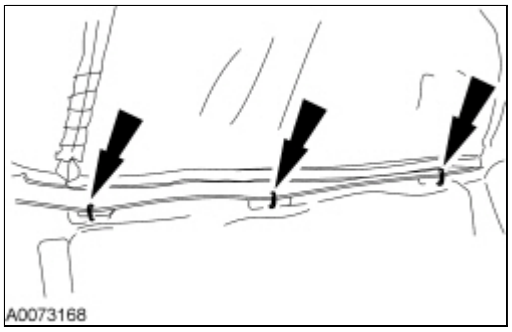


5. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the foam pad.**

   Invert the backrest cover and separate the hook-and-loop strips.



6. Remove the hog rings and backrest cover.
   - If required, remove the hog rings from the backrest frame and separate from the foam pad.



7. To install, reverse the removal procedure.

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Seat Backrest Heater Mat — Front

Removal

NOTICE: **The heater mat is not designed to be separated from the foam pad. Doing so will damage the foam pad. Install a new foam pad and heater mat. Failure to follow this instruction can result in seat component damage and system failure.**

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat backrest cover. For additional information, refer to Seat Backrest Cover — Front in this section.

2. Disconnect the backrest heater mat electrical connector and detach the wiring harness.
   - Note wire harness routing for correct installation.

3. Remove the backrest foam pad with heater mat and discard.

Installation

WARNING: Never install heated seat parts not intended for use on this vehicle. Parts released for other model years or vehicle lines are not compatible even if they appear visually and physically similar. Installing incorrect parts will result in heated seat system performance outside design specification. Failure to follow this instruction may result in serious personal injury.

1. Install the backrest foam pad to the backrest frame.

2. ***NOTICE:*** **Remove the paper strip covering the adhesive before adhering the heater mat to the foam pad. Otherwise, damage to the seat can occur.**

   NOTE: When adhering the heater mat to the foam pad, be sure to position the heater mat so it is straight and free of any wrinkles that may show through the cover material after installation.

   Install the heater mat to the foam pad.
   - Align the heater mat square to the seat backrest with the narrow area of the heater mat tucked into the valley of the foam pad and the wiring toward the lower edge.
   - Align the upper windows of the heater mat over the listing wire in the foam pad to allow for hog ring installation when the backrest cover is installed.
   - Firmly apply the heater mat to the foam pad and rub to seal the adhesive.

3. Route the electrical connector and wire harness through the hole at the bottom of the foam pad, fasten the wire harness and connect the electrical connector.

4. Install the seat backrest cover. For additional information, refer to Seat Backrest Cover — Front in this section.

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Seat Backrest Heater Mat — Rear

Removal

NOTICE: **The heater mat is not designed to be separated from the foam pad. Doing so will damage the foam pad. Install a new foam pad and heater mat. Failure to follow this instruction can result in seat component damage and system failure.**

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the seat backrest cover. For additional information, refer to Seat Backrest Cover — Rear, Crew Cab in this section.
   - For 40 percent seat, disconnect the cushion heater mat electrical connector.

2. Disconnect and detach the backrest heater mat electrical connector.
   - Note the wire harness routing for correct installation.

3. Remove the backrest foam pad with heater mat and discard.

Installation

1. Install the backrest foam pad to the backrest frame.

2. ***NOTICE:*** **Remove the paper strip covering the adhesive before adhering the heater mat to the foam pad. Otherwise, damage to the seat can occur.**

   NOTE: When adhering the heater mat to the foam pad, be sure to position the heater mat so it is straight and free of any wrinkles that may show through the cover material after installation.

   Install the heater mat to the foam pad.
   - Align the heater mat square to the seat with the wiring toward the lower edge and tuck the narrow areas into the valley of the foam pad.
   - Align the upper windows of the heater mat over the listing wire in the foam pad to allow for hog ring installation when the backrest cover is installed.
   - Firmly apply the heater mat to the foam pad and rub to seal the adhesive.

3. Route the wire harness through the hole in the foam pad, attach and connect the electrical connector.

4. Install the seat backrest cover. For additional information, refer to Seat Backrest Cover — Front in this section.
   - For 40 percent seat, connect the cushion heater mat electrical connector.

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Seat Backrest Latch — Rear, Crew Cab

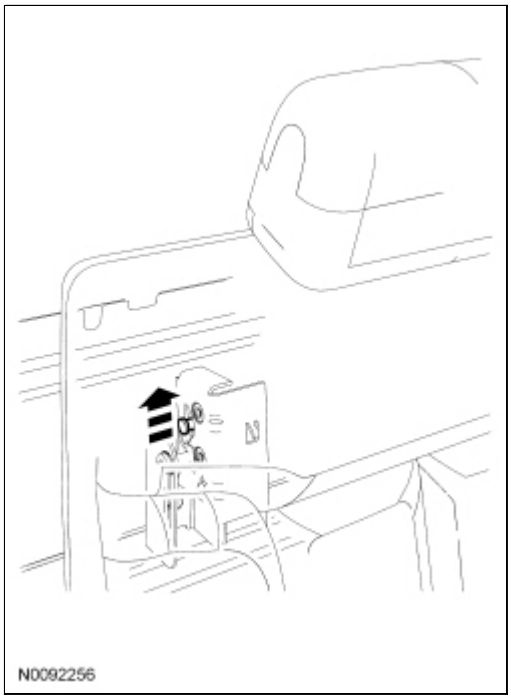
Removal and Installation

NOTE: RH shown, LH similar.

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. **NOTE:** The seat backrest latch is only accessible when the seat cushion is raised.

   Release the backrest latch.
   - From behind the backrest, pull up on the latch release and pull the backrest forward.
   - Release the cushion latch and lower the cushion and backrest.



2. Remove the 2 bolts and backrest latch.
   - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

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Seat Backrest Thermo-Electric Device

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Position the seat backrest fully forward.
2. Release the backrest cover J-clip and unzip the 2 zippers.
3. Disconnect the Thermo-Electric Device (TED) electrical connector.
4. Detach the pin-type retainer attaching the TED duct to the backrest frame.
5. Un-hook the TED from the backrest support wire and remove.
    - If equipped with power lumbar, note cable routing for correct installation.
6. To install, reverse the removal procedure.

Seat Control Switch

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. If equipped, remove the adjustable lumbar knob.
   - Adjust the lumbar until fully relaxed.
   - Release the retainer and remove the knob.

2. Remove the side shield insert.
   - Release the lower retainers and lift to release the upper retainers.
   - Disconnect the seat control switch electrical connector.
   - If equipped, disconnect the memory SET switch electrical connector.

3. Remove the seat control switch button.

4. If equipped, remove the recliner switch button.

5. Release the retaining tabs and remove switch.

6. To install, reverse the removal procedure.

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Seat Cushion Cover — Front, Center

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front, Center in this section.

1. Remove the seat. For additional information, refer to Seat — Front, Center in this section.

2. Remove the rear cupholder.
   - Remove the 2 rear cupholder screws.
   - If equipped, disconnect the power point electrical connector.

3. Remove the RH side shield.
   - Release the pin-type retainer.

4. Remove the LH side shield.
   - Remove the 2 LH side shield screws.
   - Release the pin-type retainer.

5. Remove the 2 cushion pivot bolts and cushion assembly.
   - To install, tighten to 35 Nm (26 lb-ft).

6. Remove the 2 cushion release handle screws and cushion release handle.

7. ***NOTICE:*** **Use care when separating the seat cushion cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the cushion foam pad.**

   Release the J-clip, invert the cushion cover and remove.

8. To install, reverse the removal procedure.

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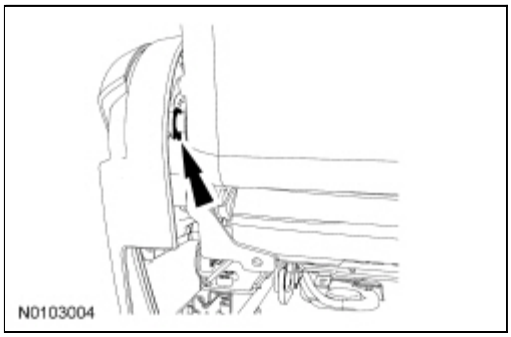
Seat Cushion Cover — Front

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat. For additional information, refer to Seat — Front in this section.

2. For SuperCab, remove the manual recline handle, if equipped.
   - Insert an appropriate tool behind the cushion side shield, release the retainer and remove the handle.



3. If equipped, remove the adjustable lumbar knob.
   - Adjust the lumbar until fully relaxed.
   - Release the retainer and remove the knob.

4. Remove the side shield insert.
   - Release the lower retainers and lift to release the upper retainers.
   - If equipped, disconnect the seat control switch electrical connector.
   - If equipped, disconnect the memory SET switch electrical connector.

5. Remove the side shield.
   - Remove the front and rear side shield screw.
   - Pull the cushion side shield outward to release the retainers.
   - Reinstall all retainers back to the side shield.

6. Release cushion cover rear J-clip and rear flaps.

7. If equipped, disconnect the cushion heater mat electrical connector and detach the wiring harness.

8. Release all the cushion cover retainers and remove the cover and foam pad.

9. ***NOTICE:*** **Use care when separating the seat cushion cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the foam pad.**

   Remove all the hog rings and cushion cover.
   - For correct installation, make sure the rear strap on the cushion cover is looped around the

cushion foam pad.

- For climate controlled seat, before installation, make sure the cushion manifold is correctly fitted into the valleys of the foam pad.

10. To install, reverse the removal procedure.

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Seat Cushion Cover — Rear, Crew Cab

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

NOTE: 40 percent seat shown, 60 percent similar.

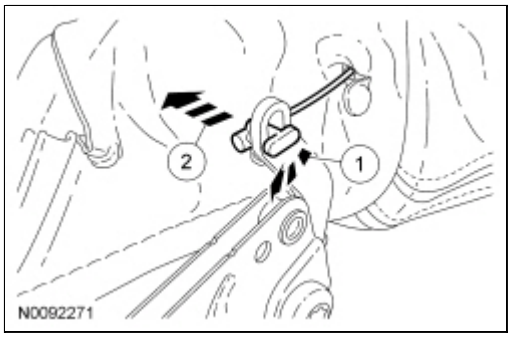
1. Remove the seat. For additional information, refer to Seat — Rear, Crew Cab, 40 Percent or Seat — Rear, Crew Cab, 60 Percent in this section.

2. If equipped, pry up to release the retainers and remove the accessory hook from the cushion bottom side.

3. Pry up to release the retainers and remove the latch bezel from the cushion bottom side.

4. Remove the screw and outboard side shield.

5. Detach the latch cable clamp.
    1. Rotate cable end to align with the slot in the clamp.
    2. Pull the cable end through the slot and separate from the clamp.



6. If equipped, disconnect the cushion heater mat electrical connector.

7. ***NOTICE:*** **Use care when separating the seat cushion cover from the hook-and-loop strip or the hook-and-loop strip can be torn from the foam pad.**

    Release the J-clip(s) and partially invert the cushion cover.
    - For 60 percent seat, remove the hog ring from the safety belt buckle sleeve.
    - Route the latch release cable through the cushion cover flap.

8. Remove all the hog rings and cushion cover.

9. To install, reverse the removal procedure.
    - Make sure the lower anchors and tethers for children are accessible.

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Seat Cushion Cover — Rear, SuperCab

Removal and Installation

NOTE: 40 percent and 60 percent rear seat cushion covers are removed in the same manor.

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, SuperCab in this section.

1. Remove the rear seat cushion. For additional information, refer to Seat — Rear, SuperCab in this section.
2. Release the cushion cover J-clip.
3. ***NOTICE:*** **Use care when separating the seat cushion cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the cushion foam pad.**

   Invert the cushion cover to the row of hog rings.
4. Remove the hog rings.
5. Invert and remove the cushion cover.
   - If needed, separate and remove foam pad from the cushion frame.
6. To install, reverse the removal procedure.

Seat Cushion Heater Mat — Front

Removal

NOTICE: **The heater mat is not designed to be separated from the foam pad. Doing so will damage the foam pad. Install a new foam pad and heater mat. Failure to follow this instruction can result in seat component damage and system failure.**

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat cushion cover. For additional information, refer to Seat Cushion Cover — Front in this section.

2. Remove the cushion foam pad with heater mat and discard.

Installation

WARNING: Never install heated seat parts not intended for use on this vehicle. Parts released for other model years or vehicle lines are not compatible even if they appear visually and physically similar. Installing incorrect parts will result in heated seat system performance outside design specification. Failure to follow this instruction may result in serious personal injury.

1. Install the cushion foam pad to the seat track.

2. ***NOTICE:*** **Remove the paper strip covering the adhesive before adhering the heater mat to the foam pad. Otherwise, damage to the seat can occur.**

   NOTE: When adhering the heater mat to the foam pad, be sure to position the heater mat so it is straight and free of any wrinkles that may show through the cover material after installation.

   Install the heater mat to the foam pad.
   - Align the heater mat square to the seat cushion with the narrow area of the heater mat tucked into the valley of the foam pad and the wiring toward the front edge.
   - Align the windows of the heater mat over the listing wire in the foam pad to allow for hog ring installation when the cushion cover is installed.
   - Firmly apply the heater mat to the foam pad and rub to seal the adhesive.

3. Fasten the wire harness and connect the electrical connector.

4. Install the seat cushion cover. For additional information, refer to Seat Cushion Cover — Front in this section.

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Seat Cushion Heater Mat — Rear

Removal

NOTICE: **The heater mat is not designed to be separated from the foam pad. Doing so will damage the foam pad. Install a new foam pad and heater mat. Failure to follow this instruction can result in seat component damage and system failure.**

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the seat cushion cover. For additional information, refer to Seat Cushion Cover — Rear, Crew Cab in this section.

2. Disconnect the cushion heater mat electrical connector.
   - Note the wire harness routing for correct installation.

3. Remove the cushion foam pad with heater mat and discard.

Installation

1. Install the cushion foam pad.

2. ***NOTICE:*** **Remove the paper strip covering the adhesive before adhering the heater mat to the foam pad. Otherwise, damage to the seat can occur.**

   NOTE: When adhering the heater mat to the foam pad, be sure to position the heater mat so it is straight and free of any wrinkles that may show through the cover material after installation.

   Install the heater mat to the foam pad.
   - Align the heater mat square to the seat with the wiring toward the rear edge and tuck the narrow areas into the valley of the foam pad.
   - Align the windows of the heater mat over the listing wire in the foam pad to allow for hog ring installation when the cushion cover is installed.
   - Firmly apply the heater mat to the foam pad and rub to seal the adhesive.

3. Route the wire harness through the hole in the foam pad and connect the electrical connector.

4. Install the seat cushion cover. For additional information, refer to Seat Cushion Cover — Front in this section.

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Seat Cushion Thermo-Electric Device

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat cushion cover. For additional information, refer to Seat Cushion Cover — Front in this section.

2. Remove the screw from the Thermo-Electric Device (TED) mounting bracket.

3. Remove the cushion TED .
   - Disconnect the electrical connector.
   - Detach the pin-type retainer and wiring harness.
   - Route the wiring harness and remove the TED .

4. To remove the TED mounting bracket, un-hook from the cushion support wires.

5. To install, reverse the removal procedure.

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Seat Latch — Front, Center

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front, Center in this section.

1. Remove the seat. For additional information, refer to Seat — Front, Center in this section.

2. Remove the rear cupholder.
   - Remove the 2 rear cupholder screws.
   - If equipped, disconnect the power point electrical connector.

3. Remove the backrest latch cover.

4. Remove the RH side shield.
   - Release the pin-type retainer.

5. Remove the 2 backrest latch upper bolts.
   - Lower the backrest to avoid damaging the pivot side.
   - To install, tighten to 60 Nm (44 lb-ft).

6. Remove the 2 backrest latch lower bolts and backrest latch.
   - To install, tighten to 45 Nm (33 lb-ft).

7. To install, reverse the removal procedure.

Seat Latch — Rear, Crew Cab

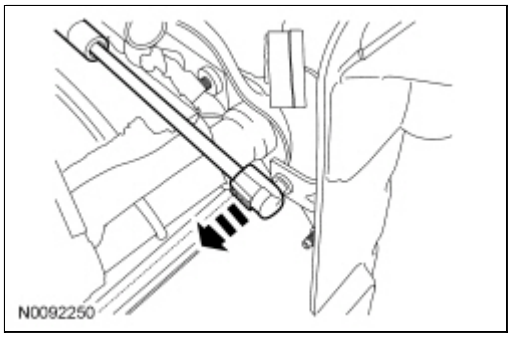
Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the seat cushion cover. For additional information, refer to Seat Cushion Cover — Rear, Crew Cab in this section.

2. Remove the 2 screws and latch release handle.
   - Release the cable retainer.
   - Note cable routing for correct installation.

3. For 60 percent seat, detach the assist spring strut from the outboard riser.



4. Remove the front and rear latch bolts.
   - To install, tighten to 32 Nm (24 lb-ft).

5. Remove the cushion pivot bolt, outboard riser and cushion latch.
   - To install, tighten to 32 Nm (24 lb-ft).

6. To install, reverse the removal procedure.

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Seat Latch — Rear, SuperCab

Removal and Installation

NOTE: 40 percent and 60 percent rear seat cushion latches are removed in the same manor.

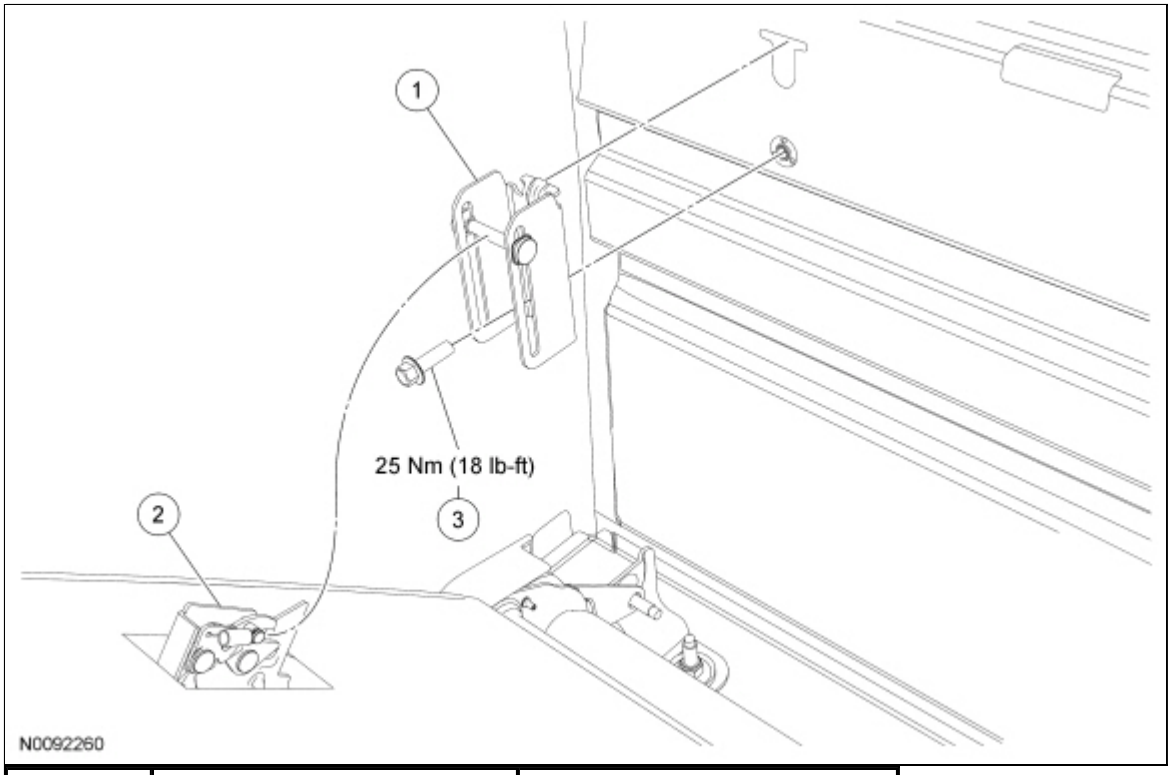
NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, SuperCab in this section.

1. Remove the rear seat. For additional information, refer to Seat — Rear, SuperCab in this section.
2. Remove the cushion pivot bolt.
   - To install, tighten to 33 Nm (24 lb-ft).
3. Remove the rear screw from the outboard riser.
   - Separate the cushion from the inboard riser to avoid pivot bushing damage.
   - To install, tighten to 6 Nm (53 lb-in).
4. Remove the rear latch bolt and outboard seat riser.
   - To install, tighten to 24 Nm (18 lb-ft).
5. Remove the screw and latch bolt cover.
6. Remove the front latch bolt and cushion latch.
   - To install, tighten to 32 Nm (24 lb-ft).
7. To install, reverse the removal procedure.

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Seat Latch Striker — Rear, Crew Cab

NOTE: 40 percent shown, 60 percent similar.



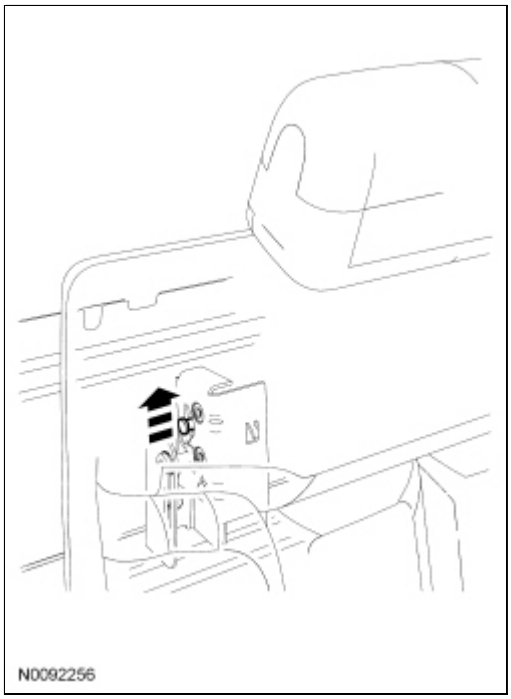
Item	Part Number	Description
1	62452	Striker
2	61383	Backrest latch
3	W505284	Striker bolt

Removal and Installation

1. **NOTE:** The seat backrest latch is only accessible when the seat cushion is raised.

   Release the backrest latch.
   - From behind the backrest, pull up on the latch release and pull the backrest forward.
   - Release the cushion latch and lower the cushion and backrest.
   - To install, slide the striker pin up/down and align to the backrest latch.

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2. Remove the bolt and striker.
    - To install, tighten to 25 Nm (18 lb-ft).

3. To install, reverse the removal procedure.
    - Make sure the backrest is fully latched when completed.

Seat Recliner Motor

Removal

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat. For additional information, refer to Seat — Front in this section.

2. For SuperCab with manual recliner, release the retainer and remove the handle.

3. Remove the side shield insert.
   - Release the lower retainers and lift to release the upper retainers
   - If equipped, disconnect the seat control switch electrical connector.
   - If equipped, disconnect the memory SET switch electrical connector.

4. Remove the side shield.
   - Remove the front and rear side shield screws.
   - Pull the cushion side shield outward to release the retainers.
   - Reinstall all retainers back to the side shield.

5. Release the backrest cover J-clip and unzip the 2 zippers.
   - Route the J-clip between the seat cushion and backrest.

6. If equipped, remove the backrest Thermo-Electric Device (TED). For additional information, refer to Seat Backrest Thermo-Electric Device in this section.

7. If equipped, remove the power lumbar. For additional information, refer to Lumbar Assembly — Power in this section.

8. If equipped, detach the manual adjustable lumbar from the backrest frame and position aside.
   - Pinch the lumbar retainers together to release from the backrest frame.
   - For installation, make sure the arrow is pointed up.

9. If equipped, disconnect the backrest heater mat electrical connector and detach the wire harness.

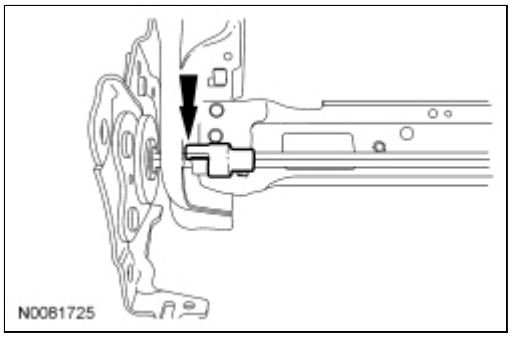
10. Push the backrest cover and foam pad away to gain access to the power recliner.

11. Remove the torque shaft retainer.

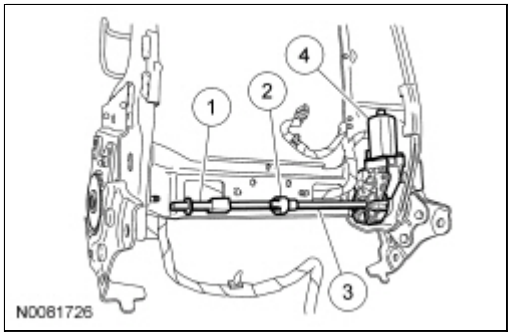
12. Remove the recline motor bolt.

13. Release the 2 clips (1 shown) and slide the sleeve back on the recliner torque shaft.

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14. Remove the power recline motor.
    1. Slide the recliner torque shaft assembly out of the recliner and remove the short torque shaft.
    2. Remove the sleeve from the long torque shaft.
    3. Slide the torque shaft out of the recline motor.
    4. Disconnect the electrical connector and remove the power recline motor.



15. To install, reverse the removal procedure.
    - If a new power recliner motor has been installed on a driver seat with memory, operate the recliner in both directions through the full range of travel to allow the Driver Seat Module (DSM) to correctly register recliner stop positions and prevent premature stooping points after repair is complete.

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Seat Track Motor — Front

Material

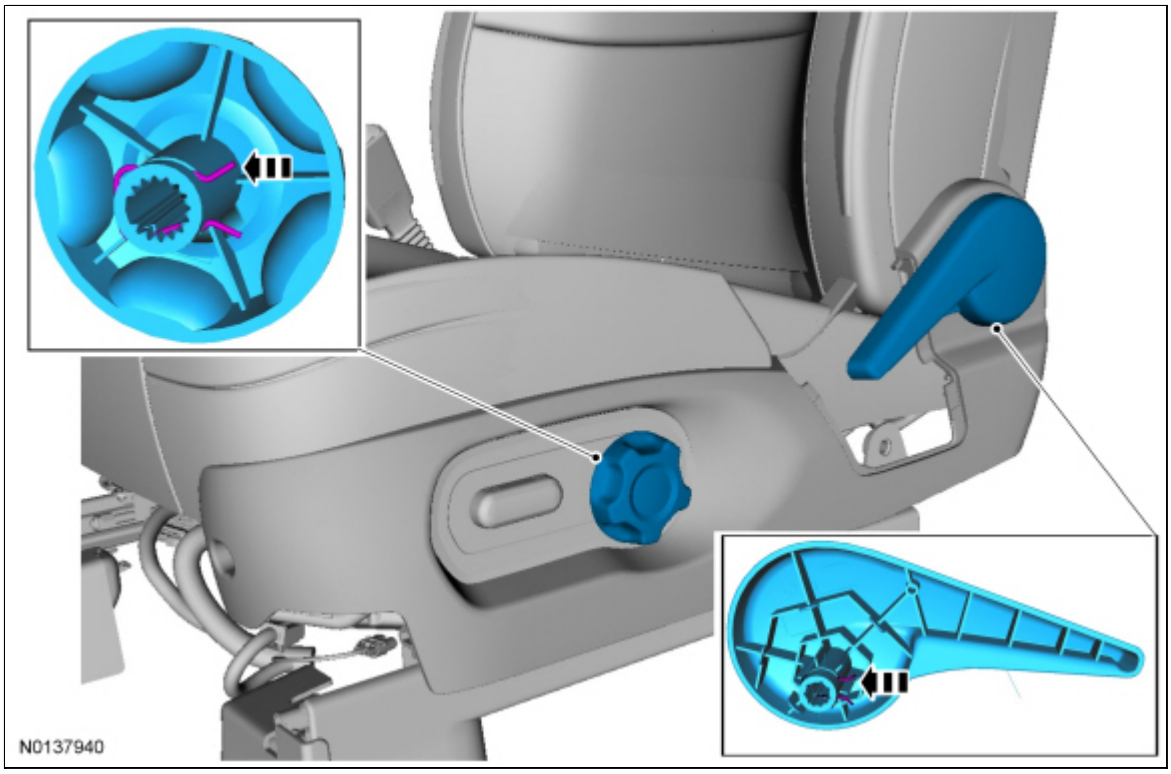
Item	Specification
Motorcraft® Threadlock and Sealer TA-25	WSK-M2G351-A5

Removal

WARNING: Wear protective gloves when handling components or parts that have pointed or sharp edges. Failure to follow this instruction may result in serious personal injury.

NOTE: Typical driver seat shown, others similar.

1. Remove the seat. Refer to Seat — Front .
2. If equipped.



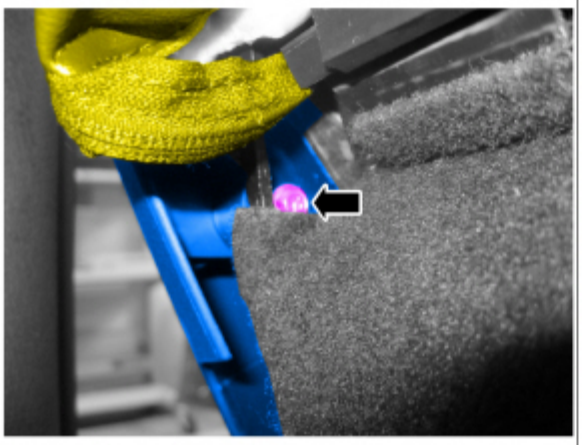
3. If equipped.

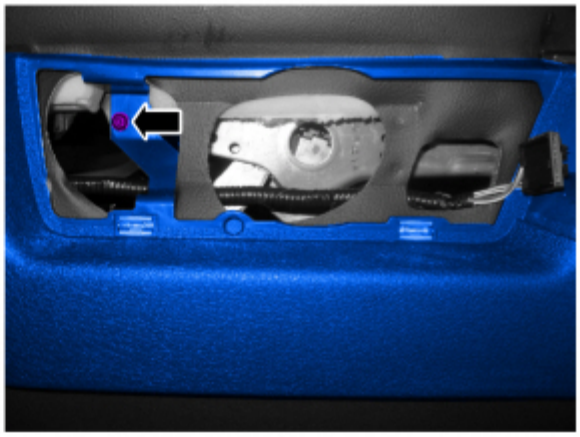




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4. Remove the screws and side shield.

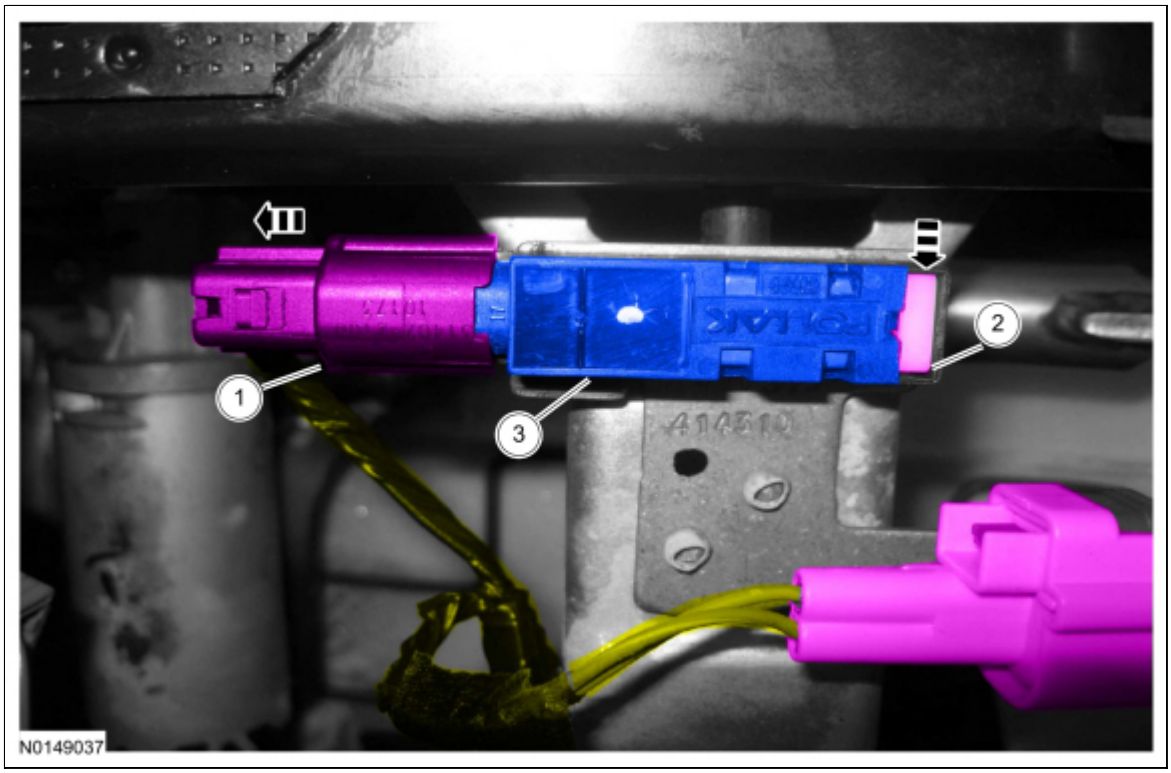




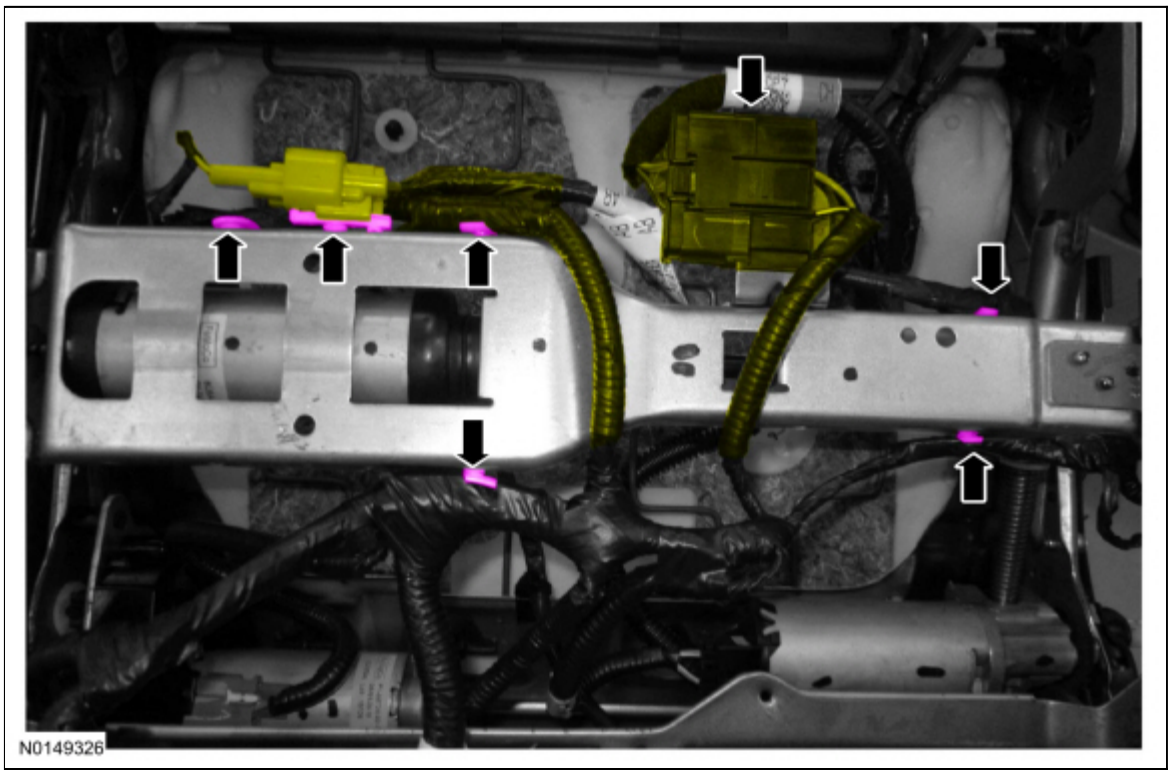
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5. If equipped.

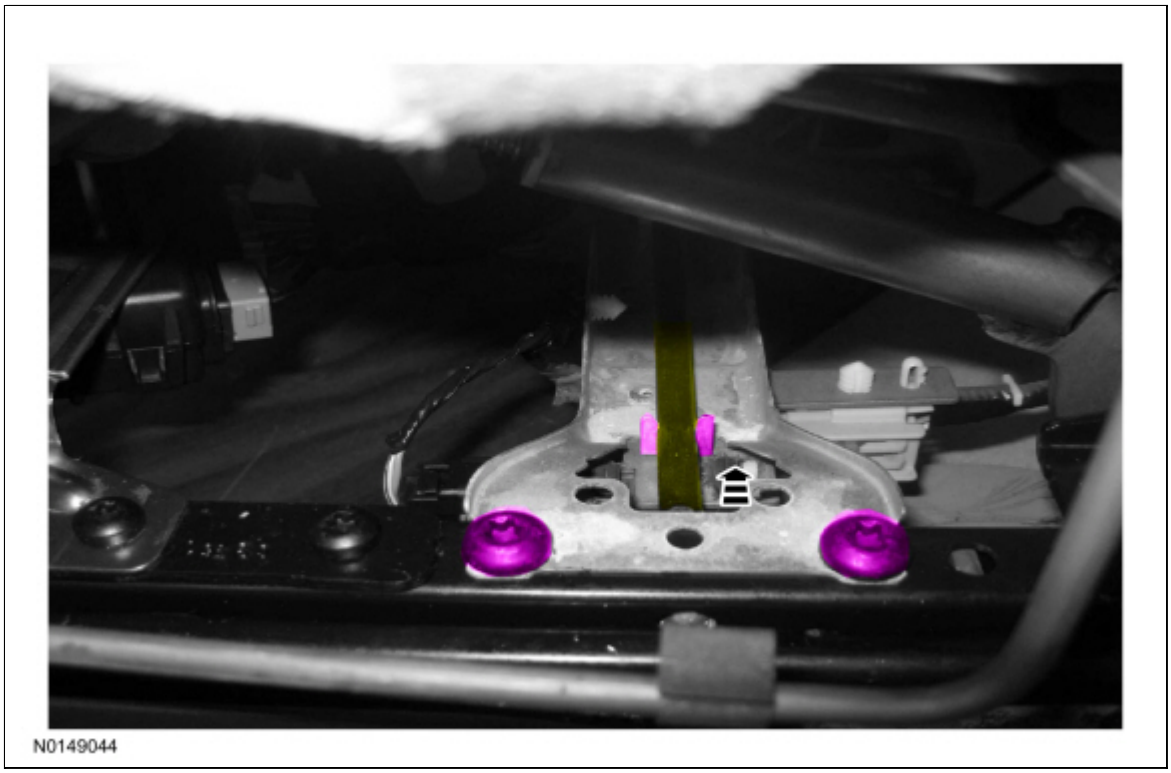
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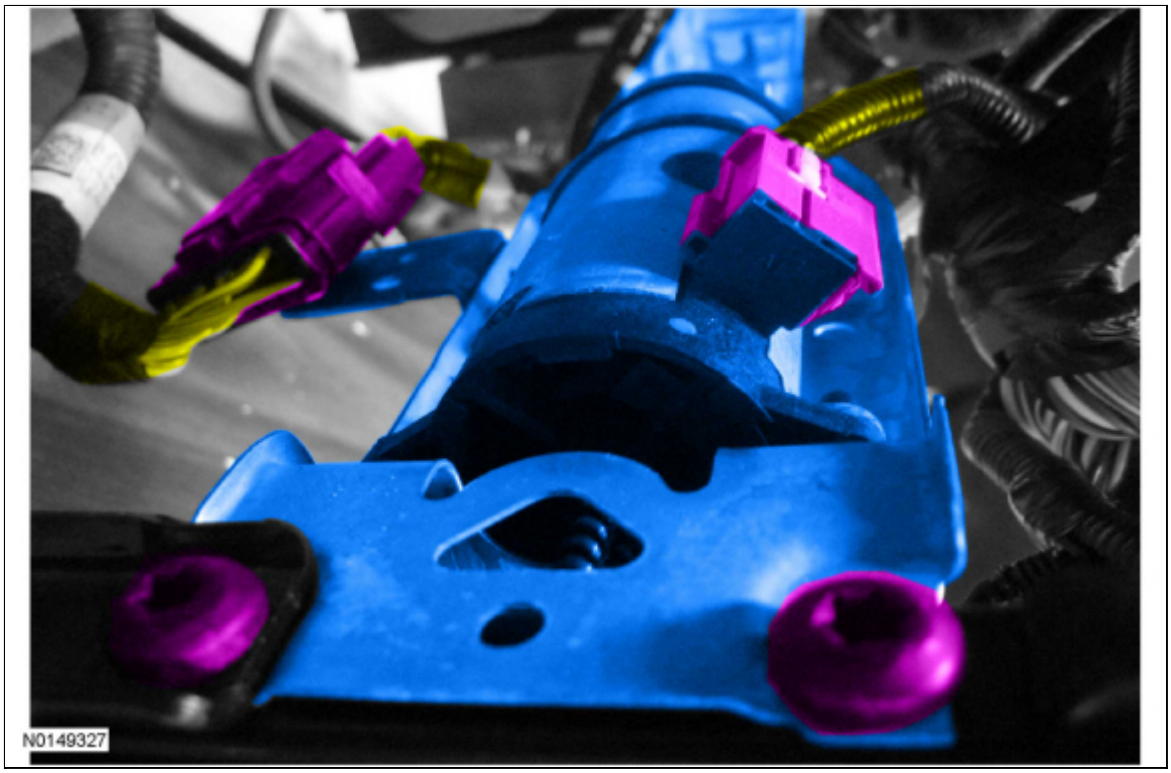
6. **NOTE:** Seat cushion wire harness take-outs will vary with seat option content. Note the wire harness routing, attachment points and connections to the horizontal seat motor and bracket for installation.



7.



8.



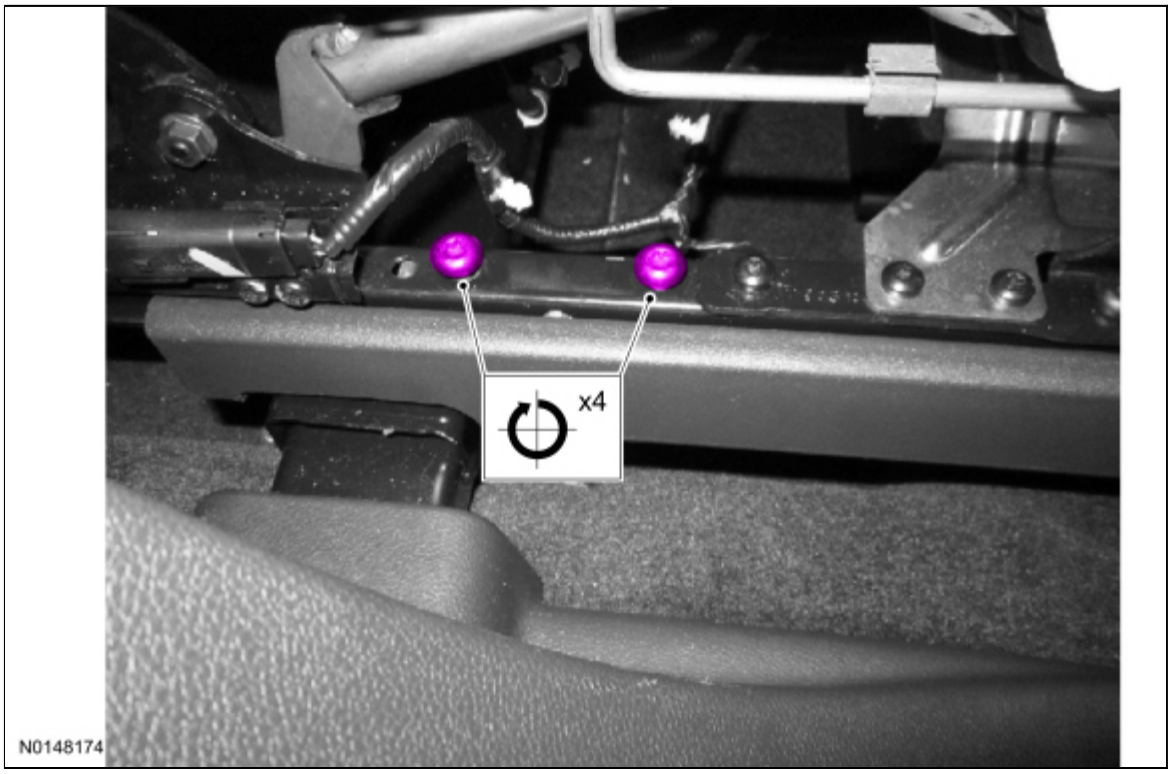
Installation

1. **NOTE:** Applying pressure to the lower seat track rail forward or backward can aid in bolt hole

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alignment.

On both sides.

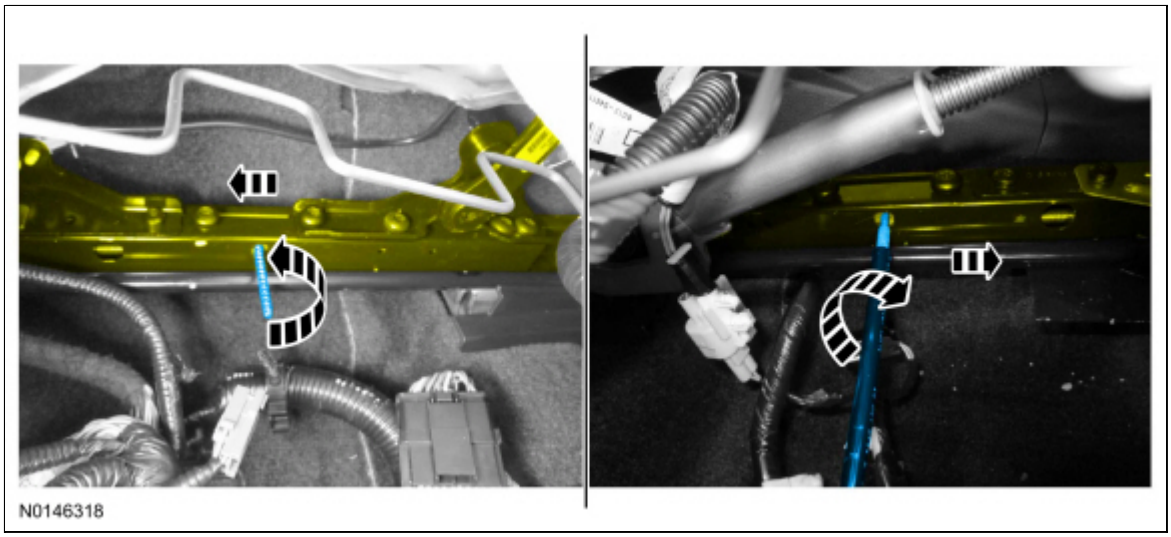


2. ***NOTICE:*** **When using a drill to move the seat track, do not move the seat track to its forward or rearward end of travel stops. Doing so can result in damage to the seat track requiring its replacement.**

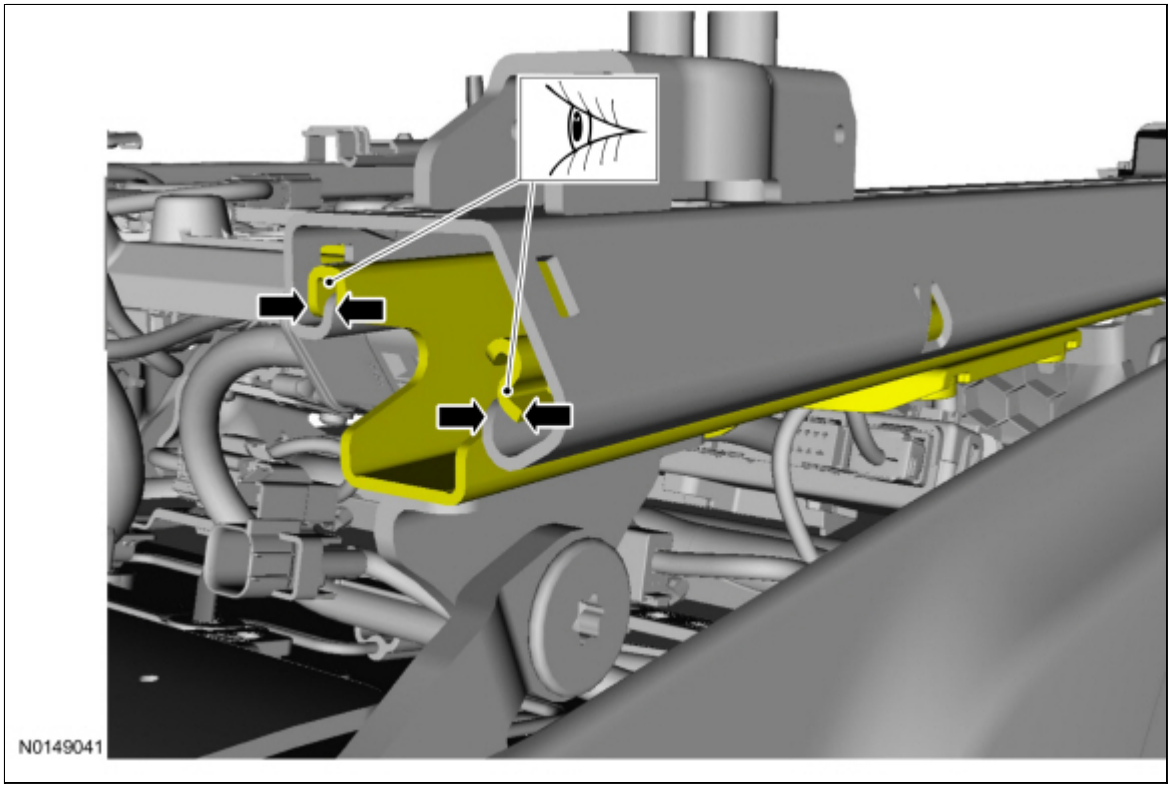
   NOTE: Be sure to drive the seat track evenly or the track will bind during movement.

   NOTE: Rotate the cables using 2 drills operating at similar speeds to most efficiently position the seat track.

   Align the seat track on both sides.
   General Equipment: Drill(s).
   - Insert the original seat track motor cables into the inboard and outboard gearbox and seat track rails.
   - Drive each gearbox and seat track uniformly until the rear edge of the upper and lower seat tracks are flush.

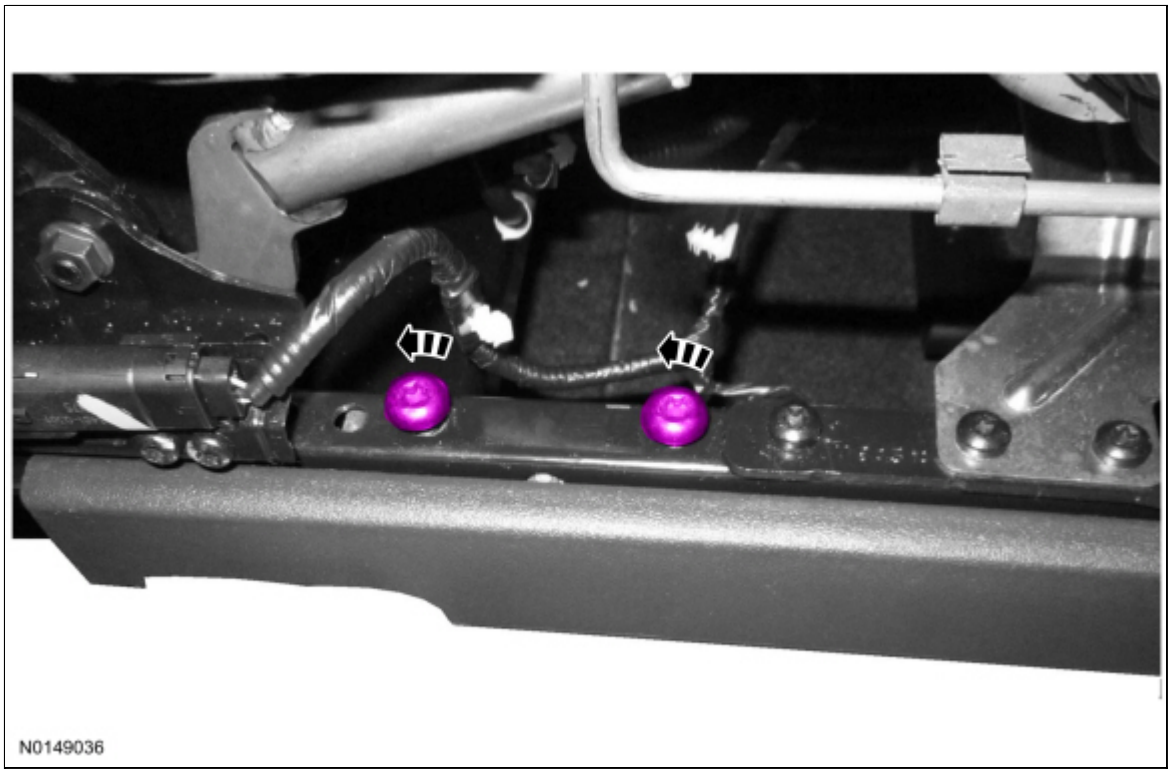


3. The rear edges of the upper and lower seat track rails must align with each other on both sides.

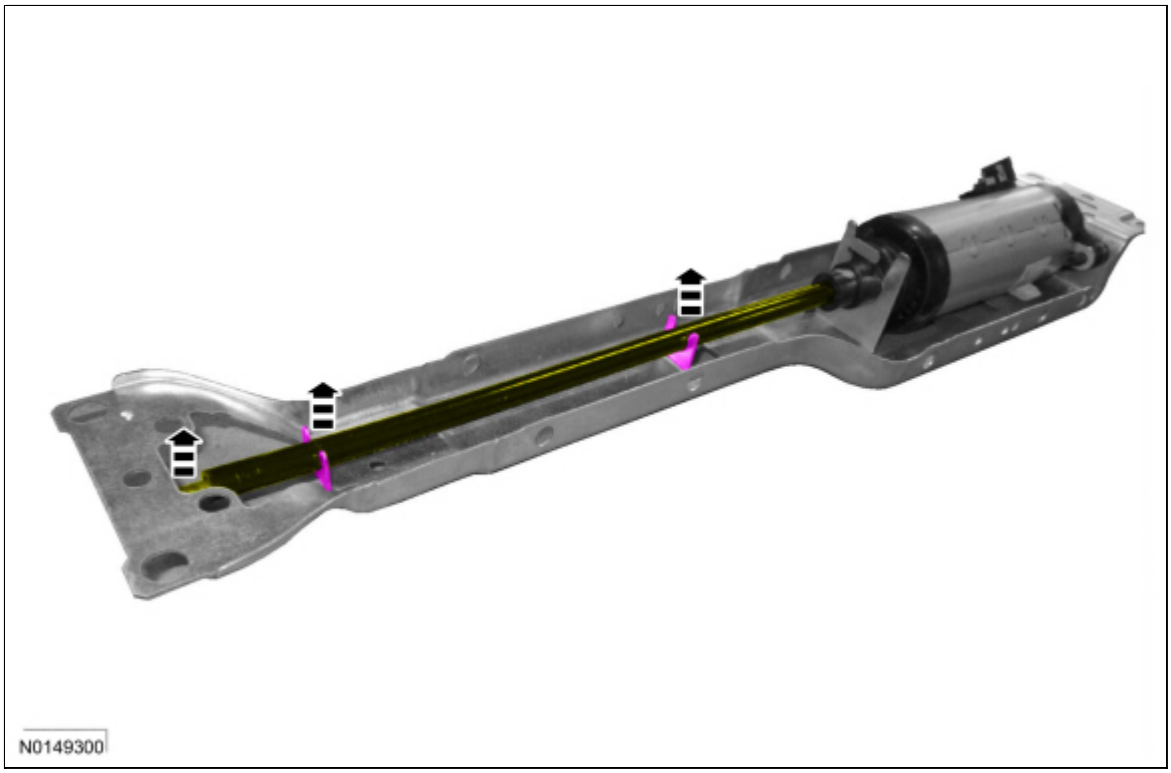


4. On both sides.

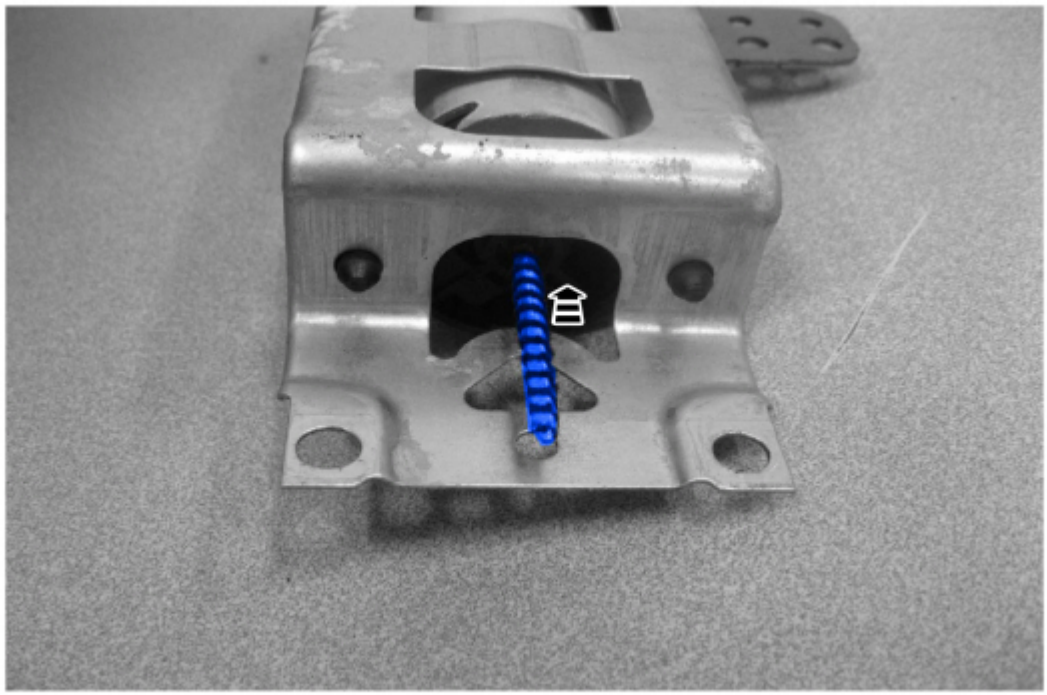
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5.



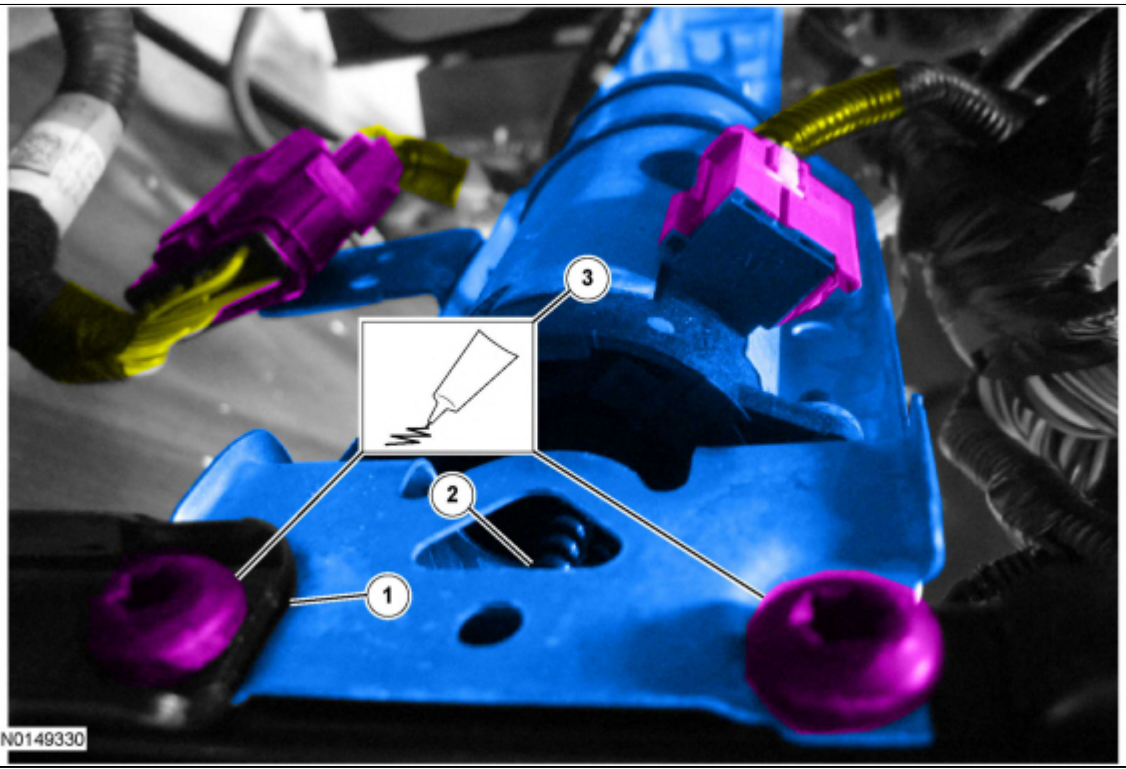
6.



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7. **NOTE:** Applying pressure to either the upper or lower seat track rail can aid in bolt hole alignment.

    1. Install the horizontal motor and bracket assembly onto the seat track making sure the bracket is positioned between the seat belt anchor bracket and the upper seat track rail.
    2. Insert the small cable through the seat track rail and into the gearbox hole.
    3. Apply Threadlock and Sealer to the 2 bolts and tighten to 24 Nm (18 lb-ft).



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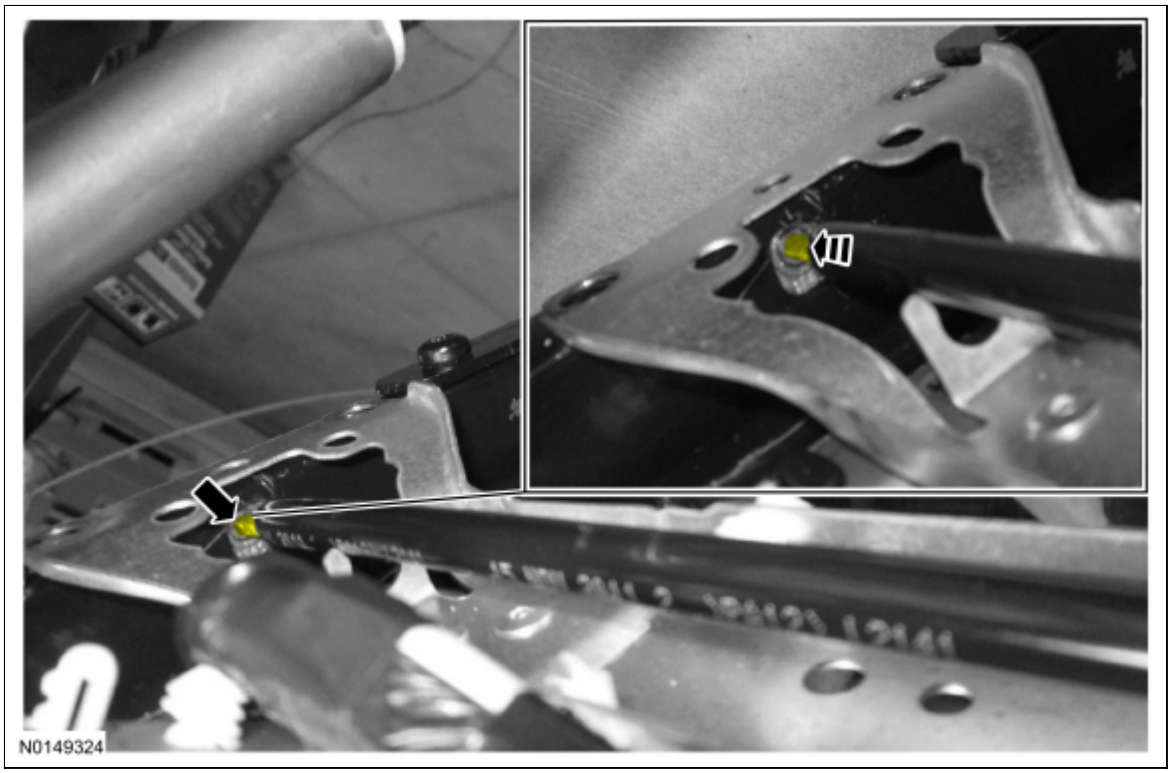
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8. **NOTE:** The cable felt should not be visible when the cable is correctly engaged to the horizontal motor square drive.

    - Push the cable into the horizontal motor square drive twisting back and forth to engage the cable.

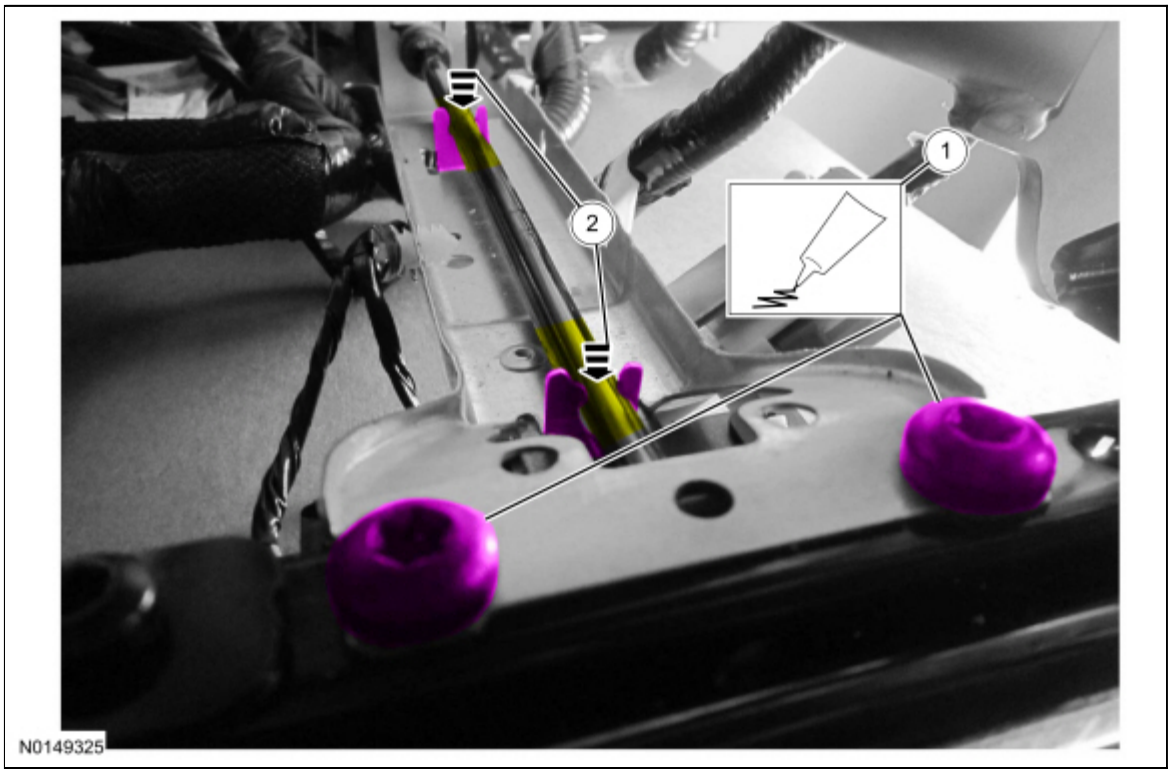


9.



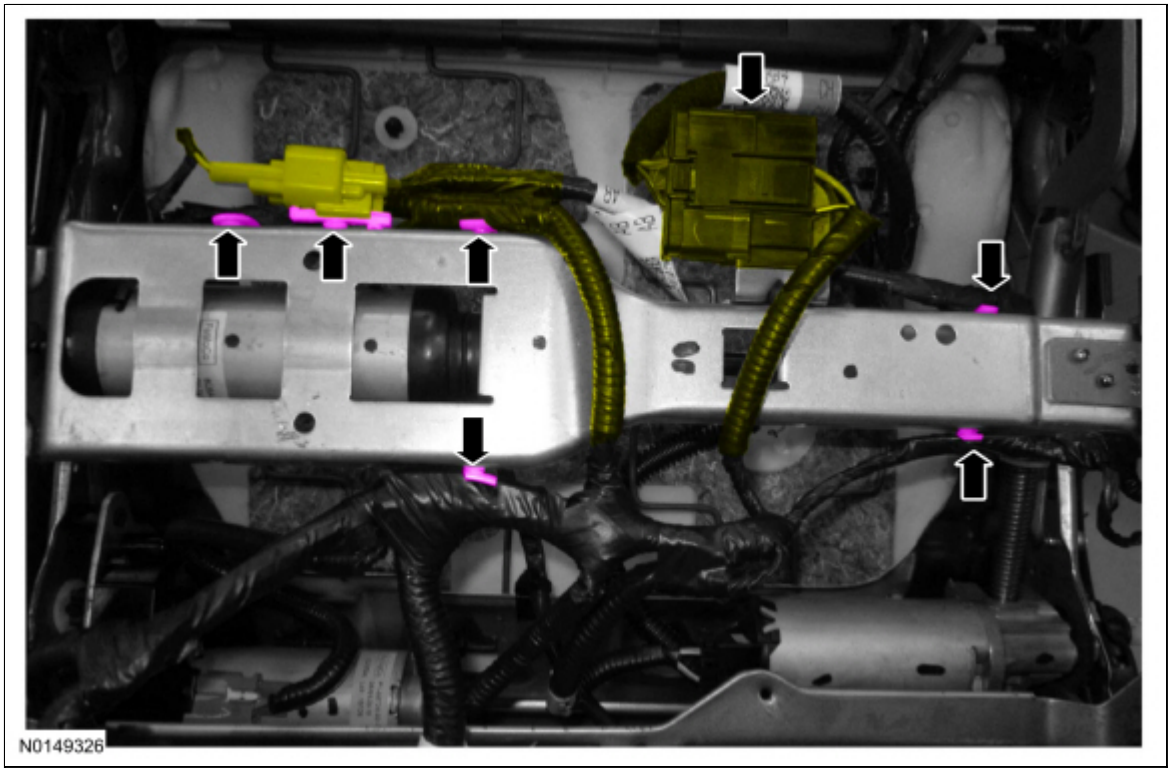
10. **NOTE:** Applying pressure to either the upper or lower seat track rail can aid in bolt hole alignment.

    1. Apply Threadlock and Sealer to the 2 bolts and tighten to 24 Nm (18 lb-ft).
    2. -

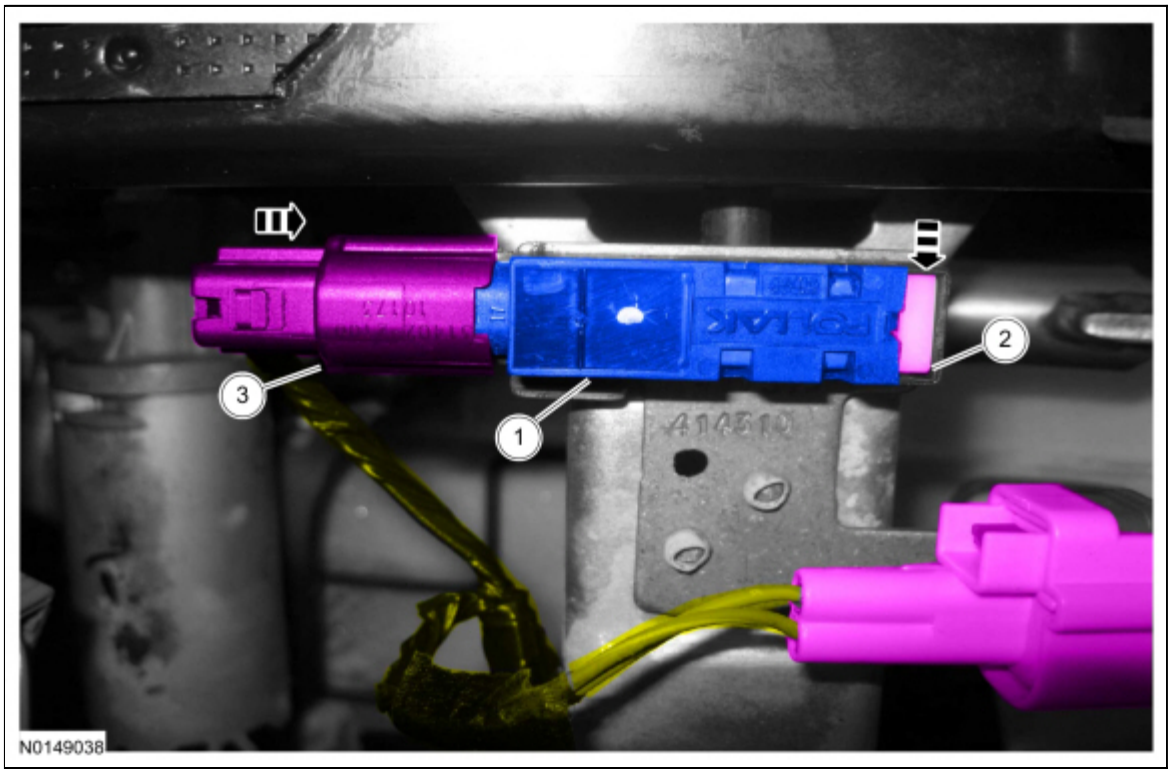


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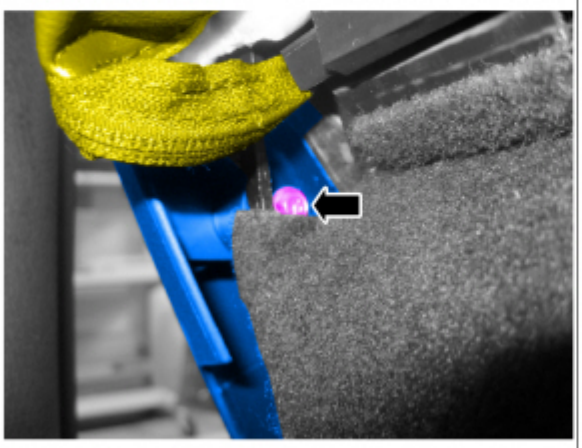
11. From beneath the seat, route, attach and connect the seat cushion wire harness as noted during removal.

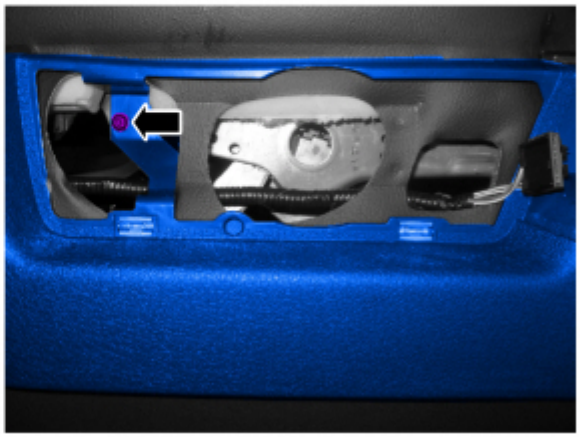


12. If equipped.



13. Install the side shield and screws.





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14. If equipped.

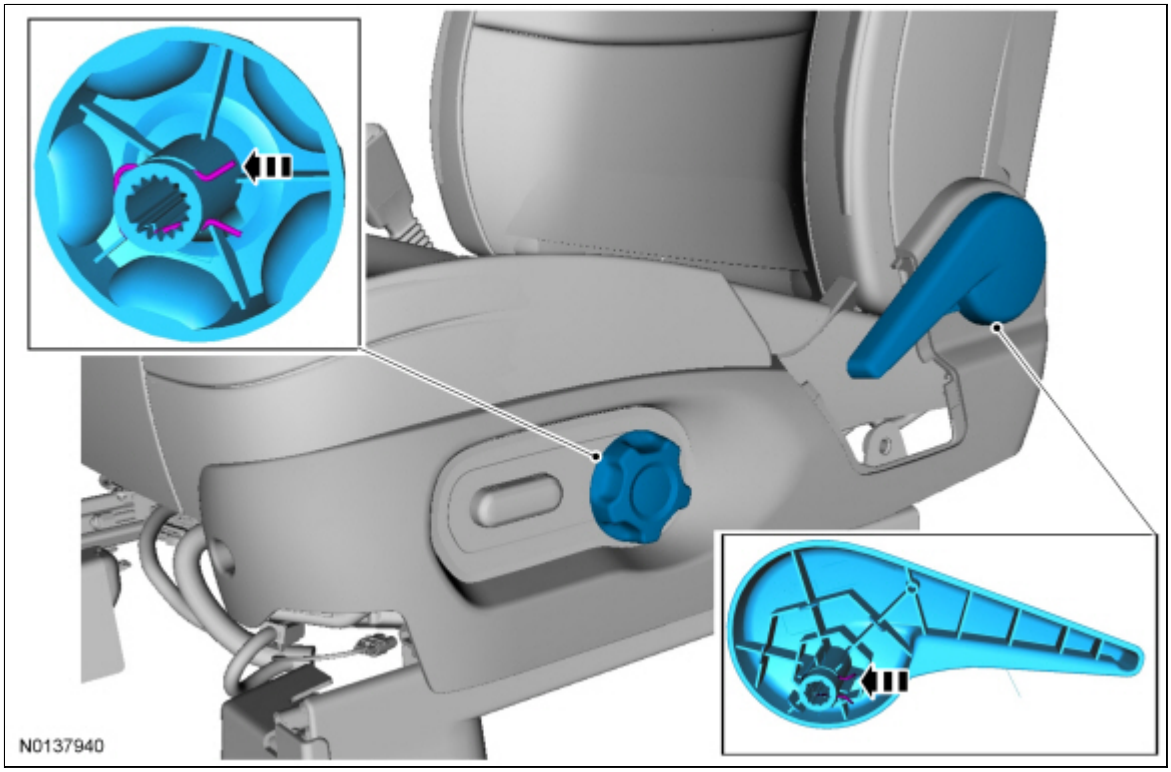




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15. If equipped.



16. Install the front seat. Refer to Seat — Front .

17. On vehicles with memory seat, operate the horizontal motor in both directions through the full range of travel to allow the DSM to correctly register stop positions and prevent premature stopping points after the repair is complete.

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Seat Track

Removal and Installation

NOTE: For parts identification and location, refer to Seat — Exploded View, Front

NOTE: Removal steps in this procedure may contain install details.

1. Remove the seat backrest. Refer to Seat Backrest — Front .
2. Remove the seat cushion cover. Refer to Seat Cushion Cover — Front .
3. Remove the 6 pin-type retainers, front inboard, rear inboard and outboard seat track covers.
4. Remove the bolt and safety belt buckle.
   - Disconnect the safety belt buckle electrical connector and detach the wire harness.
   - To install, tighten to 40 Nm (30 lb-ft).
5. If driver seat, remove the seat position sensor. Refer to Section 501-20B .
6. If equipped, remove the DSM . Refer to Driver Seat Module (DSM) .
7. If equipped, remove the DCSM . Refer to Dual Climate Controlled Seat Module (DCSM) .
8. If equipped, remove the cushion TED . Refer to Seat Cushion Thermo-Electric Device .
9. For passenger seat, remove the OCSM . Refer Occupant Classification System Module (OCSM) procedure in Section 501-20B .
10. Disconnect any remaining electrical connectors, detach the wire harness retainers and remove the wire harness. For correct passenger seat wire harness routing, Refer to Seat Wire Harness Routing .
11. To install, reverse the removal procedure.
    - If a new seat track has been installed on a driver seat with memory, operate the seat track in all directions through the full range of travel to allow the DSM to correctly register seat track stop positions and prevent premature stopping points after repair is complete.
12. If a passenger seat was serviced, carry out the OCS System Reset. Refer to the General Procedures portion of Section 501-20B .

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Seat Armrest — Rear, Crew Cab

Disassembly and Assembly

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the armrest. For additional information, refer to Seat Armrest — Rear, Crew Cab in this section.
2. If equipped, release the retainer clips and remove the cupholder bezel cover.
3. Open the zipper at the rear edge and invert the armrest cover.
4. Release the front retainer strips and remove the armrest cover.
    - For installation, make sure the pull strap is accessible.
5. Remove the plastic liner bag.
6. Remove the armrest foam pad.
7. Remove the 2 pin-type retainers and plastic cover.
8. If equipped, remove the 3 screws and cupholder.
9. To assemble, reverse the disassembly procedure.

Seat Backrest — Front

Disassembly and Assembly

NOTE: For parts identification and location, refer to Seat — Exploded View, Front in this section.

1. Remove the seat backrest. For additional information, refer to Seat Backrest — Front in this section.

2. Remove the seat backrest cover. For additional information, refer to Seat Backrest Cover — Front in this section.

3. Remove the backrest foam pad.

4. If equipped, remove the backrest Thermo-Electric Device (TED). For additional information, refer to Seat Backrest Thermo-Electric Device in this section.

5. If equipped, remove the power lumbar assembly. For additional information, refer to Lumbar Assembly — Power in this section.

6. If equipped, remove the manual lumbar assembly.
   - Detach the cable from the backrest frame.
     - Note cable routing for correct installation.
   - Pinch the lumbar retainers together to release from the backrest frame.
   - For installation, make sure the arrow is pointed up.

7. ***NOTICE:*** **Inspect the backrest support and retainers for damage. If any damaged, loose or detached retainers are found, new retainers must be installed. Failure to follow this instruction may result in backrest support failure.**

   Remove the backrest support.
   - Detach the 2 lower retainers from the backrest frame.
   - Using a suitable tool, release and detach the 2 upper retainers and remove the backrest support.
     - For installation, make sure the backrest support rests in front of the backrest frame and install the retainers from the front side. Crimp and tighten the retainers over the backrest support and backrest frame.

8. To assemble, reverse the disassembly procedure.

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Seat Backrest — Rear, Crew Cab

Disassembly and Assembly

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab in this section.

1. Remove the seat backrest. For additional information, refer to Seat Backrest — Rear, Crew Cab in this section.

2. Remove the seat backrest cover. For additional information, refer to Seat Backrest Cover — Rear, Crew Cab in this section.

3. Remove the 2 bolts and backrest latch.
    - To install, tighten to 10 Nm (89 lb-in).

4. If equipped, remove the heated seat system components.
    - Disconnect and detach the backrest heater mat electrical connector.
    - For 60 percent backrest, remove the heated seat module and bracket.
        - Disconnect the 2 heated seat module electrical connectors.
        - Remove the 2 screws, heated seat module and bracket.
        - To install, tighten to 14 Nm (124 lb-in).
    - Release the pin-type retainers and remove the wire harness.
        - Note the wire harness routing for correct installation.

5. Remove the hog rings and foam pad from the backrest frame.

6. To assemble, reverse the disassembly procedure.

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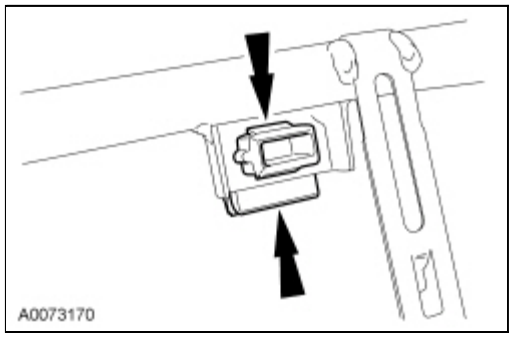
Seat Backrest — Rear, SuperCab

Disassembly and Assembly

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, SuperCab in this section.

1. Remove the seat backrest cover. For additional information, refer to Seat Backrest Cover — Rear, SuperCab in this section.

2. Push the release tabs and remove the 3 backrest plastic lock clips (one shown).



3. To assemble, reverse the disassembly procedure.

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Seat Cushion — Front

Disassembly and Assembly

1. The seat cushion frame and seat track are serviced as a seat track assembly. To disassemble the serviceable seat track components, refer to Seat Track in this section.

Seat Cushion — Rear, CrewCab

Disassembly and Assembly

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, Crew Cab .

1. Remove the seat cushion latch. Refer to Seat Latch — Rear, Crew Cab .

2. Remove the cushion foam pad.
   - If equipped, disconnect the cushion heater mat electrical connector.
     - Note the wire harness routing for correct installation.

3. Remove the bolt and safety belt buckle.
   - To install, tighten to 32 Nm (24 lb-ft).

4. Remove the screw and inboard side shield.

5. Remove the inboard pivot bolt, inboard pedestal and cushion.
   - To install, tighten to 32 Nm (24 lb-ft).

6. To assemble, reverse the disassembly procedure.

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Seat Cushion — Rear, SuperCab

Disassembly and Assembly

NOTE: For parts identification and location, refer to Seat — Exploded View, Rear, SuperCab in this section.

1. Remove the rear seat cushion cover(s). For additional information, refer to Seat Cushion Cover — Rear, SuperCab in this section.

2. Remove the seat cushion latch. For additional information, refer to Seat Latch — Rear, SuperCab in this section.

3. Remove the riser rear screw and inboard riser from the rear seat frame.
   - To install, tighten to 6 Nm (53 lb-in).

4. Remove the 2 screws and 2 backrest latches from the rear seat frame.

5. To assemble, reverse the disassembly procedure.

Material

Item	Specification	Fill Capacity
Dow Urethane Adhesive Betaseal™ Express	—	—
Dow Urethane One Step Glass Primer Betaprime™ 5500 / 5500A / 5500SA	—	—
Foam Core Butyl E69Z-19562-A	WSB-M3G143-B1	—
Motorcraft® Lacquer Touch-Up Paint (match color to exterior grid wire) PMP-19500-XXXXX	ESR-M2P100-C	—
Permatex® Quick Grid™ Rear Window Defogger Repair Kit 15067	—	—
Sika Urethane Adhesive Sika Tack ASAP	—	—
Sika Urethane Metal and Glass Primer Sika 206 G+P	—	—
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A	—

General Specifications

Item	Specification
Terminal Kit — Back Glass 4F1Z-14421-AA	—

Torque Specifications

Description	Nm	lb-ft	lb-in
B-pillar below belt bracket bolts	11	—	97
C-pillar below belt bracket bolts	11	—	97
Door window glass-to-regulator bolts	11	—	97
Door window regulator fasteners	11	—	97
Rear window glass nuts	4	—	35
Rear window glass regulator and motor assembly screws	11	—	97

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Tether anchor bolt	30	22	—

Glass, Frames and Mechanisms

The glass, frames and mechanisms section consists of the following:

- Accessory delay relay
- Body Control Module (BCM)
- FDIM (touchscreen, if equipped)
- Front Controls Interface Module (FCIM)
- Front door window glass
- Front door window regulator and motor
- Front door window top run
- HVAC module
- Power/manual sliding glass panel (if equipped)
- Rear door window glass
- Rear door window regulator and motor
- Rear door window top run
- Rear window defrost relay
- Rear window glass
- Rear window glass regulator and motor
- Window control switch
- Windshield glass

If equipped with power windows, the window control switch:

- is located on each door trim panel.
- can be used to manually raise or lower all windows from the LH front window control switch or the individual side window from the corresponding individual door window control switch.
- can manually raise or lower the LH or RH front window when the corresponding front window control switch is pressed/pulled and held in the first detent position.
- can automatically raise or lower the LH or RH front window when the corresponding front window control switch is momentarily pressed/pulled to the second detent position and released.
- has a lock-out feature (SuperCab and SuperCrew only). When the LH front window lock-out switch is in the LOCK position, the rear passenger windows only operate from the LH front window control switch.

The rear glass can be equipped with an optional manual or power sliding glass.

Delayed Accessory Feature

The accessory delay relay, located in the BCM , provides voltage for the operation of the power windows and the roof opening panel (if equipped). The accessory delay relay is active when the ignition is in the RUN or the ACC position, or when the ignition is changed from RUN or ACC to the OFF/LOCK position and the LH and RH front doors are closed.

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Heated Rear Window

The HVAC module controls the state of the rear window defrost relay. The defrost system is activated at one of the three following locations: HVAC module, FCIM or FDIM (8-inch [203mm] touchscreen). If equipped, the rear window defrost can also be activated/deactivated by using voice commands. When the rear window defrost relay is active, the rear window defrost grid is energized and the rear window defrost status LED illuminates. For vehicles equipped with a power sliding rear window, the rear window defrost grid (and status LED) does not operate unless the rear sliding window glass is in the fully CLOSED position.

If equipped, the customer can select certain climate control modes/preferences when the vehicle is started using the remote start feature. When the rear defrost is set to AUTO mode, the rear window defrost activates when the outside temperature is less than 0° C (32° F). Once the ignition is cycled to the ON position, the climate control system returns to the previous settings (last ignition-ON cycle) and adjustments can be made normally. For additional information on how to set the remote start preferences, refer to the Owner's Literature.

Glass, Frames and Mechanisms

Special Tool(s)

 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-300 mA incandescent bulb test lamp
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Delayed Accessory Power

The Body Control Module (BCM) controls voltage to the power windows with the accessory delay relay. The BCM activates the accessory delay relay whenever the ignition is in the RUN or the ACC position, or when the ignition is changed from RUN or ACC to the OFF position and the LH and RH front doors are closed.

The BCM deactivates the accessory delay relay when:

- the LH front door is ajar and the ignition is in the OFF or key-out position.
- the RH front door is ajar and the ignition is in the OFF or key-out position.
- ten minutes have elapsed since the ignition was changed from ACC or RUN to the OFF position.

LH and RH Front Power Window Control

The LH and RH front door window motors have integral electronics and must be initialized whenever a new

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window motor has been installed. Initialization is required to learn the full UP position and the profile of the glass as it travels through the glass channel. Once initialized, obstacle detection is enabled. When mechanical repairs have been carried out on the window regulator or glass run, the window motor must be de-initialized, and then initialized. The window control switch sends 2 separate signals to the window motor: up and down. When the window control switch is pressed to the first detent position, a 12-volt signal is sent to the window motor to request an up or down operation. When auto up or auto down is requested (switch pressed to the second detent position), the window control switch provides a 12-volt signal on both the up and down line simultaneously. During an auto up or auto down request, the window motor determines intended window direction by the signal first received. If the window control switch is pressed too quickly to the second detent position (less than 5 milliseconds of time between first detent signal and second detent signal), the window motor is not able to determine the intended direction request and cannot operate until the window control switch is released and pressed again. The up and down contacts are floating within the window control switch when the switch is in the neutral position. The up and down feeds to the window motor are all low current.

The LH and RH front window motors operate when the delayed accessory relay is active. The high current required to move the front windows are supplied through the B+ and motor ground input.

The LH and RH front window regulator motors have a protection shutdown feature that disables the motor operation if the windows are continually operated up and down for a number of cycles (6-10). The feature disables the motor operation for 5 minutes to prevent damage to the regulator motors. Normal operation will resume when the window switch has been inactive for 5 minutes.

When the LH or RH front window motor is operating in auto up or auto down mode, movement of the front window can be stopped by pressing the switch to any position (UP, DOWN, auto UP, auto DOWN). The front window control switches must be released before the window can move again.

A new LH or RH front window motor cannot operate in one-touch up mode and the bounce-back feature is disabled prior to initialization. If the switch is actuated to the auto UP position and released, window movement stops when the up contact in the front window control switch is released. If the front window motor is removed from the window regulator drum housing, or if a new front window motor is installed, it must be initialized. Refer to Window Motor Initialization in this section.

The front window motors automatically adjust to system changes throughout its life: changes in seal drag and slight changes in the full OPEN position occur and are automatically compensated for. Once initialized, the window motor soft stalls into the upper position contributing to extended durability of the system. If the window does not seal completely in the full UP position (very small gaps/non bounce-back events only), the window switch can be actuated to the UP position to energize the window motor for a fraction of a second to fully seal and this new position is learned.

Bounce-Back

The front window motors have a bounce-back feature. If an obstacle has been detected in the window opening as the window glass is moving upward, the window motor automatically reverses direction and moves the glass toward the bounce-back position (in both up and one-touch up modes). If an obstruction occurs between 4 mm (0.15 in) and 200 mm (7.87 in) of window opening, the bounce-back position is approximately at 250 mm (9.84 in) of window opening. If an obstruction occurs at a position greater than 200 mm (7.87 in) of window opening, the bounce-back position is approximately at 50 mm (1.96 in) below where the obstruction occurred.

Security Override

To override a bounce-back condition (to overcome the resistance of ice on the window or seals for

example), within 2 seconds after the window reaches the bounce-back position, pull and hold the window control switch. The window travels up with no bounce-back or pinch protection. If the window control switch is released before the window is fully closed, the window stops. If the ignition is turned to OFF or START (without delayed accessory), the window motor stops.

Rear Passenger Window Operation — SuperCab and SuperCrew Only

Rear passenger windows can be raised or lowered using the LH front window control switch or the corresponding passenger window control switch. The rear passenger window control switches receive power when the delayed accessory relay is active and the LH front window lock-out switch is in the UNLOCK position. When the LH front window lock-out switch is in the LOCK position, the rear passenger windows only operate from the LH front window control switch.

Rear Window Defrost (if equipped)

When the rear window defrost switch is pressed and the engine is running, the HVAC module activates the rear window defrost relay located in the Battery Junction Box (BJB). When the rear window defrost relay is active, the rear window defrost grid is energized and the rear window defrost status LED is illuminated. For vehicles equipped with a power sliding rear window, the rear window defrost grid does not activate unless the rear sliding window glass is in the fully CLOSED position due to a glass position switch in series with the grid circuit. The glass position switch is integral to the power sliding rear window assembly. There is a feedback circuit incorporated into the glass position switch which illuminates the rear window defrost switch LED when the defrost grid is active and the sliding glass is fully closed. If the sliding glass is opened while the defrost system is active, the heated mirrors continue to operate and the rear window defrost switch LED is no longer illuminated.

The HVAC module deactivates the rear window defrost relay when one of the following conditions is met:

- The rear window defrost switch is pressed when the feature is active
- Ignition state is changed from RUN to OFF/LOCK
- The 15-minute timing function is completed

Feature Inputs

- Ignition RUN position (12V on both RUN and RUN/ACC inputs)
- Rear window defrost switch (momentary contact to ground when switch is pressed)

Feature Output

- Rear window defrost relay control (grounded when activated, open circuit when deactivated)

Remote Start Climate Operation (if equipped)

The customer can select different climate control modes/preferences when the vehicle is started using the remote start feature. This can be accessed through the message center. For information on how to set the remote start preferences, refer to the Owner's Literature. When the rear defrost is set to AUTO mode, the rear window defrost activates when the outside temperature is less than 0° C (32° F) and the vehicle is started using the remote start feature. No climate control adjustments are recognized during remote start operation. Once the ignition is cycled to the ON position, the climate control system returns to the previous settings (last ignition-ON cycle) and adjustments can be made normally. If the previous setting was off, the climate control system turns off.

Inspection and Verification

1. Verify the customer concern.

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2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Window regulator and motor assembly
• Window glass
• Window control switch
	• Loose, corroded connectors
	• Circuitry
	• Window control switch
	• Battery Junction Box (BJB) fuse(s):
	  ▪ 32 (40A)
	  ▪ 54 (5A)
	• Body Control Module (BCM) circuit breaker 48 (30A)
	• BCM fuse(s):
	  ▪ 1 (30A)
	  ▪ 3 (30A)
	  ▪ 32 (15A)
	• Accessory delay relay
	• Rear window defrost relay
	• Rear window defrost grid

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test:
   - If the scan tool responds with no communication from one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the CMDTCs and carry out the self-test diagnostics for the BCM, FCIM and HVAC module.

9. If the DTCs retrieved are related to the concern, go to the Body Control Module (BCM) DTC Chart or HVAC Module DTC Chart. For all other DTCs, refer to Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B131A:12	Delayed Accessory Power: Circuit Short To Battery	GO to Pinpoint Test J.
B131A:14	Delayed Accessory Power: Circuit Short To Ground or Open	If the delayed accessory is always on, GO to Pinpoint Test K. If the delayed accessory is inoperative, GO to Pinpoint Test J.
All other DTCs	—	REFER to the Master DTC Chart in Section 419-10.

HVAC Module DTC Chart

DTC	Description	Action
B1C83:11	Rear Defog Relay: Circuit Short to Ground	REFER to Section 501-09 to diagnose the inoperative heated mirror system.
B1C83:12	Rear Defog Relay: Circuit Short to Battery	REFER to Section 501-09 to diagnose the inoperative heated mirror system.
B1C83:13	Rear Defog Relay: Circuit Open	REFER to Section 501-09 to diagnose the inoperative heated mirror system.
All other DTCs	—	REFER to the Master DTC Chart in Section 412-00.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All power windows are inoperative — intermittent operation, SuperCab or SuperCrew	• Circuit breaker • Wiring, terminals or connectors	• GO to Pinpoint Test A.
• All power windows are inoperative	• Fuse • Circuit breaker • Accessory delay	• GO to Pinpoint Test B.

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	relay • Wiring, terminals or connectors • Window control switch • Body Control Module (BCM)	
• All passenger power windows are inoperative — LH and RH rear	• Wiring, terminals or connectors • Window control switch	• GO to Pinpoint Test L .
• A single power window is inoperative — LH front	• Fuse • Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test C .
• A single power window is inoperative — RH front	• Fuse • Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test D .
• A single power window is inoperative — LH rear	• Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test E .
• A single power window is inoperative — RH rear	• Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test F .
• A single power window is inoperative — power sliding rear window	• Wiring, terminals or connectors • Overhead console switch • Power sliding rear window motor	• GO to Pinpoint Test G .
• The one-touch up/down feature is inoperative	• Power window motor not initialized • Battery power was lost while power window motor was operating • Window control switch • Power window	• GO to Pinpoint Test M .

	motor	
• The defrost system is inoperative	• Fuse(s) • Rear window defrost relay • Wiring, terminals or connectors • Rear sliding glass position switch (if equipped) • Rear window defrost grid • HVAC module • Front Controls Interface Module (FCIM)	• GO to Pinpoint Test H .
• The defrost switch LED does not illuminate — the defroster operates	• Wiring, terminals or connectors • HVAC module • Front Controls Interface Module (FCIM) • Rear sliding glass contacts	• If equipped with rear sliding glass, GO to Pinpoint Test H . • If not equipped with rear sliding glass: ▪ For vehicles equipped with EMTC , INSTALL a new HVAC module. REFER to Section 412-01 . ▪ For vehicles equipped with EATC , INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure.
• The defrost system does not shut off automatically	• Wiring, terminals or connectors • Rear window defrost relay • HVAC module	• GO to Pinpoint Test I .
• The defrost system does not respond to voice command only	• Voice recognition system	• VERIFY the rear window defrost operation using the instrument panel rear window defrost switch. If the rear window defrost is still inoperative, GO to Pinpoint Test H . If the rear window defrost operates, Refer to the appropriate section in Group 415 for the procedure.
• The defrost system does not respond to touchscreen command only	• Touchscreen	• VERIFY the rear window defrost operation using the instrument panel rear window defrost switch. If the rear window defrost is still inoperative, GO to Pinpoint Test H . If the rear window defrost operates, Refer to the appropriate section in Group 415 for the procedure.
• The delayed accessory is inoperative	• Door ajar switches • Wiring, terminals or connectors • Accessory delay	• GO to Pinpoint Test J .

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	relay • BCM	
• The delayed accessory does not turn off	• Wiring, terminals or connectors • Accessory delay relay • BCM	• GO to Pinpoint Test K .

Pinpoint Tests

Pinpoint Test A: All Power Windows are Inoperative — Intermittent Operation, SuperCab or SuperCrew

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

Normal Operation

Voltage is supplied to the LH front window control switch through Body Control Module (BCM) circuit breaker 48 (30A). Intermittent operation can be caused by a short to ground which temporarily causes the circuit breaker to open. Once open, all power windows are inoperative until the circuit breaker cools and the contacts close again. Activating all window control switches one at a time in both directions until the breaker opens can help in narrowing down the exact location of the short circuit if present.

This pinpoint test is intended to diagnose the following:

- Circuit breaker
- Wiring, terminals or connectors

PINPOINT TEST A: ALL POWER WINDOWS ARE INOPERATIVE — INTERMITTENT OPERATION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK FOR A SHORT TO GROUND IN THE POWER WINDOW SYSTEM	
• Disconnect: BCM Circuit Breaker 48 (30A). • Install a fused jumper wire in place of BCM circuit breaker 48 (30A). • Ignition ON. • Attempt to operate each individual power window in both directions from the LH window control switch as well as the passenger door(s) window control switch(es). • **Did the jumper wire fuse open during the test?**	**Yes** REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new circuit breaker. TEST the system for normal operation.

Pinpoint Test B: All Power Windows are Inoperative

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

Normal Operation

Voltage is supplied to the LH front window control switch from the accessory delay relay. For SuperCab or SuperCrew, the LH front window control switch supplies voltage to the rear window control switches when the lock-out switch is in the UNLOCK position.

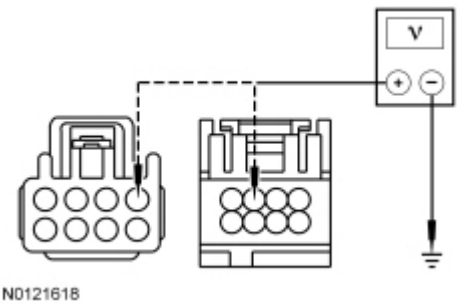
This pinpoint test is intended to diagnose the following:

- Fuse
- Circuit breaker
- Accessory delay relay
- Wiring, terminals or connectors
- Window control switch
- BCM

PINPOINT TEST B: ALL POWER WINDOWS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

B1 CHECK THE VOLTAGE TO THE LH FRONT WINDOW CONTROL SWITCH
• Disconnect: LH Front Window Control Switch C504 (Regular Cab) or C535A (SuperCab or SuperCrew).
• Ignition ON.
• Measure the voltage between LH front window control switch and ground.
  ▪ For regular cab, measure the voltage between C504-3, circuit CBP32 (GN/VT), harness side and ground.
  ▪ For SuperCab or SuperCrew, measure the voltage between C535B-1, circuit CBP01 (BU), harness side and ground.

 	
N0121618
• **Is the voltage greater than 10 volts?**
	Yes
	INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation.
	
	No
	VERIFY Body Control Module (BCM) fuse 32 (15A) (regular cab) or BCM circuit breaker 48 (30A) (SuperCab or SuperCrew) is OK. If OK, GO to Pinpoint Test J to diagnose the accessory delay circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation.

Pinpoint Test C: A Single Power Window is Inoperative — LH Front

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Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

NOTE: De-initialize, then initialize the front window motor when any of the following occur:

- the LH or RH front window motor is removed from the window regulator drum housing
- a new window regulator and/or motor is installed
- a new window glass is installed
- a new top run is installed
- a new top run is installed
- any operation in which grease or lubricants are applied to the window regulator or glass run

Normal Operation

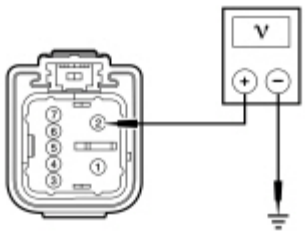
Voltage is supplied to the LH front window control switch and LH front power window motor from the accessory delay relay. The LH front power window motor has dedicated high current voltage and ground circuits. When the LH front window control switch is activated, a low current voltage signal is supplied to the LH front power window motor which causes the window to move upward or downward.

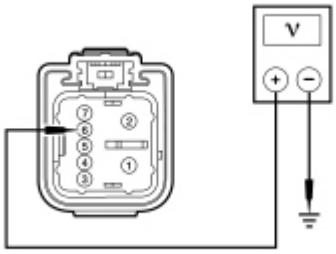
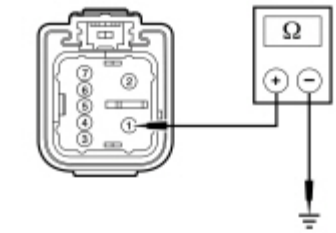
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Window control switch
- Power window motor

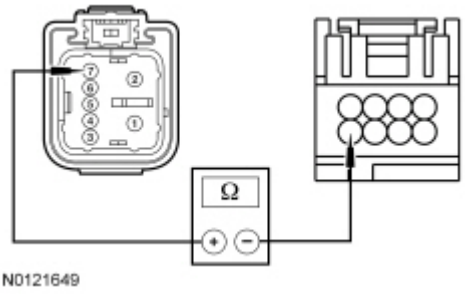
PINPOINT TEST C: A SINGLE POWER WINDOW IS INOPERATIVE — LH FRONT

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

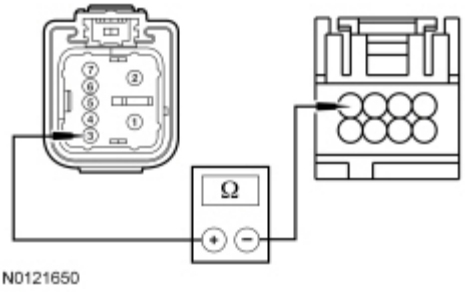
Test Step	Result / Action to Take
C1 CHECK THE VOLTAGE TO THE POWER WINDOW MOTOR • Ignition OFF. • Disconnect: LH Front Power Window Motor C524. • Measure the voltage between LH front power window motor C524-2, circuit SBP01 (RD), harness side and ground.  N0121645 • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 . **No** VERIFY Body Control Module (BCM) fuse 1 (30A) is OK. If OK, REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

C2 CHECK THE LH FRONT POWER WINDOW MOTOR DELAYED ACCESSORY FEED	
• Ignition ON. • Measure the voltage between LH front power window motor C524-6, circuit CBP32 (GN/VT), harness side and ground.  N0121646 • **Is the voltage greater than 10 volts?**	**Yes** GO to C3 . **No** VERIFY Body Control Module (BCM) fuse 32 (15A) is OK. If OK, REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
C3 CHECK THE LH FRONT POWER WINDOW MOTOR GROUND	
• Ignition OFF. • Measure the resistance between LH front power window motor C524-1, circuit GD134 (BK/VT), harness side and ground.  N0121647 • **Is the resistance less than 5 ohms?**	**Yes** GO to C4 . **No** REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
C4 CHECK THE WINDOW CONTROL SWITCH TO LH FRONT MOTOR CIRCUITS FOR AN OPEN	
• Disconnect: LH Front Window Control Switch C504 (regular cab) or C535A (SuperCab or SuperCrew). • Measure the resistance between LH front power window motor and LH front window control switch. ▪ For regular cab, measure the resistance between LH front power window motor C524-7, circuit CPW10 (YE/VT), harness side and LH front window control switch C504-8, circuit CPW10 (YE/VT), harness side. ▪ For SuperCab or SuperCrew, measure the resistance between LH front power window motor C524-7, circuit CPW10 (YE/VT), harness side and LH front window control switch C535A-8, circuit CPW10 (YE/VT), harness side.	**Yes** GO to C5 . **No** REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

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- **Is the resistance less than 5 ohms?**

C5 CHECK THE WINDOW CONTROL SWITCH TO LH FRONT MOTOR CIRCUITS FOR AN OPEN	
• Measure the resistance between LH front power window motor and LH front window control switch. ▪ For regular cab, measure the resistance between LH front power window motor C524-3, circuit CPW11 (BU/GY), harness side and LH front window control switch C504-4, circuit CPW11 (BU/GY), harness side. ▪ For SuperCab or SuperCrew, measure the resistance between LH front power window motor C524-3, circuit CPW11 (BU/GY), harness side and LH front window control switch C535A-4, circuit CPW11 (BU/GY), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to C6 . **No** REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
C6 CHECK THE LH FRONT WINDOW CONTROL SWITCH	
• Carry out the LH front window control switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the window control switch pass the component test?**	**Yes** INSTALL a new LH front window regulator motor. REFER to Window Regulator Motor in this section. INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. **No** INSTALL a new LH front window control switch. REFER to Window Control

	Switch — Front in this section. INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

Pinpoint Test D: A Single Power Window is Inoperative — RH Front

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

NOTE: De-initialize, then initialize the front power window motor when any of the following occur:

- the LH or RH front power window motor is removed from the window regulator drum housing
- a new window regulator and/or motor is installed
- a new window glass is installed
- a new top run is installed
- a new top run is installed
- any operation in which grease or lubricants are applied to the window regulator or glass run

Normal Operation

Voltage is supplied to the LH and RH front window control switches and RH front power window motor from the accessory delay relay. The RH front power window motor has dedicated high current voltage and ground circuits. When the LH or RH front window control switch is activated, a low current voltage signal is supplied to the RH front power window motor which causes the window to move upward or downward.

This pinpoint test is intended to diagnose the following:

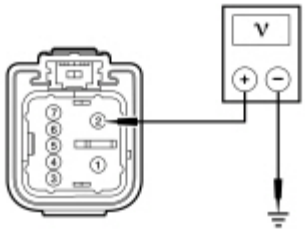
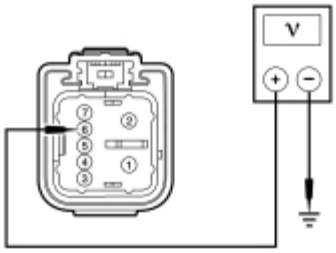
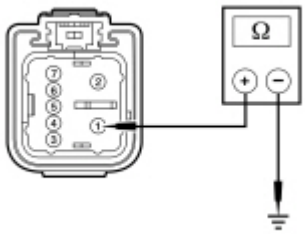
- Fuse
- Wiring, terminals or connectors
- Window control switch
- Power window motor

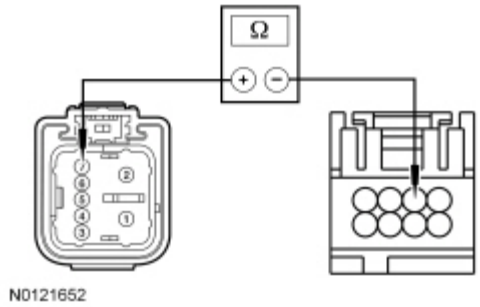
PINPOINT TEST D: A SINGLE POWER WINDOW IS INOPERATIVE — RH FRONT

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

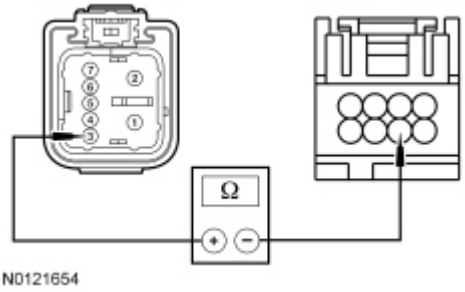
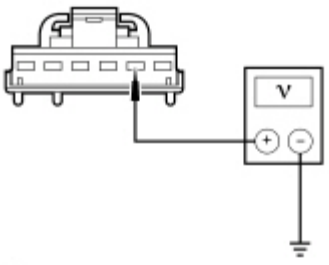
Test Step	Result / Action to Take
D1 CHECK THE RH FRONT POWER WINDOW OPERATION FROM THE LH FRONT WINDOW CONTROL SWITCH	
• Ignition ON. • Attempt to operate the RH front window using the LH front window control switch. • **Does the RH front window operate when using the LH front window control switch?**	**Yes** GO to D8 . **No** GO to D2 .
D2 CHECK THE VOLTAGE TO THE POWER WINDOW MOTOR	
	Yes

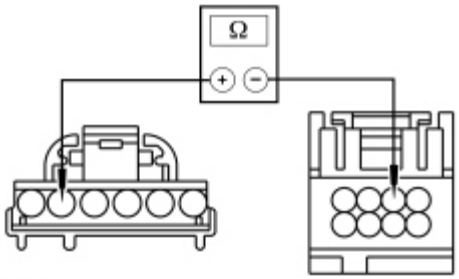
repair4less

• Ignition OFF. • Disconnect: RH Front Power Window Motor C608. • Measure the voltage between RH front power window motor C608-2, circuit SBP03 (BU/RD), harness side and ground.  N0121645 • **Is the voltage greater than 10 volts?**	GO to D3 . **No** VERIFY Body Control Module (BCM) fuse 3 (30A) is OK. If OK, REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D3 CHECK THE RH FRONT POWER WINDOW MOTOR DELAYED ACCESSORY FEED	
• Ignition ON. • Measure the voltage between RH front power window motor C608-6, circuit CBP32 (GN/VT), harness side and ground.  N0121646 • **Is the voltage greater than 10 volts?**	**Yes** GO to D4 . **No** VERIFY Body Control Module (BCM) fuse 32 (15A) is OK. If OK, REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D4 CHECK THE RH FRONT POWER WINDOW MOTOR GROUND	
• Ignition OFF. • Measure the resistance between RH front power window motor C608-1, circuit GD139 (BK/YE), harness side and ground.  N0121647 • **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

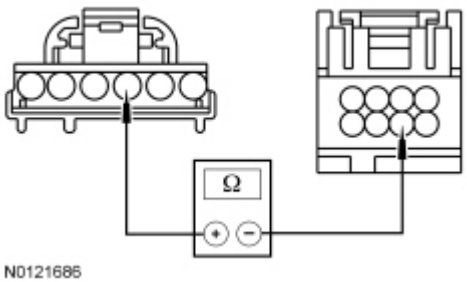
D5 CHECK THE WINDOW CONTROL SWITCH TO RH FRONT MOTOR CIRCUITS FOR AN OPEN • Disconnect: LH Front Window Control Switch C504 (Regular Cab) or C535A (SuperCab or SuperCrew). • Measure the resistance between RH front power window motor and LH front window control switch. ▪ For regular cab, measure the resistance between RH front power window motor C608-7, circuit CPW12 (GN/OG), harness side and LH front window control switch C504-2, circuit CPW12 (GN/OG), harness side. ▪ For SuperCab or SuperCrew, measure the resistance between RH front power window motor C608-7, circuit CPW12 (GN/OG), harness side and LH front window control switch C535A-2, circuit CPW12 (GN/OG), harness side.  N0121652 • **Is the resistance less than 5 ohms?**	**Yes** GO to D6 . **No** REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D6 CHECK THE WINDOW CONTROL SWITCH TO RH FRONT MOTOR CIRCUITS FOR AN OPEN • Measure the resistance between RH front power window motor and LH front window control switch. ▪ For regular cab, measure the resistance between RH front power window motor C608-3, circuit CPW13 (BN/YE), harness side and LH front window control switch C504-6, circuit CPW13 (BN/YE), harness side. ▪ For SuperCab or SuperCrew, measure the resistance between RH front power window motor C608-3, circuit CPW13 (BN/YE), harness side and LH front window control switch C535A-6, circuit CPW13 (BN/YE), harness side.	**Yes** GO to D7 . **No** REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

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 N0121654 • **Is the resistance less than 5 ohms?**	
D7 CHECK THE LH FRONT WINDOW CONTROL SWITCH	
• Carry out the LH front window control switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the window control switch pass the component test?**	**Yes** INSTALL a new RH front window regulator motor. REFER to Window Regulator Motor in this section. INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. **No** INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D8 CHECK THE VOLTAGE TO THE RH FRONT WINDOW CONTROL SWITCH	
• Ignition OFF. • Disconnect: RH Front Window Control Switch C604. • Ignition ON. • Measure the voltage between RH front window control switch C604-2, circuit CBP32 (GN/VT), harness side and ground.  N0043634 • **Is the voltage greater than 10 volts?**	**Yes** GO to D9. **No** REPAIR the circuit. TEST the system for normal operation.
D9 CHECK THE WINDOW CONTROL SWITCH CIRCUITS FOR AN OPEN	
• Ignition OFF.	**Yes**

• Disconnect: LH Front Window Control Switch C504 (Regular Cab) or C535A (SuperCab or SuperCrew).
• Measure the resistance between RH front window control switch and LH front window control switch.
  ▪ For regular cab, measure the resistance between RH front window control switch C604-5, circuit CPW12 (GN/OG), harness side and LH front window control switch C504-2, circuit CPW12 (GN/OG), harness side.
  ▪ For SuperCab or SuperCrew, measure the resistance between RH front window control switch C604-5, circuit CPW12 (GN/OG), harness side and LH front window control switch C535A-2, circuit CPW12 (GN/OG), harness side.

N0121685
• **Is the resistance less than 5 ohms?**
	GO to D10 .
	
	No
	REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

D10 CHECK THE WINDOW CONTROL SWITCH CIRCUITS FOR AN OPEN	

• Measure the resistance between RH front window control switch and LH front window control switch.
  ▪ For regular cab, measure the resistance between RH front window control switch C604-3, circuit CPW13 (BN/YE), harness side and LH front window control switch C504-6, circuit CPW13 (BN/YE), harness side.
  ▪ For SuperCab or SuperCrew, measure the resistance between RH front window control switch C604-3, circuit CPW13 (BN/YE), harness side and LH front window control switch C535A-6, circuit CPW13 (BN/YE), harness side.

N0121686
• **Is the resistance less than 5 ohms?**
	Yes
	INSTALL a new RH front window control switch. REFER to Window Control Switch — Front in this section. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
	
	No
	REPAIR the circuit. DE-INITIALIZE, then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

repair4less

Pinpoint Test E: A Single Power Window is Inoperative — LH Rear

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

Normal Operation

The LH rear window control switch receives voltage from the LH front window control switch when the lock-out switch is in the UNLOCK position. Ground is also provided to the LH rear window control switch from the LH front window control switch. The LH rear window control switch transfers voltage and ground to the power window motor. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the power window motor.

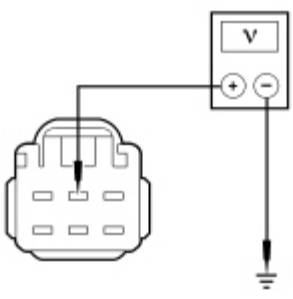
When operating the LH rear window from the LH front window control switch, voltage and ground is sent from the LH front window control switch through the normally closed contacts within the LH rear window control switch. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the power window motor.

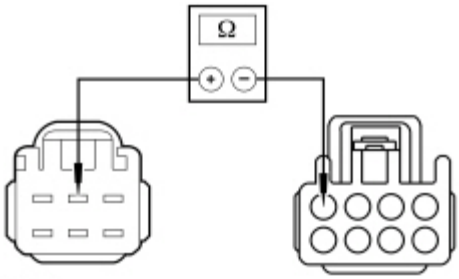
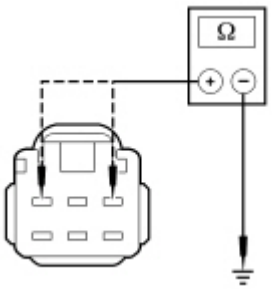
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Window control switch
- Power window motor

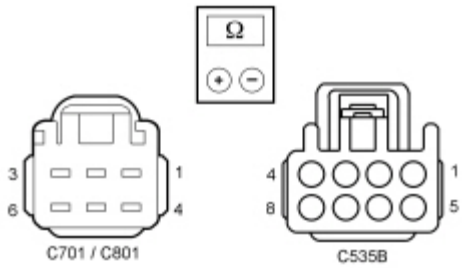
PINPOINT TEST E: A SINGLE POWER WINDOW IS INOPERATIVE — LH REAR

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE VOLTAGE TO THE LH REAR WINDOW CONTROL SWITCH	
• Disconnect: LH Rear Window Control Switch C701. • Ignition ON. • **NOTE:** Set the LH front window lock-out switch to the UNLOCK position. • Measure the voltage between LH rear window control switch C701-2, circuit CPW14 (VT/WH), harness side and ground.  N0092722 • **Is the voltage greater than 10 volts?**	**Yes** GO to E3 . **No** GO to E2 .
E2 CHECK THE WINDOW CONTROL SWITCH POWER CIRCUIT	

FOR AN OPEN	
• Ignition OFF. • Disconnect: LH Front Window Control Switch C535B. • Measure the resistance between LH rear window control switch C701-2, circuit CPW14 (VT/WH), harness side and LH front window control switch C535B-4, circuit CPW14 (VT/WH), harness side.  N0121692 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
E3 CHECK THE GROUNDS TO THE LH REAR WINDOW CONTROL SWITCH	
• Ignition OFF. • Measure the resistance between LH rear window control switch C701-1, circuit CPW16 (BU/OG), harness side and ground; and between LH rear window control switch C701-3, circuit CPW15 (YE), harness side and ground.  N0092724 • **Are the resistances less than 5 ohms?**	**Yes** GO to E5 . **No** GO to E4 .
E4 CHECK THE CIRCUITS TO THE LH REAR WINDOW CONTROL SWITCH FOR AN OPEN	
• Disconnect: LH Front Window Control Switch C535B. • Measure the resistance between LH rear window control switch C701, harness side and LH front window control switch C535B, harness side using the following chart: **LH Rear Window Control Switch** / **Circuit** / **LH Front Window Control Switch** C701-3 / CPW15 (YE) / C535B-6 C701-1 / CPW16 (BU/OG) / C535B-5	**Yes** INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation. **No** REPAIR the circuit(s). TEST the system for normal operation.

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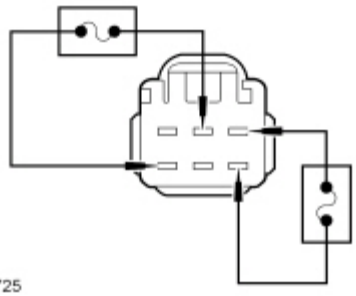


N0121693

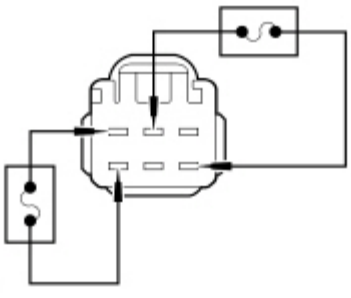
- **Are the resistances less than 5 ohms?**

E5 CHECK THE LH REAR WINDOW OPERATION

- Ignition ON.
- **NOTE:** Set the LH front window lock-out switch to the UNLOCK position.
- Connect a fused jumper wire between LH rear window control switch C701-2, circuit CPW14 (VT/WH), harness side and C701-6, circuit CPW21 (BN), harness side; and a second fused jumper wire between LH rear window control switch C701-4, circuit CPW22 (GN/VT), harness side and C701-1, circuit CPW16 (BU/OG), harness side. The LH rear window should operate in the upward direction.


N0092725

- Connect a fused jumper wire between LH rear window control switch C701-2, circuit CPW14 (VT/WH), harness side and C701-4, circuit CPW22 (GN/VT), harness side; and a second fused jumper wire between LH rear window control switch C701-6, circuit CPW21 (BN), harness side and C701-3, circuit CPW15 (YE), harness side. The LH rear window should operate in the downward direction.


N0092726

- **Does the LH rear window operate correctly?**

Yes
If the LH rear window did not operate with the LH rear window control switch, INSTALL a new LH rear window control switch. REFER to Window Control Switch — Rear in this section. TEST the system for normal operation.

If the LH rear window did operate with the LH rear window control switch, but not with the LH front window control switch, INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation.

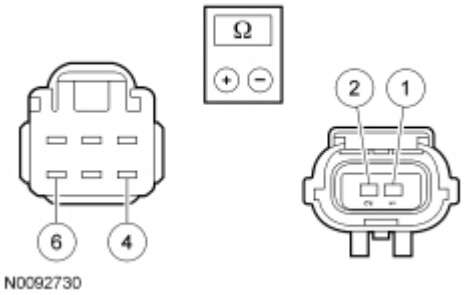
No
GO to E6 .

E6 CHECK THE POWER WINDOW MOTOR CIRCUITS FOR AN

OPEN

- Ignition OFF.
- Disconnect: LH Rear Power Window Motor C726 (SuperCab) or C703 (SuperCrew).
- For SuperCab, measure the resistance between LH rear window control switch C701, harness side and LH rear power window motor C726, harness side using the following chart:

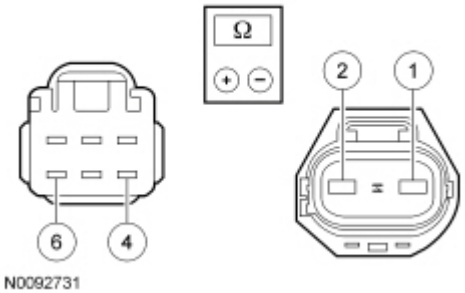
LH Rear Window Control Switch	Circuit	LH Rear Power Window Motor
C701-6	CPW21 (BN)	C726-1
C701-4	CPW22 (GN/VT)	C726-2



N0092730

- For SuperCrew, measure the resistance between LH rear window control switch C701, harness side and LH rear power window motor C703, harness side using the following chart:

LH Rear Window Control Switch	Circuit	LH Rear Power Window Motor
C701-6	CPW21 (BN)	C703-1
C701-4	CPW22 (GN/VT)	C703-2



N0092731

- **Are the resistances less than 5 ohms?**

Yes
INSTALL a new LH rear power window motor. REFER to Window Regulator Motor in this section. TEST the system for normal operation.

No
REPAIR the circuit(s). TEST the system for normal operation.

Pinpoint Test F: A Single Power Window is Inoperative — RH Rear

repair4less

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

Normal Operation

The RH rear window control switch receives voltage from the LH front window control switch when the lock-out switch is in the UNLOCK position. Ground is also provided to the RH rear window control switch from the LH front window control switch. The RH rear window control switch transfers voltage and ground to the power window motor. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the power window motor.

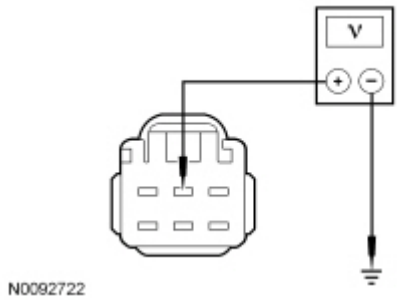
When operating the RH rear window from the LH front window control switch, voltage and ground is sent from the LH front window control switch through the normally closed contacts within the RH rear window control switch. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the power window motor.

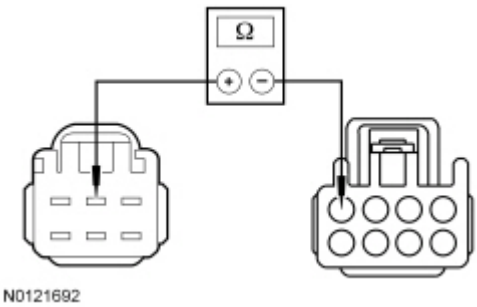
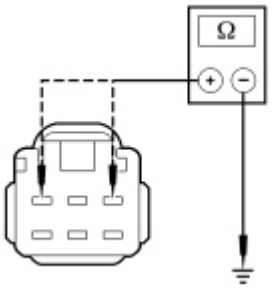
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Window control switch
- Power window motor

PINPOINT TEST F: A SINGLE POWER WINDOW IS INOPERATIVE — RH REAR

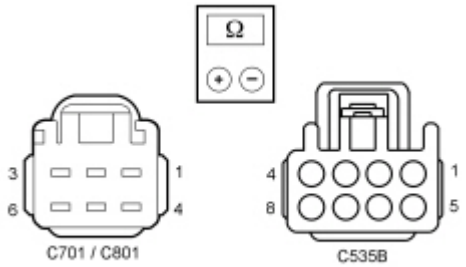
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK THE VOLTAGE TO THE RH REAR WINDOW CONTROL SWITCH	
• Disconnect: RH Rear Window Control Switch C801. • Ignition ON. • **NOTE:** Set the LH front window lock-out switch to the UNLOCK position. • Measure the voltage between RH rear window control switch C801-2, circuit CPW14 (VT/WH), harness side and ground.  N0092722 • **Is the voltage greater than 10 volts?**	**Yes** GO to F3 . **No** GO to F2 .
F2 CHECK THE WINDOW CONTROL SWITCH POWER CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: LH Front Window Control Switch C535B. • Measure the resistance between RH rear window control switch	**Yes** INSTALL a new LH front window control switch.

C801-2, circuit CPW14 (VT/WH), harness side and LH front window control switch C535B-4, circuit CPW14 (VT/WH), harness side.  N0121692 • **Is the resistance less than 5 ohms?**	REFER to Window Control Switch — Front in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
F3 CHECK THE GROUNDS TO THE LH REAR WINDOW CONTROL SWITCH	
• Ignition OFF. • Measure the resistance between RH rear window control switch C801-1, circuit CPW18 (GY/VT), harness side and ground; and between RH rear window control switch C801-3, circuit CPW17 (BN/GN), harness side and ground.  N0092724 • **Are the resistances less than 5 ohms?**	**Yes** GO to F5 . **No** GO to F4 .
F4 CHECK CIRCUITS CPW17 (BN/GN) AND CPW18 (GY/VT) FOR AN OPEN	
• Disconnect: LH Front Window Control Switch C535B. • Measure the resistance between RH rear window control switch C801, harness side and LH front window control switch C535B, harness side using the following chart:	**Yes** INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation. **No** REPAIR the circuit(s). TEST the system for normal operation.

RH Rear Window Control Switch	Circuit	LH Front Window Control Switch
C801-3	CPW17 (BN/GN)	C535B-4
C801-1	CPW18 (GY/VT)	C535B-7

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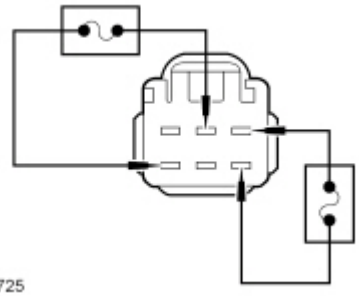


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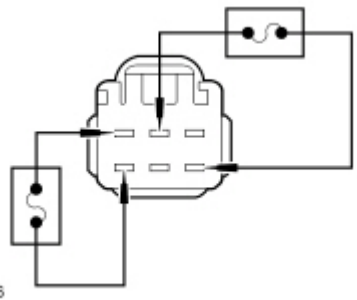
- **Are the resistances less than 5 ohms?**

F5 CHECK THE RH REAR WINDOW OPERATION

- Ignition ON.
- **NOTE:** Set the LH front window lock-out switch to the UNLOCK position.
- Connect a fused jumper wire between RH rear window control switch C801-2, circuit CPW14 (VT/WH), harness side and C801-6, circuit CPW23 (GY), harness side; and a second fused jumper wire between RH rear window control switch C801-4, circuit CPW24 (WH/VT), harness side and C801-1, circuit CPW18 (GY/VT), harness side. The RH rear window should operate in the downward direction.


N0092725

- Connect a fused jumper wire between RH rear window control switch C801-2, circuit CPW14 (VT/WH), harness side and C801-4, circuit CPW24 (WH/VT), harness side; and a second fused jumper wire between RH rear window control switch C801-6, circuit CPW23 (GY), harness side and C801-3, circuit CPW17 (BN/GN), harness side. The RH rear window should operate in the upward direction.


N0092726

- **Does the LH rear window operate correctly?**

Yes
If the RH rear window did not operate with the RH rear window control switch, INSTALL a new RH rear window control switch. REFER to Window Control Switch — Rear in this section. TEST the system for normal operation.

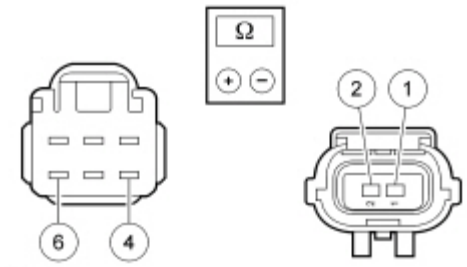
If the RH rear window did operate with the RH rear window control switch, but not with the LH front window control switch, INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation.

No
GO to F6 .

F6 CHECK THE POWER WINDOW MOTOR CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect: RH Rear Power Window Motor C828 (SuperCab) or C803 (SuperCrew).
- For SuperCab, measure the resistance between RH rear window control switch C801, harness side and RH rear power window motor C828, harness side using the following chart:

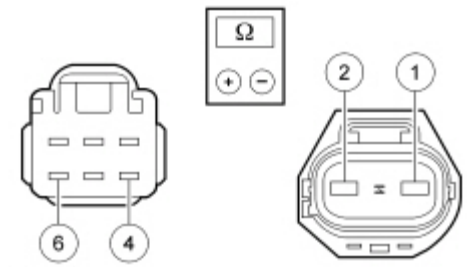
RH Rear Window Control Switch	Circuit	RH Rear Power Window Motor
C801-6	CPW23 (GY)	C828-1
C801-4	CPW24 (WH/VT)	C828-2



N0092730

- For SuperCrew, measure the resistance between RH rear window control switch C801, harness side and RH rear power window motor C803, harness side using the following chart:

RH Rear Window Control Switch	Circuit	RH Rear Power Window Motor
C801-6	CPW23 (GY)	C803-1
C801-4	CPW24 (WH/VT)	C803-2



N0092731

- **Are the resistances less than 5 ohms?**

Yes
INSTALL a new RH rear power window motor. REFER to Window Regulator Motor in this section. TEST the system for normal operation.

No
REPAIR the circuit(s). TEST the system for normal operation.

Pinpoint Test G: A Single Power Window is Inoperative — Power Sliding Rear Window

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

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Normal Operation

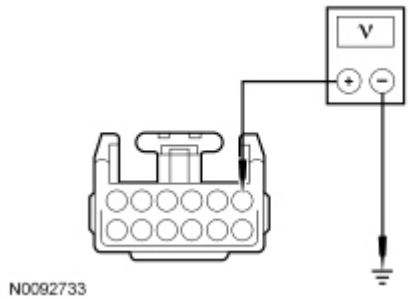
The overhead console switch supplies voltage and ground to the power sliding window motor to control movement. The overhead console switch controls movement by reversing polarity of the voltage and ground circuits being supplied to the power sliding window motor.

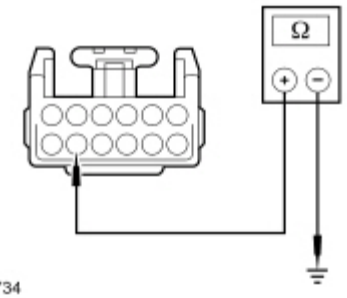
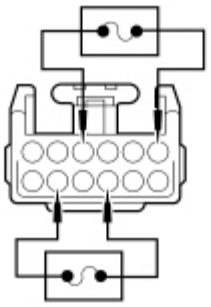
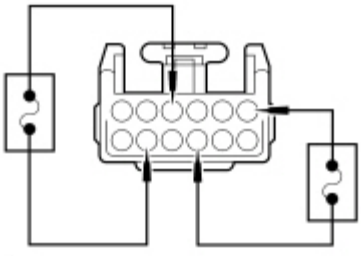
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Overhead console switch
- Power sliding window motor

PINPOINT TEST G: A SINGLE POWER WINDOW IS INOPERATIVE — POWER SLIDING REAR WINDOW

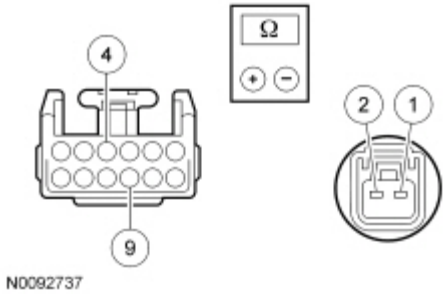
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 CHECK THE POWER WINDOW OPERATION	
• Ignition ON. • Verify the power windows operate. • **Do the power windows operate?**	**Yes** GO to G2 . **No** GO to Pinpoint Test B to diagnose the inoperative power windows.
G2 CHECK THE VOLTAGE TO THE OVERHEAD CONSOLE SWITCH	
• Ignition OFF. • Disconnect: Overhead Console Switch C912. • Ignition ON. • Measure the voltage between overhead console switch C912-1, circuit CBP01 (BU), harness side and ground.  N0092733 • **Is the voltage greater than 10 volts?**	**Yes** GO to G3 . **No** REPAIR the circuit. TEST the system for normal operation.
G3 CHECK THE GROUND TO THE OVERHEAD CONSOLE SWITCH FOR AN OPEN	
• Ignition OFF. • Measure the resistance between overhead console switch C912-11, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to G4 .

 N0092734 • **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit(s). TEST the system for normal operation.
G4 CHECK THE OVERHEAD CONSOLE SWITCH	
• Ignition ON. • Connect a fused jumper between overhead console switch C912-1, circuit CBP01 (BU), harness side and C912-4, circuit CPW59 (VT/BN), harness side; and a second fused jumper wire between overhead console switch C912-9, circuit CPW58 (YE/OG), harness side and C912-11, circuit GD139 (BK/YE), harness side. The power sliding window should open.  N0092735 • Connect a fused jumper between overhead console switch C912-1, circuit CBP01 (BU), harness side and C912-9, circuit CPW58 (YE/OG), harness side; and a second fused jumper wire between overhead console switch C912-4, circuit CPW59 (VT/BN) and C912-11, circuit GD139 (BK/YE), harness side. The rear sliding window should close.  N0092736 • **Did the rear power sliding window open and close?**	**Yes** INSTALL a new overhead console control switch. TEST the system for normal operation. **No** GO to G5 .
G5 CHECK THE POWER SLIDING WINDOW MOTOR CIRCUITS FOR AN OPEN	
• Disconnect: Power Sliding Window Motor C3145. • Measure the resistance between overhead console switch C912, harness side and power sliding window motor C3145, harness side using the following chart:	**Yes** INSTALL a new rear sliding window motor. REFER to Window

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Overhead Console Switch	Circuit	Power Sliding Window Motor
C912-9	CPW58 (YE/OG)	C3145-2
C912-4	CPW59 (VT/BN)	C3145-1



- **Are the resistances less than 5 ohms?**

Regulator Motor — Rear in this section. TEST the system for normal operation.

No
REPAIR the circuit(s). TEST the system for normal operation.

Pinpoint Test H: The Defrost System is Inoperative

Refer to Wiring Diagrams Cell 56 , Heated Window for schematic and connector information.

Normal Operation

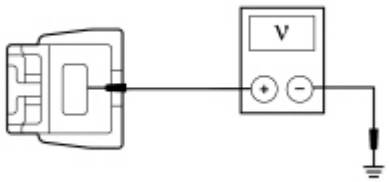
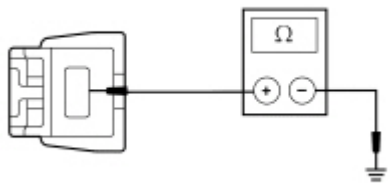
When the engine is running and the defrost switch is pressed, the HVAC module activates the rear window defrost relay. The defrost system is activated at one of the three following locations: HVAC module, FCIM or FDIM (8-inch [203mm] touchscreen). The FCIM and/or FDIM sends the defrost request message to the HVAC module over the Controller Area Network (CAN). When the rear window defrost relay is active, voltage is supplied to the rear window defrost grid. For vehicles equipped with a power sliding rear window, the rear window defrost grid does not activate unless the rear sliding window glass is in the fully CLOSED position due to a glass position switch in series with the grid circuit. The glass position switch is integral to the power sliding rear window assembly. The glass position switch sends a feedback signal to the HVAC module. When this signal is received, the HVAC module sends a message to the FCIM to illuminate the rear window defrost switch LED when the defrost grid is active and the sliding glass is fully closed. If the sliding glass is opened while the defrost system is active, the heated mirrors continue to operate and the rear window defrost switch LED is no longer illuminated.

This pinpoint test is intended to diagnose the following:

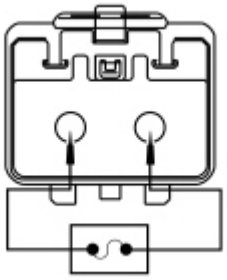
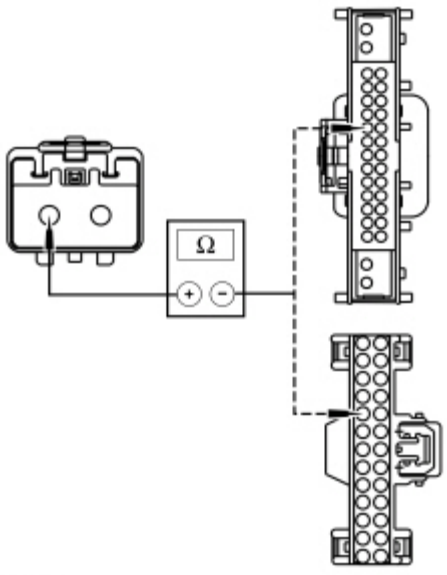
- Fuse(s)
- Rear window defrost relay
- Wiring, terminals or connectors
- Rear sliding glass position switch (if equipped) (part of power sliding rear window assembly)
- Rear window defrost grid
- HVAC module
- FCIM

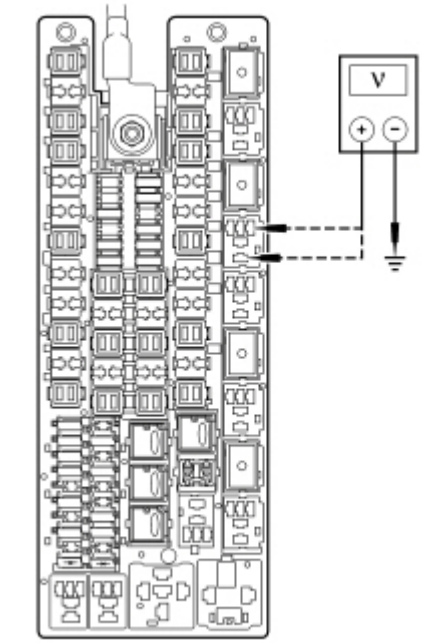
PINPOINT TEST H: THE DEFROST SYSTEM IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

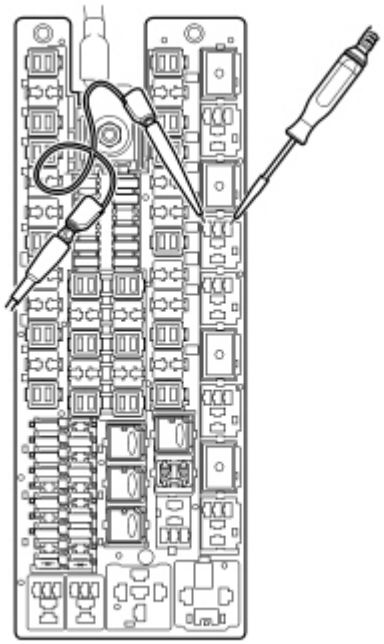
Test Step	Result / Action to Take
H1 CHECK THE REAR WINDOW DEFROST GRID VOLTAGE	
• Disconnect: Rear Window Defrost Grid Power (Passenger Side Terminal). • Start the engine. • Activate the rear window defrost switch and measure the voltage between rear window defrost grid power terminal, harness side and ground.  A0010641 • **Is the voltage greater than 10 volts?**	**Yes** GO to H2. **No** GO to H5.
H2 CHECK THE REAR WINDOW DEFROST GRID GROUND	
• Ignition OFF. • Disconnect: Rear Window Defrost Grid Ground (Driver Side Terminal). • Measure the resistance between rear window defrost grid ground terminal, harness side and ground.  A0010644 • **Is the resistance less than 5 ohms?**	**Yes** If equipped with a power sliding rear window, GO to H3. If not equipped with a power sliding rear window, CARRY OUT the Grid Wire Test in this section. ATTEMPT to REPAIR the rear window defrost grid, REFER to Window Grid Wire Repair. If not repairable, INSTALL a new rear window glass assembly. REFER to Window Glass — Rear in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
H3 CHECK THE REAR WINDOW DEFROST SWITCH LED OPERATION	
• Ignition OFF. • Disconnect: Rear Window Defrost Grid Inline (Passenger Side) C3368. • Install a fused jumper wire between rear window defrost grid inline C3368-1, circuit CH122 (WH/OG), harness side and C3368-2, circuit CRD06 (BN/YE), harness side.	**Yes** CARRY OUT the Grid Wire Test in this section. ATTEMPT to REPAIR the rear window defrost grid, REFER to Window Grid Wire Repair. If not repairable, INSTALL a new rear window glass assembly. REFER to

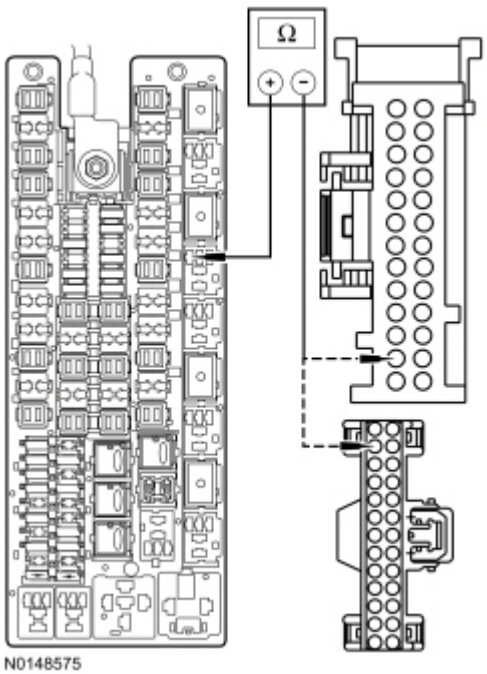
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 N0122406 • Start the engine. • Activate the rear window defrost switch. • **Does the rear window defrost switch LED illuminate?**	Window Glass — Rear in this section. TEST the system for normal operation. **No** GO to H4.
H4 CHECK THE REAR WINDOW DEFROST FEEDBACK CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228B or HVAC Module — Electronic Manual Temperature Control (EMTC) C294A. • Measure the resistance between rear window defrost grid inline C3368 and the HVAC module. ▪ For vehicles equipped with EMTC, measure the resistance between rear window defrost grid inline C3368-1, circuit CH122 (WH/OG), harness side and HVAC module — EMTC C294A-22, circuit CH122 (WH/OG), harness side. ▪ For vehicles equipped with EATC, measure the resistance between rear window defrost grid inline C3368-1, circuit CH122 (WH/OG), harness side and HVAC module — EATC C228B-7, circuit CH122 (WH/OG), harness side.  N0148574 • **Is the resistance less than 5 ohms?**	**Yes** GO to H10. **No** REPAIR the circuit. TEST the system for normal operation.

H5 CHECK THE POWER TO THE RELAY	
• Ignition OFF. • Disconnect: Rear Window Defrost Relay. • Ignition ON. • Measure the voltage between rear window defrost relay socket pin 1, circuit CBB54 (VT/OG), harness side and ground; and between pin 3, circuit SBB32 (VT/RD), harness side and ground.  N0093251 • **Is the voltage greater than 10 volts for both measurements?**	**Yes** GO to H6 . **No** VERIFY Battery Junction Box (BJB) fuse(s) 32 (40A) and 54 (5A) are OK. If OK, REPAIR the circuit(s). TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation.
H6 CHECK THE HVAC MODULE	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Start the engine. • Activate the rear window defrost switch. • Connect the 12-volt incandescent test light between rear window defrost relay socket pin 2, circuit CRD02 (BN/BU) and rear window defrost relay socket pin 1, circuit CBB54 (VT/OG).	**Yes** GO to H7 . **No** For vehicles equipped with the 4.2-inch (107mm) or 8-inch (203mm) display, GO to H8 . For vehicles not equipped with the 4.2-inch (107mm) or 8-inch (203mm) display, GO to H9 .

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 N0101517 • **Does the test light illuminate?**	
H7 CHECK THE REAR WINDOW DEFROST RELAY	
• Ignition OFF. • Carry out the rear window defrost relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the rear window defrost relay pass the component test?**	**Yes** REPAIR open in circuit CRD06 (BN/YE). TEST the system for normal operation. **No** INSTALL a new rear window defrost relay. TEST the system for normal operation.
H8 CHECK THE REAR DEFROST SWITCH (CC_SW_R_DEF) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — FCIM . • Monitor the FCIM CC_SW_R_DEF PID while pressing and releasing the rear window defrost switch. • **Does the PID agree with the rear defrost switch status?**	**Yes** GO to H9 . **No** INSTALL a new FCIM . Refer to the appropriate section in Group 415 for the procedure. TEST the system for normal operation.
H9 CHECK THE REAR WINDOW DEFROST RELAY CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228B or HVAC Module — Electronic Manual Temperature Control (EMTC) C294A. • Measure the resistance between rear window defrost relay and the HVAC module. ▪ For vehicles equipped with EATC , measure the resistance between rear window defrost relay socket pin 2, circuit CRD02 (BN/BU) and HVAC module — EMTC C294A-25, circuit CRD02 (BN/BU), harness	**Yes** GO to H10 . **No** REPAIR the circuit. TEST the system for normal operation.

side. ■ For vehicles equipped with EATC , measure the resistance between rear window defrost relay socket pin 2, circuit CRD02 (BN/BU) and HVAC module — EATC C228A-25, circuit CRD02 (BN/BU), harness side.  N0148575 • **Is the resistance less than 5 ohms?**	
H10 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Disconnect all HVAC module electrical connectors. • Check for: ■ corrosion. ■ pushed-out pins. • Connect all HVAC module electrical connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test I: The Defrost System Does Not Shut Off Automatically

Refer to Wiring Diagrams Cell 56 , Heated Window for schematic and connector information.

Normal Operation

When the engine is running and the defrost switch is pressed, the HVAC module activates the rear window defrost relay. The rear window defrost switch is integral to the HVAC module (if equipped with EMTC) or the FCIM (if equipped with EATC). For vehicles equipped with EATC , the FCIM sends the defrost request message to the HVAC module over the Controller Area Network (CAN). When the rear window defrost relay

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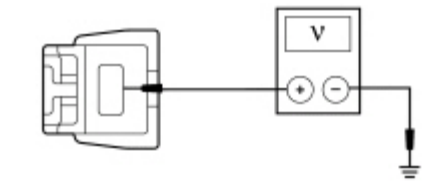
is active, voltage is supplied to the rear window defrost grid. For vehicles equipped with a power sliding rear window, the rear window defrost grid does not activate unless the rear sliding window glass is in the fully CLOSED position due to a glass position switch in series with the grid circuit. The glass position switch is integral to the power sliding rear window assembly. The glass position switch sends a feedback signal to the HVAC module to illuminate the rear window defrost switch LED when the defrost grid is active and the sliding glass is fully closed. For vehicles equipped with EATC , the HVAC module sends a message to the FCIM to illuminate the rear window defrost switch LED when the defrost grid is active and the sliding glass is fully closed. If the sliding glass is opened while the defrost system is active, the heated mirrors continue to operate and the rear window defrost switch LED is no longer illuminated.

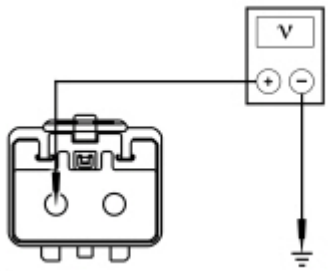
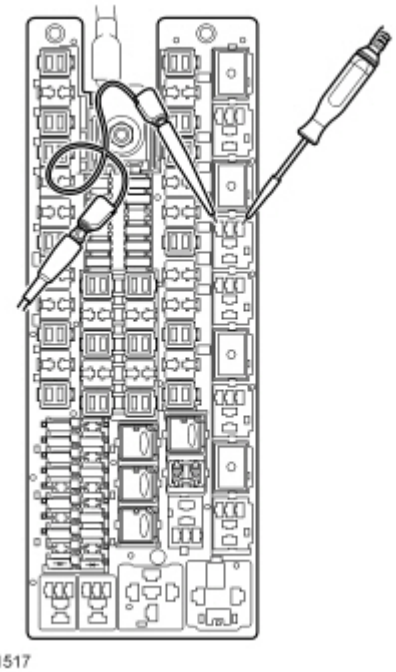
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Rear window defrost relay
- HVAC module

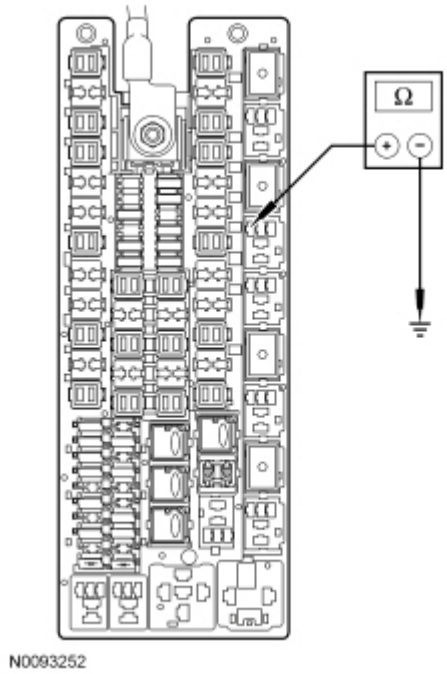
PINPOINT TEST I: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
I1 CHECK REAR WINDOW DEFROST GRID POWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Rear Window Defrost Relay. • Disconnect: Rear Window Defrost Grid Power (Passenger Side Terminal). • Ignition ON. • Measure the voltage between rear window defrost grid power terminal, harness side and ground.  A0010641 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit CRD06 (BN/YE) for a short to voltage. TEST the system for normal operation. **No** If equipped with a power sliding rear window, GO to I2 . If not equipped with a power sliding rear window, GO to I4 .
I2 CHECK THE REAR WINDOW DEFROST SWITCH LED STATUS	
• Observe the rear window defrost switch status. • **Is the rear window defrost switch LED illuminated?**	**Yes** GO to I3 . **No** GO to I4 .
I3 CHECK THE REAR WINDOW DEFROST FEEDBACK CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF.	**Yes**

• Disconnect: Rear Window Defrost Grid Inline (passenger side) C3368. • Disconnect: HVAC Module — EATC C228B or HVAC Module — Electronic Manual Temperature Control (EMTC) C294A. • Ignition ON. • Measure the voltage between rear window defrost grid inline C3368-1, circuit CH122 (WH/OG), harness side and ground.  N0122474 • **Is any voltage present?**	REPAIR the circuit. TEST the system for normal operation. **No** GO to I6 .
I4 CHECK THE HVAC MODULE ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Start the engine. • Connect the 12-volt incandescent test light between rear window defrost relay socket pin 2, circuit CRD02 (BN/BU) and rear window defrost relay socket pin 1, circuit CBB54 (VT/OG).  N0101517 • **Does the test light illuminate?**	**Yes** GO to I5 . **No** INSTALL a new rear window defrost relay. TEST the system for normal operation.
I5 CHECK THE REAR WINDOW DEFROST RELAY CONTROL CIRCUIT	

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FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module — EATC C228B or HVAC Module — Electronic Manual Temperature Control (EMTC) C294A. • Measure the resistance between rear window defrost relay socket pin 2, circuit CRD02 (BN/BU), harness side and ground.  N0093252 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I6 . **No** REPAIR short to ground in circuit CH122 (WH/OG). TEST the system for normal operation.
I6 CHECK FOR CORRECT HVAC MODULE OPERATION	

• Disconnect all HVAC module connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all HVAC module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test J: The Delayed Accessory is Inoperative

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

Normal Operation

The accessory delay relay is located in the Body Control Module (BCM). When the ignition is turned ON, the BCM activates the accessory delay relay by grounding the relay coil. When the ignition is turned to the OFF position, the BCM continues to ground the accessory delay relay coil for approximately 10 minutes, or until a front door is opened. When the accessory delay relay is active, it supplies voltage to the power window system.

- DTC B131A:12 (Delayed Accessory Power: Circuit Short To Battery) — sets when the BCM senses a short to voltage on the accessory delay relay control circuit.
- DTC B131A:14 (Delayed Accessory Power: Circuit Short To Ground or Open) — sets when the BCM senses an open or short to ground on the accessory delay relay control circuit.

This pinpoint test is intended to diagnose the following:

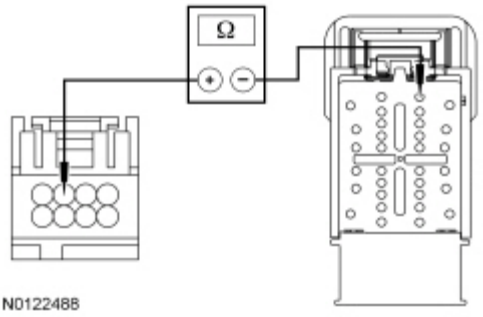
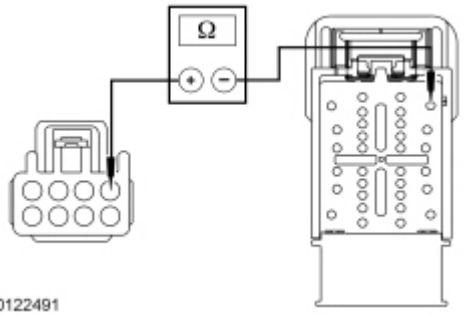
- Door ajar switches
- Accessory delay relay
- Wiring, terminals or connectors
- BCM

PINPOINT TEST J: THE DELAYED ACCESSORY IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
J1 CHECK FOR CORRECT OPERATION OF THE DOOR AJAR SWITCHES	
• Open and close the front doors. Verify the interior lights turn on when the doors are open and off when the doors are closed. • **Do the interior lights operate normally?**	**Yes** GO to J2. **No** REFER to Section 417-02 to diagnose the interior lighting and door ajar switches.
J2 CHECK THE ACCESSORY DELAY RELAY	
• Disconnect: Accessory Delay Relay. • Carry out the accessory delay relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the delayed accessory relay pass the component test?**	**Yes** VERIFY Body Control Module (BCM) fuse 32 (15A) (regular cab) or BCM circuit breaker 48 (30A) (SuperCab or SuperCrew) is OK. If OK, GO to J3. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new accessory delay relay. TEST the system for normal operation.
J3 CHECK THE LH FRONT WINDOW CONTROL SWITCH POWER CIRCUIT FOR AN OPEN	
• Ignition OFF.	**Yes**

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• Disconnect: BCM C2280D. • Disconnect: LH Front Window Control Switch C504 (Regular Cab) or C535B(SuperCab or SuperCrew). • For regular cab, measure the resistance between LH front window control switch C504-3, circuit CBP32 (GN/VT), harness side and BCM C2280D-17, circuit CBP32 (GN/VT), harness side.  N0122488 • For SuperCab or SuperCrew, measure the resistance between LH front window control switch C535B-1, circuit CBP01 (BU), harness side and BCM C2280D-27, circuit CBP01 (BU), harness side.  N0122491 • **Is the resistance less than 5 ohms?**	GO to J4. **No** REPAIR the circuit. TEST the system for normal operation.

J4 CHECK FOR CORRECT BCM OPERATION
• Disconnect all BCM connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test K: The Delayed Accessory Does Not Turn Off

Refer to Wiring Diagrams Cell 100, Power Windows for schematic and connector information.

Normal Operation

The accessory delay relay is located in the Body Control Module (BCM). When the ignition is turned ON, the BCM activates the accessory delay relay by grounding the relay coil. When the ignition is turned to the OFF position, the BCM continues to ground the accessory delay relay coil for approximately 10 minutes, or until a front door is opened. When the accessory delay relay is active, it supplies voltage to the power window system.

- DTC B131A:14 (Delayed Accessory Power: Circuit Short To Ground or Open) — sets when the BCM senses an open or short to ground on the accessory delay relay control circuit.

This pinpoint test is intended to diagnose the following:

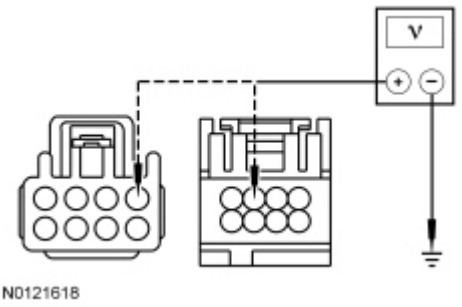
- Accessory delay relay
- Wiring, terminals or connections
- BCM

PINPOINT TEST K: THE DELAYED ACCESSORY DOES NOT TURN OFF

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
K1 CHECK FOR STUCK/STICKING ACCESSORY DELAY RELAY	
• Disconnect: Accessory Delay Relay. • Ignition ON. • Attempt to operate the power windows. • **Do the power windows still operate?**	**Yes** GO to K3. **No** GO to K2.
K2 CHECK THE ACCESSORY DELAY RELAY	
• Ignition OFF. • Carry out the accessory delay relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the accessory delay relay pass the component test?**	**Yes** GO to K4. **No** INSTALL a new accessory delay relay. TEST the system for normal operation.
K3 CHECK THE LH FRONT WINDOW CONTROL SWITCH POWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: BCM C2280D. • Disconnect: LH Front Window Control Switch C504 (Regular Cab) or C535A (SuperCab or SuperCrew). • Ignition ON. • Measure the voltage between LH front window control switch and ground. ▪ For regular cab, measure the voltage between C504-3, circuit CBP32 (GN/VT), harness side and ground. ▪ For SuperCab or SuperCrew, measure the voltage between C535B-1, circuit CBP01 (BU), harness side and ground.	**Yes** REPAIR circuit CBP01 (BU) or CBP32 (GN/VT) for a short to voltage. TEST the system for normal operation. **No** GO to K4.

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 N0121618 • **Is any voltage present?**	

K4 CHECK FOR CORRECT BCM OPERATION
• Disconnect all BCM connectors.
• Check for:
  ▪ corrosion.
  ▪ pushed-out pins.
• Connect all BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test L: All Passenger Power Windows are Inoperative — LH and RH Rear

Refer to Wiring Diagrams Cell 100, Power Windows for schematic and connector information.

Normal Operation

The LH and RH rear window control switches receive voltage from the LH front window control switch when the lock-out switch is in the UNLOCK position. Ground is also provided to the LH and RH rear window control switches from the LH front window control switch. The LH and RH rear window control switches transfer voltage and ground to the power window motor. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the power window motor.

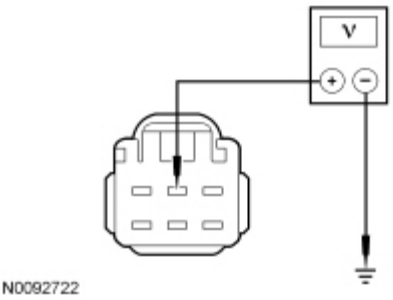
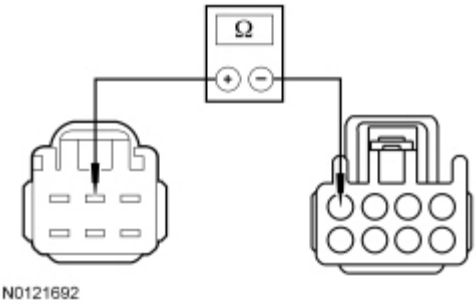
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- LH front window control switch

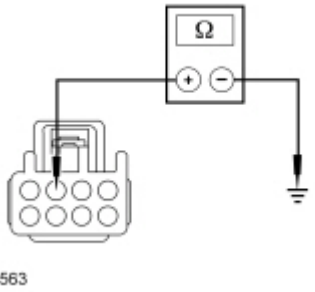
PINPOINT TEST L: ALL PASSENGER POWER WINDOWS ARE INOPERATIVE — LH AND RH REAR

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
L1 CHECK THE VOLTAGE TO THE LH REAR WINDOW CONTROL	

SWITCH	
• Disconnect: LH Rear Window Control Switch C701. • Ignition ON. • **NOTE:** Set the LH front window lock-out switch to the UNLOCK position. • Measure the voltage between LH rear window control switch C701-2, circuit CPW14 (VT/WH), harness side and ground.  N0092722 • **Is the voltage greater than 10 volts?**	**Yes** GO to L3 . **No** GO to L2 .
L2 CHECK THE WINDOW CONTROL SWITCH POWER CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: LH Front Window Control Switch C535B. • Measure the resistance between LH rear window control switch C701-2, circuit CPW14 (VT/WH), harness side and LH front window control switch C535B-4, circuit CPW14 (VT/WH), harness side.  N0121692 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
L3 CHECK THE LH FRONT WINDOW CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: LH Front Window Control Switch C535B. • Measure the resistance between LH front window control switch C535B-3, circuit GD134 (BK/VT), harness side and ground.	**Yes** INSTALL a new LH front window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

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 N0122563 • **Is the resistance less than 5 ohms?**	

Pinpoint Test M: The One-Touch Up/Down Feature is Inoperative

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

NOTE: A new power window motor will not operate in one-touch up mode until initialized. Refer to Window Motor Initialization in this section.

Normal Operation

During normal operation, when the window control switch is pressed to the second detent position to request a one-touch up or down operation, the window control switch provides a 12-volt signal on both the up and down line simultaneously. During a one-touch up or down request, the window motor determines intended window direction by the signal first received (first detent position). If the window control switch is pressed too quickly to the second detent position (less than 5 milliseconds of time between first detent signal and second detent signal), the window motor will not be able to determine the intended direction request and will not operate until the window control switch is released and pressed again.

This pinpoint test is intended to diagnose the following:

- Power window motor not initialized
- Window control switch
- Window regulator motor

PINPOINT TEST M: THE ONE-TOUCH UP/DOWN FEATURE IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
M1 CHECK FOR POWER (B+) LOSS DURING WINDOW OPERATION	
• Verify if power (B+) was lost during window operation. • **Was power (B+) lost while the window was in operation?**	**Yes** RAISE the suspect window to the fully CLOSED position. VERIFY the window glass stalls into the upper header seal. The window should function normally. TEST the system for normal operation. **No** GO to M2 .

M2 DE-INITIALIZE, THEN INITIALIZE THE WINDOW MOTOR	
• De-initialize the suspect window motor, then carry out the window motor initialization procedure. Refer to Window Motor Initialization in this section. • **Is the one-touch down feature operating correctly?**	**Yes** The system is operating normally at this time. The window motor lost initialization. **No** GO to M3 .
M3 CHECK THE SUSPECT WINDOW CONTROL SWITCH	
• Ignition OFF. • Disconnect: Suspect Window Control Switch C504 (LH front, Regular Cab) C535A, C535B (Supercrew or SuperCab), or C604 (RH front). • Carry out the component test for the suspect window control switch. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the window control switch pass the component test?**	**Yes** INSTALL a new window regulator and motor. REFER to Window Regulator and Motor — Front Door in this section. INITIALIZE the window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. **No** INSTALL a new window control switch. REFER to Window Control Switch — Front in this section. TEST the system for normal operation.

Component Test

Grid Wire Test

1. Using a bright lamp in the vehicle, inspect the wire grid from the exterior. A broken grid wire will appear as a brown spot.

2. Run the engine at idle. Set the rear window defrost switch to ON. The indicator light should come on.

3. Working in the vehicle with a voltmeter, contact the broad red-brown stripes of the rear glass window positive lead to battery side and the negative lead to ground side. The meter should read 10-13 volts. A lower voltage reading indicates a loose ground connection.

4. Contact a good ground point with the negative lead of the meter. The voltage reading should not change.

5. With the negative lead of the meter grounded, touch each grid line of the heated rear window glass at its midpoint with the positive lead. A reading of approximately 6 volts indicates the line is good. A reading of 0 volt indicates the line is broken between the midpoint and the B+ side of the grid line. A reading of 12 volts indicates the circuit is broken between the midpoint of the grid line and ground.

6. Pinpointing the exact position of the break can be accomplished (if the voltmeter reads 0 volt when the midpoint of the grid line is touched with the positive lead of the voltmeter) by moving the positive lead of the voltmeter toward the B+ side of the grid line and touching the grid line until the voltmeter reads 12 volts. If the voltmeter reads 12 volts when the midpoint of the grid line is touched with the positive lead of the voltmeter, simply move the positive lead of the voltmeter toward the ground connection of the grid line and touch the grid line until the voltmeter reads 0 volt.

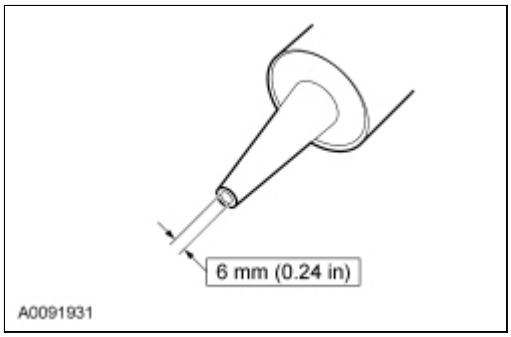
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Glass Reseal — Windshield

Material

Item	Specification
Dow Urethane Adhesive Betaseal™ Express	—
Sika Urethane Adhesive Sika Tack ASAP	—
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

1. Remove the cowl panel grille. For additional information, refer to Section 501-02 .
2. If equipped, remove the overhead console or dome lamp assembly. For additional information, refer to Section 501-12 .
3. Remove the interior rear view mirror. For additional information, refer to Section 501-09 .
4. If equipped, remove the rain sensor. For additional information, refer to Section 501-16 .
5. Remove the A-pillar trim panels, sunvisors and sunvisor clips. For additional information, refer to Section 501-05 .
6. Partially lower the front portion of the headliner near the windshield upper opening and block with a suitable material.
7. Clean the edge formed by the existing urethane adhesive and the glass on the inside at the top, sides and outside on the bottom of the windshield with glass cleaner.
8. Cut the urethane adhesive applicator tip to specification.



9. **NOTE:** Use either a high-ratio electric or battery-operated caulk gun that will apply the urethane adhesive with less effort and a continuous bead.

   NOTE: Make sure all gaps in the urethane adhesive are smoothed into one continuous bead.

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Apply urethane adhesive over the top of the existing urethane adhesive.

- Apply the urethane adhesive to the top and sides of the windshield from the interior of the vehicle.
- Apply the urethane adhesive to the bottom of the windshield from the exterior of the vehicle.

10. **NOTE:** The urethane adhesive must cure for a minimum of one hour before testing for air or water leaks.

    After the urethane adhesive has cured, check the windshield seal for air or water leaks through the urethane adhesive bead and add urethane adhesive as necessary.

11. Position the front portion of the headliner.

12. Install the A-pillar trim panels, sunvisors and sunvisor clips. For additional information, refer to Section 501-05 .

13. If equipped, install the rain sensor. For additional information, refer to Section 501-16 .

14. Install the interior rear view mirror. For additional information, refer to Section 501-09 .

15. If equipped, install the overhead console or dome lamp assembly. For additional information, refer to Section 501-12 .

16. Install the cowl panel grille. For additional information, refer to Section 501-02 .

Lead Terminal Repair

General Equipment

Terminal Kit — Back Glass 4F1Z-14421-AA

Material

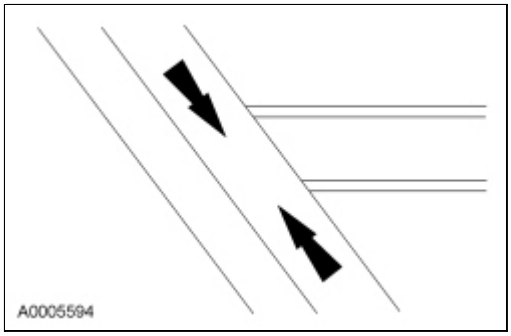
Item	Specification
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

NOTE: This procedure is for vehicles equipped with fixed rear window assembly only. The lead terminals cannot be repaired on vehicles equipped with a power sliding rear window.

1. Bring the vehicle up to room temperature of at least 16°C (60°F) or above.

2. **NOTE:** The new terminal will cover the original terminal location, but it must be placed so that the terminal conductive areas will be placed on a good conductive base.

   Clean the bus bar in the area to be repaired with steel wool (000 to 0000 grade), and then with glass cleaner to remove all dirt, wax, grease, oil or other foreign material.



3. ***NOTICE:*** **Do not use any type of flame torch or flame-heated soldering gun for this procedure. Use of these tools provide inadequate heat generation at the tip and the exhaust heat can cause damage to plastic trim parts in the area. Use only an electric soldering gun with 100 watts or more of power. Before using the soldering gun, be sure to melt a small amount of rosin core solder to the tip. The solder will assist in achieving better heat transfer from the soldering gun tip to the new terminal.**

   NOTE: Depending on the original terminal location, and whether the terminal is covered by pillar trim, will determine where to locate the new terminal. Some grid line bus bars may only allow the placement of the terminal above or below the original tab location due to space limitations. For most vehicle applications, the replacement tab location will cover the original tab location, but still allow the replacement tab to attach to the bus bar on good conductive material.

   Place the replacement terminal type A over the original tab location, making sure the conductive

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areas of the terminal will be on a good conductive area. Do not place the terminal tab foot on the original location, which does not have conductive material.

4. Hold the terminal in place with an item such as a regular lead pencil at a 90 degree angle from the terminal. (Holding at other than a 90 degree angle may allow the terminal to slip when the solder liquefies.)

5. **NOTE:** The new terminal has pre-applied solder, flux and temperature-sensitive paint. The paint provides a visual indication when the terminal has reached the correct temperature to melt solder on the terminal. When the correct temperature is achieved, the temperature paint will liquefy and change color.

   Place the soldering gun tip on the top of the terminal, but not on the painted areas of the tab. Energize the soldering gun and watch for the painted area of the terminal to liquefy and change color. The paint should liquefy in approximately 25-45 seconds after heating. As soon as the paint color completely changes on either side of the terminal, de-energize the soldering gun and continue to hold the terminal in place with the soldering gun and pencil for an additional 30 seconds.

6. Remove the soldering gun and pencil from the terminal. The terminal should be allowed to cool for another 2 minutes before the wiring lead is attached to the terminal.

7. Attach the electrical lead connection to this terminal, turn on the heated rear window and verify the operation.

Window Glass Adjustment — Front Door

NOTE: A misadjusted front window glass may cause a customer concern of slow power window travel when raising the window.

1. If equipped with power windows, remove the window control switch. For additional information, refer to Window Control Switch — Front in this section.
2. Remove the front door trim panel. For additional information, refer to Section 501-05 .
3. Position aside the front door watershield.
4. Temporarily install the window control switch or the window crank to raise or lower the window glass as necessary to access the glass-to-regulator assembly bolts.
5. Loosen the front door window glass-to-regulator assembly bolts.
6. Push the glass up into the header by hand, then shift the glass rearward until it stops against the rear window run seal while lowering the glass back down into the window glass clamps.
7. **NOTE:** Make sure the window glass is seated in the bottom of the glass clamps.

   Tighten the front door window glass-to-regulator assembly bolts to 11 Nm (97 lb-in).
8. Install the watershield.
9. Install the front door trim panel. For additional information, refer to Section 501-05 .
10. If equipped with power windows, install the window control switch. For additional information, refer to Window Control Switch — Front in this section.

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Window Grid Wire Repair

General Equipment

Polypropylene Film Fine Line Tape (Commercially available)

Material

Item	Specification
Motorcraft® Lacquer Touch-Up Paint (match color to exterior grid wire) PMP-19500-XXXXX	ESR-M2P100-C
Permatex® Quick Grid™ Rear Window Defogger Repair Kit 15067	—
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

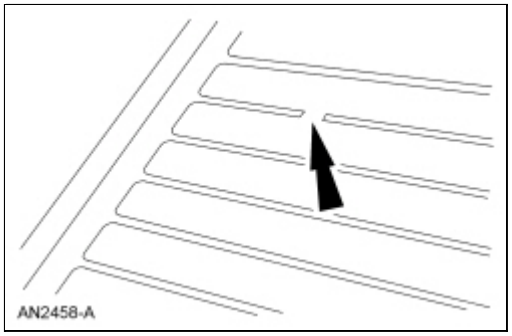
NOTE: The grid line material is not embedded into the glass, but is baked to the glass surface and consequently can be scraped off. An undamaged grid line will have small ridges that project above the surface of the glass and can easily be felt when running a fingernail across them. Grid lines that have been "razor bladed" will feel smooth when a fingernail is dragged across the affected area. Inoperative lines may appear to the eye to be undamaged due to residue remaining on the glass and will require diagnosis with a voltmeter or 12V test lamp. For additional information, refer to Diagnosis and Testing in this section.

1. Bring the vehicle up to a room temperature of at least 16°C (60°F) or above.

2. ***NOTICE:*** **Do not use scrapers, sharp instruments or abrasive window cleaners on the interior surface of the rear window glass as this may cause damage to the grid lines.**

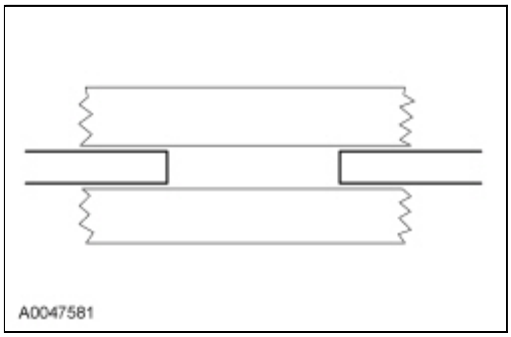
   Clean the entire grid line repair area with glass cleaner and 0000 steel wool to remove all dirt, wax, grease, oil or other foreign material.

3. Mark the location of the grid break on the exterior of the rear window glass.



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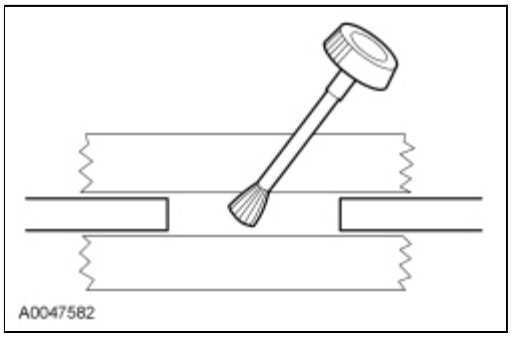
4. Using a polypropylene film fine line tape, mask the area directly above and below the grid break extending the tape 26 mm (1.02 in) beyond the concern area in both directions. The break area should be at the center of the mask.



5. **NOTE:** If the brown layer is not broken or missing, apply only the silver grid repair compound to the break. If both the brown and silver layers of the grid are broken or missing, apply a coating of the lacquer touch up paint across the break in the grid line prior to applying the rear window defroster repair compound. Do not overlap the silver grid line with the paint. Several applications may be necessary to achieve a color match.

   NOTE: Allow at least 5 minutes of drying time between applications for the touch up paint or the silver repair coating. Applying fewer coats or not allowing adequate drying time between coats will produce repaired resistance that is greater than OEM resistance, resulting in poor defrost performance and excessive localized heating.

   Apply the repair coating to the grid break area in several smooth, continuous strokes. Extend the silver repair coating at least 6.35 mm (0.25 in) on both sides of the break area.
   Apply a minimum of 6 applications of the grid repair compound.



6. **NOTE:** The repair coating air-dries in approximately one minute and can be energized after 5 minutes. Optimum adhesion occurs after approximately 24 hours.

   Allow the repair area to dry completely and remove the mask.

7. ***NOTICE:*** **Be careful not to damage the grid line with the razor blade. If this occurs, additional repair may be necessary.**

   Remove any excess repair compound above or below the grid line with a razor blade.

8. **NOTE:** The interior side of the grid lines are not painted, but due to the silver tarnishing will tend to change the grid to a gold or brown color. The repair area will be bright silver and will also tarnish over time to match the rest of the grid.

Test the system for normal operation.

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Window Motor Initialization

NOTE: Initialization is required to learn both the full UP and full DOWN positions and the profile of the glass as it travels through the glass channel. Once initialized, obstacle detection is enabled. This procedure is only required for LH and RH front window motors.

NOTE: The front window motor must be de-initialized, then initialized whenever the front window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

NOTE: A new (original factory setting) or de-initialized front window motor cannot operate in one-touch up mode until initialized. If a new front window motor has been installed, proceed to the initialization procedure.

NOTE: If diagnosing a LH or RH front window switch problem, carry out the window initialization procedure before installing a new window switch.

NOTE: All front window components (window glass, window regulator, window motor, seals and glass top run) must be installed and tightened to specification before carrying out the initialization procedure.

NOTE: Excessive bounce-back (window reverses direction with no obstructions present) can indicate that a de-initialization procedure may need to be carried out.

De-Initialization Procedure

NOTE: The front window motor must be de-initialized (reset to its original factory settings) before carrying out the initialization procedure.

1. Turn the ignition ON.

2. Operate the window control switch in one-touch mode and remove power from the window motor **while the window is moving** by one of the following methods:
    1. Disconnect the vehicle battery cable **while the window is moving** .
    2. Remove the LH or RH front window motor fuse **while the window is moving** .

3. This de-initializes the window motor and reset the window motor to its original factory settings.

4. Carry out the initialization procedure to turn the one-touch-up feature on.

Window Motor Initialization

WARNING: Keep objects and body parts clear of the glass panel when carrying out the initialization procedure. During the initialization procedure, the glass panel closes with high force and cannot detect objects in its path. Failure to follow this instruction may result in serious personal injury.

NOTE: The front window must be in the full OPEN position for this procedure to operate correctly.

NOTE: If the initialization procedure is only partially completed, the front window motor remains de-initialized and operates only in proportional up/down and one-touch-down modes.

5. Turn the ignition ON.

6. Activate and hold the window control switch in the UP position at the second detent until the window glass stalls for 2 seconds into the glass top run and release the switch.

7. Activate and hold the window control switch in the DOWN position at the second detent until the window glass stalls for 2 seconds at the bottom of its travel and release the switch.

8. Test for correct window operation by carrying out the one-touch-up and one-touch-down features.

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Door Glass Top Run — Front

Removal and Installation

NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

1. Remove the front door window glass. For additional information, refer to Window Glass — Front Door in this section.

2. Remove the exterior rear view mirror. For additional information, refer to Section 501-09 .

3. Remove the front door outer belt moulding. For additional information, refer to Section 501-08 .

4. Remove the front door glass top run.
    - Remove the front door glass top run through the top opening of the front door.

5. To install, reverse the removal procedure.
    - Initialize the front window motor. For additional information, refer to Window Motor Initialization in this section.

Door Glass Top Run — Rear, SuperCab

Removal and Installation

1. Position the rear door window glass in the full downward position.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the rear door interior moulding.
4. Remove the rear door window glass top run.
    - Remove the rear door window glass top run through the top opening of the rear door.
5. To install, reverse the removal procedure.

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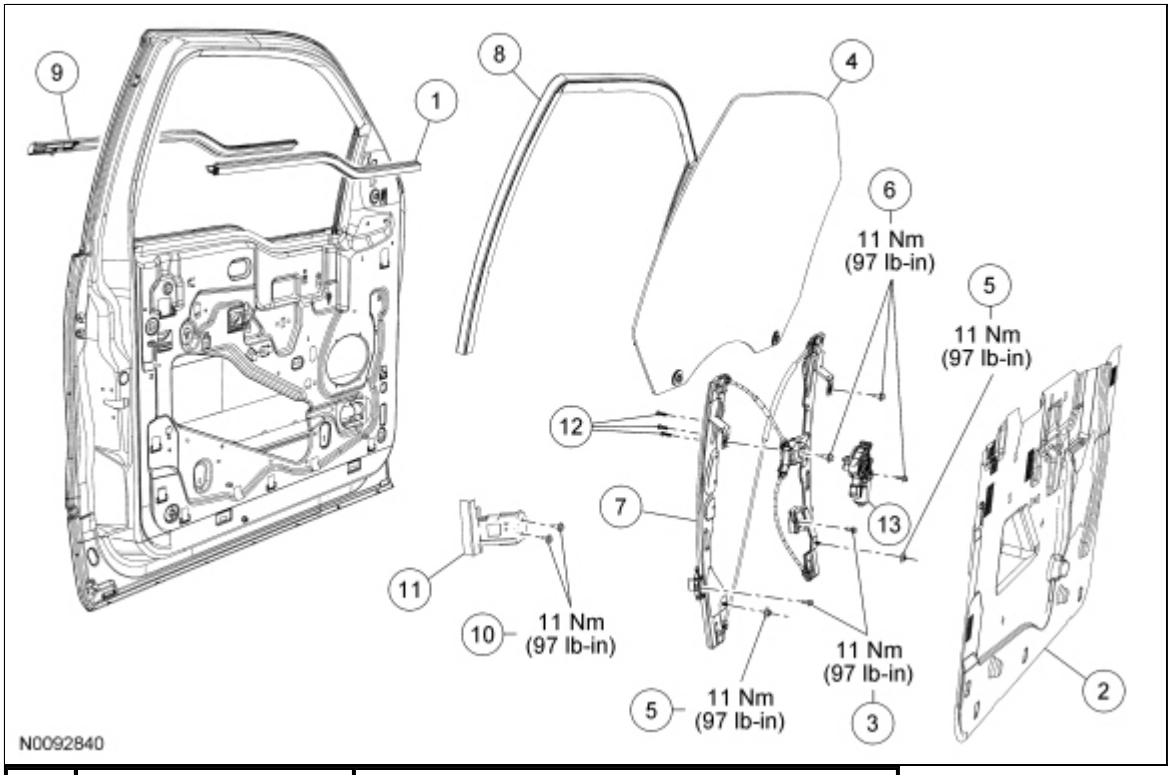
Door Glass Top Run — Rear, SuperCrew

Removal and Installation

1. Position the rear door window glass in the full downward position.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the rear door interior moulding.
4. Remove the rear door window glass top run.
    - Remove the rear door window glass top run through the top opening of the rear door.
5. To install, reverse the removal procedure.

Glass, Frames and Mechanisms — Exploded View, Front Door

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	1521434 RH/ 1521435 LH	Front door interior moulding
2	15237A04 RH/ 15237A05 LH	Front door watershield
3	—	Front door window glass-to-regulator assembly bolts (2 required)
4	1521410 RH/ 1521411 LH	Front door window glass
5	W711059	Front door window regulator nuts (2 required)
6	W714438	Front door window regulator bolts (3 required)
7	1523200 RH/ 1523201 LH	Front door window regulator assembly
8	1521596 RH/ 1521597 LH	Front door glass top run
9	1521452 RH/ 1521453 LH	Front door window glass exterior moulding

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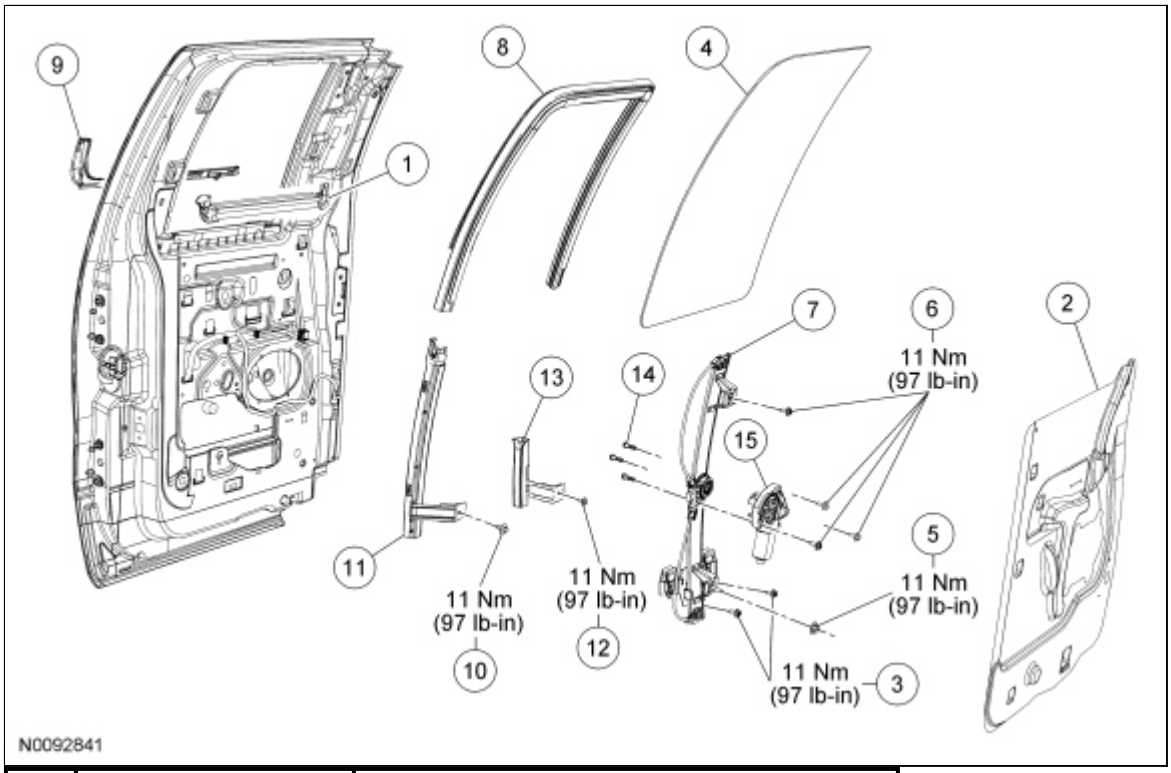
10	W714438	Front door below belt bracket bolts (2 required)
11	15263A20 RH/ 15263A21 LH	Front door below belt bracket
12	—	Window regulator motor bolts (3 required)
13	—	Window regulator motor

1. For additional information, refer to the procedures in this section.

Glass, Frames and Mechanisms — Exploded View, Rear Door

SuperCab

NOTE: LH side shown, RH side similar.



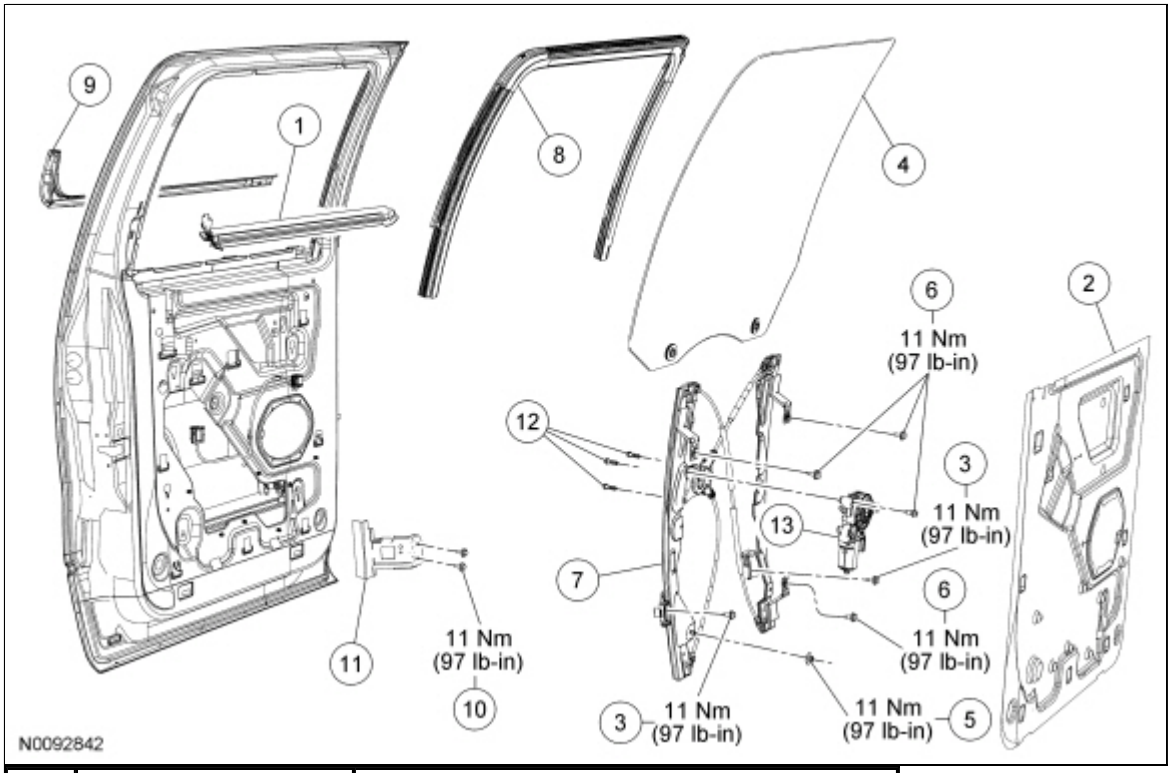
Item	Part Number	Description
1	1825860 RH/ 1825861 LH	Rear door interior moulding
2	1827458 RH/ 1827459 LH	Rear door watershield
3	—	Rear door window glass-to-regulator assembly bolts (2 required)
4	1825712 RH/ 1825713 LH	Rear door window glass
5	W711059	Rear door window regulator nut
6	W714438	Rear door window regulator bolts (4 required)
7	1827000 RH/ 1827001 LH	Rear door window regulator assembly
8	1825764 RH/ 1825765 LH	Rear door window glass top run
9	1825596 RH/	Rear door exterior moulding

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	1825597 LH	
10	W707622	C-pillar below belt bracket bolt
11	18263B00 RH/ 18263B01 LH	C-pillar below belt bracket
12	W714438	B-pillar below belt bracket bolt
13	1826342 RH/ 1826343 LH	B-pillar below belt bracket
14	—	Window regulator motor bolt (3 required)
15	—	Window regulator motor

SuperCrew

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	1625766 RH/ 1625767 LH	Rear door interior moulding
2	1627458 RH/ 1627459 LH	Rear door watershield
3	—	Rear door window glass-to-regulator assembly bolts (2 required)
4	1625712 RH/ 1625713 LH	Rear door window glass
5	W711059	Rear door window regulator nut

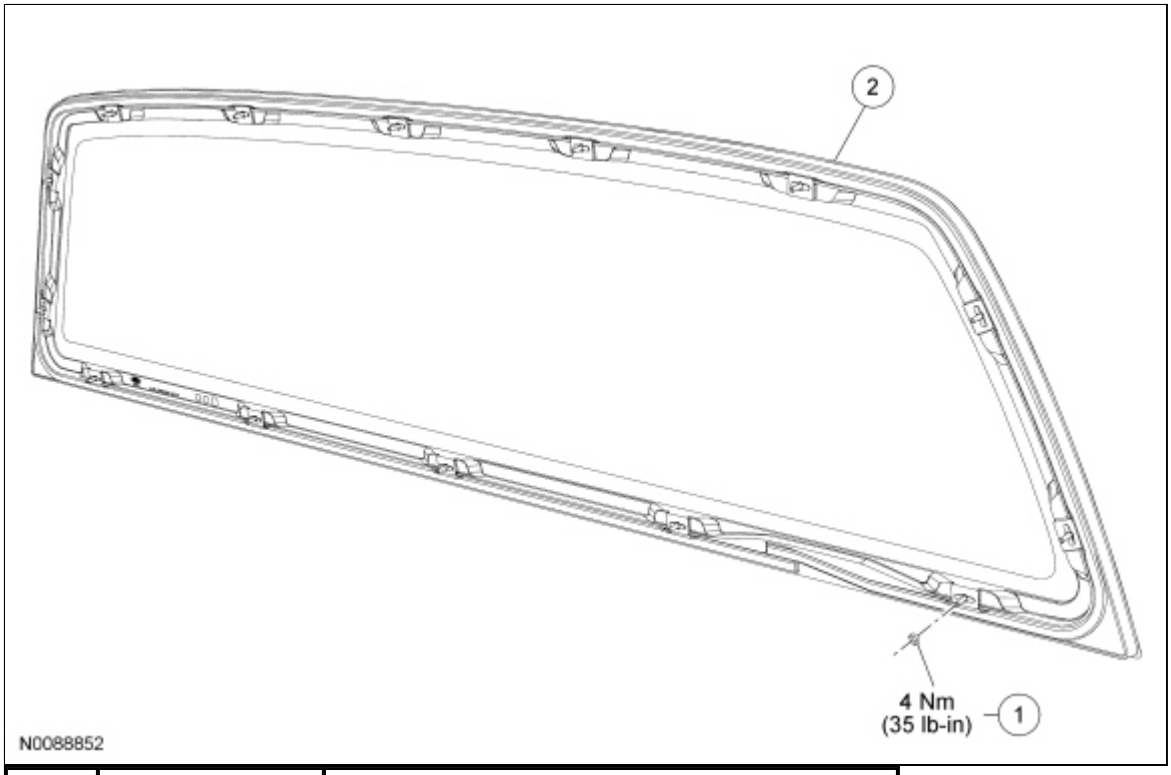
6	W714438	Rear door window regulator bolts (4 required)
7	1627000 RH/ 1627001 LH	Rear door window regulator assembly
8	1625766 RH/ 1625767 LH	Rear door window glass top run
9	1625596 RH/ 1625597 LH	Rear door exterior moulding
10	W714438	C-pillar below bracket bolt (2 required)
11	16236B00 RH/ 16236B01 LH	C-pillar below belt bracket
12	—	Window regulator motor bolts (3 required)
13	—	Window regulator motor

1. For additional information, refer to the procedures in this section.

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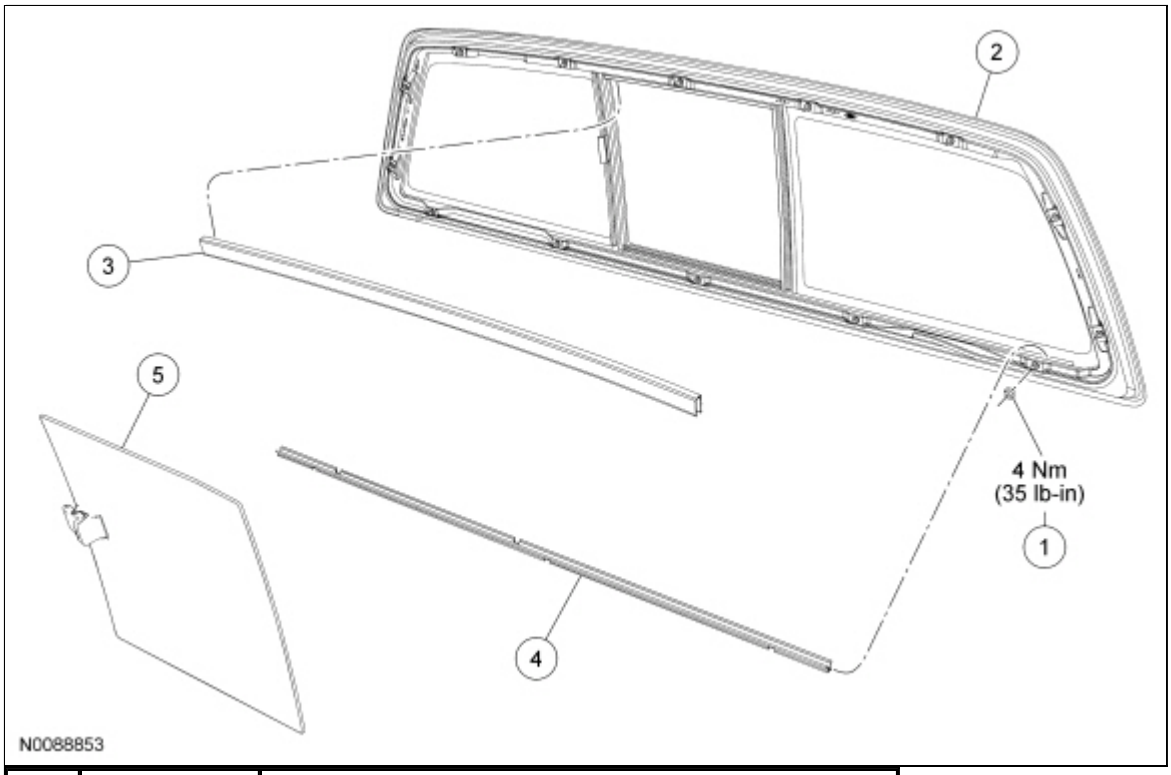
Glass, Frames and Mechanisms — Exploded View, Rear

Fixed Rear Window



Item	Part Number	Description
1	N621901	Rear window glass nut (14 required)
2	42006	Rear window glass assembly

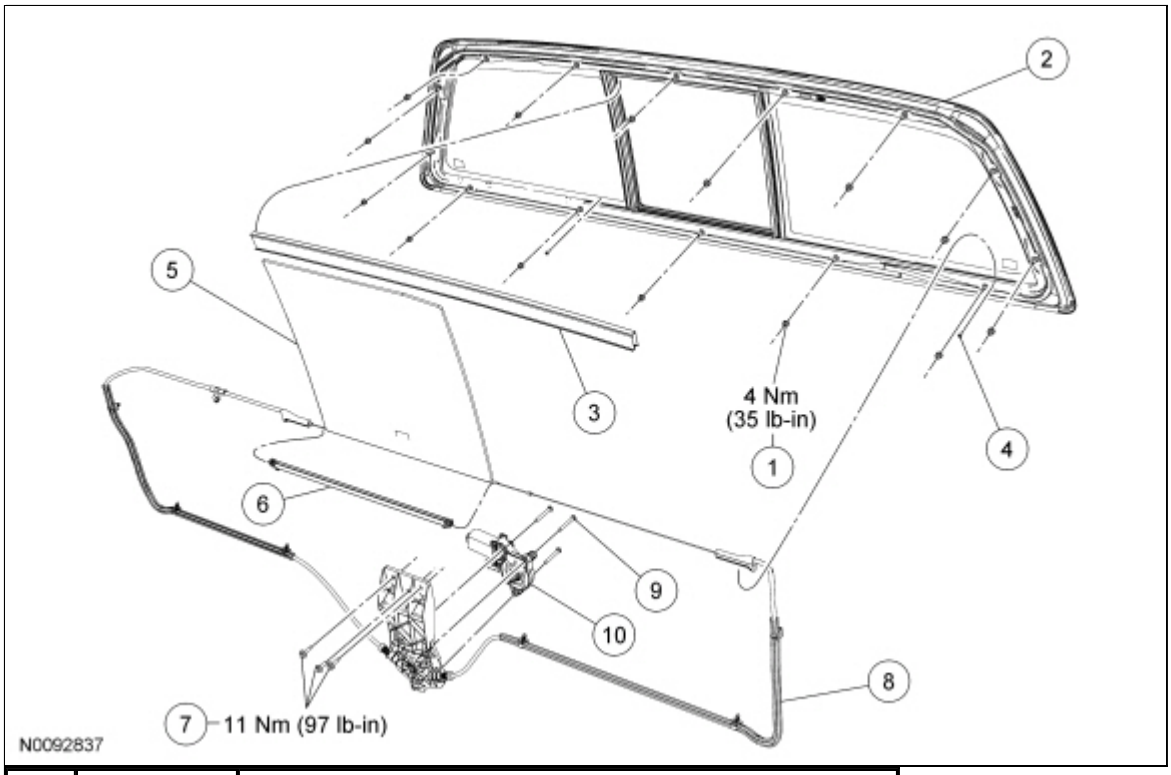
Manual Sliding Rear Window



Item	Part Number	Description
1	N621901	Rear window glass nut (14 required)
2	420A26	Rear power/manual sliding window glass assembly
3	422A36	Upper rail filler (part of window glass assembly)
4	422A20B	Lower rail filler (part of window glass assembly)
5	42006	Manual sliding glass panel

Power Sliding Rear Window

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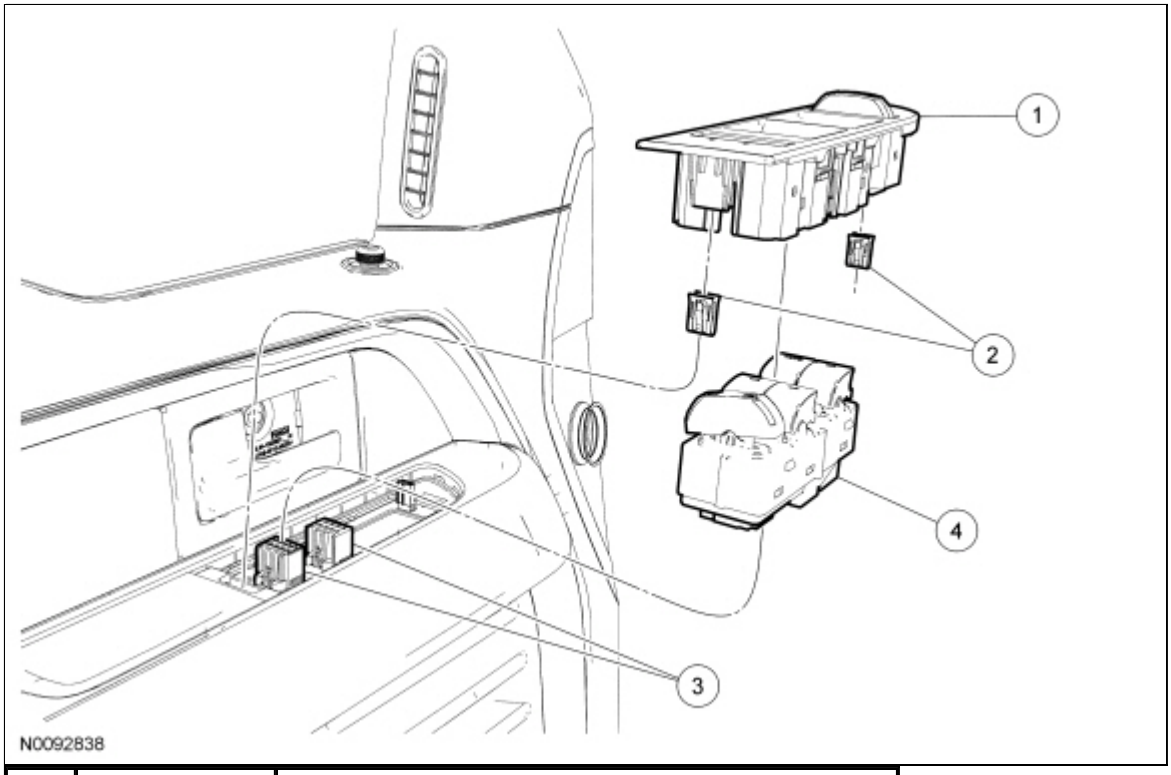
Item	Part Number	Description
1	N621901	Rear window glass nut (14 required)
2	420A26	Rear power/manual sliding window glass assembly
3	422A36	Upper rail filler (part of window glass assembly)
4	—	Transition block screw (2 required)
5	42006	Power sliding glass panel
6	422B68	Center bracket guide
7	N605891	Rear window glass regulator and motor assembly screws (3 required)
8	1523394	Rear window glass regulator and motor assembly
9	—	Rear window glass regulator motor screw (3 required)
10	5423394	Rear window glass regulator motor

1. For additional information, refer to the individual procedures in this section.

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Window Control Switch — Front

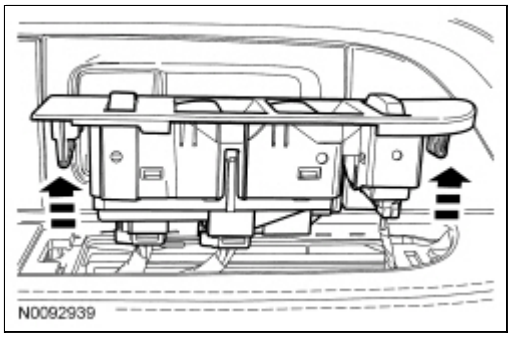
NOTE: LH shown, RH similar.



Item	Part Number	Description
1	14528 RH/ 14527 LH	Window control switch bezel (Regular cab)
1	14524 RH/ 14525 LH	Window control switch bezel (SuperCab and SuperCrew)
2	—	Window control switch bezel clips (part of window control switch bezel) (2 required)
3	14A005	Window control switch electrical connectors
4	14529	Window control switch

Removal and Installation

1. Using a suitable trim tool, release the 2 clips on the outer edge of the window control switch bezel and pull the window control switch assembly straight upward.



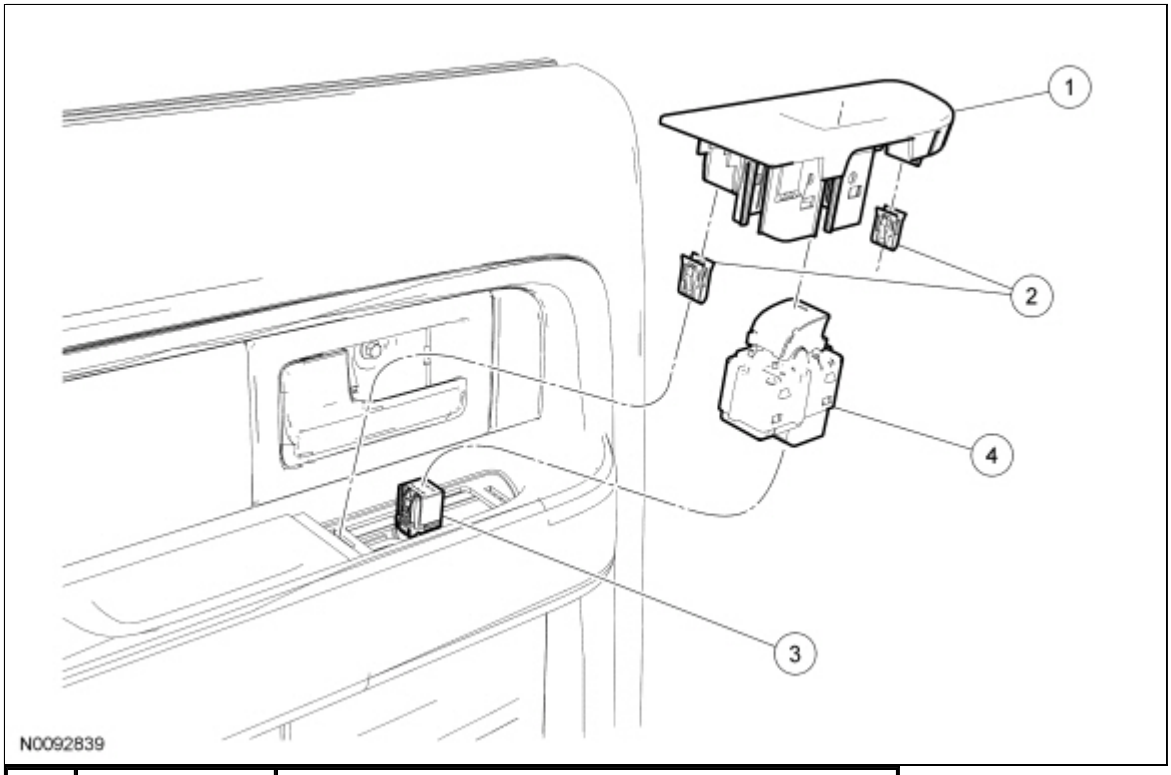
2. Disconnect the window control switch electrical connectors.
3. Release the tabs and remove the window control switch from the bezel.
4. To install, reverse the removal procedure.

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Window Control Switch — Rear

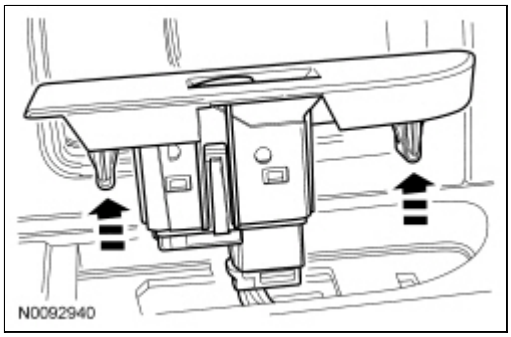
NOTE: LH shown, RH similar.



Item	Part Number	Description
1	14528 RH/ 14527 LH	Window control switch bezel
2	—	Window control switch bezel clips (part of window control switch bezel) (2 required)
3	—	Window control switch electrical connector
4	14529	Window control switch

Removal and Installation

1. Using a suitable trim tool, release the 2 clips on the outer edge of the window control switch bezel and pull the window control switch assembly straight upward.



2. Disconnect the window control switch electrical connector.
3. Release the tabs and remove the window control switch from the bezel.
4. To install, reverse the removal procedure.

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Window Glass — Front Door

Removal

NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

With power windows

1. Remove the window control switch. For additional information, refer to Window Control Switch — Front in this section.

All vehicles

2. Remove the front door trim panel. For additional information, refer to Section 501-05 .

3. Remove the front door interior moulding.

4. If equipped, remove the bolster assembly.
   - Remove the bolt and 2 pin-type retainers.

5. Position aside the front door watershield.

6. Remove the 2 front door below belt bracket bolts and bracket.
   - If equipped, disconnect the electrical wiring harness pushpin.

7. Temporarily install the window control switch or the window crank to raise or lower the window as necessary to access the glass-to-regulator assembly bolts.

8. Loosen the 2 front door window glass-to-regulator assembly bolts.

9. Tape the window in position, then lower the front door window regulator to the full downward position.

10. **NOTE:** The top run may be positioned aside to gain additional clearance if needed.

    Tip the front of the glass down and pull the front door window glass out through the top outboard side of the door.

Installation

All vehicles

1. Install the glass into the door and tape in place.
   - Reposition the top run if it was positioned aside during the glass removal.

2. Temporarily install the window control switch or the window crank to raise or lower the regulator as necessary to access the glass-to-regulator assembly bolts.

3. **NOTE:** It is important that this step is performed to prevent a customer concern of slow power window travel when raising the window.

   Push the glass up into the header by hand, then shift the glass rearward until it stops against the rear window run seal while lowering the glass back down into the window glass clamps.

4. **NOTE:** Make sure the window glass is seated in the bottom of the glass clamps.

   Tighten the 2 front door window glass-to-regulator assembly bolts to 11 Nm (97 lb-in).

5. Install the 2 front door below belt bracket bolts and bracket.
   - Tighten to 11 Nm (97 lb-in).

6. Install the front door watershield.

7. If equipped, install the bolster assembly.
   - Tighten the bolt and install the 2 pin-type retainers.

8. Install the front door interior moulding.

9. Install the front door trim panel. For additional information, refer to Section 501-05 .

With power windows

10. Install the window control switch. For additional information, refer to Window Control Switch — Front in this section.
    - Initialized the front window motor. For additional information, refer to Window Motor Initialization in this section.

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Window Glass — Rear Door, SuperCab

Removal and Installation

1. Remove the window control switch. For additional information, refer to Window Control Switch — Rear in this section.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the rear door mounted speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.
4. Remove the rear door interior moulding.
5. Position aside the rear door watershield.
6. Temporarily install the window control switch to raise or lower the window as necessary to access the glass-to-regulator assembly bolts.
7. Remove the C-pillar below belt bracket bolt and bracket.
   - Slide the bracket down to disengage from the U-channel in the door.
   - To install, tighten to 11 Nm (97 lb-in).
8. Remove the B-pillar below belt bracket bolt and bracket.
   - To install, tighten to 11 Nm (97 lb-in).
9. Loosen the rear door window glass-to-regulator assembly bolts.
   - To install, tighten to 11 Nm (97 lb-in).
10. Tape the window in position, then lower the rear door window regulator to the full downward position.
11. Remove the rear door window glass.
    - Pull the rear door window glass out through the top inboard side of the door.
12. To install, reverse the removal procedure.

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Window Glass — Rear Door, SuperCrew

Removal and Installation

1. Remove the window control switch. For additional information, refer to Window Control Switch — Rear in this section.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the rear door mounted speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.
4. Remove the rear door interior moulding.
5. Position aside the rear door watershield.
6. Temporarily install the window control switch to raise or lower the window as necessary to access the glass-to-regulator assembly bolts.
7. Loosen the rear door window glass-to-regulator assembly bolts.
    - To install, tighten to 11 Nm (97 lb-in).
8. Tape the window in position, then lower the rear door window regulator to the full downward position.
9. Remove the rear door window glass.
    - Pull the rear door window glass out through the top inboard side of the door.
10. To install, reverse the removal procedure.

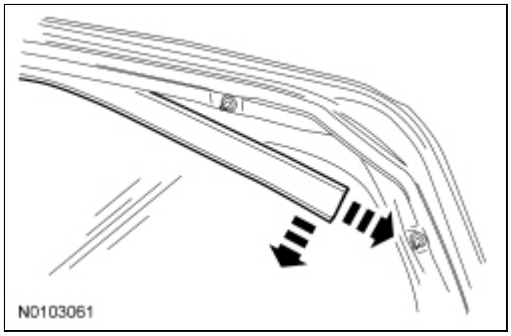
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Window Glass — Rear, Manual Sliding Panel

1. Remove the rear window glass assembly from the vehicle and place on a stable work surface. For additional information, refer to Window Glass — Rear in this section.

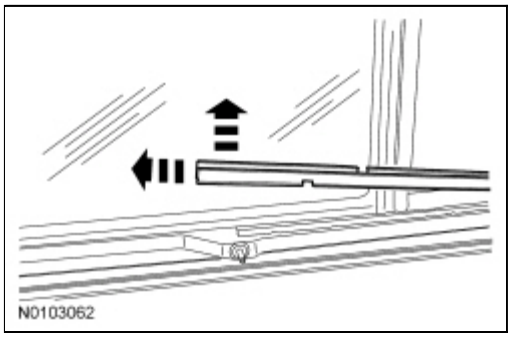
2. Position the sliding glass panel to the full CLOSED position.

3. Remove the upper rail filler.
   - Pull down the driver side of the upper filler while carefully sliding it out of the track towards the driver side of the rear glass assembly.



4. Position the sliding glass panel to the full OPEN position.

5. Remove the lower rail filler.
   - Pull up the passenger side of the lower filler while carefully sliding it out of the track towards the passenger side of the rear glass assembly.



6. Push the sliding glass upward and tilt the bottom inward to disengage the sliding glass from the track. Remove the sliding glass panel.

7. To install, reverse the removal procedure.

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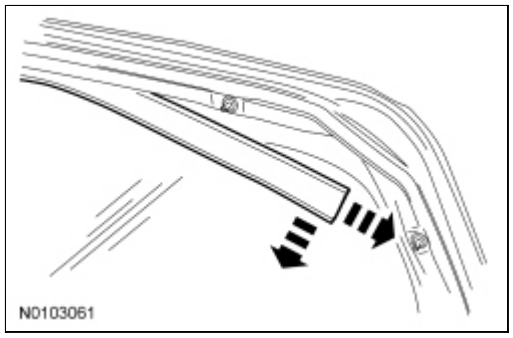
Window Glass — Rear, Power Sliding Panel

NOTE: If equipped with rear window defrost, the sliding glass panel cannot be serviced separately. The rear window must be replaced as a complete assembly. For additional information, refer to Window Glass — Rear in this section.

1. Remove the rear window glass assembly from the vehicle and place on a stable work surface. For additional information, refer to Window Glass — Rear in this section.

2. Position the sliding glass panel to the full CLOSED position.

3. Remove the upper rail filler.
   - Pull down the driver side of the upper filler while carefully sliding it out of the track towards the driver side of the rear glass assembly.



4. Push the sliding glass upward and tilt the bottom inward to disengage the sliding glass from the center bracket guide. Remove the sliding glass panel.

5. To install, reverse the removal procedure.

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Window Glass — Rear

Material

Item	Specification
Foam Core Butyl E69Z-19562-A	WSB-M3G143-B1

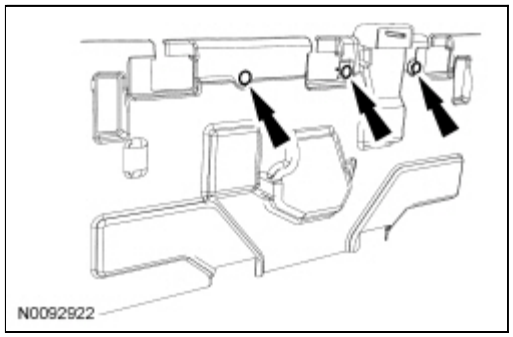
Removal

NOTE: If the rear window glass is being removed to repair a dust/water leak, remove and reinstall the existing rear window glass.

All vehicles

1. For regular and SuperCab vehicles, remove the headliner. For SuperCrew vehicles, lower and position the headliner forward. For additional information, refer to Section 501-05 .

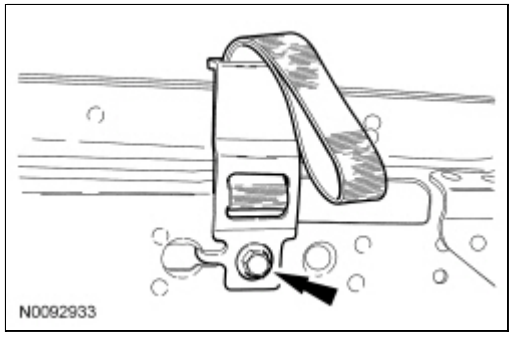
2. Remove the rear trim panel pin-type retainers.



3. Position aside the rear trim panel.

4. If equipped, disconnect the 2 rear window defrost grid electrical connectors.
   - If equipped with power sliding window, disconnect the in-line electrical connector (blue).

5. If equipped, remove the center tether anchor bolt and tether anchor.



6. Remove the rear window glass nuts.

7. ***NOTICE:*** **Use only a plastic windshield setting tool to slide under the seal to separate the foam core butyl from the glass. Once the glass starts to separate from the body, constant hand pressure will break the seal and the glass can be removed. The aid of an assistant will be required to support the glass during this step to prevent damage to the glass frame, body or power sliding window cables (if equipped). Failure to use a plastic windshield setting tool can damage the body or the glass frame.**

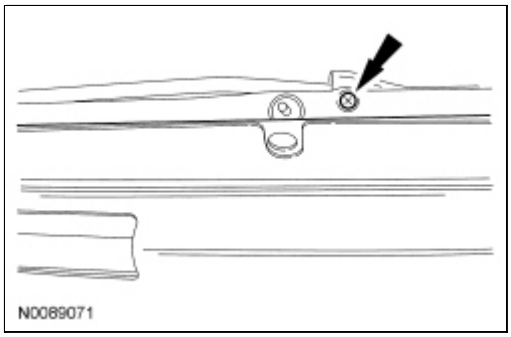
   NOTE: If equipped with a power sliding rear window, the glass must be supported in close proximity to the body during the following power sliding rear window removal steps.

   Remove the rear glass from the vehicle.

Power sliding rear window

8. **NOTE:** LH transition block screw shown, RH similar.

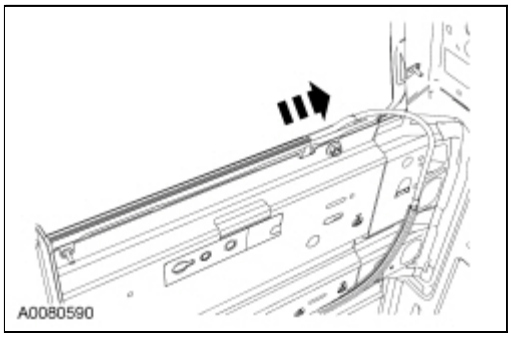
   Remove the 2 screws from the LH and RH transition blocks.



9. ***NOTICE:*** **The following substeps are to prevent the cables from popping out of the motor housing. If an existing regulator and motor assembly is to be reused, do not allow the cables to pop out of the motor housing, as they can unwind from the drum. If the cables unwind from the drum, a new regulator and motor assembly will have to be installed.**

   NOTE: LH side shown, RH side similar.

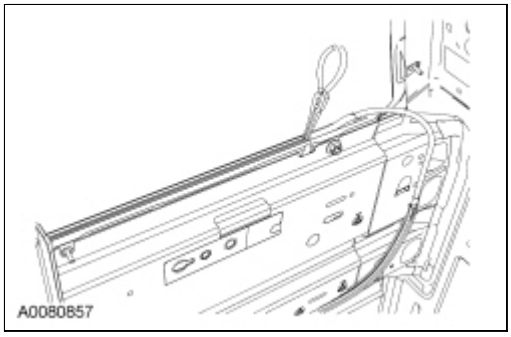
   Remove the LH cable first, then the RH side cable. Press and hold the transition block away from the centerline of the vehicle.



10. **NOTE:** LH side shown, RH side similar.

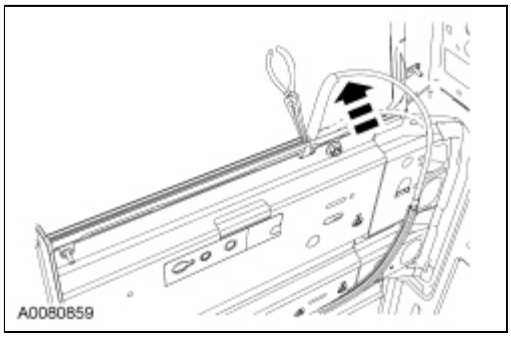
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Clamp and hold the cable near the transition block.



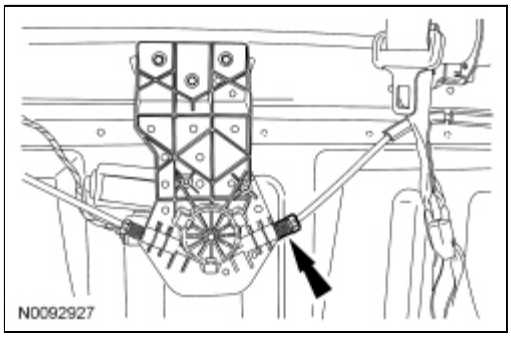
11. **NOTE:** LH side shown, RH side similar.

    Gently pull up the end of the transition block and lift it out of the groove. Do not release the clamp.



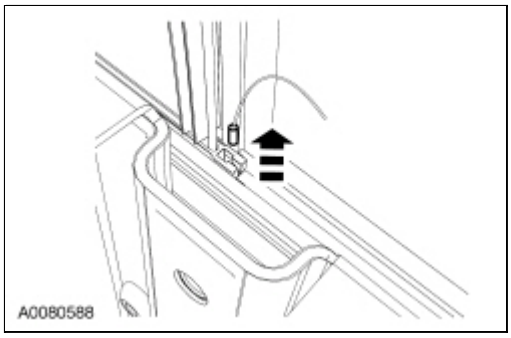
12. **NOTE:** LH side shown, RH side similar.

    Slowly release the clamp on the cable to gradually unload the tensioning spring on the motor housing.



13. **NOTE:** LH side shown, RH side similar.

    Remove the cable swag from the guide bracket on the sliding rear window.



NOTE: The remaining removal step(s) are only necessary when transferring the original sliding glass panel to the new rear sliding window assembly.

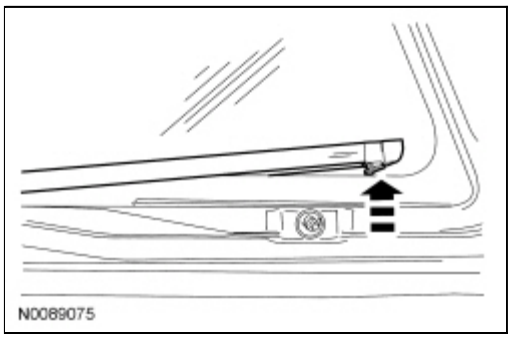
Power or manual sliding rear window

14. Remove the sliding rear window glass. For additional information, refer to Window Glass — Rear, Power Sliding Panel or Window Glass — Rear, Manual Sliding Panel in this section.

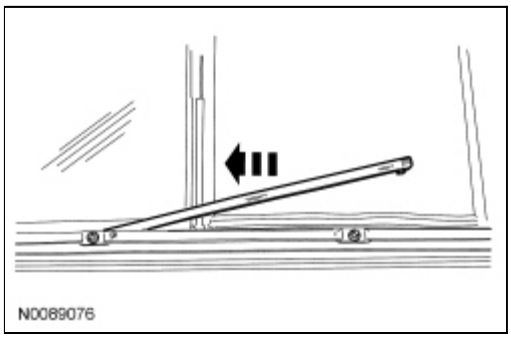
15. Remove the upper and lower rail fillers from the new rear window glass frame assembly.

Power sliding rear window

16. Slide the center bracket guide all the way to the LH side, then pull the LH side straight up so the guide foot can pass through the slot in the glass frame assembly.



17. Carefully slide the center bracket guide all the way to the RH side, then pull the RH side straight up so the guide foot can pass through the slot in the glass frame assembly. Transfer the center bracket guide to the new rear glass assembly.



Power or manual sliding rear window

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18. Transfer the original sliding rear window glass to the new rear glass assembly. For additional information, refer to Window Glass — Rear, Power Sliding Panel or Window Glass — Rear, Manual Sliding Panel in this section.

Installation

All vehicles

1. **NOTE:** Remove as much of the foam core butyl as possible from the body and window glass prior to installation.

   Apply foam core butyl to the window. Overlap the foam core butyl by 25 mm (1 in) at the bottom middle of the rear window glass.

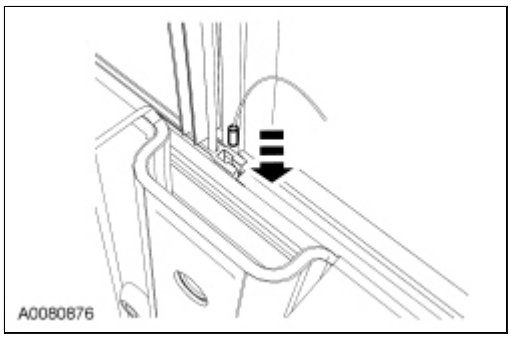
Power sliding rear window

2. ***NOTICE:*** **The following substeps are to prevent the cables from popping out of the motor housing. If an existing regulator and motor assembly is to be reused, do not allow the cables to pop out of the motor housing, as they can unwind from the drum. If the cables unwind from the drum, a new regulator and motor assembly will have to be installed.**

   NOTE: The aid of an assistant will be required to support the glass in close proximity to the body opening during the following power sliding rear window installation steps.

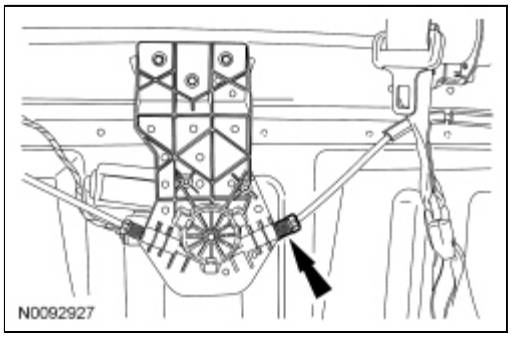
   NOTE: LH side shown, RH side similar.

   Install the LH cable first, then the RH side cable. Install the cable swag into the guide bracket on the sliding rear window.



3. **NOTE:** LH side shown, RH side similar.

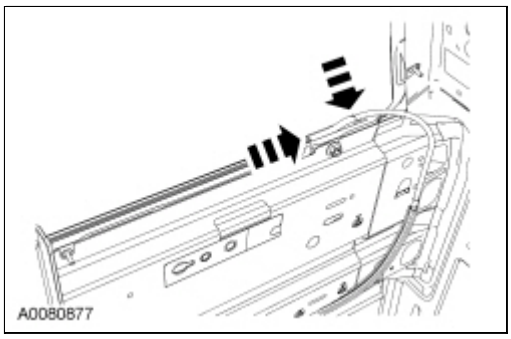
   Compress and hold the cable tension spring.



4. **NOTE:** LH side shown, RH side similar.

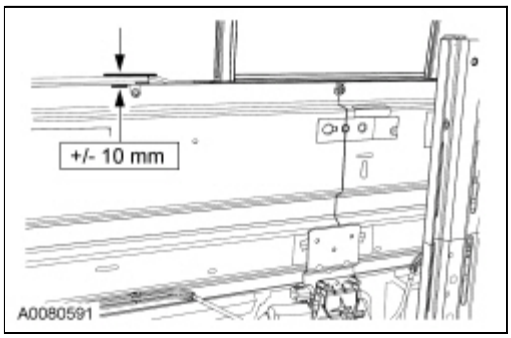
   NOTE: While holding the LH cable under tension, cycle the window motor to decrease the freeplay on the RH cable. Reducing the freeplay on the RH cable will allow ease of installation of the RH cable.

   Press the transition block away from the centerline of the vehicle, then snap it into the groove. Release the cable tension spring.



5. **NOTE:** LH side shown, RH side similar.

   The transition block is correctly seated when its top edge is +/- 10 mm (0.39 in) above the top of the window opening.



6. Install the LH and RH transition block screws.

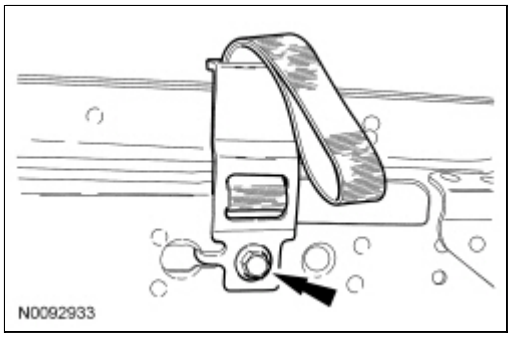
All vehicles

7. Carefully install the rear window glass into the body opening.

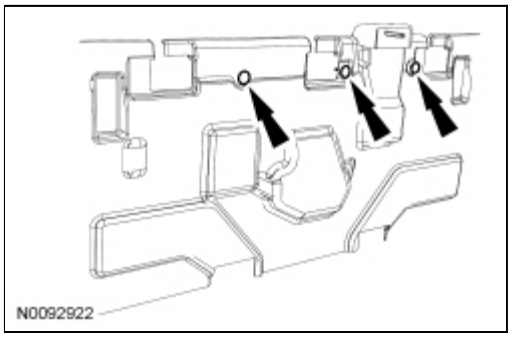
8. Install the rear window glass nuts.
   - Tighten to 4 Nm (35 lb-in).

9. If equipped, install the center tether anchor bolt and tether anchor.
   - To install, tighten to 30 Nm (22 lb-ft).

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10. If equipped, connect the rear window defrost grid electrical connectors.
11. Install the rear trim panel.
12. Install the rear trim panel pin-type retainers.



13. For regular and SuperCab vehicles, install the headliner. For SuperCrew vehicles, raise and reposition the headliner. For additional information, refer to Section 501-05 .

Window Regulator and Motor — Front Door

Removal

NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

With power windows

1. Remove the window control switch. For additional information, refer to Window Control Switch — Front in this section.

All vehicles

2. Remove the front door trim panel. For additional information, refer to Section 501-05 .

3. If equipped, remove the bolster assembly.
   - Remove the bolt and 2 pin-type retainers.

4. Position aside the front door watershield.

5. Temporarily install the window control switch or the window crank to raise or lower the window as necessary to access the glass-to-regulator assembly bolts.

All vehicles

6. Loosen the 2 front door window glass-to-regulator assembly bolts.

7. Tape the window in the full upward position, then lower the front door window regulator to the full downward position.

With power windows

8. Disconnect the window regulator motor electrical connector.

All vehicles

9. Remove and/or loosen the front door window regulator fasteners.
   - Remove the front door window regulator assembly through the large opening in the door.

Installation

All vehicles

1. Install the front door window regulator assembly.
   - Tighten all front door window regulator fasteners to 11 Nm (97 lb-in).

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With power windows

2. Connect the window regulator motor electrical connector.

All vehicles

3. Temporarily install the window control switch or the window crank to raise or lower the regulator as necessary to access the glass-to-regulator assembly bolts.

4. **NOTE:** It is important that this step is performed to prevent a customer concern of slow power window travel when raising the window.

   Push the glass up into the header by hand, then shift the glass rearward until it stops against the rear window run seal while lowering the glass back down into the window glass clamps.

5. **NOTE:** Make sure the window glass is seated in the bottom of the glass clamps.

   Tighten the 2 front door window glass-to-regulator assembly bolts to 11 Nm (97 lb-in).

6. Install the front door watershield.

7. If equipped, install the bolster assembly.
   - Tighten the bolt and install the 2 pin-type retainers.

8. Install the front door trim panel. For additional information, refer to Section 501-05 .

With power windows

9. Install the window control switch. For additional information, refer to Window Control Switch — Front in this section.
   - Initialized the front window motor. For additional information, refer to Window Motor Initialization in this section.

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Window Regulator and Motor — Rear Door, SuperCab

Removal and Installation

1. Remove the window control switch. For additional information, refer to Window Control Switch — Rear in this section.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the rear door mounted speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.
4. Position aside the rear door watershield.
5. Temporarily install the window control switch to raise or lower the window as necessary to access the glass-to-regulator assembly bolts.
6. Loosen the rear door window glass-to-regulator assembly bolts.
    - To install, tighten to 11 Nm (97 lb-in).
7. Secure the rear door glass in the full upward position with tape, then lower the rear door window regulator to the full downward position.
8. Disconnect the rear door window motor electrical connector.
9. Remove and/or loosen the rear door window regulator assembly fasteners.
    - Remove the regulator assembly through the large opening in the door.
    - To install, tighten to 11 Nm (97 lb-in).
10. To install, reverse the removal procedure.

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Window Regulator and Motor — Rear Door, SuperCrew

Removal and Installation

1. Remove the window control switch. For additional information, refer to Window Control Switch — Rear in this section.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the rear door mounted speaker. For additional information, Refer to the appropriate section in Group 415 for the procedure.
4. Position aside the rear door watershield.
5. Temporarily install the window control switch to raise or lower the window as necessary to access the glass-to-regulator assembly bolts.
6. Loosen the rear door window glass-to-regulator assembly bolts.
    - To install, tighten to 11 Nm (97 lb-in).
7. Secure the rear door glass in the full upward position with tape, then lower the rear door window regulator to the full downward position.
8. Disconnect the rear door window motor electrical connector.
9. Remove and/or loosen the rear door window regulator assembly fasteners.
    - Remove the regulator assembly through the large opening in the door.
    - To install, tighten to 11 Nm (97 lb-in).
10. To install, reverse the removal procedure.

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Window Regulator and Motor — Rear

Removal

1. Remove the rear window glass. For additional information, refer to Window Glass — Rear in this section.

2. Disconnect the rear window glass motor electrical connector.

3. Remove the rear window glass regulator and motor assembly screws.
   - To install, tighten to 11 Nm (97 lb-in).

4. Remove the rear window glass regulator and motor assembly from the vehicle.

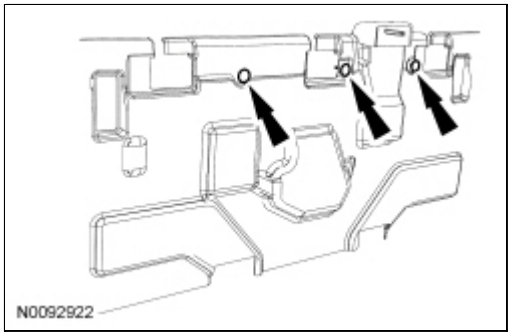
5. ***NOTICE:*** **If installing a new regulator and motor assembly, make sure any clips, retainers or wire ties that may have been used for shipping purposes are removed once the new regulator and motor are installed. Failure to follow this instruction may result in damage to the new regulator and motor assembly.**

   To install, reverse the removal procedure.

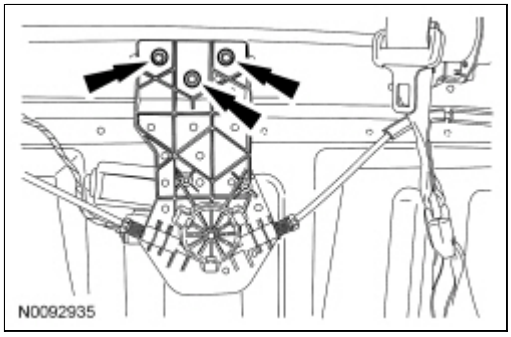
Window Regulator Motor — Rear

Removal

1. For SuperCab and SuperCrew, remove the rear corner trim panels.
   - For SuperCab, remove the B-pillar trim panels. For additional information, refer to Section 501-05 .
   - For SuperCrew, remove the C-pillar trim panels. For additional information, refer to Section 501-05 .
2. Remove the rear trim panel pin-type retainers and the rear trim panel.

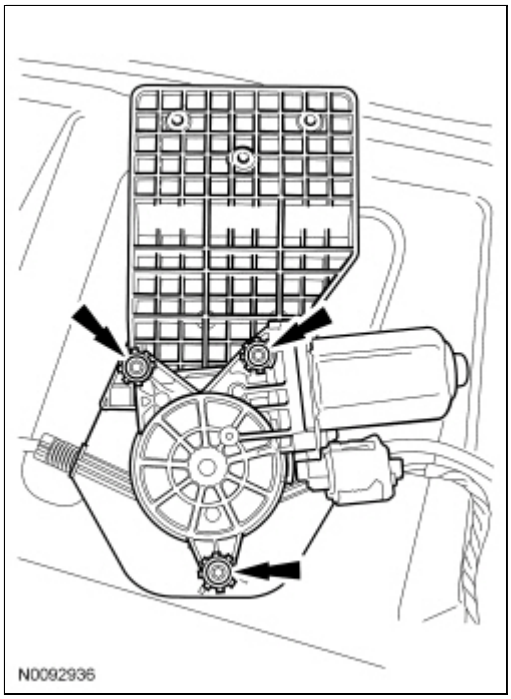


3. Disconnect the rear window glass motor electrical connector.
4. Remove the 3 rear window glass regulator and motor assembly screws.

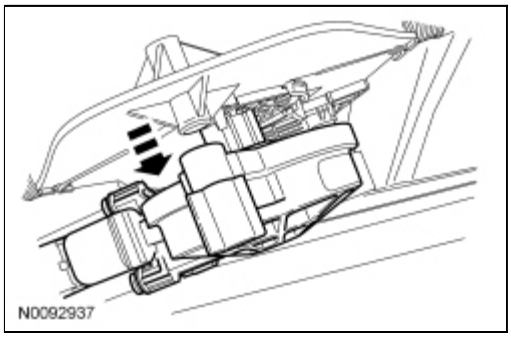


5. Carefully remove the 3 bolts attaching the steel bracket to the plastic cable housing.

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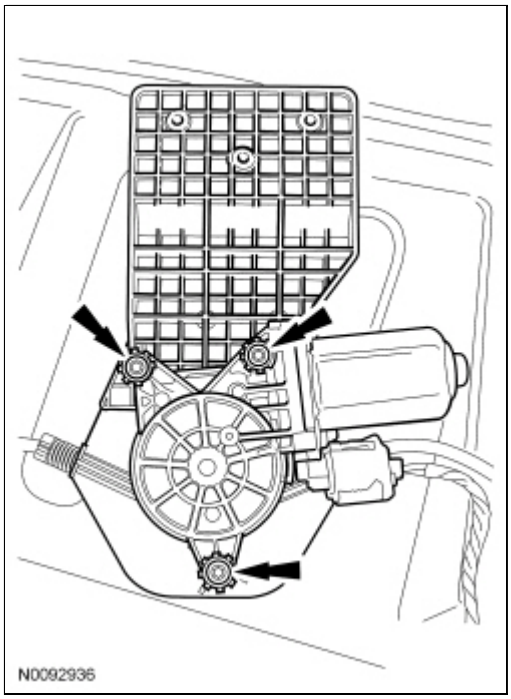


6. Hold the plastic cable housing and motor together, place a screwdriver between the drum (located in the cable housing) and the motor housing and pry the motor away from the drum, making sure the drum stays inside the plastic cable housing.

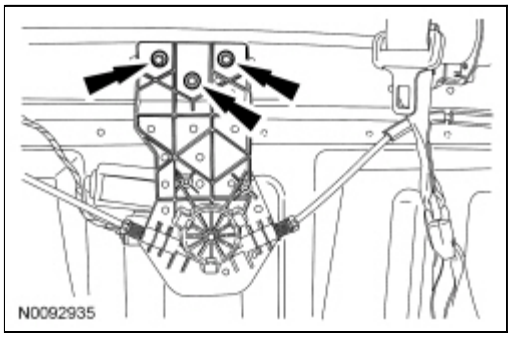


Installation

1. Align the motor gear splines onto the drum and press the motor into place, making sure there is correct alignment of the attachment bolt holes.
    - Install the 3 bolts attaching the steel bracket to the plastic cable housing.

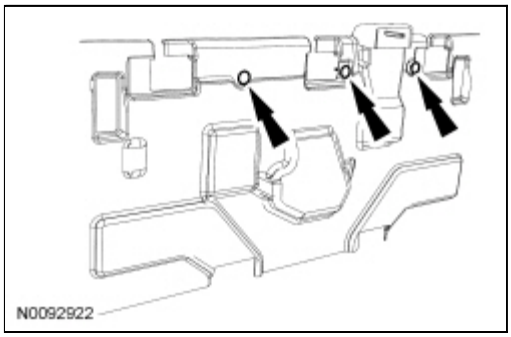


2. Install the rear window glass regulator and motor assembly screws.
    - Tighten to 11 Nm (97 lb-in).



3. Connect the rear window glass motor electrical connector.

4. Install the rear trim panel and the pin-type retainers.



5. For SuperCab and SuperCrew, install the rear corner trim panels.
    - For SuperCab, install the B-pillar trim panels. For additional information, refer to Section 501-05 .

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- For SuperCrew, install the C-pillar trim panels. For additional information, refer to Section 501-05 .

Window Regulator Motor

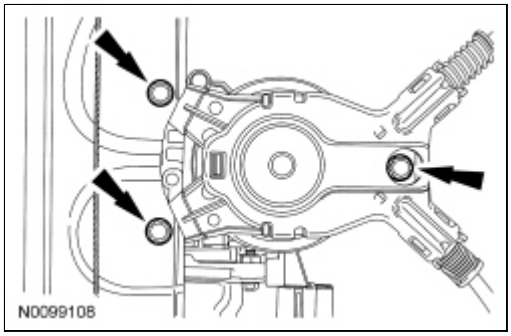
Removal and Installation

NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

1. Remove the window regulator and motor assembly. For additional information, refer to Window Regulator and Motor — Front Door , Window Regulator and Motor — Rear Door, SuperCab or Window Regulator and Motor — Rear Door, SuperCrew in this section.

2. **NOTE:** Front door window regulator shown, all others similar.

   Remove the 3 door window-to-regulator bolts.

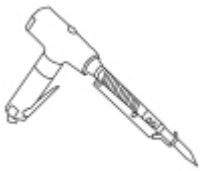
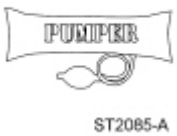
   

3. To install, reverse the removal procedure.
   - Initialized the front window motor. For additional information, refer to Window Motor Initialization in this section.

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Windshield Glass

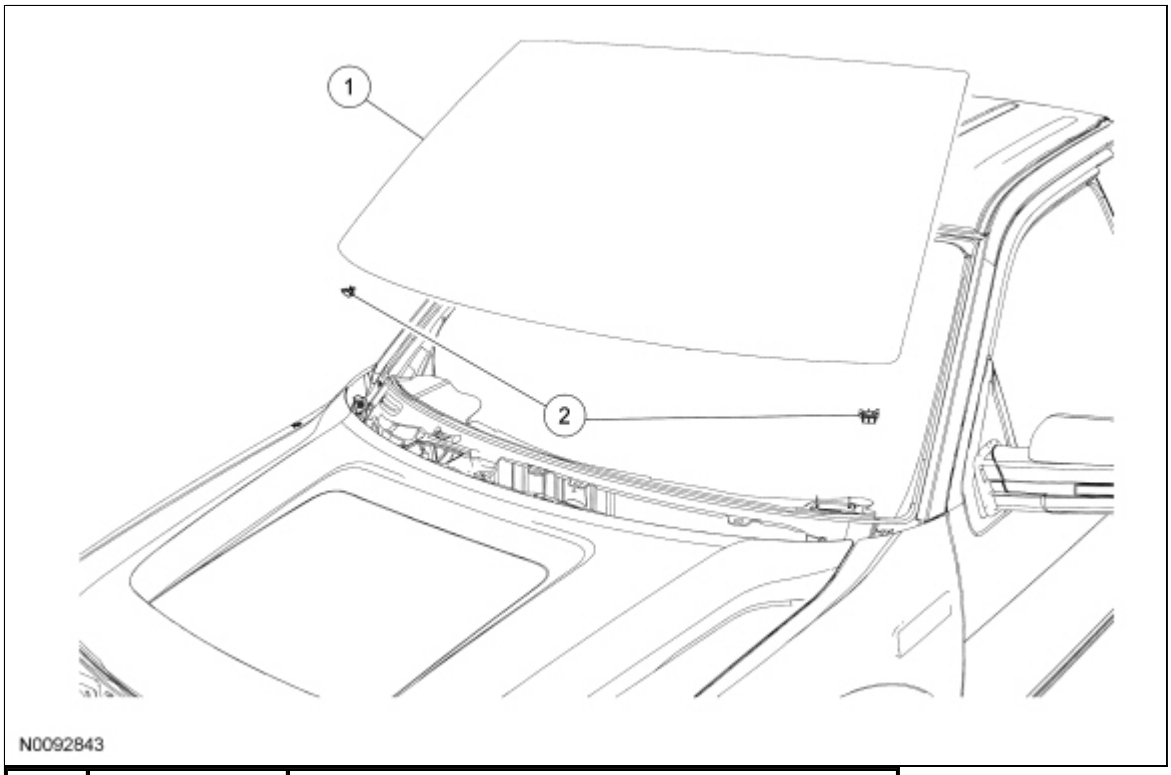
Special Tool(s)

 ST3109-A	Air Caulking Gun AST405 or equivalent
 ST3274-A	Deluxe Air Windshield Knife 300-AST 1770E or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent

Material

Item	Specification
Dow Urethane Adhesive Betaseal™ Express	—
Dow Urethane One Step Glass Primer Betaprime™ 5500 / 5500A / 5500SA	—
Sika Urethane Adhesive Sika Tack ASAP	—
Sika Urethane Metal and Glass Primer Sika 206 G+P	—
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

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Item	Part Number	Description
1	03100	Windshield glass
2	03489	Windshield glass spacer blocks (2 required)

Removal

1. Remove the cowl panel grille. For additional information, refer to Section 501-02 .
2. If equipped, remove the overhead console or dome lamp assembly. For additional information, refer to Section 501-12 .
3. Remove the interior rear view mirror. For additional information, refer to Section 501-09 .
4. If equipped, remove the rain sensor. For additional information, refer to Section 501-16 .
5. Remove the A-pillar trim panels, sunvisors and sunvisor clips. For additional information, refer to Section 501-05 .
6. Partially lower the front portion of the headliner near the windshield upper opening and block with a suitable material.
7. **WARNING: Wear eye and ear protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.**

   WARNING: Wear protective gloves when handling components or parts that have pointed or sharp edges. Failure to follow this instruction may result in serious personal injury.

   NOTICE: **To avoid rust formation, use extreme care not to scratch the paint or primer or**

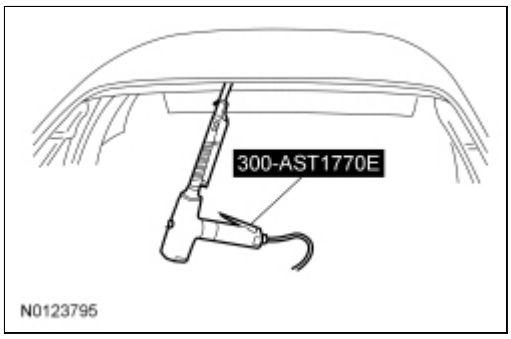
otherwise damage the pinchweld during glass removal.

NOTE: Insert the blade into the Deluxe Air Windshield Knife so that the flat side is against the glass. This will leave the entire urethane adhesive bead on the pinchweld and allow a dry fit of the replacement windshield glass.

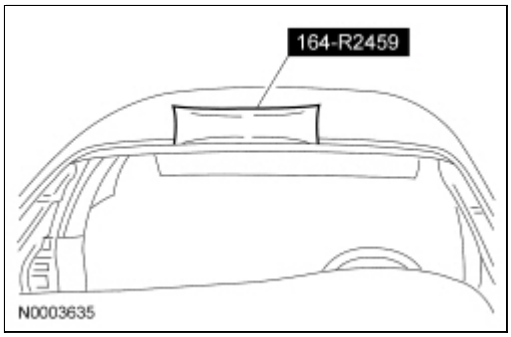
NOTE: Lubricate the urethane adhesive with water to aid the Deluxe Air Windshield Knife when cutting the urethane adhesive.

NOTE: Support the windshield glass to prevent the glass from dropping while cutting the urethane adhesive.

Working from inside the vehicle, cut the urethane adhesive using the Deluxe Air Windshield Knife starting at the top center and working toward the bottom corners then across the bottom.



8. Using The Pumper, distance the windshield glass from the body.



9. **NOTE:** Removing the windshield glass requires more than one technician.

   Using the Deluxe Air Windshield Knife, cut the remaining urethane adhesive and remove the windshield glass and place on a stable work surface.

Installation

NOTE: For additional material guidelines, refer to the manufacturer's installation information.

1. Inspect the glass spacer blocks for damage. If necessary, install new spacer blocks.

2. Dry-fit the windshield glass on the existing urethane adhesive bead on the pinch weld.
   - Position the windshield glass on the pinch weld.
   - Center the glass in the opening.
   - Adjust the windshield spacer blocks as needed for best fit.

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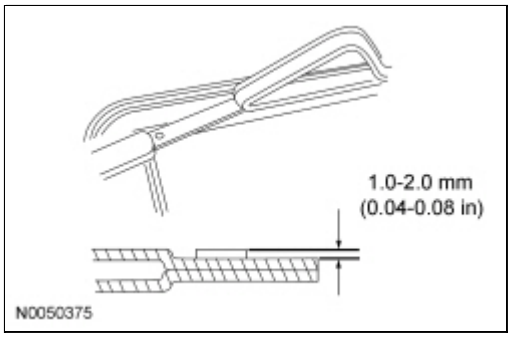
- Make alignment marks with tape or non-staining grease pencil (preferably at the spacer blocks) on the windshield glass and the body.

3. After the dry-fit alignment, remove the glass from the body opening and place on a stable work surface with the interior side of the glass facing upward.

4. **WARNING: Repair any corrosion found on the pinch weld. The pinch weld is a structural component of the vehicle. Corrosion left unrepaired may reduce the structural integrity of the vehicle. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   NOTE: Avoid scratching the pinch weld. Repair all minor scratches or exposed metal on the pinch weld following manufacturer's instructions. Use the same brand pinch weld primer, glass primer and urethane adhesive.

   Using an appropriate tool, trim the urethane adhesive leaving a 1 mm to 2 mm (0.04 in to 0.08 in) base of original equipment urethane adhesive on the pinchweld.



5. Using a clean shop towel, brush or oil-free compressed air, clean the pinch weld area around the existing urethane adhesive. Remove any foreign material or water that may have entered during glass removal.

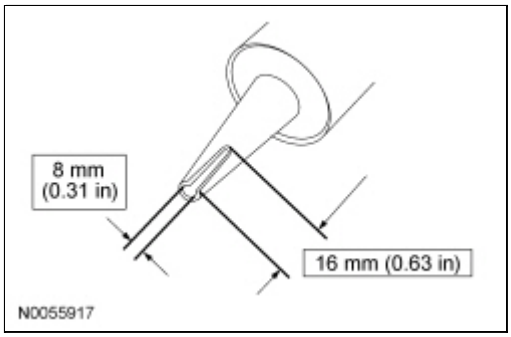
6. If reinstalling the same windshield glass, remove the remaining urethane adhesive from the windshield glass leaving a thin layer to bond with the new urethane adhesive bead.

7. Clean the inside of the windshield glass surface with glass cleaner.
   - Make sure to thoroughly clean the surface of the blackened border area where the urethane adhesive will be applied.

8. ***NOTICE:*** **Be sure to use the same brand and cure-rate products for the urethane adhesive and glass primer. Do not mix different brands of urethane adhesive and glass primer. Refer to the Material Chart in this procedure.**

   If installing a new windshield glass, apply glass primer according to manufacturer's instructions. Allow at least 6 minutes to dry.

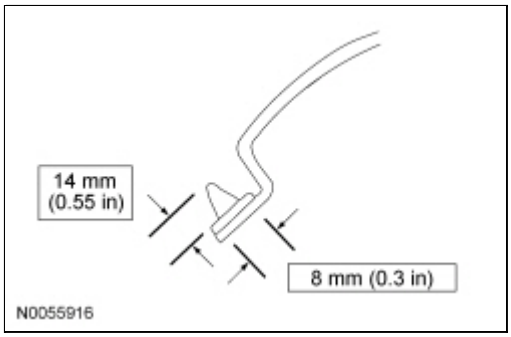
9. Cut the urethane adhesive applicator tip to specification.



10. **NOTE:** Use either an Air Caulking Gun or a high-ratio, electric or battery-operated caulk gun that will apply the urethane adhesive with less effort and continuous bead.

    NOTE: The windshield glass must be positioned within 10 minutes of applying the urethane adhesive.

    Apply urethane adhesive on top of the existing trimmed urethane adhesive bead on the pinch weld, starting and ending at the bottom of the windshield near the center, making sure there are no gaps in the bead.



11. **WARNING: Improper curing of the urethane adhesive may adversely affect glass retention, which is important for restraint system performance during a crash. Carefully follow the urethane adhesive manufacturer's curing instructions. Do not drive the vehicle until the urethane adhesive seal has cured. Failure to follow these instructions may result in serious injury to vehicle occupant(s) during a crash.**

    NOTICE: **Before positioning the windshield glass, open vehicle windows to prevent the air pressure of closing doors from affecting the urethane adhesive bond.**

    Position the windshield glass on the pinch weld using the alignment marks made previously.

12. **NOTE:** The urethane adhesive must cure for a minimum of one hour before testing for air or water leaks.

    After the urethane adhesive has cured, check the windshield glass seal for air or water leaks through the urethane adhesive bead and add urethane adhesive as necessary.

13. Position the front portion of the headliner.

14. Install the A-pillar trim panels, sunvisors and sunvisor clips. For additional information, refer to Section 501-05 .

15. If equipped, install the rain sensor. For additional information, refer to Section 501-16 .

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16. Install the interior rear view mirror. For additional information, refer to Section 501-09 .

17. If equipped, install the overhead console or dome lamp assembly. For additional information, refer to Section 501-12 .

18. Install the cowl panel grille. For additional information, refer to Section 501-02 .

Torque Specifications

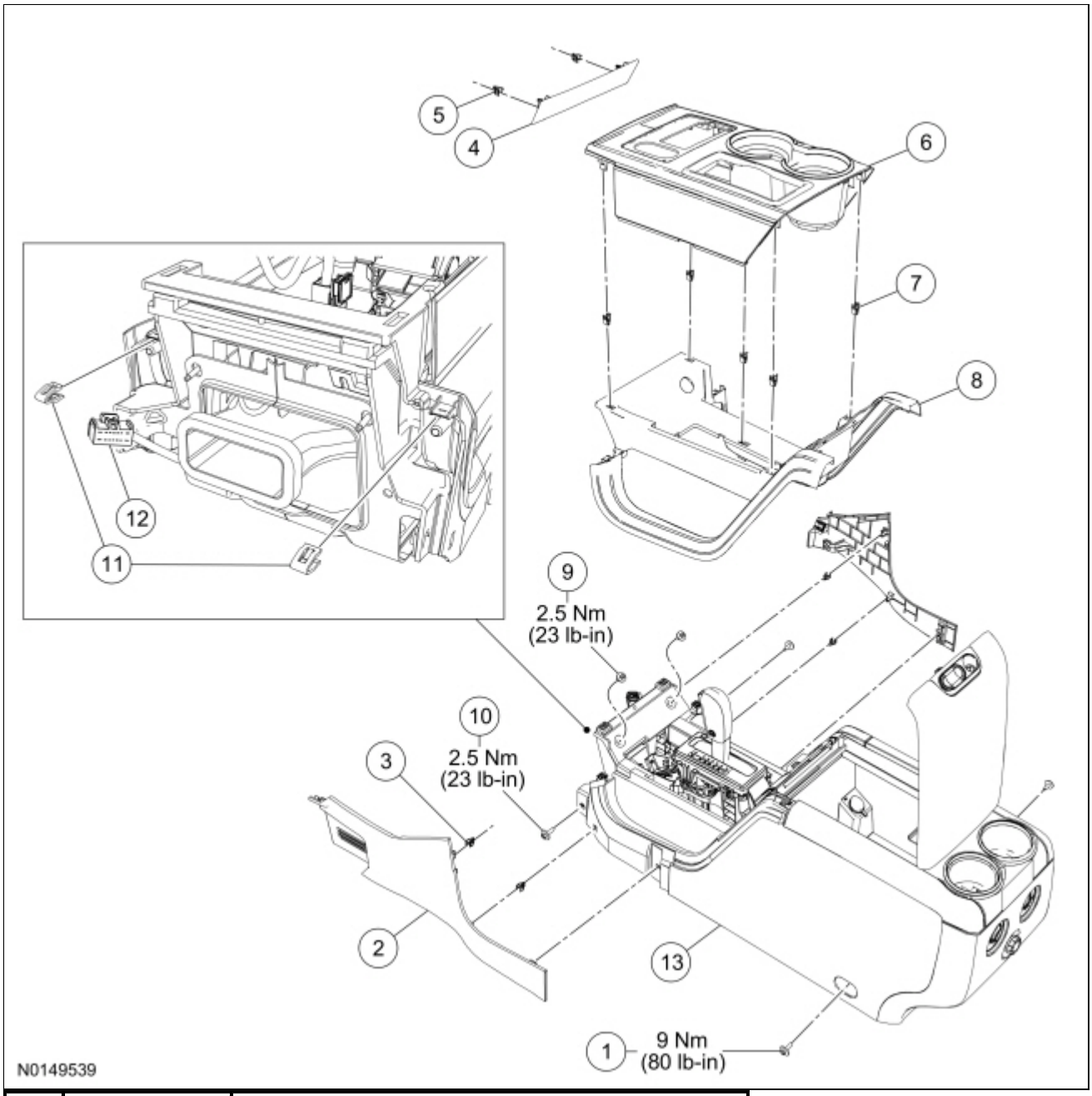
Description	Nm	lb-ft	lb-in
Center instrument panel support bracket bolts	9	—	80
Floor console front bolts	2.5	—	23
Floor console rear bolts	9	—	80
Floor console-to-instrument panel bolts	2.5	—	23
Hood release handle bolt	9	—	80
Instrument panel side bolts	30	22	—
Instrument panel upper bolts	30	22	—
Steering column shaft-to-steering column bolt	30	22	—

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Console — Floor

Mark LT, Platinum, Limited

NOTE: Floor console with flow thru vents and selector lever shown, floor console without flow thru vents and selector lever similar.



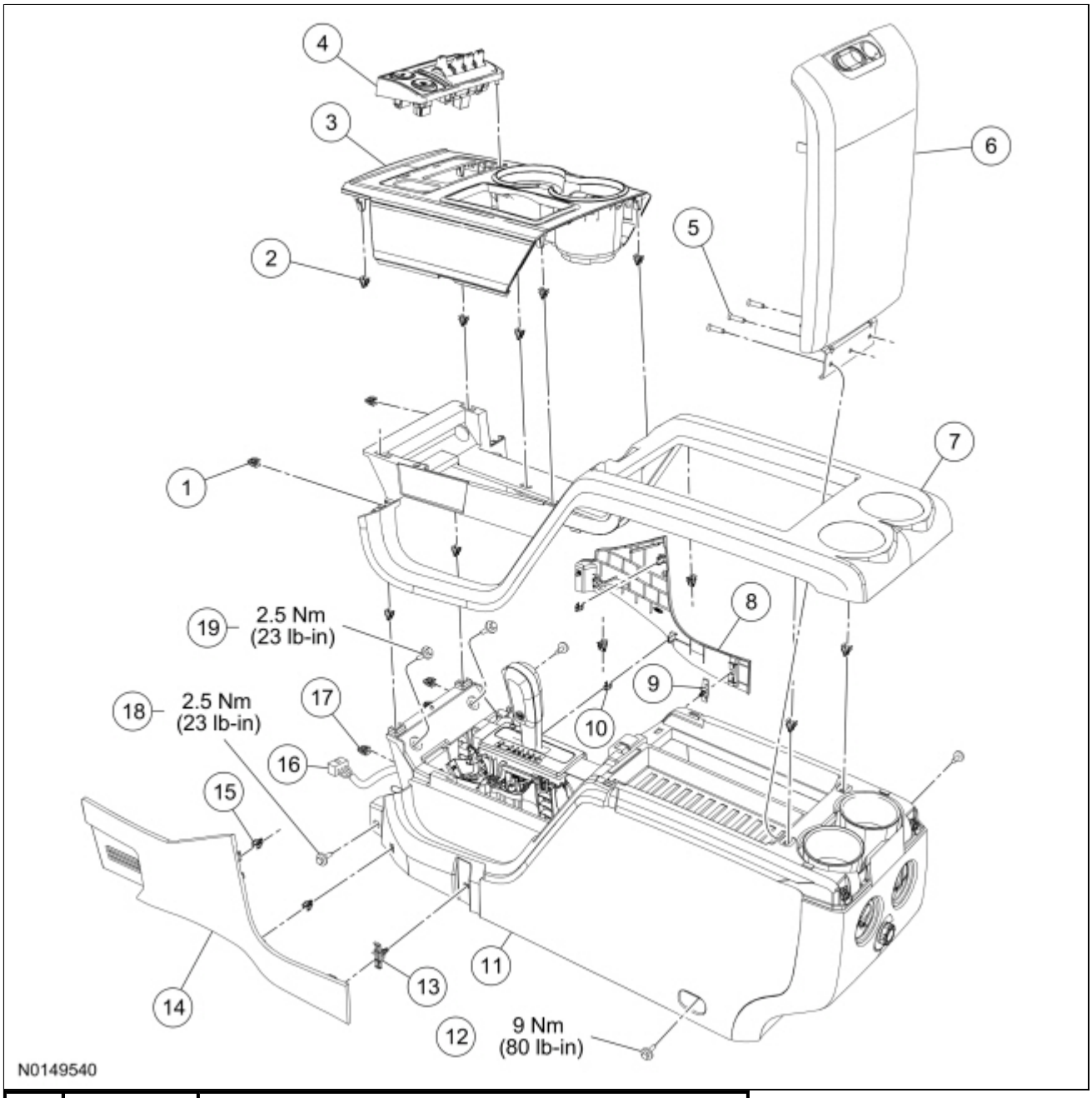
Item	Part Number	Description
1	W714064	Floor console rear bolt (2 required)

2	04608 RH/ 04609 LH	Floor console lower trim panel
3	W712210	Floor console lower trim panel retaining clip (2 required per side)
4	046B32	Instrument panel-to-floor console finish panel
5	—	Instrument panel-to-floor console finish panel retaining clip (part of 04B32) (2 required)
6	045A76	Floor console upper finish panel
7	—	Floor console upper finish panel retaining clip (part of 045A76) (5 required)
8	04567A	Selector lever trim panel
9	W704734	Floor console-to-instrument panel bolt
10	W704734	Floor console front bolt (2 required)
11	—	Floor console retaining clips (part of 045A36) (5 required)
12	—	Floor console electrical connector (part of 045A36)
13	045A36	Floor console

All Other Vehicles

NOTE: Floor console with flow thru vents and selector lever shown, floor console without flow thru vents and selector lever similar.

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Item	Part Number	Description
1	W705289	Selector lever trim panel retaining clip (8 required)
2	—	Floor console upper finish panel retaining clip (part of 045A76) (5 required)
3	045A76	Floor console upper finish panel
4	13K724	Auxiliary switch assembly (SVT Raptor)
5	W714473	Storage compartment door screw (3 required)
6	—	Storage compartment door (part of 045A36)
7	04567A	Selector lever trim panel
8	04608	RH floor console lower trim panel

9	—	RH floor console lower trim panel pin-type retainer (part of 04608)
10	W712210	RH floor console lower trim panel retaining clip (2 required)
11	045A36	Floor console
12	W714064	Floor console rear bolt (2 required)
13	—	LH floor console lower trim panel pin-type retainer (part of 04609)
14	04609	LH floor console lower trim panel
15	W712210	LH floor console lower trim panel retaining clip (2 required)
16	—	Floor console electrical connector (part of 045A36)
17	—	Floor console retaining clips (part of 045A36) (2 required)
18	W704734	Floor console front bolt (2 required)
19	W704734	Floor console-to-instrument panel bolt (2 required)

Removal and Installation

Vehicles with selector lever in floor console

1. Apply the parking brake.

All vehicles

2. Position the front seats forward.

3. Remove the 2 floor console rear bolts.
   - To install, tighten to 9 Nm (80 lb-in).

4. Position the front seats rearward.

Consoles with flow thru vents

5. Remove the LH and RH floor console lower finish panels, in the following sequence.
   1. Pull the rear section of the panels outward to release the retaining clips.
   2. Pull the panels toward the rear of the vehicle.
   3. If equipped, disconnect the ambient light connector(s).

All vehicles — except Mark LT, Platinum, Limited

6. Remove the 3 screws and storage compartment door.

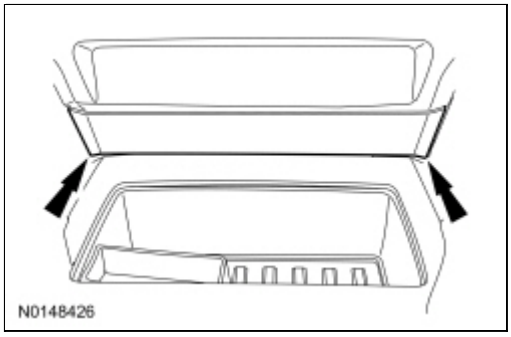
Vehicles with selector lever in floor console

7. ***NOTICE:*** **When prying on a component, a non-marring tool must be used or damage to the component may occur.**

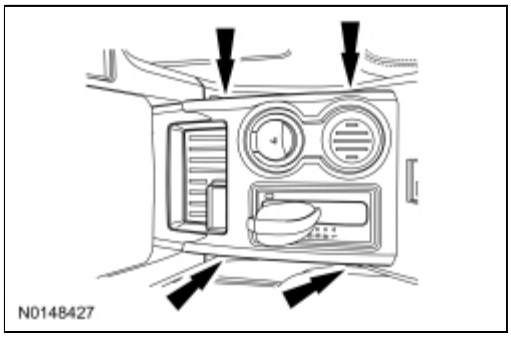
   Remove the instrument panel-to-floor console finish panel.
   - Using a non-marring tool, gently pry outward at the lower corners of the instrument panel-to-

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floor console finish panel to release the retaining clips.



8. Remove the floor console upper finish panel.
    - Lift the floor console upper finish panel upward, at the locations indicated, to release the retaining clips.



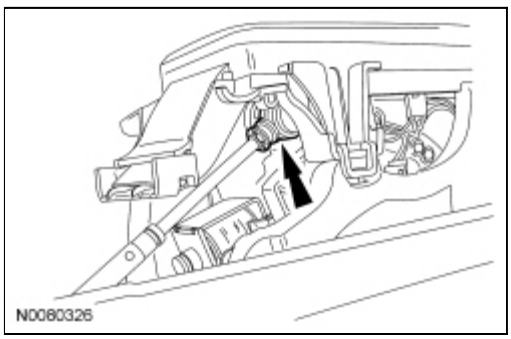
9. Remove the selector lever trim panel.
    - Lift the selector lever trim panel upward releasing the retaining clips from the floor console.

10. Remove the 2 floor console-to-instrument panel bolts.
    - To install, tighten to 2.5 Nm (23 lb-in).

11. Remove the 2 floor console front bolts.
    - To install, tighten to 9 Nm (80 lb-in).

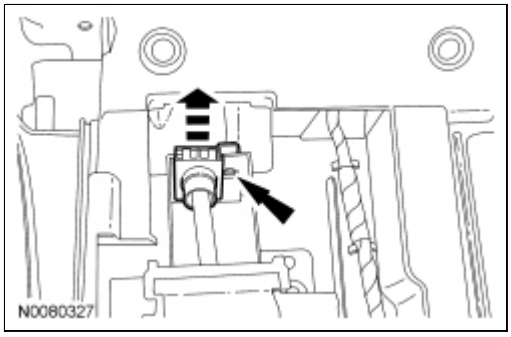
12. Position the floor console rearward.

13. Disconnect the selector lever cable from the selector lever assembly.



14. Release the selector lever cable retaining tab and remove the selector lever cable from the selector

lever assembly retainer.



Vehicles without selector lever in floor console

15. Remove the 4 floor console front bolts.
    - To install, tighten to 9 Nm (80 lb-in).

All vehicles

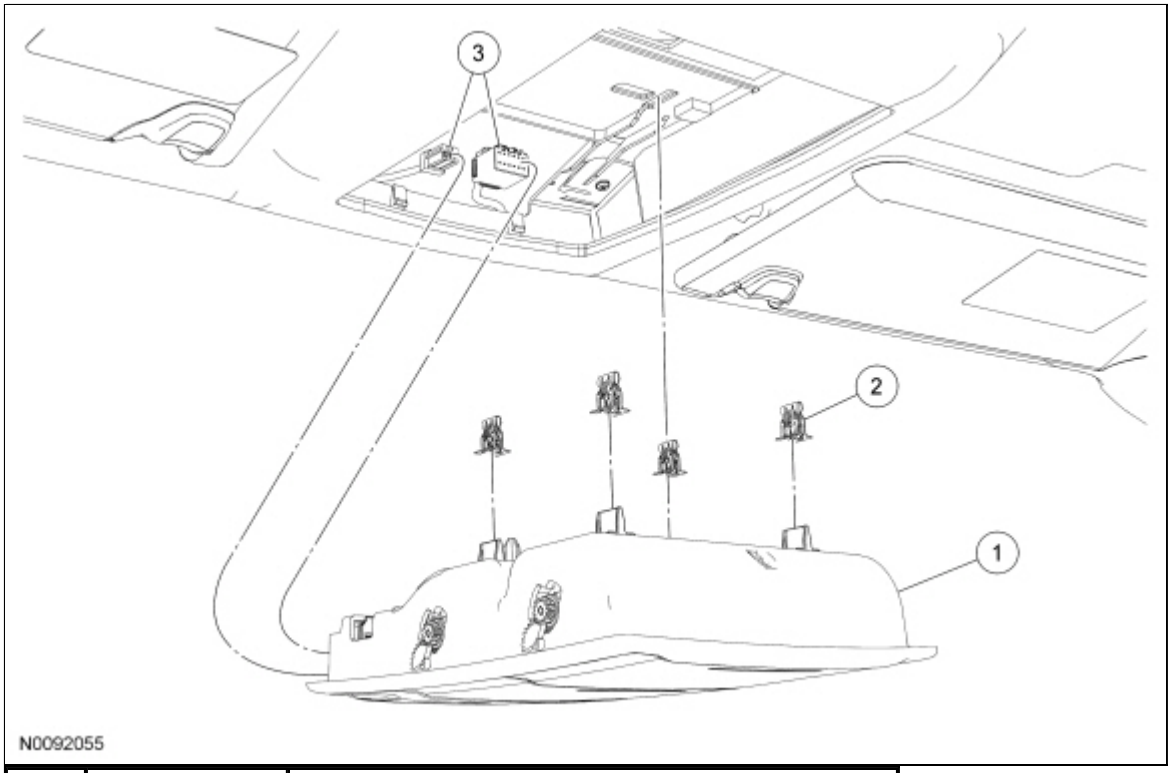
16. Disconnect the floor console electrical connector(s).

17. Remove the floor console.

18. To install, reverse the removal procedure.
    - Make sure to align the trim panel retaining clips to the adjacent retaining clip holes.

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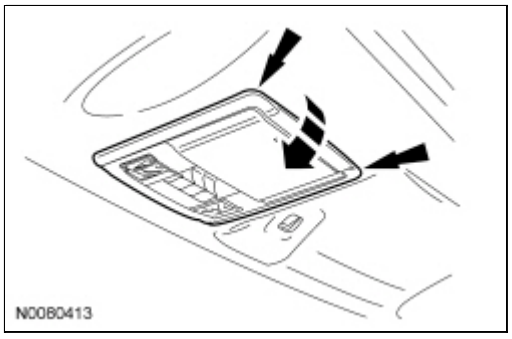
Console — Overhead



Item	Part Number	Description
1	519A70	Overhead console
2	W705289	Overhead console retaining clip (4 required)
3	14358	Overhead console wiring harness

Removal and Installation

1. Pull the rear edge of the overhead console downward, at the locations shown, and then pull rearward.



2. Disconnect the electrical connectors.

3. Remove the overhead console.

4. To install, reverse the removal procedure.
    - Make sure to align the overhead console retaining clips to the adjacent retaining clip holes.

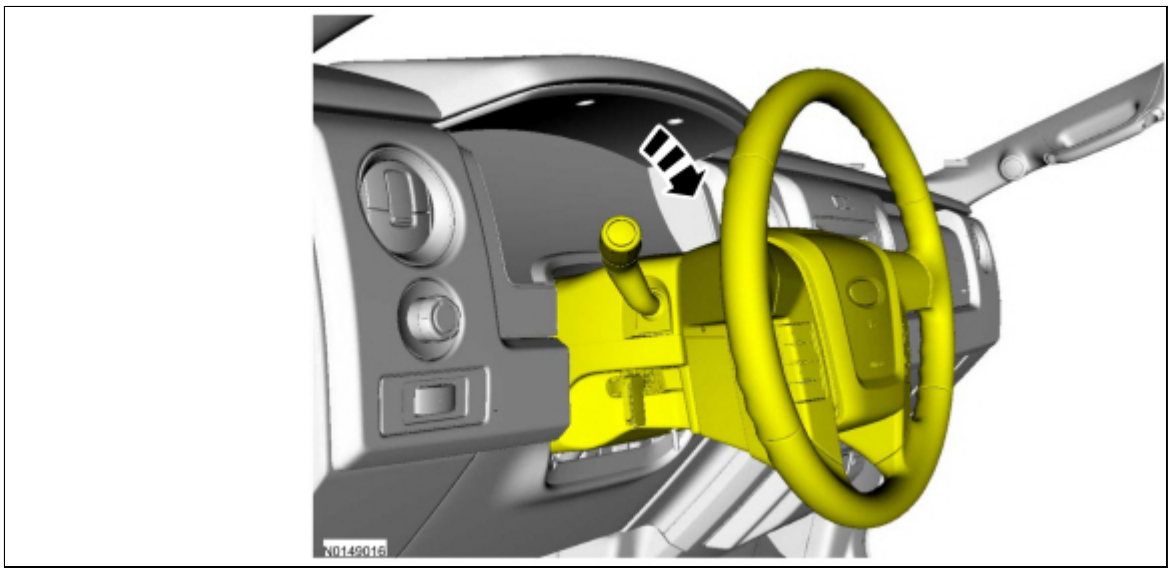
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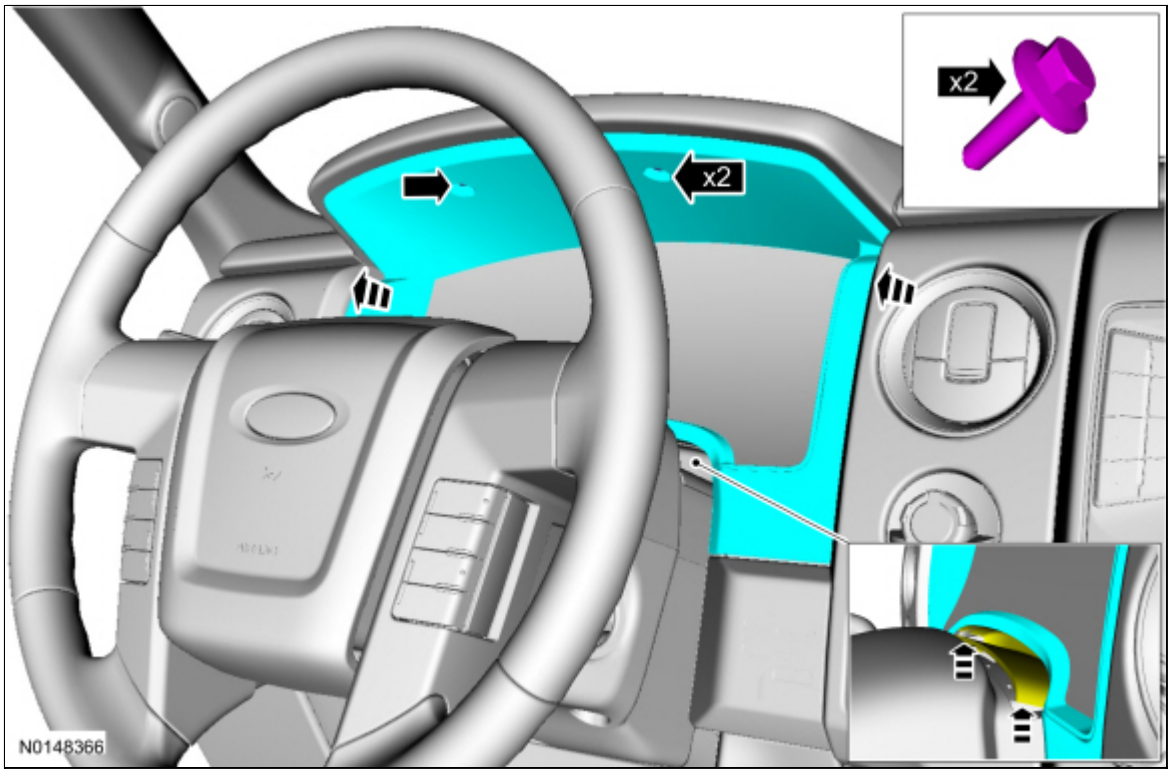
Instrument Cluster Finish Panel

Removal and Installation

1. Apply the parking brake.
2. Place the selector lever in the 1 position.
3. Position the steering wheel downward.



4. Remove the 2 instrument cluster finish panel screws and remove the instrument cluster finish panel.
    - Release the gap hider retainers.
    - Pull the instrument cluster finish panel toward the rear of the vehicle to release the retaining clips.

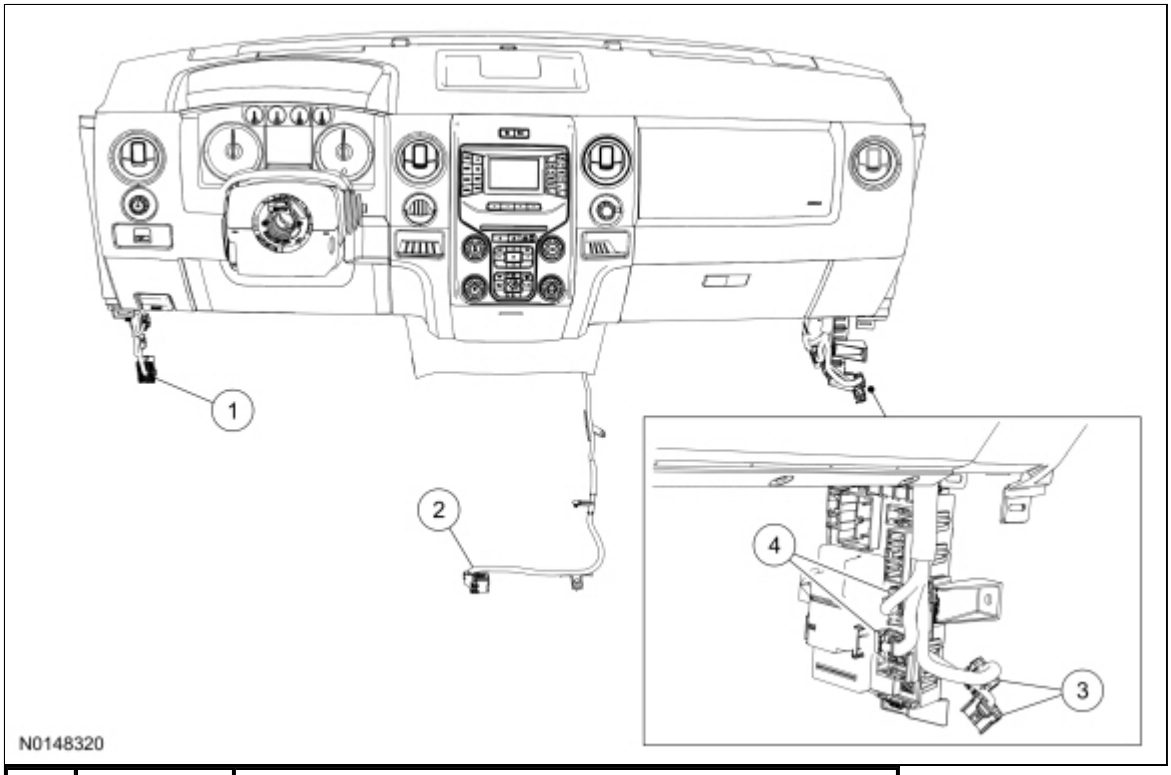


5. To install, reverse the removal procedure.

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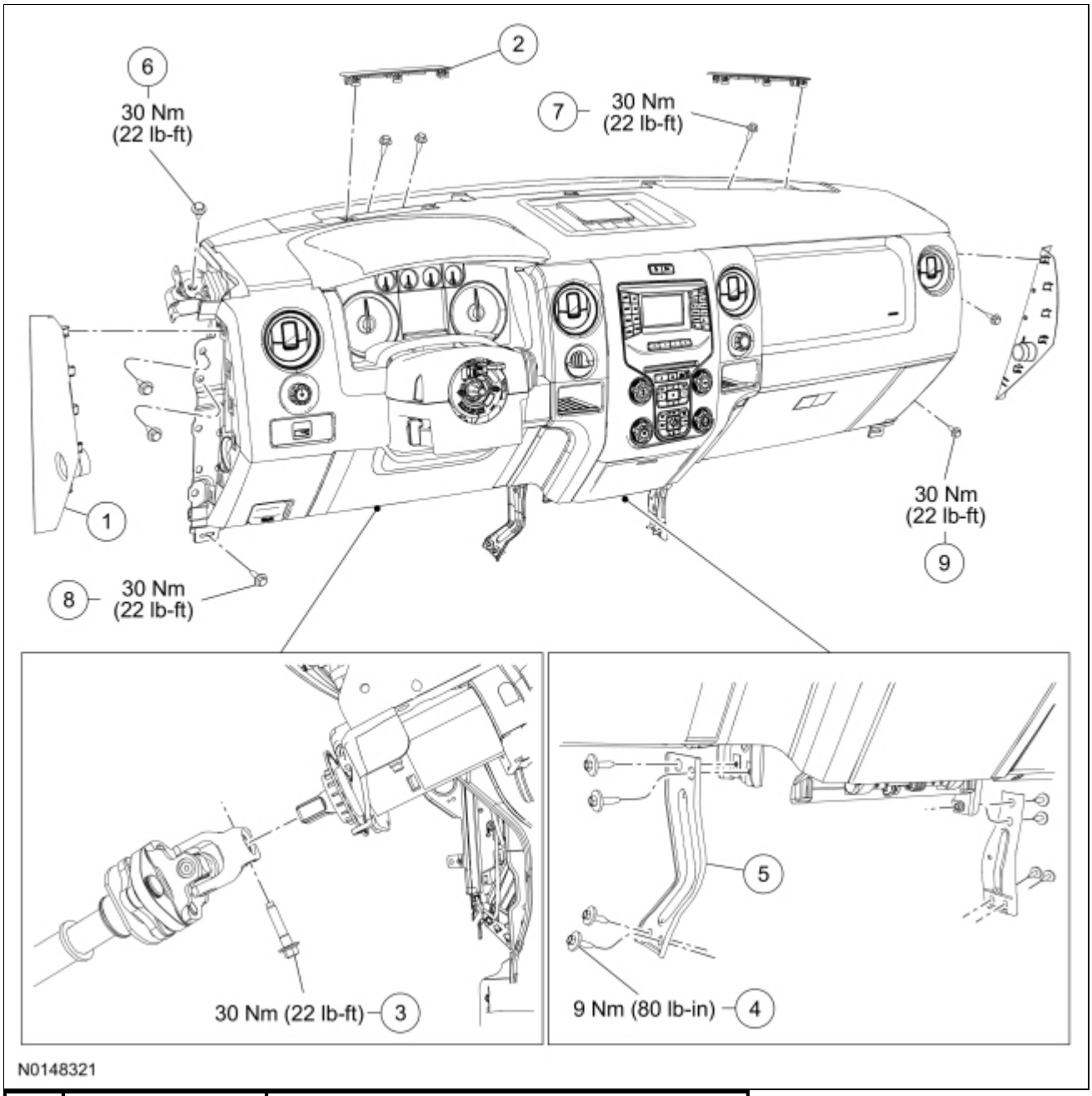
Instrument Panel — Exploded View

Instrument Panel Electrical Connectors



Item	Part Number	Description
1	—	LH lower cowl electrical connector (part of 14401)
2	—	Small Restraints Control Module (RCM) electrical connector (part of 14401)
3	—	RH lower cowl electrical connectors (part of 14401)
4	—	Smart Junction Box (SJB) electrical connectors (part of 14401)

Instrument Panel Fasteners

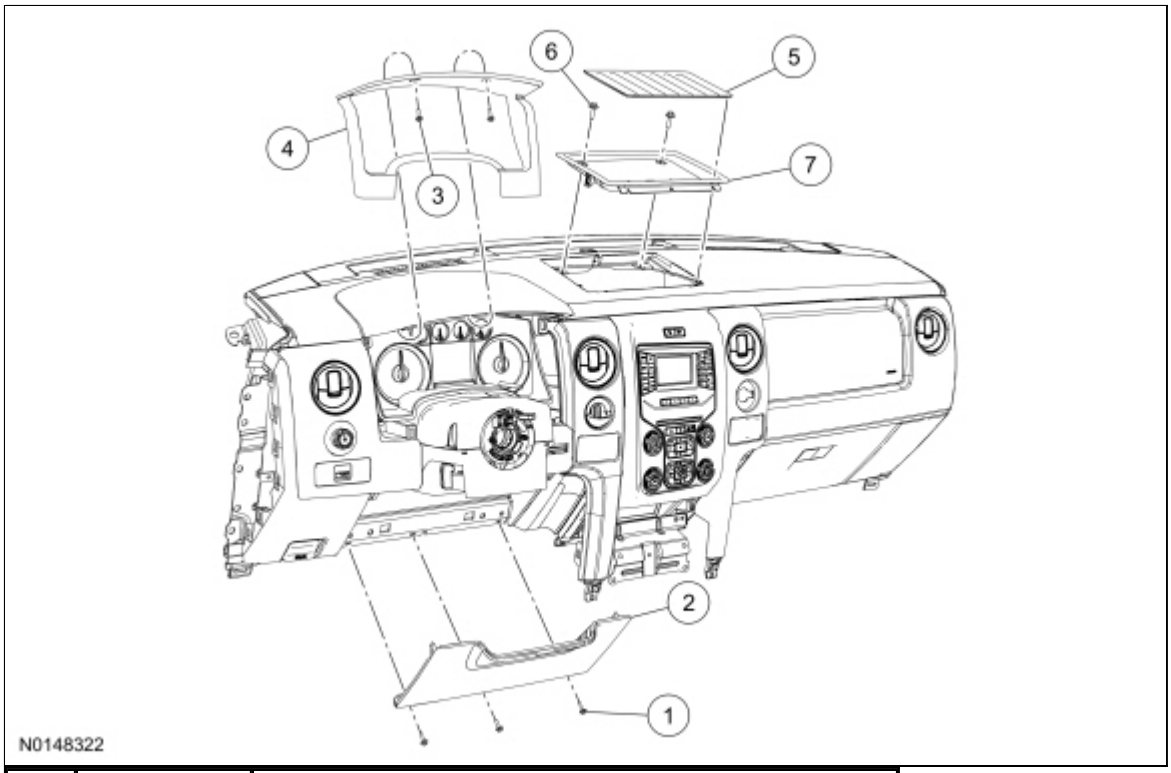


Item	Part Number	Description
1	04480 RH/ 04481 LH	Instrument panel side finish panel
2	043C54	Instrument panel upper cowl trim panel
3	N808684	Steering column shaft-to-steering column bolt
4	N807316	Center instrument panel support bracket bolt (4 required per side)
5	045F38 LH/ 045B00 RH	Center instrument panel support bracket (2 required)
6	W706426	LH instrument panel upper bolt (3 required)
7	W706426	RH instrument panel upper bolt

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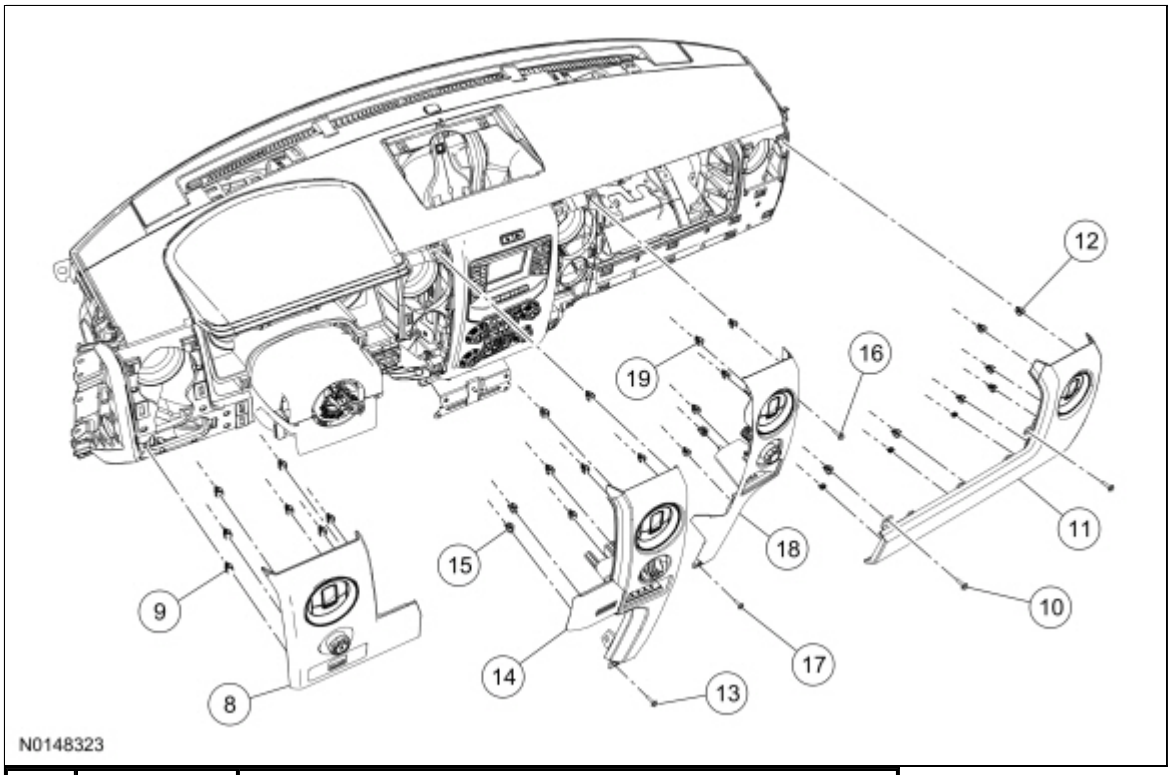
8	W706426	LH instrument panel side bolt (3 required)
9	W706426	RH instrument panel side bolt (2 required)

Instrument Panel Finish Panels



Item	Part Number	Description
1	W707628	Steering column opening trim panel screw (3 required)
2	04459	Steering column opening trim panel
3	—	Instrument cluster finish panel screw (2 required)
4	044D70	Instrument cluster finish panel
5	045G34A	Upper storage compartment mat
6	—	Upper storage compartment screw (2 required)
7	042A82	Upper storage compartment

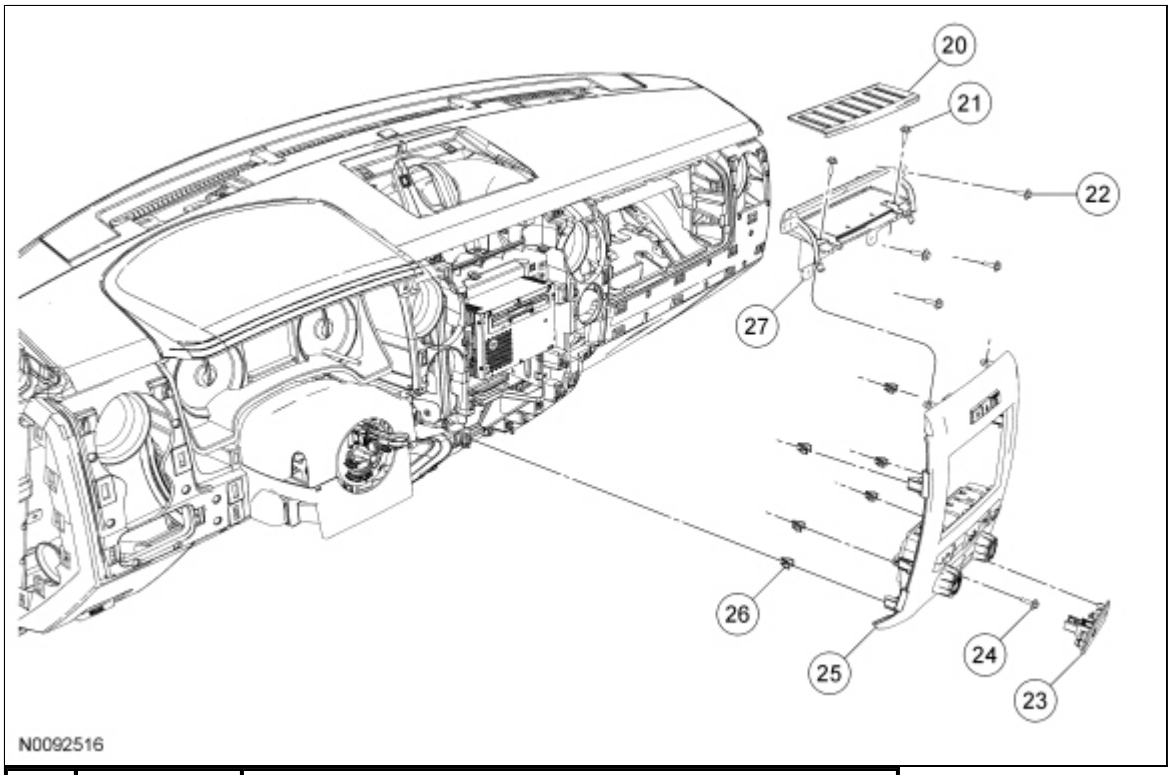
Instrument Panel Finish Panels (Continued)



Item	Part Number	Description
8	04338B	LH instrument panel finish panel
9	W712210	LH instrument panel finish panel retaining clip (7 required)
10	W707281	RH instrument panel finish panel screw (2 required)
11	04338A	RH instrument panel finish panel
12	W712210	RH instrument panel finish panel retaining clip (10 required)
13	W707281	LH center instrument panel finish panel bolt
14	04338D	LH center instrument panel finish panel
15	W712210	LH center instrument panel finish panel retaining clip (8 required)
16	—	RH center instrument panel finish panel upper bolt
17	W707281	RH center instrument panel finish panel lower bolt
18	04338C	RH center instrument panel finish panel
19	W712210	RH center instrument panel finish panel lower bolt retaining clip (6 required)

Instrument Panel Finish Panels (AM/FM Single CD Only)

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Item	Part Number	Description
20	045G34B	Center instrument panel upper finish panel mat
21	—	Center instrument panel lower finish panel upper screw (2 required)
22	—	Center instrument panel upper finish panel screw (4 required)
23	044D82	Audio input jack trim cover
24	—	Center instrument panel lower finish panel lower screw
25	04302	Center instrument panel lower finish panel
26	W712210	Center instrument panel lower finish panel retaining clip (6 required)
27	061B58	Center instrument panel upper finish panel

1. For additional information, refer to the procedures in this section.

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Instrument Panel Finish Panel — Center, LH

Vehicles with flow thru floor console

1. Apply the parking brake.

2. Position the front seats forward.

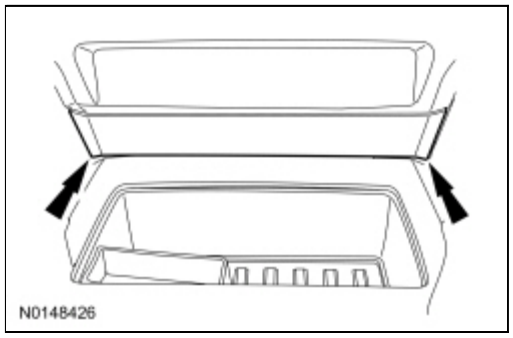
3. Remove the 2 floor console rear bolts.
   - To install, tighten to 9 Nm (80 lb-in).

4. Position the front seats rearward.

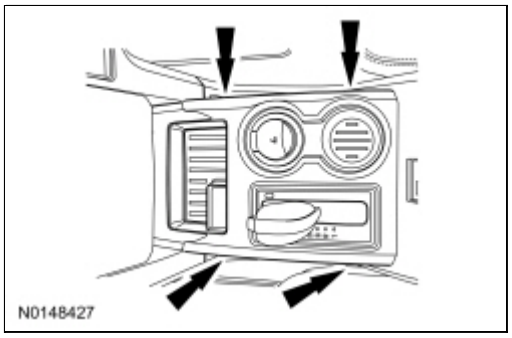
5. Remove the LH and RH floor console lower finish panels, in the following sequence.
   1. Pull the rear section of the panels outward to release the retaining clips.
   2. Pull the panels toward the rear of the vehicle.
   3. Disconnect the ambient lighting.

6. ***NOTICE:*** **When prying on a component, a non-marring tool must be used or damage to the component may occur.**

   Remove the instrument panel-to-floor console finish panel.
   - Using a non-marring tool, gently pry outward at the lower corners of the instrument panel-to-floor console finish panel to release the retaining clips.



7. Remove the floor console upper finish panel.
   - Lift the floor console upper finish panel upward, at the locations indicated, to release the retaining clips.



8. Remove the selector lever trim panel.
    - Lift the selector lever trim panel upward releasing the retaining clips from the floor console.

9. Remove the 2 floor console-to-instrument panel bolts.
    - To install, tighten to 2.5 Nm (23 lb-in).

10. Remove the 2 floor console front bolts.
    - To install, tighten to 9 Nm (80 lb-in).

11. Position the floor console rearward.

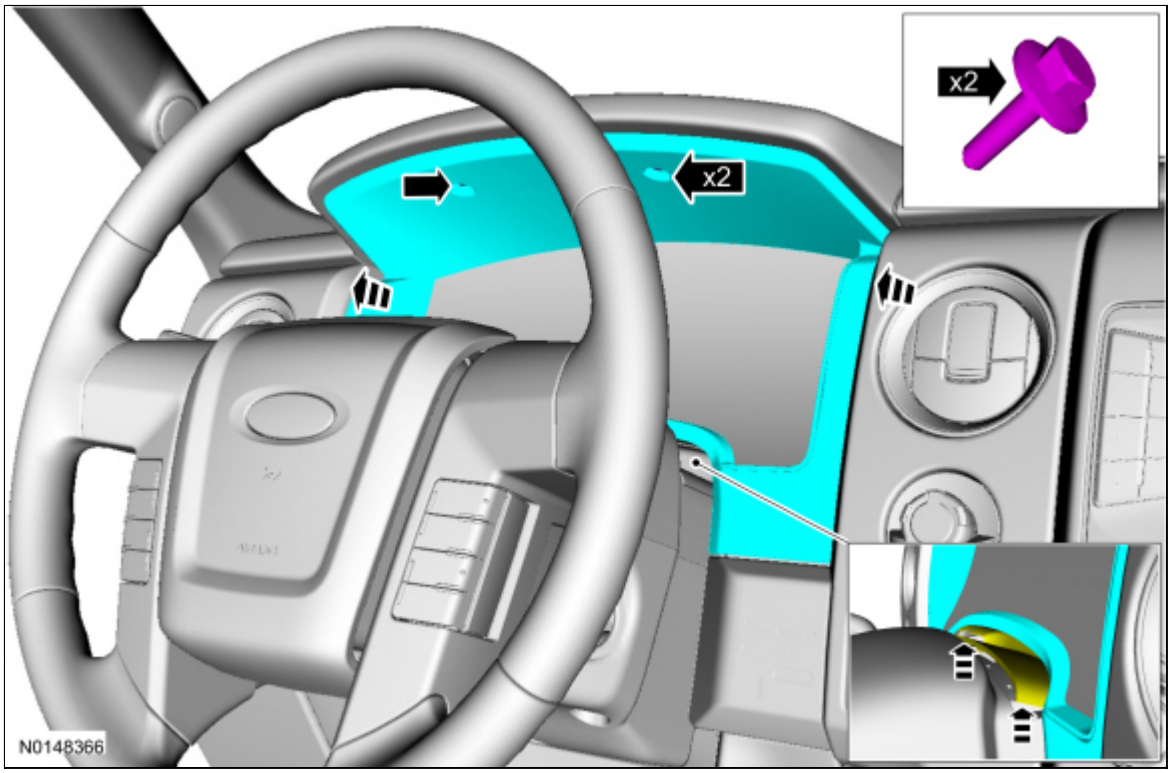
Vehicles without flow thru floor console

12. Remove the lower instrument panel trim panel.

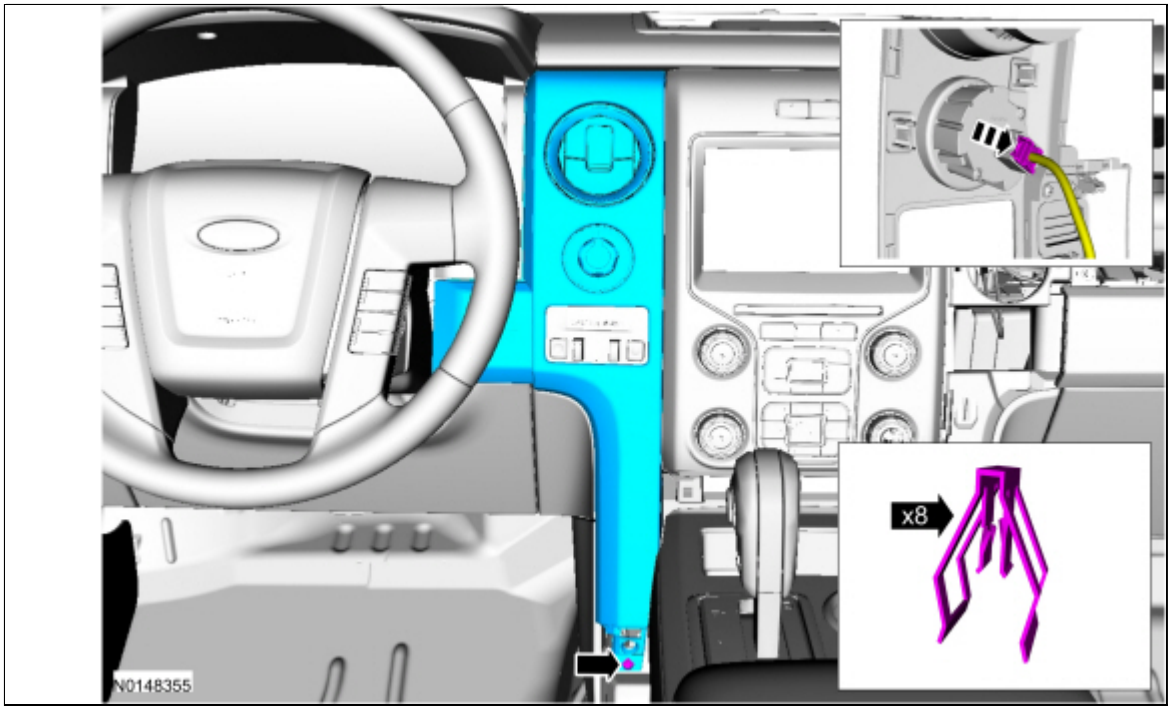
All vehicles

13. Remove the 2 instrument cluster finish panel screws and the instrument cluster finish panel.
    - Release the gap hider retainers.

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14. Remove the LH center instrument panel trim panel lower bolt and the LH center instrument panel trim panel.
    - Pull the LH center instrument panel trim panel toward the rear of the vehicle to release the retaining clips.
    - If equipped, disconnect the electrical connector.



15. To install, reverse the removal procedure.

- Make sure to align the finish panel retaining clips to the adjacent retaining clip holes.

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Instrument Panel Finish Panel — Center, Lower

Removal and Installation

Vehicles with flow thru floor console

NOTE: This procedure applies to AM/FM, AM/FM single CD audio systems only.

1. Apply the parking brake.

2. Position the front seats forward.

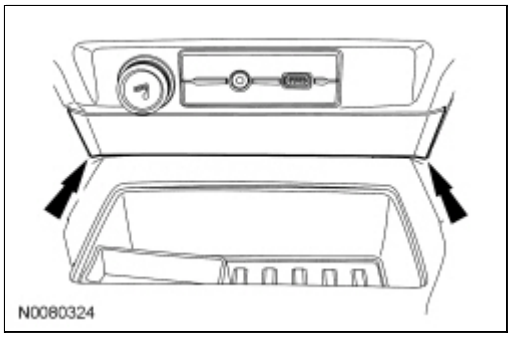
3. Remove the 2 floor console rear bolts.
   - To install, tighten to 9 Nm (80 lb-in).

4. Position the front seats rearward.

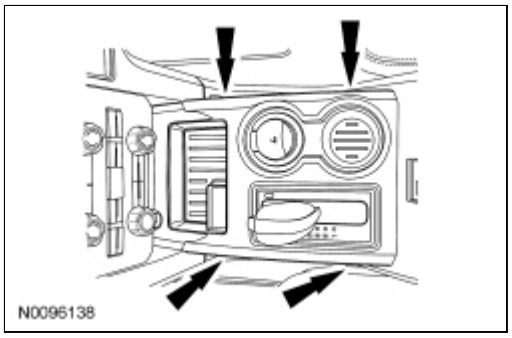
5. Remove the LH and RH floor console lower finish panels, in the following sequence.
   1. Pull the rear section of the panels outward to release the retaining clips.
   2. Pull the panels toward the rear of the vehicle.
   3. Disconnect the ambient lighting.

6. ***NOTICE:*** **When prying on a component, a non-marring tool must be used or damage to the component may occur.**

   Remove the instrument panel-to-floor console finish panel.
   - Using a non-marring tool, gently pry outward at the lower corners of the instrument panel-to-floor console finish panel to release the retaining clips.


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7. Remove the floor console upper finish panel.
   - Lift the floor console upper finish panel upward, at the locations indicated, to release the retaining clips.



8. Remove the selector lever trim panel.
    - Lift the selector lever trim panel upward releasing the retaining clips from the floor console.

9. Remove the 2 floor console-to-instrument panel bolts.
    - To install, tighten to 2.5 Nm (23 lb-in).

10. Remove the 2 floor console front bolts.
    - To install, tighten to 9 Nm (80 lb-in).

11. Position the floor console rearward.

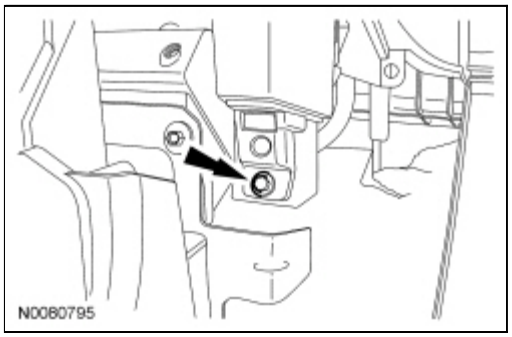
Vehicles without flow thru floor console

12. Remove the lower instrument panel trim panel.

All vehicles

13. **NOTE:** RH center instrument panel trim panel lower bolt is shown, LH center instrument panel trim panel lower bolt is similar.

    Remove the LH and RH center instrument panel trim panel lower bolts.



14. Remove the 2 instrument cluster finish panel screws.

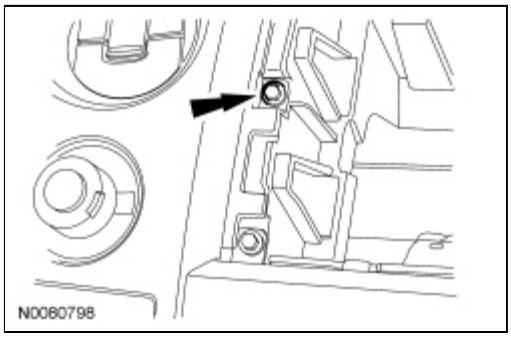
15. Remove the instrument cluster finish panel.

16. Remove the LH center instrument panel trim panel.
    - Pull the LH center instrument panel trim panel toward the rear of the vehicle to release the retaining clips.
    - If equipped, disconnect the electrical connector.

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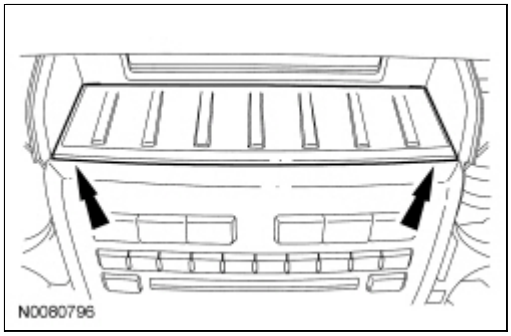
17. Remove the passenger air bag module. For additional information, refer to Section 501-20B .

18. Remove the RH center instrument panel trim panel upper bolt.

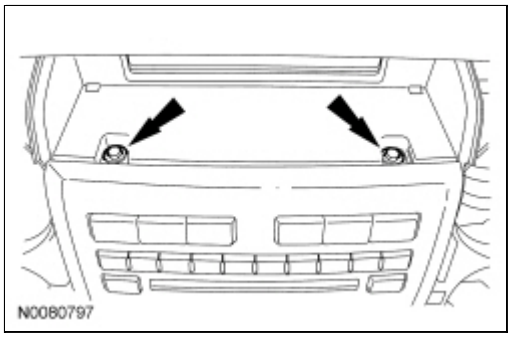


19. Remove the RH center instrument panel trim panel.
    - Pull the RH center instrument panel trim panel toward the rear of the vehicle to release the retaining clips.
    - If equipped, disconnect the electrical connector.

20. Remove the center instrument panel upper finish panel mat.

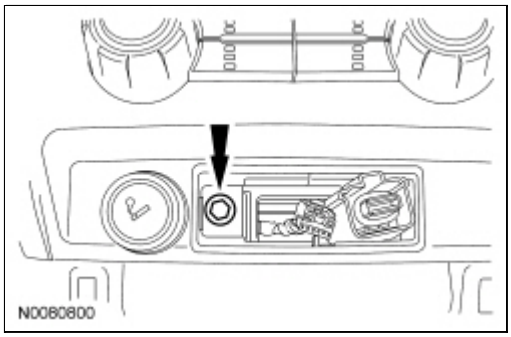


21. Remove the 2 center instrument panel lower finish panel upper screws.



22. Remove the audio input jack trim cover.
    - Using a non-marring tool, pry outward on the lower left corner of the audio input jack cover.
    - Disconnect the electrical connector(s).

23. Remove the instrument panel lower center finish panel center screw.



24. Remove the instrument panel lower center finish panel.
    - Pull the instrument panel lower finish panel toward the rear of the vehicle to release the retaining clips.
    - Disconnect the electrical connectors.

25. To install, reverse the removal procedure.
    - Make sure to align the finish panel retaining clips to the adjacent retaining clip holes.

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Instrument Panel Finish Panel — Center, RH

Vehicles with flow thru floor console

1. Apply the parking brake.

2. Position the front seats forward.

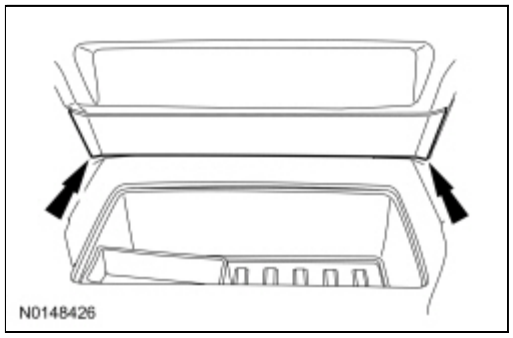
3. Remove the 2 floor console rear bolts.
   - To install, tighten to 9 Nm (80 lb-in).

4. Position the front seats rearward.

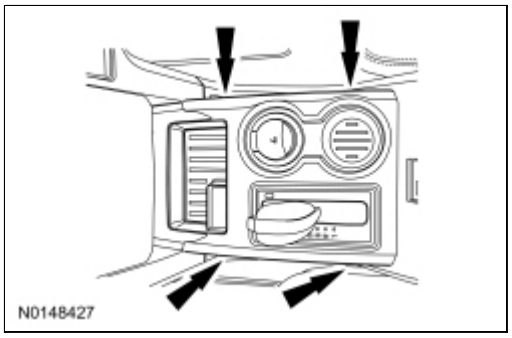
5. Remove the LH and RH floor console lower finish panels, in the following sequence.
   1. Pull the rear section of the panels outward to release the retaining clips.
   2. Pull the panels toward the rear of the vehicle.
   3. Disconnect the ambient lighting.

6. ***NOTICE:*** **When prying on a component, a non-marring tool must be used or damage to the component may occur.**

   Remove the instrument panel-to-floor console finish panel.
   - Using a non-marring tool, gently pry outward at the lower corners of the instrument panel-to-floor console finish panel to release the retaining clips.



7. Remove the floor console upper finish panel.
   - Lift the floor console upper finish panel upward, at the locations indicated, to release the retaining clips.



8. Remove the selector lever trim panel.
    - Lift the selector lever trim panel upward releasing the retaining clips from the floor console.

9. Remove the 2 floor console-to-instrument panel bolts.
    - To install, tighten to 2.5 Nm (23 lb-in).

10. Remove the 2 floor console front bolts.
    - To install, tighten to 9 Nm (80 lb-in).

11. Position the floor console rearward.

Vehicles without flow thru floor console

12. Remove the lower instrument panel trim panel.

All vehicles

13. Remove the passenger air bag module. For additional information, refer to Section 501-20B .

14. Remove the RH center instrument panel trim panel upper and lower bolt and the RH center instrument panel trim panel.
    - Pull the RH center instrument panel trim panel toward the rear of the vehicle to release the retaining clips.
    - If equipped, disconnect the electrical connector.

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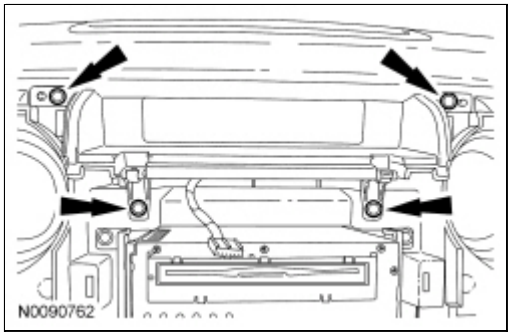
15. To install, reverse the removal procedure.
    - Make sure to align the finish panel retaining clips to the adjacent retaining clip holes.

Instrument Panel Finish Panel — Center, Upper

Removal and Installation

1. Remove the center instrument panel lower finish panel. For additional information, refer to Instrument Panel Finish Panel — Center, Lower in this section.

2. Remove the 4 center instrument panel upper finish panel screws.



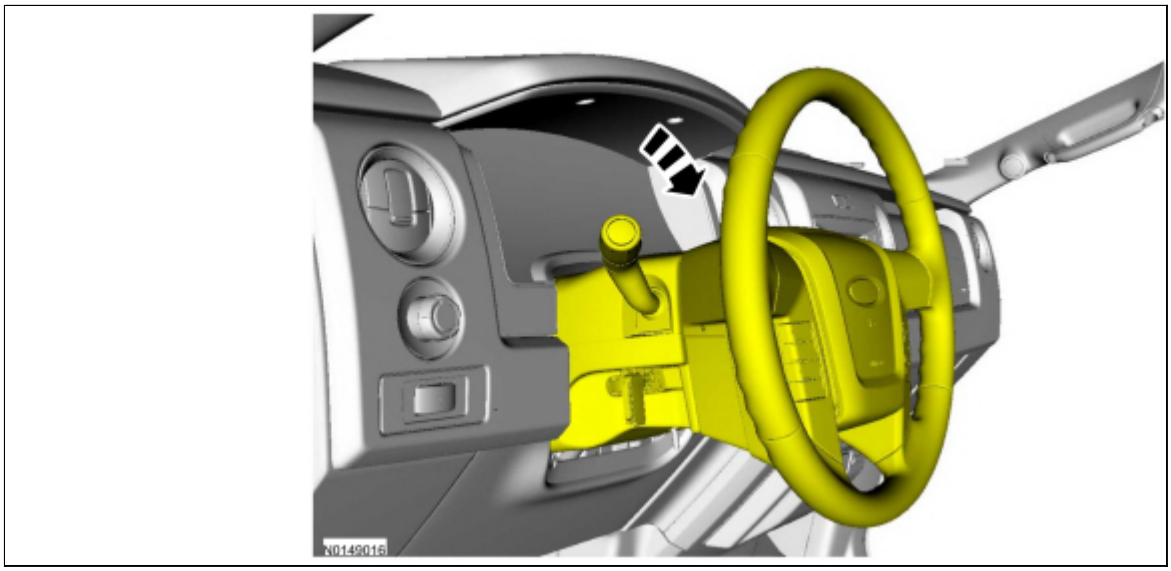
3. To install, reverse the removal procedure.

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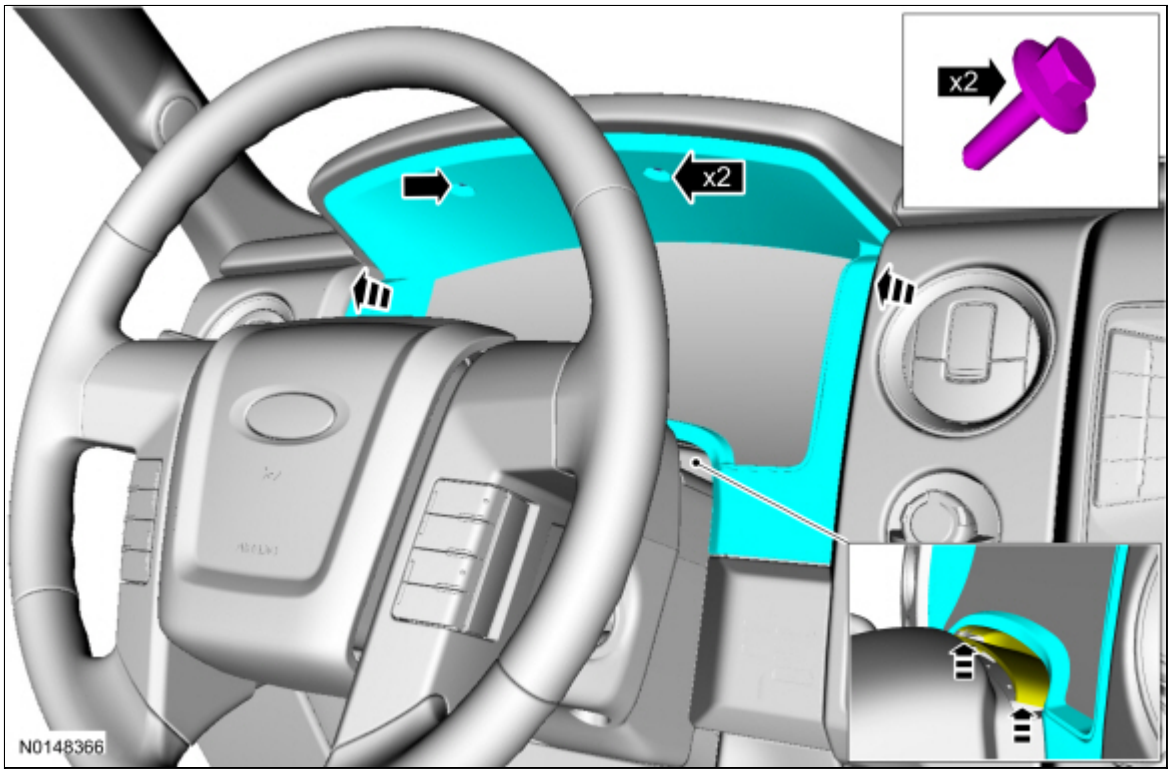
Instrument Panel Finish Panel — LH

Removal and Installation

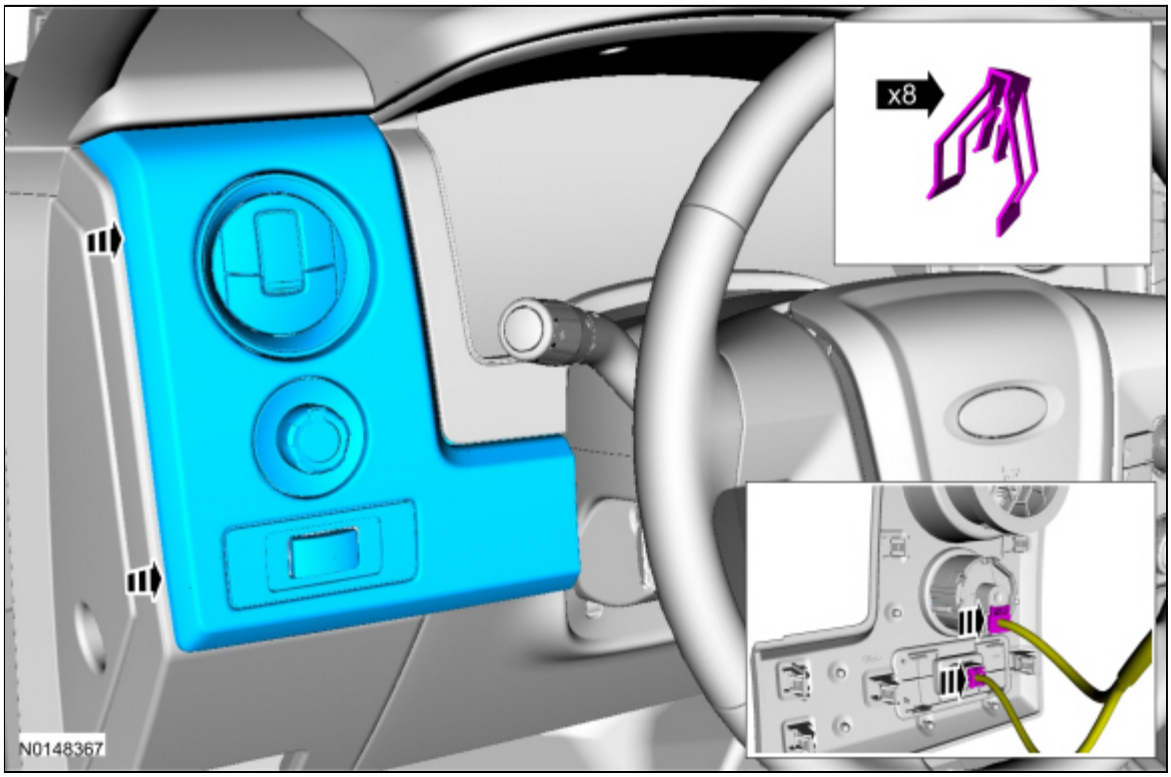
1. Position the steering wheel downward.



2. Remove the 2 instrument cluster finish panel screws and the instrument cluster finish panel.
   - Release the gap hider retainers
   - Pull the instrument cluster finish panel toward the rear of the vehicle to release the retaining clips.



3. Remove the LH instrument panel finish panel.
    - Pull the LH instrument panel finish panel toward the rear of the vehicle to release the retaining clips.
        - Disconnect the electrical connectors.



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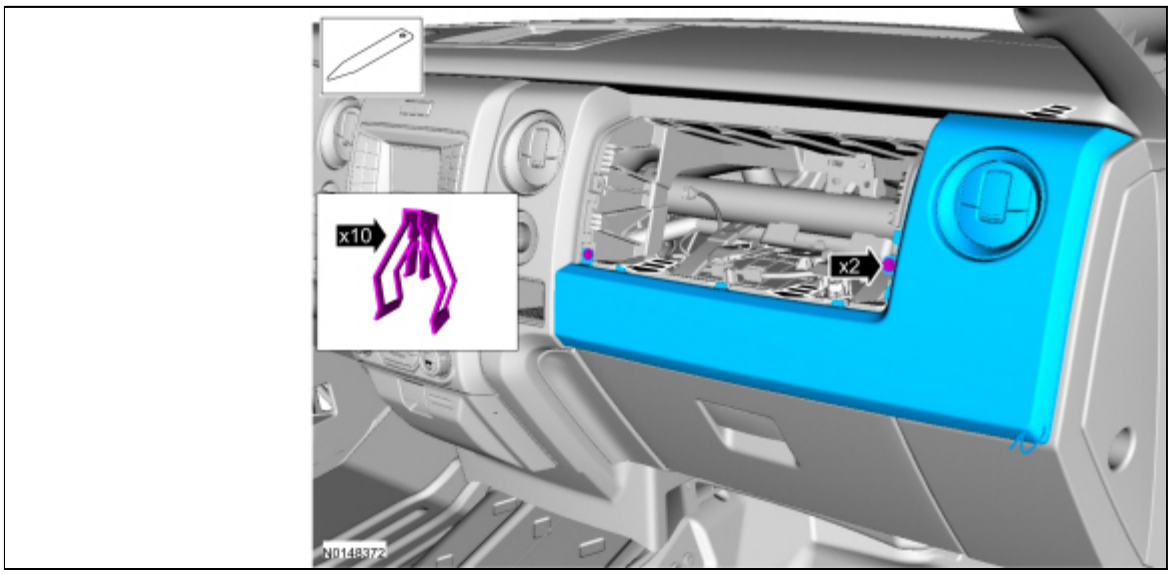
4. To install, reverse the removal procedure.

Instrument Panel Finish Panel — RH

Removal and Installation

1. Remove the passenger air bag module. For additional information, refer to Section 501-20B .

2. Remove the 2 RH instrument panel finish panel screws and the RH instrument panel finish panel.
   - Pull the RH instrument panel finish panel toward the rear of the vehicle to release the retaining clips.



3. To install, reverse the removal procedure.
   - Make sure to align the finish panel retaining clips to the adjacent retaining clip holes.

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Instrument Panel

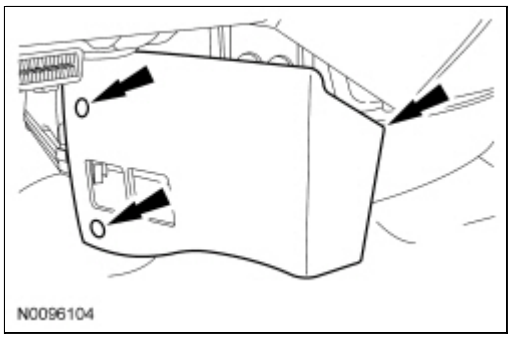
Removal

All vehicles

1. Apply the parking brake.
2. Place the selector lever in the NEUTRAL position.
3. If equipped with adjustable pedals, move the pedals to the full forward position.
4. Remove the steering wheel. For additional information, refer to Section 211-04 .
5. Remove the Instrument Cluster (IC). For additional information, refer to Section 413-01 .

Vehicles without floor console

6. Remove the valance panel and the 3 pin-type retainers.



Vehicles with floor console

7. Remove the floor console. For additional information, refer to Console — Floor in this section.

Vehicles with rear footwell ducts

8. Remove the front passenger seat. For additional information, refer to Section 501-10 .

All vehicles

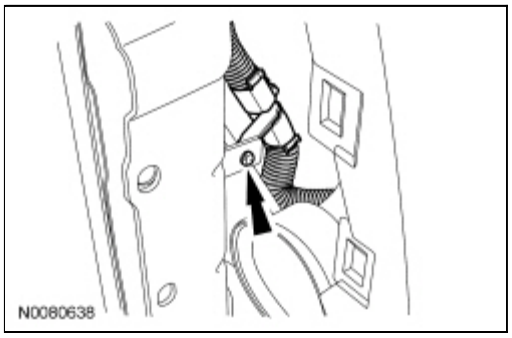
9. Remove the LH and RH front door scuff plate trim panels.
10. Position the LH and RH front door weatherstrip seals aside.
11. Remove the A-pillar trim panels and cowl side trim panels. For additional information, refer to Section 501-05 .
12. Remove the LH and RH instrument panel side finish panels.

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13. Remove the LH and RH lower cowl trim panels.
    - Remove the RH lower cowl trim panel pushpin retainer.

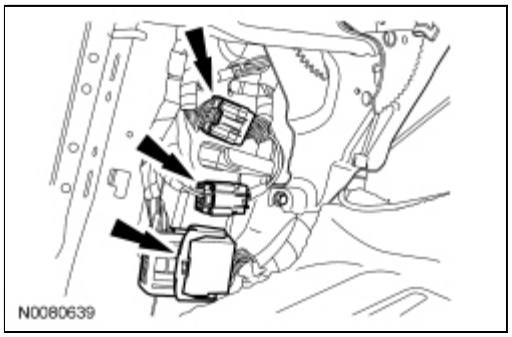
14. Remove the parking brake release handle bolt.

15. Detach the wire harness pin-type retainer and route the parking brake release handle through the lower instrument panel frame.



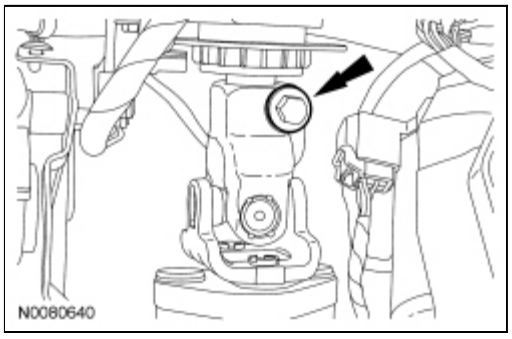
16. Remove the hood release handle bolt and position aside the hood release handle.

17. Disconnect the 3 electrical connectors at the LH lower cowl.



18. Detach the wire harness pin-type retainer at the LH lower cowl.

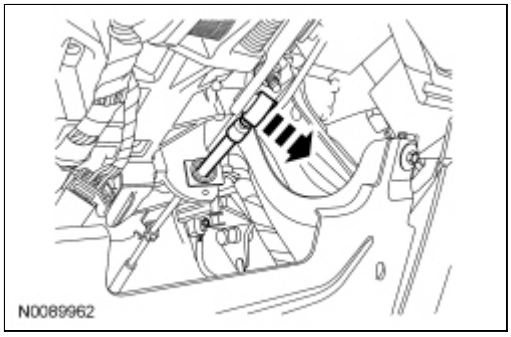
19. Remove and discard the steering column shaft-to-steering column bolt.



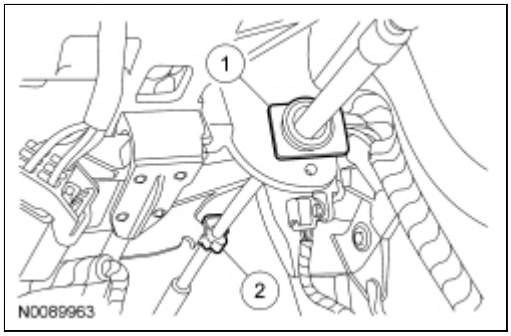
20. Separate the steering column shaft from the steering column.

Vehicles with column shift

21. Disconnect the steering column selector lever cable from the selector lever.

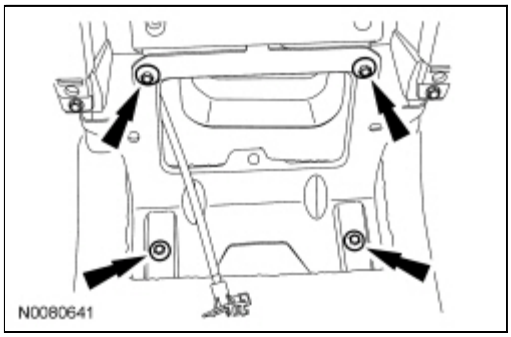


22. Position aside the steering column selector lever cable in the following sequence.
    1. Remove the selector lever cable from the bracket.
    2. Remove the selector lever cable pin-type retainer and position aside the steering column selector lever cable.



If equipped with a floor console

23. Remove the 4 center instrument panel support bracket bolts and remove the center instrument panel support bracket.



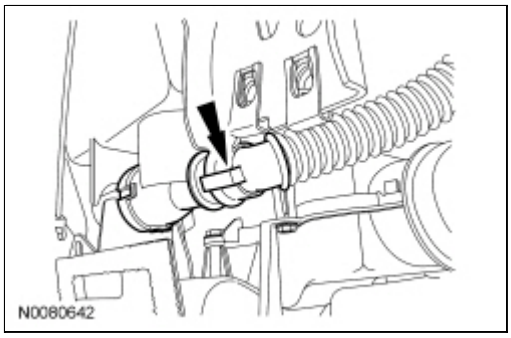
All vehicles

24. Position aside the LH footwell carpet, remove the 4 LH center instrument panel support bracket bolts.

25. Remove the LH center instrument panel support bracket.

26. If equipped, disconnect the in-vehicle temperature sensor hose.

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27. Detach the wire harness pin-type retainer located on the RH center instrument panel support bracket.

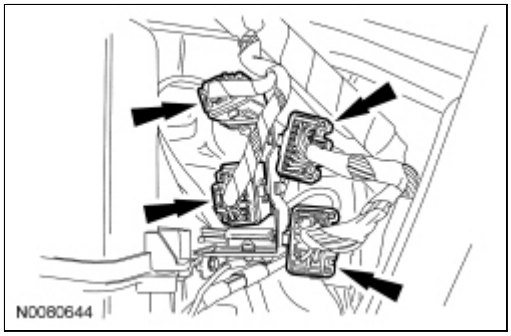
28. Position aside the RH footwell carpet and remove the 4 RH center instrument panel support bracket bolts.

29. Remove the RH center instrument panel support bracket.

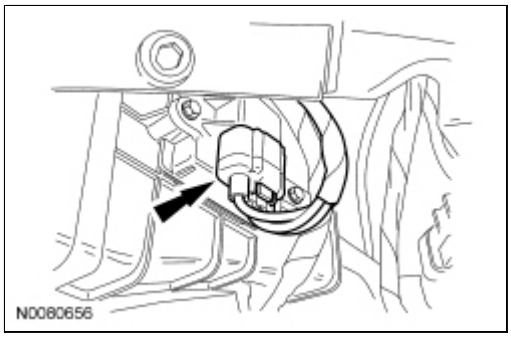
30. Fully lower the glove compartment door in the following sequence.
    1. Open the glove compartment door.
    2. Depress the 2 glove compartment door tabs inward and fully lower the glove compartment door.

31. Disconnect the radio antenna and if equipped, the satellite antenna.

32. Disconnect the 4 electrical connectors located on the HVAC housing.



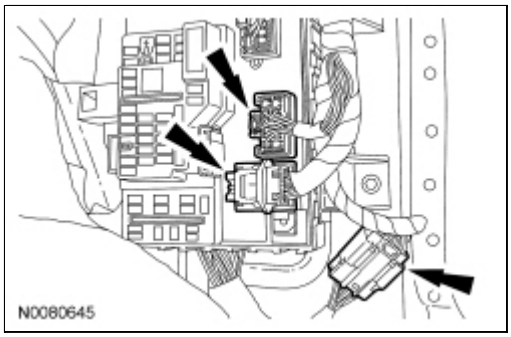
33. Disconnect the blower motor speed controller electrical connector.



34. Fully close the glove compartment door in the following sequence.
    1. Lift the glove compartment door upward.
    2. Depress the 2 glove compartment door tabs inward and fully close the glove compartment

door.

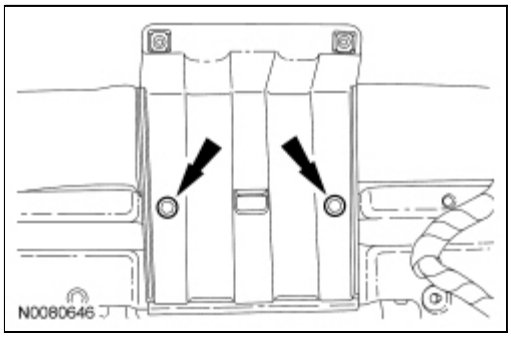
35. Disconnect the electrical connector at the RH lower cowl and the 2 Smart Junction Box (SJB) electrical connectors.



36. Detach the 2 wire harness pin-type retainers from the SJB .

37. Remove the LH and RH instrument panel upper cowl trim panels.

38. Remove the 2 screws from the instrument panel reinforcement bracket located in the IC opening.



39. Pull the instrument panel reinforcement bracket toward the rear of the vehicle.

40. Remove the 3 LH instrument panel upper bolts.

41. Remove the RH instrument panel upper bolt.

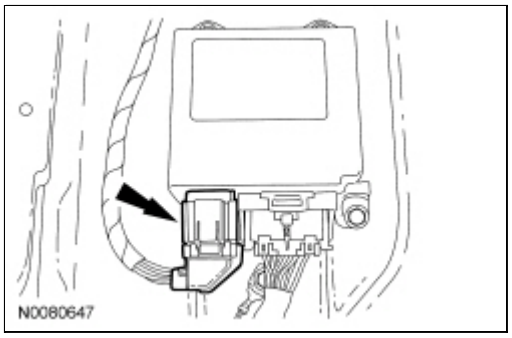
42. Remove the Digital Signal Processing (DSP) module, if equipped with a Sony® sound system. For additional information, refer to Section 415-00E .

Vehicles with 20 percent front seat

43. Remove the cushion tray in the following sequence.
    1. Raise the 20 percent front seat cushion.
    2. Remove the 2 pushpins and lift the rear edge of the cushion tray upward to release the retainers.
    3. Pull the cushion tray rearward to unhook the front edge of the cushion tray from the seat frame.
    4. Lift upward to remove the cushion tray.

44. Lift the small carpet flap and disconnect the small Restraints Control Module (RCM) connector.

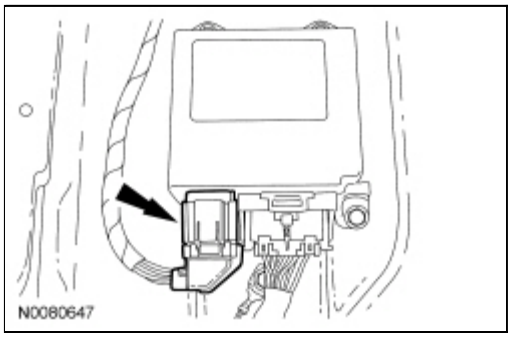
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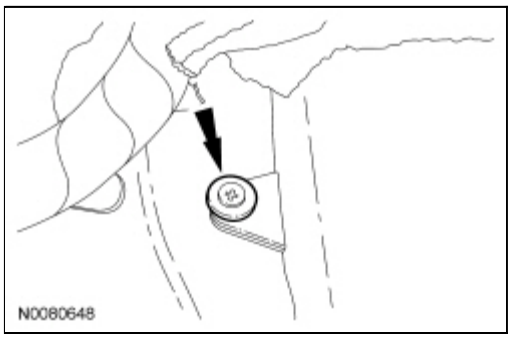
45. Remove the RCM wire harness scrivet from under the small carpet flap.
46. Pull back the front footwell area of the passenger side carpet to gain access to the RCM wire harness.
47. Remove the RCM wire harness scrivet and detach the RCM wire harness pin-type retainer.
48. Pull the RCM wire harness out from under the 20 percent front seat bracket and the carpet.

Vehicles with a floor console

49. Lift the small carpet flap and disconnect the small RCM electrical connector.



50. Remove the wire harness scrivet from under the small carpet flap.
51. Pull back the front footwell area of the passenger side carpet to gain access to the RCM wire harness.
52. If equipped, remove the passenger floor duct pushpin retainer.



53. If equipped, position the passenger floor duct above the carpet.

54. Detach the RCM wire harness pin-type retainer.

55. Pull the RCM wire harness under the floor console mounting bracket.

56. If equipped, lift the passenger floor duct upward and detach the wire harness pin-type retainer.

57. If equipped, pull the wire harness under the passenger floor duct.

All vehicles

58. ***NOTICE:*** **To avoid damage to the instrument panel, an assistant is required to support the panel before carrying out this step.**

    Remove the LH and RH instrument panel side bolts.

59. ***NOTICE:*** **To avoid damage to the instrument panel, an assistant is required when carrying out this step.**

    NOTICE: **To avoid damage to the wire harness, make sure that all electrical wiring and connectors are not caught up on other components.**

    Remove the instrument panel form the vehicle.
    - Transfer parts as needed.

Installation

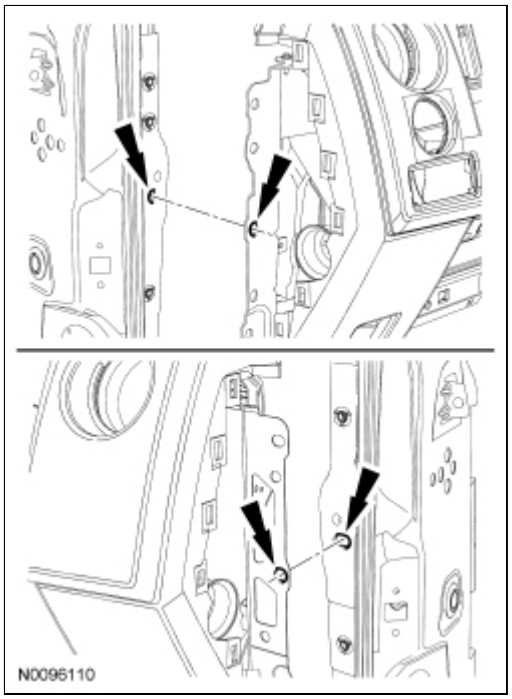
All vehicles

1. ***NOTICE:*** **To avoid damage to the instrument panel, an assistant is required when carrying out this step.**

   NOTICE: **To avoid damage to the wire harness, make sure that all electrical wiring and connectors are routed correctly.**

   Install the instrument panel into the vehicle and using a tapered punch or suitable tool, center the instrument panel.
   - Install the LH and RH instrument panel side bolts.
     - Tighten to 30 Nm (22 lb-ft).

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2. Install the LH and RH instrument panel upper bolts.
    - Tighten to 30 Nm (22 lb-ft).

3. Install the LH and RH instrument panel upper trim panels.

Vehicles with a floor console

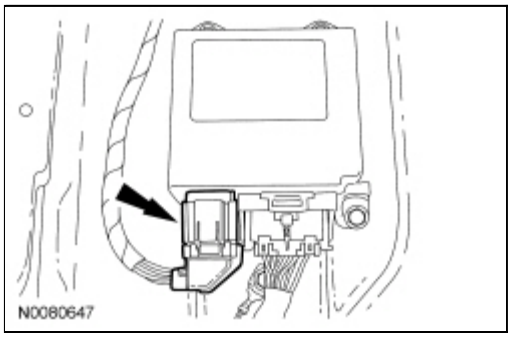
4. If equipped, lift the passenger floor duct upward and route the RCM wire harness under the passenger floor duct.

5. Install the 2 RCM wire harness pin-type retainers.

6. Route the RCM wire harness under the carpet and the floor console mounting bracket.

7. Install the front footwell area of the passenger side carpet.

8. Lift the small carpet flap and connect the small RCM electrical connector.

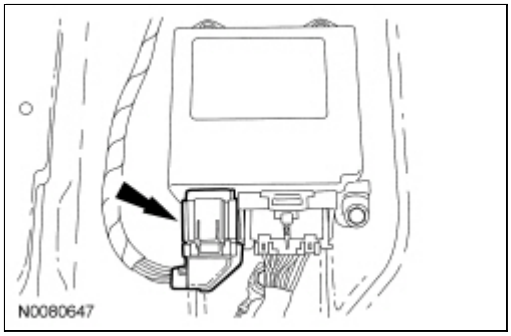


9. Attach the RCM wire harness scrivet.

10. Install the small carpet flap.

Vehicles with 20 percent front seat

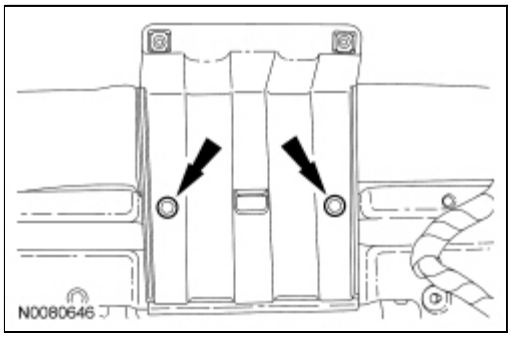
11. Route the RCM wire harness under the carpet and the 20 percent front seat bracket.
12. Install the RCM wire harness scrivet and attach the RCM wire harness pin-type retainer.
13. Install the front footwell area of the passenger side carpet.
14. Lift the small carpet flap and connect the small RCM connector.



15. Install the RCM wire harness scrivet.
16. Install the small carpet flap.
17. Install the cushion tray in the following sequence.
    1. Install the cushion tray on to the seat frame.
    2. Install the 2 pushpins.
    3. Lower the 20 percent front seat cushion.

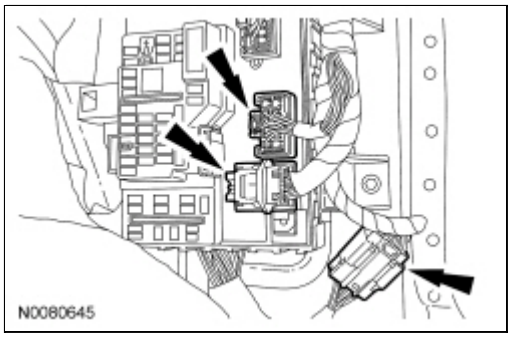
All vehicles

18. Install the DSP module, if equipped with a Sony® sound system. For additional information, refer to Section 415-00E .
19. Lift the instrument panel reinforcement bracket upward.
20. Install and tighten the 2 instrument panel reinforcement bracket screws.



21. Connect the electrical connector at the RH lower cowl and the 2 SJB electrical connectors.

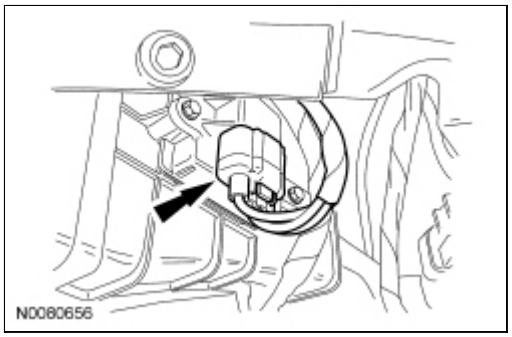
repair4less



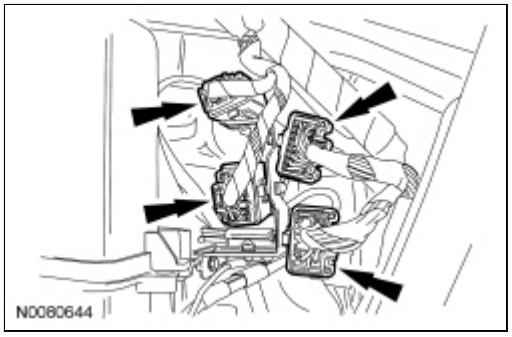
22. Attach the 2 wire harness pin-type retainers onto the SJB .

23. Fully lower the glove compartment door in the following sequence.
    1. Open the glove compartment door.
    2. Depress the 2 glove compartment door tabs inward and fully lower the glove compartment door.

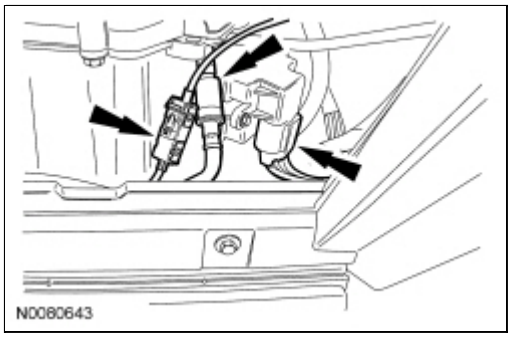
24. Connect the blower motor speed controller electrical connector.



25. Connect the 4 electrical connectors located on the HVAC housing.



26. Connect the radio antenna and if equipped, the satellite antenna.



27. Fully close the glove compartment door in the following sequence.
    1. Lift the glove compartment door upward.
    2. Depress the 2 glove compartment door tabs inward and fully close the glove compartment door.

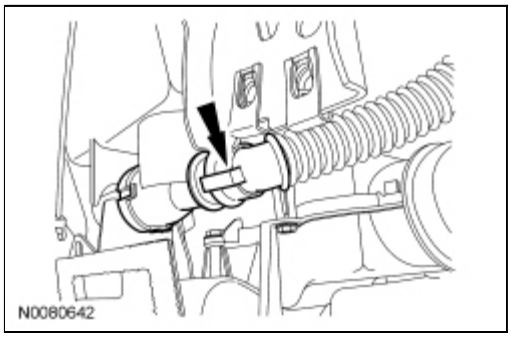
28. Position aside the RH footwell carpet and install the RH center instrument panel support bracket.

29. Install the 4 RH center instrument panel support bracket bolts.
    - Tighten to 9 Nm (80 lb-in).

30. Attach the wire harness pin-type retainer onto the RH center instrument panel support bracket.

31. Install the RH footwell carpet.

32. If equipped, connect the in-vehicle temperature sensor hose.



33. Position aside the LH footwell carpet and install the LH center instrument panel support bracket.

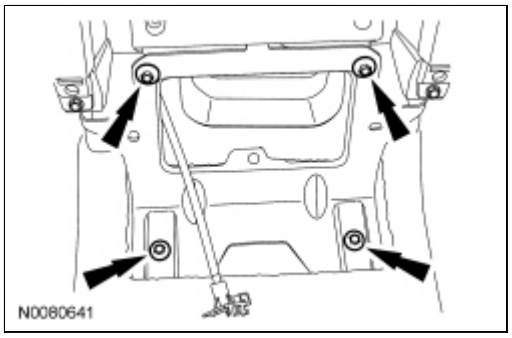
34. Install the 4 LH center instrument panel support bracket bolts.
    - Tighten to 9 Nm (80 lb-in).

35. Install the LH footwell carpet.

If equipped with a floor console

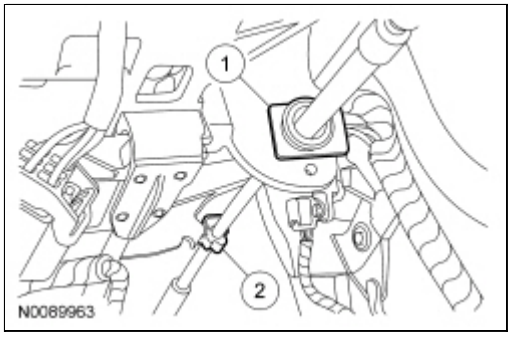
36. Install the center instrument panel support bracket and the 4 center instrument panel support bracket bolts.
    - Tighten to 9 Nm (80 lb-in).

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Vehicles with column shift

37. Install the selector lever cable in the following sequence.
    1. Install the selector lever cable onto the bracket.
    2. Install the selector lever cable pin-type retainer.

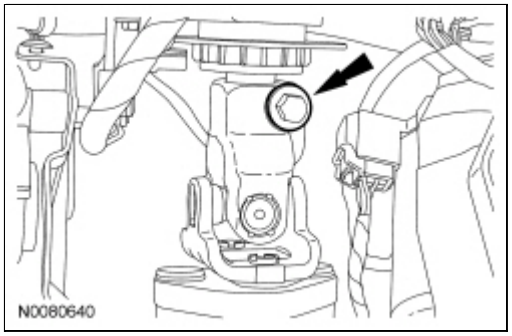


38. Connect the selector lever cable onto the selector lever.

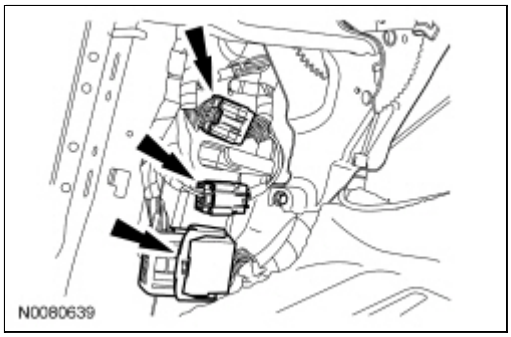
All vehicles

39. Connect the steering column shaft to the steering column.

40. Install a new steering column shaft-to-steering column bolt.
    - Tighten to 30 Nm (22 lb-ft).

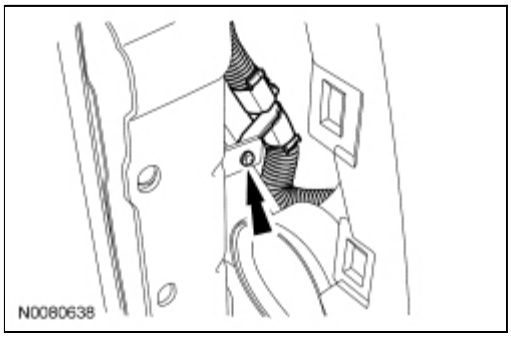


41. Connect the 3 electrical connectors and attach the wire harness pin-type retainer at the LH lower cowl.



42. Install the hood release handle and the hood release handle bolt.
    - Tighten to 9 Nm (80 lb-in).

43. Route the parking brake release handle through the lower instrument panel frame and attach the wire harness pin-type retainer.



44. Install the parking brake release handle bolt.

45. Install the LH and RH lower cowl trim panels.
    - Install the RH lower cowl trim panel pushpin retainer.

46. Install the LH and RH instrument panel side finish panels.

47. Install the A-pillar trim panels and cowl side trim panels. For additional information, refer to Section 501-05 .

48. Install the LH and RH front door weatherstrip seals.

49. Install the LH and RH front door scuff plate trim panels.

Vehicles with rear footwell ducts

50. Install the front passenger seat. For additional information, refer to Section 501-10 .

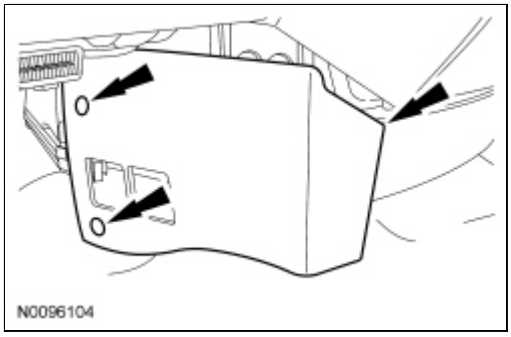
Vehicles with floor console

51. If equipped, install the floor console. For additional information, refer to Console — Floor in this section.

Vehicles without floor console

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52. Install the valance panel and the 3 pin-type retainers.



All vehicles

53. Install the IC . For additional information, refer to Section 413-01 .

54. Install the steering wheel. For additional information, refer to Section 211-04 .

Power Point

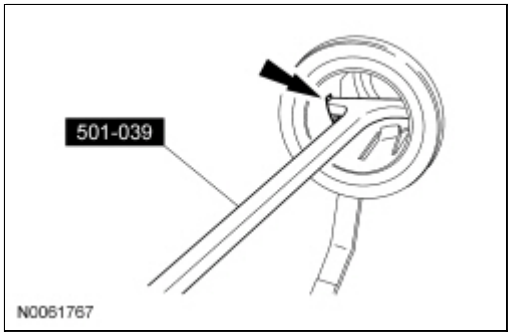
Special Tool(s)

 ST3024-A	Remover, Power Point Socket 501-039 or equivalent

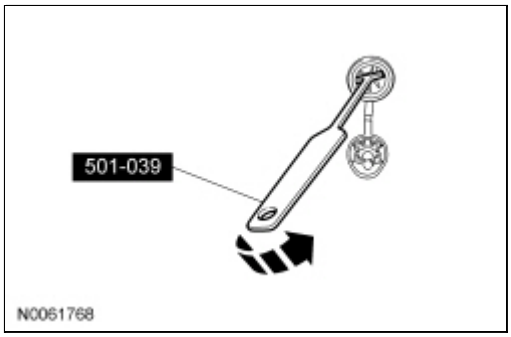
Removal

NOTE: Power point cover may differ depending on location.

1. Open the power point cover.
2. Install the Power Point Socket Remover in one of the power point socket slots.

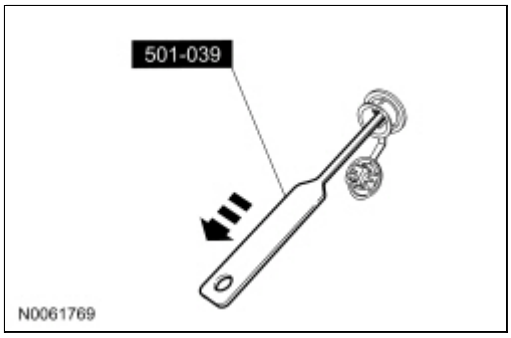


3. Position the Power Point Socket Remover so that it engages in the adjacent slot.



4. Using the Power Point Socket Remover, pull the power point socket out of the retainer.

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5. Disconnect the electrical connector.

Installation

1. Connect the electrical connector.
2. Slide the power point socket into the retainer.

Storage Compartment — Lower

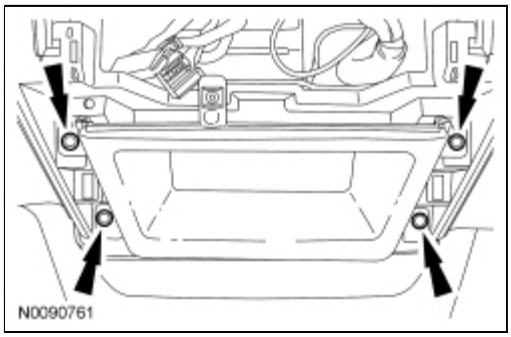
Removal and Installation

All vehicles

1. Remove the lower instrument panel center finish panel. For additional information, refer to Instrument Panel Finish Panel — Center, Lower in this section.

Vehicles equipped with a storage compartment

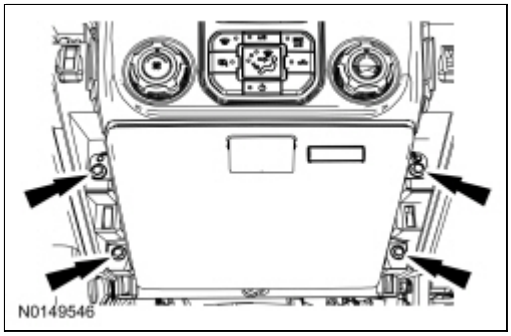
2. Remove the 4 instrument panel lower storage compartment screws.



3. Remove the instrument panel lower storage compartment.

Vehicles equipped with an media bin

4. Remove the 4 media bin screws.



5. Remove the media bin.

All vehicles

6. To install, reverse the removal procedure.

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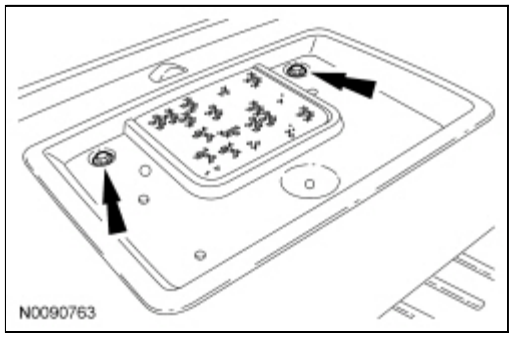
Storage Compartment — Upper

Removal and Installation

1. Remove the instrument panel upper storage compartment mat.

2. **NOTE:** Instrument panel upper storage compartment with speaker shown, instrument panel upper storage compartment without speaker similar.

   Remove the 2 instrument panel upper storage compartment screws.



3. Remove the instrument panel upper storage compartment in the following sequence.
   1. Lift upward on the front edge of the instrument panel upper storage compartment.
   2. Pull the instrument panel upper storage compartment toward the front of the vehicle.
   3. If equipped, disconnect the electrical connector.

4. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B	—
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Door latch bolts	12	—	106
Door latch striker bolts	25	18	—
Exterior door handle bolt	7	—	62
Exterior door handle nuts	7	—	62
Hood latch bolts	35	26	—
Pickup bedside step latch nuts	9	—	80
Primary hood latch release handle bolt	9	—	80
Secondary hood latch release handle bolt	8	—	71
Tailgate access panel bolts	5	—	44
Tailgate latch bolts	25	18	—
Tailgate latch striker	40	30	—
Tailgate release handle nuts	9	—	80

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Handles, Locks, Latches and Entry Systems

Hood Latch

The hood latch system consists of the following components:

- Hood latch
- Primary hood latch release handle and cable
- Secondary hood latch release handle and cable

Front Door

The front door entry system consists of the following components:

- Door ajar switch (part of the front door latch)
- Door lock cylinder
- Exterior front door handle
- Front door latch
- Front door lock actuator (part of the front door latch)
- Interior door handle actuating cable
- Interior door handle

Rear Door, SuperCab

The SuperCab rear door latch system consists of the following components:

- Interior door handle
- Lower rear door latch and cable
- Upper rear door latch and cable

Rear Door, Crew Cab

The Crew Cab rear door latch system consists of the following components:

- Door ajar switch (part of the rear door latch)
- Exterior rear door handle
- Interior door handle
- Interior door handle actuating cable
- Rear door latch
- Rear door lock actuator (part of the rear door latch)

Tailgate

The tailgate latch system consists of the following components:

- Tailgate latches
- Tailgate latch actuating rods

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- Tailgate latch release handle
- Tailgate latch remote control

Spare Tire

To prevent theft of the spare tire, the vehicle is equipped with a spare tire lock cylinder.

Power Locks

The power lock/unlock feature requests all of the vehicle doors locked or unlocked upon a customer request from either door lock control switch in the vehicle. The power door locking system functions independently of ignition status or vehicle speed.

Autolock

The autolock feature locks all the doors when the following conditions are met:

- all the doors are closed
- the ignition switch is in the RUN position
- the vehicle is shifted into any gear, putting the vehicle in motion
- the vehicle attains a speed greater than 20 km/h (12 mph)

The autolock feature repeats when:

- any door is opened then closed while the ignition is still in the RUN position
- the vehicle speed is 15 km/h (9 mph) or slower
- and the vehicle then attains a speed greater than 20 km/h (12 mph)

Refer to Autolock and Auto-Unlock Programming in this section for programming information.

Auto-Unlock

NOTE: The doors do not auto-unlock if the vehicle has been locked using a door lock control switch, Remote Keyless Entry (RKE) transmitter, or keyless entry keypad before the driver door is opened.

The auto-unlock feature unlocks all the doors when the following conditions are met:

- the ignition switch is in the RUN position
- all the doors are closed
- the vehicle has been in motion at a speed greater than 20 km/h (12 mph)
- the vehicle then comes to a stop
- the ignition is switched to the OFF or ACC position
- the driver door is opened within 10 minutes of the ignition being switched to the OFF, LOCK or ACC position

Refer to Autolock and Auto-Unlock Programming in this section for programming information.

Smart Unlock

The smart unlock feature prevents the doors from locking with the key in the ignition lock cylinder. When the Body Control Module (BCM) receives a lock command from a door lock control switch only with the key in the ignition lock cylinder and one of the front doors open, the BCM commands the doors to unlock.

The vehicle can still be locked with the ignition key in the ignition cylinder by locking the doors with the push button rods, the door lock cylinder or a lock command from a Remote Keyless Entry (RKE) transmitter.

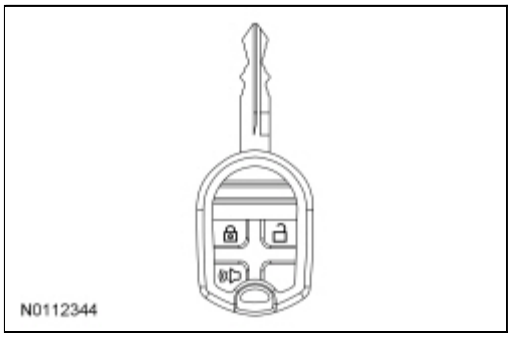
Remote Keyless Entry (RKE)

The RKE system uses an Integrated Keyhead Transmitter (IKT). The IKT incorporates both the Passive Anti-Theft System (PATS) functions and the RKE transmitter functions in a single device.

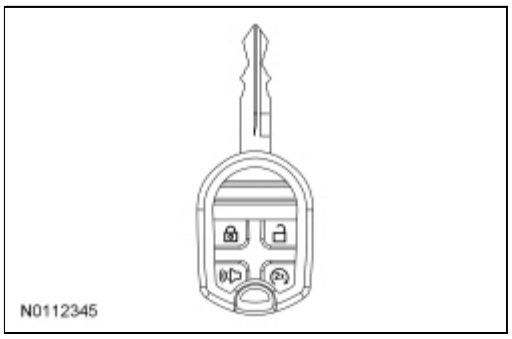
The RKE transmitter is programmed automatically during PATS programming. During PATS programming, the BCM obtains the Transmitter Identification Code (TIC) from the IKT .

The BCM accepts programming of up to 4 IKTs . In addition to the IKTs , 4 conventional keyfobs can also be programmed to the vehicle if requested by the customer. For information on programming the IKTs , refer to the key programming procedures in Section 419-01B . Refer to Remote Keyless Entry (RKE) Transmitter Programming in this section for keyfob programming information.

IKT Without Remote Start



IKT With Remote Start



The RKE transmitter carries out the following functions:

- Unlocks the driver door
- Unlocks all doors
- Locks all doors
- Activates/deactivates the panic alarm
- Commands the interior lamps on (when unlocking) and off (when locking)
- Provides a long flash of the turn signals when UNLOCK is pressed
- Remotely start the engine (if equipped with the factory installed system)
- Sounds the horn once when LOCK is pressed twice within 3 seconds, and the doors are closed
- Sounds the horn twice when LOCK is pressed twice within 3 seconds, and any door is ajar

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The RKE transmitter has a normal operating range of 10 m (33 ft).

Remote Keyless Entry (RKE) Lock/Unlock Control — Unlock

The RKE feature provides lock/unlock functions independently of key position, vehicle speed, or transmission position. The RKE feature provides a stepped (if enabled) process for unlocking the doors. Upon receipt of the first request for unlocking the doors, the RKE feature requests the BCM to unlock the driver door only and provides a long flash of the turn signals. If another unlock request is received within 3 seconds of the first, the RKE feature requests the BCM to unlock all the doors. This feature can be configured to global unlock, so that all the doors unlock on the first press of the UNLOCK button. Refer to Stepped Unlock Programming in this section for programming information.

Remote Keyless Entry (RKE) Lock/Unlock Control — Lock

The RKE feature requests that all the doors be locked when the LOCK button is pressed. On any press of the LOCK button with all doors closed, the BCM provides one flash of the turn signals. If any door is ajar, no flash occurs. As soon as the last door is closed, the BCM provides the flash of the turn signals. If 2 presses of the LOCK button are received within 3 seconds, the horn chirps once and the turn signals flash twice to indicate that all the doors are closed and locked. If any door is ajar when the second lock request is received within 3 seconds of the first, the RKE transmitter feature requests the BCM to chirp the horn twice without flashing the turn signals to indicate all the doors are locked but one or more doors are ajar. When the key is in the RUN or START position, the turn signal flashes and horn chirp confirmations do not occur.

Panic Alarm

The panic alarm feature provides audible and visual alarms which are evident from the exterior of the vehicle. The panic alarm feature requests that the turn signals are flashed and the horn sounds until deactivation. The flashing of the outputs occurs simultaneously. Activation of the panic alarm is accomplished by pressing the panic button on an RKE transmitter whenever the key is in the OFF position. At all other times this feature is disabled. Deactivation of an active panic alarm is accomplished by any of the following actions:

- A second press of the RKE transmitter panic button
- The key is switched out of the OFF position
- A period of 2 minutes and 45 seconds has elapsed since the initial activation

Remote Keyless Entry (RKE) Transmitter Memory Seat

The RKE transmitter feature provides a memory position for the seat/adjustable pedals/mirrors/steering column feature. When the unlock button is pressed, the driver seat, the adjustable pedals, the mirrors, and the steering column move to the desired memory position (the seat, pedal, mirror, and steering column position correspond to the transmitter being used). This feature can be enabled/disabled. Refer to Remote Memory Activation and Remote Memory Deactivation in this section for programming information.

Remote Start

The factory installed remote start (if equipped), is controlled by an IKT and allows the engine to be started from outside the vehicle. Refer to Section 303-06 for information on the remote start feature.

Keyless Entry Keypad

The keyless entry keypad (if equipped), located in the exterior handle of the driver door, provides a method for the customer to access the vehicle without a key or RKE transmitter. The keyless entry keypad feature:

- Locks all doors

- Unlocks the driver door
- Unlocks all doors
- Programs/erases the customer keypad code
- Enables/disables auto-locking
- Enables/disables auto-unlocking
- Illuminates the keypad
- Illuminates the interior lamps

The keyless entry keypad feature operates independently of key position status, vehicle speed, or transmission position. When a keyless entry keypad button is pressed, the keyless entry keypad buttons illuminate to provide better visibility. If buttons 7/8 and 9/0 are pressed simultaneously or 5 seconds have elapsed since the last button press, the illumination is turned off.

Vehicles equipped with a keyless entry keypad are programmed with a factory set 5-digit entry code. This code is provided to the customer on a wallet card in the Owner's Literature package. In addition, this code is available through the use of a scan tool and is printed on the BCM label located on the back side of the module (installed position). When entering codes, each digit must be entered within 5 seconds of the previous button press. The BCM accepts the programming of 3 personal entry codes. Refer to Keyless Entry Keypad Code Programming in this section for programming information.

Unlocking the Doors with the Keyless Entry Keypad System

To unlock the driver door (with stepped unlock enabled), enter either the factory set code or the personal code (each digit must be pressed within 5 seconds of the prior digit). This also illuminates the interior lamps.

To unlock all doors with stepped unlock enabled, enter either the factory set code or the personal code (driver door unlocks) and press the 3/4 button within 5 seconds.

To unlock all doors with stepped unlock disabled, enter either the factory set code or the personal code. This also illuminates the interior lamps. Refer to Stepped Unlock Programming in this section for information on how to program the stepped unlocking.

Locking the Doors with the Keyless Entry Keypad System

It is not necessary to enter the factory set or personal code prior to locking all the doors. To lock all the doors, press the 7/8 and 9/0 buttons at the same time with the driver door closed.

Keyless Entry Keypad Memory Seat Feature

The keypad provides a memory position for the seat/adjustable pedals/mirrors/steering column feature. The feature is associated with the personal entry codes and positions the driver seat, the adjustable pedals, the mirrors, and the steering column to move to the desired memory position (the seat, pedal, mirror, and steering column position correspond to the personal code being used). Refer to Keyless Entry Keypad Code Programming in this section for programming information.

Anti-Scan Feature

To provide added security, the keyless entry keypad is disabled for 1 minute after pressing the button 35 times without a valid entry code being entered. The keypad flashes during this 1-minute mode with all functionality disabled except for buttons 7/8 and 9/0 still being allowed to lock the vehicle.

Anti-scan is turned off after any of the following events:

- One minute of keyless entry keypad inactivity has elapsed

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- The RKE transmitter UNLOCK button is pressed
- The key is turned to the RUN position

Handles, Locks, Latches and Entry Systems

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light (SGT27000) or equivalent 250-300 mA incandescent bulb test lamp
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Material

Item	Specification
Multi-Purpose Grease Motorcraft® XL-5 (aerosol) and/or CRC® SL3151	ESB-M1C93-B
Motorcraft® Penetrating and Lock Lubricant (US); Motorcraft® Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—

Principles of Operation

Power Locks

The Body Control Module (BCM) monitors the door lock control switches. When the BCM receives an unlock/lock command from either door lock control switch, the BCM energizes a relay (internal to the BCM)

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to supply the correct power and grounds for the door lock actuators.

Remote Keyless Entry (RKE)

The Remote Keyless Entry (RKE) feature is controlled by BCM . The BCM receives the RKE inputs from the Tire Pressure Monitor (TPM) module over the Medium Speed Controller Area Network (MS-CAN). When any RKE transmitter button is pressed, the signal is received by the TPM module internal antenna. The TPM module then filters the RKE signal received to make sure it is a programmed transmitter. If the signal received is from a programmed transmitter, the TPM module sends the RKE command to the BCM over the MS-CAN . The BCM then interprets the RKE command and activates the corresponding output.

The BCM requests the illuminated entry feature to turn the interior lamps on when an unlock command is received. If a lock command is received, the illuminated entry feature turns off. The BCM then supplies voltage to the appropriate door lock actuator(s) to lock or unlock the doors. The RKE transmitter can also be used to activate the panic alarm. On vehicles with memory, the RKE transmitter also causes the BCM to send a MS-CAN message to the Driver Seat Module (DSM) to activate all memory features to the positions associated with the RKE transmitter being used.

Remote Start

The factory equipped remote start system is controlled by the BCM . How the BCM receives the remote start command from an Integrated Keyhead Transmitter (IKT) is very similar to the RKE function. For additional information on the factory equipped remote start system, refer to Section 303-06 .

Keyless Entry Keypad

The keyless entry keypad is hardwired to the BCM . The BCM interprets the inputs from the keyless entry keypad and then controls the associated operation. The keyless entry keypad is illuminated for 5 seconds when any button is pressed. The BCM requests the illuminated entry feature to turn the interior lamps on when a valid entry code is received. If a lock all doors code is entered, the illuminated entry feature turns off.

NOTE: The keyless entry keypad does not lock the doors if the driver door is ajar.

The keyless entry keypad supplies a signal to the BCM when the buttons are pressed. The BCM then supplies voltage to the appropriate door lock actuator(s) to lock or unlock the doors. On vehicles with memory, the keyless entry keypad also causes the BCM to send an MS-CAN message to the DSM to activate all memory features to the positions associated with the personal entry code entered on the keypad.

Field-Effect Transistor (FET) Protection

Field-Effect Transistor (FET) is a type of transistor that when used with module software can be used to monitor and control current flow on module outputs. The FET protection strategy is used to prevent module damage in the event of excessive current flow.

The BCM utilizes an FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit is still shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based

on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by a command to clear the continuous DTCs. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC U1000:00 and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When each level is reached, the DTC associated with the short circuit sets along with DTC U1000:00. These DTCs can be cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs U1000:00 and U3000:49 set along with the associated short circuit DTC. DTC U3000:49 cannot be cleared and the module must be replaced after the repair.

The BCM FET protected output circuit for the handles, locks, and latches system is the keypad illumination output circuit.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Door handles ● Binding latch mechanisms	● Body Control Module (BCM) fuse(s): ■ 18 (10A) ■ 20 (20A) ● Wiring, terminals or connectors ● Door lock control switches ● Keyless entry keypad ● Integrated Keyhead Transmitter (IKT) ● TPM module ● BCM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

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If the scan tool does not communicate with the VCM :

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs for the BCM .

8. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM .

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

Body Control Module (BCM) DTC Chart

DTC	Description	Action
B10AB:00	Remote Keyless Entry Synchronization: No Sub Type Information	GO to Pinpoint Test H .
B1218:00	Transmitter Identification Code: No Sub Type Information	GO to Pinpoint Test H .
B121A:11	Keypad Illumination Output: Circuit Short to Ground	GO to Pinpoint Test G .
B121B:01	Keypad Input Switch: General Electrical Failure	GO to Pinpoint Test F .
B126A:01	Drivers Door Interior Lock Switch: General Electrical Failure	GO to Pinpoint Test E .
B130D:00	Memory Full for Integrated Key Programming: No Sub Type Information	The maximum amount of Integrated Keyhead Transmitters (IKTs) (4) have been programmed into the Body Control Module (BCM). Obtain all the customer's IKTs . Erase all the IKTs and program a maximum of 4.
All other DTCs	—	REFER to Section 419-10 .

Symptom Chart

Symptom Chart — Electrical

Condition	Possible Sources	Action
• All door locks are inoperative	• Fuse • Wiring, terminals or connectors • Body Control Module (BCM)	• GO to Pinpoint Test A .
• A single/more than one door lock is inoperative	• Wiring, terminals or connectors • Door lock actuators • BCM	• GO to Pinpoint Test B .
• The door locks operate only one way	• Wiring, terminals or connectors • Door lock control switch • BCM	• GO to Pinpoint Test C .
• All door locks are inoperative from one switch	• Wiring, terminals or connectors • Door lock control switch	• GO to Pinpoint Test D .
• The doors do not lock/unlock using the keyless entry keypad	• Wiring, terminals or connectors • Keyless entry keypad • BCM	• GO to Pinpoint Test F .
• The keyless entry keypad illumination is inoperative/does not operate correctly	• Wiring, terminals or connectors • Keyless entry keypad • BCM	• GO to Pinpoint Test G .
• The Remote Keyless Entry (RKE) transmitter is inoperative	• Integrated Keyhead Transmitter (IKT) • IKT battery • IKT button pressed a substantial amount of times while outside the range of the vehicle • IKT programming • Tire Pressure Monitor (TPM) module • BCM	• GO to Pinpoint Test H .
• An individual button/feature is inoperative from the Remote Keyless Entry (RKE) transmitter	• Door locks • Horn system • Factory remote start system (if equipped) • Turn signal system • IKT	• GO to Pinpoint Test I .
• The Remote Keyless Entry (RKE) transmitter has poor	• Environmental interference • IKT	• GO to Pinpoint Test J .

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range performance	• IKT battery • TPM module	
• The autolock does not operate correctly	• Programming • Door ajar switch input • Vehicle speed signal message	• GO to Pinpoint Test K .
• The smart unlock does not operate correctly	• Key-in-ignition switch • Door ajar switch input	• GO to Pinpoint Test L .
• The auto-unlock does not operate correctly	• Programming • Door ajar switch input • Vehicle speed signal message	• GO to Pinpoint Test M .
• The memory seat does not operate correctly using the Remote Keyless Entry (RKE) transmitter	• The remote memory feature is not activated	• ACTIVATE the remote memory. REFER to Remote Memory Activation in this section. TEST the system for normal operation. If the remote memory is still inoperative, REFER to Section 501-10 to diagnose the memory seat.
• The 2-step door unlocking does not operate correctly	• The 2-step door unlocking is disabled	• PROGRAM the 2-step door unlocking. REFER to Stepped Unlock Programming in this section. TEST the system for normal operation.

Symptom Chart — Mechanical

Condition	Possible Sources	Action
• Hard to open/close door from either door handle	• Door alignment • Door hinges • Striker adjustment • Door latch	• GO to Pinpoint Test N .
• A door is difficult/does not open from the exterior door handle	• Broken or binding linkage • Exterior door handle to latch rod adjustment • Exterior door handle • Door latch	• GO to Pinpoint Test O .
• A door is difficult/does not open from the interior door handle	• Broken or binding cable/linkage • Door latch	• GO to Pinpoint Test P .
• Exterior door release handle sticks	• Binding linkage • Broken handle	• GO to Pinpoint Test Q .

	return spring • Exterior door handle to latch rod adjustment • Door latch	
• Interior door release handle sticks	• Binding cable • Broken handle return spring • Door latch	• GO to Pinpoint Test R .
• Manual interior lock/unlock rod inoperative	• Bent or binding lock rod • Door latch	• OPERATE the door lock rod manually while observing the door lock rod for any binding or if the rod is bent. ▪ If the rod is bent or damaged, REPAIR as necessary. TEST the system for normal operation. ▪ If the rod is OK, INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.
• Squeak/rattle/chucking noise from door	• Door alignment • Striker adjustment • Door latch	• GO to Pinpoint Test S .
• Manual door lock cylinder inoperative	• Bent or binding lock rod and lever • Door lock cylinder • Door latch	• GO to Pinpoint Test T .
• Ignition key cannot be returned to the OFF position	• Wiring, terminals or connectors • Transmission selector lever • Binding steering column components • Ignition lock cylinder • Ignition switch	• GO to Pinpoint Test U .

Pinpoint Tests

Pinpoint Test A: All Door Locks Are Inoperative

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Refer to Wiring Diagrams Cell 110 , Power Door Locks for schematic and connector information.

Normal Operation

The Body Control Module (BCM) supplies voltage to the lock all relay, the unlock driver door relay or unlock all relay based upon input from the door lock control switches, the Remote Keyless Entry (RKE) transmitter, or the keyless entry keypad. Upon a lock request, the BCM supplies voltage on the all door lock circuit and ground on the driver and passenger door unlock circuits. Upon an unlock request, the voltage and ground are reversed on the previously listed circuits. When the door lock and unlock relays are not energized they are connected to ground. A dedicated BCM ground circuit is provided only for the lock and unlock relays.

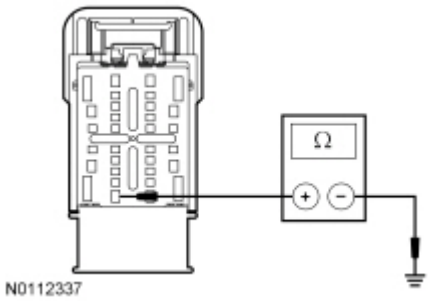
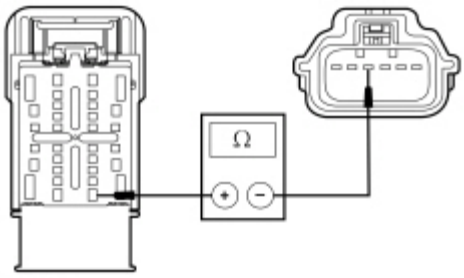
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- BCM

PINPOINT TEST A: ALL DOOR LOCKS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE DOOR LOCK OPERATION FROM BOTH DOOR LOCK CONTROL SWITCHES	
• Check the operation of all of the door lock actuators from both of the door lock control switches. • **Are all of the door lock actuators inoperative from both door lock control switches?**	**Yes** GO to A2 . **No** GO to Pinpoint Test D .
A2 VERIFY ALL DOOR LOCKS ARE INOPERATIVE	
• Press the lock and unlock buttons from a door lock control switch while observing the door locks. • **Are all the door locks inoperative from both switch positions (lock and unlock)?**	**Yes** VERIFY the BCM fuse 20 (20A) is OK. If OK, GO to A3 . If not OK, GO to A5 . **No** CHECK the symptom(s) and GO to Symptom Chart - Electrical .
A3 CHECK THE POWER DOOR LOCK RELAY GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280D. • Measure the resistance between the BCM C2280D-16, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to A4 . **No** REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation.

 N0112337 • **Is the resistance less than 5 ohms?**	
A4 CHECK THE ALL LOCK CIRCUIT FOR AN OPEN	
• Disconnect: LH Front Door Lock Actuator C525. • Measure the resistance between the BCM C2280D-26, circuit CPL11 (GY/BN), harness side and the LH front door lock actuator C525-4, circuit CPL11 (GY/BN), harness side.  N0119388 • **Is the resistance less than 5 ohms?**	**Yes** GO to A6 . **No** REPAIR CPL11 (GY/BN) for an open. TEST the system for normal operation.
A5 CHECK THE ALL LOCK CIRCUIT FOR A SHORT TO GROUND	
• Install a new BCM fuse 20 (20A). • Operate the door lock actuators by pressing LOCK on the door lock control switch. • **Is the BCM fuse 20 (20A) OK?**	**Yes** REPAIR circuit CPL51 (BU/GN) or circuit CPL52 (VT/GY) for a short to ground. TEST the system for normal operation. **No** REPAIR circuit CPL11 (GY/BN) for a short to ground. TEST the system for normal operation.
A6 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM .
	REFER to Section 419-10 .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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Pinpoint Test B: A Single/More Than One Door Lock Is Inoperative

Refer to Wiring Diagrams Cell 110 , Power Door Locks for schematic and connector information.

Normal Operation

The Body Control Module (BCM) supplies voltage to the lock all relay, the unlock driver door relay or unlock all relay based upon input from the door lock control switches, the Remote Keyless Entry (RKE) transmitter, or the keyless entry keypad. Upon a lock request, the BCM supplies voltage on the all door lock circuit and ground on the driver and passenger door unlock circuits. Upon an unlock request, the voltage and ground are reversed on the previously listed circuits. When the door lock and unlock relays are not energized they are connected to ground. A dedicated BCM ground circuit is provided only for the lock and unlock relays.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door lock actuators
- BCM

PINPOINT TEST B: A SINGLE/MORE THAN ONE DOOR LOCK IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTICE: **The following Pinpoint Test uses a test light to simulate normal circuit loads. Use only the test lamp recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Rotunda Flex Probe kit for the test light probe connection to the vehicle. Do not use the test lamp probe directly on any connector.**

Test Step	Result / Action to Take
B1 CHECK THE DOOR LATCH FOR BINDING	
• Lock and unlock the inoperative door lock using the door lock rod. • **Does the door lock and unlock?**	**Yes** GO to B3 . **No** GO to B2 .
B2 CHECK THE LOCK ROD FOR BINDING	
• Operate the door lock rod manually while observing the door lock rod for any binding or if the rod is bent. • **Is the door lock rod bent or binding?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.
B3 CHECK THE ALL LOCK CIRCUIT FOR VOLTAGE	
• Ignition OFF.	**Yes**

- Disconnect: Inoperative Door Lock Actuator.
- Connect a test light between the inoperative door lock actuator, harness side and ground as follows:

Inoperative Door Lock Actuator	Connector-Pin	Circuit
LH front	C525-4	CPL11 (GY/BN)
RH front	C609-4	CPL11 (GY/BN)
LH rear	C705-4	CPL11 (GY/BN)
RH rear	C805-4	CPL11 (GY/BN)



N0120890

- **NOTE:** The BCM only supplies voltage to the actuator momentarily. It is important to monitor the test light while pressing the door lock control switch.
- Monitor the test light while pressing the door lock control switch in the LOCK position.
- **Does the test light momentarily illuminate?**

GO to B4.

No
REPAIR circuit CPL11 (GY/BN) for an open. TEST the system for normal operation.

B4 CHECK THE UNLOCK CIRCUITS FOR VOLTAGE

- Connect a test light between the inoperative door lock actuator, harness side and ground as follows:

Inoperative Door Lock Actuator	Connector-Pin	Circuit
LH front	C525-3	CPL51 (BU/GN)

Yes
INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.

No

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RH front	C609-3	CPL52 (VT/GY)
LH rear	C705-3	CPL52 (VT/GY)
RH rear	C805-3	CPL52 (VT/GY)



N0120891

- **NOTE:** The BCM only supplies voltage to the actuator momentarily. It is important to monitor the test light while pressing the door lock control switch.
- Monitor the test light while pressing the door lock control switch in the UNLOCK position.
- **Does the test light momentarily illuminate?**

GO to B5 .

B5 CHECK THE UNLOCK CIRCUITS FOR AN OPEN

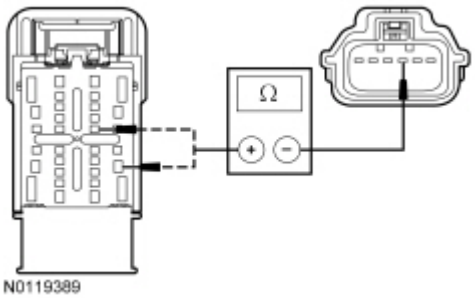
- Disconnect: BCM C2280D.
- Measure the resistance between the BCM , harness side and the inoperative door lock actuator, harness side as follows:

BCM Connector-Pin	Inoperative Door Lock Actuator Connector-Pin	Circuit
C2280D-21	C525-3	CPL51 (BU/GN)
C2280D-31	C609-3	CPL52 (VT/GY)
C2280D-31	C705-3	CPL52 (VT/GY)
C2280D-31	C805-3	CPL52

Yes
GO to B6 .

No
REPAIR circuit CPL51 (BU/GN) or circuit CPL52 (VT/GY) for an open. TEST the system for normal operation.

		(VT/GY)



- **Is the resistance less than 5 ohms?**

B6 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Door Locks Operate Only One Way

Refer to Wiring Diagrams Cell 110, Power Door Locks for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends voltage signals to the door lock control switches through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signaling the BCM to lock or unlock the doors. The door lock control switches have a dedicated ground circuit.

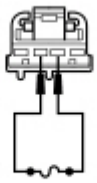
This pinpoint test is intended to diagnose the following:

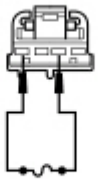
- Wiring, terminals or connectors
- Door lock control switch
- BCM

PINPOINT TEST C: THE DOOR LOCKS OPERATE ONLY ONE WAY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

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Test Step	Result / Action to Take
C1 CHECK THE RECORDED BCM DTCs FROM THE SELF-TEST • Check the recorded results from the BCM self-test. • **Is DTC B126A:01 present?**	**Yes** GO to Pinpoint Test E . **No** GO to C2 .
C2 VERIFY THE OPERATION OF BOTH DOOR LOCK CONTROL SWITCHES • Ignition OFF. • Press the lock and unlock button of both door lock control switches while observing the door lock operation. • **Do the door locks operate only one way from both switches?**	**Yes** GO to C4 . **No** GO to C3 .
C3 CHECK THE LOCK INPUT OR UNLOCK INPUT CIRCUIT FOR AN OPEN (SINGLE SWITCH INOPERATIVE) • Disconnect: Suspect Door Lock Control Switch. • Unlock the doors from the working door lock control switch. • Connect a fused jumper wire between the LH door lock control switch C505-3, circuit CPK19 (BU/GN), harness side and the LH door lock control switch C505-2, circuit GD134 (BK/VT), harness side; or between the RH door lock control switch C605-3, circuit CPK19 (BU/GN), harness side and the RH door lock control switch C605-2, circuit GD139 (BK/YE), harness side.  N0072779 • Remove the jumper wire. • Connect a fused jumper wire between the LH door lock control switch C505-4, circuit CPK23 (YE/VT), harness side and the LH door lock control switch C505-2, circuit GD134 (BK/VT), harness side; or between the RH door lock control switch C605-4, circuit CPK23 (YE/VT), harness side and the RH door lock control switch C605-2, circuit GD139 (BK/YE), harness side.	**Yes** REMOVE the jumper wire. INSTALL a new door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation. **No** REMOVE the jumper wire. REPAIR the input circuit in question. TEST the system for normal operation.

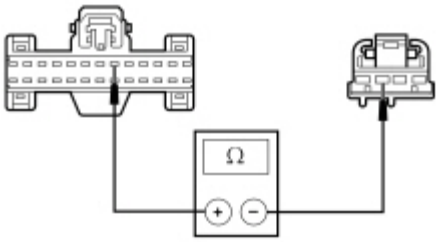


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- **Do the doors lock and unlock with the jumper wire?**

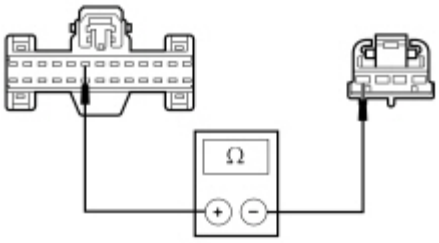
C4 CHECK THE LOCK INPUT OR UNLOCK INPUT CIRCUIT FOR AN OPEN (BOTH SWITCHES INOPERATIVE)

- Disconnect: RH Door Lock Control Switch C605.
- Disconnect: BCM C2280C.
- If the doors do not lock, measure the resistance between the BCM C2280C-6, circuit CPK19 (BU/GN), harness side and the RH door lock control switch C605-3, circuit CPK19 (BU/GN), harness side.



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- If the doors do not unlock, measure the resistance between the BCM C2280C-8, circuit CPK23 (YE/VT), harness side and the RH door lock control switch C605-4, circuit CPK23 (YE/VT), harness side.



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- **Is the resistance less than 5 ohms?**

Yes
GO to C5 .

No
REPAIR circuit CPK19 (BU/GN) or circuit CPK23 (YE/VT) for an open. TEST the system for normal operation.

C5 CHECK FOR CORRECT BCM OPERATION

- Disconnect all the BCM connectors.
- Check for:
  - corrosion
  - damaged pins
  - pushed-out pins
- Connect all the BCM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation.

No
The system is

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	operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: All Door Locks Are Inoperative From One Switch

Refer to Wiring Diagrams Cell 110 , Power Door Locks for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends voltage signals to the door lock control switches through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signaling the BCM to lock or unlock the doors. The door lock control switches have a dedicated ground circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door lock control switch

PINPOINT TEST D: ALL DOOR LOCKS ARE INOPERATIVE FROM ONE SWITCH

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE SUSPECT DOOR LOCK CONTROL SWITCH FOR CORRECT OPERATION	
• Disconnect: Suspect Door Lock Control Switch. • Carry out the door lock control switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Does the door lock control switch pass the component test?**	**Yes** REPAIR circuit GD134 (BK/VT) or GD139 (BK/YE) for an open. TEST the system for normal operation. **No** INSTALL a new door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.

Pinpoint Test E: DTC B126A:01

Refer to Wiring Diagrams Cell 110 , Power Door Locks for schematic and connector information.

Normal Operation

The Body Control Module (BCM) sends voltage signals to the door lock control switches through the lock

and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signaling the BCM to lock or unlock the doors. The door lock control switches have a dedicated ground circuit.

- DTC B126A:01 (Drivers Door Interior Lock Switch: General Electrical Failure) — sets when the BCM detects a short to ground from the lock or unlock request input circuits.

This pinpoint test is intended to diagnose the following:

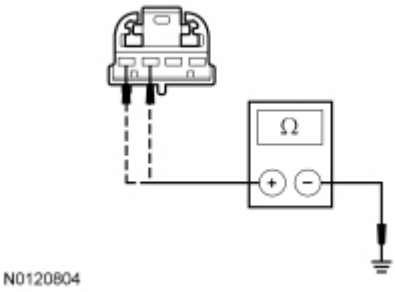
- Wiring, terminals or connectors
- Door lock control switch
- BCM

PINPOINT TEST E: DTC B126A:01

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE RECORDED BCM DTCs FROM THE SELF-TEST • Check the recorded results from the BCM self-test. • **Is DTC B126A:01 present?**	**Yes** GO to E2. **No** CHECK the symptom(s) and GO to Symptom Chart - Electrical.
E2 CHECK THE LH DOOR LOCK CONTROL SWITCH • Disconnect: LH Door Lock Control Switch C505. • Repeat the BCM self-test. • **Is DTC B126A:01 retrieved again?**	**Yes** LEAVE the switch disconnected. GO to E3. **No** INSTALL a new LH door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.
E3 CHECK THE RH DOOR LOCK CONTROL SWITCH • Disconnect: RH Door Lock Control Switch C605. • Repeat the BCM self-test. • **Is DTC B126A:01 retrieved again?**	**Yes** LEAVE the switch disconnected. GO to E4. **No** INSTALL a new RH door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.
E4 CHECK THE LOCK OR UNLOCK INPUT CIRCUIT FOR A SHORT TO GROUND	

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• Ignition OFF. • Disconnect: BCM C2280C. • Measure the resistance between the RH door lock control switch C605-3, circuit CPK19 (BU/GN), harness side and ground; and between the RH door lock control switch C605-4, circuit CPK23 (YE/VT), harness side and ground.  N0120804 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to E5 . **No** REPAIR circuit CPK19 (BU/GN) or circuit CPK23 (YE/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
E5 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM .
	REFER to Section 419-10 .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: The Doors Do Not Lock/Unlock Using The Keyless Entry Keypad

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

The Body Control Module (BCM) monitors for a ground signal on the keyless entry keypad signal input circuits. When an individual keypad button is pressed, an individual or combination of the input circuits is routed to ground. The BCM then determines which button was pressed based on which circuit(s) are grounded. The keypad has a dedicated ground circuit. Once the BCM determines that the 5-digit personal entry code, or the factory set 5-digit entry code has been entered on the keypad, the BCM then energizes the driver door unlock relay to unlock the driver door (stepped unlock enabled).

To unlock all the doors, the 3/4 button must be pressed within 5 seconds of the 5-digit code being entered.

To lock all the doors, the 5-digit code does not need to be entered. Press the 7/8 and 9/0 buttons at the same time, with the driver door closed.

The keyless entry keypad has an anti-scan feature to help prevent theft. If a valid 5-digit code is not entered within 7 attempts (35 consecutive button presses), the keyless entry keypad goes into anti-scan. In anti-scan mode, the keypad illumination flashes and all input is ignored except for pressing the 7/8 and 9/0 buttons,

which will lock all doors.

- DTC B121B:01 (Keypad Input Switch: General Electrical Failure) — sets when the BCM detects a short to ground on any of the keyless entry keypad input circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Keyless entry keypad
- BCM

PINPOINT TEST F: THE DOORS DO NOT LOCK/UNLOCK USING THE KEYLESS ENTRY KEYPAD

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

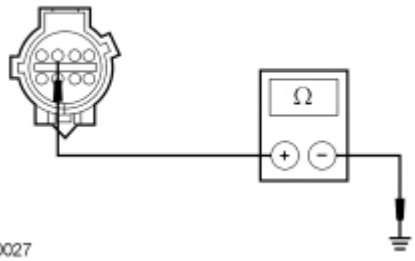
Test Step	Result / Action to Take
F1 CHECK THE BCM KEYPAD CODE • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Observe the BCM PIDs (KEYCODE_1stD, KEYCODE_2ndD, KEYCODE_3rdD, KEYCODE_4thD, and KEYCODE_5thD). Read and record the 5-digit factory set entry code. • Enter the 5-digit factory set entry code on the keyless entry keypad. • **Do the doors unlock?**	**Yes** The system is operating as designed. INFORM the customer of the correct system operation. **No** GO to F2.
F2 RETRIEVE THE RECORDED BCM DTCs FROM THE SELF-TEST • Check for recorded BCM DTCs from the self-test. • **Is DTC B121B:01 recorded?**	**Yes** GO to F3. **No** GO to F4.
F3 REPEAT THE BCM SELF-TEST • Disconnect: Keyless Entry Keypad C500. • Clear the DTCs, then repeat the BCM self-test. • **Is DTC B121B:01 recorded?**	**Yes** GO to F9. **No** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation.
F4 CHECK THE BCM KEYPAD PIDs • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Press each keyless entry keypad button while observing the PIDs (KYPD_BTN_1/2, KYPD_BTN_3/4, KYPD_BTN_5/6, KYPD_BTN_7/8, and KYPD_BTN_9/0). • **Do the PIDs display active when the corresponding button is**	**Yes** GO to F10. **No** GO to F5.

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pressed?

F5 CHECK THE KEYPAD GROUND CIRCUIT FOR AN OPEN

- Disconnect: Keyless Entry Keypad C500.
- Measure the resistance between the keyless entry keypad C500-3, circuit GD134 (BK/VT), harness side and ground.



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- **Is the resistance less than 5 ohms?**

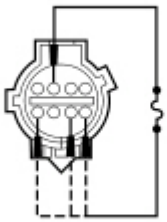
Yes
GO to F6 .

No
REPAIR circuit GD134 (BK/VT) for an open. TEST the system for normal operation.

F6 CHECK THE KEYLESS ENTRY KEYPAD

- Connect a fused jumper wire between the keyless entry keypad, harness side, while monitoring the BCM PIDs (KYPD_BTN_1/2, KYPD_BTN_7/8, and KYPD_BTN_9/0) as follows:

Keyless Entry Keypad Connector-Pin/Circuit	Keyless Entry Keypad Connector-Pin/Circuit	BCM PID
C500-8 CPK29 (GY/BU)	C500-3 GD134 (BK/VT)	KYPD_BTN_1/2
C500-6 CPK30 (VT/GN)	C500-3 GD134 (BK/VT)	KYPD_BTN_7/8
C500-5 CPK31 (YE/GN)	C500-3 GD134 (BK/VT)	KYPD_BTN_9/0



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- **Do the PIDs display active when the jumper wire is connected?**

Yes
INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section.

No
REMOVE the jumper wire. GO to F7 .

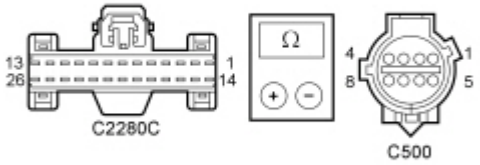
F7 CHECK THE KEYPAD INPUT CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect: BCM C2280C.

Yes
GO to F8 .

- Measure the resistance between the BCM, harness side and the keyless entry keypad, harness side as follows:

BCM Connector-Pin	Circuit	Keyless Entry Keypad Connector-Pin
C2280C-24	CPK29 (GY/BU)	C500-8
C2280C-18	CPK30 (VT/GN)	C500-6
C2280C-11	CPK31 (YE/GN)	C500-5



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- **Are the resistances less than 5 ohms?**

No
REPAIR the circuit in question for an open. TEST the system for normal operation.

F8 CHECK THE KEYPAD INPUT CIRCUITS FOR A SHORT TO EACH OTHER

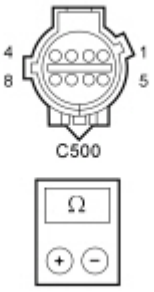
- Measure the resistance between the keyless entry keypad, harness side as follows:

Keyless Entry Keypad Connector-Pin	Circuits	Keyless Entry Keypad Connector-Pin
C500-8	CPK29 (GY/BU) and CPK30 (VT/GN)	C500-6
C500-8	CPK29 (GY/BU) and CPK31 (YE/GN)	C500-5
C500-6	CPK30 (VT/GN) and CPK31 (YE/GN)	C500-5

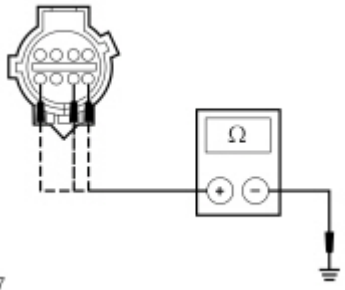
Yes
GO to F9.

No
REPAIR the circuits in question. TEST the system for normal operation.

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- **Are the resistances greater than 10,000 ohms?**

F9 CHECK THE KEYPAD INPUT CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: BCM C2280C. • Measure the resistance between the keyless entry keypad, harness side and ground as follows: **Connector-Pin** / **Circuit** C500-8 / CPK29 (GY/BU) C500-6 / CPK30 (VT/GN) C500-5 / CPK31 (YE/GN)  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F10. **No** REPAIR the circuit in question for a short to ground. CLEAR the DTCs. REPEAT the self-test.
F10 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM. REFER to Section 419-10. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Keyless Entry Keypad Illumination Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

When any keypad button is pressed the Body Control Module (BCM) sends voltage to the keyless entry keypad LEDs on the illumination circuit to assist the driver in entering an access code at night. The keyless entry keypad has a separate ground circuit for the LEDs.

The keyless entry keypad has an anti-scan feature to help prevent theft. If a valid 5-digit code is not entered within 7 attempts (35 consecutive button presses), the keyless entry keypad goes into anti-scan mode. In anti-scan mode, the keypad illumination flashes and all input is ignored except for pressing the 7/8 and 9/0 buttons, which locks all the doors.

- DTC B121A:11 (Keypad Illumination Output: Circuit Short to Ground) — sets when the BCM detects a short to ground on the keyless entry keypad illumination circuit.

This pinpoint test is intended to diagnose the following:

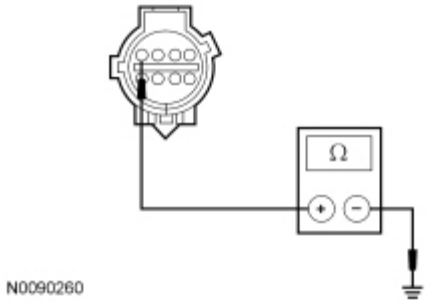
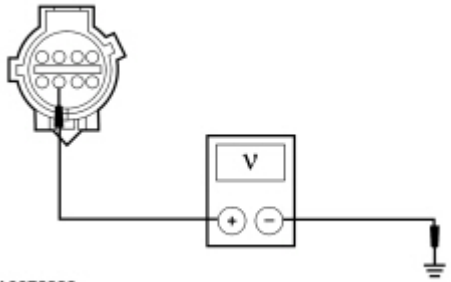
- Wiring, terminals or connectors
- Keyless entry keypad
- BCM

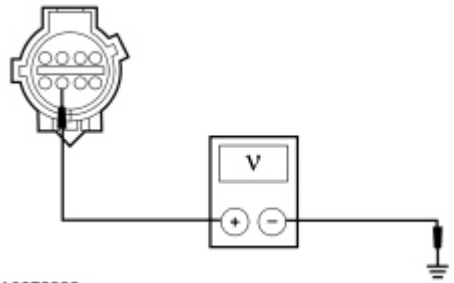
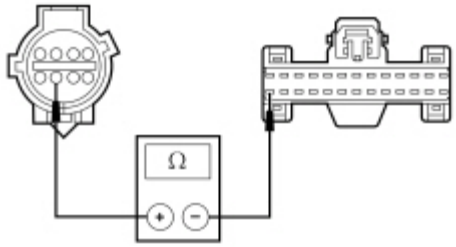
PINPOINT TEST G: THE KEYLESS ENTRY KEYPAD ILLUMINATION IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

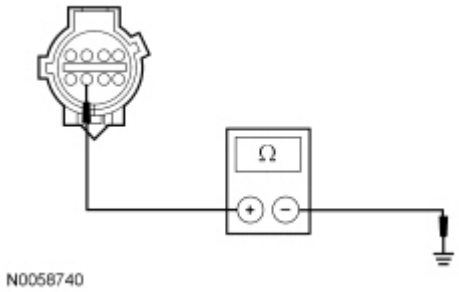
Test Step	Result / Action to Take
G1 CHECK THE KEYLESS ENTRY KEYPAD OPERATION	
• Press the 7/8 and 9/0 buttons simultaneously on the keyless entry keypad. • **Do all of the doors lock?**	**Yes** GO to G2 . **No** GO to Pinpoint Test F .
G2 CHECK THE RECORDED BCM DTCs FROM THE SELF-TEST	
• Check the recorded results from the BCM self-test. • **Is DTC B121A:11 present?**	**Yes** GO to G9 . **No** GO to G3 .
G3 CHECK THE KEYLESS ENTRY KEYPAD ILLUMINATION	
• Check the keyless entry keypad illumination. • **Is the keyless entry keypad illumination always on?**	**Yes** GO to G8 . **No** GO to G4 .

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G4 CHECK THE KEYPAD ILLUMINATION GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Keyless Entry Keypad C500. • Measure the resistance between the keyless entry keypad C500-4, circuit GD134 (BK/VT), harness side and ground.  N0090260 • **Is the resistance less than 5 ohms?**	**Yes** GO to G5 . **No** REPAIR circuit GD134 (BK/VT) for an open. CLEAR the DTCs. REPEAT the self-test.
G5 CHECK THE KEYPAD ILLUMINATION CIRCUIT FOR REFERENCE VOLTAGE	
NOTE: The BCM sends out a constant reference voltage on circuit CPK28 (WH/GN) for its own circuit diagnostics. This voltage is 10 volts (+/- 1 volt). • Ignition ON. • Measure the voltage between the keyless entry keypad C500-7, circuit CPK28 (WH/GN), harness side and ground.  A0078888 • **Is 10 volts (+/- 1 volt) present?**	**Yes** GO to G6 . **No** GO to G7 .
G6 CHECK FOR BCM OUTPUT	
NOTE: This pinpoint test checks for a voltage increase above the reference voltage checked in the previous pinpoint test when the keypad lamp is active commanded on. • Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Measure the voltage between the keyless entry keypad C500-7, circuit CPK28 (WH/GN), harness side and ground while active commanding the BCM PID (KEY_PAD_LMP) on.	**Yes** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to G11 .

 A0078888 • **Is the voltage greater than 11 volts?**	
G7 CHECK THE KEYPAD ILLUMINATION CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: BCM C2280C. • Measure the resistance between the keyless entry keypad C500-7, circuit CPK28 (WH/GN), harness side and the BCM C2280C-26, circuit CPK28 (WH/GN), harness side.  N0120808 • **Is the resistance less than 5 ohms?**	**Yes** GO to G11 . **No** REPAIR circuit CPK28 (WH/GN) for an open. CLEAR the DTCs. REPEAT the self-test.
G8 CHECK THE KEYPAD ILLUMINATION CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: BCM C2280C. • Ignition ON. • Observe the keypad illumination. • **Is the keypad still illuminated?**	**Yes** REPAIR circuit CPK28 (WH/GN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to G11 .
G9 CHECK THE KEYLESS ENTRY KEYPAD FOR A SHORT TO GROUND	
• Disconnect: Keyless Entry Keypad C500. • Clear the DTCs, then repeat the BCM self-test. • **Is DTC B121A:11 recorded?**	**Yes** GO to G10 . **No** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation.
G10 CHECK THE KEYPAD ILLUMINATION CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF.	**Yes**

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• Disconnect: BCM C2280C. • Measure the resistance between the keyless entry keypad C500-7, circuit CPK28 (WH/GN), harness side and ground.  N0058740 • **Is the resistance greater than 10,000 ohms?**	GO to G11 . **No** REPAIR circuit CPK28 (WH/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
G11 CHECK FOR CORRECT BCM OPERATION	

• Disconnect all the BCM connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the BCM connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new BCM .
	REFER to Section 419-10 .
	TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: The Remote Keyless Entry (RKE) Transmitter Is Inoperative

Normal Operation

The Remote Keyless Entry (RKE) feature is controlled by the Tire Pressure Monitor (TPM) module and the Body Control Module (BCM). When a button is pressed on an Integrated Keyhead Transmitter (IKT) the Transmitter Identification Code (TIC) and RKE command is received by the internal TPM antenna. If the TPM module determines that it is a valid and programmed TIC , it sends the RKE command and TIC to the BCM over the Medium Speed Controller Area Network (MS-CAN). When the BCM receives the RKE command, it carries out the command by controlling the door locks or activating the horn and turn signals for the panic alarm.

The RKE transmitters and the BCM also utilize a rolling code to prevent the code from being "captured" by a code grabber. The system advances the counter in the RKE transmitter and the BCM every time an RKE transmitter button is pressed.

- DTC B10AB: 00 (Remote Keyless Entry Synchronization: No Sub Type Information) — sets when the BCM detects the rolling counter received from an RKE transmitter is out of synchronization with the rolling counter stored in the module.
- DTC B1218: 00 (Transmitter Identification Code: No Sub Type Information) — sets when the BCM detects an invalid TIC from an IKT .

This pinpoint test is intended to diagnose the following:

- IKT

- IKT battery
- IKT button pressed a substantial amount of times while outside the range of the vehicle
- IKT programming
- TPM module
- BCM

PINPOINT TEST H: THE RKE TRANSMITTER IS INOPERATIVE

NOTE: Aftermarket or dealer-installed systems may adversely affect the RKE system operation. These systems should be disconnected before diagnosing any RKE concerns.

Test Step	Result / Action to Take
H1 CHECK FOR THE CORRECT IKTs • **NOTE:** Make sure the IKTs are those provided with the OEM system and not from an aftermarket system, or a dealer-installed system that may have been installed on the vehicle. • Check that the correct IKTs are used with the vehicle. Compare the IKTs with the one shown in Handles, Locks, Latches and Entry Systems in the Description and Operation portion of this section. • **Are the correct RKE transmitters present?**	**Yes** GO to H2. **No** The system cannot be tested without the correct IKTs. INFORM the customer that the correct IKTs must be present to proceed with diagnosis of the system.
H2 CHECK THE RKE OPERATION WHEN THE TPM MODULE IS IN AN AWAKE MODE • Open and close the driver door. • Press any button on the IKT. • **Does the RKE feature operate?**	**Yes** GO to H3. **No** GO to H4.
H3 CHECK THE RKE OPERATION WHEN THE TPM MODULE IS IN A SLEEP MODE • Ignition OFF. • Let the vehicle sit for 10 minutes to allow the vehicle modules to go into a sleep mode. • Press any button on the IKT. • **Does the RKE feature operate?**	**Yes** The system is operating correctly at this time. **No** GO to H12.
H4 PERFORM THE NETWORK TEST ON THE TPM MODULE • Connect the scan tool. • Ignition ON. • Perform the network test on the TPM module. • **Does the TPM module pass the network test?**	**Yes** GO to H5. **No** REFER to Section 418-00 to diagnose the TPM module does not respond to the scan tool.
H5 CHECK FOR TPMS DTCs • Perform the BCM self-test.	**Yes**

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• **Are any TPMS DTCs recorded?**	DIAGNOSE all TPMS DTCs first. REFER to section Section 204-04 . **No** GO to H6 .
H6 CHECK FOR DTC B10AB:00 OR DTC B1218:00 FROM THE BCM SELF-TEST	
• Check the recorded results from the BCM self-test. • **Is DTC B10AB:00 or DTC B1218:00 present?**	**Yes** For DTC B10AB: 00 GO to H7 . For DTC B1218: 00 GO to H8 . **No** GO to H8 .
H7 RESYNCHRONIZE THE INOPERATIVE IKT	
• Ignition OFF. • Ignition ON. • Ignition OFF. • Press any button on the IKT . • **Does the RKE feature operate?**	**Yes** The system is OK. CLEAR the DTCs. REPEAT the self-test. **No** GO to H8 .
H8 MAKE SURE THE RKE TRANSMITTER SIGNAL IS BEING RECEIVED	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Press a button on the IKT while observing the BCM PIDs (TIC_LAST_BC and LST_RKE_xMTR). • **Does the Transmitter Identification Code (TIC) and RKE command show up on the scan tool screen when a button is pressed?**	**Yes** GO to H9 . **No** GO to H10 .
H9 CHECK IF THE RKE TRANSMITTERS ARE PROGRAMMED	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Press a button on the IKT and compare the BCM PID (TIC_LAST_BC) with the PIDs (TIC_01_BCM, 2, 3, 4, 7, 8, 9, or 10). • **Does the TIC displayed match any of the TICs stored in memory?**	**Yes** GO to H13 . **No** PROGRAM the inoperative IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. CLEAR the DTCs. REPEAT the self-test.
H10 CHECK THE IKT BATTERY	
• Using a thin coin, open the IKT . • Do not clean off any grease from the battery terminals on the back surface of the circuit board. • Verify the correct battery is used (CR2032). • Remove the IKT battery and measure the voltage. • **Is the voltage greater than 2.5 volts?**	**Yes** GO to H11 . **No** INSTALL a new battery (make sure the battery is seated correctly). DO NOT reprogram the IKT (weak or dead batteries do not erase TICs from memory). TEST the system for normal operation.

H11 CHECK FOR NORMAL OPERATION WITH A KNOWN GOOD IKT	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger . • Use the customer's second IKT , or a known good RKE transmitter that is correct for the vehicle, press a button on the IKT while observing the BCM PID (TIC_LAST_BC). • **Does the TIC show up on the scan tool when a button is pressed?**	**Yes** REPLACE the inoperative IKT and PROGRAM the new IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. CLEAR the DTCs. REPEAT the self-test. **No** GO to H13 .
H12 CHECK FOR CORRECT TPM MODULE OPERATION	
• Disconnect the TPM module connector. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect the TPM module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new TPM module. REFER to Section 204-04 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
H13 CHECK FOR CORRECT BCM OPERATION	
• Disconnect all the BCM connectors. • Check for: ▪ corrosion ▪ damaged pins ▪ pushed-out pins • Connect all the BCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BCM . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test I: An Individual Button/Feature Is Inoperative From The Remote Keyless Entry (RKE) Transmitter

Normal Operation

The Remote Keyless Entry (RKE) feature is controlled by the Tire Pressure Monitor (TPM) module and the Body Control Module (BCM). When a button is pressed on an Integrated Keyhead Transmitter (IKT) the Transmitter Identification Code (TIC) and RKE command is received by the internal TPM antenna. If the TPM module determines that it is a valid and programmed TIC , it sends the RKE command and TIC to the BCM over the Medium Speed Controller Area Network (MS-CAN). When the BCM receives the RKE command, it carries out the command by controlling the door locks or activating the horn and turn signals for the panic alarm.

The BCM will disable the panic feature if the ignition key is in any position other than OFF or LOCK.

This pinpoint test is intended to diagnose the following:

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- Door locks
- Factory remote start system (if equipped)
- Horn system
- Turn signal system
- IKT

PINPOINT TEST I: AN INDIVIDUAL BUTTON/FEATURE IS INOPERATIVE FROM THE RKE TRANSMITTER

Test Step	Result / Action to Take
I1 VERIFY THE DOOR LOCK OPERATION	
• Press the lock and unlock button from the driver door lock control switch while observing the door lock operation. • **Do the door locks operate correctly?**	**Yes** GO to I2. **No** CHECK the symptom(s) and GO to Symptom Chart - Electrical.
I2 VERIFY THE HORN OPERATION	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select the BCM PID (HORN) and active command the horn on. • **Does the horn sound when commanded on?**	**Yes** GO to I3. **No** REFER to Section 413-06.
I3 VERIFY THE HAZARD LAMP OPERATION	
• Place the hazard switch in the ON position. • **Do the hazard lamps operate correctly?**	**Yes** For vehicles without remote start, REPLACE the inoperative IKT and PROGRAM the new IKT individually or PROGRAM all the IKTs. REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation. For vehicles equipped with the factory remote start, GO to I4. **No** REFER to Section 417-01.
I4 VERIFY THE REMOTE START BUTTON	
• Enter the following diagnostic mode on the scan tool: BCM DataLogger. • Select the BCM PID (LST_RKE_xMTR) while pressing the remote start button on an IKT.	**Yes** REFER to Section 303-06. **No** REPLACE the inoperative IKT and PROGRAM the new IKT individually or PROGRAM all the IKTs. REFER to Section 419-01B for the programming procedures. If all the IKTs are

• **Does the PID indicate the remote start button is being pressed?**	to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation.

Pinpoint Test J: The Remote Keyless Entry (RKE) Transmitter Has Poor Range Performance

Normal Operation

The Remote Keyless Entry (RKE) transmitter has a normal operating range of 10 m (33 ft). The Tire Pressure Monitor (TPM) module has an internal antenna to receive the RKE transmitter signal. When the TPM module receives a command from a programmed RKE transmitter, the TPM module sends the RKE signal to the Body Control Module (BCM), which processes the command to provide the appropriate output.

This pinpoint test is intended to diagnose the following:

- Environmental interference
- IKT
- IKT battery
- TPM module

PINPOINT TEST J: THE RKE TRANSMITTER HAS POOR RANGE PERFORMANCE

NOTE: All RKE transmitters must be present to begin diagnosis of the RKE system.

NOTE: Aftermarket or dealer-installed systems can adversely affect the RKE system operation. These systems must be disconnected before diagnosing any RKE concerns.

Test Step	Result / Action to Take
J1 CHECK FOR THE CORRECT RKE TRANSMITTERS	
• **NOTE:** Make sure the RKE transmitters are those provided with the OEM system and not from an aftermarket system, or a dealer-installed system that may have been installed on the vehicle. • Check that the correct IKTs are used with the vehicle. Compare the IKTs with the one shown in Handles, Locks, Latches and Entry Systems in the Description and Operation portion of this section. • **Are the correct RKE transmitters present?**	**Yes** GO to J2. **No** The system cannot be tested without the correct RKE transmitters. INFORM the customer that the correct RKE transmitters must be present to proceed with diagnosis of the system.
J2 CHECK ALL RKE TRANSMITTERS FOR POOR RANGE PERFORMANCE	
• **NOTE:** The 10 m (33 ft) measurement of range is not the standard but is a guideline that clearly indicates a vehicle is experiencing normal range performance. • Check all RKE transmitters for poor range performance (less than 10 m [33 ft]).	**Yes** GO to J4. **No** GO to J3.

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• **Do all RKE transmitters experience poor range?**	
J3 CHECK THE IKT BATTERY • Using a thin coin, open the IKT . • Do not clean off any grease from the battery terminals on the back surface of the circuit board. • Verify the correct battery is used (CR2032). • Remove the IKT battery and measure the voltage. • **Is the voltage greater than 2.5 volts?**	**Yes** REPLACE the inoperative IKT and PROGRAM the new IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation. **No** INSTALL a new battery (make sure the battery is seated correctly). DO NOT reprogram the IKT (weak or dead batteries do not erase TICs from memory). TEST the system for normal operation.
J4 CHECK THE LOCATION OF THE VEHICLE AND THE APPROACH ANGLES AROUND THE VEHICLE • Make sure the poor performance is consistent in nature and is not from one approaching angle. • The RKE transmitter range performance may be degraded in certain locations. For example, if the vehicle is within 0.5 mile (0.8 km) of high-power devices or radio/TV towers, the operating distance of the RKE transmitters may be reduced. • **Is the poor range performance consistent around the vehicle?**	**Yes** GO to J5 . **No** The system is operating correctly at this time. The range may have been affected by environmental interference.

J5 CHECK FOR CORRECT TPM MODULE OPERATION
• Disconnect all the TPM module connectors.
• Check for:
  ▪ corrosion
  ▪ damaged pins
  ▪ pushed-out pins
• Connect all the TPM module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new TPM module. REFER to Section 204-04 . TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test K: The Autolock Does Not Operate Correctly

Normal Operation

The Body Control Module (BCM) energizes the lock relay based on input from the ajar switches, the ignition switch, the Transmission Range (TR) sensor and the vehicle speed signal. The BCM locks the doors when the following conditions are met:

- All the doors are closed

- The ignition switch is in the RUN position
- The vehicle is shifted into any gear putting the vehicle in motion
- The vehicle attains a speed greater than 20 km/h (12 mph)

This pinpoint test is intended to diagnose the following:

- Programming
- Door ajar switch input
- Vehicle speed signal message

PINPOINT TEST K: THE AUTOLOCK DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
K1 CHECK THE COURTESY LAMP OPERATION • Open and close the doors while checking the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** GO to K2 . **No** REFER to Section 417-02 .
K2 CHECK THE VEHICLE SPEED OPERATION • Check the operation of the speedometer. • **Does the speedometer operate correctly?**	**Yes** ENABLE the autolock feature. REFER to Autolock and Auto-Unlock Programming in this section. **No** REFER to Section 413-01 .

Pinpoint Test L: The Smart Unlock Does Not Operate Correctly

Normal Operation

The Body Control Module (BCM) commands all doors to unlock based on input from the key-in-ignition switch and the door ajar signal. This feature helps prevent the keys from being locked in the vehicle by unlocking the doors if the key is in the ignition and either front door is ajar.

The vehicle can still be locked with the key in the ignition, by using the manual lock rod, a key in the door lock cylinder, the keyless entry keypad, or the LOCK button on a Integrated Keyhead Transmitter (IKT).

This pinpoint test is intended to diagnose the following:

- Key-in-ignition switch
- Door ajar switch input

PINPOINT TEST L: THE SMART UNLOCK DOES NOT OPERATE CORRECTLY

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Test Step	Result / Action to Take
L1 CHECK THE DOOR LOCK OPERATION	
• Check the operation of the door locks from the driver door lock control switch. • **Do all the doors lock and unlock?**	**Yes** GO to L2 . **No** CHECK the symptom(s) and GO to Symptom Chart - Electrical .
L2 CHECK THE COURTESY LAMP OPERATION	
• Open and close the left front door while checking the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** REFER to Section 413-01 to DIAGNOSE the key-in-ignition warning chime. **No** REFER to Section 417-02 .

Pinpoint Test M: The Auto-Unlock Does Not Operate Correctly

Normal Operation

The Body Control Module (BCM) energizes the unlock relay based on input from the door ajar switches and the vehicle speed signal. The BCM unlocks the doors when the following conditions are met:

- The vehicle speed has exceeded 20 km/h (12 mph) then dropped to 0 km/h (0 mph)
- The key is turned to the OFF or ACC position
- The LH front door is opened within 10 minutes of the key being turned to the OFF or ACC position

The auto-unlock feature is cancelled if the doors are locked with the door lock control switch or the Integrated Keyhead Transmitter (IKT) within the 10-minute active window. After the 10-minute active window expires, the auto-unlock feature does not unlock the doors if the driver door is opened.

This pinpoint test is intended to diagnose the following:

- Programming
- Door ajar switch input
- Vehicle speed signal message

PINPOINT TEST M: THE AUTO-UNLOCK DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
M1 CHECK THE COURTESY LAMP OPERATION	
• Open and close the doors while observing the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** GO to M2 . **No** REFER to Section 417-02 .
M2 CHECK THE VEHICLE SPEED	

OPERATION	
• Check the operation of the speedometer. • **Does the speedometer operate correctly?**	**Yes** ENABLE the auto-unlock feature. REFER to Autolock and Auto-Unlock Programming in this section. **No** REFER to Section 413-01 .

Pinpoint Test N: Hard To Open/Close Door From Either Door Handle

Normal Operation

The door latch can be actuated from the interior or exterior door handle. When actuated, the door latch releases and allows the door to open. If the door latch or the door hinges have insufficient lubrication or if the striker or door are misaligned, it causes extra force to be used when opening or closing the door.

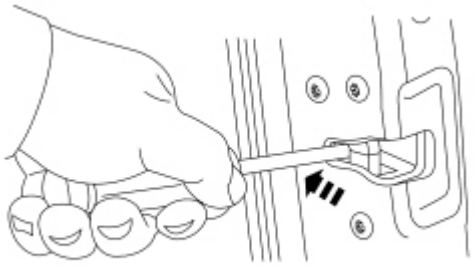
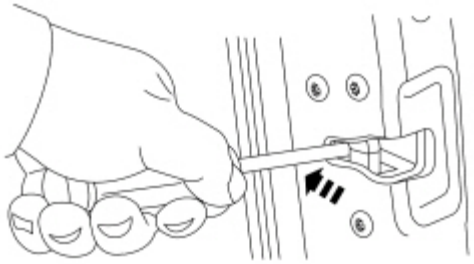
This pinpoint test is intended to diagnose the following:

- Door alignment
- Door hinges
- Striker adjustment
- Door latch

PINPOINT TEST N: HARD TO OPEN/CLOSE DOOR FROM EITHER DOOR HANDLE

Test Step	Result / Action to Take
N1 CHECK THE LATCH OPERATION FROM BOTH DOOR HANDLES	
• Open and close the door using both the interior and exterior door handles. • **Does the door open normally from one of the door handles?**	**Yes** If the door is difficult/does not open from the exterior door handle, GO to Pinpoint Test O . If the door is difficult/does not open from the interior door handle, GO to Pinpoint Test P . **No** If the door does not operate correctly from both door handles, GO to N2 .
N2 CHECK THE LATCH OPERATION	
• Open the door. • Using a screwdriver, fully close the latch (2 clicks).	**Yes** GO to N4 . **No** GO to N3 .

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 N0094195 • Verify that the latch releases easily while pulling on the interior/exterior door handle. • **Does the latch release easily?**	
N3 CHECK THE LATCH OPERATION AFTER LUBRICATION	
• Lubricate the door latch. Refer to Latch Lubrication in this section. • Using a screwdriver, fully close the latch (2 clicks).  N0094195 • Verify that the latch releases easily while pulling on the interior/exterior door handle. • **Does the latch release easily?**	**Yes** The concern was caused by an insufficiently lubricated door latch. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.
N4 CHECK THE STRIKER ADJUSTMENT	
• Check the adjustment of the striker. Refer to Section 501-03 . • **Is the striker adjusted correctly?**	**Yes** GO to N5 . **No** ADJUST the striker as necessary. TEST the system for normal operation.
N5 CHECK THE DOOR ALIGNMENT	
• Check the alignment of the door. Refer to Section 501-03 . • **Is the door aligned correctly?**	**Yes** LUBRICATE the door hinges. TEST the system for normal operation. **No** ADJUST the door as necessary. TEST the system for normal operation.

Pinpoint Test O: A Door Is Difficult/Does Not Open From The Exterior Door Handle

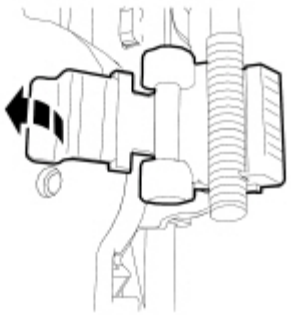
Normal Operation

The exterior door handle is connected to the door latch with an actuating rod. When the exterior door handle is pulled it causes the actuating rod to push down on the latch lever. The actuating rod can be adjusted for proper exterior door handle operation. When the latch lever is moved, the door latch releases, allowing the door to open.

This pinpoint test is intended to diagnose the following:

- Broken or binding linkage
- Exterior door handle to latch rod adjustment
- Exterior door handle
- Door latch

PINPOINT TEST O: A DOOR IS DIFFICULT/DOES NOT OPEN FROM THE EXTERIOR DOOR HANDLE

Test Step	Result / Action to Take
O1 CHECK THE LATCH OPERATION FROM BOTH DOOR HANDLES • Open the door using both the interior and exterior door handles. • **Does the door open normally from one of the door handles?**	**Yes** If the door is difficult/does not open from only the exterior door handle, GO to O2. **No** If the door does not operate correctly from both door handles, GO to Pinpoint Test N.
O2 CHECK THE EXTERIOR DOOR HANDLE • Remove the door trim panel. Refer to Section 501-05. • Open the clip and disconnect the exterior door handle actuating rod.  N0088081 • Pull and release the exterior door handle. • **Does the exterior door handle operate correctly?**	**Yes** GO to O3. **No** INSTALL a new exterior door handle. REFER to Exterior Front Door Handle or Exterior Door Handle — SuperCrew in this section. TEST the system for normal operation.
O3 CHECK THE EXTERIOR DOOR HANDLE AND LINKAGE OPERATION • Operate the exterior door handle while observing the linkage. • **Are any of the exterior door handle components or linkages binding or broken?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** GO to O4.

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O4 CARRY OUT THE EXTERIOR DOOR HANDLE ADJUSTMENT	
• Carry out the exterior door handle to latch rod adjustment. Refer to Door Handle to Latch Rod Adjustment in this section. • **Does the exterior door handle operate correctly?**	**Yes** The concern was caused by an improperly adjusted exterior door handle. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.

Pinpoint Test P: A Door Is Difficult/Does Not Open From The Interior Door Handle

Normal Operation

The interior door handle is connected to the door latch by an actuating cable. When the interior door handle is pulled it causes the cable to pull on the latch lever. When the latch lever is moved, the door latch releases, allowing the door to open.

This pinpoint test is intended to diagnose the following:

- Broken or binding cable/linkage
- Door latch

PINPOINT TEST P: A DOOR IS DIFFICULT/DOES NOT OPEN FROM THE INTERIOR DOOR HANDLE

Test Step	Result / Action to Take
P1 CHECK THE LATCH OPERATION FROM BOTH DOOR HANDLES	
• For the rear SuperCrew doors, make sure the child lock is in the unlock position. • Open the door using both the interior and exterior door handles. • **Does the door open normally from one of the door handles?**	**Yes** If the door is difficult/does not open from only the interior door handle, GO to P2. **No** If the door does not operate correctly from both door handles, GO to Pinpoint Test N.
P2 CHECK THE INTERIOR DOOR HANDLE AND CABLE/LINKAGE OPERATION	
• Remove the door trim panel. Refer to Section 501-05. • Install the interior door handle back onto the release cable. • Operate the interior door handle while observing the cable/linkage. • **Are any of the interior door handle components or cable/linkages binding or broken?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.

Pinpoint Test Q: Exterior Door Release Handle Sticks

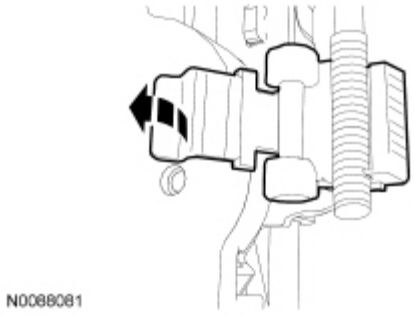
Normal Operation

The exterior door handle is connected to the door latch with an actuating rod. When the exterior door handle is pulled it causes the actuating rod to push down on the latch lever. The actuating rod can be adjusted for proper exterior door handle operation. When the latch lever is moved, the door latch releases, allowing the door to open. The handle has a return spring to make sure the handle returns to a closed position.

This pinpoint test is intended to diagnose the following:

- Binding linkage
- Broken handle return spring
- Exterior door handle to latch rod adjustment
- Door latch

PINPOINT TEST Q: EXTERIOR DOOR RELEASE HANDLE STICKS

Test Step	Result / Action to Take
Q1 CHECK FOR A BROKEN RETURN SPRING	
• Remove the door trim panel. Refer to Section 501-05 . • Open the clip and disconnect the exterior door handle actuating rod.  N0088081 • Pull and release the exterior door handle. • **Does the exterior door handle return to a closed position once released?**	**Yes** GO to Q2 . **No** INSTALL a new exterior door handle. REFER to Exterior Front Door Handle or Exterior Door Handle — SuperCrew in this section. TEST the system for normal operation.
Q2 CARRY OUT THE EXTERIOR DOOR HANDLE ADJUSTMENT	
• Carry out the exterior door handle to latch rod adjustment. Refer to Door Handle to Latch Rod Adjustment in this section. • **Does the exterior door handle operate correctly?**	**Yes** The concern was caused by an improperly adjusted exterior door handle. **No** GO to Q3 .
Q3 CHECK THE EXTERIOR DOOR HANDLE AND LINKAGE OPERATION	

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• Operate the exterior door handle while observing the linkage. • **Are any of the exterior door handle components or linkages binding?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation.

Pinpoint Test R: Interior Door Release Handle Sticks

Normal Operation

The interior door handle is connected to the door latch by an actuating cable. When the interior door handle is pulled it causes the cable to pull on the latch lever. When the latch lever is moved, the door latch releases, allowing the door to open. The handle has a return spring to make sure the handle returns to a closed position.

This pinpoint test is intended to diagnose the following:

- Binding cable
- Broken handle return spring
- Door latch

PINPOINT TEST R: INTERIOR DOOR RELEASE HANDLE STICKS

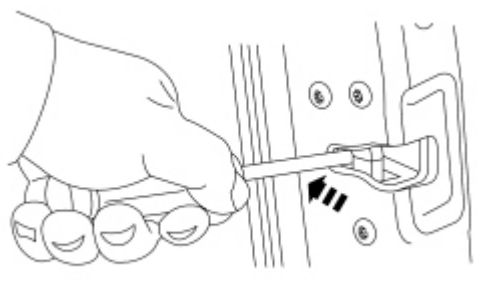
Test Step	Result / Action to Take
R1 CHECK FOR A BROKEN RETURN SPRING	**Yes** GO to R2. **No** INSTALL a new interior door handle. REFER to Interior Door Handle — Front or Interior Door Handle — SuperCrew in this section. TEST the system for normal operation.
• Remove the interior door handle. Refer to Interior Door Handle — Front or Interior Door Handle — SuperCrew in this section. • Pull and release the interior door handle. • **Does the interior door handle return to a closed position once released?**	
R2 CHECK THE INTERIOR DOOR HANDLE CABLE OPERATION	**Yes** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation. **No** REPAIR as necessary. TEST the system for normal operation.
• Remove the door latch release cable. • Observe the door latch release cable for any damage or binding. • **Is the door latch release cable OK?**	

Pinpoint Test S: Squeak/Rattle/Chucking Noise From Door

This pinpoint test is intended to diagnose the following:

- Door alignment
- Striker adjustment
- Door latch

PINPOINT TEST S: SQUEAK/RATTLE/CHUCKING NOISE FROM DOOR

Test Step	Result / Action to Take
S1 CHECK FOR ANY LOOSE COMPONENTS • Remove the door trim panel. Refer to Section 501-05 . • Inspect inside the door for any loose components. • **Are there any loose components inside the door?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** GO to S2 .
S2 CHECK THE STRIKER ADJUSTMENT • Check the adjustment of the striker. Refer to Section 501-03 . • **Is the striker adjusted correctly?**	**Yes** GO to S3 . **No** ADJUST the striker as necessary. TEST the system for normal operation.
S3 CHECK THE DOOR ALIGNMENT • Check the alignment of the door. Refer to Section 501-03 . • **Is the door aligned correctly?**	**Yes** GO to S4 . **No** ADJUST the door as necessary. TEST the system for normal operation.
S4 CHECK THE LATCH OPERATION AFTER LUBRICATION • Lubricate the door latch. Refer to Latch Lubrication in this section. • Using a screwdriver, fully close the latch (2 clicks).  N0094195 • Operate the door latch and listen for the noise.	**Yes** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch — SuperCrew in this section. TEST the system for normal operation. **No** The concern was caused by an insufficiently lubricated door latch.

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• **Is the original noise still present after the latch is lubricated?**	

Pinpoint Test T: Manual Door Lock Cylinder Inoperative

Normal Operation

The door lock cylinder is connected to the door latch via a lock rod and can be used to manually lock/unlock a door.

This pinpoint test is intended to diagnose the following:

- Bent or binding lock rod and lever
- Door lock cylinder
- Door latch

PINPOINT TEST T: MANUAL DOOR LOCK CYLINDER INOPERATIVE

Test Step	Result / Action to Take
T1 CHECK THE LOCK CYLINDER OPERATION AFTER LUBRICATION	
• Spray a lock lubricant such as Motorcraft XL-1 into the lock cylinder opening for a couple seconds. • Operate the door lock cylinder with the key. • **Does the door lock and unlock using the door lock cylinder?**	**Yes** The concern was caused by an insufficiently lubricated lock cylinder. Spray a multi-purpose grease such as Motorcraft XL-5 into the lock cylinder for a couple seconds to provide long term lubrication. **No** GO to T2 .
T2 CHECK THE DOOR LOCK CYLINDER	
• Remove the door lock cylinder. Refer to Door Lock Cylinder in this section. • Operate the door lock cylinder with the key. • **Does the door lock cylinder rotate freely to both lock and unlock positions?**	**Yes** GO to T3 . **No** INSTALL a new door lock cylinder. REFER to Door Lock Cylinder in this section. TEST the system for normal operation.
T3 CHECK THE DOOR LOCK CYLINDER LINKAGE	
• Install the door lock cylinder. Refer to Door Lock Cylinder in this section. • Operate the door lock cylinder while observing the linkage. • **Is the door lock cylinder rod and lever bent or binding?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch in this section. TEST the system for normal operation.

Pinpoint Test U: Unable To Remove The Key From The Ignition Lock Cylinder

Refer to Wiring Diagrams Cell 37 , Shift Interlock for schematic and connector information.

Normal Operation

The ignition switch contains a key removal inhibit solenoid. The solenoid prevents the ignition lock cylinder to be turned to lock and the key removed any time the transmission selector lever is in any position except park. The inhibit solenoid receives voltage at all times from the Body Control Module (BCM) fuse 28 (15A). When the transmission selector lever is in any gear except park, the selector switch closes, which supplies ground to the solenoid.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Transmission selector lever
- Binding steering column components
- Ignition lock cylinder
- Ignition switch

PINPOINT TEST U: IGNITION KEY CANNOT BE RETURNED TO THE OFF POSITION

Test Step	Result / Action to Take
U1 CHECK FOR AN ENERGIZED KEY REMOVAL INHIBIT SOLENOID	
• Remove the BCM fuse 28 (15A). • Attempt to turn the ignition key to the run position and then back to the lock position and remove the key. • **Does the ignition lock cylinder turn to the lock position and can the key be removed?**	**Yes** REFER to Section 211-05 to continue diagnosis of the key removal inhibit solenoid system. **No** GO to U2 .
U2 CHECK THE IGNITION LOCK CYLINDER FOR BINDING	
• Remove the ignition lock cylinder. Refer to Ignition Lock Cylinder — Functional in this section. • Rotate the ignition lock cylinder through all positions using the key. • **Does the ignition lock cylinder freely rotate through all positions and can the key be removed from the lock cylinder?**	**Yes** REFER to Section 211-05 to continue diagnosis of the steering column for any binding steering column components or ignition switch. **No** INSTALL a new ignition lock cylinder. REFER to Ignition Lock Cylinder — Functional in this section. TEST the system for normal operation.

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Autolock and Auto-Unlock Programming

Programming the Autolock Feature Using the Door Lock Control Switch

NOTE: The autolock feature can also be programmed using the message center.

NOTE: The autolock feature can be activated or deactivated independently of the auto-unlock feature.

NOTE: When programming the autolock feature using the door lock control switch method, the following steps must be carried out within 30 seconds or the procedure will need to be repeated. If the procedure needs to be repeated, wait 30 seconds between programming sessions.

1. **NOTE:** Prior to beginning, make sure the ignition key is in the OFF position and all vehicle doors are closed.

   Turn the ignition key from the OFF to the ON position.

2. Press the unlock button on the door lock control switch 3 times.

3. Turn the ignition key from the ON to the OFF position.

4. Press the unlock button on the door lock control switch 3 times.

5. Turn the ignition key to the ON position. The horn chirps once to indicate that programming mode is entered.

6. To enable/disable the autolock feature, press the unlock button on the door lock control switch, then the lock button. The horn chirps once if the autolocks are disabled or twice (one short chirp followed by a long chirp) if the autolocks are enabled.

7. Turn the ignition key to the OFF position. The horn chirps once to signal that the programming is complete.

Programming the Autolock Feature Using the Keyless Entry Keypad

NOTE: The autolock feature can also be programmed using the message center.

NOTE: The autolock feature can be activated or deactivated independently of the auto-unlock feature.

1. Turn the ignition key to the OFF position and close all vehicle doors.

2. Enter the permanent factory keyless entry keypad code.

3. Press and hold the 3/4 button on the keypad. While holding the 3/4 button, press the 7/8 button.

4. Release the 7/8 button, then release the 3/4 button. The horn chirps once if the autolocks are disabled or twice (one short chirp followed by a honk) if the autolocks are enabled.

Programming the Auto-Unlock Feature Using the Door Lock Control Switch

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NOTE: The auto-unlock feature can also be programmed using the message center.

NOTE: The auto-unlock feature can be activated or deactivated independently of the autolock feature.

NOTE: When programming the auto-unlock feature using the door lock control switch method, the following steps must be carried out within 30 seconds or the procedure will need to be repeated. If the procedure needs to be repeated, wait 30 seconds between programming sessions.

1. **NOTE:** Prior to beginning, make sure the ignition key is in the OFF position and all vehicle doors are closed.

   Turn the ignition key from the OFF to the ON position.

2. Press the unlock button on the door lock control switch 3 times.

3. Turn the ignition key from the ON to the OFF position.

4. Press the unlock button on the door lock control switch 3 times.

5. Turn the ignition key to the ON position. The horn chirps once to indicate that programming mode is entered.

6. To enable/disable the auto-unlock feature, press the lock button on the door lock control switch, then the unlock button. The horn chirps once if auto-unlock is disabled or twice (one short chirp followed by a long chirp) if auto-unlock is enabled.

7. Turn the ignition key to the OFF position. The horn chirps once to signal that the programming is complete.

Programming the Auto-Unlock Feature Using the Keyless Entry Keypad

NOTE: The auto-unlock feature can also be programmed using the message center.

NOTE: The auto-unlock feature can be activated or deactivated independently of the autolock feature.

1. Turn the ignition key to the OFF position and close all vehicle doors.

2. Enter the permanent factory keyless entry keypad code.

3. Press and hold the 3/4 button on the keypad. While holding the 3/4 button, press and release the 7/8 button. While still holding the 3/4 button, press and release the 7/8 button a second time.

4. Release the 3/4 button. The horn chirps once if auto-unlock is disabled or twice (one short chirp followed by a honk) if auto-unlock is enabled.

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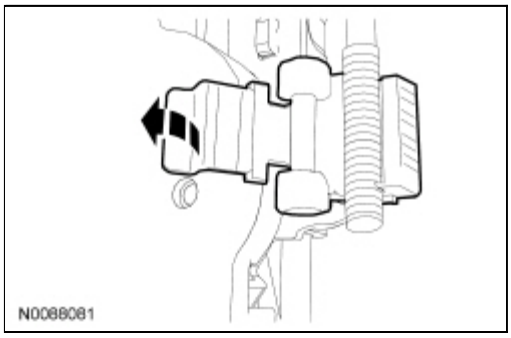
Door Handle to Latch Rod Adjustment

NOTE: If the vehicle is equipped with an adjustable door latch actuating rod, perform this procedure.

NOTE: An incorrectly adjusted exterior door handle can cause a loose handle, rattle noise, door hard to open from the outside door handle, or the outside door handle to not sit flush in the closed position.

NOTE: Prior to carrying out the adjustment procedure, the door latch, exterior door handle, and linkages must be installed on the door.

1. Raise the door glass to the full-up position.
2. Remove the door trim panel. For additional information, refer to Section 501-05 .
3. Position the water shield aside.
4. Open the clip and disconnect the exterior door handle actuating rod.



5. Position the actuating rod and latch actuating lever in a neutral position.
6. **NOTE:** Do not push up or pull down on the actuating rod or latch actuating lever.

   Reinstall the exterior door handle actuating rod back into the clip.
7. Close the clip and test the system to make sure that the exterior door handle is operating correctly.
8. Reseal the water shield.
9. Install the door trim panel. For additional information, refer to Section 501-05 .

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Keyless Entry Keypad Code Programming

Programming a Personal Entry Code and Keypad Association to Memory Features (If Equipped)

NOTE: The system allows 3 personal codes to be programmed.

NOTE: Multiple personal codes can be programmed in one step. When programming multiple codes in one step, each code must be programmed by entering each button within 5 seconds of each other. If 5 seconds elapse between any button press, programming mode is exited.

NOTE: If only a single personal code is desired or unable to program multiple codes in one step, each personal code can be programmed individually by repeating Steps 1-5 for each code desired.

1. Enter the factory set 5-digit keyless entry keypad code.

2. Within 5 seconds, press the 1/2 button on the keypad to activate the programming mode.

3. Enter the new personal 5-digit keyless entry keypad code. Each number must be entered within 5 seconds of each other.

4. After entering the new personal code, press a 6th button to program each new code.
   - Pressing 1/2 stores the first personal code (if equipped with memory, this code is associated with driver 1 settings).
   - Pressing 3/4 stores the second personal code (if equipped with memory, this code is associated with driver 2 settings).
   - Pressing 5/6, 7/8 or 9/0 stores the third personal code, but does not associate the code with a memory setting.

5. The door locks lock and unlock to confirm the new code is programmed.

Erasing a Personal Entry Code

1. Enter the factory set 5-digit keyless entry keypad code.

2. Within 5 seconds, press the 1/2 button on the keypad and release.

3. Within 5 seconds, press and hold the 1/2 button for 2 seconds.

4. All personal codes are now erased and only the factory set 5-digit code works.

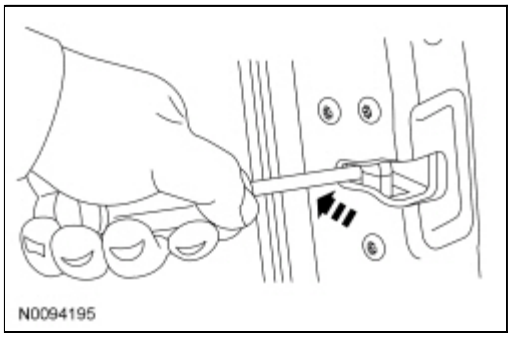
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Latch Lubrication

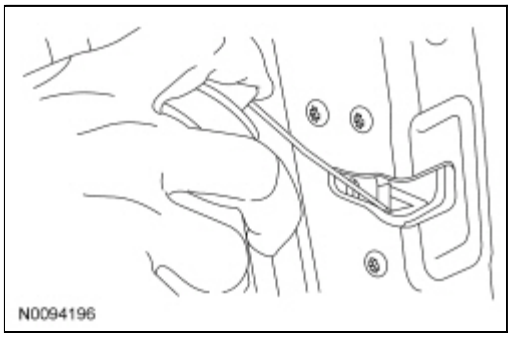
Material

Item	Specification
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B

1. Open the door.
2. Using a screwdriver, fully close the latch (2 clicks).



3. Spray the multi-purpose grease into the opening on the door latch for approximately 5 seconds.



4. Open the latch using either the interior or exterior door handle.
5. Open and close the door several times to circulate the lubricant inside the latch.
6. Wipe off any excess grease.

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Remote Keyless Entry (RKE) Transmitter Programming

NOTE: This procedure is for programming conventional keyfobs only. The Remote Keyless Entry (RKE) transmitter of the Integrated Keyhead Transmitter (IKT) is programmed automatically during the Passive Anti-Theft System (PATS) programming. For additional information, refer to the key programming procedures in Section 419-01B to program the IKT .

NOTE: The RKE transmitters can also be programmed with the scan tool.

NOTE: All RKE transmitters must be programmed at the same time.

NOTE: Do not apply the brake pedal during this sequencing, as doing so ends the sequence and the transmitters will not be programmed.

1. Electronically unlock the door locks using the door lock control switch.

2. Cycle the ignition switch from the OFF to the RUN position 8 times in rapid succession (within 10 seconds), with the eighth turn ending in RUN. If the module successfully enters program mode, it locks and then unlocks all the doors.

3. **NOTE:** If no action is taken within 20 seconds after a transmitter has been programmed, the programming sequence ends (the doors lock and unlock to confirm that programming is complete).

   Within 20 seconds, press any button on the RKE transmitter to be programmed. The doors lock and then unlock to confirm that each RKE transmitter is programmed. Repeat this step for each RKE transmitter.

4. Exiting the programming mode is accomplished if one of the following occurs:
   - The key transitions to the OFF position.
   - 20 seconds have passed since entering programming mode or since the last RKE transmitter was programmed.
   - The maximum number (4) of RKE transmitters have been programmed.

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Remote Memory Activation

1. Move the driver seat, power mirrors, and adjustable pedals to the desired positions using the associated controls.
2. Press and hold control button 1 for five seconds. A tone will be heard after two seconds confirming memory position has been set. Continue to hold until a second tone is heard after five seconds.
3. Within three seconds press the lock button.
4. Wait 10 seconds, then press the unlock button.
5. Repeat this procedure for memory 2 and another transmitter if desired.

Remote Memory Deactivation

1. Press the set button on the memory set switch.
2. Within 5 seconds, press any button on the Remote Keyless Entry (RKE) transmitter that you wish to deactivate and then press the set button on the memory set switch.
3. If a second memory setting is desired to be deactivated, repeat the procedure with the second RKE transmitter.

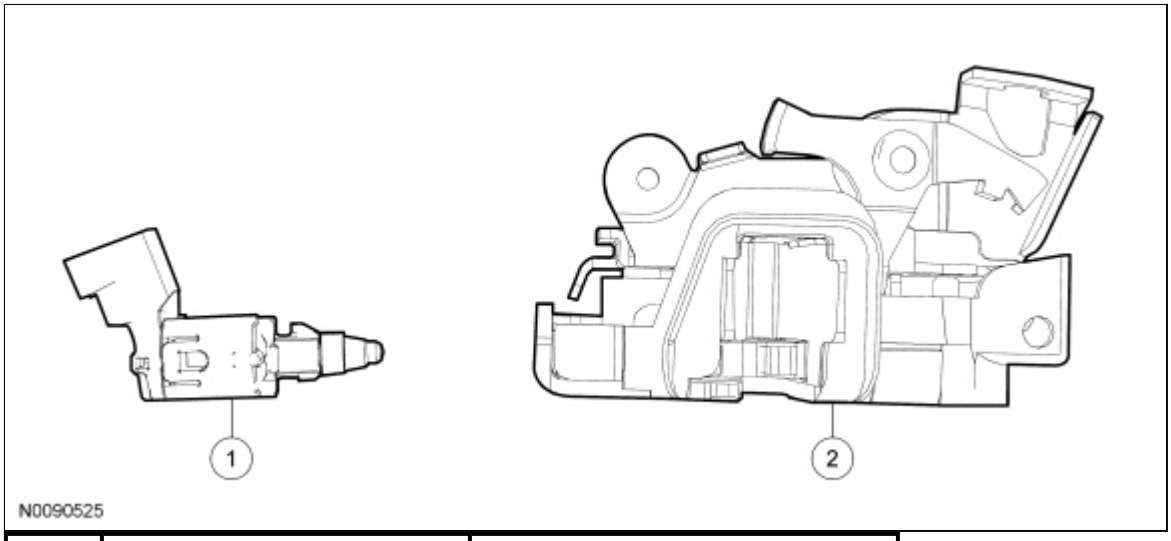
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Stepped Unlock Programming

1. With the ignition switch in the OFF position, press the LOCK and UNLOCK buttons on the Remote Keyless Entry (RKE) transmitter simultaneously for 4 seconds.
    - The turn signals flash twice to indicate the mode change.

2. Repeat Step 1 to enable/disable the stepped unlocking feature.

Door Ajar Switch — Rear, SuperCab

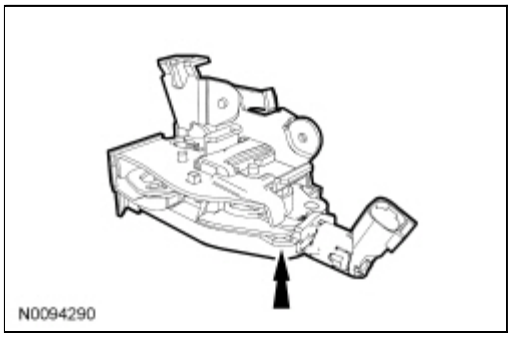


Item	Part Number	Description
1	18265B29	Door ajar switch
2	18264A01/ 18264A00	Lower door latch (LH/RH)

Removal and Installation

1. Remove the lower rear door latch. For additional information, refer to Rear Door Latch — Lower, SuperCab in this section.

2. Insert a screwdriver or suitable tool into the opening on the door latch and push up on the tab.



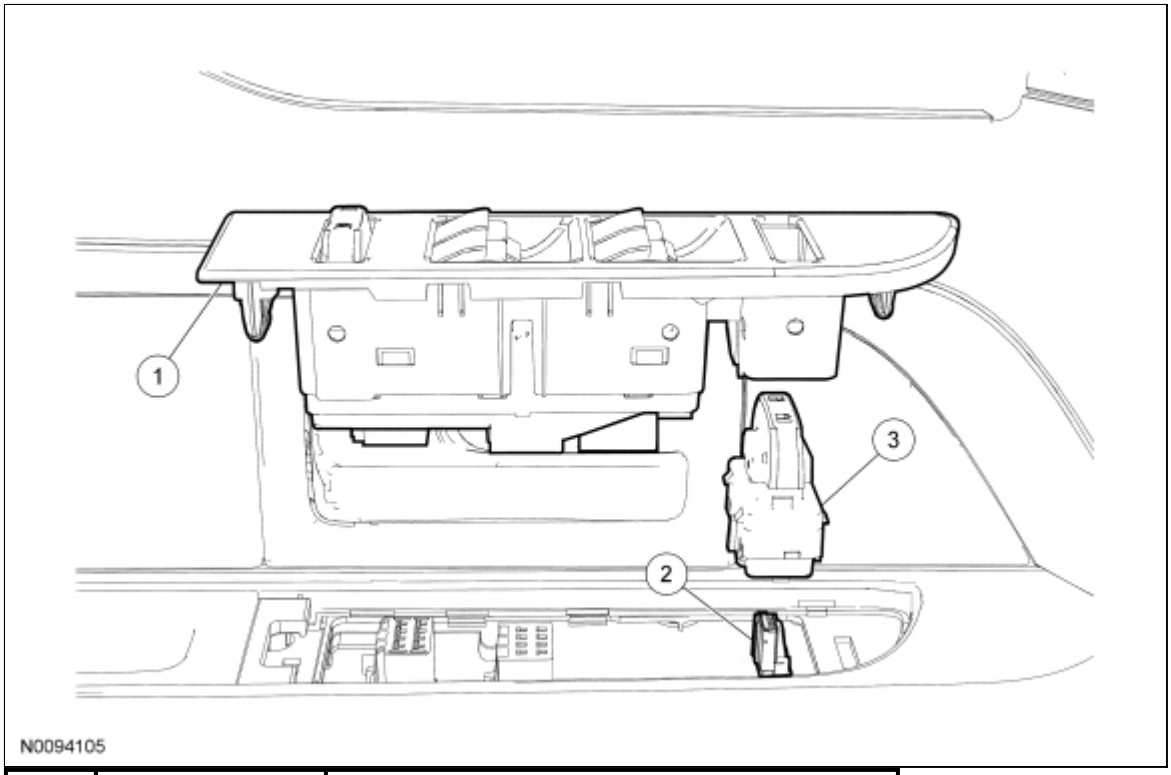
3. Rotate the door ajar switch and remove from the door latch.

4. To install, reverse the removal procedure.

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Door Lock Control Switch

NOTE: LH side shown, RH side similar.



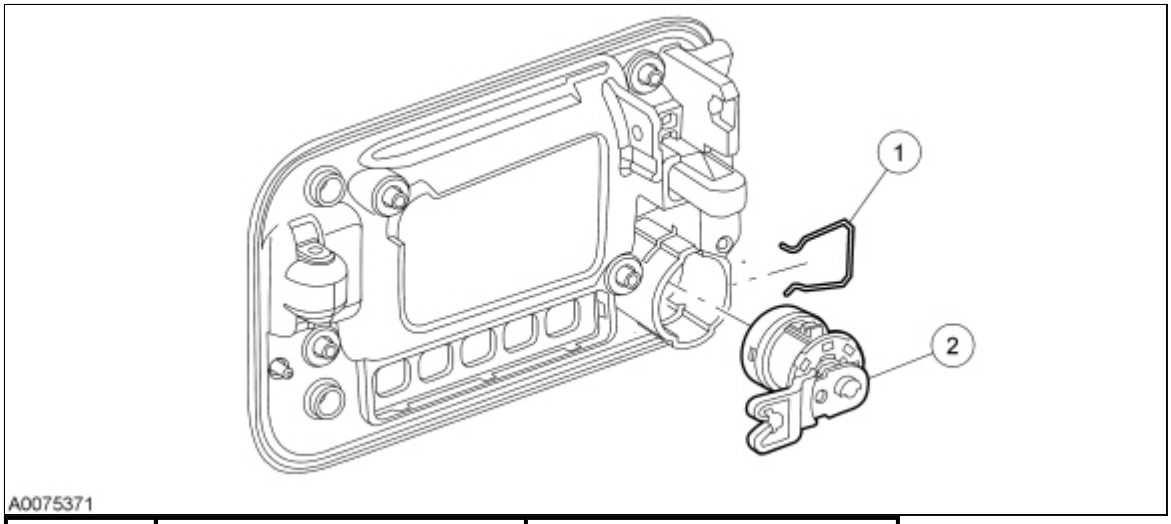
Item	Part Number	Description
1	14527/ 14528	Switch plate cover (LH/RH)
2	—	Door lock switch electrical connector
3	14028	Door lock control switch

Removal and Installation

1. Lift up to remove the switch plate cover.
2. Disconnect the electrical connector.
3. Release the door lock control switch tabs and remove the door lock control switch.
4. To install, reverse the removal procedure.

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Door Lock Cylinder



Item	Part Number	Description
1	1522023	Retaining clip
2	1521990	Lock cylinder

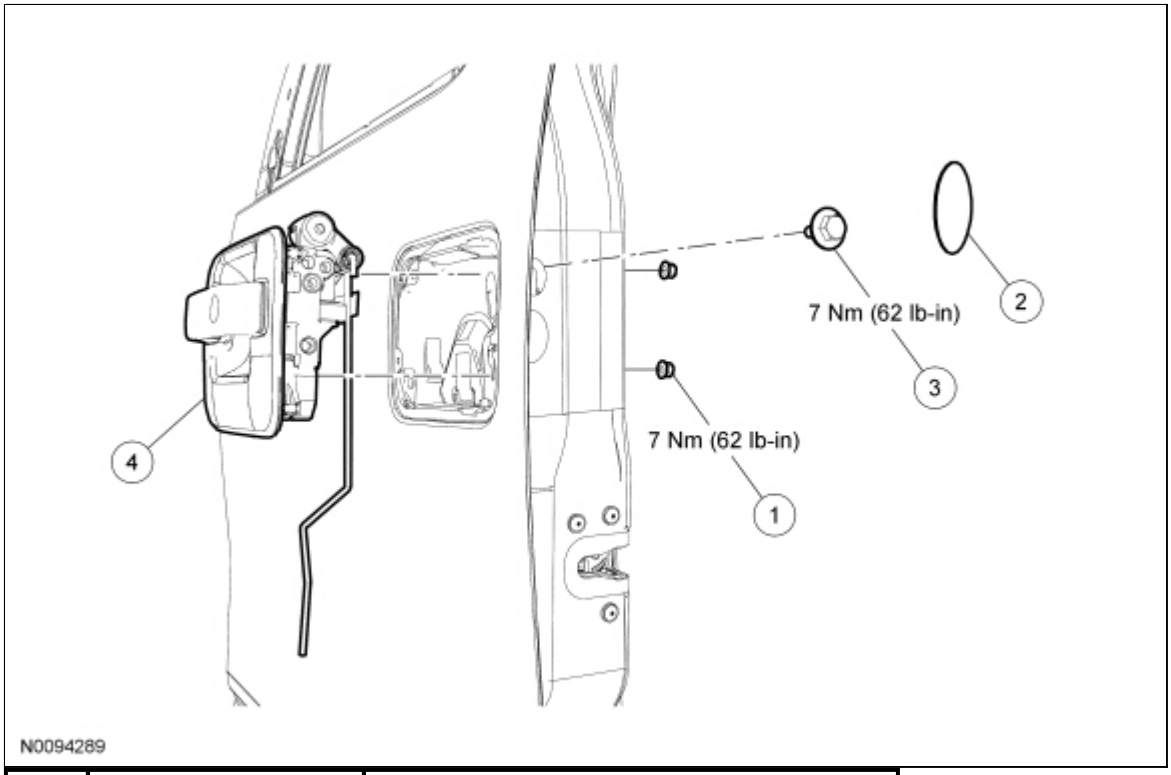
Removal and Installation

NOTE: Individual door lock cylinders are repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build a new lock cylinder to the current key code of the vehicle.

1. Remove the exterior front door handle. For additional information, refer to Exterior Front Door Handle in this section.
2. Remove the retaining clip and the door lock cylinder.
3. To install, reverse the removal procedure.

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Exterior Door Handle — SuperCrew



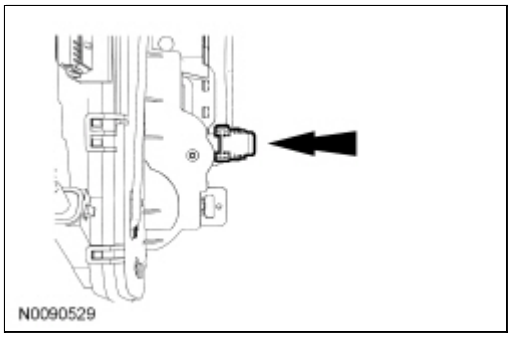
Item	Part Number	Description
1	N620480	Exterior door handle nuts (2 required)
2	W714163	Exterior rear door handle seal
3	W709562	Exterior rear door handle bolt
4	1626605/ 1626604	Exterior rear door handle (LH/RH)

Removal and Installation

NOTE: The door window glass must be completely raised.

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Position the water shield aside.
3. Open the clip and disconnect the exterior rear door handle actuating rod.

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4. Remove the 2 exterior door handle nuts.
    - To install, tighten to 7 Nm (62 lb-in).

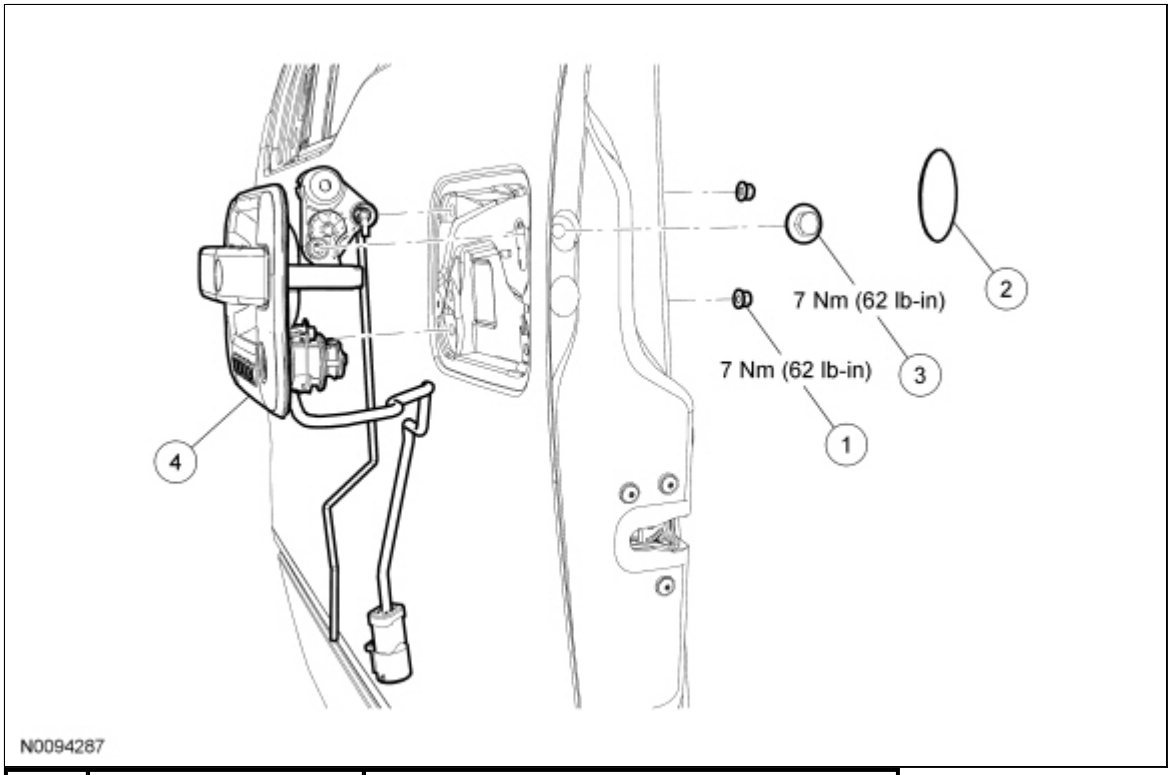
5. Remove the upper exterior rear door handle seal.

6. Remove the exterior door handle bolt.
    - To install, tighten to 7 Nm (62 lb-in).

7. Remove the exterior door handle.

8. To install, reverse the removal procedure.

Exterior Front Door Handle



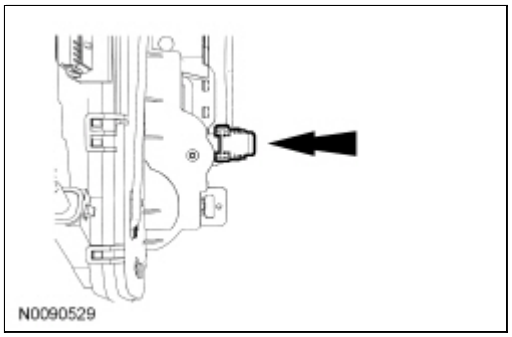
Item	Part Number	Description
1	N620480	Exterior door handle nuts (2 required)
2	W714163	Exterior door handle bolt seal
3	W709562	Exterior door handle bolt
4	1522405/ 1522404	Exterior door handle (LH/RH)

Removal and Installation

NOTE: The door window glass must be completely raised.

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Remove the side impact energy absorption panel.
3. Position the water shield aside.
4. If equipped, disconnect the actuating rod from the door lock cylinder.
5. Open the clip and disconnect the exterior front door handle actuating rod from the front door latch.

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6. If equipped, disconnect the keyless entry keypad electrical connector and disconnect the harness channel from the door.

7. Remove the 2 exterior door handle nuts.
    - To install, tighten to 7 Nm (62 lb-in).

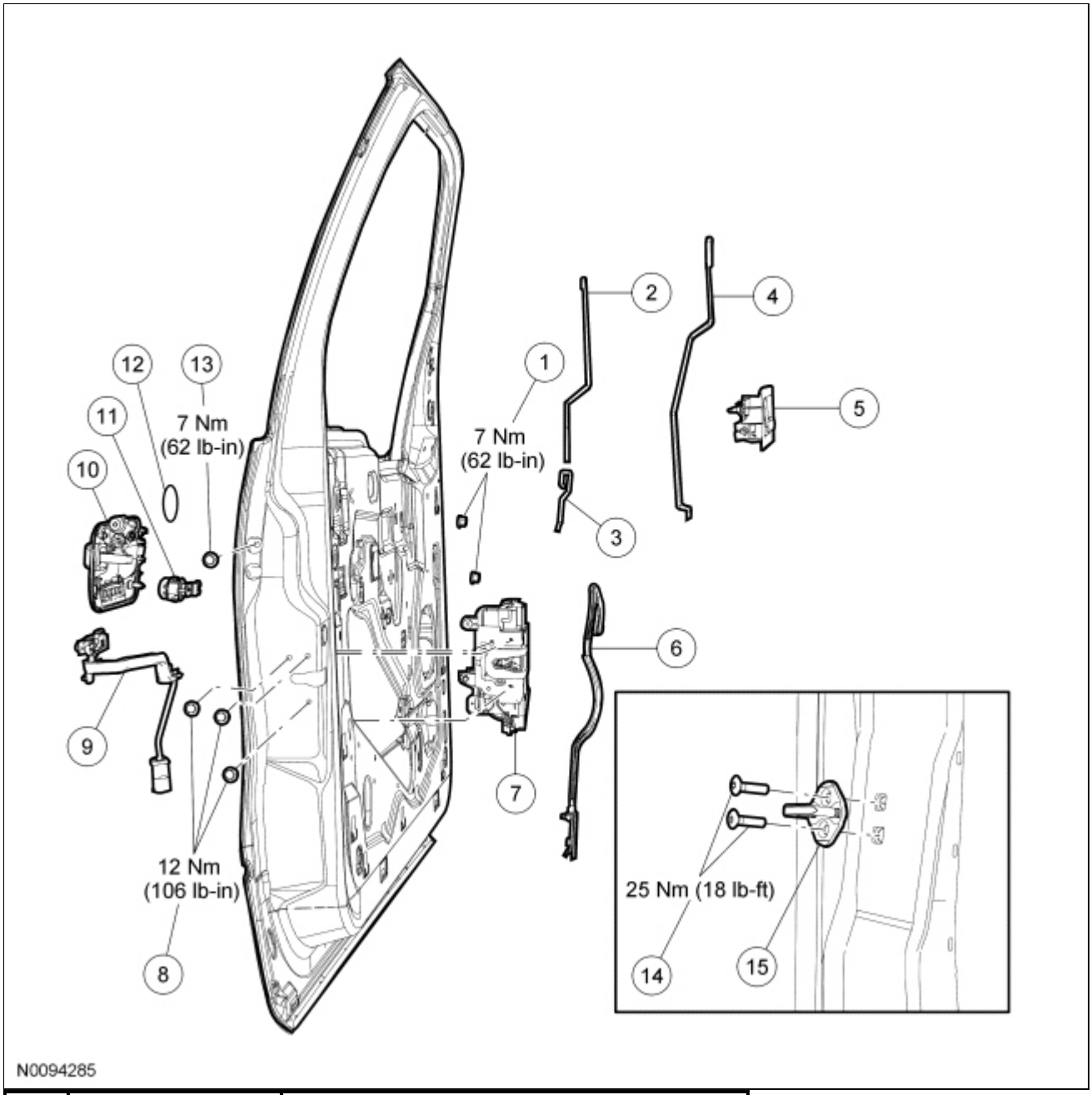
8. Remove the upper exterior front door handle bolt seal.

9. Remove the exterior front door handle bolt.
    - To install, tighten to 7 Nm (62 lb-in).

10. Remove the exterior front door handle.

11. To install, reverse the removal procedure.

Front Door Handles, Locks and Latches — Exploded View



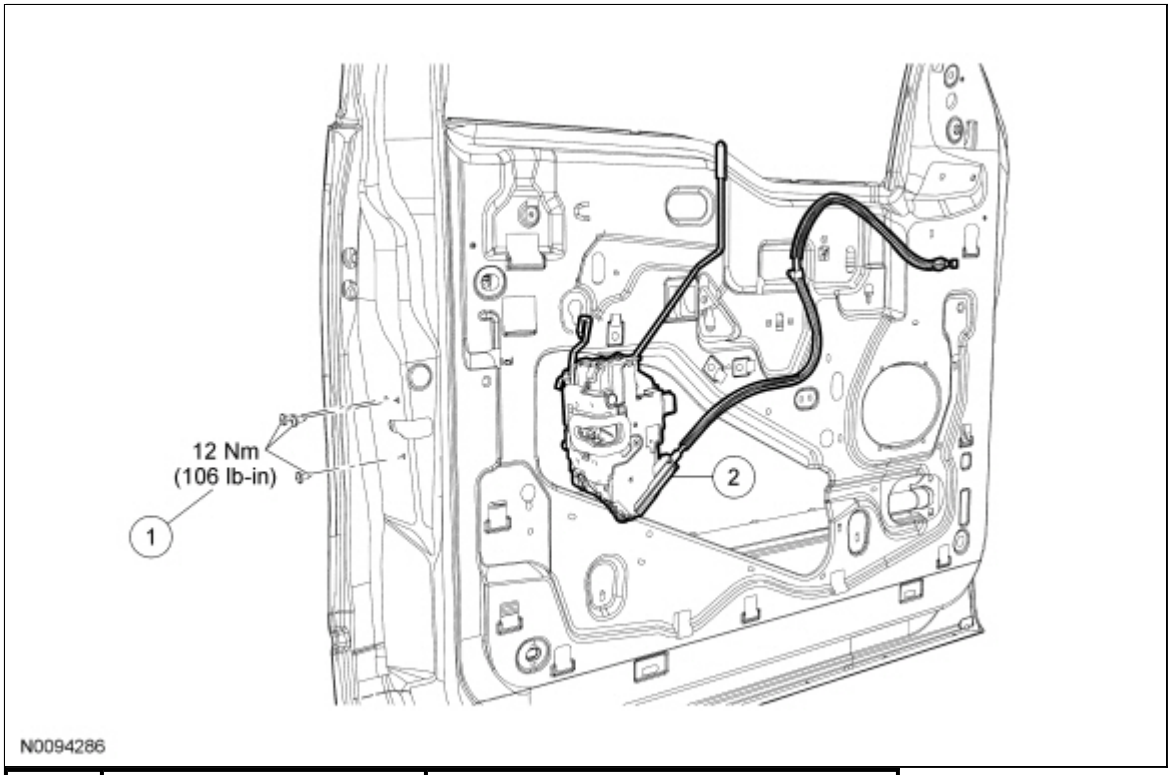
Item	Part Number	Description
1	N620480	Exterior door handle nuts (2 required)
2	1522153/ 1522152	Exterior door handle actuating rod (LH/RH)
3	1522135/ 1522134	Lock cylinder actuating rod (LH/RH)
4	1521853/ 1521852	Door lock rod (LH/RH)

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5	1522601/ 1522600	Interior door handle (LH/RH)
6	63221A00	Door latch release cable
7	5421813/ 5421812	Door latch (LH/RH)
8	W714092	Door latch bolts (3 required)
9	14A626	Keyless entry keypad (if equipped)
10	1522405/ 1522404	Exterior door handle (LH/RH)
11	1521990	Door lock cylinder
12	W714163	Exterior door handle bolt seal
13	W709562	Exterior door handle bolt
14	W714017	Door latch striker bolts (2 required)
15	1522008	Door latch striker

1. For additional information, refer to the procedures in this section.

Front Door Latch



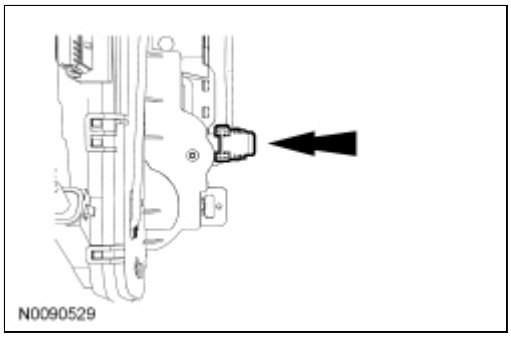
Item	Part Number	Description
1	W714092	Door latch bolts (3 required)
2	5421813/ 5421812	Door latch (LH/RH)

Removal and Installation

NOTE: The door window glass must be completely raised.

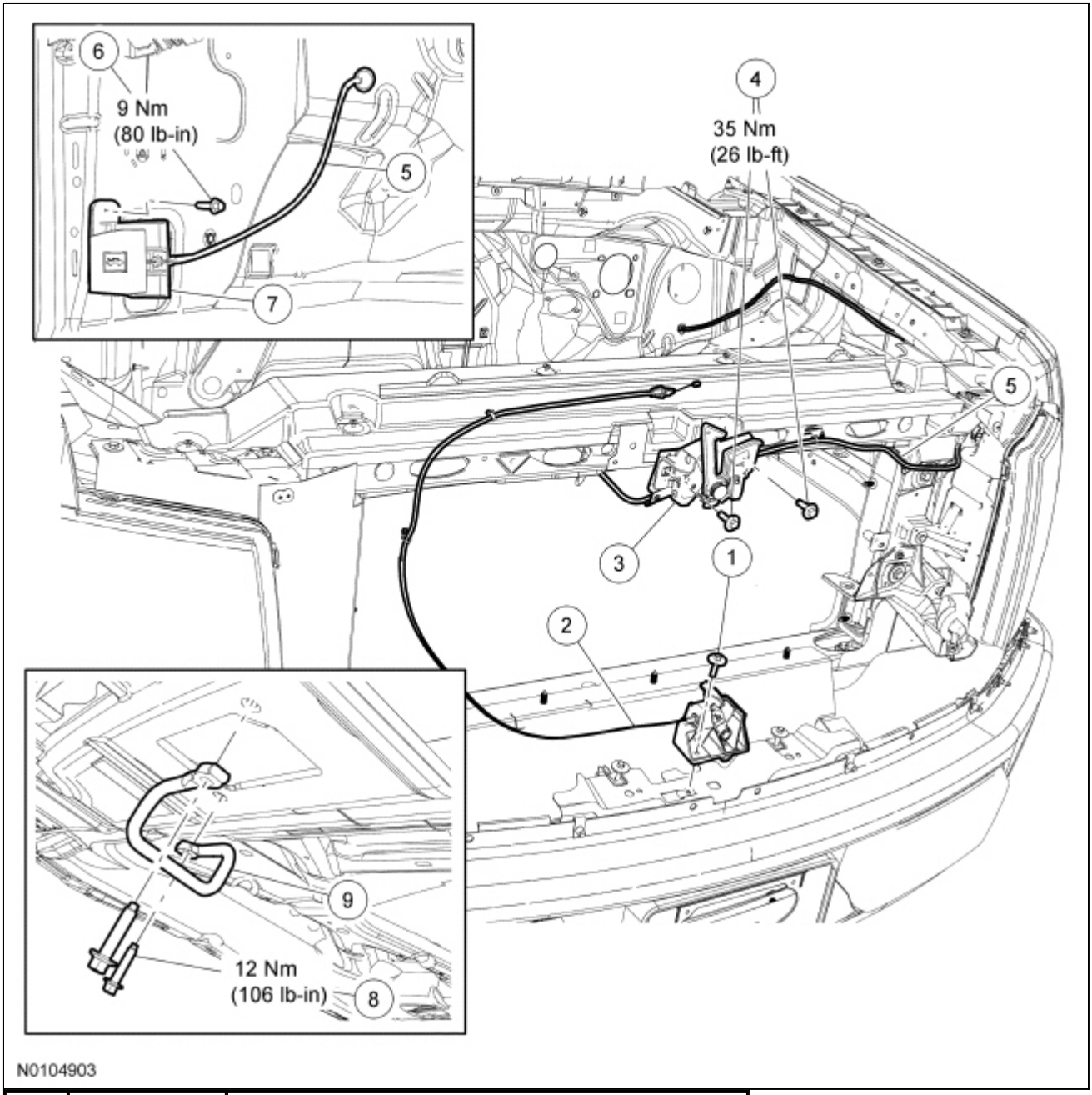
1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Remove the side impact energy absorption panel.
3. Position the water shield aside.
4. Release the interior front door handle actuating cable from the locating clip.
5. Disconnect the front door latch electrical connector.
6. If equipped, disconnect the actuating rod from the door lock cylinder.
7. Open the clip and disconnect the exterior front door handle actuating rod from the front door latch.

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8. Remove the 3 door latch bolts.
    - To install, tighten to 12 Nm (106 lb-in).
9. Remove the front door latch.
10. To install, reverse the removal procedure.

Hood Latch and Components — Exploded View



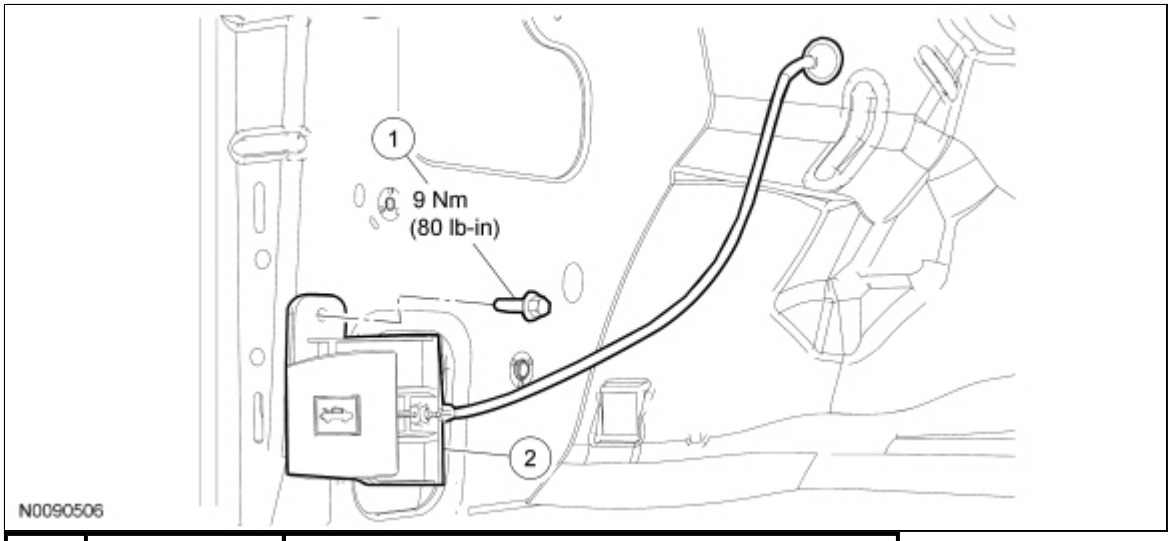
Item	Part Number	Description
1	W505425	Secondary hood latch release handle bolt
2	16916	Secondary hood latch release handle and cable
3	16700	Hood latch
4	W711848	Hood latch bolts (2 required)

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5	16916	Primary hood latch release cable
6	W707722	Primary hood latch release handle bolt
7	16916	Primary hood latch release handle
8	W500215	Hood latch striker bolts (2 required)
9	16K689	Hood latch striker

1. For additional information, refer to the procedures in this section.

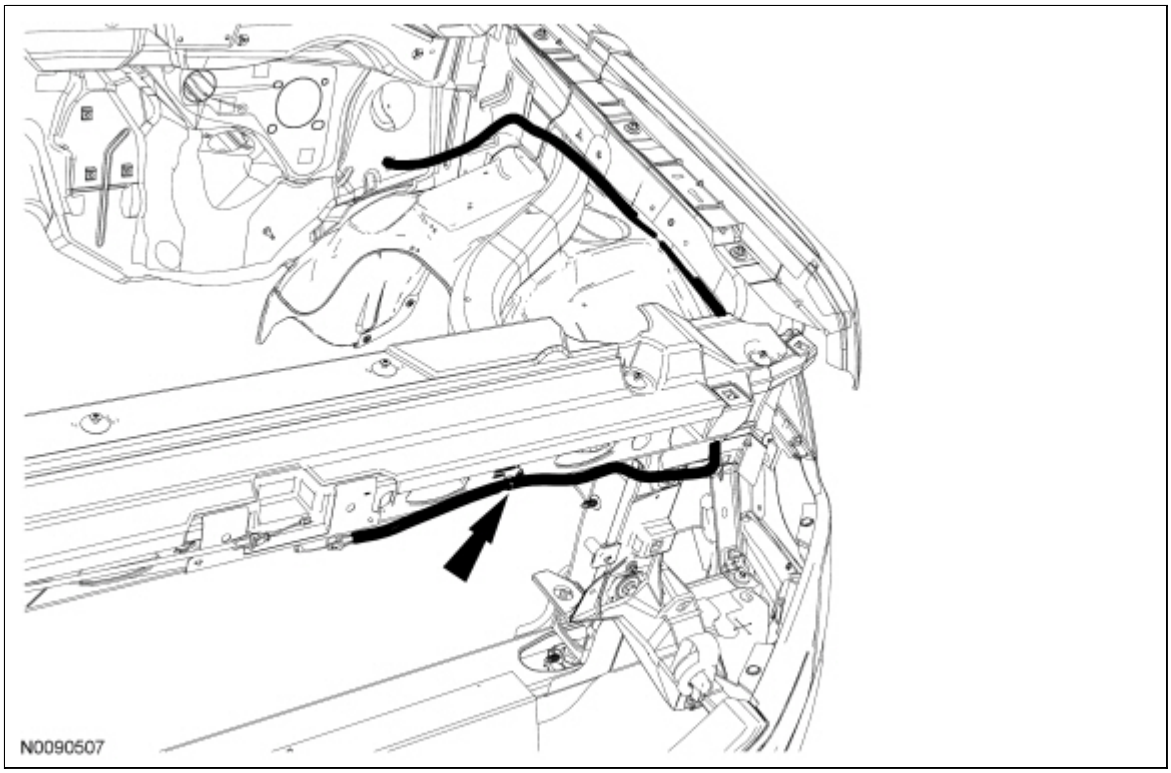
Hood Latch Release Handle — Primary



Item	Part Number	Description
1	N805375	Primary hood latch release handle bolt
2	16916	Primary hood latch release handle and cable

Primary Hood Latch Release Cable Routing

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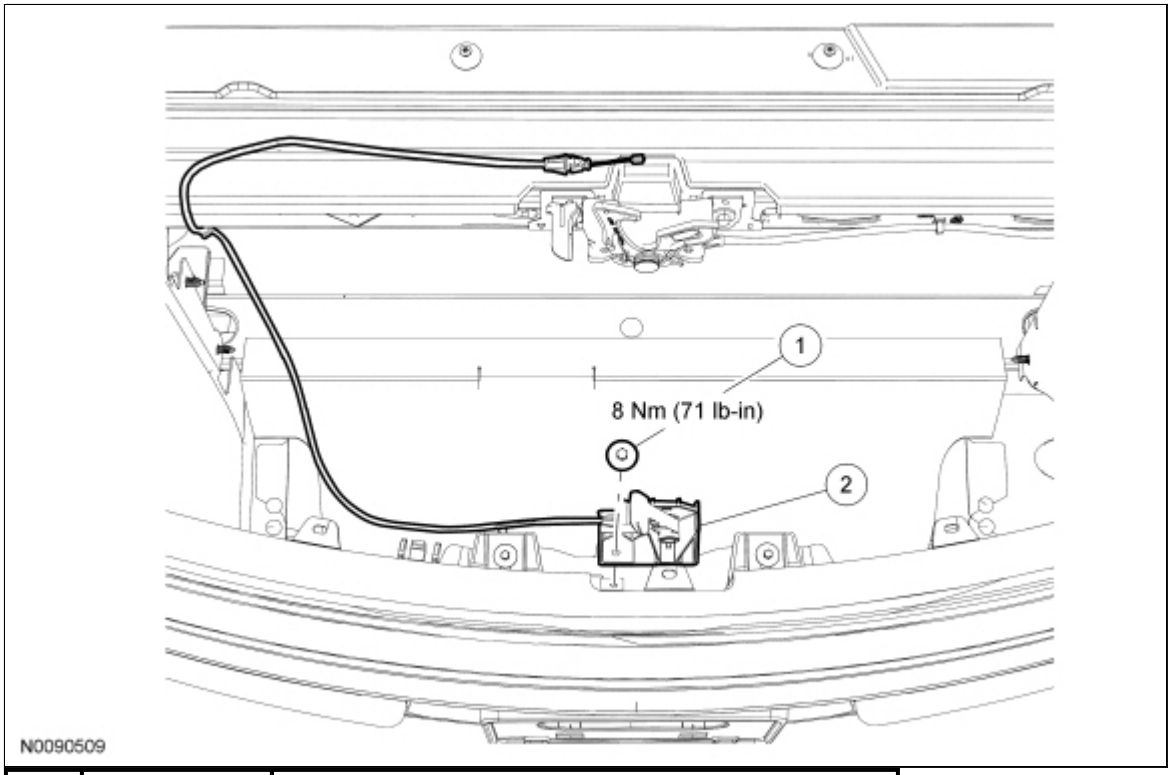


Removal and Installation

1. Remove the hood latch. For additional information, refer to Hood Latch in this section.
2. Remove the air cleaner element. For additional information, refer to Section 303-12 .
3. Remove the degas bottle bolts and position the degas bottle assembly aside.
4. Remove the cowl side trim panel. For additional information, refer to Section 501-05 .
5. Remove the primary hood latch release handle bolt.
    - To install, tighten to 9 Nm (80 lb-in).
6. Release the cable locators and remove the primary hood latch release cable.
7. To install, reverse the removal procedure.
    - When the hood latch is installed, the latch adjustment must be checked to make sure the latch is installed and aligned correctly.

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Hood Latch Release Handle — Secondary



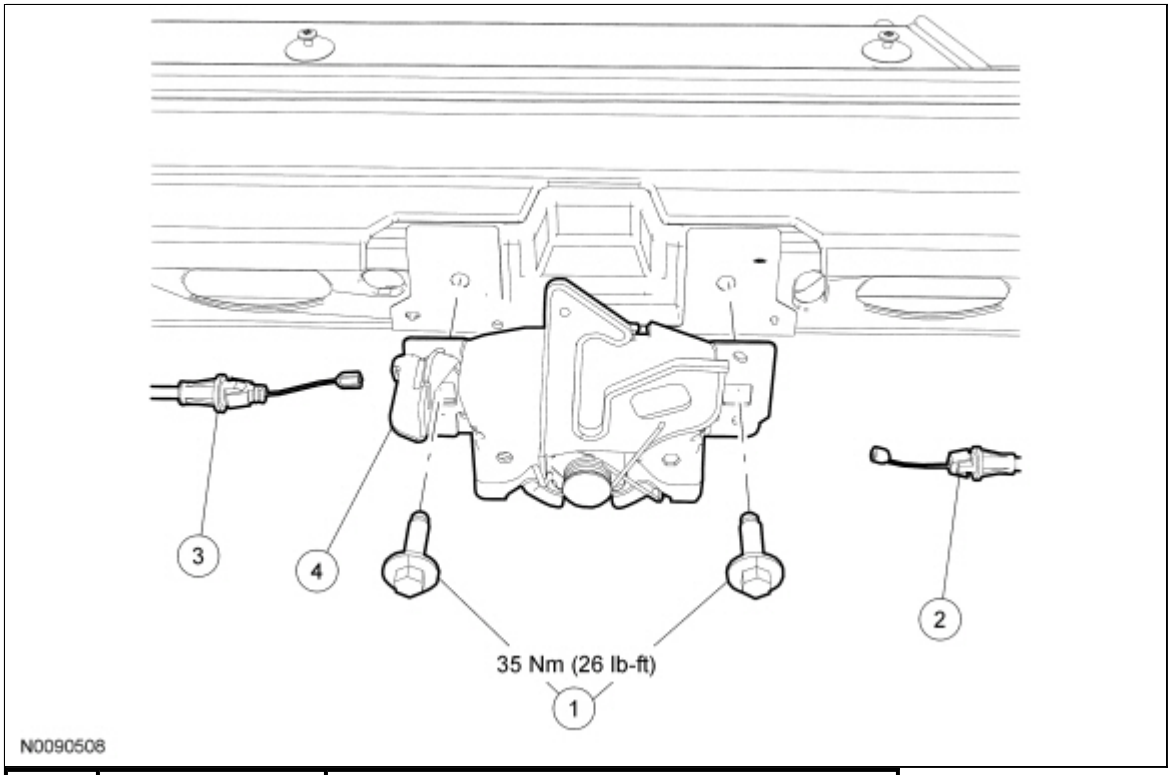
Item	Part Number	Description
1	W711848	Secondary hood latch release handle bolt
2	16916	Secondary hood latch release handle and cable

Removal and Installation

1. Disconnect the secondary hood latch release cable from the hood latch.
2. Disconnect the secondary hood latch release cable from the guide clips.
3. Remove the secondary hood latch release handle bolt.
    - To install, tighten to 8 Nm (71 lb-in).
4. Remove the secondary hood latch release.
5. To install, reverse the removal procedure.

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Hood Latch



Item	Part Number	Description
1	W711848	Hood latch bolts (2 required)
2	16916	Primary hood latch release cable
3	16916	Secondary hood latch release cable
4	16700	Hood latch

Removal and Installation

1. **NOTE:** Mark the location of the hood latch with a permanent-type marker.

   Remove the 2 hood latch bolts and position the hood latch aside.
   - To install, tighten to 35 Nm (26 lb-ft).

2. Disconnect the primary hood latch release cable.

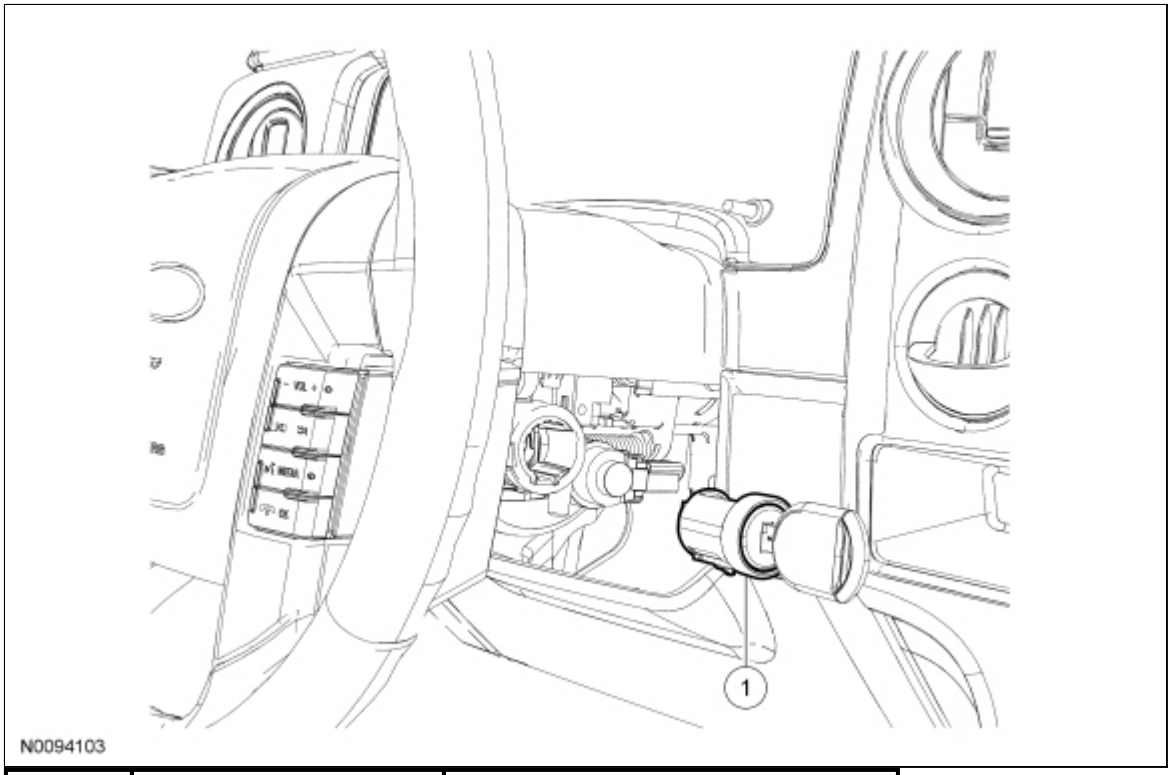
3. Disconnect the secondary hood latch release cable.

4. Remove the hood latch.

5. To install, reverse the removal procedure.
   - When the hood latch is installed, the latch adjustment must be checked to make sure the latch is installed and aligned correctly.

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Ignition Lock Cylinder — Functional



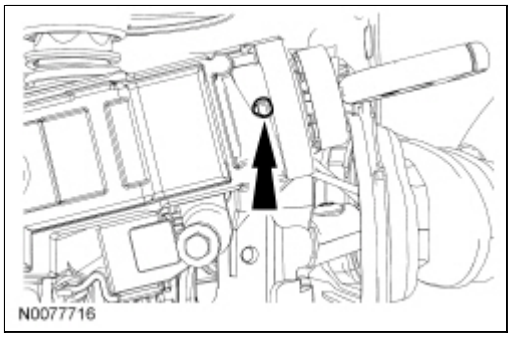
Item	Part Number	Description
1	11582	Ignition lock cylinder

Removal

NOTE: The individual lock cylinders are repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build a new lock cylinder to the current key code of the vehicle.

1. Remove the Passive Anti-Theft System (PATS) transceiver. For additional information, refer to Section 419-01B .

2. With the ignition switch in the ACC position, press the locking pin with a suitable tool and remove the lock cylinder.



Installation

1. Make sure the lock cylinder is in the ACC position.

2. Insert the ignition lock cylinder into the ignition lock cylinder access hole located on the steering column.
    - Make sure to align the locking pin with the locking pin access hole.

3. Rotate the ignition key through all lock cylinder positions to check for correct operation.

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Ignition Lock Cylinder — Non Functional

Removal

1. Remove the Passive Anti-Theft System (PATS) transceiver. For additional information, refer to Section 419-01B .

2. Remove the ignition lock cylinder.
   - Use a 1/8-inch diameter drill bit to drill out the lock cylinder retaining pin.
   - Remove and discard the ignition lock cylinder and drill shavings from the steering column.

3. Remove the bearing retainer.

4. Remove the steering column lock housing bearing and steering column lock gear.

Installation

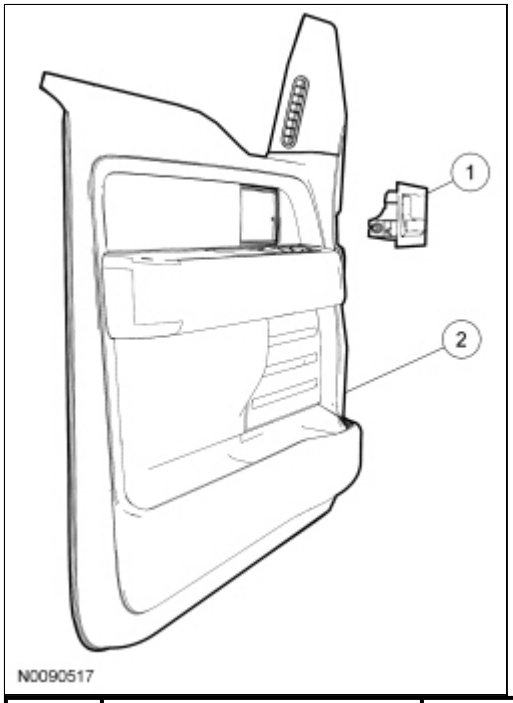
1. Thoroughly clean all drill shavings from the steering column and inspect it for damage.

2. Install a new ignition lock cylinder.
   - Verify the ignition lock cylinder operation.

3. If needed, program the new PATS keys. For additional information, refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in Section 419-01B .

Interior Door Handle — Front

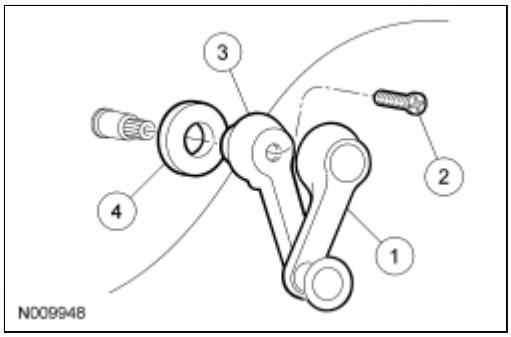
NOTE: LH side shown, RH similar.



Item	Part Number	Description
1	1522601/ 1522600	Interior door handle (LH/RH)
2	1823943/ 1823942	Door trim panel (LH/RH)

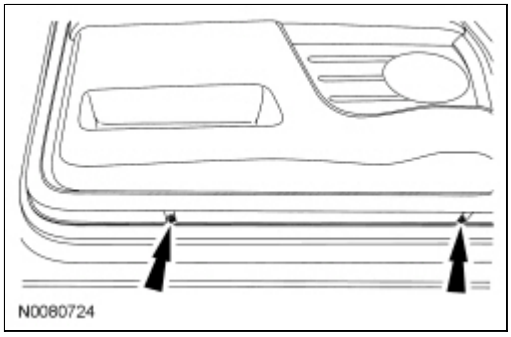
Removal and Installation

1. If equipped, remove the window regulator handle.
    1. Separate the handle cover from the handle.
    2. Remove the screw.
    3. Remove the window regulator handle.
    4. Remove the spacer.

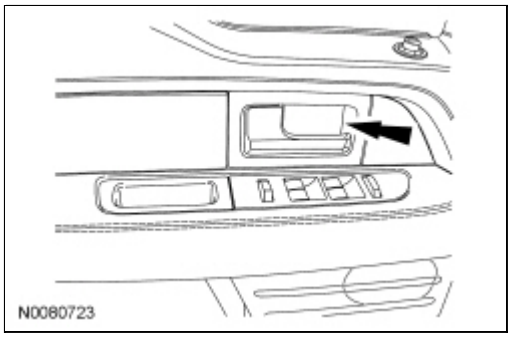


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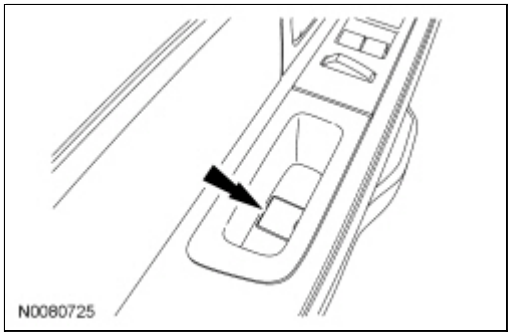
2. Remove the 2 front door trim panel lower screws.



3. Remove the door handle screw cover and screw.



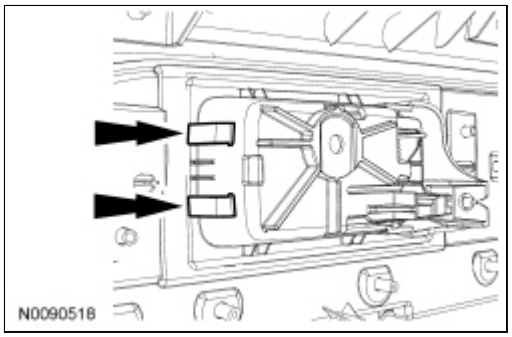
4. Remove the pull cup screw cover and screw.



5. ***NOTICE:*** **Do not pull directly outward on the front door trim panel, as damage may occur.**

   Position the front door trim panel outward.
   - Lift upward to remove the front door trim panel and position outward.
   - Disconnect the interior handle activating cable from the interior door handle.

6. Release the interior door handle retaining tabs and remove the interior door handle.

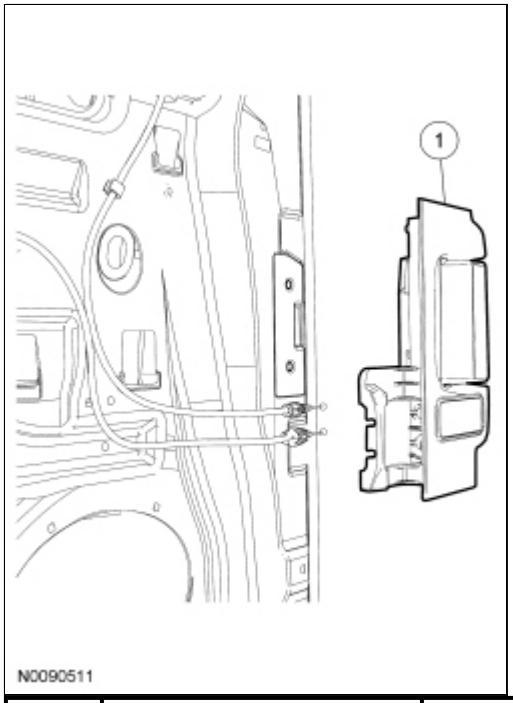


7. To install, reverse the removal procedure.

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Interior Door Handle — SuperCab

NOTE: LH side shown, RH similar.



Item	Part Number	Description
1	1822601/ 1822600	Interior door handle (LH/RH)

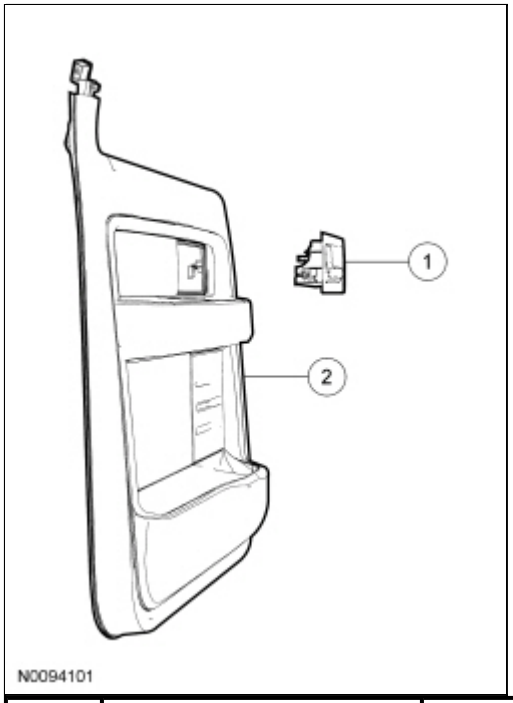
Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Disconnect the upper door latch release cable from the interior door handle.
3. Disconnect the lower door latch release cable from the interior door handle, and remove the interior door handle.
4. To install, reverse the removal procedure.

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Interior Door Handle — SuperCrew

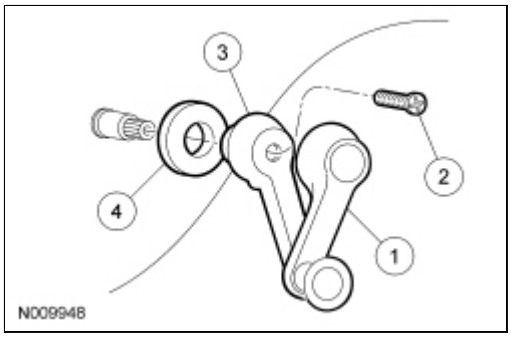
NOTE: LH side shown, RH similar.



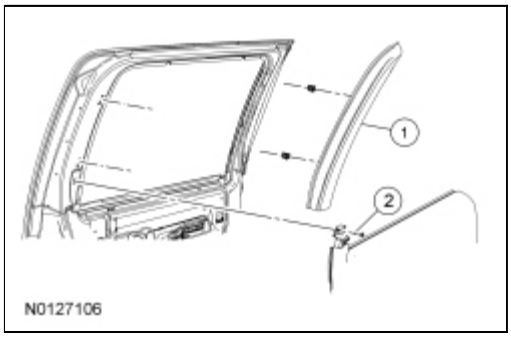
Item	Part Number	Description
1	1822601/ 1822600	Interior door handle (LH/RH)
2	1627407/ 1627406	Door trim panel (LH/RH)

Removal and Installation

1. If equipped, remove the window regulator handle.
    1. Separate the handle cover from the handle.
    2. Remove the screw.
    3. Remove the window regulator handle.
    4. Remove the spacer.



2. Remove the rear door garnish moulding.
    1. Pull outward to release the rear door garnish moulding clips from the door.
    2. Remove the upper rear door trim panel screw.



3. Remove the rear door handle cover plate.

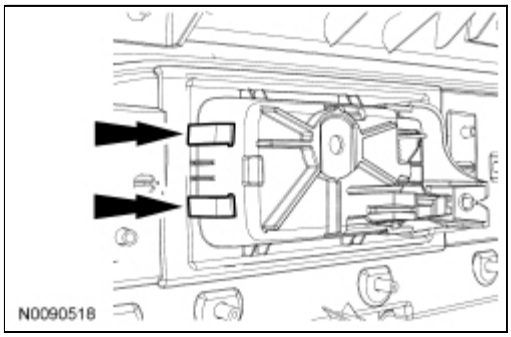
4. Remove the rear door handle screw.

5. Remove the 2 rear door trim panel screws.

6. ***NOTICE:*** **Do not pull directly outward on the rear door trim panel. Damage may occur.**

   Position the rear door trim panel outward.
    - Lift upward to remove the rear door trim panel and position outward.
    - Disconnect the interior handle activating cable from the interior door handle.

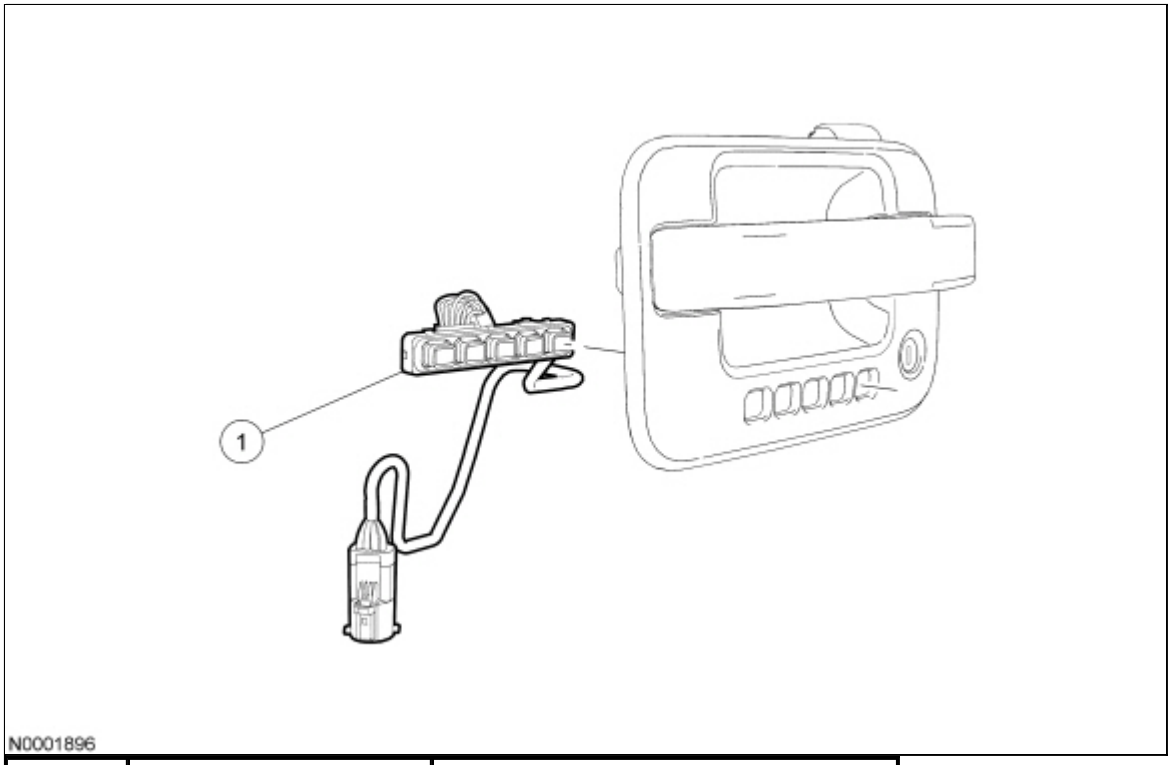
7. Release the interior door handle retaining tabs and remove the interior door handle.



8. To install, reverse the removal procedure.

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Keyless Entry Keypad



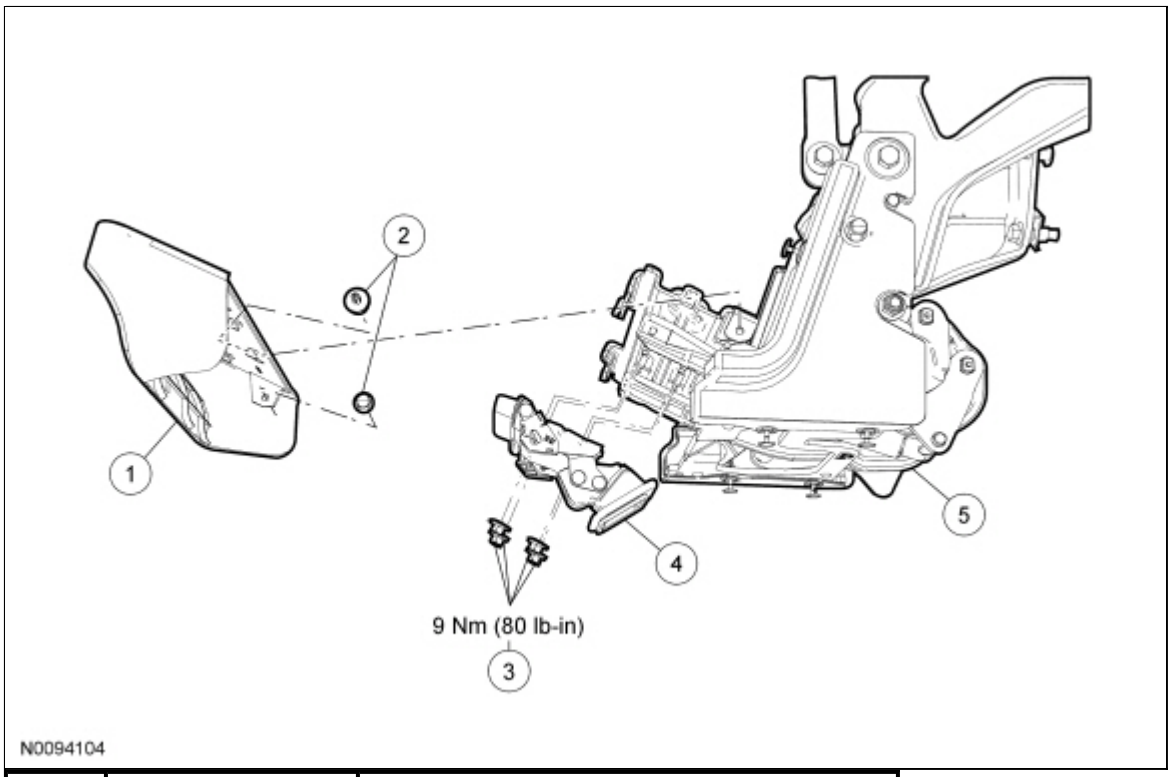
Item	Part Number	Description
1	14A626	Keyless entry keypad

Removal and Installation

1. Remove the exterior front door handle. For additional information, refer to Exterior Front Door Handle in this section.
2. Release the locking tabs and remove the keyless entry keypad.
3. To install, reverse the removal procedure.

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Pickup Bed Side Step Latch



Item	Part Number	Description
1	1520044	Step cover
2	W505153	Step cover screws (2 required)
3	—	Step latch nuts (4 required)
4	1516516	Step latch
5	—	Step assembly

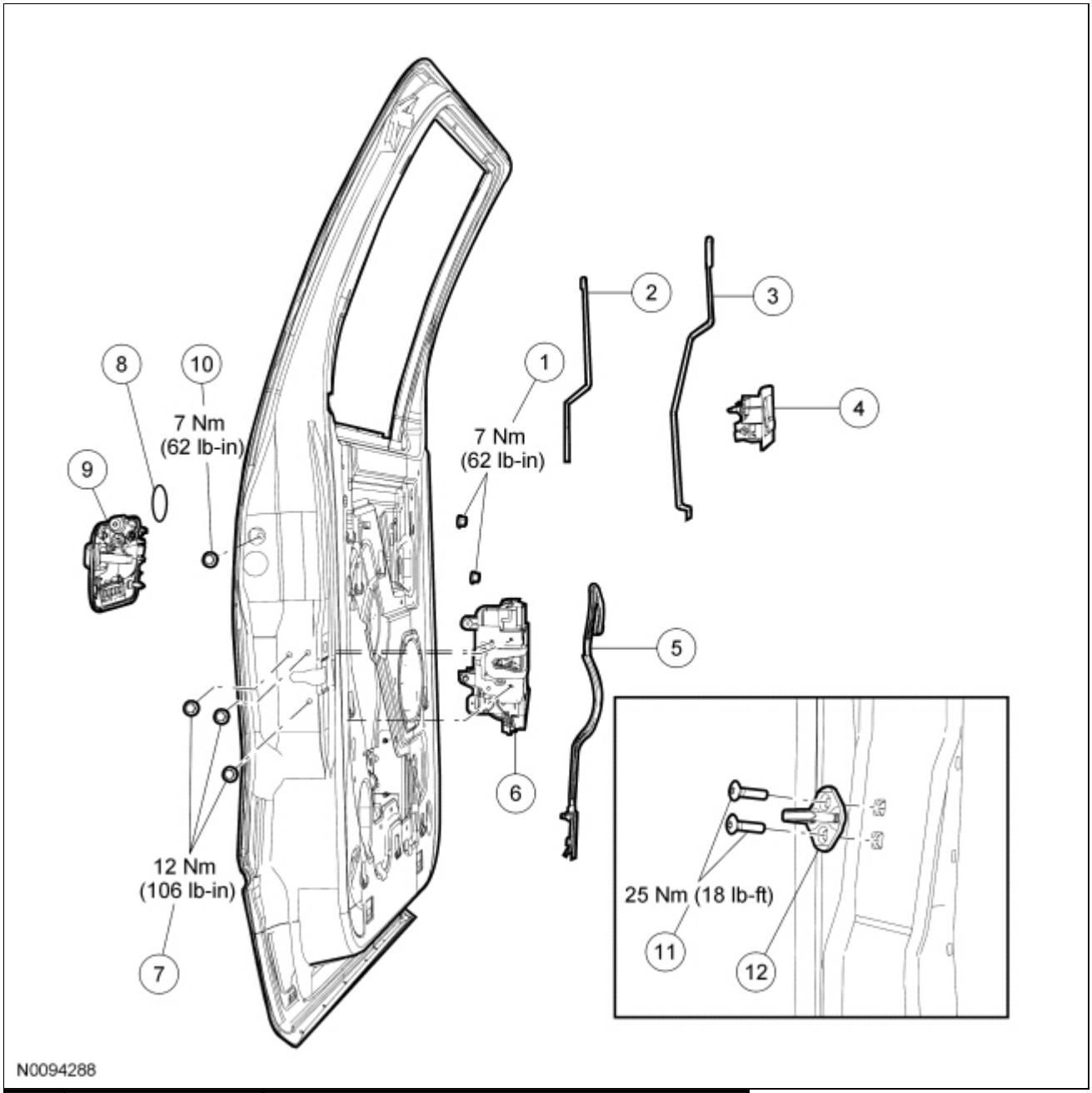
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Open the step to the full extended position.
3. Remove the 2 step cover screws.
4. Slide the step cover off the step.
5. Remove the 4 latch nuts and the latch.
    - To install, tighten to 9 Nm (80 lb-in).

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6. To install, reverse the removal procedure.

Rear Door Handles, Locks and Latches — Exploded View, Super Crew



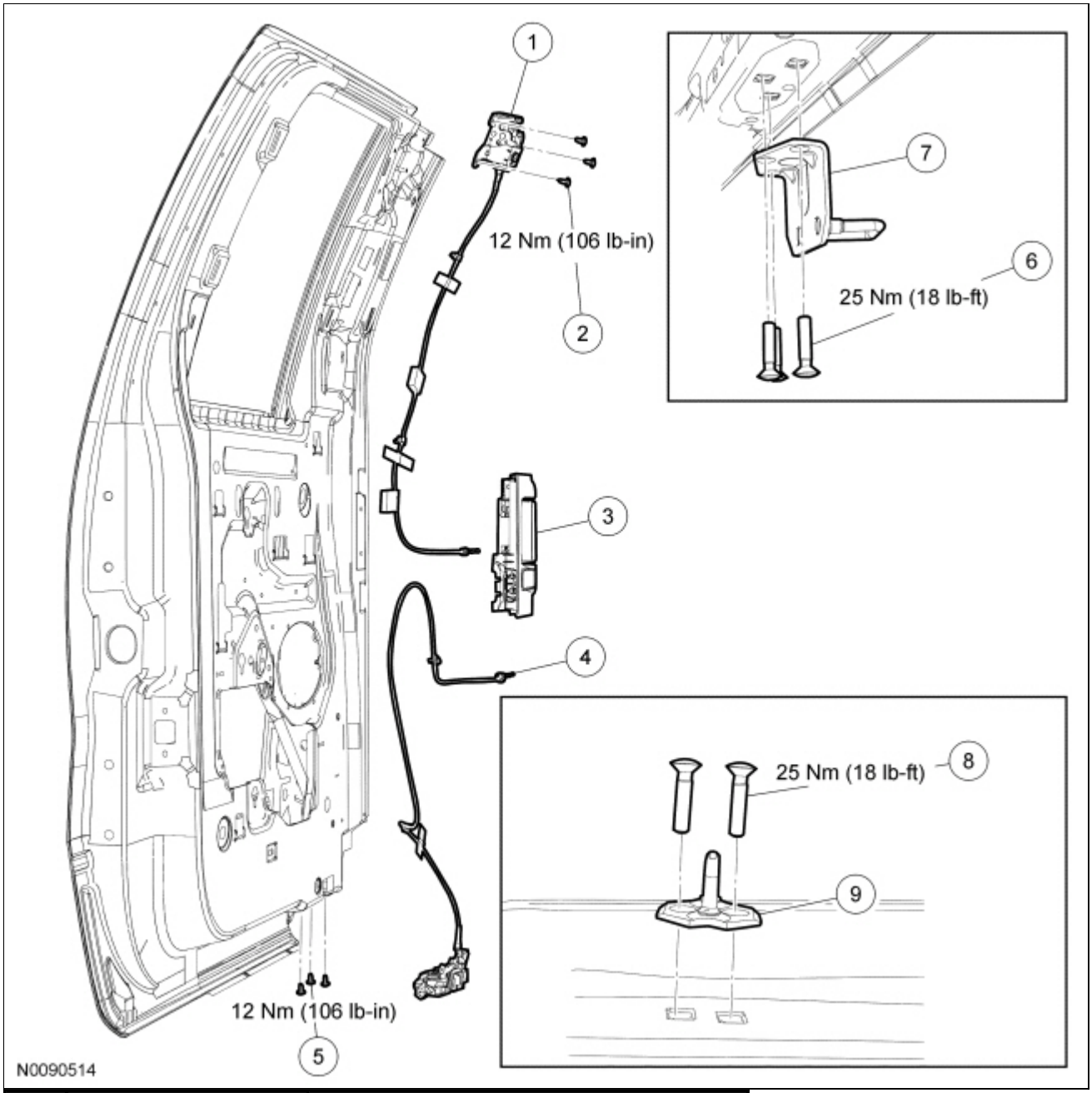
Item	Part Number	Description
1	N620480	Exterior door handle nuts (2 required)
2	1626461/ 1626460	Exterior rear door handle actuating rod (LH/RH)
3	1522152	Door lock rod
4	1822601/ 1822600	Interior door handle (LH/RH)

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5	54221A00	Door latch release cable
6	5426413/ 5426412	Door latch (LH/RH)
7	W714092	Door latch bolts (3 required)
8	W714163	Exterior rear door handle seal
9	1626605/ 1626604	Exterior rear door handle (LH/RH)
10	W709562	Exterior rear door handle bolt
11	W714017	Door latch striker bolts (2 required)
12	1522008	Door latch striker

1. For additional information, refer to the procedures in this section.

Rear Door Handles, Locks and Latches — Exploded View, SuperCab



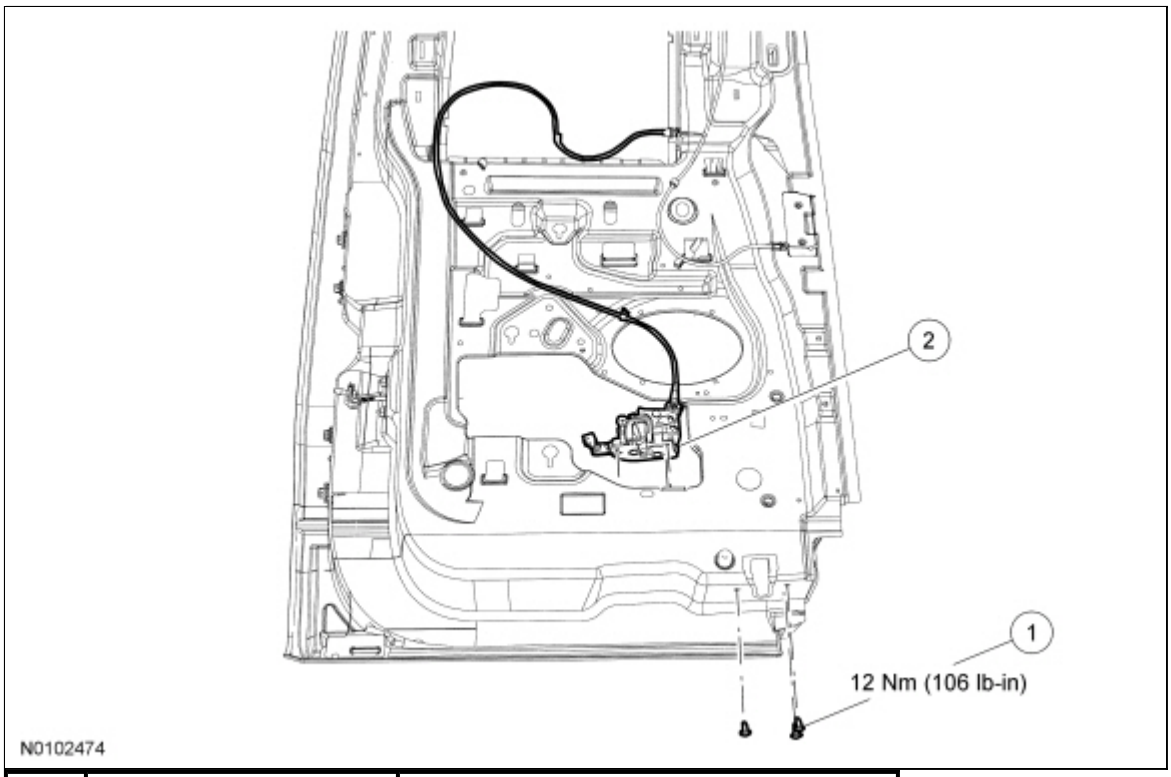
Item	Part Number	Description
1	18264A01/ 18264A00	Upper door latch and cable (LH/RH)
2	W714092	Upper door latch bolts (3 required)
3	1822601/ 1822600	Interior door handle (LH/RH)
4	18264A01/ 18264A00	Lower door latch and cable (LH/RH)

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5	W714092	Lower door latch bolts (3 required)
6	W710881	Upper door latch striker bolts (3 required)
7	18265A05/ 18265A04	Upper door latch striker (LH/RH)
8	W710881	Lower door latch striker bolts (2 required)
9	18264B70	Lower door latch striker

1. For additional information, refer to the procedures in this section.

Rear Door Latch — Lower, SuperCab



Item	Part Number	Description
1	W714092	Lower door latch bolts (3 required)
2	18264A01/ 18264A00	Lower door latch and cable (LH/RH)

Removal and Installation

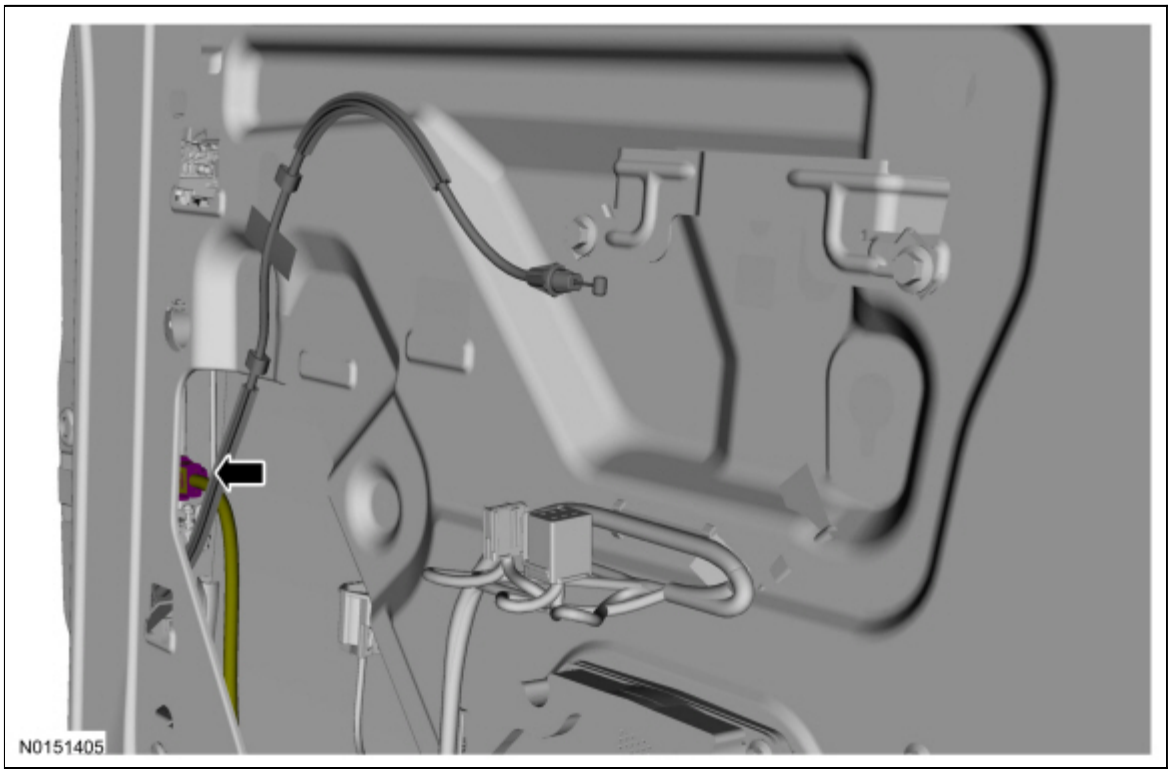
1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Position the water shield aside.
3. Disconnect the door ajar switch electrical connector.
4. Disconnect the lower door latch actuating cable from the interior door handle.
5. Remove the interior door handle actuating cable from the guide clips.
6. Remove the 3 lower door latch bolts and the lower door latch.
   - To install, tighten to 12 Nm (106 lb-in).
7. To install, reverse the removal procedure.

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Rear Door Latch — SuperCrew

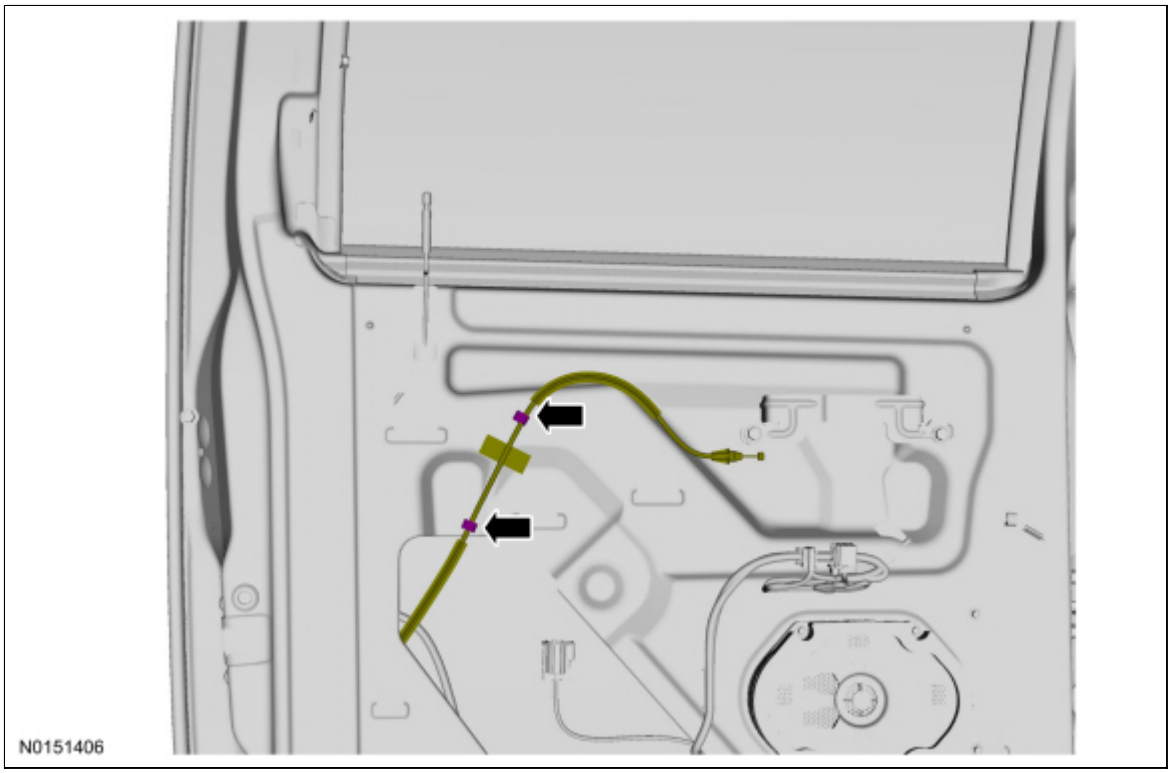
Removal and Installation

1. Remove the rear window regulator and motor. For additional information, refer to Section 501-11 .
2. Disconnect the rear door latch electrical connector.

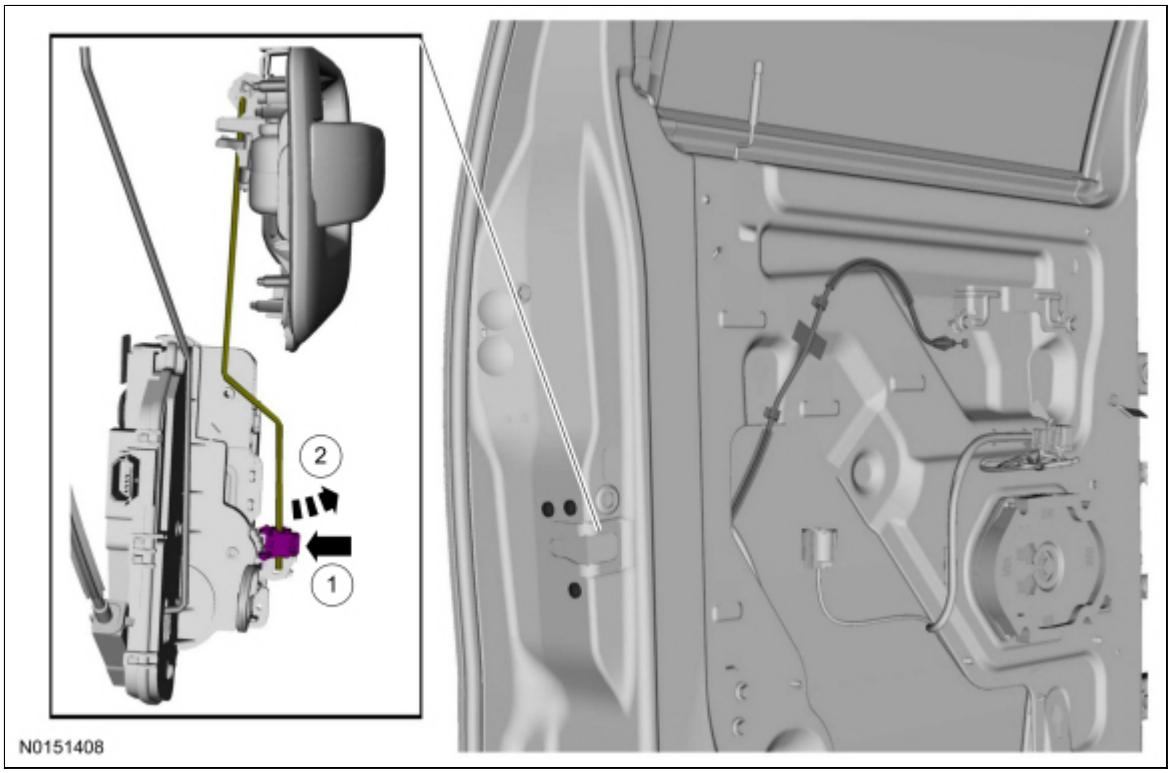


3. Disconnect the 2 rear inside door handle cable routing clips from the door.

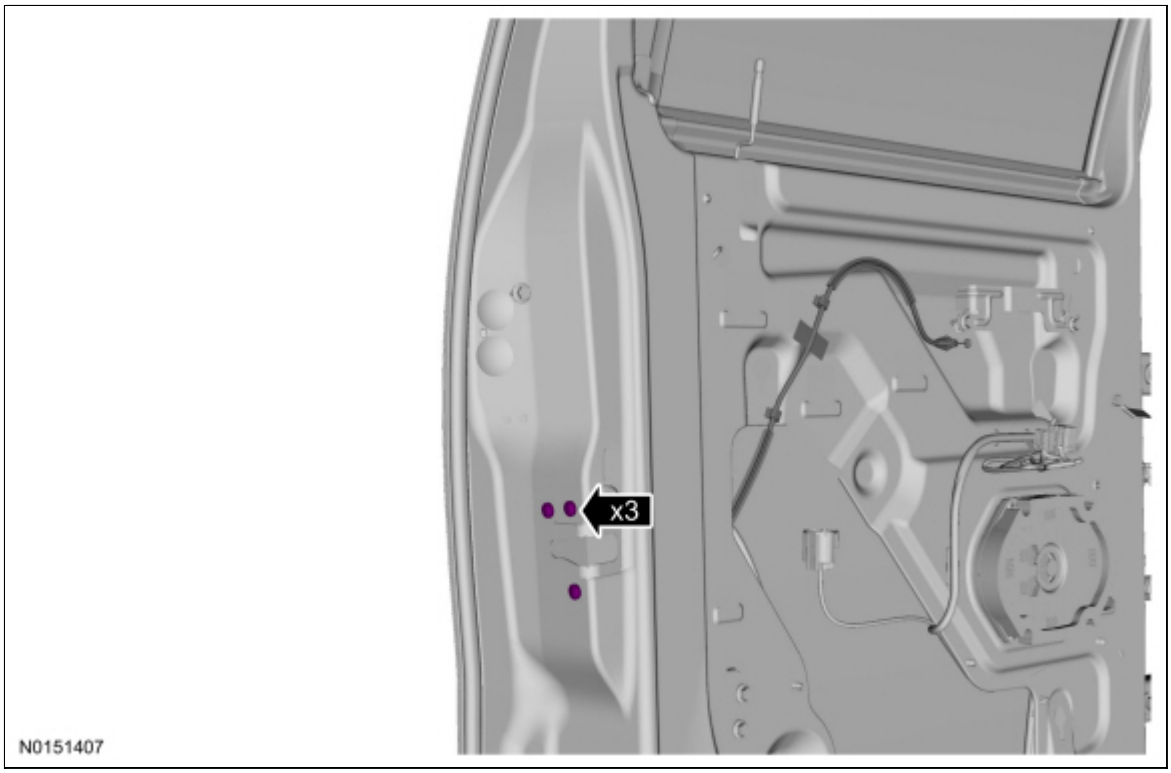
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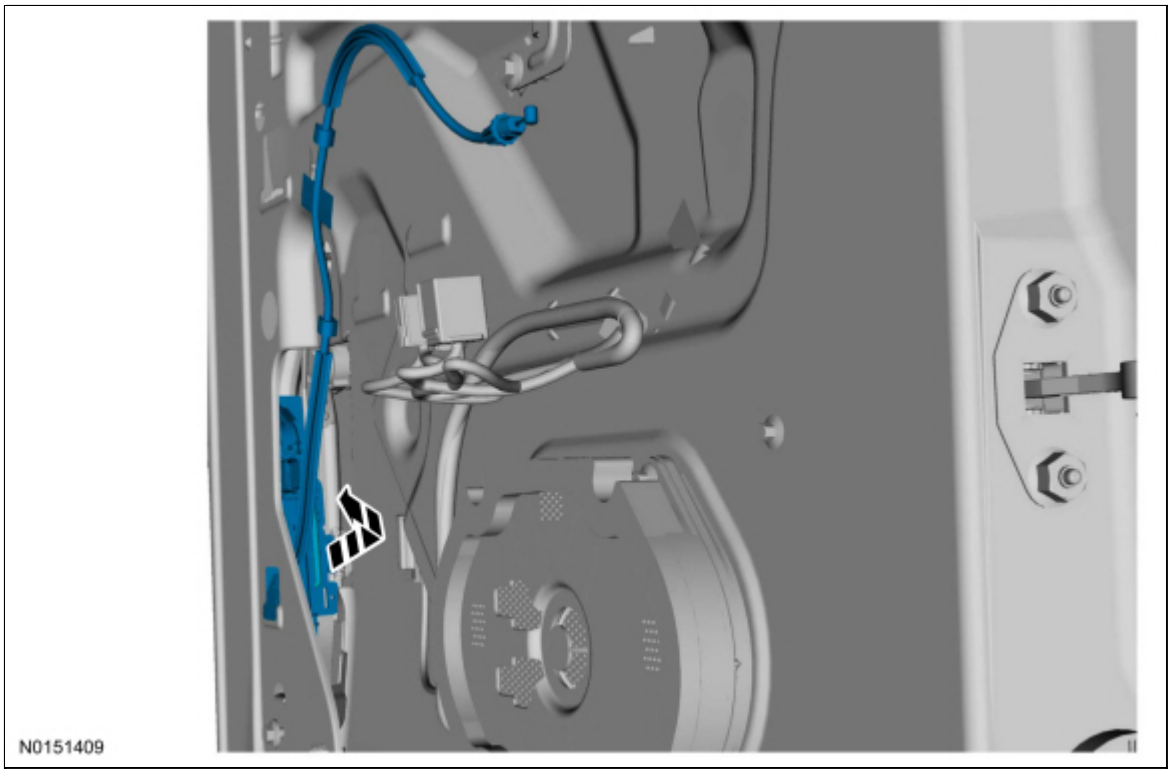
4. Open the clip and disconnect the exterior rear door handle actuating rod from the latch.



5. Remove the 3 door latch bolts.
    - To install, tighten to 12 Nm (106 lb-in).



6. Remove the latch.



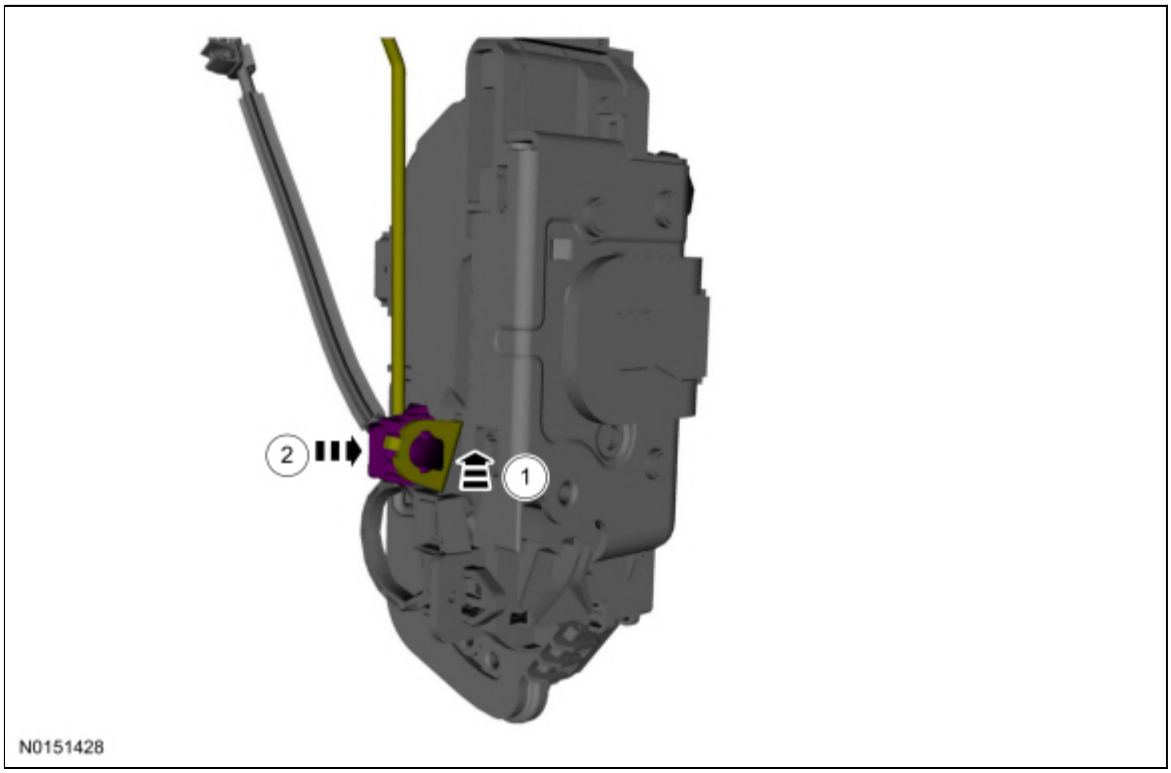
Installation

1. ***NOTICE:*** **Ensure the latch lever is in the relaxed (all the way up) position prior to connecting**

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the exterior rear door handle actuating rod to the latch. Do not apply downward pressure when connecting the exterior rear door handle actuating rod to the latch this could result in improper operation of the power door lock.

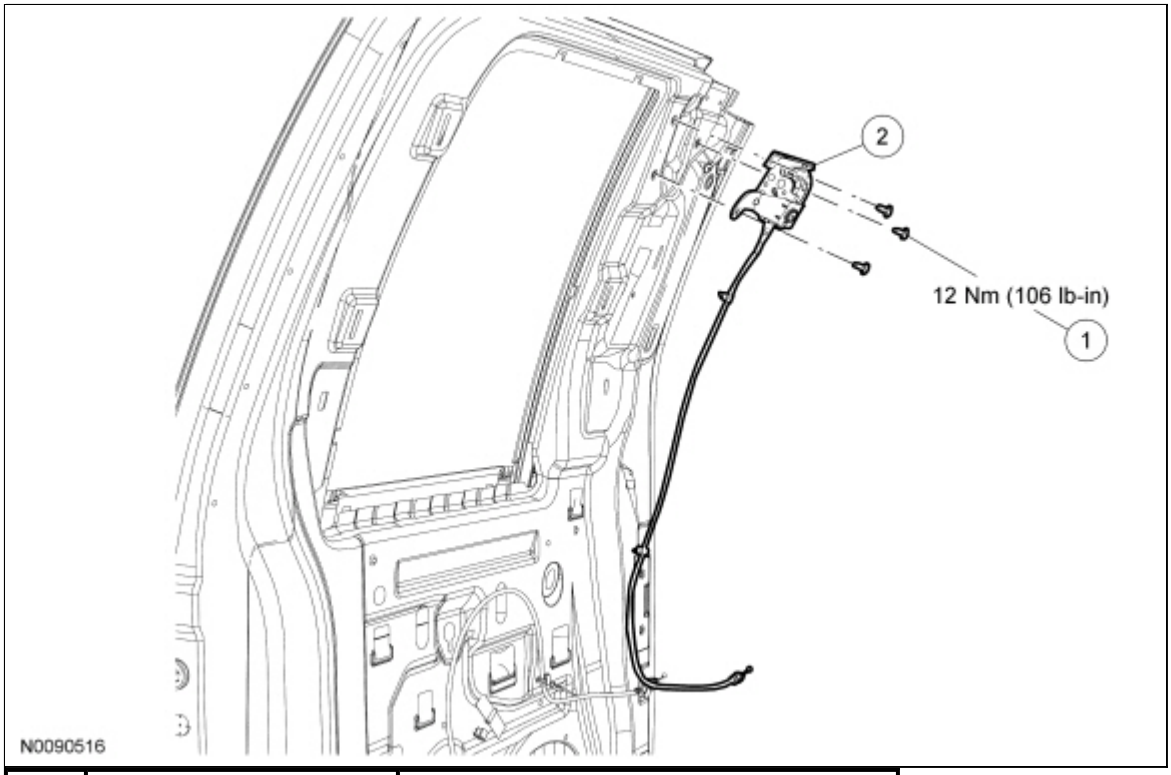
To install, reverse the removal procedure.



2. Check for proper operation.
    1. Lock the doors using the power door lock switch.
    2. Attempt to open the door using the exterior door handle.
    3. If the door opens, locate the clip on the latch and re-adjust the position of the clip on the door handle actuating rod.

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Rear Door Latch — Upper, SuperCab



Item	Part Number	Description
1	W714092	Upper door latch bolts (3 required)
2	18264A01/ 18264A00	Upper door latch and cable (LH/RH)

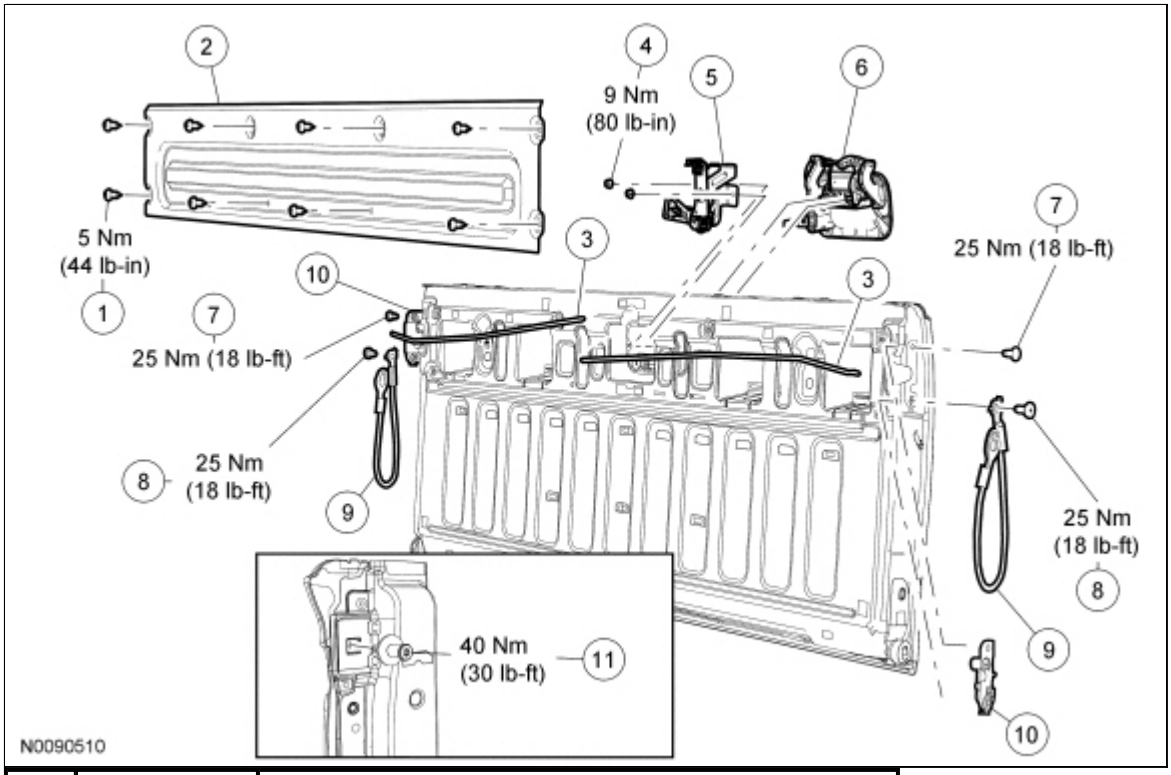
Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Disconnect the upper door latch actuating cable from the interior door handle.
3. Remove the interior door handle actuating cable from the guide clips.
4. Remove the 3 upper door latch bolts and the upper door latch.
    - To install, tighten to 12 Nm (106 lb-in).
5. To install, reverse the removal procedure.

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Tailgate Handle, Lock and Latches — Exploded View

NOTE: Conventional tailgate without step shown, others similar.



Item	Part Number	Description
1	—	Tailgate access panel screws (8 required for conventional tailgate, 7 for flareside, and 13 for step tailgate)
2	—	Tailgate access panel
3	—	Tailgate latch actuating rods
4	N620480	Tailgate remote control nuts (2 required)
5	9943170	Tailgate remote control
6	9943400	Tailgate release handle
7	N806910	Tailgate latch bolt (upper)
8	W711291	Tailgate latch bolt (lower)
9	5443053/ 5443052	Tailgate latch cable (LH/RH)
10	9943150	Tailgate latches
11	99404A42	Tailgate latch striker

1. For additional information, refer to the procedures in this section.

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Tailgate Latch Remote Control

Removal and Installation

1. If equipped, remove the tailgate step assist handle. For additional information, refer to Section 501-04 .

2. Remove the bolts and the tailgate access panel (7 bolts for flareside bed, 8 for without step tailgate, or 13 with step tailgate).
   - To install, tighten to 5 Nm (44 lb-in).

3. Open the 2 clips and release the 2 tailgate latch actuating rods from the tailgate remote control.

4. If equipped, release the tailgate latch actuating rod locator from the tailgate.

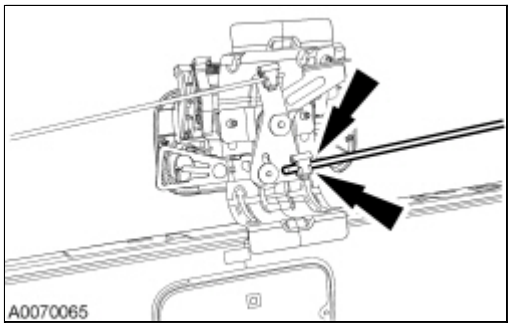
5. Remove the 2 tailgate release handle nuts and the tailgate remote control.
   - To install, tighten to 9 Nm (80 lb-in).

6. To install, reverse the removal procedure.

Tailgate Latch

Removal and Installation

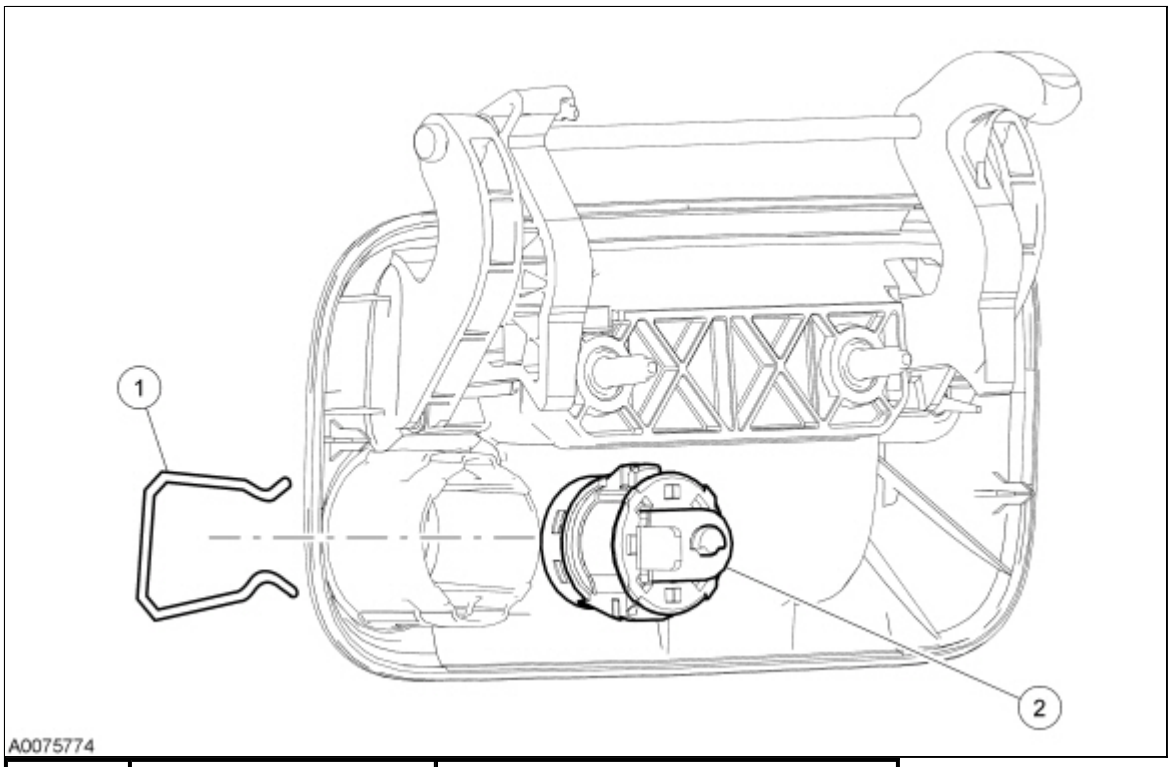
1. Open and support the tailgate.
2. If equipped, remove the tailgate step assist handle. For additional information, refer to Section 501-04 .
3. Remove the bolts and the tailgate access panel (7 bolts for flareside bed, 8 for without step tailgate, or 13 with step tailgate).
   - To install, tighten to 5 Nm (44 lb-in).
4. Open the clip and release the tailgate latch actuating rod from the tailgate remote control.



5. If equipped, release the tailgate latch actuating rod locator from the tailgate.
6. Remove the upper tailgate latch bolt.
   - To install, tighten to 25 Nm (18 lb-ft).
7. Remove the lower tailgate latch bolt and the tailgate latch cable.
   - To install, tighten to 25 Nm (18 lb-ft).
8. Remove the tailgate latch.
9. To install, reverse the removal procedure.

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Tailgate Lock Cylinder



Item	Part Number	Description
1	1522023	Retaining clip
2	1521990	Tailgate lock cylinder

Removal and Installation

NOTE: When a new lock cylinder is installed, the tailgate lock cylinder, door lock cylinders and the ignition lock cylinder should be installed as a set. This eliminates carrying an extra key which fits only 1 lock. If a new key is to be used, the new key code is attached to a tag.

NOTE: The individual door lock cylinders are repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build a new lock cylinder to the current key code of the vehicle.

1. Remove the tailgate release handle. For additional information, refer to Tailgate Release Handle in this section.
2. Remove retaining clip and the tailgate lock cylinder.
3. To install, reverse the removal procedure.

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Tailgate Release Handle

Removal and Installation

1. If equipped, remove the tailgate step assist handle. For additional information, refer to Section 501-04 .

2. Remove the bolts and the tailgate access panel (7 bolts for flareside bed, 8 for without step tailgate, or 13 with step tailgate).
   - To install, tighten to 5 Nm (44 lb-in).

3. Remove the 2 tailgate release handle nuts.
   - To install, tighten to 9 Nm (80 lb-in).

4. Remove the tailgate release handle.

5. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Motorcraft® Premium Quality Windshield Washer Fluid (Canada) CXC-37-(A, B, D, and F) (Canada)	—	4.0L
Motorcraft® Premium Windshield Washer Concentrate (US) ZC-32-A or B (US)	WSB-M8B16-A2	4.0L

General Specifications

Item	Specification
LH windshield wiper blade park measurement	70 mm (2.756 in)
RH windshield wiper blade park measurement	84.582 mm (3.335 in)

Torque Specifications

Description	Nm	lb-in
Windshield wiper motor assembly bolts	8	71

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Wipers and Washers

The wiper and washer system(s) consists of the following components:

- Body Control Module (BCM)
- Front camera washer (SVT Raptor only, if equipped)
- Multifunction switch
- Rain sensor (if equipped)
- Rain sensor bracket (if equipped)
- Steering Column Control Module (SCCM)
- Washer pump
- Washer reservoir (integral to the battery tray)
- Windshield wiper blades
- Windshield wiper motor
- Windshield wiper mounting arm and pivot shaft
- Windshield wiper pivot arms
- Windshield wiper relay

Wipers

The wiper system is activated by the wiper/washer switch. The wiper/washer switch is mounted to the SCCM . The SCCM commands the windshield wiper motor to activate the appropriate low, high and intermittent modes. When commanded by the SCCM , the windshield wiper motor activates the rear window wiper motor INT 1 and INT 2 modes.

Washers

The washer system is activated by the wiper/washer switch. The wiper/washer switch is mounted to the SCCM . The SCCM commands the windshield wiper motor to activate the appropriate front or rear wash modes. The front and rear washer system share the same washer reservoir and a bi-directional washer pump. The windshield wiper motor controls the direction of the washer pump to direct washer fluid to the windshield or rear window.

Courtesy Wipe Feature

When the windshield washer system is activated, the wipers cycle 3 times with washer fluid, followed by one final wipe a few seconds later to clear any remaining fluid that is dripping from the top of the windshield. This feature can be enabled/disabled through the message center. For additional information on enabling/disabling this feature, refer to the Owner's Literature.

Rain Sensitive Wipers (if equipped)

When equipped, the rain sensitive wiper feature replaces the intermittent wiper feature. The rain sensitive feature is active when the wiper/washer switch is in any of the 5 auto/intermittent sensitivity settings. The setting closest to OFF is the least sensitive to moisture, the highest setting being the most sensitive to moisture.

The rain sensitive wiper feature can be turned enabled/disabled through the message center.

When the rain sensitive wipers are disabled from the message center, or the windshield wiper motor detects a fault with the rain sensor input, the windshield wiper motor changes to a default intermittent mode. The timing of the wipers correspond to a standard intermittent setting based on the auto/intermittent sensitivity setting on the wiper/washer switch.

The rain sensor is located on the windshield next to the rear view mirror. A gel-type lens is used as the interface between the rain sensor and the windshield. The rain sensor gel-type lens is part of the rain sensor and cannot be replaced separately on a rain sensor of this type.

Wiper Activated Headlamps (if equipped)

If equipped with automatic headlamps, the BCM illuminates the exterior lamps within 10 seconds of the windshield wipers being activated by the wiper/washer switch when the headlamp control switch is in the AUTOLAMP position. The BCM continues to illuminate the exterior lamps for approximately 30 seconds after the windshield wipers have been turned off.

If equipped with rain sensitive wipers (feature must be enabled through the message center) and the wiper/washer switch is in one of the 5 auto/intermittent settings, the BCM illuminates the exterior lamps within 30 seconds of the windshield wipers being activated by moisture detected on the windshield when the headlamp control switch is in the AUTOLAMP position. The BCM continues to illuminate the exterior lamps for approximately 60 seconds after the windshield wipers have been deactivated (moisture no longer detected on the windshield).

Speed Dependent Wipers (if equipped)

The speed dependent feature increases the frequency of wiping to compensate for the extra moisture that accumulates on the windshield as the vehicle speed increases. This feature activates when the wiper/washer switch is in any intermittent setting except the INT 1 position. As vehicle speed increases, the speed dependent feature gradually shortens the delay between wipes.

Front Video Camera Washer System (if equipped)

When the wiper/washer switch is placed in the CAMERA WASH position, the windshield wiper motor activates the washer pump to to direct washer fluid at the front video camera lens.

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Wipers and Washers

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST3094-A	Test Light SGT27000 or equivalent 250-350 mA incandescent bulb test lamp SGT27000

Principles of Operation

Windshield Wiper Operation

The wiper system is activated by the multifunction switch. The multifunction switch is mounted to the Steering Column Control Module (SCCM). The SCCM commands the wiper motor to activate the appropriate wash, low, high and intermittent modes through a private Local Interconnect Network (LIN).

When the multifunction switch is in the HIGH position, the wiper motor also receives a ground signal which is hardwired directly through the SCCM (bypassing the logic within the module). This fail-safe circuit makes sure that the wipers function in HIGH speed mode in the event of a LIN communication failure.

Vehicles equipped with a front video camera have a front camera washer control switch that is part of the multifunction switch.

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Washer System (if not equipped with front video camera)

When the multifunction switch is placed in the WASH position, the SCCM sends the request to the windshield wiper motor through the LIN . The windshield wiper motor supplies voltage to the washer pump, which then directs washer fluid to the windshield.

Washer System (if equipped with front video camera)

When the multifunction switch is placed in the WASH position, the windshield wiper motor supplies voltage to the washer pump. Ground is provided to the washer pump through the normally closed contact in the front camera washer relay (located in the auxiliary Battery Junction Box (BJB)).

When the front video camera washer control is activated, the SCCM sends the request to the windshield wiper motor through the LIN . The windshield wiper motor controls the direction of the washer pump to direct washer fluid to the front video camera.

Courtesy Wipe Feature

When the washer system is activated, the wipers cycle 3 times with washer fluid, followed by one final wipe a few seconds later to clear any remaining fluid that is dripping from the top of the windshield. This feature can be enabled/disabled through the message center. For information on enabling/disabling this feature, refer to the Owner's Literature.

Speed Dependent Wipers

If equipped, the speed dependent feature increases the frequency of wiping to compensate for the extra moisture that accumulates on the windshield as the vehicle speed increases. This feature activates when the multifunction switch is in any intermittent setting except the INT 1 position. As vehicle speed increases, the speed dependent feature gradually shortens the delay between wipes. The SCCM receives Vehicle Speed Sensor (VSS) information from the Body Control Module (BCM) through the High Speed Controller Area Network (HS-CAN). The SCCM sends the VSS information to the wiper motor through the LIN .

Rain Sensitive Wipers (if equipped)

When equipped, the rain sensitive wiper feature replaces the intermittent wiper feature. The rain sensitive feature is active when the multifunction switch is in any of the 5 auto/intermittent sensitivity settings. The setting closest to OFF is the least sensitive to moisture, the highest setting being the most sensitive to moisture.

The rain sensor optically senses water on the windshield. An infrared beam of specific intensity lights a section of the windshield. The intensity of the reflected beam is measured and compared to the intensity of the transmitted beam. If there is water on the surface of the windshield, the beam distorts, reducing the intensity of the beam. If the beam is not reflected completely, it is interpreted as rain on the windshield and the windshield wipers are started.

The rain sensor sends data through the LIN to the windshield wiper motor. When the rain sensitive wiper feature is enabled, based on the data received from the rain sensor and the auto/intermittent setting on the multifunction switch, the system automatically activates and adjusts the wiper speed and frequency when

moisture is detected on the windshield.

A gel-type lens is used as the interface between the rain sensor and the windshield. If the lens is missing or damaged, the rain sensing wipers can be inoperative. The rain sensor gel-type lens is part of the rain sensor and cannot be replaced separately on a rain sensor of this type.

The rain sensitive wiper feature can be enabled/disabled through the message center.

When the rain sensitive wipers are disabled from the message center, or the windshield wiper motor detects a fault with the rain sensor input, the windshield wiper motor changes to a default intermittent mode. The timing of the wipers correspond to a standard intermittent setting based on the auto/intermittent sensitivity setting on the multifunction switch.

Wiper Activated Headlamps

If equipped with automatic headlamps, the SCCM sends a message to the BCM over the HS-CAN to illuminate the exterior lamps within 10 seconds of the wipers being activated by the multifunction switch when the headlamp control switch is in the AUTOLAMP position. The BCM continues to illuminate the exterior lamps for approximately 30 seconds after the wipers have been turned off.

If equipped with rain sensitive wipers (feature must be enabled through the message center) and the multifunction switch is in 1 of the 5 auto/intermittent settings, the SCCM sends a message to the BCM over the HS-CAN to illuminate the exterior lamps within 30 seconds of the wipers being activated by moisture detected on the windshield when the headlamp control switch is in the AUTOLAMP position. The BCM continues to illuminate the exterior lamps for approximately 60 seconds after the wipers have been deactivated (moisture no longer detected on the windshield).

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Wiper linkage ● Washer nozzles ● Washer fluid hoses ● Wiper blades	● Battery Junction Box (BJB) fuse(s): ■ 41 (15A) (vehicles equipped with front video camera only) ■ 49 (30A) ■ 54 (5A) (vehicles equipped with front video camera only) ■ 79 (5A) ● Wiper relay ● Rain sensor (if equipped) ● Wiper motor ● Washer pump ● Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to next section.

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4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.

   If the scan tool does not communicate with the VCM:
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM.
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00, The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record the Continuous Memory Diagnostic Trouble Codes (CMDTCs).

8. Clear the CMDTCs and carry out the self-test diagnostics for the Steering Column Control Module (SCCM) and the Body Control Module (BCM).

9. If the DTCs retrieved are related to the concern, refer to the Steering Column Control Module (SCCM) DTC Chart. For all other SCCM DTCs, refer to Section 211-05. For any BCM DTCs, refer to Section 419-10.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Charts

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1008:09	Wiper Mode Switch: Component Failure	INSTALL a new multifunction switch. REFER to Section 211-05. CLEAR the DTCs and REPEAT the self-test. If the DTC is retrieved again, INSTALL a new SCCM. REFER to Section 211-05.
B1051:09	Front Washer Switch: Component Failure	INSTALL a new multifunction switch. REFER to Section 211-05. CLEAR the DTCs and REPEAT the self-test. If the DTC is retrieved again, INSTALL a new SCCM. REFER to Section 211-05.

B10AD:02	Rain Sensor: General Signal Failure	GO to Pinpoint Test E .
B10AD:08	Rain Sensor: Bus Signal / Message Failure	GO to Pinpoint Test E .
B10AD:49	Rain Sensor: Internal Electronic Failure	INSTALL a new rain sensor. REFER to Rain Sensor in this section. CLEAR the DTCs. REPEAT the self-test.
B1131:02	Wiper Motor Module: General Signal Failure	GO to Pinpoint Test B .
B1131:08	Wiper Motor Module: Bus Signal / Message Failure	GO to Pinpoint Test B .
B12F7:09	Single Wipe Switch: Component Failure	INSTALL a new multifunction switch. REFER to Section 211-05 . CLEAR the DTCs and REPEAT the self-test. If the DTC is retrieved again, INSTALL a new SCCM . REFER to Section 211-05 .
All other DTCs	—	REFER to Section 211-05 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All windshield wiper modes are inoperative	• Fuse • Wiring, terminals or connectors • Wiper relay • Multifunction switch • Wiper motor • Steering Column Control Module (SCCM)	• GO to Pinpoint Test A .
• The intermittent and/or low speed windshield wipers are inoperative	• Wiring, terminals or connectors • Multifunction switch • Wiper motor • Rain sensor (if equipped) • SCCM	• GO to Pinpoint Test B .
• The high speed windshield wipers are inoperative	• Windshield wiper motor	• INSTALL a new windshield wiper motor. REFER to Wiper Motor .
• The windshield wipers stay on continuously	• Wiring, terminals or connectors • Wiper relay • Multifunction switch • Wiper motor • SCCM	• GO to Pinpoint Test C .

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• The windshield wipers do not operate correctly in the intermittent mode	• Multifunction switch • Wiper motor • SCCM	• If the vehicle is not equipped with rain sensitive wipers, GO to Pinpoint Test D . • If the vehicle is equipped with rain sensitive wipers, GO to Pinpoint Test E .
• The rain sensitive wiper feature is inoperative	• Fuse • Wiring, terminals or connectors • Rain sensitive feature not enabled • Foreign material on windshield, such as dirt, dust or bugs • Wiper blades • Windshield glass • Multifunction switch • Wiper motor • Rain sensor • SCCM	• GO to Pinpoint Test E .
• The rain sensitive wipers have erratic/inconsistent operation	• Foreign material on windshield, such as dirt, dust or bugs • Wiper blades • Windshield glass • Rain sensor	• GO to Pinpoint Test E .
• The rain sensitive wipers are too sensitive/not sensitive enough to moisture	• Foreign material on windshield, such as dirt, dust or bugs • Wiper blades • Damaged windshield glass • Multifunction switch • Rain sensor	• GO to Pinpoint Test E .
• The windshield wipers do not park at the correct position	• Wiper mounting arm and pivot shaft • Wiper motor	• GO to Pinpoint Test F .
• The washer pump is inoperative or always on - vehicles not equipped with front video camera	• Wiring, terminals or connectors • Washer pump • Multifunction switch • Wiper motor • SCCM	• GO to Pinpoint Test G .
• The washer pump is inoperative or always on - vehicles equipped with front video camera	• Wiring, terminals or connectors • Washer pump • Multifunction switch • Wiper motor • Front camera washer relay	• GO to Pinpoint Test H .

Pinpoint Tests

Pinpoint Test A: The Windshield Wipers Are Inoperative

Refer to Wiring Diagrams Cell 81 , Wipers and Washers for schematic and connector information.

Normal Operation

The wiper relay (located in the Battery Junction Box (BJB)) is energized when the ignition is ON. The wiper relay provides voltage to the wiper motor. The multifunction switch is mounted to the Steering Column Control Module (SCCM). The SCCM commands the wiper motor to activate the appropriate wash, low, high and intermittent modes through a Local Interconnect Network (LIN).

When the multifunction switch is in the HIGH position, the wiper motor receives ground which is hardwired directly through the SCCM (bypassing the logic within the SCCM and the wiper motor). This fail-safe circuit makes sure that the wipers function in HIGH speed mode in the event of a LIN communication failure.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Wiper relay
- Multifunction switch
- Wiper motor
- SCCM

PINPOINT TEST A: ALL WINDSHIELD WIPER MODES ARE INOPERATIVE

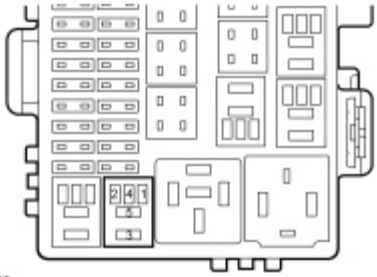
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>A1 CHECK THE WIPER RELAY</td><td rowspan="2">Yes
REMOVE the known good relay. INSTALL a new wiper relay.

No
REMOVE the known good relay. GO to A2 .</td></tr>
<tr><td>• Disconnect: Wiper Relay .
• Substitute a known good relay and recheck the windshield wiper motor operation.
• Do the wipers operate?</td></tr>
<tr><td>A2 CHECK THE BATTERY SUPPLIED VOLTAGE CIRCUIT TO THE WIPER RELAY FOR AN OPEN</td><td rowspan="2">Yes
GO to A3 .

No
VERIFY the BJB fuse 49 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.</td></tr>
<tr><td>• Ignition OFF.
• Measure the voltage between:
<table><tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>Wiper relay pin 3</td><td>SBB49 (RD)</td><td>—</td><td>Ground</td></tr></table></td></tr>
</table>

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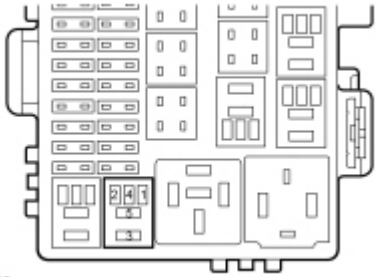
N0136159

- **Is the voltage greater than 11 volts?**

A3 CHECK THE IGNITION SUPPLIED VOLTAGE CIRCUIT TO THE WIPER RELAY FOR AN OPEN

- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Wiper relay pin 1	CDC64 (WH/BU)	—	Ground



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- **Is the voltage greater than 11 volts?**

Yes
GO to A4 .

No
REPAIR the circuit.

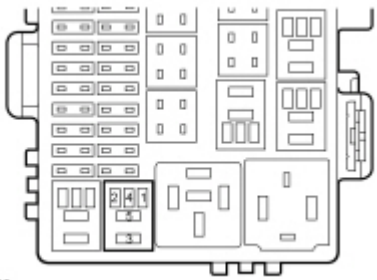
A4 CHECK THE WIPER RELAY COIL GROUND CIRCUIT FOR AN OPEN

- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
Wiper relay pin 1	CDC64 (WH/BU)	Wiper relay pin 2	GD123 (BK/GY)

Yes
GO to A5 .

No
REPAIR the circuit.

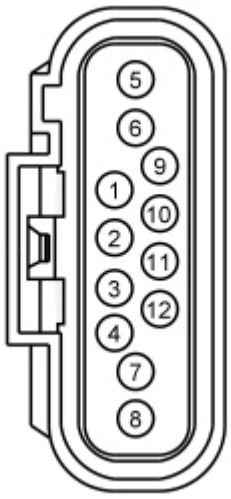


- **Is the voltage greater than 11 volts?**

A5 CHECK THE WINDSHIELD WIPER MOTOR VOLTAGE SUPPLY CIRCUIT FOR AN OPEN

- Ignition OFF.
- Connect: Wiper Relay .
- Disconnect: Windshield Wiper Motor C125 .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C125-8	CRW03 (VT/WH)	—	Ground



- **Is the voltage greater than 11 volts?**

Yes
GO to A6 .

No
REPAIR the circuit.

A6 CHECK THE WINDSHIELD WIPER MOTOR GROUND CIRCUIT FOR AN OPEN

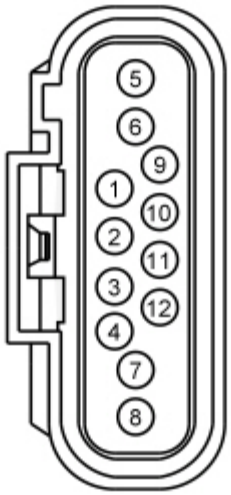
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C125-8	CRW03 (VT/WH)	C125-6	GD120 (BK/GN)

Yes
GO to A7 .

No
REPAIR the circuit.

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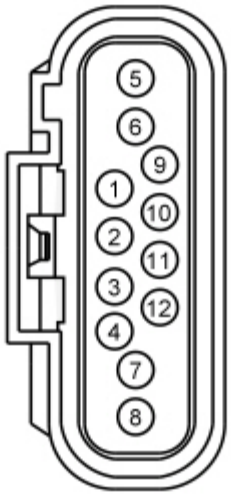


- **Is the voltage greater than 11 volts?**

A7 CHECK THE FAIL-SAFE HIGH SPEED WIPER GROUND CIRCUIT CONTROL

- Ignition OFF.
- Place the multifunction switch to the high speed setting.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C125-1	CRW15 (BN/WH)	—	Ground



- **Is the resistance less than 3 ohms?**

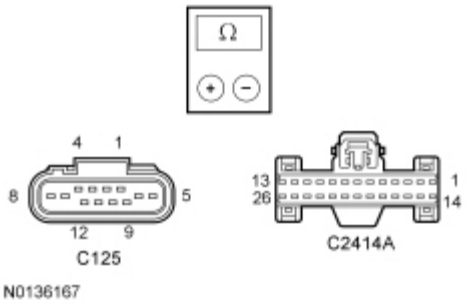
Yes
INSTALL a new windshield wiper motor. REFER to Wiper Motor .

No
GO to A8 .

A8 CHECK THE FAIL-SAFE HIGH SPEED WIPER GROUND CIRCUIT FOR AN OPEN

NOTE: If steps A1-A7 did not identify the cause of the concern, a double fault is present. After the fail-safe ground is diagnosed and repaired, it is necessary check all operation modes and diagnose any symptom still

Yes
INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If

present. • Disconnect: SCCM C2414A . • Measure the **resistance** between: Positive Lead: Pin C125-1, Circuit CRW15 (BN/WH) Negative Lead: Pin C2414A-12, Circuit CRW15 (BN/WH)  • **Is the resistance less than 3 ohms?**	the concern is still present, GO to A9 . **No** REPAIR the circuit.
A9 CHECK FOR CORRECT SCCM OPERATION	
• Disconnect and inspect all SCCM connectors. • Repair: ▪ corrosion (install new connector or terminals – clean module pins) ▪ damaged or bent pins – install new terminals/pins ▪ pushed-out pins – install new pins as necessary • Reconnect the SCCM connectors. Make sure they seat and latch correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** CHECK On-Line Automotive Service Information System (OASIS) for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to Section 211-05 . **No** The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test B: The Intermittent And/Or Low Speed Windshield Wipers Are Inoperative

Refer to Wiring Diagrams Cell 81 , Wipers and Washers for schematic and connector information.

Normal Operation

The wiper relay (located in the Battery Junction Box (BJB)) is energized when the ignition is ON. The wiper relay provides voltage to the wiper motor. The multifunction switch is mounted to the Steering Column Control Module (SCCM). The SCCM commands the wiper motor to activate the appropriate wash, low, high and intermittent modes through a Local Interconnect Network (LIN).

When the multifunction switch is in the HIGH position, the wiper motor receives ground which is hardwired

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directly through the SCCM (bypassing the logic within the SCCM and the wiper motor). This fail-safe circuit makes sure that the wipers function in HIGH speed mode in the event of a LIN communication failure.

- DTC B1131:02 (Wiper Motor Module: General Signal Failure) — Sets when the SCCM detects a general signal failure occurs on the LIN .
- DTC B1131:08 (Wiper Motor Module: Bus Signal / Message Failure) — Sets when the SCCM loses communication with the windshield wiper motor over the LIN .

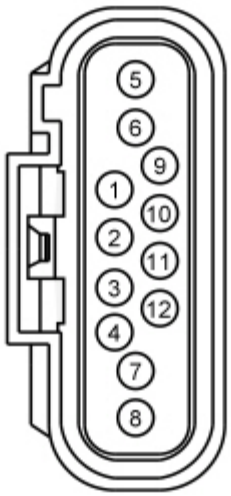
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- Windshield wiper motor
- Rain sensor (if equipped)
- SCCM

PINPOINT TEST B: THE INTERMITTENT AND/OR LOW SPEED WINDSHIELD WIPERS ARE INOPERATIVE

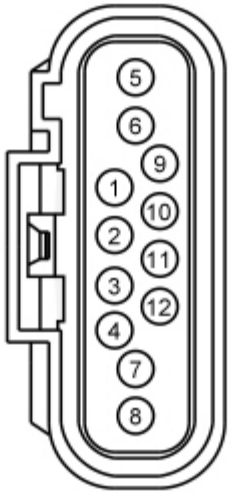
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK FOR SCCM DTC B1131:02 OR DTC B1131:08	
• Ignition ON. • Using a scan tool, perform the SCCM self-test. • **Is DTC B1131:02 or DTC B1131:08 present?**	**Yes** GO to B4 . **No** GO to B2 .
B2 CHECK THE LOW SPEED WINDSHIELD WIPER OPERATION	
• Place the multifunction switch to the low speed setting and observe the windshield wipers. Place the multifunction switch to the off setting. • **Do the windshield wipers operate with the multifunction switch in the low speed setting?**	**Yes** If not equipped with a rain sensor, GO to Pinpoint Test D . If equipped with a rain sensor, GO to Pinpoint Test E . **No** GO to B3 .
B3 CHECK THE MULTIFUNCTION SWITCH LOW SPEED SETTING INPUT	
• Using a scan tool, monitor the SCCM F_WIP_SLO_SW PID. • Place the multifunction switch to the low speed setting. • **Does the PID indicate the multifunction switch is in the low speed setting?**	**Yes** INSTALL a new windshield wiper motor. REFER to Wiper Motor . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If the concern is still present, INSTALL a new SCCM . REFER to Section 211-05 .

B4 CHECK THE HIGH SPEED WIPER OPERATION • Place the multifunction switch to the high speed setting and observe the windshield wipers. Place the multifunction switch to the off setting. • **Do the windshield wipers operate with the multifunction switch in the high speed setting?**	**Yes** If equipped with a rain sensor, GO to B5 . If not equipped with a rain sensor, GO to B6 . **No** GO to Pinpoint Test A .
B5 ISOLATE THE RAIN SENSOR • Ignition OFF. • Disconnect: Rain Sensor C914 . • Ignition ON. • **NOTE:** DTC B10AD:02 or DTC B10AD:08 may set and should be ignored. • Using a scan tool, clear the DTCs and then perform the SCCM self-test. • **Is DTC B1131:02 or DTC B1131:08 still present?**	**Yes** GO to B6 . **No** INSTALL a new rain sensor. REFER to Rain Sensor .
B6 CHECK THE WINDSHIELD WIPER MOTOR LOGIC GROUND CIRCUIT FOR AN OPEN • Ignition OFF. • Disconnect: Windshield Wiper Motor C125 . • Measure the **resistance** between: Positive Lead: Pin C125-3, Circuit GD120 (BK/GN) Negative Lead: Pin —, Circuit Ground  • **Is the resistance less than 3 ohms?**	**Yes** GO to B7 . **No** REPAIR the circuit.
B7 CHECK THE LIN CIRCUIT FOR A SHORT TO VOLTAGE • Disconnect: SCCM C2414A . • Ignition ON. • Measure the **voltage** between:	**Yes** REPAIR the circuit. **No** GO to B8 .

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Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C125-4	VDN05 (YE/GY)	—	Ground

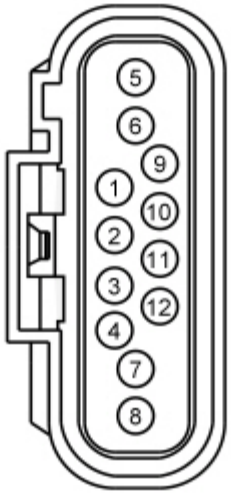


- **Is any voltage present?**

B8 CHECK THE LIN CIRCUIT FOR A SHORT TO GROUND

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C125-4	VDN05 (YE/GY)	—	Ground



- **Is the resistance greater than 10,000 ohms?**

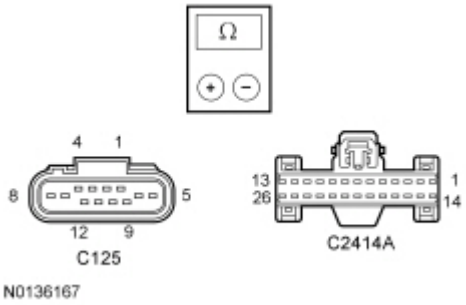
Yes
GO to B9.

No
REPAIR the circuit.

B9 CHECK THE LIN CIRCUIT FOR AN OPEN

<table>
<tr>
<td>

Measure the resistance between:

<table>
<tr><th colspan="2">Positive Lead</th><th colspan="2">Negative Lead</th></tr>
<tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr>
<tr><td>C125-4</td><td>VDN05 (YE/GY)</td><td>C2414A-20</td><td>VDN05 (YE/GY)</td></tr>
</table>


Is the resistance less than 3 ohms?

</td>
<td>Yes
INSTALL a new windshield wiper motor. REFER to Wiper Motor . TEST the system for normal operation. If the concern is still present, GO to B10 .

No
REPAIR the circuit.</td>
</tr>
<tr>
<td>B10 CHECK FOR CORRECT SCCM OPERATION

Disconnect and inspect all SCCM connectors.
Repair:

corrosion (install new connector or terminals – clean module pins)
damaged or bent pins – install new terminals/pins
pushed-out pins – install new pins as necessary

Reconnect the SCCM connectors. Make sure they seat and latch correctly.
Operate the system and determine if the concern is still present.
Is the concern still present?

</td>
<td>Yes
CHECK On-Line Automotive Service Information System (OASIS) for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to Section 211-05 .

No
The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.</td>
</tr>
</table>

Pinpoint Test C: The Windshield Wipers Stay On Continuously

Refer to Wiring Diagrams Cell 81 , Wipers and Washers for schematic and connector information.

Normal Operation

The wiper relay (located in the Battery Junction Box (BJB)) is energized when the ignition is ON. The wiper relay provides voltage to the wiper motor. The multifunction switch is mounted to the Steering Column Control Module (SCCM). The SCCM commands the wiper motor to activate the appropriate wash, low, high and intermittent modes through a Local Interconnect Network (LIN).

When the multifunction switch is in the HIGH position, the wiper motor receives ground which is hardwired directly through the SCCM (bypassing the logic within the SCCM and the wiper motor). This fail-safe circuit makes sure that the wipers function in HIGH speed mode in the event of a LIN communication failure.

This pinpoint test is intended to diagnose the following:

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- Wiring, terminals or connectors
- Wiper relay
- Multifunction switch
- Wiper motor
- SCCM

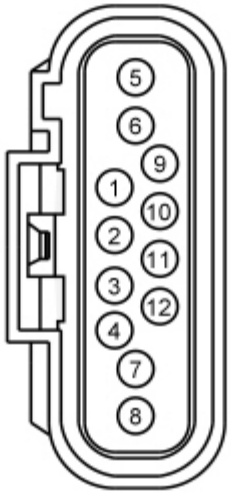
PINPOINT TEST C: THE WINDSHIELD WIPERS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK THE WINDSHIELD WIPER OPERATION WITH THE IGNITION OFF	
• Ignition OFF. • Observe the windshield wiper operation. • **Are the windshield wipers operating?**	**Yes** GO to C2 . **No** GO to C3 .
C2 CHECK THE WIPER RELAY OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Wiper Relay . • Observe the windshield wiper operation. • **Do the windshield wipers continue to operate?**	**Yes** REPAIR the circuit. **No** INSTALL a new wiper relay.
C3 CHECK THE MULTIFUNCTION SWITCH INPUT	

• Ignition ON.
• Make sure the multifunction switch is in the off setting.
• Using a scan tool, monitor the SCCM multifunction switch PIDs:
  • F_WASH_SW
  • F_WIP_INT_D1
  • F_WIP_INT_D2
  • F_WIP_INT_D3
  • F_WIP_INT_D4
  • F_WIP_INT_D5
  • F_WIP_SLO_SW
  • F_WIPE_FAST_SW
• **Are all of the PIDs displayed as OFF?**
	Yes
	GO to C4 .
	
	No
	INSTALL a new multifunction switch. REFER to Section 211-05 .
	
	If the concern is still present, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.

C4 CHECK THE WINDSHIELD WIPER OPERATION WITH THE SCCM DISCONNECTED	
• Ignition OFF. • Disconnect: SCCM C2414A . • Ignition ON. • Observe the windshield wiper operation. • **Do the windshield wipers continue to operate?**	**Yes** GO to C5 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If the concern is still present, GO to C6 .

C5 CHECK THE HIGH SPEED FAIL-SAFE CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Windshield Wiper Motor C125 . • Measure the **resistance** between: Positive Lead: Pin C125-1, Circuit CRW15 (BN/WH) Negative Lead: Pin —, Circuit Ground  • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new windshield wiper motor. REFER to Wiper Motor . **No** REPAIR the circuit.
C6 CHECK FOR CORRECT SCCM OPERATION	

• Disconnect and inspect all SCCM connectors.
• Repair:
  ▪ corrosion (install new connector or terminals – clean module pins)
  ▪ damaged or bent pins – install new terminals/pins
  ▪ pushed-out pins – install new pins as necessary
• Reconnect the SCCM connectors. Make sure they seat and latch correctly.
• Operate the system and determine if the concern is still present.
• **Is the concern still present?**
	Yes
	CHECK On-Line Automotive Service Information System (OASIS) for any applicable TSBs . If a TSB exists for this concern, DISCONTINUE this test and FOLLOW TSB instructions. If no TSBs address this concern, INSTALL a new SCCM . REFER to Section 211-05 .
	
	No
	The system is operating correctly at this time. The concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test D: The Windshield Wipers Do Not Operate Correctly In The Intermittent Mode

Normal Operation

The wiper relay (located in the Battery Junction Box (BJB)) is energized when the ignition is ON. The wiper relay provides voltage to the wiper motor. The multifunction switch is mounted to the Steering Column Control Module (SCCM). The SCCM commands the wiper motor to activate the appropriate wash, low, high and intermittent modes through a Local Interconnect Network (LIN).

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This pinpoint test is intended to diagnose the following:

- Multifunction switch
- Windshield wiper motor
- SCCM

PINPOINT TEST D: THE WINDSHIELD WIPERS DO NOT OPERATE CORRECTLY IN THE INTERMITTENT MODE

Test Step	Result / Action to Take
D1 VERIFY IF THE VEHICLE IS EQUIPPED WITH A RAIN SENSOR	
• Inspect the vehicle for a rain sensor. • **Is the vehicle equipped with a rain sensor?**	**Yes** GO to D2. **No** GO to D3.
D2 VERIFY THE RAIN SENSITIVE WIPER FEATURE IS DISABLED IN THE VEHICLE MESSAGE CENTER	
• Ignition ON. • Access the vehicle settings in the message center using the steering wheel controls and check the rain sensitive feature setting. • **Is the rain sensitive feature enabled?**	**Yes** GO to Pinpoint Test E. **No** GO to D3.
D3 CHECK THE LOW SPEED WIPER OPERATION	
• Ignition ON. • Place the multifunction switch to the low speed setting and observe the windshield wipers. Place the multifunction switch to the off setting. • **Do the low speed wipers operate when the low speed setting is selected?**	**Yes** GO to D4. **No** GO to Pinpoint Test B.
D4 CHECK THE INPUT FROM THE MULTIFUNCTION SWITCH	

• Using a scan tool, monitor the SCCM multifunction switch PIDs:
  • F_WIP_INT_D1
  • F_WIP_INT_D2
  • F_WIP_INT_D3
  • F_WIP_INT_D4
  • F_WIP_INT_D5
• Cycle the multifunction switch from off through each of the intermittent settings.
• **Do the PIDs correspond correctly with each setting selection?**
	Yes
	INSTALL a new windshield wiper motor. REFER to Wiper Motor.
	
	No
	INSTALL a new multifunction switch. REFER to Section 211-05. TEST the system for normal operation. If the concern is still present, INSTALL a new SCCM. REFER to Section 211-05.

Pinpoint Test E: The Rain Sensitive Wiper Feature Is Inoperative

Refer to Wiring Diagrams Cell 81, Wipers and Washers for schematic and connector information.

Normal Operation

The rain sensitive wiper feature replaces the intermittent wiper feature. The rain sensitive feature is active when the multifunction switch is in any of the 5 auto/intermittent sensitivity settings. The setting closest to OFF is the least sensitive to moisture, the highest setting being the most sensitive to moisture.

The rain sensor sends data through the LIN to the windshield wiper motor. When the rain sensitive wiper feature is enabled, based on the data received from the rain sensor and the auto/intermittent setting on the multifunction switch, the system automatically activates and adjusts the wiper speed and frequency when moisture is detected on the windshield.

The rain sensor optically senses water on the windshield. An infrared beam lights a section of the windshield. The intensity of the reflected beam is measured and compared to the intensity of the transmitted beam. If there is water on the surface of the windshield, the beam distorts, reducing the intensity of the beam. If the beam is not reflected completely, it is interpreted as rain on the windshield and the windshield wipers are activated.

A gel-type lens is used as the interface between the rain sensor and the windshield. If the lens is missing or damaged, the rain sensing wipers can be inoperative. The rain sensor gel-type lens is part of the rain sensor and cannot be replaced separately on a rain sensor of this type.

The rain sensitive wiper feature can be enabled/disabled through the message center.

When the rain sensitive wipers are disabled from the message center, or the windshield wiper motor detects a fault with the rain sensor input, the windshield wiper motor changes to a default intermittent mode. The timing of the wipers correspond to a standard intermittent setting based on the auto/intermittent sensitivity setting on the multifunction switch.

- B10AD:02 (Rain Sensor: General Signal Failure) — This DTC sets when the SCCM determines a general signal failure has occurred on the LIN .
- B10AD:08 (Rain Sensor: Bus Signal / Message Failure) — This DTC sets when the SCCM determines a communication error has occurred on the LIN . If the rain sensitive wipers are inoperative only, this DTC may be caused by an open in the rain sensor power or ground circuit or an open in the LIN circuit.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Rain sensitive feature not enabled
- Foreign material on windshield, such as dirt, dust or bugs
- Wiper blades
- Windshield glass
- Multifunction switch
- Windshield wiper motor
- Rain sensor
- SCCM

PINPOINT TEST E: THE RAIN SENSITIVE WIPER FEATURE IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE LOW SPEED WIPER OPERATION	

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NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.** • Ignition ON. • Place the multifunction switch to the low speed setting and observe the windshield wipers. Place the multifunction switch to the off setting. • **Do the low speed wipers operate when the low speed setting is selected?**	**Yes** GO to E2. **No** GO to Pinpoint Test B.
E2 CHECK FOR DTC B1131:02 OR DTC B1131:08	
• Ignition ON. • Using a scan tool, perform the SCCM self-test. • **Is DTC B1131:02 or DTC B1131:08 present?**	**Yes** GO to Pinpoint Test B. **No** GO to E3.
E3 CHECK FOR DTC B10AD:02 OR DTC B10AD:08	
• Review the results from the SCCM self-test. • **Is DTC B10AD:02 or DTC B10AD:08 present?**	**Yes** GO to E12. **No** GO to E4.
E4 VERIFY THE RAIN SENSITIVE WIPER FEATURE IS ENABLED IN THE VEHICLE MESSAGE CENTER	
• Access the vehicle settings in the message center using the steering wheel controls. Make sure the rain sensitive feature is enabled. • **Is the rain sensitive feature enabled?**	**Yes** GO to E5. **No** ENABLE the rain sensitive feature. INFORM the customer how to enable/disable the rain sensitive feature.
E5 CHECK THE INPUT FROM THE MULTIFUNCTION SWITCH	

• Using a scan tool, monitor the SCCM multifunction switch PIDs:
  • F_WIP_INT_D1
  • F_WIP_INT_D2
  • F_WIP_INT_D3
  • F_WIP_INT_D4
  • F_WIP_INT_D5
• Cycle the multifunction switch from off through each of the auto/intermittent sensitivity settings.
• **Do the PIDs correspond correctly with each setting selection?**
	Yes
	GO to E6.
	
	No
	INSTALL a new multifunction switch. REFER to Section 211-05. TEST the system for normal operation. If the concern is still present, INSTALL a new SCCM. REFER to Section 211-05.

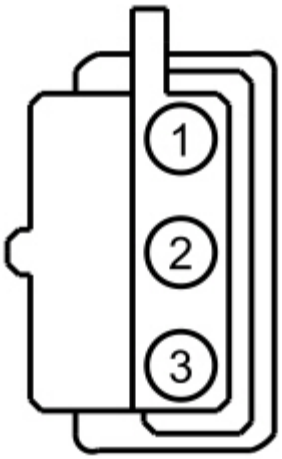
E6 CHECK THE WINDSHIELD FOR DAMAGE	
• Ignition OFF. • Inspect the windshield glass for any cracks, pits or other visible damage around the area of the rain sensor. • **Is any windshield damage present near the area of the rain sensor?**	**Yes** INSTALL a new windshield. REFER to Section 501-11. **No** GO to E7.
E7 CHECK THE WINDSHIELD GLASS FOR STREAKING	
• Ignition ON.	**Yes**

• Turn the multifunction switch to the low speed wiper setting and while applying water to the windshield surface. Observe the wipe quality, especially around the area or the rain sensor. • **Is any streaking present on the windshield around the area of the rain sensor?**	GO to E8 . **No** GO to E10 .
E8 CHECK THE WINDSHIELD WIPER BLADES FOR STREAKING	
• Ignition OFF. • Clean the windshield glass with glass cleaner. • Clean the wiper blades with isopropyl alcohol swabs. Wipe the entire length of the wiper blades. • Ignition ON. • Place the multifunction switch to the low speed wiper setting and while applying water to the windshield surface. Observe the wipe quality, especially around the area or the rain sensor. • **Was there noticeable improvement in the wipe quality after cleaning the glass and the wiper blades?**	**Yes** GO to E9 . **No** INSTALL new wiper blades. GO to E9 .
E9 RECHECK THE RAIN SENSITIVE WIPERS OPERATION	
• Place the multifunction switch to the auto/intermittent 5 setting (most sensitive to moisture) while applying water on the windshield above the rain sensor. • **Do the wipers operate when water is applied to the windshield surface?**	**Yes** The system is operating correctly at this time. The concern may have been caused by poor wipe quality on the windshield around the rain sensor. **No** GO to E10 .
E10 CHECK FOR THE PRESENCE OF THE LENS GEL	
• Ignition OFF. • Lightly press the rain sensor against the windshield and release the rain sensor clips. • **Does the rain sensor remain adhered to the windshield?**	**Yes** ATTACH the retaining clips. GO to E11 . **No** The sensor gel-type lens is missing or damaged. INSTALL a new rain sensor. REFER to Rain Sensor .
E11 INSPECT THE RAIN SENSOR MOUNTING AREA	
NOTE: The rain sensor gel-type lens can be damaged or contaminated during rain sensor removal, rain sensor bracket separation or incorrect installation. • From the outside of the vehicle, inspect the area of the windshield glass where the rain sensor is mounted. The rain sensor contact area should appear black, with no bubbles, air pockets or contaminants between the windshield glass and the rain sensor. • **Does the rain sensor contact area appear black, with no bubbles, air pockets or contaminants between the windshield glass and the rain sensor?**	**Yes** GO to E12 . **No** REMOVE and INSTALL the rain sensor correctly. REFER to Rain Sensor . TEST the system for normal operation. If the concern is still present, GO to E15 .
E12 CHECK THE RAIN SENSOR VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF.	**Yes**

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- Disconnect: Rain Sensor C914 .
- Ignition ON.
- Measure the **voltage** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C914-1	SBB79 (YE)	—	Ground



- **Is the voltage greater than 11 volts?**

GO to E13 .

No
VERIFY BJB fuse 79 (5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

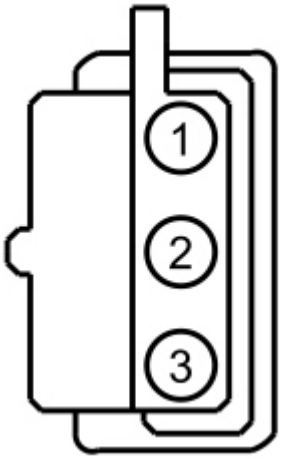
E13 CHECK THE RAIN SENSOR GROUND CIRCUIT FOR AN OPEN

- Ignition OFF.
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C914-3	GD133 (BK)	—	Ground

Yes
GO to E14 .

No
REPAIR the circuit.

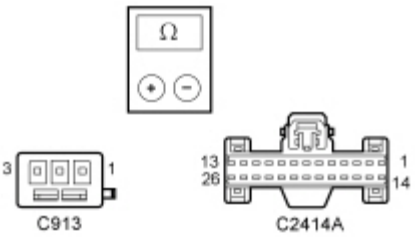


- **Is the resistance less than 3 ohms?**

E14 CHECK THE LIN CIRCUIT FOR AN OPEN

- Disconnect: SCCM C2414B .
- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C914-2	VDN05 (YE/GY)	C2414A-20	VDN05 (YE/GY)



N0136174

- **Is the resistance less than 3 ohms?**

Yes
GO to E15 .

No
REPAIR the circuit.

E15 CHECK FOR CORRECT RAIN SENSOR OPERATION

- Inspect the rain sensor connector.
- Repair:
  - corrosion (install new connector or terminals – clean module pins)
  - damaged or bent pins – install new terminals/pins
  - pushed-out pins – install new pins as necessary
- Reconnect the rain sensor connector. Make sure it seats and latches correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new rain sensor. REFER to Rain Sensor . TEST the system for normal operation.

If the concern is still present, INSTALL a new windshield wiper motor. REFER to Wiper Motor .

No
The system is operating correctly at this time. The

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	concern may have been caused by module connections. ADDRESS the root cause of any connector or pin issues.

Pinpoint Test F: The Windshield Wipers Do Not Park At The Correct Position

Normal Operation

When the multifunction switch is placed in the OFF position, the motor continues to operate until the motor returns to the PARK position and the internal Hall-effect sensor senses the motor magnet. The output to the integral run/park relay deactivates the relay and disconnects the voltage to the motor.

This pinpoint test is intended to diagnose the following:

- Wiper mounting arm and pivot shaft
- Wiper motor

PINPOINT TEST F: THE WINDSHIELD WIPERS DO NOT PARK AT THE CORRECT POSITION

Test Step	Result / Action to Take
F1 CHECK THE WIPER MOUNTING ARE AND PIVOT SHAFT FOR DAMAGE	
• Ignition OFF. • Inspect the wiper mounting arm and pivot shaft for damage. • **Is the wiper mounting arm and pivot shaft OK?**	**Yes** GO to F2 . **No** INSTALL a wiper mounting arm and pivot shaft. REFER to Wiper Mounting Arm and Pivot Shaft .
F2 CHECK THE WINDSHIELD WIPER PARK RELAY OPERATION	
• Ignition ON. • Place the multifunction switch to the low speed setting. When the wiper blades are in the middle of a wipe, place the multifunction switch off. • **Do the windshield wipers immediately stop when the multifunction switch is turned off?**	**Yes** INSTALL a new windshield wiper motor. REFER to Wiper Motor . **No** ADJUST the pivot arms. REFER to Wiper Blade and Pivot Arm Adjustment .

Pinpoint Test G: The Washer Pump Is Inoperative Or Always On - Vehicles Not Equipped With Front Video Camera

Refer to Wiring Diagrams Cell 81 , Wipers and Washers for schematic and connector information.

Normal Operation

When the multifunction switch is placed in the WASH position, the Steering Column Control Module (SCCM)

sends the request to the wiper motor over the Local Interconnect Network (LIN). The wiper motor then supplies power to the washer pump, which directs washer fluid to the windshield.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Washer pump
- Windshield wiper motor
- SCCM

PINPOINT TEST G: THE WASHER PUMP IS INOPERATIVE OR ALWAYS ON - VEHICLES NOT EQUIPPED WITH FRONT VIDEO CAMERA

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>G1 CHECK THE MULTIFUNCTION SWITCH INPUT</td><td rowspan="2">Yes
If the washer pump is always on, GO to G2. If the washer pump is inoperative, GO to G3.

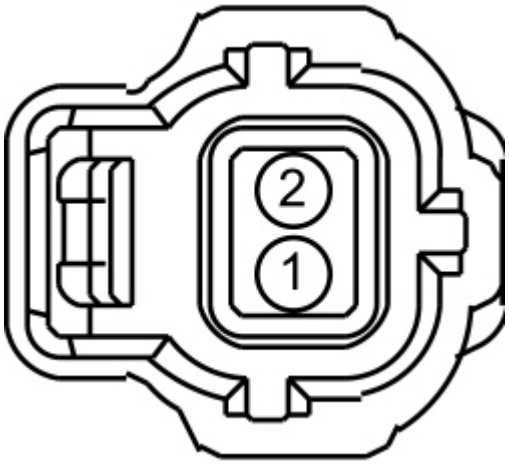
No
INSTALL a new multifunction switch. REFER to Section 211-05.

If the concern is still present, INSTALL a new SCCM. REFER to Section 211-05.</td></tr>
<tr><td>• Ignition ON.
• Using a scan tool, monitor the SCCM F_WASH_SW PID.
• Press and release the washer switch on the multifunction switch.
• Does the PID indicate correctly when the switch pressed and released?</td></tr>
<tr><td>G2 CHECK THE WASHER PUMP SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE</td><td rowspan="2">Yes
REPAIR the circuit.

No
INSTALL a new windshield wiper motor. REFER to Wiper Motor.</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Windshield Wiper Motor C125 .
• Ignition ON.
• Does the washer pump continue to operate?</td></tr>
<tr><td>G3 CHECK THE WASHER PUMP CONTROL CIRCUIT INTEGRITY</td><td rowspan="2">Yes
GO to G5.

No
GO to G4.</td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Washer Pump C137 .
• Connect a test light between:
<table><tr><th>Pin</th><th>Circuit</th><th>Pin</th><th>Circuit</th></tr><tr><td>—</td><td>Positive battery post</td><td>C137-1</td><td>CRW14 (BU/WH)</td></tr></table></td></tr>
</table>

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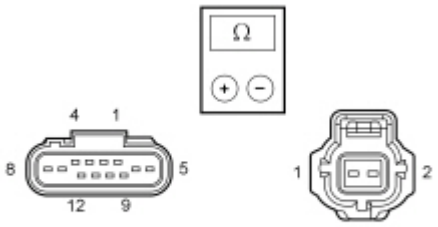


- **Does the test light illuminate?**

G4 CHECK THE WASHER PUMP CONTROL CIRCUIT FOR AN OPEN

- Measure the **resistance** between:

Positive Lead		Negative Lead	
Pin	Circuit	Pin	Circuit
C125-7	CRW14 (BU/WH)	C137-1	CRW14 (BU/WH)



N0138461

- **Is the resistance less than 3 ohms?**

Yes
INSTALL a new windshield wiper motor. REFER to Wiper Motor .

No
REPAIR the circuit.

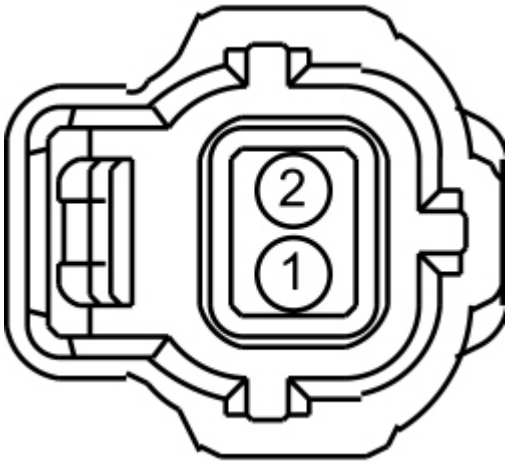
G5 CHECK THE WASHER PUMP GROUND CIRCUIT FOR AN OPEN

- Connect a **test light** between:

Pin	Circuit	Pin	Circuit
—	Positive battery post	C137-2	GD120 (BK/GN)

Yes
INSTALL a new washer pump. REFER to Washer Pump .

No
REPAIR the circuit.

 • **Does the test light illuminate?**	

Pinpoint Test H: The Washer Pump is Inoperative Or Always On — Vehicles Equipped With Front Video Camera

Refer to Wiring Diagrams Cell 81 , Wipers and Washers for schematic and connector information.

Normal Operation

When the multifunction switch is placed in the WASH position, the Steering Column Control Module (SCCM) sends the request to the windshield wiper motor through the Local Interconnect Network (LIN). The wiper motor then supplies power to the washer pump, which directs washer fluid to the windshield. When the front camera washer control is activated, the Steering Column Control Module (SCCM) sends the request to the windshield wiper motor through the Local Interconnect Network (LIN). The windshield wiper motor controls the direction of the washer pump to direct washer fluid to the front video camera.

When a windshield wash is requested, the windshield wiper motor supplies voltage to the washer pump. Ground is provided to the washer pump through the normally closed contact in the front camera washer relay (located in the auxiliary BJB).

When a front camera wash is requested, the windshield wiper motor activates the front camera washer relay. When the front camera washer relay is energized, it provides voltage to the washer pump. Ground is provided to the washer pump through the windshield wiper motor.

This pinpoint test is intended to diagnose the following:

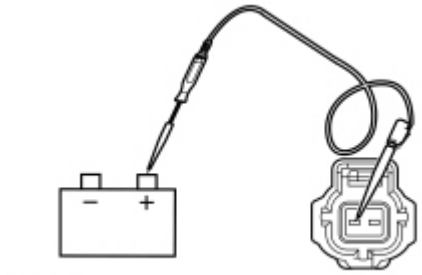
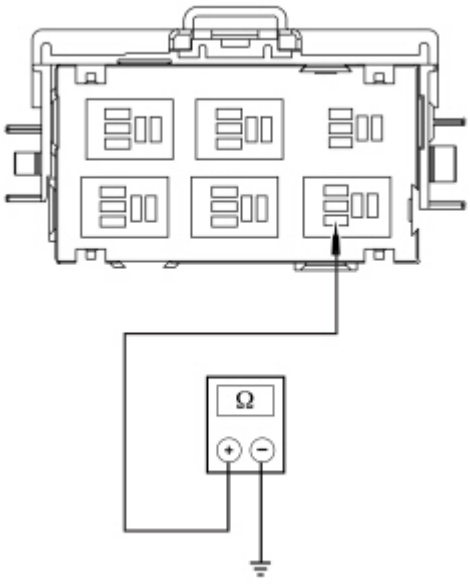
- Fuse
- Front camera washer relay
- SCCM
- Washer pump
- Wiring, terminals or connectors
- Multifunction switch
- Windshield wiper motor

PINPOINT TEST H: THE WASHER PUMP IS INOPERATIVE OR ALWAYS ON — VEHICLES EQUIPPED WITH FRONT VIDEO CAMERA

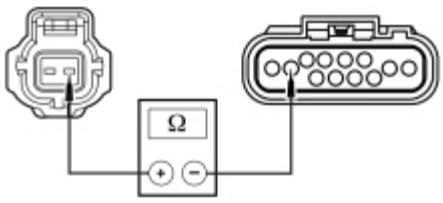
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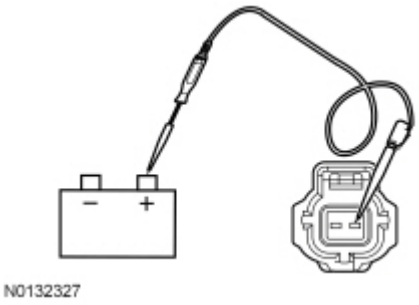
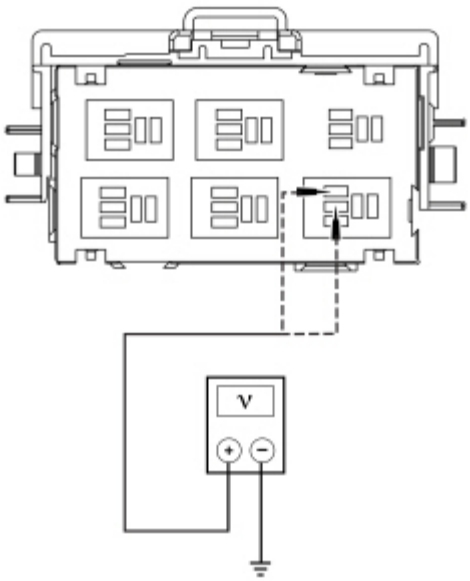
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 CHECK THE MULTIFUNCTION SWITCH (F_WASH_SW) AND (F_CAMRA_WASHSW) PIDs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger — SCCM . • While monitoring the SCCM F_WASH_SW PID, place the multifunction switch into the windshield wiper WASH position. • While monitoring the SCCM F_CAMRA_WASHSW PID, rotate the front camera washer control to the WASH position. • **Do each of the PIDs change to the ON state when the multifunction switch and front camera washer control are in the applicable WASH positions?**	**Yes** If a washer function is inoperative, GO to H2 . If the windshield washer function is always on, GO to H12 . If the front camera washer function is always on, GO to H13 . **No** INSTALL a new multifunction switch. REFER to section Section 211-05 . TEST the system for normal operation. If the concern is still present, INSTALL a new SCCM . REFER to Section 211-05 . TEST the system for normal operation.
H2 CHECK THE WINDSHIELD WASH FUNCTION	
• Ignition ON. • Attempt to operate the windshield wash function. • **Does the washer pump operate in the windshield WASH position?**	**Yes** GO to H8 . **No** GO to H3 .
H3 CHECK THE WASHER PUMP CONTROL CIRCUIT FOR AN OPEN	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition OFF. • Disconnect: Washer Pump Motor C137 . • Connect a 12-volt incandescent test light between the positive battery post and the washer pump motor C137-1, circuit CRW24 (BU/WH), harness side.	**Yes** GO to H6 . **No** GO to H4 .

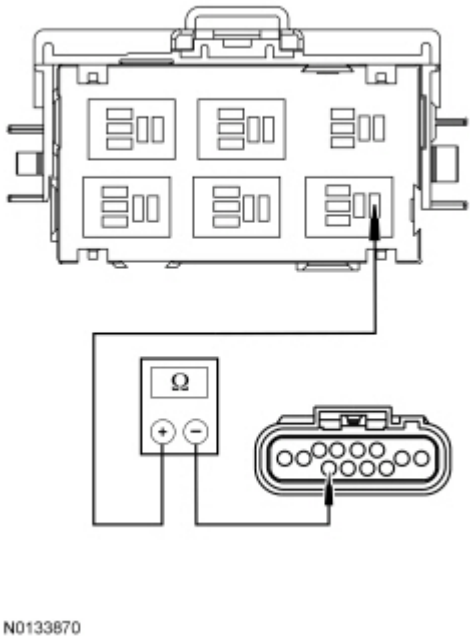
 N0132328 • **Does the test light illuminate?**	
H4 CHECK THE FRONT CAMERA WASHER RELAY (WINDSHIELD WASH)	
• Disconnect: Front Camera Washer Relay . • Carry out the front camera washer relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the front camera washer relay pass the component test?**	**Yes** GO to H5 . **No** INSTALL a new front camera washer relay. TEST the system for normal operation.
H5 CHECK THE FRONT CAMERA WASHER RELAY GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between the camera washer relay socket pin 4, circuit GD120 (BK/GN) and ground.  N0132330 • **Is the resistance less than 3 ohms?**	**Yes** REPAIR circuit CRW24 (BU/WH) for an open. TEST the system for normal operation. **No** REPAIR circuit GD120 (BK/GN) for an open. TEST the system for normal operation.
H6 CHECK THE WASHER PUMP CONTROL CIRCUIT FOR AN OPEN	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in**	**Yes** INSTALL a new washer pump. REFER to Washer

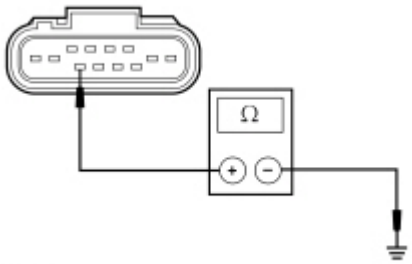
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the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector. • Ignition ON. • Connect a 12-volt incandescent test light between the washer pump motor C137-1, circuit CRW24 (BU/WH), harness side and the washer pump motor C137-2, circuit CRW14 (GY), harness side.  N0119238 • Observe the test light while placing the multifunction switch into the windshield WASH position. • **Does the test light illuminate when WASH is selected?**	Pump in this section. TEST the system for normal operation. **No** GO to H7 .
H7 CHECK THE WASHER PUMP CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Windshield Wiper Motor C125 . • Measure the resistance between the washer pump C137-2, circuit CRW14 (GY), harness side and the windshield wiper motor C125-7, circuit CRW14 (GY), harness side.  N0121923 • **Is the resistance less than 3 ohms?**	**Yes** INSTALL a new windshield wiper motor. REFER to Wiper Motor in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
H8 CHECK THE WINDSHIELD WIPER MOTOR FOR AN INTERNAL OPEN	
***NOTICE:* The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition OFF. • Disconnect: Washer Pump Motor C137 . • Connect a 12-volt incandescent test light between the positive battery post and the washer pump motor C137-2, circuit CRW14	**Yes** GO to H9 . **No** INSTALL a new windshield wiper motor. REFER to Wiper Motor in this section. TEST the system for normal operation.

(GY), harness side.  N0132327 • **Does the test light illuminate?**	
H9 CHECK THE FRONT CAMERA WASHER RELAY (INOPERATIVE)	
• Disconnect: Front Camera Washer Relay . • Carry out the front camera washer relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the front camera washer relay pass the component test?**	**Yes** GO to H10 . **No** INSTALL a new front camera washer relay. TEST the system for normal operation.
H10 CHECK FOR VOLTAGE TO THE FRONT CAMERA WASHER RELAY	
• Ignition ON. • Measure the voltage between the front camera washer relay socket pin 1, circuit CBB54 (VT/OG) and ground; and between the front camera washer relay socket pin 5, circuit SBB41 (RD) and ground.  N0132333 • **Are the voltages greater than 11?**	**Yes** GO to H11 . **No** VERIFY BJB fuses 41 (15A) and 54 (5A) are OK. If OK, REPAIR the circuit in question. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

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H11 CHECK THE FRONT CAMERA WASHER RELAY CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Windshield Wiper Motor C125 . • Measure the resistance between the front camera washer relay socket pin 3, circuit CRW34 (BU/BN) and the windshield wiper motor C125-12, circuit CRW34 (BU/BN), harness side.  N0133870 • **Is the resistance less than 3 ohms?**	**Yes** INSTALL a new windshield wiper motor. REFER to Wiper Motor in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
H12 CHECK THE WASHER PUMP SUPPLY CIRCUIT FROM THE WIPER MOTOR FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Windshield Wiper Motor C125 . • Ignition ON. • **Does the washer pump continue to operate?**	**Yes** REPAIR circuit CRW14 (GY) for a short to voltage. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Wiper Motor .
H13 CHECK THE FRONT CAMERA WASHER RELAY OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Front Camera Washer Relay . • Ignition ON. • **Does the washer pump continue to operate?**	**Yes** REPAIR circuit CRW24 (BU/WH) for a short to voltage. TEST the system for normal operation. **No** GO to H14 .
H14 CHECK THE FRONT CAMERA WASHER RELAY (ALWAYS ON)	

• Ignition OFF. • Carry out the front camera washer relay component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Did the front camera washer relay pass the component test?**	**Yes** GO to H15 . **No** INSTALL a new front camera washer relay. TEST the system for normal operation.
H15 CHECK THE FRONT CAMERA WASHER RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: Windshield Wiper Motor C125 . • Measure the resistance between the windshield wiper motor C125-12, circuit CRW34 (BU/BN), harness side.  N0138462 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Wiper Motor .

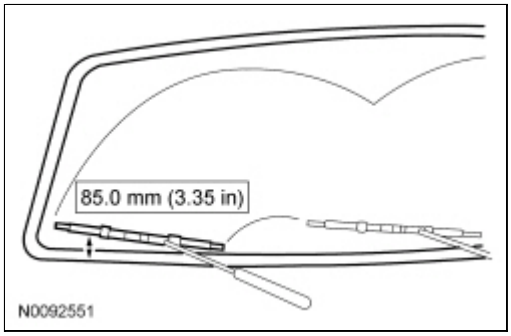
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Wiper Blade and Pivot Arm Adjustment

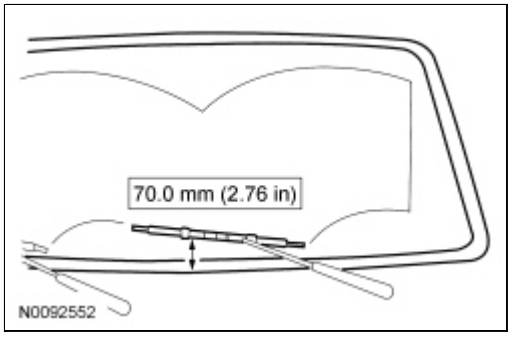
1. Cycle and park the wipers.

2. **NOTE:** Make sure there is no mechanical binding in the linkage preventing the wiper arms from returning to the fully parked position.

   Verify the distance between the center of the passenger wiper blade and the bottom of the windshield glass is within specifications.

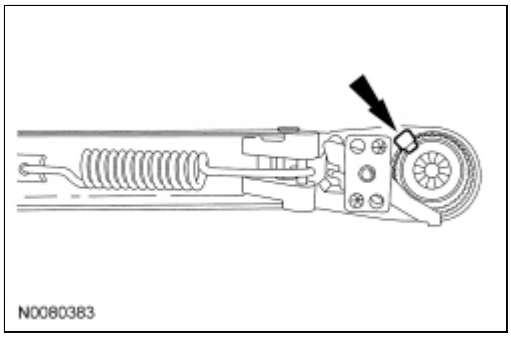


3. Verify the distance between the center of the driver wiper blade and the bottom of the windshield glass is within specifications.



4. **NOTE:** The alignment key is used for production only. The alignment key does not need to be reinstalled.

   If the distance is not within specifications, remove the wiper pivot arm and with a flat-blade screwdriver, remove the alignment key (if equipped). Reposition the wiper pivot arm to specifications. For additional information, refer to Wiper Pivot Arm in this sections.



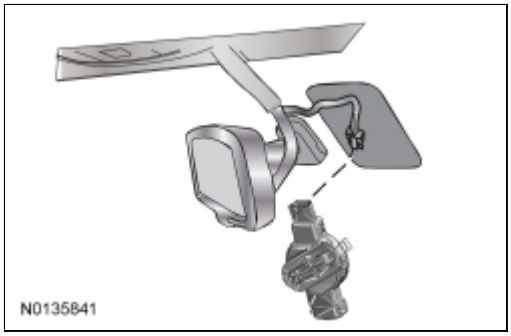
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Rain Sensor Bracket

NOTE: The rain sensor bracket primer and adhesive are not included in service kit (part number 19G382) and need to be ordered separately. The rain sensor bracket primer and adhesive part numbers and ordering instructions are available in the parts ordering system.

NOTE: The rain sensor bracket adhesive will take at least 6 hours to dry.

1. Disconnect the rain sensor electrical connector.



2. Disengage the metal rain sensor mounting clips from the old rain sensor bracket and separate the old rain sensor bracket from the rain sensor.
    - Discard the old rain sensor bracket, it is not to be reused.

3. Using a razor blade, carefully remove any residual glue from the windshield glass.

4. Using isopropyl alcohol and a clean cloth, wipe the windshield glass where the rain sensor and rain sensor bracket were mounted to remove any residual adhesive, contaminants, or loose glue particles.

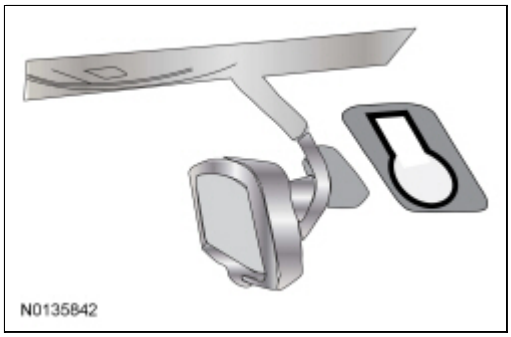
5. Wipe glass with a clean cloth to make sure the glass is clean and dry.

6. Apply specified primer onto a clean cloth.

7. Insert a cotton swab or equivalent, onto the wet area of the cloth.

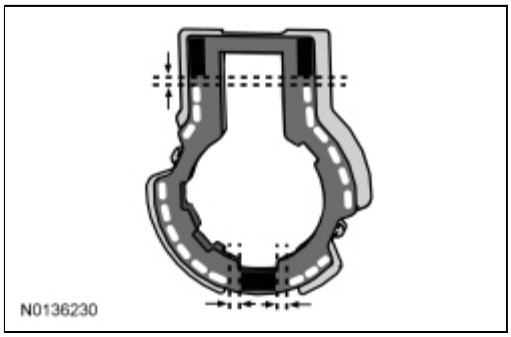
8. ***NOTICE:*** **Do not apply primer to the rain sensor view window area.**

    Using a cotton swab or equivalent, apply the primer onto the contact area of the rain sensor bracket area of the windshield glass.



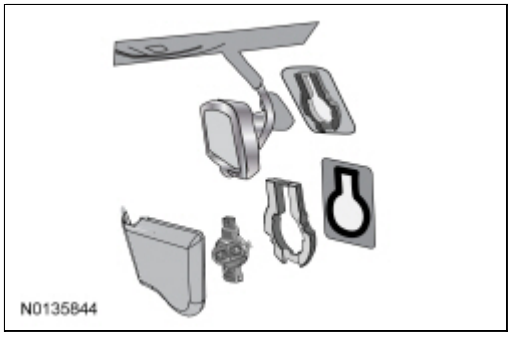
9. **NOTE:** Apply the adhesive to the outer periphery of the bracket mounting surface to prevent adhesive squeeze out toward the sensor viewing window.

   Remove release paper from the new rain sensor bracket. Using a 3M® EPX Plus II applicator or equivalent, apply a 1 to 2 mm (0.039 in to 0.078 in) bead of specified adhesive to the rain sensor bracket. Apply the bracket to the windshield within 90 seconds of applying adhesive to the bracket.
   - Adhesive path should terminate 2 mm (0.078 in) prior to running into the 3 adhesive tape pieces.
   - Remove the protective paper from the adhesive tape pieces.



10. **NOTE:** If the rain sensor bracket is not mounted in the correct location on the windshield glass the rain sensor may not function correctly, resulting in incorrect or erratic wiping. In addition, the trim cover may be misaligned once installed.

    Apply the rain sensor bracket onto the windshield making sure the open end of the bracket is facing the 12 o'clock position and that the bracket is centered around the rain sensor view window area.



11. Allow the adhesive to dry for at least 6 hours.

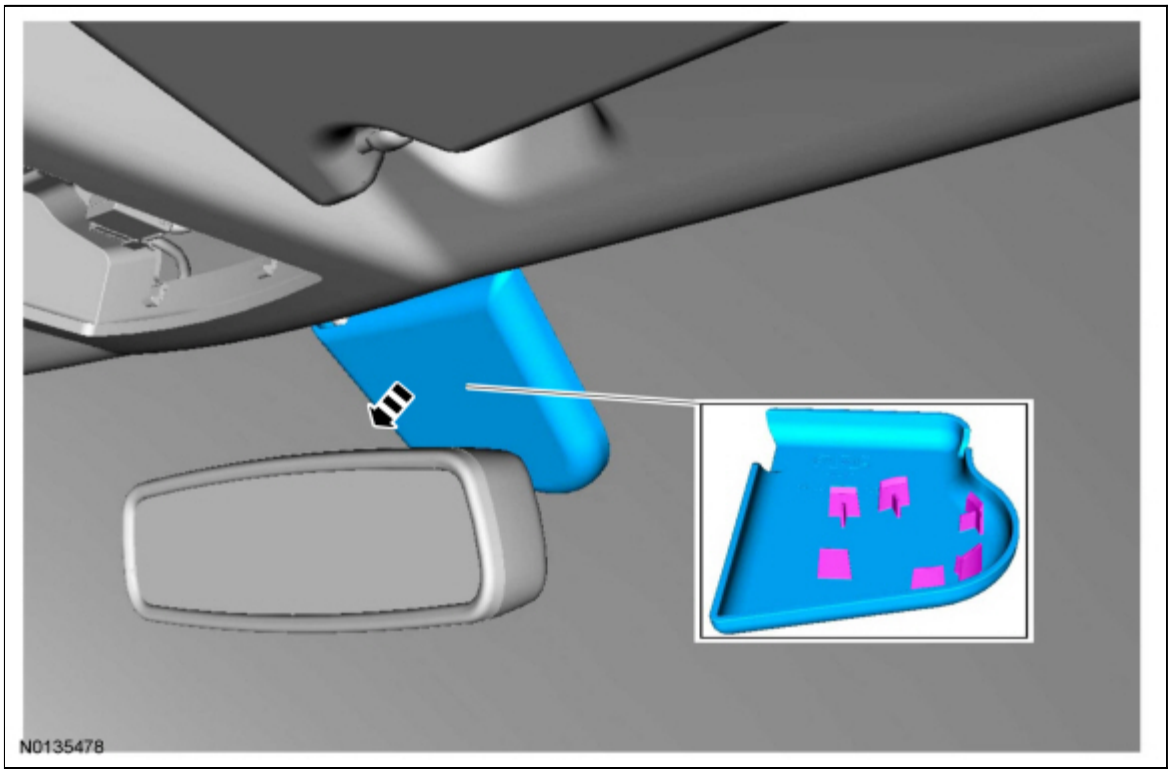
12. Install the rain sensor. For additional information, refer to Rain Sensor in this section.

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Rain Sensor

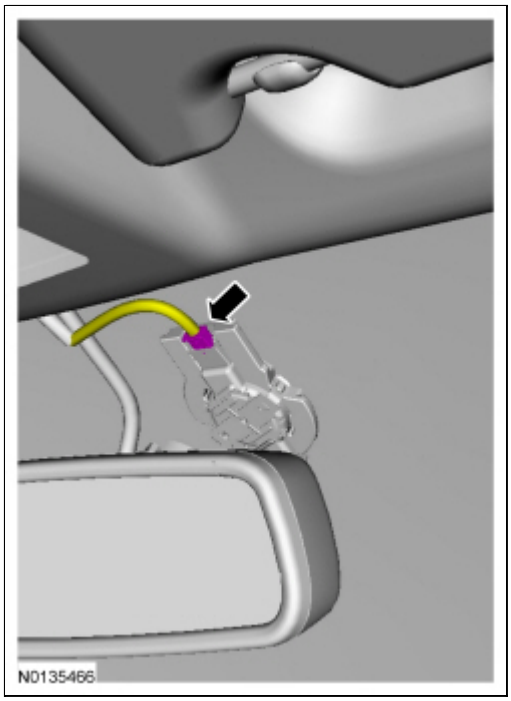
Removal

1.

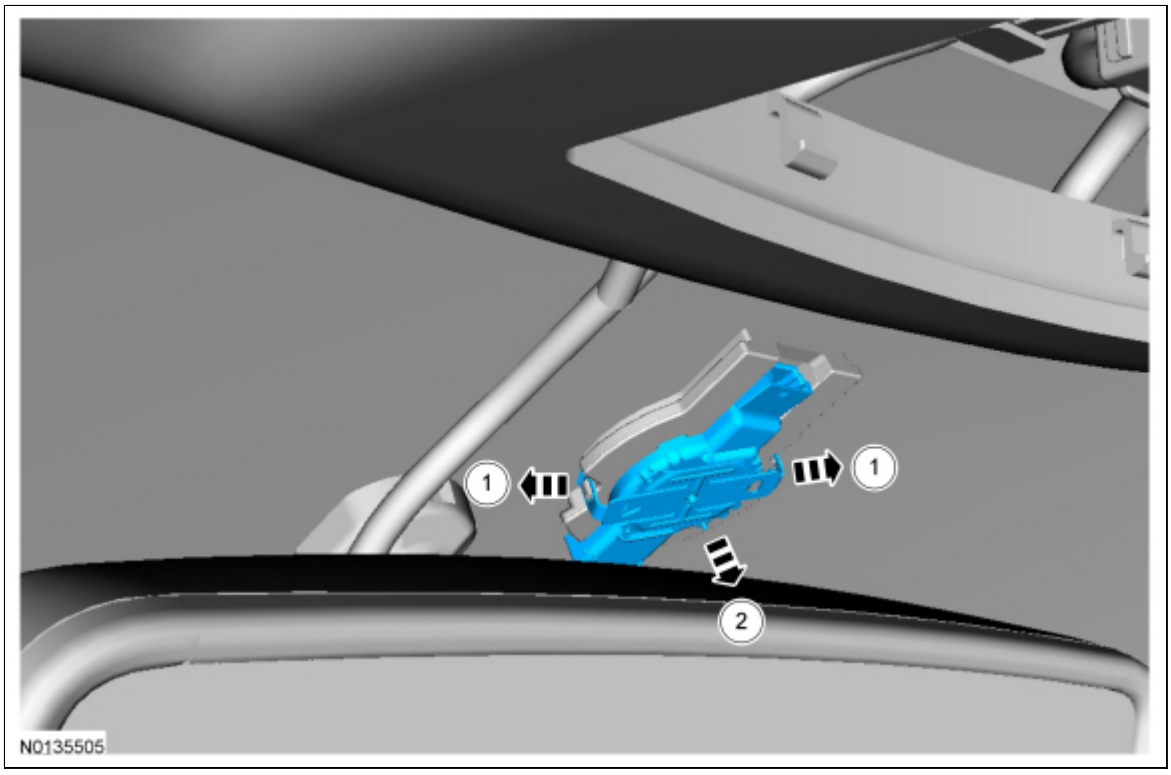


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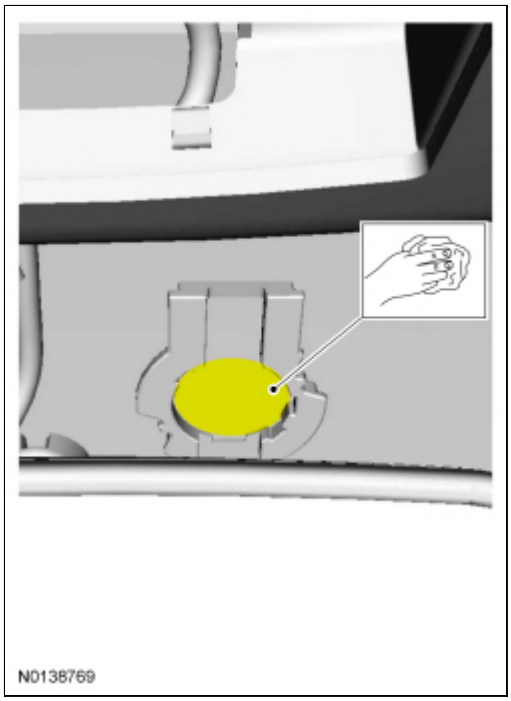
3.



Installation

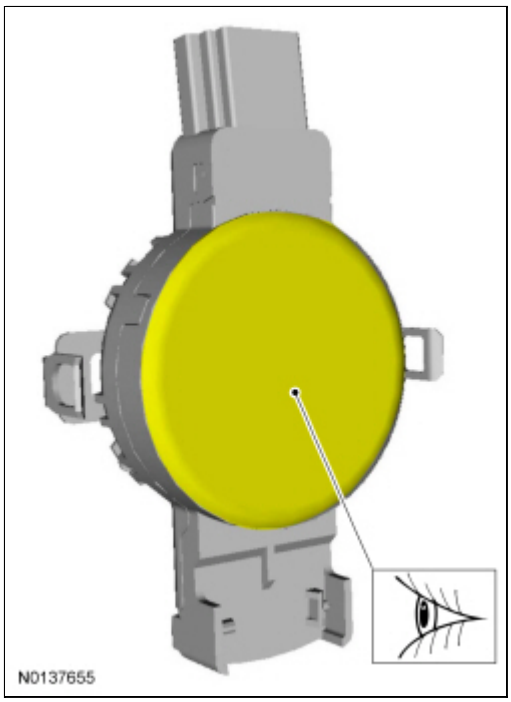
1. **NOTE:** Glass must be clean and dry.

   Clean the specified component with the specified material.



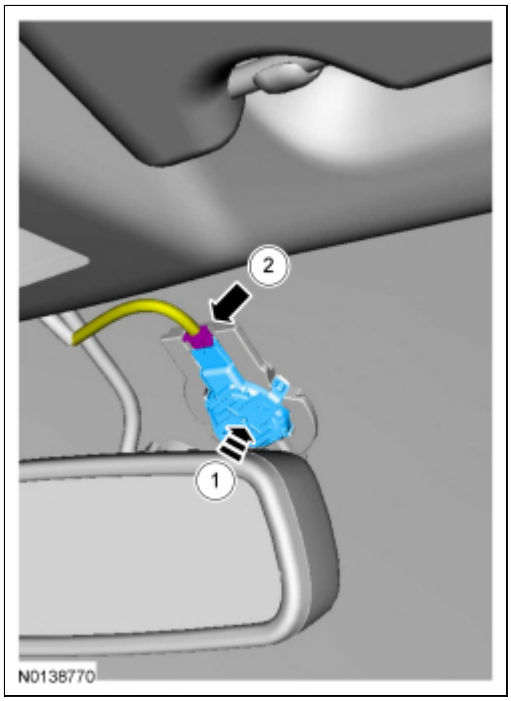
2. ***NOTICE:*** **If rain sensor gel is damaged or contaminated a new sensor must be installed.**

   If installing original rain sensor, visual check.

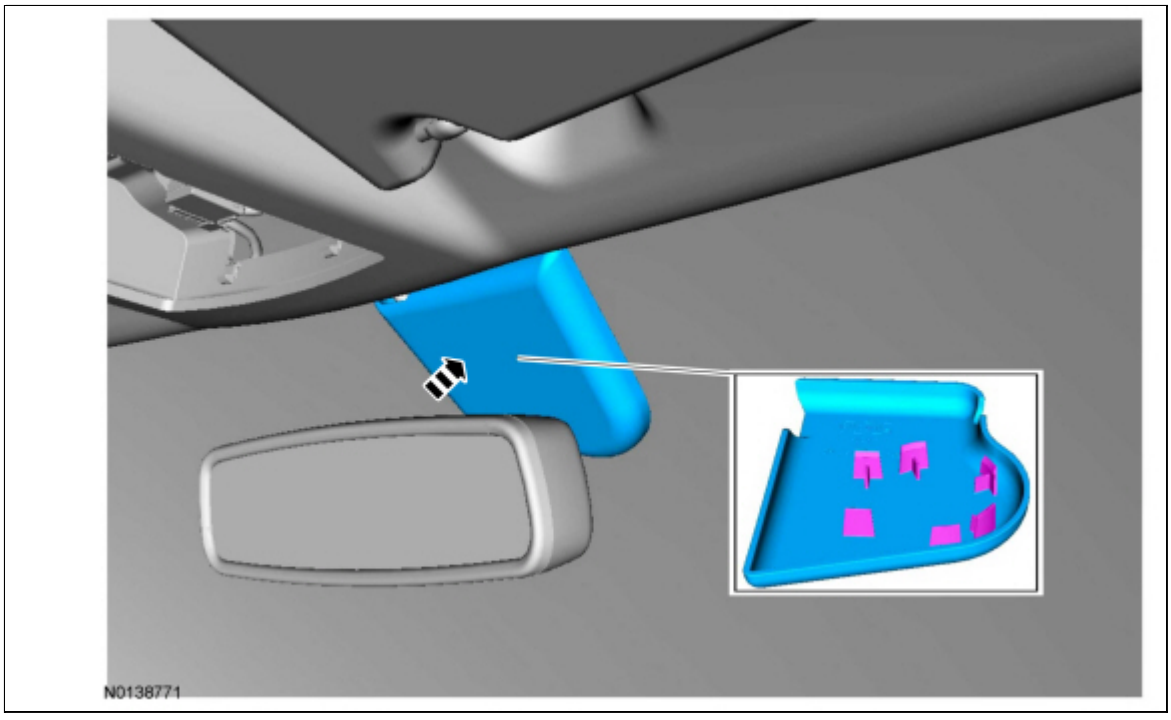


3.

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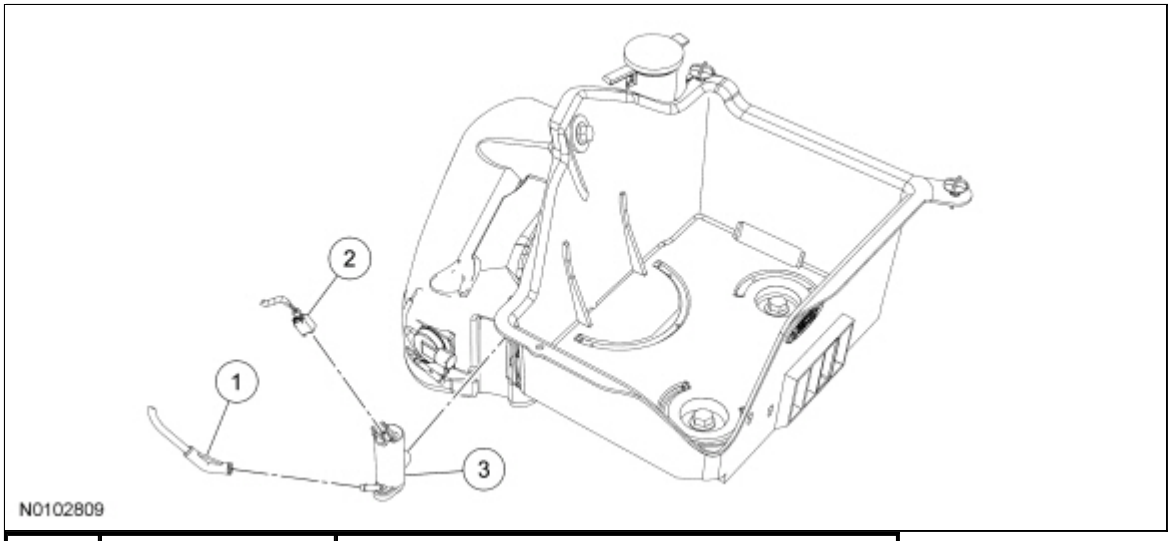


4.



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Washer Pump



Item	Part Number	Description
1	17A605A	Washer fluid hose
2	17664	Washer pump electrical connector
3	17664	Washer pump

Removal and Installation

WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

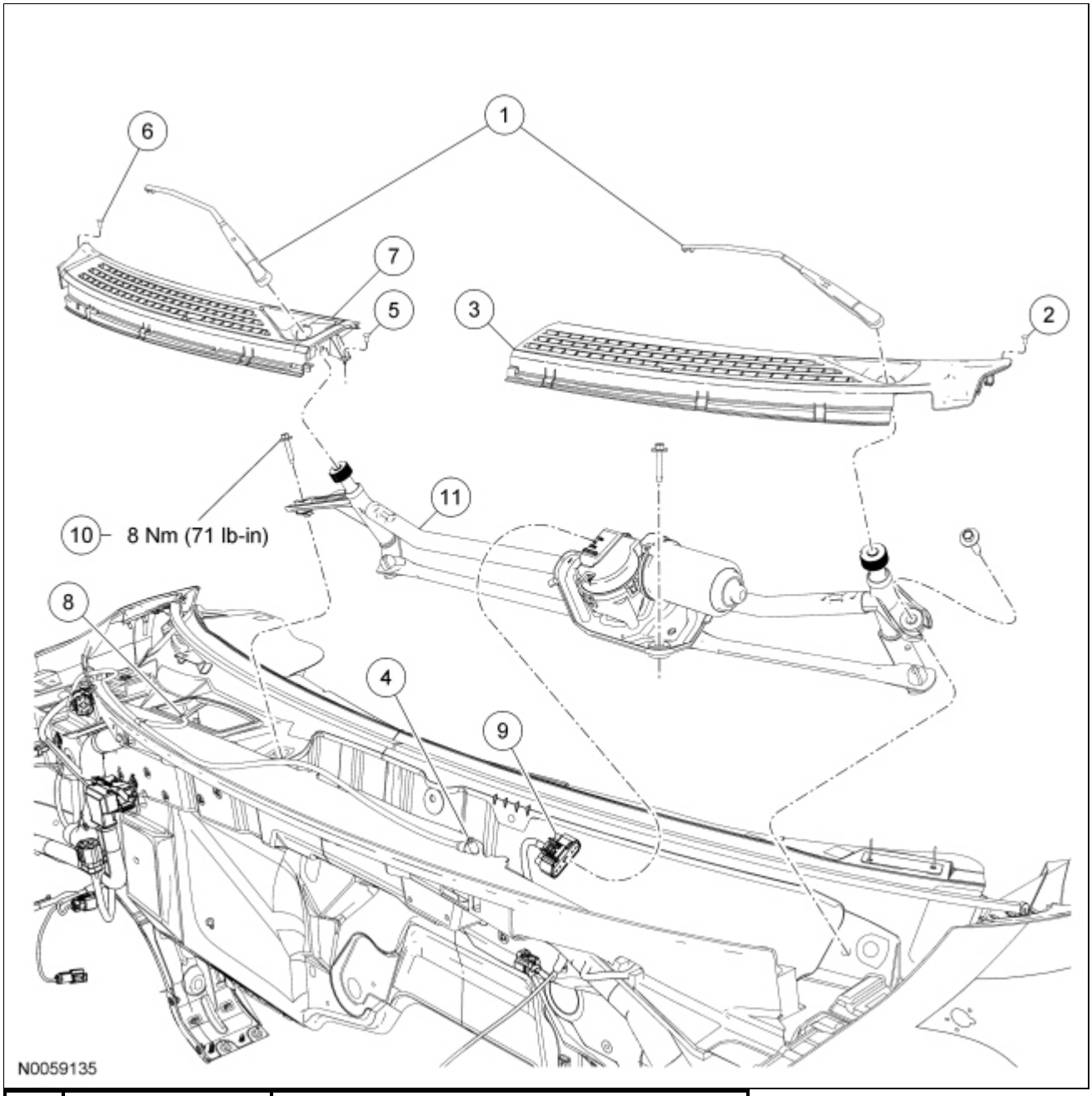
NOTICE: **When servicing the washer pump, be careful not to damage the washer pump seal.**

NOTICE: **Do not operate the washer pump before filling the washer reservoir. Failure to do so may result in premature washer pump failure.**

1. Remove the RH headlamp assembly. For additional information, refer to Section 417-01 .
2. Drain the windshield washer reservoir.
3. Disconnect the washer reservoir hose.
4. Disconnect the washer pump electrical connector.
5. Remove the washer pump.
6. To install, reverse the removal procedure.

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Wiper and Washer System — Exploded View



Item	Part Number	Description
1	17526 RH/ 17527 LH	Wiper arms
2	W710312	Pin-type fastener
3	022A69	LH cowl grille panel
4	17A605A	Washer hose

5	—	Cowl panel grille screw (part of 022A68)
6	W710312	Pin-type fastener
7	022A68	RH cowl grille panel
8	17A605A	Washer hose
9	—	Wiper motor electrical connector (part of 12A581)
10	N807391	Wiper mounting arm and pivot shaft bolt (3 required)
11	17508A	Wiper mounting arm and pivot shaft

1. For additional information, refer to the procedures in this section.

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Wiper Motor

Removal and Installation

1. **NOTE:** The windshield wiper motor is not serviceable separately. The windshield wiper motor and the mounting arm and pivot shaft must be replaced together.

   Remove the windshield wiper mounting arm and pivot shaft. For additional information, refer to Windshield Wiper Mounting Arm and Pivot Shaft in this section.

2. To install, reverse the removal procedure.

Wiper Mounting Arm and Pivot Shaft

Removal and Installation

1. Remove the cowl panel grille. For additional information, refer to Section 501-02 .
2. Remove the 3 wiper mounting arm and pivot shaft bolts.
   - To tighten, tighten to 8 Nm (71 lb-in).
3. Disconnect the wiper motor electrical connector.
4. Remove the wiper mounting and pivot shaft assembly.
5. To install, reverse the removal procedure.

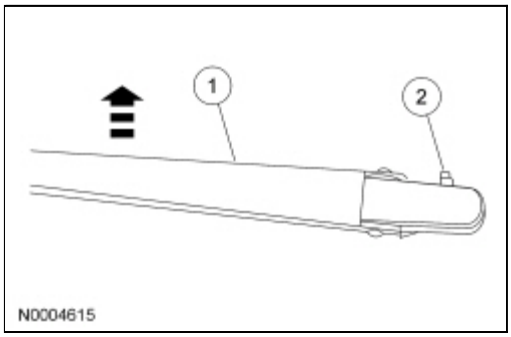
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Wiper Pivot Arm

Removal and Installation

1. Remove the wiper pivot arm.
    1. Position the wiper pivot arm upward.
    2. **NOTE:** During installation, it is necessary to pull the locking tab out to its full open (unlatched) position and hold while assembling the pivot arm onto the mounting arm and pivot shaft.

       Pull outward on the retaining tab and remove the wiper pivot arm.



2. To install, reverse the removal procedure.
    - If necessary, align the wiper blade and pivot arm. For additional information, refer to Wiper Blade and Pivot Arm Adjustment in this section.

General Specifications

Item	Specification
Roof Opening Panel Alignment	
Roof opening panel alignment, glass front edge-to-roof opening panel	-3 to 0 mm (-0.118 to 0 in)
Roof opening panel alignment, glass rear edge-to-roof opening panel	-1 to 2 mm (-0.039 to 0.079 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Roof opening panel air deflector screws	1	—	9
Roof opening panel frame bolts	9	—	80
Roof opening panel frame-to-B-pillar bolts	23	17	—
Roof opening panel glass screws	4	—	35
Roof opening panel motor screws	4	—	35

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Roof Opening Panel

The roof opening panel system consists of:

- Roof opening panel air deflector
- Roof opening panel control switch
- Roof opening panel drain hoses
- Roof opening panel frame
- Roof opening panel glass
- Roof opening panel motor/module
- Roof opening panel rear trough guide
- Roof opening panel shield
- Roof opening panel trough
- Roof opening panel weatherstrip

Roof Opening Panel Operation

The roof opening panel assembly uses an integrated motor and module to operate the roof opening panel. The roof opening panel is an electronically operated glass panel that has one-touch open, one-touch close and one-touch vent features.

To open the roof opening panel, press and release the SLIDE control switch. The roof opening panel will open automatically. The roof opening panel movement can be stopped at any time by pressing the switch again.

To vent the roof opening panel, the roof opening panel must first be in the CLOSED position. When the roof opening panel is in the CLOSED position, press and release the TILT control switch. The roof opening panel will move to the VENT position automatically. To close the roof opening panel from the VENT position, pull and hold the TILT control switch until the glass panel stops moving.

To close the roof opening panel, pull and release the SLIDE or TILT control switch. The roof opening panel will close automatically. The roof opening panel movement can be stopped at any time by activating the SLIDE or TILT control switch in either direction.

Bounce-Back

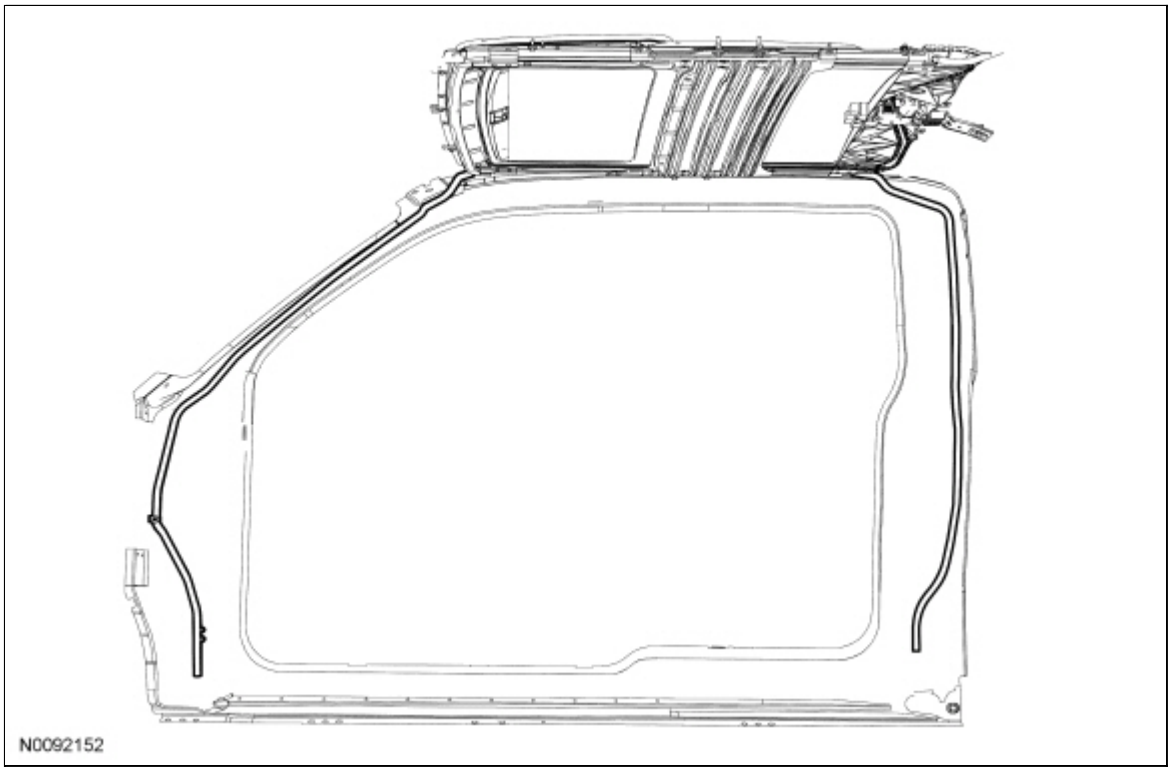
The roof opening panel has a bounce-back feature. If an obstacle has been detected in the roof opening panel as the sliding glass is closing, the roof opening panel will automatically open and stop at a predetermined position.

Security Override

To override a bounce-back condition (to overcome the resistance of ice on the roof opening panel seal for example), within 2 seconds of a bounce-back event, pull and hold the SLIDE or TILT control switch. The closing force will begin to increase each time the roof opening panel is closed for the first 3 closing cycles (bounce-back will still be enabled).

Roof Opening Panel Drain Hose Routing — SuperCab

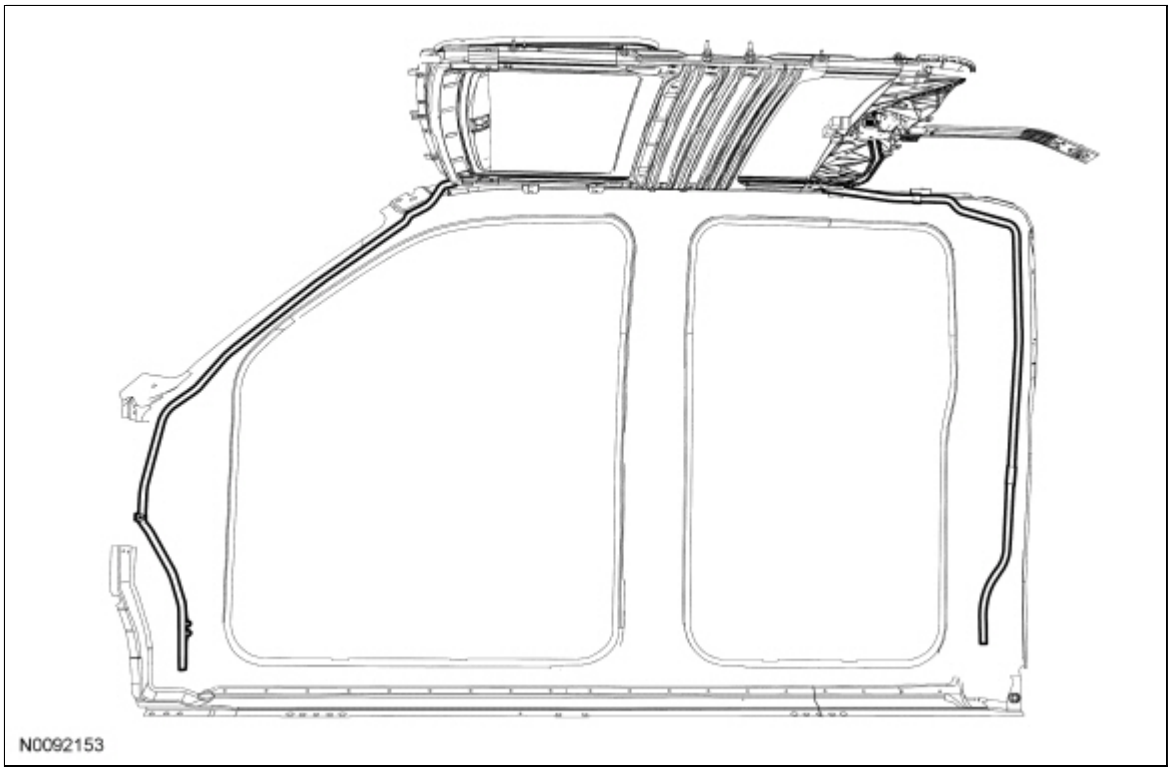
NOTE: Passenger side shown, driver side similar.



Roof Opening Panel Drain Hose Routing — SuperCrew

NOTE: Passenger side shown, driver side similar.

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Roof Opening Panel

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent

Principles of Operation

The roof opening panel assembly uses an integrated motor and module to operate the roof opening panel. The roof opening panel motor and module are installed new as an assembly. The roof opening panel is an electronically operated glass panel that can be opened, closed or vented by the roof opening panel switch.

The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel system, including whenever:

- the roof opening panel motor has been removed from the roof opening panel system.
- the roof opening panel glass has been removed from the roof opening panel system.
- the roof opening panel assembly has been removed from the vehicle.
- a new roof opening panel motor has been installed.
- a new roof opening panel glass has been installed.
- a new roof opening panel assembly has been installed.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

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• Roof opening panel • Roof opening panel frame • Roof opening panel drain hoses • Roof opening panel lifter assemblies • Roof opening panel water trough • Roof opening panel air deflector assembly • Roof opening panel weatherstrip • Roof opening panel shield	• Battery Junction Box (BJB) fuse 48 (20A) • Body Control Module (BCM) fuse 32 (15A) • Wiring, terminals or connectors • Accessory delay relay • Overhead console switch

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the concern is not visually evident, determine the symptom. GO to Symptom Chart - Roof Opening Panel or GO to Symptom Chart - NVH .

Symptom Chart — Roof Opening Panel

Symptom Chart — Roof Opening Panel

Condition	Possible Sources	Action
• The roof opening panel leaks	• Roof opening panel alignment • Roof opening panel weatherstrip • Roof opening panel rear trough guide • Damaged, clogged or obstructed roof opening panel drain hoses • Roof opening panel frame • Incorrect position of the roof opening panel glass • Sealant joints at frame (rail and track assembly) joints	• GO to Pinpoint Test B .
• The roof opening panel does not open or close	• Fuse(s) • Accessory delay relay • Wiring, terminals or connectors • Overhead console switch • Roof opening panel motor/module assembly	• GO to Pinpoint Test E .

• The roof opening panel does not open or close in VENT position	• Wiring, terminals or connectors • Overhead console switch • Roof opening panel motor/module assembly	• GO to Pinpoint Test F .
• The express open/close is inoperative	• Roof opening panel motor not initialized • Roof opening panel motor/module	• INITIALIZE the roof opening panel motor/module. REFER to Roof Opening Panel Motor Initialization in this section. If concern is still present after initialization, INSTALL a new roof opening panel motor/module. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation.
• The roof opening panel does not stop in FLUSH from any position	• Incorrect roof opening panel alignment	• ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section.
• Roof opening panel reverses during operation	• Incorrect roof opening panel alignment • Foreign material in guide track(s)	• ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. • REMOVE foreign material from guide track.

Symptom Chart — NVH

Symptom Chart — NVH

NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• The roof opening panel has excessive wind noise	• Roof opening panel glass alignment • Roof opening panel weatherstrip • Roof opening panel air deflector assembly	• GO to Pinpoint Test A .
• The roof opening panel rattles	• Roof opening panel glass alignment • Roof opening panel air deflector assembly • Roof opening panel water trough and guides	• GO to Pinpoint Test C .

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	• Roof opening panel lifter assemblies • Roof opening panel tracks • Roof opening panel shield (sunshade) • Roof opening panel assembly	
• The roof opening panel is noisy during operation	• Obstructed or damaged roof opening panel • Roof opening panel lifter assemblies • Roof opening panel alignment • Noisy roof opening panel motor/module assembly • Roof opening panel shield (sunshade)	• GO to Pinpoint Test D .

Pinpoint Tests

Pinpoint Test A: The Roof Opening Panel Has Excessive Wind Noise

Normal Operation

When the roof opening panel glass is completely closed, it is flush with the roof panel.

This pinpoint test is intended to diagnose the following:

- Roof opening panel glass alignment
- Roof opening panel weatherstrip
- Roof opening panel air deflector assembly

PINPOINT TEST A: THE ROOF OPENING PANEL HAS EXCESSIVE WIND NOISE

Test Step	Result / Action to Take
A1 VERIFY ROOF OPENING PANEL NOISE	
• Road test the vehicle with the roof opening panel in the CLOSED and OPEN position. • **Is the wind noise present only in the OPEN position?**	**Yes** GO to A4 . **No** GO to A2 .
A2 CHECK THE ROOF OPENING PANEL ALIGNMENT	
• Make sure the roof opening panel glass is centered and flush with the roofline. • **Is the roof opening panel aligned correctly?**	**Yes** GO to A3 . **No** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.

A3 CHECK THE ROOF OPENING PANEL WEATHERSTRIP	
NOTE: Make sure the weatherstrip is secured to the glass, not cut, cracked, pinched, loose or obstructed in CLOSED, VENT and OPEN positions. • Check the roof opening panel weatherstrip. • **Is the roof opening panel weatherstrip OK?**	**Yes** REFER to Section 501-00 to diagnose other possible sources of the excessive wind noise. **No** INSTALL a new roof opening panel weatherstrip. TEST the system for normal operation.
A4 CHECK THE AIR DEFLECTOR	
• Make sure the air deflector is securely attached and check for torn and unsecured tethers. • **Is the air deflector OK?**	**Yes** GO to A5 . **No** REPAIR or INSTALL a new air deflector assembly. REFER to Air Deflector in this section. TEST the system for normal operation.
A5 CHECK THE AIR DEFLECTOR FOR VIBRATION	
• Road test the vehicle and check for air deflector vibration. • **Did the air deflector vibrate?**	**Yes** MODIFY the curvature of the air deflector and RETEST. **No** PARTIALLY close the roof opening panel until the noise is eliminated. If the noise is eliminated, ADVISE the customer that changing glass location eliminates the wind noise. If the wind noise is not eliminated, INSTALL a new air deflector assembly. REFER to Air Deflector in this section. TEST the system for normal operation.

Pinpoint Test B: The Roof Opening Panel Leaks

Normal Operation

When the roof opening panel glass is completely closed, it is flush with the roof panel.

This pinpoint test is intended to diagnose the following:

- Roof opening panel alignment
- Roof opening panel weatherstrip
- Roof opening panel rear trough guide
- Damaged, clogged or obstructed roof opening panel drain hoses
- Roof opening panel frame
- Incorrect position of the roof opening panel glass
- Sealant joints at frame (rail and track assembly) joints

PINPOINT TEST B: THE ROOF OPENING PANEL LEAKS

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Test Step	Result / Action to Take
B1 VERIFY CUSTOMER OPERATION OF THE ROOF OPENING PANEL WHEN PARKED • Make sure the customer is parking with the roof opening panel in the CLOSED position. • **Is the customer parking with the roof opening panel in the CLOSED position?**	**Yes** GO to B2 . **No** ADVISE the customer to refer to the Owner's Literature for correct operation of the roof opening panel.
B2 CHECK THE ALIGNMENT OF THE ROOF OPENING PANEL • Make sure the roof opening panel glass is centered and flush with the roof line. • **Is the roof opening panel aligned correctly?**	**Yes** GO to B3 . **No** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.
B3 CHECK THE WEATHERSTRIP CONDITION **NOTE:** The weatherstrip has a bonded joint located on the passenger side or rear edge. This is not a defect. • Make sure the roof opening panel weatherstrip is not cracked, torn or loose. • Check the roof opening panel weatherstrip. • **Is the roof opening panel weatherstrip in good condition and free from damage?**	**Yes** GO to B4 . **No** INSTALL a new roof opening panel weatherstrip. TEST the system for normal operation.
B4 CHECK THE WATER TROUGH AND GUIDE CONDITION • Check the water trough and guide for damage and/or incorrect attachment and function. • **Is the water trough and guide OK?**	**Yes** GO to B5 . **No** REPAIR the water trough or INSTALL a new component as necessary. TEST the system for normal operation.
B5 CHECK THE DRAIN HOSES **NOTE:** Drain hoses can be viewed with a flashlight by removing the headliner lace around the inside opening and gently pulling down on the headliner. (On some vehicles, hook-and-loop tape style attachments have been installed in place of trim lace.) • Make sure the drain hoses are correctly attached, not cracked, slit, pinched or obstructed. • **Are all the drain hoses present and attached correctly?**	**Yes** GO to B6 . **No** REPAIR or INSTALL new drain hose (s) as necessary. TEST the system for normal operation.
B6 CHECK THE DRAIN HOSES FOR CORRECT FLOW **NOTE:** Drain hoses must flow downhill and cannot be pinched or restricted by headliner or any other trim	**Yes** INSPECT other areas of the vehicle

components. For drain hose routing information, refer to Roof Opening Panel in this section. • With the panel OPEN, slowly pour water into the water trough area and make sure that the same amount of water exits the vehicle at the bottom of the A- and C-pillars. • Check the drain hoses for obstructions by blowing compressed air through the drain spouts in the water trough area, then retest with water. • **Are the drain hoses operating correctly?**	that may cause water to enter the roof area such as the windshield. If no concern is found, GO to B7 . **No** LOWER the headliner and INSPECT the drain hoses for correct routing. REPAIR or INSTALL a new drain hose(s). TEST the system for normal operation.
B7 CHECK THE CONDITION OF THE ROOF OPENING PANEL FRAME	
• Check the roof opening panel frame for damage that may cause the roof opening panel seal to seat incorrectly. • **Is the roof opening panel frame OK?**	**Yes** INSTALL a new roof opening panel. REFER to Roof Opening Panel in this section. **No** REPAIR roof opening panel frame as necessary. TEST the system for normal operation.

Pinpoint Test C: The Roof Opening Panel Rattles

Normal Operation

When the roof opening panel glass is completely closed, it is flush with the roof panel. All components should be secured correctly.

This pinpoint test is intended to diagnose the following:

- Roof opening panel glass alignment
- Roof opening panel air deflector assembly
- Roof opening panel water trough and guides
- Roof opening panel lifter assemblies
- Roof opening panel tracks
- Roof opening panel shield (sunshade)
- Roof opening panel assembly

PINPOINT TEST C: THE ROOF OPENING PANEL RATTLES

Test Step	Result / Action to Take
C1 CHECK THE ROOF OPENING PANEL TIGHTNESS	
• With the roof opening glass panel in the CLOSED position, manually push up and fore/aft on the glass panel. • **Is the roof opening panel glass loose?**	**Yes** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation. **No** GO to C2 .

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C2 CHECK THE ROOF OPENING PANEL TRACKS • Open the roof opening panel. • Check the roof opening panel tracks for obstructions or foreign material and damage. • **Are the roof opening panel tracks OK?**	**Yes** GO to C3 . **No** REMOVE all the roof opening panel track obstructions and REPAIR the roof opening panel tracks. TEST the system for normal operation.
C3 CHECK THE ROOF OPENING PANEL WATER TROUGH AND REAR TROUGH GUIDES • Check the roof opening panel water trough and rear trough guides for any obstructions. • **Are the roof opening panel water trough and rear trough guides installed securely and free from obstructions?**	**Yes** GO to C4 . **No** REMOVE all obstructions from the roof opening panel water trough. SECURE the trough guides or INSTALL new roof opening panel rear trough guides if damaged. REFER to Roof Opening Panel Rear Trough Guide in this section. TEST the system for normal operation.
C4 CHECK THE ROOF OPENING PANEL SHIELD (SUNSHADE) • Check the roof opening panel shield (sunshade) for correct installation with all tabs in track channels and the guide feet intact. • **Is the roof opening panel shield installed correctly?**	**Yes** GO to C5 . **No** INSTALL the roof opening panel shield correctly. REFER to Roof Opening Panel Shield in this section. TEST the system for normal operation.
C5 CHECK THE ROOF OPENING PANEL AIR DEFLECTOR ASSEMBLY • Check the roof opening panel air deflector assembly for obstructions, damage and incorrect attachments. • **Is the roof opening panel air deflector assembly OK?**	**Yes** GO to C6 . **No** REMOVE all obstructions and REPAIR or INSTALL a new roof opening panel air deflector assembly. REFER to Air Deflector in this section. TEST the system for normal operation.
C6 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES • Verify the roof opening panel lifter assemblies are free from obstructions and damage. • **Are the roof opening panel lifter assemblies OK?**	**Yes** GO to C7 . **No** REMOVE all obstructions from the roof opening panel lifter assemblies and REPAIR any damage. TEST the system for normal operation.
C7 CHECK THE ROOF OPENING PANEL FRAME ATTACHMENTS • Check for correct torque and installation of the roof opening	**Yes** GO to C8 .

panel frame. • **Is the roof opening panel correctly installed and tightened to specification?**	**No** TIGHTEN or REINSTALL the roof opening panel frame. REFER to Roof Opening Panel Frame in this section. TEST the system for normal operation.
C8 CHECK THE ROOF OPENING PANEL FRAME TO HEADLINER FOR RATTLES	
• Check roof opening panel frame to headliner for any interference condition that would induce a rattle. • **Is there a condition that causes a rattle?**	**Yes** INSTALL a suitable sound damper material to correct the condition. If the rattle still persists, INSTALL a new roof opening panel frame or headliner. REFER to Roof Opening Panel Frame in this section. TEST the system for normal operation. **No** INSTALL a new roof opening panel frame. REFER to Roof Opening Panel Frame in this section. TEST the system for normal operation.

Pinpoint Test D: The Roof Opening Panel is Noisy During Operation

Normal Operation

The roof opening panel operates smoothly while opening and closing.

This pinpoint test is intended to diagnose the following:

- Obstructed or damaged roof opening panel
- Roof opening panel lifter assemblies
- Roof opening panel alignment
- Noisy roof opening panel motor/module assembly
- Roof opening panel shield (sunshade)

PINPOINT TEST D: THE ROOF OPENING PANEL IS NOISY DURING OPERATION

Test Step	Result / Action to Take
D1 CHECK THE ROOF OPENING PANEL FOR OBSTRUCTIONS OR DAMAGE	
• Check the roof opening panel for any obstructions and damage. • **Are there any obstructions and/or damage?**	**Yes** REMOVE all obstructions. REPAIR any damage or INSTALL a new roof opening panel frame. REFER to Roof Opening Panel Frame in this section. TEST the system for normal operation. **No** GO to D2.
D2 CHECK THE ROOF OPENING PANEL ALIGNMENT	

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• Check the roof opening panel during operation. • **Is the roof opening panel loose or incorrectly aligned?**	**Yes** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation. **No** GO to D3.
D3 CHECK THE ROOF OPENING PANEL TRACKS	
• Open the roof. • Check the roof opening panel tracks for obstructions and damage. • **Are the roof opening panel tracks OK?**	**Yes** GO to D4. **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
D4 CHECK THE ROOF OPENING PANEL SHIELD (SUNSHADE)	
• Check the roof opening panel shield (sunshade) for correct movement. • **Is the roof opening panel shield moving correctly?**	**Yes** GO to D5. **No** REMOVE and REINSTALL the roof opening panel shield. REFER to Roof Opening Panel Shield in this section. TEST the system for normal operation.
D5 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES	
• Check the roof opening panel lifter assemblies for obstructions and damage. • **Are the roof opening panel lifter assemblies OK?**	**Yes** GO to D6. **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
D6 CHECK THE ROOF OPENING PANEL MOTOR/MODULE	
• Remove the roof opening panel motor/module and leave the electrical connector connected. • Operate the roof opening panel to the full OPEN and CLOSED position. • **Does the motor/module make excessive noise?**	**Yes** INSTALL a new roof opening panel motor/module. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** REINSTALL the roof opening panel motor. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. If the roof opening panel is still noisy, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel Frame in this section. If the roof opening panel is no longer noisy, the system is operating correctly. The concern may have been caused by an incorrectly installed roof opening panel motor.

Pinpoint Test E: The Roof Opening Panel Does Not Open or Close

Refer to Wiring Diagrams Cell 101 , Roof Opening Panel for schematic and connector information.

The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel system, including whenever:

- the roof opening panel motor has been removed from the roof opening panel system.
- the roof opening panel glass has been removed from the roof opening panel system.
- the roof opening panel assembly has been removed from the vehicle.
- a new roof opening panel motor has been installed.
- a new roof opening panel glass has been installed.
- a new roof opening panel assembly has been installed.

Refer to Roof Opening Panel Motor Initialization in this section.

Normal Operation

The roof opening panel uses an integrated motor and module to operate the roof opening panel. A new roof opening panel motor/module is installed as an assembly.

The roof opening panel motor/module receives voltage from the accessory delay relay when the ignition is in the ACC or RUN position. The overhead console switch supplies ground signals to the roof opening panel motor/module to operate the roof opening panel.

This pinpoint test is intended to diagnose the following:

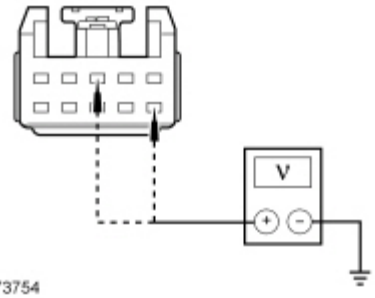
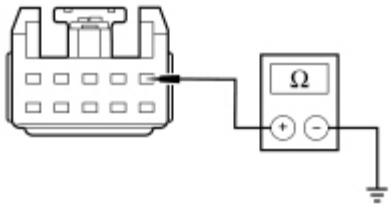
- Fuse(s)
- Accessory delay relay
- Wiring, terminals or connectors
- Overhead console switch
- Roof opening panel motor/module assembly

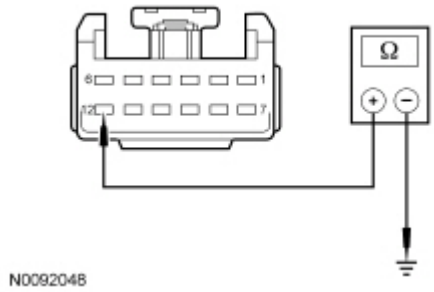
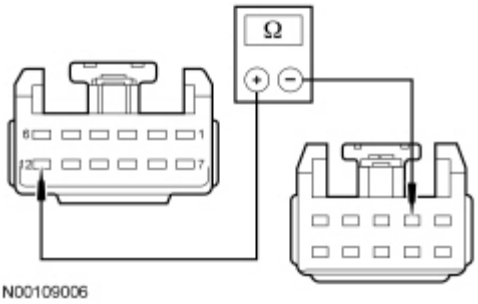
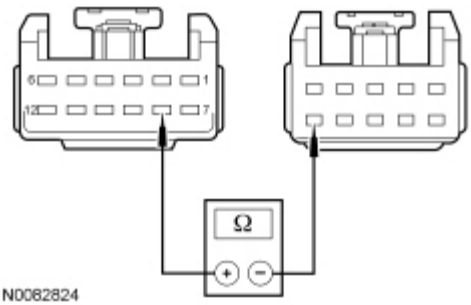
PINPOINT TEST E: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

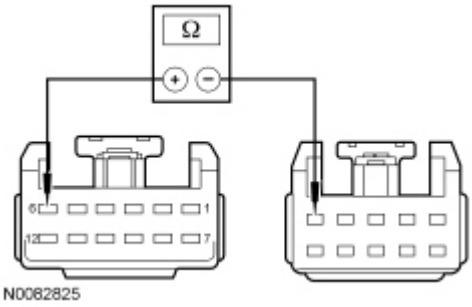
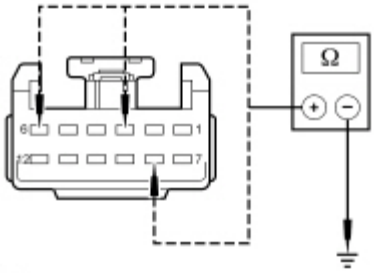
Test Step	Result / Action to Take
E1 CHECK THE POWER WINDOWS	
• Ignition ON. • Verify the power windows operate. • **Do the power windows operate?**	**Yes** GO to E2 . **No** REFER to Section 501-11 to diagnose the accessory delay relay circuit.
E2 CHECK THE MOTOR/MODULE FOR INITIALIZATION	
• Attempt to carry out the Roof Opening Panel Motor Initialization procedure. Refer to Roof Opening Panel Motor Initialization in this section. • **Is the concern still present, or does the roof opening**	**Yes** GO to E3 . **No**

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panel motor fail to initialize?	The system is operating normally at this time. The roof opening panel motor was not initialized.
E3 CHECK THE OVERHEAD CONSOLE SWITCH • Ignition OFF. • Disconnect: Overhead Console Switch C912. • Carry out the overhead console switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the overhead console switch OK?**	**Yes** GO to E4 . **No** INSTALL a new overhead console switch. REFER to Roof Opening Panel Control Switch in this section. TEST the system for normal operation.
E4 CHECK VOLTAGE TO THE ROOF OPENING PANEL MOTOR/MODULE • Disconnect: Roof Opening Panel Motor/Module C921. • Ignition ON. • Measure the voltage between roof opening panel motor/module C921-3, circuit CBP32 (GN/VT), harness side and roof opening panel motor/module C921-6, circuit SBB48 (VT/RD), harness side and ground.  A0073754 • **Are the voltages greater than 10 volts for both measurements?**	**Yes** GO to E5 . **No** VERIFY Battery Junction Box (BJB) fuse 48 (20A) and BCM fuse 32 (15A) are OK. If OK, REPAIR circuit SBB48 (VT/RD) and/or CBP32 (GN/VT) for an open. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
E5 CHECK THE ROOF OPENING PANEL MOTOR/MODULE GROUND • Ignition OFF. • Measure the resistance between roof opening panel motor/module C921-1, circuit GD139 (BK/YE), harness side and ground.  A0073757 • **Is the resistance less than 5 ohms?**	**Yes** GO to E6 . **No** REPAIR the circuit. TEST the system for normal operation.

E6 CHECK THE OVERHEAD CONSOLE SWITCH GROUND	
• Measure the resistance between overhead console switch C912-12, circuit CPR39 (VT/WH), harness side and ground.  N0092048 • **Is the resistance less than 5 ohms?**	**Yes** GO to E8 . **No** GO to E7 .
E7 CHECK THE COMMON CIRCUIT FOR AN OPEN	
• Measure the resistance between overhead console switch C912-12, circuit CPR39 (VT/WH), harness side and roof opening panel motor/module C921-2, circuit CPR39 (VT/WH), harness side.  N00109006 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new roof opening panel motor/module. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
E8 CHECK THE ROOF OPENING PANEL CONTROL CIRCUIT FOR AN OPEN	
• Measure the resistance between overhead console switch C912-8, circuit CPR40 (YE/OG), harness side and roof opening panel motor/module C921-10, circuit CPR40 (YE/OG), harness side.  N0082824 • **Is the resistance less than 5 ohms?**	**Yes** GO to E9 . **No** REPAIR the circuit. TEST the system for normal operation.
E9 CHECK THE ROOF OPENING PANEL CONTROL CIRCUIT FOR AN OPEN	

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• Measure the resistance between overhead console switch C912-6, circuit CPR31 (VT/BN), harness side and roof opening panel motor/module C921-5, circuit CPR31 (VT/BN), harness side.  N0082825 • **Is the resistance less than 5 ohms?**	**Yes** GO to E10 . **No** REPAIR the circuit. TEST the system for normal operation.
E10 CHECK THE ROOF OPENING PANEL CONTROL CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between overhead console switch C912, harness side and ground using the following chart: **Overhead Console Switch** / **Circuit** C912-6 / CPR31 (VT/BN) C912-3 / CPR38 (WH/BU) C912-8 / CPR40 (YE/OG)  N0092049 • **Is the resistance greater than 10,000 ohms for all measurements?**	**Yes** GO to E11 . **No** REPAIR the circuit(s). TEST the system for normal operation.
E11 CHECK THE ROOF OPENING PANEL MOTOR/MODULE FOR CORRECT OPERATION	

• Disconnect all roof opening panel motor/module connectors.
• Check for:
  ▪ corrosion.
  ▪ bent pins.
  ▪ pushed-out pins.
• Connect all roof opening panel motor/module connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• **Is the concern still present?**
	Yes
	INSTALL a new roof opening panel motor/module. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation.
	
	No
	The system is operating correctly at this time. Concern

	may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test F: The Roof Opening Panel Does Not Open or Close in VENT Position

Refer to Wiring Diagrams Cell 101 , Roof Opening Panel for schematic and connector information.

The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel system, including whenever:

- the roof opening panel motor has been removed from the roof opening panel system.
- the roof opening panel glass has been removed from the roof opening panel system.
- the roof opening panel assembly has been removed from the vehicle.
- a new roof opening panel motor has been installed.
- a new roof opening panel glass has been installed.
- a new roof opening panel assembly has been installed.

Refer to Roof Opening Panel Motor Initialization in this section.

Normal Operation

The roof opening panel uses an integrated motor and module to operate the roof opening panel. A new roof opening panel motor/module is installed as an assembly.

The roof opening panel motor/module receives voltage from the accessory delay relay when the ignition is in the ACC or RUN position. The overhead console switch supplies ground signals to the roof opening panel motor/module to operate the roof opening panel.

This pinpoint test is intended to diagnose the following:

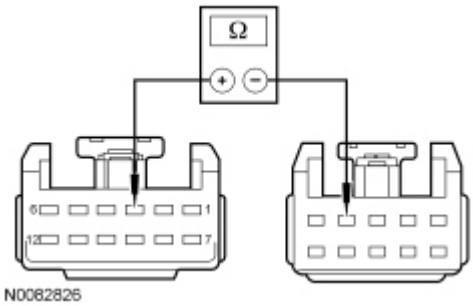
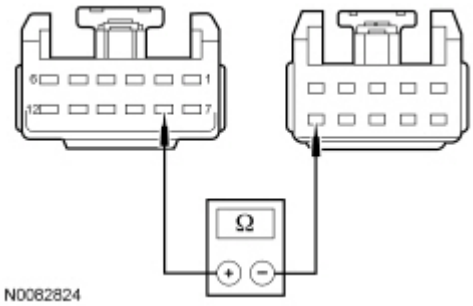
- Wiring, terminals or connectors
- Overhead console switch
- Roof opening panel motor/module assembly

PINPOINT TEST F: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE IN VENT POSITION

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK THE ROOF OPENING PANEL MOTOR/MODULE FOR INITIALIZATION	
• Attempt to carry out the roof opening panel motor initialization procedure. Refer to Roof Opening Panel Motor Initialization in this section. • **Is the concern still present, or does the roof opening panel motor fail to initialize?**	**Yes** GO to F2 . **No** The system is operating

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	normally at this time. The roof opening panel motor was not initialized.
F2 CHECK THE OVERHEAD CONSOLE SWITCH • Ignition OFF. • Disconnect: Overhead Console Switch C912. • Carry out the overhead console switch component test. Refer to Wiring Diagrams Cell 149 for component testing. • **Is the overhead console switch OK?**	**Yes** GO to F3 . **No** INSTALL a new roof opening panel switch. REFER to Roof Opening Panel Control Switch in this section. TEST the system for normal operation.
F3 CHECK THE ROOF OPENING PANEL CONTROL CIRCUIT FOR AN OPEN • Measure the resistance between overhead console switch C912-3, circuit CPR38 (WH/BU), harness side and roof opening panel motor/module C921-4, circuit CPR38 (WH/BU), harness side.  N0082826 • **Is the resistance less than 5 ohms?**	**Yes** GO to F4 . **No** REPAIR the circuit. TEST the system for normal operation.
F4 CHECK THE ROOF OPENING PANEL CONTROL CIRCUIT FOR AN OPEN • Measure the resistance between overhead console switch C912-8, circuit CPR40 (YE/OG), harness side and roof opening panel motor/module C921-10, circuit CPR40 (YE/OG), harness side.  N0082824 • **Is the resistance less than 5 ohms?**	**Yes** GO to F5 . **No** REPAIR the circuit. TEST the system for normal operation.
F5 CHECK THE ROOF OPENING PANEL MOTOR/MODULE FOR CORRECT OPERATION • Disconnect all roof opening panel motor/module connectors. • Check for:	**Yes** INSTALL a new roof opening

■ corrosion. ■ bent pins. ■ pushed-out pins. ● Connect all roof opening panel motor/module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	panel motor/module. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

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Roof Opening Panel Alignment

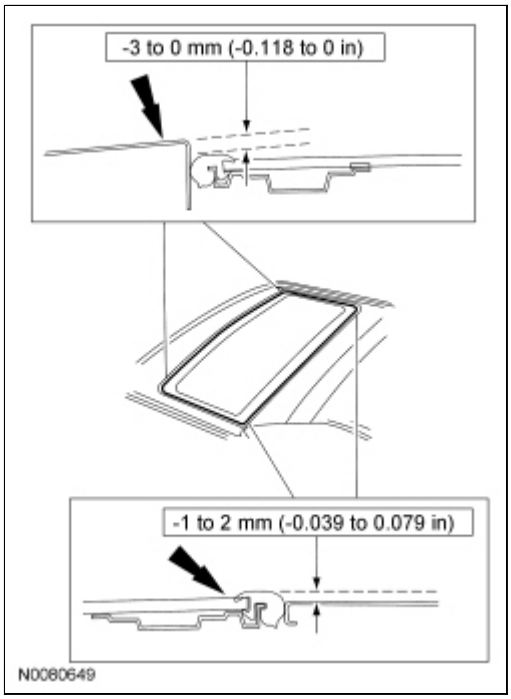
NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel assembly has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. Position the roof opening panel in the CLOSED position.

2. Loosen the 4 roof opening panel glass screws.

3. **NOTE:** Make sure the roof opening panel is centered in the roof opening.

   Adjust the roof opening panel glass height to specification.



4. Maintain horizontal and vertical roof opening panel positions while adjusting and tighten the 4 roof opening panel glass screws to 4 Nm (35 lb-in).

5. Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

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Roof Opening Panel Motor Initialization

WARNING: Keep objects and body parts clear of the glass panel when carrying out the initialization procedure. During the initialization procedure, the glass panel closes with high force and cannot detect objects in its path. Failure to follow this instruction may result in serious personal injury.

NOTE: A new roof opening panel motor will only open and must be initialized.

NOTE: The roof opening panel motor initialization procedure must be done when repairs are carried out on any part of the roof opening panel system, including: any time the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel assembly has been installed.

1. Turn the ignition to the RUN position.
   - For an existing roof opening panel motor, skip to Step 3.
   - For a new roof opening panel motor, proceed to Step 2.

2. **NOTE:** If the slide switch is released before initialization movements are complete, turn the ignition key to the OFF position, then back to the RUN position and repeat this step.

   For a new roof opening panel motor/module:
   - Press the slide switch until the roof opening panel moves past the full OPEN position and continue to hold for approximately 10 seconds. The roof opening panel will cycle slightly rearward and then slightly forward to the stored OPEN position.
   - Quickly release and re-press and hold the slide switch. The roof opening panel glass will move to the full VENT position, then back to CLOSED (initialization movements). The initialization movements will start within approximately 3 seconds after the switch is pressed. When the initialization movements are complete, go to Step 4.

3. **NOTE:** All roof opening panel motor/module assemblies have an electronically controlled comfort stop position, which is approximately 50 mm (2 in) from the full OPEN position. When the roof opening panel is opened, the slide switch must be released when the comfort stop position has been reached and then pressed again to fully open the roof opening panel.

   NOTE: If the slide switch is released before initialization movements are complete, turn the ignition key to the OFF position, then back to the RUN position, and repeat this step.

   For an existing roof opening panel motor/module:
   - Press and hold the slide switch until the roof opening panel glass moves to the full OPEN position. Release the switch.
   - Press and hold the slide switch for approximately 10 seconds. The roof opening panel will cycle slightly rearward and then slightly forward to the stored OPEN position.
   - Quickly release and re-press and hold the slide switch. The roof opening panel glass will move to full VENT position, then back to CLOSED (initialization movements). The initialization movements will start within approximately 3 seconds after the switch is pressed.

4. Release the slide switch and test the system for normal operation by carrying out one-touch open, one-touch close and one-touch vent operations.

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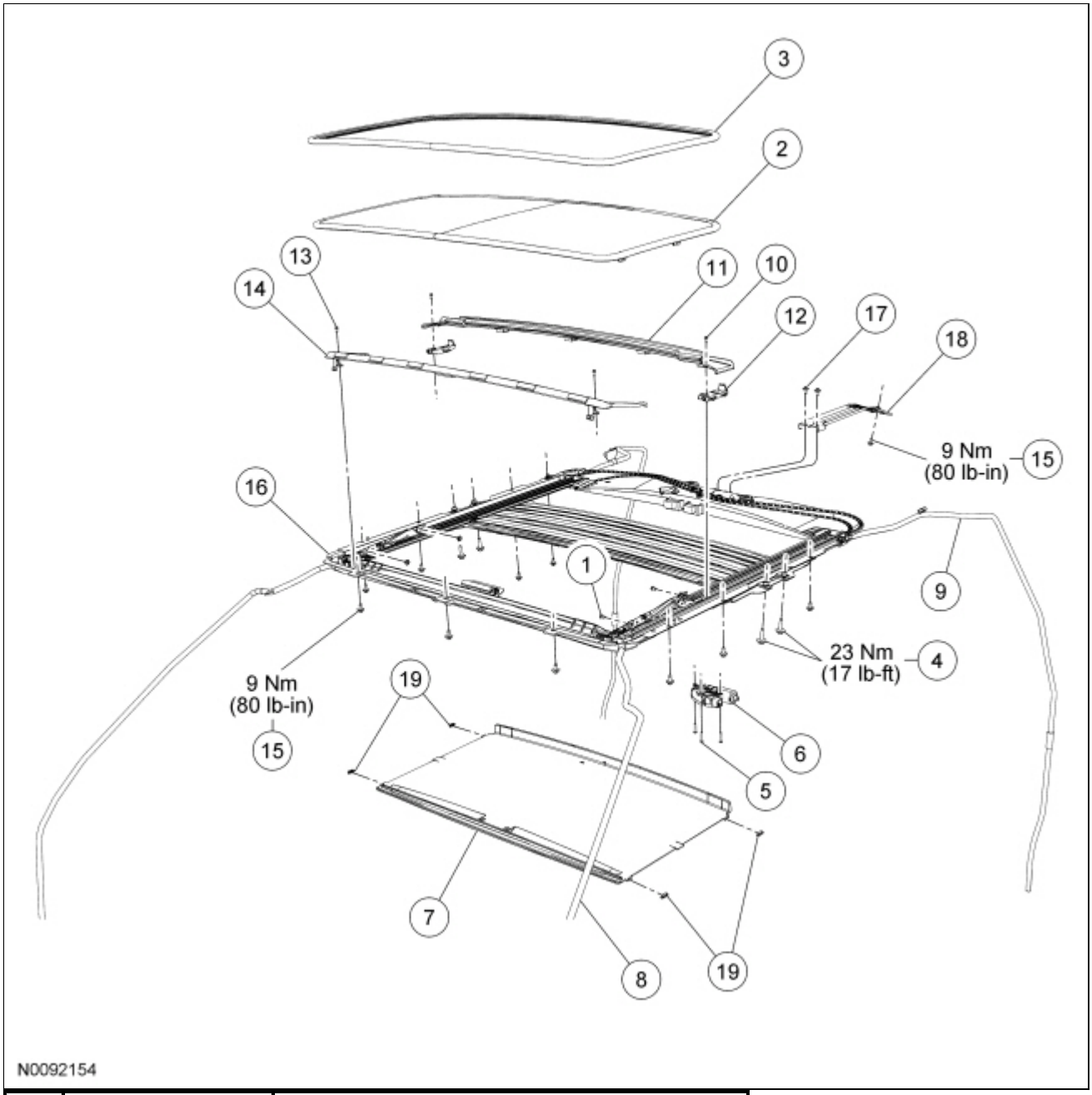
Air Deflector

Removal and Installation

1. Place the roof opening panel glass in the fully OPEN position.
2. Remove the 2 air deflector screws.
3. Rotate the front of the air deflector up, and slide the pivot points toward the rear of the vehicle to release the air deflector from the retaining hooks.
4. To install, reverse the removal procedure.

Roof Opening Panel — Exploded View

NOTE: SuperCrew shown, SuperCab similar.



Item	Part Number	Description
1	26502F24	Roof opening panel glass screw (4 required)
2	18500A18	Roof opening panel glass
3	7851884	Roof opening panel weatherstrip

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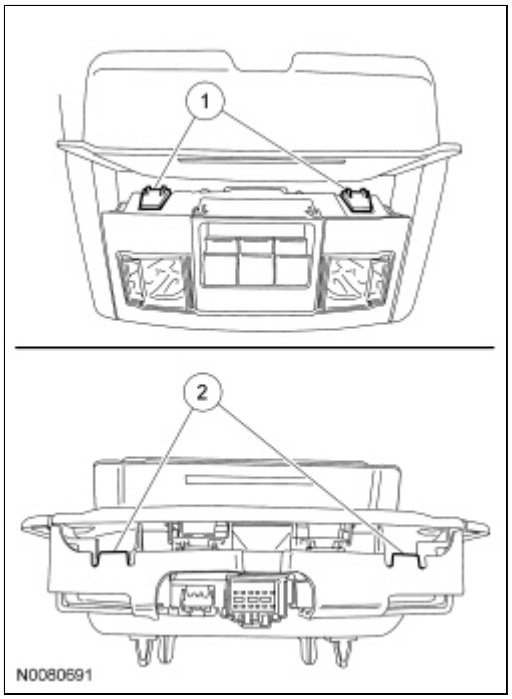
4	W505434	Roof opening panel frame-to-B-pillar bolts (4 required)
5	15C682	Roof opening panel motor bolt (3 required)
6	15790	Roof opening panel motor/module
7	78519A02	Roof opening panel shield
8	18502C52	Roof opening panel front drain hose (2 required)
9	18502C52/ 16502C52	Roof opening panel rear drain hose (2 required) (SuperCab/SuperCrew)
10	26502F36	Roof opening panel trough screw
11	7854022	Roof opening panel trough
12	78500A64 RH/ 78500A65 LH	Roof opening panel rear trough guide
13	26502F36	Screw (2 required)
14	26500A26	Air deflector
15	W705382	Roof opening panel frame bolts (10 required)
16	1651070/ 1851070	Roof opening panel frame (SuperCab/SuperCrew)
17	18502F36	Bolt
18	16502074/ 18502P74	Roof opening panel support bracket (SuperCab/SuperCrew)
19	78502C10	Roof opening panel shield guide feet (4 required)

1. For additional information, refer to the procedures in this section.

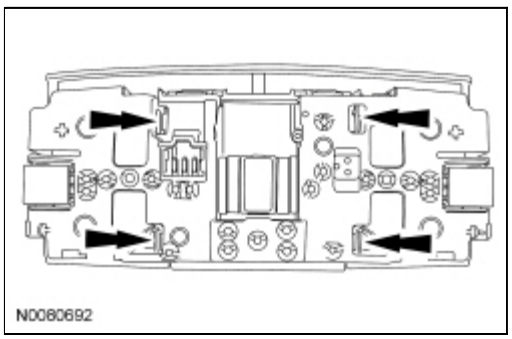
Roof Opening Panel Control Switch

Removal and Installation

1. Remove the overhead console. For additional information, refer to Section 501-12 .
2. Disconnect the 2 overhead console electrical connectors.
3. Remove the light assembly from the overhead console.
    1. Carefully pull the 2 rear tabs outward and rotate the light assembly slightly away from the overhead console.
    2. Carefully pull the 2 front tabs outward and remove the light assembly from the overhead console.

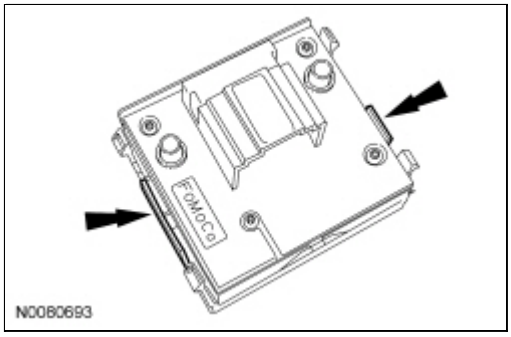


4. Disengage the 4 tabs and remove the switch from the light assembly.



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5. Disengage the 2 tabs and remove the switch bezel from the switch.



6. To install, reverse the removal procedure.

Roof Opening Panel Frame

Removal and Installation

NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel frame has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. Remove the roof opening panel air deflector. For additional information, refer to Air Deflector in this section.

2. Remove the roof opening panel shield. For additional information, refer to Roof Opening Panel Shield in this section.

3. Remove the overhead console. For additional information, refer to Section 501-12 .

4. Lower the headliner. For additional information, refer to Section 501-05 .
   - Remove the A-pillar, B-pillar and C-pillar (if equipped) trim panels.
   - Remove the LH and RH sun visors and clips.
   - If equipped, remove the 3 headliner pin-type retainers.
   - If equipped, remove the 2 headliner garment hooks.
   - Disconnect the front and rear headliner electrical connectors.

5. **NOTE:** Make sure the drain hoses are not kinked during installation.

   Disconnect the 2 roof opening panel front drain hoses from the frame.

6. **NOTE:** Make sure the drain hoses are not kinked during installation.

   Disconnect the 2 roof opening panel rear drain hoses from the frame.

7. Remove the 4 roof opening panel frame-to-B-pillar bolts.
   - To install, tighten to 23 Nm (17 lb-ft).

8. ***NOTICE:*** **To avoid damage to the roof opening panel frame, be sure to support the frame when removing the mounting bolts.**

   Remove the 10 roof opening panel frame mounting bolts.
   - To install, tighten to 9 Nm (80 lb-in).

9. Remove the roof opening panel frame.

10. **NOTE:** If installing a new roof opening panel frame, transfer parts as necessary from the existing roof opening panel assembly.

    To install, reverse the removal procedure.
    - Align the roof opening panel. For additional information, refer to Roof Opening Panel

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Alignment in this section.

- Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel Glass

Removal and Installation

NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel frame has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. **NOTE:** The roof opening panel glass must be in the CLOSED position.

   Remove the 4 roof opening panel glass screws.

2. Remove the roof opening panel glass.

3. To install, reverse the removal procedure.
   - Align the roof opening panel. For additional information, refer to Roof Opening Panel Alignment in this section.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

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Roof Opening Panel Motor

Removal and Installation

NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel frame has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. Lower the rear of the headliner. For additional information, refer to Section 501-05 .
   - For SuperCab vehicles, remove the B-pillar trim panels.
   - For SuperCrew vehicles, remove the C-pillar trim panels.
   - If equipped, remove the 3 headliner pin-type retainers.
   - If equipped, remove the 2 headliner garment hooks.

2. Disconnect the roof opening panel motor electrical connector.

3. Remove the 3 roof opening panel motor screws.
   - To install, tighten to 4 Nm (35 lb-in).

4. Remove the roof opening panel motor.

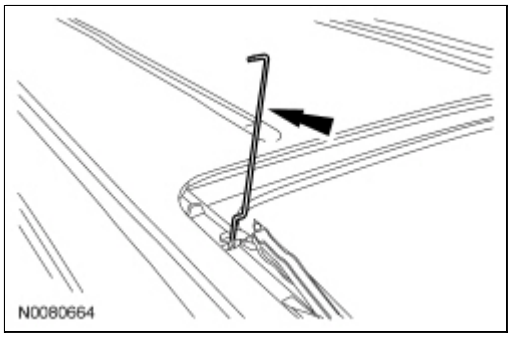
5. To install, reverse the removal procedure.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel Rear Trough Guide

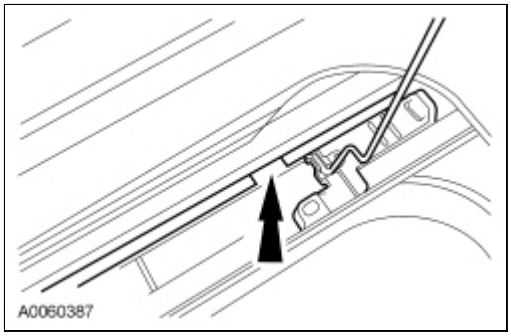
Removal and Installation

NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel frame has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. Remove the trough assembly. For additional information, refer to Trough Assembly in this section.
2. Disconnect the trough guide rods from the lifter arm assemblies.

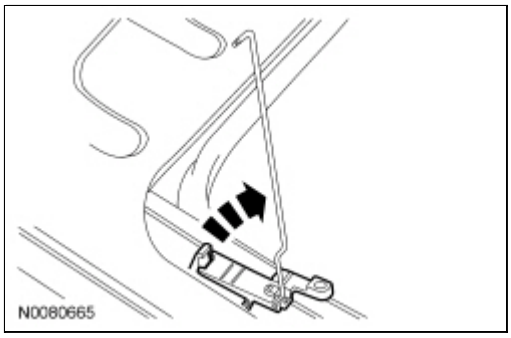


3. Slide the trough guide back to the slot (approximately 15 mm [0.6 in]) cut in the track.



4. Position the roof opening panel to the VENT position.
5. Carefully twist the trough guide through the slot in the track to remove.

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6. Inspect the trough guide assembly for damage. If damage is found, inspect the track for broken pieces and remove them.

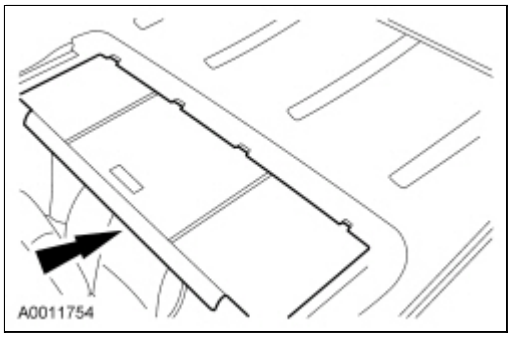
7. To install, reverse the removal procedure.
   - Align the roof opening panel. For additional information, refer to Roof Opening Panel Alignment in this section.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel Shield

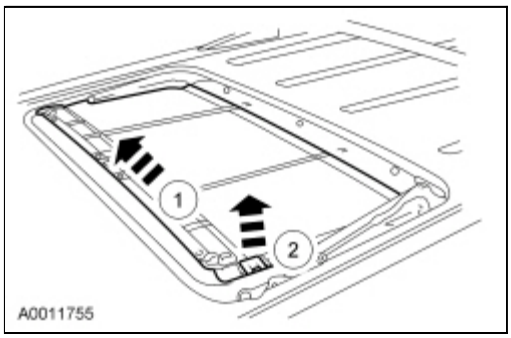
Removal and Installation

NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel frame has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. Remove the trough assembly. For additional information, refer to Trough Assembly in this section.
2. Slide the roof opening panel shield halfway forward.

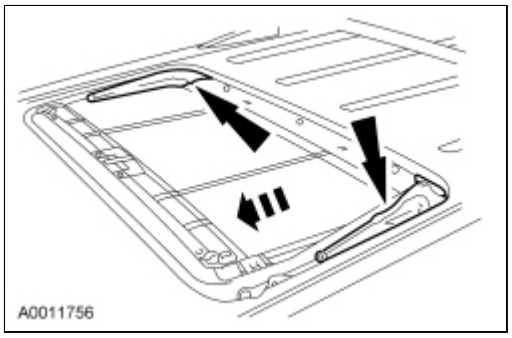


3. Disengage the front roof opening panel shield guide feet.
    1. Push the roof opening panel shield toward one side of the vehicle.
    2. Carefully flex the front portion of the roof opening panel shield upward to disengage the guide feet.



4. Slide the roof opening panel shield forward and release the rear guide feet.

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5. To install, reverse the removal procedure.
    - Align the roof opening panel. For additional information, refer to Roof Opening Panel Alignment in this section.
    - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

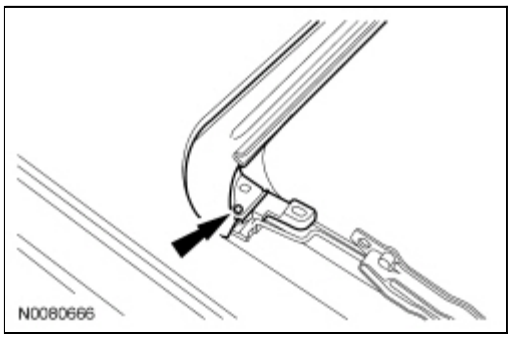
Trough Assembly

Removal and Installation

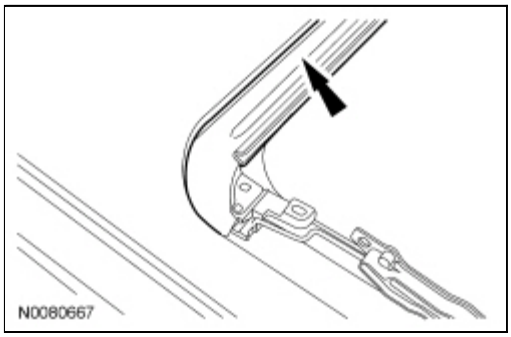
NOTE: The roof opening panel motor must be initialized when repairs are carried out on any part of the roof opening panel, including: whenever the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel frame has been installed. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

1. Remove the roof opening panel glass. For additional information, refer to Roof Opening Panel Glass in this section.

2. Remove the 2 trough guide retaining screws.



3. Remove the trough from the trough guide assembly.



4. To install, reverse the removal procedure.
   - Align the roof opening panel. For additional information, refer to Roof Opening Panel Alignment in this section.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

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Torque Specifications

Description	Nm	lb-ft	lb-in
Frame mounting bracket-to-front bumper nuts	115	85	—
Front bumper cover-to-fender bolts	3	—	27
Front bumper cover-to-radiator support bolts	3	—	27
Rear bumper nuts	175	129	—
Rear harness ground bolt	10	—	89
Tow hook bolts	115	85	—

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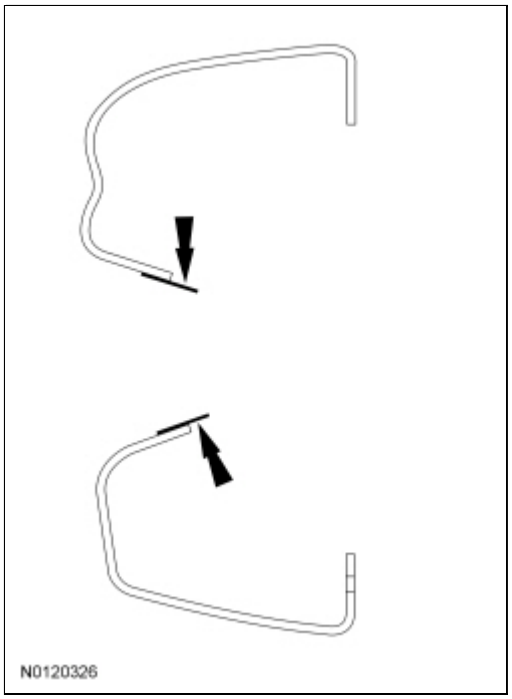
Bumper Rust Prevention — Front, Chrome

Material

Item	Specification
High Temperature Anti-Corrosion Coating PM-13-A	—
Motorcraft® Custom Bright Metal Cleaner ZC-15	ESR-M5B194-B

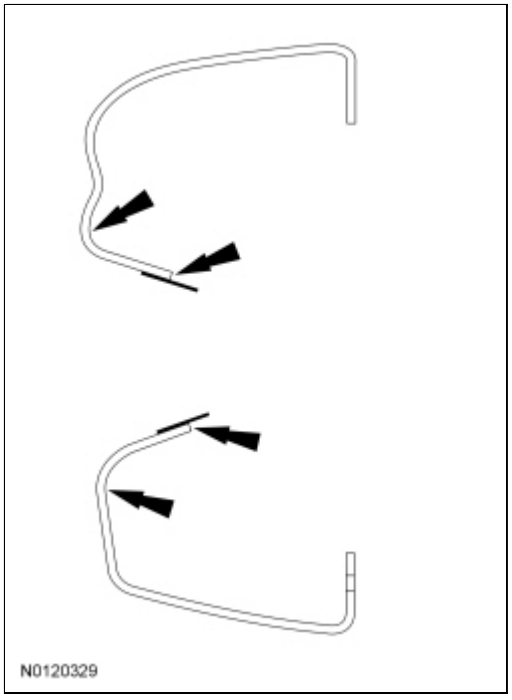
1. If equipped remove the license plate bracket.
2. If equipped, remove the foglamp assembly. For additional information, refer to Section 417-01 .
3. Remove the front bumper. For additional information, refer to Bumper — Front .
4. If equipped, remove the center vent grille pin-type retainers and the center vent grille.
5. Clean excessive dirt from an area of 2" (50 mm) around all 3 cutouts on the inside of the bumper.
6. **NOTE:** Use protective gloves when applying the Motorcraft Custom Bright Metal Cleaner.

   Clean the red rust stains from the inside edges of the center vent and fog lamp openings with Motorcraft Custom Bright Metal Cleaner.
7. Apply masking tape around the center vent and the fog lamp openings on the outside chrome part of the front bumper allowing for a 1 inch overhang into the openings.



8. **NOTE:** Use protective gloves when applying the anti-corrosion coating.

   Using a foam brush, paint the edge of the center vent and the fog lamp openings and at least 1" (25 mm) around the inside of the front bumper with the Motorcraft Anti-Corrosion Coating.



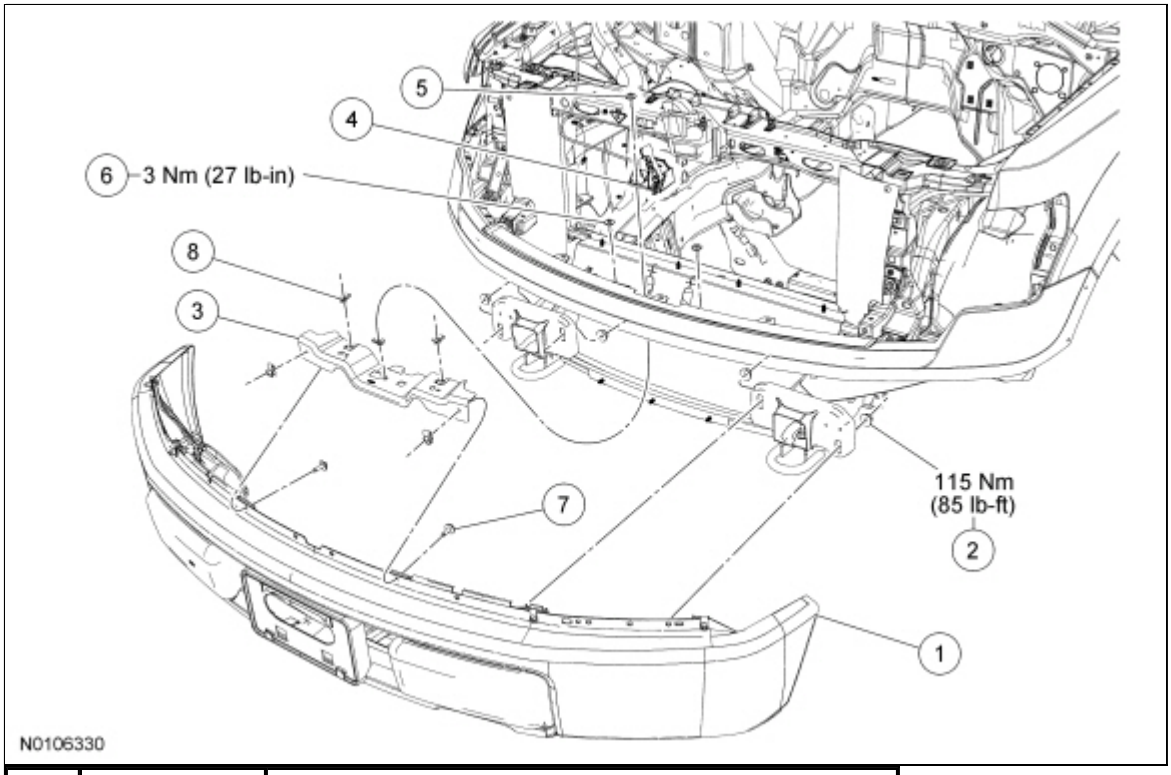
9. Remove the masking tape from around the center vent and the fog lamp openings.
10. If equipped, install the center vent grille and the center vent grille pin-type retainers.
11. Install the front bumper. For additional information, refer to Bumper — Front .

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12. If equipped, install the fog lamp assembly. For additional information, refer to Section 417-01 .
13. If equipped, install the license plate bracket.

Bumper — Front

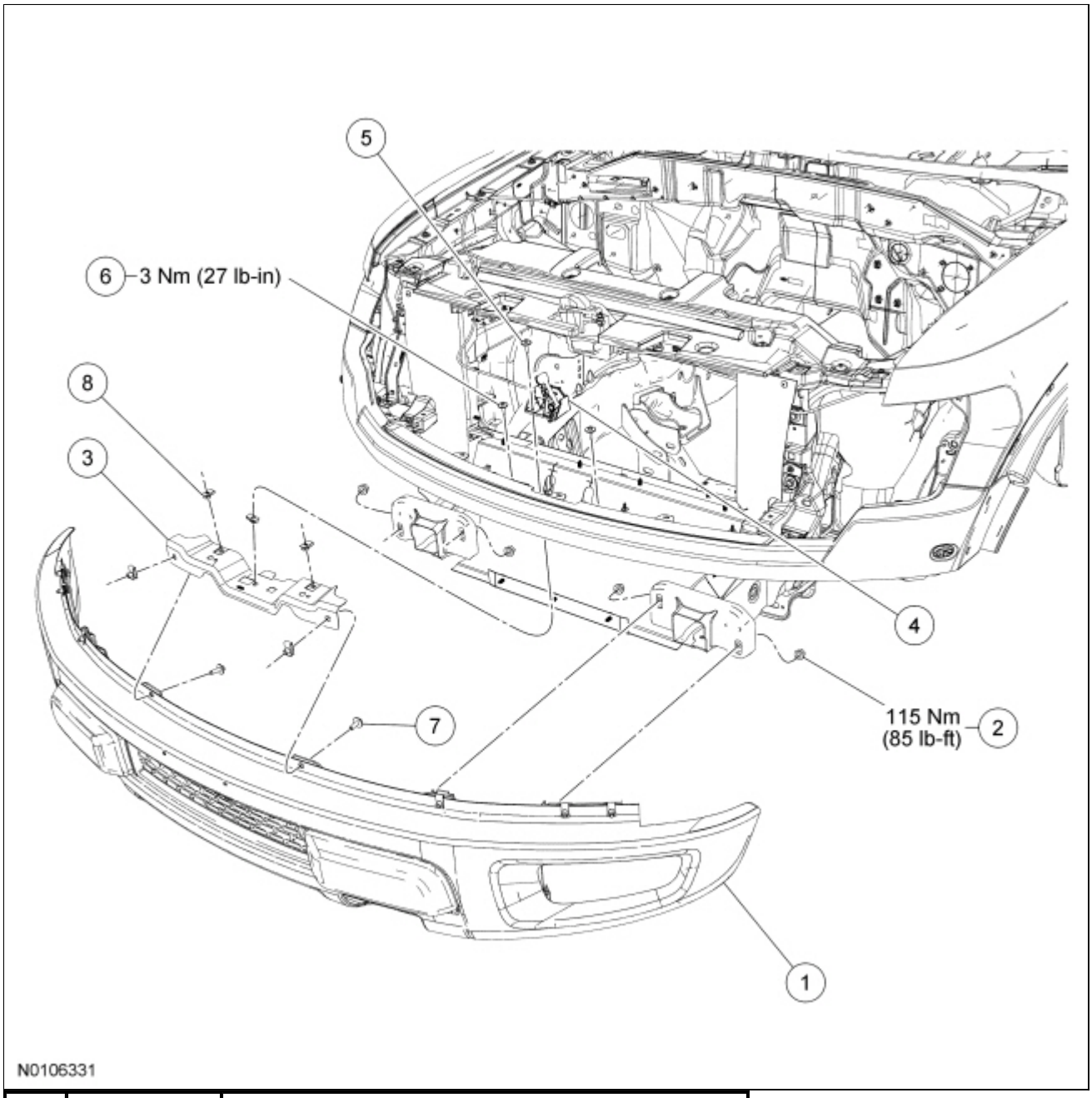
F-150 Except F-150 SVT Raptor



Item	Part Number	Description
1	17D957	Front bumper
2	N804525-S	Front bumper nut (4 required)
3	17C947	Bumper cover-to-bumper bracket
4	16B975	Hood release
5	N811847	Hood release bolt
6	N811847	Bumper cover-to-bumper bracket bolt (2 required)
7	N811847	Bumper bracket-to-bumper bolt (2 required)
8	W520802	Bumper J-clip nut (5 required)

F-150 SVT Raptor

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Item	Part Number	Description
1	17F813	Front bumper
2	N804525-S	Front bumper nut (4 required)
3	17C947	Bumper cover-to-bumper bracket
4	16B975	Hood release
5	N811847	Hood release bolt
6	N811847	Bumper cover-to-bumper bracket bolt (2 required)
7	N811847	Bumper bracket-to-bumper bolt (2 required)
8	W520802	Bumper J-clip nut (5 required)

Removal and Installation

1. Remove the hood release retaining bolt.

2. Position aside the hood release assembly.
    - Disconnect the hood release cable routing retainer.

3. Remove the 2 bumper cover-to-bumper bracket bolts.
    - To install, tighten to 3 Nm (27 lb-in).

4. If equipped, disconnect the fog lamp electrical connectors.

5. **NOTE:** To assist with bumper alignment, mark the 4 bumper mounting nuts to the bumper bracket.

   Remove the 4 front bumper nuts.
    - To install, tighten to 115 Nm (85 lb-ft).

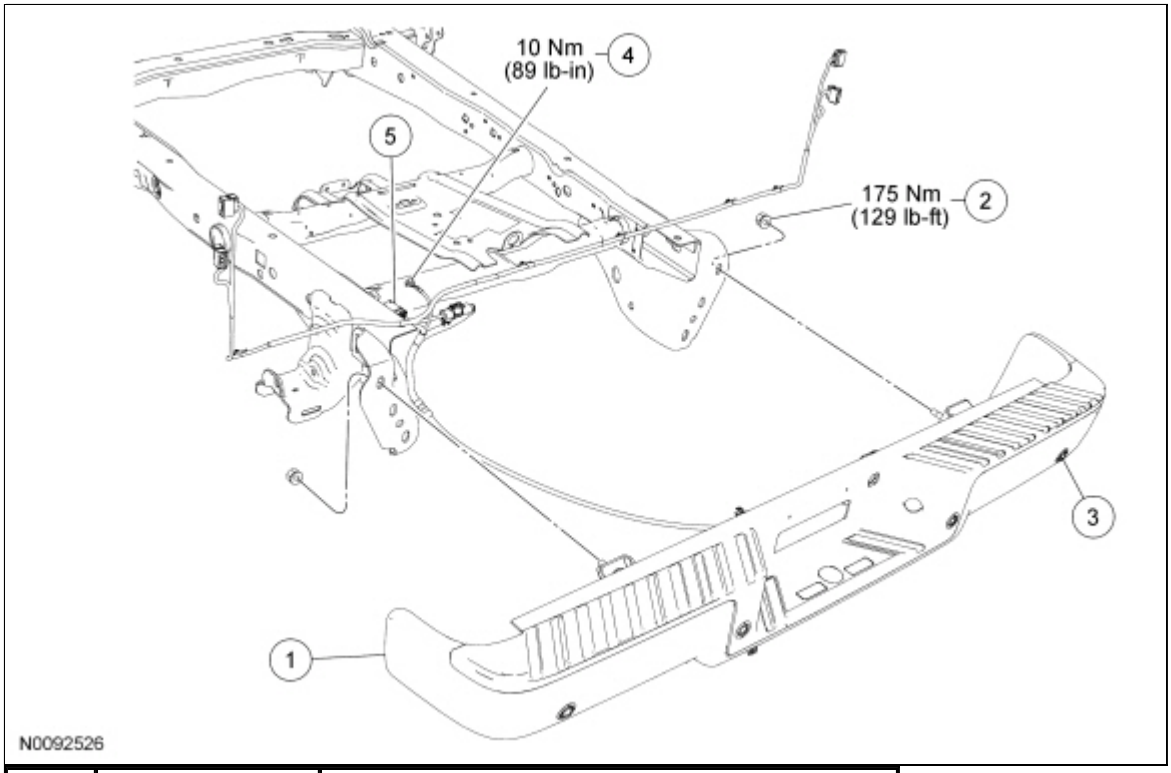
6. Remove the front bumper.

7. To install, reverse the removal procedure.

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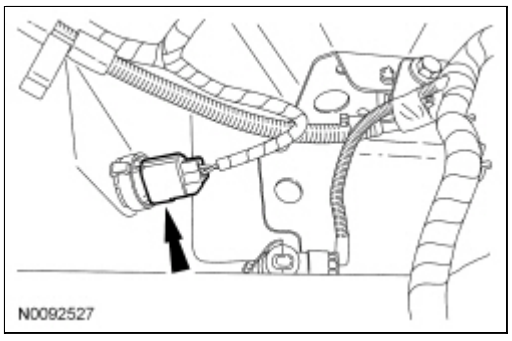
Bumper — Rear



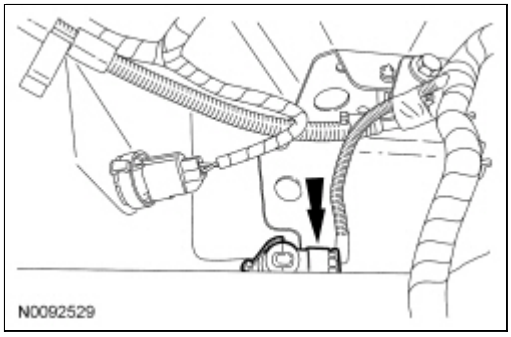
Item	Part Number	Description
1	17775	Rear bumper
2	W708634-S	Rear bumper nut (4 required)
3	11523	Rear parking aid sensor (if equipped)
4	W701082	Ground bolt
5	—	Rear electrical harness connector

Removal and Installation

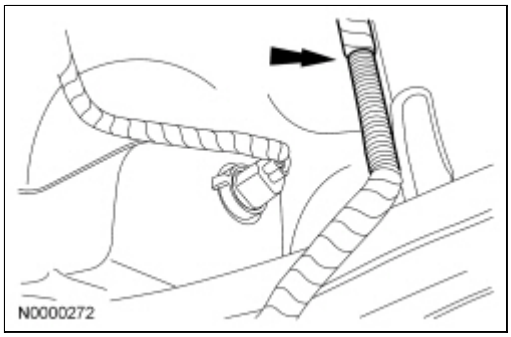
1. Disconnect the 2 license plate lamp electrical connectors and unclip the harness from the bumper.



2. If equipped, disconnect the parking aid sensors and unclip the harness from the bumper.



3. If equipped, detach the trailer harness pin-type retainer from the rear bumper.



4. Remove the rear bumper nuts.
    - To install, tighten the new nuts to 175 Nm (129 lb-ft).

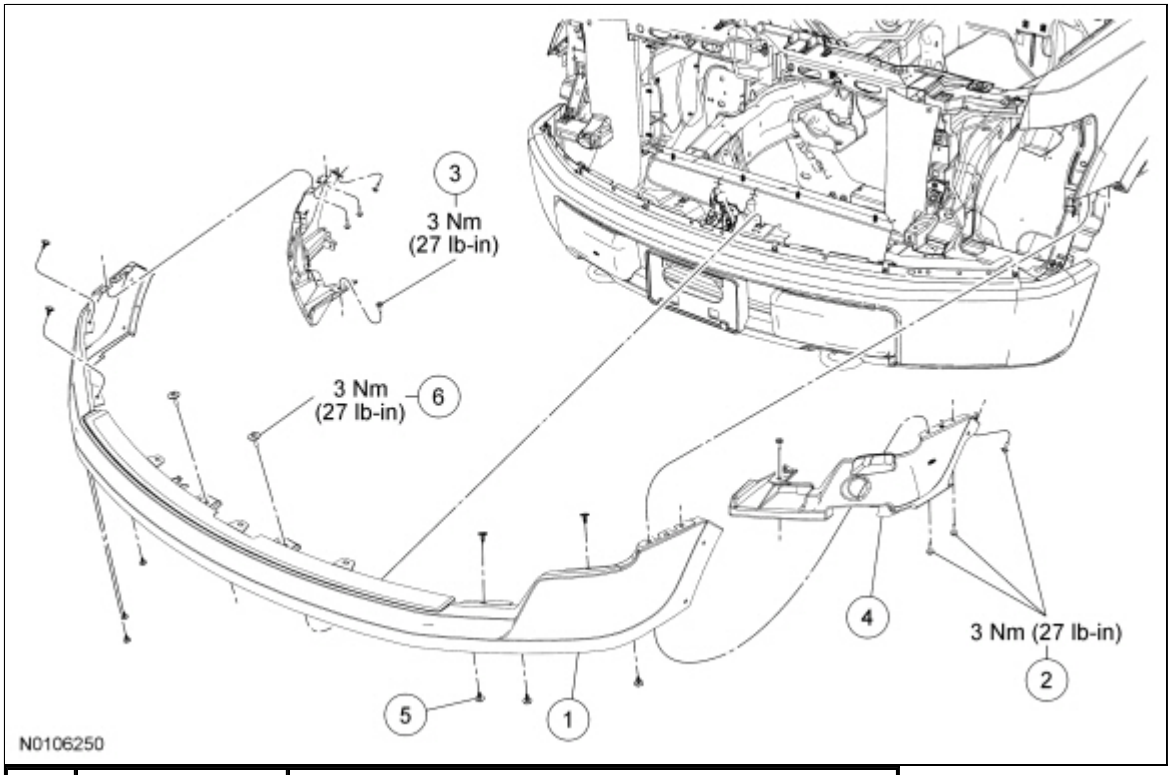
5. Remove the rear bumper.

6. To install, reverse the removal procedure.
    - Transfer components as necessary. If equipped with a rear parking aid sensor, refer to Section 413-13 for additional information.

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Bumper Cover — Front

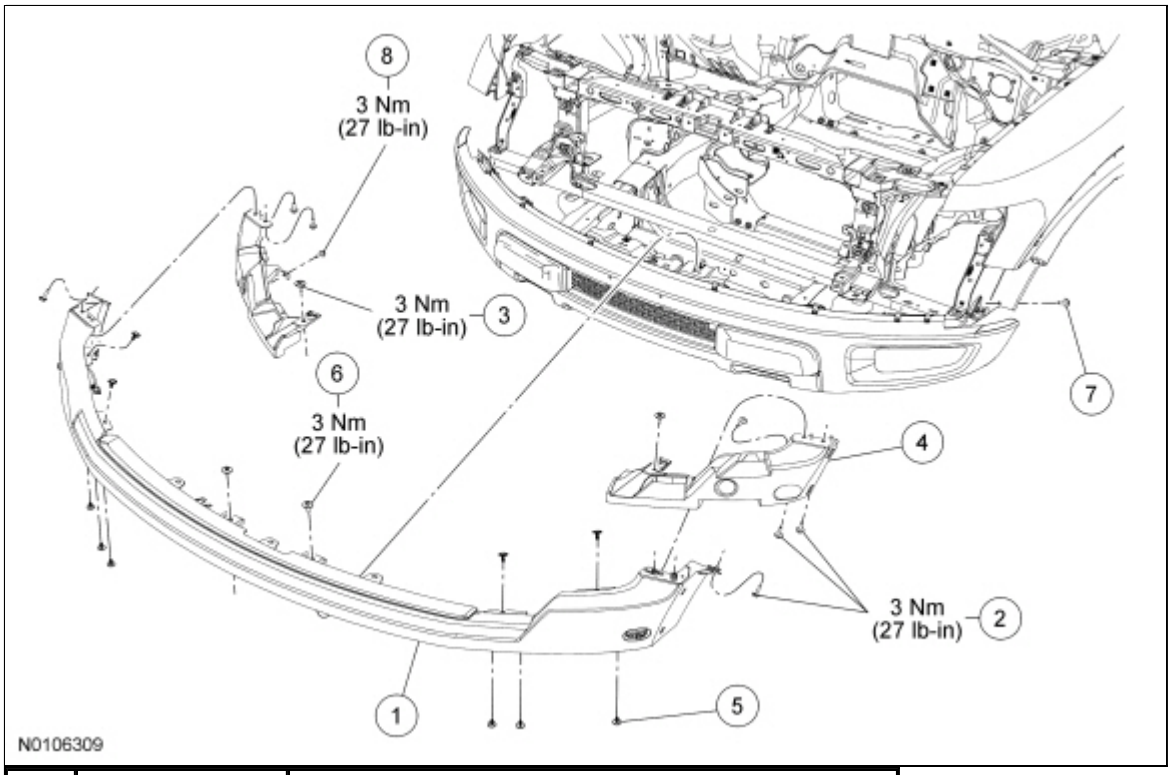
F-150 Except F-150 SVT Raptor



Item	Part Number	Description
1	17D957	Front bumper cover
2	W505424	Front bumper cover-to-fender bolts (6 required)
3	W505424	Front bumper cover-to-radiator support bolt (2 required)
4	17754 RH/ 17755 LH	Front bumper cover bracket
5	W705589	Front bumper cover-to-bumper cover bracket pin-type retainer (10 required)
6	N811847	Bumper cover-to-bumper bracket bolt (2 required)

F-150 SVT Raptor

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Item	Part Number	Description
1	17D957	Front bumper cover
2	W505424	Front bumper cover-to-fender bolts (6 required)
3	W505424	Front bumper cover-to-radiator support bolt (2 required)
4	17754 RH/ 17755 LH	Front bumper cover bracket
5	W705589	Front bumper cover-to-bumper cover bracket pin-type retainer (10 required)
6	N811847	Front bumper cover-to-bumper bracket bolt (2 required)
7	W705392	Fender splash shield screw (2 required)
8	W505424	Lower fender reinforcement-to-bumper cover bracket bolt (2 required)

Removal and Installation

All vehicles

1. Remove the headlamps. For additional information, refer to Section 417-01 .

2. Remove the 6 front bumper cover-to-front fender bolts.
   - To install, tighten to 3 Nm (27 lb-in).

3. **NOTE:** Any time the bumper cover-to-bumper bracket bolts are loosened or removed, new bolts must be installed.

Remove and discard the 2 bumper cover-to-bumper bracket bolts.
- To install, tighten to 3 Nm (27 lb-in).

Except F-150 SVT Raptor

4. Remove the 10 front bumper cover-to-bumper cover bracket pin-type retainers.

F-150 SVT Raptor

5. Remove the 8 front bumper cover-to-bumper cover bracket pin-type retainers.

Vehicles equipped with fender mouldings

6. Remove the fender mouldings. For additional information, refer to Section 501-08 .

All vehicles

7. **NOTE:** The rearward portion of the front bumper cover must be pulled upward and outward to release it from the bumper cover brackets.

   Remove the front bumper cover.

8. Inspect the bumper cover brackets for damage. If necessary, install new bumper cover brackets.

9. To install, reverse the removal procedure.
   - Install the 2 new bumper cover-to-bumper bolts and tighten to 3 Nm (27 lb-in).

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Torque Specifications

Description	Nm	lb-ft
Front Safety Belts		
D-ring bolt	40	30
Safety belt anchor bolt-driver and passenger seat (Crew Cab and regular cab)	40	30
Safety belt buckle bolt-driver and passenger seat	40	30
Safety belt anchor bolt-front center	45	33
Safety belt buckle bolt-front center	45	33
Safety belt retractor bolt-front center	45	33
Safety belt retractor and pretensioner bolts	40	30
Safety belt shoulder height adjuster bolt	40	30
Turning loop bolts (part of front, center safety belt retractor)	40	30
Rear Safety Belts		
Center safety belt retractor anchor and LH safety belt buckle nut (SuperCab)	80	59
Center safety belt retractor bolts	40	30
Child safety seat tether anchor bolts	25	18
D-ring bolt	40	30
Safety belt anchor bolt (Crew Cab)	40	30
Safety belt buckle bolt (seat mounted, Crew Cab)	32	24
Safety belt buckle nut (SuperCab)	80	59
Safety belt retractor anchor nut (Crew Cab)	80	59
Safety belt retractor bolt	40	30
Turning loop bolts (part of rear, center safety belt retractor)	40	30

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Safety Belt System

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

When installing new active occupant restraint components, use only replacement parts specified in the Ford Catalog Advantage™ or equivalent.

The active restraint system consists of the following serviceable items:

- Front safety belt buckles, attached to the inboard side of the driver and passenger seat tracks
- Front center safety belt retractor attached to the RH side of the front center seat back frame
- Front center safety belt buckle attached to the LH side of the front center seat base frame
- Detachable safety belt anchor attached to the RH side front center seat base frame
- Front safety belt retractors and pretensioners, located behind the B-pillar trim panels (Crew Cab and regular cab) or in the rear door (SuperCab)
- Belt Tension Sensor (BTS), located at the safety belt anchor point of the front passenger outboard safety belt
- Rear outboard safety belt retractors, located behind the B-pillar trim panels (SuperCab) or C-pillar trim panels (Crew Cab)
- Rear center safety belt retractor attached to the back panel of the cab
- RH rear safety belt buckles, attached to the floor pan (SuperCab)
- RH rear safety belt buckles, seat mounted and attached to the seat risers (Crew Cab)
- LH rear safety belt buckles attached to the floor pan (SuperCab and Crew Cab)
- Rear child safety seat tether anchors, at all seating positions, attached to the back panel of the cab
- Lower Anchors and Tethers for CHildren (LATCH) attached to the rear seat risers (Crew Cab and SuperCab only)

Safety Belt Retractors

The safety belt retractors include the following features:

- Dual locking mode
  - Emergency Locking Retractor (ELR)
  - Automatic Locking Retractor (ALR) (all except driver seat, front center seat, and rear center seat)
- Safety belt retractors and pretensioners (front outboard only)
- BTS (front outboard passenger only)
- Cinch tongue (front center and rear center seats only)

Automatic Locking Retractor (ALR)

The ALR mode is used when locking a child seat in an outboard seating position. The ALR mode is automatically activated when the safety belt webbing is fully extracted from the retractor and then allowed to retract. As the safety belt webbing is retracted back onto the spool, an audible clicking sound is made indicating the safety belt retractor is in ALR mode and the safety belt webbing will not pull back out of the safety belt retractor. To disengage the ALR mode, allow the safety belt webbing to fully retract back onto the spool. The ALR mode is disengaged when the webbing is free to extract and retract back into the retractor. For testing, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Cinch Tongue

Front center and rear center safety belt retractors are equipped with a locking cinch tongue. The locking cinch tongue slides up and down the safety belt webbing when it is in the stowed position or while putting the safety belt on. When the locking cinch tongue is latched into the buckle, the cinch tongue allows the lap portion of the safety belt to become shorter, but locks the webbing in place to restrict it from becoming longer. Before latching a cinch tongue into the buckle, the lap portion of the safety belt may have to be lengthened. To lengthen the lap belt, pull some webbing out of the safety belt retractor. While holding the webbing below the tongue, grasp the tip (metal portion) of the tongue so that it is parallel to the webbing and slide the tongue upward. Provide enough lap belt length so the tongue can reach the buckle. To fasten a cinch tongue, pull the safety belt from the retractor so the shoulder belt portion of the safety belt crosses the occupant's shoulder and chest. Be sure the belt is not twisted. If the belt is twisted, remove the twist. For instructions on how to remove a twist, refer to Safety Belt Tongue Rotated on Belt in this section. Insert the locking cinch tongue into the correct buckle for the seating position until a snap is heard and latching is felt. Make sure the tongue is securely fastened to the buckle by pulling on the tongue. Adjust the lap belt portion of the safety belt by pulling up on the shoulder belt until the lap belt fits snugly and as low as possible around the occupant's hips.

Emergency Locking Retractor (ELR)

The ELR is a vehicle-sensitive feature designed to activate and lock the safety belt webbing during hard braking, hard cornering or in an impact of approximately 24 km/h (15 mph). The ELR feature helps to reduce the forward movement of the driver and passengers. For testing, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Retractor Pretensioners

The pretensioner is a pyrotechnic device that deploys when activated by the Restraints Control Module (RCM) to remove excess safety belt webbing from the shoulder and lap safety belt in the event of an impact. If a deployment of the safety belt retractor pretensioners occurs, a new assembly must be installed. Refer to Safety Belt Retractor and Pretensioner — Regular Cab and Crew Cab or Safety Belt Retractor and Pretensioner — SuperCab in this section.

For safety belt retractor pretensioner diagnostic and disposal information, refer to Section 501-20B .

Belt Tension Sensor (BTS)

The BTS is located at the RH front safety belt retractor pretensioner anchor point and operates as part of the Occupant Classification Sensor (OCS) system. To diagnose the BTS , refer to Section 501-20B .

Safety Belt Buckles

Front Safety Belt Buckles

The safety belt buckles are attached to the inboard side of the driver and passenger seat tracks and, if equipped, to the LH side of the center seat base frame.

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After any crash, safety belt buckles must be inspected to verify correct function.

Rear Safety Belt Buckles

On the SuperCab, the RH rear safety belt buckles are attached to the floor and the LH rear safety belt buckle is part of the rear center safety belt retractor and attaches to the floor. On the Crew Cab, the RH rear safety belt buckles are attached to the seat risers and the LH rear safety belt buckle is part of the rear center safety belt retractor and attaches to the floor.

After any crash, safety belt system components (including retractors and buckles) must be inspected to verify correct function.

Child Safety Seat Restraints

The child safety seat restraints include the following items:

- Serviceable rear child safety seat tether anchors, at all seating positions, attached to the back panel of the cab.
- Non-serviceable Lower Anchors and Tethers for CHildren attached to the rear seat risers on the SuperCab and Crew Cab only. Regular cab vehicles are not equipped with Lower Anchors and Tethers for CHildren.

If a child safety seat was in use during a collision, inspect the child safety seat component mounting areas and repair any damage and restore the vehicle to the original production configuration.

Safety Belt System

Principles of Operation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

Safety Belt Warning System

The conditions of operation for the driver and/or passenger safety belt warning indicator and chime operate as follows:

- If the driver and/or passenger safety belt is not buckled with the ignition ON, then the safety belt warning indicator illuminates for 1 to 2 minutes and the warning chime sounds for 4 to 8 seconds
- If the driver and/or passenger safety belt is buckled while the warning indicator is illuminated and the warning chime is sounding, then the indicator and chime will turn off
- If the driver and/or passenger safety belt is buckled before the ignition is in the ON position, the safety belt warning indicator and chime will remain off

Belt-Minder®

The Belt-Minder® feature is a supplemental warning to the safety belt warning function. This feature provides an additional reminder that the driver and/or front passenger safety belt is unbuckled by intermittently sounding a chime and illuminating the safety belt warning indicator in the Instrument Panel Cluster (IPC).

Either the driver or front passenger safety belt systems may activate the Belt-Minder®. If the Belt-Minder® warnings have expired (warnings for approximately 5 minutes) for one occupant (driver or front passenger), the other occupant can still activate the Belt-Minder® feature.

When a MyKey® is in the ignition, deactivation of the Belt-Minder® is ignored. The Belt-Minder® feature can be activated or deactivated by the administrator key. Using the non-administrator key overrides the deactivation of the Belt-Minder® feature. Refer to Section 419-01B or the Owner's Literature for further information on MyKey® functionality.

The passenger Belt-Minder® feature is activated only when the Occupant Classification Sensor (OCS) system detects an occupant in the right front seat and the occupants weight exceeds a programmed limit. For information on the OCS system, refer to Section 501-20B .

To activate or deactivate the Belt-Minder® feature, refer to Section 413-01 .

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If...	Then...
the driver and/or passenger safety belt is buckled before the ignition is in the ON position or less than 1-2 minutes have elapsed since the ignition has been turned ON...	the Belt-Minder® feature does not activate.
the driver and/or front passenger safety belt is not buckled before the vehicle has reached at least 5 km/h (3 mph) and 1-2 minutes have elapsed since the ignition has been turned ON...	the Belt-Minder® feature is activated — the safety belt warning indicator illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until the safety belt(s) is buckled.
the driver or front passenger safety belt becomes unbuckled for approximately one minute while the vehicle is traveling at least 5 km/h (3 mph) and more than 1-2 minutes have elapsed since the ignition has been ON...	the Belt-Minder® feature is activated — the safety belt warning indicator illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until the safety belt(s) is buckled.

Inspection and Verification

1. Verify the customer concern.

2. Inspect to determine if any of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Safety belt webbing integrity (torn, frayed, cut or stretched) • Safety belt buckle and tongue assembly • Safety belt retractor	• Bare, broken or disconnected wire • Connector not tightly engaged • Safety belt warning indicator burned out or broken

3. If the inspection reveals an obvious concern(s) that can be readily identified, service as required. With the exception of removing a twist from the safety belt webbing, do not attempt to repair a component of the safety belt system; new components must be installed.

4. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .

5. To check the active restraint system for correct operation, carry out the appropriate Functional Test procedure(s). Refer to Component Test in this section.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action

• The safety belt warning indicator does not operate	• Burned-out indicator/LED • Wiring, terminals or connectors • Instrument Panel Cluster (IPC) • Restraints Control Module (RCM)	• If the air bag warning indicator is illuminated, REFER to Section 501-20B . If the air bag warning indicator is not illuminated, REFER to Section 413-01 .
• The safety belt warning chime does not operate	• Wiring, terminals or connectors • Safety belt switch • IPC • RCM	• If the air bag warning indicator is illuminated, REFER to Section 501-20B . If the air bag warning indicator is not illuminated, REFER to Section 413-01 .
• The safety belt retractor webbing does not extract or exhibits excessive pressure on the occupant during use	• Safety belt retractor is in Automatic Locking Retractor (ALR) mode • Safety belt retractor binding internally	• CARRY OUT the Functional Test — Safety Belt Retractor, ALR Mode. REFER to Component Test in this section. INSTALL new components as directed.
• The safety belt retractor webbing does not retract or has excessive slack during use	• Twisted or incorrectly routed safety belt webbing • Safety belt retractor binding internally • Safety belt retractor	• CORRECT the twisted safety belt webbing. REFER to Safety Belt Tongue Rotated on Belt or Safety Belt Twisted at the Safety Belt Guide in this section. CARRY OUT the appropriate Functional Test procedure. REFER to Component Test in this section. • INSTALL a new safety belt retractor. For front safety belt retractors, REFER to Safety Belt Retractor and Pretensioner — Regular Cab and Crew Cab , Safety Belt Retractor — Front, Center or Safety Belt Retractor and Pretensioner — SuperCab in this section. For rear safety belt retractors, REFER to Safety Belt Retractor — Rear or Safety Belt Retractor — Rear, Center in this section.
• The Belt-Minder® feature is inoperative	• Wiring, terminals or connectors • Belt-Minder® feature is deactivated	• REFER to Section 413-01 or the Seating and Safety Restraints section of the Owner's Literature to activate the Belt-Minder® feature. If the Belt-Minder® is activated, REFER to Section 413-01 to diagnose.
• The safety belt tongue is rotated on the safety belt webbing	• Twisted or incorrectly routed safety belt webbing	• REFER to Safety Belt Tongue Rotated on Belt in this section.
• The safety belt	• Twisted or	• REFER to Safety Belt Twisted at the

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webbing is twisted at the safety belt guide	incorrectly routed safety belt webbing	Safety Belt Guide in this section.
• The safety belt webbing is dirty or soiled	• Dirty or soiled safety belt webbing	• REFER to Safety Belt Cleaning in this section.

Component Test

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

Carry out the appropriate Functional Test(s) as determined in Inspection and Verification.

Functional Test — Safety Belt Buckle and Tongue

The safety belt buckle and tongue assembly must operate freely during the latching and unlatching function. Fasten the safety belt by inserting the tongue (male portion) into the buckle (female portion).

1. Verify the following during the latching sequence:
   - Tongue insertion is not hindered by excessive effort.
   - A click is heard when the safety belt buckle latches the tongue.
2. Verify the system integrity by forcefully pulling on the safety belt webbing.
3. Unlatch the safety belt by fully depressing the safety belt buckle release button and allowing the safety belt to release and retract.
4. Verify the following during the unlatching process:
   - Push-button depression does not require excessive effort.
   - The tongue can be removed easily from the buckle.
5. Repeat the above steps 3 times.
6. If the functional test reveals a concern(s), install a new safety belt buckle or safety belt retractor as required.

Functional Test — Safety Belt Retractor

The safety belt retractor must be freely operational for extraction and retraction of the safety belt webbing between full extension and in-vehicle stowed positions.

1. Extract and retract the safety belt between the full extension and stowed positions.

2. Verify the safety belt retractor operates without excessive effort or binding.

3. Install a new safety belt retractor if any concern is found or the complaint has been verified.

Functional Test — Safety Belt Retractor, Automatic Locking Retractor (ALR) Mode

1. Position the seat backrest fully upright (if adjustable).

2. Position the safety belt shoulder height adjuster (if equipped) in the full down or up position.

3. Fasten the safety belt.

4. Pull out the safety belt webbing until the Automatic Locking Retractor (ALR) feature is activated.

5. Allow the safety belt webbing to retract until it stops.

6. Pull on the safety belt webbing to check that the safety belt retractor has remained in the ALR mode. If the safety belt retractor is not locked, install a new safety belt retractor.

7. Unfasten the safety belt and allow the safety belt webbing to retract to its stowed position.

8. Pull out and retract the safety belt webbing to verify the safety belt retractor has converted automatically out of ALR mode. If the safety belt retractor remains locked in the ALR mode, install a new safety belt retractor.

Functional Test — Safety Belt Retractor, Road Test Inspection

WARNING: The driver and passenger must be prepared to brace themselves in the event the safety belt retractor does not lock. Failure to follow this instruction may result in serious personal injury.

NOTE: Make sure there is no excessive slack in the safety belt webbing across the torso during testing.

NOTE: Do not jerk on the safety belt webbing when carrying out this test.

1. Test the safety belts in the following sequence:
    1. Fasten the safety belts and proceed to a safe area.
    2. Attain a speed of 24 km/h (15 mph).
    3. **WARNING: Apply maximum brake force only on dry concrete or equivalent hard surface, never on wet pavement or gravel. Failure to follow this instruction may result in serious personal injury.**

       Grasp the shoulder harness, lean forward and apply the brakes, making a maximum braking application without a skid.
    4. The safety belts should lock up with minimum webbing extension.
    5. If there is a lockup of all safety belt retractors being tested, the safety belt retractors are functioning correctly. If any safety belt retractor fails to lock up, install a new safety belt retractor(s).

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Safety Belt Cleaning

WARNING: Do not bleach or re-dye the safety belt webbing, as the webbing may weaken. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.

1. Clean the safety belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided with the soap.

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Safety Belt Inspection and Repair After a Collision

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. Before installing a new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be worked back to its original shape and structural integrity.

2. Install the new safety belt(s) at any seating position(s) where deployment has occurred and the safety belt(s) were used. Carry out the Functional Test Procedure for all seating positions. For additional information, refer to the appropriate Function Test procedure in Safety Belt System in this section.

Safety Belt Maintenance

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. The safety belt assemblies should be periodically inspected to make sure that they have not become damaged and that they remain in correct operating condition, particularly if they have been subjected to severe stress.

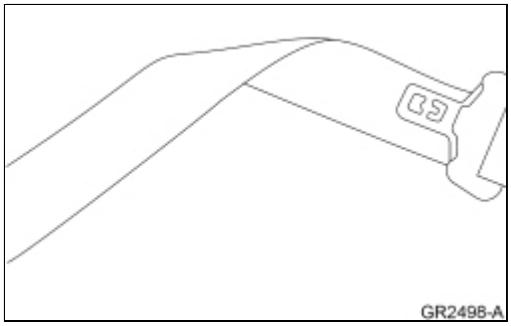
2. Before installing the new safety belt assembly, the safety belt retaining areas must be inspected for damage and distortion. If the retaining points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

3. Install the new safety belt(s). Refer to the appropriate procedure(s) in this section. Carry out the appropriate Functional Test Procedure. For additional information, refer to the appropriate Functional Test Procedure in Safety Belt System in this section.

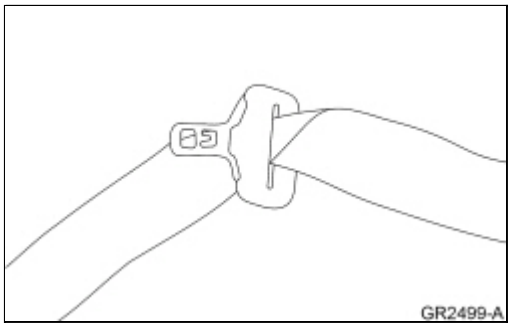
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Safety Belt Tongue Rotated on Belt

1. Fold the safety belt as indicated.



2. Pull the safety belt tongue over the fold in the safety belt.

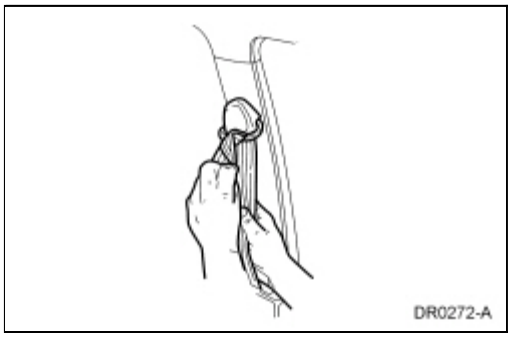


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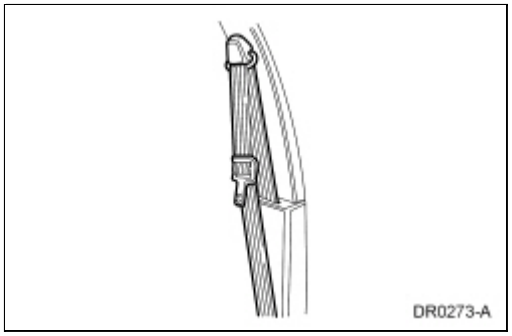
Safety Belt Twisted at the Safety Belt Guide

NOTE: These procedures apply to both wire-formed and stamped D-ring designs.

1. Grasp the safety belt webbing at the shoulder belt guide (D-ring).



2. Feed the folded portion of the safety belt webbing through the safety belt guide (D-ring) to remove the twist from the belt webbing.



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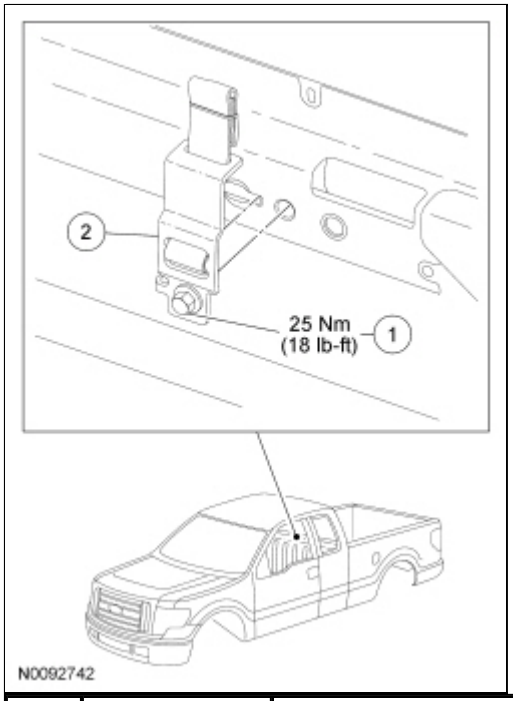
Child Safety Seat Tether Anchor — LATCH, SuperCab and Crew Cab

Removal and Installation

1. The lower anchors and tethers for children are serviced as part of the rear seat frames and are not serviceable separately.
    - For Crew Cab, install a new rear seat cushion frame. For additional information, refer to Seat Cushion — Rear, Crew Cab in the Disassembly and Assembly portion of Section 501-10 .
    - For SuperCab, install a new rear seat frame. For additional information, refer to Seat Cushion — Rear, SuperCab in the Disassembly and Assembly portion of Section 501-10 .

Child Safety Seat Tether Anchor

NOTE: SuperCab shown, other cab styles similar.



Item	Part Number	Description
1	—	Tether anchor bolt (part of 613D74) (3 required)
2	613D74	Tether anchor (3 required)

Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

WARNING: Always tighten the child safety seat tether anchor/bolt to specification. Failure to follow this instruction may result in the child's safety seat being incorrectly secured, which increases the risk of serious personal injury or death to the child in a sudden stop or crash.

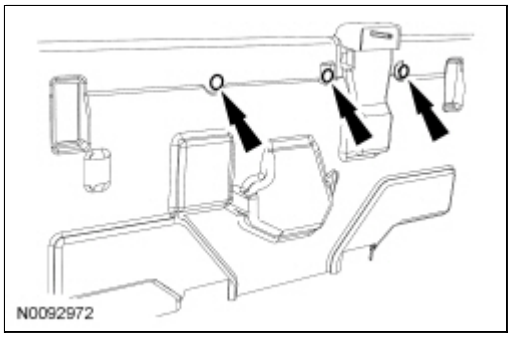
1. **For Crew Cab vehicles** , fold the rear seat backrest down. For additional information, refer to Seat — Rear, Crew Cab, 60 Percent or Seat — Rear, Crew Cab, 40 Percent in the Removal and Installation portion of Section 501-10 .

2. **For SuperCab vehicles** , remove the rear seat backrest. For additional information, refer to appropriate steps in Seat — Rear, SuperCab in the Removal and Installation portion of Section 501-

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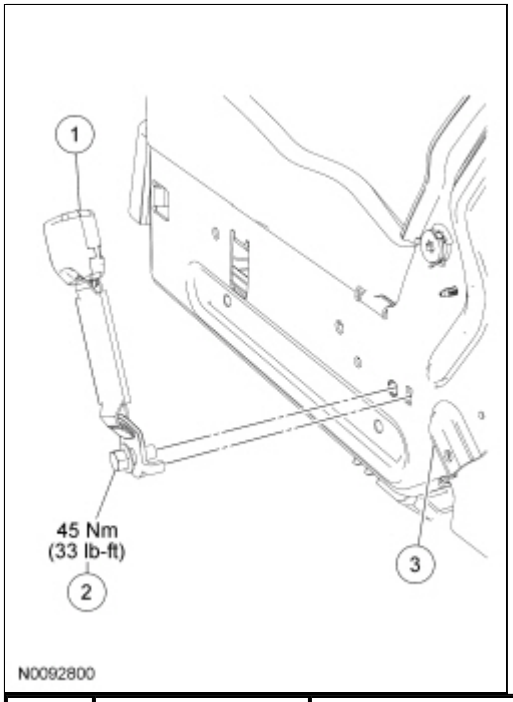
3. **For regular cab vehicles** , fold the seat backrest down, remove the 3 pin-type retainers and position the rear sound insulator aside.



4. Remove the tether anchor bolt(s) and tether anchor(s).
    - To install, tighten to 25 Nm (18 lb-ft).

5. To install, reverse the removal procedure.

Safety Belt Buckle — Front, Center



Item	Part Number	Description
1	611B70	Safety belt buckle
2	—	Safety belt buckle bolt (part of 611B70)
3	61708	Front center seat base frame

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. Remove the front center seat. For additional information, refer to the Removal and Installation portion of Section 501-10 .

2. Remove the LH side shield. For additional information, refer to the Front Center Seat Exploded View procedure in the Removal and Installation portion of Section 501-10 .

3. Remove the bolt and safety belt buckle.
   - To install, tighten to 45 Nm (33 lb-ft).

4. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

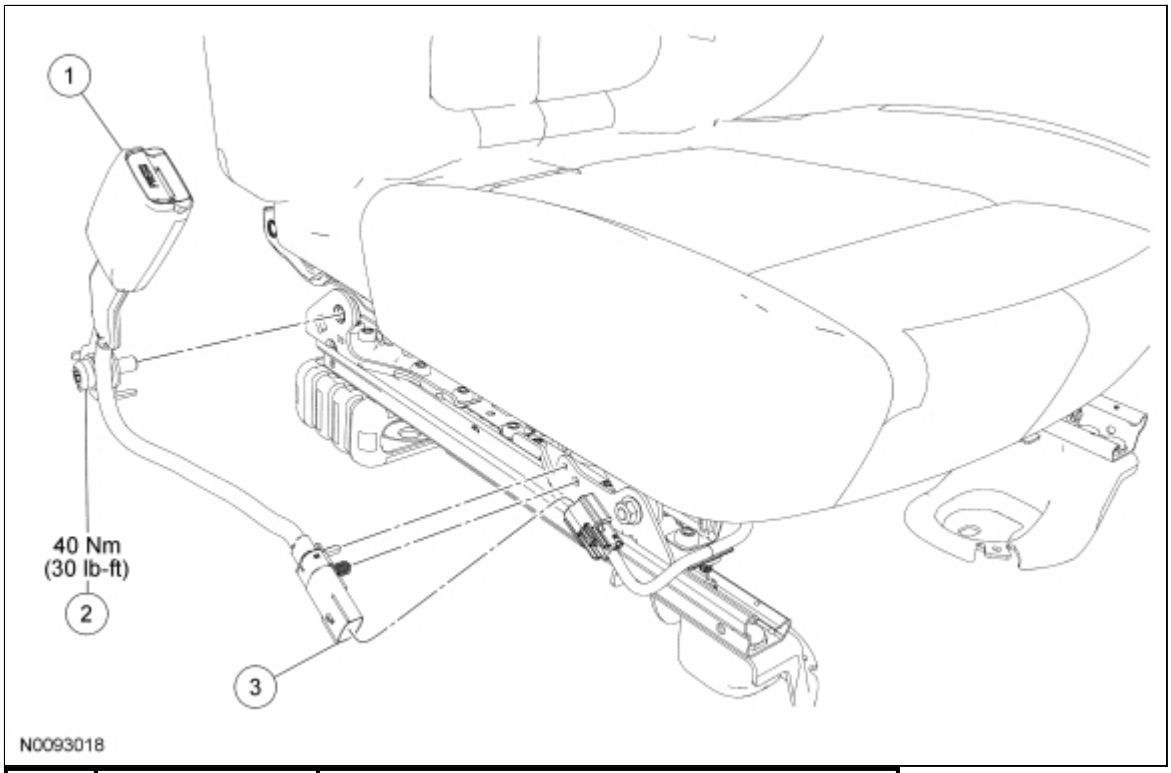
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5. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Buckle — Front

NOTE: Driver seat shown, passenger similar.

NOTE: Refer to the installation steps in Section 501-10 for tightening sequence and torque specification.



Item	Part Number	Description
1	61203	Safety belt buckle
2	—	Safety belt buckle bolt (part of 61203)
3	—	Electrical connector

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

1. Remove the seat. For additional information, refer to Section 501-10 .

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2. Disconnect the electrical connector and detach the wiring harness pin-type retainer.

3. Remove the bolt and safety belt buckle.
    - If equipped, pull the safety belt buckle through the seat cushion trim located on the side of the seat.
    - To install, tighten to 40 Nm (30 lb-ft).

4. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

    To install, reverse the removal procedure.

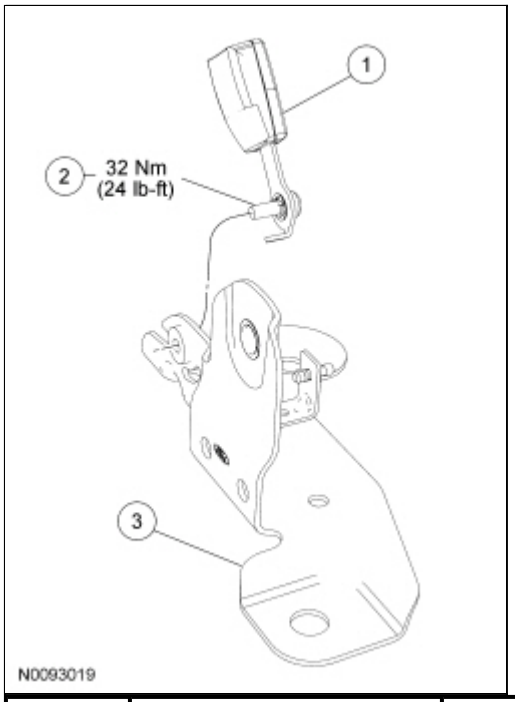
5. Install the seat.
    - For passenger seat, carry out the Occupant Classification Sensor (OCS) System Reset. For additional information, refer to the General Procedures portion of Section 501-20B .

6. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Buckle — Rear

Crew Cab

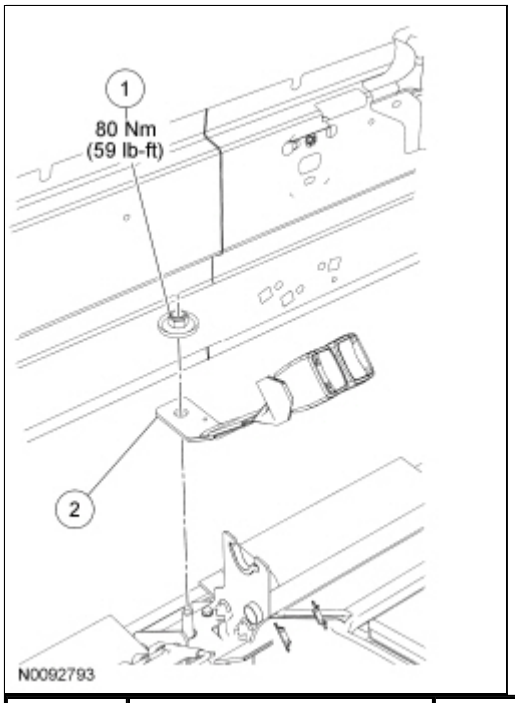
NOTE: 40 percent seat riser shown, 60 percent similar.



Item	Part Number	Description
1	60044	Safety belt buckle
2	—	Bolt (part of 60044)
3	—	40 percent seat riser

SuperCab

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Item	Part Number	Description
1	W708731	Nut
2	60044	RH safety belt buckle

Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

NOTE: The LH rear safety belt buckle is attached to the rear center safety belt retractor anchor. For removal and installation procedures, refer to Safety Belt Retractor — Rear, Center in this section.

Crew Cab

1. Fold the rear seat cushion up.

2. Remove the bolt and safety belt buckle.
   - To install, tighten to 32 Nm (24 lb-ft).

SuperCab

3. Remove the rear seat backrest. For additional information, refer to the appropriate steps in Seat — Rear, SuperCab in the Removal and Installation portion of Section 501-10 .

4. Remove the nut and safety belt buckle assembly.
   - To install, tighten to 80 Nm (59 lb-ft).

All vehicles

5. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

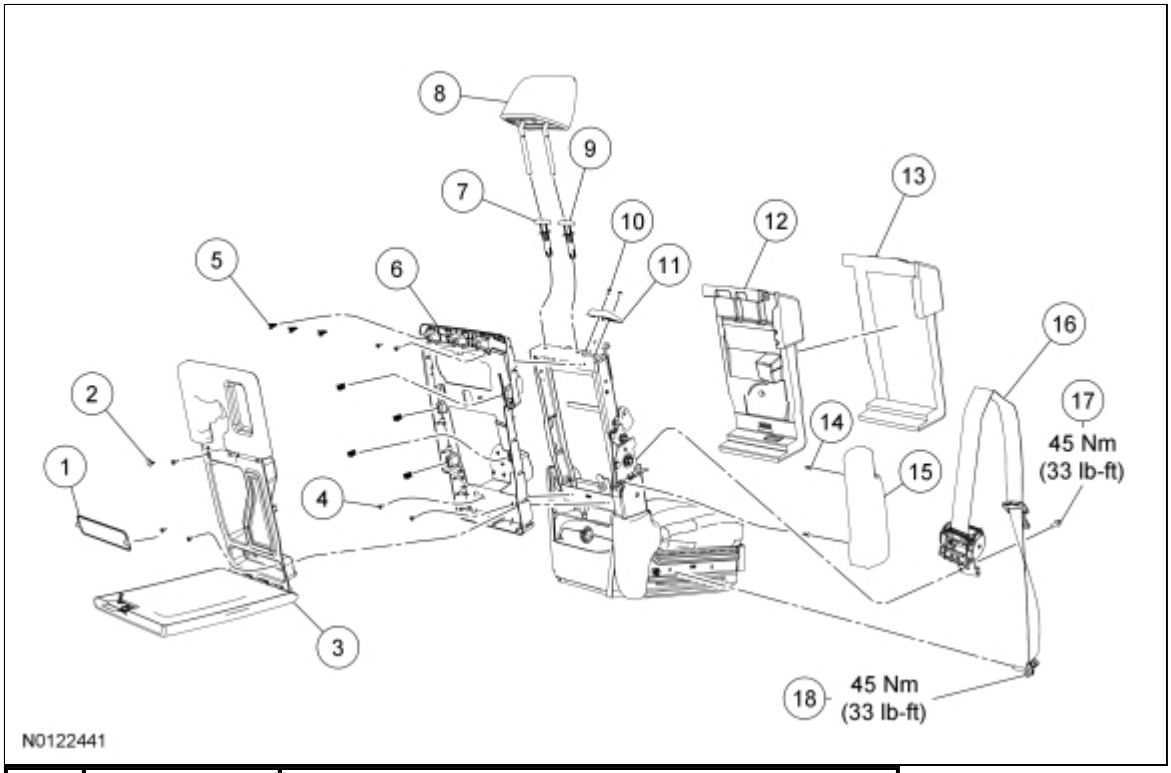
   To install, reverse the removal procedure.

6. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Safety Belt Retractor — Front, Center



Item	Part Number	Description
1	045G34	Trim cover
2	W506841	Screw
3	644A22	Armrest/storage bin
4	W303547	Screw (4 required)
5	W711045	Clip (7 required)
6	—	Armrest/storage bin bracket
7	610A18	Head restraint guide sleeve (master)
8	611A08	Head restraint
9	610A18	Head restraint guide sleeve (slave)
10	W303547	Screw (2 required)
11	601B30	Safety belt bezel
12	64810	Backrest foam pad
13	64416	Backrest cover
14	W707211	Pin-type retainer (part of 672A33) (2 required)
15	672A28	Backrest latch cover
16	611B64	Safety belt retractor

17	W505275	Safety belt retractor bolt
18	—	Safety belt anchor bolt (part of 611B64)

Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

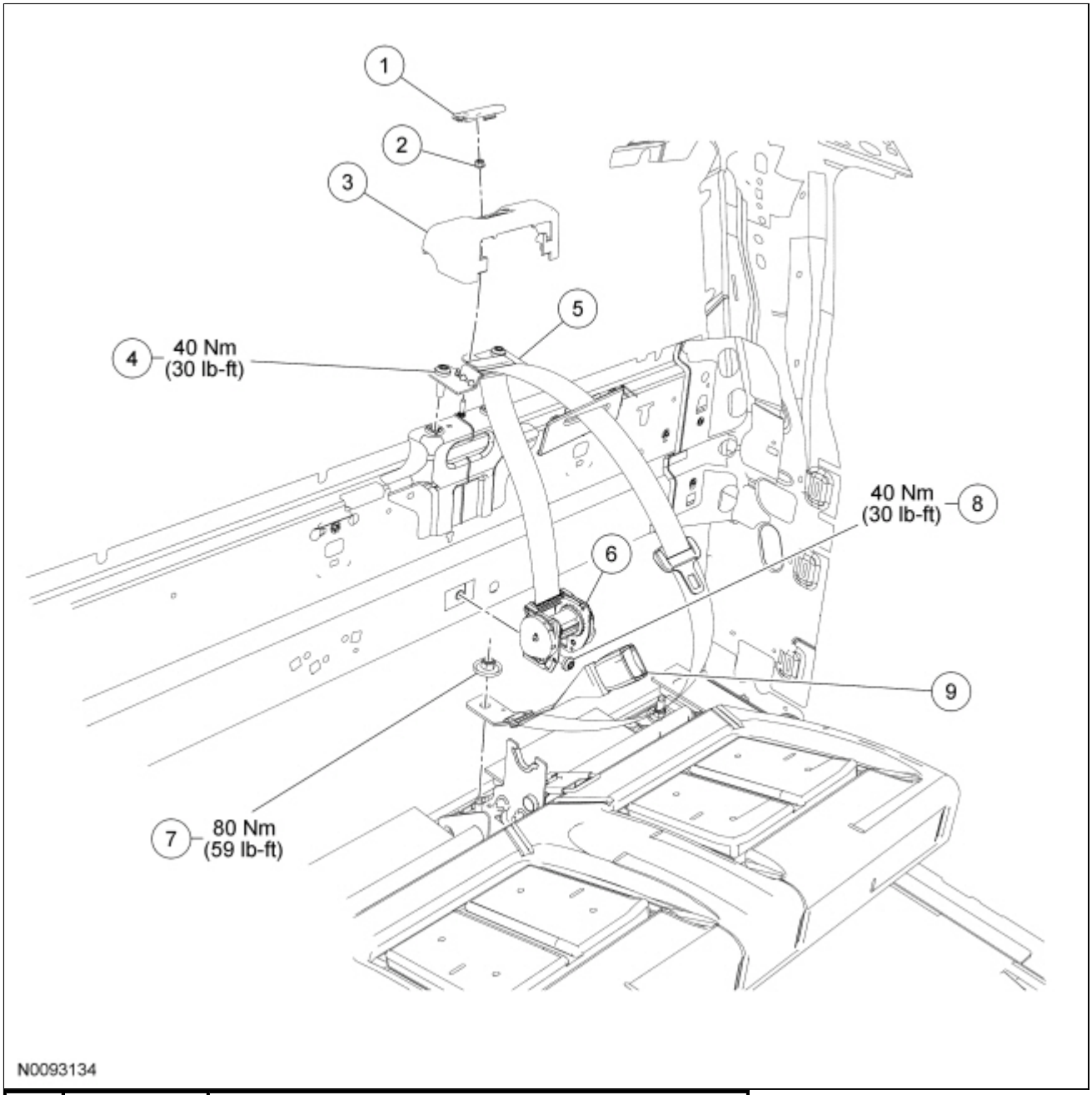
1. Remove the front center seat. For additional information, refer to Section 501-10 .
2. Open the arm rest cover, remove the 3 screws and armrest storage bin.
3. Push the release buttons and remove the head restraint.
4. Remove and discard the 2 head restraint guide sleeves. For additional information, refer to section Section 501-10 .
5. Remove the 2 screws and center seat belt retractor bezel.
6. Detach the backrest cover from the storage bin bracket.
7. Remove the safety belt anchor bolt.
   - To install, tighten to 45 Nm (33 lb-ft).
8. Remove the 4 screws to the armrest storage bin bracket and position aside.
9. Remove the bolt and safety belt retractor.
   - To install, tighten to 45 Nm (33 lb-ft).
10. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

    To install, reverse the removal procedure.
11. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Safety Belt Retractor — Rear, Center

SuperCab

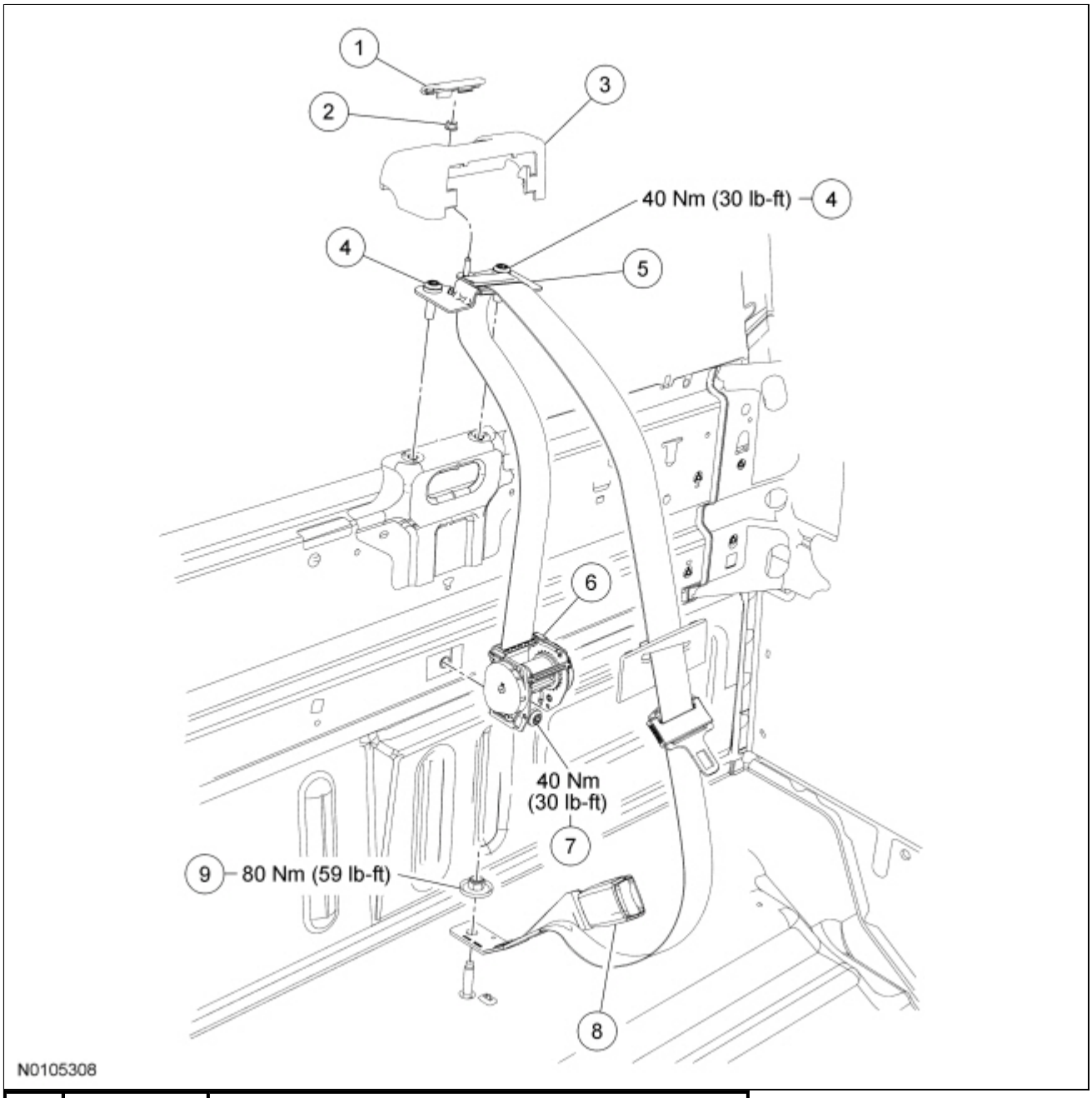


Item	Part Number	Description
1	601B32	Nut cover
2	W707142	Nut

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3	60220	Tower cover bezel
4	—	Turning loop bolt (part of 611B64) (2 required)
5	—	Turning loop (part of 611B64)
6	611B64	Safety belt retractor
7	W708731	Safety belt retractor anchor nut
8	—	Safety belt retractor bolt (part of 611B64)
9	—	Safety belt retractor anchor and buckle (part of 611B64)

Crew Cab



Item	Part Number	Description
1	601B32	Nut cover
2	W707142	Nut
3	60220	Tower cover bezel
4	—	Turning loop bolts (part of 611B64) (2 required)
5	—	Turning loop (part of 611B64)
6	611B64	Safety belt retractor
7	—	Safety belt retractor bolt (part of 611B64)
8	—	Safety belt retractor anchor and buckle (part of 611B64)

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9	W708731	Safety belt retractor anchor nut

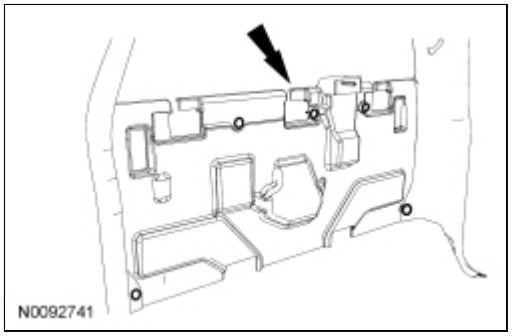
Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. For SuperCab, remove the rear seat backrest. For additional information, refer to the appropriate steps in Seat — Rear, SuperCab in the Removal and Installation portion of Section 501-10 .

2. For Crew Cab, remove the rear seat. For additional information, refer to Removal and Installation portion of Section 501-10 .

3. Remove the 5 pin-type retainers and rear sound insulator.



4. Remove the tower cover bezel.
   - Pry up on the front, middle portion of the nut cover and remove.
   - Remove the nut.
   - Remove the tower cover bezel.

5. Remove the bolts and turning loop.
   - To install, tighten to 40 Nm (30 lb-ft).

6. For SuperCab, remove the nut and safety belt retractor anchor.
   - To install, tighten to 80 Nm (59 lb-ft).

7. Remove the bolt and safety belt retractor.
   - To install, tighten to 40 Nm (30 lb-ft).

8. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

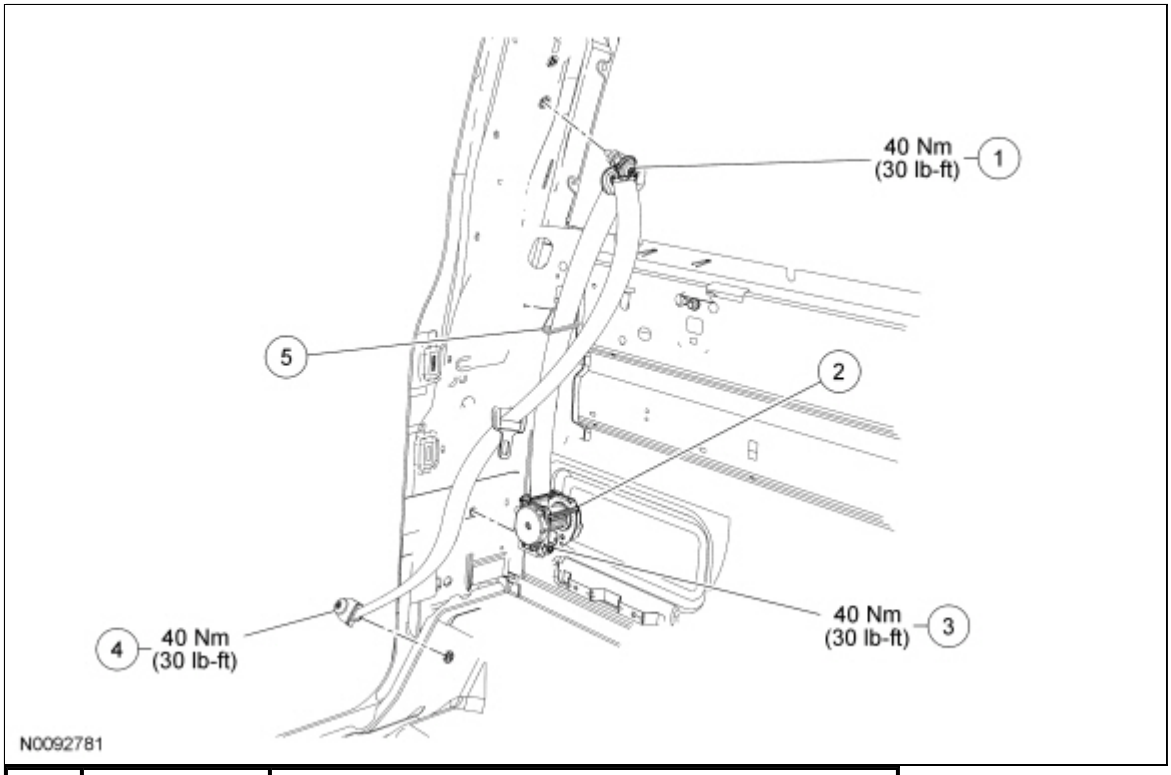
   To install, reverse the removal procedure.

9. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Safety Belt Retractor — Rear

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	—	D-ring bolt (part of 611B68)
2	611B68	Safety belt retractor
3	—	Safety belt retractor bolt (part of 611B68)
4	—	Safety belt retractor anchor bolt (part of 611B68)
5	—	Safety belt guide

Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. For SuperCab, remove the B-pillar trim panel. For additional information, refer to Section 501-05 .
2. For Crew Cab, remove the C-pillar trim panel. For additional information, refer to Section 501-05 .

3. Remove safety belt retractor bolt.
    - To install, tighten to 40 Nm (30 lb-ft).

4. Remove the safety belt retractor.

5. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

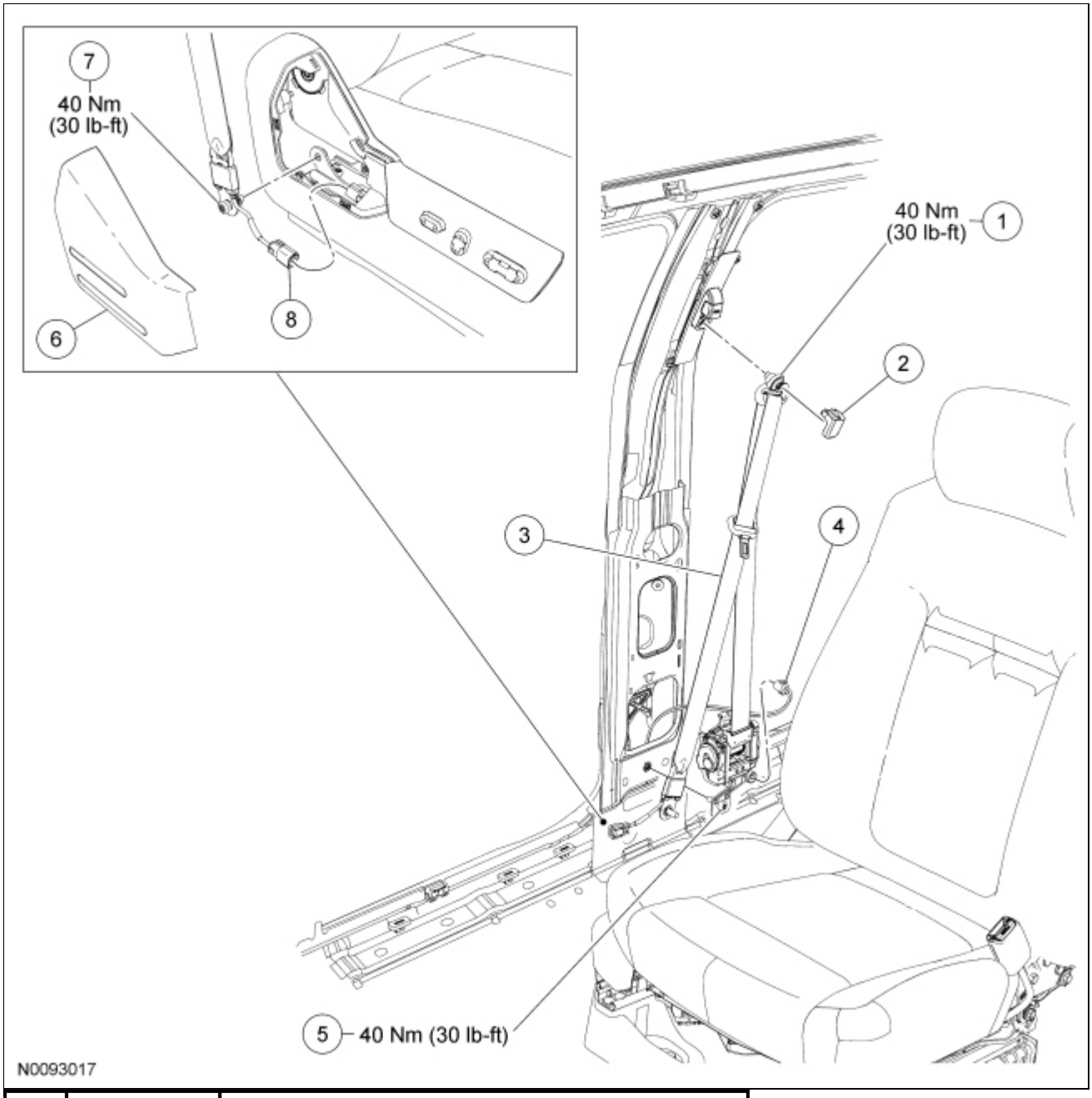
6. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Safety Belt Retractor and Pretensioner — Regular Cab and Crew Cab

NOTE: Crew Cab shown, regular cab similar.



Item	Part Number	Description
1	—	D-ring bolt (part of 612D64)
2	60262	D-ring cover
3	612D64	Safety belt retractor

4	—	Pretensioner electrical connector (part of 14A005)
5	—	Safety belt retractor bolt (part of 612D64)
6	61692	Safety belt anchor cover
7	—	Safety belt anchor bolt (part of 612D64)
8	—	Belt Tension Sensor (BTS) electrical connector

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

2. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .

3. Remove the bolt, rotate the retractor to detach the hook from the B-pillar sheet metal and remove the safety belt retractor.
   - To install, tighten to 40 Nm (30 lb-ft).

4. Disconnect the safety belt retractor and pretensioner electrical connector.

5. Remove the safety belt retractor.

6. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants. To install, reverse the removal procedure.

   To install, reverse the removal procedure.

7. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

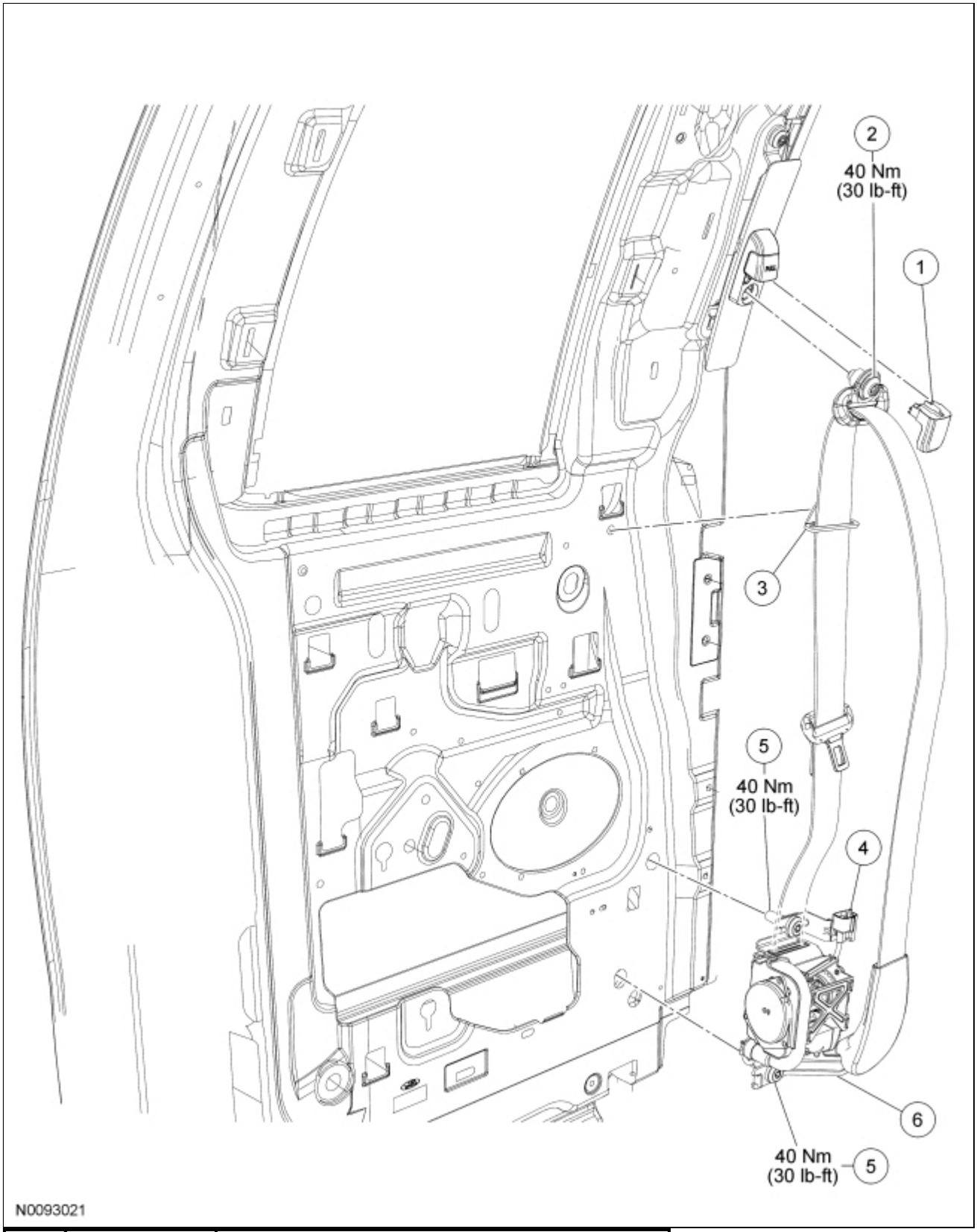
8. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Safety Belt Retractor and Pretensioner — SuperCab

NOTE: LH door shown, RH similar.

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Item	Part Number	Description
1	60262	D-ring cover
2	—	D-ring bolt (part of 612D65)

3	—	Webbing guide and retainer (part of 61D65)
4	—	Electrical connector (part of 612D65)
5	—	Bolts (part of 612D65)
6	612D65	Safety belt retractor and pretensioner

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

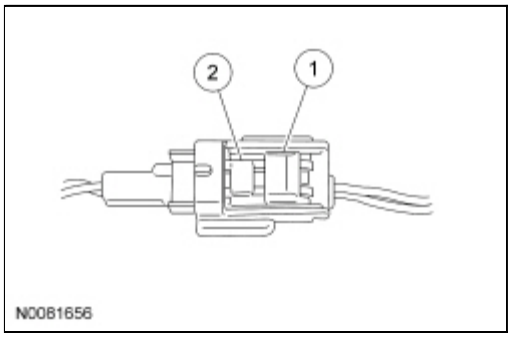
NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

2. Remove the rear door trim panels. For additional information, refer to Section 501-05 .

3. Disconnect the safety belt retractor and pretensioner electrical connector.
    1. Slide the lock clip back.
    2. Press the tab in and disconnect the electrical connector.



4. Detach the webbing retainer from the door.

5. Remove the 2 bolts and safety belt retractor and pretensioner.
    - To install, tighten to 40 Nm (30 lb-ft).

6. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

    To install, reverse the removal procedure.

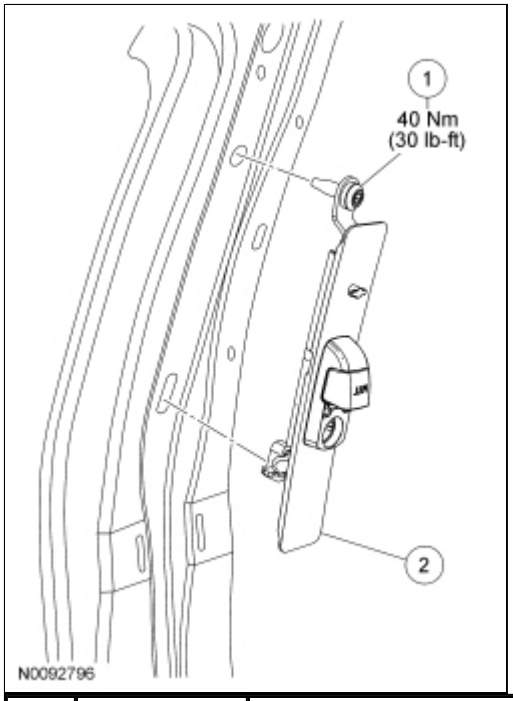
7. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

8. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Safety Belt Shoulder Height Adjuster — Regular Cab and Crew Cab

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	—	Safety belt shoulder height adjuster bolt (part of 602B82)
2	602B82	Safety belt shoulder height adjuster

Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .

2. Remove safety belt shoulder height adjuster.
   - Remove the bolt.
   - Rotate the safety belt shoulder height adjuster to detach the lower tab from the B-pillar and remove.
   - To install, tighten to 40 Nm (30 lb-ft).

3. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and

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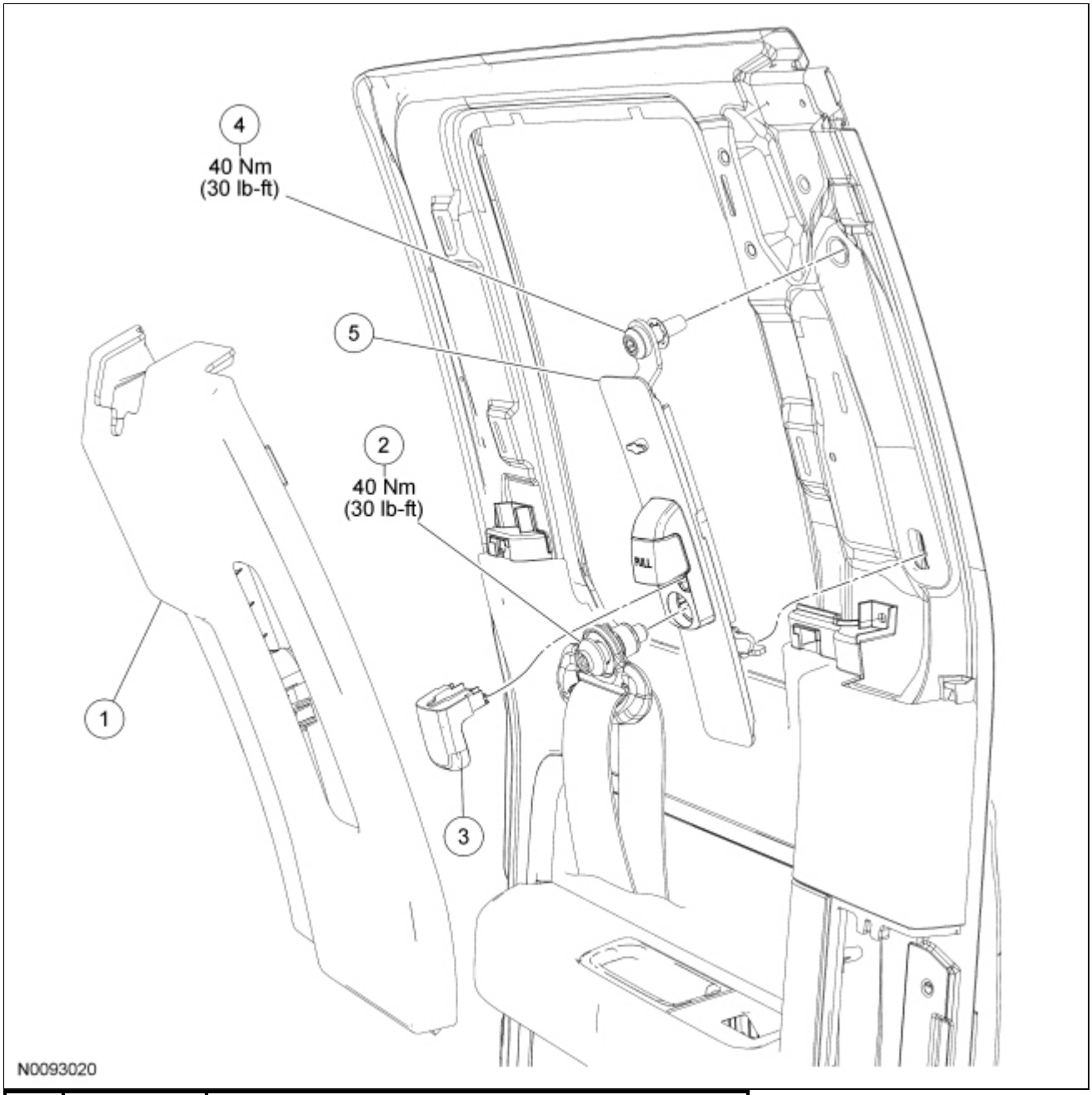
buckles are accessible to the occupants.

To install, reverse the removal procedure.

4. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Shoulder Height Adjuster — SuperCab

NOTE: LH door shown, RH similar.



Item	Part Number	Description
1	25504	Rear door front garnish moulding
2	—	D-ring bolt (part of 612D65)

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3	60262	D-ring cover
4	—	Safety belt shoulder height adjuster bolt (part of 602B82)
5	602B82	Safety belt shoulder height adjuster

Removal and Installation

WARNING: All safety belt components must be inspected and corrected as part of any collision repair. Inspect all safety belt components as prescribed by Safety Belt Inspection and Repair After a Collision found in Section 501-20A General Procedures of this manual. Failure to follow this instruction may result in incorrect operation of the safety belt system and increase the risk of serious personal injury or death in a crash.

1. Remove the D-ring cover.

2. Remove the D-ring bolt.
   - To install, tighten to 40 Nm (30 lb-ft).

3. Remove the rear door front garnish moulding.

4. Remove the bolt and safety belt shoulder height adjuster.
   - Rotate the safety belt shoulder height adjuster to remove the lower tab from the sheet metal slot.
   - To install, tighten to 40 Nm (30 lb-ft).

5. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

6. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

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Torque Specifications

Description	Nm	lb-in
Front impact severity sensor bolt	12	106
Passenger air bag module bolts	8	71
Restraints Control Module (RCM) bolts	12	106
Side air bag module nuts	9	80
Safety Canopy® module bolts — (all cab styles) [a]	—	—
Side impact sensor bolt — second row	12	106

[a] Refer to the procedure in this section.

Airbag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

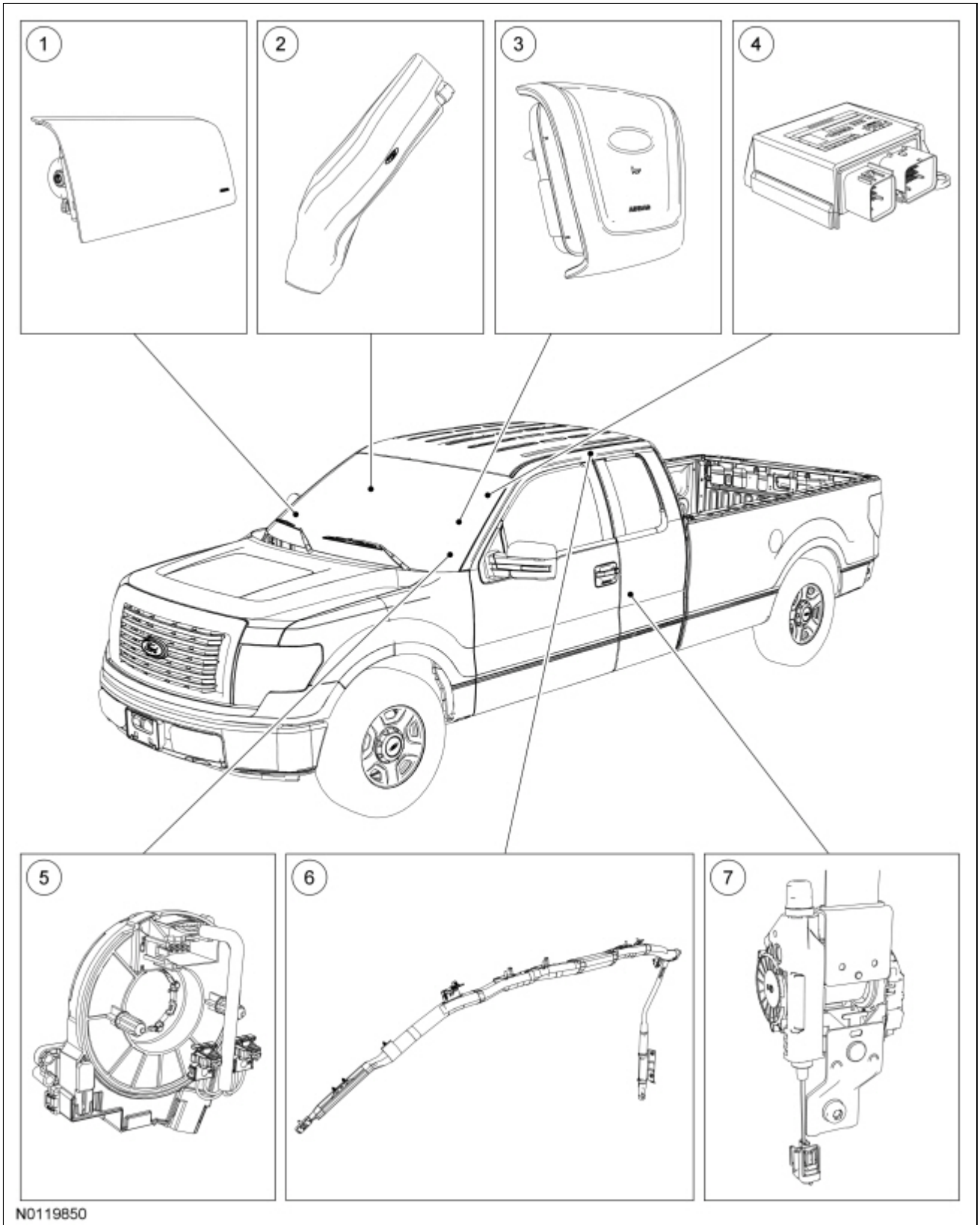
The airbag SRS is designed to provide increased collision protection for front seat occupants in addition to that provided by the 3-point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantage of the SRS .

This vehicle line contains dual-stage deployment (advanced restraint system) driver and front passenger airbags.

The serviceable airbag and safety belt pretensioner SRS components are shown in the following illustrations.

Airbag and Safety Belt Pretensioner Supplemental Restraint System (SRS) Components (Illustration 1 of 2)

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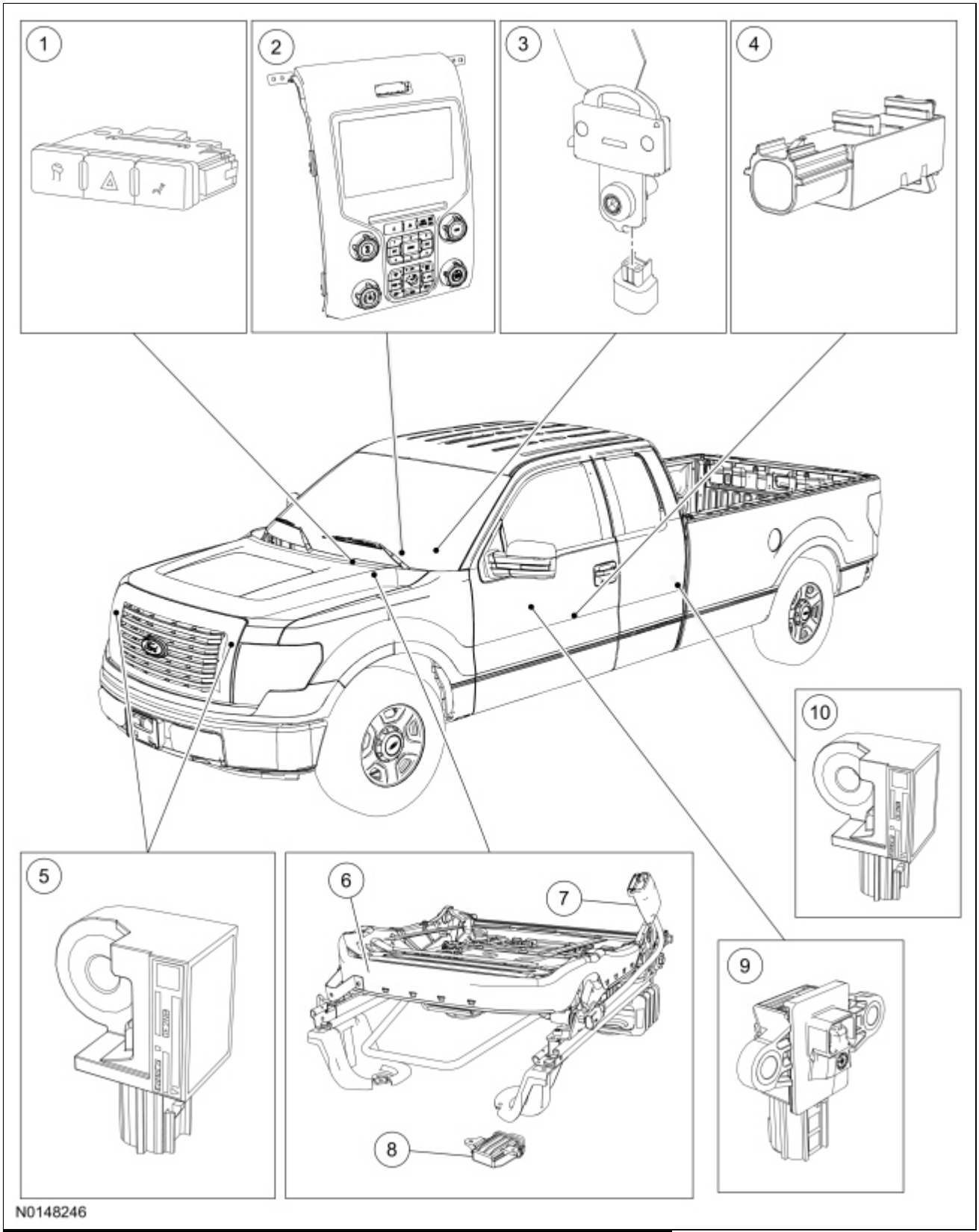


Item	Part Number	Description
1	044A74	Passenger airbag
2	611D11/611D10	Driver/passenger seat side airbag

3	043B13	Driver airbag
4	14B321	RCM
5	14A664	Clockspring
6	042D95/042D94	Driver/passenger Safety Canopy®
7	611B09/611B08	Driver/passenger safety belt retractor pretensioner assembly

Airbag and Safety Belt Pretensioner Supplemental Restraint System (SRS) Components (Illustration 2 of 2)

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Item	Part Number	Description
1	2C418	PAD indicator (part of hazard/traction control switch assembly) (vehicles without 4.2" LCD

		IPC display only)
2	18842	FCIM (includes PAD indicator) (vehicles with 4.2" LCD IPC display only)
3	611B08	BTS (part of passenger safety belt retractor pretensioner assembly)
4	14B416	Driver seat track position sensor
5	14B004	LH/RH front impact severity sensor
6	61704 (manual seat)/61710 (power seat)	Passenger seat track assembly (includes OCS weight sensor bolts)
7	61203/61202	Driver/passenger safety belt buckle (includes safety belt buckle switch)
8	14B056	OCSM
9	14B345	Driver/passenger front door side impact sensor (pressure sensor)
10	14B004	Driver/passenger second row side impact sensor

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Airbag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The Restraints Control Module (RCM) continuously receives/monitors all inputs from the following Supplemental Restraint System (SRS) components.

- LH and RH front impact severity sensors
- Driver and passenger front door side impact sensors
- Driver and passenger second row side impact sensors
- Safety belt buckle switches (driver and passenger)
- Driver seat track position sensor
- Occupant Classification System Module (OCSM)

If the RCM detects sudden vehicle deceleration and/or lateral deceleration based on all the information received from all sensors and switches and determines that deployment is required, the RCM sends voltage and current to deploy the appropriate SRS components.

The RCM contains an internal sensor that detects vehicle rollover angles. If the RCM determines that a rollover condition exists and deployment is required, the RCM deploys the applicable SRS components.

During a frontal or side crash, the RCM can deploy the following SRS components, based on crash severity and sensor input.

- Safety belt retractor pretensioner(s)

- Seat side air bag(s)
- Safety Canopy®
- Driver and passenger dual-stage air bag(s) (one or both stages)

The fact that the safety belt pretensioners, Safety Canopy® or air bags did not activate for both front seat occupants in a crash does not indicate that something is wrong with the system.

The RCM carries out a self-test of the SRS during each startup. If a SRS fault exists, the air bag warning indicator illuminates and remains illuminated for the rest of the ignition cycle. In addition to the self-test at start up, the RCM continuously monitors all of its SRS components and circuitry for correct operation.

Air Bag Warning Indicator

The air bag warning indicator:

- is located in the Instrument Panel Cluster (IPC) and proves out by lighting for 6 seconds and then turn off.
- flashes and/or illuminates based on the message the IPC receives from the RCM .
- illuminates if the IPC does not receive a message from the RCM .

Air Bag Module Second Stage Deployment Check

Because the driver and passenger front air bags each have 2 deployment stages, it is possible that Stage 1 has deployed and Stage 2 has not.

If a front air bag module has deployed, it is **mandatory** that the front air bag module be remotely deployed using the appropriate air bag disposal procedure.

- For information on driver air bag module and/or passenger air bag module remote deployment, refer to Pyrotechnic Device Disposal in this section.

Clockspring

The clockspring allows for continuous electrical connections between the driver air bag module and the RCM when the steering wheel is turned.

Driver Air Bag Module

The driver air bag module is a dual-stage air bag, upon receiving a flow of current from the RCM , deploying at 1 of 2 different rates depending upon vehicle impact severity and impact sensor input.

High Speed Controller Area Network (HS-CAN)

This vehicle utilizes a communication system called a High Speed Controller Area Network (HS-CAN). The RCM communicates with various modules for required information about the vehicle. Refer to Section 418-

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00 for information about the HS-CAN .

Occupant Classification System (OCS)

The Occupant Classification System (OCS) is found only on the front passenger seat. The OCS classifies the size of the front passenger seat occupant and provides this information to the RCM . The RCM uses this information (and other inputs) in determining the deployment strategy of the passenger air bag and pretensioner. The OCS has 2 weight sensor bolts that are mounted to the inboard rail of the seat track and are only serviced with the seat track assembly. The OCSM is mounted to the electrical bracket underneath the seat cushion pan and can be serviced separately from the seat track assembly.

The OCS is also used for operation of the passenger Belt-Minder®. For information on the passenger Belt-Minder® feature, refer to Section 501-20A . To deactivate or reactivate the passenger Belt-Minder® feature, refer to Section 413-01 or the Owner's Literature.

Belt Tension Sensor (BTS)

The Belt Tension Sensor (BTS):

- is a 3-wire Hall-effect sensor located at the safety belt anchor point and is part of the front passenger safety belt and retractor assembly.
- is used in conjunction with the OCS .

The BTS is used by the OCS to identify the presence of a child safety seat on the front passenger seat. The BTS senses the tension on the safety belt assembly then provides an output to the OCSM , indicating that the safety belt assembly is cinched. After sensing the weight applied to the seat by the occupant and using the BTS input, the OCSM determines how the occupant should be classified and communicates this information to the RCM . If the occupant is classified as a child, the RCM automatically deactivates the passenger air bag module and illuminates the Passenger Air Bag Deactivation (PAD) indicator.

Passenger Air Bag Deactivation (PAD) Indicator — Vehicles without 4.2" LCD IPC display

The PAD indicator is a visual indicator used to inform the front seat occupants of the front passenger air bag state. The PAD indicator is located in the instrument panel as part of the hazard/traction control switch and is visible to each front seat occupant.

For vehicles without a 4.2" LCD IPC display, the RCM controls the state of the PAD indicator through a direct hard-wired connection. The PAD indicator output is based on information provided by the OCSM and illuminates to indicate the front passenger air bag module is disabled. An execption to this is when the front passenger seat is determined to be empty, in which case it is not necessary to indicate that the passenger airbag is disabled. In all other cases, the PAD indicator is unlit when the passenger air bag module is enabled.

The RCM briefly activates the PAD indicator to prove-out the indicator function and verify to the front occupants the PAD indicator is functioning correctly

The following table indicates the passenger air bag status and the PAD indicator status based the size of the front passenger occupant.

Passenger Air Bag and Passenger Air Bag Deactivation (PAD) Indicator Status — Vehicles without 4.2" LCD IPC display

Occupant Size	Passenger Safety Belt Buckle Status	Passenger Air Bag Status	PAD Indicator Status
Empty	Unbuckled	Disabled	Unlit
Empty	Buckled	Disabled	Lit
Small	Buckled/ Unbuckled	Disabled	Lit
Large	Buckled/ Unbuckled	Enabled	Unlit

Passenger Air Bag Deactivation (PAD) Indicator — Vehicles with 4.2" LCD IPC display

The PAD indicator is a visual indicator used to inform the front seat occupants of the front passenger air bag state. The PAD indicator is located in the instrument panel as part of the FCIM and is visible to each front seat occupant.

For vehicles with a 4.2" LCD IPC display, the RCM controls the state of the PAD indicator via the HS-CAN and I-CAN . The PAD indicator output is based on information provided by the OCSM . When the passenger airbag is activated, the PAD indicator displays ON. If the RCM has deactivated the passenger airbag, the PAD indicator displays OFF.

The RCM briefly activates the PAD indicator to prove-out the indicator function and verify to the front occupants the PAD indicator is functioning correctly.

The following table indicates the passenger air bag status and the PAD indicator status based the size of the front passenger occupant.

Passenger Air Bag and Passenger Air Bag Deactivation (PAD) Indicator Status — Vehicles with 4.2" LCD IPC display

Occupant Size	Passenger Safety Belt Buckle Status	Passenger Air Bag Status	PAD Indicator Status
Empty	Buckled/ Unbuckled	Disabled	OFF: Lit
			ON: Unlit
Small	Buckled/ Unbuckled	Disabled	OFF: Lit
			ON: Unlit
Large	Buckled/ Unbuckled	Enabled	OFF: Unlit
			ON: Lit

Passenger Air Bag Module

The passenger air bag module is a dual-stage air bag, deploying at 1 of 2 different rates depending upon vehicle impact severity and sensor input.

Restraints Control Module (RCM)

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WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the airbags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: This vehicle is equipped with the SYNC® feature which contains the 911 assist option. Refer to the Owner's Literature.

The RCM carries out the following functions:

- Deploys the air bag(s)/Safety Canopy® in the event of a deployable crash
- Activates the driver and passenger retractor pretensioner(s) to control the tension of the driver and passenger safety belts in the event of a deployable crash
- Monitors the SRS for faults
- Sends a message to the IPC to illuminate the air bag warning indicator if a fault is detected
- Communicates through the Data Link Connector (DLC) the current or historical DTCs

The RCM monitors the SRS for possible faults. If a fault is detected, the RCM requests the IPC to illuminate the air bag warning indicator. When the ignition is turned OFF and then ON, the IPC proves out the air bag warning indicator by lighting for 6 seconds. If no faults are detected by the RCM, the IPC turns the air bag warning indicator off and it remains off. If the RCM detects a fault, it sends a message to the IPC to turn the air bag warning indicator on and it remains on for the rest of the ignition cycle. If the RCM requests illumination of the air bag warning indicator and the air bag warning indicator does not function, the IPC automatically activates an audible chime. The chime is a series of 5 sets of 5 tone bursts. If the chime is heard, the SRS and the air bag warning indicator require repair.

The RCM includes a backup power supply. This feature provides sufficient backup power to deploy the air bags in the event that the ignition circuit is lost or damaged during impact. The backup power supply depletes its stored energy approximately one minute after power and/or ground is removed from the RCM.

Post Crash Alert Function

The post crash alert is a function controlled by the Body Control Module (BCM). If the RCM determines that an impact of a pre-determined severity (the air bags may or may not be deployed) has occurred, the RCM sends a message to the BCM over the High Speed Controller Area Network (HS-CAN) and the post crash alert function is activated. The post-crash alert function activates the hazard lamp function and cycles the horn on 3 times, then off for 4 seconds, and repeats this cycle until the battery is discharged or the function is turned off. The post crash alert function can be turned off by:

- pressing the hazard flasher lamp switch (which may need to be pressed more than once).
- pressing the Remote Keyless Entry (RKE) transmitter UNLOCK button.
- pressing the RKE transmitter PANIC button.

Safety Belt Buckle Switches

The safety belt buckle switches indicate to the RCM whether the safety belts are buckled or unbuckled.

The RCM also communicates the driver safety belt buckle switch status to the IPC, which monitors the information to control the safety belt warning indicator. For information on the safety belt warning indicator, refer to Section 413-01.

Safety Belt Retractor Pretensioner

Safety belt retractor pretensioners control the tension of the driver and passenger safety belts in the event of a deployable collision.

Safety Canopy® Module

WARNING: Anytime the Safety Canopy® or side air curtain module has deployed, a new headliner and new A-, B- and C-pillar upper trim panels and attaching hardware must be installed. Remove any other damaged components and hardware and install new components and hardware as needed. Failure to follow these instructions may result in the Safety Canopy® or side air curtain module deploying incorrectly and increases the risk of serious personal injury or death in a crash.

NOTE: The Safety Canopy® modules are **NOT** interchangeable. If installing a new Safety Canopy® module, the correct Safety Canopy® module **MUST** be installed for the vehicle application.

The Safety Canopy® module:

- is mounted above the headliner.
- attaches from the A-pillar frame to the B-pillar or C-pillar frame.

Seat Track Position Sensor

The seat track position sensor indicates the position of the driver seat along the seat track to the RCM. The sensor detects the presence of a shunt bracket on the track, indicating that the seat has moved forward beyond a certain point of adjustment. The RCM uses seat track position sensor information to determine the deployment rate of the dual-stage driver air bag module.

Secondary Air Bag Warning (Chime)

The secondary air bag warning chime is an audible chime located in and controlled by the IPC. If a fault is detected with the air bag warning indicator, a DTC is stored in memory of the IPC. Upon receiving the message from the RCM that a SRS fault has been detected, the IPC sounds the secondary air bag warning chime in a pattern of 5 sets of 5 beeps.

Impact Sensor

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For this vehicle line, the SRS uses up to 6 satellite sensors in addition to the RCM. The RCM is mounted to the center tunnel beneath the console (if equipped) or front center seat. All vehicles have 2 front impact severity sensors located in the front of the vehicle, mounted on the radiator support. The first row impact sensors (side restraints sensor 1) are mounted in each of the front doors behind the trim panel, the second row impact sensors (side restraints sensor 2, Crew Cab and SuperCab) are located on each C-pillar. The driver/passenger front door side impact sensor are pressure sensors and are **not interchangeable** with other sensors on the vehicle. Mounting orientation is critical for correct operation of all impact sensors.

Seat Side Air Bag Module

The side air bag module:

- deploys upon receiving a flow of current from the RCM, initiated by the side restraints sensor and internal RCM circuitry.
- is mounted in the seat backrest.
- is used in conjunction with a Safety Canopy® module.

Inspection and Verification

1. Verify the customer concern by checking the air bag warning indicator in the Instrument Panel Cluster (IPC). Refer to Prove Out the System in this section.

2. Visually inspect for obvious signs of mechanical or electrical damage. Do not disconnect electrical connectors until directed to do so within the pinpoint test.

Visual Inspection Chart

Mechanical	Electrical

• Damaged Restraints Control Module (RCM) or loose mounting
• Damaged LH or RH front impact severity sensor(s)
• Damaged side impact sensor front door and/or C-pillar
• Damaged or disconnected Passenger Air Bag Deactivation (PAD) indicator
• Damaged front driver/passenger seat assembly
	• Open Body Control Module (BCM) fuse (s):
	  ▪ 36 (10A)
	  ▪ 41 (7.5A)
	• Damaged wiring harness
	• Loose, damaged or corroded connectors
	• Circuitry open/shorted
	• Damaged shorting bars
	• Loose, damaged or pinched passenger seat wire harness

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

If the scan tool does not communicate with the VCM :

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record on-demand and Continuous Memory Diagnostic Trouble Codes (CMDTCs) from the RCM and Occupant Classification System Module (OCSM).

8. If the DTCs retrieved are related to the concern, go to the DTC Charts. For all other DTCs, refer to Section 419-10 .

9. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

The DTCs can be retrieved from the RCM and the Occupant Classification System Module (OCSM) with a scan tool via the Data Link Connector (DLC).

Restraints Control Module (RCM) DTC Chart

NOTE: Always make sure the correct Supplemental Restraint System (SRS) component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action To Take
Continuous lamp	The Air Bag Warning Indicator is Illuminated Continuously	GO to Pinpoint Test A .
B0001:11	Driver Frontal Stage 1 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test B .
B0001:12	Driver Frontal Stage 1 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test B .

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B0001:13	Driver Frontal Stage 1 Deployment Control: Circuit Open	GO to Pinpoint Test B .
B0001:1A	Driver Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test B .
B0001:2B	Driver Frontal Stage 1 Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W .
B0001:4A	Driver Frontal Stage 1 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X .
B0002:11	Driver Frontal Stage 2 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test C .
B0002:12	Driver Frontal Stage 2 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test C .
B0002:13	Driver Frontal Stage 2 Deployment Control: Circuit Open	GO to Pinpoint Test C .
B0002:1A	Driver Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test C .
B0002:2B	Driver Frontal Stage 2 Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W .
B0002:4A	Driver Frontal Stage 2 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X .
B0004:11	Driver Knee Bolster Deployment Control: Circuit Short to Ground	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0004:12	Driver Knee Bolster Deployment Control: Circuit Short to Battery	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0004:13	Driver Knee Bolster Deployment Control: Circuit Open	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation

		(PMI). REFER to Restraints Control Module (RCM) in this section.
B0004:1A	Driver Knee Bolster Deployment Control: Circuit Resistance Below Threshold	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0004:2B	Driver Knee Bolster Deployment Control: Signal Cross Coupled	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0004:4A	Driver Knee Bolster Deployment Control: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0005:11	Collapsible Steering Column Deployment Control: Circuit Short to Ground	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0005:12	Collapsible Steering Column Deployment Control: Circuit Short to Battery	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0005:13	Collapsible Steering Column Deployment Control: Circuit Open	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0005:1A	Collapsible Steering Column Deployment Control: Circuit Resistance Below Threshold	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle.

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		INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0005:2B	Collapsible Steering Column Deployment Control: Signal Cross Coupled	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0005:4A	Collapsible Steering Column Deployment Control: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0010:11	Passenger Frontal Stage 1 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test D.
B0010:12	Passenger Frontal Stage 1 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test D.
B0010:13	Passenger Frontal Stage 1 Deployment Control: Circuit Open	GO to Pinpoint Test D.
B0010:1A	Passenger Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test D.
B0010:2B	Passenger Frontal Stage 1 Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W.
B0010:4A	Passenger Frontal Stage 1 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X.
B0011:11	Passenger Frontal Stage 2 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test E.
B0011:12	Passenger Frontal Stage 2 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test E.
B0011:13	Passenger Frontal Stage 2 Deployment Control: Circuit Open	GO to Pinpoint Test E.
B0011:1A	Passenger Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test E.
B0011:2B	Passenger Frontal Stage 2 Deployment Control: Signal	GO to Pinpoint Test W.

	Cross Coupled	
B0011:4A	Passenger Frontal Stage 2 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X .
B0020:11	Left Side Airbag Deployment Control: Circuit Short to Ground	GO to Pinpoint Test F .
B0020:12	Left Side Airbag Deployment Control: Circuit Short to Battery	GO to Pinpoint Test F .
B0020:13	Left Side Airbag Deployment Control: Circuit Open	GO to Pinpoint Test F .
B0020:1A	Left Side Airbag Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test F .
B0020:2B	Left Side Airbag Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W .
B0020:4A	Left Side Airbag Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X .
B0021:11	Left Curtain Deployment Control 1: Circuit Short to Ground	GO to Pinpoint Test G .
B0021:12	Left Curtain Deployment Control 1: Circuit Short to Battery	GO to Pinpoint Test G .
B0021:13	Left Curtain Deployment Control 1: Circuit Open	GO to Pinpoint Test G .
B0021:1A	Left Curtain Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test G .
B0021:2B	Left Curtain Deployment Control 1: Signal Cross Coupled	GO to Pinpoint Test W .
B0021:4A	Left Curtain Deployment Control 1: Incorrect Component Installed	GO to Pinpoint Test X .
B0028:11	Right Side Airbag Deployment Control: Circuit Short to Ground	GO to Pinpoint Test H .
B0028:12	Right Side Airbag Deployment Control: Circuit Short to Battery	GO to Pinpoint Test H .
B0028:13	Right Side Airbag Deployment Control: Circuit Open	GO to Pinpoint Test H .
B0028:1A	Right Side Airbag Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test H .
B0028:2B	Right Side Airbag Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W .
B0028:4A	Right Side Airbag Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X .

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B0029:11	Right Curtain Deployment Control 1: Circuit Short to Ground	GO to Pinpoint Test I .
B0029:12	Right Curtain Deployment Control 1: Circuit Short to Battery	GO to Pinpoint Test I .
B0029:13	Right Curtain Deployment Control 1: Circuit Open	GO to Pinpoint Test I .
B0029:1A	Right Curtain Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test I .
B0029:2B	Right Curtain Deployment Control 1: Signal Cross Coupled	GO to Pinpoint Test W .
B0029:4A	Right Curtain Deployment Control 1: Incorrect Component Installed	GO to Pinpoint Test X .
B0050:11	Driver Seatbelt Sensor: Circuit Short to Ground	GO to Pinpoint Test J .
B0050:12	Driver Seatbelt Sensor: Circuit Short to Battery	GO to Pinpoint Test J .
B0050:13	Driver Seatbelt Sensor: Circuit Open	GO to Pinpoint Test J .
B0050:1D	Driver Seatbelt Sensor: Circuit Current Out of Range	GO to Pinpoint Test J .
B0050:2B	Driver Seatbelt Sensor: Signal Cross Coupled	GO to Pinpoint Test W .
B0050:4A	Driver Seatbelt Sensor: Incorrect Component Installed	GO to Pinpoint Test X .
B0052:11	Passenger Seatbelt Sensor: Circuit Short to Ground	GO to Pinpoint Test K .
B0052:12	Passenger Seatbelt Sensor: Circuit Short to Battery	GO to Pinpoint Test K .
B0052:13	Passenger Seatbelt Sensor: Circuit Open	GO to Pinpoint Test K .
B0052:1D	Passenger Seatbelt Sensor: Circuit Current Out of Range	GO to Pinpoint Test K .
B0052:2B	Passenger Seatbelt Sensor: Signal Cross Coupled	GO to Pinpoint Test W .
B0052:4A	Passenger Seatbelt Sensor: Incorrect Component Installed	GO to Pinpoint Test X .
B0080:11	Driver Seatbelt Load Limiter Deployment Control: Circuit Short to Ground	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.

B0080:12	Driver Seatbelt Load Limiter Deployment Control: Circuit Short to Battery	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0080:13	Driver Seatbelt Load Limiter Deployment Control: Circuit Open	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0080:1A	Driver Seatbelt Load Limiter Deployment Control: Circuit Resistance Below Threshold	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). Use As-Built data when CARRYING OUT Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0080:2B	Driver Seatbelt Load Limiter Deployment Control: Signal Cross Coupled	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0080:4A	Driver Seatbelt Load Limiter Deployment Control: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0082:11	Passenger Seatbelt Load Limiter Deployment Control: Circuit Short to Ground	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0082:12	Passenger Seatbelt Load Limiter Deployment Control: Circuit Short to Battery	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation

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		(PMI). REFER to Restraints Control Module (RCM) in this section.
B0082:13	Passenger Seatbelt Load Limiter Deployment Control: Circuit Open	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0082:1A	Passenger Seatbelt Load Limiter Deployment Control: Circuit Resistance Below Threshold	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0082:2B	Passenger Seatbelt Load Limiter Deployment Control: Signal Cross Coupled	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0082:4A	Passenger Seatbelt Load Limiter Deployment Control: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B0090:11	Left Frontal Restraints Sensor: Circuit Short to Ground	GO to Pinpoint Test L .
B0090:4A	Left Frontal Restraints Sensor: Incorrect Component Installed	GO to Pinpoint Test X .
B0090:81	Left Frontal Restraints Sensor: Invalid Serial Data Received	INSTALL a new LH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0090:93	Left Frontal Restraints Sensor: No Operation	GO to Pinpoint Test L .
B0090:96	Left Frontal Restraints Sensor: Component Internal Failure	INSTALL a new LH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0091:11	Left Side Restraints Sensor 1: Circuit Short to Ground	GO to Pinpoint Test M .
B0091:4A	Left Side Restraints Sensor 1: Incorrect Component Installed	GO to Pinpoint Test X .
B0091:81	Left Side Restraints Sensor 1: Invalid Serial Data Received	INSTALL a new driver front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section.

B0091:93	Left Side Restraints Sensor 1: No Operation	GO to Pinpoint Test M .
B0091:96	Left Side Restraints Sensor 1: Component Internal Failure	INSTALL a new driver front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section.
B0092:11	Left Side Restraints Sensor 2: Circuit Short to Ground	GO to Pinpoint Test N .
B0092:4A	Left Side Restraints Sensor 2: Incorrect Component Installed	GO to Pinpoint Test X .
B0092:81	Left Side Restraints Sensor 2: Invalid Serial Data Received	INSTALL a new driver second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section.
B0092:93	Left Side Restraints Sensor 2: No Operation	GO to Pinpoint Test N .
B0092:96	Left Side Restraints Sensor 2: Component Internal Failure	INSTALL a new driver second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section.
B0095:11	Right Frontal Restraints Sensor: Circuit Short to Ground	GO to Pinpoint Test O .
B0095:4A	Right Frontal Restraints Sensor: Incorrect Component Installed	GO to Pinpoint Test X .
B0095:81	Right Frontal Restraints Sensor: Invalid Serial Data Received	INSTALL a new RH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0095:93	Right Frontal Restraints Sensor: No Operation	GO to Pinpoint Test O .
B0095:96	Right Frontal Restraints Sensor: Component Internal Failure	INSTALL a new RH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0096:11	Right Side Restraints Sensor 1: Circuit Short to Ground	GO to Pinpoint Test N .
B0096:4A	Right Side Restraints Sensor 1: Incorrect Component Installed	GO to Pinpoint Test X .
B0096:81	Right Side Restraints Sensor 1: Invalid Serial Data Received	INSTALL a new passenger front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section.
B0096:93	Right Side Restraints Sensor 1: No Operation	GO to Pinpoint Test N .
B0096:96	Right Side Restraints Sensor 1: Component Internal Failure	INSTALL a new passenger front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section.
B0097:11	Right Side Restraints Sensor 2: Circuit Short to Ground	GO to Pinpoint Test M .
B0097:4A	Right Side Restraints Sensor 2: Incorrect Component Installed	GO to Pinpoint Test X .
B0097:81	Right Side Restraints Sensor 2: Invalid Serial Data Received	INSTALL a new passenger second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section.

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B0097:93	Right Side Restraints Sensor 2: No Operation	GO to Pinpoint Test M .
B0097:96	Right Side Restraints Sensor 2: Component Internal Failure	INSTALL a new passenger second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section.
B00A0:09	Occupant Classification System: Component Failure	GO to Pinpoint Test R .
B00A0:4A	Occupant Classification System: Incorrect Component Installed	GO to Pinpoint Test R .
B00A0:63	Occupant Classification System: Circuit / Component Protection Time-Out	GO to Pinpoint Test R .
B00A0:64	Occupant Classification System: Signal Plausibility Failure	GO to Pinpoint Test R .
B00A0:68	Occupant Classification System: Event Information	GO to Pinpoint Test R .
B00B5:11	Driver Seat Track Position Restraints Sensor: Circuit Short to Ground	GO to Pinpoint Test S .
B00B5:12	Driver Seat Track Position Restraints Sensor: Circuit Short to Battery	GO to Pinpoint Test S .
B00B5:13	Driver Seat Track Position Restraints Sensor: Circuit Open	GO to Pinpoint Test S .
B00B5:1D	Driver Seat Track Position Restraints Sensor: Circuit Current Out of Range	GO to Pinpoint Test S .
B00B5:2B	Driver Seat Track Position Restraints Sensor: Signal Cross Coupled	GO to Pinpoint Test W .
B00B5:4A	Driver Seat Track Position Restraints Sensor: Incorrect Component Installed	GO to Pinpoint Test X .
B00D5:01	Restraint System Passenger Disable Indicator: General Electrical Failure	CONFIGURE the RCM using As-Built data. CLEAR all RCM DTCs and REPEAT the self-test. If DTC B00D5:01 returns, the RCM has received a fault message from the FCIM indicating a fault in the PAD indicator. CARRY OUT a self-test of the FCIM and REPAIR any DTCs. Do not replace the RCM for this DTC.
B00D5:11	Restraint System Passenger Disable Indicator: Circuit Short to Ground	GO to Pinpoint Test T .
B00D5:12	Restraint System Passenger Disable Indicator: Circuit Short to Battery	GO to Pinpoint Test T .
B00D5:13	Restraint System Passenger Disable Indicator: Circuit Open	GO to Pinpoint Test T .

B00D5:4A	Restraint System Passenger Disable Indicator: Incorrect Component Installed	GO to Pinpoint Test X .
B00DF:13	Passenger Restraints Disable Switch: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B1193:00	Crash Event Storage Full and Locked: No Sub Type Information	This DTC indicates the vehicle has been involved in a collision. INSTALL a new RCM and impact sensors. REFER to Inspection and Repair After a Supplemental Restraint System (SRS) Deployment in this section.
B11CD:11	Driver Frontal Airbag Canister Vent: Circuit Short to Ground	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B11CD:12	Driver Frontal Airbag Canister Vent: Circuit Short to Battery	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B11CD:13	Driver Frontal Airbag Canister Vent: Circuit Open	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B11CD:1A	Driver Frontal Airbag Canister Vent: Circuit Resistance Below Threshold	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B11CD:2B	Driver Frontal Airbag Canister Vent: Signal Cross Coupled	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI . Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this

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		section.
B11CD:4A	Driver Frontal Airbag Canister Vent: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B11D8:12	Restraint Event Notification: Circuit Short to Battery	GO to Pinpoint Test AI.
B11D8:14	Restraint Event Notification: Circuit Short to Ground or Open	GO to Pinpoint Test AI.
B1202:01	Restraint System Passenger Enable Indicator: General Electrical Failure	The RCM has received a fault message from the FCIM indicating a fault in the PAD indicator. CARRY OUT a self-test of the FCIM and REPAIR any DTCs. Do not replace the RCM for this DTC.
B1211:11	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Ground	GO to Pinpoint Test U.
B1211:12	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Battery	GO to Pinpoint Test U.
B1211:13	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Open	GO to Pinpoint Test U.
B1211:1A	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test U.
B1211:2B	Driver Seatbelt Retractor Pretensioner Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W.
B1211:4A	Driver Seatbelt Retractor Pretensioner Deployment Control: Incorrect Component Installed	GO to Pinpoint Test X.
B1212:11	Driver Seatbelt Buckle Pretensioner Deployment Control: Circuit Short to Ground	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B1212:12	Driver Seatbelt Buckle Pretensioner Deployment Control: Circuit Short to Battery	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation

		(PMI). REFER to Restraints Control Module (RCM) in this section.
B1212:13	Driver Seatbelt Buckle Pretensioner Deployment Control: Circuit Open	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B1212:1A	Driver Seatbelt Buckle Pretensioner Deployment Control: Circuit Resistance Below Threshold	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B1212:2B	Driver Seatbelt Buckle Pretensioner Deployment Control: Signal Cross Coupled	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B1212:4A	Driver Seatbelt Buckle Pretensioner Deployment Control: Incorrect Component Installed	**NOTE:** This vehicle is not equipped with this component. This DTC indicates the RCM is incorrectly configured or the incorrect RCM is installed to the vehicle. INSTALL a new RCM and CARRY OUT PMI. Use As-Built data when carrying out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
B1214:11	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Ground	GO to Pinpoint Test V.
B1214:12	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Battery	GO to Pinpoint Test V.
B1214:13	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Open	GO to Pinpoint Test V.
B1214:1A	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test V.
B1214:2B	Passenger Seatbelt Retractor Pretensioner Deployment Control: Signal Cross Coupled	GO to Pinpoint Test W.
B1214:4A	Passenger Seatbelt Retractor Pretensioner Deployment Control: Incorrect Component	GO to Pinpoint Test X.

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	Installed	
U0028:08	Vehicle Communication Bus A: Bus Signal / Message Failure	GO to Pinpoint Test Y .
U0028:88	Vehicle Communication Bus A: Bus Off	GO to Pinpoint Test Y .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	**NOTE:** The DTC sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new RCM as part of repair. REFER to Section 418-00 to diagnose no communication with the Body Control Module (BCM).
U0154:00	Lost Communication With Restraints Occupant Classification System Module: No Sub Type Information	**NOTE:** The DTC sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new RCM as part of repair. REFER to Section 418-00 to diagnose no communication with the Occupant Classification System Module (OCSM).
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	**NOTE:** The DTC sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new RCM as part of repair. REFER to Section 418-00 to diagnose the communication concern.
U0253:00	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	**NOTE:** This DTC sets in the RCM if a message is not received from the Accessory Protocol Interface Module (APIM). CHECK for additional RCM and APIM DTCs. REFER to the appropriate section to diagnose the DTCs. If no other DTCs are present, REFER to Section 418-00 to diagnose the APIM communication concern.
U0300:00	Internal Control Module Software Incompatibility: No Sub Type Information	CARRY OUT Programmable Module Installation (PMI). RETRIEVE RCM DTCs. If RCM DTC U0300:00 is retrieved on-demand during self-test, INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section.
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	CARRY OUT a self-test of the BCM . REFER to Section 419-10 to diagnose any DTCs that are retrieved.
U0554:00	Invalid Data Received From Accessory Protocol Interface Module: No Sub Type Information	CHECK for additional RCM and APIM DTCs. REFER to the appropriate section to diagnose the DTCs.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CARRY OUT PMI . RETRIEVE RCM DTCs. If RCM DTC U2100:00 is retrieved on-demand, INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section.
U2200:00	Control Module Configuration Memory Corrupt: No Sub Type Information	INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). Use As-Built data when CARRYING out Programmable Module Installation (PMI)

		for this DTC. REFER to Restraints Control Module (RCM) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
U3000:49	Control Module: Internal Electronic Failure	INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). If DTC U2200:00 is also present, use As-Built data when CARRYING out Programmable Module Installation (PMI). REFER to Restraints Control Module (RCM) in this section.
U3000:4A	Control Module: Incorrect Component Installed	GO to Pinpoint Test X .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test Z .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test Z .

Occupant Classification System Module (OCSM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action To Take
B0061:11	Passenger Seatbelt Tension Sensor: Circuit Short to Ground	GO to Pinpoint Test AA .
B0061:12	Passenger Seatbelt Tension Sensor: Circuit Short to Battery	GO to Pinpoint Test AA .
B0061:13	Passenger Seatbelt Tension Sensor: Circuit Open	GO to Pinpoint Test AA .
B0061:1C	Passenger Seatbelt Tension Sensor: Circuit Voltage Out of Range	GO to Pinpoint Test AA .
B00A0:54	Occupant Classification System: Missing Calibration	GO to Pinpoint Test AB .
B00A0:67	Occupant Classification System: Signal Incorrect After Event	CARRY OUT the Occupant Classification System (OCS) zero seat weight test. REFER to Occupant Classification Sensor (OCS) System Zero Seat Weight Test in this section.
B00A0:76	Occupant Classification System: Wrong Mounting Position	GO to Pinpoint Test AB .
B00A0:97	Occupant Classification System: Component or System Operation	GO to Pinpoint Test AC .

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	Obstructed or Blocked	
B00C2:12	Passenger Seat Occupant Classification Sensor "C": Circuit Short To Battery	GO to Pinpoint Test AD .
B00C2:13	Passenger Seat Occupant Classification Sensor "C": Circuit Open	GO to Pinpoint Test AD .
B00C2:1A	Passenger Seat Occupant Classification Sensor "C": Circuit Resistance Blow Threshold	GO to Pinpoint Test AD .
B00C2:49	Passenger Seat Occupant Classification Sensor "C": Internal Electronic Failure	GO to Pinpoint Test AB .
B00C2:81	Passenger Seat Occupant Classification Sensor "C": Invalid Serial Data	REPAIR all other Occupant Classification System Module (OCSM) DTCs first. If no other OCSM DTCs are present, INSTALL a new seat track (includes OCS weight sensor bolts). REFER to Section 501-10 .
B00C3:12	Passenger Seat Occupant Classification Sensor "D": Circuit Short To Battery	GO to Pinpoint Test AE .
B00C3:13	Passenger Seat Occupant Classification Sensor "D": Circuit Open	GO to Pinpoint Test AE .
B00C3:1A	Passenger Seat Occupant Classification Sensor "D": Circuit Resistance Blow Threshold	GO to Pinpoint Test AE .
B00C3:49	Passenger Seat Occupant Classification Sensor "D": Internal Electronic Failure	GO to Pinpoint Test AB .
B00C3:81	Passenger Seat Occupant Classification Sensor "D": Invalid Serial Data	REPAIR all other Occupant Classification System Module (OCSM) DTCs first. If no other OCSM DTCs are present, INSTALL a new seat track (includes OCS weight sensor bolts). REFER to Section 501-10 .
B1193:00	Crash Event Storage Full and Locked: No Sub Type Information	INSTALL new passenger seat track assembly with weight sensor bolts. REFER to Section 501-10 . CLEAR all DTCs before carrying out the System Reset procedure. REFER to Inspection and Repair After a Supplemental Restraint System (SRS) Deployment in this section.
B1A59:01	Sensor 5 Volt Supply: General Electrical Failure	GO to Pinpoint Test AF .
B1A59:11	Sensor 5 Volt Supply: Circuit Short to Ground	GO to Pinpoint Test AF .
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	U0100:00 sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new OCSM as part of repair for DTC U0100:00. REFER to Section 418-00 to diagnose lost communication with the PCM.

U0140:00	Lost Communication With Body Control Module: No Sub Type Information	U0140:00 sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new OCSM as part of repair for DTC U0140:00. REFER to Section 418-00 to diagnose lost communication with the BCM .
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	U0151:00 sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new OCSM as part of repair for DTC U0151:00. REFER to Section 418-00 to diagnose lost communication with the RCM .
U0401:00	Invalid Data Received From ECM/PCM "A": No Sub Type Information	U0401:00 sets in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new OCSM as part of repair for DTC U0401:00. CARRY OUT PCM Self Test. REPAIR any vehicle speed or communication-related DTCs. REFER to DTC Chart in Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U0401:81	Invalid Data Received From ECM/PCM "A": Invalid Serial Data Received	This DTC sets when the OCSM is not receiving the vehicle speed data that it expects from the PCM. The OCSM is not the problem module. Do not install a new OCSM as part of repair for DTC U0401:81. CARRY OUT the PCM Self Test. REPAIR any DTCs. REFER to DTC Chart in Section 303-14 or the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	U0422:00 sets in a module that is reporting a communication fault from another module on the data bus. The OCSM is not the problem module. Do not install a new OCSM as part of repair for DTC U0422:00. CARRY OUT Body Control Module (BCM) Self Test. REPAIR any ignition switch or communication-related DTCs. REFER to the DTC Chart in Section 419-10 .
U0422:81	Invalid Data Received From Body Control Module: Invalid Serial Data Received	U0422:81 sets when the OCSM is not receiving the ignition status data that it expects from the BCM . The OCSM is not the problem module. Do not install a new OCSM as part of repair for DTC U0422:81. CARRY OUT Body Control Module (BCM) Self Test. REPAIR any ignition switch or communication-related DTCs. REFER to the DTC Chart in Section 419-10 .
U0452:00	Invalid Data Received From Restraints Control Module: No Sub Type Information	U0452:00 sets in a module that is reporting a communication fault from another module on the data bus. The OCSM is not the problem module. Do not install a new OCSM as part of repair for DTC U0452:00.

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		CARRY OUT RCM Self Test. REPAIR any SRS -related DTCs. REFER to the Restraints Control Module (RCM) DTC Chart in this section.
U0452:81	Invalid Data Received From Restraints Control Module: No Sub Type Information	U0452:00 sets when the OCSM is not receiving the SRS data that it expects from the RCM . The OCSM is not the problem module. Do not install a new OCSM as part of repair for DTC U0452:81. CARRY OUT RCM Self Test. REPAIR any SRS -related DTCs. REFER to the Restraints Control Module (RCM) DTC Chart in this section.
U200D:12	Control Module Output Power A: Circuit Short To Battery	GO to Pinpoint Test AG .
U200E:11	Control Module Output Power B: Circuit Short To Ground	GO to Pinpoint Test AH .
U200E:12	Control Module Output Power B: Circuit Short To Battery	GO to Pinpoint Test AH .
U200E:1A	Control Module Output Power B: Circuit Resistance Below Threshold	GO to Pinpoint Test AH .
U3000:49	Control Module: Internal Electronic Failure	REPAIR all other OCSM DTCs first. REPEAT the self-test. If U3000:49 returns, INSTALL a new OCSM . REFER to Occupant Classification System Module (OCSM) in this section.
U3000:53	Control Module: Deactivated	CLEAR all OCSM DTCs and REPEAT the self-test. If U3000:53 returns, INSTALL a new OCSM . REFER to Occupant Classification System Module (OCSM) in this section.
U3000:54	Control Module: Missing Calibration	CARRY OUT the OCS reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test Z .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test Z .

FCIM DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action To Take
B00D5:01	Restraint System Passenger Disable Indicator: General Electrical Failure	Refer to the appropriate section in Group 415 for the procedure..

B1202:01	Restraint System Passenger Enable Indicator: General Electrical Failure	Refer to the appropriate section in Group 415 for the procedure..
All other DTCs	—	Refer to the appropriate section in Group 415 for the procedure..

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The air bag warning indicator is illuminated continuously	• Fuse to Restraints Control Module (RCM) • Wiring, terminals or connectors • Damaged Data Link Connector (DLC) • Instrument Panel Cluster (IPC) • RCM	• GO to Pinpoint Test A .
• Air bag indicator flashing	• Air bag/pretensioner Supplemental Restraint System (SRS) fault	• CARRY OUT RCM and Occupant Classification System Module (OCSM) self-tests. REFER to DTC Charts in this section.
• Audible tone — DTCs retrieved	• Air bag SRS fault and air bag warning indicator fault	• CARRY OUT RCM and IPC self-tests. REFER to Restraints Control Module (RCM) DTC Chart in this section and the IPC DTC Chart in Section 413-01 .
• The RCM does not respond to the scan tool	• Fuse • Scan tool • DLC • Wiring, terminals or connectors • RCM	• REFER to Section 418-00 to diagnose the no communication concern.
• The Occupant Classification System Module (OCSM) does not respond to the scan tool	• Fuse • Scan tool • DLC • Wiring, terminals or connectors • OCSM	• REFER to Section 418-00 to diagnose the no communication concern.

Pinpoint Tests

Pinpoint Test A: The Air Bag Warning Indicator is Illuminated Continuously

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Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) illuminates the air bag indicator continuously for 6 seconds. If the Supplemental Restraint System (SRS) is fault free, the air bag warning indicator turns off and remains off. If a fault is detected in the SRS , the air bag warning indicator illuminates and remains illuminated for the rest of the ignition cycle until the fault is no longer detected. The Restraints Control Module (RCM) communicates to the IPC module via the High Speed Controller Area Network (HS-CAN). The IPC illuminates the air bag warning indicator based on messaging from the RCM or if there is no communication between the RCM and IPC .

This pinpoint test is intended to diagnose the following:

- IPC
- RCM

PINPOINT TEST A: THE AIR BAG WARNING INDICATOR IS ILLUMINATED CONTINUOUSLY

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
A1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Were any DTCs retrieved on-demand during self-test?**	**Yes** If DTCs were retrieved, GO to the DTC Charts in this section for diagnostic direction. Do not clear any DTCs until all DTCs have been resolved. **No** If the RCM **does communicate** with the scan tool, REFER to Section 413-01 to diagnose the IPC concern. If the RCM **does not communicate** with the scan tool, REFER to Section 418-00 to diagnose no power to the scan tool. Do not clear any DTCs until all DTCs have been resolved.

Pinpoint Test B: DTCs B0001:11, B0001:12, B0001:13 and B0001:1A

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

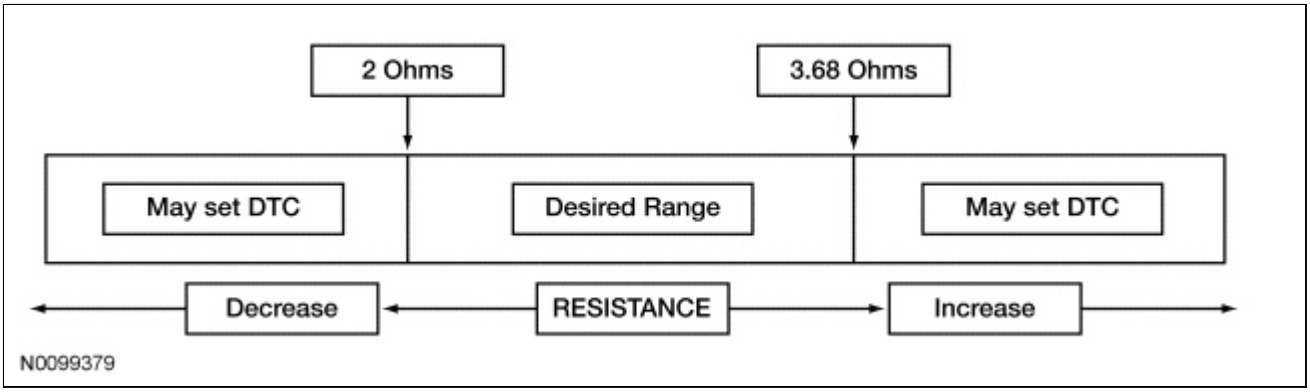
The Restraints Control Module (RCM) continuously monitors the driver air bag module stage 1 circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver air bag module

If a fault is detected, the RCM stores DTC B0001:11, B0001:12, B0001:13 or B0001:1A in memory and sends a message to the Instrument Panel Cluster (IPC) module to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement, in combination with an age correction factor, to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Clockspring
- Driver air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0001:11 — Driver Frontal Stage 1 Deployment Control: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either driver air bag stage 1 circuit.
• B0001:12 — Driver Frontal Stage 1	A fault is indicated when the RCM senses a short to

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Deployment Control: Circuit Short to Battery	voltage on either driver air bag stage 1 circuit.
• B0001:13 — Driver Frontal Stage 1 Deployment Control: Circuit Open	A fault is indicated when the RCM measures more than the desired resistance range between driver air bag stage 1 circuits.
• B0001:1A — Driver Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between driver air bag stage 1 circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clockspring
- Driver air bag module
- RCM

PINPOINT TEST B: DTCs B0001:11, B0001:12, B0001:13 AND B0001:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

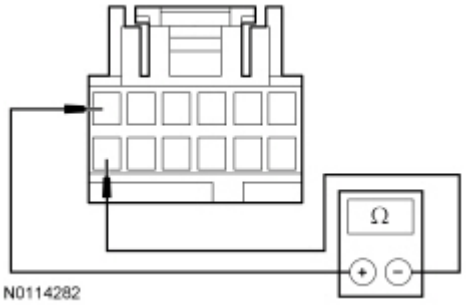
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
B1 RETRIEVE RCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0001:11, B0001:12, B0001:13 or B0001:1A**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-

retrieved on-demand during self-test?	demand during self-test. For DTC B0001:13 or B0001:1A, GO to B2 . For DTC B0001:11, GO to B12 . For DTC B0001:12, GO to B15 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0001:13 or B0001:1A, GO to B20 . For DTC B0001:11, GO to B21 . For DTC B0001:12, GO to B22 .
B2 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_00_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_00_R. • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** GO to B19 . **No** GO to B3 .
B3 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_00_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• Remove the lower steering column shroud to access the clockspring electrical connector. • While monitoring the DEPLOY_00_R PID, carry out the harness test of the driver air bag circuits and accessible connectors (including any in-line connectors) by wiggling and flexing the wire harness, connectors, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness or INSTALL a new clockspring as needed. REFER to Clockspring in this section. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to B23 . **No** For PID value less than 2 ohms, GO to B4 . For PID value greater than 3.68 ohms, GO to B8 .

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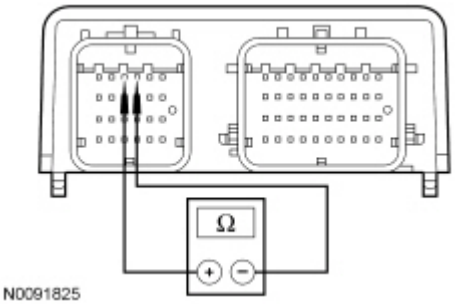
B4 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0001:1A to B0001:13?**	**Yes** GO to B17 . **No** GO to B5 .
B5 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0001:1A to B0001:13?**	**Yes** GO to B18 . **No** GO to B6 .
B6 CHECK FOR A SHORT BETWEEN DRIVER AIR BAG STAGE 1 CIRCUITS	
• Measure the resistance between C218A-6, circuit CR101 (VT/BN), harness side and C218A-12, circuit RR101 (YE/GN), harness side.	**Yes** GO to B7 . **No** REPAIR circuits CR101 (VT/BN) and RR101 (YE/GN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to B24 .



- **Is the resistance greater than 10,000 ohms?**

B7 CHECK THE RCM FOR LOW RESISTANCE

- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Disconnect: RCM C310A and C310B .
- Measure the resistance between RCM C310A pins 3 and 4, component side.



- **Is the resistance greater than 10,000 ohms?**

Yes
REPAIR circuits CR101 (VT/BN) and RR101 (YE/GN).

Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to B24 .

No
GO to B19 .

B8 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN

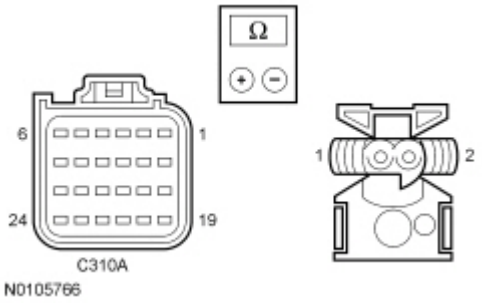
- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Remove the driver air bag module. Refer to Driver Airbag in this section.
- Disconnect: RCM C310A and C310B .
- Measure the resistance between RCM C310A, harness side and driver air bag module stage 1 C216A, harness side, using the following chart.

RCM	Circuit	Driver Air Bag Module
C310A-4	CR101 (VT/BN)/(WH)	C216A-1
C310A-3	RR101 (YE/GN)/(BU)	C216A-2

Yes
GO to B10 .

No
GO to B9 .

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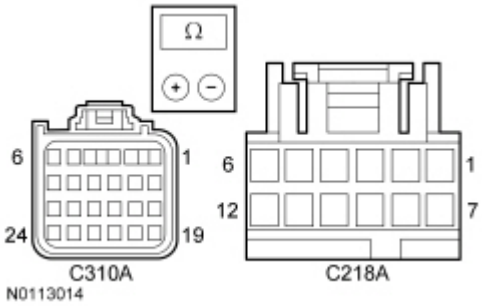


- **Are the resistances less than 1 ohm?**

B9 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)

- Disconnect: Clockspring C218A .
- Measure the resistance between RCM C310A, harness side and clockspring C218A, harness side using the following chart.

RCM	Circuit	Clockspring Electrical Connector
C310A-4	CR101 (VT/BN)	C218A-6
C310A-3	RR101 (YE/GN)	C218A-12



- **Are the resistances less than 0.5 ohm?**

Yes
GO to B18 .

No
REPAIR circuit CR101 (VT/BN) or RR101 (YE/GN).

Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to B24 .

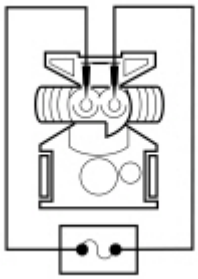
B10 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

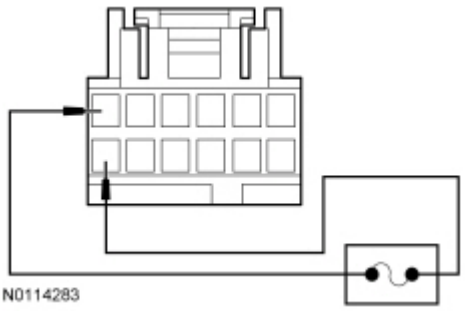
- Connect: RCM C310A and C310B .
- Connect a fused jumper wire between driver air bag module stage 1 C216A-1, circuit CR101 (WH), harness side, and C216A-2, circuit RR101 (BU), harness side.

Yes
REMOVE the fused jumper wire and GO to B17 .

No
REMOVE the fused jumper wire and GO to B11 .


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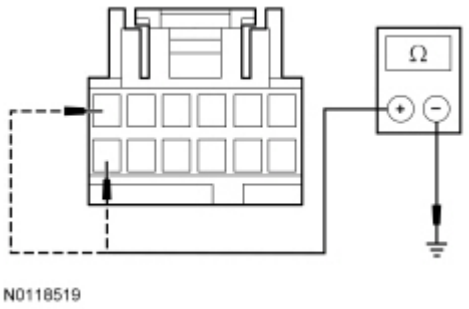
- Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: Self Test — RCM .
- **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag stage 1 circuits shorted together, a low resistance fault is normally retrieved on stage 1. Stage 2 shows an open circuit fault due to the driver air bag being disconnected.
- **Was DTC B0001:1A retrieved on-demand during self-test?**

B11 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Clockspring C218A . • Connect a fused jumper wire between clockspring C218A-6, circuit CR101 (VT/BN), harness side and C218A-12, circuit RR101 (YE/GN), harness side.  N0114283 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the clockspring stage 1 circuits shorted together, a low resistance fault is normally retrieved on stage 1. Stage 2 shows an open circuit fault due to the driver air bag being disconnected. • **Was DTC B0001:1A retrieved on-demand during self-test?**	**Yes** REMOVE the fused jumper wire and GO to B18 . **No** REMOVE the fused jumper wire and GO to B19 .
B12 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	

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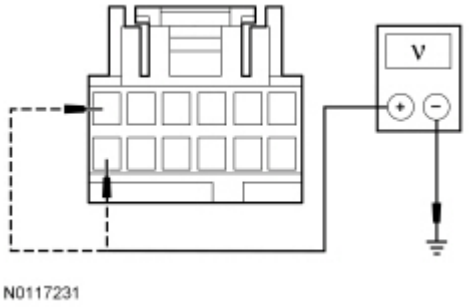
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0001:11 to B0001:13?**	**Yes** GO to B17 . **No** GO to B13 .
B13 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the clockspring disconnected, open circuit faults are normally retrieved on driver air bag stages 1 and 2. • **Did the on-demand DTC change from B0001:11 to B0001:13?**	**Yes** GO to B18 . **No** GO to B14 .
B14 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between clockspring:
  ▪ C218A-6, circuit CR101 (VT/BN), harness side and ground.
  ▪ C218A-12, circuit RR101 (YE/GN), harness side and ground.
	Yes
	GO to B19 .
	
	No
	Due to the shorting bar feature in the RCM electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar.
	
	REPAIR circuit CR101 (VT/BN) or RR101 (YE/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.

 N0118519 • **Are the resistances greater than 10,000 ohms?**	GO to B24 .
B15 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO BATTERY INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Disconnect: Clockspring C218A . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults are normally retrieved on driver air bag stages 1 and 2. • **Did the on-demand DTC change from B0001:12 to B0001:13?**	**Yes** GO to B18 . **No** GO to B16 .
B16 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Measure the voltage between clockspring:
  ▪ C218A-6, circuit CR101 (VT/BN), harness side and ground.
  ▪ C218A-12, circuit RR101 (YE/GN), harness side and ground.
	Yes
	Due to the shorting bar feature in the RCM electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar.
	
	REPAIR circuit CR101 (VT/BN) or RR101 (YE/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to B24 .
	
	No
	GO to B19 .

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- **Is voltage present on either circuit?**

B17 CONFIRM THE DRIVER AIR BAG MODULE FAULT	
NOTE: Make sure all SRS components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Install the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new driver air bag module. REFER to Driver Airbag in this section. GO to B24 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0001:13 or B0001:1A, GO to B20 . For DTC B0001:11, GO to B21 . For DTC B0001:12, GO to B22 .
B18 CONFIRM THE CLOCKSPRING FAULT	
NOTE: Make sure all SRS components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Clockspring C218A . • Install the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to B24 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0001:13 or B0001:1A, GO to B20 . For DTC B0001:11, GO to

	B21 . For DTC B0001:12, GO to B22 .
B19 CONFIRM THE RCM FAULT **NOTE:** Make sure all SRS components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damaged, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • If previously removed, install the driver air bag module. Refer to Driver Airbag in this section. • Connect: Clockspring C218A (if previously disconnected) . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to B24 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0001:13 or B0001:1A, GO to B20 . For DTC B0001:11, GO to B21 . For DTC B0001:12, GO to B22 .
B20 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_00_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT • Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_00_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to B23 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell

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	5 , Connector Repair Procedures for schematic and connector information. GO to B24 .
B21 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND FAULT	
• Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0001:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to B24 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to B23 .
B22 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0001:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to B24 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to B23 .
B23 CHECK THE HARNESS AND CONNECTORS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module: ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or	**Yes** REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and

frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. • Inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	connector information. GO to B24 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to B24 .
B24 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test C: DTCs B0002:11, B0002:12, B0002:13 and B0002:1A

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) continuously monitors the driver air bag module stage 2 circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver air bag module

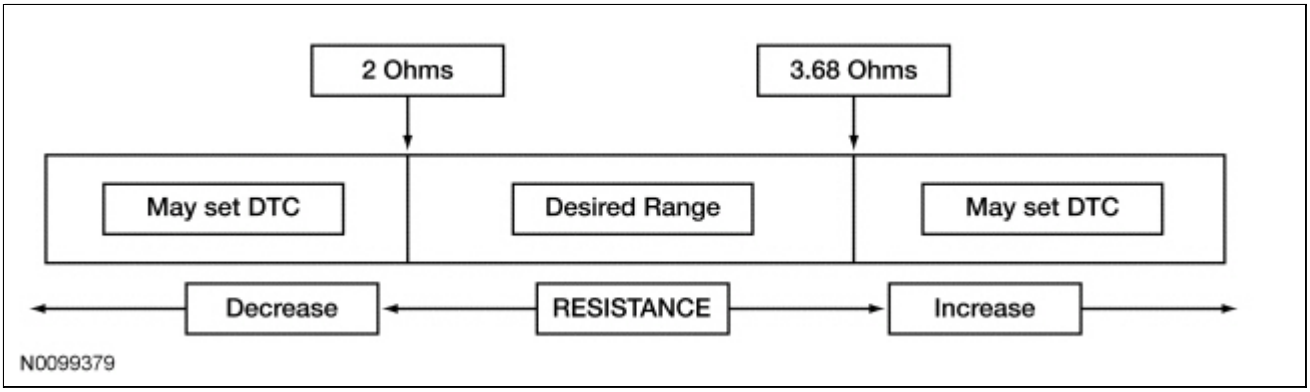
If a fault is detected, the RCM stores DTC B0002:11, B0002:12, B0002:13 or B0002:1A in memory and sends a message to the Instrument Panel Cluster (IPC) module to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement, in combination with an age correction factor, to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle

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ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Clockspring
- Driver air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0002:11 — Driver Frontal Stage 2 Deployment Control: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either driver air bag stage 2 circuit.
• B0002:12 — Driver Frontal Stage 2 Deployment Control: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either driver air bag stage 2 circuit.
• B0002:13 — Driver Frontal Stage 2 Deployment Control: Circuit Open	A fault is indicated when the RCM measures more than the desired resistance range between driver air bag stage 2 circuits.
• B0002:1A — Driver Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between driver air bag stage 2 circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clockspring
- Driver air bag module
- RCM

PINPOINT TEST C: DTCs B0002:11, B0002:12, B0002:13 AND B0002:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to

follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

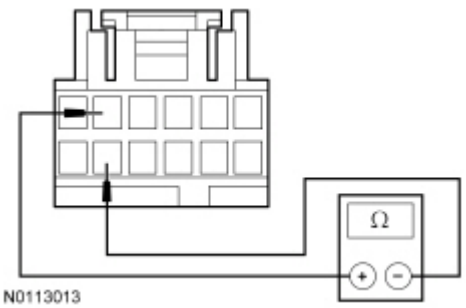
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
C1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0002:11, B0002:12, B0002:13 or B0002:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0002:13 or B0002:1A, GO to C2 . For DTC B0002:11, GO to C11 . For DTC B0002:12, GO to C14 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .

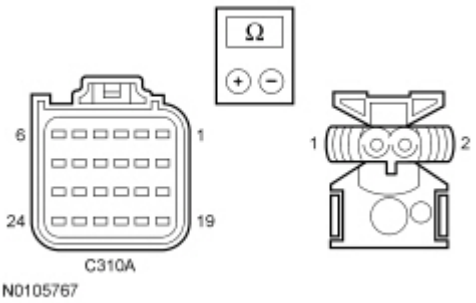
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C2 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_01_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_01_R. • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** GO to C18 . **No** GO to C3 .
C3 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_01_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• Remove the lower steering column shroud to access the clockspring electrical connector. • While monitoring the DEPLOY_01_R PID, carry out the harness test of the driver air bag circuits and accessible connectors (including any in-line connectors), by wiggling and flexing the wire harness, connectors, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness or INSTALL a new clockspring as needed. REFER to Clockspring in this section. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to C23 . **No** For PID value less than 2 ohms, GO to C4 . For PID value greater than 3.68 ohms, GO to C7 .
C4 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0002:1A to B0002:13?**	**Yes** GO to C16 . **No** GO to C5 .
C5 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT	

CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0002:1A to B0002:13?**	**Yes** GO to C17 . **No** GO to C6 .
C6 CHECK FOR A SHORT BETWEEN DRIVER AIR BAG STAGE 2 CIRCUITS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between C218A-5, circuit CR102 (BU), harness side and C218A-11, circuit RR102 (WH), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C18 . **No** REPAIR circuits CR102 (BU) and RR102 (WH). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to C23 .
C7 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between RCM C310A, harness side and driver air bag module stage 2 C216B, harness side using the following chart.	**Yes** GO to C9 . **No** GO to C8 .

RCM	Circuit	Driver Air Bag Module
C310A-7	CR102 (BU)/(YE/GN)	C216B-1
C310A-8	RR102 (WH)/(VT/BN)	C216B-2

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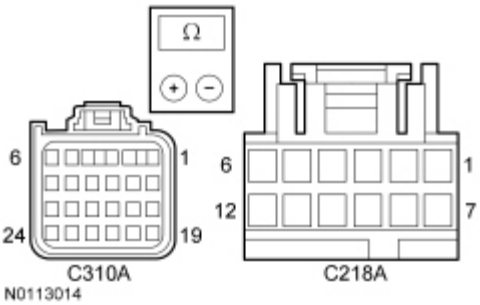


- **Are the resistances less than 1 ohm?**

C8 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)

- Disconnect: Clockspring C218A .
- Measure the resistance between RCM C310A, harness side and clockspring C218A, harness side using the following chart.

RCM	Circuit	Clockspring Electrical Connector
C310A-7	CR102 (BU)	C218A-5
C310A-8	RR102 (WH)	C218A-11



- **Are the resistances less than 0.5 ohm?**

Yes
GO to C17 .

No
REPAIR circuit CR102 (BU) or RR102 (WH).

Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to C23 .

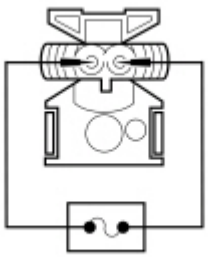
C9 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

- Connect: RCM C310A and C310B .
- Connect a fused jumper wire between driver air bag module stage 2 C216B-1, circuit CR102 (YE/GN), harness side, and driver air bag module stage 2 C216B-2, circuit RR102 (VT/BN), harness side.

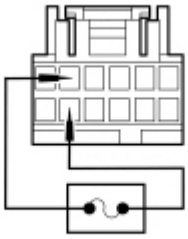
Yes
GO to C16 .

No
GO to C10 .



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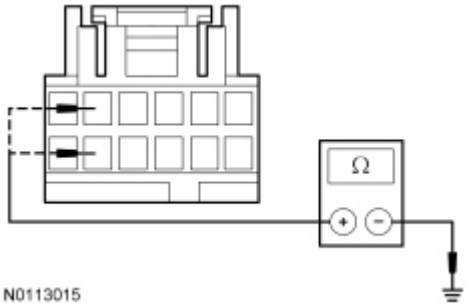
- Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: Self Test — RCM .
- **DIAGNOSTIC TIP:** When viewing DTCs with driver air bag module stage 2 circuits shorted together, a low resistance fault is normally retrieved on stage 2. Stage 1 shows an open circuit fault due to the driver air bag being disconnected.
- **Was DTC B0002:1A retrieved on-demand during self-test?**

C10 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Clockspring C218A . • Connect a fused jumper wire between clockspring C218A-5, circuit CR102 (BU), harness side, and C218A-11, circuit RR102 (WH), harness side.  N0114274 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the clockspring stage 2 circuits shorted together, a low resistance fault is normally retrieved on stage 2. Stage 1 shows an open circuit fault due to the driver air bag being disconnected. • **Was DTC B0002:1A retrieved on-demand during self-test?**	**Yes** GO to C17 . **No** GO to C18 .
C11 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	

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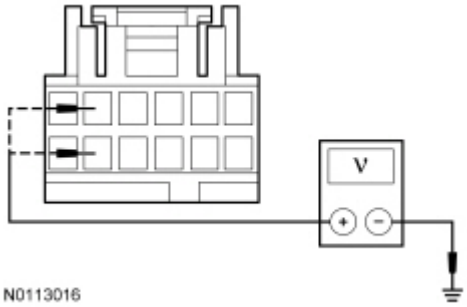
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0002:11 to B0002:13?**	**Yes** GO to C16 . **No** GO to C12 .
C12 CHECK DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0002:11 to B0002:13?**	**Yes** GO to C17 . **No** GO to C13 .
C13 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between clockspring:
  ▪ C218A-5, circuit CR102 (BU), harness side and ground.
  ▪ C218A-11, circuit RR102 (WH), harness side and ground.
	Yes
	GO to C18 .
	
	No
	REPAIR circuit CR102 (BU) or RR102 (WH).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to C23 .

 • **Are the resistances greater than 10,000 ohms?**	
C14 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO BATTERY INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Disconnect: Clockspring C218A . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0002:12 to B0002:13?**	**Yes** GO to C17 . **No** GO to C15 .
C15 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Measure the voltage between clockspring:
  ▪ C218A-5, circuit CR102 (BU), harness side and ground.
  ▪ C218A-11, circuit RR102 (WH), harness side and ground.
	Yes
	REPAIR circuit CR102 (BU) or RR102 (WH).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to C23 .
	
	No
	GO to C18 .

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- **Is voltage present on either circuit?**

C16 CONFIRM THE DRIVER AIR BAG MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Install the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new driver air bag module. REFER to Driver Airbag in this section. GO to C23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .
C17 CONFIRM THE CLOCKSPRING FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Clockspring C218A . • Install the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to C23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to

	C20 . For DTC B0002:12, GO to C21 .
C18 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • If previously removed, install the driver air bag module. Refer to Driver Airbag in this section. • Connect: Clockspring C218A (if previously disconnected) . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to C23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .
C19 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_01_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_01_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to C22 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell

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	5 , Connector Repair Procedures for schematic and connector information. GO to C23 .
C20 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND FAULT	
• Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0002:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to C23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to C22 .
C21 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Airbag in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0002:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to C23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to C22 .
C22 CHECK HARNESS AND CONNECTORS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or	**Yes** REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and

frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. • Inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	connector information. GO to C23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to C23 .
C23 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test D: DTCs B0010:11, B0010:12, B0010:13 and B0010:1A

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) continuously monitors the passenger air bag module stage 1 circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted passenger air bag module

If a fault is detected, the RCM stores DTC B0010:11, B0010:12, B0010:13 or B0010:1A in memory and sends a message to the Instrument Panel Cluster (IPC) module to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement, in combination with an age correction factor, to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle

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ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Passenger air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0010:11 — Passenger Frontal Stage 1 Deployment Control: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either passenger air bag stage 1 circuit.
• B0010:12 — Passenger Frontal Stage 1 Deployment Control: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either passenger air bag stage 1 circuit.
• B0010:13 — Passenger Frontal Stage 1 Deployment Control: Circuit Open	A fault is indicated when the RCM measures greater than the desired resistance range between passenger air bag stage 1 circuits.
• B0010:1A — Passenger Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between passenger air bag stage 1 circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Passenger air bag module
- RCM

PINPOINT TEST D: DTCs B0010:11, B0010:12, B0010:13 AND B0010:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

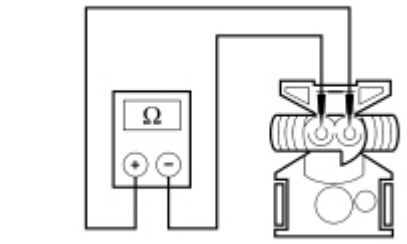
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
D1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0010:11, B0010:12, B0010:13 or B0010:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0010:13 or B0010:1A, GO to D2 . For DTC B0010:11, GO to D9 . For DTC B0010:12, GO to D11 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0010:13 or B0010:1A, GO to D14 . For DTC B0010:11, GO to D15 . For DTC B0010:12, GO to D16 .
D2 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_05_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_05_R.	**Yes** GO to D13 .

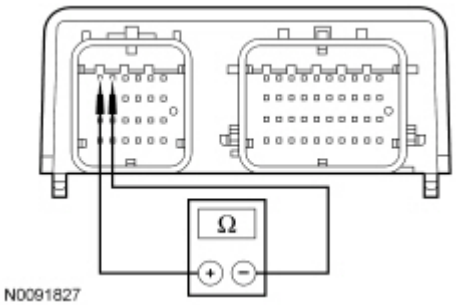
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• **Does the PID value read between 1.7 and 2.78 ohms?**	**No** GO to D3 .
D3 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_05_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• While monitoring the DEPLOY_05_R PID, carry out the harness test of the passenger air bag module circuits and accessible connectors (including any in-line connectors), by wiggling connectors and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness as needed. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to D18 . **No** For PID value less than 1.7 ohms, GO to D4 . For PID value greater than 2.78 ohms, GO to D7 .
D4 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger air bag module disconnected, open circuit faults are normally retrieved on passenger air bag stages 1 and 2. • **Did the on-demand DTC change from B0010:1A to B0010:13?**	**Yes** GO to D12 . **No** GO to D5 .
D5 CHECK FOR A SHORT BETWEEN PASSENGER AIR BAG STAGE 1 CIRCUITS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Measure the resistance between passenger air bag C256A-2, circuit CR103 (GY/BU), harness side and C256A-1, circuit RR103 (VT/GN), harness side.	**Yes** GO to D13 . **No** GO to D6 .



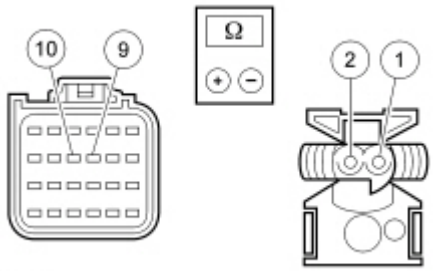
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- **Is the resistance greater than 10,000 ohms?**

D6 CHECK THE RCM FOR LOW RESISTANCE	
• Disconnect: RCM C310A and C310B . • Measure the resistance between RCM C310A pins 1 and 2, component side.  N0091827 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR circuits CR103 (GY/BU) and RR103 (VT/GN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to D18 . **No** GO to D13 .

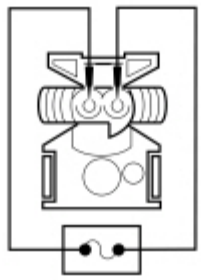
D7 CHECK THE PASSENGER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Disconnect: RCM C310A and C310B . • Measure the resistance between RCM C310A, harness side and passenger air bag module C256A, harness side using the following chart. **RCM** / **Circuit** / **Passenger Air Bag Module Stage 1 Electrical Connector** C310A-1 / CR103 (GY/BU) / C256A-2 C310A-2 / RR103 (VT/GN) / C256A-1	**Yes** GO to D8 . **No** REPAIR circuit CR103 (GY/BU) or RR103 (VT/GN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to D18 .

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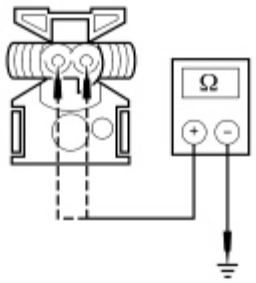


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- **Are the resistances less than 0.5 ohm?**

D8 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B . • Connect a fused jumper wire between passenger air bag module stage 1 C256A-2, circuit CR103 (GY/BU), harness side, and C256A-1, circuit RR103 (VT/GN), harness side.  N0114275 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger air bag module stage 1 circuits shorted together, a low resistance fault is normally retrieved on stage 1. Stage 2 shows an open circuit fault due to the passenger air bag being disconnected. • **Did the on-demand DTC change from B0010:13 to B0010:1A?**	**Yes** REMOVE the fused jumper wire and GO to D12 . **No** REMOVE the fused jumper wire and GO to D13 .
D9 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.	**Yes** GO to D12 . **No** GO to D10 .

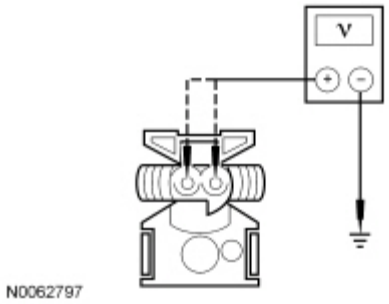
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger air bag module disconnected, open circuit faults are normally retrieved on passenger air bag stages 1 and 2. • **Did the on-demand DTC change from B0010:11 to B0010:13?**	
D10 CHECK THE PASSENGER AIR BAG STAGE 1 CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between passenger air bag module:
  ▪ C256A-2, circuit CR103 (GY/BU), harness side and ground.
  ▪ C256A-1, circuit RR103 (VT/GN), harness side and ground.

 	
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• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to D13 .
	
	No
	Due to the shorting bar feature in the RCM electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar.
	
	REPAIR circuit CR103 (GY/BU) or RR103 (VT/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to D18 .

D11 CHECK THE PASSENGER AIR BAG STAGE 1 CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Air Bag Module C256A and C256B .
• Disconnect: RCM C310A and C310B .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Measure the voltage between passenger air bag module:
  ▪ C256A-2, circuit CR103 (GY/BU), harness side and ground.
  ▪ C256A-1, circuit RR103 (VT/GN), harness side and ground.
	Yes
	Due to the shorting bar feature in the RCM electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar.
	
	REPAIR circuit CR103 (GY/BU) or RR103 (VT/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.

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 N0062797 • **Is voltage present on either circuit?**	GO to D18 . **No** GO to D13 .
D12 CONFIRM THE PASSENGER AIR BAG MODULE FAULT **NOTE:** Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Passenger Air Bag Module C256A and C256B (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new passenger air bag module. REFER to Passenger Airbag in this section. GO to D18 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0010:13 or B0010:1A, GO to D14 . For DTC B0010:11, GO to D15 . For DTC B0010:12, GO to D16 .
D13 CONFIRM THE RCM FAULT **NOTE:** Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found.	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to D18 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0010:13 or B0010:1A, GO to D14 .

Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: Passenger Air Bag Module C256A and C256B (if previously disconnected) . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	For DTC B0010:11, GO to D15 . For DTC B0010:12, GO to D16 .
D14 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_05_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_05_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to D17 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to D18 .
D15 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL CIRCUITS FOR AN INTERMITTENT SHORT TO GROUND FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0010:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to D18 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time.**

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	Install SRS components only when directed to do so in the pinpoint test. GO to D17 .
D16 CHECK THE PASSENGER FRONTAL STAGE 1 DEPLOYMENT CONTROL CIRCUITS FOR AN INTERMITTENT SHORT TO BATTERY FAULT • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0010:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to D18 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to D17 .

D17 CHECK THE HARNESS AND CONNECTORS
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Air Bag Module C256A (if not previously disconnected) .
• Disconnect: Passenger Air Bag Module C256B (if not previously disconnected) .
  ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
• **Were any concerns found?**
	Yes
	REPAIR as necessary.
	
	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
	
	GO to D18 .
	
	No
	The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to D18 .

D18 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete.

Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	RETURN the vehicle to the customer.

Pinpoint Test E: DTCs B0011:11, B0011:12, B0011:13 and B0011:1A

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) continuously monitors the passenger air bag module stage 2 circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted passenger air bag module

If a fault is detected, the RCM stores DTC B0011:11, B0011:12, B0011:13 or B0011:1A in memory and sends a message to the Instrument Panel Cluster (IPC) module to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Passenger air bag module
- RCM

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DTC Description	Fault Trigger Condition
• B0011:11 — Passenger Frontal Stage 2 Deployment Control: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either passenger air bag stage 2 circuit.
• B0011:12 — Passenger Frontal Stage 2 Deployment Control: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either passenger air bag stage 2 circuit.
• B0011:13 — Passenger Frontal Stage 2 Deployment Control: Circuit Open	A fault is indicated when the RCM measures greater than the desired resistance range between passenger air bag stage 2 circuits.
• B0011:1A — Passenger Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between passenger air bag stage 2 circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Passenger air bag module
- RCM

PINPOINT TEST E: DTCs B0011:11, B0011:12, B0011:13 AND B0011:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

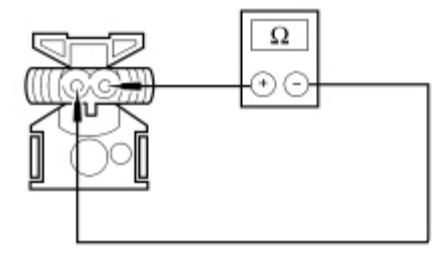
NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
E1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0011:11, B0011:12, B0011:13 or B0011:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0011:13 or B0011:1A, GO to E2 . For DTC B0011:11, GO to E8 . For DTC B0011:12, GO to E10 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0011:13 or B0011:1A, GO to E13 . For DTC B0011:11, GO to E14 . For DTC B0011:12, GO to E15 .
E2 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_06_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_06_R. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** GO to E12 . **No** GO to E3 .
E3 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_06_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• While monitoring the DEPLOY_06_R PID, carry out the harness test of the passenger air bag module circuits and accessible connectors (including any in-line connectors), by wiggling connectors and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms while**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness as needed.

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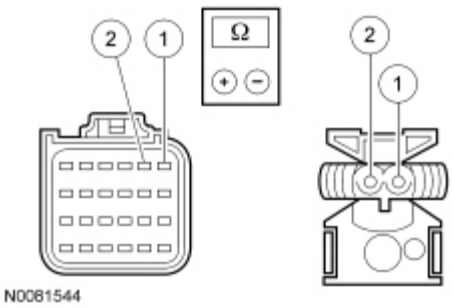
carrying out the harness test?	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to E17 . **No** For PID value less than 1.7 ohms, GO to E4 . For PID value greater than 2.78 ohms, GO to E6 .
E4 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger air bag module disconnected, open circuit faults are normally retrieved on passenger air bag stages 1 and 2. • **Did the on-demand DTC change from B0011:1A to B0011:13?**	**Yes** GO to E11 . **No** GO to E5 .
E5 CHECK FOR A SHORT BETWEEN PASSENGER AIR BAG STAGE 2 CIRCUITS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between C256B-2, circuit CR104 (YE/GY), harness side and C256B-1, circuit RR104 (WH/BU), harness side.  A0030495	**Yes** GO to E12 . **No** REPAIR circuits CR104 (YE/GY) and RR104 (WH/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to E17 .

- **Is the resistance greater than 10,000 ohms?**

E6 CHECK THE PASSENGER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN

- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Disconnect: Passenger Air Bag Module C256A and C256B .
- Disconnect: RCM C310A and C310B .
- Measure the resistance between RCM C310A, harness side and passenger air bag module C256B, harness side using the following chart.

RCM	Circuit	Passenger Air Bag Module Stage 2 Electrical Connector
C310A-10	CR104 (YE/GY)	C256B-2
C310A-9	RR104 (WH/BU)	C256B-1



- **Are the resistances less than 0.5 ohm?**

Yes
GO to E7 .

No
REPAIR circuit CR104 (YE/GY) or RR104 (WH/BU).

Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to E17 .

E7 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)

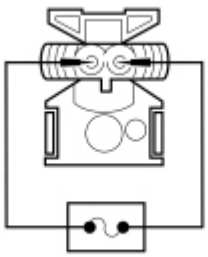
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

- Connect: RCM C310A and C310B .
- Connect a fused jumper wire between passenger air bag module stage 2 C218A-2, circuit CR104 (YE/GY), harness side, and C218A-1, circuit RR104 (WH/BU), harness side.

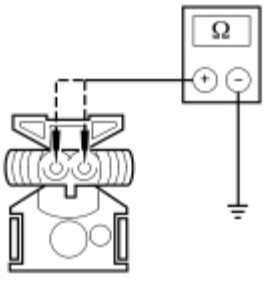
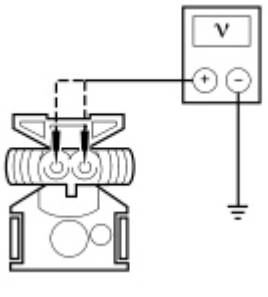
Yes
REMOVE the fused jumper wire and GO to E11 .

No
REMOVE the fused jumper wire and GO to E12 .

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 N0113511 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger air bag module stage 2 circuits shorted together, a low resistance fault is normally retrieved on stage 2. Stage 1 shows an open circuit fault due to the passenger air bag module being disconnected. • **Did the on-demand DTC change from B0011:13 to B0011:1A?**	
E8 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger air bag module disconnected, open circuit faults are normally retrieved on stages 1 and 2. • **Did the on-demand DTC change from B0011:11 to B0011:13?**	**Yes** GO to E11 . **No** GO to E9 .
E9 CHECK THE PASSENGER AIR BAG STAGE 2 CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between passenger air bag module:
  ▪ C256B-2, circuit CR104 (YE/GY), harness side and ground.
  ▪ C256B-1, circuit RR104 (WH/BU), harness side and
	Yes
	GO to E12 .
	
	No
	REPAIR circuit CR104 (YE/GY) or RR104 (WH/BU).
	
	Refer to Wiring Diagrams Cell 5

ground.  A0094161 • **Are the resistances greater than 10,000 ohms?**	for schematic and connector information. GO to E17 .
E10 CHECK THE PASSENGER AIR BAG STAGE 2 CIRCUITS FOR A SHORT TO VOLTAGE • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Disconnect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between passenger air bag module: ▪ C256B-2, circuit CR104 (YE/GY), harness side and ground. ▪ C256B-1, circuit RR104 (WH/BU), harness side and ground.  A0094162 • **Is voltage present on either circuit?**	**Yes** REPAIR circuit CR104 (YE/GY) or RR104 (WH/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to E17 . **No** GO to E12 .
E11 CONFIRM THE PASSENGER AIR BAG MODULE FAULT **NOTE:** Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Passenger Air Bag Module C256A and C256B (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering	**Yes** INSTALL a new passenger air bag module. REFER to Passenger Airbag in this section. GO to E17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS**

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and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0011:13 or B0011:1A, GO to E13 . For DTC B0011:11, GO to E14 . For DTC B0011:12, GO to E15 .
E12 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: Passenger Air Bag Module C256A and C256B (if previously disconnected) . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to E17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0011:13 or B0011:1A, GO to E13 . For DTC B0011:11, GO to E14 . For DTC B0011:12, GO to E15 .
E13 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_06_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_06_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the**

	pinpoint test. GO to E16 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to E17 .
E14 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0011:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to E17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to E16 .
E15 CHECK THE PASSENGER FRONTAL STAGE 2 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Air Bag Module C256A and C256B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0011:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to E17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to E16 .

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E16 CHECK THE HARNESS AND CONNECTORS	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Air Bag Module C256A (if not previously disconnected) .
• Disconnect: Passenger Air Bag Module C256B (if not previously disconnected) .
  ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
• **Were any concerns found?**
	Yes
	REPAIR as necessary.
	
	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
	
	GO to E17 .
	
	No
	The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to E17 .

E17 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test F: DTCs B0020:11, B0020:12, B0020:13 and B0020:1A

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) continuously monitors the driver seat side air bag module and circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver seat side air bag module

If a fault is detected, the RCM stores DTC B0020:11, B0020:12, B0020:13 or B0020:1A in memory and

sends a message to the Instrument Panel Cluster (IPC) module to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Driver seat side air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0020:11 — Left Side Airbag Deployment Control: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either driver seat side air bag circuit.
• B0020:12 — Left Side Airbag Deployment Control: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either driver seat side air bag circuit.
• B0020:13 — Left Side Airbag Deployment Control: Circuit Open	A fault is indicated when the RCM measures greater than the desired resistance range between the driver seat side air bag circuits.
• B0020:1A — Left Side Airbag Deployment Control: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between the driver seat side air bag circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Driver seat side air bag module
- RCM

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PINPOINT TEST F: DTCs B0020:11, B0020:12, B0020:13 AND B0020:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
F1 RETRIEVE RCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0020:11, B0020:12, B0020:13 or B0020:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0020:13 or B0020:1A, GO to F2 . For DTC B0020:11, GO to F8 . For DTC B0020:12, GO to F10 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only.

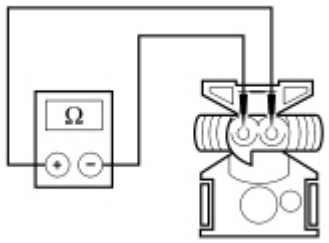
	For DTC B0020:13 or B0020:1A, GO to F13. For DTC B0020:11, GO to F14. For DTC B0020:12, GO to F15.
F2 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL RESISTANCE (DEPLOY_10_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM. ▪ Monitor and record PID DEPLOY_10_R. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** GO to F12. **No** GO to F3.
F3 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL RESISTANCE (DEPLOY_10_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• While monitoring the DEPLOY_10_R PID, carry out the harness test of the driver seat side air bag circuits and accessible connectors (including any in-line connectors) by wiggling connectors and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness as needed. Refer to Wiring Diagrams Cell 5, Connector Repair Procedures for schematic and connector information. GO to F17. **No** For PID value less than 1.7 ohms, GO to F4. For PID value greater than 2.78 ohms, GO to F6.
F4 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Seat Side Air Bag Module C367. • **NOTE:** Unzip the trim cover to access the driver seat side air bag module electrical connector. • Repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM. • **DIAGNOSTIC TIP:** When viewing DTCs with the driver seat	**Yes** GO to F11. **No** GO to F5.

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side air bag module disconnected, an open circuit fault is normally retrieved.
- **Did the on-demand DTC change from B0020:1A to B0020:13?**

F5 CHECK FOR A SHORT BETWEEN DRIVER SEAT SIDE AIR BAG CIRCUITS

- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Disconnect: RCM C310A and C310B .
- Measure the resistance between driver seat side air bag module C367-1, circuit CR105 (GN/BU), harness side and C367-2, circuit RR105 (GY/YE), harness side.



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- **Is the resistance greater than 10,000 ohms?**

Yes
GO to F12 .

No
REPAIR circuits CR105 (GN/BU) and RR105 (GY/YE).

Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to F17 .

F6 CHECK THE DRIVER SEAT SIDE AIR BAG CIRCUITS FOR AN OPEN

- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Disconnect: Driver Seat Side Air Bag Module C367 .
- **NOTE:** Unzip the trim cover to access the driver seat side air bag module electrical connector.
- Disconnect: RCM C310A and C310B .
- Measure the resistance between RCM C310B, harness side and driver seat side air bag module C3051, harness side using the following chart.

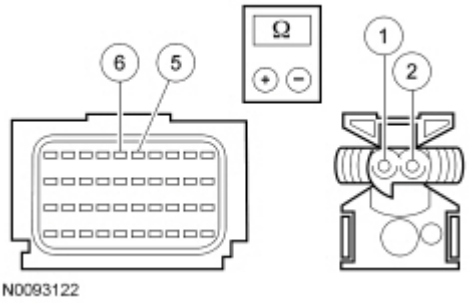
RCM	Circuit	Driver Seat Side Air Bag Module Electrical Connector
C310B-6	CR105 (GN/BU)	C367-1
C310B-5	RR105 (GY/YE)	C367-2

Yes
GO to F7 .

No
REPAIR circuit CR105 (GN/BU) or RR105 (GY/YE).

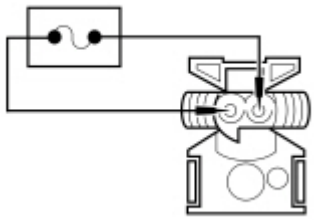
Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to F17 .



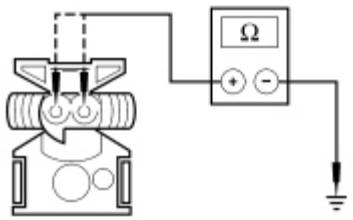
N0093122

- **Are the resistances less than 0.5 ohm?**

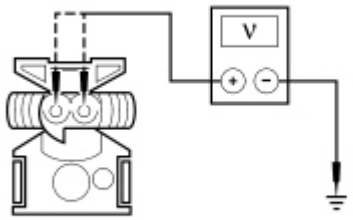
F7 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B . • Connect a fused jumper wire between driver seat side air bag C367-1, circuit CR105 (VT/GY), harness side and C367-2, circuit RR105 (YE/OG), harness side.  N0119863 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver seat side air bag module circuits shorted together, a low resistance fault is normally retrieved. • **Did the on-demand DTC change from B0020:13 to B0020:1A?**	**Yes** REMOVE the fused jumper wire and GO to F11 . **No** REMOVE the fused jumper wire and GO to F12 .
F8 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.	**Yes** GO to F11 . **No** GO to F9 .

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• Disconnect: Driver Seat Side Air Bag Module C367 . • **NOTE:** Unzip the trim cover to access the driver seat side air bag module electrical connector. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver seat side air bag module disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0020:11 to B0020:13?**	
F9 CHECK THE DRIVER SEAT SIDE AIR BAG CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between driver seat side air bag module:
  ▪ C367-1, circuit CR105 (GN/BU), harness side and ground.
  ▪ C367-2, circuit RR105 (GY/YE), harness side and ground.

 	
N0093123
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to F12 .
	
	No
	REPAIR circuit CR105 (GN/BU) or RR105 (GY/YE).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to F17 .

F10 CHECK THE DRIVER SEAT SIDE AIR BAG CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Seat Side Air Bag Module C367 . • **NOTE:** Unzip the trim cover to access the driver seat side air bag module electrical connector. • Disconnect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between driver seat side air bag module: ▪ C367-1, circuit CR105 (GN/BU), harness side and ground.	**Yes** REPAIR circuit CR105 (GN/BU) or RR105 (GY/YE). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to F17 . **No** GO to F12 .

▪ C367-2, circuit RR105 (GY/YE), harness side and ground.  N0093124 • **Is voltage present on either circuit?**	
F11 CONFIRM THE DRIVER SEAT SIDE AIR BAG MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Driver Seat Side Air Bag Module C367 . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** REMOVE and INSPECT the driver seat side air bag module harness for damage. REFER to Side Airbag in this section. If a concern is found, REPAIR as necessary. Refer to Wiring Diagrams Cell 5 for schematic and connector information. If a concern **was not** found, INSTALL a new driver seat side air bag module. REFER to Side Airbag in this section. GO to F17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0020:13 or B0020:1A, GO to F13 . For DTC B0020:11, GO to F14 . For DTC B0020:12, GO to F15 .
F12 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the	**Yes**

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RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded.
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Prior to reconnecting any previously disconnected SRS component:
  ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
  ▪ repair any concerns found.
 	
Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
 	
• Connect: Driver Seat Side Air Bag Module C367 .
• Connect: RCM C310A and C310B (if previously disconnected) .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self Test — RCM .
• **Was the original DTC retrieved on-demand during self-test?**
	INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to F17 .
	
	No
	In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.**
	
	For DTC B0020:13 or B0020:1A, GO to F13 .
	
	For DTC B0020:11, GO to F14 .
	
	For DTC B0020:12, GO to F15 .

F13 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL RESISTANCE (DEPLOY_10_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_10_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to F16 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to F17 .
F14 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND	

FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0020:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to F17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to F16 .
F15 CHECK THE LEFT SIDE AIRBAG DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Seat Side Air Bag Module C367 . • **NOTE:** Unzip the trim cover to access the driver seat side air bag module electrical connector. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0020:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to F17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to F16 .
F16 CHECK THE HARNESS AND CONNECTORS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Seat Side Air Bag Module C367 . • **NOTE:** Unzip the trim cover to access the driver seat side air bag module electrical connector. ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B CPA lever/lock for	**Yes** REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to F17 . **No** The fault is not present and

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correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to F17.
F17 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS, repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints. • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM. • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs. PROVE OUT the SRS. The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test G: DTCs B0021:11, B0021:12, B0021:13 and B0021:1A

Normal Operation

The Restraints Control Module (RCM) continuously monitors the driver Safety Canopy® and circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver Safety Canopy®

If a fault is detected, the RCM stores DTC B0021:11, B0021:12, B0021:13 or B0021:1A in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM. If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring

- Connections
- Driver Safety Canopy® module
- RCM



DTC Description	Fault Trigger Condition
• B0021:11 — Left Curtain Deployment Control 1: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either driver Safety Canopy® circuit.
• B0021:12 — Left Curtain Deployment Control 1: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either driver Safety Canopy® circuit.
• B0021:13 — Left Curtain Deployment Control 1: Circuit Open	A fault is indicated when the RCM measures greater than the desired resistance range between the driver Safety Canopy® circuits.
• B0021:1A — Left Curtain Deployment Control 1: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between the driver Safety Canopy® circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Driver Safety Canopy® module
- RCM

PINPOINT TEST G: DTCs B0021:11, B0021:12, B0021:13 AND B0021:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and

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verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

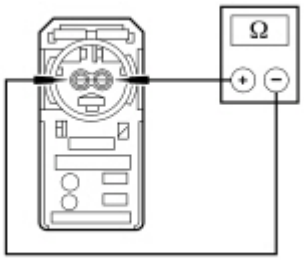
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
G1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0021:11, B0021:12, B0021:13 or B0021:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0021:13 or B0021:1A, GO to G2 . For DTC B0021:11, GO to G8 . For DTC B0021:12, GO to G10 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0021:13 or B0021:1A, GO to G13 . For DTC B0021:11, GO to G14 . For DTC B0021:12, GO to G15 .
G2 CHECK THE LEFT CURTAIN DEPLOYMENT CONTROL 1 RESISTANCE (DEPLOY_11_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_11_R. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** GO to G12 . **No** GO to G3 .
G3 CHECK THE LEFT CURTAIN DEPLOYMENT CONTROL 1 RESISTANCE (DEPLOY_11_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• While monitoring the DEPLOY_11_R PID, carry out the harness test of the driver Safety Canopy® circuits and accessible connectors (including any in-line connectors) by wiggling connectors and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness as needed.

while carrying out the harness test?	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to G17 . **No** For PID value less than 1.7 ohms, GO to G4 . For PID value greater than 2.78 ohms, GO to G6 .
G4 CHECK THE LEFT CURTAIN DEPLOYMENT CONTROL 1 DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Safety Canopy® C9018 . ▪ For regular cab, remove the LH side B-pillar trim panel. ▪ For SuperCab and Crew Cab, remove the LH C-pillar trim panel. ▪ Refer to Interior Trim in Section 501-05 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver Safety Canopy® disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0021:1A to B0021:13?**	**Yes** GO to G11 . **No** GO to G5 .
G5 CHECK FOR A SHORT BETWEEN DRIVER SAFETY CANOPY® CIRCUITS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between driver Safety Canopy® C3321-1, circuit CR109 (BN/BU), harness side and C3321-2, circuit RR109 (BU/GN), harness side.	**Yes** GO to G12 . **No** REPAIR circuits CR109 (BN/BU) and RR109 (BU/GN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to G17 .

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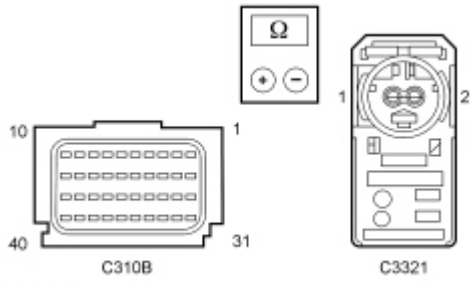
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- **Is the resistance greater than 10,000 ohms?**

G6 CHECK THE DRIVER SAFETY CANOPY® CIRCUITS FOR AN OPEN	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Driver Safety Canopy® C3321 .
  ▪ For regular cab, remove the LH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the LH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
• Disconnect: RCM C310A and C310B .
• Measure the resistance between RCM C310B, harness side and driver Safety Canopy® C3321, harness side using the following chart.
	Yes
	GO to G7 .
	
	No
	REPAIR circuit CR109 (BN/BU) or RR109 (BU/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to G17 .

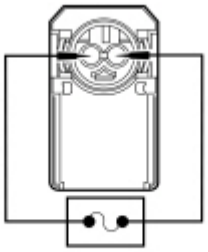
RCM	Circuit	Driver Safety Canopy® Module Electrical Connector
C310B-7	CR109 (BN/BU)	C3321-1
C310B-8	RR109 (BU/GN)	C3321-2



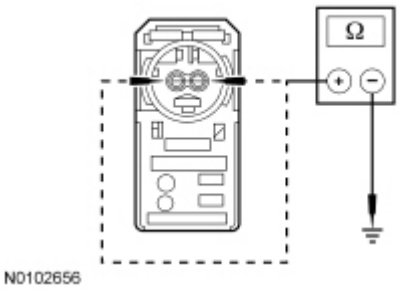
N0102653

- **Are the resistances less than 0.5 ohm?**

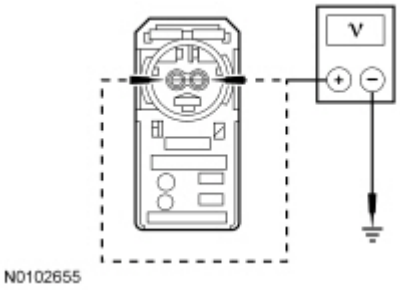
G7 CHECK THE LEFT CURTAIN DEPLOYMENT CONTROL 1 DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.	**Yes** REMOVE the fused jumper wire and GO to G11 .

• Connect: RCM C310A and C310B . • Connect a fused jumper wire between driver Safety Canopy® C3321-1, circuit CR109 (BN/BU), harness side and C3321-2, circuit RR109 (BU/GN), harness side.  N0114277 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver Safety Canopy® circuits shorted together, a low resistance fault is normally retrieved. • **Did the on-demand DTC change from B0021:13 to B0021:1A?**	**No** REMOVE the fused jumper wire and GO to G12 .
G8 CHECK THE LEFT CURTAIN DEPLOYMENT CONTROL 1 DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Safety Canopy® C3321 . ▪ For regular cab, remove the LH side B-pillar trim panel. ▪ For SuperCab and Crew Cab, remove the LH C-pillar trim panel. ▪ Refer to Interior Trim in Section 501-05 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver Safety Canopy® disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0021:11 to B0021:13?**	**Yes** GO to G11 . **No** GO to G9 .
G9 CHECK THE DRIVER SAFETY CANOPY® CIRCUITS FOR A SHORT TO GROUND	

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• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between driver Safety Canopy®:
  ▪ C3321-1, circuit CR109 (BN/BU), harness side and ground.
  ▪ C3321-2, circuit RR109 (BU/GN), harness side and ground.

 	
N0102656
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to G12 .
	
	No
	REPAIR circuit CR109 (BN/BU) or RR109 (BU/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to G17 .

G10 CHECK THE DRIVER SAFETY CANOPY® CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Driver Safety Canopy® C3321 .
  ▪ For regular cab, remove the LH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the LH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
• Disconnect: RCM C310A and C310B .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Measure the voltage between driver Safety Canopy®:
  ▪ C3321-1, circuit CR109 (BN/BU), harness side and ground.
  ▪ C3321-2, circuit RR109 (BU/GN), harness side and ground.

 	
N0102655
• **Is voltage present on either circuit?**
	Yes
	REPAIR circuit CR109 (BN/BU) or RR109 (BU/GN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to G17 .
	
	No
	GO to G12 .

G11 CONFIRM THE DRIVER SAFETY CANOPY® MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Driver Safety Canopy® C3321 . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new driver Safety Canopy®. REFER to Safety Canopy Module in this section. GO to G17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0021:13 or B0021:1A, GO to G13 . For DTC B0021:11, GO to G14 . For DTC B0021:12, GO to G15 .
G12 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: Driver Safety Canopy® C3321 . • Connect: RCM C310A and C310B (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM .	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to G17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0021:13 or B0021:1A, GO to G13 . For DTC B0021:11, GO to G14 . For DTC B0021:12, GO to G15 .

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• **Was the original DTC retrieved on-demand during self-test?**	
G13 CHECK THE LEFT CURTAIN DEPLOYMENT CONTROL 1 RESISTANCE (DEPLOY_11_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_11_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to G16 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to G17 .
G14 CHECK FOR AN INTERMITTENT LEFT CURTAIN DEPLOYMENT CONTROL 1 SHORT TO GROUND FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0021:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to G17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to G16 .
G15 CHECK FOR AN INTERMITTENT LEFT CURTAIN DEPLOYMENT CONTROL 1 SHORT TO BATTERY FAULT	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Driver Safety Canopy® C3321 .
  ▪ For regular cab, remove the LH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the LH C-pillar trim panel.
	Yes
	DEPOWER the SRS and REPAIR as necessary.
	
	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.

▪ Refer to Interior Trim in Section 501-05 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0021:12 retrieved on-demand during self-test?**	GO to G17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to G16 .
G16 CHECK THE HARNESS AND CONNECTORS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Safety Canopy® C3321 . ▪ For regular cab, remove the LH side B-pillar trim panel. ▪ For SuperCab and Crew Cab, remove the LH C-pillar trim panel. ▪ Refer to Interior Trim in Section 501-05 . ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	**Yes** REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to G17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to G17 .
G17 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test H: DTCs B0028:11, B0028:12, B0028:13 and B0028:1A

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

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Normal Operation

The Restraints Control Module (RCM) continuously monitors the passenger seat side air bag module circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted passenger seat side air bag module

If a fault is detected, the RCM stores DTC B0028:11, B0028:12, B0028:13 or B0028:1A in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Passenger seat side air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0028:11 — Right Side Airbag Deployment Control: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either passenger seat side air bag circuit.
• B0028:12 — Right Side Airbag Deployment Control: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either passenger seat side air bag circuit.
• B0028:13 — Right Side Airbag Deployment Control: Circuit Open	A fault is indicated when the RCM measures greater than the desired resistance range between the passenger seat side air bag circuits.

• B0028:1A — Right Side Airbag Deployment Control: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between the passenger seat side air bag circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Passenger seat side air bag module
- RCM

PINPOINT TEST H: DTCs B0028:11, B0028:12, B0028:13 AND B0028:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

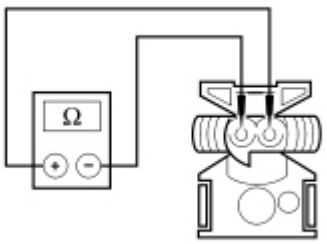
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
H1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0028:11, B0028:12, B0028:13 or B0028:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test.

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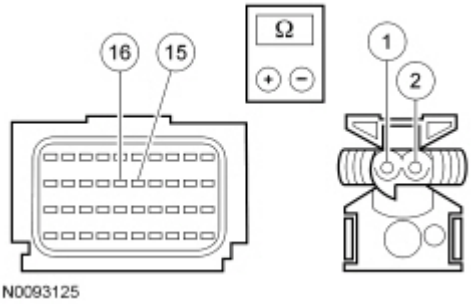
	For DTC B0028:13 or B0028:1A, GO to H2. For DTC B0028:11, GO to H8. For DTC B0028:12, GO to H10. **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0028:13 or B0028:1A, GO to H13. For DTC B0028:11, GO to H14. For DTC B0028:12, GO to H15.
H2 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL RESISTANCE (DEPLOY_13_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM. ▪ Monitor and record PID DEPLOY_13_R. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** GO to H12. **No** GO to H3.
H3 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL RESISTANCE (DEPLOY_13_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• While monitoring the DEPLOY_13_R PID, carry out the harness test of the passenger side air bag circuits and accessible connectors (including any in-line connectors) by wiggling connectors and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness as needed. Refer to Wiring Diagrams Cell 5, Connector Repair Procedures for schematic and connector information. GO to H17. **No** For PID value less than 1.7 ohms, GO to H4. For PID value greater than 2.78 ohms, GO to H6.
H4 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.	**Yes** GO to H11. **No** GO to H5.

• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C337 . • **NOTE:** Unzip the trim cover to access the passenger seat side air bag module electrical connector. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger seat side air bag module disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0028:1A to B0028:13?**	
H5 CHECK FOR A SHORT BETWEEN PASSENGER SEAT SIDE AIR BAG CIRCUITS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between passenger seat side air bag C337-1, circuit CR106 (VT/GY), harness side and C337-2, circuit RR106 (YE/OG), harness side.  N0093121 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H12 . **No** REPAIR circuits CR106 (VT/GY) and RR106 (YE/OG). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to H17 .
H6 CHECK THE PASSENGER SEAT SIDE AIR BAG CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C337 . • Disconnect: RCM C310A and C310B . • Measure the resistance between RCM C310B, harness side and passenger seat side air bag module C337, harness side using the following chart.	**Yes** GO to H7 . **No** REPAIR circuit CR106 (VT/GY) or RR106 (YE/OG). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to H17 .

RCM	Circuit	Passenger Seat Side Air Bag Module Electrical Connector
C310B-16	CR106 (VT/GY)	C337-1
C310B-	RR106	C337-2

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15	(YE/OG)	



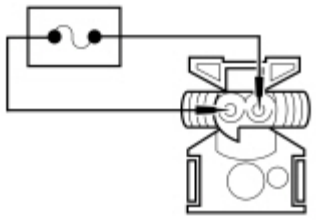
N0093125

- **Are the resistances less than 0.5 ohm?**

H7 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

- Connect: RCM C310A and C310B .
- Connect a fused jumper wire between passenger seat side air bag C337-1, circuit CR106 (VT/GY), harness side and C337-2, circuit RR106 (YE/OG), harness side.


N0119863

- Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: Self Test — RCM .
- **DIAGNOSTIC TIP:** When viewing DTCs with the passenger side air bag circuits shorted together, a low resistance fault is normally retrieved.
- **Did the on-demand DTC change from B0028:13 to B0028:1A?**

Yes
REMOVE the fused jumper wire and GO to H11 .

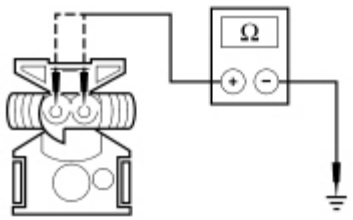
No
REMOVE the fused jumper wire and GO to H12 .

H8 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If

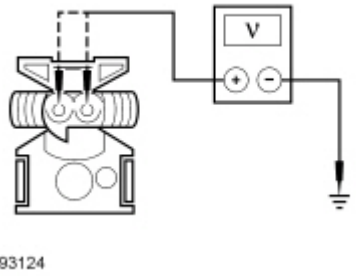
Yes
GO to H11 .

the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C337 . • **NOTE:** Unzip the trim cover to access the passenger seat side air bag module electrical connector. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger seat side air bag module disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0028:11 to B0028:13?**	**No** GO to H9 .
H9 CHECK THE PASSENGER SEAT SIDE AIR BAG CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between passenger seat side air bag:
  ▪ C337-1, circuit CR106 (VT/GY), harness side and ground.
  ▪ C337-2, circuit RR106 (YE/OG), harness side and ground.

 	
N0093123
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to H12 .
	
	No
	REPAIR circuit CR106 (VT/GY) or RR106 (YE/OG).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to H17 .

H10 CHECK THE PASSENGER SEAT SIDE AIR BAG CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C337 . • **NOTE:** Unzip the trim cover to access the passenger seat side air bag module electrical connector. • Disconnect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering	**Yes** REPAIR circuit CR106 (VT/GY) or RR106 (YE/OG). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to H17 .

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and Repowering in this section. • Ignition ON. • Measure the voltage between passenger seat side air bag: ▪ C337-1, circuit CR106 (VT/GY), harness side and ground. ▪ C337-2, circuit RR106 (YE/OG), harness side and ground.  N0093124 • **Is voltage present on either circuit?**	**No** GO to H12 .
H11 CONFIRM THE PASSENGER SEAT SIDE AIR BAG MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Passenger Seat Side Air Bag Module C337 . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** REMOVE and INSPECT the passenger seat side air bag module wire harness for damage. REFER to Side Airbag in this section. If a concern is found, REPAIR the seat side air bag wire harness. If a concern **was not** found, INSTALL a new passenger seat side air bag module. REFER to Side Airbag in this section. GO to H17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0028:13 or B0028:1A, GO to H13 . For DTC B0028:11, GO to H14 . For DTC B0028:12, GO to H15 .
H12 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the	**Yes** INSTALL a new RCM . REFER

RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded.
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Prior to reconnecting any previously disconnected SRS component:
  ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
  ▪ repair any concerns found.
 	
Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
 	
• Connect: Passenger Seat Side Air Bag Module C337 .
• Connect: RCM C310A and C310B (if previously disconnected) .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self Test — RCM .
• **Was the original DTC retrieved on-demand during self-test?**
	to Restraints Control Module (RCM) in this section. GO to H17 .
	
	No
	In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.**
	
	For DTC B0028:13 or B0028:1A, GO to H13 .
	
	For DTC B0028:11, GO to H14 .
	
	For DTC B0028:12, GO to H15 .

H13 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL RESISTANCE (DEPLOY_13_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_13_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to H16 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to H17 .
H14 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND	

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FAULT	
• Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0028:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to H17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to H16 .
H15 CHECK THE RIGHT SIDE AIRBAG DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C337 . • **NOTE:** Unzip the trim cover to access the passenger seat side air bag module electrical connector. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0028:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to H17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to H16 .
H16 CHECK THE HARNESS AND CONNECTORS	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Seat Side Air Bag Module C337 .
• **NOTE:** Unzip the trim cover to access the passenger seat side air bag module electrical connector.
  ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B CPA lever/lock for
	Yes
	REPAIR as necessary.
	
	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
	
	GO to H17 .
	
	No
	The fault is not present and

correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to H17 .
H17 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test I: DTCs B0029:11, B0029:12, B0029:13 and B0029:1A

Normal Operation

The Restraints Control Module (RCM) continuously monitors the passenger Safety Canopy® circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted passenger Safety Canopy®

If a fault is detected, the RCM stores DTC B0029:11, B0029:12, B0029:13 or B0029:1A in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test requires the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at the time of diagnosis. Following this direction helps make sure that minor changes in resistance do not create a repeat concern. This test uses process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring

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- Connections
- Passenger Safety Canopy® module
- RCM



DTC Description	Fault Trigger Condition
• B0029:11 — Right Curtain Deployment Control 1: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on either passenger Safety Canopy® circuit.
• B0029:12 — Right Curtain Deployment Control 1: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on either passenger Safety Canopy® circuit.
• B0029:13 — Right Curtain Deployment Control 1: Circuit Open	A fault is indicated when the RCM measures greater than the desired resistance range between the passenger Safety Canopy® circuits.
• B0029:1A — Right Curtain Deployment Control 1: Circuit Resistance Below Threshold	A fault is indicated when the RCM measures less than the desired resistance range between the passenger Safety Canopy® circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Passenger Safety Canopy® module
- RCM

PINPOINT TEST I: DTCs B0029:11, B0029:12, B0029:13 AND B0029:1A

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and

verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

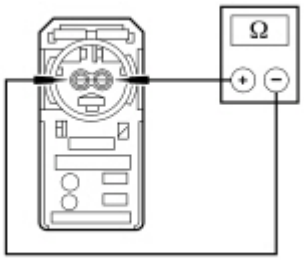
Test Step	Result / Action to Take
I1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0029:11, B0029:12, B0029:13 or B0029:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0029:13 or B0029:1A, GO to I2 . For DTC B0029:11, GO to I8 . For DTC B0029:12, GO to I10 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0029:13 or B0029:1A, GO to I13 . For DTC B0029:11, GO to I14 . For DTC B0029:12, GO to I15 .
I2 CHECK THE RIGHT CURTAIN DEPLOYMENT CONTROL 1 RESISTANCE (DEPLOY_14_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_14_R. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** GO to I12 . **No** GO to I3 .
I3 CHECK THE RIGHT CURTAIN DEPLOYMENT CONTROL 1 RESISTANCE (DEPLOY_14_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• While monitoring the DEPLOY_14_R PID, carry out the harness test of the passenger Safety Canopy® circuits and accessible connectors (including any in-line connectors), by wiggling connectors and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness as needed.

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while carrying out the harness test?	Refer to Wiring Diagrams Cell 5, Connector Repair Procedures for schematic and connector information. GO to I17. **No** For PID value less than 1.7 ohms, GO to I4. For PID value greater than 2.78 ohms, GO to I6.
I4 CHECK THE RIGHT CURTAIN DEPLOYMENT CONTROL 1 DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.
• Ignition OFF.
• Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Safety Canopy® C3329.
  ▪ For regular cab, remove the RH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the RH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05.
• Repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self Test — RCM.
• **DIAGNOSTIC TIP:** When viewing DTCs with the passenger Safety Canopy® disconnected, an open circuit fault is normally retrieved.
• **Did the on-demand DTC change from B0029:1A to B0029:13?**
	Yes
	GO to I11.
	
	No
	GO to I5.

I5 CHECK FOR A SHORT BETWEEN PASSENGER SAFETY CANOPY® CIRCUITS	
• Ignition OFF. • Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between passenger Safety Canopy® C3329-1, circuit CR111 (BN/WH), harness side and C3329-2, circuit RR111 (YE/VT), harness side.	**Yes** GO to I12. **No** REPAIR circuits CR111 (BN/WH) and RR111 (YE/VT). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to I17.



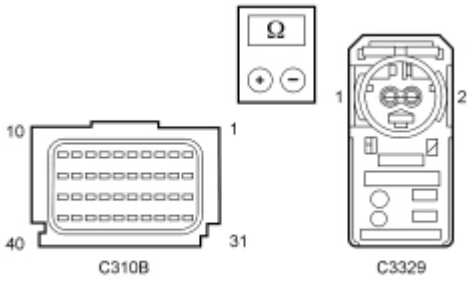
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- **Is the resistance greater than 10,000 ohms?**

I6 CHECK THE PASSENGER SAFETY CANOPY® CIRCUITS FOR AN OPEN	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Safety Canopy® C3329 .
  ▪ For regular cab, remove the RH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the RH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
• Disconnect: RCM C310A and C310B .
• Measure the resistance between RCM C310B, harness side and passenger Safety Canopy® C3329, harness side using the following chart.
	Yes
	GO to I7 .
	
	No
	REPAIR circuit CR111 (BN/WH) or RR111 (YE/VT).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to I17 .

RCM	Circuit	Passenger Safety Canopy® Electrical Connector
C310B-17	CR111 (BN/WH)	C3329-1
C310B-18	RR111 (YE/VT)	C3329-2

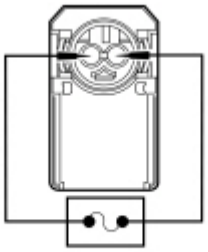


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- **Are the resistances less than 0.5 ohm?**

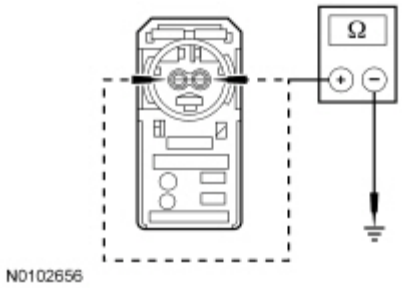
I7 CHECK THE RIGHT CURTAIN DEPLOYMENT CONTROL 1 DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.	**Yes** REMOVE the fused jumper wire and GO to I11 .

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• Connect: RCM C310A and C310B . • Connect a fused jumper wire between passenger Safety Canopy® C3329-1, circuit CR111 (BN/WH), harness side and C3329-2, circuit RR111 (YE/VT), harness side.  N0114277 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger Safety Canopy® circuits shorted together, a low resistance fault is normally retrieved. • **Did the on-demand DTC change from B0029:13 to B0029:1A?**	**No** REMOVE the fused jumper wire and GO to I12 .
I8 CHECK THE RIGHT CURTAIN DEPLOYMENT CONTROL 1 DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Safety Canopy® C3329 .
  ▪ For regular cab, remove the RH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the RH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self Test — RCM .
• **DIAGNOSTIC TIP:** When viewing DTCs with the passenger Safety Canopy® disconnected, an open circuit fault would normally be retrieved.
• **Did the on-demand DTC change from B0029:11 to B0029:13?**
	Yes
	GO to I11 .
	
	No
	GO to I9 .

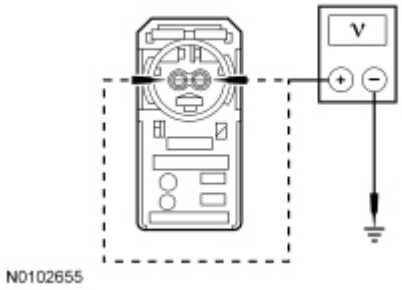
I9 CHECK THE PASSENGER SAFETY CANOPY® CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: RCM C310A and C310B .
• Measure the resistance between passenger Safety Canopy®:
  ▪ C3329-1, circuit CR111 (BN/WH), harness side and ground.
  ▪ C3329-2, circuit RR111 (YE/VT), harness side and ground.

 	
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• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to I12 .
	
	No
	REPAIR circuit CR111 (BN/WH) or RR111 (YE/VT).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to I17 .

I10 CHECK THE PASSENGER SAFETY CANOPY® CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Safety Canopy® C3329 .
  ▪ For regular cab, remove the RH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the RH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
• Disconnect: RCM C310A and C310B .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Measure the voltage between passenger Safety Canopy® C9019:
  ▪ C3329-1, circuit CR111 (BN/WH), harness side and ground.
  ▪ C3329-2, circuit RR111 (YE/VT), harness side and ground.
	Yes
	REPAIR circuit CR111 (BN/WH) or RR111 (YE/VT).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to I17 .
	
	No
	GO to I12 .

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- **Is voltage present on either circuit?**

I11 CONFIRM THE PASSENGER SAFETY CANOPY® MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Passenger Safety Canopy® C3329 . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new passenger Safety Canopy®. REFER to Safety Canopy Module in this section. GO to I17 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** For DTC B0029:13 or B0029:1A, GO to I13 . For DTC B0029:11, GO to I14 . For DTC B0029:12, GO to I15 .
I12 CONFIRM THE RCM FAULT	

NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded.
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Prior to reconnecting any previously disconnected SRS component:
  ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
  ▪ repair any concerns found.
	Yes
	INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to I17 .
	
	No
	In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.**
	
	For DTC B0029:13 or B0029:1A, GO to I13 .
	
	For DTC B0029:11, GO to I14 .

Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: Passenger Safety Canopy® C3329 . • Connect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	For DTC B0029:12, GO to I15 .
I13 CHECK THE RIGHT CURTAIN DEPLOYMENT CONTROL 1 RESISTANCE (DEPLOY_14_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger — RCM . ▪ Monitor and record PID DEPLOY_14_R. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to I16 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to I17 .
I14 CHECK FOR AN INTERMITTENT RIGHT CURTAIN DEPLOYMENT CONTROL 1 SHORT TO GROUND FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0029:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. GO to I17 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to I16 .

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I15 CHECK FOR AN INTERMITTENT RIGHT CURTAIN DEPLOYMENT CONTROL 1 SHORT TO BATTERY FAULT	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Safety Canopy® C3329 .
  ▪ For regular cab, remove the RH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the RH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness frequently.
• Enter the following diagnostic mode on the scan tool: Self Test — RCM .
• **Was DTC B0029:12 retrieved on-demand during self-test?**
	Yes
	DEPOWER the SRS and REPAIR as necessary.
	
	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
	
	GO to I17 .
	
	No
	The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to I16 .

I16 CHECK THE HARNESS AND CONNECTORS	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Driver Safety Canopy® C3329 .
  ▪ For regular cab, remove the RH side B-pillar trim panel.
  ▪ For SuperCab and Crew Cab, remove the RH C-pillar trim panel.
  ▪ Refer to Interior Trim in Section 501-05 .
  ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
• **Were any concerns found?**
	Yes
	REPAIR as necessary.
	
	Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
	
	GO to I17 .
	
	No
	The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to I17 .

I17 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints .	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

• **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	

Pinpoint Test J: DTCs B0050:11, B0050:12, B0050:13 and B0050:1D

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the driver safety belt buckle switch circuits for the following faults:

- Open circuit
- Short to voltage
- Short to ground
- Current out of range
- Faulted driver safety belt buckle switch

If a fault is detected, the RCM stores DTC B0050:11, B0050:12, B0050:13 or B0050:1D in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

DTC Description	Fault Trigger Condition
• B0050:11 — Driver Seatbelt Sensor: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on the driver safety belt buckle switch circuit.
• B0050:12 — Driver Seatbelt Sensor: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on the driver safety belt buckle switch circuit.
• B0050:13 — Driver Seatbelt Sensor: Circuit Open	A fault is indicated when the RCM senses an open on either driver safety belt buckle switch circuit.
• B0050:1D — Driver Seatbelt Sensor: Circuit Current Out of Range	A fault is indicated when the RCM senses current out of an acceptable range between the driver safety belt buckle switch circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Driver safety belt buckle and pretensioner
- RCM

PINPOINT TEST J: DTCs B0050:11, B0050:12, B0050:13 AND B0050:1D

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

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WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

***NOTICE:* Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

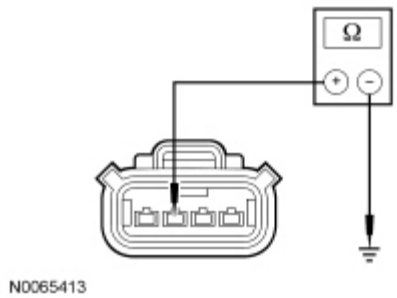
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

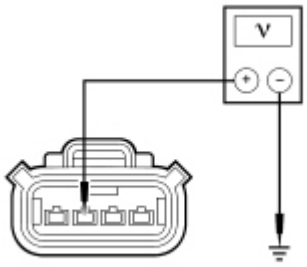
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
J1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0050:11, B0050:12, B0050:13 or B0050:1D retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0050:11 or B0050:1D, GO to J2 . For DTC B0050:12, GO to J4 . For DTC B0050:13, GO to J5 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. GO to J10 .
J2 CHECK THE DRIVER SEATBELT SENSOR DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND OR CURRENT OUT OF RANGE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.	**Yes** GO to J8 . **No**

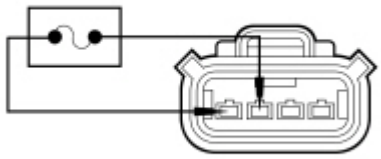
• Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Disconnect: Driver Safety Belt Buckle C3065 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver safety belt buckle disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0050:11 or B0050:1D to B0050:13?**	For DTC B0050:11, GO to J3 . For DTC B0050:1D, GO to J9 .
J3 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between driver safety belt buckle C3065-3, circuit CR201 (GN/BU), harness side and ground.  N0065413 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J9 . **No** REPAIR circuit CR201 (GN/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to J11 .
J4 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Seat Side Air Bag Module C3051 . • Disconnect: Driver Safety Belt Buckle C3065 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between driver safety belt buckle C3065-3, circuit CR201 (GN/BU), harness side and ground.	**Yes** REPAIR circuit CR201 (GN/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to J11 . **No** GO to J9 .

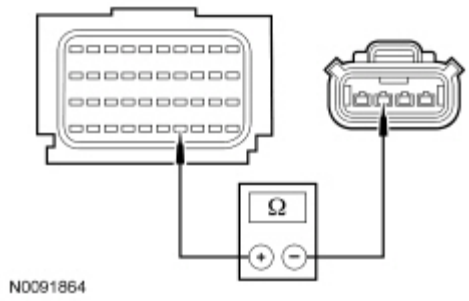
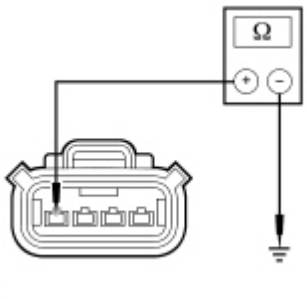
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- **Is any voltage present?**

J5 CHECK THE DRIVER SEATBELT SENSOR DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Drive Seat Side Air Bag Module C3051 . • Disconnect: Driver Safety Belt Buckle C3065 . • Connect a fused jumper wire between driver safety belt buckle C3065-3, circuit CR201 (GN/BU), harness side and C3065-4, circuit RR137 (BU/GY), harness side.	**Yes** REMOVE the fused jumper wire and GO to J8 . **No** REMOVE the fused jumper wire and GO to J6 .
 N0119864 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver safety belt buckle switch circuits shorted together, a short to ground fault is normally retrieved. • **Did the on-demand DTC change from B0050:13 to B0050:11?**	
J6 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH CIRCUIT FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between RCM C310B-34, circuit	**Yes** GO to J7 . **No** REPAIR circuit CR201 (GN/BU).

CR201 (GN/BU), harness side and driver safety belt buckle C3065-3, circuit CR201 (GN/BU), harness side.  • **Is the resistance less than 0.5 ohm?**	Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to J11 .
J7 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between driver safety belt buckle C3065-4, circuit RR137 (BU/GY)/GD174 (BK/WH), harness side and ground.  • **Is the resistance less than 3 ohms?**	**Yes** GO to J9 . **No** REPAIR circuit RR137 (BU/GY)/GD174 (BK/WH). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to J11 .
J8 CONFIRM THE DRIVER SAFETY BELT BUCKLE SWITCH FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair	**Yes** INSTALL a new driver safety belt buckle and pretensioner. REFER to Section 501-20A . GO to J11 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to J10 .

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Procedures for schematic and connector information. • Connect: RCM C310A and C310B (if previously disconnected) . • Connect: Driver Safety Belt Buckle C3065 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	
J9 CONFIRM THE RCM FAULT	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to J11 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to J10 .
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: Driver Safety Belt Buckle C3065 . • Connect: RCM C310A and C310B (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	
J10 CHECK FOR AN INTERMITTENT FAULT	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test.
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Safety Belt Buckle C3065 . ▪ inspect connector(s) (including any in-line	

connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ■ inspect wire harness for any damage, pinched, cut or pierced wires. ■ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component (s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0050:11, B0050:12, B0050:13 or B0050:1D retrieved on-demand during self-test?**	For DTC B0050:11 or B0050:1D, GO to J2 . For DTC B0050:12, GO to J4 . For DTC B0050:13, GO to J5 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to J11 .
J11 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test K: DTCs B0052:11, B0052:12, B0052:13 and B0052:1D

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the passenger safety belt buckle switch circuits for the following faults:

- Open circuit
- Short to voltage
- Short to ground

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- Current out of range
- Faulted passenger safety belt buckle switch

If a fault is detected, the RCM stores DTC B0052:11, B0052:12, B0052:13 or B0052:1D in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

DTC Description	Fault Trigger Condition
• B0052:11 — Passenger Seatbelt Sensor: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on the passenger safety belt buckle switch circuit.
• B0052:12 — Passenger Seatbelt Sensor: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on the passenger safety belt buckle switch circuit.
• B0052:13 — Passenger Seatbelt Sensor: Circuit Open	A fault is indicated when the RCM senses an open on either passenger safety belt buckle switch circuit.
• B0052:1D — Passenger Seatbelt Sensor: Circuit Current Out of Range	A fault is indicated when the RCM senses current out of an acceptable range between the passenger safety belt buckle switch circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Passenger safety belt buckle and pretensioner
- RCM

PINPOINT TEST K: DTCs B0052:11, B0052:12, B0052:13 AND B0052:1D

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in

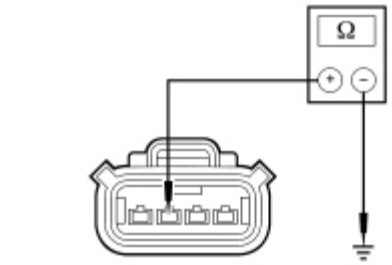
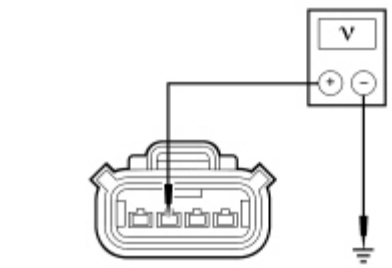
incorrect diagnosis of the SRS .

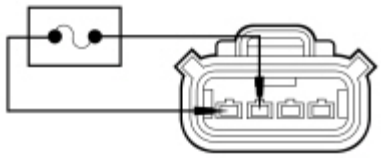
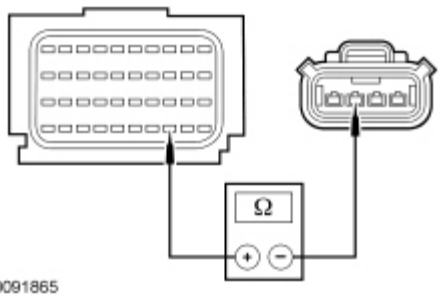
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

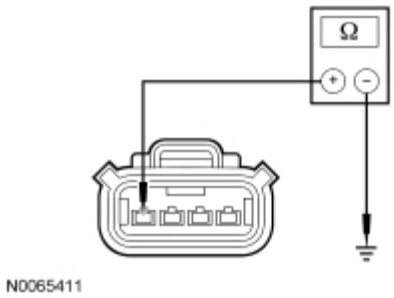
Test Step	Result / Action to Take
K1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0052:11, B0052:12, B0052:13 or B0052:1D retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0052:11 or B0052:1D, GO to K2 . For DTC B0052:12, GO to K4 . For DTC B0052:13, GO to K5 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. GO to K10 .
K2 CHECK THE PASSENGER SEATBELT SENSOR DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND OR CURRENT OUT OF RANGE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Passenger Safety Belt Buckle C3066 . • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger safety belt buckle disconnected, an open circuit fault is normally retrieved. • **Did the on-demand DTC change from B0052:11 or B0052:1D to B0052:13?**	**Yes** GO to K8 . **No** For DTC B0052:11, GO to K3 . For DTC B0052:1D, GO to K9 .

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K3 CHECK THE PASSENGER SAFETY BELT BUCKLE SWITCH CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between passenger safety belt buckle C3066-3, circuit CR203 (GY/VT), harness side and ground.  N0065413 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K9 . **No** REPAIR circuit CR203 (GY/VT). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to K11 .
K4 CHECK THE PASSENGER SAFETY BELT BUCKLE SWITCH CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: Passenger Safety Belt Buckle C3066 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between passenger safety belt buckle C3066-3, circuit CR203 (GY/VT), harness side and ground.  N0065410 • **Is any voltage present?**	**Yes** REPAIR circuit CR203 (GY/VT). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to K11 . **No** GO to K9 .
K5 CHECK THE PASSENGER SEATBELT SENSOR DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF.	**Yes** REMOVE the fused jumper wire and GO to K8 . **No** REMOVE the fused jumper wire

• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Seat Side Air Bag Module C339 . • Disconnect: Passenger Safety Belt Buckle C3066 . • Connect a fused jumper wire between passenger safety belt buckle C3066-3, circuit CR203 (GY/VT), harness side and C3066-4, circuit GD901 (BK), harness side.  N0119864 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger safety belt buckle circuits shorted together, a short to ground fault is normally retrieved. • **Did the on-demand DTC change from B0052:13 to B0052:11?**	and GO to K6 .
K6 CHECK THE PASSENGER SAFETY BELT BUCKLE SWITCH CIRCUIT FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between RCM C310B-33, circuit CR203 (GY/VT), harness side and the passenger safety belt buckle C3066-3, circuit CR203 (GY/VT), harness side.  N0091865 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to K7 . **No** REPAIR circuit CR203 (GY/VT). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to K11 .
K7 CHECK THE PASSENGER SAFETY BELT BUCKLE SWITCH GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between passenger safety belt buckle C3066-4, circuit GD901 (BK)/GD174 (BK/WH), harness side and ground.	**Yes** GO to K9 .

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 N0065411 • **Is the resistance less than 3 ohms?**	**No** REPAIR circuit GD901 (BK)/GD174 (BK/WH). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to K11 .
K8 CONFIRM THE PASSENGER SAFETY BELT BUCKLE SWITCH FAULT **NOTE:** Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: RCM C310A and C310B (if previously disconnected) . • Connect: Passenger Safety Belt Buckle C3066 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new passenger safety belt buckle and pretensioner. REFER to Section 501-20A . GO to K11 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to K10 .
K9 CONFIRM THE RCM FAULT **NOTE:** Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to K11 . **No** In the process of diagnosing the

• Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: Passenger Safety Belt Buckle C3066 . • Connect: RCM C310A and C310B (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to K10 .
K10 CHECK FOR AN INTERMITTENT FAULT • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Safety Belt Buckle C3066 . ▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component (s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0052:11, B0052:12, B0052:13 or B0052:1D retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0052:11 or B0052:1D, GO to K2 . For DTC B0052:12, GO to K4 . For DTC B0052:13, GO to K5 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to K11 .
K11 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for

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follow this instruction may result in serious personal injury or death in the event of an accidental deployment. • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test L: DTCs B0090:11 or B0090:93

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the LH front impact severity sensor and circuits for the following faults:

- Open circuit
- Short to voltage
- Short to ground

If a fault is detected, the RCM stores DTC B0090:11 or B0090:93 in memory and sends a message to theInstrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

- B0090:11 (Left Frontal Restraints Sensor: Circuit Short to Ground) — A fault is indicated when the RCM senses a short to ground on the LH front severity impact sensor feed circuit.
- B0090:93 (Left Frontal Restraints Sensor: No Operation) — A fault is indicated when the RCM senses a faulted sensor, a short to voltage on the feed circuit or an open feed or return circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- LH front impact severity sensor
- RCM

PINPOINT TEST L: DTCs B0090:11 OR B0090:93

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

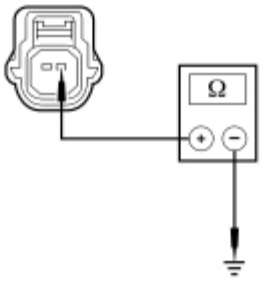
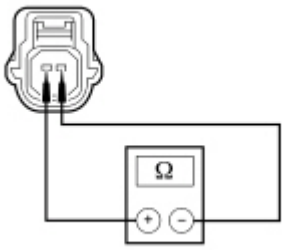
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

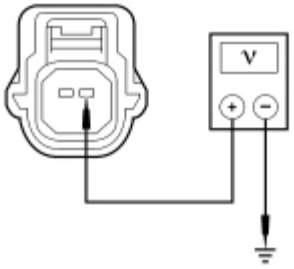
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: Do not probe any impact sensor. The impact sensor cannot be tested using a multi-meter.

Test Step	Result / Action to Take
L1 RETRIEVE RCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0090:11 or B0090:93 retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0090:11, GO to L2 . For DTC B0090:93, GO to L5 . **No** The fault is intermittent when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. GO to L10 .
L2 CHECK THE LEFT FRONTAL RESTRAINTS SENSOR DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED) **NOTE:** This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: LH Front Impact Severity Sensor C1465 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Did the on-demand DTC change from B0090:11 to B0090:93?**	**Yes** INSTALL a new LH front impact severity sensor. REFER to Front Impact Severity Sensor in this section. GO to L11 . **No** GO to L3 .

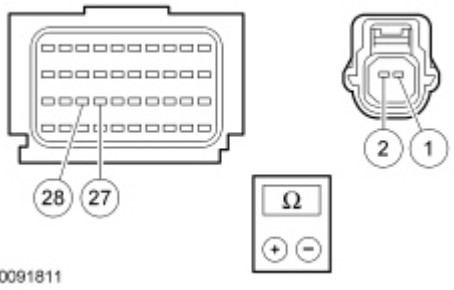
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L3 CHECK THE LH FRONT IMPACT SEVERITY SENSOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between LH front impact severity sensor C1465-1, circuit VR213 (VT/GN), harness side and ground.  N0092553 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to L4 . **No** REPAIR circuit VR213 (VT/GN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to L11 .
L4 CHECK FOR A SHORT BETWEEN LH FRONT IMPACT SEVERITY SENSOR CIRCUITS	
• Measure the resistance between LH front impact severity sensor C1465-1, circuit VR213 (VT/GN), harness side and C1465-2, circuit RR129 (YE/GY), harness side.  N0036987 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to L9 . **No** REPAIR circuits VR213 (VT/GN) and RR129 (YE/GY). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to L11 .
L5 CHECK THE LH FRONT IMPACT SEVERITY SENSOR AND RCM CONNECTIONS (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Inspect LH front impact severity sensor C1465 to be fully seated and locked. Seat and lock connector as necessary. • Gain access to the RCM and inspect C310A and C310B to be fully seated and locked. Seat and lock the connector(s) as necessary. Refer to Restraints Control Module (RCM) in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self	**Yes** GO to L6 . **No** Fault corrected. GO to L11 .

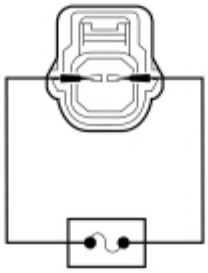
Test — RCM . • **Was DTC B0090:93 retrieved on-demand during self-test?**	
L6 CHECK THE LH FRONT IMPACT SEVERITY SENSOR FEED CIRCUIT FOR A SHORT TO VOLTAGE (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: LH Front Impact Severity Sensor C1465 . • Disconnect: RCM C310A and C310B . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between LH front impact severity sensor: ▪ C1465-1, circuit VR213 (VT/GN), harness side and ground.  N0106003 • **Is any voltage present?**	**Yes** REPAIR circuit VR213 (VT/GN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to L11 . **No** GO to L7 .
L7 CHECK THE LH FRONT IMPACT SEVERITY SENSOR CIRCUITS FOR AN OPEN (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Measure the resistance between RCM C310B, harness side and LH front impact severity sensor C1465, harness side using the following chart.	**Yes** GO to L8 . **No** REPAIR circuit VR213 (VT/GN) or RR129 (YE/GY). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to L11 .

RCM	Circuit	LH Front Impact Severity Sensor
C310B-27	VR213 (VT/GN)	C1465-1
C310B-28	RR129 (YE/GY)	C1465-2

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- **Are the resistances less than 0.5 ohm?**

L8 CHECK THE LEFT FRONTAL RESTRAINTS SENSOR DTC FOR A FAULT STATUS CHANGE (NO OPERATION INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B . • Connect a fused jumper wire between LH front impact severity sensor C1465-1, circuit VR213 (WH/BU), harness side and C1465-2, circuit RR129 (GN/BU), harness side.  N0114279 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Did the on-demand DTC change from B0090:93 to B0090:11?**	**Yes** REMOVE the fused jumper wire and INSTALL a new LH front impact severity sensor. REFER to Front Impact Severity Sensor in this section. GO to L11 . **No** REMOVE the fused jumper wire and GO to L9 .
L9 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to L11 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when**

terminals. ■ inspect wire harness for any damage, pinched, cut or pierced wires. ■ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ■ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: RCM C310A and C310B . • Connect: LH Front Impact Severity Sensor C1465 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**directed to do so in the pinpoint test.** GO to L10 .
L10 CHECK FOR AN INTERMITTENT FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: LH Front Impact Severity Sensor C1465 . • Disconnect: RCM C310A and C310B . • Inspect for the following: ■ inspect harness and component connectors for loose or spread terminals and loose or frayed wire connections at terminals. ■ inspect wire harness for any damage, pinched, cut or pierced wires. ■ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ■ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component (s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0090:11 or B0090:93 retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0090:11, GO to L2 . For DTC B0090:93, GO to L5 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to L11 .
L11 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to

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• Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test M: DTCs B0091:11, B0091:93, B0097:11 and B0097:93

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the driver front door impact sensor and passenger second row side impact sensor (SuperCab and Crew Cab vehicles only) circuits for the following faults:

- Open circuit
- Short to voltage
- Short to ground
- Faulted driver front door side impact sensor
- Faulted passenger second row side impact sensor (SuperCab and Crew Cab vehicles only)

If a fault is detected, the RCM stores DTC B0091:11, B0091:93, B0097:11 or B0097:93 in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM communicates with each impact sensor, if the RCM is unable to communicate with the sensor, a DTC is stored in memory. A Continuous Memory Diagnostic Trouble Code (CMDTC) **no operation** (failure type :93) can be set by a short to voltage on the return circuit of the impact sensor.

NOTE: A short to ground on either impact sensor feed circuit sets DTCs B0091:11 and B0097:11 on SuperCab and Crew Cab vehicles.

A short to voltage on either impact sensor feed or return circuit sets DTCs B0091:93 and B0097:93 on SuperCab and Crew Cab vehicles.

DTC Description	Fault Trigger Condition
• B0091:11 — Left Side Restraints Sensor 1: Circuit Short to Ground	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a shorted driver front door side impact sensor, a shorted passenger second row side impact sensor, a short to ground on the driver front door side impact sensor feed circuit or a short to ground on the passenger second row side impact sensor feed circuit. For regular cab vehicles, a fault is indicated when the RCM senses a shorted driver front door side impact sensor or a short to ground on the driver front

	door side impact sensor feed circuit.
• B0091:93 — Left Side Restraints Sensor 1: No Operation	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a faulted driver front door side impact sensor, a short to voltage on the feed or return circuit of the driver front door side impact sensor, a short to voltage on the feed or return circuit of passenger second row side impact sensor or an open feed or return circuit of the driver front door side impact sensor. For regular cab vehicles, a fault is indicated when the RCM senses a faulted driver front door side impact sensor, a short to voltage on the feed or return circuit of the driver front door side impact sensor or an open feed or return circuit of the driver front door side impact sensor.
• B0097:11 — Right Side Restraints Sensor 2: Circuit Short to Ground	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a shorted driver front door side impact sensor, a shorted passenger second row side impact sensor, a short to ground on the driver front door side impact sensor feed circuit or a short to ground on the passenger second row side impact sensor feed circuit.
• B0097:93 — Right Side Restraints Sensor 2: No Operation	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a faulted passenger second row side impact sensor, a short to voltage on the feed or return circuit of passenger second row side impact sensor, a short to voltage on the feed or return circuit of the driver front door side impact sensor or an open feed or return circuit of the passenger second row side impact sensor.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Driver front door side impact sensor
- Passenger second row side impact sensor
- RCM

PINPOINT TEST M: DTCs B0091:11, B0091:93, B0097:11 AND B0097:93

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts

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catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

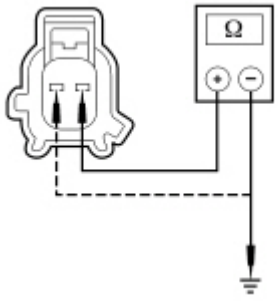
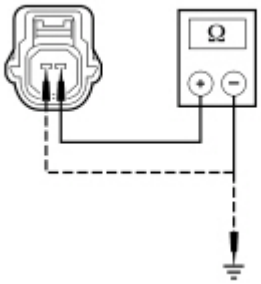
NOTE: Do not probe any impact sensor. The impact sensor cannot be tested using a multi-meter.

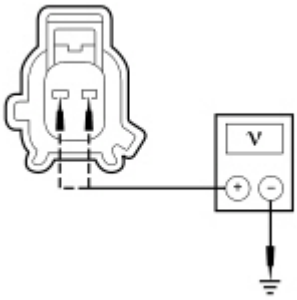
Test Step	Result / Action to Take
M1 RETRIEVE RCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Were any DTCs retrieved on-demand during self-test?**	**Yes** Fault(s) cannot be cleared until corrected and the DTC(s) are no longer retrieved on-demand during self-test. **SuperCab and Crew Cab Vehicles** For DTC B0091:11 **AND** B0097:11, GO to M2 . For DTC B0091:93 **AND** B0097:93, GO to M6 . For DTC B0091:93 **ONLY** , GO to M8 . For DTC B0097:93 **ONLY** , GO to M11 . **Regular Cab Vehicles** For DTC B0091:11, GO to M2 . For DTC B0091:93, GO to M8 . **No** The fault is intermittent when present as a CMDTC only. GO to M15 .
M2 CHECK THE LEFT SIDE RESTRAINTS SENSOR 1 DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED) **NOTE:** This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Front Door Side Impact Sensor C567 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver front	**Yes** INSTALL a new driver front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section. GO to M16 . **No** For SuperCab and Crew Cab vehicles, GO to M3 . For regular cab vehicles, GO to M4 .

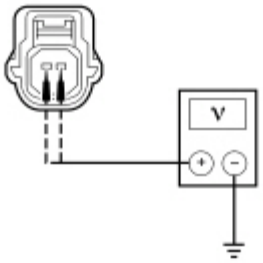
door side impact sensor disconnected, an open circuit (no operation) fault is normally retrieved. • **For SuperCab and Crew Cab vehicles, did the on-demand DTCs change from B0091:11 and B0097:11 to B0091:93?** **For regular cab vehicles, did the on-demand DTC change from B0091:11 to B0091:93?**	
M3 CHECK THE RIGHT SIDE RESTRAINTS SENSOR 2 DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	**Yes** INSTALL a new passenger second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section. GO to M16. **No** GO to M4.
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Driver Front Door Side Impact Sensor C567. • Disconnect: Passenger Second Row Side Impact Sensor C3249. • Repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM. • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger second row side impact sensor disconnected, an open circuit (no operation) fault is normally retrieved. • **Did the on-demand DTC change from B0091:11 and B0097:11 to B0097:93?**	
M4 CHECK THE DRIVER FRONT DOOR SIDE IMPACT SENSOR FEED CIRCUIT FOR A SHORT TO GROUND AND SHORT BETWEEN SENSOR CIRCUITS	**Yes** For SuperCab and Crew Cab vehicles, GO to M5. For regular cab vehicles, GO to M14. **No** REPAIR circuit VR217 (GY/YE) and/or RR131 (VT/GY). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to M16.

• Ignition OFF.
• Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Driver Front Door Side Impact Sensor C567 (if not previously disconnected).
• Disconnect: RCM C310A and C310B.
• Measure the resistance between driver front door side impact sensor:
  ▪ C567-1, circuit VR217 (GY/YE), harness side and ground.
  ▪ C567-1, circuit VR217 (GY/YE), harness side and C567-2, circuit RR131 (VT/GY), harness side.	

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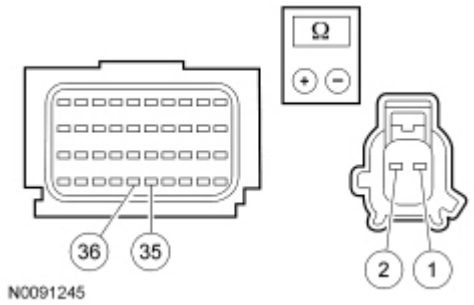
 N0106402 • **Are the resistances greater than 10,000 ohms?**	
M5 CHECK THE PASSENGER SECOND ROW SIDE IMPACT SENSOR FEED CIRCUIT FOR A SHORT TO GROUND AND SHORT BETWEEN SENSOR CIRCUITS	
• Measure the resistance between passenger second row side impact sensor: ▪ C3249-1, circuit VR220 (VT/OG), harness side and ground. ▪ C3249-1, circuit VR220 (VT/OG), harness side and C3249-2, circuit RR134 (BN/BU), harness side.  N0106403 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to M14 . **No** REPAIR circuit VR220 (VT/OG) and/or RR134 (BN/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to M16 .
M6 CHECK THE DRIVER FRONT DOOR SIDE IMPACT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B (if not previously disconnected) . • Disconnect: Driver Front Door Side Impact Sensor C567 (if not previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between driver front door side impact sensor: ▪ C567-1, circuit VR217 (GY/YE), harness side and ground. ▪ C567-2, circuit RR131 (VT/GY), harness side and ground.	**Yes** REPAIR circuit VR217 (GY/YE) or RR131 (VT/GY). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to M16 . **No** For SuperCab and Crew Cab vehicles, GO to M7 . For regular cab vehicles, GO to M9 .

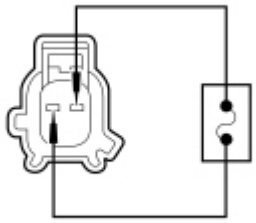
 N0052817 • **Is voltage present on either circuit?**	
M7 CHECK THE PASSENGER SECOND ROW SIDE IMPACT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE (NO OPERATION INDICATED)	

• Ignition OFF.
• Disconnect: Passenger Second Row Side Impact Sensor C3249 .
• Ignition ON.
• Measure the voltage between passenger second row side impact sensor:
  ▪ C3249-1, circuit VR220 (VT/OG), harness side and ground.
  ▪ C3249-2, circuit RR134 (BN/BU), harness side and ground.

N0036990
• **Is voltage present on either circuit?**
	Yes
	REPAIR circuit VR220 (VT/OG) or RR134 (BN/BU).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to M16 .
	
	No
	GO to M14 .

M8 CHECK THE DRIVER FRONT DOOR SIDE IMPACT SENSOR AND RCM CONNECTIONS (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Gain access to the driver front door side impact sensor and inspect C567 to be fully seated and locked. Seat and lock the connector as necessary. Refer to Side Impact Sensor — Front Door in this section. • Gain access to the RCM and inspect C310A and C310B to be fully seated and locked. Seat and lock the connector(s) as necessary. Refer to Restraints Control Module (RCM) in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON.	**Yes** For SuperCab and Crew Cab vehicles, GO to M9 . For regular cab vehicles, GO to M6 . **No** Fault corrected. GO to M16 .

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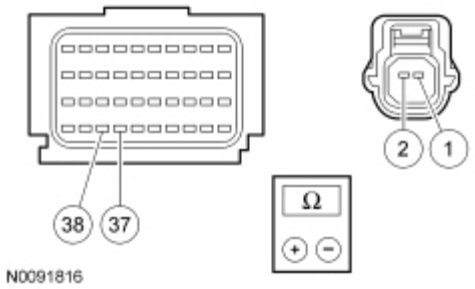
• Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0091:93 retrieved on-demand during self-test?**	
M9 CHECK THE DRIVER FRONT DOOR SIDE IMPACT SENSOR CIRCUITS FOR AN OPEN (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B (if not previously disconnected) . • Disconnect: Driver Front Door Side Impact Sensor C567 (if not previously disconnected) . • Measure the resistance between RCM C310B, harness side and driver front door side impact sensor C567, harness side using the following chart. **RCM** / **Circuit** / **Driver Front Door Side Impact Sensor** C310B-36 / VR217 (GY/YE) / C567-1 C310B-35 / RR131 (VT/GY) / C567-2  N0091245 • **Are the resistances less than 0.5 ohm?**	**Yes** GO to M10 . **No** REPAIR circuit VR217 (GY/YE) or RR131 (VT/GY). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to M16 .
M10 CHECK THE LEFT SIDE RESTRAINTS SENSOR 1 DTC FOR A FAULT STATUS CHANGE (NO OPERATION INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B . • Connect a fused jumper wire between driver front door side impact sensor C567-1, circuit VR217 (GY/YE), harness side and C567-2, circuit RR131 (VT/GY), harness side.	**Yes** REMOVE the fused jumper wire and INSTALL a new driver front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section. GO to M16 . **No** REMOVE the fused jumper wire and GO to M14 .

 N0109792 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver front door side impact sensor circuits shorted together, a short to ground fault is normally retrieved. • **For SuperCab and Crew Cab vehicles, did the DTC change from B0091:93 to B0091:11 and B0097:11?** **For regular cab vehicles, did the DTC change from B0091:93 to B0091:11?**	
M11 CHECK THE PASSENGER SECOND ROW SIDE IMPACT SENSOR AND RCM CONNECTIONS (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Gain access to the passenger second row side impact sensor and inspect C3249 to be fully seated and locked. Seat and lock the connector as necessary. Refer to Side Impact Sensor — Second Row in this section. • Gain access to the RCM and inspect C310A and C310B to be fully seated and locked. Seat and lock the connector(s) as necessary. Refer to Restraints Control Module (RCM) in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0097:93 retrieved on-demand during self-test?**	**Yes** GO to M12 . **No** Fault corrected. GO to M16 .
M12 CHECK THE PASSENGER SECOND ROW SIDE IMPACT SENSOR CIRCUITS FOR AN OPEN (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Disconnect: Passenger Second Row Side Impact Sensor C3249 . • Measure the resistance between RCM C310B, harness side	**Yes** GO to M13 . **No** REPAIR circuit VR220 (VT/OG) or RR134 (BN/BU).

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and passenger second row side impact sensor C3249, harness side using the following chart.

RCM	Circuit	Passenger Second Row Side Impact Sensor
C310B-37	VR220 (VT/OG)	C3249-1
C310B-38	RR134 (BN/BU)	C3249-2



N0091816

- **Are the resistances less than 0.5 ohm?**

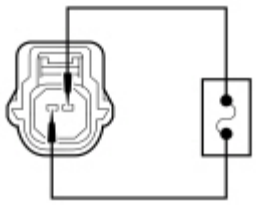
Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to M16 .

M13 CHECK THE RIGHT SIDE RESTRAINTS SENSOR 2 DTC FOR A FAULT STATUS CHANGE (NO OPERATION INDICATED)

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

- Connect: RCM C310A and C310B .
- Connect a fused jumper wire between passenger second row side impact sensor C3249-1, circuit VR220 (VT/OG), harness side and C3249-2, circuit RR134 (BN/BU), harness side.


N0109791

- Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: Self Test — RCM .
- **DIAGNOSTIC TIP:** When viewing DTCs with the passenger

Yes
REMOVE the fused jumper wire and INSTALL a new passenger second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section. GO to M16 .

No
REMOVE the fused jumper wire and GO to M14 .

second row side impact sensor circuits shorted together, a short to ground fault is normally retrieved. • **Did the DTC change from B0097:93 to B0097:11 and B0091:11?**	
M14 CONFIRM THE RCM FAULT **NOTE:** Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: RCM C310A and C310B . • Connect: Driver Front Door Side Impact Sensor C567 (if previously disconnected) . • Connect: Passenger Second Row Side Impact Sensor C3249 (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to M16 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to M15 .
M15 CHECK FOR AN INTERMITTENT FAULT • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Affected Impact Sensor Driver Front Door Side Impact Sensor C567 and/or Passenger Second Row Side Impact Sensor C3249 (if equipped) . • Disconnect: RCM C310A and C310B . • Inspect for the following: ▪ inspect harness and component connectors for loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B CPA lever/lock for	**Yes** Fault(s) cannot be cleared until corrected and the DTC(s) are no longer retrieved on-demand during self-test. **SuperCab and Crew Cab Vehicles** For DTC B0091:11 **AND** B0097:11, GO to M2 . For DTC B0091:93 **AND** B0097:93, GO to M6 .

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correct operation. Refer to Restraints Control Module (RCM) in this section. ■ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component (s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0091:11, B0091:93, B0097:11 or B0097:93 retrieved on-demand during self-test?**	For DTC B0091:93 **ONLY** , GO to M8 . For DTC B0097:93 **ONLY** , GO to M11 . **Regular Cab Vehicles** For DTC B0091:11, GO to M2 . For DTC B0091:93, GO to M8 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to M16 .
M16 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • If not previously directed to do so, depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Reconnect all SRS components (if previously disconnected). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test N: DTCs B0092:11, B0092:93, B0096:11 and B0096:93

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the passenger front door impact sensor, driver second row side impact sensor (SuperCab and Crew Cab vehicles only) circuits for the following faults:

- Open circuit
- Short to voltage
- Short to ground
- Faulted passenger front door side impact sensor
- Faulted driver second row side impact sensor (SuperCab and Crew Cab vehicles only)

If a fault is detected, the RCM stores DTC B0092:11, B0092:93, B0096:11 or B0096:93 in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM communicates with each impact sensor, if the RCM is unable to communicate with the sensor, a DTC is stored in memory. A Continuous Memory Diagnostic Trouble Code (CMDTC) **no operation** (failure type :93) can be set by a short to voltage on the return circuit of the impact sensor.

NOTE: A short to ground on either impact sensor feed circuit sets DTCs B0092:11 and B0096:11 on SuperCab and Crew Cab vehicles.

A short to voltage on either impact sensor feed or return circuit sets DTCs B0092:93 and B0096:93 on SuperCab and Crew Cab vehicles.

DTC Description	Fault Trigger Condition
• B0092:11 — Left Side Restraints Sensor 2: Circuit Short to Ground	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a shorted passenger front door side impact sensor, a shorted driver second row side impact sensor, a short to ground on the passenger front door side impact sensor feed circuit or a short to ground on the driver second row side impact sensor feed circuit.
• B0092:93 — Left Side Restraints Sensor 2: No Operation	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a faulted driver second row side impact sensor, a short to voltage on the feed or return circuit of driver second row side impact sensor, a short to voltage on the feed or return circuit of the passenger front door side impact sensor or an open feed or return circuit of the driver second row side impact sensor.
• B0096:11 — Right Side Restraints Sensor 1: Circuit Short to Ground	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a shorted passenger front door side impact sensor, a shorted driver second row side impact sensor, a short to ground on the passenger front door side impact sensor feed circuit or a short to ground on the driver second row side impact sensor feed circuit. For regular cab vehicles, a fault is indicated when the RCM senses a shorted passenger front door side impact sensor or a short to ground on the passenger front door side impact sensor feed circuit.
• B0096:93 — Right Side Restraints Sensor 1: No Operation	For SuperCab and Crew Cab vehicles, a fault is indicated when the RCM senses a faulted passenger front door side impact sensor, a short to voltage on the feed or return circuit of the passenger front door side impact sensor, a short to voltage on the feed or return circuit of driver second row side impact sensor or an open feed or return circuit of the passenger front door side impact sensor. For regular cab vehicles, a fault is indicated when the RCM senses a faulted passenger front door side impact sensor, a short to voltage on the feed or return circuit of the passenger front door side impact sensor or an open feed or return circuit of the passenger front door side impact sensor.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Passenger front door side impact sensor
- Driver second row side impact sensor
- RCM

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PINPOINT TEST N: DTCs B0092:11, B0092:93, B0096:11 AND B0096:93

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

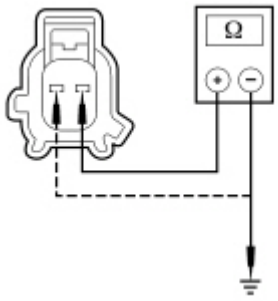
NOTE: Do not probe any impact sensor. The impact sensor cannot be tested using a multi-meter.

Test Step	Result / Action to Take
N1 RETRIEVE RCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Were any DTCs retrieved on-demand during self-test?**	**Yes** Fault(s) cannot be cleared until corrected and the DTC(s) are no longer retrieved on-demand during self-test. **SuperCab and Crew Cab Vehicles** For DTC B0092:11 **AND** B0096:11, GO to N2 . For DTC B0092:93 **AND** B0096:93, GO to N6 . For DTC B0092:93 **ONLY** , GO to N11 . For DTC B0096:93 **ONLY** , GO to N8 . **Regular Cab Vehicles** For DTC B0096:11, GO to N2 .

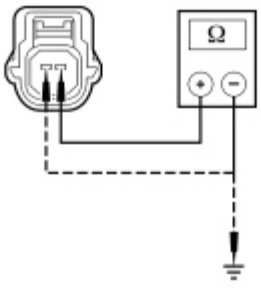
	For DTC B0096:93, GO to N8 . **No** The fault is intermittent when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. GO to N15 .
N2 CHECK THE RIGHT SIDE RESTRAINTS SENSOR 1 DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Passenger Front Door Side Impact Sensor C644 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the passenger front door side impact sensor disconnected, an open circuit (no operation) fault is normally retrieved. • **For SuperCab and Crew Cab vehicles, did the on-demand DTCs change from B0092:11 and B0096:11 to B0096:93?** **For regular cab vehicles, did the on-demand DTC change from B0096:11 to B0096:93?**	**Yes** INSTALL a new passenger front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section. GO to N16 . **No** For SuperCab and Crew Cab vehicles, GO to N3 . For regular cab vehicles, GO to N4 .
N3 CHECK THE LEFT SIDE RESTRAINTS SENSOR 2 DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Passenger Front Door Side Impact Sensor C644 . • Disconnect: Driver Second Row Side Impact Sensor C3248 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver second row side impact sensor disconnected, an open	**Yes** INSTALL a new driver second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section. GO to N16 . **No** GO to N4 .

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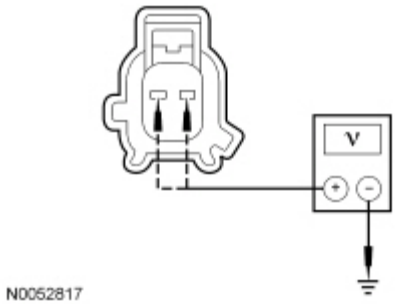
circuit (no operation) fault is normally retrieved. • **Did the on-demand DTC change from B0092:11 and B0096:11 to B0092:93?**	
N4 CHECK THE PASSENGER FRONT DOOR SIDE IMPACT SENSOR FEED CIRCUIT FOR A SHORT TO GROUND AND SHORT BETWEEN SENSOR CIRCUITS	

• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Passenger Front Door Side Impact Sensor C644 (if not previously disconnected) .
• Disconnect: RCM C310A and C310B .
• Measure the resistance between passenger front door side impact sensor:
  ▪ C644-1, circuit VR218 (YE/OG), harness side and ground.
  ▪ C644-1, circuit VR218 (YE/OG), harness side and C644-2, circuit RR132 (BU/WH), harness side.

 	
N0106402
• **Are the resistances greater than 10,000 ohms?**
	Yes
	For SuperCab and Crew Cab vehicles, GO to N5 .
	
	For regular cab vehicles, GO to N14 .
	
	No
	REPAIR circuit VR218 (YE/OG) and/or RR132 (BU/WH).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to N16 .

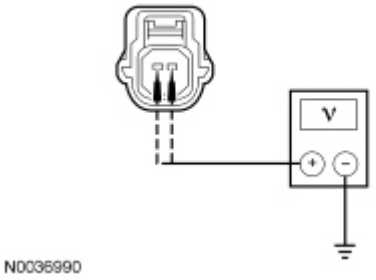
N5 CHECK THE DRIVER SECOND ROW SIDE IMPACT SENSOR FEED CIRCUIT FOR A SHORT TO GROUND AND SHORT BETWEEN SENSOR CIRCUITS	

• Measure the resistance between driver second row side impact sensor:
  ▪ C3248-1, circuit VR219 (GN/WH), harness side and ground.
  ▪ C3248-1, circuit VR219 (GN/WH), harness side and C3248-2, circuit RR133 (GY/BN), harness side.

 	
N0106403
• **Are the resistances greater than 10,000 ohms?**
	Yes
	GO to N14 .
	
	No
	REPAIR circuit VR219 (GN/WH) and/or RR133 (GY/BN).
	
	Refer to Wiring Diagrams Cell 5 for schematic and connector information.
	
	GO to N16 .

N6 CHECK THE PASSENGER FRONT DOOR SIDE IMPACT	

SENSOR CIRCUITS FOR A SHORT TO VOLTAGE (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B (if not previously disconnected) . • Disconnect: Passenger Front Door Side Impact Sensor C644 (if not previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between passenger front door side impact sensor: ▪ C644-1, circuit VR218 (YE/OG), harness side and ground. ▪ C644-2, circuit RR132 (BU/WH), harness side and ground.  N0052817 • **Is voltage present on either circuit?**	**Yes** REPAIR circuit VR218 (YE/OG) or RR132 (BU/WH). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to N16 . **No** For SuperCab and Crew Cab vehicles, GO to N7 . For regular cab vehicles, GO to N9 .
N7 CHECK THE DRIVER SECOND ROW SIDE IMPACT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Driver Second Row Side Impact Sensor C3248 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between driver second row side impact sensor: ▪ C3248-1, circuit VR219 (GN/WH), harness side and ground. ▪ C3248-2, circuit RR133 (GY/BN), harness side and ground.	**Yes** REPAIR circuit VR219 (GN/WH) or RR133 (GY/BN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to N16 . **No** GO to N14 .

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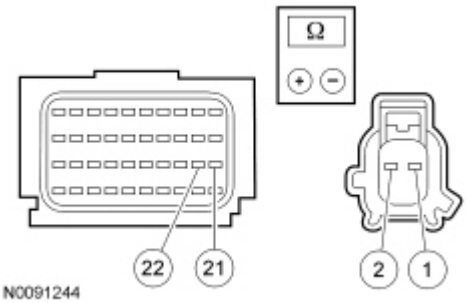


- **Is voltage present on either circuit?**

N8 CHECK THE PASSENGER FRONT DOOR SIDE IMPACT SENSOR AND RCM CONNECTIONS (NO OPERATION INDICATED)	
• Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Gain access to the passenger front door side impact sensor and inspect C644 to be fully seated and locked. Seat and lock the connector as necessary. Refer to Side Impact Sensor — Front Door in this section. • Gain access to the RCM and inspect C310A and C310B to be fully seated and locked. Seat and lock the connector(s) as necessary. Refer to Restraints Control Module (RCM) in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0096:93 retrieved on-demand during self-test?**	**Yes** For SuperCab and Crew Cab vehicles, GO to N9 . For regular cab vehicles, GO to N6 . **No** Fault corrected. GO to N16 .
N9 CHECK THE PASSENGER FRONT DOOR SIDE IMPACT SENSOR CIRCUITS FOR AN OPEN (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B (if not previously disconnected) . • Disconnect: Passenger Front Door Side Impact Sensor C644 (if not previously disconnected) . • Measure the resistance between RCM C310B, harness side and passenger front door side impact sensor C644, harness side using the following chart.	**Yes** GO to N10 . **No** REPAIR circuit VR218 (YE/OG) or RR132 (BU/WH). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to N16 .

RCM	Circuit	Passenger Front Door Side Impact Sensor

C310B-22	VR218 (YE/OG)	C644-1
C310B-21	RR132 (BU/WH)	C644-2

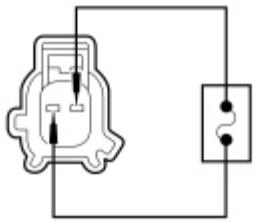


- **Are the resistances less than 0.5 ohm?**

N10 CHECK THE RIGHT SIDE RESTRAINTS SENSOR 1 DTC FOR A FAULT STATUS CHANGE (NO OPERATION INDICATED)

NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

- Connect: RCM C310A and C310B .
- Connect a fused jumper wire between passenger front door side impact sensor C644-1, circuit VR218 (YE/OG), harness side and C644-2, circuit RR132 (BU/WH), harness side.



- Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: Self Test — RCM .
- **DIAGNOSTIC TIP:** When viewing DTCs with the passenger front door side impact sensor circuits shorted together, a short to ground fault is normally retrieved.
- **For SuperCab and Crew Cab vehicles, did the DTC change from B0096:93 to B0092:11 and B0096:11?**

  For regular cab vehicles, did the DTC change from B0096:93 to B0096:11?

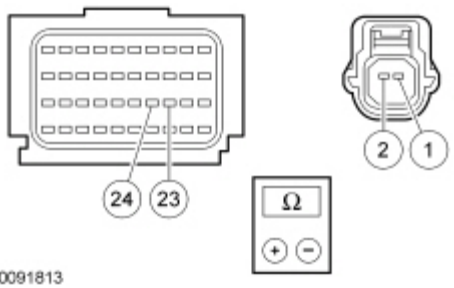
Yes
REMOVE the fused jumper wire and INSTALL a new passenger front door side impact sensor. REFER to Side Impact Sensor — Front Door in this section. GO to N16 .

No
REMOVE the fused jumper wire and GO to N14 .

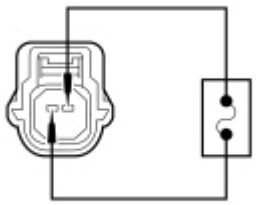
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N11 CHECK THE DRIVER SECOND ROW SIDE IMPACT SENSOR AND RCM CONNECTIONS (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Gain access to the driver second row side impact sensor and inspect C3248 to be fully seated and locked. Seat and lock the connector as necessary. Refer to Side Impact Sensor — Second Row in this section. • Gain access to the RCM and inspect C310A and C310B to be fully seated and locked. Seat and lock the connector(s) as necessary. Refer to Restraints Control Module (RCM) in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0092:93 retrieved on-demand during self-test?**	**Yes** GO to N12 . **No** Fault corrected. GO to N16 .
N12 CHECK THE DRIVER SECOND ROW SIDE IMPACT SENSOR CIRCUITS FOR AN OPEN (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Disconnect: Driver Second Row Side Impact Sensor C3248 . • Measure the resistance between RCM C310B, harness side and driver second row side impact sensor C3248, harness side using the following chart.	**Yes** GO to N13 . **No** REPAIR circuit VR219 (GN/WH) or RR133 (GY/BN). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to N16 .

RCM	Circuit	Driver Second Row Side Impact Sensor
C310B-23	VR219 (GN/WH)	C3248-1
C310B-24	RR133 (GY/BN)	C3248-2



- **Are the resistances less than 0.5 ohm?**

N13 CHECK THE LEFT SIDE RESTRAINTS SENSOR 2 DTC FOR A FAULT STATUS CHANGE (NO OPERATION INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B . • Connect a fused jumper wire between driver second row side impact sensor C3248-1, circuit VR219 (GN/WH), harness side and C3248-2, circuit RR133 (GY/BN), harness side.  N0109791 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver second row side impact sensor circuits shorted together, a short to ground fault would normally be retrieved. • **Did the DTC change from B0092:93 to B0092:11 and B0096:11?**	**Yes** REMOVE the fused jumper wire and INSTALL a new driver second row side impact sensor. REFER to Side Impact Sensor — Second Row in this section. GO to N16 . **No** REMOVE the fused jumper wire and GO to N14 .
N14 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5 , Connector Repair	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to N16 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to N15 .

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Procedures for schematic and connector information. • Connect: RCM C310A and C310B . • Connect: Passenger Front Door Side Impact Sensor C644 (if previously disconnected) . • Connect: Driver Second Row Side Impact Sensor C3248 (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	

N15 CHECK FOR AN INTERMITTENT FAULT
 	
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Disconnect: Affected Impact Sensor Passenger Front Door Side Impact Sensor C644 and/or Driver Second Row Side Impact Sensor C3248 (if equipped) .
• Disconnect: RCM C310A and C310B .
• Inspect for the following:
  ▪ inspect harness and component connectors for loose or spread terminals and loose or frayed wire connections at terminals.
  ▪ inspect wire harness for any damage, pinched, cut or pierced wires.
  ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section.
  ▪ repair any concerns found.
 	
Refer to Wiring Diagrams Cell 5 , Connector Repair Procedures for schematic and connector information.
 	
• Connect: All Previously Disconnected Component (s)/Connector(s) .
• Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
• Ignition ON.
• Enter the following diagnostic mode on the scan tool: Self Test — RCM .
• **Was DTC B0092:11, B0092:93, B0096:11 or B0096:93 retrieved on-demand during self-test?**
	Yes
	Fault(s) cannot be cleared until corrected and the DTC(s) are no longer retrieved on-demand during self-test.
	
	SuperCab and Crew Cab Vehicles
	
	For DTC B0092:11 **AND** B0096:11, GO to N2 .
	
	For DTC B0092:93 **AND** B0096:93, GO to N6 .
	
	For DTC B0092:93 **ONLY** , GO to N11 .
	
	For DTC B0096:93 **ONLY** , GO to N8 .
	
	Regular Cab Vehicles
	
	For DTC B0096:11, GO to N2 .
	
	For DTC B0096:93, GO to N8 .
	
	No
	The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to N16 .

N16 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • If not previously directed to do so, depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Reconnect all SRS components (if previously	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction.

disconnected). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test O: DTCs B0095:11 and 0095:93

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the RH front impact severity sensor circuits for the following faults:

- Open circuit
- Short to voltage
- Short to ground
- Faulted RH front impact severity sensor

If a fault is detected, the RCM stores DTC B0095:11 or B0095:93 in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

- B0095:11 (Right Frontal Restraints Sensor: Circuit Short to Ground) — A fault is indicated when the RCM senses a short to ground on the RH front impact severity sensor feed circuit.
- B0095:93 (Right Frontal Restraints Sensor: No Operation) — A fault is indicated when the RCM senses a faulted sensor, a short to voltage on the feed circuit or an open feed or return circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- RH front impact severity sensor
- RCM

PINPOINT TEST O: DTCs B0095:11 AND B0095:93

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and

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verification before proceeding with the pinpoint test.

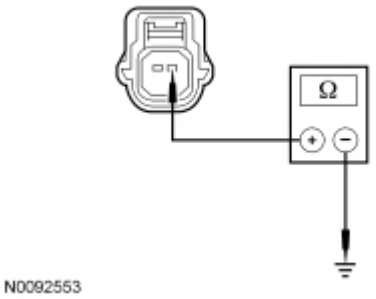
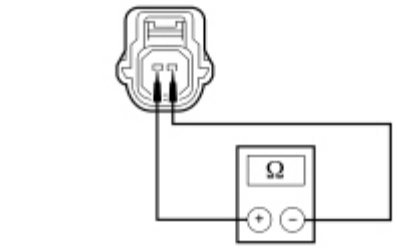
NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: Do not probe any impact sensor. The impact sensor cannot be tested using a multi-meter.

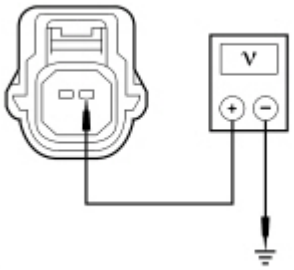
Test Step	Result / Action to Take
O1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0095:11 or B0095:93 retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0095:11, GO to O2 . For DTC B0095:93, GO to O5 . **No** The fault is intermittent when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. GO to O10 .
O2 CHECK THE RIGHT FRONTAL RESTRAINTS SENSOR DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RH Front Impact Severity Sensor C1466 . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Did the on-demand DTC change from B0095:11 to B0095:93?**	**Yes** INSTALL a new RH front impact severity sensor. REFER to Front Impact Severity Sensor in this section. GO to O11 . **No** GO to O3 .
O3 CHECK THE RH FRONT IMPACT SEVERITY SENSOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF.	**Yes**

• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B . • Measure the resistance between RH front impact severity sensor C1466-1, circuit VR214 (WH/BU), harness side and ground.  N0092553 • **Is the resistance greater than 10,000 ohms?**	GO to O4 . **No** REPAIR circuit VR214 (WH/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to O11 .
O4 CHECK FOR A SHORT BETWEEN RH FRONT IMPACT SEVERITY SENSOR CIRCUITS	
• Measure the resistance between RH front impact severity sensor C1466-1, circuit VR214 (WH/BU), harness side and C1466-2, circuit RR130 (GN/BU), harness side.  N0036987 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O9 . **No** REPAIR circuits VR214 (WH/BU) and RR130 (GN/BU). Refer to Wiring Diagrams Cell 5 for schematic and connector information. GO to O11 .
O5 CHECK THE RH FRONT IMPACT SEVERITY SENSOR AND RCM CONNECTIONS (NO OPERATION INDICATED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Inspect RH front impact severity sensor C1466 to be fully seated and locked. Seat and lock the connector as necessary. • Gain access to the RCM and inspect C310A and C310B to be fully seated and locked. Refer to Restraints Control Module (RCM) in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0095:93 retrieved on-demand during self-test?**	**Yes** GO to O6 . **No** Fault corrected. GO to O11 .

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O6 CHECK THE RH FRONT IMPACT SEVERITY SENSOR FEED CIRCUIT FOR A SHORT TO VOLTAGE (NO OPERATION INDICATED)

- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Disconnect: RH Front Impact Severity Sensor C1466 .
- Disconnect: RCM C310A and C310B .
- Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Ignition ON.
- Measure the voltage between RH front impact severity sensor:
  - C1466-1, circuit VR214 (WH/BU), harness side and ground.



N0105003

- **Is any voltage present?**

Yes
REPAIR circuit VR214 (WH/BU).

Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to O11 .

No
GO to O7 .

O7 CHECK THE RH FRONT IMPACT SEVERITY SENSOR CIRCUITS FOR AN OPEN (NO OPERATION INDICATED)

- Ignition OFF.
- Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.
- Measure the resistance between RCM C310B, harness side and RH front impact severity sensor C1466, harness side using the following chart.

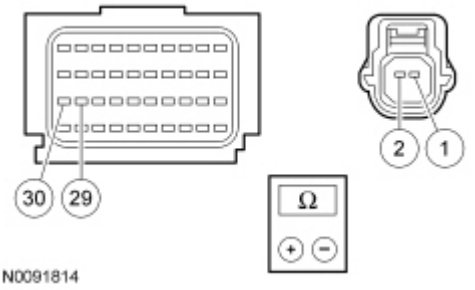
RCM	Circuit	RH Front Impact Severity Sensor
C310B-30	VR214 (WH/BU)	C1466-1
C310B-29	RR130 (GN/BU)	C1466-2

Yes
GO to O8 .

No
REPAIR circuit VR214 (WH/BU) or RR130 (GN/BU).

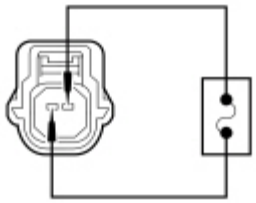
Refer to Wiring Diagrams Cell 5 for schematic and connector information.

GO to O11 .



N0091814

- **Are the resistances less than 0.5 ohm?**

O8 CHECK THE RIGHT FRONTAL RESTRAINTS SENSOR DTC FOR A FAULT STATUS CHANGE (NO OPERATION INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B . • Connect a fused jumper wire between RH front impact severity sensor C1466-1, circuit VR214 (WH/BU), harness side and C1466-2, circuit RR130 (GN/BU), harness side.  N0109791 • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Did the DTC change from B0095:93 to B0095:11?**	**Yes** REMOVE the fused jumper wire and INSTALL a new RH front impact severity sensor. REFER to Front Impact Severity Sensor in this section. GO to O11 . **No** REMOVE the fused jumper wire and GO to O9 .
O9 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Prior to reconnecting any previously disconnected SRS component: ▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to O11 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the**

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▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5, Connector Repair Procedures for schematic and connector information. • Connect: RH Front Impact Severity Sensor C1466 . • Connect: RCM C310A and C310B (if previously disconnected) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was the original DTC retrieved on-demand during self-test?**	**pinpoint test.** GO to O10 .
O10 CHECK FOR AN INTERMITTENT FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RH Front Impact Severity Sensor C1466 . • Disconnect: RCM C310A and C310B . • Inspect for the following: ▪ inspect harness and component connectors for loose or spread terminals and loose or frayed wire connections at terminals. ▪ inspect wire harness for any damage, pinched, cut or pierced wires. ▪ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ▪ repair any concerns found. Refer to Wiring Diagrams Cell 5, Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component (s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B0095:11 or B0095:93 retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0095:11, GO to O2 . For DTC B0095:93, GO to O5 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to O11 .
O11 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • If not previously directed to do so, depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to

Repowering in this section. • Reconnect all SRS components (if previously disconnected). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . The repair is complete. RETURN the vehicle to the customer.

Pinpoint Test R: DTCs B00A0:09, B00A0:4A, B00A0:63, B00A0:64 and B00A0:68

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) is in constant communication with various control modules on the High Speed Controller Area Network (HS-CAN), one of them is the Occupant Classification System Module (OCSM). The RCM continuously monitors the HS-CAN for fault messages reported by the OCSM . The RCM also checks for the correct identification of the OCSM . If the RCM receives fault message(s) from the OCSM , it stores DTC B00A0:09, B00A0:4A, B00A0:63, B00A0:64 or B00A0:68 in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

This pinpoint test is intended to diagnose the following:

- OCSM
- RCM

DTC Description	Fault Trigger Condition
• B00A0:09 — Occupant Classification System: Component Failures	A fault is indicated when the RCM receives a message from the OCSM that a fault exists within the OCS .
• B00A0:4A — Occupant Classification System: Incorrect Component Installed	A fault is indicated when the RCM senses the OCSM is present but not configured.
• B00A0:63 — Occupant Classification System: Circuit / Component Protection Time-Out	A fault is indicated when the RCM receives 8 or more invalid states from the OCSM .
• B00A0:64 — Occupant Classification System: Signal Plausibility Failure	A fault is indicated when the RCM receives messages containing upper or lower data limits other than limits stored in memory.
• B00A0:68 — Occupant Classification System: Event Information	A fault is indicated when the RCM receives a message from the OCSM containing incorrect data.

PINPOINT TEST R: DTCs B00A0:09, B00A0:4A, B00A0:63, B00A0:64 AND B00A0:68

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WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

***NOTICE:* Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
R1 RETRIEVE RCM DTCs • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B00A0:09, B00A0:4A, B00A0:63, B00A0:64 or B00A0:68 retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B00A0:09, B00A0:63 or B00A0:68, RETRIEVE DTCs from the OCSM and REFER to the Occupant Classification System Module (OCSM) DTC Chart for diagnostic direction. For DTC B00A0:4A or B00A0:64, GO to R2 . **No** CHECK for causes of the intermittent fault. Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

	ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition frequently. **Do not install any new SRS components at this time. Install SRS components only when directed to do so in the pinpoint test.** GO to R5.
R2 VERIFY THE OCSM PART NUMBER • Enter the following diagnostic mode on the scan tool: Log Viewer . • Retrieve and record the OCSM part number from Log Viewer. • Check the part number recorded against the part number listed in the parts catalog. • **Is the correct OCSM installed in the vehicle?**	**Yes** GO to R3. **No** INSTALL the correct OCSM. REFER to Occupant Classification System Module (OCSM) in this section. GO to R5.
R3 VERIFY THE RCM PART NUMBER • Retrieve and record the RCM part number from Log Viewer. • Check the part number recorded against the part number listed in the parts catalog. • **Is the correct RCM installed in the vehicle?**	**Yes** GO to R4. **No** INSTALL the correct RCM. REFER to Restraints Control Module (RCM) in this section. GO to R5.
R4 CHECK THE RCM • Ignition ON. • Carry out Programmable Module Installation (PMI) for the RCM. Manually enter As-Built data. Refer to Section 418-01. • Enter the following diagnostic mode on the scan tool: Self Test — RCM. • **Was DTC B00A0:4A retrieved on-demand during self-test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to R5. **No** Fault corrected. GO to R5.
R5 CHECK FOR ADDITIONAL SRS DTCs • Ignition OFF. • **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS, repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — Restraints . • **NOTE:** When selecting Restraints from the Self Test menu, DTCs are retrieved from the RCM and OCSM. • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs. PROVE OUT the SRS. The repair is complete. RETURN the vehicle to the customer.

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Pinpoint Test S: DTCs B00B5:11, B00B5:12, B00B5:13 and B00B5:1D

Refer to Wiring Diagrams Cell 46 , Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) monitors the driver seat track position sensor circuits for the following faults:

- Short to ground
- Short to voltage
- Open circuit
- Current out of range
- Faulted driver seat track position sensor

If a fault is detected, the RCM stores DTC B00B5:11, B00B5:12, B00B5:13 or B00B5:1D in memory and sends a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

DTC Description	Fault Trigger Condition
• B00B5:11 — Driver Seat Track Position Restraints Sensor: Circuit Short to Ground	A fault is indicated when the RCM senses a short to ground on the driver seat track position sensor circuit.
• B00B5:12 — Driver Seat Track Position Restraints Sensor: Circuit Short to Battery	A fault is indicated when the RCM senses a short to voltage on the driver seat track position sensor circuit.
• B00B5:13 — Driver Seat Track Position Restraints Sensor: Circuit Open	A fault is indicated when the RCM senses an open on the driver seat track position sensor circuit. An open driver seat track position sensor ground circuit sets this fault.
• B00B5:1D — Driver Seat Track Position Restraints Sensor: Circuit Current Out of Range	A fault is indicated when the RCM senses current out of an acceptable range between the driver seat track position sensor circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Driver seat track position sensor
- RCM

PINPOINT TEST S: DTCs B00B5:11, B00B5:12, B00B5:13 AND B00B5:1D

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Only disconnect or reconnect Supplemental Restraint System (SRS) components when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the parts catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
S1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test — RCM . • **Was DTC B00B5:11, B00B5:12, B00B5:13 or B00B5:1D retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B00B5:11 or B00B5:1D, GO to S2 . For DTC B00B5:12, GO to S4 . For DTC B00B5:13, GO to S5 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. GO to S10 .
S2 CHECK THE DRIVER SEAT TRACK POSITION RESTRAINTS SENSOR DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND OR CURRENT OUT OF RANGE INDICATED)	
NOTE: This pinpoint test step attempts to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is	**Yes** GO to S8 .

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Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

WARNING: Remove restraint system diagnostic tools from the vehicle prior to road testing. If tools are not removed, the supplemental restraint system (SRS) device may not deploy in a crash. Failure to follow this instruction may result in serious personal injury or death in a crash and possibly violate vehicle safety standards.

NOTE: After diagnosing or repairing a SRS , the restraint system diagnostic tools (if required) must be removed before operating the vehicle over the road.

NOTE: Deployable devices (such as air bag modules, pretensioners) may deploy alone or in various combinations depending on the impact event.

NOTE: Always refer to the appropriate workshop manual procedures prior to carrying out vehicle repairs affecting the SRS and safety belt system.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. **NOTE:** Refer to the correct removal and installation procedure for all SRS components being installed.

   When any deployable device or combination of devices have deployed and/or the RCM has DTC B1231/B1193:00 (Event Threshold Exceeded) in memory, the repair of the vehicle SRS is to include the removal of all deployed devices and the installation of new deployable devices, the removal and installation of new impact sensors and the removal and installation of a new RCM . DTCs must be cleared from all required modules after repairs are carried out.

Vehicles with an OCS

2. **NOTE:** After installation of new OCS components, carry out the OCS Reset procedure as instructed in the workshop manual. Refer to the appropriate workshop manual for OCS removal and installation procedure.

   When a vehicle has been involved in a collision and the OCSM has DTC B1231/B1193:00 stored in memory, the repair of the OCS is to include the following procedures for the specified system:
   - For rail-type OCS , inspect the passenger side floorpan for damage and repair as necessary. Install new OCS rails. Do not install a new OCSM unless DTC B1231 cannot be cleared.
   - For weight sensor bolt-type OCS , inspect the passenger side floorpan for damage and repair as necessary. Install a new seat track with OCS weight sensor bolts. DTC must be cleared from the OCSM before carrying out OCS Reset. Do not install a new OCSM unless DTC B1231/B1193:00 cannot be cleared.
   - For bladder-type OCS , inspect for damage and repair as necessary. If installation of an OCS component is required, an OCS service kit must be installed.

All vehicles

3. When any damage to the impact sensor mounting points or mounting hardware has occurred, repair or install new mounting points and mounting hardware as needed.

4. When the driver air bag module has deployed, a new clockspring must be installed.

5. New driver and/or front passenger safety belt systems (including retractors, buckles, anchors and height adjusters) must be installed if the vehicle is involved in a collision that results in deployment of the driver and/or front passenger safety belt pretensioners. For additional information, refer to Section 501-20A .

6. Inspect the entire vehicle for damage, including the following components:
   - Steering column (deployable column if equipped)
   - Instrument panel knee bolsters and mounting points
   - Instrument panel braces and brackets
   - Instrument panel and mounting points
   - Seats and seat mounting points
   - Safety belts, safety belt buckles, safety belt retractors and safety belt anchors. For additional information, refer to Section 501-20A .
   - SRS wiring, wiring harnesses and connectors

7. After carrying out the review and inspection of the entire vehicle for damage, repair or install new components as needed.

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Occupant Classification Sensor (OCS) System Reset

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

WARNING: The following precautions must be taken before carrying out the following procedure on the front passenger seat:

- **Park the vehicle on level ground.**
- **Make sure the occupant classification system (OCS) is stabilized at a temperature in the range of 5□C to 48□C (41□F to 118□F) and is not exposed to temperatures outside that range.**
- **Make sure the front passenger seat is empty and dry.**
- **Make sure the front passenger seat repair is complete and all attached components (head restraint, seat side shield) are correctly installed.**
- **Make sure nothing is placed in the map pockets (if equipped) of the front passenger seat.**
- **Make sure nothing is underneath the front passenger seat.**
- **Make sure no non-factory installed items (seat covers, DVD screens) are on or contacting the front passenger seat. If any non-factory items were installed to the seat, remove the item(s) and communicate to the customer that any alteration/modification to the front passenger seat may affect performance of the OCS. Refer to the Owner's Literature.**
- **Make sure the seat is correctly installed in the vehicle.**

Failure to follow these instructions may result in incorrect operation of the OCS and increases the risk of serious personal injury or death in a crash.

After Deployment

NOTE: After installation of new OCS system components and completion of Inspection and Repair After a Supplemental Restraint System (SRS) Deployment , the OCSM will have DTCs stored in memory. These DTCs will clear after a successful System Reset.

1. Check that all steps have been carried out as outlined in the Inspection and Repair After a Supplemental Restraint System (SRS) Deployment procedure in this section.

2. If no concerns are found, **proceed to Step 4 to carry out the System Reset** .

No Deployment

NOTE: After installation of new OCS system components (seat track assembly or OCSM), the OCSM will have DTCs stored in memory. These DTCs will clear after a successful System Reset.

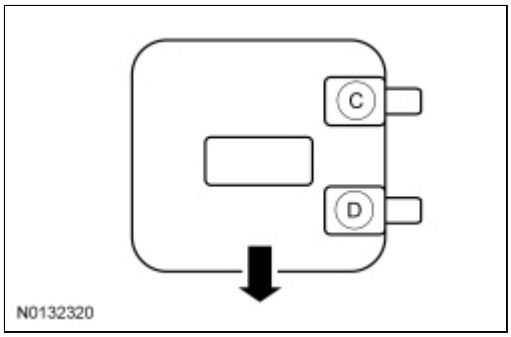
3. Carry out the RCM self-test. If DTC B00A0:09 is retrieved on-demand, retrieve OCSM DTCs.

- If DTCs are retrieved on-demand in the OCSM and **NO** new components have been installed, refer to the Occupant Classification System Module (OCSM) DTC Chart for diagnostic direction.
- If no DTCs are retrieved on-demand in the OCSM , CLEAR the DTC from the RCM and carry out the System Reset.

OCS System Reset

4. Turn the ignition to the OFF position.

5. Prepare the passenger seat for a System Reset and make sure:
   - the OCS weight sensor bolt harness connections are correct for each sensor at the correct locations. Refer to Wiring Diagrams cell 46 for schematic and connector information. Refer to the illustration for correct sensor location on the seat.
   - the seat wiring harnesses are routed and secured correctly and are not twisted, pinched, pulling down or pushing up on any seat component. Refer to Seat Wire Harness Routing in Section 501-10 .
   - all seat fasteners have been tightened to specification as identified in the Workshop Manual. Refer to Section 501-10 .
   - the seat track is correctly aligned (manual seat track) — check the seat track fastener hole alignment, lift the seat adjust bar to align the holes in the track bracket to the holes in the floor.
   - the seat is correctly installed in the vehicle.
   - the passenger safety belt buckle is unbuckled.
   - the front passenger seat is empty and there is nothing underneath the seat. Remove any items from the seat that were not factory installed.
   - the seat backrest is in the upright (vertical) position.
   - the seat is at the mid-point of the seat track travel.
   - the seat height is in its middle position (power seat only).
   - the hysteresis has been removed from the front passenger seat by firmly hitting the back of the seat head restraint 3 times.
   - the vehicle electrical system voltage is **below 18 volts and above 11.5 volts** before continuing with the OCS System Reset.



6. Turn the ignition ON, **wait 8 seconds** .

7. Carry out the OCS System Reset.
   - If the System Reset was successful, carry out the Occupant Classification System (OCS) Zero Seat Weight Test. Refer to Occupant Classification Sensor (OCS) System Zero Seat Weight Test in this section.
   - If the System Reset was unsuccessful, **proceed to Step 8** .

8. **NOTE: Do not install any new OCS system components at this time. OCS system components should only be installed when directed to do so.**

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Carry out the OCSM self-test.

- If DTC B00A0:54 is retrieved on-demand, refer to the DTC Charts for diagnostic direction of this DTC.
- If any other DTCs are retrieved on-demand from the OCSM , **proceed to Step 9** .

9. Inspect all the items listed in **Step 5** for causes of an unsuccessful System Reset, repair as necessary. **Retest the system** .

10. If the System Reset was successful, carry out the Occupant Classification Sensor (OCS) System Zero Seat Weight Test in this section.
    If the System Reset was unsuccessful, install a new passenger seat track assembly. For additional information, refer to Section 501-10 .

Pyrotechnic Device Disposal

Disposal of Deployable Devices and Pyrotechnic Devices That are Undeployed/Inoperative

NOTE: All inoperative air bag modules and safety belt pretensioners have been placed on the Mandatory Return List. All discolored or damaged air bag modules must be treated the same as any inoperative live air bag being returned.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the undeployed/inoperative device. Refer to the appropriate procedure in this section or Section 501-20A .

3. **NOTE:** When installing a new air bag module or inflatable safety belt inflator, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and the VIN must be recorded and sent to Ford Motor Company.

   If installing a new air bag module or inflatable safety belt inflator, record the necessary information and return the inoperative air bag module to Ford Motor Company.

Disposal of Deployable Devices and Pyrotechnic Devices That Are Deployed

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the deployed device. Refer to the appropriate procedure in this section or Section 501-20A .

3. **NOTE:** If a dual stage driver or passenger air bag module has deployed due to a crash event, the air bag module requires manual deployment to make sure both stages and the active canister vent have deployed before scrapping the vehicle or disposing of the air bag module. To determine if a vehicle is equipped with dual stage driver or passenger air bag modules, refer to the Description and Operation portion of this section.

   Dispose of the deployed device in the same manner as any other part to be scrapped.

Disposal of Deployable Devices and Pyrotechnic Devices That Require Manual Deployment

1. Safety and environmental concerns require consideration and treatment of restraints system deployable and pyrotechnic devices when disposing of vehicles, deployable devices or pyrotechnic devices. Deploying deployable and pyrotechnic devices before scrapping a vehicle or the device eliminates the potential for hazardous exposures or reactions during processing. If special handling procedures are followed, deployable and pyrotechnic devices can be deployed safely and recycled with the vehicle, shipped separately to a recycling facility or disposed of safely.

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NOTE: To determine the deployable devices a vehicle is equipped with, refer to the Description and Operation portion of this section.

A vehicle equipped with any of the following deployable devices requires manual deployment of the devices before scrapping the vehicle or component. Refer to the appropriate portion of this procedure.

- Driver air bag module
- Inflatable safety belt inflators
- Knee air bag module
- Passenger air bag module
- Seat side air bag modules
- Safety Canopy® modules
- Side air curtain modules

2. **NOTE:** To determine the pyrotechnic devices a vehicle is equipped with, refer to the Description and Operation portion of this section.

   A vehicle equipped with any of the following pyrotechnic devices requires manual deployment of the devices before scrapping the vehicle or component. Refer to the appropriate portion of this procedure.
   - Safety belt buckle pretensioners
   - Safety belt retractor pretensioners
   - Safety belt anchor pretensioners
   - Adaptive load-limiting retractors
   - Deployable steering column

3. **NOTE:** To determine if a vehicle is equipped with dual stage driver or passenger air bag modules, refer to the Description and Operation portion of this section.

   If a dual stage driver or passenger air bag module has deployed due to a crash event, the air bag module requires manual deployment to make sure both stages and the active canister vent have deployed before scrapping the vehicle or disposing of the air bag module. Refer to Driver Air Bag Module, Passenger Air Bag Module, Knee Air Bag Module and Seat Side Air Bag Module — Remote Deployment in this procedure.

Driver Air Bag Module, Passenger Air Bag Module, Knee Air Bag Module and Seat Side Air Bag Module — Remote Deployment

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

WARNING: Always carry a live airbag with the deployment door, trim cover or tear seam pointed away from the body. Do not place a live airbag down with the deployment door, trim cover or tear seam facing down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

WARNING: Always carry a live Safety Canopy or side air curtain assembly with the tear seam pointed away from your body. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.

WARNING: Deploy all supplemental restraint system (SRS) devices (airbags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: For air bag modules with multiple loops, deploy all of the loops on the air bag module.

NOTE: Some driver and passenger front air bags have 2 deployment stages and an active canister vent. After a collision it is possible that Stage 1 has deployed and Stage 2 and the active canister vent have not.

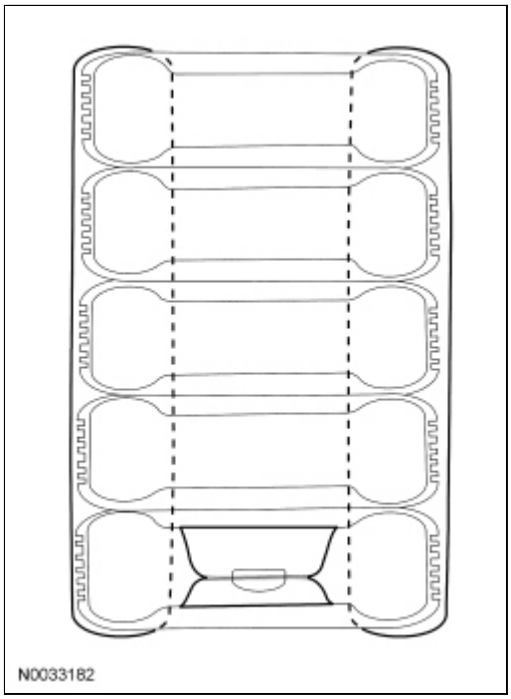
If a front air bag module has deployed, it is **mandatory** that the front air bag module be remotely deployed using the appropriate air bag disposal procedure.

NOTE: A typical air bag disposal is shown that is similar for all vehicles.

All driver, passenger, knee and seat side air bag modules

1. Make a container to house the air bag module for deployment.
    - **NOTE:** The tires must be of sufficient size to accommodate the air bag module.

      Obtain a tire and wheel assembly and an additional 4 tires (without wheels) of the same size.
    - With the tire and wheel assembly on the bottom, stack the tires.
    - Securely tie all of the tires together.



2. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

3. Remove the air bag module. Refer to the appropriate procedure in this section.

4. **NOTE:** If the air bag module does not have a hard-wired pigtail, cut the wires and connector(s) from the vehicle wire harness and reconnect to the air bag module.

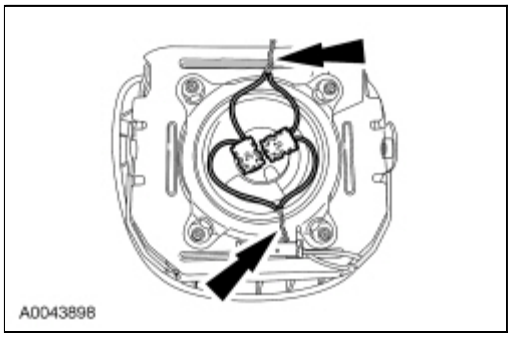
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Cut each of the air bag module wires near the electrical connector that connects to the vehicle wire harness.

5. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

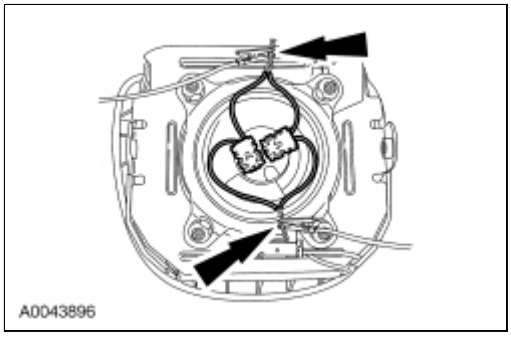
6. **NOTE:** Typical driver air bag module with 2 loops shown, other air bag modules with multiple loops or multiple features (canister vent, active tether) similar.

   For air bag modules with multiple loops, twist together a wire from each loop then repeat for the remaining wires from each loop.



7. Make a jumper harness to deploy the air bag module.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

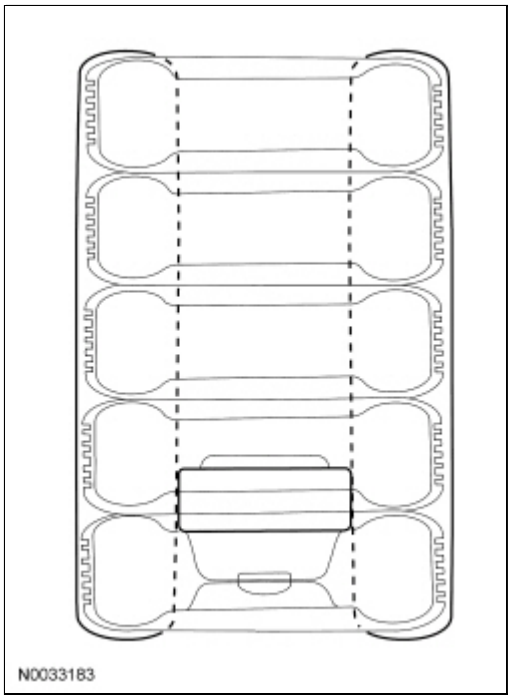
8. Using the end of the jumper harness where the wires are not connected together, attach each wire of the jumper harness to each wire of the air bag module or to the twisted-together wires if multiple loops. Use tape or other insulating material to make sure that the leads do not make contact with each other.



Driver air bag modules

9. **NOTE:** Make sure the air bag connections are maintained.

   For driver air bag modules, with the stack of tires upright and the wheel on the bottom, carefully place the driver air bag module, with the trim cover facing up, on the wheel.

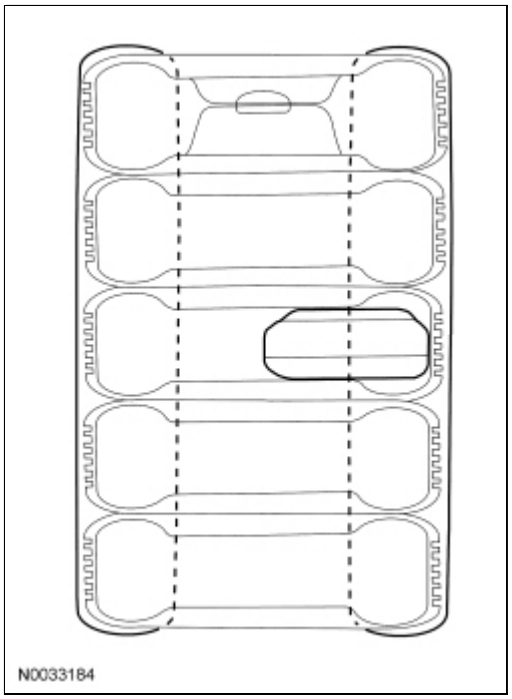


Passenger, knee and seat side air bag modules

10. **NOTE:** Make sure the air bag connections are maintained.

    Tip the stack of tires on its side and place the air bag module inside the center tire, making sure that there are 2 tires beneath the tire containing the air bag module and 2 tires (including the tire and wheel assembly) above the tire containing the air bag module.

11. Place the tire stack upright, with the wheel on top.



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All driver, passenger, knee and seat side air bag modules

12. Remain at least 9.14 m (30 ft) away from the air bag module.

13. From the end of the jumper harness that is not connected to the air bag module, disconnect the 2 wires of the jumper harness from each other.

14. Deploy the air bag module by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

15. To allow for cooling, wait at least 10 minutes before approaching the deployed air bag module.

16. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Safety Belt Anchor Pretensioners, Safety Belt Buckle Pretensioners, Safety Belt Retractor Pretensioners, Adaptive Load Limiting Safety Belt Retractors and Safety Belt Inflators — Remote Deployment

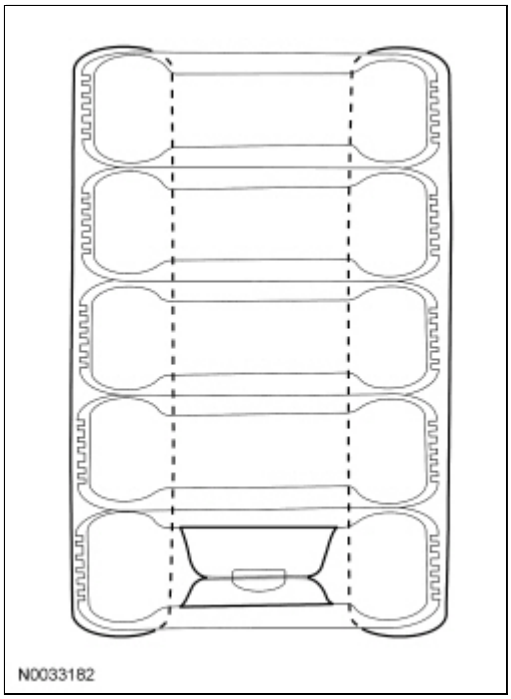
WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Deploy all supplemental restraint system (SRS) devices (airbags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: A typical safety belt buckle, retractor and inflator disposal is shown that is similar for all vehicles.

1. Make a container to house the safety belt buckle or retractor for deployment.
    - **NOTE:** The tires must be of sufficient size to accommodate the safety belt buckle, retractor or inflator.

      Obtain a tire and wheel assembly and 4 additional tires (without wheels) of the same size.
    - With the tire and wheel assembly on the bottom, stack the tires.
    - Securely tie all of the tires together.



2. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

3. Remove the safety belt buckle, retractor or inflator. Refer to the appropriate procedure in Section 501-20A .
   - When deploying a safety belt buckle pretensioner, install a nut and bolt of sufficient length and of the same diameter as was used to retain it to the seat.

4. **NOTE:** If the safety belt anchor, buckle, retractor or inflator does not have a hard-wired pigtail, it will be necessary to cut the wires and connector(s) from the vehicle wire harness and reconnect to the safety belt buckle, retractor or inflator.

   Cut each of the safety belt anchor, buckle, retractor or inflator wires near the electrical connector that connects to the vehicle wire harness.

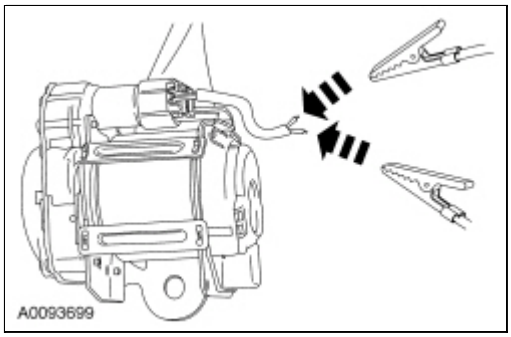
5. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

6. Make a jumper harness to deploy the safety belt buckle, retractor or inflator.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

7. **NOTE:** Typical safety belt retractor pretensioner shown, other safety belt anchor pretensioners, buckle pretensioners, load-limiting retractors and safety belt inflators similar.

   Using the end of the jumper harness that the wires are not connected together, attach each wire of the jumper harness to each wire of the safety belt anchor, buckle, retractor or inflator. Use tape or other insulating material to make sure that the leads do not make contact with each other.

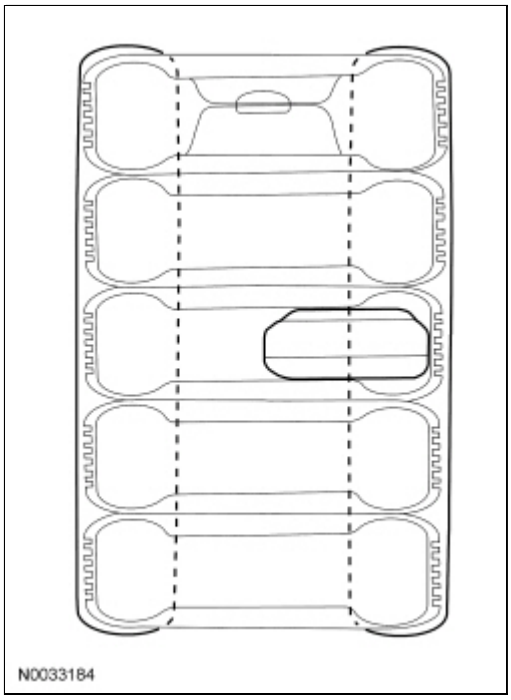
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8. **NOTE:** Make sure the safety belt anchor, buckle, retractor or inflator connections are maintained.

   Tip the stack of tires on its side and place the safety belt anchor, buckle, retractor or inflator inside the center tire, making sure that there are 2 tires beneath the tire containing the safety belt anchor, buckle, retractor or inflator and 2 tires (including the tire and wheel assembly) above the tire containing the safety belt anchor, buckle, retractor or inflator.

9. Place the tire stack upright, with the wheel on top.



10. Remain at least 9.14 m (30 ft) away from the safety belt anchor, buckle, retractor or inflator.

11. From the end of the jumper harness that is not connected to the safety belt anchor, buckle, retractor or inflator, disconnect the 2 wires of the jumper harness from each other.

12. Deploy the safety belt anchor pretensioner, buckle pretensioner, retractor pretensioner or inflator by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

13. To allow for cooling, wait at least 10 minutes before approaching the deployed safety belt anchor pretensioner, buckle pretensioner, retractor pretensioner or inflator.

14. Dispose of the deployed safety belt anchor, buckle, retractor or inflator in the same manner as any

other part to be scrapped.

Safety Belt Anchor Pretensioners, Safety Belt Buckle Pretensioners, Safety Belt Retractor Pretensioners and Load Limiting Safety Belt Retractors — In-Vehicle Deployment

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Deploy all supplemental restraint system (SRS) devices (airbags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: A typical safety belt buckle and retractor disposal is shown that is similar for all vehicles.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Access the safety belt anchor, buckle or retractor electrical connectors. For additional information, refer to Section 501-20A .

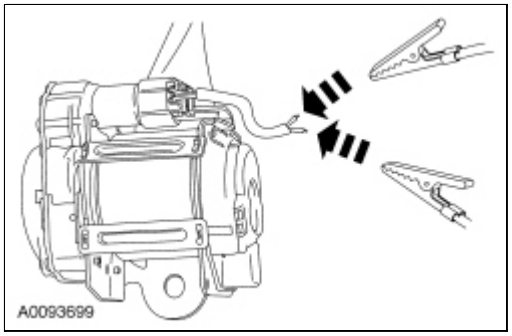
3. Cut each of the safety belt anchor, buckle or retractor wires, leaving at least 101.6 mm (4 in) to work with.

4. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

5. Make a jumper harness to deploy the safety belt anchor, buckle or retractor.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

6. **NOTE:** Typical safety belt retractor pretensioner shown, other safety belt anchor pretensioners, buckle pretensioners and load-limiting retractors are similar.

   Using the end of the jumper harness that the wires are not connected together, attach each wire of the jumper harness to each wire of the safety belt anchor, buckle or retractor. Use tape or other insulating material to make sure that the leads do not make contact with each other.



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7. Remain at least 9.14 m (30 ft) away from the safety belt anchor, buckle or retractor.

8. From the end of the jumper harness that is not connected to the safety belt anchor, buckle or retractor, disconnect the 2 wires of the jumper harness from each other.

9. Deploy the safety belt anchor pretensioner, buckle pretensioner or retractor pretensioner by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

10. To allow for cooling, wait at least 10 minutes before approaching the deployed safety belt anchor pretensioner, buckle pretensioner or retractor pretensioner.

11. Dispose of the deployed safety belt anchor, buckle or retractor in the same manner as any other part to be scrapped.

Safety Canopy® Modules and Side Air Curtain Modules — In-Vehicle Deployment

WARNING: Deploy all supplemental restraint system (SRS) devices (airbags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: The Safety Canopy® module deployment for a scrapped vehicle will occur in its installed position in the vehicle.

NOTE: A typical Safety Canopy® module disposal is shown that is similar for all vehicles.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

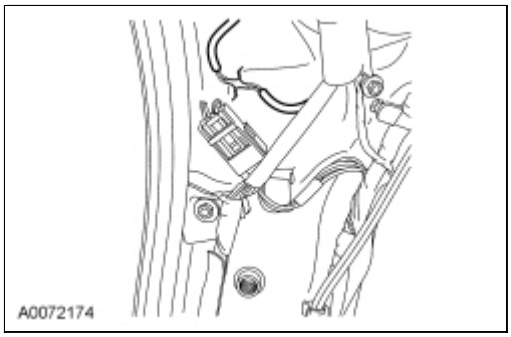
2. Access the Safety Canopy®/side air curtain module electrical connectors. For additional information, refer to the appropriate procedure in this section.

3. Cut each of the Safety Canopy®/side air curtain module wires leaving at least 101.6 mm (4 in) to work with.

4. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

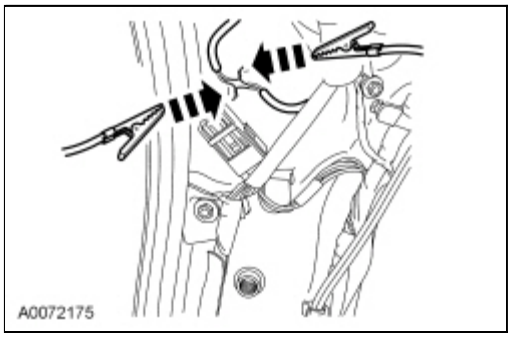
5. **NOTE:** Typical Safety Canopy®/side air curtain module with 2 loops shown, other Safety Canopy®/side air curtain modules with 2 loops are similar.

   For Safety Canopy®/side air curtain modules with multiple loops, twist together a wire from each loop then repeat for the remaining wires from each loop.



6. Make a jumper harness to deploy the Safety Canopy®/side air curtain module.
    - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
    - At one end of the jumper harness, connect the wires together.

7. Using the end of the jumper harness where the wires are not connected together, attach each wire of the jumper harness to each wire of the Safety Canopy®/side air curtain module or to the twisted-together wires if multiple loops. Use tape or other insulating material to make sure that the leads do not make contact with each other.



8. From the end of the jumper harness that is not connected to the Safety Canopy®/side air curtain module, disconnect the 2 wires of the jumper harness from each other.

9. Deploy the Safety Canopy®/side air curtain module by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

10. To allow for cooling, wait at least 10 minutes before approaching the deployed Safety Canopy®/side air curtain module.

11. Dispose of the deployed Safety Canopy®/side air curtain module in the same manner as any other part to be scrapped.

Deployable Steering Column — In-Vehicle Deployment

WARNING: Deploy all supplemental restraint system (SRS) devices (airbags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in

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the General Procedures portion of this section.

2. **NOTE:** It may be necessary to lower or remove the deployable steering column from the instrument panel to access the deployable steering column electrical connector.

   Access the deployable steering column electrical connector.

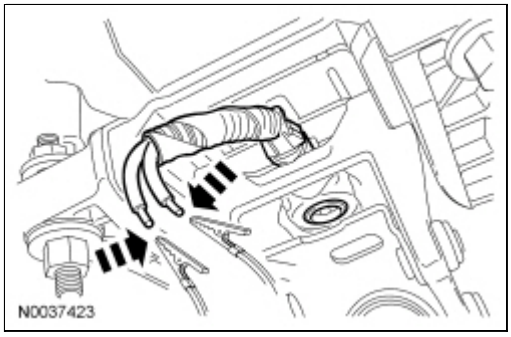
3. **NOTE:** If the deployable steering column does not have a hard-wired pigtail, it will be necessary to cut the wires and connector(s) from the vehicle wire harness and reconnect to the deployable steering column.

   Cut each of the deployable steering column wires, leaving at least 101.6 mm (4 in) to work with.

4. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

5. Make a jumper harness to deploy the deployable steering column.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

6. Using the end of the jumper harness where the wires are not connected together, attach each wire of the jumper harness to each wire of the deployable steering column. Use tape or other insulating material to make sure that the leads do not make contact with each other.



7. Remain at least 9.14 m (30 ft) away from the deployable steering column.

8. From the end of the jumper harness that is not connected to the deployable steering column, disconnect the 2 wires of the jumper harness from each other.

9. Deploy the deployable steering column by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

10. To allow for cooling, wait at least 10 minutes before approaching the deployed steering column.

11. Dispose of the deployed steering column in the same manner as any other part to be scrapped.

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Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Deactivation

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

2. **WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.**

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

3. Remove the driver air bag module. For additional information, refer to Driver Airbag in this section.

4. Remove the 3 passenger air bag module bolts.

5. ***NOTICE:*** **Do not handle the passenger air bag module by grabbing the edges of the passenger air bag cover. Damage to the passenger air bag module may occur.**

   Partially remove the passenger air bag module from the instrument panel.

6. Disconnect the 2 passenger air bag module electrical connectors.

7. Under the passenger seat, slide and disengage the locking clip, release the tab and disconnect inline electrical connector C339.

8. Under the driver seat, slide and disengage the locking clip, release the tab and disconnect inline electrical connector C3051.

9. Disconnect the LH side safety canopy module electrical connector.
   - For regular cab, remove the LH side B-pillar trim panel.
   - For SuperCab and SuperCrew, remove the LH side C-pillar trim panel.
     For additional information, refer to Section 501-05 .

10. Disconnect the RH side safety canopy module electrical connector.
    - For regular cab, remove the RH side B-pillar trim panel.
    - For SuperCab and SuperCrew, remove the RH side C-pillar trim panel.
      For additional information, refer to Section 501-05 .

11. Install the RCM fuse 31 (10A) in the SJB .

12. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Reactivation

1. Remove RCM fuse 31 (10A) from the SJB .

2. Disconnect the battery ground cable and wait at least one minute.

3. Connect the LH side safety canopy module electrical connector.
   - For regular cab, install the LH side B-pillar trim panel.
   - For SuperCab and SuperCrew, install the LH side C-pillar trim panel.
     For additional information, refer to Section 501-05 .

4. Connect the RH side safety canopy module electrical connector.
   - For regular cab, install the RH side B-pillar trim panel.
   - For SuperCab and SuperCrew, install the RH side C-pillar trim panel.
     For additional information, refer to Section 501-05 .

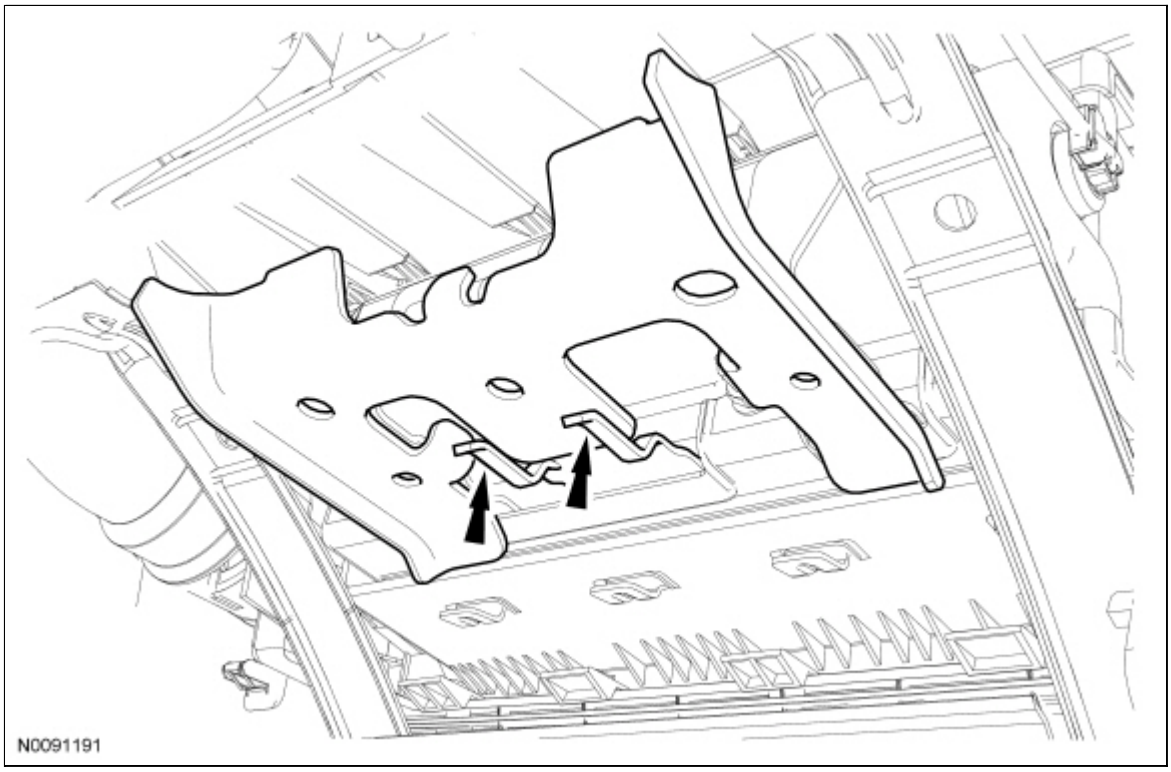
5. Under the driver seat, connect inline electrical connector C339, slide and engage the locking clip.

6. Under the driver seat, connect inline electrical connector C3051, slide and engage the locking clip.

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7. Connect the 2 passenger air bag module electrical connectors.

8. Position the passenger air bag module so that the tabs are oriented as shown.



9. Install the 3 passenger air bag module bolts.
    - Tighten to 8 Nm (71 lb-in).

10. Install the driver air bag module. Refer to Driver Airbag in this section.

11. Repower the SRS. For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

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Supplemental Restraint System (SRS) Depowering and Repowering

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Depowering Procedure

WARNING: Wear eye and ear protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

WARNING: To reduce the risk of accidental deployment, do not use any memory saver devices. Failure to follow this instruction may result in serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Turn all vehicle accessories OFF.
2. Turn the ignition OFF.
3. At the Body Control Module (BCM), located below the RH side of the instrument panel, remove the cover and RCM fuse 36 (10A) from the BCM . For additional information, refer to the Wiring Diagrams manual.
4. Turn the ignition ON and monitor the air bag warning indicator for at least 30 seconds. The air bag warning indicator will remain lit continuously (no flashing) if the correct RCM fuse has been removed. If the air bag warning indicator does not remain illuminated continuously, remove the correct RCM

fuse before proceeding.

5. Turn the ignition OFF.

6. **WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.**

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

Repowering Procedure

1. Turn the ignition from OFF to ON.

2. Install RCM fuse 36 (10A) to the BCM and close the cover.

3. **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any airbag when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**

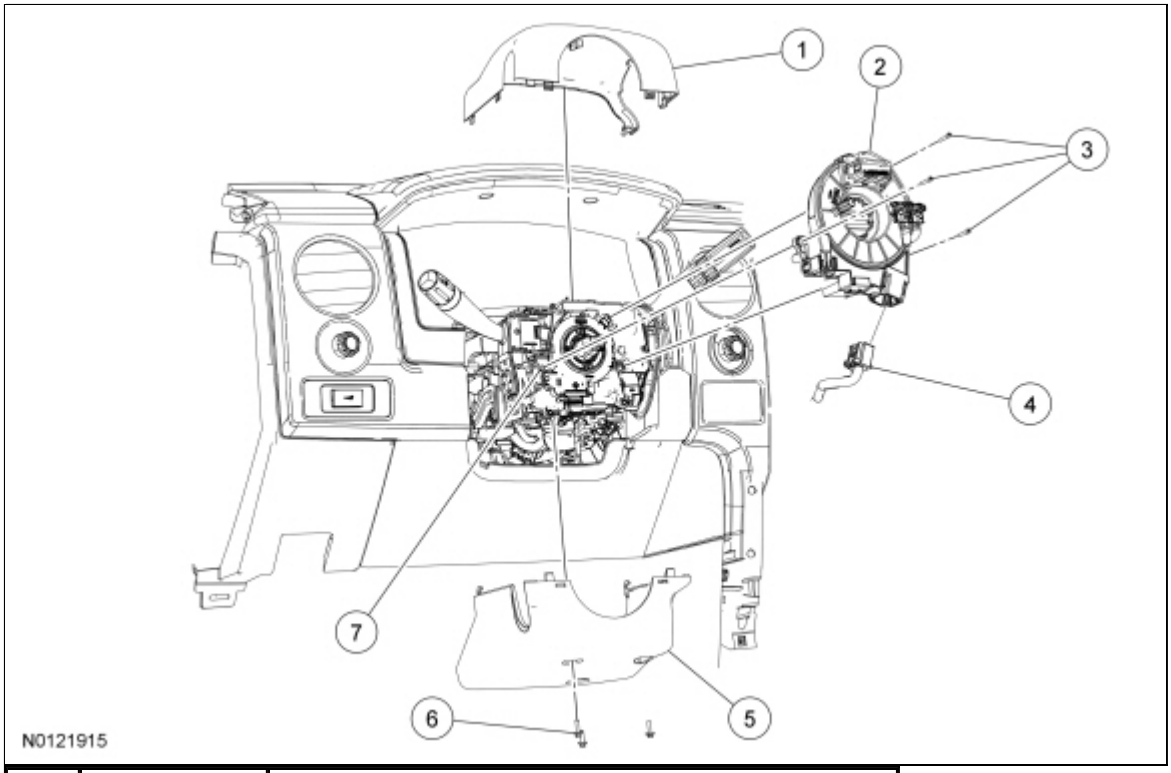
   Connect the battery ground cable.

4. Prove out the SRS as follows:
   Turn the ignition from ON to OFF. Wait 10 seconds, then turn the ignition back to ON and monitor the air bag warning indicator with the air bag modules installed. The air bag warning indicator will light continuously for approximately 6 seconds and then turn off. If an air bag SRS fault is present, the air bag warning indicator will:
   - fail to light.
   - remain lit continuously.
   - flash at a 5 Hz rate (RCM not configured).

   The air bag warning indicator may not illuminate until approximately 30 seconds after the ignition has been turned from the OFF to the ON position. This is the time required for the RCM to complete the testing of the SRS . If the air bag warning indicator is inoperative and a SRS fault exists, a chime will sound in a pattern of 5 sets of 5 beeps. If this occurs, the air bag warning indicator and any SRS fault discovered must be diagnosed and repaired.
   Clear all continuous DTCs from the RCM and Occupant Classification System Module (OCSM) using a scan tool.

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Clockspring



Item	Part Number	Description
1	3530	Upper steering column shroud
2	14A644	Clockspring
3	W506943	Clockspring screws (3 required)
4	—	Clockspring electrical connector (part of 14401)
5	3530	Lower steering column shroud
6	—	Lower steering column shroud screw (3 required)
7	3F791	Steering Column Control Module (SCCM)

Removal

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the driver air bag module. For additional information, refer to Driver Airbag in the Removal and Installation portion of this section.

2. Remove the steering wheel. For additional information, refer to Section 211-04 .

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3. Remove the upper and lower steering column shrouds.
    1. Remove the 3 screws.
    2. Unclip the lower steering column shroud from the upper steering column shroud and remove.
        - If equipped, position the selector lever boot aside.

4. Disconnect the clockspring electrical connector.

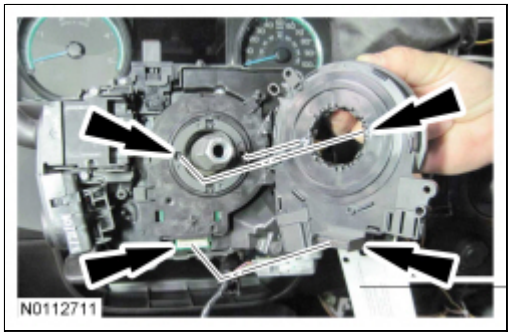
5. Remove the 3 screws and clockspring.

Installation

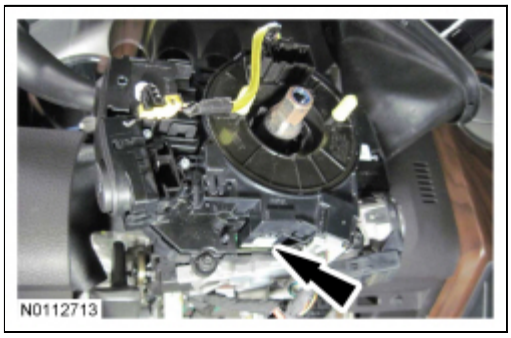
WARNING: If the clockspring is not correctly centralized, it may fail prematurely. If in doubt, repeat the centralizing procedure. Failure to follow these instructions may increase the risk of serious personal injury or death in a crash.

NOTE: Typical clockspring shown. Only the 6.2L application is equipped with the steering wheel rotation sensor located behind the clockspring. All other engine applications, the steering wheel rotation sensor is part of the Electronic Power Assist Steering (EPAS) and is not serviced separately.

1. Position the clockspring onto the steering column.
    - Align the electrical connector ends and the 2 clockspring pins on the back of the clockspring to the 2 steering wheel rotation sensor pin holes.



2. With the clockspring pins aligned to the steering wheel rotation sensor pin holes, push the clockspring in, seating the electrical connector.



3. ***NOTICE:*** **If installing a new clockspring, do not remove the clockspring anti-rotation key until the steering wheel is installed. If the anti-rotation key has been removed before installing the steering wheel, the clockspring must be centered. Failure to follow this instruction may result in component damage and/or system failure.**

   Install the 3 clockspring screws.

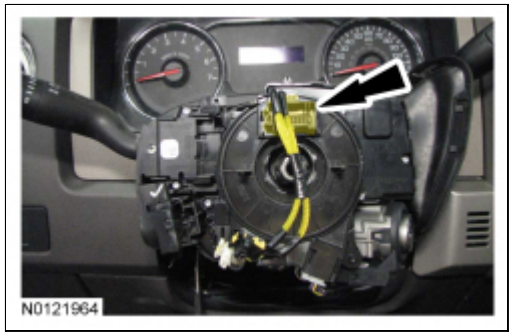
4. Connect the clockspring electrical connector.

5. **WARNING: If the clockspring is not correctly centralized, it may fail prematurely. If in doubt, repeat the centralizing procedure. Failure to follow these instructions may increase the risk of serious personal injury or death in a crash.**

   NOTICE: **Do not over-rotate the clockspring inner rotor. The internal ribbon wire is connected to the clockspring rotor. The internal ribbon wire acts as a stop and can be broken from its internal connection. Failure to follow this instruction may result in component damage and/or system failure.**

   If a new clockspring was installed and the anti-rotation key has not been removed **proceed to Step 7** .
   If a new clockspring was installed and the anti-rotation key has been removed before the steering wheel is installed, or the same clockspring is being installed, rotate the clockspring inner rotor **counterclockwise** . Carefully feel for the ribbon wire to run out of length with slight resistance and stop rotating the clockspring inner rotor.

6. To center the clockspring, start with the clockspring rotated fully counterclockwise as indicated in Step 5. Rotate the clockspring inner rotor, wiring and connector clockwise through 3.5 full revolutions with the connector up in the 12 o'clock position. Verify that the clockspring is correctly centralized by observing that the clockspring rotor, wiring and connector are in the 12 o'clock position.



7. Install the lower steering column shroud and 3 screws.

8. Attach the upper steering column shroud to the lower steering column shroud.
   - If equipped, position back the selector lever boot.

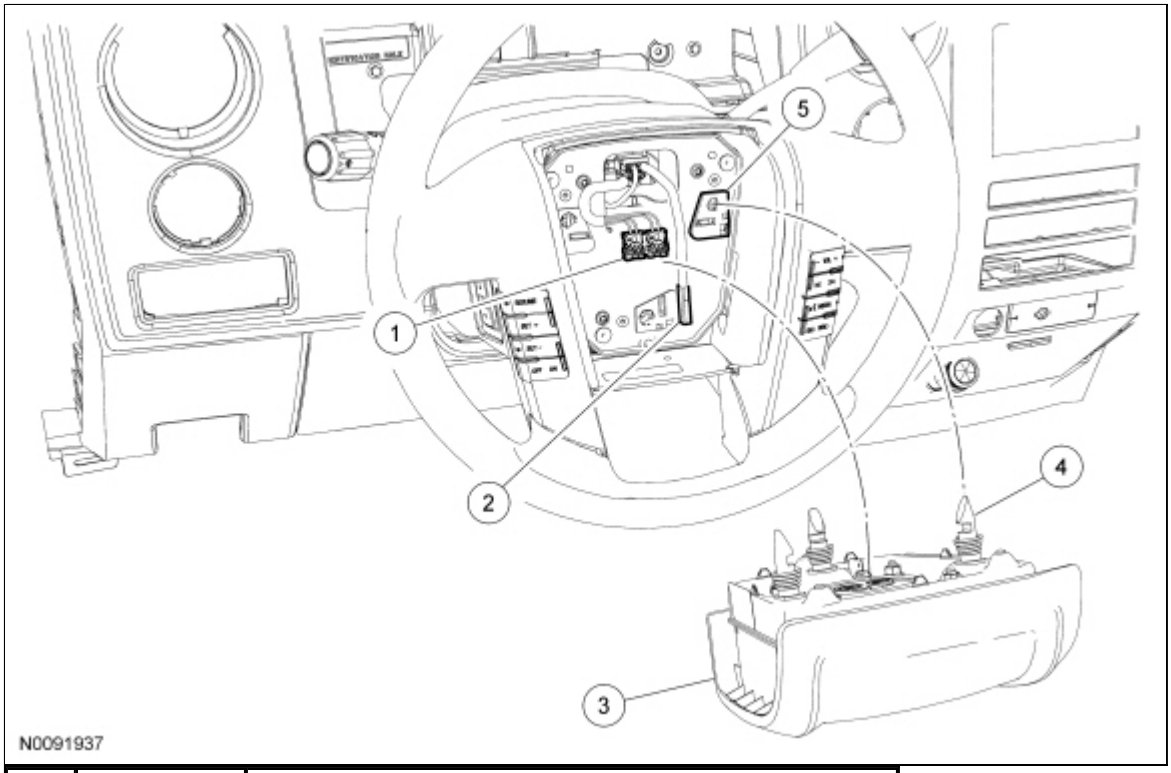
9. Install the steering wheel. For additional information, refer to Section 211-04 .

10. If a new clockspring was installed, remove the anti-rotation key.

11. Install the driver air bag module. For additional information, refer to Driver Airbag in the Removal and Installation portion of this section.

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Driver Airbag



Item	Part Number	Description
1	—	Driver air bag module electrical connector (part of 14A664)
2	—	Horn electrical connector (part of 14A664)
3	043B13	Driver air bag module
4	—	Attachment pin (part of 043B13) (1 of 3)
5	—	Wire clip (1 of 3)

Removal

WARNING: Always carry a live airbag with the deployment door, trim cover or tear seam pointed away from the body. Do not place a live airbag down with the deployment door, trim cover or tear seam facing down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is

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removed and the ignition is ON.

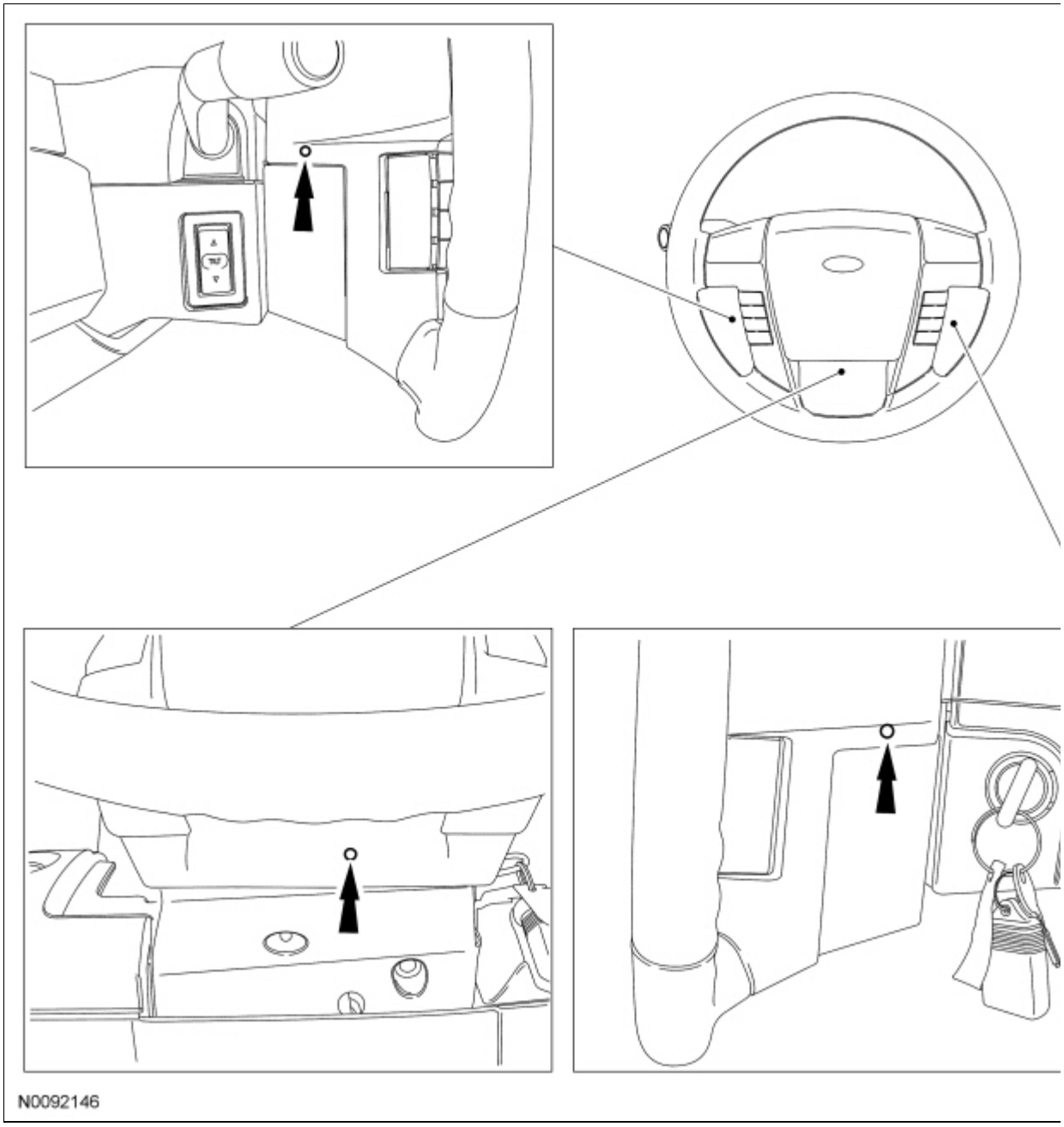
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

2. **NOTE:** The bottom, LH and RH wire clip access hole locations are shown.

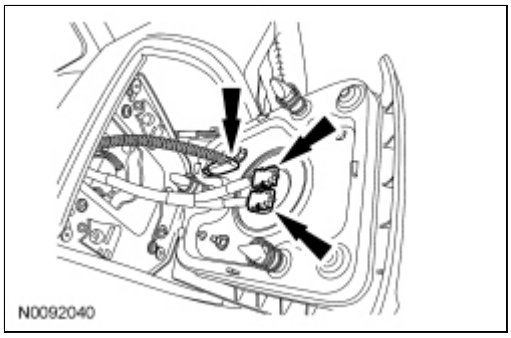
   NOTE: The attachment pin at the bottom of the steering wheel must be released from the wire clip before the LH and RH side.

   Starting with the wire clip at the bottom of the steering wheel, release the attachment pin from the wire clip.
   - Insert a 3-mm hex key or a suitable tool through the access hole, position the tool against the wire clip to disengage the attachment pin.
   - Push the wire clip inward and pull the driver air bag module away from the steering wheel.
   - Repeat for the 2 attachment pins on the LH and RH side of the steering wheel.



3. Remove the driver air bag module.
    - Compress the tabs and disconnect the 2 driver air bag module electrical connectors.
    - Disconnect the horn electrical connector.
    - Remove the driver air bag module.

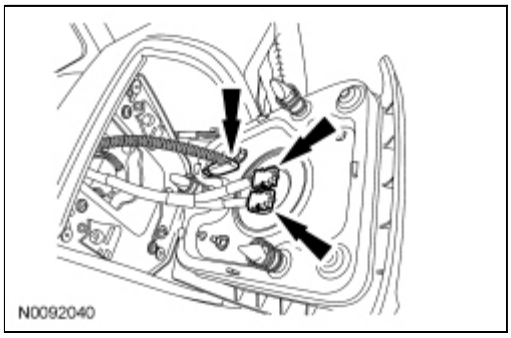
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Installation

WARNING: Prior to reinstalling a previously removed driver air bag module, make sure to correctly position the wire clip that retains the driver air bag module to the steering wheel. Failure to follow this instruction will result in incorrect installation of the driver air bag module and increases the risk of serious personal injury or death in a crash.

1. Connect the driver air bag module and horn electrical connectors.

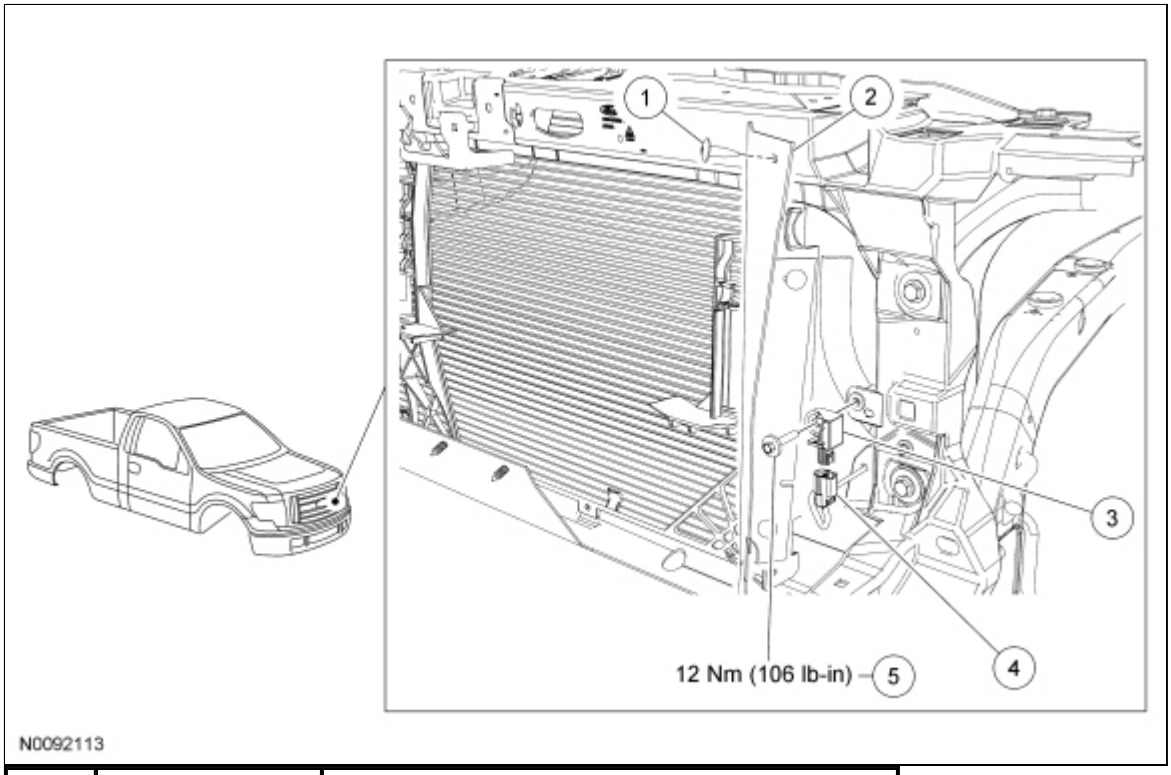


2. Align the 3 attachment pins to the wire clip openings in the steering wheel and position the driver air bag module in place.
3. With the attachment pins aligned, push inward to seat the driver air bag module.
4. Pull firmly on the driver air bag module corners to make sure that the attachment pins are completely engaged.
5. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

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Front Impact Severity Sensor

NOTE: LH front impact severity sensor shown, RH similar.



Item	Part Number	Description
1	W706350	Scrivet
2	8310	LH air deflector
3	14B004	LH front impact severity sensor
4	—	Electrical connector (part of 12A581)
5	W713506	Front impact severity sensor bolt

WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the airbags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the scrivet and fold the LH air deflector back.

3. Disconnect the electrical connector.

4. **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

   Remove the bolt and LH front impact severity sensor.
   - To install, tighten to 12 Nm (106 lb-in).

5. To install, reverse the removal procedure.

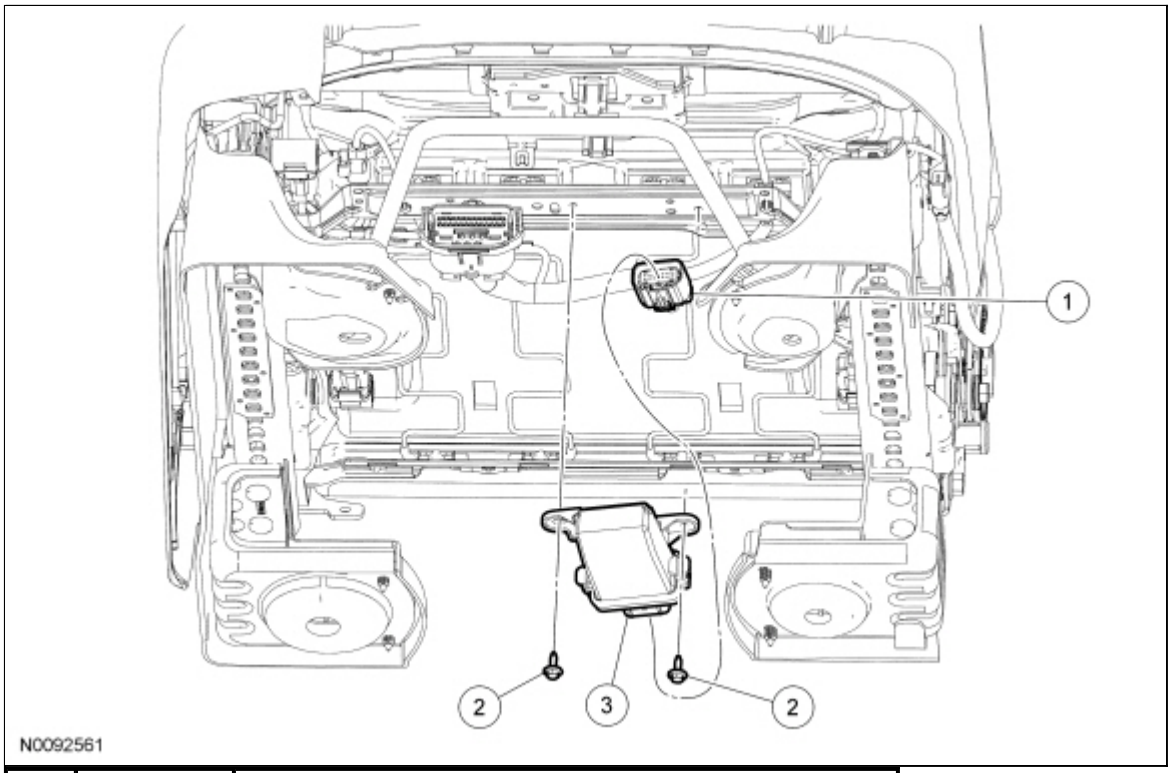
6. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

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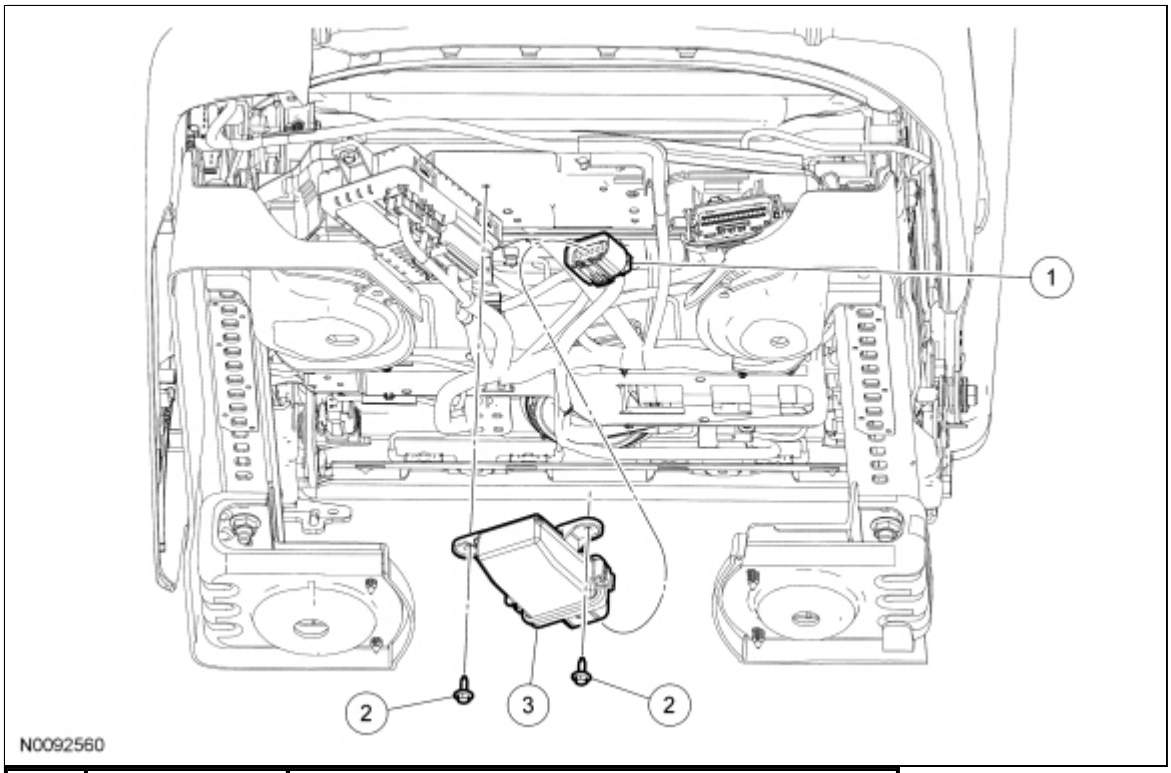
Occupant Classification System Module (OCSM)

Manual Seat



Item	Part Number	Description
1	—	Occupant Classification System Module (OCSM) electrical connector (part of 14A699)
2	W505153	OCSM screws
3	14B056	OCSM

Power Seat



Item	Part Number	Description
1	—	OCSM electrical connector (part of 14A699)
2	W505153	OCSM screws
3	14B056	OCSM

Removal and Installation

1. **NOTE:** Ignition must be OFF when disconnecting the Occupant Classification System Module (OCSM) electrical connector. Otherwise, a DTC will set in the Restraints Control Module (RCM) memory and must be cleared before releasing the vehicle.

   Turn the ignition OFF and wait at least one minute.

2. Disconnect the OCSM electrical connector.

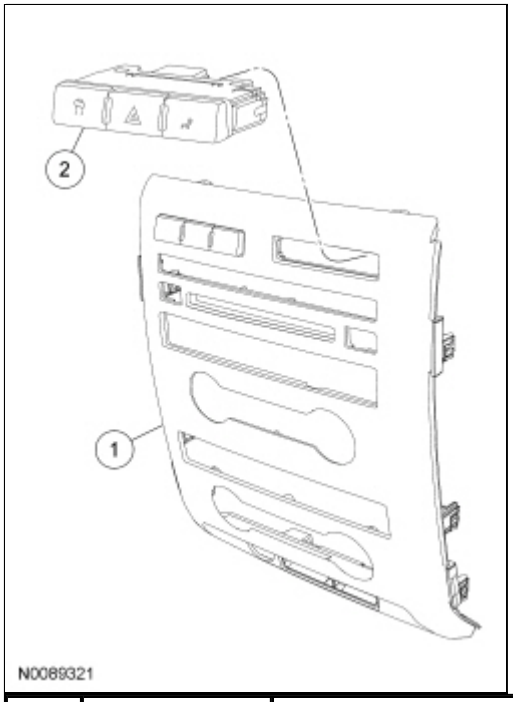
3. Remove the 2 screws and OCSM .

4. To install, reverse the removal procedure.

5. If a new OCSM has been installed, carry out the Occupant Classification System (OCS) System Reset procedure. For additional information, refer to Occupant Classification Sensor (OCS) System Reset in the General Procedures portion of this section.

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Passenger Airbag Deactivation (PAD) Indicator



Item	Part Number	Description
1	04302	Instrument panel center finish panel
2	13350	Passenger Air Bag Deactivation (PAD) indicator

NOTE: The Passenger Air Bag Deactivation (PAD) indicator is part of the hazard/ traction control switch.

1. **NOTE:** Ignition must be OFF when disconnecting the PAD indicator electrical connector. Otherwise, a DTC will be set in the Restraints Control Module (RCM) memory and must be cleared before releasing the vehicle.

   Turn the ignition OFF and wait at least one minute.

2. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .

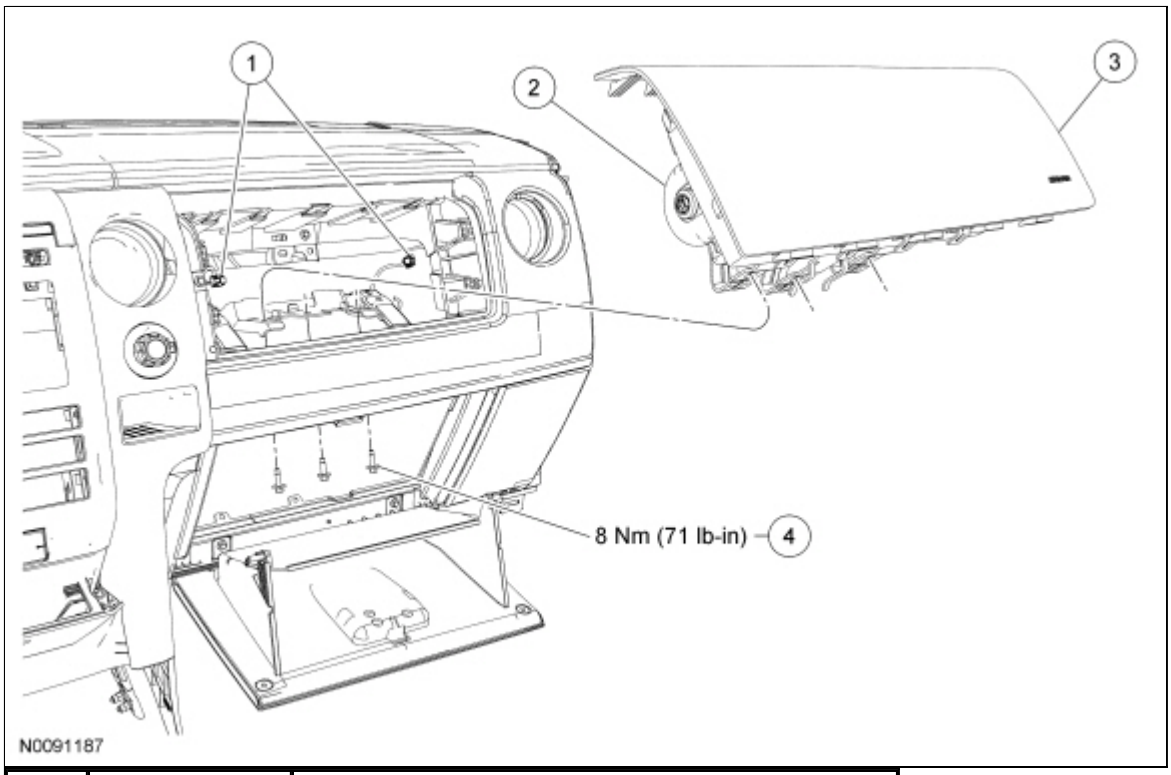
3. Disconnect the PAD indicator electrical connector.

4. Press the 2 tabs inward and remove the PAD indicator.

5. To install, reverse the removal procedure.

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Passenger Airbag



Item	Part Number	Description
1	—	Electrical connectors (part of 14401)
2	044A74	Passenger air bag module assembly
3	04338	Passenger air bag cover
4	W708568	Passenger air bag module bolt (3 required)

Removal and Installation

WARNING: Always carry a live airbag with the deployment door, trim cover or tear seam pointed away from the body. Do not place a live airbag down with the deployment door, trim cover or tear seam facing down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before

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releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the 3 passenger air bag module bolts.

3. ***NOTICE:*** **Do not handle the passenger air bag module by grabbing the edges of the passenger air bag cover. Damage to the passenger air bag module may occur.**

   Partially remove the passenger air bag module from the instrument panel.

4. Disconnect the 2 electrical connectors and remove the passenger air bag module.

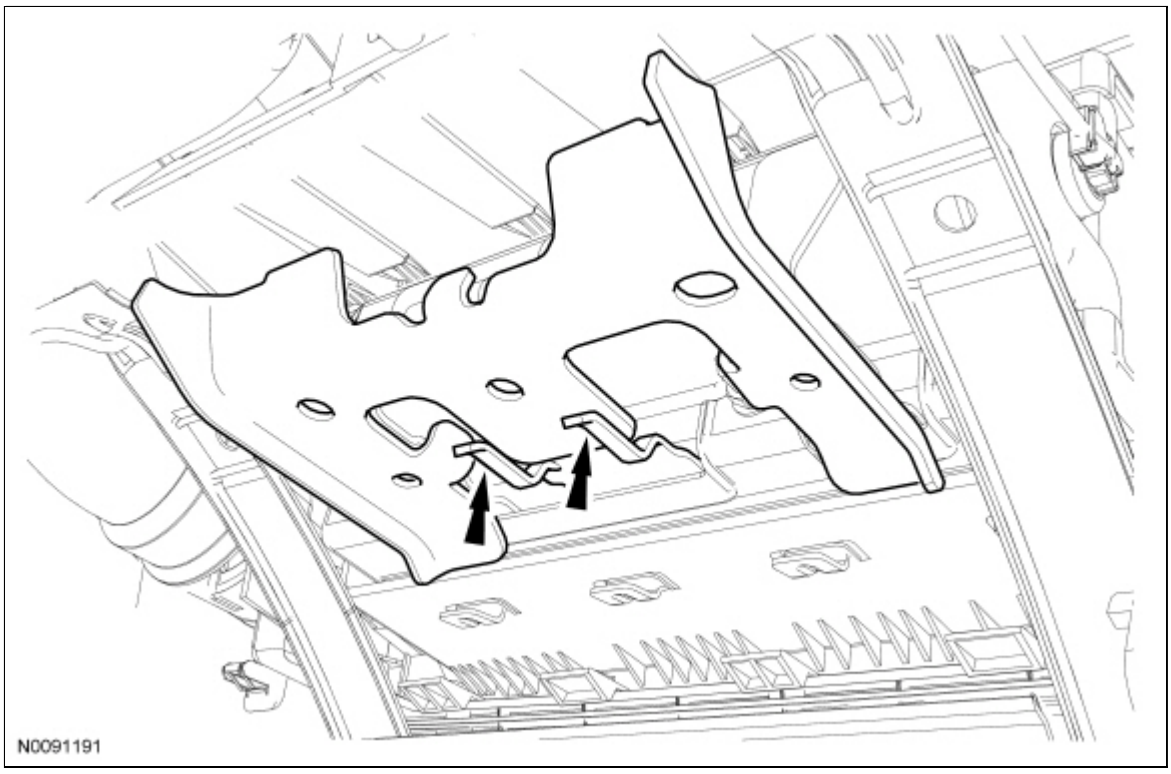
Installation

1. ***NOTICE:*** **Do not handle the passenger air bag module by grabbing the edges of the passenger air bag cover. Damage to the passenger air bag module may occur.**

   Partially install the passenger air bag module in the instrument panel.

2. Connect the 2 electrical connectors.

3. Position the passenger air bag module so that the tabs are oriented as shown.

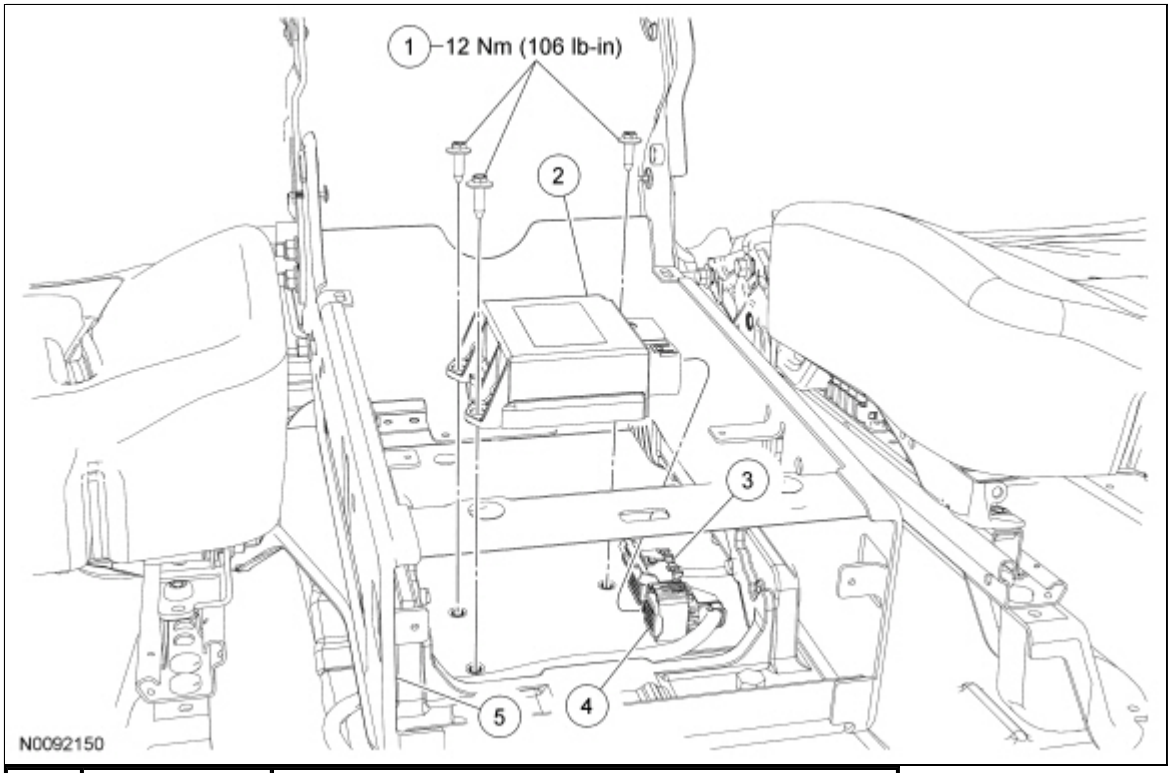


4. Install the 3 passenger air bag module bolts.
   - Tighten to 8 Nm (71 lb-in).

5. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

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Restraints Control Module (RCM)



Item	Part Number	Description
1	W707722	Restraints Control Module (RCM) bolts
2	14B321	RCM
3	—	RCM large electrical connector (part of 14A005)
4	—	RCM small electrical connector (part of 14401)
5	61708	Front center seat base frame

WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the airbags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: This vehicle is equipped with the SYNC® feature which contains the 911 assist option. Refer to the Owners' Literature.

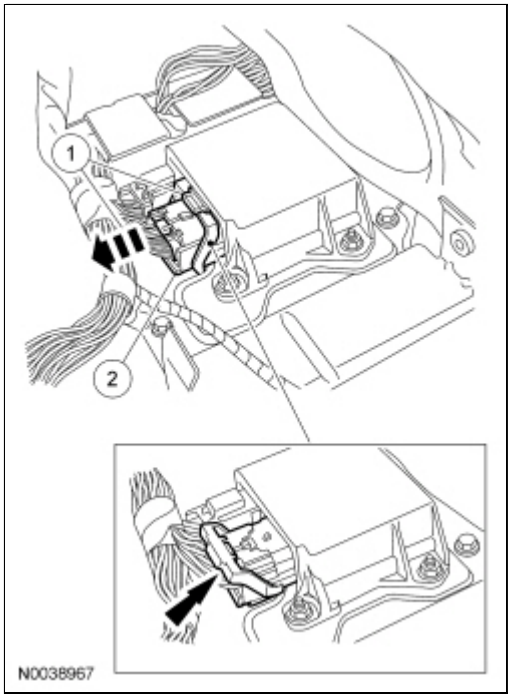
1. When installing a new RCM , carry out the appropriate steps necessary for the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

2. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

3. If equipped, remove the floor console. For additional information, refer to Section 501-12 .

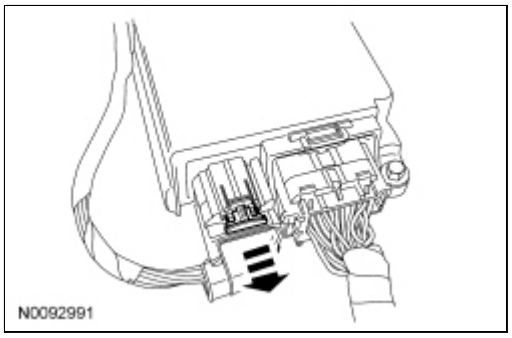
4. If equipped, remove the front center seat cushion and cupholder assembly. For additional information, refer to Section 501-10 .

5. Disconnect the RCM large electrical connector.
    1. Pinch the thumb tab and pivot the connector position assurance lever all the way back until it stops.
    2. Disconnect the RCM electrical connector.



6. Disengage the lock tab, press and disconnect the RCM small electrical connector.

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7. Remove the 3 RCM bolts.

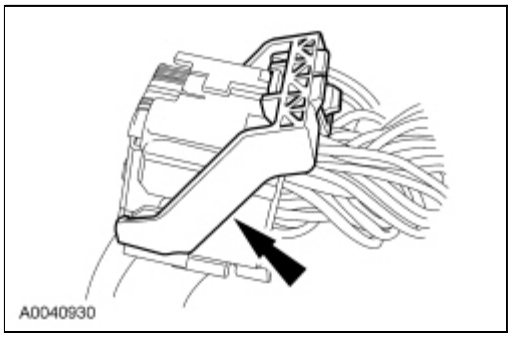
8. Remove the RCM .

Installation

WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.

1. Position the RCM and install the bolts.
   - Tighten to 12 Nm (106 lb-in).

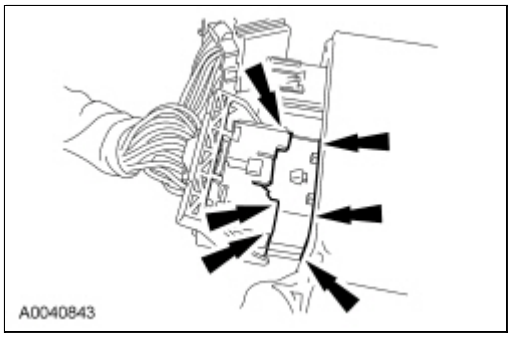
2. Make sure the connector position assurance lever is in the full RELEASE position before attempting to connect the connector.



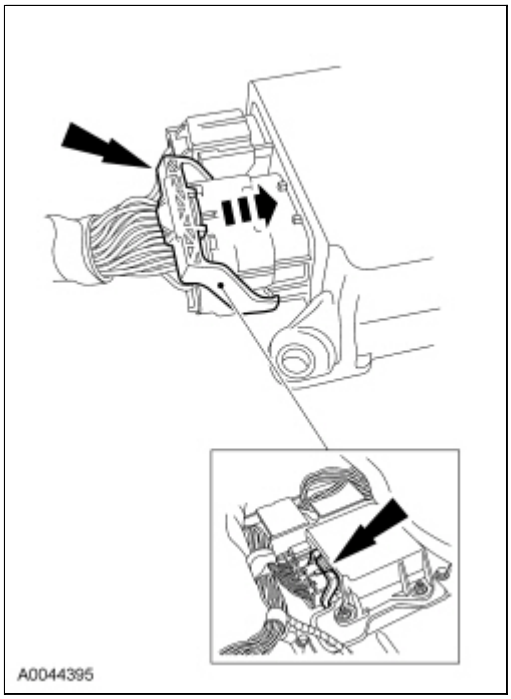
3. ***NOTICE:*** **Putting the large Restraints Control Module (RCM) electrical connector into the RCM on an angle can cause incorrect electrical connections and damage components.**

   Position the large RCM electrical connector into the RCM .
   - ***NOTICE:*** **Do not push the connector on to where the lever pivots and seats itself. Light pressure is needed to get the connector into position on the Restraints Control Module (RCM) before using the lever to fully seat the connector. Failure to follow this instruction may result in component damage and/or system failure.**

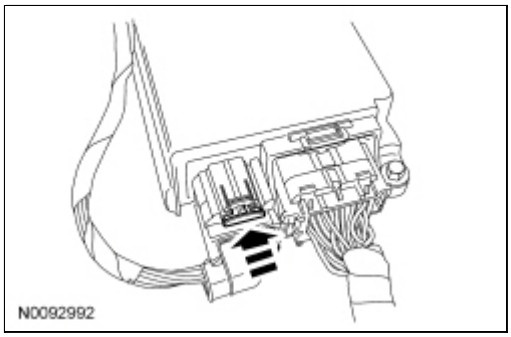
     With the large RCM electrical connector uniformly aligned to the RCM , lightly push in until a click is heard and a slight resistance is felt.



4. Connect the large RCM electrical connector.
    - Using the connector position assurance lever, pivot it toward the RCM , drawing the connector into the RCM .
        - Make sure the thumb tab is engaged to the retainer on the RCM and locked in place.



5. Connect the small RCM electrical connector and push the lock tab in.



6. If equipped, install the floor console. For additional information, refer to Section 501-12 .

7. If equipped, install the front center seat cushion and cupholder assembly. For additional information,

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refer to Section 501-10 .

8. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

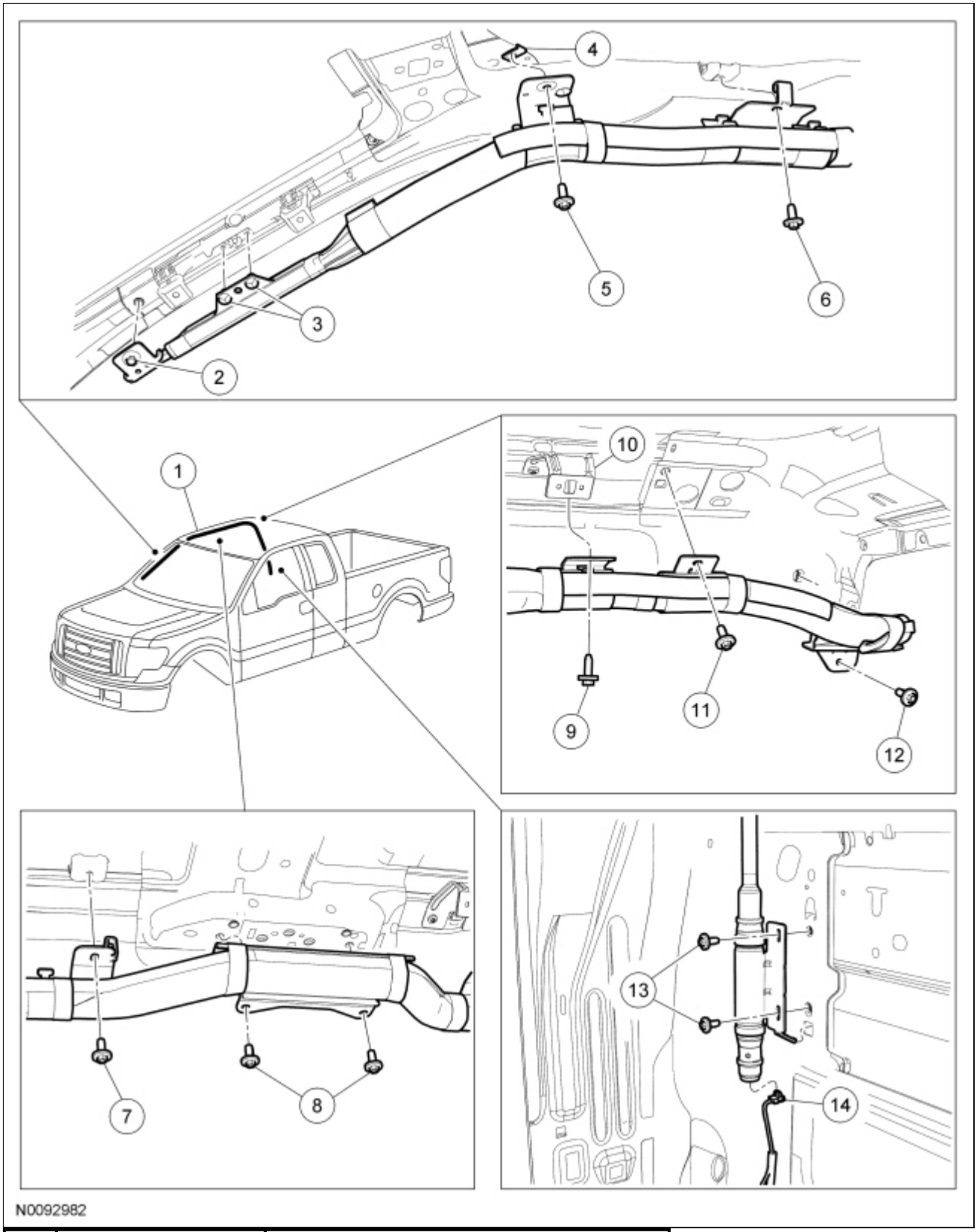
9. If a new RCM was installed, carry out the appropriate steps to complete the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

Safety Canopy Module

NOTE: SuperCab shown, other cab styles similar.

NOTE: The Safety Canopy® module bolts must be tightened in the sequence described in this procedure.

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N0092982

Item	Part Number	Description
1	042D94 RH/ 042D95 LH	Safety Canopy® module

2	—	A-pillar tether bolt (part of 04D94 RH/ 042D95 LH)
3	—	Pin-type retainers (part of 04D94 RH/ 042D95 LH)
4	—	J-nut
5	W713976	Bolt
6	W713976	Bolt
7	W713976	Bolt
8	W713976	Center locator bolts
9	W713976	Bolt
10	29019	Roof opening panel bracket (if equipped)
11	W713976	Bolt
12	W713976	Bolt
13	W713976	Safety Canopy® module canister bolts
14	—	Electrical connector (part of 14A005)

Removal

WARNING: Always carry a live Safety Canopy or side air curtain assembly with the tear seam pointed away from your body. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.

WARNING: Anytime the Safety Canopy® or side air curtain module has deployed, a new headliner and new A-, B- and C-pillar upper trim panels and attaching hardware must be installed. Remove any other damaged components and hardware and install new components and hardware as needed. Failure to follow these instructions may result in the Safety Canopy® or side air curtain module deploying incorrectly and increases the risk of serious personal injury or death in a crash.

WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the headliner. For additional information, refer to Section 501-05 .

3. Detach the 2 Safety Canopy® module pin-type retainers from the A-pillar.
   - If equipped with a satellite radio, on the RH side detach the pin-type retainers and position the antenna lead aside.

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4. Remove the A-pillar tether bolt.
5. Remove the 10 Safety Canopy® module bolts.
6. Disconnect the Safety Canopy® module electrical connector.
7. Detach the Safety Canopy® module canister hook from the sheet metal slot.

8. Remove the Safety Canopy® module.

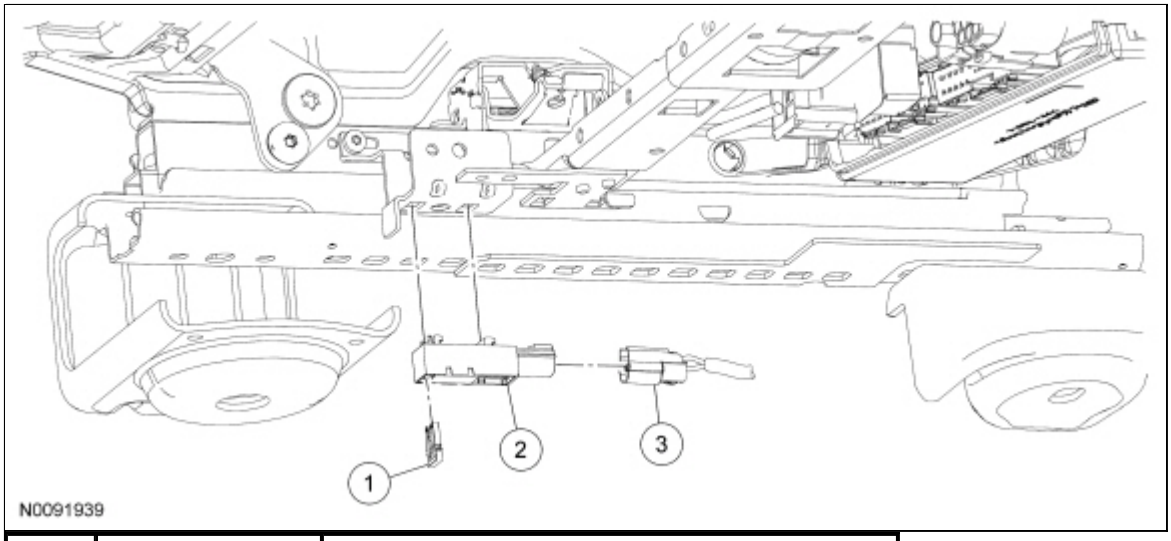
Installation

WARNING: Before installing a Safety Canopy or side air curtain assembly, inspect the roofline for any damage. If necessary, the sheet metal must be reworked to its original condition and structural integrity. Install new fasteners if damaged and remove foreign material. Failure to follow these instructions may result in the Safety Canopy or side air curtain deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

WARNING: Inspect a Safety Canopy® or side air curtain module before installation. If the module is damaged, the cover has separated or the Safety Canopy® or side air curtain material has been exposed, install a new module. Do not attempt to repair the module. Failure to follow these instructions may result in the Safety Canopy® or side air curtain deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

WARNING: Never put any type of fastener or tie strap around any part of a Safety Canopy® module, side air curtain module or interior trim panel. This will prevent the Safety Canopy® or side air curtain module from deploying correctly. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.

Seat Position Sensor



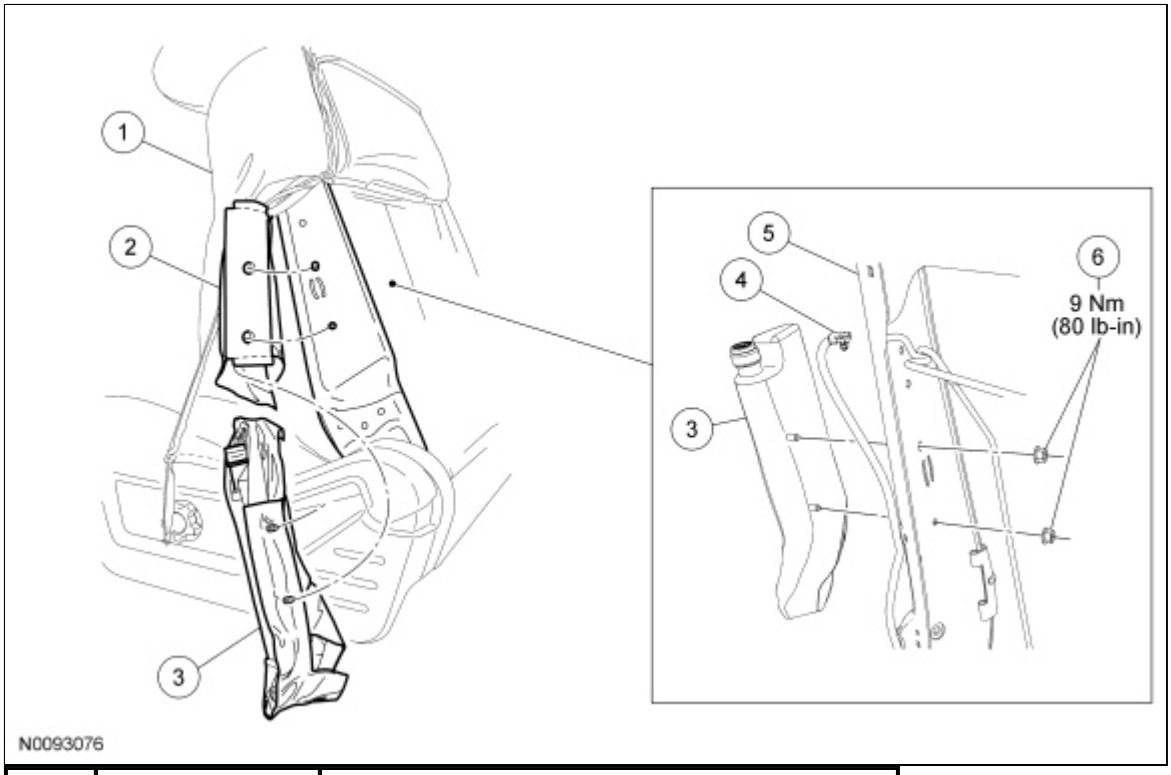
Item	Part Number	Description
1	—	Lock tab
2	14B416	Seat position sensor
3	—	Electrical connector (part of 14A699)

1. Remove the driver seat. For additional information, refer to Seat Removal and Installation in Section 501-10 .
2. Disconnect the seat position sensor electrical connector.
3. Remove the lock tab.
4. Remove the seat position sensor.
5. To install, reverse the removal procedure.

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Side Airbag

NOTE: Driver seat shown, passenger similar.



Item	Part Number	Description
1	64417	Backrest cover
2	—	Deployment chute (part of 64417)
3	611D10	Side air bag module
4	—	Electrical connector (part of 14K155)
5	61018	Seat backrest frame
6	W520111	Side air bag module nuts (2 required)

Removal and Installation

WARNING: Always carry a live airbag with the deployment door, trim cover or tear seam pointed away from the body. Do not place a live airbag down with the deployment door, trim cover or tear seam facing down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

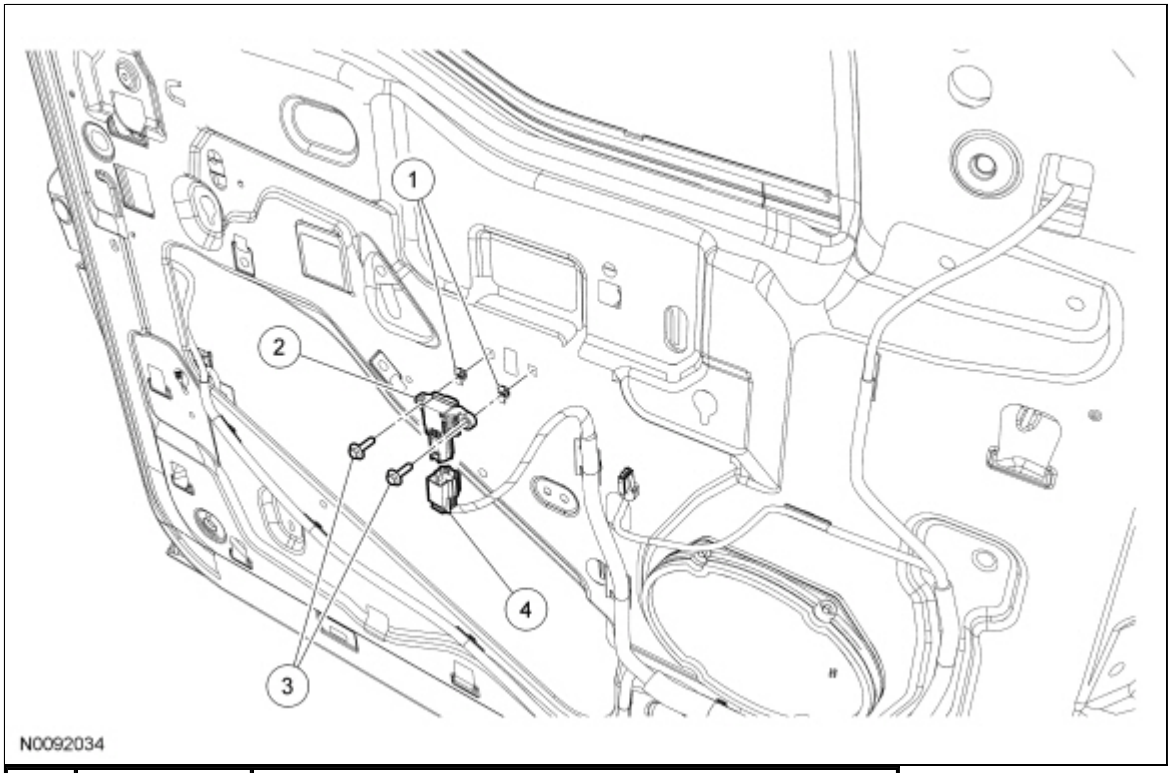
WARNING: Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

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WARNING: If the seat side airbag cover has been damaged or separated from its mounting, or if the airbag material has been exposed, install a new seat side airbag assembly. Never try to repair the seat side airbag assembly. Failure to follow these instructions may result in the seat side airbag deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

Side Impact Sensor — Front Door

NOTE: LH door shown, RH door similar.



Item	Part Number	Description
1	W710564	Insert nuts (2 required)
2	14B345	Side impact sensor (pressure sensor)
3	W705314	Side impact sensor bolts (2 required)
4	—	Side impact sensor electrical connector (part of 14631)

WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the airbags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

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1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

2. Remove the front door trim panel. For additional information, refer to Section 501-05 .

3. Disconnect the electrical connector.

4. ***NOTICE:*** **To prevent stripping the insert nuts, tighten the side impact sensor bolts only enough to secure the side impact sensor.**

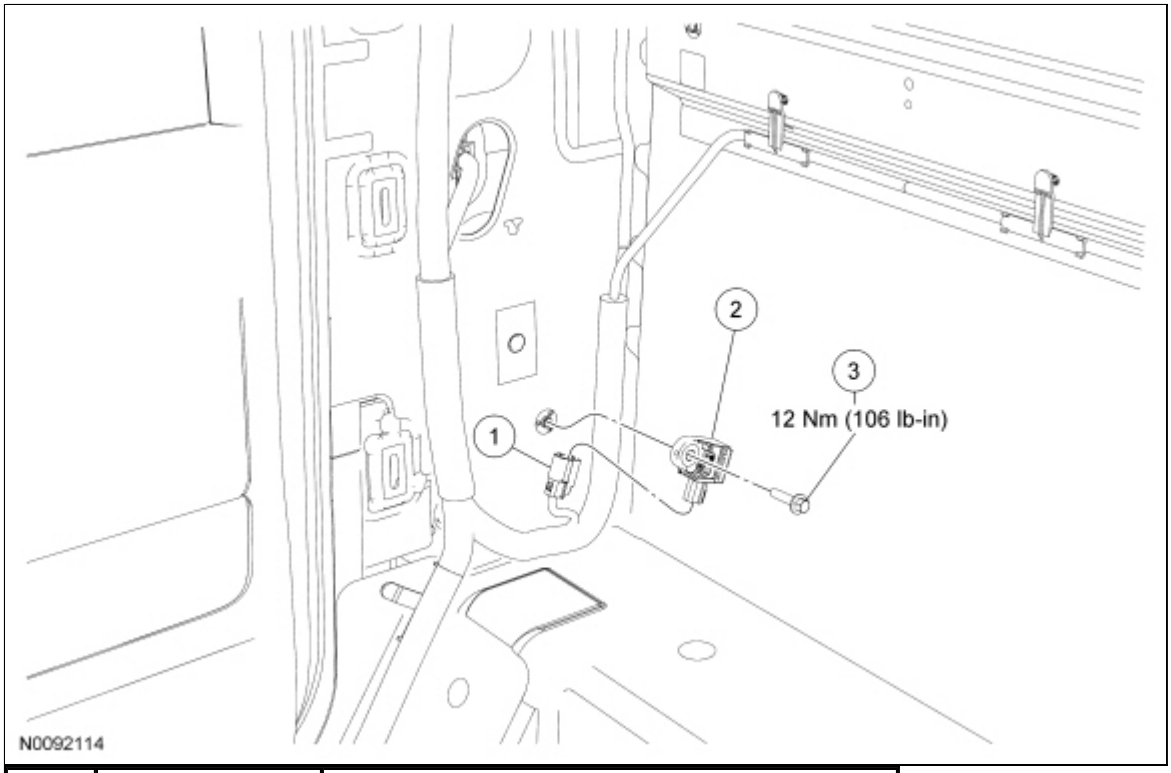
   Remove the bolts and side impact sensor.

5. To install, reverse the removal procedure.

6. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

Side Impact Sensor — Second Row

NOTE: RH side shown, LH similar.



Item	Part Number	Description
1	—	Electrical connector (part of 14A005)
2	14B345	Side impact sensor
3	W505256	Side impact sensor bolt

WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the airbags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

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2. **SuperCab:** remove the B-pillar trim panel.
   SuperCrew: remove the C-pillar trim panel.
   For additional information, refer to the Removal and Installation procedures in Section 501-05 .

3. Disconnect the side impact sensor electrical connector.

4. **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

   NOTE: Make sure the B- or C-pillar and side impact sensor mating surface is clean and free of foreign material.

   Remove the bolt and side impact sensor.
   - To install, tighten to 12 Nm (106 lb-in).

5. To install, reverse the removal procedure.

6. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

Material

Item	Specification	Fill Capacity
Motorcraft® Clear Silicone Rubber TA-32	ESB-M4G92-A	—
Motorcraft® Metal Bonding Adhesive TA-1	—	—
Motorcraft® Acid Neutralizer ZC-1-A	—	—
Motorcraft® Alkaline Neutralizer ZC-2-A	—	—
3M™ Perfect-It™ Show Car Liquid Wax 39026	—	—
Motorcraft® Detail Wash ZC-3-A	ESR-M14P4-A	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—
Premium Undercoating ValuGard™ VG101, VG101A (aerosol)	—	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—	—
Motorcraft® Plastic Bonding Adhesive TA-9	—	—
Roof Ditch Sealer Fusor® 122EZ, 3M™ 08307	—	—
Motorcraft® Seam Sealer TA-2	—	—
Trim and Weatherstrip Adhesive Permatex® Black Super Weatherstrip Adhesive, 81850	—	—
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A	—

General Equipment
3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080

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I4 Inverter Spot Welder 254-00014
Inverter Welder with Metal Inert Gas (MIG) Welder 254-00015

General Specifications -Welding Specifications

Item	Specification
Plug Weld Hole	8 mm (0.31 in)
Weld Wire ER70S-3 or equivalent	0.9-0.11 mm (0.035-0.045 in)

Weld Nugget Chart

Test Thickness of Metal (mm)	Nugget Size
0.7 + 0.7	4.3 mm (0.16 in)
0.7 + 0.7 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9	4.7 mm (0.18 in)
0.9 + 0.9 + 0.9	4.7 mm (0.18 in)
1.0 + 1.0	5.2 mm (0.2 in)
1.0 + 1.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0	7.1 mm (0.27 in)
2.0 + 2.0 + 2.0	7.1 mm (0.27 in)
3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 0.7	4.3 mm (0.16 in)
0.7 + 3.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9 + 2.0	4.7 mm (0.18 in)
2.0 + 0.9 + 1.0	5.2 mm (0.2 in)
1.0 + 3.0 + 1.0	5.2 mm (0.2 in)
3.0 + 1.0 + 2.0	7.1 mm (0.27 in)
0.9 + 0.7 + 0.9	4.3 mm (0.16 in)

Descriptions of Ford Steel Families

Grade	Alloy Content	Heat Treatment	Typical Applications	Comments
Mild Steel, Bake Hardened, Solid	Low	Fully annealed/dead soft	Body panels (closures, floor pan,	—

Solution Strengthened			dash panel)	
High-Strength Low Alloy (HSLA)	Low	Fully annealed/dead soft	Rails, structural members	Strengthened with fine particles and small grain size
Dual Phase Steel (DP)	Medium (Manganese Silicon, Molybdenum Chromium)	Fully annealed/partially hardened	Rails, structural members	15-50% of structure is hard martensite
Ultra High Strength Steel (UHSS) (Martensitic, Boron)	Low	Fully hardened	Rocker reinforcements, door beams, bumper beams	100% of structure is hard martensite
Transformation Induced Plasticity Steel (TRIP)	High (Manganese, Phosphorous, Silicon, Aluminum)	Fully annealed/partially hardened	To be determined	Complex microstructure for high strength and ductility

Ford Recommended Steel Repairability Matrix

Grade	Trade Descriptions	Welding Method			Cold Repairs	Use of Heat for Repair	Temperature Range	Maximum Heat
		Metal Inert Gas (MIG)	Squeeze-Type Resistance Spot Welding (STRW)	MIG Braze				
Mild Steel	Mild	Yes	Yes	N/A	Yes [a]	Yes	Up to 650°C (1,200°F)	90 sec. x 2
Laminate Steel	Quiet Steel	No	Yes	No	Yes [a]	N/A	N/A	N/A
Bake Hardened Steel (BH)	BH 180, BH 210, BH 250, BH 280	Yes	Yes	Yes [b]	Yes [a]	Yes	Up to 650°C (1,200°F)	90 sec. x 2
Solid Solution Strengthened	—	Yes	Yes	Yes [b]	Yes [a]	Yes	Up to 650° C (1,200°F)	90 sec. x 2
High-Strength Low Alloy (HSLA)	HSLA 250, HSLA 350, HSLA 550	Yes	Yes	Yes [b]	Yes [a]	Yes	Up to 650°C (1,200°F)	90 sec. x 2
Dual Phase Steel (DP)	DP 500 class, DP 600 class	Yes	Yes	Yes [b]	Yes [a]	No	N/A	N/A
DP [c]	DP 700 class, DP 900 class and DP 1,000 class	Yes [d]	Yes	Yes [b]	No	No	N/A	N/A
Ultra High Strength Steel (UHSS) (Martensitic,	Boron	Yes [a]	Yes	Yes [b]	No	No	N/A	N/A

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Boron) [e]								
Transformation Induced Plasticity Steel (TRIP)	TRIP 590, TRIP 780, TRIP 980	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[a] Cold repairs can be performed if damage excludes kinks. May section only if approved procedure in workshop manual.

[b] MIG braze allowed for non-structural applications only.

[c] Dual phase steels DP 700, DP 780, DP 980 and DP 1000 must be replaced at factory joints, no sectioning unless approved procedure in workshop manual.

[d] For DP 980 and DP 1,000 class, use Metal Inert Gas (MIG) plug welding only, no stitch welding.

[e] Boron components must be replaced at factory joints, no sectioning allowed.

Adhesives

Material

Item	Specification
Clear Silicone Rubber TA-32	ESB-M4G92-A
Metal Bonding Adhesive TA-1	—
Plastic Bonding Adhesive TA-9	—
Trim and Weatherstrip Adhesive TA-14-A	—

Adhesives are used in a variety of applications. Typical uses for adhesives include roof panels, door skins and quarter panels. Trim applications include body side mouldings, emblems, stationary glass and weatherstripping. Combination sealer/adhesives are also used. Surface preparation is critical to a high quality repair. Following the label instructions for the product is essential.

Work in a well-ventilated area and protect adjacent surfaces when working with adhesives. The use of eye protection and protective clothing is also recommended when working with adhesives. Carry out a trial fit, mark and align the surfaces before bonding the materials together.

Seam sealers and corrosion protection may be necessary once the adhesive(s) has cured, depending on the application. The following is a list of adhesives recommended for certain types of applications:

- Metal Bonding Adhesive — For bonding cold-rolled steel, galvanized steel, aluminum and correctly prepared E-coat. It is used for door skin and roof panel replacement and OEM structural adhesive replacement.
- Plastic Bonding Adhesive — For bonding a variety of plastics to plastics and plastics to primed, painted or E-coated metals. Also for general purpose bonding of trim components.
- Trim and Weatherstrip Adhesive — For use on body side moulding, emblems, trim, bumper impact strips and carpeting.
- Clear Silicone Rubber — Used for sealing water leaks, noise concerns, remounting trim and repairing torn weatherstripping.

Structural Adhesive

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Observe the prescribed welding procedures when carrying out sheet metal repairs. Refer to Weld-Bonding in this section.**

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NOTE: Ford Motor Company does not approve or recognize structural repair procedures using anything but genuine Ford parts.

Structural repairs (frames, rails, aprons and body panels) carried out using other than Ford Motor Company parts have not been tested. In addition, structural equivalence and corrosion protection cannot be assured.

Returning a vehicle to pre-accident condition can only be assured if repair procedures are carried out by skilled technicians using genuine Ford Motor Company parts and approved methods.

Structural component repair procedures approved by Ford using genuine parts have been validated through testing by Ford Motor Company engineers. Should alternative structural component repair procedures and/or parts be used, repairers should be aware of the potential liability they incur.

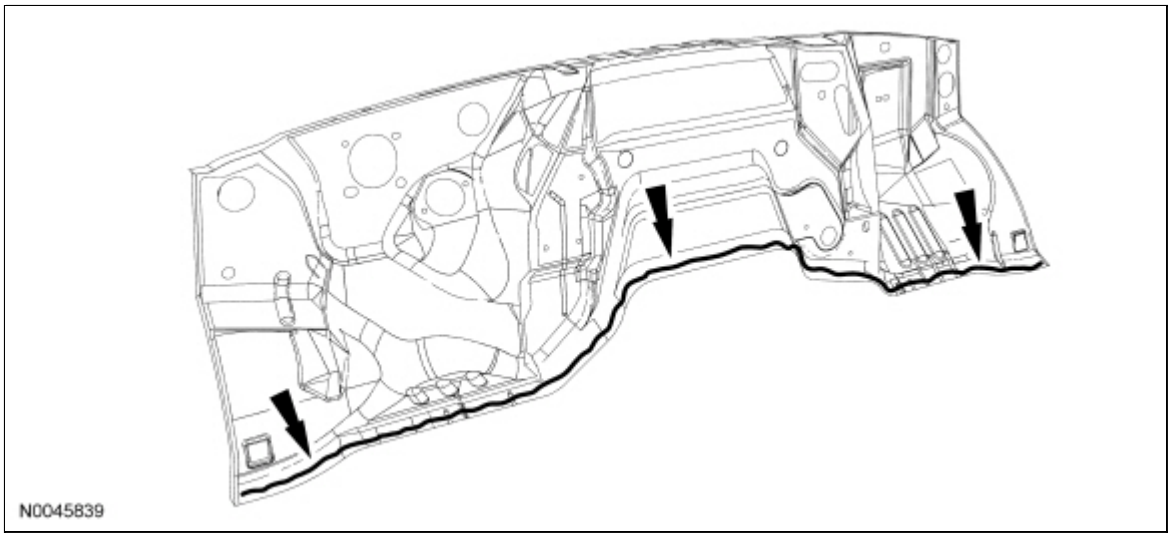
NOTE: Factory spot welds may be substituted with either Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

NOTE: Remove the outer body sheet metal from the affected area prior to carrying out any reinforcing panel replacement. Refer to Sectioning Guidelines in this section.

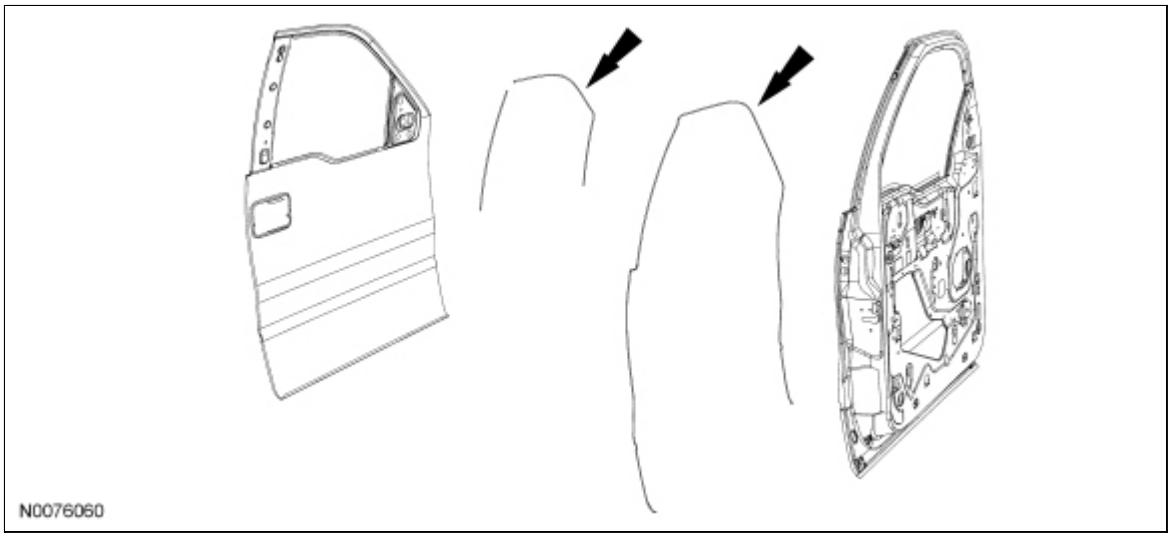
NOTE: The following illustrations show the application and location of structural adhesives.

NOTE: Arrows indicate adhesive application locations.

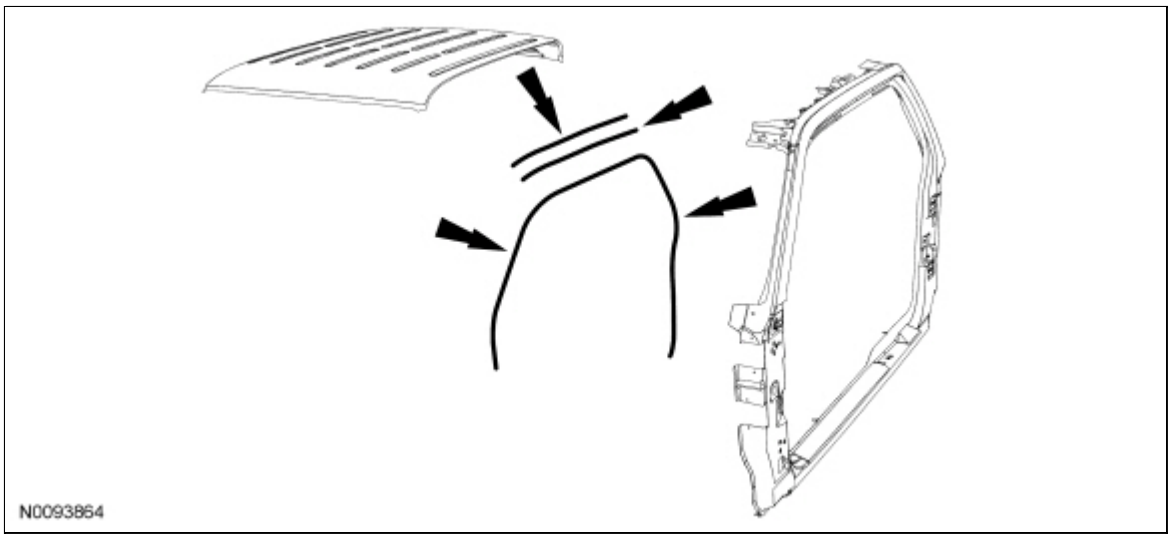
Dash Panel



Door Outer Panel-to-Door Assembly — All Vehicles

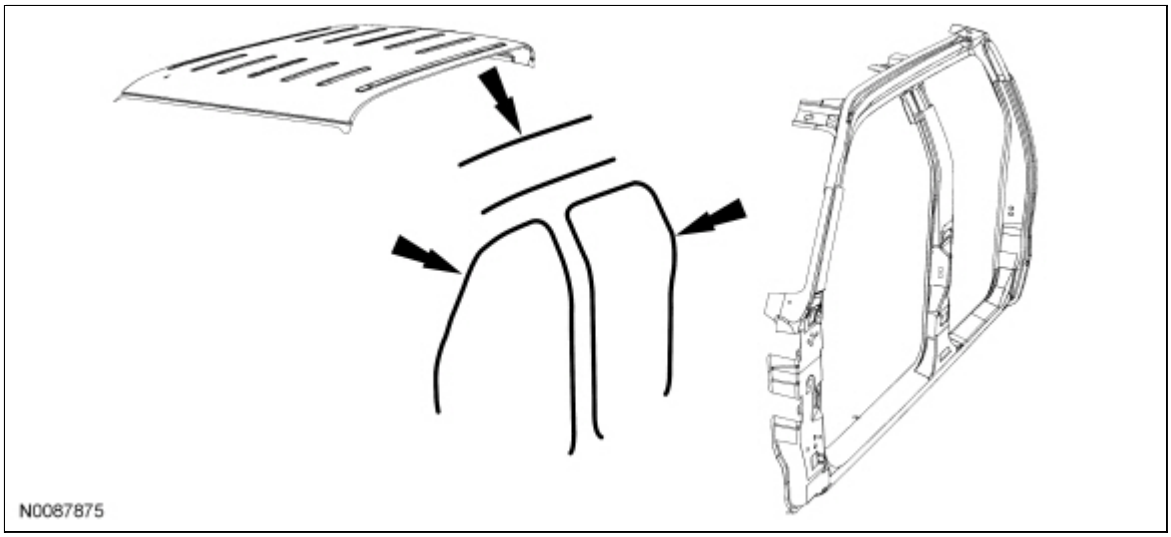


Door Frame Opening — Regular Cab, SuperCab



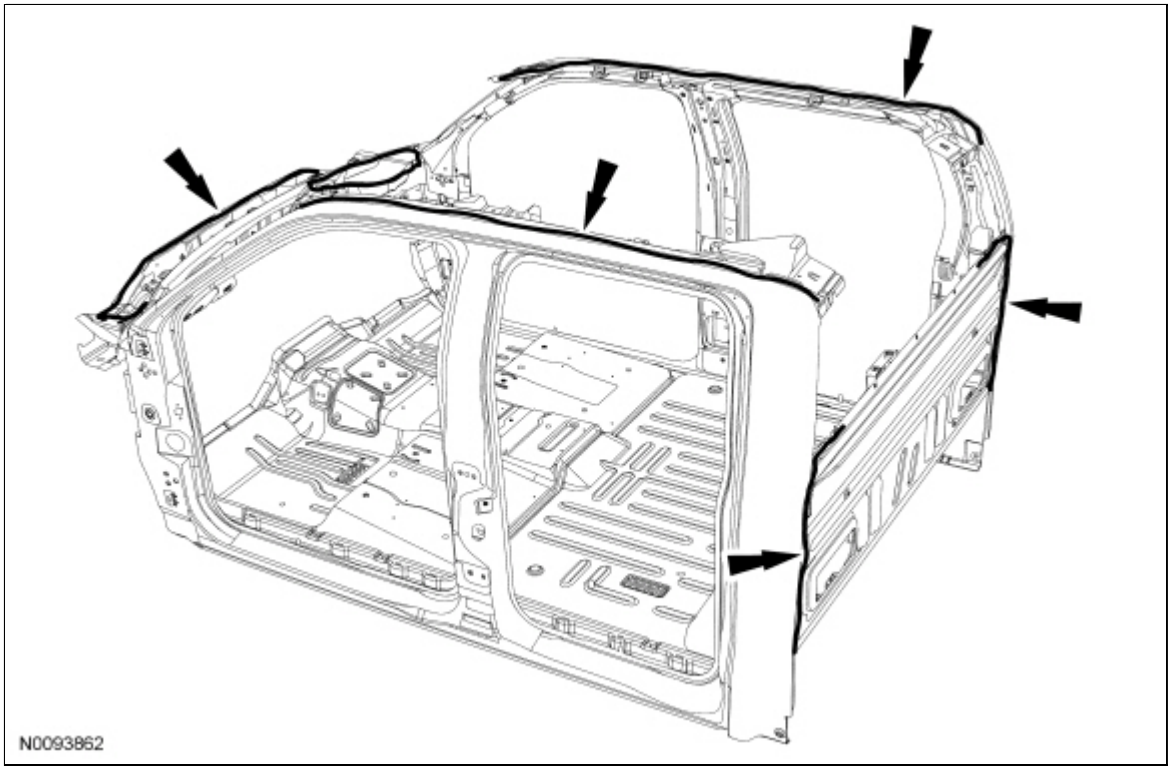
Door Frame Opening — SuperCrew

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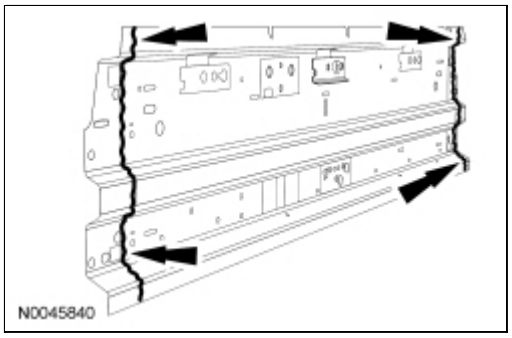
Cab Structure

NOTE: SuperCrew shown, SuperCab and regular cab similar.



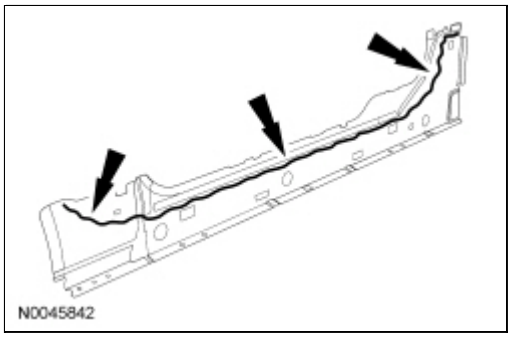
Cab Back Panel Reinforcement

NOTE: Panel inner view indicated.



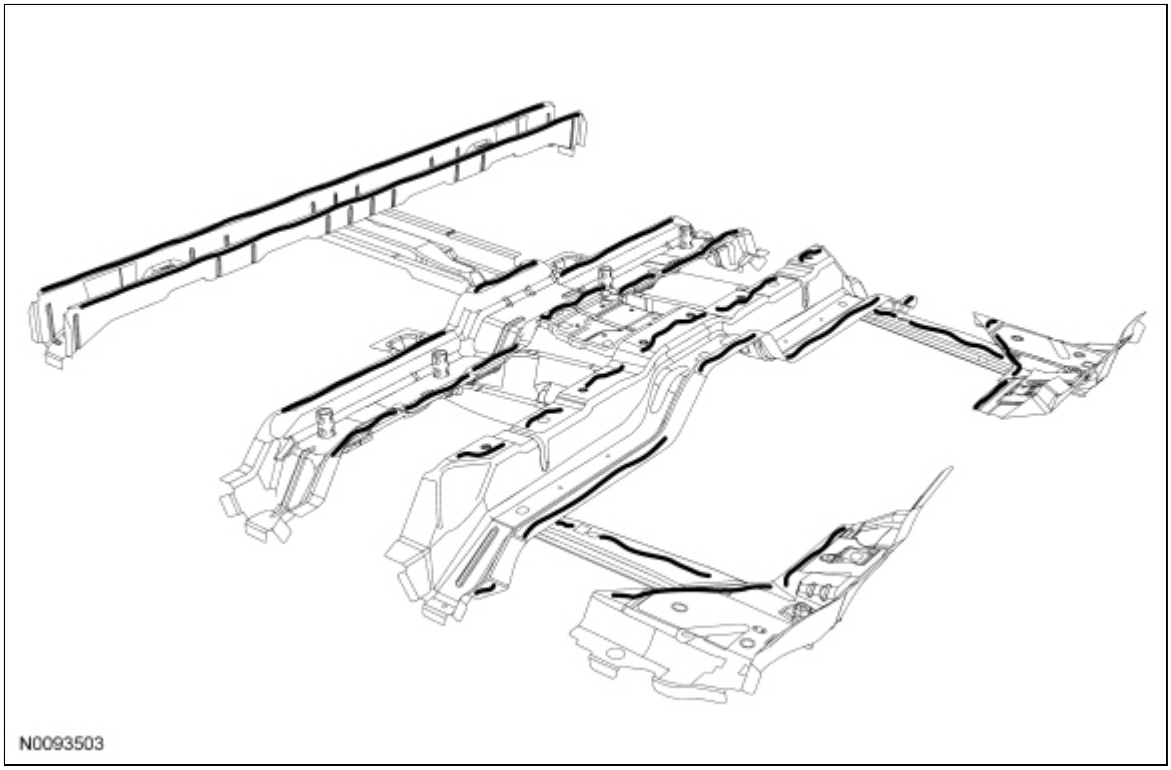
Floor Side Member

NOTE: Adhesive applied between side member and floor side.



Floor Reinforcements — Regular Cab

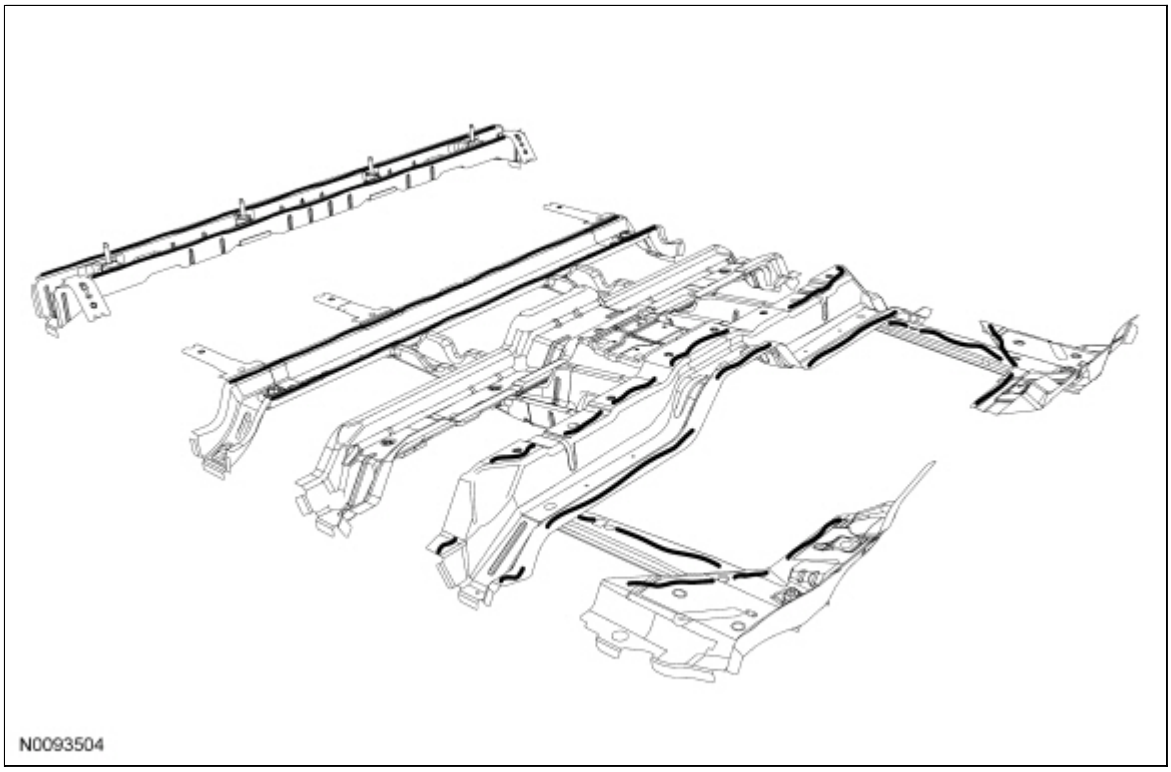
NOTE: Bold lines indicate adhesive bead locations.



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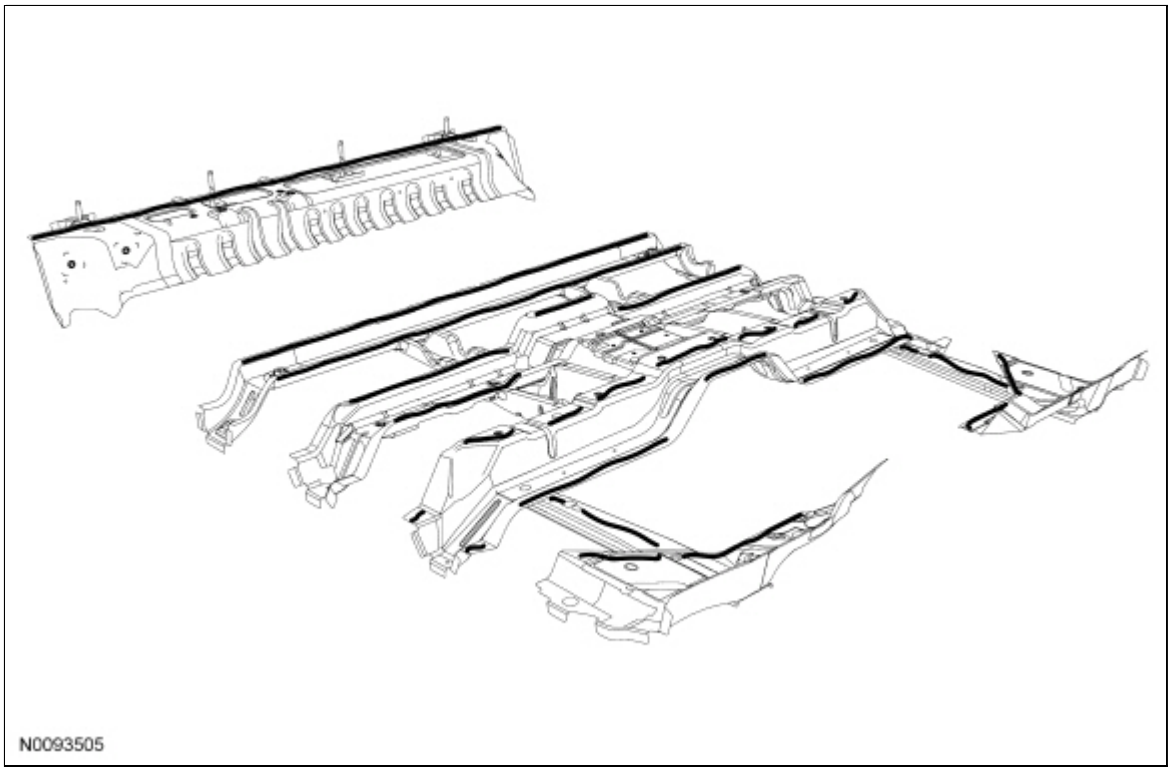
Floor Reinforcements — SuperCab

NOTE: Bold lines indicate adhesive bead locations.



Floor Reinforcements — SuperCrew Cab

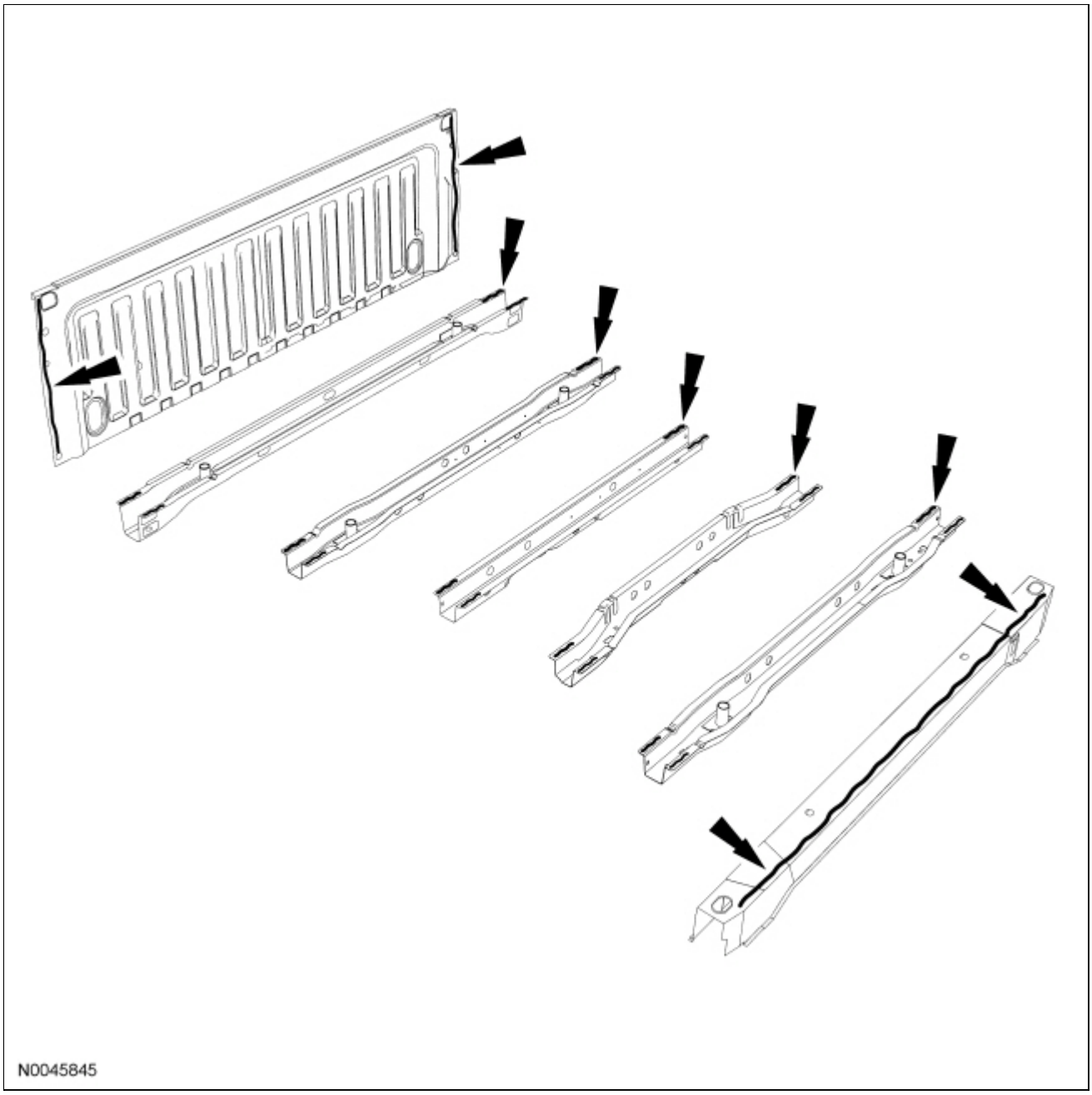
NOTE: Bold lines indicate adhesive bead locations.



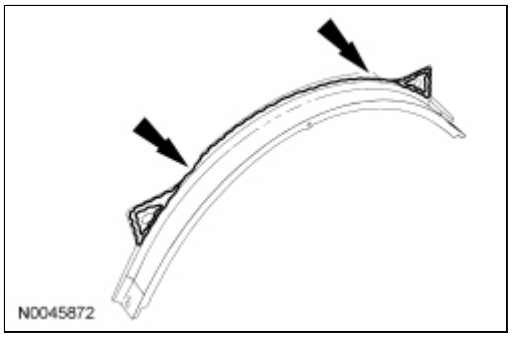
Pickup Box Underbody

NOTE: Adhesive applied on right and left ends of floor reinforcements.

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Wheelhouse Panel — Styleside Pickup Box



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Body

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

The body consists of the following:

- Cab-forward design
- Full frame bolted to the body
- Aluminum hood
- Body side outer panel constructed of dent resistant High-Strength Steel (HSS) and mild steels
- Magnesium radiator support
- Front structure inner reinforcement is hydroformed High-Strength Low Alloy (HSLA) rail assembly
- Lightweight steel welded panel construction
- Extensive use of HSLA , Dual Phase Steel (DP) and Boron steel in the cab body structure(s)
- Dash panel constructed of laminated sound/vibration steel
- Bolted, removable front fenders, hinged doors, tailgate and hood
- Fender outer panels constructed of dent resistant HSS steel
- Front and rear door outer panels constructed of dent resistant HSS steel
- Structural adhesive used throughout the body shell and underbody
- Regular cab, SuperCab and SuperCrew cab styles
- Styleside pickup bed available with 1.67 m (5.5 ft), 1.98 m (6.5 ft) and 2.44 m (8.0 ft) pickup bed length
- 3,198 mm (126 in) wheelbase
- 3,365 mm (133 in) wheelbase
- 3,671 mm (145 in) wheelbase
- 3,988 mm (157 in) wheelbase
- 4,140 mm (163 in) wheelbase
- **NOTE:** For information regarding cab style and pickup bed configurations, refer to Section 100-01 .

  Platinum edition available in SuperCrew cab style only
- Platinum edition has unique chrome body side cladding
- Platinum edition has unique chrome pickup bed rail bars
- Mastic sound deadener material used on floor pans

F-150 SVT Raptor package contains the following:

- SuperCab
- 1.67 m (5.5 ft) pickup bed length
- Steel pickup bed outer panels

- 3,365 mm (133 in) wheelbase
- Sheet-Molded Composite (SMC) hood and front fenders
- Unique grille
- Modified front and rear bumpers

Lincoln Mark LT (Mexico only) contains the following:

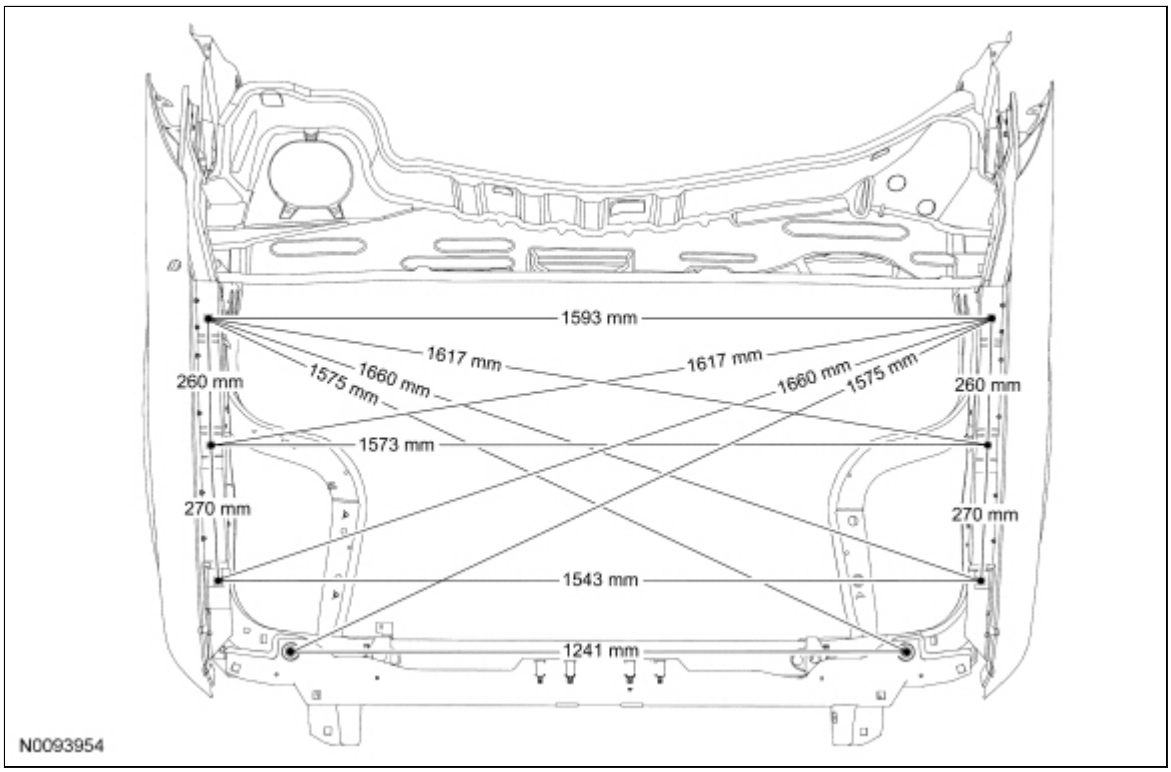
- Lincoln Mark LT available in SuperCrew cab, styleside
- Lincoln Mark LT has unique chrome grille
- Lincoln Mark LT has unique chrome body side cladding
- Lincoln Mark LT has unique chrome pickup bed rail bars
- Lincoln Mark LT has unique tailgate applique

For dimensional information, refer to the following illustrations.

Underhood Dimensions

NOTICE: **The front structure rails cannot be sectioned and must be serviced at the original factory seam locations or as an assembly if damaged. It is mandatory that the replacement section be installed as delivered at the original factory seam locations or energy collision management can be compromised.**

NOTE: Measurements are obtained on center, unless otherwise indicated.

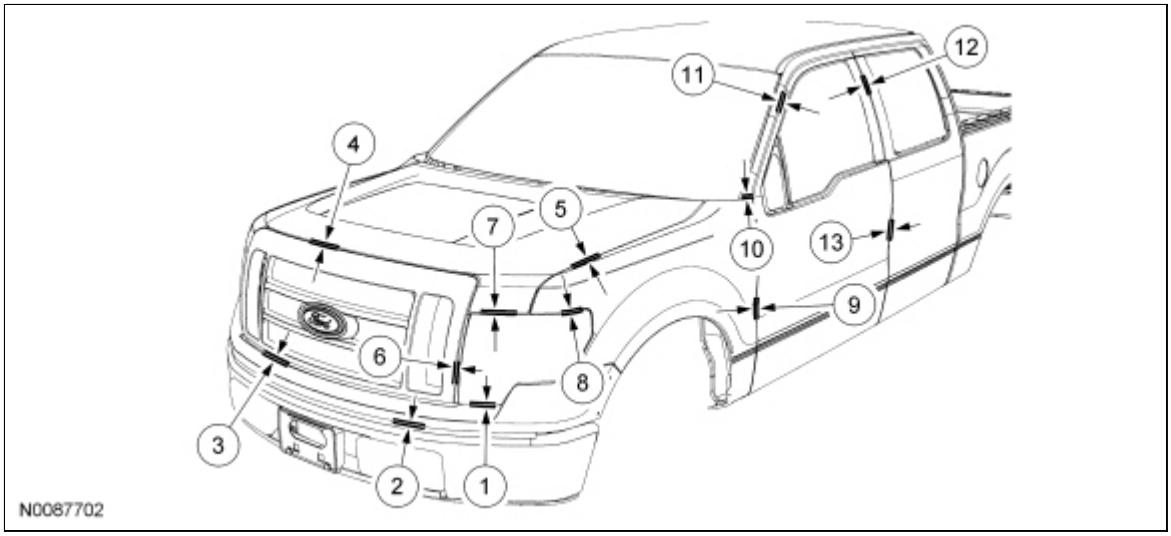


Body Margins

NOTE: Dimensions apply to all cab and box styles unless otherwise indicated. Dimensions apply to right and left side. SuperCrew cab shown.

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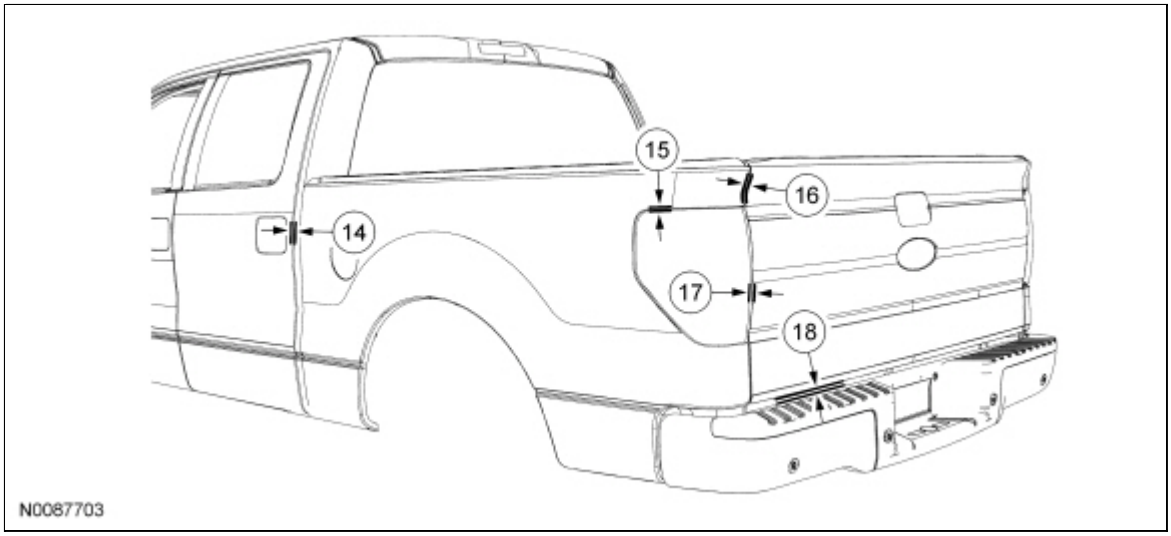
NOTE: F-150 SVT Raptor hood, grille and fender margin specifications are identical with F-150.



Item	Description	Specification	Flushness Specification
1	Headlamp to upper fascia	3.0 mm (0.118 in) ± 3.0 mm (0.118 in)	—
2	Fascia to bumper	19.0 mm (0.748 in) ± 6.0 mm (0.236 in)	7.0 mm (0.275 in) ± 7.0 mm (0.275 in)
3	Grille to fascia	15.0 mm (0.59 in) ± 5.0 mm (0.196 in)	—
4	Hood to grille	1.5 mm (0.059 in) ± 1.5 mm (0.059 in)	1.0 mm (0.039 in) ± 1.0 mm (0.039 in)
5	Hood to fender	4.0 mm (0.157 in) ± 2.0 mm (0.078 in)	0.0 mm (in) ± 2.0 mm (0.078 in)
6	Headlamp to grille	8.0 mm (0.314 in) ± 4.5 mm (0.177 in)	—
7	Hood to headlamp	7.5 mm (0.295 in) ± 2.5 mm (0.098 in)	—
8	Fender to headlamp	3.0 mm (0.118 in) ± 2.0 mm (0.078 in)	0.0 mm (in) ± 2.0 mm (0.078 in)
9	Front door to fender (all cab styles)	5.0 mm (0.196 in) ± 2.0 mm (0.078 in)	-0.5 mm (-0.019 in) ± 2.0 mm (0.078 in)
10	Fender to A-pillar	4.0 mm (0.157 in) ± 2.0 mm (0.078 in)	—
11	Door to A-pillar	5.0 mm (0.196 in) ± 2.0 mm (0.078 in)	-3.3 mm (-0.129 in) ± 2.0 mm (0.078 in)
12	Front door to rear door (applique on regular cab)	5.0 mm (0.196 in) ± 2.0 mm (0.078 in)	0.0 mm (in) ± 2.0 mm (0.078 in)
13	Front door to rear door (door opening panel on regular cab)	5.0 mm (0.196 in) ± 2.0 mm (0.078 in)	0.0 mm (in) ± 2.0 mm (0.078 in)

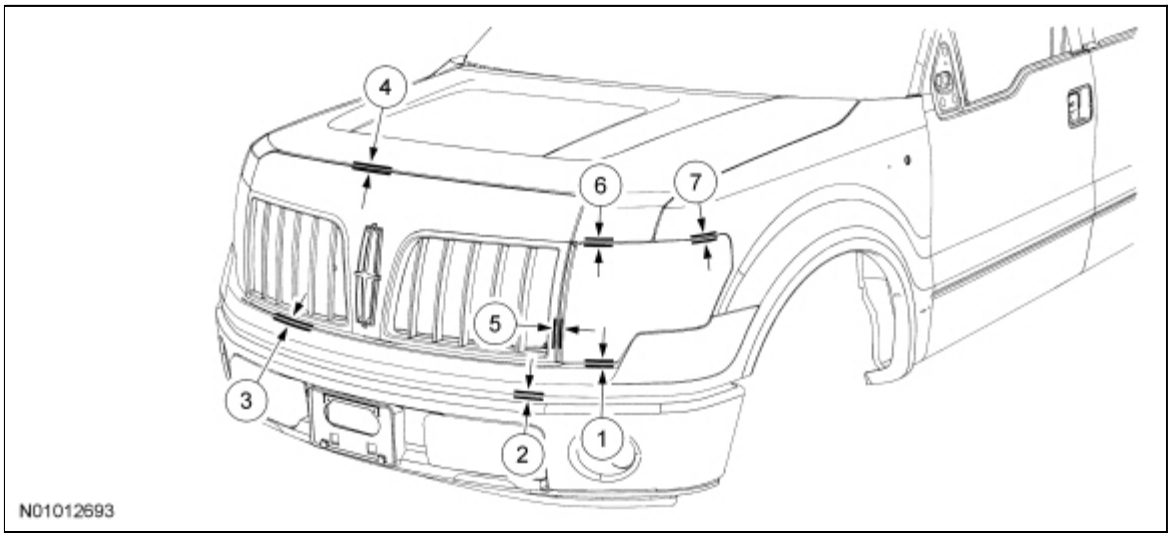
Body Margins

NOTE: Styleside shown, F-150 SVT Raptor margin specifications are identical.



Item	Description	Specification	Flushness Specification
14	Cab to pickup bed	25.0 mm (0.984 in) ± 5.0 mm (0.196 in)	5.0 mm (0.196 in) ± 5.0 mm (0.196 in)
15	Rear lamp to outer panel	2.0 mm (0.078 in) ± 1.5 mm (0.059 in)	5.0 mm (0.196 in) ± 1.5 mm (0.059 in)
16	Tailgate to pickup bed	5.0 mm (0.196 in) ± 2.5 mm (0.098 in)	0.0 mm (in) ± 2.5 mm (0.098 in)
17	Tailgate to rear lamp	5.0 mm (0.196 in) ± 2.5 mm (0.098 in)	5.0 mm (0.196 in) ± 2.5 mm (0.098 in)
18	Tailgate to step pad	30. mm ± 5.0 mm (0.196 in)	—

Body Margins — Lincoln Mark LT (Mexico only)

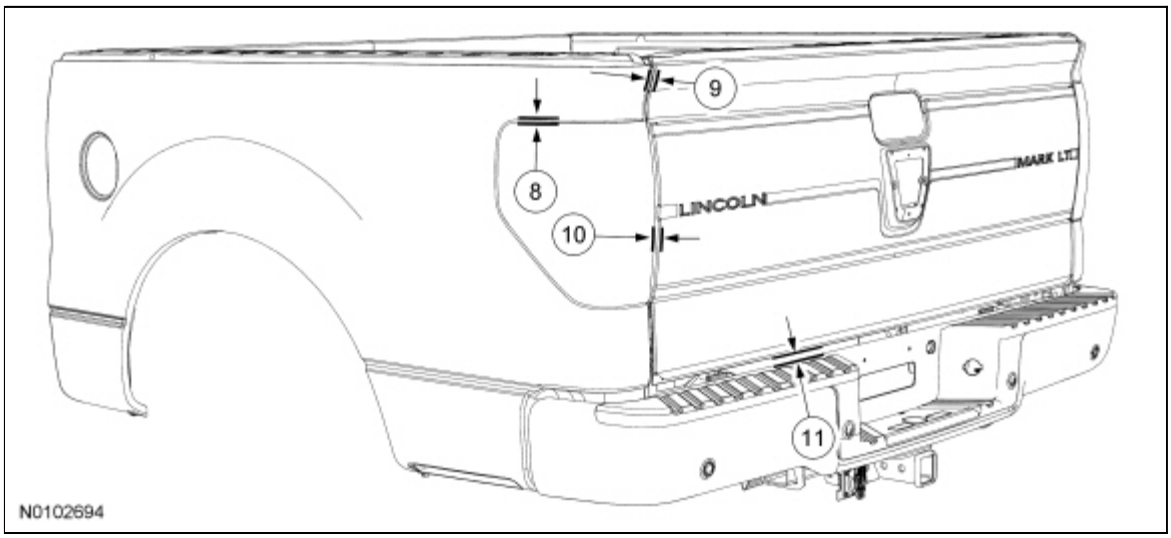


Item	Description	Specification	Flushness Specification

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1	Headlamp to upper fascia	3.0 mm (0.118 in) ± 3.0 mm (0.118 in)	—
2	Fascia to bumper	19.0 mm (0.748 in) ± 6.0 mm (0.236 in)	7.0 mm (0.275 in) ± 7.0 mm (0.275 in)
3	Grille to fascia	15.0 mm (0.59 in) ± 5.0 mm (0.196 in)	—
4	Hood to grille	1.5 mm (0.059 in) ± 1.5 mm (0.059 in)	1.0 mm (0.039 in) ± 1.0 mm (0.039 in)
5	Headlamp to grille	8.0 mm (0.314 in) ± 4.5 mm (0.177 in)	—
6	Hood to headlamp	7.5 mm (0.295 in) ± 2.5 mm (0.098 in)	—
7	Fender to headlamp	3.0 mm (0.118 in) ± 2.0 mm (0.078 in)	0.0 mm (in) ± 2.0 mm (0.078 in)

Body Margins — Lincoln Mark LT (Mexico only)

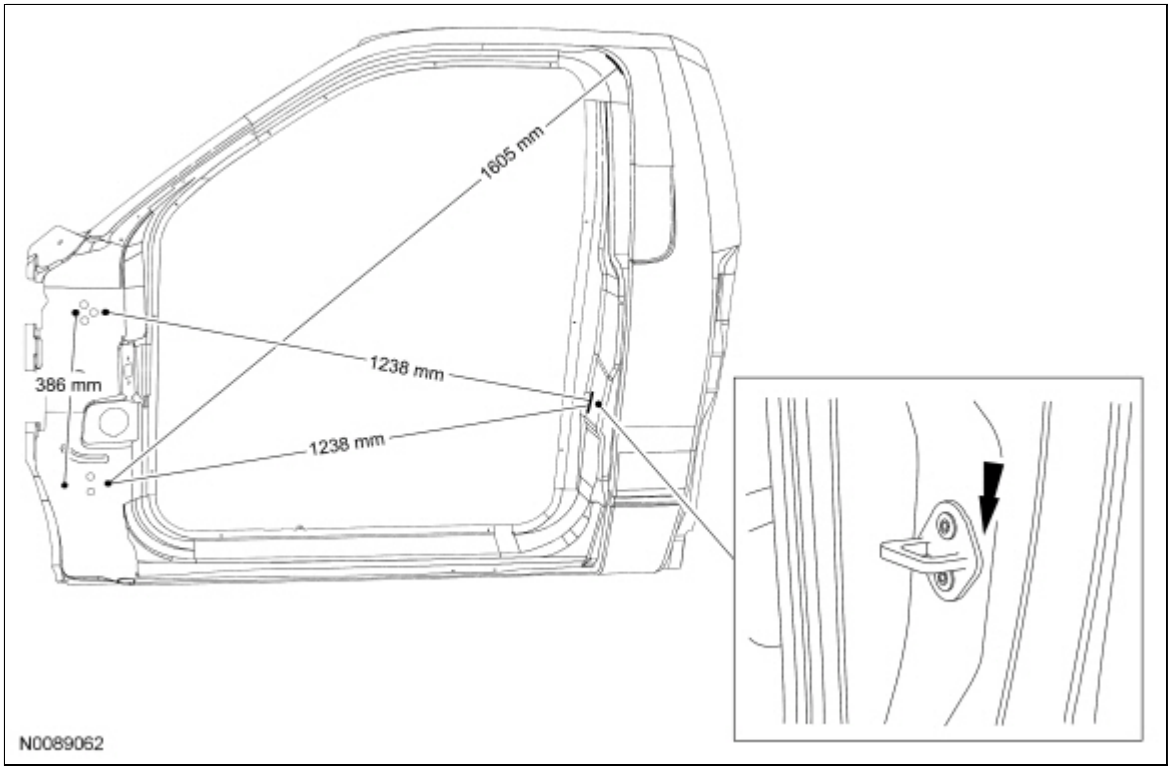


Item	Description	Specification	Flushness Specification
8	Rear lamp to outer panel	2.0 mm (0.078 in) ± 1.5 mm (0.059 in)	5.0 mm (0.196 in) ± 1.5 mm (0.059 in)
9	Tailgate to pickup bed	5.0 mm (0.196 in) ± 2.5 mm (0.098 in)	0.0 mm (in) ± 2.5 mm (0.098 in)
10	Tailgate to rear lamp	5.0 mm (0.196 in) ± 2.5 mm (0.098 in)	5.0 mm (0.196 in) ± 2.5 mm (0.098 in)
11	Tailgate to step pad	30.0 mm (1.181 in) ± 5.0 mm (0.196 in)	—

Body Side Dimensions

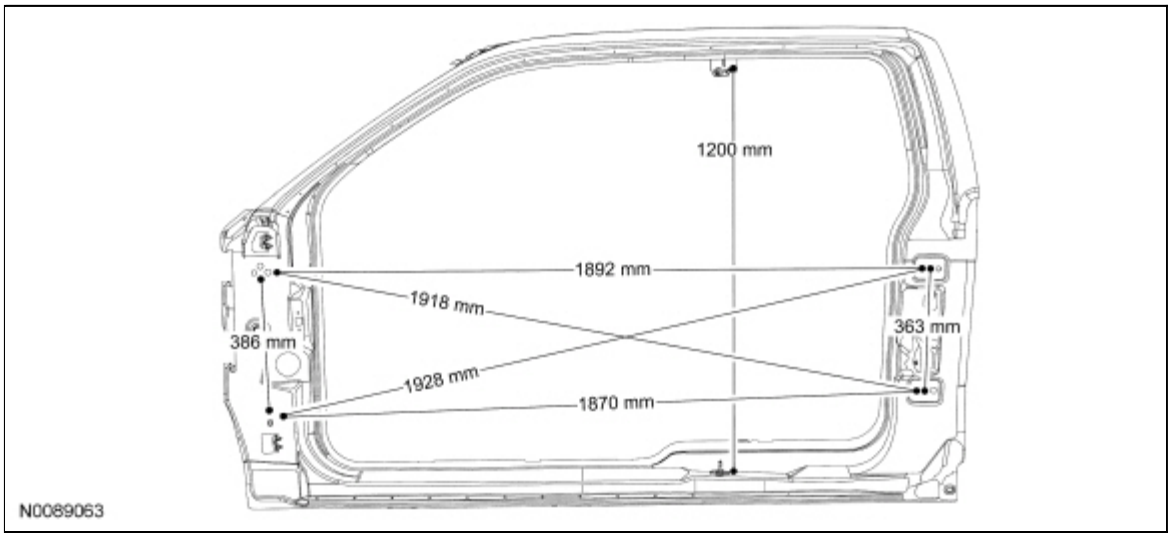
Regular Cab

NOTE: Measurements are obtained on center, unless otherwise indicated. Measurement at door striker obtained flush with body surface.



SuperCab

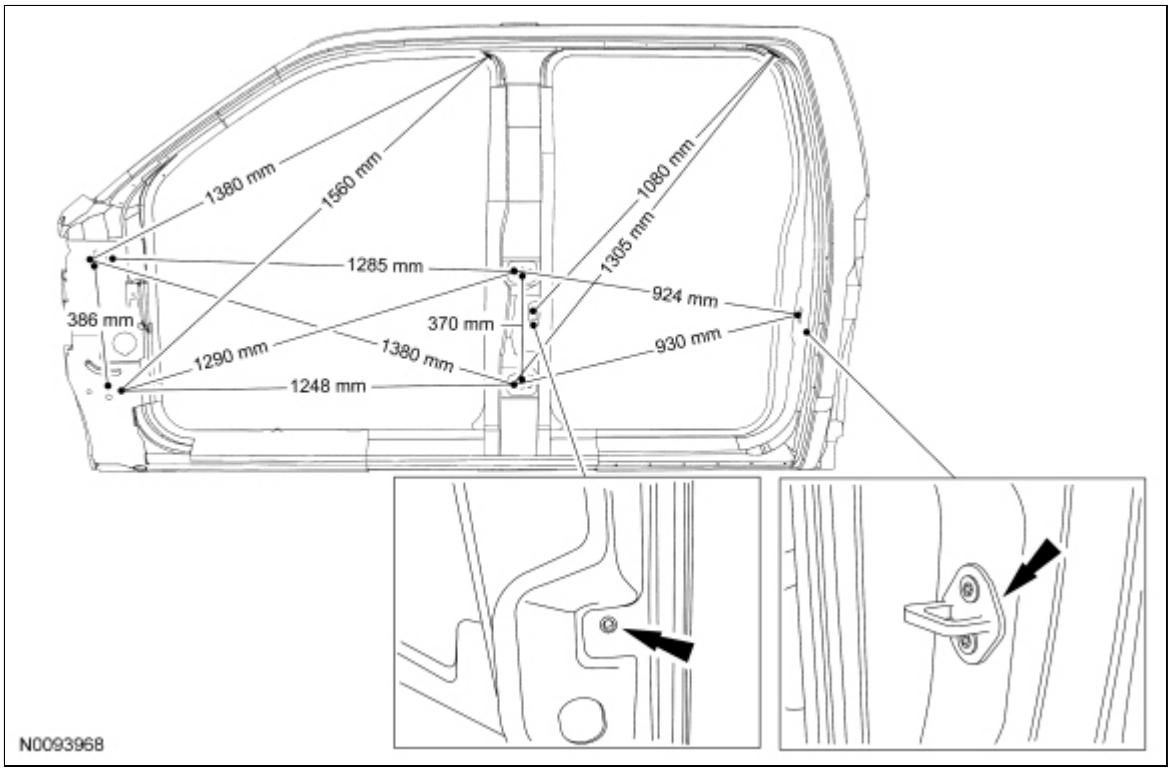
NOTE: Measurements are obtained on center, unless otherwise indicated.



SuperCrew Cab

NOTE: Measurements are obtained on center, unless otherwise indicated. Measurement at door striker obtained flush with body surface.

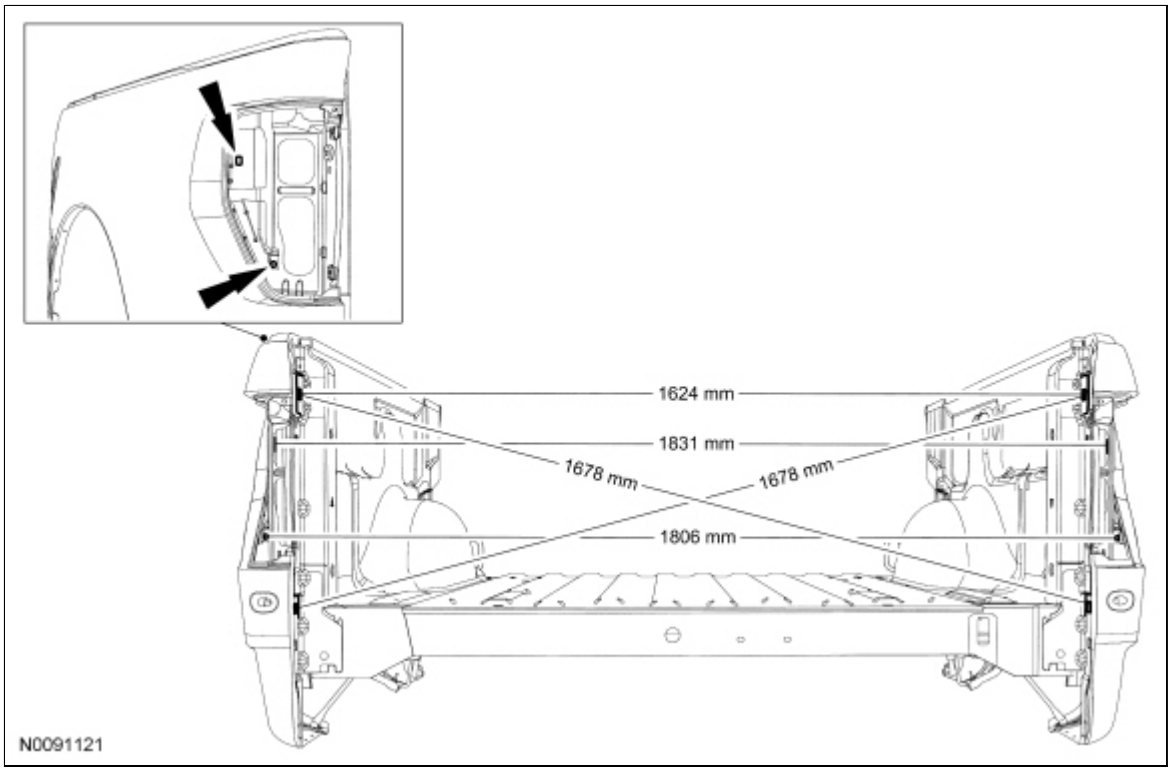
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Tailgate Opening Dimensions

Styleside

NOTE: Styleside tailgate opening dimensions identical for all pickup bed lengths. Measurements taken flush from striker and lower hinge mount surfaces.



Underbody Dimensions

WARNING: Frame rail crush zones absorb crash energy during a collision and must be replaced if damaged. Prior to replacement of frame rail crush zones, straighten damaged frame rails to correct frame dimensions. Failure to follow these instructions may adversely affect frame rail crush zone performance and may result in serious personal injury to vehicle occupants in a crash.

Frame Datum Height — Regular Cab

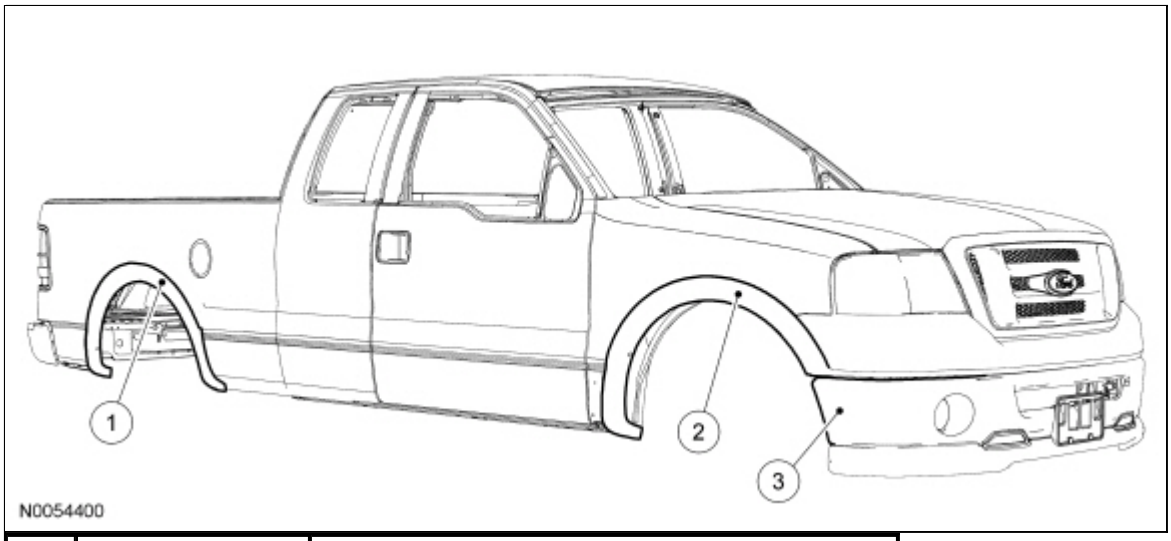
NOTE: Datum height determined measuring from lower edge of holes and slots on center, unless otherwise indicated.

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Plastic Components

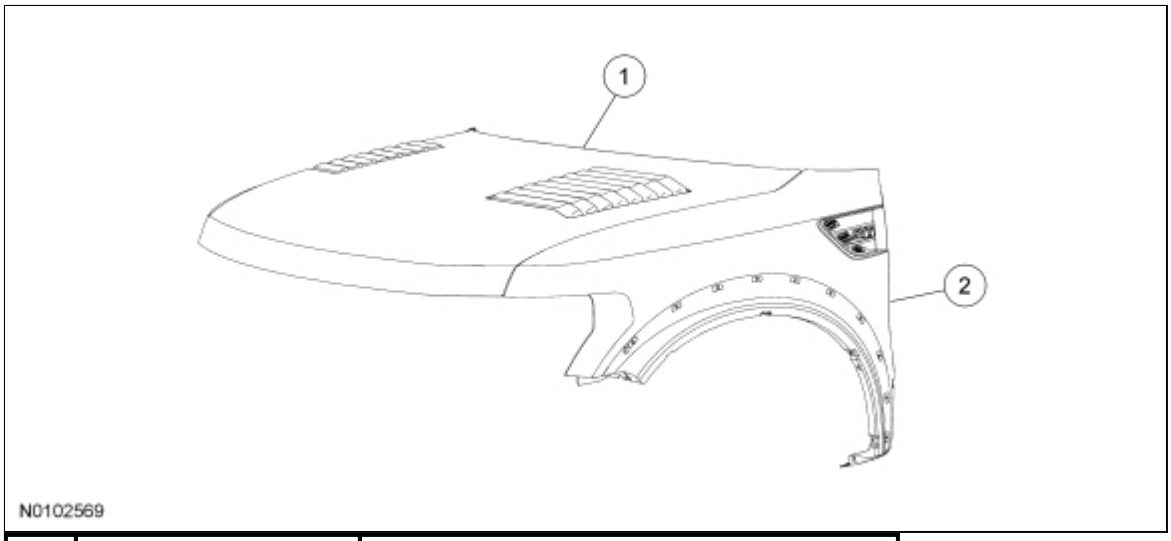
Exterior Plastic Components — Painted

NOTE: The following illustration(s) are not all-inclusive of trim levels available. The actual trim level of the vehicle will determine the viability of carrying out a plastic repair.



Item	Part Number	Description
1	29165 LH/ 29164 RH	Wheel arch moulding (rear) — Thermoplastic Olefin (TPO)
2	16039 LH/ 16038 RH	Wheel arch moulding (front) — TPO
3	17D957	Bumper cover (front) — TPO

F-150 SVT Raptor



Item	Part Number	Description
1	16612	Hood panel — Sheet-Molded Composite (SMC)
2	16006A LH/ 16005A RH	Fender — SMC

Several considerations will determine viability of plastic repair procedure(s):

- Is the damage cosmetic or structural?
- Can the repair be carried out on the vehicle?
- Is the part readily available?
- Is component repair the most cost effective method?
- Can the component be economically restored to original strength and appearance?
- Will the repair provide for the fastest, highest quality repair?

Several types of plastic are in use for automotive application. However, all plastics will fall into 2 primary categories of thermoplastic or thermosetting plastic.

Thermosetting Plastic

Generally, thermosetting plastics are made with 2-part thermosetting resins. When mixed together, heat is generated, producing a cure that is irreversible. Because of this, thermosetting plastics will require the use of a 2-part adhesive for repair.

Sheet-Molded Composite (SMC)

Sheet-Molded Composite (SMC) is a type of thermosetting plastic that uses glass fibers or nylon fibers in combination with thermosetting polyester resins. When fully cured, SMC is strong and rigid.

SMC is similar to, but not identical to fiberglass. Ford Motor Company uses SMC in components such as fenders, hoods and liftgates.

Thermoplastic Compounds

Thermoplastic compounds are manufactured by a process that is reversible. Thermoplastics can be remolded repeatedly by reheating. This characteristic of thermoplastics makes plastic welding a possible

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repair alternative. A repair of thermoplastic compounds is still possible through the use of 2-part adhesive and filler repair materials and reinforcements as needed. Thermoplastics are widely used in interior trim components, wheel flares, body side cladding and bumper covers.

Polyolefin

Polyolefins fall into the family of thermoplastics with one unique characteristic: An oily or waxy feel to the material when sanded or ground. Polyolefin lends itself very well to remolding through the use of heat. Because of this, components made of this material lend themselves well to the possibility of plastic welding. Most adhesive repair materials and paint will not bond to surface of a polyolefin unless an adhesion promoter specially formulated for plastic is first applied to the exposed raw surface. Otherwise, polyolefins are repaired like most other thermoplastics. Some typical uses of polyolefins are bumper covers, fan shrouds and wheel housings.

Correct identification of the various types of plastic is necessary to select the appropriate repair method(s) to carry out high quality plastic repairs. Refer to Plastics Identification in this section.

Sealers

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

The correct sealing of joints is essential to repairing the vehicle correctly. Sealers are used to prevent wind noise, water leaks, exhaust fumes and dust from entering the vehicle. They also provide anti-corrosion barriers. Sealers are applied to areas such as door and rear compartment hem flanges, wheelhouse, quarter outer, floor, cowl, roof and other panel-to-panel attaching points. The following joint sealers are recommended for use depending upon the application:

- Brushable Seam Sealer — A sealer intended to restore the original brushed seam appearance. It is used to seal lap joints in sheet metal that are spot welded (for example, floorpans and cowls). Use a product obtained locally.
- Roof Ditch Sealer — A self-leveling sealer used for drip rails, roof seams, quarter panels to rear deck and for water leaks.
- Seam Sealer — Heavy-bodied, non-sag adhesive/sealer for use on standing cosmetic seams, truck bed seams, tooled door skin seams and floor pans. Also used for water leaks and noise concerns.

Sealers should remain flexible after curing and must be paintable. Follow the manufacturer's directions for correct application of these materials.

Any damage to originally sealed joints should be repaired by resealing. Along with attaching points of new panels, open joints that require bridging of sealer to close a gap should be sealed using a heavy-bodied sealer.

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Sound Deadeners and Insulators

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Mastic is made of a combustible material and should be removed prior to carrying out welding procedures to the area. Heat zones from welding near the mastic can cause the mastic material to burn.**

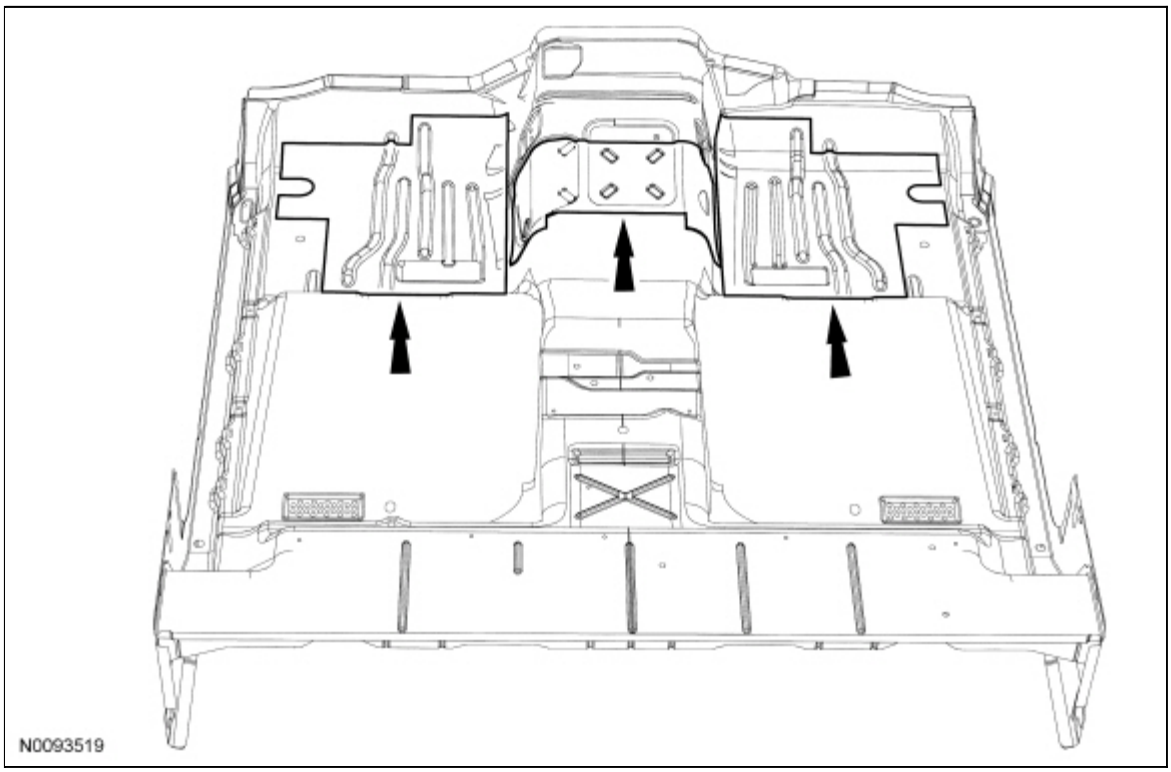
NOTICE: **Corrosion protection must be restored to the area AFTER the mastic material is applied. Corrosion protection products may be wax based and loss of adhesion may occur.**

NOTE: The following illustrations serve as a reference to indicate mastic patch (butyl pad) locations. Additional insulators and sound deadeners are used beyond those indicated in the illustration.

NOTE: To restore the vehicle to design intent, missing or damaged sound deadeners and insulators should be replaced with the equivalent service replacement component. In instances where pumpable material is applied when manufactured and can not be duplicated, cut-to-fit mastic material is an acceptable replacement.

Regular Cab

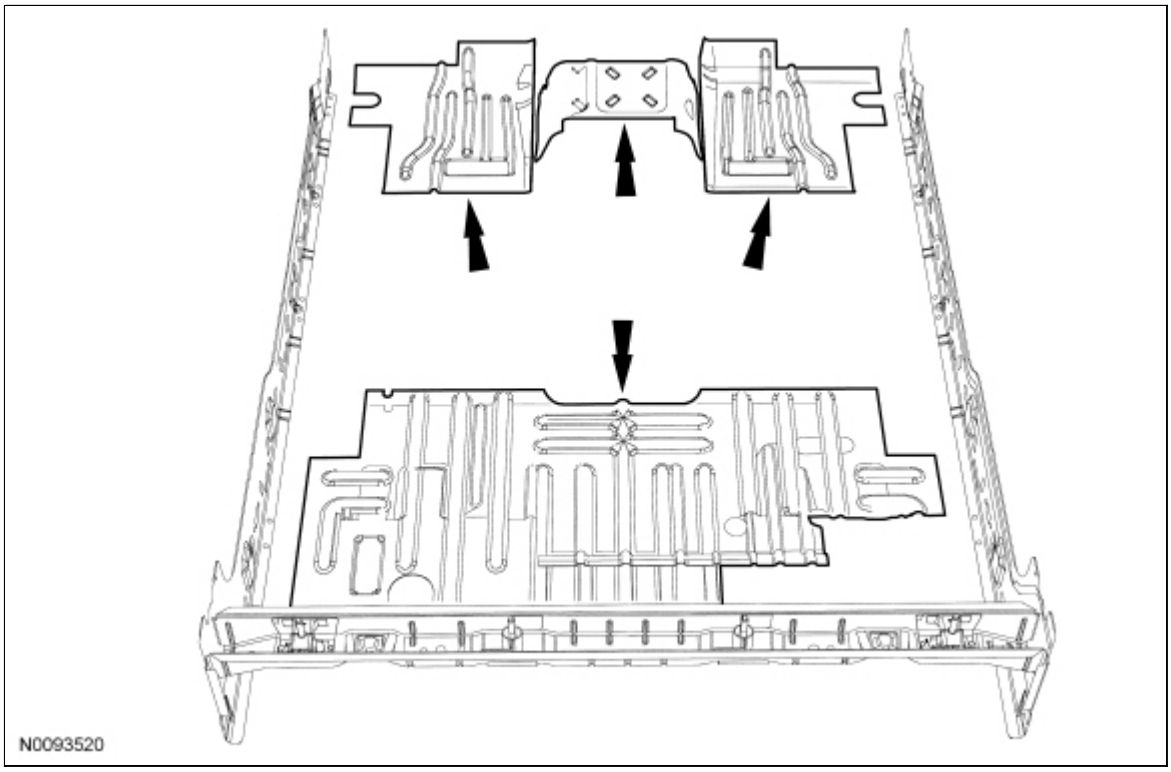
NOTE: Floor pan interior view.



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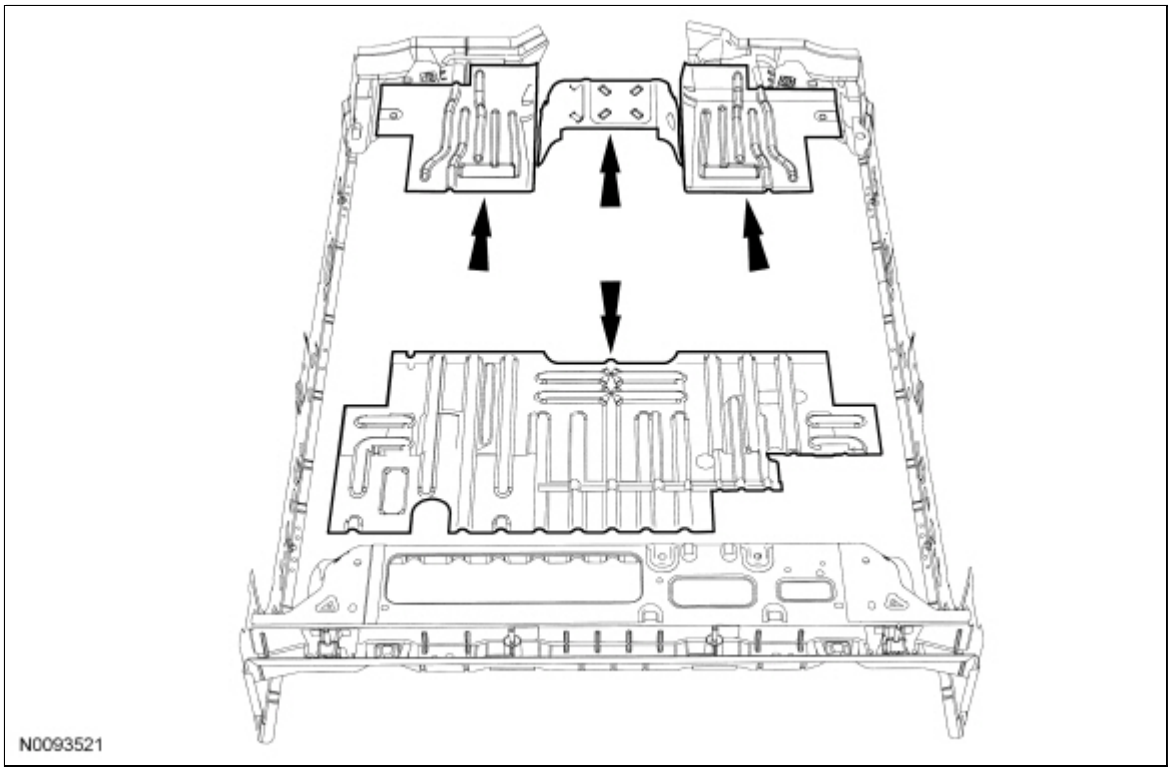
SuperCab

NOTE: Floor pan interior view.



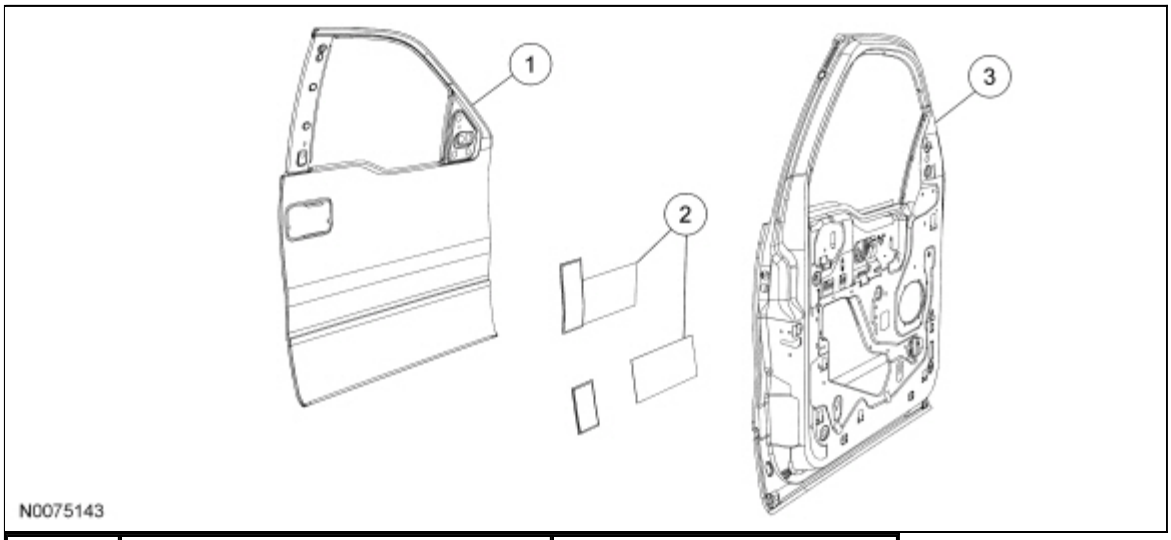
SuperCrew Cab

NOTE: Floor pan interior view.



Door

NOTE: Front door shown, rear door(s) similar.



Item	Part Number	Description
1	20201 LH/ 20200 RH	Door outer panel
2	99P30A2	Mastic material
3	20125 LH/ 20124 RH	Door assembly

1. Whenever replacement of an existing mastic insulator is carried out, the surface must be thoroughly cleaned to make sure correct adhesion will occur. The surface should be 10°C (50°F) or greater before applying the mastic. The use of a heat gun to warm the metal surface will aid in adhesion.

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Welding Precautions — Steel

Material

General Specifications -Welding Specifications

 **WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.**

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Anchoring and Pulling Guidelines

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

NOTICE: **The unique cab structure design and material characteristics of the cab(s) require unique and specific anchoring equipment to ensure proper restoration of pre-accident condition of the vehicle. In instances of crash damage extending in to the cab platform, the cab may need to be removed from the frame for correct repair. Failure to use the correct equipment or technique recommendations may result in inadvertent additional damage to the cab structure and floor.**

NOTICE: **Anchoring equipment must be used to hold the cab at both the pinch welds and at all the cab mount isolator locations. Failure to use the correct equipment or technique recommendations may result in inadvertent additional damage to the cab structure and floor.**

NOTE: Crew Cab shown, others similar.

1. Anchor the vehicle at both the pinch weld locations and the cab mount locations as indicated in the illustrations. Use the original cab mounting hardware with the anchoring equipment. For dimensional information of the frame and body, refer to Body in this section.

Plastics Identification

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Plastics Repair

Material

Item	Specification
Plastic Bonding Adhesive TA-9	—

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

1. In deciding whether to repair or install a new component, follow these guidelines.
   - Is a part readily available?
   - Can the damaged part be economically returned to its original strength and appearance, or will the labor cost exceed the cost of a new component?
   - Will repair provide for the fastest, highest quality repair?

2. ***NOTICE:*** **Never apply solvents such as lacquer thinner or reducer at any stage of plastic repair. Solvents, cleaners and water are absorbed by many types of plastics and by the glass fibers used for reinforcements. If this occurs, the plastic may swell in the area of repair and cause the repair to fail. Remove cleaners and water quickly and use air and heat to speed up drying.**

   NOTICE: **During the repair of many plastics and particularly polyolefin plastics, an adhesion promoter must be applied to the substrate to allow repair materials and paint to bond correctly. Reapplication is required when grinding or sanding through the sealer or primered layers.**

   NOTE: When possible, it is recommended to carry out as much of the plastic repair as possible on the vehicle. Parts mounted on the vehicle are held in correct alignment throughout the repair. Attempting to repair the part off the vehicle may cause misalignment. This could lead to failure of the repair.

   Select the correct repair method by identifying the type of plastic being repaired. For additional information, refer to Plastics Identification in this section to determine the type of plastic being repaired.

3. **NOTE:** Always refer to the manufacturer's label directions for the type of repair materials, fillers and bonding agents being used as they are material specific.

   Determine whether a reinforcement piece is needed as a backer on large repairs.
   - Construct a reinforcement piece from a scrap piece of the type of plastic being repaired and

follow manufacturer's label directions for the type of system being used.

- When repairing Sheet-Molded Composite (SMC), a reinforcement piece can be constructed using several layers of glass cloth saturated with resin or structural adhesive. The weave of the cloth or screening should be loose enough to allow the resin to thoroughly penetrate. Reinforcement should cover the entire area of damage and extend outward beyond the damage or joint area.

Sheet-Molded Composite (SMC) Panel Repair

NOTE: The following procedure applies to repair of structural cracks and large gouges. If damage is cosmetic, use of reinforcing cloth may not be necessary.

1. Panels to be repaired should be dry and at room temperature 18°C (65°F) to 24°C (75°F) prior to carrying out any repairs. Both sides of the panel must be thoroughly cleaned before sanding or grinding.

2. Cover the break in the SMC (front and back) with masking tape. This protects the damaged area from absorbing the prep cleaner and eliminates wicking of the cleaner through the fibers into the SMC .

3. Remove all waxes, silicones, dirt and road oils from the area surrounding both sides of the damaged area with a plastics wax and grease remover.
    - Remove the tape and sand the back of the repair area with an angle grinder, Dual Action (D/A) sander or by hand using 80-grit sandpaper. Remove all dust with a vacuum and tack cloth.

4. Create a reinforcing patch using a piece of scrap SMC that conforms well to the back of the damaged area or form a patch from fiberglass cloth.
    - Cut a section of cloth large enough to cover the repair, plus 25.4 mm (1 in) around the repair area.
    - Cut a section of plastic film backing approximately 25.4 mm (1 in) larger than the cloth. Lay the plastic on a smooth, flat surface where it will be used to create a pyramid patch.

5. Follow manufacturer's directions and apply plastic repair adhesive to the plastic film backing and smooth with plastic spreader to recommended thickness. Place the pre-cut fiberglass cloth on the adhesive-coated plastic film. Cover the cloth with a coat of repair adhesive and spread to the recommended thickness.

6. Apply the prepared patch to the backside of the panel and compress. Follow manufacturer's instructions for adhesive cure. Remove plastic film after adhesive cures and sand as necessary to remove roughness.

7. Remove masking tape from the front side of damaged area and grind down to the backing patch. Use an angle grinder with a 30- to 40-grit wheel. Make a gradual taper in the area, this will prevent bull's-eyes or read-through in the finished repair. Sand prepared area with a D/A sander or hand-sand with 80-grit sandpaper.

8. Build a pyramid patch using fiberglass cloth or equivalent and plastic repair adhesive. Following manufacturer's directions, apply patch to damaged area.

9. Rough-grind area to remove excess adhesive. Sand repair area with 80-grit sandpaper, making sure to cut slightly below the SMC finished surface. This will allow for a finish coat of plastic body repair material.

10. Apply a finish coat of plastic repair filler material per manufacturer's directions.

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11. Finish-sand, prime and topcoat using Ford-approved paint systems.

Thermoplastic Compounds

1. In deciding whether to repair or install a new component, follow these guidelines.
    - Is a part readily available?
    - Can the damaged part be economically returned to its original strength and appearance, or will the labor cost exceed the cost of a new component?
    - Will repair provide for the fastest, highest quality repair?

2. **NOTE:** The following steps are to be used as a guideline. Depending on what brand of adhesives or patch materials are used, procedures may vary slightly.

   Thoroughly clean the damaged area with wax and grease remover formulated for use with plastics.

3. Hand sand the repair area with 80-grit sandpaper and remove any foreign material with compressed air.

4. Apply a plastics adhesion promoter per label directions to the repair area.

5. For small repairs, a plastic adhesive filler can be applied to the damaged area. Follow manufacturer's directions and build layers to form a thickness above the damaged area. This will allow the area to be sanded smooth.

6. To repair large holes or cracks, measure and cut a piece of fiberglass cloth or equivalent 25.4 mm (1 in) larger than the crack or hole.
    - Apply plastic repair adhesive to the damaged area and immediately apply fiberglass cloth into plastic adhesive for reinforcement. Apply additional plastic repair adhesive for strength and shape as required.

7. Contour and shape the repair as necessary with a D/A sander. Avoid sanding through the repair.

8. Finish-sand the area and carry out any required paint operations using Ford-approved paint systems.

Tab Repair — Bumper

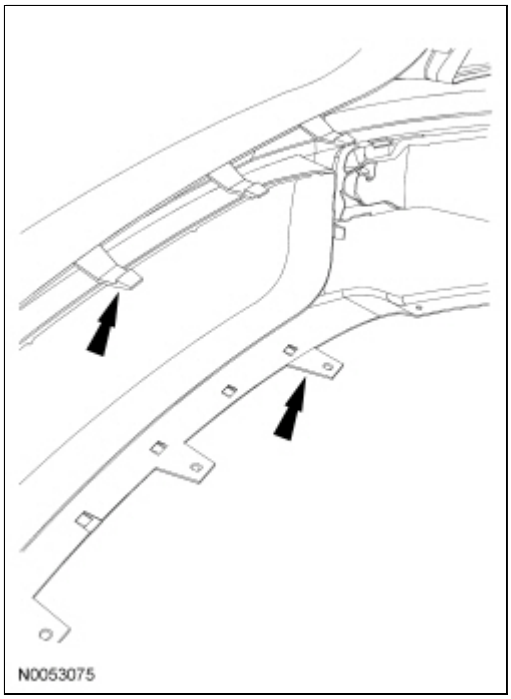
1. **NOTE:** Inspect the bumper cover to determine if part of it can be repaired to an acceptable level of quality of appearance, fit and durability. Will labor and material cost of the repair meet or exceed the cost of a new replacement bumper cover? If the bumper cover is determined to be repairable, proceed to the following steps.

   NOTE: The following steps are to be used as a guideline. Depending on what brand of adhesives or patch materials are used, procedures may vary slightly.

   Remove the affected bumper. For additional information, refer to Section 501-19 .

NOTE: Illustration is not vehicle specific.

2. Clean the broken tab(s) with a plastics wax and grease remover.



3. Hand sand the repair area with 80-grit sandpaper and remove any foreign material with compressed air.

4. Apply a plastics adhesion promoter per label directions to the repair area.

5. Measure and cut a patch of fiberglass cloth or equivalent large enough to form the front of the tab, then slope back in a wedge shape approximately 51 mm (2 in) from original tab.

6. Prepare the repair adhesive cloth patch per manufacturer's instructions and apply to the affected area.
    - Immediately position the plastic repair material patch to form the tab shape.

7. Allow appropriate cure time and shape the repair tab using a small angle sander. Use extreme care to not sand through the exterior surface.

8. Carry out any required paint repair operations to the bumper cover using Ford-approved paint systems.

9. Reassemble and install the bumper cover. For additional information, refer to Section 501-19 .

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Refinishing — Environmental Damage

Material

Item	Specification
Motorcraft® Acid Neutralizer ZC-1-A	—
Motorcraft® Alkaline Neutralizer ZC-2-A	—
3M™ Perfect-It™ Show Car Liquid Wax 39026	—
Motorcraft® Detail Wash ZC-3-A	—

Iron Oxide (Rail Dust) or Acid Rain Decontamination

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

***NOTICE:* In extreme cases of contamination, the vehicle may require refinishing. To avoid paint failure, follow the appropriate decontamination procedure prior to carrying out any panel refinishing procedure.**

NOTE: Iron oxide contamination appears as tiny rust spots on horizontal surfaces and in severe cases can be felt. This damage is typically caused from rail shipment, storage near railroad tracks or fallout from industrial manufacturing facilities.

NOTE: Acid rain contamination can be identified as water spotting and, in severe cases, staining within the water spots.

1. ***NOTICE:* Never paint over iron particles as rust spots will reoccur. Use only the recommended decontamination procedure detailed below.**

   Rinse any dust, dirt and foreign material from the vehicle body with cold water. Flush liberally.

2. Prepare the acid neutralizer by mixing 8 parts of water to 1 part neutralizer in a bucket.

3. ***NOTICE:* To avoid paint failure, do not allow the product to dry on the vehicle.**

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NOTE: Use a separate wash mitt for each product applied to the vehicle.

Working quickly and beginning at the top of the vehicle and working to the sides, apply the acid neutralizer mix to the entire vehicle. Keep the vehicle wet with the solution and lightly agitate for 5 to 7 minutes. Continue around the vehicle 4 to 5 times. For severe conditions, work the product for up to 8 minutes.

4. Rinse the vehicle completely with cold water to remove the product.
5. Dry only the horizontal surfaces of the vehicle, do not dry the glass at this time.
6. ***NOTICE:*** **To avoid damage to the paint surface, do not apply the alkaline neutralizer directly to the vehicle plastic trim.**

   NOTE: Use a separate wash mitt for each product applied to the vehicle.

   NOTE: Alkaline neutralizer is a ready-to-use product. Do not mix with water.

   Pour the alkaline neutralizer into a squirt bottle and apply the solution to a clean wash mitt.
7. ***NOTICE:*** **To avoid paint failure, do not allow the alkaline neutralizer to dry on the vehicle.**

   Apply the product to the vehicle keeping the solution wet and lightly agitate for 5 to 7 minutes. For severe conditions, work the product for up to 8 minutes.
8. Rinse the vehicle completely with cold water to remove the product.
9. Prepare the detail wash by mixing 29.5 ml (1 oz) with 3.78L (1 gal) of water.
10. Using a clean wash mitt, shampoo the entire vehicle and rinse with cold water. Dry the vehicle completely.
11. Visually inspect the paint surface for any remaining evidence of ferrous metal particles. Repeat procedure as necessary.

Surface Finishing Following Decontamination

1. ***NOTICE:*** **When attempting to affect a repair by buffing, polishing or color sanding, do not remove an excess of 0.3 mil of paint film or refinishing will be required.**

   NOTE: Acid rain discoloring or etching may require color sanding in addition to buffing and polishing. In extreme cases, refinishing may be required if the following procedure does not restore the vehicle finish.

   NOTE: Do not intermix buffing products. Use only one manufacturer's product.

   NOTE: Always follow the manufacturer's product usage sequence. Use the appropriate buffing or polishing pad at the recommended buffing speed as specified by the product manufacturer.

   Apply rubbing compound to the vehicle surface as recommended by the product manufacturer.
2. Apply machine glaze to the vehicle surface as recommended by the product manufacturer.

3. Use an alcohol and water mixture (1 to 1) to clean the buffed and polished areas. Verify removal of scratches and swirls before the application of the final polish.

4. Apply a final polish material by hand, with a dual-action sander and foam pad, or with an orbital polisher and appropriate polishing bonnet.

5. Wash and dry the vehicle.

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Refinishing — Manufacturing Damage

Material

Item	Specification
3M™ Perfect-It™ Show Car Liquid Wax 39026	—
Motorcraft® Detail Wash ZC-3-A	—

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTICE: **To avoid overspray damage to adjacent panels, protect adjacent areas/substrates when preparing for and during refinishing.**

NOTE: Peeling/delamination concerns can be described as lack of adhesion, either between the substrate and topcoats or between individual coats of paint.

1. Wash the repair area with detail wash or pH-neutral soap and water.
2. Remove any trim, emblems and hardware from the area to be repaired.
3. **NOTE:** All delamination must be removed.

   Sand or media blast the damaged surface, keeping the repair area as minimal as possible.
4. Treat any bare metal surface to prevent flash corrosion, and prime and block sand as necessary prior to refinishing.
5. Mask the adjacent panels to protect from overspray.
6. Spot repair the base coat as necessary, following the paint manufacturer's prescribed procedures.
7. Following the paint manufacturer's prescribed procedure, apply clear coat to the entire panel.

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Restoring Corrosion Protection Following Repair

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Premium Undercoating ValuGard™ VG101, VG101A (aerosol)	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Drilling access holes in body panels is not recommended. Drilling holes will break the original paint finish and promote corrosion.**

NOTE: Corrosion protection needs to be restored whenever it is necessary to sand or grind through painted surfaces or E-coat, or when bare metal repairs are made.

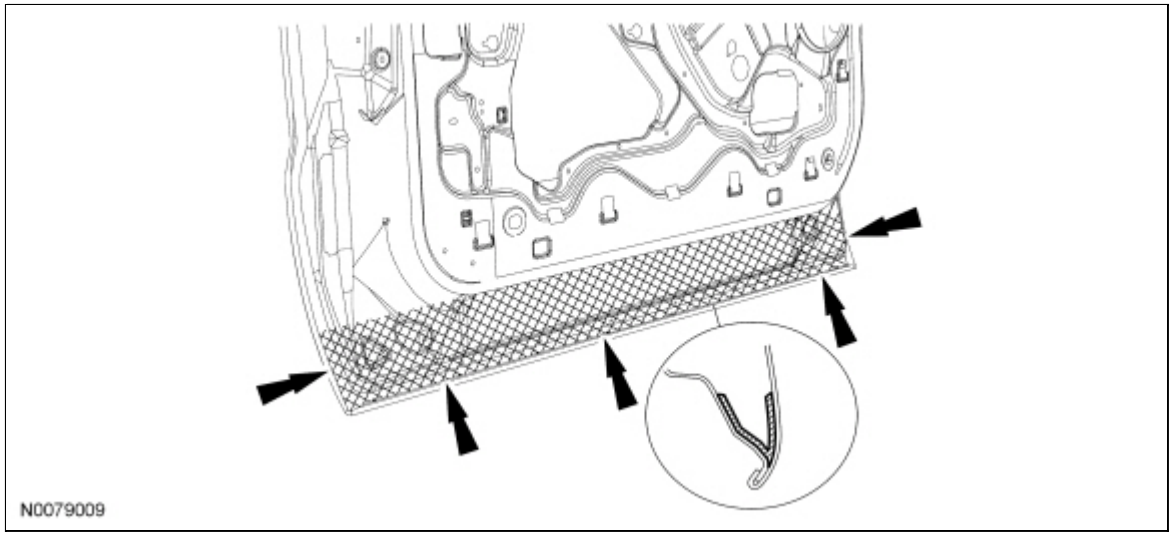
NOTE: Refer to product label for preparation and handling instructions.

1. The surfaces must be free of oil, dirt and other foreign material. Carry out the process in the following sequence.
    1. Thoroughly clean and degrease metal surfaces using metal surface prep to remove wax and grease.
    2. For best results, the vehicle should be at room temperature. Attach the rust inhibitor canister to the Rust Inhibitor Installation Kit 286-00002.
    3. Rust inhibitor should be applied after the welding and refinishing process. Product cannot be welded through.
    4. Air pressure setting for applicator gun is 448-517 kPa (65-75 psi).
        - Use the long wand when spraying enclosed areas. The spray nozzle provides a 360-degree spray pattern. Insert the wand as far as possible into the access hole, pull the trigger and wait 2-3 seconds and slowly pull the wand out of the access hole.
        - The short, hook-shaped wand sprays in one direction and must be rotated to provide complete coverage.
        - Apply the material in light mist coats.
        - Material displaces moisture.
    5. Clean up any overspray with a mild solvent such as mineral spirits or bug and tar remover.

NOTE: The following illustrations provide typical applications of body seams and spot welded flanges and are not vehicle specific.

2. **NOTE:** Door assembly lower view.

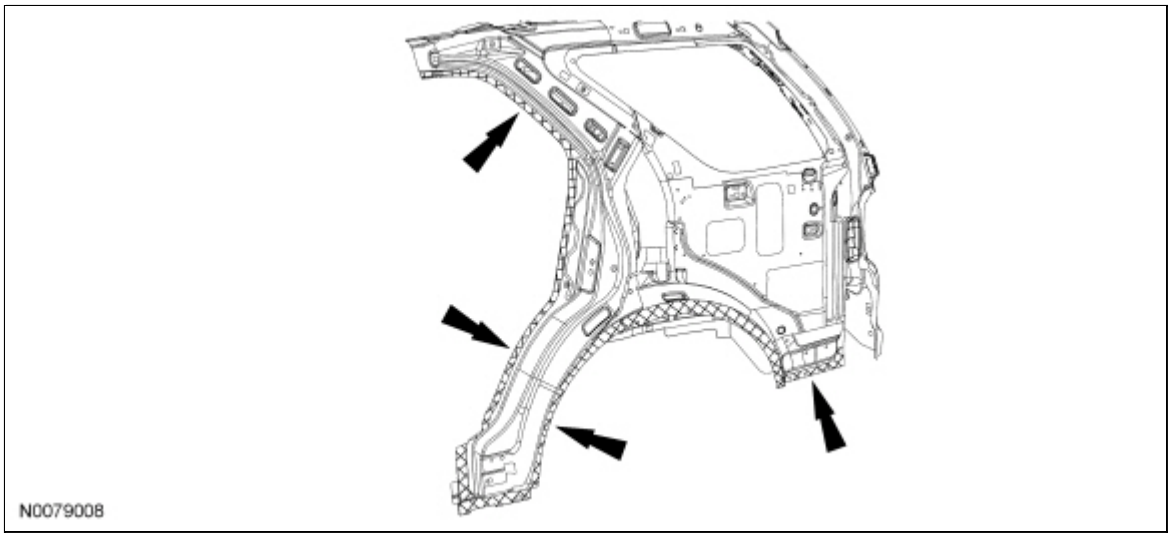
    Apply rust inhibitor as shown to the inside of the door shell on all the interior metal surfaces using the most suitable applicator wand. Apply material to the exposed edges after carrying out the welding process. Make sure horizontal surfaces are well protected as they are more susceptible to corrosion. Keep door drain holes clear to prevent moisture buildup.



3. **NOTE:** Quarter panel inner view.

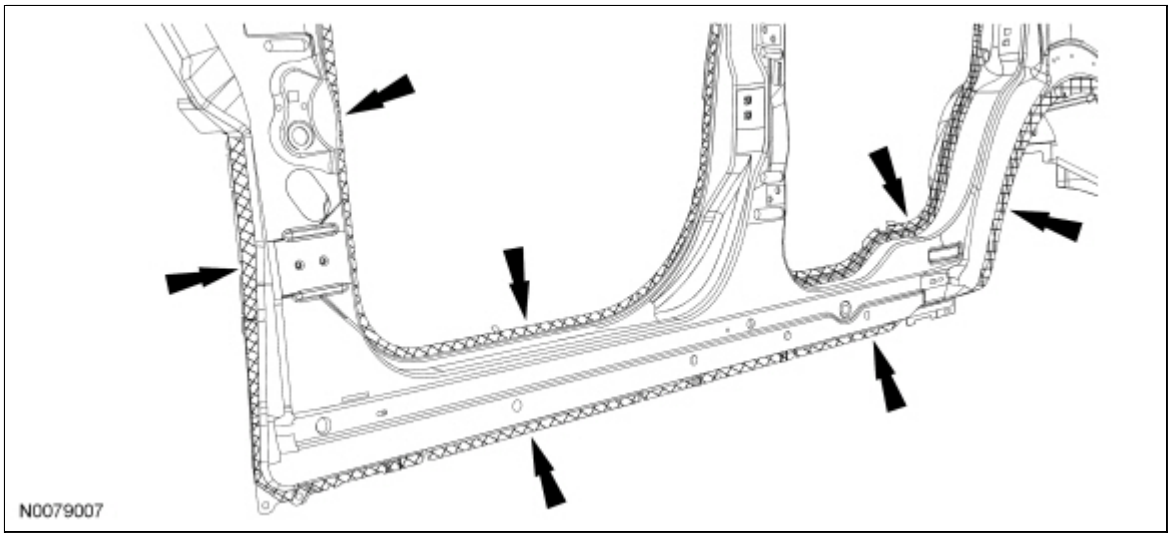
    Apply rust inhibitor to the closed channel portion of the spot weld flange areas using the short, hook-shaped wand. Apply material to the exposed edges after carrying out the welding process. Make sure horizontal surfaces are well protected as they are more susceptible to corrosion.

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4. **NOTE:** Door frame opening view.

   Apply rust inhibitor to the closed channel portion of the spot weld flange areas using the short, hook-shaped wand. Make sure horizontal surfaces are well protected as they are more susceptible to corrosion.



Body and Frame Undercoating

1. **WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.**

   WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not allow undercoating on powertrain components. Failure to follow these instructions may result in incorrect operation of these components.**

NOTE: Refer to product label for preparation and handling instructions.

NOTE: Avoid high-pressure water spray cleaning to treated underbody area for 24 hours.

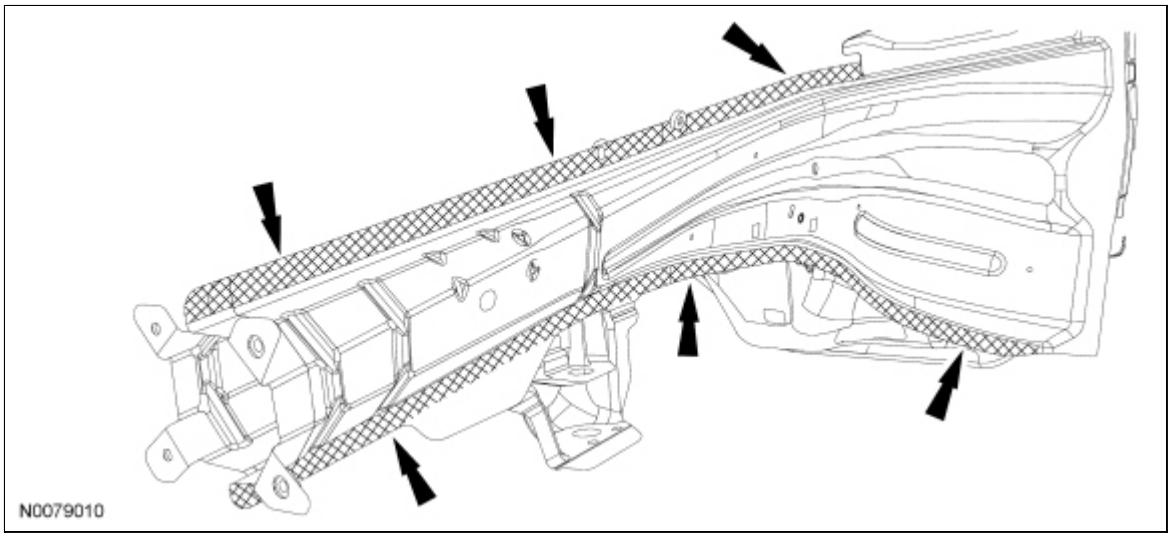
Wire brush the area and make sure the surfaces are free of oil, dirt and other foreign material. Carry out the undercoating process in the following sequence.

1. Thoroughly clean and degrease metal surfaces using metal surface prep to remove wax and grease.
2. For best results, the vehicle should be at room temperature.
    - Canister attaches directly to the dispensing gun. Attach the undercoating canister to the Undercoating Spray Gun 286-00001.
3. Undercoat should be applied after the welding and refinishing process. Product cannot be welded through.
4. Air pressure setting for applicator gun is 552-621 kPa (80-90 psi).
    - Apply light mist coats, applicator sprays in fogging pattern.
    - Material displaces moisture.
5. Clean up any overspray with a mild solvent such as mineral spirits or bug and tar remover.

NOTE: The following illustrations provide typical applications to frame rails and are not vehicle specific.

2. **NOTE:** Frame rail exterior spot-weld flange view.

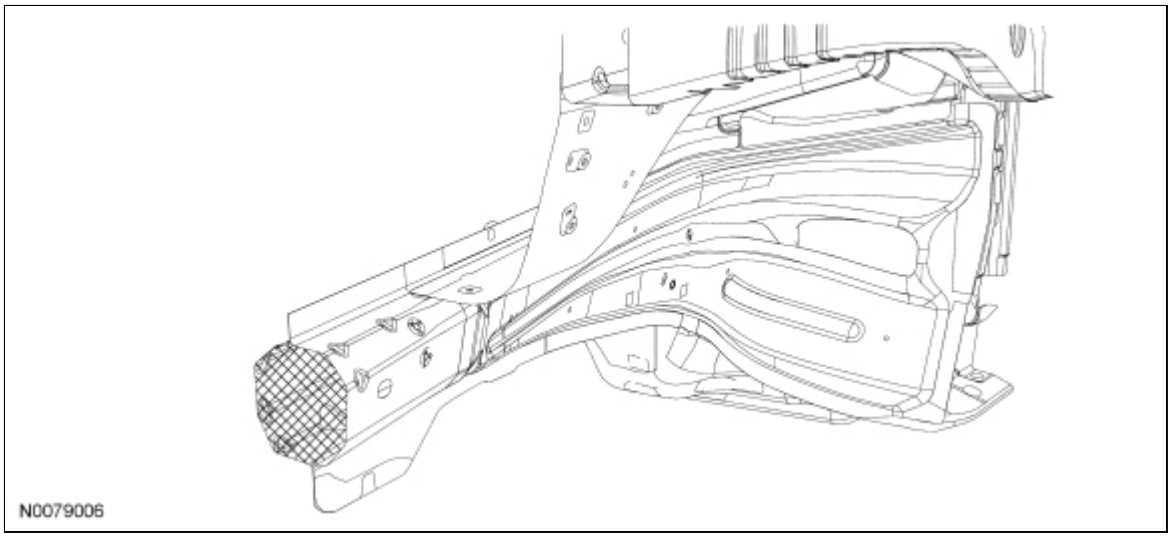
   Apply undercoat material to the exterior exposed edges after carrying out the welding and refinishing process.



3. **NOTE:** Cross section view of typical unibody frame rail shown.

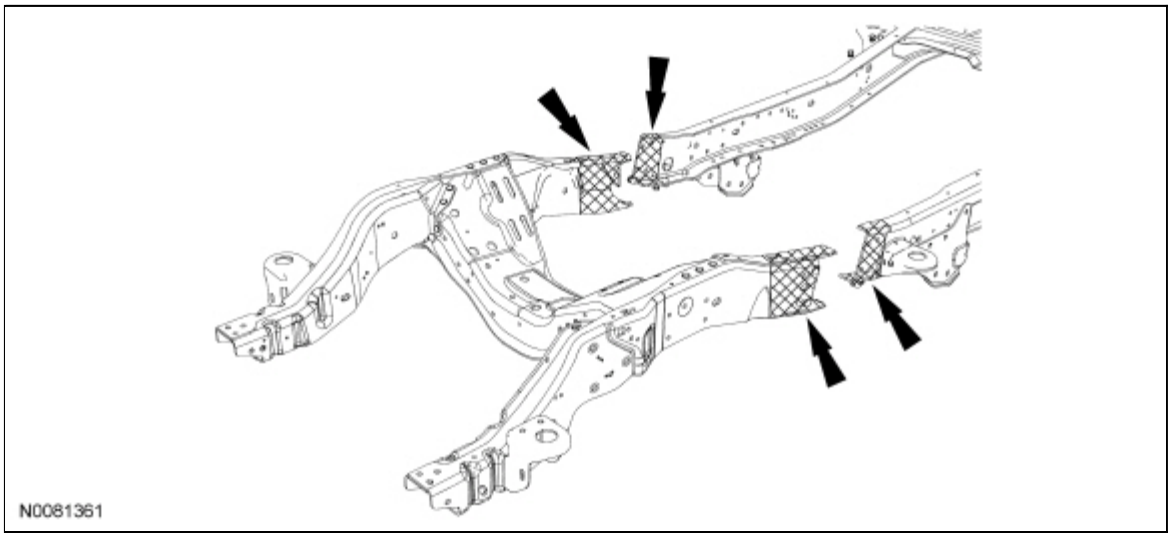
   Apply rust inhibitor to the inner surfaces of the rail after carrying out welding process. Use the long wand and insert as far as possible, depress trigger and wait 2-3 seconds and slowly pull the wand to make sure the area is completely fogged.

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4. **NOTE:** Full frame vehicle, front rail-to-mid rail section repair shown.

   Apply undercoat material to the exposed surfaces after carrying out the welding process. Make sure to completely cover any bare metal areas.



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Sectioning Guidelines

General Equipment

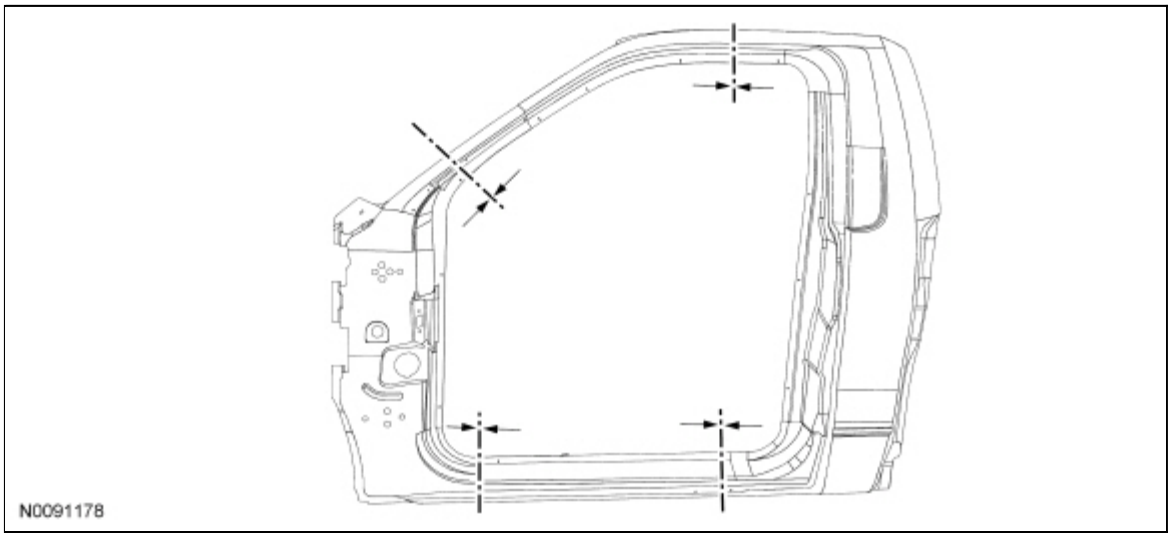
3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Premium Undercoating PM-25-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—
Seam Sealer TA-2	—

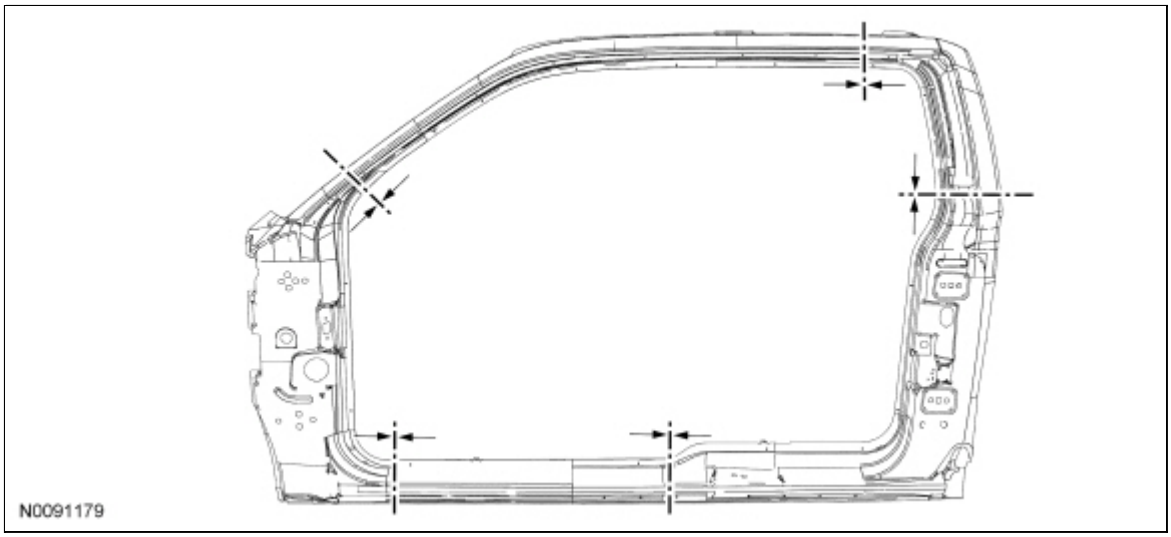
Regular Cab

NOTE: Left side shown, right side similar.



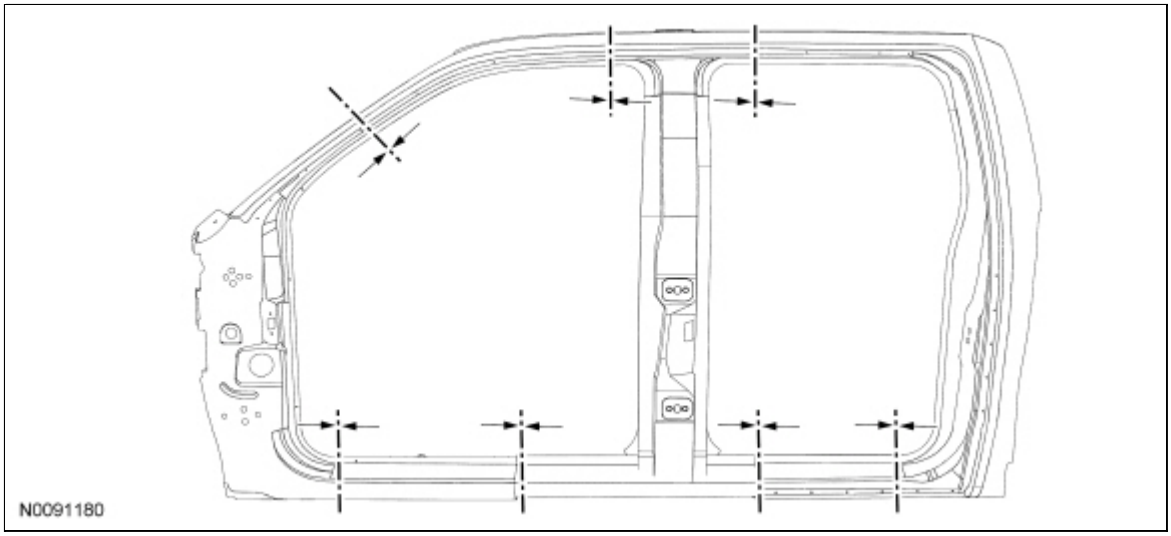
SuperCab

NOTE: Left side shown, right side similar.



SuperCrew

NOTE: Left side shown, right side similar.



WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to

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follow these instructions may result in serious personal injury.

WARNING: Do not carry out body side sectioning repairs in areas of laser welds. Factory laser welds cannot be duplicated with conventional welding equipment and structural integrity may be compromised. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

WARNING: Do not cut or grind body side components within 50 mm (1.96 in) of restraint anchoring points. Welding within 50 mm (1.96 in) of restraint anchoring points may result in incorrect operation of restraint devices. For additional restraints anchoring location information, refer to Section 501-20A and Section 501-20B . Failure to follow these instructions may result in serious injury to vehicle occupant(s).

WARNING: Do not carry out body side sectioning repairs in areas of door hinge or striker anchoring points. Welding within 50 mm (1.96 in) of door hinge or striker locations may compromise structural integrity during a collision. Failure to follow these instructions may result in serious injury to vehicle occupant(s).

***NOTICE:* Electronic modules and related wiring may be damaged when exposed to heat from welding procedures. Carefully disconnect and remove, or position away from heat affected areas. For additional information, refer to Welding Precautions — Steel in this section.**

1. ***NOTICE:* Sectioning procedures can only be carried out on the outer body side panel. No sectioning repairs can be carried out on inner reinforcement panels. Failure to follow these instructions may compromise structural integrity of the cab structure.**

   Correct vehicle dimensions must be maintained when carrying out sectioning procedures to body side panels or pillar areas. Refer to Body for dimensional information.

2. **NOTE:** Factory spot welds may be substituted with either Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

   Corrosion protection needs to be restored whenever it is necessary to sand or grind through painted surfaces or E-coat, or when bare metal repairs are carried out. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

3. Detrim the vehicle as necessary and drill out the spot welds from the damaged area. Using an air chisel or reciprocating saw, cut off the portion of the panel to be replaced.

4. Where possible, create a backer piece using a portion of the old panel. This will create a stronger joint.

5. When welding overlapping surfaces or substrates, apply a weld-through between the surfaces prior to welding. When the surfaces have been welded, apply corrosion protection material to the surfaces or substrates.
   - Make sure horizontal joints and flanges are correctly sealed with seam sealer to prevent moisture intrusion. Water and moisture migrate to horizontal joints and corrosion tends to occur more rapidly in these areas. Metal surfaces must be clean and dry before applying seam sealer.

6. Proceed with refinish procedures following Ford-approved paint guidelines. After refinishing, apply corrosion protection material as required.

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Weld-Bonding

General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Metal Bonding Adhesive TA-1	—
Motorcraft® Metal Surface Prep ZC-31-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—
Seam Sealer TA-2	—

Weld-Bonding — Squeeze-Type Resistance Spot Welding (STRW) Method

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety

restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

NOTE: On door shells that are manufactured with structural adhesives only, weld bonding door skins is not recommended. Only metal bonding adhesive should be used.

NOTE: Weld-bonding is a method used to join metals using Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) welding and structural adhesive. The steps listed in this procedure apply to both types of welding. STRW is the preferred method. MIG welding should only be used when areas to be welded cannot be accessed using STRW -type machinery.

NOTE: Factory spot welds should be substituted with either resistance spot welds or MIG plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

1. Verify the vehicle is dimensionally correct on a frame machine. Straighten if necessary.

2. Remove damaged panels with an air saw or air chisel. Remove only large portions of the damaged panel. Avoid cutting into mating flanges or adjacent parts.

3. Drill out the spot welds using an appropriate spot-weld cutter and remove the remaining portions of the panel to be replaced.

4. Prepare any damaged flanges on the vehicle using hammer and dolly.

5. Grind the mating surface of the original flanges no greater than 25 mm (0.98 in) where the metal bonding adhesive will be applied.
   - Be sure to remove galvanizing on metal. Metal should have a shiny appearance.
   - Be careful not to damage the corners or thin the metal. The E-coat should also be removed on the opposite side of the flange only where the spot welds are to be placed. Clean surfaces with metal surface prep or equivalent.

6. Dry-fit and clamp the replacement service parts to verify a correct fit.
   - Remove the service part after verifying correct fit and alignment.

7. **NOTE:** The ends of welding clamps should be insulated on the ends using tape or similar material when welding is carried out.

   Follow manufacturer's prescribed welding procedures and settings. For additional information, refer to Welding Precautions — Steel in this section.

8. Prepare the adhesive. Dispense a small amount of metal bonding adhesive from the cartridge to make sure of an even flow of both components. Attach the mixing tip and dispense a mixing tip length of adhesive to make sure of a correct mix ratio.

9. **NOTE:** Welding can be carried out anytime during the adhesive curing process, or after the adhesive is fully cured. Welder settings will vary when welding through wet adhesive versus welding through fully cured adhesive. Refer to welder manufacturer's recommended settings for welding through fully cured adhesive. It is recommended to place a shunt weld in an area with no adhesive to make sure of conductivity, particularly when welding through fully cured adhesive.

   NOTE: Refer to the product label for handling and preparation instructions.

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Create a test sample.

1. Prepare the metal and adhesive as described. Apply a 6-9 mm (0.23-0.35 in) bead of adhesive and weld the sample.
2. Place the welded sample in a vice and carry out destructive weld tests by peeling the scrap metal apart using large lock-type pliers. Measure the weld nugget to determine that the nugget meets Ford weld nugget requirements. If the weld nugget does not meet required size, adjust welder settings until the correct weld nugget size is achieved.
3. When the correct weld nugget size is achieved, the service part can be weld-bonded. For additional information, refer to the weld nugget table in Specifications in this section.

10. Apply a 6-9 mm (0.23-0.35 in) bead of metal bonding adhesive to the vehicle prepared flange surface.

11. Place the service part(s) in the correct position on the vehicle.
    - When positioned, do not pull the component away from the vehicle. If repositioning is necessary, slide the service part(s). This will make sure of correct contact between the components and adhesive.

12. Clamp evenly and tightly. The adhesive contains glass beads which will prevent over-clamping the component.

13. **NOTE:** Refer to product label for cure times and handling instructions. Clamps may be removed immediately after the component is welded.

    Wipe excess adhesive from the panel before it cures.

14. Finish any cosmetic section seams with fiber-filled body filler. Rough sand the filler, apply conventional body filler after the adhesive cures and block-sand the area.

15. Use seam sealer wherever a cosmetic seam sealer is required.

16. Mix and apply primer surfacer per Ford-approved paint recommendations.

17. Mix and apply basecoat per Ford-approved paint recommendations.

18. Mix and apply clearcoat per Ford-approved paint recommendations. Refinishing materials may be force-dried following paint manufacturer's recommendations.

19. Apply anti-corrosion treatment to the repair area as required. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

Weld-Bonding — Metal Inert Gas (MIG) Welding Method

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Metal Inert Gas (MIG) weld-bonding can be substituted as an alternative to Squeeze-Type Resistance Spot Welding (STRW). It may only be used to weld areas that are inaccessible to STRW machinery. However, when accessible, STRW is the preferred method.

NOTE: On door shells that are manufactured with structural adhesives only, weld-bonding door skins is not recommended. Only metal bonding adhesive should be used.

NOTE: Factory spot welds should be substituted with either resistance spot welds or MIG plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

1. Remove damaged panels with an air saw or air chisel. Remove only large portions of the damaged panel. Avoid cutting into mating flanges or adjacent parts.
    - Drill out the spot welds using an appropriate spot-weld cutter and remove the remaining portions of the panel to be replaced.

2. After removing the damaged sheet metal panel(s), repair any damaged flanges on the vehicle using a hammer and dolly.

3. Using an appropriate grinder, carefully grind around the entire receiving flange area following the original welds. Be sure to remove all E-coat, paint or galvanized coating from the mating surfaces of the joint.
    - Be sure to remove galvanizing on metal. Metal should have a shiny appearance.
    - Be careful not to damage the corners or thin the metal. The E-coat should also be removed on the opposite side of the flange only where the spot welds are to be placed. Clean the surface with metal surface prep or equivalent.

4. Repeat the procedure from Step 3 on the mating surface of the replacement service part(s).

5. Prepare the new service panel for plug welds.
    - Using the original panel as a reference, drill or punch 8 mm (0.31 in) diameter holes in the exact number as the original spot welds. The holes should be positioned as close as possible to the original spot weld locations, without lining up exactly on top of an original spot weld site.
    - To make sure of correct weld performance, grind the immediate perimeter of the plug weld hole. Grind only in the area of the plug weld; this will keep corrosion to a minimum.

6. Dry-fit and clamp the replacement service parts to verify a correct fit and alignment.

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- Remove the service part after verifying correct fit and alignment.

7. The vehicle prepared flange areas where plug welds will be located must be kept free of adhesive. Apply 25 mm (0.98 in) tape to the plug weld areas to prevent contamination from the adhesive.

8. Prepare the adhesive. Dispense a small amount of metal bonding adhesive from the cartridge to make sure of an even flow of both components. Attach the mixing tip and dispense a mixing tip length of adhesive to make sure of correct mix ratio.

9. **NOTE:** Refer to product label for cure times and handling instructions.

   Apply a 6-9 mm (0.23-0.35 in) bead of adhesive to the vehicle prepared flange surface. Remove the tape from the plug weld areas.

10. Place the service part(s) in the correct position on the vehicle.
    - When positioned, do not pull the component away from the vehicle. If repositioning is necessary, slide the service part(s). This will make sure of correct contact between the components and adhesive.

11. Clamp evenly and tightly. The adhesive contains glass beads which will prevent over-clamping the component.

12. **NOTE:** Welding can be carried out anytime during the adhesive curing process or after the adhesive is fully cured.

    NOTE: If welding will not be carried out immediately, refer to product label for cure times and handling instructions. Clamps may be removed immediately after the component is welded.

    Wipe excess adhesive from the panel before it cures.

13. Finish any cosmetic section seams with fiber-filled body filler. Rough sand the filler, apply conventional body filler after the adhesive cures and block-sand the area.

14. Use seam sealer wherever a cosmetic seam sealer is required.

15. Mix and apply primer surfacer per Ford-approved paint recommendations.

16. Mix and apply basecoat per Ford-approved paint recommendations.

17. Mix and apply clearcoat per Ford-approved paint recommendations. Refinishing materials may be force-dried following paint manufacturer's recommendations.

18. Apply anti-corrosion treatment to the repair area as required. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

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Door Outer Panel

Special Tool(s)

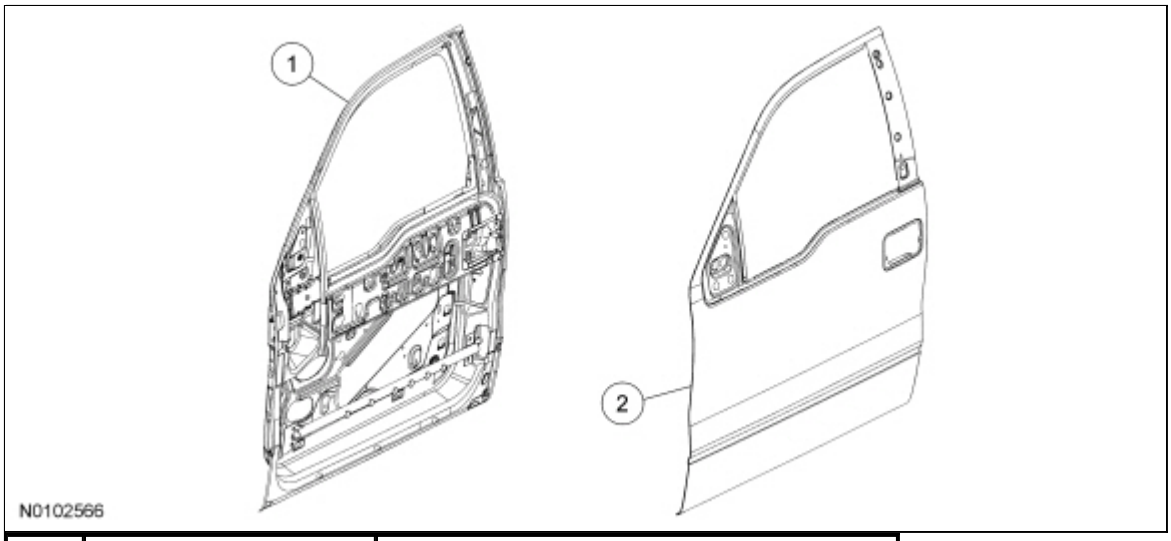
 ST1073-A	Heat Gun 107-R0300
 ST2738-A	Heat Treatment Induction Resistance Spot Welder 254-00001

Material

Item	Specification
Flexible Foam Repair Fusor® 121, or equivalent; obtain locally	—
Metal Bonding Adhesive TA-1	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—
Seam Sealer TA-2	—

Door Assembly

NOTE: Door intrusion beam is constructed of Boron steel and is non-serviceable.



Item	Part Number	Description
1	20125 LH/ 20124 RH	Door assembly — mild and boron steel
2	20201 LH/ 20200 RH	Door outer panel — mild steel

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

1. Remove the outside door handle and mirror assembly. For additional information, refer to Section 501-09 .

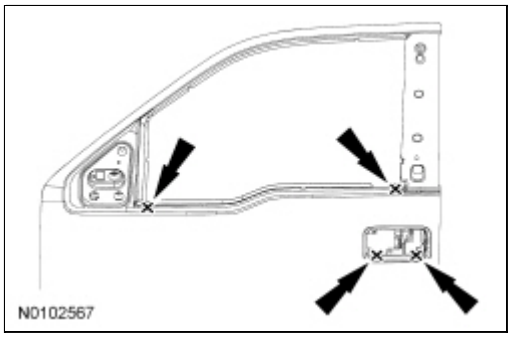
2. Remove the outer door trim, including mouldings and weatherstrips.

3. Remove the door assembly and secure on a workstand.

4. ***NOTICE:*** **Use care when drilling out spot welds to avoid drilling through door shell assembly and damaging the door shell.**

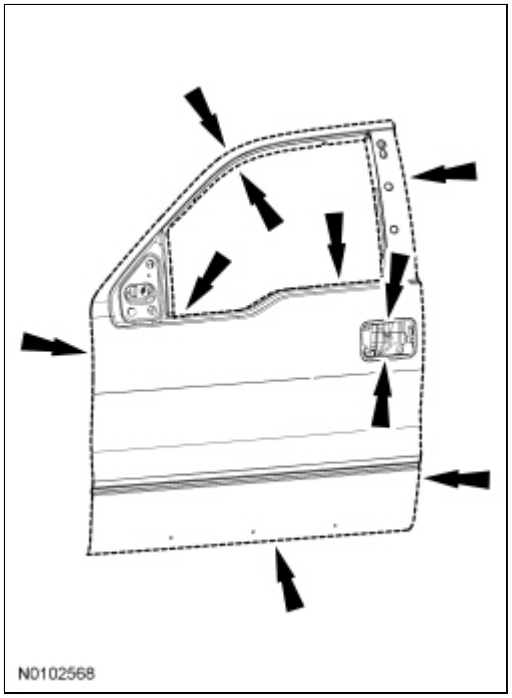
   Using a spot weld cutter or equivalent, locate and drill out the spot welds on the door panel.

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5. ***NOTICE:*** **Use extreme care to avoid cutting the door shell or inner belt reinforcement and damaging the door shell assembly.**

   Using a disc grinder, grind along the perimeter of the outer door panel hem to separate the hem edges as indicated in the illustration.



6. **NOTE:** The use of a Heat Gun may aid in softening the door panel adhesive.

   Prior to removing the outer panel, use a sharp knife to cut the adhesive between the door outer panel, beltline reinforcement and intrusion beam.
   - Using a flat-blade chisel or equivalent, remove the original panel.
   - Using a sharp knife or broad edge scraper, remove the remaining portion of the hem flange from the door shell.
   - Remove any remaining adhesive from the door shell flange.

7. Trial fit the service replacement panel to the door shell assembly.

8. Prepare the service replacement panel joint areas by sanding clean all mating surfaces.

9. Prepare the door shell assembly by grinding all the mating surfaces including the inner hem and outer belt reinforcement and the intrusion beam.

10. Apply metal bonding adhesive to the following areas: service replacement hem flange and outer belt reinforcement-to-outer panel.

11. Position and align the new door outer panel to the door shell assembly, carefully turn the assembly over and begin the hemming process.
    - Using a door panel installation tool or the hammer and dolly method, close the perimeter door hem and smooth any residual adhesive in the joints.

12. Temporarily install the door assembly on the vehicle to verify correct alignment and fit.

13. Apply 2 to 3 spot welds to hold the door panel in position on the door assembly.

14. Place the door assembly back on a workstand and weld the door, replacing the original spot welds, using a Squeeze-Type Resistance Spot Welding (STRW) machine. Finish grind as necessary and trial fit the upper beltline moulding and mirror.

15. Prime and apply seam sealer in the lower hem flange area.

16. Prime and paint the door using Ford-approved paint system.

17. Apply flexible foam repair to the intrusion beam and upper belt reinforcement areas of the door assembly to maintain original equipment performance.

18. Apply rust inhibitor inside the door to all hem areas and upper beltline area. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

19. Reassemble and install door and align. For additional information regarding door fitment specifications, refer to Body in this section.

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repair4less

Frame Members — Bed Attachment Bracket

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-000014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Premium Undercoating PM-25-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—

WARNING: Frame rail crush zones absorb crash energy during a collision and must be replaced if damaged. Prior to replacement of frame rail crush zones, straighten damaged frame rails to correct frame dimensions. Failure to follow these instructions may adversely affect frame rail crush zone performance and may result in serious personal injury to vehicle occupants in a crash.

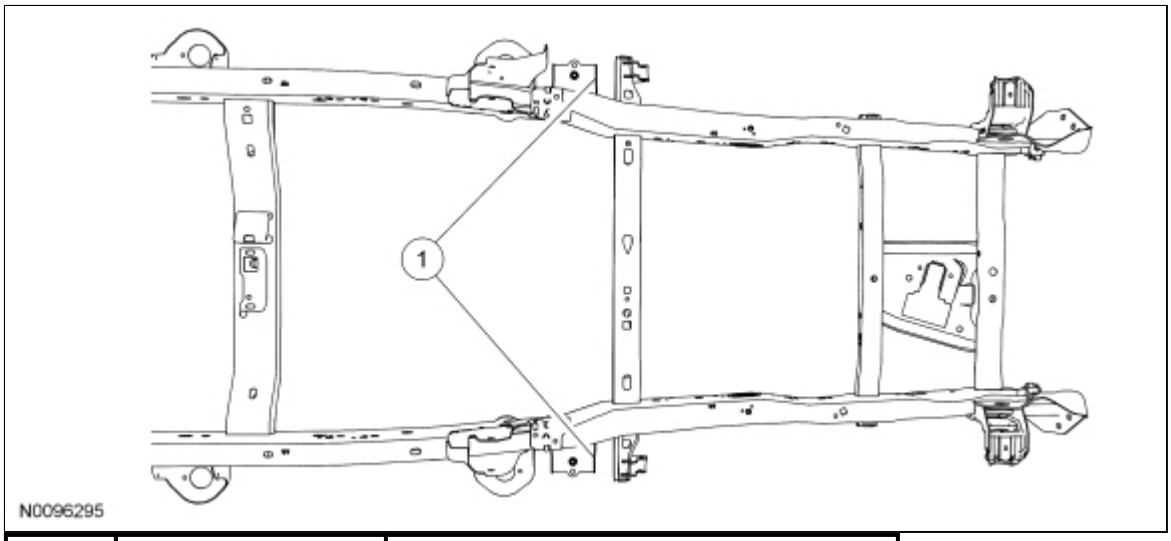
WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to

follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Observe prescribed welding procedures when carrying out repairs to the frame assembly. For additional information, refer to Welding Precautions — Steel in this section.

NOTE: This procedure applies to vehicles with 1.67 m (5.5 ft) pickup bed.



Item	Part Number	Description
1	102C60	Bed attachment bracket kit

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

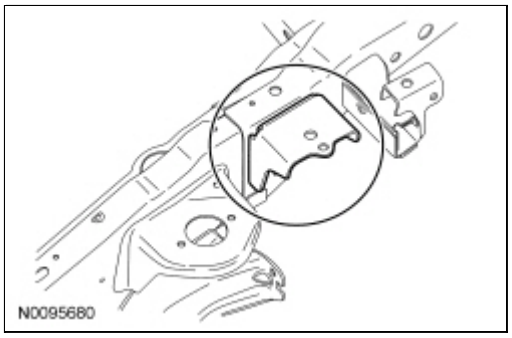
Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

1. Remove the rear tailgate assembly and complete pickup bed assembly. For additional information, refer to Section 501-04 .

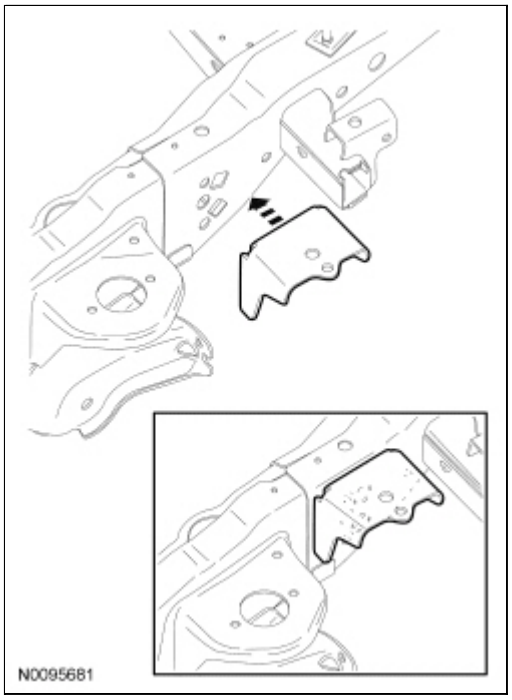
2. Cover the evaporative emissions fuel line, tie back the fuel filler tube and any wire harnesses from the repair area.

3. Grind the welds that retain the attachment bracket and remove the forward bed-to-frame retention bracket from the frame.

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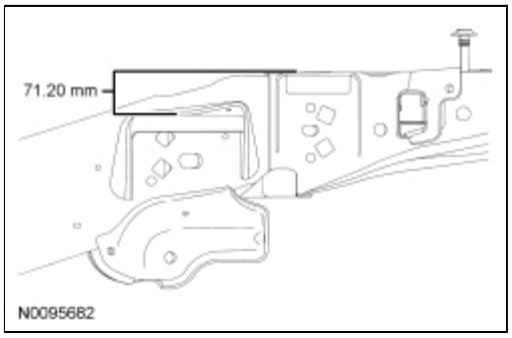


4. Using a wire brush or sanding disc, remove E-coat paint from the surrounding frame rail area within approximately 15 mm (0.59 in) of the intended weld location.



5. Using a wire brush or sanding disc, remove the E-coat paint from the replacement bracket edges.

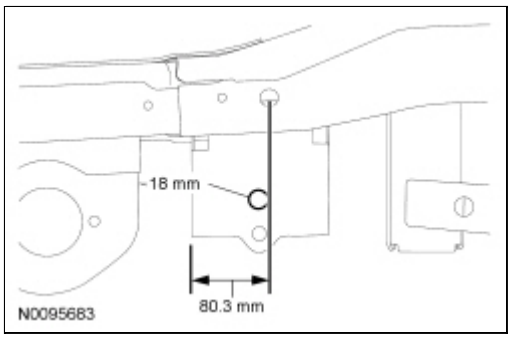
6. Locate the correct mounting position of the new brackets, relative the rear body mount frame bracket and existing hole in the top of the frame rail. Tack weld the brackets in position.



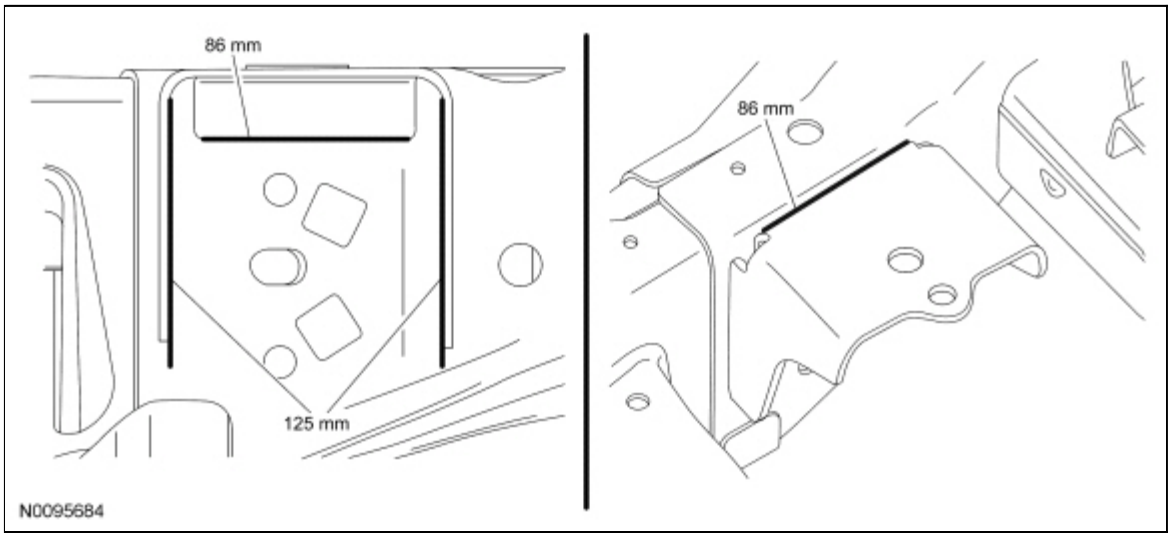
7. **NOTE:** Using the replacement pickup bed, locate pickup bed holes to the existing frame attachment holes maintaining correct front-of-bed to cab cross car flushness and fore-aft-margins equal from left

hand side to right hand side. Check to make sure the character line on the cab and the character line on the bed match on left hand and right hand side. Adjust the bracket as necessary to match cab and bed character lines.

Mark the position of the attachment hole, on the new frame bracket, by inserting a marker through the existing forward bed floor pan hole. Drill an 18 mm (0.708 in) hole into the new frame bracket.



8. Remove the pickup bed and complete welding the new frame bracket to the frame side rail. Use a MIG welding machine capable of producing 200 amps minimum must be used. Use 0.9-1.1 mm (0.035-0.045 in) ER70S-3 or equivalent weld wire that is compatible with mild (Society of Automotive Engineers (SAE) 1010) steel.
    - Dress welds as necessary.



9. Clean exposed metal surfaces with metal surface prep or equivalent.

10. Apply corrosion protection to the repair area as required. For additional information regarding corrosion protection, refer to Restoring Corrosion Protection Following Repair in this section.

11. **NOTE:** New attachment clips must be installed whenever the pickup bed is removed. Install new attachment clips, part number W708605, before installing the pickup bed. Make sure the anti-squeak pads, part number F0TA-5C036-AA and YL34-5C036-AA, are located in the correct positions before installing the pickup bed.

    Reinstall the pickup bed. For additional information, refer to Section 501-04 .

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Frame Members — Front Frame Horn

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

General Equipment

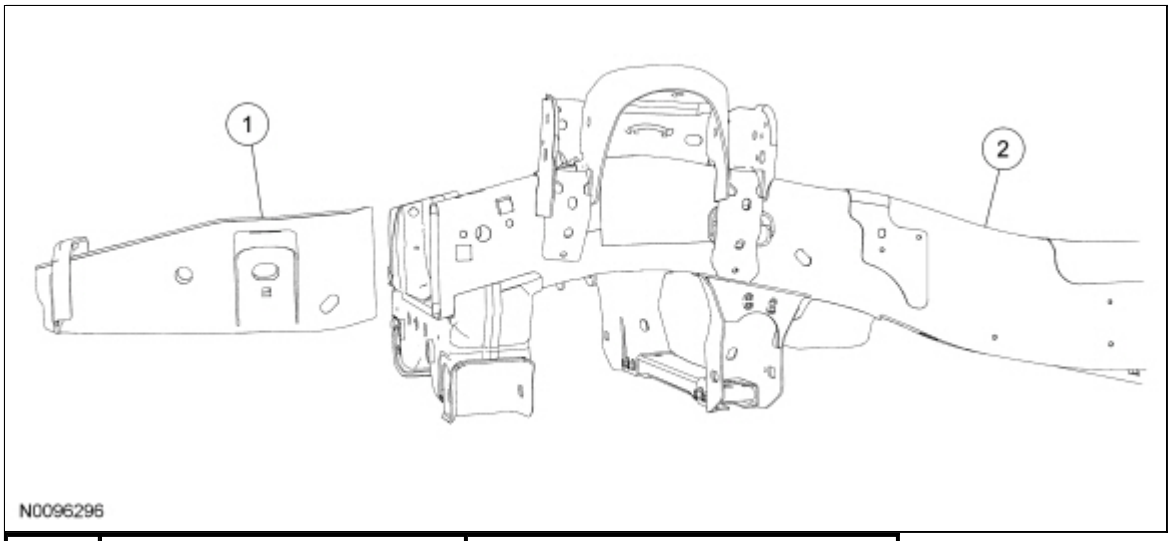
3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-000014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Premium Undercoating PM-25-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—

Front Frame Horn

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Item	Part Number	Description
1	5D059 LH/ 5D058 RH	Frame rail replacement kit
2	5005	Frame assembly

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Frame rail crush zones absorb crash energy during a collision and must be replaced if damaged. Prior to replacement of frame rail crush zones, straighten damaged frame rails to correct frame dimensions. Failure to follow these instructions may adversely affect frame rail crush zone performance and may result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Observe prescribed welding procedures when carrying out repairs to the frame assembly. For additional information, refer to Welding Precautions — Steel in this section.

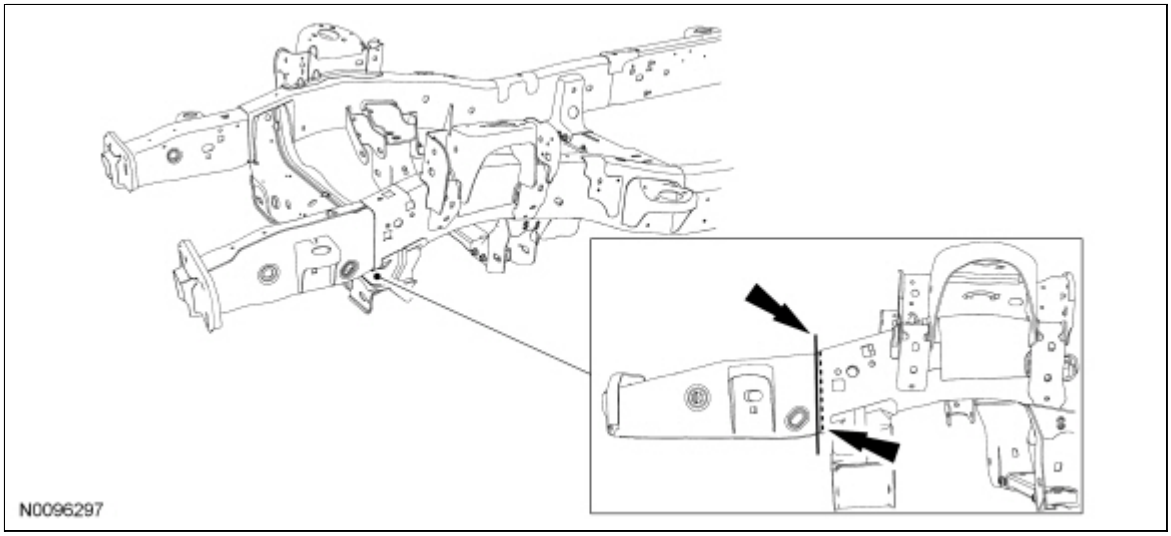
1. **NOTE:** All body alignment measurements are carried out with the vehicle detrimmed. Measurements are made metal to metal, on center, unless otherwise specified.

Measure the vehicle to determine if the body requires straightening and alignment. The vehicle must be restored its correct overall dimensions prior to beginning this procedure. For body dimensional information, refer to Body in this section.
- Anchor the vehicle to a frame rack following the equipment manufacturer's instructions.

2. Remove the bumper. For additional information, refer to Section 501-19 .

3. Unbolt the Front End Sheet Metal (FESM) body mount bolts.
   - Raise the body if required. For additional information, refer to Section 502-02 .

4. Locate the vertical weld of the front frame horn to center rail.

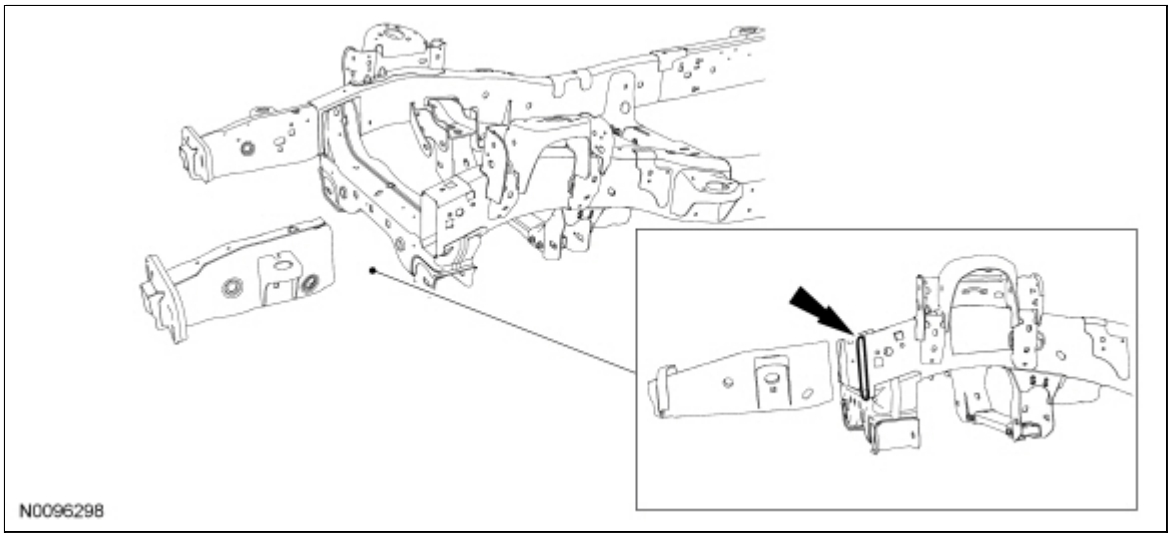


5. Using a plasma cutter, reciprocating saw or cut-off wheel, remove the damaged front frame horn section. Do not cut directly along the weld line. Leave enough material on the front side of the weld line to allow the edge to be ground back exactly to the line. This is necessary to make sure of correct fit between the frame and the replacement frame section.

6. Grind off the excess welding material that remains in front of the weld line on the existing frame.
   - Remove the remaining piece (ring-like) of the front frame horn from inside the mid-rail.

7. Using a wire brush or sandpaper, remove the E-coat from the outer surfaces of the replacement service section within approximately 15 mm (0.59 in) of the repair joint.
   - Using a wire brush, remove any foreign material from the frame within approximately 15 mm (0.59 in) of the repair joint.

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8. **NOTE:** The front frame rail replacement section is tapered at the ends to fit into the frame.

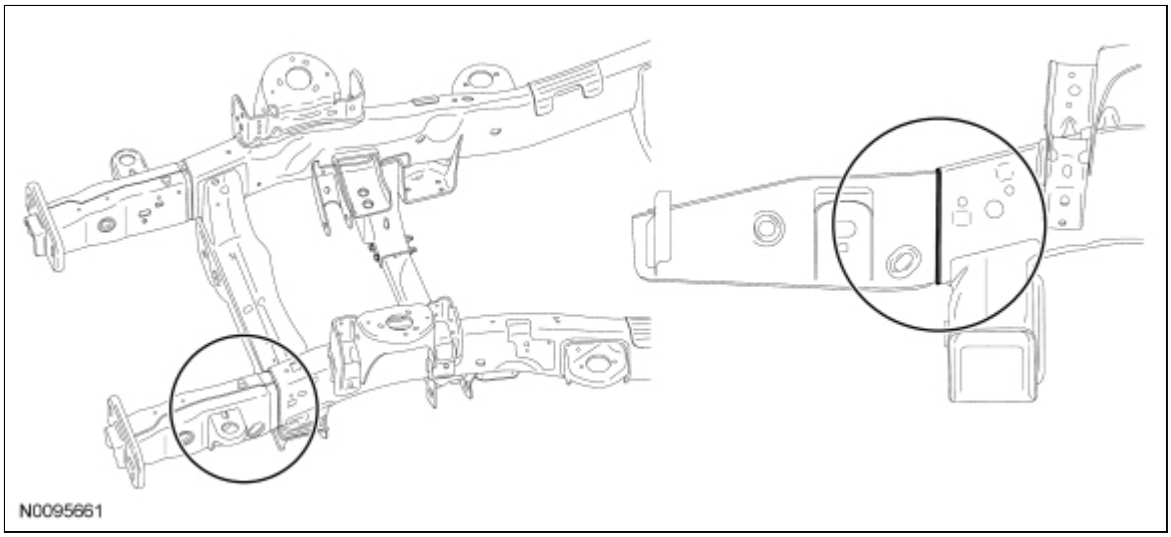
   NOTE: The frame rail service component must be located to maintain original factory dimensions. For additional information, refer to Body in this section for correct frame dimensional information.

   Install the replacement front frame horn section inside the center rail of the frame. Support the replacement service section in position. Check that the FESM body mount bracket lines up with the sheet metal hole for the body mount.

9. Make sure the repair joint and surrounding repair area have attained a minimum temperature of 10°C (50°F) before carrying out the weld procedure.

10. Tack weld at the 4 corners and check the fit and alignment.
    - Lower the body onto the frame and recheck fit and alignment, then raise it.

11. Weld the joint completely around the perimeter, if fit and alignment are correct, using a Metal Inert Gas (MIG) welding machine capable of producing a minimum of 200 amps. Use 0.9-1.1 mm (0.035-0.045 in) ER70S-3 or equivalent weld wire that is compatible with mild (Society of Automotive Engineers (SAE) 1010) steel.



12. Dress the weld(s) as necessary.

13. Use a dye penetrant to determine if any cracks or large voids exist in the weld joint. If cracks or other defects exist, grind out the defect and repair until the weld is free of defects.
    - Clean the repair area with metal surface prep and apply anti-corrosion coating to the affected areas of the frame and service replacement section. For additional information regarding corrosion protection, refer to Restoring Corrosion Protection Following Repair in this section.

14. Reinstall components removed during disassembly. Make sure all fasteners are tightened to the correct specification.

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Frame Members — Front Frame Section

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

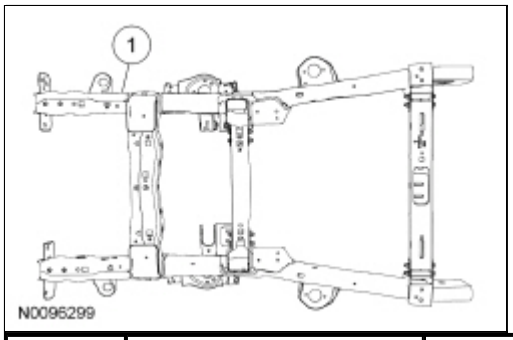
General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-000014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Premium Undercoating PM-25-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—

Front Frame Section



Item	Part Number	Description
1	5E029	Front frame section kit

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Frame rail crush zones absorb crash energy during a collision and must be replaced if damaged. Prior to replacement of frame rail crush zones, straighten damaged frame rails to correct frame dimensions. Failure to follow these instructions may adversely affect frame rail crush zone performance and may result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Observe prescribed welding procedures when carrying out repairs to the frame assembly. For additional information, refer to Welding Precautions — Steel in this section.

1. **NOTE:** All body alignment measurements are carried out with the vehicle detrimmed. Measurements are made metal to metal, on center, unless otherwise specified.

   Measure the vehicle to determine if the body requires straightening and alignment. The vehicle must be restored its correct overall dimensions prior to beginning this procedure. For body dimensional information, refer to Body in this section.

2. Remove the bumper assembly. For additional information, refer to Section 501-19 .

3. Remove the grille assembly and reinforcement.

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4. Remove the front fenders. For additional information, refer to Section 501-02 .

5. Remove the front skid plate (if equipped). For additional information, refer to Section 205-03 .

6. Remove the engine mount retaining bolts and loosen the exhaust manifold-to-cylinder head fasteners. For additional information, refer to Section 303-00 .

7. Loosen the radiator shroud retainer bolts. For additional information, refer to Section 303-03 .

8. Anchor the vehicle to a frame rack following the equipment manufacturer's instructions.
    - Remove the front wheels. For additional information, refer to Section 204-04 .

9. **NOTE:** All body alignment measurements are carried out with the vehicle detrimmed. Measurements are made metal to metal, on center unless otherwise specified.

    Measure the vehicle to determine if the body and frame requires straightening and alignment. For additional dimensional information, refer to Body in this section.

10. Carry out complete removal of front suspension and steering components including upper and lower control arms, steering gear, steering linkages, sway bar, springs and shocks. For additional information, refer to Section 204-01A , Section 204-01B and Section 211-02 .

11. Remove the front drive axle and half shafts. For additional information, refer to Section 205-03 .

12. Raise and support the engine/transmission assembly and remove the transmission support crossmember. For additional information, refer to Section 502-02 .
    - Inspect the transmission crossmember for twists, bends or cracks.

13. Loosen the body mount-to-frame bushing bolts from the radiator support and the forward cab support. For additional information, refer to Section 502-02 .

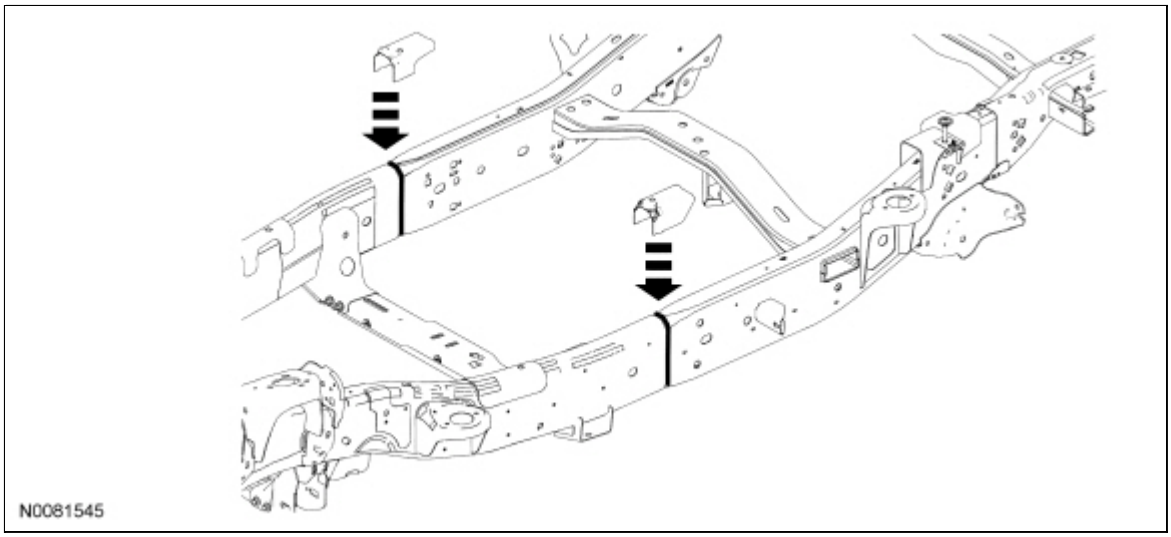
14. Using the frame rack towers and light tension, support the front radiator support of the vehicle by raising it slightly above the frame rail mounts.

15. Disconnect and remove any remaining wiring, lines, and related fittings from the frame section.

16. ***NOTICE:*** **Do not damage the center side rail during removal, it will be reused. Only cut through the depth of the weld, as the center rail underlaps the front frame rail.**

    NOTE: The front frame section is retained by welded lap joints and an additional reinforcement bracket at the section joint. This procedure calls for grinding of the original welded joints for removal, followed by welding the section into position.

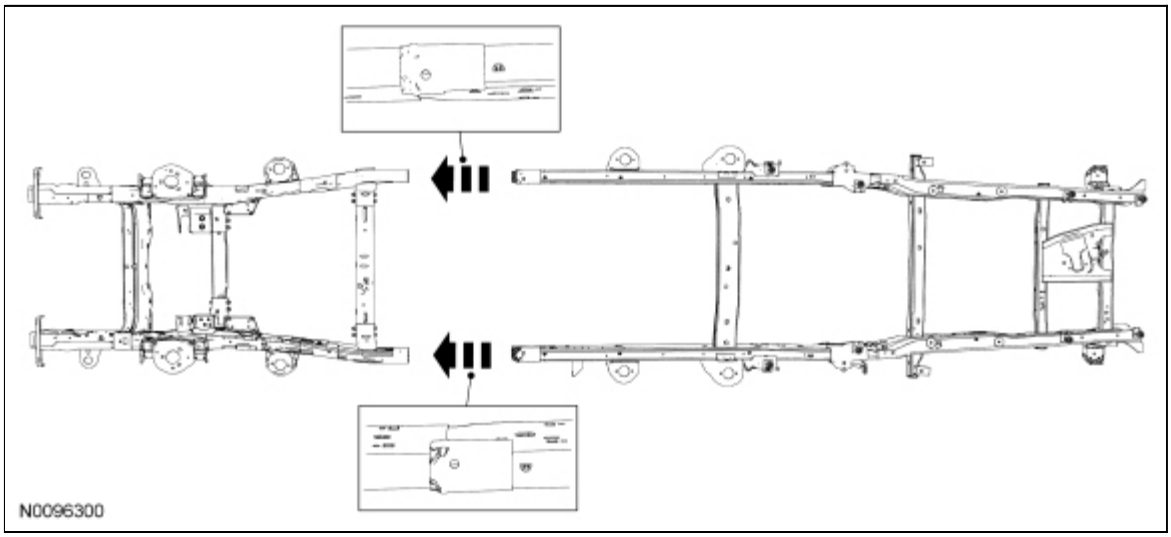
    Using a plasma cutter, reciprocating saw or cut-off wheel, remove the damaged front frame horn section. Do not cut directly along the weld line. Leave enough material on the front side of the weld line to allow the edge to be ground back exactly to the line. This is necessary to make sure of correct fit between the frame and the replacement frame section.



17. Grind off the excess welding material that remains in front of the weld line on the existing frame.
    - Remove only the weld material. Do not grind out the center frame rail that must be reused.

18. Using an air chisel with a sharp one-inch wedge-type chisel, separate the ground area of the joints.

19. With help of an assistant, remove the complete front section of the frame.



20. Using a wire brush or sandpaper, remove the E-coat from the outer surfaces of the replacement service section within approximately 15 mm (0.59 in) of the repair joint.
    - Using a wire brush, remove any foreign material from the frame within approximately 15 mm (0.59 in) of the repair joint. Clean the surface with metal surface prep or equivalent.

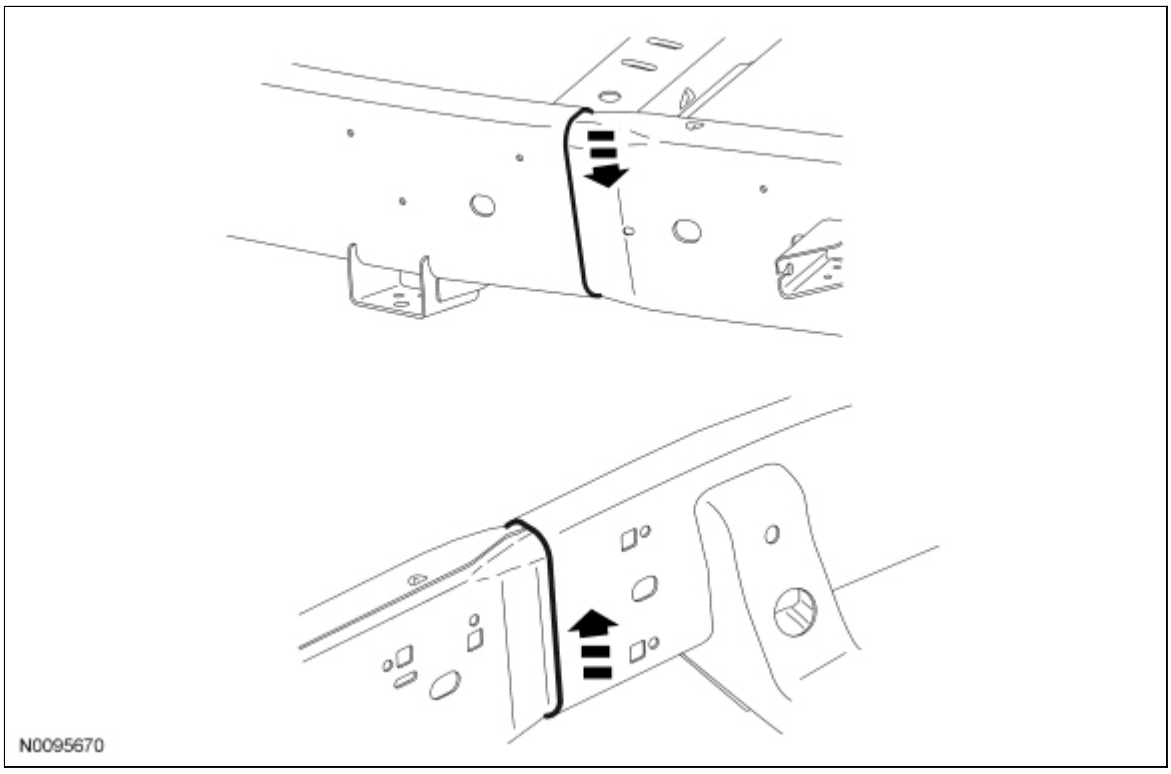
21. With the help of an assistant, position the new frame section into place on the vehicle and support with jackstands or a transmission style jack.
    - Loosely clamp the replacement section in a preliminary position.

22. Carry out frame measurements to verify correct position of the replacement section and clamp firmly into position. For additional dimensional information, refer to Body in this section.
    - Apply a weld-through primer locally in the areas to be welded.

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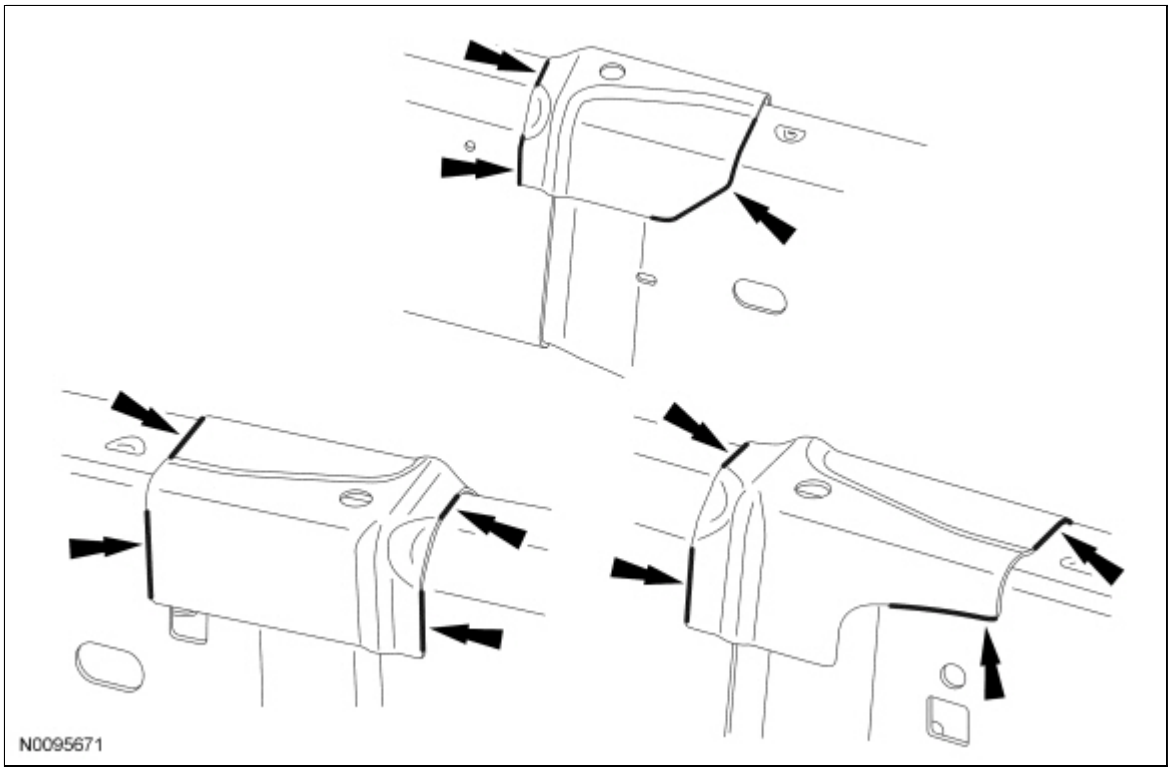
23. Make sure the repair joint and surrounding repair area have attained a minimum temperature of 10°C (50°F) before carrying out the weld procedure.

24. Weld the joint completely around the front-to-center rail joints, if fit and alignment are correct, using a Metal Inert Gas (MIG) welding machine capable of producing a minimum of 200 amps. Use 0.9-1.1 mm (0.035-0.045 in) ER70S-3 or equivalent weld wire that is compatible with mild (Society of Automotive Engineers (SAE) 1010) steel.



25. **NOTE:** Illustration indicates weld locations for outboard and inboard reinforcement of the left hand and right hand reinforcements.

    Position the reinforcement brackets at the section joint in the original location. Clamp in place, apply a weld-through primer and weld the brackets as indicated.



26. Use a dye penetrant to determine if any cracks or large voids exist in the weld joint. If cracks or other defects exist, grind out the defect and repair until the weld is free of defects.
    - Clean the repair area with metal surface cleaner and apply anti-corrosion coating to the affected areas of the frame and service replacement section. For additional information regarding corrosion protection, refer to Restoring Corrosion Protection Following Repair in this section.

27. Reinstall the transmission crossmember and the lower engine/transmission assembly, and tighten fasteners to correct specification.

28. Inspect for damage and reinstall the suspension, steering and driveline components previously removed.

29. Remove the vehicle from the frame rack and carry out reassembly and installation of any remaining components.

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Frame Members — Rear Frame Section

Special Tool(s)

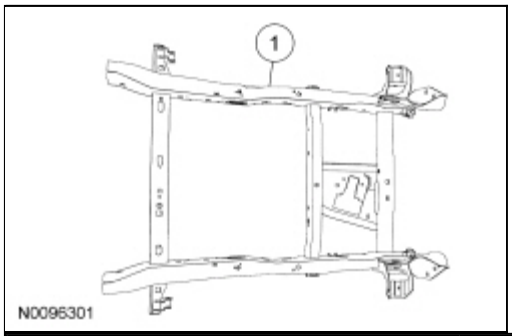
 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-000014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Premium Undercoating PM-25-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—



Item	Part Number	Description

repair4less

1	5F040	Rear frame section

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Leaf spring front attachment brackets are not required when carrying out rear frame section replacement. These are available separately (base part number 5775/6) if they have been damaged and require replacement.

NOTE: Observe prescribed welding procedures when carrying out repairs to the frame assembly. For additional information, refer to Welding Precautions — Steel in this section.

1. **NOTE:** All body alignment measurements are carried out with the vehicle detrimmed. Measurements are made metal to metal, on center, unless otherwise specified.

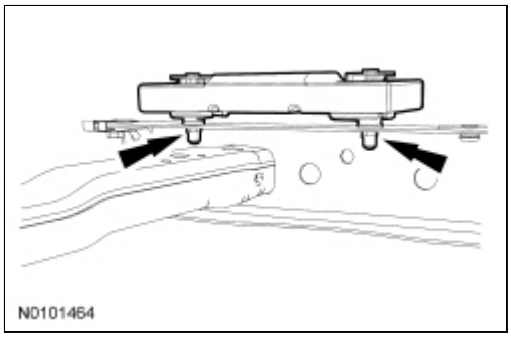
   Measure the vehicle to determine if the body requires straightening and alignment. The vehicle must be restored its correct overall dimensions prior to beginning this procedure. For body dimensional information, refer to Body in this section.
   - Anchor the vehicle to a frame rack following the equipment manufacturer's instructions.

2. Remove the rear bumper assembly. For additional information, refer to Section 501-19 .

3. Remove the rear tailgate assembly and complete pickup box assembly. For additional information, refer to Section 501-04 .

4. Lower and remove the spare tire and remove the spare tire carrier assembly from the frame section.

5. If equipped, remove the frame dampener located on the left rear frame rail.



6. Drain and remove the fuel tank assembly. For additional information, refer to Section 310-00 . Plug the open lines.
    - Disconnect and remove the evaporative emissions unit from the frame section.

7. Remove exhaust hangers and the exhaust system. For additional information, refer to Section 309-00 .

8. Remove the running board step (if equipped). For additional information, refer to Section 501-08 .

9. Position the vehicle on a frame rack and anchor in place following the equipment manufacturer's guidelines.

10. **NOTE:** All body alignment measurements are carried out with the vehicle detrimmed. Measurements are made metal-to-metal, on center unless otherwise specified.

    Measure the vehicle to determine if the body and frame requires straightening and alignment. For additional dimensional information, refer to Body in this section.

11. Position and tighten fixtures to hold the front eye bolts of the leaf spring attachments. This will secure the rear axle and spring assembly in place as the frame section is removed and replaced.

12. Using the frame rack towers, position a support chain under the rear cab mount area of the center section of the frame and apply light tension to secure the cab and center section in place.

13. Remove the rear shock absorbers. For additional information, refer to Section 204-04 .

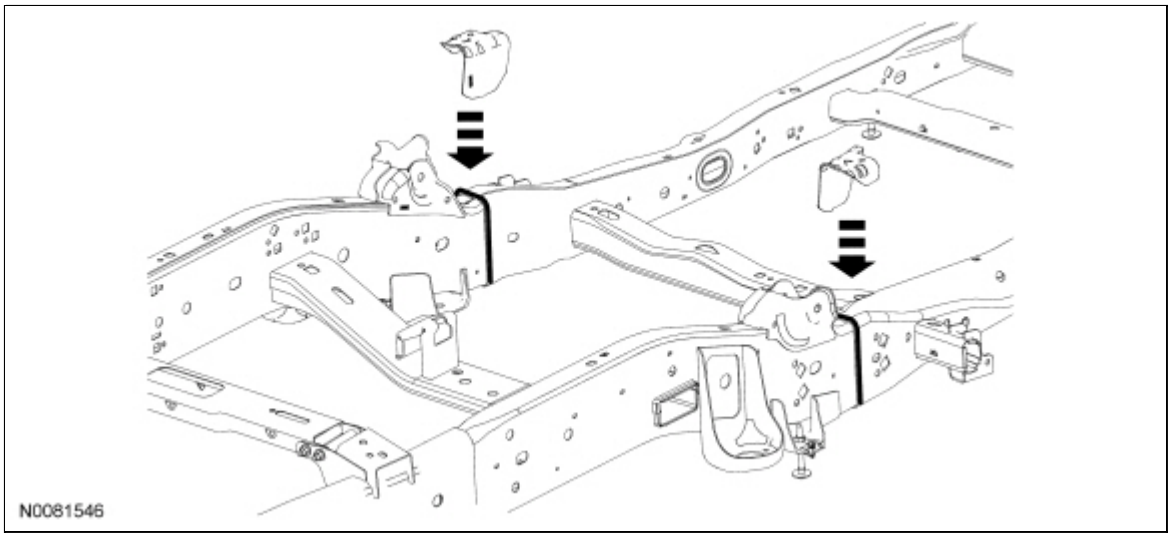
14. **WARNING: Adjust the rear axle height to relieve spring tension before removing any shackle bolts, nuts or spring pins. Springs under tension may release with great force. Failure to follow this instruction may result in serious personal injury.**

    Remove the rear spring eye bolts. With the help of an assistant, hold the spring down with a large pry bar, then slowly release tension after removing the bolt. For additional information, refer to Section 204-04 .

15. **NOTE:** The rear frame section on this vehicle is retained by a welded joint and reinforcement bracket near the forward leaf spring eye brackets.

    Using a high-speed grinder and correct eye, face and ear protection, grind the welds holding the rear frame reinforcement brackets to the frame rail and remove the brackets completely.

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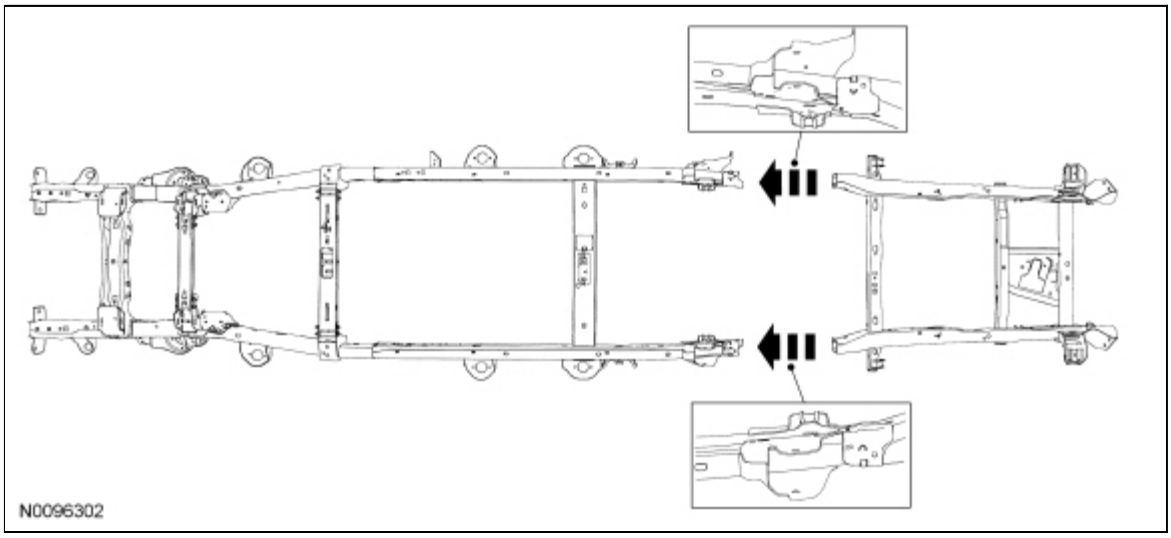


16. Using a high-speed grinder and correct eye, face and ear protection, grind the welds holding the center and rear frame sections together. Make sure not cut into the center side rail as it must be reused.

17. Grind off the excess welding material that remains in front of the weld line on the existing frame.
    - Remove only the weld material. Do not grind out the center frame rail as it will be reused.

18. Using an air chisel with a sharp one-inch, wedge-type chisel, separate the ground area of the joints.

19. With the help of an assistant, remove the complete rear frame section.



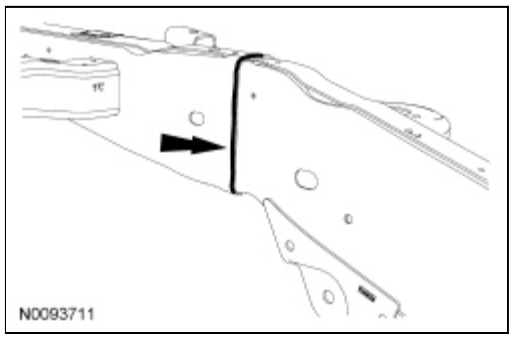
20. With the help of an assistant, position the replacement section into the center section of the frame.
    - Loosely clamp the replacement section in place.

21. Carry out frame measurements to verify correct position of the replacement section and clamp firmly into position. For additional dimensional information, refer to Body in this section.
    - Apply a weld-through primer locally in the areas to be welded.

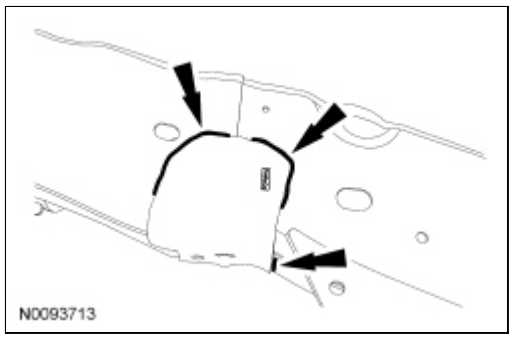
22. Make sure the repair joint and surrounding repair area have attained a minimum temperature of 10°C (50°F) before carrying out the weld procedure.

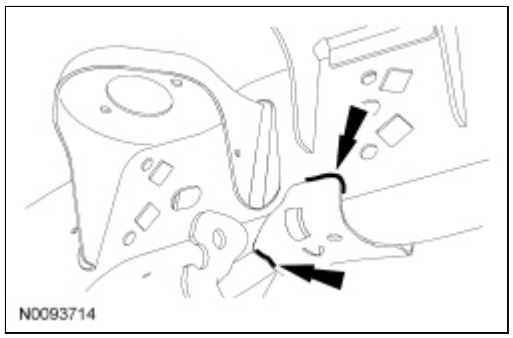
23. With correct measurements verified and the replacement section in position, tack weld the replacement section to the center section.

24. When fit and alignment are correct, weld the new section to the original center section on all overlap joints using a MIG welding machine capable of producing a minimum of 200 amps. Use 0.9-1.1 mm (0.035-0.045 in) ER70S-3 or equivalent weld wire that is compatible with mild (Society of Automotive Engineers (SAE) 1010) steel.
    - Dress weld(s) as necessary.



25. Position the rear reinforcement brackets and clamp in place. Apply a weld-through primer to the areas to be welded and weld as shown.





26. Use a dye penetrant to determine if any cracks or large voids exist in the weld joint. If cracks or other defects exist, grind out the defect and repair until the weld is free of defects.
    - Clean the repair area with metal surface cleaner and apply anti-corrosion coating to the affected areas of the frame and service replacement section. For additional information regarding corrosion protection, refer to Restoring Corrosion Protection Following Repair in this section.

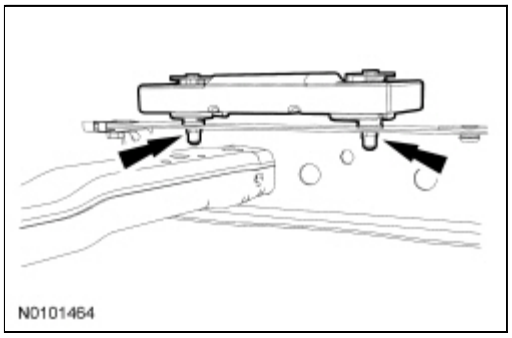
27. Reinstall the rear springs and shocks. For additional information, refer to Section 204-04 .

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28. Reinstall the spare tire carrier assembly.

29. Reinstall the fuel tank and evaporative emissions unit. For additional information, refer to Section 310-00 .

30. If equipped, reinstall the frame dampener on the frame rail of service replacement frame.
    - Tighten to 47 Nm (35 lb-ft).



31. Reinstall the exhaust system. For additional information, refer to Section 309-00 .

32. Reinstall the pickup bed assembly. For additional information, refer to Section 501-04 .

33. Remove the vehicle from the frame rack and complete any final assembly required.

Inner Body Reinforcing Panels

General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Premium Undercoating PM-25-A	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—
Seam Sealer TA-2	—

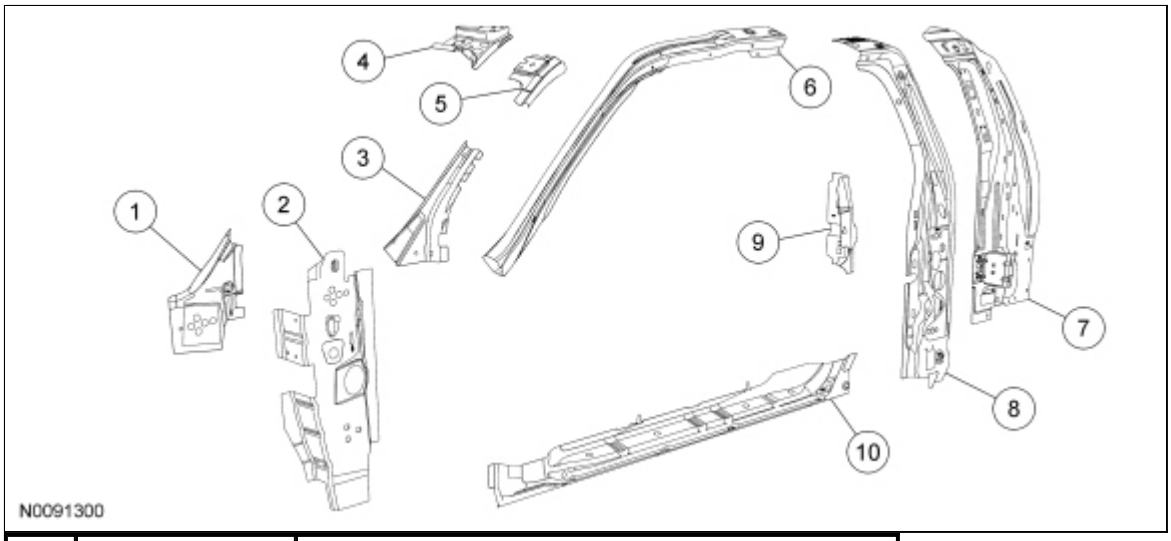
Exploded View — Regular Cab

NOTICE: **Sectioning procedures can only be carried out on the outer body side panel. No sectioning repairs can be carried out on inner reinforcement panels. Failure to follow these instructions may compromise structural integrity of the cab structure.**

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.

NOTE: Left side shown, right side similar.

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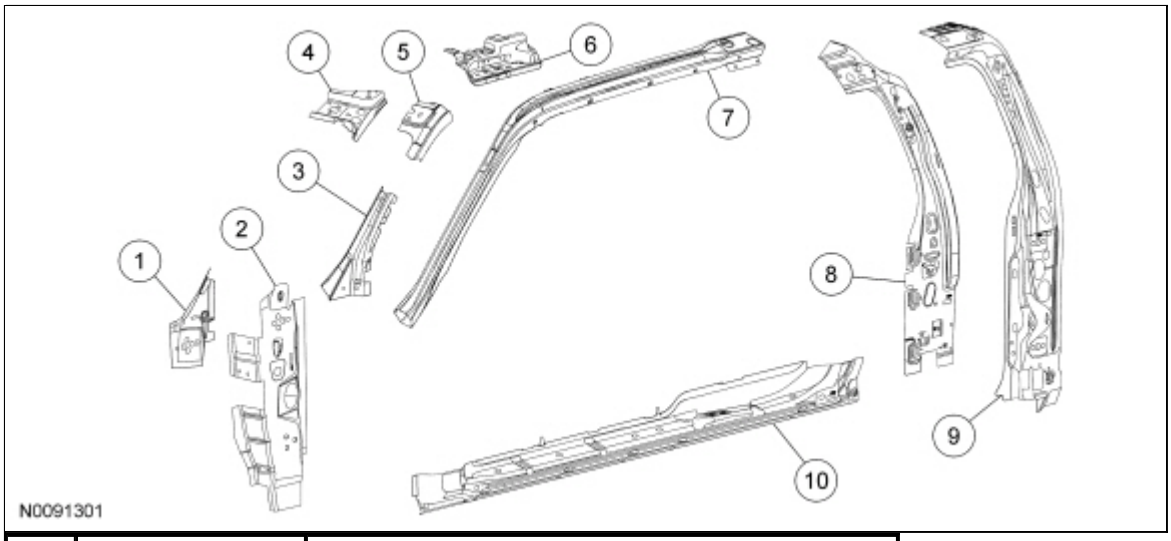


Item	Part Number	Description
1	02525 LH/ 02524 RH	A-pillar reinforcement — Dual Phase Steel (DP) 780 steel
2	02527 LH/ 02526 RH	Front body pillar reinforcement — High-Strength Low Alloy (HSLA) 350 steel
3	02527 LH/ 02526 RH	Front body pillar reinforcement— HSLA 350 steel
4	30B03 LH/ 30B02	Windshield header lower reinforcement — DP 780 steel
5	30A63 LH/ 30A62 RH	Windshield header upper bracket — mild steel
6	203A05 LH/ 203A04 RH	Door opening panel reinforcement — DP 780 steel
7	—	Cab corner inner panel — HSLA 350 steel
8	28137 LH/ 208136 RH	Body lock pillar — HSLA 350 steel
9	278B11 LH/ 278B10 RH	Back panel reinforcement — HSLA 350
10	10143 LH/ 10142 RH	Rocker panel reinforcement — HSLA 350 steel

Exploded View — SuperCab

NOTE: Left side shown, right side similar.

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.



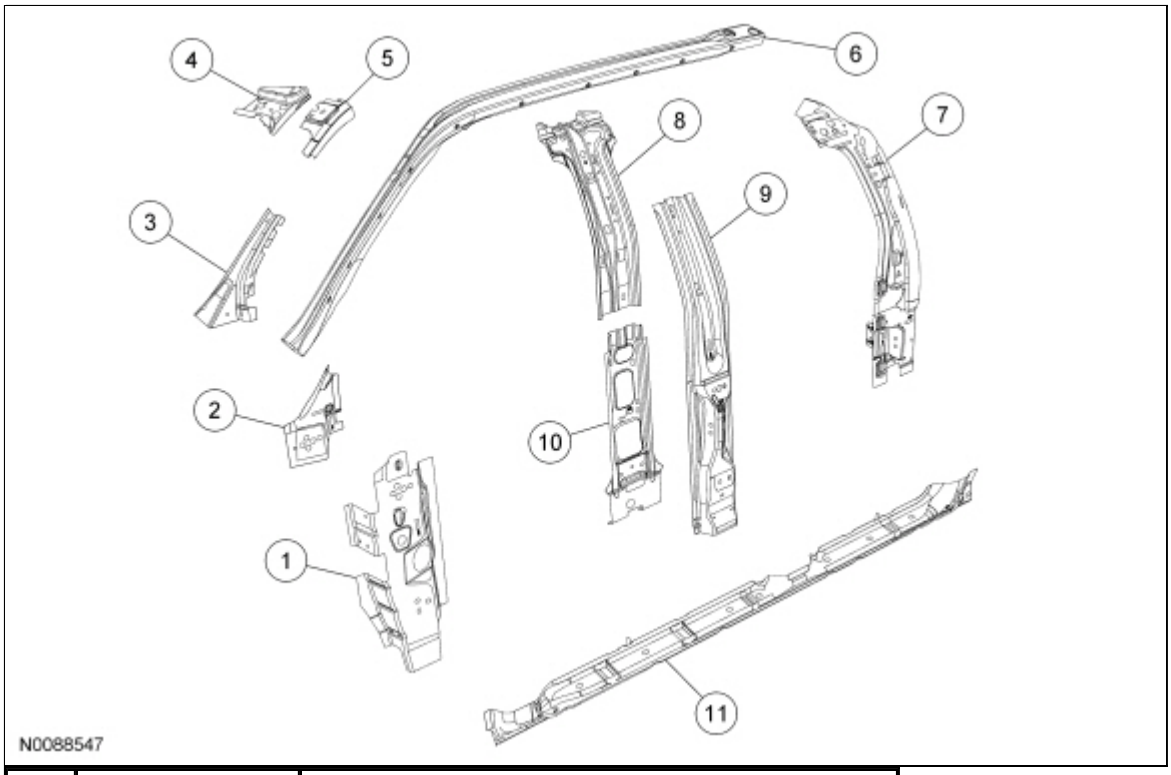
Item	Part Number	Description
1	02525 LH/ 02524 RH	A-pillar reinforcement — Dual Phase Steel (DP) 780 steel
2	02527 LH/ 02526 RH	Front body pillar reinforcement — High-Strength Low Alloy (HSLA) 350 steel
3	02533 LH/ 02532 RH	A-pillar lower reinforcement — HSLA 350 steel
4	30B03 LH/ 30B02	Windshield header lower reinforcement — DP 780 steel
5	30A63 LH/ 30A62 RH	Windshield header upper bracket — mild steel
6	502W45 LH/ 502W44 RH	Roof bow reinforcement — HSLA 350 steel
7	203A05 LH/ 203A04 RH	Door opening panel reinforcement — DP 780 steel
8	40477 LH/ 40476 RH	Cab corner inner panel — DP 600 steel
9	28137 LH/ 208136 RH	Body lock pillar — HSLA 350 steel
10	10143 LH/ 10142 RH	Rocker panel reinforcement — HSLA 350 steel

Exploded View — SuperCrew Cab

NOTE: Left side shown, right side similar.

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.

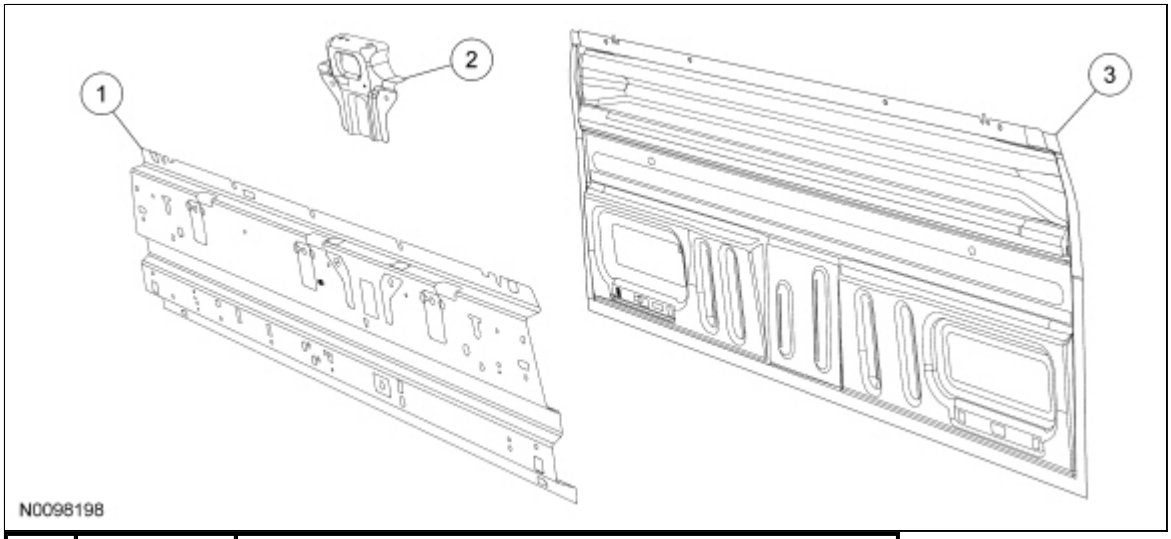
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Item	Part Number	Description
1	02527 LH/ 02526 RH	Front body pillar reinforcement — High-Strength Low Alloy (HSLA) 350 steel
2	02525 LH/ 02524 RH	A-pillar reinforcement — Dual Phase Steel (DP) 780 steel
3	02533 LH/ 02532 RH	A-pillar lower reinforcement — HSLA 350 steel
4	30B03 LH/ 30B02 RH	Windshield header lower reinforcement — DP 780 steel
5	30A63 LH/ 30A62 RH	Windshield header upper bracket — mild steel
6	203A05 LH/ 203A04 RH	Door opening panel reinforcement — DP 780 steel
7	40477 LH/ 40476 RH	Cab corner inner panel — DP 600 steel
8	204A13 LH/ 204A12 RH	Center body pillar inner reinforcement — DP 600 steel
9	24509 LH/ 24508 RH	Center body pillar assembly — Boron steel
10	24327 LH/ 24326 RH	Center body pillar inner lower — HSLA 350 steel
11	10143 LH/ 10142 RH	Rocker panel reinforcement — HSLA 350 steel

Exploded View — Back Panel

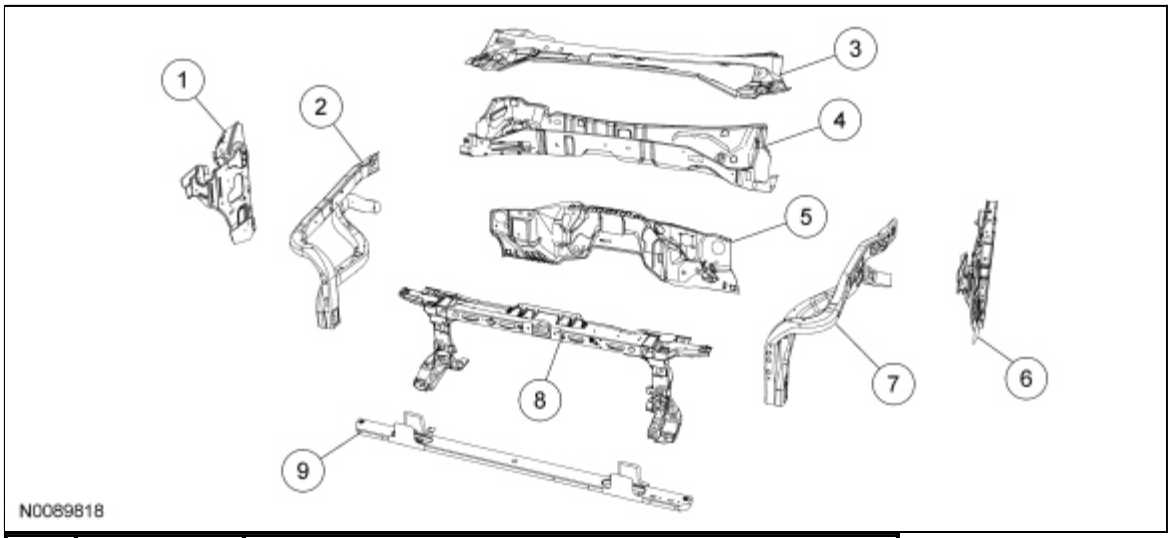
NOTE: Back panel is common for all cab styles.



Item	Part Number	Description
1	403E32	Back panel reinforcement — High-Strength Low Alloy (HSLA) 350 steel
2	—	Reinforcement (part of 403E32) — HSLA 350 steel
3	40300	Back panel — High-Strength Steel (HSS)

Exploded View — Front Structure

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.



Item	Part Number	Description
1	02038	Cowl side panel — High-Strength Low Alloy (HSLA) 350 steel

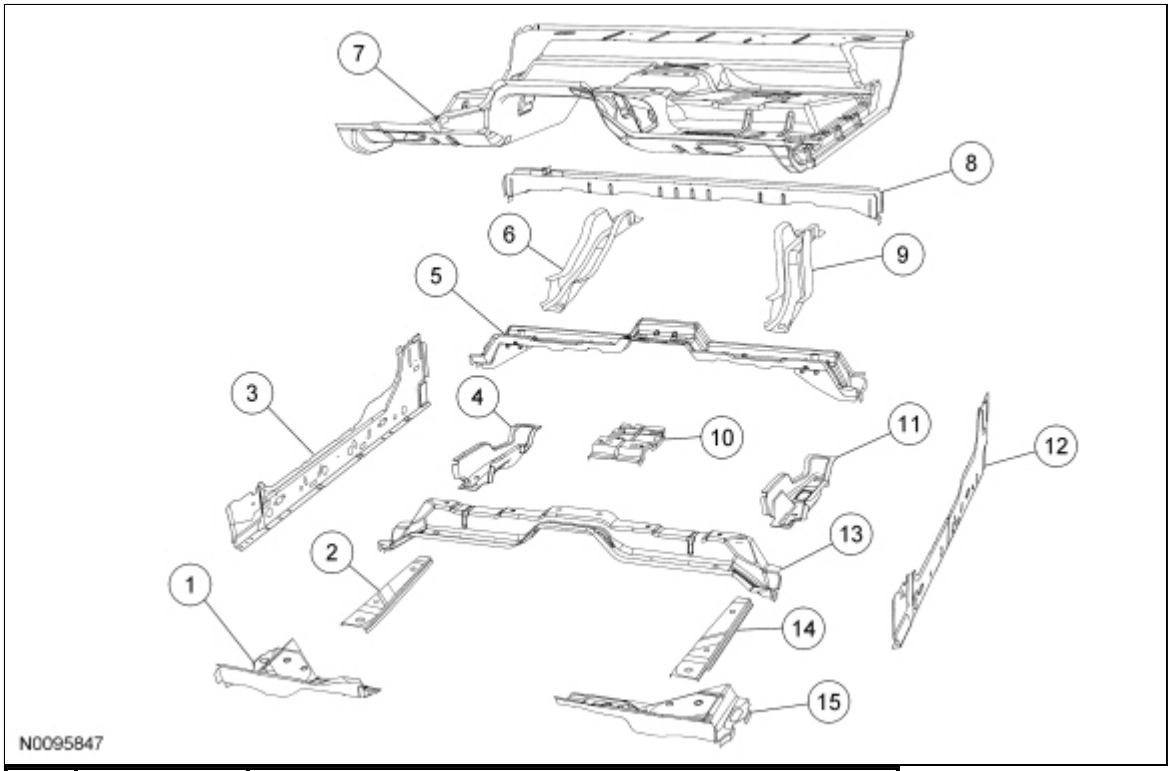
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2	16C274	Inner fender reinforcement — HSLA 350 steel
3	02015	Cowl panel upper — HSLA 350 steel
4	02030	Cowl top inner panel — mild steel
5	01610	Dash panel — laminated steel
6	02039	Cowl side panel — HSLA 350 steel
7	16C275	Inner fender reinforcement — HSLA 350 steel
8	16138A	Radiator support — magnesium alloy
9	16138B	Lower radiator support — HSLA 350 steel

Underbody — Regular Cab

NOTE: Underbody reinforcements and crossmembers are serviced as an assembly, excluding the floor side member reinforcements.

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.



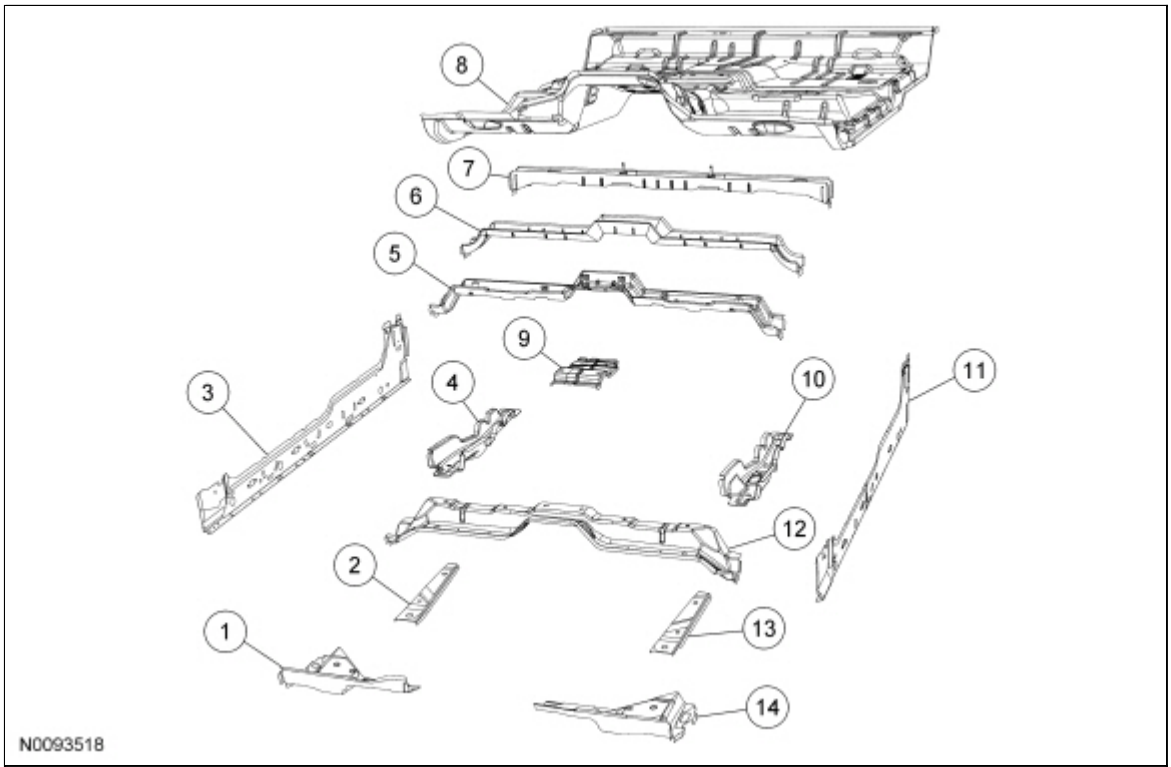
Item	Part Number	Description
1	10414	Reinforcement — High-Strength Low Alloy (HSLA) 350 steel
2	15000K62	Reinforcement — HSLA 350 steel
3	10116	Floor side member — HSLA 550 steel
4	10370	Reinforcement — HSLA 350 steel

5	10624	Crossmember — HSLA 350 steel
6	10118	Front side member reinforcement — HSLA 350 steel
7	11140	Floor pan assembly — mild steel
8	624C06	Reinforcement — HSLA 350 steel
9	10119	Front side member reinforcement — HSLA 350 steel
10	101C94	Reinforcement — HSLA 350 steel
11	10370	Reinforcement — HSLA 350 steel
12	10117	Floor side member — HSLA 550 steel
13	10684	Crossmember — HSLA 350 steel
14	15000K62	Reinforcement — HSLA 350 steel
15	10415	Reinforcement — HSLA 350 steel

Underbody — SuperCab

NOTE: Underbody reinforcements and crossmembers are serviced as an assembly, excluding the floor side member reinforcements.

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.



Item	Part Number	Description
1	10414	Front crossmember — High-Strength Low Alloy (HSLA) 350 steel

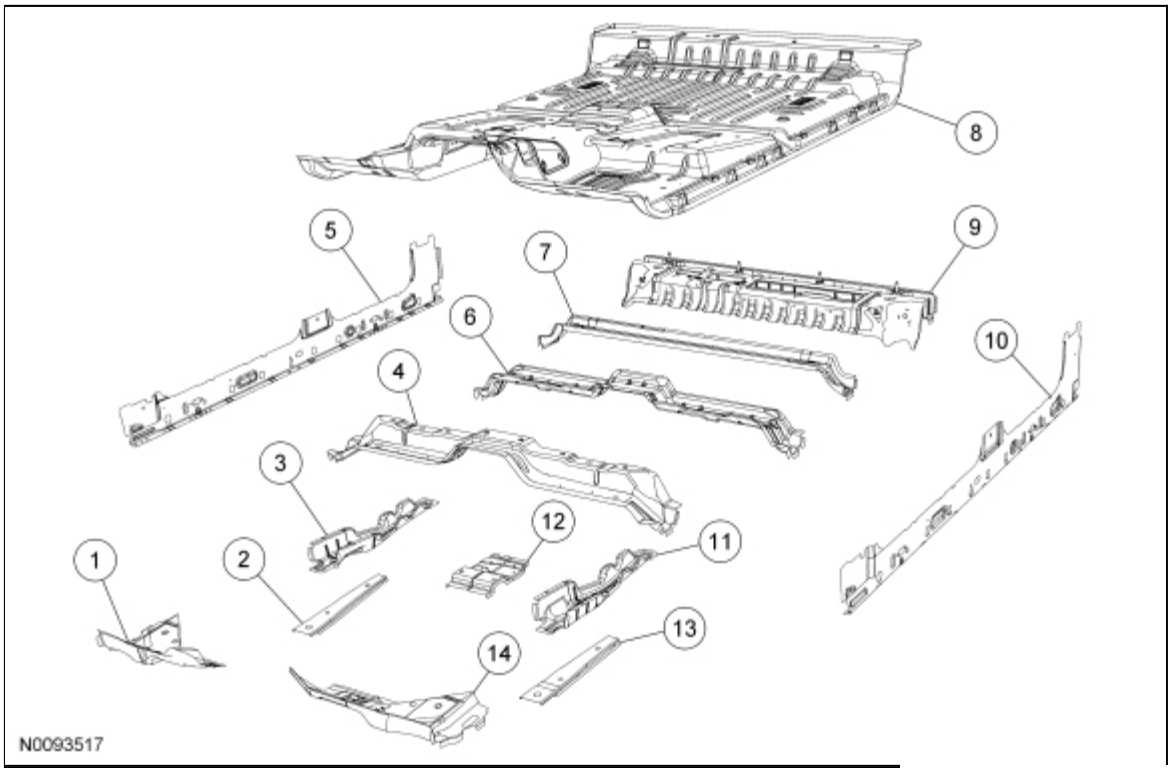
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2	15000K62	Reinforcement — HSLA 350 steel
3	10116	Floor side member — HSLA 550 steel
4	10370	Floor side inner reinforcement — HSLA 350 steel
5	10624	Front floor center crossmember — HSLA 350 steel
6	102A24	Rear floor center crossmember — HSLA 350 steel
7	109A68	Crossmember — HSLA 350 steel
8	11135	Floor pan assembly — mild steel
9	101C94	Floor pan bracket — HSLA 350 steel
10	10371	Floor side inner reinforcement — HSLA 350 steel
11	10117	Floor side member — HSLA 550 steel
12	10684	Front floor crossmember — HSLA 350 steel
13	15000K62	Reinforcement — HSLA 350 steel
14	10415	Front crossmember — HSLA 350 steel

Underbody — SuperCrew Cab

NOTE: Underbody reinforcements and crossmembers are serviced as an assembly, excluding the floor side member reinforcements.

NOTE: Refer to the steel repairability matrix chart in the Specifications portion of this section for specific information regarding steel descriptions.



Item	Part Number	Description

1	10414	Front crossmember — High-Strength Low Alloy (HSLA) 350 steel
2	15000K61	Reinforcement — HSLA 350 steel
3	10370	Floor side inner reinforcement — HSLA 350 steel
4	10684	Front floor crossmember — HSLA 350 steel
5	10116	Floor side member — HSLA 350 steel
6	10624	Front floor center crossmember — HSLA 350 steel
7	102A24	Rear floor center crossmember — HSLA 350 steel
8	11140	Floor pan assembly — mild steel
9	108A36	Rear floor crossmember and reinforcement assembly — HSLA 350 steel
10	10117	Floor side member — HSLA 550
11	10371	Reinforcement — HSLA 350 steel
12	101C94	Floor pan bracket — HSLA 350 steel
13	15000K62	Reinforcement — HSLA 350 steel
14	10415	Front crossmember — HSLA 350 steel

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Do not cut or grind body side components within 50 mm (1.96 in) of restraint anchoring points. Welding within 50 mm (1.96 in) of restraint anchoring points may result in incorrect operation of restraint devices. For additional restraints anchoring location information, refer to Section 501-20A and Section 501-20B . Failure to follow these instructions may result in serious injury to vehicle occupant(s).

WARNING: Do not carry out body side sectioning repairs in areas of laser welds. Factory laser welds cannot be duplicated with conventional welding equipment and structural integrity may be compromised. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

NOTE: Whenever it is necessary to carry out weld-bonding procedures, refer to Weld-Bonding in this section.

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NOTE: Factory spot welds may be substituted with either Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

1. ***NOTICE:*** **Electronic modules and related wiring may be damaged when exposed to heat from welding procedures. Carefully disconnect and remove, or position away from heat affected areas. For additional information, refer to Welding Precautions — Steel in this section.**

   Remove the outer body sheet metal from the affected area prior to carrying out any reinforcing panel replacement. For additional information, refer to Sectioning Guidelines in this section.

2. When welding overlapping surfaces or substrates, apply a weld-through primer between the surfaces prior to welding. When the surfaces have been welded, apply corrosion protection material to the surfaces or substrates. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

3. Where possible, create a backer piece using a portion of the old panel. This will create a stronger joint.

4. Appropriate seam sealer needs to be applied to exposed joints and seams in addition to corrosion protection, particularly horizontal surfaces where moisture collects and migrates. Exposed seams and joints can corrode or rust prematurely if seam sealer is not applied correctly. Clean surfaces with metal surface prep or equivalent prior to applying seam sealer. For additional information, refer to Sealers in this section.

5. Proceed with refinish procedures following Ford-approved paint guidelines.

Pickup Bed Side Panel — Styleside

General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

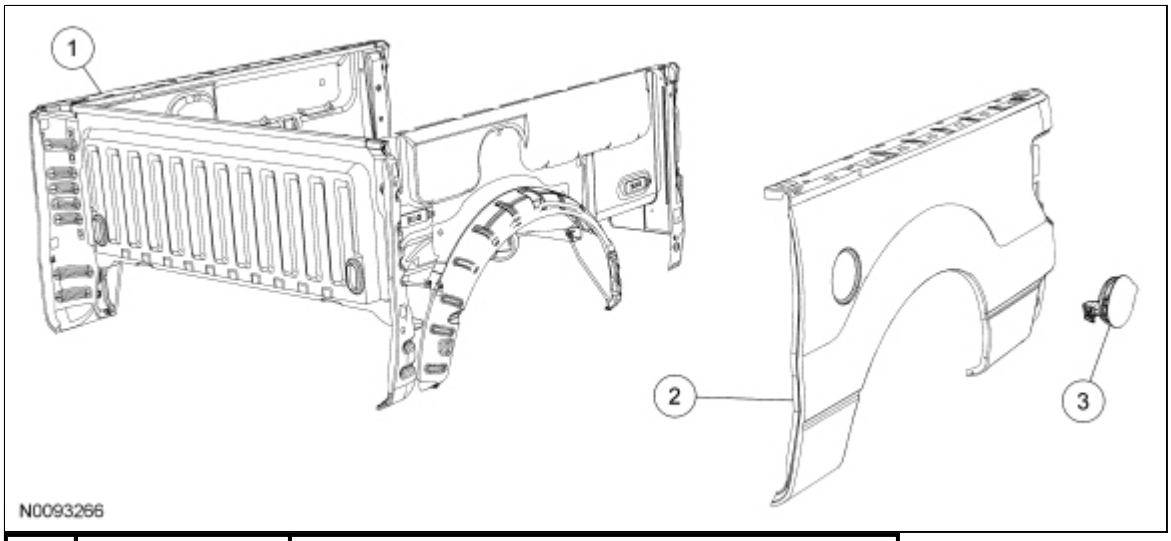
Item	Specification
Flexible Foam Repair Fusor® 121, or equivalent; obtain locally	—
Metal Bonding Adhesive TA-1	—
Premium Undercoating ValuGard™ VG101, VG101A (aerosol)	—
Rust Inhibitor ValuGard™ VG104, VG104A (aerosol)	—
Seam Sealer TA-2	—

Pickup Bed Side Panel — Styleside

NOTE: Factory spray in bedliner (Tough Bed®) is made of a special highly durable multi-part resin. Repairs cannot be performed using conventional body shop chemical or spray equipment. To ensure proper adhesion, correct surface texture and a lasting repair, all work must be done using products that have been tested and approved by Ford Motor Company. There are 2 repair procedure levels for repairing the Tough Bed® material. Refer to www.fordbedlinerrepair.com for further instruction.

NOTE: Left side shown, right side similar.

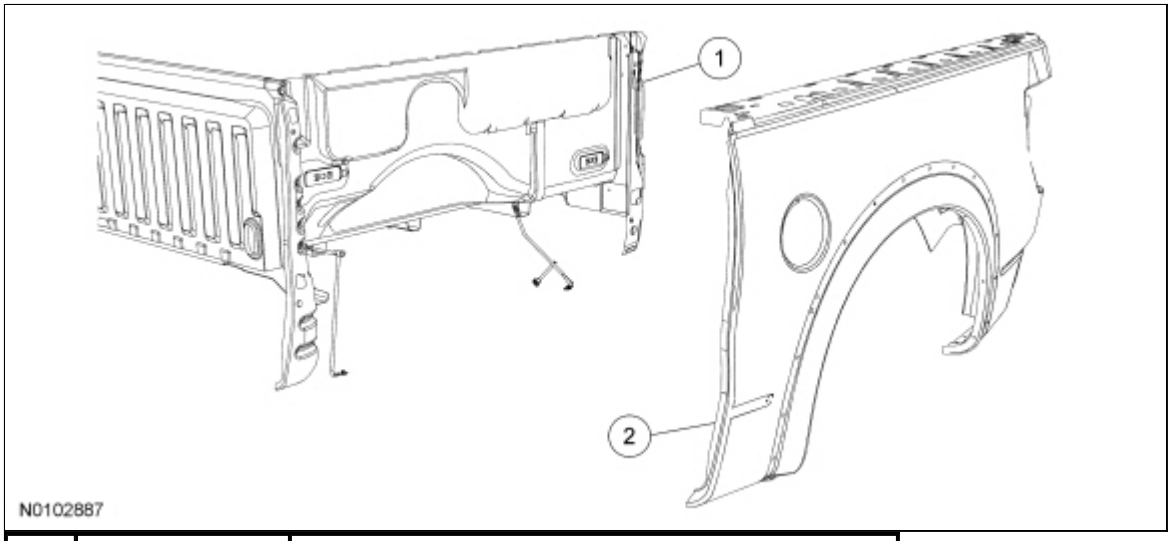
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Item	Part Number	Description
1	—	Pickup bed assembly — High-Strength Low Alloy (HSLA) and mild steel
2	27841 LH/ 27840 RH	Panel assembly — mild steel
3	405C46	Fuel filler door assembly — mild steel

F-150 SVT Raptor

NOTE: The Raptor outer panel is serviced as a module assembly using the same procedure as the Styleside panel.



Item	Part Number	Description
1	—	Pickup bed assembly — High-Strength Low Alloy (HSLA) and mild steel
2	27841 LH/ 27840 RH	Panel assembly — mild steel

All Methods

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Appropriate seam sealer needs to be applied to exposed joints and seams in addition to corrosion protection, particularly horizontal surfaces where moisture collects and migrates. Exposed seams and joints can corrode or rust prematurely if seam sealer is not applied correctly. For additional information, refer to Sealers in this section.**

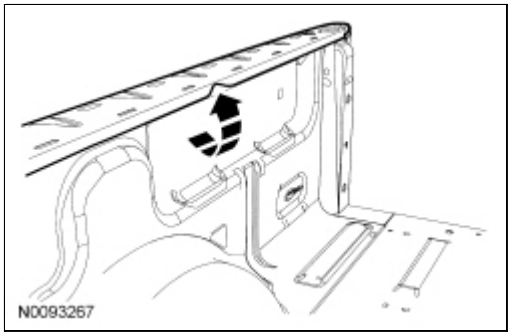
NOTE: Factory spot welds may be substituted with either Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

NOTE: Observe prescribed welding procedures when carrying out any body side section repair. For additional information, refer to Welding Precautions — Steel in this section.

1. Remove the tailgate assembly. For additional information, refer to Section 501-04 .
2. Remove the rear lamp assembly from the affected side. For additional information, refer to Section 417-01 .
3. If equipped, remove the wheelhouse opening moulding(s).
4. Remove the pickup bed upper rail moulding from the affected side.
5. Remove the pickup bed assembly and place on suitable workstands. For additional information, refer to Section 501-04 .

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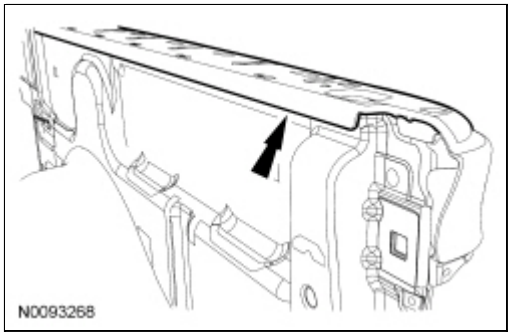
6. Using suitable pliers, bend the inner flange upwards along the bed upper rail to allow access for a spot weld cutting tool.



7. ***NOTICE:*** **Use caution to only drill through the spot welds in the outer panel to avoid damage to the inner panel.**

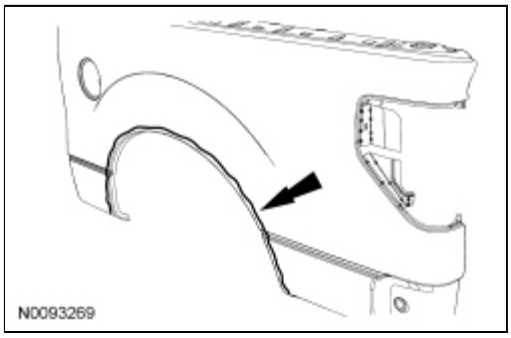
   Using a commercially available spot weld cutter or equivalent, drill out the spot welds that are accessible.

8. Using an air chisel or hand-held weld splitter, separate the weld flanges at the bed rail and front laps of the panel.

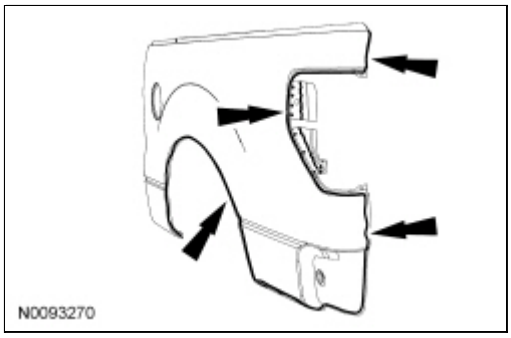


9. **NOTE:** DO NOT remove the foam sealer from around the inside of the wheel opening.

   Using an air saw or air chisel, cut the outer panel, making sure not to cut into the mating flanges or adjacent parts.



10. Continue cutting along the lines until the panel can be completely removed.



11. Drill out the remaining spot welds.

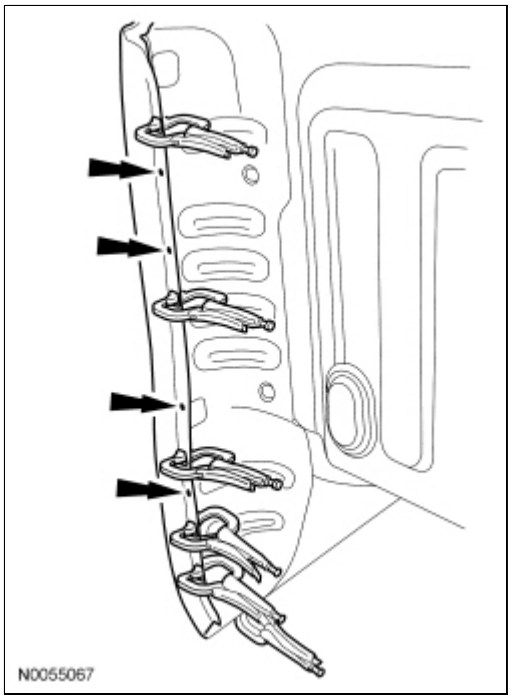
12. Using an air chisel or hand-held splitter, separate and remove the remaining outer panel material.

13. Straighten all flanges as necessary using a hammer and dolly.

14. Using a suitable grinder and grinding disc, carefully grind the mating surfaces of the receiving flanges on the vehicle as follows:
    - Make sure to remove all E-coat, paint or galvanized coating from the mating surfaces. If the metal has a pewter appearance, the galvanized coating has not been completely removed. A shiny appearance must be left after grinding.
    - DO NOT damage the corners or thin the metal.
    - DO NOT GRIND above the mating surface area. This will help eliminate the possibility of corrosion formation after the repair is completed.

15. Dry-fit and clamp the new outer panel to check fit.

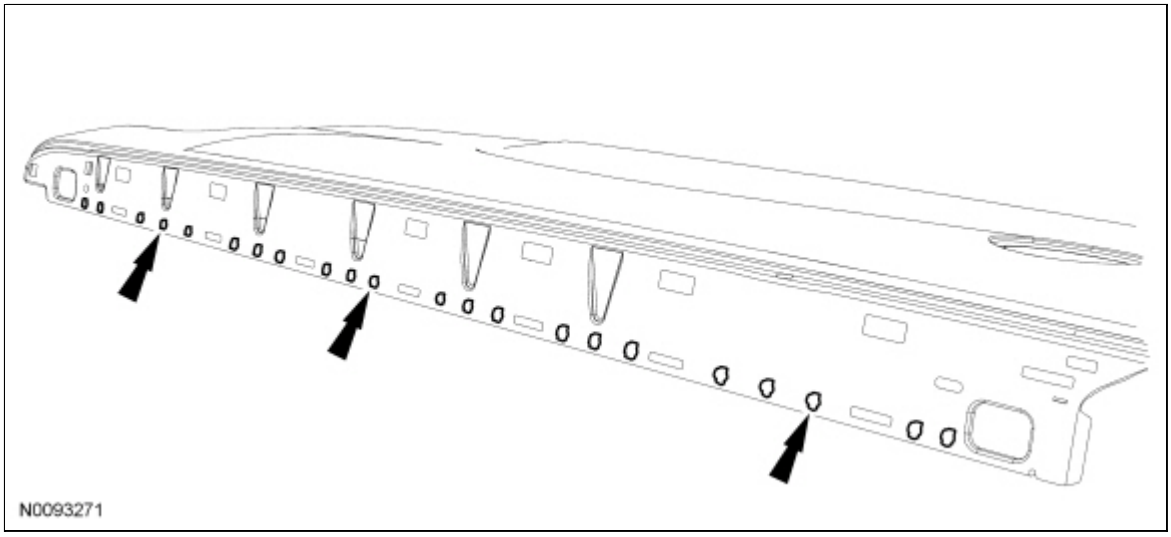
16. Using the original spot welds as a guide, mark the new spot weld locations next to, but not on top of, the original spot weld locations on the new outer panel.



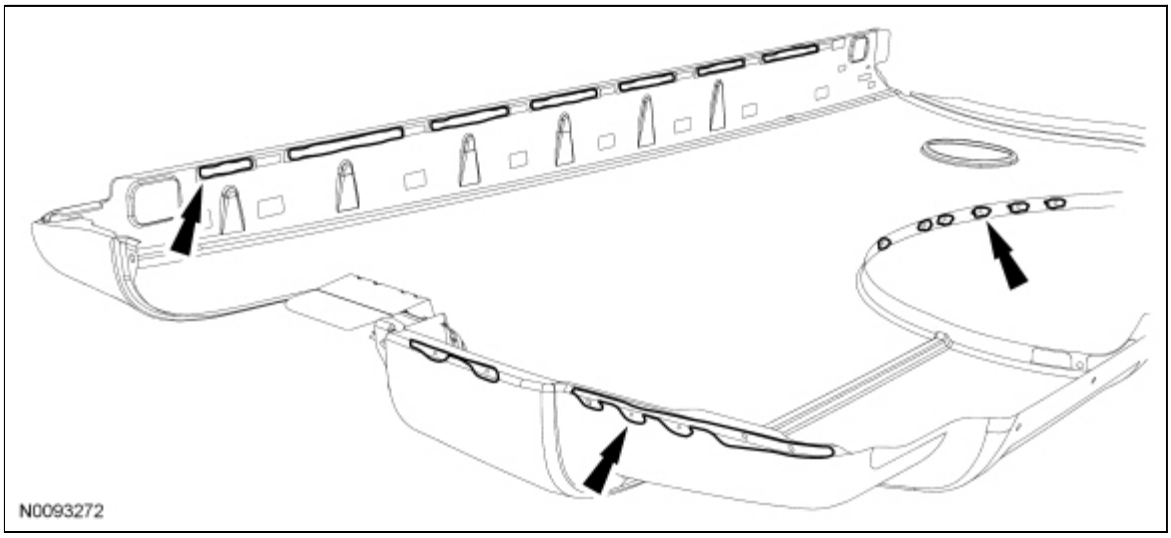
17. Remove the panel and place on suitable work stands.

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Squeeze-Type Resistance Spot Welding (STRW) Method



18. Using a suitable grinder and grinding disc, carefully grind only the spots marked earlier in the new outer panel as follows:
    - Make sure to remove all E-coat, paint or galvanized coating from the mating surfaces. If the metal has a pewter appearance, the galvanized coating has not been completely removed. A shiny appearance must be left after grinding.
    - DO NOT damage the corners or thin the metal.
    - DO NOT GRIND above the mating surface area. This will help eliminate the possibility of corrosion formation after the repair is completed.



19. **NOTE:** Set up spot welder per manufacturer's recommendations for metal thickness.

    Prepare the metal bonding adhesive by placing the cartridge into an applicator gun and dispense a small amount of adhesive to level plungers. Install a mixing tip onto the cartridge and dispense a 75 mm (2.95 in) bead of adhesive onto a scrap piece of cardboard to make sure the components are correctly mixed and ready to apply.

20. **NOTE:** Refer to the adhesive product label for use and preparation instructions.

Perform a weld bond test as follows:

- Prepare 2 pieces of scrap for bonding. These will be used for a test weld.

21. Verify the resistance spot welder is set to manufacturer's recommended settings for the thickness of the metal.

22. Apply a 6 mm (0.23 in) to 9 mm (0.35 in) bead of adhesive onto the test pieces of metal.

23. **NOTE:** Clamps should have tape over the ends to insulate them during welding.

    Clamp the pieces together and apply one weld.

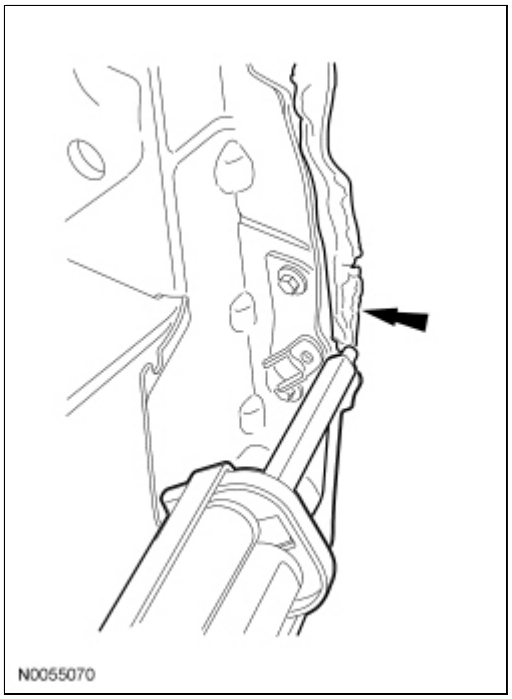
24. Remove the clamp, then place the welded pieces in a vise and perform destructive weld test by peeling the scrap metal apart using large channel lock pliers. Measure the size of the weld nugget to verify it meets Ford Motor Company weld nugget requirements. For additional information, refer to the weld nugget table in Specifications in this section.

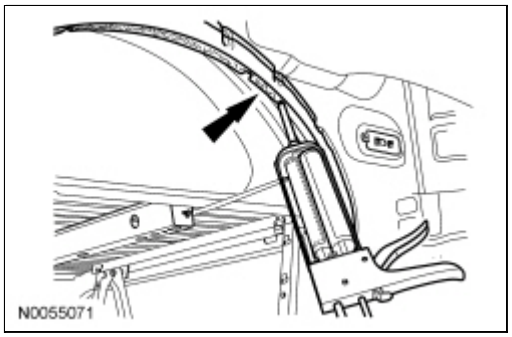
25. Proceed with the panel installation once the correct weld nugget size is achieved.

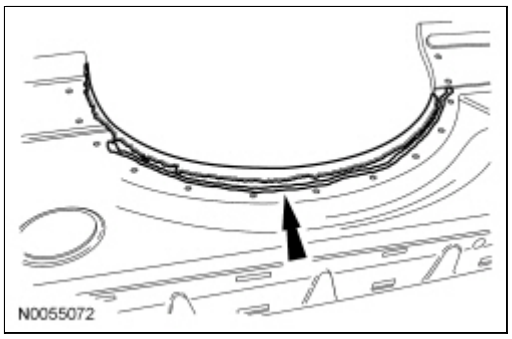
26. Wipe all dust and grit off the panel to prepare the service replacement outer panel for installation.
    - Remove any foreign material from the vehicle in the repair area.

27. Apply a bead of adhesive approximately 6 mm (0.23 in) to 10 mm (0.39 in) wide, to the flanges on the vehicle and the mating surfaces of the new outer panel in the following locations:
    - Top rail flange
    - Short vertical flange at front top of bed
    - Forward vertical flange
    - Small area at bottom of inner panel just behind forward vertical flange
    - Rear vertical flange
    - Around tail lamp area
    - Small area behind wheel opening beneath tail lamp area
    - Wheel opening flange
    - The area of the panel that contacts the wheel opening foam sealer
    - Apply an extra bead of adhesive to the inside corner around the wheel opening on the new outer panel

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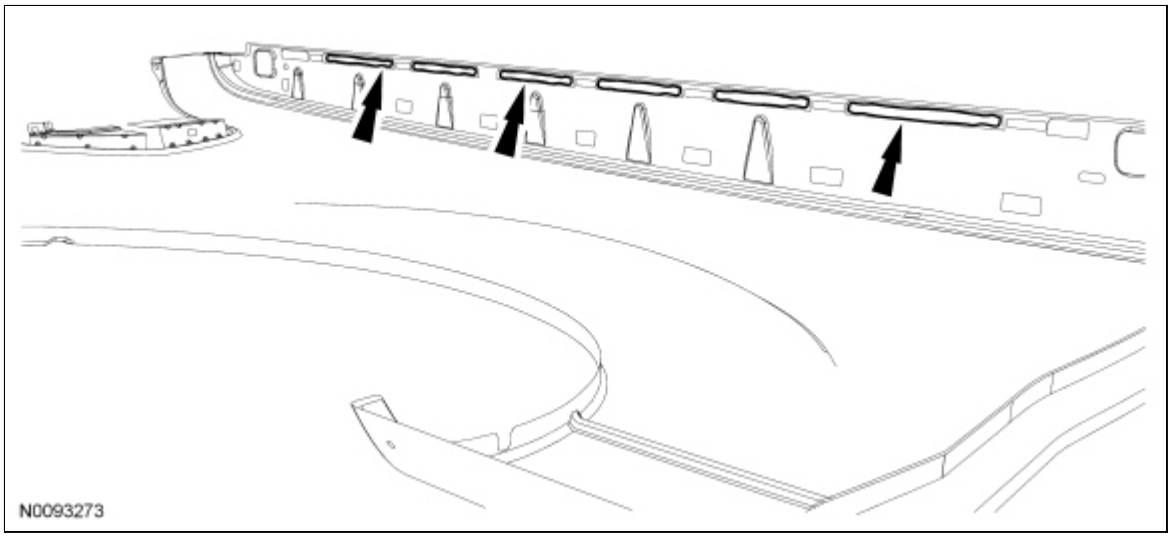






28. **NOTE:** Do not scrape off the adhesive. Do not spread out the extra bead of adhesive that was applied to the inside corner at the wheel opening.

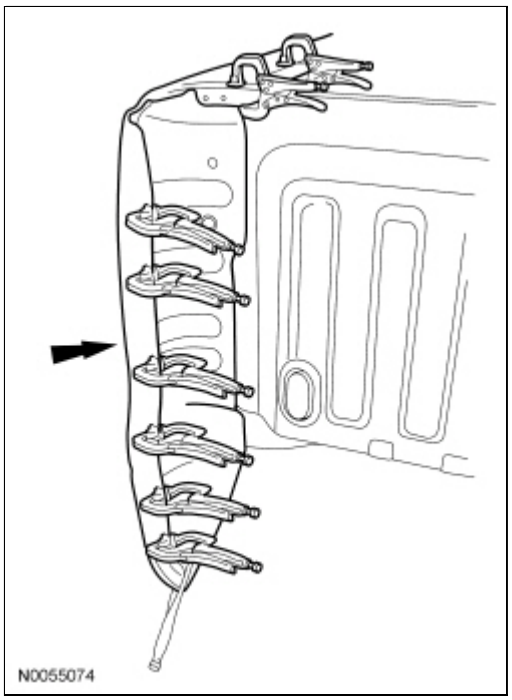
    Using a paint stick or equivalent, spread the adhesive to cover the entire area where the E-coat was ground off.



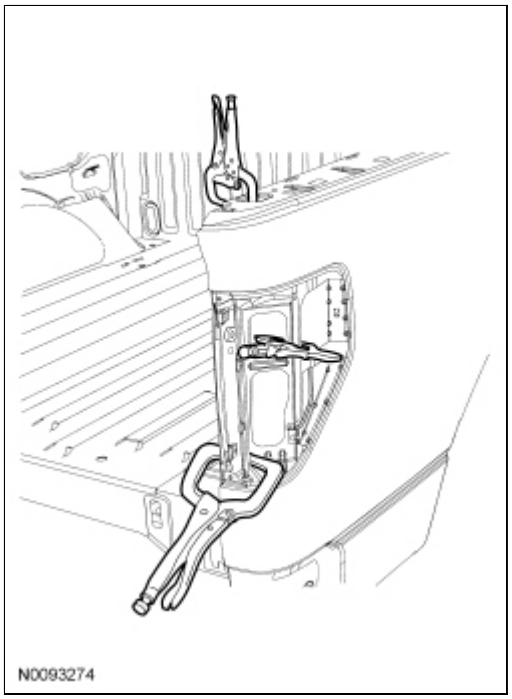
29. Position the new outer panel onto the bed. Once positioned, DO NOT PULL the panel away from the bed. If repositioning is necessary, SLIDE the panel. This maintains correct contact between the components and the adhesive.

30. **NOTE:** Clamps should have tape over the ends to insulate them during welding.

    Clamp the panel in place evenly and tightly. Glass beads in the adhesive will prevent over-clamping the components.



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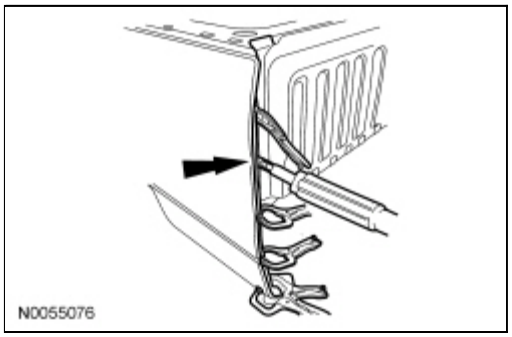
31. Wipe away any excess adhesive, where possible, before it cures.

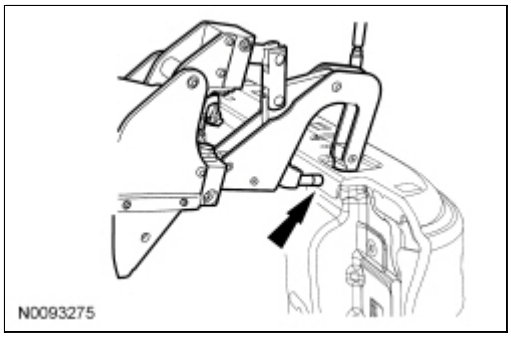
32. **NOTE:** Welding can be carried out anytime during the adhesive curing process or after the adhesive is fully cured. Welder settings will vary when welding through wet adhesive versus welding through cured adhesive. Use the welder manufacturer's recommended settings for welding through adhesive.

    NOTE: It is best to place a shunt weld (in an area with no adhesive) as the first weld to make sure you have correct conductivity, particularly when welding through cured adhesive.

    NOTE: If welding will not be carried out immediately, follow the adhesive product label for cure times.

    Spot weld the new panel in place, maintaining original spot weld spacing. Welds should be placed as close as possible to the original welds, BUT NOT DIRECTLY OVER AN ORIGINAL SPOT WELD.





Metal Inert Gas (MIG) Welding Method

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Appropriate seam sealer needs to be applied to exposed joints and seams in addition to corrosion protection, particularly horizontal surfaces where moisture collects and migrates. Exposed seams and joints can corrode or rust prematurely if seam sealer is not applied correctly. For additional information, refer to Sealers in this section.**

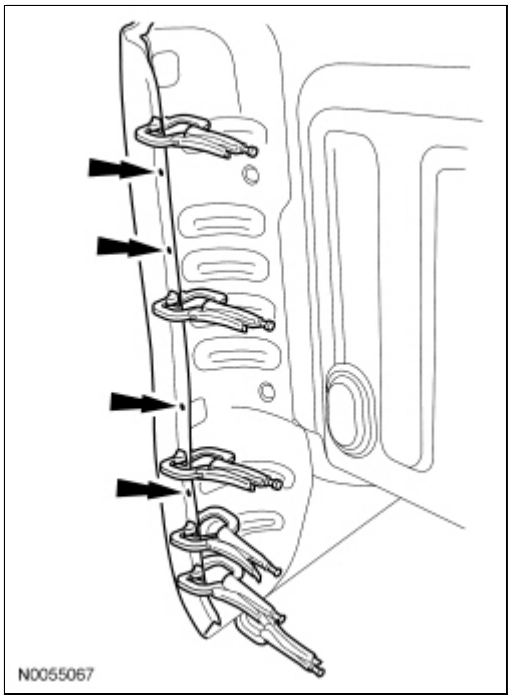
33. Straighten all flanges as necessary using hammer and dolly.

34. Using a suitable grinder and grinding disc, carefully grind the mating surfaces of the receiving flanges on the vehicle as follows:
    - Make sure to remove all E-coat, paint or galvanized coating from the mating surfaces. If the metal has a pewter appearance, the galvanized coating has not been completely removed. A shiny appearance must be left after grinding.
    - DO NOT damage the corners or thin the metal.
    - DO NOT GRIND above the mating surface area. This will help eliminate the possibility of corrosion formation after the repair is completed.

35. Dry-fit and clamp the new outer panel to check fit.

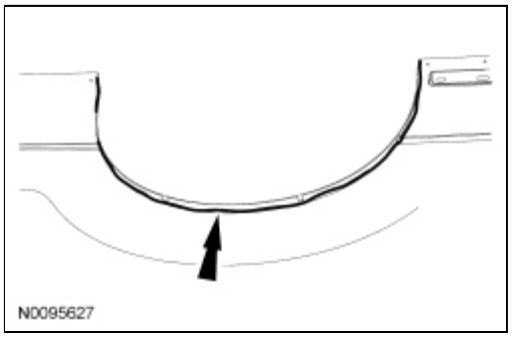
36. Using the original spot welds as a guide, mark the new spot weld locations next to, but not on top of, the original spot weld locations on the new outer panel.

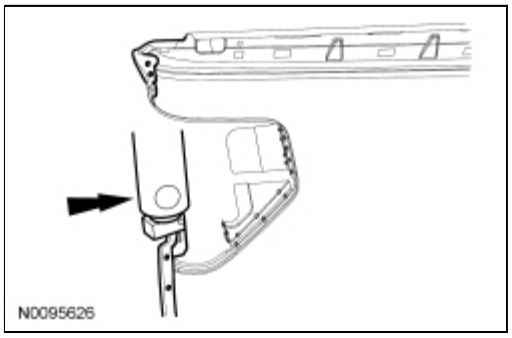
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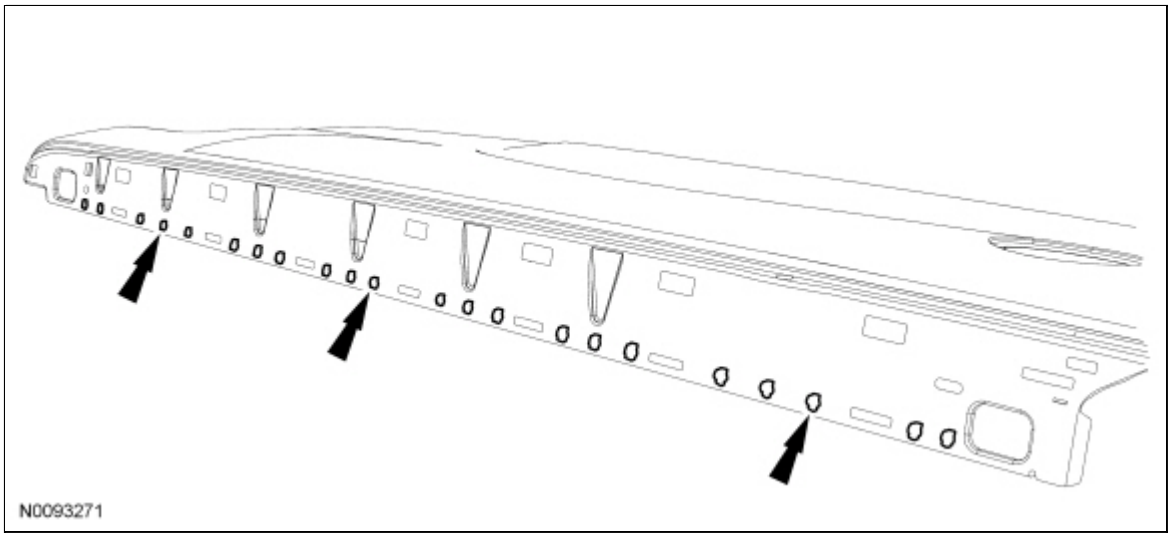


37. Remove the panel and place on suitable work stands.

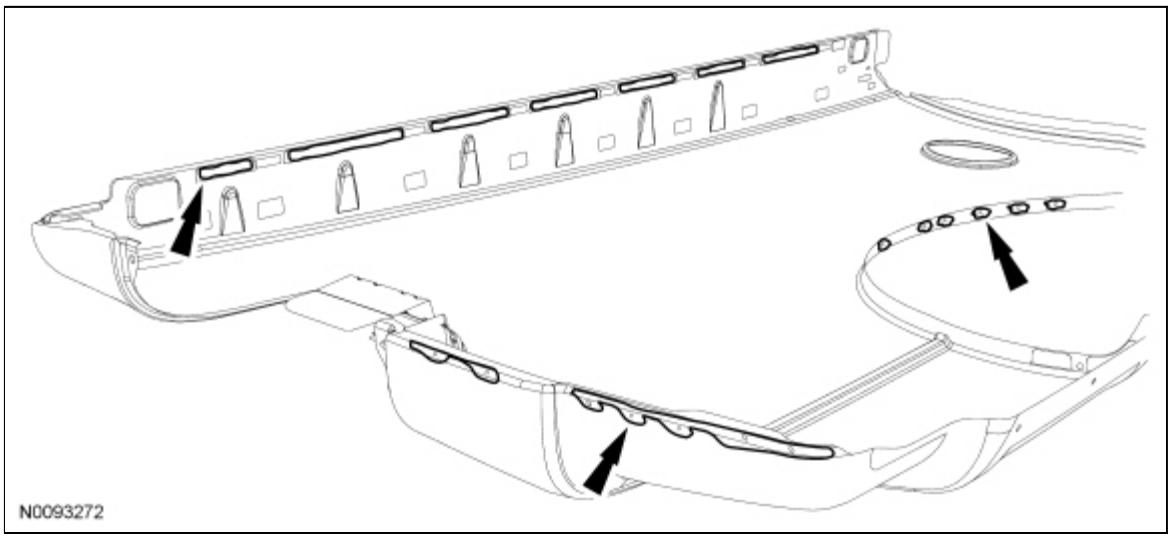
38. Drill or punch the exact number of holes to match the number of spot welds that secured the original panel. The holes should be 8 mm (0.31 in) diameter and as close to the original spot welds without lining up exactly on top of the original spot welds.







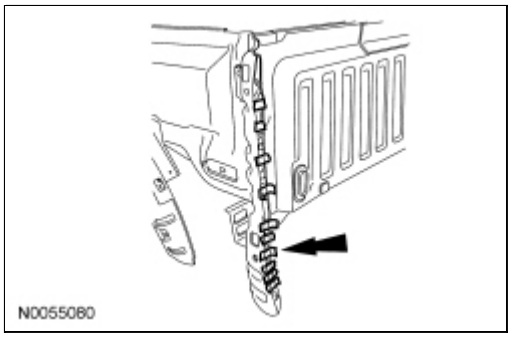
39. Using a suitable grinder and grinding disc, carefully grind only the spots marked earlier in the new outer panel as follows:
    - Make sure to remove all E-coat, paint or galvanized coating from the mating surfaces. If the metal has a pewter appearance, the galvanized coating has not been completely removed. A shiny appearance must be left after grinding.
    - DO NOT damage the corners or thin the metal.
    - DO NOT GRIND above the mating surface area. This will help eliminate the possibility of corrosion formation after the repair is completed.



40. Wipe all dust and grit off the panel to prepare the service replacement outer panel for installation.
    - Remove any foreign material from the vehicle in the repair area.

41. Apply 25.4 mm (1 in) masking tape over the plug weld locations marked earlier to prevent contamination from the adhesive.

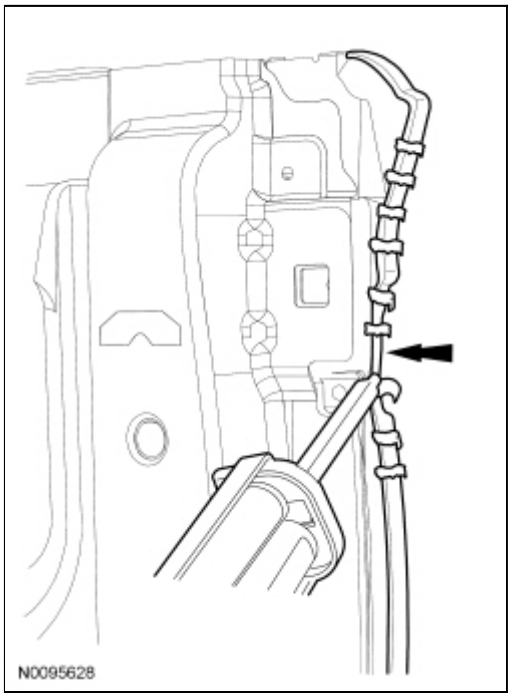
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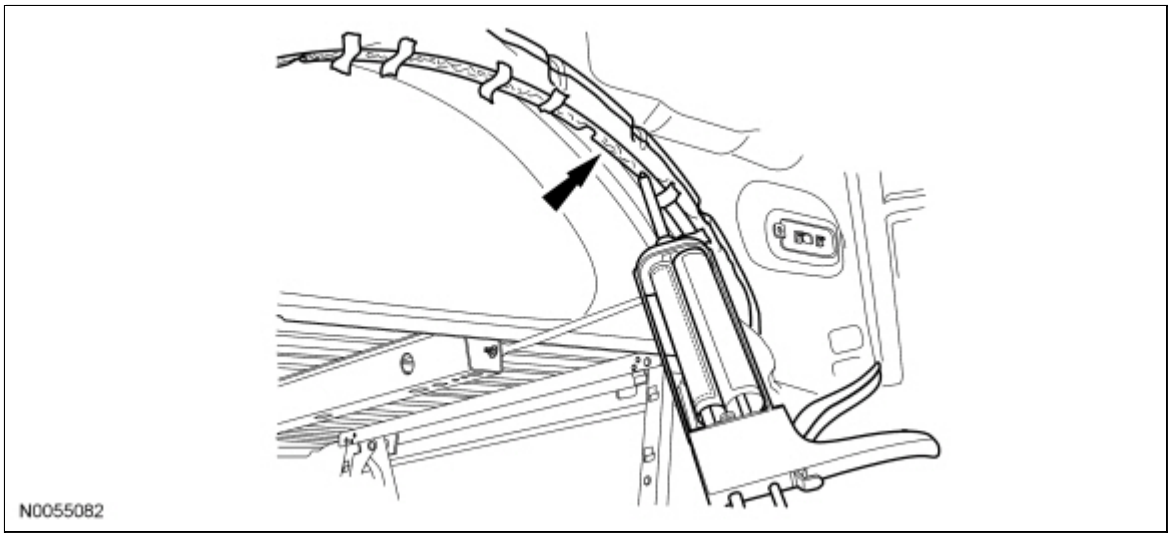


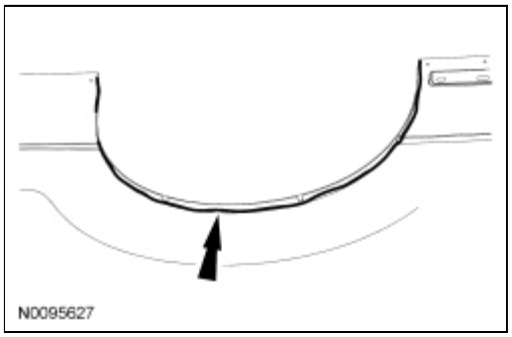
42. **NOTE:** Refer to the adhesive product label for use and preparation instructions.

    Prepare the metal bonding adhesive by placing the cartridge into an applicator gun and dispense a small amount of adhesive to level plungers. Install a mixing tip onto the cartridge and dispense a 75 mm (2.95 in) bead of adhesive onto a scrap piece of cardboard to make sure the components are correctly mixed and ready to apply.

43. Apply a bead of adhesive approximately 6 mm (0.23 in) to 10 mm (0.39 in) wide to the flanges on the vehicle and the mating surfaces of the new outer panel in the following locations:
    - Top rail flange
    - Short vertical flange at front top of bed
    - Forward vertical flange
    - Small area at bottom of inner panel just behind forward vertical flange
    - Rear vertical flange
    - Around tail lamp area
    - Small area behind wheel opening beneath tail lamp area
    - Wheel opening flange
    - The area of the panel that contacts the wheel opening foam sealer
    - Apply an extra bead of adhesive to the inside corner around the wheel opening on the new outer panel

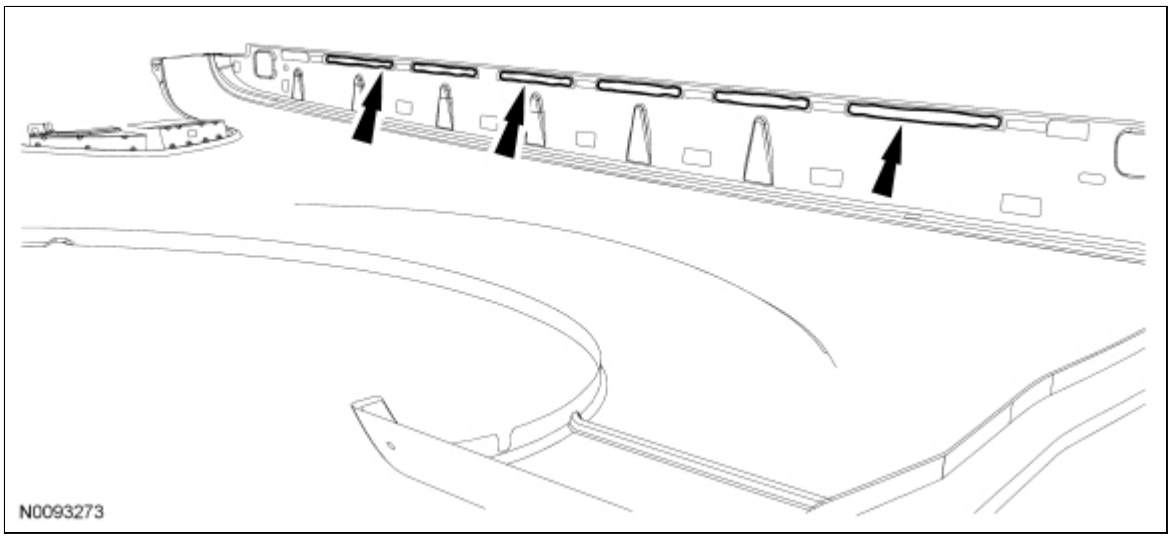






44. **NOTE:** Do not scrape off the adhesive. Do not spread out the extra bead of adhesive that was applied to the inside corner at the wheel opening.

    Using a paint stick or equivalent, spread the adhesive to cover the entire area where the E-coat was ground off.



45. Remove the tape to expose the bare metal around the plug weld areas.

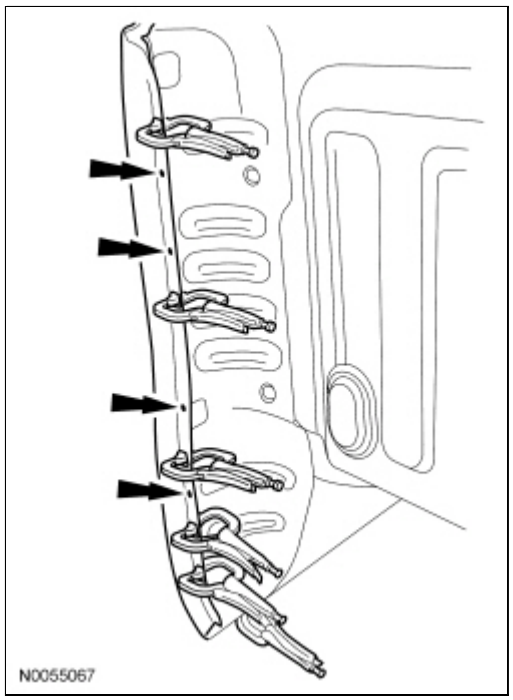
46. Position the new outer panel onto the bed. Once positioned, DO NOT PULL the panel away from the

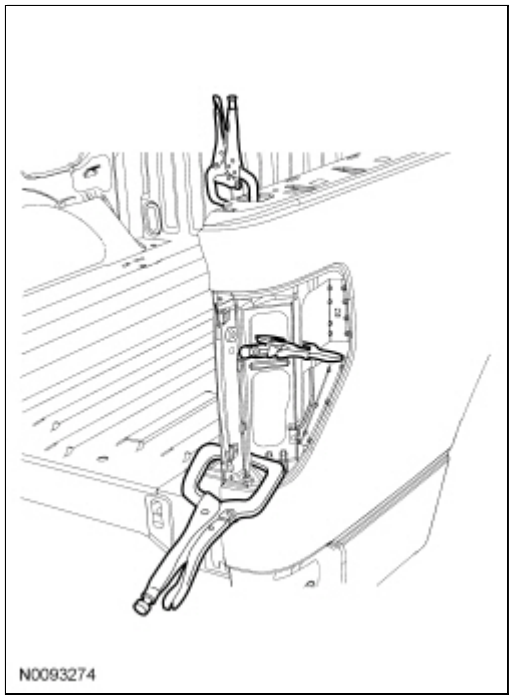
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bed. If repositioning is necessary, SLIDE the panel. This maintains correct contact between the components and the adhesive.

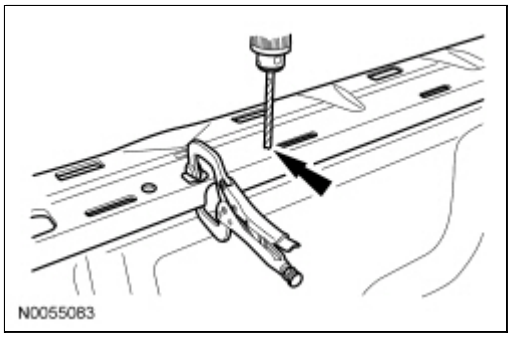
47. **NOTE:** Clamps should have tape over the ends to insulate them during welding.

    Clamp the panel in place evenly and tightly. Glass beads in the adhesive will prevent over-clamping the components.

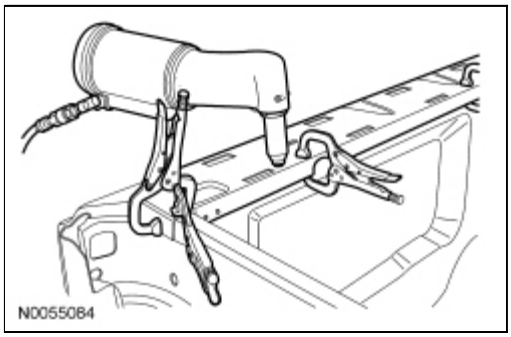




48. Using an 8 mm (0.31 in) bit, drill through the top rail in the new panel and the inner panel in the locations marked indicating the original spot welds.



49. Using locally procured rivets (3/16 x 0.440 oval head blind steel rivet), rivet the new panel in place along the upper rail.



50. **NOTE:** Welding can be carried out anytime, while the adhesive cures or after the adhesive is fully cured. Follow the adhesive label instructions for cure times.

    Weld the new panel in place. Welds should be placed as close as possible to the original welds, BUT NOT DIRECTLY OVER AN ORIGINAL SPOT WELD.

All methods

51. Remove the clamps after welding is completed.

52. Apply flexible foam sealer to the outer panel-to-inner panel wheel opening joint.

53. Restore corrosion protection to all bare metal surfaces. Finish any cosmetic seams with seam sealer. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

54. Proceed with the refinish process and follow Ford-approved paint procedures.

55. Reinstall the pickup bed assembly. For additional information, refer to Section 501-04 .

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Roof Panel

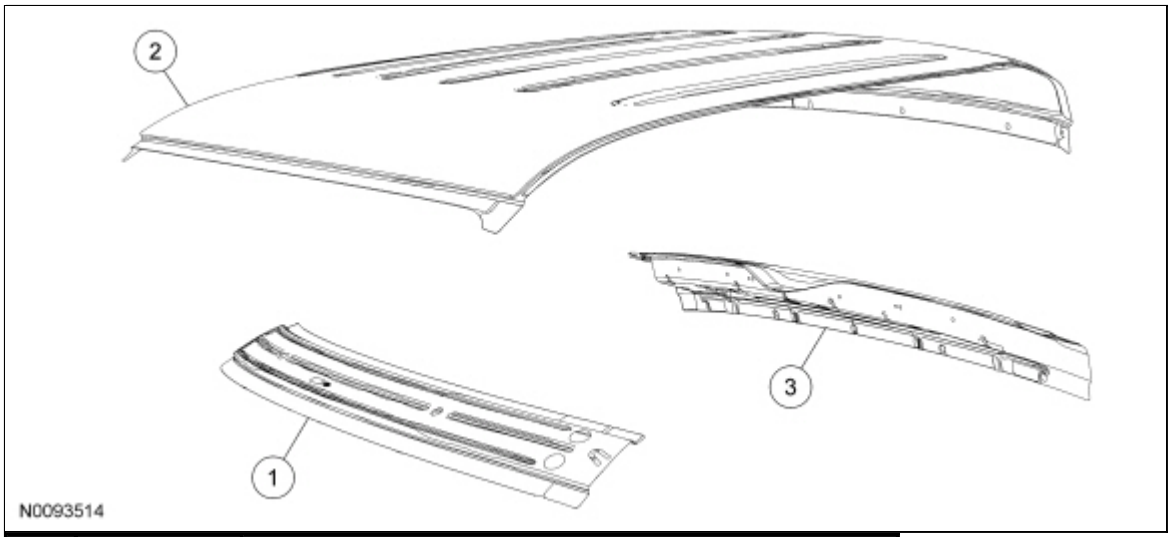
General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Flexible Foam Repair Fusor® 121, or equivalent; obtain locally	—
Metal Bonding Adhesive TA-1	—
Roof Ditch Sealer Fusor® 122EZ or equivalent, obtain locally	—
Seam Sealer TA-2	—

Regular Cab

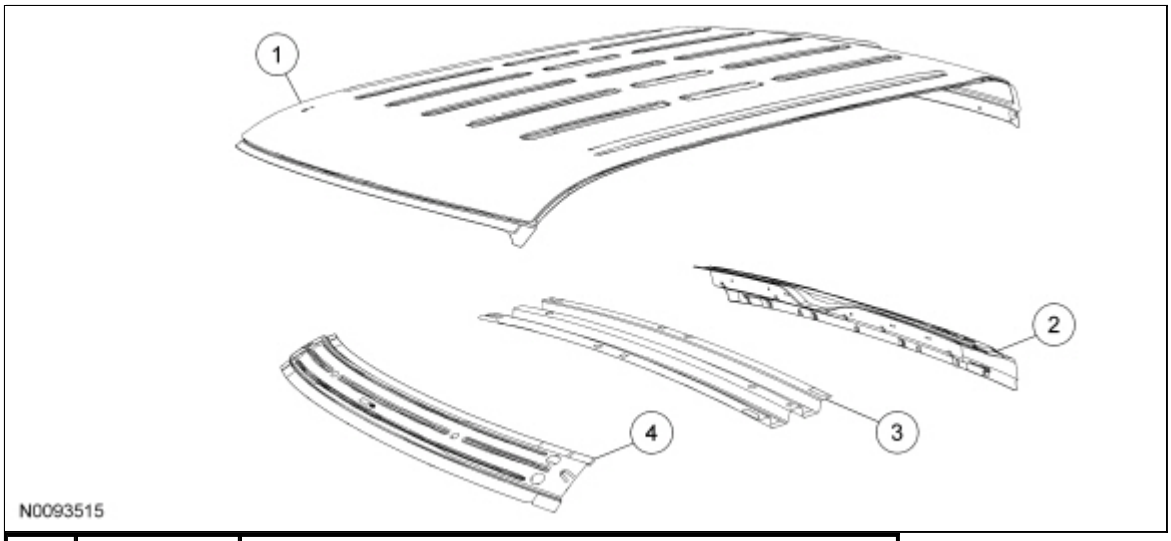


Item	Part Number	Description
1	03418	Windshield header — High-Strength Low Alloy (HSLA) 350 steel

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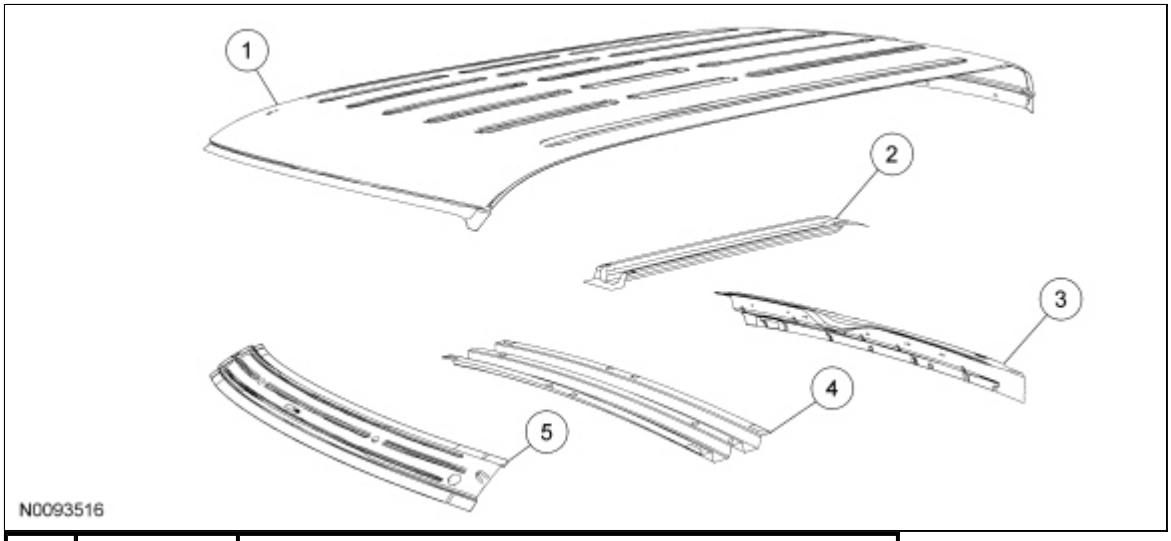
2	50202	Roof panel — mild steel
3	40418	Back panel assembly — HSLA 350 steel

SuperCab



Item	Part Number	Description
1	50202	Roof panel — mild steel
2	40484	Back panel assembly — High-Strength Low Alloy (HSLA) 350 steel
3	502A74	Roof bow — HSLA 350 steel
4	03418	Windshield header — HSLA 350 steel

SuperCrew Cab



	Part	

Item	Number	Description
1	50202	Roof panel — mild steel
2	50291	Roof panel reinforcement — mild steel
3	40484	Back panel assembly — High-Strength Low Alloy (HSLA) 350 steel
4	502A74	Roof bow — HSLA 350 steel
5	03418	Windshield header — HSLA 350 steel

Removal

WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

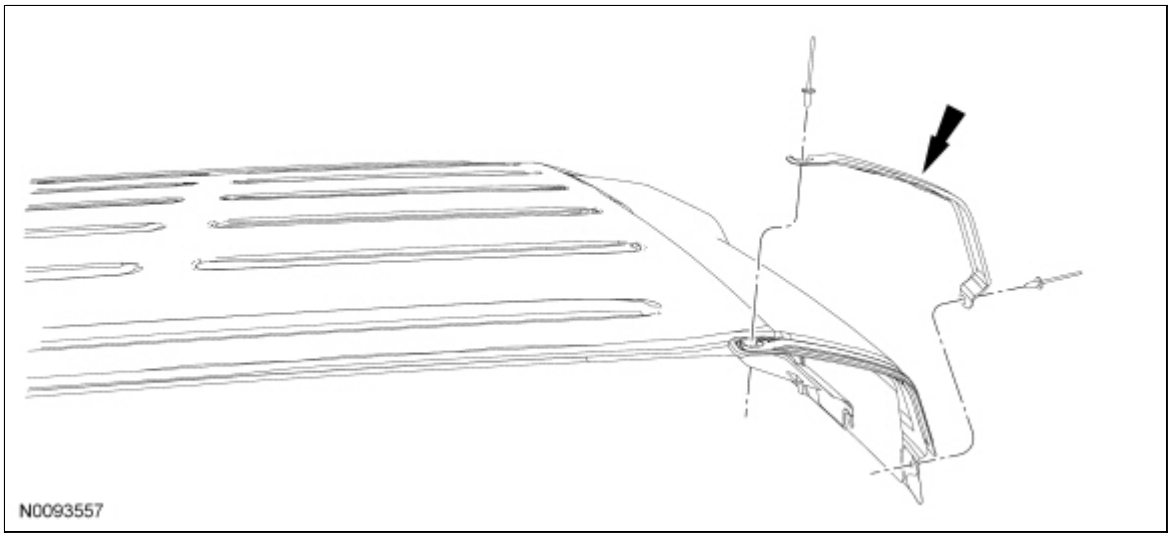
WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

***NOTICE:* Be sure to adequately protect all glass, exterior finish and interior trim to avoid surface contamination from repair materials.**

NOTE: The driver and passenger sides of the roof panel are laser welded. Installation of a new roof panel will employ a weld-bonding technique. The use of mechanical welding and chemical bonding are both part of the installation technique.

1. Remove the windshield and rear window glass. For additional information, refer to Section 501-05 .
2. Remove the headliner. For additional information, refer to Section 501-05 .
3. Remove the roof rear corner mouldings. The moulding is attached with rivets which must be drilled out to remove.

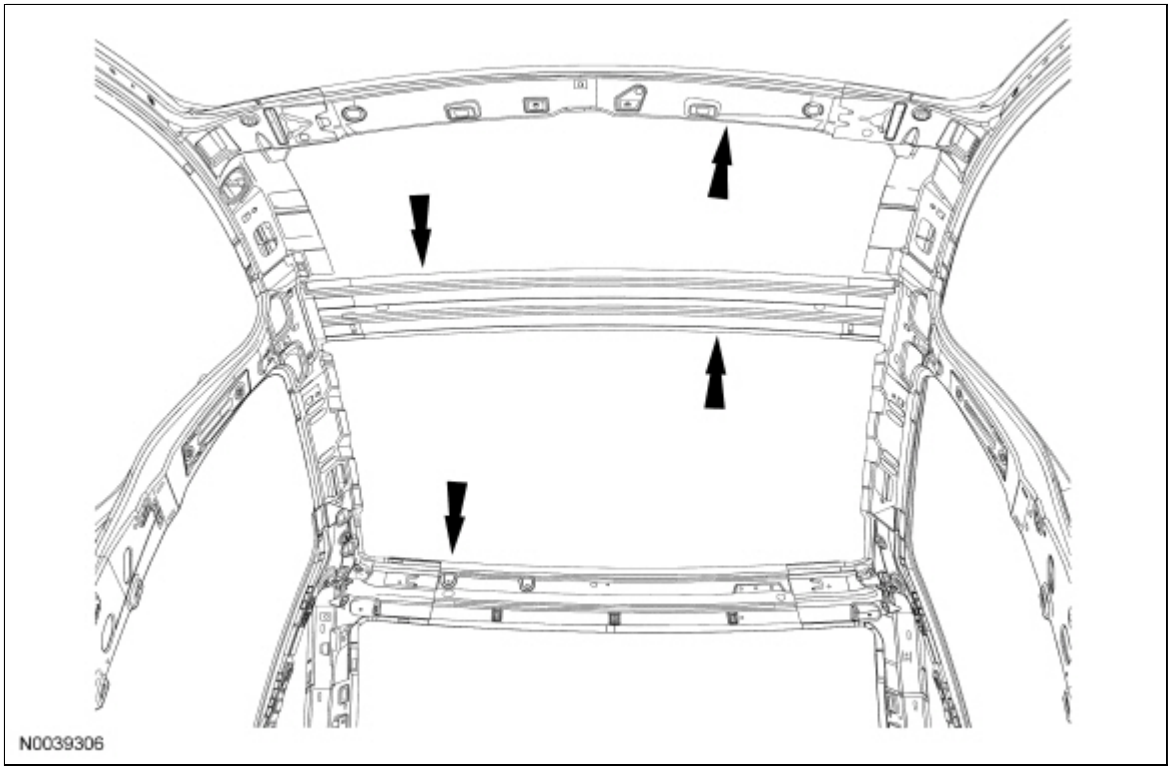
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4. **NOTE:** For installation purpose, particular attention must be paid to the depth (thickness) of the sealer removed.

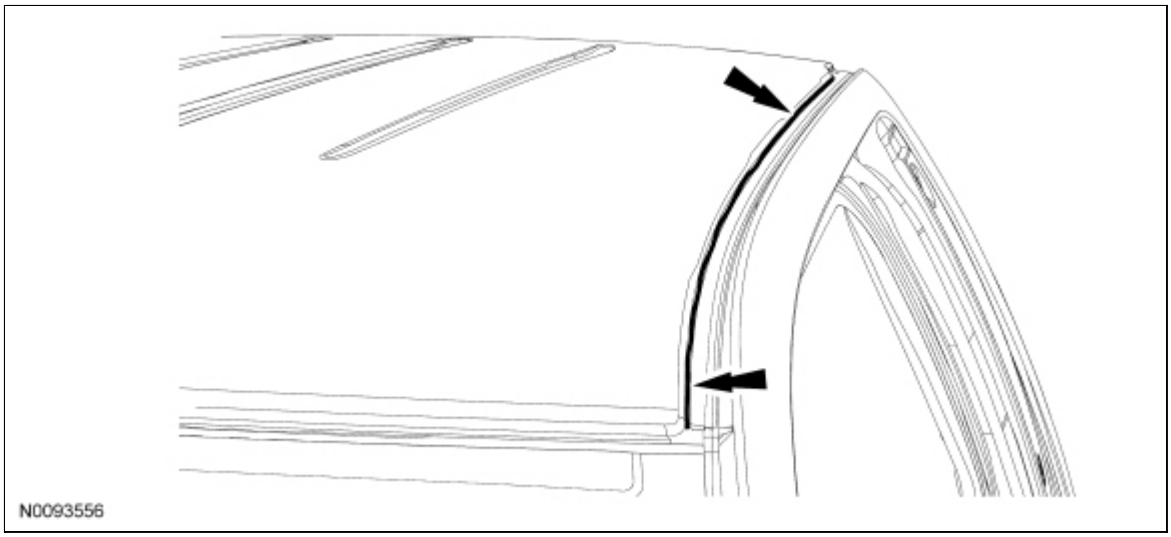
   Using a heat gun and a narrow scraper, remove the sealer along the entire length of the roof sides. Remove the sealer as completely as possible.

5. From inside the vehicle, leaving as much of the foam as possible intact, separate the NVH foam along the roof bows from the roof panel using a flexible and sharp broad scraper or knife.



6. Remove (drill out) all the roof panel spot welds from the windshield header and back panel assembly.

7. Using a die grinder, carefully cut along the upper flange of the roof panel, the entire length of the panel.



8. With the help of an assistant, remove the roof panel from the vehicle.

9. Using an air chisel equipped with a flat chisel or similar, remove the remaining portion of the roof panel from the roof ditch area.

Installation

1. Using a hammer and dolly, straighten any damage caused to flange areas during removal.

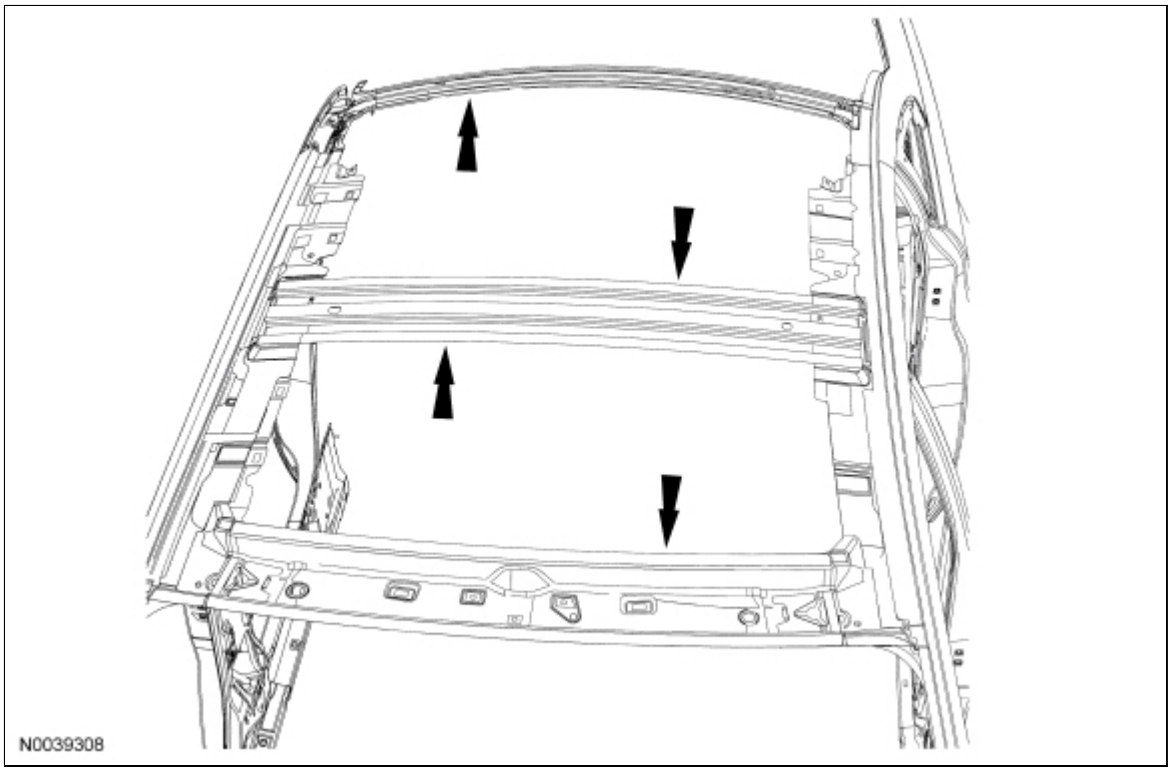
2. Using a grinder, carefully prepare the roof ditch area for the new roof panel.

3. With the help of an assistant, position the new roof panel on the vehicle.

4. Correctly align and index-mark the positioning of the panel-to-vehicle and remove the panel.

5. Apply a 13 mm (0.51 in) tall bead of seam sealer directly to the NVH foam remaining on the roof bows. Apply a bead of metal bonding adhesive following label instructions, along the roof ditch area on each side.

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6. Reinstall the roof panel aligning it to the index marks made during the test fitting. If adjustment is necessary, do not lift the roof panel, slide to reposition. Make sure good contact is made with the sealer and adhesive and carefully clamp the roof panel on all sides.

7. **NOTE:** The roof panel is not welded along the roof ditch flange, only metal bonding adhesive is used.

   Using a resistance spot welder, weld the roof panel to the vehicle in the windshield and back panel assembly areas. Spot welds should match factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

8. Using a Metal Inert Gas (MIG) welder, seam weld the roof panel at each corner with 10 mm (0.39 in) long weld beads.
   - Apply flexible foam as necessary between roof panel and reinforcements to maintain NVH performance.

9. Prepare the repair area for refinish material application following Ford-approved paint recommendations.

10. Apply a quality primer-sealer following the paint manufacturer's recommendation for both compatibility and application.

11. **NOTE:** Always use refinishing materials from a single paint manufacturer. Combining products from more than one manufacturer may result in refinishing material incompatibility issues and potential void of warranty for each product applied.

    If required, follow up with a quality primer-surfacer following Ford-approved paint recommendations. Block sand to level using the recommended grit sandpaper.

12. ***NOTICE:*** **Failure to purge air bubbles from the roof ditch sealer may result in air trapped in the roof ditch which may cause refinishing materials to pop.**

Stand the roof ditch sealer vertically (nose up) for a minimum of 30 minutes prior to application to permit trapped air to rise to the top so it may be purged.

13. Position the vehicle so it is level front-to-rear.
    - Using masking tape, form a dam at each end of the roof ditch (both sides) to prevent sealer run-off.

14. Apply the roof ditch sealer following product directions to a depth equal to the sealer noted during removal.

15. Allow the sealer to cure 40-60 minutes at room temperature before refinishing. If roof ditch sealer has been allowed to cure in excess of 2 hours, scuff the surface using a red scuff pad.

16. Refinish the roof and repair area following Ford-approved paint recommendations.

17. Allow refinishing materials sufficient cure time to permit safe handling (refer to paint manufacturer's specification) and install the roof corner mouldings.

18. Install the headliner. For additional information, refer to Section 501-05 .

19. Install the windshield and rear window glass. For additional information, refer to Section 501-11 .

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Material

Item	Specification	Fill Capacity
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Body mount-to-body bolt No. 1	115	85	—
Body mount-to-body bolt No. 2 (SuperCab and SuperCrew)	115	85	—
Body mount-to-body bolt No. 3 (regular cab)	115	85	—
Body mounts-to-frame nuts	70	52	—
Exhaust hanger bolt	40	30	—
Front End Sheet Metal (FESM) body mount bolt	80	59	—
Heat shield screws	20	—	177
Trailer hitch assembly-to-bumper bolts	175	129	—
Transmission mount nuts	103	76	—
Transmission support crossmember nuts	103	76	—

Frame and Body Mounting

The frame consists of 2 steel channel rails, a front crossmember, transmission support crossmember and a rear crossmember (trailer hitch). The side rails and welded crossmembers are not replaced separately. A front frame rail repair kit (5D058 and 5D059) is available if the front rail is to be repaired.

For diagonal or X-frame checking, refer to Section 501-35 . When welding is carried out on a vehicle, refer to Section 501-35 .

Body Mounts

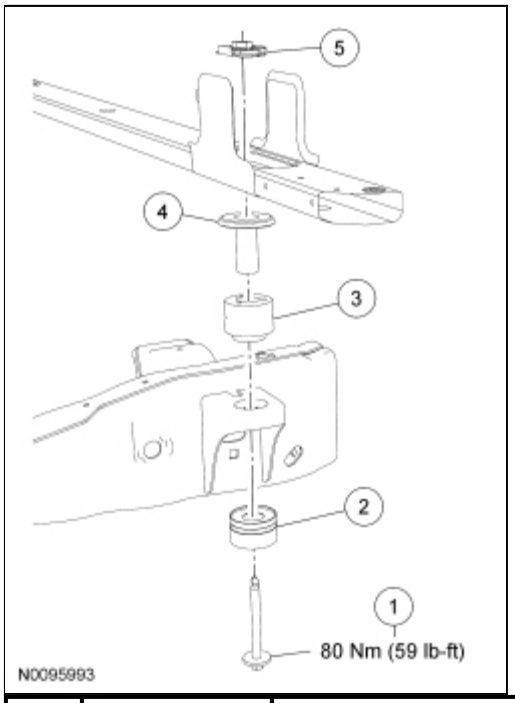
The body support mounts:

- secure the body to the frame.
- cannot be lubricated during body support mount installation.

NOTE: Body fasteners are reusable if the following steps are followed:

- Body bolt threads must be cleaned of thread sealer by using a wire wheel or wire brush.
- Apply a new treatment of threadlock and sealer to the body bolt threads.
- Install the body bolts. For additional torque and material information refer to Specifications in this section.

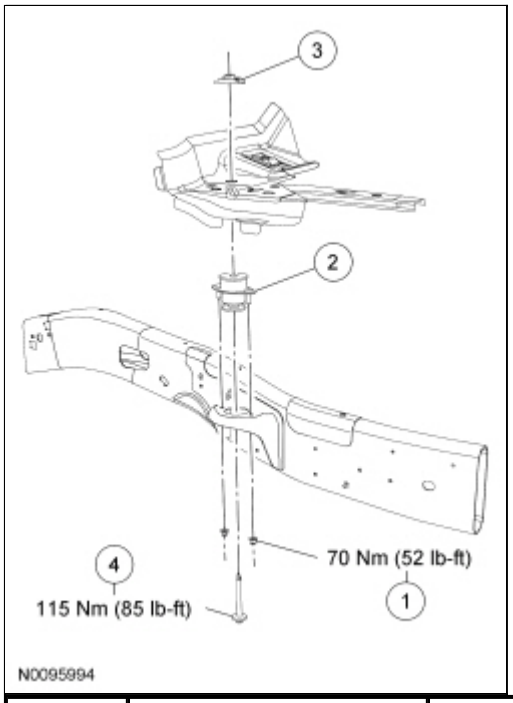
Body — Front End Sheet Metal (FESM) Body Mount



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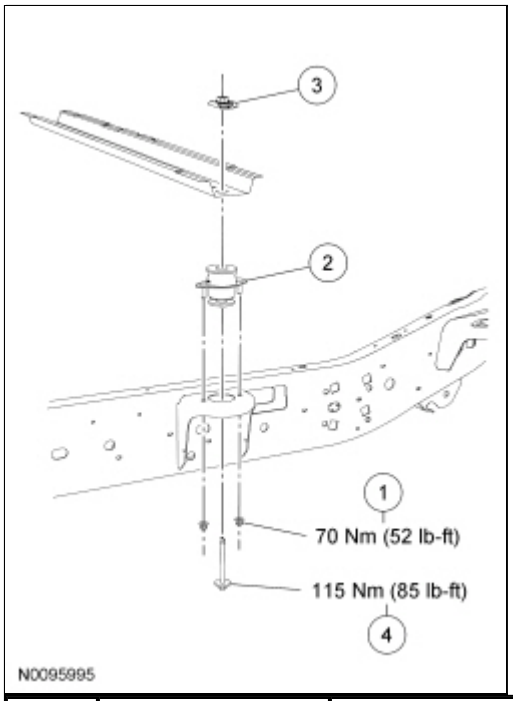
Item	Part Number	Description
1	W713789	Front End Sheet Metal (FESM) body mount bolt
2	00193	FESM body mount lower
3	00192	FESM body mount upper
4	—	FESM body mount upper spacer
5	001B39A	Body cage nut

Body Mount — No. 1 (LH/RH, All Cabs)



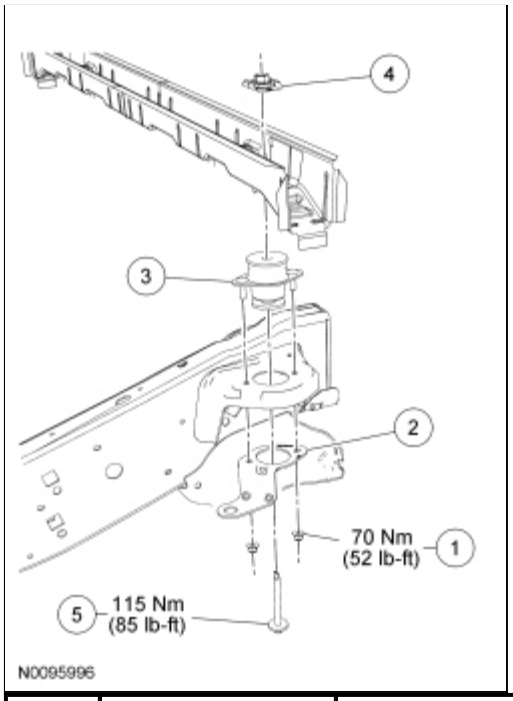
Item	Part Number	Description
1	W713760	Body mount No. 1 nut
2	00154	Body mount No. 1
3	101C38	Body cage nut
4	W713789	Body mount bolt

Body Mount — No. 2 (LH/RH, SuperCab and SuperCrew Only)



Item	Part Number	Description
1	W713760	Body mount No. 2 nuts (2 required)
2	00154	Body mount No. 2
3	101C38	Body cage nut
4	W713789	Body mount bolt

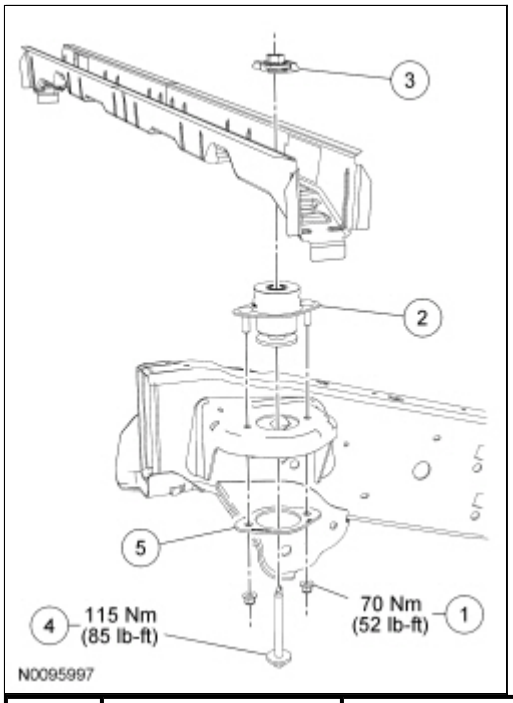
Body Mount — No. 3 (LH, All Cabs)



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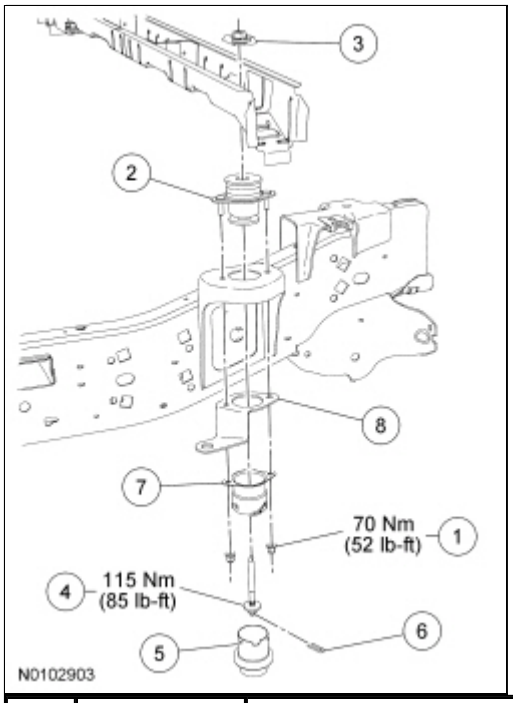
Item	Part Number	Description
1	W713760	Body mount No. 3 nut (2 required)
2	5R084-A	Body mount reinforcement — LH
3	00154	Body mount No. 3
4	101C38	Body cage nut
5	W713789	Body mount bolt

Body Mount — No. 3 (RH, All Cabs)



Item	Part Number	Description
1	W713760	Body mount nut (2 required)
2	00154	Body mount No. 3
3	101C38	Body cage nut
4	W713789	Body mount bolt
5	5R084-B	Body mount reinforcement — RH

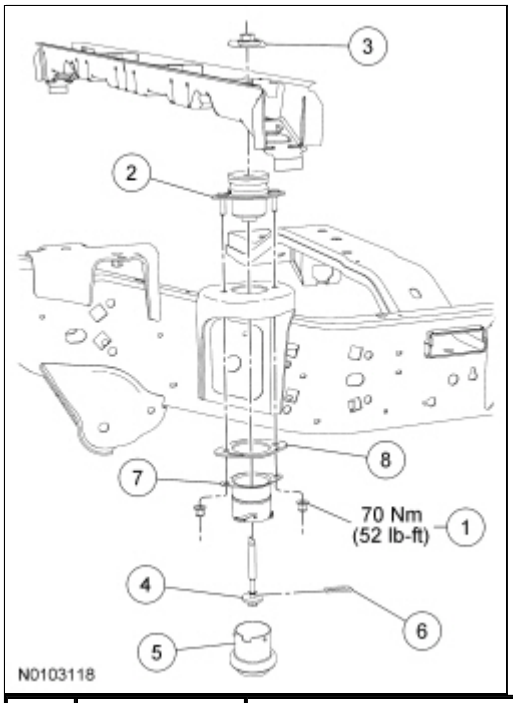
Hydraulic Body Mount — No. 3, Hydraulic (LH All Cabs)



Item	Part Number	Description
1	W713760	Body mount nut (2 required)
2	00154	Body mount No. 3
3	101C38	Body cage nut
4	W714739	Body mount bolt
5	5D008-A	Hydraulic body mount lower housing
6	—	Hydraulic body mount lower housing snap ring (part of 5D008)
7	5D008-B	Hydraulic body mount upper housing
8	5R084-A	Body mount reinforcement — LH

Hydraulic Body Mount — No. 3, Hydraulic (RH, All Cabs)

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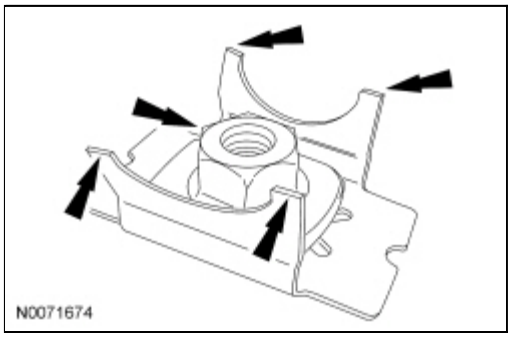
Item	Part Number	Description
1	W713760	Body mount nut (2 required)
2	00154	Body mount No. 3
3	101C38	Body cage nut
4	W714739	Body mount bolt
5	5D008-A	Hydraulic body mount lower housing
6	—	Hydraulic body mount lower housing snap ring (part of 5D008)
7	5D008-B	Hydraulic body mount upper housing
8	5R084-B	Body mount reinforcement — RH

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Body Retainer Cage Nuts

Front End Sheet Metal (FESM)

1. Remove the headlamp assembly. For additional information, refer to Section 417-01 .
2. Bend the tabs of the damaged cage nut retainer upward to access the cage nut.



3. Using a suitable tool, hold the cage nut and remove the Front End Sheet Metal (FESM) body mount bolt.
   - Discard the FESM bolt.
4. ***NOTICE:*** **Do not use a standard nut as a replacement for the nut being removed. Failure to use the correct part number for the nut may result in damage to the vehicle.**

   NOTE: If the cage nut is not damaged, it is not necessary to replace it with a new cage nut. The old cage nut may be used if the threads of the nut are not damaged.

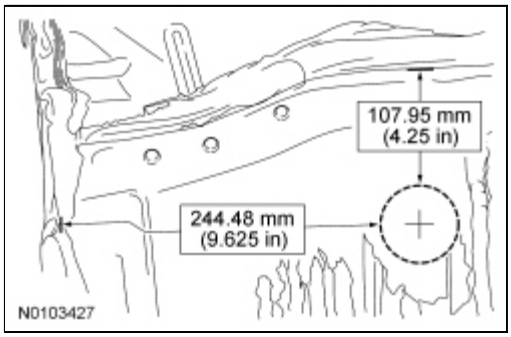
   NOTE: Remove the new cage nut from the cage and install the cage nut into the pre-existing cage.

   Install the new cage nut into the location from which the damaged nut was removed.
5. Bend the tabs of the cage nut retainer back into position to secure the cage nut.
6. Install a new FESM body mount bolt.
   - Tighten the new bolt to 80 Nm (59 lb-ft).
7. Install the headlamp assembly. For additional information, refer to Section 417-01 .

Body mount No. 1 (all cabs)

8. Remove the front seat. For additional information, refer to Section 501-10 .
9. Remove the scuff plate trim panel.
   - Pull upward to release the scuff plate trim panel clips from the body.
10. Peel the carpet back to gain access to the No. 1 body mount retainer cage nut location.

11. Mark the location of the body retainer cage nut.
    - Measure 244.48 mm (9.625 in) from the body side-to-floor pan seam towards the inside of the vehicle.
    - Measure 107.95 mm (4.25 in) from the cowl-to-floor pan seam towards the inside of the vehicle.



12. Using a 50 mm (1.968 in) hole saw, drill a hole into the floor pan.

13. Bend the tabs of the damaged cage nut upward to access the cage nut.

14. Using a suitable tool, hold the cage nut and remove the body mount bolt.
    - Discard the body mount bolt.

15. ***NOTICE:*** **Do not use a standard nut as a replacement for the nut being removed. Failure to use the correct part number for the nut may result in damage to the vehicle.**

    NOTE: If the cage nut is not damaged, it is not necessary to replace it with a new cage nut. The old cage nut may be used if the threads of the nut are not damaged.

    NOTE: Make sure that the surface of the cage nut retainer is flat prior to installing the cage nut.

    NOTE: Remove the new cage nut from the cage and install the cage nut into the pre-existing cage.

    Install the new cage nut into the location from which the damaged nut was removed.

16. Install a new body mount bolt.
    - Tighten the new bolt to 115 Nm (85 lb-ft).

17. Install the new service plug (W651023-S300).

18. Position the carpet into the correct orientation.

19. ***NOTICE:*** **To avoid damage to the scuff plate trim panel, remove any retaining clips from the body and attach them to the scuff plate trim panel before installing.**

    Install the scuff plate trim panel.

Body mount No. 2 (SuperCab and SuperCrew only)

20. Remove the scuff plate trim panel.
    - Pull upward to release the scuff plate trim panel clips from the body.

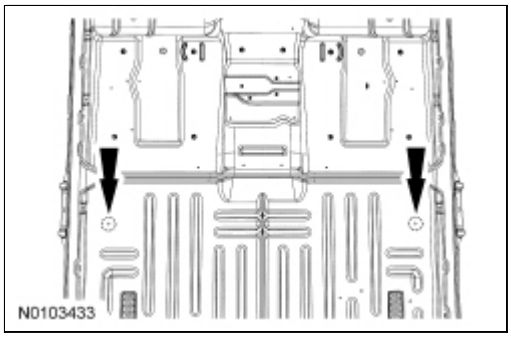
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21. Remove the front seat. For additional information, refer to Section 501-10 .

22. Remove the console. For additional information, refer to Section 501-12 .

23. **NOTE:** The No. 2 body mounts are located directly under the locations shown.

    Peel the carpet back to gain access to the body mount No. 2 location.



24. Using a 50 mm (1.968 in) hole saw, drill a hole through the floor pan to gain access to the body mount No. 2 cage nut.

25. Bend the tabs of the damaged cage nut upward to access the cage nut.

26. Using a suitable tool, hold the cage nut and remove the body mount bolt.
    - Discard the body mount bolt.

27. ***NOTICE:*** **Do not use a standard nut as a replacement for the nut being removed. Failure to use the correct part number for the nut may result in damage to the vehicle.**

    NOTE: If the cage nut is not damaged, it is not necessary to replace it with a new cage nut. The old cage nut may be used if the threads of the nut are not damaged.

    NOTE: Make sure that the surface of the cage nut retainer is flat prior to installing the cage nut.

    NOTE: Remove the new cage nut from the cage and install the cage nut into the pre-existing cage.

    Install the new cage nut into the location from which the damaged nut was removed.

28. Install a new body mount bolt.
    - Tighten the new bolt to 115 Nm (85 lb-ft).

29. Install the new service plug (W651023-S300).

30. Position the carpet into the correct orientation.

31. ***NOTICE:*** **To avoid damage to the scuff plate trim panel, remove any retaining clips from the body and attach them to the scuff plate trim panel before installing.**

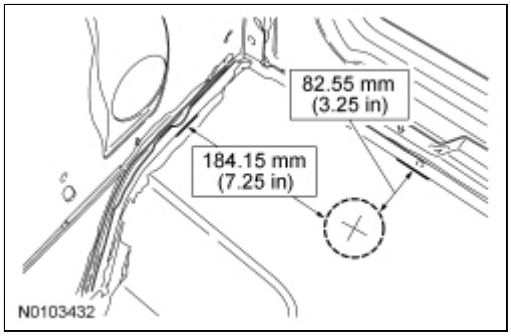
    Install the scuff plate trim panel.

Body mount No. 3 (regular cab)

32. Remove the scuff plate trim panel.
    - Pull upward to release the scuff plate trim panel clips from the body.

33. Peel back the carpet to gain access to the body retainer cage nut location.

34. Mark the location of the body retainer cage nut.
    - Measure 184.15 mm (7.25 in) from the body side-to-floor pan seam towards the interior of the vehicle.
    - Measure 82.55 mm (3.25 in) from the body rear end-to-floor pan seam towards the interior of the vehicle.



35. Using a 50 mm (1.968 in) hole saw, drill a hole in the marked location.

36. Bend the tabs of the damaged cage nut upward to access the cage nut.

37. Using a suitable tool, hold the cage nut and remove the body mount bolt.
    - Discard the body mount bolt.

38. ***NOTICE:*** **Do not use a standard nut as a replacement for the nut being removed. Failure to use the correct part number for the nut may result in damage to the vehicle.**

    NOTE: If the cage nut is not damaged, it is not necessary to replace it with a new cage nut. The old cage nut may be used if the threads of the nut are not damaged.

    NOTE: Make sure that the surface of the cage nut retainer is flat prior to installing the cage nut.

    NOTE: Remove the new cage nut from the cage and install the cage nut into the pre-existing cage.

    Install the new cage nut into the location from which the damaged nut was removed.

39. Install a new body mount bolt.
    - Tighten the new bolt to 115 Nm (85 lb-ft).

40. Install the new service plug (W651023-S300).

41. Position the carpet into the correct orientation.

42. ***NOTICE:*** **To avoid damage to the scuff plate trim panel, remove any retaining clips from the body and attach them to the scuff plate trim panel before installing.**

    Install the scuff plate trim panel.

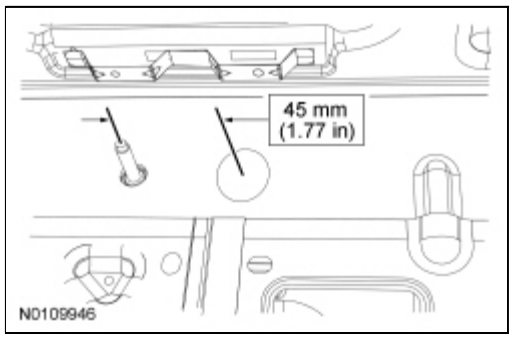
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Body mount No. 3 (SuperCab and SuperCrew)

43. Remove the scuff plate trim panel.
    - Pull upward to release the scuff plate trim panel clips from the body.

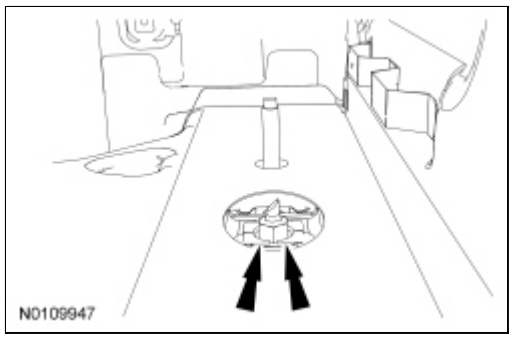
44. Remove the rear seat. For additional information, refer to Section 501-10 .

45. Mark the location for the access hole.
    - Measure 45 mm (1.77 in) from the center of the rear seat stud toward the interior of the vehicle.



46. Using a 50 mm (1.968 in) hole saw, drill a hole in the marked location.

47. Looking in the access hole toward the exterior wall of the vehicle, bend the tabs of the damaged cage nut upward to access the cage nut.



48. Using a suitable tool, hold the cage nut and remove the body mount bolt.
    - Discard the body mount bolt.

49. ***NOTICE:*** **Do not use a standard nut as a replacement for the nut being removed. Failure to use the correct part number for the nut may result in damage to the vehicle.**

    NOTE: If the cage nut is not damaged, it is not necessary to replace it with a new cage nut. The old cage nut may be used if the threads of the nut are not damaged.

    NOTE: Make sure that the surface of the cage nut retainer is flat prior to installing the cage nut.

    NOTE: Remove the new cage nut from the cage and install the cage nut into the pre-existing cage.

    Install the new cage nut into the location from which the damage nut was removed.

50. Install a new body mount bolt.
    - Tighten the new bolt to 115 Nm (85 lb-ft).

51. Install the new service plug (W651023-S300).

52. Position the carpet into the correct orientation.

53. Install the rear seat. For additional information, refer to Section 501-10 .

54. ***NOTICE:*** **To avoid damage to the scuff plate trim panel, remove any retaining clips from the body and attach them to the scuff plate trim panel before installing.**

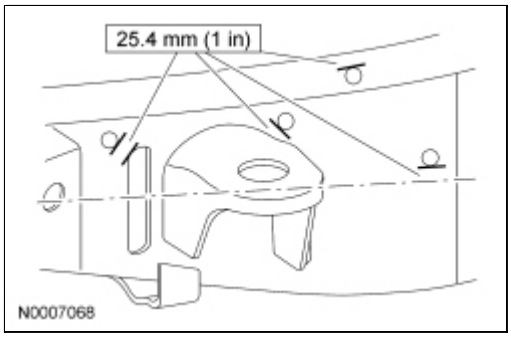
    Install the scuff plate trim panel.

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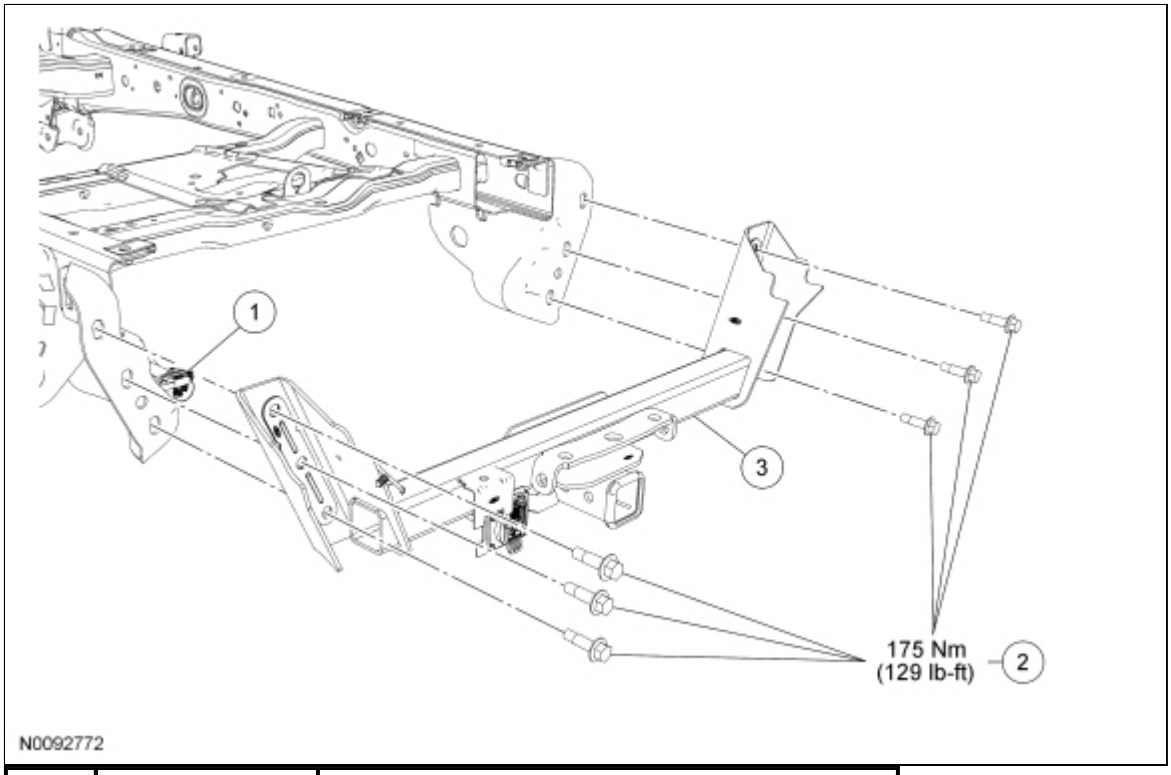
Frame Drilling

1. If a hole must be drilled in the frame, make sure the hole meets the following requirements:
    - The hole is at least the specified distance from the edge of the nearest hole.
    - The edge of the drilled hole is at least the specified distance from the edge of the flange.
    - The hole is at least the specified distance above the frame centerline.
    - The drilled hole is at least the specified distance from any other existing bracket or component of the frame.



Trailer Hitch

Removal and Installation

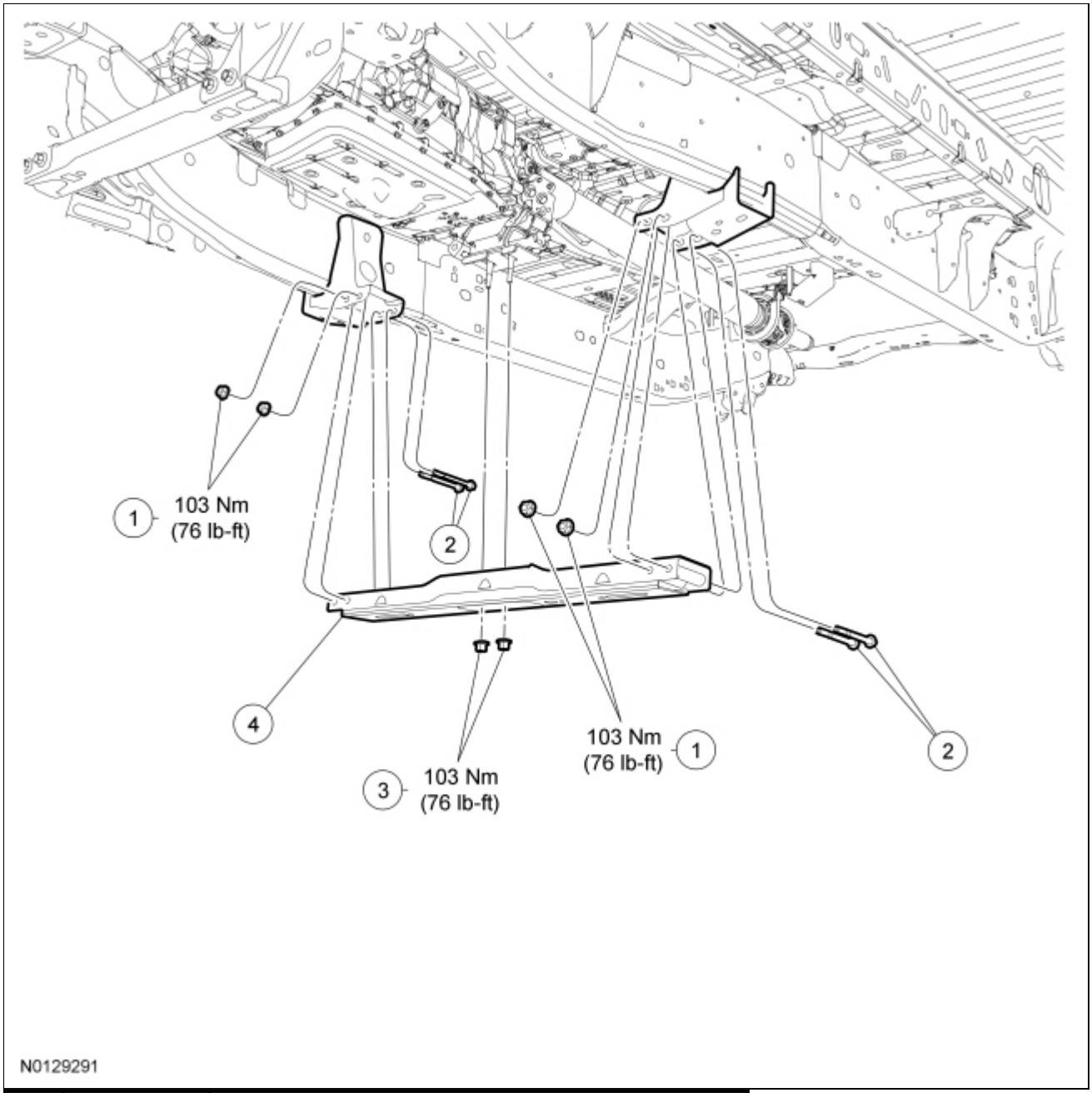


Item	Part Number	Description
1	—	Trailer light/brake electrical connector
2	N811645-S	Trailer hitch bolts
3	W504042-S	Trailer hitch

1. Remove the rear bumper. For additional information, refer to Section 501-19 .
2. Disconnect the trailer light/brake electrical connector.
3. Remove the trailer hitch bolts and remove the trailer hitch.
   - To install, tighten to 175 Nm (129 lb-ft).
4. To install, reverse the removal procedure.

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Transmission Support Crossmember



Item	Part Number	Description
1	W520114	Transmission support crossmember nuts (4 required)
2	W714418	Transmission support crossmember bolts (4 required)
3	W520114	Transmission mount nuts (2 required)

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4	7H474	Transmission support crossmember

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the 2 heat shield screws.
3. Support the transmission with a suitable jack.
4. Remove the 2 transmission support nuts.
5. Remove the 4 transmission support crossmember nuts.
6. Remove the 4 transmission support crossmember support bolts.
7. Remove the transmission support crossmember.

Installation

1. Position the transmission support crossmember and install the transmission support crossmember support nuts and bolts.
    - Tighten the nuts to 103 Nm (76 lb-ft).
2. Remove the transmission jack.
3. Install the 2 transmission support nuts.
    - Tighten to 103 Nm (76 lb-ft).
4. Install the 2 heat shield screws.
    - Tighten to 20 Nm (177 lb-in).

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